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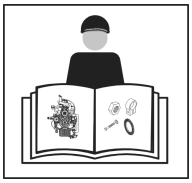
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EFFECTIVITY PAGE

https://truckmanualshub.com/

Table of Contents

Section 1 — Safety

General 1-1
Caution, Warning, and Danger 1-1
Safety Standard 1-2
Maintenance Safety 1-2
General 1-2
Mounting and Dismounting 1-2
Before Servicing the Machine 1-2
Fuel Hazards 1-3
Engine Coolant Hazards 1-3
Hydraulic System Hazards 1-4
Electrical System Hazards 1-4
Tire and Wheels Hazards 1-5
Rollover Protective Structure (ROPS) and Falling Object Protective Structure (FOPS) 1-6
Decals and Placards 1-6
General 1-6
Cleaning Decals 1-6
Attaching Decals 1-7
Decal Locations 1-7

Section 2 — Identification and Specifications

Serial Number Locations 2-1
Machine Serial Number 2-1
Engine Serial Number, John Deere 2-2
Axle Serial Number 2-3
Attachment Serial Number Plate 2-3
Identification 2-4
Specifications 2-5
Engine Specifications 2-8
John Deere 4045T 2-8

Section 3 — General Maintenance

General Instructions 3-1
Service Preparation Procedures 3-1
Service And Repair Procedures 3-2
Replacement Parts 3-3
General 3-3
Lubrication 3-3
General 3-3

https://truckmanualshub.com/

Table of Contents

Fluid and Lubricant Specifications 3-4
General Specifications 3-4
Engine Oil Specifications 3-4
Transmission Oil Specifications 3-5
Fuel Requirements 3-6
Grease 3-6
Care and Cleaning 3-7
Cleaning Exterior Surfaces 3-7
Cleaning the Cab 3-7
Cleaning Decals 3-8
Attaching Decals 3-8
Storage 3-8
Preparing the Machine for Long-Term Storage 3-8
Preparing the Machine After Long-Term Storage 3-9
Torque Specifications 3-10
General Torques for Standard Bolts, Capscrews, and Nuts 3-10
Hydraulic Fitting Torques 3-14
Jump Starting Procedures 3-16
Conversion Charts 3-18

Section 4 — Reference Diagrams

Mid-Inlet Hydraulic Schematic . . . . . Diagram 4-1
Control Valve . . . . . Diagram 4-2
. 4-5
Electrical Schematic . . . . . Diagram 4-3

Section 5 — Supply, Pressure, and Return Hydraulics

General 5-1
Major System Components 5-1
General Description 5-1
Hydraulic Systems 5-3
General Hydraulic Maintenance Practices 5-3
Safe Maintenance Practices 5-3
Cleanliness 5-4
Checking Hydraulic Lines 5-5
Hydraulic Reservoir 5-6
Description 5-6
Filling Hydraulic Reservoir 5-8
Reservoir Drain and Refill 5-11
Removal 5-13
Installation 5-15

https://truckmanualshub.com/

Table of Contents

Sight Gauge 5-16
Description 5-16
Removal 5-17
Installation 5-18
Suction Strainer 5-19
Description 5-19
Removal and Cleaning 5-20
Installation 5-20
Hydraulic Return Filter 5-21
Description 5-21
Checking Filter Condition 5-21
Replacing Return Filter Element 5-22
Removal 5-25
Installation 5-26
Reservoir Breather 5-26
Description 5-26
Removal and Installation 5-27
Hydraulic Pressure Filter 5-27
Description 5-27
Replacing Pressure Filter Element 5-28
Removal 5-29
Installation 5-30
Hydraulic Pump 5-30
Description 5-30
Troubleshooting Pump Problems 5-31
Removal 5-33
Hydraulic Pump 5-33
Installation 5-37
Checking Pump Flow Rate 5-38
Mid-Inlet Control Valve 5-40
Description 5-40
Removal 5-43
Installation 5-44
Rear Axle Stabilizer Control Valve 5-44
Description 5-44
Removal, Rear Axle Stabilizer Control Valve 5-47
Boom Extend Lockout Valve 5-49
Description 5-49
Hydraulic Diagnostic Ports 5-49
General 5-49
Roll-Back Hose Tray 5-51
General 5-51
Removal 5-51
Installation 5-53

https://truckmanualshub.com/

Table of Contents

Section 6 — Boom and Transfer

Boom and Transfer Hydraulics 6-1
General Description 6-1
Joystick Controls 6-2
General Description 6-2
Removal 6-3
Installation 6-4
Disassembly 6-5
Hydraulic Cylinders 6-9
Description 6-9
Checking Cylinder Condition 6-10
Boom Hoist Cylinder 6-12
Description 6-12
Removal 6-13
Installation 6-14
Overhaul 6-15
Front Carriage Tilt Cylinder 6-18
Description 6-18
Removal 6-19
Installation 6-20
Overhaul 6-21
Rear Carriage Tilt Cylinder 6-24
Description 6-24
Removal 6-25
Installation 6-26
Overhaul 6-27
Selector Valve 6-29
Description 6-29
Removal 6-30
Installation 6-31
Overhaul 6-31
Troubleshooting 6-33
Boom Slide Pads — General 6-34
Description 6-34
Slide Pad Inspection 6-34
Lubrication 6-36
Slide Area Surface Finish 6-36
Replacing and Shimming Boom Slide Pads — General 6-38
Quick Attach 6-40
Description 6-40
Disconnecting an Attachment 6-40
Connecting an Attachment 6-42
Removal 6-44
Installation 6-45

https://truckmanualshub.com/

Table of Contents

Boom Angle Inclinometer 6-46
Description 6-46
Replacement 6-46
4-Section Boom 6-47
Description 6-47
Shimming Procedures 6-48
Inspection Procedures 6-53
Boom Removal 6-55
installation 6-62
Boom Disassembly 6-63
Assembly 6-84
Boom Extend and Retract Chains 6-106
Chain Lubrication 6-107
Boom Chain Tension Check 6-108
Boom Hose Replacement 6-109
Extension Cylinder 6-111
Boom Extension Proximity Switch 6-117
Description 6-117
Removal 6-118
Installation 6-119
Adjustments 6-119
Transfer Carriage 6-120
Description 6-120
Installation 6-127
Rollers, Bushings, and Shims 6-129

Section 7 — Frame Tilt and Oscillation

Frame Tilt System 7-1
General Description 7-1
Circuit Description 7-1
Frame Tilt Control Valve 7-3
Description 7-3
Removal 7-4
Installation 7-5
Overhaul 7-6
Frame Tilt Cylinder 7-8
Description 7-8
Removal 7-9
Installation 7-10
Overhaul 7-12
Counterbalance Valve Cartridge 7-15
Frame Level Indicator 7-16
Description 7-16
Adjustment 7-16

https://truckmanualshub.com/

Table of Contents

Rear Oscillation Lock System 7-17
General Description, Models with Control Manifold Hydraulics 7-17
Theory of Operation and Circuit Logic 7-18
Testing Rear Oscillation Lock Circuit 7-23
Rear Oscillation Lock Cylinder 7-24
Description 7-24
Removal 7-25
Installation 7-26
Overhaul 7-28
Oscillation Control Block 7-31
Description 7-31
Removal 7-32
Installation 7-34
Overhaul 7-35
Boom Elevation Proximity Switch 7-37
Description 7-37
Removal 7-38
Installation 7-39
Adjustment 7-39

Section 8 — Transmission

Transmission Assembly Component Terminology 8-1
Transmission Description 8-1
Transmission Operation 8-2
Transmission Specifications 8-3
Transmission General Specification 8-3
Transmission Performance Specification 8-3
Transmission Lubrication 8-3
Transmission Maintenance 8-4
Transmission Removal 8-6
Transmission Inspection and Internal Repair 8-10
Transmission Installation 8-10
After Transmission Service or Replacement 8-12
Transmission Shift Logic 8-13
Troubleshooting 8-15
Transmission Troubleshooting 8-16

Section 9 — Axles and Brakes

Axle and Drive Shaft Component Terminology 9-1
General Information 9-1
Axle Assembly 9-2
Axle Inspection, Internal Service and Repair 9-5

https://truckmanualshub.com/

Table of Contents

Axle Installation 9-5
Axle Service and Troubleshooting 9-6
Drive Shafts 9-7
Drive Shaft Maintenance 9-8
DriveShaft Removal 9-8
Transmission-to-Axle Drive Shaft 9-9
Drive Shaft Disassembly 9-9
Drive Shaft Assembly 9-10
Service Brakes 9-12
Service Brake Pressure Switch Replacement 9-12
Accumulator 9-13
General 9-13
Precautions 9-14
Pre-Charging Accumulator 9-14
Checking Pre-charge 9-16
Towing a Disabled Machine 9-17
Manually Releasing the Park Brake 9-18
Manually Resetting the Park Brake 9-18

Section 10 — Outriggers

Outriggers 10-1
General 10-1
Removal 10-2
Installation 10-3
Outrigger Cylinders 10-4
General 10-4
Removal 10-5
Installation 10-6
Overhaul 10-7
Differential Pressure Switch 10-9
Description 10-9
Boom Extension Proximity Switch 10-10
Description 10-10
Removal 10-11
Installation 10-12
Adjustments 10-12
Outrigger Control Valves 10-13
Description 10-13
Removal 10-14
Installation 10-15

https://truckmanualshub.com/

List of Figures

Fig. 1-1: Decals and Placards 1-8
Fig. 1-2: Instrument Panel Decals 1-8
Fig. 1-3: Control Decals 1-9
Fig. 1-4: Disconnect Battery Decal and Slow Moving Vehicle Sign 1-9
Fig. 1-5: Steer Selector Plate 1-10
Fig. 1-6: Hydraulic Reservoir/Fuel Tank Decals 1-10
Fig. 1-7: Fork Carriage Decals 1-10
Fig. 2-1: Machine Serial Number Plate 2-1
Fig. 2-2: Engine Serial Number — John Deere 2-2
Fig. 2-3: Axle Serial Number 2-3
Fig. 2-4: Attachment Serial Number Plate 2-3
Fig. 2-5: Top View 2-4
Fig. 2-6: Left Side View 2-4
Fig. 3-1: SAE Grade Identification 3-10
Fig. 3-4: Metric Class Identification 3-13
Fig. 5-1: Major Hydraulic Components 5-1
Fig. 5-2: Mid-Inlet Hydraulic Components 5-3
Fig. 5-3: Hydraulic Reservoir Location 5-6
Fig. 5-4: Hydraulic Reservoir 5-7
Fig. 5-5: Recommended Reservoir Filling Method 5-8
Fig. 5-6: Alternate Reservoir Filling Method 5-9
Fig. 5-7: Hydraulic Reservoir Drain and Refill 5-11
Fig. 5-8: Hydraulic Reservoir/Fuel Tank Installation 5-13
Fig. 5-9: Hydraulic Reservoir Sight Gauge 5-16
Fig. 5-10: Reservoir Sight Gauge Installation 5-17
Fig. 5-11: Suction Strainer Installation 5-19
Fig. 5-12: Hydraulic Return Filter 5-21
Fig. 5-13: Return Filter Pressure Gauge 5-21
Fig. 5-14: Filter Housing Cover 5-22
Fig. 5-15: Filter Element Assembly 5-23
Fig. 5-16: Return Filter Assembly 5-25
Fig. 5-17: Reservoir Breather 5-26
Fig. 5-18: Hydraulic Pressure Filter – Control Manifold Hydraulics 5-27
Fig. 5-19: Hydraulic Pressure Filter Element 5-28
Fig. 5-20: Hydraulic Pressure Filter Assembly 5-29
Fig. 5-21: Hydraulic Pump Location 5-30
Fig. 5-22: Hydraulic Pump Hoses – Mid-Inlet Hydraulics 5-33
Fig. 5-23: Hydraulic Pump Installation – Mid-Inlet Hydraulics 5-35

https://truckmanualshub.com/

List of Figures

Fig. 5-24: Checking Hydraulic Pump Flow Rate 5-38
Fig. 5-25: Mid-Inlet Control Valve Location 5-40
Fig. 5-26: Mid-Inlet Control Valve Components. 5-40
Fig. 5-27: Mid-Inlet Control Valve Configurations, ... 5-42
Fig. 5-28: Mid-Inlet Control Valve Installation 5-43
Fig. 5-29: Rear Axle Stabilizer Control Valve Location 5-44
Fig. 5-30: Rear Axle Stabilizer Control Valve Ports. 5-45
Fig. 5-31: Rear Axle Stabilizer Control Valve. 5-47
Fig. 5-32: Boom Extend Lockout Valve 5-49
Fig. 5-33: Hydraulic Diagnostic Ports - Models with Mid-Inlet Hydraulics 5-49
Fig. 5-34: Roll-Back Hose Frame Location - Control Manifold Hydraulics 5-51
Fig. 5-35: Roll-Back Tray Installation - Mid-Inlet Hydraulics 5-52
Fig. 6-1: Major Boom and Transfer Hydraulic Components 6-1
Fig. 6-2: Joystick 6-2
Fig. 6-3: Joystick Installation 6-3
Fig. 6-4: Joystick Components 6-5
Fig. 6-5: Pilot Pressure Diagnostic Port. 6-8
Fig. 6-6: Pilot Pressure Plug 6-9
Fig. 6-7: Boom Hoist Cylinders 6-12
Fig. 6-8: Boom Hoist Cylinder Installation 6-13
Fig. 6-9: Boom Hoist Cylinder Assembly 6-15
Fig. 6-10: Front Carriage Tilt Cylinder 6-18
Fig. 6-11: Front Carriage Tilt Cylinder Installation 6-19
Fig. 6-12: Front Carriage Tilt Cylinder Assembly. 6-21
Fig. 6-13: Rear Carriage Tilt Cylinder 6-24
Fig. 6-14: Rear Carriage Tilt Cylinder Installation 6-25
Fig. 6-15: Rear Carriage Tilt Cylinder Assembly 6-27
Fig. 6-16: Selector Valve 6-29
Fig. 6-17: Selector Valve Installation 6-30
Fig. 6-18: Selector Valve Assembly. 6-31
Fig. 6-19: Load Bearing Pad 6-34
Fig. 6-20: Pad Worn, But Still OK 6-35
Fig. 6-21: Pad Must Be Replaced 6-35
Fig. 6-22: Bolted Boom Slide Pad 6-35
Fig. 6-23: Slide Pad Without Chamfers – 3 and 4-Section Boom 6-36
Fig. 6-24: Damaged Slide Surface 6-37
Fig. 6-25: Slide Surface Repair 6-37
Fig. 6-26: Slide Pad Installation (2-Section Shown) 6-38

https://truckmanualshub.com/

List of Figures

Fig. 6-27: Positioning Retaining Block 6-38
Fig. 6-28: Determining Capscrew Length 6-39
Fig. 6-29: Correctly Installed Capscrew 6-39
Fig. 6-30: Quick Attach Rear View 6-40
Fig. 6-31: Release Handle 6-40
Fig. 6-32: Lock Plate 6-41
Fig. 6-33: Rotating Quick Attach Downwards 6-41
Fig. 6-34: Lowering Boom 6-41
Fig. 6-35: Retracting Boom 6-42
Fig. 6-36: Extending Boom 6-42
Fig. 6-37: Raising Boom 6-42
Fig. 6-38: Rotating Quick Attach Forward 6-43
Fig. 6-39: Lock Plate Engaged 6-43
Fig. 6-40: Lower Pivot of Carriage Tilt Cylinder 6-44
Fig. 6-41: Quick Attach Pivot 6-45
Fig. 6-42: Boom Angle Inclinometer 6-46
Fig. 6-43: Boom Angle Inclinometer Installation 6-46
Fig. 6-44: 4-Section Boom 6-47
Fig. 6-45: Boom Slide Pad Locations – 4-Section Boom 6-48
Fig. 6-46: Boom Section Gaps – Front of 4-Section Boom 6-48
Fig. 6-47: Lower Shim Installation – Front of 4-Section Boom 6-49
Fig. 6-48: Upper Shim Installation – Front of 4-Section Boom 6-49
Fig. 6-49: Boom Section Gaps – Rear of 4-Section Boom 6-50
Fig. 6-50: Lower Shim Installation - Rear of 4-Section Boom 6-50
Fig. 6-51: Upper Shim Installation – Rear of 4-Section Boom 6-51
Fig. 6-52: Clearances Between Boom Sections – Rear of 4-Section Boom 6-51
Fig. 6-53: Gaps Between Pads and Boom – Rear of 4-Section Boom 6-52
Fig. 6-54: Clearances Between Boom Sections – Front of 4-Section Boom 6-52
Fig. 6-55: Gaps Between Pads and Boom – Front of 4-Section Boom 6-53
Fig. 6-56: Inner Boom Cross-Section at Window 6-54
Fig. 6-57: Middle (Forward) Boom Cross-Section at Window 6-54
Fig. 6-58: Middle (Forward) Boom Cross-Section at Window 6-55
Fig. 6-59: 4-Section Boom Cover Installation 6-56
Fig. 6-60: Hose Connections, 4-Section Boom 6-56
Fig. 6-61: Cylinder Pivot Pins 6-57
Fig. 6-62: Upper Rear Slide Pad Removal – Middle (Rear) Boom Section 6-58
Fig. 6-63: Upper Rear Slide Pad Removal – Middle (Forward) Boom Section 6-59
Fig. 6-64: Upper Rear Slide Pad Removal – Inner Boom Section 6-59

https://truckmanualshub.com/

List of Figures

Fig. 6-65: Locations for Chain Attachment – Inner Boom Section 6-60
Fig. 6-66: 4-Section Boom Pivot Pins 6-61
Fig. 6-67: Slide Pad Removal – Outer Boom Section 6-64
Fig. 6-68: Lower Front Slide Pad Removal – Middle (Rear) Boom Section 6-65
Fig. 6-69: Disconnecting Hoses Between Sections 6-66
Fig. 6-70: Extension Cylinder Removal – 4-Section Boom 6-67
Fig. 6-71: Upper Front Slide Pad Removal – Middle (Rear) Boom Section 6-68
Fig. 6-72: Upper Front Slide Pad Removal – Middle (Forward) Boom Section 6-69
Fig. 6-73: Upper Chain – Middle (Forward) to Middle (Rear) Boom Sections 6-69
Fig. 6-74: Upper Chain Roller Assembly – Middle (Forward) Boom Section 6-70
Fig. 6-75: Disconnecting Chains at Rear of Inner Boom 6-71
Fig. 6-76: Disconnecting Chains at Rear of Middle (Forward) Boom 6-71
Fig. 6-77: Slide Pad Removal – Inner Boom Section 6-72
Fig. 6-78: Slide Pad Removal – Middle (Forward) Boom Section 6-73
Fig. 6-79: Grease Hose Assembly 6-74
Fig. 6-80: Rear Chain Roller Removal - Middle (Forward) Boom Section 6-75
Fig. 6-81: Hose and Tube Removal – Inner Boom Section 6-76
Fig. 6-82: Upper Chain Assembly 6-77
Fig. 6-83: Upper Chain Roller Assembly – Middle (Rear) Boom Section 6-77
Fig. 6-84: Removing Lower Chains 6-78
Fig. 6-85: Slide Pads – Middle (Rear) Boom Section 6-79
Fig. 6-86: Chain and Hose Guide Assembly 6-80
Fig. 6-87: Tubes and Hoses – Middle (Rear) and Outer Boom Sections 6-81
Fig. 6-88: Side Slide Pads – Outer Boom Section 6-82
Fig. 6-89: Outer Boom Tubes and Hoses 6-83
Fig. 6-90: Outer Boom Tube and Hose Assembly 6-85
Fig. 6-91: Extension Cylinder Installation 6-86
Fig. 6-92: Lower Chains on Outer Boom Section 6-87
Fig. 6-93: Lower Rear Slide Pad Installation - Middle (Rear) Boom Section 6-88
Fig. 6-94: Tubes and Hoses – Middle (Rear) Boom Sections 6-89
Fig. 6-95: Chain and Hose Guide Assembly 6-90
Fig. 6-96: Installation of Lower Chain – Middle (Rear) Boom Section 6-91
Fig. 6-97: Upper Chain Roller Assembly – Middle (Rear) Boom Section 6-92
Fig. 6-98: Chain Roller Assemblies - Middle (Forward) Boom Section 6-93
Fig. 6-99: Slide Pad Installation – Middle (Forward) Boom Section 6-94
Fig. 6-100: Hydraulic Hose and Tube Installation – Inner Boom Section 6-95
Fig. 6-101: Slide Pad Installation – Inner Boom Section 6-96
Fig. 6-102: Grease Hose Installation 6-96

https://truckmanualshub.com/

List of Figures

Fig. 6-103: Upper Chain Installation – Inner Boom Section 6-97
Fig. 6-104: Upper Slide Pad Installation – Front of Middle (Forward) Boom Section 6-98
Fig. 6-105: Upper Chain and Hose Reel Assembly – Middle (Forward) Boom 6-99
Fig. 6-106: Rear Slide Pad Installation 6-99
Fig. 6-107: Front Slide Pad Installation – Outer and Middle (Rear) Boom Sections 6-100
Fig. 6-108: Lower Chain Installation – Inner Boom Section 6-101
Fig. 6-109: Lower Chain Installation – Middle (Forward) Boom Section 6-101
Fig. 6-110: Upper Chains – Middle (Rear) to Outer Boom Sections 6-102
Fig. 6-111: Upper Chain – Middle (Forward) to Middle (Rear) Boom Sections 6-103
Fig. 6-112: Securing Lower Chains – Middle (Rear) and Outer Boom Sections 6-103
Fig. 6-113: Securing Boom Extension Cylinder 6-104
Fig. 6-114: Connecting Hoses Between Sections 6-105
Fig. 6-115: Boom Tension Check 6-108
Fig. 6-116: 4-Section Boom Extension Cylinder 6-111
Fig. 6-117: 4-Section Boom Extension Cylinder Installation 6-112
Fig. 6-118: 4-Section Boom Extension Cylinder Assembly 6-114
Fig. 6-119: Boom Extension Proximity Switch 6-117
Fig. 6-120: Boom Extension Proximity Switch Operation 6-118
Fig. 6-121: Boom Extension Proximity Switch Assembly 6-118
Fig. 6-122: Boom Extension Proximity Switch Adjustment 6-119
Fig. 6-123: Transfer Carriage 6-120
Fig. 6-124: Disconnecting Transfer Cylinder from Transfer Carriage 6-121
Fig. 6-125: Boom Elevation Proximity Switch Wiring 6-122
Fig. 6-126: Boom Cover Installation 6-122
Fig. 6-127: Boom Extension Proximity Switch Wiring 6-123
Fig. 6-128: Disconnecting Hydraulic Hoses from Transfer Carriage 6-124
Fig. 6-129: Transfer Carriage with Boom Installation 6-125
Fig. 6-130: Transfer Carriage Installation 6-126
Fig. 6-131: Transfer Carriage – Front Rollers, Bushings, and Shims 6-129
Fig. 6-132: Shims for Front Transfer Rollers 6-130
Fig. 6-133: Scraper Plate 6-131
Fig. 6-134: Transfer Carriage – Rear Rollers, Bushings, and Shims 6-132
Fig. 6-135: Spacer Washers for Rear Transfer Rollers 6-133
Fig. 6-136: Rear Slide Block Installation 6-134
Fig. 7-1: Frame Tilt System Components 7-1
Fig. 7-2: Frame Tilt Control Valve 7-3
Fig. 7-3: Frame Tilt Control Valve Installation 7-4
Fig. 7-4: Frame Tilt Control Valve (Exploded View) 7-6

https://truckmanualshub.com/

List of Figures

Fig. 7-5: Frame Tilt Cylinder 7-8
Fig. 7-6: Frame Tilt Cylinder Installation 7-9
Fig. 7-7: Frame Tilt Cylinder (Exploded View) 7-12
Fig. 7-8: Counterbalance Valve Cartridges, Frame Tilt Cylinder 7-15
Fig. 7-9: Frame Level Indicator 7-16
Fig. 7-10: Leveling the Frame 7-16
Fig. 7-11: Circuit Operation Below 40° 7-18
Fig. 7-12: Circuit Operation Above 40° 7-19
Fig. 7-13: Circuit Operation Above 20° Below 40° 7-20
Fig. 7-14: Circuit Operation Above 20° Below 40° with Service Brake Applied 7-21
Fig. 7-15: Circuit Operation Below 20° With the Service Brake Applied 7-22
Fig. 7-16: Rear Oscillation Lock Cylinder 7-24
Fig. 7-17: Rear Oscillation Lock Cylinder Installation 7-25
Fig. 7-18: Rear Oscillation Lock Cylinder (Exploded View) 7-28
Fig. 7-19: Oscillation Control Block 7-31
Fig. 7-20: Oscillation Control Block Installation 7-32
Fig. 7-21: Oscillation Control Block (Exploded View) 7-35
Fig. 7-22: Boom Elevation Proximity Switch 7-37
Fig. 7-23: Boom Elevation Proximity Switch Operation 7-38
Fig. 7-24: Boom Elevation Proximity Switch Assembly 7-38
Fig. 7-25: Boom Elevation Proximity Switch Adjustment 7-39
Fig. 8-1: ZF Transmission 8-1
Fig. 8-2: Transmission Serial Number Plate Location 8-3
Fig. 8-3: The Lubrication and Maintenance Flip Chart 8-4
Fig. 8-4: Transmission Oil Cooler Hose Connections 8-5
Fig. 8-5: Disconnect the Battery Negative (-) Cable 8-6
Fig. 8-6: Drain Transmission Oil 8-7
Fig. 8-7: Transmission Oil Cooler Hose Connections 8-8
Fig. 8-8: Remove Transmission from Frame 8-9
Fig. 8-9: Transmission External Components 8-10
Fig. 8-10: Install the Transmission 8-11
Fig. 8-11: Transmission Oil Cooler Hose Connections 8-11
Fig. 8-12: Transmission Shift Logic Schematic 8-15
Fig. 9-1: Axle and Drive Shaft 9-1
Fig. 9-2: Service Brake Pedal Pressure Switch 9-12
Fig. 9-3: Accumulator 9-13
Fig. 9-4: Accumulator Charging 9-15
Fig. 9-5: Park Brake Hoses 9-17

https://truckmanualshub.com/

List of Figures

Fig. 10-1: Outriggers 10-1
Fig. 10-2: Outrigger Installation 10-2
Fig. 10-3: Outrigger Cylinders 10-4
Fig. 10-4: Outrigger Cylinder Installation 10-5
Fig. 10-5: Outrigger Cylinder Assembly 10-7
Fig. 10-6: Boom Extension Proximity Switch 10-10
Fig. 10-7: Boom Extension Proximity Switch Operation 10-11
Fig. 10-8: Boom Extension Proximity Switch Assembly 10-11
Fig. 10-9: Boom Extension Proximity Switch Adjustment 10-12
Fig. 10-10: Outrigger Controls 10-13
Fig. 10-11: Outrigger Control Valve Installation 10-14

https://truckmanualshub.com/

List of Tables

Table 3-1: General Fluid and Lubricant Specifications 3-1
Table 3-2: John Deere Engine Oil Specifications 3-2
Table 3-3: ZF Transmission Oil Specifications 3-3
Table 3-4: Torque for JIC and SAE Female Swivel Nuts 3-4
Table 3-5: Torque for Non-adjustable O-ring Fittings 3-5
Table 3-6: Torque for Adjustable O-ring Fittings 3-6
Table 3-7: Torque for O-ring Plugs 3-7
Table 3-8: Pipe Thread Fittings (Steel) 3-8
Table 3-9: Inch Fraction, Decimal, and Metric Conversion Chart 3-9
Table 3-10: Miscellaneous Conversions 3-10
Table 5-1: Rear Axle Stabilizer Control Valve Markings 5-1
Table 7-1: Rear Oscillation Lock Circuit Test Matrix 7-1

https://truckmanualshub.com/

List of Tables

https://truckmanualshub.com/

Table of Contents

General 1
Caution, Warning, and Danger 1
Safety Standard 2
Maintenance Safety 2
General 2
Mounting and Dismounting 2
Before Servicing the Machine 2
Fuel Hazards 3
Engine Coolant Hazards 3
Hydraulic System Hazards 4
Electrical System Hazards 4
Tire and Wheels Hazards 5
Rollover Protective Structure (ROPS) and Falling Object Protective Structure (FOPS) 6
Decals and Placards 6
General 6
Cleaning Decals 6
Attaching Decals 7
Decal Locations 7

List of Figures

Fig. 1-1: Decals and Placards 1-8
Fig. 1-2: Instrument Panel Decals 1-8
Fig. 1-3: Control Decals 1-9
Fig. 1-4: Disconnect Battery Decal and Slow Moving Vehicle Sign 1-9
Fig. 1-5: Steer Selector Plate 1-10
Fig. 1-6: Hydraulic Reservoir/Fuel Tank Decals 1-10
Fig. 1-7: Fork Carriage Decals 1-10

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Section 1 — Safety

General

Observing basic safety rules and precautions can eliminate accidents when operating, maintaining, and repairing the forklift. The Operator's Manual contains detailed information regarding safety practices when driving and operating the forklift. Always be alert to potential hazardous situations that could result in injury to yourself or bystanders. Care should also be taken to avoid damage to the equipment. Maintenance should always be done by trained personnel using proper tools.

Caution, Warning, and Danger



W1049

Hazards are identified by the "Safety Alert Symbol" and followed by a signal word: Caution, Warning, or Danger.



CAUTION: Means that a situation COULD be hazardous and MAY result in personal injury if not avoided. CAUTION is also used to alert against unsafe practices that could result in equipment damage.



WARNING: Means that a situation COULD be hazardous and MAY result in serious injury or death if not avoided.



DANGER: Means that a situation IS HAZARDOUS and WILL result in serious injury or death if not avoided.

Safety Standard

The ASME/ANSI B56.6 safety standard for rough terrain forklift trucks defines safety requirements relating to the design, operation, and maintenance of these vehicles. For a copy of this standard write to:

The American Society of Mechanical Engineers
United Engineering Center
345 East 47th Street
New York, NY 10017

Maintenance Safety

General

DO NOT attempt machine operation or maintenance until you have read and fully understand the safety instructions in this section. Only trained and authorized personnel should be permitted to operate or maintain the machine.

Mounting and Dismounting

Mount and dismount the machine only where steps and handholds are provided. Keep steps, handholds and the cab floor free of debris, mud, and other foreign matter. Replace damaged, loose, or excessively worn no-slip surfacing on cab floor.

Face the machine when mounting and dismounting. Do not attempt to get off the machine while it is moving. Never jump off the machine. Do not mount or dismount the machine when carrying tools, equipment, etc.

Before Servicing the Machine

Before servicing the machine, position the forklift in a level area out of any traffic lanes and follow safe shutdown procedures as described in the Owners/Operators Manual supplied with each machine.

Wear all the protective clothing and personal safety gear necessary to perform the job safely. This may include:

- Aprons
- Heavy gloves
- Safety glasses or goggles
- Safety shoes
- Welding helmet
- Filter mask or respirator.

Check the following items:

- If the forklift should not be started, attach a “**DO NOT OPERATE**” warning tag to the steering wheel and remove the ignition key.

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- Make certain there is adequate light and ventilation.
- Remove any foreign substances (i.e. oil, grease, water, snow, ice) to eliminate any slippery surfaces and to remove all contaminants from the area.
- Use only the correct tools to perform the maintenance or repair.
- Make sure all jacks, hoists, jack stands, or blocks are stable and strong enough to handle the weight of the forklift or component that you will be working on.
- Remove only the guards or covers that provide access to the area being serviced and replace all guards or covers when work is complete.

Note: *Keep bystanders away if access doors are open or guards are removed. NEVER leave the forklift unattended with open access doors or any guards removed.*

Fuel Hazards

Observe the following practices to reduce the possibility of an explosion when working with fuel.

- Never fill the tank with the engine running. Shut off engine and ignition during refueling.
- Make sure you have adequate ventilation during refueling.
- Do not permit anyone to be on the machine during refueling.
- Always ground the fuel nozzle against the filler neck to avoid sparks.
- Never use an open flame when checking the fuel level in the tank.
- Keep sparks and open flames away from fuel.
- Do not smoke while refueling or when handling fuel containers.
- Never cut or weld on or near fuel lines, tanks, or containers.
- Never overfill the tank or spill fuel. If you spill fuel, clean it up immediately. Spilled fuel must be completely absorbed or evaporated before starting the engine.
- Make sure the fuel cap is in place before starting the engine.

Engine Coolant Hazards

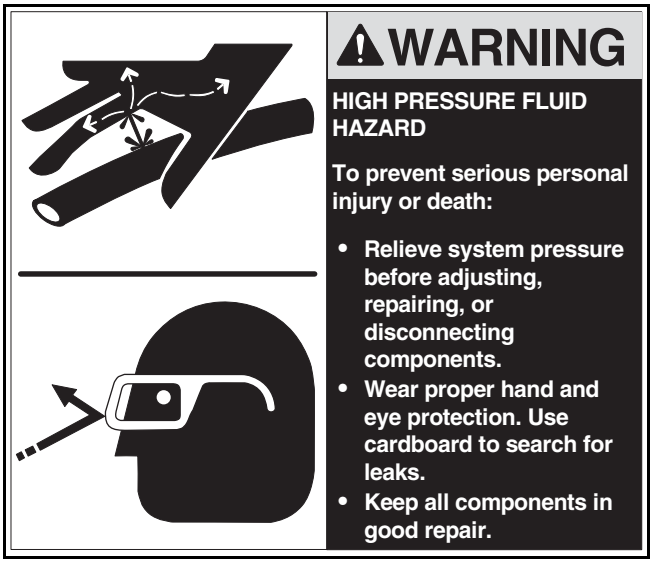
Liquid cooling systems build up extreme heat and pressure as the engine gets hot. Use care when servicing the system.

Take the following precautions before removing the radiator cap:

- Stop the engine and wait for the system to cool down.
- Wear protective clothing and safety glasses.
- Turn the radiator cap slowly to the first stop position to allow the pressure to escape before removing the cap completely.

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Hydraulic System Hazards



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The hydraulic system is under pressure whenever the engine is running and can hold pressure after the engine is shut down. After forks or attachments are resting on the ground or support, make sure pressure is relieved from all hydraulic lines and components before removing them from the circuit.

Remember the following during inspection of the hydraulic system:

- Wait for fluid to cool down before disconnecting lines.
- **DO NOT** use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks.
- Wear appropriate eye protection.
- If any hydraulic fluid is injected into the skin, get medical attention immediately.
- When venting or filling the hydraulic system, loosen the filler cap slowly and remove it gradually.
- **NEVER** reset any relief valve in the hydraulic system to a pressure higher than that specified in this manual.

Electrical System Hazards

Be aware of the following safety issues when working with batteries.

Explosive gases are always present around batteries. This is especially true when the battery is being charged.

To avoid explosion…

- **DO NOT** use smoking materials near batteries.
- Keep arcs, sparks, and open flames away from batteries.
- Provide adequate ventilation.

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To avoid personal injury…

- Electrolyte in batteries contains sulfuric acid which is a poison and can cause severe chemical burns. Wear a face shield and safety glasses to prevent contact with your eyes and face.
- Wear chemical resistant gloves and clothing to keep acid off your skin and regular clothing.

Important: *If electrolyte is ever ingested or splashed into your eyes, get medical attention immediately.* ***NEVER*** *give fluids that would induce vomiting. Eyes should be flushed with clean water as soon as possible. If electrolyte comes in contact with your skin or clothing, immediately wash it off with a large quantity of clean water.*

- Before working on the electrical system, disconnect the battery cable(s). **NEVER** check the battery by placing a metal object across the battery posts; the resulting spark could ignite anything flammable, causing a fire or an explosion.
- Always disconnect the battery before welding on the machine.



CAUTION: When removing the battery, always remove the negative (–) cable first. When installing, connect the positive (+) cable first.

Tire and Wheels Hazards

The stability of the forklift can be dramatically affected by incorrect inflation or the lack of ballast fill. It is good practice to check your tires and wheels on a daily basis.

Check tires for…

- The correct pressure
- Cuts or bulges
- Nails or punctures
- The proper ballast required
- Uneven or excessive wear.

Check wheels for…

- Condition of valve stems and caps, making sure valve caps are kept on
- Damage to the rims
- Missing or loose lug nuts or bolts
- Obvious misalignment.

All tire service should be performed by a qualified tire service center or by an authorized person. This person must be properly trained in the procedures and use of safety equipment designed for tire servicing.

When servicing wheels and tires, remember…

- **NEVER** over inflate a tire. Over inflation could result in an explosion.
- Punctures that could have allowed the ballast fill in a tire to leak out must be repaired and the tire refilled with ballast before the forklift is put back in operation.

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- **NEVER** reinflate a tire that has been run flat or seriously under inflated **WITHOUT** removing the tire from the wheel. Have the tire and rim closely inspected for damage before remounting.
- Clean the area around all wheel lug nuts or bolts. Periodically check the torque per the specifications until the torque value stabilizes; then check at regularly scheduled intervals.

Rollover Protective Structure (ROPS) and Falling Object Protective Structure (FOPS)

The machines are equipped with a Rollover Protective Structure (ROPS) to guard the operator if the machine tips over. The Falling Object Protective Structure (FOPS) is built into the ROPS. The FOPS protects the operator from falling objects.

Despite the protection of the ROPS/FOPS, it cannot protect the operator from every possible hazard. Do not consider the ROPS/FOPS a substitute for safe practices and good common sense.

Any modification to a ROPS/FOPS, such as welding or drilling holes in the structural members for mounting brackets, will affect the ROPS/FOPS capability to provide the required protection.

Any modification or repair without the specific written approval of JLG will void the ROPS/FOPS certification. Contact your authorized JLG dealer before making any modifications or repairs. Failure to do so may void the ROPS/FOPS certification.

Decals and Placards

General

The decals on the machine provide instructions for safe and correct operation. Never make modifications affecting safe operation or capacity without the expressed written approval of JLG. When approved modifications are made, the user is responsible for seeing that appropriate decals, load charts, and instructions are changed.

All plates and decals must be in place and legible at all times. Damaged placards and decals should be replaced. Clean dirty decals.

In California, the machine MUST be equipped with a Proposition 65 Warning decal.

Cleaning Decals

If soiled with dirt, clean decals with mild soap. Use a mild alcohol solution if soiled with grease. Do not use solvents that may damage the decal. Replace all damaged, missing, or painted decals that cannot be read. On refurbished or replaced parts, all missing decals must be replaced. See your JLG dealer for replacement decals and placards.

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Attaching Decals

The surface on which a decal is to be attached must be dry and free of all dirt and grease. Remove the backing from the decal and apply decal in its correct location. Once in place, rub entire surface of the decal with your thumb, applying sufficient pressure to ensure good adhesion of the decal to the mounting surface.

Decal Locations

Decals and placards that provide information, instructions, and address safety issues include the following:

- Attachment Capacity Plate (Fig. 1-7)
- Boom Extension Indicator Decal (Fig. 1-1)
- Boom Movement Control Decal (Fig. 1-3)
- Cab Transfer Extension Decal (Fig. 1-1)
- California Proposition 65 Warning Decal (Fig. 1-1)
- Carriage Safety Decal (Fig. 1-7)
- Carry Load Low Caution Decal (Fig. 1-2)
- Caution Plate (Fig. 1-1)
- Diesel Fuel Only Decal (Fig. 1-6)
- Disconnect Battery Decal (Fig. 1-4)
- Don’t Be Careless Decal (Fig. 1-2)
- Forklift Signals Decal (Fig. 1-1)
- Frame Tilt Control Decal (Fig. 1-3)
- Frame Transfer Extension Decal (Fig. 1-1)
- Hydraulic Breather Decal (Fig. 1-6)
- Hydraulic Oil Only Decal (Fig. 1-6)
- Load Chart Capacities Flip Card (Fig. 1-1)
- Low Brake Pressure Decal (Fig. 1-2)
- Lubrication Schedule Flip Card (Fig. 1-1)
- Notice Decal (General Operating Instructions) (Fig. 1-1)
- Outrigger Caution Decal (Fig. 1-2)
- Outrigger Control Decal (Fig. 1-3)
- Parking Brake Decal (Fig. 1-2)
- Pressure Test Ports Decal (Fig. 1-1)
- Rear Oscillation Lock Light Decal (Fig. 1-2)
- Slow Moving Vehicle Sign (Fig. 1-4)
- Steer Selector Plate (Fig. 1-5)
- Tire Ballast Required Decal (Fig. 1-1)
- Transfer and Fork Tilt Control Decal (Fig. 1-3)
- Transmission Declutch Decal (Fig. 1-2)

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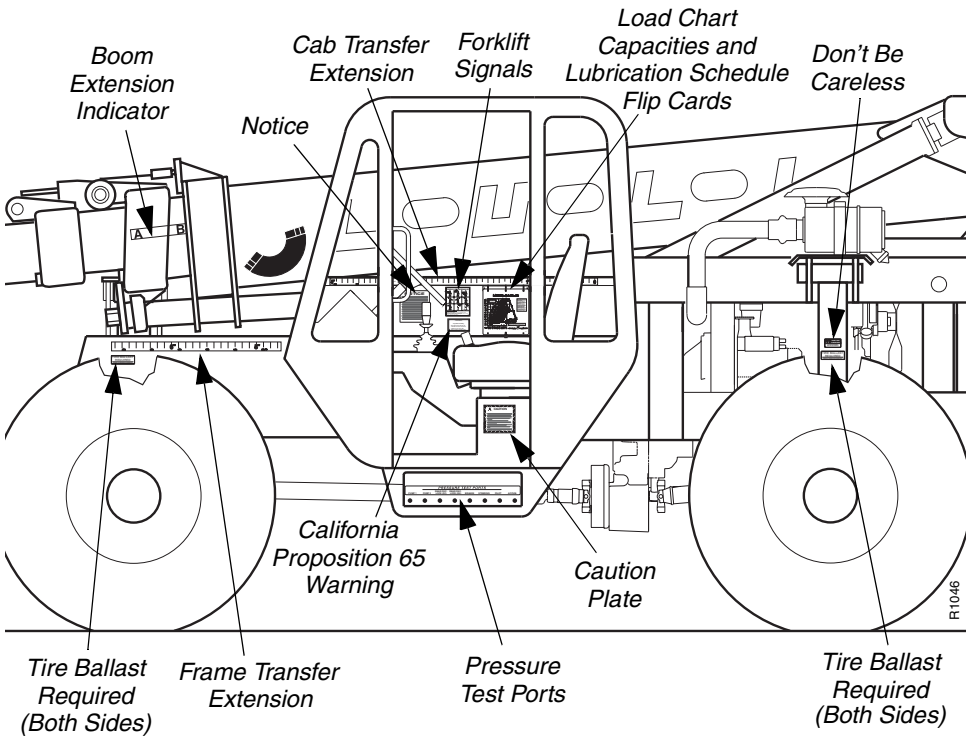


Fig. 1-1: Decals and Placards

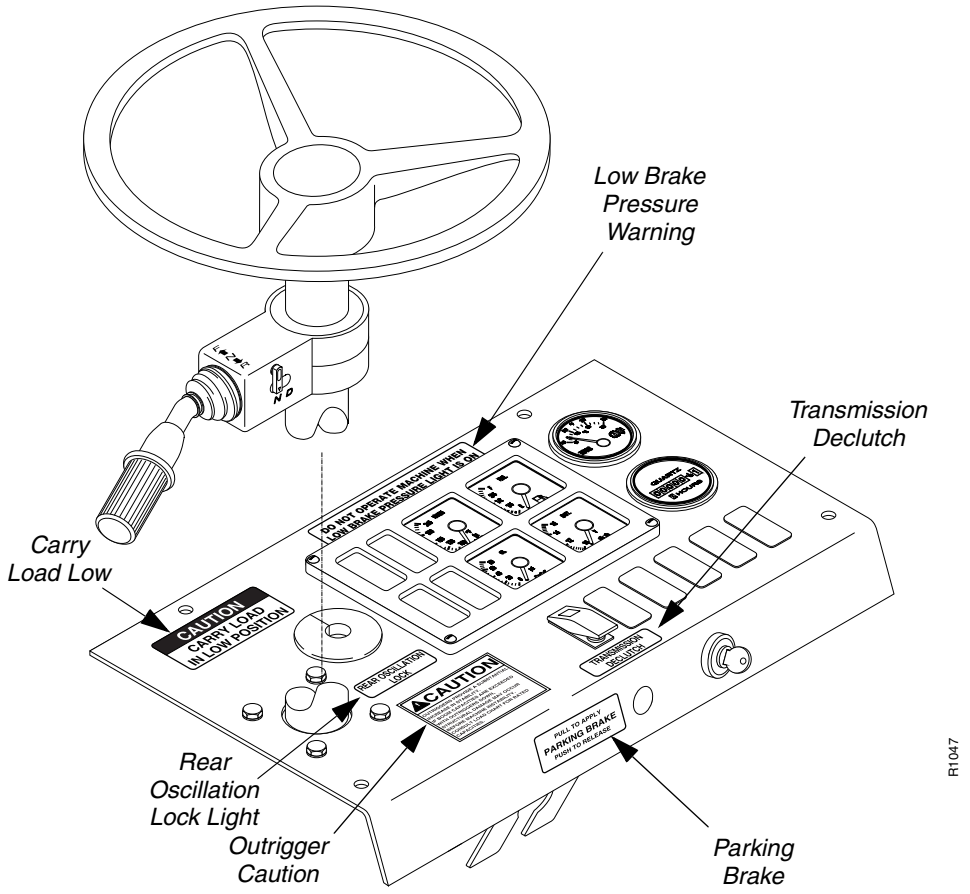


Fig. 1-2: Instrument Panel Decals

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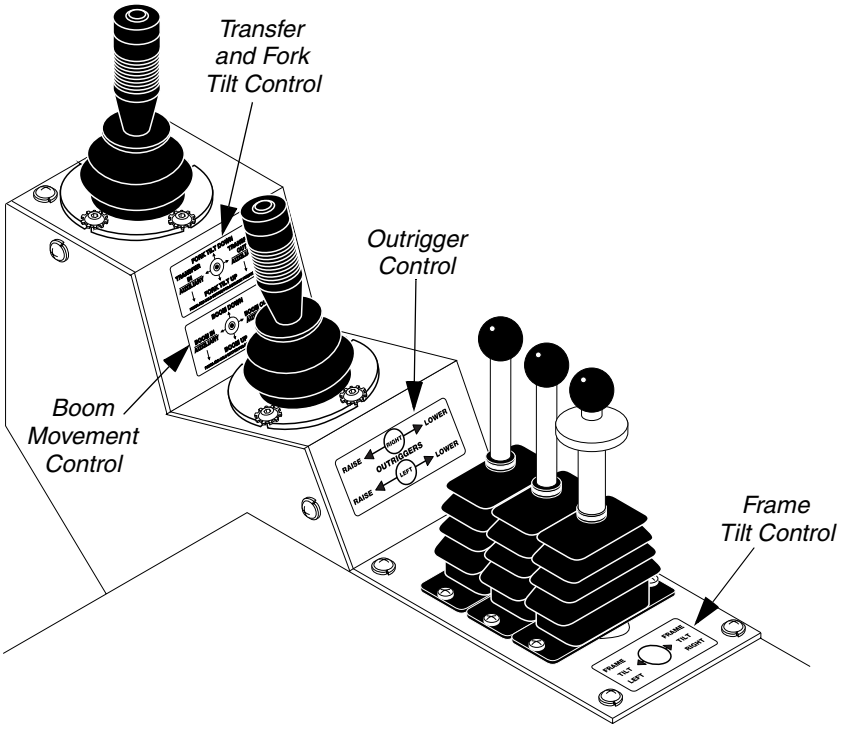


Fig. 1-3: Control Decals

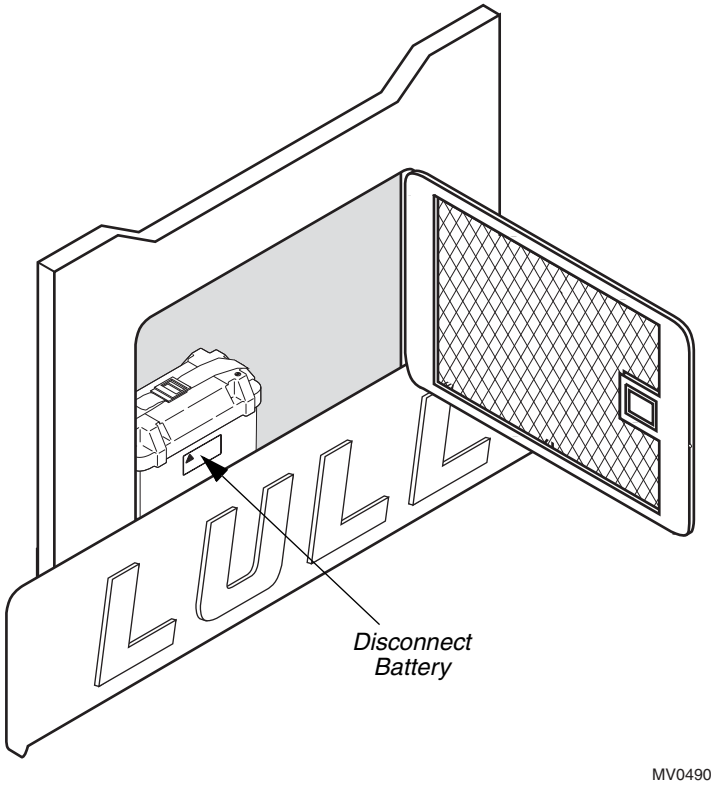


Fig. 1-4: Disconnect Battery Decal and Slow Moving Vehicle Sign

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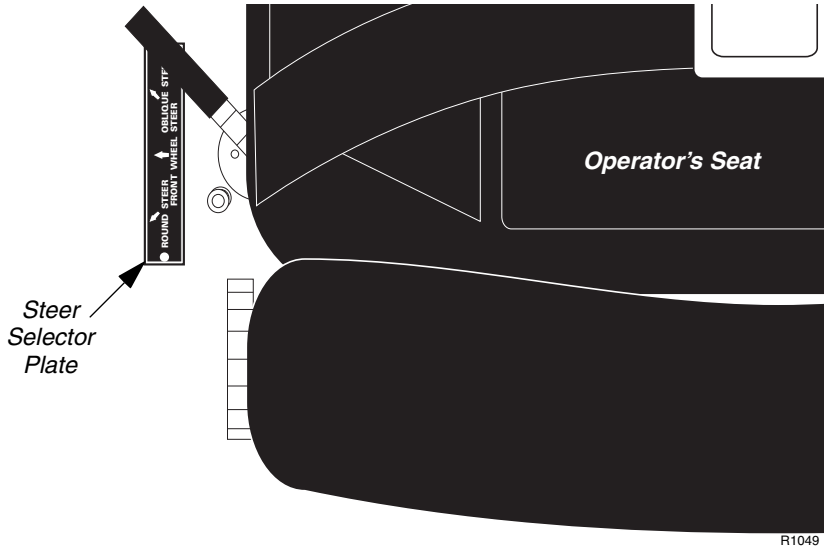


Fig. 1-5: Steer Selector Plate

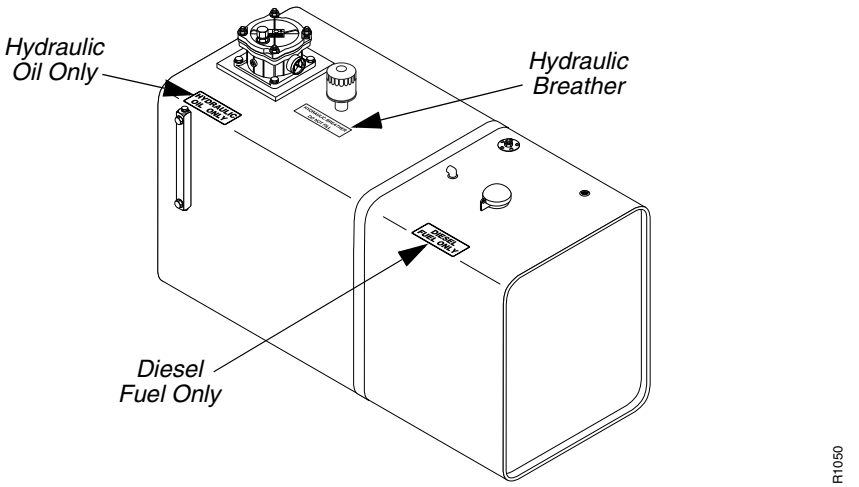


Fig. 1-6: Hydraulic Reservoir/Fuel Tank Decals

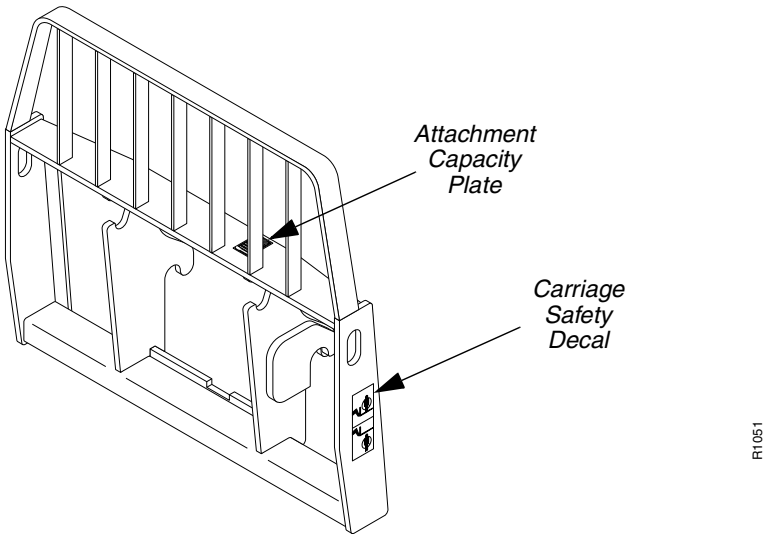


Fig. 1-7: Fork Carriage Decals

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Table of Contents

Serial Number Locations 2-1
Machine Serial Number 2-1
Engine Serial Number, John Deere 2-2
Axle Serial Number 2-3
Attachment Serial Number Plate 2-3
Identification 2-4
Specifications 2-5
Engine Specifications 2-8
John Deere 4045T 2-8

List of Figures

Fig. 2-1: Machine Serial Number Plate 2-1
Fig. 2-2: Engine Serial Number — John Deere 2-2
Fig. 2-3: Axle Serial Number 2-3
Fig. 2-4: Attachment Serial Number Plate 2-3
Fig. 2-5: Top View 2-4
Fig. 2-6: Left Side View 2-4

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Section 2 — Identification and Specifications

Serial Number Locations

Machine Serial Number

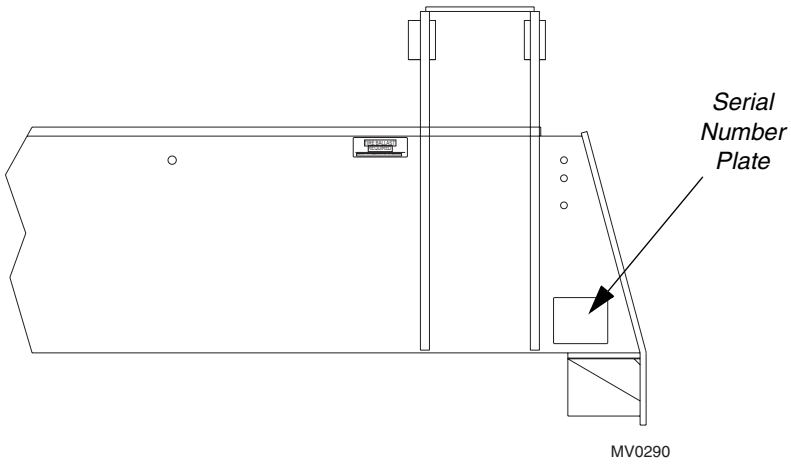


Fig. 2-1: Machine Serial Number Plate

(Ref. Fig. 2-1) The machine serial number plate is located on the frame behind the right front tire.

Engine Serial Number, John Deere

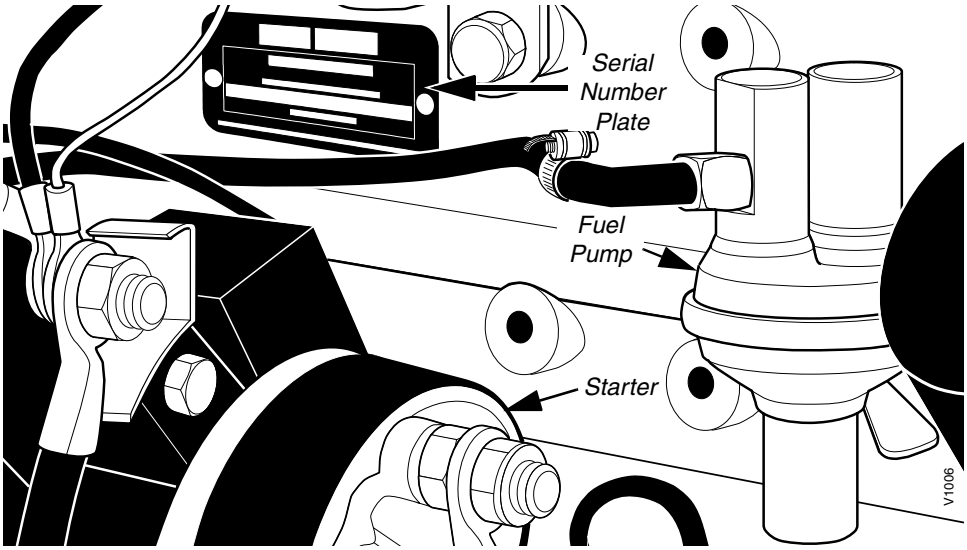


Fig. 2-2: Engine Serial Number — John Deere

(Ref. Fig. 2-2) The engine serial number plate is located on the left side of the engine near the starter and fuel pump.

John Deere engines include an options code decal located on top of the engine manifold cover. Do not damage, remove, or paint over this decal. It is recommended that this information be written down for future reference.

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Axle Serial Number

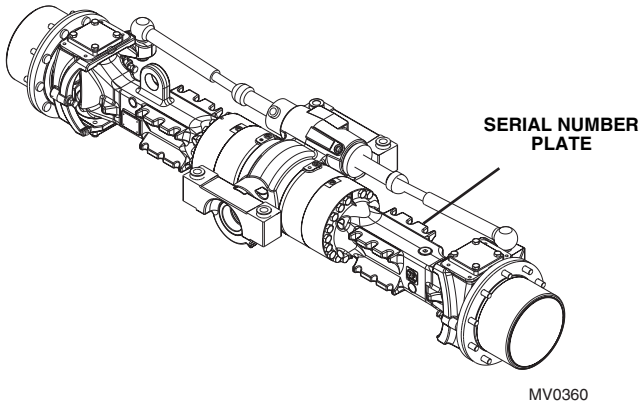


Fig. 2-3: Axle Serial Number

(Ref. Fig. 2-3) The front axle serial number plate is located on the left front side of the axle housing. The rear axle serial number plate is located on the right rear side of the axle housing.

Attachment Serial Number Plate

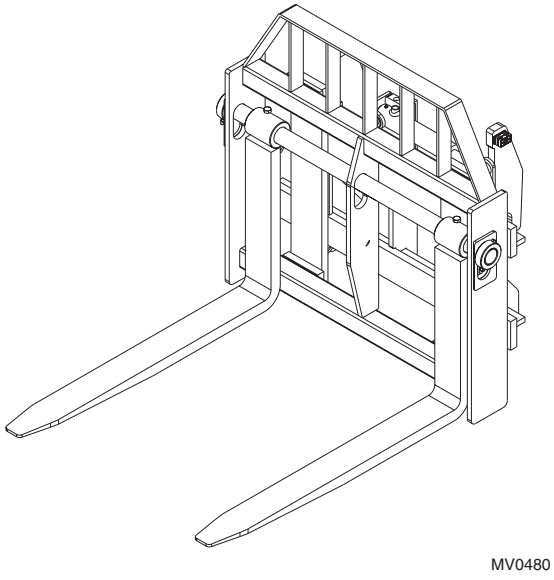


Fig. 2-4: Attachment Serial Number Plate

(Ref. Fig. 2-4) The location of this plate varies with each attachment.

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Identification

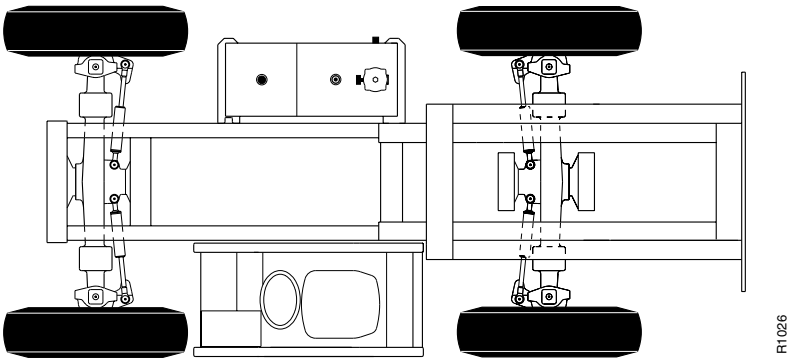


Fig. 2-5: Top View

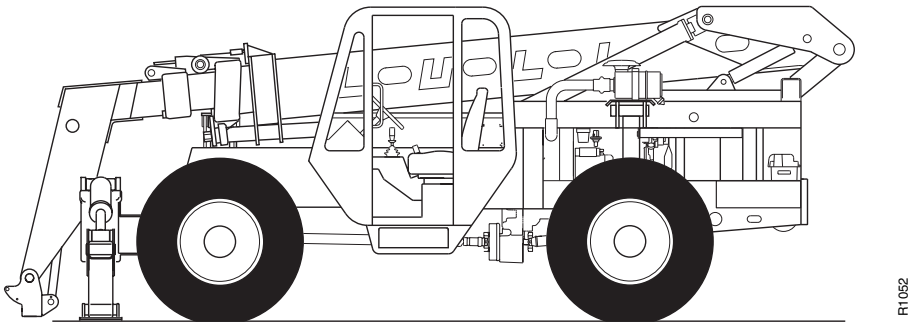


Fig. 2-6: Left Side View

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Specifications

General Operating Specifications

Lift and Carry Capacity	10,000 lbs.
Maximum Lift Height	54 Feet
Boom Elevation Angle	-5° to +69°
TransAction	80 Inches
Maximum Horizontal Forward Reach:	45 Feet
Maximum Reach at Maximum Lift	14 Feet
Capacity at Maximum Reach:	1500 lbs
Below Grade	40 Inches
Drive	4-Wheel
Steer Modes	Front Wheel, 4-Wheel Round, 4-Wheel Oblique
Frame Tilt	10° Right and Left
Empty Vehicle Weight:	Approximately 32,000lbs.

Dimensions

Note: *Dimensions listed are for forklift with all components fully retracted in travel mode.*

Overall Height	97 Inches
Overall Width	101 Inches
Overall Length	24 Feet, 10 Inches (w/42” Fork)
Wheelbase	124 Inches
Outside Turning Radius	14 Feet, 2Inches
Ground Clearance	20.5 Inches

Capacities

Hydraulic System (Including Reservoir)	65 Gallons
Hydraulic Reservoir	47 Gallons
Fuel Tank	36 Gallons
Cooling System	18 Quarts
Engine Crankcase Oil w/Filter (John Deere)	14 Quarts
Transmission Drain and Refill	19 Quarts
Front Axle	
Differential	9.5 Quarts
Planetary Hubs	54 Ounces
Rear Axle	
Differential	10.5 Quarts
Planetary Hubs	40.5 Ounces

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Pressures	Hydraulic:
	Boom Hoist and Extend Valve Relief . . . . . 3000 psi
	4- or 5-Section Relief Valve . . . . . 3150 psi
	Carriage Tilt Valve Section, Up Port Relief . . . . . 2800 psi
	Carriage Tilt Valve Section, Down Port Relief. . . . . 2800 psi
	Steering . . . . . 2355 psi
	Brakes. 425psi
	Joystick Control Pilot. . . . . 510 psi
	Hydraulic Return Filter . . . . . 0–15 psi
	Accumulator:
	Dry Nitrogen Pre-Charge . . . . . .400 psi
	Accumulator Charge Valve . . . 1000 (Low Limit), 1125 (High Limit)
Transmission	Manufacturer. . . . . Zahnradfabrik (ZF)
	Model 4WG-98TC
	Type . . . . . 4-Speed Electric Powershift with Torque Converter
	Speeds . . . . . 4 Forward, 3 Reverse
	Filter . . . . . .Spin-On
Travel Speeds	1st Gear . . . . . .3.5 mph (5,6 km/hr)
	2nd Gear. . . . . 6 mph (9,7 km/hr)
	3rd Gear . . . . . .15.2 mph (24,5 km/hr)
	4th Gear (Forward Only). . . . . .22 mph (35 km/hr)
Axles	Manufacturer. . . . . Zahnradfabrik (ZF)
	Model
	Front MS-T-3060
	Rear MS-T-3055
	Type . . . . . Off-Highway with Drive and Steering Functions

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Wheels/Tires	Lugs . . . . . 10 (Torque to 320 ft-lbs) 14 × 24 Tires (Bias & Radial): Tire Size . . . . . 14 × 24 Water . . . . . 57 Gallons Calcium Chloride . . . . . 150 lbs Foam . . . . . 720 psi Pressure . . . . . 70 psi
Service Brakes	Manufacturer . . . . . Zahnradfabrik (ZF) Type . . . . . Hydraulically Actuated, Internal, Wet Disc
Parking Brake	Manufacturer . . . . . Zahnradfabrik (ZF) Type . . . . . (SAHR) Spring Applied Hydraulically Released
Engine Models	(See “Engine Specifications” on page 2-8) John Deere 4045T F 275 . . . . . 115 HP @ 2500 rpm
Hydraulic Pump	Type . . . . . Tandem Gear
Electrical System	System Voltage . . . . . 12-Volt, Negative Ground Battery . . . . . 12-Volt, 925CCA Alternator: Bosch . . . . . 95 Amp
Working Temperatures	Hydraulic Oil . . . . . 140–180°F Transmission Oil . . . . . 104–230°F Engine Oil . . . . . See Engine Manual Engine Coolant . . . . . 180–185°F

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Engine Specifications

John Deere 4045T

Fuel	Diesel
Aspiration	Turbocharged
Cooling	Liquid
Horsepower	115 HP @ 2500 rpm
Maximum Torque	291 ft-lbs @ 1400 rpm
Piston Displacement	275 Cubic Inches
Number of Cylinders	4 Vertical In-Line
Cycle	4 Stroke
Combustion System	Direct Injection
Compression Ratio	17.6:1
Oil Filter	Spin-On
Air Cleaner	Dry Cartridge
High rpm	2650-2750
Idle rpm	890-910

https://truckmanualshub.com/

Table of Contents

General Instructions 3-1
Service Preparation Procedures 3-1
Service And Repair Procedures 3-2
Replacement Parts 3-3
General 3-3
Lubrication 3-3
General 3-3
Fluid and Lubricant Specifications 3-4
General Specifications 3-4
Engine Oil Specifications 3-4
Transmission Oil Specifications 3-5
Fuel Requirements 3-6
Grease 3-6
Care and Cleaning 3-7
Cleaning Exterior Surfaces 3-7
Cleaning the Cab 3-7
Cleaning Decals 3-8
Attaching Decals 3-8
Storage 3-8
Preparing the Machine for Long-Term Storage 3-8
Preparing the Machine After Long-Term Storage 3-9
Torque Specifications 3-10
General Torques for Standard Bolts, Capscrews, and Nuts 3-10
Hydraulic Fitting Torques 3-14
Jump Starting Procedures 3-16
Conversion Charts 3-18

List of Figures

Fig. 3-1: SAE Grade Identification 3-10
Fig. 3-4: Metric Class Identification 3-13

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List of Tables

Table 3-1: General Fluid and Lubricant Specifications 3-1
Table 3-2: John Deere Engine Oil Specifications 3-2
Table 3-3: ZF Transmission Oil Specifications 3-3
Table 3-4: Torque for JIC and SAE Female Swivel Nuts 3-4
Table 3-5: Torque for Non-adjustable O-ring Fittings 3-5
Table 3-6: Torque for Adjustable O-ring Fittings 3-6
Table 3-7: Torque for O-ring Plugs 3-7
Table 3-8: Pipe Thread Fittings (Steel) 3-8
Table 3-9: Inch Fraction, Decimal, and Metric Conversion Chart 3-9
Table 3-10: Miscellaneous Conversions 3-10

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Section 3 — General Maintenance

General Instructions

Performance of your machine is dependent on proper maintenance and lubrication at designated intervals. Proper operating procedures and a regularly scheduled maintenance and lubrication program will increase the life of machine components and reduce machine down time.

Should a defect or failure occur to your machine, take it out of service immediately. The machine must not continue to operate under any circumstances as serious damage to the machine or personal injury may result.

Attach a warning tag to the steering wheel of the forklift. If the forklift should not be started, remove the ignition key.

Before doing any maintenance or repair work, get permission. Do not perform any maintenance without authorization.

If you have been authorized to do maintenance, read the service manual, study the instructions, and examine all the instructions and messages on the machine.

When performing inspection, maintenance, lubrication, or adjustments to the machine, be alert to evidence of excessive wear including odors and noises that may indicate damage, malfunction, or other maintenance problems.

Service Preparation Procedures

- Choose a clean, level work area. Check clearances and make sure you have sufficient room. Make certain there is adequate light and ventilation.
- Park machine on level surface, set the parking brake, level the frame, and shut off the engine.
- Clean the walking and working surfaces. Remove oil, grease, ice, snow, mud, and water to eliminate slippery areas. Sand any remaining slippery areas.
- Make sure you have the correct tools. Keep tools clean and inspect power cords.
- Make sure jacks and hoists are available and in good condition. Never use jacks with cracked, bent, or twisted parts. Never use frayed, twisted, or pinched cables. Never use bent or distorted hooks.
- Make use of mechanical assists. To protect your back from possible injury, use proper lifting methods.

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Service And Repair Procedures

CAUTION: Unless specifically told not to, lower the boom to the ground, apply the parking brake, and stop the engine before servicing, adjusting, or repairing the machine.

WARNING: Release all hydraulic pressure before doing any maintenance or repairs to the hydraulic system.

WARNING: Liquid cooling systems build up pressure as the engine gets hot. Before removing the radiator cap, stop the engine and let the system cool. Remove the radiator cap only after the coolant is cold.

- Be careful not to damage machined and polished surfaces.
- Tighten all bolts, fittings and connections to specifications.
- Avoid fires and explosive hazards.
- Handle all solvents and dry chemicals according to procedures identified on manufacturers' containers. Work in a well-ventilated area. Make sure you know where fire extinguishers are kept and how to use them.
- Use an approved solvent to clean parts. Never use gasoline or diesel fuel.
- Shut off the engine and electrical equipment while filling the fuel tank. Use extra caution when fueling while the engine is hot. Always ground the fuel nozzle against the filler neck to avoid sparks.

WARNING: Never smoke while handling fuel or working on the fuel system. The fumes in an empty fuel container are explosive. Never cut or weld on fuel lines, tanks, or containers.

- Avoid spilling fuel. If a spill occurs, wipe it up immediately.
- Never weld on forks, boom, support frame or overhead guard without written consent from JLG.
- Install all guards, covers and shields after servicing. Repair or replace any that are damaged.
- Refill systems with approved or recommended fluids. Start the engine and check for leaks

WARNING: Diesel fuel or hydraulic fluid under pressure can penetrate the skin or damage eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks but do not use your hand. Wear appropriate eye protection. If fluid enters skin or eye, get medical attention immediately.

- Operate all controls and make sure the forklift is functioning properly. Road test the machine if necessary. After testing, shut down and recheck the work you performed. Recheck all fluid levels before releasing machine for operation.

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Replacement Parts

General

Record the machine model, serial number, and component serial numbers for reference when ordering replacement parts. See “Serial Number Locations” in Section 2.

Use only JLG authorized replacement parts and fluids. Use of parts other than JLG authorized parts may adversely effect machine reliability, performance, and safety and may void the warranty.

JLG assumes no liability for equipment damages caused by the use of unauthorized replacement parts.

Lubrication

General

For best machine performance, follow the instructions found on the machine’s service lubrication schedule.

- Clean around all oil fill holes before checking or adding oil.
- Keep all lubricants and lubricating equipment clean and free of foreign matter both while in use and while in storage.
- Wipe off any excess lubricants that spill or overflow. Oily or greasy surfaces tend to collect dirt and foreign matter which can work its way into bearings and gears.

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Fluid and Lubricant Specifications

General Specifications

Table 3-1: General Fluid and Lubricant Specifications

SYSTEM OR COMPONENT	FLUID OR LUBRICATION	SPECIFICATION
Fuel System[1]	See "Fuel Requirements"	
Hydraulic System	Tractor Hydraulic Fluid	Mobilfluid®424
Engine Cooling System[1]	See engine manufacturer's operator's manual.	
Engine Oil[1]	See “Engine Oil Specifications”	
Transmission	See “Transmission Oil Specifications”	
Differential (Front & Rear)	Tractor Hydraulic Fluid	Mobilfluid®424
Planetary Hub	Tractor Hydraulic Fluid	Mobilfluid®424
Grease Points	Grease	Lithium-based

[1] Consult engine manufacturer's operator manual for additional information.

MV0500

Engine Oil Specifications

John Deere Engines

Use the table below to select the oil viscosity based on expected air temperature range during the period between oil changes. Consult the John Deere Operator’s Manual for additional information.

Note: *New John Deere engines use special break-in oil for the initial period of operation. Consult engine Operator’s Manual for additional information.*

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Table 3-2: John Deere Engine Oil Specifications

ENGINE OIL, DEERE		
Oil Grade	**Temperature Range °F**	**Temperature Range °C**
SAE 5W-30	-22 to +86 °F	-30 to +30 °C
SAE 10W-30	-4 to +86 °F	-20 to +30 °C
SAE 15W-40	+5 to +122 °F	-15 to +50 °C
SAE 30W	+32 to +86 °F	0 to +30 °C
SAE 40W	-50 to +104 °F	+10 to +40 °C
Arctic oil (e.g. MIL-L-46167B)	Below -22 °F	Below -30 °F
Approved Engine Oil Specifications		
API CD/CE CCMC Specifications D4, D5 SAE 5W-30 SAE 10W-30 SAE 15W-40 SAE 30W SAE 40W MIL-46167B		

MV0510

Transmission Oil Specifications

The following table shows approved lubricants and associated temperature ranges for use with ZF 4WG series transmissions.

Table 3-3: ZF Transmission Oil Specifications

ZF 4WG-98TC TRANSMISSIONS		
Oil Grade	**Minimum Oil Temperature for Starting Engine**	**Minimum Oil Temperature for Engaging Transmission**
Recommended		
Mobilfluid®424	-4 °F (-20 °C)	+86 °F (+30 °C)
Engine Oils		
SAE 20W-20	+14 °F (-10 °C)	+41 °F (+5 °C)
SAE 15W-40	+5 °F (-15 °C)	+32 °F (0 °C)
SAE 10W, 10W-30, 10W-40	-4 °F (-20 °C)	+23 °F (-5 °C)
Automatic Transmission Fluid (ATF)		
ATF	-22 °F (-30 °C)	+14 °F (-10 °C)
Approved Lubricants (Engine Oils)		
API CD/ CE/ CF/ SF/ SG MIL-L-2104 C/ D/ E MIL-L-46152 C/ D/ E SAE 10W SAE 10W-30 SAE 10W-40 SAE 15W-40 SAE 20W-20		
Automatic Transmission Fluid (ATF) may only be used at ambient temperatures below +14 °F (-10 °C)		

MV0520

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Fuel Requirements

Diesel fuels are blended to meet the local temperature requirements. The standard grades are:

1. 1D for temperatures -22 to +86 °F (-30 to +30 °C)
2. 2D for temperatures +14 to +122 °F (-10 to +50 °C).

There are two main classifications of diesel fuel in general use:

1. Low-sulphur, “on-highway” diesel fuel
2. Medium-sulfur, “off-highway” diesel fuel. This fuel contains blue dye.

The engine manufacturer specifies the diesel fuel requirements. Additional information can be found in the engine manufacturer’s Operator’s Manual.

Consult your local fuel distributor for the properties of the diesel fuels available in your area

Grease

- Use a lithium base grease with E.P. additives and rust inhibitors. A #2 grade should be used at temperatures above 32° F (0° C) and #1 grade at or below 32° F (0° C).
- Wipe off all fittings before applying grease. Dirt on the fitting can be forced through the opening in the fitting and cause premature bearing failure.
- Lubricate all grease fittings with the specified grease.

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Care and Cleaning

Wash the machine regularly. A clean well-maintained machine helps prevent safety hazards and makes problem areas more recognizable.

Remove all items that do not belong on the machine. Secure all loose items such as lunch boxes, tools, and additional equipment.

Cleaning Exterior Surfaces

- High pressure water or steam may be used to clean the exterior. Give extra attention to the underside.
- **DO NOT** damage or wash off decals when using high pressure water or steam. See “Cleaning Decals” below.
- Clean the mirror carefully.
- **DO NOT** allow mud or snow to accumulate on engine or transmission.
- Make sure radiator and transmission oil cooler fins are clean.
- Commercial engine degreasers may be used to clean the engine and transmission. Follow the product instructions closely.
- **NEVER** spray water or cleaner on a hot engine or transmission, especially on a hot turbocharger.
- Commercial general purpose degreasers and detergents may be used to help clean thick deposits. Do not use chemicals that can damage paint or decals.
- **Avoid** spraying water on electrical components such as the alternator, starter, gauges, and electrical items under the dash.
- Be careful around the fuel fill and hydraulic reservoir breather. Water may get into tanks and damage fuel and/or hydraulic components.
- To help prevent freezing, allow water to drain or dry before operating in cold weather.

Cleaning the Cab

- Clean dust and dirt from all areas of the cab. Be careful to keep water spray away from electrical components under the dash.
- Clean vinyl items with commercial vinyl cleaner. Treat with vinyl protectant to guard against ultraviolet damage. Do not use vinyl protectant on rubber or plastic controls if it will leave them slippery.
- Clean the windows inside and out. Remove any decals from windows that are not original equipment.
- Carefully clean plastic gauge and indicator lenses. Use a soft cloth and a cleaner suitable for plastic. Dust and dirt can scratch the clear plastic.
- Make sure step and hand holds are clean.
- Remove accumulated dirt from brake and accelerator pedals.

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Cleaning Decals

If soiled with dirt, clean decals with mild soap. Use a mild alcohol solution if soiled with grease. Do not use solvents that may damage the decal. Replace all damaged, missing, or painted decals that cannot be read. On refurbished or replaced parts, all missing decals must be replaced.

See your JLG dealer for replacement decals and placards.

Attaching Decals

The surface on which a decal is to be attached must be dry and free of all dirt and grease. Remove the backing from the decal and apply decal in its correct location. Once in place, rub entire surface of the decal with your thumb, applying sufficient pressure to ensure good adhesion of the decal to the mounting surface.

Storage

The following procedures are to be used if the machine will not be operated for a long period of time.

Preparing the Machine for Long-Term Storage

Prior to placing the machine into storage, perform the following:

1. Wash off the entire machine.
2. Lubricate all grease fittings as instructed in “Grease” on page 3-6 of this section
3. Change engine oil according to specifications described in Table 3-2 on page 5.
4. Apply grease to all exposed hydraulic cylinder rod areas.
5. Disconnect battery cables. If the machine is to be stored under cold conditions, remove the battery and store it in a heated area.
6. Check engine coolant level and make sure it has an adequate coolant-to-water ratio for the conditions it will be stored in.
7. Check transmission fluid level and fill if necessary according to the guidelines described in Table 3-3 on page 5 of this section.
8. Preferable, store the machine inside where it will remain dry. If it must be stored outside, park it on a concrete slab or on lumber laid on flat, level ground and cover it with a tarp.

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Preparing the Machine After Long-Term Storage

After removing the machine from storage and before placing it back in service, perform the following:

1. If covered with a tarp, remove it.
2. Wipe off grease from cylinder rods.
3. Loosen drain plug from bottom of fuel tank and drain into suitable container until fluid is clean.
4. Loosen drain plug on bottom of hydraulic oil reservoir and drain into suitable container until fluid is clean.
5. Loosen drain on fuel/water separator on engine and drain into suitable container until fluid is clean.
6. Check nitrogen recharge.
7. Check engine coolant and hydraulic fluid levels. Add fluids if necessary.
8. If battery was stored separately from the machine, install it.
9. Connect battery cables.
10. Start engine using start safety procedures as described in the Owner/Operator Manual.
11. After the engine has warmed up, test all hydraulic functions and controls.
12. Check transmission operation.
13. Shut the machine down and check for any hydraulic leaks and repair, as necessary.



WARNING: Hydraulic fluid under pressure can penetrate the skin or damage eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks but do not use your hand. Wear appropriate eye protection. If fluid enters skin or eye, get medical attention immediately.

14. Check for any other leaks and repair as necessary.
15. Check other fluid levels and replenish as necessary. Refer to your service/lubrication charts.

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Torque Specifications

General Torques for Standard Bolts, Capscrews, and Nuts

Figure 3-2 and Figure 3-3 lists torque values for standard bolts and nuts. They are intended as a guide for typical applications. Values for specific applications take precedence over those in the following tables.

Note: *Values are for plated or lubricated bolts and nuts.*

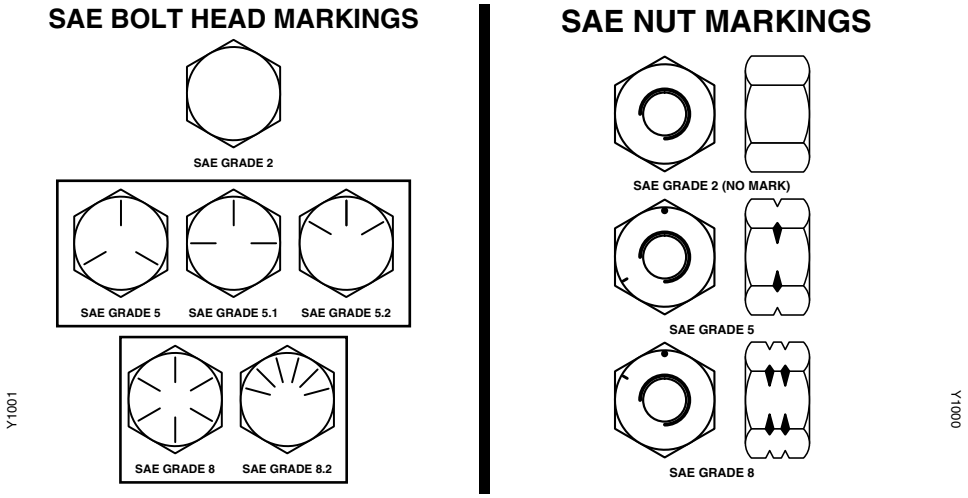


Fig. 3-1: SAE Grade Identification

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SIZE	THD	BOLT DIA. (IN.)	THREAD STRESS AREA (SQ. IN.)	VALUES FOR ZINC PLATED BOLTS ONLY								UNPLATED CAP SCREWS	
				SAE GRADE 5 BOLTS & GRADE 2 NUTS				SAE GRADE 8 BOLTS & GRADE 8 NUTS				UNBRAKO 1960 SERIES SOCKET HEAD CAP SCREW WITH LOC-WEL PATCH	
				CLAMP LOAD (LB.)	TORQUE (DRY OR LOC. 263)	TORQUE (LUB.)	TORQUE (LOCTITE 262)	TORQUE (LOCTITE 242 OR 271)	CLAMP LOAD (LB.)	TORQUE (DRY OR LOC. 263)	TORQUE (LUB.)	TORQUE (LOCTITE 262)	TORQUE (LOCTITE 242 OR 271)	CLAMP LOAD (LB.)	TORQUE (as received)
					LB. IN.	LB. IN.	LB. IN.	LB. IN.		LB. IN.	LB. IN.	LB. IN.	LB. IN.		LB. FT.
4	40	0.1120	0.00604	380	8	6	—	—	540	12	9	—	—	—	—
	48		0.00661	420	9	7	—	—	600	13	10	—	—	—	—
6	32	0.1380	0.00909	580	16	12	—	—	820	23	17	—	—	—	—
	40		0.01015	610	18	13	—	—	920	25	19	—	—	—	—
8	32	0.1640	0.01400	900	30	22	—	—	1260	41	31	—	—	—	—
	36		0.01474	940	31	23	—	—	1320	43	32	—	—	—	—
10	24	0.1900	0.01750	1120	43	32	—	—	1580	60	45	—	—	—	—
	32		0.02000	1285	49	36	—	—	1800	68	51	—	—	—	—
1/4	20	0.2500	0.0318	2020	96	75	—	105	2860	144	108	—	160	3180	13
	28		0.0364	2320	120	86	—	135	3280	168	120	—	185	3640	14
					LB. FT.	LB. FT.	LB. FT.	LB. FT.		LB. FT.	LB. FT.	LB. FT.	LB. FT.		
5/16	18	0.3125	0.0524	3340	17	13	16	19	4720	25	18	22	30	5240	25
	24		0.0580	3700	19	14	17	21	5220	25	20	25	30	5800	27
3/8	16	0.3750	0.0775	4940	30	23	28	35	7000	45	35	40	50	7750	45
	24		0.0878	5600	35	25	32	40	7900	50	35	45	55	8780	50
7/16	14	0.4375	0.1063	6800	50	35	45	55	9550	70	55	63	80	10630	70
	20		0.1187	7550	55	40	50	60	10700	80	60	70	90	11870	75
1/2	13	0.5000	0.1419	9050	75	55	68	85	12750	110	80	96	120	14190	110
	20		0.1599	10700	90	65	80	100	14400	120	90	108	135	15990	115
9/16	12	0.5625	0.1820	11600	110	80	98	120	16400	150	110	139	165	18200	155
	18		0.2030	12950	120	90	109	135	18250	170	130	154	190	20300	165
5/8	11	0.6250	0.2260	14400	150	110	135	165	20350	220	170	180	240	22600	210
	18		0.2560	16300	170	130	153	190	23000	240	180	204	265	25600	220
3/4	10	0.7500	0.3340	21300	260	200	240	285	30100	380	280	301	420	33400	365
	16		0.3730	23800	300	220	268	330	33600	420	320	336	465	37300	400
7/8	9	0.8750	0.4620	29400	430	320	386	475	41600	600	460	485	660	46200	585
	14		0.5090	32400	470	350	425	520	45800	660	500	534	725	50900	635
1	8	1.000	0.6060	38600	640	480	579	675	51500	900	680	687	990	60600	865
	12		0.6630	42200	700	530	633	735	59700	1000	740	796	1100	66300	915
1-1/8	7	1.1250	0.7630	42300	800	600	714	840	68700	1280	960	1030	1400	76300	1240
	12		0.8560	47500	880	660	802	925	77000	1440	1080	1155	1575	85600	1380
1-1/4	7	1.2500	0.9690	53800	1120	840	1009	1175	87200	1820	1360	1453	2000	96900	1750
	12		1.0730	59600	1240	920	1118	1300	96600	2000	1500	1610	2200	107300	1880
1-1/2	6	1.500	1.1550	64100	1460	1100	1322	1525	104000	2380	1780	1907	2625	115500	2320
	12		1.3150	73000	1680	1260	1506	1750	118100	2720	2040	2165	3000	131500	2440
1-1/2	6	1.500	1.4050	78000	1940	1460	1755	2025	126500	3160	2360	2530	3475	140500	3040
	12		1.5800	87700	2200	1640	1974	2300	142200	3560	2660	2844	3925	158000	3270

SAE GRADE 5 SAE GRADE 8

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

Fig. 3-2: General Torques for Standard Bolts, Capscrews, and Nuts

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SIZE	THD	BOLT DIA. (IN.)	THREAD STRESS AREA (SQ. IN.)	VALUES FOR ZINC PLATED BOLTS ONLY								UNPLATED CAP SCREWS		
				SAE GRADE 5 BOLTS & GRADE 2 NUTS				SAE GRADE 8 BOLTS & GRADE 8 NUTS				UNBRAKO 1960 SERIES SOCKET HEAD CAP SCREW		
				CLAMP LOAD (LB.)	TORQUE			CLAMP LOAD (LB.)	TORQUE			CLAMP LOAD (LB.)	TORQUE (as received)	
					(DRY OR LOC. 263) NM	(LUB.) NM	(LOCTITE 262) NM	(LOCTITE 242 OR 271) NM		(DRY OR LOC. 263) NM	(LUB.) NM	(LOCTITE 262) NM	(LOCTITE 242 OR 271) NM		WITHOUT LOC-WEL PATCH N/M	WITH LOC-WEL PATCH N/M
4	40	0.1120	0.00604	380	.8	.8	—	—	540	1.4	1.0	—	—	—	—	—
	48		0.00661	420	1.0	.8	—	—	600	1.5	1.0	—	—	—	—	—
6	32	0.1380	0.00909	580	1.8	1.4	—	—	820	2.6	2.0	—	—	—	—	—
	40		0.01015	610	2.0	1.6	—	—	920	2.8	2.2	—	—	—	—	—
8	32	0.1640	0.01400	900	3.4	2.4	—	—	1260	4.6	3.4	—	—	—	—	—
	36		0.01474	940	3.4	2.6	—	—	1320	5	3.6	—	—	—	—	—
10	24	0.1900	0.01750	1120	5	3.6	—	—	1580	7	5	—	—	—	—	—
	32		0.02000	1285	6	4	—	—	1800	8	6	—	—	—	—	—
1/4	20	0.2500	0.0318	2020	11	8	—	12	2860	16	12	—	18	3180	18	19
	28		0.0364	2320	14	10	—	15	3280	19	14	—	21	3640	19	20
5/16	18	0.3125	0.0524	3340	23	18	22	26	4720	34	24	30	41	5240	34	38
	24		0.0580	3700	26	19	23	28	5220	34	27	34	41	5800	37	41
3/8	16	0.3750	0.0775	4940	41	31	38	47	7000	61	47	54	68	7750	61	68
	24		0.0878	5600	47	34	43	54	7900	68	47	61	75	8780	68	75
7/16	14	0.4375	0.1063	6800	68	47	61	75	9550	95	75	85	108	10630	95	104
	20		0.1187	7550	75	54	68	81	10700	108	81	95	122	11870	102	111
1/2	13	0.5000	0.1419	9050	102	75	92	115	12750	149	108	130	163	14190	149	163
	20		0.1599	10700	122	88	108	136	14400	163	122	146	183	15990	156	172
9/16	12	0.5625	0.1820	11600	149	108	133	163	16400	203	149	188	224	18200	210	230
	18		0.2030	12950	163	122	148	183	18250	230	176	209	258	20300	224	247
5/8	11	0.6250	0.2260	14400	203	149	183	224	20350	298	230	244	325	22600	285	313
	18		0.2560	16300	230	176	207	258	23000	325	244	277	359	25600	298	328
3/4	10	0.7500	0.3340	21300	353	271	325	386	30100	515	380	408	569	33400	495	542
	16		0.3730	23800	407	298	363	447	33600	569	434	456	630	37300	542	597
7/8	9	0.8750	0.4620	29400	583	434	523	644	41600	813	624	658	895	46200	793	874
	14		0.5090	32400	637	475	576	705	45800	895	678	724	983	50900	861	949
1	8	1.000	0.6060	38600	868	651	785	915	51500	1220	922	931	1342	60600	1173	1288
	12		0.6630	42200	949	719	858	997	59700	1356	1003	1079	1491	66300	1241	1356
1-1/8	7	1.1250	0.7630	42300	1085	813	968	1139	68700	1735	1302	1396	1898	76300	1681	1851
	12		0.8560	47500	1193	895	1087	1254	77000	1952	1464	1566	2135	85600	1871	2061
1-1/4	7	1.2500	0.9690	53800	1518	1139	1368	1593	87200	2468	1844	1970	2712	96900	2373	2610
	12		1.0730	59600	1681	1247	1516	1763	96600	2712	2034	2183	2983	107300	2549	2807
1-1/2	6	1.500	1.1550	64100	1979	1491	1792	2068	104000	3227	2413	2586	3559	115500	3145	3457
	12		1.3150	73000	2278	1708	2042	2373	118100	3688	2766	2935	4067	131500	3308	3640
1-1/2	6	1.500	1.4050	78000	2630	1979	2379	2745	126500	4284	3200	3430	4711	140500	4122	4535
	12		1.5800	87700	2983	2224	2676	3118	142200	4827	3606	3856	5322	158000	4433	4881

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

Fig. 3-3: General Torques for Metric Bolts, Capscrews, and Nuts

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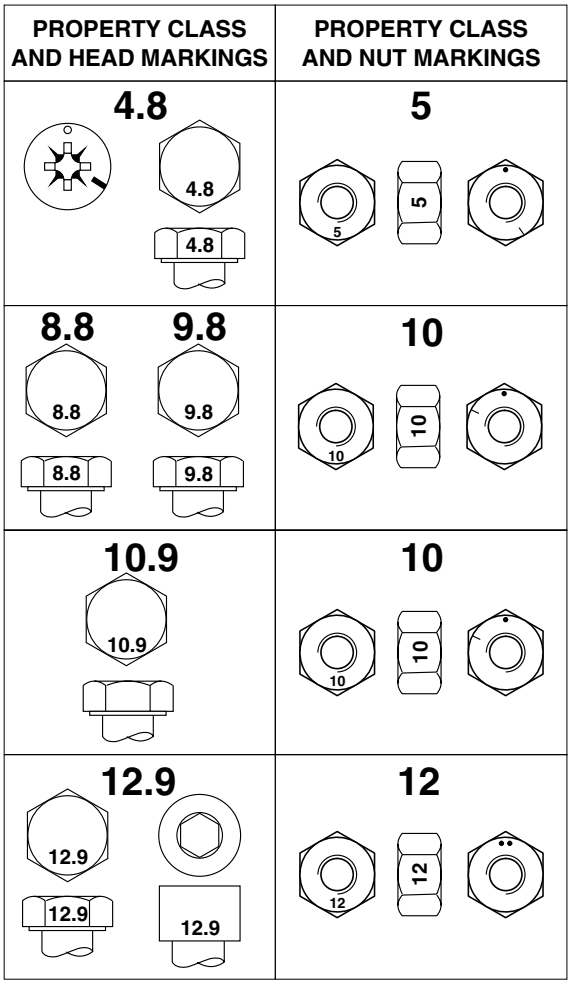


Fig. 3-4: Metric Class Identification

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Hydraulic Fitting Torques

JIC and SAE Female Swivel Nuts

It is recommended that the nut be torqued to the approximate minimum value. If leakage occurs, tighten nut without exceeding maximum torque value.

Note: *Use two wrenches to tighten hydraulic line nuts.*

Table 3-4: Torque for JIC and SAE Female Swivel Nuts

Size	SAE Port Thread Size	Approx. Min. Torque		Max. Torque		Flats[1]
-4	7/16-20	130	in-lbs	150	in-lbs	2
-5	1/2-20	165	"	195	"	2
-6	9/16-18	235	"	265	"	1 1/4
-8	3/4-16	44	ft-lbs	48	ft-lbs	1
-10	7/8-14	50	"	58	"	1
-12	1 1/16-12	79	"	88	"	1
-16	1 5/16-12	117	"	125	"	1
-20	1 5/8-12	158	"	175	"	1
-24	1 7/8-12	188	"	213	"	1
-32	2 1/2-12	250	"	283	"	1

1. Number of flats on nut to be turned past finger tight. This method will produce the approximate torque.

Non-adjustable O-ring Fittings

To install straight thread, non-adjustable O-ring fittings:

1. Check condition of O-ring and replace as necessary. Do not install a fitting with a damaged O-ring.
2. Lubricate O-ring with clean hydraulic fluid and torque per Table 3-5.

Table 3-5: Torque for Non-adjustable O-ring Fittings

Size	SAE Port Thread Size	Min. Torque		Max. Torque	
-2	5/16-24	85	in-lbs	95	in-lbs
-4	7/16-20	205	"	235	"
-6	9/16-18	25	ft-lbs	29	ft-lbs
-8	3/4-16	46	"	50	"
-10	7/8-14	85	"	95	"
-12	1 1/16-12	105	"	115	"
-16	1 5/16-12	154	"	166	"
-20	1 5/8-12	213	"	237	"
-24	1 7/8-12	238	"	262	"

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Adjustable O-ring Fittings

To install straight thread, adjustable O-ring fittings:

1. Check condition of O-ring and replace as necessary. Do not install a fitting with a damaged O-ring.
2. Lubricate O-ring with clean hydraulic fluid.
3. Back off the locknut fully.
4. Screw fitting into port until backup washer contacts face of port.
5. Position fitting by unscrewing a maximum of one turn.
6. Hold the fitting in position with a wrench and torque locknut per Table 3-6.

Table 3-6: Torque for Adjustable O-ring Fittings

Size	SAE Port Thread Size	Min. Torque		Max. Torque	
-2	5/16-24	60	in-lbs	70	in-lbs
-4	7/16-20	160	"	180	"
-6	9/16-18	25	ft-lbs	29	ft-lbs
-8	3/4-16	40	"	44	"
-10	7/8-14	58	"	63	"
-12	1 1/16-12	75	"	85	"
-16	1 5/16-12	109	"	121	"
-20	1 5/8-12	213	"	237	"
-24	1 7/8-12	238	"	262	"

O-ring Plugs

To install straight thread O-ring plugs:

1. Check condition of O-ring and replace as necessary. Do not install a plug with a damaged O-ring.
2. Lubricate O-ring with clean hydraulic fluid and torque per Table 3-7.

Table 3-7: Torque for O-ring Plugs

	SAE Port	Hollow Hex Head				Hex Head			
Size	Thread Size	Min. Torque		Max. Torque		Min. Torque		Max. Torque	
-2	5/16-24	30	in-lbs	40	in-lbs	85	in-lbs	95	in-lbs
-4	7/16-20	125	"	145	"	205	"	235	"
-6	9/16-18	210	"	230	"	25	ft-lbs	29	ft-lbs
-8	3/4-16	44	ft-lbs	48	ft-lbs	46	"	50	"
-10	7/8-14	70	"	80	"	85	"	95	"
-12	1 1/16-12	80	"	90	"	105	"	115	"
-16	1 5/16-12	129	"	141	"	154	"	166	"
-20	1 5/8-12	213	"	237	"	213	"	237	"
-24	1 7/8-12	238	"	262	"	238	"	262	"

Pipe Thread Fittings

To install National Pipe Thread (NPT) fittings:

1. Apply sealant sparingly to male pipe threads only, avoiding the first few threads at the end of the fitting.

Note: *Do not use Teflon tape or excessive amounts of sealant. System contamination will result.*

2. Install fitting and tighten per Table 3-8.

Table 3-8: Pipe Thread Fittings (Steel)

Fitting Size	Thread Size (NPT)	Turns[1]
-2	1/8-27	2–3
-4	1/8-27	2–3
-6	1/4-18	1.5–3
-8	3/8-18	2–3
-10	1/2-14	2–3
-12	3/4-14	2–3
-16	1-11.5	1.5–2.5
-20	1 1/4-11.5	1.5–2.5
-24	1 1/2-11.5	1.5–2.5

1.Turns past finger tight

Jump Starting Procedures



CAUTION:

- Improper jump starting procedures can cause an explosion resulting in personal injury.
- Sparks near batteries can cause explosions.
- Do not allow jump cable ends to touch each other or the machine.
- Battery acid can cause personal injury if it contacts skin or eyes. Always wear eye protection when jump starting a machine.
- Always connect battery positive (+) to battery positive (+) and battery negative (-) to ground on the machine. Make the final ground connection away from the battery.
- Allowing the two machines to touch during jump starting can cause damage to bearings and electrical circuits.
- This machine has a 12 volt starting system. Use the same voltage (12 volts) for jump starting. Use of higher voltage can damage the electrical system.
- Never charge a frozen battery.

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1. Move the boost start machine (or auxiliary power source) close enough to the stalled machine for the cables to reach without allowing the machines to touch. Place the transmission shift selector in NEUTRAL, engage the park brake, and turn off engine (or shut off auxiliary power source).
2. On the stalled machine, turn the ignition switch to OFF.
3. Connect the positive (+) jumper cable to the positive (+) cable terminal of the discharged battery on the stalled machine. Ensure a solid connection. DO NOT allow positive cable clamps to touch ANYTHING other than the battery terminal.
4. Connect the other end of the positive (+) jumper cable to the positive (+) terminal of the boost battery (or auxiliary power source).
5. Connect one end of the negative (–) jumper cable to the negative (–) terminal of the boost battery (or auxiliary power source).
6. Make the final connection of the negative (–) jumper cable to the frame of the stalled machine away from the battery, fuel and hydraulic lines, and moving parts.
7. Start the engine on the boost machine or energize the auxiliary power source.
8. Wait at least two minutes for the battery in the stalled machine to partially charge.
9. Attempt to start the stalled machine (see “Starting Procedures” in your Owner/Operator Manual).
10. Immediately after the stalled machine starts, disconnect the jumper cables in reverse order.

