



An Oshkosh Corporation Company

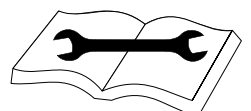
---

# Service and Maintenance Manual

***Model***  
***600SC***  
***600SJC***  
***660SJC***

***P/N - 3120898***

November 22, 2016









## SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

### A GENERAL

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

#### **⚠ WARNING**

**MODIFICATION OF THE MACHINE WITHOUT CERTIFICATION BY A RESPONSIBLE AUTHORITY THAT THE MACHINE IS AT LEAST AS SAFE AS ORIGINALLY MANUFACTURED, IS A SAFETY VIOLATION.**

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

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

#### **⚠ WARNING**

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

### B HYDRAULIC SYSTEM SAFETY

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

Relieve system pressure by cycling the applicable control several times with the engine stopped and ignition on, to direct any line pressure back into the reservoir. Pressure feed lines to system components can then be disconnected with minimal fluid loss.

### C MAINTENANCE

#### **⚠ WARNING**

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

- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICEMANUAL.
- KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.
- USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.
- NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR BOOM SAFETY PROP HAS BEEN ENGAGED.
- BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.
- BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.



## **REVISION LOG**

Original Issue	- February 24, 2000
Revised	- July 21, 2000
Revised	- February 10, 2002
Revised	- November 22, 2016



**TABLE OF CONTENTS**

<b>SUBJECT - SECTION, PARAGRAPH</b>	<b>PAGE NO.</b>
<b>SECTION A - INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS</b>	
A General . . . . .	A-1
B Hydraulic System Safety . . . . .	A-1
C Maintenance . . . . .	A-1
<b>SECTION 1 - SPECIFICATIONS</b>	
1.1 Capacities . . . . .	1-1
Fuel Tank . . . . .	1-1
Hydraulic Oil Tank . . . . .	1-1
Hydraulic System (Including Tank) . . . . .	1-1
Engine Crankcase . . . . .	1-1
1.2 Component Data . . . . .	1-1
Engine - Diesel (Liquid-Cooled) . . . . .	1-1
Swing System . . . . .	1-1
Auxiliary Power Pump . . . . .	1-1
1.3 Performance Data . . . . .	1-2
Turning Radius (Outside) . . . . .	1-2
Turning Radius (Inside) . . . . .	1-2
Boom Elevation . . . . .	1-2
Machine Weight approximately . . . . .	1-2
Machine Height (Stowed) . . . . .	1-2
Machine Length (Stowed) . . . . .	1-2
Machine Width . . . . .	1-2
1.4 Function Speeds . . . . .	1-2
Machine Orientation When Doing Speed Tests . . . . .	1-2
Test Notes . . . . .	1-3
1.5 Torque Requirements . . . . .	1-3
1.6 Lubrication . . . . .	1-3
Deutz F4M1011F Engine . . . . .	1-3
Hydraulic Oil . . . . .	1-4
Lubrication Specifications . . . . .	1-4
1.7 Pressure Settings . . . . .	1-4
1.8 Cylinder Specifications . . . . .	1-5
1.9 Major Component Weights . . . . .	1-5
1.10 Critical Stability Weights . . . . .	1-5
1.11 Serial Number Locations . . . . .	1-6
<b>SECTION 2 - GENERAL</b>	
2.1 Machine Preparation, Inspection, and Maintenance . . . . .	2-1
General . . . . .	2-1
Preparation, Inspection, and Maintenance . . . . .	2-1
Pre-Start Inspection . . . . .	2-1
Pre-Delivery Inspection and Frequent Inspection . . . . .	2-1
Annual Machine Inspection . . . . .	2-1
Preventative Maintenance . . . . .	2-1
2.2 Service and Guidelines . . . . .	2-2
General . . . . .	2-2
Safety and Workmanship . . . . .	2-2
Cleanliness . . . . .	2-2
Components Removal and Installation . . . . .	2-2
Component Disassembly and Reassembly . . . . .	2-3
Pressure-Fit Parts . . . . .	2-3
Bearings . . . . .	2-3
Gaskets . . . . .	2-3



## TABLE OF CONTENTS

---

### TABLE OF CONTENTS (continued)

SUBJECT - SECTION, PARAGRAPH	PAGE NO.
Bolt Usage and Torque Application . . . . .	2-3
Hydraulic Lines and Electrical Wiring . . . . .	2-3
Hydraulic System . . . . .	2-3
Lubrication . . . . .	2-3
Battery . . . . .	2-3
Lubrication and Servicing . . . . .	2-3
2.3 Lubrication and Information . . . . .	2-4
Hydraulic System . . . . .	2-4
Hydraulic Oil . . . . .	2-4
Changing Hydraulic Oil . . . . .	2-4
Lubrication Specifications . . . . .	2-4
2.4 Cylinder Drift Test . . . . .	2-5
Platform Drift . . . . .	2-5
Cylinder Drift . . . . .	2-5
2.5 Pins and Composite Bearing Repair Guidelines . . . . .	2-5
<b>SECTION 3 - TURNTABLE</b>	
3.1 Tilt Alarm Switch . . . . .	3-1
Manual Adjustment . . . . .	3-1
3.2 Throttle Checks and Adjustments - Deutz . . . . .	3-2
General . . . . .	3-2
Procedure . . . . .	3-2
Controller Status . . . . .	3-2
Failure Modes . . . . .	3-3
3.3 Swing Hub . . . . .	3-4
Adjustment Procedures . . . . .	3-4
3.4 Swing Bearing . . . . .	3-4
Turntable Bearing Mounting Bolt Condition Check . . . . .	3-4
Wear Tolerance . . . . .	3-5
Swing Bearing Replacement . . . . .	3-5
Swing Bearing Torque Values . . . . .	3-7
3.5 Swing Brake - Mico . . . . .	3-8
Disassembly . . . . .	3-8
Inspection . . . . .	3-8
Assembly . . . . .	3-8
<b>SECTION 4 - BOOM &amp; PLATFORM</b>	
4.1 Platform . . . . .	4-1
Platform Sections Replacement . . . . .	4-1
4.2 Boom Rope Torquing Procedures . . . . .	4-1
Torque Procedures . . . . .	4-1
4.3 Wear Pads . . . . .	4-2
Main Boom . . . . .	4-2
4.4 Wire Rope . . . . .	4-3
Inspection . . . . .	4-3
Three Month Inspection . . . . .	4-3
12 Year or 7000 Hour Replacement . . . . .	4-3
Additional Replacement Criteria . . . . .	4-3
4.5 Boom Maintenance . . . . .	4-3
Removal . . . . .	4-3
Disassembly of Boom Sections . . . . .	4-5
Inspection . . . . .	4-9
Assembly . . . . .	4-10
Installation . . . . .	4-14



