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Service and Maintenance Manual

Models

E450A

E450AJ

M450A

M450AJ

SN 0300208529

to Present

PN - 3121714

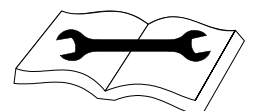
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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

MODIFICATION OR ALTERATION OF AN AERIAL WORK PLATFORM 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.

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

REVISION LOG

Original Issue	A - October 31, 2016
Revised	B - August 23, 2017
Revised	C - June 29, 2018 - Revised Covers
Revised	D - November 30, 2018

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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
1.2	Tires	1-1
1.3	Capacities	1-1
1.4	Dimensional Data	1-2
1.5	Torque Specifications	1-2
1.6	Lubrication Specifications	1-2
	Hydraulic Oil	1-2
1.7	Critical Stability Weights	1-3
1.8	Major Component Weights	1-3
1.9	Serial Number Locations	1-3
1.10	Maintenance and Lubrication	1-5
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 Reassembly	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
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

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
SECTION 3 - CHASSIS & TURNTABLE		
3.1	Tires & Wheels.....	3-1
	Tire Inflation.....	3-1
	Tire Damage.....	3-1
	Tire Replacement.....	3-1
	Wheel 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 Module.....	3-5
3.4	Speed Sensor.....	3-6
3.5	Drive Hub.....	3-13
	Roll and Leak Testing.....	3-13
	Tightening and Torquing Bolts.....	3-13
	Main Disassembly.....	3-14
	Output Carrier Disassembly.....	3-16
	Input Carrier Disassembly.....	3-18
	Hub-spindle Disassembly.....	3-19
	Cover Disassembly.....	3-20
	Input Carrier Assembly.....	3-21
	Output Planet Gear Assembly.....	3-21
	Output Carrier Assembly.....	3-22
	Hub-spindle Assembly.....	3-22
	Cover Assembly.....	3-23
	Main Assembly.....	3-23
3.6	Drive Motor.....	3-26
	Removal.....	3-26
	Disassembly.....	3-26
	Inspection.....	3-26
	Assembly.....	3-27
	Installation.....	3-27
3.7	Swing Bearing.....	3-29
	Turntable Bearing Mounting Bolt Condition Check.....	3-29
	Wear Tolerance.....	3-30
	Replacement of Swing Bearing.....	3-31
	Swing Bearing Torque Value.....	3-35
	Checking Worm Gear End Play.....	3-35
	Adjusting End Play.....	3-35
3.8	Swing Motor.....	3-37
	Preparation Before Disassembly.....	3-40
	Disassembly and Inspection.....	3-40
	Assembly.....	3-47
	One Piece Stator Construction.....	3-53
	Two Piece Stator Construction.....	3-54
	Final Checks.....	3-54
3.7	Battery Maintenance and Charging.....	3-55
	Battery Maintenance, Quarterly.....	3-55
	Optional On Board Generator.....	3-55
	Battery Charging (On Board Charger).....	3-55

SECTION NO.	TITLE	PAGE NO.
3.8	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
	Checking/Changing the Battery Charger Algorithm	3-62
3.9	Generator.....	3-63
	Engine.....	3-63
	Alternator.....	3-63
	Dynamo and Dynamo Voltage Regulator	3-63
	Dynamo Output Fuse	3-63
	Control Fuse	3-63
	Start Battery	3-65
	Engine Starter.....	3-65
	Start Control Relay	3-65
	Fuel Control Relay.....	3-66
	Glow Plug Control Relay.....	3-66
	Glow Plug.....	3-66
	Fuel Pump	3-67
	Fuel Solenoid	3-67
	Engine Low Oil Pressure Switch.....	3-67
	Engine Oil Temperature Sensor.....	3-67
	Alternator Output Current Sensor.....	3-68
	Engine Speed Sensor.....	3-68
	RBS Engine/Generator Controller	3-68
	Warnings and Safety Precautions	3-69
	System Controls.....	3-69
	System Status and Performance Monitoring	3-69
	System Settings.....	3-69
	RBS Start.....	3-70
	RBS shutdown	3-70
	RBS Alarms and Flash Codes.....	3-71
	Resetting the RBS Controller.....	3-71
	Maintenance Schedule	3-71
	Troubleshooting	3-72
	APU Engine Start Battery Boosting.....	3-73
3.10	Supplementary fuse for apu	3-74
	Tools And Material	3-74
	Procedure	3-74
 SECTION 4 - BOOM & PLATFORM		
4.1	Platform	4-1
	Support Removal	4-1
	Support Installation	4-2
4.2	Rotator and Slave Cylinder Removal	4-4
	Removal	4-4
	Installation.....	4-4
4.3	Main Boom Powertrack (E/M450AJ)	4-5
	Removal	4-5
	Installation.....	4-5
4.4	Boom Maintenance	4-6
	Removal	4-6
	Disassembly	4-7
	Inspection	4-7
	Assembly	4-7
	Installation.....	4-8
4.5	Wear Pads	4-9
4.6	Boom Limit Switches.....	4-9

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
4.7	Boom Cleanliness Guidelines	4-9
4.8	Articulating Jib Boom.....	4-12
	Removal	4-12
	Disassembly.....	4-12
	Inspection.....	4-12
	Assembly	4-12
4.9	Boom Synchronizing Procedure.....	4-13
4.10	Foot switch Adjustment	4-13
4.11	Rotary actuator.....	4-14
	Theory Of Operation.....	4-14
	Tools Required for Assembly/Disassembly.....	4-14
	Disassembly.....	4-17
	Inspection.....	4-20
	Assembly	4-21
	Installing Counterbalance Valve.....	4-25
	Greasing Thrust Washers	4-26
	Testing the Actuator.....	4-26
	Installation and Bleeding	4-27
	Troubleshooting	4-28
4.12	Powertrack Maintenance	4-29
	Removing a Link.....	4-29
	Installing a New Link.....	4-32
	Replacing Fixed End Brackets	4-37
	Replacing Moving End Brackets	4-39
4.13	Skyguard.....	4-41
	Operation	4-41
	Function Test.....	4-41
	Diagnostics & Troubleshooting	4-42
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

SECTION NO.	TITLE	PAGE NO.
5.3	Hydraulic Cylinders	5-54
	Platform Level (Slave) Cylinder (E450Aonly)	5-54
	Platform Level (Slave) Cylinder E/M450AJ	5-59
	Jib Lift Cylinder (E/M 450AJ Only)	5-65
	Lower Lift Cylinder	5-71
	Mid Lift Cylinder	5-80
	Upper Lift Cylinder	5-88
	Master Cylinder (E450A only)	5-97
	Master Cylinder E/M450AJ	5-102
	Steer Cylinder	5-108
	Telescope Cylinder (E450A only)	5-113
	Telescope Cylinder E/M450AJ	5-118
5.4	Cylinder Removal And Installation	5-126
	Main Boom Lift Cylinder Removal	5-126
	Main Boom Lift Cylinder Installation	5-126
	Mid Boom Lift Cylinder Removal	5-127
	Mid Boom Lift Cylinder Installation	5-127
	Lower Boom Lift Cylinder Removal	5-128
	Lower Boom Lift Cylinder Installation	5-128
	Main Boom Telescope Cylinder Removal	5-129
	Main Boom Telescope Cylinder Installation	5-129
5.5	Mid and Lower Lift Cylinder Bleeding Procedure	5-130
5.6	Pressure Setting Procedures	5-130
	Main Relief	5-130
	Main Lift Down Relief	5-130
	Lower Lift Down Relief	5-130
	Telescope Relief	5-130
	Platform Level Up Relief	5-131
	Platform Level Down Relief	5-131
	Steer Relief	5-132
	Jib Lift (Up and Down) Relief	5-132
	Releveling Valve Relief	5-132
 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
6.4	Function Speed	6-23
	Help Descriptions and Fault Flash Codes	6-34
	Analyzer Diagnostics Menu Structure	6-40
	System Self Test	6-46
6.5	Calibrating Steer	6-51
6.6	Calibrating Tilt Sensor	6-53
6.7	Calibrating Load Sensing	6-55
6.8	LSS System	6-58
	Diagnostic Menu	6-59
	Calibration Procedure	6-60
	Testing & Evaluation	6-65
	Troubleshooting	6-66
6.9	Resetting The MSSO System	6-67

TABLE OF CONTENTS

SECTION NO.	TITLE	PAGE NO.
SECTION 7	- BASIC ELECTRICAL INFORMATION & ELECTRICAL 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
	Installation of Dielectric Grease	7-5
	Deutsch HD, DT, DTM, DRC Series	7-5
	AWP Seal	7-5
	AMP Mate-N-Lok	7-6
	DIN Connectors	7-6
	Exclusions	7-6
7.5	AMP Connector	7-8
	Applying Silicone Dielectric Compound to AMP Connectors	7-8
	Assembly	7-8
	Disassembly	7-10
	Wedge Lock	7-10
	Service - Voltage Reading	7-10
7.6	DEUTSCH Connectors	7-12
	DT/DTP Series Assembly	7-12
	DT/DTP Series Disassembly	7-12
	HD30/HDP20 Series Assembly	7-13
	HD30/HDP20 Series Disassembly	7-13
7.7	Wiring Harness Connector Labels	7-14
	Connector Labels	7-14
	Component Labels	7-14

FIGURE NO.	TITLE	PAGE NO.
1-1.	Serial Number Locations	1-3
1-2.	Maintenance & Lubrication Diagram	1-4
1-3.	Torque Chart (SAE Fasteners - Sheet 1 of 5)	1-8
1-4.	Torque Chart (SAE Fasteners - Sheet 2 of 5)	1-9
1-5.	Torque Chart (SAE Fasteners - Sheet 3 of 5)	1-10
1-6.	Torque Chart (METRIC Fasteners - Sheet 4 of 5)	1-11
1-7.	Torque Chart (METRIC Fasteners - Sheet 5 of 5)	1-12
2-1.	Engine Operating Temperature Specifications - Kubota	2-10
3-1.	Spindle Assembly	3-3
3-2.	Chassis Component Location	3-4
3-3.	Drive Components	3-5
3-4.	Cable Routing	3-6
3-5.	Relay	3-7
3-6.	System Fuses	3-8
3-7.	Ignition Relay Fuse	3-9
3-8.	Drive Fuses	3-10
3-9.	Drive Limit Switch	3-11
3-10.	Steering Installation and spindle	3-12
3-11.	Main Assembly - Sheet 1 of 2	3-14
3-12.	Main Assembly - Sheet 2 of 2	3-15
3-13.	Output Carrier	3-16
3-14.	Planet Gear	3-17
3-15.	Input Carrier	3-18
3-16.	Hub Spindle	3-19
3-17.	Cover Assembly	3-20
3-18.	Drive Hub - Sheet 1 of 2	3-24
3-19.	Drive Hub - Sheet 2 of 2	3-25
3-20.	Drive Motor	3-28
3-21.	Swing Bearing Feeler Gauge Check	3-29
3-22.	Swing Bearing Tolerance Boom Placement	3-30
3-23.	Swing Bearing Tolerance Measuring Point	3-30
3-24.	Swing Bearing Torquing Sequence	3-32
3-25.	Swing Bearing Removal - E450A	3-33
3-26.	Swing Bearing Removal - E450AJ, M450AJ	3-34
3-27.	Swing Components	3-36
3-28.	Swing Motor - Cutaway	3-37
3-29.	Swing Motor - Exploded View	3-39
3-30.	On Board Generator	3-56
3-31.	Battery Charger (E450A/AJ)	3-59
3-32.	Battery Charger (M450AJ)	3-60
3-33.	Generator	3-64
4-1.	Location of Components Platform Support	4-1
4-2.	Platform Support Torque Values	4-3
4-3.	Wear Pad Thickness	4-9
4-4.	Boom Limit Switches	4-10
4-5.	Platform Components and Attaching Hardware (M450A & E450A)	4-11
4-6.	Location of Components - Articulating Jib Boom	4-12
4-7.	Rotary Actuator (Exploded View)	4-15
4-8.	Rotator- Assembly Drawing	4-16
4-9.	Rotator Counterbalance Valve	4-25
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

FIGURE NO.	TITLE	PAGE NO.
5-8.	ORB-MPP Thread	5-4
5-9.	MFF-BSPP Thread.....	5-4
5-10.	FL61-FL62.....	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 (Slave) Cylinder (E450A only).....	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 Head Removal.....	5-59
5-26.	Cylinder Rod Support.....	5-59
5-27.	Platform Level (Slave) Cylinder - E/M450AJ (SN 0300208529 to Present, SN B300001429 through B300002486)	5-60
5-28.	Platform Level (Slave) Cylinder - E/M450AJ (SN B300002487 to Present).....	5-61
5-29.	Composite Bearing Installation	5-63
5-30.	Rod Seal Installation	5-63
5-31.	Cylinder Head Seal Installation.....	5-63
5-32.	Wiper Seal Installation	5-64
5-33.	Installation of Head Seal Kit.....	5-64
5-34.	Piston Seal Kit Installation.....	5-64
5-35.	Cylinder Barrel Support.....	5-65
5-36.	Cylinder Head Removal.....	5-65
5-37.	Cylinder Rod Support.....	5-65
5-38.	Jib Lift Cylinder (SN 0300208529 to Present, SN B300001429 through B300002486).....	5-66
5-39.	Jib Lift Cylinder (SN B300002487 to Present).....	5-67
5-40.	Composite Bearing Installation	5-69
5-41.	Rod Seal Installation	5-69
5-42.	Cylinder Head Seal Installation.....	5-69
5-43.	Wiper Seal Installation	5-70
5-44.	Installation of Head Seal Kit.....	5-70
5-45.	Piston Seal Kit Installation.....	5-70
5-46.	Cylinder Barrel Support.....	5-71
5-47.	Cylinder Cap Removal	5-71
5-48.	Cylinder Head Removal.....	5-71
5-49.	Cylinder Head Removal.....	5-72
5-50.	Cylinder Rod Support.....	5-72
5-51.	Lower Lift Cylinder - E450A (SN 0300235601 through 0300239755), E450AJ/M450AJ (SN 0300208529 through 0300239252, SN B300001429 through B300002461)	5-73
5-52.	Lower Lift Cylinder - E450A (SN 0300239756 to Present)	5-74
5-53.	Lower Lift Cylinder - E450AJ/M450AJ (SN 0300239253 to Present, SN B300002462 through B300002486)	5-75
5-54.	Lower Lift Cylinder - E450AJ/M450AJ (SN B300002487 to Present).....	5-76
5-55.	Composite Bearing Installation	5-78
5-56.	Rod Seal Installation	5-78
5-57.	Cylinder Head Seal Installation.....	5-78
5-58.	Wiper Seal Installation	5-79
5-59.	Installation of Head Seal Kit.....	5-79
5-60.	Piston Seal Kit Installation.....	5-79
5-61.	Cylinder Barrel Support.....	5-80

FIGURE NO.	TITLE	PAGE NO.
5-62.	Cylinder Cap Removal	5-80
5-63.	Cylinder Head Removal	5-80
5-64.	Cylinder Head Removal	5-81
5-65.	Cylinder Rod Support	5-81
5-66.	Mid Lift Cylinder - E450A (SN 0300235601 through 0300239755), E450AJ/M450AJ (SN 0300208529 through 0300239252, SN B300001429 through B300002461)	5-82
5-67.	Mid Lift Cylinder - E450A (SN 0300239756 to Present), E450AJ/M450AJ (SN 0300239253 to Present, SN B300002462 through B300002486)	5-83
5-68.	Mid Lift Cylinder - E450AJ/M450AJ (SN B300002487 to Present)	5-84
5-69.	Composite Bearing Installation	5-86
5-70.	Rod Seal Installation	5-86
5-71.	Cylinder Head Seal Installation	5-86
5-72.	Wiper Seal Installation	5-87
5-73.	Installation of Head Seal Kit	5-87
5-74.	Piston Seal Kit Installation	5-87
5-75.	Cylinder Barrel Support	5-88
5-76.	Cylinder Cap Removal	5-88
5-77.	Cylinder Head Removal	5-88
5-78.	Cylinder Head Removal	5-89
5-79.	Cylinder Rod Support	5-89
5-80.	Upper Lift Cylinder - E450A (SN 0300235601 through 0300239755), E450AJ/M450AJ (SN 0300208529 through 0300239755, SN B300001429 through B300002486)	5-90
5-81.	Upper Lift Cylinder - E450A (SN 0300239756 to Present)	5-91
5-82.	Upper Lift Cylinder - E450AJ/M450AJ (SN 0300239756 to Present)	5-92
5-83.	Upper Lift Cylinder - E450AJ/M450AJ (SN B300002487 to Present)	5-93
5-84.	Composite Bearing Installation	5-95
5-85.	Rod Seal Installation	5-95
5-86.	Cylinder Head Seal Installation	5-95
5-87.	Wiper Seal Installation	5-96
5-88.	Installation of Head Seal Kit	5-96
5-89.	Piston Seal Kit Installation	5-96
5-90.	Cylinder Barrel Support	5-97
5-91.	Cylinder Rod Support	5-97
5-92.	Master Cylinder (E450A only)	5-98
5-93.	Composite Bearing Installation	5-100
5-94.	Rod Seal Installation	5-100
5-95.	Cylinder Head Seal Installation	5-100
5-96.	Wiper Seal Installation	5-101
5-97.	Installation of Head Seal Kit	5-101
5-98.	Piston Seal Kit Installation	5-101
5-99.	Cylinder Barrel Support	5-102
5-100.	Cylinder Head Removal	5-102
5-101.	Cylinder Rod Support	5-102
5-102.	Master Cylinder E/M450AJ (SN 0300208529 to Present, SN B300001429 through B300002486)	5-103
5-103.	Master Cylinder E/M450AJ (SN B3000024867 to Present)	5-104
5-104.	Composite Bearing Installation	5-106
5-105.	Rod Seal Installation	5-106
5-106.	Cylinder Head Seal Installation	5-106
5-107.	Wiper Seal Installation	5-107
5-108.	Installation of Head Seal Kit	5-107
5-109.	Piston Seal Kit Installation	5-107
5-110.	Cylinder Barrel Support	5-108
5-111.	Spanner Nut Removal	5-108
5-112.	Cylinder Rod Support	5-108
5-113.	Steer Cylinder	5-109
5-114.	Rod Seal Installation	5-111
5-115.	Cylinder Head Seal Installation	5-111

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
5-116.	Wiper Seal Installation	5-111
5-117.	Installation of Head Seal Kit	5-111
5-118.	Piston Seal Kit Installation	5-112
5-119.	Cylinder Barrel Support	5-113
5-120.	Cylinder Cap Removal	5-113
5-121.	Cylinder Rod Support	5-113
5-122.	Telescope Cylinder (E450A only)	5-114
5-123.	Composite Bearing Installation	5-116
5-124.	Rod Seal Installation	5-116
5-125.	Cylinder Head Seal Installation	5-116
5-126.	Wiper Seal Installation	5-117
5-127.	Installation of Head Seal Kit	5-117
5-128.	Piston Seal Kit Installation	5-117
5-129.	Cylinder Barrel Support	5-118
5-130.	Cylinder Cap Removal	5-118
5-131.	Cylinder Head Removal	5-118
5-132.	Cylinder Rod Support	5-119
5-133.	Telescope Cylinder - E/M450AJ (SN 0300208529 to Present, SN B300001429 through B300002486) ...	5-120
5-134.	Telescope Cylinder - E450AJ/M450AJ (SN B300002487 to Present)	5-121
5-135.	Composite Bearing Installation	5-123
5-136.	Rod Seal Installation	5-123
5-137.	Cylinder Head Seal Installation	5-123
5-138.	Wiper Seal Installation	5-124
5-139.	Installation of Head Seal Kit	5-124
5-140.	Piston Seal Kit Installation	5-124
5-141.	Components Boom	5-125
5-142.	Main Boom Lift Cylinder Removal	5-126
5-143.	Mid Boom Lift Cylinder Removal	5-127
5-144.	Lower Boom Lift Cylinder Removal	5-128
5-145.	Main Telescope Cylinder Removal	5-129
5-146.	Jib Valve Location	5-132
5-147.	Hydraulic Component Location	5-133
5-148.	Steer Valve Pressure Adjustment	5-134
5-149.	Steer Valve Component	5-135
5-150.	Steer Valve Torque Specification	5-136
5-151.	Main Valve Pressure Adjustment	5-137
5-152.	Main Valve Components	5-138
5-153.	Main Control Valve Torque Specification	5-139
5-154.	Releveling Valve Torque Specification	5-140
5-155.	Jib Valve Torque Specification (SN 0300208529 through 0300233452, SN B300001429 through B300002532)	5-141
5-156.	Jib Valve Torque Specification (SN 0300233452 to Present, SN B300002533 to Present)	5-142
5-157.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 1 of 7	5-144
5-158.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 2 of 7	5-145
5-159.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 3 of 7	5-146
5-160.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 4 of 7	5-147
5-161.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 5 of 7	5-148
5-162.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 6 of 7	5-149
5-163.	Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 7 of 7	5-150
5-164.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 1 of 7	5-152

FIGURE NO.	TITLE	PAGE NO.
5-165.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 2 of 7	5-153
5-166.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 3 of 7	5-154
5-167.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 4 of 7	5-155
5-168.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 5 of 7	5-156
5-169.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 6 of 7	5-157
5-170.	Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 7 of 7	5-158
6-1.	Hand Held Analyzer	6-1
6-2.	Analyzer Software P1.4 - Sheet 1 of 5	6-17
6-3.	Analyzer Software P1.4 - Sheet 2 of 5	6-18
6-4.	Analyzer Software P1.4 - Sheet 3 of 5	6-19
6-5.	Analyzer Software P1.4 - Sheet 4 of 5	6-20
6-6.	Analyzer Software P1.4 - Sheet 5 of 5	6-21
6-7.	Control Module Location - Sheet 1 of 2	6-24
6-8.	Control Module Location - Sheet 2 of 2	6-25
6-9.	Analyzer Connecting Points	6-26
6-10.	Power Module - LH	6-27
6-11.	Power Module - RH	6-28
6-12.	Ground Control Module - Sheet 1 of 3	6-29
6-13.	Ground Control Module - Sheet 2 of 3	6-30
6-14.	Ground Control Module - Sheet 3 of 3	6-31
6-15.	Platform Module - Sheet 1 of 2	6-32
6-16.	Platform Module - Sheet 2 of 2	6-33
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.	Application to Female Contacts	7-5
7-6.	Use of Seal Plugs	7-6
7-7.	Connector Assembly Figure 1	7-8
7-8.	AMP Connector	7-8
7-9.	Connector Assembly Figure 2	7-9
7-10.	Connector Assembly Figure 3	7-9
7-11.	Connector Assembly Figure 4	7-9
7-12.	Connector Disassembly	7-10
7-13.	Connector Installation	7-11
7-14.	DT/DTP Contact Installation	7-12
7-15.	DT/DTP Contact Removal	7-12
7-16.	HD/HDP Contact Installation	7-13
7-17.	HD/HDP Locking Contacts Into Position	7-13
7-18.	HD/HDP Contact Removal	7-13
7-19.	HD/HDP Unlocking Contacts	7-13
7-20.	Platform Console Harness - Sheet 1 of 4	7-16
7-21.	Platform Console Harness - Sheet 2 of 4	7-17
7-22.	Platform Console Harness - Sheet 3 of 4	7-18
7-23.	Platform Console Harness - Sheet 4 of 4	7-19
7-24.	Platform Beacon Harness	7-20
7-25.	Load Sensing System Harness (LSS) - Sheet 1 of 2	7-22
7-26.	Load Sensing System Harness - Sheet 2 of 2	7-23
7-27.	Main Valve Harness - Sheet 1 of 3	7-24
7-28.	Main Valve Harness - Sheet 2 of 3	7-25
7-29.	Main Valve Harness - Sheet 3 of 3	7-26
7-30.	Turntable Harness - Sheet 1 of 3	7-28
7-31.	Turntable Harness - Sheet 2 of 3	7-29
7-32.	Turntable Harness - Sheet 3 of 3	7-30
7-33.	Ground Control Panel Harness - Sheet 1 of 3	7-32
7-34.	Ground Control Panel Harness - Sheet 2 of 3	7-33
7-35.	Ground Control Panel Harness - Sheet 3 of 3	7-34

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
7-36.	Chassis Traction Harness - Sheet 1 of 4	7-36
7-37.	Chassis Traction Harness - Sheet 2 of 4	7-37
7-38.	Chassis Traction Harness - Sheet 3 of 4	7-38
7-39.	Chassis Traction Harness - Sheet 4 of 4	7-39
7-40.	Chassis to Turntable Harness.	7-40
7-41.	Chassis Steer/Brake Harness - Sheet 1 of 2	7-42
7-42.	Chassis Steer/Brake Harness - Sheet 2 of 2	7-43
7-43.	Chassis Head /Tail Light Harness - Sheet 1 of 2.....	7-44
7-44.	Chassis Head /Tail Light Harness - Sheet 2 of 2.....	7-45
7-45.	Inverter IGN Harness.	7-46
7-46.	Platform Work Light Harness.	7-47
7-47.	Generator IGN Harness - Sheet 1 of 2	7-48
7-48.	Generator IGN Harness - Sheet 2 of 2	7-49
7-49.	SkyGuard Harness - Sheet 1 of 2.....	7-50
7-50.	SkyGuard Harness Sheet - 2 of 2.....	7-51
7-51.	Soft Touch Harness - Sheet 1 of 2.....	7-52
7-52.	Soft Touch Harness - Sheet 2 of 2.....	7-53
7-53.	Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 1 of 4.....	7-54
7-54.	Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 2 of 4.....	7-55
7-55.	Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 3 of 4.....	7-56
7-56.	Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 4 of 4.....	7-57
7-57.	Gen 2 Plat Interface Harness	7-58
7-58.	Electrical Schematic - Sheet 1 of 18.....	7-59
7-59.	Electrical Schematic - Sheet 2 of 18.....	7-60
7-60.	Electrical Schematic - Sheet 3 of 18.....	7-61
7-61.	Electrical Schematic - Sheet 4 of 18.....	7-62
7-62.	Electrical Schematic - Sheet 5 of 18.....	7-63
7-63.	Electrical Schematic - Sheet 6 of 18.....	7-64
7-64.	Electrical Schematic - Sheet 7 of 18.....	7-65
7-65.	Electrical Schematic - Sheet 8 of 18.....	7-66
7-66.	Electrical Schematic - Sheet 9 of 18.....	7-67
7-67.	Electrical Schematic - Sheet 10 of 18	7-68
7-68.	Electrical Schematic - Sheet 11 of 18	7-69
7-69.	Electrical Schematic - Sheet 12 of 18	7-70
7-70.	Electrical Schematic - Sheet 13 of 18	7-71
7-71.	Electrical Schematic - Sheet 14 of 18	7-72
7-72.	Electrical Schematic - Sheet 15 of 18	7-73
7-73.	Electrical Schematic - Sheet 16 of 18	7-74
7-74.	Electrical Schematic - Sheet 17 of 18	7-75
7-75.	Electrical Schematic - Sheet 18 of 18	7-76

TABLE NO.	TITLE	PAGE NO.
1-1	Operating Specifications	1-1
1-2	Tire Specifications	1-1
1-3	Capacities	1-1
1-4	Dimensional Data	1-2
1-5	Torque Requirements	1-2
1-6	Hydraulic Oil	1-2
1-7	Mobil DTE 10 Excel 15 Specs	1-2
1-8	Mobil EAL 224H Specs	1-3
1-9	Critical Stability Weights	1-3
1-10	Major Component Weights	1-3
1-11	Lubrication Specifications	1-5
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	3-38
3-3	Battery Charger Fault Codes (Delta-Q)	3-58
3-4	Battery Algorithms	3-62
3-5	Controller Interface Pin Assignments	3-68
3-6	RBS Alarms and Flash Codes	3-71
3-7	Troubleshooting	3-72
4-1	Troubleshooting	4-28
4-2	SkyGuard Function Table	4-42
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	Cartridge Torque Values	5-136
5-34	Coil Torque Values	5-136

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
5-35	Cartridge Torque Values	5-139
5-36	Coil Torque Values.....	5-139
5-37	Cartridge Torque Values	5-140
5-38	Cartridge Torque Values	5-141
5-39	Coil Torque Values.....	5-141
5-40	Cartridge Torque Values	5-142
6-1	Analyzer Abbreviations	6-6
6-2	Machine Configuration Programming Information	6-8
6-3	Machine Configuration Programming Settings	6-12
6-4	Personality Ranges/Defaults	6-13
6-5	Function Speeds	6-23
6-6	Machine Setup Descriptions	6-34
6-7	JLG Control System Flash Codes	6-34
6-8	Help Descriptions and Fault Flash Codes	6-35
6-9	DIAGNOSTICS - Menu Descriptions.....	6-40
6-10	System Test Descriptions	6-46
6-11	System Test Messages	6-47
6-12	Diagnostic Menu Descriptions	6-59
6-13	Accessory Weights	6-61
6-14	SkyGlazier Capacity Reductions	6-63
6-15	Pipe Rack Capacity Reductions	6-63
6-16	LSS Troubleshooting Chart	6-66
6-17	Diagnostic Trouble Codes	6-69
7-1	Wiring Harness Connector Labels	7-14

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating Specifications

Maximum Work Load (Capacity) ANSI Markets Unrestricted:	500lbs. (227 kg)
Maximum Work Load (Capacity) CE & Australia Markets Unrestricted:	500lbs. (230 kg)
Travel Speed	3.2 mph (5.2 kph)
Maximum Travel Grade (Gradeability)	30%
Maximum Travel Grade (Side Slope)	5°
Maximum Height: (Stowed) E450A E450AJ/M450AJ	6 ft. 6.25 in. (1.9 m) 6 ft. 7 in. (2.0 m)
Maximum Horizontal Platform Reach E450A E450AJ/M450AJ	23 ft. 1 in. (7.0 m) 23 ft. 9 in. (7.24 m)
Turning Radius (Curb to Curb)	15 ft. 3 in. (4.65 m)
Turning Radius (Inside)	2 ft. (0.61 m)
Maximum Tire Load: E450A M450AJ, E450AJ	6100 lbs. (2,767 kg) 6900 lbs. (3,130 kg)
Ground Bearing Pressure E450A M450AJ, E450AJ	64 psi (4.5 kg/cm ²) 75 psi (5.2 kg/cm ²)
System Voltage	48 volts
Battery Life per Charge	7 hours continuous
Battery Recharge Time Charger Generator	17 hours from full discharge 6.2 hours
Gross Machine Weight (Platform Empty) E450A E450AJ/M450AJ	13,100 lbs. (5942 kg) 15,100 lbs. (6804 kg)

1.2 TIRES

Table 1-2. Tire Specifications

Size	IN240/55-17.5	IN240/55-17.5	26x7x20
Load Range	E	E	N/A
Ply Rating	10	10	N/A
Tire Pressure	90 psi (6.2 Bar)	Foam-Filled	Solid

1.3 CAPACITIES

Table 1-3. Capacities

Generator Fuel Tank	4 Gallons (15.1 L)
Hydraulic Oil Tank	5 Gallons (19L) w/10% air space
Hydraulic System (Including Tank)	9 Gallons (34.1 L)
Torque Hub, Drive*	25.5 ounces (0.75 L)
*Torque hubs should be one half full of lubricant.	

1.4 DIMENSIONAL DATA

Table 1-4. Dimensional Data

Machine Length (stowed) E450A M450AJ, E450AJ	18 ft. 8.0 in. (5.69 m) 21 ft. 2 in. (6.45 m)
Up and Over Platform Height E450A M450AJ, E450AJ	24 ft. 7 in. (7.49 m) 25 ft. 3 in. (7.7 m)
Horizontal Reach @ Maximum Up and Over E450A M450AJ, E450AJ	23 ft. 1 in. (7.0 m) 23 ft. 9 in. (7.24 m)
Machine Width	5 ft. 9 in. (1.75 m)
Wheel Base	6 ft. 7.0 in. (2.00 m)
Working Height	51 ft. 0 in. (15.54 m)
Platform Height	45 ft. 0 in. (13.72 m)
Track Width	5 ft. 0 in. (1.51 m)
Tail Swing (Any Position)	0
Ground Clearance E450A M450AJ, E450AJ	Drive Reduced = 8.5 in. (0.22 m) 8 in. (0.20 m)

1.5 TORQUE SPECIFICATIONS

Table 1-5. Torque Requirements

Description	Torque Value	Interval Hours
Wheel Lugs	170 ft. lbs. (230 Nm)	150
Swing Bearing (JLG Threadlocker)	190 ft. lbs. (260 Nm)	50/600*

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

1.6 LUBRICATION SPECIFICATIONS

Refer to Section 1.10, Maintenance and Lubrication, for specific lubrication procedures.

Hydraulic Oil

Table 1-6. 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, 10W30
+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: Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities.

NOTE: When temperatures remain consistently below 20 degrees F. (-7 degrees C.), JLG Industries recommends the use of Mobil DTE10.

Table 1-7. 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
Density (Kg/l) @ 15°C	0.8375
Density (lb/in3) @ 60°F	0.0302

Table 1-8. Mobil EAL 224H Specs

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

1.7 CRITICAL STABILITY WEIGHTS

Table 1-9. Critical Stability Weights

Component	LB.	KG.
Counterweight	3850	1746
Tire & Wheel (foam-filled)	207	94
Platform (4ft [1.2 m])	90	41
Platform (5 ft [1.5 m])	100	45
Battery (each)	120	54

⚠ WARNING

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

1.8 MAJOR COMPONENT WEIGHTS

Table 1-10. 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
Slave 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	3850	1746
Machine Complete	14480	6568

1.9 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the left rear of frame, in front of left rear wheel. If the serial number plate is damaged or missing, the machine serial number is stamped on the top left side of the frame and the top left side of the turntable. In addition, the serial number is stamped on top of the end of the upper boom, mid boom, and lower boom at the left rear of the booms.

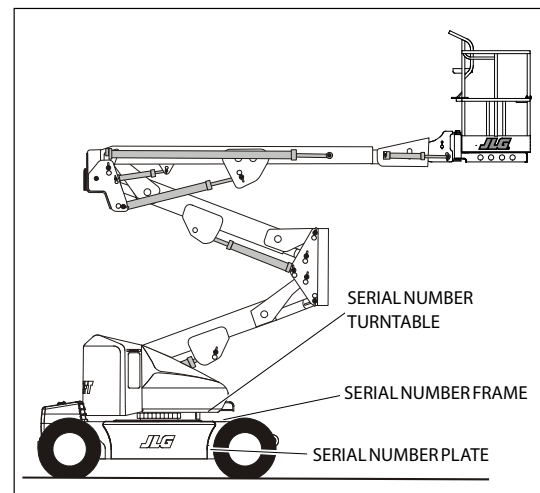


Figure 1-1. Serial Number Locations

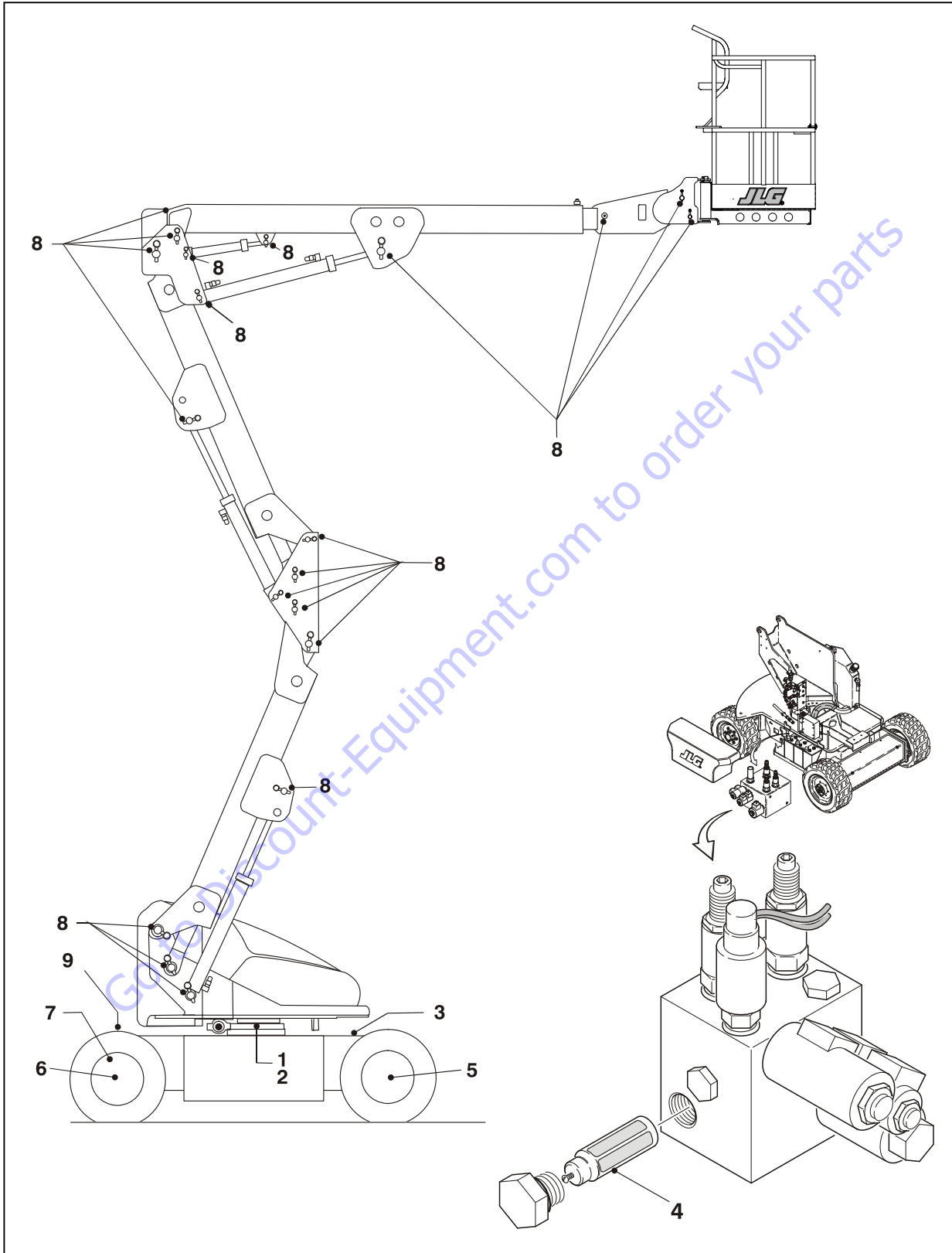


Figure 1-2. Maintenance & Lubrication Diagram

1.10 MAINTENANCE AND LUBRICATION

NOTE: The following numbers correspond to those in Figure 1-2, Maintenance & Lubrication Diagram.

Table 1-11. 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 lbs. minimum).
EPGL	Extreme Pressure Gear Lube (oil) meeting API Service Classification GL-5 or Mil-Spec Mil-L-2105.
HO	Hydraulic Oil. Mobil DTE-10
OG*	Open Gear Lube - Tribol Molub-Alloy 936 Open Gear Compound. (JLG Part No. 3020027)
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHA 460.
LL	Synthetic Lithium Lubricant, Gredag 741 Grease. (JLG Part No. 3020022)
EO	Engine (crankcase) Oil. Refer to Engine Operation Manual.

*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) - 2 Grease Fittings
 Capacity - A/R
 Lube - MPG
 Interval - Every 3 months or 150 hrs of operation
 Comments - Remote Access (Optional).

2. Swing Bearing/Worm Gear Teeth

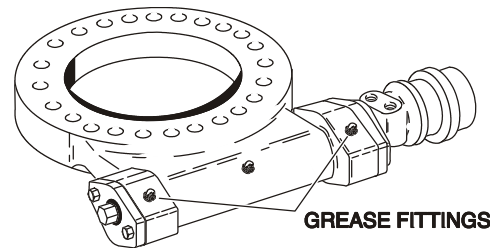


Lube Point(s) - Grease Fittings
 Capacity - Spray On
 Lube - OG or Mobiltac375NC
 Interval - A/R
 Comments - If necessary install grease fittings into worm gear housing and grease bearings.

NOTE: OG will allow better cycle times than Mobiltac375NC, however Mobiltac375NC must be used in dusty environments. If the swing function becomes noisy and/or rough lubricate the bearing teeth.

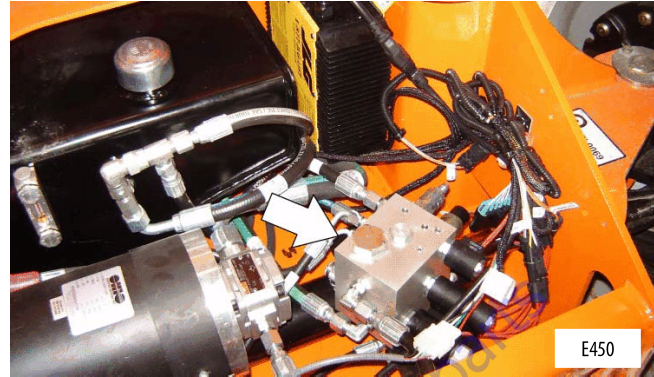
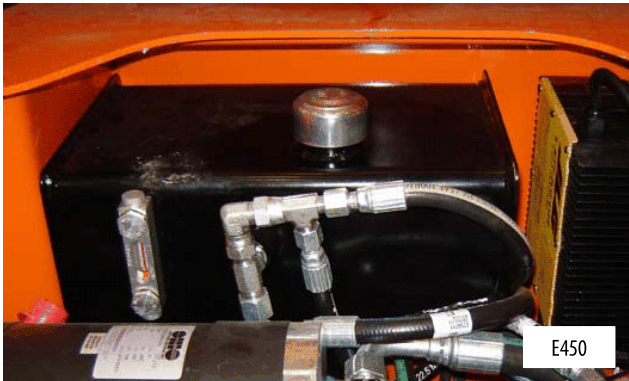
CAUTION

DO NOT OVERGREASE BEARINGS. OVERGREASING BEARINGS WILL RESULT IN BLOWING OUTER SEAL IN HOUSING.



SECTION 1 - SPECIFICATIONS

3. Hydraulic Tank

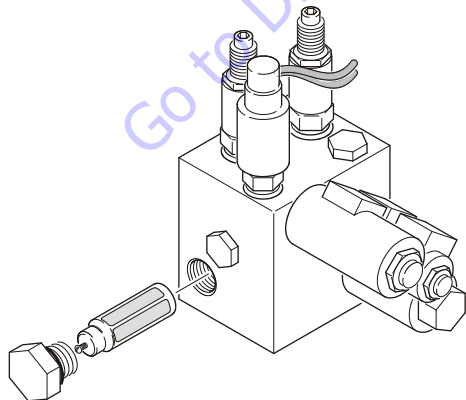


Lube Point(s) - Fill Cap
Capacity - 4 Gal. (15.1 L)
Lube - HO

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. A common symptom of a dirty filter is sluggishness experienced in hydraulic functions.

5. Wheel Drive Hub

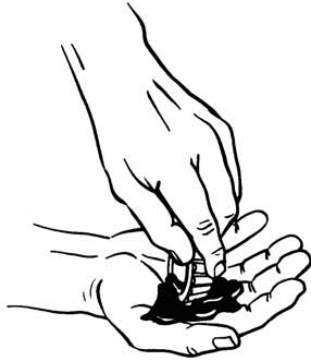


Lube Point(s) - Level/Fill Plug
Capacity - 17 oz. (1/2 Full)

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.

7. Spindles/Bushing

Capacity - A/R
 Lube - Lithium Lubricant
 Interval - Every 2 years or 1200 hours of operation
 Comments - At Spindle/Bushing Replacement; Coat I.D. of bushings prior to installing king pins.

8. Boom Pivot Pins/Bushing

Capacity - A/R
 Lube - Lithium Lubricant
 Interval - Every 2 years or 1200 hours of operation
 Comments - At boom pivot pins/bushing replacement; Coat I.D. of bushings prior to installing pivot pins.

9. Engine



Lube Point(s) - Fill Cap
 Capacity - Refer to Engine Manual
 Lube - EO
 Interval - 3 Months or 150 hours of operation
 Comments - Check level daily/Change in accordance with engine manual.

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)																	
SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 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™ 131)		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)		
					IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB	FT-LB	IN-LB
4	40	0.1120	0.00604	380	8	0.9	6	0.8									
4	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									
6	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									
8	36	0.1640	0.01474	940	31	3.5	22	2.6									
10	24	0.1900	0.01750	1120	43	4.8	32	3.5									
10	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							
1/4	28	0.2500	0.0364	2320	120	13.5	86	10	135	15							
5/16	18	0.3125	0.0624	3340	17	23	13	18	19	26							
5/16	24	0.3125	0.0680	3700	19	26	14	19	21	29							
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48							
3/8	24	0.3750	0.0878	5600	35	47	25	34	40	54							
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75							
7/16	20	0.4375	0.1187	7550	55	75	40	54	60	82							
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116							
1/2	20	0.5000	0.1589	10700	90	122	65	88	100	136							
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163							
9/16	18	0.5625	0.2030	12950	120	163	90	122	135	184							
5/8	11	0.6250	0.2280	14400	150	203	110	149	165	224							
5/8	18	0.6250	0.2560	16300	170	230	130	176	190	258							
3/4	10	0.7500	0.3340	21300	260	353	200	285	338	440							
3/4	16	0.7500	0.3730	23800	300	407	220	298	330	449							
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646							
7/8	14	0.8750	0.5090	32400	470	637	350	475	520	707							
1	8	1.0000	0.6060	38600	640	868	480	651	719	959							
1	12	1.0000	0.6630	42200	700	949	530	719	795	1000							
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142							
1 1/8	12	1.1250	0.8560	47500	880	1193	660	895	925	1258							
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598							
1 1/4	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768							
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074							
1 3/8	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380							
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754							
1 1/2	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128							

NO. 5000059 REV. K

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

REFERENCE JLG THREAD LOCKING COMPOUND			
JLG P/N	Loctite® P/N	ND Industries P/N	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

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 (Loclote@ 242™ or 271™ OR Vibra-TITE™ K=0.16)		Clamp Load	Torque (Dry or Loclote@ 263) K=0.17		Torque (Loclote@ 242™ or 271™ OR Vibra-TITE™ K=16)		Torque (Loclote@ 262™ or TITE™ 131) K=0.15	
					IN-LB	[N.m]	IN-LB	[N.m]		IN-LB	[N.m]	IN-LB	[N.m]		IN-LB
4	40	0.1120	0.00604	380	7	0.8									
4	48	0.1120	0.00661	420	8	0.9									
6	32	0.1380	0.00909	580	14	1.5									
8	40	0.1640	0.01400	900	25	2.8									
36	36	0.1640	0.01474	940	26	2.9									
10	24	0.1900	0.01750	1120	36	4.1									
32	32	0.1900	0.02000	1285	42	4.7									
1/4	20	0.2500	0.0318	2020	86	9.7	80	9	2860	122	14	114	13		
28	28	0.2500	0.0364	2320	99	11.1	95	11	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	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	4720	20	25	20	25	20	25
24	24	0.3125	0.0580	3700	15	20	15	21	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	4940	25	35	25	34	7000	35	50	35	50	35	50
24	24	0.3750	0.0878	5600	30	40	28	38	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	6800	40	55	40	54	9550	60	80	55	75	50	70
20	20	0.4375	0.1187	7550	45	60	44	60	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	9050	65	90	60	82	12750	90	120	85	115	80	110
20	20	0.5000	0.1593	10700	75	100	88	97	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	11600	90	120	87	118	16400	130	175	125	170	115	155
18	18	0.5625	0.2030	12950	105	145	97	132	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	14400	130	175	120	163	20350	180	245	170	230	160	220
18	18	0.6250	0.2560	16300	145	195	136	185	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	21300	225	305	213	290	30100	320	435	300	410	280	380
16	16	0.7500	0.3730	23800	255	345	238	324	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	29400	365	495	343	466	41600	515	700	485	660	455	620
14	14	0.8750	0.5090	32400	400	545	378	514	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	38600	545	740	515	700	51500	730	995	685	930	645	875
12	12	1.0000	0.6630	42200	600	815	563	765	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	68700	1095	1490	1030	1400	965	1310
12	12	1.1250	0.8560	47500	755	1025	713	969	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	87200	1545	2100	1455	1980	1365	1855
12	12	1.2500	1.0740	59600	1055	1435	993	1351	96800	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	104000	2025	2755	1905	2590	1785	2430
12	12	1.3750	1.3150	73000	1420	1930	1358	1820	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	126500	2690	3660	2530	3440	2370	3225
12	12	1.5000	1.5800	87700	1865	2535	1754	2385	142200	3020	4105	2845	3870	2665	3625

NO. 500059 REV. K

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

Figure 1-4. Torque Chart (SAE Fasteners - Sheet 2 of 5)

SOCKET HEAD CAP SCREWS																					
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Magni Coating (Ref 4150701)*				Zinc Yellow Chromate Fasteners (Ref 4150707)*												
					Torque (Dry) K = 17	Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or TITE™ 131) K=0.15	Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or TITE™ 131) K=0.15	Clamp Load See Note 4	Torque (Dry) K = 20	Torque (Locitite® 242™ or 271™ OR Vibra-TITE™ 111 or TITE™ 131) K=0.18	Torque (Locitite® 262™ or 271™ OR Vibra-TITE™ 111 or TITE™ 131) K=0.15										
		In	Sq In	LB	IN-LB	FT-LB	[N.m]	IN-LB	FT-LB	[N.m]	LB	IN-LB	FT-LB	[N.m]	IN-LB	FT-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	114	13				2860	143	129	15							
	28	0.2500	0.0364	3280	139	131	15				3280	164	148	17							
5/16	18	0.3125	0.0524	4720	20	25	25	20	25	25	4720	25	20	25	20	25	25	25			
	24	0.3125	0.0580	5220	25	35	20	25	25	25	5220	35	25	25	20	25	20	25			
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50	7000	45	60	40	55	35	50	50			
	24	0.3750	0.0878	7900	40	55	40	55	40	55	7900	50	70	45	60	35	50	50			
7/16	14	0.4375	0.1063	9650	60	80	55	75	50	70	9650	70	95	65	90	50	70	70			
	20	0.4375	0.1187	10700	65	90	60	80	60	80	10700	80	110	70	95	60	80	80			
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110	12750	105	145	95	130	110	110	110			
	20	0.5000	0.1599	14400	100	135	95	130	90	120	14400	120	165	110	150	90	120	120			
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155	16400	155	210	140	190	115	155	155			
	18	0.5625	0.2030	18250	145	195	135	185	130	175	18250	170	230	155	210	130	175	175			
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220	20350	210	285	190	260	160	220	220			
	18	0.6250	0.2560	23000	205	280	190	260	180	245	23000	240	325	215	290	180	245	245			
3/4	10	0.7500	0.3340	30100	320	435	300	380	280	380	30100	375	510	340	460	280	380	380			
	16	0.7500	0.3730	33600	355	485	335	455	315	430	33600	420	570	380	515	315	430	430			
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620	41600	605	825	545	740	455	620	620			
	14	0.8750	0.5090	45800	570	775	535	730	500	680	45800	670	910	600	815	500	680	680			
1	8	1.0000	0.6060	51500	730	995	685	930	645	875	51500	860	1170	775	1055	645	875	875			
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015	59700	995	1355	895	1215	745	1015	1015			
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310	68700	1290	1755	1160	1580	965	1310	1310			
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475	77000	1445	1965	1300	1770	1085	1475	1475			
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855	87200	1815	2470	1635	2225	1365	1855	1855			
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055	96600	2015	2740	1810	2460	1510	2055	2055			
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430	104000	2385	3245	2145	2915	1785	2430	2430			
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760	118100	2705	3680	2435	3310	2030	2760	2760			
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225	126500	3165	4305	2845	3670	2370	3225	3225			
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625	142200	3555	4835	3200	4350	2665	3625	3625			

NO. 500059 REV. K

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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

Figure 1-5. Torque Chart (SAE Fasteners - Sheet 3 of 5)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)											
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*											
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS											
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Locite@263™)	Torque (Lub)	Torque (Locite@262™ OR Vibra-TITE™ 131)	Torque (Locite@242™ or 271™ OR Vibra-TITE™ 111 or 140)	Clamp Load	Torque (Dry or Locite@263™) K = 0.20	Torque (Lub OR Locite@242™ or 271™ OR Vibra-TITE™ 111 or 140) K = 0.18	Torque (Locite@262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13			
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22			
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47			
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8	8.85			
6	1	20.10	8.74	11	7.9	9.4	12	12.5			
7	1	28.90	12.6	18	13	16	19	18.0	25	23	19
8	1.25	36.60	15.9	26	19	23	28	22.8	37	33	27
10	1.5	58.00	25.2	50	38	45	55	36.1	70	65	55
12	1.75	84.30	36.7	88	66	79	97	52.5	125	115	95
14	2	115	50.0	140	105	126	154	71.6	200	180	150
16	2	157	68.3	219	164	197	241	97.8	315	280	235
18	2.5	192	83.5	301	226	271	331	119.5	430	385	325
20	2.5	245	106.5	426	320	383	469	152.5	610	550	460
22	2.5	303	132.0	581	436	523	639	189.0	830	750	625
24	3	353	153.5	737	553	663	811	222.0	1065	960	800
27	3	459	199.5	1080	810	970	1130	286.0	1545	1390	1160
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2095	1885	1575
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2855	2570	2140
36	4	817	355.5	2560	1920	2300	2690	509.0	3665	3300	2750
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5865	5275	4395

NO. 5000059 REV. K

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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
 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.

Figure 1-6. Torque Chart (METRIC Fasteners - Sheet 4 of 5)

Values for Magni Coated Fasteners (Ref 4150701)										
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*					
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™, K=0.17)	Torque (Loctite® 262™ OR Vibra-TITE™, 131) K=0.16	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™, 111 or 140) K=0.15	Clamp Load	Torque (Dry or Loctite® 263™, K = 0.17)	Torque (Lub 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]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0	3.13			
3.5	0.6	6.78	2.95	1.8	1.7	1.5	4.22			
4	0.7	8.78	3.82	2.6	2.4	2.3	5.47			
5	0.8	14.20	6.18	5.3	4.9	4.6	8.85			
6	1	20.10	8.74	9	8.4	7.9	12.5	13	12	11
7	1	28.90	12.6	15	14	13	18.0	21	20	19
8	1.25	36.60	15.9	22	20	19	22.8	31	29	27
10	1.5	58.00	25.2	43	40	38	36.1	61	58	55
12	1.75	84.30	36.7	75	70	66	52.5	105	100	95
14	2	115	50.0	119	110	105	71.6	170	160	150
16	2	157	68.3	186	175	165	97.8	265	250	235
18	2.5	192	83.5	256	240	225	119.5	365	345	325
20	2.5	245	106.5	362	340	320	152.5	520	490	460
22	2.5	303	132.0	494	465	435	189.0	705	665	625
24	3	353	153.5	627	590	555	222.0	905	850	800
27	3	459	199.5	916	860	810	286.0	1315	1235	1160
30	3.5	561	244.0	1245	1170	1100	349.5	1780	1680	1575
33	3.5	694	302.0	1694	1595	1495	432.5	2425	2285	2140
36	4	817	355.5	2176	2050	1920	509.0	3115	2930	2750
42	4.5	1120	487.0	3477	3275	3070	698.0	4985	4690	4395

NO. 5000059 REV. K

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 OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM

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.

Figure 1-7. Torque Chart (METRIC Fasteners - Sheet 5 of 5)

PARTS FINDER

**Search Website
by Part Number**



**Search Manual
Library For Parts
Manual & Lookup Part
Numbers – Purchase
or Request Quote**

Search Manuals

Enter your information to search for manuals and parts.

* Brand:

* Model:

* Serial:

* Part Number:

SEARCH

**Can't Find Part or
Manual? Request Help
by Manufacturer,
Model & Description**

Parts Order Form

Please fill in the following information:

Manufacturer:	<input type="text"/>
Model:	<input type="text"/>
Description:	<input type="text"/>
Part Number:	<input type="text"/>
Quantity:	<input type="text"/>
Notes:	<input type="text"/>

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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 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 aerial work platforms. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

The Annual Machine Inspection must be performed by a Factory-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 At each 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 Reassembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

NOTICE

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

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

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

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

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

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.
2. JLG recommends Mobil DTE-10 hydraulic oil, which has an SAE viscosity of 10W and a viscosity index of 168.

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 seal.
- Normal thermal expansion and contraction of the hydraulic oil within cylinders (See Cylinder Thermal Drift below).

The first two circumstances may result in cylinder movement due to oil leakage 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, peeling, 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.
- 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	INTERVAL		
	Pre-Delivery ¹ or Frequent ² Inspection	Annual ³ (Yearly) Inspection	Every 2 Years
Boom Assembly			
Boom Weldments	1,2,4	1,2,4	
Hose/Cable Carrier Installations	1,2,9,12	1,2,9,12	
Pivot Pins and Pin Retainers	1,2	1,2	
Sheaves, Sheave Pins	1,2	1,2	
Bearings	1,2	1,2	
Wear Pads	1,2	1,2	
Covers or Shields	1,2	1,2	
Extend/Retract Chain or Cable Systems	1,2,3	1,2,3	
Platform Assembly			
Platform		1,2	
Railing	1	1,2	
Gate	1,5	1,5	
Floor	1	1,2	
Rotator	5,9,15		
Lanyard Anchorage Point	1,2,10	1,2,10	
Turntable Assembly			
Swing Bearing or Worm Gear	1,2,14	1,2,3,13,14	
Oil Coupling	9		
Swing Drive System	11	11	
Turntable Lock	1,2,5	1,2,5	
Hood, Hood Props, Hood Latches	5	1,2,5	
Chassis Assembly			
Tires	16,17,18	16,17,18	
Wheel Nuts/Bolts	15	15	
Wheel Bearings			14,24
Oscillating Axle/Lockout Cylinder Systems		5,8	
Outrigger or Extendable Axle Systems	5,8	5,8	
Steer Components			
Drive Motors			
Drive Hubs	11	11	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL		
	Pre-Delivery ¹ or Frequent ² Inspection	Annual ³ (Yearly) Inspection	Every 2 Years
Functions/Controls			
Platform Controls	5,6	6	
Ground Controls	5,6	6	
Function Control Locks, Guards, or Detents	1,5	5	
Footswitch	5	5	
Emergency Stop Switches (Ground & Platform)	5	5	
Function Limit or Cutout Switch Systems	5	5	
Capacity Indicator		5	
Drive Brakes	5		
Swing Brakes	5		
Boom Synchronization/Sequencing Systems		5	
Manual Descent or Auxiliary Power	5	5	
Power System			
Engine Idle, Throttle, and RPM	3	3	
Engine Fluids (Oil, Coolant, Fuel)	9,11	11	
Air/Fuel Filter	1,7	7	
Exhaust System	1,9	9	
Batteries	1,9	19	
Battery Fluid	11	11	
Battery Charger	5	5	
Fuel Reservoir, Cap, and Breather	1,2,5	1,5	
Hydraulic/Electric System			
Hydraulic Pumps	1,2,9		
Hydraulic Cylinders	1,2,7,9	1,2,9	
Cylinder Attachment Pins and Pin Retainers	1,2,9	1,2	
Hydraulic Hoses, Lines, and Fittings	1,2,9,12	1,2,9,12	
Hydraulic Reservoir, Cap, and Breather	1,2,5,9	1,5	24
Hydraulic Filter	1,7,9	7	
Hydraulic Fluid	7,11	7,11	
Electrical Connections	1,20	20	
Instruments, Gauges, Switches, Lights, Horn	1	5,23	
General			
Operators and Safety Manuals in Storage Box	21	21	
ANSI and EMI Manuals/Handbooks Installed		21	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL		
	Pre-Delivery ¹ or Frequent ² Inspection	Annual ³ (Yearly) Inspection	Every 2 Years
Capacity Decals Installed, Secure, Legible	21	21	
All Decals/Placards Installed, Secure, Legible	21	21	
Walk-Around Inspection Performed			
Annual Machine Inspection Due	21		
No Unauthorized Modifications or Additions	21	21	
All Relevant Safety Publications Incorporated	21	21	
General Structural Condition and Welds	2,4	2,4	
All Fasteners, Pins, Shields, and Covers	1,2	1,2	
Grease and Lubricate to Specifications	22	22	
Function Test of All Systems	21	21,22	
Paint and Appearance	7	7	
Stamp Inspection Date on Frame		22	
Notify JLG of Machine Ownership		22	
Footnotes:			
¹ Prior to each sale, lease, or delivery			
² In service for 3 months or 150 Hours; or Out of service for 3 months or more; or Purchased used			
³ Annually, no later than 13 months from the date of the prior inspection			
Performance Codes:			
1 - Check for proper and secure installation			
2 - Visual inspection for damage, cracks, distortion or excessive wear			
3 - Check for proper adjustment			
4 - Check for cracked or broken welds			
5 - Operates Properly			
6 - Returns to neutral or "off" position when released			
7 - Clean and free of debris			
8 - Interlocks function properly			
9 - Check for signs of leakage			
10 - Decals installed and legible			
11 - Check for proper fluid level			
12 - Check for chafing and proper routing			
13 - Check for proper tolerances			
14 - Properly lubricated			
15 - Torqued to proper specification			
16 - No gouges, excessive wear, or cords showing			
17 - Properly inflated and seated around rim			
18 - Proper and authorized components			
19 - Fully charged			
20 - No loose connections, corrosion, or abrasions			
21 - Verify			
22 - Perform			
23 - Sealed Properly			
24 - Drain, Clean, Refill			

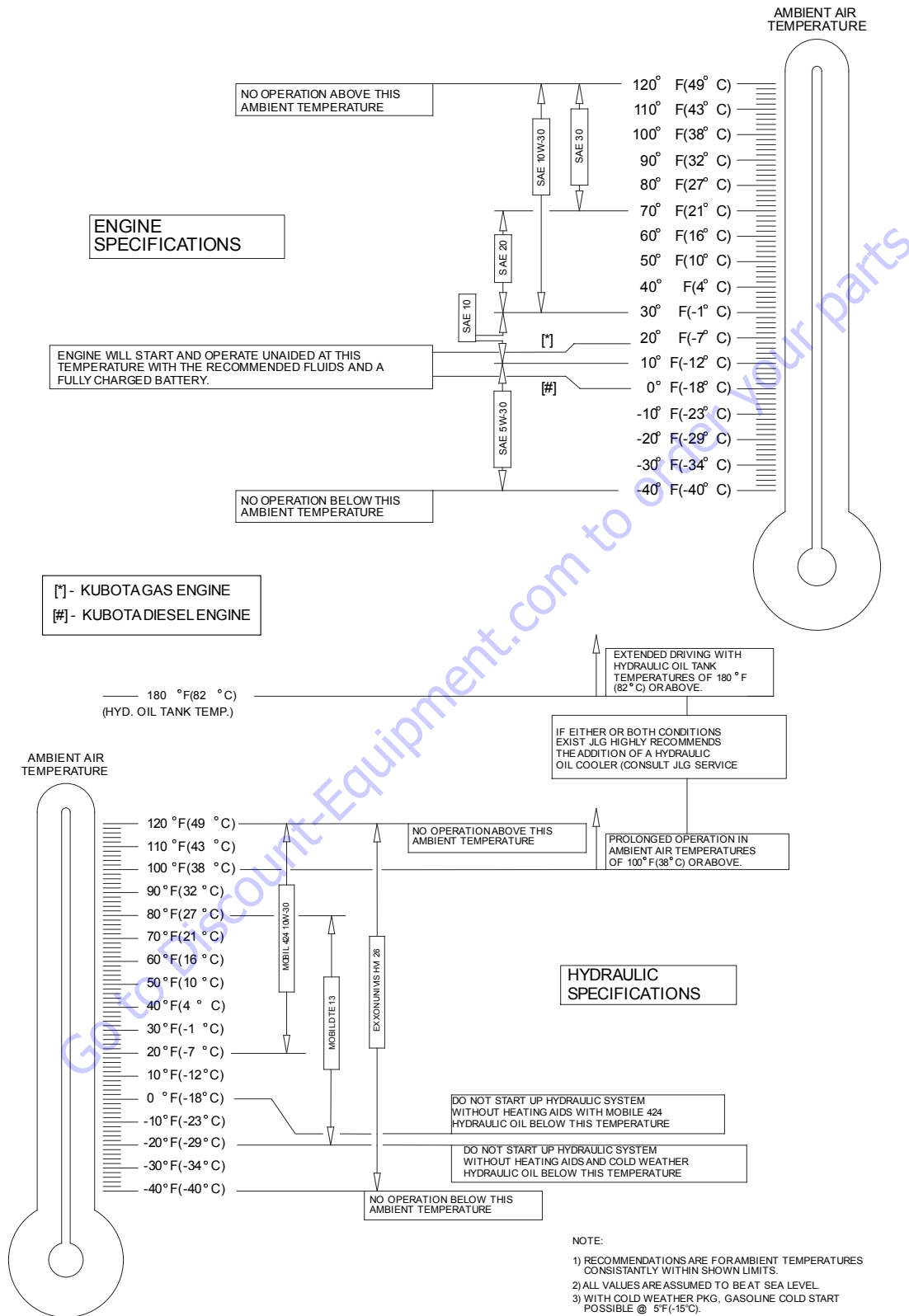


Figure 2-1. Engine Operating Temperature Specifications - Kubota

PARTS FINDER

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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 Inflation

The air pressure for pneumatic tires must be equal to the air pressure that is stenciled on the side of the JLG product or rim decal for safe and proper operational characteristics.

Tire Damage

For pneumatic tires, JLG Industries, Inc. recommends that when any cut, rip, or tear is discovered that exposes sidewall or tread area cords in the tire, measures must be taken to remove the JLG product from service immediately. Arrangements must be made for replacement of the tire or tire assembly.

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. When selecting and installing a replacement tire, ensure that all tires are inflated to the pressure recommended by JLG. Due to size variations between tire brands, both tires on the same axle should be the same.

Wheel Replacement

The rims installed on each product model have been designed for stability requirements which consist of track width, tire pressure, 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

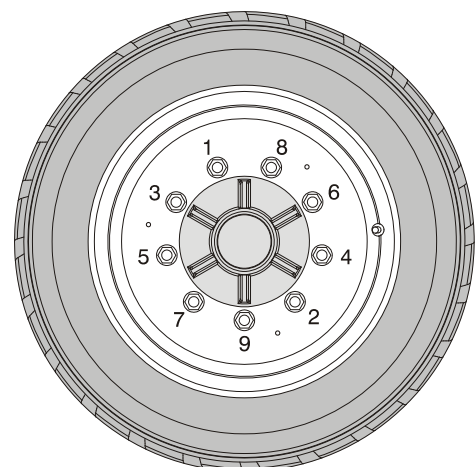
It is extremely important to apply and maintain proper wheel mounting torque.

! 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:



- 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)	100 ft. lbs. (130 Nm)	170 ft. lbs. (255 Nm)

- Wheel nuts should be torqued after first 50 hours of operation and after each wheel removal. Check torque every 3 months or 150 hours of operation.

3.2 SPINDLE

Setting Wheel Bearing End Play

NOTICE

BE SURE NOT TO OVER-TIGHTEN THE SPINDLE NUT.

- Tighten the spindle nut to assure the bearings are properly seated.
- Loosen the spindle nut completely until the nut can be turned by hand.
- Tighten the spindle nut by hand using a socket without rotating the hub.
- 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 1/2 of the cotter pin hole in the spindle can be seen in a slot, back nut off to nearest slot and insert pin.
- 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.
- 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.

- 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:

- Hub should rotate freely when spun by hand.
- 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 through the entire bearing cavity and through 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 all rollers of the inner and outer bearings.

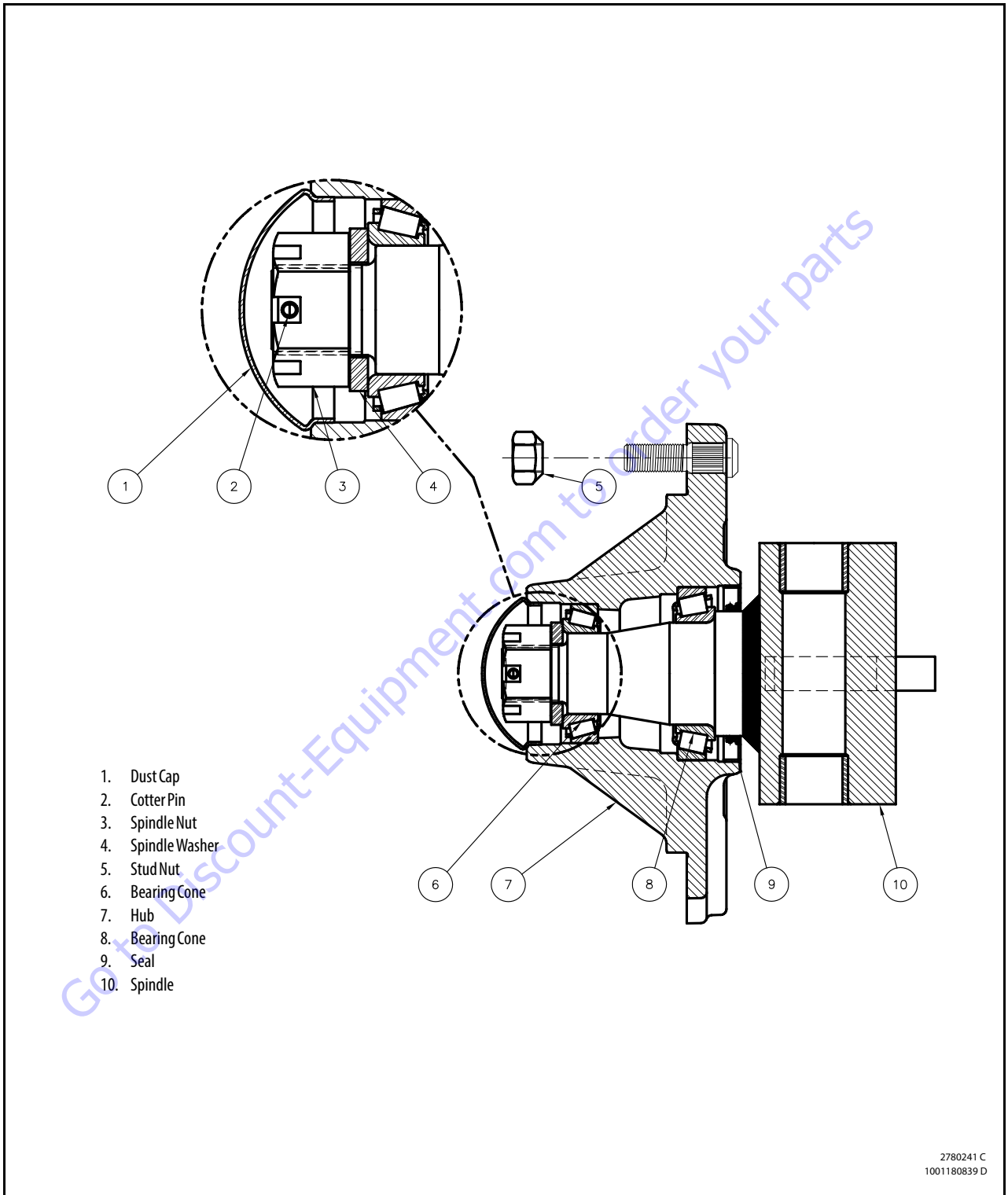
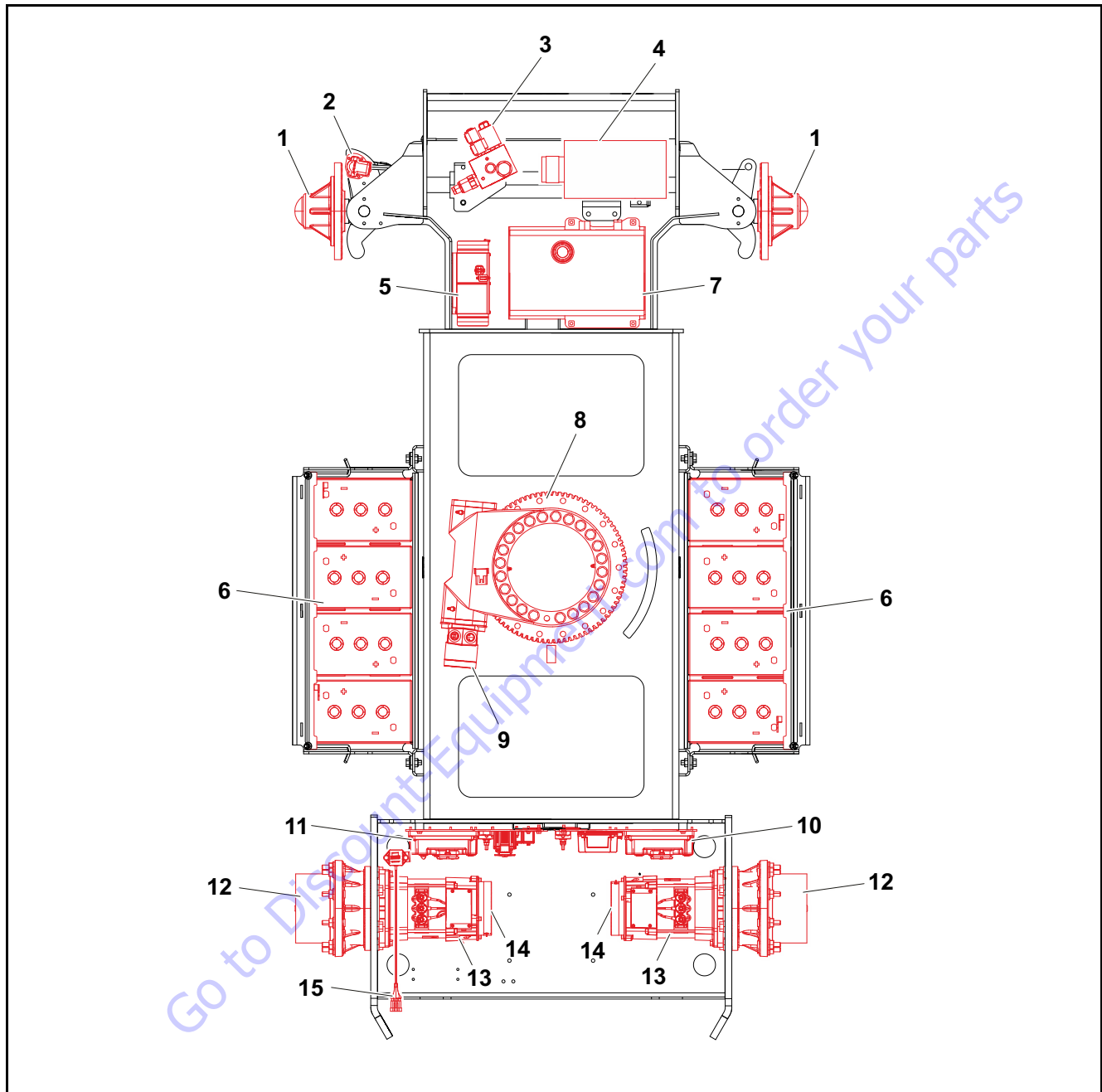


Figure 3-1. Spindle Assembly



- | | | |
|-----------------------|---------------------------------|-------------------------------|
| 1. Spindle | 6. Battery | 11. Drive Module (Left/Slave) |
| 2. Steer Angle Sensor | 7. Hydraulic Tank | 12. Drive Hub |
| 3. Steer Valve | 8. Swing Bearing | 13. Drive Motor |
| 4. Motor/Pump | 9. Swing Motor | 14. Drive Brake |
| 5. Battery Charger | 10. Drive Module (Right/Master) | 15. Dual Axial Sensor |

Figure 3-2. Chassis Component Location

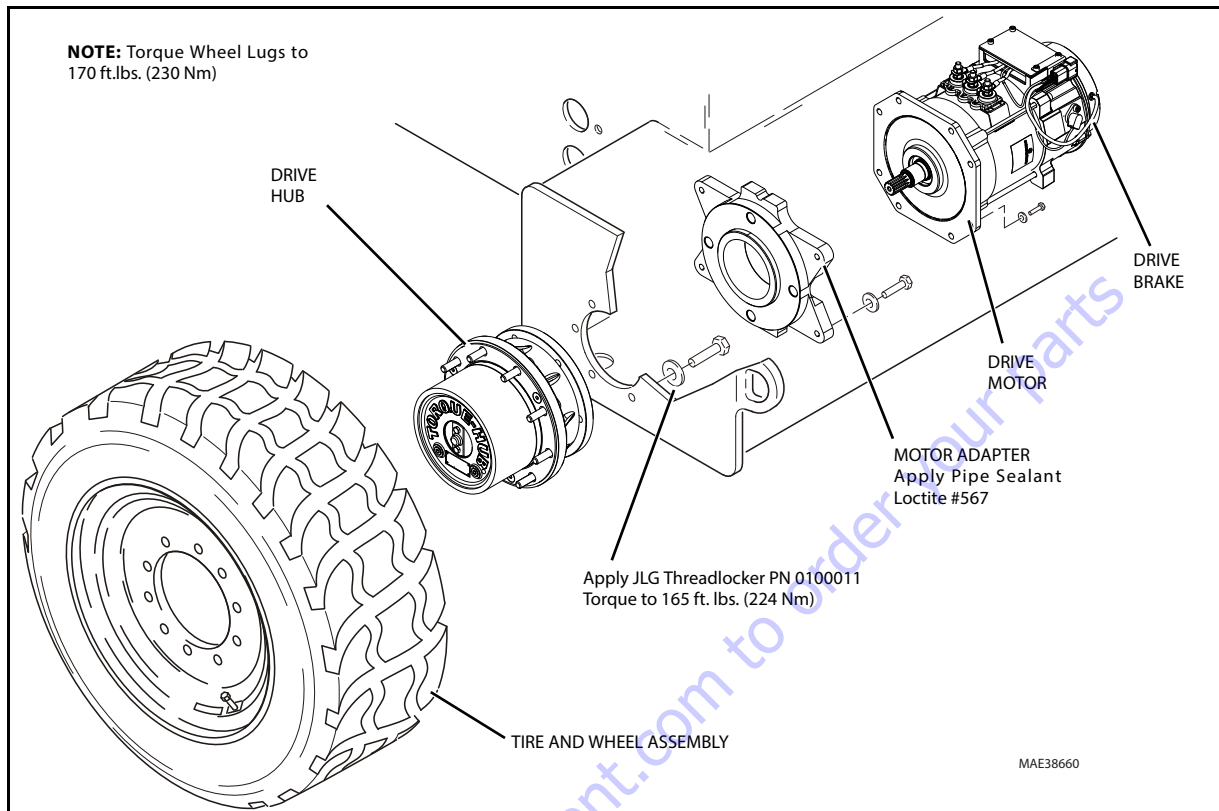


Figure 3-3. Drive Components

3.3 TILT MODULE

When installing a new tilt module, always ensure that it is calibrated using the JLG Control System analyzer before operating the machine. Refer to Section 6, JLG Control System Analyzer Kit Instructions. Use a standard bubble level in two different directions to ensure that the machine's frame is level prior to installing the new tilt module.

1. Place the machine on a flat, level surface. Check for level by placing a bubble level on the frame in both directions.
2. Plug in the analyzer (Analyzer - PN 1600244, Cable - PN 1600633) into port J9 on the power module or port J1 on the platform module.
3. Use the right arrow key to curse over to "ACCESSLEVEL 2". Depress Enter.

4. Use Up/Down arrow keys to enter the following password "33271". Depress Enter.
5. Use the right arrow to curse over to "LEVEL VEHICLE". Depress Enter. Depress Enter again.
6. Verify that the tilt reading is now "0.0: 0.0".

⚠ WARNING

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

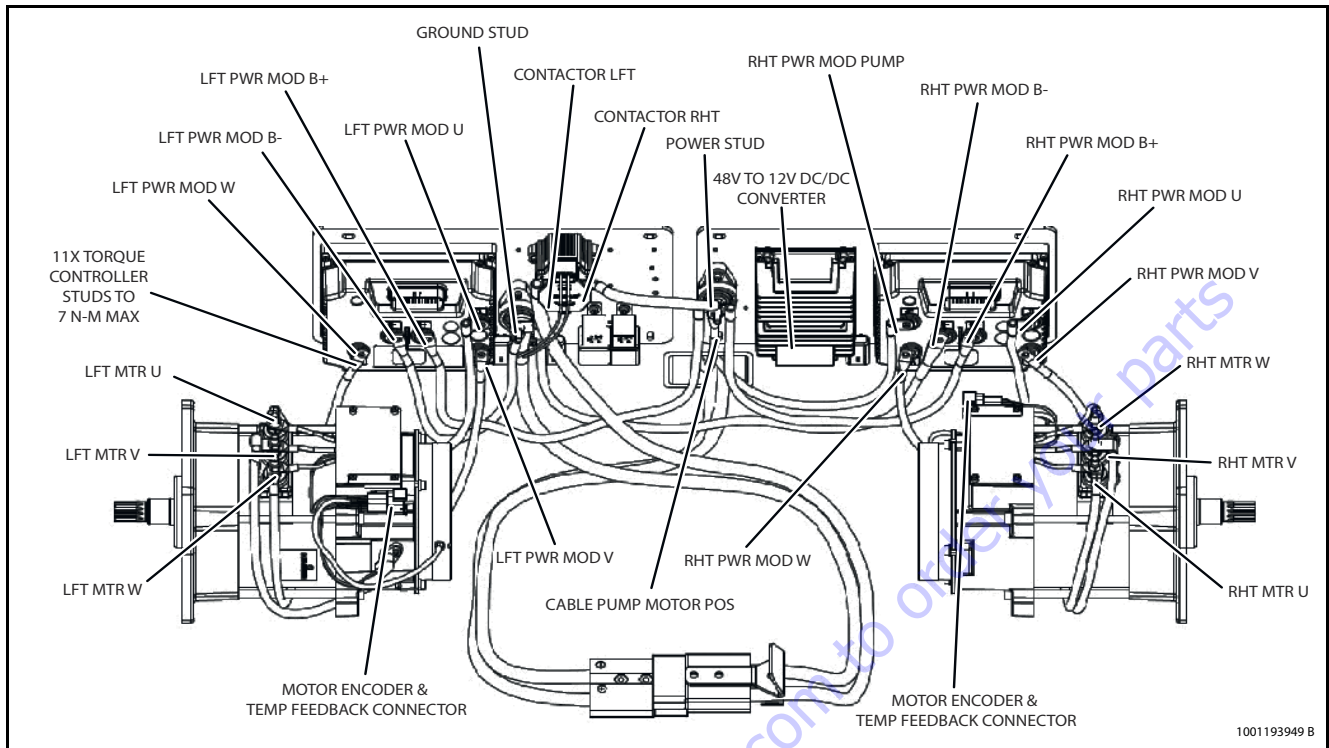
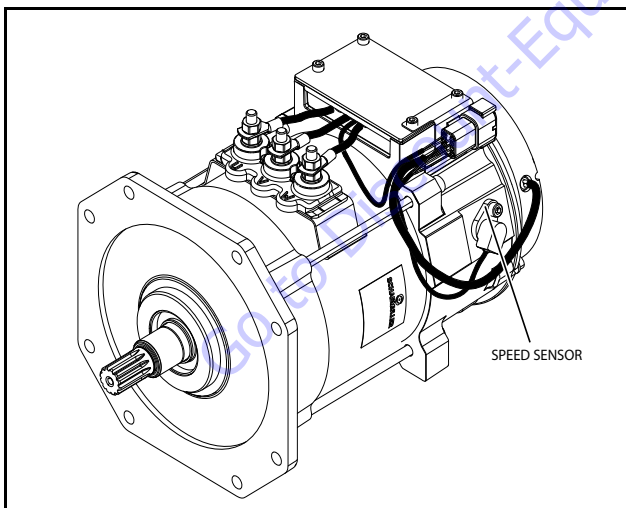


Figure 3-4. Cable Routing

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.

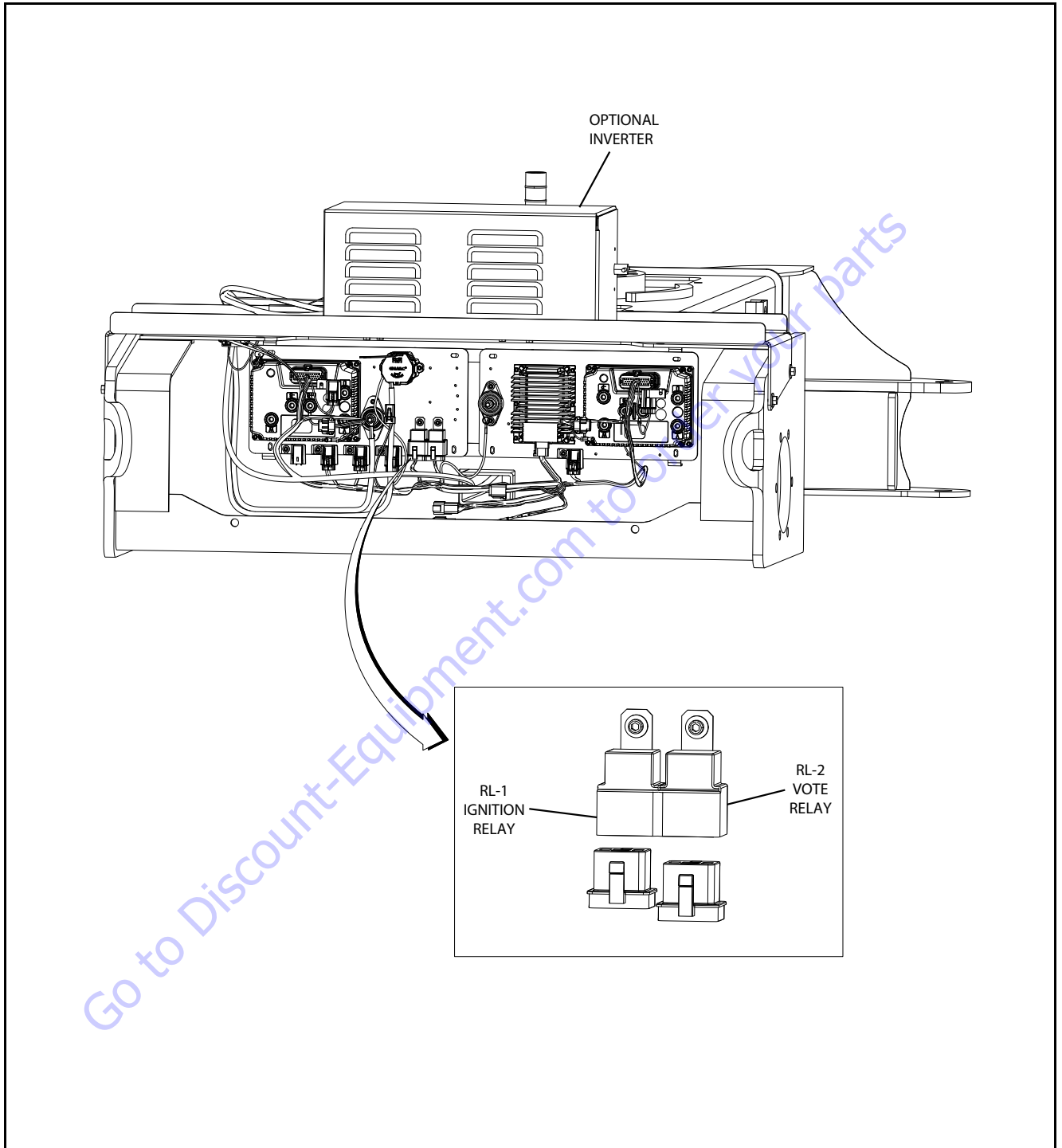


Figure 3-5. Relay

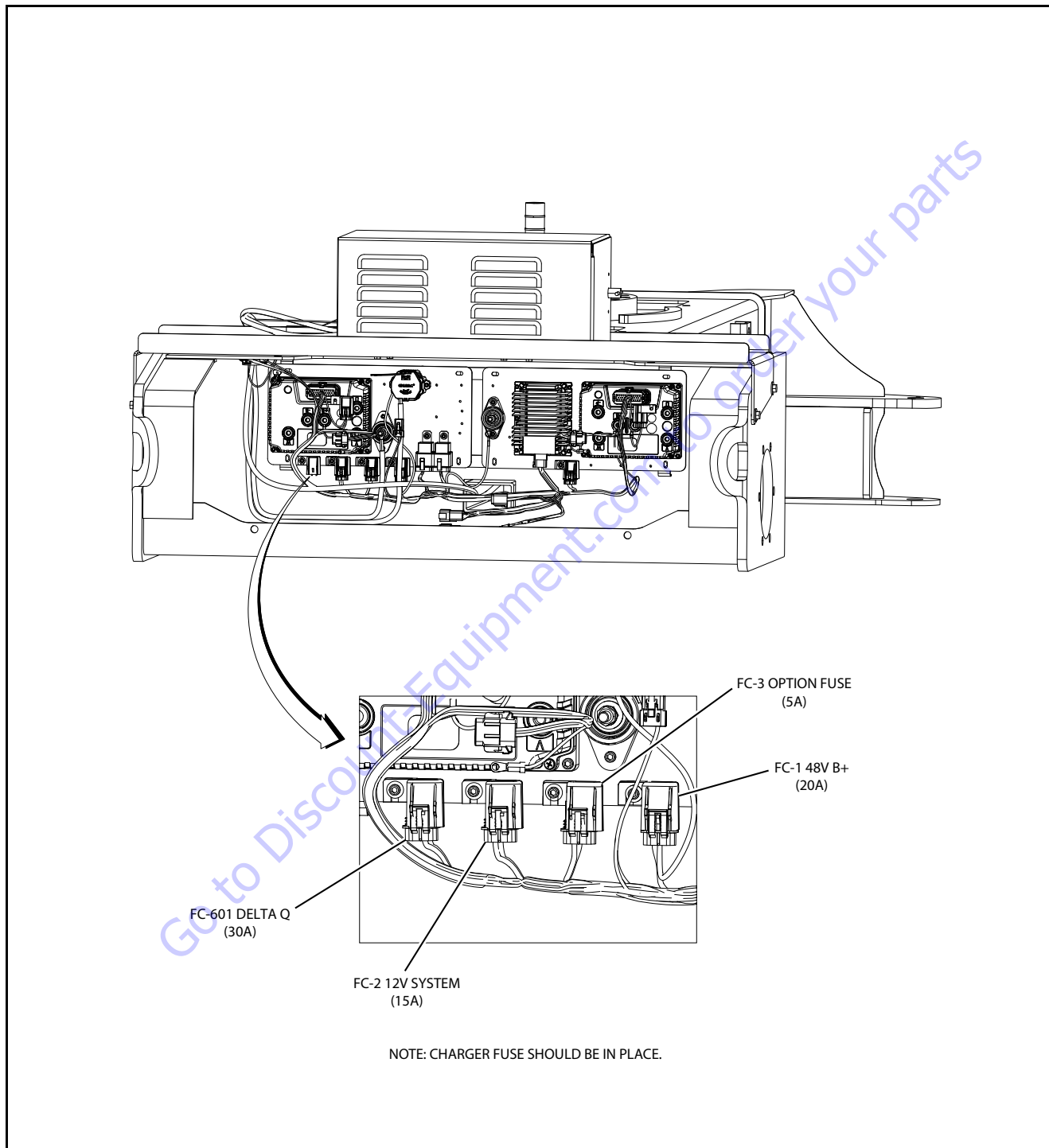


Figure 3-6. System Fuses

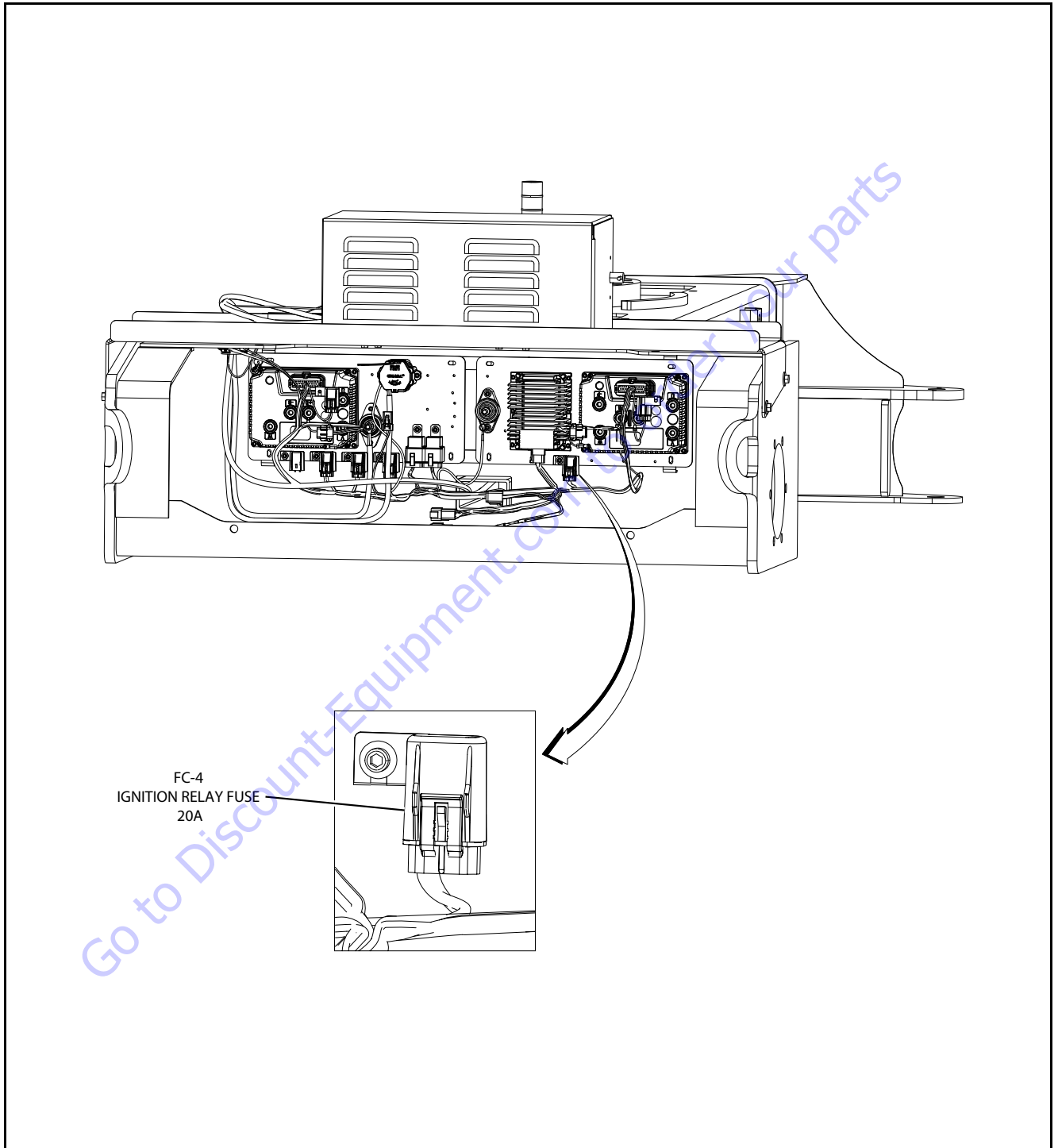


Figure 3-7. Ignition Relay Fuse

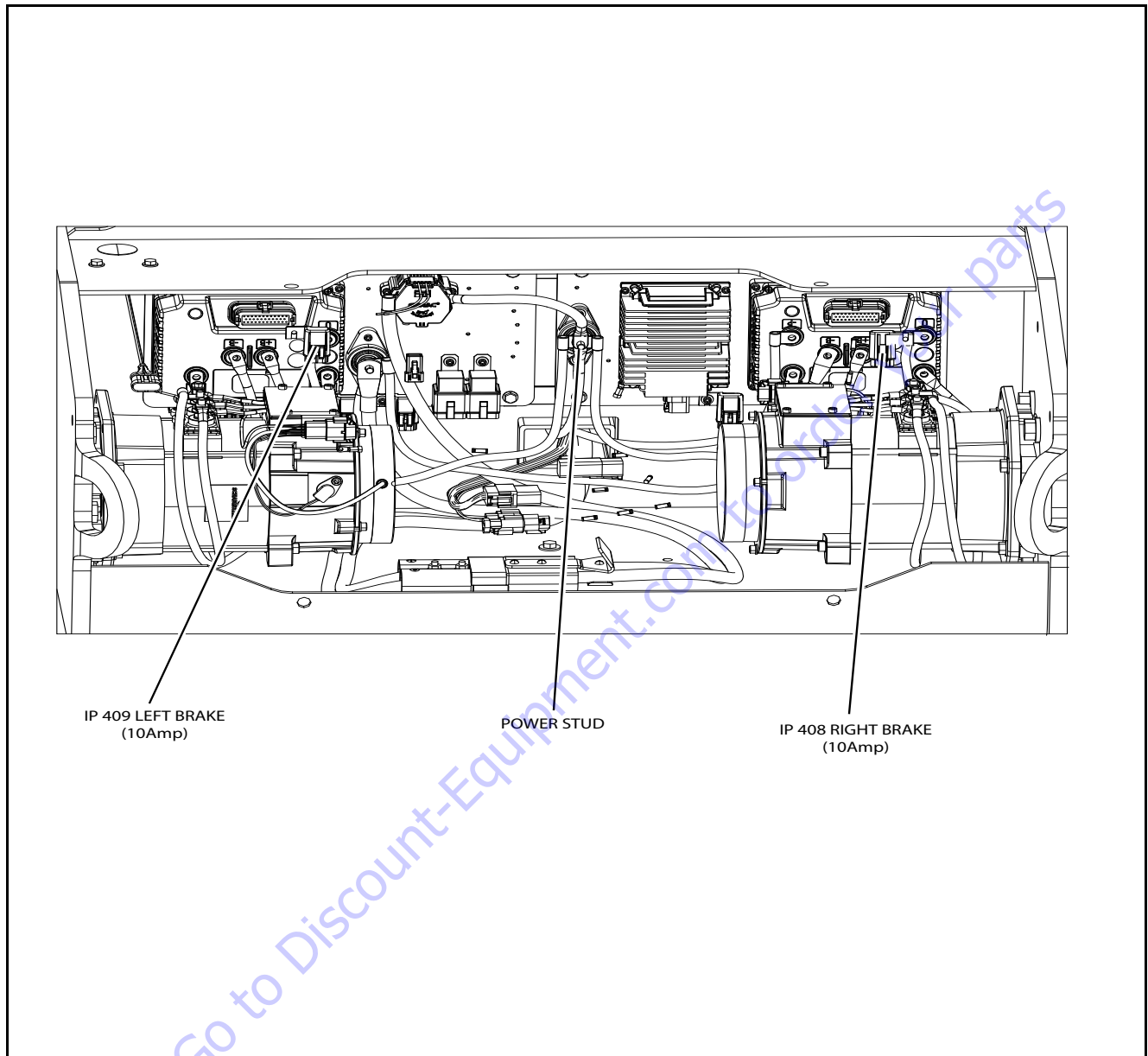


Figure 3-8. Drive Fuses

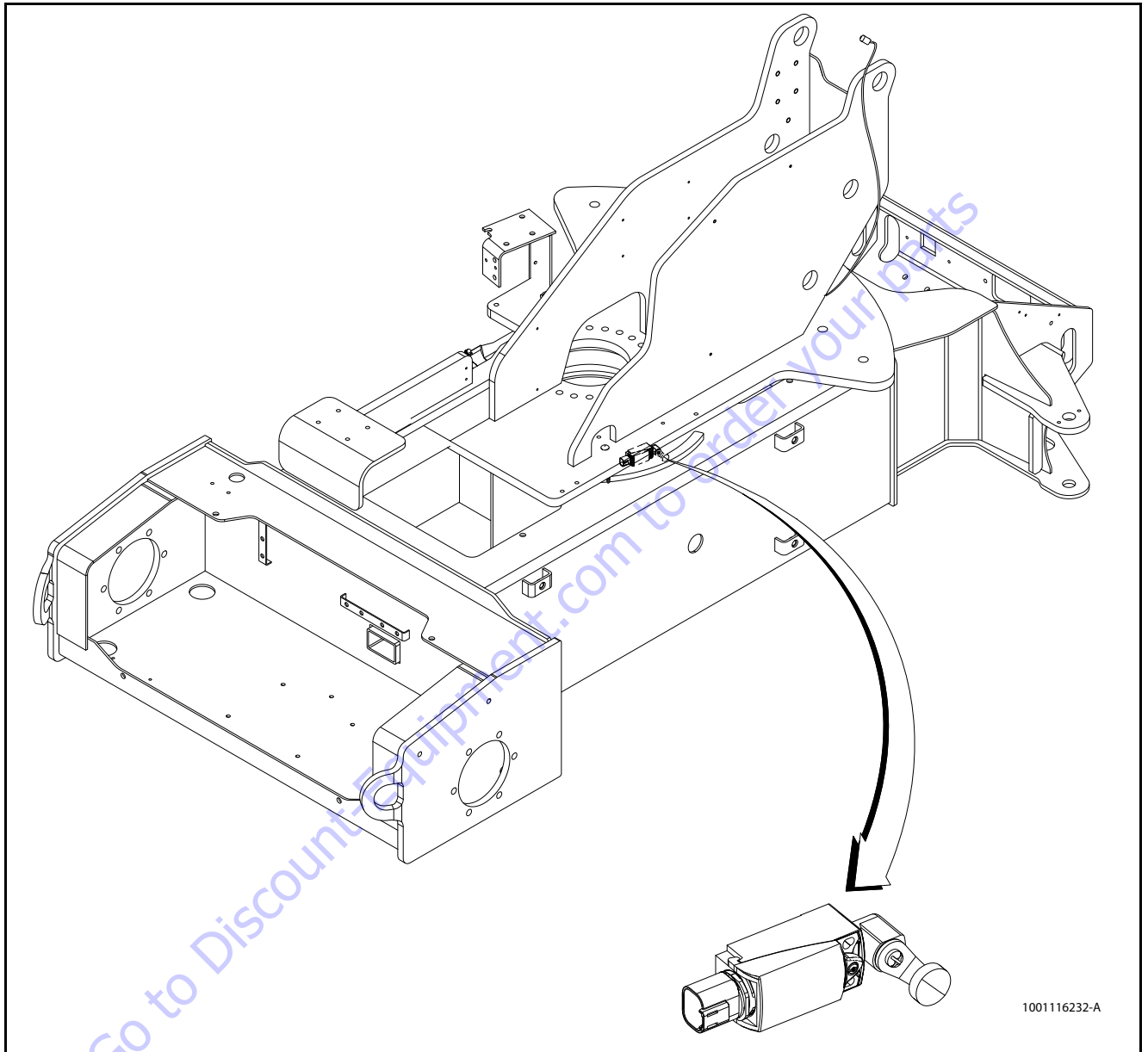
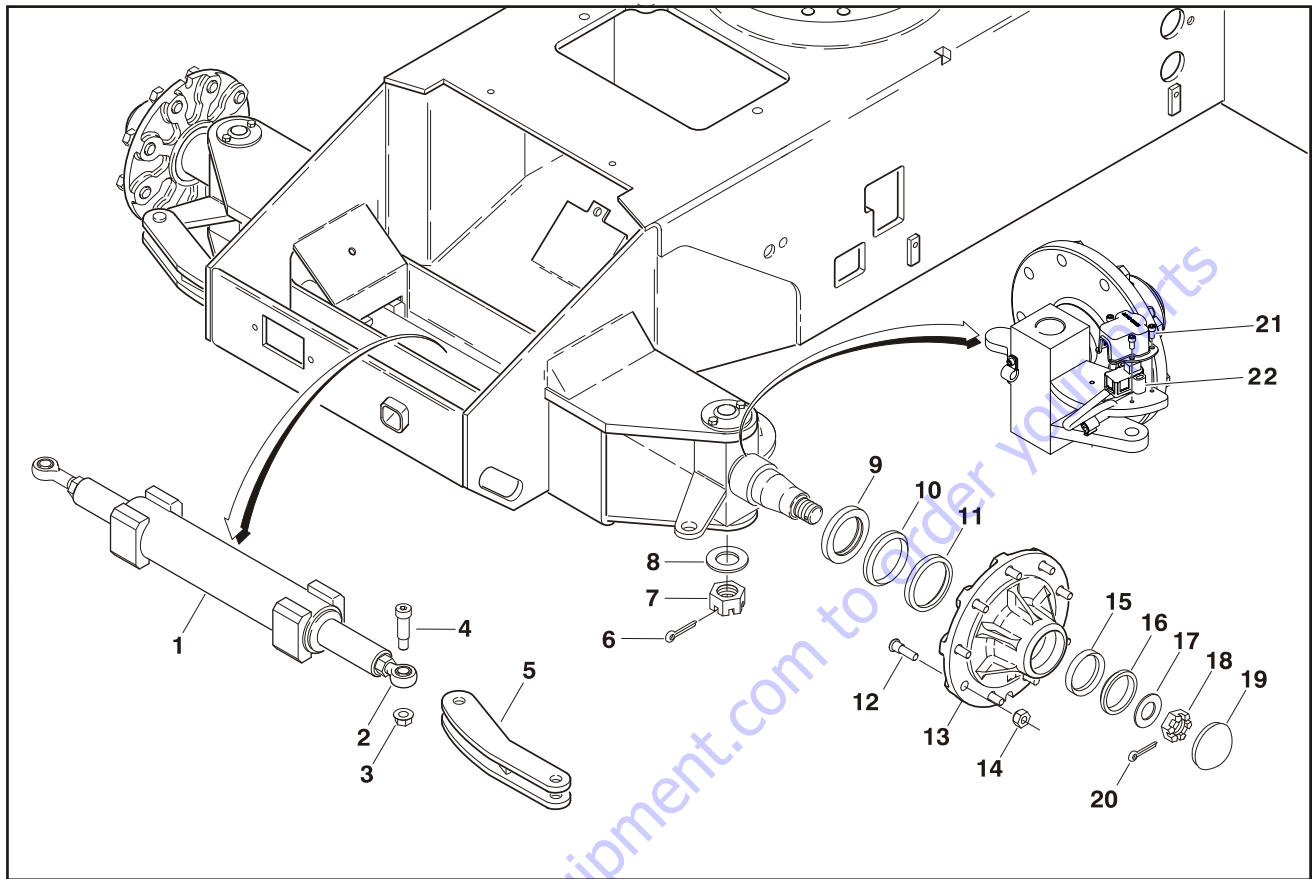


Figure 3-9. Drive Limit Switch



- | | | | |
|-------------------|-----------------------|------------------------|-------------------------|
| 1. Steer Cylinder | 7. Castle Nut | 13. Hub | 18. Castle Nut |
| 2. Rod End | 8. Thrust Washer | 14. Lug Nut | 19. Dust Cap |
| 3. Nut | 9. Lip Seal | 15. Outer Bearing Cup | 20. Cotter Pin |
| 4. Shoulder Screw | 10. Bearing Cone | 16. Outer Bearing Cone | 21. Capscrew |
| 5. Steer Link | 11. Inner Bearing Cup | 17. Tanged Washer | 22. Angle Sensor Switch |
| 6. Cotter Pin | 12. Wheel Stud | | |

Figure 3-10. Steering Installation and spindle

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 (See Brake Disassembly Procedure).*

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.

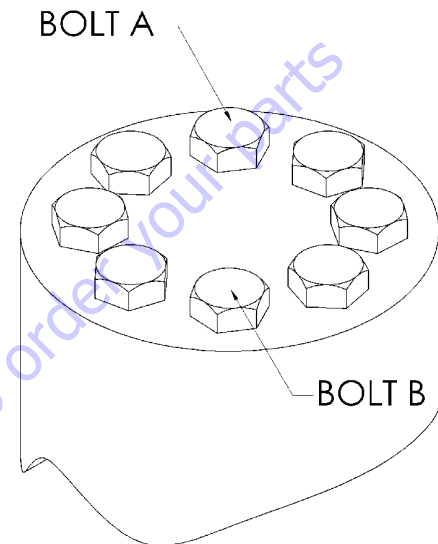
Leak Test (Main Unit)

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 3-11., Main Assembly - Sheet 1 of 2 and Figure 3-12., 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.

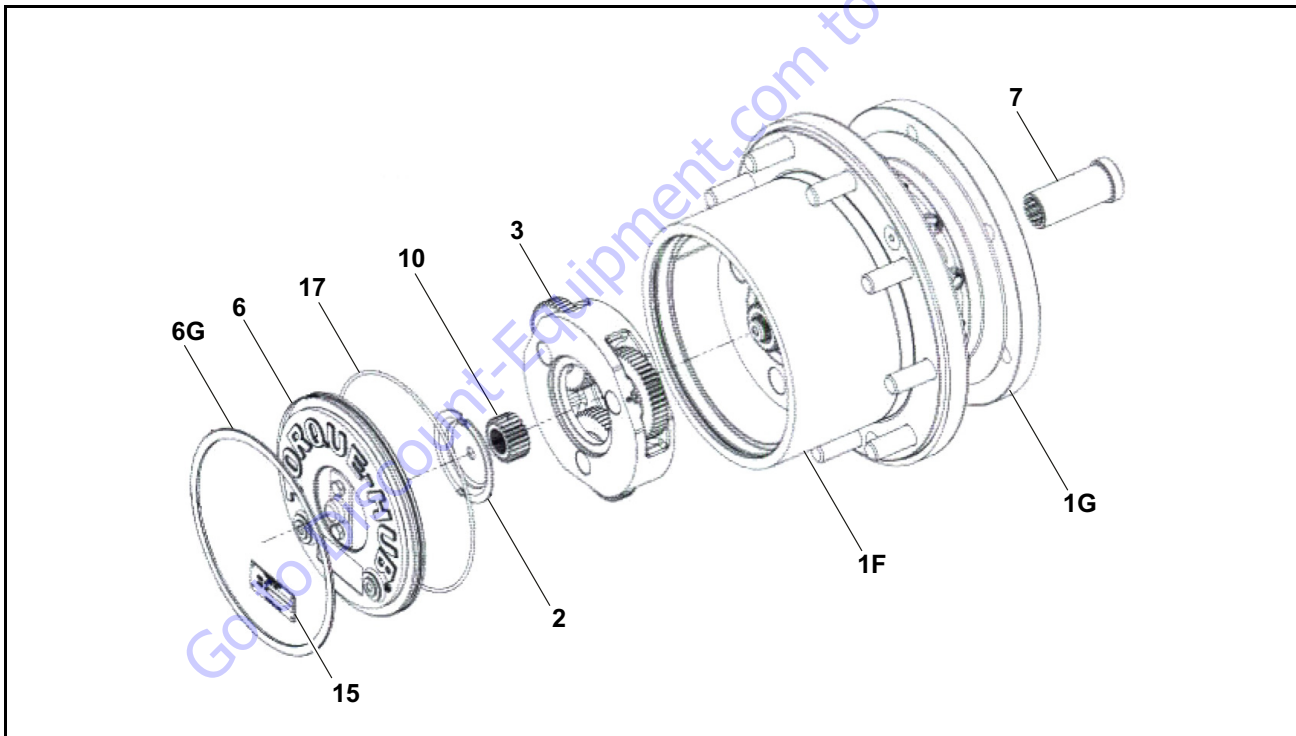
6. Remove the First Stage Sun Gear (10) if applicable.

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).

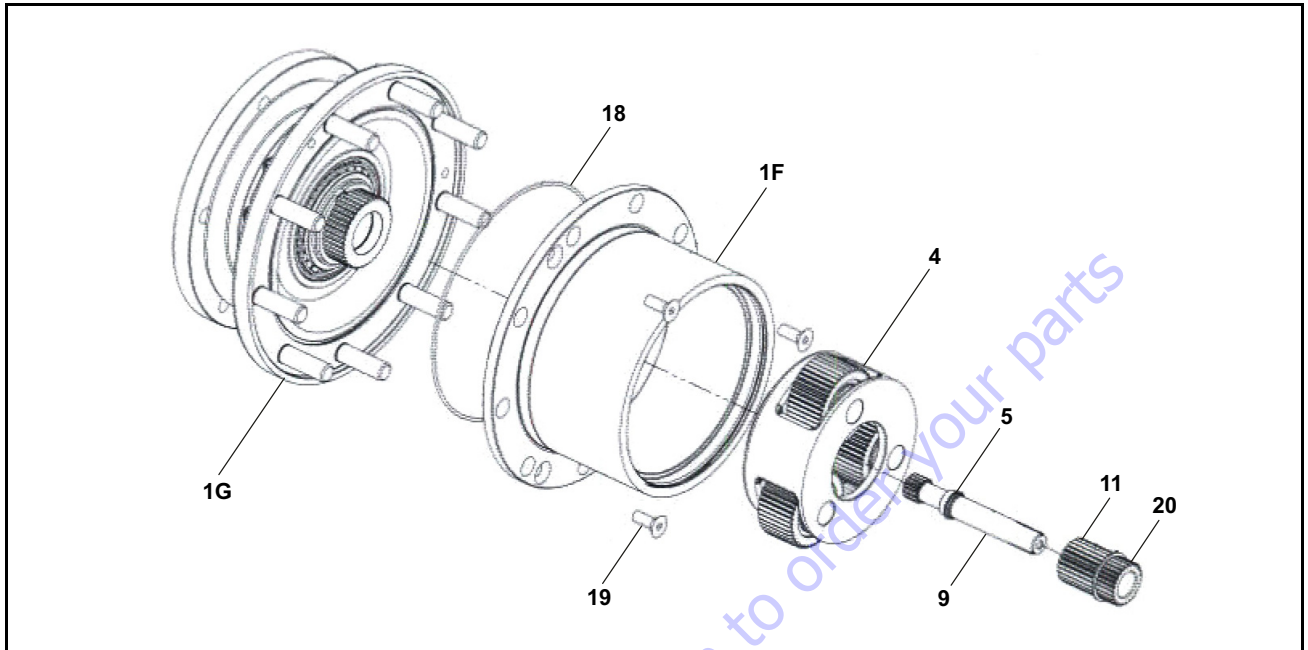
NOTE: On units with a ratio 48:1, the Sun Gear (11) and the Input Shaft (9) will need to be removed together.

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 | 15. I.D. Plate |
| 6. Cover Assembly | 18. O-ring |
| 6G. Retaining Ring | 19. Flat Head Bolt |

Figure 3-11. 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 3-12. Main Assembly - Sheet 2 of 2

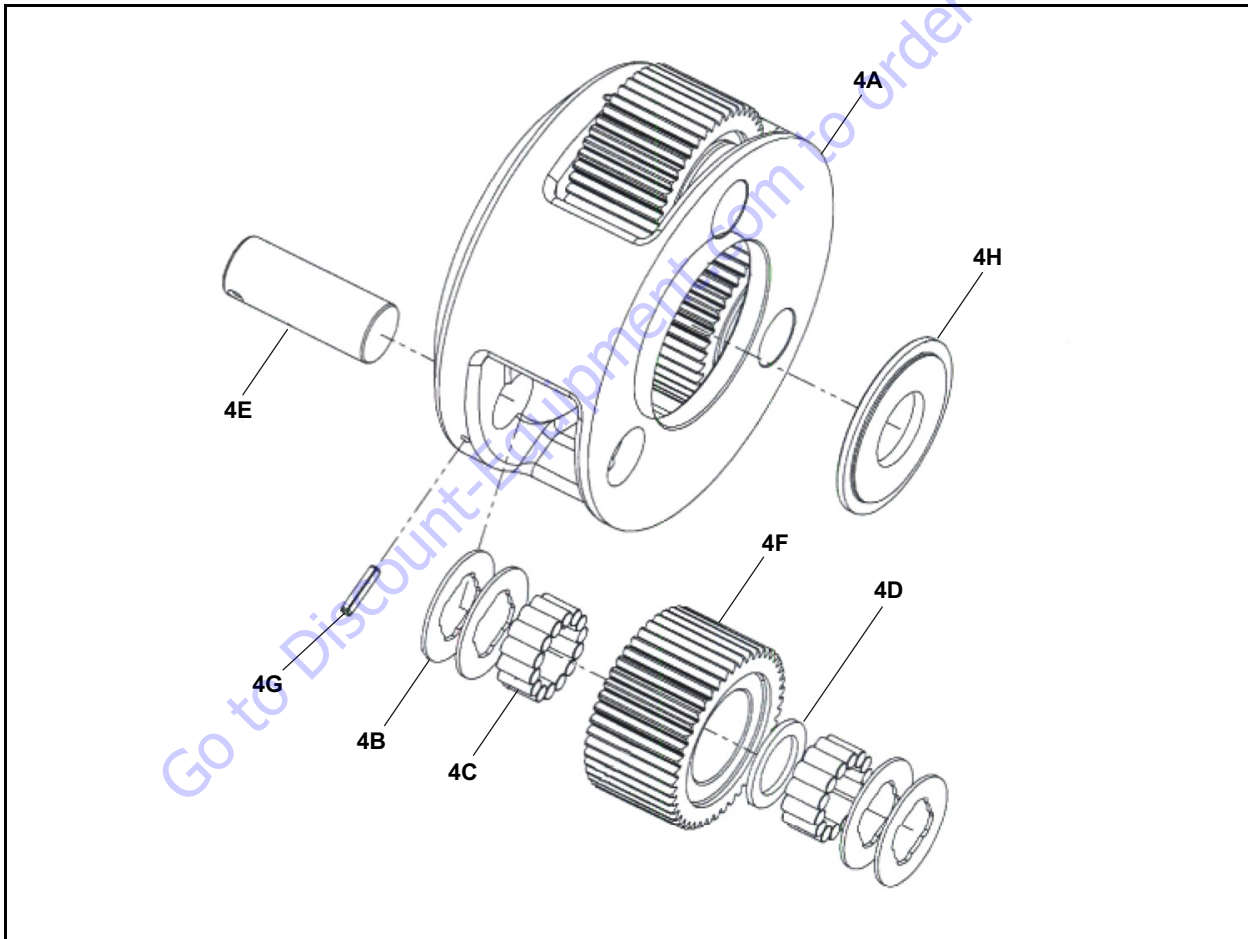
Output Carrier Disassembly

NOTE: Refer to Figure 3-13., Output Carrier and Figure 3-14., 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).

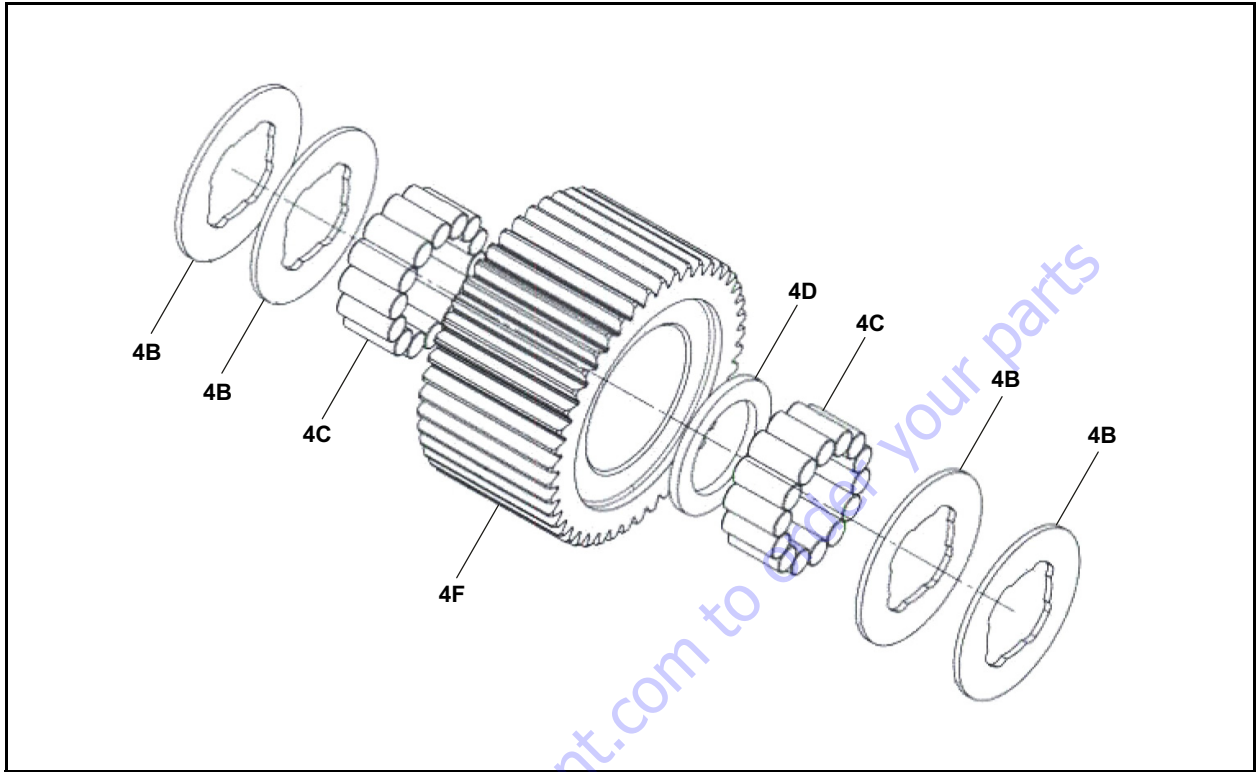
NOTE: The Roll Pins (4G) should not be reused when reassembling the unit.

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 through 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 3-13. Output Carrier



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

Figure 3-14. Planet Gear

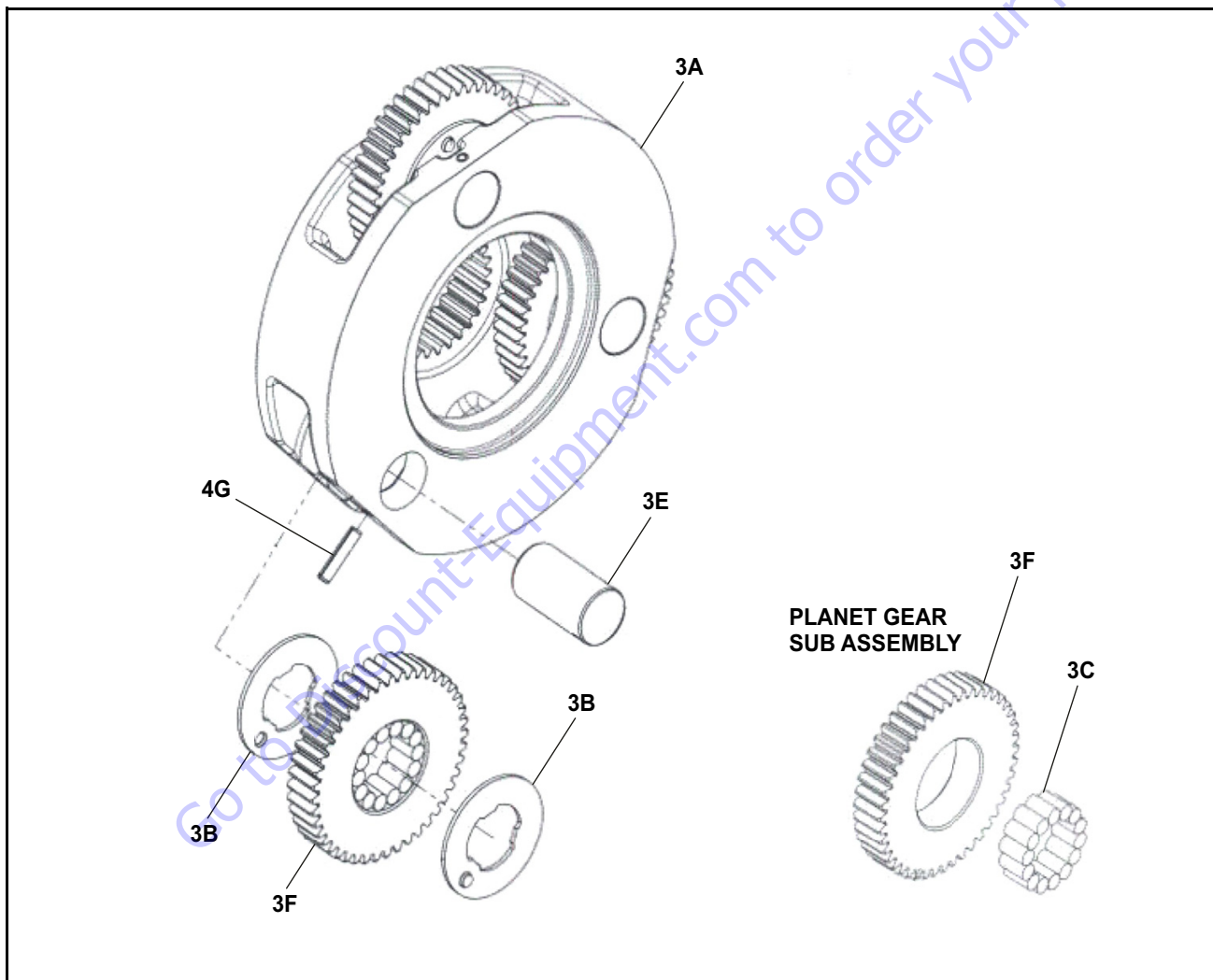
Input Carrier Disassembly

NOTE: Refer to Figure 3-15., 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 | 3E. Planet Shaft |
| 3B. Thrust Washer | 3F. Planet Gear |
| 3C. Needle Bearing | 4G. Roll Pin |

Figure 3-15. Input Carrier

Hub-spindle Disassembly

NOTE: Refer to Figure 3-16., 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.

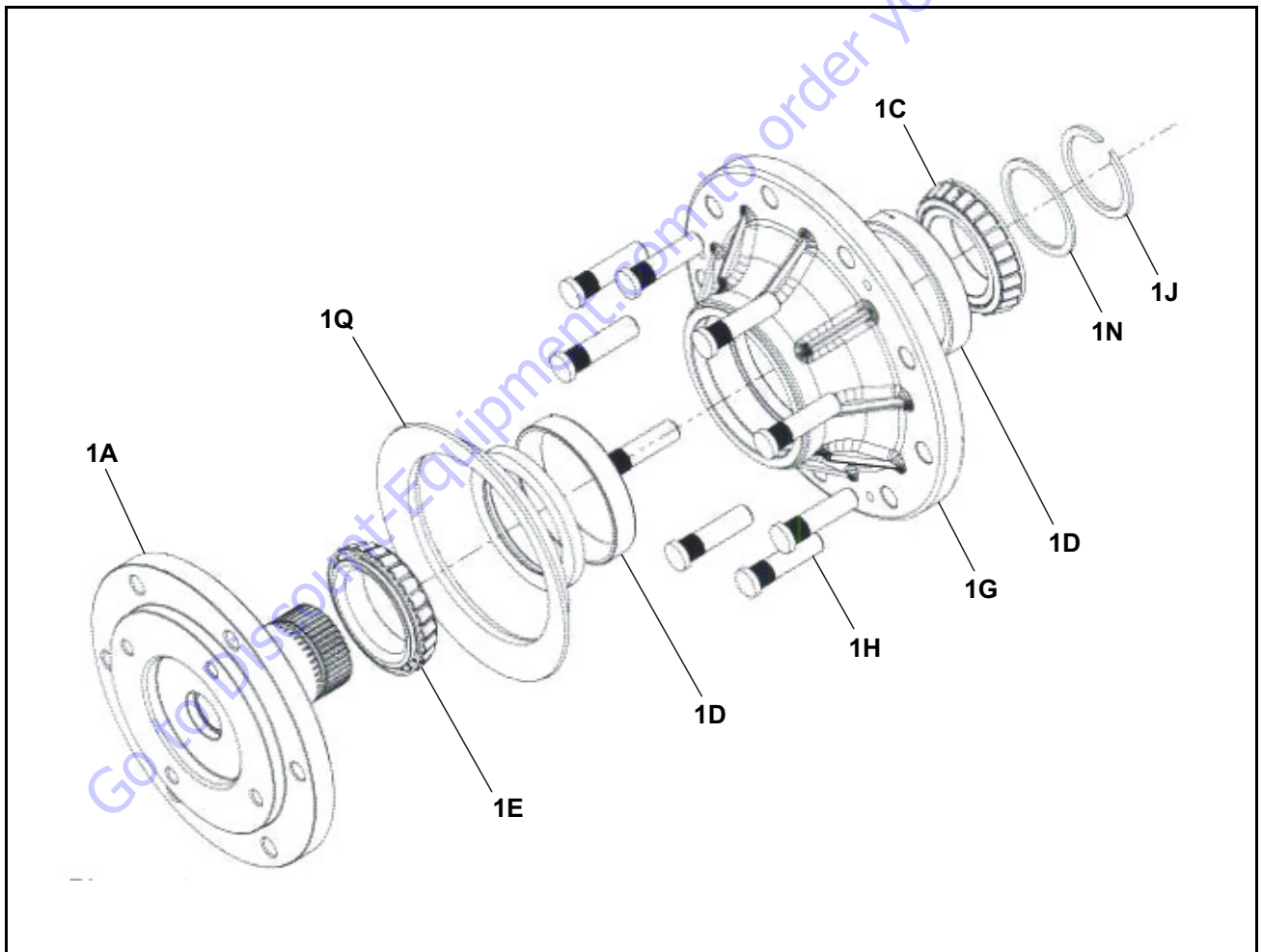
6. If necessary, press 9 Studs (1H) out of Hub (1G). Locate Hub (1G) on Seal (1B) end.

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 3-16. Hub Spindle

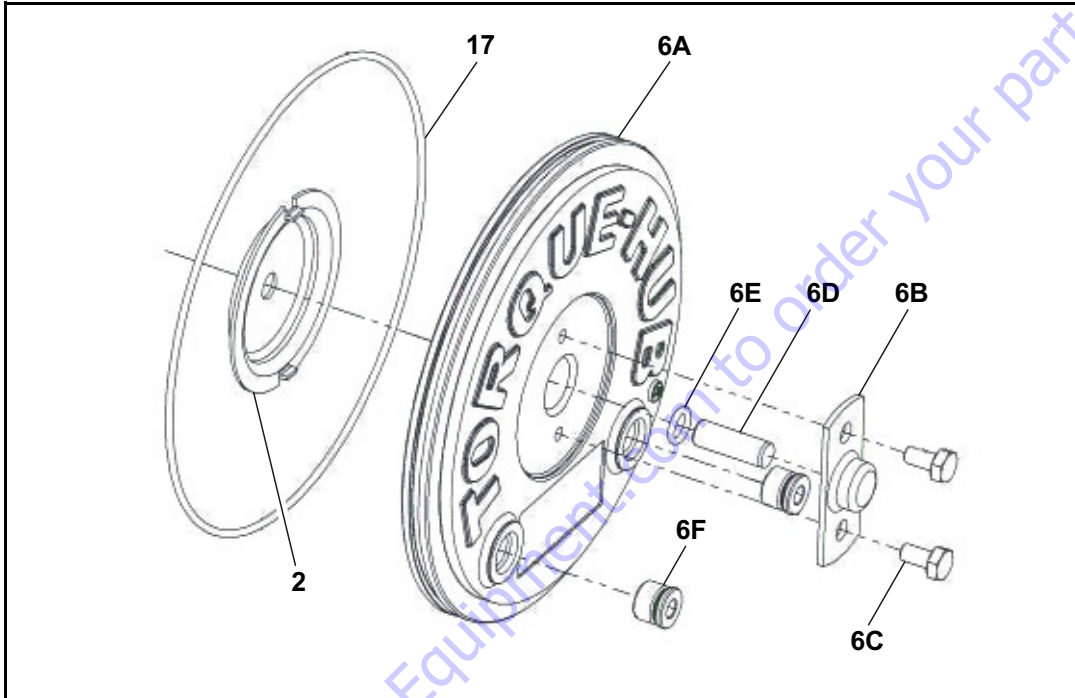
Cover Disassembly

NOTE: Refer to Figure 3-17., 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 |
| 3A. Input Carrier | 6E. O-ring |
| 6A. Cover | 6F. Pipe Plug |
| 6B. Disengage Cap | 17. O-ring |
| 6C. Bolt | |

Figure 3-17. Cover Assembly

Input Carrier Assembly

NOTE: Refer to Figure 3-15., 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 Rollers (3C).

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

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

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

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

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

Output Planet Gear Assembly

NOTE: Refer to Figure 3-14., Planet Gear.

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

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

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

Output Carrier Assembly

NOTE: Refer to Figure 3-13., 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 OD 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 3-16., Hub Spindle

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

1. Place Hub (1 G) 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.
3. Turn hub over and press Bearing Cup (1D) into hub using appropriate pressing tool.
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 3-17., 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.
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 3-11., Main Assembly - Sheet 1 of 2 and Figure 3-12., 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.
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.

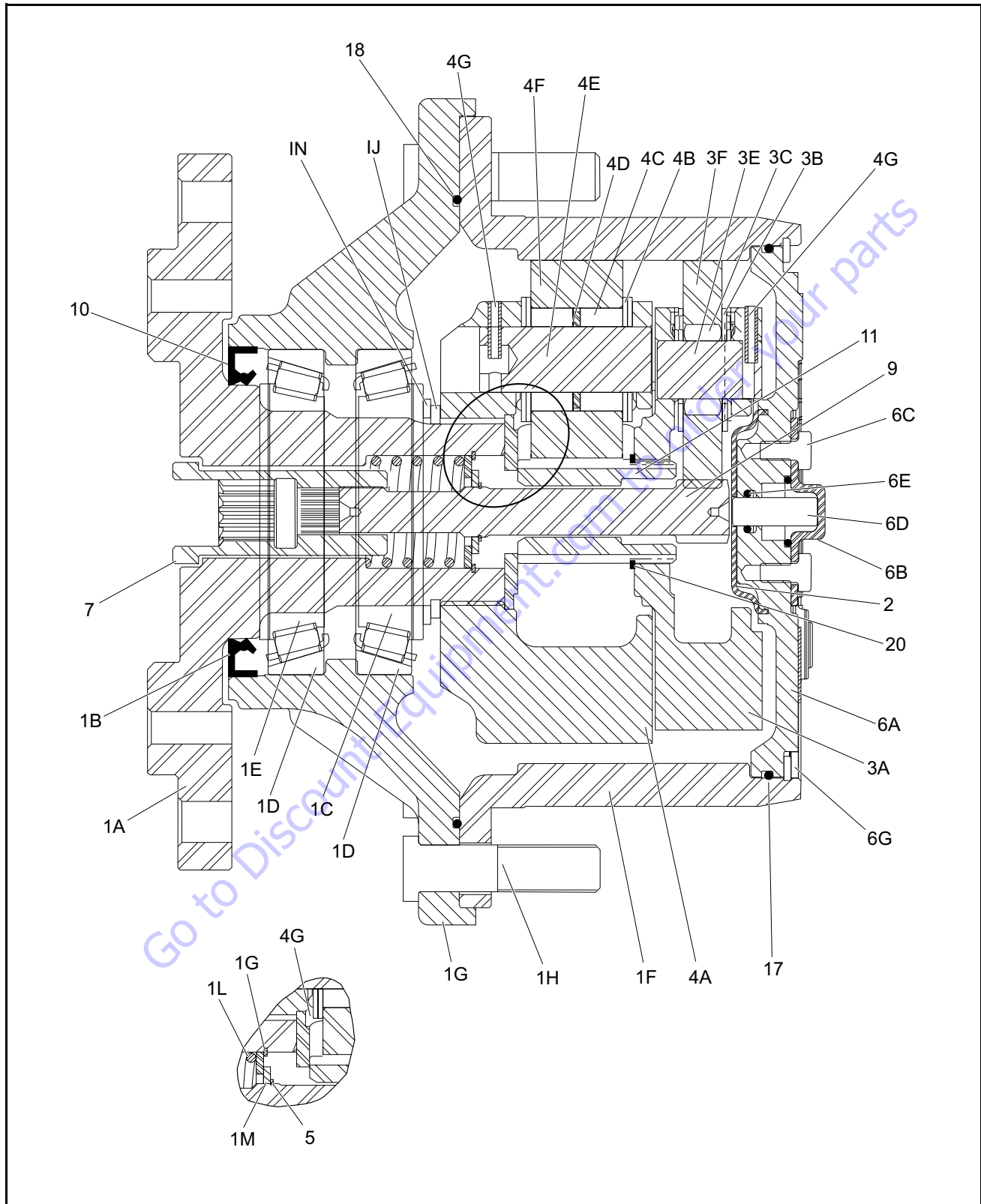


Figure 3-18. Drive Hub - Sheet 1 of 2

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 3-19. Drive Hub - Sheet 2 of 2

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 lbs. (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 3-20., 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 3-20., 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 lbs. (43 kg).