Conversion Charts

Table 3-9: Inch Fraction, Decimal, and Metric Conversion Chart

Inch Fract.	Inch Dec.	mm	Inch Fract.	Inch Dec.	mm
1/64	0.0156	*0.40*	33/64	0.5156	*13.10*
1/32	0.0313	*0.79*	17/32	0.5313	*13.49*
3/64	0.0469	*1.19*	35/64	0.5469	*13.89*
1/16	**0.0625**	***1.59***	**9/16**	**0.5625**	***14.29***
5/64	0.0781	*1.98*	37/64	0.5781	*14.68*
3/32	0.0938	*2.38*	19/32	0.5938	*15.08*
7/64	0.1094	*2.78*	39/64	0.6094	*15.48*
1/8	**0.1250**	***3.18***	**5/8**	**0.6250**	***15.88***
9/64	0.1406	*3.57*	41/64	0.6406	*16.27*
5/32	0.1563	*3.97*	21/32	0.6563	*16.67*
11/64	0.1719	*4.37*	43/64	0.6719	*17.07*
3/16	**0.1875**	***4.76***	**11/16**	**0.6875**	***17.46***
13/64	0.2031	*5.16*	45/64	0.7031	*17.86*
7/32	0.2188	*5.56*	23/32	0.7188	*18.26*
15/64	0.2344	*5.95*	47/64	0.7344	*18.65*
1/4	**0.2500**	***6.35***	**3/4**	**0.7500**	***19.05***
17/64	0.2656	*6.75*	49/64	0.7656	*19.45*
9/32	0.2813	*7.14*	25/32	0.7813	*19.84*
19/64	0.2969	*7.54*	51/64	0.7969	*20.24*
5/16	**0.3125**	***7.94***	**13/16**	**0.8125**	***20.64***
21/64	0.3281	*8.33*	53/64	0.8281	*21.03*
11/32	0.3438	*8.73*	27/32	0.8438	*21.43*
23/64	0.3594	*9.13*	55/64	0.8594	*21.83*
3/8	**0.3750**	***9.53***	**7/8**	**0.8750**	***22.23***
25/64	0.3906	*9.92*	57/64	0.8906	*22.62*
13/32	0.4063	*10.32*	29/32	0.9063	*23.02*
27/64	0.4219	*10.72*	59/64	0.9219	*23.42*
7/16	**0.4375**	***11.11***	**15/16**	**0.9375**	***23.81***
29/64	0.4531	*11.51*	61/64	0.9531	*24.21*
15/32	0.4688	*11.91*	31/32	0.9688	*24.61*
31/64	0.4844	*12.30*	63/64	0.9844	*25.00*
1/2	**0.5000**	***12.70***	**1**	**1.0000**	***25.40***

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Table 3-10: Miscellaneous Conversions

Multiply	By	To Get or Multiply	By	To Get
International System (IS) Unit	**Conversion Factor**	**Non-IS Unit**	**Conversion Factor**	**IS Unit**
		Torque		
Newton Meter (N•m)	x 8.9	= in-lb.	x 0.113	= Nm
Newton Meter (N•m)	x 0.74	= ft-lb.	x 1.36	= Nm
		Pressure (Pa = N/m^2)		
Kilopascal (kPa)	x 4.0	= in H_2O	x 0.249	= kPa
Kilopascal (kPa)	x 0.30	= in. Hg	x 3.38	= kPa
Kilopascal (kPa)	x 0.145	= psi	x 6.89	= kPa
bar	x 14.5	= psi	x 0.069	= bar
Newton/mm^2	x 145.04	= psi	x 0.0069	= bar
		Stress (Pa = N/m^2)		
Megapascal (mPa)	x 145	**= psi**	x 0.00689	= MPa
		Power (W = J/s)		
Kilowatt (kW)	x 1.36	= PS(cv)	x 0.736	= kW
Kilowatt (kW)	x 1.34	= HP	x 0.746	= kW
Kilowatt (kW)	x 0.948	= Btu/s	x 1.055	= kW
Watt (W)	x 0.74	= ft-lb/s	x 1.36	= W
		Energy (J = (N•m)		
Kilojoulè (kJ)	x 0.948	= Btu	x 1.055	= kJ
Joule (J)	x 0.239	= calorie	x 4.19	= J
		Velocity and Acceleration		
Meter per sec^2 (m/s^2)	x 3.28	= ft/s^2	x 0.305	= m/s^2
Meter per sec (m/s)	x 3.28	= ft/s	x 0.305	= m/s
Kilometer per hour (km/h)	x 0.62	= mph	x 1.61	= km/h
		Flow Rate		
Leter/mn (dm^3/mn)	x 0.264	= US gal/min	x 3.785	= L/min
		Horse Power/Torque		
(BHP x 5252) ÷ rpm = TQ (ft-lb.)		(TQ x R.P.M.) ÷ 5252 = B.H.P.		
Metric HP x 0.9863 = U.S. HP				
U.S. HP x 1.014 = Metric HP				
		Temperature		
°C = (°F-32) ÷ 1.8		°F = (°C x 1.8) + 32		
		Miles		
Nautical Mile	x 1.15078	= Statute Mile		
Statute Mile	x 0.86897	= Nautical Mile		

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Table of Contents

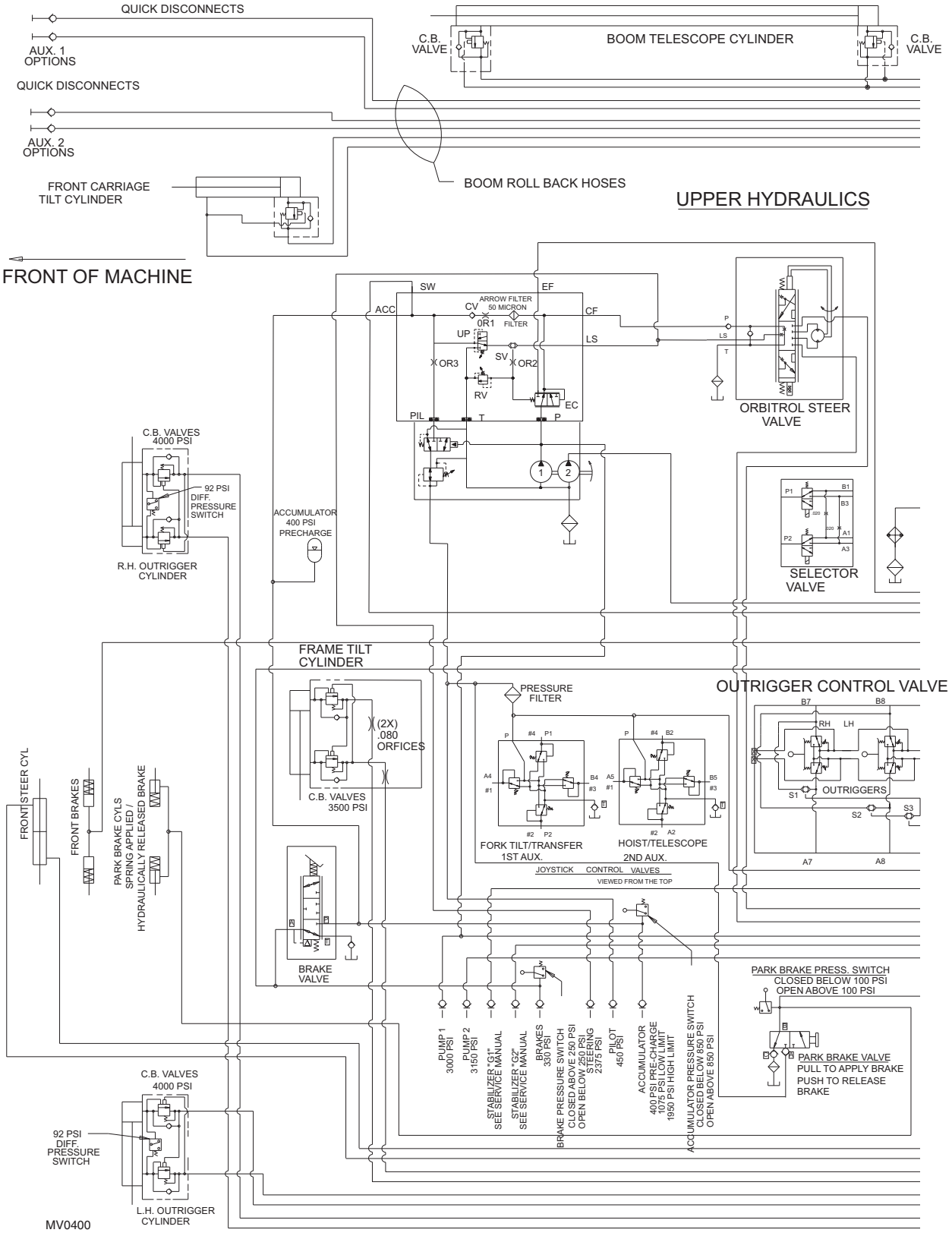
Mid-Inlet Hydraulic Schematic . . . . . Diagram 4-1
Control Valve . . . . . Diagram 4-2
Electrical Schematic . . . . . Diagram 4-3

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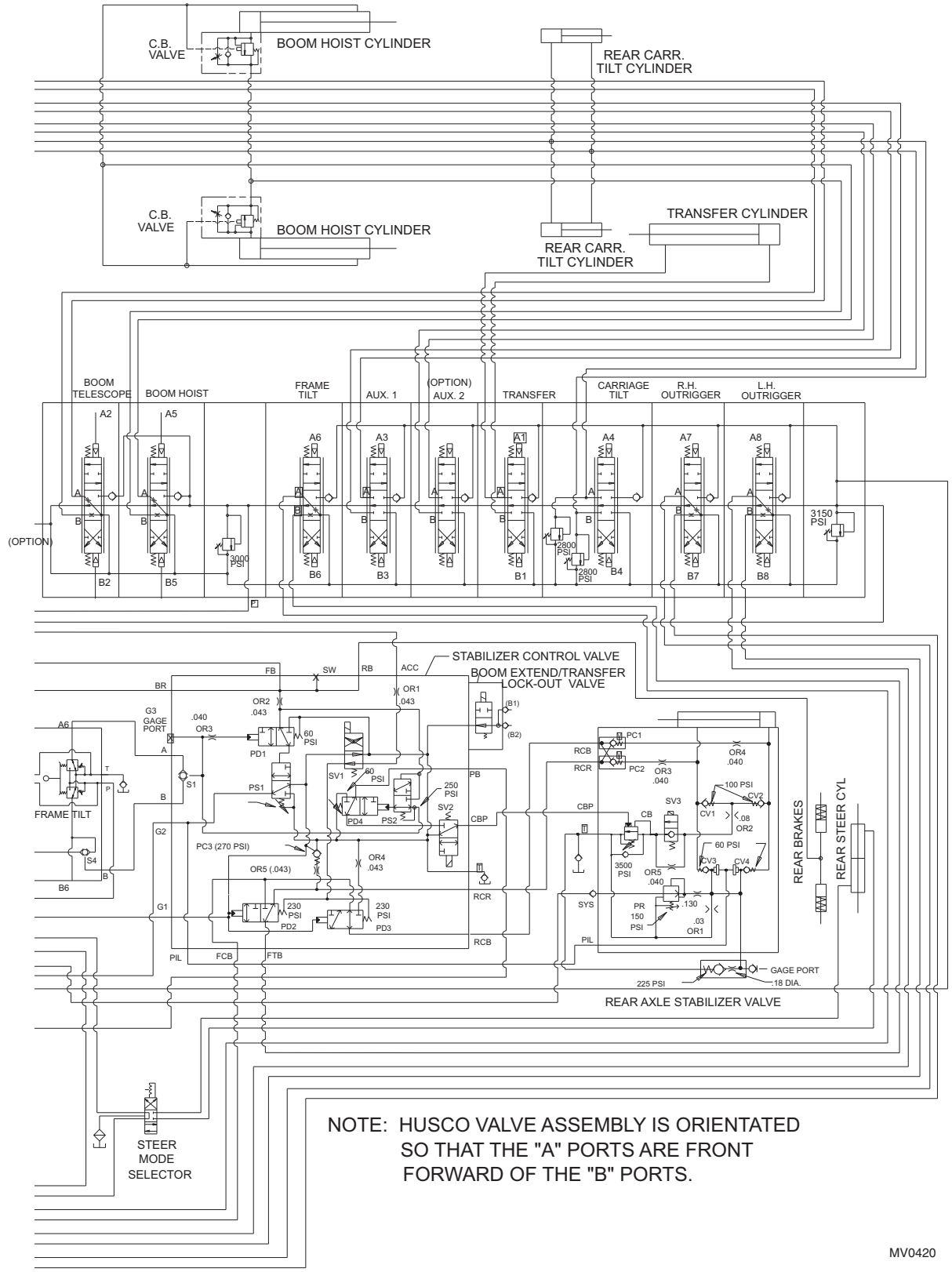
Section 4 — Reference Diagrams

Diagram 4-1 — Mid-Inlet Hydraulic Schematic



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Diagram 4-1 — Mid-Inlet Hydraulic Schematic (cont'd)



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Diagram 4-1 — Mid-Inlet Hydraulic Schematic (cont'd)

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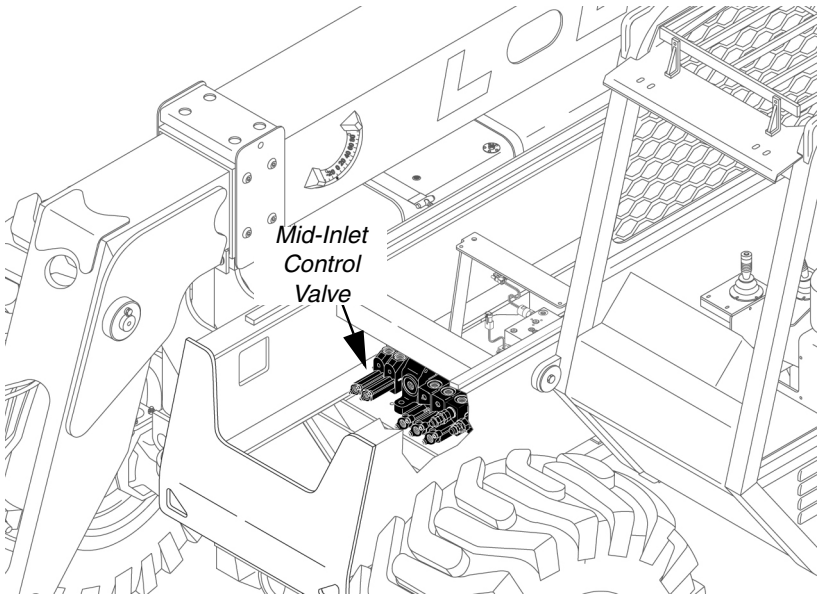
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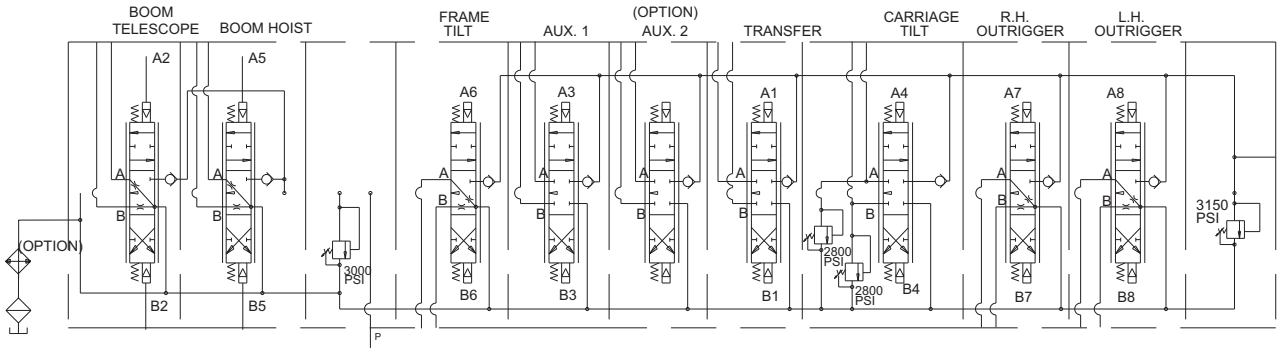
Diagram 4-1 — Mid-Inlet Hydraulic Schematic (cont'd)

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Diagram 4-2 — Control Valve





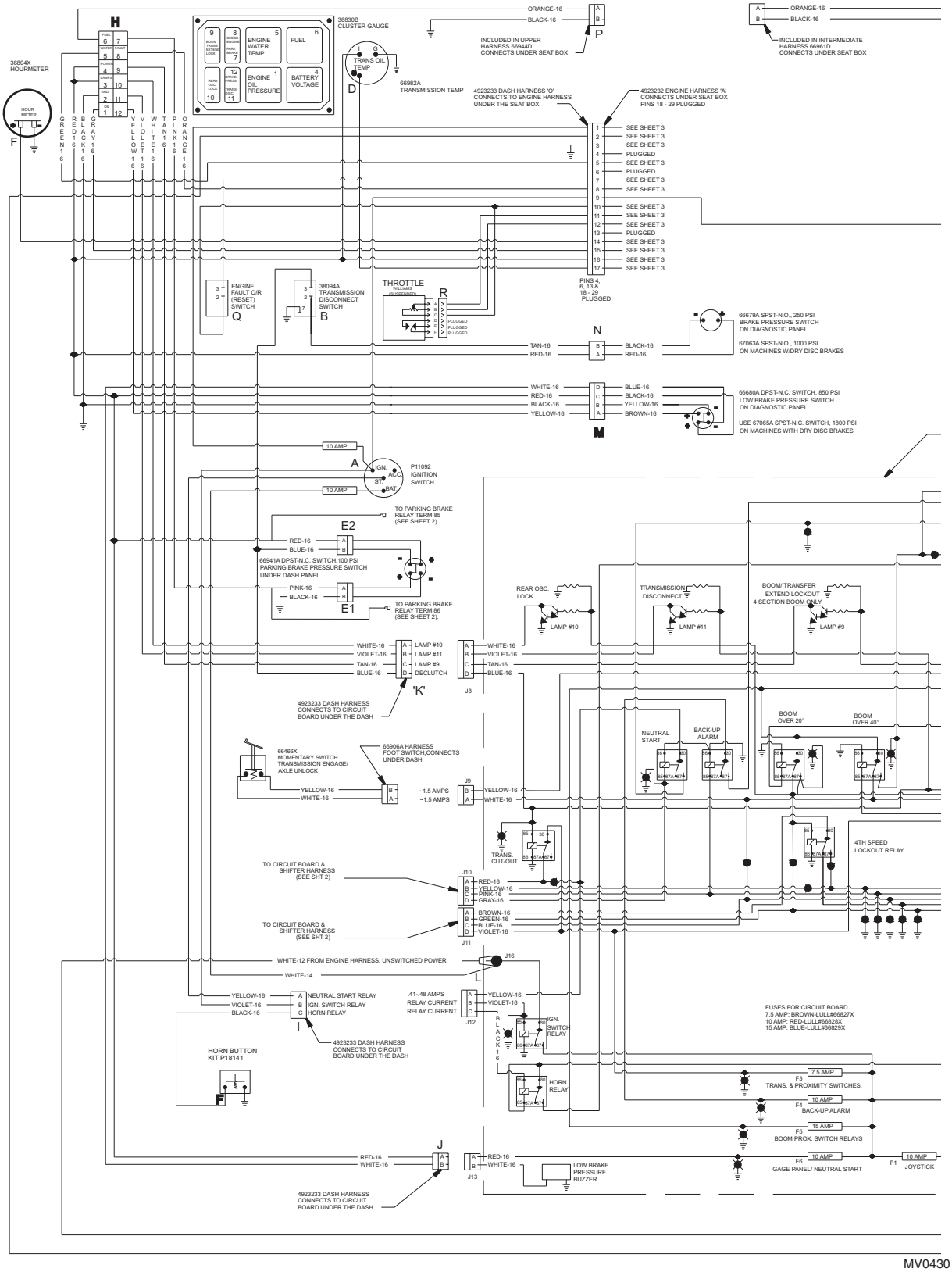
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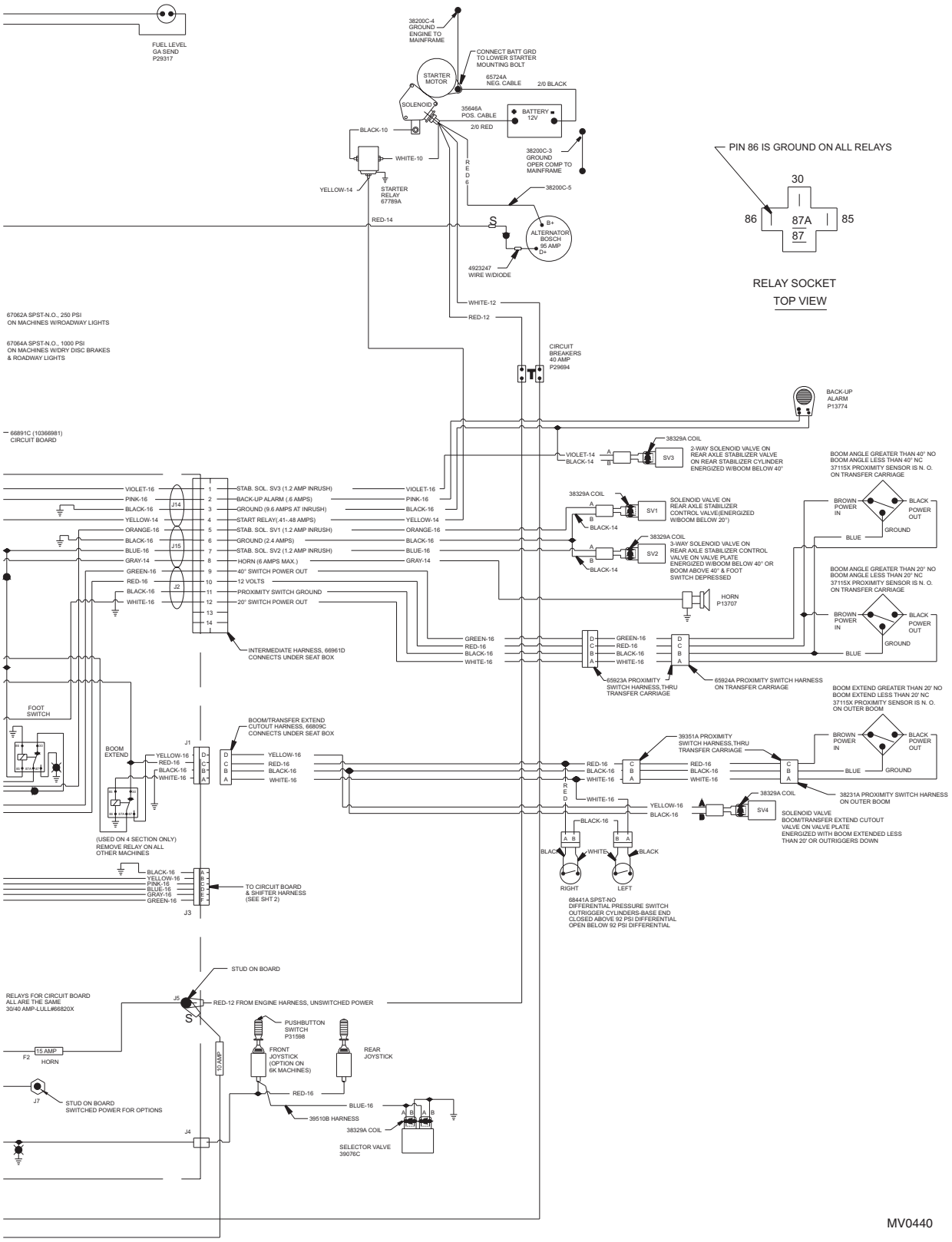
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Diagram 4-3 — Electrical Schematic



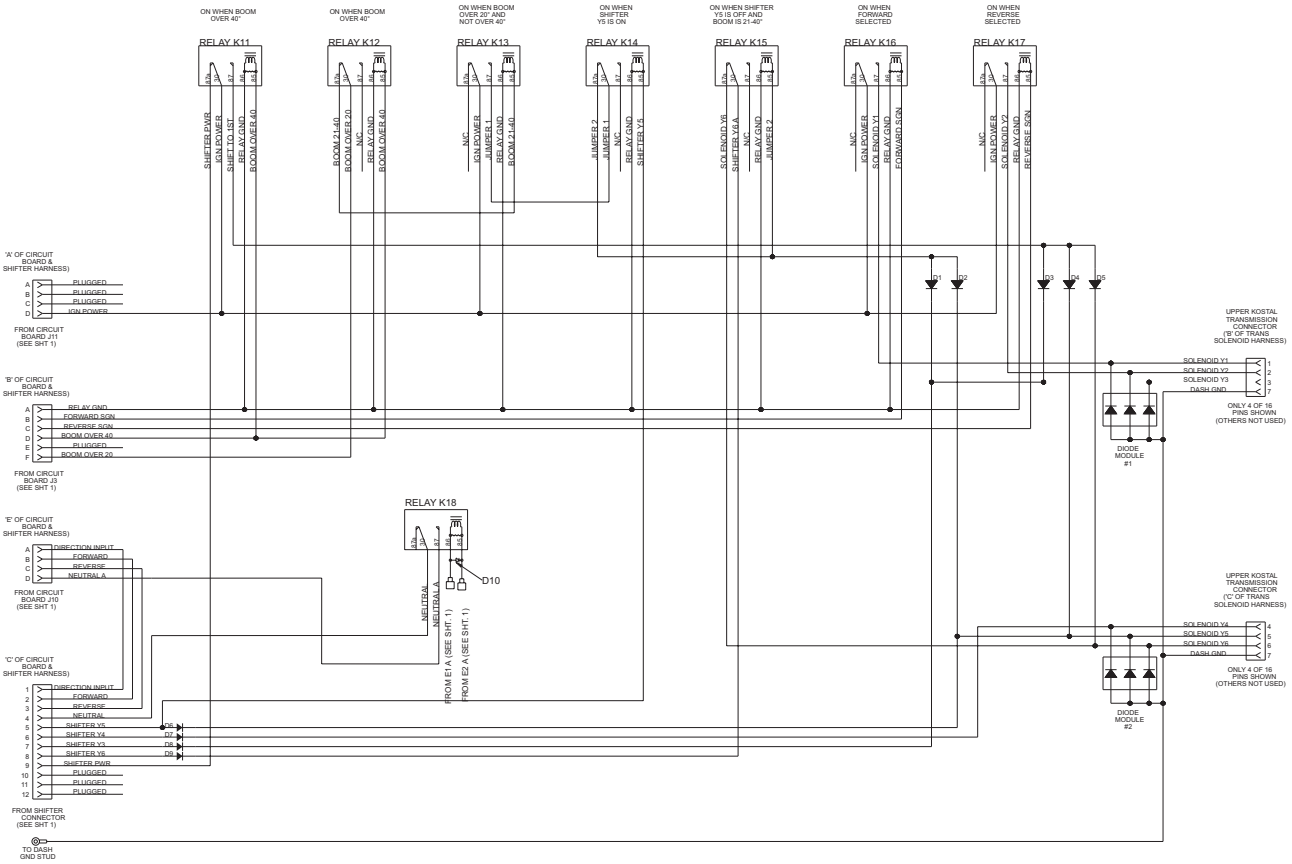
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Diagram 4-3 — Electrical Schematic (cont'd)

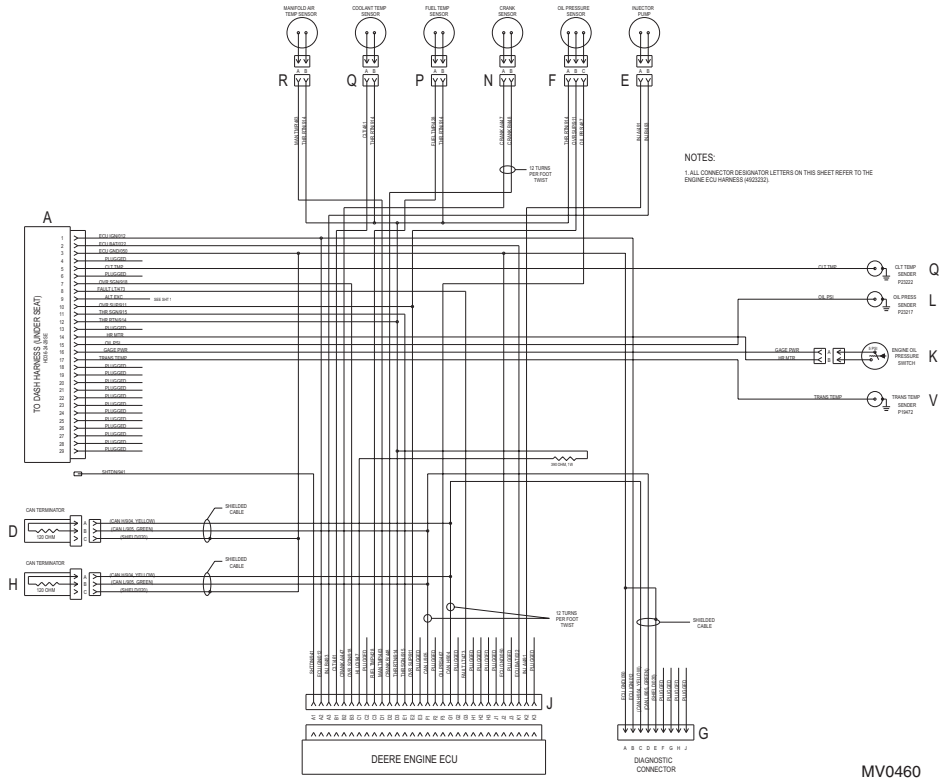


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Diagram 4-3 — Electrical Schematic (cont'd)



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Diagram 4-3 — Electrical Schematic (cont'd)

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Diagram 4-3 — Electrical Schematic (cont'd)

NOTES

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Table of Contents

General 5-1
Major System Components 5-1
General Description 5-1
Hydraulic Systems 5-3
General Hydraulic Maintenance Practices 5-3
Safe Maintenance Practices 5-3
Cleanliness 5-4
Checking Hydraulic Lines 5-5
Hydraulic Reservoir 5-6
Description 5-6
Filling Hydraulic Reservoir 5-8
Reservoir Drain and Refill 5-11
Removal 5-13
Installation 5-15
Sight Gauge 5-16
Description 5-16
Removal 5-17
Installation 5-18
Suction Strainer 5-19
Description 5-19
Removal and Cleaning 5-20
Installation 5-20
Hydraulic Return Filter 5-21
Description 5-21
Checking Filter Condition 5-21
Replacing Return Filter Element 5-22
Removal 5-25
Installation 5-26
Reservoir Breather 5-26
Description 5-26
Removal and Installation 5-27
Hydraulic Pressure Filter 5-27
Description 5-27
Replacing Pressure Filter Element 5-28
Removal 5-29
Installation 5-30
Hydraulic Pump 5-30
Description 5-30
Troubleshooting Pump Problems 5-31

https://truckmanualshub.com/

Removal 5-33
Hydraulic Pump 5-33
Installation 5-37
Checking Pump Flow Rate 5-38
Mid-Inlet Control Valve 5-40
Description 5-40
Removal 5-43
Installation 5-44
Rear Axle Stabilizer Control Valve 5-44
Description 5-44
Removal, Rear Axle Stabilizer Control Valve 5-47
Boom Extend Lockout Valve 5-49
Description 5-49
Hydraulic Diagnostic Ports 5-49
General 5-49
Roll-Back Hose Tray 5-51
General 5-51
Removal 5-51
Installation 5-53

List of Figures

Fig. 5-1: Major Hydraulic Components 5-1
Fig. 5-2: Mid-Inlet Hydraulic Components 5-3
Fig. 5-3: Hydraulic Reservoir Location 5-6
Fig. 5-4: Hydraulic Reservoir 5-7
Fig. 5-5: Recommended Reservoir Filling Method 5-8
Fig. 5-6: Alternate Reservoir Filling Method 5-9
Fig. 5-7: Hydraulic Reservoir Drain and Refill 5-11
Fig. 5-8: Hydraulic Reservoir/Fuel Tank Installation 5-13
Fig. 5-9: Hydraulic Reservoir Sight Gauge 5-16
Fig. 5-10: Reservoir Sight Gauge Installation 5-17
Fig. 5-11: Suction Strainer Installation 5-19
Fig. 5-12: Hydraulic Return Filter 5-21
Fig. 5-13: Return Filter Pressure Gauge 5-21
Fig. 5-14: Filter Housing Cover 5-22
Fig. 5-15: Filter Element Assembly 5-23
Fig. 5-16: Return Filter Assembly 5-25
Fig. 5-17: Reservoir Breather 5-26
Fig. 5-18: Hydraulic Pressure Filter – Control Manifold Hydraulics 5-27

https://truckmanualshub.com/

Fig. 5-19: Hydraulic Pressure Filter Element 5-28
Fig. 5-20: Hydraulic Pressure Filter Assembly 5-29
Fig. 5-21: Hydraulic Pump Location 5-30
Fig. 5-22: Hydraulic Pump Hoses – Mid-Inlet Hydraulics 5-33
Fig. 5-23: Hydraulic Pump Installation – Mid-Inlet Hydraulics 5-35
Fig. 5-24: Checking Hydraulic Pump Flow Rate 5-38
Fig. 5-25: Mid-Inlet Control Valve Location 5-40
Fig. 5-26: Mid-Inlet Control Valve Components 5-40
Fig. 5-27: Mid-Inlet Control Valve Configurations, ... 5-42
Fig. 5-28: Mid-Inlet Control Valve Installation 5-43
Fig. 5-29: Rear Axle Stabilizer Control Valve Location 5-44
Fig. 5-30: Rear Axle Stabilizer Control Valve Ports 5-45
Fig. 5-31: Rear Axle Stabilizer Control Valve 5-47
Fig. 5-32: Boom Extend Lockout Valve 5-49
Fig. 5-33: Hydraulic Diagnostic Ports - Models with Mid-Inlet Hydraulics 5-49
Fig. 5-34: Roll-Back Hose Frame Location - Control Manifold Hydraulics 5-51
Fig. 5-35: Roll-Back Tray Installation - Mid-Inlet Hydraulics 5-52

List of Tables

Table 5-1: Rear Axle Stabilizer Control Valve Markings 5-1

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Section 5 — Supply, Pressure, and Return Hydraulics

General

Major System Components

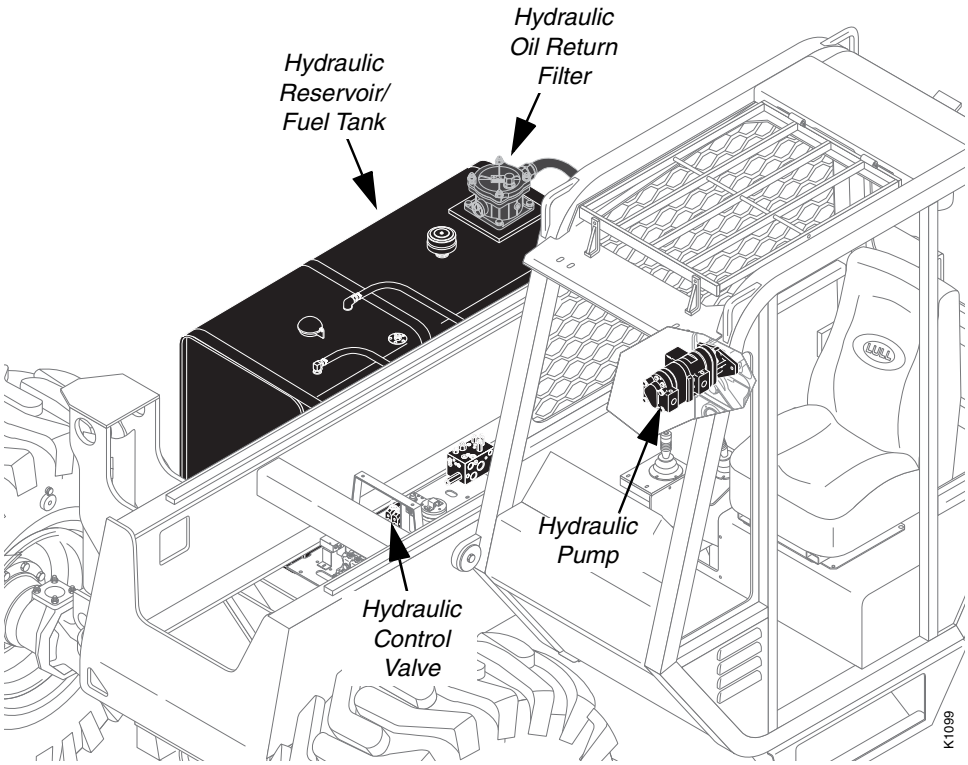


Fig. 5-1: Major Hydraulic Components

General Description

(Ref. Fig. 5-1) The hydraulic system consists of the following circuits:

- Boom Extension (See Section 6)
- Boom Hoist (See Section 6)
- Carriage Tilt (See Section 6)
- Transfer Carriage (See Section 6)
- Frame Tilt (See Section 7)
- Auxiliary — 1st - Standard, 2nd - Optional (See Section 6)
- Steering
- Service Brakes (See Section 9)
- Rear Axle Oscillation Lock (See Section 6)
- Outriggers

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These circuits are supplied by a two-section, gear-type hydraulic pump, driven directly from the transmission power takeoff. The closest to the shaft pump supplies flow to all circuits except steering and the steer selector valve. The second pump supplies flow to all circuits via the steering priority valve.

The boom extension and hoist circuits are controlled by a two-spool valve with pressure relief. The frame tilt, carriage tilt, transfer carriage, and auxiliary circuits are controlled by a four-spool valve (five-spool optional) with pressure relief. The carriage tilt circuits are also equipped with two work port relief valves. The outrigger circuits are controlled by two additional valve sections with no-relief plugs. The steering circuit is controlled by a steering control unit and steering mode selector valve. The service brake circuit is controlled by a hydraulic power brake valve and includes an accumulator.

The boom extension, boom hoist, carriage tilt, outrigger, and frame tilt cylinders are equipped with externally mounted counterbalance valves. The counterbalance valves prevent movement of the cylinders in event of downstream hydraulic line failure, leakage through the main control valve or fittings. The counterbalance valves prevent movement of the cylinders when the engine is off, even if the control valve levers are operated. The counterbalance valves also provide over-load relief protection.

The hydraulic reservoir is mounted on the right-hand side of the machine. The hydraulic system return filter/magnetic separator is located at the top of the reservoir. The strainer and suction line is located at the bottom of the back side of the reservoir.

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Hydraulic Systems

Mid-Inlet Hydraulic System

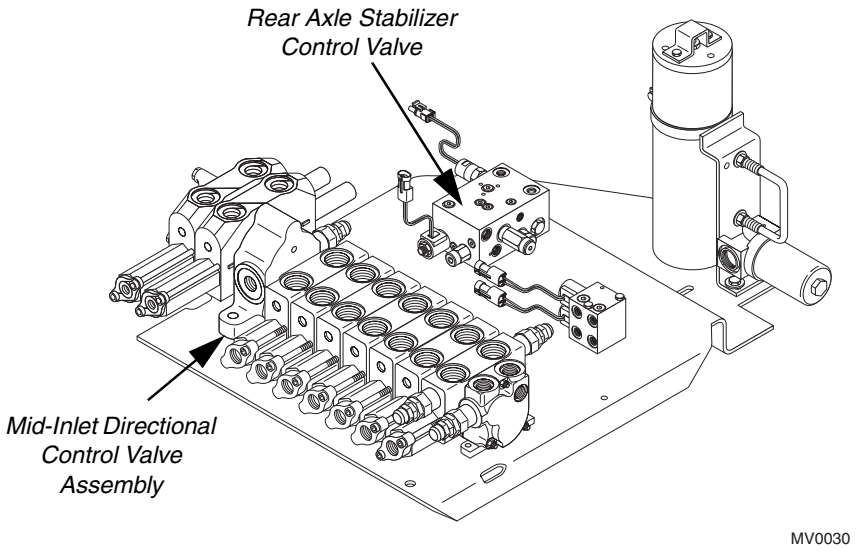
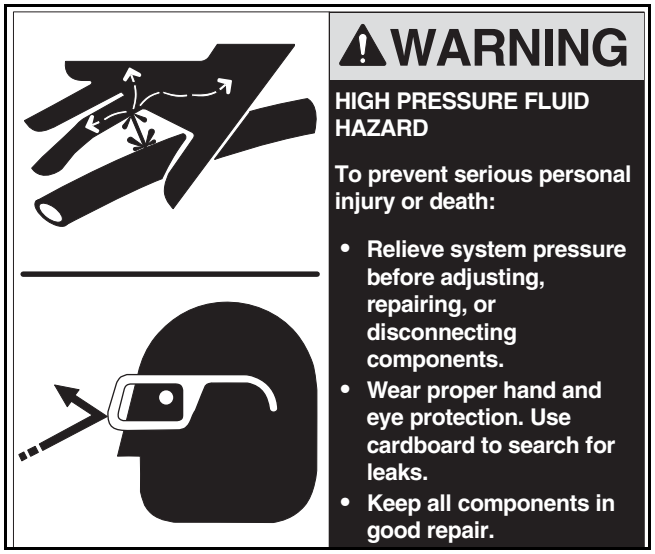


Fig. 5-2: Mid-Inlet Hydraulic Components

The term “mid-inlet hydraulic system” is used to reference and differentiate the types of components used in the hydraulic system. This system was designed to simplify the hydraulic system and improve overall reliability. It uses a rear axle stabilizer control valve along with a mid-inlet directional control valve assembly to control all hydraulic functions.

General Hydraulic Maintenance Practices

Safe Maintenance Practices



- The hydraulic system is under pressure whenever the engine is running and can hold pressure after the engine is shut down. After forks or attachments are resting on the ground or support, make sure pressure is relieved from all hydraulic lines and components before removing them from the circuit.

Remember the following during inspection and maintenance of the hydraulic system:

- Wait for fluid to cool down before disconnecting lines.
- **DO NOT** use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks.
- Wear appropriate eye protection.
- If anyone is injured by or if any hydraulic fluid is injected into the skin, get medical attention immediately.
- When venting or filling the hydraulic system, loosen the filler cap slowly and remove it gradually.
- **NEVER** reset any relief valve in the hydraulic system to a pressure higher than that shown in the Specifications Section of this manual.

Cleanliness

Cleanliness is critical when servicing hydraulic systems.

KEEP DIRT AND OTHER CONTAMINANTS OUT OF THE SYSTEM!

Small particles can score valves, seize pumps and clog orifices, causing expensive repair jobs.

Steam clean or use solvents to clean the area of the machine around a hydraulic component before it is removed.

When steam cleaning or using water to clean a machine, be sure the reservoir breather filter is protected to keep water out of the system.

Use caps or plugs to cover ends of disconnected lines, or to plug openings when working on a hydraulic system.

When removing parts for service, clean them with a suitable solvent and store them in plastic bags or other clean containers until they are installed again.

Thoroughly rinse the cleaned parts, and dry them using compressed air. Protect the parts immediately with a coating of rust preventive oil.

A clean work bench is an absolute must when servicing hydraulic components. An industrial-type vacuum cleaner is a valuable aid in removing dust, dirt, and tiny metal particles from the work area.

Check the condition of the tools you use and make sure they are clean. Use hammers made of plastic or leather so there is no danger of metal chips getting into components.

Despite all the precautions you take when working with a hydraulic system, some contaminants will get into the system anyway. High quality hydraulic oils keep these contaminants in suspension and the filters will collect them

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as the oil passes through. A high quality hydraulic oil contains many additives which work to keep contaminants from damaging the system. However, these additives lose their effectiveness after a period of time. Therefore, change the oil at recommended intervals to make sure the additives do their job.

The system filter can absorb only a limited amount of dirt particles and other contaminants from the oil. Therefore, replace the filter element at the recommended intervals so the cleaning process can be maintained.

Checking Hydraulic Lines

Inspect hydraulic lines and fittings for gouges, nicks, kinks, leaks, and collapsed or deteriorating hoses.

Note: *Even small leaks can be detected by oil stains or build-up of dirt or other foreign material in a suspect area.*

Replace any tube lines that are pinched or dented.

Replace a hose if any of the following conditions exist:

- Any evidence of hydraulic oil leakage at the surface of the hose or its junction with the metal end couplings.
- Any blistering or abnormal deformation to the outer covering of the hose.
- Hydraulic oil leakage at any threaded or clamped joint that cannot be eliminated by normal tightening.
- Evidence of excessive abrasion or scrubbing on the outer surface of hose or hoses.

Important: *When tightening loose lines or connections, use two wrenches to avoid twisting hose or tubes. Tighten loose connections only until the leak stops. An over-tightened fitting may result in overstressing and/or cracking. Replace any connectors that continue to leak. See "Hydraulic Fitting Torques" in Section 3 for torque specifications for hydraulic fittings and hydraulic line connections.*

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Hydraulic Reservoir

Description

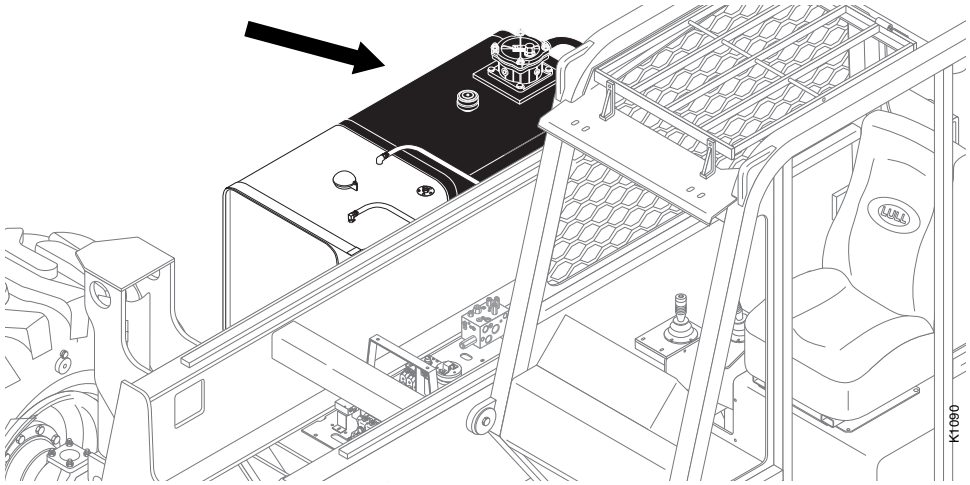


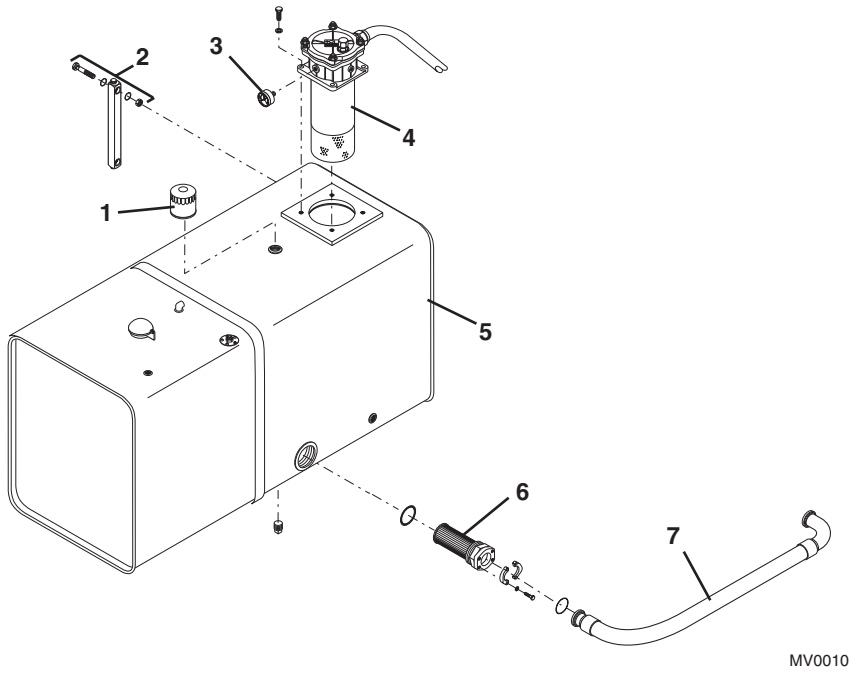
Fig. 5-3: Hydraulic Reservoir Location

(Ref. Fig. 5-3) The hydraulic reservoir is mounted on the right-hand side of the machine and is located next to the fuel tank. It has a capacity of 47 gallons. The major components associated with the hydraulic reservoir are:

- Hydraulic Tank Breather
- Hydraulic Tank Sight Gauge
- Pressure Gauge
- Hydraulic Oil Return Filter
- Hydraulic Oil Strainer.

A breakdown of hydraulic reservoir parts is shown in Fig. 5-4.

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#	Description
1	Hydraulic Tank Breather (Models with Mid-Inlet Hydraulics)
2	Hydraulic Tank Sight Gauge
3	Pressure Gauge
4	Return Filter Assembly

#	Description
5	Hydraulic Oil Tank
6	Hydraulic Oil Strainer (Models with Mid-Inlet Hydraulics)
7	Suction Line

Fig. 5-4: Hydraulic Reservoir

(Ref. Fig. 5-4) The hydraulic system return filter assembly (Item 4), along with the pressure gauge (Item 3), is located within the return filter housing, located at the top of the reservoir (Item 5).

The strainer (Item 6) and suction line (Item 7) are located at the bottom of the back side of the reservoir.

A pressure differential gauge (Item 3) is fitted to the return filter housing to monitor filter condition.

A breather filter assembly (Item 1) is threaded into the top of the reservoir. It allows for expansion of fluid and prevents vacuum in the tank.

Check the hydraulic reservoir daily for the proper oil level. Maintain oil level at the full mark on the sight gauge (Item 2) with all cylinders retracted.

Important: *Do not operate the machine if the oil level falls below the low mark on the sight gauge. Low oil level could damage the pump and other components.*

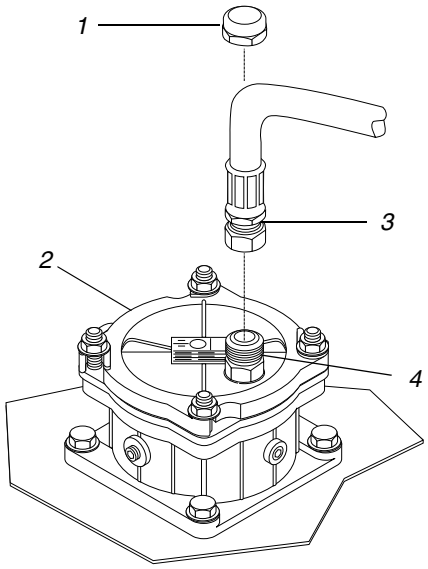
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Filling Hydraulic Reservoir

Preferred Method

CAUTION: Do not fill reservoir through the breather opening. The hydraulic system can become contaminated.

Oil must be filtered through the return filter to ensure purity. Contamination, even small amounts, can permanently damage hydraulic system components and void the warranty.



#	Description	#	Description
1	Hex Cap	3	Hydraulic Hose
2	Cover	4	Male JIC (37°) Filler Fitting

Fig. 5-5: Recommended Reservoir Filling Method

(Ref. Fig. 5-5) The following is the recommended filling procedure for the hydraulic reservoir:

1. The machine must be parked on a level surface and the frame must be level.
2. Retract all cylinders except frame tilt cylinder. Apply the park brake and stop the engine.
3. Clean area around hex cap (Item 1) on the cover (Item 2). Loosen and remove the hex cap.
4. Provide a hydraulic hose of suitable length to run between hydraulic oil fill pump and male JIC (37°) filler fitting (Item 4), in return filter housing cover. The reservoir end of the hose must be fitted with a 1-1/16-12 JIC (37°) female hose fitting.
5. Assemble hose (Item 3) to reservoir filler fitting (Item 4) and tighten.
6. Fill reservoir until oil level in sight gauge is at HIGH mark. Use hydraulic oil as specified in “Fluid and Lubricant Specifications” in Section 3.

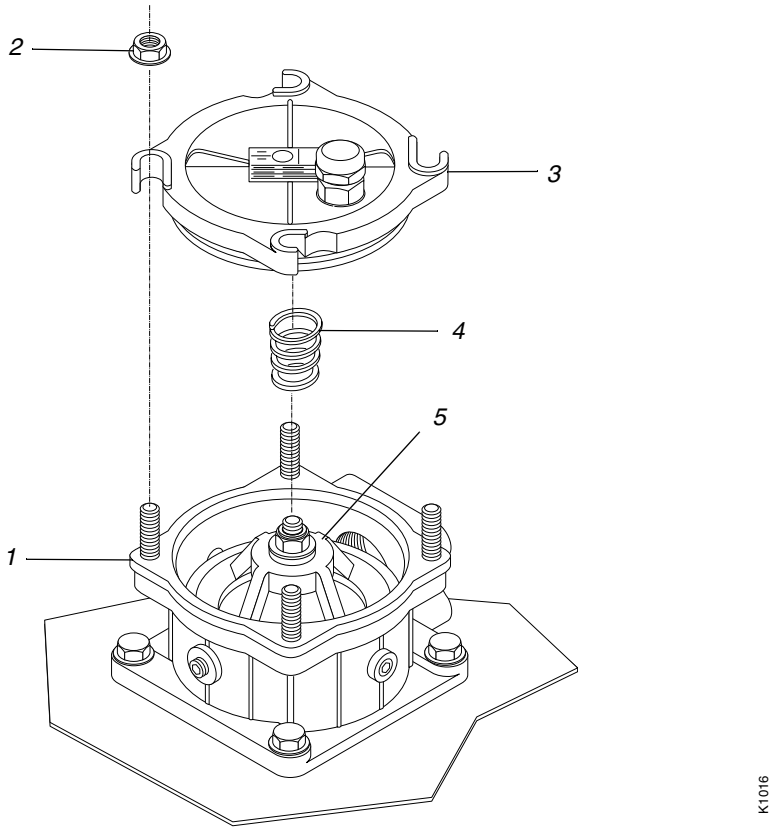
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7. Start engine and allow hydraulic system to warm up. Operate controls gradually until you fully extend and retract each cylinder, including steering cylinders. This procedure removes air from the system.
8. Level the frame, retract all cylinders except frame tilt cylinder, and stop the engine. Recheck oil level and add oil as required.
9. Loosen and remove hose (Item 3) from reservoir filler fitting (Item 4). Install hex cap (Item 1) and torque to 70 ft-lbs.

Filling Hydraulic Reservoir Alternate Method

CAUTION: Do not fill reservoir through breather opening. The hydraulic system can become contaminated.

Oil must be filtered through the return filter to ensure purity. Contamination, even small amounts, can permanently damage hydraulic system components and void the warranty.



#	Description
1	Return Filter Housing
2	Flange Nut
3	Cover

#	Description
4	Spring
5	Hydraulic Filter Element

Fig. 5-6: Alternate Reservoir Filling Method

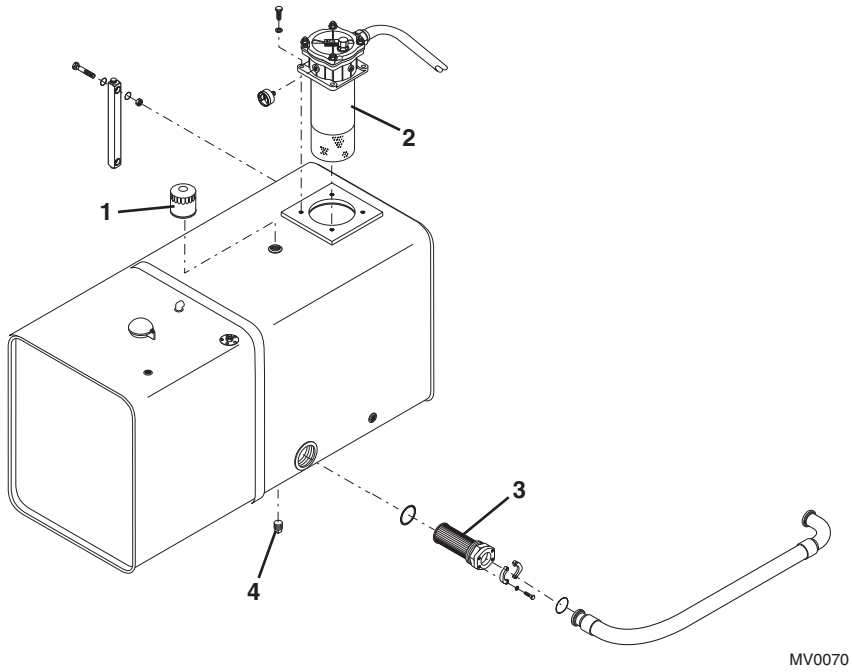
(Ref. Fig. 5-6) The following is an alternate filling procedure for the hydraulic reservoir.

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1. The machine must be parked on a level surface and the frame must be level.
2. Retract all cylinders except frame tilt cylinder, apply the park brake, and stop the engine.
3. Clean return filter housing (Item 1) and surrounding area.
4. Remove four (4) flange nuts (Item 2) that secure the filter housing cover (Item 3). Set hardware aside on a clean surface.
5. Lift the cover (Item 3) and spring (Item 4) from housing (Item 1) and set aside on a clean surface.
6. ***SLOWLY*** pour hydraulic oil into filter element (Item 5). It takes several moments for oil to drain through the element. Continue to add oil until HIGH mark is reached on hydraulic reservoir sight gauge.
7. Make sure the cover (Item 3) and spring (Item 4) are clean.
8. Place spring (Item 4) in position on filter element assembly (Item 5).
9. Place the cover (Item 3) in position and secure it to the filter housing (Item 1) with four (4) flange nuts (Item 2). Torque nuts to 35 ft-lbs.
10. Start the engine and allow hydraulic system to warm up. Operate controls gradually until you can fully extend and retract each cylinder, including steering cylinders. This procedure removes air from the system.
11. Retract all cylinders and stop the engine.
12. Recheck oil level and add oil as necessary.

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Reservoir Drain and Refill



#	Description
1	Breather Filter
2	Return Filter Assembly

#	Description
3	Hydraulic Oil Suction Strainer
4	Drain Plug

Fig. 5-7: Hydraulic Reservoir Drain and Refill

(Ref. Fig. 5-7) The following procedure describes draining and refilling the hydraulic reservoir.

1. Lower the boom to the ground, apply the parking brake, and stop the engine.

CAUTION: Do not place hands in hot hydraulic oil. Hot hydraulic oil can cause severe burns and skin irritation.

2. Remove hydraulic reservoir drain plug (Item 4) and drain hydraulic oil into an appropriate container. Dispose of drained oil properly.
3. To remove the return filter assembly (Item 2), see “Removal” on page 5-25.
4. To remove the suction strainer (Item 3), see “Removal and Cleaning” on page 5-20.
5. Clean inside of reservoir of rust, sludge, scale, metallic particles, deposits, and other residue with solvent. Drain into suitable container and wipe clean with dry, lint-free wipes. Dry with compressed air and use a shop vacuum to remove any remaining particles.

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6. Clean the strainer (Item 2) by back flushing with solvent. Dry the strainer element thoroughly with compressed air. Install it as described under “Installation” on page 5-20.
7. Install the reservoir drain plug (Item 4). Tighten two or three turns past finger tight. If it is necessary to use thread sealant to stop fluid leakage, apply sealant only to last few threads close to the drain plug head.



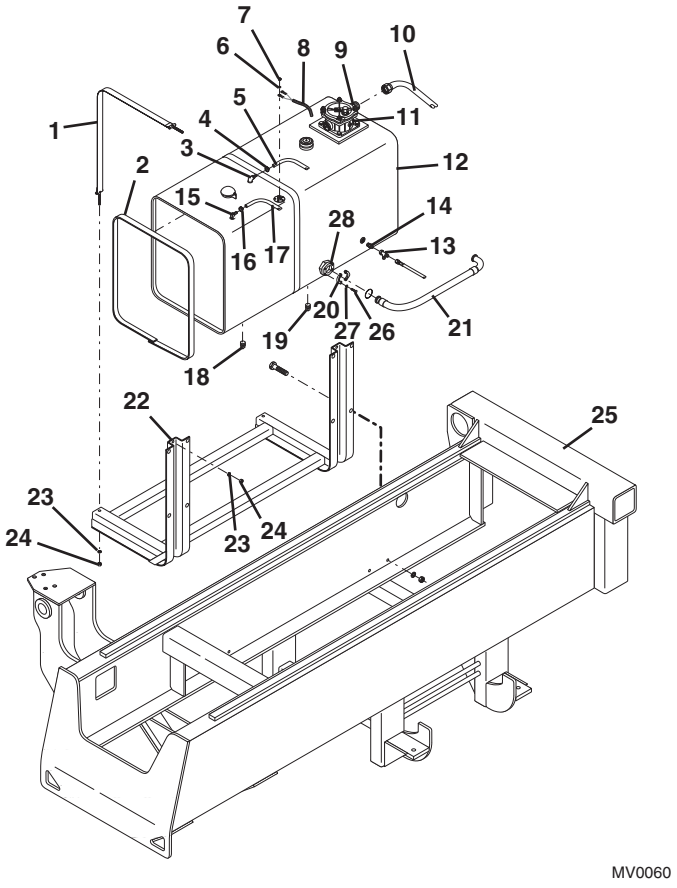
CAUTION: To avoid contamination of hydraulic system, do not apply thread sealant to end threads of drain plug.

8. To install return filter assembly (Item 2), see “Installation” on page 5-26.
9. Install a new breather filter assembly (Item 1).
10. Fill hydraulic reservoir. see “Filling Hydraulic Reservoir” on page 5-8.

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Removal

Hydraulic Reservoir and Fuel Tank



#	Description	#	Description
1	Tank Hold-Down Strap	15	90° Elbow
2	Chemprene Belting	16	Hose Clamp
3	Pipe Adapter	17	Fuel Return Hose
4	Hose Clamp	18	Fuel Tank Drain Plug
5	Fuel Supply Hose	19	Hydraulic Reservoir Drain Plug
6	Flatwasher	20	Flange Halve
7	Nut	21	Hydraulic Suction Hose
8	Wiring Harness	22	Tank Support Mount
9	JIC Pipe Connector	23	Lockwasher
10	Return Manifold Tube	24	Nut
11	Hydraulic Oil Return Filter	25	Main Frame (Front End)
12	Hydraulic Reservoir/Fuel Tank	26	Capscrew
13	Swivel Branch Tee	27	Lockwasher
14	Check Valve	28	Hydraulic Oil Strainer

Fig. 5-8: Hydraulic Reservoir/Fuel Tank Installation

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(Ref. Fig. 5-8) The following procedure describes removal of the hydraulic reservoir/fuel tank.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Remove the hydraulic reservoir drain plug (Item 19) and drain hydraulic fluid into a suitable container. Dispose of drained fluid properly. Temporarily reinstall drain plug.
3. Remove fuel tank drain plug (Item 18) and drain the fuel into an suitable container. Dispose of drained fuel properly. Temporarily reinstall drain plug.



WARNING: Fuel is highly combustible. Avoid all possibilities of sparks that could ignite the fuel. Drain the fuel tank in a well ventilated area, away from smoking materials, open flames, or exposed heater parts.

4. Remove two (2) nuts (Item 7) and flatwashers (Item 6) securing wiring harness (Item 8) to fuel sender.
5. Loosen and disconnect swivel nut of swivel branch tee (Item 13) from check valve (Item 14).
6. Tag fuel lines (Items 17 and 5). Remove hose clamps (Items 4 and 16) on fuel lines. Cap elbow (Item 15) and pipe adapter (Item 3).
7. Remove the four (4) capscrews (Item 26) and lockwashers (Item 27) securing the two (2) flange halves (Item 20) and the hydraulic suction hose (Item 21) to the hydraulic strainer (Item 28). Remove the flange halves.
8. Loosen and remove the return manifold tube (Item 10) connected to the JIC pipe connector (Item 9) on the hydraulic oil return filter (Item 11).



CAUTION: To avoid personal injury and/or damage to the equipment, support the hydraulic tank to ensure that it does not twist or fall when removing or installing it.

9. After ensuring that the tank is properly supported, remove the four (4) each nuts (Item 24) and lockwashers (Item 23) that secure the two (2) tank hold-down straps (Item 1) to the tank support mount (Item 22).
10. Remove the hydraulic reservoir/fuel tank (Item 12) to an appropriate area for cleaning/inspection.
11. Inspect reservoir/fuel tank for damage and replace if necessary.
12. Remove hydraulic reservoir drain plug and perform steps 3 thru 5 under “Reservoir Drain and Refill” on page 5-11.
13. Remove the fuel tank drain plug. Clean the inside of the fuel tank with high-pressure jet spray of diesel fuel to ensure it is free of rust, sludge, scale, metallic particles, deposits, and other residue. Drain into suitable container and hand wipe clean with dry rags.

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14. Perform steps 6 through 9 under “Reservoir Drain and Refill” on page 5-11.
15. Install the fuel tank drain plug (Item 18). Tighten two or three turns past finger tight. If it is necessary to use thread sealant to stop fluid leakage, make sure that the sealant is applied only to the last few threads close to the drain plug head.

CAUTION: To avoid contamination of the fuel system, do not apply thread sealant to the end threads of the drain plug.

Installation

Hydraulic Reservoir and Fuel Tank

(Ref. Fig. 5-8) The following procedure describes installation of the hydraulic reservoir/fuel tank.

1. Inspect the two (2) pieces of chemprene belting (Item 2) and replace if necessary.

CAUTION: To avoid personal injury and/or damage to the equipment, support the hydraulic tank to ensure that it does not twist or fall when removing or installing it.

2. While ensuring that the hydraulic reservoir/fuel tank is properly supported and in the proper position, attach the two (2) tank hold-down straps (Item 1) over the two pieces of chemprene belting and to the tank support mount (Item 22) using four (4) each nuts (Item 24) and lockwashers (Item 23). For final tightening, torque nuts to 35 ft-lbs.
3. Reconnect the suction tube elbow (Item 21) to the JIC pipe connector (Item 20).
4. Reconnect swivel nut of swivel branch tee (Item 13) to check valve (Item 14). For final tightening, torque to 44–48 ft-lbs.
5. Reconnect return manifold tube (Item 10) to JIC pipe connector (Item 9) on hydraulic oil return filter (Item 11). For final tightening, torque connector on return manifold tube to 188–213 ft-lbs.
6. Reconnect fuel lines (Items 17 and 5) to elbow (Item 15) and pipe adapter (Item 3). Secure the fuel lines to the fittings with hose clamps (Items 4 and 16) and tighten as necessary.
7. Install wiring harness (Item 8) on fuel sender with two (2) flatwashers (Item 6) and nuts (Item 7). Tighten nuts until snug.
8. Fill hydraulic reservoir according to the preferred method on page 5-8.
9. Fill fuel tank as outlined in Section 3.

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Sight Gauge

Description

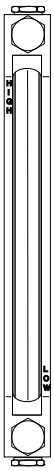


Fig. 5-9: Hydraulic Reservoir Sight Gauge

Note: *When checking oil quantity, the machine must be on a level surface and the frame must be level.*

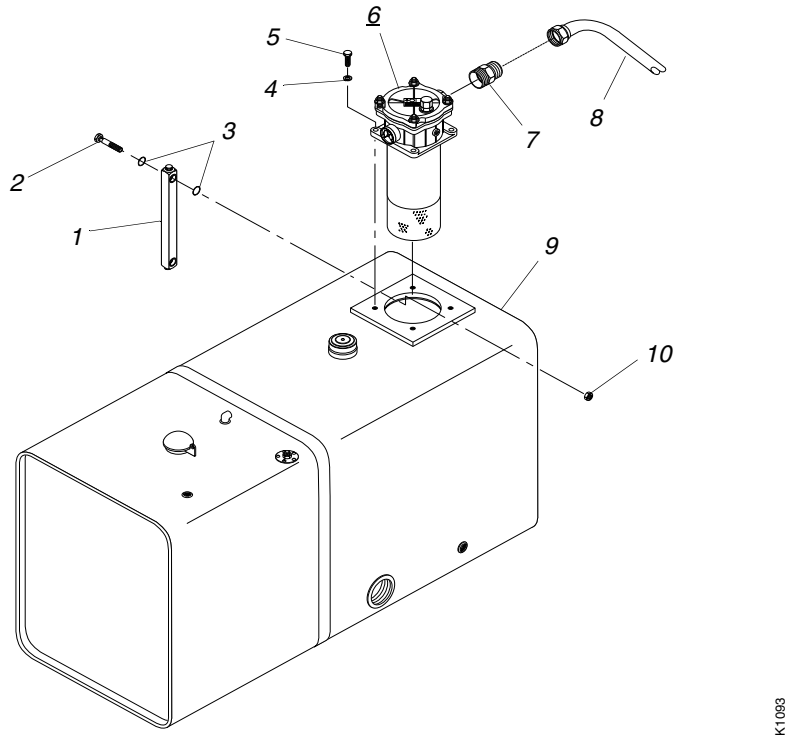
The hydraulic reservoir sight gauge is located on the side of the reservoir (see Fig. 5-10, Item 1).

The hydraulic fluid level in the reservoir changes considerably during operation and a reading should not be taken until the boom is lowered to the ground, the parking brake is applied, the engine is stopped, and all hydraulic pressure is released in the system. The hydraulic reservoir sight gauge should then show the fluid level being near the high level. If necessary, add hydraulic fluid, being careful not to overfill.

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Removal

Sight Gauge



#	Description
1	Hydraulic Sight Gauge
2	Hollow Hex Head Bolt
3	O-Ring
4	Lockwasher
5	Capscrew

#	Description
6	Hydraulic Oil Return Filter Assy
7	JIC Pipe Connector
8	Return Manifold Tube
9	Hydraulic Reservoir
10	Nut

Fig. 5-10: Reservoir Sight Gauge Installation

(Ref. Fig. 5-10) The following procedures describes removal of the reservoir sight gauge.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Remove the hydraulic reservoir drain plug (Item 19) and drain hydraulic fluid into a suitable container. Dispose of drained fluid properly.
3. Disconnect return manifold tube (Item 8) connected to the JIC pipe connector (Item 7) on the hydraulic oil return filter assembly (Item 6).
4. Remove four (4) each capscrews (Item 5) and lockwashers (Item 4) that secure the hydraulic oil return filter assembly (Item 6) to the hydraulic reservoir (Item 9). Remove the hydraulic oil return filter assembly.
5. Reaching inside the opening for the hydraulic oil return filter assembly in the hydraulic fluid reservoir, remove the two (2) nuts (Item 10) that secure the sight gauge to the hydraulic reservoir.

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6. Remove the sight gauge (Item 1) along with the two (2) hollow hex head bolts (Item 2).
7. Clean the two openings in the side of the hydraulic reservoir with appropriate solvent. Plug openings.

Installation

Sight Gauge

(Ref. Fig. 5-10) The following procedures describes installation of the reservoir sight gauge.

1. Remove the four (4) O-rings (Item 3) from the sight gauge and clean O-rings with appropriate solvent. Dry with compressed air. Check for and replace any damaged O-rings.
2. Inspect sight gauge for damage and replace if necessary. Clean sight gauge with appropriate solvent and dry with compressed air.
3. Install four (4) O-rings (Item 3) in sight gauge. Lubricate each O-ring before installing it.
4. Clean the two (2) hollow hex head bolts (Item 2) with appropriate solvent; inspect and replace if damaged.
5. Install sight gauge (Item 1) on hydraulic reservoir (Item 9) with hollow hex head bolts (Item 2) and nuts (Item 10). Tighten as necessary.
6. Install hydraulic oil return filter assembly (Item 6) as per instructions on page 5-26.
7. Reconnect return manifold tube (Item 8) to the JIC pipe connector (Item 7) on the hydraulic oil return filter assembly (Item 6). For final tightening, torque hex head connector on return manifold tube to 188–213 ft-lbs.
8. lean the inside of the reservoir of rust, sludge, scale, metallic particles, deposits, and other residue with high pressure jet spray of diesel fuel. Drain into suitable container and hand wipe clean with dry rags. Dispose of contaminated diesel fuel properly.
9. Install the reservoir drain plug (Item 4). Tighten two or three turns past finger tight. If it is necessary to use thread sealant to stop fluid leakage, apply sealant only to the last few threads close to the drain plug head.



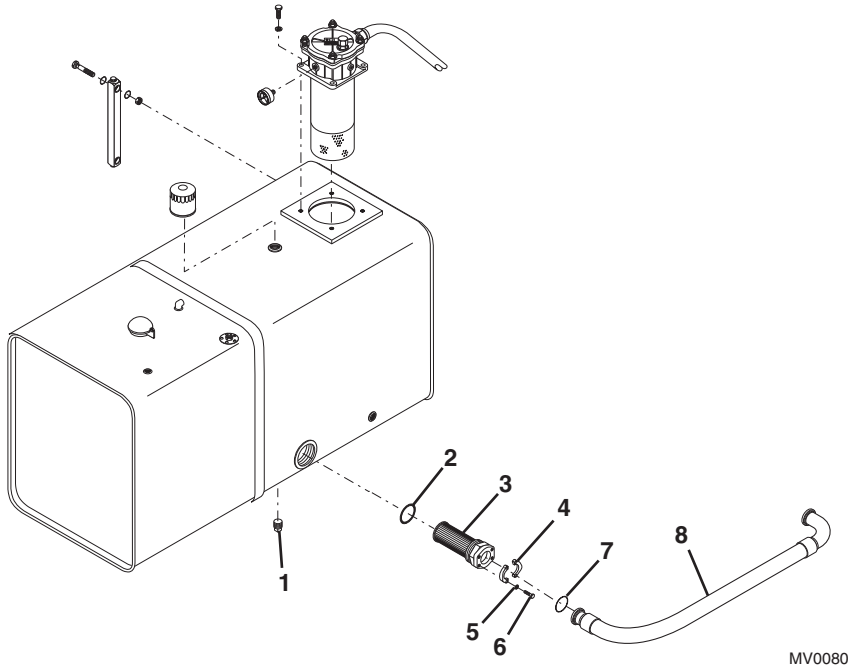
CAUTION: To avoid contamination of the hydraulic system, do not apply thread sealant to the end threads of the drain plug.

10. Fill hydraulic reservoir. (See page 5-8.)

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Suction Strainer

Description



#	Description	#	Description
1	Drain Plug	5	Lockwasher
2	O-Ring	6	Capscrew
3	Hydraulic Oil Strainer	7	O-Ring
4	Flange Half	8	Hydraulic Suction Hose

Fig. 5-11: Suction Strainer Installation

(Ref. Fig. 5-11) The suction strainer is located behind the hydraulic reservoir. It removes contaminants as oil is pumped out of the hydraulic reservoir.

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Removal and Cleaning

Suction Strainer

(Ref. Fig. 5-11) The following procedures describes removal of the suction strainer on models with mid-inlet hydraulics.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Remove the hydraulic reservoir drain plug (Item 1) and drain hydraulic fluid into a suitable container. Dispose of drained fluid properly.
3. Remove the four (4) capscrews (Item 6) and lockwashers (Item 5) securing the two (2) flange halves (Item 4) and the hydraulic suction hose (Item 8) to the hydraulic strainer (Item 3). Remove the flange halves.
4. Remove and discard the O-ring (Item 7) from the hydraulic suction hose.
5. Loosen and remove the strainer (Item 3) from the reservoir. Take the strainer to an appropriate area for further cleaning.
6. Clean the strainer (Item 3) by back flushing with solvent. Dry the strainer element thoroughly with compressed air.

Installation

Suction Strainer

(Ref. Fig. 5-11) The following procedures describes installation of the suction strainer on models with mid-inlet hydraulics.

1. Insert hydraulic oil strainer (Item 3) into cavity in hydraulic reservoir and tighten until snug.
2. Install a new O-ring (Item 7) on the hydraulic suction hose (Item 8).
3. Install the hydraulic suction hose on the hydraulic oil strainer using the two flange halves (Item 4) and the four (4) lockwashers (Item 5) and capscrews (Item 6). 4
4. Apply thread sealant to few threads near the head of drain plug (Item 1). Install the drain plug. Tighten 2–3 turns past finger tight.
5. Fill hydraulic reservoir according to the preferred method on page 5-8.

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Hydraulic Return Filter

Description

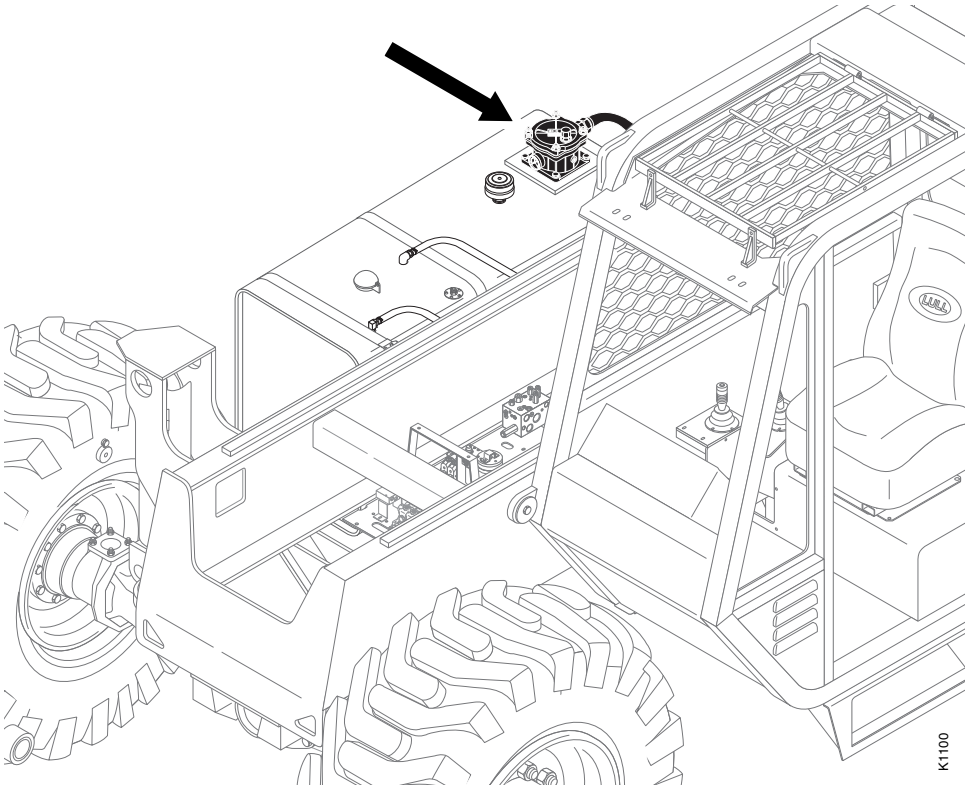


Fig. 5-12: Hydraulic Return Filter

(Ref. Fig. 5-12) The hydraulic return filter assembly is located on the hydraulic reservoir. Its function are to filter return hydraulic oil entering the reservoir and provide a means to fill the reservoir.

Checking Filter Condition

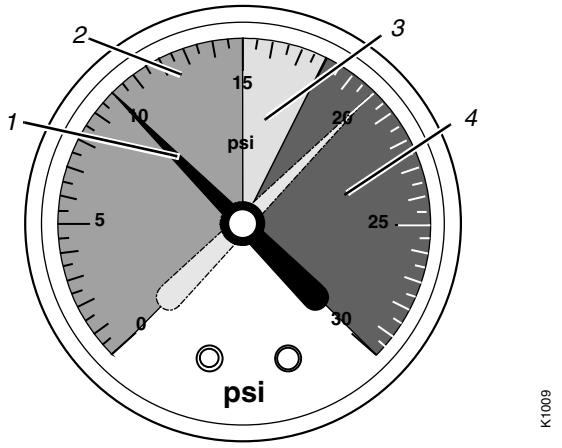


Fig. 5-13: Return Filter Pressure Gauge

Note: *Check indicator with engine at idle, after thirty minutes of operation.*

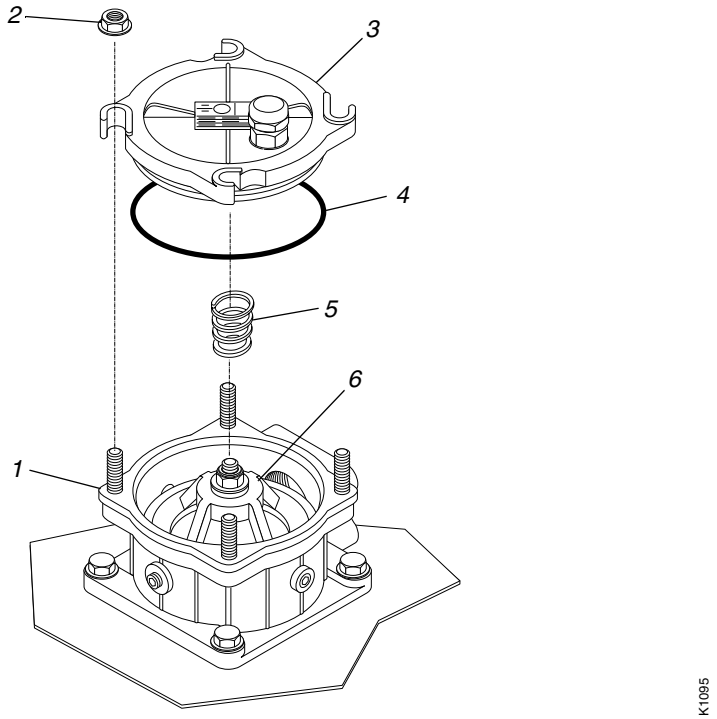
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The return filter pressure gauge is located on the side of the return filter housing.

The gauge indicates hydraulic fluid pressure entering the return filter element. As contamination accumulates in the filter element, pressure rises.

The acceptable operating pressure range is 0–15 psi and is indicated by needle ***(1)*** positioned in green arc ***(2)***. Pressures above 15 psi, orange arc ***(3)*** and red arc ***(4)***, indicate that the return filter element must be serviced.

Replacing Return Filter Element



#	Description	#	Description
1	Return Filter Housing	4	O-Ring
2	Flange Nut	5	Spring
3	Filter Housing Cover	6	Hydraulic Filter Element

Fig. 5-14: Filter Housing Cover

Disassembly, Return Filter Element

(Ref. Fig. 5-14) The following procedure describes removal of the return filter element.

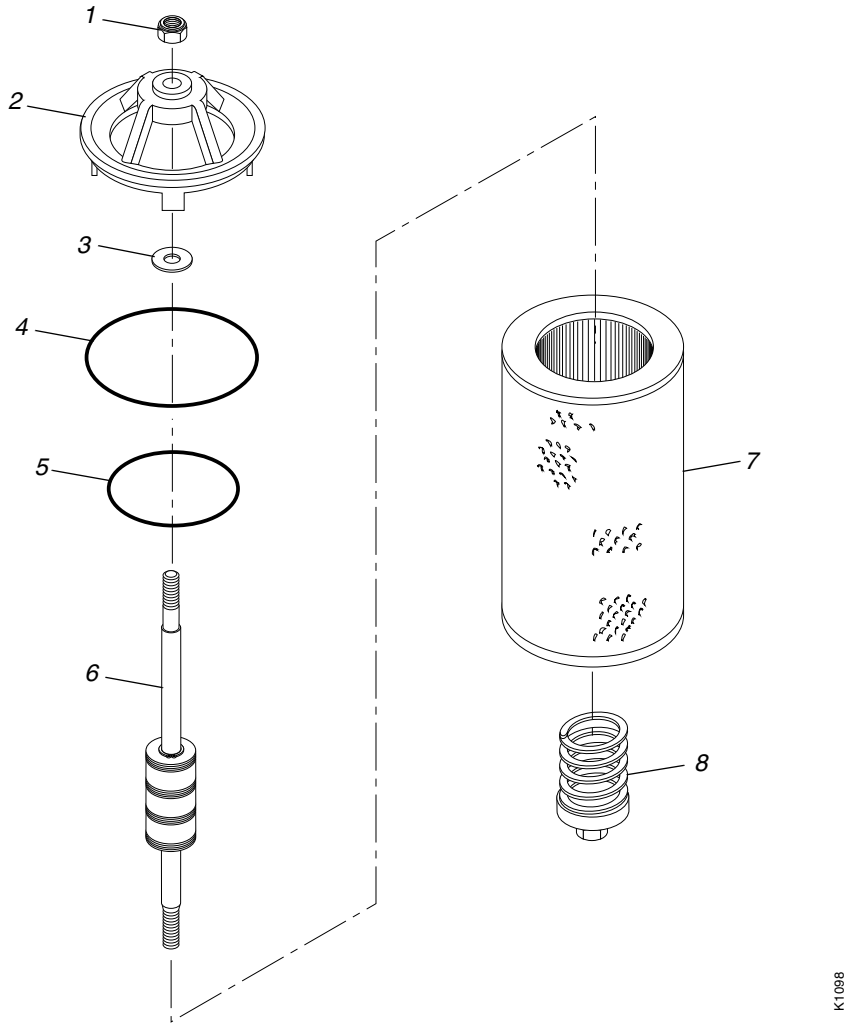
1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.

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2. Loosen four (4) flange nuts (Item 2) that secure cover (Item 3) to return filter housing (Item 1). Loosen them only enough to be able to rotate cover. While applying pressure to cover, rotate cover clockwise so that recessed areas of cover line up to flange nuts. ***Slowly*** release pressure and remove cover.

CAUTION: Care must be taken to avoid injury when removing cover. Do not remove flange nuts. There is pressure under cover from spring (Item 5).

3. Remove spring (Item 5) and return filter element assembly (Item 6) and take to a suitable location for further inspection and cleaning.
4. To protect system from contamination while working on filter element assembly, place cover (Item 3) back on return filter housing (Item 1) and tighten flange nuts (Item 2).



#	Description
1	Lock Nut
2	Trestle
3	Flatwasher
4	O-Ring

#	Description
5	Filter Element O-Ring
6	Tie Rod
7	Filter Element
8	Bypass Spring Assembly

Fig. 5-15: Filter Element Assembly

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Replacement, Return Filter Element

(Ref. Fig. 5-15) The following procedure describes replacing the return filter element.

1. To avoid contamination, place all parts on clean paper or cloth.
2. Loosen and remove lock nut (Item 1) that secures trestle (Item 2) to filter element (Item 7).
3. Remove trestle and flatwasher (Item 3).
4. Loosen bypass spring assembly (Item 8) by turning it counter-clockwise. Remove bypass spring assembly and tie rod (Item 6) from filter element (Item 7). Discard contaminated filter element.
5. Remove and inspect two (2) trestle O-rings (Items 4 and 5). Clean trestle and O-rings with solvent. Dry with compressed air. Lubricate O-rings with hydraulic oil and install.
6. Clean washer, lock nut, bypass spring assembly, and tie rod with solvent. Dry with compressed air.
7. Insert short end of tie rod (Item 6) through new filter element (Item 7). Connect bypass spring assembly (Item 8) to end of tie rod. Tighten by turning bypass spring assembly clockwise until snug and completely engaged on tie rod.
8. Reassemble flatwasher (Item 3), trestle (Item 2), and lock nut (Item 1) on other end of tie rod.

Reassembly, Return Filter Element

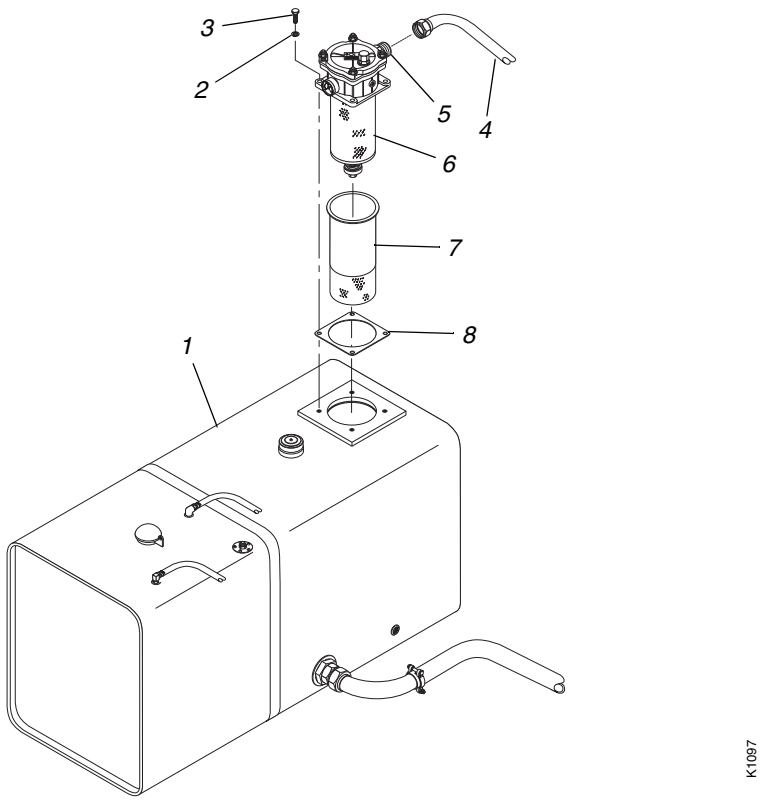
(Ref. Fig. 5-14) The following procedure describes installation of the return filter element.

1. Loosen four (4) flange nuts (Item 2) enough so cover (Item 3) can be removed from filter assembly head (Item 1). Twist cover clockwise so that recessed areas of cover line up to flange nuts before removing it.
2. Inspect and clean cover O-ring (Item 4) and replace if necessary. Lubricate O-ring with hydraulic oil and install on cover.
3. Insert filter element assembly (Item 6) into return filter housing (Item 1).
4. Place spring (Item 5) so it rests vertically on top of trestle.
5. Place cover (Item 3) on filter assembly head making sure recessed areas of cover line up with flange nuts.
6. Press down on cover until it can be rotated counter clockwise and slide under flange nuts (Item 2). Torque flange nuts to 35 ft-lbs.

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Removal

Return Filter Assembly



#	Description	#	Description
1	Hydraulic Oil Reservoir	5	Connector
2	Lockwasher	6	Return Hydraulic Oil Filter
3	Capscrew	7	Diffuser
4	Return Manifold Tube	8	Rubber Gasket

Fig. 5-16: Return Filter Assembly

(Ref. Fig. 5-16) The following procedure describes disassembly of the return filter assembly.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Clean the area around the return filter housing (Item 6).
3. Loosen and remove the return manifold tube (Item 4) connected to the connector (Item 5) on the hydraulic oil return filter assembly (Item 6).
4. Loosen and remove four (4) capscrews (Item 3) and lockwashers (Item 2) that secure the hydraulic oil return filter assembly (Item 6) to the hydraulic oil reservoir (Item 1). Remove the hydraulic oil return filter assembly. To avoid contamination, place all parts on a clean surface.
5. Remove the rubber gasket (Item 8) and clean it with an appropriate solvent. Inspect condition of the gasket and replace it if necessary.

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6. Remove the diffuser (Item 7) and clean with solvent. Dry with compressed air.

Installation

Return Filter Assembly

(Ref. Fig. 5-16) The following procedures describes installation of the return filter assembly.

1. Reassemble the diffuser (Item 7) and the rubber gasket (Item 8) with the hydraulic return assembly (Item 6).
2. Install the return filter assembly on the hydraulic reservoir with the four (4) lockwashers (Item 2) and capscrews (Item 3). Torque the capscrews evenly to 276 in-lbs.
3. Connect the return manifold tube (Item 4) to the connector (Item 5) on the hydraulic oil return filter assembly (Item 6). Torque the nut on the return manifold tube to 188–213 ft-lbs.

Reservoir Breather

Description

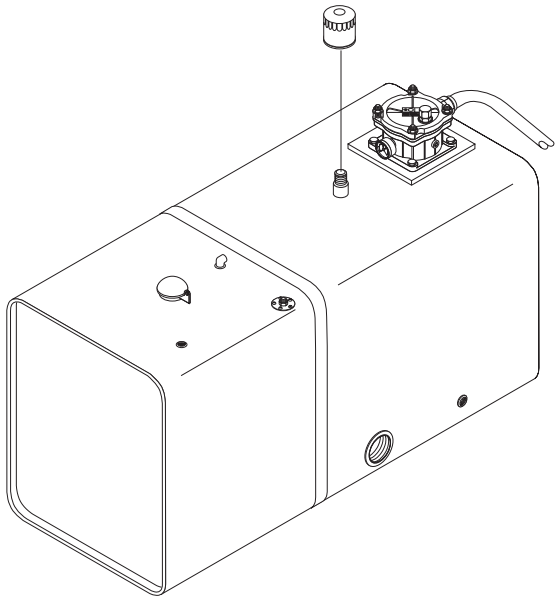


Fig. 5-17: Reservoir Breather

(Ref. Fig. 5-17) The reservoir breather is located on the top of the hydraulic reservoir near the return filter. It allows for expansion of fluid and prevents vacuum in the tank.

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Removal and Installation

Reservoir Breather

1. Loosen and remove breather, using tool on hex portion of breather.
2. Replace breather per the maintenance schedule found on the machine or if damaged.
3. Install breather on tank and tighten as necessary.

CAUTION: To avoid contamination of the hydraulic system, do not use thread sealant or Teflon tape.

CAUTION: To avoid the possibility of the hydraulic system being contaminated, do not fill the reservoir through the breather opening.

Hydraulic Pressure Filter

Description

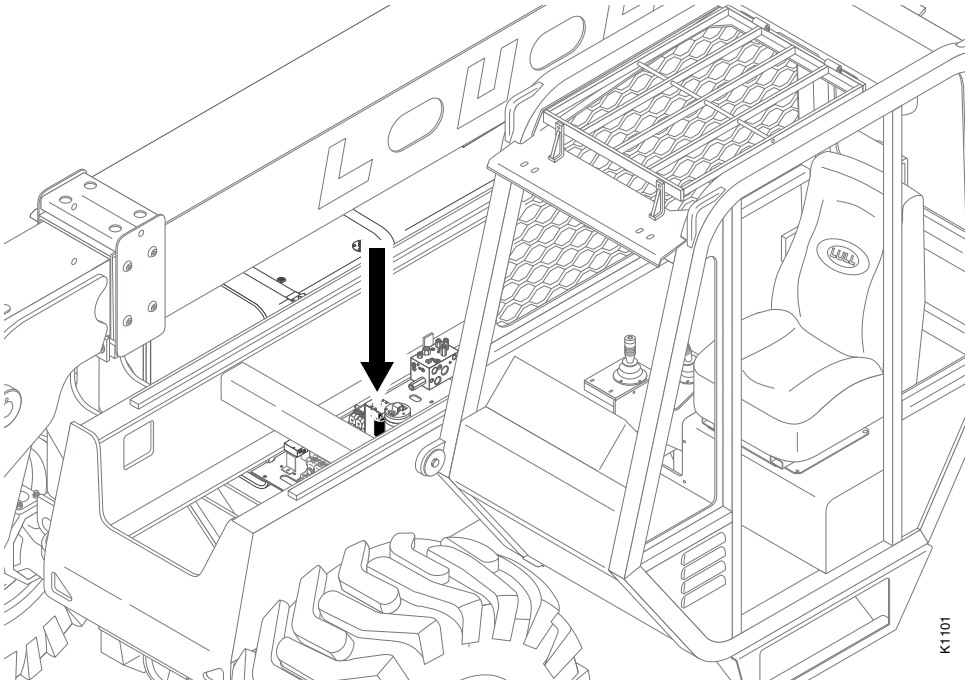
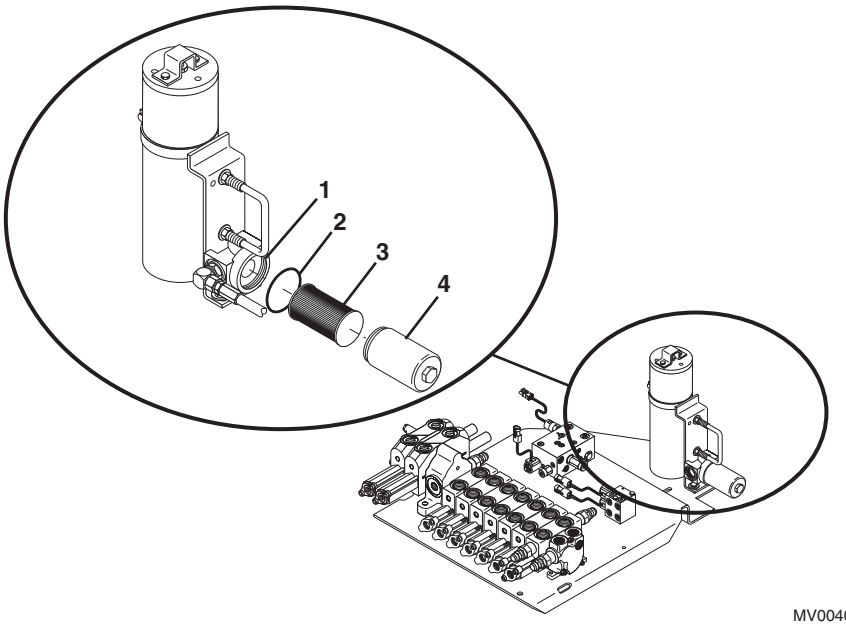


Fig. 5-18: Hydraulic Pressure Filter – Control Manifold Hydraulics

The hydraulic pressure filter is located on the mounting bracket for the pressure filter and accumulator which is attached to the valve plate. While Fig. 5-18 illustrates the hydraulic pressure filter. The function of the pressure filter is to remove contaminants from the oil traveling to the joystick controls.

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#	Description
1	Filter Head
2	Bowl O-Ring

#	Description
3	Filter Element
4	Bowl

Fig. 5-19: Hydraulic Pressure Filter Element

(Ref. Fig. 5-19) The following procedure describes replacement of the hydraulic pressure filter element.

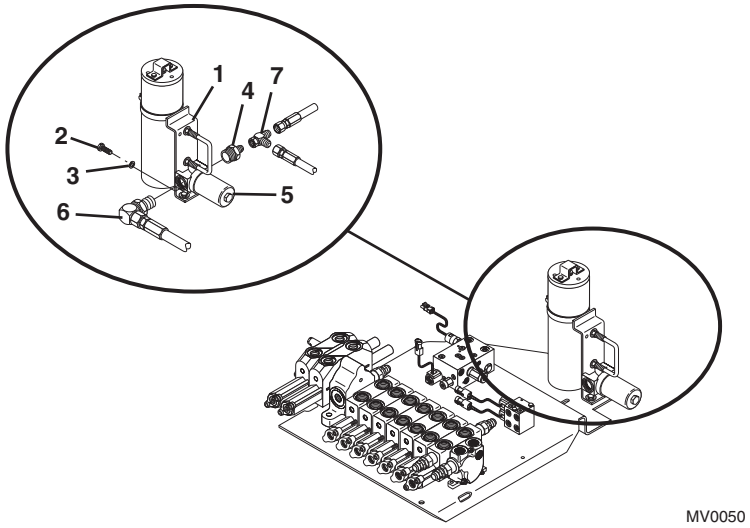
1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Clean hydraulic pressure filter assembly to avoid contamination of system while removing hydraulic pressure filter assembly.
3. Unscrew and remove filter element bowl (Item 4) from filter head (Item 1).
4. Remove filter element (Item 3) and discard it.
5. Remove bowl O-ring (Item 2), clean with an solvent, and dry with compressed air. Replace it if damaged.
6. Clean filter element bowl and filter head with solvent and dry with compressed air.

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7. Insert a new filter element into bowl. Lubricate bowl O-ring with hydraulic oil and install it on bowl.
8. Screw bowl into filter head and tighten until snug.

Removal

Pressure Filter Assembly



#	Description
1	Filter Mounting Bracket
2	Capscrew
3	Lockwasher
4	90° O-Ring Hose Elbow

#	Description
5	Pressure Filter Assembly
6	90° O-Ring Hose Elbow
7	Swivel Tee

Fig. 5-20: Hydraulic Pressure Filter Assembly

(Ref. Fig. 5-20) The following procedure describes removal of the hydraulic pressure filter assembly.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Clean the hydraulic pressure assembly to avoid contamination of the system while removing the hydraulic pressure filter assembly.
3. Tag and ***slowly*** loosen the three (3) fittings (Items 4, 6 and 7) from the pressure filter assembly and bleed any remaining oil. Cap fittings.
4. While securing the hydraulic pressure filter assembly (Item 5), loosen and remove the four (4) each capscrews (Item 2) and lockwashers (Item 3) that connect the pressure filter assembly to the filter mounting bracket (Item 1).

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5. Remove the pressure filter assembly from the hole in the filter mounting bracket.

Installation

Pressure Filter Assembly

(Ref. Fig. 5-20) The following procedure describes installation of the hydraulic pressure filter assembly.

1. Insert the pressure filter assembly through the hole in the filter mounting bracket, making sure that the bypass indicator is closest to back of the mounting bracket.
2. Secure the pressure filter assembly to the mounting bracket with the four (4) each capscrews and lockwashers. For final tightening, torque the capscrews to 75 in-lbs.
3. Connect the three (3) fittings (Items 4,6 and 7) to the pressure filter assembly. For final tightening, torque to 75–85 ft-lbs.

Hydraulic Pump

Description

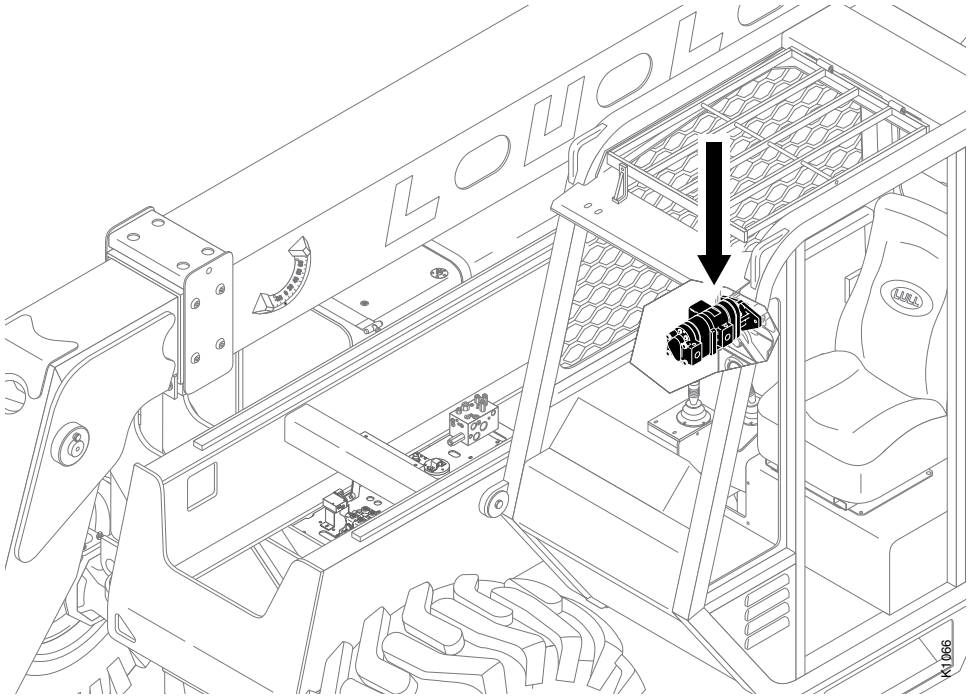


Fig. 5-21: Hydraulic Pump Location

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(Ref. Fig. 5-21) The hydraulic pump is located on the transmission towards the back of the machine.The hydraulic pump used is a two-section gear type, driven directly from the transmission power takeoff.

PUMP SPECIFICATIONS:

Type - Gear
Sections - Two
Manufacturer - Vickers
Model - G2020
GPM - 18 at 2500 RPM (Cover End - Pump 1)
GPM - 26 at 2500 RPM (Shaft End - Pump 2)

Troubleshooting Pump Problems

Problem	Probable Cause	Solution
1. Excessive pump noise	A. Low oil level in the hydraulic reservoir	Fill reservoir to proper level with the recommended hydraulic fluid. DO NOT overfill.
	B. Air in the system	1. Operate hydraulic system until purged. 2. Check inlet (suction) lines and fittings for air leaks.
	C. Vacuum condition	1. Check inlet (suction) lines and fittings for restrictions. 2. Check reservoir breather filter conditions.
	D. Oil too thick	Be certain correct type of oil is used for refilling or adding to the system. Viscosity must be correct for ambient temperatures.
	E. Cold weather	Run hydraulic system until unit is warm to the touch and noise disappears. Check oil viscosity.
2. Pump Overheating	A. Internal leakage	Return vehicle to maintenance shop for evaluation and repair.
	B. Low fluid level	Add oil to operating level.
3. System not developing pressure	A. Relief valve open	Replace or repair the relief valve.
	B. Loss of fluid internally (slippage)	Return the vehicle to the maintenance shop for repair of hydraulic system.

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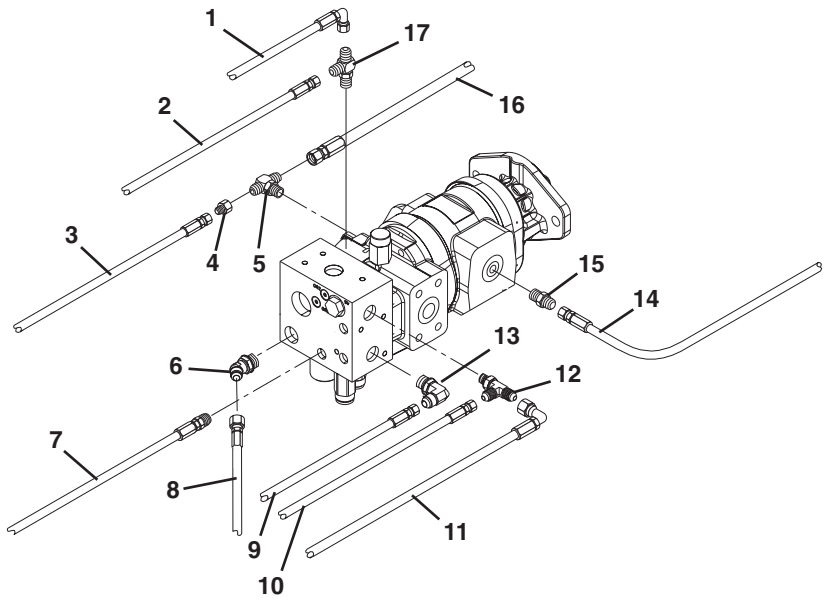
Problem	Probable Cause	Solution
	C. Disconnected or broken pump drive	Inspect and repair or replace.
4. Loss of fluid	A. Ruptured hydraulic lines B. Loose fittings C. Leaking gaskets or seals in pump or circuit	1. Check all external connections, tubing, and hoses. Tighten connections and replace any ruptured tubes or hoses. 2. Observe mating sections of pump for leaks. 3. Replace seals or gaskets if possible.

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Removal

Hydraulic Pump

.



#	Description
1	Hydraulic Hose to Test Port
2	Hydraulic Hose to Accumulator
3	Hydraulic Hose to Test Port
4	Reducer Adapter
5	Branch Tee
6	Elbow
7	Hydraulic Hose to Steer Motor
8	Hydraulic Hose to Steer Motor
9	Hydraulic Hose to Accumulator
10	Hydraulic Hose to Steer Motor

#	Description
11	Hydraulic Hose to Test Port
12	Run Tee
13	Elbow
14	Hydraulic Hose to Elbow on Rear Axle Stabilizer Valve
15	Connector
16	Hyd. Hose to Connector on Rear Axle Stabilizer Valve
17	Run Tee

Fig. 5-22: Hydraulic Pump Hoses – Mid-Inlet Hydraulics

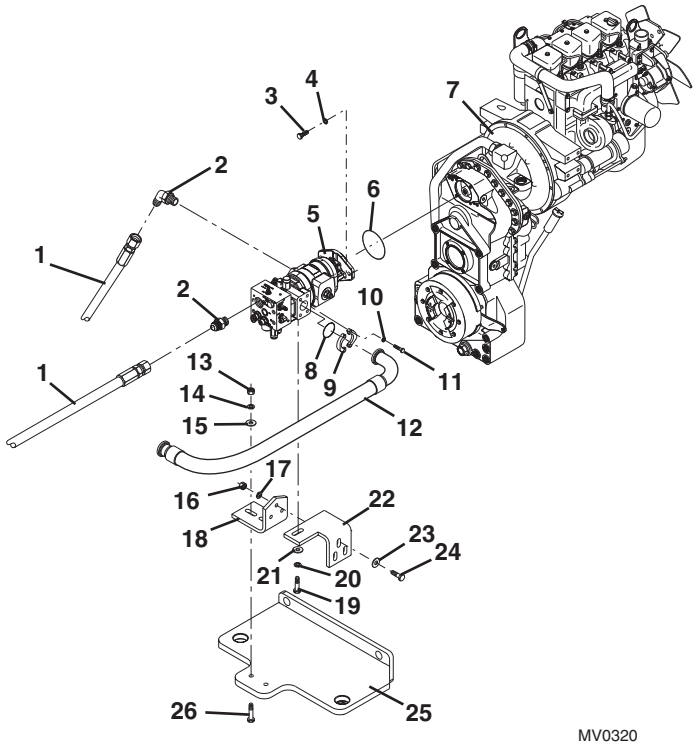
(Ref. Fig. 5-22) The following describes initial steps for removal of the hydraulic pump.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Install brake pressure diagnostic port test gauge into brake diagnostic port (see page 5-49).