**TABLE OF CONTENTS (continued)**

<b>SUBJECT - SECTION, PARAGRAPH</b>	<b>PAGE NO.</b>
4.6 Articulating Jib Boom . . . . .	4-14
Removal . . . . .	4-14
Disassembly . . . . .	4-14
Inspection . . . . .	4-15
Assembly . . . . .	4-15
4.7 Limit Switch Adjustment . . . . .	4-15
4.8 Rotator - Helac . . . . .	4-17
Disassembly . . . . .	4-17
Inspection . . . . .	4-19
Assembly . . . . .	4-19
4.9 Foot Switch Adjustment . . . . .	4-20
4.10 SUPERFLEX Controller . . . . .	4-20
System Overview . . . . .	4-20
System Elements . . . . .	4-20
General Description . . . . .	4-21
SUPERFLEX Terminal Identification . . . . .	4-22
SUPERFLEX Terminal Assignments . . . . .	4-22
Setup and Tuning . . . . .	4-23
How to Perform the Normal-Active Tuning Process . . . . .	4-24
How to make Bench-Static Adjustments . . . . .	4-25
Troubleshooting . . . . .	4-27
How To Troubleshoot the SUPERFLEX Controller . . . . .	4-27
How to Troubleshoot the Digisensor . . . . .	4-27
Important Reminders . . . . .	4-31
Crawler Tracking Adjustments . . . . .	4-32
Drive & Steer Function Check . . . . .	4-32
Superflex Inputs And Outputs . . . . .	4-45
<b>SECTION 5 - HYDRAULICS</b>	
5.1 Cylinders - Theory of Operation . . . . .	5-1
Systems Incorporating Double Acting Cylinders . . . . .	5-1
Systems Incorporating Holding Valves . . . . .	5-1
5.2 Valves - Theory of Operation . . . . .	5-1
Solenoid Control Valve - Rexroth . . . . .	5-1
Relief Valves . . . . .	5-1
5.3 Cylinder Checking Procedure . . . . .	5-1
Cylinders Without Counterbalance Valves - Master Cylinder and Steer Cylinder . . . . .	5-1
Cylinders With Single Counterbalance Valve . . . . .	5-2
Cylinders With Dual Counterbalance Valves . . . . .	5-2
5.4 Cylinder Repair . . . . .	5-3
Disassembly . . . . .	5-3
Cleaning and Inspection . . . . .	5-4
Assembly . . . . .	5-5
5.5 Cylinder Removal and Installation . . . . .	5-9
Main Boom Telescope Cylinder Removal . . . . .	5-9
Main Boom Telescope Cylinder Installation . . . . .	5-9
Main Boom Lift Cylinder Removal . . . . .	5-10
Main Boom Lift Cylinder Installation . . . . .	5-10
5.6 Pressure Setting Procedures . . . . .	5-11
Main Relief, Steer, Swing and Lift Down . . . . .	5-11
Platform Level . . . . .	5-11
Articulating Jib Boom (If Equipped) . . . . .	5-11
5.7 Hydraulic Pump W/hayes Pump Drive Coupling Lubrication . . . . .	5-16
5.8 Hydraulic Component Start-Up Procedures and recommendations . . . . .	5-16



**TABLE OF CONTENTS (continued)**

<b>SUBJECT - SECTION, PARAGRAPH</b>	<b>PAGE NO.</b>
<b>SECTION 6 - UNDERCARRIAGE</b>	
6.1 Track Carrier Roller . . . . .	6-1
Removal . . . . .	6-1
Installation . . . . .	6-2
Disassembly . . . . .	6-2
Assembly . . . . .	6-5
6.2 Track Roller . . . . .	6-8
Removal . . . . .	6-8
Disassembly . . . . .	6-10
Assembly . . . . .	6-11
Installation . . . . .	6-14
6.3 Track . . . . .	6-15
Separate . . . . .	6-15
Connect . . . . .	6-16
6.4 Front Idler and Recoil Spring . . . . .	6-18
Removal . . . . .	6-18
Installation . . . . .	6-18
Front Idler Disassembly . . . . .	6-19
Front Idler Assembly . . . . .	6-20
Recoil Spring Disassembly . . . . .	6-22
Recoil Spring Assembly . . . . .	6-25
6.5 Track Adjuster . . . . .	6-27
Removal . . . . .	6-27
Disassembly . . . . .	6-27
Assembly . . . . .	6-29
Installation . . . . .	6-30
6.6 Final Drive Sprocket . . . . .	6-30
Removal . . . . .	6-30
Installation . . . . .	6-31
6.7 Travel Brake Valve . . . . .	6-32
Removal . . . . .	6-32
6.8 Travel Motor . . . . .	6-32
Removal . . . . .	6-32
6.9 Travel Brake Valve . . . . .	6-34
Disassembly . . . . .	6-34
6.10 Travel Brake Valve . . . . .	6-35
Assembly . . . . .	6-35
Installation Procedure . . . . .	6-36
6.11 Travel Motor . . . . .	6-37
Disassembly . . . . .	6-37
Assembly . . . . .	6-38
Installation . . . . .	6-40
6.12 Final Drive . . . . .	6-41
Removal . . . . .	6-41
Disassembly . . . . .	6-42
Assembly . . . . .	6-50
Installation . . . . .	6-56
Final Drive Oil - Change . . . . .	6-57
Final Drive Oil Level Check . . . . .	6-58
6.13 Swivel . . . . .	6-58
Removal . . . . .	6-58
Disassembly . . . . .	6-61
Assembly . . . . .	6-61
Installation . . . . .	6-61



**TABLE OF CONTENTS (continued)**

<b>SUBJECT - SECTION, PARAGRAPH</b>	<b>PAGE NO.</b>
6.14 Towing Information . . . . .	6-62
Towing the Machine. . . . .	6-62
Final Drive Sun Gear Removal. . . . .	6-63
6.15 Track Adjustment - Adjust . . . . .	6-63
Measuring Track Tension . . . . .	6-64
Tightening the Track . . . . .	6-64
Loosening the Track . . . . .	6-64
Track Adjustment - Inspect . . . . .	6-64
6.16 Undercarriage- Check . . . . .	6-64
<b>SECTION 7 - SCHEMATICS</b>	
7.1 General . . . . .	7-1
7.2 Troubleshooting . . . . .	7-1
7.3 Hydraulic Circuit Checks. . . . .	7-1