1. Use suitable lifting device to support the drive motor.
2. Install the drive motor to the machine.

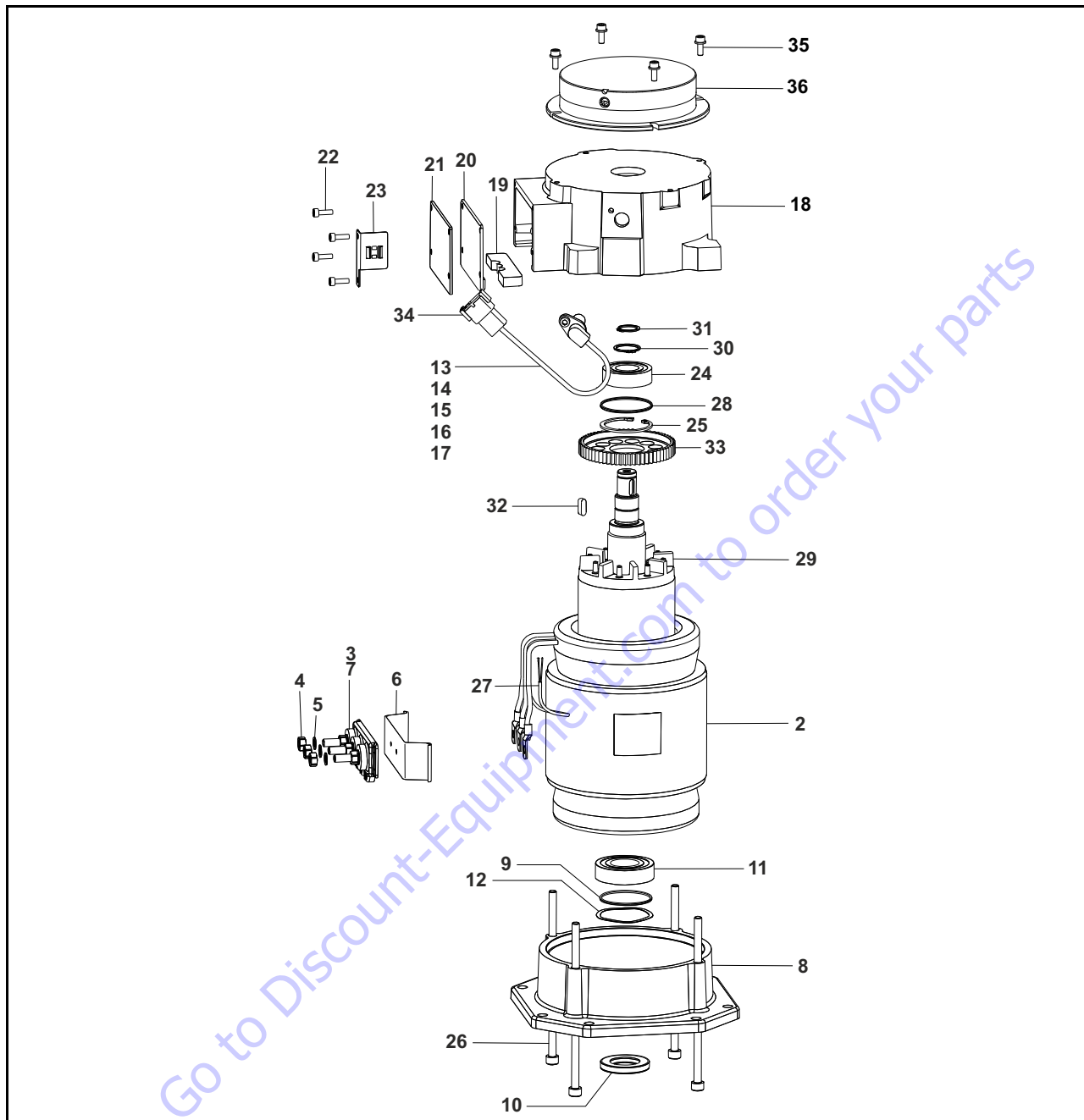
CAUTION

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

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

NOTE: Apply JLG Threadlocker PN 0100011 to bolts before installation.

5. Install drive brake on to the drive motor.
6. Reconnect all electrical connections to the drive motor.
7. 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 3-20. Drive Motor

3.7 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

NOTICE

THE SWING BEARING IS ONE OF THE MOST CRITICAL POINTS ON AN AERIAL LIFT. IT IS HERE THAT THE STRESSES OF LIFTING ARE CONCENTRATED, AT THE CENTER OF ROTATION. BECAUSE OF THIS, PROPER MAINTENANCE OF THE SWING BEARING BOLTS IS A MUST FOR SAFE OPERATION.

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 JLG Threadlocker PN 0100019. 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 3-22, 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 3-21, 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 3-21, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

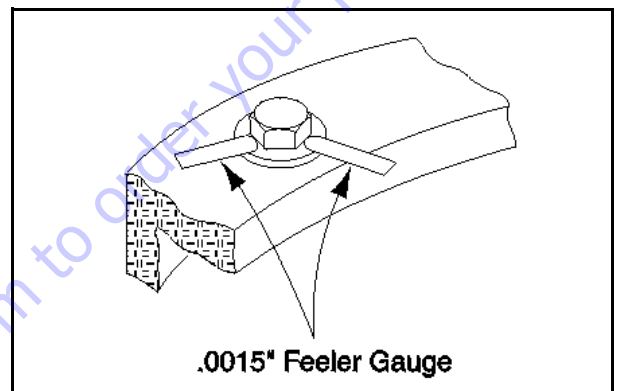


Figure 3-21. Swing Bearing Feeler Gauge Check

Wear Tolerance

1. With the boom positioned over the side of the machine, the Upper Boom horizontal with telescope fully

extended and Mid/Lower Boom stowed, (See Figure 3-22.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-23.)

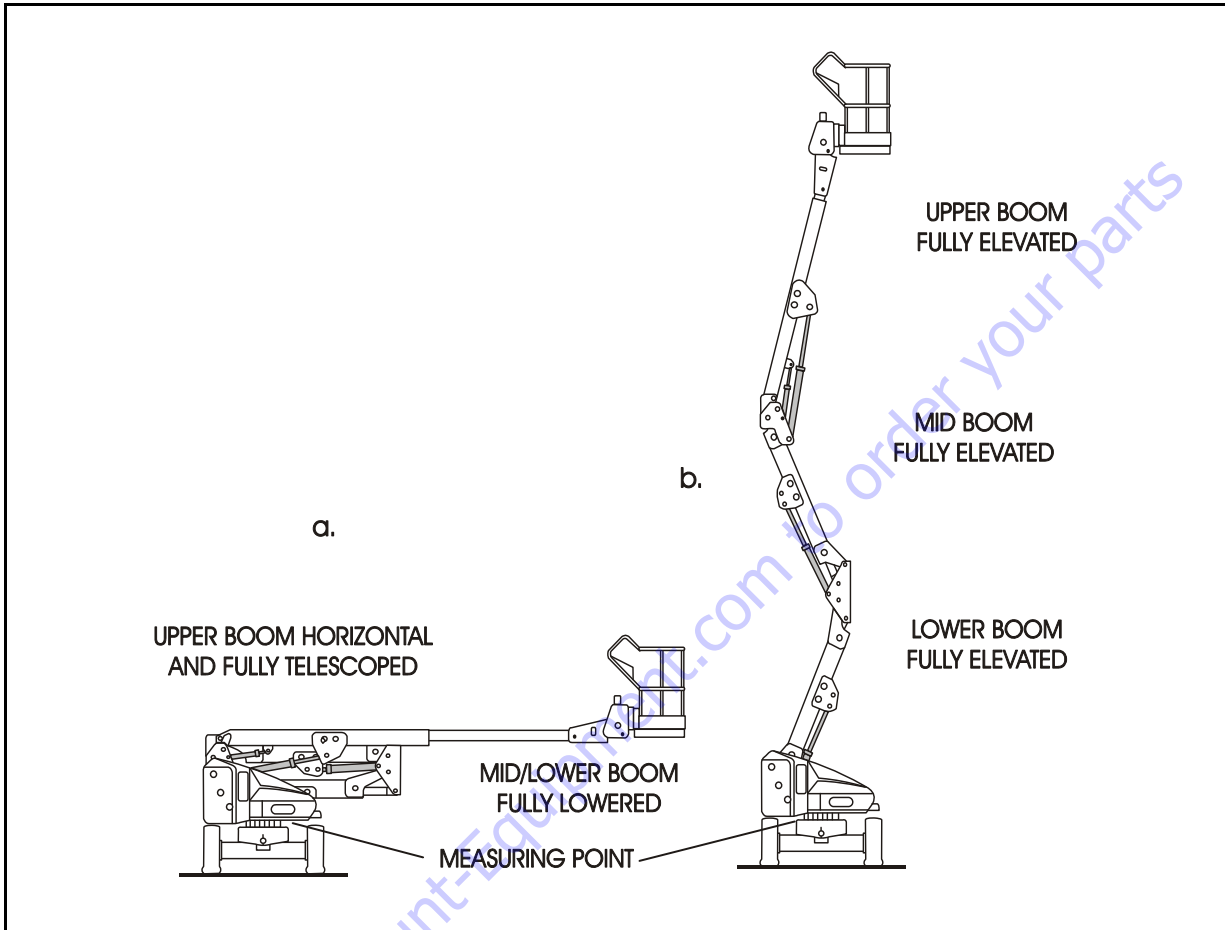


Figure 3-22. Swing Bearing Tolerance Boom Placement

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, (See Figure 3-22.) using a magnetic base dial indicator, measure and

record the distance between the swing bearing and turntable (See Figure 3-23.).

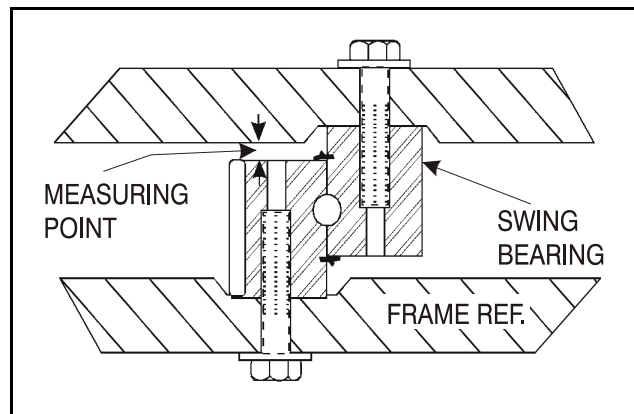


Figure 3-23. Swing Bearing Tolerance Measuring Point

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 3-24., Swing Bearing Torquing 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.

NOTE: If Tribol Molub-Alloy 936 Open Gear Compound or Mobilith SHC Bearing Grease are not available, Multi-Purpose Grease (MPG) can be substituted, however the service interval will be shorter.

- e. Using suitable lifting equipment, install bearing/rotation box assembly to frame with soft spot (red) 90 degrees relative to load axis. If reusing old bearing, ensure that scribed line of outer race of the bearing aligns with the scribed mark on the frame.

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.

- f. Apply a light coating of JLG Threadlocker PN 0100019 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.

- g. Following the torque sequence diagram shown in Figure 3-24., tighten the bolts to an initial torque of 130 ft. lbs. (175 Nm). Then following the same sequence, tighten to a final torque of 190 ft. lbs. (260 Nm).
- h. Remove lifting equipment from bearing.
- i. Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.
- j. 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.
- k. Apply a light coating of JLG Threadlocker PN 0100019 to the new bearing bolts and install through the turntable and inner race of bearing.
- l. Following the torque sequence shown in Figure 3-24., 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).
- m. Remove the lifting equipment.
- n. Route hydraulic lines through center of turntable and frame and connect as tagged prior to removal.
- o. Using all applicable safety precautions, activate the hydraulic system and functionally check swing system for proper and safe operation.

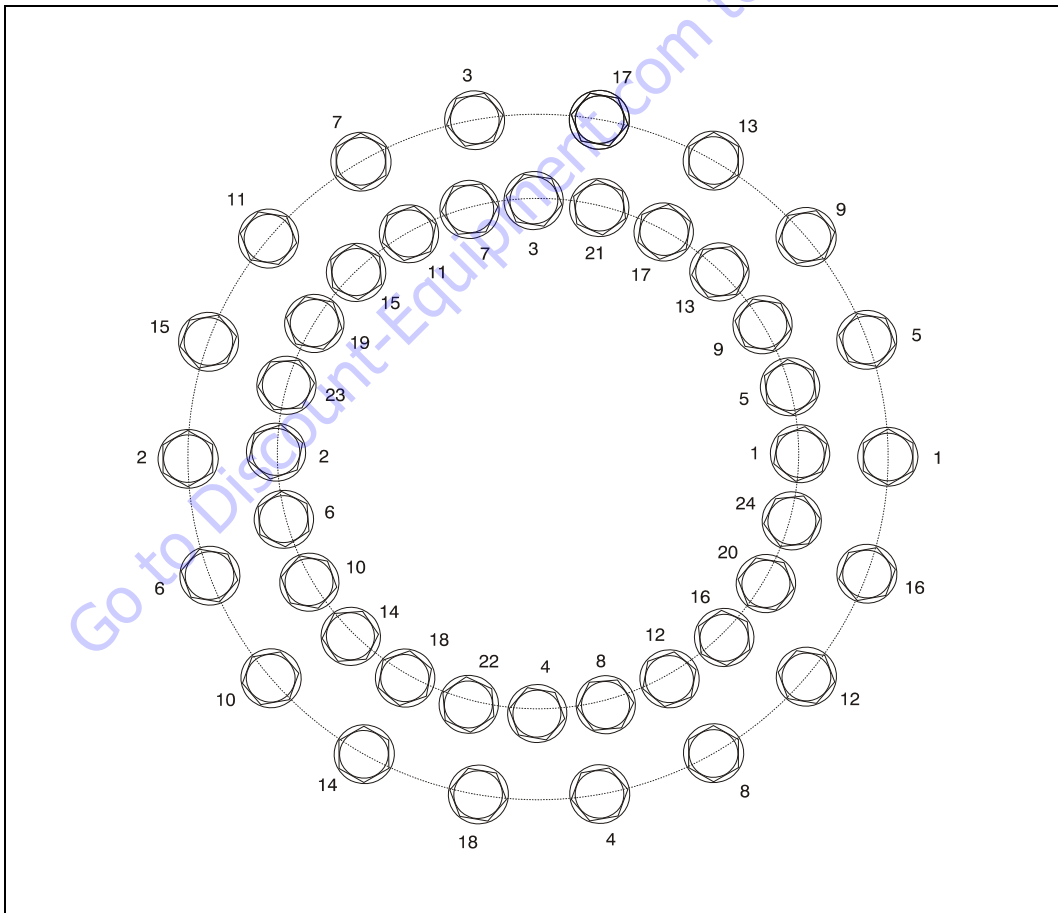


Figure 3-24. Swing Bearing Torquing Sequence

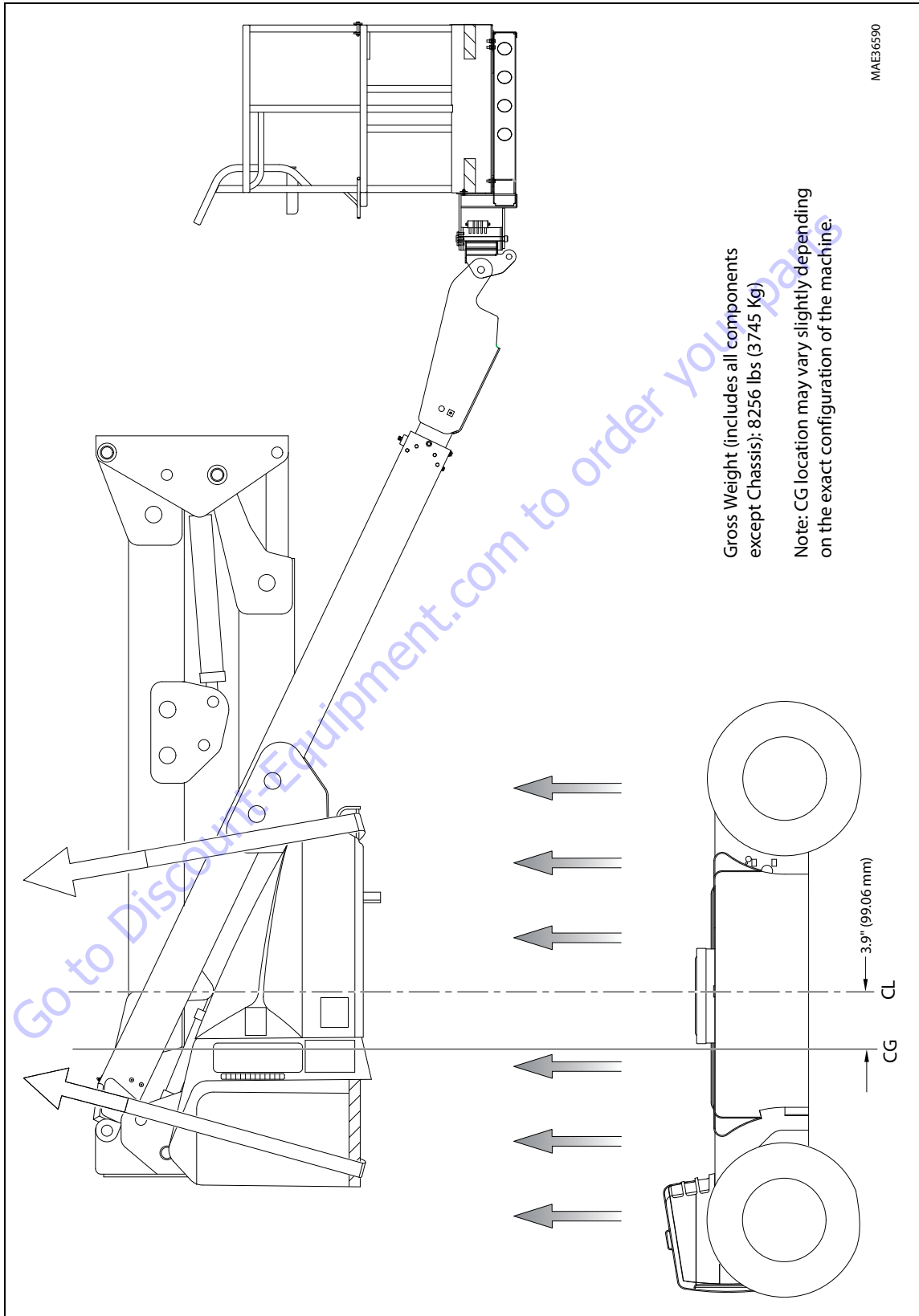


Figure 3-25. Swing Bearing Removal - E450A

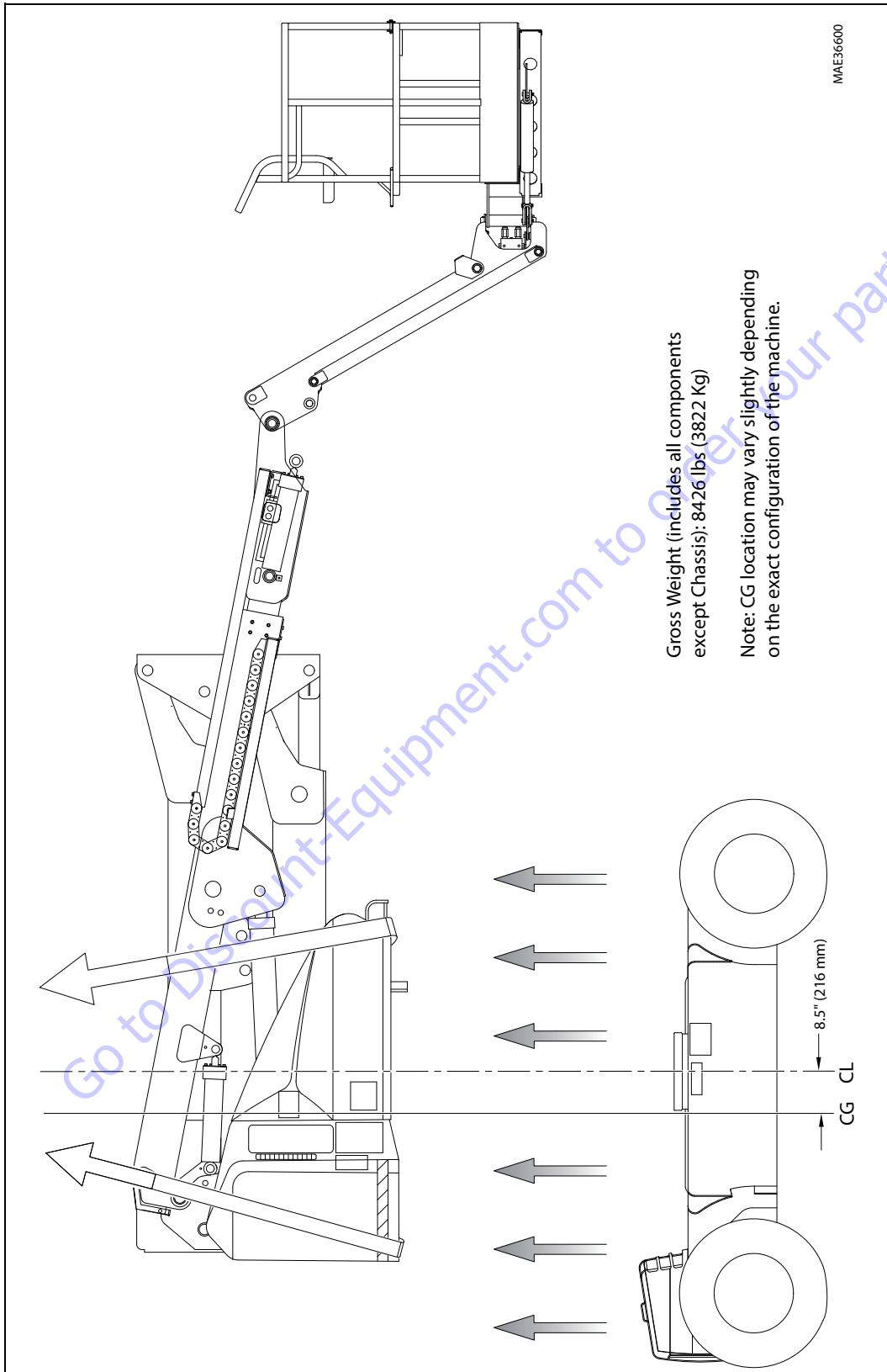


Figure 3-26. Swing Bearing Removal - E450AJ, M450AJ

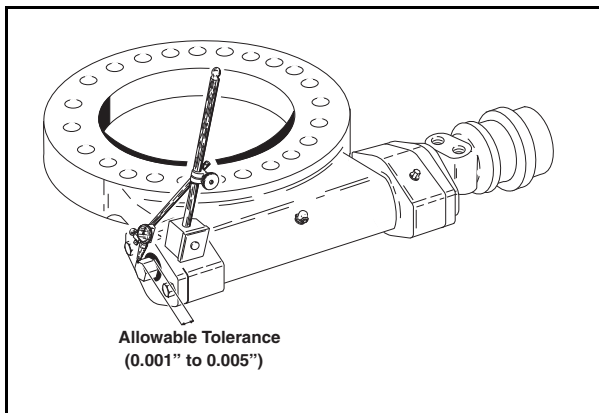
Swing Bearing Torque Value

Install with JLG Threadlocker - 190 ft. lbs. (260 Nm).

Checking Worm Gear End Play

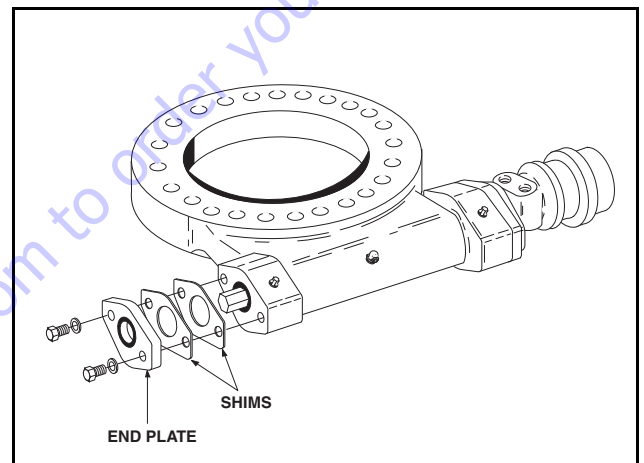
NOTE: JLG Industries requires that a annual inspection be performed on the worm gear end play.

1. Using a dial indicator, measure end play of worm gear, by applying side to side movement by hand to platform.
2. If tolerance exceeds 0.010", reduce end play to less than 0.005". Refer to Adjusting End Play.



Adjusting End Play

1. Remove end plate.
2. Measure and record total thickness of existing shim pack.
3. Determine thickness of shim pack required to obtain 0.001" - 0.005" end play.
4. Adjust shim pack thickness as required to obtain proper end play. Reduce end play by removing thicker shims and replacing with thinner shims, included in kit.
5. Replace end plate and torque bolts to 90 ft. lbs. (122 Nm).
6. Recheck end play.



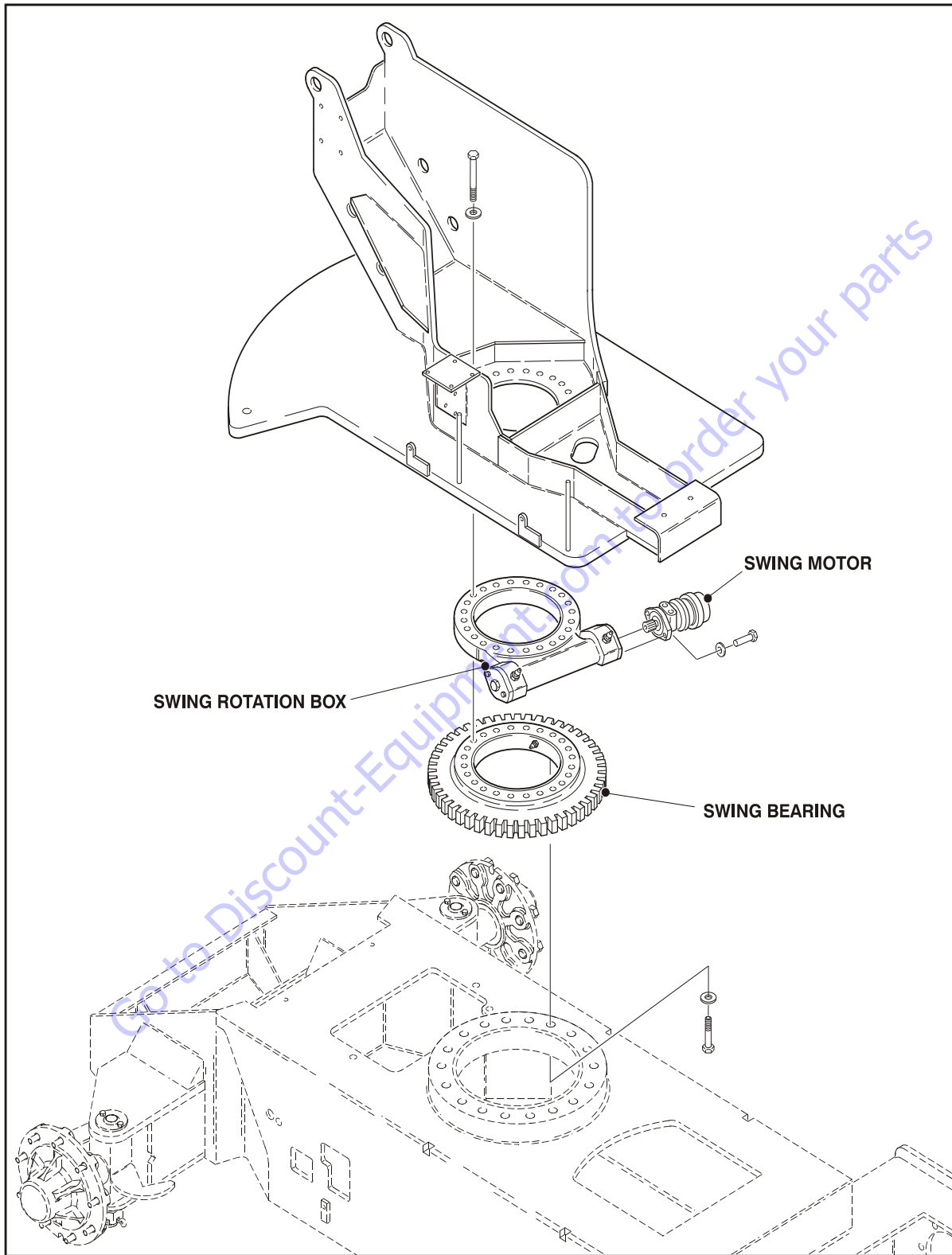


Figure 3-27. Swing Components

3.8 SWING MOTOR

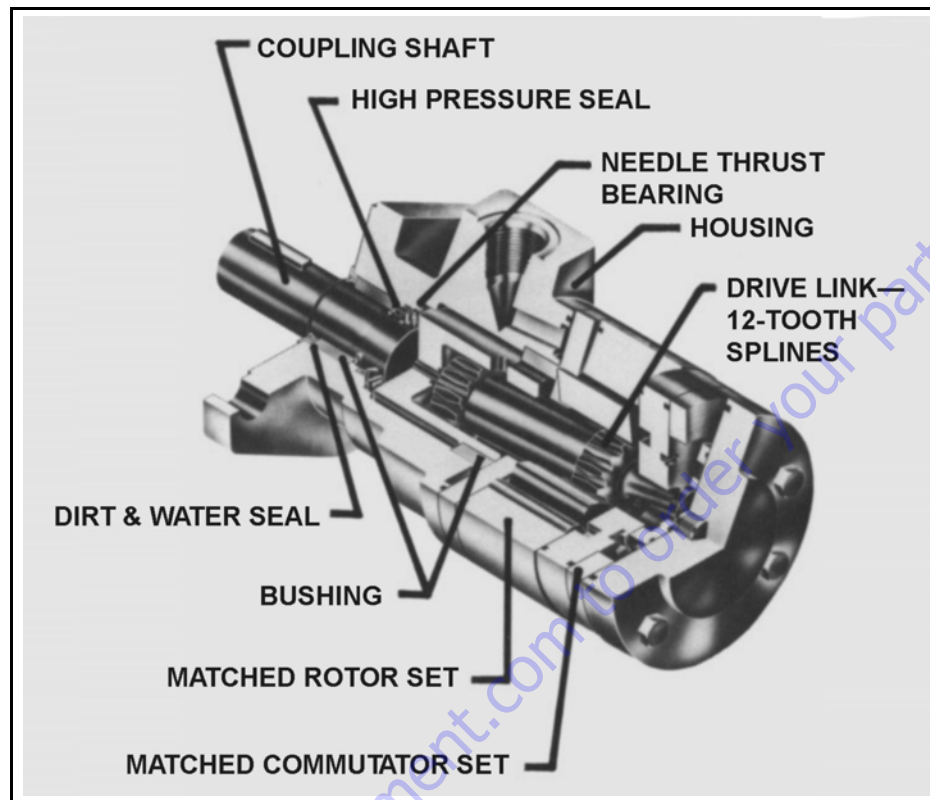


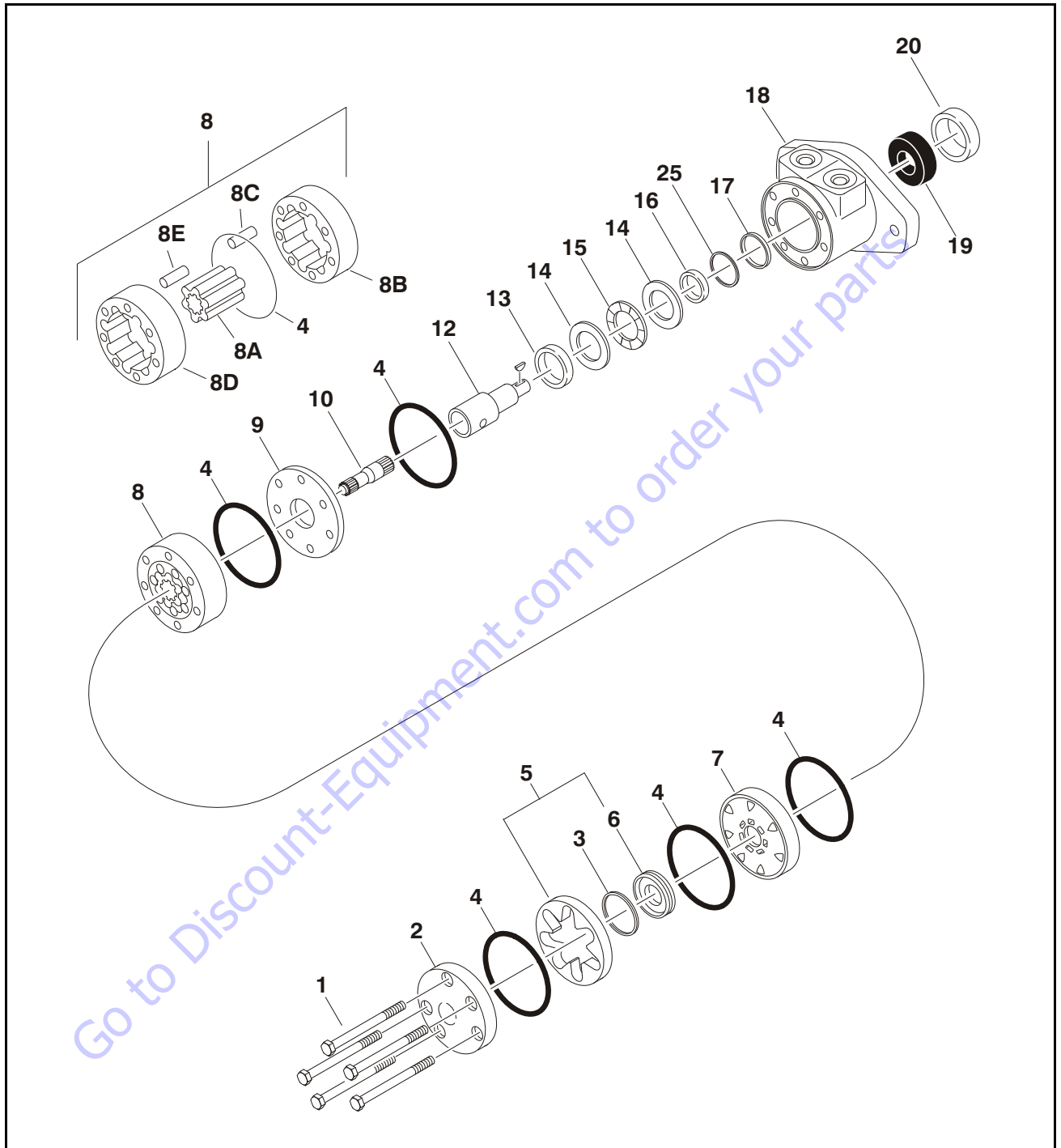
Figure 3-28. Swing Motor - Cutaway

⚠ 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	<ol style="list-style-type: none"> 1. Hose fittings loose, worn or damaged. 2. Oil seal rings (4) deteriorated by excess heat. 3. Special bolt (1, 1A, 1B or 1C) loose or its sealing area deteriorated by corrosion. 4. Internal shaft seal (16) worn or damaged. 5. Worn coupling shaft (12) and internal seal (16). 	<p>Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.</p> <p>Replace oil seal rings by disassembling unit.</p> <p>(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.</p> <p>Replace seal. Disassembly of motor unit necessary.</p> <p>Replace coupling shaft and seal by disassembling unit.</p>
Significant loss of speed under load	<ol style="list-style-type: none"> 1. Lack of sufficient oil supply 2. High internal motor leakage 3. Severely worn or damaged internal splines. 4. Excessive heat. 	<p>(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.</p> <p>Replace worn rotor set by disassembling unit.</p> <p>Replace rotor set, drive link and coupling shaft by disassembling unit.</p> <p>Locate excessive heat source (usually a restriction) in the system and correct the condition.</p>
Low mechanical efficiency or undue high pressure required to operate unit	<ol style="list-style-type: none"> 1. Line blockage 2. Internal interference 3. Lack of pumping pressure 4. Excessive binding or loading in system external to motor unit. 	<p>Locate blockage source and repair or replace.</p> <p>Disassemble unit, identify and remedy cause and repair, replacing parts as necessary.</p> <p>Check for and repair worn pump.</p> <p>Locate source and eliminate cause.</p>



- | | | | | | |
|---------------|--------------------|--------------------|--------------------|-----------------------|-------------------|
| 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 3-29. 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.

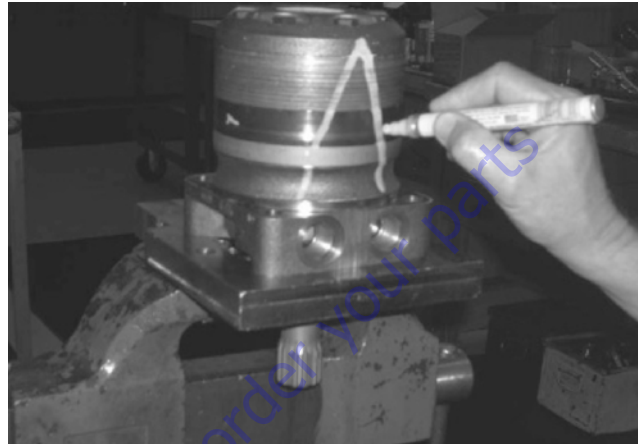
⚠ CAUTION

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

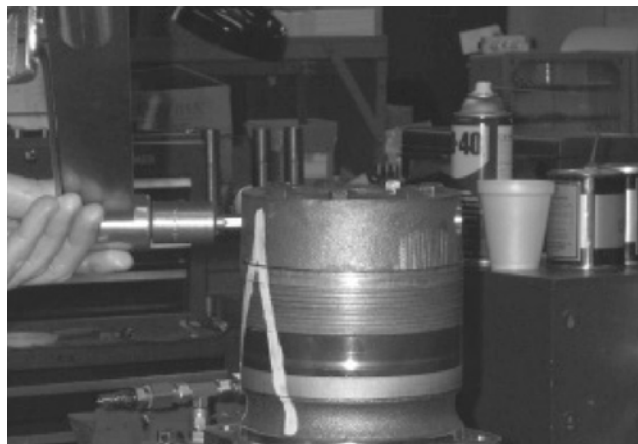
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.

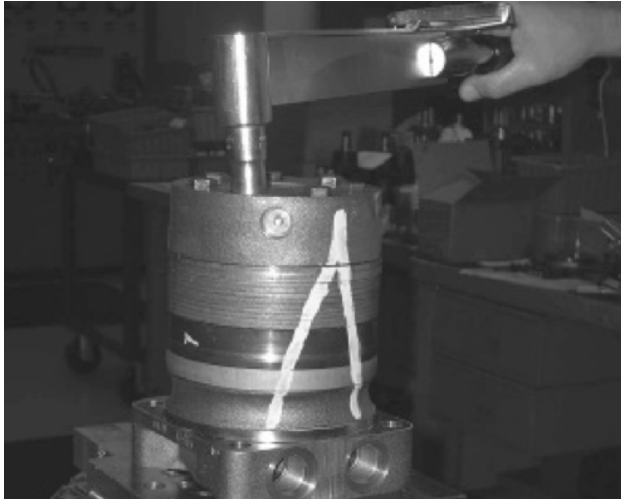


⚠ WARNING

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.

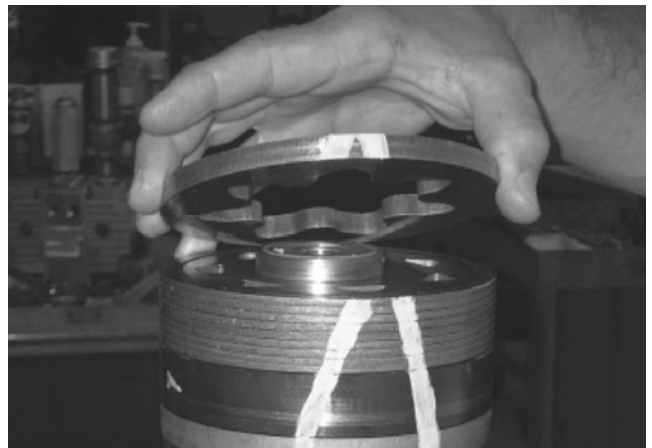


5. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary.



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.



SECTION 3 - CHASSIS & TURNTABLE

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.

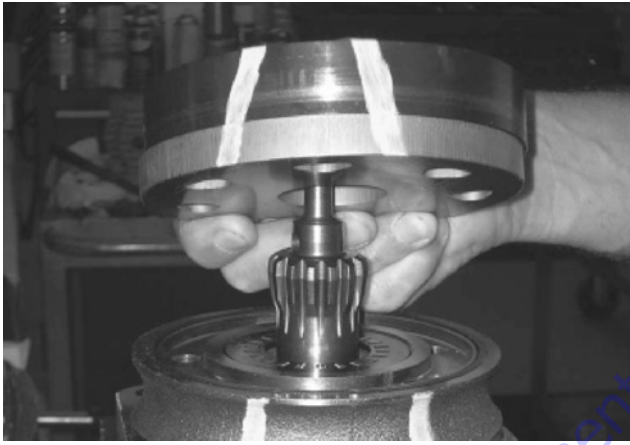


8. Remove manifold (7) and inspect for cracks surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. A polished pattern on the ground surface from commutator or rotor rotation is normal. Remove and discard the seal rings (4) that are on both sides of the manifold.



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.

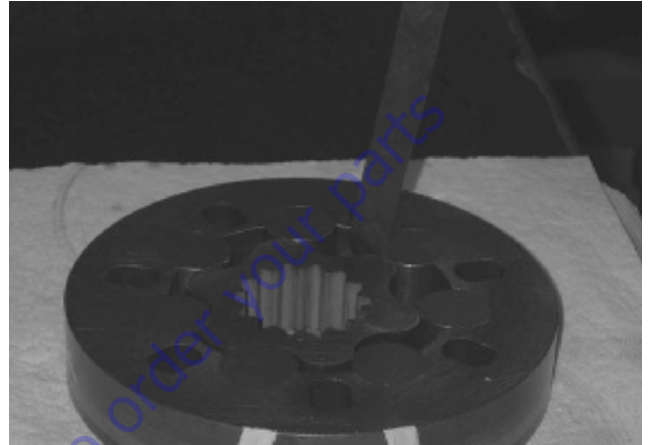
9. Remove rotor set (8) and wearplate (9), together to retain the rotor set in its assembled form, maintaining the same rotor vane to stator contact surfaces. The drive link (10) may come away from the coupling shaft (12) with the rotor set, and wearplate. You may have to shift the rotor set on the wearplate 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.



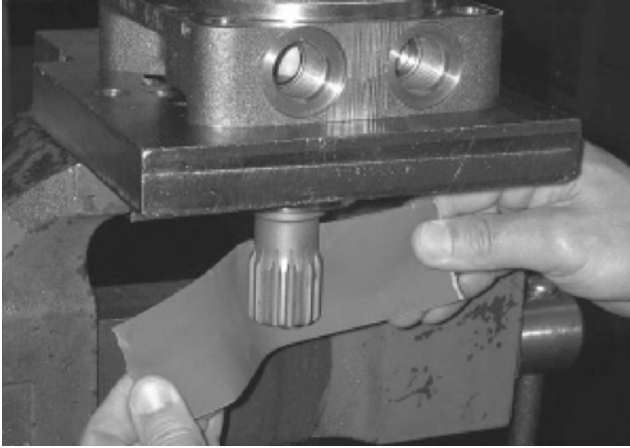
NOTE: If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.

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).



SECTION 3 - CHASSIS & TURNTABLE

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.



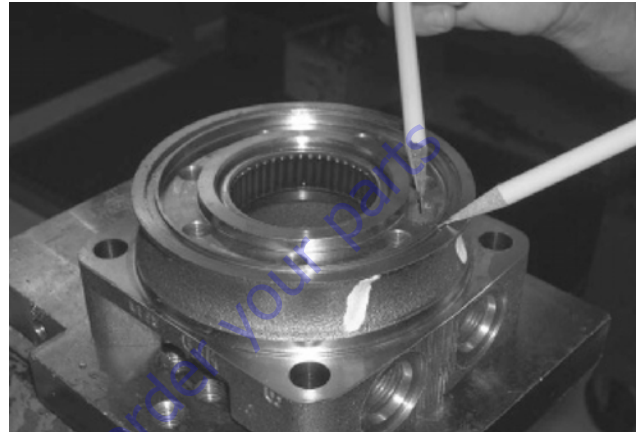
- 16.** Remove seal (16) and back up ring (17) from housing (18) and backup washer (25). Discard both.



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



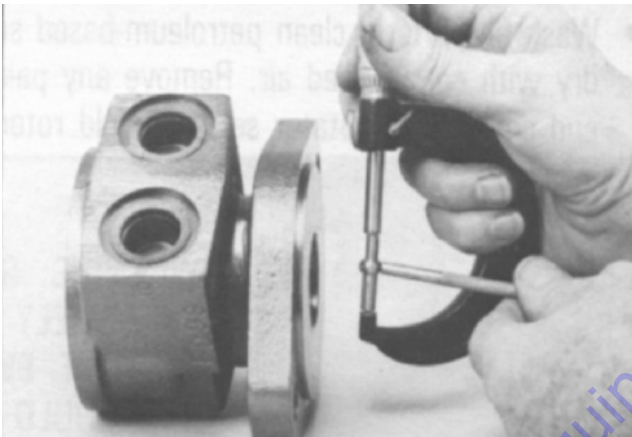
- 18.** Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly.



- 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

SECTION 3 - CHASSIS & TURNTABLE

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.

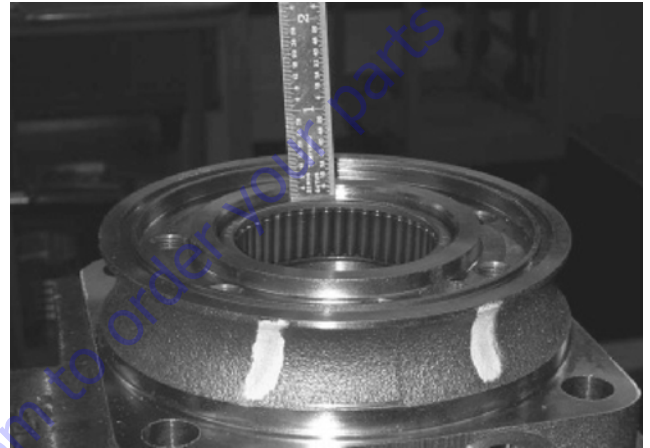


NOTE: Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square

with the press base and the bearing/ bushing is not cocked when pressing a bearing/bushing into the housing.

⚠ CAUTION

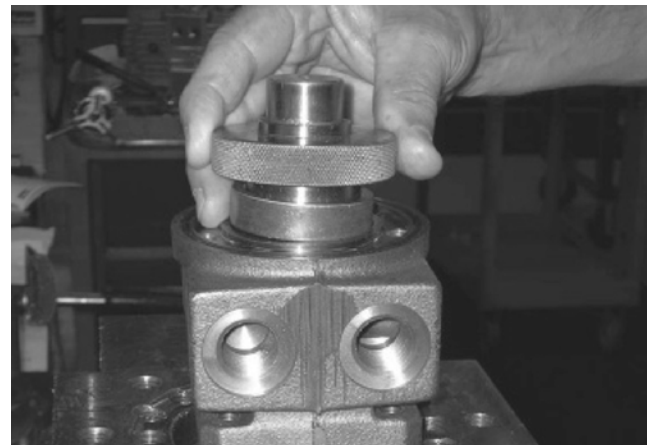
IF A BEARING MANDREL IS NOT AVAILABLE AND ALTERNATE METHODS ARE USED TO PRESS IN BEARING/BUSHING (13) AND (19) THE BEARING/BUSHING DEPTHS SPECIFIED MUST BE ACHIEVED TO INSURE ADEQUATE BEARING SUPPORT AND CORRECT RELATIONSHIP TO ADJACENT COMPONENTS WHEN ASSEMBLED.



⚠ CAUTION

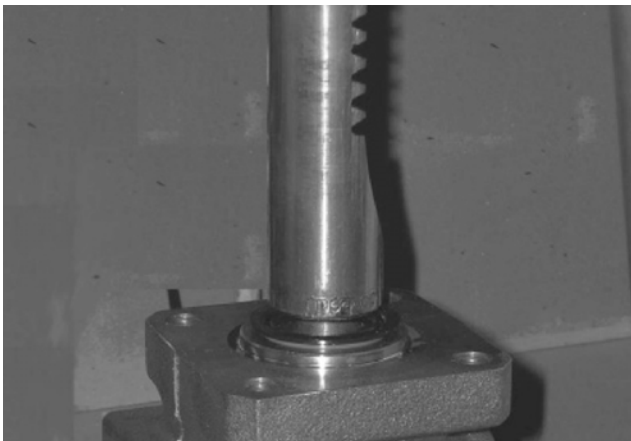
BECAUSE THE BEARING/BUSHINGS (13) AND (19) HAVE A PRESS FIT INTO THE HOUSING THEY MUST BE DISCARDED WHEN REMOVED. THEY MUST NOT BE REUSED.

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).



SECTION 3 - CHASSIS & TURNTABLE

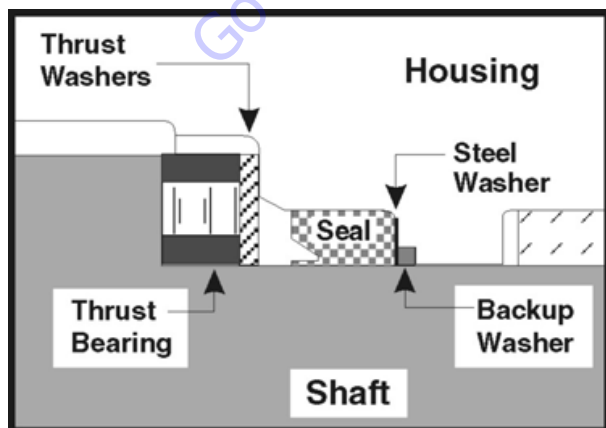
3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore. The dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



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.

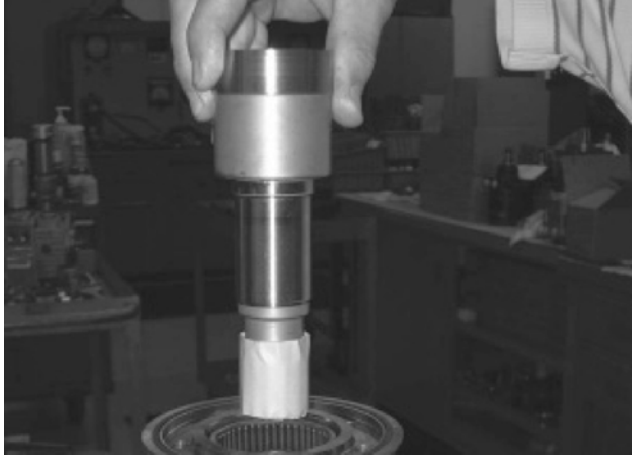


NOTE: The motor requires one thrust washer (14) with thrust bearing (15). The coupling shaft will be seated directly against the thrust bearing.

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).



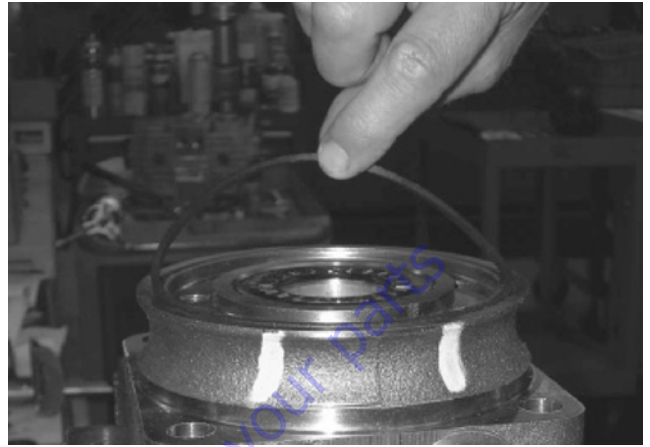
⚠ CAUTION

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.



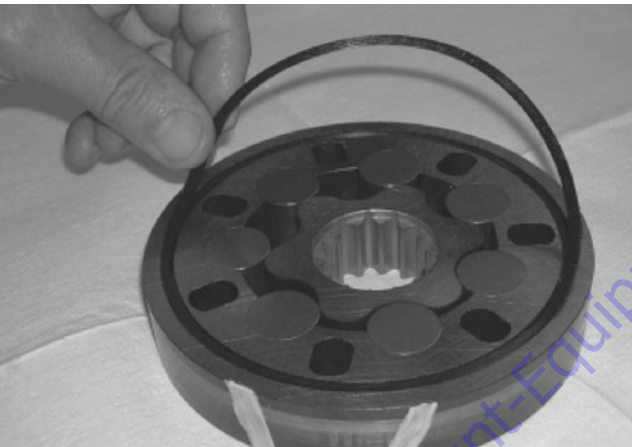
NOTE: Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

SECTION 3 - CHASSIS & TURNTABLE

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.

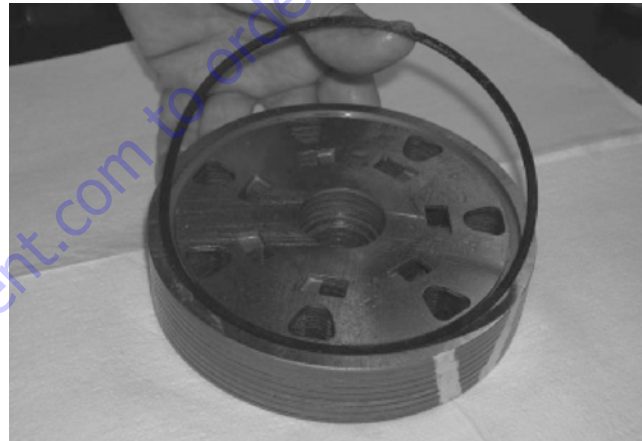


NOTE: It may be necessary to turn one alignment stud out of the housing (18) temporarily to assemble rotor set (8) or manifold (7) over the drive link.

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

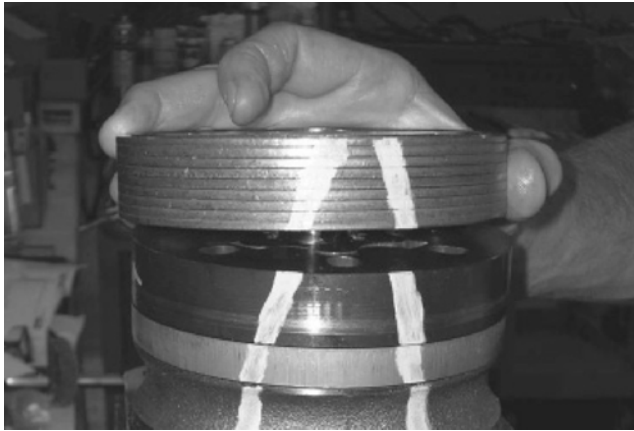
NOTE: The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the 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.



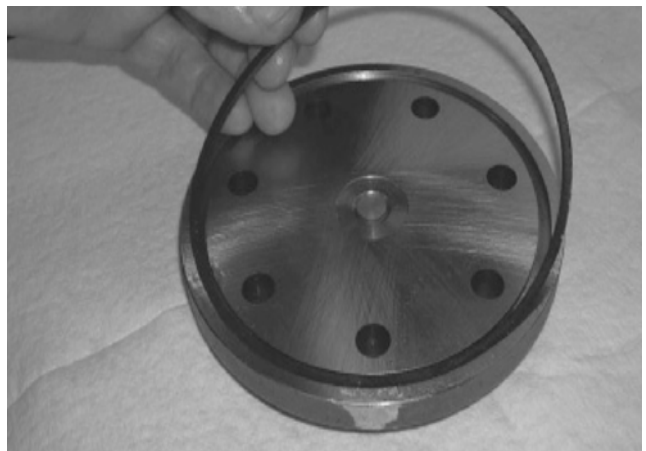
- 17.** Assemble the commutator ring (6) over alignment studs onto the manifold.

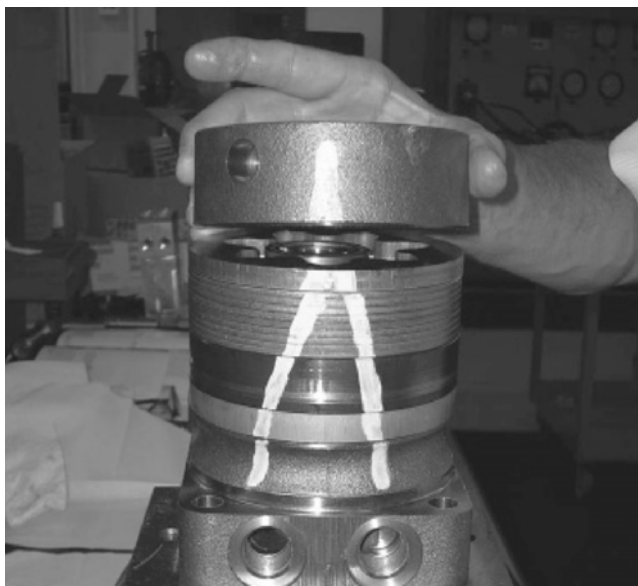


- 18.** Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.

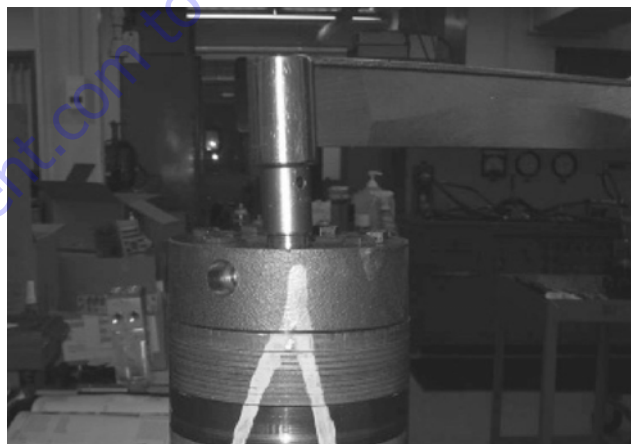
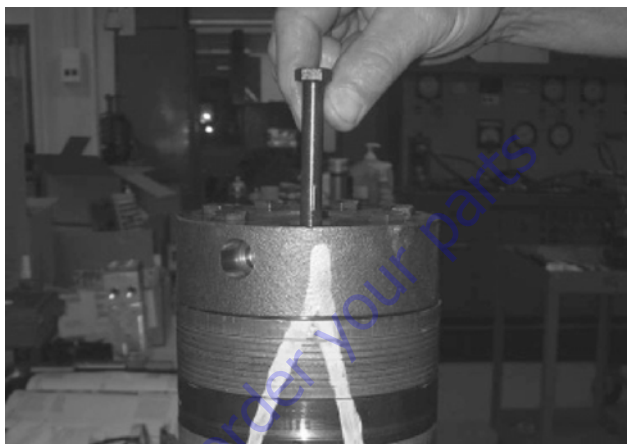


- 19.** Assemble a new seal ring (4) into end cover (2) and assemble end cover over the alignment studs and onto the commutator set. If the end cover has only 5 bolt holes be sure the cover holes are aligned with the 5 threaded holes in housing (18). The correct 5 bolt end cover bolt hole relationship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





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 N m).



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.



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 L 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 flat 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 p.s.i. 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 N m)
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.

3.7 BATTERY MAINTENANCE AND CHARGING

Battery Maintenance, Quarterly

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

NOTICE

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" 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.

Optional On Board Generator

⚠ WARNING

EXHAUST GAS HAZARD. RUN THE GENERATOR IN A WELL VENTILATED AREA ONLY.

NOTICE

WHEN THE GENERATOR ENABLE CONTROL LOCATED IN THE PLATFORM CONTROL BOX IS IN THE ON POSITION AND THE GROUND EMERGENCY STOP SWITCH IS ON (PULLED OUT), THE GENERATOR WILL START AUTOMATICALLY WHEN THE BATTERIES REACH A LOW-CHARGE STATE, AUTOMATICALLY CHARGING THE BATTERIES. THE GENERATOR WILL ALSO AUTOMATICALLY START IF THE GENERATOR START BATTERY IS LOW.

NOTE: The engine will automatically shut down under the following conditions:

High Engine Oil Temperature
Low Engine Oil Pressure
Engine Overspeed
Generator Overvoltage
Batteries fully charged

⚠ 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 Charging (On Board Charger)

1. For maximum battery life:
 - a. Avoid completely discharging the batteries.
 - b. Fully charge the batteries each day the machine is used.
 - c. Charge the batteries at available times between charging.
 - d. Be sure the battery fluid covers the battery plates before charging, but to avoid overflow, do not top off the fluid level until charging.
2. To charge the batteries, connect the charger to a 115 volt source with a 15 amp minimum capacity.
3. The Charger will shut off automatically when the batteries are fully charged.
4. The charge cycle is complete when the ammeter reads 0 amps. Any reading indicates the charge cycle is not complete.
5. Depleted batteries will take approximately 17 hours to charge.

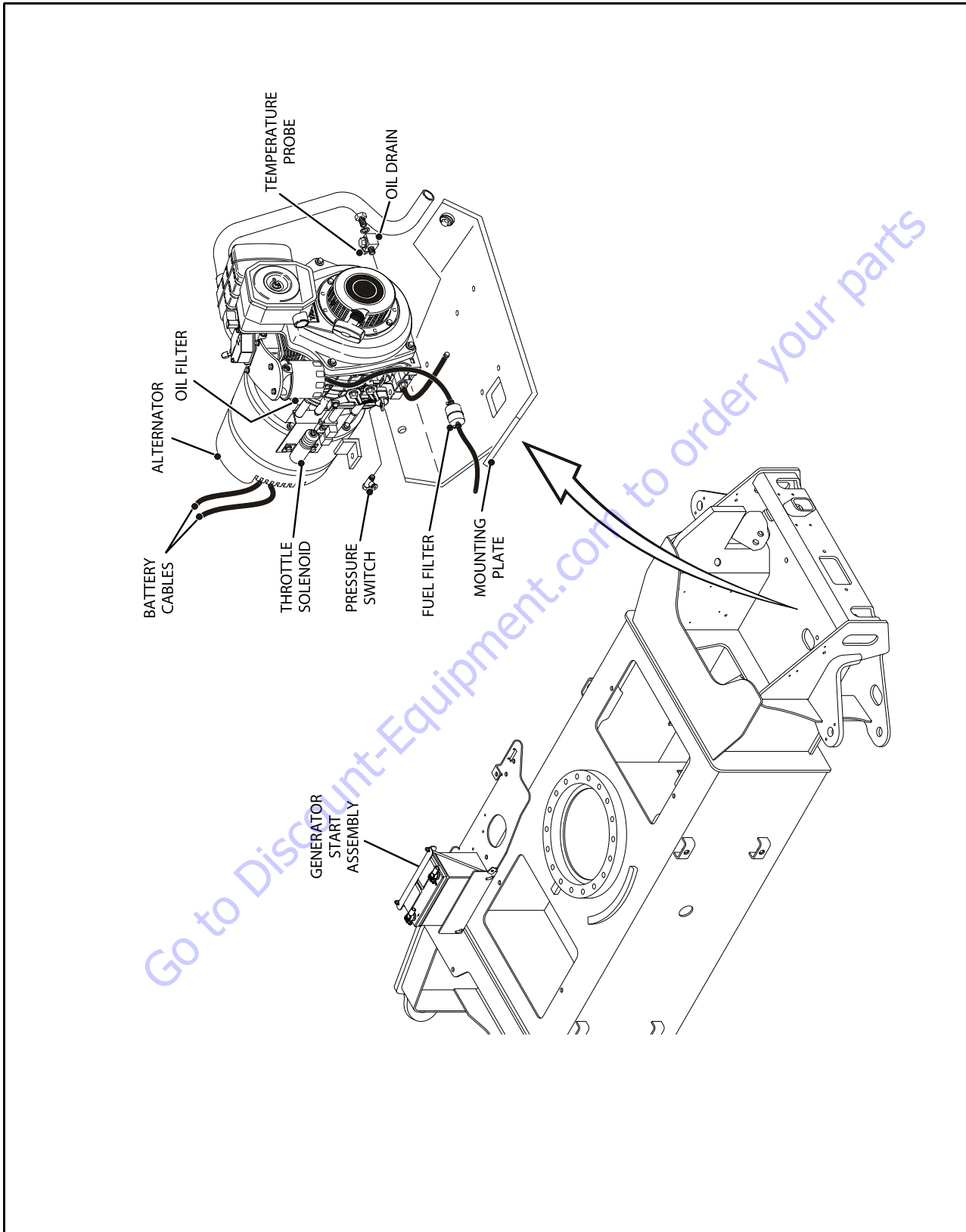


Figure 3-30. On Board Generator

3.8 BATTERY CHARGER

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 CYCLE 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

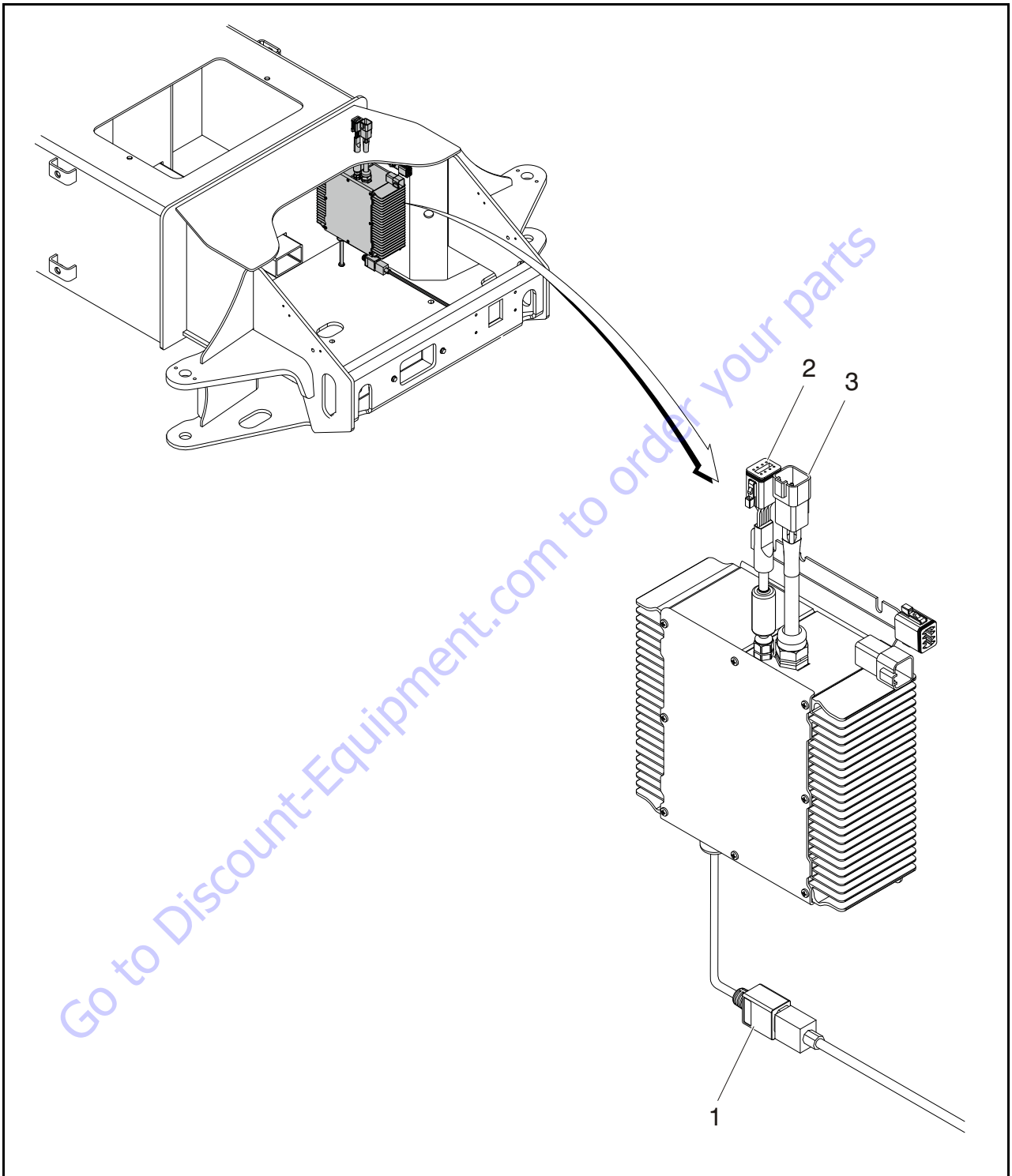
1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the safety instructions recommended by the battery manufacturer.
2. Make sure charger connections to battery terminals 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.

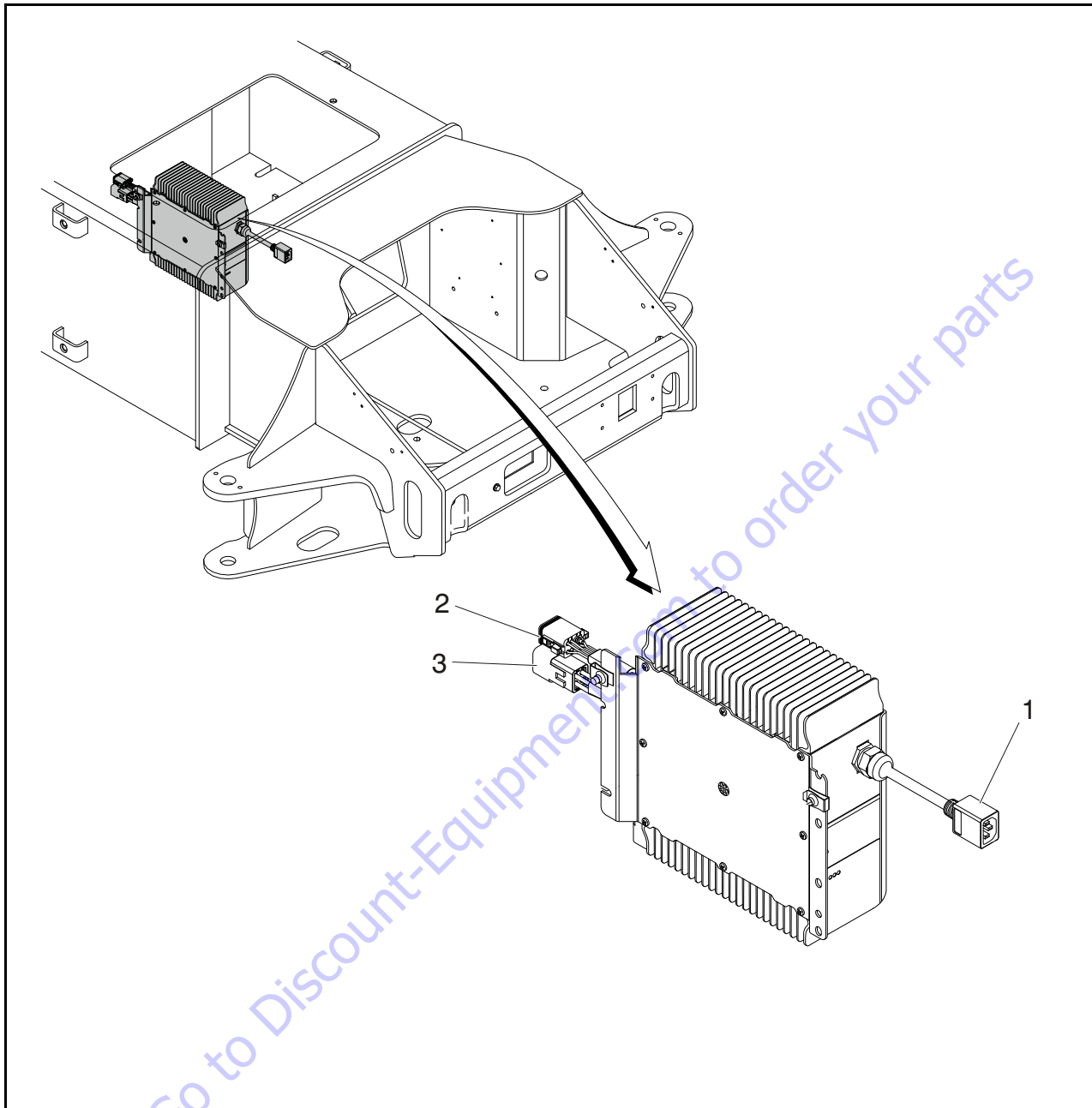
Table 3-3. Battery Charger Fault Codes (Delta-Q)

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 0.5VDC. 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 (E450A/AJ)



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

Figure 3-32. Battery Charger (M450AJ)

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 not 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 damaging 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 indication 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 not use high pressure. Do not use 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.

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.

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.

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.

Table 3-4. Battery Algorithms

Algorithm #	JLG PN	Battery Type	Proper Algorithm Setting
173	1001114782	DISCOVEREV305A-A	43
173	0400055	USBATTERYL16	173

3.9 GENERATOR

NOTE: Throughout the Generator section, the abbreviation RBS is used. RBS stands for Rotary Battery System, which is the generator system.

The engine-driven generator is designed to produce a DC output directly without the need of a separate rectifier. Included in the RBS unit is the engine, generator, engine/generator controller, harness and related components.

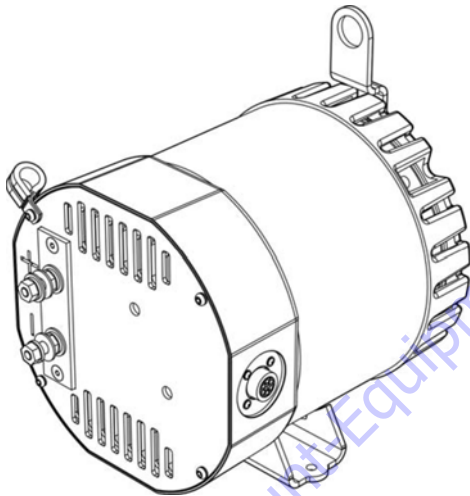
Engine

Peak rating: 6.2 HP

Continuous rating: 5.6 HP at 3600 RPM

Refer to the Engine Manual for a complete description of the engine.

Alternator



The RBS is equipped with a brushless DC output alternator.

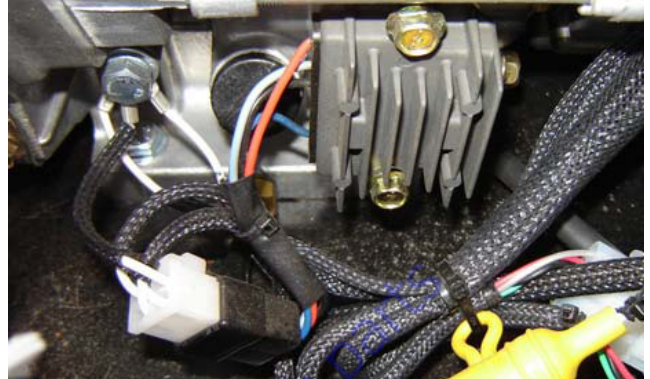
The 3-phase AC output of the alternator is full wave rectified and presented to the output terminals.

Output rating: 58.0V at 45A

Voltage regulation and current limiting is provided by the RBS Engine/Generator Controller.

The rectifier diodes and output current sensor are located in the alternator endbell.

Dynamo and Dynamo Voltage Regulator

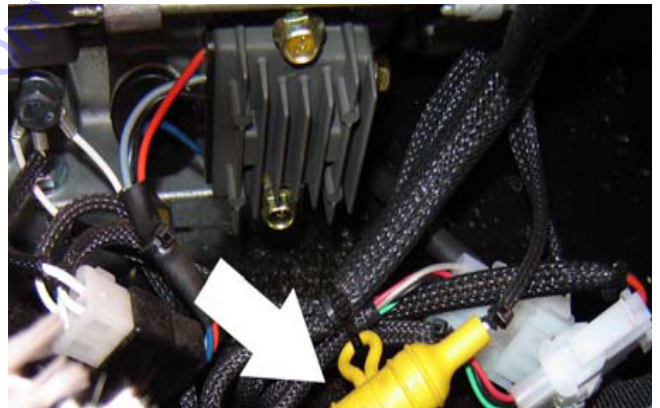


The engine is equipped with a dynamo and dynamo voltage regulator.

Dynamo output: 12V
7A DC

Refer to the Engine Manual for a complete description of the dynamo and dynamo voltage regulator.

Dynamo Output Fuse



This fuse protects the dynamo output; it is located on the left side of the engine.

Rating: 20ADC

Control Fuse

The control fuse provides power to the engine/generator controller and the relays for start control, fuel control and glow plug.

Rating: 15ADC

This fuse is located on the right side of the engine.

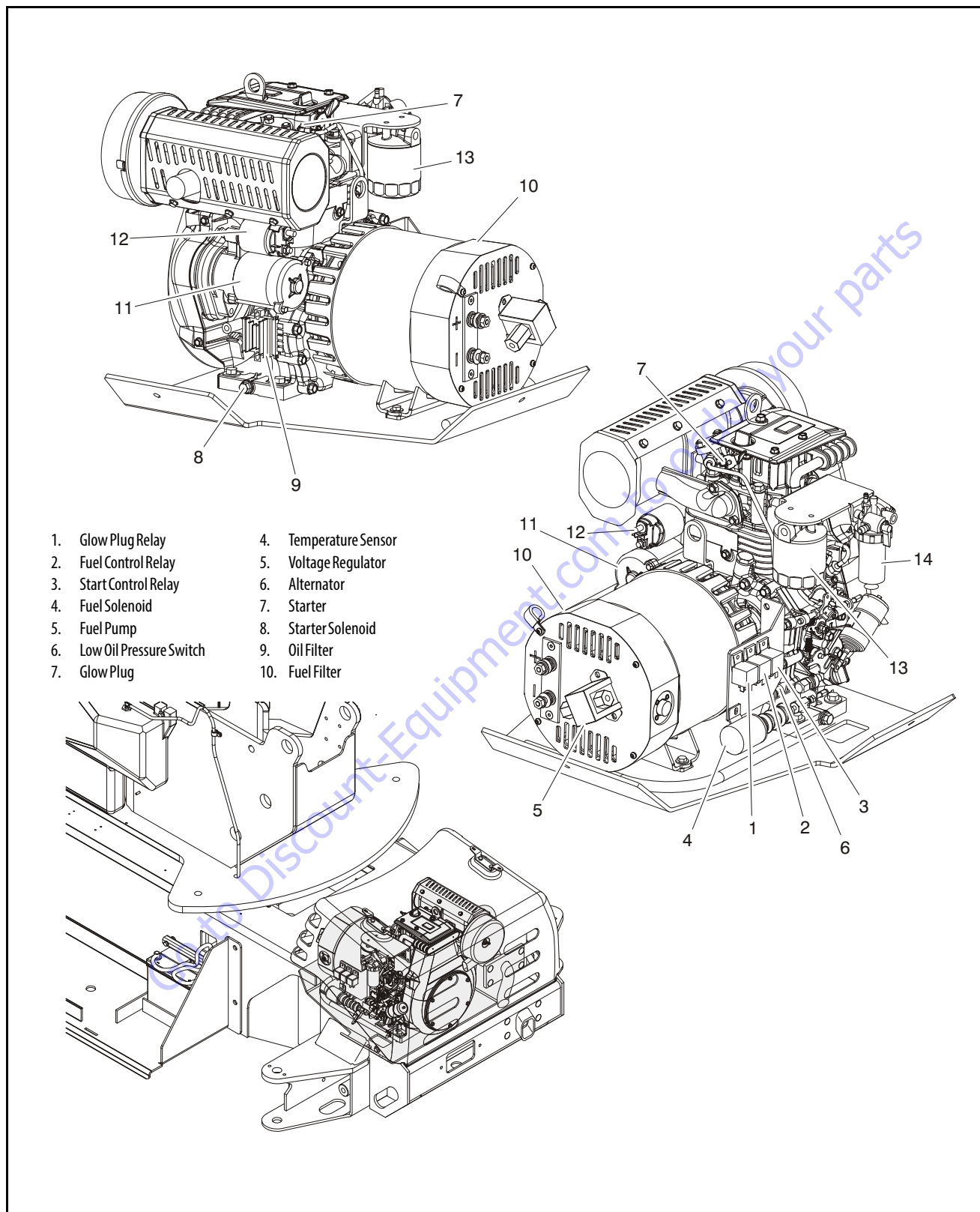
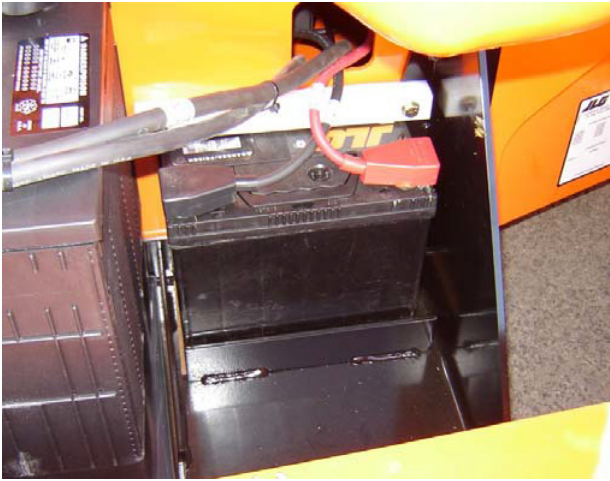


Figure 3-33. Generator

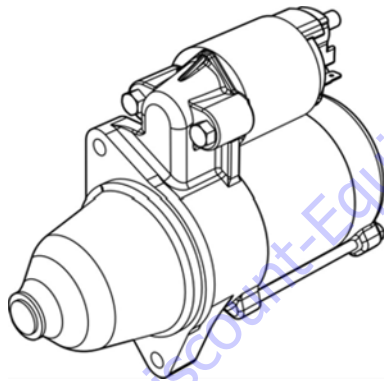
Start Battery



The RBS requires a 12V lead-acid start battery (not supplied with the system), which provides starting power and power for the RBS controls.

This battery is charged by the engine dynamo and dynamo regulator when the engine is running.

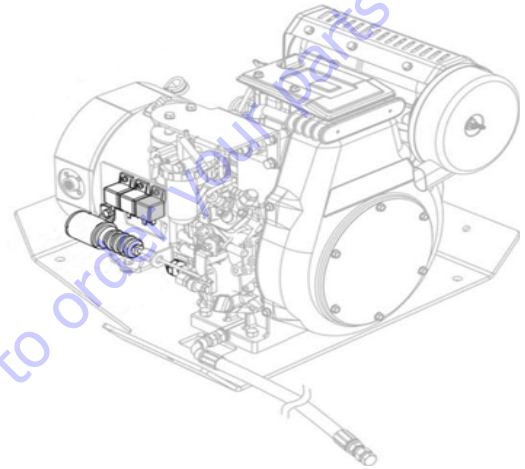
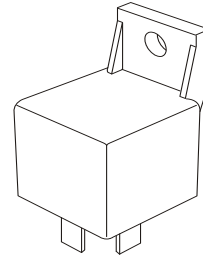
Engine Starter



The engine is equipped with a 12VDC starter, which provides the mechanical power to crank the engine. Electrical power for the starter is provided by the start battery.

The starter is energized by the start control relay.

Start Control Relay

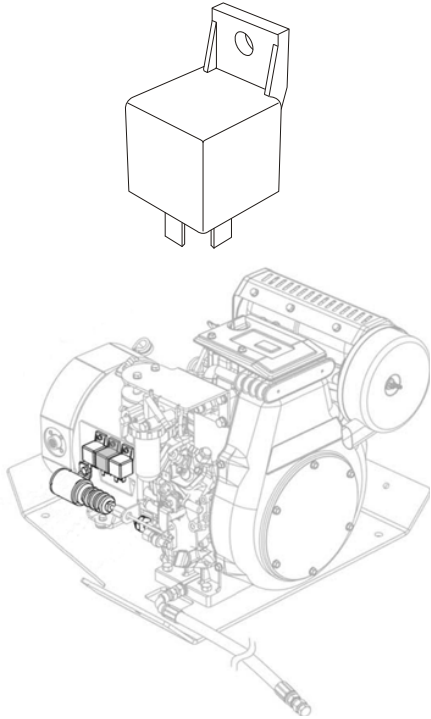


The start control relay energizes the solenoid of the engine starter and the pull coil of the engine fuel solenoid.

The start control relay is energized by the engine/generator controller from pin J2-4.

The start control relay is located on the fuel solenoid bracket on the right side of the engine.

Fuel Control Relay

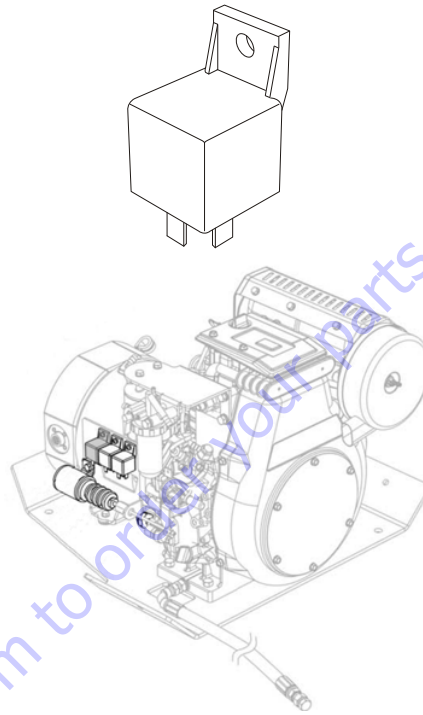


The fuel control relay energizes the hold coil of the fuel solenoid.

The fuel control relay is energized by the engine/generator controller from pin J2-3.

The fuel control relay is located on the fuel solenoid bracket on the right side of the engine.

Glow Plug Control Relay



The glow plug control relay energizes the glow plug. It is energized by the engine/generator controller, pin J2-27.

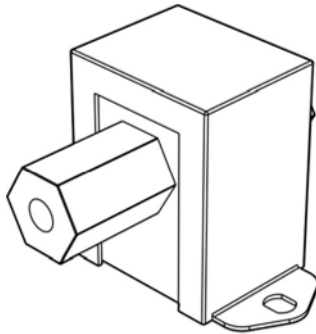
The glow plug control relay is located on the fuel solenoid bracket on the right side of the engine.

Glow Plug

The glow plug is a resistive heating element located in the combustion chamber. It is used during starting at temperatures below 32°F (0°C).

The heater is energized by the glow plug control relay.

Fuel Pump

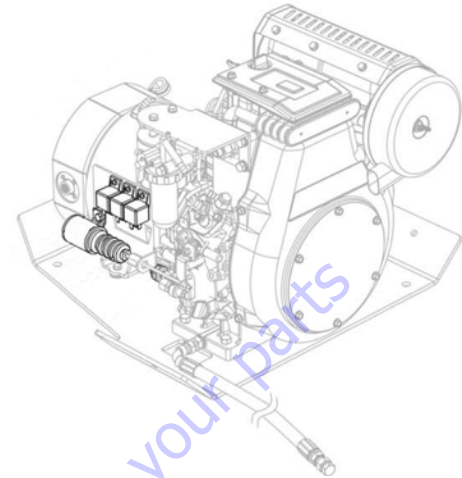


The fuel pump runs in parallel with the fuel solenoid hold coil which is run by the fuel control relay.

The pump runs whenever the engine runs, and keeps the fuel filter filled. Excess fuel flows through the return line back to the fuel tank.

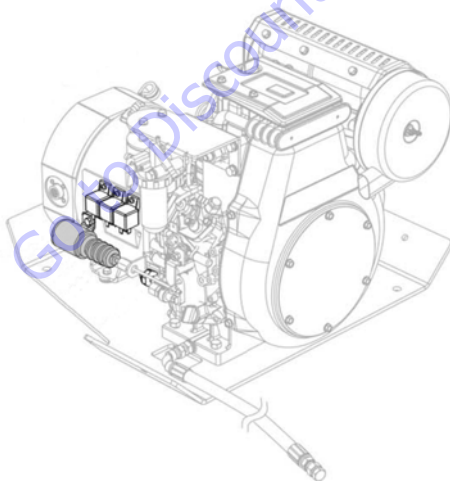
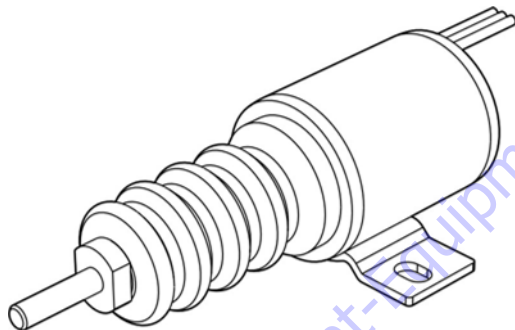
The fuel pump is located on the right side of the engine.

Engine Low Oil Pressure Switch



The engine is equipped with a low oil pressure switch. This switch is closed when the oil pressure is below 7psi. It is mounted on the side cover.

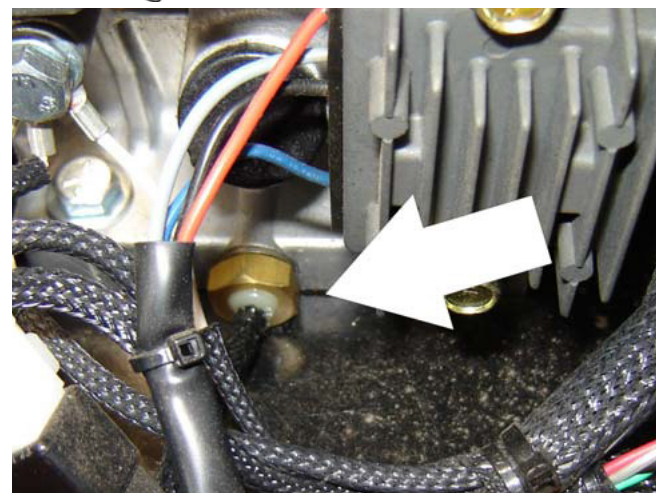
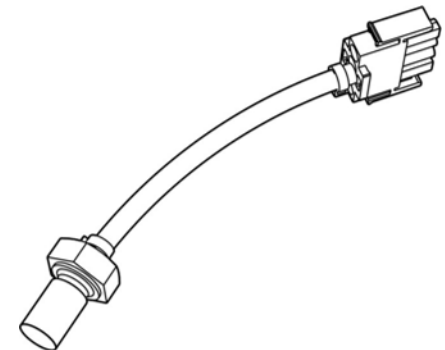
Fuel Solenoid



The fuel solenoid actuates the run/stop lever of the engine. This solenoid has a pull coil energized by the start control relay and a hold coil energized by the fuel control relay.

The fuel solenoid is located on the right side of the engine.

Engine Oil Temperature Sensor



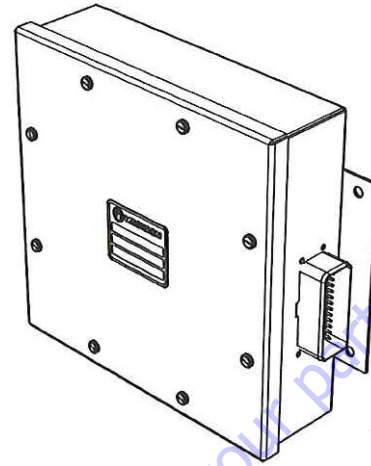
The engine oil temperature sensor is used to sense the temperature of the oil in the sump of the engine.

This sensor provides an analog signal to the engine/generator controller. The primary use of this signal is for high

engine temperature shutdown 248°F (120°C) for the engine. The signal is also used in determining if the air glow plug should be energized.

The engine oil temperature sensor is connected to the engine/generator controller at pins J2-8 and J2-19.

The engine oil temperature sensor is located on the left side of the engine.



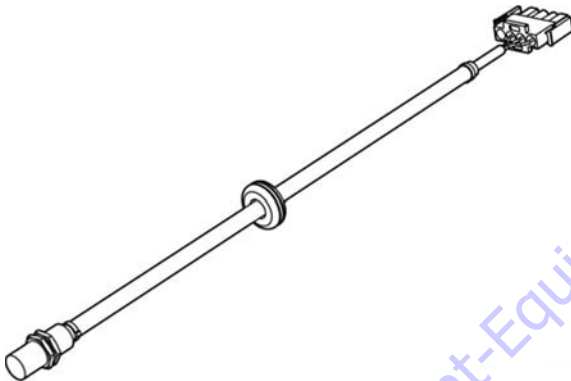
Alternator Output Current Sensor

The alternator output current sensor provides a signal proportional to the output current of the alternator to the engine/generator controller. The output current is regulated at 45ADC.

The alternator output current sensor is connected to the engine/generator controller at pins J2-21, J2-31 and J2-32.

The alternator output current sensor is located inside the rear cover of the alternator.

Engine Speed Sensor



The engine speed sensor provides a signal proportional to the rotational speed of the engine to the engine/generator controller. This signal is used by the engine/generator controller to determine starter cut-out, overspeed fault and underspeed fault. If the signal is not present at the engine/generator controller, the unit will fault with a loss of speed signal indication.

The engine speed sensor is connected to the engine/generator controller at pins J2-9, J2-15 and J2-20.

The engine speed sensor is located inside the recoil starter cover at the front of the engine.

RBS Engine/Generator Controller

The control system enclosure houses the RBS engine/generator controller, which performs all control tasks associated with the RBS.

The engine/generator controller interface is via a J2 35-pin connector.

Table 3-5. Controller Interface Pin Assignments

PIN	FUNCTION
1	System 48VDC
2	System 0VDC
3	Fuel solenoid
4	Starter Solenoid
5	Manual call to start
6	Low oil pressure
7	Not used
8	Engine oil temperature
9	Speed sensing input
10	RS-232 +12V
11	RXD
12	TXD
13	LED Driver GND
14	LED Driver +48V
15	Speed sensor GND
16	Not used
17	Not used
18	- Output voltage
19	Engine oil temperature/ambient temp. + 8V
20	Speed Sensing + 8V
21	Output current sensor (GND)
22	Not used
23	RS-232 GND
24	- Field drive
25	+ Start battery
26	- Start battery
27	Pre-heat
28	Inhibit run
29	Engine temp. switch

Table 3-5. Controller Interface Pin Assignments

PIN	FUNCTION
30	+ Output voltage
31	Speed sensing + 5V
32	Output current sense
33	Not used
34	Not used
35	Field Drive

Warnings and Safety Precautions

⚠ WARNING

THE RBS MAY START WITHOUT WARNING.

⚠ WARNING

MORE THAN ONE LIVE CIRCUIT IS USED INSIDE THE RBS CONTROL PANEL. EXERCISE CAUTION WHEN THE CONTROL PANEL IS OPEN, EVEN WHEN THE RBS IS NOT RUNNING.

System Controls

INHIBIT RUN INPUT

The inhibit run input prevents the RBS from starting, clears any existing calls to start and stops the engine immediately. To return to normal operating mode, the inhibit run input must be removed.

MANUAL CALL TO START

The manual call to start input initiates an automatic run of the RBS unit.

RS232 PORT

The RS232 allows the RBS to be monitored and controlled using an analyzer.

System Status and Performance Monitoring

System status and performance can be monitored by the analyzer.

System Settings

CALL TO START SETTINGS

Low battery voltage call to start level	48.0 VDC
Low battery voltage remove call to start level	54.0 VDC
Low temperature call to start level	5°C
Low temperature remove call to start level	8°C
Low start battery voltage call to start level	12.2 V
Low start battery voltage remove call to start level	12.9 V

CURRENT AND VOLTAGE SETTINGS

Normal output voltage level	58.0 VDC
Extend output voltage level	58.0 VDC
Current limit level	45 ADC
High voltage shutdown level	63 ADC
Finish charging current level	30 ADC

TIME DELAY SETTINGS

TD engine start	30s
TD purge	0s
TD bypass	10s
TD engine run	1800s
TD cool-down	30s
TD high volts	2s

CRANK SETTINGS

Crank time	15s
Reset time	15s
Crank cycles	3

SPEED TIME AND GLOW PLUG SETTINGS

TD no speed signal	5s
TD DC sensing fault	10s
Starter disconnect	1000 Hz
Overspeed shutdown	3800 RPM
Underspeed shutdown	2000 RPM
Glow plug on temperature	5°C
Glow plug on time	15s

RBS Start

Call to start	Manual	48VDC applied to the input
	Automatic	1 Low battery voltage (below 48VDC)
		2 Low engine temperature (below 5°C)
		3 Low start battery voltage (below 12.2V)
Engine start time delay		RBS waits to verify that call to start is valid (not a transient condition).
Preheat delay		- if engine temperature is below 32°F (0°C)
Crank time (Rest time)		RBS will crank and rest until engine starts, or Overcrank fault is indicated after 3 failed crank cycles.
Time delay bypass		RBS waits until normal engine operating conditions are reached before Low oil pressure and Underspeed faults are monitored.

RBS shutdown

Call to start removed	Manually	Inhibit run input applied
	Automatically:	1 Battery voltage above 54VDC and finish charging current below 30ADC
		2 Engine temperature above 8°C
		3 Start battery voltage above 12.9V and finish charging current below 30ADC
Engine run time delay		This period ensures that no further call to start conditions occur prior to cool-down period.
Cool-down period		Alternator output is reduced to a minimal level to allow the engine to cool down.

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RBS Alarms and Flash Codes

In the event of an RBS alarm, a flash code will be issued and an alarm indicated on the analyzer.

Table 3-6. RBS Alarms and Flash Codes

Flash Code	Problem		RBS Condition
1-1	Low Oil Pressure ¹	Below 7psi	Shutdown
1-2	High Engine Temp.	Over 248°F (120°C)	Shutdown
1-3	Overspeed	Over 3800 RPM	Shutdown
1-4	Underspeed 1	Below 2000 RPM	Shutdown
	Overcrank	3 failed crank cycles Call to start removed	Call to start removed
1-5	No Speed Signal ²		Shutdown
2-1	Overvoltage ³	Over 63VDC	Shutdown
2-2	Engine Starting System fault ⁴		Alarm
2-4	Loss Of Voltage Sense	Alternator output less than 1/2 of the system nominal voltage (58VDC)	Shutdown
steady	Unit Enabled, no faults		Unit can respond to any call to start
-	Unit Off / Disabled		Unit will not respond to any call to start
Notes:			
1 Enabled once time delay bypass period has elapsed after engine startup.			
2 Delayed to ensure the fault was not momentary.			
3 Measured at the alternator output, shutdown is delayed by a factory set period to ensure the fault was not caused by a transient condition.			
4 Indicates a problem with the engine start battery, engine magneto or magneto-voltage regulator.			

Alarms must be reset once the fault has been corrected (see below).

Resetting the RBS Controller

The RBS can be reset using the analyzer or by disabling and re-enabling the RBS controller. This will clear any current fault condition with the controller.

Maintenance Schedule

Check oil level every 24 hours

Change engine oil and filter every 150 hours

Troubleshooting

Table 3-7. Troubleshooting

Flash Code	Problem	Solution
-	Unit Off / Disabled (engine will not crank)	<p>Check position of selector switch.</p> <p>Verify that the inhibit run is released.</p> <p>Check the warning LED. Remedy fault if present and restart the RBS.</p> <p>Check the start battery voltage.</p> <p>Check control fuse.</p> <p>Check for loose wiring or connection.</p>
1-1	Low Oil Pressure	<p>Check oil level.</p> <p>Check oil supply lines.</p> <p>Refer to Kubota Workshop manual WSM OC60/80/95.</p> <p>Verify correct operation of oil pressure switch with a test gauge.</p>
1-2	High Engine Temp.	<p>Check for obstructions in the cooling airflow to the engine.</p> <p>Check that the ambient temperature is within the design limits of the engine.</p> <p>Verify correct operation of engine temperature sensor.</p>
1-3	Overspeed	<p>Verify setting of governor lever. Readjust, if required.</p> <p>Refer to Kubota Workshop manual WSM OC60/80/95.</p>
1-4	Underspeed	<p>Ensure there is an adequate supply of fuel to the engine.</p> <p>Ensure there is an adequate supply of combustion air to the engine. Check air cleaner.</p> <p>Verify setting of governor lever. Readjust if required.</p> <p>Refer to Kubota OC60 Engine Manual.</p>
	Overcrank	<p>Check fuel level.</p> <p>Check fuel connections.</p> <p>Verify operation of fuel solenoid and fuel pump.</p> <p>Check the start battery voltage.</p> <p>If the engine exhaust contains white smoke then fuel is entering the engine but the engine is not firing. Refer to the Kubota OC60 Engine Manual for further checks.</p> <p>If the ambient temperature is low, verify that the heater and/or glow plug are operating.</p>
1-5	No Speed Signal	Check wiring connections.
2-1	Overvoltage	Check alternator output voltage.
2-2	Engine Starting System fault	Check engine start battery charging system for current output.
		Check for failed engine start battery.
2-4	Loss Of Voltage Sense	

APU Engine Start Battery Boosting

Always connect the POSITIVE (+) of the booster battery to the POSITIVE (+) of the APU start battery, and the NEGATIVE (-) of the booster battery to the ground of the engine block.

WARNINGS:

⚠ WARNING

ALWAYS SHIELD YOUR EYES AND AVOID LEANING OVER THE BATTERY WHENEVER POSSIBLE.

⚠ WARNING

DO NOT ALLOW BATTERY ACID TO CONTACT EYES OR SKIN. FLUSH ANY CONTACTED AREA WITH WATER IMMEDIATELY. SEEK MEDICAL ATTENTION IF IRRITATION PERSISTS.

⚠ WARNING

STARTING BATTERIES GENERATE EXPLOSIVE GASES. KEEP SPARKS, FLAME AND LIGHTED CIGARETTES AWAY FROM BATTERIES.

⚠ WARNING

IMPROPER USE OF A BOOSTER BATTERY TO START AN APU MAY CAUSE AN EXPLOSION.

⚠ WARNING

DO NOT ATTEMPT TO JUMP START AN APU WITH A LOW ACID LEVEL IN THE BATTERY.

⚠ WARNING

THE VOLTAGE OF THE BOOSTER BATTERY MUST BE RATED AT 12V. THE AMP-HOUR CAPACITY OF THE BOOSTER BATTERY MUST NOT BE LOWER OR SUBSTANTIALLY HIGHER THAN THAT OF THE DISCHARGED BATTERY. USE OF BATTERIES OF DIFFERENT VOLTAGE OR SUBSTANTIALLY DIFFERENT AMP-HOUR RATING MAY CAUSE AN EXPLOSION OR PERSONAL INJURY. APPLYING A HIGHER VOLTAGE WHILE BOOSTING WILL ALSO CAUSE DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS.

⚠ WARNING

A CHARGING SYSTEM (BATTERY CHARGER OR BATTERY CHARGING ALTERNATOR) MUST NEVER BE ENERGIZED WHILE BOOSTING. DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS WILL RESULT.

NOTICE

THE MAIN BATTERY OF THE LIFT MUST NEVER BE USED TO BOOST THE APU. DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS WILL RESULT.

3.10 SUPPLEMENTARY FUSE FOR APU

The purpose of this section is to describe the procedure to add a supplementary fuse for the Engine Generator Controller for the APU.

Tools And Material

- - Weather proof fuse holder - JLG PN 2400081
- - AGC1, 1 Amp fuse - JLG PN 2400080
- - 45 cm of #16 AWG wire - JLG PN 4920019
- - 2 X insulated butt splice connectors - JLG PN 4460035
- - 6 X medium length wire ties - JLG PN 4240033
- - Wire/Side cutters
- - 5/32" Allen Key
- - Crimping tool

Procedure

⚠ WARNING

BEFORE BEGINNING THIS PROCEDURE, ENSURE THAT ALL SOURCES OF POWER ARE DISCONNECTED FROM THE APU!

This procedure is common for all applications of the APU. The photos contained in this document illustrate the modification performed to an APU supplied in a JLG M450 lift.

1. Locate the harness at the rear of the APU.



2. where the harness attaches to the rear cover of the generator and the connection point for the new inline fuse.



3. Remove the socket head drive screw with a 5/32" Allen key. Next remove the cable clamp from the harness.



4. Cut and remove the Wire Ties holding the Harness label to the harness. Next, remove the Wire Ties so that the cable sleeve can be moved, exposing the conductors of the harness.



6. Re-install the harness with the new fuse in place.

5. Cut wire 106 going to the Engine/Generator Controller after the existing connection point and install the conductors that lead to the new inline fuse holder. Use insulated butt splice connectors for these conductors.



7. Reconnect the lift and APU start battery. The APU is now ready for use.

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NOTES:

A large area consisting of two columns of horizontal lines, intended for handwritten notes.

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SECTION 4. BOOM & PLATFORM

4.1 PLATFORM

Support Removal

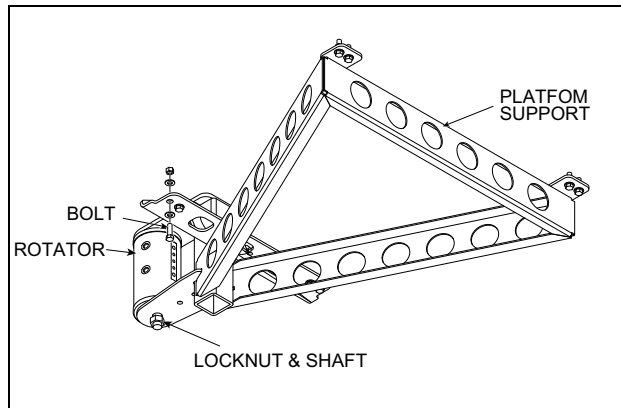
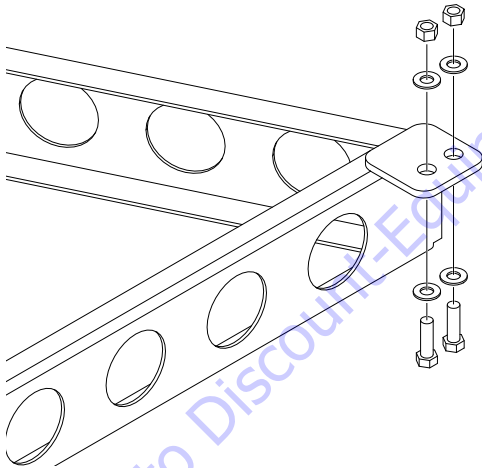


Figure 4-1. Location of Components Platform Support

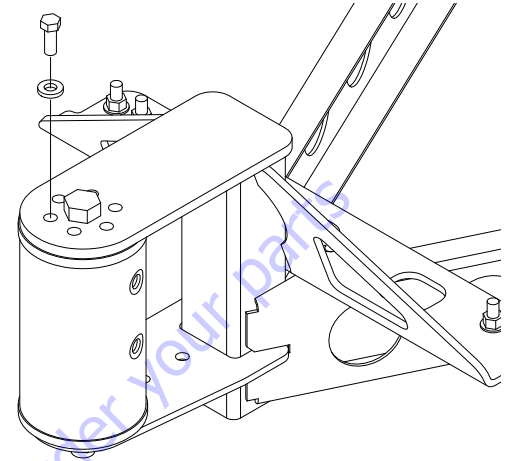
1. Disconnect electrical cables from control console.
2. Remove the bolts securing the platform to the platform support, then remove the platform.



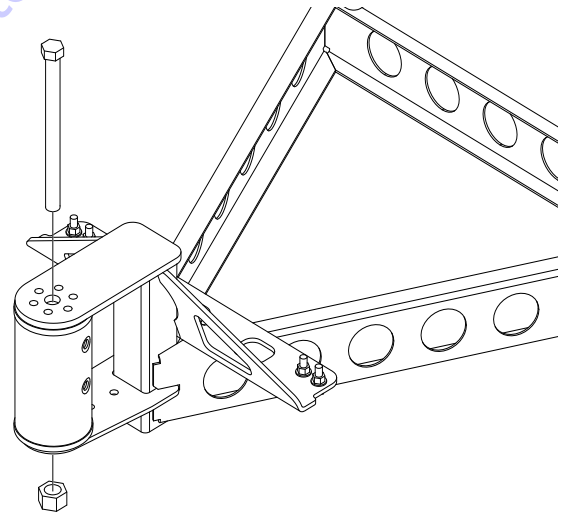
3. Using a suitable lifting device, support the platform support.

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

4. Remove the bolts and locknuts securing the support to the rotator.



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

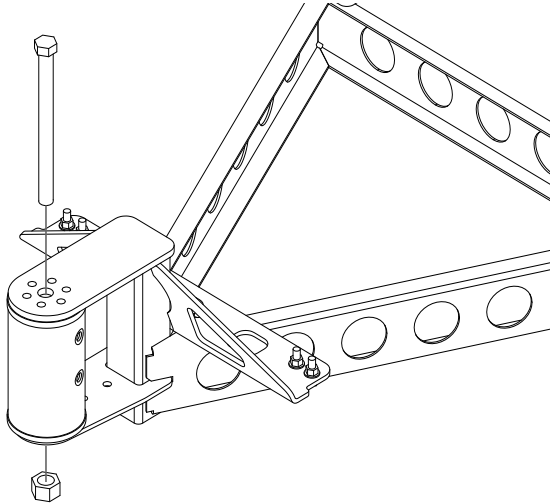


Support Installation

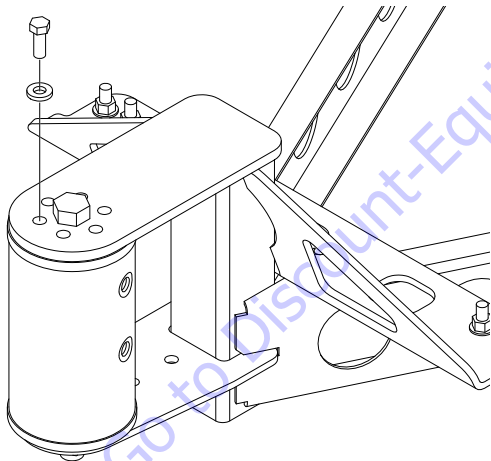
1. Using a suitable lifting device, support the platform support and position it on the rotator.

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

2. Install the rotator center bolt.

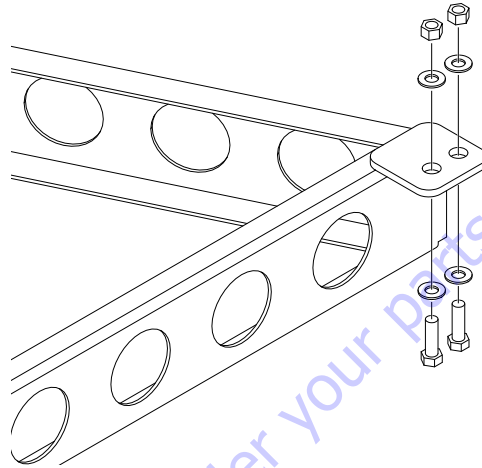


3. Apply JLG Threadlocker PN 0100011 to the bolts and locknuts securing the support to the rotator and install the bolts and locknuts.

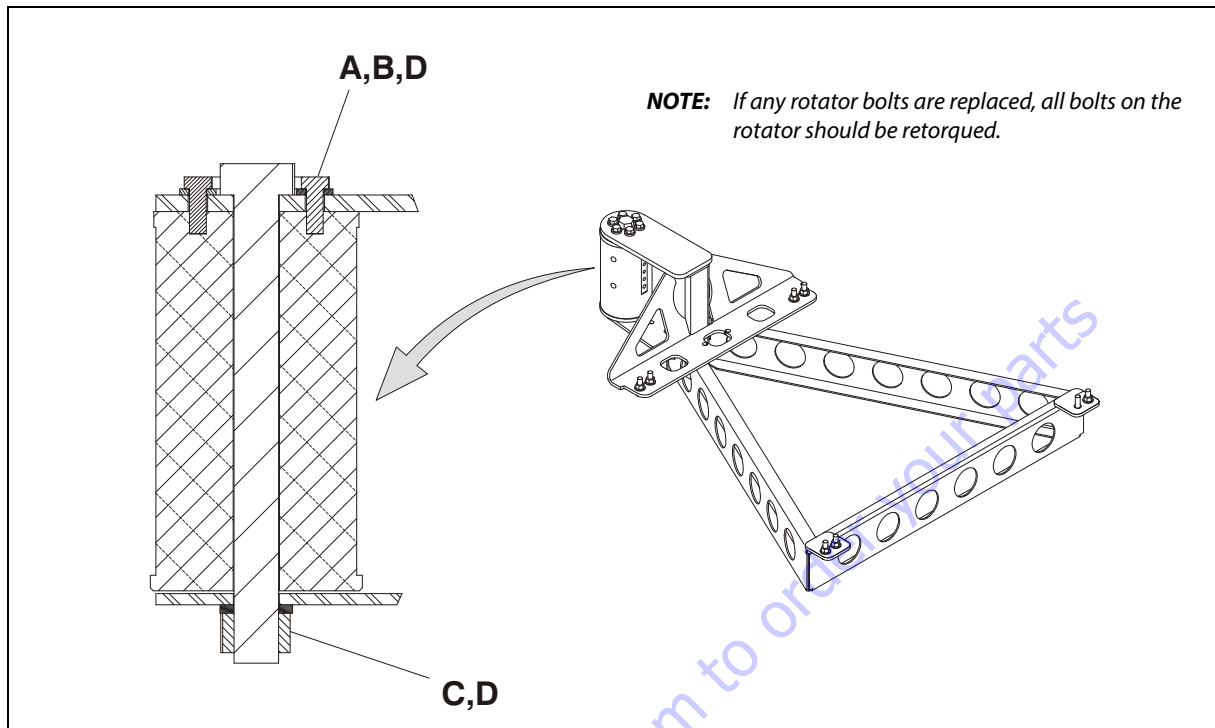


4. Torque the nut on the rotator center bolt to 250-270 ft. lbs. (339-366 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

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



6. Connect the electrical cables to the platform control console.



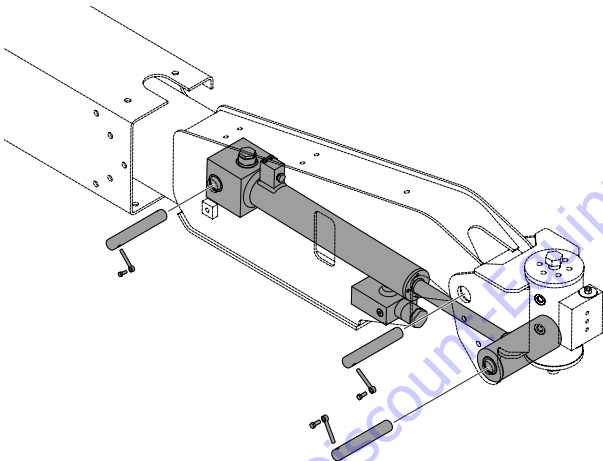
- A Torque to 40 ft. lbs. (55 Nm)
- B JLG Thread locker (#0100011)
- C Torque to 250-270 ft. lbs. (339-366 Nm)
- D Check torque every 150 hours of operation

Figure 4-2. Platform Support Torque Values

4.2 ROTATOR AND SLAVE CYLINDER REMOVAL

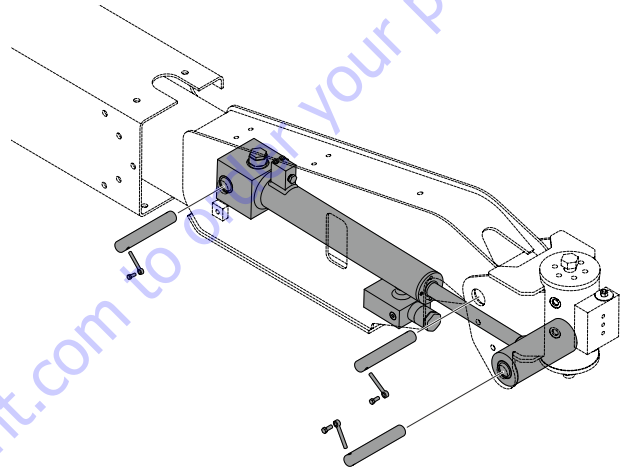
Removal

1. Using a suitable lifting equipment, adequately support main boom weight along entire length.
2. Tag and disconnect hydraulic lines to the rotator. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Supporting the rotator, remove hardware from pin. Using a suitable brass drift and hammer remove pin from the rotator.
4. Remove the hardware from pin. Using a suitable brass drift and hammer, remove from the fly boom and remove the rotator.
5. Supporting the slave cylinder, remove the hardware from pin. Using a suitable brass drift and hammer, remove pin from the fly boom.
6. Tag and disconnect hydraulic lines to the slave leveling cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports. Remove the slave cylinder.



Installation

1. Using a suitable lifting equipment, adequately support main boom weight along entire length.
2. Supporting the slave cylinder, Using a suitable brass drift and hammer, Install pin to the fly boom.
3. Using a suitable brass drift and hammer, Install pin to the fly boom and Install the rotator.
4. Using a suitable brass drift and hammer, Install pin to the rotator.
5. Remove tag and reconnect the hydraulic lines to the rotator and the slave cylinder.



4.3 MAIN BOOM POWERTRACK (E/M450AJ)

Removal

1. Disconnect wiring harness connectors located in main upright.

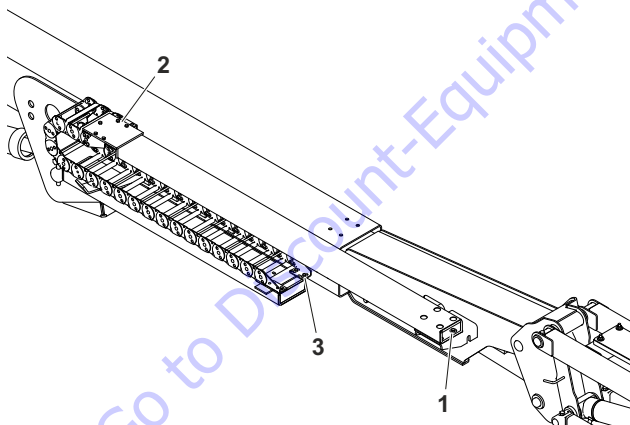
NOTICE

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

2. Tag and disconnect hydraulic lines to the connectors at boom assembly. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove hydraulic lines and electrical cables from Powertrack.

NOTE: The Main Boom weighs approximately 590lbs. (268kg).

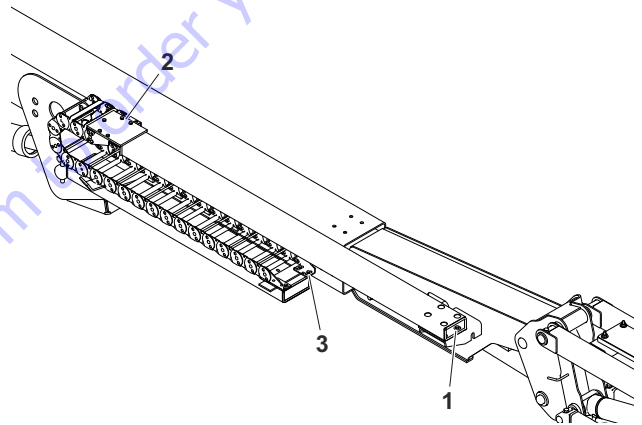
4. Using suitable lifting equipment, adequately support Powertrack weight along entire length.
5. Remove bolts #1 securing the push tube on the fly boom section.
6. Remove bolts #2 that attaches rail to the push tube on the main boom section.
7. With powertrack supported and using all applicable safety precautions, remove bolts #3 securing rail to the base boom. Remove powertrack from the boom section.



Installation

NOTE: The Main Boom weighs approximately 590lbs. (268kg).

1. Using suitable lifting equipment, adequately support Powertrack weight along entire length.
2. With powertrack supported and using all applicable safety precautions, install bolts #3 securing rail to the base boom.
3. Install bolts #2 that attaches rail to the push tube on the main boom section.
4. Install bolts #1 securing the push tube on the fly boom section.
5. Remove tag and reconnect all hydraulic lines.
6. Reconnect all electrical harness.



4.4 BOOM MAINTENANCE

Removal

- a. Remove hardware securing the cover plate on the side of the base boom section and remove hose clamps. Disconnect wiring harness from ground control harness connector.

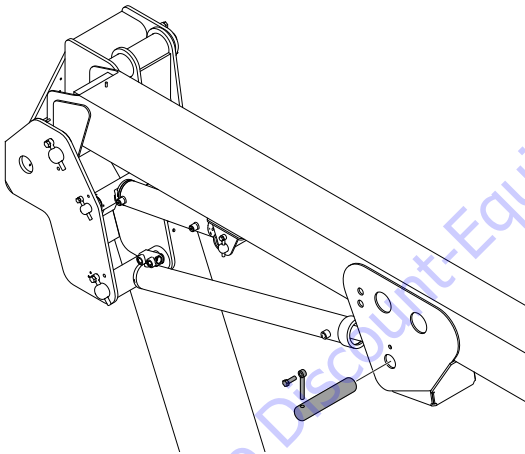
NOTICE

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

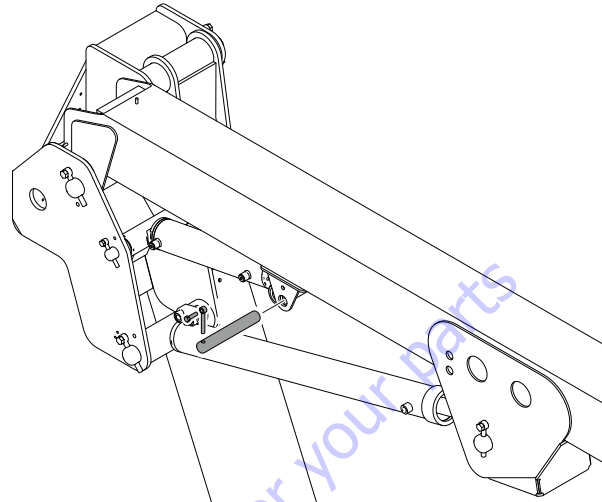
- b. Tag and disconnect hydraulic lines from boom to control valve. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

NOTE: The Main Boom weighs approximately 450lbs. (204kg).

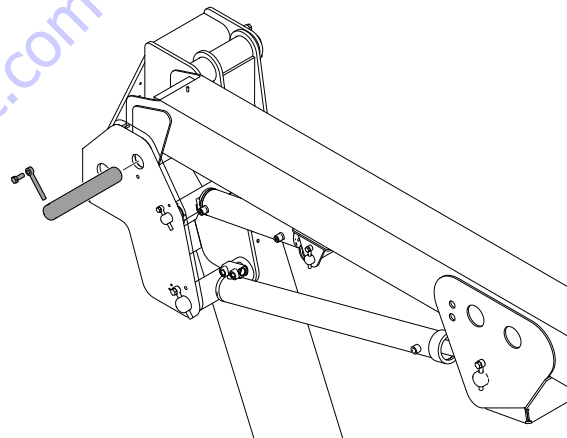
- c. Using a suitable lifting equipment, adequately support boom weight along entire length.
- d. Remove hardware securing the lift cylinder pin. Using a suitable brass drift and hammer, remove pin from the base boom.



- e. Remove hardware securing the master cylinder pin. Using a suitable brass drift and hammer, remove pin from the base boom.



- f. Remove hardware securing the base boom pin. Using a suitable brass drift and hammer, remove pin from the upright.



- g. Using all applicable safety precautions, carefully lift boom assembly clear of upright and lower to ground or suitable supported work surface.

Disassembly

1. Loosen jam nuts on aft end of fly boom wear pad adjustment and loosen adjustments.
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 pin #1. Shut down hydraulic system.
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.
4. Remove hardware securing telescope cylinder #1 to the fly boom section, then remove pin from fly.
5. Remove hardware securing telescope cylinder to the base boom section.

NOTICE

WHEN REMOVING TELESCOPE CYLINDER FROM BOOM SECTIONS. CARE SHOULD BE TAKEN NOT TO LET CYLINDER REST ON POWERTRACK WHICH COULD CAUSE DAMAGE TO POWERTRACK.

6. Using a suitable lifting device, remove telescope cylinder from boom sections.
7. Using a piece of tape, mark the length of hoses and wires from front of fly boom and bottom of base boom for reassembly.
8. Remove hardware securing the front cover on base boom section.
9. Loosen jam nuts on front wear pad adjustments and loosen adjustments.
10. Remove hardware securing the front wear pads on base boom section, remove wear pads.
11. Remove wire clamp on the inside of the fly nose.
12. Manually push the fly boom section into base boom section to gain access to the powertrack attachment bolts on the right side of the base boom section.
13. Remove hardware securing the powertrack to the aft end of the fly boom section.
14. Using a suitable lifting device, remove fly boom from boom section.
15. Remove hydraulic lines and electrical cables from powertrack.
16. Remove hardware securing powertrack to the base boom section. Remove powertrack.

Inspection

1. Inspect boom pivot pin for wear, scoring or other damage, and for tapering or ovality. Replace pin as necessary.
2. Inspect lift and master 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 as shown in Section 4.5, Wear Pads.
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

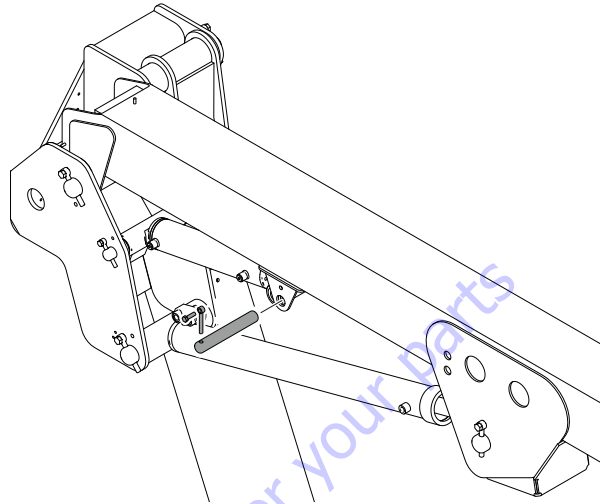
1. Install power track to the attach point on the inside of the base boom section. Secure power track with hardware.
2. Install hydraulic lines and electrical cables into the power track.
3. Install wear pads to the aft end of the fly section.
4. Using suitable lifting equipment, slide fly section into the base section until power track attach point aligns with holes in side of base section.
5. Attach the power track to the aft end of fly boom section. Secure power track with hardware.
6. Using suitable lifting equipment, slide fly boom section out to gain access to telescope cylinder attach pin hole.
7. Measure the distance between the telescope cylinder port block attach point on base boom section and the attach point on fly boom section.
8. Connect a suitable auxiliary hydraulic power source to the telescope cylinder port block.
9. Extend the telescope cylinder the distance of the two attach points.
10. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the boom assembly.

NOTICE

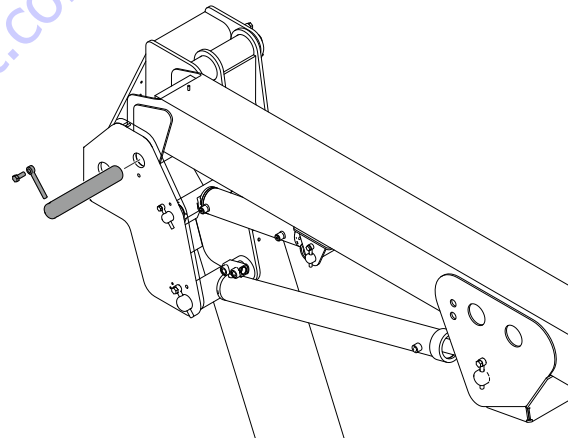
WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, CARE MUST BE TAKEN NOT TO DAMAGE THE POWER TRACK ASSEMBLY.

SECTION 4 - BOOM & PLATFORM

11. Slowly slide the telescope cylinder into boom assembly, align rod end with attach point in fly section. Insert pin and secure with retaining ring.
12. Align bolt holes at aft end of base boom section with telescope cylinder port block. Secure telescope cylinder with hardware.
13. Install wear pads at end of base boom section. Adjust the adjustable wear pads to zero clearance. Adjust pads alternately side to side, so that fly boom section is centered in base boom section.
14. Retract boom section fully. Adjust wear pads at aft end of boom section to zero clearance. Adjust pads alternately side to side, so that fly boom section is centered in base boom section.
15. Disconnect auxiliary power source from telescope cylinder.



4. If necessary, gently tap pins into position with a soft headed mallet, ensuring that attach holes in pins are aligned with attach holes in boom structure. Secure with hardware.

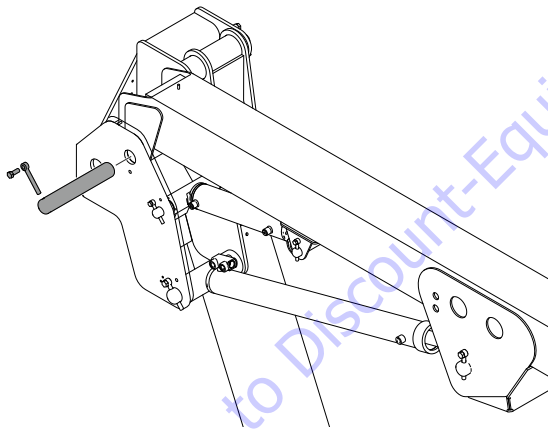


5. Connect all hosing and wiring.
6. Install the slave leveling cylinder to the boom assembly.
7. Install the platform to the boom assembly.
8. Connect all hosing and wiring at platform control station.
9. Using all safety precautions, operate machine systems and extend and retract boom for four or five cycles.
10. Shut down machine systems and check for leakage.

Installation

NOTE: The Main Boom weighs approximately 450lbs. (204kg).

1. Using suitable lifting equipment, position boom assembly on upright so that boom pivot holes in both boom and upright are aligned.
2. Install boom pivot pin, ensuring that location of the hole in pivot pin aligns with attach point on upright.



3. Using all applicable safety precautions, operate lifting equipment in order to position boom lift and master cylinders so that holes in cylinder rod ends and boom structure are aligned. Insert cylinder pins.

4.5 WEAR PADS

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

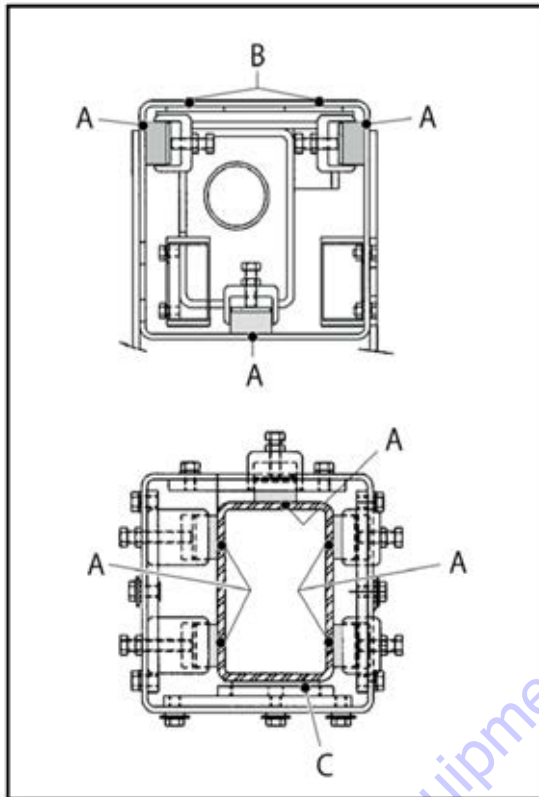


Figure 4-3. Wear Pad Thickness

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.

4.6 BOOM LIMIT SWITCHES

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

4.7 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.
5. 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.
6. 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.

SECTION 4 - BOOM & PLATFORM

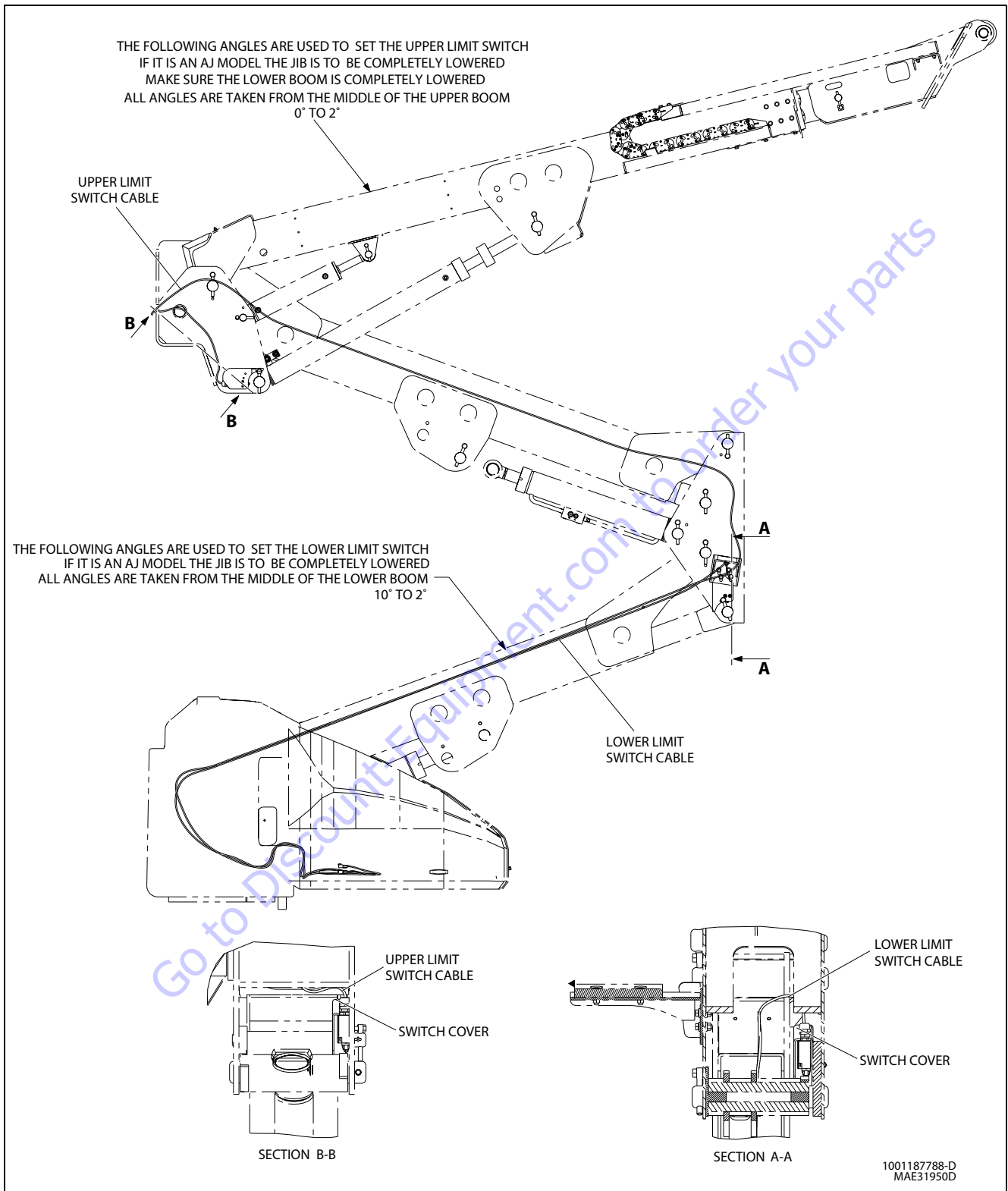


Figure 4-4. Boom Limit Switches

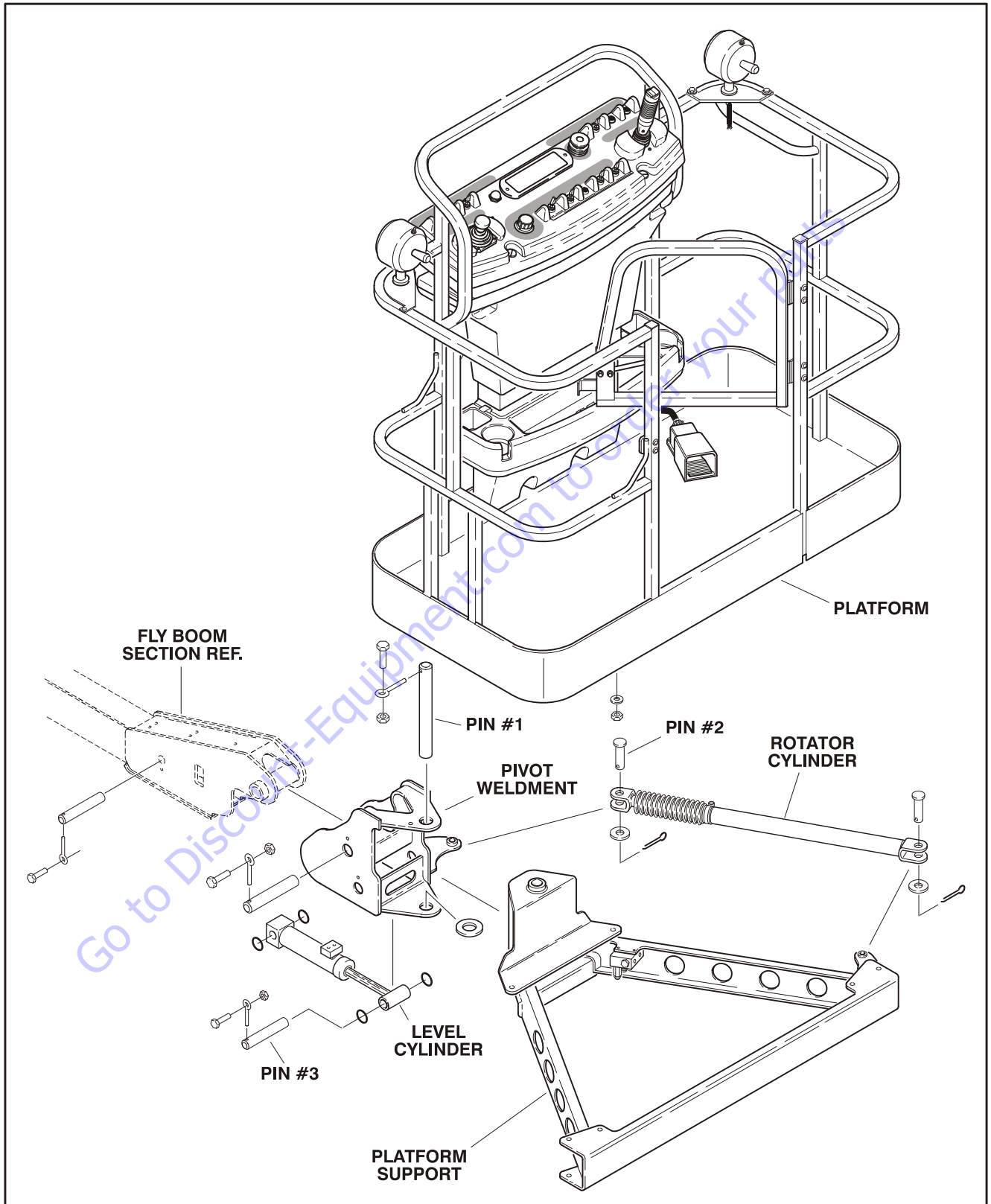


Figure 4-5. Platform Components and Attaching Hardware (M450A & E450A)

4.8 ARTICULATING JIB BOOM

Removal

1. For platform/support removal see platform/support removal diagram. See Section 4.1, 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.