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3. While watching test gauge, press brake pedal numerous times until pressure gauge reads 0 psi. Remove test gauge from diagnostic port.
4. Thoroughly clean the hydraulic pump to ensure that dirt will not get into the system/transmission.
5. Tag and ***slowly*** loosen the ten (10) hydraulic hoses shown in Fig. 5-22 (Items 1, 2, 3, 7 thru 11, 14 and 16) and the two (2) hydraulic hoses shown in Fig. 5-24 (Items 1 & 12). Bleed any remaining oil into appropriate container. Disconnect hoses. Cap fittings and hoses.

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#	Description	#	Description
1	Hydraulic Hose	14	Lockwasher
2	Elbow	15	Flatwasher
3	Capscrew	16	Nut
4	Lockwasher	17	Lockwasher
5	Hydraulic Pump	18	Lower Pump Support Bracket
6	O-Ring	19	Capscrew
7	Transmission	20	Lockwasher
8	O-ring	21	Flatwasher
9	Flange Half	22	Upper Pump Support Bracket
10	Lockwasher	23	Flatwasher
11	Capscrew	24	Capscrew
12	Hydraulic Suction Hose	25	Transmission Mount
13	Nut	26	Capscrew

Fig. 5-23: Hydraulic Pump Installation – Mid-Inlet Hydraulics

(Ref. Fig. 5-23) The following procedures completes the steps necessary for removal of the hydraulic pump.

1. Tag and ***slowly*** loosen two (2) hydraulic hoses (Item 1) and bleed any remaining oil. Disconnect hoses from connectors (Item 2). Cap fittings and hoses.
2. Remove four (4) capscrews (Item 11) and lockwashers (Item 10) securing the two (2) flange halves (Item 9) to the hydraulic suction hose (Item 12). Remove the flange halves.

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CAUTION: Before removing support bracket or loosening capscrews that secure the hydraulic pump to the transmission (Item 7), support the pump to ensure that it does not twist or fall.

3. Remove capscrews (Item 19), lockwashers (Item 20), and flatwashers (Item 21) securing upper pump support bracket (Item 22) to the pump.
4. Remove two (2) capscrews (Item 3) and lockwashers (Item 4) securing the hydraulic pump to the transmission.
5. Pull the pump straight out from the transmission and take it to an appropriate area for further inspection.

CAUTION: To avoid contamination of system, cap hoses and cover opening in transmission after pump is removed.

Inspection and Maintenance, Hydraulic Pump

The following steps describe cleaning and replacement of fittings and O-rings for the hydraulic pump after it has been removed.

1. (Ref. Fig. 5-23) Remove and discard O-rings (Items 6 and 8).
2. Make notes of positions of hydraulic fittings shown in Fig. 5-22 and Fig. 5-23. Tag and remove all fittings. Clean with appropriate solvent and dry with compressed air. Inspect and replace if damaged.
3. Clean exposed areas of hydraulic pump with appropriate solvent and dry with compressed air.
4. (Ref. Fig. 5-23) Lubricate and install new O-rings on pump.
5. Lubricate threaded portion of each fitting, including the O-ring.

Steps 6 thru 14 apply to Fig. 5-22. Refer to notes made earlier for correct positioning of all fittings.

6. Install connector (Item 6) in lower port on front of pump.
7. Install run tee (Item 17) on top of pump.
8. Install branch tee (Item 5) on side of pump.
9. Install reducer adapter (Item 4) on the branch tee (Item 5).
10. Install connector (Item 15) on side of pump.
11. Install swivel run tee (Item 12) on side of pump.
12. Install elbow (Item 13) on side of pump.

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Installation

Hydraulic Pump

(Ref. Fig. 5-22 and Fig. 5-23) The following procedure is for the installation of the hydraulic pump.

Step 1 thru Step 5 refer to Fig. 5-23.

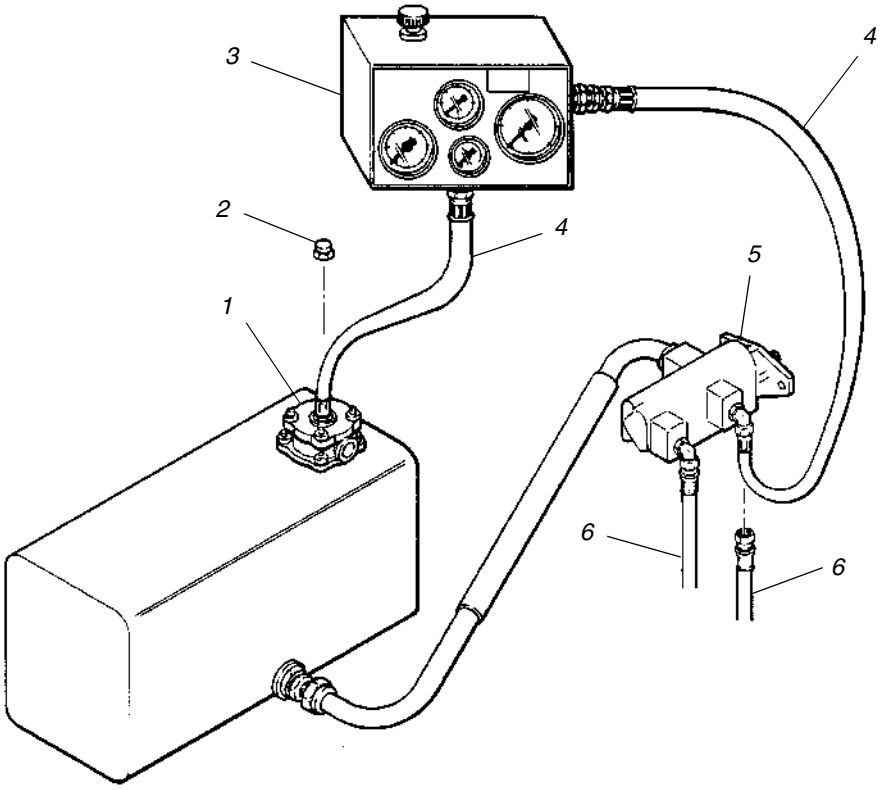
1. If the pump support brackets were removed,
   a. Install lower pump support bracket on park brake cylinder mount with two (2) capscrews (Item 26), flatwashers (Item 15), lockwashers (Item 14), and nuts (Item 13).
   b. Install upper pump support bracket on lower pump support bracket with three (3) capscrews (Item 24), flatwashers (Item 23), lockwashers (Item 17), and nuts (Item 16).
2. Insert assembled hydraulic pump straight into the transmission making sure the pump is supported so it cannot twist and cause damage. Install the pump on the transmission with the two (2) capscrews (Item 3) and lockwashers (Item 4).
3. Secure upper pump support bracket to pump with two (2) each flatwashers (Item 21), lockwashers (Item 20), and capscrews (Item 19).
4. Connect hydraulic suction hose (Item 12) to pump by installing two (2) flange halves (Item 9) and four (4) lockwashers (Item 10) and capscrews (Item 11).
5. Connect two (2) hydraulic hoses (Item 1) on connectors (Item 2) on side of pump.

Step 6 thru Step 16 refer to Fig. 5-23.

6. Install hydraulic hose (Item 3) from Pump 1 test port to reducer adapter (Item 4).
7. Install hydraulic hose (Item 1) from test port to branch tee (Item 17).
8. Install hydraulic hose (Item 2) from accumulator to run tee (Item 17).
9. Install hydraulic hose (Item 16) from rear axle stabilizer valve to run tee (Item 5).
10. Install hydraulic hose (Item 7) from steer motor to hydraulic pump.
11. Install hydraulic hose (Item 8) from steer motor to elbow (Item 6).
12. Install hydraulic hose (Item 9) from accumulator to elbow (Item 13).
13. Install hydraulic hose (Item 10) from steer motor to run tee (Item 12) on side of pump.
14. Install hydraulic hose (Item 11) from test port to run tee (Item 12).
15. Install hydraulic hose (Item 14) from rear axle stabilizer valve to connector (Item 15).
16. Start the engine and check for hydraulic leaks. Correct as necessary.

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Checking Pump Flow Rate



#	Description
1	Return Filter Housing
2	Hex Cap
3	Hydraulic Tester

#	Description
4	Test Loop Hose (2)
5	Hydraulic Pump
6	Pressure Hose (2)

Fig. 5-24: Checking Hydraulic Pump Flow Rate

(Ref. Fig. 5-24) If the pump(s) is suspected of delivering below rated capacity, use the following procedure to check pump flow rate:

1. Lower boom to the ground, apply parking brake and stop engine. Release all hydraulic pressure in the system (See warning and procedure under “General Hydraulic Maintenance Practices” on page 5-3 of this section).
2. Loosen and remove pressure line hose (Item 6) from pressure port of pump (Item 5) to be tested.
3. Loosen and remove hex cap (Item 2) from top of return filter housing (Item 1).
4. Assemble a hydraulic tester (Item 3) in a test loop between the pump and return filter. Use hydraulic hose (Item 4) with a minimum burst pressure rating of 12,000 psi. Hose end fittings for the pump and return filter must be 1 1/16-12 JIC (37°) female.
5. Determine the system's maximum rated pressure (which is the specified-relief setting for boom hoist and extend control valve). See Fluid Pressures under “Specifications” for your model forklift in section 2.

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6. Adjust pressure relief valve setting to 100 psi over that of system's maximum rated pressure.

Important: *Be sure the load valve is open before starting the engine.*

7. Start the engine and, when it is at normal operating temperature, open the throttle control all the way. Slowly close the load valve to load the system. (Do not exceed system's maximum rated pressure). Continue loading until normal operating temperature of the system is reached (see “Hydraulic Oil Working Temperature @ under Specifications @ for your model forklift in Section 2).
8. Open load valve. Record maximum pump flow at zero pressure.
9. Slowly close the load valve until the system is at the maximum rated pressure. Record the pump flow.
10. Open load valve until pump pressure is again at zero.
11. Shut off the engine.
12. Disconnect test loop from pump and return filter housing. Reconnect pump pressure hose (Item 6) and install hex cap (Item 2) atop return filter housing.

Pump flow at maximum pressure should be at least 75 percent of the rated pump flow. For rated pump flow, see “Hydraulic Pump”, under “Specifications”, in Section 2.

Repair or replace pump if pump flow rate is less than 75 percent of rated capacity. see “Hydraulic Pump” on page 5-30 for replacement pump procedures.

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Mid-Inlet Control Valve

Description

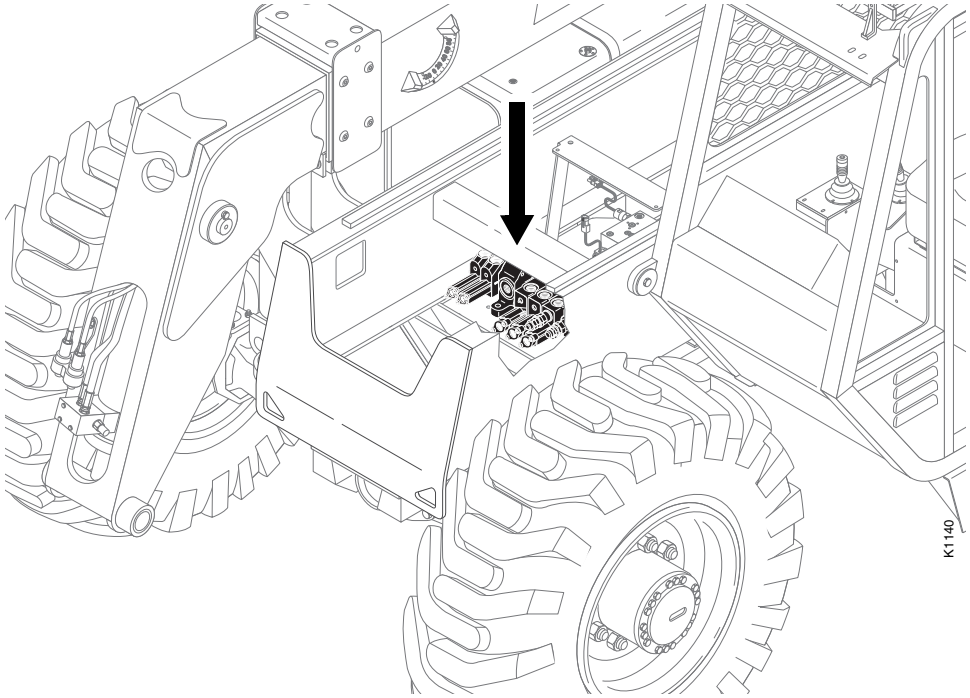


Fig. 5-25: Mid-Inlet Control Valve Location

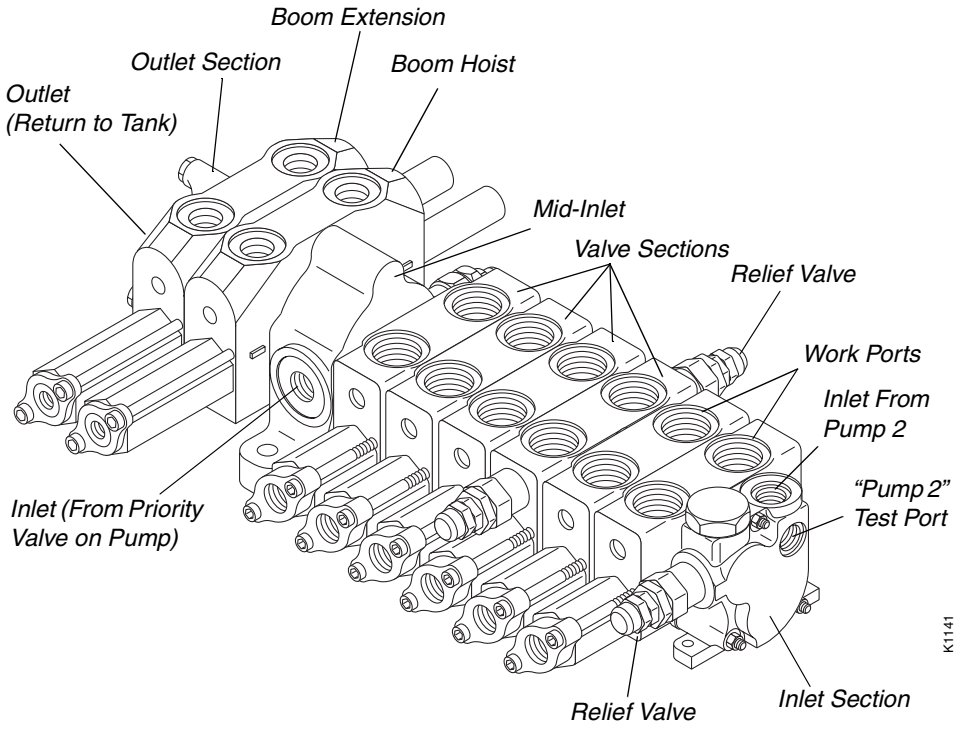


Fig. 5-26: Mid-Inlet Control Valve Components

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(Ref. Fig. 5-25 and Fig. 5-26)The mid-inlet control valve is located on the valve plate, near the middle of the machine. This valve controls hydraulic functions for the following circuits:

- L.H. Outrigger
- R.H. Outrigger
- Carriage Fork Tilt
- Transfer Carriage
- 1st Auxiliary Hydraulics
- 2nd Auxiliary Hydraulics
- Frame Tilt

To the right of the mid-inlet section, there are two boom-controlling sections for the following circuits:

- Boom Hoist
- Boom Extension (Telescope)

The presence of these circuits, and the controlling valve sections, depends upon the machine model and installed options (see Fig. 5-27 and Fig. 5-29).

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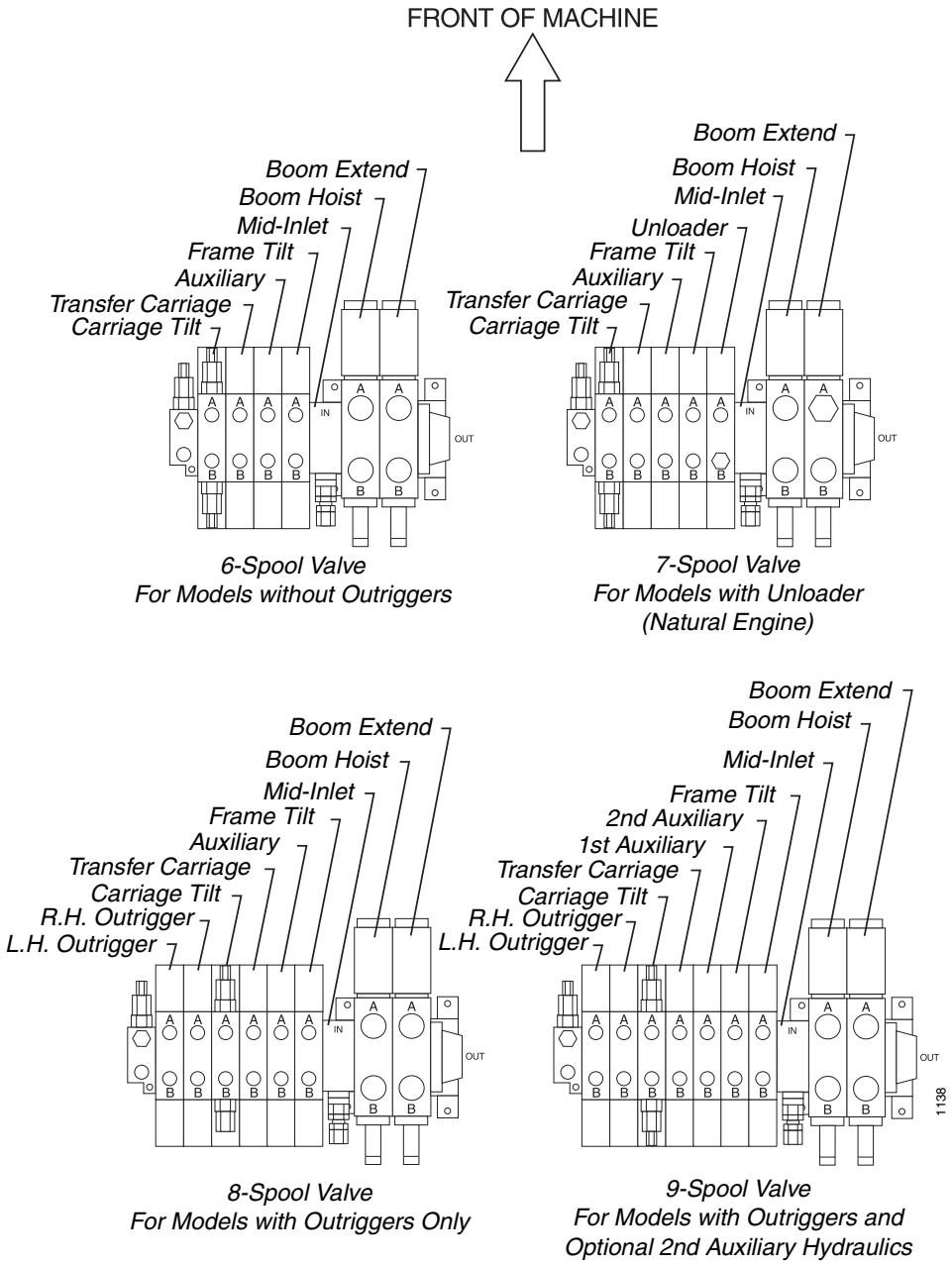


Fig. 5-27: Mid-Inlet Control Valve Configurations,

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Removal

Mid-Inlet Control Valve

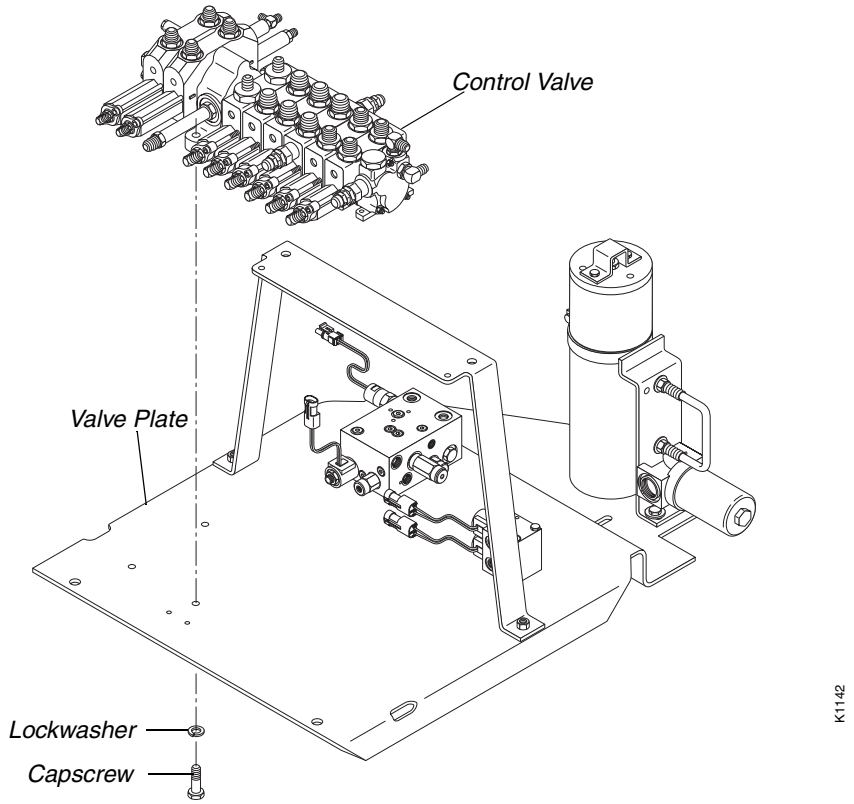


Fig. 5-28: Mid-Inlet Control Valve Installation

(Ref. Fig. 5-28) The following procedure describes removal of the mid-inlet control valve.

1. Follow preparation procedures as outlined in Section 3.
2. Install a brake pressure diagnostic test gauge onto the “Brakes” diagnostic port.
3. While watching the test gauge, press the brake pedal numerous times until the pressure gauge reads 0 psi. Remove the test gauge and cap the diagnostic port.
4. Tag and disconnect all hydraulic lines from control valve fittings. Cap all hoses, tubes, and fittings. Tag all fittings.
5. Remove three (3) capscrews and lockwashers securing the mid-inlet control valve to the valve plate.
6. Using appropriate lifting devices, lift the control valve from valve plate and take to an appropriate location for disassembly and cleaning.

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Installation

Mid-Inlet Control Valve

1. (Ref. Fig. 5-28) Position the control valve on the valve plate. Secure with three (3) lockwashers and capscrews.
2. Connect all hydraulic hoses and tubes to fittings on the control valve. Torque per instructions in Section 3.
3. Start the engine and repeatedly cycle all hydraulic circuits controlled by the valve to remove air from the system.
4. Stop engine and check for hydraulic leaks. Tighten connections as necessary.

Rear Axle Stabilizer Control Valve

Description

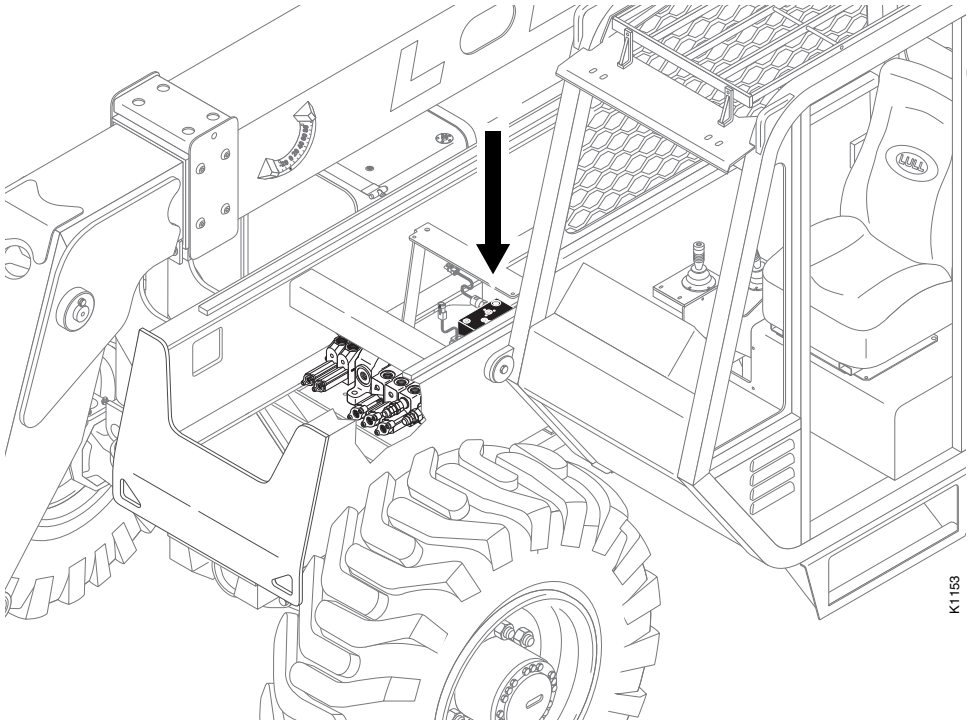


Fig. 5-29: Rear Axle Stabilizer Control Valve Location

(Ref. Fig. 5-29) The rear axle stabilizer control valve is located on the valve plate near the middle of the machine. This valve controls hydraulic functions using the following valves:

- Solenoid Valve
- Piloted 3-Way Cartridge Valve
- Sequence Cartridge Valve
- Piloted 2-Way Cartridge Valve
- Shuttle Cartridge Valve
- Boom Extend Lockout Valve - Used on models with outriggers

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Fig. 5-30 illustrates views of the control valve, showing port locations and markings. Table 5-1 is a list of markings for each side of these valves.

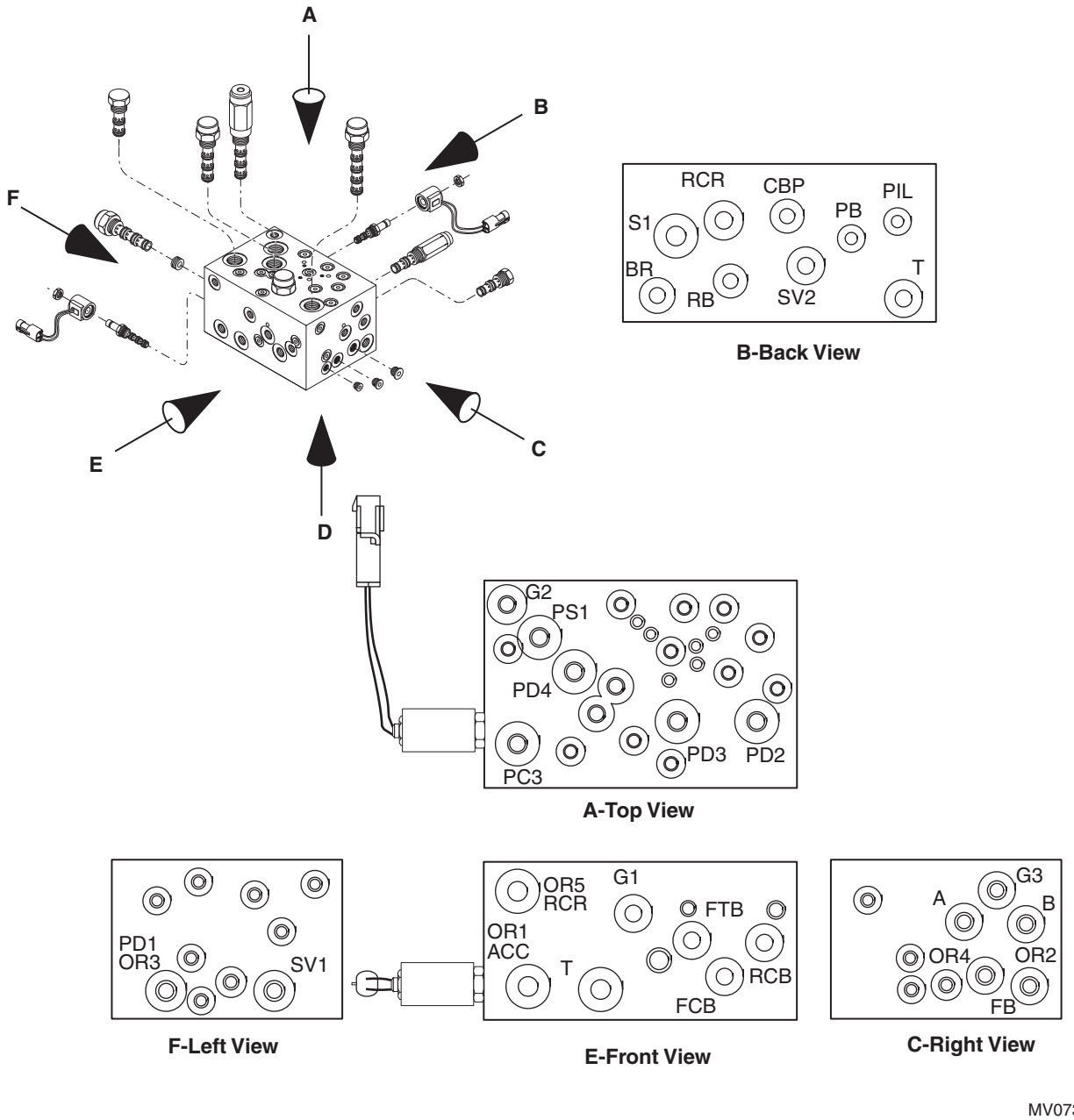


Fig. 5-30: Rear Axle Stabilizer Control Valve Ports

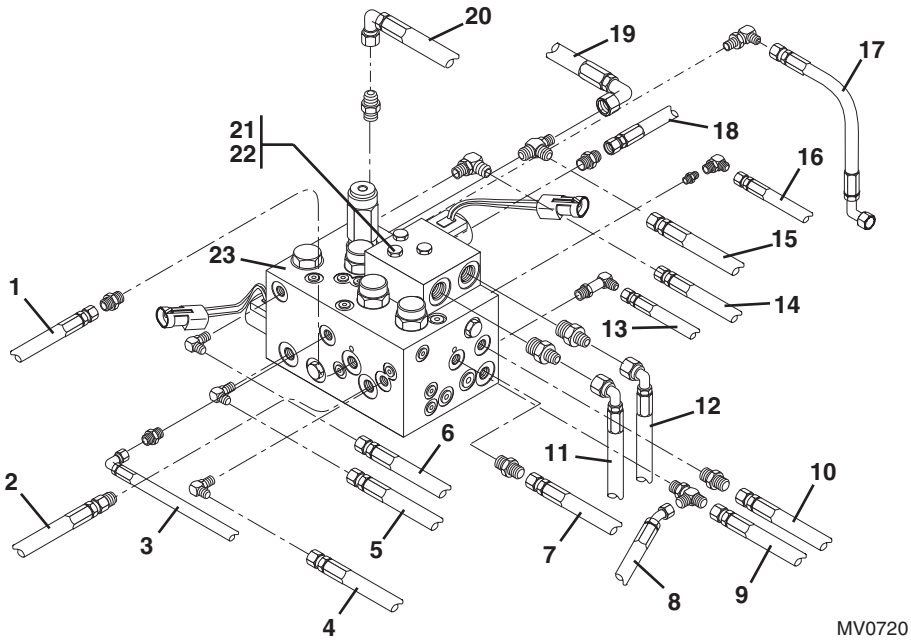
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Table 5-1: Rear Axle Stabilizer Control Valve Markings

View	Marking	Description
A - Top View	G2	Gauge #1 - Test Port (Rear Osc. Lock)
	PS1	Piloted Sequence Valve
	PC3	Cartridge Valve
	PD2	Piloted CartridgeValve
	PD3	Piloted CartridgeValve
	PD4	Piloted Cartridge Valve
B - Back View	S1	Shuttle Cartridge Valve
	RB	Rear Brakes
	SV2	Solenoid Valve
	PS2	Sequence Valve
	BR	Brake
	CBP	Stabilizer Lock Valve
	PB	Power Brake
	PIL	Stabilizer Lock Valve
	T	Tank
C - Right View	A	Port A
	B	Port B
	G3	Gauge #3 - Test Port (Rear Osc. Lock)
	FB	Front Brakes
	OR2	Orifice #2
	OR4	Orifice #3
E - Front View	RCR	Stabilizer Lock Valve
	G1	Gauge #1
	FTB	Piloted Sequence Valve
	FCB	Frame Tilt Cylinder
	RCB	Stabilizer Lock Valve
F - Left View	OR3	Orifice #3
	SV1	Solenoid Valve
	PD1	Piloted Cartridge Valve

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Removal, Rear Axle Stabilizer Control Valve



#	Description
1	Hose for Connector at FTB Port
2	Hose at FCB Port
3	Hose for Connector at G1 Port
4	Hose for Connector at RCB Port
5	Hose for Elbow at ACC Port
6	Hose for Elbow at RCR Port
7	Hose for Connector at FB Port
8	Hose for Run Tee at A Port
9	Hose for Run Tee at A Port
10	Hose for Connector at B Port
11	Hose for Connector on Boom Extend Lockout Valve
12	Hose for Connector on Boom Extend Lockout Valve

#	Description
13	Hose for Elbow at BR Port
14	Hose for Elbow at PIL Port
15	Hose for Run Tee at T Port
16	Hose for Elbow at RB Port
17	Hose for Connector at PB Port
18	Hose for Connector at FB Port
19	Hose for Run Tee at PB Port
20	Hose for Connector at G2 Port
21	Capscrew
22	Lockwasher
23	Valve

Fig. 5-31: Rear Axle Stabilizer Control Valve.

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WARNING: Hot hydraulic fluid can cause severe burns. Wait for the hydraulic fluid to cool before servicing any hydraulic component.

WARNING: Relieve hydraulic pressure before servicing any hydraulic component. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

(Ref. Fig. 5-31) The following procedure describes removal of the rear axle stabilizer control valve.

1. Follow preparation procedures as outlined in Section 3 of this manual. Be sure to follow the guidelines in this section detailed under “General Hydraulic Maintenance Practices” on page 5-3.
2. Install brake pressure diagnostic port test gauge into brake diagnostic port (see page 5-49).
3. While watching test gauge, press brake pedal numerous times until pressure gauge reads 0 psi. Remove test gauge from diagnostic port.
4. Thoroughly clean the rear axle stabilizer control valve.
5. Disconnect intermediate wiring harness from the low brake pressure switch and solenoid valve.
6. Tag and ***slowly*** loosen all hydraulic hoses. Disconnect hoses and bleed any remaining oil into appropriate container. Cap fittings and hoses.
7. Remove the three (3) each capscrews (Item 21) and lockwashers (Item 22) securing the rear axle stabilizer control valve (Item 23) to the valve plate.
8. Remove the rear axle stabilizer control valve from the machine and take it to a clean area appropriate for further disassembly, cleaning, and overhauling.

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Boom Extend Lockout Valve

Description

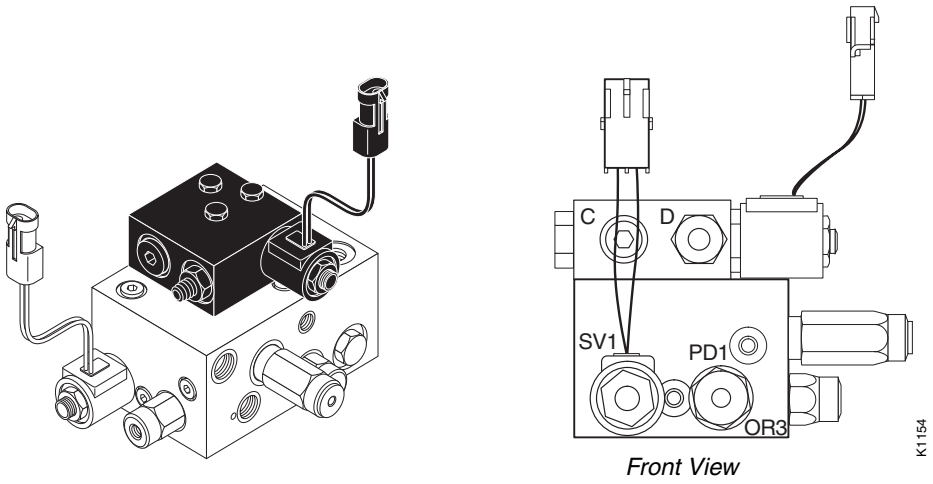


Fig. 5-32: Boom Extend Lockout Valve

(Ref. Fig. 5-32) The boom extend lockout valve is used on models with outriggers and is standard equipment on 1044C-54 models. It is located on top of the rear axle stabilizer control valve.

Hydraulic Diagnostic Ports

General

The eight (8) hydraulic diagnostic ports are located beneath the operator's compartment and can be accessed through the opening in the operator's step.

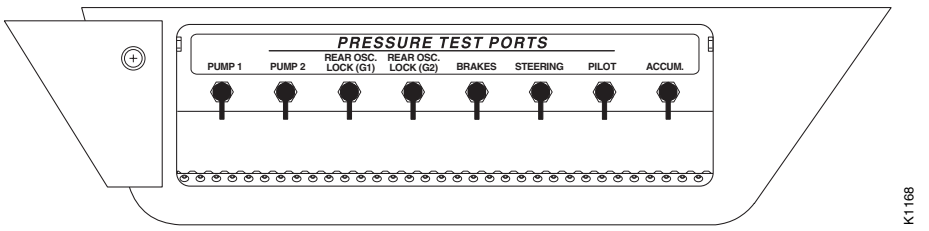


Fig. 5-33: Hydraulic Diagnostic Ports - Models with Mid-Inlet Hydraulics

(Ref. Fig. 5-33) The hydraulic ports on models with mid-inlet hydraulics are:

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- **Pump 1** – Used for reading pressure of the hydraulic pump #1. Pressure limit is 3000 psi.
- **Pump 2** – Used for reading pressure of the hydraulic pump #2. Pressure limit is 3150 psi.
- **Rear Osc. Lock (G1)** – Used for reading output pressure of the solenoid valve SV1. It is useful when diagnosing service malfunctions in the rear axle stabilizer circuit.
- **Rear Osc. Lock (G2)** – Used for reading pressure in the rear oscillation lock circuit.
- **Brakes** – Used for reading pressure of the brake circuit and is used to indicate when pressure is eliminated from the system prior to disconnecting hydraulic hoses. Pressure limit is 425 psi.
- **Steering** – Used for reading pressure of the steering circuit. Pressure limit is 2355 psi.
- **Pilot** – Used for reading pressure of the joystick circuit. Pressure limit is 500 psi.
- **Accum.** – Used for reading of pressure in the accumulator charging circuit. Pre-charge pressure is 400 psi. The low pressure limit is 1000 psi and the high pressure limit is 1125 psi.



CAUTION: To ensure that system is kept free of dirt and contamination, always cap all ports when not in use.

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Roll-Back Hose Tray

General

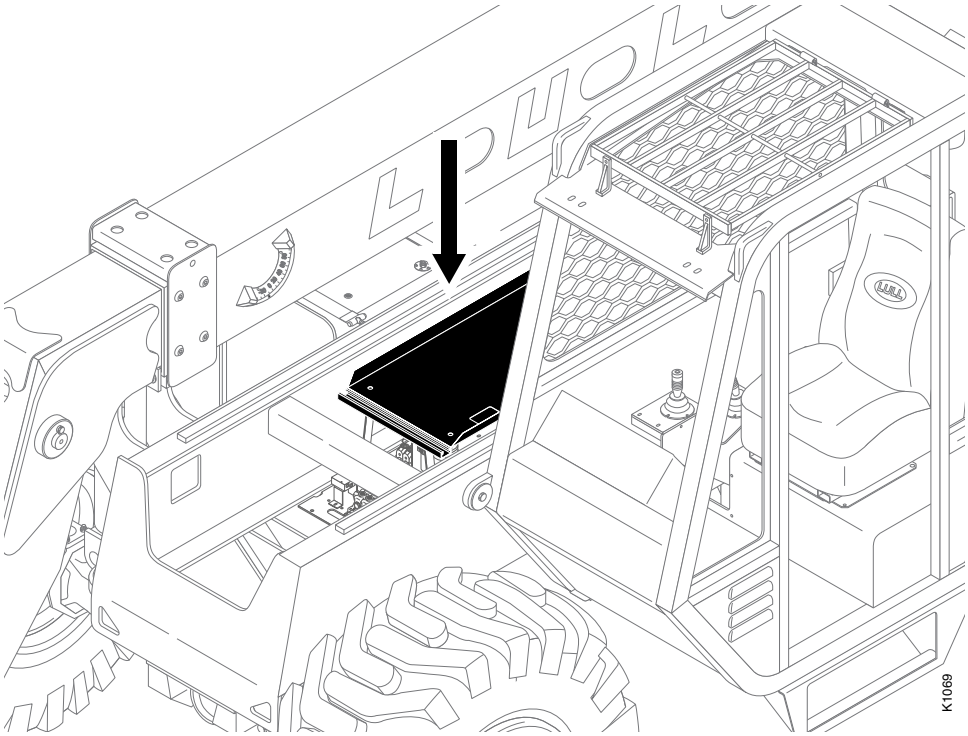


Fig. 5-34: Roll-Back Hose Frame Location - Control Manifold Hydraulics

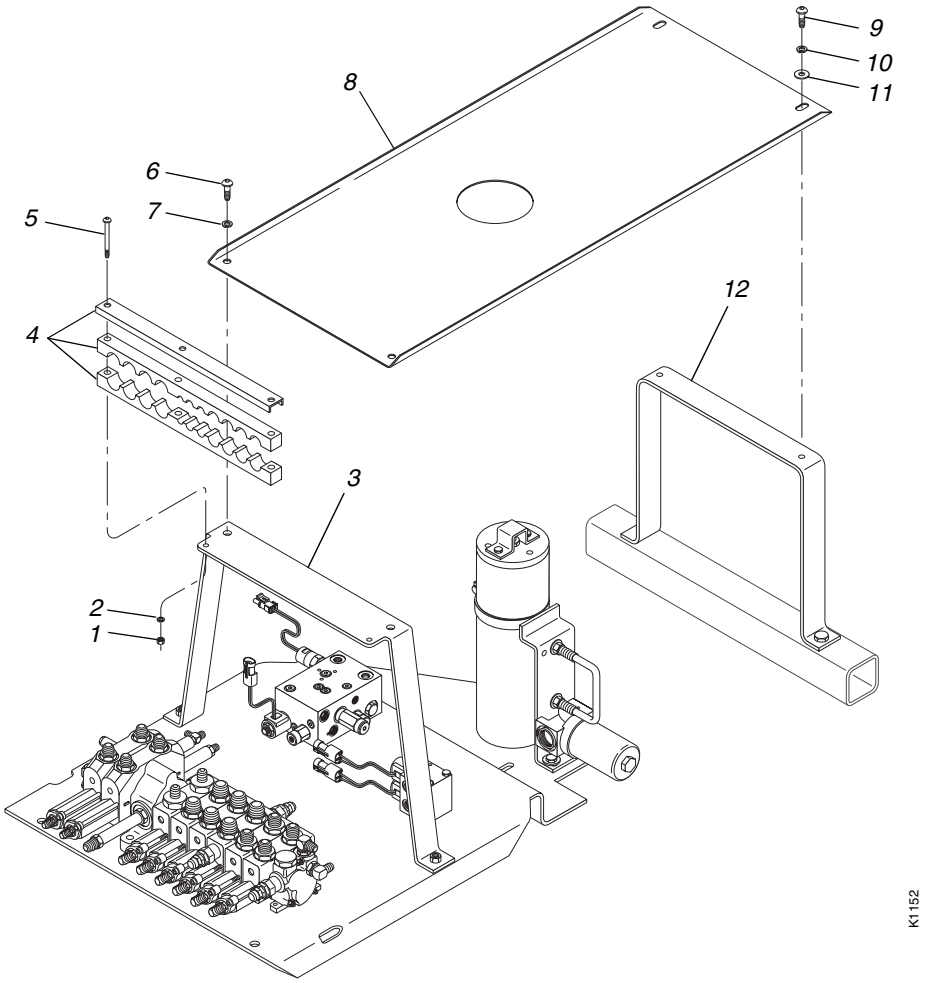
(Ref. Fig. 5-34) The roll-back hose tray is located near the middle of the machine, above the valve plate.

Removal

Roll-Back Hose Tray

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Mid-Inlet Hydraulic System



#	Description	#	Description
1	Nut	7	Lockwasher
2	Lockwasher	8	Roll-Back Hose Tray
3	Front Hose Tray Support Bracket	9	Button Head Socket Capscrew
4	Hose Mount	10	Lockwasher
5	Button Head Socket Capscrew	11	Flatwasher
6	Button Head Socket Capscrew	12	Rear Hose Tray Support Bracket

Fig. 5-35: Roll-Back Tray Installation - Mid-Inlet Hydraulics

(Ref. Fig. 5-35) The following procedure describes removal of the roll-back hose tray used in models with a mid-inlet hydraulic system.

1. Remove the two (2) each button head socket capscrews (Item 6) and lockwashers (Item 7) securing the roll-back hose tray (Item 8) to the front hose tray support bracket (Item 3).
2. Remove the two (2) each button head socket capscrews (Item 9), lockwashers (Item 10), and flatwashers (Item 11) securing the roll-back hose tray to the rear hose tray support bracket (Item 12).
3. Remove the roll-back hose tray from the machine.

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Installation

Roll-Back Hose Tray

(Ref. Fig. 5-35) The following procedure describes installation of the roll-back hose tray used in models with mid-inlet hydraulics.

1. Inspect and clean the roll-back hose tray.
2. Place the roll-back hose tray on the two support brackets making sure it is in the same position as when removed.
3. Secure the roll-back hose tray (Item 8) to the rear hose tray support bracket with two (2) each flatwashers (Item 11), lockwashers (Item 10), and button head socket capscrews (Item 9). Tighten as necessary.
4. Secure the roll-back hose tray to the front hose tray support bracket (Item 3) with two (2) lockwashers (Item 7) and button head socket capscrews (Item 6). Tighten as necessary.

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Table of Contents

Boom and Transfer Hydraulics 6-1
General Description 6-1
Joystick Controls 6-2
General Description 6-2
Removal 6-3
Installation 6-4
Disassembly 6-5
Hydraulic Cylinders 6-9
Description 6-9
Checking Cylinder Condition 6-10
Boom Hoist Cylinder 6-12
Description 6-12
Removal 6-13
Installation 6-14
Overhaul 6-15
Front Carriage Tilt Cylinder 6-18
Description 6-18
Removal 6-19
Installation 6-20
Overhaul 6-21
Rear Carriage Tilt Cylinder 6-24
Description 6-24
Removal 6-25
Installation 6-26
Overhaul 6-27
Selector Valve 6-29
Description 6-29
Removal 6-30
Installation 6-31
Overhaul 6-31
Troubleshooting 6-33
Boom Slide Pads — General 6-34
Description 6-34
Slide Pad Inspection 6-34
Lubrication 6-36
Slide Area Surface Finish 6-36
Replacing and Shimming Boom Slide Pads — General 6-38

https://truckmanualshub.com/

Quick Attach 6-40
Description 6-40
Disconnecting an Attachment 6-40
Connecting an Attachment 6-42
Removal 6-44
Installation 6-45
Boom Angle Inclinometer 6-46
Description 6-46
Replacement 6-46
4-Section Boom 6-47
Description 6-47
Shimming Procedures 6-48
Inspection Procedures 6-53
Boom Removal 6-55
installation 6-62
Boom Disassembly 6-63
Assembly 6-84
Boom Extend and Retract Chains 6-106
Chain Lubrication 6-107
Boom Chain Tension Check 6-108
Boom Hose Replacement 6-109
Extension Cylinder 6-111
Boom Extension Proximity Switch 6-117
Description 6-117
Removal 6-118
Installation 6-119
Adjustments 6-119
Transfer Carriage 6-120
Description 6-120
Installation 6-127
Rollers, Bushings, and Shims 6-129

List of Figures

Fig. 6-1: Major Boom and Transfer Hydraulic Components 6-1
Fig. 6-2: Joystick 6-2
Fig. 6-3: Joystick Installation 6-3
Fig. 6-4: Joystick Components 6-5
Fig. 6-5: Pilot Pressure Diagnostic Port. 6-8
Fig. 6-6: Pilot Pressure Plug 6-9
Fig. 6-7: Boom Hoist Cylinders 6-12
Fig. 6-8: Boom Hoist Cylinder Installation 6-13
Fig. 6-9: Boom Hoist Cylinder Assembly 6-15

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Fig. 6-10: Front Carriage Tilt Cylinder 6-18
Fig. 6-11: Front Carriage Tilt Cylinder Installation 6-19
Fig. 6-12: Front Carriage Tilt Cylinder Assembly 6-21
Fig. 6-13: Rear Carriage Tilt Cylinder 6-24
Fig. 6-14: Rear Carriage Tilt Cylinder Installation 6-25
Fig. 6-15: Rear Carriage Tilt Cylinder Assembly 6-27
Fig. 6-16: Selector Valve – Models with Mid-Inlet Hydraulics 6-29
Fig. 6-17: Selector Valve Installation – Models with Mid-Inlet Hydraulics 6-30
Fig. 6-18: Selector Valve Assembly – Models with Mid-Inlet Hydraulics 6-31
Fig. 6-19: Load Bearing Pad 6-34
Fig. 6-20: Pad Worn, But Still OK 6-35
Fig. 6-21: Pad Must Be Replaced 6-35
Fig. 6-22: Bolted Boom Slide Pad 6-35
Fig. 6-23: Slide Pad Without Chamfers – 3 and 4-Section Boom 6-36
Fig. 6-24: Damaged Slide Surface 6-37
Fig. 6-25: Slide Surface Repair 6-37
Fig. 6-26: Slide Pad Installation (2-Section Shown) 6-38
Fig. 6-27: Positioning Retaining Block 6-38
Fig. 6-28: Determining Capscrew Length 6-39
Fig. 6-29: Correctly Installed Capscrew 6-39
Fig. 6-30: Quick Attach Rear View 6-40
Fig. 6-31: Release Handle 6-40
Fig. 6-32: Lock Plate 6-41
Fig. 6-33: Rotating Quick Attach Downwards 6-41
Fig. 6-34: Lowering Boom 6-41
Fig. 6-35: Retracting Boom 6-42
Fig. 6-36: Extending Boom 6-42
Fig. 6-37: Raising Boom 6-42
Fig. 6-38: Rotating Quick Attach Forward 6-43
Fig. 6-39: Lock Plate Engaged 6-43
Fig. 6-40: Lower Pivot of Carriage Tilt Cylinder 6-44
Fig. 6-41: Quick Attach Pivot 6-45
Fig. 6-42: Boom Angle Inclinometer 6-46
Fig. 6-43: Boom Angle Inclinometer Installation 6-46
Fig. 6-44: 4-Section Boom 6-47
Fig. 6-45: Boom Slide Pad Locations – 4-Section Boom 6-48
Fig. 6-46: Boom Section Gaps – Front of 4-Section Boom 6-48
Fig. 6-47: Lower Shim Installation – Front of 4-Section Boom 6-49
Fig. 6-48: Upper Shim Installation – Front of 4-Section Boom 6-49

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Fig. 6-49: Boom Section Gaps – Rear of 4-Section Boom 6-50
Fig. 6-50: Lower Shim Installation - Rear of 4-Section Boom 6-50
Fig. 6-51: Upper Shim Installation – Rear of 4-Section Boom 6-51
Fig. 6-52: Clearances Between Boom Sections – Rear of 4-Section Boom 6-51
Fig. 6-53: Gaps Between Pads and Boom – Rear of 4-Section Boom 6-52
Fig. 6-54: Clearances Between Boom Sections – Front of 4-Section Boom 6-52
Fig. 6-55: Gaps Between Pads and Boom – Front of 4-Section Boom 6-53
Fig. 6-56: Inner Boom Cross-Section at Window 6-54
Fig. 6-57: Middle (Forward) Boom Cross-Section at Window 6-54
Fig. 6-58: Middle (Forward) Boom Cross-Section at Window 6-55
Fig. 6-59: 4-Section Boom Cover Installation 6-56
Fig. 6-60: Hose Connections, 4-Section Boom 6-56
Fig. 6-61: Cylinder Pivot Pins 6-57
Fig. 6-62: Upper Rear Slide Pad Removal – Middle (Rear) Boom Section 6-58
Fig. 6-63: Upper Rear Slide Pad Removal – Middle (Forward) Boom Section 6-59
Fig. 6-64: Upper Rear Slide Pad Removal – Inner Boom Section 6-59
Fig. 6-65: Locations for Chain Attachment – Inner Boom Section 6-60
Fig. 6-66: 4-Section Boom Pivot Pins 6-61
Fig. 6-67: Slide Pad Removal – Outer Boom Section 6-64
Fig. 6-68: Lower Front Slide Pad Removal – Middle (Rear) Boom Section 6-65
Fig. 6-69: Disconnecting Hoses Between Sections 6-66
Fig. 6-70: Extension Cylinder Removal – 4-Section Boom 6-67
Fig. 6-71: Upper Front Slide Pad Removal – Middle (Rear) Boom Section 6-68
Fig. 6-72: Upper Front Slide Pad Removal – Middle (Forward) Boom Section 6-69
Fig. 6-73: Upper Chain – Middle (Forward) to Middle (Rear) Boom Sections 6-69
Fig. 6-74: Upper Chain Roller Assembly – Middle (Forward) Boom Section 6-70
Fig. 6-75: Disconnecting Chains at Rear of Inner Boom 6-71
Fig. 6-76: Disconnecting Chains at Rear of Middle (Forward) Boom 6-71
Fig. 6-77: Slide Pad Removal – Inner Boom Section 6-72
Fig. 6-78: Slide Pad Removal – Middle (Forward) Boom Section 6-73
Fig. 6-79: Grease Hose Assembly 6-74
Fig. 6-80: Rear Chain Roller Removal - Middle (Forward) Boom Section 6-75
Fig. 6-81: Hose and Tube Removal – Inner Boom Section 6-76
Fig. 6-82: Upper Chain Assembly 6-77
Fig. 6-83: Upper Chain Roller Assembly – Middle (Rear) Boom Section 6-77
Fig. 6-84: Removing Lower Chains 6-78
Fig. 6-85: Slide Pads – Middle (Rear) Boom Section 6-79
Fig. 6-86: Chain and Hose Guide Assembly 6-80
Fig. 6-87: Tubes and Hoses – Middle (Rear) and Outer Boom Sections 6-81

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Fig. 6-88: Side Slide Pads – Outer Boom Section 6-82
Fig. 6-89: Outer Boom Tubes and Hoses 6-83
Fig. 6-90: Outer Boom Tube and Hose Assembly 6-85
Fig. 6-91: Extension Cylinder Installation 6-86
Fig. 6-92: Lower Chains on Outer Boom Section 6-87
Fig. 6-93: Lower Rear Slide Pad Installation - Middle (Rear) Boom Section 6-88
Fig. 6-94: Tubes and Hoses – Middle (Rear) Boom Sections 6-89
Fig. 6-95: Chain and Hose Guide Assembly 6-90
Fig. 6-96: Installation of Lower Chain – Middle (Rear) Boom Section 6-91
Fig. 6-97: Upper Chain Roller Assembly – Middle (Rear) Boom Section 6-92
Fig. 6-98: Chain Roller Assemblies - Middle (Forward) Boom Section 6-93
Fig. 6-99: Slide Pad Installation – Middle (Forward) Boom Section 6-94
Fig. 6-100: Hydraulic Hose and Tube Installation – Inner Boom Section 6-95
Fig. 6-101: Slide Pad Installation – Inner Boom Section 6-96
Fig. 6-102: Grease Hose Installation 6-96
Fig. 6-103: Upper Chain Installation – Inner Boom Section 6-97
Fig. 6-104: Upper Slide Pad Installation – Front of Middle (Forward) Boom Section 6-98
Fig. 6-105: Upper Chain and Hose Reel Assembly – Middle (Forward) Boom 6-99
Fig. 6-106: Rear Slide Pad Installation 6-99
Fig. 6-107: Front Slide Pad Installation – Outer and Middle (Rear) Boom Sections 6-100
Fig. 6-108: Lower Chain Installation – Inner Boom Section 6-101
Fig. 6-109: Lower Chain Installation – Middle (Forward) Boom Section 6-101
Fig. 6-110: Upper Chains – Middle (Rear) to Outer Boom Sections 6-102
Fig. 6-111: Upper Chain – Middle (Forward) to Middle (Rear) Boom Sections 6-103
Fig. 6-112: Securing Lower Chains – Middle (Rear) and Outer Boom Sections 6-103
Fig. 6-113: Securing Boom Extension Cylinder 6-104
Fig. 6-114: Connecting Hoses Between Sections 6-105
Fig. 6-115: Boom Tension Check 6-108
Fig. 6-116: 4-Section Boom Extension Cylinder 6-111
Fig. 6-117: 4-Section Boom Extension Cylinder Installation 6-112
Fig. 6-118: 4-Section Boom Extension Cylinder Assembly 6-114
Fig. 6-119: Boom Extension Proximity Switch 6-117
Fig. 6-120: Boom Extension Proximity Switch Operation 6-118
Fig. 6-121: Boom Extension Proximity Switch Assembly 6-118
Fig. 6-122: Boom Extension Proximity Switch Adjustment 6-119
Fig. 6-123: Transfer Carriage 6-120
Fig. 6-124: Disconnecting Transfer Cylinder from Transfer Carriage 6-121
Fig. 6-125: Boom Elevation Proximity Switch Wiring 6-122
Fig. 6-126: Boom Cover Installation 6-122

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Fig. 6-127: Boom Extension Proximity Switch Wiring 6-123
Fig. 6-128: Disconnecting Hydraulic Hoses from Transfer Carriage 6-124
Fig. 6-129: Transfer Carriage with Boom Installation 6-125
Fig. 6-130: Transfer Carriage Installation 6-126
Fig. 6-131: Transfer Carriage – Front Rollers, Bushings, and Shims 6-129
Fig. 6-132: Shims for Front Transfer Rollers 6-130
Fig. 6-133: Scraper Plate. 6-131
Fig. 6-134: Transfer Carriage – Rear Rollers, Bushings, and Shims 6-132
Fig. 6-135: Spacer Washers for Rear Transfer Rollers 6-133
Fig. 6-136: Rear Slide Block Installation 6-134

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Section 6 — Boom and Transfer

Boom and Transfer Hydraulics

General Description

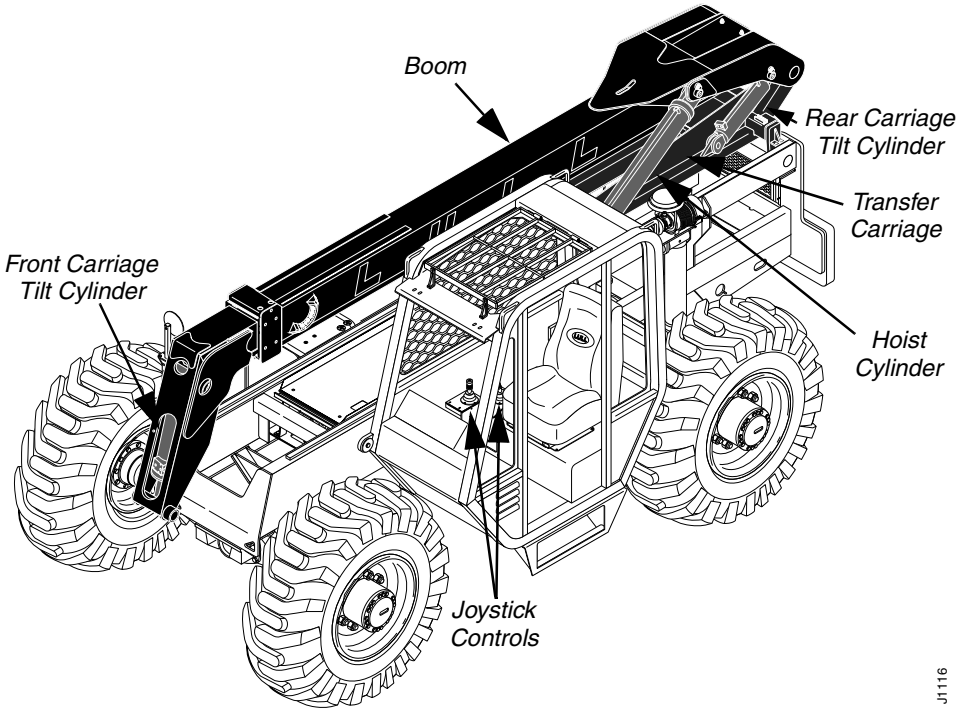


Fig. 6-1: Major Boom and Transfer Hydraulic Components

(Ref. Fig. 6-1) The following are major boom and transfer components:

- Boom - 2, 3, or 4 Sections
- Boom Extension Cylinder (not visible in illustration)
- Front Carriage Tilt Cylinder
- Boom Hoist Cylinder
- Rear Carriage Tilt Cylinder
- Joystick Controls
- Transfer Carriage

Further information on the hydraulic system can be found in Section 4.

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Joystick Controls

General Description

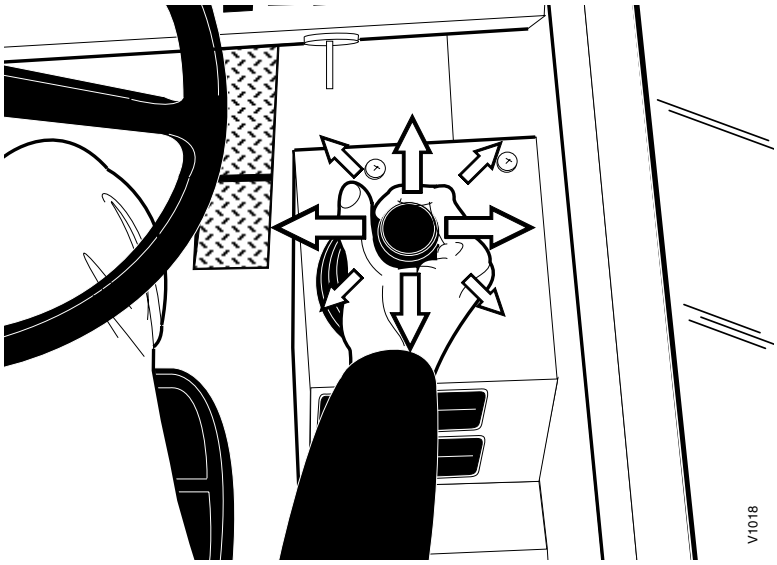


Fig. 6-2: Joystick

(Ref. Fig. 6-2) The joysticks control hydraulic flow to the associated cylinders.

Control is proportional: The more joystick movement, the greater the action. The speed of cylinder action is also affected by engine/hydraulic pump speed. Action is quicker at higher engine speeds.

Joysticks can be moved in any direction and are not limited to front/back, left/right movement. Moving a joystick in a diagonal direction will cause a combination of actions.

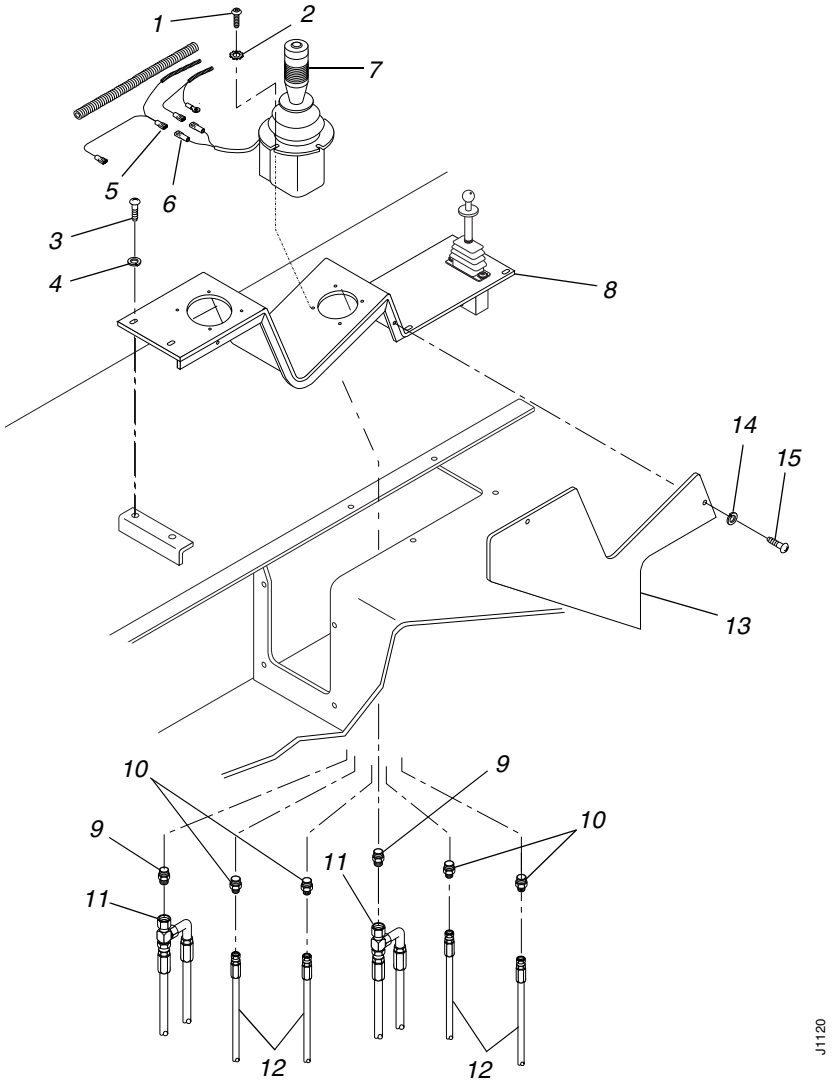
A switch is located on the top of the front joystick, under a protective rubber cap. Pressing this switch down with your thumb activates the auxiliary function.

Note: *Releasing the switch while moving the joystick left or right changes the function of the joystick back to transfer carriage control.*

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Removal

Joystick



#	Description
1	Button Head Socket Capscrew
2	Lockwasher with Internal Teeth
3	Phillips Truss Head Screw
4	Flatwasher
5	Wiring Harness
6	Lead Connector
7	Joystick
8	Control Panel

#	Description
9	Connector
10	Connector
11	Swivel Tee
12	Hydraulic Hose
13	Side Panel
14	Capscrew
15	Lockwasher

Fig. 6-3: Joystick Installation

(Ref. Fig. 6-3) The following steps are required to remove the joystick.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Remove two (2) capscrews (Item 14) and lockwashers (Item 15) securing side panel (Item 13) to control panel (Item 8). Remove side panel.

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3. Tag, loosen, and remove two (2) swivel tees (Item 11) from connectors (Item 9) on bottom of joystick.
4. Tag, loosen, and remove remaining four (4) hydraulic hoses (Item 12) from connectors (Item 10).
5. Tag and disconnect two (2) lead connectors (Item 6) from wiring harness (Item 5).
6. Loosen and remove four (4) each capscrews (Item 1) and lockwashers (Item 2) securing joystick (Item 7) to control panel.
7. Remove joystick and take it to a suitable area for further disassembly and cleaning.
8. Remove six connectors (Items 9 and 10) from bottom of joystick and manifold. Clean with solvent. Dry with compressed air and inspect for damage. Replace if necessary.

Installation

Joystick

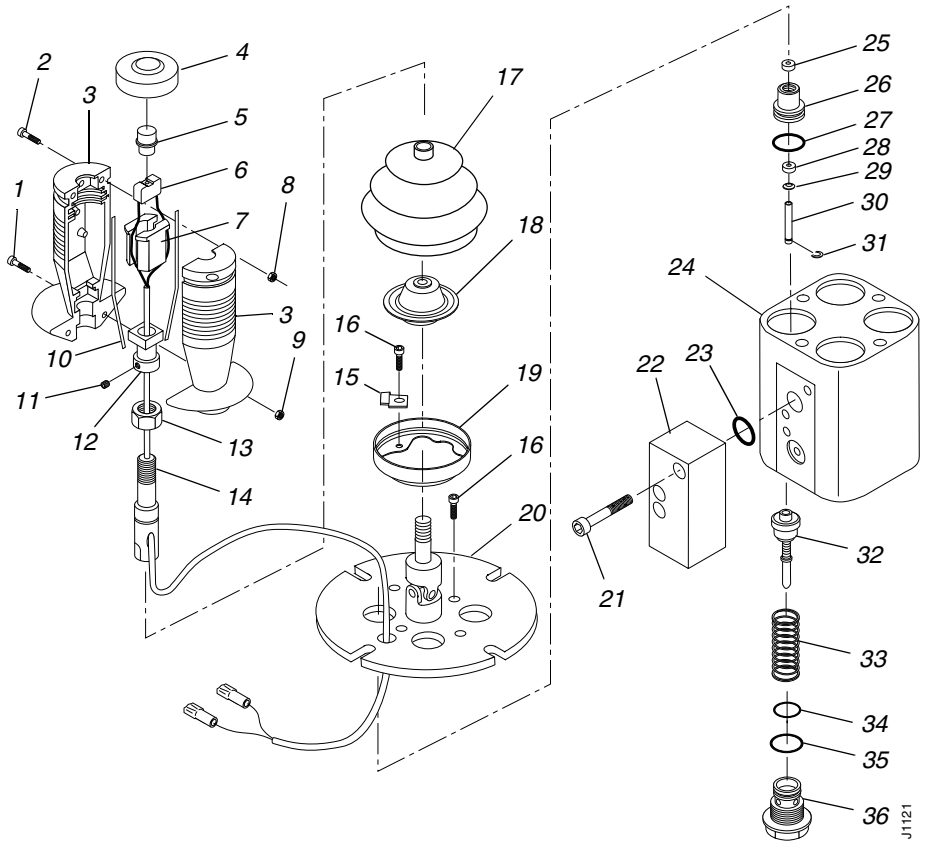
(Ref. Fig. 6-3) The following steps are required to install the joystick.

1. Install two (2) connectors (Item 9): one in center port in bottom of joystick (Item 7) and the other in the bottom of the manifold. Torque connectors to 25–29 ft-lbs.
2. Install remaining four (4) connectors (Item 10) in ported guides in bottom of joystick body. Torque connectors to 25–29 ft-lbs.
3. Install assembled joystick on control panel (Item 8) with four (4) each capscrews (Item 1) and lockwashers (Item 2). Torque capscrews to 50 in-lbs.
4. Reconnect two (2) lead connectors (Item 6) to wiring harness (Item 5).
5. Clean swivel nuts on hoses and tees with solvent.
6. Reconnect swivel tees/hydraulic hoses (Item 11) to connectors (Item 9). Torque swivel nuts to 130–150 in-lbs.
7. Reconnect remaining four (4) hydraulic hoses (Item 12) to connectors (Item 10). Torque swivel nuts on hoses to 235–265 in-lbs.
8. Reconnect two (2) lead connectors (Item 6) to wiring harness (Item 5).
9. Install side panel (Item 13) on control panel with two (2) lockwashers (Item 15) and capscrews (Item 14). Torque capscrews to 96 in-lbs.

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Disassembly

Joystick



#	Description
1	Socket Head Capscrew
2	Socket Head Capscrew
3	Half Handle
4	Cap
5	Push Button
6	Switch
7	Guide
8	Hex Nut
9	Hex Nut
10	Seal
11	Setscrew
12	Lever Joint
13	Retaining Nut
14	Stem
15	Clip
16	Socket Head Capscrew
17	Boot
18	Cam

#	Description
19	Retainer
20	Flange
21	Socket Head Capscrew
22	Manifold
23	O-ring
24	Body
25	Wiper
26	Guide
27	O-ring
28	Seal
29	Spreader
30	Plunger
31	240
32	Spool
33	Spring
34	O-ring
35	O-ring
36	Ported Guide

Fig. 6-4: Joystick Components

(Ref. Fig. 6-4) The following steps are required to disassemble and repair the joystick.

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1. Pull back boot (Item 17) so that access to retainer (Item 19) and flange (Item 20) can be made.
2. Loosen and remove four (4) socket head capscrews (Item 16) and one (1) clip (Item 15) that secure retainer and flange to joystick body (Item 24). Separate body from joystick handle assembly.
3. Disassemble joystick body assembly as follows:
   a. Loosen and remove three (3) socket head capscrews (Item 21) securing manifold (Item 22) to body.
   b. Remove O-ring (Item 23) from manifold. Discard O-ring.
   c. The following steps are required to remove parts (Items 25 thru 36) located in each port:

      Note: *Because the spools (Item 32) may differ from each other, it is strongly recommended that when they are removed, they should be removed one at a time and then reinstalled before another is removed.*

      1). Loosen and remove one (1) of the four (4) ported guides (Item 36) from body.
      2). Remove two (2) O-rings (Items 34 and 35) from ported guide. Discard O-rings.
      3). Remove spool (Item 32) and spring (Item 33) from body.
      4). Remove guide assembly (Items 25 thru 31) from body.
      5). Remove O-ring (Item 27) from guide (Item 26). Discard O-ring.
      6). Clean remaining parts with solvent. Dry with compressed air. Inspect and replace if damaged.

      Note: *Items 25 thru 31 cannot be purchased individually. The O-ring (Item 27) can only be purchased as a part of a seal kit. If any of the remaining parts become damaged, it will be necessary to purchase a complete new guide assembly.*

      7). Inspect open port in body and clean as necessary.
      8). Obtain O-ring (Item 27) from seal kit. Lubricate O-ring before installing it.
      9). Install new O-ring on guide (Item 26). Lubricate and install guide assembly (Items 21 thru 36) in body.
      10). Lubricate and install spring (Item 33) and spool (Item 32) in body.
      11). Obtain new O-rings from seal kit. Install large O-ring (Item 35) and then smaller O-ring (Item 34) on ported guide (Item 36).
      12). Install ported guide in body. Torque guide to 260 in-lbs.
   d. Repeat Step c for each of the remaining three (3) ports, one port at a time.

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e. Clean all remaining parts of joystick body assembly, including the body's center port, with solvent. Dry with compressed air. Inspect and replace any damaged parts.

Note: *The body (Item 24) cannot be purchased individually. If it becomes damaged, it will be necessary to replace the entire joystick assembly.*

f. Lubricate and install new O-ring (Item 23) in manifold (Item 22).

g. Install manifold on body with three (3) capscrews (Item 21). Torque capscrews to 22 in-lbs.

4. Remove flange (Item 20) from stem (Item 14). Separate flange, retainer (Item 19), cam (Item 18), and boot (Item 17) from stem.

5. Clean items 15 thru 20 with solvent. Inspect and replace if damaged.

6. Disassemble handle assembly (Items 1 thru *14*) as follows:

a. Remove joystick cap (Item 4).

b. Loosen and remove two (2) each hex nuts (Item 1) and capscrews (Item 9) near bottom of joystick handle.

c. Loosen and remove two (2) each hex nuts (Item 8) and capscrews (Item 2) near top of joystick handle.

d. Separate the two (2) half handles (Item 3) and remove the push button (Item 5).

e. Remove switch (Item 6) from guide (Item 7) if damaged.

f. If the switch is damaged, remove connecting wires and discard switch. Solder wires to outside tabs on new switch. Install switch in guide.

g. Inspect remaining parts and replace if damaged.

Note: *Unless they are damaged, it will not be necessary to remove lever joint (Item 12) and retaining nut (Item 13) from stem (Item 14), to remove setscrew (Item 11) from lever joint, or to remove seal (Item 10) from handle half.*

Note: *Only the handle halves (Item 3), cap (Item 4), push button (Item 5), and switch (Item 6) can be purchased individually. If any of the remaining items become damaged, it will be necessary replace the entire handle assembly.*

h. Install push button in guide while installing guide and lever joint in one (1) half handle ensuring that each is placed in the correct slot of half handle.

i. Secure the two (2) half handles together with two (2) each hex nuts (Item 8) and capscrews (Item 2) near top of joystick handle.

j. Install remaining two (2) each hex nuts (Item 1) and capscrews (Item 9) near bottom of joystick handle. Tighten the four (4) screws until snug.

k. Reinstall cap on joystick.

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7. Install boot (Item 17) on stem (Item 14) making sure that the top lip of the boot rests in the channel in the stem.
8. Roll back boot and install cam (Item 18), retainer (Item 19), and flange (Item 20) on stem.
9. Install flange on joystick body with two (2) capscrews (Item 16). Install retainer on flange with remaining two (2) capscrews, ensuring that one capscrew also secures the wire to the retainer with the clip (Item 15). Torque capscrews to 28 in-lbs.
10. Make final adjustment of cam and flange as follows:
    a. Make sure the cam is backed off enough to ensure that all four (4) plungers (Item 30) are in the spring-offset position.
    b. Apply thread locking compound to flange thread.
    c. Screw cam and stem on flange until cam just touches the plungers.
    d. Screw cam a maximum of 1/4 turn and then torque back cam against stem to 160 in-lbs.
11. Return boot to correct position, covering retainer.

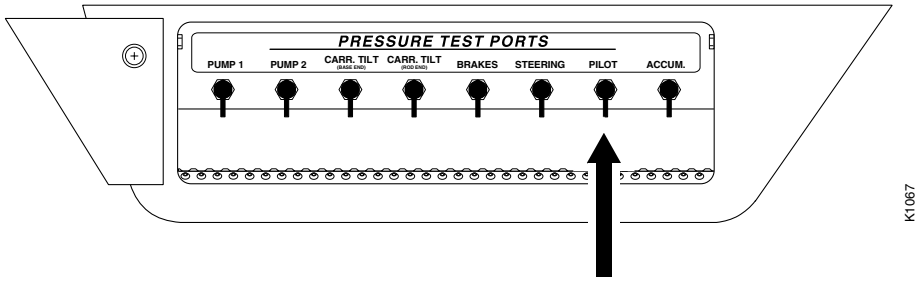


Fig. 6-5: Pilot Pressure Diagnostic Port

12. Test pilot pressure as follows:
    a. (Ref. Fig. 6-5) Connect a 600 psi gauge to the pilot pressure test port located behind the cab step.
    b. Start the machine and check pilot pressure. While the engine is idling, the pilot pressure should read 510 ±25 psi.

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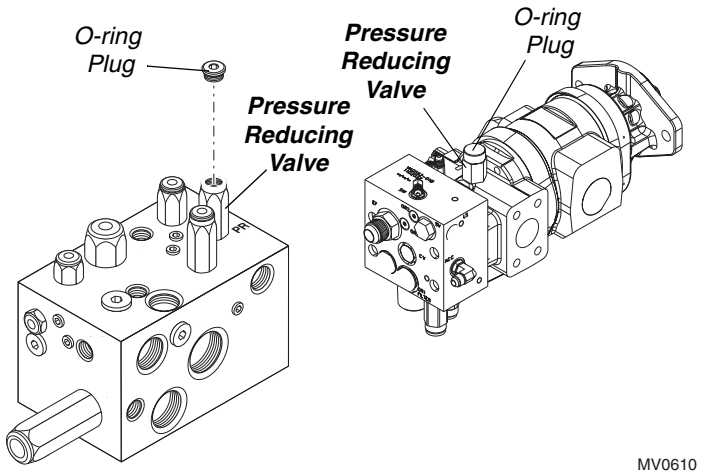


Fig. 6-6: Pilot Pressure Plug

c. (Ref. Fig. 6-6) If the pilot pressure is not within the recommended range, adjust pressure as follows:

   1). For models with mid-inlet hydraulics, remove the O-ring plug from the pressure reducing cartridge with a 5/16" Allen wrench. Use a 1/4" Allen wrench to adjust the reducing valve by turning clockwise to increase pressure and counterclockwise to decrease pressure.

   Note: *This pressure reducing cartridge is located on the hydraulic pump.*

   2). Install O-ring plug.

   3). Retest pilot pressure, and make any additional valve adjustments as required.

Hydraulic Cylinders

Description

All hydraulic cylinders used on JLG forklifts are a double-acting, non-cushioned type with chromed rods.

The boom hoist, carriage tilt, boom extension, and frame tilt cylinders are equipped with externally mounted counterbalance valves. These counterbalance valves prevent movement of the cylinders in the event of downstream hydraulic line failure or leakage through the control valves or fittings. Counterbalance valves prevent movement of the cylinders when the engine is off, even if the control valve levers are operated. Counterbalance valves also provide relief valve over pressure protection.

WARNING: Do not remove counterbalance valves from cylinders on the machine while the cylinder is under load (extended). If a counterbalance valve must be removed, first retract the cylinder and remove all hydraulic pressure in the cylinder. Wear eye protection when removing counterbalance valves.

WARNING: Hydraulic cylinders equipped with counterbalance valves may have hydraulic pressure stored within the cylinder even after the cylinder is removed from the machine. If a counterbalance valve must be removed, do so carefully while wearing eye protection.

Checking Cylinder Condition

Exposed piston rods can be damaged by impact with hard objects. If the smooth surface of the rod is marred, the rod seal may be damaged.

Cylinders need to be inspected periodically to check for excessive play at the cylinder pivot ends. Excessive play is an indication of worn bushings that will need to be replaced.

Note: *When the machine or cylinders are stored, retract the cylinder rods to protect them.*

Cylinder maintenance requires periodic inspection for wear and checks for leakage.

External Leakage

If a cylinder end cap is leaking or if the cylinder leaks around the rod, the seals must be replaced.

WARNING: **DO NOT** use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks.

Internal Leakage

Leakage past the piston seals inside the cylinder can cause sluggish movement or settling under load. Piston leakage can be caused by worn piston seals or scored cylinder walls. Scored cylinder walls may be caused by hydraulic oil contamination. Check hydraulic cylinders for internal leakage using the following procedure:

1. Lower the boom to the ground, apply the park brake, retract the cylinder, and stop the engine.
2. Install brake pressure diagnostic port test gauge into brake diagnostic port.
3. While watching test gauge, press brake pedal numerous times until pressure gauge reads 0 psi. Remove test gauge and cap diagnostic port.

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4. Remove the hose at the base end of the cylinder and plug the hose.
5. Start the engine and activate the control that will supply hydraulic oil to the rod end of the cylinder.
6. If there is leakage from the disconnected end of the cylinder, remove the cylinder and make repairs. If there is no leakage, reconnect the hose and tighten (see installation procedures for each cylinder for torque specifications).

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Boom Hoist Cylinder

Description

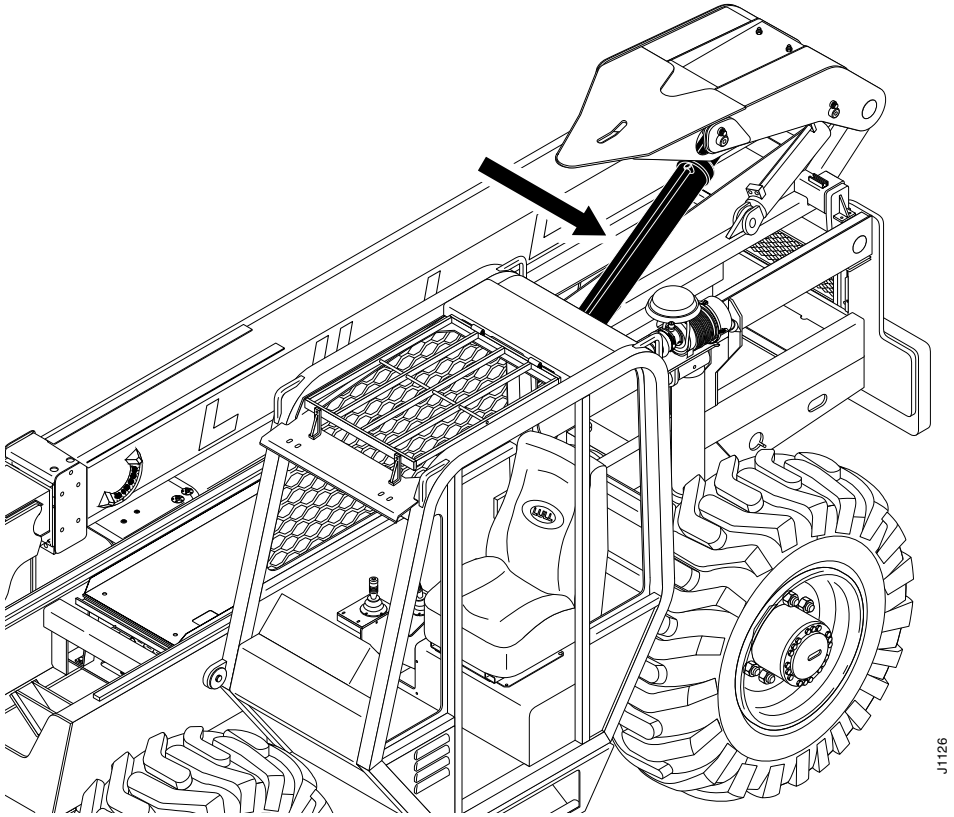


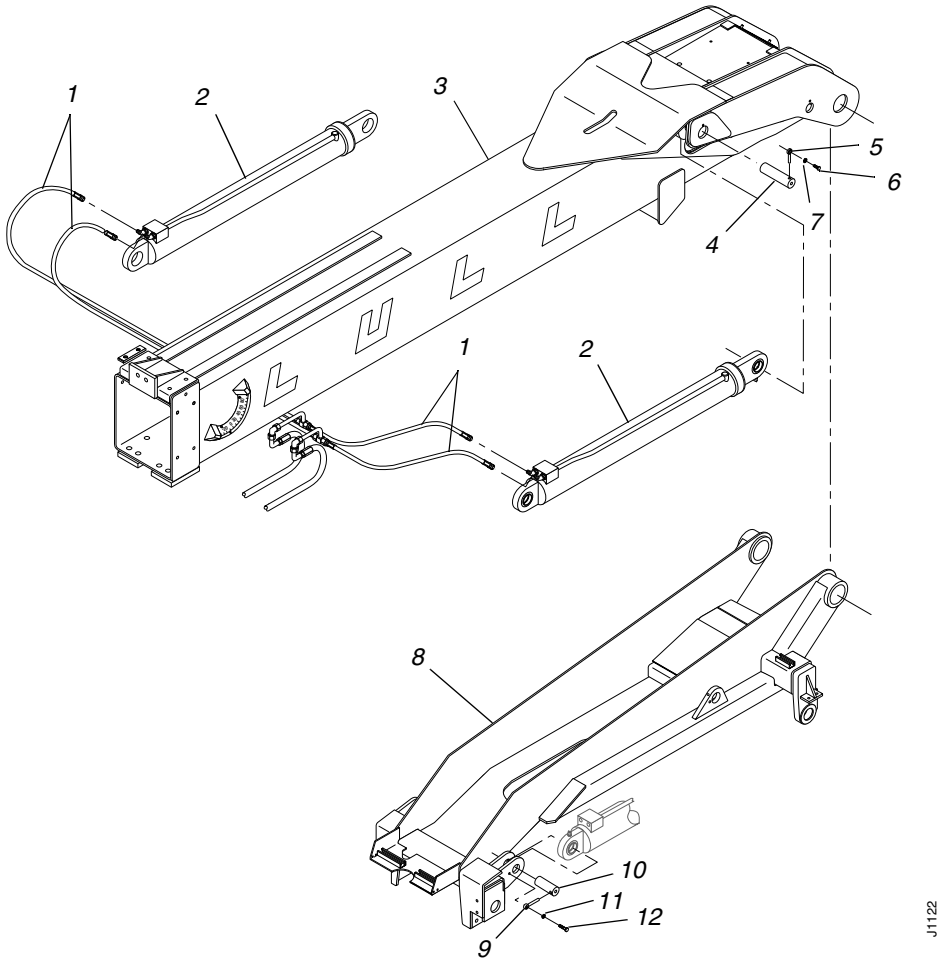
Fig. 6-7: Boom Hoist Cylinders

(Ref. Fig. 6-7) Two (2) boom hoist cylinders are used to raise and lower the boom. They are attached on one end to the outer boom and the other end is attached to the transfer carriage/boom cradle near the rear of the operator's compartment. Daily lubrication of the two grease fittings on each cylinder is required.

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Removal

Boom Hoist Cylinder



#	Description
1	Hydraulic Hose
2	Hoist Cylinder
3	Outer Boom
4	Pivot Pin - Rod End
5	Lock Pin
6	Hex Capscrew

#	Description
7	Lockwasher
8	Transfer Carriage/Boom Cradle
9	Lock Pin
10	Pivot Pin - Base End
11	Lockwasher
12	Hex Capscrew

Fig. 6-8: Boom Hoist Cylinder Installation

(Ref. Fig. 6-8) The following steps are required to remove boom hoist cylinders.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom to the ground, apply the park brake, retract the cylinder, and stop the engine.
3. Loosen and remove hydraulic hoses (Item 1) from fittings on hoist cylinder (Item 2). Bleed any remaining oil into a suitable container. Cap fittings and hoses.
4. Loosen and remove capscrew (Item 6) and lockwasher (Item 7) from rod end lock pin (Item 5).

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WARNING: To avoid personal and/or equipment damage, support the hydraulic cylinder before removing pins. Use suitable blocking and lifting devices when removing heavy machine components.

Note: *Cylinder pins are designed to be removed with a slide hammer.*

5. Remove lock pin from rod end pivot pin (Item 4).
6. Remove rod end hoist cylinder pin from outer boom (Item 3).
7. Slowly lower supported cylinder until it rests on main frame.
8. Loosen and remove capscrew (Item 12) and lockwasher (Item 11) from base end lock pin (Item 9).
9. Remove lock pin from base end pivot pin (Item 10).
10. Remove base end hoist cylinder pin from transfer carriage/boom cradle (Item 8).
11. Slowly remove the cylinder from the machine and take it to a location suitable for inspection and disassembly.

Installation

Boom Hoist Cylinder

(Ref. Fig. 6-8) The following steps are required to install boom hoist cylinders.

1. Using sling(s), crane, or other suitable means, position base end of cylinder (Item 2) in its proper location on the transfer carriage/boom cradle (Item 8).

WARNING: To avoid personal and/or equipment damage, make sure the cylinder is properly supported until it is completely installed.

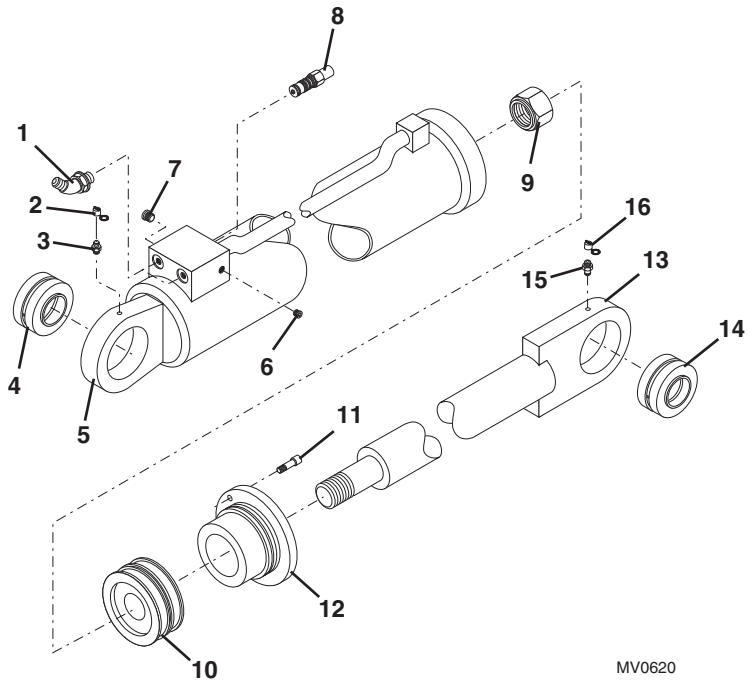
Note: *Be sure to apply thread locking compound to the threads of the capscrews before installing them.*

2. Align cylinder with pin bosses in transfer carriage/boom cradle and install pivot pin (Item 10). Secure pivot pin with lock pin (Item 5), lockwasher (Item 11), and capscrew (Item 12). Torque capscrew to 55 ft-lbs.
3. Place rod end of cylinder in its proper location and insert rod end pivot pin (Item 4) to secure the cylinder to outer boom (Item 3).
4. Secure pivot pin with lock pin (Item 9), lockwasher (Item 7) and capscrew (Item 6). Torque capscrew to 55 ft-lbs.
5. Clean hydraulic hose ends with solvent and reconnect them to fittings on each hoist cylinder. Torque hose swivel nuts to 50–58 ft-lbs.
6. Lubricate grease fittings with EP lithium based grease.

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Overhaul

Boom Hoist Cylinder



#	Description	#	Description
1	45 Degree Elbow	9	Rod Nut
2	Grease Fitting Cover	10	Piston
3	Grease Fitting	11	Set Screw
4	Self-Aligning Bushing - Base End	12	Rod Bearing Head
5	Cylinder Barrel	13	Cylinder Rod
6	Hollow Hex O-ring Plug	14	Self-Aligning Bushing - Rod End
7	Hollow Hex O-ring Plug	15	Grease Fitting
8	Counterbalance Valve Cartridge	16	Grease Fitting Cover

Fig. 6-9: Boom Hoist Cylinder Assembly

(Ref. Fig. 6-9) The following steps are required to overhaul boom hoist cylinders.

1. Mount or support cylinder vertically with rod end down. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under the cylinder.
2. Release oil pressure in the cylinder as follows:

WARNING: The counterbalance valve cartridge traps hydraulic oil in the cylinder which may be under pressure. Wear proper eye and hand protection when removing counterbalance valve cartridges. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

a. Place socket wrench over counterbalance valve cartridge (Item 8). Wrap a clean shop rag around the socket to cover the area of the counterbalance valve cartridge.

b. Carefully and slowly, turn cartridge out of manifold block to release pressure in cylinder.

3. Remove the counterbalance valve cartridge.
4. Slowly extend and retract cylinder by hand to remove most of the hydraulic oil.
5. Remove one (1) set screw (Item 11) securing rod bearing head (Item 12) to barrel.
6. Remove cylinder rod (Item 13) from cylinder barrel (Item 5).

CAUTION: To prevent possible damage to components, support rod and head; do not wiggle rod or head back and forth during removal.

7. Remove rod nut (Item 9), piston (Item 10), and rod bearing head from cylinder rod.
8. Remove two (2) O-ring plugs (Items 6 and 7).
9. Remove the two elbows (Item 1) from the cylinder manifold block.
10. Inspect bushings for damage. The following steps are necessary if bushing(s) need to be replaced:

    a. Remove bushing (Item 4) from cylinder barrel (Item 5) and/or remove bushing (Item 14) from cylinder rod (Item 13) using a bushing driver and hammer or press.

    b. Install new bushing so that it is centered in axle boss.

    c. To ensure proper lubrication, make sure an adequate amount of grease is applied to the grease fitting(s) after cylinder is reinstalled on machine.

11. If necessary, remove grease fitting covers (Items 2 and 16) and grease fittings (Items 3 and 15) on the cylinder. Inspect and replace if damaged. Install and tighten fittings 1.5 to 3 turns past finger tight.
12. Remove all O-rings, wear rings, and backup rings from cylinder components and discard.
13. Thoroughly clean components with solvent and dry with compressed air.
14. Inspect inner surface of barrel, outer surface of piston, and length of rod for scratches and scoring. If barrel, piston, or rod is damaged, it must be replaced.
15. Check condition of threads on rod, nut, and capscrews. Do not attempt to repair damaged threads.

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16. Inspect counterbalance valve cartridge (Item 8), including O-rings, for condition and replace as necessary. Do not disassemble the cartridge. Service to counterbalance valve cartridges is limited to installing new O-rings or replacing the entire cartridge.
17. Lubricate counterbalance valve cartridge O-rings with clean hydraulic oil.
18. Install cartridge in manifold block.
19. Install O-ring plug (Item 6) in manifold block.
20. Install O-ring plug (Item 7) in manifold block.
21. Lubricate new O-ring with hydraulic oil and install inside piston (seals rod to piston).
22. Lubricate new O-ring, backup ring, seals, and wear rings with hydraulic oil and install on head. Using a seal driver, install new wiper seal in head. Lubricate wiper seal with hydraulic oil.
23. Slide head (Item 12) and piston (Item 10) onto rod (Item 13). Lubricate threads on rod with hydraulic oil and install rod nut (Item 9). Torque rod nut to 2600-2800 ft-lbs.
24. Lubricate new seal and wear rings with hydraulic oil and install on piston.
25. Apply removable (blue) thread locking adhesive to threads on (1) set screw (Item 11). Coat inside of barrel (Item 5) with hydraulic oil. To avoid damaging seals during assembly, carefully insert rod and head into barrel. Install set screw until snug.
26. Install two (2) elbows (Item 1) on cylinder manifold.
27. Lubricate grease fittings with EP lithium based grease.

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Front Carriage Tilt Cylinder

Description

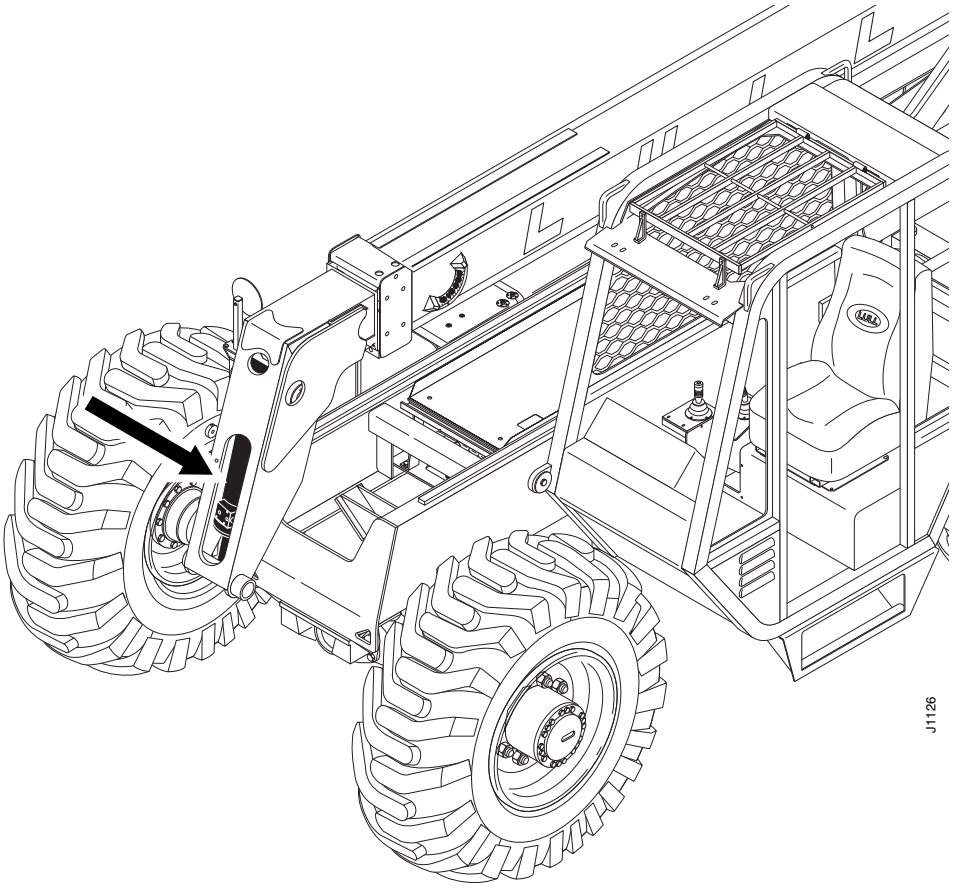


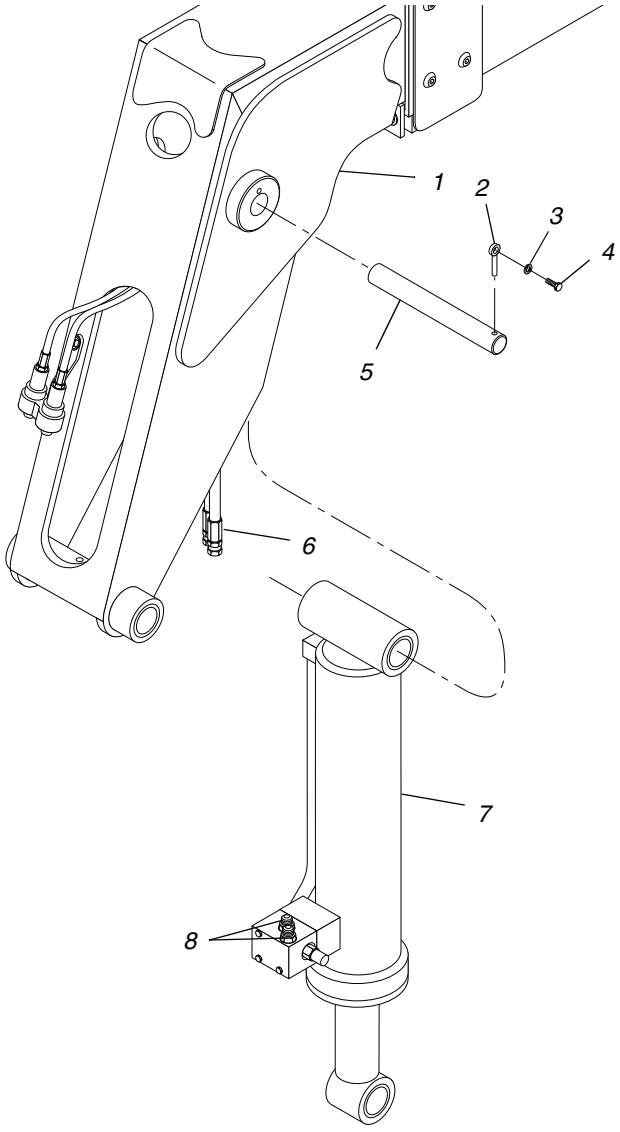
Fig. 6-10: Front Carriage Tilt Cylinder

The front carriage tilt cylinder is located inside the inner boom section at the front of the machine connecting to the inner boom and to the quick attach assembly. It controls attachment tilt when the appropriate joystick handle is activated. Maximum operating pressure is at approximately 3175 psi. Daily lubrication of the two grease fittings is required.

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Removal

Front Carriage Tilt Cylinder



#	Description	#	Description
1	Inner Boom Section Pin Boss	5	Upper Pivot Pin
2	Lock Pin	6	Hydraulic Hose
3	Lockwasher	7	Front Carriage Tilt Cylinder
4	Capscrew	8	O-ring Connector

Fig. 6-11: Front Carriage Tilt Cylinder Installation

(Ref. Fig. 6-11) The following steps are required to remove the front carriage tilt cylinder.

1. Remove quick attach assembly. See page 6-44
2. Tag and disconnect two (2) hydraulic hoses (Item 6) from connectors (Item 8). Cap fittings and hoses.
3. Support cylinder (Item 7) with sling(s) and crane, or other suitable means. Make sure equipment has sufficient capacity to support weight of cylinder; the cylinder weighs approximately 200 pounds.

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WARNING: To avoid personal and/or equipment damage, support the hydraulic cylinder before removing pins. Use suitable blocking and lifting devices when removing heavy machine components.

4. Remove capscrew (Item 4), lockwasher (Item 3), and lock pin (Item 2) from upper pivot pin (Item 5) of front carriage tilt cylinder. Remove pivot pin.
5. Carefully remove cylinder from boom nose (Item 1).
6. Clean with solvent and dry with compressed air. Inspect all components for condition and wear. Replace as necessary.

Installation

Front Carriage Tilt Cylinder

(Ref. Fig. 6-11) The following steps are required to install the front carriage tilt cylinder.

1. Using sling(s), crane, or other suitable means, position cylinder in boom nose. Align cylinder with pin bosses in boom and install pivot pin. Secure pin with lock pin, lockwasher, and capscrew. Torque capscrew to 55 ft-lbs.