**LIST OF FIGURES**

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
1-1.	Serial Number Locations. . . . .	1-6
1-2.	Lubrication Point Location . . . . .	1-8
1-3.	Torque Chart . . . . .	1-10
3-1.	Tilt Switch Adjustment. . . . .	3-1
3-2.	Addco Adjustments. . . . .	3-2
3-3.	Swing Torque Hub Adjustment. . . . .	3-4
3-4.	Swing Bearing Bolt Feeler Gauge Check . . . . .	3-5
3-5.	Swing Bearing Tolerance Measuring Point. . . . .	3-5
3-6.	Swing Bearing Tolerance Boom Placement . . . . .	3-6
3-7.	Swing Bearing Torque Sequence. . . . .	3-8
3-8.	Swing Brake Assembly (Mico) . . . . .	3-9
4-1.	Platform Section Replacement . . . . .	4-1
4-2.	Dimensions of Boom Sections . . . . .	4-1
4-3.	Clamping Wire Ropes . . . . .	4-1
4-4.	Location and Thickness of Wear Pads . . . . .	4-2
4-5.	Location of Components - Platform Support . . . . .	4-4
4-6.	Location of Components - Rotator and Leveling Cylinder . . . . .	4-4
4-7.	Location of Components - Boom Powertrack. . . . .	4-4
4-8.	Boom Assembly Cutaway - S Models - Sheet 1 of 3 . . . . .	4-6
4-9.	Boom Assembly Cutaway - S Models - Sheet 2 of 3 . . . . .	4-7
4-10.	Boom Assembly Cutaway - S Models - Sheet 3 of 3 . . . . .	4-8
4-11.	Disassembly of Sheave Assembly . . . . .	4-8
4-12.	Disassembly Wire Rope Routing Procedure . . . . .	4-9
4-13.	Dimension of Sheaves When New . . . . .	4-10
4-14.	Routing Installation of Retract Wire Ropes . . . . .	4-11
4-15.	Reassembly of Components - Boom Powertrack Assembly . . . . .	4-12
4-16.	Boom Powertrack Installation . . . . .	4-13
4-17.	Location of Components - Articulating Jib Boom. . . . .	4-14
4-18.	Limit Switches Adjustments . . . . .	4-16
4-20.	Removing Portion of End Cap . . . . .	4-17
4-21.	Heating Setscrew . . . . .	4-17
4-22.	Removing Setscrew. . . . .	4-17
4-23.	Removing End Cap. . . . .	4-17
4-19.	Rotator Assembly (Helac) . . . . .	4-18
4-24.	Removing Shaft from Housing . . . . .	4-19



**LIST OF FIGURES (continued)**

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
4-25.	Removing Sleeve from Housing . . . . .	4-19
4-26.	Actuator Timing . . . . .	4-20
4-27.	SUPERFLEX Terminal Identification . . . . .	4-22
4-28.	Wiring Diagram - Single Coil Uni-Directional Flow Control Valve - 1 Axis. . . . .	4-22
4-29.	Controller Pattern . . . . .	4-23
4-30.	Calibration Flow Diagram . . . . .	4-26
4-31.	Testing the SUPERFLEX . . . . .	4-27
4-32.	Digisensor Troubleshooting . . . . .	4-28
4-33.	Typical SUPERFLEX System Wiring Diagram . . . . .	4-29
4-34.	OPTIMIZER Keypad . . . . .	4-30
5-1.	Cylinder Barrel Support. . . . .	5-3
5-2.	Cap Screw Removal . . . . .	5-3
5-3.	Cylinder Rod Support . . . . .	5-3
5-4.	Tapered Bushing Removal . . . . .	5-4
5-5.	Gar-Max Bearing Installation. . . . .	5-4
5-6.	Rod Seal Installation . . . . .	5-5
5-7.	Poly-Pak Piston Seal Installation. . . . .	5-5
5-8.	Wiper Seal Installation. . . . .	5-5
5-9.	Installation of Head Seal Kit . . . . .	5-6
5-10.	Piston Seal Kit Installation. . . . .	5-6
5-11.	Tapered Bushing Installation . . . . .	5-7
5-12.	Seating the Tapered Bearing . . . . .	5-7
5-13.	Rod Assembly Installation. . . . .	5-8
5-14.	Boom Positioning and Support, Cylinder Repair . . . . .	5-9
5-15.	Articulating Jib Boom Pressure Adjustments . . . . .	5-11
5-16.	Main Control Valve Pressure Adjustments - Sheet 1 of 2. . . . .	5-12
5-17.	Main Control Valve Pressure Adjustments - Sheet 2 of 2. . . . .	5-13
5-18.	Location of Components - Main Control Valve (Sheet 1) . . . . .	5-14
5-19.	Location of Components - Main Control Valve (Sheet 2) . . . . .	5-15
6-1.	Undercarriage Components . . . . .	6-1
6-2.	Track Carrier Roller - Exploded View . . . . .	6-3
6-3.	Track Carrier Roller . . . . .	6-4
6-4.	Track Roller - Exploded View . . . . .	6-9
6-5.	Track Roller . . . . .	6-10
6-6.	Track Link Assembly . . . . .	6-16
6-7.	Track Shoe . . . . .	6-16
6-8.	Front Idler Assembly . . . . .	6-19
6-9.	Recoil Spring Assembly . . . . .	6-22
6-10.	Track Adjuster . . . . .	6-28
6-11.	Travel Motor. . . . .	6-33
6-12.	Final Drive . . . . .	6-43
6-13.	Tooling (J) . . . . .	6-56
6-14.	Swivel Assembly . . . . .	6-60
7-1.	Electrical Components Installation - Sheet 1 . . . . .	7-2
7-2.	Electrical Components Installation - Sheet 2 . . . . .	7-3
7-3.	Electrical Schematic - Deutz or Isuzu - Sheet 1 of 2. . . . .	7-4
7-4.	Electrical Schematic - Deutz or Isuzu - Sheet 2 of 2. . . . .	7-5
7-5.	Electrical Schematic - Australian w/Deutz or Isuzu - Sheet 1 of 2 . . . . .	7-6
7-6.	Electrical Schematic - Australian w/Deutz or Isuzu - Sheet 2 of 2 . . . . .	7-7
7-7.	Hydraulic Schematic - Sheet 1 of 4. . . . .	7-8
7-8.	Hydraulic Schematic - Sheet 2 of 4. . . . .	7-9
7-9.	Hydraulic Schematic - Sheet 3 of 4. . . . .	7-10
7-10.	Hydraulic Schematic - Sheet 4 of 4. . . . .	7-11
7-11.	Hydraulic Schematic w/GFT24 Drive - Sheet 1 of 4 . . . . .	7-12