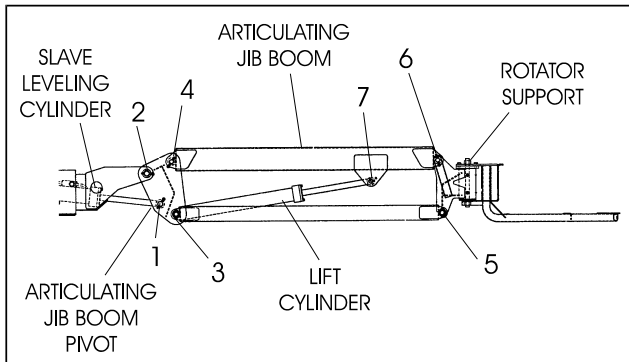


Figure 4-6. Location of Components - Articulating Jib Boom

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

Assembly

NOTE: For location of components See Figure 4-6., Location of Components - Articulating Jib Boom.

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

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

4.9 BOOM SYNCHRONIZING PROCEDURE

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

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

4.10 FOOT SWITCH ADJUSTMENT

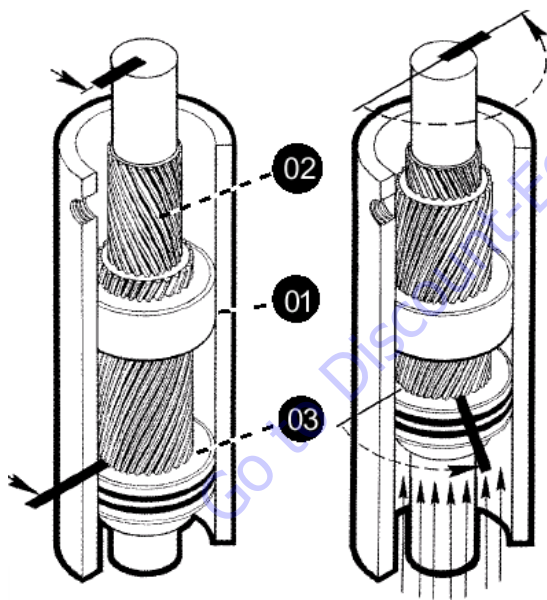
Adjust switch so that functions will operate when pedal is at center of travel. If switch operates within last 1/4 inch (6.35 mm) of travel, top or bottom, it should be adjusted.

4.11 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 setscrews or pins.

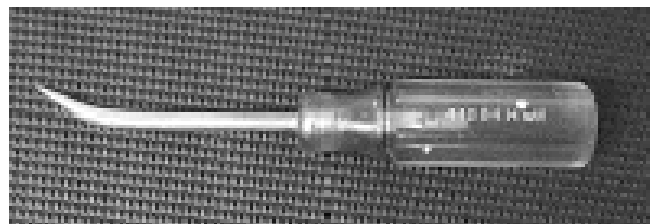


NOTE: Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary. As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously.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

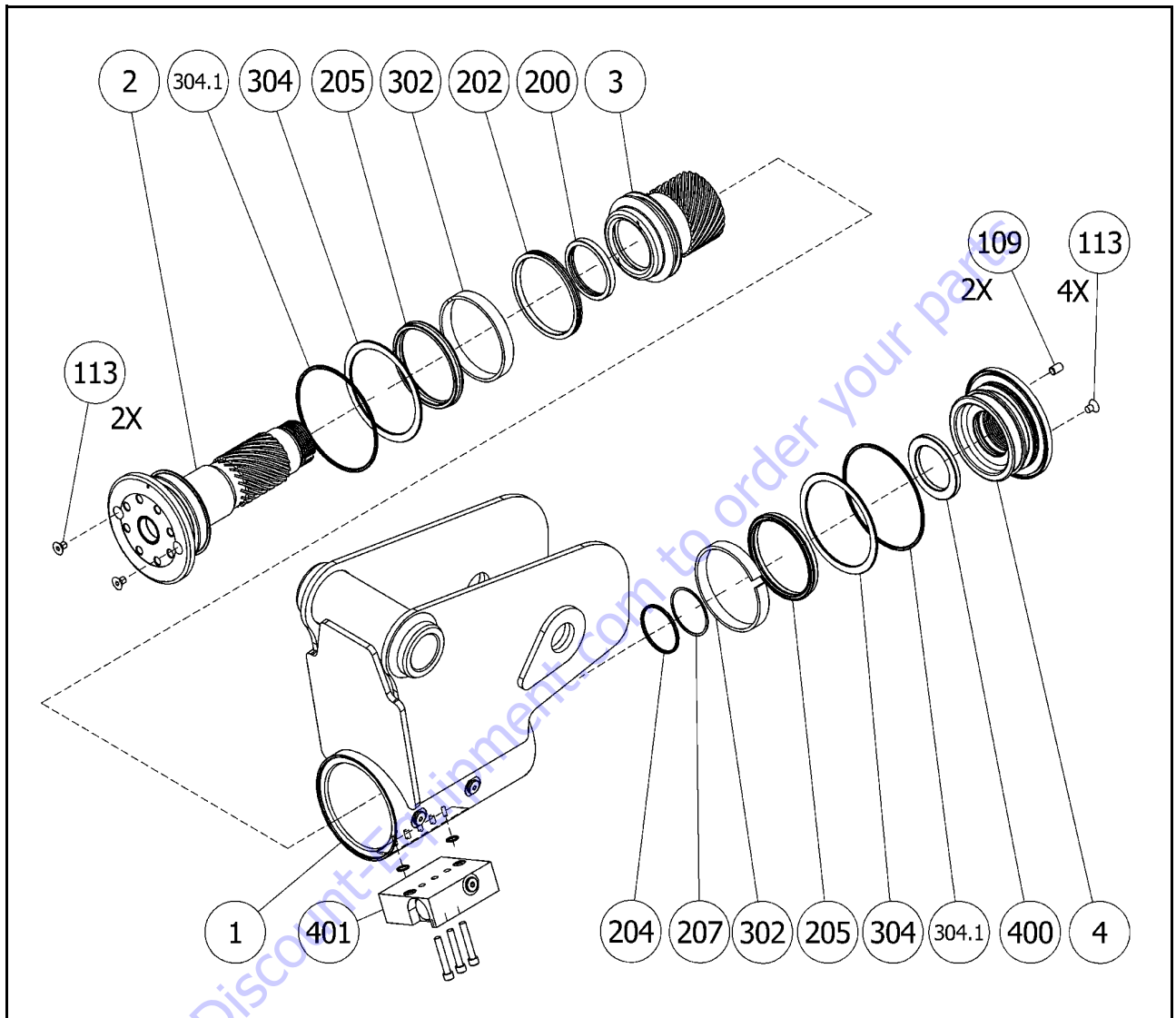
Tools Required for Assembly/Disassembly

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- mark the timing marks and outline troubled areas.
3. Allen wrench- removal of port plugs and setscrews.
4. Box knife- removal of seals.
5. Seal tool- assembly and disassembly of seals and wear guides.
6. Pry bar- removal of end cap and manual rotation of shaft.
7. Rubber mallet- removal and installation of shaft and piston sleeve assembly.
8. Nylon drift- installation of piston sleeve.
9. End cap dowel pins- removal and installation of end cap (sold with Helac seal kit).

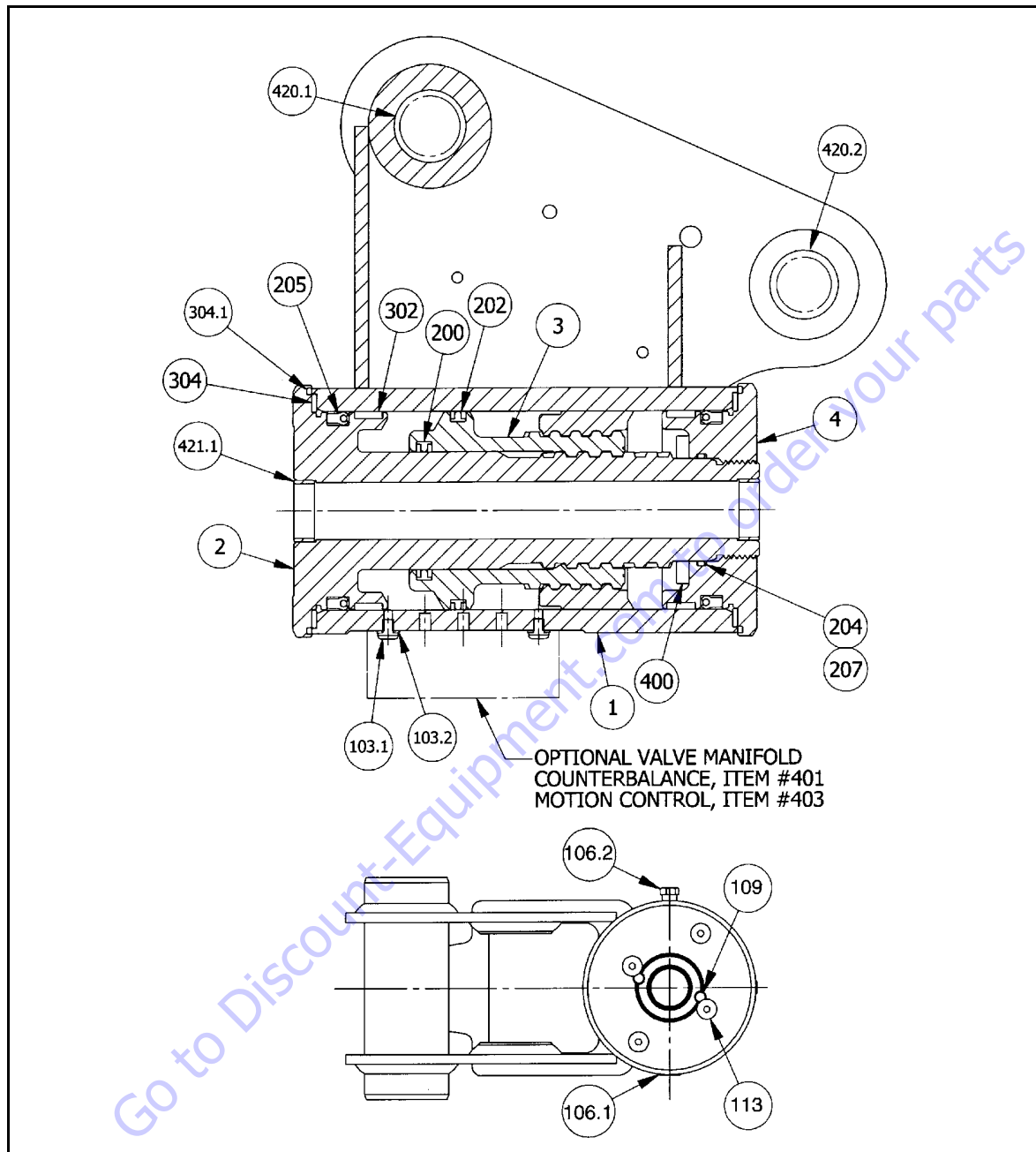


The seal tool is merely a customized standard flat headscrewdriver. To make this tool you will need to heat the flat end with a torch. Secure the heated end of the screwdriver in a vice and physically bend the heated end to a slight radius. Once the radius is achieved round off all sharp edges of the heated end by using a grinder. There may be some slight modifications for your own personal preference.



- | | | |
|------------------|------------------|---------------------------|
| 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 Ring | |
| 113. Capscrew | 302. Wear Guide | |

Figure 4-7. Rotary Actuator (Exploded View)



PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. WearGuide	400. StopTube
2. Shaft	103.2. Washer	202. T-Seal	304. ThrustWasher	420.1 Bushing
3. Piston Sleeve	106.1. PortPlug	204. O-ring		420.2 Bushing
4. End Cap	106.2. PortPlug	205. CupSeal		421.1 Bushing
	109. Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Wiper Seal		

Figure 4-8. 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) to drill 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 counter clock-wise.



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

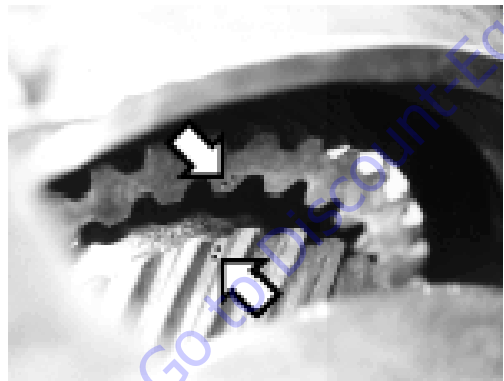
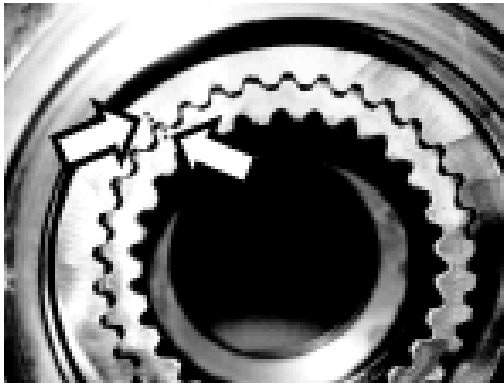


SECTION 4 - BOOM & PLATFORM

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.

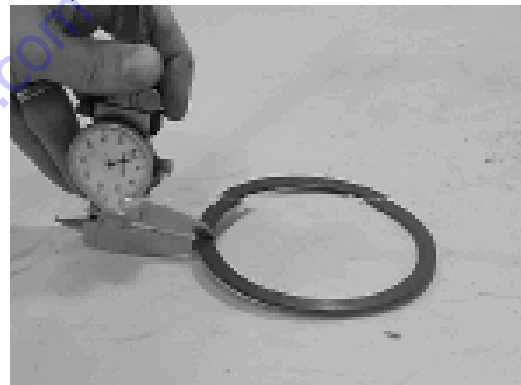


Inspection

- 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 its 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 its 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).



SECTION 4 - BOOM & PLATFORM

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.



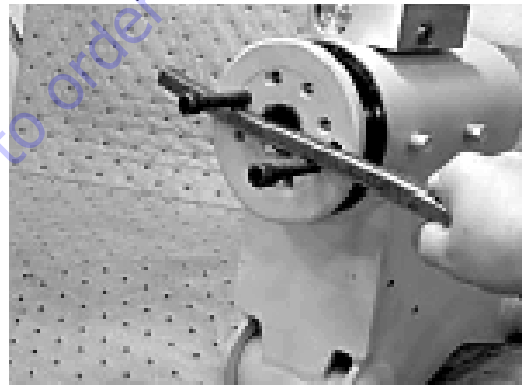
12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.



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.



SECTION 4 - BOOM & PLATFORM

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 setscrews (113) over the lock pins. Tighten them to 25 in. lbs. (2.825 Nm).



Installing Counterbalance Valve

Refer to Figure 4-9., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Loctite.
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. JLG Threadlocker PN 0100011 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 in. lbs. (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.

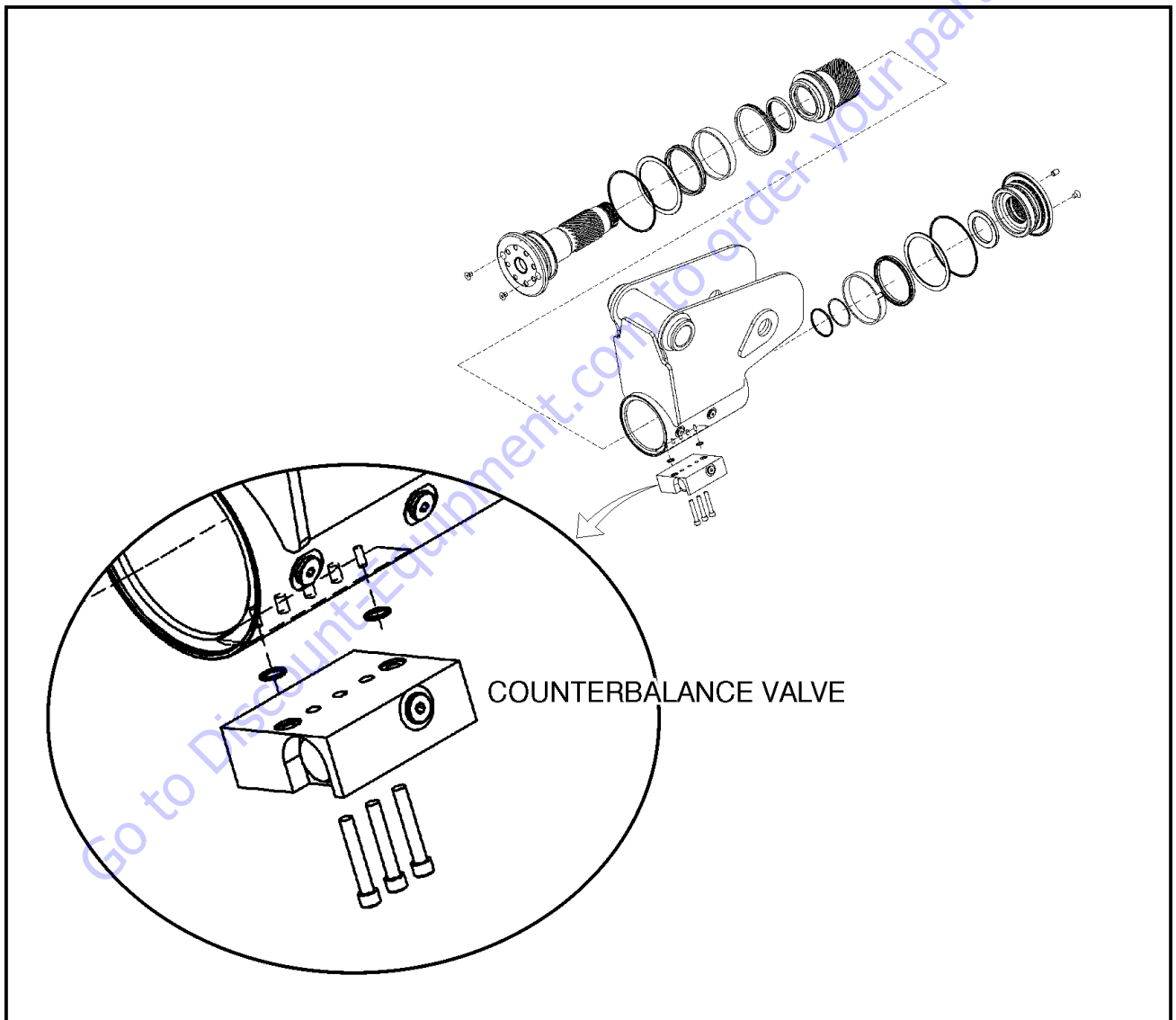


Figure 4-9. Rotator Counterbalance Valve

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 setscrews. 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.

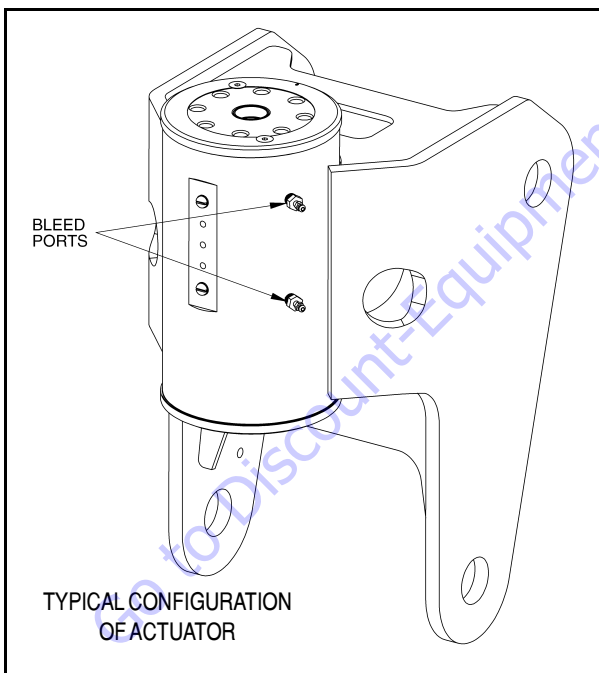
Installation and Bleeding

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.



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
4. Shaft rotates slowly or not at all	<p>a. Insufficient torque output</p> <p>b. Low rate of fluid flow</p> <p>c. Control or counterbalance valve has internal leak</p> <p>d. Piston and/or shaft seal leak</p> <p>e. Corrosion build-up on the thrust surfaces</p> <p>f. Swollen seals and composite bearings caused by incompatible hydraulic fluid</p>	<p>a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.</p> <p>b. Inspect ports for obstructions and hydraulic lines for restrictions and leaks.</p> <p>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.</p> <p>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.</p> <p>e. Re-build the actuator. Remove all rust then polish. Replacement parts may be needed.</p> <p>f. Re-build the actuator. Use fluid that is compatible with seals and bearings.</p>
5. Operation is erratic or not responsive	<p>a. Air in actuator</p>	<p>a. Purge air from actuator. See bleeding procedures.</p>
6. Shaft will not fully rotate	<p>a. Twisted or chipped gear teeth</p> <p>b. Port fittings are obstructing the piston</p>	<p>a. Check for gear binding. Actuator may not be able to be rebuilt and may need to be replaced. Damage could be a result of overload or shock.</p> <p>b. Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.</p>
7. Selected position cannot be maintained	<p>a. Control or counterbalance valve has internal leak</p> <p>b. Piston and/or shaft seal leak</p> <p>c. Air in actuator</p>	<p>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.</p> <p>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.</p> <p>c. Purge air from actuator. See bleeding procedures</p>

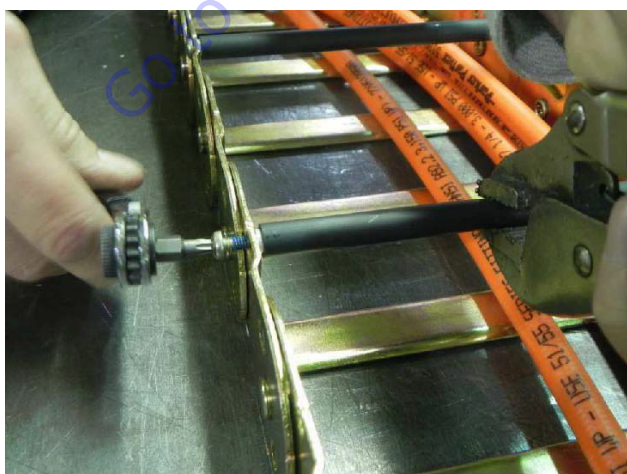
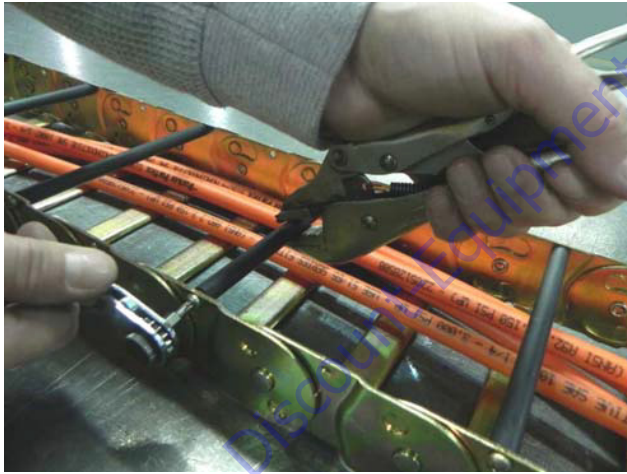
4.12 POWERTRACK MAINTENANCE

Removing a Link

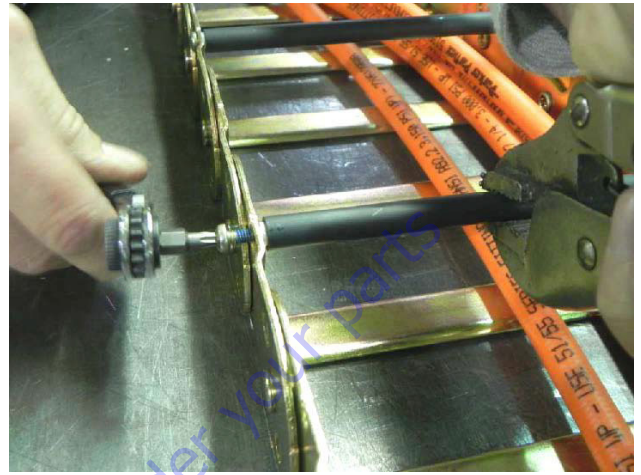
NOTE: Hoses shown in the powertrack are for example only. Actual hose and cable arrangements will be different.



1. Clamp the bar and poly roller tightly so they do not spin when removing the screw. With a small $\frac{1}{4}$ " ratchet and a t-20 torx bit, remove the 8-32 x 0.500 screw from one side.

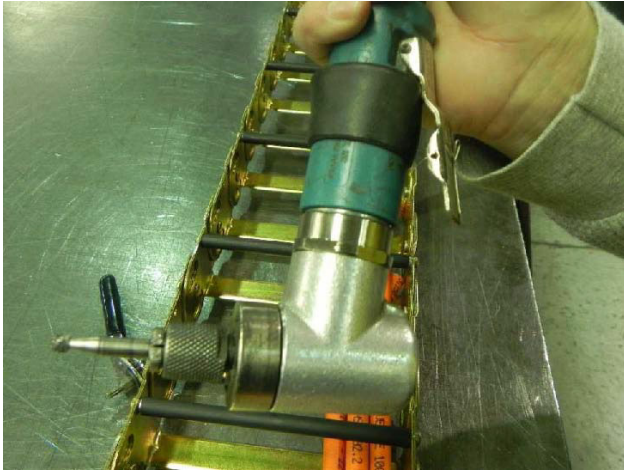


2. Repeat step 1 and remove the screw from the other side of track. Remove the bar/poly roller from the powertrack..

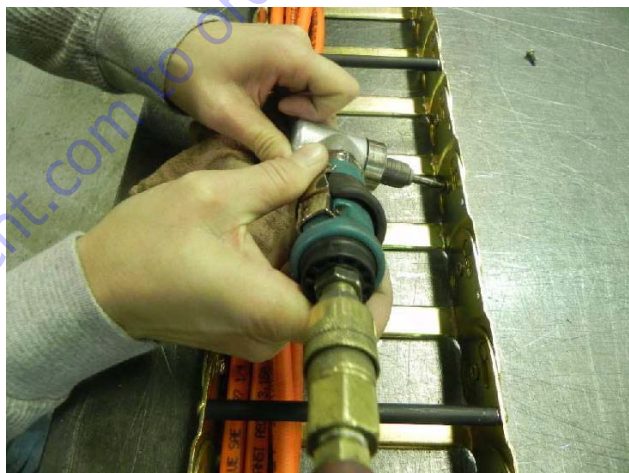
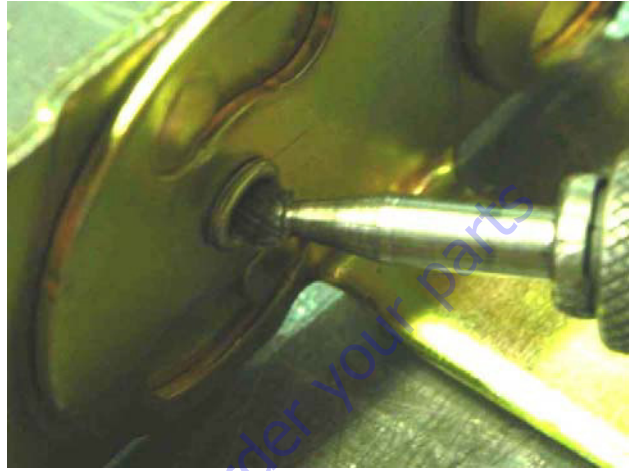


SECTION 4 - BOOM & PLATFORM

3. To remove a link, the rivets holding the links together must be removed. Use a right-angle pneumatic die grinder with a 1/4" ball double cut bur attachment.



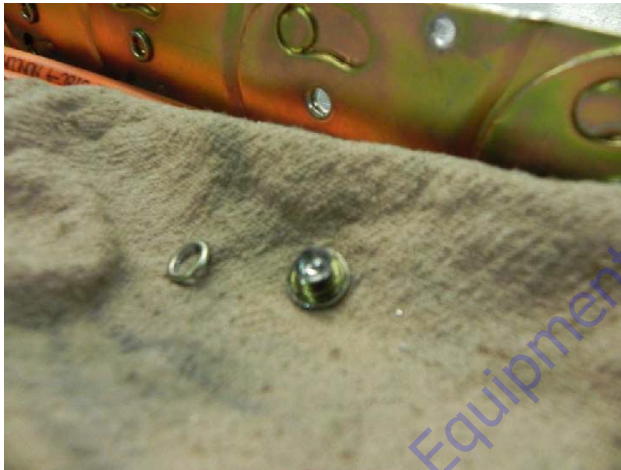
4. Insert the tool into the rolled over end of the rivet as shown. Grind out the middle of the rivet until the rolled over part of the rivet falls off. Repeat this step for all the rivets that must be removed.



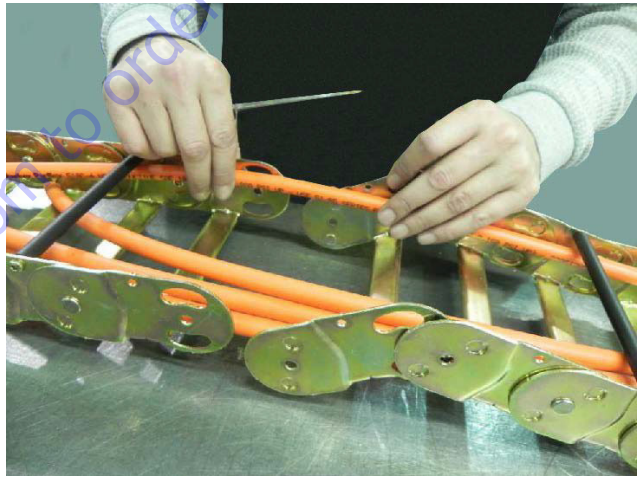
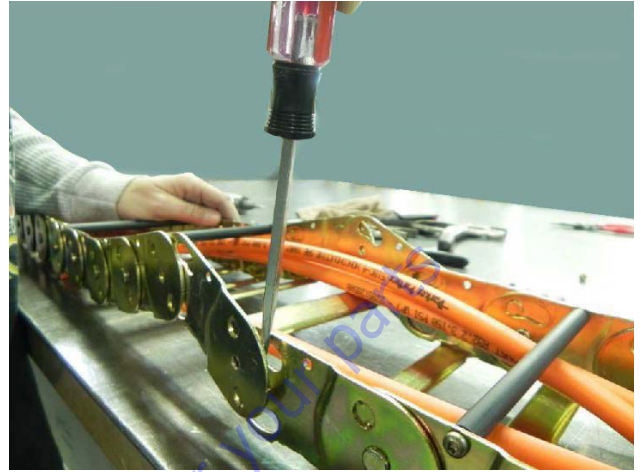
NOTICE

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.

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



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



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.

SECTION 4 - BOOM & PLATFORM

7. Remove the link from the other section of the powertrack using a screwdriver.

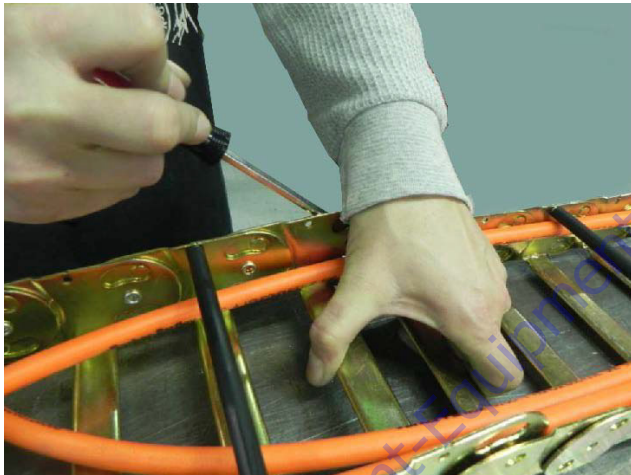
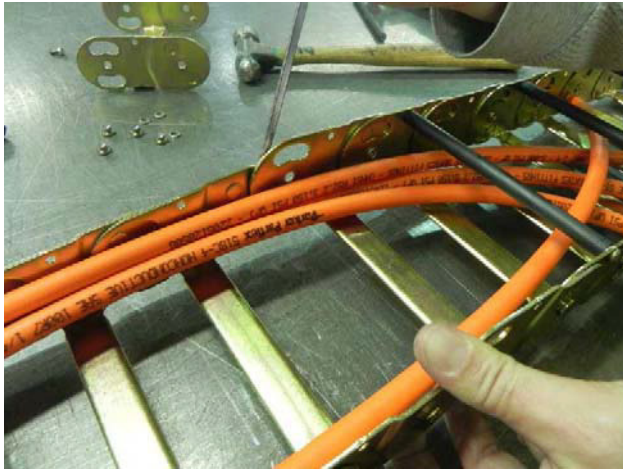


Installing a New Link

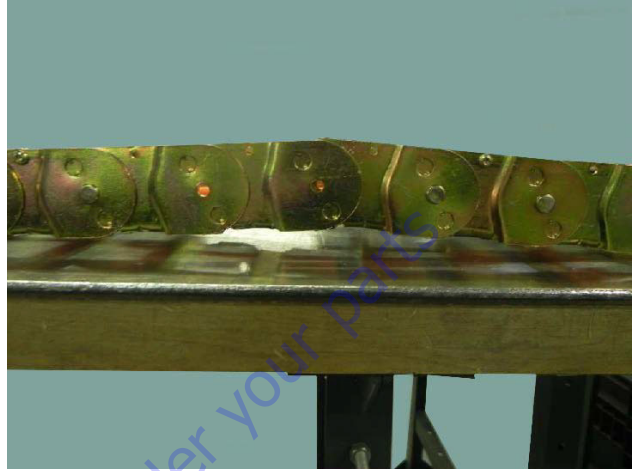
1. Squeeze the peanut cut out end of the new link into the half-shear (female) end of the track section.



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.



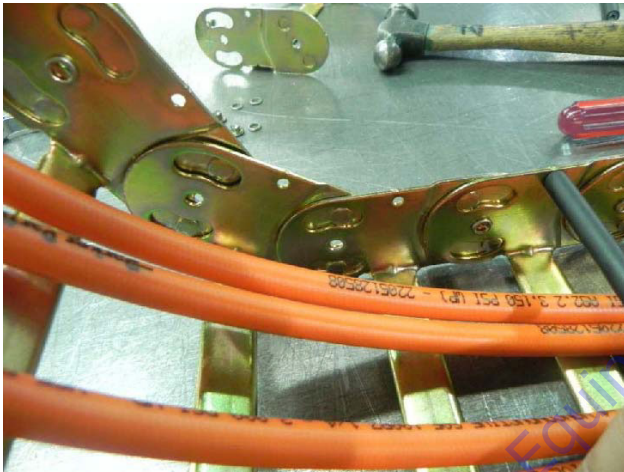
3. After the new link is installed in the powertrack the round half-shears will not fit properly in the peanut cut-outs yet.



4. Pull the moving end out over the track so that the new connection is positioned in the curve of the powertrack.

SECTION 4 - BOOM & PLATFORM

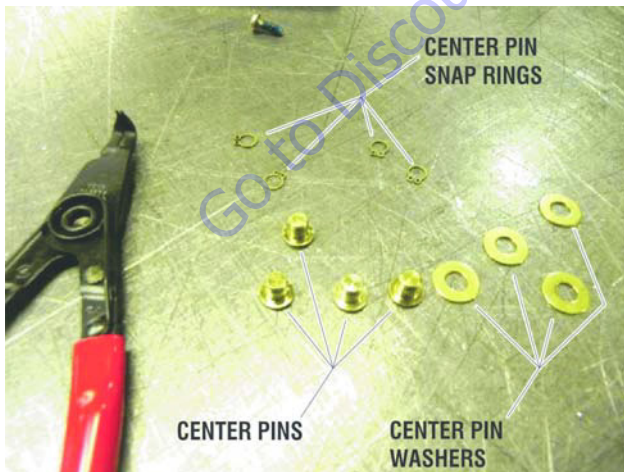
In this position the round half-shears will rotate into the peanut cut outs.



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



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



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.

SECTION 4 - BOOM & PLATFORM

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.



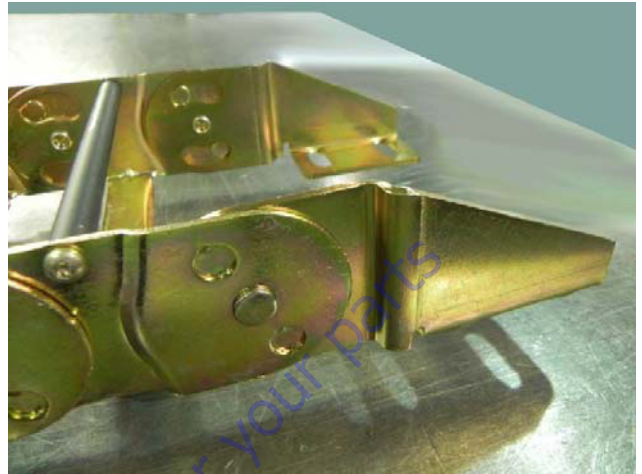
10. Install a new 8-32 x 0.500 self threading screw on the other side.



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.



SECTION 4 - BOOM & PLATFORM

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



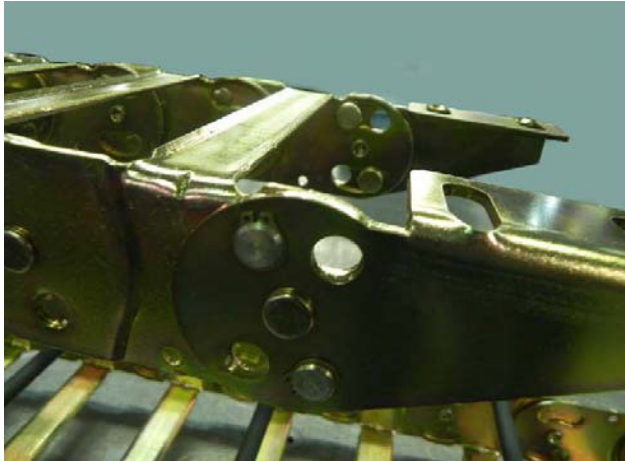
NOTE: When installing snap rings make sure they are seated in pin groove and closed properly.



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



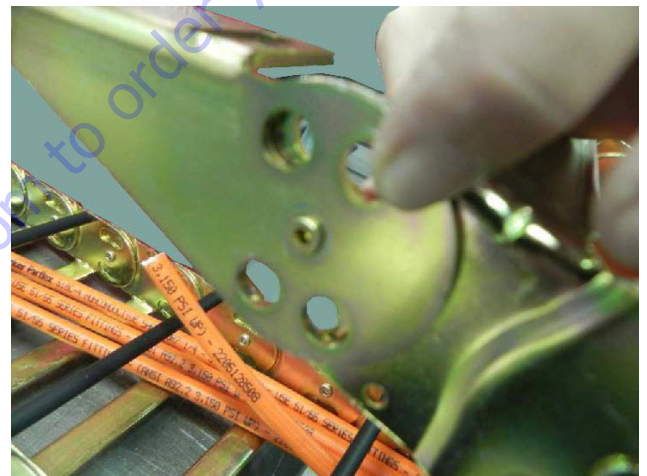
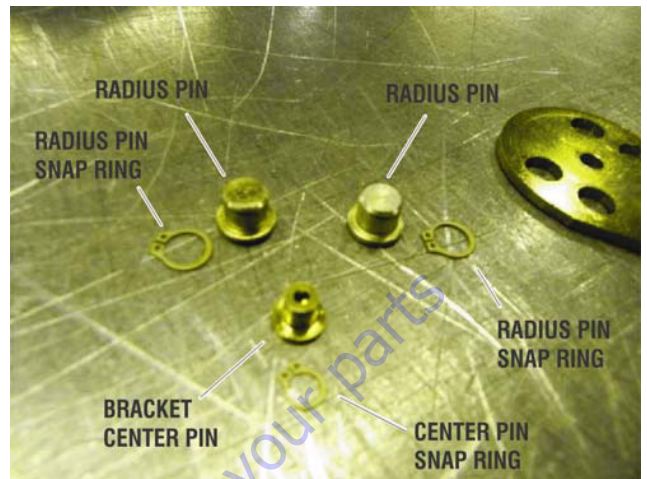
Replacing Moving End Brackets



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.

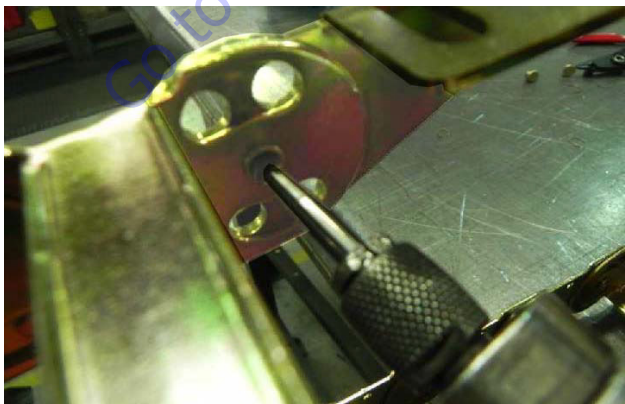


2. Take new bracket and install center pin with snap ring.



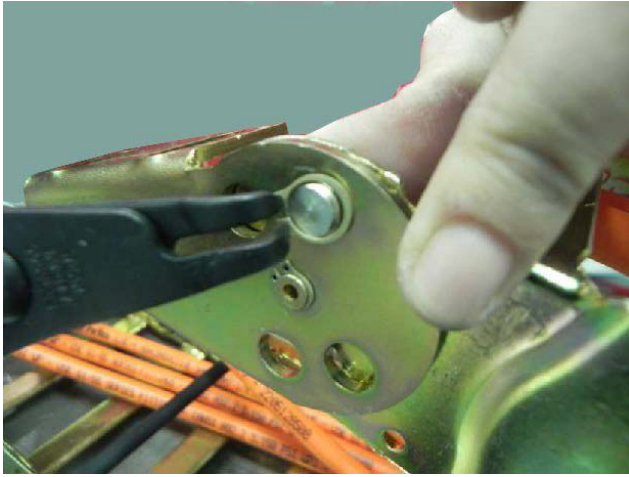
NOTICE

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.



SECTION 4 - BOOM & PLATFORM

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.

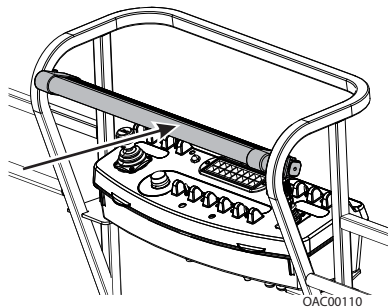


4.13 SKYGUARD

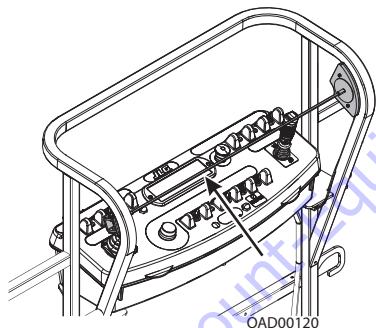
Operation

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.

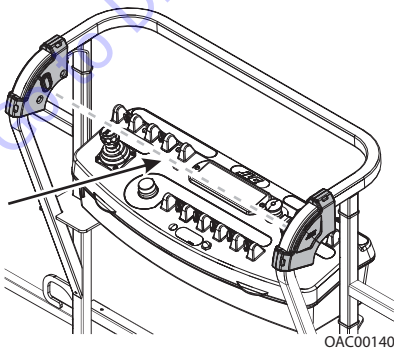
Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



SkyGuard



SkyGuard SkyLine™



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 system is installed on the machine, but no option is 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 6-17 for more fault code information

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

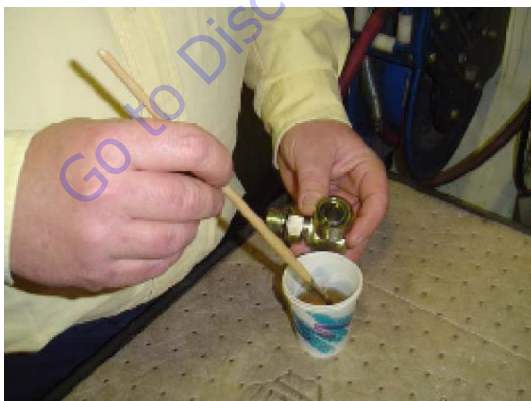
Cup and Brush

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

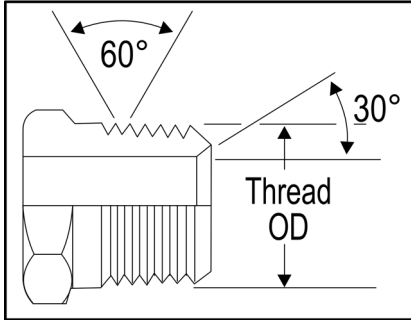


Figure 5-1. NPTF Thread

BSPT = British standard pipe tapered per ISO7-1

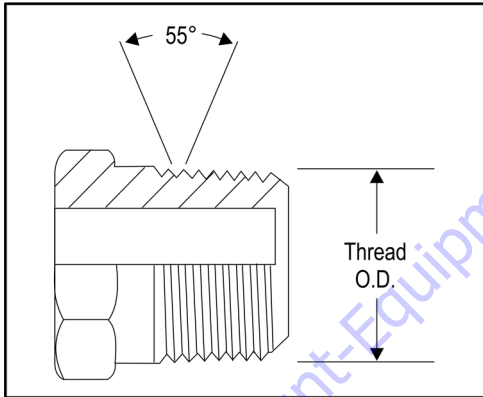


Figure 5-2. BSPT Thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

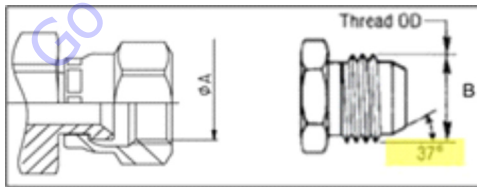


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

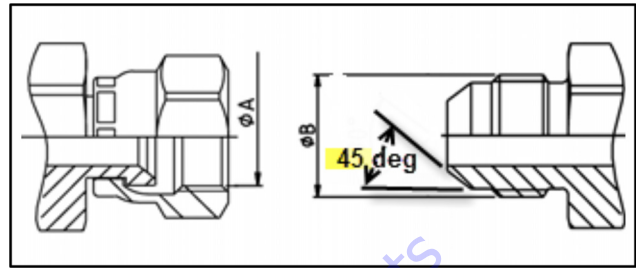


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

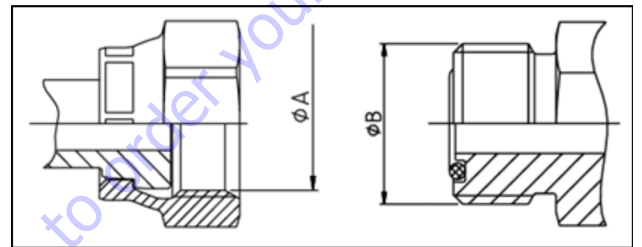


Figure 5-5. ORFS Thread

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

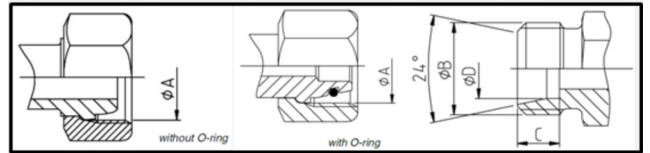


Figure 5-6. MTBL-MBTS Thread

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

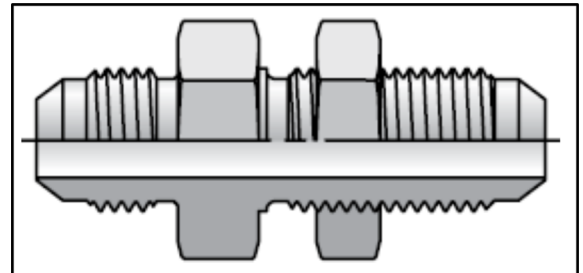


Figure 5-7. Bulkhead Thread

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

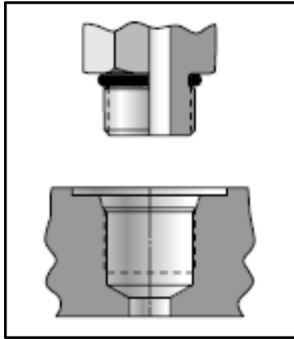


Figure 5-8. ORB-MPP Thread

MFF = metric flat face port per ISO 9974-1

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

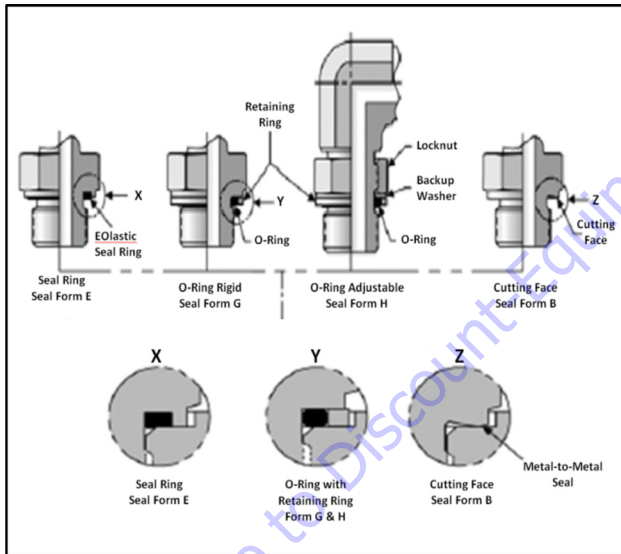


Figure 5-9. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

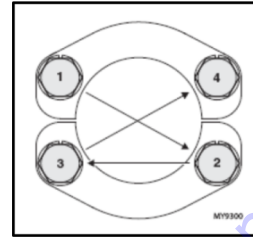


Figure 5-10. FL61-FL62

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.

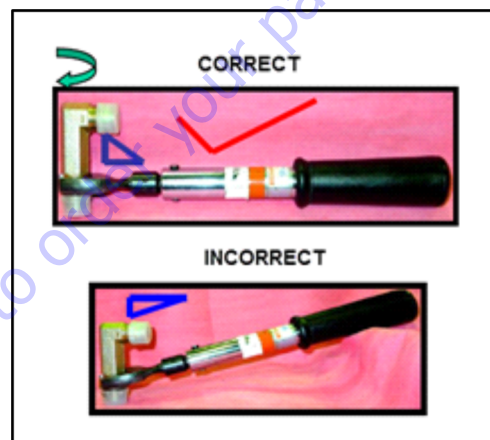


Figure 5-11. Torque Wrench Angle

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 Loctite 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.

MENT. 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.

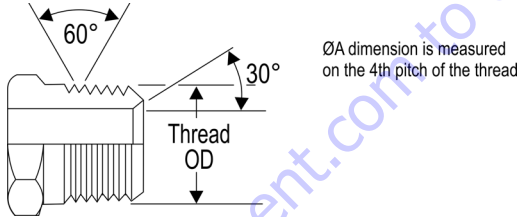
NOTE: TFFT values provided in Table 5-1, NPTF Pipe Thread are applicable for the following material configurations:

- a. STEEL fittings with STEEL mating components.
- b. STEEL fittings with ALUMINUM or BRASS mating components.
- c. ALUMINUM or BRASS fittings with STEEL mating components.
- d. ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

⚠ 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 ALIGN-

Table 5-1. NPTF Pipe Thread



TYPE/FITTING IDENTIFICATION					
Material	Dash Size	Thread Size (UNF)	ØA*		Turns From Finger Tight (TFFT)**
			(in)	(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 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 Loctite 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 ALIGN-

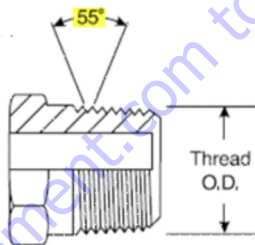
MENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

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:

- a. STEEL fittings with STEEL mating components.
- b. STEEL fittings with ALUMINUM or BRASS mating components.
- c. ALUMINUM or BRASS fittings with STEEL mating components.
- d. 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	ØA*		
		(BSPT)	(in)	(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 FFWR and TFFT Methods 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.

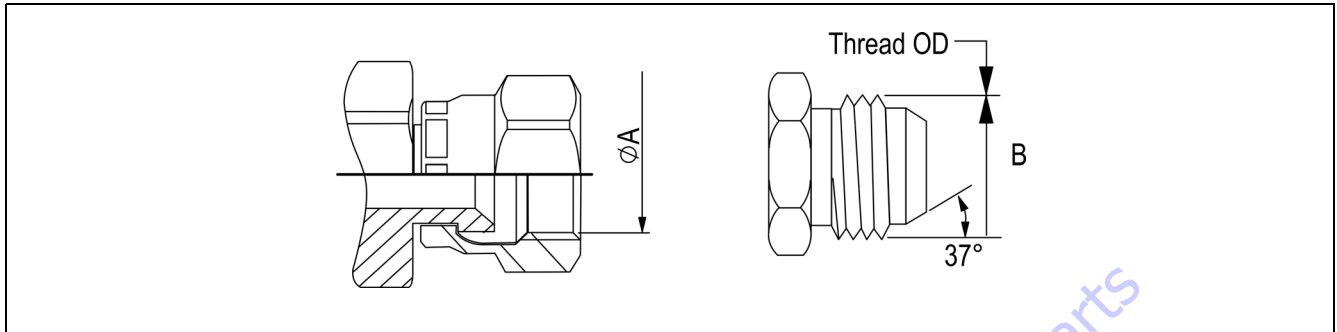
3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC) Thread - Steel or Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

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:

- a. STEEL fittings with ALUMINUM or BRASS mating components.
- b. ALUMINUM or BRASS fittings with STEEL mating components.
- c. ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

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



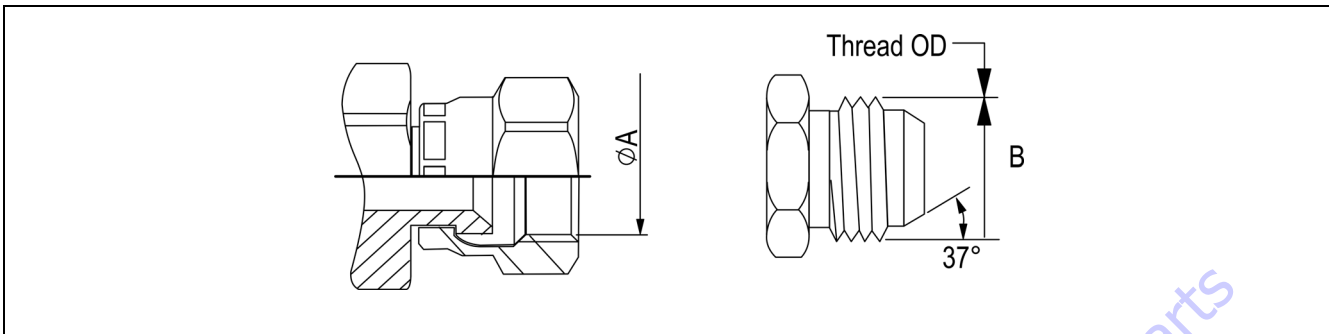
TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
			(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8	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	1 3/16-12	1.11	28.30	1.19	30.10	100	105	110	136	142	149	1 to 1-1/2
	16	1 5/16-12	1.23	31.30	1.31	33.30	118	124	130	160	168	176	3/4 to 1
	20	1 5/8-12	1.54	39.20	1.63	41.30	168	176	185	228	239	251	3/4 to 1
	24	1 7/8-12	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 FFWR and TFFT Methods for FFWR procedure requirements.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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	
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.

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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.

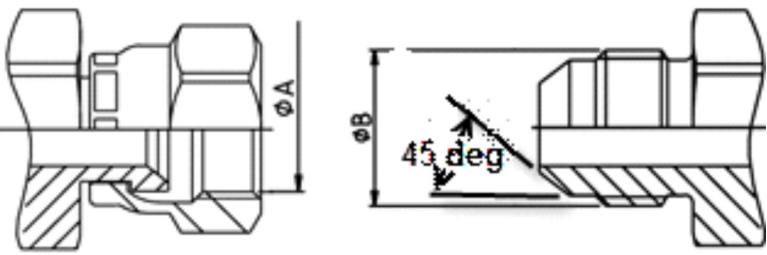
4. Torque fitting to value listed in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass while using the Double Wrench Method outlined in this section. Refer to FFWR and TFFT Methods for procedure requirements if using the TFFT method.

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:

- a. STEEL fittings with ALUMINUM or BRASS mating components.
- b. ALUMINUM or BRASS fittings with STEEL mating components.
- c. ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

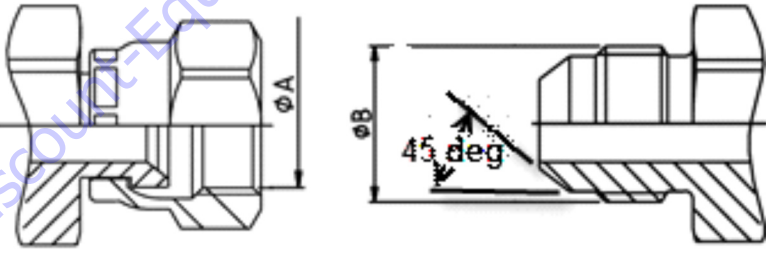
Table 5-5. 45° Flare (SAE) - Steel



TYPE/FITTING IDENTIFICATION							Torque						Turns From Finger Tight (TFFT)**
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	1/4 to 1/2
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33	1/4 to 1/2
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62	1/4 to 1/2
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89	1/4 to 1/2
	12	1 1/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125	1/4 to 1/2

* ØA and ØB thread dimensions for reference only.
 ** See FFWR and TFFT Methods for TFFT procedure requirements.

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



TYPE/FITTING IDENTIFICATION							Torque						Turns From Finger Tight (TFFT)**
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	1/4 to 1/2
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20	1/4 to 1/2
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41	1/4 to 1/2
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58	1/4 to 1/2
	12	1 1/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83	1/4 to 1/2

* 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.

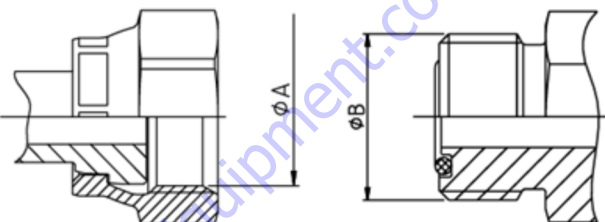
5. Torque nut to value listed in Table 5-7, O-ring Face Seal (ORFS) - Steel or Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass while using the Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

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:

- a. STEEL fittings with ALUMINUM or BRASS mating components.
- b. ALUMINUM or BRASS fittings with STEEL mating components.
- c. ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

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

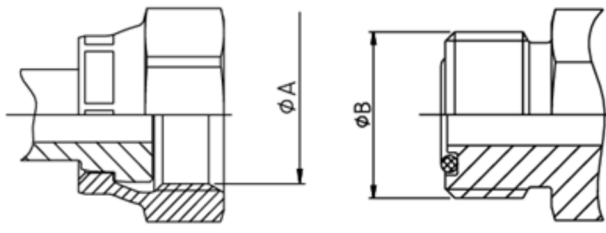


TYPE/FITTING IDENTIFICATION							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	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	13/16-12	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	17/16-12	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 1/16-12	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*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
			(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
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.

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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.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque						Flats from Wrench Resistance (F.F.W.R)**			
		(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	[Ft-Lb]			[N-m]						
								Min	Nom	Max	Min	Nom	Max				
STEEL FITTINGS WITH STEEL MATING COMPONENTS	DIN 24° CONE FLARELESS BITE (MBTL) FITTING	6	M12x1.5	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	M14x1.5	12.50	14.00	7.00	8.20							1.5 to 1.75			
		10	M16x1.5	14.50	16.00	7.00	10.20							1.5 to 1.75			
		12	M18x1.5	16.50	18.00	7.00	12.20							1.5 to 1.75			
		15	M22x1.5	20.50	22.00	7.00	15.20							1.5 to 1.75			
		18	M26x1.5	24.50	26.00	7.50	18.20							1.5 to 1.75			
		22	M30x2	27.90	30.00	7.50	22.20							1.5 to 1.75			
		28	M36x2	33.90	36.00	7.50	28.20							1.5 to 1.75			
		35	M45x2	42.90	45.00	10.50	35.30							1.5 to 1.75			
	42	M52x2	49.90	52.00	11.00	42.30	1.5 to 1.75										
	DIN 24° CONE FLARELESS BITE (MBTS) FITTING	TYPE	Tube O.D.	Thread M Size	ØA*	ØB*	C*	ØD*	Torque						Flats from Wrench Resistance (F.F.W.R)**		
			(mm)	(Metric)	(mm)	(mm)	(mm)	(mm)	[Ft-Lb]			[N-m]					
									Min	Nom	Max	Min	Nom	Max			
					6	M14x1.5	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	M16x1.5	14.50	16.00	7.00	8.20							1.5 to 1.75
					10	M18x1.5	16.50	18.00	7.50	10.20							1.5 to 1.75
					12	M20x1.5	18.50	20.00	7.50	12.20							1.5 to 1.75
					14	M22x1.5	20.50	22.00	8.00	14.20							1.5 to 1.75
16					M24x1.5	22.50	24.00	8.50	16.20	1.5 to 1.75							
20	M30x2	27.90			30.00	10.50	20.20	1.5 to 1.75									
25	M36x2	33.90			36.00	12.00	25.20	1.5 to 1.75									
30	M42x2	39.90			42.00	13.50	30.20	1.5 to 1.75									
38	M52x2	49.90	52.00	16.00	38.30	1.5 to 1.75											

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

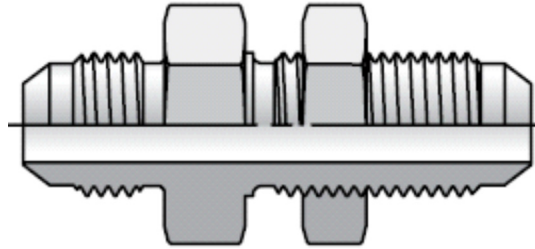
** See FFWR and TFFT Methods for FFWR procedure requirements.

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, Bulkhead Fittings (BH) - INCH and Table 5-11, Bulkhead Fittings (BH) - METRIC while using the Double Wrench Method.

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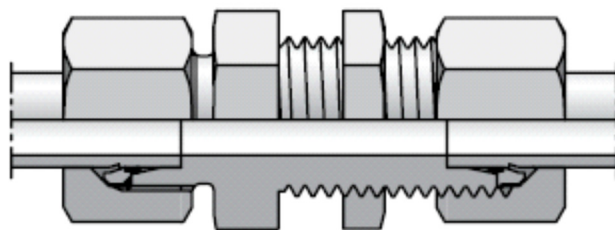
Table 5-10. Bulkhead Fittings (BH) - INCH



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	13/16-12	135	142	149	183	193	202	
		14	15/16-12	170	179	187	230	243	254	
		16	17/16-12	200	210	220	271	285	298	
		20	111/16-12	245	258	270	332	350	366	
	24	2-12	270	284	297	366	385	403		
	37° FLARE (JIC) BULKHEAD FITTING	TYPE	Dash Size	Thread Size	Torque					
					[Ft-Lb]			[N-m]		
		(UNF)	Min	Nom	Max	Min	Nom	Max		
		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	11/16-12	135	142	149	183	193	202	
		14	13/16-12	170	179	187	230	243	254	
		16	15/16-12	200	210	220	271	285	298	
		20	15/8-12	245	258	270	332	350	366	
24		17/8-12	270	284	297	366	385	403		
32	2 1/2-12	310	326	341	420	442	462			

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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	M12x1.5	14	15	16	19	20	22
		8	M14x1.5	17	18	19	23	24	26
		10	M16x1.5	22	23	24	30	31	33
		12	M18x1.5	35	37	39	47	50	53
		15	M22x1.5	44	47	50	60	64	68
		18	M26x1.5	70	75	80	95	102	108
		22	M30x2	115	120	125	156	163	169
		28	M36x2	150	157	164	203	213	222
		35	M45x2	155	162	169	210	220	229
		42	M52x2	220	230	240	298	312	325
	DIN 24° CONE FLARELESS BITE (MBTS) BULKHEAD FITTING	Connecting Tube O.D.	Thread M Size	Torque					
		(mm)	(metric)	[Ft-Lb]			[N-m]		
				Min	Nom	Max	Min	Nom	Max
		6	M14x1.5	17	15	16	23	20	22
		8	M16x1.5	22	18	19	30	24	26
		10	M18x1.5	35	23	24	47	31	33
		12	M20x1.5	40	35	37	54	47	50
		14	M22x1.5	44	47	50	60	64	68
		16	M24x1.5	70	75	80	95	102	108
		20	M30x2	115	120	125	156	163	169
25	M36x2	150	157	164	203	213	222		
30	M42x2	155	162	169	210	220	229		
38	M52x2	220	230	240	298	312	325		

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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 Tables 5-17, O-RING BOSS (ORB) while using the Double Wrench Method.

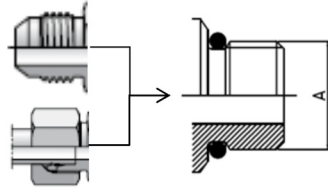
NOTE: *The table headings identify the straight thread O-ring port and the type on the other side of the fitting. The torque will be applied to the straight thread O-ring port.*

NOTE: *Torque values provided in Table 5-12 thru Table 5-17, O-RING BOSS (ORB) are segregated based on the material configuration of the connection.*

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

- a. STEEL fittings with ALUMINUM or BRASS mating components.
 - b. ALUMINUM or BRASS fittings with STEEL mating components.
 - c. 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 counter bore of the port.

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



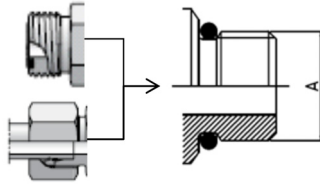
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	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					
					Ft-Lb or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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

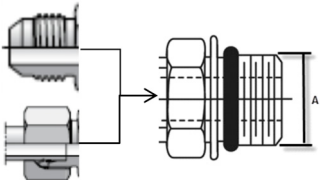


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	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	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					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					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	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 5-14. O-ring Boss (ORB) - Table 3 of 6



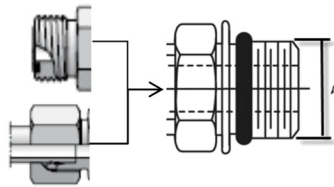
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	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					
					Ft-Lb or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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					
					Ft-Lb or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	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	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 (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
					(UNF)	(in)	(mm)	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	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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



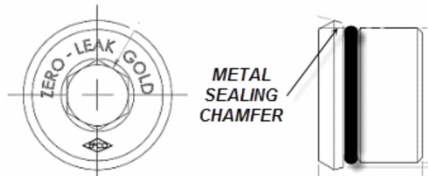
TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
			(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(30)	(32)	(33)	3	4	4
	3	3/8-24	0.37	9.52	(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	2 1/2-12	2.50	63.50	375	394	413	510	534	560	
TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
					Ft-Lb or (in-lb)			[N-m]		
			(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom
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	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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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 (UNF)	ØA*		Torque**					
			(in)	(mm)	Ft-Lb or (in-lb)			[N-m]		
					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	1 1/16-12	1.06	27.00	51	54	57	69	73	77
	14	1 3/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	1 5/16-12	1.31	33.30						
	20	1 5/8-12	1.63	41.30						
	24	1 7/8-12	1.87	47.60						
32	2 1/2-12	2.50	63.50							
TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size (UNF)	ØA*		Torque**					
			(in)	(mm)	Ft-Lb or (in-lb)			[N-m]		
					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	1 1/16-12	1.06	27.00	51	54	57	69	73	77
	14	1 3/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	1 5/16-12	1.31	33.30						
	20	1 5/8-12	1.63	41.30						
	24	1 7/8-12	1.87	47.60						
32	2 1/2-12	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.

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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, Metric Flat Face Port (MFF) - L Series and Table 5-21, Table 5-22, Table 5-23, Metric Flat Face Port (MFF) - S Series while using the Double Wrench Method.

NOTE: 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.

NOTE: Torque values provided in Table 5-18, Table 5-19, Table 5-20, Metric Flat Face Port (MFF) - L Series and Table 5-21, Table 5-22, and Table 5-23, Metric Flat Face Port (MFF) - S Series are segregated based on the material configuration of the connection.

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

- a. STEEL fittings with ALUMINUM or BRASS mating components.
 - b. ALUMINUM or BRASS fittings with STEEL mating components.
 - c. 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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3

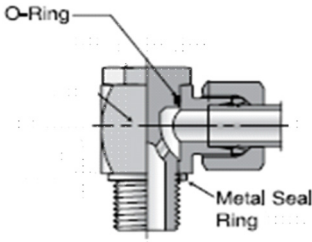
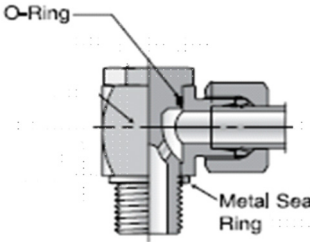
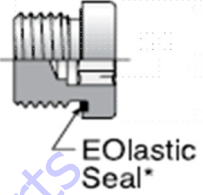
TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[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
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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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
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 (metric)	Connecting Tube O.D. (mm)	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
			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
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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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					
	(metric)	(mm)	[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
			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
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 (metric)	Connecting Tube O.D. (mm)	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
			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
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

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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	--	--	--	--	--	--
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	--	--	--	--	--	--

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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, Metric Pipe Parallel O-ring Boss (MPP) while using the Double Wrench Method.

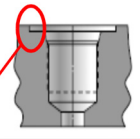
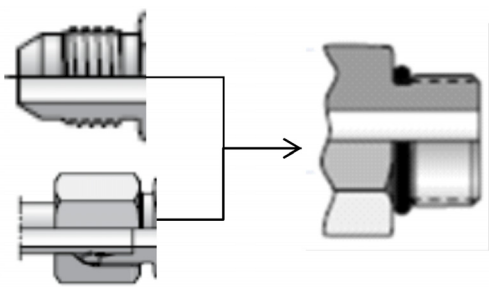
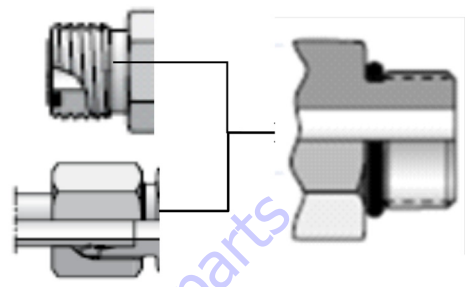
NOTE: *The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.*

NOTE: *Torque values provided in Table 5-24, Metric Pipe Parallel O-ring Boss (MPP) are segregated based on the material configuration of the connection.*

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

- a. STEEL fittings with ALUMINUM or BRASS mating components.
 - b. ALUMINUM or BRASS fittings with STEEL mating components.
 - c. 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)

 <p>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.</p>														
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, British Standard Parallel Pipe Port (BSPP) - L Series and Table 5-28, Table 5-29, Table 5-30, British Standard Parallel Pipe Port (BSPP) - S Series while using the Double Wrench Method.

NOTE: *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.*

NOTE: *Torque values provided in Table 5-25, Table 5-26, Table 5-27, British Standard Parallel Pipe Port (BSPP) - L Series and Table 5-28, Table 5-29, Table 5-30, British Standard Parallel Pipe Port (BSPP) - S Series are segregated based on the material configuration of the connection.*

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

- a. STEEL fittings with ALUMINUM or BRASS mating components.
 - b. ALUMINUM or BRASS fittings with STEEL mating components.
 - c. 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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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
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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-26. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3

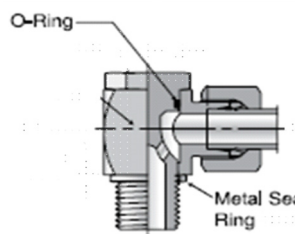
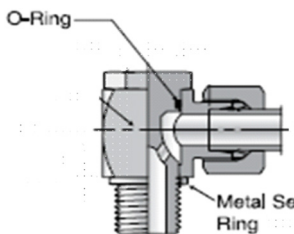
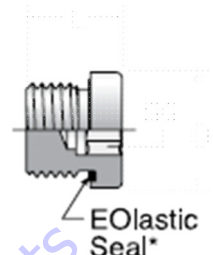
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end							
MATERIAL	BSPP Thread G Size	Connecting Tube 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	G1/8A	6	13	14	14	18	19	19	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	52	55	57	70	75	77	52	55	57	70	75	77		
	G1/2A	15	66	70	73	90	95	99	66	70	73	90	95	99		
	G1/2A	18	66	70	73	90	95	99	66	70	73	90	95	99		
	G3/4A	22	133	140	146	180	190	198	133	140	146	180	190	198		
	G1A	28	229	241	252	310	327	342	229	241	252	310	327	342		
	G1-1/4A	35	332	349	365	450	473	495	332	349	365	450	473	495		
	G1-1/2A	42	398	418	438	540	567	594	398	418	438	540	567	594		
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	8	9	9	11	12	12	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	34	36	37	46	49	50	34	36	37	46	49	50		
	G1/2A	15	43	45	47	58	61	64	43	45	47	58	61	64		
	G1/2A	18	43	45	47	58	61	64	43	45	47	58	61	64		
	G3/4A	22	86	91	95	117	123	129	86	91	95	117	123	129		
	G1A	28	149	157	164	202	213	222	149	157	164	202	213	222		
	G1-1/4A	35	216	227	237	293	308	321	216	227	237	293	308	321		
	G1-1/2A	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		
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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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
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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-29. British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3

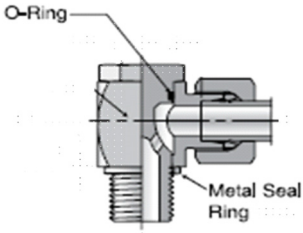
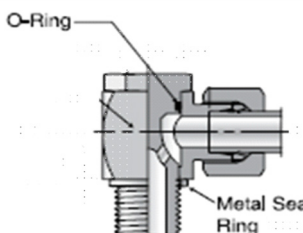
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting 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
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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

Table 5-30. British Standard Parallel Pipe Port (BSPP) - 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						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]		
			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							
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							

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.

* Typical for JLG Straight Male Stud Fittings.

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings.

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**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 O-ring Installation (Replacement) 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 5-31, Flange Code (FL61 & FL62) - Inch Fasteners and Table 5-32, Flange Code (FL61 & FL62) - Metric Fasteners.

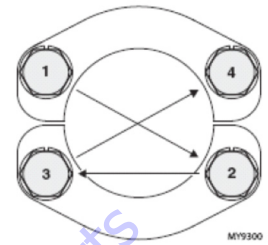
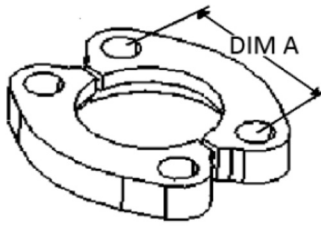
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SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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					
		(in)	(mm)	(in)	(mm)		[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
							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	
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.



M19300

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

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 (Metric)	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
		(in)	(mm)	(in)	(mm)		[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
							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	M8x1.25	18	19	19	24	25	26	18	19	19	24	25	26
	16	1.00	25	2.06	52.32	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	20	1.25	32	2.31	58.67	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	24	1.50	38	2.75	69.85	M10x1.5	37	39	41	50	53	55	37	39	41	50	53	55
	32	2.00	51	3.06	77.72	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	40	2.50	64	3.50	88.90	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	48	3.00	76	4.19	106.43	M12x1.75	68	71	75	92	97	101	68	71	75	92	97	101
	56	3.50	89	4.75	120.65	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
	64	4.00	102	5.13	130.30	M16x2	155	163	170	210	221	231	155	163	170	210	221	231
80	5.00	127	6.00	152.40	M16x2	155	163	170	210	221	231	155	163	170	210	221	231	
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	M8x1.25	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	M10x1.5	--	--	--	--	--	--	52	54	57	70	74	77
	16	1.00	25	2.25	57.15	M12x1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M12x1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M14x2	--	--	--	--	--	--	133	139	146	180	189	198
	24	1.50	38	3.12	79.25	M16x2	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	M20x2.5	--	--	--	--	--	--	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.

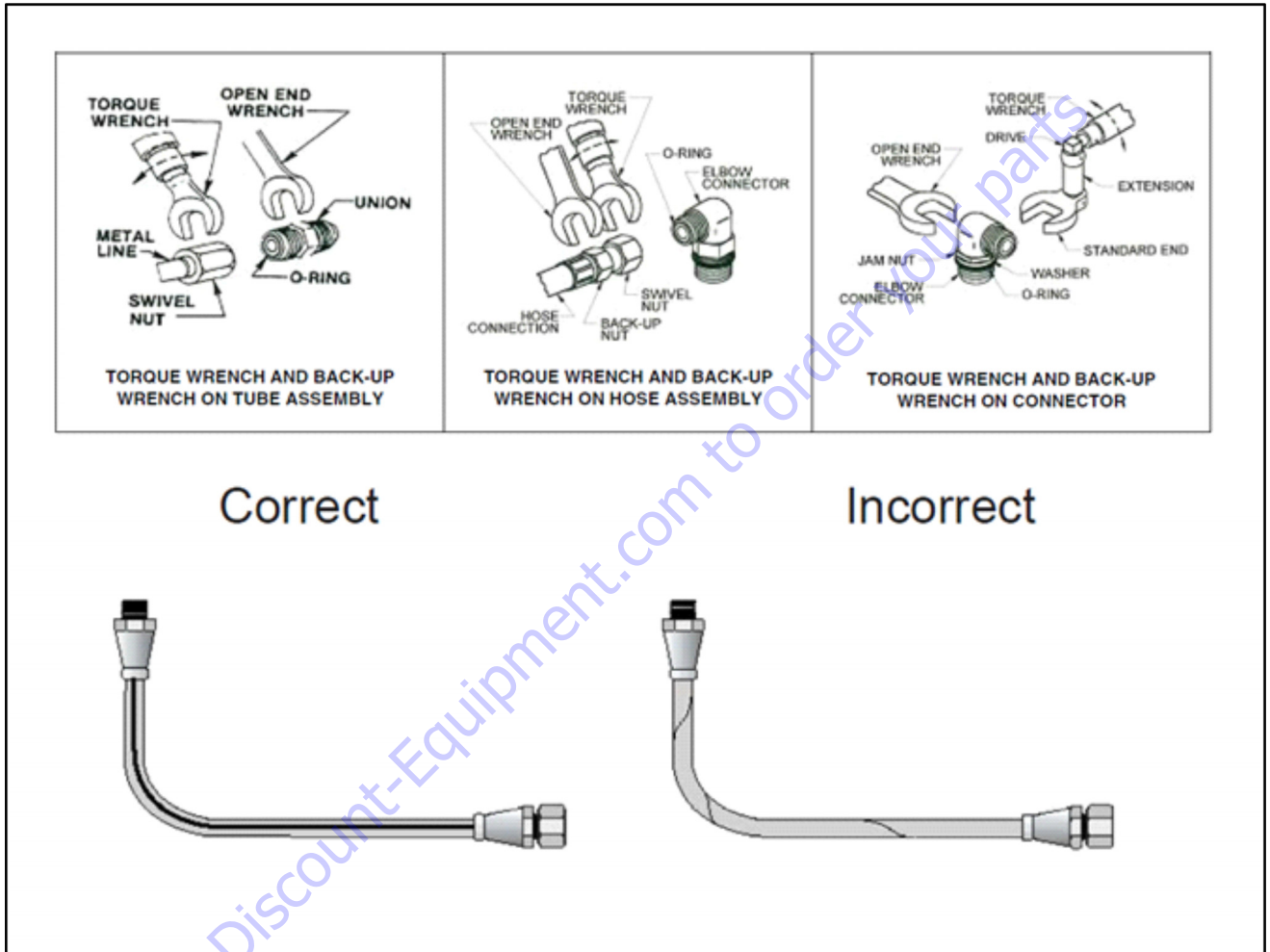


Figure 5-12. Double Wrench Method

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, 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.

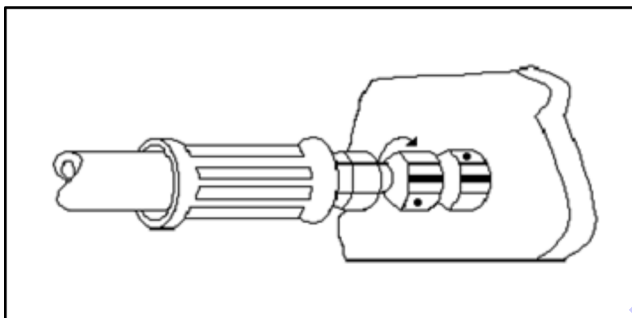


Figure 5-13. FFWR Method

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, 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.

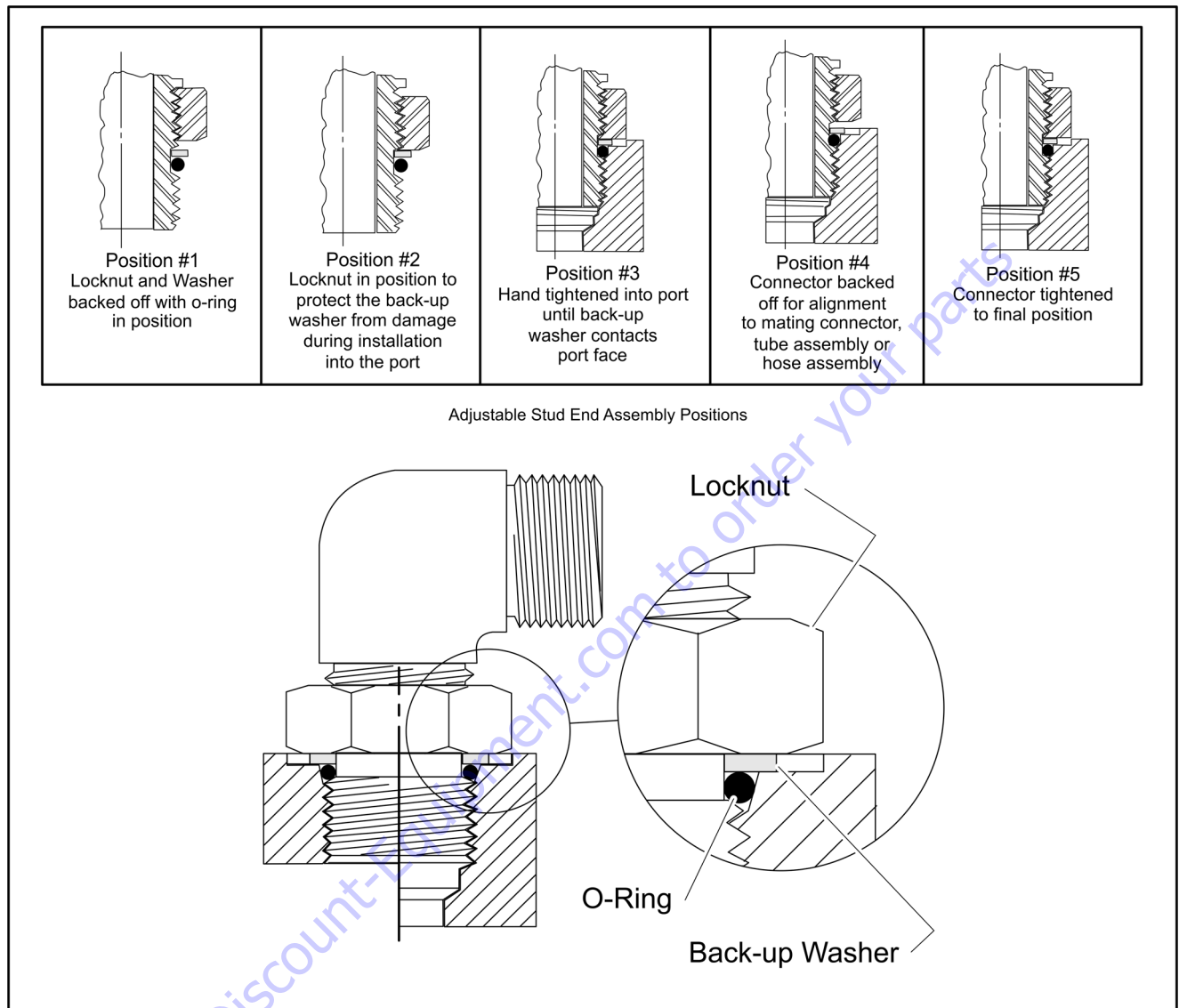


Figure 5-14. Adjustable Stud End Assembly

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 (Slave) Cylinder (E450Aonly)

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 counterbalance valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

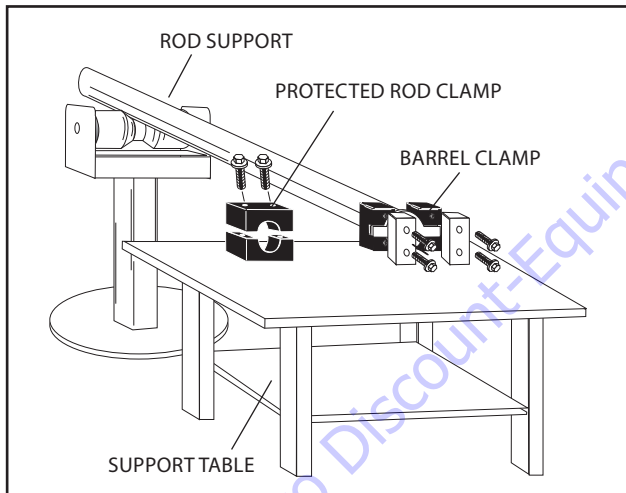


Figure 5-15. Cylinder Barrel Support

5. Using a 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.

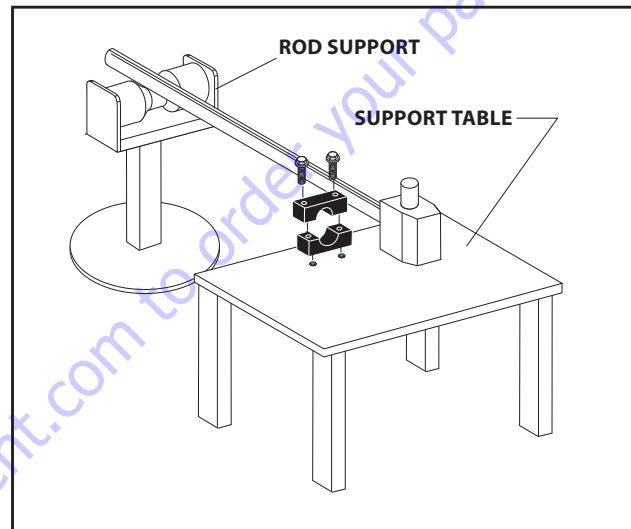
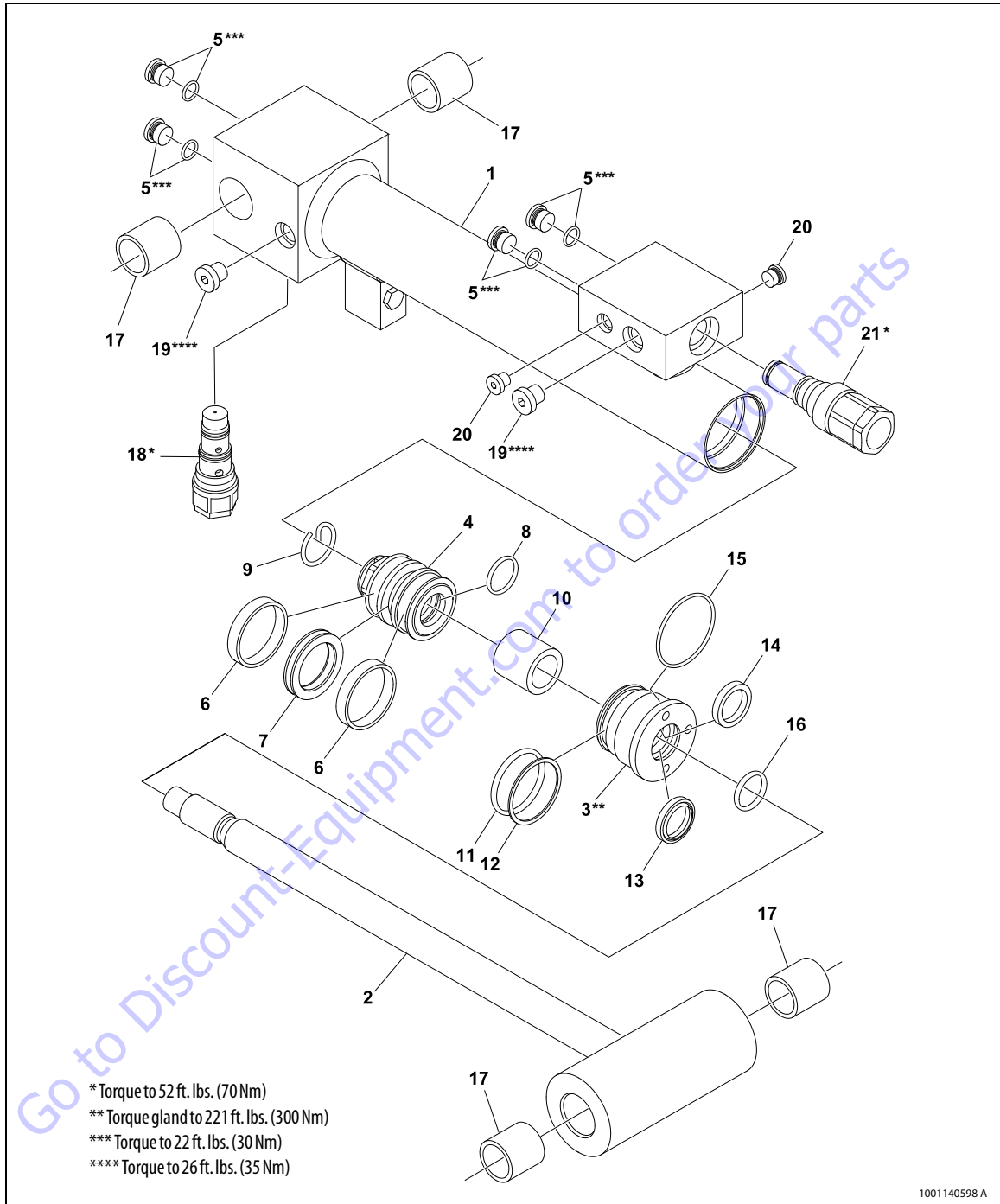


Figure 5-16. Cylinder Rod Support



- | | | | | |
|-----------|----------------|-----------------|--------------|--------------------------|
| 1. Barrel | 6. Wear Ring | 10. Spacer | 14. Rod Seal | 18. Counterbalance Valve |
| 2. Rod | 7. Piston Seal | 11. O-ring | 15. O-ring | 19. Plug |
| 3. Head | 8. O-ring | 12. Backup Ring | 16. O-ring | 20. Plug |
| 4. Piston | 9. Retainer | 13. Wiper Seal | 17. Bushing | 21. Counterbalance Valve |
| 5. Plug | | | | |

Figure 5-17. Platform Level (Slave) Cylinder (E450A only)

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 retainer 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 o-rings, seals and wear rings.
12. Remove piston spacer from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

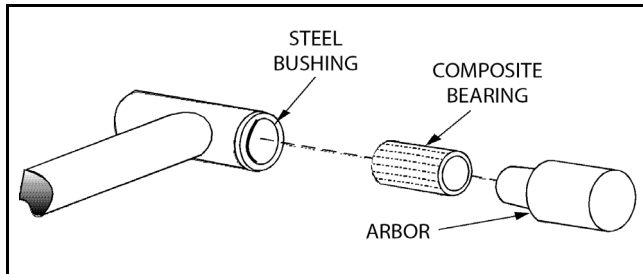


Figure 5-18. Composite Bearing Installation

12. 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 gland groove.

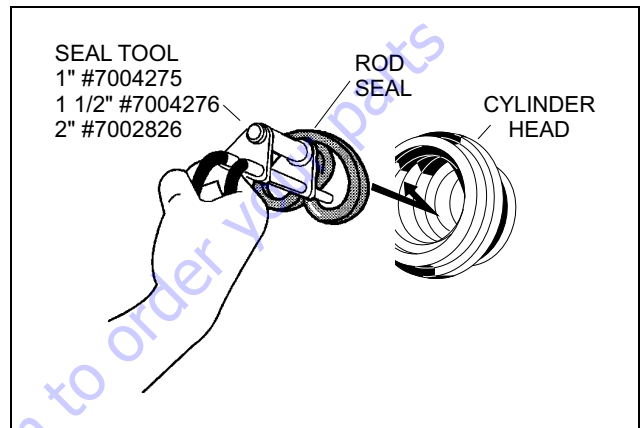


Figure 5-19. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

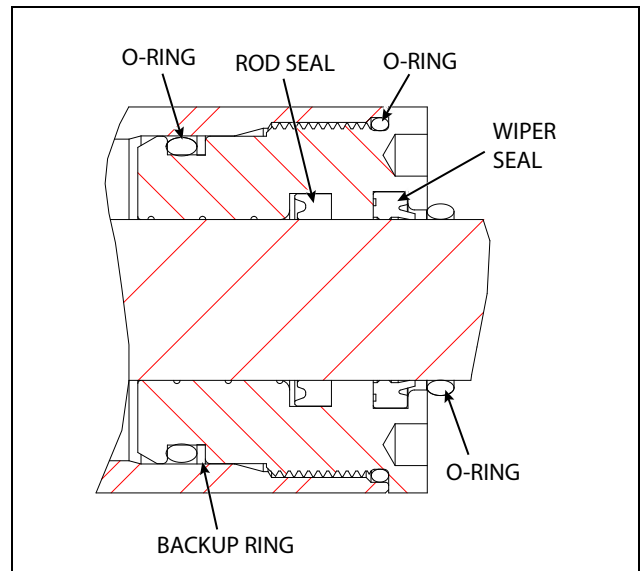


Figure 5-20. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove.

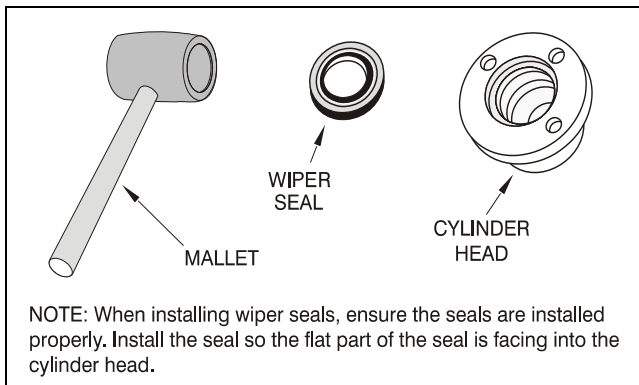


Figure 5-21. Wiper Seal Installation

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

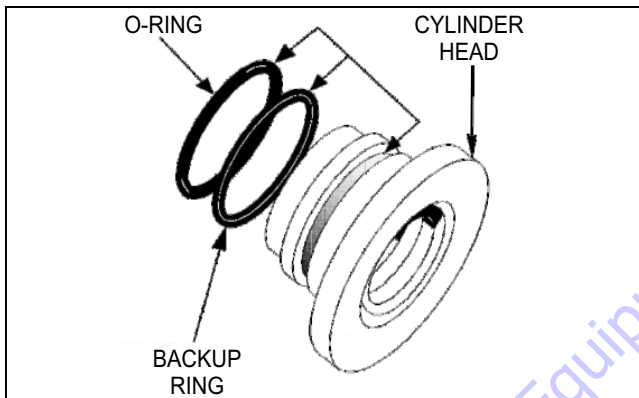


Figure 5-22. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer.
10. Remove the cylinder rod from the holding fixture.

11. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

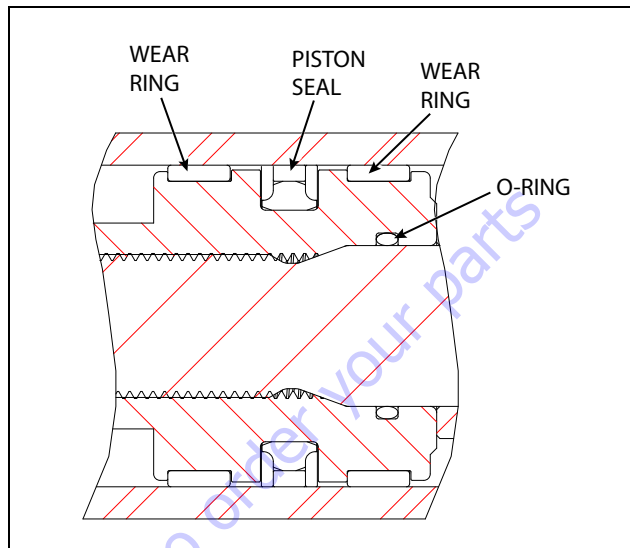


Figure 5-23. Piston Seal Kit Installation

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 ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Screw the cylinder head gland into the barrel using a spanner wrench. Torque gland to 221 ft. lbs. (300 Nm).
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.
17. Install the counterbalance valves in the rod port block. Torque to 52 ft. lbs. (70 Nm).

Platform Level (Slave) Cylinder E/M450AJ

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 counterbalance valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

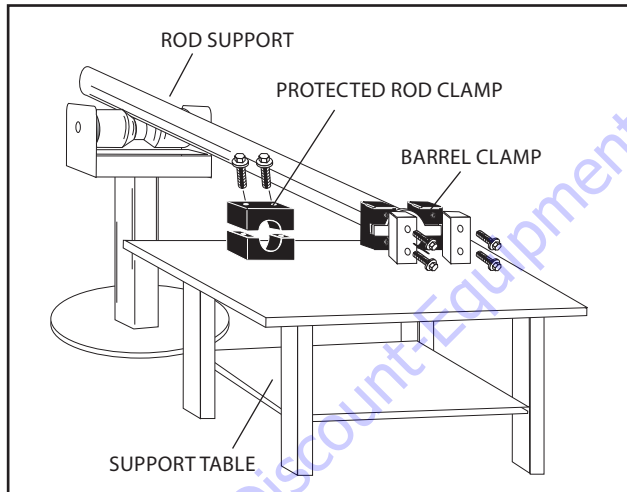


Figure 5-24. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

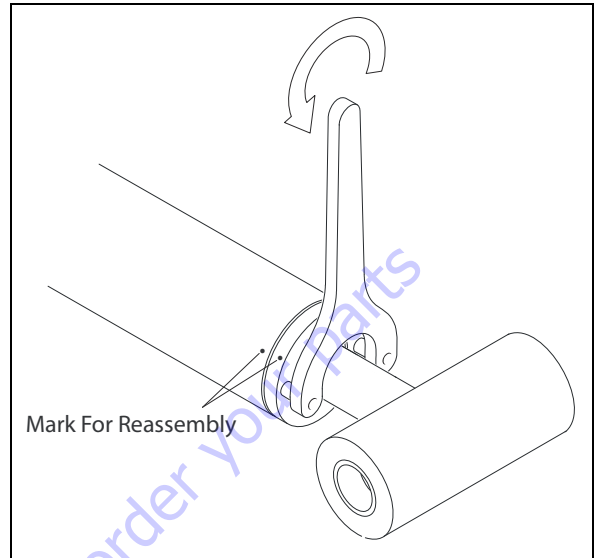


Figure 5-25. Cylinder Head Removal

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.

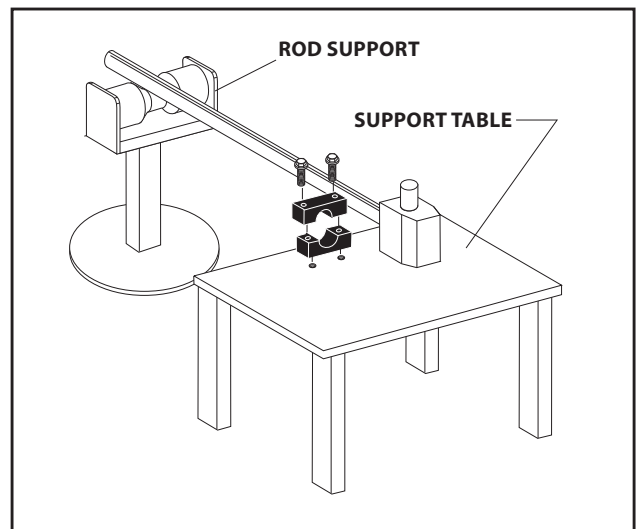
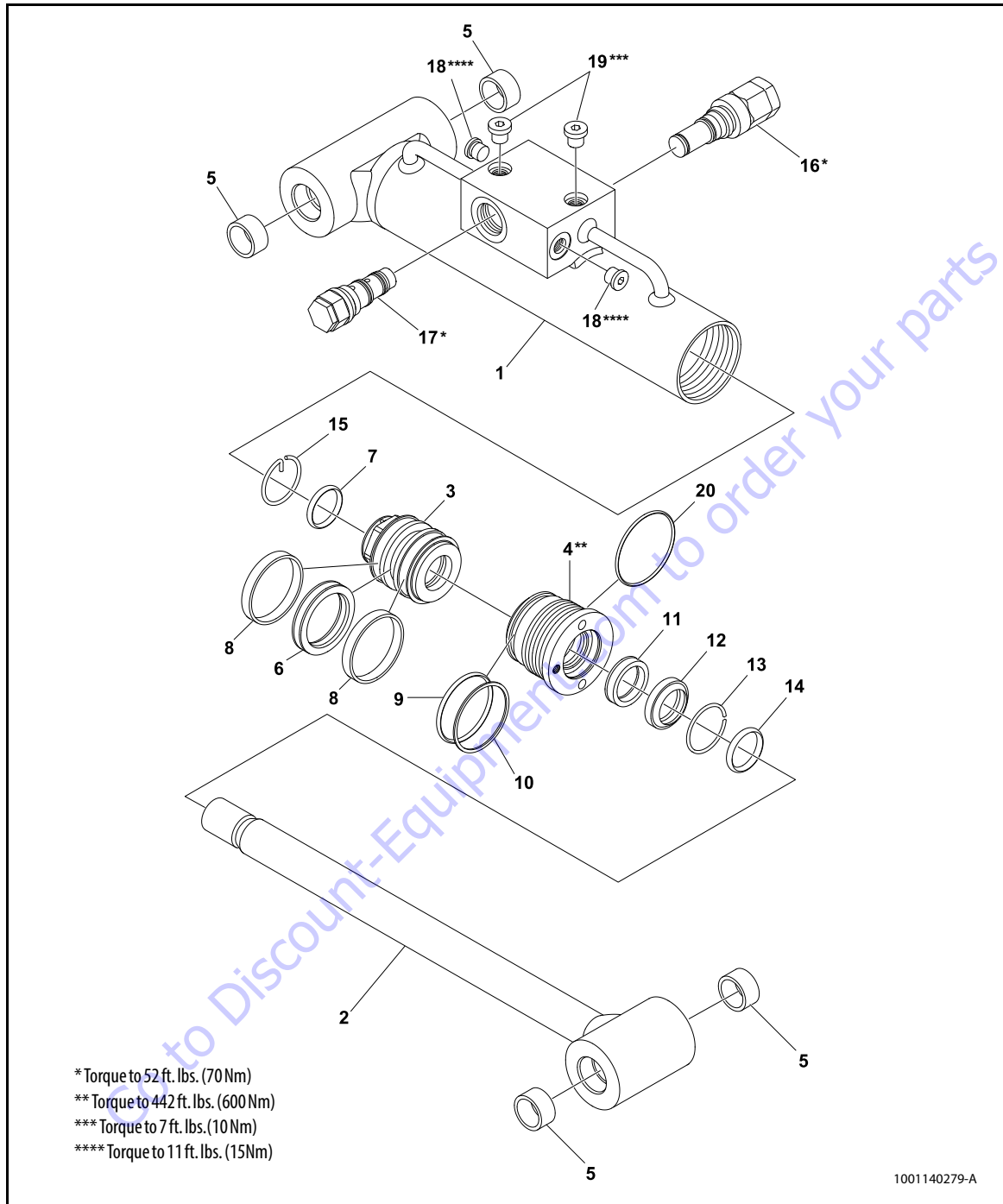
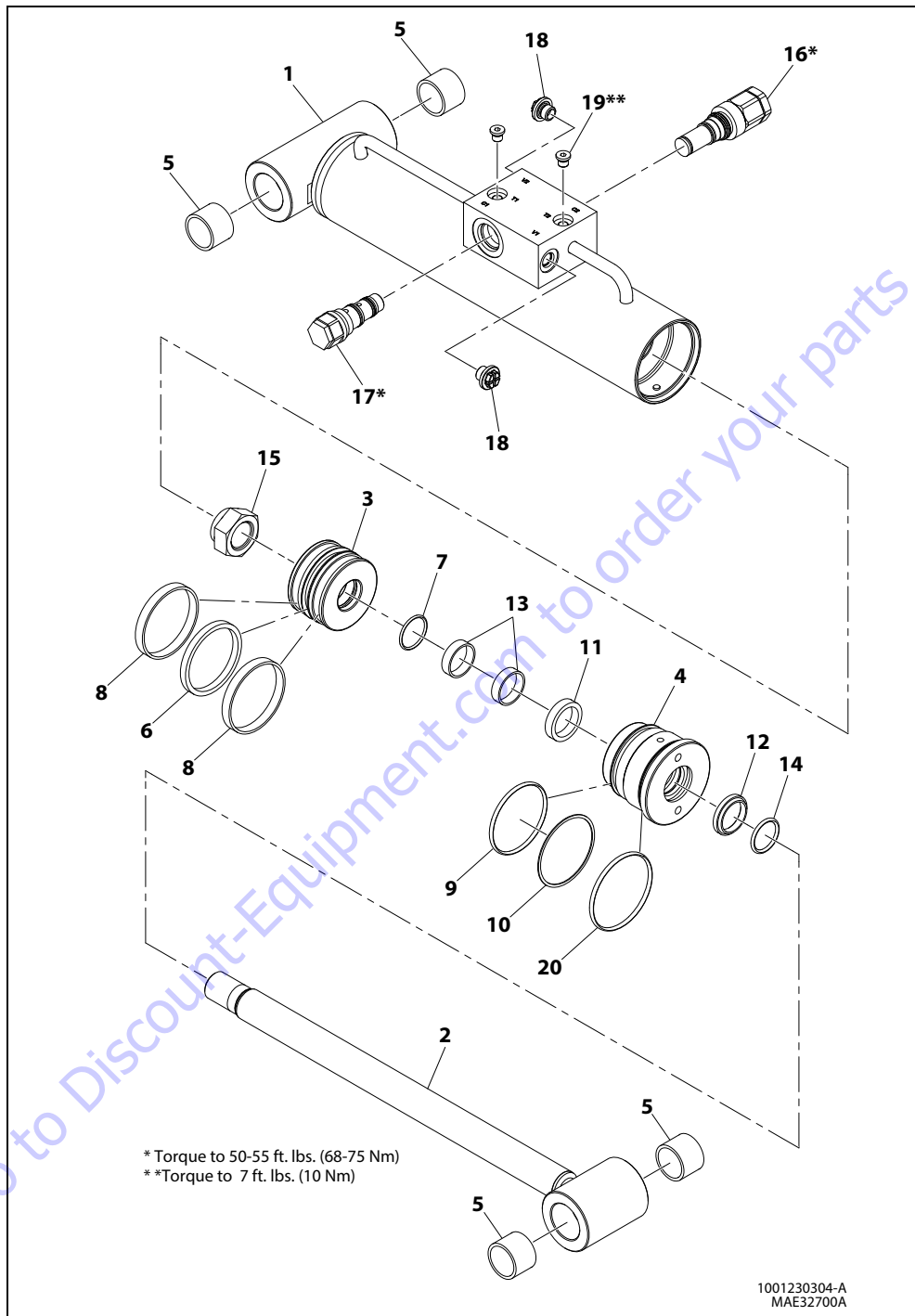


Figure 5-26. Cylinder Rod Support



- | | | | | |
|-----------|----------------|-----------------|--------------------------|--------------------------|
| 1. Barrel | 5. Bushing | 9. O-ring | 13. Retaining Ring | 17. Counterbalance Valve |
| 2. Rod | 6. Piston Seal | 10. Backup Ring | 14. O-ring | 18. Plug |
| 3. Piston | 7. O-ring | 11. Rod Seal | 15. Retainer | 19. Plug |
| 4. Head | 8. Wear Ring | 12. Wiper Seal | 16. Counterbalance Valve | 20. O-ring |

Figure 5-27. Platform Level (Slave) Cylinder - E/M450AJ (SN 0300208529 to Present, SN B300001429 through B300002486)



- | | | | |
|------------|-----------------|----------------|--------------------------|
| 1. Barrel | 6. Piston Seal | 11. Rod Seal | 16. Counterbalance Valve |
| 2. Rod | 7. O-ring | 12. Wiper Seal | 17. Counterbalance Valve |
| 3. Piston | 8. Wear Ring | 13. Wear Ring | 18. Plug |
| 4. Head | 9. O-ring | 14. O-ring | 19. Plug |
| 5. Bushing | 10. Backup Ring | 15. Locknut | 20. O-ring |

Figure 5-28. Platform Level (Slave) Cylinder - E/M450AJ (SN B300002487 to Present)

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 retainer which attach the piston to the rod. Refer Figure 5-27.
10. Loosen and remove locknut which attaches the piston to the rod. Refer Figure 5-28.
11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seals and wear rings.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

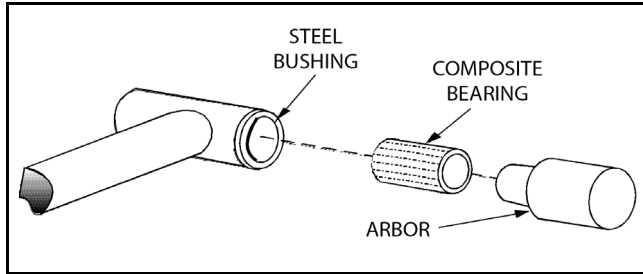


Figure 5-29. Composite Bearing Installation

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 gland groove.

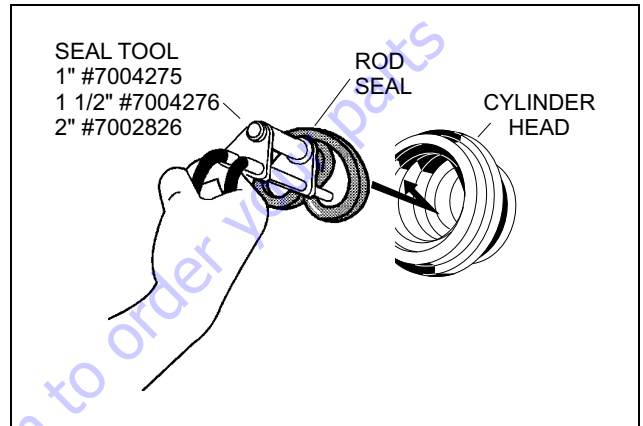


Figure 5-30. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

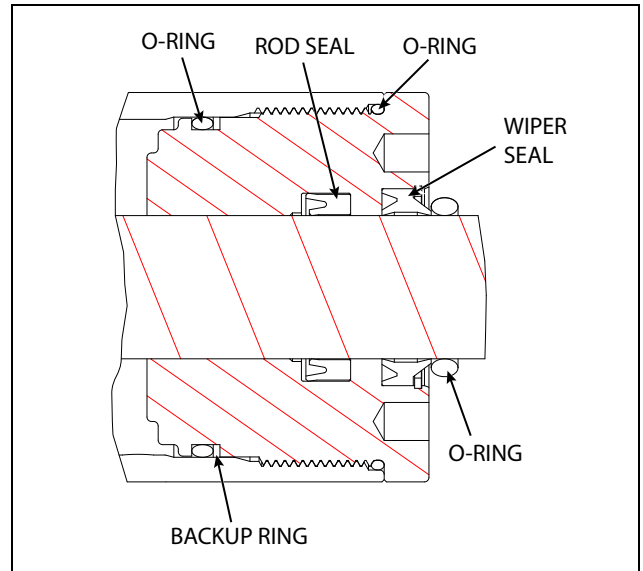


Figure 5-31. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install the new retaining ring into the applicable cylinder head gland groove.

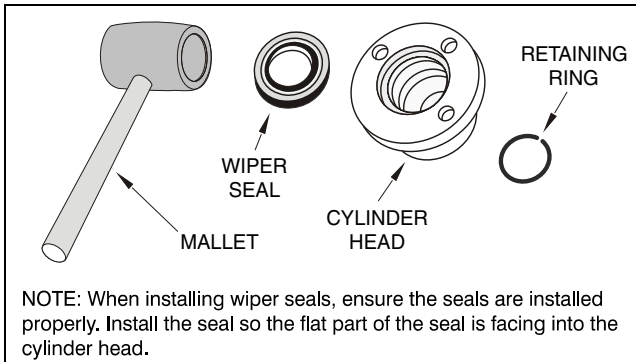


Figure 5-32. Wiper Seal Installation

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

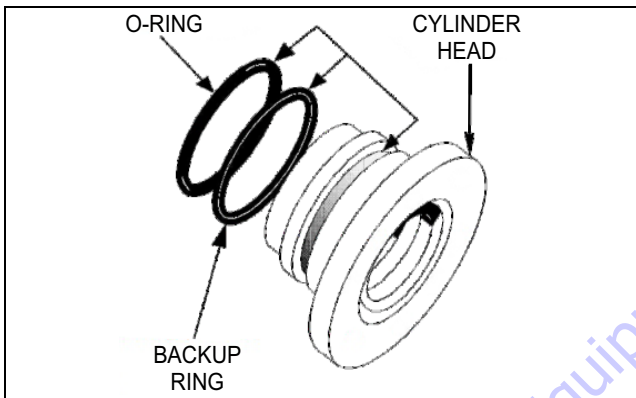


Figure 5-33. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring and backup rings 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. Thread piston onto rod until it abuts and install the retainer. Refer Figure 5-27.
9. Tread piston onto rod until it abuts and install the lock nut. Refer Figure 5-28.

10. Remove the cylinder rod from the holding fixture.
11. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

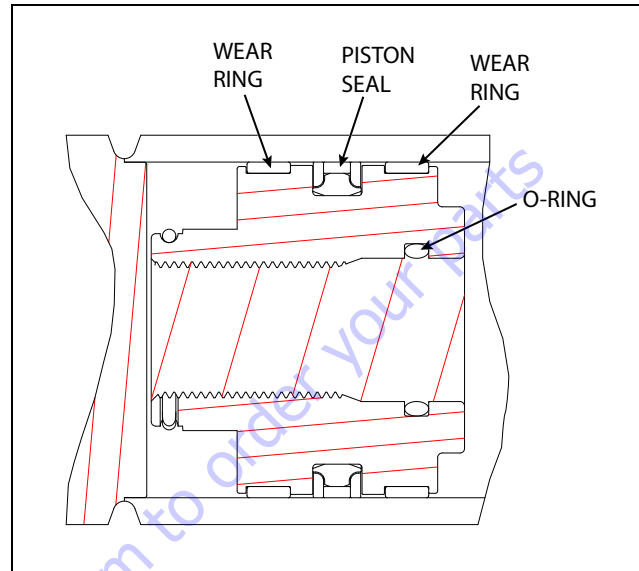


Figure 5-34. Piston Seal Kit Installation

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 ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Screw the cylinder head gland 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.
17. Install the counterbalance valves in the rod port block. Torque as shown in Figure 5-27. and Figure 5-28.

Jib Lift Cylinder (E/M 450AJ Only)

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 counterbalance valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

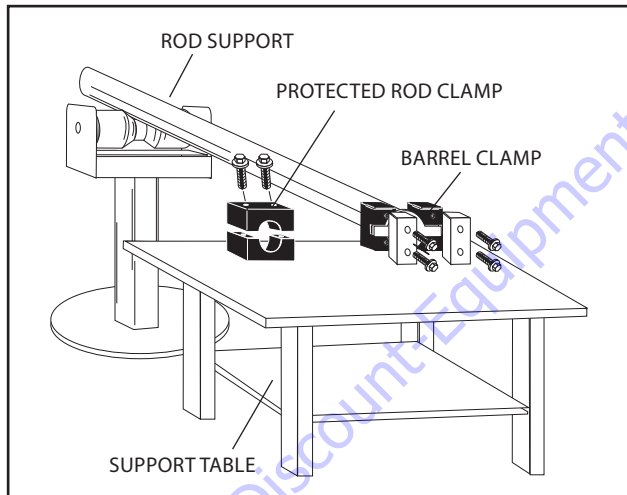


Figure 5-35. Cylinder Barrel Support

5. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

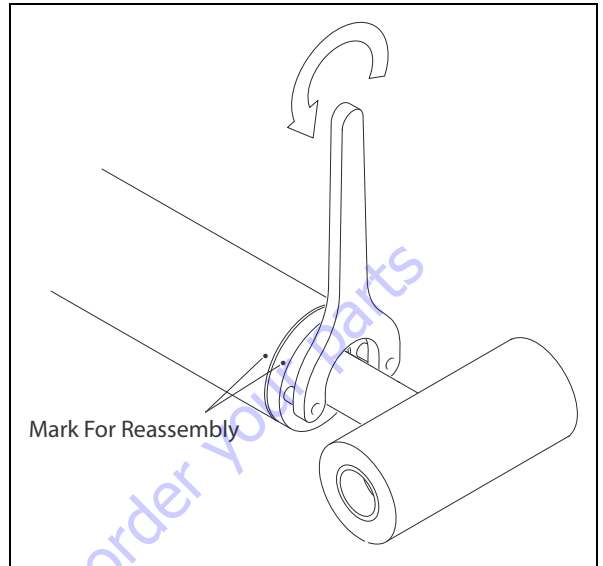


Figure 5-36. Cylinder Head Removal

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.

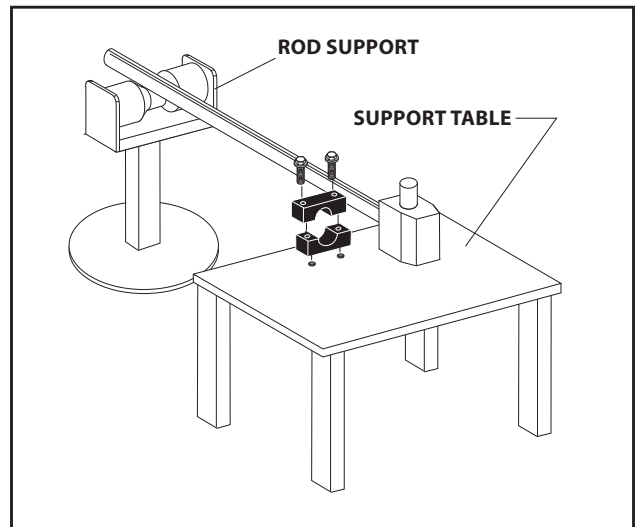
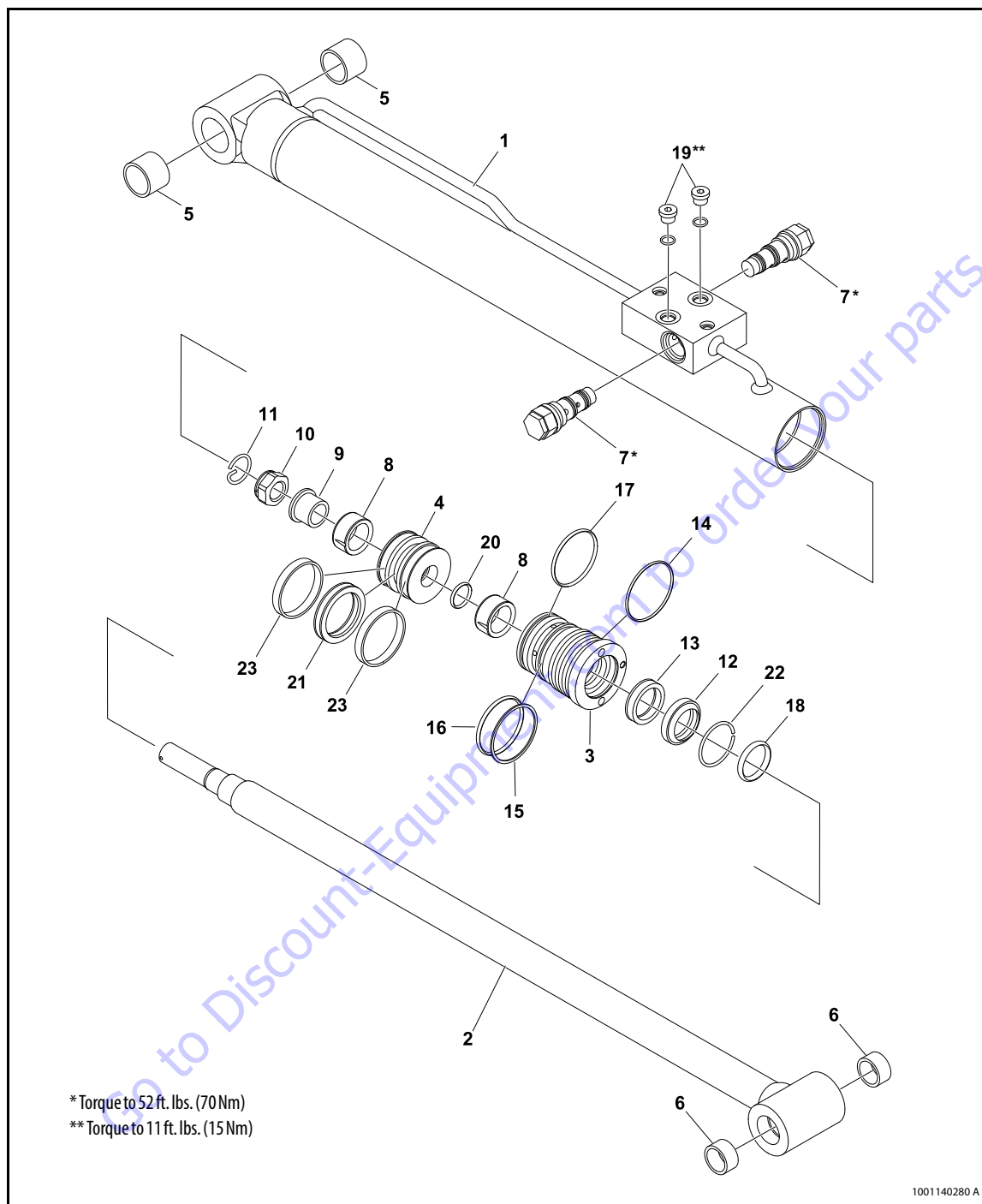
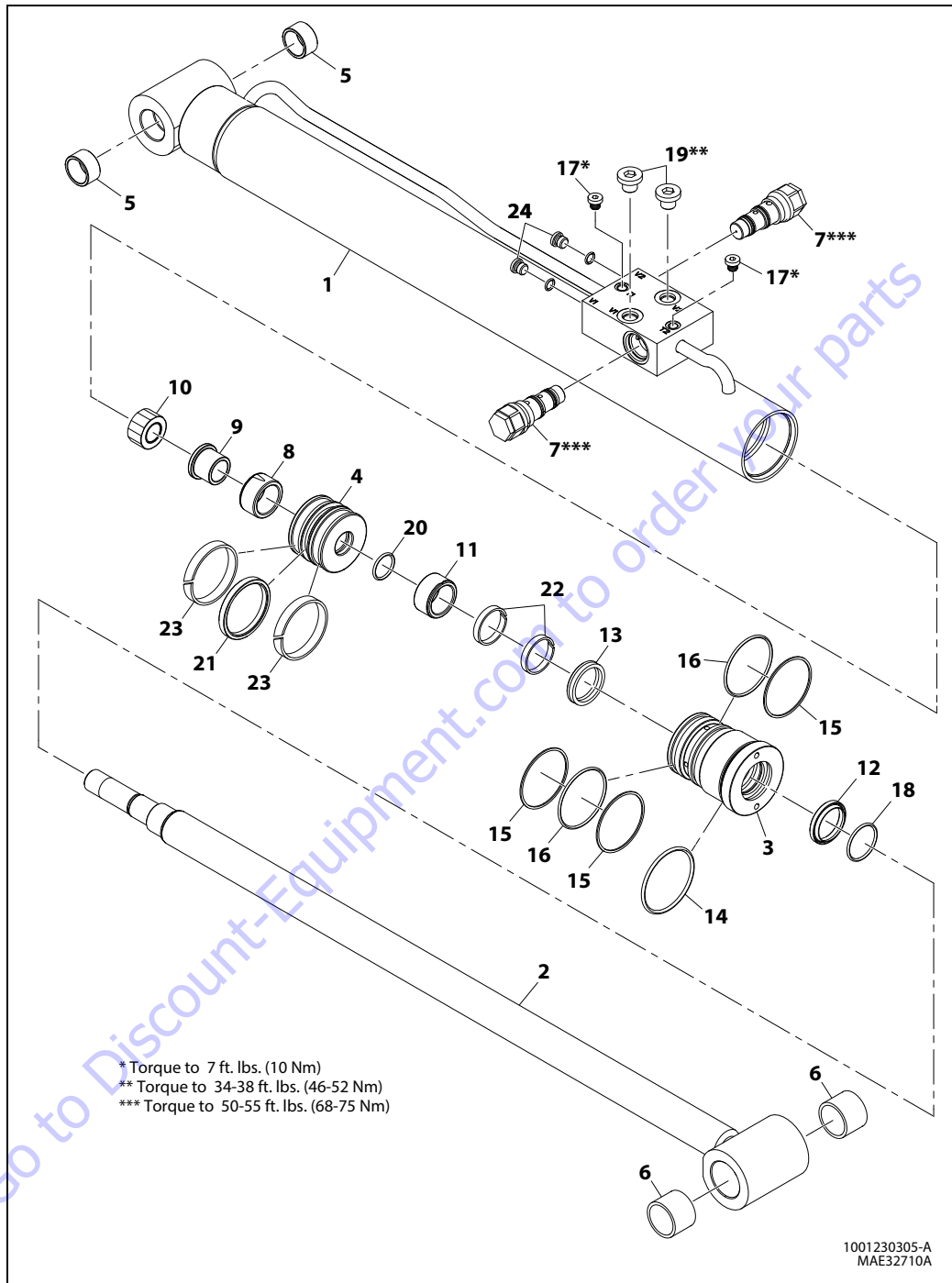


Figure 5-37. Cylinder Rod Support



- | | | | | |
|------------|-------------------------|-----------------|------------|--------------------|
| 1. Barrel | 6. Bushing | 11. Retainer | 16. O-ring | 21. Piston Seal |
| 2. Rod | 7. Counterbalance Valve | 12. Wiper Seal | 17. O-ring | 22. Retaining Ring |
| 3. Head | 8. Bushing | 13. Rod Seal | 18. O-ring | 23. Wear Ring |
| 4. Piston | 9. Sleeve | 14. O-ring | 19. Plug | |
| 5. Bushing | 10. Locknut | 15. Backup Ring | 20. O-ring | |

Figure 5-38. Jib Lift Cylinder (SN 0300208529 to Present, SN B300001429 through B300002486)



- | | | | | | |
|-----------|-------------------------|----------------|-----------------|------------|-----------------|
| 1. Barrel | 5. Bushing | 9. Sleeve | 13. Rod Seal | 17. Plug | 21. Piston Seal |
| 2. Rod | 6. Bushing | 10. Locknut | 14. O-ring | 18. O-ring | 22. Wear Ring |
| 3. Head | 7. Counterbalance Valve | 11. Plug | 15. Backup Ring | 19. Plug | 23. Wear Ring |
| 4. Piston | 8. Bushing | 12. Wiper Seal | 16. O-ring | 20. O-ring | 24. Plug |

Figure 5-39. Jib Lift Cylinder (SN B300002487 to Present)

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 retainer which attach the piston to the rod. Refer Figure 5-38.
10. Loosen and remove locknut which attaches the piston to the rod. Refer Figure 5-39.
11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seals and wear rings.
13. Remove bushings from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

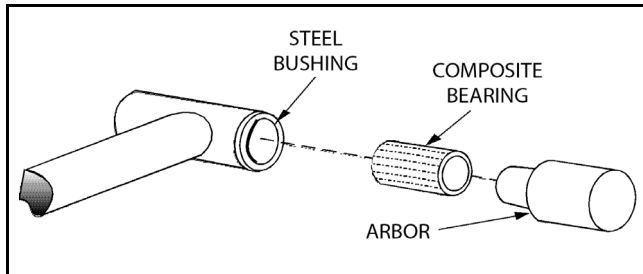


Figure 5-40. Composite Bearing Installation

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 gland groove.

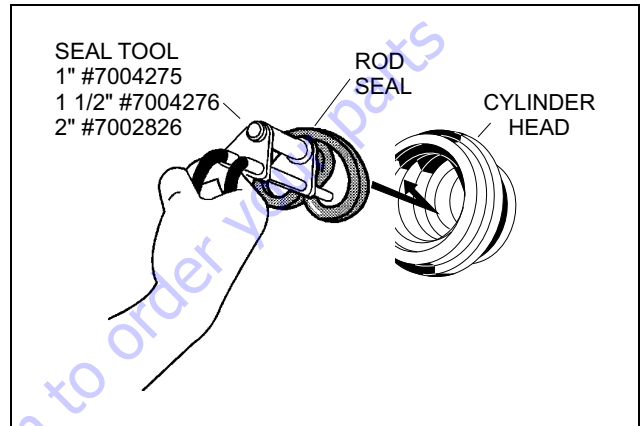


Figure 5-41. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

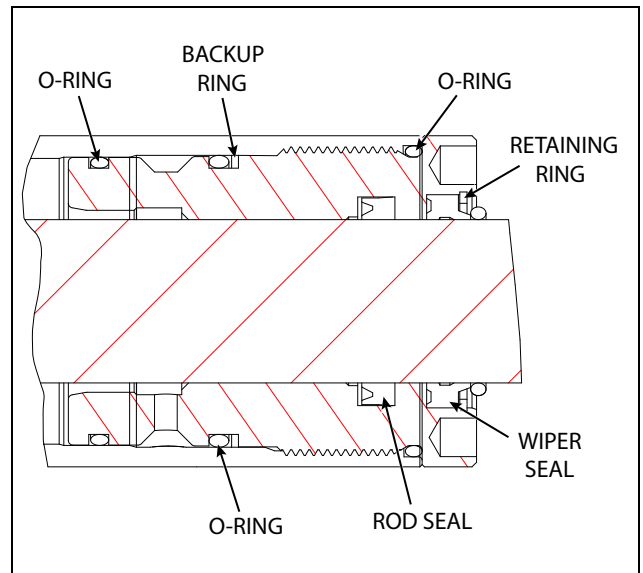


Figure 5-42. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install the new retaining ring into the applicable cylinder head gland groove.

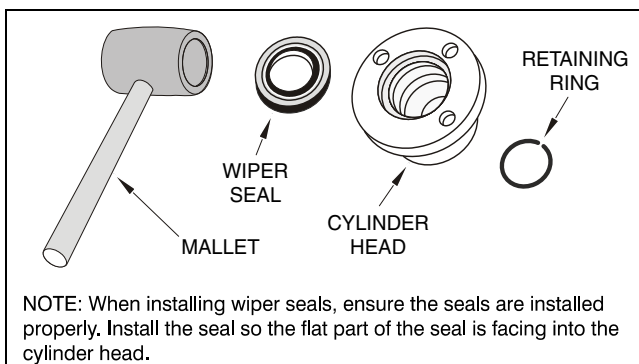


Figure 5-43. Wiper Seal Installation

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

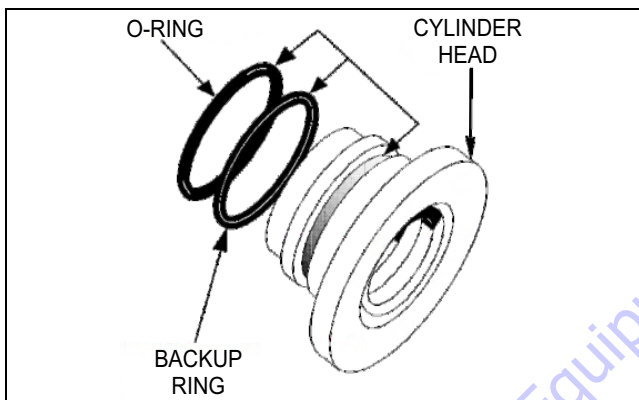


Figure 5-44. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer. Refer Figure 5-38.
10. Thread piston onto rod until it abuts the spacer end and install the Locknut. Refer Figure 5-39.