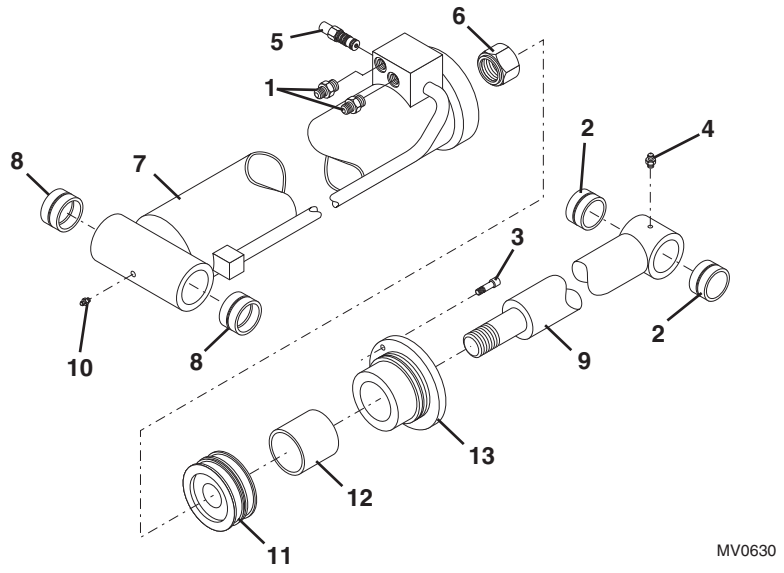
Note: *Be sure to apply thread locking compound to the threads of the capscrew before installing it.*

2. Attach two (2) hoses to cylinder. Tighten swivel nuts on hoses (Item 6) to 50–58 ft-lbs.
3. Lubricate grease fitting at each end of the cylinder with EP lithium based grease.

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Overhaul

Front Carriage Tilt Cylinder



#	Description
1	O-ring Connector
2	Bushing
3	Set Screw
4	Grease Fitting
5	Counterbalance Valve Cartridge
6	Rod Nut
7	Cylinder Barrel
8	Bushing
9	Cylinder Rod

#	Description
10	Grease Fitting
11	Piston
12	Tube
13	Rod Bearing Head

Fig. 6-12: Front Carriage Tilt Cylinder Assembly

(Ref. Fig. 6-12) The following steps are required to overhaul the front carriage tilt cylinder.

1. Mount or support cylinder vertically with rod end down. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under the cylinder.
2. Release oil pressure in the cylinder as follows:

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WARNING: The counterbalance valve cartridge traps hydraulic pressure in the cylinder. Wear proper eye and hand protection when removing counterbalance valve cartridges. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

a. Place socket wrench over counterbalance valve cartridge (Item 5). Wrap a clean shop rag around the socket to cover the area of the counterbalance valve cartridge.

b. Carefully and slowly, turn cartridge out of manifold block (Item 2) to release pressure in cylinder.

3. Remove the counterbalance valve cartridge.
4. Slowly extend and retract cylinder by hand to remove most of the hydraulic oil.
5. Remove one (1) set screw (Item 3) securing rod bearing head (Item 13) to barrel.
6. Remove cylinder rod (Item 9) from cylinder barrel (Item 7).

CAUTION: To prevent possible damage to components, support rod and head; do not wiggle rod or head back and forth during removal.

7. Remove rod nut (Item 6), piston (Item 11), tube (Item 12), and rod bearing head from cylinder rod.
8. Remove the two (2) connectors (Item 1) from the cylinder manifold block (Item 2).
9. Inspect bushings for damage. The following steps are necessary if bushing(s) need to be replaced:

   a. Remove bushing (Item 8) from cylinder barrel and/or remove bushing (Item 2) from cylinder rod using a bushing driver and hammer or press. Drive one bushing all the way through to remove other bushing.

   b. Install new bushings so they are flush with outer edge boss to 0.02" below.

   c. To ensure proper lubrication, make sure an adequate amount of grease is applied to the grease fitting(s) after cylinder is reinstalled on machine.

10. Remove all O-rings, wear rings, and backup rings from cylinder components and discard.
11. Thoroughly clean components with solvent and dry with compressed air.
12. Inspect inner surface of barrel, outer surface of piston, and length of rod for scratches and scoring. If barrel, piston, or rod is damaged, it must be replaced.
13. Check condition of threads on rod, nut, and setscrew. Do not attempt to repair damaged threads.

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14. Inspect counterbalance valve cartridge (Item 5), including O-rings, for condition and replace as necessary. Do not disassemble the cartridge. Service to counterbalance valve cartridges is limited to installing new O-rings and replacing the entire cartridge.
15. Lubricate counterbalance valve cartridge O-rings with clean hydraulic oil.
16. Install cartridge in manifold block.
17. Lubricate new O-ring with hydraulic oil and install inside piston (seals rod to piston).
18. Lubricate new O-ring, backup ring, seals, and wear rings with hydraulic oil and install on head. Using a seal driver, install new wiper seal in head. Lubricate wiper seal with hydraulic oil.
19. Slide head (Item 13), tube (Item 12), and piston (Item 11) onto rod (Item 9). Lubricate threads on rod with hydraulic oil and install rod nut (Item 6). Torque rod nut to 2600-2800 ft-lbs.
20. Lubricate new seal and wear rings with hydraulic oil and install on piston.
21. Apply removable (blue) thread locking adhesive to threads on (1) set screw (Item 3). Coat inside of barrel (Item 7) with hydraulic oil. To avoid damaging seals during assembly, carefully insert rod and head into barrel.
22. Install two (2) connectors (Item 1) on cylinder manifold.
23. If necessary, grease fittings (Items 4 and 10) from cylinder. Inspect and replace if damaged. Install and tighten fittings 1.5 to 3 turns past finger tight.
24. Lubricate grease fittings with EP lithium based grease.

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Rear Carriage Tilt Cylinder

Description

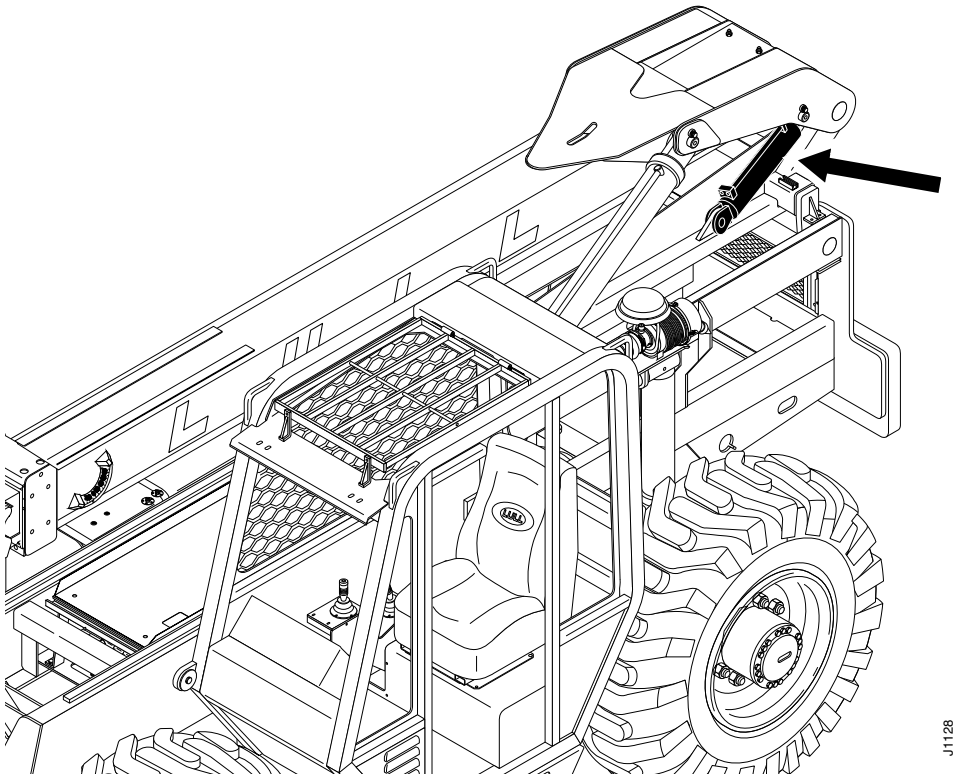


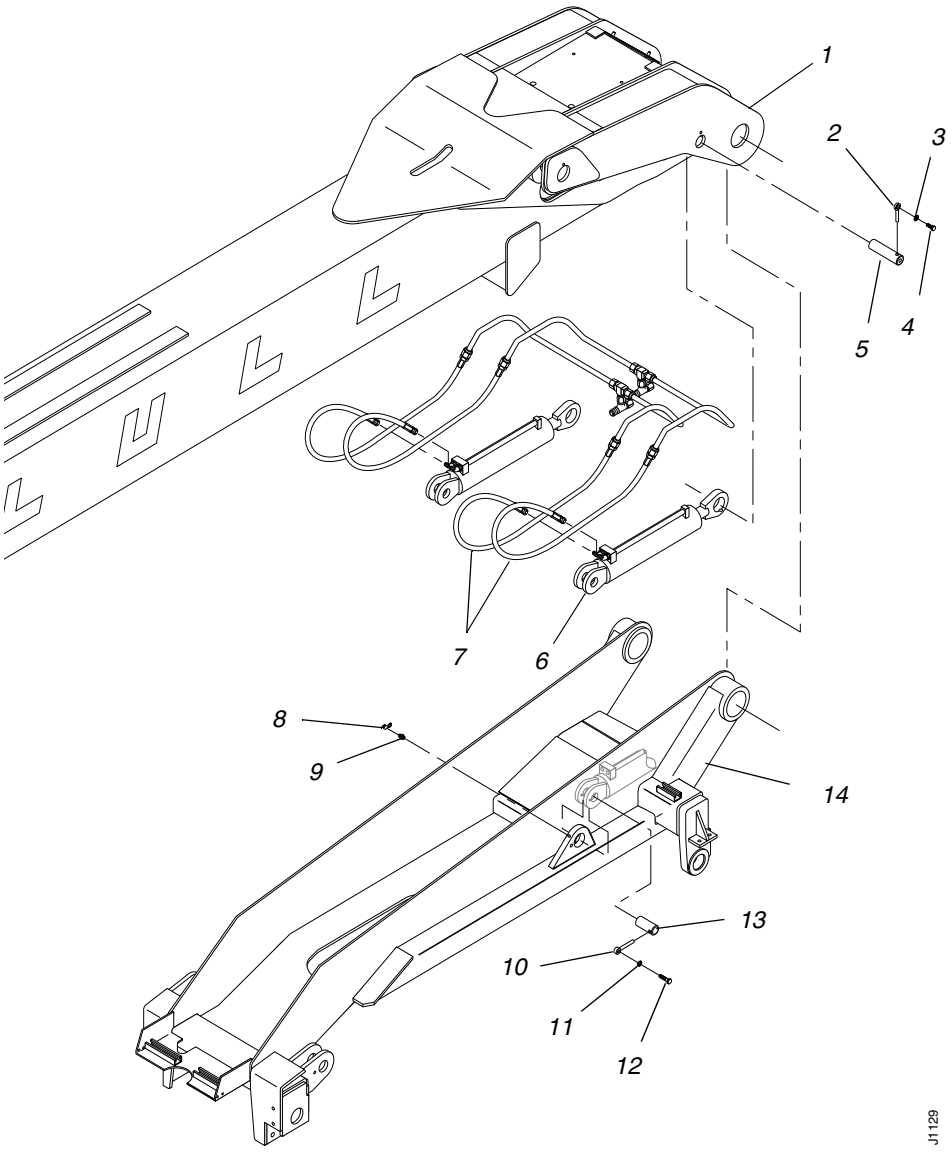
Fig. 6-13: Rear Carriage Tilt Cylinder

Two rear carriage tilt cylinders are located at the rear of the outer boom section, one on each side. These cylinders maintain the attachment tilt position as the boom is raised and lowered. As boom elevation changes, a specific amount of oil in the cylinders moves to the front carriage tilt cylinder, automatically adjusting the attachment tilt.

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Removal

Rear Carriage Tilt Cylinder



#	Description
1	Outer Boom
2	Lock Pin
3	Lockwasher
4	Hex Head Capscrew
5	Cylinder Pivot Pin - Rod End
6	Rear Carriage Tilt Cylinder
7	Hydraulic Hose

#	Description
8	Grease Fitting Cover
9	Grease Fitting
10	Lock Pin
11	Lockwasher
12	Hex Head Capscrew
13	Cylinder Pivot Pin - Base End
14	Transfer Carriage/Boom Cradle

Fig. 6-14: Rear Carriage Tilt Cylinder Installation

(Ref. Fig. 6-14) The following steps are required to remove rear carriage tilt cylinders.

1. Follow preparation procedures as outlined in Section 3.
2. Lower the boom to the ground, apply the park brake, retract the cylinder, and stop the engine.

3. Tag and disconnect two (2) hydraulic hoses (Item 7) from elbows on both cylinders (Item 6). Cap fittings and hoses.
4. Support each cylinder with sling(s) and crane, or other suitable means. Make sure equipment has sufficient capacity to support weight of cylinder.

WARNING: To avoid personal and/or equipment damage, support hydraulic cylinders before removing pins. Use suitable blocking and lifting devices when removing heavy machine components.

5. Loosen and remove capscrew (Item 4) and lockwasher (Item 3) from rod end lock pin (Item 2).
6. Remove lock pin from rod end cylinder pivot pin (Item 5).
7. Remove rod end cylinder pin from outer boom (Item 1).
8. Slowly lower supported cylinder until it rests on main frame.
9. Loosen and remove capscrew (Item 12) and lockwasher (Item 11) from base end lock pin (Item 10).
10. Remove lock pin from base end cylinder pivot pin (Item 13).
11. Remove base end cylinder pin from transfer carriage/boom cradle (Item 14).
12. Slowly remove the cylinder from the machine and take it to a location suitable for inspection and disassembly.

Installation

Rear Carriage Tilt Cylinder

(Ref. Fig. 6-14) The following steps are required to install rear carriage tilt cylinders.

1. Using sling(s), crane, or other suitable means, position base end of cylinder (Item 6) in its proper location on the transfer carriage/boom cradle (Item 14).

WARNING: To avoid personal and/or equipment damage, make sure each cylinder is properly supported until it is completely installed.

Note: *Be sure to apply thread locking compound to the threads of the capscrews before installing them.*

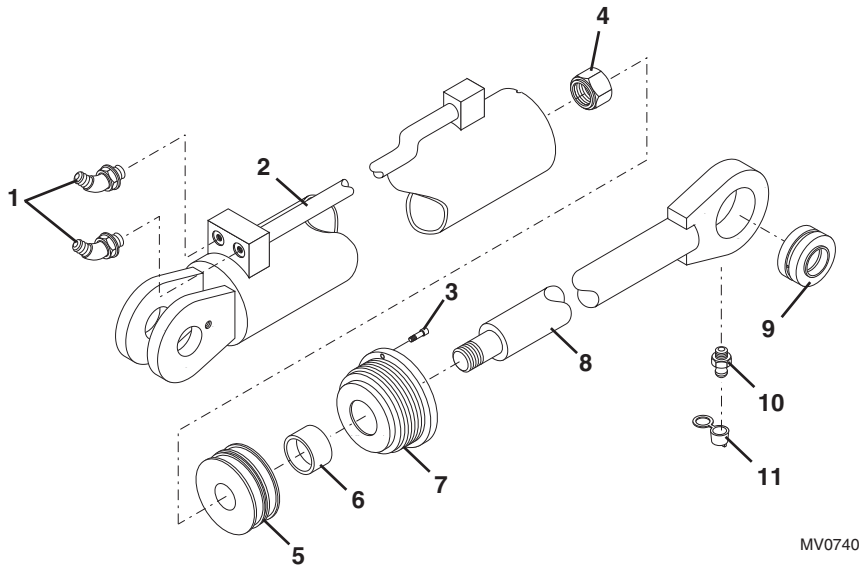
2. Align cylinder with pin bosses in transfer carriage/boom cradle and install pivot pin (Item 13). Secure pivot pin with lock pin (Item 10), lockwasher (Item 11), and capscrew (Item 12). Torque capscrew to 55 ft-lbs.
3. Place rod end of cylinder in its proper location and insert rod end pivot pin (Item 5) to secure the cylinder to the outer boom (Item 1).
4. Secure pivot pin with lock pin (Item 2), lockwasher (Item 3), and capscrew (Item 4). Torque capscrew to 55 ft-lbs.

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5. Clean hydraulic hose ends with solvent. Attach two (2) hoses (Item 7) to elbows on each cylinder. Torque hose swivel nuts to 44−48 ft-lbs.
6. If necessary, remove grease fitting cover(s) (Item 8) and grease fitting(s) (Item 9). Clean and inspect for damage; replace if necessary. Install grease fitting(s) and covers; torque fitting(s) 1.5 to 3 turns past finger tight.
7. Lubricate grease fittings with EP lithium based grease.

Overhaul

Rear Carriage Tilt Cylinder



#	Description
1	45° O-ring Elbow
2	Cylinder Barrel
3	Setscrew
4	Rod Nut
5	Piston
6	Tube

#	Description
7	Rod Bearing Head
8	Rod
9	Self-Aligned Bushing
10	Grease Fitting
11	Grease Fitting Cover

Fig. 6-15: Rear Carriage Tilt Cylinder Assembly

(Ref. Fig. 6-15) The following steps are required to overhaul the rear carriage tilt cylinder.

1. Lay cylinder horizontally in a vice or hold it down with a strap wrench. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under the cylinder.
2. Remove the two (2) elbows (Item 1) from the manifold block on the cylinder barrel (Item 2).
3. Remove the setscrew (Item 3).
4. Install a spanner wrench in the two (2) holes in the end of the rod bearing head (Item 7). Unscrew the rod bearing head.

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5. Remove the cylinder rod assembly from cylinder barrel.

CAUTION: To prevent possible damage to components, support cylinder rod assembly; do not wiggle rod or head back and forth during removal.

6. Remove rod nut (Item 4), piston (Item 5), tube (Item 6), and rod bearing head from rod (Item 8).
7. Inspect bushings for damage. The following steps are necessary if bushing(s) need to be replaced:
   a. Remove bushing (Item 9) from cylinder rod using a bushing driver and hammer or press.
   b. Install new bushing so that it is centered in rod end opening.
   c. To ensure proper lubrication, make sure an adequate amount of grease is applied to the grease fitting after cylinder is reinstalled on machine.
8. If necessary, remove grease fitting cover (Item 11) and grease fitting (Item 10) from cylinder. Inspect and replace if damaged. Install and tighten fitting 1.5 to 3 turns past finger tight.
9. Remove all O-rings, wear rings, and backup rings from cylinder components and discard.
10. Thoroughly clean components with solvent and dry with compressed air.
11. Inspect inner surface of barrel, outer surface of piston, and length of rod for scratches and scoring. If barrel, piston, or rod is damaged, it must be replaced.
12. Check condition of threads on rod and rod nut. Do not attempt to repair damaged threads.
13. Lubricate new O-ring with hydraulic oil and install inside piston (seals rod to piston).
14. Lubricate new O-ring, backup ring, seals, and wear rings with hydraulic oil and install on rod bearing head. Using a seal driver, install new wiper seal in head. Lubricate wiper seal with hydraulic oil.
15. Slide rod bearing head (Item 7), tube (Item 6) (see note after Step 6), and piston (Item 5) onto rod (Item 8). Lubricate threads on rod with hydraulic oil and install rod nut (Item 4). Torque rod nut as follows:

    550 ft-lbs.
16. Lubricate new seal and wear rings with hydraulic oil and install on piston.
17. Apply removable (blue) thread locking adhesive to threads on (1) set screw (item 3) Coat inside of cylinder barrel (Item 2) with hydraulic oil. To avoid damaging seals during assembly, carefully insert cylinder rod assembly into cylinder barrel.

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18. Install cylinder rod assembly in cylinder barrel. Install a spanner wrench in two (2) holes of rod bearing head and tighten until it is snug against the cylinder barrel.
19. Install two (2) elbows (Item 1) on cylinder manifold. Torque connectors to 40−44 ft-lbs.
20. Lubricate grease fittings with EP lithium based grease.

Selector Valve

Description

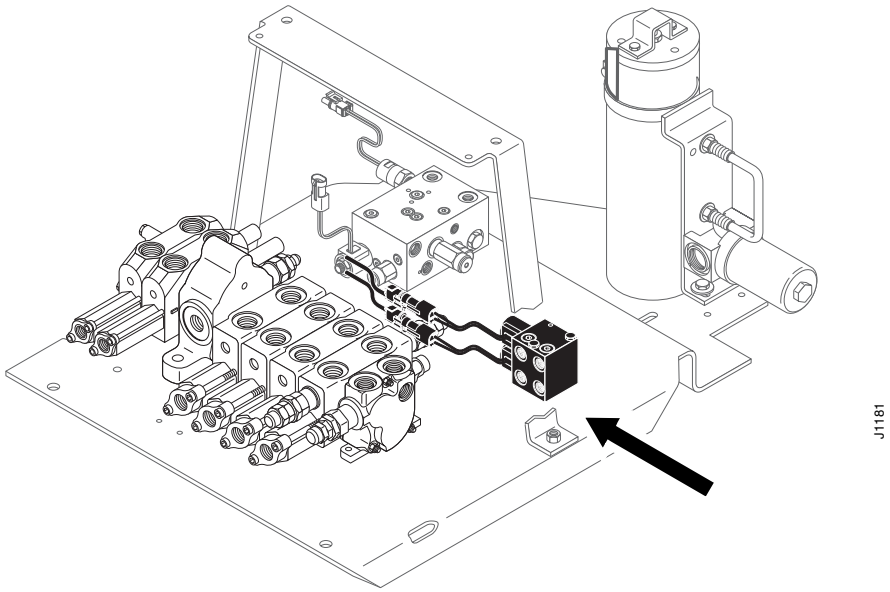


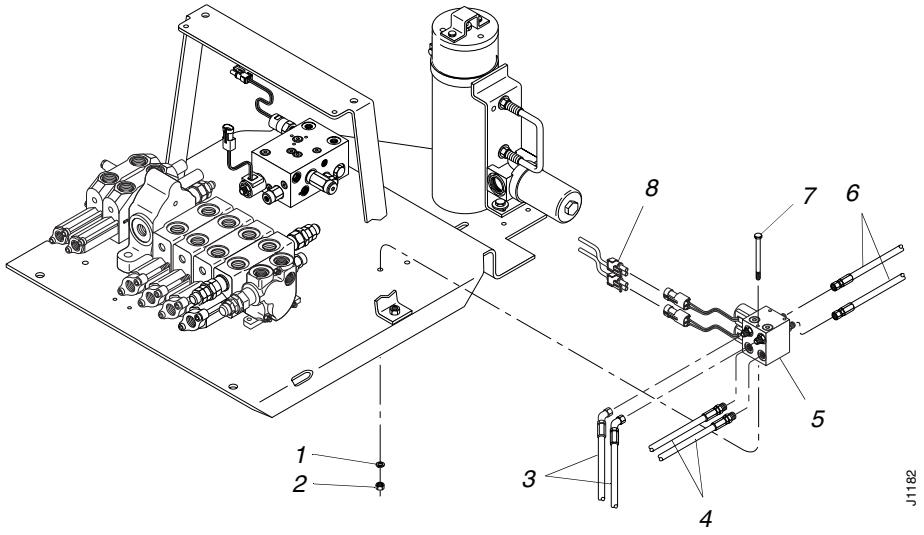
Fig. 6-16: Selector Valve

The 6-port circuit selector valve (directional control valve) is located on the valve plate near the center of the machine. It directs fluid to the control valve when the joystick is activated. The 6-port selector valve directs the flow of hydraulic oil from the joystick controller to the appropriate control valve section. The solenoids are used to change the flow of oil from one control valve section to the other.

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Removal

Selector Valve



#	Description	#	Description
1	Lockwasher	5	Selector Valve
2	Nut	6	Hydraulic Hoses (Joystick)
3	Hydraulic Hoses	7	Capscrew
4	Hydraulic Hoses	8	Joystick Wiring Harness

Fig. 6-17: Selector Valve Installation

(Ref. Fig. 6-17) The following steps are required to remove the selector valve in models with a mid-inlet hydraulic system.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Install brake pressure diagnostic port test gauge into brake diagnostic port.
3. While watching test gauge, press and release brake pedal numerous times until pressure gauge reads 0 psi. Remove test gauge from diagnostic port.
4. Remove roll-back hose tray.
5. To avoid contamination of the system, clean selector valve.
6. Disconnect joystick wiring harness (Item 8) from selector valve.
7. Tag and loosen six (6) hydraulic hoses (Items 3, 4, and 6) and bleed any remaining oil into a suitable container. Disconnect hoses. Cap fittings and hoses.
8. Remove two (2) each nuts (Item 1), lockwashers (Item 2), and capscrews (Item 7) securing selector valve (Item 5) to the valve plate.
9. Take selector valve and mounting hardware to a suitable area for cleaning and further disassembly.
10. Clean mounting hardware with solvent. Dry with compressed air, inspect for damage, and replace as necessary.

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Installation

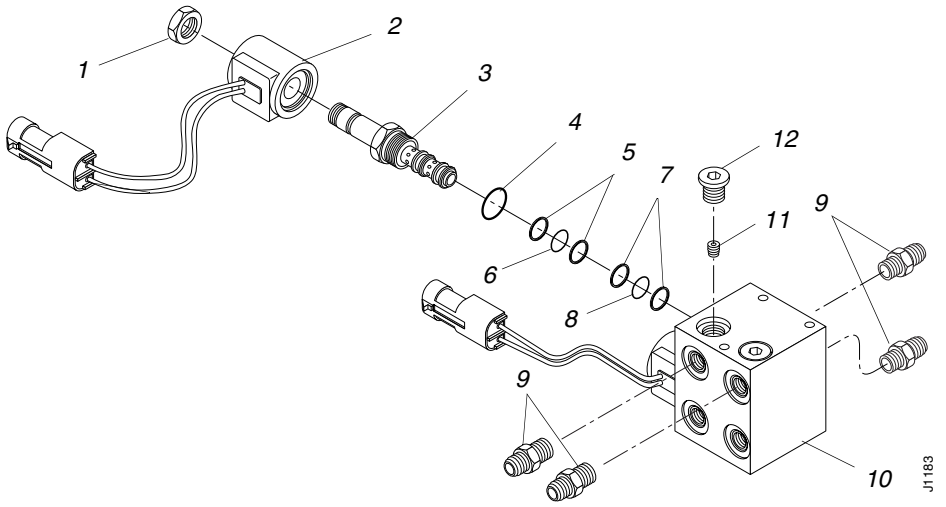
Selector Valve

(Ref. Fig. 6-17) The following steps are required to install the selector valve in models with a mid-inlet hydraulic system.

1. Secured the selector valve (Item 5) to the valve plate with two (2) each capscrews (Item 7), lockwashers (Item 2), and nuts (Item 1). Torque nuts to 50 in-lbs.
2. Reconnect four (4) hydraulic hoses (Items 3 and 6) to respective elbows at ports A3, B3, P1, and P2 on selector valve. Torque hydraulic hose swivel nuts to 130–150 in-lbs.
3. Install two (2) hydraulic hoses (Item 4) to ports A1 and B1 on selector valve and torque hose swivel nuts to 130–150 in-lbs.
4. Reconnect joystick wiring harness (Item 8) to selector valve.

Overhaul

Selector Valve



#	Description	#	Description
1	Nut	7	Backup Rings
2	Coil	8	O-ring
3	Solenoid Valve	9	Connector
4	O-ring	10	Valve Body
5	Backup Rings	11	Orifice
6	O-ring	12	O-ring Plug

Fig. 6-18: Selector Valve Assembly

(Ref. Fig. 6-18) The following steps describe disassembly and overhaul of the selector valve assembly in models with a mid-inlet hydraulic system.

1. Loosen and remove four (4) connectors (Item 9) from valve body (Item 10).
2. Loosen and remove two (2) each O-ring plugs (Item 12) and orifices (Item 11).
3. Loosen and remove nut (Item 1) from solenoid valve (Item 3).

4. Remove coil (Item 2) from solenoid valve.
5. Loosen and remove solenoid valve from valve body.
6. Remove O-rings and backup rings (Items 4 thru 8) from solenoid valve. Discard O-rings and backup rings.
7. Repeat Step 3 thru Step 6 for the other solenoid valve.
8. Clean all remaining parts with solvent and dry with compressed air. Visually inspect the valve body to make sure all cavities are free of contamination including burrs and chips as well as pieces of O-rings. Inspect for all parts for damage and replace as necessary.
9. Obtain seal kit. Lubricate each O-ring and backup ring before installing it. Install O-rings on each solenoid valve in descending order, making sure the largest is installed first and the smallest last. Make sure that O-rings (Items 6 and 8) are installed between their backup rings.
10. Check valves for any visible contamination. Dip each valve in clean oil up to the largest O-ring (Item 4) before installing it in the valve body.
11. Install valves on valve body (Item 10). Torque each valve to 20 ft-lbs.
12. Install coil (Item 2) on solenoid valve with nut (Item 1). Torque nut to 5 ft-lbs.
13. Install two (2) orifices in the valve body. Torque orifices to 30–40 in-lbs.
14. Install two (2) O-ring plugs in valve body. Torque plugs to 125–145 in-lbs.
15. Install four (4) connectors in ports A3, B3, P1, and P2. Torque connectors to 160–180 in-lbs.

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Troubleshooting

Problem	Probable Cause	Solution	Reference
1. Boom fails to extend or retract	A. Broken hydraulic line(s) and/or connection leaks B. Faulty extension cylinder C. Broken chains or chain connections	A. Replace hydraulic tube(s)/hose(s) and/or tighten loose connections. B. Repair extension cylinder seals. C. Repair or replace chains. D. Check pump pressure	
2. Boom fails to raise or lower	A. Broken hydraulic line(s) and/or connection leaks B. Faulty hoist cylinder(s) C. Faulty components in raise/lower hydraulic circuitry	A. Replace hydraulic hose(s)/tube(s) and/or tighten loose connections. B. Repair cylinder seals. C. Repair or replace damaged components. D. Check pump pressure	
3. Excessive boom pivot pin or cylinder pivot pin wear	A. Failure to grease at regular intervals B. Worn bushings	A. Replace worn pins and lubricate at recommended intervals. B. Replace bushings and lubricate at recommended intervals.	
4. Excessive Slide Pad Wear	A. Improper shimming of slide pads B. Contaminated or rusted slide pad sliding surfaces after long term storage	A. Make proper shim adjustments. B. Clean and lubricate slide pad sliding surfaces.	See page 6-38, and page 6-48 (4-section). See page 6-36.
5. Jerky boom extend or retract functions	A. Chains out of adjustment	A. Readjust chains.	
6. Excessive Chain Wear	A. Chains out of adjustment B. Improper chain lubrication	A. Replace and readjust chains. B. Replace chain(s) and lubricate at recommended intervals.	

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Boom Slide Pads — General

Description

Within the slide boom assemblies, there art two classifications of slide pads:

- Load Bearing Slide Pads

  Load bearing slide pads are located at the front and on the bottom of any boom section that contains another section. Load bearing pads are also located on the top rear of a boom section that is placed inside another section.

- Non-Load Bearing Slide Pads

  Non-load bearing slide pads are located at the front and on the top of a boom section that contains another section. Pads that are located at the rear and on the bottom of a boom that fits inside of another or any pads that are located on a side of any boom section are also non-load bearing slide pads.

Slide Pad Inspection

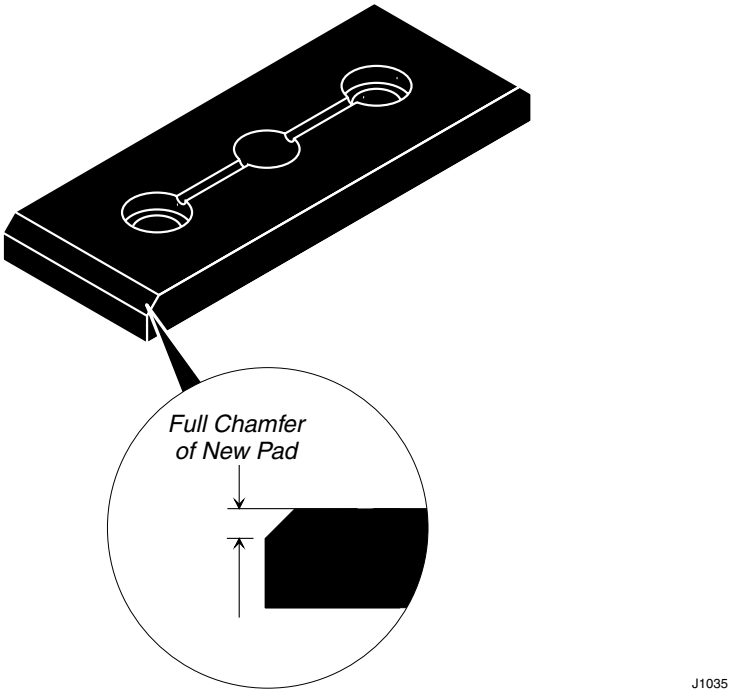


Fig. 6-19: Load Bearing Pad

(Ref. Fig. 6-19) Except for the lower slide pads located at the rear of the middle boom on 3-section booms, all other slide pads have a chamfer on each end of the top side (the side that wears). The depth of this chamfer varies, depending on the part number, and shows the amount of usable pad remaining.

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Slide Pads with Chamfers



Fig. 6-20: Pad Worn, But Still OK

(Ref. Fig. 6-20) ***Inspect all pads weekly*** for condition and amount of chamfer wear. As a pad wears, the chamfer will get smaller. As long as a portion of the chamfer is visible, the pad is OK and does not need to be replaced.

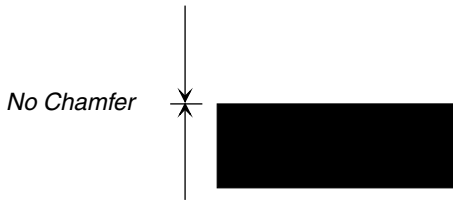


Fig. 6-21: Pad Must Be Replaced

(Ref. Fig. 6-21) When the chamfer is gone, the pad must be replaced.

Important: *Never use a boom slide pad that has worn past the chamfer. The boom will be damaged.*

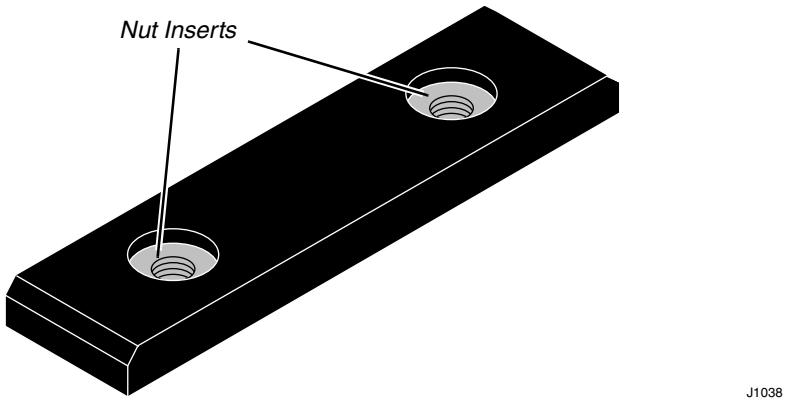


Fig. 6-22: Bolted Boom Slide Pad

(Ref. Fig. 6-22) Chamfered slide pads that have nut inserts are secured to the boom with capscrews, lockwashers (spring and/or star), and flatwashers (if needed).

Slide Pads without Chamfers

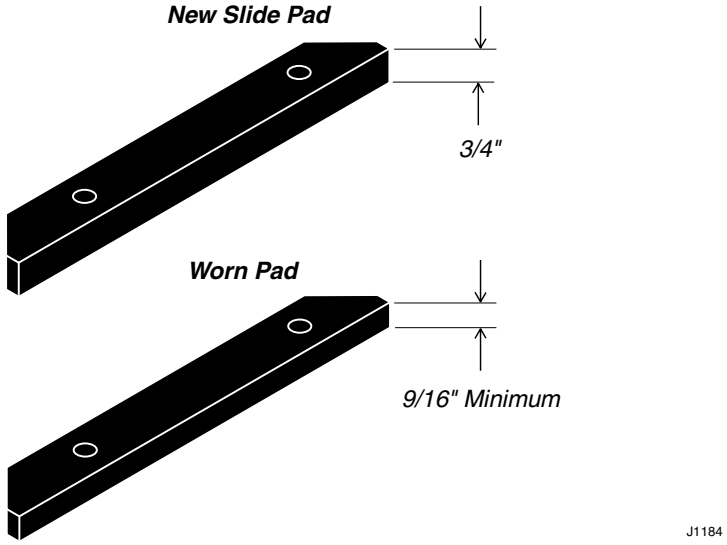


Fig. 6-23: Slide Pad Without Chamfers – 3 and 4-Section Boom

(Ref. Fig. 6-23) The lower slide pads, located at the rear of the middle boom on 3-section booms and at the rear of the middle (rear) boom on 4-section booms, do not have chamfers. It will be necessary to measure the thickness of these slide pads to ensure that they are a minimum of 9/16".

Lubrication

Load bearing pad slide areas must be greased at least monthly. Working conditions and heavy usage may warrant greasing more often.

Fully extend and lower the boom, then apply a thin coat of **EP Lithium based grease** on exposed pad slide areas. Retract the boom fully and use the grease fittings provided at the rear of the boom section(s) for lubricating those areas.

Slide Area Surface Finish

The areas on each boom section where the main load bearing pads slide must be smooth and free of nicks and scratches. Rough surfaces will greatly reduce the service life of slide pads. The general rule is: if you can catch your fingernail on a scratch, it must be repaired.

Damaged areas that are 0.030" deep or less may be repaired by blending the area smooth. Grind just enough material away to remove the damage, then blend the area using fine sand paper. See Fig. 6-24 and Fig. 6-25.

Damage greater than 0.030" deep must be filled with weld and ground smooth.

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Another option is to install/replace boom wear strips. Contact the JLG Service Department or your dealer for information about available wear strips.

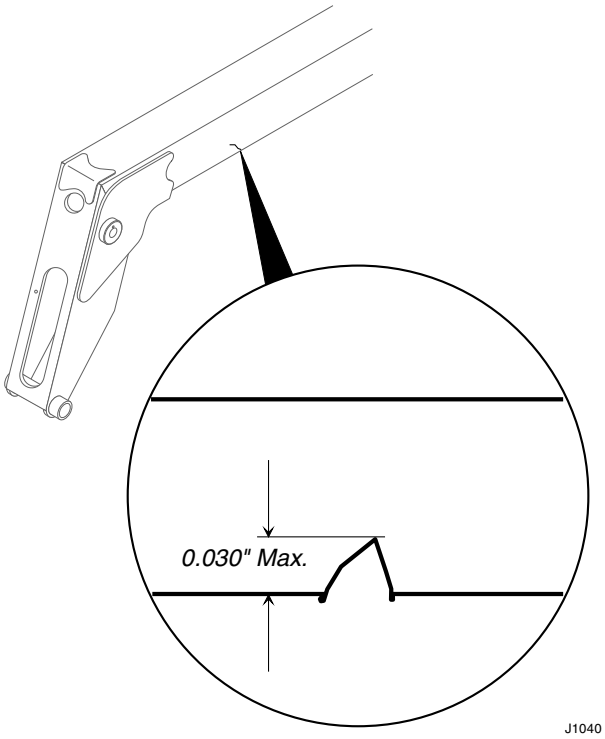


Fig. 6-24: Damaged Slide Surface

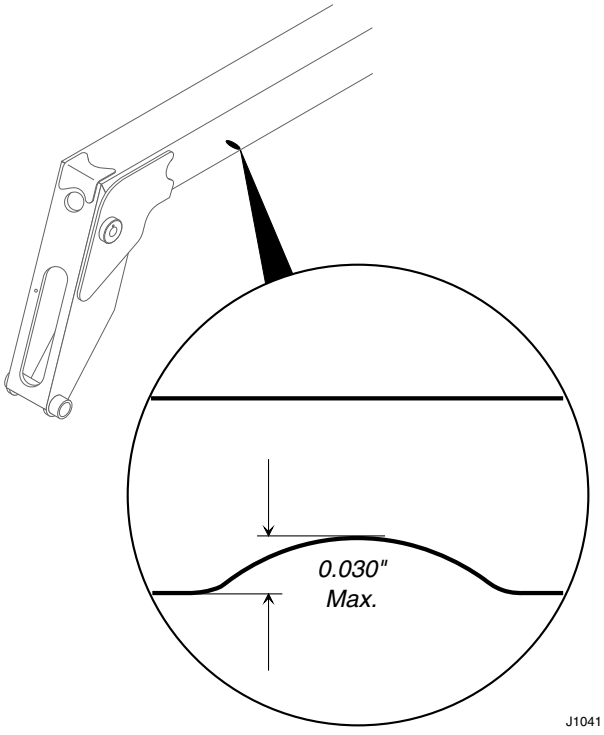


Fig. 6-25: Slide Surface Repair

Replacing and Shimming Boom Slide Pads — General

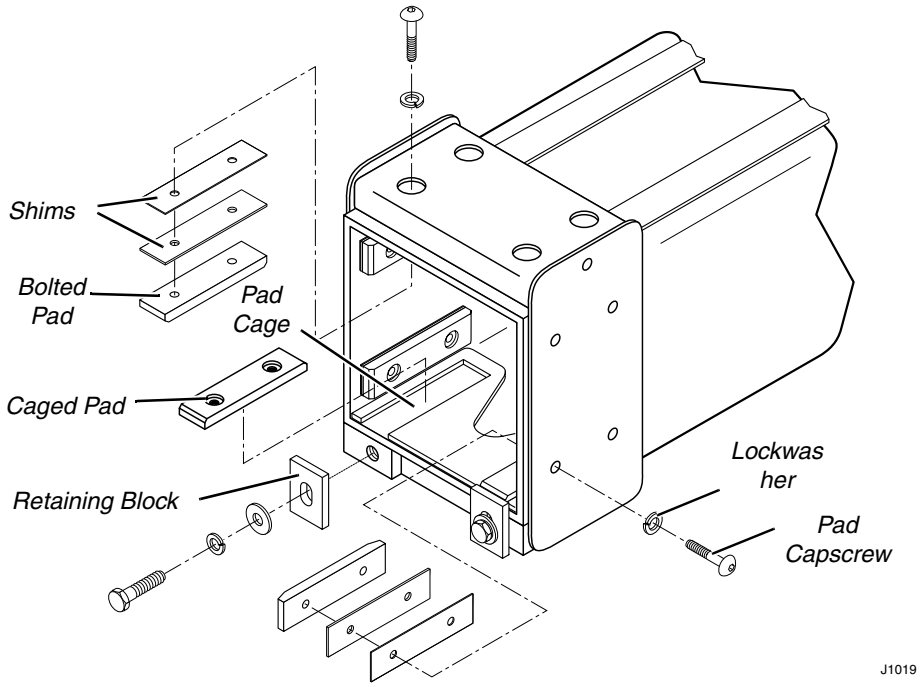


Fig. 6-26: Slide Pad Installation (2-Section Shown)

(Ref. Fig. 6-26) As boom pads wear, it becomes necessary to install or remove shims to maintain the correct clearances. Specific instructions and clearances for 2-section, 3-section, and 4-section booms are provided on following pages.

Usually, the main load bearing pads (caged pads) are the only pads that will need shimming. The other pads are not normally subjected to heavy wear.

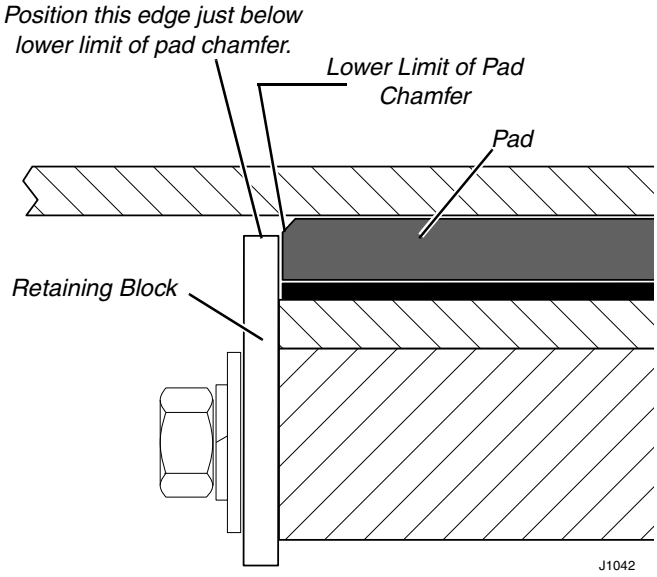
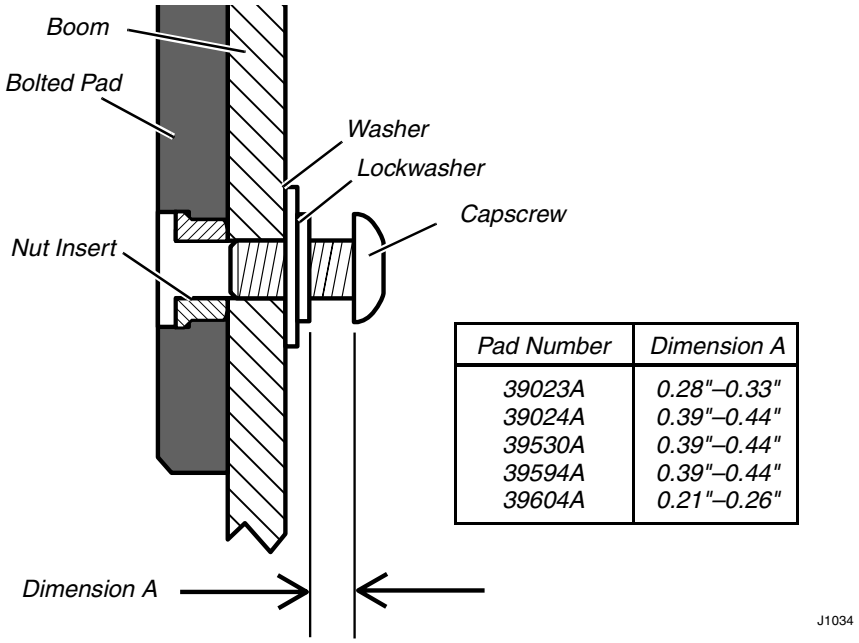


Fig. 6-27: Positioning Retaining Block

(Ref. Fig. 6-27) After shimming caged pads, the retaining block must be correctly positioned to prevent possible damage to the boom.

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Adding or removing shims from bolted pads may require a different capscrew length or washer selection.



Pad Number	Dimension A
39023A	0.28"–0.33"
39024A	0.39"–0.44"
39530A	0.39"–0.44"
39594A	0.39"–0.44"
39604A	0.21"–0.26"

Fig. 6-28: Determining Capscrew Length

(Ref. Fig. 6-28) Select a combination of capscrew length, flatwasher (if needed), and lockwasher (spring and/or star) to obtain the required dimension (Dimension A). This dimension will ensure that the capscrew will not protrude past the nut insert and cause boom damage. See Fig. 6-29. Capscrews that can be purchased from JLG come in three (3) lengths (3/4", 1", and 1-1/4").

Clearance is measured from under the capscrew head to the *lockwasher.* A lockwasher must always be used under the capscrew head.

Apply nonpermanent thread locking compound to the first few threads of the capscrew before final installation.

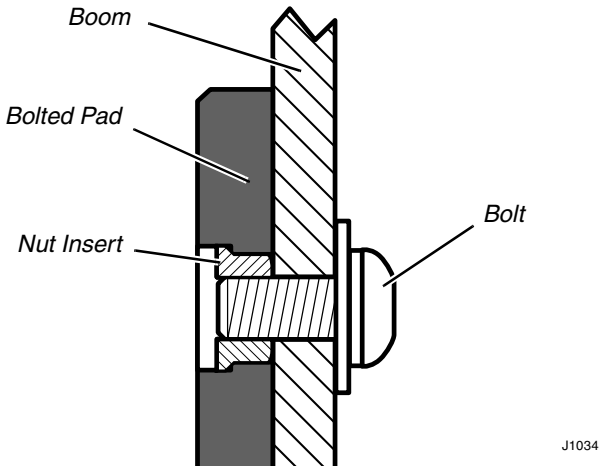


Fig. 6-29: Correctly Installed Capscrew

(Ref. Fig. 6-29) The end of the installed capscrew should be flush with, or just beneath, the inner edge of the nut insert.

Quick Attach

Description

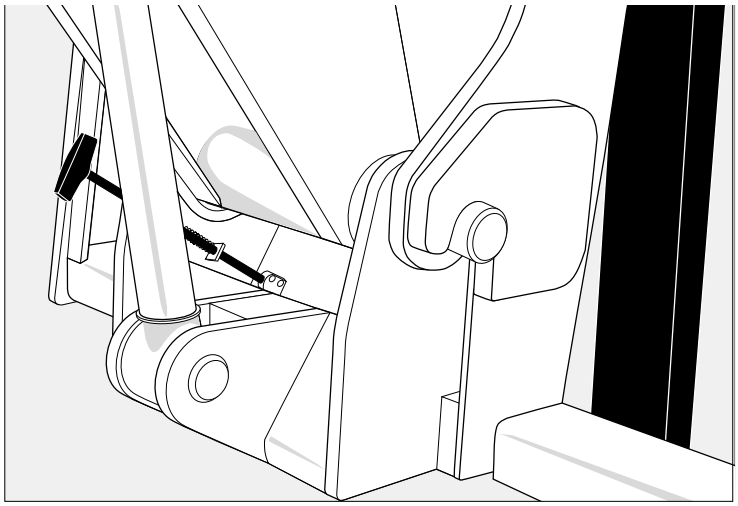


Fig. 6-30: Quick Attach Rear View

(Ref. Fig. 6-30) The quick attach is designed for easy connection and disconnection of various attachments. By pulling the release handle, attachments can be easily interchanged.

Disconnecting an Attachment

1. Come to a complete stop on flat, level ground.
2. Set the park brake.
3. Raise the boom so attachment clears the ground.
4. Extend the boom a short distance.
5. Lower the boom to rest the attachment on level ground.
6. Shut off engine.
7. Disconnect attachment hydraulic lines (if equipped).

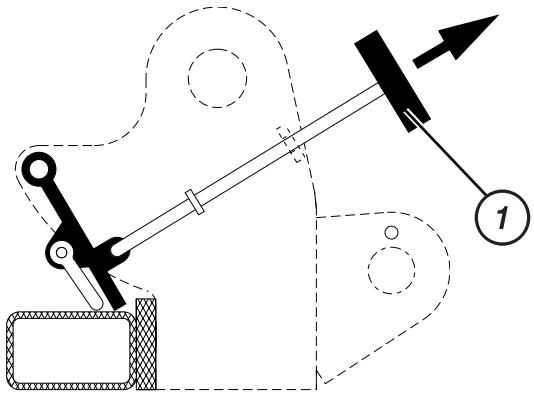


Fig. 6-31: Release Handle

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8. Pull release handle ***(1)*** back.

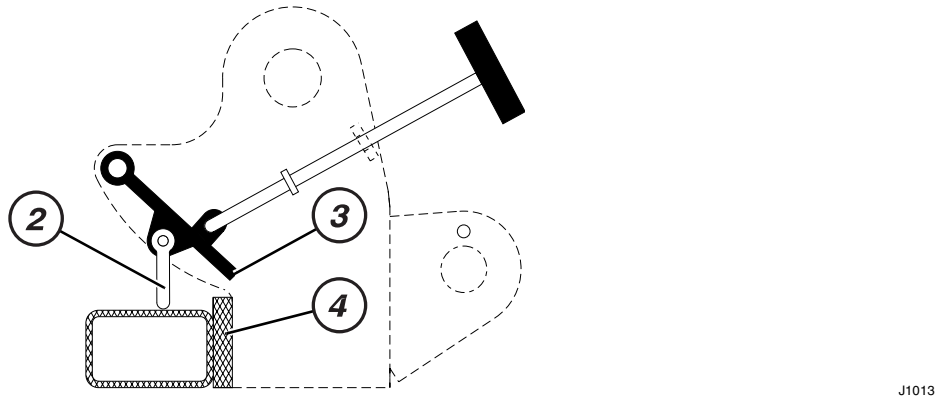


Fig. 6-32: Lock Plate

9. The lock pin ***(2)*** should engage the attachment, clearing the lock plate ***(3)*** from the attachment stop ***(4)***.

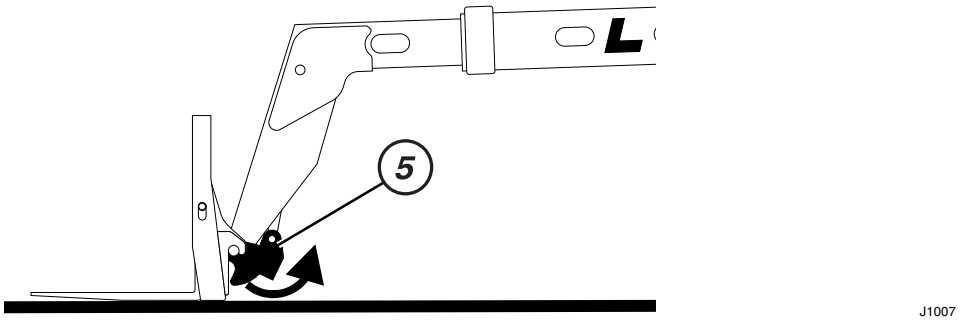


Fig. 6-33: Rotating Quick Attach Downwards

10. Start the engine. Fully rotate quick attach ***(5)*** downwards by using the attachment tilt control.

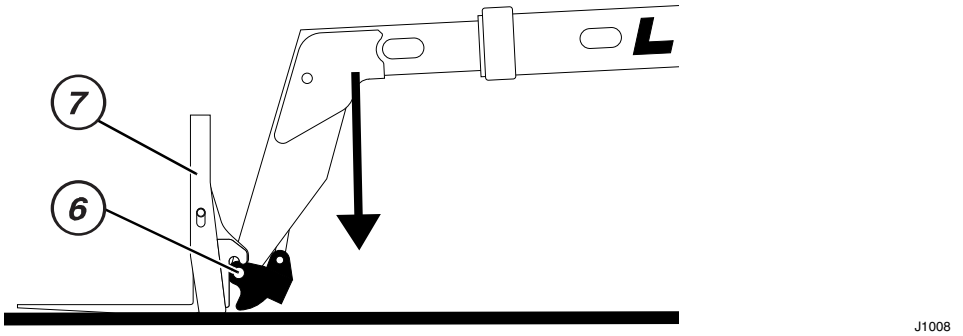


Fig. 6-34: Lowering Boom

11. Lower boom enough to clear quick attach pivot pin ***(6)*** from attachment ***(7)***.

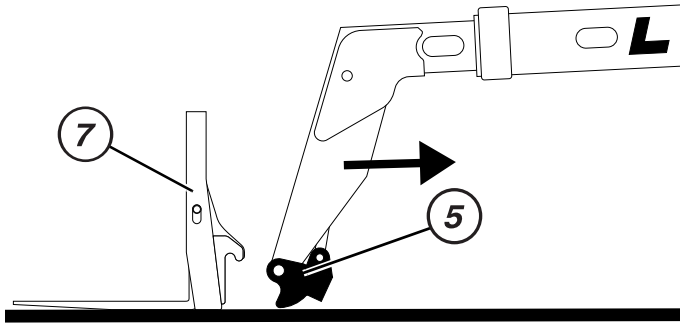


Fig. 6-35: Retracting Boom

12. Retract the boom until quick attach ***(5)*** is clear of attachment ***(7)***.

Connecting an Attachment

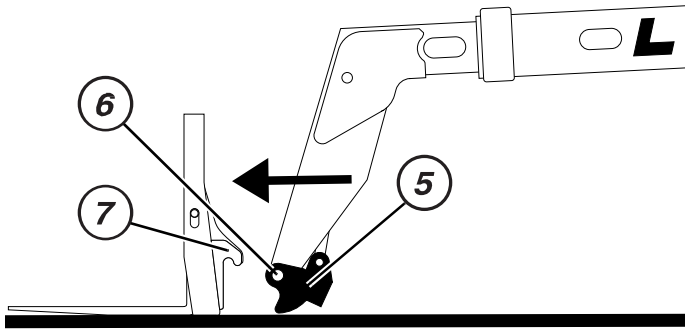


Fig. 6-36: Extending Boom

1. With quick attach ***(5)*** rotated fully downwards, extend the boom until quick attach pivot pin ***(6)*** is properly aligned underneath the attachment ***(7)***.

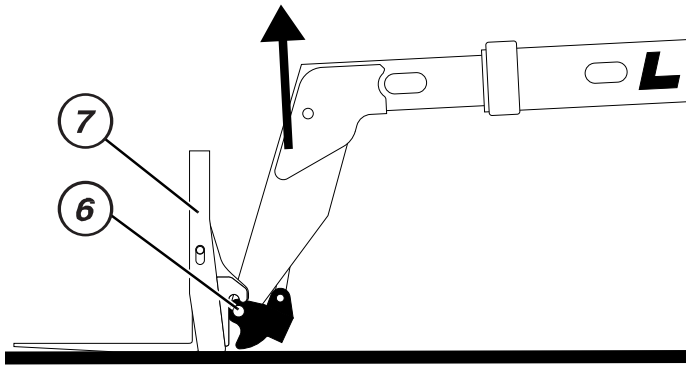


Fig. 6-37: Raising Boom

2. Raise the boom to engage the quick attach pivot pin ***(6)*** with the attachment ***(7)***.

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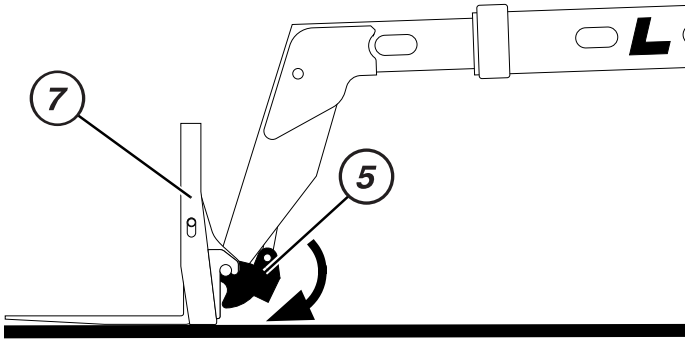


Fig. 6-38: Rotating Quick Attach Forward

3. Rotate the quick attach ***(5)*** upwards to engage the attachment ***(7)***.
4. Shut off engine.

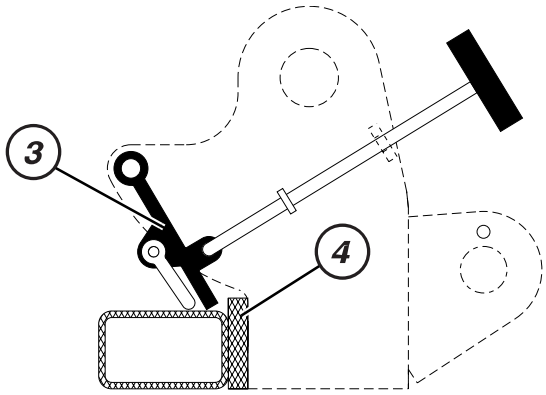


Fig. 6-39: Lock Plate Engaged

5. Check to see that the lock plate ***(3)*** is engaged ahead of the attachment stop ***(4)***.

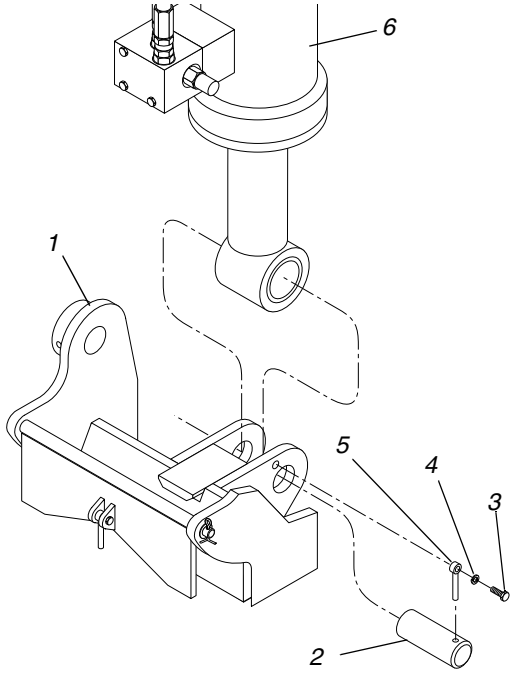


6. Connect attachment hydraulic hoses (if equipped).

Removal

Quick Attach

1. Disconnect attachment from quick attach.
2. Fully retract boom and transfer carriage (if equipped), level quick attach and lower boom to ground.
3. Set park brake, lock shift selector in NEUTRAL position, shut off engine and remove ignition key from switch. Block all wheels.

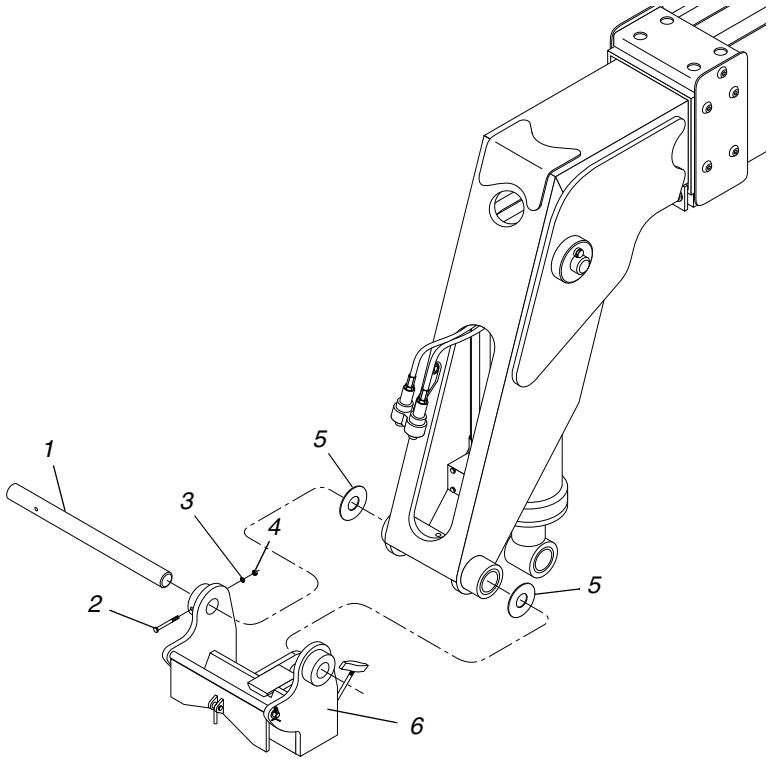


#	Description	#	Description
1	Quick Attach	4	Lockwasher
2	Pivot Pin	5	Lock Pin
3	capscrew	6	Front Carriage Tilt Cylinder

Fig. 6-40: Lower Pivot of Carriage Tilt Cylinder

4. (Ref. Fig. 6-40) Remove capscrew (Item 3), lockwasher (Item 4), and lock pin (Item 5) from lower pivot pin (Item 2) of front carriage tilt cylinder (Item 6). Remove pivot pin from quick attach (Item 1).

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#	Description	#	Description
1	Pivot Pin	4	Nut
2	Capscrew	5	Shim
3	Lockwasher	6	Quick Attach

Fig. 6-41: Quick Attach Pivot

5. (Ref. Fig. 6-41) Remove nut (Item 4), lockwasher (Item 3), and capscrew (Item 2) from quick attach pivot pin (Item 1).
6. Remove quick attach pivot pin and shims (Item 5) (if installed).
7. Clean and inspect all parts for condition and wear. Replace as necessary.

Installation

Quick Attach

1. Align quick attach (Item 6) to boom. Check gaps between quick attach and boom. Select shims to center quick attach on boom.
2. (Ref. Fig. 6-41) Install quick attach pivot pin (Item 1) and shims (Item 5). Secure pivot pin with capscrew (Item 2), lockwasher (Item 3), and nut (Item 4).
3. (Ref. Fig. 6-40) Align rod-end of front carriage tilt cylinder with quick attach. Install pivot pin and secure with lock pin, lockwasher, and capscrew.
4. Lubricate grease fittings with EP lithium based grease.

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Boom Angle Inclinometer

Description

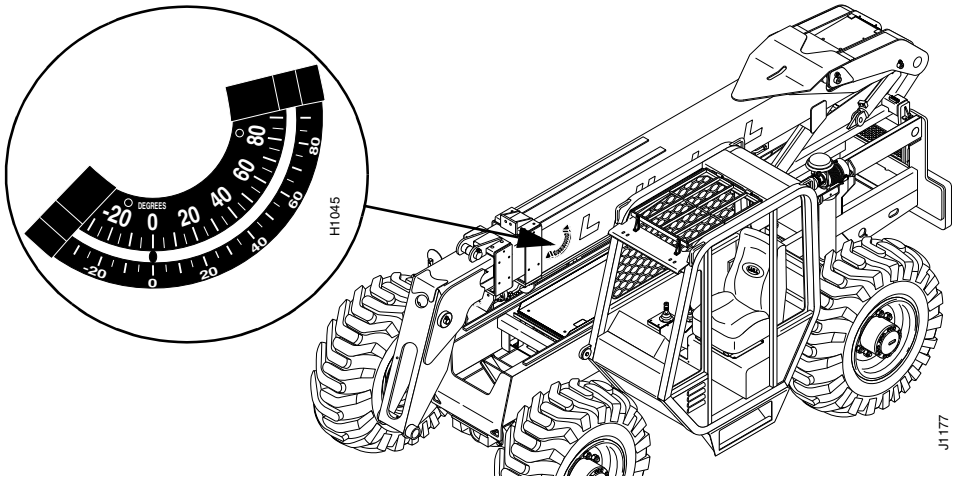
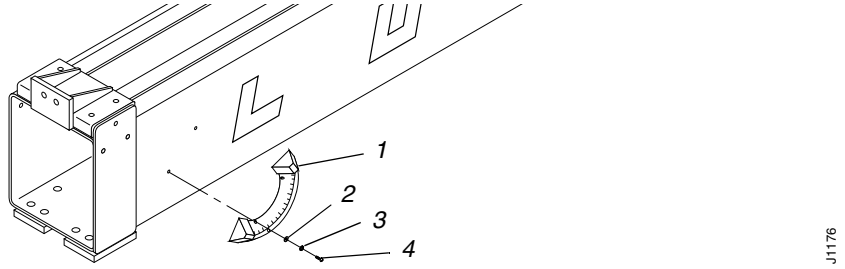


Fig. 6-42: Boom Angle Inclinometer

(Ref. Fig. 6-42) The boom angle inclinometer is located near the front of the outer boom section.

The boom angle inclinometer shows the angle of the boom relative to level ground. This indicator is used with the boom extension indicator, transfer carriage extension indicator (if equipped), and machine load chart to determine correct boom lifting capacities.

Replacement



#	Description	#	Description
1	Boom Angle Inclinometer	3	Starwasher
2	Flatwasher	4	Round Head Screw

Fig. 6-43: Boom Angle Inclinometer Installation

1. Remove two (2) each round head screws (Item 4), starwashers (Item 3), and flatwashers (Item 2) along with the boom angle indicator (Item 1) from the boom.
2. Discard old boom angle inclinometer.
3. Clean and inspect hardware for damage and replace as necessary.
4. Install new boom angle inclinometer with two (2) each flatwashers, starwashers, and round head screws. Tighten screws until snug.

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4-Section Boom

Description

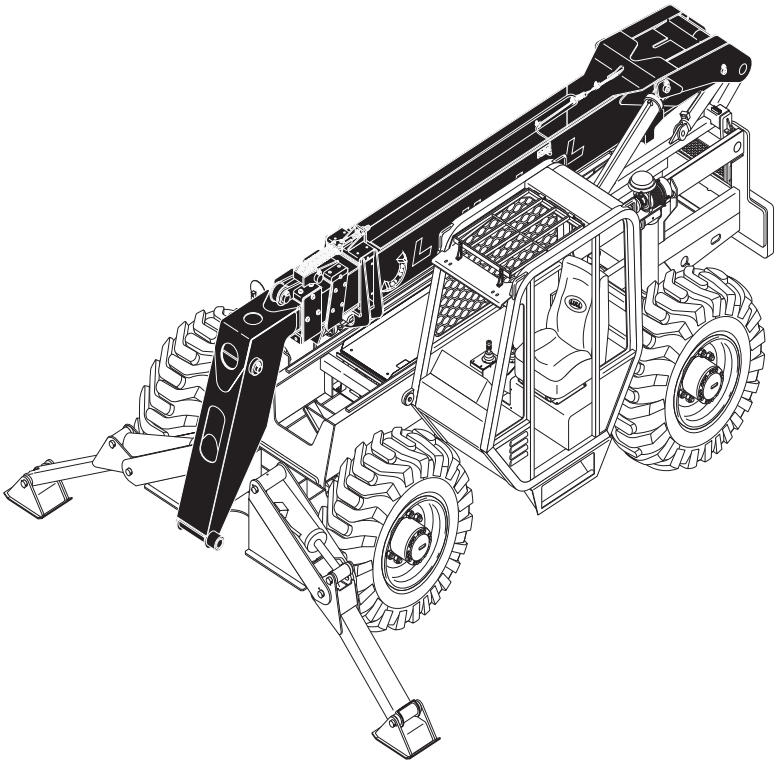
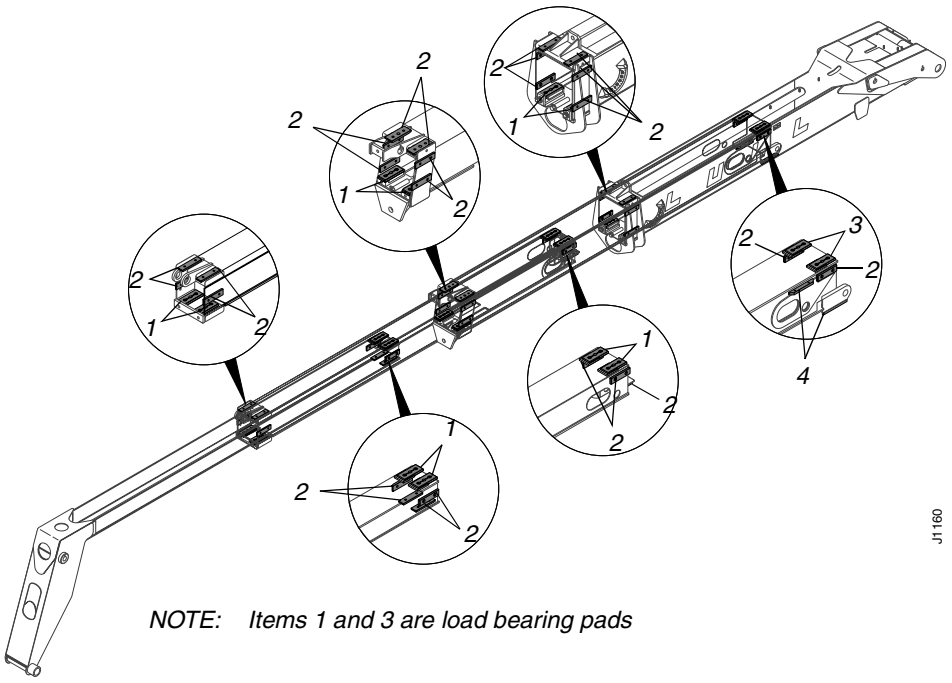


Fig. 6-44: 4-Section Boom

The 4-section boom is used on 1044C-54 models. It is a fully synchronized slide boom with a 54 foot maximum lift height. The boom on the 1044C-54 has a maximum forward reach of 45 feet.

Shimming Procedures

4-Section Boom



NOTE: Items 1 and 3 are load bearing pads

#	Description
1	Boom Pad, 1" Thick x 3" Wide
2	Boom Pad, 9/16" Thick x 2" Wide
3	Boom Pad, 3/4" Thick x 3" Wide

#	Description
4	Boom Pad, 3/4" Thick x 1-1/4" Wide

Fig. 6-45: Boom Slide Pad Locations – 4-Section Boom

1. Park machine on firm, level surface and apply park brake. Level the frame. Level and fully retract the boom. Shut off engine.
2. Determine if all boom slide pads are serviceable. (See “Slide Pad Inspection” on page 6-34). Have replacement pads ready as required.

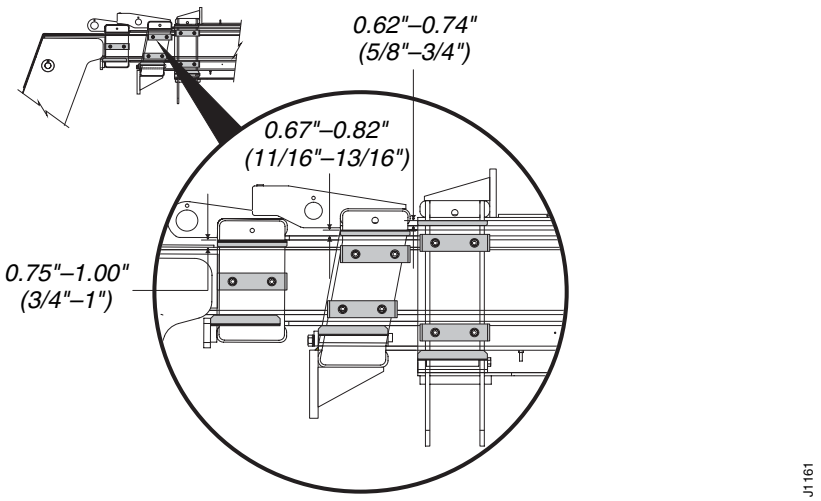


Fig. 6-46: Boom Section Gaps – Front of 4-Section Boom

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3. (Ref. Fig. 6-46) Measure the gap between boom sections at all upper front pads. If the dimensions are *not* within the specified range, proceed to Step 4. If the dimensions *are* within the specified range, proceed to Step 5.

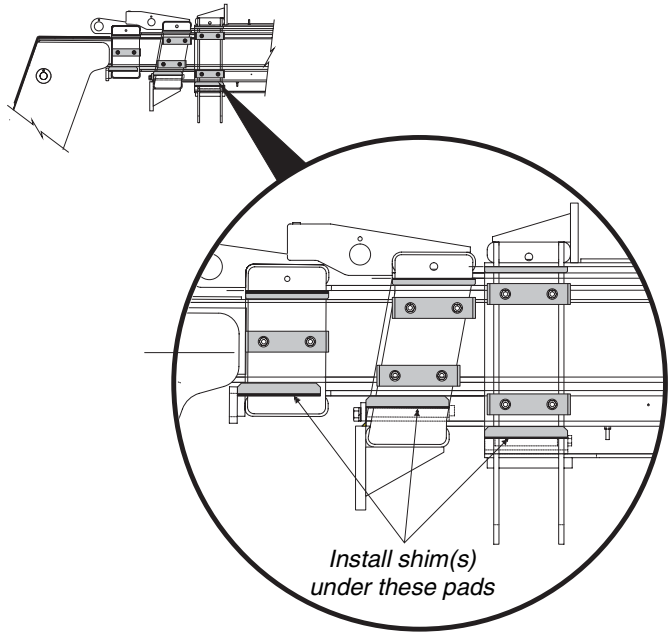


Fig. 6-47: Lower Shim Installation – Front of 4-Section Boom

4. (Ref. Fig. 6-47) Install/remove shim(s) under indicated pads to obtain clearances specified in Step 3.

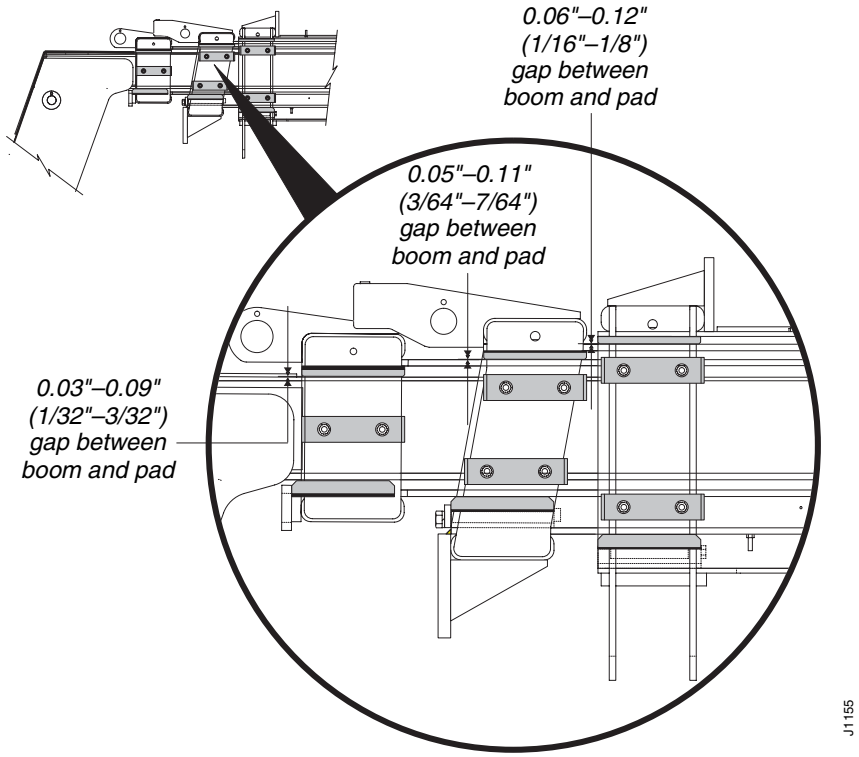


Fig. 6-48: Upper Shim Installation – Front of 4-Section Boom

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5. (Ref. Fig. 6-48) Install/remove shim(s) under indicated pads to obtain specified clearances.

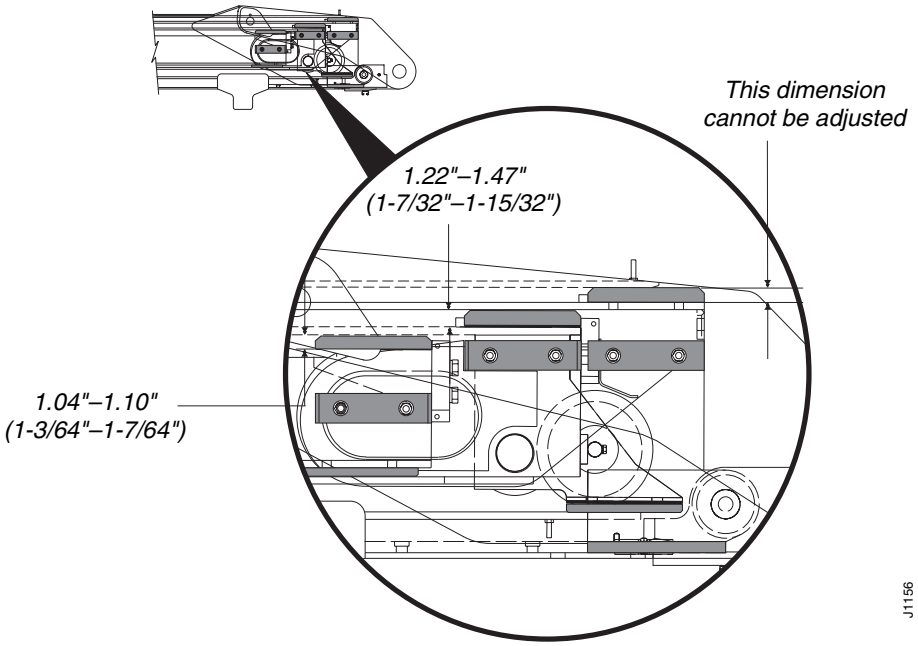


Fig. 6-49: Boom Section Gaps – Rear of 4-Section Boom

6. (Ref. Fig. 6-49) Measure the gaps between the inner, middle (forward), and middle (rear) sections at the upper pads. Spacing between the middle (rear) and outer boom section cannot be adjusted. If the dimensions are not within the specified range, proceed to Step 7. If the dimensions are within the specified range, proceed to Step 8.

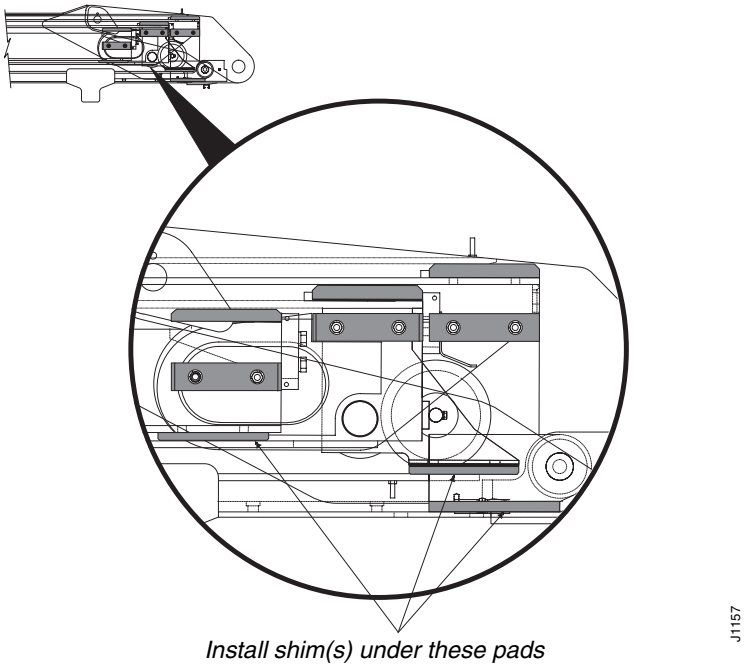


Fig. 6-50: Lower Shim Installation - Rear of 4-Section Boom

7. (Ref. Fig. 6-50)Install/remove shim(s) under indicated pads to obtain clearance specified in Step 6.

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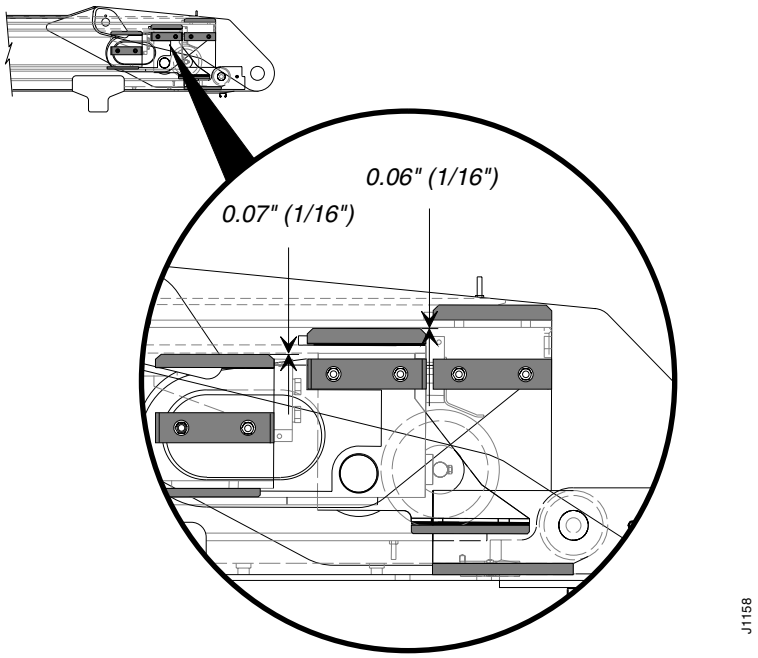
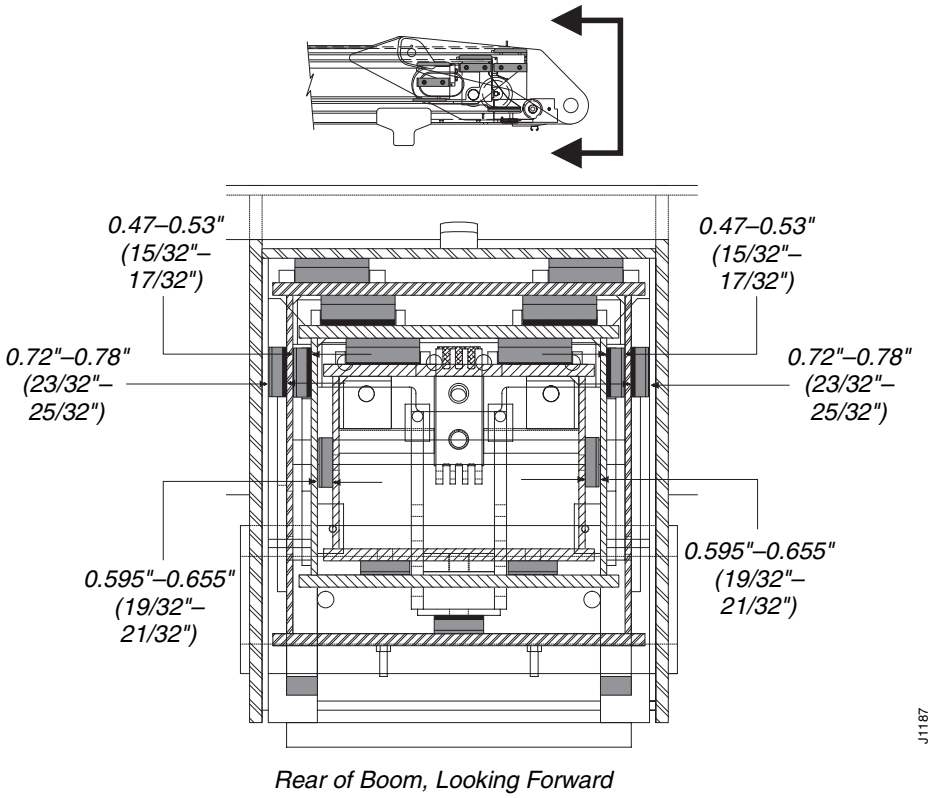


Fig. 6-51: Upper Shim Installation – Rear of 4-Section Boom

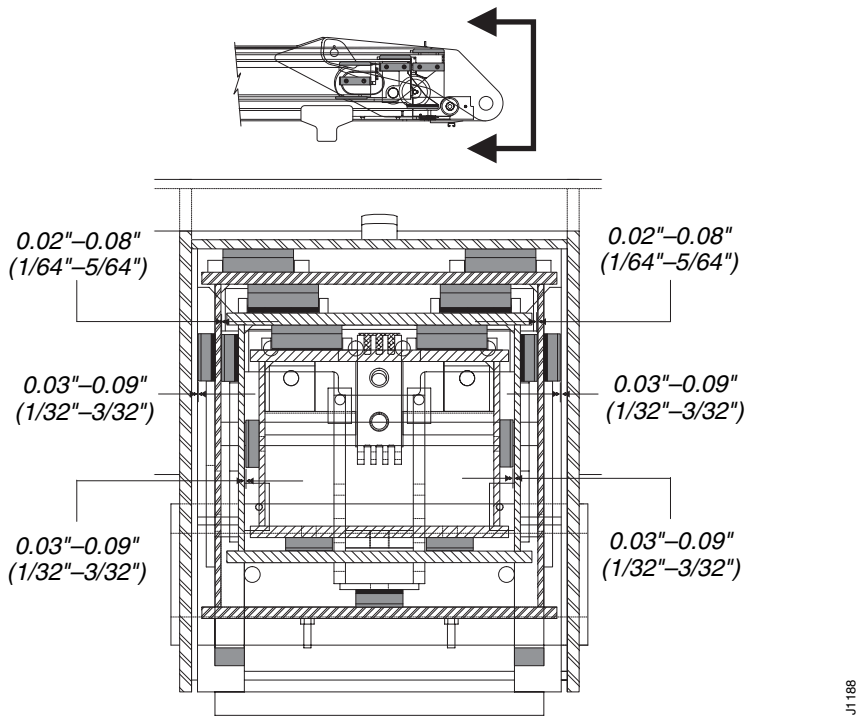
8. (Ref. Fig. 6-51) Install/remove shim(s) under indicated pads to obtain specified clearances.



Rear of Boom, Looking Forward

Fig. 6-52: Clearances Between Boom Sections – Rear of 4-Section Boom

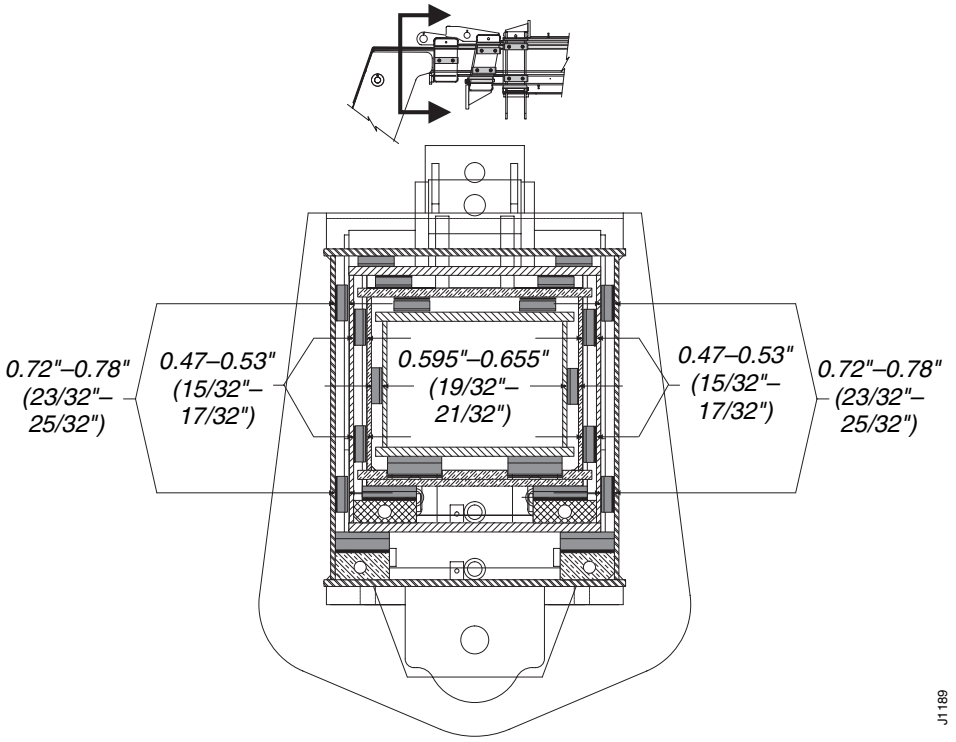
9. (Ref. Fig. 6-52) Adjust boom positions to obtain clearances between boom sections as shown. Measure these clearances at the slide pad locations.



Rear of Boom, Looking Forward

Fig. 6-53: Gaps Between Pads and Boom – Rear of 4-Section Boom

10. (Ref. Fig. 6-53) Install/remove shim(s) under indicated pads to obtain specified clearances making sure clearances on both sides of each boom section are the same.



Front of Boom, Looking Rearward

Fig. 6-54: Clearances Between Boom Sections – Front of 4-Section Boom

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11. (Ref. Fig. 6-54) Adjust boom positions to obtain clearances between boom sections as shown. Measure these clearances at the slide pad locations.

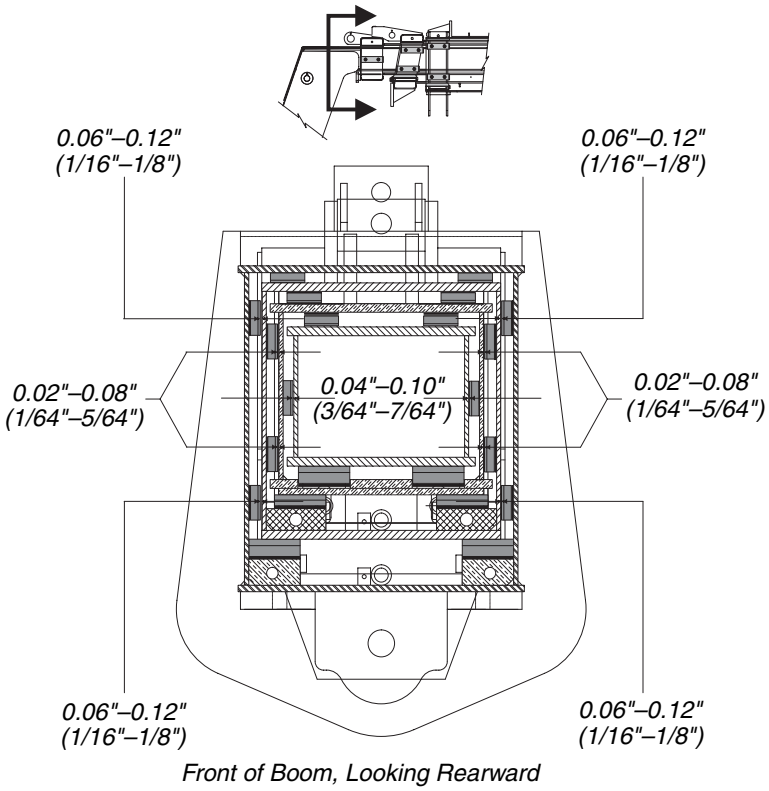


Fig. 6-55: Gaps Between Pads and Boom – Front of 4-Section Boom

12. (Ref. Fig. 6-55) Install/remove shim(s) under indicated pads to obtain specified clearances making sure clearances on both sides of each boom section are the same.
13. Extend boom and lubricate as described under “Lubrication” on page 6-36.
14. Check boom extension and retraction for binding against slide pads.

Inspection Procedures

4-Section Boom

These procedures are intended to determine if localized deformation has occurred on the inner, middle (forward), and middle (rear) boom sections.

1. Extend the boom and lower the forks to the ground.

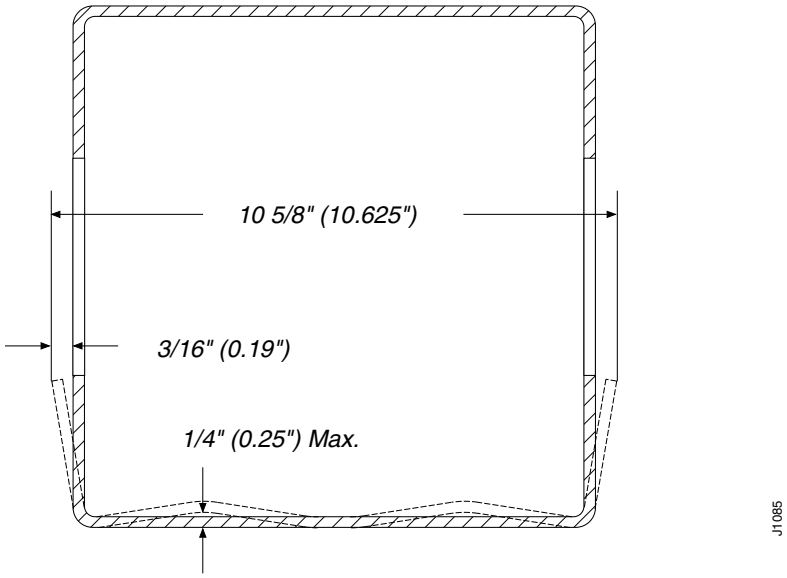


Fig. 6-56: Inner Boom Cross-Section at Window

2. (Ref. Fig. 6-56) Place a straight edge against the bottom surface of the inner boom section. Measure the distance from the straight edge to the bottom surface of the boom tube. This distance should not exceed 1/4" (0.25"). The maximum deflection will be found just in front of the middle (forward) boom section.
3. (Ref. Fig. 6-56) The side walls may also deflect outward at the window areas. Take this measurement across the inner boom tube, through the windows. Maximum allowable deflection is 3/16" (0.19) per side. The maximum allowable inner boom tube width is 10-5/8" (10.625"), measured through the windows.

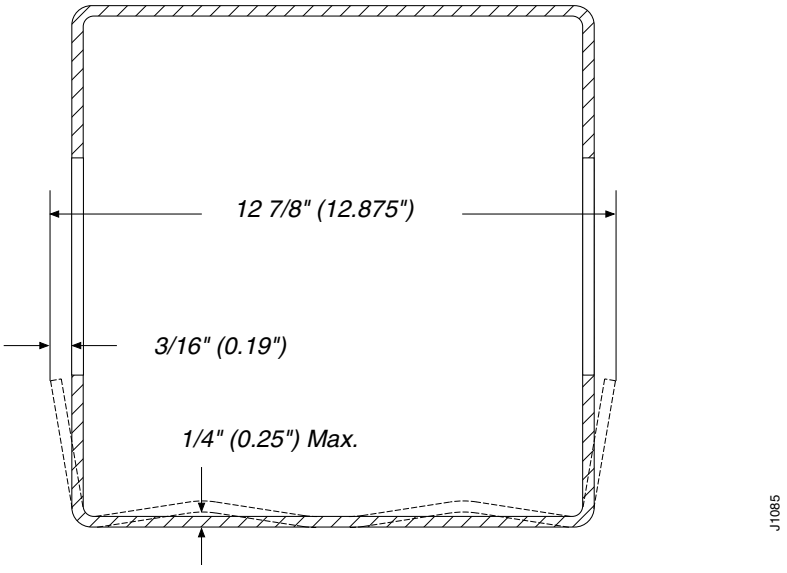


Fig. 6-57: Middle (Forward) Boom Cross-Section at Window

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4. (Ref. Fig. 6-57) Place a straight edge against the bottom surface of the middle (forward) boom section. Measure the distance from the straight edge to the bottom surface of the boom tube. This distance should not exceed 1/4" (0.25"). The maximum deflection will be found just in front of the middle (rear) boom section.
5. (Ref. Fig. 6-57) The side walls may also deflect outward at the window areas. Take this measurement across the middle (forward) boom tube, through the windows. Maximum allowable deflection is 3/16" (0.19") per side. The maximum allowable middle (forward) boom tube width is 12-7/8" (12.875"), measured through the windows.

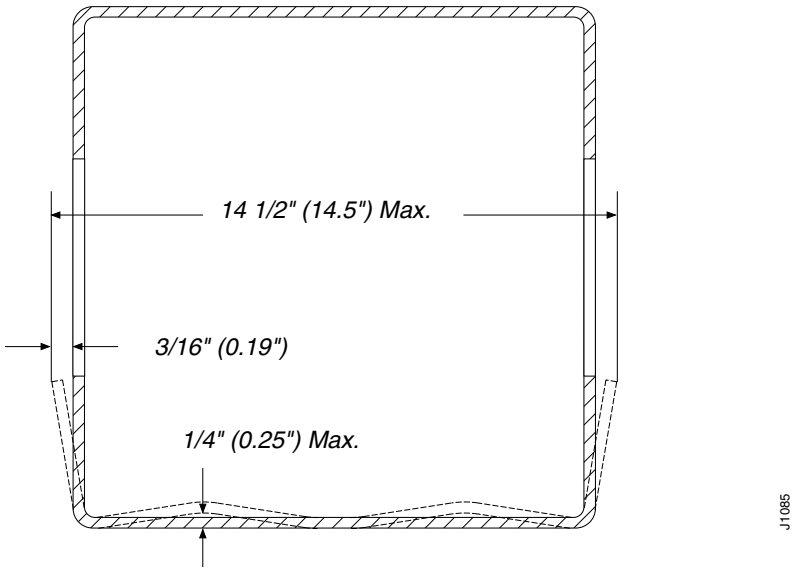


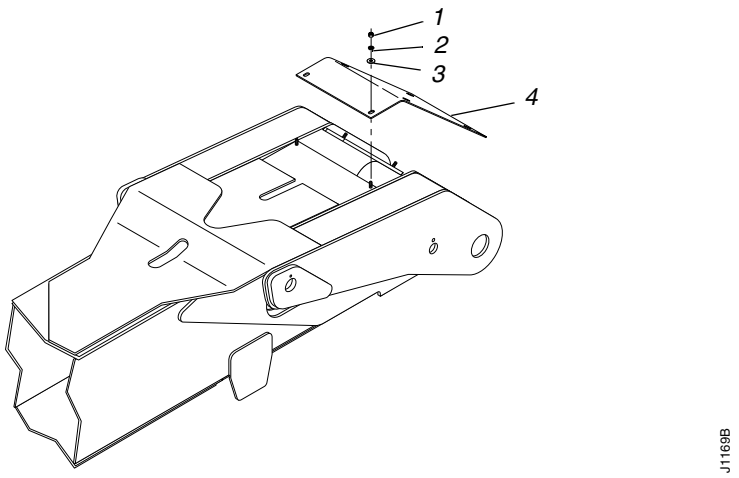
Fig. 6-58: Middle (Forward) Boom Cross-Section at Window

6. (Ref. Fig. 6-58) Place a straight edge against the bottom surface of the middle (rear) boom section. Measure the distance from the straight edge to the bottom surface of the boom tube. This distance should not exceed 1/4" (0.25"). The maximum deflection will be found just in front of the outer boom section.
7. (Ref. Fig. 6-58) The side walls may also deflect outward at the window areas. Take this measurement across the middle (rear) boom tube, through the windows. Maximum allowable deflection is 3/16" (0.19) per side. The maximum allowable middle (forward) boom tube width is 14-1/2" (14.5"), measured through the windows.

Boom Removal

4-Section Boom

1. Remove Quick Attach. See page 6-44.
2. Park machine on firm, level surface. If so equipped, fully retract transfer carriage. Fully retract boom before lowering it to the ground.
3. Set park brake, lock shift selector in NEUTRAL position, shut off engine and remove ignition key from switch. Block all wheels.
4. Position crane next to machine.

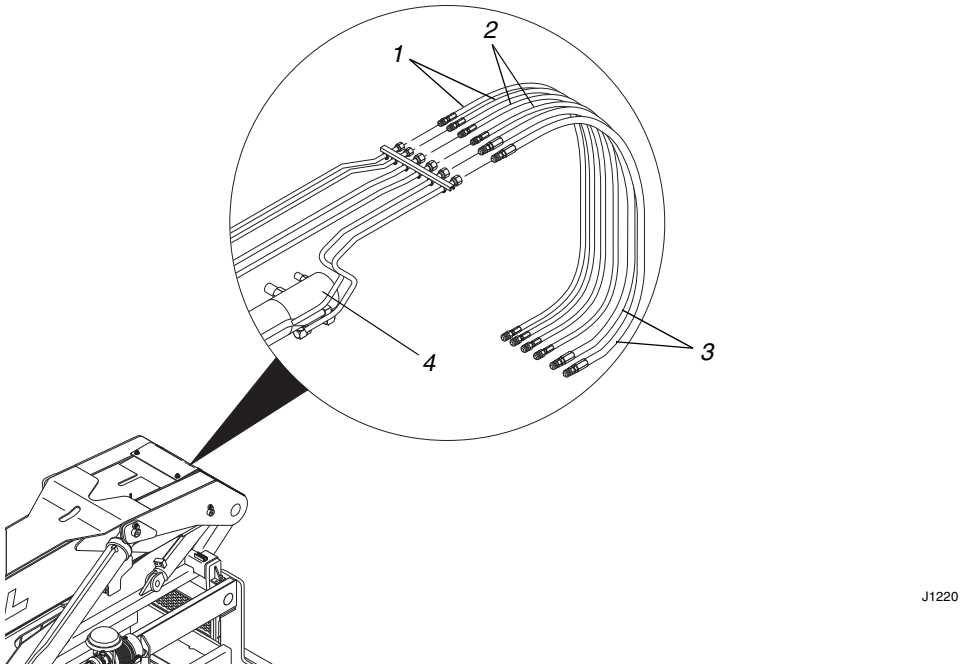


#	Description
1	Nut
2	Lockwasher

#	Description
3	Flatwasher
4	Boom Cover

Fig. 6-59: 4-Section Boom Cover Installation

5. (Ref. Fig. 6-59) Remove six (6) each nuts (Item 1), lockwashers (Item 2), and flatwashers (Item 3) securing boom cover (Item 4) to boom. Remove boom cover.
6. Remove boom elevation proximity switch. See “Boom Elevation Proximity Switch” in Section 7.
7. Remove boom extension proximity switch. See Step 8 on page 6-123.



#	Description
1	Auxiliary Hydraulic Hoses
2	Carriage Tilt Hoses

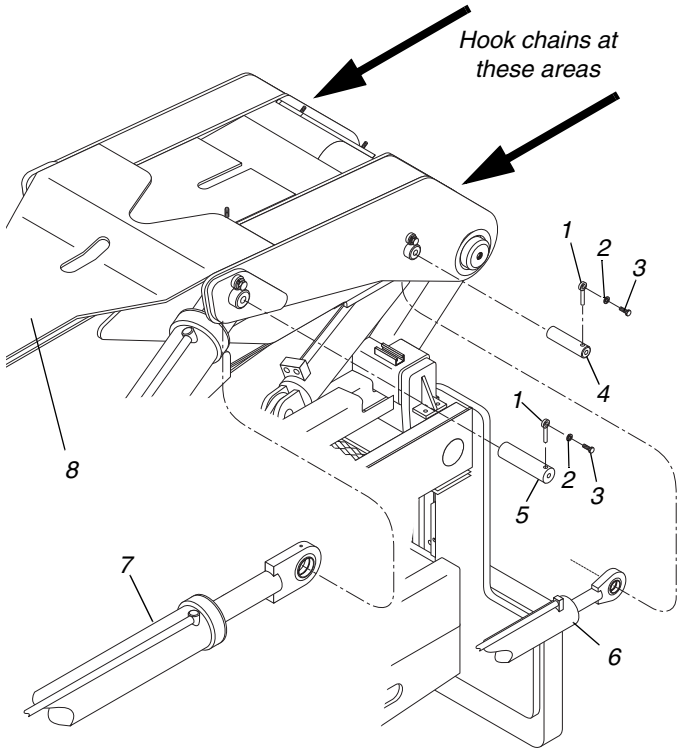
#	Description
3	Boom Extension Hoses
4	Boom Extension Cylinder

Fig. 6-60: Hose Connections, 4-Section Boom

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8. (Ref. Fig. 6-60) Tag and disconnect two (2) hoses at boom extension cylinder lines (Item 3). Cap lines and hoses
9. Tag and disconnect two (2) carriage tilt hoses (Item 2), and two (2) auxiliary hydraulics hoses (Item 1) at the boom. Cap hoses and lines.
10. Place sling around inner boom section, at the front. Chains with hooks may be attached to the rear of the outer boom section, near the pivot pin bosses (Ref. Fig. 6-61). Attach sling and chains to crane hook and lift crane to support weight of boom.