**LIST OF FIGURES (continued)**

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
7-12.	Hydraulic Schematic w/GFT24 Drive - Sheet 2 of 4 . . . . .	7-13
7-13.	Hydraulic Schematic w/GFT24 Drive - Sheet 3 of 4 . . . . .	7-14
7-14.	Hydraulic Schematic w/GFT24 Drive - Sheet 4 of 4 . . . . .	7-15

**LIST OF TABLES**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
1-1	Function Speeds (In Seconds) . . . . .	1-2
1-2	Torque Requirements . . . . .	1-3
1-3	Hydraulic Oil . . . . .	1-4
1-4	Mobil DTE 13M Specs. . . . .	1-4
1-5	Lubrication Specifications . . . . .	1-4
1-6	Cylinder Specifications . . . . .	1-5
1-7	Major Component Weights . . . . .	1-5
1-8	Critical Stability Weights . . . . .	1-5
1-9	Lubrication Chart . . . . .	1-9
2-1	Inspection and Maintenance . . . . .	2-2
2-2	Cylinder Drift . . . . .	2-5
2-3	Inspection and Preventive Maintenance Schedule . . . . .	2-6
3-1	Position Controller Truth Table . . . . .	3-2
4-1	Adjusting Threshold . . . . .	4-24
4-2	Adjustment Values . . . . .	4-25
4-3	Factory Defaults . . . . .	4-25
5-1	Cylinder Head and Tapered Bushing Torque Specifications . . . . .	5-8
5-2	Holding Valve Torque Specifications . . . . .	5-8
6-1	Track Carrier Roller Required Tools - Removal and Installation . . . . .	6-1
6-2	Track Carrier Roller Required Tools - Assembly . . . . .	6-5
6-3	Track Roller Required Tools - Removal . . . . .	6-8
6-4	Track Roller Required Tools - Assembly . . . . .	6-11
6-5	Track Roller Required Tools - Removal . . . . .	6-14
6-6	Track Required Tools - Separate . . . . .	6-15
6-7	Track Required Tools - Connect . . . . .	6-16
6-8	Front Idler Required Tools - Assembly . . . . .	6-20
6-9	Recoil Spring Required Tools - Disassembly . . . . .	6-22
6-10	Recoil Spring Required Tools - Assembly . . . . .	6-25
6-11	Track Adjuster Required Tools - Assembly . . . . .	6-29
6-12	Final Drive Sprocket Required Tools - Removal . . . . .	6-30
6-13	Final Drive Sprocket Required Tools - Installation . . . . .	6-31
6-14	Travel Motor Required Tools - Removal . . . . .	6-32
6-15	Travel Motor Required Tools - Disassembly . . . . .	6-37
6-16	Travel Motor Required Tools - Assembly . . . . .	6-38
6-17	Travel Motor Required Tools - Installation . . . . .	6-40
6-18	Final Drive Required Tools - Removal . . . . .	6-41
6-19	Final Drive Required Tools - Disassembly . . . . .	6-42
6-20	Final Drive Required Tools - Assembly . . . . .	6-50
6-21	Final Drive Required Tools - Installation . . . . .	6-56



**This page left blank intentionally.**



## SECTION 1. SPECIFICATIONS

### 1.1 CAPACITIES

#### Fuel Tank

39 U.S. Gallons (147.6 l)

#### Hydraulic Oil Tank

31 U.S. Gallons (117.3 l) with 10% air space

#### Hydraulic System (Including Tank)

37.2 U.S. Gallons (140.8 l)

#### Engine Crankcase

Deutz F4M1011F Diesel w/Filter - 11 quarts (10.5 l)

### 1.2 COMPONENT DATA

#### Engine - Diesel (Liquid-Cooled)

Manufacturer/Model- Deutz F4M1011F.

Oil Capacity.

5 Quarts (4.5 l) Cooling System.

11 Quarts (10.5 l) w/Filter.

16 Quarts (15 l) Total Capacity.

Low RPM - 1800.

High RPM - 2800.

Alternator - 60 Amp, belt drive.

Battery - 1000 Cold Cranking Amps, 210 Minutes ReserveCapacity, 12 VDC.

Fuel Consumption.

Low RPM - 1.90 GPH (7.19 lph).

High RPM - 2.50 GPH (9.46 lph).

Horsepower - 65 @ 3000 RPM, full load.

Engine - Diesel. (Water-Cooled)

#### Swing System

Swing Motor Displacement - 4.62 cu. in. (75 cm<sup>3</sup>).

Swing Brake - Automatic spring applied hydraulically released disc brakes.

Swing Hub Ratio - 50:1.

Hydraulic Gear Pump. (at 1800 RPM)

7.9 GPM (29.90 lpm).

Pump Displacement - 1.02 cu. in. (16 cm<sup>3</sup>).

Clockwise Rotation.

#### Auxiliary Power Pump

2.6 GPM (9.84 lpm) @ 1200 PSI. (82.7 BAR.

Pump Displacement - .244 cu. in. (14 cm<sup>3</sup>).

DC Motor.

Clockwise Rotation.

Hydraulic Filter - In-line.

Return - Bypass Type.

10 Microns Absolute.

Charge.

10 Microns Absolute.

Hydraulic Strainers (In Tank).

30 Microns.



**1.3 PERFORMANCE DATA****Travel Speed**

1.6 MPH (2.6 Km/hr.)

**Travel Speed - Out of Transport**

0.4 MPH (0.6 Km/hr.)

**Gradeability.**

55%

**Turning Radius (Outside)**

8 ft. (2.4 m)

**Turning Radius (Inside)**

0

**Boom Elevation**

600SC - +60 ft. 2 13/16 in. (18.36 m)

-6 ft. 1 11/16 in. (1.87 m)

600SCJ - +60 ft. 5 3/4 in. (18.43 m)

-9 ft. 9 3/16 in. (2.98 m)

660SCJ - +66 ft. 7 5/8 in. (20.31 m)

-11 ft. 5 1/4 in. (3.49 m)

**Machine Weight approximately**

Steel Track - 25,900 lbs. (11,748 kg)

Rubber Track - 26,860 lbs. (12,184 kg)

**Machine Height (Stowed)**

Steel Track - 8'4" (2.54 m)

Rubber Track - 8'6" (2.59 m)

**Machine Length (Stowed)**

35' 6" (10.8 m)

**Machine Width**

8 ft. (2.4 m)

**1.4 FUNCTION SPEEDS****Table 1-1. Function Speeds (In Seconds)**

Function	Speed
Lift Up	46-60
Lift Down	33-43
Swing Right & Left*	79-101
Telescope In	22-33
Telescope Out	50-67
Platform Rotate Right & Left**	16-25
Jib Up	22-34
Jib Down	16-26
Drive (Forward & Reverse)	85-90
Drive Out of Transport (Forward & Reverse)	80-85
*Max 10% Difference Between Left & Right	
**Max 15% Difference Between Left & Right	