11. Remove the cylinder rod from the holding fixture.
12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

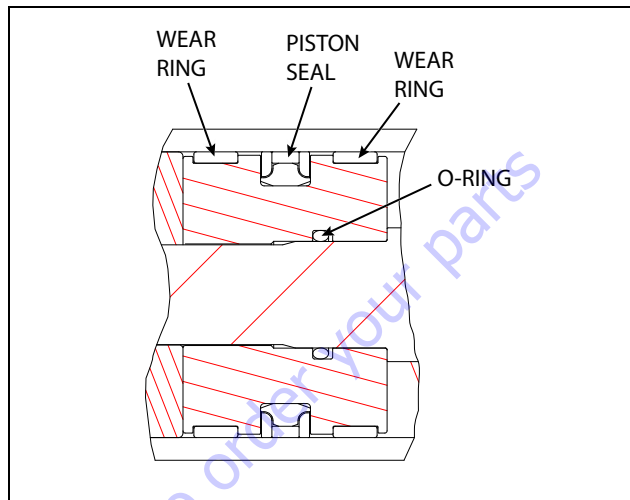


Figure 5-45. Piston Seal Kit Installation

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 gland can be inserted into the barrel cylinder.
16. Screw the cylinder head gland 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 counterbalance valves in the rod port block. Torque as shown in Figure 5-38. and Figure 5-39.

Lower 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 cartridge holding valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

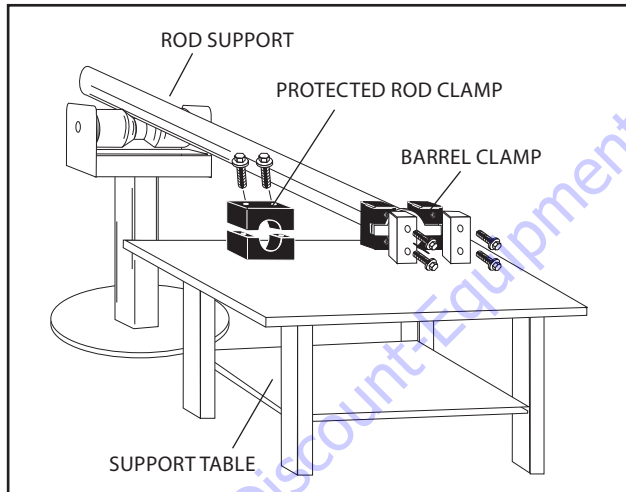


Figure 5-46. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew the cylinder cap from the barrel. Refer Figure 5-51.

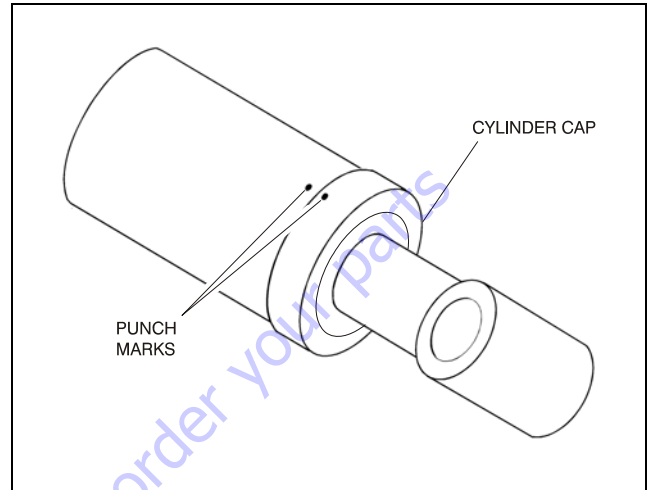


Figure 5-47. Cylinder Cap Removal

- b. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-54.

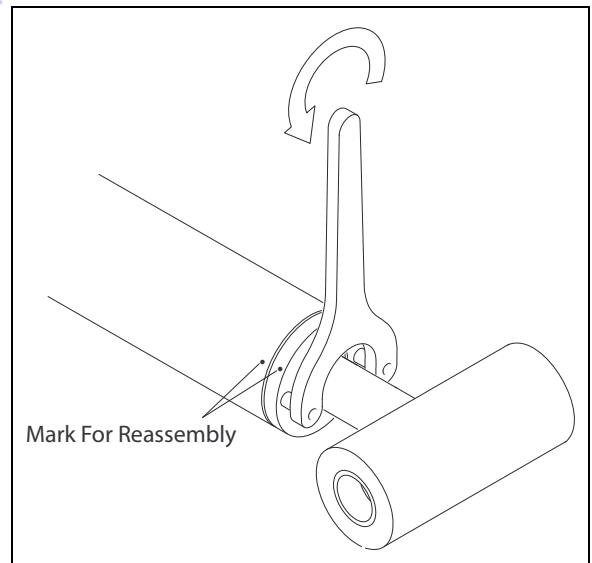


Figure 5-48. Cylinder Head Removal

- c. Unscrew cylinder head with hook spanner wrench. Refer Figure 5-52. & Figure 5-53.

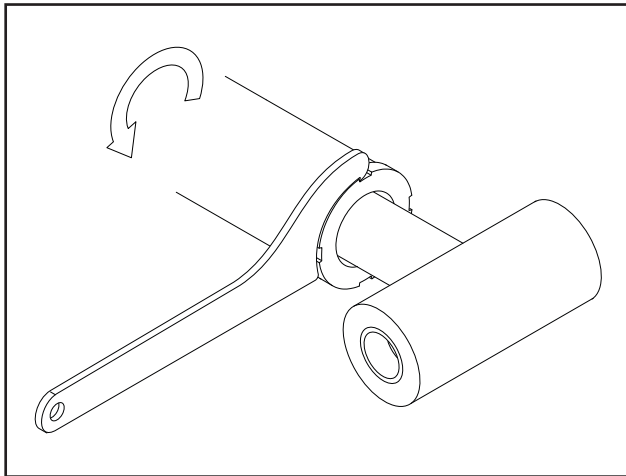


Figure 5-49. Cylinder Head Removal

- 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.

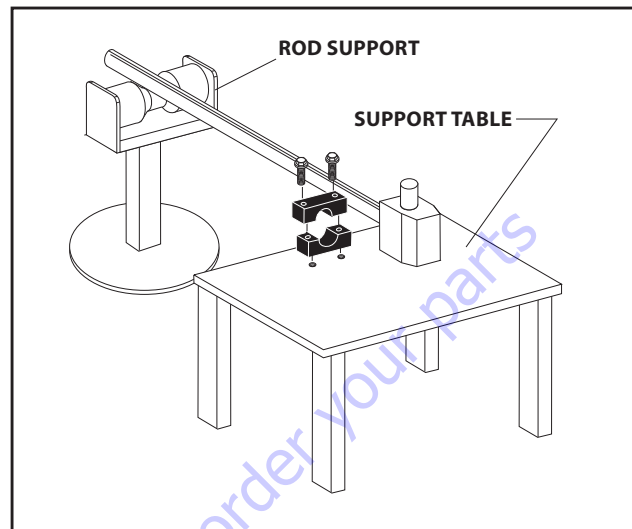
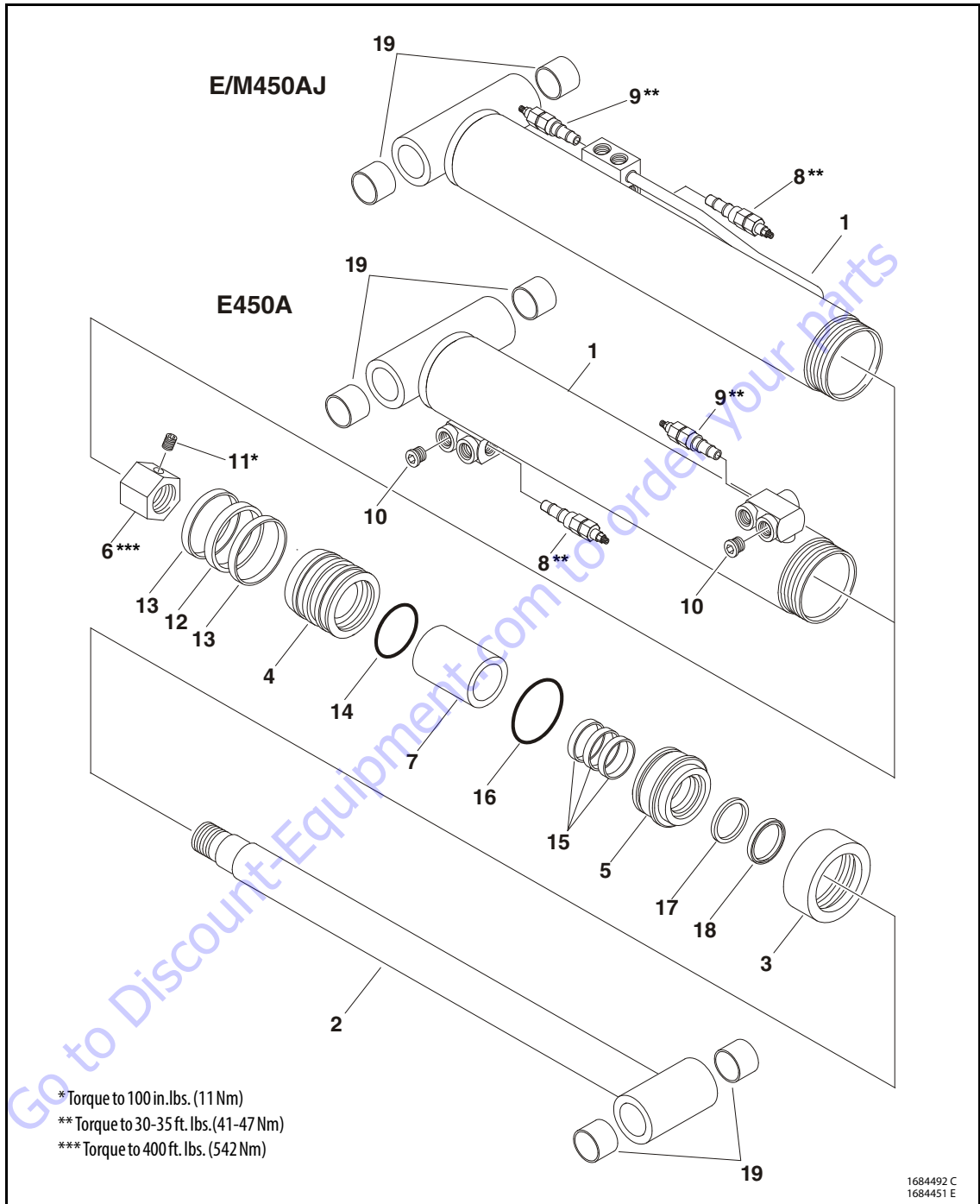
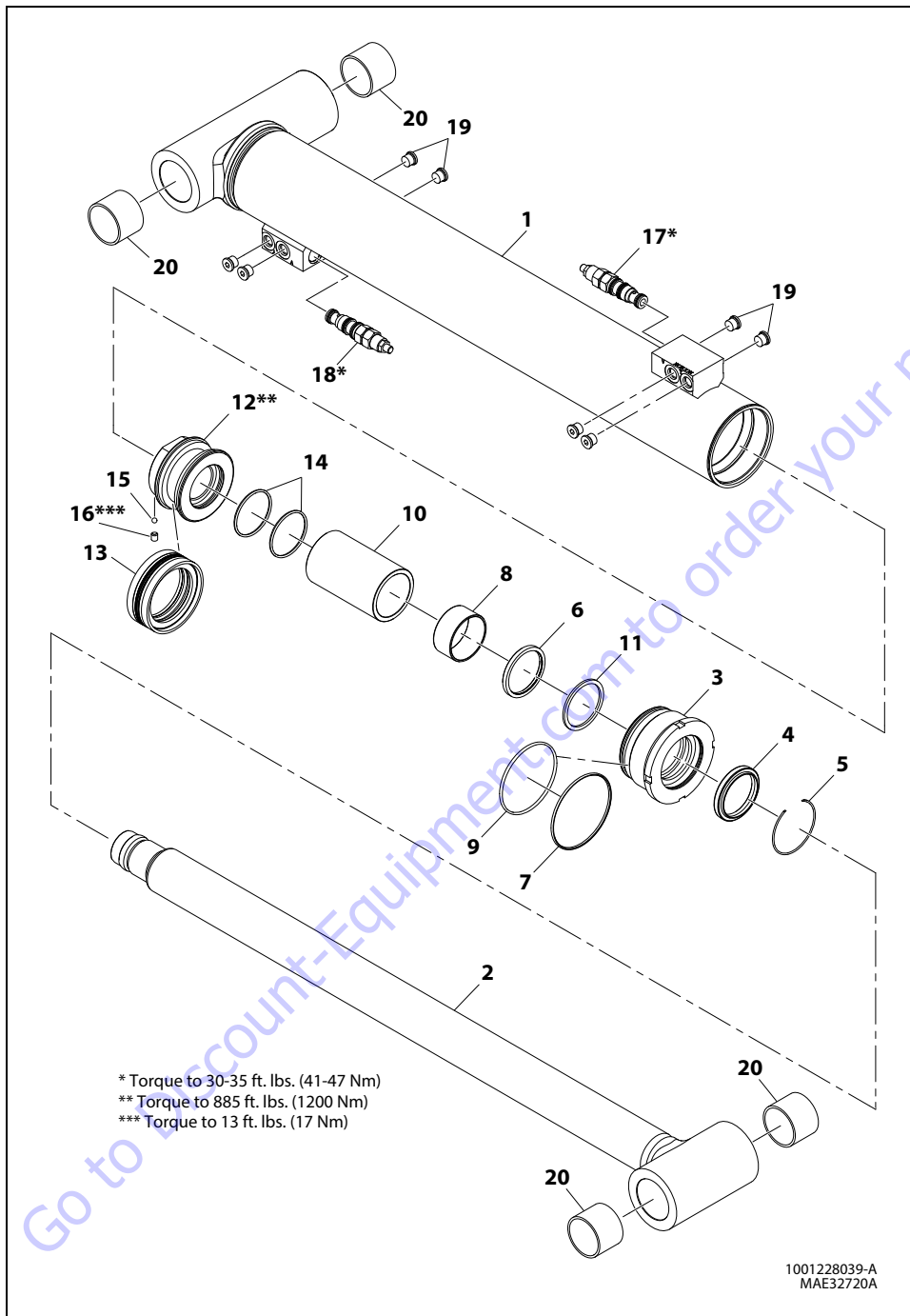


Figure 5-50. Cylinder Rod Support



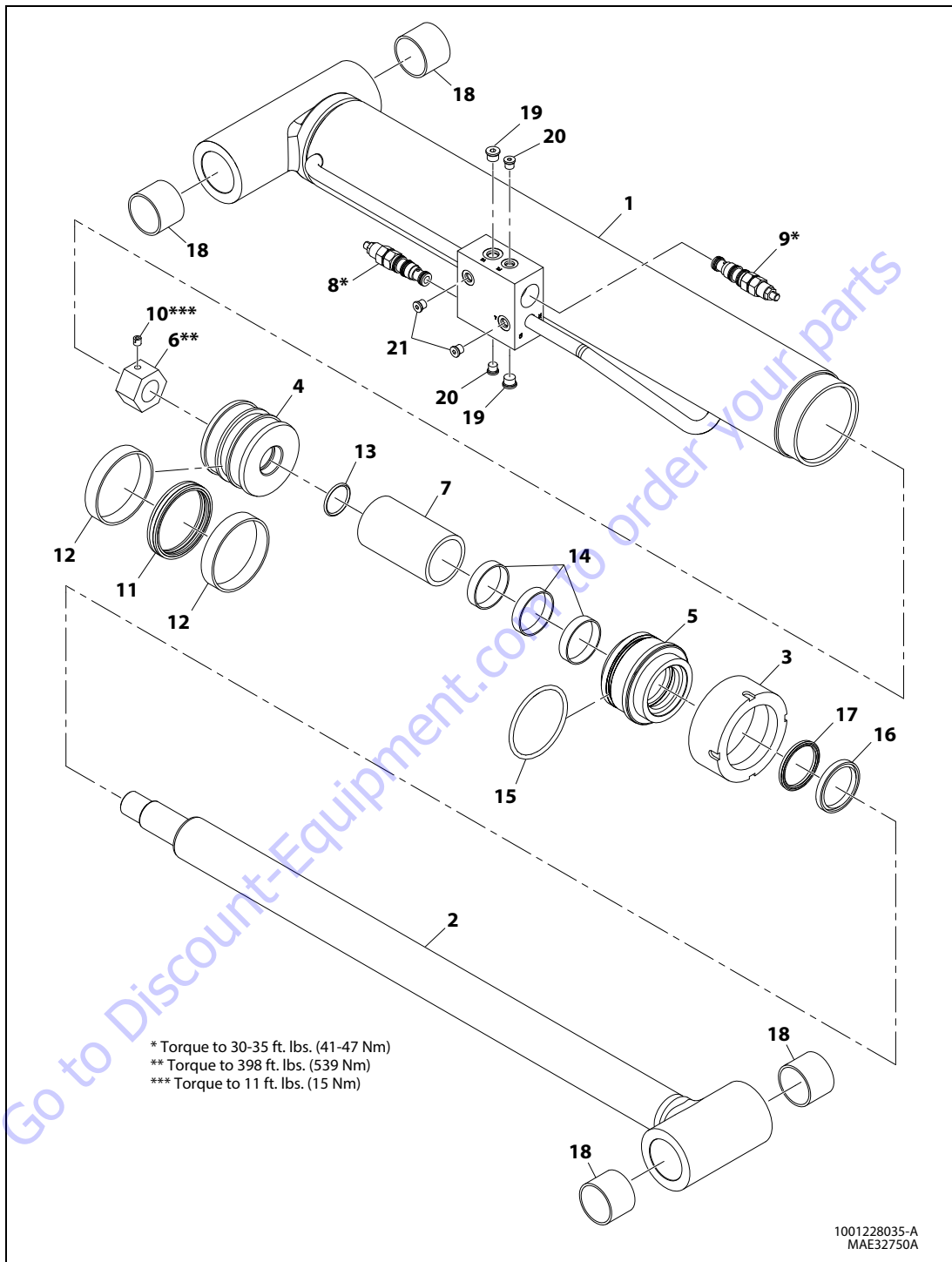
- | | | | | |
|-------------|--------------------|--------------------|---------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Wear Ring | 17. Rod Seal |
| 2. Rod | 6. Locknut | 10. Plug | 14. O-ring | 18. Wiper Seal |
| 3. Retainer | 7. Tube Spacer | 11. Setscrew | 15. Wear Ring | 19. Bushing |
| 4. Piston | 8. Cartridge Valve | 12. Piston Seal | 16. O-ring | |

Figure 5-51. Lower Lift Cylinder - E450A (SN 0300235601 through 0300239755), E450AJ/M450AJ (SN 0300208529 through 0300239252, SN B300001429 through B300002461)



- | | | | | |
|---------------|----------------|------------|-----------------|---------------------|
| 1. Barrel | 5. Retainer | 9. O-ring | 13. Piston Seal | 17. Cartridge Valve |
| 2. Rod | 6. Rod Seal | 10. Spacer | 14. O-ring | 18. Cartridge Valve |
| 3. Head | 7. Backup Ring | 11. O-ring | 15. Steel Ball | 19. Plug |
| 4. Wiper Seal | 8. Wear Ring | 12. Piston | 16. Setscrew | 20. Bushing |

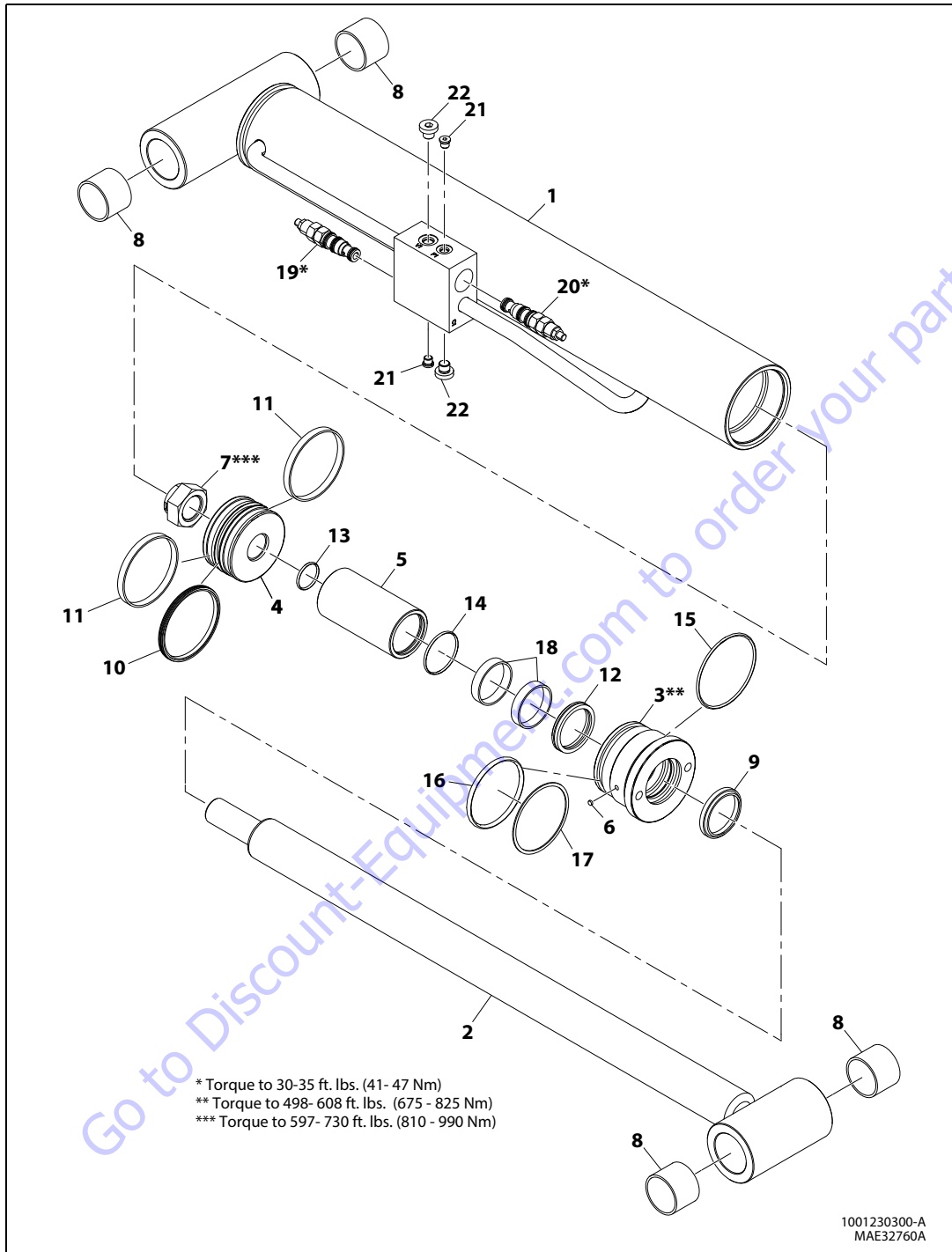
Figure 5-52. Lower Lift Cylinder - E450A (SN 0300239756 to Present)



- | | | | | | |
|-------------|--------------------|--------------------|---------------|----------------|----------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. O-ring | 17. Wiper Seal | 21. Plug |
| 2. Rod | 6. Locknut | 10. Setscrew | 14. Wear Ring | 18. Bushing | |
| 3. Retainer | 7. Spacer | 11. Piston Seal | 15. O-ring | 19. Plug | |
| 4. Piston | 8. Cartridge Valve | 12. Wear Ring | 16. Rod Seal | 20. Plug | |

Figure 5-53. Lower Lift Cylinder - E450AJ/M450AJ (SN 0300239253 to Present, SN B300002462 through B300002486)

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS



- | | | | | |
|-----------|------------------|----------------|--------------------------|----------|
| 1. Barrel | 6. Locking Piece | 11. Wear Ring | 16. O-ring | 21. Plug |
| 2. Rod | 7. Locknut | 12. Wiper Seal | 17. Backup Ring | 22. Plug |
| 3. Head | 8. Bushing | 13. O-ring | 18. Wear Ring | |
| 4. Piston | 9. Rod Seal | 14. O-ring | 19. Counterbalance Valve | |
| 5. Spacer | 10. Piston Seal | 15. O-ring | 20. Counterbalance Valve | |

Figure 5-54. Lower Lift Cylinder - E450AJ/M450AJ (SN B300002487 to Present)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Piston removal for Figure 5-51. and Figure 5-53. as mention below:
 - a. Unscrew the setscrew from the locknut.
 - b. Loosen and remove locknut which attach the piston to the rod.
 - c. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
10. Piston removal for Figure 5-52. as mention below:
 - a. Loosen and remove the setscrew and ball which attaches the piston to the rod.
 - b. Screw the piston counterclockwise and remove the piston from cylinder rod.
11. Piston removal for Figure 5-54. as mention below:
 - a. Loosen and remove locknut which attaches the piston to the rod.
 - b. Screw the piston counterclockwise and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seals and wear rings.
13. Remove bushings from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, wear rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

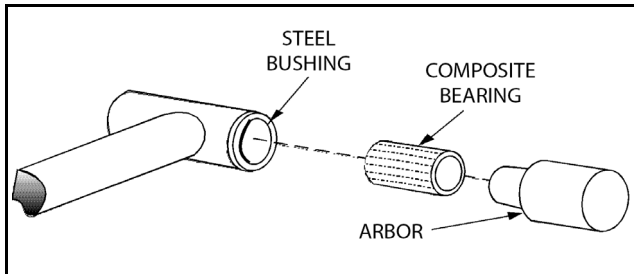


Figure 5-55. Composite Bearing Installation

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 gland groove.

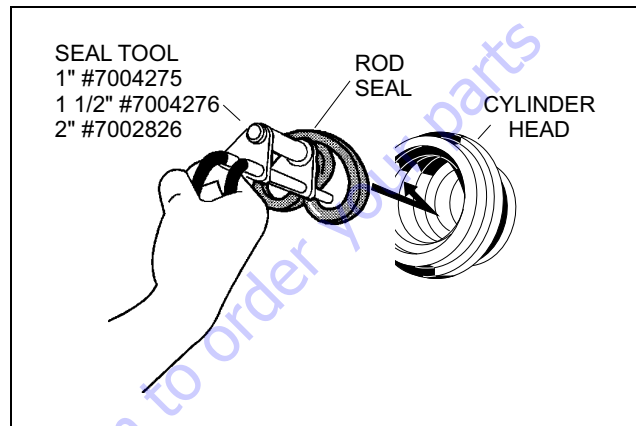


Figure 5-56. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

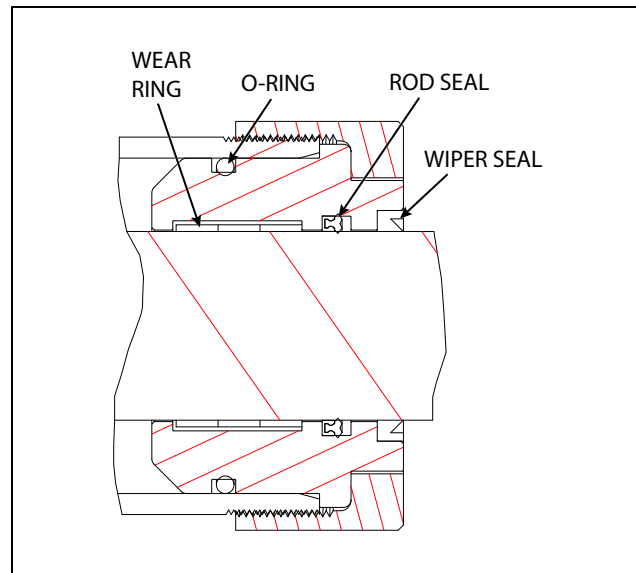


Figure 5-57. Cylinder Head Seal Installation

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

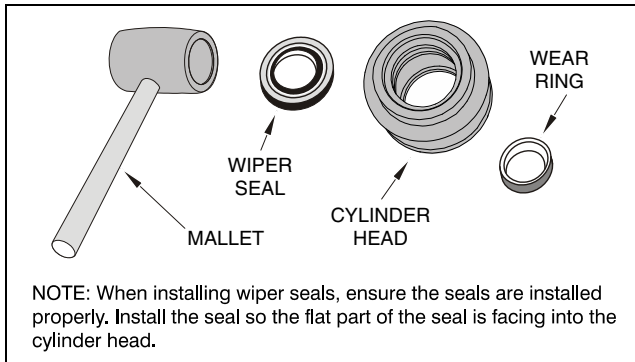


Figure 5-58. Wiper Seal Installation

3. Place a new o-ring in the applicable outside diameter groove of the cylinder head.

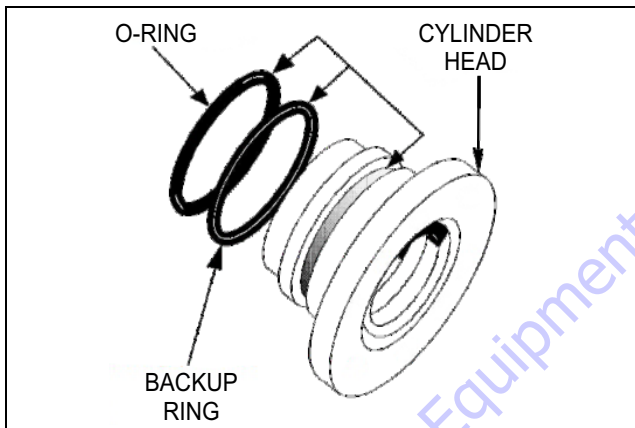


Figure 5-59. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end.
10. Secure piston as mentioned below:
 - a. Install the locknut and setscrew on the piston and attach the piston on the rod. Refer Figure 5-51. and Figure 5-53.

- b. Install the setscrew and ball on the piston and attach the piston on the rod. Refer Figure 5-52.
- c. Install locknut onto the piston and attach the piston on the rod. Refer Figure 5-54.

11. Remove the cylinder rod from the holding fixture.
12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

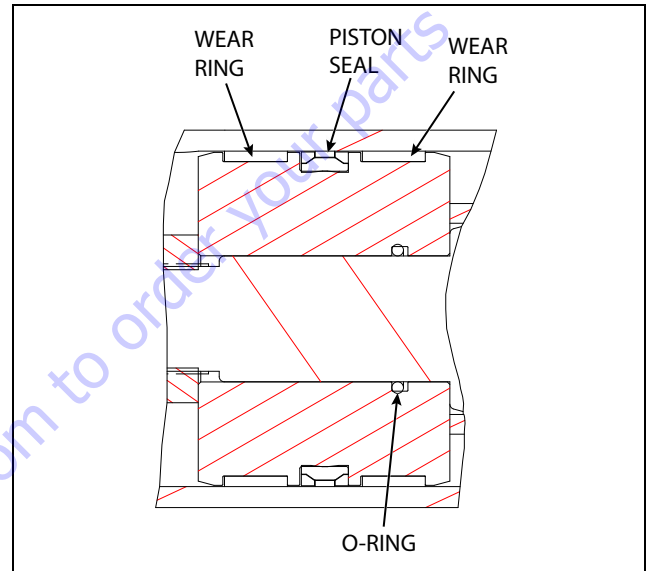


Figure 5-60. Piston Seal Kit Installation

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 gland can be inserted into the barrel cylinder.
16. Install cylinder head as mention below:
 - a. Secure the cylinder head gland and the cylinder cap. Refer Figure 5-51.
 - b. Screw the cylinder head into barrel using hook spanner wrench and pin-face spanner wrench. as shown in Figure 5-52., Figure 5-53. and Figure 5-54.
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 holding valves in the rod port block. Torque to 30-35 ft. lbs. (40-47 Nm).

Mid 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 cartridge holding valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

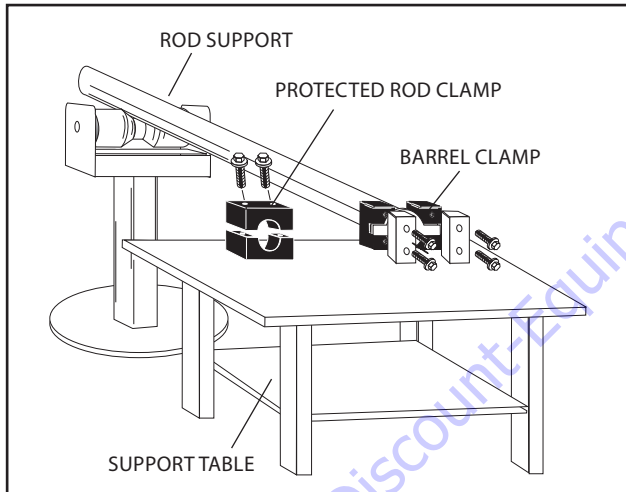


Figure 5-61. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew the cylinder cap from the barrel. Refer Figure 5-66.

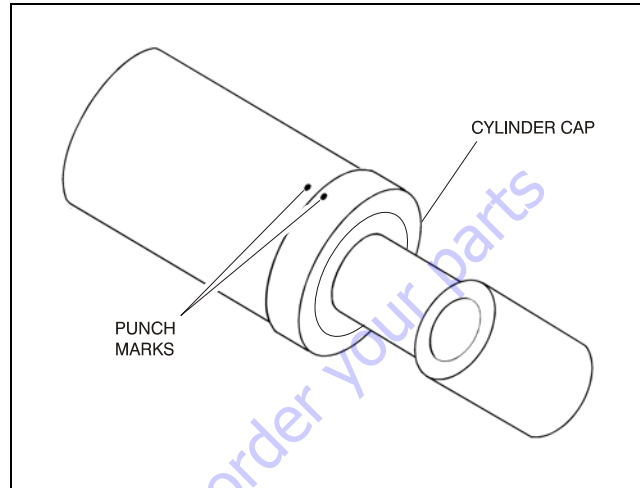


Figure 5-62. Cylinder Cap Removal

- b. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-68.

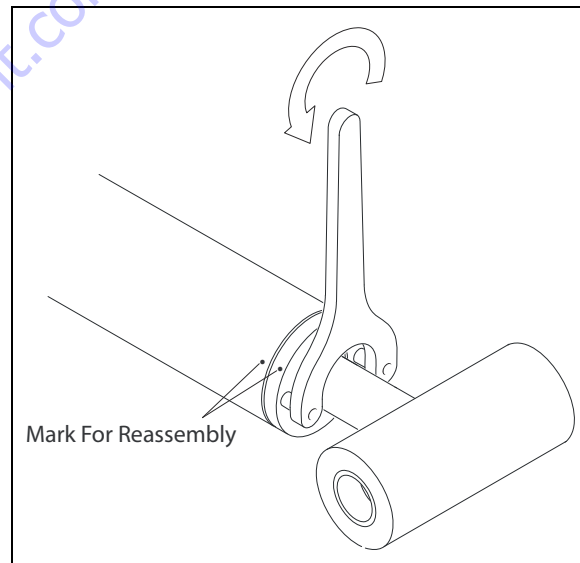


Figure 5-63. Cylinder Head Removal

- c. Unscrew cylinder head with hook spanner wrench. Refer Figure 5-67.

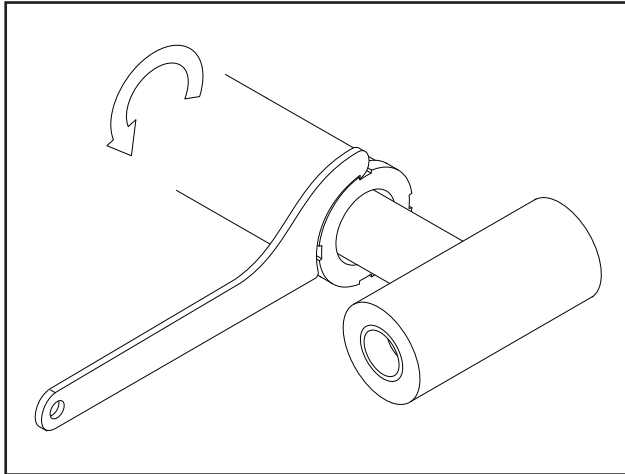


Figure 5-64. Cylinder Head Removal

- 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.

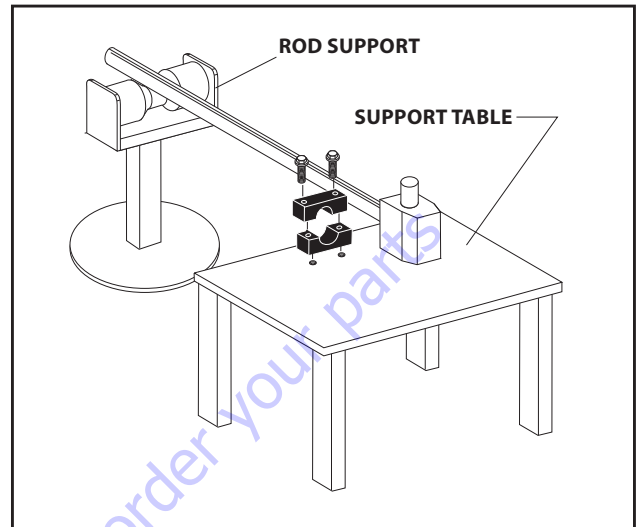
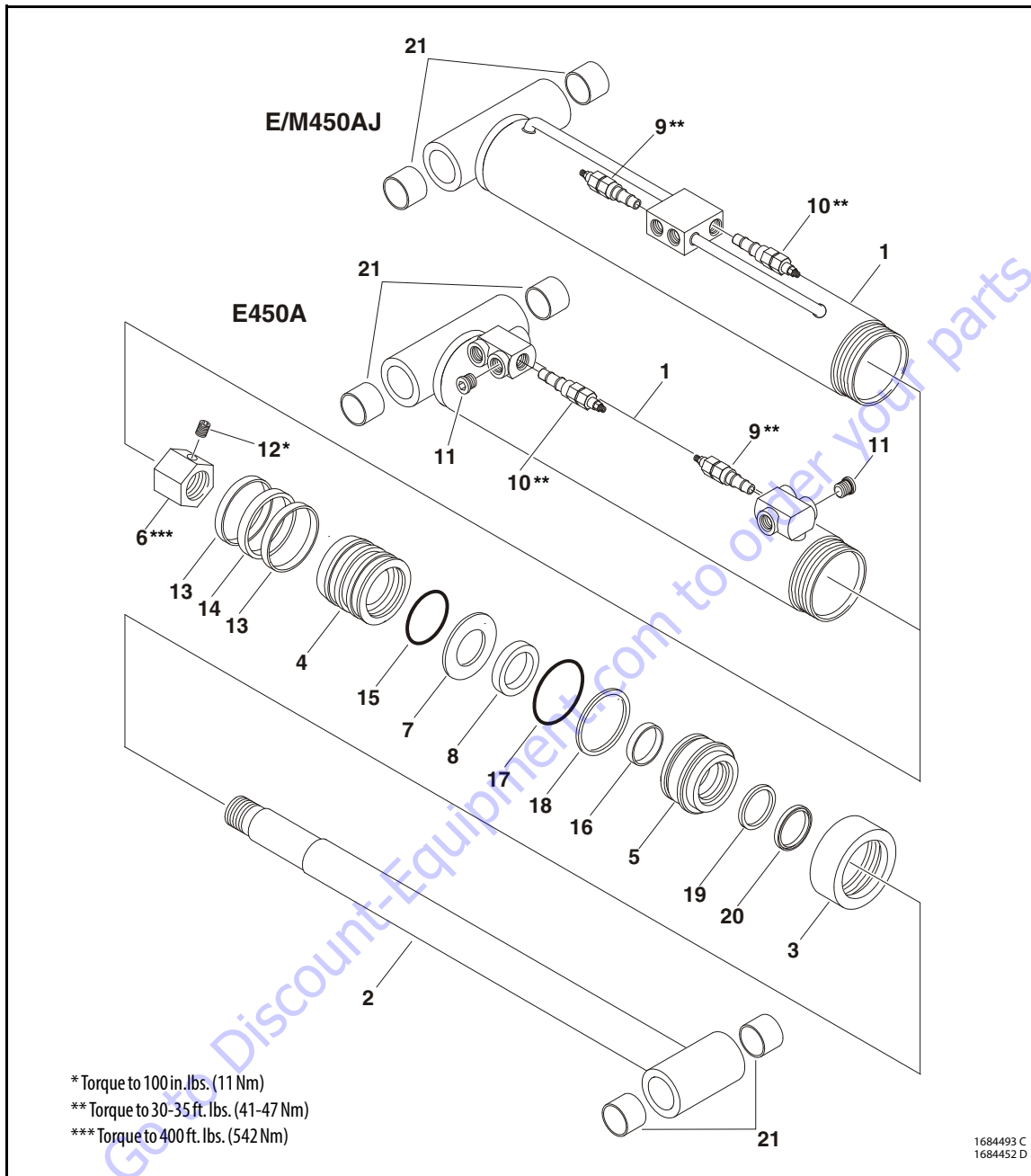


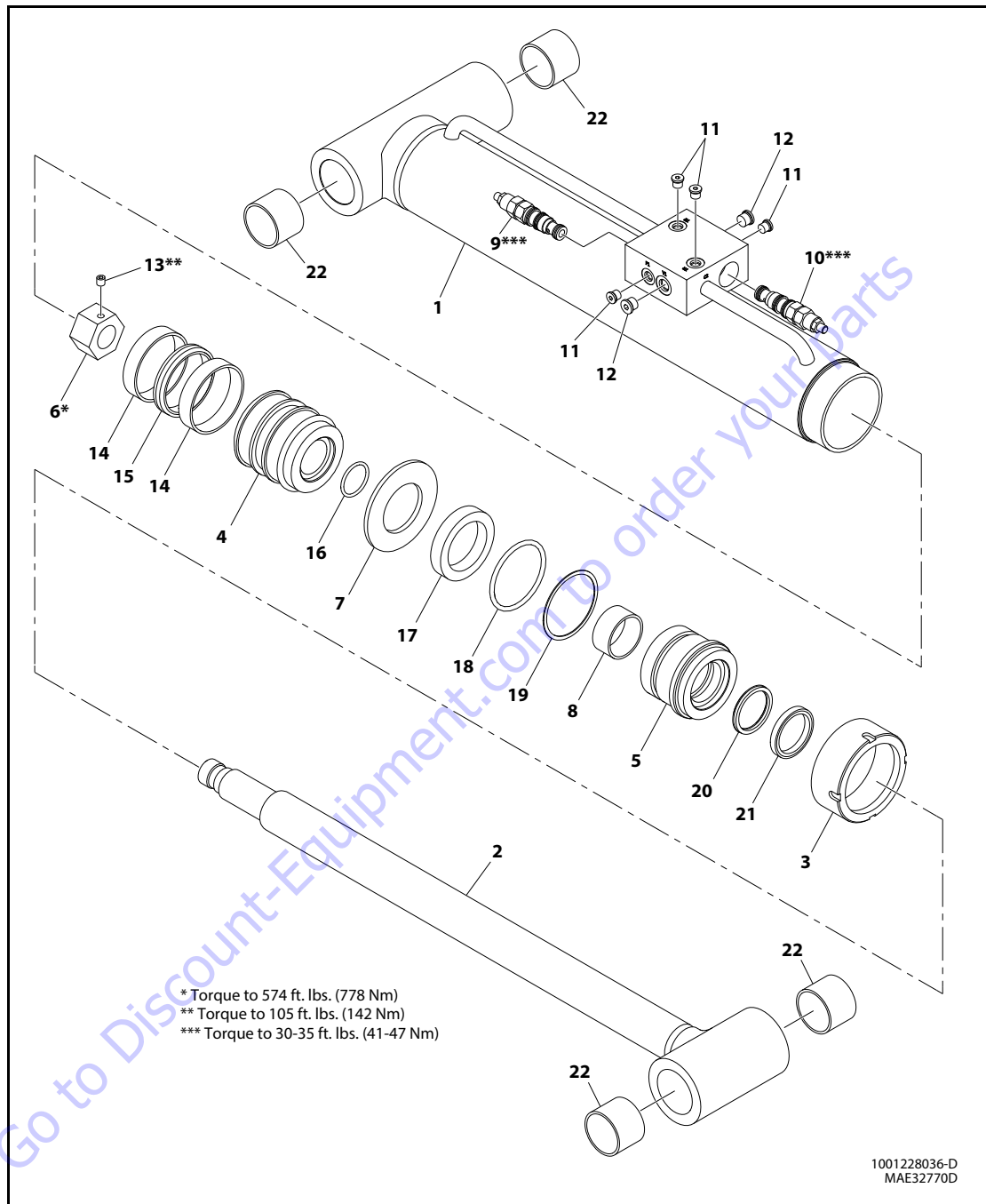
Figure 5-65. Cylinder Rod Support

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS



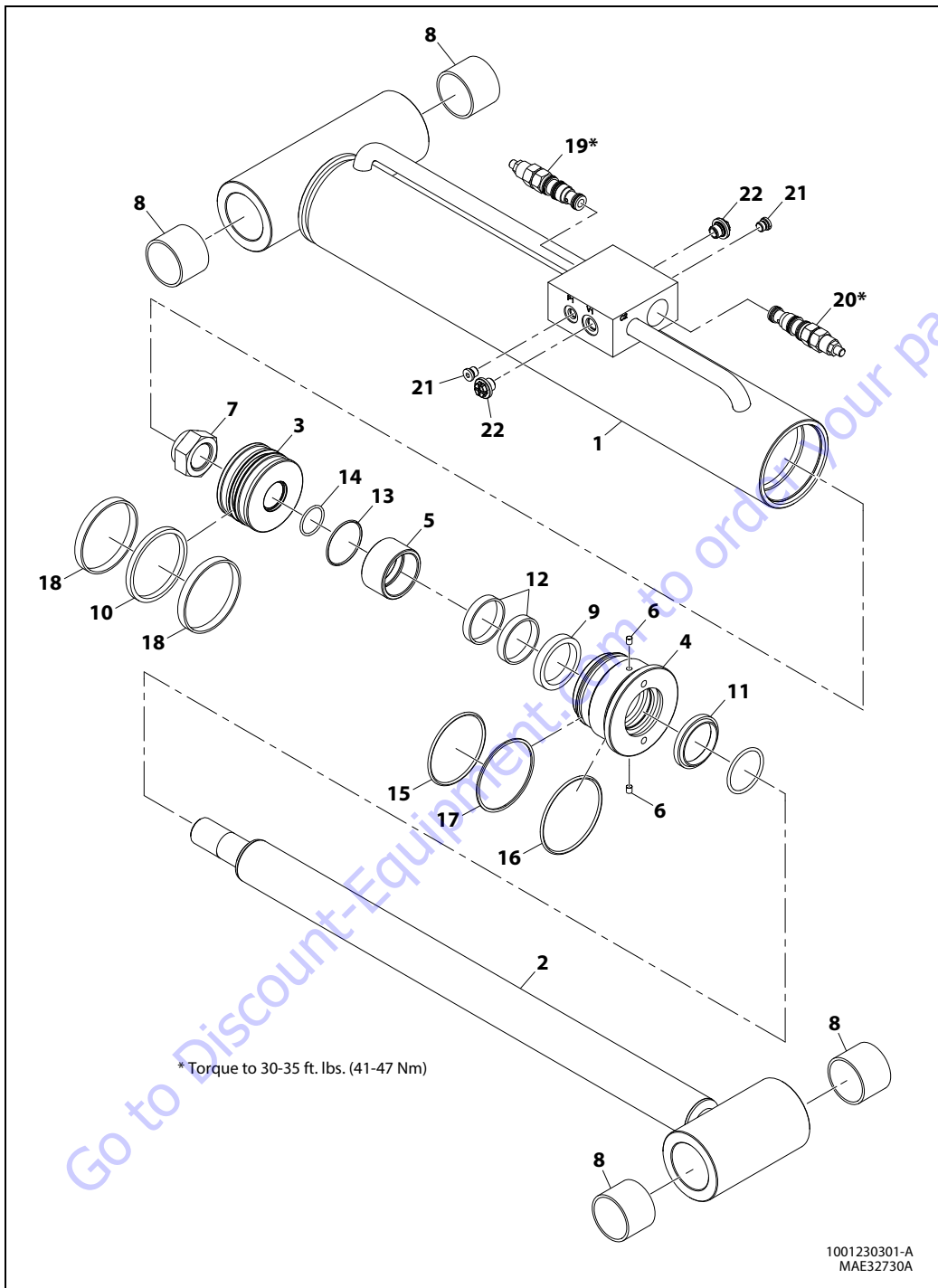
- | | | | | |
|-------------|--------------------|---------------------|-----------------|-----------------|
| 1. Barrel | 6. Locknut | 10. Cartridge Valve | 14. Piston Seal | 18. Backup Ring |
| 2. Rod | 7. Washer | 11. Plug | 15. O-ring | 19. Rod Seal |
| 3. Retainer | 8. Spacer | 12. Setscrew | 16. Wear Ring | 20. Wiper Seal |
| 4. Piston | 9. Cartridge Valve | 13. Wear Ring | 17. O-ring | 21. Bushing |
| 5. Head | | | | |

Figure 5-66. Mid Lift Cylinder - E450A (SN 0300235601 through 0300239755), E450AJ/M450AJ (SN 0300208529 through 0300239252, SN B300001429 through B300002461)



- | | | | | | |
|-------------|------------|---------------------|-----------------|-----------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Setscrew | 17. Wear Ring | 21. Wiper Seal |
| 2. Rod | 6. Locknut | 10. Cartridge Valve | 14. Wear Ring | 18. O-ring | 22. Bushing |
| 3. Retainer | 7. Washer | 11. Plug | 15. Piston Seal | 19. Backup Ring | |
| 4. Piston | 8. Spacer | 12. Plug | 16. O-ring | 20. Rod Seal | |

Figure 5-67. Mid Lift Cylinder - E450A (SN 0300239756 to Present), E450AJ/M450AJ (SN 0300239253 to Present, SN B300002462 through B300002486)



- | | | | | | |
|-----------|------------------|-----------------|------------|--------------------------|----------|
| 1. Barrel | 5. Spacer | 9. Rod Seal | 13. O-ring | 17. Backup Ring | 21. Plug |
| 2. Rod | 6. Locking Piece | 10. Piston Seal | 14. O-ring | 18. Wear Ring | 22. Plug |
| 3. Piston | 7. Locknut | 11. Wiper Seal | 15. O-ring | 19. Counterbalance Valve | |
| 4. Head | 8. Bushing | 12. Wear Ring | 16. O-ring | 20. Counterbalance Valve | |

Figure 5-68. Mid Lift Cylinder - E450AJ/M450AJ (SN B300002487 to Present)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Piston removal for Figure 5-66. and Figure 5-67. as mention below:
 - a. Unscrew the setscrew from the locknut.
 - b. Loosen and remove locknut which attach the piston to the rod.
 - c. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
10. Piston removal for Figure 5-68. as mention below:
 - a. Loosen and removal locknut which attaches the piston to the rod.
 - b. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
11. Remove and discard the piston o-rings, seals and wear rings.
12. Remove the spacer and washer from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

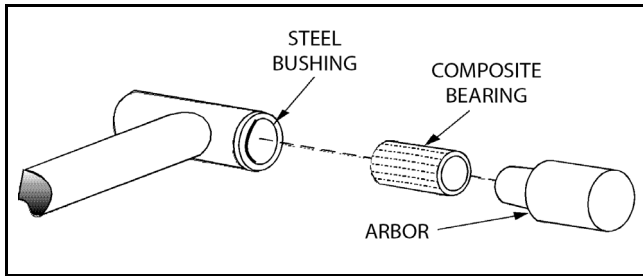


Figure 5-69. Composite Bearing Installation

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 gland groove.

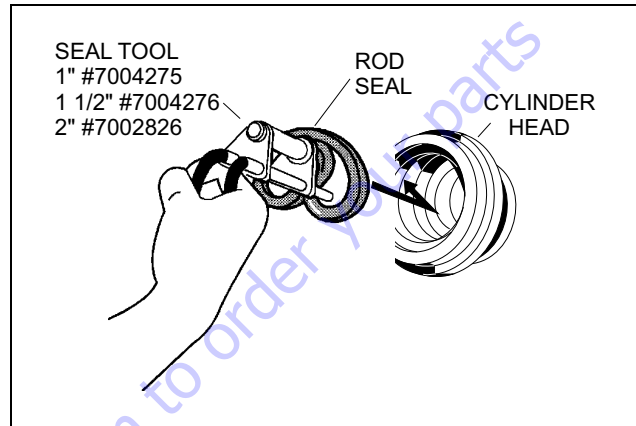


Figure 5-70. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

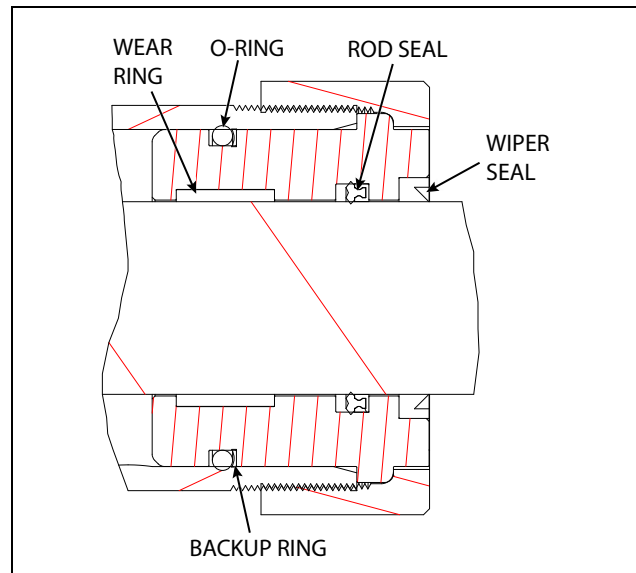


Figure 5-71. Cylinder Head Seal Installation

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

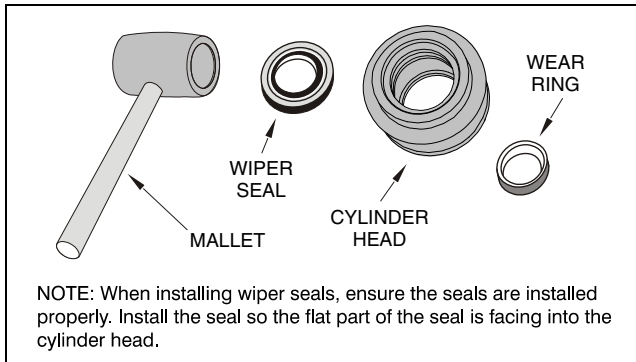


Figure 5-72. Wiper Seal Installation

3. Place a new o-ring in the applicable outside diameter groove of the cylinder head.

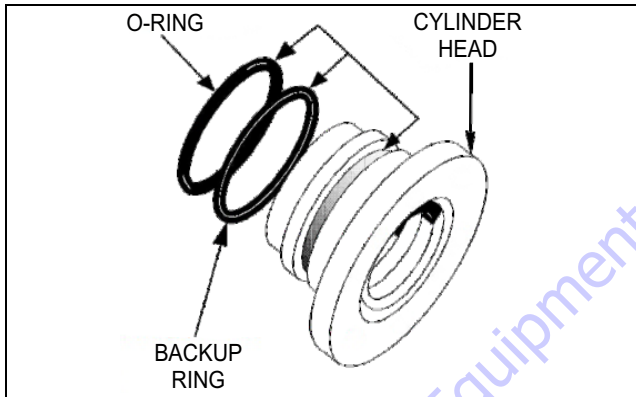


Figure 5-73. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer and washer onto the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end.
10. Secure piston as mentioned below:
 - a. Install the locknut and setscrew on the piston and attach the piston on the rod. Refer Figure 5-66. and Figure 5-67.

- b. Install locknut onto the piston and attach the piston on the rod. Refer Figure 5-68.

11. Remove the cylinder rod from the holding fixture.
12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

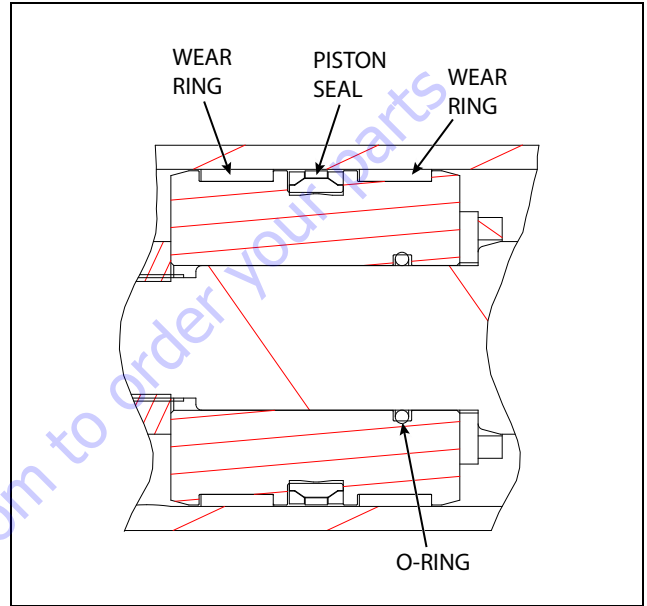


Figure 5-74. Piston Seal Kit Installation

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 gland can be inserted into the barrel cylinder.
16. Install cylinder head as mention below:
 - a. Secure the cylinder head gland and the cylinder cap. Refer Figure 5-66.
 - b. Screw the cylinder head into barrel using hook spanner wrench and pin-face spanner wrench. Refer Figure 5-67. and Figure 5-68.
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 holding valves in the rod port block. Torque to 30-35 ft. lbs. (40-47 Nm).

Upper 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 cartridge holding valve from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

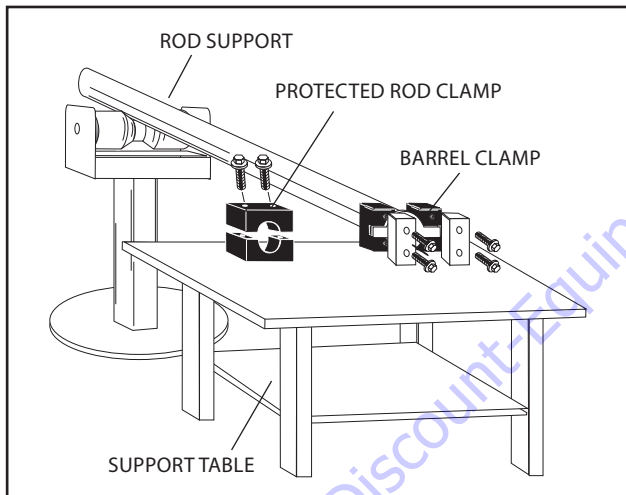


Figure 5-75. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew the cylinder cap from the barrel. Refer Figure 5-80.

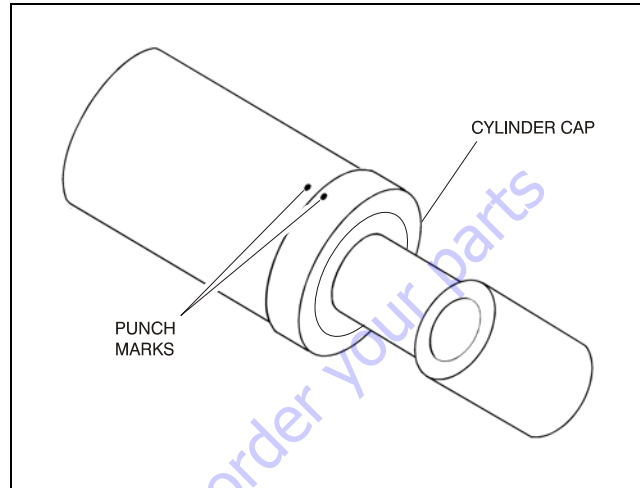


Figure 5-76. Cylinder Cap Removal

- b. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-83.

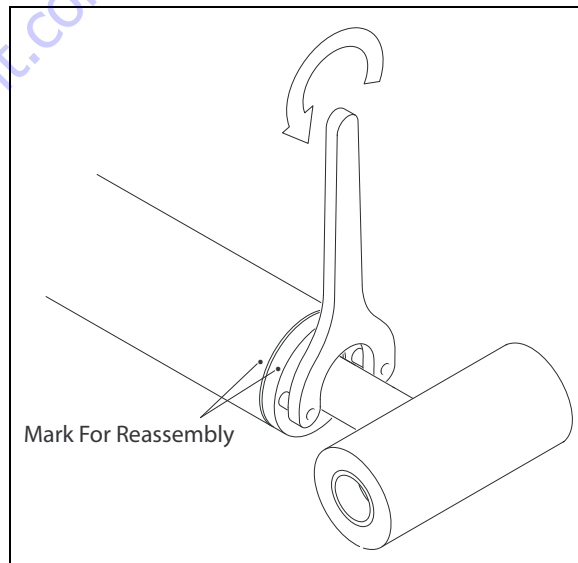


Figure 5-77. Cylinder Head Removal

- c. Unscrew cylinder head with hook spanner wrench. Refer Figure 5-81. and Figure 5-82.

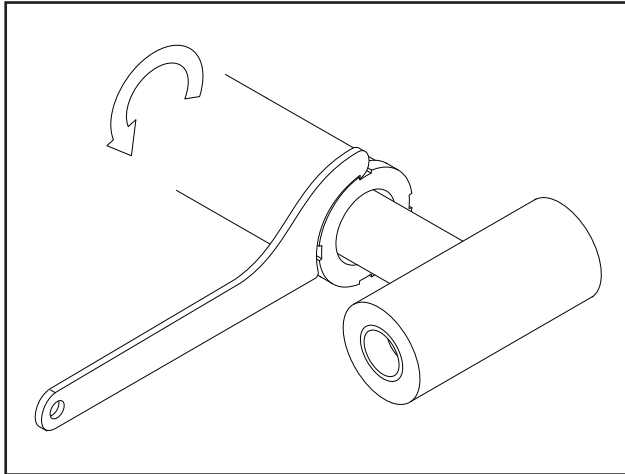


Figure 5-78. Cylinder Head Removal

- 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.

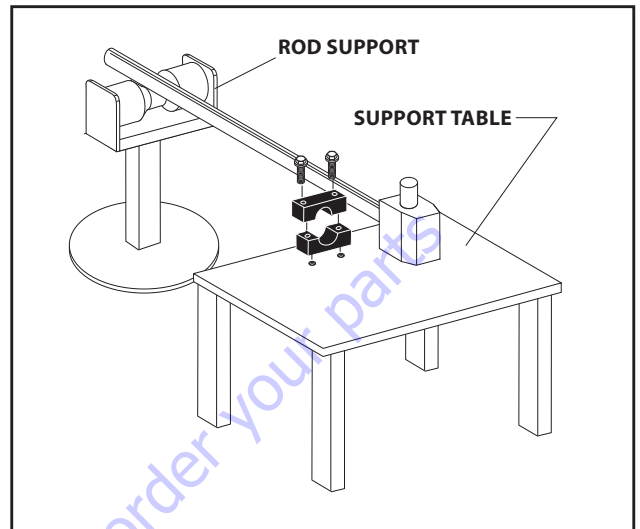
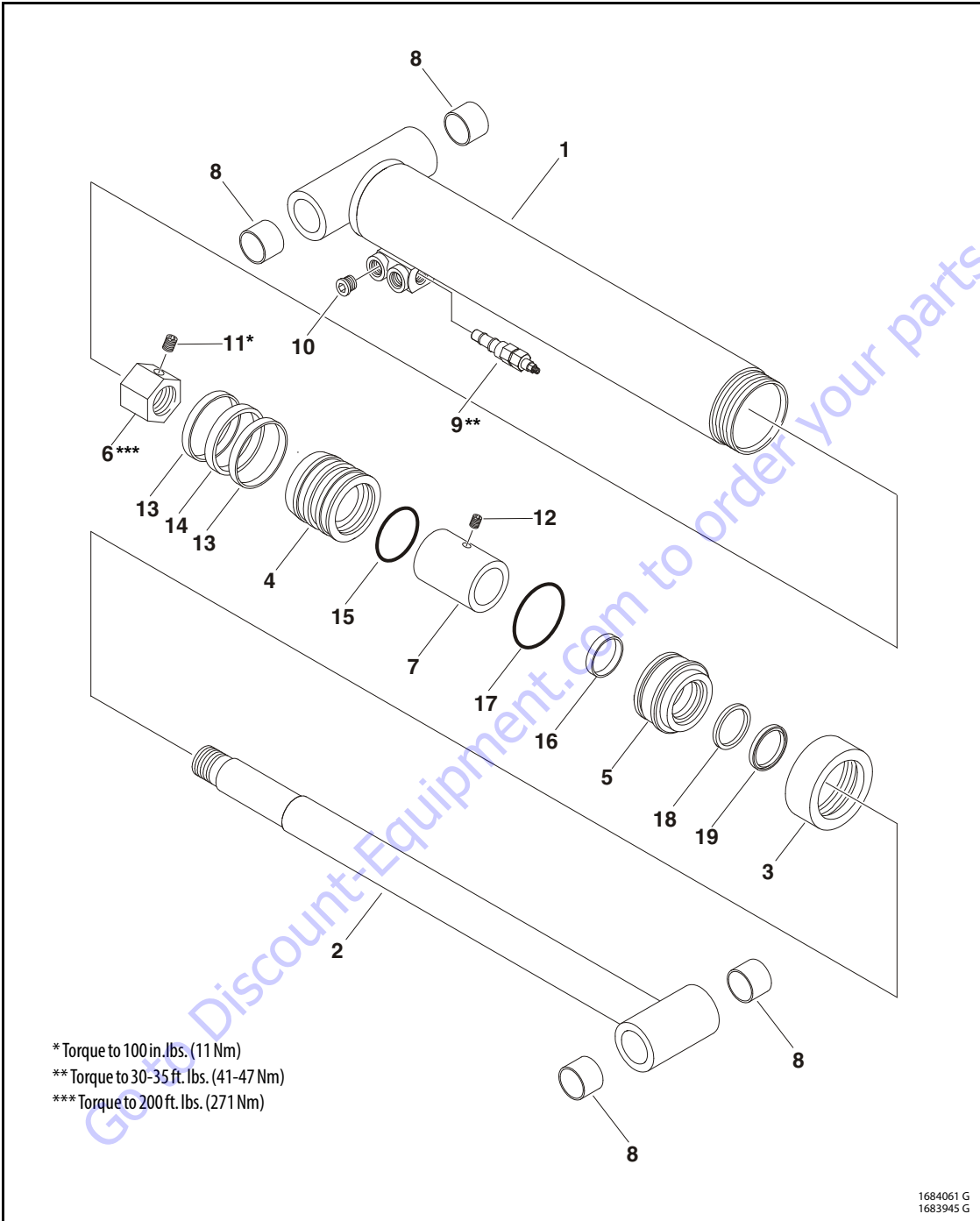
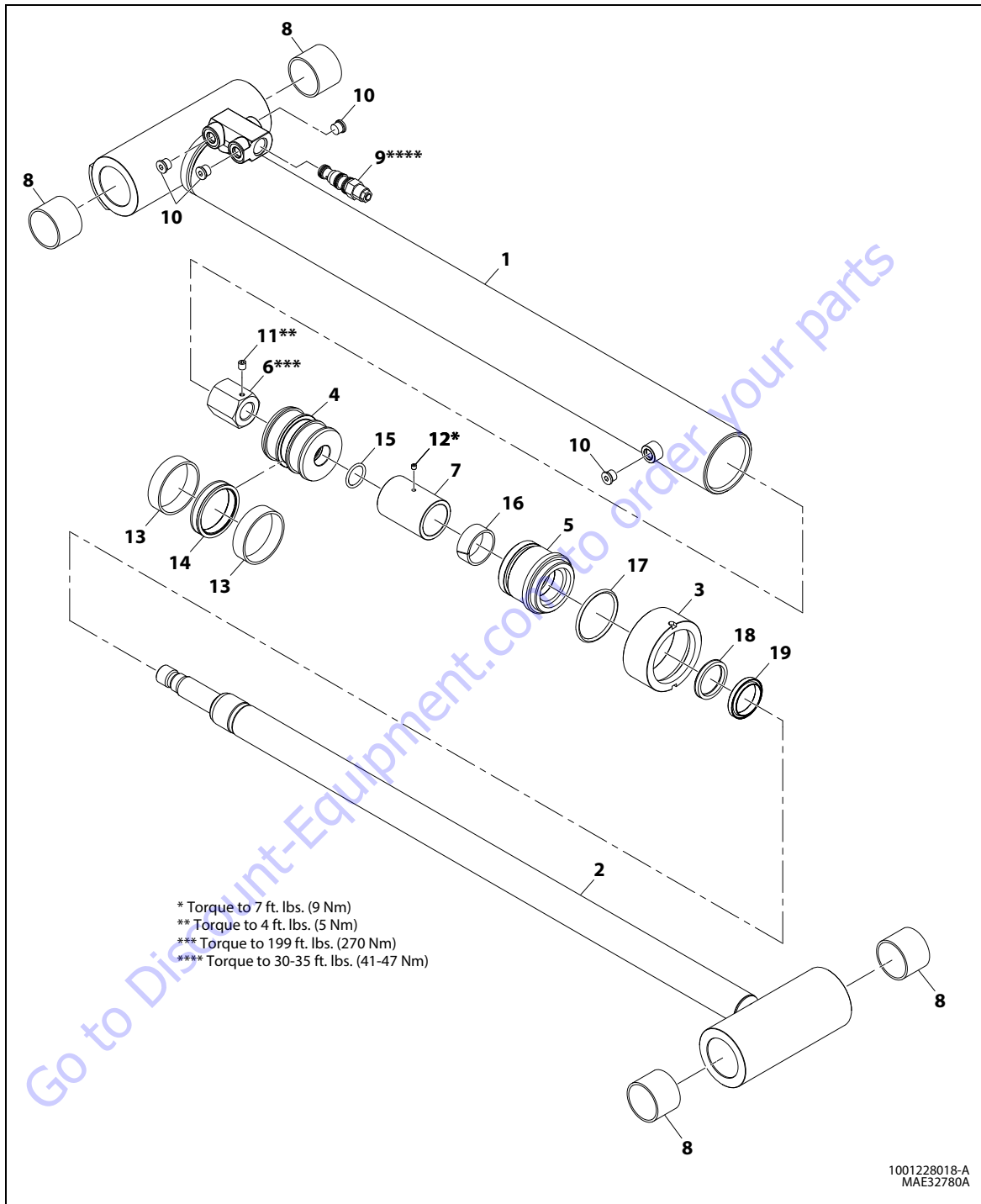


Figure 5-79. Cylinder Rod Support



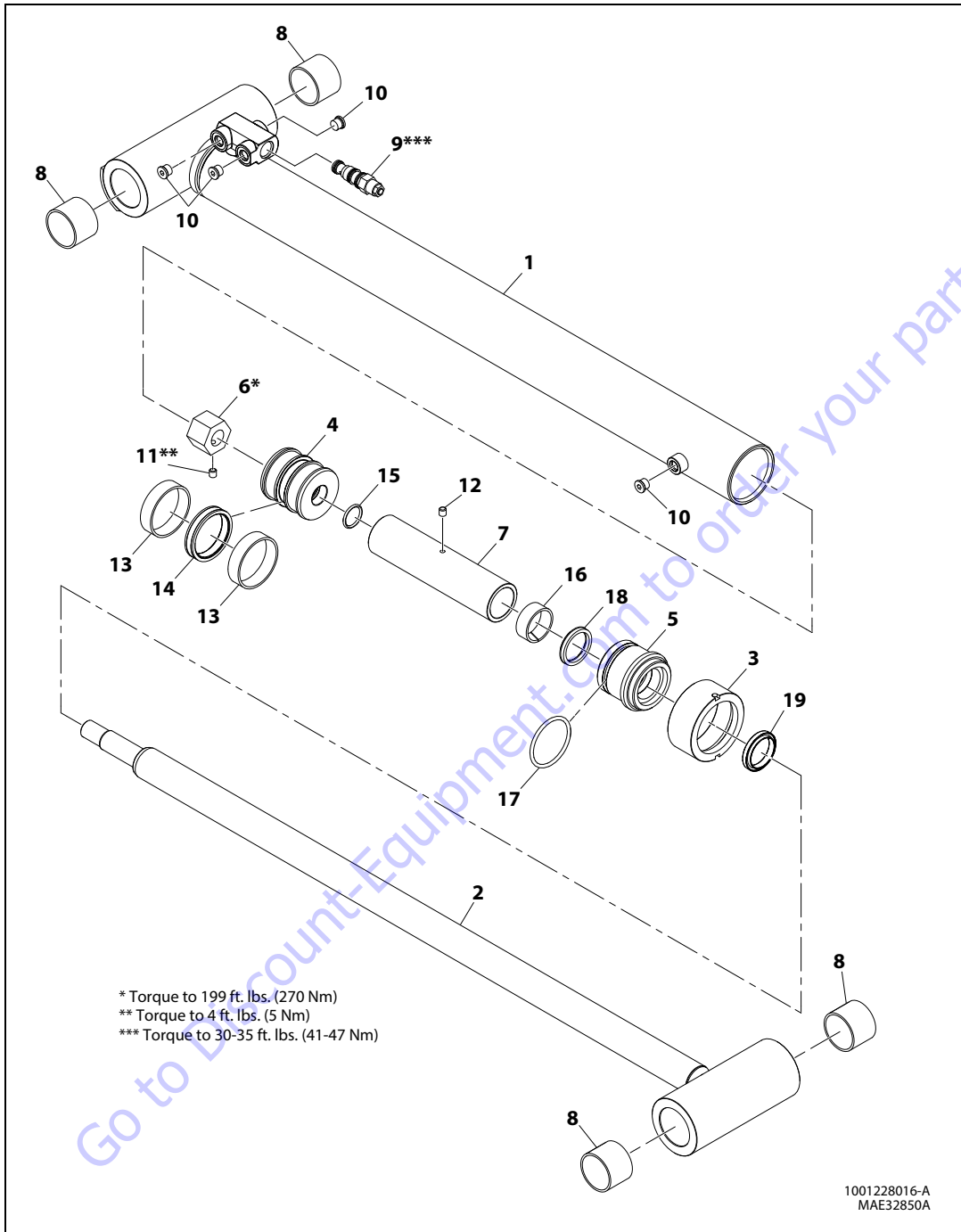
- | | | | | |
|-------------|------------|--------------------|-----------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Wear Ring | 17. O-ring |
| 2. Rod | 6. Locknut | 10. Plug | 14. Piston Seal | 18. Rod Seal |
| 3. Retainer | 7. Spacer | 11. Setscrew | 15. O-ring | 19. Wiper Seal |
| 4. Piston | 8. Bushing | 12. Setscrew | 16. Wear Ring | |

Figure 5-80. Upper Lift Cylinder - E450A (SN 0300235601 through 0300239755), E450AJ/M450AJ (SN 0300208529 through 0300239755, SN B300001429 through B300002486)



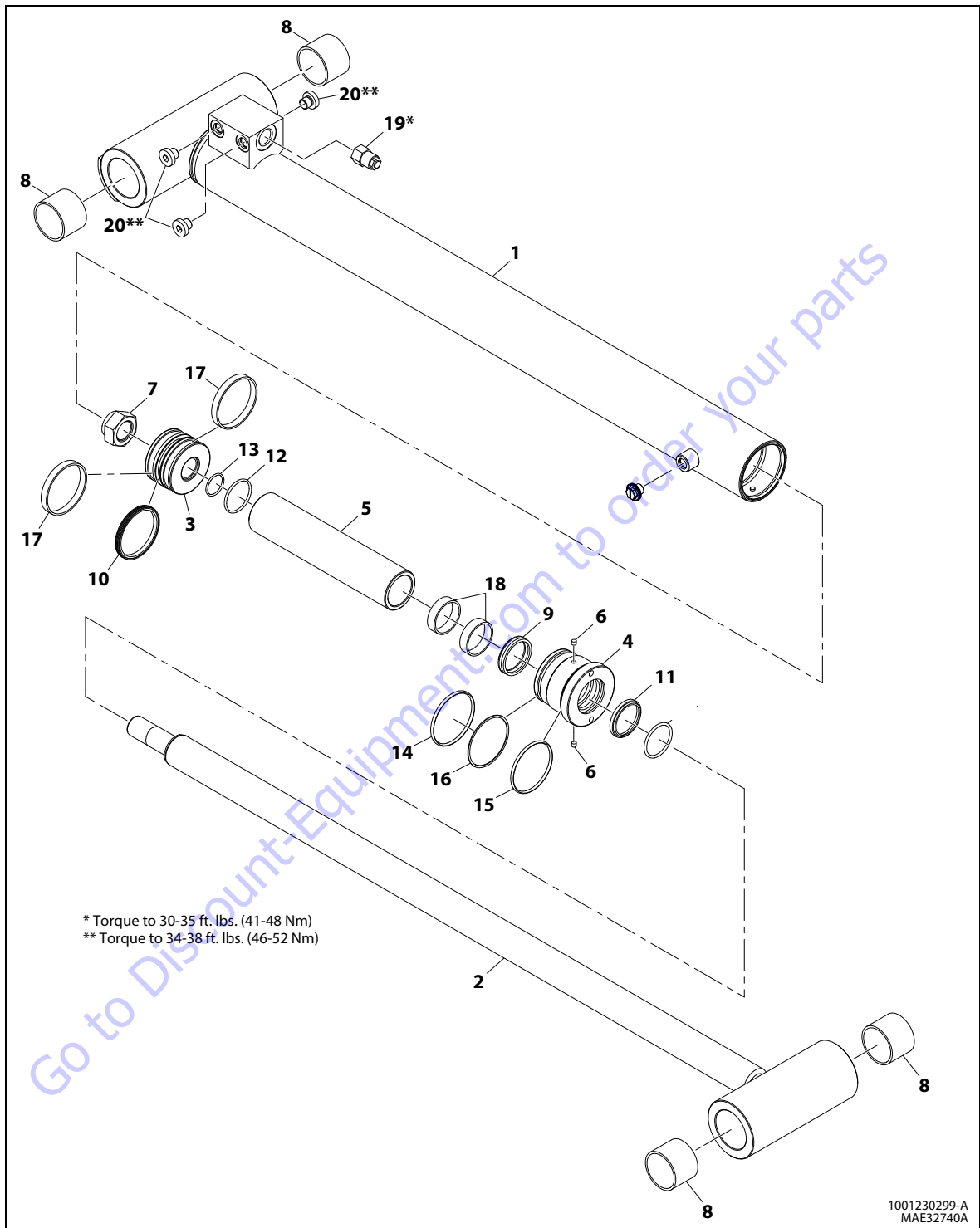
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|-------------|------------|--------------------|-----------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Wear Ring | 17. O-ring |
| 2. Rod | 6. Locknut | 10. Plug | 14. Piston Seal | 18. Rod Seal |
| 3. Retainer | 7. Spacer | 11. Setscrew | 15. O-ring | 19. Wiper Seal |
| 4. Piston | 8. Bushing | 12. Setscrew | 16. Wear Ring | |

Figure 5-81. Upper Lift Cylinder - E450A (SN 0300239756 to Present)



- | | | | | |
|-------------|------------|--------------------|-----------------|----------------|
| 1. Barrel | 5. Head | 9. Cartridge Valve | 13. Wear Ring | 17. O-ring |
| 2. Rod | 6. Locknut | 10. Plug | 14. Piston Seal | 18. Rod Seal |
| 3. Retainer | 7. Spacer | 11. Setscrew | 15. O-ring | 19. Wiper Seal |
| 4. Piston | 8. Bushing | 12. Setscrew | 16. Wear Ring | |

Figure 5-82. Upper Lift Cylinder - E450AJ/M450AJ (SN 0300239756 to Present)



- | | | | | |
|-----------|------------------|-----------------|-----------------|--------------------------|
| 1. Barrel | 5. Spacer | 9. Rod Seal | 13. O-ring | 17. Wear Ring |
| 2. Rod | 6. Locking Piece | 10. Piston Seal | 14. O-ring | 18. Wear Ring |
| 3. Piston | 7. Locknut | 11. Wiper Seal | 15. O-ring | 19. Counterbalance Valve |
| 4. Head | 8. Bushing | 12. O-ring | 16. Backup Ring | 20. Plug |

Figure 5-83. Upper Lift Cylinder - E450AJ/M450AJ (SN B300002487 to Present)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Unscrew the setscrew from the locknut, if applicable.
10. Loosen and remove locknut which attach the piston to the rod.
11. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seals and wear rings.
13. Loosen and remove capscrew which attaches spacer to the rod. Remove Spacer from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

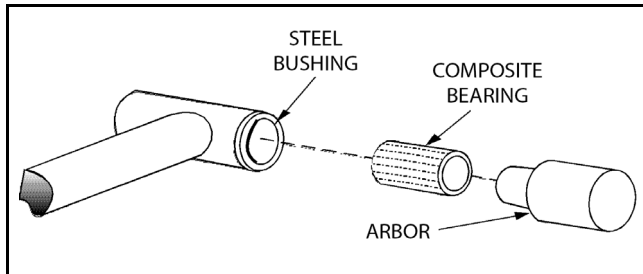


Figure 5-84. Composite Bearing Installation

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 gland groove.

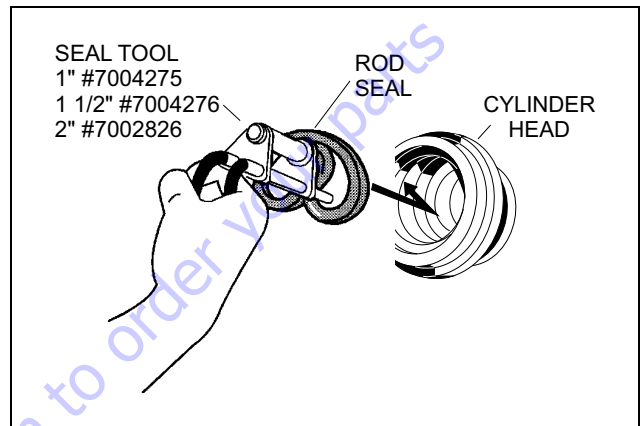


Figure 5-85. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

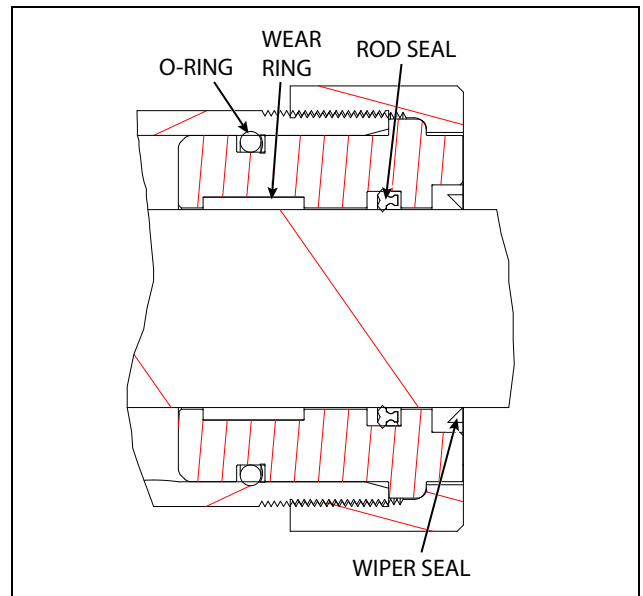


Figure 5-86. Cylinder Head Seal Installation

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

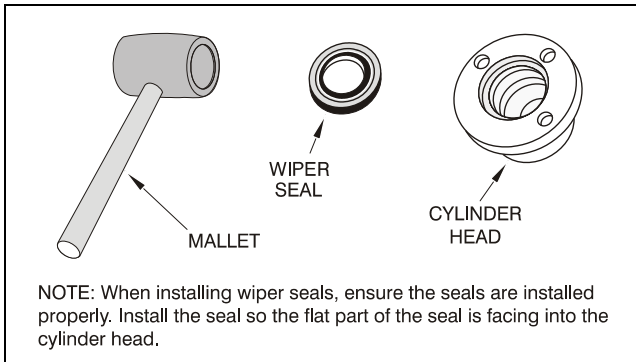


Figure 5-87. Wiper Seal Installation

3. Place a new o-ring in the applicable outside diameter groove of the cylinder head.

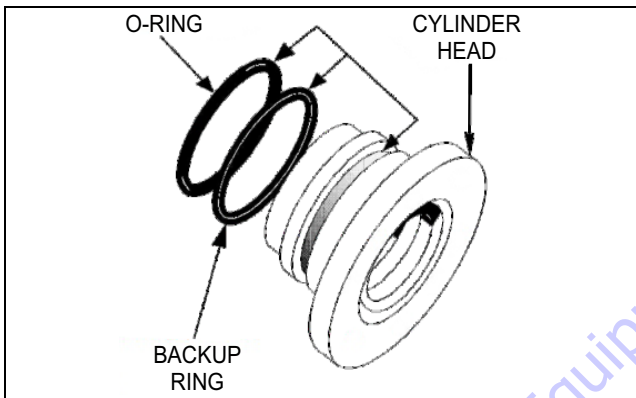


Figure 5-88. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod and use capscrew to attach spacer to the rod.
6. Place a new o-ring and backup rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end.
10. Install the locknut and setscrew on the piston and attach the piston on the rod, if applicable.
11. Install locknut on the piston and attach piston on the rod.

12. Remove the cylinder rod from the holding fixture.
13. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

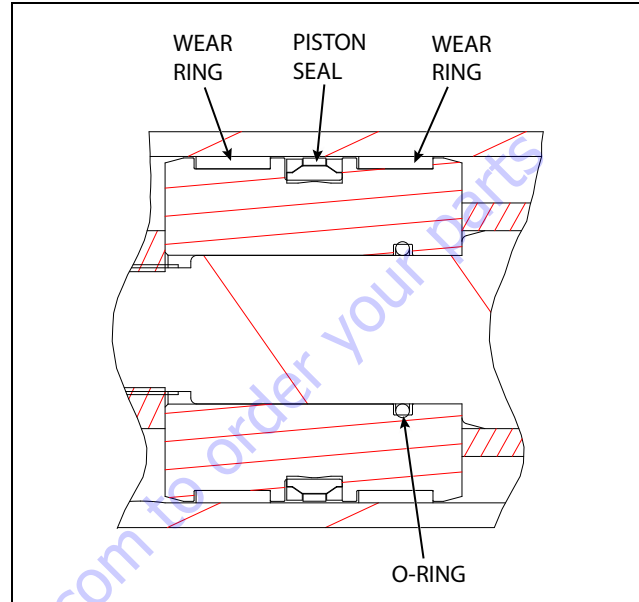


Figure 5-89. Piston Seal Kit Installation

14. 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.

15. 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.
16. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
17. Install cylinder head as mention below:
 - a. Secure the cylinder head gland and the cylinder cap. Refer Figure 5-80.
 - b. Screw the cylinder head into barrel using hook spanner wrench and pin-face spanner wrench. Refer Figure 5-81., Figure 5-82. and Figure 5-83.
18. 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.
19. Install the cartridge holding valves in the rod port block. Torque to 30-35 ft. lbs. (40-47 Nm).

Master Cylinder (E450A only)

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.

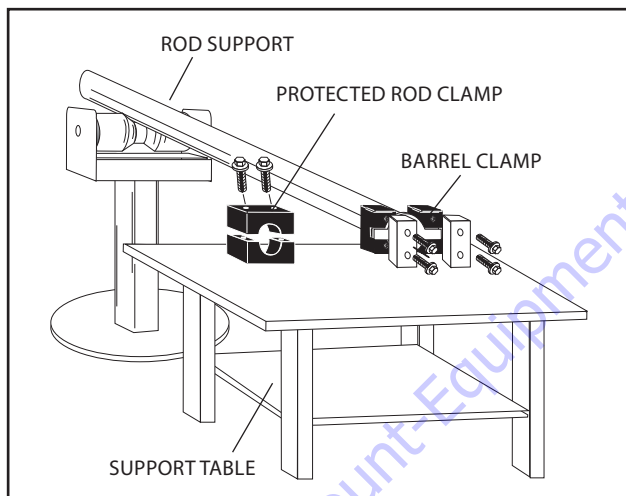


Figure 5-90. Cylinder Barrel Support

4. Using a spanner wrench, unscrew the cylinder head from the 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.

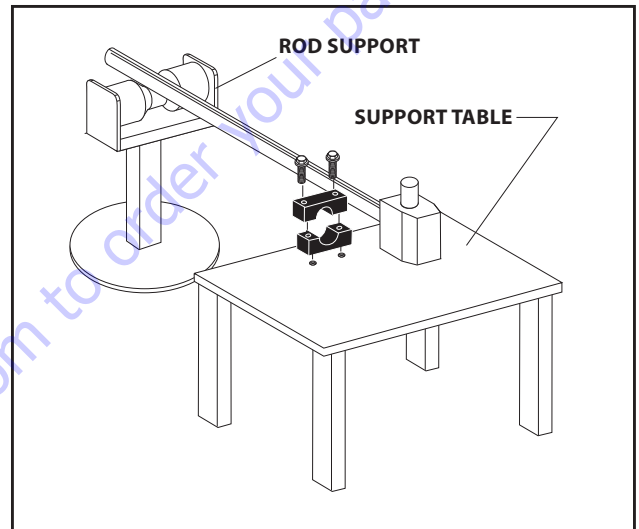
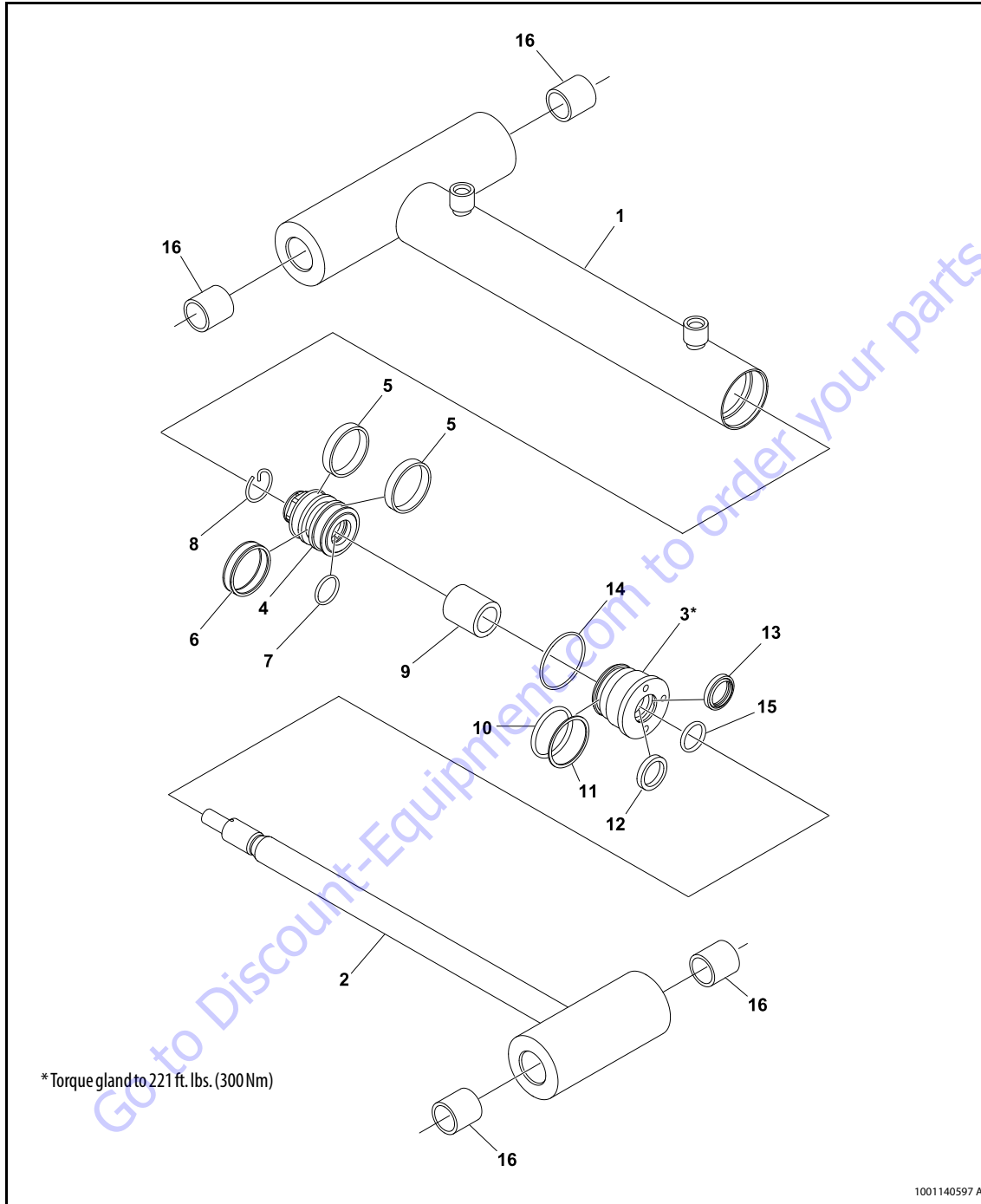


Figure 5-91. Cylinder Rod Support



- | | | | |
|-----------|----------------|-----------------|----------------|
| 1. Barrel | 5. Wear Ring | 9. Spacer | 13. Wiper Seal |
| 2. Rod | 6. Piston Seal | 10. O-ring | 14. O-ring |
| 3. Head | 7. O-ring | 11. Backup Ring | 15. O-ring |
| 4. Piston | 8. Retainer | 12. Rod Seal | 16. Bushing |

Figure 5-92. Master Cylinder (E450A only)

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 retainer from the cylinder rod.
9. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seals and wear rings.
11. Remove piston spacer from the rod.
12. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

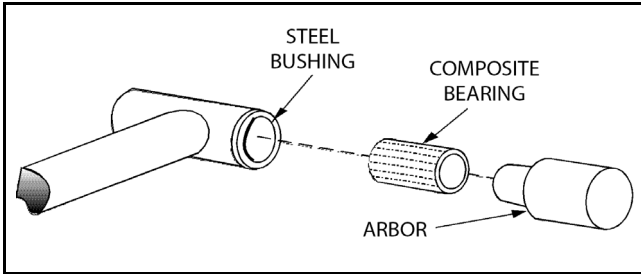


Figure 5-93. Composite Bearing Installation

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 gland groove.

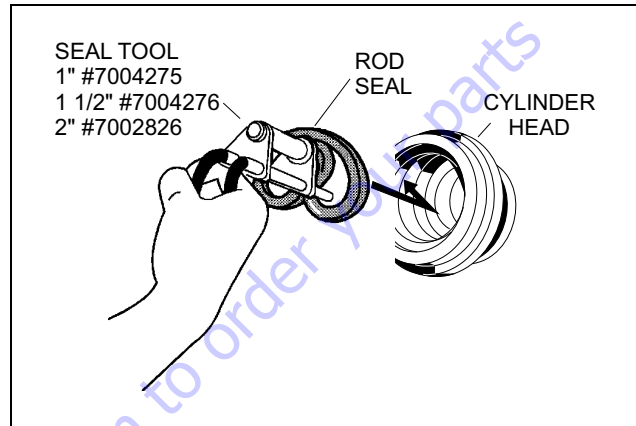


Figure 5-94. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

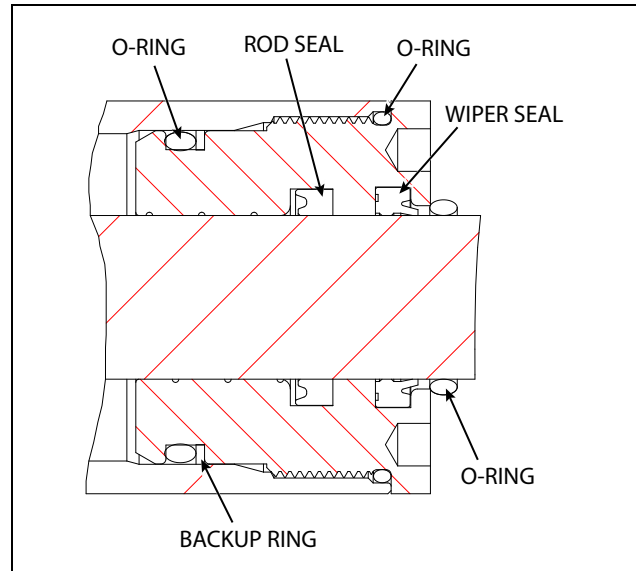


Figure 5-95. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove.

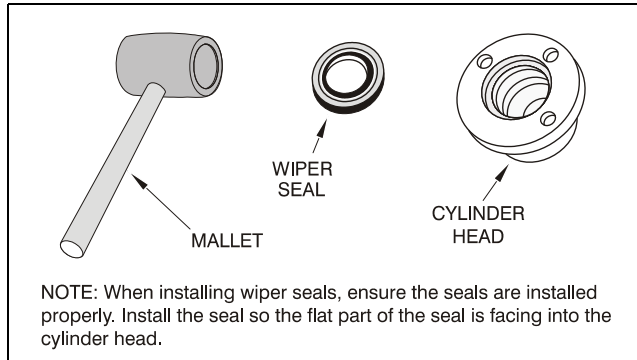


Figure 5-96. Wiper Seal Installation

3. Place a new o-rings and backup seal in the applicable outside diameter groove of the cylinder head.

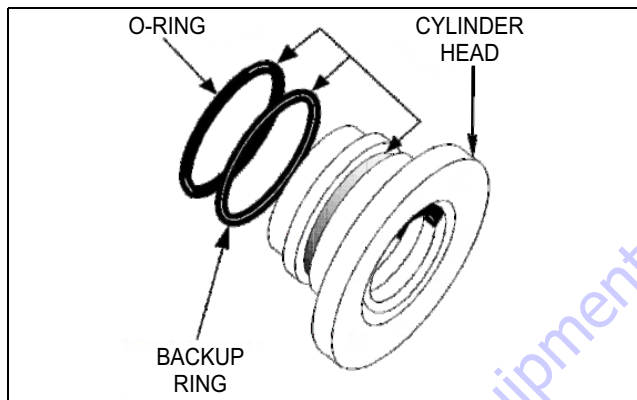


Figure 5-97. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer.
10. Remove the cylinder rod from the holding fixture.

11. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

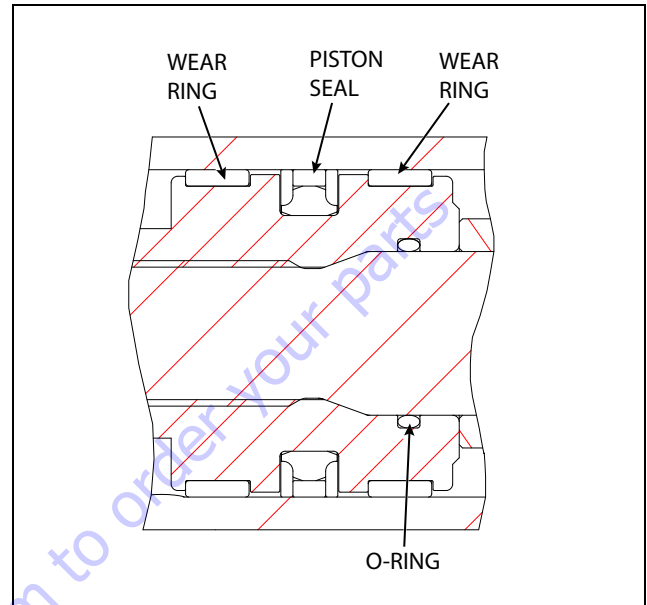


Figure 5-98. Piston Seal Kit Installation

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 ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Screw the cylinder head gland into the barrel using a spanner wrench. Torque gland to 221 ft. lbs. (300 Nm).
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.

Master Cylinder E/M450AJ

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.

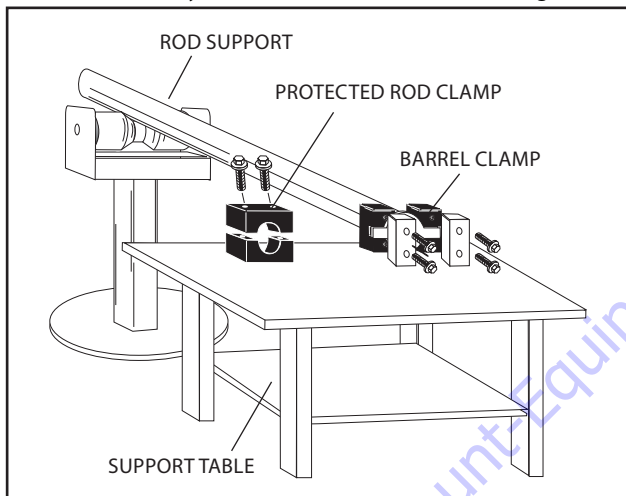


Figure 5-99. Cylinder Barrel Support

4. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel.

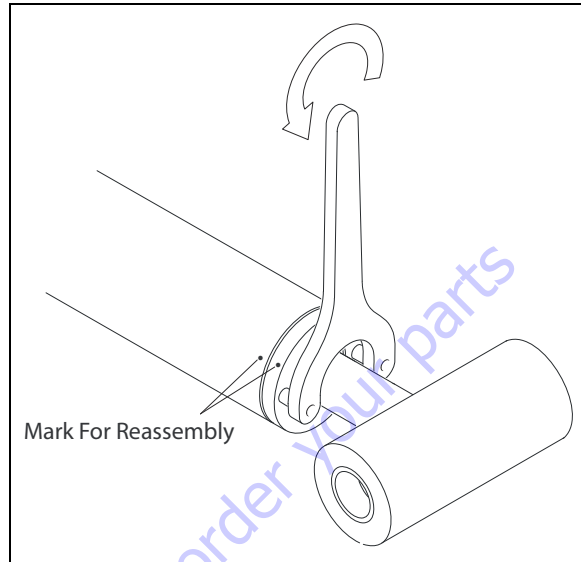


Figure 5-100. Cylinder Head Removal

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.

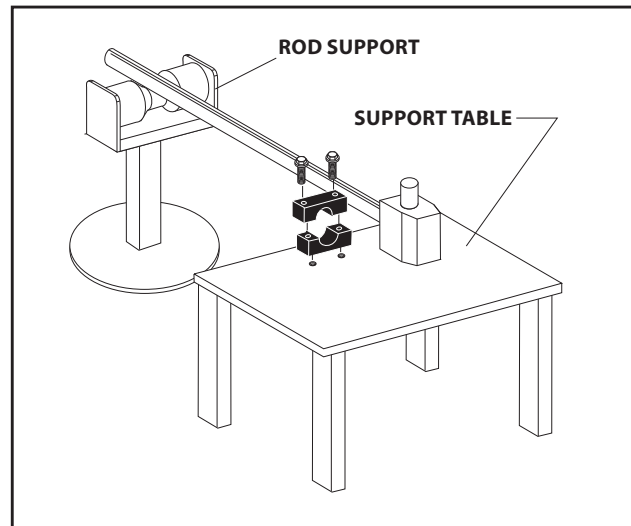
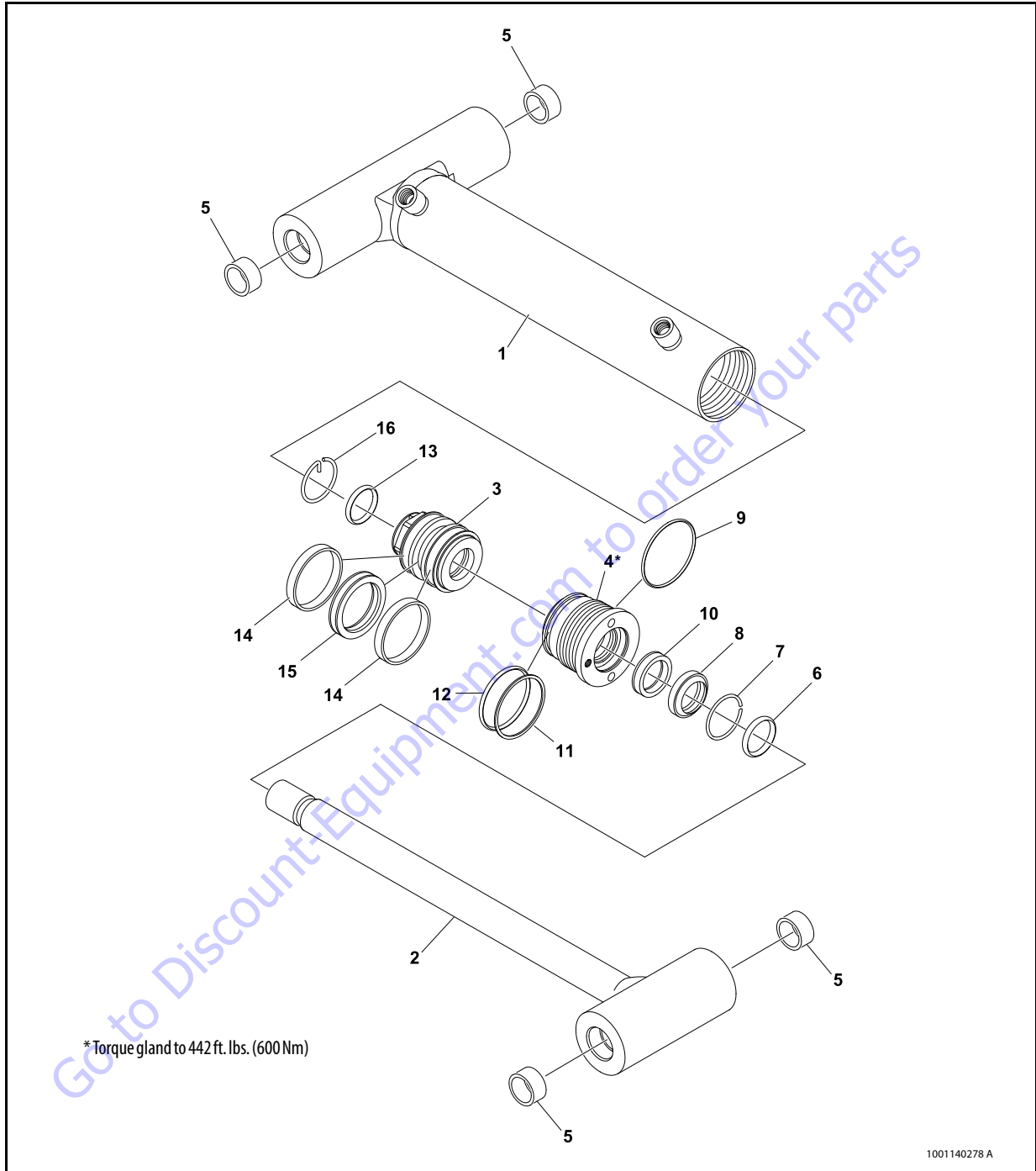
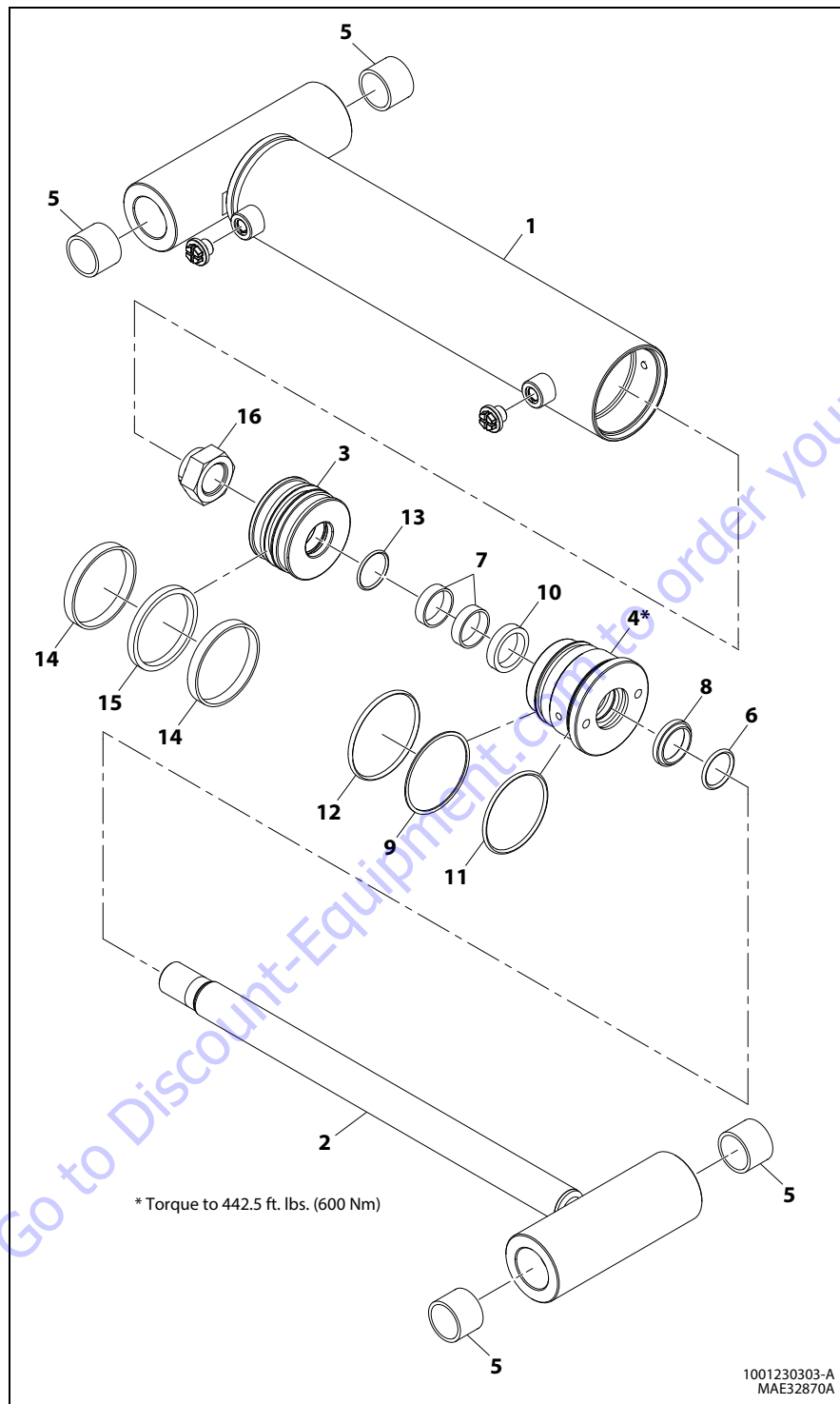


Figure 5-101. Cylinder Rod Support



- | | | | |
|-----------|-------------------|-----------------|-----------------|
| 1. Barrel | 5. Bushing | 9. O-ring | 13. O-ring |
| 2. Rod | 6. O-ring | 10. Rod Seal | 14. Wear Ring |
| 3. Head | 7. Retaining Ring | 11. Backup Ring | 15. Piston Seal |
| 4. Piston | 8. Wiper Seal | 12. O-ring | 16. Retainer |

Figure 5-102. Master Cylinder E/M450AJ (SN 0300208529 to Present, SN B300001429 through B300002486)



- | | | | |
|-----------|---------------|-----------------|-----------------|
| 1. Barrel | 5. Bushing | 9. O-ring | 13. O-ring |
| 2. Rod | 6. O-ring | 10. Rod Seal | 14. Wear Ring |
| 3. Piston | 7. Wear Ring | 11. Backup Ring | 15. Piston Seal |
| 4. Head | 8. Wiper Seal | 12. O-ring | 16. Locknut |

Figure 5-103. Master Cylinder E/M450AJ (SN B3000024867 to Present)

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Piston removal for Figure 5-102. as mention below:
 - a. Remove the retainer from the cylinder rod.
 - b. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
9. Piston removal for Figure 5-103. as mention below:
 - a. Loosen and remove locknut which attaches the piston to the rod.
 - b. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seals and wear rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, retaining rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

NOTE: Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.

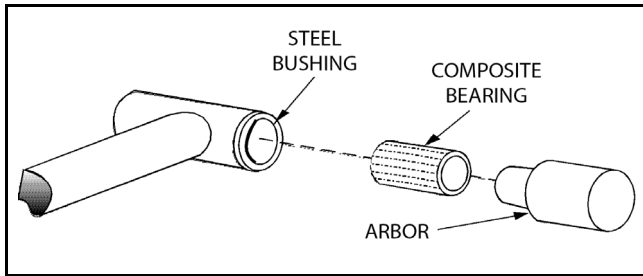


Figure 5-104. Composite Bearing Installation

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 gland groove.

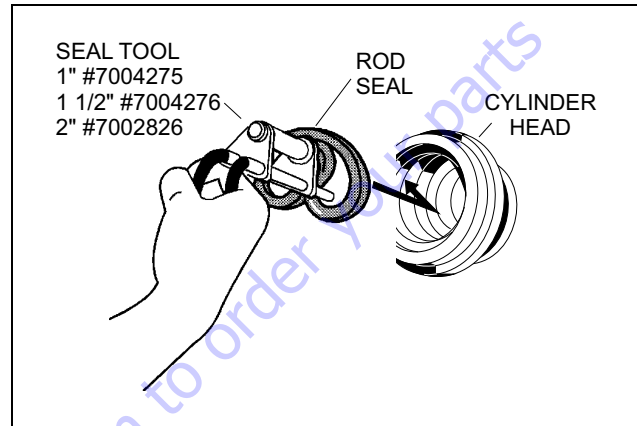


Figure 5-105. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

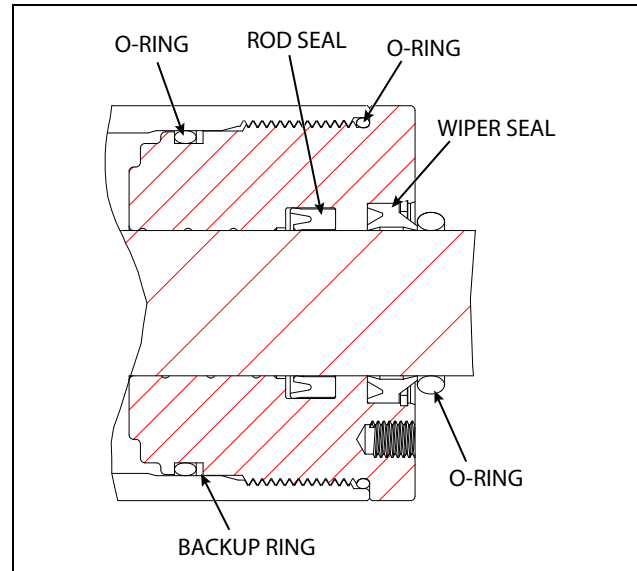


Figure 5-106. Cylinder Head Seal Installation

- Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new retaining ring into the applicable cylinder head gland groove.

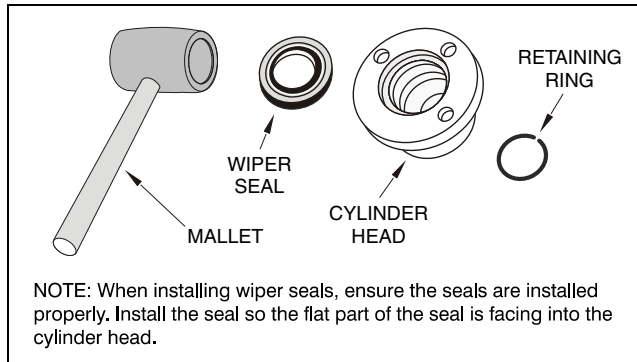


Figure 5-107. Wiper Seal Installation

- Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder head.

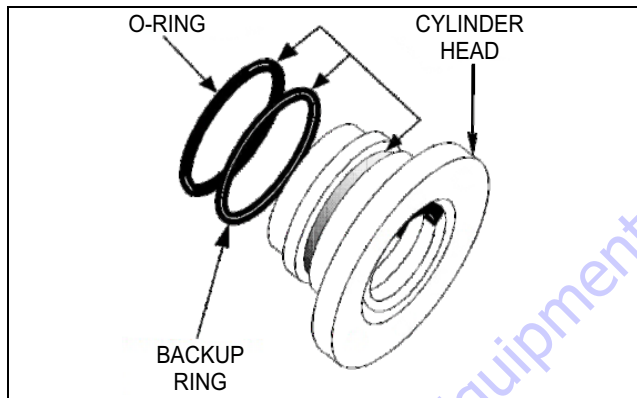


Figure 5-108. Installation of Head Seal Kit

- Install o-ring onto the cylinder rod. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
- Place a new o-ring in the inner piston diameter groove.
- Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
- Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
- Thread piston onto rod until it abuts the spacer end and install the retainer.
- Remove the cylinder rod from the holding fixture.

- Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

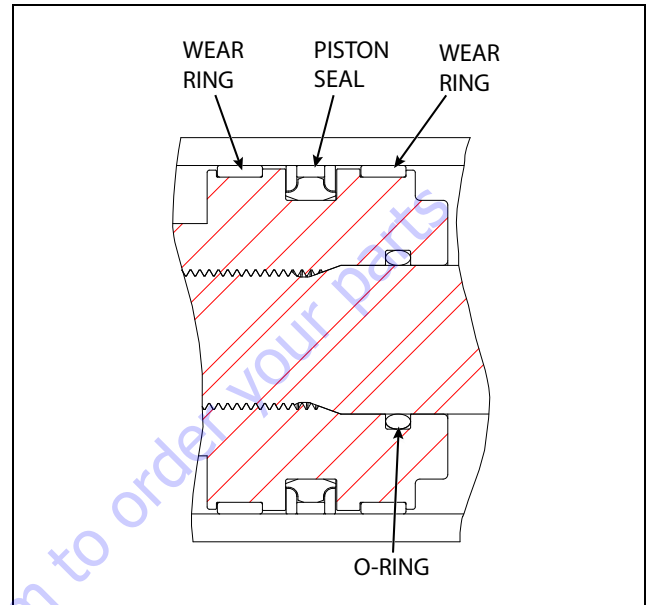


Figure 5-109. Piston Seal Kit Installation

- 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.

- 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.
- Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
- Screw the cylinder head gland into the barrel using a pin-face spanner wrench. Torque gland to 442 ft. lbs. (600 Nm).
- 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.

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.

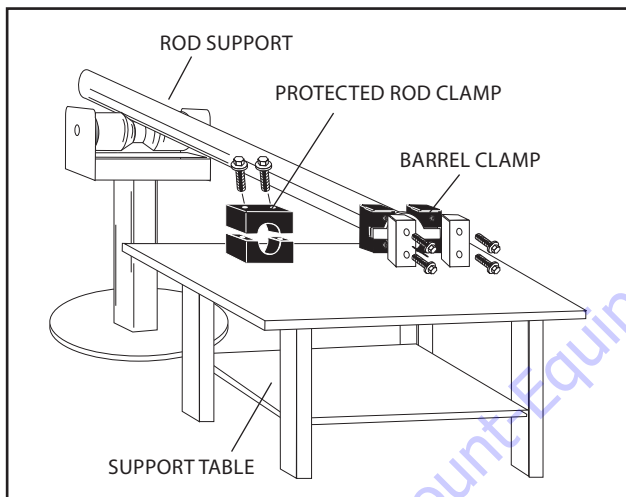


Figure 5-110. Cylinder Barrel Support

4. Using a hook spanner, loosen and remove spanner nut from cylinder barrel.

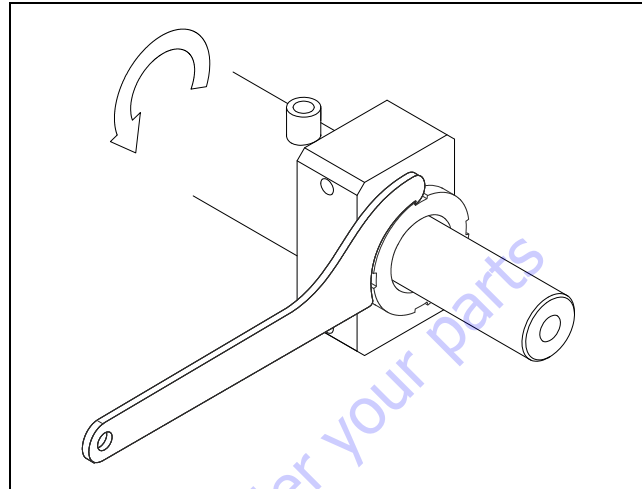


Figure 5-111. Spanner Nut Removal

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.

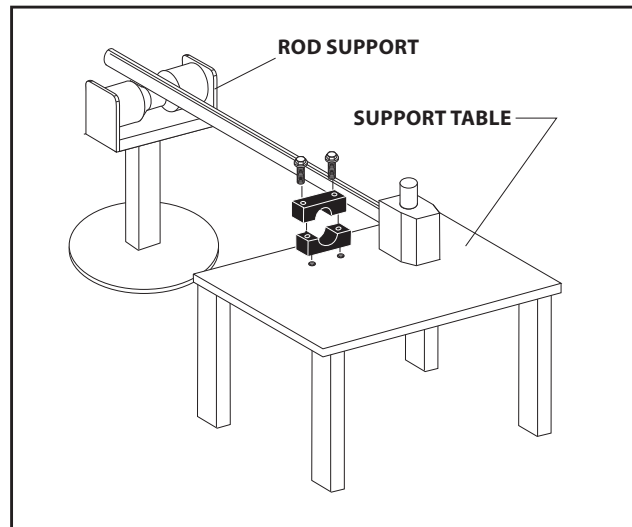
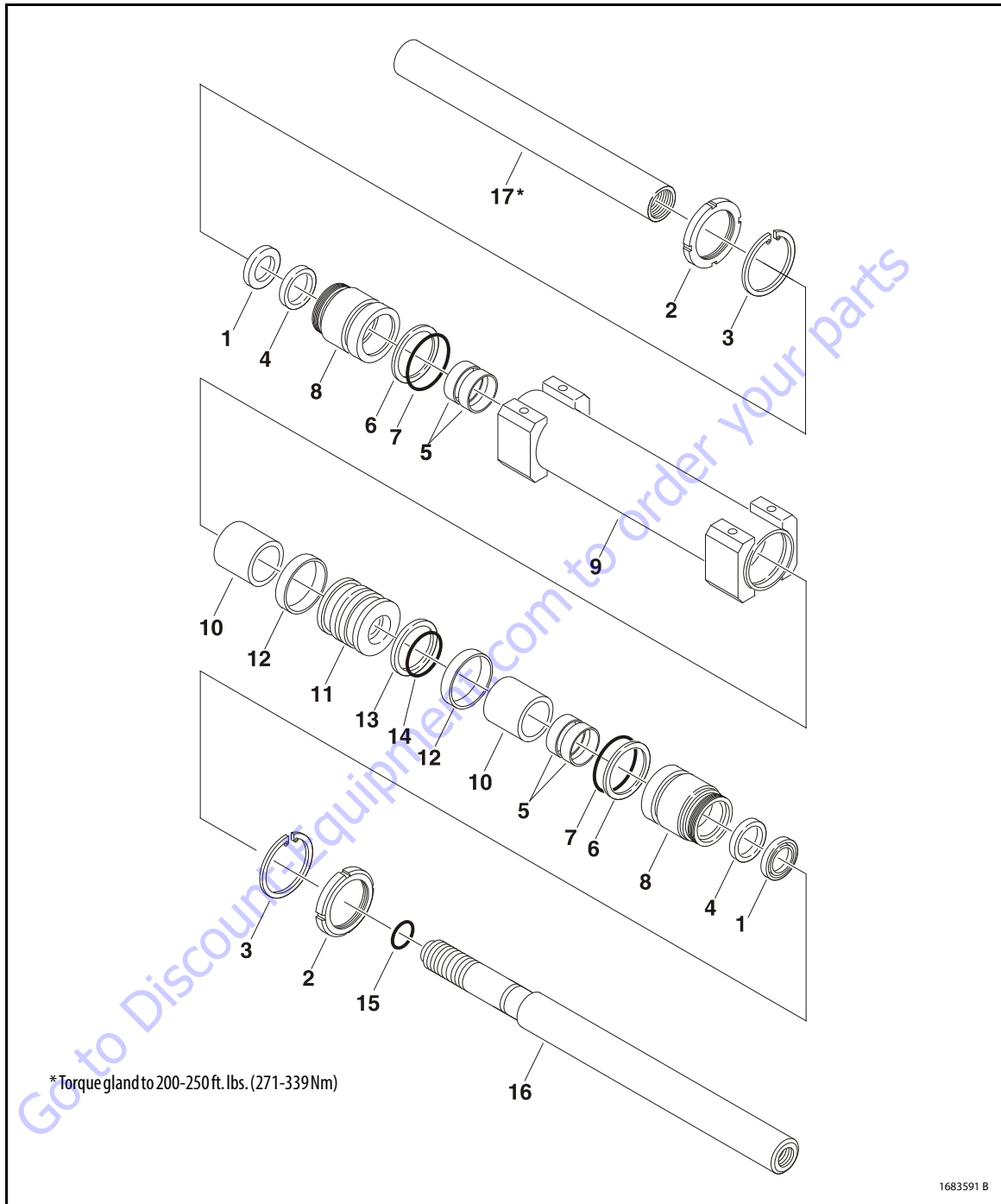


Figure 5-112. Cylinder Rod Support



- | | | | |
|-------------------|----------------|---------------|------------|
| 1. Wiper | 6. Backup Ring | 10. Tube | 14. O-ring |
| 2. Spanner Nut | 7. O-ring | 11. Piston | 15. O-ring |
| 3. Retaining Ring | 8. Guide | 12. Wear Ring | 16. Rod |
| 4. Lip Seal | 9. Barrel | 13. Seal | 17. Rod |
| 5. Wear Ring | | | |

Figure 5-113. 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. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
9. Remove and discard the piston o-rings, seals and wear rings.
10. Remove bushings from the rod.
11. Remove the rod from the holding fixture. Remove the cylinder guide gland, Discard the wear ring, backup rings, o-rings, retaining rings, lip 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 gland groove.

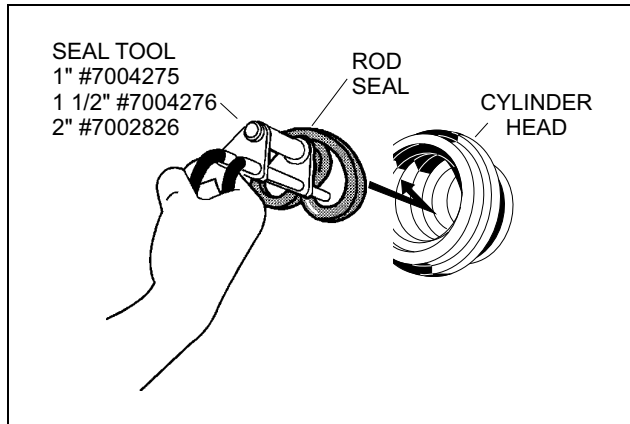


Figure 5-114. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

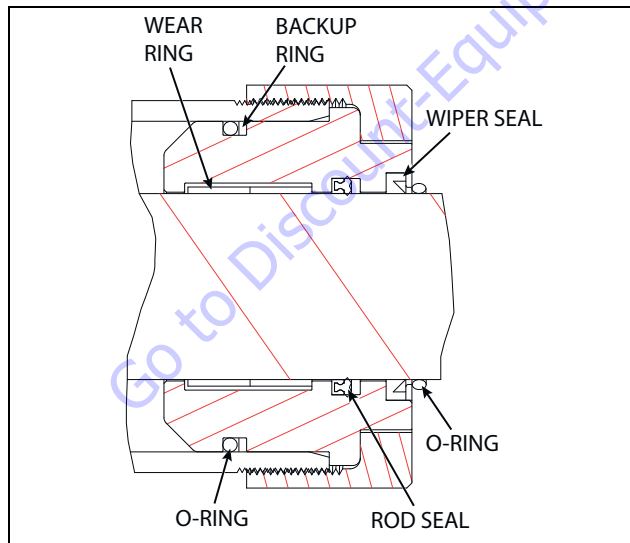
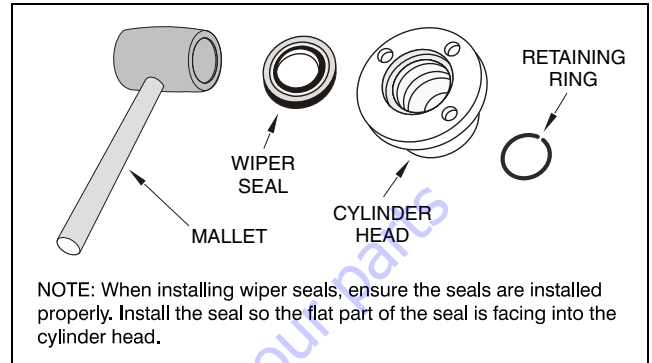


Figure 5-115. Cylinder Head Seal Installation

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 5-116. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder guide.

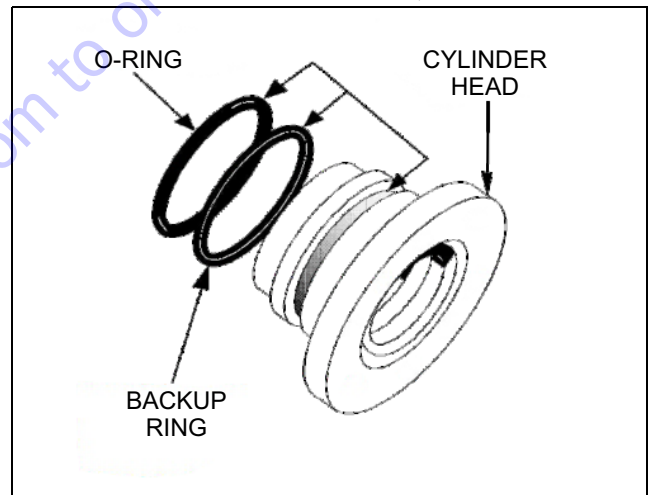


Figure 5-117. Installation of Head Seal Kit

4. Install the guide gland on the rod, ensuring that the wiper and lip seals are not damaged or dislodged. Push the guide along the rod to the rod end.
5. Push the piston tube onto the rod.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Place a new o-ring in the inner piston diameter groove.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the piston tube end.
10. Install the piston tube onto the rod.
11. Remove the cylinder rod from the holding fixture.

12. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

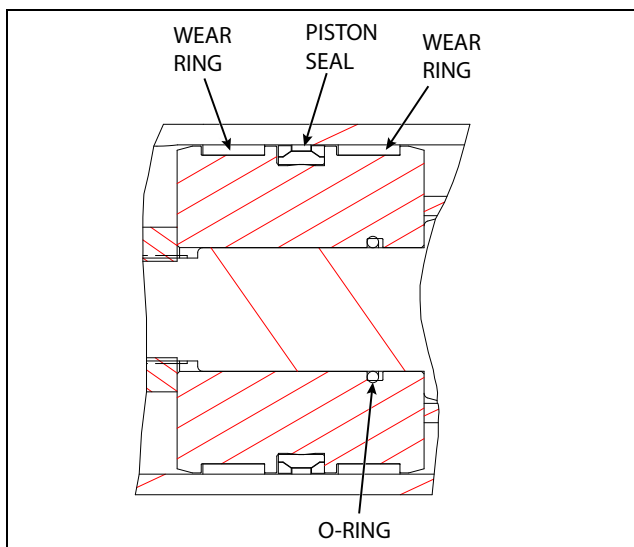


Figure 5-118. Piston Seal Kit Installation

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 are not damaged or dislodged.
15. Screw both the cylinder rod ends and torque to 200-250 ft lbs. (271-339 Nm).
16. Continue pushing the rod into the barrel until the cylinder guide gland can be inserted into the barrel cylinder.
17. Using a hook spanner, install spanner nut into the cylinder barrel.
18. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

Telescope Cylinder (E450A only)

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 counterbalance valve and fittings from the cylinder port block. Remove wear pads from the cylinder.
4. Place the cylinder barrel into a suitable holding fixture.

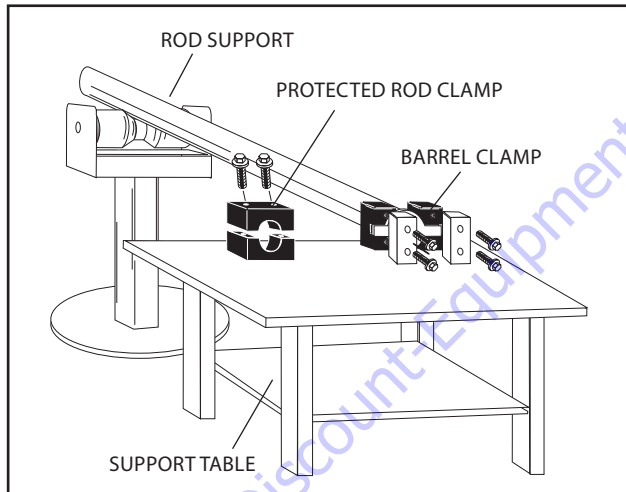


Figure 5-119. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew the cylinder cap from the barrel.

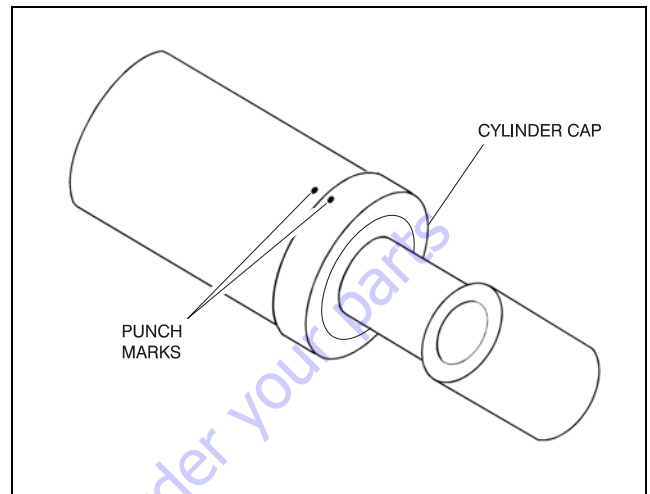


Figure 5-120. Cylinder Cap Removal

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.