CAUTION: Make sure crane, slings, and chains have sufficient capacity to support the weight of the boom. A 4-section boom assembly, including boom extension cylinder, weighs approximately 6,650 pounds.



#	Description	#	Description
1	Lock Pin	5	Pivot Pin, Boom Hoist Cylinder
2	Lockwasher	6	Rear Carriage Tilt Cylinder
3	Bolt	7	Boom Hoist Cylinder
4	Pivot Pin, Rear Carriage Tilt Cyl.	8	Boom

Fig. 6-61: Cylinder Pivot Pins

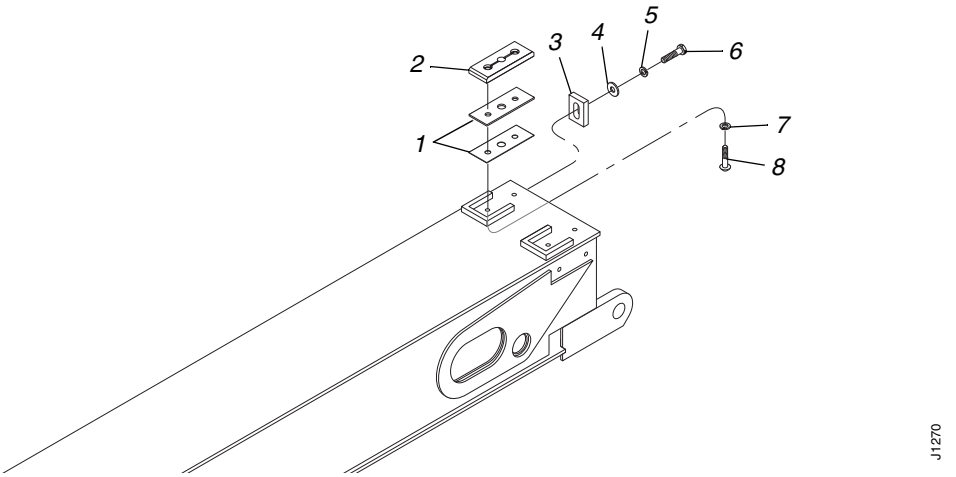
11. (Ref. Fig. 6-61) Remove four (4) capscrews (Item 3) and lockwashers (Item 2) from lock pins (Item 1) securing rear carriage tilt cylinders (Item 6) and boom hoist cylinders (Item 7) to the boom (Item 8). Remove four (4) lock pins from pivot pins (Items 4 and 5).

CAUTION: Make sure each cylinder is fully supported so it does not fall and cause personal or equipment damage when it is being removed.

12. (Ref. Fig. 6-61) Starting at a rear carriage tilt cylinder (Item 6), use a slide hammer puller threaded into the pivot pin (Item 4) to remove the pivot pin from boom. After the pivot pin has been removed, allow the cylinder to swing down and away from the boom.

CAUTION: Use suitable blocking to support cylinders and prevent damage to the surrounding structure.

13. (Ref. Fig. 6-61) Repeat Step 12 for the remaining rear carriage tilt cylinder.
14. (Ref. Fig. 6-61) Continue with each of the two (2) hoist cylinders (Item 7) by using a slide hammer puller threaded into pivot pin (Item 5) to remove it. After the pivot pin has been removed, allow the cylinder to swing down and away from the boom.

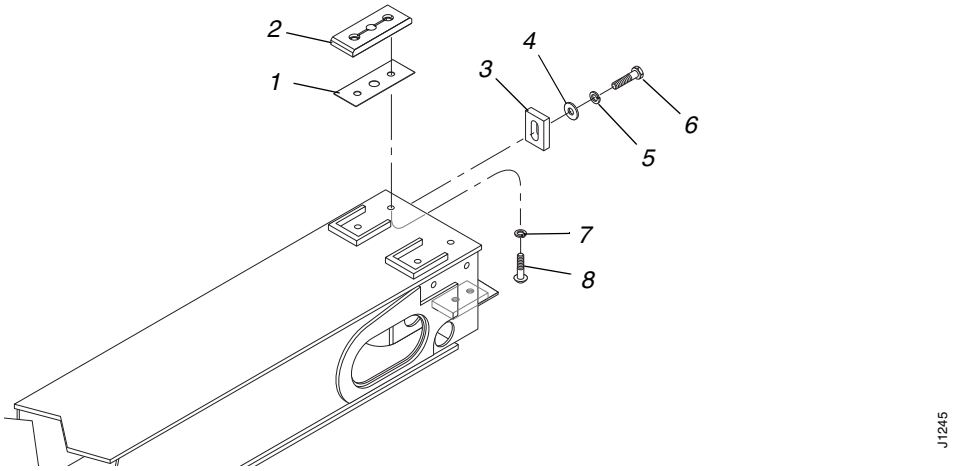


#	Description	#	Description
1	Shim	5	Lockwasher
2	Upper Rear Slide Pad	6	Capscrew
3	Pad Retainer	7	Lockwasher
4	Flatwasher	8	Button-Head Socket Capscrew

Fig. 6-62: Upper Rear Slide Pad Removal – Middle (Rear) Boom Section

15. (Ref. Fig. 6-62) Remove upper rear slide pads from middle (rear) boom section as follows:
    a. Remove two (2) each capscrews (Item 6), lockwashers (Item 5), flatwashers (Item 4), and pad retainers (Item 3) from rear of middle (rear) boom section.
    b. Remove four (4) capscrews (Item 8) and lockwashers (Item 7) securing upper slide pads to rear of middle (rear) boom section. Remove two (2) slide pads (Item 2) and shims (Item 1).

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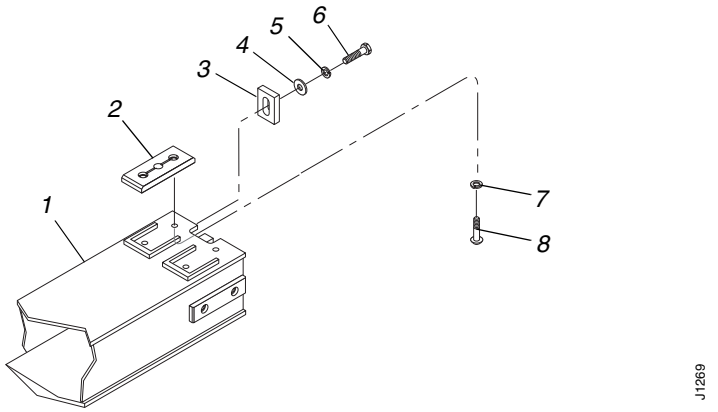
#	Description	#	Description
1	Shim	5	Flatwasher
2	Rear Upper Slide Pad	6	Capscrew
3	Pad Retainer	7	Lockwasher
4	Lockwasher	8	Button-Head Socket Capscrew

Fig. 6-63: Upper Rear Slide Pad Removal – Middle (Forward) Boom Section

16. (Ref. Fig. 6-63) Remove upper rear slide pads from middle (front) boom section as follows:

    a. Remove two (2) each capscrews (Item 6), lockwashers (Item 4), flatwashers (Item 5), and pad retainers (Item 3) securing upper slide pads to rear of middle (forward) boom section.

    b. Remove four (4) capscrews (Item 8) and lockwashers (Item 7) securing slide pads (Item 2) to top rear of middle (forward) boom section. Remove slide pads and shims (Item 1).



#	Description	#	Description
1	Inner Boom Section	5	Lockwasher
2	Upper Slide Pad	6	Capscrew
3	Pad Retainer	7	Lockwasher
4	Flatwasher	8	Button-Head Socket Capscrew

Fig. 6-64: Upper Rear Slide Pad Removal – Inner Boom Section

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17. (Ref. Fig. 6-64) Remove upper rear slide pads from inner boom section as follows:

    a. Remove two (2) each capscrews (Item 6), lockwashers (Item 5), flatwashers (Item 4), and pad retainers (Item 3) from rear of inner boom section.

    b. Remove four (4) capscrews (Item 8) and lockwashers (Item 7) securing upper slide pads (Item 2) to rear of inner boom section. Remove the two (2) slide pads.

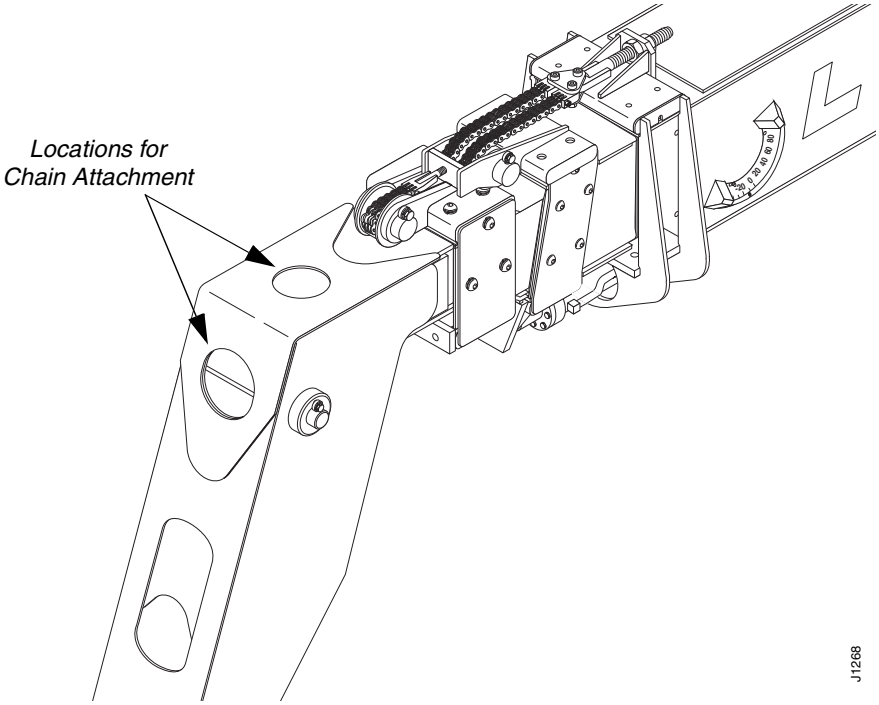
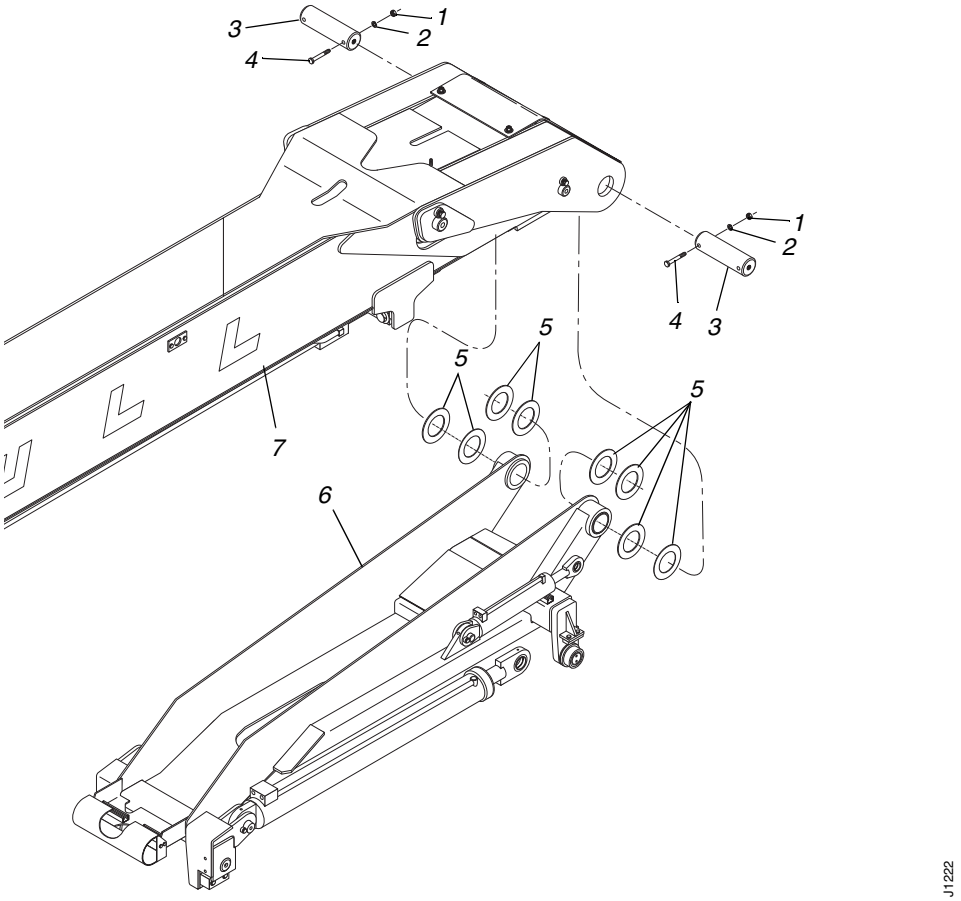


Fig. 6-65: Locations for Chain Attachment – Inner Boom Section

18. (Ref. Fig. 6-65) Because the chain and hose guide assembly interferes with removal of the boom pivot pins, it will be necessary to extend the boom approximately eight (8) inches. To do so, attach a chain to one of the openings either on the front or top of the inner boom section and pull the sections straight out.

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#	Description
1	Nut
2	Lockwasher
3	Boom Pivot Pin
4	Bolt

#	Description
5	Shims
6	Transfer Carriage/Boom Cradle
7	Boom Assembly

Fig. 6-66: 4-Section Boom Pivot Pins

19. (Ref. Fig. 6-66) Remove two (2) each nuts (Item 1), lockwashers (Item 2), and capscrews (Item 4) from boom pivot pins (Item 3).

CAUTION: Make sure slings and chains are secure and crane is supporting the weight of the boom.

20. (Ref. Fig. 6-66) Using the slide hammer puller, remove the two (2) boom pivot pins and shims (Item 5).
21. (Ref. Fig. 6-66) Carefully lift the boom assembly (Item 7) clear of the transfer carriage/boom cradle (Item 6).
22. Swing the boom away from the machine and position it above a firm, level surface. Rotate the boom upside down and lower it onto support blocks.
23. Remove the front carriage tilt cylinder. See page 6-19.

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installation

4-Section Boom

1. Prepare replacement boom for installation by removing strapping and blocks used for shipment. Note location of straps and blocks for use on the previously removed boom.
2. With the replacement boom still lying upside down, the front carriage tilt cylinder should be installed at this point. It is easier to install when the boom is in this position. See page 6-20
3. Attach slings/chains to the boom and crane. Lift the boom and rotate it to the upright position.
4. Position the boom over the transfer carriage/boom cradle. Carefully lower boom and align boom pivot boss with the matching bosses in the transfer carriage/boom cradle.
5. (Ref. Fig. 6-66) Partially insert two (2) boom pivot pins to temporarily secure the boom pivot. Check gaps between boom pivot boss and the matching bosses in the transfer carriage/boom cradle. Select appropriate shim sizes to center the boom in the transfer carriage/boom cradle.
6. (Ref. Fig. 6-66) Slide the boom pivot pins out one at a time and insert the required shims. Fully insert the boom pivot pins.
7. (Ref. Fig. 6-61) Align rod-end of a boom hoist cylinder with the matching boss on the boom. Insert pivot pin and secure with lock pin, lockwasher, and capscrew. Repeat this procedure for the other hoist cylinder and rear carriage tilt cylinders.
8. The slings/chains and crane may be removed at this point.
9. (Ref. Fig. 6-61) Connect the two (2) auxiliary hydraulic hoses and two (2) carriage tilt hoses to the rear of the boom.
10. Connect the two (2) hoses to the boom extension cylinder lines.
11. Lubricate all pivot grease fittings with EP lithium based grease.
12. Install boom extension proximity switch. See Step 9 on page 6-128.
13. Install boom elevation proximity switch in transfer carriage/boom cradle. See “Boom Elevation Proximity Switch” in Section 7.
14. Install quick attach assembly to boom. See page 6-45.
15. (Ref. Fig. 6-66) Start engine and extend the boom approximately eight inches. Shut engine off. Secure pivot pins with two (2) capscrews, lockwashers, and nuts. Torque nuts to 110 ft-lbs.
16. Start engine and cycle the frame tilt fully several times.
    a. Raise the boom, noting that **Rear Osc Lock** light illuminates when boom is at about 40° elevation. If light does not illuminate, stop and lower the boom. Follow procedures for under “Boom Elevation Proximity Switch” in Section 7.
    b. Complete proximity switch adjustment before proceeding to Step 17.
17. Cycle all boom hydraulics several times to remove air from system.

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a. With the outriggers up, extend the boom, noting that **Boom Extension** proximity light illuminates when the boom is extended to specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage). If light does not illuminate, stop and retract the boom. See page 6-119 for adjustment procedures.

b. Retract and lower boom to ground and shut off engine.

c. Complete proximity switch adjustment before proceeding to Step 18.

18. Inspect hydraulic connections for leaks and tighten as necessary.

19. (Ref. Fig. 6-59) Install boom cover (Item 4) with six (6) each flatwashers (Item 3), lockwashers (Item 2), and nuts (Item 1). Tighten nuts to 180 in-lbs.

Boom Disassembly

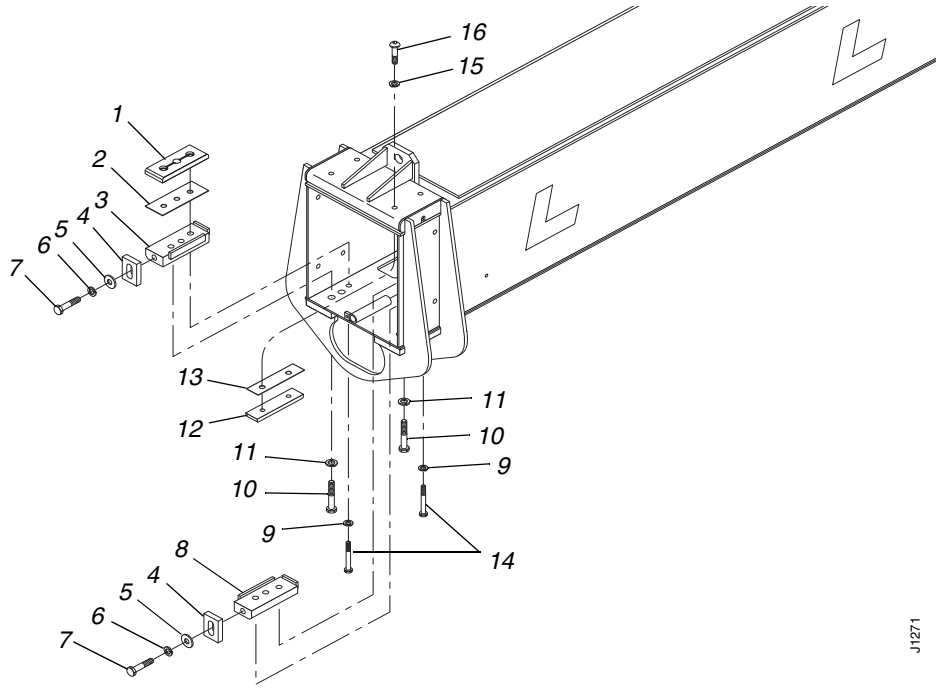
4-Section Boom

1. Remove boom assembly from machine.
2. Place boom assembly on work stands in upside down position.



CAUTION: To avoid personal and equipment damage, make sure that the boom is properly supported through this entire procedure.

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#	Description
1	Lower Slide Pad
2	Shim
3	Right Hand Retainer Block
4	Pad Retainer
5	Flatwasher
6	Lockwasher
7	Capscrew
8	Left Hand Retainer Block

#	Description
9	Lockwasher
10	Capscrew
11	Lockwasher
12	Upper Slide Pad
13	Shim
14	Capscrew
15	Lockwasher
16	Button-Head Socket Capscrew

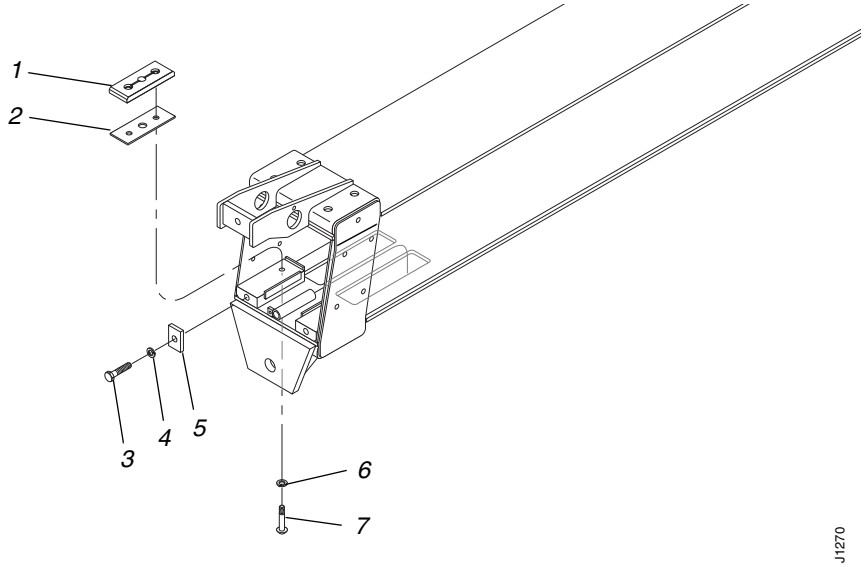
Fig. 6-67: Slide Pad Removal – Outer Boom Section

3. (Ref. Fig. 6-67) Remove the lower slide pads from outer boom section as follows:

   a. Remove two (2) each capscrews (Item 7), lockwashers (Item 6), flatwashers (Item 5), and pad retainers (Item 4) from retainer blocks (Items 3 and 8).

   b. Remove four (4) capscrews (Items 10 and 14) and lockwashers (Items 9 and 11) securing retainer blocks to outer boom section. Remove two (2) each lower slide pads (Item 1), shims (Item 2) and retainer blocks.

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#	Description
1	Lower Front Slide Pad
2	Shim
3	Capscrew
4	Lockwasher

#	Description
5	Pad Retainer
6	Lockwasher
7	Button-Head Socket Capscrew

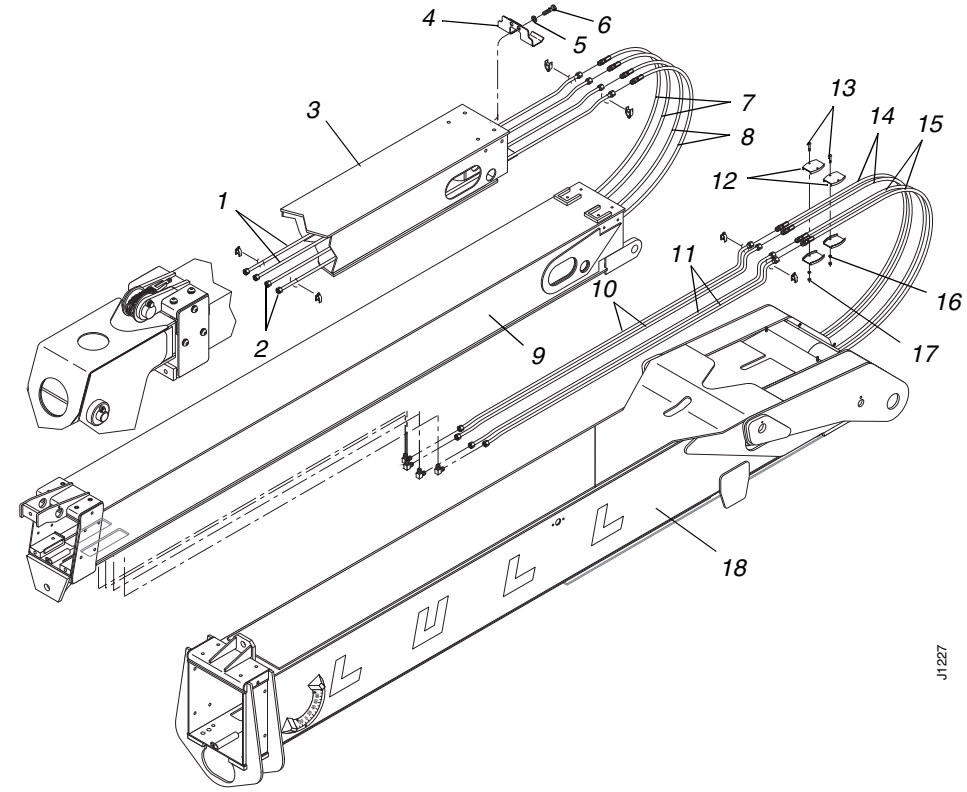
Fig. 6-68: Lower Front Slide Pad Removal – Middle (Rear) Boom Section

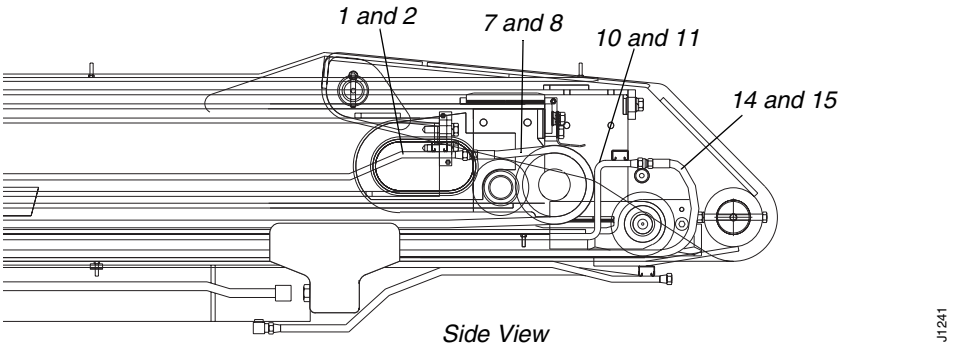
4. (Ref. Fig. 6-68) Remove lower front slide pads from middle (rear) boom section as follows:

   a. Remove two (2) each capscrews (Item 3), lockwashers (Item 4), and pad retainers (Item 5) from rear of middle (rear) boom section.

   b. Remove four (4) capscrews (Item 7) and lockwashers (Item 6) securing upper slide pads to rear of middle (rear) boom section. Remove two (2) slide pads (Item 1) and shims (Item 2).

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Side View

#	Description
1	Auxiliary Hydraulic Tube
2	Carriage Tilt Hydraulic Tube
3	Middle (Front) Boom Section
4	Hose Guard
5	Lockwasher
6	Capscrew
7	Auxiliary Tilt Hydraulic Hose
8	Carriage Tilt Hydraulic Hose
9	Middle (Rear) Boom Section

#	Description
10	Auxiliary Hydraulic Tube
11	Carriage Tilt Hydraulic Tube
12	Half Clamp
13	Round Head Screw
14	Auxiliary Hydraulic Hose
15	Carriage Tilt Hydraulic Hose
16	Lockwasher
17	Nut
18	Outer Boom Section

Fig. 6-69: Disconnecting Hoses Between Sections

5. (Ref. Fig. 6-69) Disconnect hoses between sections as follows:

   a. Remove two (2) capscrews (Item 6), lockwashers (Item 5), and the hose guard (Item 4) from the rear of the middle (front) boom section (Item 3).

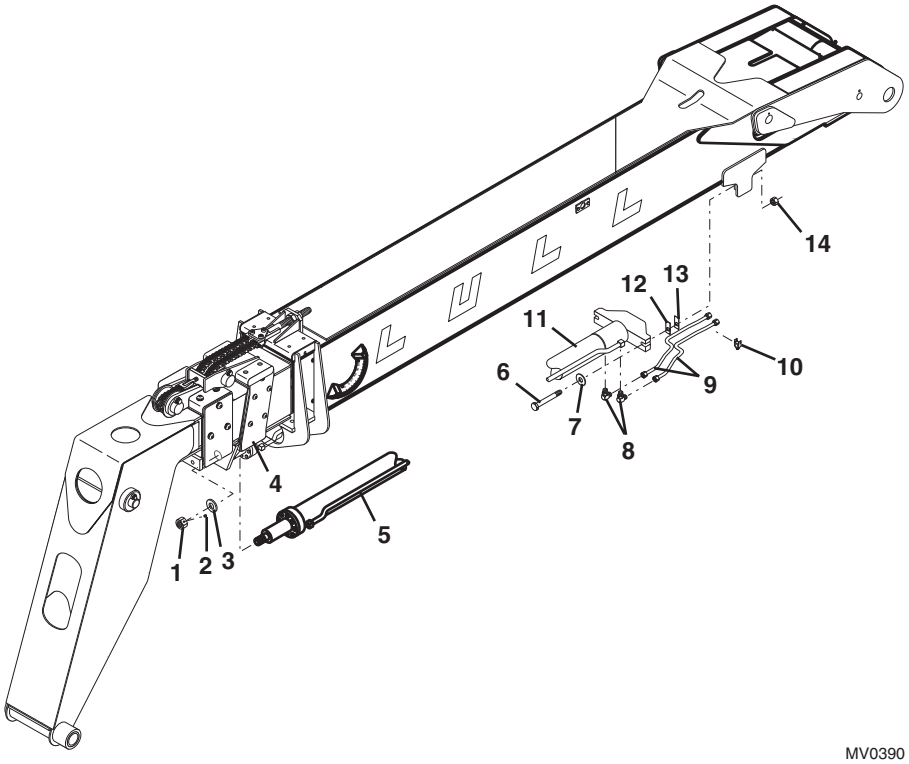
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CAUTION: Be sure to note orientation of the hose guard during removal. Your hose guard may be different from that shown above. If the hose guard is reversed at assembly, equipment damage may occur during operation of machine.

b. Loosen and remove hydraulic hoses (two (2) each auxiliary and carriage tilt) (Items 7 and 8) from hydraulic tubes (Items 1 and 2) at rear of middle (front) boom section. Bleed any remaining oil into a suitable container. Tag and cap hoses and tubes.

c. Loosen and remove hydraulic hoses (two (2) each auxiliary and carriage tilt) (Items 14 and 15) from hydraulic tubes (Items 10 and 11) at rear of outer boom section (Item 18). Bleed any remaining oil into a suitable container. Tag and cap hoses and tubes.

d. For early production models, remove four (4) each nuts (Item 17), lockwashers (Item 16), round head screws (Item 13), and half clamps (Item 12).



#	Description
1	Rod Nut
2	Socket Setscrew
3	Extension Cylinder Rod Boss
4	Middle (Rear) Boom Section
5	Boom Extension Cylinder
6	Capscrew
7	Flatwasher
8	Elbow
9	Hydraulic Tube

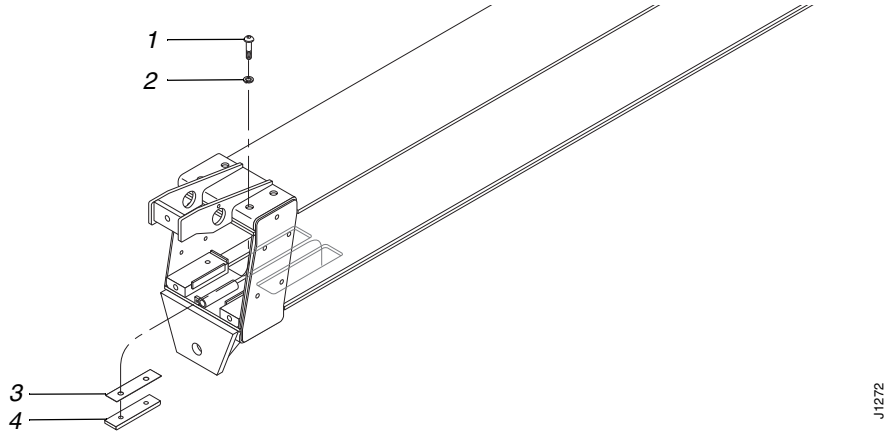
#	Description
10	Cushion Clamp
11	Extension Cylinder Base Mount
12	Shim
13	Shim
14	Nut
15	Capscrew
16	Lockwasher
17	Flatwasher
18	Extension Cylinder Base Mount

Fig. 6-70: Extension Cylinder Removal – 4-Section Boom

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6. (Ref. Fig. 6-70) Remove extension cylinder as follows:
   a. Support the extension cylinder with sling(s) or other suitable means. Make sure support items have sufficient capacity to support the weight of the cylinder. The extension cylinder weighs 650 pounds.
   b. Loosen and remove two (2) hydraulic tubes (Item 9) from elbows (Item 8) on boom extension cylinder (Item 5). Bleed any remaining oil into a suitable container. Tag and cap fittings and tubes.
   c. Loosen nut on two (2) cushion clamps (Item 10) and remove clamps and hydraulic tubes from mounting channel on outer boom section.
   d. Loosen two (2) socket setscrews (Item 2) in rod nut (Item 1).
   e. Loosen and remove rod nut and rod boss (Item 3) securing boom extension cylinder to front of middle (rear) boom section (Item 4).
   f. Loosen and remove hardware securing extension cylinder to outer boom section as follows:

      Remove two (2) each nuts (Item 14), capscrews (Item 6), and flatwashers (Item 7) securing extension cylinder base mount (Item 11) to outer boom section. Remove the shim(s) (Items 12 and 13).
   g. Remove the extension cylinder.
7. Turn boom assembly over and place it on work stands in upright position.
8. (Ref. Fig. 6-67) Remove upper slide pads on outer boom as follows:
   a. Remove four (4) capscrews (Item 16) and lockwashers (Item 15) securing top slide pads (Item 12) to outer boom.
   b. Remove the two (2) slide pads and shims (Item 13).

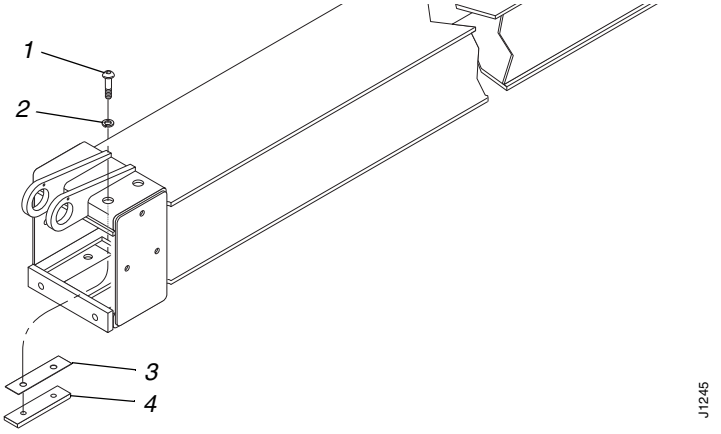


#	Description	#	Description
1	Button-Head Socket Capscrew	3	Shim
2	Lockwasher	4	Upper Front Slide Pad

Fig. 6-71: Upper Front Slide Pad Removal – Middle (Rear) Boom Section

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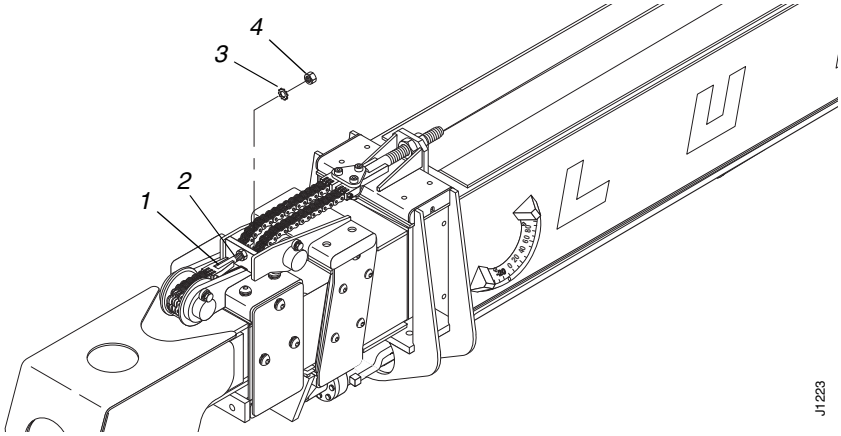
9. (Ref. Fig. 6-71) Remove upper front slide pads from middle (rear) boom section as follows:
   a. Remove two (2) each capscrews (Item 1), lockwashers (Item 2), from front of middle (rear) boom section.
   b. Remove two (2) slide pads (Item 4) and shims (Item 3).



#	Description	#	Description
1	Button-Head Socket Capscrew	3	Shim
2	Lockwasher	4	Front Upper Slide Pad

Fig. 6-72: Upper Front Slide Pad Removal – Middle (Forward) Boom Section

10. (Ref. Fig. 6-72) Remove upper front slide pads from middle (front) boom section as follows:
    a. Remove two (2) capscrews (Item 1) and lockwashers (Item 2) securing each of the two (2) upper slide pads to the front of the middle (forward) boom section.
    b. Remove two (2) slide pads (Item 4) and shims (Item 3).

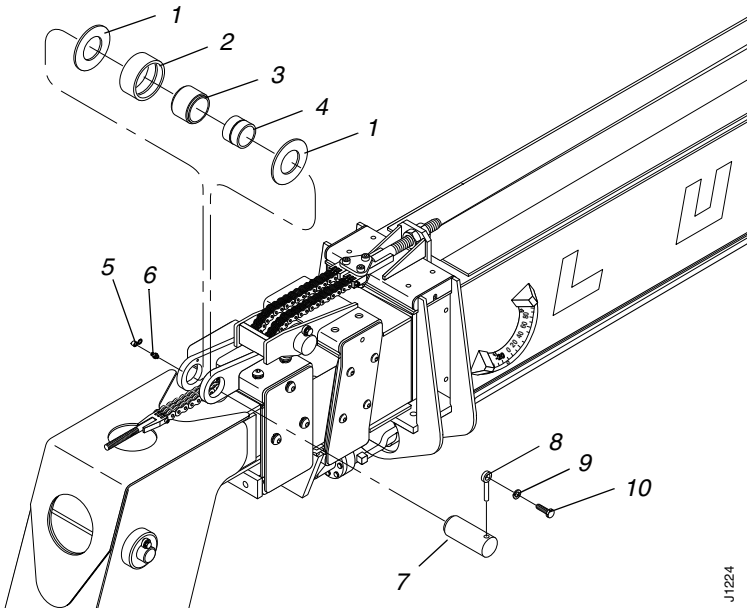


#	Description	#	Description
1	Chain Adjustment Anchor	3	Lockwasher
2	Jam Nut	4	Nut

Fig. 6-73: Upper Chain – Middle (Forward) to Middle (Rear) Boom Sections

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11. (Ref. Fig. 6-73) Remove jam nut (Item 2) and lockwasher (Item 3) securing upper chain adjustment anchor (Item 1) to middle (rear) boom section.
12. Remove chain adjustment anchor from bracket at top of middle (rear) boom section and lay chain over top of inner boom section.

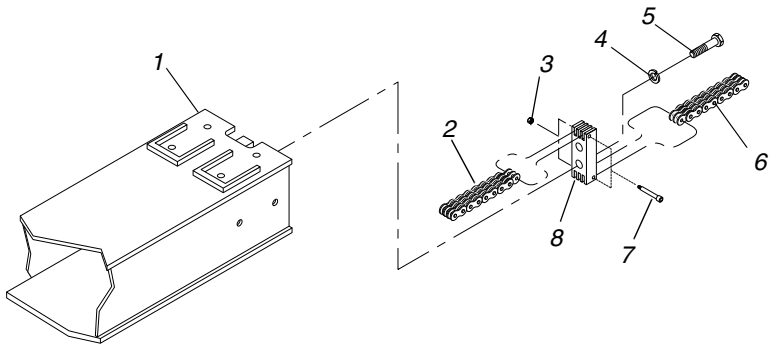


#	Description	#	Description
1	Chain Guide Washer	6	Grease Fitting
2	Bushing	7	Chain Roller Pin
3	Chain Roller	8	Lock Pin
4	Chain Roller Bushing	9	Lockwasher
5	Grease Fitting Cover	10	Capscrew

Fig. 6-74: Upper Chain Roller Assembly – Middle (Forward) Boom Section

13. (Ref. Fig. 6-74) Remove capscrew (Item 10), lockwasher (Item 9), and lock pin (Item 8) from chain roller pin (Item 7).
14. (Ref. Fig. 6-74) Remove chain roller pin, two (2) guide washers (Item 1), bushing (Item 2), chain roller (Item 3), and chain roller bushing (Item 4).

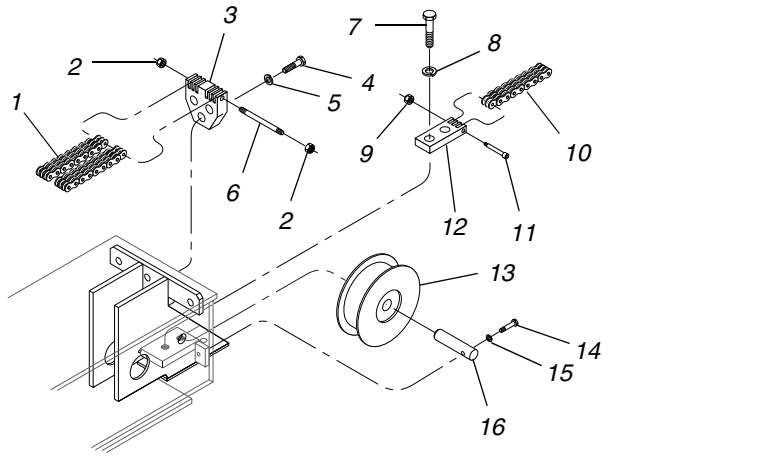
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#	Description	#	Description
1	Inner Boom	5	Capscrew
2	Upper Chain	6	Lower Chain
3	Lock Nut	7	Shoulder Bolt
4	Lockwasher	8	Rear Chain Anchor

Fig. 6-75: Disconnecting Chains at Rear of Inner Boom

15. (Ref. Fig. 6-75) Disconnect chains from rear of inner boom as follows:
    a. Remove two (2) lock nuts (Item 3) and shoulder bolts (Item 7) securing chains (Items 2 and 6) to rear chain anchor (Item 8).
    b. Remove two (2) capscrews (Item 5), lockwashers (Item 4), and rear chain anchor from rear of inner boom (Item 1).



#	Description	#	Description
1	Upper Chain	9	Lockwasher
2	Lock Nut	10	Lower Chain
3	Upper Chain Anchor	11	Shoulder Bolt
4	Capscrew	12	Lower Chain Anchor
5	Lockwasher	13	Hose Reel
6	Chain Anchor Rod	14	Capscrew
7	Lock Nut	15	Lockwasher
8	Capscrew	16	Hose Reel Pin

Fig. 6-76: Disconnecting Chains at Rear of Middle (Forward) Boom

16. (Ref. Fig. 6-76) Disconnect chains from rear of middle (forward) boom as follows:

a. Remove two (2) lock nuts (Item 2), chain anchor rod (Item 6), and upper chain (Item 1).

b. Remove capscrew (Item 4), lockwasher (Item 5), and upper chain anchor (Item 3).

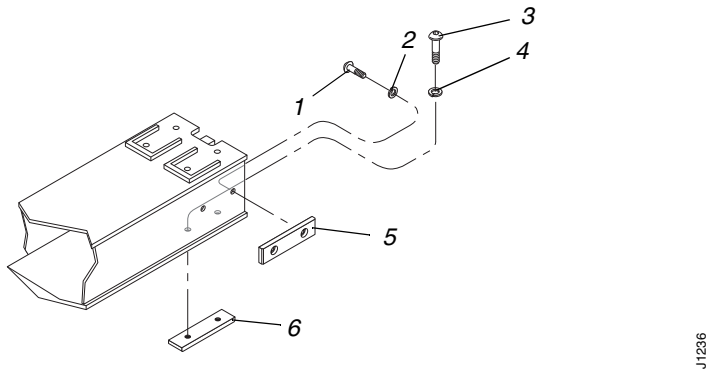
c. Remove capscrew (Item 14), lockwasher (Item 15), and hose reel pin (Item 16) securing each of the two (2) hose reels (Item 13) to the rear of the middle (forward) boom section. Remove hose reels.

d. Remove two (2) each capscrews (Item 7) and lockwashers (Item 8) securing lower chain anchor (Item 12) to middle (forward) boom section.

e. Remove lock nut (Item 9), shoulder bolt (Item 11), and lower chain anchor from lower chain (Item 10).

17. (Ref. Fig. 6-75) Pull upper chain (Item 2) out through front of boom.

18. Slide inner and middle (forward) boom sections out of middle (rear) boom section. Place middle (forward) section (with inner) on work stands upside down.

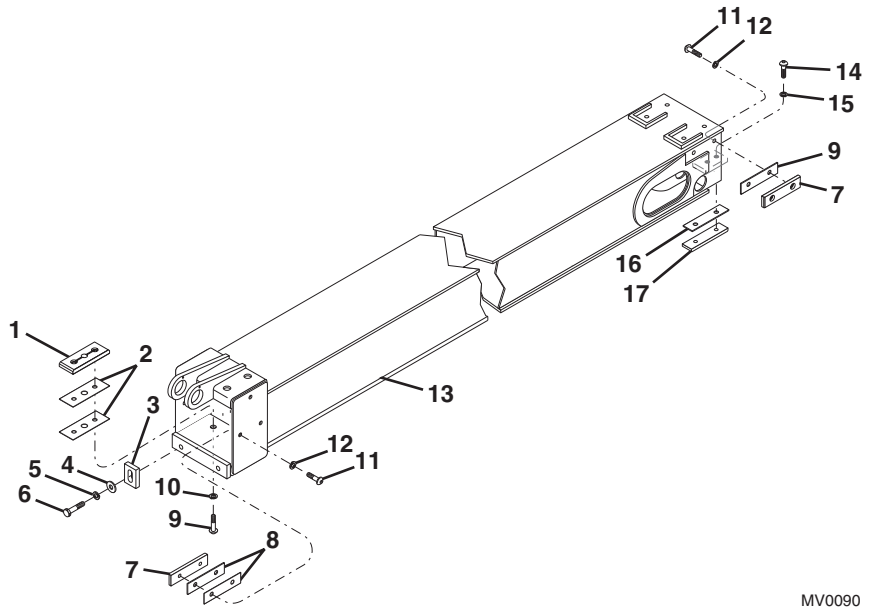


#	Description	#	Description
1	Button-Head Socket Capscrew	4	Lockwasher
2	Lockwasher	5	Side Slide Pad
3	Button-Head Socket Capscrew	6	Bottom Slide Pad

Fig. 6-77: Slide Pad Removal – Inner Boom Section

19. (Ref. Fig. 6-77) Remove eight (8) capscrews (Items 1 and 3) and lockwashers (Items 2 and 4) securing two (2) side and two (2) bottom slide pads (Items 5 and 6) to rear of inner boom section. Remove slide pads.

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#	Description
1	Front Bottom Slide Pad
2	Shim
3	Pad Retainer
4	Flatwasher
5	Lockwasher
6	Capscrew
7	Side Slide Pad
8	Shim
9	Button-Head Socket Capscrew
10	Lockwasher

#	Description
11	Button-Head Socket Capscrew
12	Lockwasher
13	Middle (Forward) Boom Assy
14	Button-Head Socket Capscrew
15	Lockwasher
16	Shim
17	Rear Bottom Slide Pad
18	Pad Retainer

Fig. 6-78: Slide Pad Removal – Middle (Forward) Boom Section

20. (Ref. Fig. 6-78) Remove remaining slide pads from middle (forward) boom section as follows:

    a. Remove four (4) capscrews (Item 11) and lockwashers (Item 12) securing two (2) side slide pads (Item 7) to front of middle (forward) boom section (Item 13). Remove slide pads and shims (Item 8). Repeat this step for the rear side slide pads.

    b. (Ref. Fig. 6-78) Remove two (2) each capscrews (Item 6), lockwashers (Item 5), flatwashers (Item 4), and pad retainers (Item 3) from front of middle (forward) boom section.

c. (Ref. Fig. 6-78) Remove lower slide pads from front of middle (forward) boom section as follows:

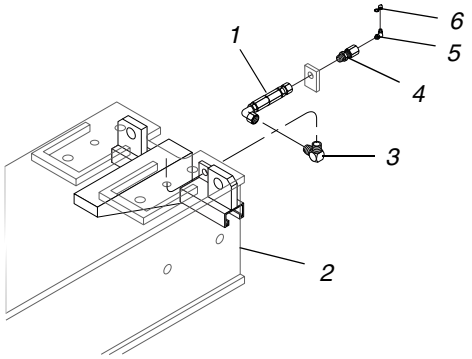
1). Remove two (2) socket capscrews (Item 9) and lockwashers (Item 10) securing lower slide pads (Item 1) to front of boom section.

2). Remove slide pads and shims (Item 2).

21. (Ref. Fig. 6-78) Remove two (2) capscrews (Item 14) and lockwashers (Item 15) securing bottom slide pad (Item 17) to rear of middle (forward) boom section. Remove slide pad and shim(s) (Item 16).

22. Slide inner boom section out of middle (forward) boom section. Place inner boom on work stands in upright position.

23. Remove auxiliary hydraulic quick disconnects from inner boom.



#	Description	#	Description
1	Grease Hose	4	Bulkhead Adapter
2	Inner Boom Section	5	Grease Fitting
3	Elbow	6	Grease Fitting Cover

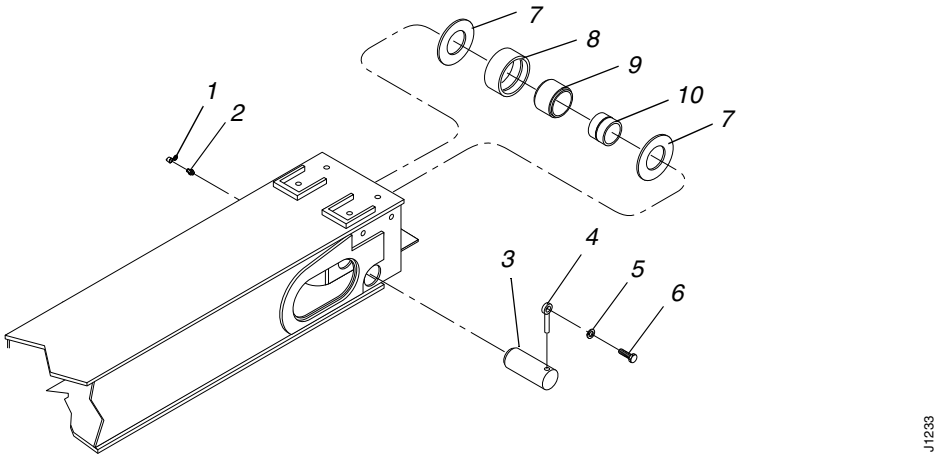
Fig. 6-79: Grease Hose Assembly

24. (Ref. Fig. 6-79) Remove bulkhead adapter (Item 4) from rear of inner boom section (Item 2).

25. (Ref. Fig. 6-79) Loosen and remove grease hose (Item 1) and elbow (Item 3) from inside of inner boom section.

26. Flip middle (forward) boom section to upright position.

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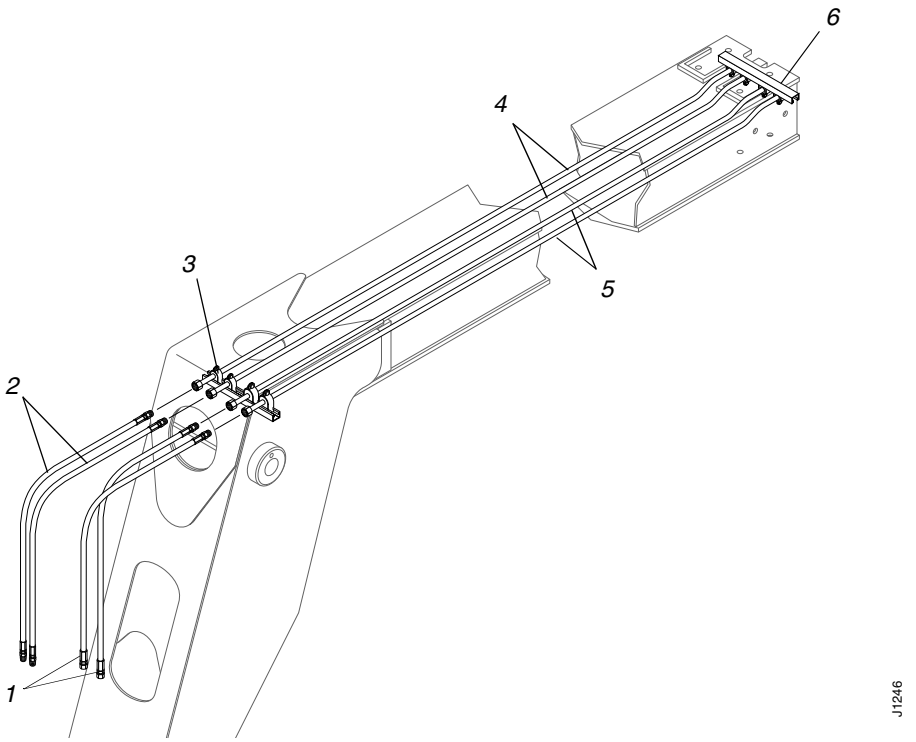
#	Description
1	Grease Fitting Cover
2	Grease Fitting
3	Chain Roller Pin
4	Lock Pin
5	Lockwasher

#	Description
6	Capscrew
7	Chain Guide Washer
8	Bushing
9	Chain Roller
10	Chain Roller Bushing

Fig. 6-80: Rear Chain Roller Removal - Middle (Forward) Boom Section

27. (Ref. Fig. 6-80) Remove rear chain roller assembly as follows:
    a. Remove capscrew (Item 6), lockwasher, (Item 5) and lock pin (Item 4) from chain roller pin (Item 3).
    b. Remove chain roller pin, two (2) chain guide washers (Item 7), bushing (Item 8), chain roller (Item 9), and chain roller bushing (Item 10).
28. Turn over inner boom section and place on work stands in upside down position.
29. Remove front carriage tilt cylinder from inner boom (See page 6-19, Steps 2–6).

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#	Description
1	Auxiliary Hydraulic Hoses
2	Carriage Tilt Hydraulic Hoses
3	Cushion Clamp

#	Description
4	Auxiliary Hydraulic Tubes
5	Carriage Tilt Hydraulic Tubes
6	Mounting Channel

Fig. 6-81: Hose and Tube Removal – Inner Boom Section

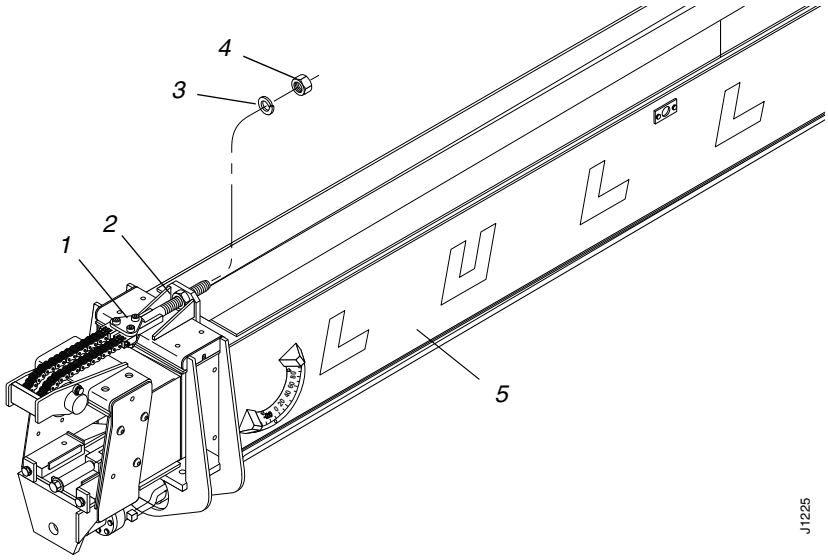
30. (Ref. Fig. 6-81) Remove tubes and hoses from inner boom section as follows:

    a. Remove lock nuts from cushion clamps (Item 3) securing auxiliary and carriage tilt hydraulic tubes (Items 4 and 5) in mounting channels (Item 6).

    b. Slide cushion clamps from mounting channel and remove hydraulic tubes from inner boom section.

    c. Remove hydraulic hoses (Items 1 and 2) from tubes.

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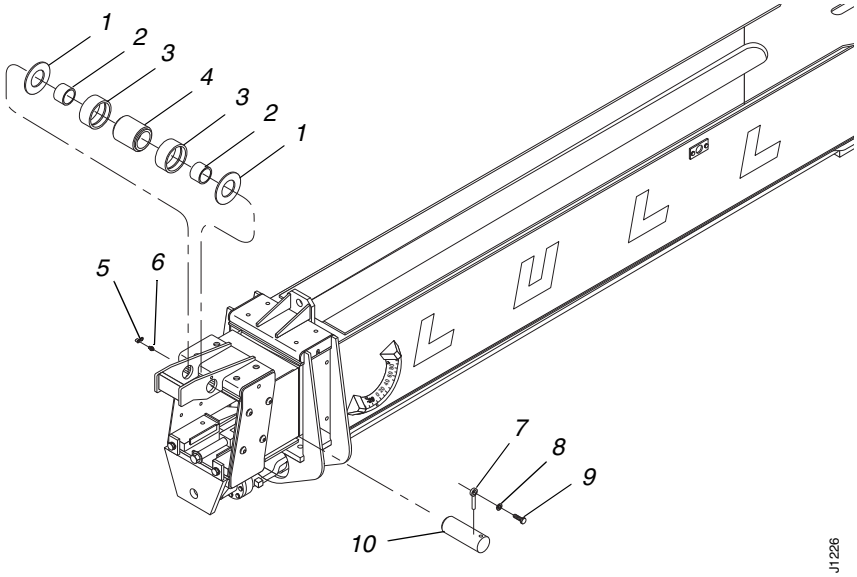


#	Description
1	Chain Anchor
2	Jam Nut
3	Lockwasher

#	Description
4	Nut
5	Outer Boom Section

Fig. 6-82: Upper Chain Assembly

31. (Ref. Fig. 6-82) Remove nut (Item 4) and lockwasher (Item 3) securing upper chain anchor (Item 1) to outer boom section (Item 5). Remove upper chain assembly from boom.

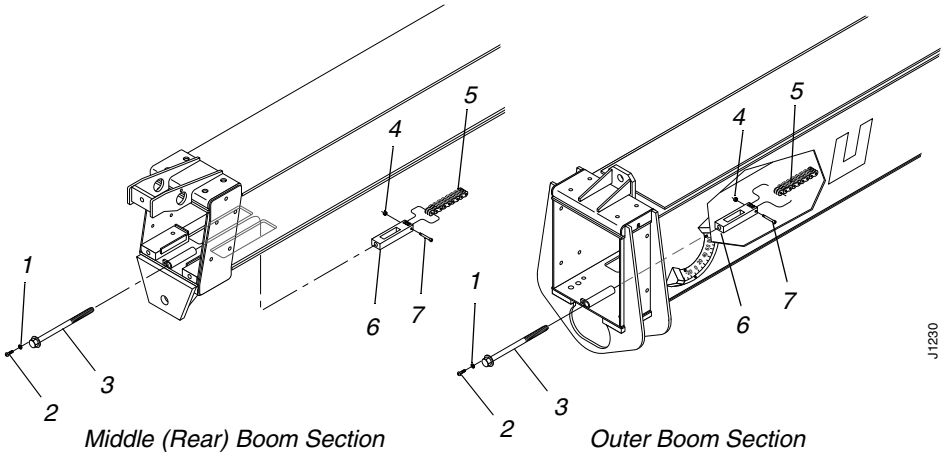


#	Description
1	Chain Guide Washer
2	Chain Roller Bushing
3	Hardened Bushing
4	Chain Roller
5	Grease Fitting Cover

#	Description
6	Grease Fitting
7	Lock Pin
8	Lockwasher
9	Capscrew
10	Chain Roller Pin

Fig. 6-83: Upper Chain Roller Assembly – Middle (Rear) Boom Section

32. (Ref. Fig. 6-83) Remove capscrew (Item 9), lockwasher (Item 8), and lock pin (Item 7) from chain roller pin (Item 10).
33. (Ref. Fig. 6-83) Remove chain roller pin along with two (2) each chain guide washers (Item 1), chain roller bushings (Item 2), hardened bushings (Item 3), and the chain roller (Item 4).



Middle (Rear) Boom Section *Outer Boom Section*

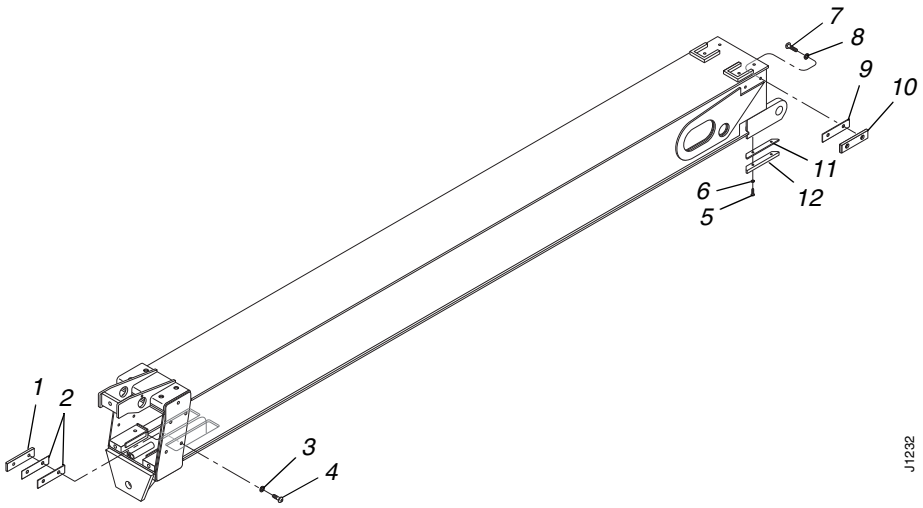
#	Description
1	Lockwasher
2	Button Head Capscrew
3	Chain Adjustment Rod
4	Lock Nut

#	Description
5	Chain
6	Chain Adjustment Block
7	Shoulder Bolt

Fig. 6-84: Removing Lower Chains

34. (Ref. Fig. 6-84) Remove lower chains from the middle (rear) and outer boom sections as follows:
    a. Remove capscrew (Item 2) and lockwasher (Item 1).
    b. Remove chain adjustment rod (Item 3).
    c. Pull the chain assembly (Items 4 thru 7) out through rear of boom.
35. Slide middle (rear) boom out of outer boom section and place it on work stands in upright position.

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#	Description	#	Description
1	Front Side Slide Pad	7	Button-Head Socket Capscrew
2	Shim	8	Lockwasher
3	Lockwasher	9	Shim
4	Button-Head Socket Capscrew	10	Rear Side Slide Pad
5	Button-Head Socket Capscrew	11	Shim
6	Lockwasher	12	Rear Lower Slide Pad

Fig. 6-85: Slide Pads – Middle (Rear) Boom Section

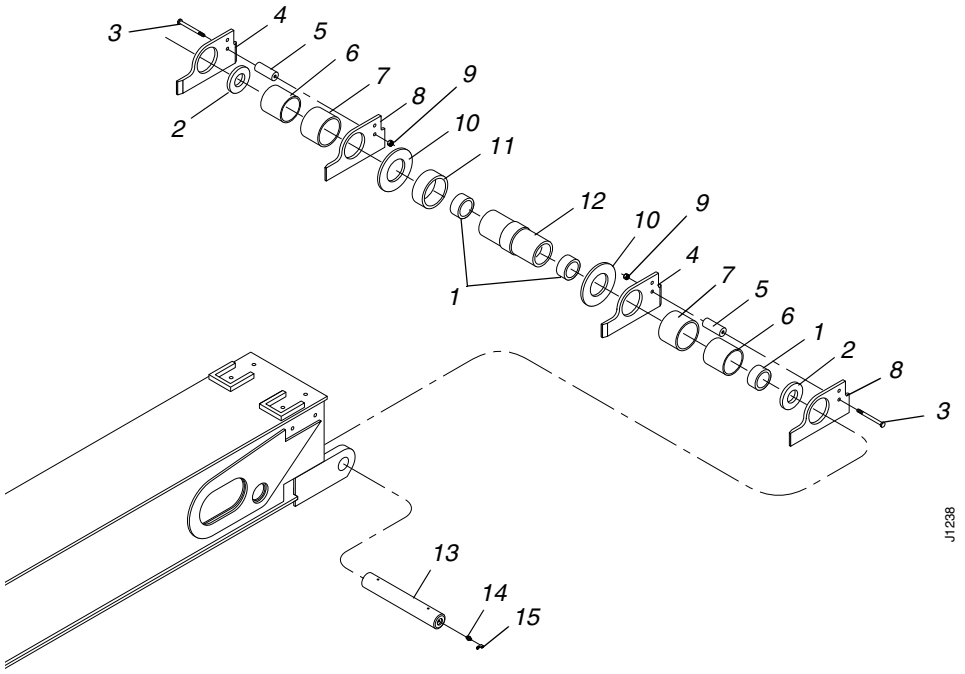
36. (Ref. Fig. 6-85) Remove remaining slide pads from middle (rear) boom section as follows:

    a. Remove eight (8) each capscrews (Item 4) and lockwashers (Item 3) securing side slide pads to front of middle (rear) boom section. Remove four (4) slide pads (Item 1) and shims (Item 2).

    b. Remove four (4) each capscrews (Item 7) and lockwashers (Item 8) securing side slide pads to rear of middle (rear) boom section. Remove two (2) slide pads (Item 10) and shims (Item 9).

    c. Remove four (4) each capscrews (Item 5) and lockwashers (Item 6) securing lower slide pads to rear of middle (rear) boom section. Remove two (2) slide pads (Item 12) and shims (Item 11).

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#	Description
1	Roller Bushing
2	Washer
3	Capscrew
4	Right Hand Hose Guide
5	Hose Guide Spacer
6	Hose Spacer
7	Plastic Bushing
8	Left Hand Hose Guide

#	Description
9	Lock Nut
10	Chain Roller Washer
11	Hardened Bushing
12	Chain and Hose Roller
13	Chain and Hose Roller Shaft
14	Grease Fitting
15	Grease Fitting Cover

Fig. 6-86: Chain and Hose Guide Assembly

37. (Ref. Fig. 6-86) Remove chain and hose guide assembly from rear of middle (rear) boom section as follows:

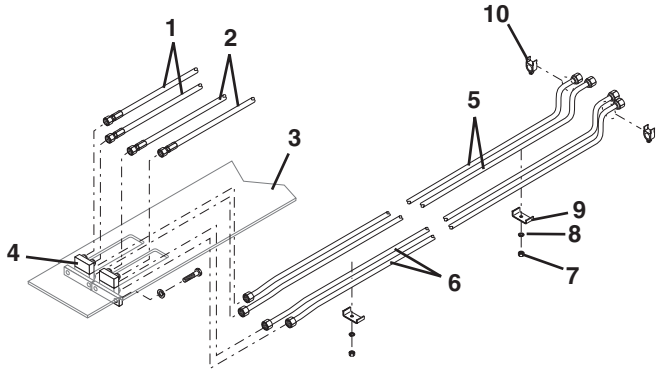
    a. Remove chain and hose roller shaft (Item 13) from rear of middle (rear) boom section. Remove chain and hose roller assembly.

    b. Remove two (2) lock nuts (Item 9) and capscrews (Item 3).

    c. Separate two (2) each right hand hose guides (Item 4), washers (Item 2), roller bushings (Item 1), hose guide spacers (Item 5), hose spacers (Item 6), plastic bushings (Item 7), and left hand hose guides (Item 8) from chain and hose roller (Item 12).

    d. Remove two (2) chain roller washers (Item 10) and the hardened bushing (Item 11) from the chain and hose roller.

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#	Description
1	Auxiliary Hydraulic Hose
2	Carriage Tilt Hydraulic Hose
3	Middle (Rear) Boom Section
4	Hydraulic Manifold Block
5	Auxiliary Hydraulic Tube
6	Carriage Tilt Hydraulic Tube

#	Description
7	Nut
8	Lockwasher
9	Clamp
10	Cushion Clamp

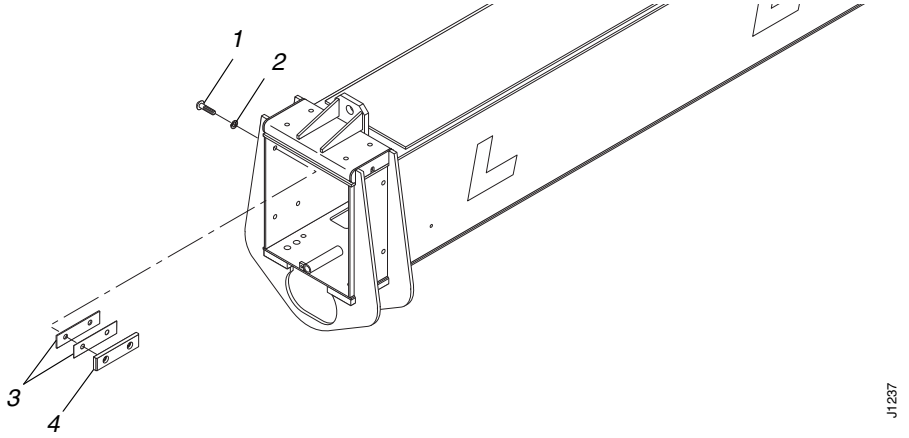
Fig. 6-87: Tubes and Hoses – Middle (Rear) and Outer Boom Sections

38. (Ref. Fig. 6-87) Remove middle (rear) boom section hoses as follows:
    a. Loosen and remove two (2) auxiliary and two (2) carriage tilt hydraulic hoses (Items 1 and 2) from hydraulic manifold block (Item 4).
    b. Bleed any remaining oil into a suitable container and remove hoses from inside middle (rear) boom section (Item 3). Tag and cap hoses and fittings.
39. Flip middle (rear) boom section upside down and place on work stands.
40. (Ref. Fig. 6-87) Remove hydraulic tubes from bottom of middle (rear) boom section as follows:

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a. Remove two (2) each nuts (Item 7), lockwashers (Item 8), and tube clamps (Item 9) securing each set of auxiliary and carriage tilt hydraulic tubes (Items 5 and 6) to bottom of middle (rear) boom section.

b. Loosen screw on cushion clamps (Item 10). Slide cushion clamps out of channel and remove hydraulic tubes from boom section.



#	Description
1	Button-Head Socket Capscrew
2	Lockwasher

#	Description
3	Shim
4	Side Slide Pad

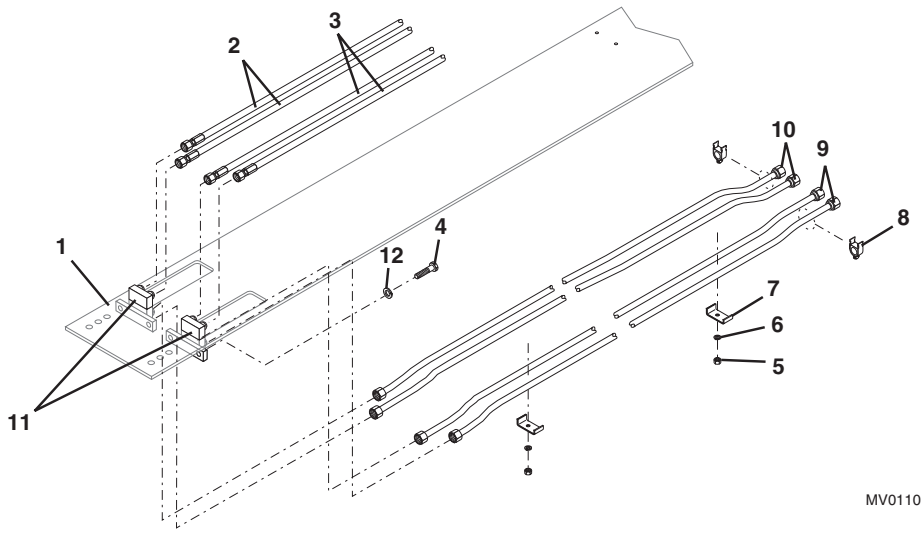
Fig. 6-88: Side Slide Pads – Outer Boom Section

41. (Ref. Fig. 6-88) Remove side slide pads from outer boom section as follows:

    a. Remove four (4) capscrews (Item 1) and lockwashers (Item 2) securing side slide pads to outer boom.

    b. Remove the two (2) slide pads (Item 4) and shims (Item 3).

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#	Description
1	Outer Boom Section
2	Auxiliary Hydraulic Hose
3	Carriage Tilt Hydraulic Hose
4	Capscrew
5	Nut
6	Lockwasher
7	Clamp

#	Description
8	Cushion Clamp
9	Auxiliary Hydraulic Tube
10	Carriage Tilt Hydraulic Tube
11	Hydraulic Manifold Block
12	Lockwasher

Fig. 6-89: Outer Boom Tubes and Hoses

42. (Ref. Fig. 6-89) Remove outer boom hydraulic hoses as follows:
    a. Loosen and remove auxiliary and front carriage tilt hydraulic hoses (Items 2 and 3) from hydraulic manifold blocks (Item 11). Bleed any remaining oil into a suitable container.
    b. Remove hoses from inside outer boom section (Item 1). Cap and tag hoses and open ports on manifold blocks.
43. Turn outer boom section over and place it upside down on work stands.
    a. Loosen and remove four (4) auxiliary and front carriage tilt hydraulic tubes (Items 9 and 10) from hydraulic manifold blocks (Item 11). Bleed any remaining oil from tubes into a suitable container. Tag and cap hydraulic tubes and open ports on hydraulic manifold blocks.

b. Remove two (2) each nuts (Item 5), lockwashers (Item 6), and clamps (Item 7) securing each set of hydraulic tubes to bottom of outer boom section.

c. Loosen screws on cushion clamps (Item 8). Slide cushion clamps out of channel and remove hydraulic tubes.

d. Remove two (2) capscrews (Item 4) and lockwashers (Item 12) securing each manifold block to the outer boom. Remove the manifold blocks.

Note: *If damaged, further disassembly of chain assemblies may become necessary. If required, information on the removal and installation of additional items such as the boom angle indicator is covered elsewhere in this manual. Additional information of removal and installation of the boom elevation proximity switch and the boom extension proximity switch is also covered in this manual.*

Assembly

4-Section Boom

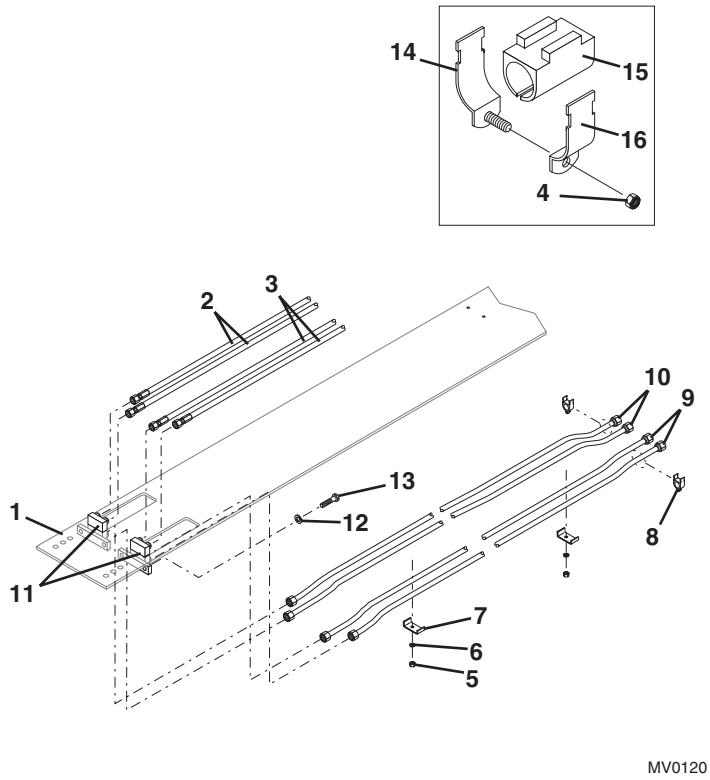
1. Use crane, chains, and slings to lift and place outer boom section on work stands in upside down position.



CAUTION: To avoid personal and equipment damage, make sure that major boom components are properly supported through this entire procedure.

Note: *This procedure assumes that the boom has been completely disassembled. In certain areas, references are made to other locations in this manual where specific subjects are covered in detail.*

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#	Description
1	Outer Boom Section
2	Auxiliary Hydraulic Hose
3	Carriage Tilt Hydraulic Hose
4	Lock Nut
5	Nut
6	Lockwasher
7	Clamp
8	Cushion Clamp
9	Auxiliary Hydraulic Tube

#	Description
10	Carriage Tilt Hydraulic Tube
11	Hydraulic Manifold Block
12	Lockwasher
13	Capscrew
14	Left Clamp Half
15	Plastic Cushion
16	Right Clamp Half

Fig. 6-90: Outer Boom Tube and Hose Assembly

2. (Ref. Fig. 6-90) Install auxiliary and front carriage tilt hydraulic tubes and hoses on outer boom section as follows:

   a. Install auxiliary and hydraulic hoses (Items 2 and 3) to two (2) hydraulic manifold blocks (Item 11). Torque swivel nuts on hoses to 50–58 ft-lbs.

   b. Install auxiliary and front carriage tilt hydraulic tubes (Items 9 and 10) on manifold blocks. Make sure the tube is positioned so that the longest portion of each tube will be close to bottom of the boom section (Item 1). Torque swivel nut on tubes to 50–58 ft-lbs.

   c. Place hoses through openings in bottom of outer boom section (Item 1) and install hydraulic manifold blocks on outer section with lockwashers (Item 12) and capscrews (Item 13). Torque capscrews to 55 ft-lbs.

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d. Install a cushion clamp (Item 8) on each hydraulic tube as follows:

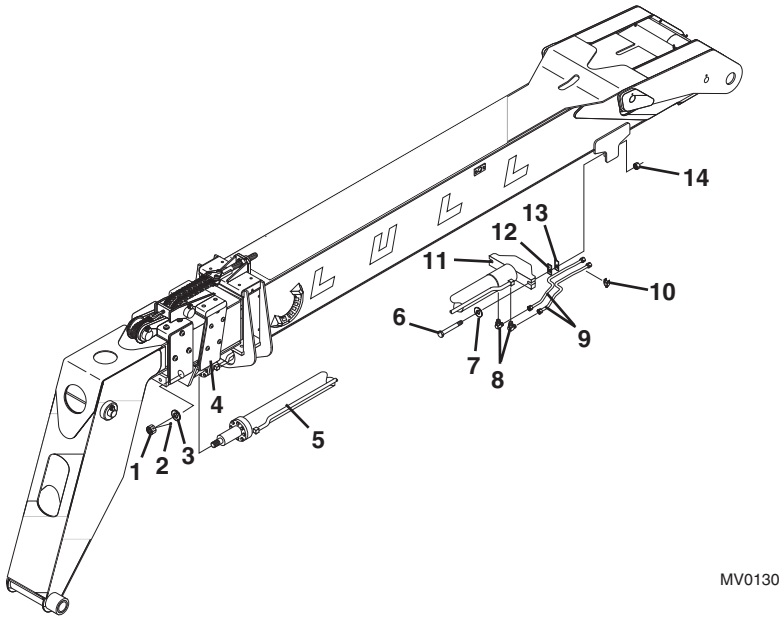
   1). Install plastic cushion (Item 15) on hydraulic tube.

   2). Slide left cushion clamp half (Item 14) to correct position in channel on bottom of outer boom (Item 1).

   3). Position tube with cushion next to left cushion half and slide right cushion half (Item 16) into channel.

   4). Secure two halves of clamp together with lock nut (Item 4). Tighten lock nut until snug.

e. Secure hydraulic tubes to bottom of boom section with two (2) each clamps (Item 7), lockwashers (Item 6), and nuts (Item 5). Torque nuts to 96 in-lbs.



#	Description
1	Rod Nut
2	Socket Setscrew
3	Extension Cylinder Rod Boss
4	Middle (Rear) Boom Section
5	Boom Extension Cylinder
6	Capscrew
7	Flatwasher

#	Description
8	Elbow
9	Hydraulic Tube
10	Cushion Clamp
11	Extension Cylinder Base Mount
12	Shim
13	Shim
14	Nut

Fig. 6-91: Extension Cylinder Installation

3. (Ref. Fig. 6-91) Install extension cylinder on outer boom section as follows:

   a. Using sling(s), crane, or other suitable means, position rod end of cylinder (Item 5) in its proper location on the middle (rear) boom section (Item 4).

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WARNING: To avoid personal and/or equipment damage, make sure the cylinder is properly supported until it is completely installed.

b. Secure cylinder to outer boom section with hardware as follows.

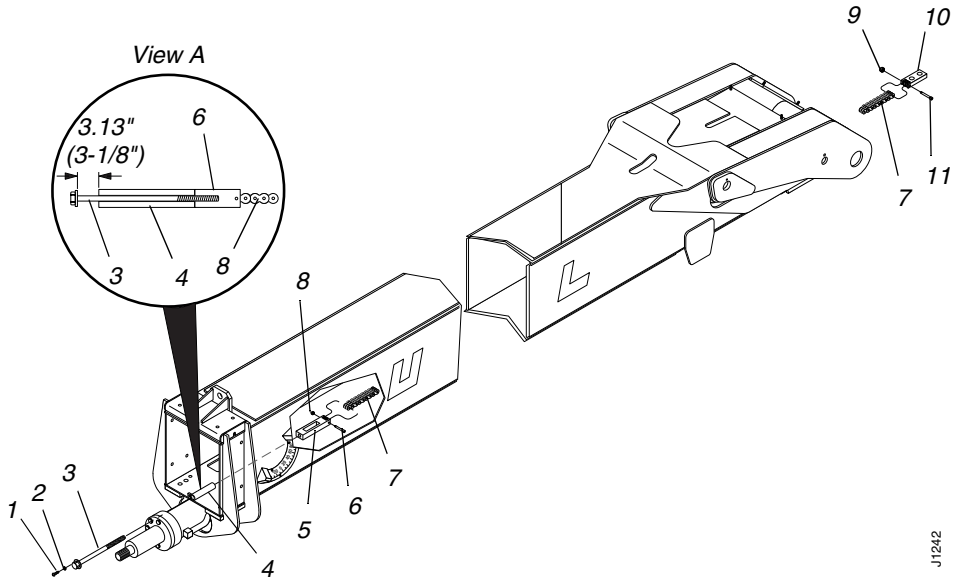
Use two (2) each nuts (Item 14), flatwashers (Item 7), and capscrews (Item 6) to secure extension cylinder base mount (Item 11) to rear of outer boom section. Install as many shims (Items 12 and 13) as necessary before installing the nuts. Torque nuts to 680 ft-lbs.

c. Install two (2) hydraulic tubes (Item 9)on extension cylinder elbows (Item 8). Torque swivel nuts on hydraulic tubes to 79–88 ft-lbs.

d. Install cushion clamp (Item 10) on each hydraulic tube as described in Substep d under Step 2 on Page 68.

4. Apply EP lithium based grease to the inside top surfaces of outer boom section (slide pad slide areas).

5. Turn outer boom section over and place it in upright position on work stands.



#	Description
1	Capscrew
2	Lockwasher
3	Chain Adjustment Rod
4	Anchor Base
5	Chain Adjustment Block
6	Shoulder Bolt

#	Description
7	Lower Chain
8	Lock Nut
9	Lock Nut
10	Lower Chain Anchor
11	Shoulder Bolt

Fig. 6-92: Lower Chains on Outer Boom Section

6. (Ref. Fig. 6-92) Add lower chain to inside of outer boom section as follows:

a. Install lower chain anchor (Item 10) on lower chain (Item 7) with lock nut (Item 9) and shoulder bolt (Item 11). Torque lock nut to 108 in-lbs.

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b. Install chain adjustment block (Item 5) on other end of lower chain with shoulder bolt (Item 6) and lock nut (Item 8). Torque lock nut to 108 in-lbs.

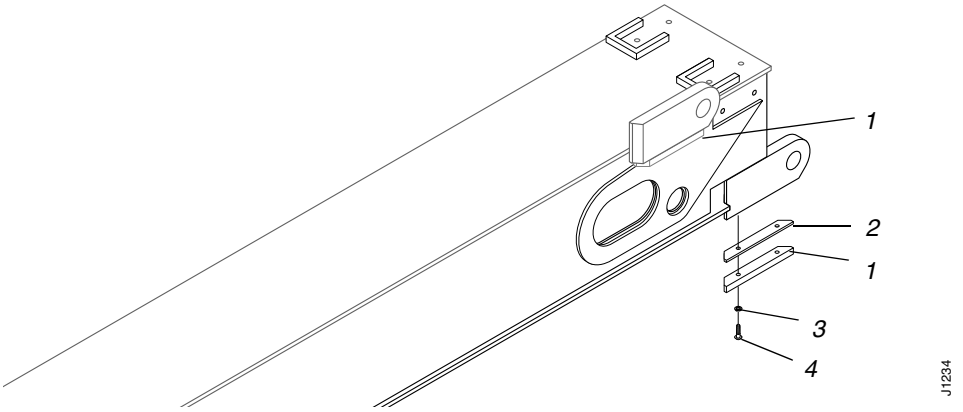
c. Position chain adjustment block tight against back of anchor base (Item 4) at bottom of outer boom section as shown in View A.

d. Thread chain adjustment rod (Item 3) into block until specified measurement is obtained.

e. Push adjustment rod fully into anchor base.

f. Lay chain flat inside of outer boom section. Attach a cord or wire to end of chain for ease in handling after all four sections are assembled.

7. Place middle (rear) boom section upside down on work stands.



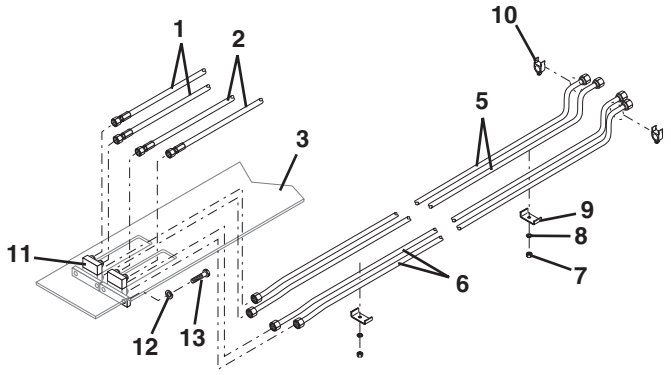
#	Description
1	Lower Rear Slide Pad
2	Shim

#	Description
3	Lockwasher
4	Button-Head Socket Capscrew

Fig. 6-93: Lower Rear Slide Pad Installation - Middle (Rear) Boom Section

8. (Ref. Fig. 6-93) After applying thread locking compound to the capscrews, install two (2) lower, rear slide pads (Item 1) and shim(s) (Item 2) to bottom of middle (rear) boom section with lockwashers (Item 3) and capscrews (Item 4) according to drawing specifications. Torque capscrews to 180 in-lbs.

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#	Description
1	Auxiliary Hydraulic Hose
2	Carriage Tilt Hydraulic Hose
3	Middle (Rear) Boom Section
4	Capscrew
5	Auxiliary Hydraulic Tube
6	Carriage Tilt Hydraulic Tube

#	Description
7	Nut
8	Lockwasher
9	Clamp
10	Cushion Clamp
11	Hydraulic Manifold Block
12	Lockwasher

Fig. 6-94: Tubes and Hoses – Middle (Rear) Boom Sections

9. (Ref. Fig. 6-94) Install hydraulic tubes and hoses on middle (rear) boom section as follows:

   a. Install auxiliary and front carriage tilt hydraulic tubes (Items 5 and 6) on hydraulic manifold blocks (Item 11). Make sure the tube is positioned so that the longest portion of each tube will be close to bottom of the boom section (Item 3). Torque swivel nut on tubes to 50–58 ft-lbs.

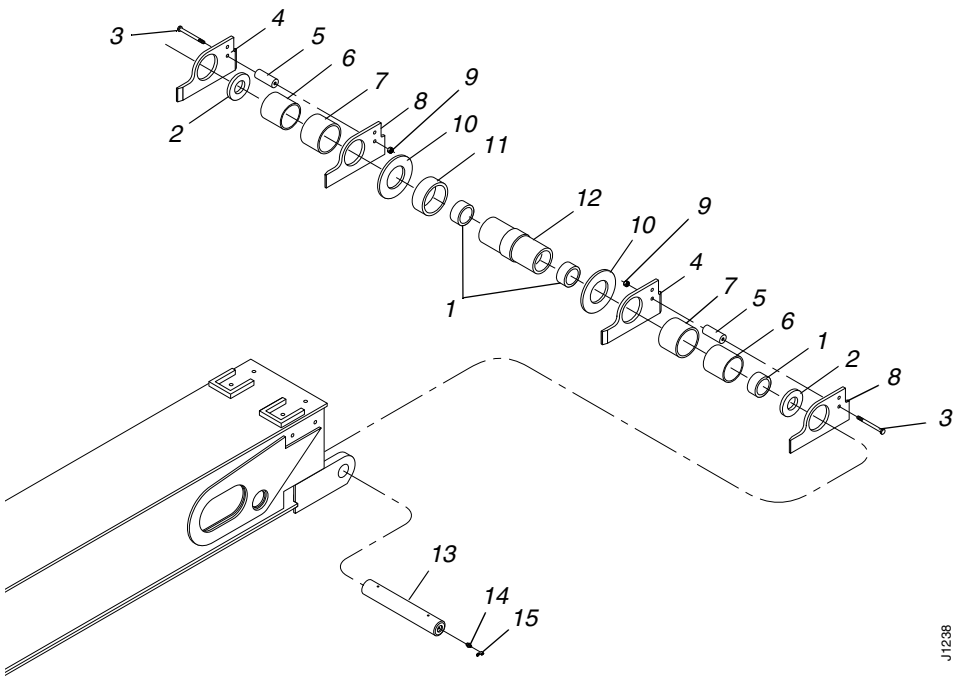
   b. Install two (2) manifold block on middle (rear) boom section with four (4) lockwashers (Item 12) and capscrews (Item 4). Torque capscrews to 55 ft-lbs.

   c. Install cushion clamp (Item 10) on each hydraulic tube and secured in mounting channel as described in Substep d under Step 2 on page 6-85.

   d. Securing hydraulic tubes to bottom of boom section with two (2) each clamps (Item 9), lockwashers (Item 8), and nuts (Item 7). Torque nuts to 96 in-lbs.

   e. Install auxiliary and hydraulic hoses (Items 1 and 2) to hydraulic manifold blocks. Torque swivel nuts on hoses to 50–58 ft-lbs.

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#	Description
1	Roller Bushing
2	Washer
3	Capscrew
4	Right Hand Hose Guide
5	Hose Guide Spacer
6	Hose Spacer
7	Plastic Bushing
8	Left Hand Hose Guide

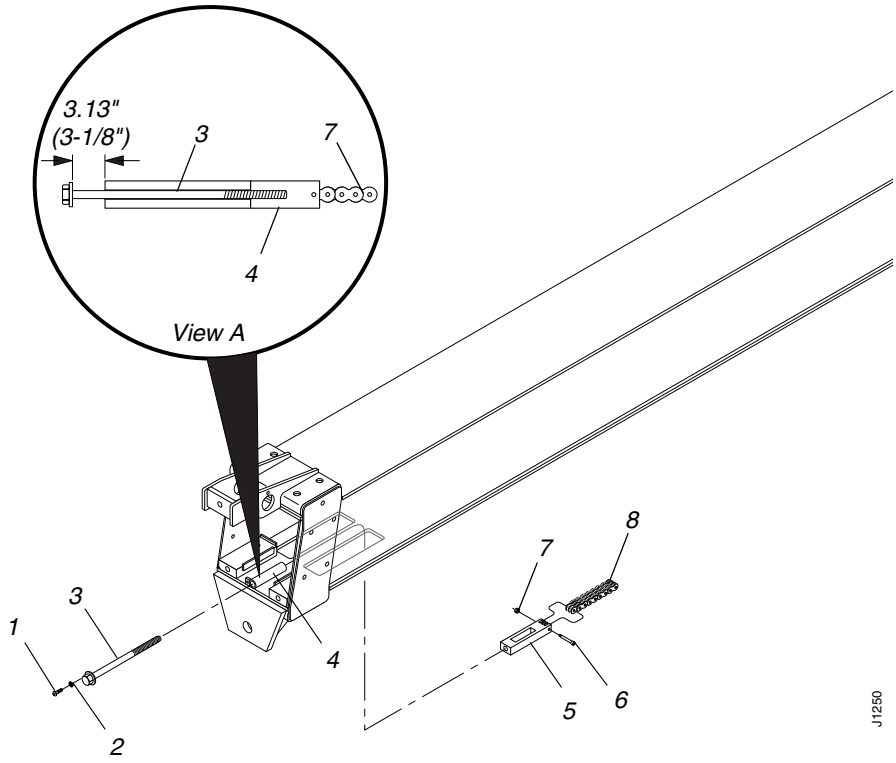
#	Description
9	Lock Nut
10	Chain Roller Washer
11	Hardened Bushing
12	Chain and Hose Roller
13	Chain and Hose Roller Shaft
14	Grease Fitting
15	Grease Fitting Cover

Fig. 6-95: Chain and Hose Guide Assembly

10. (Ref. Fig. 6-95) Install chain and hose guide assembly on rear of middle (rear) boom section as follows:
    a. Install two (2) roller bushings (Item 1) inside chain and hose roller (Item 12) — one in each end.
    b. Install hardened bushing (Item 11) and two (2) chain roller washers (Item 10) on the chain and hose roller.
    c. Install two (2) each left hand hose guides (Item 8), plastic bushings (Item 7), hose spacers (Item 6), washers (Item 2), and right hand hose guides (Item 4) on chain and hose roller.
    d. Install two hose guide spacers (Item 5) between left and right hand hose guides with two (2) lock nuts (Item 9) and capscrews (Item 3). Torque the lock nuts to 180 in-lbs.
    e. Install chain and hose roller assembly on rear of boom section with chain and hose roller shaft (Item 13).
    f. Install two (2) grease fittings (Item 14) and grease fittings covers (Item 15) on chain and hose roller shaft.

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11. Turn middle (rear) boom section over to upright position on work stands.

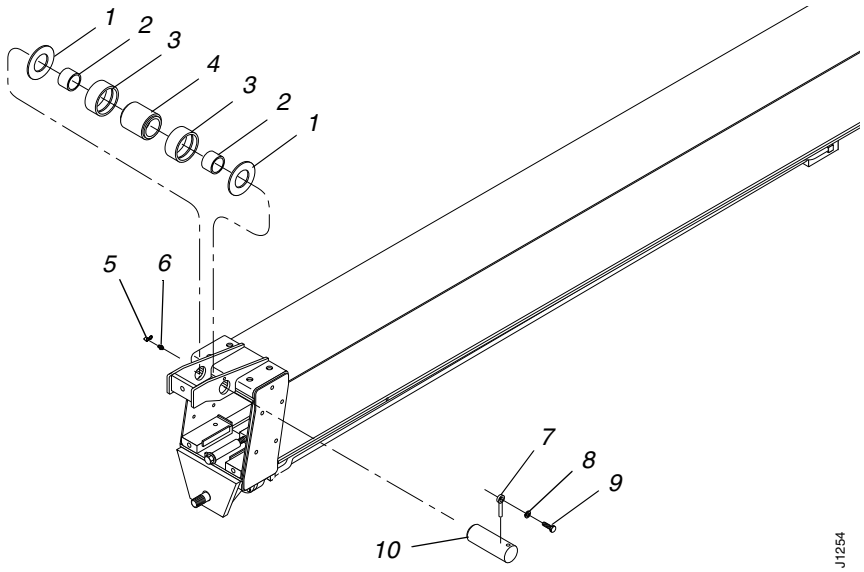


#	Description	#	Description
1	Button-Head Socket Capscrew	5	Chain Adjustment Block
2	Lockwasher	6	Shoulder Bolt
3	Chain Adjustment Rod	7	Lock Nut
4	Anchor Base	8	Chain

Fig. 6-96: Installation of Lower Chain – Middle (Rear) Boom Section

12. Install lower chain on bottom of middle (rear) boom section as follows:
    a. Install chain adjustment block (Item 5) on lower chain with shoulder bolt (Item 6) and lock nut (Item 7). Torque lock nut to 108 in-lbs.
    b. Position chain adjustment block tight against back of anchor base (Item 4) at bottom of middle (rear) boom section as shown in View A.
    c. Thread chain adjustment rod (Item 3) into block until specified measurement is obtained.
    d. Push adjustment rod fully into anchor base.
    e. Lay chain flat inside of middle (rear) section. Attach a cord or wire to end of chain for ease in handling after all four sections are assembled.

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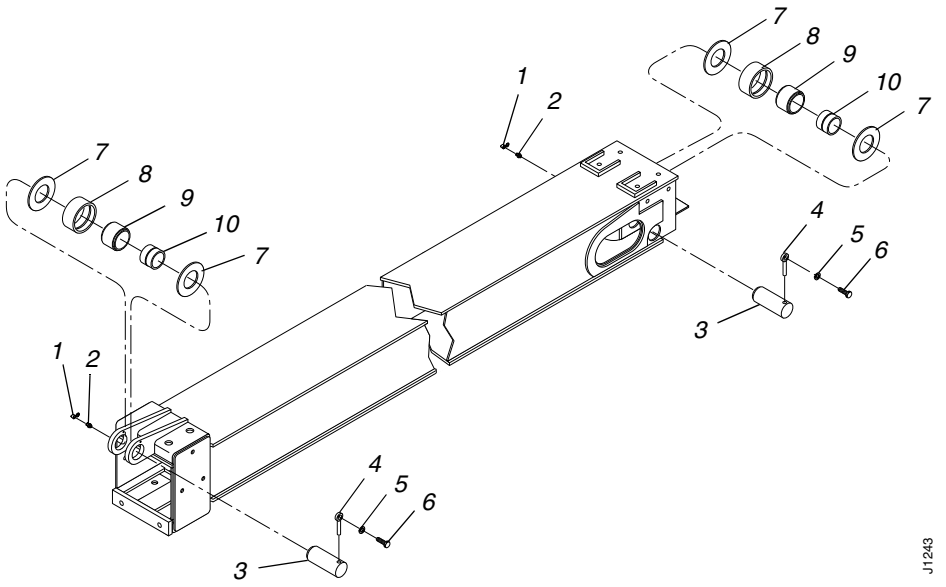


#	Description	#	Description
1	Chain Guide Washer	6	Grease Fitting
2	Chain Roller Bushing	7	Lock Pin
3	Hardened Bushing	8	Lockwasher
4	Chain Roller	9	Capscrew
5	Grease Fitting Cover	10	Chain Roller Pin

Fig. 6-97: Upper Chain Roller Assembly – Middle (Rear) Boom Section

13. (Ref. Fig. 6-97) Install upper chain roller assembly on middle (rear) boom section as follows:
    a. Install two (2) chain roller bushings (Item 2) into chain roller (Item 4).
    b. Install two (2) hardened bushings (Item 3) on chain roller.
    c. Install bushings and chain roller and two (2) chain guide washers (Item 1) on front of middle (forward) boom section with chain roller pin (Item 10).
    d. Secure chain roller pin with lock pin (Item 7), lockwasher (Item 8), and capscrew (Item 9). Torque capscrew to 110 ft-lbs.
    e. Install grease fitting (Item 6) and grease fitting cover (Item 5) on chain roller pin. Tighten the grease fitting 2–3 turns past finger tight.
14. Lift and slide middle (rear) boom section into outer boom section. Release strap securing extension cylinder to outer boom section and install cylinder end through orifice of middle (rear) section.
15. Apply EP lithium based grease to the inside bottom surfaces of middle (rear) boom section (slide pad slide areas).
16. Place middle (forward) boom section on work stands upside down.

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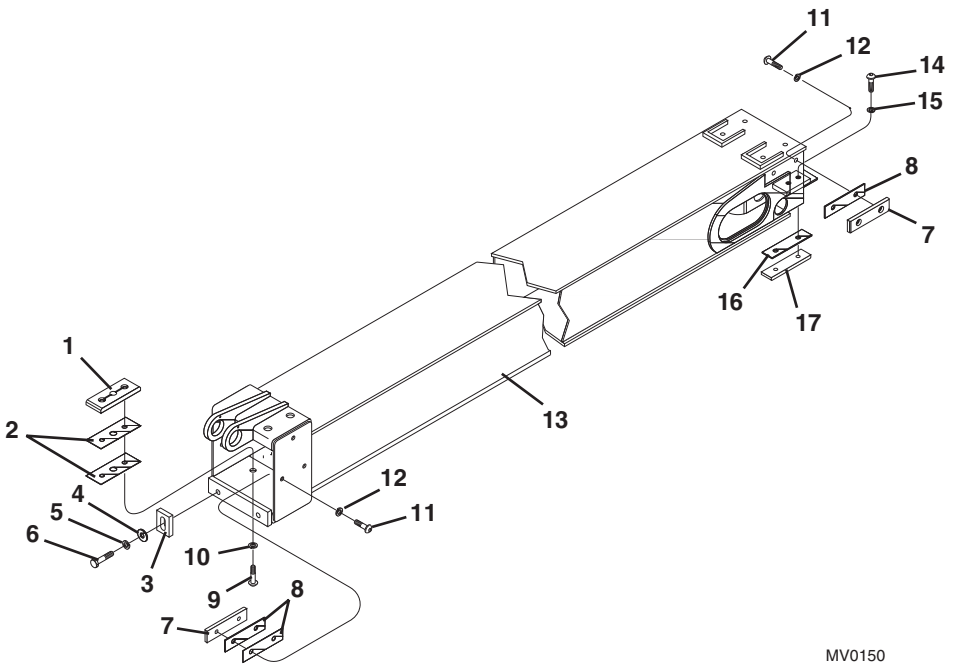


#	Description
1	Grease Fitting Cover
2	Grease Fitting
3	Chain Roller Pin
4	Lock Pin
5	Lockwasher

#	Description
6	Capscrew
7	Chain Guide Washer
8	Bushing
9	Chain Roller
10	Chain Roller Bushing

Fig. 6-98: Chain Roller Assemblies - Middle (Forward) Boom Section

17. (Ref. Fig. 6-98) Install chain roller assemblies on middle (forward) boom section as follows:
    a. Install chain roller bushing (Item 10) in chain roller (Item 9).
    b. Install chain roller in bushing (Item 8).
    c. Install chain roller and two (2) chain guide washers (Item 7) on front of boom section with chain roller pin (Item 3).
    d. Secure the chain roller pin to the boom section with lock pin (Item 4), lockwasher (Item 5), and capscrew (Item 6). Torque the capscrew to 110 ft-lbs.
    e. Install grease fitting (Item 2) and grease fitting cover (Item 1) on chain roller pin. Tighten grease fitting 2–3 turns past finger tight.
    f. Repeat the preceding steps to install chain roller assembly to the rear of the boom section.
    g. Install upper chain anchor (Item 3) on upper chains (Item 1) with chain anchor rod (Item 6) and two (2) lock nuts (Item 2). Torque lock nuts to 108 in-lbs.
    h. Install upper chain anchor to rear of boom section with lockwasher (Item 5) and capscrew (Item 4). Make sure the hole in the anchor (where the anchor rod was installed) is positioned toward the front of the boom. Torque capscrew to 280 ft-lbs.
    i. Lay upper chain on top of middle (forward) boom section.



#	Description
1	Front Bottom Slide Pad
2	Shim
3	Pad Retainer
4	Flatwasher
5	Lockwasher
6	Capscrew
7	Side Slide Pad
8	Shim
9	Button-Head Socket Capscrew

#	Description
10	Lockwasher
11	Button-Head Socket Capscrew
12	Lockwasher
13	Middle (Forward) Boom Assy
14	Button-Head Socket Capscrew
15	Lockwasher
16	Shim
17	Rear Bottom Slide Pad

Fig. 6-99: Slide Pad Installation – Middle (Forward) Boom Section

Note: *Apply thread locking compound to all slide pad mounting capscrews before installing them.*

18. (Ref. Fig. 6-99) Install shim pads on middle (forward) boom section as follows:

    a. Install bottom slide pad (Item 17) and shim(s) (Item 16) to rear of boom section with two (2) lockwashers (Item 15) and capscrews (Item 14) according to drawing specifications. Torque capscrews to 180 in-lbs.

    b. Install two (2) side slide pads (Item 7) and shim(s) (Item 8) to rear of boom section with two (2) each lockwashers (Item 12) and capscrews (Item 11) according to drawing specifications. Torque capscrews to 180 in-lbs.