**Machine Orientation When Doing Speed Tests****Lift:** Telescope Retracted. Lift Up, Record Time, Lift Down, Record Time.**Swing:** Boom at Full Elevation. Telescope Retracted. Swing the Turntable off center and stop. Swing the opposite direction and start the test when the turntable is centered up. This eliminates ramp up and down on the controller affecting times.**Telescope:** Boom at Full Elevation; Telescope Retracted; Telescope Out, Record Time. Telescope In, Record Time.**Tracking:** Test to be done on a gravelled level surface. Position the machine driving at high speed at a reference point. (No steer correction). Results should be 4 to 6 ft. (1.2 to 1.8 m) tracking error at 200 ft. (60.9 m).**Drive:** Test should be done on a gravelled level surface. Drive select switch should be set at High Speed. Start approx. 10 ft. from starting point so that the unit is at maximum speed when starting the test. Results should be recorded for a 200 ft. (60.9 m) course. Drive Forward, Record Time. Drive Reverse, Record Time.**Drive (Out of Transport):** Test should be done on a gravelled level surface. Drive select switch should be set at Low Engine, Low Drive (The platform speed knob control, if equipped, could be selected to the creep speed to simulate the boom above horizontal). Results should be recorded for a 50 ft. (15.2 m) course. Drive Forward, Record Time. Drive Reverse, Record Time.



**Platform Rotate:** Platform level and completely rotated one direction. Rotate the opposite direction, Record Time. Rotate the other direction, Record Time.

**Articulating Jib:** Platform level and centered with the boom. Start with the Jib down. Jib Up, Record Time. Jib Down, Record Time.

### Test Notes

1. Stop watch should be started with the function, not with the controller or switch.
2. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
3. The platform speed knob control must be at full speed (turned clockwise completely).
4. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).
5. Some flow control functions may not work with the speed knob clicked into the creep position.

## 1.5 TORQUE REQUIREMENTS

**Table 1-2. Torque Requirements**

Description	Torque Value (Dry)	Interval Hours
Bearing To Chassis	See Note	50/600*
Bearing To Turntable	See Note	50/600*
Wire Rope	15 ft.lbs. (20 Nm)	150
M16 Travel motor mounting bolts	175 ± 30 ft.lbs. (240 ± 40 Nm)	As required
M20 Final Drive mounting bolts	390 ± 50 ft.lbs. (530 ± 70 Nm)	As required
M20 Track roller mounting bolts	340 ± 44 ft.lbs. (460 ± 60 Nm)	As required
M24 Carrier roller mounting bolts	600 ± 70 ft.lbs. (800 ± 100 Nm)	As required
*Check swing bearing bolts for security after first 50 hours of operation and every 600 hours thereafter. (See paragraph on Swing Bearing in Section 2.)		
<b>NOTE:</b> When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart to determine proper torque value.		

## 1.6 LUBRICATION

### Deutz F4M1011F Engine

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

**When Outside Temperature is Consistently** Use SAE Viscosity Number

-20°F. to +25°F. (-29°C. to +4°C.)	*10W
+5°F. to +50°F. (+15°C. to +10°C.)	20W-20
+40°F. to +85°F. (+4°C. to +30°C.)	30
Above 75°F. (24°C.)	40

Multi Viscosity Oil (CD-SE, CD-SF)

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

**When Outside Temperature is Consistently** Use SAE Viscosity Number

-40°F. to +75°F. (-40°C. to +24°C.)	*5W-30 (Synthetic)
-15°F. to +70°F. (-26°C. to +21°C.)	10W-30
-15°F. to +85°F. (-26°C. to +30°C.)	10W-40
Above -5°F. (-21°C.)	15W-40
-5°F. to +75°F. (-21°C. to +24°C.)	15W-30

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

**NOTE:** Crankcase oil should be MIL-L2104B/MIL-L2104C or have properties of API classification CC/CD grades.



## SECTION 1 - SPECIFICATIONS

### Hydraulic Oil

**Table 1-3. Hydraulic Oil**

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE	SAE VISCOSITY GRADE
+0° to +180° F (-18° C to +83° C)	10W
+0° F to +210° F (-18° C to +99° C)	10W-20, 10W-30
+50° F to +210° F (+10° C to +210° C)	20W-20

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

**NOTE:** When temperatures remain below 20° F (-7 degrees C), JLG Industries recommends the use of Mobil DTE 13M.

**Table 1-4. Mobil DTE 13M Specs**

ISO Viscosity Grade	#32
Specific Gravity	0.877
Pour Point, Max	-40 F (-40 C)
Flash Point, Min.	330 F (166 C)
Viscosity	
at 40° C	33cSt
at 100° C	6.6 cSt
at 100° F	169 SUS
at 210° F	48 SUS
cp at -20° F	6,200
Viscosity Index	140

Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. If use of hydraulic oil other than Mobilfluid 424 is desired, contact JLG Industries for proper recommendations.

### Lubrication Specifications

**Table 1-5. Lubrication Specifications**

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° F (177° C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobilfluid 424.
EO	Engine (crankcase) Oil. Gas - API SF, SH, SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.

**NOTE:** Refer to Lubrication Chart, for specific lubrication procedures.

## 1.7 PRESSURE SETTINGS

Main Relief - 3000 PSI (206.85 Bar).

Upper Boom Lift Down - 1500 PSI (103.4 Bar).

Swing - 1700 PSI (117.2 Bar).

Platform Level Forward - 2800 PSI (193.06 Bar).

Backward - 1800 PSI (124.11 Bar).

Articulating Jib Boom Up - 1500 PSI (103 Bar).

Down - 1200 PSI (82.7 Bar).