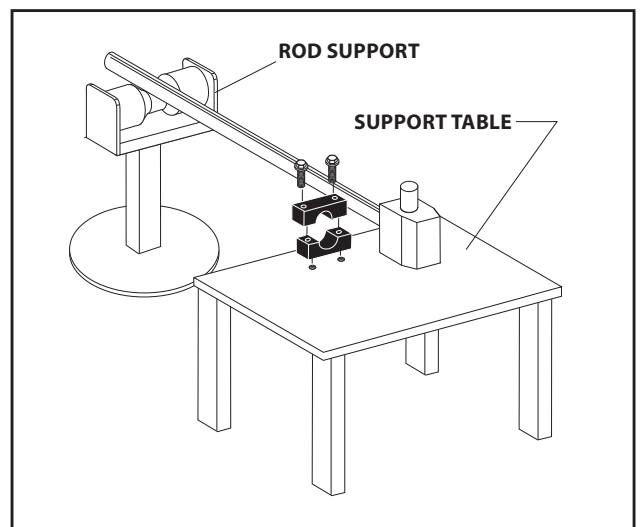
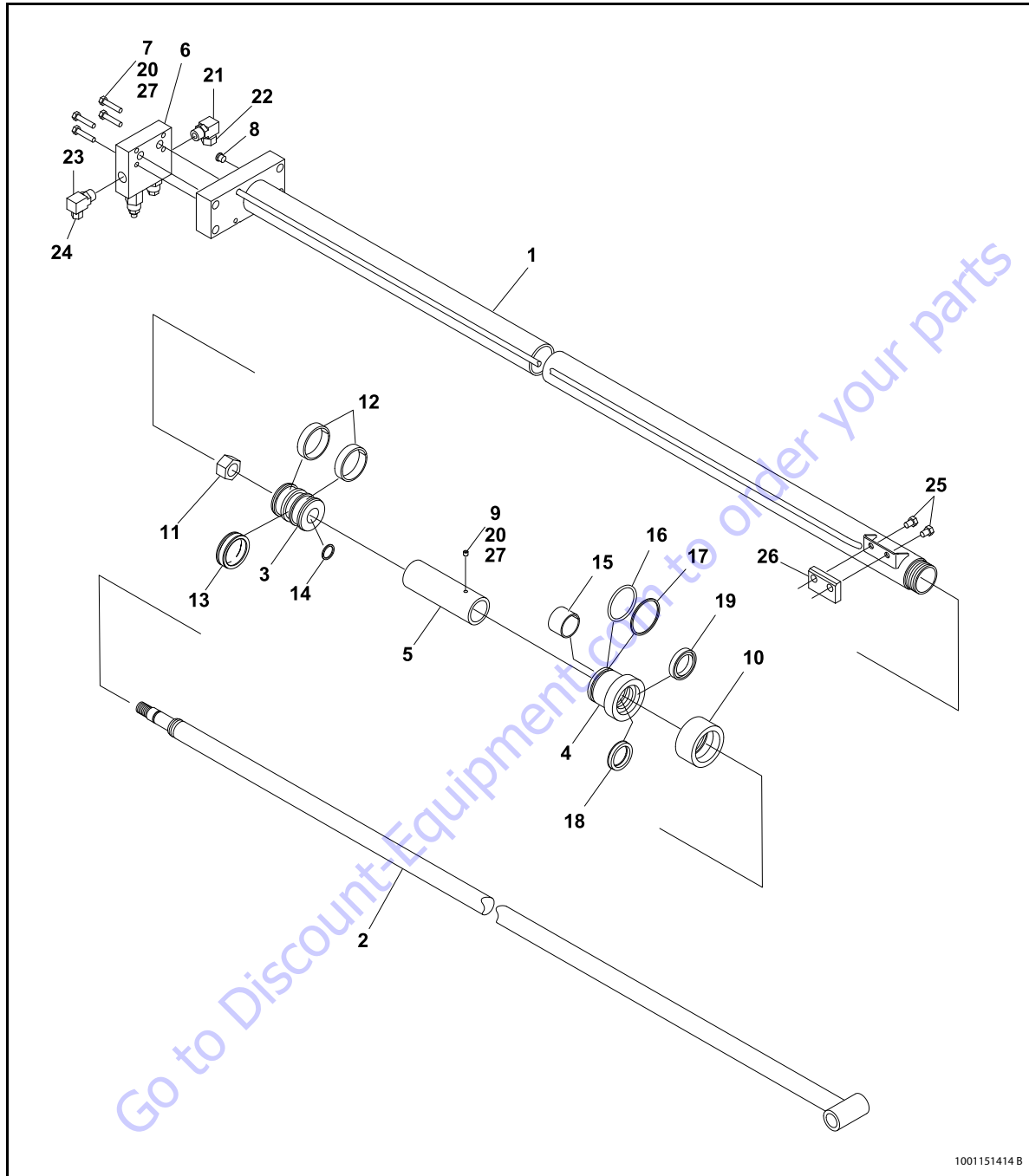


Figure 5-121. Cylinder Rod Support

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS



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- | | | | | |
|-------------------------|---------------|-----------------|--------------------|-----------------------|
| 1. Barrel | 7. Bolt | 13. Cap Seal | 18. Rod Seal | 23. Fitting |
| 2. Rod | 8. Plug | 14. O-ring | 19. Wiper Seal | 24. Cap Fitting |
| 3. Piston | 9. Setscrew | 15. Wear Ring | 20. Locking Primer | 25. Bolt |
| 4. Head | 10. End Cap | 16. O-ring | 21. Fitting | 26. Wear Pad |
| 5. Spacer | 11. Locknut | 17. Backup Ring | 22. Cap Fitting | 27. JLG Thread Locker |
| 6. Counterbalance Valve | 12. Wear Ring | | | |

Figure 5-122. Telescope Cylinder (E450A only)

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 nut which attaches 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 o-rings, cap seals and wear rings.
12. Loosen and remove setscrew which attaches the spacer to the rod. Remove the spacer.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, wear rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

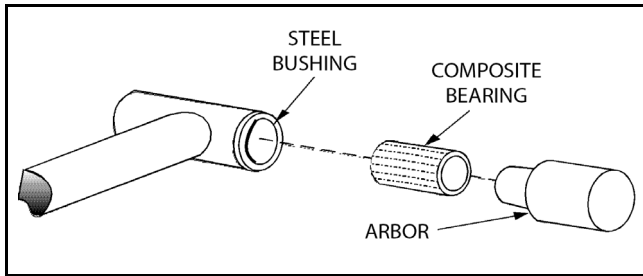


Figure 5-123. Composite Bearing Installation

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 gland groove.

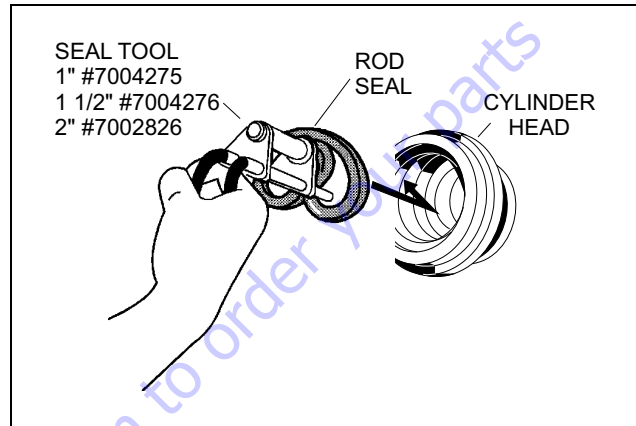


Figure 5-124. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

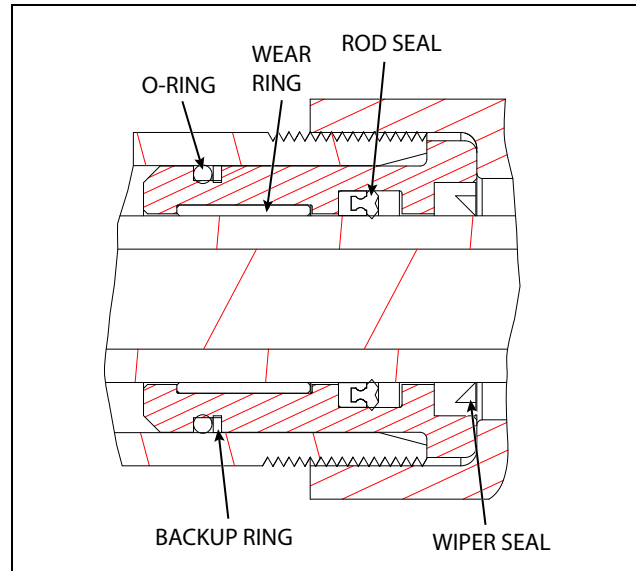


Figure 5-125. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove.

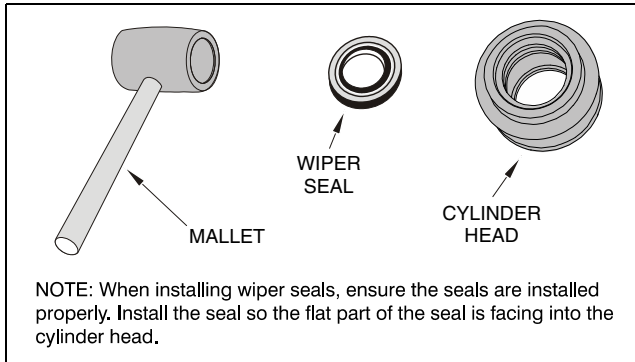


Figure 5-126. Wiper Seal Installation

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

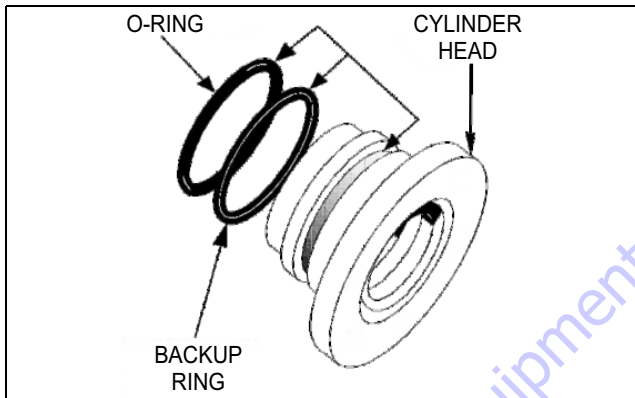


Figure 5-127. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod and use setscrew to attach spacer to the rod.
6. Place a new o-ring in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer.
10. Remove the cylinder rod from the holding fixture.

11. Place new cap seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

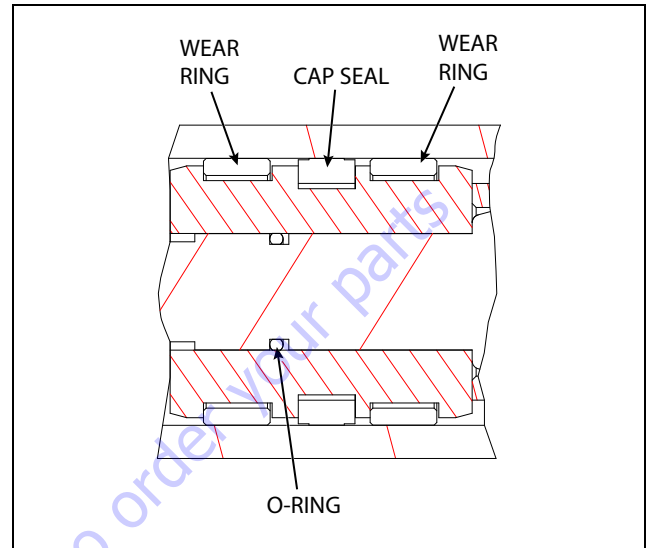


Figure 5-128. Piston Seal Kit Installation

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 ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Secure the cylinder head gland and the cylinder cap.
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.
17. Install the counterbalance valves in the rod port block.
18. Install wear pad onto the cylinder.

Telescope Cylinder E/M450AJ

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 counterbalance valve and fittings from the cylinder port block. Remove wear pads from the cylinder.
4. Place the cylinder barrel into a suitable holding fixture.

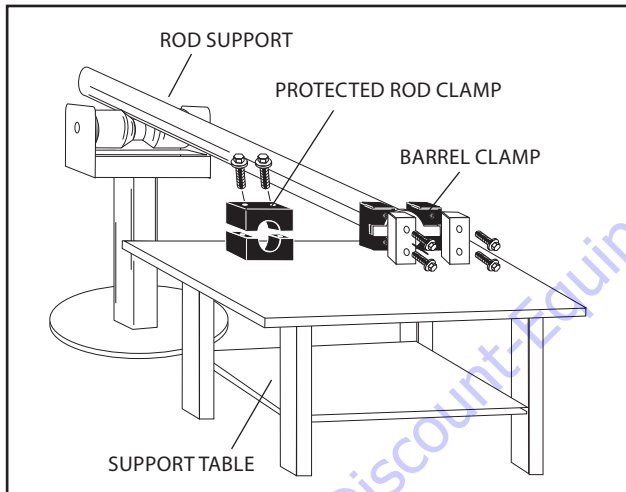


Figure 5-129. Cylinder Barrel Support

5. Remove cylinder head as mention below:
 - a. Mark cylinder head and barrel with a center punch for easy realignment. Unscrew the cylinder cap from the barrel. Refer Figure 5-133.

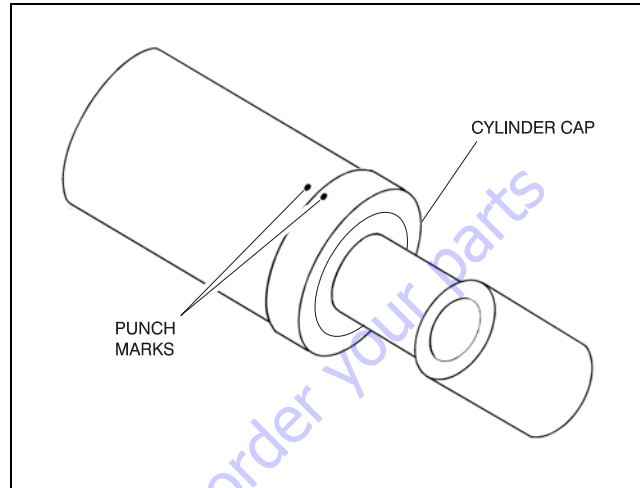


Figure 5-130. Cylinder Cap Removal

- b. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel. Refer Figure 5-134.

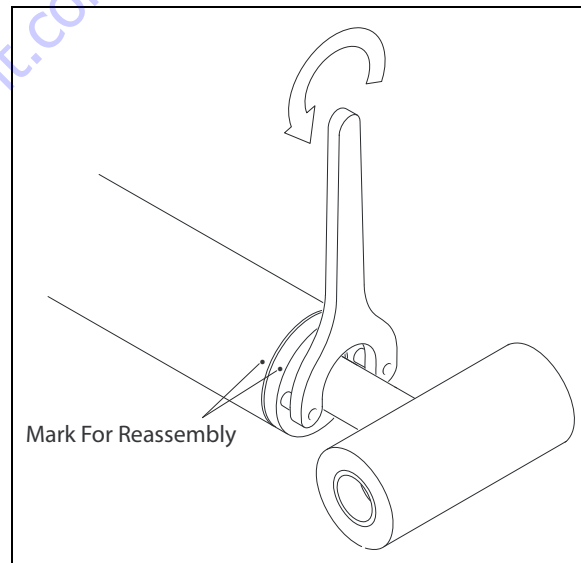


Figure 5-131. Cylinder Head Removal

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.

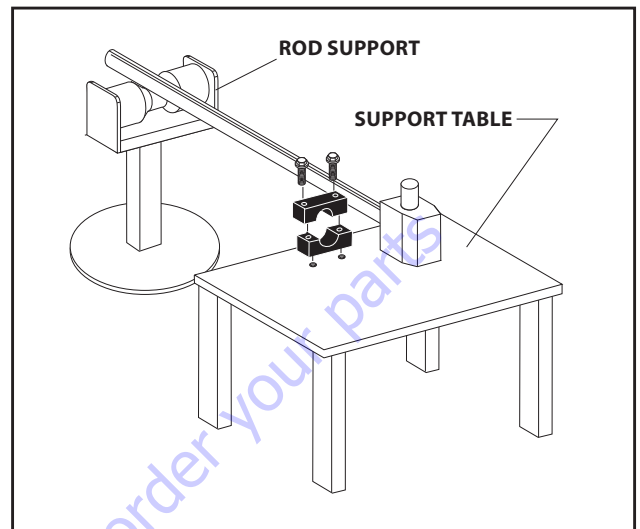
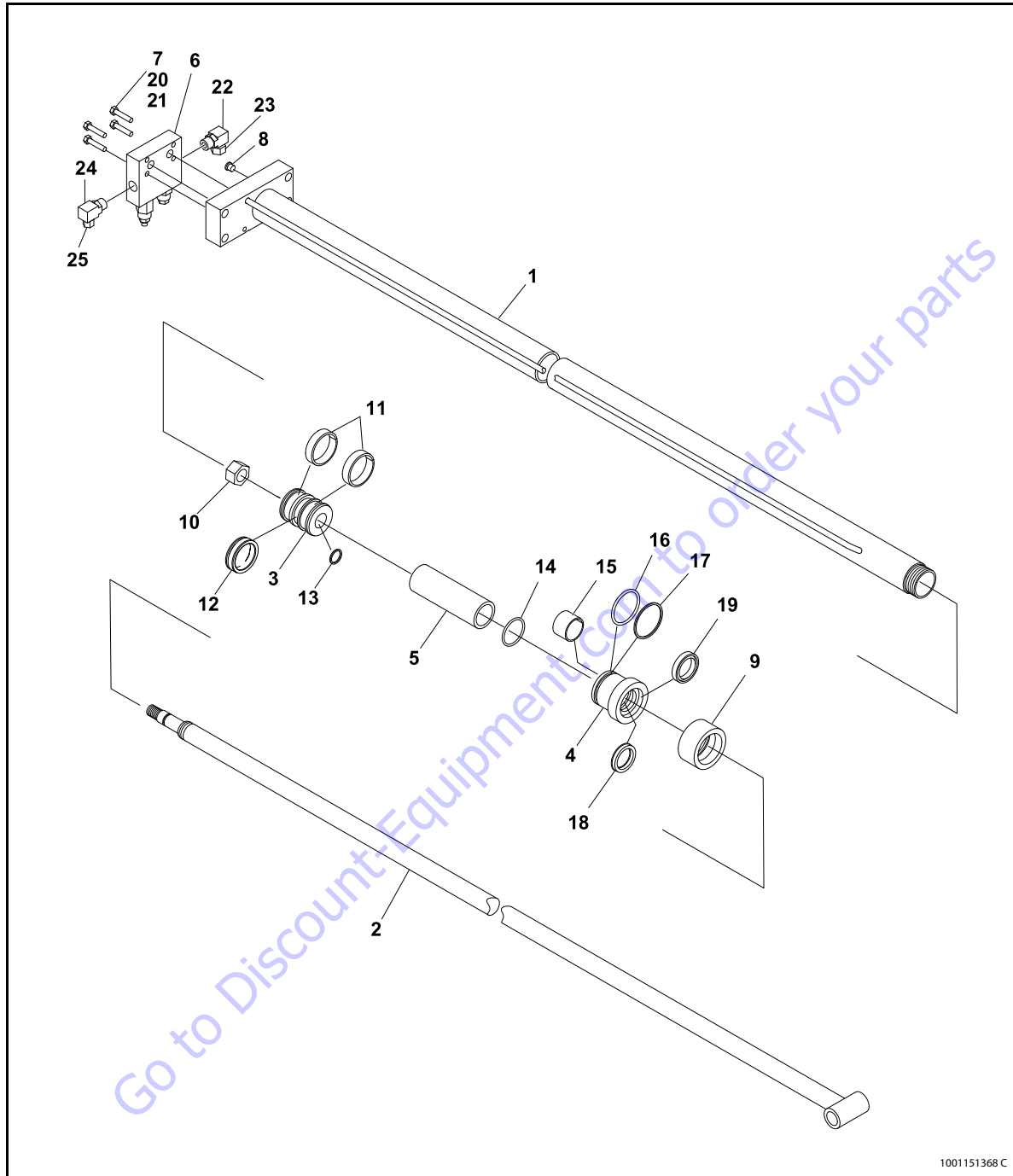


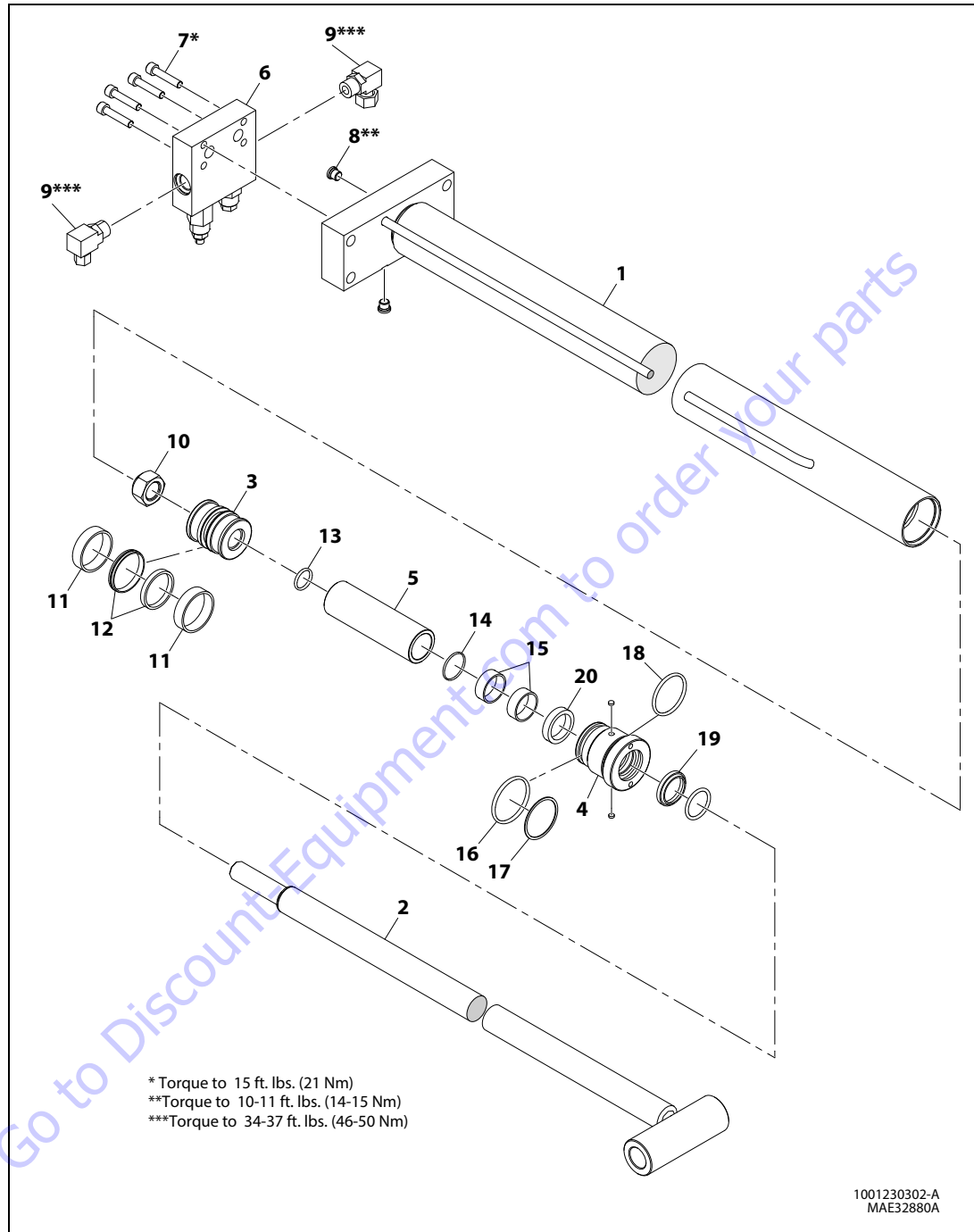
Figure 5-132. Cylinder Rod Support



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- | | | | | |
|-----------|-------------------------|---------------|-----------------------|--------------------|
| 1. Barrel | 6. Counterbalance Valve | 11. Wear Ring | 16. O-ring | 21. Locking Primer |
| 2. Rod | 7. Bolt | 12. Cap Seal | 17. Backup Ring | 22. Fitting |
| 3. Piston | 8. Plug | 13. O-ring | 18. Rod Seal | 23. Cap Fitting |
| 4. Head | 9. End Cap | 14. O-ring | 19. Wiper Seal | 24. Fitting |
| 5. Spacer | 10. Locknut | 15. Wear Ring | 20. JLG Thread Locker | 25. Cap Fitting |

Figure 5-133. Telescope Cylinder - E/M450AJ (SN 0300208529 to Present, SN B300001429 through B300002486)



- | | | | | |
|-----------|----------------------------------|---------------|---------------|-----------------|
| 1. Barrel | 5. Spacer | 9. Fitting | 13. O-ring | 17. Backup Ring |
| 2. Rod | 6. Counterbalance Valve Assembly | 10. Locknut | 14. O-ring | 18. O-ring |
| 3. Piston | 7. Bolt | 11. Wear Ring | 15. Wear Ring | 19. Wiper Seal |
| 4. Head | 8. Plug | 12. Cap Seal | 16. O-ring | 20. Rod Seal |

Figure 5-134. Telescope Cylinder - E450AJ/M450AJ (SN B300002487 to Present)

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 nut which attaches 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 o-rings, cap seals and wear rings.
12. Remove piston spacer from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, wear rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect 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.

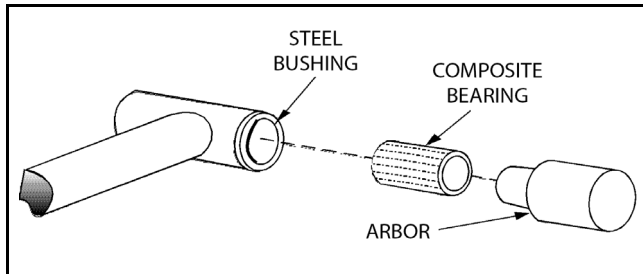


Figure 5-135. Composite Bearing Installation

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 gland groove.

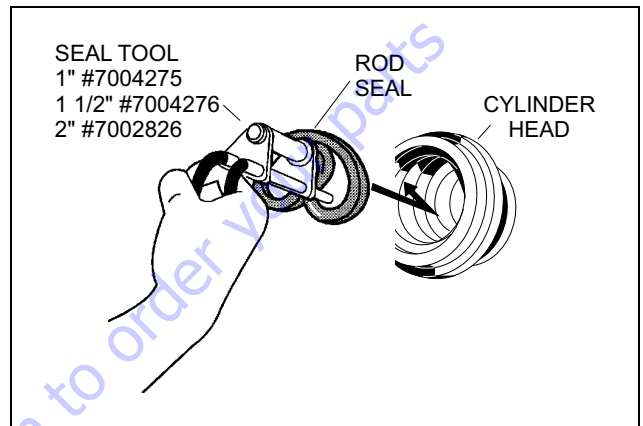


Figure 5-136. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

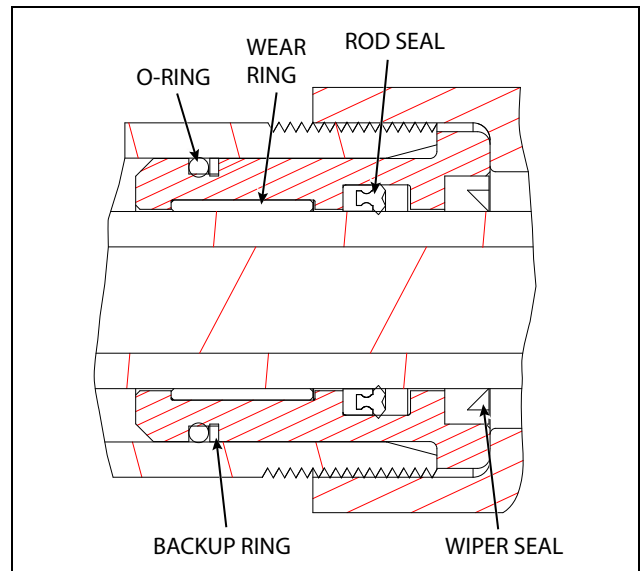


Figure 5-137. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove.

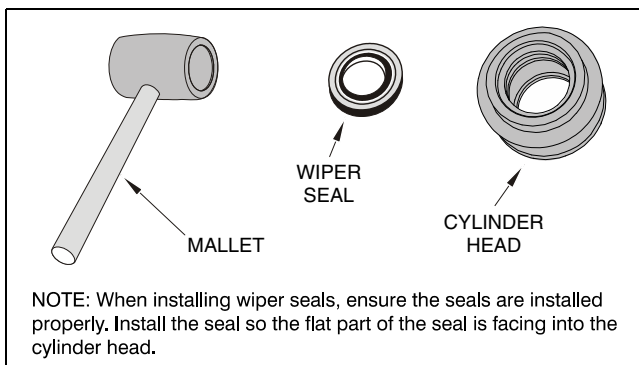


Figure 5-138. Wiper Seal Installation

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

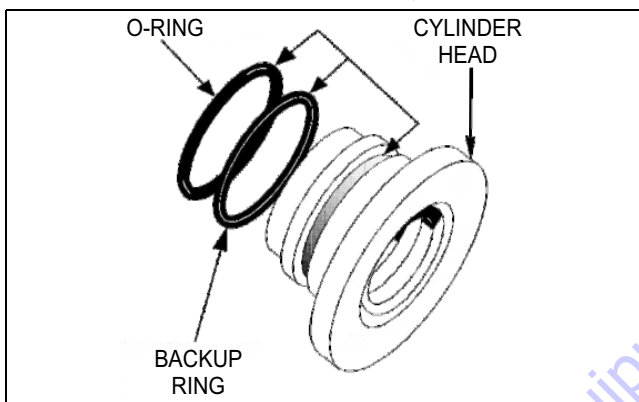


Figure 5-139. Installation of Head Seal Kit

4. Place the cylinder cap over the rod and carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Push the spacer onto the rod.
6. Place a new o-ring in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Thread piston onto rod until it abuts the spacer end and install the retainer.
10. Remove the cylinder rod from the holding fixture.

11. Place new cap seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

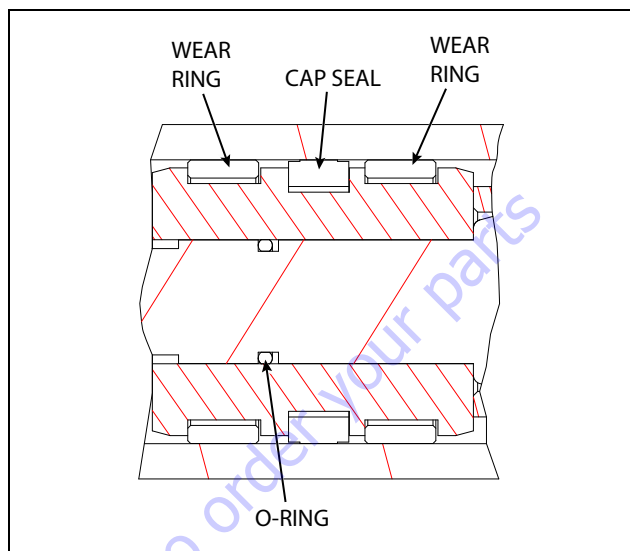


Figure 5-140. Piston Seal Kit Installation

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 ring are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
15. Install cylinder head as mention below:
 - a. Secure the cylinder head gland and the cylinder cap. Refer Figure 5-133.
 - b. Screw the cylinder head into the barrel using a pin-face spanner wrench. Refer Figure 5-134.
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.
17. Install the counterbalance valves in the rod port block.
18. Install wear pad onto the cylinder.

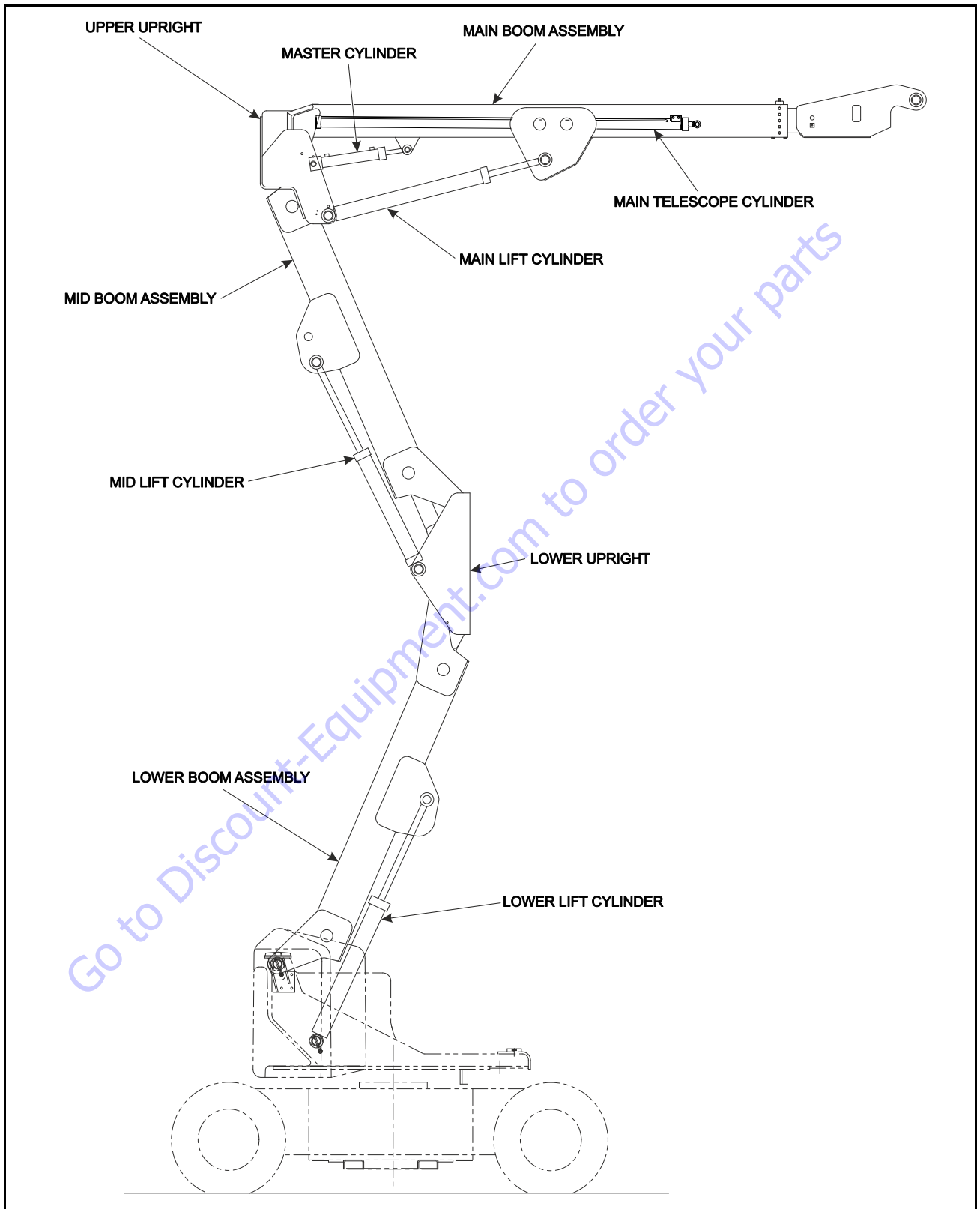


Figure 5-141. Components Boom

5.4 CYLINDER REMOVAL AND INSTALLATION

Main Boom Lift Cylinder Removal

NOTE: The Main Boom weighs approximately 450lbs. (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 lbs. (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.

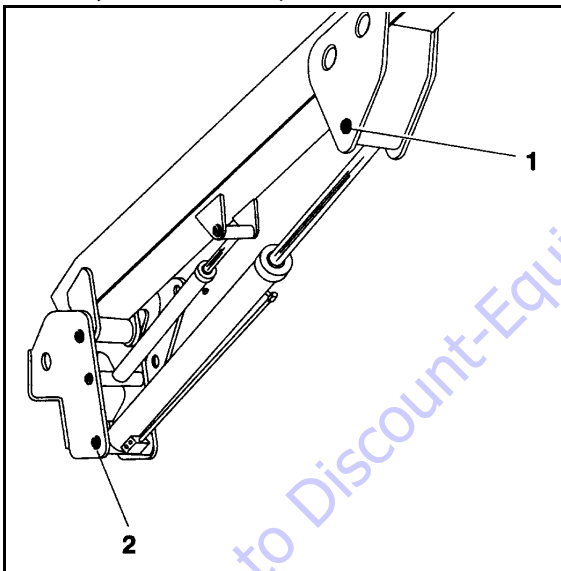


Figure 5-142. Main Boom Lift Cylinder Removal

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 lbs. (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.

Mid Boom Lift Cylinder Removal

NOTE: The Upright weighs approximately 92 lbs. (42kg) and Main Boom weighs approximately 450lbs. (204kg).

1. Place machine on flat and level surface. Place the Main Boom in a horizontal position. Place the Mid Boom in a 10 degree elevated position. Support Main Boom with a prop. Support upright with suitable lifting device.

NOTE: The Mid Lift Cylinder weighs approximately 60 lbs. (27.2 kg).

2. Using slings, restrain the lower lift cylinder.
3. Remove the hardware securing the cylinder rod attach pin #3 to the boom. Using an appropriate brass drift, drive out the cylinder rod attach pin #3.

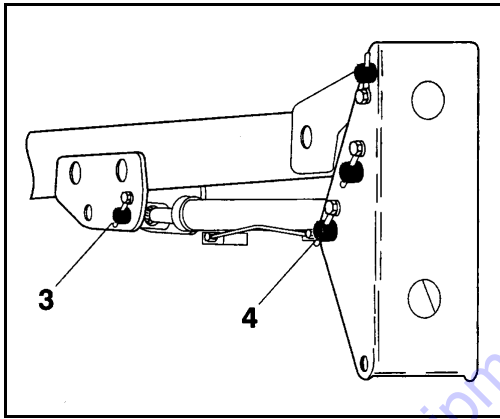


Figure 5-143. Mid Boom Lift Cylinder Removal

4. Tag and disconnect hydraulic lines from the main lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove the hardware securing the barrel end attach pin #4 to the boom. Using an appropriate brass drift, drive out the cylinder barrel pin #4.
6. Remove the lifting device from the mid lift cylinder.
7. Carefully remove cylinder from boom. Place in a suitable work area.

Mid Boom Lift Cylinder Installation

NOTE: Coat I.D. of bushings with specified lubricant prior to installing pins.

NOTE: The Mid Lift Cylinder weighs approximately 60 lbs. (27.2 kg).

1. With the booms positioned and supported, place cylinder in position and secure in place using slings.
2. Install the cylinder barrel pin #4, being sure to align the hole in the cylinder barrel pin with the retaining pin screw hole. When holes align, install hardware.
3. Correctly install hydraulic lines to cylinder as previously tagged. Extend cylinder rod slowly until attach pin hole aligns with those in boom.
4. Using a suitable brass drift, drive the cylinder rod attach pin #3 through the aligned holes. Secure the pin in place using retaining hardware.
5. Remove boom prop and suitable lifting device.
6. Take the lift cylinder through one complete cycle to assure correct functioning. Place boom in stowed position. Check hydraulic fluid and adjust accordingly.

Lower Boom Lift Cylinder Removal

NOTE: The Lower Lift Cylinder weighs approximately 130lbs. (59kg).

1. Place machine on flat and level surface. Place the Main Boom in a horizontal position. Place the Mid and Lower Booms in a 10 degree elevated position. Support Main Boom with a prop. Support upright with suitable lifting device.
2. Using slings, restrain the lower lift cylinder.
3. Remove the hardware securing the cylinder rod attach pin #5 to the boom. Using an appropriate brass drift, drive out the cylinder rod attach pin #5.

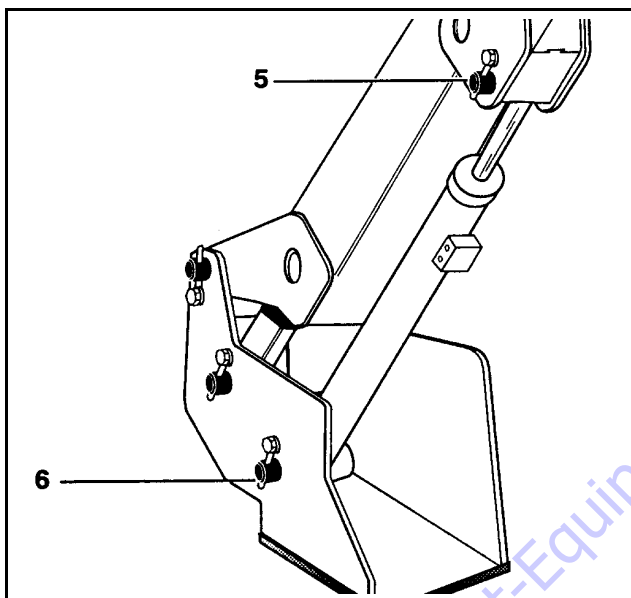


Figure 5-144. Lower Boom Lift Cylinder Removal

4. Tag and disconnect hydraulic lines from the upper lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove the hardware securing the barrel end attach pin #6 to the boom. Using an appropriate brass drift, drive out the cylinder barrel pin #6.
6. Carefully remove cylinder from boom. Place in a suitable work area.

Lower Boom Lift Cylinder Installation

NOTE: Coat I.D. of bushings with specified lubricant prior to installing pins.

NOTE: The Lower Lift Cylinder weighs approximately 130lbs. (59kg).

1. With the booms positioned and supported, place cylinder in position and secure in place using slings.
2. Install the cylinder barrel pin #6, being sure to align the hole in the cylinder barrel pin with the retaining pin screw hole. When holes align, install hardware.
3. Correctly install hydraulic lines to cylinder as previously tagged. Extend cylinder rod slowly until attach pin hole aligns with those in boom.
4. Using a suitable brass drift, drive the cylinder rod attach pin #5 through the aligned holes. Secure the pin in place using retaining hardware.
5. Remove boom prop and suitable lifting device.
6. Take the lift cylinder through one complete cycle to assure correct functioning. Place boom in stowed position. Check hydraulic fluid 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.

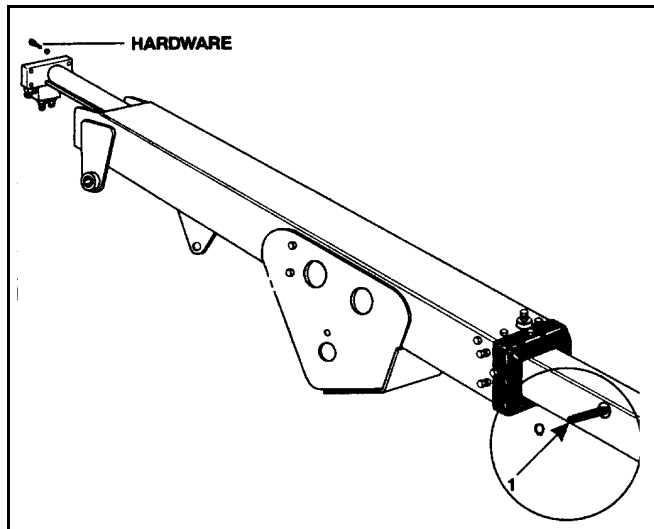


Figure 5-145. Main Telescope Cylinder Removal

NOTE: The Main Boom weighs approximately 450lbs. (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 lbs. (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 450lbs. (204kg).

2. Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.

NOTE: The Main Telescope Cylinder weighs approximately 130 lbs. (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.

5.5 MID AND LOWER LIFT CYLINDER BLEEDING PROCEDURE

NOTE: Bleeding procedure should only be necessary if rebuilding or replacing lift cylinder.

1. Check oil level in the hydraulic oil tank (all booms must be retracted).
2. Lay an oil drip pan under the rod end port block (Mid Cylinder) and crack bleeder open from the fitting in the port block.
3. From the platform, turn the speed control knob to the slow position.
4. Lift up very slowly. This will force any air out of the circuit. If the lower boom is not extending, turn the speed control up very slowly until the lower boom starts to move.
5. Raise the lower boom approximately 30.5 cm (1 foot), then close bleeder while the boom is still moving.
6. Lift down all the way.
7. Repeat this procedure until all air has been purged from the circuit. Re-check the hydraulic oil level.
8. To test, cycle the lower lift function 3-4 times to see if both cylinders stop at the same time when fully extended.

5.6 PRESSURE SETTING PROCEDURES

NOTE: Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until hydraulic system has warmed to normal operating temperatures prior to checking pressures. We also recommend using a calibrated gauge. Pressure readings are acceptable if within +/- 5% of specified pressures.

Main Relief

1. Install pressure gauge at port "G" on Steer Valve.
2. Activate and bottom out either Main or Lower Lift Up. Adjust Main Relief to value given in Figure 5-148., Steer Valve Pressure Adjustment.

Main Lift Down Relief

1. With pressure gauge at "G" port on main valve, activate and bottom out Main Lift Down.
2. Adjust Main Lift Relief to value given in Figure 5-151., Main Valve Pressure Adjustment.

Lower Lift Down Relief

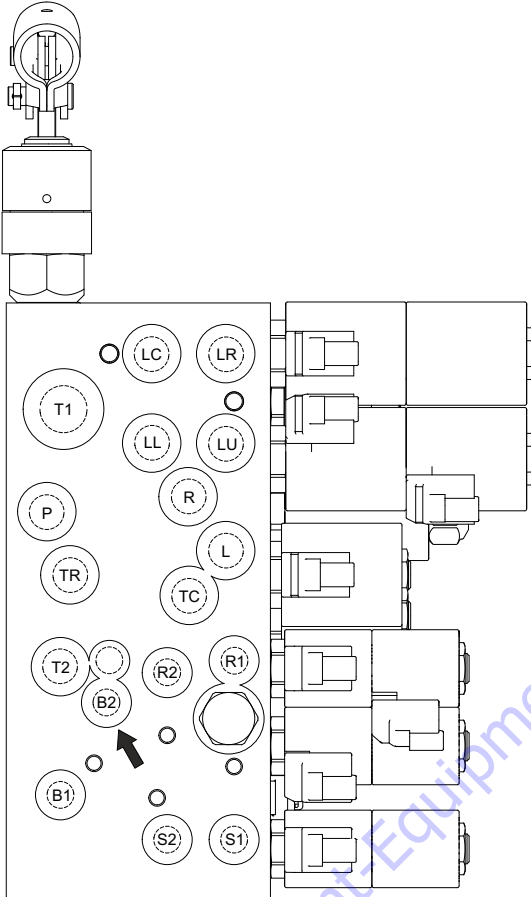
1. With pressure gauge at "G" port on main valve, activate and bottom out Mid/Lower Lift Down.
2. Adjust Mid/Lower Lift Relief to value given in Figure 5-151., Main Valve Pressure Adjustment.

Telescope Relief

1. With pressure gauge at "G" port on main valve, activate and bottom out Telescope In.
2. Adjust Telescope Relief to value given in Figure 5-151., Main Valve Pressure Adjustment.

Platform Level Up Relief

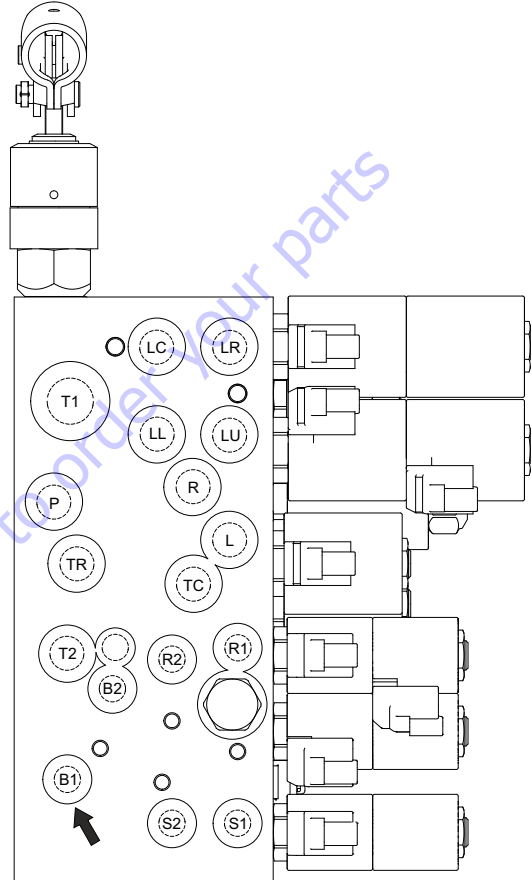
1. Install the pressure gauge at the "B2" port on the back of the Main Control Valve, activate and bottom out Platform Level Up.



2. Adjust Platform Level Up Relief to value given in Figure 5-151., Main Valve Pressure Adjustment.

Platform Level Down Relief

1. Install the pressure gauge at the "B1" port on the back of the Main Control Valve, activate and bottom out Platform Level Down.



2. Adjust Platform Level Down Relief to value given in Figure 5-151., Main Valve Pressure Adjustment.

Steer Relief

1. With pressure gauge at "G" port on steer/brake valve, activate and bottom out Steer Left or Right.
2. Adjust Steer Relief to value given in Figure 5-148., Steer Valve Pressure Adjustment.
3. Shut down hydraulic system and remove pressure gauge.

Jib Lift (Up and Down) Relief

1. Install the pressure gauge at the at the "G" port on the Main Control valve, activate and bottom out jib up or down.

Releveling Valve Relief

1. Install a pressure gauge at port "G" on the main valve.
2. Adjust the lower lift down pressure relief to the value given in Figure 5-151., Main Valve Pressure Adjustment.
3. With the lower boom lowered all the way, pull the red releveling knob and activate lower lift down.

4. Adjust the releveling pressure relief to the value given in Figure 5-151., Main Valve Pressure Adjustment. Turning clockwise increases the pressure and turning counter-clockwise decreases pressure. The relief valve is located directly below the red releveling knob.

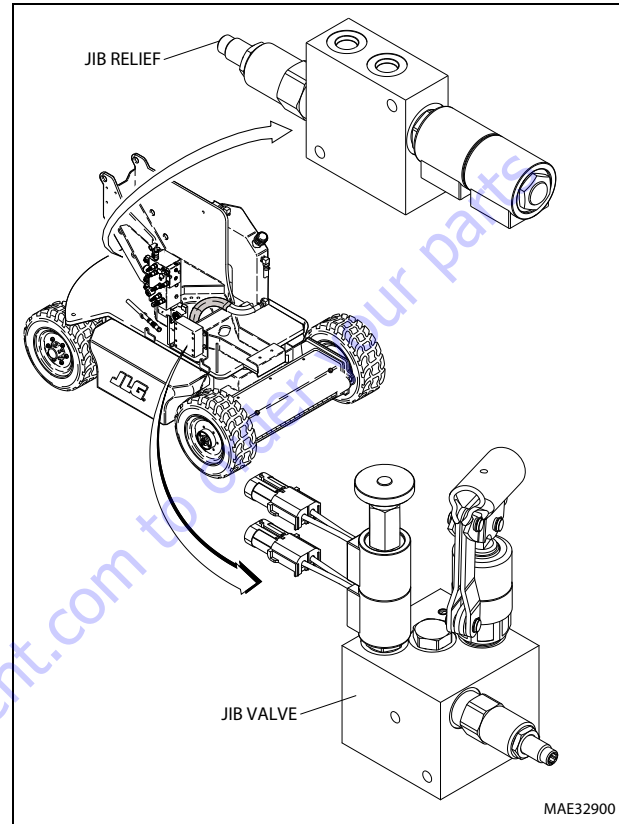
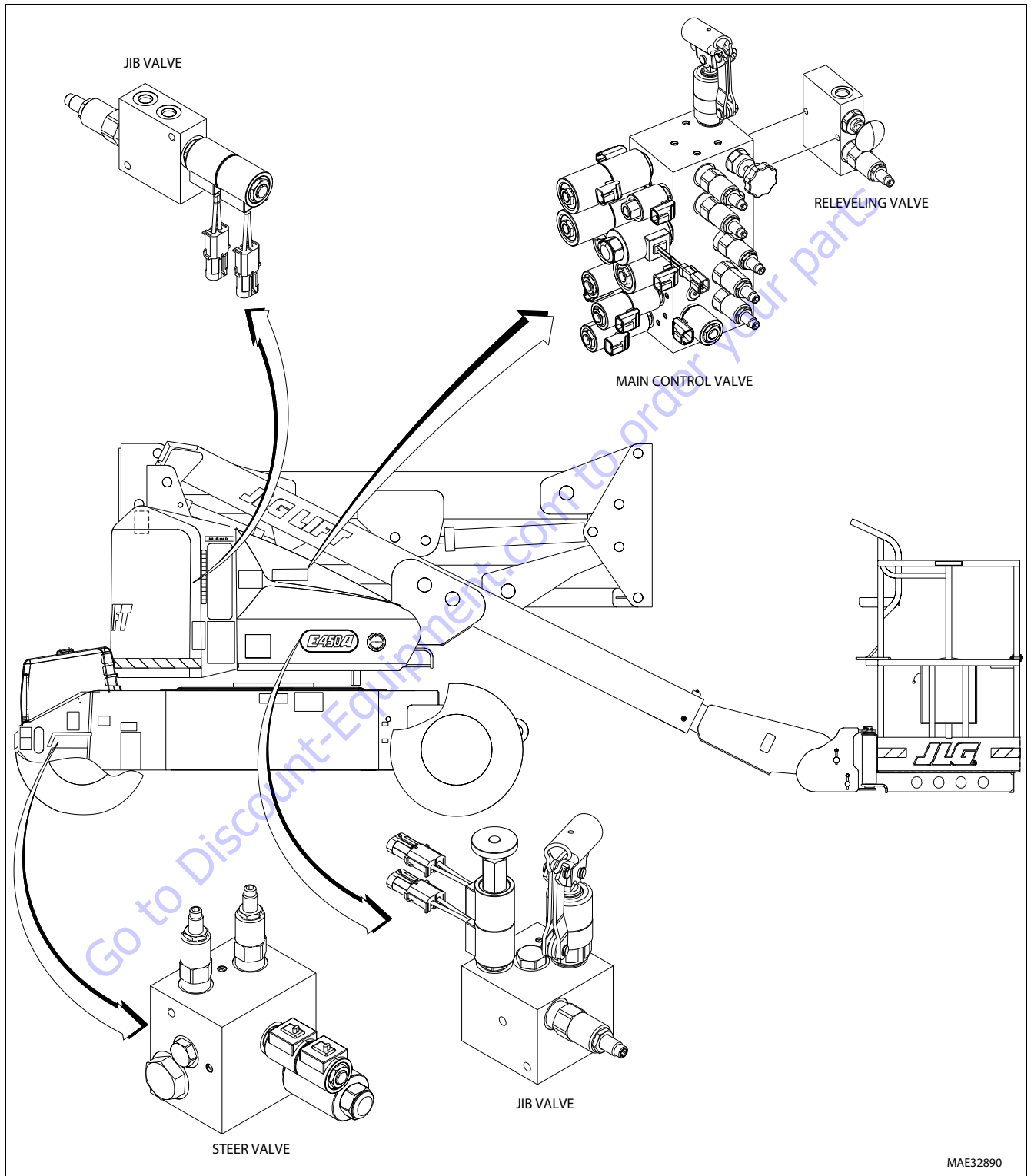


Figure 5-146. Jib Valve Location



MAE32890

Figure 5-147. Hydraulic Component Location

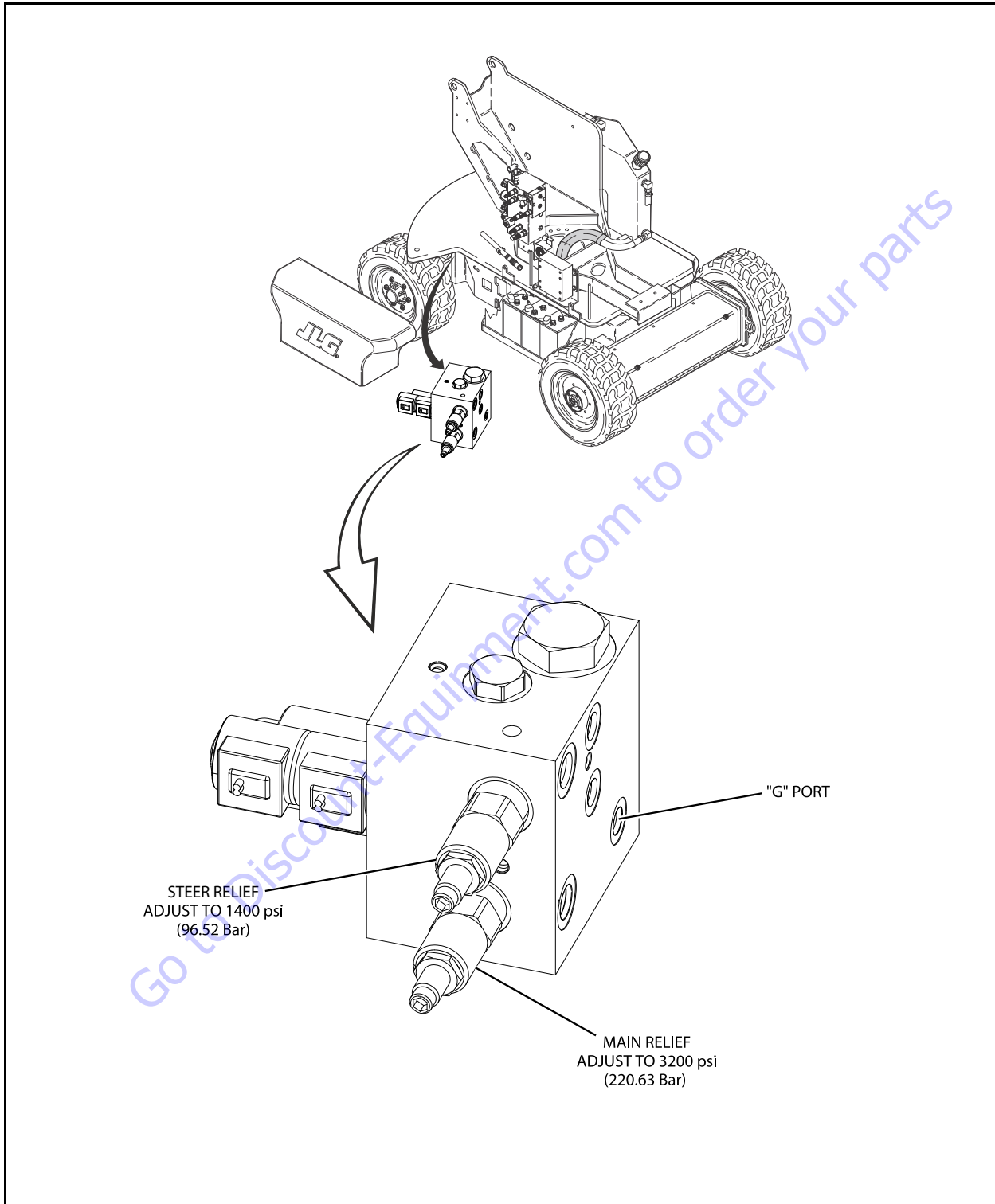


Figure 5-148. Steer Valve Pressure Adjustment

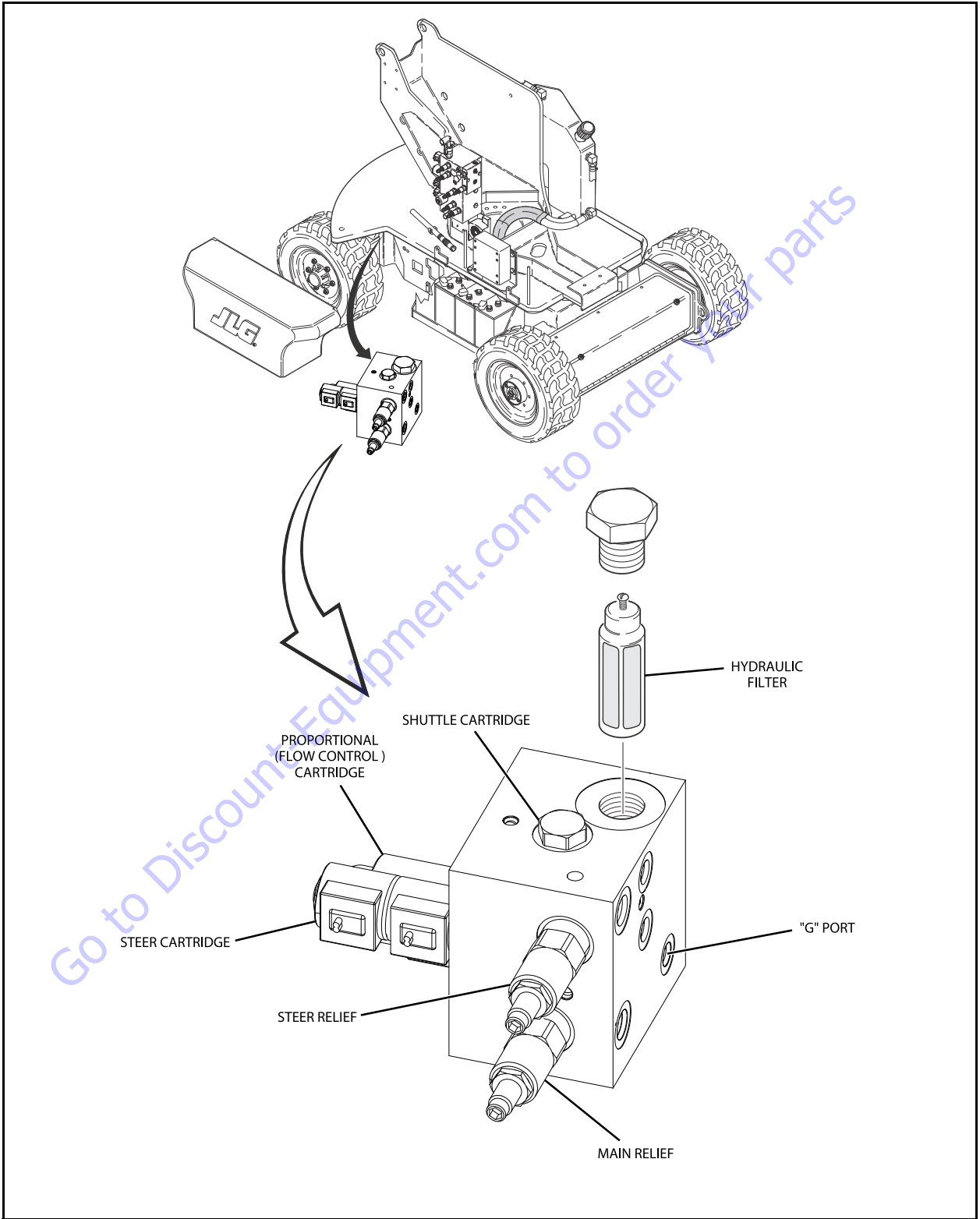
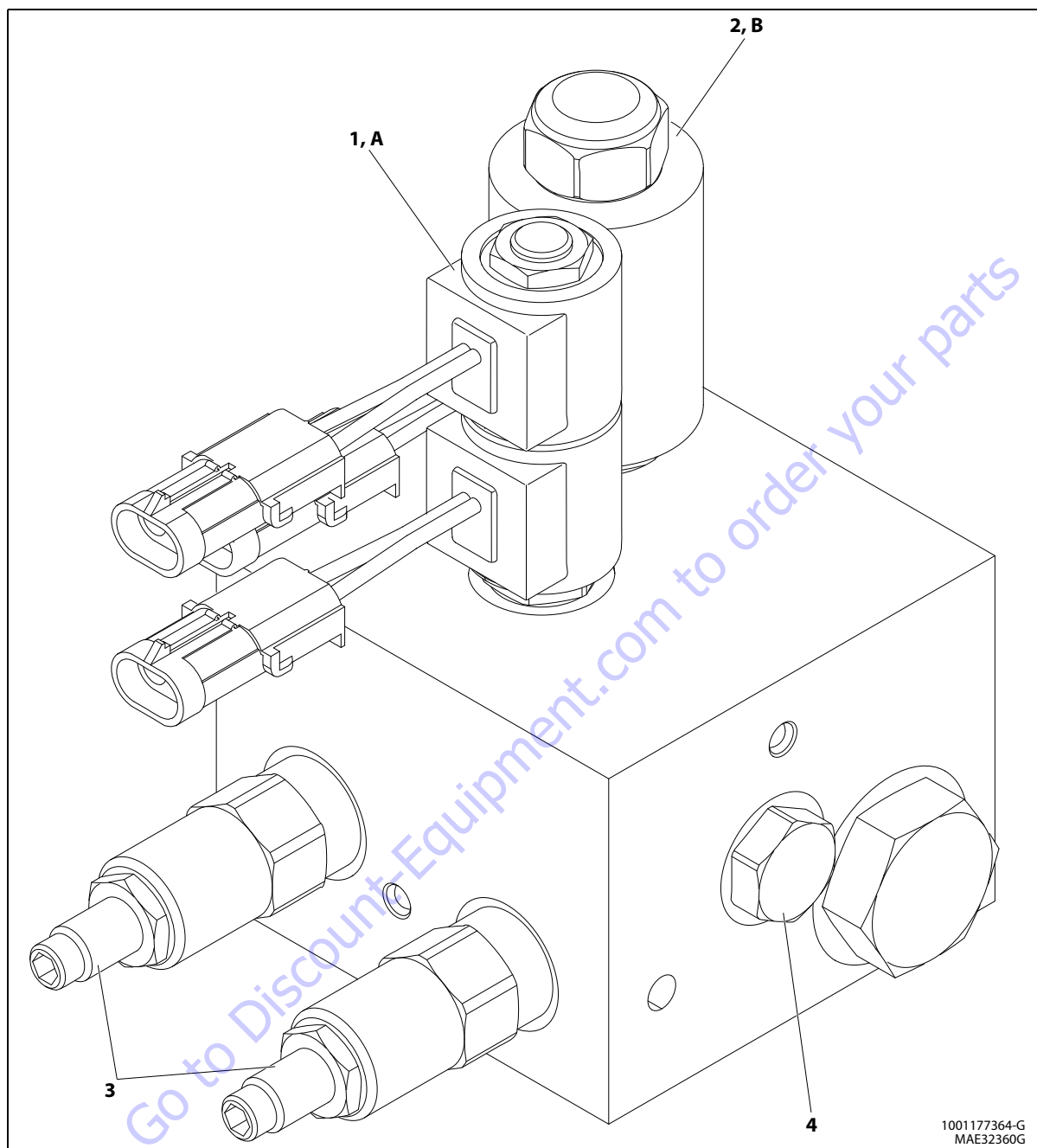


Figure 5-149. Steer Valve Component



1001177364-G
MAE32360G

Table 5-33. Cartridge Torque Values

	Ft. Lbs.	Nm
1	35-40	47-54
2	25	34
3	25-30	34-41
4	20	27

Table 5-34. Coil Torque Values

	Ft. Lbs.	Nm
A	4-5	5-7
B	10-12	13-16

Figure 5-150. Steer Valve Torque Specification

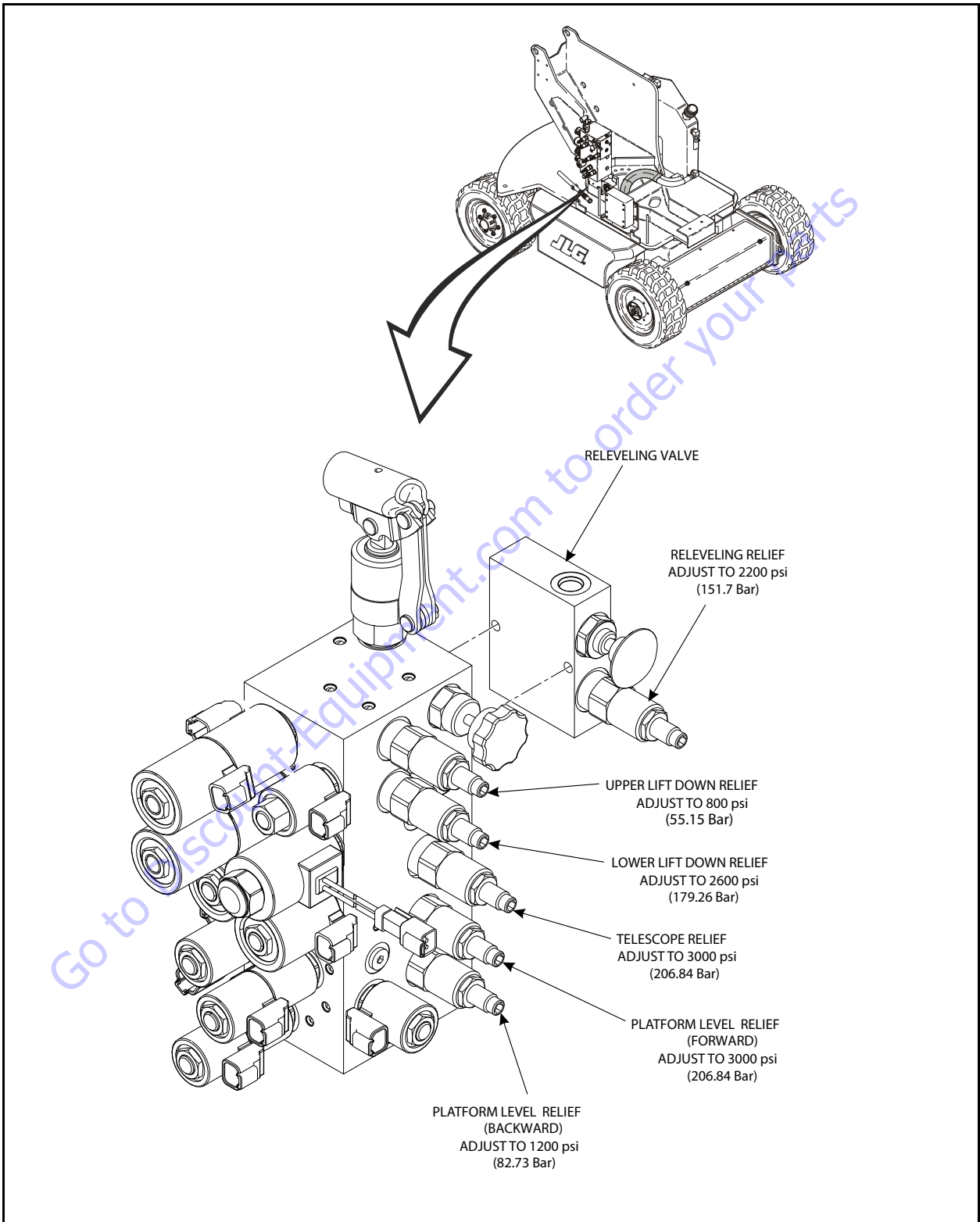


Figure 5-151. Main Valve Pressure Adjustment

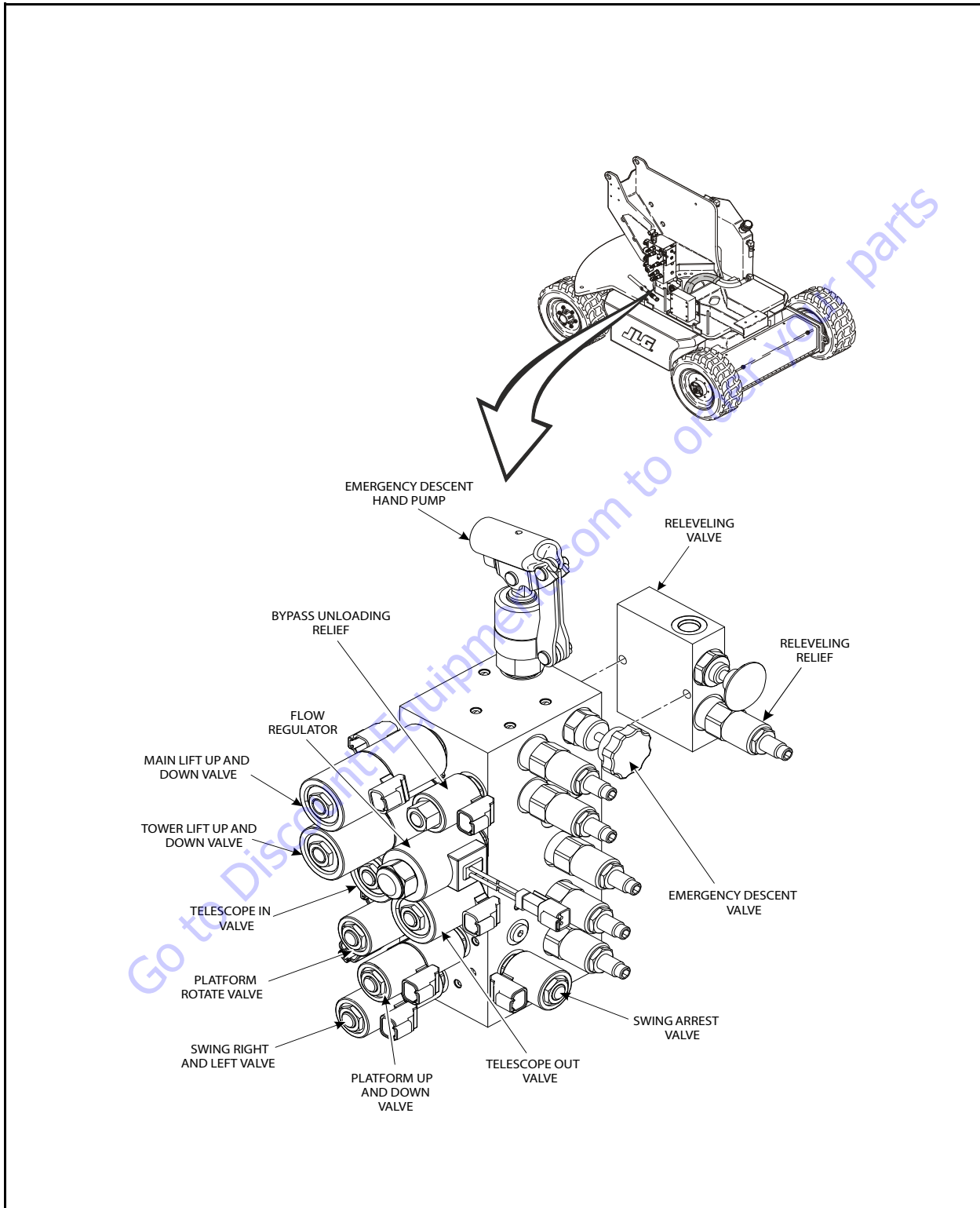
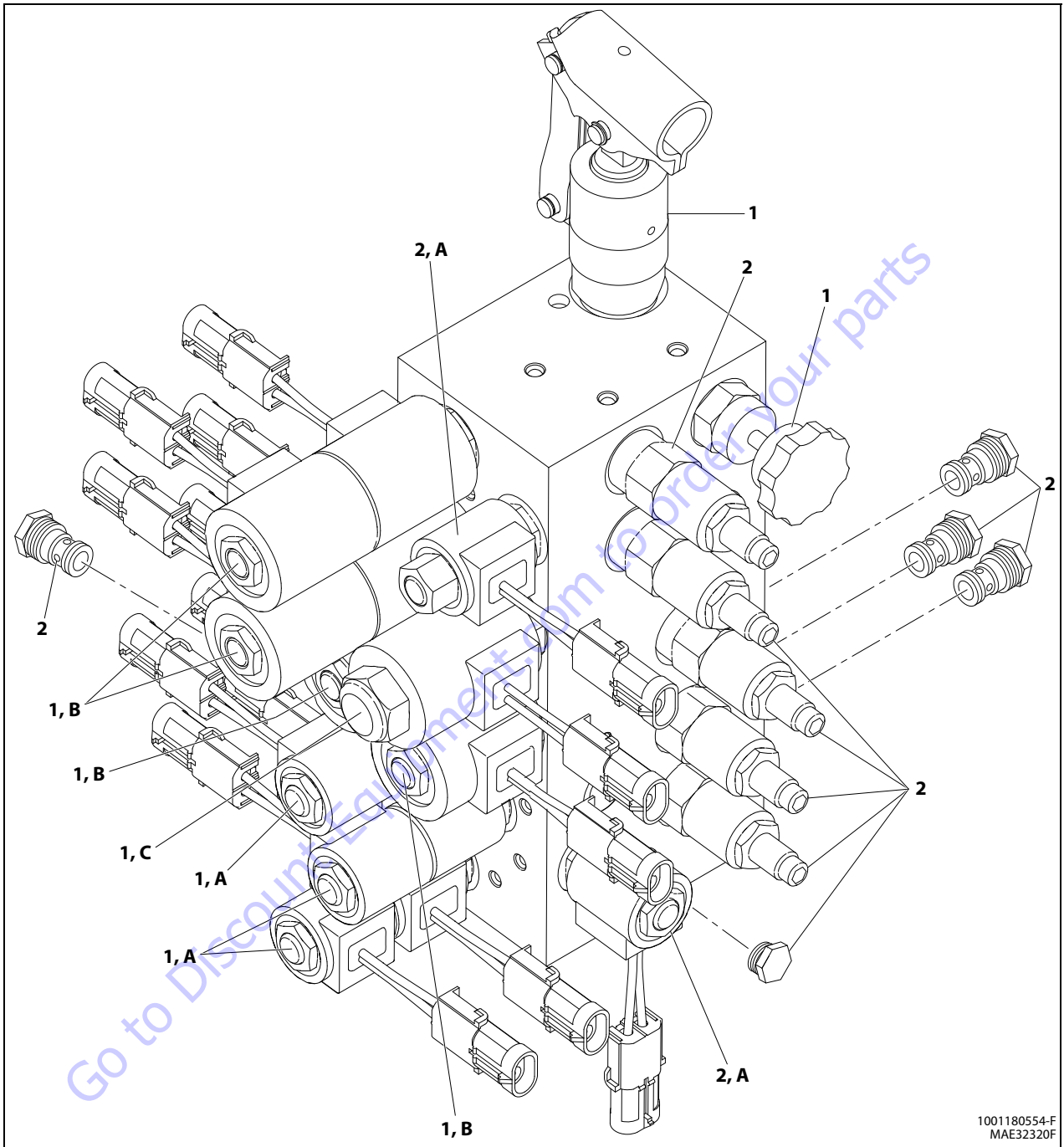


Figure 5-152. Main Valve Components



1001180554-F
MAE32320F

Table 5-35. Cartridge Torque Values

	Ft. Lbs.	Nm
1	25	34
2	20	27

Table 5-36. Coil Torque Values

	Ft. Lbs.	Nm
A	10-12	13-16
B	7-10	9-13
C	4-5	5-7

Figure 5-153. Main Control Valve Torque Specification

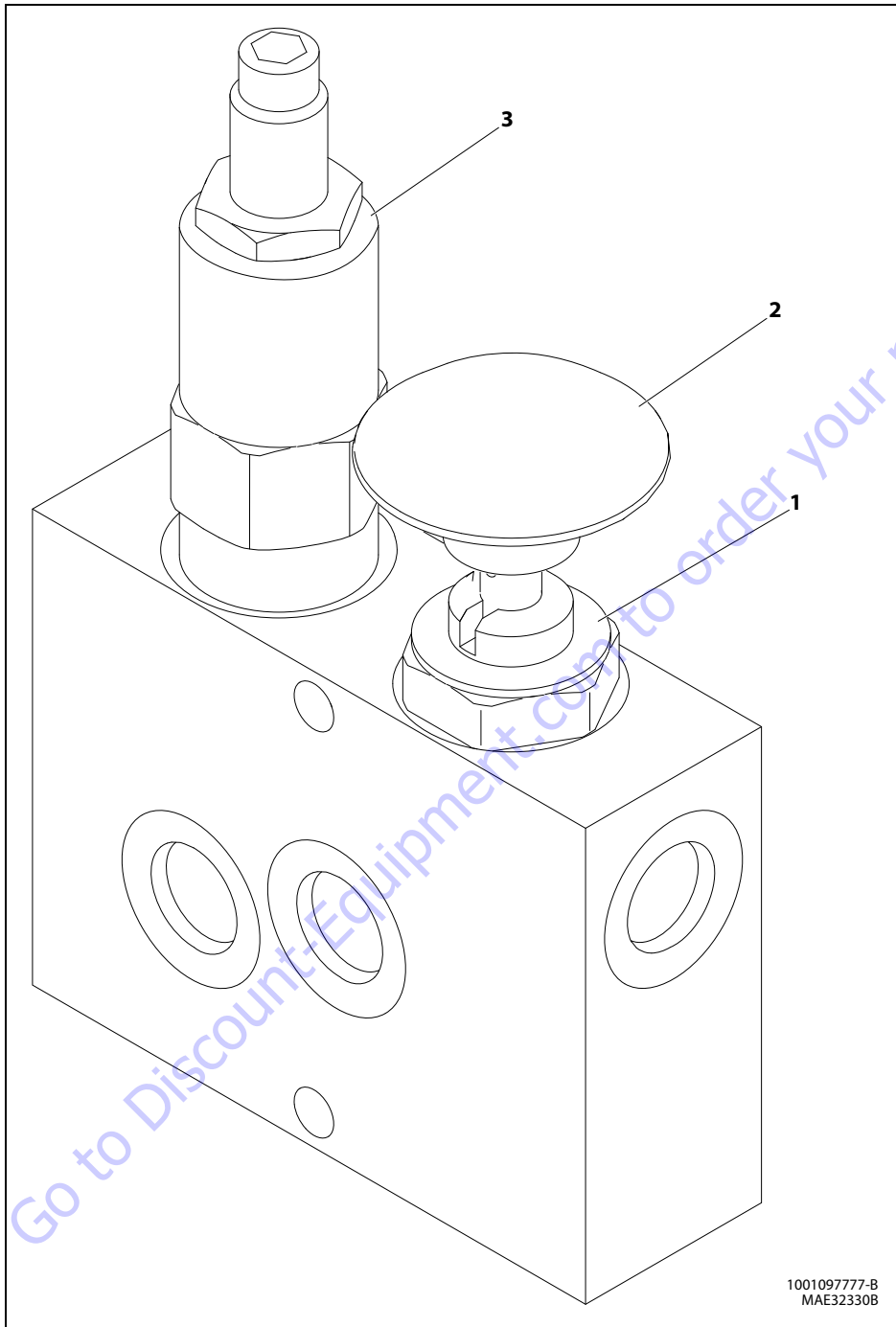


Table 5-37. Cartridge Torque Values

	Ft. Lbs.	Nm
3	20	27

Figure 5-154. Releveling Valve Torque Specification

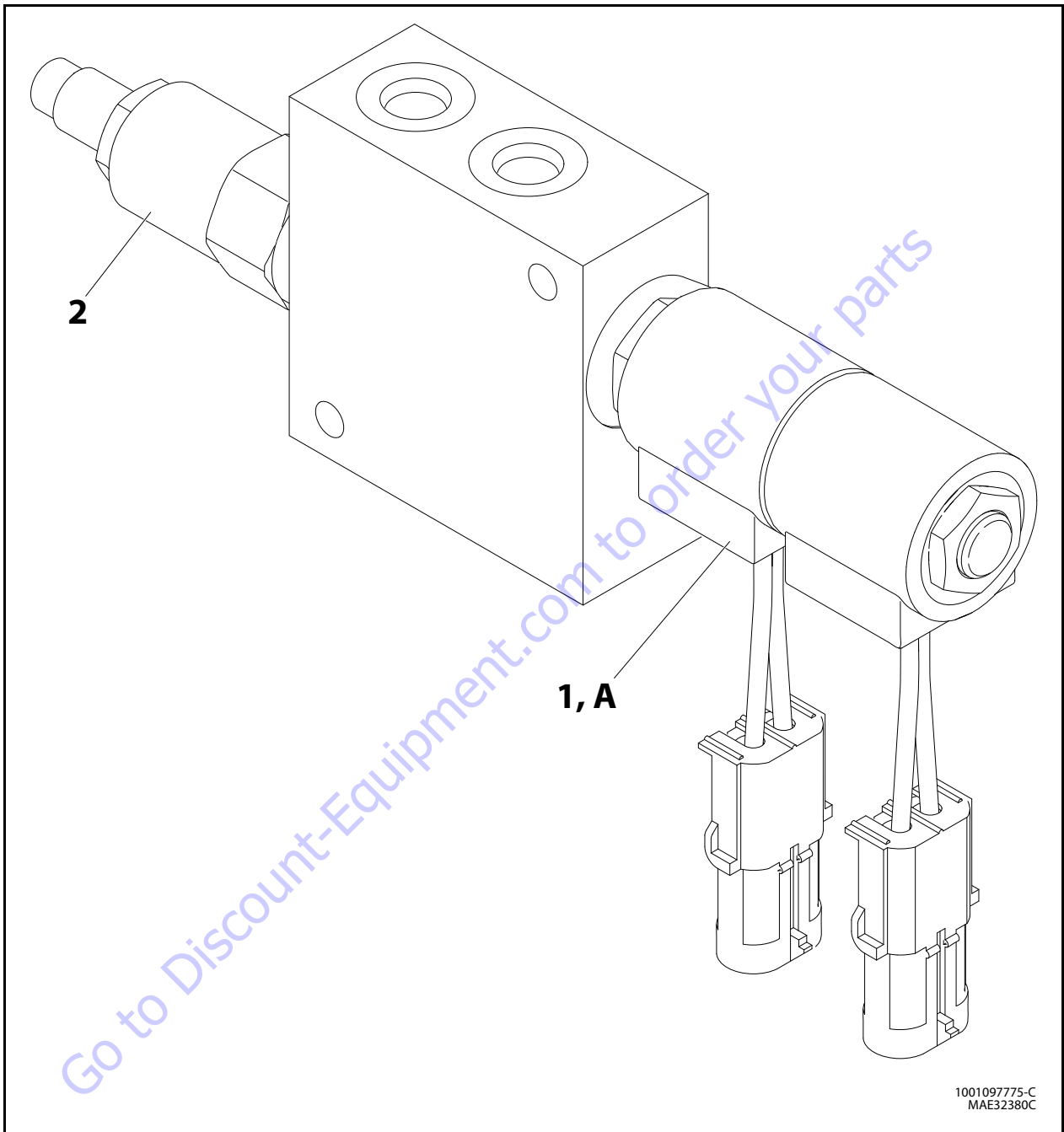


Table 5-38. Cartridge Torque Values

	Ft. Lbs.	Nm
1	25	34
2	20	27

Table 5-39. Coil Torque Values

	Ft. Lbs.	Nm
A	5	7

Figure 5-155. Jib Valve Torque Specification (SN 0300208529 through 0300233452, SN B300001429 through B300002532)

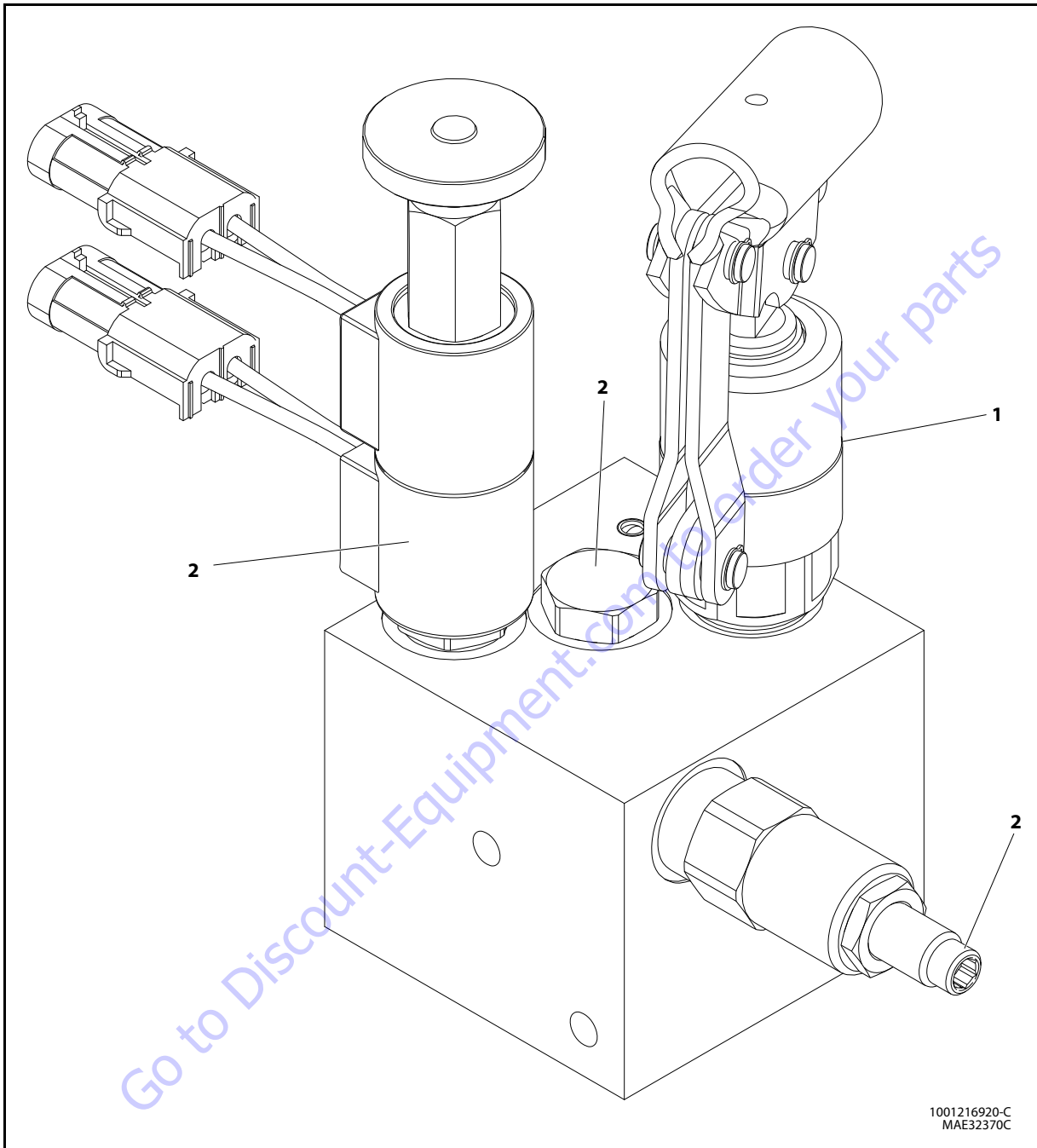


Table 5-40. Cartridge Torque Values

	Ft. Lbs.	Nm
1	25	34
2	20	27

Figure 5-156. Jib Valve Torque Specification (SN 0300233452 to Present, SN B300002533 to Present)

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SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

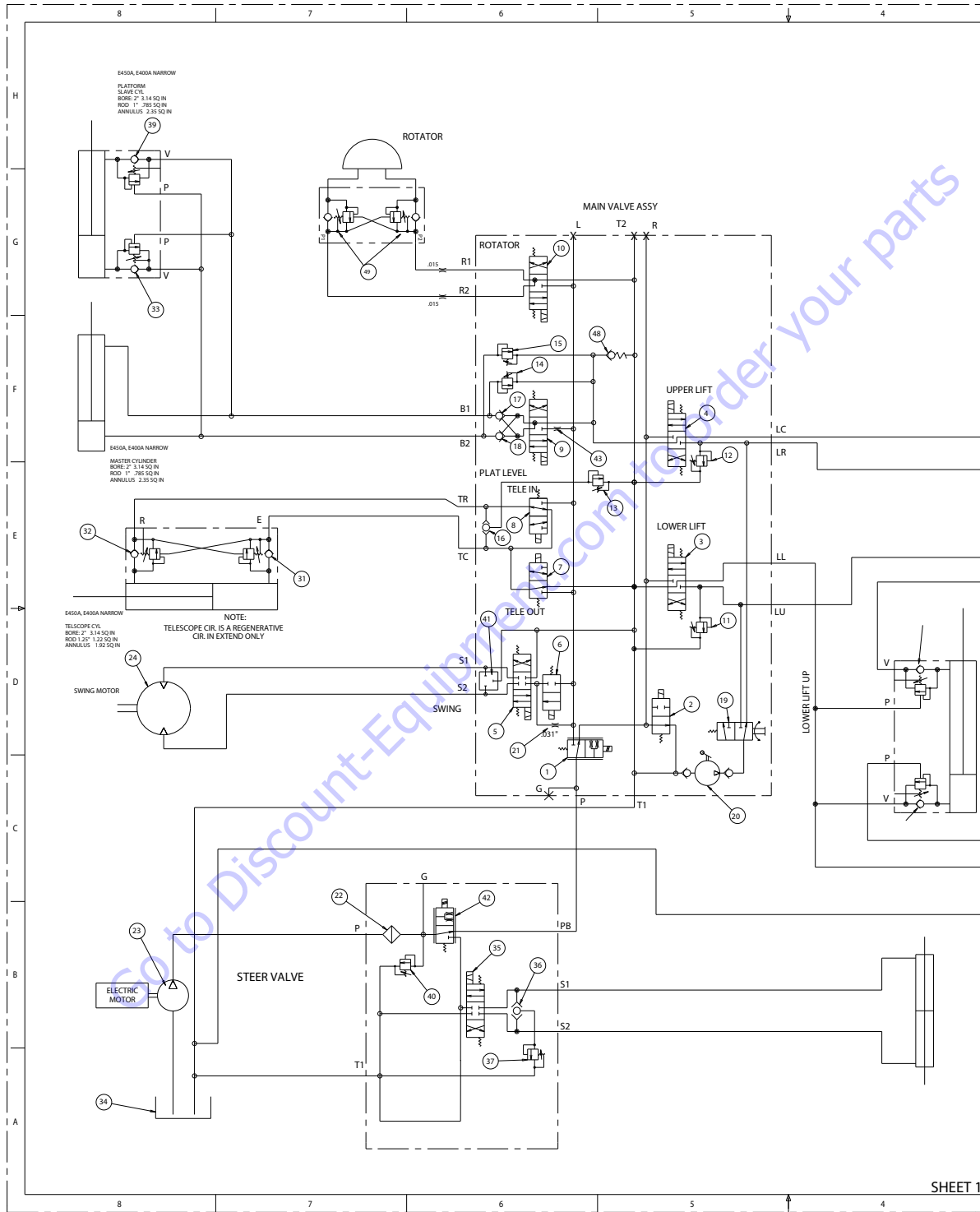


Figure 5-157. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 1 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

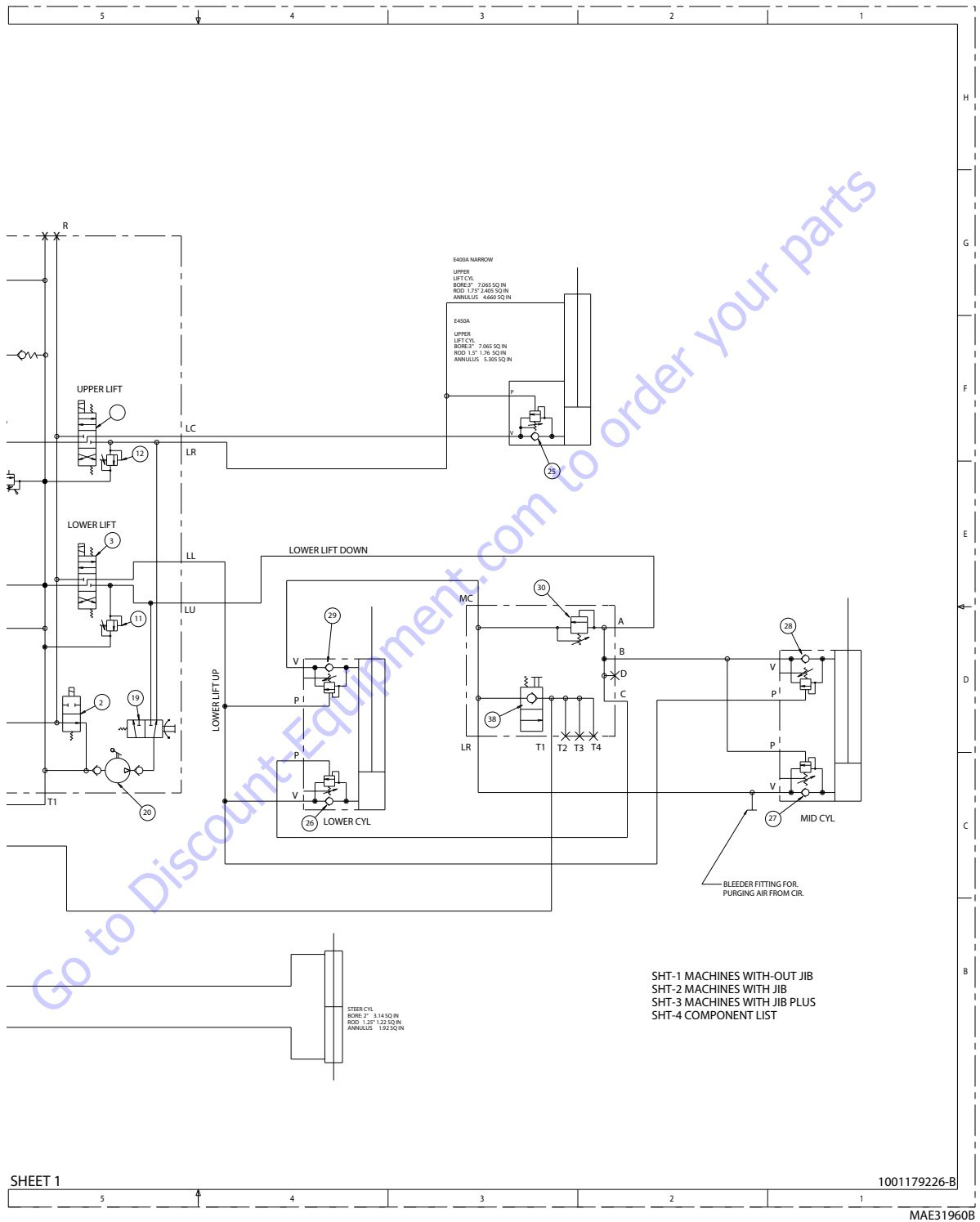


Figure 5-158. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 2 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

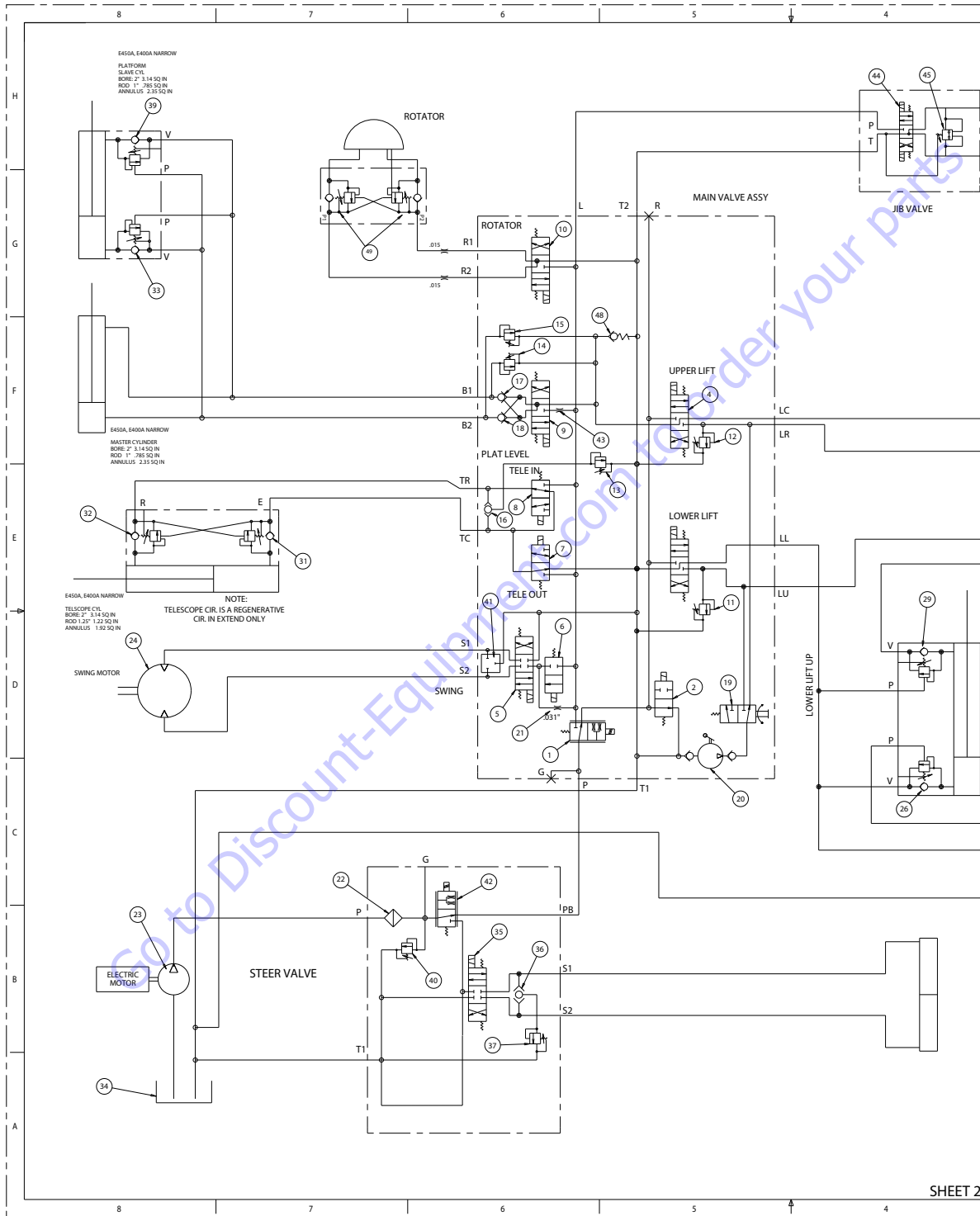


Figure 5-159. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 3 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

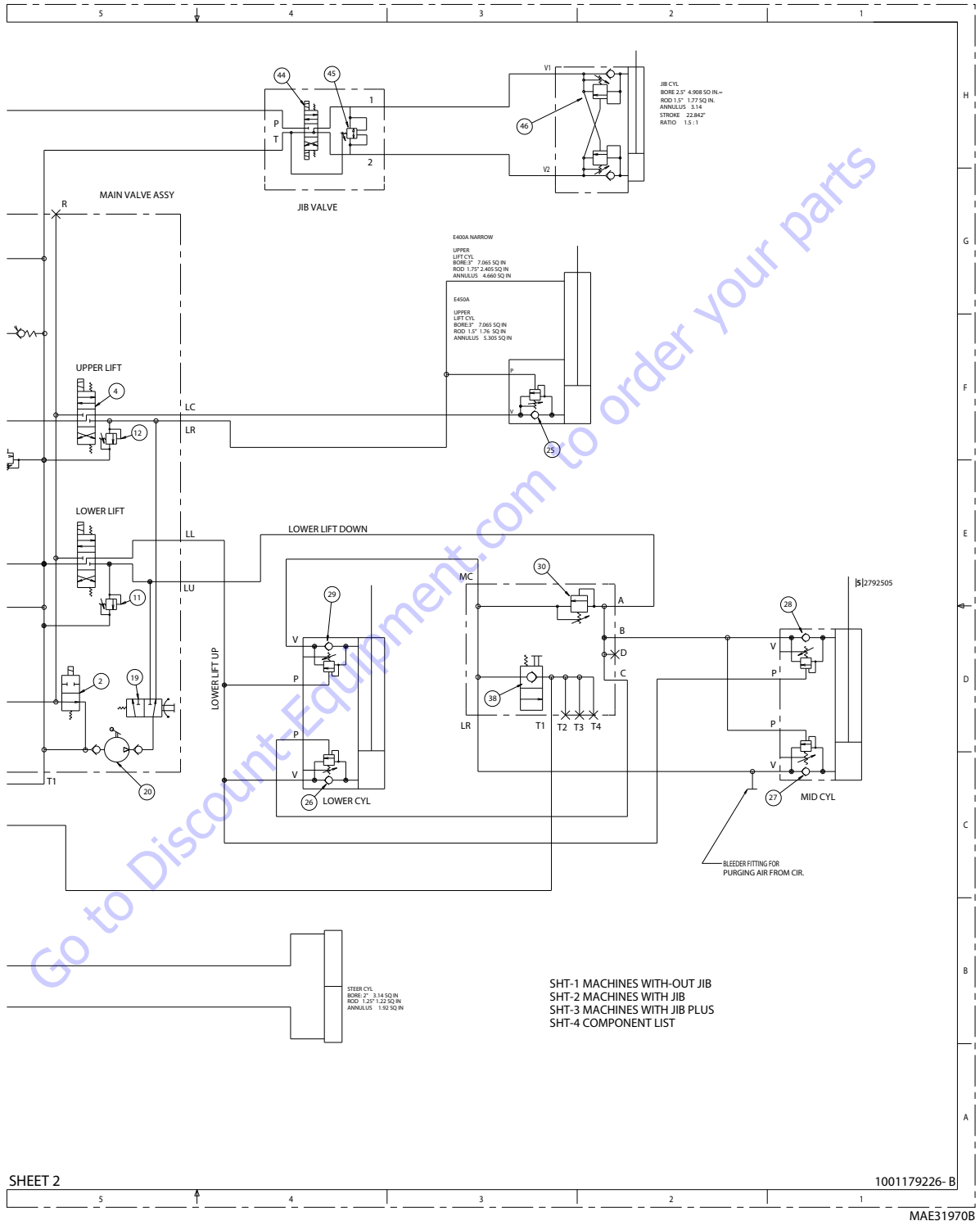


Figure 5-160. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 4 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

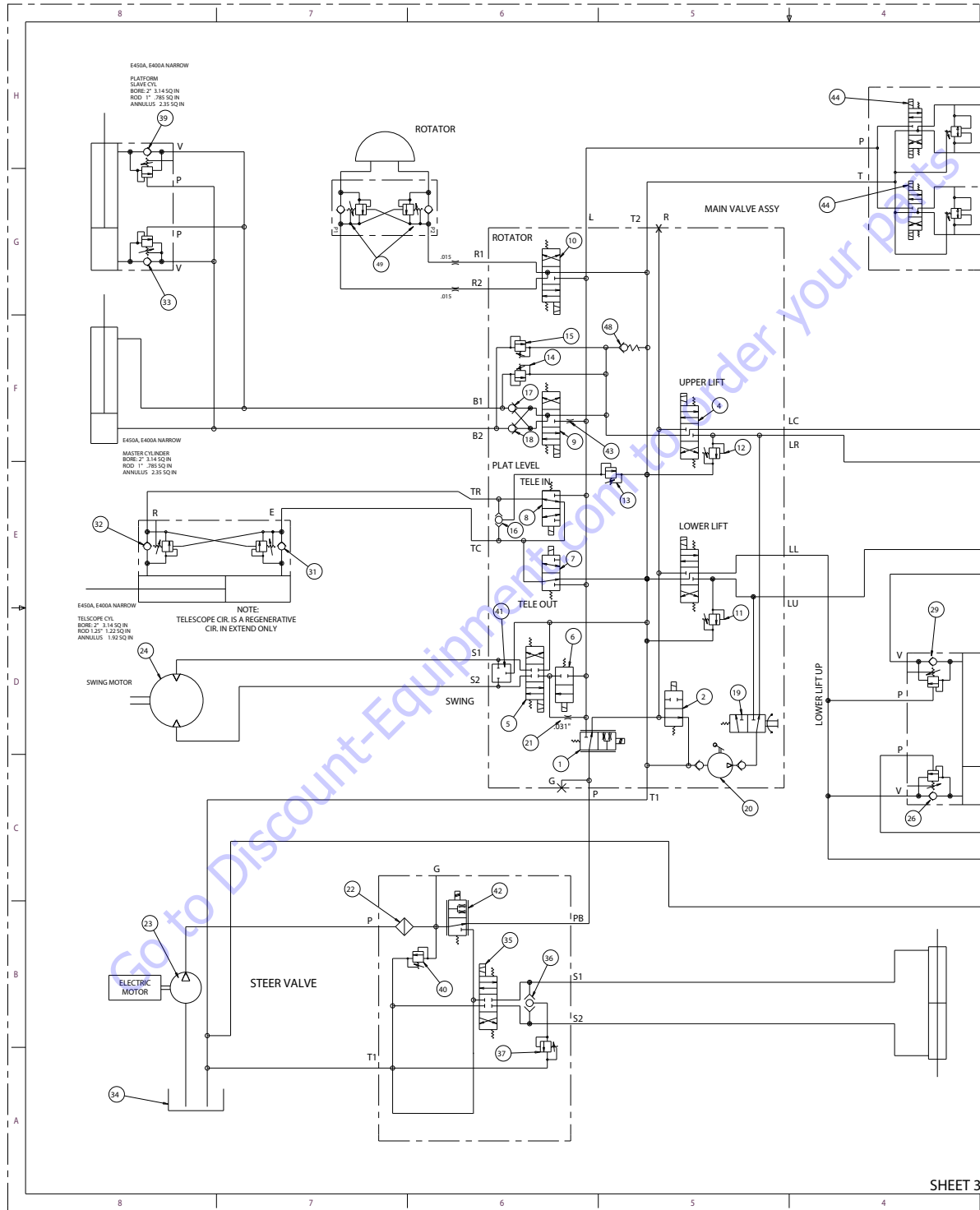


Figure 5-161. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 5 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

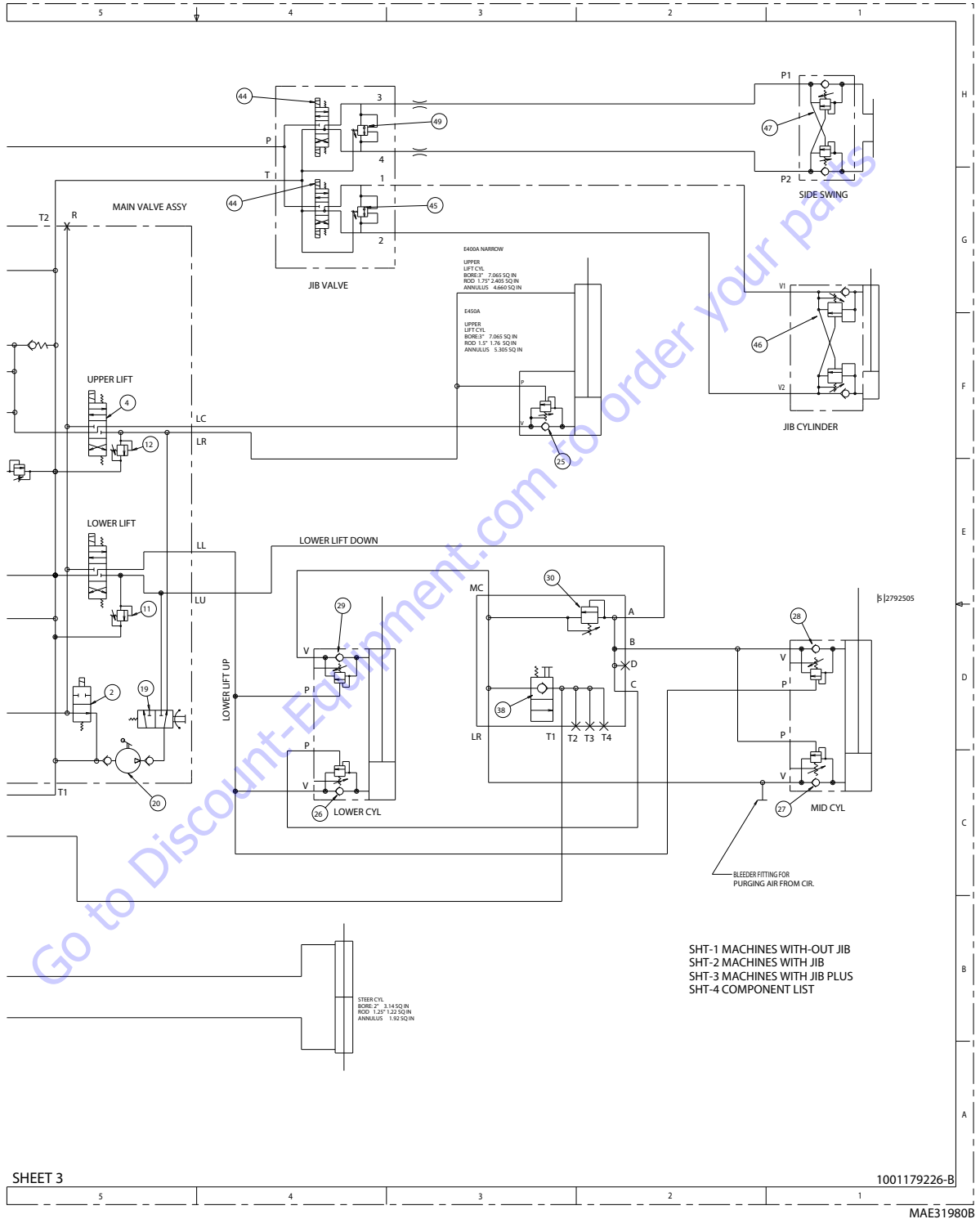


Figure 5-162. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 6 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

COMPONENT LIST	
1.	PROPORTIONAL FLOW REGULATOR, PRESSURE COMPENSATED, PV70-3001B-0-N-12DW
2.	2-POS, 2-WAY POPPET VALVE, NORMALLY OPEN, SV08-21-0-N-12DW (BYPASS UNLOADING)
3.	3-POS, 4-WAY VALVE, SV10-4722E-0-N-12DW, (LOWER LIFT)
4.	3-POS, 4-WAY VALVE, SV10-4722E-0-N-12DW, (UPPER LIFT)
5.	3-POS, 4-WAY VALVE, SV08-47C-0-N-12DW, (SWING)
6.	2-POS, 2-WAY SPOOL VALVE, NORMALLY CLOSED SV08-24-0-N-12DW
7.	2-POS, 3-WAY VALVE, SV10-33-0-N-12DW, (TELESCOPE OUT)
8.	2-POS, 3-WAY VALVE, SV10-33-0-N-12DW, (TELESCOPE IN)
9.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (PLATFORM LEVEL)
10.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (ROTATOR)
11.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/26 (LOWER LIFT DOWN) SET AT 2600 PSI
12.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-18/8.0 (UPPER LIFT DOWN) SET AT 800 PSI
13.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/30 (TELESCOPE) SET AT 3000 PSI
14.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/12 (PLATFORM LEVEL BACKWARD ROD END) SET AT 1200 PSI
15.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/30 (PLATFORM LEVEL FORWARD PISTON END) SET AT 3000 PSI
16.	SHUTTLE VALVE, LS08-30-0-N, (TELESCOPE)
17.	PILOT OPERATED CHECK, PC08-30-0-N, (PLATFORM LEVEL, ROD SIDE)
18.	PILOT OPERATED CHECK, PC08-30-0-N, (PLATFORM LEVEL, PISTON SIDE)
19.	ROTARY 2-POS, 3-WAY VALVE, MR10-31-0-N, W/6113160 (EMERGENCY DESCENT)
20.	MANUAL HAND PUMP, HP10-21A-0-N-A (0.47 IN3)
21.	0.031" ORIFICE PLUG
22.	FILTER, HIGH PRESSURE, 10@2 ABSOLUTE G1761
23.	ELECTRIC MOTOR, PUMP ASSEMBLY, 48VDC
24.	MOTOR, GEROTOR TYPE, FIXED 3.2 CU. IN., (SWING)
25.	COUNTERBALANCE CARTRIDGE, 10:1 @@ 3000 PSI, NON-VENTED SPRING
26.	COUNTERBALANCE CARTRIDGE, 1:1 @@ 3500 PSI, VENTED SPRING, SEALED PILOT
27.	COUNTERBALANCE CARTRIDGE, 1:1 @@ 3500 PSI, VENTED SPRING, SEALED PILOT
28.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 4000 PSI, VENTED SPRING, SEALED PILOT
29.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 4000 PSI, VENTED SPRING, SEALED PILOT
30.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-NC-18/22, (LEVELING RELIEF VALVE) SET AT 2200 PSI CRACKING PRESSURE
31.	COUNTERBALANCE CARTRIDGE, 10:1 @@ 2500 PSI, NON-VENTED SPRING
32.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 2500 PSI, VENTED SPRING, SEALED PILOT
33.	COUNTERBALANCE CARTRIDGE, PILOT RATIO: 7:1 (2500 PSI HOLDING, 3300 PSI THERMAL) NON-VENTED SPRING, SEALED PILOT
34.	HYDRAULIC TANK
35.	3-POS, 4-WAY VALVE, SV08-47C-0-N-12DW, (STEER)
36.	SHUTTLE VALVE, LS08-30-0-N (STEER)
37.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-NC-33/14 (STEER) SET AT 1400 PSI
38.	MANUAL, SPRING RETURN, PULL TO OPEN POPPET CARTRIDGE (MP10-20-J)
39.	COUNTERBALANCE CARTRIDGE, PILOT RATIO 10:1 (500 PSI HOLDING, 1200 PSI THERMAL) VENTED SPRING, SEALED PILOT
40.	RELIEF VALVE, DIRECT ACTING, RV58-20A-0-NC-46/32 (SYSTEM RELIEF) SET AT 3200 PSI
41.	CARTRIDGE PLUG CP08-30-0-N
42.	PROPORTIONAL FLOW REGULATOR, PRESSURE COMPENSATED, PV70-30B-0-N-12DW
43.	0.028 ORIFICE PLUG
44.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (JIB)
45.	RELIEF VALVE CRO8A-O-N-30/19 SET AT 2200 PSI
46.	COUNTERBALANCE CARTRIDGE, 7:1 @ 2500 PSI
47.	COUNTERBALANCE CARTRIDGE, 3:1 @ 3000 PSI, NON-VENTED SPRING
48.	CHECK VALVE CV08-20-0-N-60 (SET AT 60 PSI)
49.	RELIEF VALVE, CRO8A-O-N-30/30 SET AT 3000 PSI

SHT-1 MACHINES WITH-OUT JIB
 SHT-2 MACHINES WITH JIB
 SHT-3 MACHINES WITH JIB PLUS
 SHT-4 COMPONENT LIST

SHEET 4

1001179226-B

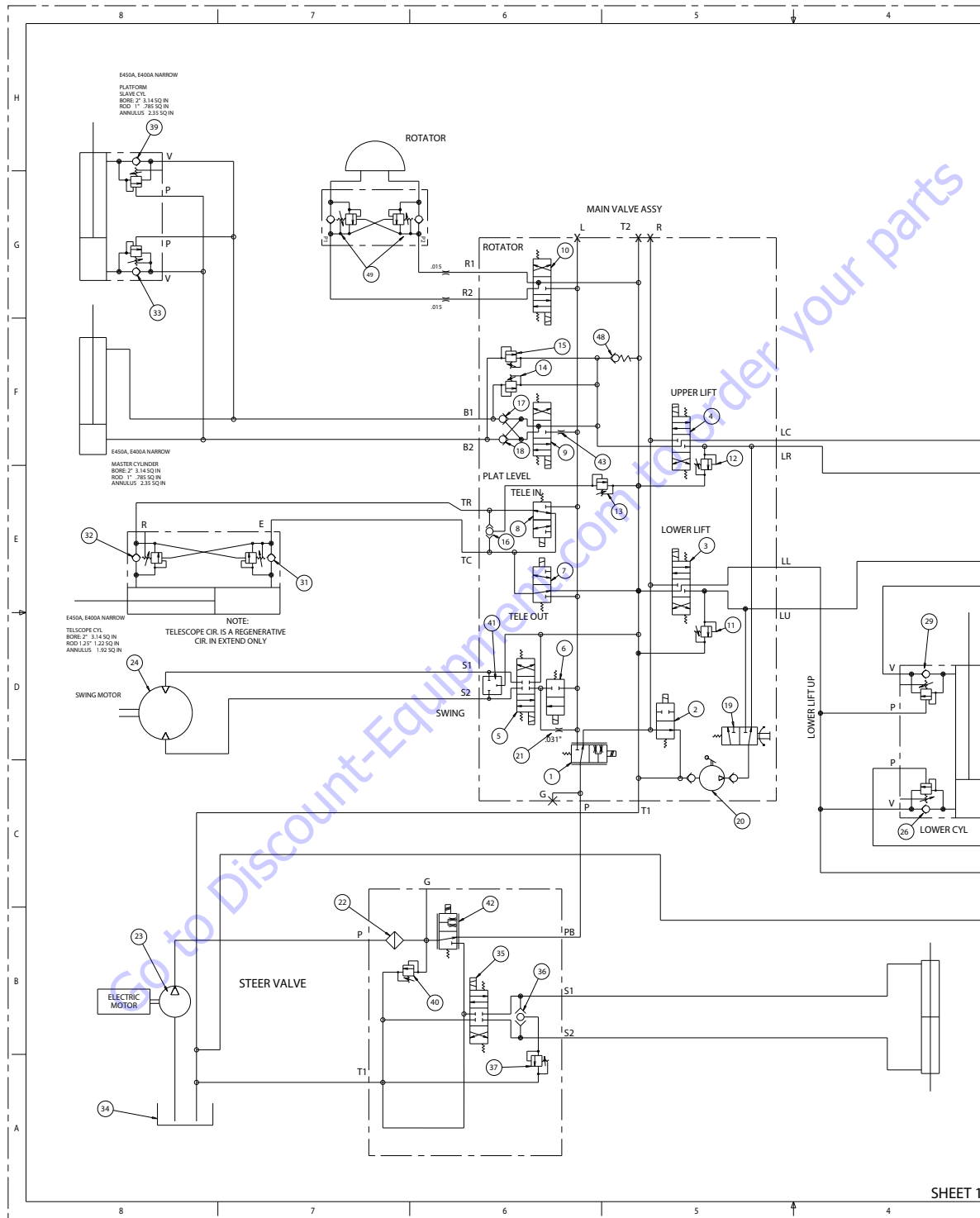
MAE31990B

Figure 5-163. Hydraulic Schematic (SN 0300208529 through 0300233451, SN B300001429 through B300002532) - Sheet 7 of 7

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SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS



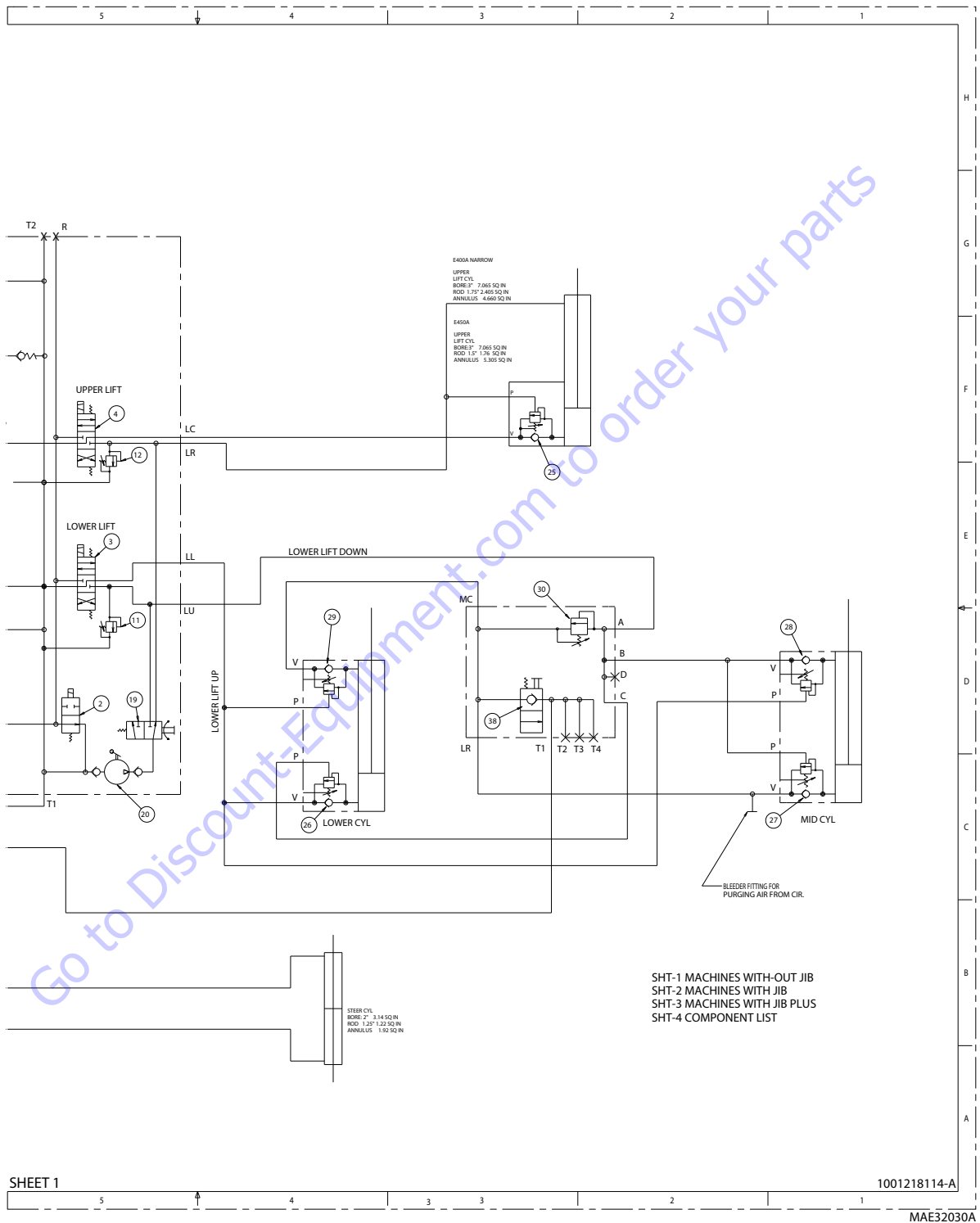


Figure 5-165. Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 2 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

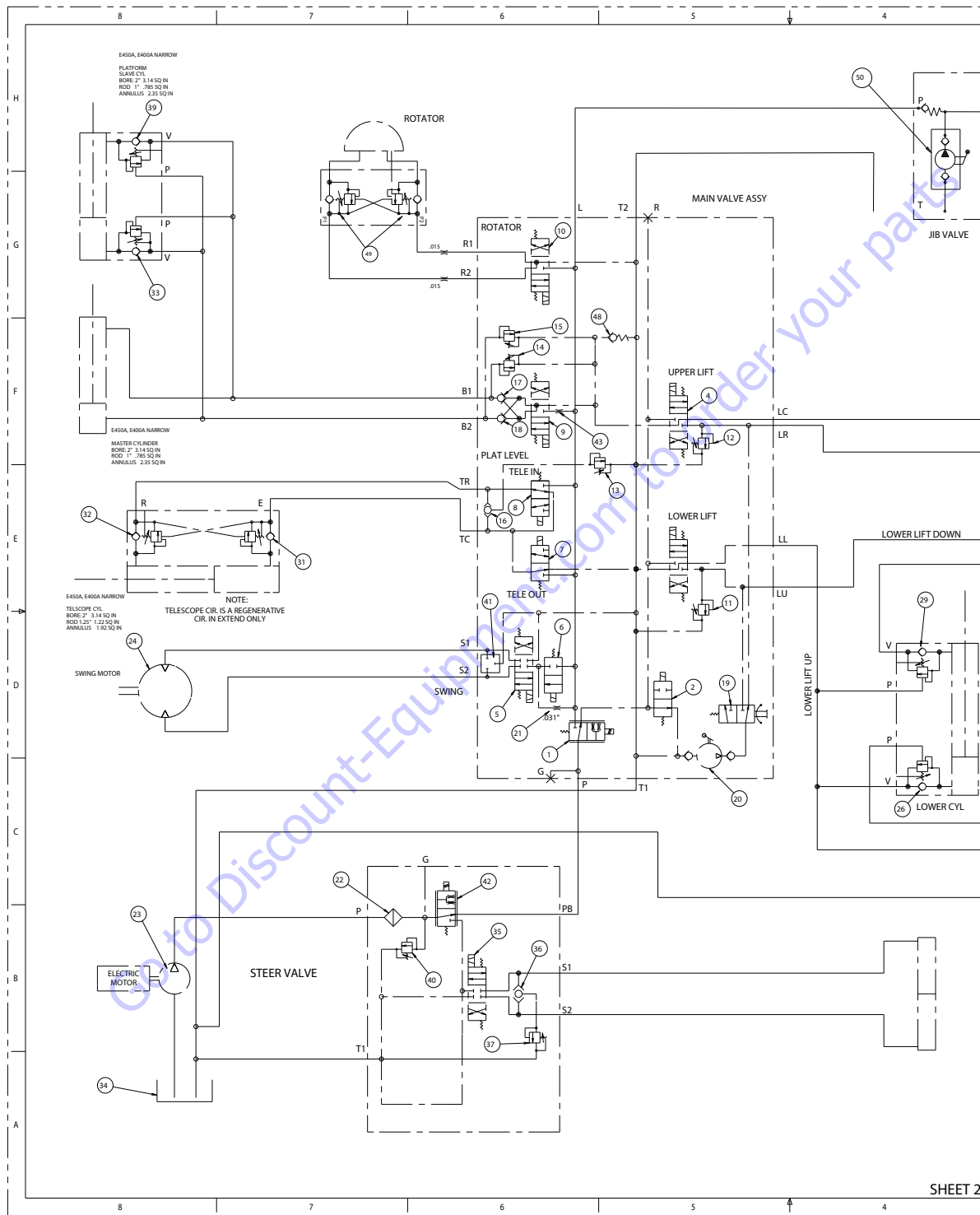


Figure 5-166. Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 3 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

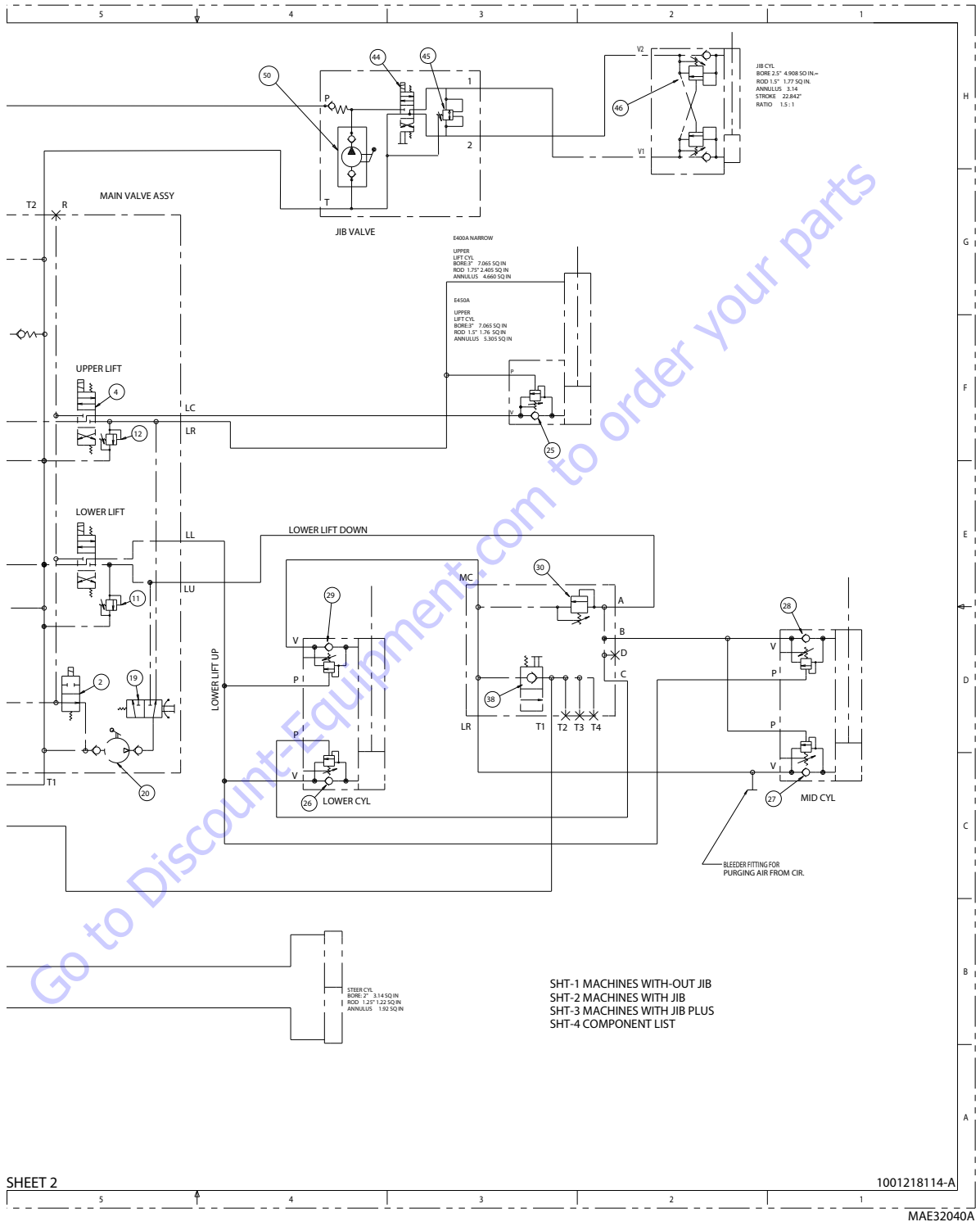


Figure 5-167. Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 4 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

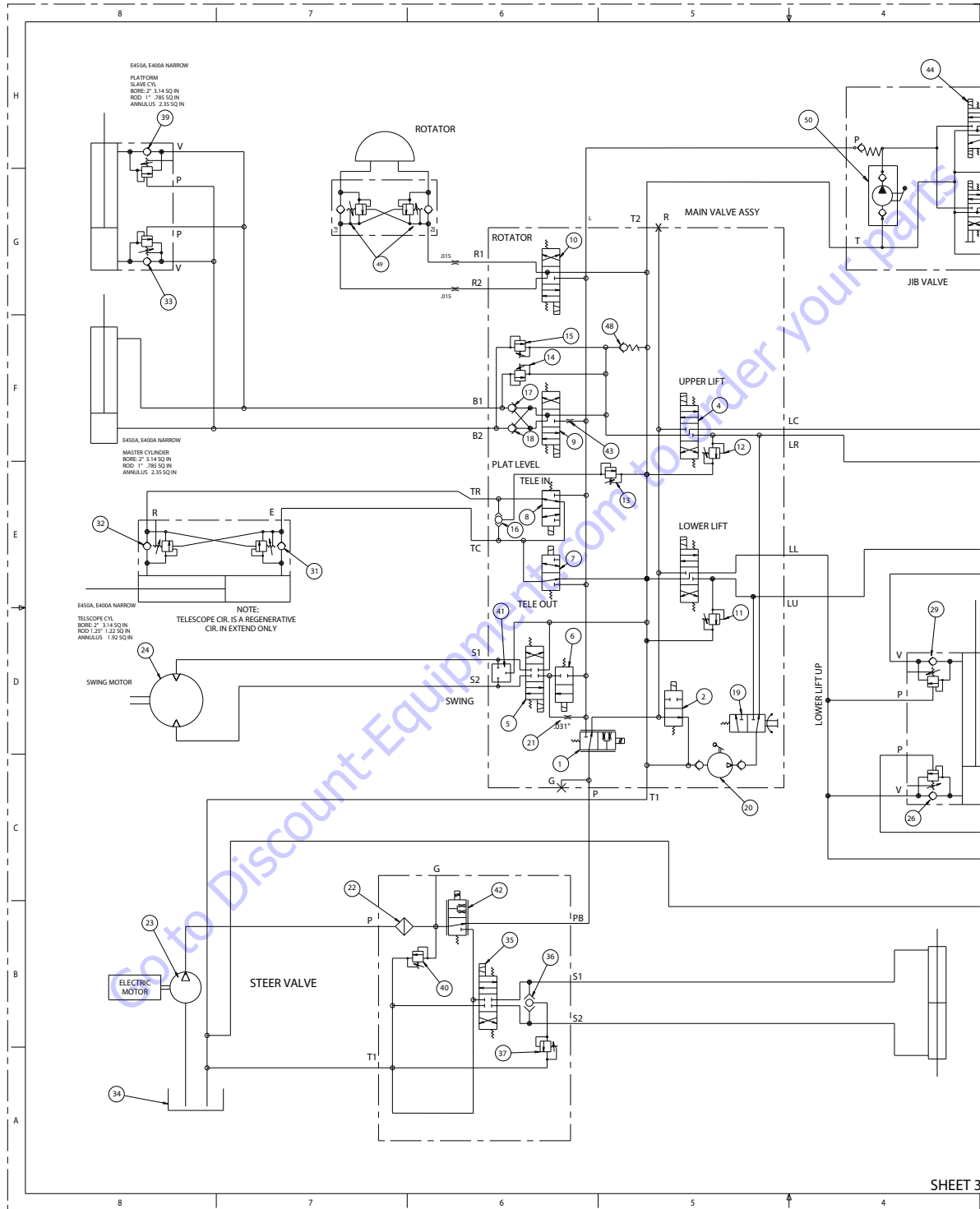


Figure 5-168. Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 5 of 7

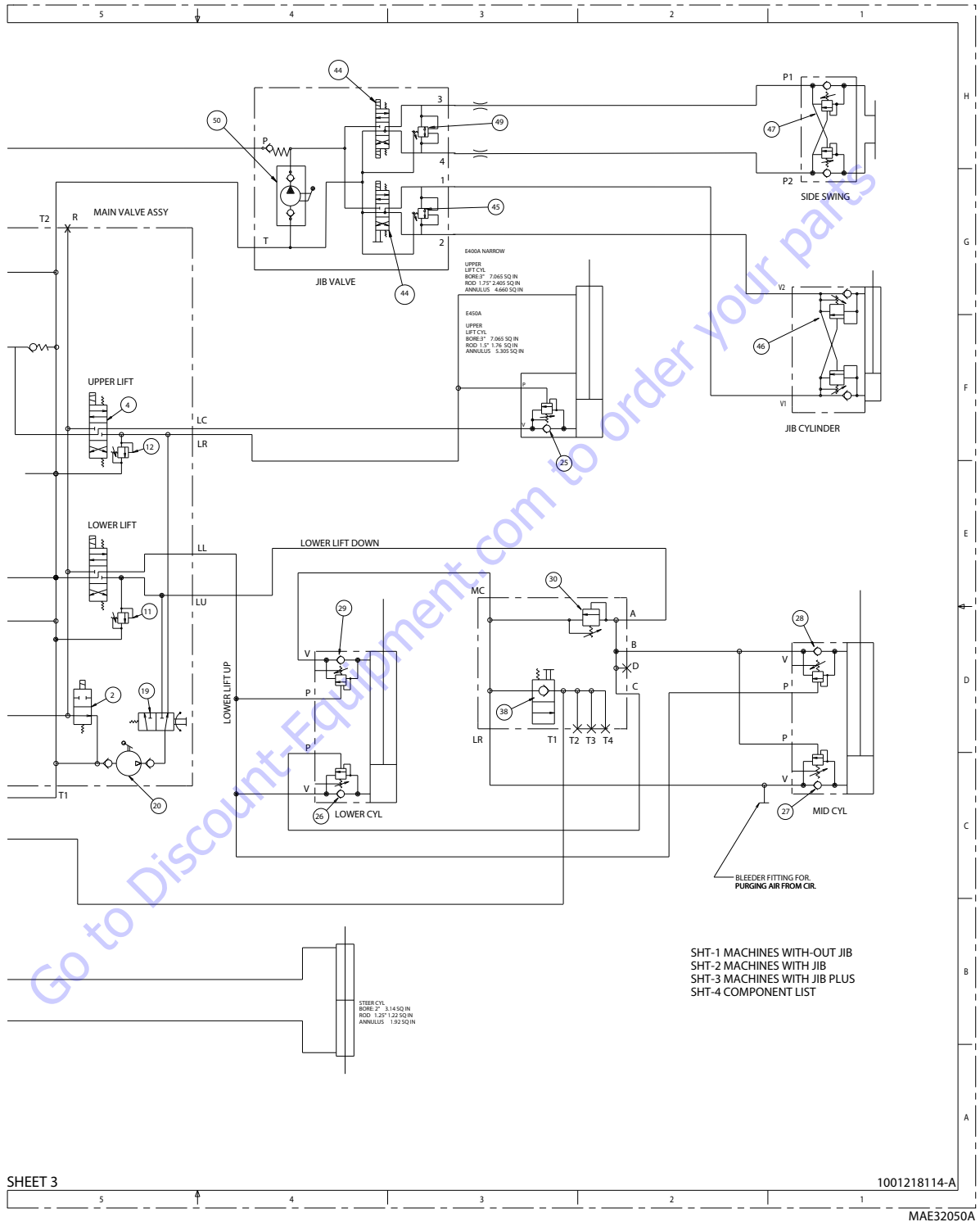


Figure 5-169. Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 6 of 7

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

COMPONENT LIST	
1.	PROPORTIONAL FLOW REGULATOR, PRESSURE COMPENSATED, PV70-3001B-0-N-12DW
2.	2-POS, 2-WAY POPPET VALVE, NORMALLY OPEN, SV08-21-0-N-12DW (BYPASS UNLOADING)
3.	3-POS, 4-WAY VALVE, SV10-4722E-0-N-12DW, (LOWER LIFT)
4.	3-POS, 4-WAY VALVE, SV10-4722E-0-N-12DW, (UPPER LIFT)
5.	3-POS, 4-WAY VALVE, SV08-47C-0-N-12DW, (SWING)
6.	2-POS, 2-WAY SPOOL VALVE, NORMALLY CLOSED SV08-24-0-N-12DW
7.	2-POS, 3-WAY VALVE, SV10-33-0-N-12DW, (TELESCOPE OUT)
8.	2-POS, 3-WAY VALVE, SV10-33-0-N-12DW, (TELESCOPE IN)
9.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (PLATFORM LEVEL)
10.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (ROTATOR)
11.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/26 (LOWER LIFT DOWN) SET AT 2600 PSI
12.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-18/8.0 (UPPER LIFT DOWN) SET AT 800 PSI
13.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/30 (TELESCOPE) SET AT 3000 PSI
14.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/12 (PLATFORM LEVEL BACKWARD ROD END) SET AT 1200 PSI
15.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-N-33/30 (PLATFORM LEVEL FORWARD PISTON END) SET AT 3000 PSI
16.	SHUTTLE VALVE, LS08-30-0-N, (TELESCOPE)
17.	PILOT OPERATED CHECK, PC08-30-0-N, (PLATFORM LEVEL, ROD SIDE)
18.	PILOT OPERATED CHECK, PC08-30-0-N, (PLATFORM LEVEL, PISTON SIDE)
19.	ROTARY 2-POS, 3-WAY VALVE, MR10-31-0-N, W/6113160 (EMERGENCY DESCENT)
20.	MANUAL HAND PUMP, HP10-21A-0-N-A (0.47 IN3)
21.	0.031" ORIFICE PLUG
22.	FILTER, HIGH PRESSURE, 10@2 ABSOLUTE G1761
23.	ELECTRIC MOTOR, PUMP ASSEMBLY, 48VDC
24.	MOTOR, GEROTOR TYPE, FIXED 3.2 CU. IN., (SWING)
25.	COUNTERBALANCE CARTRIDGE, 10:1 @@ 3000 PSI, NON-VENTED SPRING
26.	COUNTERBALANCE CARTRIDGE, 1:1 @@ 3500 PSI, VENTED SPRING, SEALED PILOT
27.	COUNTERBALANCE CARTRIDGE, 1:1 @@ 3500 PSI, VENTED SPRING, SEALED PILOT
28.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 4000 PSI, VENTED SPRING, SEALED PILOT
29.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 4000 PSI, VENTED SPRING, SEALED PILOT
30.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-NC-18/22, (LEVELING RELIEF VALVE) SET AT 2200 PSI CRACKING PRESSURE
31.	COUNTERBALANCE CARTRIDGE, 10:1 @@ 2500 PSI, NON-VENTED SPRING
32.	COUNTERBALANCE CARTRIDGE, 5:1 @@ 2500 PSI, VENTED SPRING, SEALED PILOT
33.	COUNTERBALANCE CARTRIDGE, PILOT RATIO: 7:1 (2500 PSI HOLDING, 3300 PSI THERMAL) NON-VENTED SPRING, SEALED PILOT
34.	HYDRAULIC TANK
35.	3-POS, 4-WAY VALVE, SV08-47C-0-N-12DW, (STEER)
36.	SHUTTLE VALVE, LS08-30-0-N (STEER)
37.	RELIEF VALVE, DIRECT ACTING, RV08-20A-0-NC-33/14 (STEER) SET AT 1400 PSI
38.	MANUAL, SPRING RETURN, PULL TO OPEN POPPET CARTRIDGE (MP10-20-J)
39.	COUNTERBALANCE CARTRIDGE, PILOT RATIO 10:1 (500 PSI HOLDING, 1200 PSI THERMAL) VENTED SPRING, SEALED PILOT
40.	RELIEF VALVE, DIRECT ACTING, RV58-20A-0-NC-46/32 (SYSTEM RELIEF) SET AT 3200 PSI
41.	CARTRIDGE PLUG CP08-30-0-N
42.	PROPORTIONAL FLOW REGULATOR, PRESSURE COMPENSATED, PV70-30B-0-N-12DW
43.	0.028 ORFICED PLUG
44.	3-POS, 4-WAY VALVE, SV08-47D-0-N-12DW, (JIB)
45.	RELIEF VALVE CRO8A-O-N-30/19 SET AT 2200 PSI
46.	COUNTERBALANCE CARTRIDGE, 7:1 @ 2500 PSI
47.	COUNTERBALANCE CARTRIDGE, 3:1 @ 3000 PSI, NON-VENTED SPRING
48.	CHECK VALVE CV08-20-0-N-60 (SET AT 60 PSI)
49.	RELIEF VALVE, CRO8A-O-N-30/30 SET AT 3000 PSI
50.	PUMP, HP10-21A-0-N-30

SHT-1 MACHINES WITH-OUT JIB
 SHT-2 MACHINES WITH JIB
 SHT-3 MACHINES WITH JIB PLUS
 SHT-4 COMPONENT LIST

Figure 5-170. Hydraulic Schematic (SN 0300233452 to Present, SN B300002533 to Present) - Sheet 7 of 7

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Part Packaging:

Part Labeling:

Part Marking:

Part Identification:

Part Tracking:

Part Inventory:

Part Control:

Part Management:

Part Maintenance:

Part Repair:

Part Replacement:

Part Upgrade:

Part Modification:

Part Customization:

Part Personalization:

Part Branding:

Part Marketing:

Part Sales:

Part Distribution:

Part Logistics:

Part Shipping:

Part Delivery:

Part Installation:

Part Operation:

Part Use:

Part Care:

Part Safety:

Part Compliance:

Part Regulation:

Part Standard:

Part Specification:

Part Requirement:

Part Condition:

Part Status:

Part Location:

Part Quantity:

Part Price:

Part Weight:

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Part Specification:

Part Requirement:

Part Condition:

Part Status:

Part Location:

Part Quantity:

Part Price:

Part Weight:

Part Dimensions:

Part Material:

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Part Personalization:

Part Branding:

Part Marketing:

Part Sales:

Part Distribution:

Part Logistics:

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Part Operation:

Part Use:

Part Care:

Part Safety:

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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.