19. (Ref. Fig. 6-99) Install bottom slide pads and shims on front of boom section as follows:

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a. Install two (2) bottom slide pads (Item 1) and shims (Item 2) to front of boom section with four (4) each lockwashers (Item 10) and capscrews (Item 9) according to drawing specifications. Torque capscrews to 180 in-lbs.

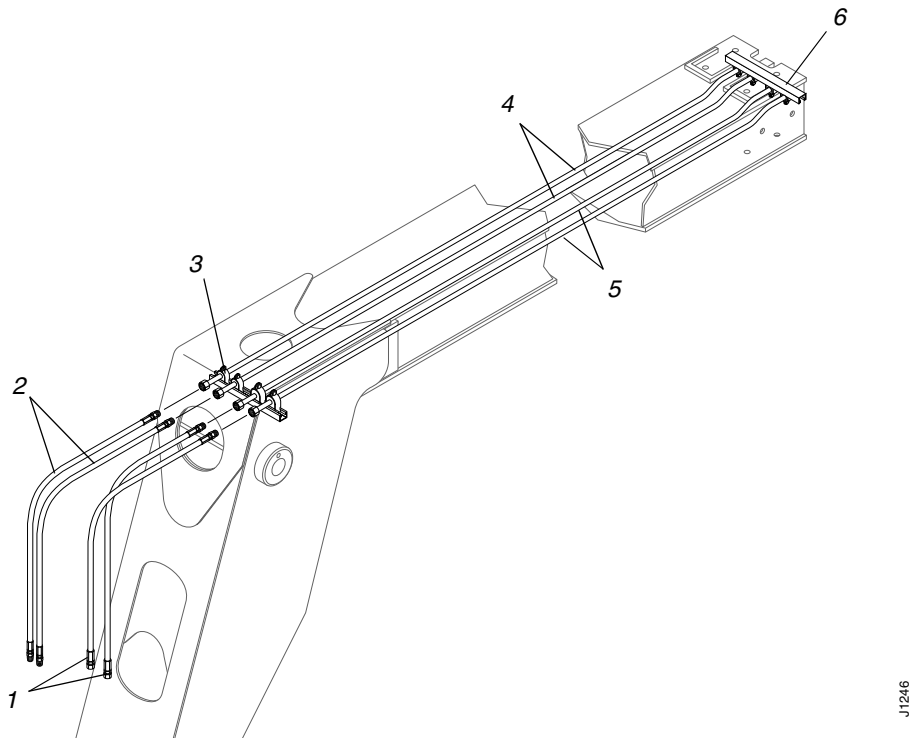
b. Install two (2) pad retainers (Item 3) on front of boom section with flatwashers (Item 4), lockwashers, (Item 5) and capscrews (Item 6). Torque capscrews to 200 ft-lbs.

c. Install two (2) side slide pads (Item 7) and shims (Item 8) on front of boom section with four (4) each lockwashers (Item 12) and capscrews (Item 11). Torque capscrews to 180 in-lbs.

20. Apply EP lithium based grease to the inside top surfaces of middle (forward) boom section (slide pad slide areas).

21. Turn middle (forward) boom section over to upright position on work stands.

22. Place inner boom section upside down on work stands.



#	Description
1	Auxiliary Hydraulic Hoses
2	Carriage Tilt Hydraulic Hoses
3	Cushion Clamp

#	Description
4	Auxiliary Hydraulic Tubes
5	Carriage Tilt Hydraulic Tubes
6	Mounting Channel

Fig. 6-100: Hydraulic Hose and Tube Installation – Inner Boom Section

23. (Ref. Fig. 6-100) Install auxiliary and front carriage tilt cylinder hydraulic hoses and tubes as follows:

a. Connect hydraulic hoses (Item 1) to carriage tilt hydraulic tubes (Item 4). Torque swivel nuts on hydraulic tubes to 50–58 ft-lbs.

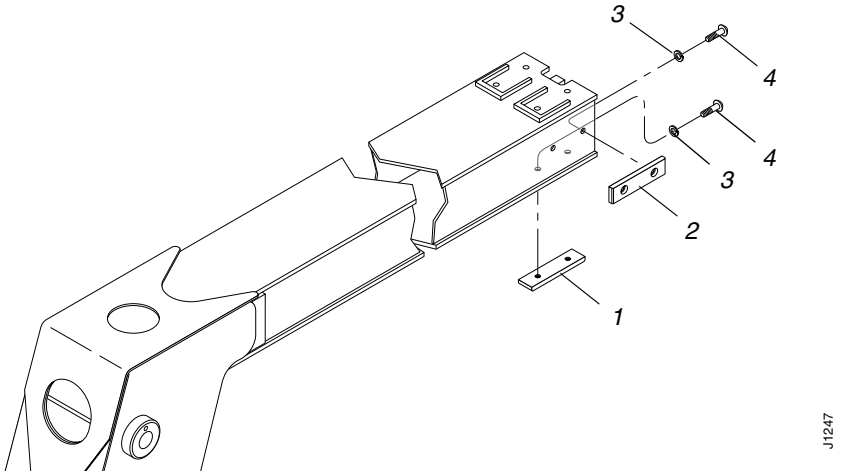
b. Connect hydraulic hoses (Item 2) to auxiliary hydraulic tubes (Item 5). Torque swivel nuts on hydraulic tubes to 50–58 ft-lbs.

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c. Install auxiliary and front carriage tilt hydraulic tubes on channels (Item 6) in inside of inner boom section with cushion clamps (Item 3) as described in Substep d under Step 2 on page 6-68.

24. Install front carriage tilt cylinder in inner boom (See page 6-20).

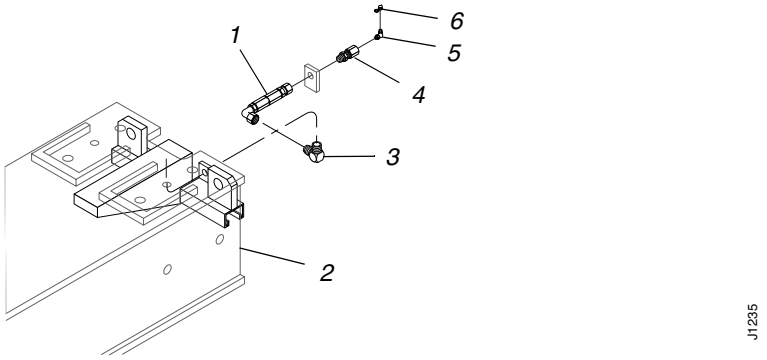
25. Install auxiliary hydraulic quick disconnects



#	Description	#	Description
1	Lower Slide Pad	3	Lockwasher
2	Side Slide Pad	4	Button-Head Socket Capscrew

Fig. 6-101: Slide Pad Installation – Inner Boom Section

26. (Ref. Fig. 6-101) After applying thread locking compound to the capscrews, install two (2) lower and two (2) side slide pads (Items 1 and 2) on inner boom section according to drawing specifications with lockwashers (Item 3) and capscrews (Item 4). Torque capscrews to 180 in-lbs.

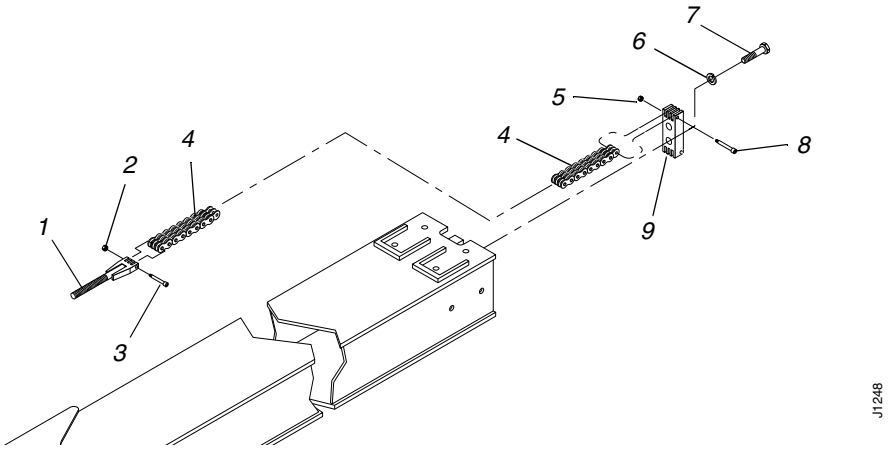


#	Description	#	Description
1	Grease Hose	4	Bulkhead Adapter
2	Inner Boom Section	5	Grease Fitting
3	Elbow	6	Grease Fitting Cover

Fig. 6-102: Grease Hose Installation

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27. (Ref. Fig. 6-102) Install grease hose assembly on rear of inner boom section as follows:
    a. Install two (2) elbows (Item 3) on inside of inner boom section making sure elbows are in correct position for grease hose to be connected.
    b. Install two (2) bulkhead adapters (Item 4) on rear of inner boom section (Item 2).
    c. Connect two (2) grease hoses (Item 1) to bulkhead adapters. Torque swivel nuts on grease hoses to 130–150 in-lbs.
    d. Connect grease hoses to elbows. Torque swivel nuts on grease hose to 130–150 in-lbs.
    e. Install grease fittings (Item 5) and grease fitting covers (Item 6) on bulkhead adapters (Item 2). Torque grease fittings 2–3 turns past finger tight.
28. Turn inner boom section over and place it on work stands in upright position.



#	Description
1	Chain Adjustment Anchor
2	Lock Nut
3	Shoulder Bolt
4	Upper Chain
5	Lock Nut

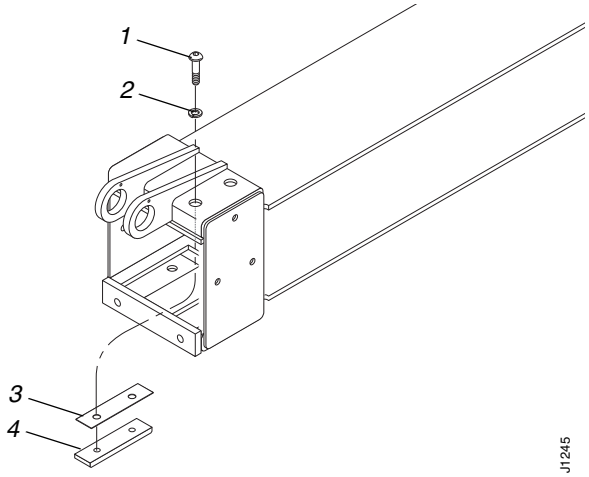
#	Description
6	Lockwasher
7	Capscrew
8	Shoulder Bolt
9	Rear Chain Anchor

Fig. 6-103: Upper Chain Installation – Inner Boom Section

29. (Ref. Fig. 6-103) Install upper chain assembly on inner boom section as follows:
    a. Install rear chain anchor (Item 9) on inner boom section with two (2) lockwashers (Item 6) and capscrews (Item 7). Torque capscrews to 280 ft-lbs.
    b. Install upper chain (Item 4) on chain anchor with shoulder bolt (Item 8) and lock nut (Item 5). Torque lock nut to 108 in-lbs.
    c. Install chain adjustment anchor (Item 1) on upper chain with shoulder bolt (Item 3) and lock nut (Item 2). Torque lock nut to 108 in-lbs.

d. Lay upper chain flat on top of inner boom section.

30. Lift inner boom section and slide it into middle (front) boom section.

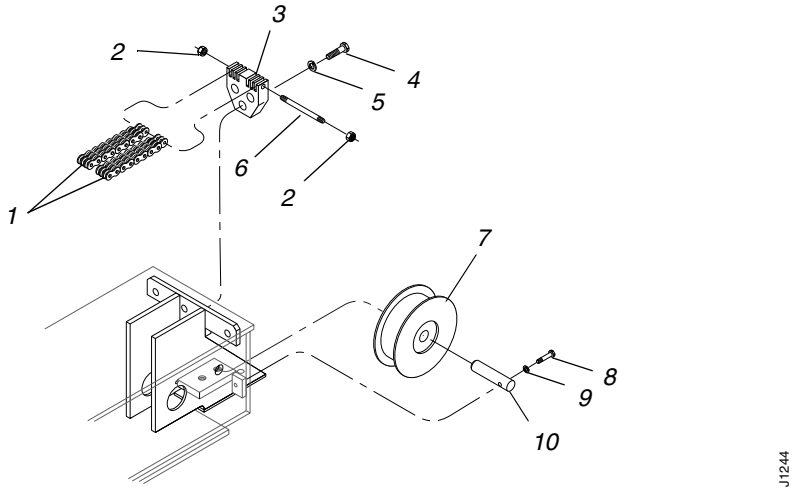


#	Description	#	Description
1	Button-Head Socket Capscrew	3	Shim
2	Lockwasher	4	Front Upper Slide Pad

Fig. 6-104: Upper Slide Pad Installation – Front of Middle (Forward) Boom Section

31. (Ref. Fig. 6-104) After applying thread locking compound to the capscrews, install two (2) upper slide pads (Item 4) and shims (Item 3) on front of middle (forward) boom section with lockwashers (Item 2) and capscrews (Item 1) according to drawing specifications. Torque capscrews to 180 in-lbs.

32. Lift middle (forward) and inner boom sections and slide them into middle (rear) boom section.



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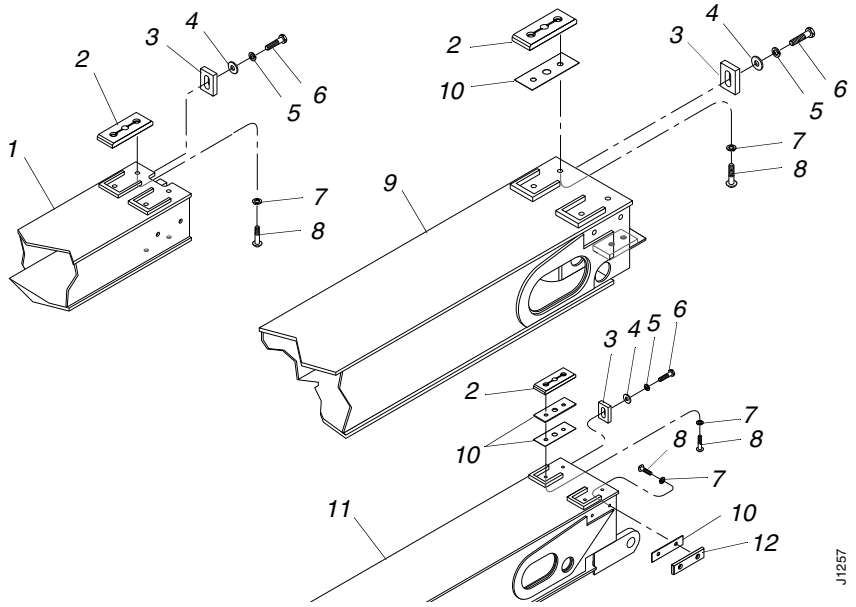
#	Description
1	Upper Chains
2	Lock Nut
3	Upper Chain Anchor
4	Capscrew
5	Lockwasher

#	Description
6	Chain Anchor Rod
7	Hose Reel
8	Capscrew
9	Lockwasher
10	Hose Reel Pin

Fig. 6-105: Upper Chain and Hose Reel Assembly – Middle (Forward) Boom

33. (Ref. Fig. 6-105) Install upper chains and hose reel assembly on middle (forward) boom section as follows:

    a. Install two (2) hose reels (Item 7) to rear of boom section with hose reel pins (Item 10). Secure each pin to boom section with lockwasher (Item 9) and capscrew (Item 8). Torque capscrews to 216 in-lbs.



#	Description
1	Inner Boom Section
2	Upper Slide Pad
3	Slide Pad Retainer
4	Flatwasher
5	Lockwasher
6	Capscrew

#	Description
7	Lockwasher
8	Button-Head Socket Capscrew
9	Middle (Forward) Boom Section
10	Shim
11	Middle (Rear) Boom Section
12	Side Slide Pad

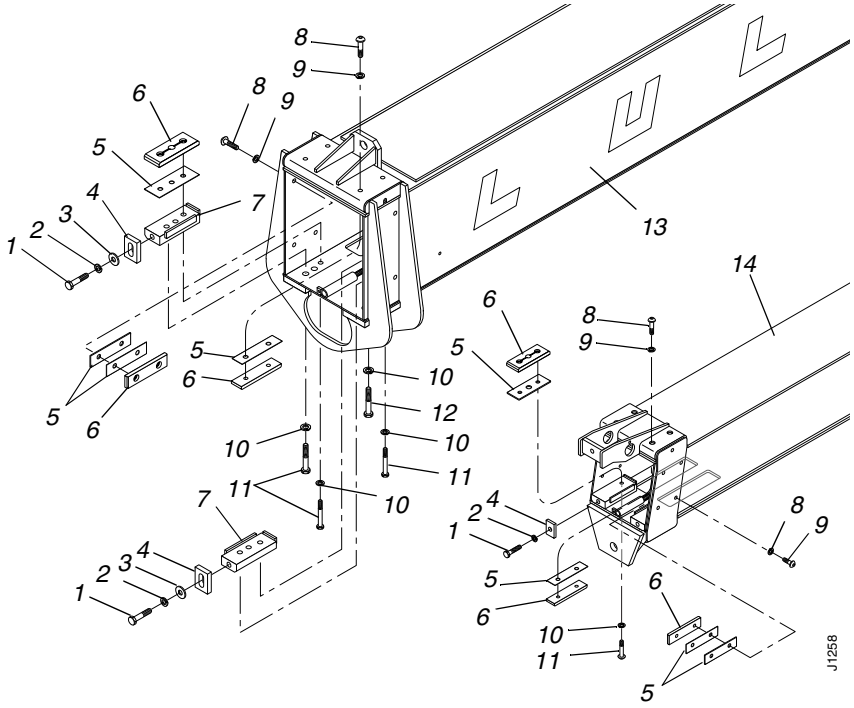
Fig. 6-106: Rear Slide Pad Installation

34. (Ref. Fig. 6-106) After applying thread locking compound to the capscrews, install remaining slide pads (Items 2 and 12) and shims (Item 10) on rear of boom sections with lockwashers (Item 7) and capscrews (Item 8). Torque slide pad capscrews to 180 in-lbs.

    Note: *See “Shimming Procedures” on page 6-48 for details in determining the number of shims that will be required when performing Steps 34 and 37.*

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35. (Ref. Fig. 6-106) Install slide pad retainers (Item 3) with flatwashers (Item 4), lockwashers (Item 5), and capscrews (Item 6). Torque capscrews to 200 ft-lbs.



#	Description	#	Description
1	Capscrew	8	Button-Head Socket Capscrew
2	Lockwasher	9	Lockwasher
3	Flatwasher	10	Lockwasher
4	Slide Pad Retainer	11	Capscrew
5	Shim	12	Capscrew
6	Slide Pad	13	Outer Boom Section
7	Retainer Block	14	Middle (Rear) Boom Section

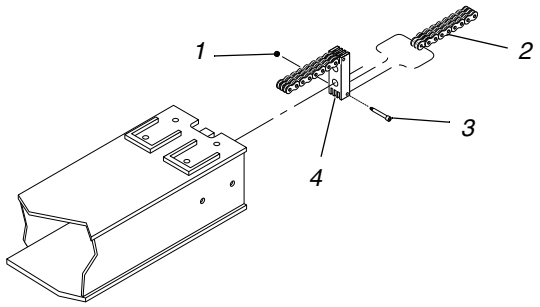
Fig. 6-107: Front Slide Pad Installation – Outer and Middle (Rear) Boom Sections

36. (Ref. Fig. 6-106) Install two (2) retainer blocks (Item 7) on front of outer boom section (Item 13) with lockwashers (Item 10) and capscrews (Items 11 and 12). Torque capscrews (Item 11) to 90 ft-lbs and capscrew (Item 12) to 200 ft-lbs.

37. (Ref. Fig. 6-106) After applying thread locking compound to the capscrews, install remaining slide pads (Item 6) and shims (Item 5) on front of outer and middle (rear) boom sections with lockwashers (Item 9) and capscrews (Item 8). Torque capscrews to 180 in-lbs.

38. (Ref. Fig. 6-106) Install remaining slide pad retainers (Item 4) with flatwashers (Item 3), lockwashers (Item 2), and capscrews (Item 1). Torque capscrews to 200 ft-lbs.

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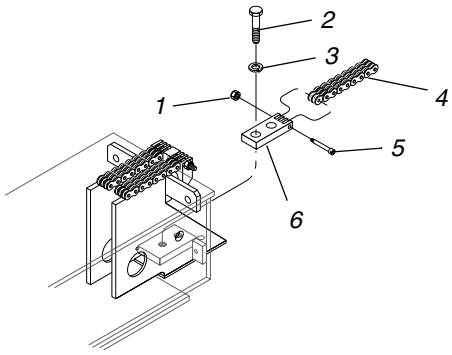


#	Description
1	Lock Nut
2	Lower Chain

#	Description
3	Shoulder Bolt
4	Rear Chain Anchor

Fig. 6-108: Lower Chain Installation – Inner Boom Section

39. Install lower chain (Item 2) from inside middle (rear) boom section to rear chain anchor (Item 4) at rear of inner boom section with shoulder bolt (Item 3) and lock nut (Item 1). Torque lock nut to 108 in-lbs.



#	Description
1	Lock Nut
2	Capscrew
3	Lockwasher

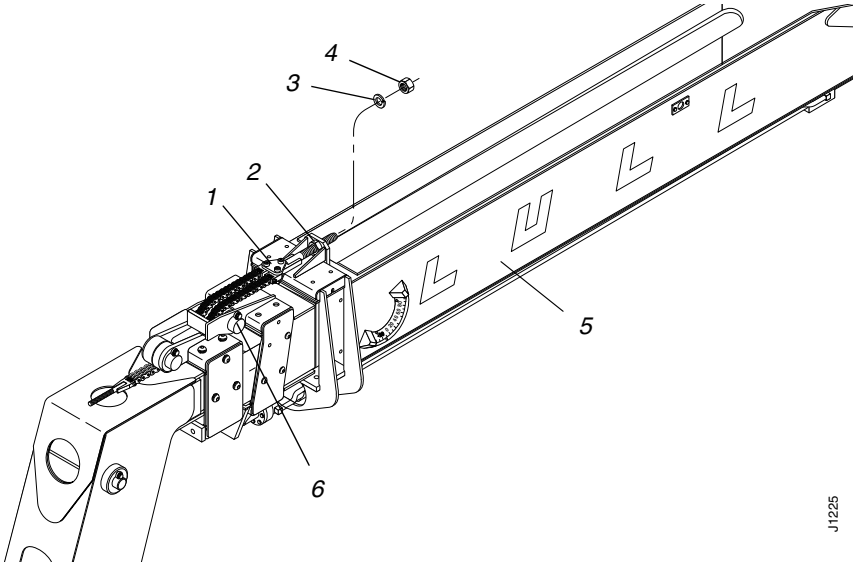
#	Description
4	Lower Chain
5	Shoulder Bolt
6	Lower Chain Anchor

Fig. 6-109: Lower Chain Installation – Middle (Forward) Boom Section

40. Install lower chain assembly from inside outer boom section to middle (front) boom section as follows:

    a. Install lower chain anchor (Item 6) on lower chain (Item 4) with shoulder bolt (Item 5) and lock nut (Item 1). Torque lock nut to 108 in-lbs.

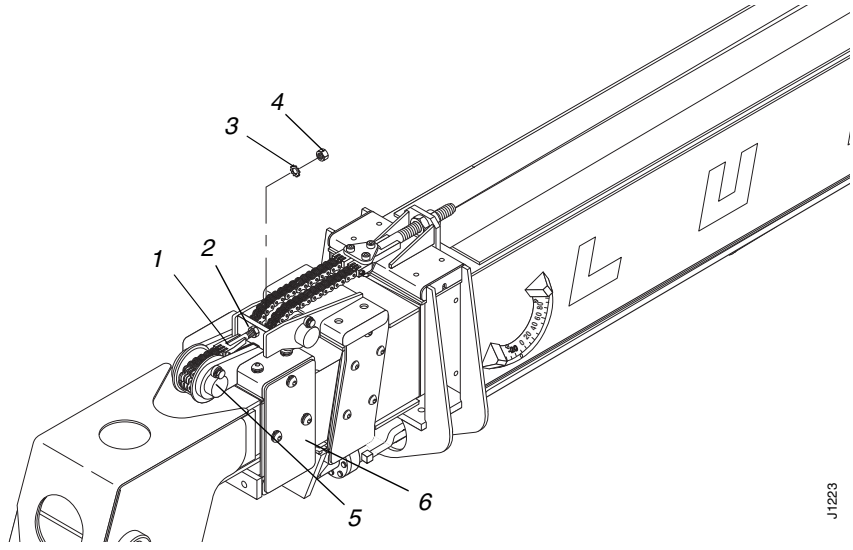
    b. Install lower chain anchor on rear of boom section with two (2) lockwashers (Item 3) and capscrews (Item 2). Torque capscrews to 280 ft-lbs.



#	Description	#	Description
1	Chain Anchor	4	Nut
2	Jam Nut	5	Outer Boom Section
3	Lockwasher	6	Upper Chain Roller Assembly

Fig. 6-110: Upper Chains – Middle (Rear) to Outer Boom Sections

41. (Ref. Fig. 6-110) Secure upper chain to outer boom section as follows:
    a. Bring upper chain lying on top of middle (front) boom section up and around the upper chain roller assembly (Item 6) on the middle (rear) boom section (Item 5).
    b. Install jam nut (Item 2) on chain anchor (Item 1) and insert threaded portion of chain anchor through opening in bracket at top of outer boom section.
    c. Secure chain anchor with lockwasher (Item 3) and nut (Item 4). Torque anchor nut to 120 ft-lbs.



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#	Description
1	Chain Adjustment Anchor
2	Jam Nut
3	Lockwasher

#	Description
4	Nut
5	Upper Chain Roller Assembly
6	Middle (Forward) Boom Section

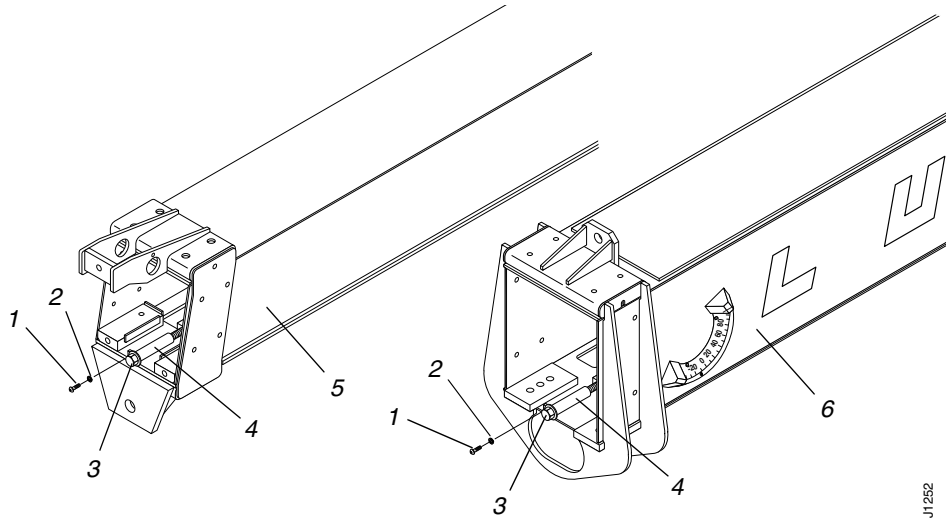
Fig. 6-111: Upper Chain – Middle (Forward) to Middle (Rear) Boom Sections

42. (Ref. Fig. 6-111) Secure upper chain to middle (rear) boom section as follows:

    a. Bring upper chain lying on top of inner boom section up and around the upper chain roller assembly (Item 5) on the middle (forward) boom section (Item 6).

    b. Install jam nut (Item 2) on chain adjustment anchor (Item 1). Insert threaded portion of chain adjustment anchor through opening in bracket at top of middle (rear) boom section.

    c. Secure chain anchor with lockwasher (Item 3) and nut (Item 4). Torque nut to 374 ft-lbs.



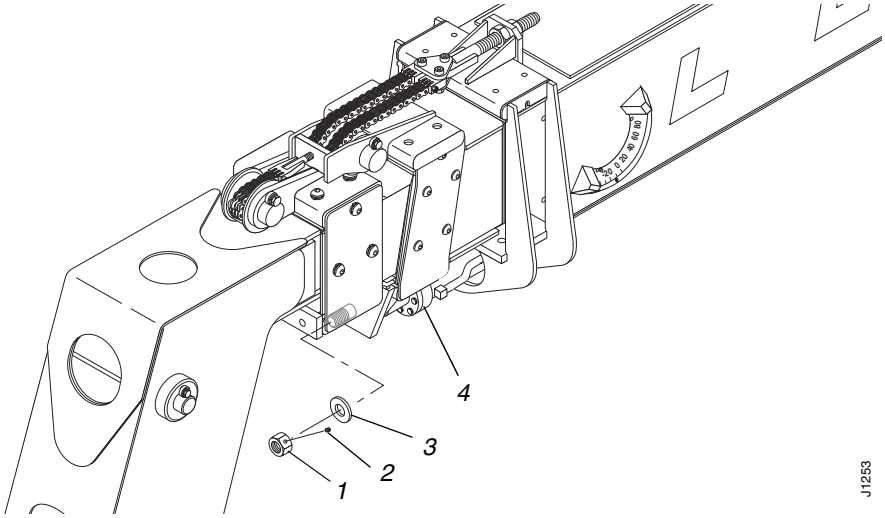
#	Description
1	Capscrew
2	Lockwasher
3	Adjustment Rod

#	Description
4	Anchor Base
5	Middle (Rear) Boom Section
6	Outer Boom Section

Fig. 6-112: Securing Lower Chains – Middle (Rear) and Outer Boom Sections

43. (Ref. Fig. 6-112) Align notch in head of adjustment rod (Item 3) with threaded hole in anchor base (Item 4) of middle (rear) (Item 5) and outer boom (Item 6) sections. Secure adjustment rod with lockwasher (Item 2) and capscrew (Item 1). Torque capscrews to 50 in-lbs.

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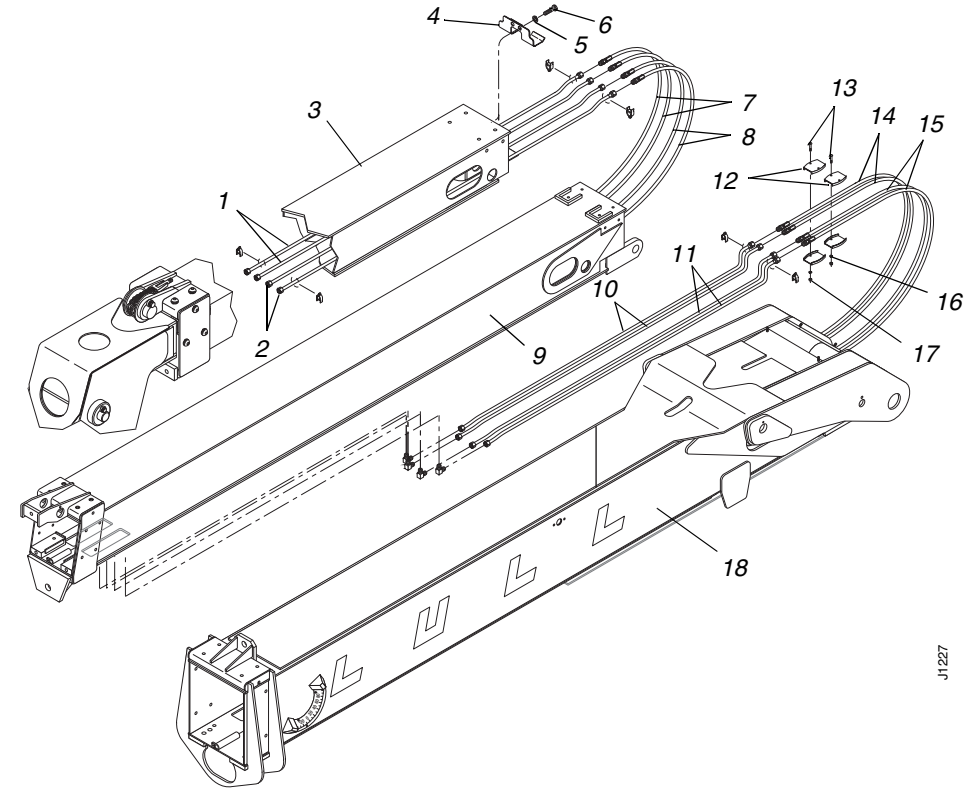


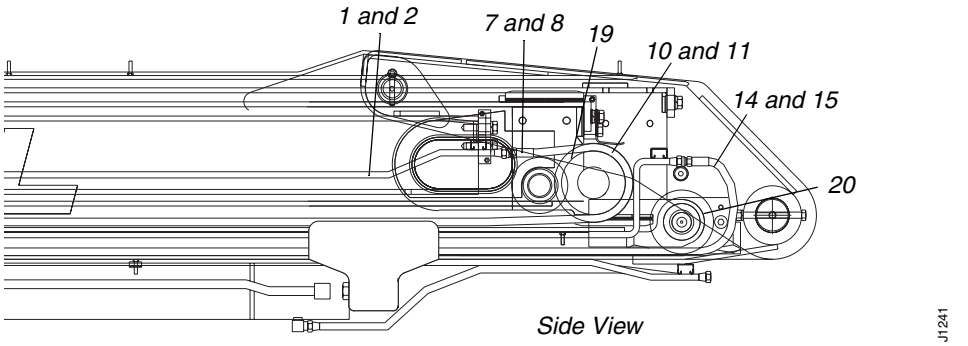
#	Description	#	Description
1		3	Cylinder Rod Boss
2	Setscrew	4	Boom Extension Cylinder

Fig. 6-113: Securing Boom Extension Cylinder

44. (Ref. Fig. 6-113) Secure extension cylinder (Item 4) to front of middle (rear) boom section with extension cylinder rod boss (Item 3) and rod nut (Item 1). Torque rod nut to 733 ft-lbs. Secure rod nut with two (2) setscrews (Item 2).

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#	Description
1	Auxiliary Hydraulic Tube
2	Carriage Tilt Hydraulic Tube
3	Middle (Front) Boom Section
4	Hose Guard
5	Lockwasher
6	Capscrew
7	Auxiliary Tilt Hydraulic Hose
8	Carriage Tilt Hydraulic Hose
9	Middle (Rear) Boom Section
10	Auxiliary Hydraulic Tube

#	Description
11	Carriage Tilt Hydraulic Tube
12	Half Clamp
13	Round Head Screw
14	Auxiliary Hydraulic Hose
15	Carriage Tilt Hydraulic Hose
16	Lockwasher
17	Nut
18	Outer Boom Section
19	Hose Reels
20	Hose Rollers

Fig. 6-114: Connecting Hoses Between Sections

45. (Ref. Fig. 6-114) Connect hydraulic hoses between boom sections as follows:

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a. Bring auxiliary and front carriage tilt hoses (Items 7 and 8) from inside the middle (rear) boom section (Item 9) up and around the two (2) hose reels (Item 19) at the rear of the middle (forward) boom section (Item 3).

b. Connect the hydraulic hoses to the hydraulic tubes (Items 1 and 2) at the rear of the inner boom section. Torque swivel nut on hydraulic hoses to 50–58 ft-lbs.

c. Install hose guard (Item 4) on rear of inner boom section with two (2) each lockwashers (Item 5) and capscrews (Item 6). Torque capscrews to 280 ft-lbs.

CAUTION: Make sure hose guard is installed in the same orientation as it was before being removed. The hose guard may be different from that shown above. If hose guard is reversed, equipment damage may occur during operation of machine.

d. Bring auxiliary and front carriage tilt hoses (Items 14 and 15) from inside the outer boom section (Item 18) up and around the hose rollers (Item 20) at the rear of the middle (rear) boom section.

e. Connect the hydraulic hoses to the hydraulic tubes (Items 10 and 11) at the rear of the middle (rear) boom section. Torque swivel nut on hydraulic hoses to 50–58 ft-lbs.

46. Install assembled 4-section boom on machine as described on page 6-62.

Boom Extend and Retract Chains

Boom Chain Inspection

WARNING: Worn pins, stretched or cracked links or cracked links or corrosive enviroments can cause chain failure.A chain failure could result in uncontrolled boom movement, loss of load or machine instabiltity, and could cause death or serious injury and/or property damage.

Under normal operating conditions the extend chains will need to be inspected every 250 hours of operation. The retract chain will need to be exposed and inspected every 1000 hours of operation. Environmental conditions and dynamic impulse/shock loads can drastically affect normal operating conditions and require more frequent inspection intervals.

a. Expose Extend Chains for Inspection

1. Park the machine on level ground. Place the travel select lever in (N) NEUTRAL, engage the parking brake switch and raise the boom to a horizontal (level) position.
2. Lower both outriggers completely
3. Fully extend the boom until both extend chains are taut. Shut the engine OFF.

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The extend chains will be visible for inspection with the machine in this state.

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.

Note: ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.*

b. Expose Retract Chains for Inspection

Note: *The three retract chains are only partially visible through the rear of the boom with all the sections retracted. It is possible to see a section of the retract chain as the boom is slowly extended. If there is ANY question that one or all the retract chains are damaged, the boom should be removed and disassembled with the retract chains being inspected and replaced if necessary.*

c. Removing Extend and Retract Chains for Inspection

The four extend chains and the three retract chains can only be removed during a complete boom teardown.

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevis' be replaced at the same time.

Note: ***DO NOT*** *attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all chains and clevis' be replaced at the same time.*

Chain Lubrication

After inspection and before being returned to service, chains must be lubricated with a quality chain lubricant ("LUBRIPLATE" Chain & Cable Fluid, "LPS3" or equivalent).

The lubricant must penetrate the chain joint to prevent wear. Applying lubricant to the external surfaces will prevent rust, but the chains should be articulated to make sure the lubricant penetrates to the working surfaces between the pins and links.

To prepare the chain for lubrication, the chain plates should be brushed with a stiff brush or wire brush to clear the space between the plates so that the lubricant can penetrate to the working surfaces.

Lubricant may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded with lubricant, and the boom should be extended and retracted to be sure that the lubricant penetrates to the working surfaces. All surplus lubricant should be wiped away from the external surfaces. **DO NOT** use a solvent for this wiping operation.

Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often.

Lubrication of chains on vehicles working consistently in extreme hot or cold conditions requires special consideration. It is important that a reputable lubrication specialist, consult the local distributor or the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, for guidance.

Boom Chain Tension Check

1. Make sure the carriage is attached to the gooseneck before doing the tension check.
2. Start the engine. If necessary, attach carriage to gooseneck. Park the vehicle on level ground. Place the travel select lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, engage the parking brake switch and raise the boom to a horizontal (level) position.
3. Lower both outriggers completely.
4. Slowly, fully extend the boom and retract it about halfway. Fully extend the boom again, then retract it 3" (51 mm) (one inch per section). Turn the engine OFF.
5. Measure the sag in each of the three boom extend chains (**1**) between the bottom of the extend chains and the top of the boom at their closest point (**2**). Acceptable boom chain sag (**3**) is between 1.5" (38 mm) and 2.5" (64 mm). If the measurement is either less than, or greater than the range given, the boom chains need to be adjusted.
6. Start the engine, retract the boom completely and turn the engine OFF. Then look at the service oval window at the rear of boom.

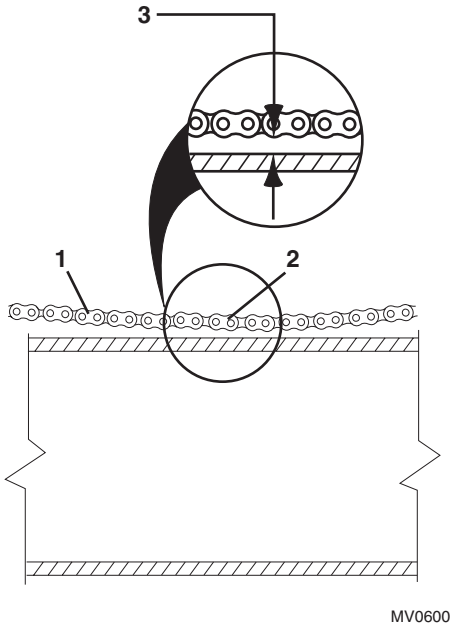


Fig. 6-115: Boom Tension Check

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7. Make sure the service ovals are lined up on the side rear of boom. If not, adjust forward middle boom section first. Tighten the extend chain to move the forward middle boom forward, or tighten the retract chain to move the forward middle boom towards the rear. recheck chain tension.
8. Then adjust the inner boom, retract the boom all the way and check the clearance at the gooseneck. Adjust as needed

Note: *If boom is too far to the rear, the gooseneck can hit the slide pad retainers.*

Boom Hose Replacement

WARNING: Fall Hazard. Use extreme caution when checking items beyond your normal reach. Use an approved ladder. Failure to comply could result in death or serious injury.

1. Lower both outriggers completely.
2. Remove the cover from the rear of the outer boom.
3. Loosen the tube clamps at the front and rear of the inner boom.
4. Remove hoses from tubes. From the rear of the boom, pull the disconnected hose ends off the hose sheaves and out the rear of the boom.

WARNING: Escaping hydraulic fluid under pressure can penetrate the skin causing death or serious injury. Relieve hydraulic pressure before serving any hydraulic component.

5. Extend the boom to the letter “C” to gain access to remove hose sheave pins through rear boom service access. Remove the hose sheave pins left and right. Then remove the hose sheaves.

WARNING: DO NOT perform service or maintenance on the vehicle with the engine running, with the exception of the transmission level check. Contact with moving parts can cause death or serious personal injury.

6. Connect new hoses to the old hoses at the rear of the boom.
7. Extend the boom until you can remove the first tube clamp on the rear middle boom.
8. Remove bolts that secure the manifolds to the boom and remove hoses from the manifolds. (For machines with 2nd aux. hydraulic lines, you will have to remove the tubes from the manifold to remove the hoses).
9. Pull the new hoses into the boom and secure the hoses and or the tubes to the manifolds. Then reconnect the manifolds to the boom.
10. Reinstall the tube clamps to the rear middle boom and retract the boom to position the hose sheave pins for reinstallation from the rear service access.

11. Install new hose sheaves with existing sheave retaining pins. Pull hoses up around sheave and reattach to tubes. Avoid crossing or twisting hoses when reconnecting and tightening.

Note: *There is a change in the hose routing. Please follow the instructions below.*

For units with 2nd aux., connect the inner hose on the hose sheave to the upper inner tube, connect the middle hose on the hose sheave to the lower 2nd aux. tube and connect the outer hose on the hose sheave to the upper outer tube.

12. At the front of the boom, pull the tubes forward until the ferrules of the tubes butt up against the hose clamps at the rear of the inner boom. At the front of the inner boom, install and secure tube stops against hose clamp channel. At the rear of the inner boom align and secure the upper tube clamps with the hoses on the hose sheaves. Secure tube clamps at the front of the inner boom. Do not secure tube clamps at the front of the inner boom. Do not secure tube clamps on 2 aux. units, see step 12.
13. This is a change in the hose routing for 2nd aux. units only. Take the hose that is connected to the tube marked 2 and transfer to the tube marked 3, take the hose from tube 3 and connect it to the tube marked 2. Repeat the procedure for tubes 4 and 5.
14. Retract the boom. Disconnect outer hoses at rear of outer boom and cap the left side hoses, to prevent the left side hoses from expelling fluid when the boom is raised or lowered to access the rear tube/hose hold down clamps.
15. Fully extend the transfer carriage and partially extend the boom. Loosen and remove the forward most tube clamps on the outer boom. Remove the fastening hardware securing the hydraulic manifold to the front and bottom of the outer boom. Disconnect the hoses from the manifold, and the tubes if necessary.
16. Remove the fastening hardware from the most rear tube/hose clamps on the under side of the outer boom. Remove the hose hold down clamp from the boom. Remove hoses from boom at the rear. Pull the hose sleeve over the hose ends that connect to the tubes at the rear of the outer boom, leaving 2” of the hose end exposed. Use the tie wraps at 12” intervals to secure the hose sleeve. Keep the locking mechanism of the tie wrap to the inside radius on the hoses.
17. Re-install the hoses. Connect the hoses to the hydraulic manifold at the front of the outer boom. Secure the manifold to the boom. Connect the tubes to the manifold. Fasten the forward most tube holder to the boom. Install the hose hold down clamp into the outer boom. Put the white plastic bushing p/n 11001518 onto the hose hold down clamp. Attach and secure the tube holder to the hose hold clamp, avoid over-tightening as this could crush the hoses. Reconnect the hoses to the tubes at the rear of the outer boom. Be careful not to twist the hoses while tightening.

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Extension Cylinder

4-Section Boom

Description

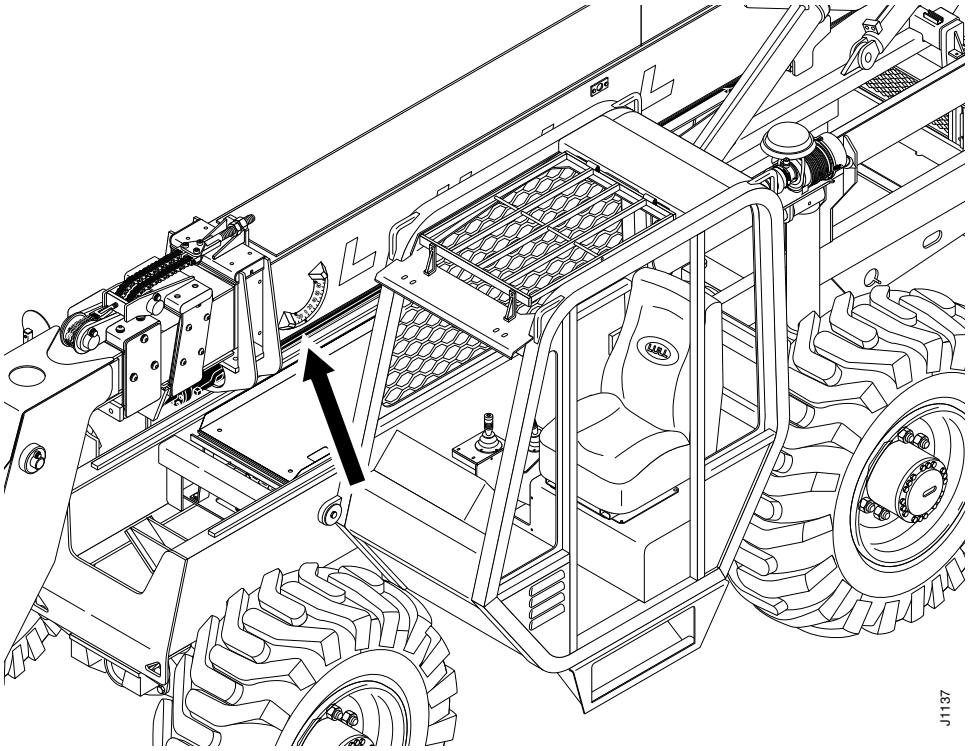
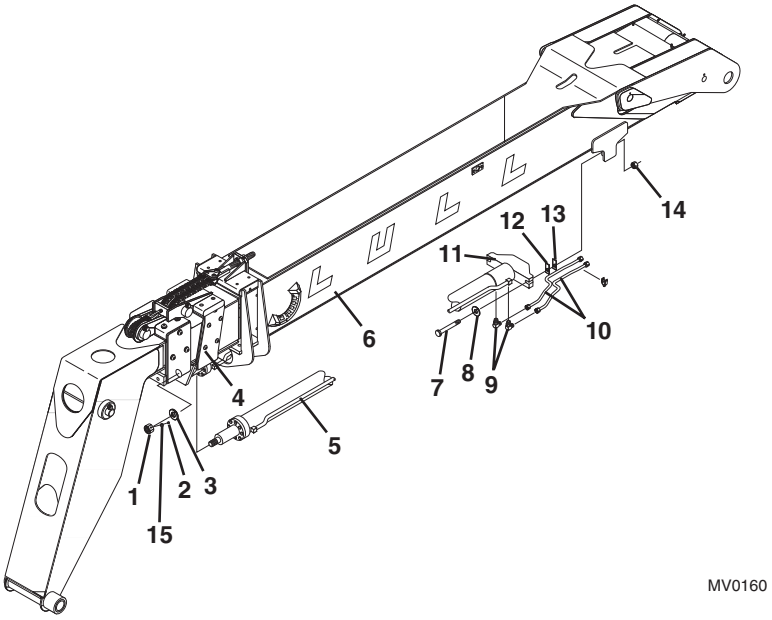


Fig. 6-116: 4-Section Boom Extension Cylinder

The 4-section boom extension cylinder is located beneath the boom assembly. It is attached from the middle (rear) to the outer boom section. Its operating pressure is 3000 psi and weighs 650 pounds. When completely retracted, it is 149-3/4" long. When fully extended, it is 280-3/4" long.

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Removal, Extension Cylinder



#	Description
1	Rod Nut
2	Socket Setscrew
3	Extension Cylinder Rod Boss
4	Middle (Rear) Boom Section
5	Boom Extension Cylinder
6	Outer Boom Section
7	Capscrew
8	Flatwasher

#	Description
9	Elbow
10	Hydraulic Tube
11	Extension Cylinder Base Mount
12	Shim
13	Shim
14	Nut
15	Lead Ball

Fig. 6-117: 4-Section Boom Extension Cylinder Installation

(Ref. Fig. 6-117) The following steps are required to remove the boom extension cylinder.

1. Follow preparation procedures as outlined in Section 3 and “General Hydraulic Maintenance Practices” on page 5-3 of this manual.
2. Disconnect any attachments and raise the boom enough so that access to the rear of the extension cylinder is possible. Apply the park brake, retract the cylinder, and shut the engine off.
3. Support the boom and extension cylinder with sling(s) and crane or other suitable means. Make sure support items have sufficient capacity to support the weight of the boom and cylinder; the combined weight of the boom and extension cylinder is approximately 6650 pounds.

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DANGER: Support of the boom is essential to avoid the possibility of injury or death should the boom fall. To avoid personal and/or equipment damage, support the hydraulic cylinder before removing any additional hardware securing cylinder to the boom. Use suitable blocking and lifting devices when removing heavy machine components.

4. Loosen and remove two (2) hydraulic tubes (Item 10) from elbows (Item 9) on boom extension cylinder (Item 5). Bleed any remaining oil into a suitable container. Cap fittings and tubes.
5. Loosen two (2) socket setscrews (Item 2) in rod nut (Item 1).
6. Loosen and remove rod nut and rod boss (Item 3) securing boom extension cylinder to front of middle (rear) boom section (Item 4).
7. Loosen and remove hardware securing extension cylinder to outer boom section (Item 6) as follows.

   Remove two (2) each nuts (Item 14), capscrews (Item 7), and flatwashers (Item 8) securing extension cylinder base mount (Item 11) to outer boom section. Also, remove the shim(s) (Items 12 and 13).
8. Slowly remove the cylinder from the machine and take it to a location suitable for inspection and disassembly.
9. Clean remaining parts with solvent and dry with compressed air. Inspect for damage and replace as necessary.

Installation, Extension Cylinder

The following steps are required to install the boom extension cylinder (Ref. Fig. 6-117).

1. Using sling(s), crane, or other suitable means, position rod end of cylinder (Item 5) in its proper location on the middle (rear) boom section (Item 4).

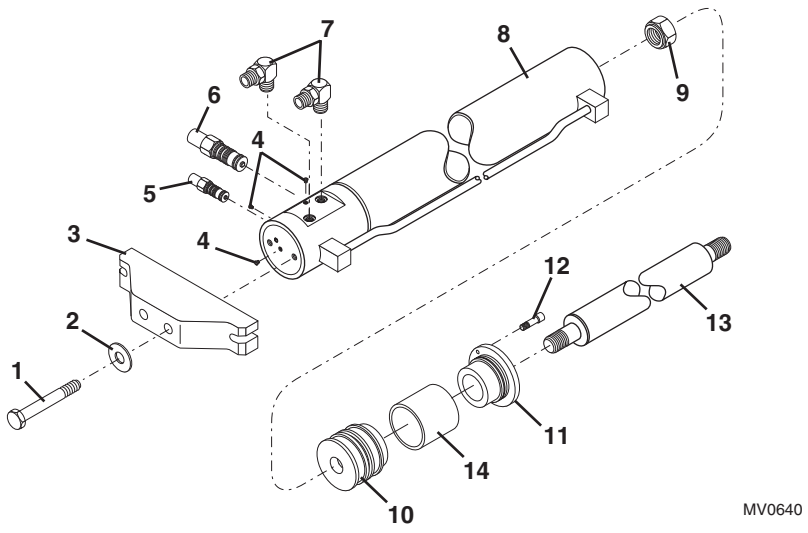
WARNING: To avoid personal and/or equipment damage, make sure the cylinder is properly supported until it is completely installed.

2. Secure cylinder to middle (rear) boom section with rod boss (Item 3) and rod nut (Item 1).
3. Secure cylinder to outer boom section with hardware as follows.

   Use two (2) each nuts (Item 14), flatwashers (Item 8), and capscrews (Item 7). Install as many shims (Items 12 and 13) as necessary before installing the nuts. Torque nuts to 680 ft-lbs.
4. Torque rod nut to 733 ft-lbs.
5. If socket setscrews (Item 2) were removed, install them in rod nut.
6. Reconnect two (2) hydraulic tubes (Item 10) to elbows on extension cylinder. Torque tube swivel nuts to 79–88 ft-lbs.

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Overhaul, Extension Cylinder



#	Description	#	Description
1	Bolt	8	Cylinder Barrel
2	Flatwasher	9	Rod Nut
3	Extension Cylinder Base Mount	10	Piston
4	Hollow Hex O-ring Plug	11	Rod Bearing Head
5	Counterbalance Valve Cartridge	12	Capscrew
6	Counterbalance Valve Cartridge	13	Rod Bearing Head
7	90° O-ring Elbow	14	Tube

Fig. 6-118: 4-Section Boom Extension Cylinder Assembly

(Ref. Fig. 6-118) The following steps are required to overhaul the boom extension cylinder.

1. Remove base mount from the cylinder barrel as follows:

   Remove two (2) each capscrews (Item 1) and flatwashers (Item 2) along with the extension cylinder base mount (Item 3) from the cylinder barrel (Item 8).

2. Mount or support cylinder vertically with rod end down. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under the cylinder.

3. Release pressure in counterbalance valve cartridges (Items 5 and 6) as follows:

WARNING: Counterbalance valve cartridges trap hydraulic pressure in the cylinder. Wear proper eye and hand protection when removing counterbalance valve cartridges. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

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a. Place socket wrench over counterbalance valve cartridge. Wrap a clean shop rag around the socket to cover the area of the counterbalance valve cartridge.

b. Carefully and slowly, turn cartridge out of manifold block to release pressure in cylinder.

4. Remove the counterbalance valve cartridges.
5. Slowly extend and retract cylinder by hand to remove most of the hydraulic oil.
6. Remove one (1) setscrew (Item 12) securing rod bearing head (Item 11) to cylinder barrel.
7. Remove cylinder rod (Item 13) from cylinder barrel.

CAUTION: To prevent possible damage to components, support rod and head; do not wiggle rod or head back and forth during removal.

8. Remove rod nut (Item 9), piston (Item 10), tube (Item 14) and rod bearing head from cylinder rod.
9. Remove the two (2) elbows (Item 7) from cylinder barrel.
10. Remove four (4) O-ring plugs (Item 4) from cylinder manifold block.
11. Remove all O-rings, wear rings, and backup rings from cylinder components and discard.
12. Thoroughly clean components with solvent and dry with compressed air. Inspect and replace if damaged.
13. Inspect inner surface of barrel, outer surface of piston, and length of rod for scratches and scoring. If barrel, piston, or rod is damaged, it must be replaced.
14. Check condition of threads on rod, nut, and capscrews. Do not attempt to repair damaged threads.
15. Inspect counterbalance valve cartridges (Items 5 and 6), including O-rings, for condition and replace as necessary. Do not disassemble cartridges. Service to counterbalance valve cartridges is limited to installing new O-rings and replacing the entire cartridge.
16. Lubricate counterbalance valve cartridge O-rings with clean hydraulic oil.
17. Install valve cartridge (Item 5) in manifold block.
18. Install valve cartridge (Item 6) in manifold block.
19. Install four O-ring plugs (Item 4) in manifold block.
20. Lubricate new O-ring with hydraulic oil and install inside piston (seals rod to piston).
21. Lubricate new seal and wear rings with hydraulic oil and install on piston.

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22. Lubricate new O-ring, backup ring, seals, and wear rings with hydraulic oil and install on head. Using a seal driver, install new wiper seal in head. Lubricate wiper seal with hydraulic oil.
23. Slide rod bearing head (Item 11), tube (Item 14) and piston (Item 10) onto rod (Item 13). Lubricate threads on rod with hydraulic oil and install rod nut (Item 9). Torque rod nut to 1460 ft-lbs.
24. Apply removable (blue) thread locking adhesive to threads on (1) set screw (Item 12). Coat inside of barrel (Item 8) with hydraulic oil. To avoid damaging seals during assembly, carefully insert rod and head into barrel.
25. Install two (2) elbows (Item 7) on cylinder barrel.
26. Install the extension cylinder base mount (Item 3) to the cylinder barrel.
27. Install with two (2) each flatwashers (Item 2) and capscrews (Item 1).

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Boom Extension Proximity Switch

Description

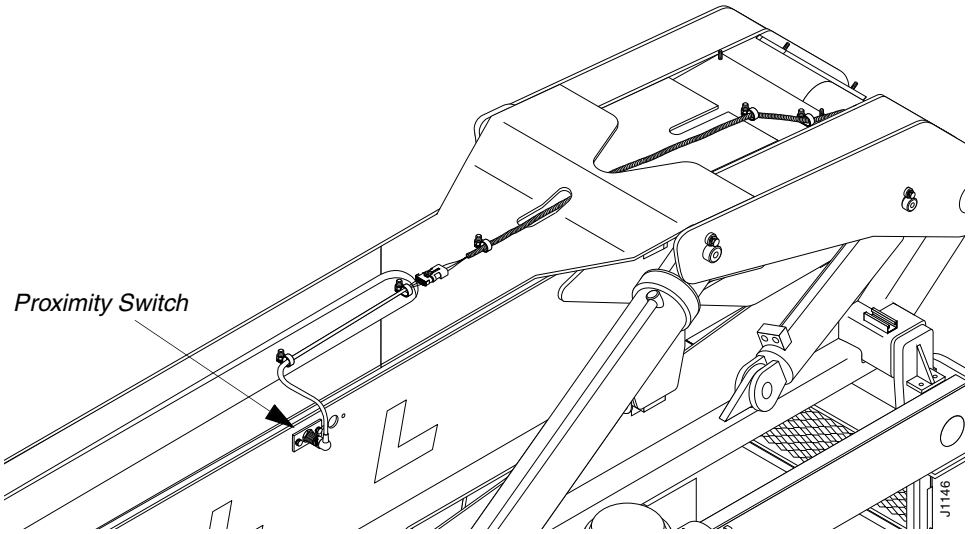


Fig. 6-119: Boom Extension Proximity Switch

(Ref. Fig. 6-119) The boom extension proximity switch is located on the left side of the outer boom section on machines with a 4-section boom. The boom extend/lockout circuit is designed to increase stability of the machine by limiting how far the boom can be extended with the outriggers up. The system will disable the boom extend and transfer extend functions and the warning lamp will come on when the boom is extended to specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage). The proximity switch then opens as it no longer senses metal. At this point, the left and right outriggers must both be lowered to the ground to allow the boom or transfer carriage to be extended any further.

Normally-open differential pressure switches in the outrigger cylinders close when the base end pressure exceeds the rod end pressure by approximately 90–95 psi. When both pressure switches close, this completes the circuit, allowing the boom and transfer carriage to be extended, and the lamp turns off. The system is fail-safe in that it requires an electrical signal to enable the boom to be extended beyond the specified distance.

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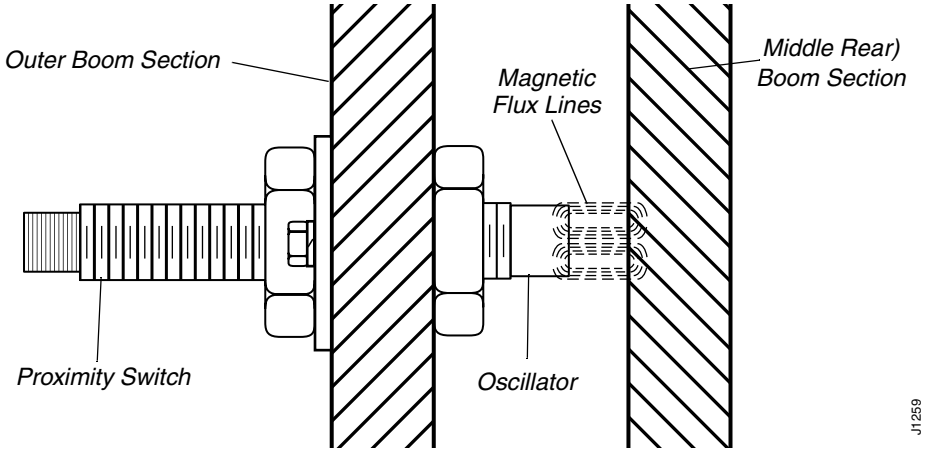
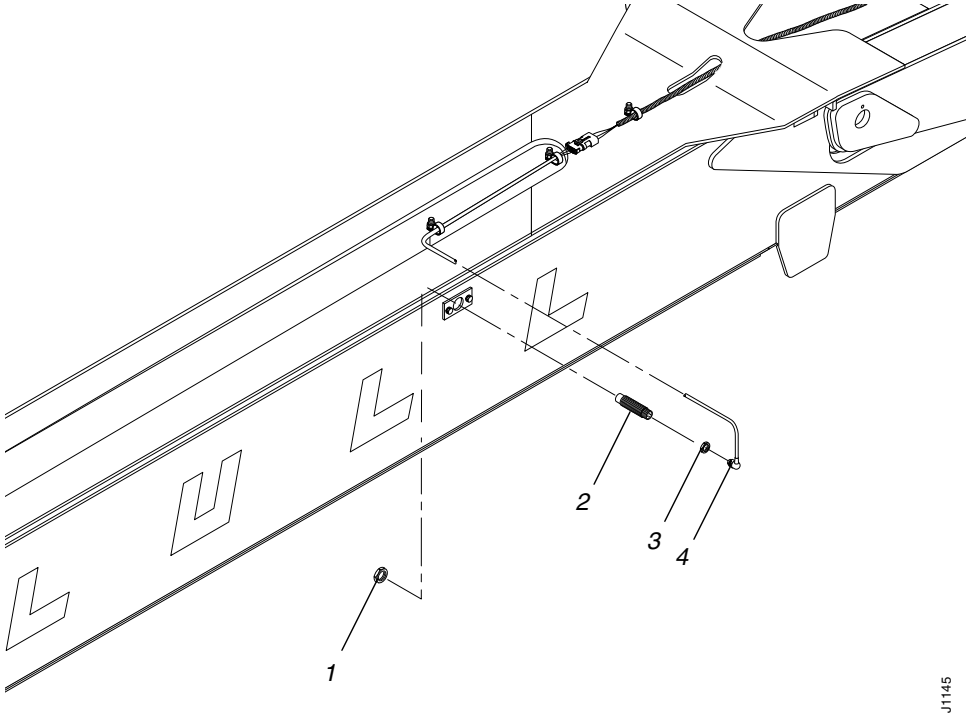


Fig. 6-120: Boom Extension Proximity Switch Operation

(Ref. Fig. 6-120) The switch operates by sending out a constant, high frequency magnetic field a short distance from the oscillator end of the switch. Eddy currents are produced in metal when the magnetic flux lines pass through it. These eddy currents oppose the oscillations of the magnetic flux lines and the oscillations stop. A sensor in the switch detects if the oscillator is on or off and this gives the switch its on/off function.

Removal

Boom Extension Proximity Switch



#	Description	#	Description
1	Inner Jam Nut	3	Outer Jam Nut
2	Proximity Switch	4	Wire Harness

Fig. 6-121: Boom Extension Proximity Switch Assembly

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(Ref. Fig. 6-121) The following procedure describes removal of the boom extension proximity switch.

1. Disconnect wire harness (Item 4) at boom extension proximity switch (Item 2).
2. Place a piece of masking tape around proximity switch body at the outer jam nut (Item 3) (this will serve as a guide during reinstallation).
3. Remove inner jam nut (Item 1) and proximity switch. Reinstall inner jam nut on proximity switch for safekeeping.

Installation

Boom Extension Proximity Switch

(Ref. Fig. 6-121) The following procedure describes installation of the boom extension proximity switch.

1. Position outer jam nut (Item 3) on switch body (Item 2) at previously marked position.
2. Install boom extension proximity switch in outer boom. Install inner jam nut (Item 1). Check gap between end of proximity switch and boom. See Fig. 6-122.
3. Connect wire harness (Item 4) to proximity switch.
4. Check operation of proximity switch by extending the boom. The boom extension proximity light must come on at specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage). If the light does not illuminate, stop and retract boom. Proceed to “Adjustments” below.

Adjustments

Boom Extension Proximity Switch

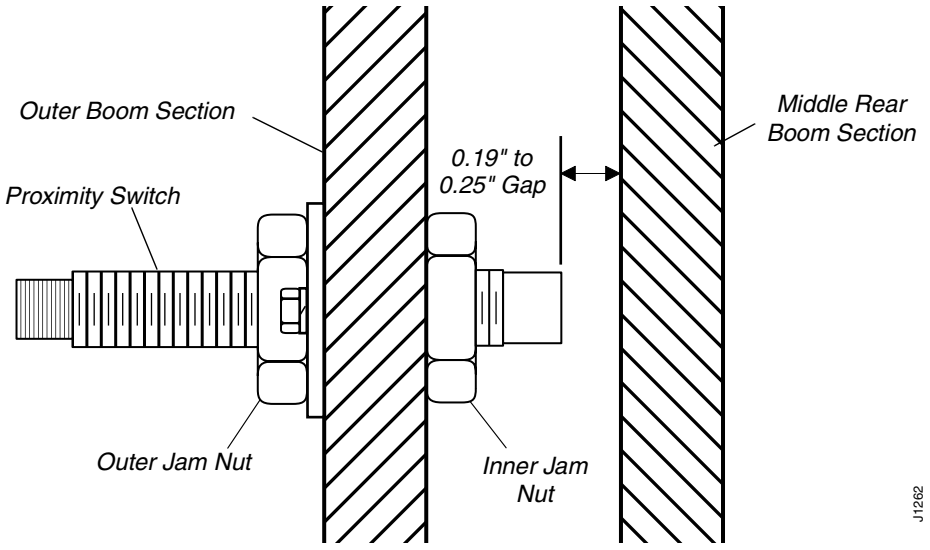


Fig. 6-122: Boom Extension Proximity Switch Adjustment

(Ref. Fig. 6-122) The following procedure describes adjustments to the boom extension proximity switch.

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1. Loosen, but do not remove the two (2) jam nuts on the proximity switch body.
2. Check gap between switch and boom. Gap must be within the range specified in Fig. 6-122.
3. If boom extension proximity light does not illuminate when boom is extended to specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage), adjust proximity switch to slightly reduce the gap. Do not exceed gap tolerances specified in Fig. 6-122. Snug jam nuts to hold switch in position.
4. Extend boom and check operation of boom extension proximity light. The light must come on when boom is extended to specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage). If light does not illuminate, stop and retract boom. Repeat Step 3.
5. Tighten jam nuts.

Transfer Carriage

Description

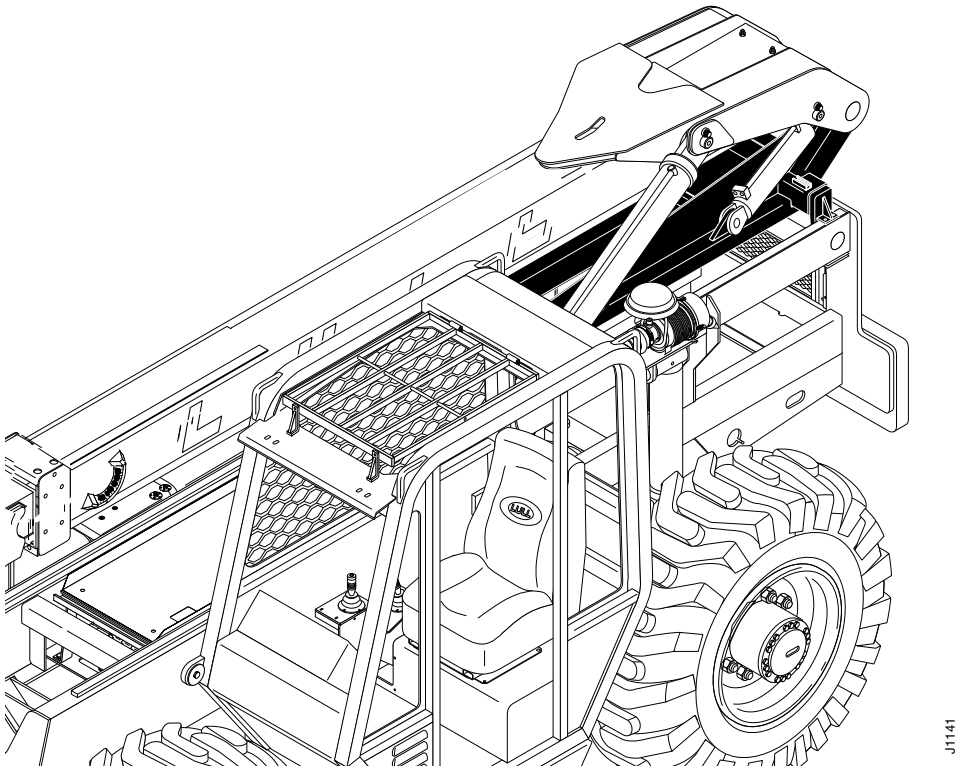


Fig. 6-123: Transfer Carriage

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The transfer carriage, along with the transfer cylinder, make up the “Trans-Action” feature. This feature makes it possible to land materials from a parked, level machine by driving the boom load forward at any height. The operator can then retract the boom and forks by moving the entire upper assembly rearward without driving the machine on uneven terrain.

Removal

Transfer Carriage

The following steps are required to remove the transfer carriage.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom to the ground, apply the park brake, retract the transfer cylinder, and stop the engine.

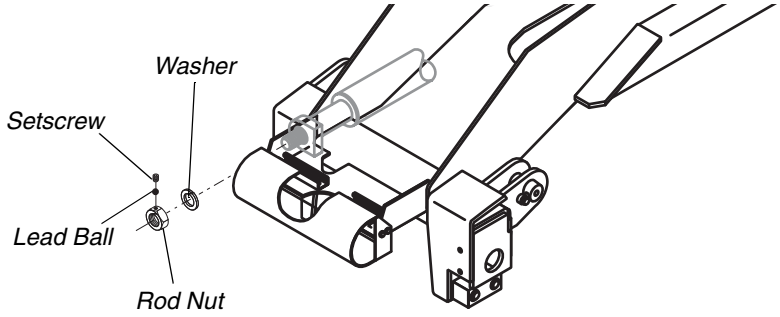


Fig. 6-124: Disconnecting Transfer Cylinder from Transfer Carriage

3. (Ref. Fig. 6-124) Loosen two (2) socket setscrews in rod nut securing transfer cylinder to the transfer carriage.
4. (Ref. Fig. 6-124) Remove transfer cylinder rod nut and washer.
5. Move transfer carriage forward enough so that the threaded port of transfer cylinder rod comes clear from its mounting hole. Block and secure the transfer cylinder to the main frame.

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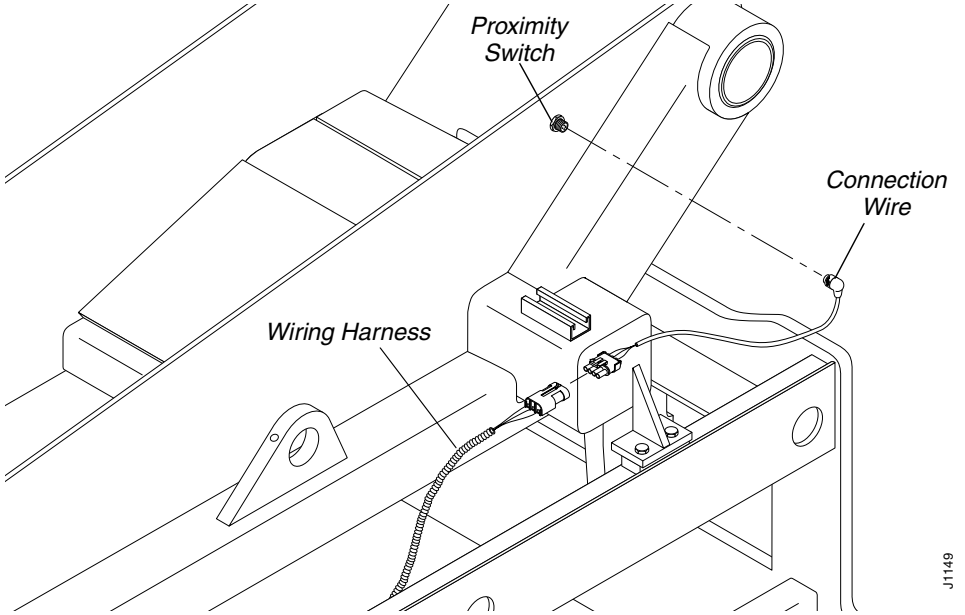
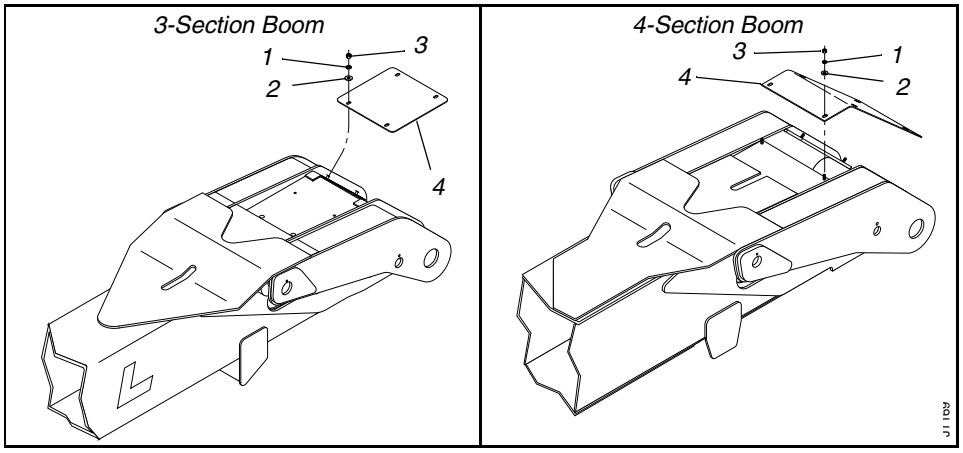


Fig. 6-125: Boom Elevation Proximity Switch Wiring

6. (Ref. Fig. 6-125) Remove boom elevation proximity switch as follows:
   a. Disconnect connection wire from boom proximity switch.
   b. Disconnect connection wire from wiring harness.
   c. Remove all wire ties that secure the wiring harness to hydraulic tubes and hoses so that it is completely separated from the transfer carriage.



#	Description
1	Lockwasher
2	Flatwasher

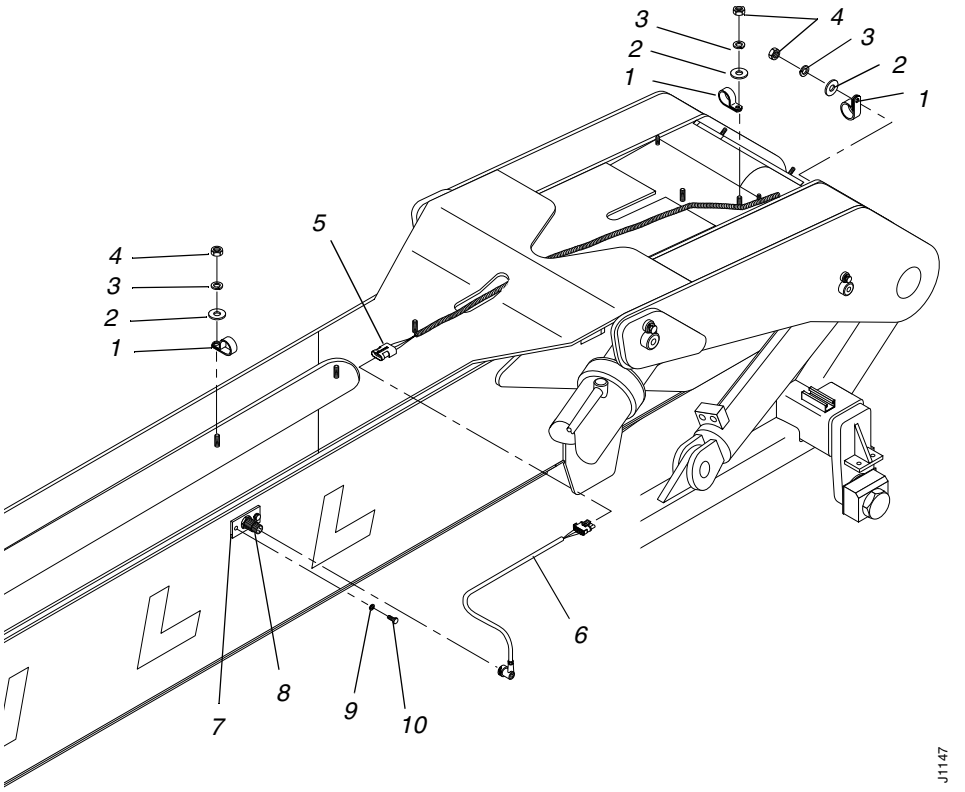
#	Description
3	Nut
4	Boom Cover

Fig. 6-126: Boom Cover Installation

7. (Ref. Fig. 6-126) Remove the boom cover on models with 3-section booms (see Step a) or 4-section booms (see Step b).
   a. Remove four (4) each nuts (Item 3), lockwashers (Item 1), and flatwashers (Item 2) securing boom cover (Item 4) to boom. Remove boom cover.

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b. Remove six (6) each nuts (Item 3), lockwashers (Item 1), and flatwashers (Item 2) securing boom cover (Item 4) to boom. Remove boom cover.



#	Description	#	Description
1	JClamp	6	Proximity Switch Connection Wire
2	Flatwasher	7	Proximity Mounting Plate
3	Lockwasher	8	Boom Extension Proximity Switch
4	Nut	9	Lockwasher
5	Proximity Switch Wiring Harness	10	Capscrew

Fig. 6-127: Boom Extension Proximity Switch Wiring

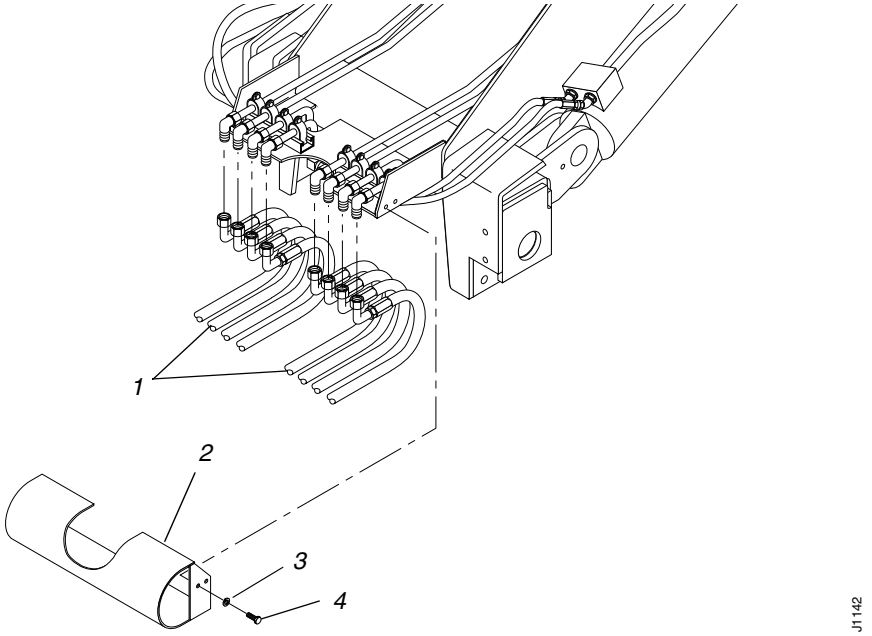
8. (Ref. Fig. 6-127) For models with a 4-section boom, remove the boom extension proximity switch as follows:

   a. Remove the six (6) each (five on top of the boom and one inside of the back left side of the boom) nuts (Item 4), lockwashers, (Item 3) flatwashers (Item 2), and J-clamps (Item 1) that secure the boom extension proximity switch wiring to the boom.

   b. Disconnect the proximity switch connection wire (Item 6) from the proximity switch (Item 8) and the wiring harness (Item 5).

   c. Remove all wire ties that secure the wiring harness to hydraulic tubes and hoses so that it is completely separated from the transfer carriage.

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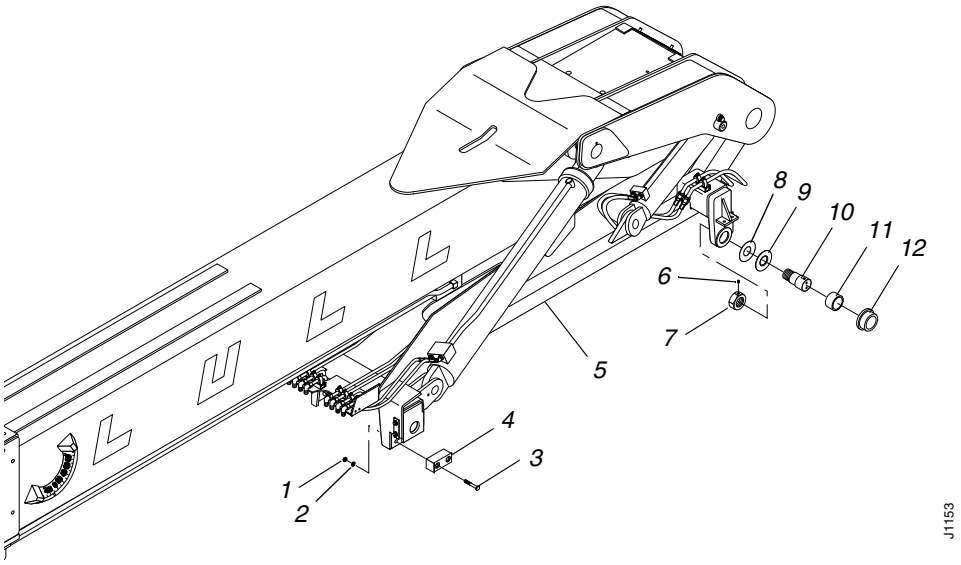


#	Description	#	Description
1	Hydraulic Hoses	3	Lockwasher
2	Hose Cover	4	Capscrew

Fig. 6-128: Disconnecting Hydraulic Hoses from Transfer Carriage

9. (Ref. Fig. 6-128) Remove four (4) each capscrews (Item 4) and lockwashers (Item 3) along with the hose cover (Item 2).
10. (Ref. Fig. 6-128) Disconnect hydraulic hoses (Item 1) from the hydraulic tube elbows.
11. If the boom and transfer carriage are being removed as an assembly, go to Step 12. If the boom is being removed separately from the transfer carriage, go to Step 13.

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#	Description
1	Nut
2	Lockwasher
3	Capscrew
4	Front Slide Block
5	Transfer Carriage
6	Setscrew

#	Description
7	Spindle Nut
8	Spacer Washer
9	Thrust Washer
10	Spindle
11	Roller Bushing
12	Transfer Roller

Fig. 6-129: Transfer Carriage with Boom Installation

12. (Ref. Fig. 6-129) The following steps are necessary if the boom and transfer carriage are to be removed as an assembly.

    a. Use sling(s), crane, or other suitable means to support the boom and transfer carriage assembly. It will be necessary to fully secure the transfer carriage securely to the boom before removal.

WARNING: To avoid personal and/or equipment damage, supporting the boom and transfer carriage is essential before removing any additional mounting hardware. Use suitable blocking and lifting devices when removing heavy machine components.

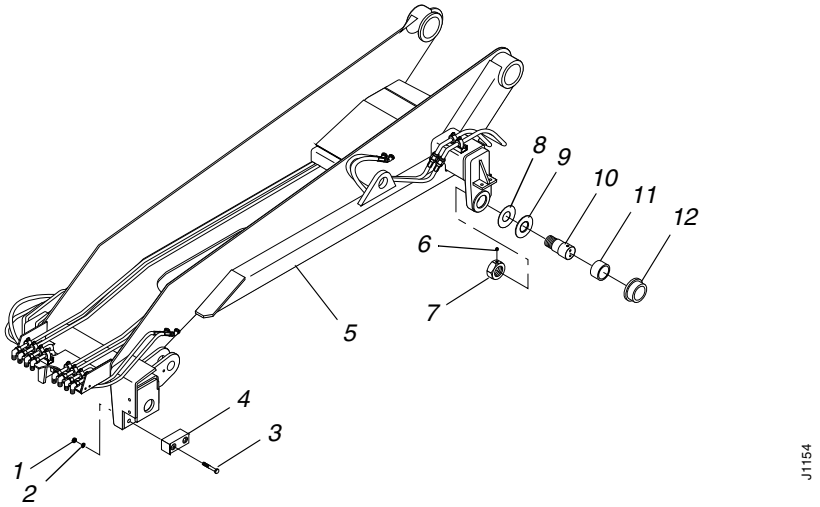
    b. Remove the four (4) each nuts (Item 1) and lockwashers (Item 2) securing the front slide blocks (Item 4) to the transfer carriage (Item 5). Remove the four (4) capscrews (Item 3) and the two (2) slide blocks.

    c. Loosen the two (2) setscrews (Item 6) in each spindle nut (Item 7).

    d. Remove the two (2) each spindle nuts, spacer washers (Item 8), thrust washers (Item 9), spindles (Item 10), roller bushings (Item 11), and transfer rollers (Item 12) from the rear transfer carriage mount.

Note: *The quantity of spacer washers used with each machine may vary.*

e. Slowly lift the boom and transfer carriage assembly up and away from the machine. Place the assembly on support blocks on a firm level surface.



#	Description
1	Nut
2	Lockwasher
3	Capscrew
4	Front Slide Block
5	Transfer Carriage
6	Setscrew

#	Description
7	Spindle Nut
8	Spacer Washer
9	Thrust Washer
10	Spindle
11	Roller Bushing
12	Transfer Roller

Fig. 6-130: Transfer Carriage Installation

13. The following steps are required if the boom is being removed separately from the transfer carriage.
    a. Remove the boom hoist cylinder (See page 6-13).
    b. Remove the rear carriage tilt cylinder (See page 6-25).
    c. Remove the boom (see this section).
    d. Use sling(s), crane, or other suitable means to support the transfer carriage assembly.

WARNING: To avoid personal and/or equipment damage, support the transfer carriage assembly before removing any additional mounting hardware. Use suitable blocking and lifting devices when removing heavy machine components.

    e. (Ref. Fig. 6-130) Remove the four (4) each nuts (Item 1) and lockwashers (Item 2) securing the two (2) front slide blocks (Item 4) to the transfer carriage (Item 5). Remove the four (4) capscrews (Item 3) and the slide blocks.
    f. (Ref. Fig. 6-130) Loosen the two (2) setscrews (Item 6) in each spindle nut (Item 7).

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g. (Ref. Fig. 6-130) Remove the two (2) spindle nuts. Remove spacer washer (Item 8), thrust washer (Item 9), spindle (Item 10), roller bushing (Item 11), and transfer roller (Item 12) from each side of the rear transfer carriage mount.

Note: *The quantity of spacer washers used with each machine may vary.*

h. Slowly lift the transfer carriage assembly up and away from the machine. Place the assembly on support blocks on a firm level surface.

Installation

Transfer Carriage

The following steps are required to install the transfer carriage.

1. If the boom and transfer carriage were removed as an assembly, go to Step 2. If the boom was removed separately from the transfer carriage, go to Step 3.
2. (Ref. Fig. 6-129) The following steps are necessary to reinstall the boom and transfer carriage assembly.
   a. Using sling(s), crane, or other suitable means of support, slowly lift the boom and transfer carriage assembly up and unto its proper position on the machine.

WARNING: To avoid personal and/or equipment damage, supporting the boom and transfer carriage assembly is essential when lifting and reinstalling it back on the machine. Make sure that the boom and transfer carriage assembly is supported until it is completely installed.

   b. Install the transfer carriage (Item 5) to rear of the main frame using the two (2) each transfer rollers (Item 12), roller bushings (Item 11), spindles (Item 10), thrust washers (Item 9), spacer washers (Item 8), and spindle nuts (Item 7). Torque spindle nuts to 3466 ft-lbs.

Note: *The quantity of spacer washers used with each machine may vary.*

   c. Secure each spindle nut with two (2) setscrews (Item 6).
   d. Install the two (2) slide blocks (Item 4) to the front of the transfer carriage with four (4) each capscrews, (Item 3) lockwashers (Item 2), and nuts (Item 1). Torque the nuts to 130 ft-lbs.
3. (Ref. Fig. 6-130) The following steps are necessary to reinstall the transfer carriage assembly.
   a. Using sling(s), crane, or other suitable means of support, slowly lift the transfer carriage assembly up and unto its proper position on the machine.

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WARNING: To avoid personal and/or equipment damage, support the transfer carriage assembly when lifting and reinstalling it back on the machine. Make sure that the transfer carriage assembly is supported until it is completely installed.

b. Install the transfer carriage (Item 5) to rear of the main frame using the two (2) each transfer rollers (Item 12), roller bushings (Item 11), spindles (Item 10), thrust washers (Item 9), spacer washers (Item 8), and spindle nuts (Item 7). Torque spindle nuts to 3466 ft-lbs.

Note: *The quantity of spacer washers used with each machine may vary.*

c. Secure each spindle nut with two (2) setscrews (Item 6).

d. Install the two (2) slide blocks (Item 4) to the front of the transfer carriage with four (4) each capscrews, (Item 3) lockwashers (Item 2), and nuts (Item 1). Torque the nuts to 130 ft-lbs.

e. Install the boom as described elsewhere in this section.

f. Install the rear carriage tilt cylinder (See page 6-26).

g. Install the boom hoist cylinder (See page 6-14).

4. Move transfer carriage backward until the threaded port of transfer cylinder rod can be inserted in its mounting hole.
5. (Ref. Fig. 6-124) Install transfer cylinder rod nut and washer. Torque cylinder rod nut to 1641 ft-lbs. Secure rod nut with two (2) setscrews.
6. (Ref. Fig. 6-128) Reconnect hydraulic hoses (Item 1) to the hydraulic tube elbows. Torque the swivel nuts on the hoses 79–88 ft-lbs.
7. (Ref. Fig. 6-128) Install the hose cover (Item 2) on the transfer carriage with four (4) each capscrews (Item 4) and lockwashers (Item 3). Torque the capscrews to 75 in-lbs.
8. (Ref. Fig. 6-125) Install boom elevation proximity switch as follows:
   a. Work the wiring harness along the hydraulic tubes on the transfer carriage.
   b. Reconnect connection wire to boom proximity switch and wiring harness.
   c. Secure wiring harness to hydraulic tubes with wire ties.
9. (Ref. Fig. 6-127) For models with a 4-section boom, install the boom extension proximity switch as follows:
   a. If necessary, install the proximity mounting plate (Item 7) with two (2) each lockwashers (Item 9) and capscrews (Item 10). Torque the capscrews to 276 in-lbs.
   b. Work the wiring harness along the hydraulic tube s on the transfer carriage and up to the top of the boom.
   c. Connect the proximity switch connection wire (Item 6) to the proximity switch (Item 8) and the wiring harness (Item 5).

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d. Secure the wiring harness and switch connection wire to the boom with six (6) each (five on top of the boom and one inside of the back left side of the boom) nuts (Item 4), lockwashers, (Item 3), flatwashers (Item 2), and J-clamps (Item 1). Tighten nuts until snug.

e. Secure the wire harness to the hydraulic tubes and hoses with wire tires.

10. (Ref. Fig. 6-126) Install the boom cover on models with 3-section (see Step a) or 4-section booms (see Step b).

    a. Install boom cover (Item 4) on boom and secure it with four (4) each flatwashers (Item 2), lockwashers (Item 1), and nuts (Item 3). Torque nuts to 180 in-lbs.

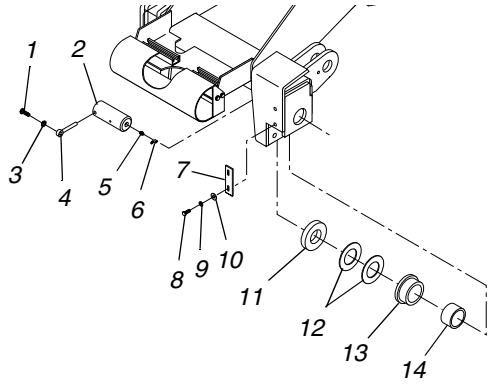
    b. Install boom cover (Item 4) on boom and secure it with six (6) each flatwashers (Item 2), lockwashers (Item 1), and nuts (Item 3). Torque nuts to 180 in-lbs.

Rollers, Bushings, and Shims

Transfer Carriage

The following procedures describe replacement of transfer rollers and bushings for the transfer carriage along with shimming procedures and replacement of scraper plates.

Front Mount Rollers, Bushings, and Shims



#	Description	#	Description
1	Capscrew	8	Capscrew
2	Front Roller Pin	9	Lockwasher
3	Lockwasher	10	Flatwasher
4	Lock Pin	11	Roller Spacer
5	Grease Fitting	12	Roller Shims
6	Grease Fitting Cover	13	Front Transfer Roller
7	Scraper Plate	14	Front Roller Bushing

Fig. 6-131: Transfer Carriage – Front Rollers, Bushings, and Shims

(Ref. Fig. 6-131) The following steps are required to replace the front transfer rollers and bushings.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom to the ground, apply the park brake, retract the transfer cylinder, and stop the engine.
3. Remove capscrew (Item 1) and lockwasher (Item 3) securing the two (2) lock pins (Item 4) to transfer carriage.

CAUTION: To avoid personal and/or equipment damage, support the boom and transfer carriage before removing the transfer roller assembly. Use suitable blocking and lifting devices to prevent the transfer carriage from dropping.

4. Remove lock pins from front roller pins (Item 2).
5. Raise the boom and transfer carriage slightly to remove roller pins, roller spacers (Item 11), roller shims (Item 12), transfer rollers (Item 13), and roller bushings (Item 14).
6. Discard transfer rollers and bushings. Clean remaining parts with solvent and dry with compressed air. Replace any damaged parts.
7. Install new bushings so that each is centered in each transfer roller.
8. Install transfer roller, roller shims, roller spacer, and roller pin on each side of transfer carriage.
9. Secure roller pins with lock pins and secure lock pins to transfer carriage with lockwashers and capscrews.

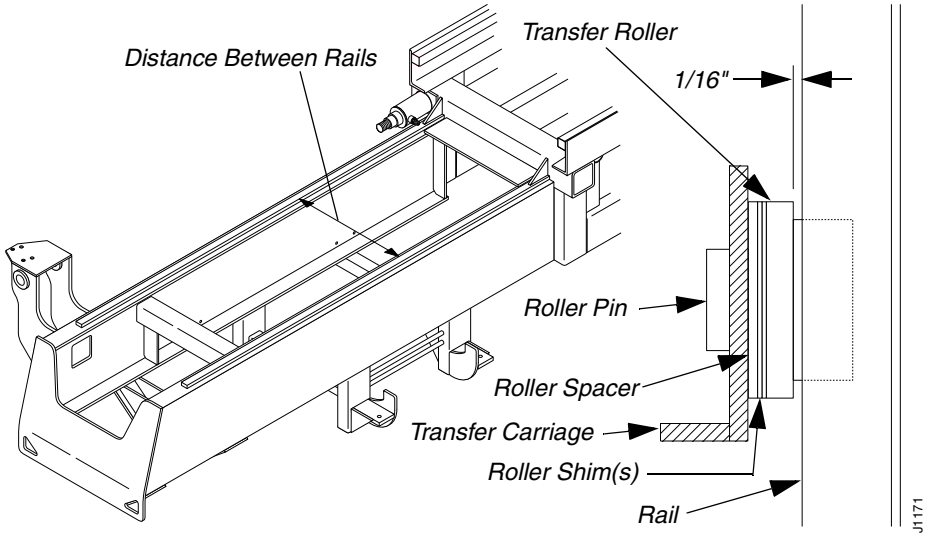


Fig. 6-132: Shims for Front Transfer Rollers

10. (Ref. Fig. 6-132) Check to see if correct number of shims are installed.
    a. Locate the point that is the shortest distance between the two rails (usually near the center of the rails).
    b. Start the engine and slowly move the transfer carriage forward until the front transfer rollers are at this point.

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c. Measure the gap between the lip of the transfer roller and the inner edge of the rail. If this measurement is not 1/16", remove the transfer roller assembly and install or remove shims until the required measurement is reached.

11. Secure front transfer roller assembly to transfer carriage by tightening capscrew (Item 1) to 55 ft-lbs.
12. Remove two (2) grease fitting cover caps (Item 6) and lubricate grease fittings (Item 5) with EP lithium based grease.

Scraper Plate

(Ref. Fig. 6-131) The following steps are required to replace scraper plates.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom to the ground, apply the park brake, retract the transfer cylinder, and stop the engine.
3. Remove two (2) each capscrews (Item 8), lockwashers (Item 9), and flatwashers (Item 10) securing each of the two (2) scraper plates (Item 7) to the front of the transfer carriage. Remove scraper plates. Clean, inspect for damage, and replace as necessary.

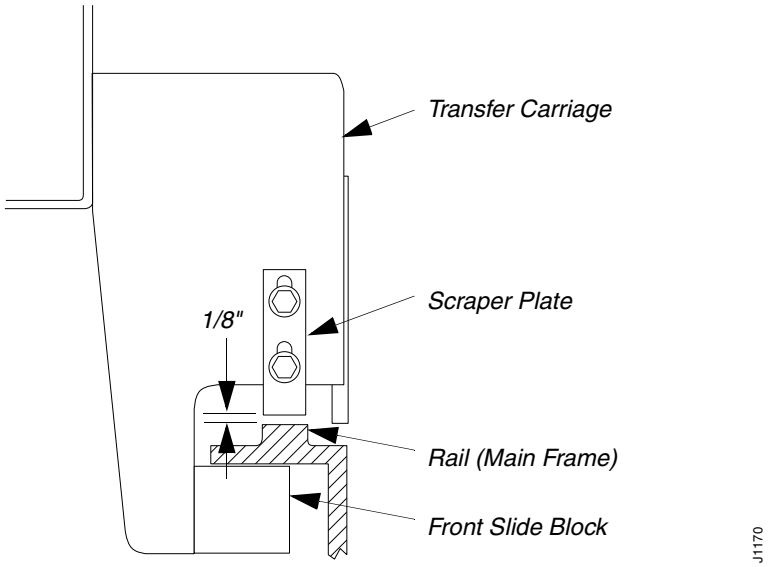
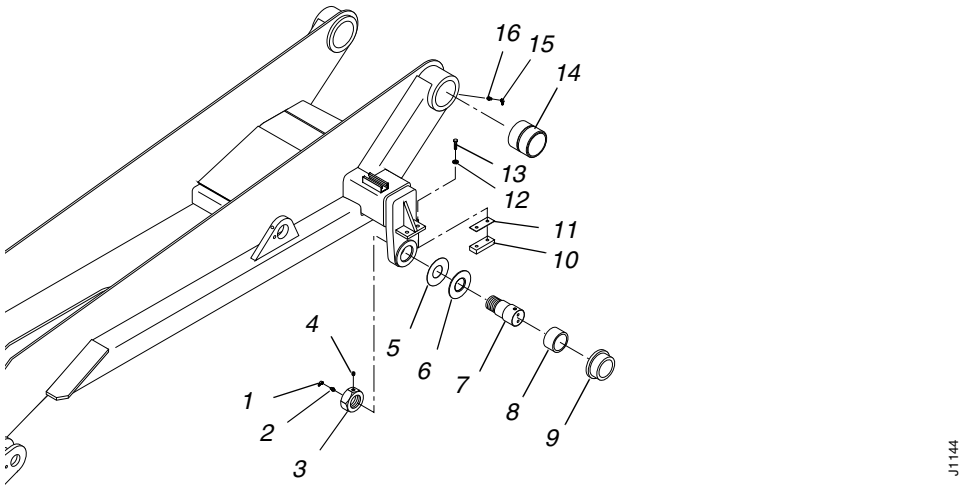


Fig. 6-133: Scraper Plate

4. Install each scraper plate with two (2) each flatwashers, lockwashers, and capscrews. Make sure that the distance from the scraper plate to the rail is as shown in Fig. 6-133. Torque capscrews to 156 in-lbs.

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Rear Mount Rollers, Bushings, and Spacer Washers



#	Description	#	Description
1	Grease Fitting Cover	9	Rear Transfer Roller
2	Grease Fitting	10	Rear Slide Block
3	Spindle Nut	11	Slide Block Shim
4	Setscrew	12	Lockwasher
5	Spacer Washer	13	Capscrew
6	Thrust Washer	14	Boom Pivot Bushing
7	Spindle	15	Grease Fitting Cover
8	Rear Roller Bushing	16	Grease Fitting

Fig. 6-134: Transfer Carriage – Rear Rollers, Bushings, and Shims

(Ref. Fig. 6-134) The following steps are required to replace rear transfer rollers and bushings.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom to the ground, apply the park brake, retract the transfer cylinder, and stop the engine.

CAUTION: To avoid personal and/or equipment damage, support the boom and transfer carriage before removing the transfer roller assembly. Use suitable blocking and lifting devices to prevent the transfer carriage from shifting.

3. Loosen two (2) setscrews (Item 4) in each spindle nut (Item 3). Remove two (2) spindle nuts.
4. Remove spacer washer(s) (Item 5), thrust washer (Item 6), spindle (Item 7), roller bushing (Item 8), and transfer roller (Item 9) from each side of transfer carriage.
5. Discard transfer rollers and bushings. Clean remaining parts with solvent and dry with compressed air. Replace any damaged parts.
6. Install new bushings so that each is centered in transfer roller.
7. Install transfer roller, spindle, thrust washer, and spacer washer(s) on each side of transfer carriage.

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8. Secure spindle to transfer carriage with spindle nut.

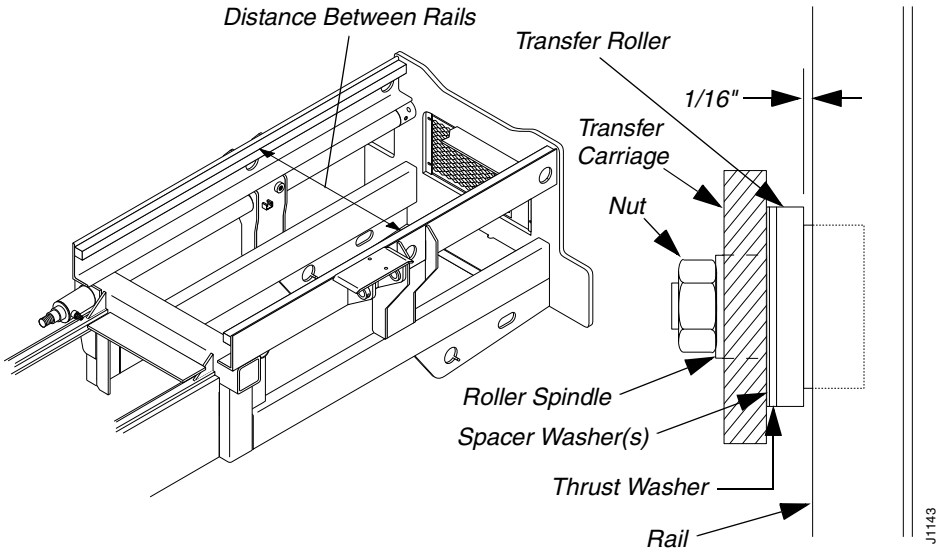


Fig. 6-135: Spacer Washers for Rear Transfer Rollers

9. (Ref. Fig. 6-135) Check to see if the number of spacer washers installed is correct.
   a. Locate the point that is the shortest distance between the two rails (usually near the center of the rails).
   b. Move the transfer carriage forward until the rear transfer rollers are at this point.
   c. Measure the gap between the lip of the transfer roller and the inner edge of the rail. If this measurement is not 1/16", remove the transfer roller assembly and install or remove spacer washers until the required measurement is reached.
10. Secure front transfer roller assembly to transfer carriage by tightening spindle nut (Item 3) to3466 ft-lbs.
11. Remove two (2) grease fitting cover caps (Item 1) and lubricate grease fittings (Item 2) with EP lithium based grease.