## 1.8 CYLINDER SPECIFICATIONS

Table 1-6. Cylinder Specifications

DESCRIPTION	BORE			STROKE			ROD DIA.		
	600SJC	660SJC	600SC	600SJC	660SJC	600SC	600SJC	660SJC	600SC
Lift	6.00 (152.4)	6.00 (152.4)	6.00 (152.4)	44.6875 (1135.1)	44.6875 (1135.1)	44.6875 (1135.1)	3 (76.2)	3 (76.2)	3 (76.2)
Telescope	3.5 (88.9)	3.5 (88.9)	3.5 (88.9)	143.1875 (3637)	168.4375 (4278.3)	177.75 (4514.9)	2.5 (63.5)	2.5 (63.5)	2.5 (63.5)
Master	3.5 (88.9)	3.5 (88.9)	3 (76.2)	13.0625 (331.8)	13.0625 (331.8)	8.5 (215.9)	1.5 (38.1)	1.5 (38.1)	1.5 (38.1)
Slave Level	3.5 (88.9)	3.5 (88.9)	3 (76.2)	13.0625 (331.8)	13.0625 (331.8)	8.5 (215.9)	1.5 (38.1)	1.5 (38.1)	1.5 (38.1)
Lift (Articulating Jib Boom)	3 (76.2)	3 (76.2)	N/A	25.5 (647.7)	25.5 (647.7)	N/A	1.5 (38.1)	1.5 (38.1)	N/A

## 1.9 MAJOR COMPONENT WEIGHTS

Table 1-7. Major Component Weights

	600SJC		660SJC		600SC	
	LB.	KG.	LB.	KG.	LB.	KG.
Platform Control Console	250	113	250	113	250	113
Platform Level Cylinder	60	27	60	27	46	21
Main Boom (Includes Lift Cyl., Rotator, and Support)	3483	1580	3783	1716	3527	1600
Turntable Complete (including engine)	7915	3590	9065	4112	7315	3318

## 1.10 CRITICAL STABILITY WEIGHTS

### WARNING

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

Table 1-8. Critical Stability Weights

		600SJC		660SJC		600SC	
		LB.	KG.	LB.	KG.	LB.	KG.
Engine	Ford	460	209	460	209	460	209
Platform	6 ft. (1.83 M)	205	93	205	93	205	93
	8 ft. (2.44 M)	230	105	230	105	230	105



### 1.11 SERIAL NUMBER LOCATIONS

A serial number plate is affixed to the left rear side of the frame. If the serial number plate is damaged or missing,

the machine serial number is stamped on the left side of the frame.