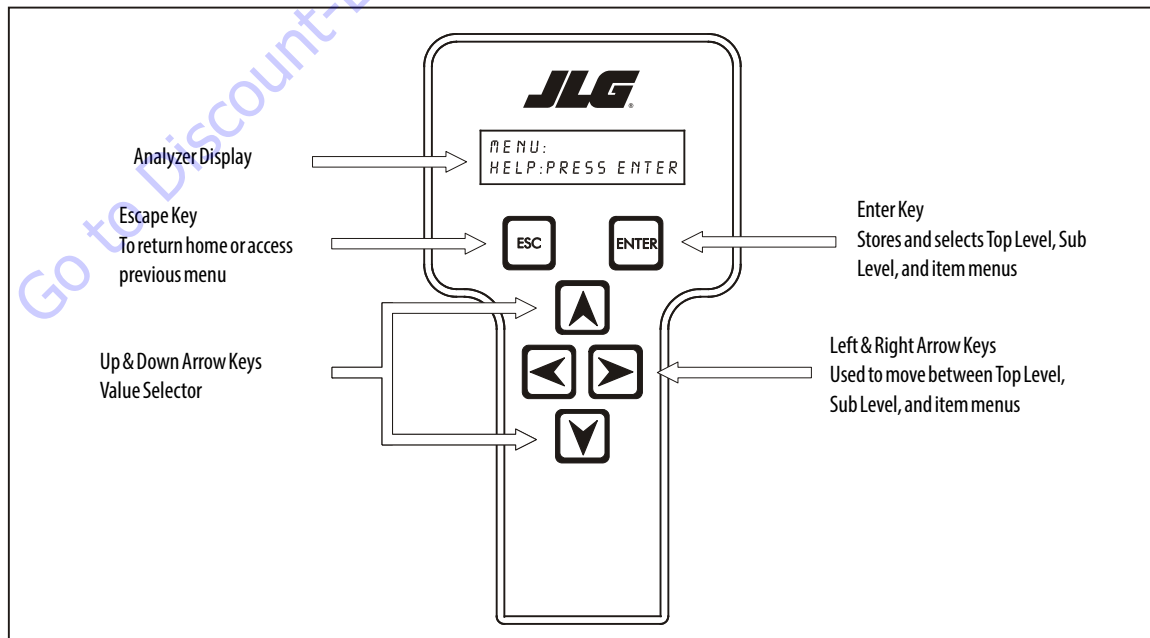


Figure 6-1. Hand Held Analyzer

To Connect the JLG Control System Analyzer

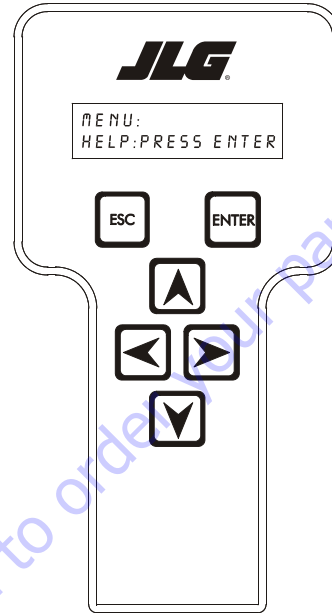
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

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

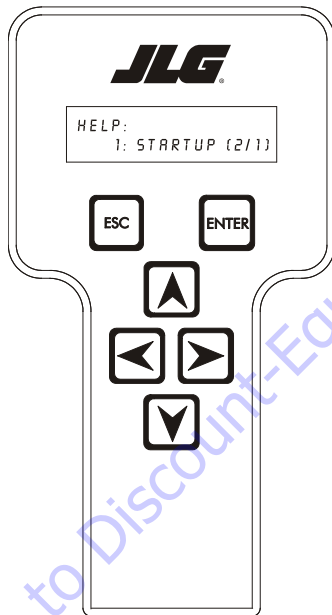
selected menu item, press **ESCAPE** ; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

- HELP
- DIAGNOSTICS
- SYSTEM TEST
- ACCESS LEVEL
- PERSONALITIES
- MACHINE SETUP
- LEVEL VEHICLE (level 1 only)
- CALIBRATIONS (view only)

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

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




LOGGED HELP
1: 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** , 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:

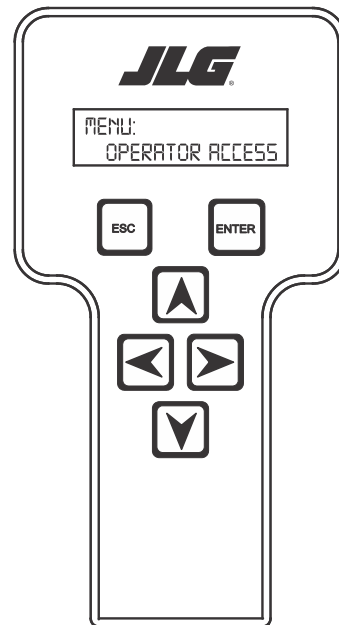
- DRIVE
- BOOM
- SYSTEM
- DATALOG
- VERSIONS

Pressing **ENTER**  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**  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

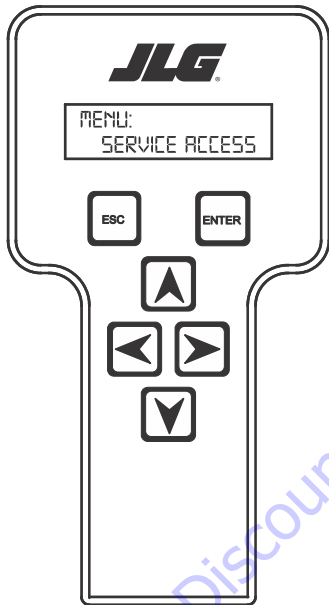
Press **ENTER**  to select the **ACCESS LEVEL** menu.

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:



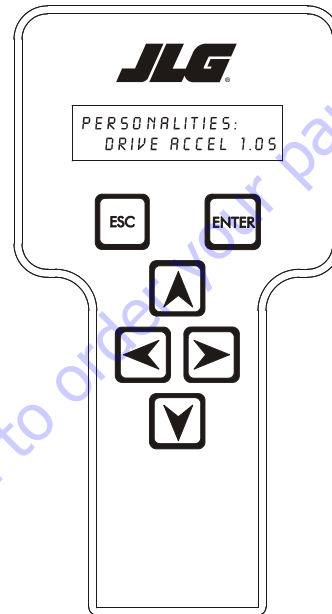
**MENU:
SERVICE ACCESS**

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 1.05**

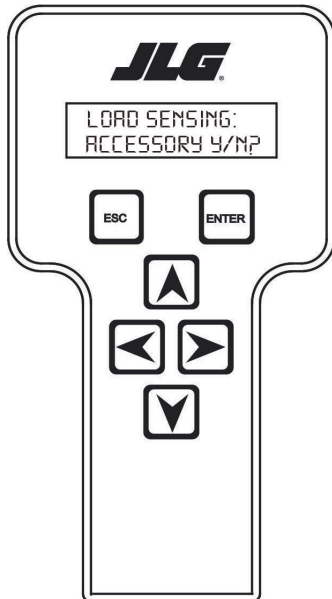
There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the **UP**

 arrow is pressed when at the maximum value nor will

the value decrease if the **DOWN**  arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at 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 6-4, Personality Ranges/Defaults, and Table 6-6, Machine Setup Descriptions in this Service Manual for the recommended factory settings.

NOTE: Password 33271 will give you access to Service Access, 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

NOTICE

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.

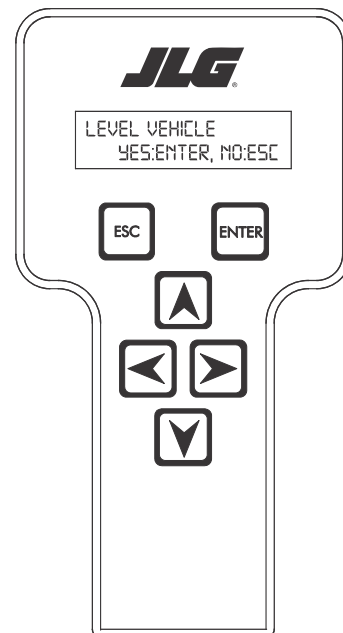
Level Vehicle Description

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 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

SECTION 6 - JLG CONTROL SYSTEM

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

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SECTION 6 - JLG CONTROL SYSTEM

Table 6-2. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
<p>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.</p>			
MODEL NUMBER: 1	1	E300	4- E450
	2	E400	
	3	E400N	
	4	E450	
	5	E600	
MARKET: 2	1	ANSI USA	2- E400, E450
	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	2- E400, E450
	2	375AH Flooded	
	3	312AH AGM	
	4	415AH Flooded	
	5	390AH AGM)	

Table 6-2. Machine Configuration Programming Information

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.	1 ANSI USA, ANSI Export, CSA, JAPAN
	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.	
GROUND ALARM: 5	1	NO: No ground alarm installed.	4
	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.	
JIB: 6	1	NO: No jib installed.	2
	2	YES: Jib installed which has up and down movements only.	
JIB SWING: 7	1	NO: No jib swing installed.	2
	2	YES: Jib installed which has side to side movements.	
SKYGUARD: 8	1	NO: No Sky Guard system installed.	2
	2	YES: Sky Guard system installed.	
SOFT TOUCH: 9	1	NO: No Soft Touch system installed.	1
	2	YES: Soft Touch system installed.	
H&T LIGHTS: 10	1	NO: No head and tail lights installed.	1
	2	YES: head and tail lights installed	

SECTION 6 - JLG CONTROL SYSTEM

Table 6-2. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
LOAD SYSTEM: 11* * Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting.	1	NO: No load sensor installed.	1
	2	WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps(5 sec ON, 2 sec OFF).	
	3	CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps(5 SECON, 2 SEC OFF).	
	4	CUTOUT ALL: All functions cutout, flash overload light (500 mS on, 500 mS off), platform alarm beeps(5 SECON, 2 SEC OFF).	
FUNCTION CUTOUT: 12* * Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting.	1	NO: No drive cutout.	1
	2	BOOM CUTOUT: Boom function cutout while driving above elevation.	
	3	DRIVE CUTOUT: Drive and steer cutout above elevation.	
DISPLAY UNITS: 13	1	METRIC	1 CSA, CE, AUS, JAPAN, GB
	2	IMPERIAL	2 ANSI USA, ANSI Export
ALERT BECON: 14* * Only visible if Skyguard is selected.	1	OFF FOR CREEP.	1
	2	20 FPM FOR CREEP.	
TEMP OUTPUT: 15* * Certain market selection will display temp cutout options.	1	NO:	1
	2	YES: Low temp cutout system is installed.	
WHEEL DRIVE: 16* * Only visible if E600 model is selected.	1	4WD: Front wheel assist (4WD) system is installed	2
	2	2WD: Front wheel assist (4WD) system is not installed.	

Table 6-2. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
CHARGER INTERLOCK: 17	1	DRIVE ONLY: Drive function is disabled when battery charger is plugged in.	1
	2	CUTOFF ALL: Drive and bottom function is disabled when battery charger is plugged in.	
PLAT LVL OVR CUT: 18	1	NO: Platform level functions above elevation.	1
	2	YES: Platform level does not function above elevation.	

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SECTION 6 - JLG CONTROL SYSTEM

Table 6-3. Machine Configuration Programming Settings

E450	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	4	4	4	4	4	4	4
Market	1	2	3	4	5	6	7
Batteries	X	X	X	X	X	X	X
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	X	X	X	X	X	X	X
Tilt	1	1	1	X	X	1	X
	2	2	2	X	X	2	X
	3	3	3	3	3	3	3
Ground Alarm	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	4	4	4	4	4	4
Jib	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Jib Swing	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Skyguard	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Soft Touch	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Head & Tail Lights	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Load System	X	1	X	1	1	1	1
	X	2	X	X	X	2	X
	X	3	X	X	3	3	X
	X	4	X	4	X	4	4
Function Cutout	1	1	1	X	1	1	1
	X	2	2	2	2	2	2
	3	3	3	X	3	3	3

Table 6-3. Machine Configuration Programming Settings

E450	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Display Units	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Alert Beacon	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Temp Cutout	X	1	X	1	X	X	1
	X	2	X	2	X	X	2
Wheel Drive	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Charger Interlock	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Plat Lvl Ovr Cut	1	1	1	1	1	1	1
	2	2	2	2	2	2	2

BOLD TEXT indicates the default setting. Plain text indicates another available selection.
ITALIC TEXT indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

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

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 Forward speed	75 to 100%	100%
	REDUCED MAXimum speed 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%	20%
	MAXimum LEFT speed	50 to 90%	60%
	MINimum RIGHT speed	20 to 40%	20%
	MAXimum RIGHT speed	50 to 90%	60%
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	36 to 80%	60%
	CREEP Maximum LEFT speed	16 to 35%	20%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	36 to 80%	60%
	CREEP maximum RIGHT speed	16 to 35%	20%

SECTION 6 - JLG CONTROL SYSTEM

Table 6-4. Personality Ranges/Defaults

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 80%	65%
	CREEP maximum UP speed	16 to 35%	30%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	36 to 80%	40%
	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 15%	15%
	MAXimum UP speed	51 to 100%	85%
	CREEP maximum UP speed	16 to 50%	30%
	MINimum DOWN speed	1 to 15%	15%
	MAXimum DOWN speed	51 to 80%	55%
	CREEP maximum DOWN speed	16 to 50%	30%
TELESCOPE	ACCEleration	0.1 to 5.0s	1.5s
	DECEleration	0.1 to 5.0s	1.5s
	MINimum IN speed	1 to 15%	1%
	MAXimum IN speed	61 to 100%	80%
	CREEP maximum IN speed	16 to 60%	45%
	MINimum OUT speed	1 to 15%	1%
	MAXimum OUT speed	61 to 100%	100%
	CREEP maximum OUT speed	16 to 60%	50%
JIB LIFT	ACCEleration	0.1 to 5.0s	1.2s
	DECEleration	0.1 to 5.0s	0.5s
	MINimum UP speed	1 to 15%	1%
	MAXimum UP speed	41 to 80%	60%
	CREEP maximum UP speed	16 to 35%	35%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	41 to 80%	45%

Table 6-4. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS
	CREEP maximum DOWN speed	16 to 35%	30%
JIB SWING	ACCEleration	0.1 to 5.0s	2.0s
	DECEleration	0.1 to 5.0s	1.0s
	MINimum LEFT speed	1 to 15%	1%
	MAXimum LEFT speed	41 to 75%	50%
	CREEP Maximum LEFT speed	16 to 40%	25%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	41 to 75%	50%
	CREEP maximum RIGHT speed	16 to 40%	25%
PLATFORM LEVEL	ACCEleration	0.1 to 5.0s	1.0s
	DECEleration	0.1 to 5.0s	0.5s
	MINimum UP speed	1 to 15%	1%
	MAXimum UP speed	36 to 60%	40%
	CREEP maximum UP speed	16 to 35%	20%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	36 to 60%	40%
	CREEP maximum DOWN speed	16 to 35%	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%	1%
	MAXimum LEFT speed	25 to 50%	30%
	CREEP Maximum LEFT speed	16 to 20%	20%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	25 to 50%	30%
	CREEP maximum RIGHT speed	16 to 20%	20%
GROUND MODE	Swing	36 to 80%	50%
	Tower UP	51 to 100%	80%
	Tower Down	51 to 100%	54%
	Lift UP	36 to 80%	60%
	Lift DOWN	36 to 80%	38%
	Telescope IN	61 to 100%	75%

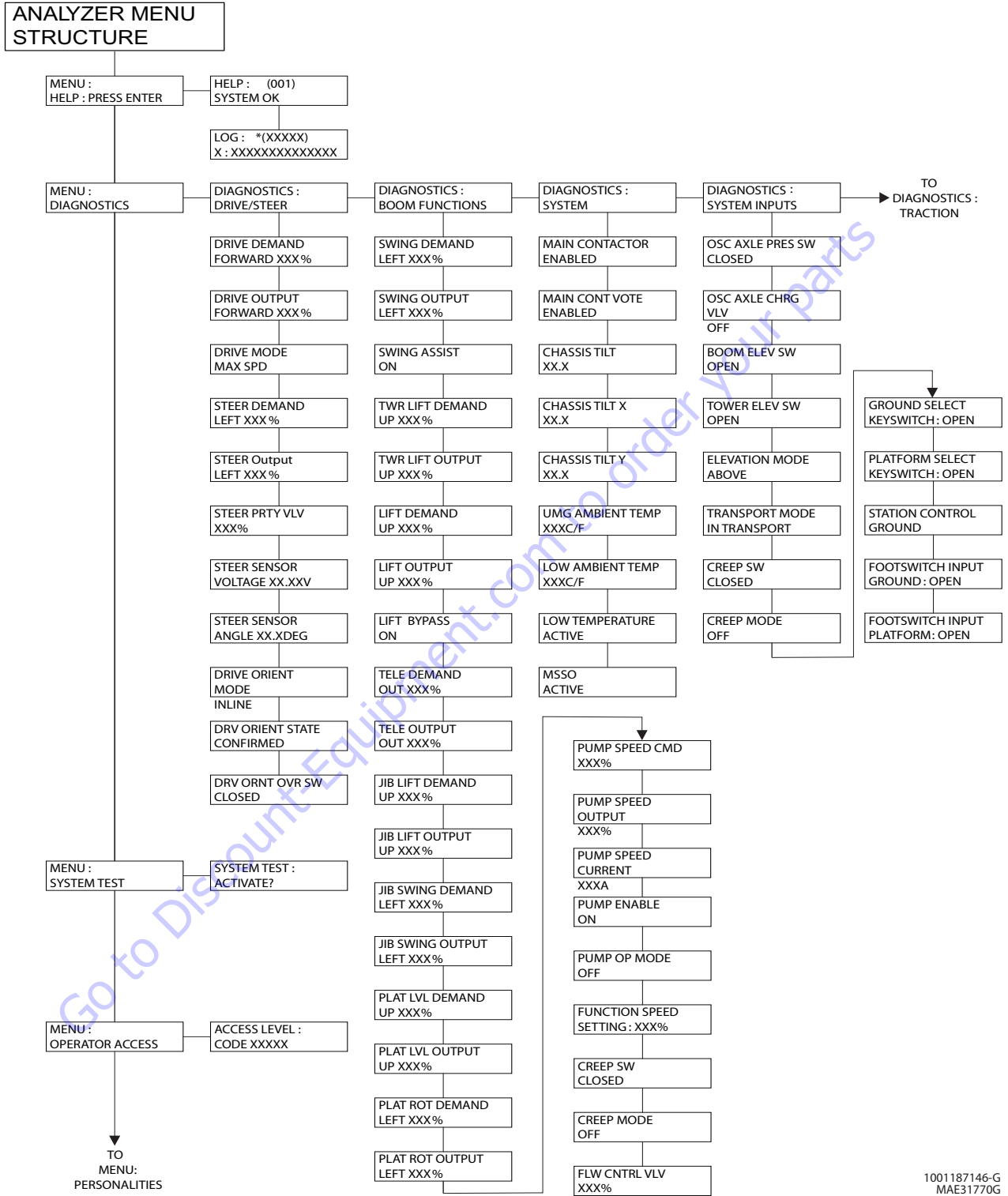
SECTION 6 - JLG CONTROL SYSTEM

Table 6-4. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS
	Telescope OUT	61 to 100%	90%
	Jib UP	41 to 80%	55%
	Jib DOWN	41 to 80%	42%
	Jib SWING	41 to 75%	45%
	Platform LEVEL	36 to 80%	38%
	Platform ROTATE	25 to 50%	28%
ALARM/HORN	Volume HORN	25 to 100%	100%
	Volume ALARM	25 to 100%	75%
TEMPERATURE CUT	LOW Cutout set	-30 to 0C	-30C
	OFFset	0 to 10C	5C

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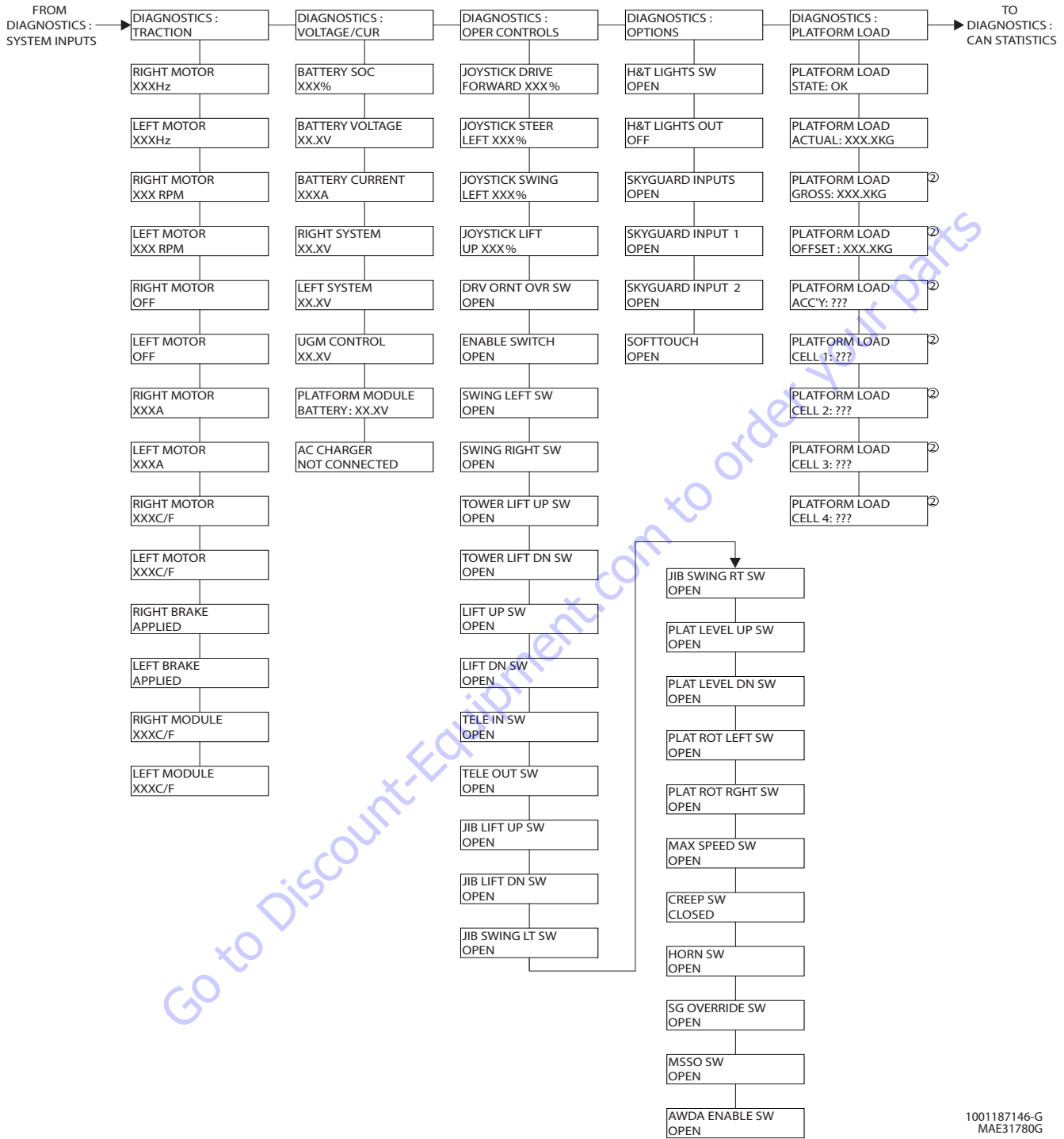


1001187146-G
MAE31770G

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 Software P1.4 - Sheet 1 of 5

SECTION 6 - JLG CONTROL SYSTEM



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MAE31780G

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 Software P1.4 - Sheet 2 of 5

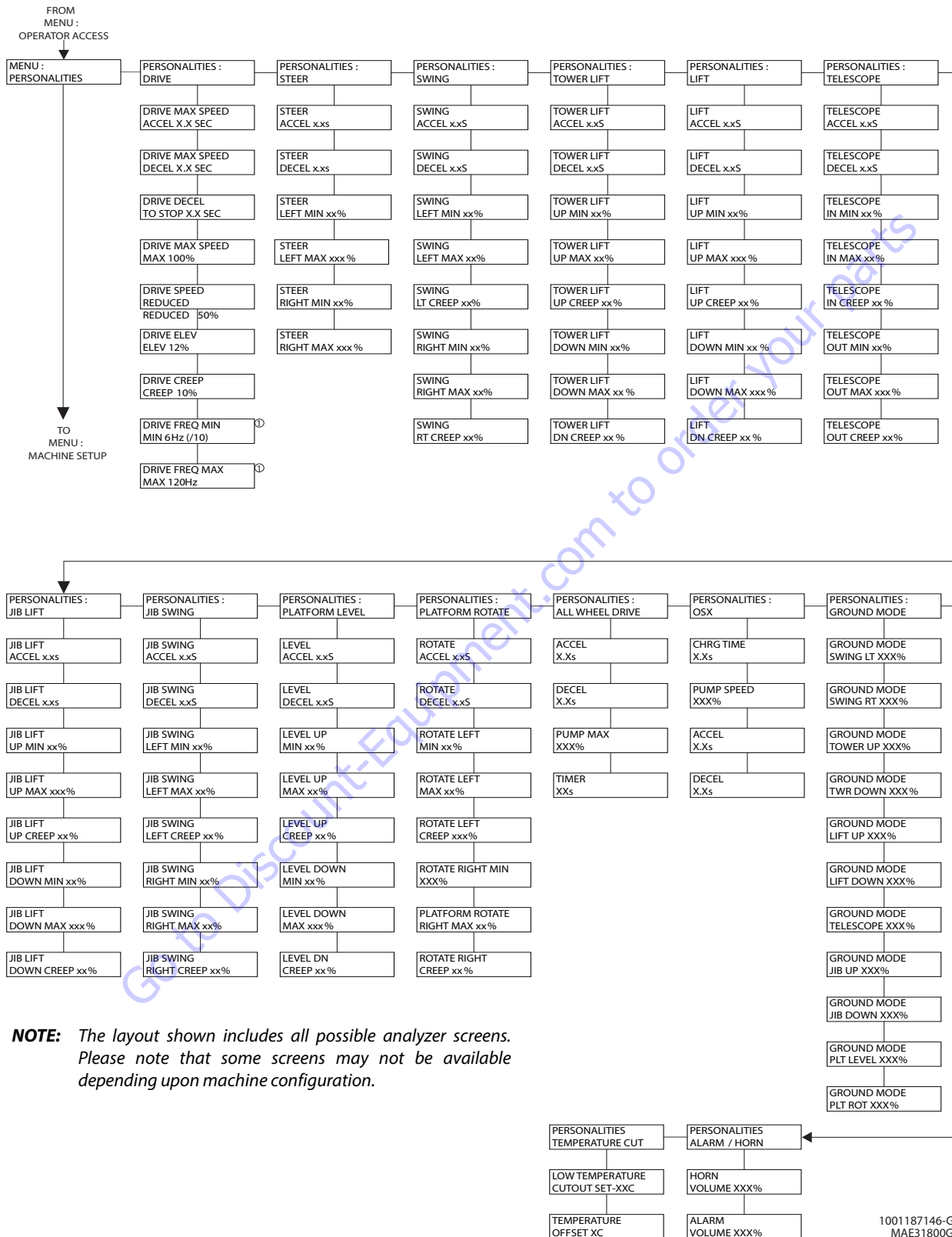


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MAE31790G

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 Software P1.4 - Sheet 3 of 5

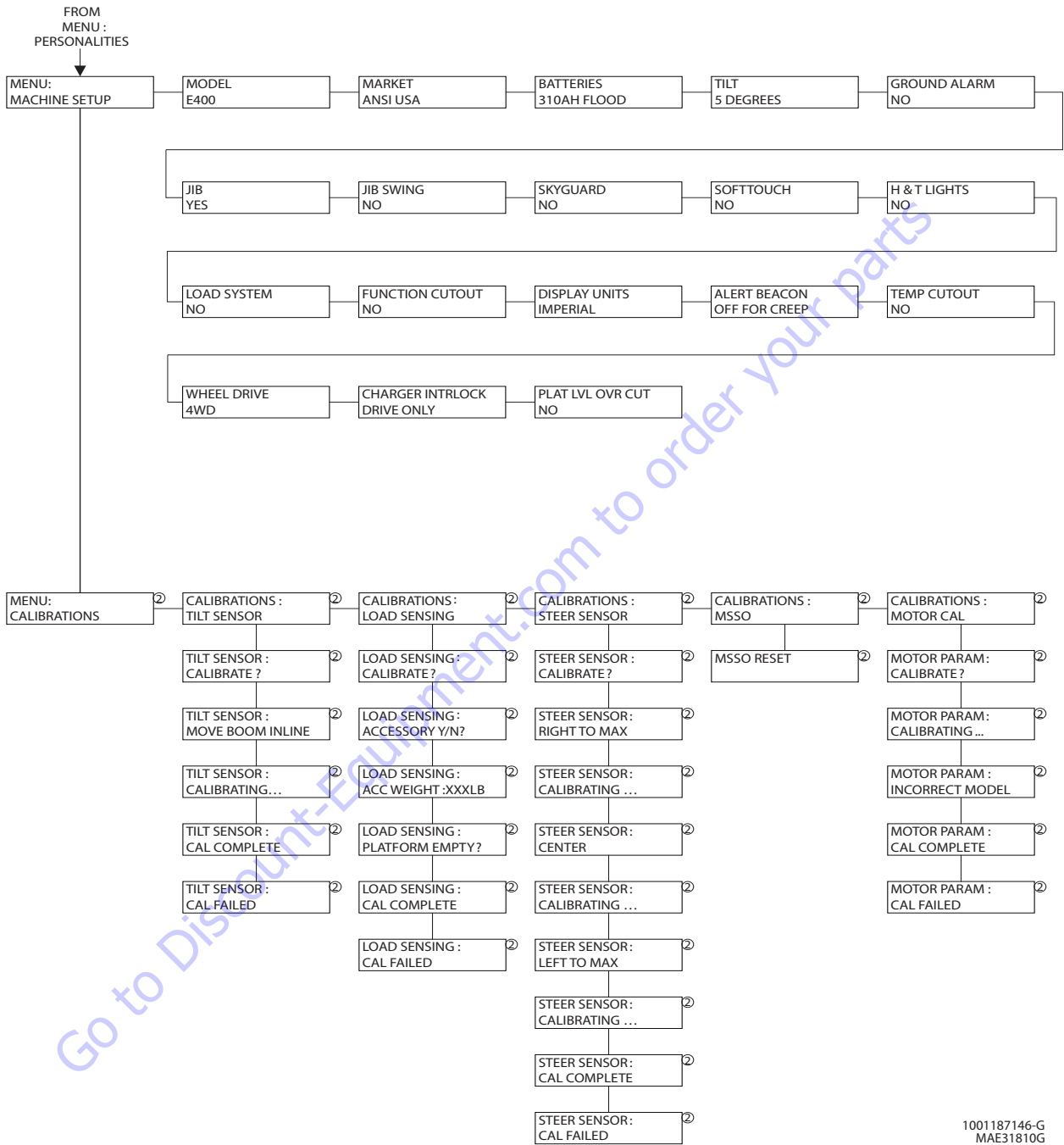
SECTION 6 - JLG CONTROL SYSTEM



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 Software P1.4 - Sheet 4 of 5

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MAE31800G



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 Software P1.4 - 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 25ft (7.6m) 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.

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 25ft (7.6m) 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, "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 $>10^{\circ}$ above horizontal to ensure the drive is operating in elevated mode. Result should be recorded for a 50ft (15.2m) 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 counterclockwise.

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 counterclockwise.

Test Notes

1. Stop watch should be started with the function movement, not with actuation of joystick and switch.
2. Drive speeds should be set to the values below regardless of the tire size.
3. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
4. The platform speed knob control must be at full speed (turned clockwise completely).
5. Some flow control functions may not work with the Platform Speed Control knob clicked into the creep position.
6. Functional speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).

6.4 FUNCTION SPEED

Table 6-5. Function Speeds

Function	Speed (In Seconds)
Main Lift Up	24-30
Main Lift Down	23-29
Turntable Swing Right & Left 360°	67-81
NOTE: Swing Left to Swing Right should be within 10% of each other.	
Telescope Out - E450AJ, M450AJ	9-12
Telescope Out - E450A, M450A	14-18
Telescope In - E450AJ, M450AJ	15-19
Telescope In - E450A, M450A	23-28
Platform Rotate - Right & Left 180°	8-14
NOTE: Rotate Left to Swing Right should be within 15% of each other.	
Jib Lift Up - E450AJ, M450AJ	24-27
Jib Lift Down - E450AJ, M450AJ	19-25
Lower Lift Up	27-33
Lower Lift Down	22-26
Drive Fwd Below Elevation	30-35
Drive Reduced/Drive Reverse Below Elevation	50-59
Drive Above Elevation (ANSI)-E450A, M450A	50-53
Drive Above Elevation (ANSI)-E450AJ, M450AJ	107-112
Drive Above Elevation (CE)-E450A, M450A	71-76
Drive Above Elevation (CE)-E450AJ, M450AJ	107-112
NOTE: Drive Forward Max to 100% (Typical)	
NOTE: Drive Reverse Max = Drive Reduced Max (Below Elevation)	

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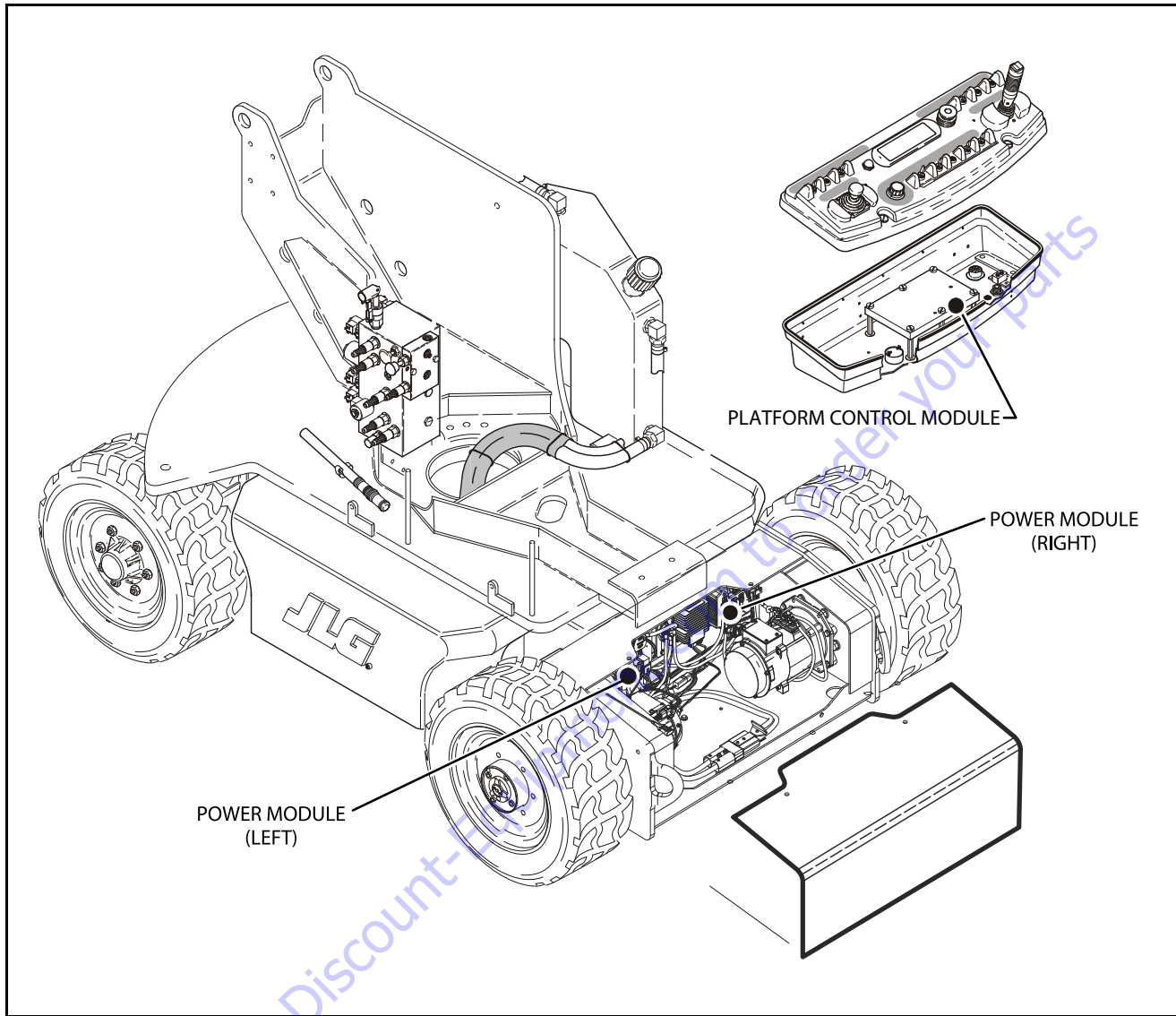


Figure 6-7. Control Module Location - Sheet 1 of 2

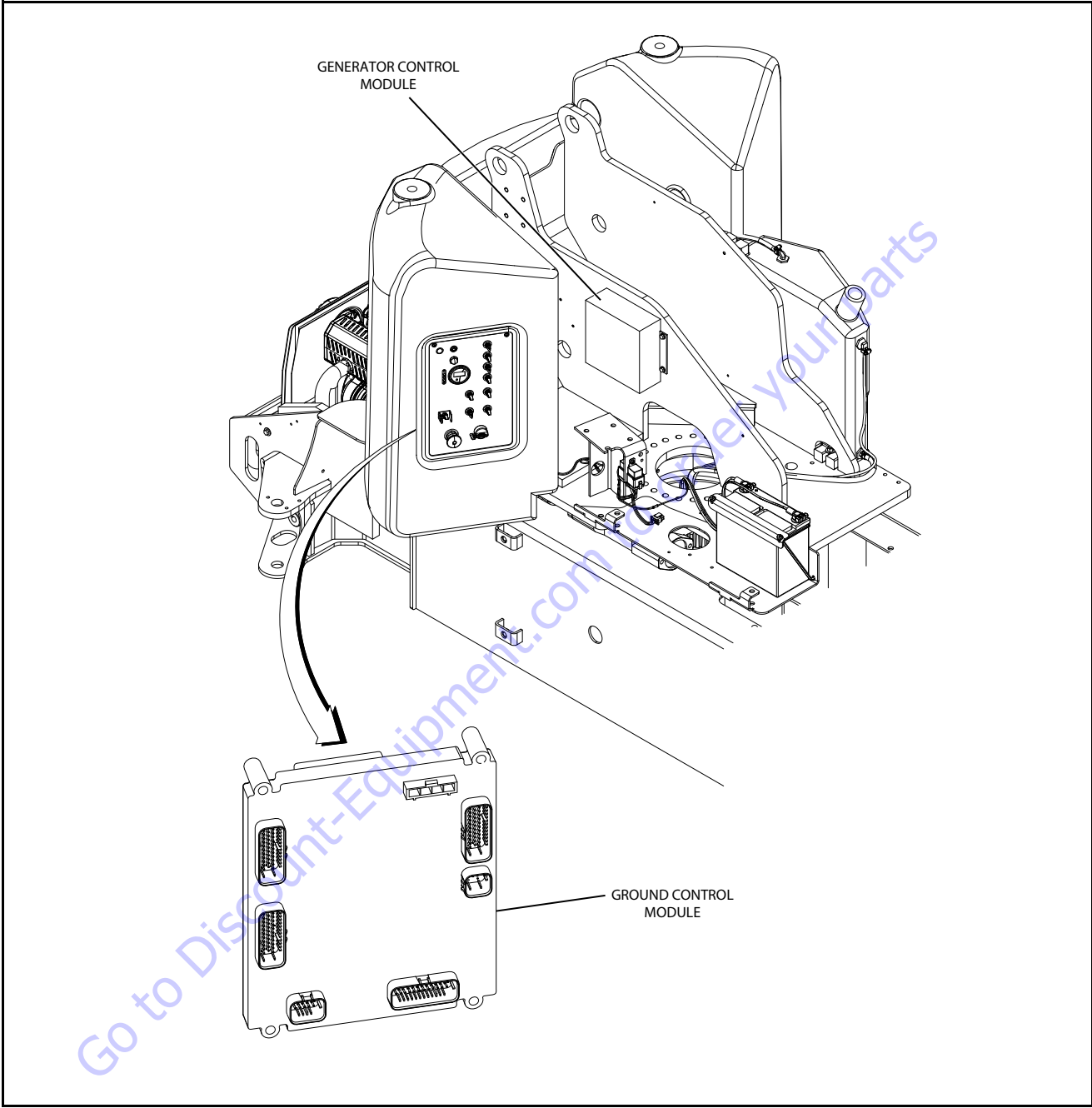


Figure 6-8. Control Module Location - Sheet 2 of 2

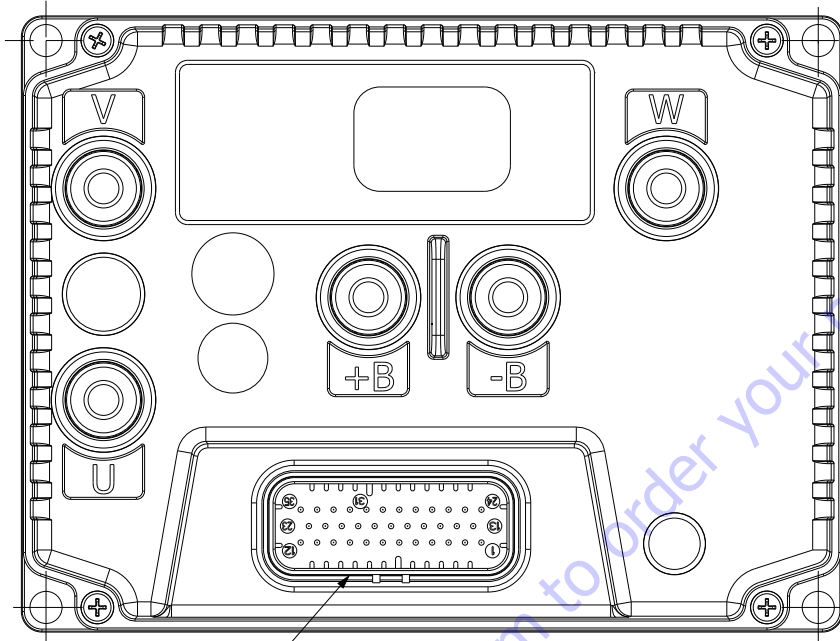


PLATFORM CONNECTION



GROUND CONTROL CONNECTION

Figure 6-9. Analyzer Connecting Points



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	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	
U	1	MOTOR PHASE U	AC	OUTPUT

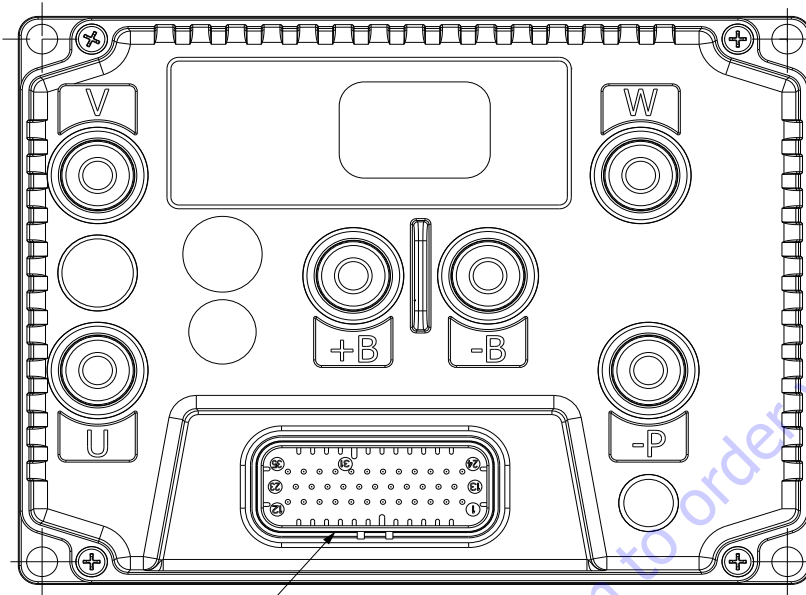
CONNECTOR	PIN	FUNCTION	TYPE	
V	1	MOTOR PHASE V	AC	OUTPUT

CONNECTOR	PIN	FUNCTION	TYPE	
W	1	MOTOR PHASE W	AC	OUTPUT

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Figure 6-10. Power Module - LH

SECTION 6 - JLG CONTROL SYSTEM



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) 48V	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
+B	1	MODULE POWER	VBAT INPUT
-P	1	PUMP	PWM OUTPUT
U	1	MOTOR PHASE U	AC OUTPUT
V	1	MOTOR PHASE V	AC OUTPUT
W	1	MOTOR PHASE W	AC OUTPUT

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Figure 6-11. Power Module - RH

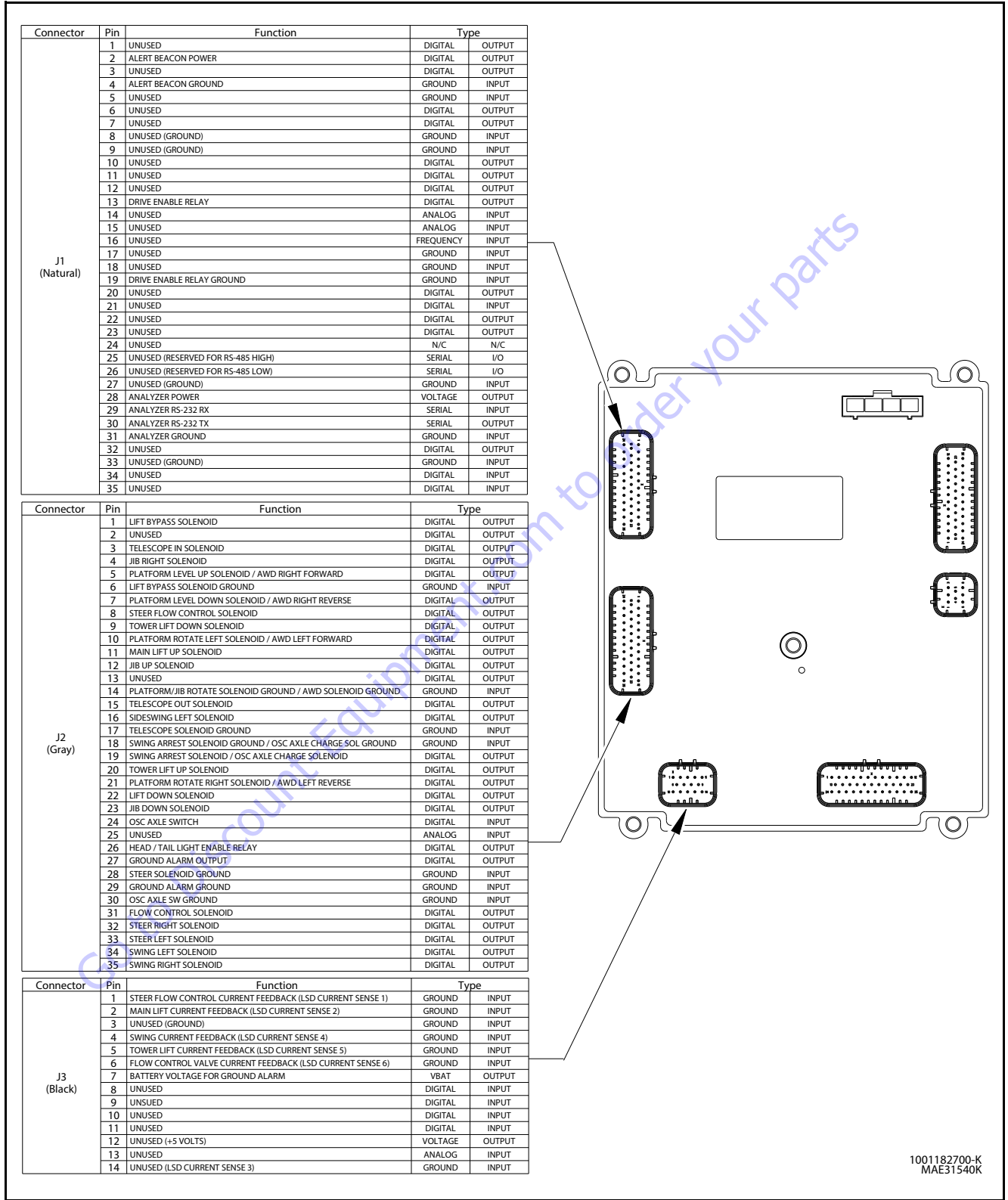


Figure 6-12. Ground Control Module - Sheet 1 of 3

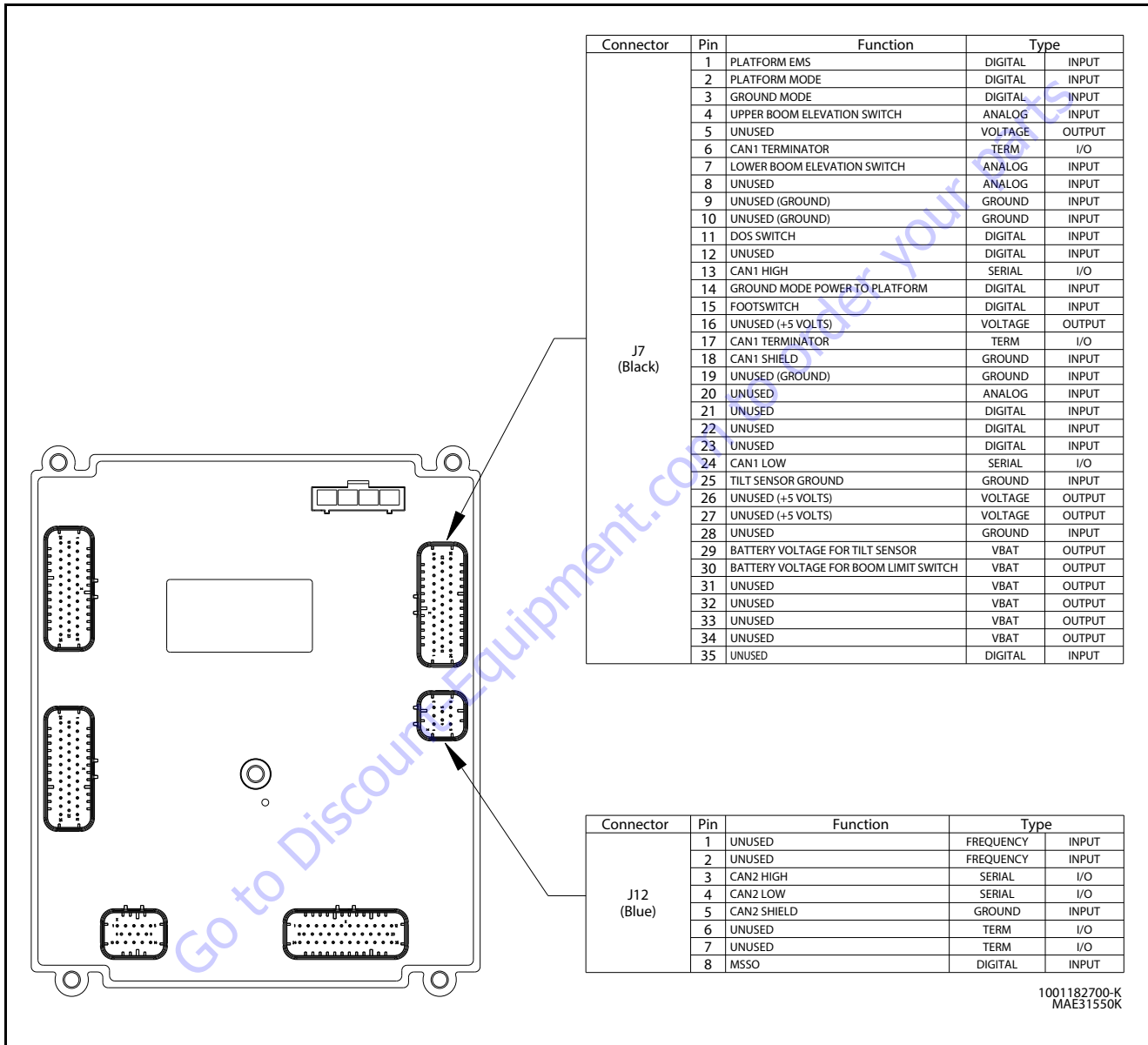
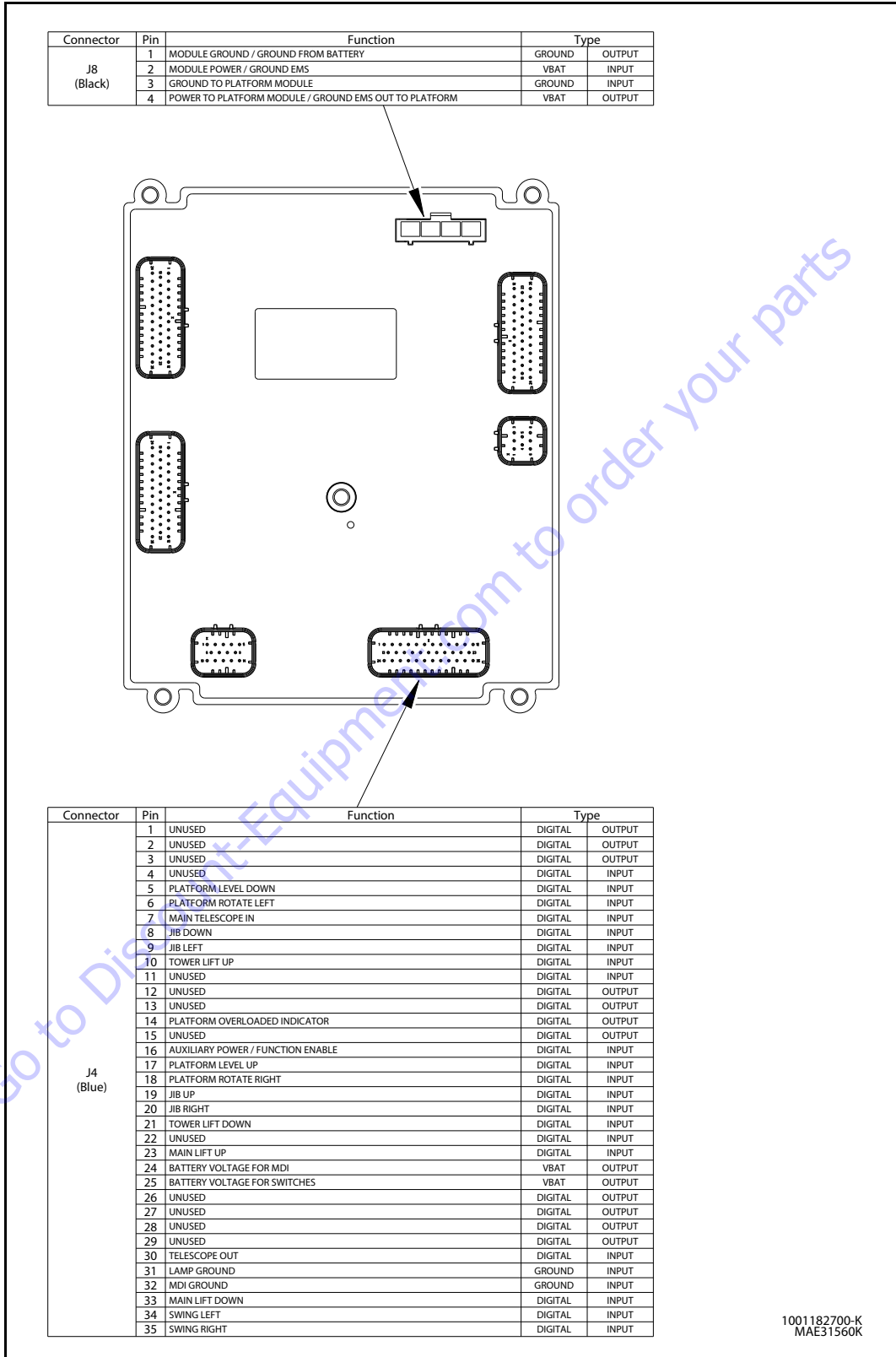
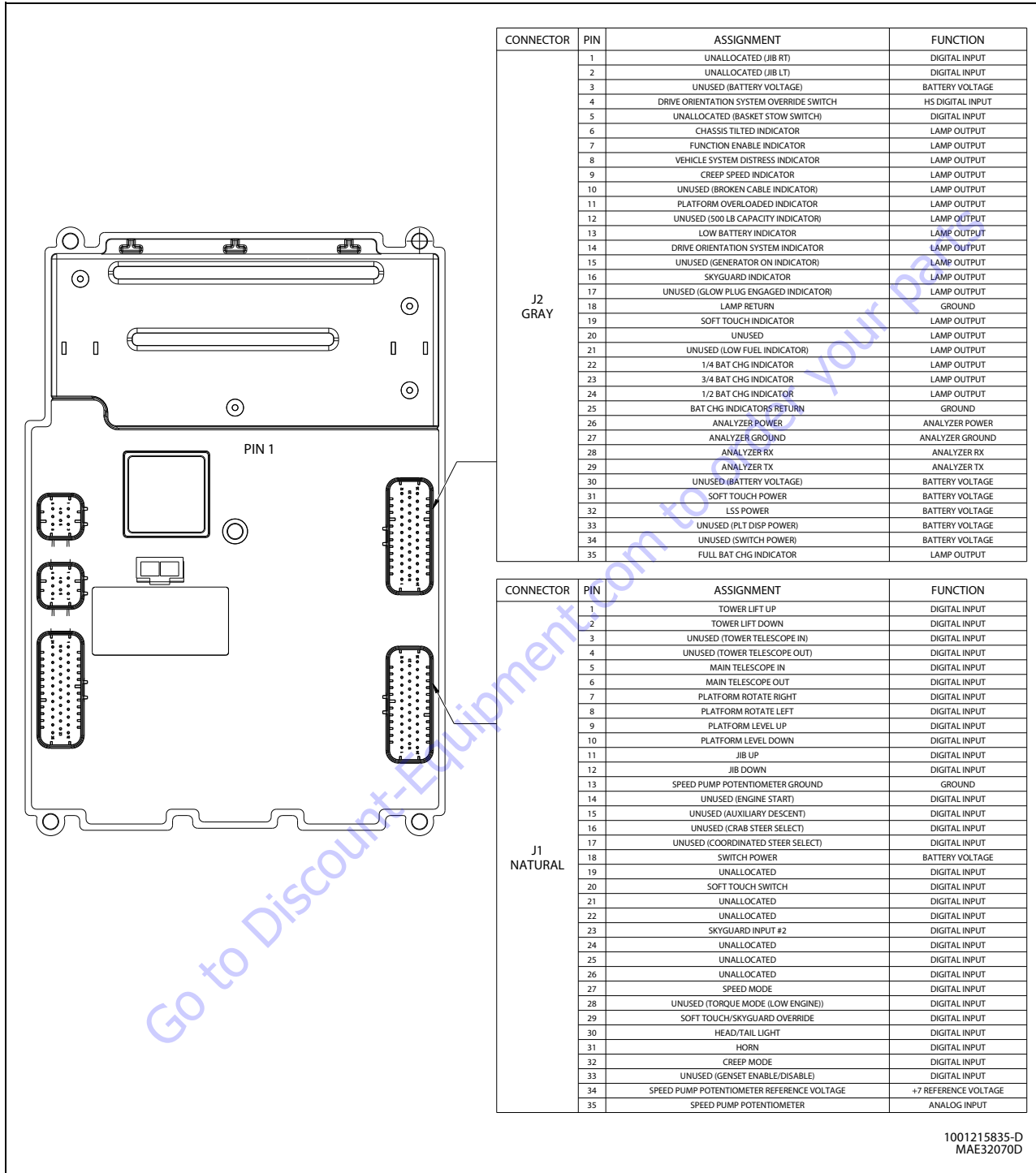


Figure 6-13. Ground Control Module - Sheet 2 of 3



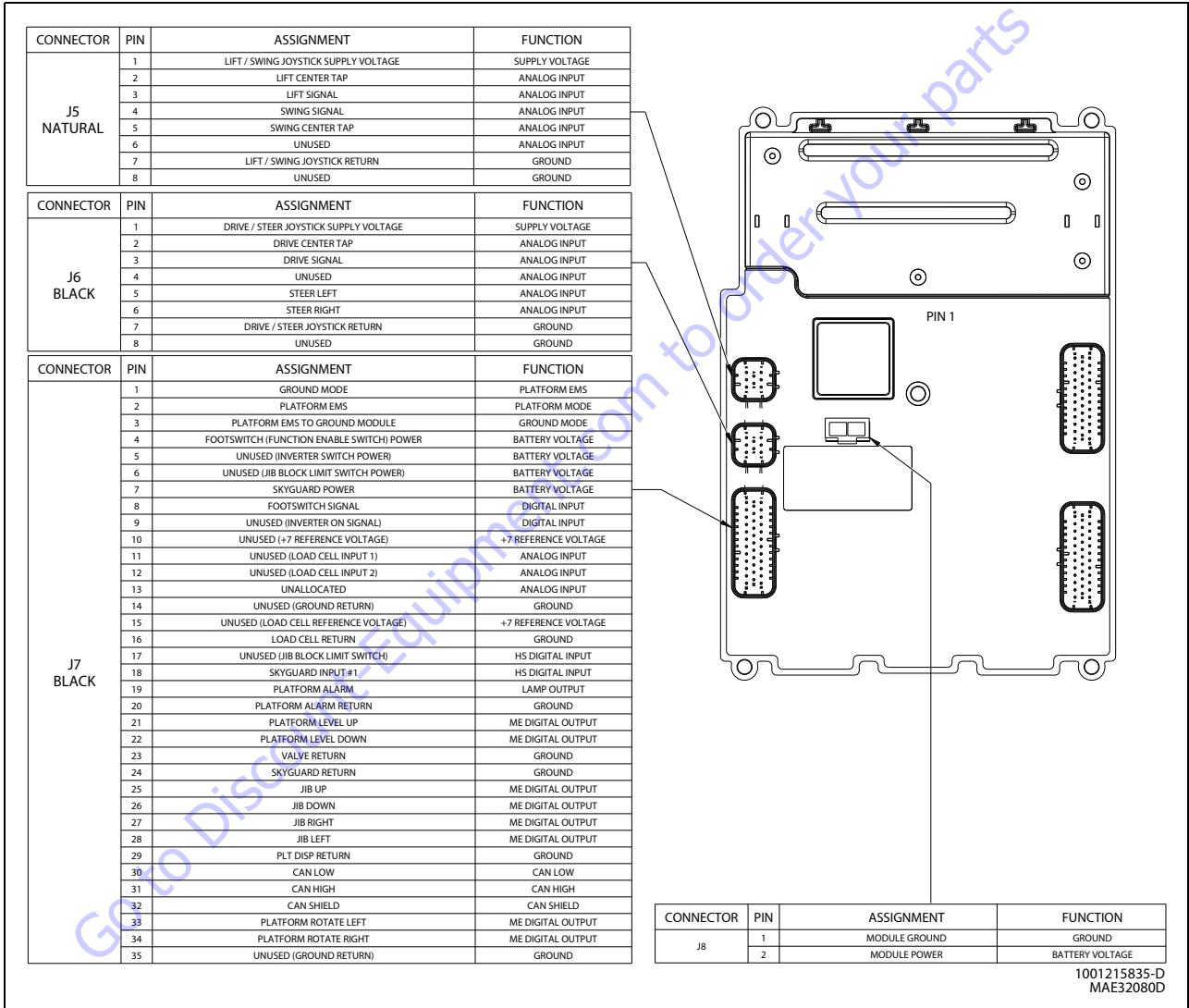
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MAE31560K

Figure 6-14. Ground Control Module - Sheet 3 of 3



1001215835-D
MAE32070D

Figure 6-15. Platform Module - Sheet 1 of 2



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MAE32080D

Figure 6-16. Platform Module - Sheet 2 of 2

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

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Table 6-8. Help Descriptions and Fault Flash Codes

Flash Code	Description
No flash code is indicated for the following help messages; they are intended to hint at a possible problem if the vehicle is not behaving as expected.	
	<p>EVERYTHING OK The "normal" help message in platform mode</p>
	<p>GROUND MODE OK The "normal" help message in ground mode</p>
	<p>BRAKES RELEASED Indicates manual brake release in ground mode</p>
	<p>DRIVING AT CREEP - TILTED Drive speed is limited to creep because the vehicle is tilted.</p>
	<p>FWS OPEN A drive or boom function has been selected but footswitch is open.</p>
	<p>PUMP MOTOR AT CURRENT LIMIT Pump current has reached controller current limit or safe operating area limit.</p>
	<p>RUNNING AT CREEP - CREEP SWITCH OPEN All function speeds are limited to creep because the creep switch is open.</p>
	<p>RUNNING AT CUTBACK - ABOVE ELEVATION All function speeds are limited to cutback speed because the vehicle is above elevation.</p>
	<p>RUNNING AT CREEP - TILTED AND ABOVE ELEVATION All function speeds are limited to creep because the vehicle is tilted and above elevation.</p>
	<p>TESTS ACTIVE - RECYCLE EMS TO END The system tests have been activated; normal vehicle operation is not allowed.</p>
	<p>TILT MODULE FAILURE: BAD TILT SENSOR There is a problem with the tilt sensor interface circuitry; the controller defaults to massively tilted and does not try to prevent vehicle roll on the grade.</p>
	<p>TRACTION MOTOR AT CURRENT LIMIT Traction current has reached controller current limit or safe operating area limit.</p>
	<p>WATER BATTERIES The batteries have been charged a number of times (set by machine digit) and need a top-up; when this is done the count will reset</p>
2/1	Flash code 2/1 indicates problems with the footswitch.
	<p>FWS FAULTY The two footswitch signals do not agree. EMS recycle required.</p>
	<p>START UP Neither EMS input is active - the system is just switching on or is discharging the capacitor bank. A welded line contactor might also cause this</p>

Table 6-8. Help Descriptions and Fault Flash Codes

2/2	Flash code 2/2 indicates problems with drive & steer selection.
	<p>DRIVE JOYSTICK FAULTY The drive joystick center tap is out of valid range, or the wiper is wire-off.</p> <p>DRIVE LOCKED - JOYSTICK MOVED BEFORE EMS/FWS Drive was selected before and during footswitch closure.</p> <p>FWS INTERLOCK TRIPPED Footswitch was closed for seven seconds with no function selected.</p> <p>STEER LOCKED - SELECTED BEFORE EMS/FWS Steer was selected before and during footswitch closure.</p> <p>STEER SWITCHES FAULTY Both steer switches are active together.</p> <p>WAITING FOR FWS TO BE OPEN Footswitch was closed when platform mode was selected.</p> <p>JOYSTICK FAULTS - CHECK PLATFORM BOX WIRING More than one of the drive, lift and swing joystick center tap or wiper voltages is out of range. This is probably due to a short-circuit across a joystick port.</p>
2/3	Flash code 2/3 indicates problems with boom function selection.
	<p>LIFT/SWING JOYSTICK FAULTY The lift or swing Joystick center tap is out of valid range, or the wiper is wire-off.</p> <p>LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE EMS/FWS Upper Lift or swing was selected before and during footswitch closure.</p> <p>PUMP POT FAULTY The pump pot is open-circuit; all platform boom functions except upper lift & swing will run at creep.</p> <p>PUMP SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM A boom function (lower lift, telescope, basket level, basket rotate, jib) has both directions selected together.</p> <p>PUMP SWITCHES LOCKED - SELECTED BEFORE EMS/FWS A boom function (lower lift, telescope, basket level, basket rotate, jib) was selected before and during footswitch closure.</p> <p>PUMP SWITCHED LOCKED - SELECTED BEFORE EMS A ground boom function (lower lift, telescope, basket level, basket rotate, jib) was selected before keyswitch.</p> <p>SWING/LIFT JOYSTICK FAULTY The swing joystick center tap is out of valid range, or the wiper is wire-off.</p>
2/5	Flash code 2/5 indicates that a function is prevented due to a cutout.
	<p>BOOM PREVENTED - DRIVE SELECTED A boom function is selected while a drive function is selected and drive cutout is configured to prevent simultaneous drive & boom operation.</p> <p>BOOM PREVENTED - FUNCTION CUTOFF ACTIVE A boom function is selected while function cutout is active and configured to cutout boom functions.</p> <p>DRIVE & BOOM PREVENTED - FUNCTION CUTOFF ACTIVE Drive or a boom function is selected while function cutout is active and configured to cutout all functions.</p> <p>DRIVE PREVENTED - ABOVE ELEVATION Drive is selected while above elevation and drive cutout is configured to prevent drive.</p> <p>DRIVE PREVENTED - BOOM MOVEMENT SELECTED Drive is selected while a boom function is selected and drive cutout is configured to prevent simultaneous drive & boom operation.</p> <p>DRIVE PREVENTED - CHARGER CONNECTED Drive is selected while the charger is on (indicated by drive cutout being active) and drive cutout is configured to prevent drive.</p> <p>DRIVE PREVENTED - TILTED AND ABOVE ELEVATION Drive is selected while drive cutout is active and drive cutout is configured to prevent drive.</p>

Table 6-8. Help Descriptions and Fault Flash Codes

	<p>TILT MODULE FAILURE: NOT COMMUNICATING There is a problem with the positrac/tilt module; the controller defaults to massively tilted and does not try to prevent vehicle roll on the grade.</p>
3/1	Flash code 3/1 indicates that a contactor did not close when energized.
	<p>LINE & DIRECTION CONTACTORS MISWIRED When the line contactor was closed traction point A went high (and the capacitor bank charge did not increase to battery supply) - this occurs if the line contactor coil wiring is swapped with that for a direction contactor coil.</p> <p>OPEN-CIRCUIT FORWARD DIRECTION CONTACTOR OR TRACTION MOTOR Traction point A did not go high when forward contactor was energized (this could be due to traction motor open-circuit or a power wiring error).</p> <p>OPEN-CIRCUIT LINE CONTACTOR OR TRACTION MOTOR The capacitor bank charge did not increase to battery supply when line contactor was energized (this could be due to a power wiring error).</p> <p>OPEN-CIRCUIT REVERSE DIRECTION CONTACTOR Traction point A did not go high when reverse contactor was energized (this could be due to traction motor open-circuit or a power wiring error).</p>
3/2	Flash code 3/2 indicates that a contactor did not open when energized.
	<p>WELDED LINE CONTACTOR The capacitor bank charge did not decrease from battery supply when line contactor was deenergized (this could be due to a power wiring error). WARNING: If the line contactor is welded, the controller will not switch off when EMS or keyswitch is turned off.</p>
3/3	Flash code 3/3 indicates that a contactor coil is short-circuited.
	<p>OVERLOADED VALVE SUPPLY-CHECK WIRING. There is a high current draw from the valve supply when no valve is energized; this is probably due to a wiring error at the ground module.</p> <p>SHORT-CIRCUIT FORWARD CONTACTOR COIL The forward contactor was not energized when required, due to coil overcurrent protection.</p> <p>SHORT-CIRCUIT LINE CONTACTOR COIL The line contactor was not energized when required, due to coil overcurrent protection.</p> <p>SHORT-CIRCUIT REVERSE CONTACTOR COIL The reverse contactor was not energized when required, due to coil overcurrent protection.</p>
4/2	Flash code 4/2 indicates that the controller is over temperature.
	<p>CONTROLLER TOO HOT - PLEASE WAIT The controller heatsink temperature reached 75 degrees. The controller is shut down until it cools to below 70 degrees.</p>
4/4	Flash code 4/4 indicates problems with the battery supply.
	<p>BATTERY LOW Battery voltage is below 40V. This is a warning - the controller does not shut down.</p> <p>BATTERY TOO HIGH - SYSTEM SHUT DOWN Battery voltage is above 62V. EMS recycle required.</p> <p>BATTERY TOO LOW - SYSTEM SHUT DOWN Battery voltage is below 33V. EMS recycle required.</p>
6/6	Flash code 6/6 indicates problems with the CANbus.
	<p>48V PROTECTION TRIPPED - CHECK INTER-MODULE WIRING The power module is not receiving acknowledgments from the platform or ground modules to transmitted data, and the protection circuit which supplies the platform and ground modules has tripped. This is probably due to wiring problems at the platform or ground module.</p>

Table 6-8. Help Descriptions and Fault Flash Codes

	<p>CANbus FAILURE: GROUND MODULE The power module is receiving from the platform module but not the ground module. This should not be possible!</p> <p>CANbus FAILURE: PLATFORM MODULE The power module is receiving from the ground module but not the platform module. This is probably due to wiring problems between the platform and ground modules.</p> <p>CANbus FAILURE: POWER MODULE The power module is not receiving acknowledgments from the platform or ground modules to transmitted data. This is probably due to wiring problems between the ground and power modules.</p>
7/7	Flash code 7/7 indicates problems with a motor.
	<p>CAPACITOR BANK FAULT - CHECK POWER CIRCUITS The capacitor bank is not charging. This is probably due to a power wiring error causing illegal current drain; it could also be due to a very low battery supply.</p> <p>OPEN-CIRCUIT PUMP MOTOR Pump point A is collapsing when the pump MOSFETs are pulsed. This is probably due to an open circuit pump motor or a power wiring error.</p> <p>OPEN-CIRCUIT DIRECTIONAL CONTACTOR OR TRACTION MOTOR Traction point A is collapsing when the traction MOSFETs are pulsed. This is probably due to an open circuit traction motor or a power wiring error. NOTE: This fault is unlikely to be seen due to interaction with speed control.</p> <p>PUMP POINT A LOW - CHECK POWER CIRCUITS Pump point A is near 0V when the pump MOSFETs are off. This is probably due to a power</p> <p>STALLED TRACTION MOTOR The power module traction MOSFET protection circuit is active. This is due to massive current drain and could be a stalled traction motor or a power wiring error.</p> <p>STALLED PUMP MOTOR The power module pump MOSFET protection circuit is active. This is due to massive current drain and could be a stalled pump motor or a power wiring error.</p> <p>TRACTION MOTOR OVERLOADED The traction motor has been operating in current limit at a low percentage on for a period of time greater than 10 seconds.</p> <p>PUMP MOTOR OVERLOADED The pump motor has been operating in current limit at a low percentage on for a period of time greater than 10 seconds.</p> <p>TRACTION CURRENT AT ZERO - CHECK SHUNT WIRING Traction current measurement is at zero. This is probably due to an open-circuit between the current measurement shunt and the power module.</p> <p>TRACTION POINT A HIGH - CHECK POWER CIRCUITS Traction point A is near battery supply when neither direction contactor is energized and the traction MOSFETs are off. This could be due to a welded direction contactor or a power wiring error.</p> <p>TRACTION POINT A LOW - CHECK POWER CIRCUITS Traction point A is near 0V when neither direction contactor is energized and the traction MOSFETs are off. This could be due to a power wiring error.</p>

Table 6-8. Help Descriptions and Fault Flash Codes


9/9	Flash code 9/9 indicates problems with the controller.
	POWER MODULE FAILURE: CONTACTOR DRIVE CODE 1 A contactor remained energized when turned off.
	POWER MODULE FAILURE: HWFS CODE 2 The hardware failsafe tests did not complete because traction point A is not safe, or the hardware failsafe is permanently tripped.
	POWER MODULE FAILURE: HWFS CODE 3 The hardware failsafe tests did not complete because a contactor was energized when all should be turned off
	POWER MODULE FAILURE: HWFS CODE 4 The hardware failsafe tests did not complete because the hardware failsafe tripped immediately when the traction MOSFETs were turned on.
	POWER MODULE FAILURE: HWFS CODE 10 The hardware failsafe tests failed because the hardware failsafe did not trip within the allowed test time.
	POWER MODULE FAILURE: HWFS CODE 11 The hardware failsafe tests failed because the hardware failsafe tripped too slowly.
	POWER MODULE FAILURE: HWFS CODE 12 The hardware failsafe tests failed because the hardware failsafe tripped too quickly.
	POWER MODULE FAILURE: HWFS CODE 13 The hardware failsafe tests failed because the hardware failsafe remained tripped when the traction MOSFETs were turned off.
	POWER MODULE FAILURE: HWFS CODE 14 The hardware failsafe tests failed because the line contactor could still be energized when the hardware failsafe was tripped
	POWER MODULE FAILURE: HWFS CODE 15 The hardware failsafe tests failed because the contactor drive failsafe did not trip within the allowed test time.
	POWER MODULE FAILURE: HWFS CODE 16 The hardware failsafe tests failed because the contactor drive failsafe tripped too slowly.
	POWER MODULE FAILURE: HWFS CODE 17 The hardware failsafe tests failed because the contactor drive failsafe tripped too quickly.
	POWER MODULE FAILURE: HWFS TEST STALLED The hardware failsafe tests did not complete, but no reason can be determined.
	POWER MODULE FAILURE: BAD TEMPERATURE SENSOR The temperature sensor measurement is invalid, this is probably due to a disconnected wire within the power module. The possibility of other disconnected wires (which could cause dangerous system function) means that the controller is shut down.
	POWER MODULE FAILURE: S/C LINE CONTACTOR DRIVER The line contactor energized when the footswitch was closed, before it was turned on, this is probably due to a failed driver within the power module, although it could be due to bad power module wirings

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 6-9. DIAGNOSTICS - Menu Descriptions

Diagnosics Submenu (Displayed on Analyzer 1 st Line)	Parameter (Displayed on Analyzer 1 st Line)	Parameter Value (Displayed on Analyzer 2 nd 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 PRTY VLV	XXX%	Steer priority bypass valve [Machine SetUp -> E450 or E400N]
	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
	SWING ASSIST	ON/OFF	Status of swing restriction bypass valve [Machine SetUp -> Model = E450 or E400N]
	LIFT OUTPUT	UP/DOWN XXX%	Direction and valve PWM output percentage
	LIFT BYPAS	ON/OFF	Status of Lift Bypass Valve [Machine SetUp -> Model = E450 or E400N]
	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 6-9. DIAGNOSTICS - Menu Descriptions

Diagnosics Submenu (Displayed on Analyzer 1 st Line)	Parameter (Displayed on Analyzer 1 st Line)	Parameter Value (Displayed on Analyzer 2 nd 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 ENABL	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]

SECTION 6 - JLG CONTROL SYSTEM

Table 6-9. DIAGNOSTICS - Menu Descriptions

Diagnosics Submenu (Displayed on Analyzer 1 st Line)	Parameter (Displayed on Analyzer 1 st Line)	Parameter Value (Displayed on Analyzer 2 nd 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	KEYSWITCH: CLOSED	Displays whether Ground Keyswitch position is being selected
		KEYSWITCH: CLOSED		
	PLATFORM SELECT	KEYSWITCH: OPEN	KEYSWITCH: CLOSED	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	GROUND: CLOSED	State of Footswitch input at UGM (Open with Footswitch is not activated).
		GROUND: CLOSED		
FOOTSWITCH INPUT	PLATFORM: CLOSED	PLATFORM: OPEN	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 6-9. DIAGNOSTICS - Menu Descriptions

Diagnosics Submenu (Displayed on Analyzer 1 st Line)	Parameter (Displayed on Analyzer 1 st Line)	Parameter Value (Displayed on Analyzer 2 nd 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]
	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 6-9. DIAGNOSTICS - Menu Descriptions

Diagnosics 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 6-9. DIAGNOSTICS - Menu Descriptions

Diagnosics Submenu (Displayed on Analyzer 1 st Line)	Parameter (Displayed on Analyzer 1 st Line)	Parameter Value (Displayed on Analyzer 2 nd 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 6-10, System Test Descriptions and Table 6-11, System Test Messages for information concerning the tests performed and available messages in this mode.

1. When the keyswitch 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 keyswitch 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 KEYSWITCH.

Table 6-10. System Test Descriptions

<p>ACTIVATE TESTS YES:ENTER, NO:ESC</p>	<p>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</p>
<p>RUN SYSTEM TEST</p>	<p>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</p>

Table 6-11. 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 is 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
	LIFT BYPASS VALVE (E400)	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	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)
	PRIORITY BYPASS (E400)	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)
	SWING ASSIST VALVE (E400)	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, E400)	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	TOWER DOWN (E300, E400)	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 6-11. 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, E400)
	OP TOWER UP	OPEN or CLOSED (advanced test after switch toggles) (E300, E400)
	CL TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles) (E300, E400)
	OP TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles) (E300, E400)
	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 6-11. 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) (E400)
	OP TOWER UP	OPEN or CLOSED (advanced test after switch toggles) (E400)
	CL TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles) (E400)
	OP TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles) (E400)
	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)

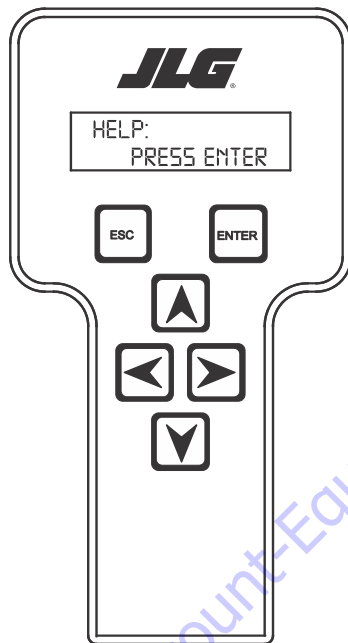
Table 6-11. System Test Messages

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 PLATFORM LEFT	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM LEFT	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM RIGHT	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.

6.5 CALIBRATING STEER

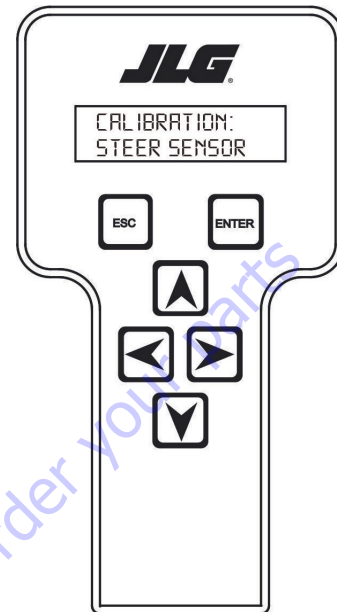
When calibrating steering, each individual wheel must be calibrated in order to make the tire and wheel parallel with the frame. Two methods to help ensure proper calibration are the use of a carpenter's square to square the spindle to the axle or aligning the two wheels on one side using a stretched 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:

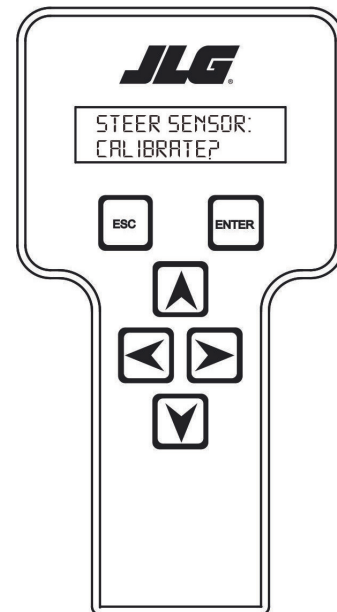


5. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

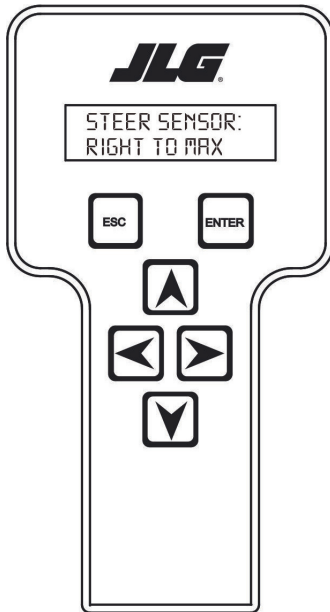
8. Use the arrow keys to reach STEER SENSOR. The screen will read:



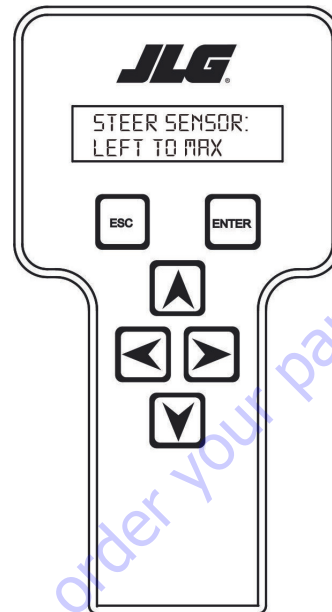
9. Hit Enter. The screen will read:



10. Hit Enter. The screen will read:

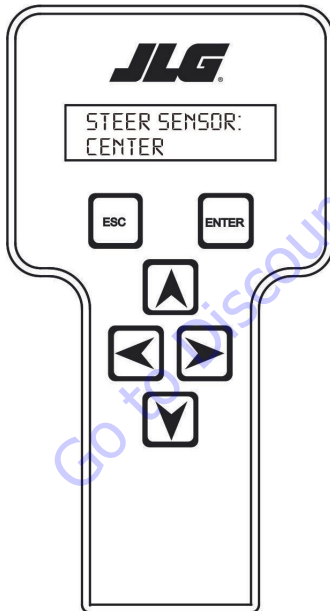


14. Hit Enter. The screen will read:



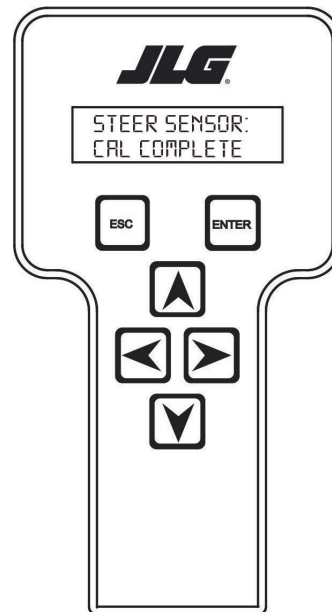
11. Activate the steer control until the tire and wheel are straight in relationship with the chassis, then leave off the control. The display will read Right Steer Maximum value.

12. Hit Enter. The screen will read:



15. The display will read Left Steer Maximum value.

16. Hit Enter. The screen will read:



13. The display will read steering Center position value.

17. After completing all the Steer Calibrations, hit ESC twice to go back to CALIBRATIONS.

6.6 CALIBRATING TILT SENSOR

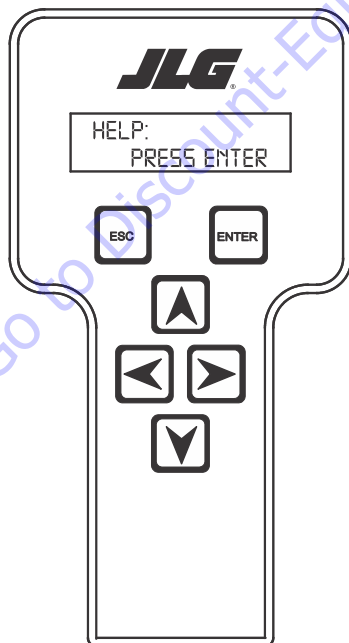
NOTICE

A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE FOLLOWING PROCEDURE IS PERFORMED.

WARNING

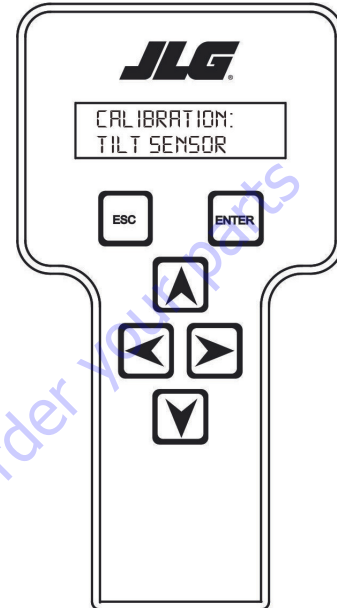
DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT ON A LEVEL SURFACE.

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:



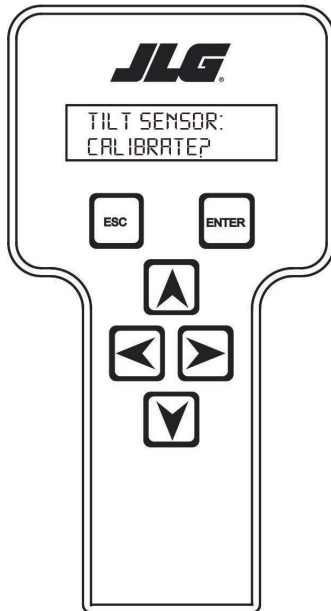
7. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
8. Enter the Access Code, 33271.

9. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.
10. Use the arrow keys to reach TILT SENSOR. The screen will read:

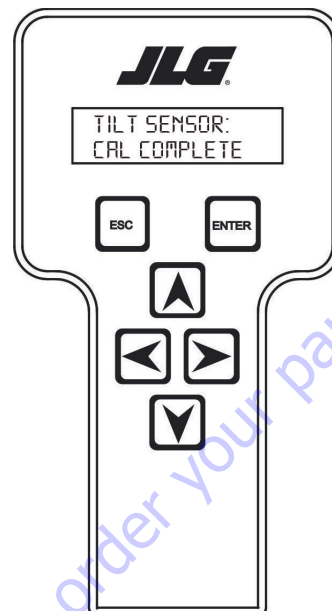


SECTION 6 - JLG CONTROL SYSTEM

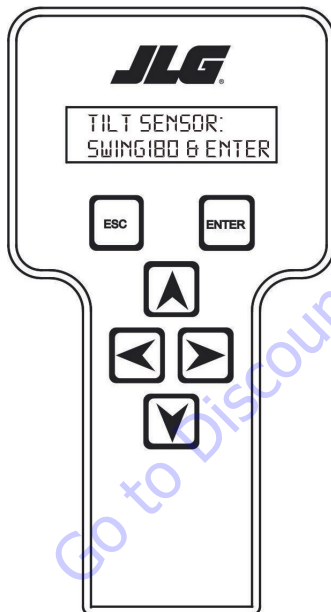
11. Hit Enter. The screen will read:



13. Hit Enter. The screen will read:



12. When prompted, swing turntable 180° to opposite end of chassis.



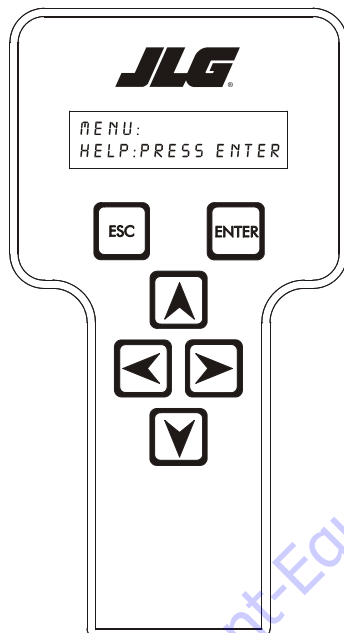
14. Upon completing swing calibration, swing turntable 180° back to the stowed position.

15. Hit ESC twice to go back to CALIBRATIONS.

6.7 CALIBRATING LOAD SENSING

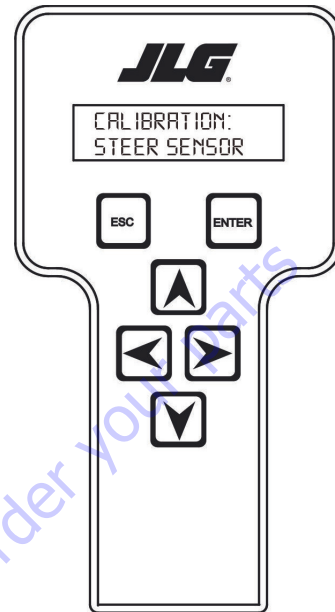
NOTE: Calibration sub-menu LOAD SENSING is visible only if MACHINE SET-UP sub-menu LOAD SYSTEM is selected to NO.

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:

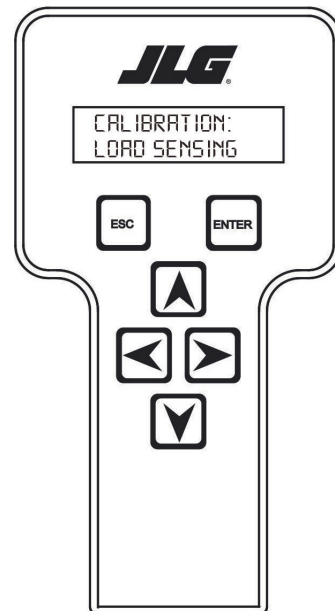


5. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

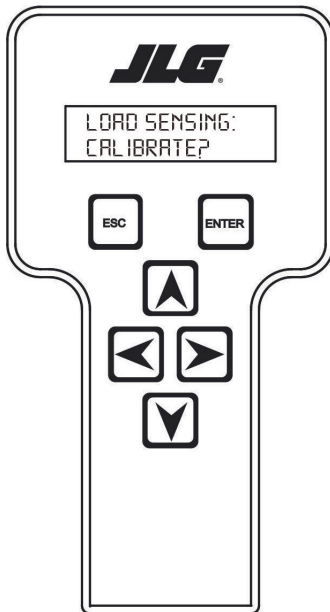
8. Use the arrow keys to reach LOAD SENSING. The screen will read:



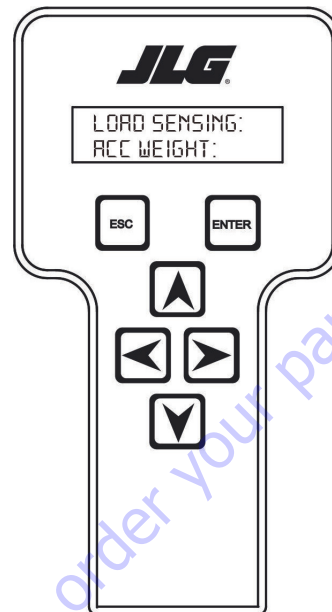
9. Hit Enter. The screen will read:



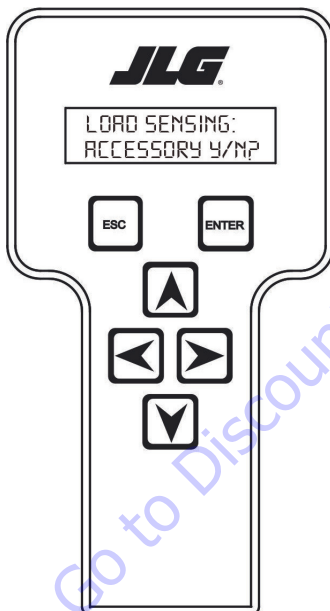
10. Hit Enter. The screen will read:



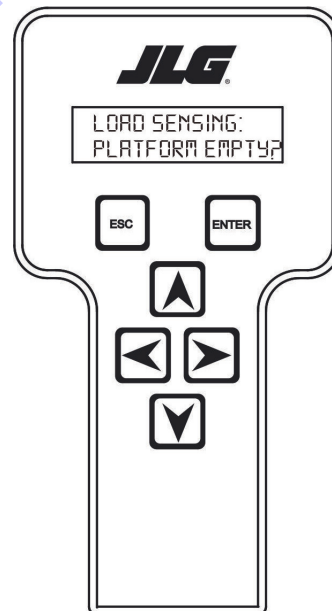
12. Hit Enter. The screen will read:



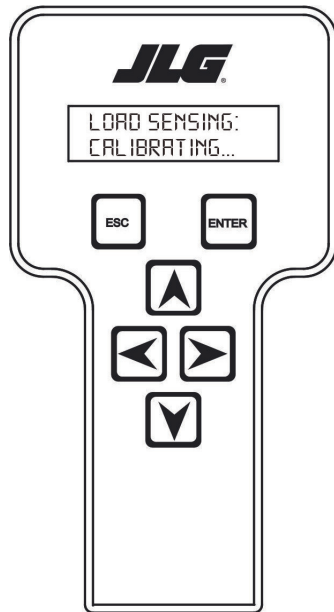
11. Hit Enter. The screen will read:



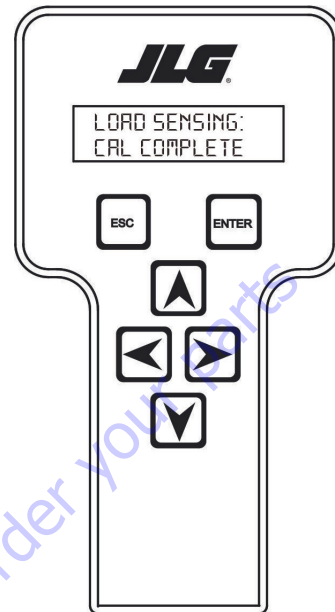
13. Hit Enter. The screen will read:



14. Hit Enter. The screen will read:




15. After few seconds, the screen will read:



16. Hit ESC twice to go back to CALIBRATIONS.

6.8 LSS SYSTEM

The JLG-designed Load Sensing System (LSS) measures platform load via a sensor mounted in the platform support structure. If the actual platform load exceeds the selected Rated Load, the following will occur:

1. The Overload Visual Warning Indicator will flash at the selected control position (platform or ground). 
2. The Platform and Ground Alarms will sound 5 seconds On, and 2 seconds Off.
3. All normal movement will be prevented from the platform control position (optional - ground control functions may be prevented).
4. Further movement is permitted by:
 - a. Removing the excess platform load until actual platform load is less than Rated Load.
 - b. Operation of the overriding emergency system (Auxiliary Power Unit).
 - c. By an authorized person at the ground control position (optional - ground control functions may be prevented).

NOTICE

THE LOAD SENSING SYSTEM MUST BE CALIBRATED WHEN ONE OR MORE OF THE FOLLOWING CONDITIONS OCCUR:

- a. LSS Sensor removal or replacement
- b. Addition or removal of certain platform mounted accessories. (Refer to Calibration)
- c. Platform is removed, replaced, repaired or shows evidence of impact.




NOTICE

THE LOAD SENSING SYSTEM REQUIRES PERIODIC FUNCTION VERIFICATION NOT TO EXCEED 6 MONTHS FROM PREVIOUS VERIFICATION. REFER TO TESTING & EVALUATION.

All calibration procedures are menu driven through the use of a JLG Analyzer.

Diagnostic Menu

The Diagnostic Menu is another troubleshooting tool for the Load Sensing System. Sensor and status information is presented in real-time for the technician. Several sub-menus exist to organize the data.

To access the Diagnostic Menu, use the LEFT  and RIGHT  Arrow keys to select DIAGNOSTICS from the Top Level Menu. Press the ENTER key  to view the menu.

Press the LEFT and RIGHT Arrow keys to view the displays and select the various sub-menus. To access a sub-menu, press the ENTER key. Once in a sub-menu, press the LEFT and RIGHT Arrow keys to view the various displays (just like a Top Level


menu). To exit a sub-menu, press the ESC key .

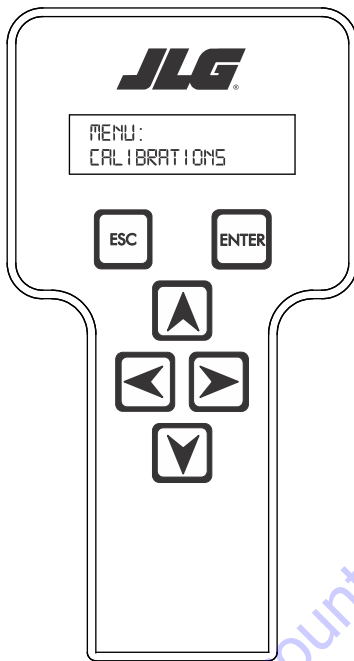
Table 6-12, Diagnostic Menu Descriptions details the structure of the Diagnostic Menu, and describes the meaning of each piece of information presented.

Table 6-12. Diagnostic Menu Descriptions


Diagnosics Menu (Displayed on Analyzer 1 st Line)	Parameter (Displayed on Analyzer 2 nd Line)	Parameter Value (Displayed on Analyzer 2 nd Line)	Description
PLATFORM LOAD	STATE:	OK / OVERLOAD	LSS Status.
PLATFORM LOAD	ACTUAL:	XXX.X KG	Calibrated weight of the platform. ??? if Platform Load is Unhealthy**.
PLATFORM LOAD (service*)	GROSS:	XXX.X KG	Gross weight of the platform. ??? if both Cells are Unhealthy**.
PLATFORM LOAD (service*)	OFFSET 1:	XXX.X KG	Stored offset weight of Cell 1. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	OFFSET 2:	XXX.X KG	Stored offset weight of Cell 1. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	ACCESSORY	XXX.X KG	Stored accessory weight. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	UNRESTRICT	XXX.X KG	UGM will set Unrestricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RESTRICT	XXX.X KG	UGM will set Restricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RAW 1:	XXX.X KG	Gross value from Cell 1. ??? if Unhealthy**.
PLATFORM LOAD (service*)	RAW 2:	XXX.X KG	Gross value from Cell 2. ??? if Unhealthy**.
* Indicates only visible in service view mode ** Typically indicates a DTC is active			

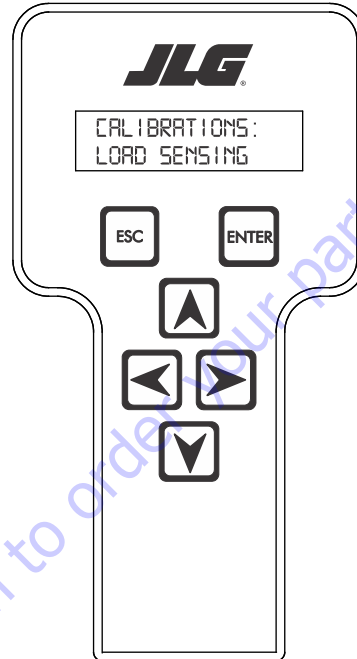
Calibration Procedure

1. Remove everything from the platform, except permanently fixed JLG Accessories, to allow the Load Sensing System to record its' weight during calibration. This includes all tools, debris, and customer-installed devices.
2. Plug the JLG Analyzer into the Machine at the Ground Station and enter Service Access Password 33271.
3. The platform should be approximately level for calibration. Level the platform from ground control (if necessary) to within +/- 5°.
4. To access the Calibration Menu, use the LEFT and RIGHT Arrow keys to select CALIBRATION from the Top Level Menu. The screen will read:

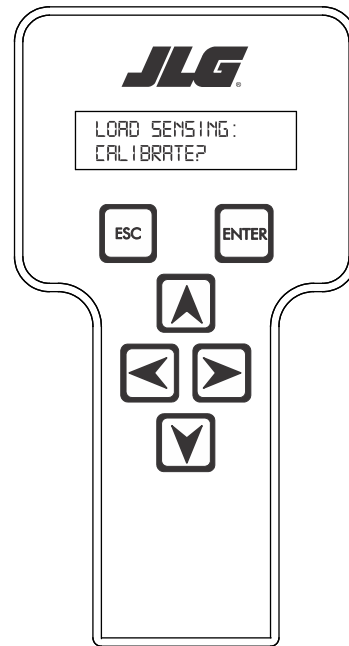


NOTE: The Calibration Menu is not available in OPERATOR ACCESS.


5. Press the ENTER key  to view the menu. Upon entry to the Calibration Menu, the JLG Control System will link to the Analyzer and the screen will read:




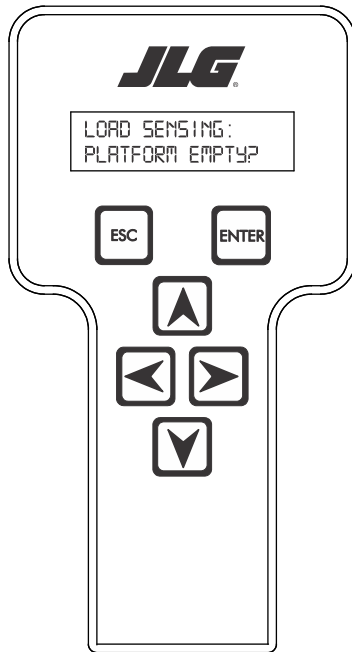
6. Press Enter . The Screen will read:




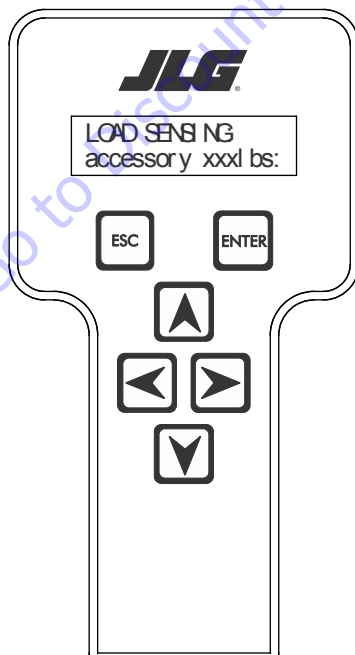
NOTE: Calibration will auto fail if LSS DTC's are active (443, 444, 4479, 4480, 663, 821, 822, 823, 824, 8218, 8222 -> 8238, 991, 992, 993, 994 or 99285).

NOTE: Pressing the ESC key  after starting calibration and before calibration is complete will display the CAL FAILED message. This will not disturb the prior calibration information.

7. Press ENTER . The analyzer screen will read:




8. If the platform is empty, press ENTER . The screen will read:



NOTE: Accessory weight will reset to 0 lbs. each time the machine is re-calibrated and will need to be re-entered.

NOTE: The Accessory weight will be temporarily stored in the Control System until calibration has been completed successfully.

Refer to Table 6-13, Accessory Weights. Use the up and down analyzer keys to enter the accessory weight(s) (in lbs). When all the accessory weights are entered, press

ENTER . The screen will read:

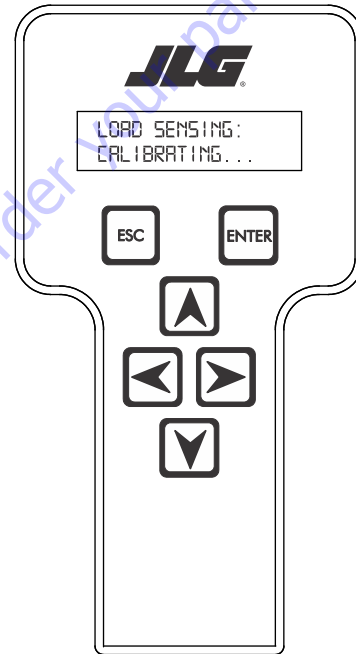


Table 6-13. Accessory Weights

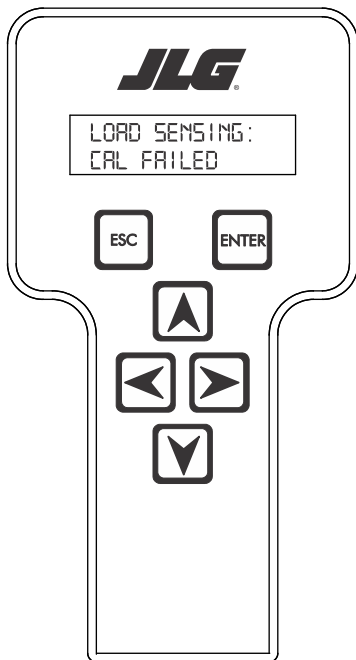
Accessory	Weight
SkyWelder (stick welder)	70 lb (32 kg)
SkyWelder Prep	Prep only = 15 lb (7 kg) Full install = 70 lb (32 kg)
SkyCutter (plasma cutter)	70 lb (32 kg)
SkCutter / SkyWelder Combo	140 lb (64 kg)
Fire Extinguisher	45 lb (20 kg)
Overhead SoftTouch	80 lb (36 kg)
Work Surface	20 lb (9 kg)

NOTE: Not all Accessories are available on every JLG model. Some Accessory combinations are prohibited due to excessive weight and/or load restriction. If any installed JLG Accessories are labeled with weight decals but are not listed in the table above, include their weight when entering the ACC WEIGHT value.


SECTION 6 - JLG CONTROL SYSTEM

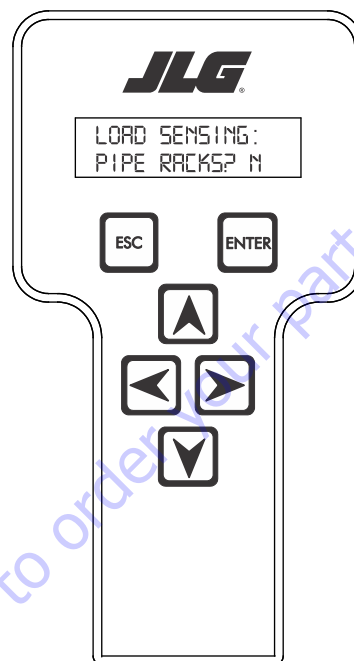
9. The control system will calculate the load cell readings and ensure it is greater than 130 lbs. (59 kg), but less than 575 lbs.(261 kg).


If the platform weight is not within the allowed range, the calibration attempt will be unsuccessful and the Analyzer will show the following:

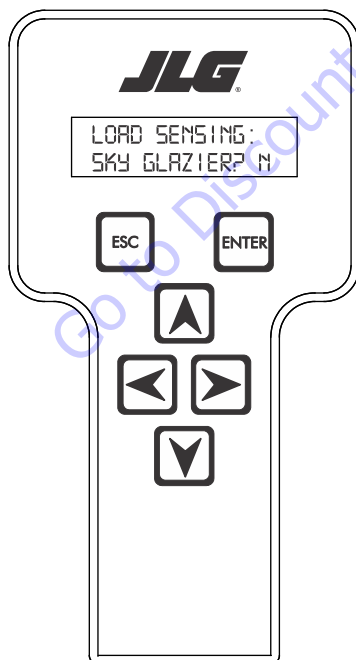


11. Use the analyzer keys to select N for no or Y for yes. Press

ENTER . The screen will read:



10. Press ENTER . The control system will ask for installed accessories. The screen will show the following:



12. Use the analyzer keys to select N for no or Y for yes. Press



ENTER. The control system will default to an estimate of unrestricted capacity, which can be adjusted if necessary. Refer to Table 6-14, SkyGlazier Capacity Reductions and Table 6-15, Pipe Rack Capacity Reductions.

The screen will read:

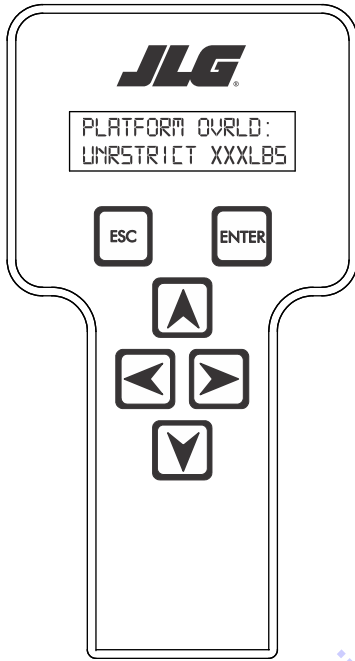


Table 6-14. SkyGlazier Capacity Reductions

Capacity	PLATFORM OVRLD	PLATFORM OVRLD RESTRICT
500 lb (227 kg)	400 lb (181 kg)	n/a
550 lb (250 kg)	400 lb (181 kg)	n/a
600 lb (272 kg)	400 lb (181 kg)	n/a
750 lb (340 kg)	n/a	590 lb (268 kg)
1000 lb (454 kg)	n/a	750 lb (340 kg)

Note: If both SkyGlazier and Pipe Racks are configured, capacity will be the lower of the two values.

Table 6-15. Pipe Rack Capacity Reductions

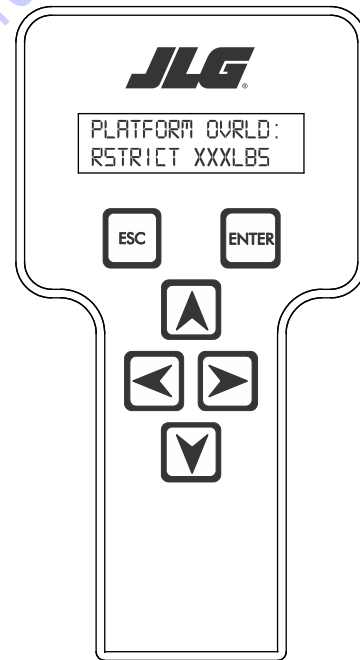
Capacity	PLATFORM OVRLD	PLATFORM OVRLD RESTRICT
500 lb (227 kg)	400 lb (181 kg)	n/a
550 lb (250 kg)	450 lb (204 kg)	n/a
600 lb (272 kg)	500 lb (227 kg)	n/a
750 lb (340 kg)	n/a	650 lb (295 kg)
1000 lb (454 kg)	n/a	900 lb (408 kg)


Note: If both SkyGlazier and Pipe Racks are configured, capacity will be the lower of the two values.

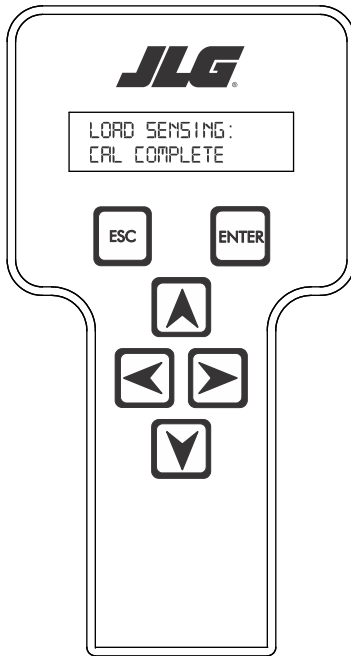
13. Press ENTER



The following screen will be displayed for restricted capacity, which can be adjusted if necessary. Refer to Table 6-14, SkyGlazier Capacity Reductions and Table 6-15, Pipe Rack Capacity Reductions.



14. Press ENTER . If calibration is successful, the screen will read:



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Testing & Evaluation

Refer to Troubleshooting if the Load Sensing System fails to meet these guidelines.

1. Connect the JLG Analyzer.
2. Level the Platform. The platform should be approximately level for analysis, or the guidelines below will not be applicable. Level the platform from Ground Control (if necessary) to within ± 5 degrees.
3. Observe the Empty Platform Weight. Proceed to the DIAGNOSTICS, PLTLOAD sub-menu and observe the measured platform load. All tools, debris, and customer-installed devices shall be removed during evaluation. Ideally, the PLTLOAD should be zero but can vary ± 15 lbs (± 7 kg). Further, the reading should be stable and should not vary by more than ± 2 lbs (± 1 kg) (unless there is heavy influence from wind or vibration).
4. Use the Technician's Weight to Evaluate. The technician should enter the platform and record the PLTLOAD reading while standing in the center of the platform.
5. Confirm Control System Warnings and Interlocks. Using the keyswitch, select Platform Mode and power-up. Start the vehicle's engine and ensure that all controls are functional and the Load Sensing System's Overload Visual and Audible Warnings are not active. Simulate an Overload by unplugging the Shear Beam Load Cell. The Overload Visual Warning should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, and 2 seconds Off. With the engine running, all control should be prevented. Cycle the Platform EMS to stop the engine and then power-up again. The Overload Visual and Audible Warning should continue. Confirm that controls are responsive when using the Auxiliary Power Unit for emergency movement. Reconnect the Load Cell. The Overload Visual and Audible Warnings should cease and normal control function should return. Switch the vehicle's keyswitch to Ground Mode and repeat the above procedure. The Overload Visual Warning at the Ground Controls should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, 2 seconds Off. However, the controls should remain functional when using the engine and the Auxiliary Power Unit (if the Control System's MACHINE SETUP, LOAD is set to "2=CUTOUT PLT". If set to "3=CUTOUT ALL", then Ground Controls will be prevented when using the engine as in the platform).
6. Confirm Control System Capacity Indication (optional for vehicles with Dual Capacity Ratings). For vehicles equipped with a Capacity Select switch on the Platform Console Box, it is necessary to examine an additional interface between the Load Sensing System and the Control System. Using the keyswitch, select Platform Mode and power-up. If necessary, put the boom in the transport position (completely stowed) and center the Jib Plus (if equipped). Place the Capacity Select switch in the unrestricted position and ensure that the proper indicator illuminates on the Platform Console Box. Plug the JLG Analyzer into the Analyzer connection and proceed to the DIAGNOSTICS, SYSTEM submenu. Ensure that the CAPACITY displays indicate OFF. Place the Capacity Select switch in the unrestricted position (if so equipped) and ensure that the proper indicator illuminates on the Platform Console Box (but does not flash). For vehicles with unrestricted capacity, ensure that the unrestricted CAPACITY display indicates ON but the restricted CAPACITY indicates OFF. For vehicles with restricted capacity, ensure that the unrestricted CAPACITY display indicates OFF but the restricted CAPACITY indicates ON.
7. Confirm Load Sensing System Performance with Calibrated Weights. Operate the vehicle from Ground Control and place the boom in the transport position (fully stowed) for safety. Plug the JLG Analyzer into the control system connection and proceed to the DIAGNOSTICS, PLTLOAD display. Place 500lbs (230kg) in the platform and ensure that PLTLOAD is with $\pm 5\%$ of the actual weight. For Dual Capacity vehicles, do the same for the alternate capacity (unrestricted or restricted).

Troubleshooting

The following tables are furnished to provide possible resolutions for common difficulties. Difficulties are classified as General, Calibration, Measurement Performance, and Host System Functionality.

Table 6-16. LSS Troubleshooting Chart

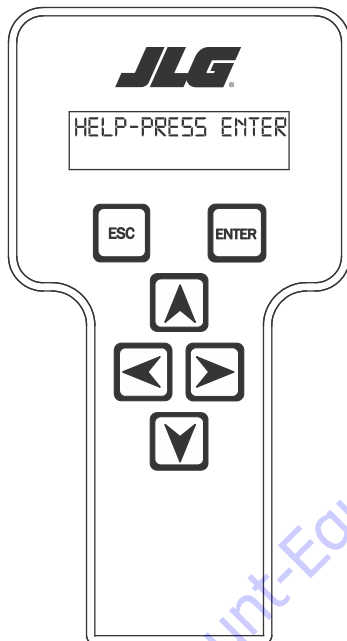
Difficulty	Possible Resolution
<p>Empty Platform Weight (DIAGNOSTICS, PLATFORM LOAD) is not within ± 15lbs (± 7kg) of zero.</p> <p>or</p> <p>Platform Load readings (DIAGNOSTICS, PLTLOAD) are unstable by more than ± 2lbs (± 1kg) (without the influence of vibration or wind).</p> <p>or</p> <p>There are large variations in Platform Load (DIAGNOSTICS, PLTLOAD) based on the location of the load. Tolerance to variations is 20lbs for an evaluation using the technician's weight, and $\pm 5\%$ of Rated Load when using calibrated weights.</p>	<p>The LSS System is unable to properly measure the platform weight.</p> <ol style="list-style-type: none"> 1. The Load Cell is not properly plugged into the LSS Harness. It is possible poor electrical contact is made. 2. Wiring leading to the Load Cell is damaged. Carefully inspect sensor wiring where it passes through cable clamps for signs of damage. Inspect wiring where damage to the channel is apparent. 3. The Load Cell was not assembled properly during installation. Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL, LOAD displays and determine if the readings are reasonable. It is often helpful to apply slight downward pressure above the sensor and observe that its output increases (increasing force measurement; decreasing means the sensor is mounted upside-down). 4. The Load Cell is contaminated by debris or moisture. Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL, LOAD displays and determine if the readings are reasonable and stable (not changing by more than ± 2lbs (± 1kg) (without the influence of vibration or wind). Lack of measurement stability is a key indication of contamination. Unplug the connector and inspect for dirt or moisture. Look carefully into the female connector on the sensor's cordset for evidence of contamination. Debris should be brushed away with a soft bristle brush (do not introduce any cleaners as they will leave conductive residue). Moisture should be allowed to evaporate or accelerated with a heat-gun (use low heat and be carefully to not melt connector materials). Moisture intrusion into the molded portion of the connector (capillary action into the wire bundle) or the Shear Beam Load Cell itself will require replacement of the sensor. 5. The Load Cell has been mechanically damaged. If the Load Cell is physically deformed or has damage to the cover it should be replaced immediately. It is also possible to have invisible mechanical damage resulting from an extreme overload (>6000lbs [>2722kg]).
<p>The Visual and Audible Overload Warnings fail to sound when platform is loaded beyond Rated Load, or when simulated by unplugging the Load Cell. Controls remain functional at Platform and Ground Control positions.</p>	<p>The Control System is failing to regard the overload signal from the LSS System, or the signal is shorted.</p> <ol style="list-style-type: none"> 1. The Load Sensing System must be enabled within the Control System. Plug the JLG Analyzer into the Control System, enter the Access Level 1 password (33271), and examine the MACHINE SETUP, LOAD sub-menu. The selection "2=CUTOUT PLT" should be displayed (platform controls prevented during overload, ground controls remain operational). In country- or customer-specific circumstance, the selection "3=CUTOUT ALL" is used (platform and ground controls prevented during overload).
<p>The Ground Audible Warning fails to sound, but the Platform Audible Warning sounds properly.</p>	<p>The Ground Alarm is missing or improperly installed. Verify that the device is mounted. Verify wiring from the Main Terminal Box and Ground Module.</p>
<p>Controls remain functional at the Ground Control position during an overload, or when simulated by unplugging the Load Cell. The Controls at the Platform Control position are prevented when using the engine, but not when using the Auxiliary Power Unit.</p>	<p>The JLG Control System is configured to prevent platform controls only in the event of overload. Alternately, the Host Control System can be configured to prevent ground and platform controls for country- or customer-specific circumstances.</p> <p>Using the JLG Analyzer, enter the Access Level 1 password (33271). Proceed to the MACHINE SETUP, LOAD sub-menu. Set this parameter to "2=CUTOUT PLT" to prevent platform controls in the event of overload. Set this parameter to "3=CUTOUT ALL" to prevent platform and ground controls in the event of overload.</p>



6.9 RESETTING THE MSSO SYSTEM

1. Use the following procedure to reset the MSSO system.
2. Position the Platform/Ground select switch to the desired position.
3. Plug the analyzer into the connector coming from the ground control module or from the platform console.

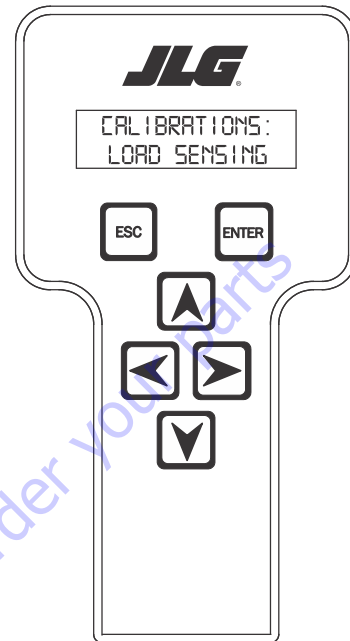
NOTE: If performing the procedure from the platform console, the Emergency Stop switch on the ground console must also be pulled out.



4. Pull out the Emergency Stop switch.
5. The analyzer screen should read:



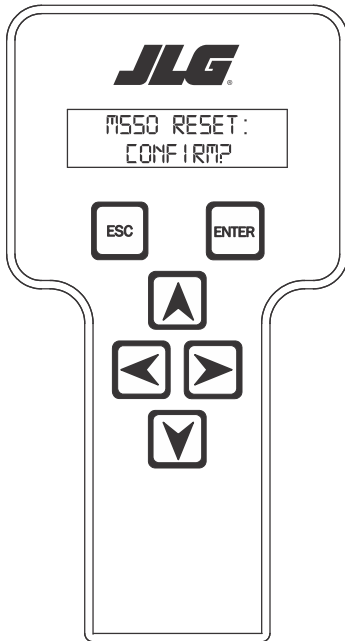
6. Use the arrow button to reach OPERATOR ACCESS. Press  Enter.
7. Enter the Access Code, 33271.
8. Use the right Arrow key to reach MENU: CALIBRATIONS. Press Enter .



9. Use the arrow keys to reach the LOAD SENSING menu. The screen should read:



10. Press ENTER .
11. Use the Down  arrow to reach MSSO RESET.

12. Press Enter . The screen will read:



13. Press Enter . The JLG Control System will reset an active 873 DTC and the MSSO System will be reset. Press Escape  to return to the CALIBRATIONS menu.

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Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
00	1	EVERYTHING OK	The UGM determines that platform station (EVERYTHING 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
00	2	GROUND MODE OK	The normal help message in Ground Mode. Displays on the analyzer only.	Ground Mode selected; & occurrence of active DTC
00	8	FUNCTIONS LOCKED OUT - SYSTEM POWERED DOWN	Conditions exist and time for automatic power-down has expired.	Power cycled
00	10	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
00	11	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
00	12	RUNNING AT CREEP - CREEP SWITCH OPEN	Machine is in Platform Mode; Platform creep switch input = HIGH; Fault RUNNING AT CREEP – TILTED AND ABOVE ELEVATION (DTC0013) is not active	Platform creep switch input = Low
00	13	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
00	33	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
00	36	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.
00	39	SKYGUARD ACTIVE – FUNCTIONS CUTOUT	Machine is in Platform Mode and SkyGuard Enabled	Trigger conditions are no longer true
00	47	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 = 19 degrees for a period of greater than 1 second. [MACHINE SETUP = E400 or 450].	The UGM detects that the grade in direction of travel is more than 3 degrees less than the machine's trip point.

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
00	48	BATTERY CHARGE LOW	Battery SOC < 10%	Battery SOC > Discharged; speed restrictions removed after controls initialized
00	46	TORQUE CUTBACK - EXCESSIVE TILT	UGM detects that the machine is ascending an inclination of greater than or equal to: 19 degrees for a period of greater than 1 second. [MACHINE SETUP = E400 or 450].	The UGM detects that the grade in direction of travel is more than 3 degrees less than the machine's trip point
21	1	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
21	2	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
21	3	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
22	1	FUNCTION PROBLEM - HORN PERMANENTLY SELECTED	The horn switch was closed during power-up	Horn switch input = LOW
22	4	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
22	5	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
22	7	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
22	11	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
22	12	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
22	13	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
22	16	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
22	17	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
22	19	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
22	20	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
22	21	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
22	22	WAITING FOR FSW TO BE OPEN	Machine is in Platform Mode AND Footswitch has been engaged since Start Up	Footswitch is disengaged
22	23	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.
22	45	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
22	46	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
22	47	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
22	48	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
22	49	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
22	50	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
22	51	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
22	52	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
22	57	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
22	58	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
22	62	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
22	63	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
22	64	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
22	86	FUNCTION PROBLEM - SOFT TOUCH / SKY-GUARD 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
23	4	FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	Both inputs associated with mutually exclusive operations are simultaneously active.	Trigger conditions no longer true.
23	10	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
23	70	FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED	If MACHINE SETUP 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.
23	71	FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED	If MACHINE SETUP 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.
23	72	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.
23	73	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.
23	105	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.
23	106	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.
23	107	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.
23	108	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.
23	109	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.
23	110	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.
23	111	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.
23	112	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.
23	113	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.
23	114	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.
23	163	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.
23	171	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.
23	172	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.