Transfer Carriage/Boom Pivot Bushings

(Ref. Fig. 6-134) The following steps are required to replace transfer carriage/boom pivot bushings.

1. Remove boom and shims as in this section.
2. Remove two (2) boom pivot bushings (Item 14) using a bushing driver and hammer. Discard bushings.

Note: *It may be necessary to cut out the old bushing.*

3. Install new bushings so that each is centered in transfer carriage boss.

Note: *It may be necessary to freeze the new bushing before installing it.*

4. Reinstall boom and shims as described earlier in this section.
5. Remove two (2) grease fitting cover caps (Item 15) and lubricate grease fittings (Item 16) with EP lithium based grease.

Rear Slide Block and Shims

(Ref. Fig. 6-134) The following steps are required to replace worn rear slide blocks.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom to the ground, apply the park brake, retract the transfer cylinder, and stop the engine.
3. Remove two (2) each capscrews (Item 13) and lockwashers (Item 12) securing each of the two rear slide blocks (Item 10) and shims (Item 11) to the transfer carriage. Remove slide blocks and shims.
4. Discard worn slide block. Clean and inspect remaining parts; replace as necessary.

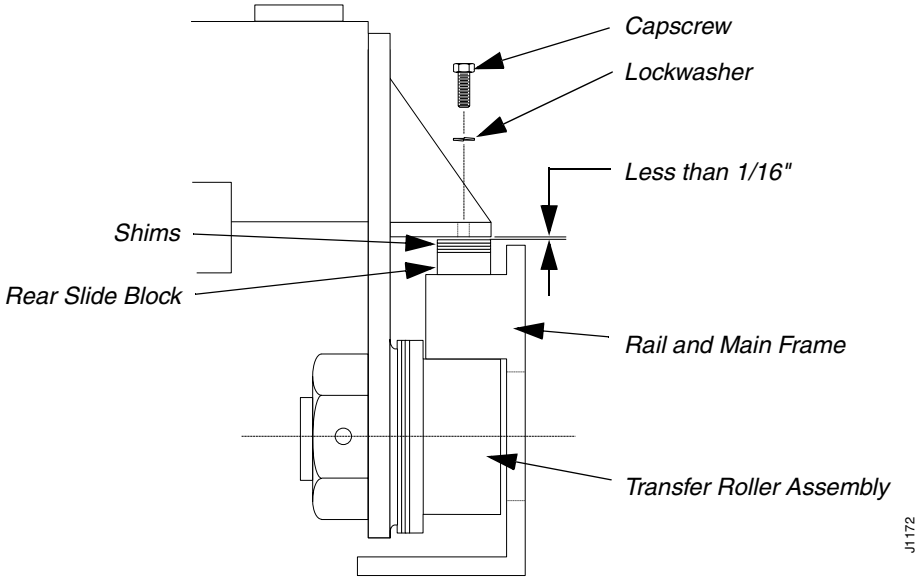


Fig. 6-136: Rear Slide Block Installation

5. (Ref. Fig. 6-136) Make sure that the correct number of shims will be installed.
   a. Check to see that the rear transfer roller is up against the bottom of the rail. It may be necessary to start the engine and relocate the weight of the boom until the transfer roller is snug against the rail.
   b. Place slide block and shims on the rail beneath the transfer carriage.
   c. Measure the space between the stack to the transfer carriage. Add or subtract shims until the remaining gap is less than 1/16".
6. Install new slide block and shims on each side of the transfer carriage with two (2) each lockwashers and capscrews. Torque capscrews to 55 ft-lbs.

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Table of Contents

Frame Tilt System 7-1
General Description 7-1
Circuit Description 7-2
Frame Tilt Control Valve 7-3
Description 7-3
Removal 7-4
Installation 7-5
Overhaul 7-6
Frame Tilt Cylinder 7-8
Description 7-8
Removal 7-9
Installation 7-10
Overhaul 7-12
Counterbalance Valve Cartridge 7-14
Frame Level Indicator 7-16
Description 7-16
Adjustment 7-16
Rear Oscillation Lock System 7-17
General Description, Models with Control Manifold Hydraulics 7-17
Theory of Operation and Circuit Logic 7-18
Testing Rear Oscillation Lock Circuit 7-23
Rear Oscillation Lock Cylinder 7-24
Description 7-24
Removal 7-25
Installation 7-26
Overhaul 7-28
Oscillation Control Block 7-31
Description 7-31
Removal 7-33
Installation 7-35
Overhaul 7-36
Boom Elevation Proximity Switch 7-38
Description 7-38
Removal 7-39
Installation 7-40
Adjustment 7-40

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List of Figures

Fig. 7-1: Frame Tilt System Components 7-1
Fig. 7-2: Frame Tilt Control Valve 7-3
Fig. 7-3: Frame Tilt Control Valve Installation 7-4
Fig. 7-4: Frame Tilt Control Valve (Exploded View) 7-6
Fig. 7-5: Frame Tilt Cylinder 7-8
Fig. 7-6: Frame Tilt Cylinder Installation 7-9
Fig. 7-7: Frame Tilt Cylinder (Exploded View) 7-12
Fig. 7-8: Counterbalance Valve Cartridges, Frame Tilt Cylinder 7-14
Fig. 7-9: Frame Level Indicator 7-16
Fig. 7-10: Leveling the Frame 7-16
Fig. 7-11: Circuit Operation Below 40° 7-18
Fig. 7-12: Circuit Operation Above 40° 7-19
Fig. 7-13: Circuit Operation Above 20° Below 40° 7-20
Fig. 7-14: Circuit Operation Above 20° Below 40° with Service Brake Applied 7-21
Fig. 7-15: Circuit Operation Below 20° With the Service Brake Applied 7-22
Fig. 7-16: Rear Oscillation Lock Cylinder 7-24
Fig. 7-17: Rear Oscillation Lock Cylinder Installation 7-25
Fig. 7-18: Rear Oscillation Lock Cylinder (Exploded View) 7-28
Fig. 7-19: Head Capscrew Torque Sequence 7-30
Fig. 7-20: Oscillation Control Block 7-31
Fig. 7-21: Oscillation Control Block Installation 7-33
Fig. 7-22: Oscillation Control Block (Exploded View) 7-36
Fig. 7-23: Boom Elevation Proximity Switch 7-38
Fig. 7-24: Boom Elevation Proximity Switch Operation 7-39
Fig. 7-25: Boom Elevation Proximity Switch Assembly 7-39
Fig. 7-26: Boom Elevation Proximity Switch Adjustment 7-40

List of Tables

Table 7-1: Rear Oscillation Lock Circuit Test Matrix 7-1

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Section 7 — Frame Tilt and Oscillation

Frame Tilt System

General Description

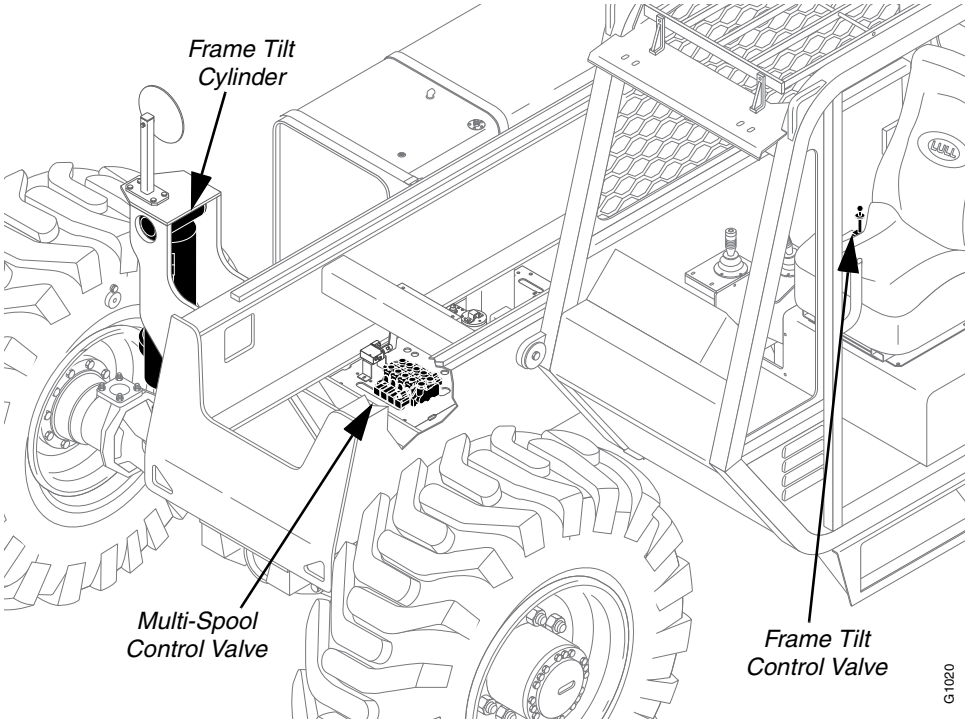


Fig. 7-1: Frame Tilt System Components

(Ref. Fig. 7-1) The frame tilt system allows the machine to be levelled laterally (side-to-side) up to 10°, left or right. The lateral angle of the machine, relative to level ground, is shown on the frame level indicator.

When hydraulic pressure is applied to the frame tilt cylinder the frame pivots around each axle. Two counterbalance valves (one on the rod end and one on the base end) are used to inhibit hydraulic fluid from exiting the frame tilt cylinder.

Function is controlled by the frame tilt control valve (see page 7-3) located in the operator's compartment.

Circuit Description

Reference Fig. 7-1 above and Section 4-1, "Reference Diagrams".

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The frame tilt system works in combination with the rear oscillation lock system. The frame tilt system is explained here. See “Rear Oscillation Lock System” on page 7-17 for detailed information concerning that system.

Control Centered

With the engine on and the boom below 40° elevation, the frame tilt system is enabled. The frame tilt control valve (see page 7-3) is normally centered and no pilot pressure is supplied to ports **A6** or **B6** of the frame tilt section of the multi-spool control valve. In this condition, the spool in the frame tilt section remains centered and no pressure is supplied to the frame tilt cylinder.

Two (2) counterbalance valves on the frame tilt cylinder prevent fluid escaping from the cylinder. This mechanically locks the cylinder in position and prevents the frame from rotating on the front axle.

Control to Right

Moving the frame tilt control handle to the right allows pilot pressure to flow from port **#2** of the control valve. This pilot pressure is routed to port **A6** of the frame tilt section of the multi-spool control valve. The spool is shifted away from port **A6**, allowing pump flow to be routed through port **A** to the rod end of the frame tilt cylinder. Pressure is sufficient to pilot the counterbalance valves open, allowing fluid to enter and leave the cylinder.

As the cylinder retracts, the frame tilts to the right and fluid from the base end of the cylinder is routed through port **B** of the frame tilt section and on to the filtered tank return.

Control to Left

Moving the frame tilt control handle to the left allows pilot pressure to flow from port **#1** of the control valve. This pilot flow is routed to port **B6** of the frame tilt section of the multi-spool control valve. The spool is shifted away from port **B6**, allowing pump flow to be routed through port **B** to the base end of the frame tilt cylinder. Pressure is sufficient to pilot the counterbalance valves open, allowing fluid to enter and leave the cylinder.

As the cylinder extends, the frame tilts to the left and fluid from the rod end of the cylinder is routed through port **A** of the frame tilt section and on to the filtered tank return.

Frame Tilt Disabled

Under certain conditions the frame tilt system is disabled by the frame tilt lockout valve. The lockout valve prevents or allows pilot flow to be routed to ports **A6** and **B6** on the frame tilt section of the multi-spool valve. The

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frame tilt lockout valve is a component of the rear oscillation lock system and its function is explained under “Rear Oscillation Lock System” on page 7-17.

Frame Tilt Control Valve

Description

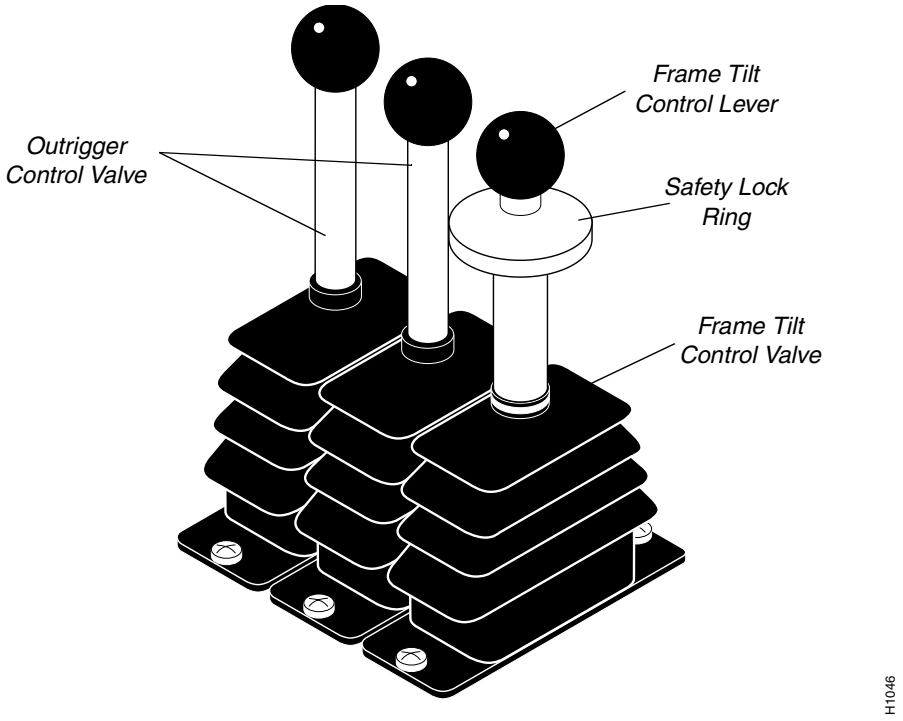


Fig. 7-2: Frame Tilt Control Valve

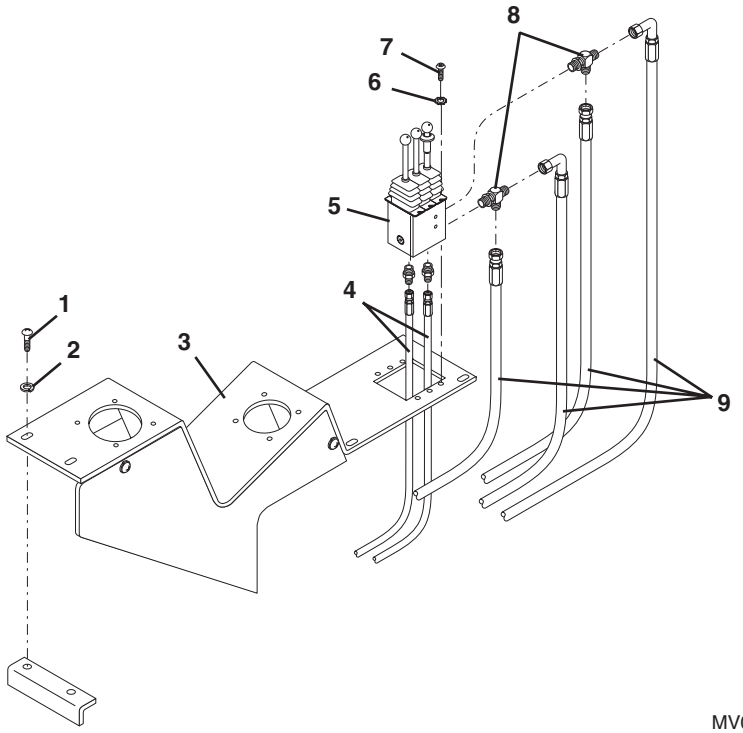
The frame tilt control lever is located immediately to the right of the driver’s seat on the control panel. It is used to level the machine laterally (side-to-side) up to 10°, left or right. The lateral angle of the machine, relative to level ground, is shown on the frame level indicator (See “Frame Level Indicator” on page 7-16). The control is functional only while the engine is running.

The control lever is equipped with a safety lock to prevent unintentional operation. Lifting the lock ring to unlock the lever allows it to be moved left or right tilting the frame accordingly. Returning the control lever to center position and releasing the lock ring secures the lever.

To level the frame, move the lever in the direction you want the ball in the frame level indicator to move. Control is proportional: a small amount of movement causes the frame to tilt slowly, while full movement of the control causes faster frame movement.

Removal

Frame Tilt Control Valve



1	Flatwasher	6	Starwasher
2	Screw	7	Capscrew
3	Control Panel	8	Fittings
4	1/4” Hoses	9	3/8” Hoses
5	Frame Tilt Control Valve		

Fig. 7-3: Frame Tilt Control Valve Installation

(Ref. Fig. 7-3) The following procedure describes removal of the frame tilt control valve.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Remove six (6) screws (Item 2) and flatwashers (Item 1) securing control panel (Item 3) to operator’s compartment. Lift up rear of control panel to expose lower portion of frame tilt control valve (Item 5).
3. Tag and disconnect six (12) hydraulic hoses (Items 4 and 9) at frame tilt control valve. Cap hoses and fittings.
4. Note Position of two (2) tee fittings (Item 8) on back side of valve body. Remove fittings.
5. Remove two (6) capscrews (Item 7) and starwashers (Item 6) retaining control valve to control panel.
6. Lift valve up to remove.

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Installation

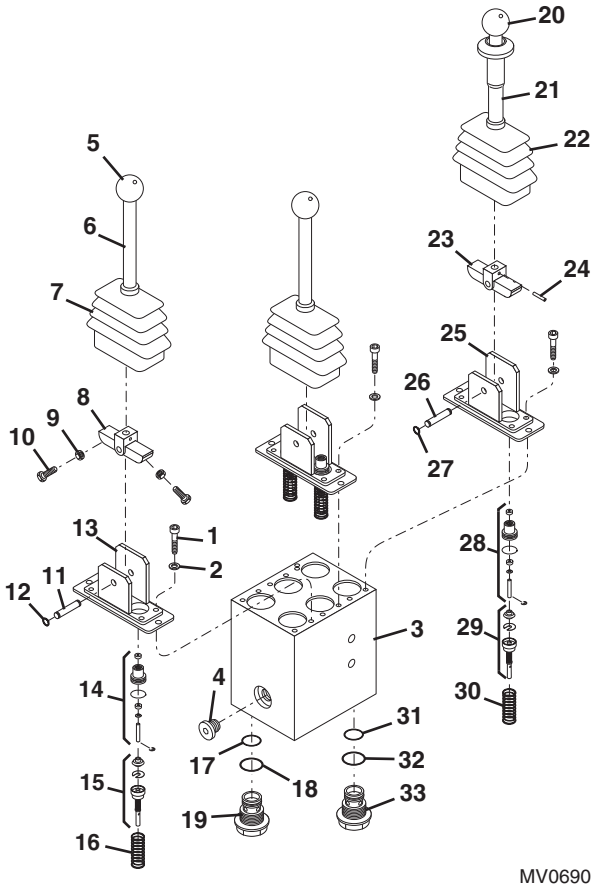
Frame Tilt Control Valve

1. (Ref. Fig. 7-3) Insert frame tilt control valve (Item 5) into control panel (Item 3) with plugged ports on front of valve body facing forward.
2. Install two (6) starwashers (Item 6) and capscrews (Item 7) to secure valve to control panel.
3. Install two (2) fittings (Item 8) into rear of valve body and position them as previously noted. Torque fittings to 300–340 in-lbs (25–29 ft-lbs).
4. Install hydraulic hoses (Items 4 and 9) onto fittings. Torque nuts on 3/8” hoses to 235–265 in-lbs (20–22 ft-lbs). Torque nuts on 1/4” hoses to 130–150 in-lbs.
5. Position control panel in operator’s compartment and secure with six (6) flatwashers (Item 1) and screws (Item 2).
6. Start engine and raise boom slightly. Tilt frame fully left and right several times to purge trapped air from frame tilt hydraulic system.
7. Level frame, and cycle remaining controls to purge air from those control circuits. Lower boom to ground, and shut off engine. Inspect for hydraulic leaks and repair as necessary.

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Overhaul

Frame Tilt Control Valve



#	Description
1	Capscrew
2	Washer
3	Body
4	Plug
5	Knob
6	Lever
7	Rubber Boot
8	Cam
9	Metric Jam Nut
10	Capscrew
11	Pivot Pin
12	CirClip
13	Flange
14	Guide Assy
15	Spring Pack
16	Spring
17	O-Ring

#	Description
18	O-Ring
19	Ported Guide
20	Knob
21	Lever Assy
22	Rubber Boot
23	Cam
24	Pin
25	Pivot Pin
26	CirClip
27	Flange
28	Guide Assy
29	Spring Pack
30	Spring
31	O-Ring
32	O-Ring
33	O-Ring

Fig. 7-4: Frame Tilt Control Valve (Exploded View)

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(Ref. Fig. 7-4) The following procedures are for the disassembly, cleaning, and assembly of the frame tilt control valve. Follow the guidelines for cleanliness as stated in Section 3 of this manual.

Cleaning and Inspection, Frame Tilt Control Valve

1. Thoroughly clean all parts, except for the lever assembly, in clean solvent and dry with compressed air. Do not immerse the lever assembly in solvent. Solvent can become trapped in the assembly and will be difficult to remove.
2. Pay particular attention to the porting in the valve body. Flush valve body with clean solvent and use compressed air to dry.
3. Inspect each spool for scratches and damage. Scoring on the spool may also indicate damage to the ported guides . If damage is evident, replace with new parts. Check fit of spools in ported guides. The spools must fit snugly with no sticking. A stuck spool can cause unintentional operation of a hydraulic circuit. Excessive play or sticking means that the spool and its ported guide must be replaced.
4. Check surface of each plunger and guide for wear and damage. Check fit of plunger in guide to make sure no sticking occurs. Like the spools, a stuck plunger can cause unintentional operation of a hydraulic circuit.
5. Inspect each spool cavity in the valve body for scratches.
6. Check condition of lever assembly, cam, pivot pin, springs, and flange . Replace as necessary.
7. Replace O-rings and seals as necessary. Lubricate O-rings and seals with clean hydraulic oil before installing them.

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Frame Tilt Cylinder

Description

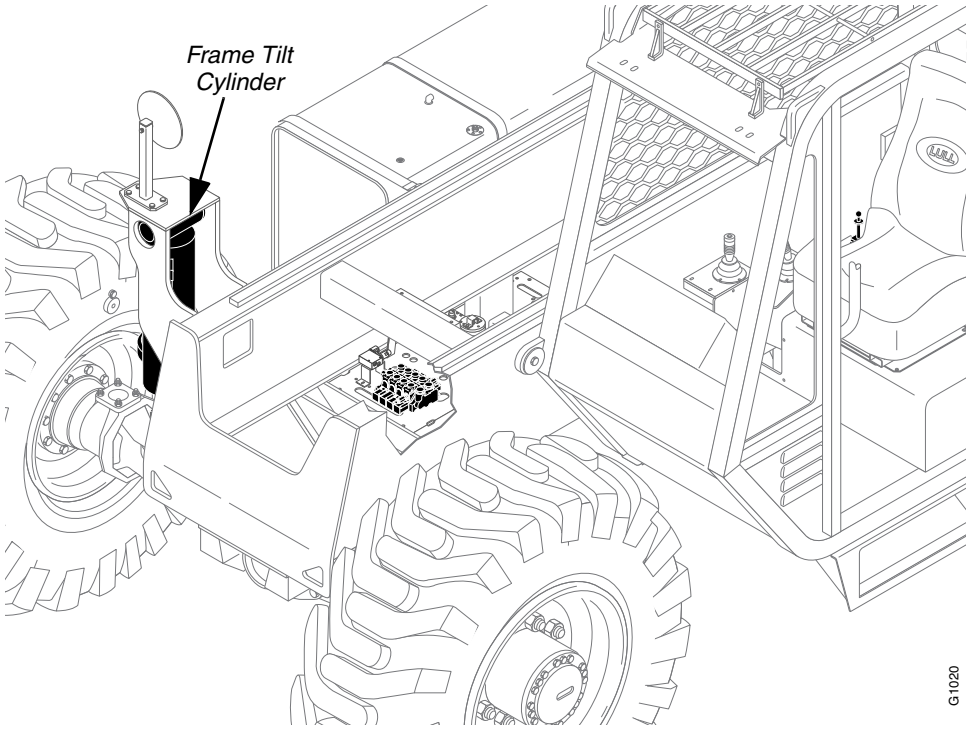


Fig. 7-5: Frame Tilt Cylinder

(Ref. Fig. 7-5) The frame tilt cylinder is located near the front of the machine, on the right side. The cylinder is mounted vertically with the base end secured to the frame and the rod end mounted to the front axle.

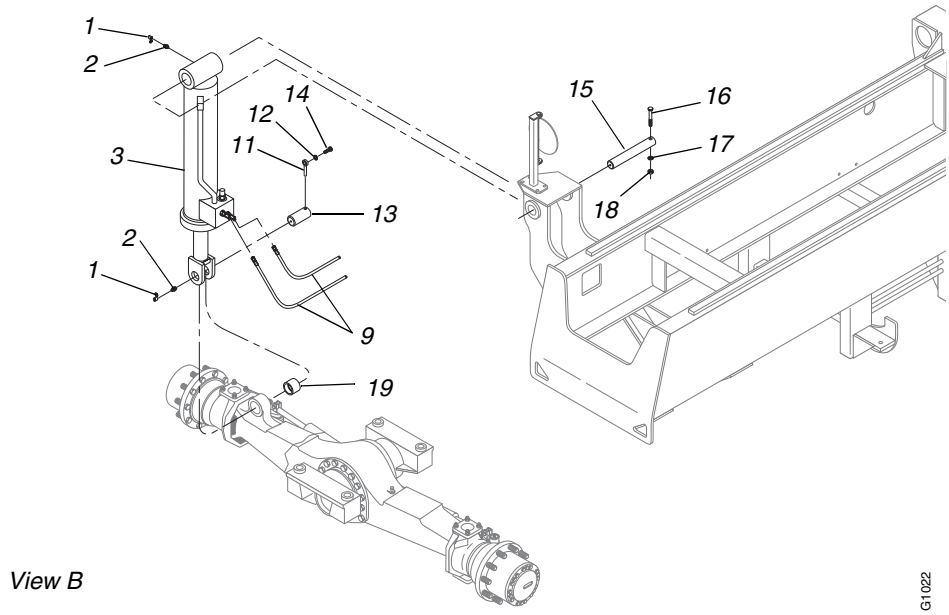
With the engine running, moving the frame tilt control valve handle (see page 7-3) to the right causes the cylinder to retract and the frame tilts to the right. Moving the tilt control handle to the left causes the cylinder to extend and the frame will tilt to the left.

There are conditions during normal machine operation when the frame tilt cylinder cannot be actuated. See “Rear Oscillation Lock System” on page 7-17 for further information.

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Removal

Frame Tilt Cylinder



#	Description
1	Grease Fitting Cover
2	Grease Fitting
3	Frame Tilt Cylinder
4	Capscrew
5	Mounting Block
6	Lockwasher
7	Nut
8	Shim
9	Hydraulic Hose
10	Mounting Block w/Lock Pin Hole

#	Description
11	Lock Pin
12	Lockwasher
13	Lower Pivot Pin
14	Capscrew
15	Upper Pivot Pin
16	Capscrew
17	Lockwasher
18	Nut
19	Lower Cylinder Bushing

Fig. 7-6: Frame Tilt Cylinder Installation

(Ref. Fig. 7-6) The following procedures are required to remove the frame tilt cylinder.

1. Follow preparation procedures as outlined in Section 3.
2. Place blocks between frame and top of front axle. These will hold the frame in place when the cylinder is removed.
3. Tag and disconnect two (2) hydraulic hoses (Item 9) at frame tilt cylinder (Item 3). Cap hoses and fittings.
4. See warning and procedures on page 7-15 for releasing hydraulic pressure in cylinder.
5. Remove nut (Item 18), lockwasher (Item 17), and capscrew (Item 16) securing cylinder upper pivot pin (Item 15) to frame.
6. Remove capscrew (Item 14), lockwasher (Item 12), and lock pin (Item 11) securing cylinder lower pivot pin (Item 13).

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7. Place a sling around the cylinder and attach the sling to suitable lifting equipment. Make sure sling and lifting equipment have sufficient capacity. The frame tilt cylinder weighs approximately 200 pounds. Using the lifting equipment, support the weight of the cylinder.
8. Remove upper pivot pin.
9. Remove lower pivot pin and shims (Item 8) (early production models only).
10. Move cylinder out and up from the machine.
11. For models with the cylinder illustrated in View B, remove lower bushing (Item 19) from front axle using bushing driver and hammer or press. Inspect and, if damaged, discard bushing.

Installation

Frame Tilt Cylinder

(Ref. Fig. 7-6) The following procedures are required to install the frame tilt cylinder.

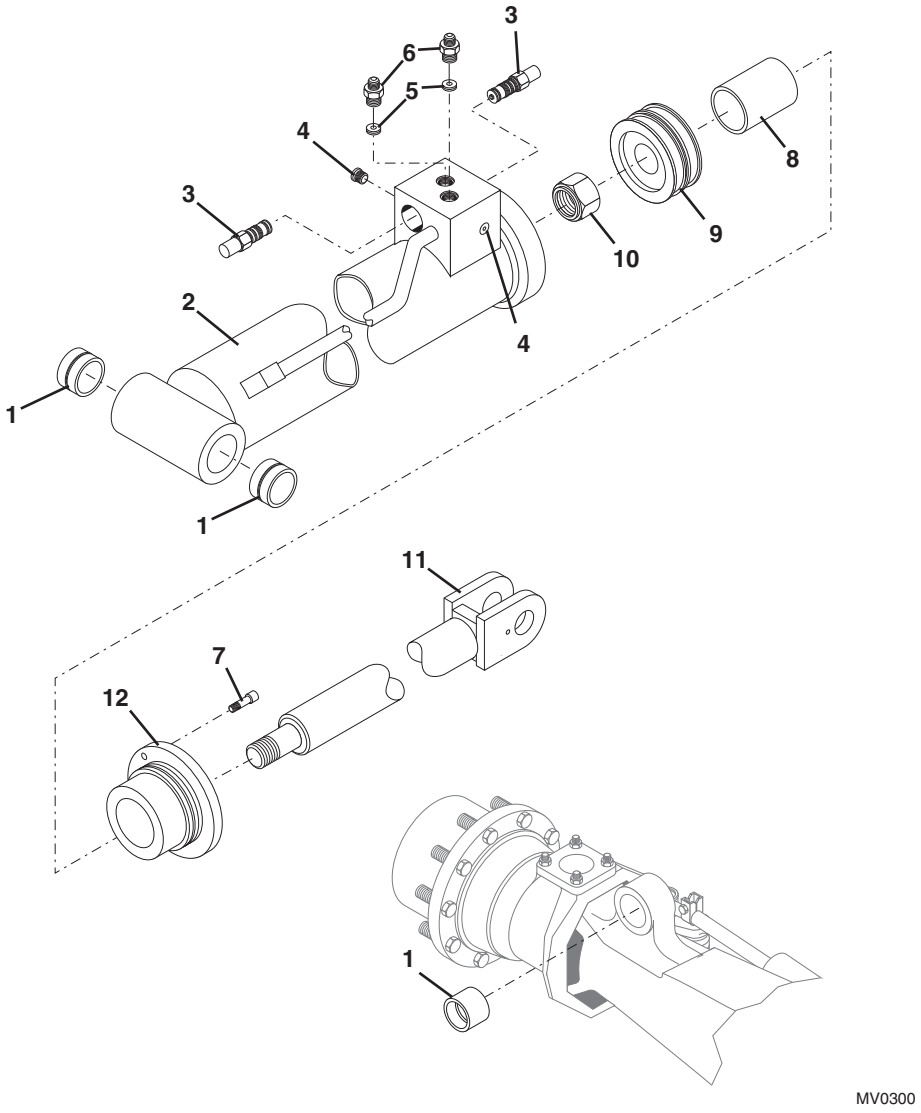
1. Prior to installation, lubricate upper and lower pivot pins with a light coating of grease.
2. For models with the cylinder illustrated in View B, install new lower bushing (Item 19) on front axle. Install bushing so that it is centered in axle boss.
3. Using suitable lifting equipment, position upper cylinder pivot at frame pivot. Install upper pivot pin so hole in pin is aligned with hole in frame boss. Secure upper pivot pin with capscrew (Item 16), lockwasher (Item 17), and nut (Item 18). Torque nut to 180 in-lbs.
4. If necessary (models with the cylinder illustrated in View A), install mounting blocks on front axle as follows:
   a. Install mounting block (Item 5) to front of axle with two (2) capscrews (Item 4), lockwashers (Item 6) and nuts (Item 7). Torque nuts to 150 ft-lbs.
   b. Install mounting block (with lock pin hole) (Item 10) to rear of axle with two (2) capscrews (Item 4), lockwashers (Item 6), and nuts (Item 7). Make sure the lock pin hole is to the rear of the machine. Torque nut to 150 ft-lbs.
5. Position lower cylinder pivot on axle to install lower pivot pin. Install lower pivot pin (Item 13) and shims (Item 8) (early production models only).
6. Secure pin with lock pin (Item 11), lockwasher (Item 12), and capscrew (Item 14). Torque capscrew to 55 ft-lbs.
7. Attach hydraulic hoses (Item 9) to fittings on cylinder. Torque hose swivel nuts to 235–265 in-lbs.
8. If necessary, install grease fittings (Item 2) and grease fitting covers (Item 1) as shown in Fig. 7-6. Torque grease fitting 1.5–3 turns past finger tight.

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9. Lubricate upper and lower pivots with grease.
10. Start engine and cycle frame tilt fully left and right several times to purge air from hydraulic system. Lower boom and shut off engine.
11. Inspect for hydraulic leaks and repair as necessary.
12. Check oil level in hydraulic reservoir. Add oil as necessary. See “Filling Hydraulic Reservoir” in Section 5 for procedures.

Overhaul

Frame Tilt Cylinder



#	Description
1	Bushing
2	Barrel
3	Counterbalance Valve Cartridge
4	O-Ring Plug
5	Orifice
6	Fitting, O-Ring
7	Set Screw

#	Description
8	Tube
9	Piston
10	Rod Nut
11	Rod
12	Head

Fig. 7-7: Frame Tilt Cylinder (Exploded View)

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Disassembly, Frame Tilt Cylinder

(Ref. Fig. 7-7) The following steps are required to disassemble the frame tilt cylinder.

1. Mount or support cylinder vertically, with rod end down. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under the cylinder.
2. Remove counterbalance valve (Item 3).

WARNING: The counterbalance valve cartridges trap hydraulic pressure in the frame tilt cylinder. Wear proper eye and hand protection when removing counterbalance valve cartridges. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

3. Slowly extend and retract cylinder by hand to remove most of the hydraulic oil.
4. Remove one (1) set screw (Item 7) securing head (Item 12) to barrel (Item 2).
5. Pull rod (Item 11) out to help remove head. Support rod and head during removal to prevent damage. Do not wiggle rod or head back and forth to remove; this may damage the components.
6. Remove rod nut (Item 10), piston (Item 9), tube (Item 8), and head from rod.
7. Remove two (2) O-ring plugs (Item 4).
8. Remove fittings (Item 6).
9. Using a large, flat bladed screw driver, remove two (2) orifices (Item 5).
10. If the bushings need to be replaced, see “Bushing Replacement” below.

Cleaning and Inspection, Frame Tilt Cylinder

1. Remove all O-rings, wear rings, and backup rings from cylinder components and discard.
2. Thoroughly wash components in solvent and dry with compressed air.
3. Inspect inner surface of barrel, outer surface of piston, and length of the rod for scratches and scoring. If barrel, piston, or rod is damaged, it must be replaced.
4. Check condition of threads on rod, nut, and capscrews. Replace as necessary. Do not attempt to repair damaged threads.

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Bushing Replacement

1. Fig. 7-7 shows both types of rod end configurations and bushing locations. Remove pivot bushings (Item 1) using a bushing driver and hammer or press. Drive one bushing all the way through to remove other bushing.
2. Install new bushings so they are flush with outer edge boss to 0.02" below. For machines with lower (rod end) pivot bushing installed in front axle: Install bushing so that it is centered in axle boss.

Assembly, Frame Tilt Cylinder

1. (Ref. Fig. 7-7) Install two (2) orifices (Item 5) using a large, flat bladed screw driver.
2. Install two (2) O-ring plugs (Item 4).
3. Lubricate new O-ring with hydraulic oil and install inside piston (seals rod to piston).
4. Lubricate new O-ring, backup ring, seals, and wear rings with hydraulic oil and install on head (Item 12). Using a seal driver, install new wiper seal in head. Lubricate wiper seal with hydraulic oil.
5. Slide head (Item 12), stroke limiter (Item 8) and piston (Item 9) onto rod (Item 11). Lubricate threads on rod with hydraulic oil and install rod nut (Item 10). Torque rod nut to 1540-1675 ft-lbs.
6. Lubricate new seal and wear rings with hydraulic oil and install on piston.
7. Apply removable (blue) thread locking adhesive to threads on (1) set screw (Item 7). Coat inside of barrel (Item 2) with hydraulic oil. Carefully insert rod and head into barrel. Do not damage seals during assembly. Install and snug set screw (Item 7).
8. Install two (2) O-ring fittings (Item 6).
9. Install counterbalance valve cartridges.

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Counterbalance Valve Cartridge

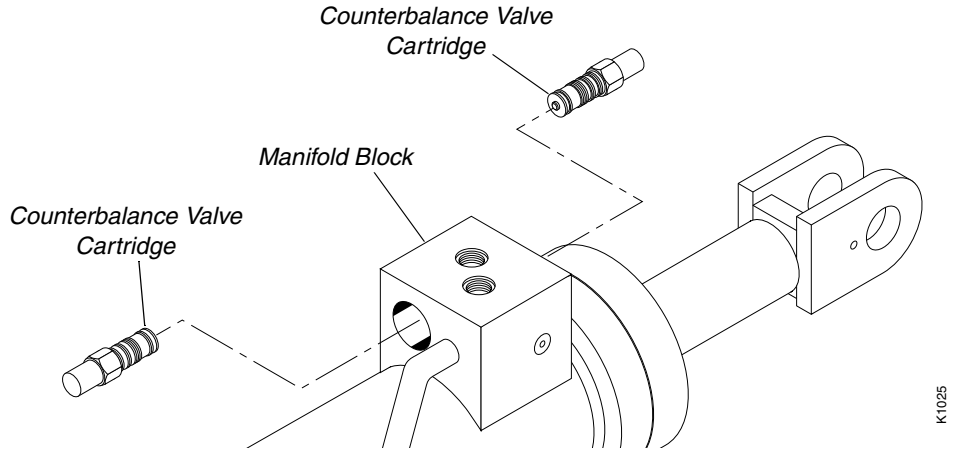


Fig. 7-8: Counterbalance Valve Cartridges, Frame Tilt Cylinder

WARNING: The counterbalance valve cartridges trap hydraulic pressure in the frame tilt cylinder. Wear proper eye and hand protection when removing counterbalance valve cartridges. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

The following procedures refer to Fig. 7-8.

Releasing Pressure in Cylinder

1. Place socket wrench over a counterbalance valve cartridge. Wrap a clean shop rag around the socket to cover the area of the counterbalance valve cartridge.
2. Carefully and slowly, turn cartridge out of manifold block to release pressure in cylinder. Repeat for other cartridge to release pressure from other end of cylinder.
3. After pressure has been released, tighten cartridges. If cartridges will not be removed, then torque counterbalance valve cartridges to 30–35 ft-lbs.

Removal and Service, Counterbalance Valve

1. Remove both cartridges and cap ports in manifold block. Inspect cartridge O-rings for condition and replace as necessary.
2. Do not disassemble the cartridge. Service to a counterbalance valve cartridge is limited to installing a new O-ring and replacing the entire cartridge.

Installation, Counterbalance Valve

1. Lubricate O-rings with clean hydraulic oil.
2. Install each cartridge in manifold block and torque to 30–35 ft-lbs.

Frame Level Indicator

Description

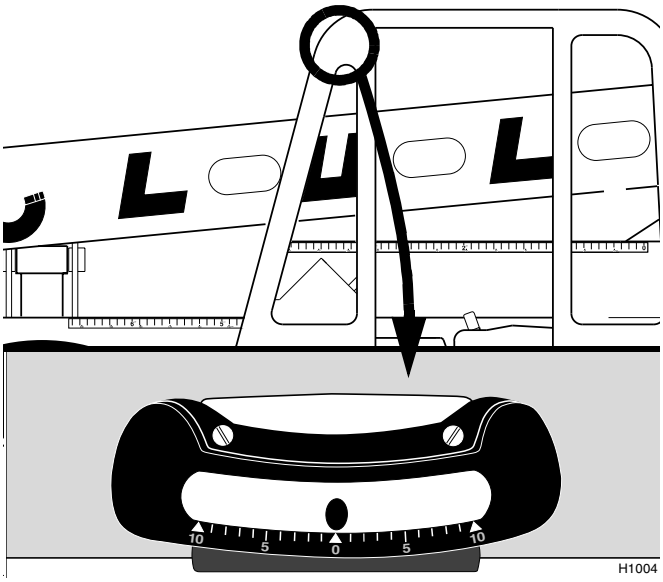


Fig. 7-9: Frame Level Indicator

(Ref. Fig. 7-9) The Frame Level Indicator shows the lateral (side-to-side) angle of the frame relative to level ground. Indicator range is from 0° to 10° left or right, in increments of one degree. When the ball is centered (0°), the machine is laterally level. The frame tilt feature may be used to correct machine angles up to 12.5° to the left or right. See “Frame Tilt Control Valve” on page 7-3.

Adjustment

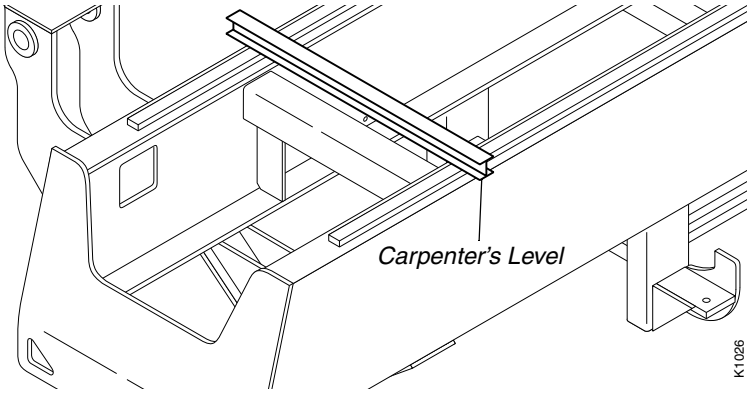


Fig. 7-10: Leveling the Frame

1. (Ref. Fig. 7-10) Park the machine on a firm, level surface. Place a carpenter’s level across the frame rails.
2. Loosen screws securing frame level indicator to its mounting bracket. Start the engine and adjust frame tilt so the carpenter’s level shows the frame is level.

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3. Adjust frame level indicator so ball is centered over 0° mark. Tighten indicator screws.

Rear Oscillation Lock System

General Description, Models with Control Manifold Hydraulics

The Rear Oscillation Lock System provides safety and stability by preventing the frame from rotating on the rear axle.

The rear oscillation lock will be operational when any or all of the following conditions apply:

- When the boom angle exceeds 40°.
- When the service brakes are applied.
- If a system component fails.

When the boom angle is above 40°, the following conditions apply:

- Rear axle cylinder locks, preventing the frame from rotating on the rear axle.

Note: *Rear oscillation lock cylinder can be unlocked by the drive lockout override switch. See Drive Lockout Override in the Operator & Safety Manual.*

- Transmission is inoperative.
- Frame tilt function is disengaged.
- REAR OSC LOCK light in the instrument cluster illuminates.
- When the frame tilt function is disengaged, it CANNOT be overridden by the operator unless the boom angle is below 40°.

When the service brakes are applied, the following conditions apply:

- Rear axle cylinder locks, preventing the frame from rotating on the rear axle.
- The rear oscillation lock cylinder can be unlocked by the frame tilt function when the boom is below 40°.

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Theory of Operation and Circuit Logic

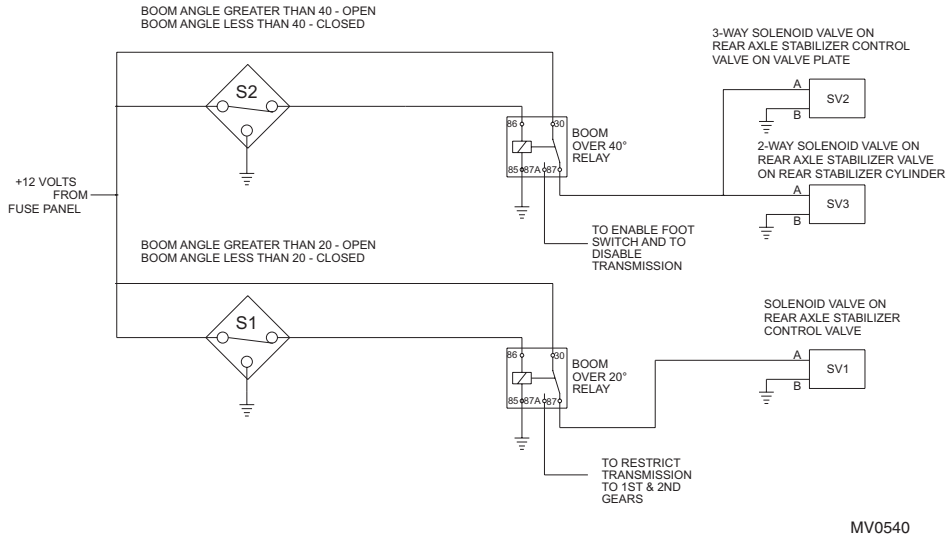


Fig. 7-11: Circuit Operation Below 40°

(Reference Fig. 7-11) Major components of the rear oscillation lock system are:

1. Boom Over 20° Elevation Proximity Switch (**S1**)-senses when boom position is above 20°.
2. Boom Over 40° Elevation Proximity Switch (**S2**)-senses when boom position is above 40°.
3. Boom Over 20° Relay-receives signal from the Boom Over 20° Elevation Proximity Switch (**S1**).
4. Boom Over 40° Relay-receives signal from the Boom Over 40° Elevation Proximity Switch (**S2**).
5. Solenoid Valve (**SV1**)-controls frame tilt functions.
6. Solenoid Valve (**SV2**)-controls rear stabilizer cylinder along with Solenoid Valve (**SV3**).
7. Solenoid Valve (**SV3**)-controls rear stabilizer cylinder along with Solenoid Valve (**SV2**).
8. Service Brake Valve (not shown)-locks the rear stabilizer cylinder when applied regardless of the status of SV2 and SV3.

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Boom Positioned Above 40°

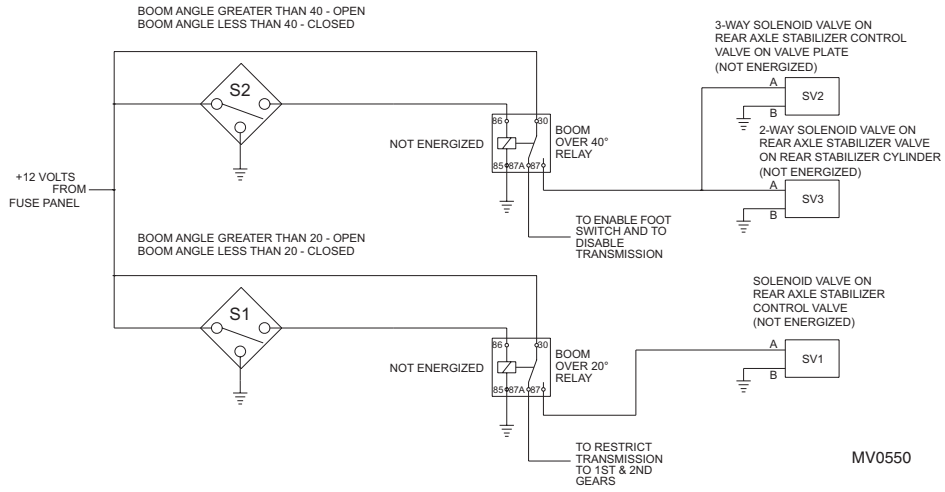


Fig. 7-12: Circuit Operation Above 40°

(Ref. Fig. 7-12) The following describes the rear axle stabilizer circuit logic when the boom is positioned above 40° elevation.

1. When the boom is above 40°, the proximity switch (**S2**) is not sensing the boom. Therefore, the proximity switch (**S1**) opens and is also not sensing the boom.
2. When the proximity switch (**S2**) is open, the Boom Over 40° relay is not energized and power is directed to the coil of Relay K11 of the transmission logic (see Transmission Section 8). When K11 is energized, power is removed from all of the transmission solenoids, which puts the transmission into Neutral and illuminates the Transmission Disconnect Lamp in the instrument cluster.
3. Additionally, when the Boom Over 40° relay is not energized, Solenoid Valves SV2 and SV3 are energized, which locks the rear stabilizer cylinder. This prevents the frame from rotating on the rear axle and illuminates the Rear Oscillation Lock lamp in the instrument cluster.
4. An additional effect of the Boom Over 40° relay not being energized is theTransmission Disconnect Override Footswitch is enabled. Pressing the Transmission Disconnect Override Footswitch, when the boom is over 40°, reengages the transmission (first gear only) and allows very slow, restricted oscillation of the frame on the rear axle. This allows the machine to be moved. This is an extremely dangerous operation – see the Operator's Manual.
5. The frame tilt is also restricted when the boom is over 40° because Solenoid Valve (**SV1**) is energized.

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Boom Positioned Above 20° Below 40°

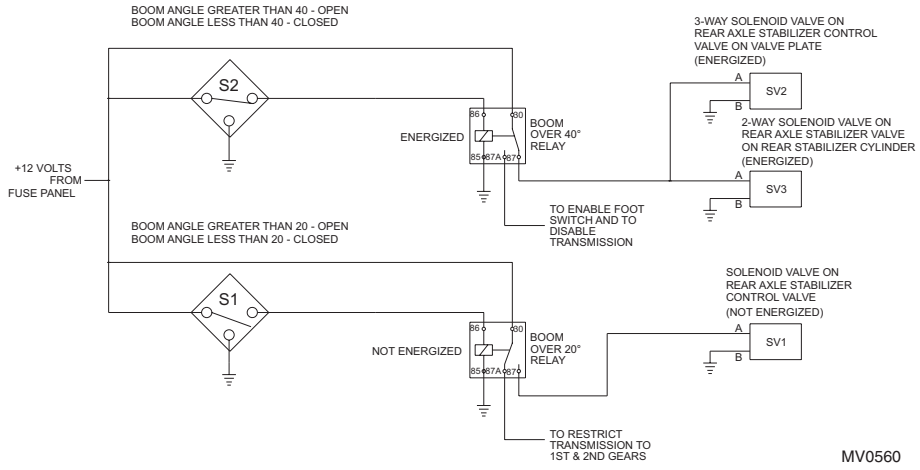


Fig. 7-13: Circuit Operation Above 20° Below 40°

(Ref. Fig. 7-13) The following describes the rear axle stabilizer circuit logic when the boom is positioned above 20° below 40° elevation.

1. When the boom is above 20° and below 40°, the proximity switch (**S2**) is sensing the boom, so the (**S2**) proximity switch closes. Proximity switch (**S1**) is not sensing the boom, so it opens when boom is above 20°.
2. When the proximity switch (**S1**) is open, the Boom Over 20° relay is not energized and power is directed to the coil of relay K13 of the transmission logic (see Transmission Section 8). When K13 is energized, the transmission is restricted to first and second gears only, regardless of the gear selected with the transmission shifter.
3. Additionally, when the Boom Over 20° relay is not energized, Solenoid Valve (**SV1**) is not energized, which restricts movement of the rear stabilizer cylinder so that the frame may oscillate on the rear axle only in a slow or restricted mode. The Boom Over 20° relay also illuminates the Rear Oscillation Lock lamp in the instrument cluster.
4. The frame tilt is also restricted when Solenoid Valve (**SV1**) is not energized.

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Boom Positioned Above 20° Below 40° With the Service Brake Applied

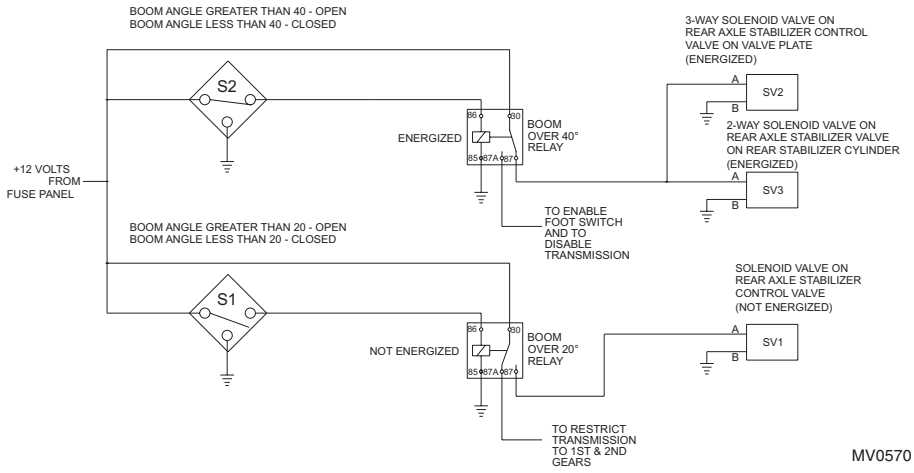


Fig. 7-14: Circuit Operation Above 20° Below 40° with Service Brake Applied

(Ref. Fig. 7-14) The following describes the rear axle stabilizer circuit logic when the boom is positioned above 20° below 40° elevation with the service brake applied.

1. When the boom is above 20° and below 40°, the proximity switch (**S2**) is sensing the boom, so the (**S2**) proximity switch closes. Proximity switch (**S1**) is not sensing the boom, so it opens when boom is above 20°.
2. When the proximity switch (**S1**) is open, the Boom Over 20° relay is not energized and Solenoid Valve (**SV1**) is not energized, which restricts the frame tilt.
3. Applying the service brake locks the rear stabilizer cylinder hydraulically, which prevents the frame from rotating on the rear axle.

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Boom Positioned Below 20° With the Service Brake Applied

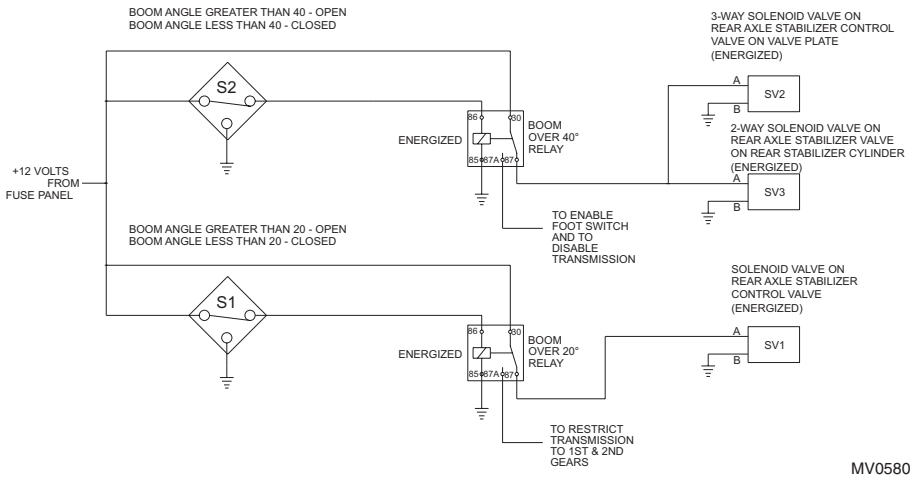


Fig. 7-15: Circuit Operation Below 20° With the Service Brake Applied

(Ref. Fig. 7-15) The following describes the rear axle stabilizer circuit logic when the boom is positioned above 20° with the service brake applied.

1. When the boom is below 20°, the proximity switch (**S1**) is sensing the boom, so the (**S1**) proximity switch closes.
2. When the proximity switch (**S1**) is closed, the Boom Over 20° relay is energized and Solenoid Valve (**SV1**) is energized, which allows unrestricted frame tilt.
3. Applying the service brake locks the rear stabilizer cylinder hydraulically, which prevents the frame from rotating on the rear axle.
4. Releasing the service brake unlocks the rear stabilizer cylinder hydraulically, which allows the frame to rotate freely on the rear axle.

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Testing Rear Oscillation Lock Circuit

Use Table 7-1 for testing the rear oscillation lock circuit.

Table 7-1: Rear Oscillation Lock Circuit Test Matrix

OPERATING PARAMETERS	S1 Proximity Switch	S2 Proximity Switch	Boom Over 20° Relay	Boom Over 40° Relay	Rear Osc. Locked Lamp	Trans. Disconnect Lamp	Rear Stabilizer Cylinder	SV1 Solenoid Valve	SV2 Solenoid Valve	SV3 Solenoid Valve
Boom below 20° Service brake released	Closed	Closed	Energized	Energized	Off	Off	Floating	Energized	Energized	Energized
Boom below 20° Service brake applied	Closed	Closed	Energized	Energized	Off	Off	Locked	Energized	Energized	Energized
Boom below 20° Service brake applied Operating Frame Tilt	Closed	Closed	Energized	Energized	Off	Off	Floating While Frame Tilting	Energized	Energized	Energized
Boom above 20° Service brake released	Open	Closed	De-energized	Energized	On	Off	Slow Restricted Oscillation	De-energized	Energized	Energized
Boom above 20° Service brake applied	Open	Closed	De-energized	Energized	On	Off	Locked	De-energized	Energized	Energized
Boom above 40° Service Brake Released	Open	Open	De-energized	De-energized	On	On	Locked	De-energized	De-energized	De-energized
Boom above 40° Service Brake Applied	Open	Open	De-energized	De-energized	On	On	Locked	De-energized	De-energized	De-energized
Boom above 40° Footswitch Depressed	Open	Open	De-energized	De-energized	On	On	Very Slow Restricted Oscillation	De-energized	Energized	De-energized

Rear Oscillation Lock Cylinder

Description

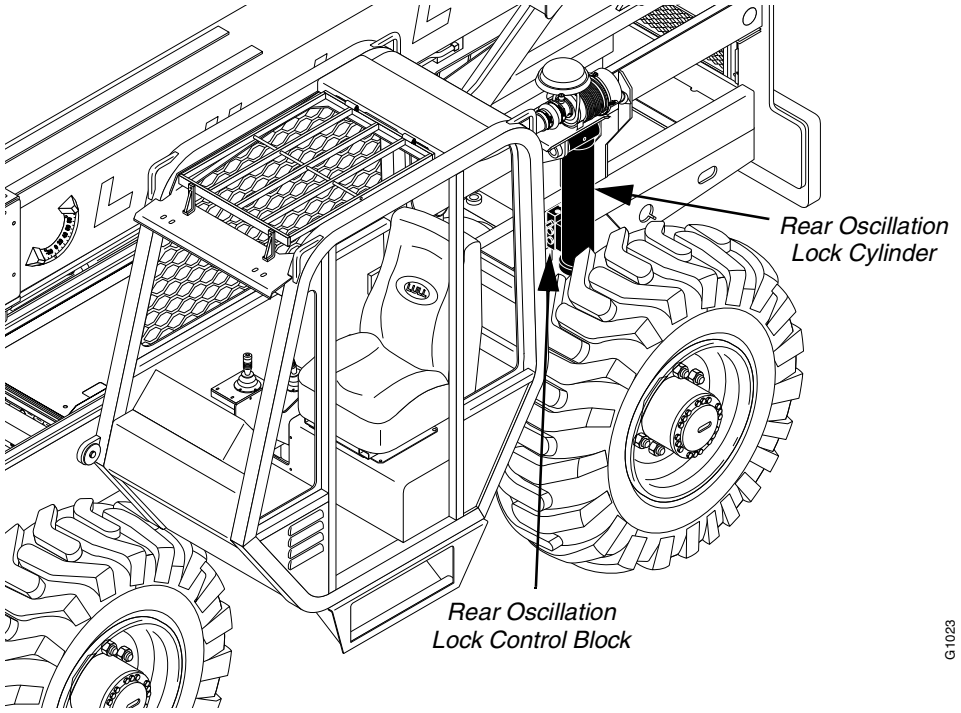


Fig. 7-16: Rear Oscillation Lock Cylinder

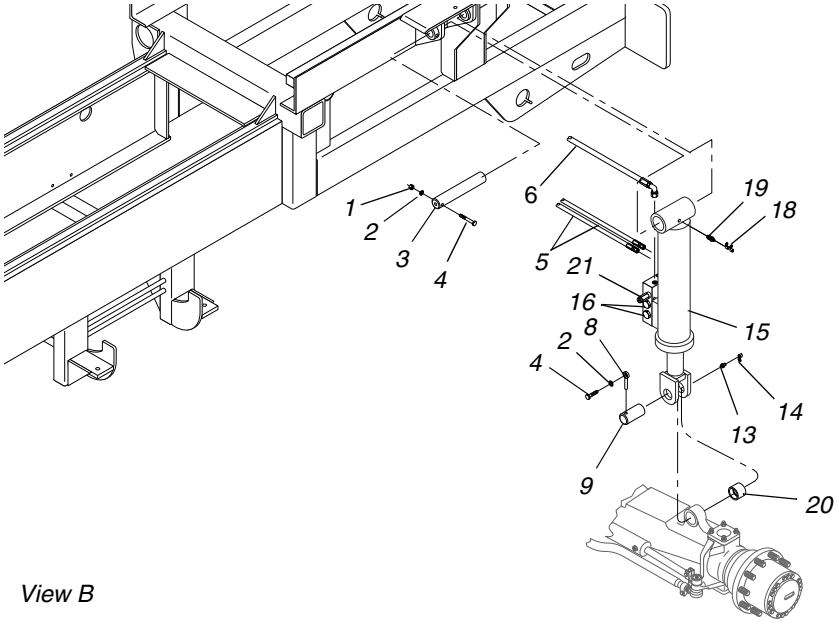
(Ref. Fig. 7-16) The rear oscillation lock cylinder is located near the rear of the machine, on the left side. The cylinder is mounted vertically with the base end secured to the frame and the rod end mounted to the rear axle.

The oscillation control block is mounted to the inboard side of the cylinder and controls hydraulic flow to and from the cylinder. When hydraulic fluid is trapped in the cylinder the frame is prevented from rotating around the rear axle.

The rear oscillation lock cylinder and the oscillation control block are components of the rear oscillation lock system. See “Rear Oscillation Lock System” on page 7-17 for more information.

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Removal



View B

#	Description
1	Nut
2	Lockwasher
3	Upper Pivot Pin
4	Capscrew
5	#6 Hydraulic Hose
6	#8 Hydraulic Hose
7	Capscrew
8	Lock Pin
9	Lower Pivot Pin
10	Lockwasher
11	Nut

#	Description
12	Mounting Base
13	Grease Fitting
14	Grease Fitting Cover
15	Rear Carriage Tilt Cylinder
16	Check Valve
17	Wiring Harness
18	Grease Fitting Cover
19	Grease Fitting
20	Bushing
21	Pressure Reducing Valve

Fig. 7-17: Rear Oscillation Lock Cylinder Installation

(Ref. Fig. 7-17) The following steps are required to remove the rear oscillation lock cylinder:

1. Follow preparation procedures as outlined in Section 3.
2. Place blocks between frame and top of rear axle. These will hold the frame in place when the cylinder is removed.
3. Install brake pressure diagnostic port test gauge onto brake diagnostic port.
4. While watching test gauge, press brake pedal numerous times until pressure gauge reads 0 psi. Remove test gauge from diagnostic port.
5. Place a suitable drip pan under rear oscillation lock cylinder.

WARNING: Residual hydraulic pressure may be trapped in rear oscillation lock cylinder. Wear proper eye and hand protection when releasing pressure from cylinder. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

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6. Slowly loosen each check valve (Item 16) on control block (labeled 3.1 and 3.2) to allow residual pressure to escape. After pressure has been released, torque check valves to 50 ft-lbs.
7. Tag and disconnect three (3) hydraulic hoses (Items 5 and 6) at oscillation control block. Cap hoses and fittings.
8. For models with control manifold hydraulics, disconnect wiring harness electrical connection (Item 17) at oscillation control block.
9. Remove nut (Item 1), lockwasher (Item 2), and capscrew (Item 4) securing cylinder upper pivot pin (Item 3) to frame.
10. Remove capscrew (Item 4), lockwasher (Item 2), and lock pin (Item 8) securing cylinder lower pivot pin (Item 9).
11. Place a sling around cylinder (Item 15) and attach sling to suitable lifting equipment. Make sure sling and lifting equipment have sufficient capacity. The rear oscillation lock cylinder weighs approximately 200 pounds. Using lifting equipment, support weight of cylinder.
12. Remove upper and lower pivot pins (Items 3 and 9). Move cylinder out and up from machine.

Installation

Rear Oscillation Lock Cylinder

(Ref. Fig. 7-17) The following steps are required to install the rear oscillation lock cylinder:

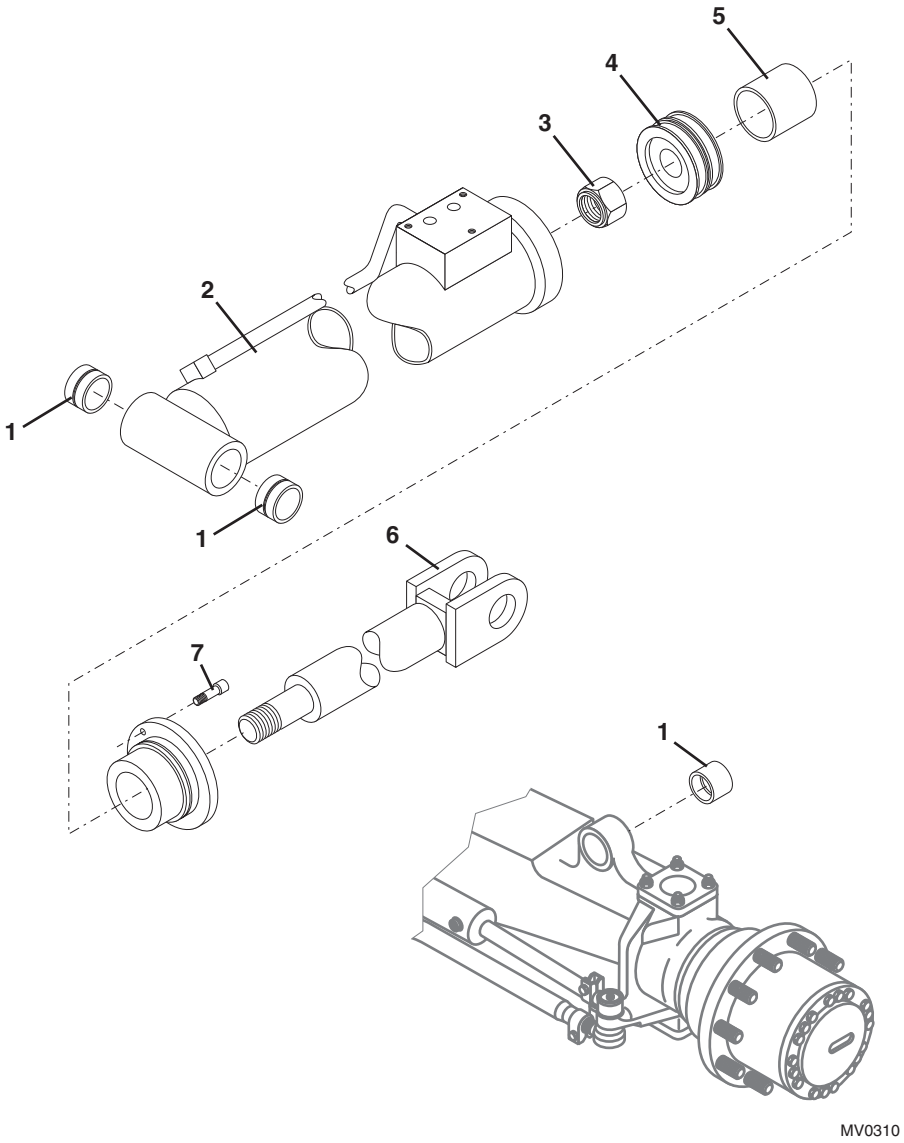
1. Prior to installation, lubricate upper and lower pivot pins with a light coating of grease.
2. Using suitable lifting equipment, position upper cylinder pivot at frame pivot. Install upper pivot pin (Item 3) so hole in pin is aligned with hole in frame boss. Secure upper pivot pin with capscrew (Item 4), lockwasher (Item 2), and nut (Item 1). Torque nut to 180 in-lbs.
3. If necessary (models with a cylinder as illustrated in View A), install mounting base (Item 12) with four (4) each capscrews (Item 7), lockwashers (Item 10), and nuts (Item 11). Torque nuts to 280 ft-lbs.
4. If necessary (models with a cylinder as illustrated in View A), install bushing (Item 20) in rear axle boss. Install bushing so that it is centered in axle boss
5. Position lower cylinder pivot on axle and install lower pivot pin. Secure pin with lock pin (Item 8), lockwasher (Item 2), and capscrew (Item 4). Torque capscrew to 55 ft-lbs.
6. Attach hydraulic hoses to fittings on oscillation control block. Torque nut on #8 hose (Item 6) to 44–48 ft-lbs. Torque nuts on #6 hoses (Item 5) to 235–265 in-lbs (20–22 ft-lbs).
7. For models with a cylinder as illustrated in View A, connect electrical lead from wiring harness (Item 17) at oscillation control block.
8. If necessary, install grease fittings (Items 13 and 19) and grease fitting covers (Items 14 and 18). Torque grease fittings 1.5–3 turns past finger tight. Lubricate upper and lower pivots with grease.

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9. Start engine and cycle frame tilt fully left and right several times to purge air from hydraulic system. Lower boom and shut off engine.
10. Inspect for hydraulic leaks and repair as necessary.
11. Check oil level in hydraulic reservoir and add as necessary. See “Filling Hydraulic Reservoir” in Section 5 for procedures.

Overhaul

Rear Oscillation Lock Cylinder



#	Description
1	Bushing
2	Barrel
3	Rod Nut
4	Piston

#	Description
5	Tube
6	Rod
7	Set screw
8	Head

Fig. 7-18: Rear Oscillation Lock Cylinder (Exploded View)

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Disassembly, Rear Oscillation Lock Cylinder

(Ref. Fig. 7-18) Disassembly procedures for the rear oscillation lock cylinder are as follows:

1. Mount or support cylinder vertically, with rod end down. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under cylinder.
2. Slowly extend and retract cylinder by hand to remove most of the hydraulic oil.
3. Remove one (1) set screw (Item 7) securing head (Item 8) to barrel (Item 2).
4. Pull rod (Item 6) out to help remove head. Support rod and head during removal to prevent damage. Do not wiggle the rod or head back and forth to remove; this may damage the components.
5. Remove rod nut (Item 3), piston (Item 4), tube (Item 5), and head from rod.
6. If the bushings need to be replaced, see “Bushing Replacement, Rear Oscillation Lock Cylinder” below.

Cleaning and Inspection, Rear Oscillation Lock Cylinder

1. Remove all O-rings, wear rings, and backup rings from cylinder components and discard.
2. Thoroughly wash components in solvent and dry with compressed air.
3. Inspect inner surface of barrel, the outer surface of piston, and rod for scratches and scoring. If barrel, piston, or rod is damaged, the component must be replaced.
4. Check condition of threads on rod, nut, and capscrews. Replace as necessary. Do not attempt to repair damaged threads.

Bushing Replacement, Rear Oscillation Lock Cylinder

1. Fig. 7-18 shows both types of rod end configurations and bushing locations. Remove pivot bushings (Item 1) using a bushing driver and hammer or press. Drive one bushing all the way through to remove other bushing.
2. Install new bushings so they are flush with outer edge of boss to 0.02" below. For machines with lower (rod end) pivot bushing installed in rear axle: Install bushing so that it is centered in axle boss.

Assembly, Rear Oscillation Lock Cylinder

1. Lubricate new O-ring with hydraulic oil and install inside piston (seals the rod to the piston).

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2. Lubricate new O-ring, backup ring, seals, and wear rings with hydraulic oil and install on head (Item 8). Using a seal driver, install new wiper seal in head. Lubricate wiper seal with hydraulic oil.
3. (Ref. Fig. 7-18) Slide head (Item 8), tube (Item 5) and piston (Item 4) onto rod (Item 6). Lubricate threads on rod with hydraulic oil and install rod nut (Item 3). Torque rod nut to 1540-1675 ft-lbs.
4. Lubricate new seal and wear rings with hydraulic oil and install on piston.
5. Apply removable (blue) thread locking adhesive to threads on (1) set screw (Item 7). Coat inside of barrel (Item 2) with hydraulic oil. Carefully insert rod and head into barrel.
6. Install oscillation control block.

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Oscillation Control Block

Description

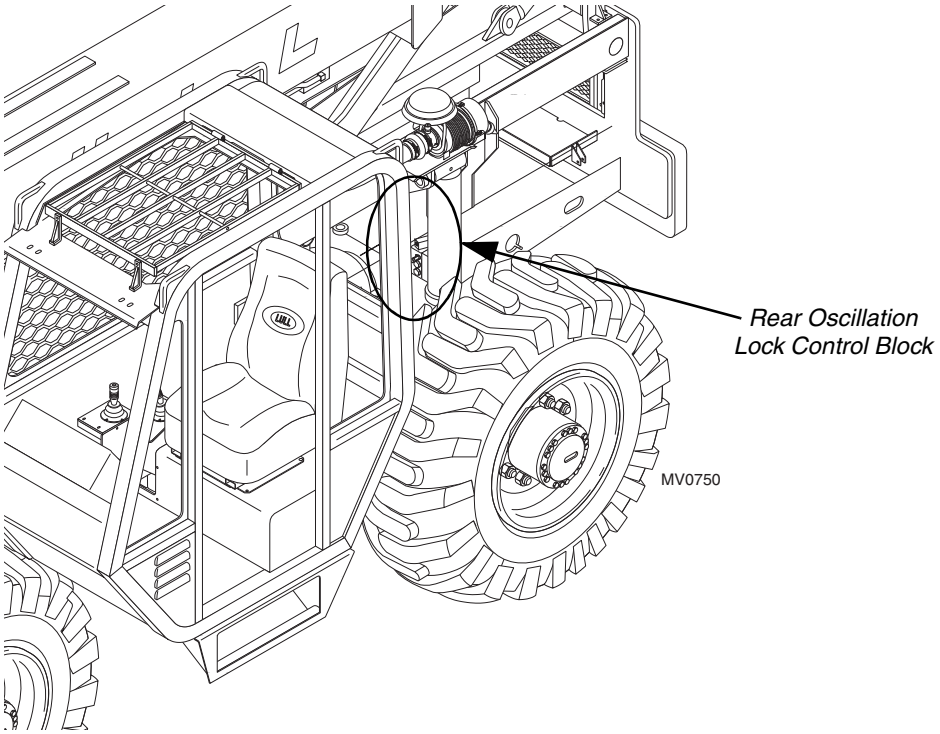


Fig. 7-19: Oscillation Control Block

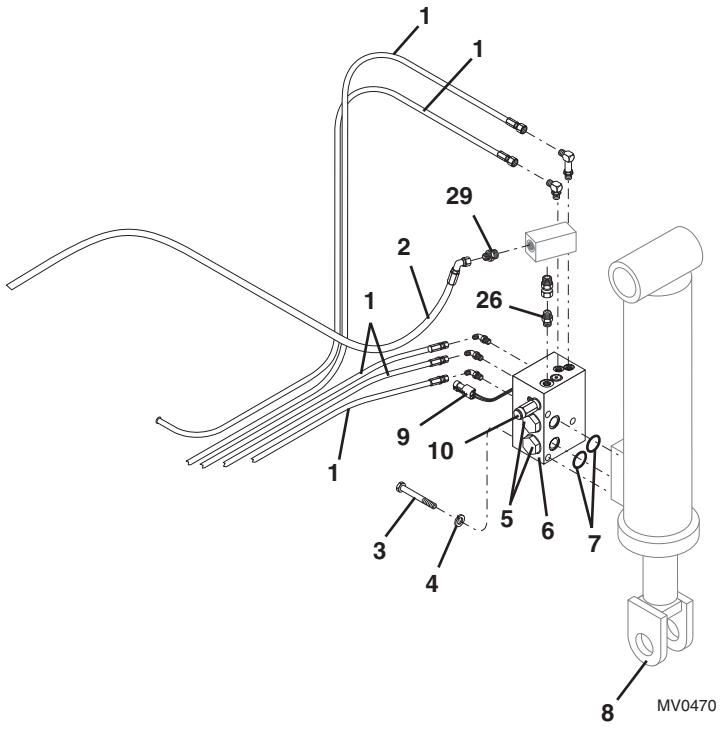
(Ref. Fig. 7-19) The oscillation control block assembly controls the function of the rear oscillation lock cylinder.

When the oscillation lock system is in UNLOCK mode, the control block allows hydraulic fluid to freely pass into and out of the cylinder.

When the oscillation lock system is in LOCK mode, the control block traps hydraulic fluid in both the rod-end and base-end of the cylinder. This hydraulic lock in the cylinder prevents the frame from rotating on the rear axle.

Removal

Oscillation Control Block



#	Description
1	#6 Hydraulic Hose
2	#8 Hydraulic Hose
3	Capscrew
4	Lockwasher
5	Check Valve Cartridge

#	Description
6	Oscillation Control Block
7	O-Ring
8	Rear Oscillation Lock Cylinder
9	Electrical Lead
10	Pressure Reducing Valve

Fig. 7-20: Oscillation Control Block Installation

Rear Oscillation Lock Cylinder Installed on Machine

(Ref. Fig. 7-20) Use the following control block removal procedures when the rear oscillation lock cylinder is installed on the machine. For removal procedures when the cylinder has been removed, see page 7-33.

1. Follow preparation procedures as outlined in Section 3.
2. Place blocks between frame and top of rear axle. This will hold the frame in place when the control block is removed.
3. Install brake pressure diagnostic port test gauge onto brake diagnostic port.
4. While watching test gauge, press brake pedal numerous times until pressure gauge reads 0 psi. Remove test gauge from diagnostic port.

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5. Place a suitable drip pan under rear oscillation lock cylinder.

WARNING: Residual hydraulic pressure may be trapped in rear oscillation lock cylinder. Wear proper eye and hand protection when releasing pressure from cylinder. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

6. Slowly loosen each check valve cartridge (Item 5) on control block (labeled 3.1 and 3.2) to allow residual pressure to escape. After pressure has been released, tighten check valves. If control block (Item 6) will not be overhauled, torque check valves to 45–50 ft-lbs.
7. For models with control manifold hydraulics, disconnect electrical connection (Item 9) at oscillation control block.
8. Tag and disconnect three (5) hydraulic hoses (Items 1 and 2) from the fittings at the oscillation control block. Cap hoses and fittings.
9. Remove three (3) capscrews (Item 3) and lockwashers (Item 4) securing control block to cylinder (Item 8). Remove control block.
10. Plug ports in cylinder.

Rear Oscillation Lock Cylinder Removed from Machine

(Ref. Fig. 7-20) Use the following control block removal procedures when the rear oscillation lock cylinder is removed from the machine. For removal procedures when the cylinder is installed on the machine, see page 7-32.

1. Support cylinder in a vice. Place a suitable pan or tray under cylinder.

WARNING: Residual hydraulic pressure may be trapped in rear oscillation lock cylinder. Wear proper eye and hand protection when releasing pressure from cylinder. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

2. Slowly loosen each check valve cartridge (Item 5) on control block (labeled 3.1 and 3.2) to allow residual pressure to escape. After pressure has been released, tighten check valves. If control block (Item 6) will not be overhauled, torque check valves to 45–50 ft-lbs.
3. Remove three (3) capscrews (Item 3) and lockwashers (Item 4) securing control block to cylinder. Remove control block.

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Installation

Oscillation Control Block

Rear Oscillation Lock Cylinder Installed on Machine

(Ref. Fig. 7-20) Use the following control block installation procedures when the rear oscillation lock cylinder is installed on the machine. For installation procedures when the cylinder has been removed, see below.

1. Clean mating surfaces of rear oscillation lock cylinder and oscillation control block.
2. Lubricate two (2) O-rings (Item 7) with hydraulic oil and install in control block.
3. Position control block on cylinder and secure with three (3) capscrews (Item 3) and lockwashers (Item 4). Torque capscrews evenly to 80 ft-lbs.
4. Attach hydraulic hoses to fittings on oscillation control block (Item 6).
5. For models with control manifold hydraulics, connect electrical lead (Item 9) at control block.
6. Start engine and tilt frame fully left and right several times to purge air from the hydraulic system. Shut off engine and check for leaks.

Rear Oscillation Lock Cylinder Removed from Machine

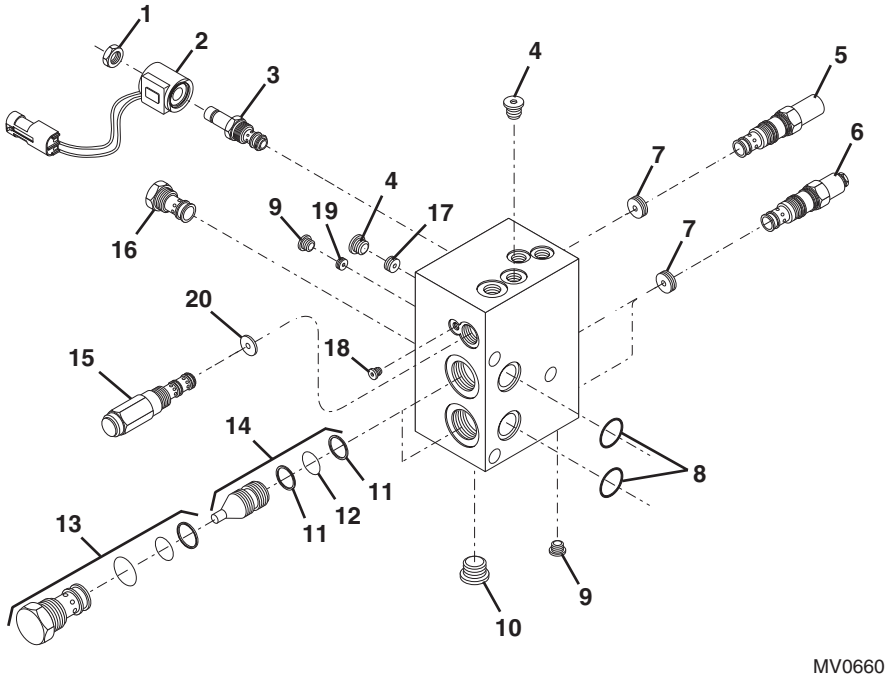
(Ref. Fig. 7-20) Use the following control block installation procedures when the rear oscillation lock cylinder is removed from the machine. For installation procedures when the cylinder is installed on the machine, see above.

1. Clean mating surfaces of rear oscillation lock cylinder and oscillation control block.
2. Lubricate two (2) O-rings (Item 7) with hydraulic oil and install in control block.
3. Position control block on cylinder and secure with three (3) capscrews (Item 3) and lockwashers (Item 4). Torque capscrews evenly to 80 ft-lbs.

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Overhaul

Oscillation Control Block



#	Description
1	Nut
2	Coil
3	Solenoid Valve
4	Seal Kit
5	Counter Balance Valve Cartridge
6	PO Check Valve (**PC1 & PC2**)
7	Orifice Plug, .040
8	O-Ring
9	Hollow Hex O-Ring Plug, #4
10	Hollow Hex O-Ring Plug, #10
11	Backup Ring

#	Description
12	O-Ring
13	Check Valve Cartridge, (**CV3 & CV4**)
14	Piston Assy
15	Pressure Reducing Valve Cartridge, (**PR**)
16	Check Valve
17	Orifice Plug
18	Hollow Hex O-Ring Plug, #2
19	Orifice Plug, .080
20	Orifice Disc, .130

Fig. 7-21: Oscillation Control Block (Exploded View)

(Ref. Fig. 7-21) Follow the guidelines for cleanliness as stated in Section 5 of this manual. The following procedures are for the disassembly, cleaning, and assembly of the oscillation control block.

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Disassembly, Oscillation Control Block

Check Valve

1. Note position of hydraulic fittings installed in block body then remove fittings.

Pressure Reducing Cartridge

2. Remove pressure reducing cartridge (Item 15) and two (2) check valve cartridges (Item 13).
3. Remove two (2) pilot pistons (Item 14).

Solenoid Valve

4. Remove the one (1) SAE #2 plugs (Item 18), three (3) SAE #4 plugs (Item 9), two (2) SAE #6 plug (Item 4), and SAE #10 plug (Item 10).
5. Orifice plug (Item 19) does not usually require removal. It will be cleaned when the block body is flushed.

Cleaning and Inspection, Oscillation Control Block

1. Remove O-rings and backup rings from pressure reducing valve cartridge (Item 15), two (2) check valve cartridges (Item 13), counter balance valve cartridge (Item 5), and PO Check Valve (Item 6). Clean these components with solvent and dry with compressed air. Inspect components for condition and cleanliness.
2. Thoroughly flush block body with solvent and dry with compressed air.
3. Clean remaining components (except solenoid coil) with solvent and dry with compressed air.
4. Inspect orifice plugs (Items 17 and 19) for blockage and clean as necessary.

Assembly, Oscillation Control Block

1. If orifice plug (Item 19) was removed, install in block body so it is finger tight. Tighten orifice plug 2–3 turns past finger tight.
2. Install two (2) SAE #6 plugs (Item 4). Torque plugs to 210–230 in-lbs.
3. Install one (1) SAE #2 plugs (Items 18). Torque plugs to 30–40 in-lbs.
4. Install three (3) SAE #4 plug (Item 9). Torque plug to 125–145 in-lbs.
5. Install SAE #10 plug (Item 10). Torque plug to 71–79 ft-lbs (850–950 in-lbs).
6. Obtain new O-rings and backup rings for pressure reducing cartridge (Item 15), two (2) check valve cartridges (Item 13), two (2) pilot pistons (Item 14), counter balance valve cartridge (Item 5), and PO Check Valve (Item 6). Lubricate all O-rings and backup rings with hydraulic oil before installing on components.

Pressure Reducing Cartridge

7. Install large O-ring on pressure reducing valve cartridge (Item 15). Install backup ring and O-ring on cartridge so backup ring is behind O-ring.
8. Lubricate all O-rings and backup rings on pressure reducing cartridge (Item 15). Install cartridge and torque to 270–300 in-lbs.

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Solenoid Valve

9. Install two (2) backup rings and O-ring on each pilot piston (Item 14) so O-ring is between backup rings. (Ref. Fig. 7-21).
10. Lubricate backup rings and O-ring on each pilot piston and install pistons in block body. Tapered end of pistons must face out as shown in Fig. 7-21.
11. Install large O-ring , O-ring , and backup ring on each check valve cartridge (Item 13).
12. Lubricate O-rings and backup ring on each check valve cartridge (Item 13). Install cartridges and torque to 45–50 ft-lbs (540–600 in-lbs).

Check Valve

13. Install check valve in SYS port and torque to 46–50 ft-lbs.
14. Install adjustable fitting in T port. Position fitting as previously noted and torque to 300–340 in-lbs (25–29 ft-lbs).
15. Two (2) O-rings (Item 8) are installed when control block is installed on rear oscillation lock cylinder. See “Installation” on page 7-34.

Boom Elevation Proximity Switch

Description

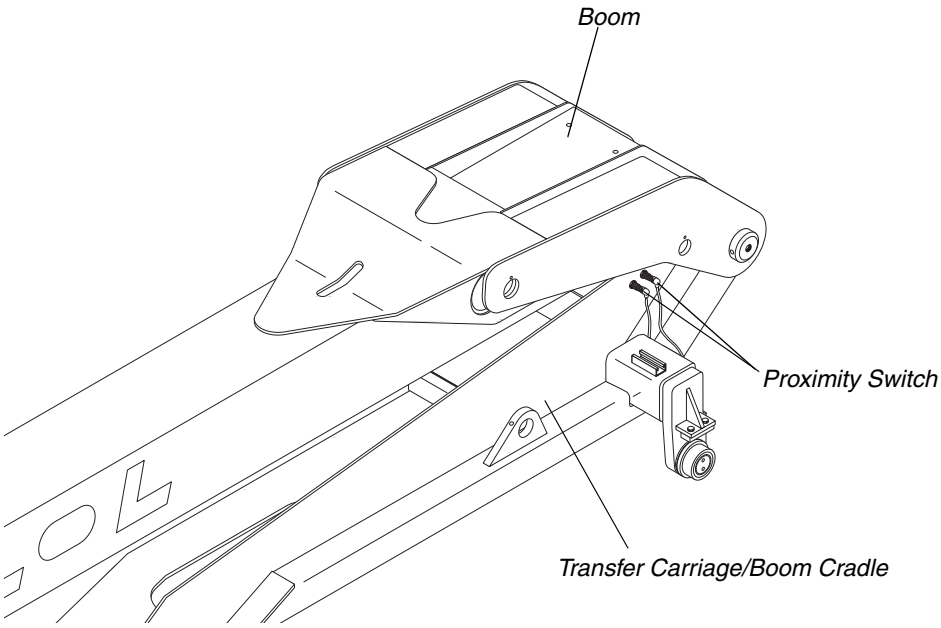


Fig. 7-22: Boom Elevation Proximity Switch

(Ref. Fig. 7-22) The boom elevation proximity switch is located on the left side of the transfer carriage/boom cradle. This normally open switch closes when the boom is below 20° elevation. This normally open switch closes when the boom is below 40° elevation.The switch is a component of the rear oscillation lock system. See “Rear Oscillation Lock System” on page 7-17.

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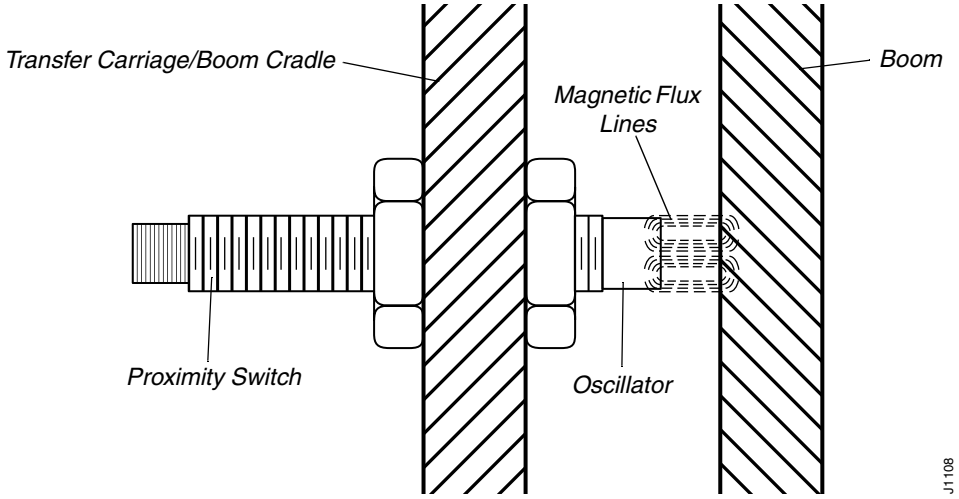
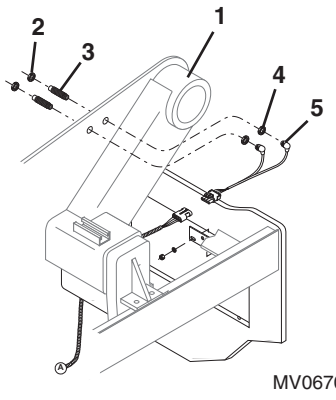


Fig. 7-23: Boom Elevation Proximity Switch Operation

(Ref. Fig. 7-23) The switch operates by sending out a constant, high frequency magnetic field a short distance from the oscillator end of the switch. Eddy currents are produced in metal when the magnetic flux lines pass through it. These eddy currents oppose the oscillations of the magnetic flux lines and the oscillations stop. A sensor in the switch detects if the oscillator is on or off and this gives the switch its on/off function.

Removal

Boom Elevation Proximity Switch



#	Description
1	Transfer Carriage/Boom Cradle
2	Inner Jam Nut
3	Proximity Switch

#	Description
4	Outer Jam Nut
5	Wire Harness

Fig. 7-24: Boom Elevation Proximity Switch Assembly

1. (Ref. Fig. 7-24) Disconnect wire harness (Item 5) at boom proximity switch (Item 3).
2. Place a piece of masking tape around proximity switch body at the outer jam nut (Item 4) (this will serve as a guide during re-installation).

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3. Remove inner jam nut (Item 2) and proximity switch form transfer carriage/boom cradle (Item 1). Re-install inner jam nut on proximity switch for safekeeping.

Installation

Boom Elevation Proximity Switch

1. Position outer jam nut (Item 4) on switch body (Item 3) at previously marked position.
2. Install boom proximity switch in transfer carriage/boom cradle (Item 1). Install inner jam nut (Item 2). Check gap between end of proximity switch and boom. See Fig. 7-25.
3. Connect wire harness (Item 5) to proximity switch.
4. Check operation of proximity switch by raising the boom. The **Rear Osc Lock** light must come on at approximately 20° of boom elevation. If the light does not illuminate, stop and lower boom. Proceed to “Adjustment” below.

Adjustment

Boom Elevation Proximity Switch

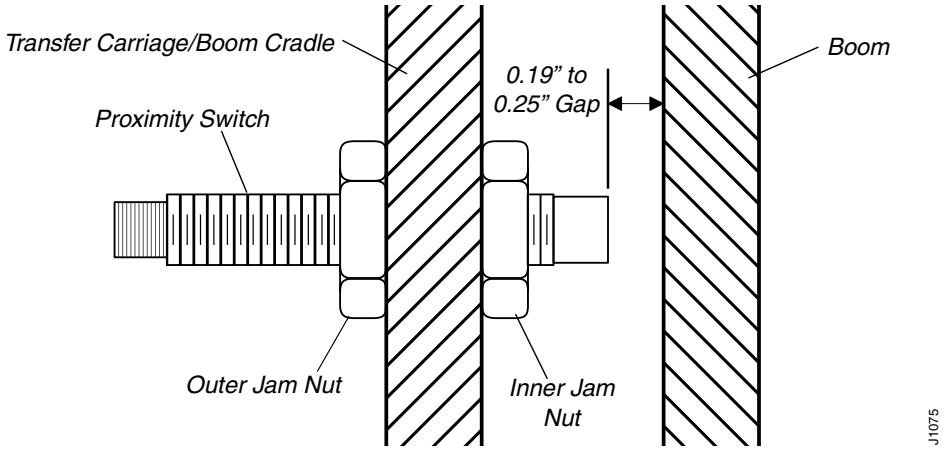


Fig. 7-25: Boom Elevation Proximity Switch Adjustment

1. Loosen, but do not remove the two (2) jam nuts on the proximity switch body.
2. Check gap between switch and boom. Gap must be within the range specified in Fig. 7-25.
3. If **Rear Osc Lock** light does not illuminate when boom is at approximately 20° elevation, adjust proximity switch to slightly reduce the gap. Do not exceed gap tolerances specified in Fig. 7-25. Snug jam nuts to hold switch in position.
4. Raise boom and check operation of **Rear Osc Lock** light. The light must come on at approximately 20° of boom elevation. If light does not illuminate, stop and lower boom. Repeat Step 3.
5. Tighten jam nuts.

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Table of Contents

Transmission Assembly Component Terminology 8-1
Transmission Description 8-1
Transmission Operation 8-2
Transmission Specifications 8-3
Transmission General Specification 8-3
Transmission Performance Specification 8-3
Transmission Lubrication 8-3
Transmission Maintenance 8-4
Transmission Removal 8-6
Transmission Inspection and Internal Repair 8-10
Transmission Installation 8-10
After Transmission Service or Replacement 8-12
Transmission Shift Logic 8-13
Troubleshooting 8-15
Transmission Troubleshooting 8-16

List of Figures

Fig. 8-1: ZF Transmission 8-1
Fig. 8-2: Transmission Serial Number Plate Location 8-3
Fig. 8-3: The Lubrication and Maintenance Flip Chart 8-4
Fig. 8-4: Transmission Oil Cooler Hose Connections 8-5
Fig. 8-5: Disconnect the Battery Negative (-) Cable 8-6
Fig. 8-6: Drain Transmission Oil 8-7
Fig. 8-7: Transmission Oil Cooler Hose Connections 8-8
Fig. 8-8: Remove Transmission from Frame 8-9
Fig. 8-9: Transmission External Components 8-10
Fig. 8-10: Install the Transmission. 8-11
Fig. 8-11: Transmission Oil Cooler Hose Connections 8-11
Fig. 8-12: Transmission Shift Logic Schematic 8-15

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Section 8 — Transmission

Transmission Assembly Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.

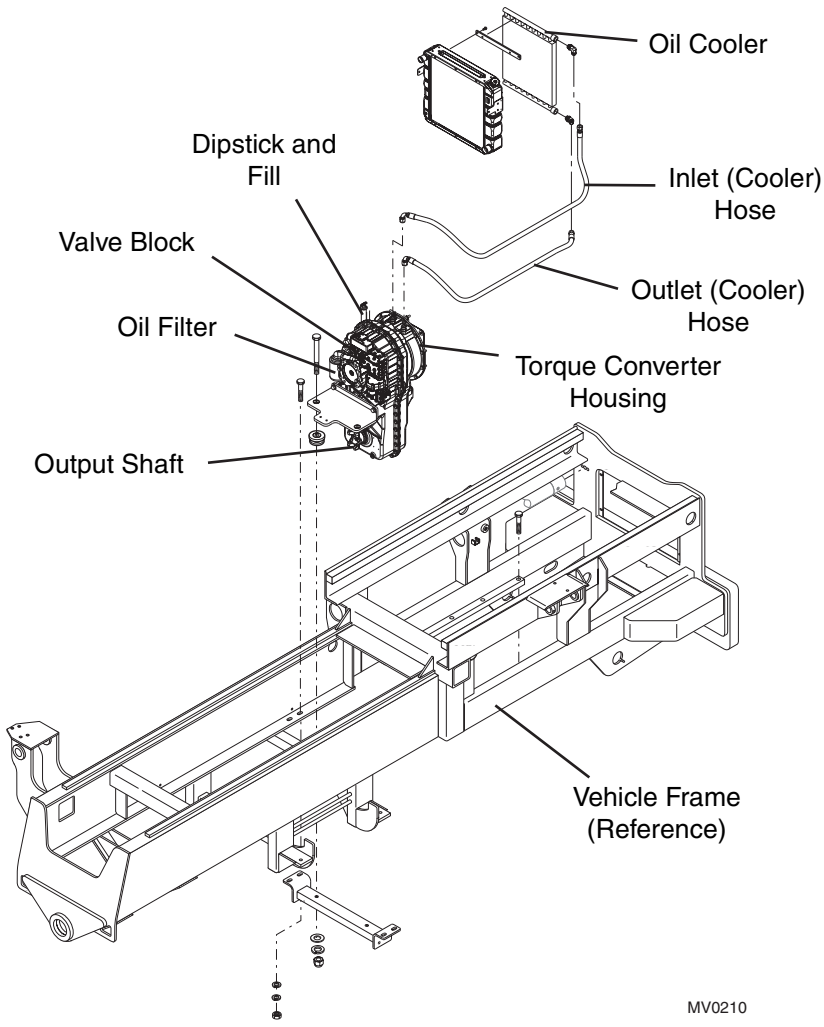


Fig. 8-1: ZF Transmission

Transmission Description

Instructions in this section pertain mainly to general specifications, towing, maintenance information, and transmission removal and installation procedures. Internal transmission service instructions and detailed specifications are provided in the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002).

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The ZF 4 WG-98 TC Transmission used in this vehicle is a four-speed configuration. The “intermediate drop” designation refers to the relative top-to-bottom length of the transmission case, chosen for its compatibility with vehicle chassis and operating requirements. Intermediate drop does not refer to an operational rpm shift or drop.

Transmission Operation

The transmission is mounted to the frame by front and rear mounting brackets and rubber isolator pads. Power from the engine is transmitted to the transmission by means of a drive shaft, bolted to the engine flywheel and a torque converter at the transmission input. The transmission in turn transmits power to the drive shafts, driving the front and rear axles.

The torque converter consists of three main components: the impeller (driver), stator and turbine (driven) in an oil-filled, enclosed housing. As the torque converter is driven by the engine flywheel, the impeller (pump) wheel rotates, forcing oil through the stator, which is held stationary by the stator shaft bolted to the transmission housing. This directs the moving oil onto the vanes of the turbine (driven) wheel, causing the turbine wheel to rotate. The turbine wheel is connected to the transmission input shaft, and transfers power to the transmission. Oil from the turbine wheel is then returned to the impeller wheel to repeat the process. This process results in an increase in the torque available at the transmission input shaft.

The transmission and torque converter are powered by their own internal hydraulic (“transmission fluid”) system, separate from the vehicle hydraulic system. Pressurized oil for the valve control circuits and torque converter is supplied by a pump located at the rear of the transmission. The pump is driven by the central shaft, which in turn is connected to the impeller of the torque converter. The vehicle is equipped with an external oil cooler to cool the transmission oil.

The transmission gear (“speed”) select lever, an electric shift control, is located on the left side of the steering column in the operator’s cab. Movement of the gear select lever energizes the selected transmission shift solenoid valves, which, in turn, direct the transmission fluid under pressure to the selected forward or reverse valve and to the designated range (gear or “speed”) clutch. Several factors, including terrain, loading, engine rpm, axle/wheel-end gearing and the selected transmission gear, determine actual vehicle speed.

To engage the clutch, the gear select lever is placed in the desired direction (forward or reverse) and range (gear or “speed”) position. The gear select lever movement energizes the selected direction and range (gear) solenoids, allowing transmission fluid under pressure to flow through tubes and passages to the selected clutch shafts. Oil sealing rings are located on the clutch shaft; these rings direct oil under pressure through a drilled passageway in the shaft to a desired clutch. Hydraulic pressure forces the piston and discs against the back-up plate. Discs, with edge tangs, clamp against toothed discs on the inner diameter, enabling the hub and the clutch shaft to lock together and drive as a unit, providing output power.

Transmission Serial Number

The transmission serial number plate (**1**) is located on the pump side (front) of the transmission at the bottom right, toward the vehicle frame. Information specified on the serial number plate includes the transmission model number, the transmission serial number and other data. Information on the serial number plate is required in correspondence regarding the transmission.

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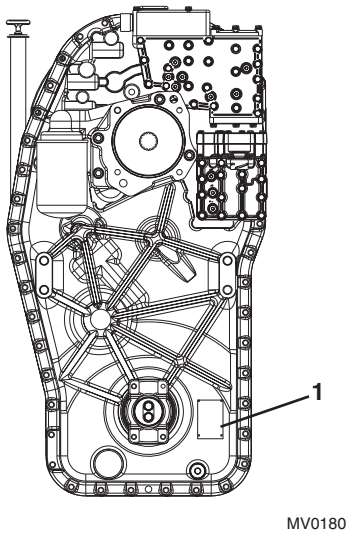


Fig. 8-2: Transmission Serial Number Plate Location

Transmission Specifications

Transmission General Specification

General transmission specifications are found in Section 2, “General Information and Specifications.” Transmission fluid information is found in Section 3-3, “ZF Transmission Oil Specifications.”.

Transmission Performance Specification

Performance criteria is based on full throttle engine speed unless otherwise specified or not applicable.

Travel Speed (standard tires, no load)

First gear.....3.5 mph (5,6 km/hr)

Second gear .....6 mph (9,7 km/hr)

Third gear .....15.2 mph (24,5 km/hr)

Fourth gear .....22 mph (35 km/hr)

Transmission Lubrication

a. Transmission Fluid

Complete transmission fluid information is found in Section 3-3, “ZF Transmission Oil Specifications.”.

b. Transmission Fluid (Oil) Capacity

Capacity w/ filter change..... 19 quarts (18 liters)

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Transmission Maintenance

WARNING: To help avoid severe burns, **DO NOT** attempt this procedure when the engine, cooling, and hydraulic systems are hot. Wait until they have cooled before proceeding.