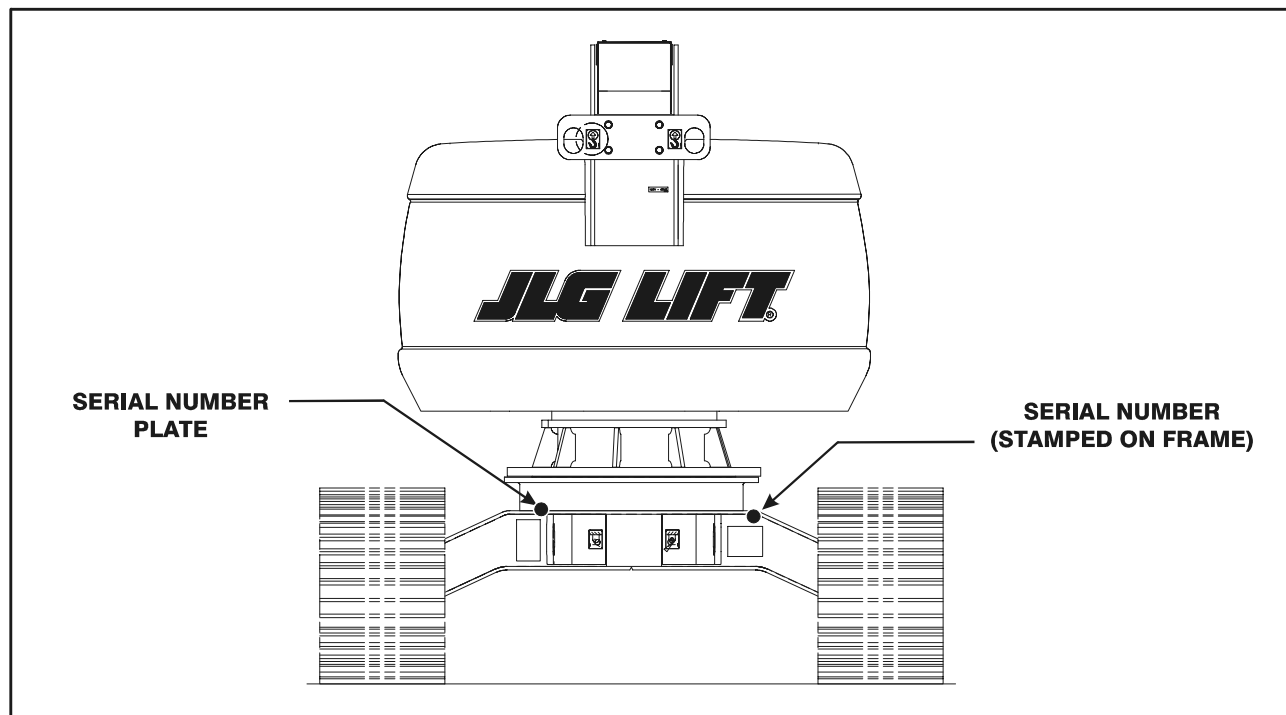


Figure 1-1. Serial Number Locations



**This page left blank intentionally.**



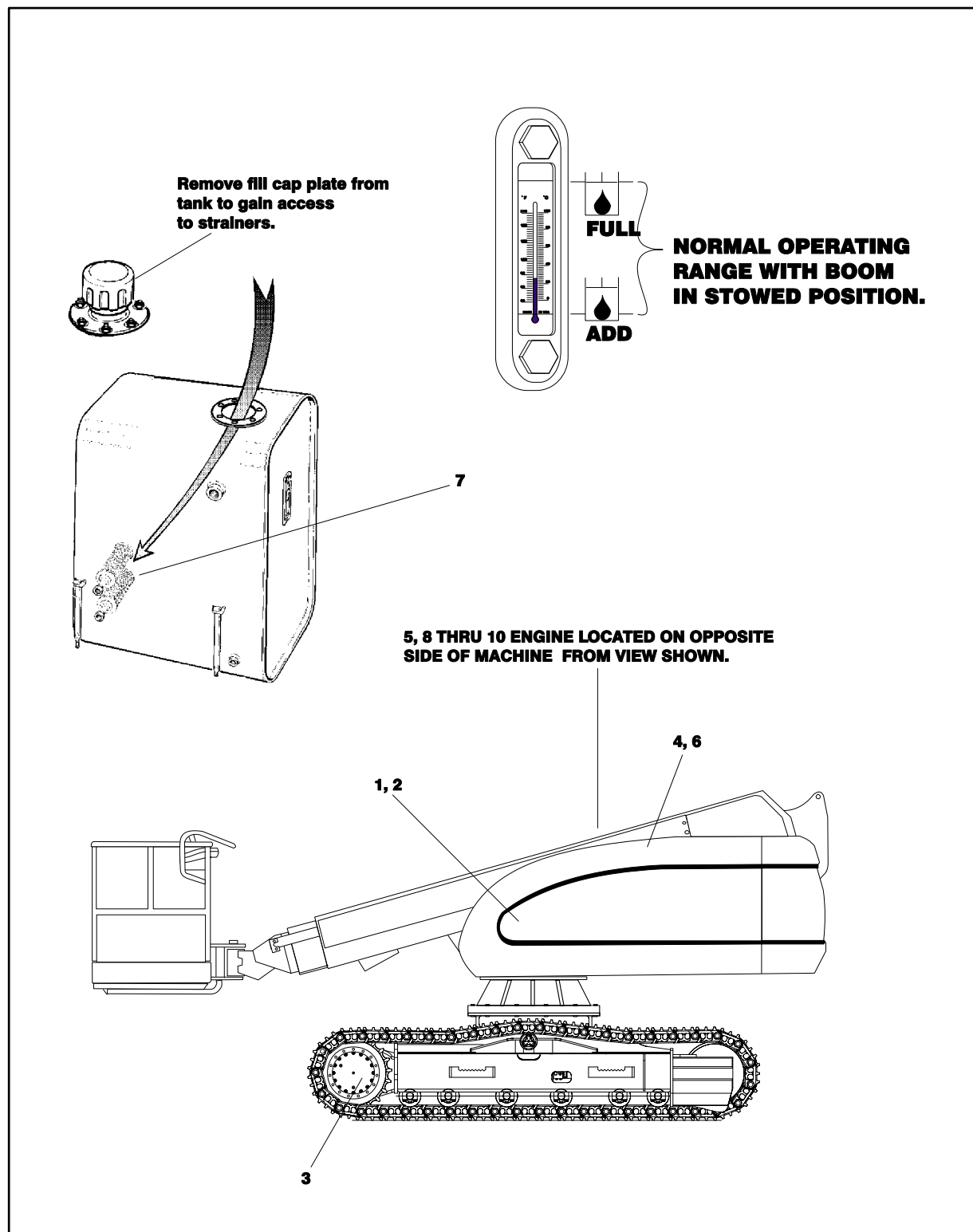


Figure 1-2. Lubrication Point Location



**Table 1-9. Lubrication Chart**

	Components	Number/Type Lube Points	Capacity	Lube	Interval		Hours		Comments
					3 Months 150 hrs	6 Months 300 hrs	1 Year 600 hrs	2 Years 1200 hrs	
Lubrication									
1	Swing Bearing	2 Grease Fittings	A/R	MPG	X				Remote Access
2	Swing Drive Hub	Level/Fill Plug	0.5 L (1/2 Full)	EPGL	X				Check level every 150 hrs/change 1200 hours
3	Final Drive Hub	Level/Fill Plug	7.9 L (1/2 Full)	EPGL	X				Check level every 150 hrs/change 1200 hours
4	Hydraulic Return Filter	N/A	N/A	N/A		X			Change after first 50 hrs. and every 300 hrs. thereafter or as indicated by Condition Indicator.
5	Hydraulic Charge Filter	N/A	N/A	N/A		X			Change after first 50 hrs. and every 300 hrs. thereafter or as indicated by Condition Indicator.
6	Hydraulic Oil	Fill Cap	116 L Tank 124 L System	HO				X	Check level daily/change 1200 hours
7	Suction Strainers (in tank)	2	N/A	N/A				X	Remove and clean at time of hydraulic oil change.
Engines									
8	Oil Change w/Filter - Deutz	Fill Cap/Spin-on Element	10.4 L Crankcase **4.7 L Cooler	EO			X		Check level daily/Change in accordance with engine manual.
9	Fuel Filter - Deutz	Replaceable Element	N/A	N/A			X		
10	Air Filter - Deutz	Replaceable Element	N/A	N/A		X			Or as indicated by Condition Indicator.
NOTES:								KEY TO LUBRICANTS	
Lubrication intervals are based on machine operation under normal conditions. For machines used in multi shift operations and/or exposed to hostile environments or conditions, lubrication frequencies must be increased accordingly.			** When changing oil in the Deutz oil cooled engine, drain both the crankcase and the cooler. When refilling it is acceptable to overfill the crankcase (15 L, capacity of both crankcase and cooler combined). Start engine, allow the engine to run until the thermostat opens (approximately 105 degrees C) cooler will fill up within minutes; shut down and wait for approximately two minutes. Check oil level, fill oil to max marking on the dipstick.					EO EPGL HO MPG	Engine Oil Extreme Pressure Gear Lube Hydraulic Fluid (Mobil #424 or equivalent) Multi-Purpose Grease



SIZE	THD	BOLT DIA. (CM)	THREAD STRESS AREA (SQ. CM)	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 (KG)		TORQUE (LUB.)		(LOCTITE 242 OR 271)	CLAMP LOAD (KG)		TORQUE (LUB.)		(LOCTITE 242 OR 271)	CLAMP LOAD (KG)	TORQUE (as received)
				(DRY OR LOC. 263)	NM	(LUB.)	NM		(DRY OR LOC. 263)	NM	(LUB.)	NM			
4	40	0.2845	0.0153	172	1	1	—	—	245	2	1	—	—	—	—
	48	0.0168	0.0168	191	1	1	—	—	272	2	1	—	—	—	—
6	32	0.3505	0.0232	263	2	2	—	—	372	3	2	—	—	—	—
	40	0.0258	0.0258	277	2	2	—	—	417	3	2	—	—	—	—
8	32	0.4166	0.0356	408	4	3	—	—	572	5	4	—	—	—	—
	36	0.0374	0.0374	426	4	3	—	—	599	5	4	—	—	—	—
10	24	0.4826	0.0445	508	5	4	—	—	717	7	5	—	—	—	—
	32	0.0508	0.0508	583	6	4	—	—	817	8	6	—	—	—	—
1/4	20	0.6350	0.0808	916	11	9	—	12	1297	16	12	—	18	1442	18
	28	0.0925	0.0925	1052	14	10	—	16	1488	19	14	—	21	1651	19
5/16	18	0.7938	0.1331	1515	23	18	22	26	2141	34	25	30	41	2377	34
	24	0.1473	0.1473	1678	26	19	23	29	2821	34	27	34	41	2631	37
3/8	16	0.9525	0.1969	2241	41	31	38	48	3175	61	48	54	68	3493	61
	24	0.2230	0.2230	2540	48	34	43	54	3583	68	48	61	75	3983	68
7/16	14	1.1112	0.2700	3085	68	48	61	75	4332	95	75	85	109	4822	95
	20	0.3015	0.3015	3425	75	68	68	81	4854	109	81	95	122	5384	102
1/2	13	1.2700	0.3604	4105	102	75	92	115	5783	149	109	130	163	6437	149
	20	0.4061	0.4061	4854	122	88	108	136	6532	163	122	148	183	7253	156
9/16	12	1.4288	0.4623	5262	149	109	133	163	7539	204	149	186	224	8256	210
	18	0.5156	0.5156	5874	163	122	148	183	8278	231	176	209	258	9208	224
5/8	11	1.5875	0.5740	6532	204	149	183	224	9231	298	231	244	326	10251	285
	18	0.6502	0.6502	7394	231	176	207	258	10433	326	244	277	359	11612	298
3/4	10	1.9050	0.8484	9662	353	271	325	387	13653	515	380	408	570	15150	495
	16	0.9474	0.9474	10796	407	298	363	448	15241	570	434	456	631	16919	542
7/8	9	2.2225	1.1735	13336	583	434	523	644	18870	814	624	658	895	20956	793
	14	1.2929	1.2929	14697	637	475	576	705	20775	895	678	724	983	23088	861
1	8	2.5400	1.5392	17509	868	651	785	915	23360	1220	922	931	1342	27488	1173
	12	1.6840	1.6840	19142	949	719	858	997	27080	1356	1003	1079	1492	30074	1241
1-1/8	7	2.8575	1.9380	19187	1085	814	968	1139	31162	1736	1302	1396	1898	34610	1681
	12	2.1742	2.1742	21546	1193	895	1087	1254	34927	1953	1464	1566	2136	38828	1871
1-1/4	7	3.1750	2.4613	24404	1519	1139	1368	1593	38554	2468	1844	1970	2712	43954	2373
	12	2.7254	2.7254	27035	1681	1247	1516	1762	43818	2712	2034	2183	2983	48671	2549
1-1/2	6	3.4925	2.9337	29076	1980	1492	1792	2068	47174	3227	2413	2586	3559	52391	3145
	12	3.3401	3.3401	33113	2278	1708	2042	2373	53570	3688	2766	2935	4068	59648	3308
1-1/2	6	3.8100	3.5687	35381	2630	1980	2379	2746	57380	4284	3200	3430	4712	63731	4122
	12	4.0132	4.0132	39781	2983	2224	2676	3118	142200	4827	3607	3856	5322	71669	4433