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
24	1	AMBIENT TEMPERATURE SENSOR - OUT OF RANGE LOW	System is in platform mode; MACHINE SETUP -> TEMP CUTOFF = yes; Low Temperature Cutout Sensor reads less than or equal to -50 °C.	Ambient Temperature sensor reading > -50 °C THEN speed restrictions removed after controls are initialized
24	2	AMBIENT TEMPERATURE SENSOR - OUT OF RANGE HIGH	System is in platform mode; MACHINE SETUP -> TEMP CUTOFF = 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
25	3	DRIVE PREVENTED - CHARGER CONNECTED	MACHINE SETUP => CHARGER INTERLOCK = DRIVE ONLY;	Trigger conditions not true; Restrictions remove after CntlIn
25	9	MODEL CHANGED - HYDRAULICS SUSPENDED - CYCLE EMS	The MACHINE SETUP => MODEL has changed	Power cycle
25	14	BOOM PREVENTED - DRIVE SELECTED	MACHINE SETUP => FUNCTION CUTOFF = BOOM CUTOFF; 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
25	16	DRIVE PREVENTED - ABOVE ELEVATION	MACHINE SETUP => FUNCTION CUTOFF = DRIVE CUTOFF; The boom is Above Elevation; The operator is attempting to activate Drive or Steer;	Not all of the trigger conditions are met
25	18	DRIVE PREVENTED – BOOM SELECTED	MACHINE SETUP => FUNCTION CUTOFF = DRIVE CUTOFF; The boom is Above Elevation; The operator is attempting to activate Drive or Steer;	Not all of the trigger conditions are met
25	38	FUNCTION PREVENTED – CHARGER CONNECTED	MACHINE SETUP => CHARGER INTERLOCK = CUTOFF 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 CntlIn
25	48	SYSTEM TEST MODE ACTIVE	UGM determines that System Test Mode is active	Power cycled
25	49	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
25	63	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)]
25	64	DRIVE PREVENTED – LEFT BRAKE NOT RELEASING	Module detects brakes have not released because EB coil is damaged	Power cycle
25	65	DRIVE PREVENTED – RIGHT BRAKE NOT RELEASING	Module detects brakes have not released because EB coil is damaged	Power cycle
25	68	TEMPERATURE CUTOFF ACTIVE – AMBIENT TEMPERATURE TOO LOW	Low Temperature Cutoff = Active	Low Temperature Cutoff = Inactive; speed restrictions removed after controls are initialized

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
25	76	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
25	78	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.
25	79	DRIVE PREVENTED – EXCESSIVE GRADE	DTC 0046 is active; Drive speed request, in direction of ascending grade, is greater than zero;	CntlNi (drive joystick returned to center position)
31	11	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
31	12	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
32	12	MAIN CONTACTOR – WELDED OR MISWIRED	Master Traction Module determines at Startup that Line Contactor is closed/stuck before command	Power cycle
32	13	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
33	4	LIFT UP VALVE – OPEN CIRCUIT	The UGM detects an open circuit at the Lift Up Solenoid	UGM no longer detects OC; Speed restriction removed after CntlNi;
33	6	LIFT DOWN VALVE – OPEN CIRCUIT	The UGM detects an open circuit at the Lift Down Solenoid	UGM no longer detects open circuit; Inhibits and restrictions removed after CntrlNi;
33	7	STEER LEFT VALVE – SHORT TO BATTERY	UGM detects a short to battery at steer left output	Power cycle
33	8	STEER LEFT VALVE – OPEN CIRCUIT	The UGM detects an open circuit at steer left output	UGM no longer detects OC; Speed restriction removed after CntlNi.
33	9	STEER RIGHT VALVE – SHORT TO BATTERY	The UGM detects a short to battery at steer right output	Power cycle
33	10	STEER RIGHT VALVE – OPEN CIRCUIT	The UGM detects an open circuit at steer right output	UGM no longer detects OC; Speed restriction removed after CntlNi.
33	11	GROUND ALARM – SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33	71	GROUND ALARM – SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33	76	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
33	77	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
33	78	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
33	82	PLATFORM LEVEL UP VALVE - SHORT TO GROUND	The UGM detects a short to ground at the platform level up output	Power cycle
33	83	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
33	84	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at the platform level up output	Power cycle
33	88	PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND	The UGM detects a short to ground at the platform level down output	Power cycle
33	89	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
33	90	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at the platform level down output	Power cycle
33	94	PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND	UGM detects a short to ground at platform rotate left output	Power cycle
33	95	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;
33	96	PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY	UGM detects a short to battery at platform rotate left output	Power cycle
33	97	PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND	UGM detects a short to ground at platform rotate right output	Power cycle
33	98	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;
33	99	PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY	UGM detects a short to battery at platform rotate right output	Power cycle
33	100	JIB LIFT UP VALVE - SHORT TO GROUND	MachineSetup -> Jib = YES; UGM detects a short to ground at the jib lift up output;	Power cycle
33	101	JIB LIFT UP VALVE - OPEN CIRCUIT	MachineSetup -> Jib = YES; UGM detects an open circuit at the jib lift up output	UGM no longer detects OC; Speed restriction removed after CntlNi;
33	102	JIB LIFT UP VALVE - SHORT TO BATTERY	MachineSetup -> Jib = YES; UGM detects a short to battery at the jib lift up output	Power cycle
33	103	JIB LIFT DOWN VALVE - SHORT TO GROUND	MachineSetup -> Jib = YES; UGM detects a short to ground at the jib lift down output	Power cycle
33	104	JIB LIFT DOWN VALVE - OPEN CIRCUIT	MachineSetup -> Jib = YES; UGM detects an open circuit at the jib lift down output	UGM no longer detects open circuit; Inhibits and restrictions removed after CntrlNi;
33	105	JIB LIFT DOWN VALVE - SHORT TO BATTERY	MachineSetup -> Jib = YES; UGM detects a short to battery at the jib lift down output	Power cycle
33	106	TOWER LIFT UP VALVE - SHORT TO GROUND	The UGM detects a short to ground at the tower lift up output	Power cycle
33	107	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;
33	108	TOWER LIFT UP VALVE - SHORT TO BATTERY	The UGM detects a short to ground at the tower lift up output	Power cycle
33	109	TOWER LIFT DOWN VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle

SECTION 6 - JLG CONTROL SYSTEM

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
33	110	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 CntrlIn;
33	111	TOWER LIFT DOWN VALVE - SHORT TO BATTERY	The UGM detects a short to ground at the tower lift down output	Power cycle
33	118	SWING RIGHT VALVE - SHORT TO GROUND	The UGM detects a short to ground at the Swing Right output	Power cycle
33	119	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 CntlIn
33	120	TELESCOPE IN VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33	122	SWING LEFT VALVE - SHORT TO GROUND	The UGM detects a short to ground at the Swing Left output	Power cycle
33	123	TELESCOPE OUT VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33	175	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 CntlIn
33	176	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
33	177	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
33	178	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 CntlIn
33	179	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
33	180	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
33	182	LIFT VALVES - SHORT TO BATTERY	UGM detects a short to 12V battery at either the Lift Up or Lift Down valve	Power cycle
33	186	TELESCOPE OUT VALVE - OPEN CIRCUIT	UGM detects an open circuit at this output	UGM no longer detects OC. Speed restrictions removed after CntlIn
33	188	TELESCOPE OUT VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33	189	TELESCOPE IN VALVE - OPEN CIRCUIT	The UGM detects an open circuit at this output	UGM no longer detects OC. Speed restrictions removed after CntlIn
33	190	TELESCOPE IN VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33	295	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 CntlIn
33	298	STEER LEFT - SHORT TO GROUND	The UGM detects a short to ground at steer left output.	Power cycle
33	305	STEER RIGHT - SHORT TO GROUND	The UGM detects a short to ground at steer right output.	Power cycle
33	314	FLOW CONTROL VALVE - OPEN CIRCUIT	The UGM detects an OC at this output	Power cycle

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
33	315	FLOW CONTROL VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33	316	FLOW CONTROL VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33	406	LIFT UP VALVE - SHORT TO GROUND	The UGM detects STG at the Lift Up Solenoid	Power cycle
33	407	LIFT DOWN VALVE - SHORT TO GROUND	The UGM detects STG at the Lift Down Solenoid	Power cycle
33	412	SWING VALVES - SHORT TO BATTERY	The UGM detects a short to 12V battery at the either Swing output	Power cycle
33	425	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
33	479	VOTING RELAY - SHORT TO BATTERY	UGM detects a short to battery at this output	Power cycle
33	480	VOTING RELAY - SHORT TO GROUND	UGM detects a short to ground at the voting relay output	Power cycle
33	549	VOTING RELAY - OPEN CIRCUIT	UGM detects an open circuit at the voting relay output	Power cycle
33	578	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.
33	579	STEER PRIORITY BYPASS VALVE - SHORT TO GROUND	The UGM detects a short to ground at steer priority bypass output	Power cycle
33	580	STEER PRIORITY BYPASS VALVE - SHORT TO BATTERY	The UGM detects a short to battery at steer priority bypass output	Power cycle
33	624	SWING BYPASS VALVE - SHORT TO GROUND	The UGM detects a short to ground at swing bypass output	Power cycle
33	625	SWING BYPASS VALVE - SHORT TO BATTERY	The UGM detects a short to battery at swing bypass output	Power cycle
33	626	SWING BYPASS VALVE - OPEN CIRCUIT	The UGM detects open circuit at swing bypass output	UGM no longer detects OC; Speed restriction removed after CntlNi.
33	627	LIFT BYPASS VALVE - SHORT TO GROUND	The UGM detects STG at lift bypass output;	Power cycle
33	628	LIFT BYPASS VALVE - SHORT TO BATTERY	The UGM detects STB at lift bypass output	Power cycle
33	629	LIFT BYPASS VALVE - OPEN CIRCUIT	The UGM detects OC at lift bypass output	Power cycle
42	19	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
42	20	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
42	23	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
42	24	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
42	28	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
42	29	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
42	32	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 DTC 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.
42	33	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 DTC 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.
44	1	BATTERY VOLTAGE TOO LOW - SYSTEM SHUT-DOWN	The UGM detects that its 12V supply voltage is less than 9.0 volts for 5 seconds.	UGM voltage > 9.25V
44	2	BATTERY VOLTAGE TOO HIGH - SYSTEM SHUT-DOWN	The UGM detects that its 12V supply voltage > 16.0 volts	Power cycle
44	3	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
44	4	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
44	20	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
44	30	BATTERY VOLTAGE TOO LOW	UGM detects that its supply voltage < 11 volts for 5 seconds.	UGM voltage > 11.25V
44	63	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.
44	64	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.
46	92	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
46	93	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
46	100	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
46	130	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
46	104	REAR LEFT SPEED SENSOR - NOT RESPONDING PROPERLY	Associated Power Module has detected an encoder or directional sensing problem	Power cycle
46	105	REAR RIGHT SPEED SENSOR - NOT RESPONDING PROPERLY	Associated Power Module has detected an encoder or directional sensing problem	Power cycle
46	108	REAR LEFT SPEED SENSOR - RPM HIGH	Associated Power Module determines an over-speed condition (measured motor speed > DRIVE MAX + 15Hz) has occurred on a motor	Power cycle
46	109	REAR RIGHT SPEED SENSOR - RPM HIGH	Associated Power Module determines an over-speed condition (measured motor speed > DRIVE MAX + 15Hz) has occurred on a motor	Power cycle
46	136	REAR LEFT BRAKE SUPPLY VOLTAGE – OUT OF RANGE LOW	Associated Power Module determines that a low parking brake supply voltage condition exists.	Power cycle
46	137	REAR RIGHT BRAKE SUPPLY VOLTAGE – OUT OF RANGE LOW	Associated Power Module determines that a low parking brake supply voltage condition exists.	Power cycle
66	2	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
66	3	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
66	13	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
66	35	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;
66	54	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
66	55	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.
66	57	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
77	25	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
77	30	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
77	31	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
77	37	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
77	53	REAR LEFT MOTOR STALLED	The UGM or Power Module(s) detects that the motor is stalled during active traction. For the UGM commanded speed \geq 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).
77	54	REAR RIGHT MOTOR STALLED	The UGM or Power Module(s) detects that the motor is stalled during active traction. For the UGM commanded speed \geq 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)
77	57	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
77	58	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
77	61	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
77	62	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
77	65	REAR LEFT MOTOR - FEEDBACK FAILURE	After main contactor is closed, Power Module detects that the motor voltage feedback circuits are damaged	Power cycle
77	66	REAR RIGHT MOTOR - FEEDBACK FAILURE	After main contactor is closed, Power Module detects that the motor voltage feedback circuits are damaged	Power cycle

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
77	69	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
77	70	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
77	73	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
77	74	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
81	3	CHASSIS TILT SENSOR NOT CALIBRATED	UGM determines that tilt sensor, <ul style="list-style-type: none"> • has not been calibrated • serial number does not match stored value uninitialized sensor has been installed (receives 10FF51C0)	Tilt sensor calibrated;
81	4	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 \geq ABS [35°] for 4 seconds. Not to be reported during Tilt Sensor calibration.	Not all of the trigger conditions are met;
81	8	TILT SENSOR STAGNANT	UGM shall consider the Tilt Sensor stagnant if neither the X-axis or Y-axis unfiltered reading change by $\geq \pm 0.05^\circ$ in 5000ms while the reported Drive speed \geq Drive Creep Hz for all Traction modules	Power cycle;
82	1	LSS CELL #1 ERROR	MACHINE SETUP -> LOAD SYSTEM \neq 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
82	2	LSS CELL #2 ERROR	MACHINE SETUP -> LOAD SYSTEM \neq 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
82	3	LSS CELL #3 ERROR	MACHINE SETUP -> LOAD SYSTEM \neq 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
82	4	LSS CELL #4 ERROR	MACHINE SETUP -> LOAD SYSTEM \neq 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
82	5	LSS HAS NOT BEEN CALIBRATED	MACHINE SETUP -> LOAD SYSTEM \neq 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
82	6	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
82	9	FUNCTIONS CUTOFF - PLATFORM OVERLOADED	The Platform is Overloaded and MACHINE SETUP -> LOAD SYSTEM = CUTOFF PLATFORM, Platform Mode is active, and conditions of LSS section apply. -or- The Platform is Overloaded and MACHINE SETUP -> LOAD SYSTEM = CUTOFF ALL and conditions of LSS section apply	UGM determines that the Platform is not Overloaded; motion restrictions removed after controls initialized

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
82	11	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
86	64	STEER SENSOR - OUT OF RANGE HIGH	The UGM observes the Master Traction Module reported steer raw voltage signal ≥ 4.5V (Constant Data)	UGM observes steer voltage within calibrated range for 1000ms; Drive Creep restriction lifted after fault clears and controls initialized
86	65	STEER SENSOR - OUT OF RANGE LOW	The UGM observes the Master Traction Module reported steer raw voltage signal ≤ 0.3V (Constant Data)	UGM observes steer angle voltage within calibrated range for 1000ms; Drive Creep restriction lifted after fault clears and controls initialized
86	66	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;
86	67	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 output 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
86	68	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 memory three times during Startup	UGM determines that sensor is calibrated
87	3	MACHINE SAFETY SYSTEM OVERRIDE OCCURRED	UGM determines that an MSSO has occurred	TBD
99	1	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
99	2	LSS EEPROM ERROR	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM detects LSS report of an anomaly that exists in the LSS EEPROM	Power cycle
99	3	LSS INTERNAL ERROR - PIN EXCITATION	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM detects LSS report of improper excitation voltage	Power cycle
99	4	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
99	8	EEPROM FAILURE - CHECK ALL SETTINGS	The UGM has detected an anomaly in EEPROM that cannot be auto-corrected from the backup EEPROM bank.	Power cycle
99	10	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
99	11	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
99	19	GROUND SENSOR REF VOLTAGE OUT OF RANGE	The UGM has detected reference voltage is out of range: $2.3V < \text{Reference Voltage} < 2.7V$ (debounced for 100ms)	Power cycle
99	20	PLATFORM SENSOR REF VOLTAGE OUT OF RANGE	The UGM detects that its reference voltage being reported by PM out of range ($4.8V < \text{voltage} < 5.2V$); debounced for 100ms	Power cycle
99	21	GROUND MODULE FAILURE - HIGH SIDE DRIVER CUTOUT FAULTY	The UGM footswitch input J7-15 is LOW	Power cycle
99	22	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
99	24	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
99	27	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
99	44	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
99	45	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
99	49	MACHINE CONFIGURATION OUT OF RANGE - CHECK ALL SETTINGS	UGM has detected an anomaly in EEPROM with regard to the Machine Setup configuration.	Power cycle
99	77	LSS CORRUPT EEPROM	MACHINE SETUP ->LOAD SYSTEM \neq NO and one of the following conditions: UGM determines LSS-stored values for Unloaded weight in Indirect 0x100 \neq 0x108 or UGM determines LSS-stored values for Accessory weight in Indirect memory \neq 0x10A; UGM determines LSS-stored checksum 1 in memory \neq checksum 2 in memory	Power cycle
99	79	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
99	86	GROUND MODULE VLOW FET FAILURE	VLow FET determined to be failed on Startup; UGM unable to read high-sensing inputs.	Power cycle
99	167	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
99	234	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
99	235	REAR LEFT MODULE - PROTECTION FAILURE	Applicable Power Module determines that an internal failure exists in the hardware protection circuit	Power cycle
99	236	REAR LEFT 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
99	237	REAR LEFT MODULE - WATCHDOG RESET	Applicable Power Module determines that Watchdog failure/reset has occurred to one if two, or both	Power cycle
99	238	REAR LEFT MODULE - WATCHDOG2 RESET	Applicable Power Module determines that Watchdog2 failure/reset has occurred	Power cycle
99	239	REAR LEFT MODULE - RAM FAILURE	Applicable Power Module determines that a RAM checksum error has occurred	Power cycle
99	240	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
99	241	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines that the data acquisition is in error	Power cycle
99	242	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
99	243	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines that the Slip Profile is in error	Power cycle
99	244	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
99	245	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines at Startup that there is a problem with overvoltage/under-voltage detection	Power cycle
99	246	REAR LEFT MODULE - CAPACITOR BANK FAULT	The power capacitor bank of the Power Module is not charging properly (increasing voltage) at Startup	Power cycle
99	247	REAR LEFT MODULE - A/D FAILURE	Applicable Power Module determines that an internal Analog Input error exists	Power cycle
99	248	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
99	249	REAR RIGHT MODULE - PROTECTION FAILURE	Applicable Power Module determines that an internal failure exists in the hardware protection circuit	Power cycle
99	250	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
99	251	REAR RIGHT MODULE - WATCHDOG RESET	Applicable Power Module determines that Watchdog failure/reset has occurred to one if two, or both	Power cycle

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
99	252	REAR RIGHT MODULE - WATCHDOG2 RESET	Applicable Power Module determines that Watchdog2 failure/reset has occurred	Power cycle
99	253	REAR RIGHT MODULE - RAM FAILURE	Applicable Power Module determines that a RAM checksum error has occurred	Power cycle
99	254	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
99	255	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the data acquisition is in error	Power cycle
99	256	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
99	257	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the Slip Profile is in error	Power cycle
99	258	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the current feedbacks are out of range at Startup or when in standby	
99	259	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines at Startup that there is a problem with overvoltage/under-voltage detection	Power cycle
99	260	REAR RIGHT MODULE - CAPACITOR BANK FAULT	The power capacitor bank of the Power Module is not charging properly (increasing voltage) at Startup	Power cycle
99	261	REAR RIGHT MODULE - A/D FAILURE	Applicable Power Module determines that an internal Analog Input error exists	Power cycle
99	264	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
99	265	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
99	270	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
99	269	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
99	273	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

Table 6-17. Diagnostic Trouble Codes

DTC Cat	DTC Num	DTC Text	Fault Description	Solution
99	274	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
99	281	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 & ELECTRICAL 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 multimeters 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

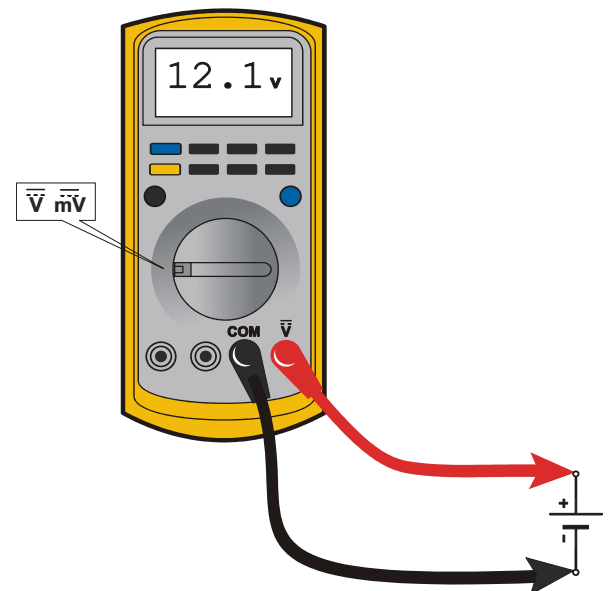


Figure 7-1. Voltage Measurement (DC)

- 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

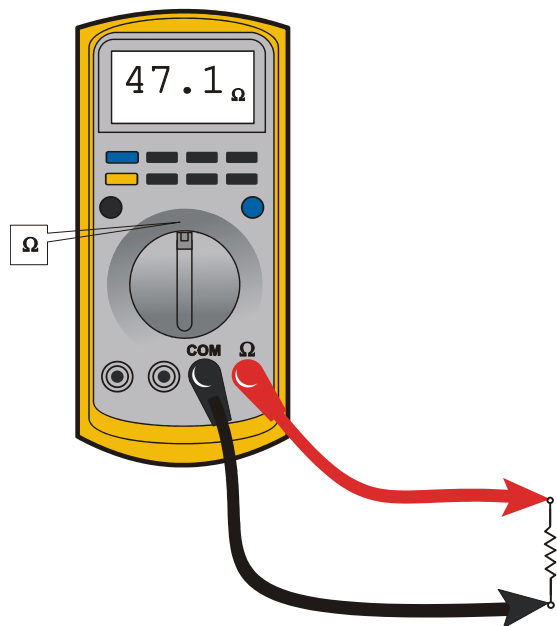


Figure 7-2. Resistance Measurement

- 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

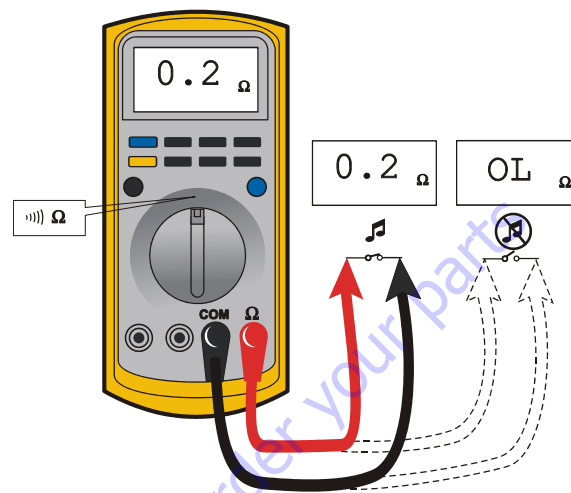


Figure 7-3. Continuity Measurement

- 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

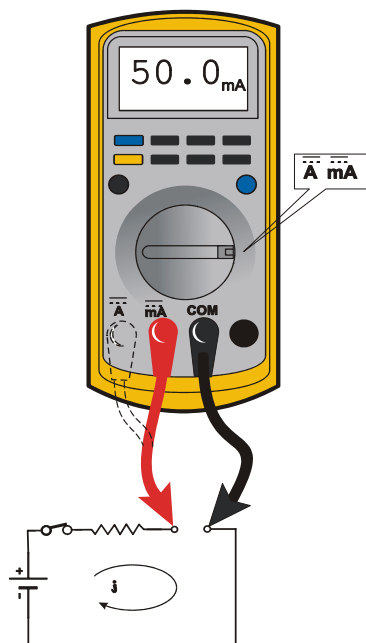


Figure 7-4. Current Measurement (DC)

- 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 prox 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.

NOTICE

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.

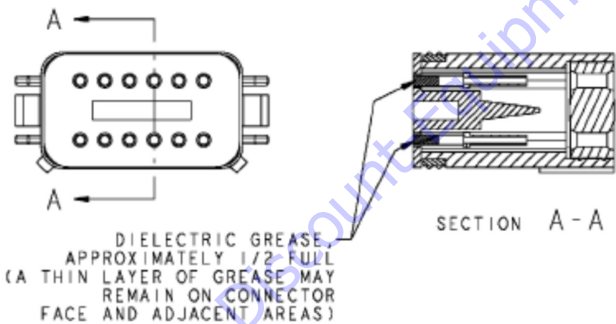
When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

Dielectric grease shall be applied to all electrical connectors at the time of connection (except those noted under Exclusions).

Installation of Dielectric Grease

Before following these instructions, refer to excluded connector types (See Exclusions below).

1. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
2. Apply dielectric grease to the female contact (fill it approximately 1/2 full; see example below)
3. Leave a thin layer of dielectric grease on the face of the connector
4. Assemble the connector system immediately to prevent moisture ingress or dust contamination
5. Pierce one of the unused wire seals prior to assembly if the connector system tends to trap air (i.e. AMP Seal) and then install a seal plug.



Deutsch HD, DT, DTM, DRC Series

The Deutsch connector system is commonly used for harsh environment interconnect. Follow the installation instructions.



AWP Seal

The AWP Seal connector system is used on the Control ADE Platform and Ground Modules.

Apply dielectric grease to the female contact. If trapped air prevents the connector from latching, pierce one of the unused wire seals. After assembly, install a seal plug (JLG #4460905) in that location to prevent moisture ingress.

Note that seal plugs may be installed by the wire harness manufacturer if an unused wire seal becomes compromised (wire inserted in the wrong cavity during assembly and then corrected).



Figure 7-5. Application to Female Contacts

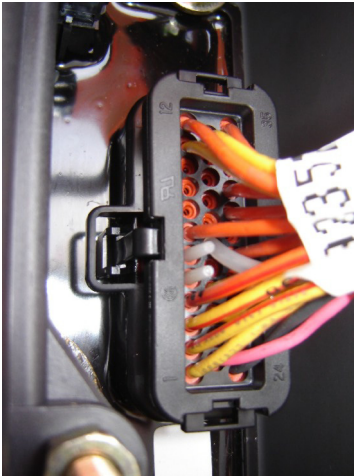


Figure 7-6. Use of Seal Plugs

AMP Mate-N-Lok

This connector system is widely used inside enclosures for general-purpose interconnect. Follow the installation instructions.



DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.



Exclusions

A limited number of connectors do not benefit from dielectric grease, or may be permanently damaged by application. Dielectric grease may not be required in properly sealed enclosures.

BRAD HARRISON / PHOENIX CONTACT M12

The connector uses gold contact material to resist corrosion and an o-ring seal for moisture integrity. If dielectric grease is mistakenly applied to this connector system, the low-force contacts cannot displace the grease to achieve electrical contact. Once contaminated, there is no practical way to remove the dielectric grease (replacement of female contacts required). The JLG Load Sensing System and 1250AJP Rotary Angle Sensors are examples of components with the M12 connector system.



AMP JUNIOR TIMER

This type of connector uses back-seals for moisture integrity. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The EMR2 engine control module from Deutz employs this connector system (for example).



7.5 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 7-7.). Proceed as follows:

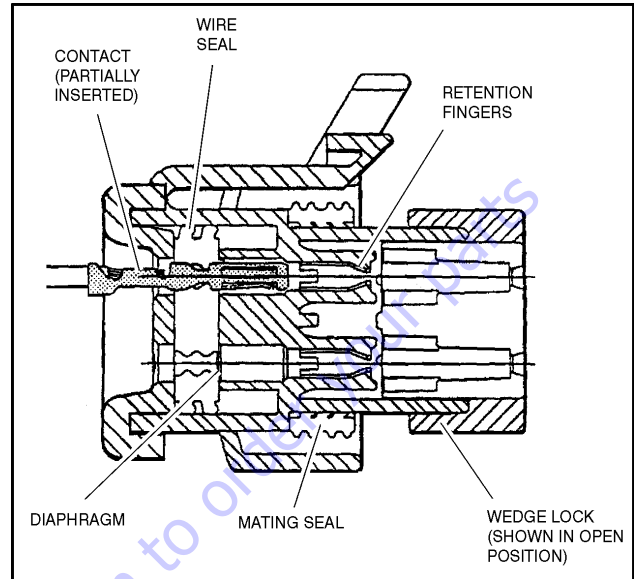


Figure 7-7. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-9.).
2. Pull back on the contact wire with a force of 1 or 2 lbs. to be sure the retention fingers are holding the contact (See Figure 7-9.).

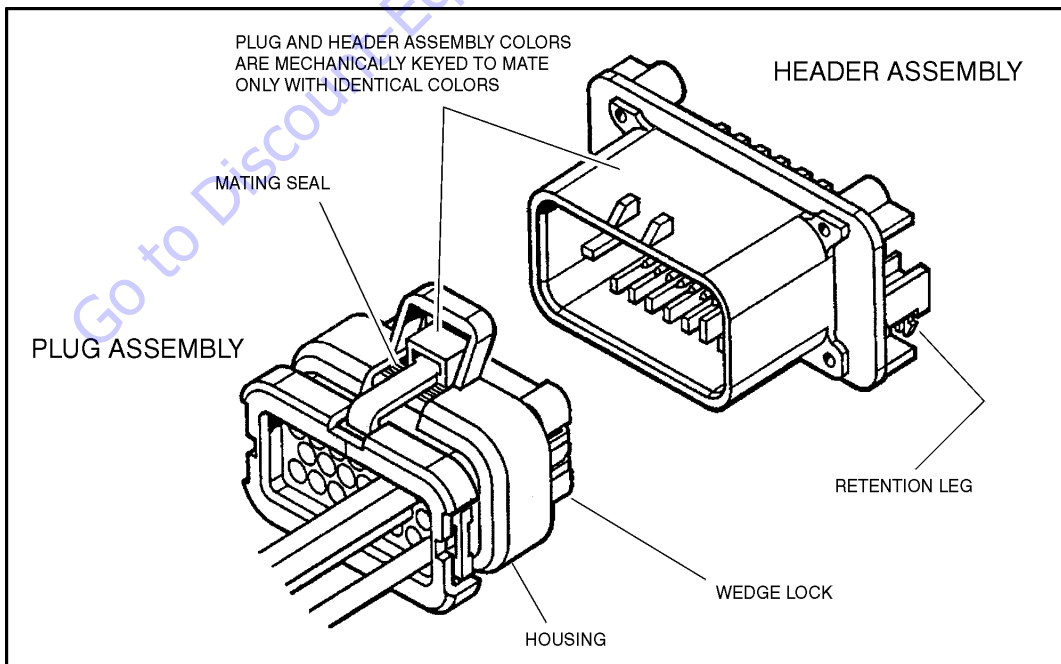


Figure 7-8. AMP Connector

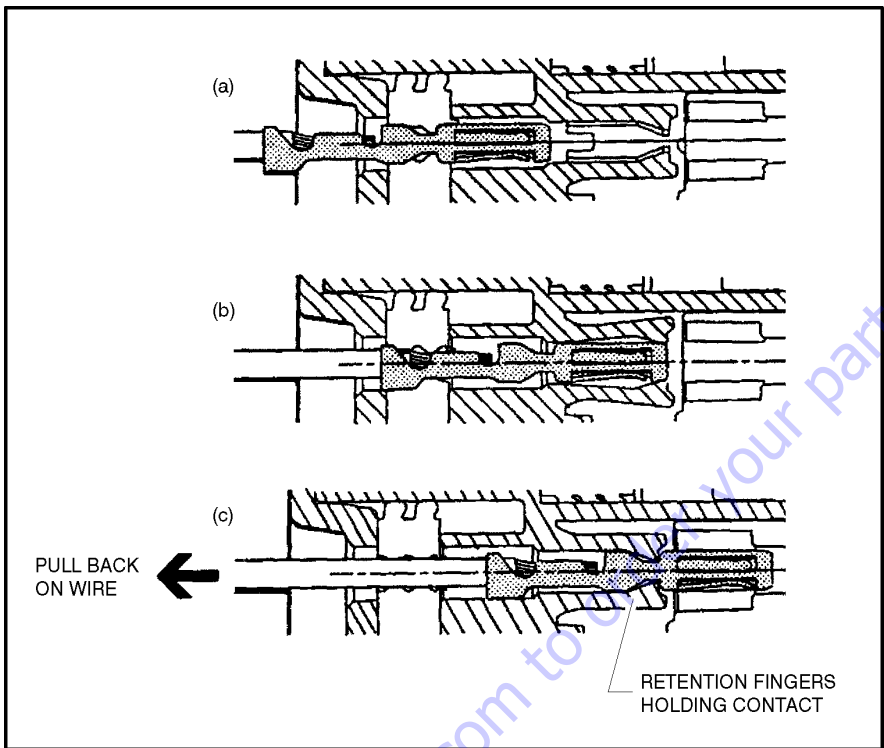


Figure 7-9. Connector Assembly Figure 2

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 7-10.).

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-11.).

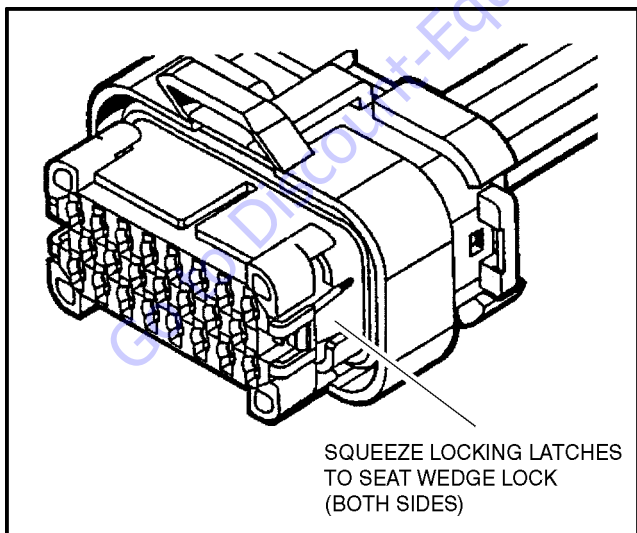


Figure 7-10. Connector Assembly Figure 3

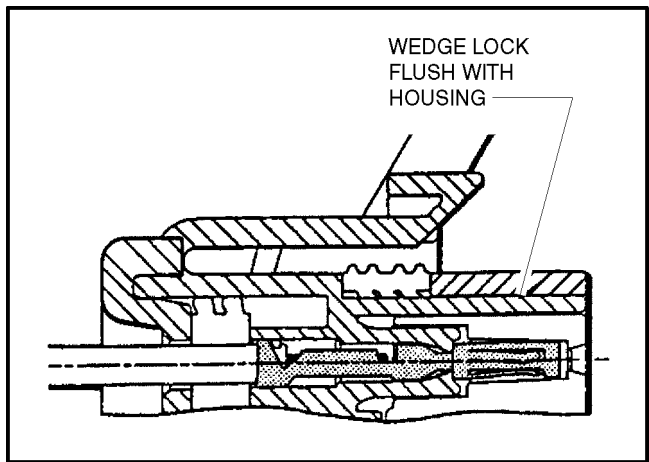


Figure 7-11. Connector Assembly Figure 4

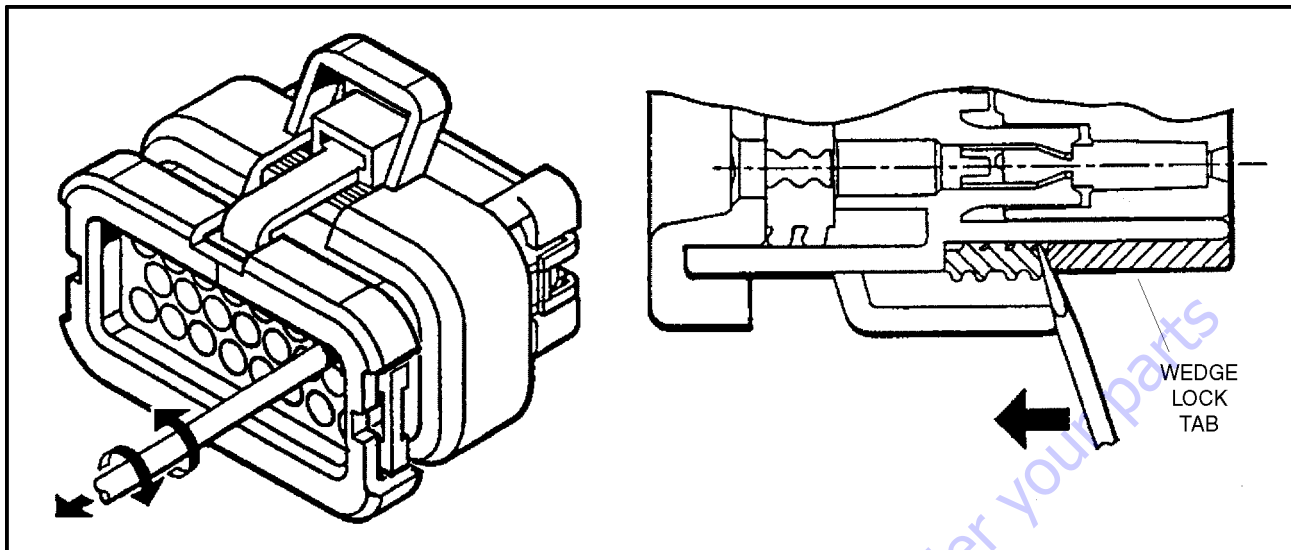


Figure 7-12. Connector Disassembly

Disassembly

5. Insert a 4.8 mm (3/16") wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
6. Pry open the wedge lock to the open position.
7. 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 AMPSEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

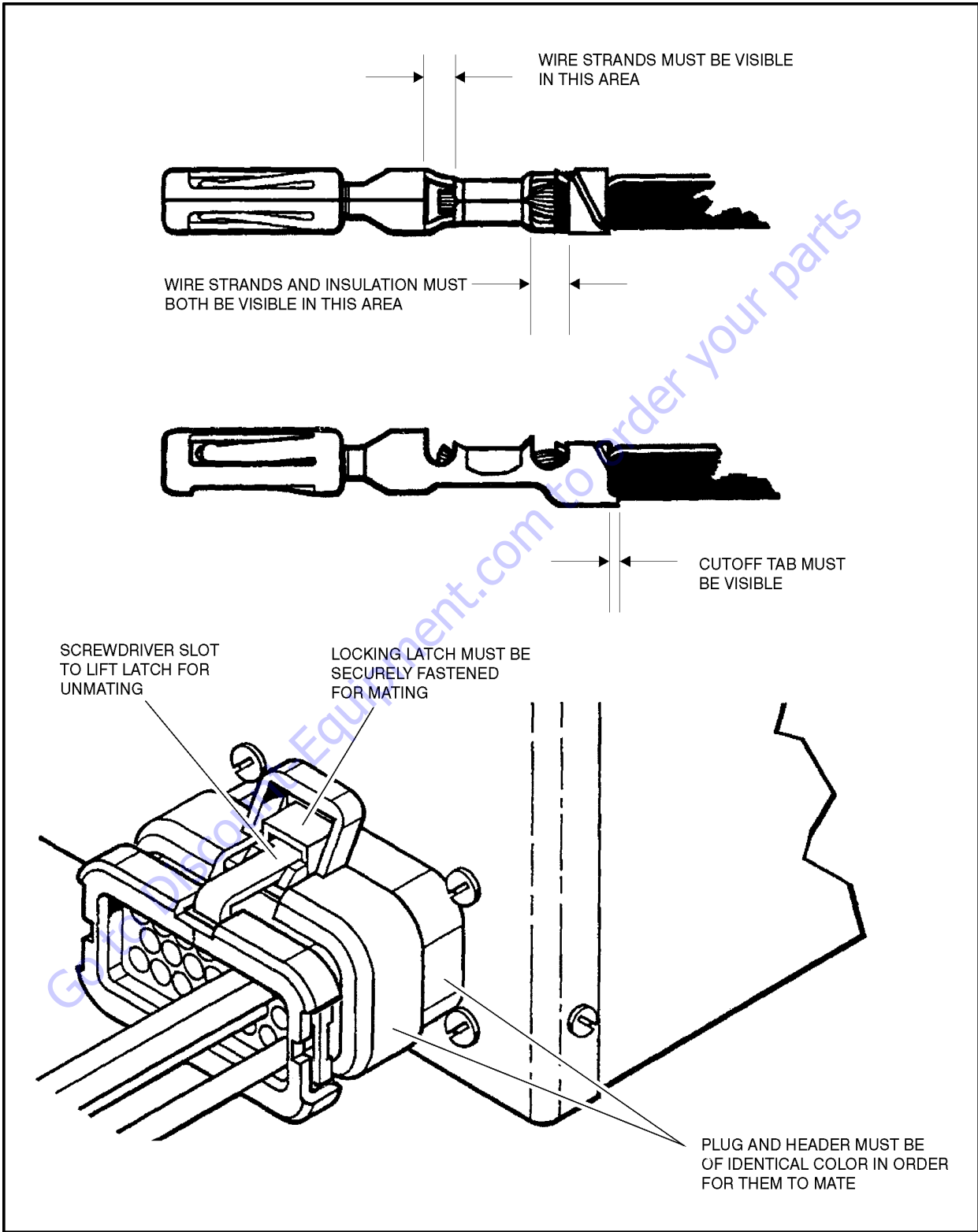


Figure 7-13. Connector Installation

7.6 DEUTSCH CONNECTORS

DT/DTP Series Assembly

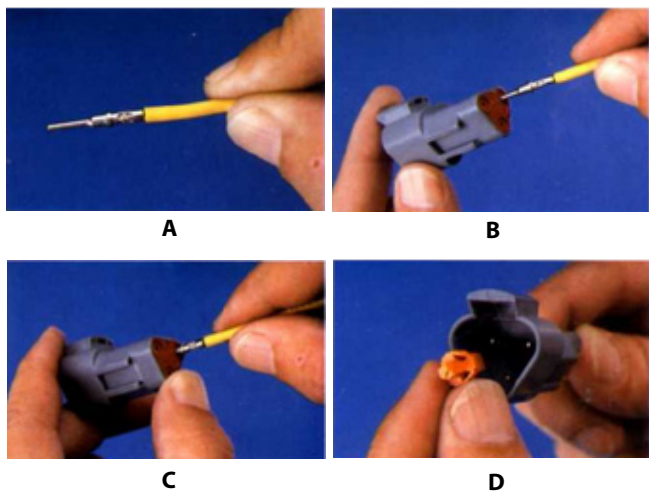


Figure 7-14. DT/DTP Contact Installation

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

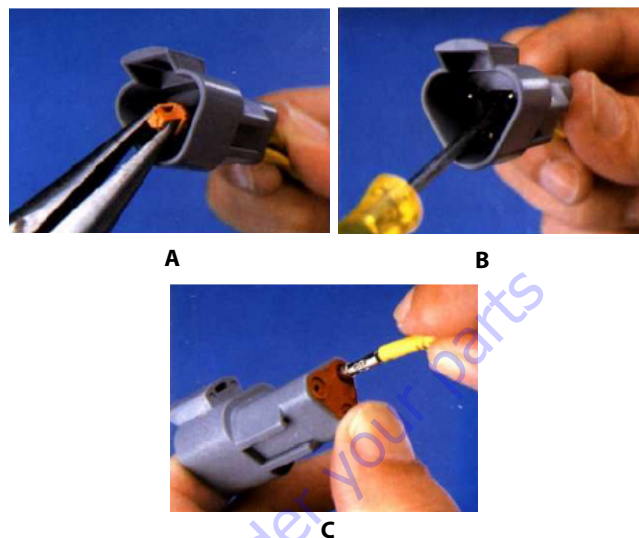


Figure 7-15. DT/DTP Contact Removal

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

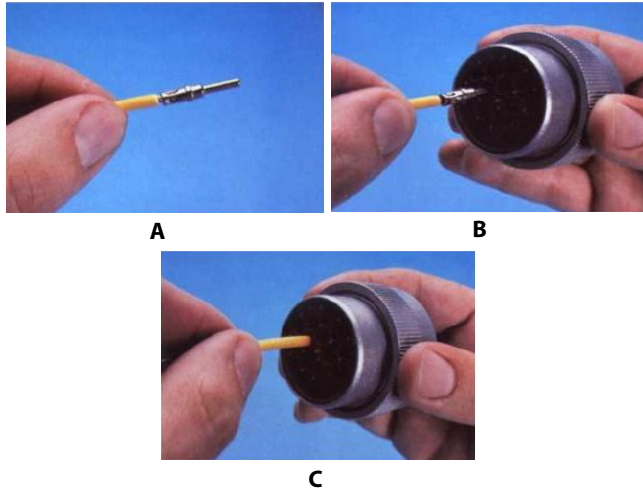


Figure 7-16. HD/HDP Contact Installation

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.

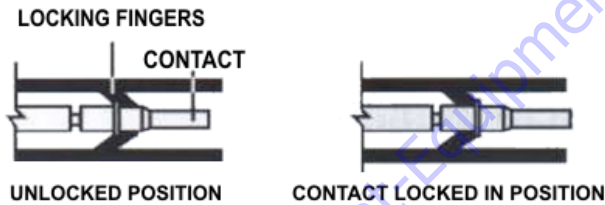


Figure 7-17. HD/HDP Locking Contacts Into Position

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

HD30/HDP20 Series Disassembly

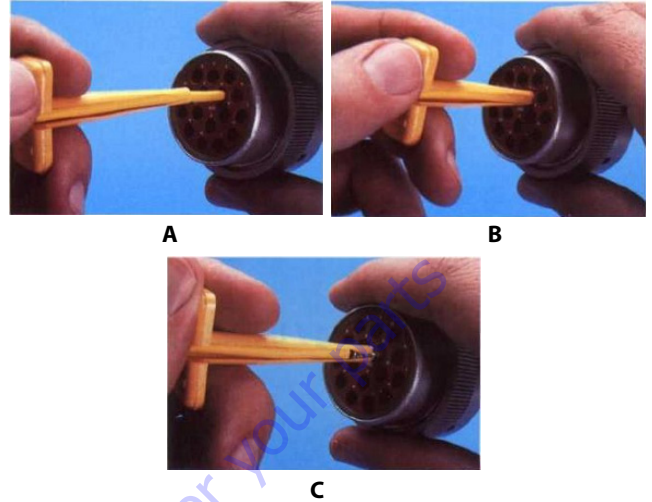


Figure 7-18. HD/HDP Contact Removal

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.

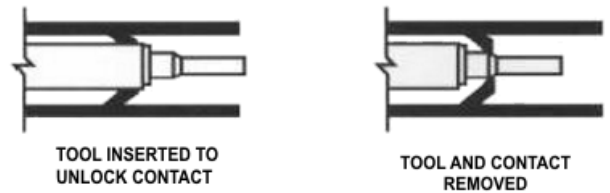


Figure 7-19. HD/HDP Unlocking Contacts

NOTE: Do Not twist or insert tool at an angle.

7.7 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

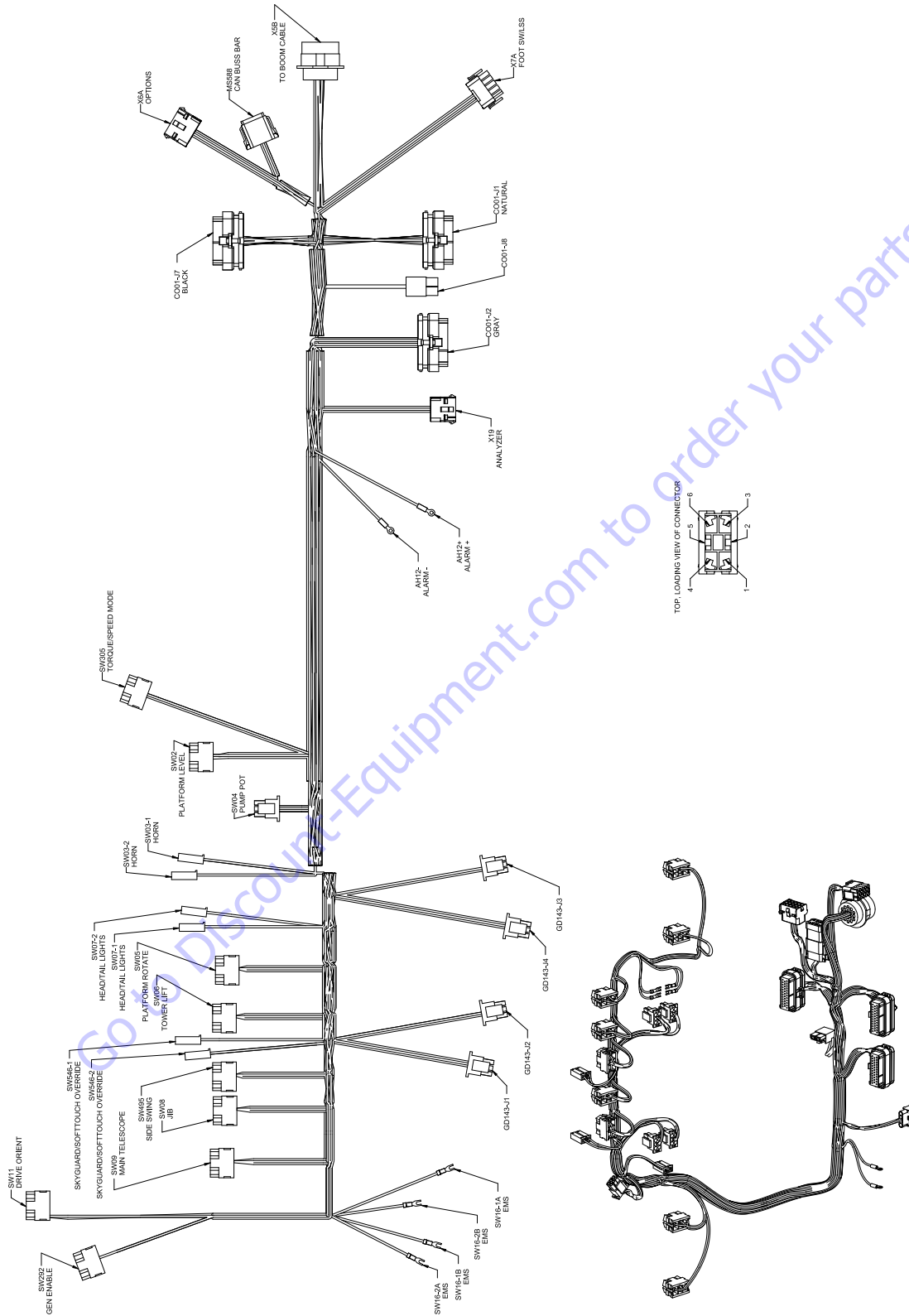
Components	Category	Label
Audible	Alarms	AH
	Horns	
Battery	Batteries	BT
	Battery Terminals	
Control Module	Ground	CO
	LSS	
	Platform	
Engine	Alternator	EC
	Cold Start	
	Controller	
	Coolant Temp	
	Fuel Pump	
	Fuel Solenoid	
	Glow Plugs	
	Oil Pressure	
Fuse & CB Fuse FC	Fuse	FC
	Fusible Link	FC
	Circuit Breaker	CB
Gauge & Display	Board	GD
	Cluster	
	Hourmeter	
	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

Components	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.
 CO1-J3 is the J3 connector for a UGM control module.
 EC9 is a glow plug supplied with the engine



1001191318 H

Figure 7-20. Platform Console Harness - Sheet 1 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

SW11 - DRIVE ORIENT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	12-1 DOS	18 AWG	GXL	1001159186		CO01-J2 (4)
2	YEL	5-14-10	18 AWG	GXL	4460419		SW546-2 (1)
2	YEL	5-14-9	18 AWG	GXL	4460419		SW03-1 (1)
3							
4							
5							
6							

SW09 - MAIN TELESCOPE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	14-0 MAIN TELE OUT	18 AWG	GXL	1001159186		CO01-J1 (6)
2	YEL	5-14-2	18 AWG	GXL	4460419		SW06 (2)
2	YEL	5-14-3	18 AWG	GXL	4460419		SW05 (2)
3	WHT	13-0 MAIN TELE IN	18 AWG	GXL	1001159186		CO01-J1 (5)
4							
5							
6							

SW292 - GEN ENABLE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1							
2	WHT	2-12-2 GEN ENABLE IGN	18 AWG	GXL	1001159186		X5B (7)
3	WHT	8-3 GEN ENABLE	18 AWG	GXL	1001159186		X5B (5)
4							
5							
6							

SW08 - JIB							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	28-0 JIB DN	18 AWG	GXL	1001159186		CO01-J1 (12)
2	YEL	5-14-5	18 AWG	GXL	4460419		SW02 (2)
2	YEL	5-14-6	18 AWG	GXL	4460419		SW495 (2)
3	WHT	27-0 JIB UP	18 AWG	GXL	1001159186		CO01-J1 (11)
4							
5							
6							

SW07-1 - HEAD/TAIL LIGHTS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	88-1 HEAD/TAIL LT	18 AWG	GXL	4460259		CO01-J1 (30)

SW495 - SIDE SWING							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	31-0 SIDE SWING LEFT	18 AWG	GXL	1001159186		CO01-J1 (26)
2	YEL	5-14-6	18 AWG	GXL	4460419		SW08 (2)
2	YEL	5-14-7	18 AWG	GXL	4460419		SW04 (1)
3	WHT	32-0 SIDE SWING RIGHT	18 AWG	GXL	1001159186		CO01-J1 (25)
4							
5							
6							

SW07-2 - HEAD/TAIL LIGHTS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-14-11	18 AWG	GXL	4460259		SW546-2 (1)

SW16-2A - EMS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
2A	YEL	5-11-3	18 AWG	GXL			CO01-J7 (2)

SW06 - TOWER LIFT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	29-30 TWR LFT DN	18 AWG	GXL	1001159186		CO01-J1 (2)
2	YEL	5-14-1	18 AWG	GXL	4460419		SW305 (2)
2	YEL	5-14-1	18 AWG	GXL	4460419		SW305 (2)
2	YEL	5-14-2	18 AWG	GXL	4460419		SW09 (2)
3	WHT	29-0 TWR LFT UP	18 AWG	GXL	1001159186		CO01-J1 (1)
4							
5							
6							

SW16-1B - EMS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1B	YEL	5-2-6	18 AWG	GXL			X5B (13)

SW16-2B - EMS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
2B	YEL	5-2-5	18 AWG	GXL			X5B (15)
2B							

SW05 - PLATFORM ROTATE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	23-0 PLAT ROT LFT	18 AWG	GXL	1001159186		CO01-J1 (8)
2	YEL	5-14-3	18 AWG	GXL	4460419		SW09 (2)
2	YEL	5-14-4	18 AWG	GXL	4460419		SW02 (2)
3	WHT	24-0 PLAT ROT RT	18 AWG	GXL	1001159186		CO01-J1 (7)
4							
5							
6							

SW16-1A - EMS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1A	YEL	5-11-2	18 AWG	GXL			X5B (9)

GD143-J2							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	98-7 BAT LOW	18 AWG	GXL	4460226		CO01-J2 (13)
2	WHT	131-3 FUNC ENABLE	18 AWG	GXL	4460226		CO01-J2 (7)
3							
4							
5							
6	WHT	1-26 DISPLAY GND	18 AWG	GXL	4460226		CO01-J2 (18)

SW546-1 - SKYGUARD/SOFTTOUCH OVERRIDE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	124-3 OVERRIDE	18 AWG	GXL	4460259		CO01-J1 (29)

SW546-2 - SKYGUARD/SOFTTOUCH OVERRIDE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-14-10	18 AWG	GXL	4460259		SW11 (2)
1	YEL	5-14-11	18 AWG	GXL	4460259		SW07-2 (1)

GD143-J4							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	129-1 TILT	18 AWG	GXL	4460226		CO01-J2 (6)
2	WHT	128-1 OVERLOAD	18 AWG	GXL	4460226		CO01-J2 (11)
3	WHT	127-1 SYS FAULT	18 AWG	GXL	4460226		CO01-J2 (8)
4	WHT	122-2 DOS	18 AWG	GXL	4460226		CO01-J2 (14)
5					4460226		
6							

GD143-J1							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	98-3 1/4 BAT CHG	18 AWG	GXL	4460226		CO01-J2 (22)
2	WHT	98-4 1/2 BAT CHG	18 AWG	GXL	4460226		CO01-J2 (24)
3	WHT	98-5 3/4 BAT CHG	18 AWG	GXL	4460226		CO01-J2 (23)
4	WHT	1-25 CHG IND GND	18 AWG	GXL	4460226		CO01-J2 (25)
5					4460226		
6	WHT	98-6 BAT FULL	18 AWG	GXL	4460226		CO01-J2 (35)

GD143-J3							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	125-2 CREEP MODE	18 AWG	GXL	4460226		CO01-J2 (9)
2	WHT	130-1 SOFT TOUCH	18 AWG	GXL	4460226		CO01-J2 (19)
3	WHT	134 SKY GUARD	18 AWG	GXL	4460226		CO01-J2 (16)
4							
5					4460226		
6							

Figure 7-21. Platform Console Harness - Sheet 2 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

SW03-2 - HORN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	49-0-1 HORN	18 AWG	GXL	4460259		CO01-J1 (31)

SW03-1 - HORN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-14-8	18 AWG	GXL	4460259		SW04 (1)
1	YEL	5-14-9	18 AWG	GXL	4460259		SW11 (2)

SW305 - TORQUE/SPEED MODE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	120-2 AWDA MAN	18 AWG	GXL	1001159186		CO01-J1 (28)
2	YEL	5-14-1	18 AWG	GXL	1001159186		SW06 (2)
3	WHT	120-1 TORQUE/SPEED MODE	18 AWG	GXL	1001159186		CO01-J1 (27)
4							
5							
6							

SW02 - PLATFORM LEVEL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	26-0 PLAT LVL DN	18 AWG	GXL	1001159186		CO01-J1 (10)
2	YEL	5-14-4	18 AWG	GXL	4460419		SW05 (2)
2	YEL	5-14-5	18 AWG	GXL	4460419		SW08 (2)
3	WHT	25-0 PLAT LVL UP	18 AWG	GXL	1001159186		CO01-J1 (9)
4							
5							
6							

SW04 - PUMP POT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-14-7	18 AWG	GXL	4460267		SW495 (2)
1	YEL	5-14-8	18 AWG	GXL	4460267		SW03-1 (1)
2	YEL	5-14	18 AWG	GXL	4460267		CO01-J1 (18)
3	WHT	125-1 CREEP MODE	18 AWG	GXL	4460267		CO01-J1 (32)
4	WHT	126-1 PUMP POT PWR	18 AWG	GXL	4460267		CO01-J1 (34)
5	WHT	1-23 PUMP POT RETURN	18 AWG	GXL	4460267		CO01-J1 (13)
6	WHT	126-2 PUMP POT CMD	18 AWG	GXL	4460267		CO01-J1 (35)

AH12 - ALARM -							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-27 ALARM GND	18 AWG	GXL			CO01-J7 (20)

AH12+ - ALARM +							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	132 PLAT ALARM	18 AWG	GXL			CO01-J7 (19)

X19 - ANALYZER							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	51-0 ANALYZER PWR	18 AWG	GXL	4460227		CO01-J2 (26)
2	GRN	52-0 ANALYZER RX	18 AWG	GXL	4460227		CO01-J2 (28)
3	WHT	53-0 ANALYZER TX	18 AWG	GXL	4460227		CO01-J2 (29)
4	BLK	54-0 ANALYZER GND	18 AWG	GXL	4460227		CO01-J2 (27)

CO01-J7 - BLACK							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	81-0 GND MODE RX	18 AWG	GXL	4460871		X5B (11)
1	WHT	132 PLAT ALARM	18 AWG	GXL	4460871		AH12+ (1)
1					4460871		
2	YEL	5-11-3	18 AWG	GXL	4460871		SW16-2A (2A)
3	WHT	82-0 PLAT TX	18 AWG	GXL	4460871		X5B (4)
4	WHT	3-16 FOOTSWITCH	18 AWG	GXL	4460871		X7A (5)
5					4460905		
6					4460905		
7	WHT	3-18 SKYG PWR	18 AWG	GXL	4460871		X7A (7)
8	WHT	131-1 FOOT SWITCH	18 AWG	GXL	4460871		X7A (4)
9					4460905		
10					4460905		
11					4460905		
12					4460905		
13					4460905		
14					4460905		
15					4460905		
16	WHT	1-28 LSS GND	18 AWG	GXL	4460871		X7A (14)
17					4460905		
18	WHT	124-1 SKYG INPUT#1	18 AWG	GXL	4460871		X7A (10)
19					4460871		
20	WHT	1-27 ALARM GND	18 AWG	GXL	4460871		AH12- (1)
21	WHT	25-3 PLAT LVL UP	18 AWG	GXL	4460871		X6A (13)
22	WHT	26-3 PLAT LVL DN	18 AWG	GXL	4460871		X6A (14)
23	WHT	1-30 VLV GND	18 AWG	GXL	4460871		X6A (5)
24	WHT	1-36 SKYG GND	18 AWG	GXL	4460871		X7A (8)
25	WHT	27-3 JIB UP	18 AWG	GXL	4460871		X6A (3)
26	WHT	28-3 JIB DN	18 AWG	GXL	4460871		X6A (4)
27	WHT	31-3 JIB RHT	18 AWG	GXL	4460871		X6A (11)
28	WHT	30-3 JIB LFT	18 AWG	GXL	4460871		X6A (12)
29	WHT	1-29 OPTION GND	18 AWG	GXL	4460871		X6A (6)
30	GRN	CAN1 LOW	18 AWG	GXL	4460871		MSS88 (3)
31	YEL	CAN1 HIGH	18 AWG	GXL	4460871		MSS88 (1)
32					4460905		
33	WHT	23-0-3 PLAT ROT LFT	18 AWG	GXL	4460871		X6A (1)
34	WHT	24-0-3 PLAT ROT RHT	18 AWG	GXL	4460871		X6A (2)
35					4460905		
NC					4460871		

X6A - OPTIONS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	23-0-3 PLAT ROT LFT	18 AWG	GXL	4460226		CO01-J7 (33)
2	WHT	24-0-3 PLAT ROT RHT	18 AWG	GXL	4460226		CO01-J7 (34)
3	WHT	27-3 JIB UP	18 AWG	GXL	4460226		CO01-J7 (25)
4	WHT	28-3 JIB DN	18 AWG	GXL	4460226		CO01-J7 (26)
5	WHT	1-30 VLV GND	18 AWG	GXL	4460226		CO01-J7 (23)
6	WHT	1-29 OPTION GND	18 AWG	GXL	4460226		CO01-J7 (29)
7							
8	YEL	CAN1 HIGH	18 AWG	GXL	4460226		MSS88 (8)
9	GRN	CAN1 LOW	18 AWG	GXL	4460226		MSS88 (6)
10							
11	WHT	31-3 JIB RHT	18 AWG	GXL	4460226		CO01-J7 (27)
12	WHT	30-3 JIB LFT	18 AWG	GXL	4460226		CO01-J7 (28)
13	WHT	25-3 PLAT LVL UP	18 AWG	GXL	4460226		CO01-J7 (21)
14	WHT	26-3 PLAT LVL DN	18 AWG	GXL	4460226		CO01-J7 (22)
15							

MS588 - CAN BUSS BAR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN1 HIGH	18 AWG	GXL	4460465		CO01-J7 (31)
2					4460466		
3	GRN	CAN1 LOW	18 AWG	GXL	4460465		CO01-J7 (30)
4					4460466		
5	GRN	CAN1 LOW	18 AWG	GXL	4460465		X5B (2)
6	GRN	CAN1 LOW	18 AWG	GXL	4460465		X6A (9)
7	YEL	CAN1 HIGH	18 AWG	GXL	4460465		X5B (3)
8	YEL	CAN1 HIGH	18 AWG	GXL	4460465		X6A (8)

Figure 7-22. Platform Console Harness - Sheet 3 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

X5B - TO BOOM CABLE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460466		
2	GRN	CAN1 LOW	18 AWG	GXL	4460464		MS588 (5)
3	YEL	CAN1 HIGH	18 AWG	GXL	4460464		MS588 (7)
4	WHT	82-0 PLAT TX	18 AWG	GXL	4460464		CO01-J7 (3)
5	WHT	8-3 GEN ENABLE	18 AWG	GXL	4460464		SW292 (3)
6	GRN	131-2 FOOT PEDAL	18 AWG	GXL	4460464		X7A (6)
7	WHT	2-12-2 GEN ENABLE IGN	18 AWG	GXL	4460464		SW292 (2)
8					4460466		
9	YEL	5-11-2	18 AWG	GXL	4460464		SW16-1A (1A)
10					4460466		
11	WHT	81-0 GND MODE RX	18 AWG	GXL	4460464		CO01-J7 (1)
12	YEL	3-8 PLAT IGN	12 AWG	GXL	4460508		CO01-J8 (2)
13	YEL	5-2-6	18 AWG	GXL	4460464		SW16-1B (1B)
14					4460466		
15	YEL	5-2-5	18 AWG	GXL	4460464		SW16-2B (2B)
16	BLK	1-5 PLAT GND	12 AWG	GXL	4460508		CO01-J8 (1)
17					4460466		
18					4460466		
19					4460466		

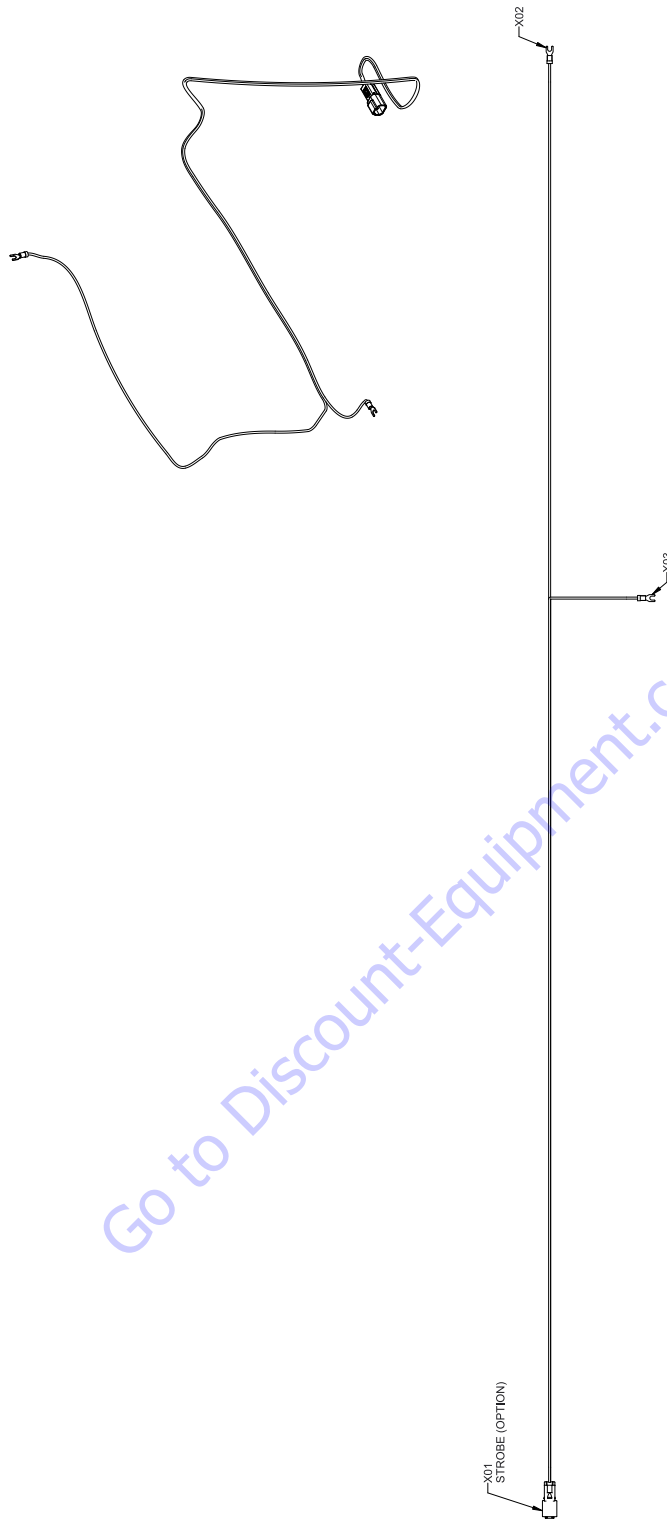
CO01-J1 - NATURAL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	29-0 TWR LFT UP	18 AWG	GXL	4460871		SW06 (3)
2	WHT	29-30 TWR LFT DN	18 AWG	GXL	4460871		SW06 (1)
3					4460905		
4					4460905		
5	WHT	13-0 MAIN TELE IN	18 AWG	GXL	4460871		SW09 (3)
6	WHT	14-0 MAIN TELE OUT	18 AWG	GXL	4460871		SW09 (1)
7	WHT	24-0 PLAT ROT RT	18 AWG	GXL	4460871		SW05 (3)
8	WHT	23-0 PLAT ROT LFT	18 AWG	GXL	4460871		SW05 (1)
9	WHT	25-0 PLAT LVL UP	18 AWG	GXL	4460871		SW02 (3)
10	WHT	26-0 PLAT LVL DN	18 AWG	GXL	4460871		SW02 (1)
11	WHT	27-0 JIB UP	18 AWG	GXL	4460871		SW08 (3)
12	WHT	28-0 JIB DN	18 AWG	GXL	4460871		SW08 (1)
13	WHT	1-23 PUMP POT RETURN	18 AWG	GXL	4460871		SW04 (5)
14					4460905		
15					4460905		
16					4460905		
17					4460905		
18	YEL	5-14	18 AWG	GXL	4460871		SW04 (2)
19					4460905		
20	WHT	124-5 SOFTT	18 AWG	GXL	4460871		X7A (12)
21					4460905		
22					4460905		
23	WHT	124-2 SKYG INPUT#2	18 AWG	GXL	4460871		X7A (11)
24					4460905		
25	WHT	32-0 SIDE SWING RIGHT	18 AWG	GXL	4460871		SW495 (3)
26	WHT	31-0 SIDE SWING LEFT	18 AWG	GXL	4460871		SW495 (1)
27	WHT	120-1 TORQUE/SPEED MODE	18 AWG	GXL	4460871		SW305 (3)
28	WHT	120-2 AWDA MAN	18 AWG	GXL	4460871		SW305 (1)
29	WHT	124-3 OVERRIDE	18 AWG	GXL	4460871		SW546-1 (1)
30	WHT	88-1 HEAD/TAIL LT	18 AWG	GXL	4460871		SW07-1 (1)
31	WHT	49-0-1 HORN	18 AWG	GXL	4460871		SW03-2 (1)
32	WHT	125-1 CREEP MODE	18 AWG	GXL	4460871		SW04 (3)
33					4460905		
34	WHT	126-1 PUMP POT PWR	18 AWG	GXL	4460871		SW04 (4)
35	WHT	126-2 PUMP POT CMD	18 AWG	GXL	4460871		SW04 (6)

CO01-J2 - GRAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2					4460905		
3					4460905		
4	WHT	122-1 DOS	18 AWG	GXL	4460871		SW11 (1)
5					4460905		
6	WHT	129-1 TILT	18 AWG	GXL	4460871		GD143-J4 (1)
7	WHT	131-3 FUNC ENABLE	18 AWG	GXL	4460871		GD143-J2 (2)
8	WHT	127-1 SYS FAULT	18 AWG	GXL	4460871		GD143-J4 (3)
9	WHT	125-2 CREEP MODE	18 AWG	GXL	4460871		GD143-J3 (1)
10					4460905		
11	WHT	128-1 OVERLOAD	18 AWG	GXL	4460871		GD143-J4 (2)
12					4460905		
13	WHT	98-7 BAT LOW	18 AWG	GXL	4460871		GD143-J2 (1)
14	WHT	122-2 DOS	18 AWG	GXL	4460871		GD143-J4 (4)
15					4460905		
16	WHT	134 SKY GUARD	18 AWG	GXL	4460871		GD143-J3 (3)
17					4460905		
18	WHT	1-26 DISPLAY GND	18 AWG	GXL	4460871		GD143-J2 (6)
19	WHT	130-1 SOFT TOUCH	18 AWG	GXL	4460871		GD143-J3 (2)
20					4460905		
21					4460905		
22	WHT	98-3 1/4 BAT CHG	18 AWG	GXL	4460871		GD143-J1 (1)
23	WHT	98-5 3/4 BAT CHG	18 AWG	GXL	4460871		GD143-J1 (3)
24	WHT	98-4 1/2 BAT CHG	18 AWG	GXL	4460871		GD143-J1 (2)
25	WHT	1-25 CHG IND GND	18 AWG	GXL	4460871		GD143-J1 (4)
26	RED	51-0 ANALYZER PWR	18 AWG	GXL	4460871		X19 (1)
27	BLK	54-0 ANALYZER GND	18 AWG	GXL	4460871		X19 (4)
28	GRN	52-0 ANALYZER RX	18 AWG	GXL	4460871		X19 (2)
29	WHT	53-0 ANALYZER TX	18 AWG	GXL	4460871		X19 (3)
30					4460905		
31	WHT	3-25 SOFTT PWR	18 AWG	GXL	4460871		X7A (9)
32	WHT	3-20 LSS PWR	18 AWG	GXL	4460871		X7A (15)
33					4460905		
34					4460905		
35	WHT	98-6 BAT FULL	18 AWG	GXL	4460871		GD143-J1 (6)

X7A - FOOT SW/LSS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1							
2							
3	WHT	1-551 JUMPER	18 AWG	GXL	4460227		X7A (13)
4	WHT	131-1 FOOT SWITCH	18 AWG	GXL	4460227		CO01-J7 (8)
5	WHT	3-16 FOOTSWITCH	18 AWG	GXL	4460227		CO01-J7 (4)
6	GRN	131-2 FOOT PEDAL	18 AWG	GXL	4460227		X5B (6)
7	WHT	3-18 SKYG PWR	18 AWG	GXL	4460227		CO01-J7 (7)
8	WHT	1-36 SKYG GND	18 AWG	GXL	4460227		CO01-J7 (24)
9	WHT	3-25 SOFTT PWR	18 AWG	GXL	4460227		CO01-J2 (31)
10	WHT	124-1 SKYG INPUT#1	18 AWG	GXL	4460227		CO01-J7 (18)
11	WHT	124-2 SKYG INPUT#2	18 AWG	GXL	4460227		CO01-J1 (23)
12	WHT	124-5 SOFTT	18 AWG	GXL	4460227		CO01-J1 (20)
13	WHT	1-551 JUMPER	18 AWG	GXL	4460227		X7A (3)
14	WHT	1-28 LSS GND	18 AWG	GXL	4460227		CO01-J7 (16)
15	WHT	3-20 LSS PWR	18 AWG	GXL	4460227		CO01-J2 (32)

CO01-J8							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-5 PLAT GND	12 AWG	GXL	4460887		X5B (16)
2	YEL	3-8 PLATIGN	12 AWG	GXL	4460887		X5B (12)

Figure 7-23. Platform Console Harness - Sheet 4 of 4



X01 STROBE (OPTION)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	TO
1	BLU/ORN	P1 PWR	18 AWG	TFFN	4460464	X02 (1)
2	BLK	P2 GND	18 AWG	TFFN	4460464	X03 (1)

X02

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	TO
1	BLU/ORN	P1 PWR	18 AWG	TFFN	N/A	X01 (1)

X03

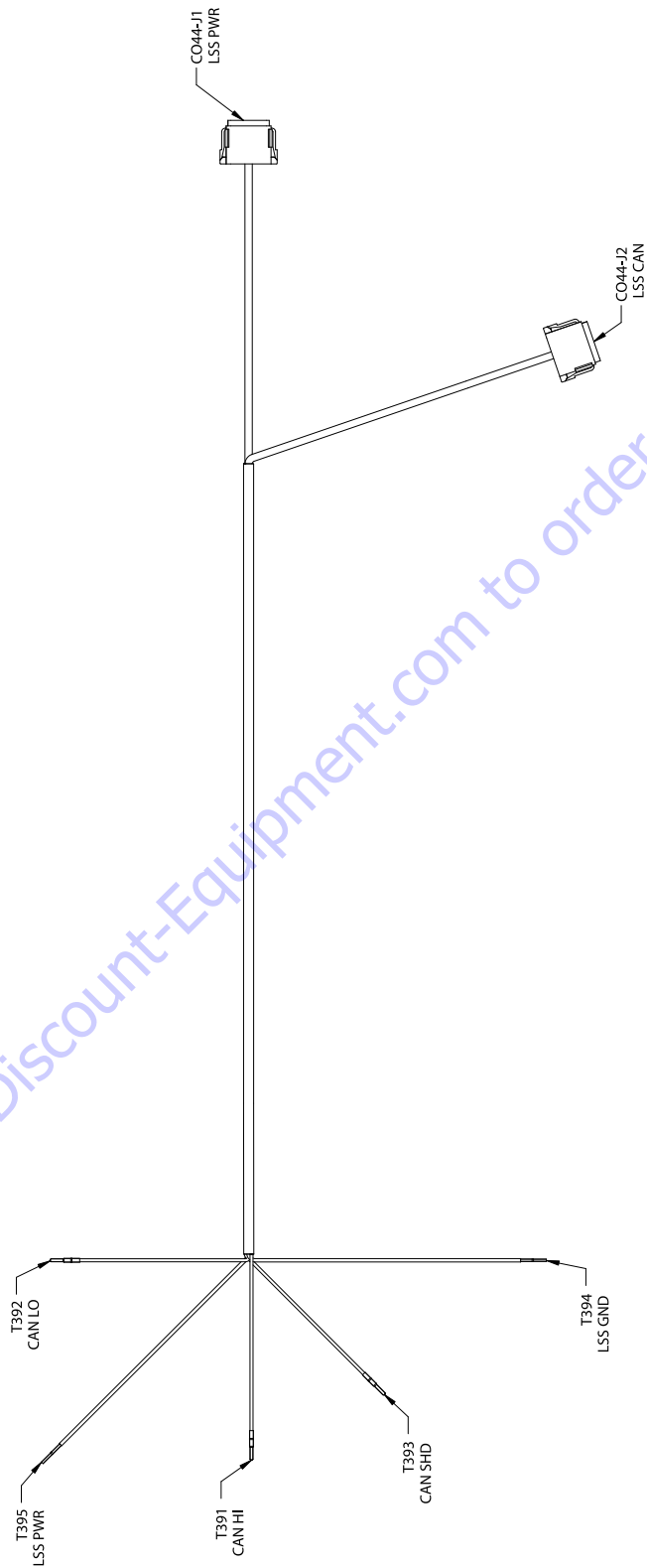
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	TO
1	BLK	P2 GND	18 AWG	TFFN	N/A	X01 (2)

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Figure 7-24. Platform Beacon Harness

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Figure 7-25. Load Sensing System Harness (LSS) - Sheet 1 of 2

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SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

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)

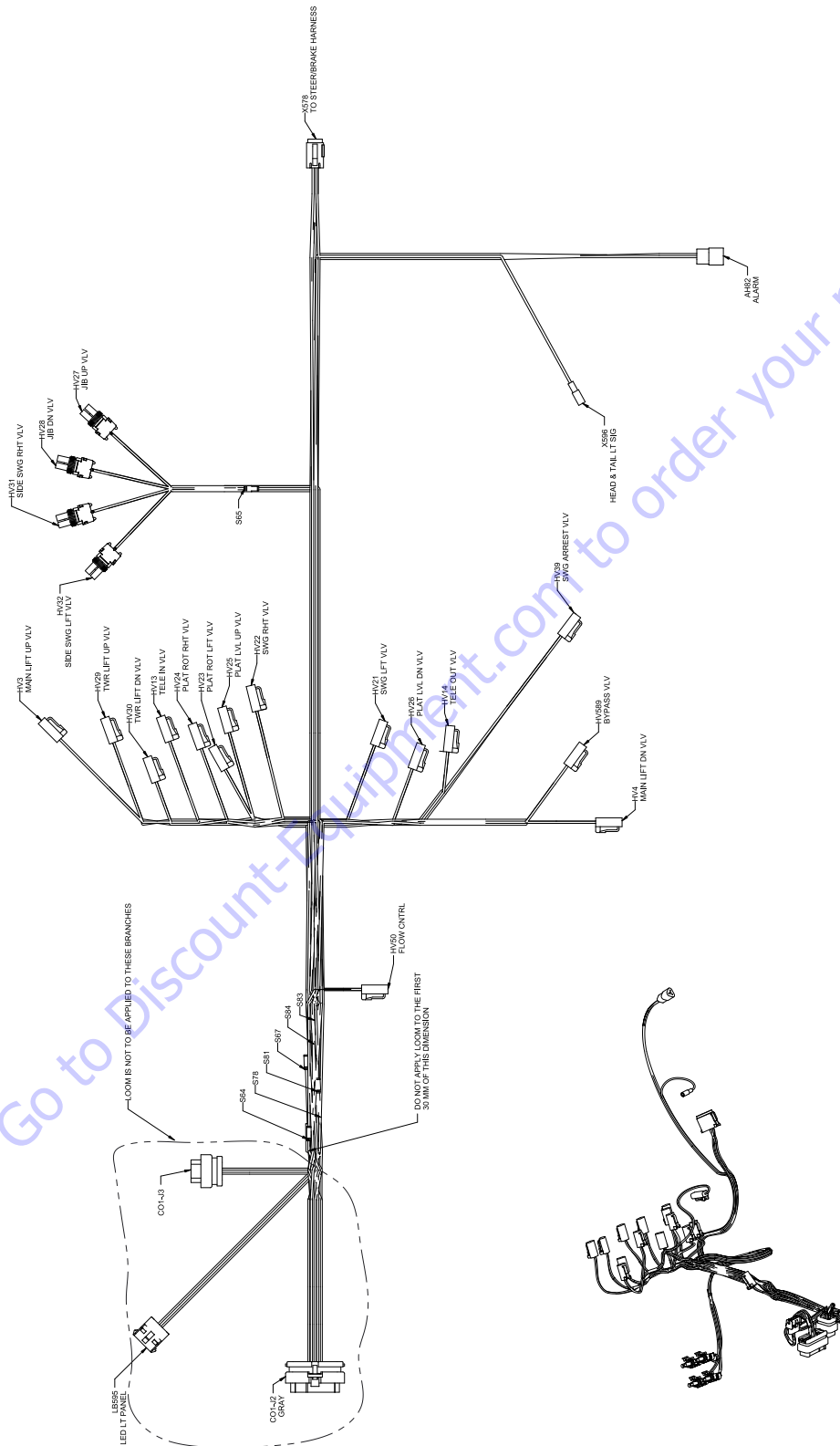
T391 - CAN HI							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	TP CAN CABLE	20 AWG	J1939 CABLE	N/A		CO44-J2 (4)

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 7-26. Load Sensing System Harness - Sheet 2 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS



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Figure 7-27. Main Valve Harness - Sheet 1 of 3

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

HV50 - FLOW CNTRL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	50-01 FLOW CNTRL	18 AWG	GXL	4460465		CO1-J2 (31)
2	WHT	38-0 CURNT FBCK	18 AWG	GXL	4460465		CO1-J3 (8)

HV13 - TELE IN VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	13-03 TELE IN	18 AWG	GXL	4460465		CO1-J2 (3)
2	BLK	4-13-2 RTN	18 AWG	GXL	4460465		S83 (1)

HV3 - MAIN LIFT UP VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	11-2 MAIN LIFT UP	18 AWG	GXL	4460465		CO1-J2 (11)
2	WHT	38-3-1 CURNT FBCK	18 AWG	GXL	4460465		S81 (1)

HV24 - PLAT ROT RHT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	24-04 PLAT ROT RHT	18 AWG	GXL	4460465		CO1-J2 (21)
2	BLK	4-27-1-4 RTN	18 AWG	GXL	4460465		S67 (1)

HV29 - TWR LIFT UP VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	29-03 TWR UP	18 AWG	GXL	4460465		CO1-J2 (20)
2	WHT	38-1-1 CURNT FBCK	18 AWG	GXL	4460465		S78 (1)

HV23 - PLAT ROT LFT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	23-04 PLAT ROT LFT	18 AWG	GXL	4460465		CO1-J2 (10)
2	BLK	4-27-1-3 RTN	18 AWG	GXL	4460465		S67 (1)

HV30 - TWR LIFT DN VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	30-03 TWR DN	18 AWG	GXL	4460465		CO1-J2 (9)
2	WHT	38-1-2 CURNT FBCK	18 AWG	GXL	4460465		S78 (1)

HV25 - PLAT LVL UP VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	25-04 PLAT LVL UP	18 AWG	GXL	4460465		CO1-J2 (5)
2	BLK	4-27-1-1 RTN	18 AWG	GXL	4460465		S67 (1)

CO1-J3							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-2 CURNT FBCK	18 AWG	GXL	4460871		X578 (8)
2	WHT	38-3 CURNT FBCK	18 AWG	GXL	4460871		S81 (2)
3					4460905		
4	WHT	38-5 CURNT FBCK	18 AWG	GXL	4460871		S84 (2)
5	WHT	38-1 CURNT FBCK	18 AWG	GXL	4460871		S78 (2)
6	WHT	38-0 CURNT FBCK	18 AWG	GXL	4460871		HV59 (2)
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		

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)

LB595 - LED LT PANEL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	448	18 AWG	GXL	4460226		X578 (4)
2	WHT	208 YELLED	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)

S84							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-5-1 CURNT FBCK	18 AWG	GXL	N/A		HV21 (2)
1	WHT	38-5-2 CURNT FBCK	18 AWG	GXL	N/A		HV22 (2)
2	WHT	38-5 CURNT FBCK	18 AWG	GXL	N/A		CO1-J3 (4)

CO1-J2 - GRAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	37-0 BYPASS VLV	18 AWG	GXL	4460871		HV589 (1)
2					4460905		
3	WHT	13-03 TELE IN	18 AWG	GXL	4460871		HV13 (1)
4	WHT	32-04 SIDE SWG RHT	18 AWG	GXL	4460871		HV31 (1)
5	WHT	25-04 PLAT LVL UP	18 AWG	GXL	4460871		HV25 (1)
6	BLK	44-0	18 AWG	GXL	4460871		HV589 (2)
7	WHT	26-04 PLAT LVL DN	18 AWG	GXL	4460871		HV26 (1)
8	WHT	4-12 STR FLOW CNTRL	18 AWG	GXL	4460871		X578 (9)
9	WHT	30-03 TWR DN	18 AWG	GXL	4460871		HV30 (1)
10	WHT	23-04 PLAT ROT LFT	18 AWG	GXL	4460871		HV23 (1)
11	WHT	11-02 MAIN LIFT UP	18 AWG	GXL	4460871		HV3 (1)
12	WHT	27-04 JIB UP	18 AWG	GXL	4460871		HV27 (1)
13					4460905		
14	BLK	4-27 RTN	18 AWG	GXL	4460871		S64 (2)
15	WHT	14-03 TELE OUT	18 AWG	GXL	4460871		HV14 (1)
16	WHT	31-04 SIDE SWG LFT	18 AWG	GXL	4460871		HV32 (1)
17	BLK	4-13 RTN	18 AWG	GXL	4460871		S83 (2)
18	BLK	4-17 RTN	18 AWG	GXL	4460871		HV39 (2)
19	WHT	38-1 SWG ARESST	18 AWG	GXL	4460871		HV39 (1)
20	WHT	29-03 TWR UP	18 AWG	GXL	4460871		HV29 (1)
21	WHT	24-04 PLAT ROT RHT	18 AWG	GXL	4460871		HV24 (1)
22	WHT	12-02 MAIN LIFT DN	18 AWG	GXL	4460871		HV4 (1)
23	WHT	28-04 JIB DN	18 AWG	GXL	4460871		HV28 (1)
24					4460905		
25					4460905		
26	WHT	42-1 HST LT	16 AWG	GXL	4460871		X596 (1)
27	WHT	48-2 ALARM SIGNAL	18 AWG	GXL	4460871		AH82 (B)
28	BLK	4-10 RTN	18 AWG	GXL	4460871		X578 (6)
29	BLK	4-12 RTN	18 AWG	GXL	4460871		AH82 (C)
30					4460905		
31	WHT	50-01 FLOW CNTRL	18 AWG	GXL	4460871		HV50 (1)
32	WHT	9-2 STEER RT	18 AWG	GXL	4460871		X578 (7)
33	WHT	16-1 STEER LT	18 AWG	GXL	4460871		X578 (5)
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)

S67							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-27-1-4 RTN	18 AWG	GXL	N/A		HV25 (2)
1	BLK	4-27-1-2 RTN	18 AWG	GXL	N/A		HV26 (2)
1	BLK	4-27-1-3 RTN	18 AWG	GXL	N/A		HV23 (2)
1	BLK	4-27-1-4 RTN	18 AWG	GXL	N/A		HV24 (2)
2	BLK	4-27-1 RTN	18 AWG	GXL	N/A		S64 (1)

S81							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-5-1 CURNT FBCK	18 AWG	GXL	N/A		HV3 (2)
1	WHT	38-5-2 CURNT FBCK	18 AWG	GXL	N/A		HV4 (2)
2	WHT	38-3 CURNT FBCK	18 AWG	GXL	N/A		CO1-J3 (2)

S78							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-1-1 CURNT FBCK	18 AWG	GXL	N/A		HV29 (2)
1	WHT	38-1-2 CURNT FBCK	18 AWG	GXL	N/A		HV30 (2)
2	WHT	38-1 CURNT FBCK	18 AWG	GXL	N/A		CO1-J3 (5)

S64							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-27-1 RTN	18 AWG	GXL	N/A		S67 (2)
1	BLK	4-27-2 RTN	18 AWG	GXL	N/A		S65 (1)
2	BLK	4-27 RTN	18 AWG	GXL	N/A		CO1-J2 (14)

HV22 - SWG RHT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	22-0-1 SWG RHT	18 AWG	GXL	4460465		CO1-J2 (35)
2	WHT	38-5-2 CURNT FBCK	18 AWG	GXL	4460465		S84 (1)

Figure 7-28. Main Valve Harness - Sheet 2 of 3

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

X596 - HEAD & TAIL LT SIG							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	42-1 H&T LT	16 AWG	GXL			CO1-J2 (26)

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	4-2 RTN	18 AWG	GXL	4460465		CO1-J2 (29)

HV32 - SIDE SWG LFT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	31-0-4 SIDE SWG LFT	18 AWG	GXL	4460743	4460458	CO1-J2 (16)
2	BLK	4-27-2-3 RTN	18 AWG	GXL	4460743	4460458	S65 (2)

HV31 - SIDE SWG RHT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	32-0-4 SIDE SWG RHT	18 AWG	GXL	4460743	4460458	CO1-J2 (4)
2	BLK	4-27-2-4 RTN	18 AWG	GXL	4460743	4460458	S65 (2)

HV28 - JIB DN VLV							
CONNECTOR PART NUMBER: 4460742							
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	4460743	4460458	CO1-J2 (23)
2	BLK	4-27-2-2 RTN	18 AWG	GXL	4460743	4460458	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	4460743	4460458	CO1-J2 (12)
2	BLK	4-27-2-1 RTN	18 AWG	GXL	4460743	4460458	S65 (2)

X578 - TO STEER/BRAKE HARNESS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	205 RED LED	18 AWG	GXL	1001116692		LB595 (4)
2	WHT	206 YEL LED	18 AWG	GXL	1001116692		LB595 (2)
3	WHT	207 GRN LED	18 AWG	GXL	1001116692		LB595 (3)
4	BLK	4-56	18 AWG	GXL	1001116692		LB595 (1)
5	WHT	10-1 STEER LT	18 AWG	GXL	1001116692		CO1-J2 (33)
6	BLK	4-40 RTN	18 AWG	GXL	1001116692		CO1-J2 (28)
7	WHT	9-2 STEER RT	18 AWG	GXL	1001116692		CO1-J2 (32)
8	WHT	38-2 CURNT FBCK	18 AWG	GXL	1001116692		CO1-J3 (1)
9	WHT	41-2 STR FLOW CNTRL	18 AWG	GXL	1001116692		CO1-J2 (8)
10					4460466		
11					4460466		
12					4460466		

S65							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-27-2 RTN	18 AWG	GXL	N/A		S64 (1)
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)
2	BLK	4-27-2-3 RTN	18 AWG	GXL	N/A		HV32 (2)
2	BLK	4-27-2-4 RTN	18 AWG	GXL	N/A		HV31 (2)

HV21 - SWG LFT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	21-0-1 SWG LFT	18 AWG	GXL	4460465		CO1-J2 (34)
2	WHT	38-5-1 CURNT FBCK	18 AWG	GXL	4460465		S84 (1)

HV26 - PLAT LVL DN VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	26-0-4 PLAT LVL DN	18 AWG	GXL	4460465		CO1-J2 (7)
2	BLK	4-27-1-2 RTN	18 AWG	GXL	4460465		S67 (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)

HV39 - SWG ARREST VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	39-1 SWG ARREST	18 AWG	GXL	4460465		CO1-J2 (19)
2	BLK	4-17 RTN	18 AWG	GXL	4460465		CO1-J2 (18)

HV589 - BYPASS VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	37-0 BYPASS VLV	18 AWG	GXL	4460465		CO1-J2 (1)
2	BLK	4-61-0	18 AWG	GXL	4460465		CO1-J2 (6)

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		CO1-J2 (22)
2	WHT	38-3-2 CURNT FBCK	18 AWG	GXL	4460465		S81 (1)

Figure 7-29. Main Valve Harness - Sheet 3 of 3

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SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

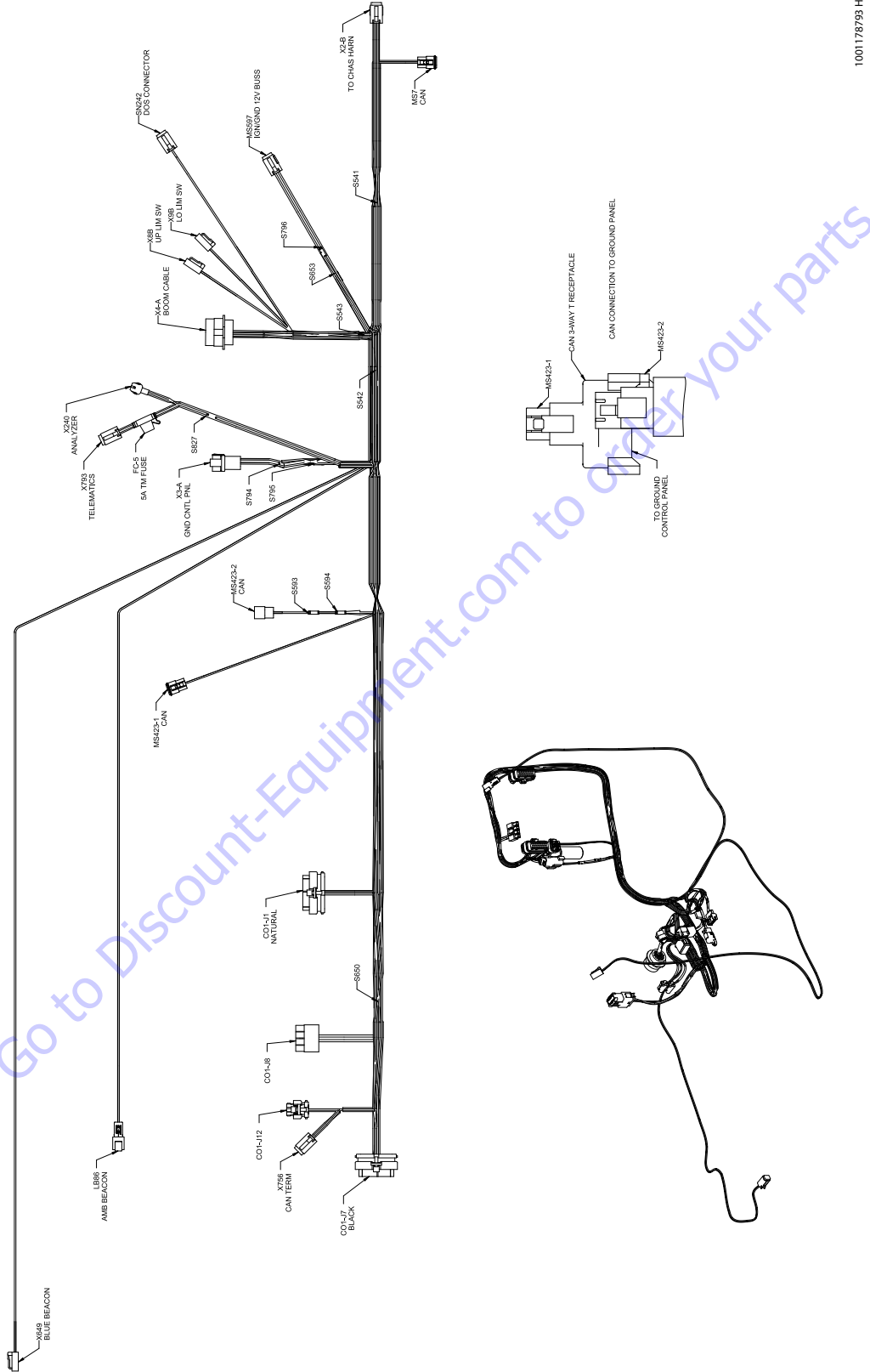


Figure 7-30. Turntable Harness - Sheet 1 of 3

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SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

C01-J7- BLACK							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	82- PLAT TX	18 AWG	GXL	4460871		S650 (1)
2	WHT	82-1 PLAT TX	18 AWG	GXL	4460871		S650 (1)
3	YEL	5-10-6	18 AWG	GXL	4460871		X3-A (6)
4	WHT	57-0 UPPER BOOM	18 AWG	GXL	4460871		X9B (1)
5					4460905		
6	WHT	CAN TERM JUMPER	18 AWG	GXL	4460871		C01-J7 (17)
7	WHT	58-0 LOWER BOOM	18 AWG	GXL	4460871		X9B (2)
8					4460905		
9					4460905		
10					4460905		
11	YEL	5-5	18 AWG	GXL	4460871		SN242 (1)
12					4460905		
13	YEL	CAN1 HI	18 AWG	GXL	4460871		S593 (1)
14	WHT	81-0 GND MODE RX	18 AWG	GXL	4460871		X4-A (11)
15	WHT	131-3 FOOTSWITCH	18 AWG	GXL	4460871		X4-A (6)
16					4460905		
17	WHT	CAN TERM JUMPER	18 AWG	GXL	4460871		C01-J7 (6)
18					4460905		
19					4460905		
20					4460905		
21					4460905		
22					4460905		
23					4460905		
24	GRN	CAN1 LO	18 AWG	GXL	4460871		S594 (1)
25	BLK	4-55	18 AWG	GXL	4460871		X2-B (10)
26					4460905		
27					4460905		
28					4460905		
29	YEL	5-50	18 AWG	GXL	4460871		X2-B (9)
30	YEL	5-33 IGN LIM SW	18 AWG	GXL	4460871		S543 (2)
31					4460905		
32	WHT	59-0 DOS	18 AWG	GXL	4460871		SN242 (4)
33					4460905		
34					4460905		
35					4460905		

C01-J1- NATURAL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2	WHT	300-1 ALERT PWR	18 AWG	GXL	4460871		X649 (1)
3					4460905		
4	BLK	300-2 ALERT GND	18 AWG	GXL	4460871		X649 (2)
5					4460905		
6					4460905		
7					4460905		
8					4460905		
9					4460905		
10					4460905		
11					4460905		
12					4460905		
13	WHT	48-10 VOTE RELAY	18 AWG	GXL	4460871		X2-B (5)
14					4460905		
15					4460905		
16					4460905		
17					4460905		
18					4460905		
19	WHT	4-52 INSTR GND	18 AWG	GXL	4460871		X2-B (6)
20					4460905		
21					4460905		
22					4460905		
23					4460905		
24					4460905		
25					4460905		
26					4460905		
27					4460905		
28	WHT	51-1 ANALYZER PWR	18 AWG	GXL	4460871		X240 (1)
29	WHT	52-1 ANALYZER RS-232 RX	18 AWG	GXL	4460871		X240 (2)
30	WHT	53-1 ANALYZER RS-232 TX	18 AWG	GXL	4460871		X240 (3)
31	WHT	54-1 ANALYZER GND	18 AWG	GXL	4460871		X240 (4)
32					4460905		
33					4460905		
34					4460905		
35					4460905		

C01-J8							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-0-1 INSTR GND	12 AWG	GXL	4460887		X2-B (3)
2	YEL	5-10-1 SWITCHED PWR	12 AWG	GXL	4460887		S541 (1)
3	BLK	PLAT GND	12 AWG	GXL	4460887		X4-A (16)
4	YEL	PLATFORM PWR	12 AWG	GXL	4460887		X4-A (12)

C01-J12							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2					4460905		
3	YEL	83-1-1 CAN2 HIGH	20 AWG	GXL	J1939 CABLE		X756 (2)
4	GRN	84-1-1 CAN2 LOW	20 AWG	GXL	J1939 CABLE		X756 (3)
5					4460905		
6					4460905		
7					4460905		
8	WHT	80-0 MSSO	18 AWG	GXL	4460871		X3-A (7)

MS423-1- CAN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	CAN1 HI	20 AWG	GXL	4460944		X4-A (3)
B	GRN	CAN1 LO	20 AWG	GXL	4460944		X4-A (2)
C					4460466		

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		S653 (1)
2	BLK	1-1-1 GND	18 AWG	GXL	4460464		S796 (1)

FC-5-5A TM FUSE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK		14 AWG	GXL	N/A		S827 (2)
2	BLK		14 AWG	GXL	N/A		X793 (3)

X649- BLUE BEACON							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	300-1 ALERT PWR	18 AWG	GXL	4460465		C01-J1 (2)
2	BLK	300-2 ALERT GND	18 AWG	GXL	4460465		C01-J1 (4)

S827							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-10-1-3 SWITCHED PWR	14 AWG	GXL	N/A		S541 (1)
2	BLK		14 AWG	GXL	N/A		FC-5 (1)

S650							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	82-1 PLAT TX	18 AWG	GXL	N/A		C01-J7 (2)
1	WHT	82-2 PLAT TX	18 AWG	GXL	N/A		C01-J7 (1)
2	WHT	82-0 PLAT TX	18 AWG	GXL	N/A		X4-A (4)

S593							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN1 HI	18 AWG	GXL	N/A		C01-J7 (13)
1	YEL	CAN1 HI	18 AWG	GXL	N/A		X2-B (11)
2	YEL	CAN1 HI	18 AWG	GXL	N/A		MS423-2 (A)

S794							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	3-0-1 CONSTANT 12V	12 AWG	GXL	N/A		X3-A (1)
2	RED	3-0 CONSTANT 12V	12 AWG	GXL	N/A		X2-B (1)
2	RED	3-0-2 CONSTANT 12V	18 AWG	GXL	N/A		X793 (1)

S594							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	GRN	CAN1 LO	18 AWG	GXL	N/A		C01-J7 (24)
1	GRN	CAN1 LO	18 AWG	GXL	N/A		X2-B (12)
2	GRN	CAN1 LO	18 AWG	GXL	N/A		MS423-2 (B)

S795							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-11-1 IGN PLAT	18 AWG	GXL	N/A		X3-A (5)
2	YEL	5-11-1-1 IGN PLAT	18 AWG	GXL	N/A		X4-A (9)
2	YEL	5-11-1-2 IGN PLAT	18 AWG	GXL	N/A		X793 (4)

S542							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-2-1 IGN MODE	18 AWG	GXL	N/A		X3-A (4)
1	YEL	5-2-5 IGN	18 AWG	GXL	N/A		X4-A (15)
2	YEL	5-2-2 IGN	18 AWG	GXL	N/A		X2-B (4)

Figure 7-31. Turntable Harness - Sheet 2 of 3

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	3&-1 CONSTANT 12V	12 AWG	GXL	1001157891		S794 (1)
2		5-10-1& IGN	12 AWG	GXL	1001157891		S541 (1)
3	YEL	5-2&	18 AWG	GXL	1001116693		X4-A (13)
4	YEL	5-2-1 IGN MODE	18 AWG	GXL	1001116693		S542 (1)
5	YEL	5-11-1 IGN PLAT	18 AWG	GXL	1001116693		S795 (1)
6	YEL	5-15&	18 AWG	GXL	1001116693		CO1-J7 (3)
7	WHT	8&-0 MSSO	18 AWG	GXL	1001116693		CO1-J12 (8)
8					4460466		

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5&-1 ANALYZER PWR	18 AWG	GXL	4460227		CO1-J1 (28)
2	WHT	5&-1 ANALYZER RS-232 RX	18 AWG	GXL	4460227		CO1-J1 (29)
3	WHT	5&-1 ANALYZER RS-232 TX	18 AWG	GXL	4460227		CO1-J1 (30)
4	WHT	5&-1 ANALYZER GND	18 AWG	GXL	4460227		CO1-J1 (31)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	CAN1 HI	18 AWG	GXL	4460944		S993 (2)
B	GRN	CAN1 LO	18 AWG	GXL	4460944		S994 (2)
C					4460466		

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	8&-1 CAN2 HIGH	20 AWG	J1939 CABLE	4460465		MST (A)
2	YEL	8&-1-1 CAN2 HIGH	20 AWG	J1939 CABLE	4460465		CO1-J12 (3)
3	GRN	8&-1-1 CAN2 LOW	20 AWG	J1939 CABLE	4460465		CO1-J12 (4)
4	GRN	8&-1 CAN2 LOW	20 AWG	J1939 CABLE	4460465		MST (B)
NC	SHLD	8&-1 SHIELD	20 AWG	J1939 CABLE		NC	MST (C)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	3&-2 CONSTANT 12V	18 AWG	GXL	4460465		S794 (2)
2	BLK	1-7-2 GND	18 AWG	GXL	4460465		S796 (1)
3	BLK		14 AWG	GXL	4460942		FC-5 (2)
4	YEL	5-11-1& IGN PLAT	18 AWG	GXL	4460465		S795 (2)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460466		
2	GRN	CAN1 LO	20 AWG	J1939 CABLE	4460943		MS423-1 (B)
3	YEL	CAN1 HI	20 AWG	J1939 CABLE	4460943		MS423-1 (A)
4	WHT	8&-0 PLAT TX	18 AWG	GXL	4460464		S850 (2)
5					4460466		
6	WHT	13&-3 FOOTSWITCH	18 AWG	GXL	4460464		CO1-J7 (15)
7	WHT	2-12& IGN	18 AWG	GXL	4460464		S853 (1)
8					4460466		
9	YEL	5-11-1 IGN PLAT	18 AWG	GXL	4460464		S795 (2)
10	YEL	5&	14 AWG	GXL	4460508		MS597 (5)
11	WHT	8&-0 GND MODE RX	18 AWG	GXL	4460464		CO1-J7 (14)
12	YEL	PLATFORM PWR	12 AWG	GXL	4460508		CO1-J8 (4)
13	YEL	5-2&	18 AWG	GXL	4460464		X3-A (3)
14					4460466		
15	YEL	5-2& IGN	18 AWG	GXL	4460464		S542 (1)
16	BLK	PLAT GND	12 AWG	GXL	4460508		CO1-J8 (3)
17					4460466		
18	BLK	4-20	14 AWG	GXL	4460508		MS597 (2)
19					4460466		

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-33-2 IGN LIM SW	18 AWG	GXL	4460465		S543 (1)
2	WHT	5&-0 LOWER BOOM	18 AWG	GXL	4460465		CO1-J7 (7)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5&	18 AWG	GXL	4460465		CO1-J7 (11)
2					4460466		
3					4460466		
4	WHT	5&-0 DOS	18 AWG	GXL	4460465		CO1-J7 (32)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5&-0 UPPER BOOM	18 AWG	GXL	4460465		CO1-J7 (4)
2	WHT	5-33-1 IGN LIM SW	18 AWG	GXL	4460465		S543 (1)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-33-1 IGN LIM SW	18 AWG	GXL	N/A		X8B (2)
1	WHT	5-33-2 IGN LIM SW	18 AWG	GXL	N/A		X9B (1)
2	YEL	5-33	IGN LIM SW	18 AWG	GXL	N/A	CO1-J7 (30)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-10-1-1 SWITCHED PWR	12 AWG	GXL	N/A		CO1-J8 (2)
1	YEL	5-10-1-2 IGN	12 AWG	GXL	N/A		X3-A (2)
1	YEL	5-10-1-3 SWITCHED PWR	14 AWG	GXL	N/A		S827 (1)
2	YEL	5-10-1	IGN	12 AWG	GXL	N/A	X2-B (2)

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)
1	WHT	2-12& IGN	18 AWG	GXL	N/A		X4-A (7)
2	WHT	2-12-1 IGN	18 AWG	GXL	N/A		MS597 (7)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-1-1 GND	18 AWG	GXL	N/A		LB86 (2)
1	BLK	1-1-2 GND	18 AWG	GXL	N/A		X793 (2)
2	BLK	1-7 GND	18 AWG	GXL	N/A		MS597 (11)

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	8&-1 CAN2 HIGH	20 AWG	J1939 CABLE	4460944		X756 (1)
B	GRN	8&-1 CAN2 LOW	20 AWG	J1939 CABLE	4460944		X756 (4)
C	SHLD	8&-1 SHIELD	20 AWG	J1939 CABLE	4460944		X756 (NC)

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		S794 (2)
2	YEL	5-10-1 IGN	12 AWG	GXL	1001157890		S541 (2)
3	BLK	4&-1 INSTR GND	12 AWG	GXL	1001157890		CO1-J8 (1)
4	YEL	5-2-2 IGN	18 AWG	GXL	1001116692		S542 (2)
5	WHT	4&-10 VOTE RELAY	18 AWG	GXL	1001116692		CO1-J1 (13)
6	WHT	4&-2 INSTR GND	18 AWG	GXL	1001116692		CO1-J1 (19)
7	YEL	5-10-2 IGN	14 AWG	GXL	1001157890		MS597 (4)
8	BLK	4&-3 INST GND	14 AWG	GXL	1001157890		MS597 (1)
9	YEL	5&-0	18 AWG	GXL	1001116692		CO1-J7 (29)
10	BLK	4&-5	18 AWG	GXL	1001116692		CO1-J7 (25)
11	YEL	CAN1 HI	18 AWG	GXL	4460944		S993 (1)
12	GRN	CAN1 LO	18 AWG	GXL	4460944		S994 (1)

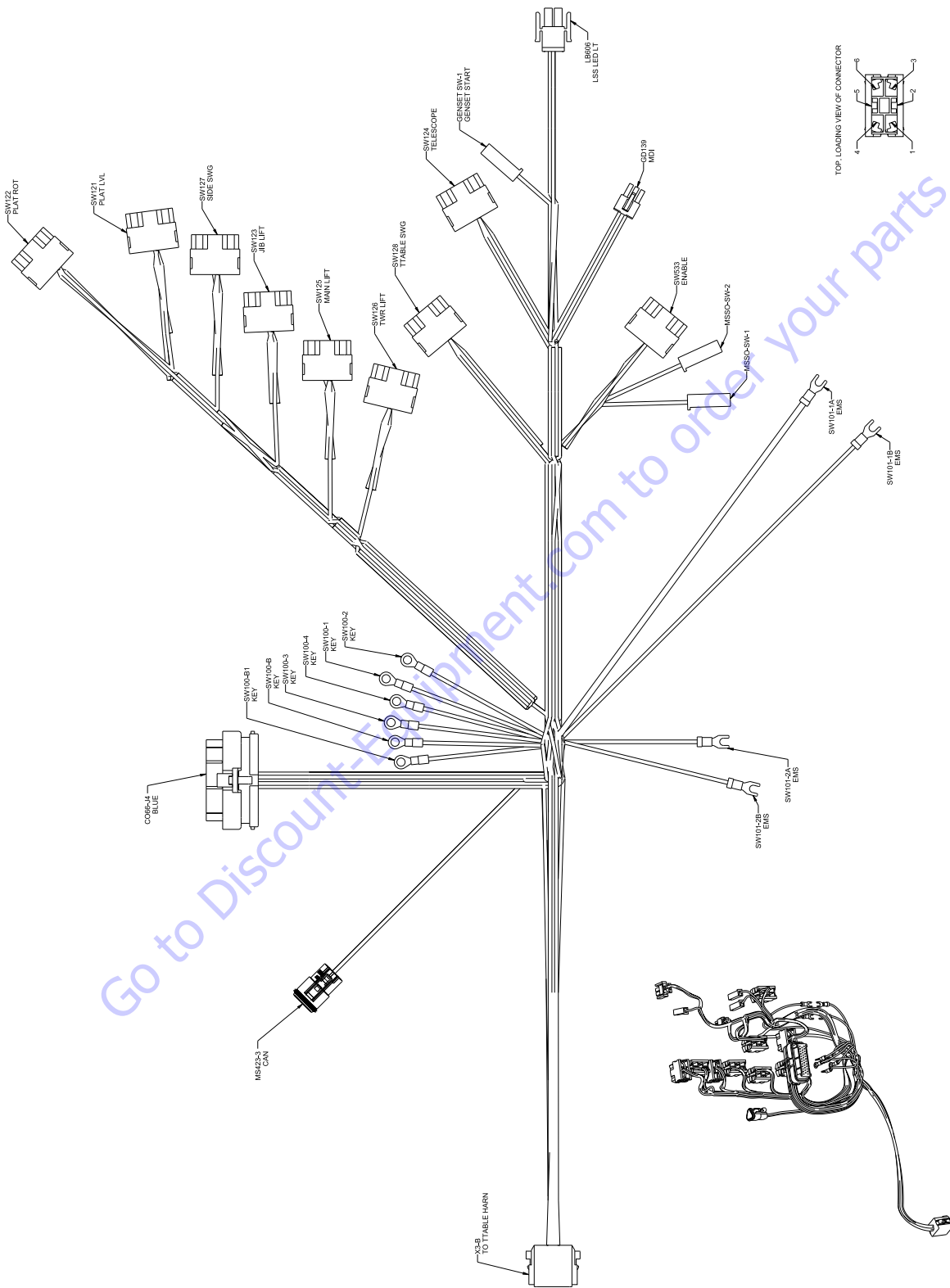
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-0-3 INST GND	14 AWG	GXL	4460942		X2-B (8)
2	BLK	4-20	14 AWG	GXL	4460942		X4-A (18)
3					4460942		
4	YEL	5-10-2 IGN	14 AWG	GXL	4460942		X2-B (7)
5	YEL	5&	14 AWG	GXL	4460942		X4-A (10)
6					4460942		
7	WHT	2-12-1 IGN	18 AWG	GXL	4460465		S653 (2)
8					4460466		
9					4460466		
10					4460466		
11	BLK	1-7 GND	18 AWG	GXL	4460465		S796 (2)
12					4460466		

Figure 7-32. Turntable Harness - Sheet 3 of 3

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SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS



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Figure 7-33. Ground Control Panel Harness - Sheet 1 of 3

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

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	1001157890		SW101-1B (1B)
3	YEL	5-2-6 IGN	18 AWG	GXL	1001156692		SW100-2 (1)
4	YEL	5-2-1 IGN GMODE	18 AWG	GXL	1001156692		SW100-4 (1)
5	WHT	5-1-1 IGN PLAT	18 AWG	GXL	1001156692		SW100-1 (1)
6	YEL	5-10-6 IGN GMODE	18 AWG	GXL	1001156692		SW100-3 (1)
7	WHT	80-0 MSSO	18 AWG	GXL	1001156692		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 (1)
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 (1)
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 (3)
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 (3)
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 (3)
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 (1)
22					4460905		
23	WHT	3-1 MAIN LIFT UP	18 AWG	GXL	4460871		SW125 (3)
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 (1)
34	WHT	21-1 SWG LFT	18 AWG	GXL	4460871		SW128 (3)
35	WHT	22-1 SWG RHT	18 AWG	GXL	4460871		SW128 (1)

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)

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)

SW100-3 - 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)

SW100-1 - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-1-1 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)

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)

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)

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	4460419		SW121 (2)
3	YEL	5-15-6	18 AWG	GXL	4460419		GENSET SW-1 (1)
2	WHT	23-0-1 PLAT ROT LFT	18 AWG	GXL	1001159186		CO66-J4 (6)
4							
5							
6							

SW121 - PLAT LVL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	26-0-1 PLAT LVL DN	18 AWG	GXL	1001159186		CO66-J4 (5)
2	YEL	5-15-6	18 AWG	GXL	4460419		SW127 (2)
2	YEL	5-15-7	18 AWG	GXL	4460419		SW122 (2)
3	WHT	25-0-1 PLAT LVL UP	18 AWG	GXL	1001159186		CO66-J4 (17)
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		SW121 (2)
2	YEL	5-15-6	18 AWG	GXL	4460419		SW123 (2)
3	WHT	32-0-1 SIDE SWG LFT	18 AWG	GXL	1001159186		CO66-J4 (9)
4							
5							
6							

SW123 - JIB LIFT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	28-0-1 JIB DN	18 AWG	GXL	1001159186		CO66-J4 (8)
2	YEL	5-15-6	18 AWG	GXL	4460419		SW125 (2)
2	YEL	5-15-6	18 AWG	GXL	4460419		SW127 (2)
3	WHT	27-0-1 JIB UP	18 AWG	GXL	1001159186		CO66-J4 (19)
4							
5							
6							

Figure 7-34. Ground Control Panel Harness - Sheet 2 of 3

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

SW125 - MAIN LIFT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	4-1 MAIN LIFT DN	18 AWG	GXL	1001159186		CO66-J4 (33)
2	YEL	5-15-4	18 AWG	GXL	4460419		SW126 (2)
2	YEL	5-15-5	18 AWG	GXL	4460419		SW123 (2)
3	WHT	3-1 MAIN LIFT UP	18 AWG	GXL	1001159186		CO66-J4 (23)
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							

SW126 - TWR LIFT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	30-2 TWR DN	18 AWG	GXL	1001159186		CO66-J4 (21)
2	YEL	5-15-3	18 AWG	GXL	4460419		SW128 (2)
2	YEL	5-15-4	18 AWG	GXL	4460419		SW125 (2)
3	WHT	29-2 TWR UP	18 AWG	GXL	1001159186		CO66-J4 (10)
4							
5							
6							

GD139- MDI							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	METER PWR	18 AWG	GXL	4460877		CO66-J4 (24)
2	BLK	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							
NC							

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)

LB606 - LSS LED LT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	106-0 LSS LAMP	18 AWG	GXL	4460227		CO66-J4 (14)
2	BLK	4-22	18 AWG	GXL	4460227		CO66-J4 (31)
2	BLK	4-23	18 AWG	GXL	4460227		MSSO-SW-1 (1)

SW101-1B - EMS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1B	YEL	5-16-3 IGN	18 AWG	GXL	N/A		X3-B (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)

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							

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)

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							

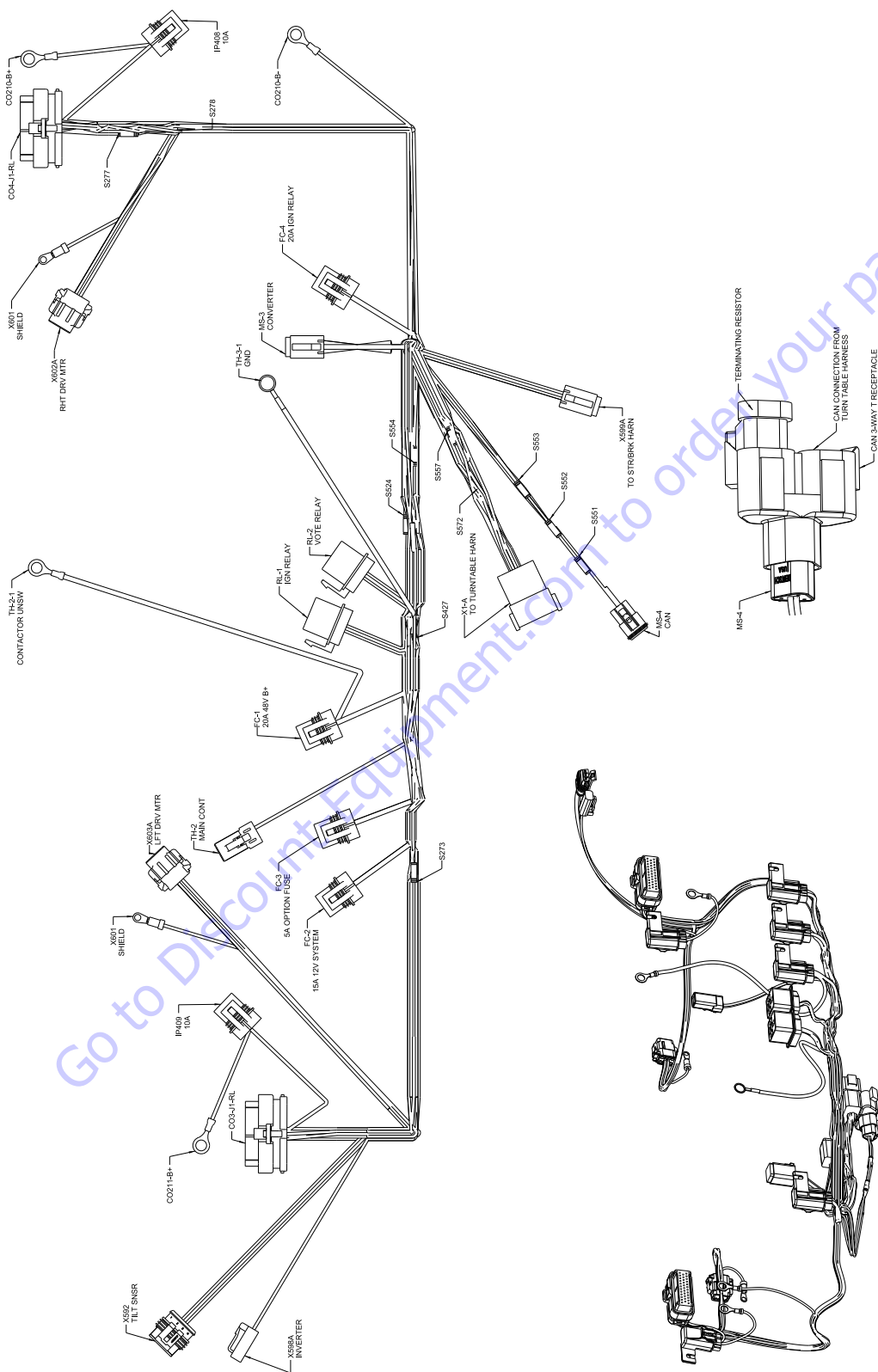
GENSET SW-1 - GENSET START							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-15-8	18 AWG	GXL	4460259		SW122 (2)

Figure 7-35. Ground Control Panel Harness - Sheet 3 of 3

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SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS



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Figure 7-36. Chassis Traction Harness - Sheet 1 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

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	X1-A (11)
4	GRN	CAN1 LO	18 AWG	GXL	1001107854	1001104498	X1-A (12)

FC-1 - 20A 48V B+							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0 B+	12 AWG	GXL	1001116734		TH-2-1 (1)
2	RED	1-0 B+	12 AWG	GXL	1001116734		S524 (1)

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		

X603A - LFT DRV MTR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	101 LFT SNR PWR	18 AWG	GXL	1001126008		CO3-J1-RL (25)
2	WHT	102 ENCODER B	18 AWG	GXL	1001126008		CO3-J1-RL (13)
3	WHT	103 ENCODER A	18 AWG	GXL	1001126008		CO3-J1-RL (14)
4	BLK	2-1-1 ENCODER GND	18 AWG	GXL	1001126008		S273 (1)
5	WHT	104 LFT TMP	18 AWG	GXL	1001126008		CO3-J1-RL (22)
6	BLK	2-1-2 LFT TMP GND	18 AWG	GXL	1001126008		S273 (1)
7	WHT	100 LFT BRK	18 AWG	GXL	1001126008		CO3-J1-RL (2)
8	WHT	1-2 LFT BRK GND	18 AWG	GXL	1001126008		CO3-J1-RL (4)

CO3-J1-RL							
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 (2)
4	WHT	1-2 LFT BRK GND	18 AWG	GXL	4460871		X603A (8)
5	BLK	2-1	18 AWG	GXL	4460871		S273 (2)
6	YEL	6-24 IGN 48 VOLT	18 AWG	GXL	4460871		S427 (2)
7					4460905		
8					4460905		
9					4460905		
10	YEL	6-26 IGN 48 VOLT	18 AWG	GXL	4460871		S427 (2)
11					4460905		
12					4460905		
13	WHT	102 ENCODER B	18 AWG	GXL	4460871		X603A (2)
14	WHT	103 ENCODER A	18 AWG	GXL	4460871		X603A (3)
15					4460905		
16					4460905		
17					4460905		
18					4460905		
19					4460905		
20					4460905		
21					4460905		
22	WHT	104 LFT TEMP	18 AWG	GXL	4460871		X603A (5)
23					4460905		
24					4460905		
25	WHT	101 LFT SNR PWR	18 AWG	GXL	4460871		X603A (1)
26					4460905		
27	GRN	CAN2 LO	20 AWG	J1939 CABLE	4460871		S552 (2)
28	YEL	CAN2 HI	20 AWG	J1939 CABLE	4460871		S551 (2)
29					4460905		
30					4460905		
31					4460905		
32					4460905		
33					4460905		
34					4460905		
35					4460905		
NC	SHLD	CAN2 SHLD	20 AWG	J1939 CABLE	N/A		S553 (2)
NC	SHIELD	METAL BRAID	18 AWG	SHLD	N/A		X601 (1)

CO211-B+							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
CONNECTOR PART NUMBER: 4460670							
1	RED	BRAKE2-IN-2	16 AWG	GXL	N/A		IP409 (1)

X601							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	METAL BRAID	18 AWG	SHLD			CO3-J1-RL (NC)

TH-2-1-CONTACTOR UNSW							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0 B+	12 AWG	GXL			FC-1 (1)

TH-2 - MAIN CONT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	VOTE-RLY-AIO	16 AWG	GXL	1001126008		RL-2 (4)
2	WHT	CONTACTOR-LS	18 AWG	GXL	1001126008		CO4-J1-RL (12)

IP409							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	BRAKE2-IN-2	16 AWG	GXL	1001116733		CO211-B+ (1)
2	RED	BRAKE2-IN	16 AWG	GXL	1001116733		CO3-J1-RL (3)

FC-2 - 15A 12V SYSTEM							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	3-0 CONSTANT 12V	12 AWG	GXL	1001116734		MS-3 (4)
2	RED	3-0 CONSTANT 12V	12 AWG	GXL	1001116734		X1-A (1)

S273							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	2-1-1 ENCODER GND	18 AWG	GXL	N/A		X603A (4)
1	BLK	2-1-2 LFT TMP GND	18 AWG	GXL	N/A		X603A (6)
2	BLK	2-1	18 AWG	GXL	N/A		CO3-J1-RL (5)

FC-3 - 5A OPTION FUSE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-10-2 IGN	12 AWG	GXL	1001116734		S572 (2)
2	YEL	5-10-2 IGN	12 AWG	GXL	1001116734		X1-A (7)

Figure 7-37. Chassis Traction Harness - Sheet 2 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

RL-1 - IGN RELAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-2 B+	18 AWG	GXL	100116732		S524 (2)
2	WHT	5-2-2 IGN	18 AWG	GXL	100116732		X1-A (4)
3							
4	YEL	6-2 IGN 48 VOLT	18 AWG	GXL	100116732		S554 (2)
5	WHT	4-2 INSTR GND	18 AWG	GXL	100116732		S557 (2)

X1-A- TO TURNTABLE 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	1001157891		FC-2 (2)
2	WHT	5-10-1 IGN	12 AWG	GXL	1001157891		FC-4 (2)
3	BLK	4-0-1 INSTR GND	12 AWG	GXL	1001157891		S557 (1)
4	WHT	5-2-2 IGN	18 AWG	GXL	100116693		RL-1 (2)
5	WHT	49-10 VOTE RELAY	18 AWG	GXL	100116693		RL-2 (2)
6	WHT	4-52 INSTR GND	18 AWG	GXL	100116693		RL-2 (5)
7	YEL	5-10-2 IGN	12 AWG	GXL	1001157891		FC-3 (2)
8	BLK	4-0-3 INSTR GND	14 AWG	GXL	100116693		S557 (1)
9	YEL	5-50	18 AWG	GXL	4460464		X592 (1)
10	BLK	4-55	18 AWG	GXL	4460464		X592 (2)
11	YEL	CAN1 HI	18 AWG	GXL	4460943		X592 (3)
12	GRN	CAN1 LO	18 AWG	GXL	4460943		X592 (4)

RL-2 - VOTE RELAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0-3 B+	16 AWG	GXL	100116733		S524 (1)
2	WHT	49-10 VOTE RELAY	18 AWG	GXL	100116732		X1-A (5)
3							
4	YEL	VOTE-RLY-HO	16 AWG	GXL	100116733		TH-2 (1)
5	WHT	4-52 INSTR GND	18 AWG	GXL	100116732		X1-A (6)

X601							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	METAL BRAID	18 AWG	SHLD			CO4-J1-RL (NC)

TH3-1- GND							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	2-0 B-	12 AWG	GXL	N/A		MS-3 (3)

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 (2)
1	WHT	6-2-5 IGN 48 VOLT	18 AWG	GXL	N/A		CO4-J1-RL (10)
2	YEL	6-2-4 IGN 48 VOLT	18 AWG	GXL	N/A		CO3-J1-RL (6)
2	YEL	6-2-6 IGN 48 VOLT	18 AWG	GXL	N/A		CO3-J1-RL (10)

CO4-J1-RL							
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	WHT	2-6 RT BRK GND	18 AWG	GXL	4460871		X602A (8)
5	BLK	GND-HO	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	CONTACTORLS	18 AWG	GXL	4460871		TH-2 (2)
13	WHT	202 RT ENCODER B	18 AWG	GXL	4460871		X602A (2)
14	WHT	203 ENCODER A	18 AWG	GXL	4460871		X602A (3)
15	BLU	STEER-SIG	18 AWG	GXL	4460871		X599A (2)
16	WHT	CHRG-STAT	18 AWG	GXL	4460871		X599A (5)
17					4460905		
18					4460905		
19					4460905		
20					4460905		
21					4460905		
22	WHT	204 RT TEMP	18 AWG	GXL	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	20 AWG	J1939 CABLE	4460871		S552 (2)
28	YEL	CAN2 HI	20 AWG	J1939 CABLE	4460871		S551 (2)
29					4460905		
30					4460905		
31					4460905		
32					4460905		
33					4460905		
34					4460905		
35					4460905		
NC	SHLD	CAN2 SHLD	20 AWG	J1939 CABLE	N/A		S553 (2)
NC	SHIELD	METAL BRAID	18 AWG	SHLD	N/A		X601 (1)

S524							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0 B+	12 AWG	GXL	N/A		FC-1 (2)
1	RED	1-0-3 B+	16 AWG	GXL	N/A		RL-2 (1)
2	RED	1-0-1 B+	12 AWG	GXL	N/A		MS-3 (1)
2	RED	1-0-2 B+	18 AWG	GXL	N/A		RL-1 (1)

S554							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	6-2-1 IGN 48 VOLT	18 AWG	GXL	N/A		X599A (6)
1	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	N/A		MS-3 (2)
1	WHT	43-1 INVERTER	18 AWG	GXL	N/A		X598A (1)
2	YEL	6-2 IGN 48 VOLT	18 AWG	GXL	N/A		RL-1 (4)
2	YEL	6-2-2 IGN 48 VOLT	18 AWG	GXL	N/A		S427 (1)

S572							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-10-0 IGN	12 AWG	GXL	N/A		MS-3 (5)
2	YEL	5-10-1 IGN	12 AWG	GXL	N/A		FC-4 (1)
2	YEL	5-10-2 IGN	12 AWG	GXL	N/A		FC-3 (1)

S557							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-0-1 INSTR GND	12 AWG	GXL	N/A		X1-A (3)
1	BLK	4-0-3 INSTR GND	14 AWG	GXL	N/A		X1-A (8)
2	BLK	4-0 INSTR GRND	12 AWG	GXL	N/A		MS-3 (6)
2	WHT	4-0-2 INSTR GND	18 AWG	GXL	N/A		RL-1 (5)

Figure 7-38. Chassis Traction Harness - Sheet 3 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

S553							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHLD	CAN2 SHLD	20 AWG	J1939 CABLE	N/A		MS-4 (C)
2	SHLD	CAN2 SHLD	20 AWG	J1939 CABLE	N/A		CO4-J1-RL (NC)
2	SHLD	CAN2 SHLD	20 AWG	J1939 CABLE	N/A		CO3-J1-RL (NC)

S552							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	GRN	CAN2 LO	20 AWG	J1939 CABLE	N/A		MS-4 (B)
2	GRN	CAN2 LO	20 AWG	J1939 CABLE	N/A		CO4-J1-RL (27)
2	GRN	CAN2 LO	20 AWG	J1939 CABLE	N/A		CO3-J1-RL (27)

S551							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN2 HI	20 AWG	J1939 CABLE	N/A		MS-4 (A)
2	YEL	CAN2 HI	20 AWG	J1939 CABLE	N/A		CO4-J1-RL (28)
2	YEL	CAN2 HI	20 AWG	J1939 CABLE	N/A		CO3-J1-RL (28)

MS-3-CONVERTER							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0-1 B+	12 AWG	GXL	1001157890		S524 (2)
2	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	1001116692		S554 (1)
3	BLK	2-0 B-	12 AWG	GXL	1001157890		TH-3-1 (1)
4	RED	3-0 CONSTANT 12V	12 AWG	GXL	1001157890		FC-2 (1)
5	YEL	5-10-0 IGN	12 AWG	GXL	1001157890		S572 (1)
6	BLK	4-0 INSTR GRND	12 AWG	GXL	1001157890		S557 (2)

FC-4 - 20A IGN RELAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-10-1 IGN	12 AWG	GXL	1001116734		S572 (2)
2	WHT	5-10-1 IGN	12 AWG	GXL	1001116734		X1-A (2)

X599A - TO STR/BRK HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	201-1 STR SNR	18 AWG	GXL	4460465		S277 (1)
2	BLU	STEER-SIG	18 AWG	GXL	4460465		CO4-J1-RL (15)
3	BLK	GND1-3	18 AWG	GXL	4460465		S278 (1)
4					4460466		
5	WHT	CHRG-STAT	18 AWG	GXL	4460465		CO4-J1-RL (16)
6	YEL	6-2-1 IGN 48 VOLT	18 AWG	GXL	4460465		S554 (1)

MS-4 - CAN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	CAN2 HI	20 AWG	J1939 CABLE	4460944		S551 (1)
B	GRN	CAN2 LO	20 AWG	J1939 CABLE	4460944		S552 (1)
C	SHLD	CAN2 SHLD	20 AWG	J1939 CABLE	4460944		S553 (1)

X602A - RHT DRV MTR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	201 RT SNR PWR	18 AWG	GXL	1001126008		S277 (2)
2	WHT	202 RT ENCODER B	18 AWG	GXL	1001126008		CO4-J1-RL (13)
3	WHT	203 ENCODER A	18 AWG	GXL	1001126008		CO4-J1-RL (14)
4	BLK	GND1-1	18 AWG	GXL	1001126008		S278 (2)
5	WHT	204 RT TEMP	18 AWG	GXL	1001126008		CO4-J1-RL (22)
6	BLK	2-7 RT TEMP GND	18 AWG	GXL	1001126008		S278 (2)
7	WHT	200 RT BRK	18 AWG	GXL	1001126008		CO4-J1-RL (2)
8	WHT	2-6 RT BRK GND	18 AWG	GXL	1001126008		CO4-J1-RL (4)