- Follow the manufacturer's instructions to avoid health hazards when using solvents and caustic cleaners.
- Exercise extreme care when using a steam cleaner to help avoid burns.

IMPORTANT: *These instructions cover only the routine maintenance of the transmission. Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002), for information on transmission internal component replacement.*

Refer to the ZF 4 WG-98 TC Transmission Technical Data and Maintenance Manual, P/N 8990449 (ZF P/N 5872 134 002), for information on transmission diagnosis and internal schematics.

Cleanliness is of extreme importance. Before attempting any repairs, thoroughly clean the exterior of the transmission to help prevent dirt from entering while performing maintenance checks and procedures.

Transmission Maintenance Schedule provides a suggested maintenance schedule with references to pertinent procedures and instructions in this manual. To help prevent transmission problems before they occur, follow the maintenance schedule.

Note: Lubrication and Maintenance Flip Card is (**1**) located inside the Cab. These decals contain a general maintenance schedule that should be followed to maintain the vehicle in good operating condition. Refer to Section 2, " General Information and Specifications."The same schedule information is presented in the appropriate owners/operators manual, with a detailed account of how to perform the procedures.

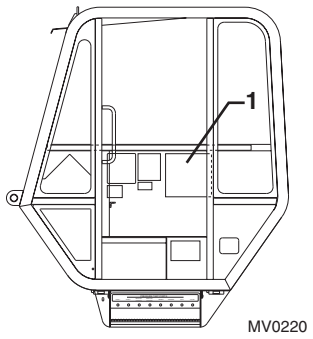


Fig. 8-3: The Lubrication and Maintenance Flip Chart

Transmission Maintenance Schedule

Complete transmission maintenance information is located in the appropriate operators & safety manual.

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- At ten hour intervals, check the transmission oil level. Refer to the appropriate operators & safety manual.
- When the vehicle completes its first 50 hours of use, change the transmission filter. Change the filter only; **DO NOT** change the transmission oil at the first 50 hour maintenance level. Refer to the appropriate operators & safety manual.
- At 1,000 hour intervals, change the transmission oil and filter. Refer to the appropriate operators & safety manual.

Periodically, depending on operating conditions and other factors, back flush the transmission oil cooler (**2**), which is located in or behind the radiator. ALWAYS back flush the transmission oil cooler after removing the transmission for repair or replacement.

The transmission oil cooler outlet hose (**3**), routed to the lower oil cooler fitting, is located on the top of the transmission. The transmission oil cooler inlet hose (**4**), routed to the upper oil cooler fitting, is located on the top of the transmission.

CAUTION: DO NOT exceed 165 psi (39.6 bar) when back flushing the oil cooler. Applying too much pressure may damage the oil cooler/radiator.

Disconnect and back flush the oil cooler portion of the radiator or the oil cooler (located behind the radiator) with oil and compressed air until all foreign material is removed. If necessary, remove the radiator or oil cooler from the vehicle, and clean the oil cooler circuit using oil, compressed air and steam.

***IMPORTANT: DO NOT** use flushing compounds for cleaning purposes*

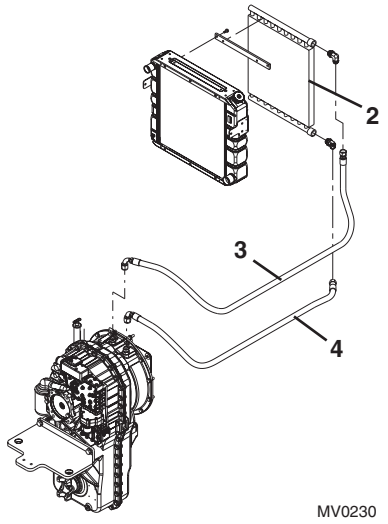


Fig. 8-4: Transmission Oil Cooler Hose Connections

Transmission Replacement

Note: *Contact the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if internal transmission repair is required during the warranty period.*

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Important: To help ensure safety and optimum performance, replace the transmission if it is damaged. Refer to the **appropriate** parts manual for ordering information.

Cleanliness is of extreme importance. Before attempting to remove the transmission, thoroughly clean the exterior of the transmission to help prevent dirt from entering during the replacement process. Avoid spraying water or cleaning solution onto or near the transmission shift solenoids and other electrical components.

Transmission Removal



WARNING: Risk of severe personal injury. **NEVER** lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

1. Park the machine on a firm, level surface, fully retract the boom, raise the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated. Refer to Section 1.5, “Accident Prevention Tags.”



WARNING: **DO NOT** get under a raised boom unless the boom is blocked up. ALWAYS block the boom before doing any servicing that requires the boom to be up. Unexpected lowering of the boom may cause death or serious injury.

3. Temporarily block up or support the boom.



WARNING: Hot hydraulic fluid can cause severe burns. Wait for hydraulic fluid to cool before servicing any hydraulic component.

4. Open the rear door. Allow the engine, transmission and hydraulic fluid to cool.
5. Drain the hydraulic oil reservoir. (Refer to the appropriate operators & safety manual for information concerning the hydraulic oil and filter change.)
6. Disconnect the battery negative (-) cable (**1**) or cables at the battery negative (-) terminal, to prevent the engine from starting accidentally.

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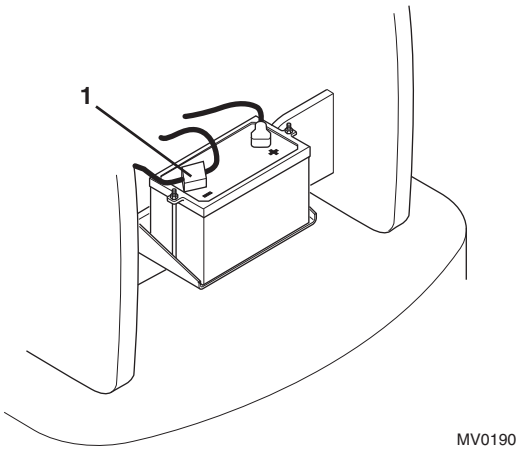


Fig. 8-5: Disconnect the Battery Negative (-) Cable

7. Thoroughly clean the transmission and surrounding area, including all hoses and fittings, before proceeding.
8. Place a suitable receptacle under the transmission drain plug. Remove the transmission drain plug (**2**), and allow the transmission oil to drain into the receptacle.
9. Transfer the used transmission oil into a suitable, covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.

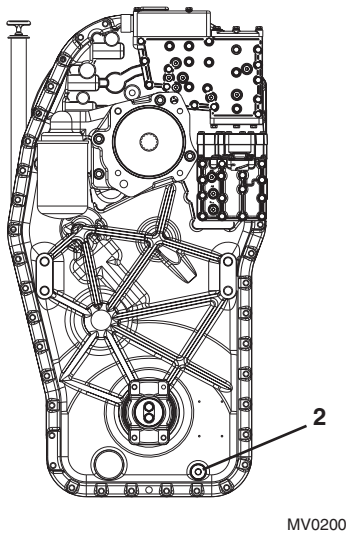


Fig. 8-6: Drain Transmission Oil

10. Remove the engine-to-transmission drive shaft.
11. Remove the transmission-to-axle drive shafts.
12. Remove the hydraulic pump.

13. Label and disconnect the transmission temperature switch connector and shift solenoid wiring harness connectors.
14. Remove the capscrew securing the black wire to the transmission housing, and disconnect the wire. **DO NOT** reinstall the capscrew at this time.
15. Remove the capscrew securing the clamp and wiring harness to the transmission housing, and move the wiring harness safely out of the way. **DO NOT** reinstall the capscrew at this time.
16. Label, disconnect and cap the transmission oil cooler inlet (**3**) and outlet (**4**) hoses at the transmission. The transmission oil cooler outlet hose, routed to the lower radiator fitting, is located on the top of the transmission. The transmission oil cooler inlet hose, routed to the upper radiator fitting, is located on top of the transmission.
17. Wipe up any spilled hydraulic and transmission oil.

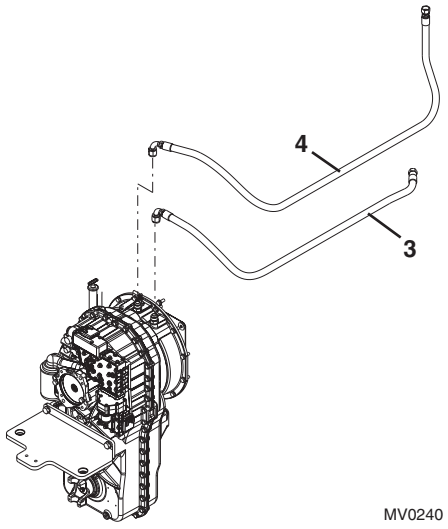


Fig. 8-7: Transmission Oil Cooler Hose Connections

18. Connect a lifting strap or chain to the top of the transmission (**18**), and to a suitable hoist or overhead crane. Operate the hoist or crane to remove slack from the chain, but **DO NOT** raise the transmission at this time.
19. Place jack under the transmission to help support it during removal.
20. Remove the two capscrews (**19**) and two lockwashers (**5**) securing the front transmission mount (**6**) to the transmission.
21. Remove the two capscrews (**7**), two mount washers (**17**), two flat washers (**8**), two lockwasher (**9**) and two hex nut (**10**).
22. Remove the four capscrews (**11**), four flat washer (**12**), four lockwasher (**13**), and four hex locknuts (**14**).
23. Remove transmission mount weldment (**15**).
24. Inspect the rubber mounts (**16**). Replace the mounts if damaged.

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WARNING: Risk of personal injury. The transmission may move while hoisting it out of the chassis. Carefully move the transmission and adjust the sling as needed. Keep fingers, hands, legs and other body parts clear of the transmission.

25. Carefully remove the transmission from the vehicle. Avoid causing damage to the transmission or surrounding parts.
26. Lift the transmission clear of the vehicle, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure the transmission so that it will not move or fall.

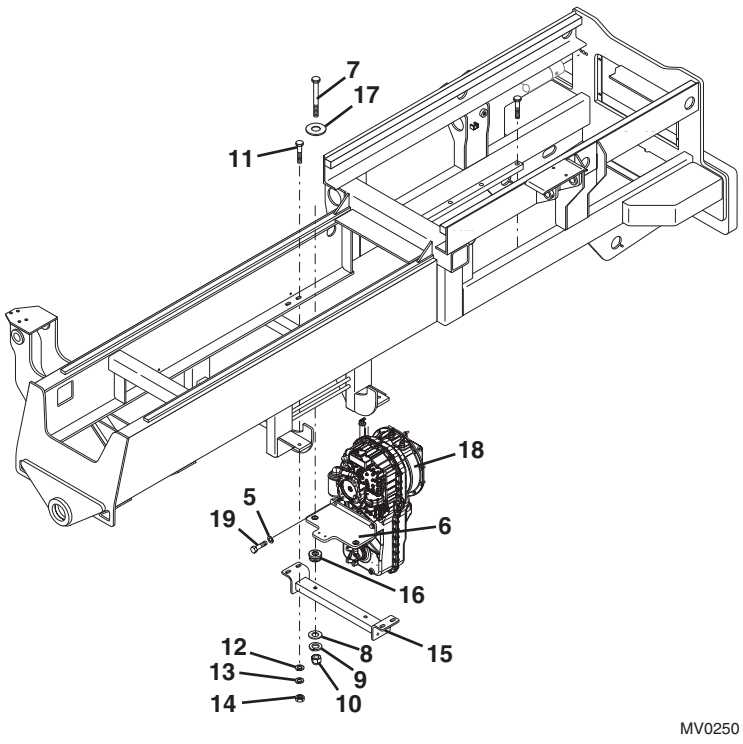


Fig. 8-8: Remove Transmission from Frame

27. Remove any external transmission components as required, including the transmission temperature switch (**20**), and inlet (**21**) and outlet (**22**) cooler hose fittings. Cover all transmission openings.
28. Remove the transmission oil filter (**23**) and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.

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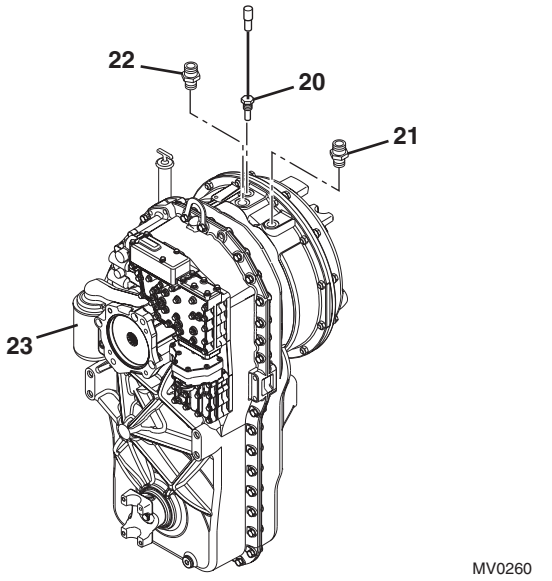


Fig. 8-9: Transmission External Components

The transmission is now ready for inspection and/or further service. Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for information on transmission diagnosis, and internal component repair or replacement.

Transmission Inspection and Internal Repair

Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for information on internal component repair or replacement. Refer to the ZF 4 WG-98 TC Transmission Technical Data Manual and Maintenance Manual, P/N 8990449 (ZF part number 5872 134 002) for information on transmission diagnosis and internal schematics.

If replacing the entire transmission, transfer the transmission temperature switch to the replacement transmission. The gear shift solenoids are included with a new transmission.

WARNING: Risk of severe personal injury. **NEVER** lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling**.**

WARNING: The transmission must be properly installed using fasteners of the correct size and grade, and torqued to their specified values.

Transmission Installation

1. Use a hoist or overhead crane and sling attached to the top of the transmission. Raise and position the transmission within the chassis.

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2. Attach the transmission to the rear mounting bracket (**6**) with two capscrews (**4**) and two lockwashers (**5**). Torque the capscrews to 148 lb-ft (200 Nm).
3. Install four capscrews (**11**), four flat washer (**12**), four lockwashers (**13**) and four hex nuts (**14**). Torque the capscrews to 148 lb-ft (200 Nm).
4. Install the two rubber mounts (**1**) and the rear transmission mounting bracket (**2**) on the transmission with two capscrews (**7**), two mounting washers (**17**), two flat washers (**8**), two lockwashers (**9**) and two hex nuts (**10**)
5. Remove the hoist or overhead crane and sling.

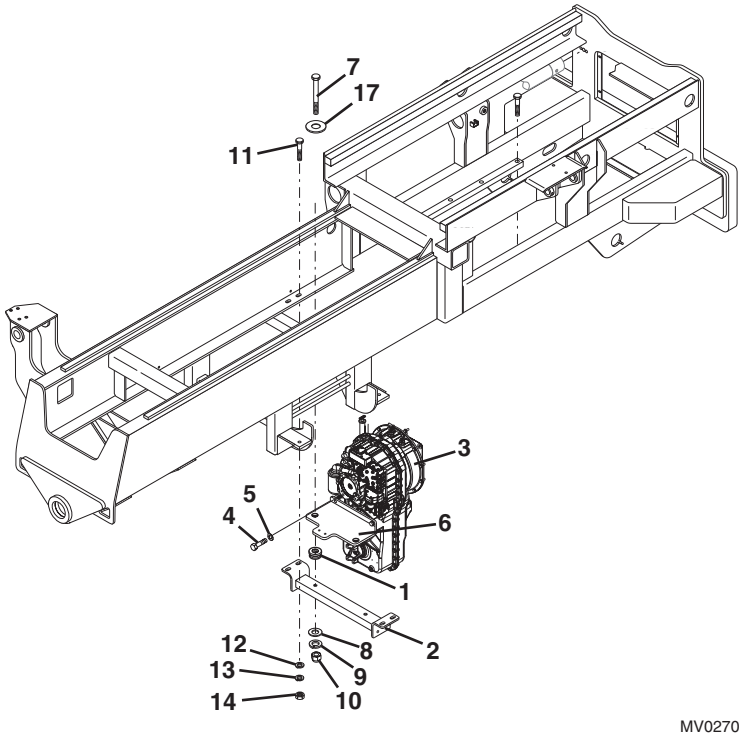


Fig. 8-10: Install the Transmission

6. Secure the wiring harness to the transmission housing.
7. Connect the transmission oil cooler inlet (**18**) and outlet (**19**) hose at the transmission.
8. Install the hydraulic pump.

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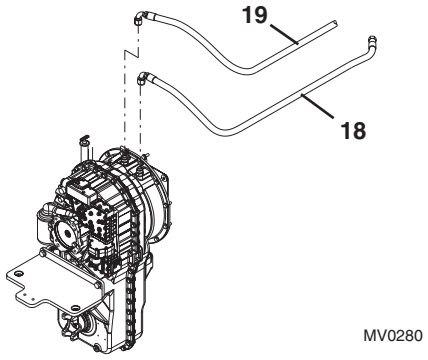


Fig. 8-11: Transmission Oil Cooler Hose Connections

9. Install the transmission-to-axle drive shafts.
10. Clean the transmission oil filter mounting surface.
11. Apply a thin film of clean Mobil 424 Tractor/Hydraulic Fluid to the new transmission filter gasket. Install the new filter and torque to 20-25 lb-ft (27-34 Nm).
12. Transmission oil may be added through the dipstick tube. Remove the dipstick and add approximately 3 gallons (11,4 liters) of Mobil 424 Tractor/Hydraulic Fluid. Check the oil level by taking intermittent dipstick readings as outlined in the appropriate operators & safety manual. **DO NOT** overfill. Reinstall the dipstick when finished.
13. Connect the battery negative (-) cable at the battery.

After Transmission Service or Replacement

Refer to the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002) for information on servicing the transmission after overhaul or repair. In general:

1. Check the transmission oil level and add oil as required.
2. Install a new transmission filter.
3. Check the torque on the drive shaft yoke capscrews.
4. Wear suitable eye protection. When an overhauled or repaired transmission is installed, thoroughly clean the oil cooler lines to and from the transmission.
5. Drain and flush the entire system.
6. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the machine for cleaning.
7. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.

CAUTION: **DO NOT** exceed 165 psi (11,4 bar) when back flushing the oil cooler. Applying too much pressure may damage the oil cooler/radiator.

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8. Back flush the transmission oil cooler portion of the radiator or the oil cooler (located behind the radiator) with oil and compressed air until all foreign material is removed. Flushing in the direction of normal oil flow does not adequately clean the cooler. If needed, remove the radiator or oil cooler from the machine.

IMPORTANT: ***DO NOT*** *use flushing compounds for cleaning purposes.*

9. Reassemble all components and fill the transmission with clean, fresh Mobil 424 Tractor/Hydraulic Fluid through the dipstick tube opening. Remove the dipstick and fill with approximately 19 quarts (18 liters) of Mobil 424 Tractor/Hydraulic Fluid. Check the level by taking intermittent dipstick readings as outlined in the appropriate Operator/Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.

10. Run the engine for two minutes at idle to help prime the torque converter and the transmission oil lines.
11. Recheck the level of the fluid in the transmission with the engine running at idle.
12. Add Mobil 424 Tractor/Hydraulic Fluid as necessary to bring the fluid level up until it reaches the FULL mark on the dipstick. Recheck the oil level when it reaches operating temperature (180-200° F or 83-94° C).
13. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

Transmission Shift Logic

There are 8 relays, 9 diodes and 2 diode modules which make up the transmission shift logic circuit. Fig. 8-12.The relays are labeled K11 through K17 (Relay K18 is not part of the transmission shift logic).

Relays K11 through K17 are part of harness assembly part number 4923246.Diodes D1 through D9 are also a part of harness assembly part number 4923246. Relays K11 through K17 and Diodes D1 through D9 are located in the cab in a small metal box behind the operator's seat on the right side of the machine.The 2 diode modules are part of harness assembly part number 4923243.The purpose of the diode modules is to allow the solenoids to be energized and de-energized without adverse effects on the rest of the transmission circuits only. They do not control how the transmission shifts.The purpose of Diodes D1 through D9 is to allow current flow in only one direction in a given wire or circuit. It is extremely important that the polarity of the diodes in the circuit is correct or the transmission will not shift as it was designed to.

The purpose of the relays is to control how the transmission shifts.

See Fig. 8-12 to determine when each of the relays is supposed to be energized.

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Normal Operation of the transmission is as follows:

When the boom is not above 20°, the transmission shifts normally (i.e., the gear selected using the Transmission Shifter is the gear the transmission shifts to).

When the boom is above 20° and not above 40°, the transmission is limited to first and second gears. Selecting first gear will put the transmission in first gear and selecting any other gear will put the transmission in second gear.

When the boom is above 40°, the transmission is disabled.

When the boom is above 40° and the Transmission Disconnect Override

Footswitch is activated, the transmission will operate in first gear only regardless of the gear selected with the Transmission Shifter. This is an extremely dangerous operation – see the Operator's Manual for more information on this.

Troubleshooting the transmission: If the transmission is not operating as described above, check the following items:

1. Check the 7.5 amp transmission fuse (**F3**) on the circuit board in the cab. If the fuse is blown, replace it with another 7.5 amp fuse. If it blows again immediately, there is an electrical short somewhere in the system that must be corrected. Never replace the fuse with one of a larger amp rating or a fire or other permanent damage to the electrical system may occur.
2. Check that power is being supplied to the Transmission Shifter at pins 1 and 9.
3. Check that Diodes D1 through D9 are installed in the proper direction and are functioning properly (they can be tested using a digital multimeter with a diode mode).Replace any failed diodes that are found.
4. Check that Relays K11 through K17 are operating properly. Replace any failed relays that are found.
5. Check the Diode Modules on the harness assembly part number 4923243. If there are failed diodes in the diode module, replace the internal circuit board with the diodes on it.
6. Check the condition of the wires on each of the harnesses that make up the transmission shift circuits. See part numbers 4923246, 4923242 and 4923243. If there are damaged wires or loose connections, repair as necessary or replace the harness.

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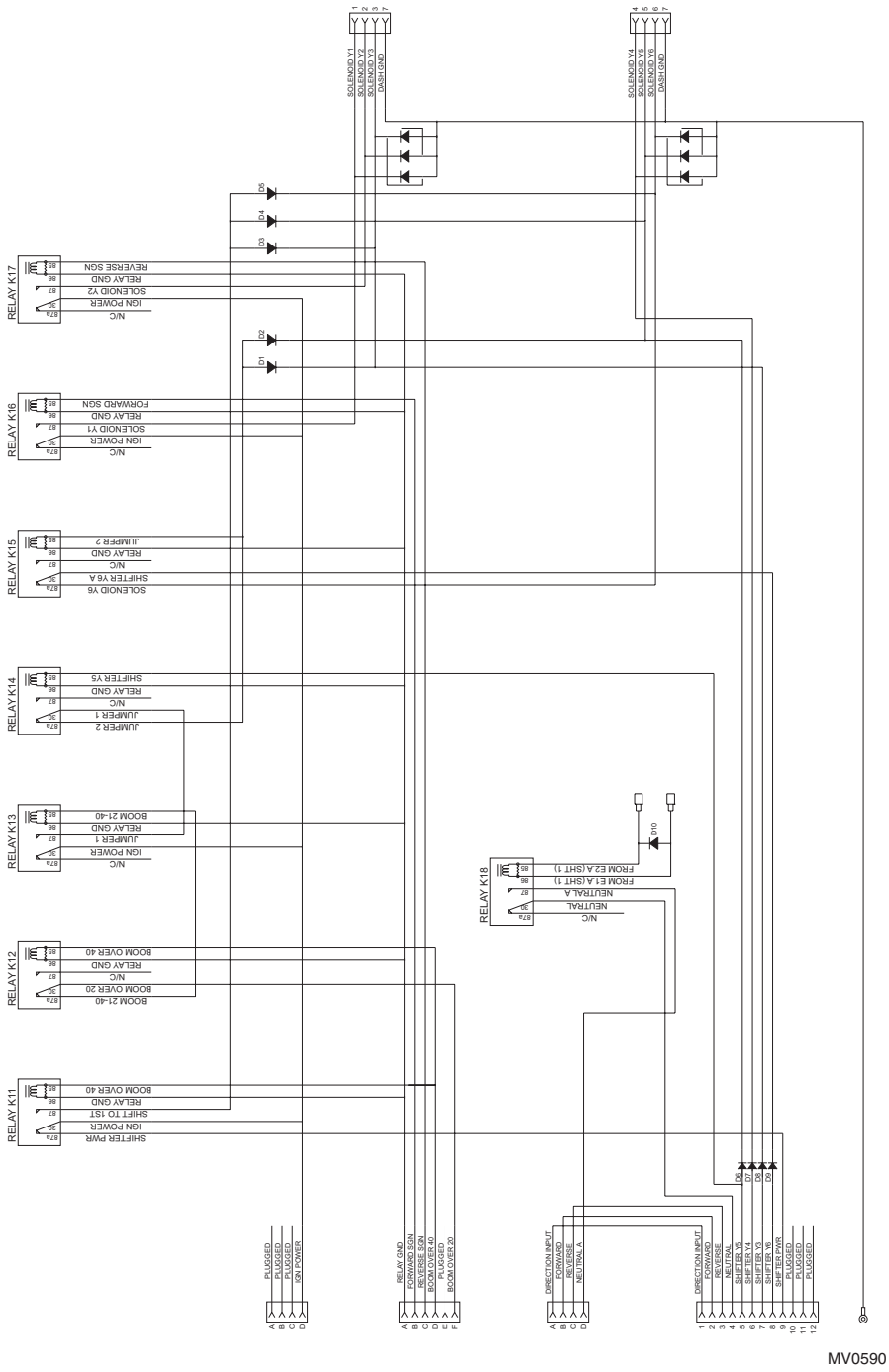


Fig. 8-12: Transmission Shift Logic Schematic

Troubleshooting

This section provides an easy reference guide covering the most common problems that may occur during operation of the transmission.

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Note: Contact the **JLG** Service Department at 1-877-554-5438 or 1-717-485-6657, if internal transmission repair is required during the warranty period.

Detailed transmission service instructions (covering repair, disassembly, reassembly and adjustment information) are provided in the ZF 4 WG-98 TC Transmission Repair Manual, P/N 8990455 (ZF P/N 5871 135 002).

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Transmission Troubleshooting

Problem	Cause	Remedy
1. Transmission will not engage or will not shift properly.	1. Oil level too high or low.	1. Fill transmission to correct level with Universal Tractor Fluid. (Refer to the appropriate owners/operators manual.)
	2. Travel select lever not functioning properly and/or a fault in the wiring harness.	2. Refer to Section 9.14.7, a. “Travel Select Lever and Wiring Harness Testing.”
	3. Transmission valve body solenoids not functioning properly.	3. Refer to Section 9.14.7, b. “Upper and Lower Transmission Valve Body Solenoid Testing.”
	4. Pilot-operated shift valves not operating properly.	4. Clean the valve spool and housing. Replace return spring as needed.
	5. Pump output pressure low.	5. Refer to Section , “Transmission Troubleshooting,” **Problem 2.** “Low or no pump flow or pressure.”
	6. Clutch piston o-rings damaged.	6. Replace o-rings.
	7. Clutch discs worn or damaged.	7. Replace clutch discs.
	8. Coupling shafts or gear teeth damaged.	8. Replace couplings.
2. Low or no pump flow or pressure.	1. Low oil level.	1. Fill transmission to correct level with Universal Tractor Fluid. (Refer to the appropriate owners/operators manual.)
	2. Transmission filled with incorrect oil, or oil contaminated.	2. Drain transmission and fill to correct level with Universal Tractor Fluid. (Refer to the appropriate owners/operators manual.)
	3. Pump suction pipe screen clogged.	3. Clean, repair and/or replace suction pipe.
	4. Central shaft damaged.	4. Replace central shaft.
	5. Pump worn or damaged.	5. Repair or replace pump assembly.

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Transmission Troubleshooting (Continued)

Problem	Cause	Remedy
3. Low clutch pressure.	1. Incorrect oil level.	1. Fill transmission to correct level with Universal Tractor Fluid. Refer to the appropriate owners/operators manual.
	2. Main pressure valve stuck open.	2. Clean the valve spool and housing.
	3. Broken or worn coupling shaft or piston o-rings.	3. Replace coupling and/or o-rings.
	4. Pressure reducing valve stuck open.	4. Clean the valve spool and housing.
4. Lack of power.	1. Park or service brake dragging.	1. Refer to Section 8.8, “Hydraulic Circuits and Troubleshooting.”
	2. Low engine rpm causes converter stall.	2. Adjust the engine rpm to specifications. Refer to Cummins Service Manual.
	3. Pump output pressure is low.	3. Refer to Section , “Transmission Troubleshooting,” **Problem 2.** “Low or no pump flow or pressure.”
	4. Clutch discs worn or damaged.	4. Replace clutch discs.
	5. Transmission overheating.	5. Refer to Section , “Transmission Troubleshooting,” **Problem 5.** “Transmission overheating (oil above 248° F [120° C]).”
5. Transmission overheating (oil above 248° F [120° C]).	1. Low oil level.	1. Fill transmission to correct level with Universal Tractor Fluid. Refer to the appropriate owners/operators manual.
	2. Clogged radiator.	2. Remove debris from the radiator.
	3. Transmission filled with incorrect oil, or oil contaminated.	3. Drain transmission and fill to correct level with Universal Tractor Fluid. Refer to the appropriate owners/operators manual.
	4. Excessive “roading.”	4. Stop and idle the engine.
	5. Restriction in oil cooler hoses.	5. Replace cooler hoses.
	6. Pump worn or damaged.	6. Repair or replace pump assembly.
	7. Engine thermostat stuck.	7. Replace engine thermostat. Refer to Section 7B.6.2, b. “Thermostat Installation.”

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Transmission Troubleshooting (Continued)

Problem	Cause	Remedy
6. Grinding or "clunking" noise from transmission.	1. Oil level too low.	1. Fill oil to correct level. Refer to appropriate owners/operators manual.
	2. Transmission filled with incorrect oil.	2. Drain transmission and fill to correct level with Universal Tractor Fluid. Refer to the appropriate owners/operators manual.
	3. Incorrect clutch engagement.	3. Refer to Section 9.14.7, "Transmission Solenoid Valves."
	4. Internal damage.	4. Repair or replace parts as needed.
	5. Broken diaphragm (flex plate).	5. Replace diaphragm (flex plate). Refer to Section , "Transmission Removal."
	6. Loose diaphragm (flex plate) mounting capscrews.	6. Tighten capscrews.
7. Oil leaking from transmission.	1. Oil leaking from vent (high oil level).	1. Remove drain plug and drain oil as needed, until oil is at correct level. Refer to the appropriate owners/operators manual). Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Drain plug loose and/or o-rings damaged or missing.	2. Replace o-rings as needed and tighten plug to 26 lb-ft (35 Nm).
	3. Hose fittings loose.	3. Tighten fittings.
	4. Oil leaking at valve bodies (possible valve body gaskets damaged or missing and/or mounting capscrews not tight).	4. Replace gaskets and/or tighten capscrews to 7 lb-ft (9,5 Nm).
	5. Housing capscrews loose.	5. Tighten capscrews to 34 lb-ft (46 Nm).
	6. Oil leaking at pump (possible pump-to-housing o-rings missing or damaged, and/or pump mounting capscrews not tight).	6. Replace o-rings and/or tighten capscrews to 85 lb-ft (115 Nm).
	7. Oil leaking at converter bell (possible converter leak and/or input shaft seal damage).	7. Replace converter and/or input shaft seal.
	8. Oil leaking at output shaft (output shaft seal damaged).	8. Replace output shaft seal.
	9. Housing damaged.	9. Replace housing as needed.

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Section 9 — Axles and Brakes

Table of Contents

Axle and Drive Shaft Component Terminology 9-1
General Information 9-1
Axle Assembly 9-2
Axle Inspection, Internal Service and Repair 9-5
Axle Installation 9-5
Axle Service and Troubleshooting 9-6
Drive Shafts 9-7
Drive Shaft Maintenance 9-8
DriveShaft Removal 9-8
Transmission-to-Axle Drive Shaft 9-9
Drive Shaft Disassembly 9-9
Drive Shaft Assembly 9-10
Service Brakes 9-12
Service Brake Pressure Switch Replacement 9-12
Accumulator 9-13
General 9-13
Precautions 9-14
Pre-Charging Accumulator 9-14
Checking Pre-charge 9-16
Towing a Disabled Machine 9-17
Manually Releasing the Park Brake 9-18
Manually Resetting the Park Brake 9-18

List of Figures

Fig. 9-1: Axle and Drive Shaft 9-1
Fig. 9-2: Service Brake Pedal Pressure Switch. 9-12
Fig. 9-3: Accumulator 9-13
Fig. 9-4: Accumulator Charging. 9-15
Fig. 9-5: Park Brake Hoses 9-17

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Section 9 — Axles and Brakes

Axle and Drive Shaft Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles and drive shafts. The following illustration identifies the components that are referred to throughout this section.

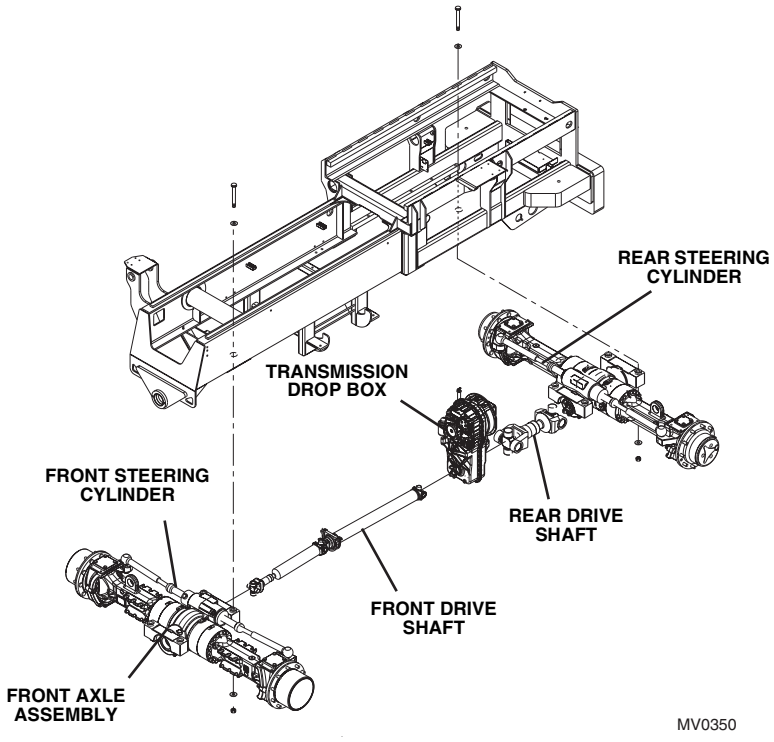


Fig. 9-1: Axle and Drive Shaft

General Information

IMPORTANT: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

Before performing any inspection, maintenance or service operation, thoroughly clean the unit. The axles and drive shafts should be checked and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Use suitable products to thoroughly clean all disassembled mechanical parts to help prevent personal injury to the worker and prevent damage to the parts. Carefully inspect the integrity of all moving parts (bearings, yokes, tubes, gears, shafts, etc.) and fasteners (nuts, bolts, washers, etc.) as they are subject to major stress and wear. Always replace elastic locknuts and any damaged, worn, cracked, seized or otherwise improper parts that could affect the safe and proper functioning of the machine, axles and drive shafts.

Axle Assembly

Axle Maintenance

Note: *Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the* Zahnradfabrik (ZF) *Repair Manuals.*

Note: *Several special axle service tools are required to properly service the axle assemblies. Contact the local* ***JLG*** *parts distributor for ordering information.*



CAUTION: Risk of personal injury. Exercise extreme care when using snap rings or spring-loaded retention devices.



WARNING: Risk of death or serious personal injury if components are assembled improperly, if components are assembled improperly, if incompatible, worn or damaged components are used, or if components are used in a non-approved application. Obtain proper training, follow recommended procedures, and use proper tools and safety equipment. Wear safety glasses at all times when working on the machine and machine components.



WARNING: An improperly supported machine can fall, causing death or serious injury. When removing the axle assembly from the machine, properly support the machine. If servicing axle components with the axle attached to the machine, securely support the carrier, differential, pinion assemblies and wheel ends.

Important: *When replacing a fastener, replace it with one of equal or higher grade and quality. Torque fasteners to the specified value for the application.*

Important: *The use of replacement parts provided by other than the original manufacturer is not recommended, as such use may cause axle failure and affect machine safety.*

- Some service operations require the use of tools specifically designed for the purpose. Use the special tools when and as recommended.

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- **DO NOT** pound, beat or hammer on end yokes and flanges to remove or to install them. Damage to axle components can occur. Remove and install end yokes and flanges by following the recommended procedures in the appropriate Zahnradfabrik (ZF) axle service manual.
- **DO NOT** attempt carrier and differential removal and installation, and differential and pinion disassembly and assembly, without thoroughly understanding the instructions in the appropriate Zahnradfabrik (ZF) publications.
- Before disassembling any parts inside the carrier, remove the entire axle assembly from the machine and securely support it with the pinion facing up in an appropriate stand or rack.
- **DO NOT** reuse oil or grease seals.

CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination in the lubricant can cause gear and bearing failure. Remove old gasket material from all surfaces.

DRYING: Use clean, lint less towels to dry components after cleaning. **DO NOT** dry bearings by spinning them with compressed air; this can damage mating surfaces due to lack of lubrication. After drying, lightly coat components with oil or a rust-preventive chemical to help protect them from corrosion. If storing components for a prolonged period, wrap them in wax paper.

PERIODIC OPERATION REQUIREMENT: Every two weeks, drive the machine far enough to cause the drive-train components to make several complete revolutions. This will help ensure that internal components receive lubrication to minimize deterioration caused by environmental factors such as high humidity.

SUBMERSION: If the machine has been exposed to water deep enough to cover the hubs, disassemble the wheel ends and inspect for water damage and contamination. If the carrier housing was submerged in water, especially if the water level was above the vent tube (breather), drain the axle and inspect internal parts for water damage and contamination. Before assembling and refilling the unit with the specified lubricant(s), clean, examine and replace damaged parts as necessary.

Note: *Use a suitable puller for bearing removal. Clean, inspect and lubricate all bearings just prior to reassembly. If replacement of a damaged bearing cup or cone is necessary, replace the cup and cone as a set.*



WARNING: Avoid prolonged engine operation in closed areas without adequate ventilation. Failure to properly ventilate exhaust fumes can result in death or severe personal injury.



WARNING: Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury. Before starting the engine, tighten all hydraulic connections and remove all tools

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from the machine. **NEVER** check for leaks using any part of the human body; use a piece of cardboard or wood instead. Wear heavy, protective gloves and eye protection.

WARNING: An improperly supported machine can fall, causing death or severe personal injury. Safely raise and adequately support the machine so that it will remain stable and in place before attempting to remove an axle.

WARNING: Hot hydraulic fluid can cause severe burns. Wait for the hydraulic fluid to cool before servicing any hydraulic component.

WARNING: Relieve hydraulic pressure before servicing any hydraulic component. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; the rear axle has neither. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on the stabilizer solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

IMPORTANT: *Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.*

1. Park the machine on a firm, level surface, level the machine, ground the attachment, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine compartment cover. Allow the engine, transmission and hydraulic fluid to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal to prevent the engine from starting accidentally.
5. If the axle will be disassembled after removal, place a suitable receptacle under the axle drain plug. Remove the drain plug and allow the axle oil to drain into the receptacle. Transfer the used axle oil into a suitable covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility.
6. Label, disconnect and cap the steering and brake lines at the axle. Wipe up any spilled oil.
7. Block the front and rear of both tires on the axle that is not being removed. Ensure that the machine will remain in place during axle removal before proceeding.

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8. Raise the machine using a suitable jack or hoist. Place suitable supports under both sides of the frame and lower the machine onto the supports. Ensure that the machine will remain in place during axle removal.
9. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
10. Mark and remove both wheel and tire assemblies from the axle that is being removed.

Note: *The wheel and tire assemblies must be re-installed later with the directional tread pattern "arrows" facing in the direction of forward travel.*

11. Remove the drive shaft assemblies.
12. On the front axle remove the capscrew and locknuts securing the lower position cylinder-mount pin to the front cylinder. Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
13. Remove the four bolts and locknuts securing the axle to the frame.
14. Remove the axles from the machine using the jack, hoist or overhead crane and sling supporting the axle. **DO NOT** raise or otherwise disturb the machine while removing the axle. Balance the axle and prevent it from tipping, turning or falling while removing it from beneath the machine. Place the axle on a suitable support or holding stand.

Axle Inspection, Internal Service and Repair

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the Axle Repair Manuals. (Refer to The Zahnradfabrik (ZF) Repair Manual)

The axle should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Axle Installation

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and limited-slip feature; the rear axle has neither. The steps below outline a typical axle installation procedure, suitable for either the front or the rear axle assembly.

1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, allowing enough room for axle installation. Ensure that the machine will remain in place during axle installation.

3. Using a suitable jack, hoist or overhead crane and sling, remove the axle from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the machine. **DO NOT** raise or otherwise disturb the machine while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position the axle under the frame, and align the axle housings with the holes in the frame.
5. Install the four axle bolts and nuts.
6. Move the cylinder into position on the axle cylinder anchor. Insert a cylinder-mount pin through the cylinder and cylinder anchor. Secure the cylinder-mount pin with one capscrew and a new locknut.
7. Apply multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
8. Install the drive shaft assemblies.
9. If reinstalling an axle previously removed from the machine, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the driveshaft yoke on the axle in the same plane as the yoke on the transmission.
10. Install the wheel and tire assemblies.
11. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
12. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.
13. Remove the blocks from the front and rear of both tires on the other axle.

Note: *ALWAYS use new o-rings when servicing the machine.*

14. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
15. Uncap and connect the steering and brake lines at their axle fittings.
16. Check the hydraulic reservoir oil level.
17. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.

Axle Service and Troubleshooting

This section provides an easy reference guide covering the most common problems that may occur during operation of the axles.

Note: *Contact the **JLG** distributor or the **JLG** Service Department at 1-877-554-5438 ext.6657, if internal axle repair is required during the warranty period.*

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Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the Axle Repair Manuals. (Refer to The Zahnradfabrik (ZF) Repair Manual).

The axle should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Drive Shafts

Drive Shaft Inspection and Service

Whenever servicing the machine, conduct a visual inspection of the drive shafts and cross and bearing assemblies (universal joints, or U-joints). A few moments spent doing this can help prevent further problems and down time later.

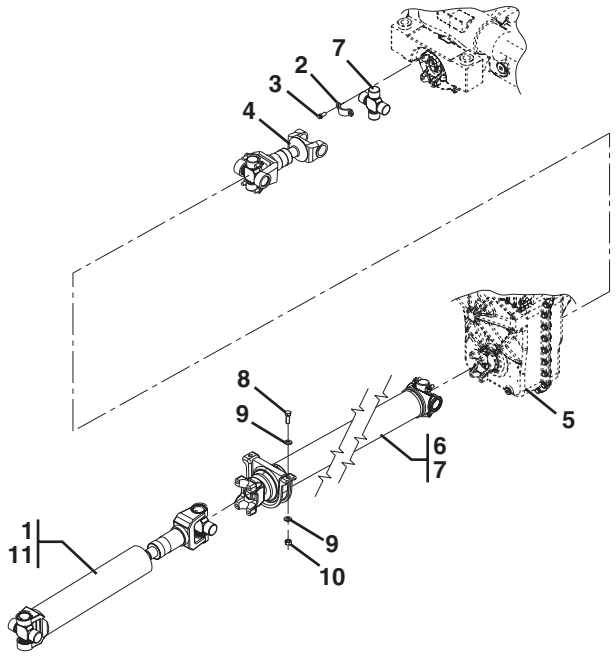
Inspect areas where the drive shaft flange yokes and slip yokes mount to the drive shafts. Attempt to turn each drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shafts and cross and bearing assemblies may cause an excessive amount of vibration or noise.

Individually inspect each cross the needle bearings and cap for signs of wear or for missing parts.

Note: *Replace the cross and bearings as a complete assembly if any parts are worn or missing. If all parts of the cross and bearing assemblies are in good condition, pack the bearing caps with a premium grade of multi-purpose wheel-bearing grease. Reattach the bearing cap to the cross, assuring that all needle bearings are present. Then, reassemble the cross and bearing assembly into the drive shaft yoke.*

1. Replace the felt seal if worn or damaged.
2. Replace the entire drive shaft assembly if any flange yoke, slip yoke or drive shaft tube is severely dented or damaged.

Cross assemblies should flex and be free from excessive binding. A slight amount of drag or resistance is desirable on a new cross and bearing assembly. Excessive looseness causes unbalance.



#	Description
1	Universal Joint Kit
2	Bearing Strap
3	Strap Bolt
4	Driveshaft
5	Transmission
6	Rear Driveshaft

#	Description
7	Universal Joint Kit
8	Hex Head Capscrew
9	Flat Washer
10	Locknut
11	Front Driveshaft

Drive Shaft Maintenance

Refer to the appropriate Operator/Safety Manual for information regarding the lubrication of the grease fittings on the drive shafts.

DriveShaft Removal

Important: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

Note: *The drive shaft assemblies are balanced assemblies. Mark the yoke and axle, transmission, transfer case, and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

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Transmission-to-Axle Drive Shaft

1. Level the machine, ground the carriage, place the travel select lever in the (N) NEUTRAL position, engage the parking brake switch and shut the engine OFF.
2. Place an Accident Prevention Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated. (Refer to Section 1.5, “Accident Prevention Tags.”)
3. Open the engine compartment access door. Allow the engine, transmission and hydraulic fluid to cool.
4. Disconnect the battery negative (-) ground cable at the battery negative (-) terminal to prevent the engine from starting accidentally.
5. The drive shaft assembly is a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.
6. Remove the four capscrews and two straps securing the bearing cross to the transmission output shaft flange.
7. Remove the four capscrews and two straps securing the bearing crosses to the axle.
8. Remove the front drive shaft assembly.
9. Repeat the above procedure on the rear drive shaft.

Drive Shaft Disassembly

Important: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke, or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate Parts Manual for ordering information.*

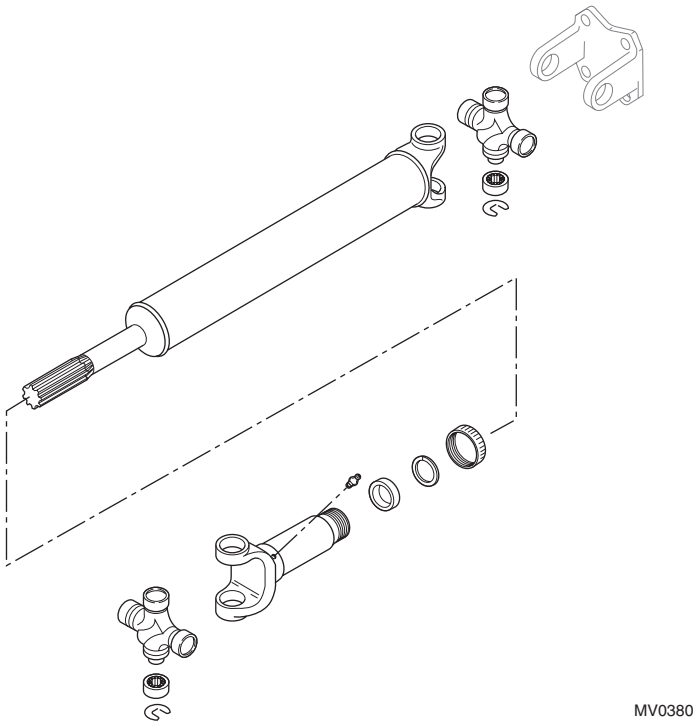
1. Use an approved, non-flammable cleaning fluid to thoroughly clean the drive shaft assembly with a brush. Wipe dry before disassembling.



CAUTION: Avoid using excess force when clamping the drive shaft in a vise. Apply only enough force to hold the drive shaft securely. Excessive force can damage the drive shaft, resulting in an unbalanced condition.

2. Place the drive shaft assembly in a bench vise.
3. Use a pair of pliers to pinch the ends of the snap rings securing the cross and bearing assemblies to the yoke. Remove the snap rings from their grooves in the yoke.

Note: *If the snap rings fail to readily snap out of their grooves in the yokes, tap the end of the bearing cap lightly to help relieve pressure against the snap rings.*



4. Use a soft, round drive pin with a flat face approximately 1/32" (0,8 mm) smaller than the hole diameter in the yoke to drive on one end of the cross and bearing assembly until the opposite bearing assembly comes out of the yoke.
5. Turn the yoke over and tap on the exposed end of the cross until the opposite bearing assembly comes out of the yoke.
6. Remove the cross from the yoke.
7. Repeat Steps 2 thru 6 to remove the cross and bearing assembly on the other end of the drive shaft.

Drive Shaft Assembly

1. Install the dust cap, split retaining ring and felt seal onto the splines of the drive shaft tube assembly.

Important: *Ensure that the reference marks made before removal on the drive shaft and slip yoke are aligned. The drive shaft and yokes must be in the same plane to help prevent excessive vibration.*

2. Align the reference marks made previously on the drive shaft and slip yoke.
3. Slide the slip yoke onto the splines of the drive shaft and tighten the dust cap securely. **DO NOT** overtighten or the cap will break.
4. Install the cross and bearing assembly into the yoke.
5. Secure the cross and bearing assembly into the yoke with snap rings. Pinch each snap ring with a pliers and insert them into their grooves in the yoke.

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6. Apply grease to grease fitting on slip yoke.

Drive Shaft Installation

Important: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

Transmission-to-Axle Drive Shafts

1. Raise the drive shaft assembly into position. The slip-yoke end of the drive shaft mounts toward the axle. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.

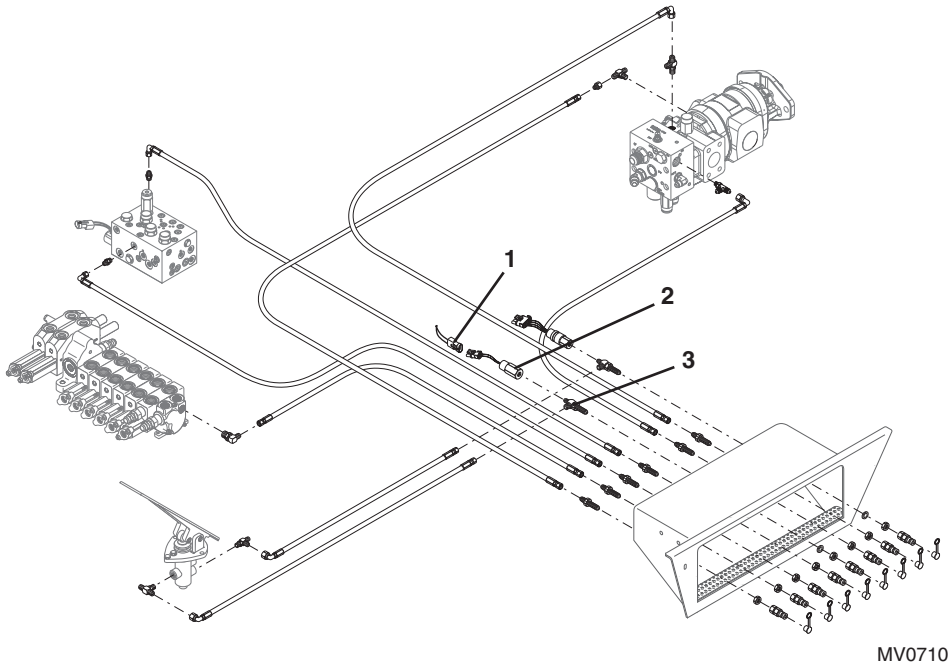
   Important: *Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

2. Install the four capscrews and two straps securing the bearing crosses to the transmission. Torque the capscrews to 60 lb-ft (81 Nm).

Service Brakes

Service Brake Pressure Switch Replacement

Mid-Inlet Hydraulics



#	Description
1	Wiring Harness Connector
2	Service Brake Pressure Switch

#	Description
3	Operators Step

Fig. 9-2: Service Brake Pedal Pressure Switch

The service brake pedal pressure switch is located behind pressure test port under the cab (see Fig. 9-2). This switch is normally open and is set to close above 250 psi.

1. Follow preparation procedures as outlined in Section 3 and in Section 5 of this manual.
2. Tag and disconnect the wiring harness connector (Item 1) from the connector on the brake pressure switch (Item 2).
3. Remove the brake pressure switch from the connector tee (Item 3). Discard the pressure switch.
4. Install a new brake pressure switch.
5. Reconnect the wiring harness connector (Item 1) to the connector on the brake pressure switch.

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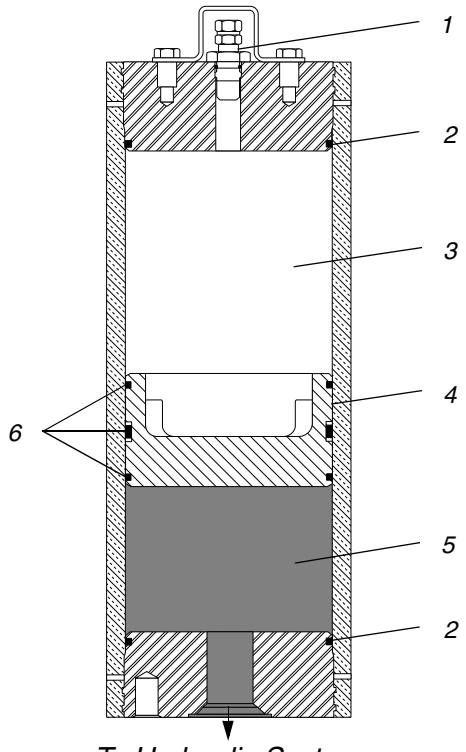
Accumulator

General

The accumulator is a 3000 psi piston-type accumulator. It has a oil volume of 116 cubic inches and gas volume of 126 cubic inches, with a bore size of four inches.

The pneumatic accumulator is operated by compressed gas. Gas and hydraulic oil occupy the same container. When oil pressure rises, incoming oil compresses the gas. When oil pressure drops, the gas expands, forcing oil out. The gas is separated from the oil by a “free floating” piston (see Fig. 9-3). This prevents mixing of gas and oil and keeps gas out of the hydraulic system. The piston (Item 4) fits into a smooth bore and uses seals (Item 6) to separate gas (Item 3) from oil (Item 5). O-rings (Item 2) in the end caps prevent leakage of gas/oil.

The accumulator must be “pre-charged” with gas before use in a system. This is done by filling the gas chamber with dry nitrogen to a pressure of 400 psi. The gas valve (Item 1) is used for pre-charging and testing the accumulator.



#	Description
1	Gas Valve
2	End Cap O-Rings
3	Gas Chamber

#	Description
4	“Free-Floating” Piston
5	Oil Chamber
6	Piston Seals

Fig. 9-3: Accumulator

Precautions

WARNING: Never fill an accumulator with oxygen! An explosion could result if oil and oxygen mix under pressure. **Always fill an accumulator with dry nitrogen.** Nitrogen gas is free of water vapor and oxygen which makes it harmless to parts and is safe to use.

CAUTION: Never fill an accumulator with air. When air is compressed, water vapor condenses and can cause corrosion. This may damage seals and ruin the accumulator.

CAUTION: Never charge an accumulator to a pressure more than that specified. Pressure should be 375–425 psi.

WARNING: Always release all hydraulic pressure before removing an accumulator from the system.

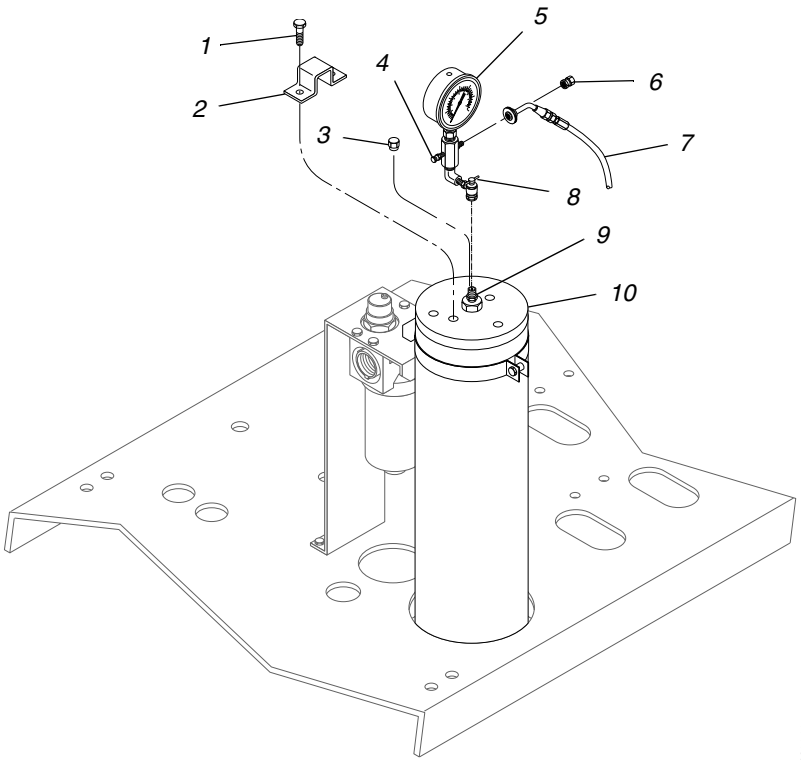
CAUTION: Before disassembling an accumulator, release both gas and hydraulic pressure. When disassembling an accumulator, make sure that dirt and abrasive materials do not enter any openings.

Pre-Charging Accumulator

Note: *Replacement accumulators shipped from the factory are not pre-charged.*

Make sure the nitrogen bottle, as well as the charging and gauging assembly used, is compatible with the gas valve assembly. The nitrogen source and all components must be rated for a pressure at least as high as the nitrogen source. It is strongly recommended that the nitrogen bottle has a high pressure regulator. Nitrogen gas bottles for water-pumped nitrogen have right-hand valve threads and are used with accumulators up to 3000 psi.

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#	Description	#	Description
1	Capscrew	6	Gauge Cap
2	Valve Guard	7	Nitrogen Hose
3	Gas Valve Cap	8	“T” Handle
4	Gauge Bleed Valve	9	Gas Valve
5	Accumulator Test Gauge	10	Accumulator

Fig. 9-4: Accumulator Charging

Pre-charge the accumulator using the following steps (see Fig. 9-4):

1. Follow preparation procedures as outlined in Section 3 and in Section 5 of this manual.
2. Make sure nitrogen supply is shut off.
3. Attach hose (Item 7) to nitrogen bottle.
4. Remove two (2) capscrews (Item 1), valve guard (Item 2), and gas valve cap (Item 3).
5. Back “T” handle (Item 8) on accumulator test gauge (Item 5) all the way out (counterclockwise). The pressure gauge must have 2500 psi capacity (correctly calibrated).
6. Mount test gauge on accumulator gas valve (Item 9) and tighten. Be sure of an air-tight connection when mounting gauge.
7. Close (turn in) bleed valve (Item 4).
8. Remove gauge cap (Item 6) from test valve.
9. While making sure not to loop or twist the hose, attach swivel nut on nitrogen hose (Item 7) to gas valve.

10. Turn “T” handle all the way down. This will depress (open) the core in the gas valve.
11. Crack open nitrogen bottle valve and **slowly** fill the accumulator. Close the nitrogen bottle valve when gauge indicates desired pre-charge pressure (400 psi).
12. Let the pre-charge set for 10–15 minutes. This will allow the gas temperature to stabilize. If the desired pre-charge range (375–425) is exceeded, close nitrogen bottle valve, then slowly open the bleed valve (Item 4) until desired pressure is reached.



CAUTION: Do not reduce pre-charge by depressing valve core with a foreign object. High pressure may rupture rubber valve seat.

13. When finished pre-charging accumulator, turn “T” handle all the way out, then open (turn out) bleed valve.
14. While holding the gas valve to keep it from turning, loosen and remove swivel nut on nitrogen hose (Item 7).
15. Install gauge cap on test valve. Remove test gauge and replace gas cap on valve (Item 3). Torque gas cap to 10–15 in-lbs. (Gas cap acts as a secondary seal.)
16. Install gas valve guard and two (2) capscrews on the accumulator gas end cap. Torque capscrews to 35 ft-lbs.

Checking Pre-charge

Gas Leaks

If an external gas leak is suspected, apply soapy water to the gas valve and seams of the gas end cap. If bubbles form, there is a leak.

If and internal gas leak is suspected, check for foaming oil in the hydraulic reservoir and/or no accumulator action. These signs usually mean faulty piston seals inside the accumulator.

Checking Accumulator Recharge Pressure and Nitrogen Pre-Charge

1. Park the vehicle on a level surface, lower boom to the ground, and engage park brake.
2. While the engine is off, pump brake pedal repeatedly until accumulator is discharged. This will allow the “free-floating” piston to bottom against the hydraulic end cap.
3. Connect a high pressure gauge to the test port marked “ACCUM.” located behind the cab step.
4. Start the engine and slowly pump the brake pedal while closely watching the test gauge.

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5. Record the lowest pressure observed before the accumulator recharges. The pressure should be 950–1200 psi. This reading is the accumulator recharge pressure.
6. Shut the engine off.
7. Slowly pump the brake pedal while closely watching the pressure gauge.
8. Record the lowest pressure observed before the pressure drops to nearly zero. This reading is the nitrogen pre-charge. This pressure should be 375–425 psi.
9. If either of the recorded readings are outside the recommended ranges, contact the JLG Service Department.

Towing a Disabled Machine

Towing a disabled machine should only be attempted as a last resort, after exhausting all other options. Make every effort to repair the machine, and move it under its own power, before using the emergency towing procedure outlined below.

Important: *In the event the vehicle is disabled and cannot be moved under engine power, the situation must be properly evaluated and dealt with on an individual basis. Contact your local **JLG** Service Department at (877) 554-5438 or (717) 485-6657 for specific instructions for your particular situation.*

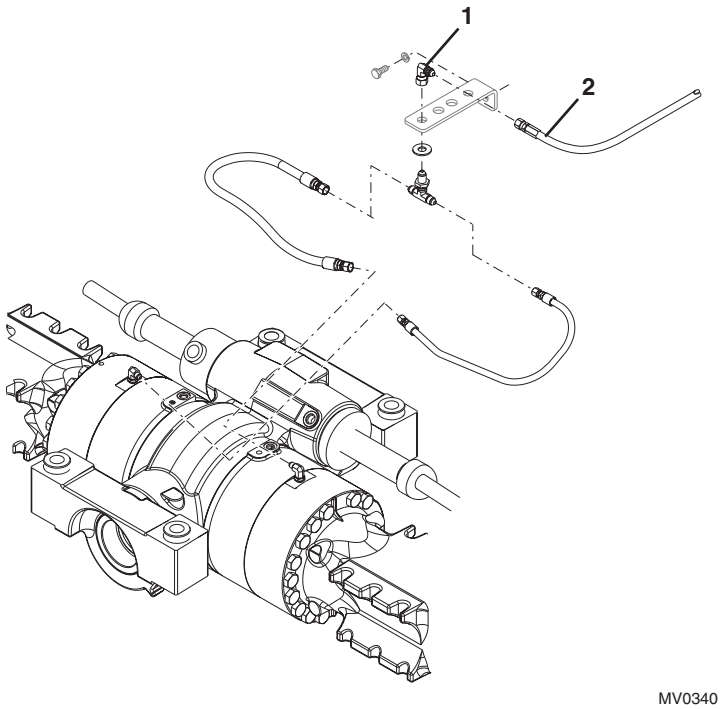


Fig. 9-5: Park Brake Hoses

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Manually Releasing the Park Brake

If it is necessary to tow the vehicle a short distance to avoid a potentially hazardous situation such as being in an unsafe area on the worksite or on a roadway, prepare the vehicle for towing as follows;

1. Remove the load from the vehicle.
2. Fully retract the transfer carriage.
3. Fully retract the boom. Position the forks approximately 24" above the ground.
4. **Block all four wheels** to prevent any unexpected movement of the vehicle after the parking brake is disabled.
5. Position the towing vehicle in place. Attach a rigid tow bar to the disabled vehicle.
6. Disconnect hose (**2**) from elbow (**1**) that is located on front of frame.
7. Attach a remote portable hydraulic pressurizing unit to elbow (**1**).
8. Clear the area of any unnecessary personnel.
9. Have an operator seated in the seat.
10. Turn the ignition switch to the ON position (with the engine not running), release the park brake (park brake switch OFF).
11. Pressurize the park brake with the pressurizing unit. Pump pressure into the park brake system. **DO NOT** exceed 425 psi.
12. Watch the pressure gauge on the pressurizing unit to ensure that the pressure in the park brake system does not drop during the towing operation.
13. Carefully remove the blocks from the four wheels of the vehicle.
14. The vehicle can now be towed or pushed out of the way. ***Tow or push the vehicle at a very slow speed!***

Manually Resetting the Park Brake

Important: *Block the wheels of the machine BEFORE attempting to reset the machine's park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.*

1. Disconnect remote portable hydraulic pressurizing unit from elbow (**1**).
2. Connect hose (**2**) to elbow (**1**) that is located on front of frame.
3. After repairs to the machine have been made, start the machine and check the park brake and service brakes for proper function.

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Table of Contents

Outriggers 10-1
General 10-1
Removal 10-2
Installation 10-3
Outrigger Cylinders 10-4
General 10-4
Removal 10-5
Installation 10-6
Overhaul 10-7
Differential Pressure Switch 10-9
Description 10-9
Boom Extension Proximity Switch 10-10
Description 10-10
Removal 10-11
Installation 10-12
Adjustments 10-12
Outrigger Control Valves 10-13
Description 10-13
Removal 10-14
Installation 10-15

List of Figures

Fig. 10-1: Outriggers 10-1
Fig. 10-2: Outrigger Installation 10-2
Fig. 10-3: Outrigger Cylinders 10-4
Fig. 10-4: Outrigger Cylinder Installation 10-5
Fig. 10-5: Outrigger Cylinder Assembly 10-7
Fig. 10-6: Boom Extension Proximity Switch 10-10
Fig. 10-7: Boom Extension Proximity Switch Operation 10-11
Fig. 10-8: Boom Extension Proximity Switch Assembly 10-11
Fig. 10-9: Boom Extension Proximity Switch Adjustment 10-12
Fig. 10-10: Outrigger Controls 10-13
Fig. 10-11: Outrigger Control Valve Installation 10-14

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Section 10 — Outriggers

Outriggers

General

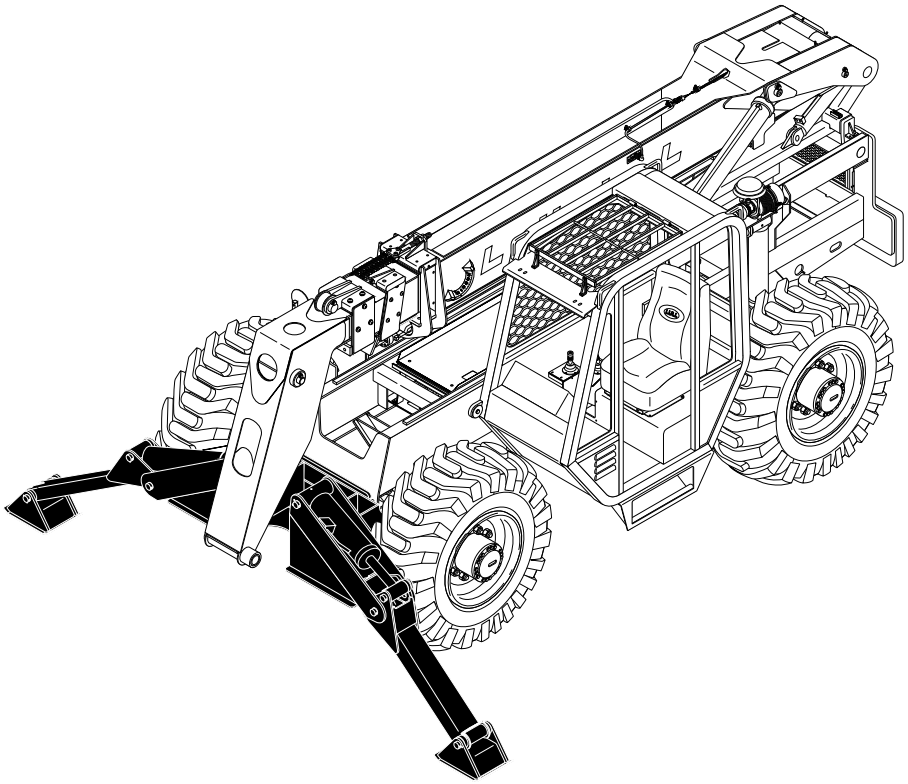


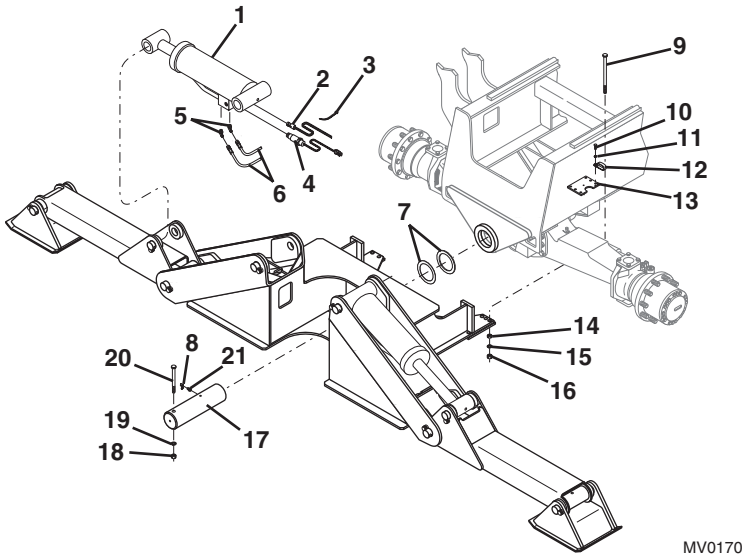
Fig. 10-1: Outriggers

Outriggers increase the stability of the machine when lifting and placing loads.

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Removal

Outriggers



#	Description
1	Outrigger Cylinder
2	Differential Pressure Switch
3	Tie
4	Wiring Harness
5	Elbow
6	Hydraulic Hose
7	Shim(s)
8	Grease Fitting Cover
9	Capscrew
10	Capscrew
11	Lockwasher

#	Description
12	Double Tube Clamp
13	Clamp Plate
14	Jam Nut
15	Starwasher
16	Nut
17	Shaft Assembly
18	Nut
19	Lockwasher
20	Capscrew
21	Grease Fitting

Fig. 10-2: Outrigger Installation

(Ref. Fig. 10-2) The following procedure describes removal of the outrigger.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Disconnect any attachments and raise the boom enough so easy access can be made to the outrigger. Apply the parking brake and fully retract the boom extension cylinder. Raise the outrigger foot pads completely and shut the engine off.
3. Support the boom and extension cylinder with sling(s) and crane or other suitable means. Make sure support items have sufficient capacity to support the weight of the boom and cylinder; the combined weight of the boom and extension cylinder is approximately 6650 pounds.

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DANGER: Support of the boom is essential to avoid the possibility of injury or death should the boom fall. Use suitable blocking and lifting devices when removing heavy machine components.

4. Place blocks or other means of support under the front and rear corners of the outrigger frame. Make sure supports are adequate to support the weight of the outrigger; the outrigger weighs approximately 2585 pounds.
5. Disconnect the wiring harness (Item 4) from the differential pressure switch (Item 2) from both cylinders. Remove the ties (Item 3) securing pressure switch wires to wiring harness or hydraulic hoses.
6. Loosen and remove two (2) hydraulic hoses (Item 6) from elbows (Item 5) on both outrigger cylinders (Item 1). Tag hoses and fittings. Bleed any remaining oil into a suitable container.
7. Remove the nut (Item 18), lockwasher (Item 19), and capscrew (Item 20) from the shaft assembly (Item 17).
8. Remove all ties around hydraulic hoses and wiring harness.
9. Remove the capscrew (Item 10), lockwasher (Item 11), and double tube clamp (Item 12) securing the hydraulic tubes to the clamp plate (Item 13) on each side of the machine.
10. Remove four (4) each nuts (Item 16), starwashers (Item 15), jam nuts (Item 14), and capscrews (Item 9) securing each of the clamp plates and the outrigger assembly to the axle. Remove the clamp plates.
11. Remove the wiring harness and hoses from outrigger and secure them to the main frame.
12. Start the engine and slowly back the machine away from the outrigger.

Installation

Outriggers

(Ref. Fig. 10-2) The following procedure describes installation of the outrigger.

1. If the bushing and shaft assembly were removed,
   a. Install the shaft assembly (Item 17) on the bushing, making sure the port for a grease fitting is on the rights side of the machine.
   b. Install a grease fitting (Item 21) on the shaft assembly. Torque the grease fitting to 1.5–3 turns past finger tight. Install a grease fitting cover (Item 8) on the grease fitting.
2. With the boom raised and fully supported, use sling(s), crane or other suitable means of support to position the outrigger until it can be slid onto the shaft assembly (Item 17).
3. Temporarily install a capscrew (Item 20) into the orifice in the shaft assembly (Item 17). Measure the gap between the outrigger assembly and the support plate boss on the main frame.
4. Remove the capscrew and outrigger assembly.

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5. Install as many shims (Item 7) as needed on shaft assembly to fill the gap measured in Step 3.

Note: *Shims are available in three different sizes – 16, 20, and 24 gauge.*

6. Reinstall the outrigger on the shaft assembly and secure it with a capscrew (Item 20), lockwasher (Item 19), and nut (Item 18). Torque the nut to 130 ft-lbs.
7. Secure the outrigger to each side of the axle with a clamp plate (Item 13) and four (4) capscrews (Item 10), jam nuts (Item 14), starwashers (Item 15), and nuts (Item 16). Torque nuts to 320 ft-lbs.
8. Install two (2) hydraulic hoses (Item 6) on the two (2) elbows (Item 5) on each outrigger cylinder (Item 1). For final tightening, torque swivel nuts on hoses to 44–48 ft-lbs.
9. Connect the wiring harness (Item 4) on the differential pressure switch (Item 2). Install a tie (Item 3) to secure the pressure switch wires to the wiring harness or the hydraulic hoses.
10. Secure the wiring harness and hydraulic hoses to the clamp plate with a double tube clamp (Item 12), lockwasher (Item 11), and capscrew (Item 10). Torque the capscrew to 276 in-lbs.

Outrigger Cylinders

General

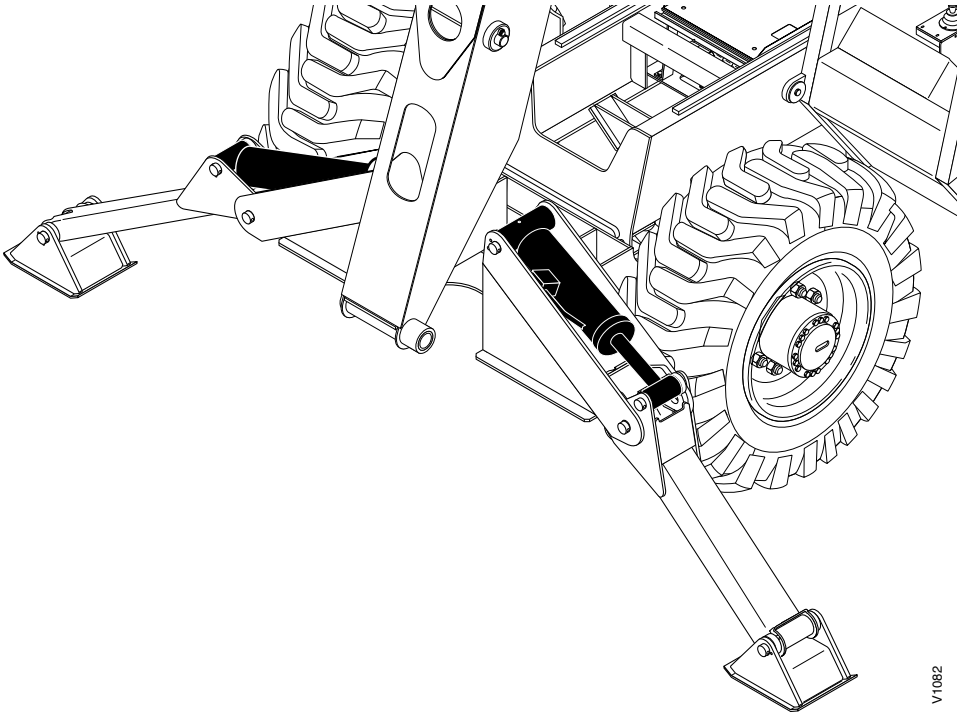


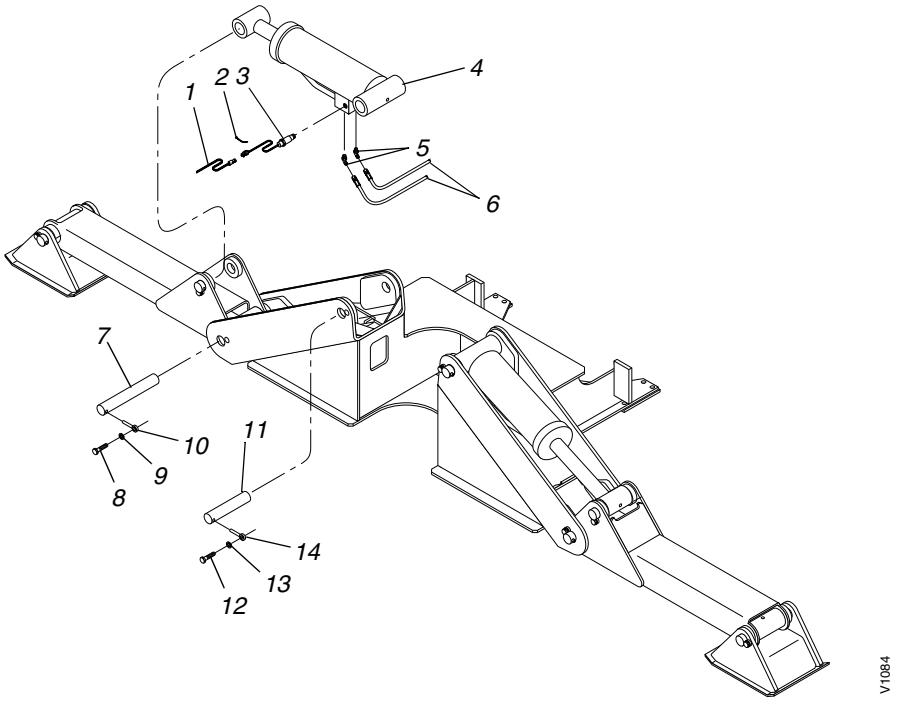
Fig. 10-3: Outrigger Cylinders

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The outrigger cylinders have an operating pressure of 3000 psi and have a 15.63” stroke. Each cylinder includes four bushings.

Removal

Outrigger Cylinders



#	Description
1	Wiring Harness
2	Tie
3	Differential Pressure Switch
4	Outrigger Cylinder
5	Elbow
6	Hydraulic Hose
7	Pin

#	Description
8	Capscrew
9	Lockwasher
10	Lock Pin
11	Pin
12	Capscrew
13	Lockwasher
14	Lock Pin

Fig. 10-4: Outrigger Cylinder Installation

(Ref. Fig. 10-4) The following procedure describes removal of the outrigger cylinders.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom, apply the parking brake, raise the outrigger foot pads completely, and shut the engine off.
3. Disconnect the wiring harness (Item 1) from the differential pressure switch (Item 3) on both cylinders. Remove the ties (Item 2) securing the pressure switch wires to the wiring harness or the hydraulic hoses.
4. Loosen two (2) hydraulic hoses (Item 6) from the elbows (Item 5) on both outrigger cylinders (Item 4).

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CAUTION: Use suitable blocking and lifting devices when removing the cylinders. Care must be taken when removing and lifting the cylinders to prevent personal injury or equipment damage.

5. Place blocking device under the top of the outrigger cylinder. Remove the capscrew (Item 12) and lockwasher (Item 13) from the lock pin (Item 14). Remove the lock pin and upper pin (Item 11).
6. Remove a capscrew (Item 8) and lockwasher (Item 9) from the lock pin (Item 10). Remove the lock pin and lower pin (Item 7).
7. Remove the outrigger cylinder.
8. Repeat Steps 5–7 for the remaining outrigger cylinder.

Installation

Outrigger Cylinders

(Ref. Fig. 10-4) The following procedure describes installation of the outrigger cylinders.

1. Use a suitable lifting device to place the outrigger cylinder in its proper location. Secure the cylinder to the outrigger by installing the lower pin (Item 7).
2. Secure the cylinder to outrigger with the upper pin (Item 11).

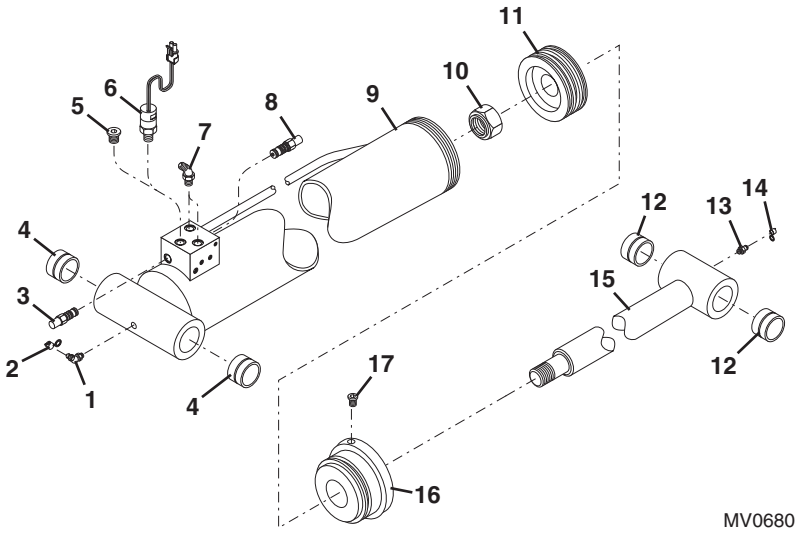
Note: B*e sure to apply blue thread sealant to the threads of the capscrews before installing them.*

3. Secure the upper pin by installing a lock pin (Item 14), lockwasher (Item 13), and capscrew (Item 12). Torque the capscrew to 55 ft-lbs.
4. Secure the lower pin by installing a lock pin (Item 10), lockwasher (Item 9), and capscrew (Item 8). Torque the capscrew to 55 ft-lbs.
5. Repeat Steps 1–4 for the remaining cylinder.
6. Install two (2) hydraulic hoses (Item 6) on elbows (Item 5) on both outrigger cylinders (Item 1). For final tightening, torque the swivel nuts on hoses to 44–48 ft-lbs.
7. Connect the wiring harness (Item 4) to the differential pressure switch (Item 2). Install a tie (Item 3) to secure the pressure switch wires to wiring harness or hydraulic hoses.

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Overhaul

Outrigger Cylinders



#	Description	#	Description
1	Grease Fitting	10	Rod Bearing Nut
2	Grease Fitting Cover	11	Piston
3	Counterbalance Valve Cartridge	12	Bushing
4	Bushing	13	Grease Fitting
5	O-ring Plug	14	Grease Fitting Cover
6	Differential Pressure Switch	15	Rod
7	Elbow	16	Head
8	Counterbalance Valve Cartridge	17	Setscrew
9	Cylinder Barrel	18	

Fig. 10-5: Outrigger Cylinder Assembly

(Ref. Fig. 10-4) The following procedure describes removal of the outrigger cylinders.

1. Mount or support the cylinder vertically with the rod end down. Hydraulic oil in cylinder will drain out during disassembly. Place a suitable pan or tray under the cylinder.
2. Remove the differential pressure switch (Item 6) from the cylinder manifold block.
3. For models with an O-ring plug (Item 5), remove the plug.
4. Release pressure in each cylinder as follows:

WARNING: The counterbalance valve cartridge traps hydraulic pressure in the cylinder. Wear proper eye and hand protection when removing counterbalance valve cartridges. Hydraulic fluid under pressure can be injected under skin or into eyes, resulting in serious personal injury or death.

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a. Place a socket wrench over each counterbalance valve cartridge (Items 3 and 8). Wrap a clean shop rag around the socket to cover the area of the counterbalance valve cartridge.

b. Carefully and slowly, turn the cartridge out of the manifold block to release pressure in cylinder.

5. Remove the counterbalance valve cartridges.
6. Slowly extend and retract the cylinder by hand to remove most of the hydraulic oil.
7. Remove two (2) elbows (Item 7) from the cylinder manifold block.
8. Loosen the setscrew (Item 17) and remove the cylinder head (Item 16) from cylinder barrel (Item 9).
9. Remove the cylinder rod (Item 15) from the cylinder barrel.

CAUTION: To prevent possible damage to components, support the rod and head; do not wiggle the rod or head back and forth during removal.

10. Remove the rod nut (Item 10), piston (Item 11), and the cylinder head (Item 16) from the cylinder rod.
11. Inspect bushings for damage. If necessary, replace the bushings as follows:

    a. Remove two (2) bushings (Item 4) from the cylinder barrel end and/or remove two (2) bushings (Item 12) from the cylinder rod end using a bushing driver and hammer or press. Drive one bushing all the way through to remove other bushing.

    b. Install new bushings so they are flush with outer edge boss to 0.02” below.

    c. To ensure proper lubrication, make sure an adequate amount of grease is applied to the grease fitting(s) after the cylinder is reinstalled on the machine.

12. If necessary, remove the grease fitting covers (Items 2 and 14) and grease fittings (Items 1 and 13) from the cylinder. Inspect and replace if damaged. Install and tighten fittings 1.5 to 3 turns past finger tight.
13. Remove all O-rings, wear rings, and backup rings from the cylinder components and discard.
14. Thoroughly clean components with solvent; dry with compressed air.
15. Inspect inner surface of barrel, outer surface of piston, and length of rod for scratches and scoring. If the barrel, piston, or rod are damaged, they must be replaced.
16. Check the condition of the threads on the rod, nut, and capscrews. Do not attempt to repair damaged threads.
17. Inspect the counterbalance valve cartridges (Items 3 and 8), including O-rings, for condition and replace as necessary. Do not disassemble cartridges. Service to counterbalance valve cartridges is limited to installing new O-rings and replacing the entire cartridge.

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18. Lubricate counterbalance valve cartridges O-rings with clean hydraulic oil.
19. Install cartridges in the manifold block.
20. Lubricate a new O-ring with hydraulic oil and install it inside the piston (seals rod to piston).
21. Lubricate new seal and wear rings with hydraulic oil and install them on the piston.
22. Slide the cylinder head (Item 16), and piston (Item 11) onto the rod (Item 15). Lubricate the threads on the rod with hydraulic oil and install the rod nut (Item 10).
23. Install the rod assembly in the cylinder barrel. Tighten the cylinder cap and secure with a setscrew (Item 17).
24. Install two (2) elbows (Item 7) on the cylinder manifold block. Torque the elbows to 40–44 ft-lbs.
25. For models with an O-ring plug (Item 5), install the plug in the control manifold block. Torque the plug to 85–95 ft-lbs.
26. Install the differential pressure switch (Item 6) on the cylinder manifold block.

Differential Pressure Switch

Description

The differential pressure switch is a cartridge-style switch with a maximum operating pressure of 6000 psi. It is a normally open circuit that is set to close at 92 psi (+0, -18 psi).

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Boom Extension Proximity Switch

Description

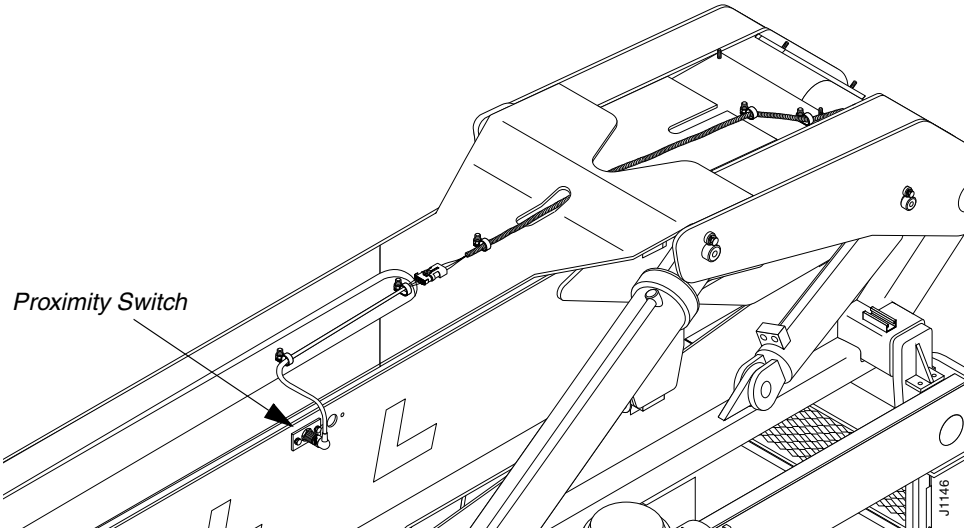


Fig. 10-6: Boom Extension Proximity Switch

(Ref. Fig. 10-6) The boom extension proximity switch is located on the left side of the outer boom section on machines with a 4-section boom. The boom extend/lockout circuit is designed to increase stability of the machine by limiting how far the boom can be extended without the outriggers down. The system will disable the boom extend and transfer extend functions and the warning lamp will come on when the boom is extended to specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage). The proximity switch then opens as it no longer senses metal. At this point, the left and right outriggers must both be lowered to the ground to allow the boom or transfer carriage to be extended any further.

Normally open differential pressure switches in the outrigger cylinders close when the base end pressure exceeds the rod end pressure by approximately 90–95 psi. When both pressure switches close, this completes the circuit, allowing the boom and transfer carriage to be extended, and the lamp turns off. The system is fail-safe in that it requires an electrical signal to enable the boom to be extended beyond the specified distance.

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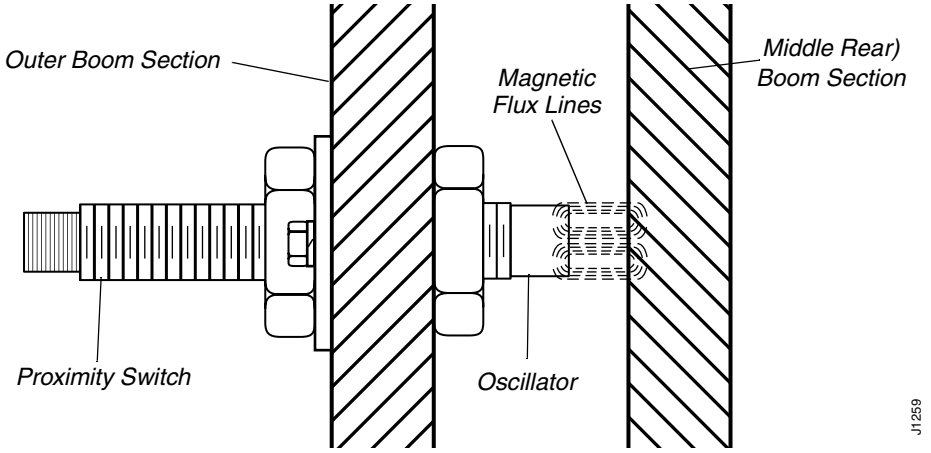
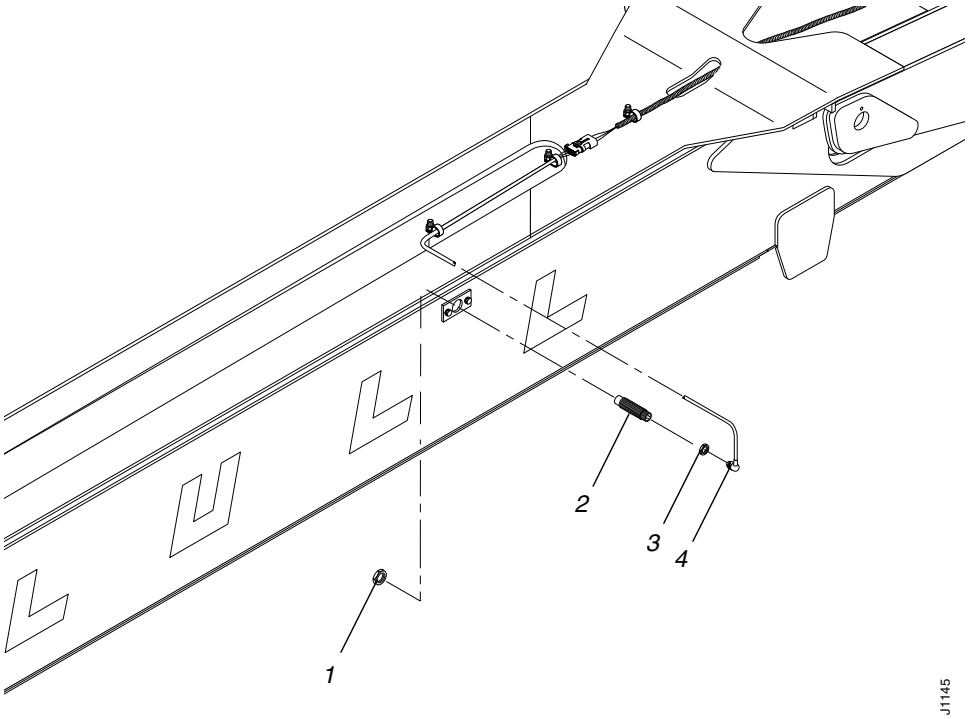


Fig. 10-7: Boom Extension Proximity Switch Operation

(Ref. Fig. 10-7) The switch operates by sending out a constant, high frequency magnetic field a short distance from the oscillator end of the switch. Eddy currents are produced in metal when the magnetic flux lines pass through it. These eddy currents oppose the oscillations of the magnetic flux lines and the oscillations stop. A sensor in the switch detects if the oscillator is on or off and this gives the switch its on/off function.

Removal

Boom Extension Proximity Switch



#	Description	#	Description
1	Inner Jam Nut	3	Outer Jam Nut
2	Proximity Switch	4	Wire Harness

Fig. 10-8: Boom Extension Proximity Switch Assembly

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(Ref. Fig. 10-8) The following procedure describes removal of the boom extension proximity switch.

1. Disconnect the wire harness (Item 4) at the boom extension proximity switch (Item 2).
2. Place a piece of masking tape around the proximity switch body at the outer jam nut (Item 3). This will serve as a guide during reinstallation.
3. Remove the inner jam nut (Item 1) and proximity switch. Reinstall the inner jam nut on the proximity switch for safekeeping.

Installation

Boom Extension Proximity Switch

(Ref. Fig. 10-8) The following procedure describes installation of the boom extension proximity switch.

1. Position the outer jam nut (Item 3) on the switch body (Item 2) at the previously marked position.
2. Install the boom extension proximity switch in the outer boom. Install the inner jam nut (Item 1). Check the gap between the end of the proximity switch and boom. See Fig. 10-9.
3. Connect the wire harness (Item 4) to the proximity switch.
4. Check operation of the proximity switch by extending the boom. The boom extension proximity light must come on at specified distance (approximately 21 feet with a tilting tower or 25 feet with a standard carriage). If the light does not illuminate, stop and retract the boom. Proceed to “Adjustments” below.

Adjustments

Boom Extension Proximity Switch

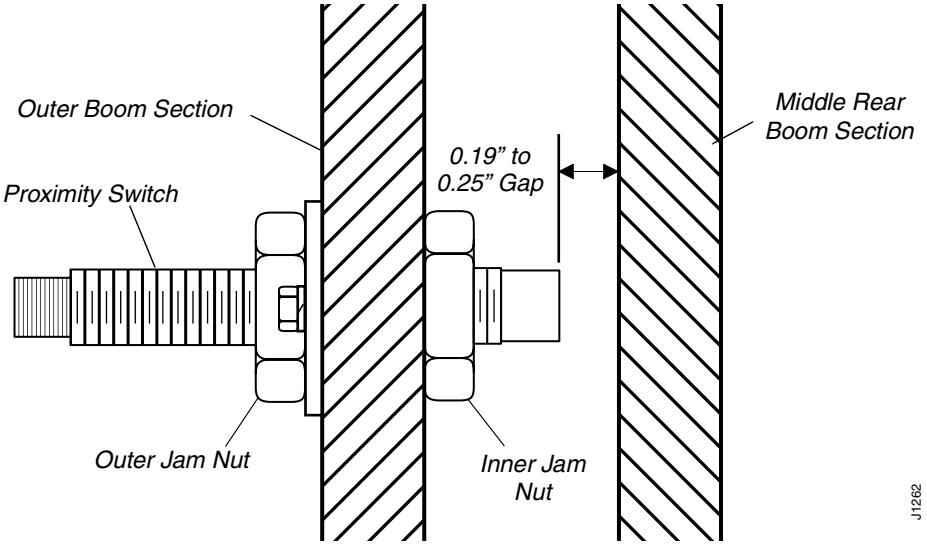


Fig. 10-9: Boom Extension Proximity Switch Adjustment

(Ref. Fig. 10-9) The following procedure describes adjustments to the boom extension proximity switch.

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1. Loosen, but do not remove the two (2) jam nuts on the proximity switch body.
2. Check the gap between switch and boom. The gap must be within the range specified in Fig. 10-9.
3. If the boom extension proximity light does not illuminate when the boom is extended to the specified distance (approximately 21 feet with a tilting tower or 25 feet with a standard carriage), adjust the proximity switch to slightly reduce the gap. Do not exceed gap tolerances specified in Fig. 10-9. Snug jam nuts to hold switch in position.
4. Extend the boom and check operation of the boom extension proximity light. The light must come on when the boom is extended to specified distance (approximately 21 feet with tilting tower or 25 feet with standard carriage). If the light does not illuminate, stop and retract the boom. Repeat Step 3.
5. Tighten the jam nuts.

Outrigger Control Valves

Description

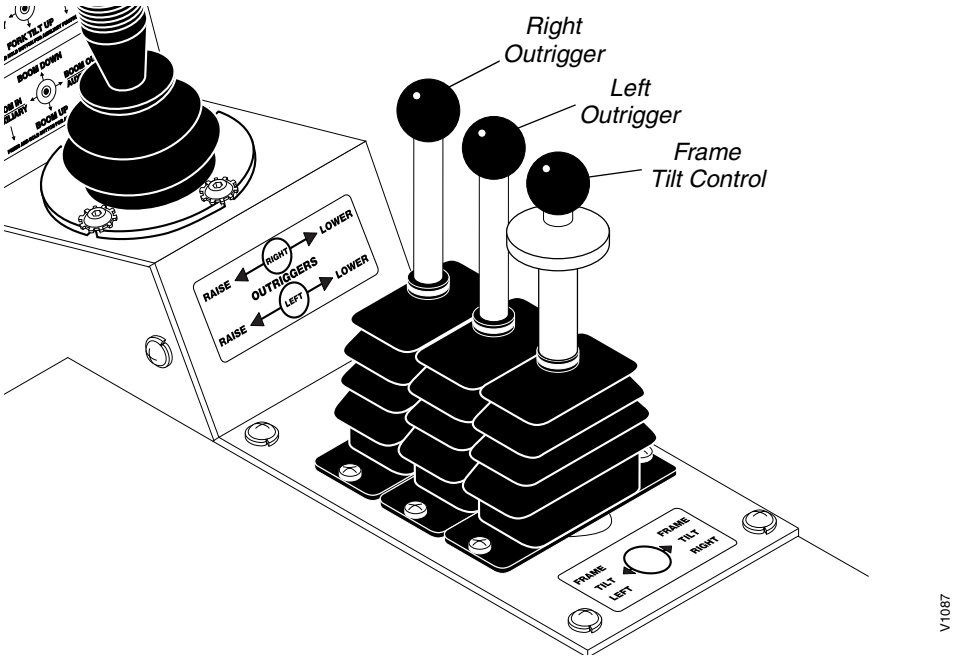


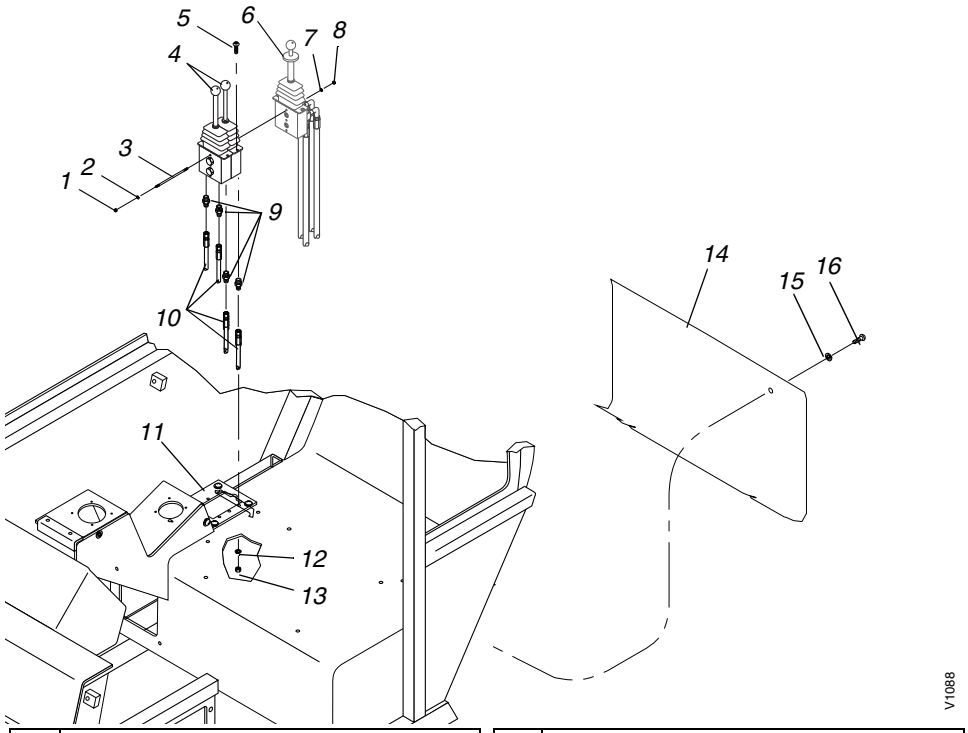
Fig. 10-10: Outrigger Controls

(Ref. Fig. 10-9) The remote controls are located to the right of the seat and consists of three sections. One section is used for frame tilt control (rear control) and two are outrigger controls. The pressure range for each section is 116–410 psi. The front control raises and lowers the right outrigger and the middle control raises and lowers the left outrigger.

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Removal

Outrigger Control Valve



#	Description
1	Nut
2	Lockwasher
3	Tie Rod
4	Outrigger Control Valve
5	Button Head Capscrew
6	Frame Tilt Control Valve
7	Lockwasher
8	Nut

#	Description
9	Connector
10	Hydraulic Hose
11	Control Panel
12	Lockwasher
13	Nut
14	Rear Cover
15	Flatwasher
16	Phillips Truss Head Screw

Fig. 10-11: Outrigger Control Valve Installation

(Ref. Fig. 10-11) The following procedure describes removal of the outrigger control valves.

1. Follow preparation procedures as outlined in Section 3 of this manual.
2. Lower the boom, apply the parking brake, raise the outrigger foot pads completely, and shut the engine off.
3. Remove four (4) screws (Item 16) and flatwashers (Item 15) securing the rear cover (Item 14) to the operator's compartment. Remove the rear cover.
4. Loosen and remove four (4) hydraulic hoses (Item 10) from the connectors (Item 9) on the bottom of the outrigger control valves (Item 4). Bleed any remaining oil into a suitable container. Tag and cap the hoses and fittings.
5. Remove the nut (Item 1) and lockwasher (Item 2) from each of the three (3) tie rods (Item 3). Remove the tie rods, along with lockwashers (Item 7) and nuts (Item 8), securing the control valve sections together.

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6. Remove the two (2) nuts (Item 13), lockwashers (Item 12), and capscrews (Item 5) securing each valve section to the control panel (Item 11). Remove the outrigger valve sections.

Installation

Outrigger Control Valve

(Ref. Fig. 10-11) The following procedure describes installation of the outrigger control valves.

1. Secure the two (2) outrigger control valves (Item 4) to the frame tilt control valve (Item 6) with three (3) tie rods (Item 3). Install lockwashers (Items 2 and 7) and nuts (Items 1 and 8) on each end of both tie rods.
2. Install each outrigger control valve on the control panel (Item 11) with two (2) capscrews (Item 5), lockwashers (Item 12), and nuts (Item 13). Torque the nuts to 50 in-lbs.
3. Install the hydraulic hoses (Item 10) on the connectors (Item 9) on the bottom of each control valve. For final tightening, torque the hose swivel nuts to 130–150 in-lbs.
4. Install the rear cover (Item 14) on the operators compartment with four (4) flatwashers (Item 15) and screws (Item 16). Torque the screws to 96 in-lbs.

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