IP408							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	BRAKE1-IN	16 AWG	GXL	1001116733		CO4-J1-RL (3)
2	RED	BRAKE1-IN-2	16 AWG	GXL	1001116733		CO210-B+ (1)

S277							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	201-1 STR SNR	18 AWG	GXL	N/A		X599A (1)
1	WHT	201-2 RT SNR PWR	18 AWG	GXL	N/A		CO4-J1-RL (25)
2	WHT	201 RT SNR PWR	18 AWG	GXL	N/A		X602A (1)

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		CO4-J1-RL (5)
1	BLK	GND1-3	18 AWG	GXL	N/A		X599A (3)
2	BLK	2-7 RT TEMP GND	18 AWG	GXL	N/A		X602A (6)
2	BLK	GND1-1	18 AWG	GXL	N/A		X602A (4)

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)

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		CO4-J1-RL (6)

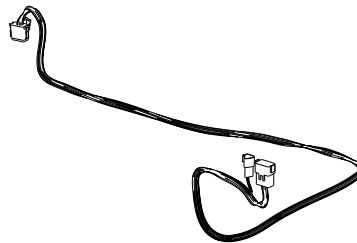
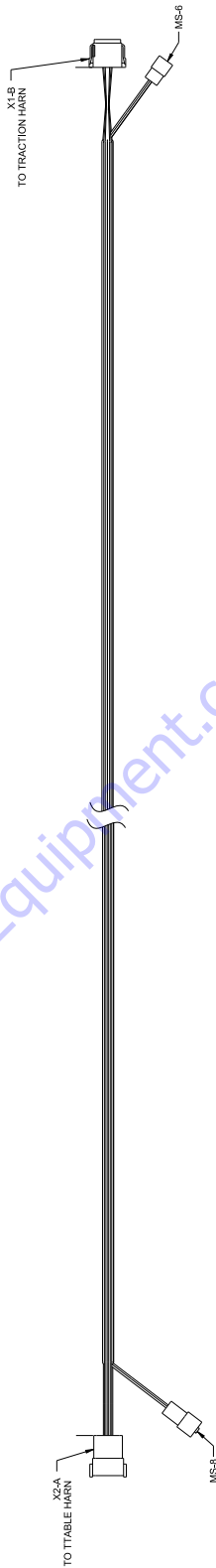
Figure 7-39. Chassis Traction Harness - Sheet 4 of 4

X2-A - TO TTABLE HARN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JKT	TERMINAL P/N	SEAL P/N	TO
1	RED	3-0 CONSTANT 12V	12 AWG	GXL	1001157891		X1-B (1)
2	WHT	5-1/1 IGN	12 AWG	GXL	1001157891		X1-B (2)
3	BLK	4-1 INSTR GND	12 AWG	GXL	1001157891		X1-B (3)
4	WHT	5-2 IGN	18 AWG	GXL	4460464		X1-B (4)
5	WHT	4-10 VOTE RELAY	18 AWG	GXL	4460464		X1-B (5)
6	WHT	4-52 INSTR GND	18 AWG	GXL	4460464		X1-B (6)
7	YEL	5-1/2 IGN	12 AWG	GXL	1001157891		X1-B (7)
8	BLK	4-43 INSTR GND	14 AWG	GXL	4460941		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	YEL	CAN HI	18 AWG	GXL	4460943		X1-B (11)
12	GRN	CAN LO	18 AWG	GXL	4460943		X1-B (12)

MS-8

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JKT	TERMINAL P/N	SEAL P/N	TO
A	YEL	8-1 CAN2-HIGH	20 AWG	J1939 CABLE	4460943		MS-6 (A)
B	GRN	8-1 CAN2-LOW	20 AWG	J1939 CABLE	4460943		MS-6 (B)
C	SHLD	8-1 SHIELD	20 AWG	J1939 CABLE	4460943		MS-6 (C)



X1-B - TO TRACTION HARN

CONN POS	WIRE LABEL	WIRE LABEL	GAUGE	JKT	TERMINAL P/N	SEAL P/N	TO
1	RED	3-0 CONSTANT 12V	12 AWG	GXL	1001157890		X2-A (1)
2	BLK	4-1 INSTR GND	12 AWG	GXL	1001157890		X2-A (2)
3	BLK	4-5 INSTR GND	12 AWG	GXL	1001157890		X2-A (3)
4	WHT	5-2 IGN	18 AWG	GXL	4460465		X2-A (4)
5	WHT	4-10 VOTE RELAY	18 AWG	GXL	4460465		X2-A (5)
6	WHT	4-52 INSTR GND	18 AWG	GXL	4460465		X2-A (6)
7	YEL	5-1/2 IGN	12 AWG	GXL	1001157890		X2-A (7)
8	BLK	4-43 INSTR GND	14 AWG	GXL	4460942		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	YEL	CAN HI	18 AWG	GXL	4460944		X2-A (11)
12	GRN	CAN LO	18 AWG	GXL	4460944		X2-A (12)

MS-6

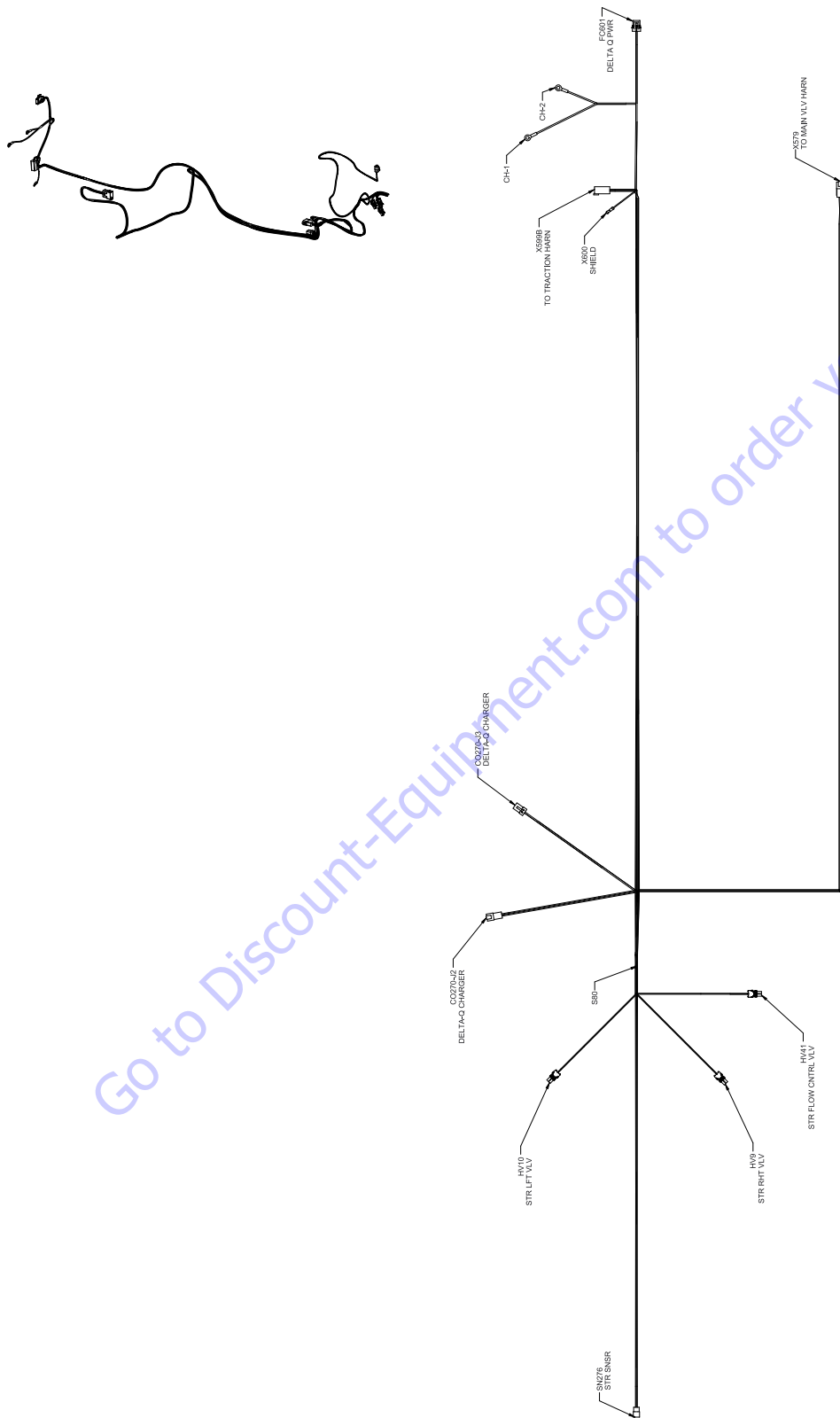
CONN POS	WIRE LABEL	WIRE LABEL	GAUGE	JKT	TERMINAL P/N	SEAL P/N	TO
A	YEL	8-1 CAN2-HIGH	20 AWG	J1939 CABLE	4460944		MS-8 (A)
B	GRN	8-1 CAN2-LOW	20 AWG	J1939 CABLE	4460944		MS-8 (B)
C	SHLD	8-1 SHIELD	20 AWG	J1939 CABLE	4460944		MS-8 (C)

Figure 7-40. Chassis to Turntable Harness

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Figure 7-41. Chassis Steer/Brake Harness - Sheet 1 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

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		X600 (1)

CO270-J2 - DELTA-Q CHARGER							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	CHRG-STAT-1	18 AWG	GXL	4460464		X599B (5)
2					4460466		
3	WHT	205 RED LED	18 AWG	GXL	4460464		X579 (1)
4	WHT	206 YEL LED	18 AWG	GXL	4460464		X579 (2)
5	BLK	4-56	18 AWG	GXL	4460464		X579 (4)
6	WHT	207 GRN LED	18 AWG	GXL	4460464		X579 (3)
7					4460466		
8	WHT	6-8 IGN PWR 48 VOLT	16 AWG	GXL	4460464		X599B (6)

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 (B)
1	BLK	4-40-2 RTN	18 AWG	GXL	N/A		HV9 (B)
2	BLK	4-40 RTN	18 AWG	GXL	N/A		X579 (6)

CO270-J3 - DELTA-Q CHARGER							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-7 B+	12 AWG	GXL	4460509		FC601 (2)
2					4460466		
3	BLK	2-2	12 AWG	GXL	4460509		CH-2 (1)
4					4460466		

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		
5	WHT	CHRG-STAT-1	18 AWG	GXL	4460464		CO270-J2 (1)
6	WHT	6-8 IGN PWR 48 VOLT	16 AWG	GXL	4460464		CO270-J2 (8)

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			FC601 (1)

HV41 - STR FLOW CNTRL VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	WHT	41-2 STR FLOW CNTRL	18 AWG	GXL	4460743	4460458	X579 (9)
B	WHT	38-2 CURNT FBCK	18 AWG	GXL	4460743	4460458	X579 (8)

CH-2							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	2-2	12 AWG	GXL			CO270-J3 (3)

HV9 - STR RHT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	WHT	9-2 STEER RT	18 AWG	GXL	4460743	4460458	X579 (7)
B	BLK	4-40-1 RTN	18 AWG	GXL	4460743	4460458	S80 (1)

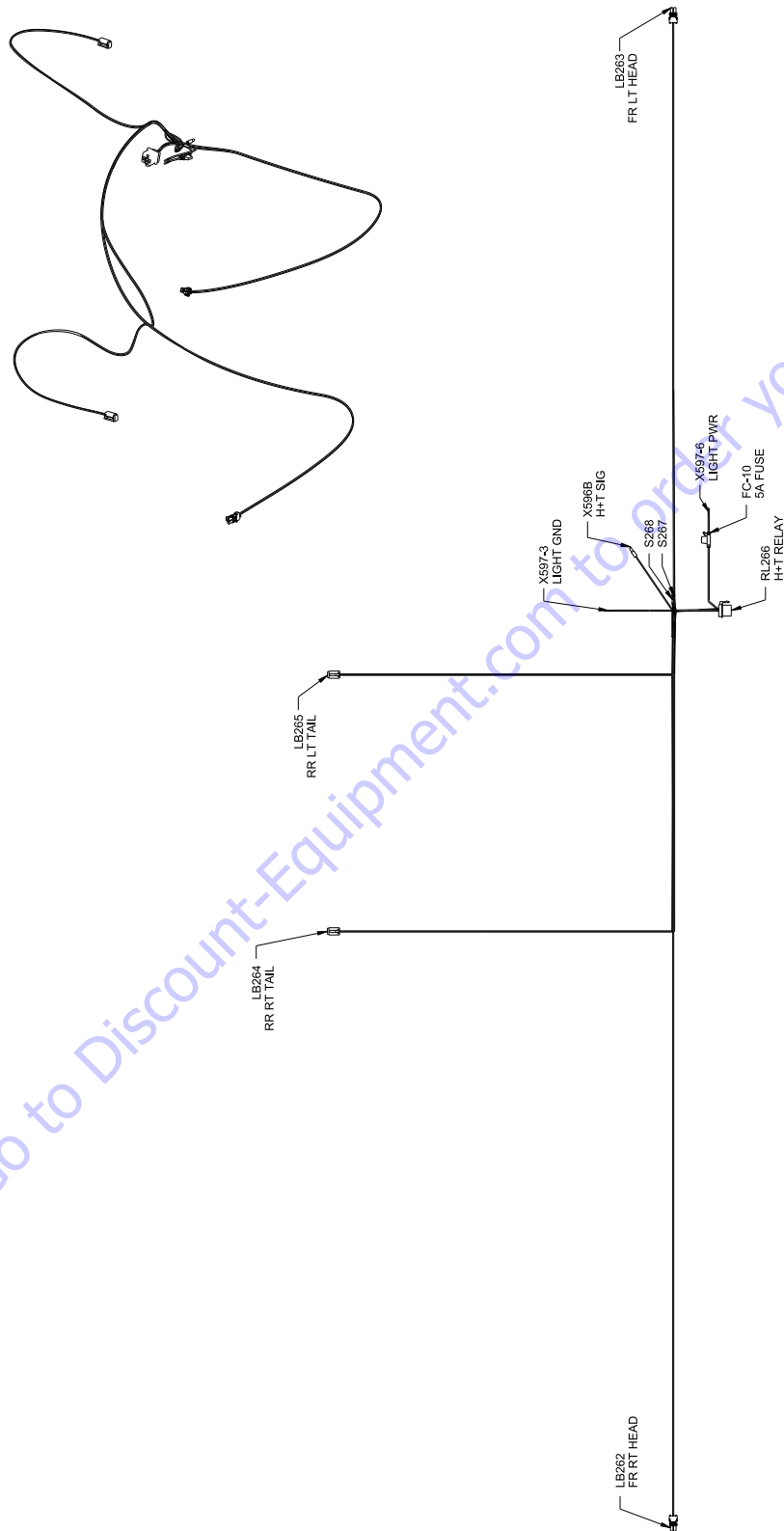
X600 - SHIELD							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	18/3 CABLE	18 AWG	SHLD			SN276 (NC)

HV10 - STR LFT VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	WHT	10-1 STEER LT-1	18 AWG	GXL	4460743	4460458	X579 (5)
B	BLK	4-40-1 RTN	18 AWG	GXL	4460743	4460458	S80 (1)

X579 - TO MAIN VLV HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	205 RED LED	18 AWG	GXL	4460464		CO270-J2 (3)
2	WHT	206 YEL LED	18 AWG	GXL	4460464		CO270-J2 (4)
3	WHT	207 GRN LED	18 AWG	GXL	4460464		CO270-J2 (6)
4	BLK	4-56	18 AWG	GXL	4460464		CO270-J2 (5)
5	WHT	10-1 STEER LT-1	18 AWG	GXL	4460464		HV10 (A)
6	BLK	4-40 RTN	18 AWG	GXL	4460464		S80 (2)
7	WHT	9-2 STEER RT	18 AWG	GXL	4460464		HV9 (A)
8	WHT	38-2 CURNT FBCK	18 AWG	GXL	4460464		HV41 (B)
9	WHT	41-2 STR FLOW CNTRL	18 AWG	GXL	4460464		HV41 (A)
10					4460466		
11					4460466		
12					4460466		

FC601 - DELTA Q PWR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-6 B+	12 AWG	GXL			CH-1 (1)
2	RED	1-7 B+	12 AWG	GXL			CO270-J3 (1)

Figure 7-42. Chassis Steer/Brake Harness - Sheet 2 of 2



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Figure 7-43. Chassis Head /Tail Light Harness - Sheet 1 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

LB262-FR RT HEAD							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-22 GND	16 AWG	GXL	4460457	4460458	S268 (2)
2	WHT	3-12-1 LIGHT	16 AWG	GXL	4460457	4460458	S267 (2)

LB263-FR LT HEAD							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-22 GND	16 AWG	GXL	4460457	4460458	S268 (2)
2	WHT	3-12-2 LIGHT	16 AWG	GXL	4460457	4460458	S267 (2)

LB265-RR LT TAIL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-22-4 GND	16 AWG	GXL	4460465		S268 (2)
2	WHT	3-12-4 LIGHT	16 AWG	GXL	4460465		S267 (2)
3					4460466		
4					4460466		

S267							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-12 LIGHT PWR	14 AWG	GXL	N/A		RL266 (4)
2	WHT	3-12-1 LIGHT	16 AWG	GXL	N/A		LB262 (2)
2	WHT	3-12-2 LIGHT	16 AWG	GXL	N/A		LB263 (2)
2	WHT	3-12-3 LIGHT	16 AWG	GXL	N/A		LB264 (2)
2	WHT	3-12-4 LIGHT	16 AWG	GXL	N/A		LB265 (2)

LB264-RR RT TAIL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-22-3 GND	16 AWG	GXL	4460465		S268 (2)
2	WHT	3-12-3 LIGHT	16 AWG	GXL	4460465		S267 (2)
3					4460466		
4					4460466		

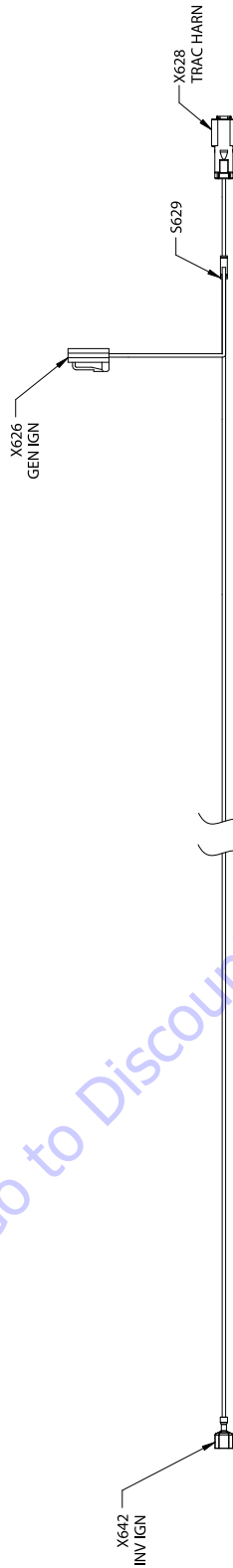
X596B-H+T SIG							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	88-2 LIGHTING	18 AWG	GXL			RL266 (5)

S268							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-22 LIGHT GND	14 AWG	GXL	N/A		X597-3 (1)
1	WHT	1-22-5 GND	18 AWG	GXL	N/A		RL266 (2)
2	BLK	1-22-1 GND	16 AWG	GXL	N/A		LB262 (1)
2	BLK	1-22-2 GND	16 AWG	GXL	N/A		LB263 (1)
2	BLK	1-22-3 GND	16 AWG	GXL	N/A		LB264 (1)
2	BLK	1-22-4 GND	16 AWG	GXL	N/A		LB265 (1)

RL266-H+T RELAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK		14 AWG	GXL	1001116733		FC-10 (2)
2	WHT	1-22-5 GND	18 AWG	GXL	1001116732		S268 (1)
3							
4	WHT	3-12 LIGHT PWR	14 AWG	GXL	1001116733		S267 (1)
5	WHT	88-2 LIGHTING	18 AWG	GXL	1001116732		X596B (1)

X597-3- LIGHT GND							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-22 LIGHT GND	14 AWG	GXL	4460942		S268 (1)

Figure 7-44. Chassis Head /Tail Light Harness - Sheet 2 of 2



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

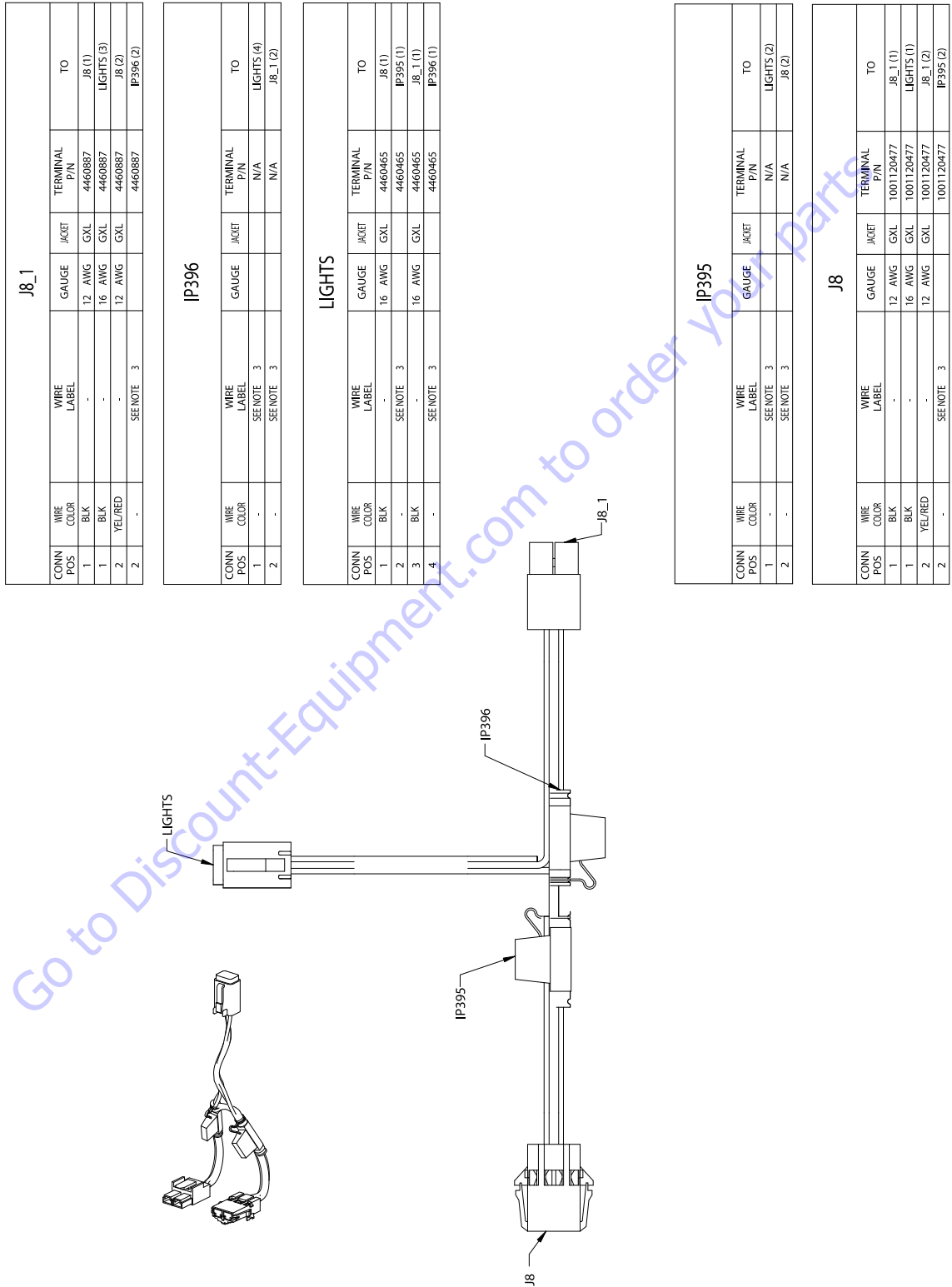
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-8-3	18 AWG	GXL	4460465		S629 (2)
2					4460466		

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)

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Figure 7-45. Inverter IGN Harness



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Figure 7-46. Platform Work Light Harness

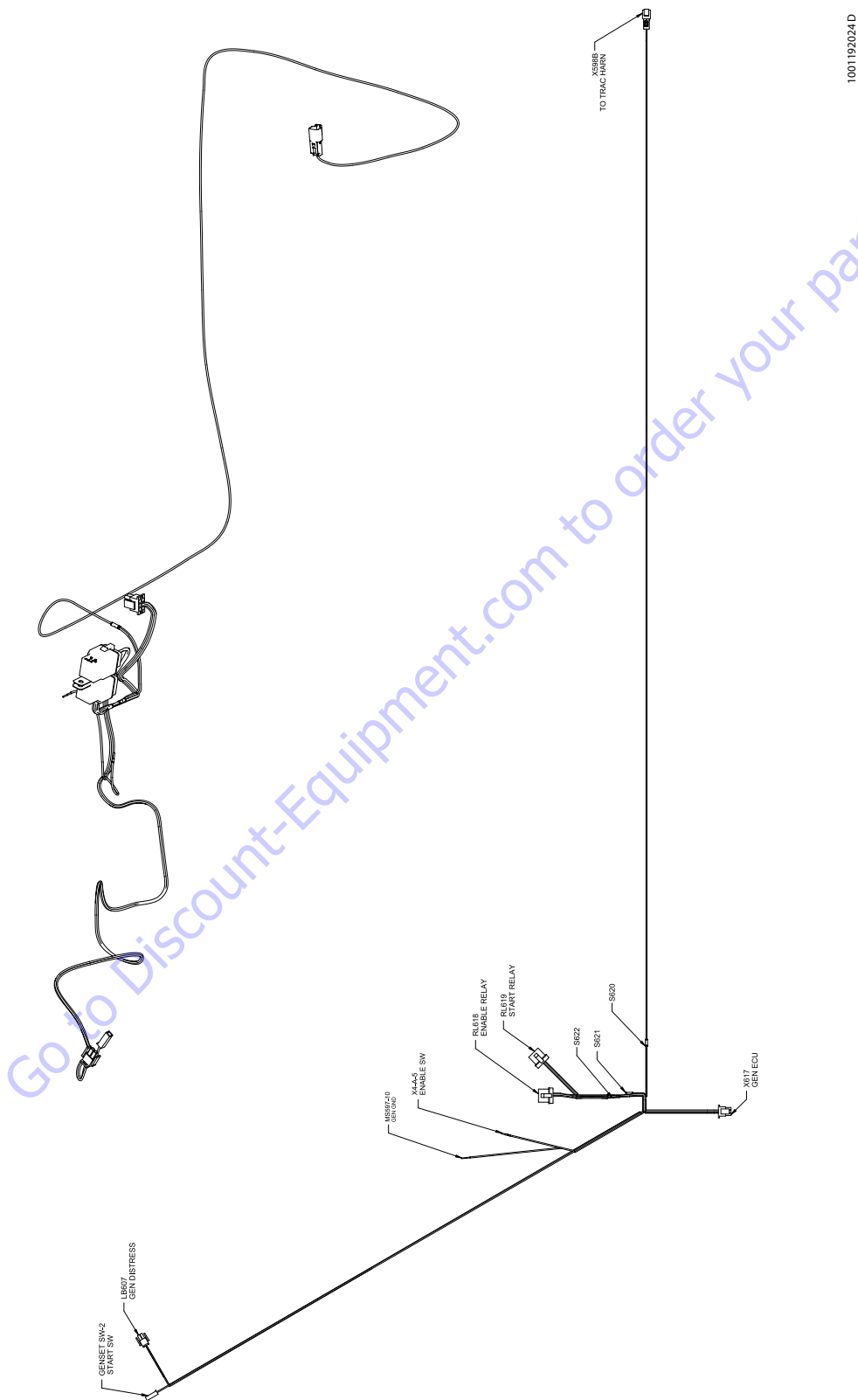


Figure 7-47. Generator IGN Harness - Sheet 1 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

GENSET SW-2 - START SW							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-2 GENSET START SW	18 AWG	GXL	4460259		RL619 (5)

LB607- GEN DISTRESS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-5 GEN DISTRESS GND	18 AWG	GXL	4460227		X617 (4)
2	WHT	8-8 GEN DISTRESS PWR	18 AWG	GXL	4460227		X617 (3)

S620							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-4-1 IGN 48VOLT	18 AWG	GXL	N/A		X5988 (1)
2	WHT	8-4-2 IGN 48VOLT	18 AWG	GXL	N/A		X617 (5)
2	WHT	8-4-3 IGN 48VOLT	18 AWG	GXL	N/A		S621 (1)

X617 - GEN ECU							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-6	14 AWG	GXL	4460267		RL618 (4)
2	WHT	8-7	14 AWG	GXL	4460267		RL619 (4)
3	WHT	8-8 GEN DISTRESS PWR	18 AWG	GXL	4460267		LB607 (2)
4	WHT	8-5 GEN DISTRESS GND	18 AWG	GXL	4460267		LB607 (1)
5	WHT	8-4-2 IGN 48VOLT	18 AWG	GXL	4460267		S620 (2)
6							

S621							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-4-3 IGN 48VOLT	18 AWG	GXL	N/A		S620 (2)
1	WHT	8-4-4 IGN 48VOLT	14 AWG	GXL	N/A		RL618 (1)
2	WHT	8-4-5 IGN 48VOLT	14 AWG	GXL	N/A		RL619 (1)

X5988 - TO TRAC HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-4-1 IGN 48VOLT	18 AWG	GXL	4460464		S620 (1)
2					4460466		

RL619 - START RELAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-4-5 IGN 48VOLT	14 AWG	GXL	100116733		S621 (2)
2	BLK	8-4-3 GND	18 AWG	GXL	100116732		S622 (2)
3					1001128128		
4	WHT	8-7	14 AWG	GXL	100116733		X617 (2)
5	WHT	8-2 GENSET START SW	18 AWG	GXL	100116732		GENSET SW-2 (1)

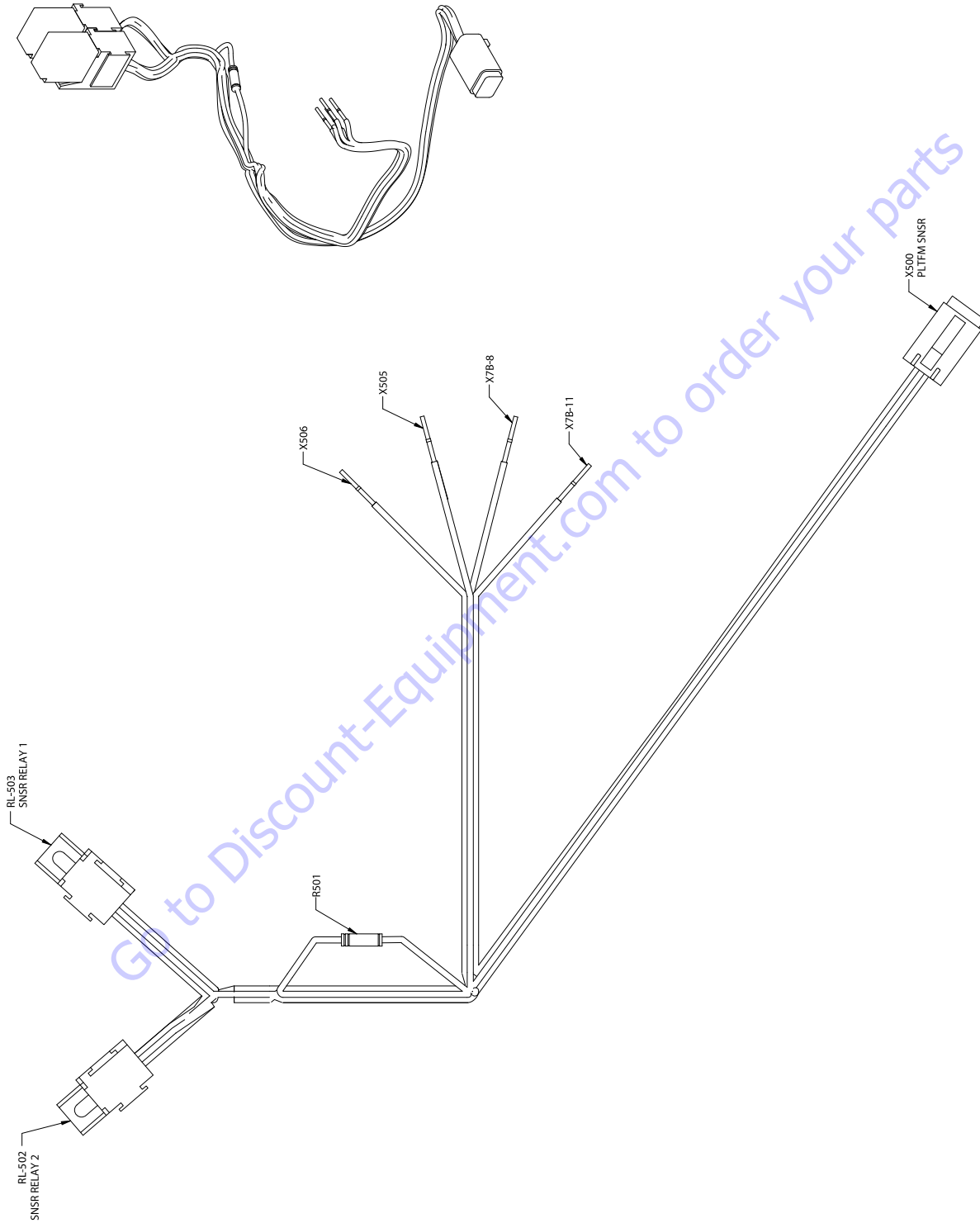
RL618 - ENABLE RELAY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-4-4 IGN 48VOLT	14 AWG	GXL	100116733		S621 (1)
2	BLK	8-1-2 GND	18 AWG	GXL	100116732		S622 (2)
3					1001128128		
4	WHT	8-6	14 AWG	GXL	100116733		X617 (1)
5	WHT	8-3 GENSET ENABLE SW	18 AWG	GXL	100116732		X4-A-5 (1)

S622							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	8-1 GND	18 AWG	GXL	N/A		MS597-10 (1)
2	BLK	8-1-2 GND	18 AWG	GXL	N/A		RL618 (2)
2	BLK	8-1-3 GND	18 AWG	GXL	N/A		RL619 (2)

MS597-10 - GEN GND							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	8-1 GND	18 AWG	GXL	N/A		S622 (1)

X4-A-5 - ENABLE SW							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-3 GENSET ENABLE SW	18 AWG	GXL	N/A		RL618 (5)

Figure 7-48. Generator IGN Harness - Sheet 2 of 2



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Figure 7-49. SkyGuard Harness - Sheet 1 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

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)

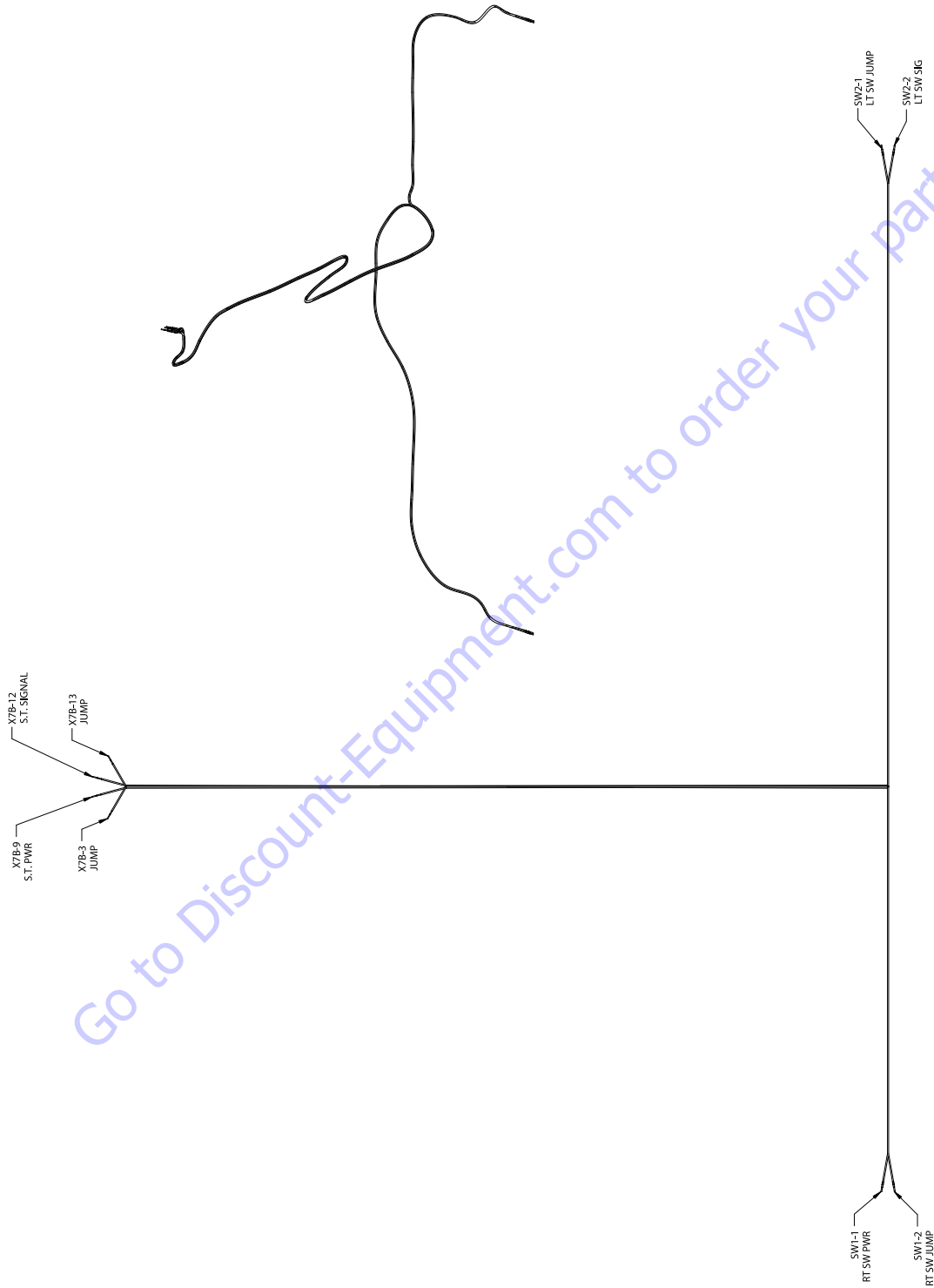
X500 - PLTFM SNRS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P10	18 AWG	GXL	4460465		R501 (2)
2	WHT	P6	18 AWG	GXL	4460465		X7B-8 (1)
3	WHT	P4	18 AWG	GXL	4460465		RL-502 (86)
4	WHT	P5	18 AWG	GXL	4460465		RL-502 (85)

RL-502 - SNRS 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 - SNRS 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 7-50. SkyGuard Harness Sheet - 2 of 2



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Figure 7-51. Soft Touch Harness - Sheet 1 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

X7B-13-JUMP							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-551-3 JUMPER	18 AWG	GXL	N/A		SW2-1 (1)

X7B-12-S.T. SIGNAL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	124-5-2 ST SWITCH	18 AWG	GXL	N/A		SW2-2 (1)

X7B-9-S.T. PWR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-25-2 ST PWR	18 AWG	GXL	N/A		SW1-1 (1)

X7B-3-JUMP							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-551-2 JUMPER	18 AWG	GXL	N/A		SW1-2 (1)

SW1-1-RT SW PWR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-25-2 ST PWR	18 AWG	GXL	N/A		X7B-9 (1)

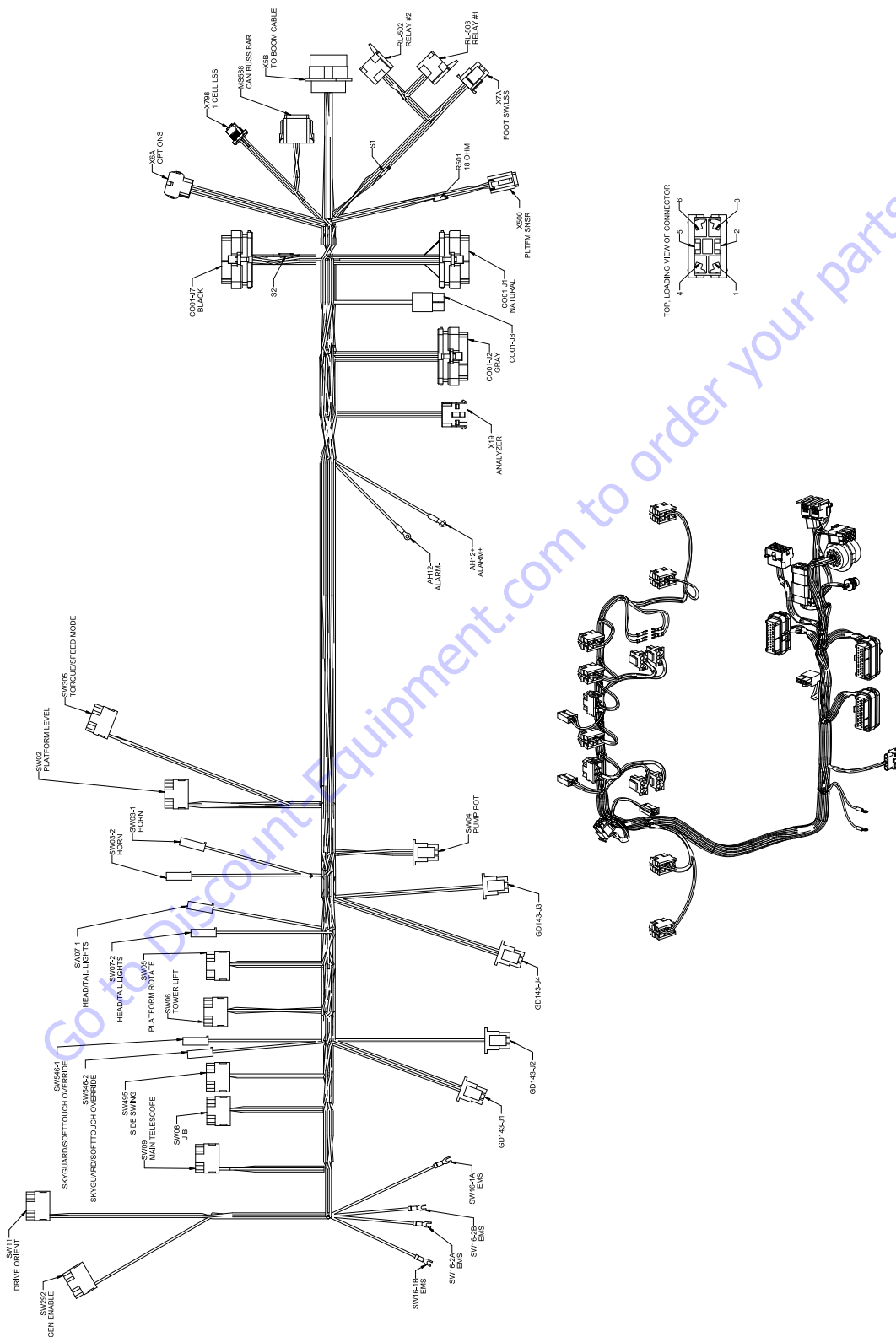
SW1-2-RT SW JUMP							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-551-2 JUMPER	18 AWG	GXL	N/A		X7B-3 (1)

SW2-1-LT SW JUMP							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-551-2 JUMPER	18 AWG	GXL	N/A		X7B-3 (1)

SW2-2-LT SW SIG							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	124-5-2 ST SWITCH	18 AWG	GXL	N/A		X7B-12 (1)

Figure 7-52. Soft Touch Harness - Sheet 2 of 2

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS



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Figure 7-53. Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 1 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

SW11 - DRIVE ORIENT							
CONNECTOR PART NUMBER: 4460418							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	122-1 DOS	18 AWG	GXL	1001159186		CO01-J2 (4)
2	WHT	5-14-10	18 AWG	GXL	4460419		SW546-2 (1)
3	WHT	5-14-9	18 AWG	GXL	4460419		SW03-1 (1)
4							
5							
6							

SW495 - SIDE SWING							
CONNECTOR PART NUMBER: 4460418							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	31-0 SIDE SWING LEFT	18 AWG	GXL	1001159186		CO01-J1 (26)
2	WHT	5-14-6	18 AWG	GXL	4460419		SW08 (2)
3	WHT	5-14-7	18 AWG	GXL	4460419		SW04 (1)
4	WHT	32-0 SIDE SWING RIGHT	18 AWG	GXL	1001159186		CO01-J1 (25)
5							
6							

SW292 - GEN ENABLE							
CONNECTOR PART NUMBER: 4460418							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1							
2	WHT	2-12-2 GEN ENABLE IGN	18 AWG	GXL	1001159186		X5B (7)
3	WHT	8-3 GEN ENABLE	18 AWG	GXL	1001159186		X5B (5)
4							
5							
6							

SW06 - TOWER LIFT							
CONNECTOR PART NUMBER: 4460418							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	29-30 TWR LFT DN	18 AWG	GXL	1001159186		CO01-J1 (2)
2	WHT	5-14-3	18 AWG	GXL	4460419		SW305 (2)
3	WHT	5-14-2	18 AWG	GXL	4460419		SW09 (2)
4	WHT	29-0 TWR LFT UP	18 AWG	GXL	1001159186		CO01-J1 (1)
5							
6							

SW07-1 - HEAD/TAIL LIGHTS							
CONNECTOR PART NUMBER: 4460260							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	86-1 HEAD/TAIL LT	18 AWG	GXL	4460259		CO01-J1 (30)

SW07-2 - HEAD/TAIL LIGHTS							
CONNECTOR PART NUMBER: 4460260							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-14-11	18 AWG	GXL	4460259		SW546-2 (1)

SW16-2A - EMS							
CONNECTOR PART NUMBER: 4460888							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
2A	WHT	5-11-3	18 AWG	GXL	N/A		CO01-J7 (2)

SW16-1B - EMS							
CONNECTOR PART NUMBER: 4460888							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1B	WHT	5-2-6	18 AWG	GXL	N/A		X5B (13)

SW16-2B - EMS							
CONNECTOR PART NUMBER: 4460888							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
2B	WHT	5-2-5	18 AWG	GXL	N/A		X5B (15)

SW16-1A - EMS							
CONNECTOR PART NUMBER: 4460888							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1A	WHT	5-11-2	18 AWG	GXL	N/A		X5B (9)

SW09 - MAIN TELESCOPE							
CONNECTOR PART NUMBER: 4460418							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	14-0 MAIN TELE OUT	18 AWG	GXL	1001159186		CO01-J1 (6)
2	WHT	5-14-2	18 AWG	GXL	4460419		SW06 (2)
3	WHT	5-14-3	18 AWG	GXL	4460419		SW05 (2)
4	WHT	13-0 MAIN TELE IN	18 AWG	GXL	1001159186		CO01-J1 (5)
5							
6							

SW08 - JIB							
CONNECTOR PART NUMBER: 4460418							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	26-0 JIB DN	18 AWG	GXL	1001159186		CO01-J1 (12)
2	WHT	5-14-5	18 AWG	GXL	4460419		SW02 (2)
3	WHT	5-14-6	18 AWG	GXL	4460419		SW495 (2)
2	WHT	27-0 JIB UP	18 AWG	GXL	1001159186		CO01-J1 (11)
4							
5							
6							

GD143-J1							
CONNECTOR PART NUMBER: 4460225							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	98-3 1/4 BAT CHG	18 AWG	GXL	4460226		CO01-J2 (22)
2	WHT	98-4 1/2 BAT CHG	18 AWG	GXL	4460226		CO01-J2 (24)
3	WHT	98-5 3/4 BAT CHG	18 AWG	GXL	4460226		CO01-J2 (23)
4	WHT	1-25 CHG IND GND	18 AWG	GXL	4460226		CO01-J2 (25)
5							
6	WHT	98-6 BAT FULL	18 AWG	GXL	4460226		CO01-J2 (35)

GD143-J2							
CONNECTOR PART NUMBER: 4460225							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	98-7 BAT LOW	18 AWG	GXL	4460226		CO01-J2 (13)
2	WHT	131-3 FUNC ENABLE	18 AWG	GXL	4460226		CO01-J2 (7)
3							
4							
5							
6	WHT	1-26 DISPLAY GND	18 AWG	GXL	4460226		CO01-J2 (18)

GD143-J4							
CONNECTOR PART NUMBER: 4460225							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	128-1 TILT	18 AWG	GXL	4460226		CO01-J2 (6)
2	WHT	128-1 OVERLOAD	18 AWG	GXL	4460226		CO01-J2 (11)
3	WHT	127-1 SYS FAULT	18 AWG	GXL	4460226		CO01-J2 (8)
4	WHT	122-2 DOS	18 AWG	GXL	4460226		CO01-J2 (14)
5							
6							

GD143-J3							
CONNECTOR PART NUMBER: 4460225							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	125-2 CREEP MODE	18 AWG	GXL	4460226		CO01-J2 (9)
2	WHT	130-1 SOFT TOUCH	18 AWG	GXL	4460226		CO01-J2 (19)
3	WHT	134 SKY GUARD	18 AWG	GXL	4460226		CO01-J2 (16)
4							
5							
6							

Figure 7-54. Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 2 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

SW03-2 - HORN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	49-01 HORN	18 AWG	GXL	4460259		CO01-J1 (31)

SW03-1 - HORN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-14-8	18 AWG	GXL	4460259		SW04 (1)
1	WHT	5-14-9	18 AWG	GXL	4460259		SW11 (2)

AH12- - ALARM-							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-27 ALARM GND	18 AWG	GXL	N/A		CO01-J7 (20)

AH12+ - ALARM+							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	132 PLAT ALARM	18 AWG	GXL	N/A		CO01-J7 (19)

X19 - ANALYZER							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	51-0 ANALYZER PWR	18 AWG	GXL	4460227		CO01-J2 (26)
2	GRN	52-0 ANALYZER RX	18 AWG	GXL	4460227		CO01-J2 (28)
3	WHT	53-0 ANALYZER TX	18 AWG	GXL	4460227		CO01-J2 (29)
4	BLK	54-0 ANALYZER GND	18 AWG	GXL	4460227		CO01-J2 (27)

SW305 - TORQUE/SPEED MODE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	120-2 AWDA MAN	18 AWG	GXL	1001159186		CO01-J1 (28)
2	WHT	5-14-1	18 AWG	GXL	1001159186		SW06 (2)
3	WHT	120-1 TORQUE/SPEED MODE	18 AWG	GXL	1001159186		CO01-J1 (27)
4							
5							
6							

SW02 - PLATFORM LEVEL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	26-0 PLAT LVL DN	18 AWG	GXL	1001159186		CO01-J1 (10)
2	WHT	5-14-4	18 AWG	GXL	4460419		SW05 (2)
2	WHT	5-14-5	18 AWG	GXL	4460419		SW08 (2)
3	WHT	25-0 PLAT LVL UP	18 AWG	GXL	1001159186		CO01-J1 (9)
4							
5							
6							

SW04 - PUMP POT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-14-7	18 AWG	GXL	4460267		SW495 (2)
1	WHT	5-14-8	18 AWG	GXL	4460267		SW03-1 (1)
2	WHT	5-14	18 AWG	GXL	4460267		CO01-J1 (18)
3	WHT	125-1 CREEP MODE	18 AWG	GXL	4460267		CO01-J1 (32)
4	WHT	126-1 PUMP POT PWR	18 AWG	GXL	4460267		CO01-J1 (34)
5	WHT	1-23 PUMP POT RETURN	18 AWG	GXL	4460267		CO01-J1 (13)
6	WHT	126-2 PUMP POT CMD	18 AWG	GXL	4460267		CO01-J1 (35)

CO01-J7 - BLACK							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	81-0 GND MODE RX	18 AWG	GXL	4460871		X5B (11)
2	WHT	5-11-3	18 AWG	GXL	4460871		SW16-2A (2A)
3	WHT	82-0 PLAT TX	18 AWG	GXL	4460871		X5B (4)
4	WHT	3-16 FOOTSWITCH	18 AWG	GXL	4460871		X7A (5)
5					4460905		
6					4460905		
7	WHT	3-18 SKYG PWR	18 AWG	GXL	4460871		R501 (1)
8	WHT	131-1 FOOT SWITCH	18 AWG	GXL	4460871		X7A (4)
9					4460905		
10					4460905		
11					4460905		
12					4460905		
13					4460905		
14					4460905		
15					4460905		
16	WHT	1-28 LSS GND	18 AWG	GXL	4460871		S2 (1)
17					4460905		
18	WHT	124-1 SKYG INPUT#1	18 AWG	GXL	4460871		RL-503 (87)
19	WHT	132 PLAT ALARM	18 AWG	GXL	4460871		AH12+ (1)
20	WHT	1-27 ALARM GND	18 AWG	GXL	4460871		AH12- (1)
21	WHT	25-0-3 PLAT LVL UP	18 AWG	GXL	4460871		X6A (13)
22	WHT	26-0-3 PLAT LVL DN	18 AWG	GXL	4460871		X6A (14)
23	WHT	1-30 VLV GND	18 AWG	GXL	4460871		X6A (5)
24	WHT	1-38 SKYG GND	18 AWG	GXL	4460871		X500 (2)
25	WHT	27-0-3 JIB UP	18 AWG	GXL	4460871		X6A (3)
26	WHT	28-0-3 JIB DN	18 AWG	GXL	4460871		X6A (4)
27	WHT	31-0-3 JIB RHT	18 AWG	GXL	4460871		X6A (11)
28	WHT	30-0-3 JIB LFT	18 AWG	GXL	4460871		X6A (12)
29	WHT	1-29 OPTION GND	18 AWG	GXL	4460871		X6A (6)
30	GRN	CAN1 LOW	18 AWG	GXL	4460871		MS588 (3)
31	YEL	CAN1 HIGH	18 AWG	GXL	4460871		MS588 (1)
32					4460905		
33	WHT	23-0-3 PLAT ROT LFT	18 AWG	GXL	4460871		X6A (1)
34	WHT	24-0-3 PLAT ROT RHT	18 AWG	GXL	4460871		X6A (2)
35					4460905		
NC					4460905		

X6A - OPTIONS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	23-0-3 PLAT ROT LFT	18 AWG	GXL	4460226		CO01-J7 (33)
2	WHT	24-0-3 PLAT ROT RHT	18 AWG	GXL	4460226		CO01-J7 (34)
3	WHT	27-0-3 JIB UP	18 AWG	GXL	4460226		CO01-J7 (25)
4	WHT	28-0-3 JIB DN	18 AWG	GXL	4460226		CO01-J7 (28)
5	WHT	1-30 VLV GND	18 AWG	GXL	4460226		CO01-J7 (23)
6	WHT	1-29 OPTION GND	18 AWG	GXL	4460226		CO01-J7 (29)
7							
8	YEL	CAN1 HIGH	18 AWG	GXL	4460226		MS588 (8)
9	GRN	CAN1 LOW	18 AWG	GXL	4460226		MS588 (6)
10							
11	WHT	31-0-3 JIB RHT	18 AWG	GXL	4460226		CO01-J7 (27)
12	WHT	30-0-3 JIB LFT	18 AWG	GXL	4460226		CO01-J7 (28)
13	WHT	25-0-3 PLAT LVL UP	18 AWG	GXL	4460226		CO01-J7 (21)
14	WHT	26-0-3 PLAT LVL DN	18 AWG	GXL	4460226		CO01-J7 (22)
15							

X798 - 1 CELL LSS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					N/A		
2	WHT	3-20-2 LSS PWR	20 AWG	CABLE	N/A		S1 (1)
3	BLU	1-28-2 LSS GND	20 AWG	CABLE	N/A		S2 (2)
4	BLK	CAN1 HIGH	20 AWG	CABLE	N/A		MS588 (2)
5	GRY	CAN1 LOW	20 AWG	CABLE	N/A		MS588 (4)

Figure 7-55. Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 3 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

MS588 - CAN BUSS BAR

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN1 HIGH	18 AWG	GXL	4460465		CO01-J7 (31)
2	BLK	CAN1 HIGH	20 AWG	CABLE	4460465		X798 (4)
3	GRN	CAN1 LOW	18 AWG	GXL	4460465		CO01-J7 (30)
4	GRY	CAN1 LOW	20 AWG	CABLE	4460465		X798 (5)
5	GRN	CAN1 LOW	18 AWG	GXL	4460465		X58 (2)
6	GRN	CAN1 LOW	18 AWG	GXL	4460465		X6A (9)
7	YEL	CAN1 HIGH	18 AWG	GXL	4460465		X58 (3)
8	YEL	CAN1 HIGH	18 AWG	GXL	4460465		X6A (8)

X5B - TO BOOM CABLE

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460466		
2	GRN	CAN1 LOW	18 AWG	GXL	4460464		MS588 (5)
3	YEL	CAN1 HIGH	18 AWG	GXL	4460464		MS588 (7)
4	WHT	82-0 PLAT TX	18 AWG	GXL	4460464		CO01-J7 (3)
5	WHT	8-3 GEN ENABLE	18 AWG	GXL	4460464		SW292 (3)
6	WHT	131-3 FOOT PEDAL	18 AWG	GXL	4460464		X7A (8)
7	WHT	2-12-2 GEN ENABLE IGN	18 AWG	GXL	4460464		SW292 (2)
8					4460466		
9	WHT	5-1-2	18 AWG	GXL	4460464		SW16-1A (1A)
10					4460466		
11	WHT	81-0 GND MODE RX	18 AWG	GXL	4460464		CO01-J7 (1)
12	WHT	3-8 PLAT IGN	12 AWG	GXL	4460508		CO01-J8 (2)
13	WHT	5-2-6	18 AWG	GXL	4460464		SW16-1B (1B)
14					4460466		
15	WHT	5-2-5	18 AWG	GXL	4460464		SW16-2B (2B)
16	WHT	1-6 PLAT GND	12 AWG	GXL	4460508		CO01-J8 (1)
17					4460466		
18					4460466		
19					4460466		

CO01-J2 - GRAY

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2					4460905		
3					4460905		
4	WHT	122-1 DOS	18 AWG	GXL	4460871		SW11 (1)
5					4460905		
6	WHT	129-1 TLT	18 AWG	GXL	4460871		GD143-J4 (1)
7	WHT	131-3 FUNC ENABLE	18 AWG	GXL	4460871		GD143-J2 (2)
8	WHT	127-1 SYS FAULT	18 AWG	GXL	4460871		GD143-J4 (3)
9	WHT	125-2 CREEP MODE	18 AWG	GXL	4460871		GD143-J3 (1)
10					4460905		
11	WHT	128-1 OVERLOAD	18 AWG	GXL	4460871		GD143-J4 (2)
12					4460905		
13	WHT	99-7 BAT LOW	18 AWG	GXL	4460871		GD143-J2 (1)
14	WHT	122-2 DOS	18 AWG	GXL	4460871		GD143-J4 (4)
15					4460905		
16	WHT	134 SKY GUARD	18 AWG	GXL	4460871		GD143-J3 (3)
17					4460905		
18	WHT	1-26 DISPLAY GND	18 AWG	GXL	4460871		GD143-J2 (6)
19	WHT	130-1 SOFT TOUCH	18 AWG	GXL	4460871		GD143-J3 (2)
20					4460905		
21					4460905		
22	WHT	86-3 14 BAT CHG	18 AWG	GXL	4460871		GD143-J1 (1)
23	WHT	98-5 34 BAT CHG	18 AWG	GXL	4460871		GD143-J1 (3)
24	WHT	88-4 12 BAT CHG	18 AWG	GXL	4460871		GD143-J1 (2)
25	WHT	1-25 CHG IND GND	18 AWG	GXL	4460871		GD143-J1 (4)
26	RED	51-0 ANALYZER PWR	18 AWG	GXL	4460871		X19 (1)
27	BLK	54-0 ANALYZER GND	18 AWG	GXL	4460871		X19 (4)
28	GRN	52-0 ANALYZER RX	18 AWG	GXL	4460871		X19 (2)
29	WHT	53-0 ANALYZER TX	18 AWG	GXL	4460871		X19 (3)
30					4460905		
31	WHT	3-25 SOFTT PWR	18 AWG	GXL	4460871		X7A (9)
32	WHT	3-20 LSS PWR	18 AWG	GXL	4460971		S1 (1)
33					4460905		
34					4460905		
35	WHT	86-6 BAT FULL	18 AWG	GXL	4460871		GD143-J1 (6)

CO01-J8

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	WHT	15	AWG	GXL	4460887	X58 (16)
2	WHT	3-6 PLAT IGN	12	AWG	GXL	4460887	X58 (12)

R501-18 OHM

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-18 SKYG PWR	18 AWG	GXL	N/A		CO01-J7 (7)
1	WHT	P9	18 AWG	GXL	N/A		RL-503 (30)
2	WHT	P10	18 AWG	GXL	N/A		X500 (1)

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	1-36 SKYG GND	18 AWG	GXL	4460465		CO01-J7 (24)
3	WHT	P4	18 AWG	GXL	4460465		RL-502 (86)
4	WHT	P5	18 AWG	GXL	4460465		RL-502 (85)

S1

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		CO01-J2 (32)
1	WHT	3-20-2 LSS PWR	20 AWG	CABLE	N/A		X798 (2)
2	WHT	3-20-1 LSS PWR	18 AWG	GXL	N/A		X7A (15)

S2

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		CO01-J7 (16)
2	WHT	1-28-1 LSS GND	18 AWG	GXL	N/A		X7A (14)
2	BLU	1-28-2 LSS GND	20 AWG	CABLE	N/A		X798 (3)

CO01-J1 - NATURAL

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	29-0 TWR LFT UP	18 AWG	GXL	4460871		SW06 (3)
2	WHT	29-30 TWR LFT DN	18 AWG	GXL	4460871		SW06 (1)
3					4460905		
4					4460905		
5	WHT	13-0 MAIN TELE IN	18 AWG	GXL	4460871		SW09 (3)
6	WHT	14-0 MAIN TELE OUT	18 AWG	GXL	4460871		SW09 (1)
7	WHT	24-0 PLAT ROT RT	18 AWG	GXL	4460871		SW05 (3)
8	WHT	23-0 PLAT ROT LFT	18 AWG	GXL	4460871		SW05 (1)
9	WHT	25-0 PLAT LVL UP	18 AWG	GXL	4460871		SW02 (3)
10	WHT	26-0 PLAT LVL DN	18 AWG	GXL	4460871		SW02 (1)
11	WHT	27-0 JIB UP	18 AWG	GXL	4460871		SW08 (3)
12	WHT	28-0 JIB DN	18 AWG	GXL	4460871		SW08 (1)
13	WHT	1-23 PUMP POT RETURN	18 AWG	GXL	4460871		SW04 (5)
14					4460905		
15					4460905		
16					4460905		
17					4460905		
18	WHT	5-4	18 AWG	GXL	4460871		SW04 (2)
19					4460905		
20	WHT	124-5 SOFTT	18 AWG	GXL	4460871		X7A (12)
21					4460905		
22					4460905		
23	WHT	124-2 SKYG INPUT#2	18 AWG	GXL	4460871		RL-502 (87)
24					4460905		
25	WHT	32-0 SIDE SWING RIGHT	18 AWG	GXL	4460871		SW495 (3)
26	WHT	31-0 SIDE SWING LEFT	18 AWG	GXL	4460871		SW495 (1)
27	WHT	120-1 TORQUE/SPEED MODE	18 AWG	GXL	4460871		SW305 (3)
28	WHT	120-2 AWDA MAN	18 AWG	GXL	4460871		SW305 (1)
29	WHT	124-3 OVERRIDE	18 AWG	GXL	4460871		SW546-1 (1)
30	WHT	88-1 HEADTAIL LT	18 AWG	GXL	4460871		SW07-1 (1)
31	WHT	48-0-1 HORN	18 AWG	GXL	4460871		SW03-2 (1)
32	WHT	125-1 CREEP MODE	18 AWG	GXL	4460871		SW04 (3)
33					4460905		
34	WHT	126-1 PUMP POT PWR	18 AWG	GXL	4460871		SW04 (4)
35	WHT	126-2 PUMP POT CMD	18 AWG	GXL	4460871		SW04 (6)

X7A - FOOT SW/LSS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1							
2							
3	WHT	1-551 JUMPER	18 AWG	GXL	4460227		X7A (13)
4	WHT	131-1 FOOT SWITCH	18 AWG	GXL	4460227		CO01-J7 (8)
5	WHT	3-18 FOOTSWITCH	18 AWG	GXL	4460227		CO01-J7 (4)
6	WHT	131-3 FOOT PEDAL	18 AWG	GXL	4460227		X58 (6)
7							
8							
9	WHT	3-25 SOFTT PWR	18 AWG	GXL	4460227		CO01-J2 (31)
10							
11							
12	WHT	124-5 SOFTT	18 AWG	GXL	4460227		CO01-J1 (20)
13	WHT	1-551 JUMPER	18 AWG	GXL	4460227		X7A (3)
14	WHT	1-28-1 LSS GND	18 AWG	GXL	4460227		S2 (2)
15	WHT	3-20-1 LSS PWR	18 AWG	GXL	4460227		S1 (2)

RL-502 - RELAY #2

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
30	WHT	P#1	18 AWG	GXL	4460420		RL-503 (30)
85	WHT	P5	18 AWG	GXL	4460420		X500 (4)
85	WHT	P5-1	18 AWG	GXL	4460420		RL-503 (85)
86	WHT	P4	18 AWG	GXL	4460420		X500 (3)
86	WHT	P4-1	18 AWG	GXL	4460420		RL-503 (86)
87	WHT	124-2 SKYG INPUT#2	18 AWG	GXL	4460421		CO01-J1 (23)
87a							

RL-503 - RELAY #1

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
30	WHT	P#2	18 AWG	GXL	4460420		R501 (1)
30	WHT	P#1	18 AWG	GXL	4460420		RL-502 (30)
85	WHT	P5-1	18 AWG	GXL	4460421		RL-502 (85)
86	WHT	P#1	18 AWG	GXL	4460421		RL-502 (86)
87	WHT	124-1 SKYG INPUT#1	18 AWG	GXL	4460421		CO01-J7 (18)
87a							

Figure 7-56. Platform Console Harness with SkyGuard and 1 Cell LSS - Sheet 4 of 4

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

CONNECTOR PART NUMBER: 1001186432		SKYGAURD RELAY #1			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
30	WHT	18 AWG	GO	1001186720	IP114 (1)
85	WHT	18 AWG	GO	100118388	S191 (1)
86	WHT	18 AWG	GO	100118388	S192 (1)
87	WHT	18 AWG	GO	1001186720	X58 (4)

CONNECTOR PART NUMBER: 1001186432		SKYGAURD RELAY #2			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
30	WHT	18 AWG	GO	1001186720	IP114 (1)
85	WHT	18 AWG	GO	100118388	S191 (1)
86	WHT	18 AWG	GO	100118388	S192 (1)
87	WHT	18 AWG	GO	1001186720	X58 (5)

CONNECTOR PART NUMBER: SPICE		S192			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
1	WHT	18 AWG	GO	N/A	RL503 (86)
2	WHT	18 AWG	GO	N/A	RL502 (86)
4	WHT	18 AWG	GO	N/A	X500 (3)

CONNECTOR PART NUMBER: SPICE		S191			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
1	WHT	18 AWG	GO	N/A	RL503 (85)
2	WHT	18 AWG	GO	N/A	RL502 (85)
5	WHT	18 AWG	GO	N/A	X500 (4)

CONNECTOR PART NUMBER: 4460939		X5B - INTERFACE			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
1	WHT	18 AWG	GO	4460944	IP114 (1)
2	WHT	18 AWG	GO	4460944	X500 (2)
3	WHT	18 AWG	GO	4460944	
4	WHT	18 AWG	GO	4460944	RL503 (87)
5	WHT	18 AWG	GO	4460944	RL502 (87)
6	WHT	18 AWG	GO	4460944	

CONNECTOR PART NUMBER: 4460984		X500 - PLATSSENSOR			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
1	WHT	18 AWG	GO	4460945	IP114 (2)
2	WHT	18 AWG	GO	4460945	X58 (2)
3	WHT	18 AWG	GO	4460945	S192 (2)
4	WHT	18 AWG	GO	4460945	S191 (2)

CONNECTOR PART NUMBER: 4460984		IP114			
CONN WIRE	WIRE LABEL	GAUGE	TERMINAL	SEAL PIN	TO
1	WHT	18 AWG	GO	N/A	X58 (1)
2	WHT	18 AWG	GO	N/A	RL503 (90)
3	WHT	18 AWG	GO	N/A	RL502 (90)
4	WHT	18 AWG	GO	N/A	X500 (1)

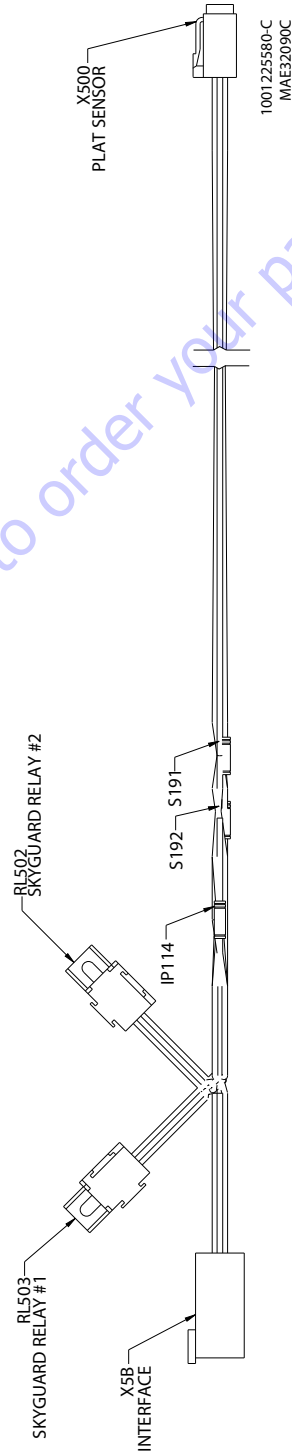


Figure 7-57. Gen 2 Plat Interface Harness

ELECTRICAL SCHEMATICS

- SHEET 2: PLATFORM CONSOLE
CONSOLE HARNESS
PLATFORM BEACON
- SHEET 3: PLATFORM AND BOOM COMPONENTS
LSS
- SHEET 4: TURNTABLE, AND UGM WIRING
MAIN VALVE HARNESS
TURNTABLE HARNESS
- SHEET 5: GROUND CONTROL WIRING
GROUND PANEL HARNESS
- SHEET 6: CHASSIS WIRING
TRACTION HARNESS
CHASSIS TO TURNTABLE
STEER/BRAKE HARNESS
- SHEET 7: OPTIONS:
GENERATOR
- SHEET 8: OPTIONS:
CHASSIS HEAD/TAIL LIGHT
INVERTER IGN
PLATFORM WORK LIGHT
GENERATOR IGN
SKY GUARD
SOFT TOUCH
- SHEET 9: PLATFORM
CONSOLE HARNESS WITH SKYGUARD
AND 1 CELL LSS
- SHEET 10: PLATFORM INTERFACE
GEN 2 PLAT INTERFACE

SHEET 1

1001173941-K
MAE31850K

Figure 7-58. Electrical Schematic - Sheet 1 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

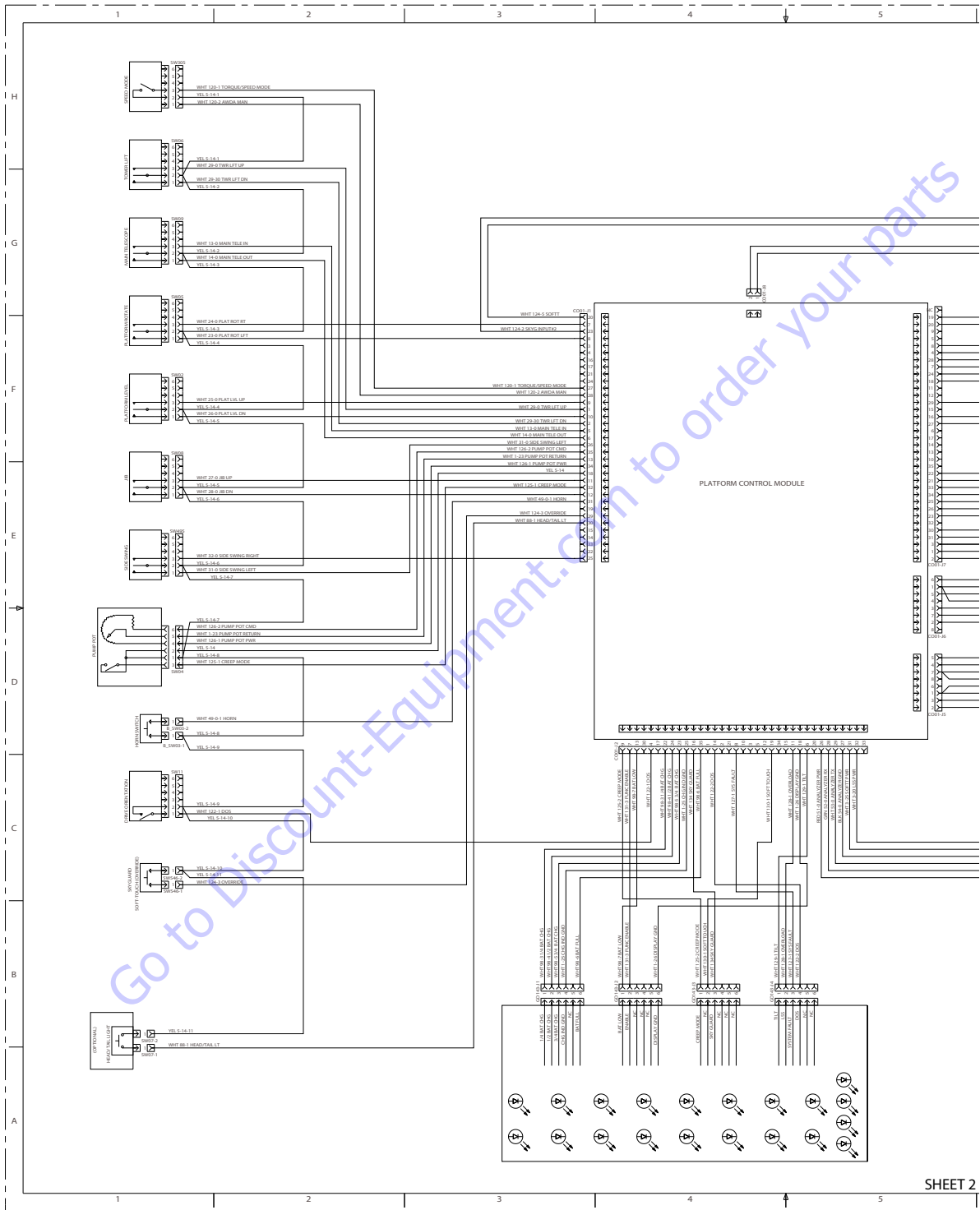


Figure 7-59. Electrical Schematic - Sheet 2 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

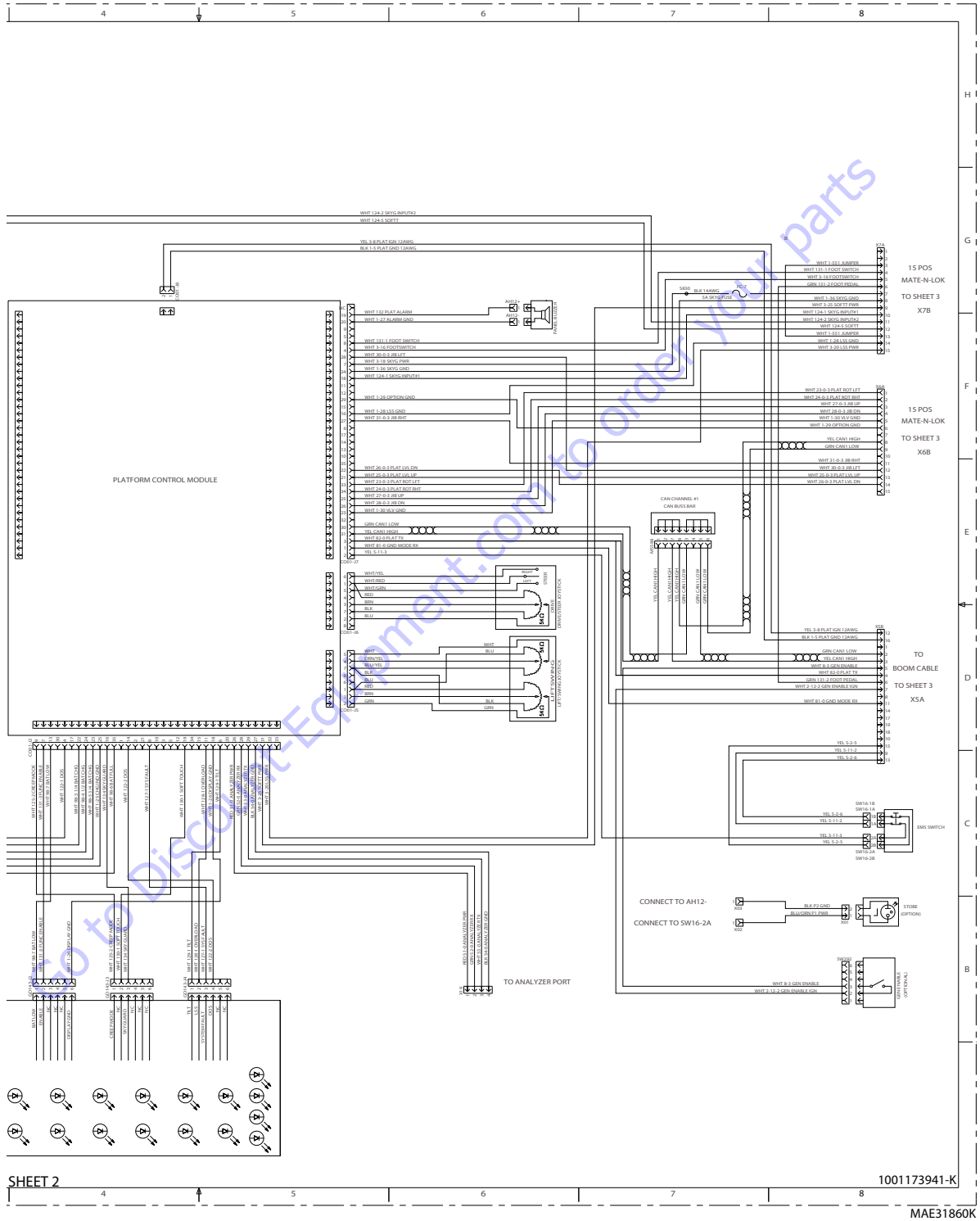


Figure 7-60. Electrical Schematic - Sheet 3 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

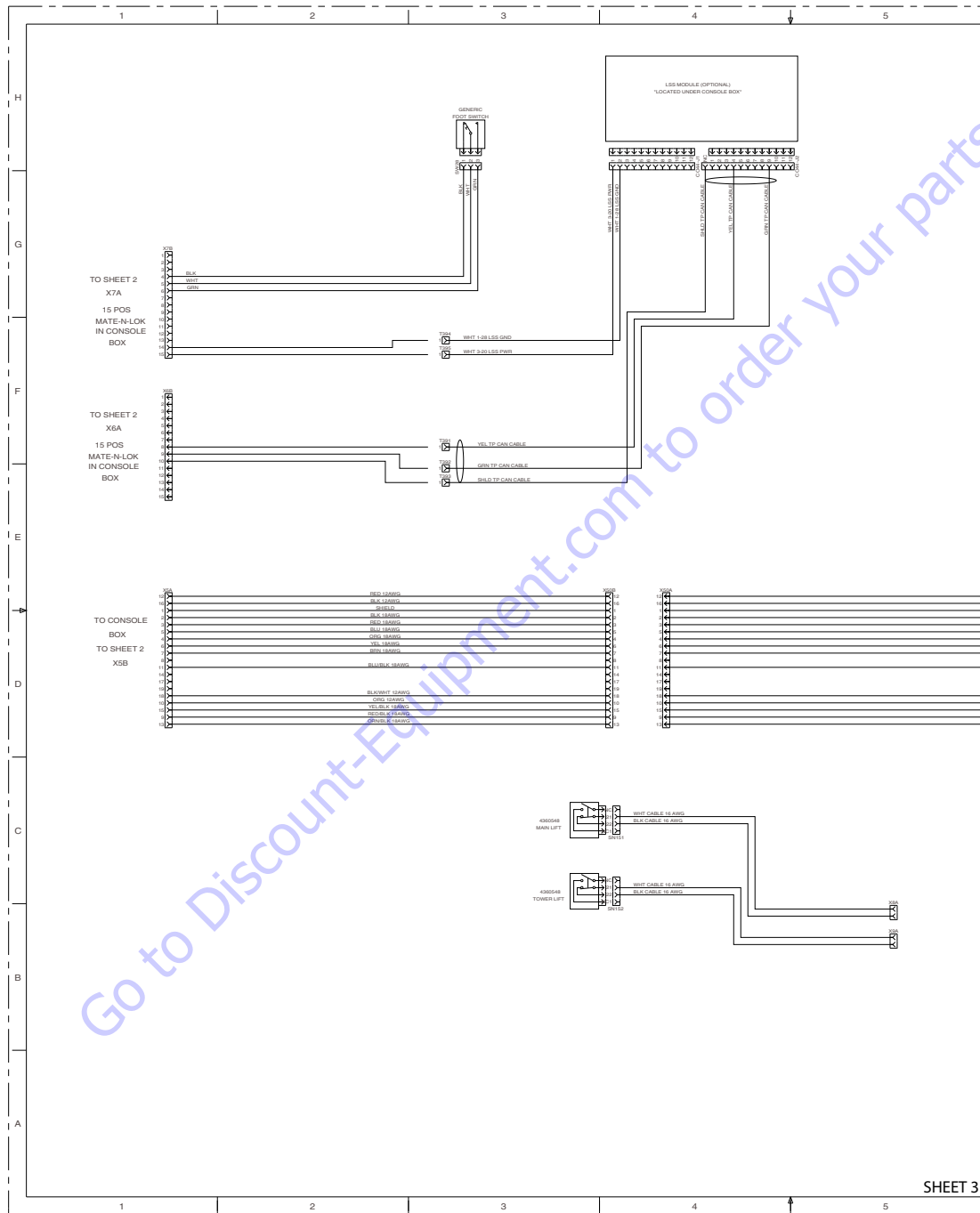


Figure 7-61. Electrical Schematic - Sheet 4 of 18

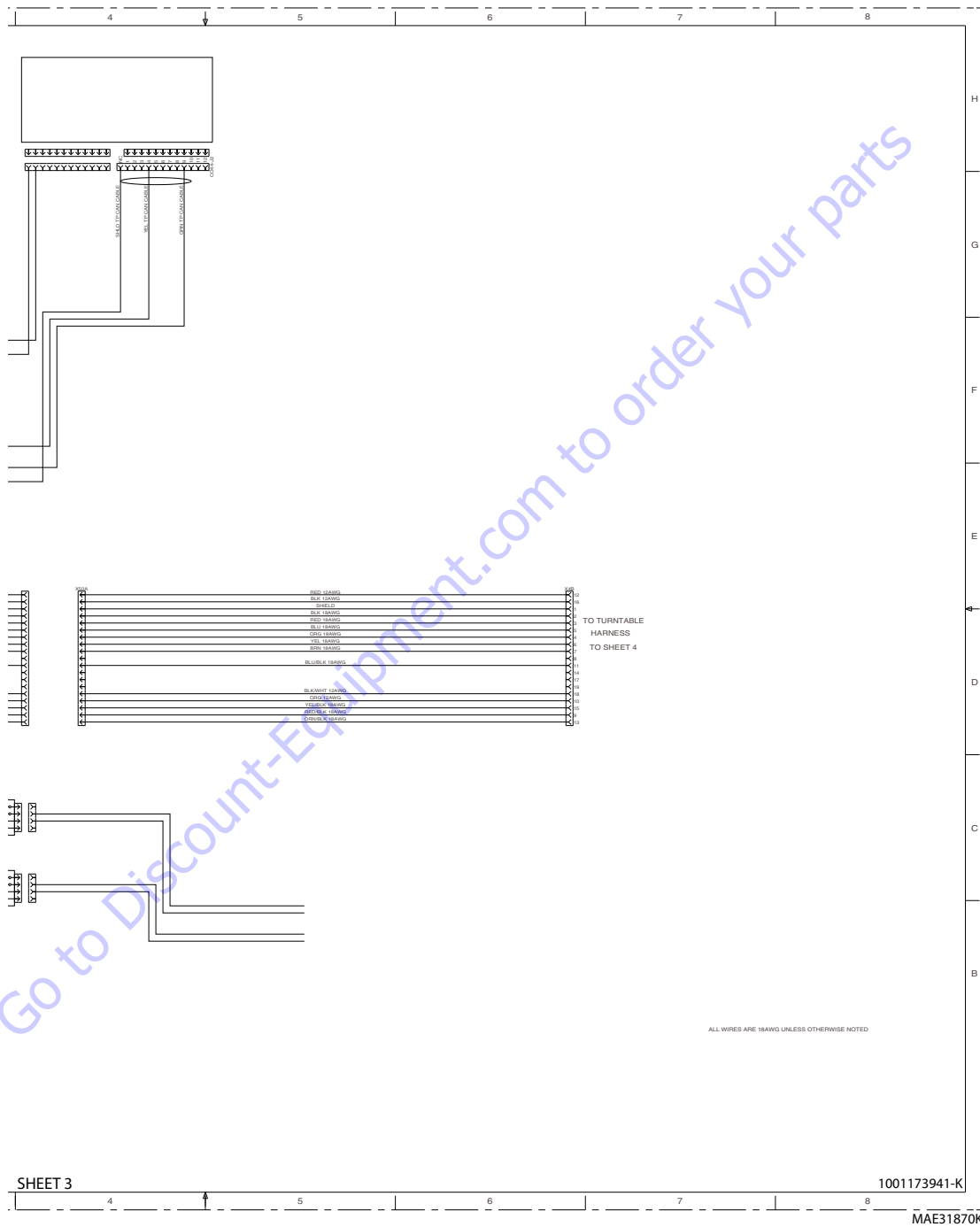


Figure 7-62. Electrical Schematic - Sheet 5 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

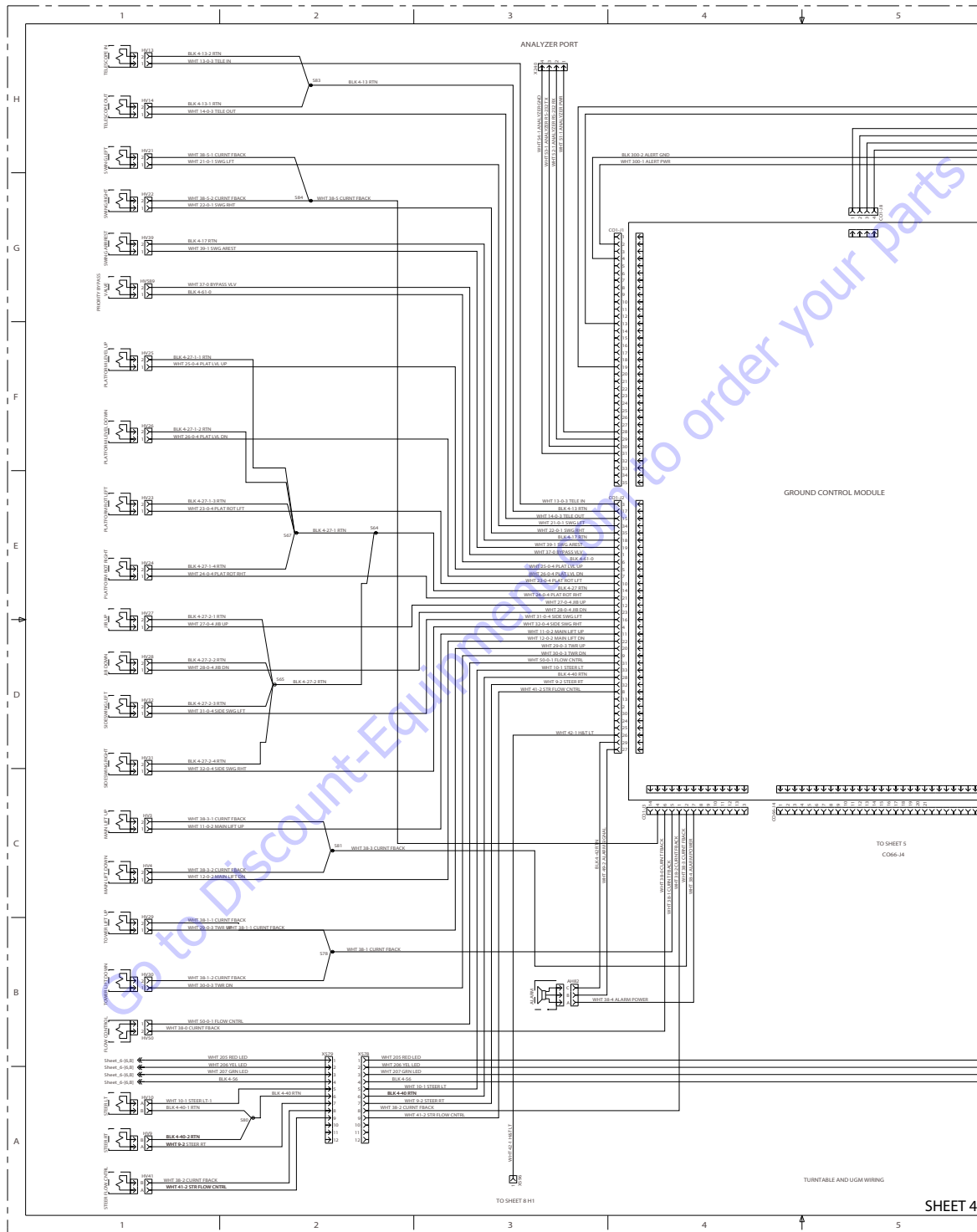


Figure 7-63. Electrical Schematic - Sheet 6 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

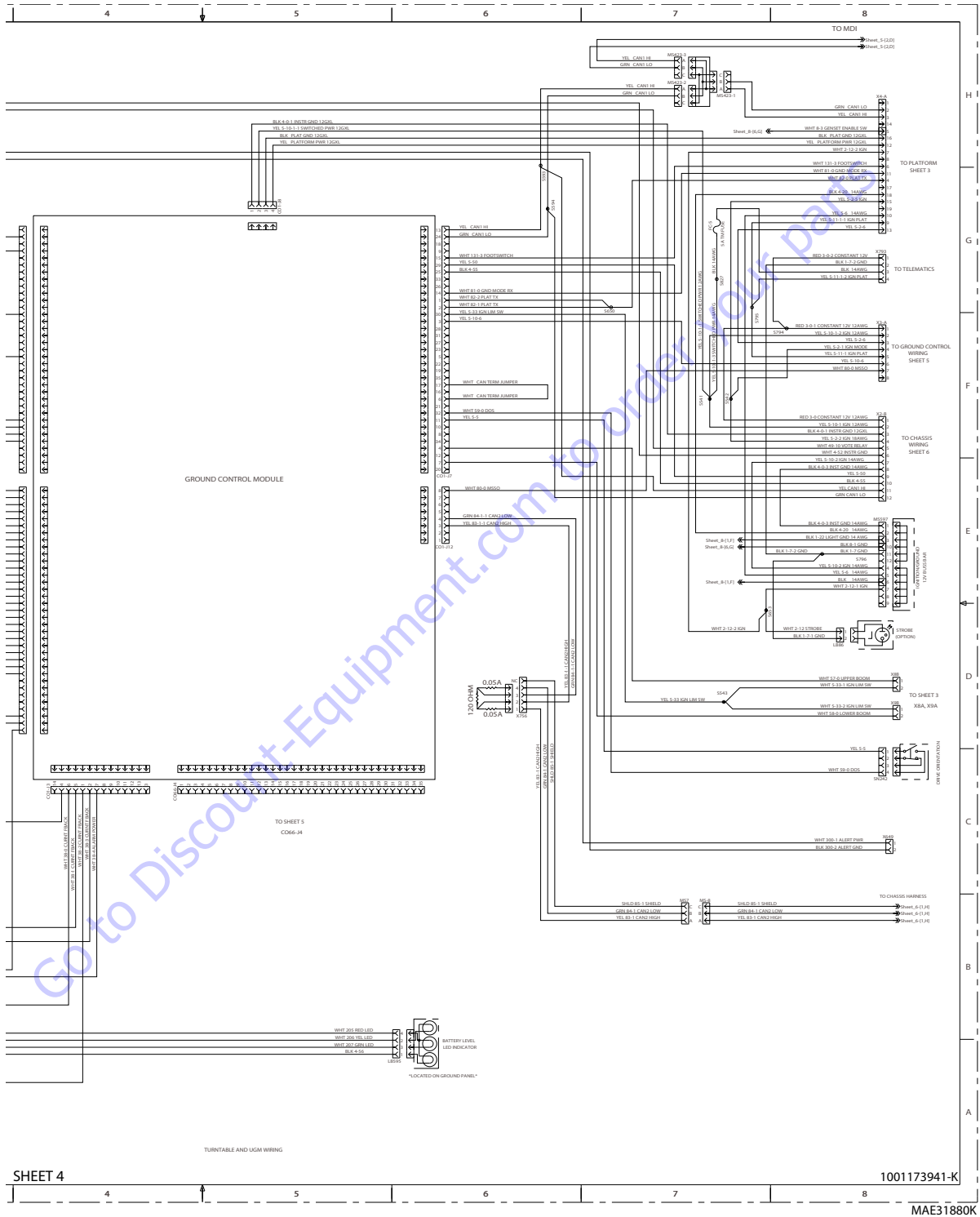


Figure 7-64. Electrical Schematic - Sheet 7 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

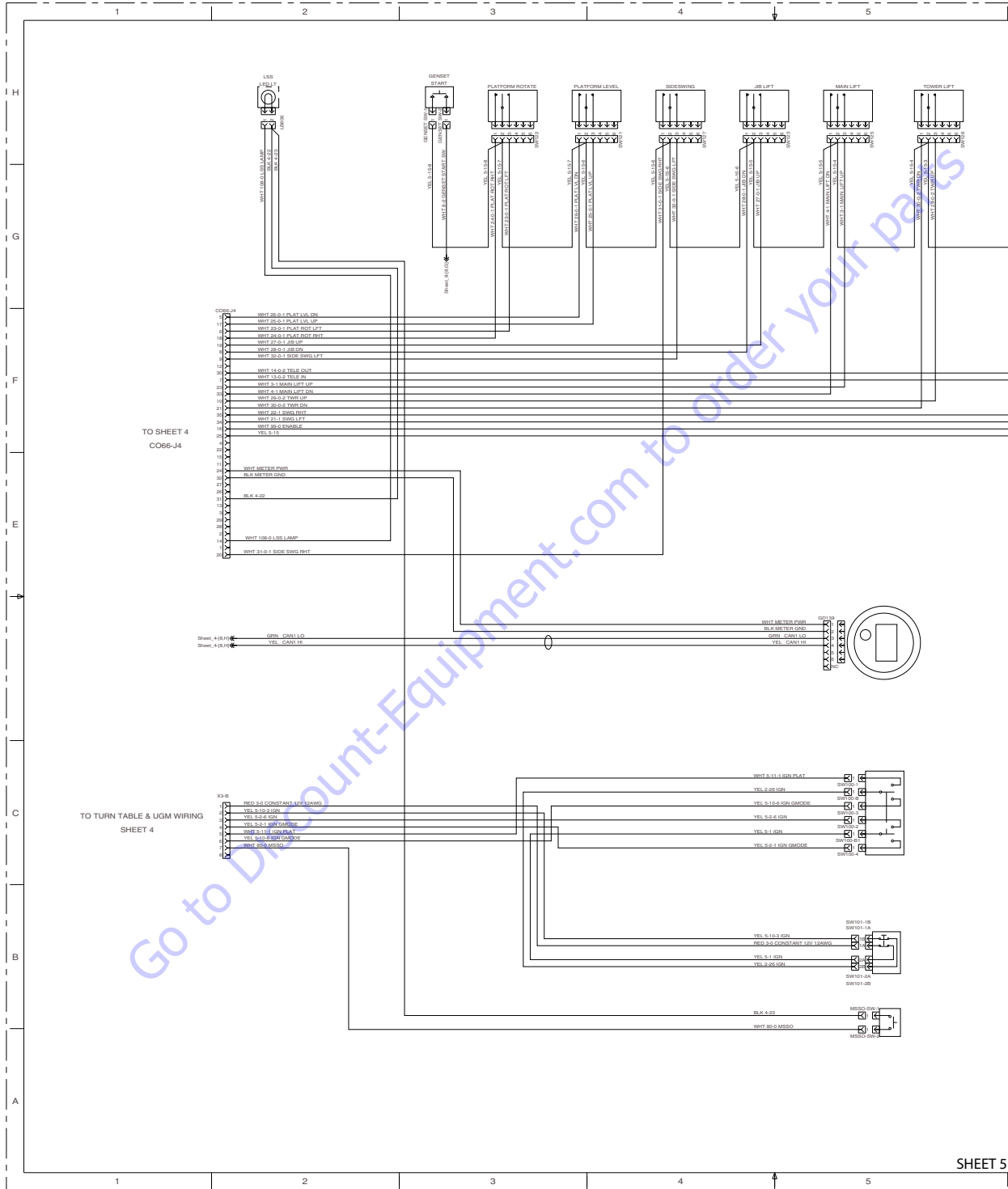


Figure 7-65. Electrical Schematic - Sheet 8 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

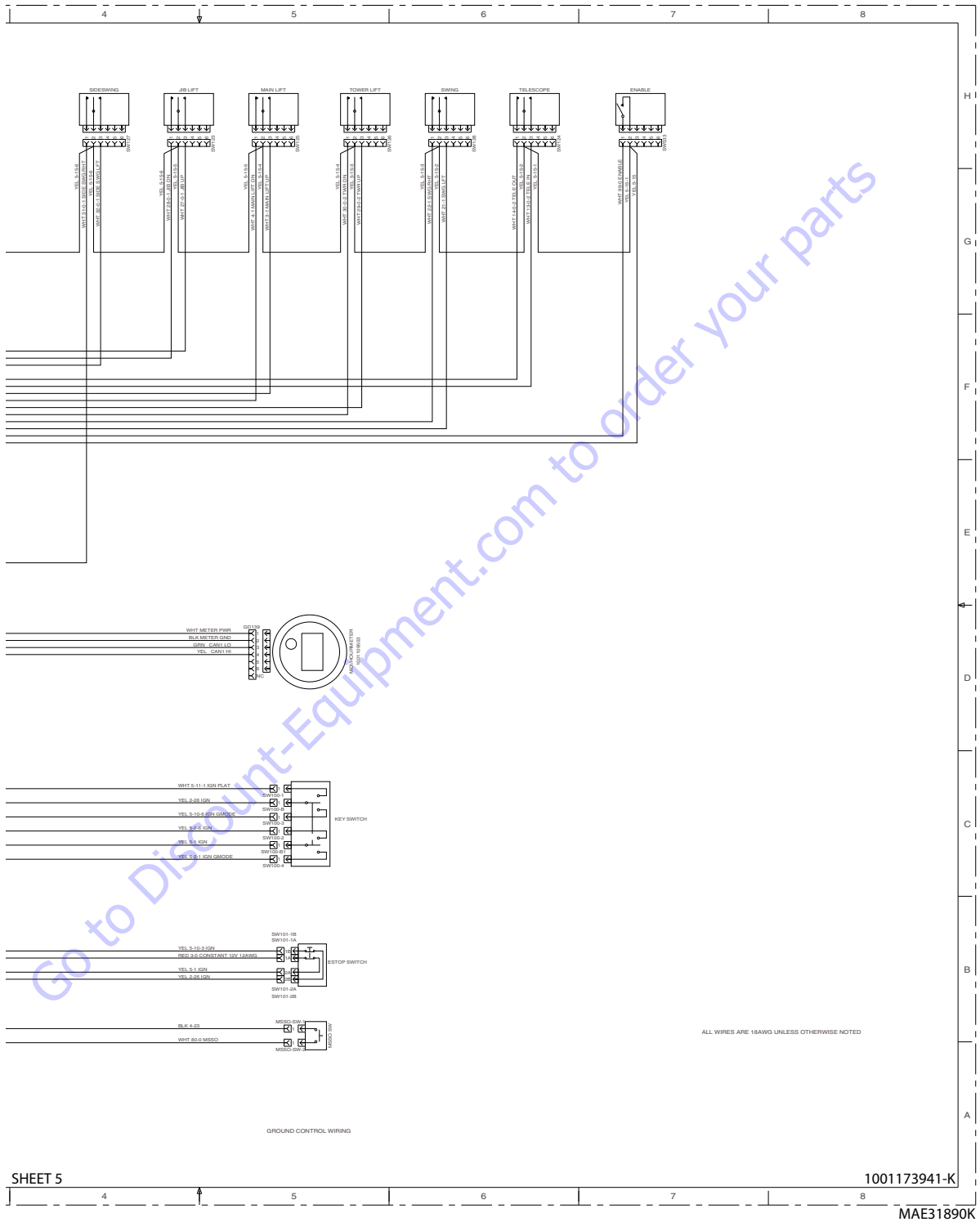


Figure 7-66. Electrical Schematic - Sheet 9 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

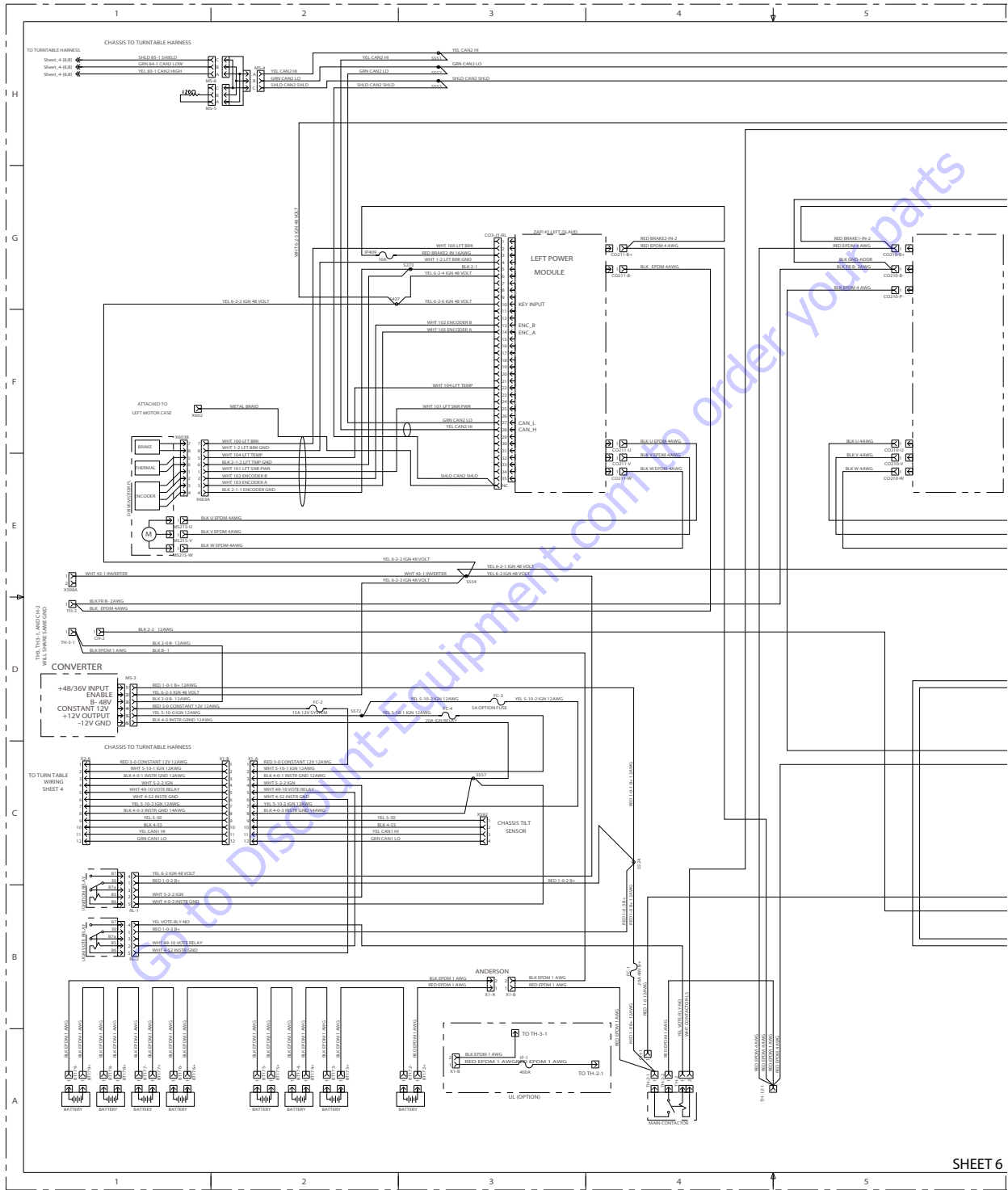


Figure 7-67. Electrical Schematic - Sheet 10 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

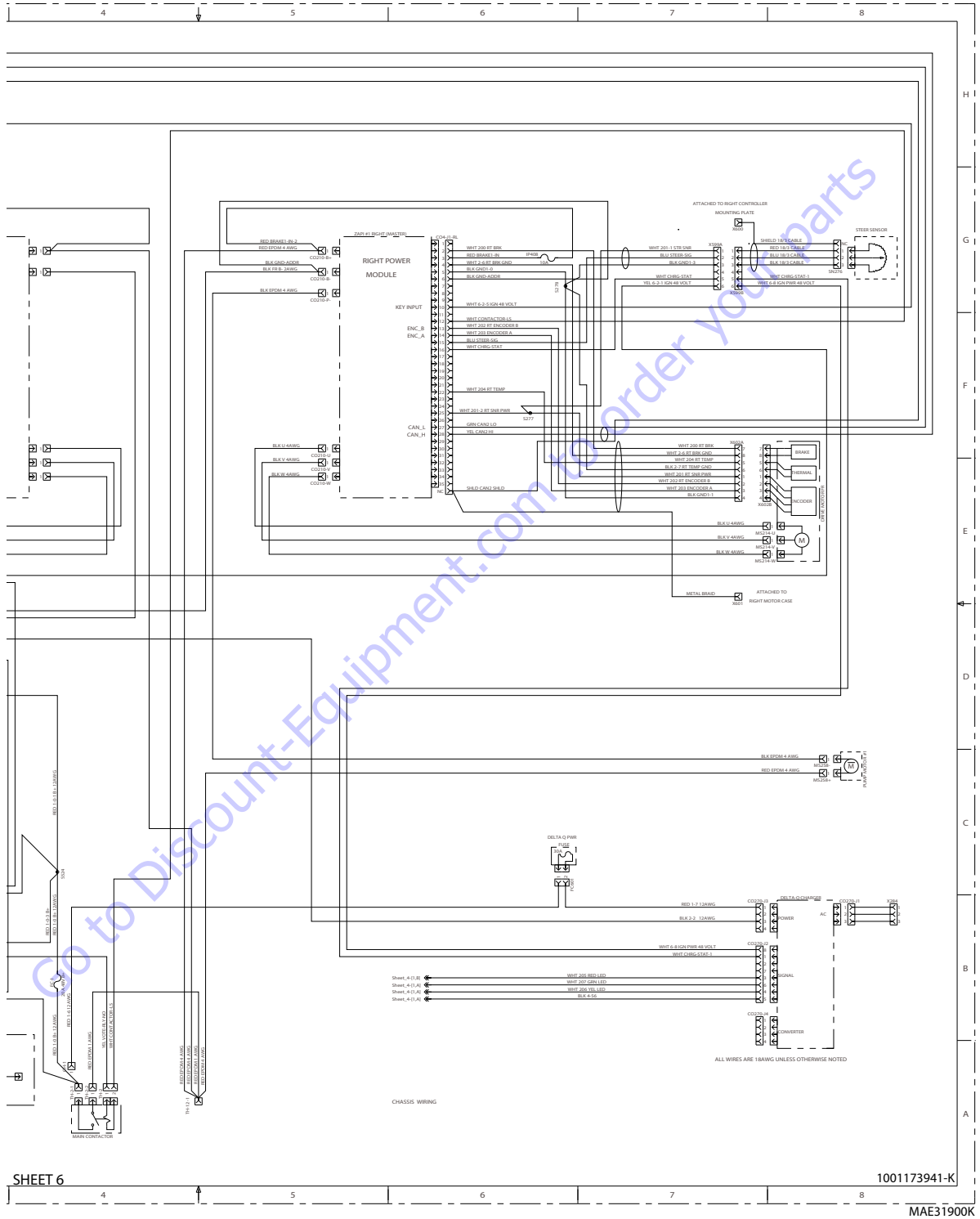


Figure 7-68. Electrical Schematic - Sheet 11 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

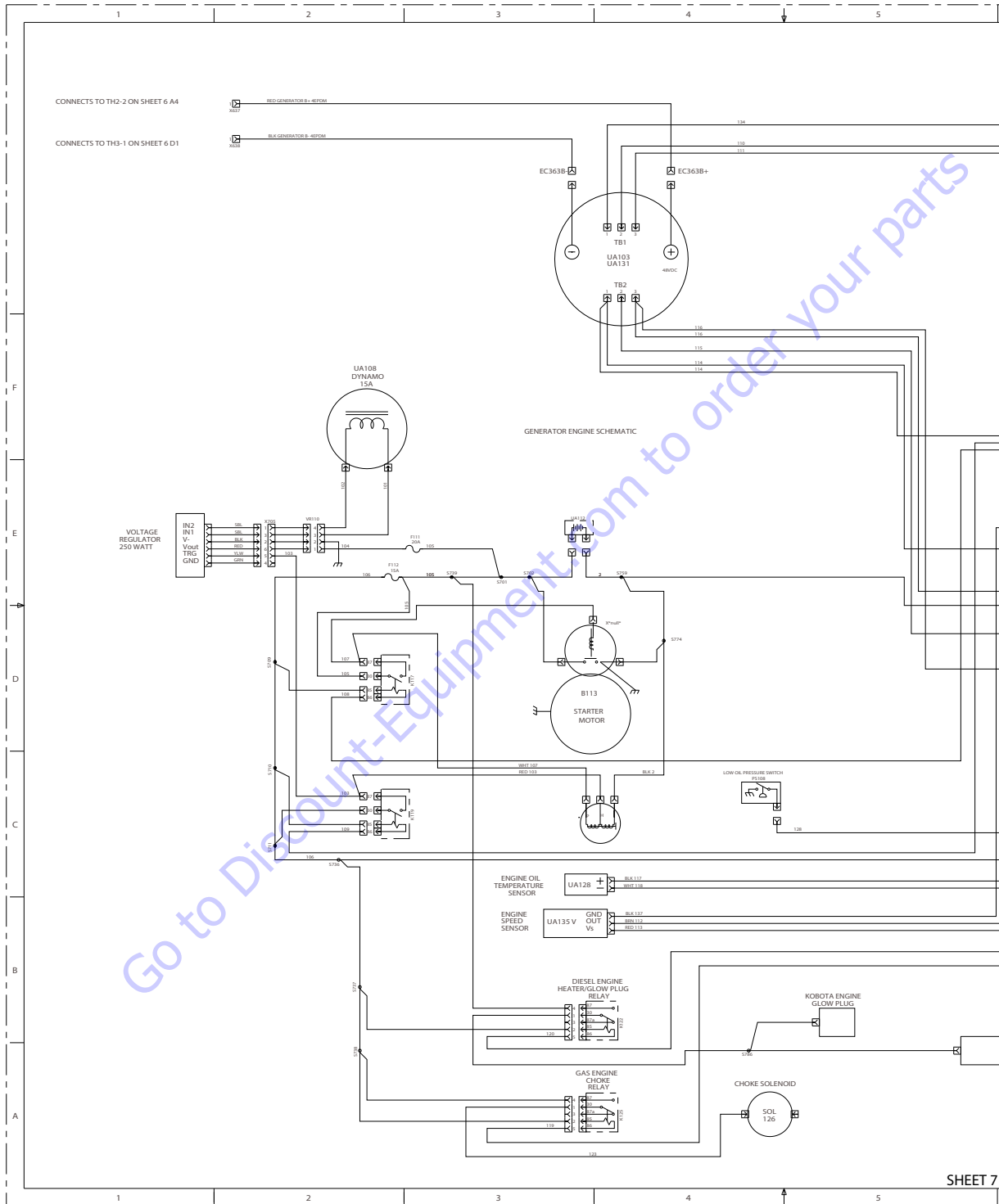


Figure 7-69. Electrical Schematic - Sheet 12 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

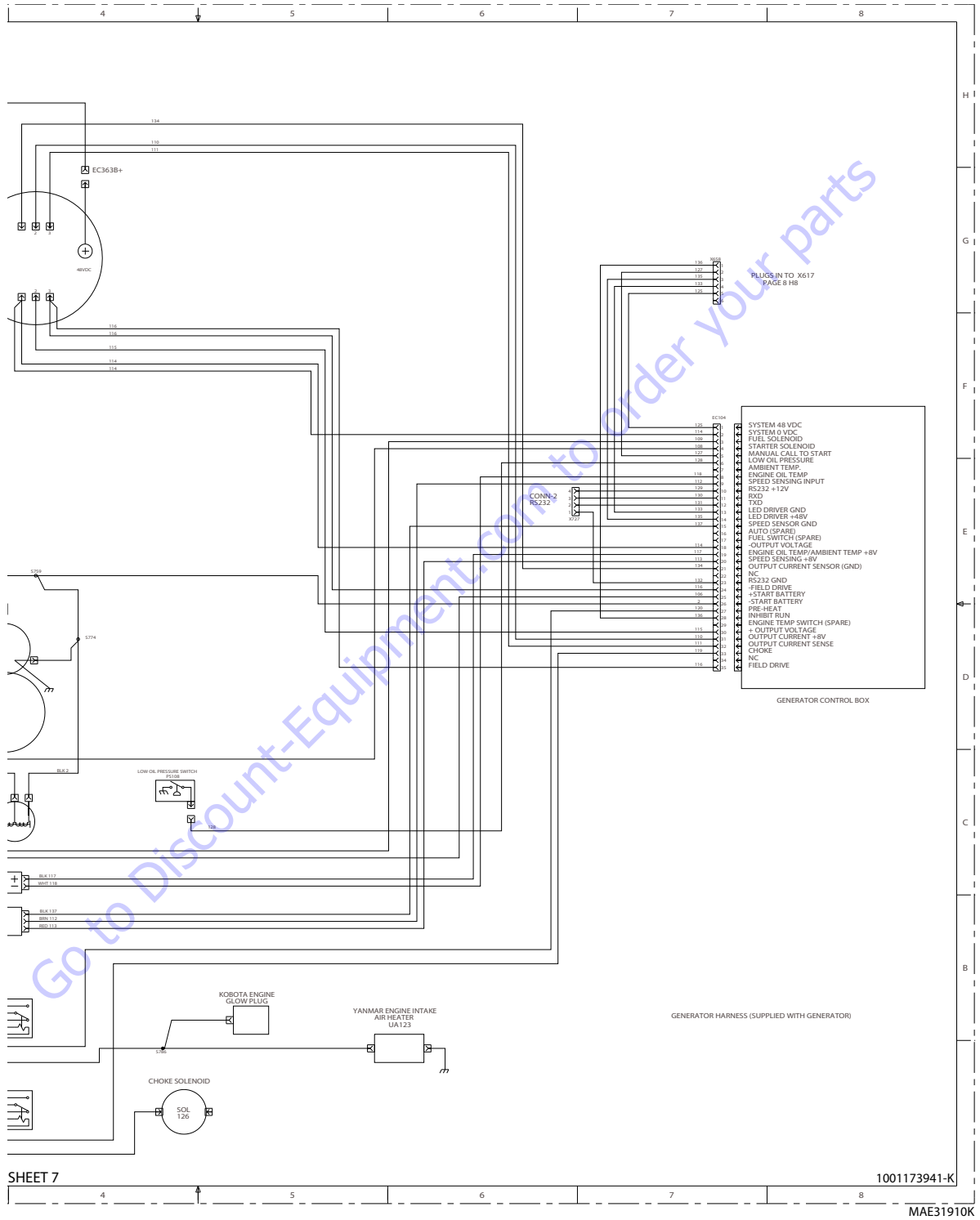


Figure 7-70. Electrical Schematic - Sheet 13 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

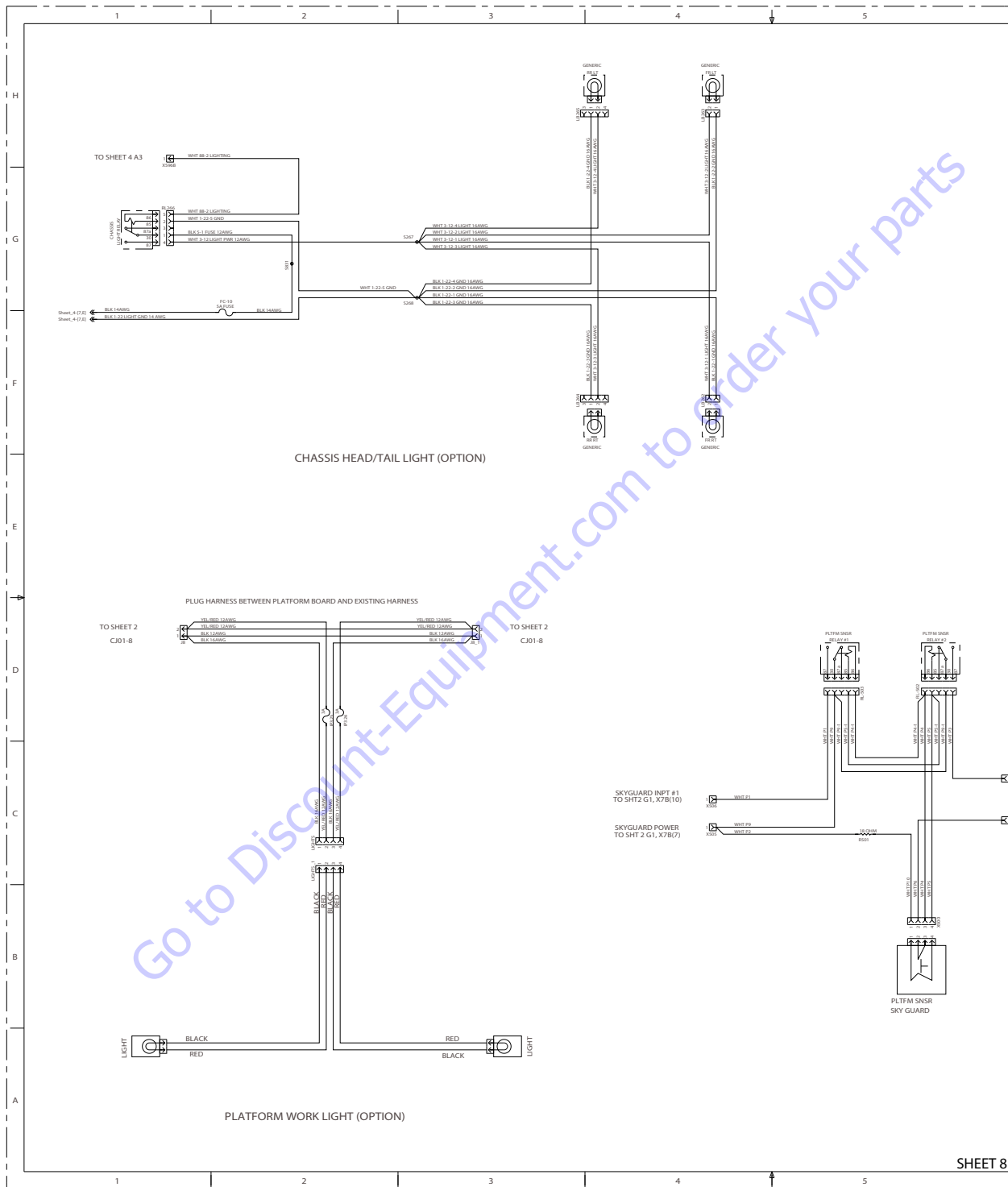


Figure 7-71. Electrical Schematic - Sheet 14 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

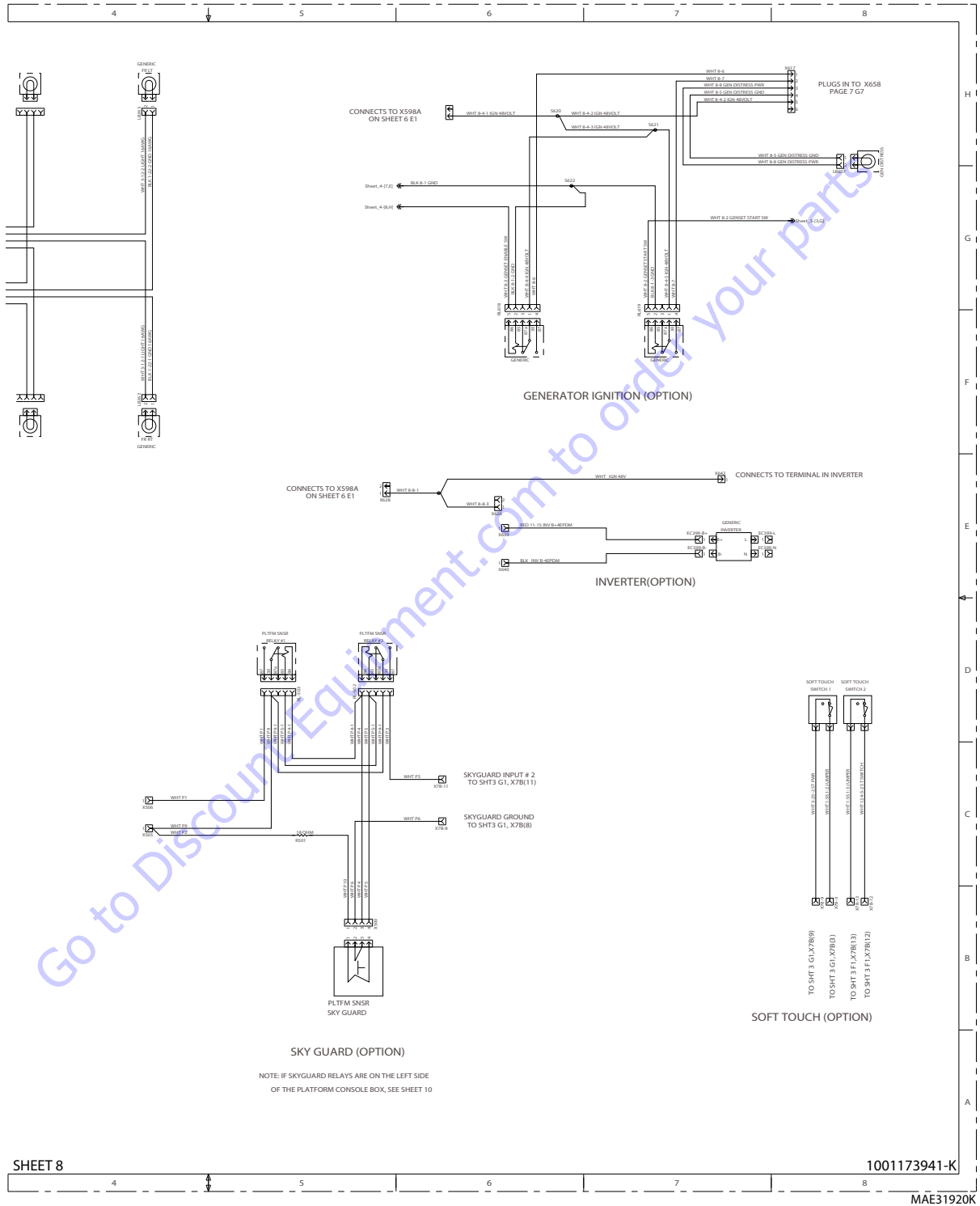
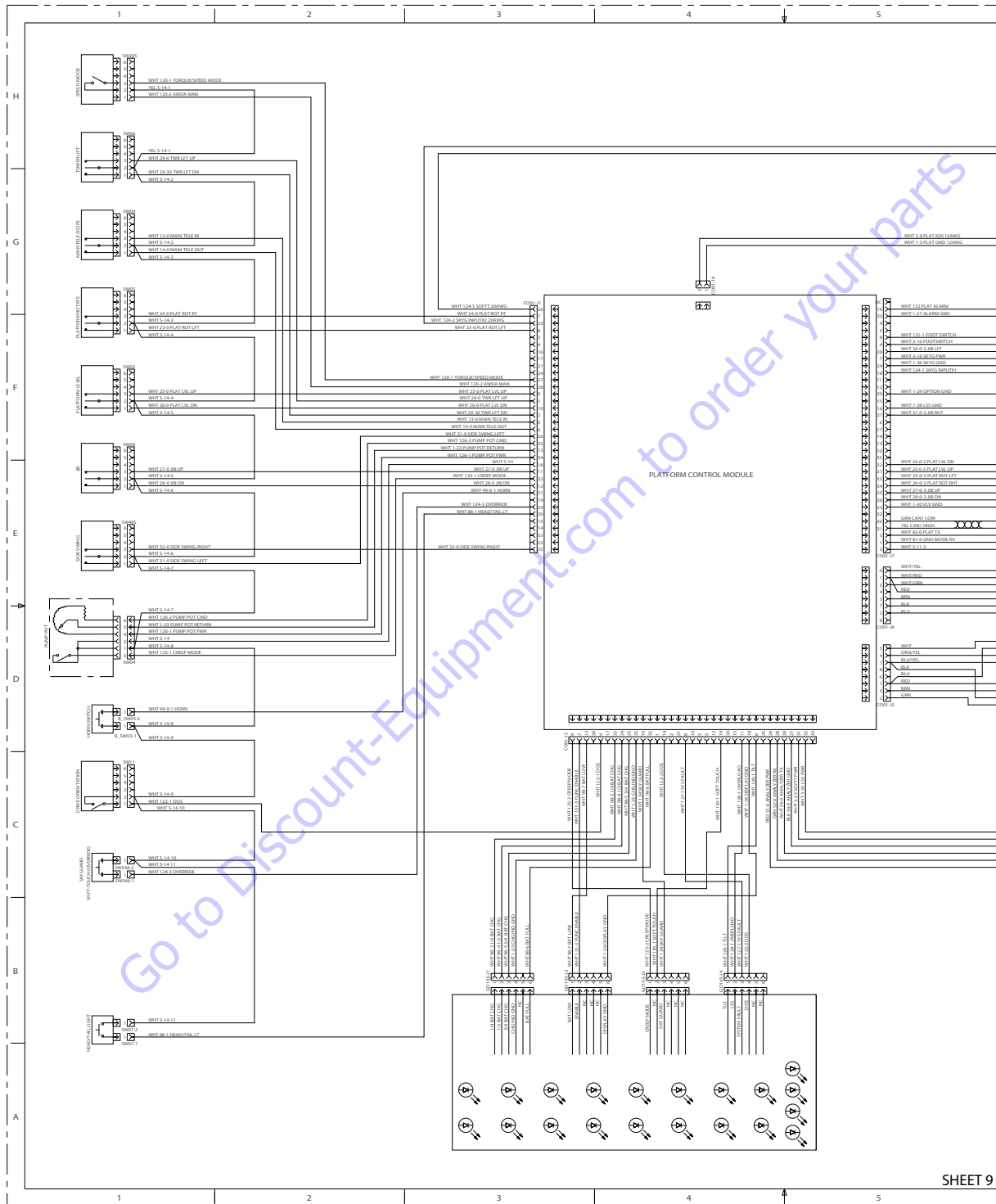


Figure 7-72. Electrical Schematic - Sheet 15 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS



SHEET 9

Figure 7-73. Electrical Schematic - Sheet 16 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

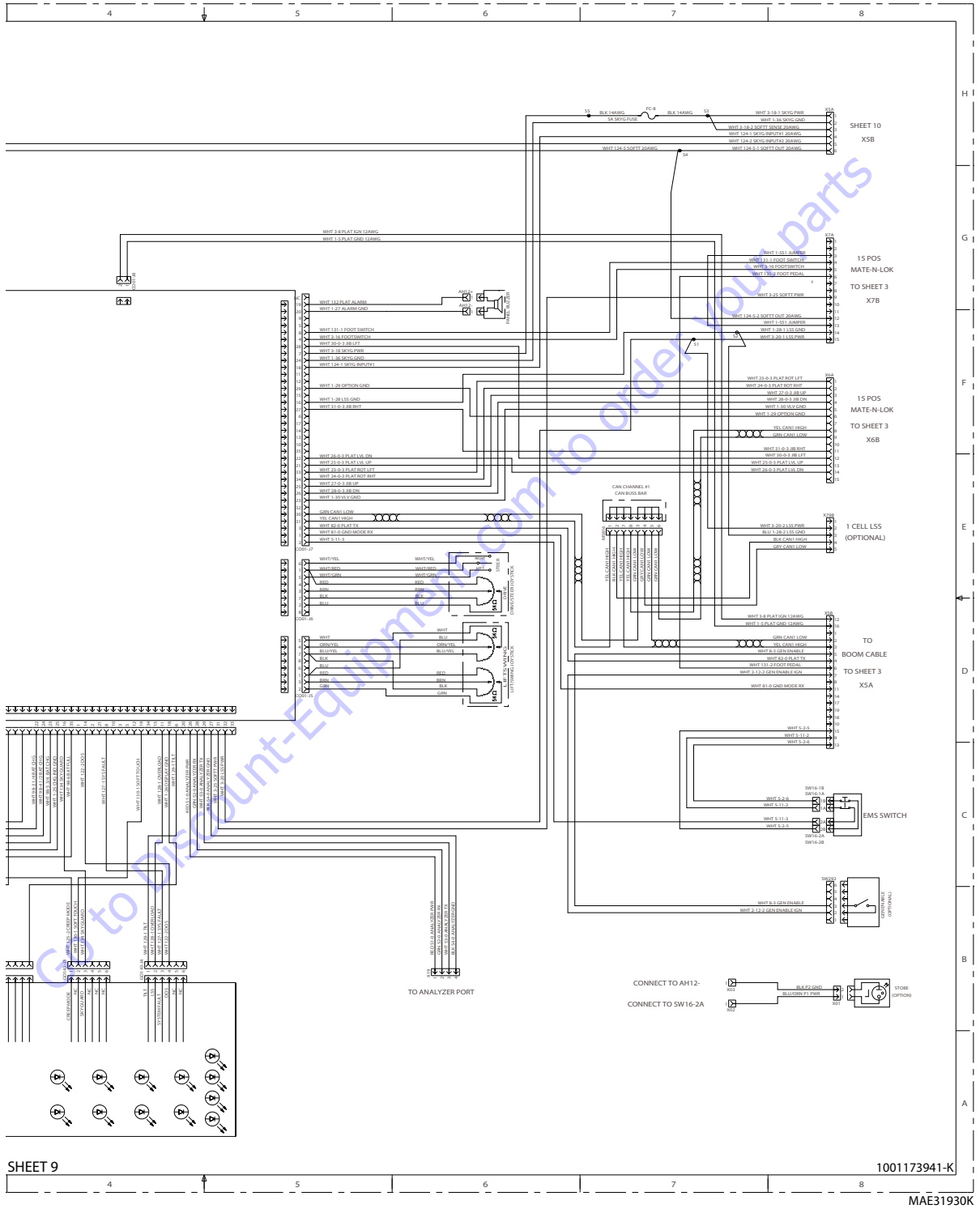


Figure 7-74. Electrical Schematic - Sheet 17 of 18

SECTION 7 - BASIC ELECTRICAL INFORMATION & ELECTRICAL SCHEMATICS

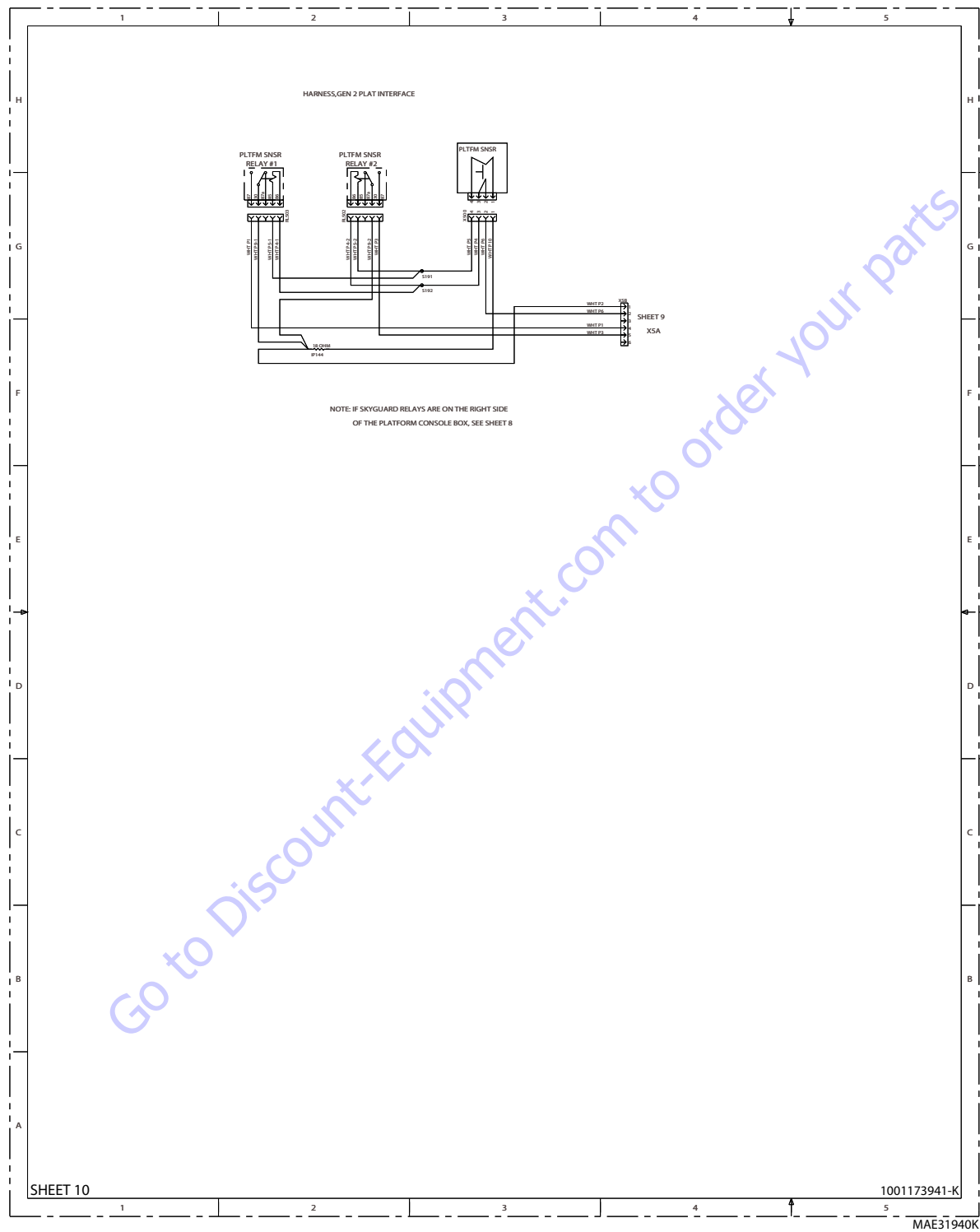


Figure 7-75. Electrical Schematic - Sheet 18 of 18

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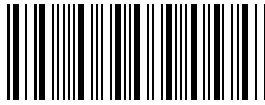
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