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



SAE GRADE 5



SAE GRADE 8

Figure 1-3. Torque Chart



## SECTION 2. GENERAL

### 2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

#### General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service.

#### Preparation, Inspection, and Maintenance

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

#### Pre-Start Inspection

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

#### Pre-Delivery Inspection and Frequent Inspection

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

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

increased as environment, severity and frequency of usage requires.

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

#### Annual Machine Inspection

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

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

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

#### Preventative Maintenance

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

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



**Table 2-1. Inspection and Maintenance**

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

## 2.2 SERVICE AND GUIDELINES

### General

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

### Safety and Workmanship

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

### Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.

2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.
3. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

### Components Removal and Installation

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



### **Component Disassembly and Reassembly**

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

### **Pressure-Fit Parts**

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

### **Bearings**

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

### **Gaskets**

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

### **Bolt Usage and Torque Application**

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.

2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.)

### **Hydraulic Lines and Electrical Wiring**

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

### **Hydraulic System**

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

### **Lubrication**

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

### **Battery**

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

### **Lubrication and Servicing**

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



### 2.3 LUBRICATION AND INFORMATION

#### Hydraulic System

---

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

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

#### Hydraulic Oil

---

1. Refer to Section 1 for recommendations for viscosity ranges.
2. JLG recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

**NOTE:** Start-up of hydraulic system with oil temperatures below -15 degrees F (-26 degrees C) is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -15 degrees F (-26 degrees C).

3. The only exception to the above is to drain and fill the system with Mobil DTE 13 oil or its equivalent. This will allow start up at temperatures down to -20 degrees F (-29 degrees C). However, use of this oil will give poor performance at temperatures above 120 degrees F (49 degrees C). Systems using DTE 13 oil should not be operated at temperatures above 200 degrees F (94 degrees C) under any condition.

#### Changing Hydraulic Oil

---

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

#### Lubrication Specifications

---

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



## 2.4 CYLINDER DRIFT TEST

Maximum acceptable cylinder drift is to be measured using the following methods.

### Platform Drift

Measure the drift of the platform to the ground. Lower booms (if equipped) slightly elevated, upper boom fully extended with the rated load in the platform and power off. Maximum allowable drift is 2 inches (5 cm) in 10 minutes. If the machine does not pass this test, proceed with the following.

### Cylinder Drift

Table 2-2. Cylinder Drift

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

Drift is to be measured at the cylinder rod with a calibrated dial indicator. The cylinder oil must be at ambient temperature and temperature stabilized.

The cylinder must have the normal load, which is the normal platform load applied.

If the cylinder passes this test, it is acceptable.

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

## 2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

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



## SECTION 2 - GENERAL

**Table 2-3. Inspection and Preventive Maintenance Schedule**

AREA	INTERVAL					
	Pre-Start <sup>1</sup> Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery <sup>2</sup> or Frequent <sup>3</sup> Inspection	Annual <sup>4</sup> (Yearly) Inspection	Every 2 Years
<b>Boom Assembly</b>	9					
Boom Weldments				1,2,4	1,2,4	
Hose/Cable Carrier Installations				1,2,9,12	1,2,9,12	
Pivot Pins and Pin Retainers				1,2	1,2	
Sheaves, Sheave Pins				1,2	1,2	
Bearings				1,2	1,2	
Wear Pads				1,2	1,2	
Covers or Shields				1,2	1,2	
Extend/Retract Chain or Cable Systems				1,2,3	1,2,3	
<b>Platform Assembly</b>	9					
Platform	1,2				1,2	
Railing	1,2			1	1,2	
Gate			5	1	1,5	
Floor	1,2			1	1,2	
Rotator		9,5				
Lanyard Anchorage Point	2			1,2,10	1,2,10	
<b>Turntable Assembly</b>	9					
Swing Bearing or Worm Gear				1,2,14	1,2,3,13,14	
Oil Coupling		9				
Swing Drive System				1,2,14	1,2,3,13,14	
Turntable Lock				1,2,5	1,2,5	
Hood, Hood Props, Hood Latches				5	1,2,5	
<b>Chassis Assembly</b>	9					
Drive Motors				1,2	1,2	
Torque Hubs				11	11	
<b>Functions/Controls</b>	9					
Platform Controls	5	5		6	6	
Ground Controls	5	5		6	6	
Function Control Locks, Guards, or Detents	1,5	1,5		5	5	
Footswitch	1,5			5	5	
Emergency Stop Switches (Ground & Platform)	5			5	5	
Function Limit or Cutout Switch Systems				5	5	
Capacity Indicator					5	
Drive Brakes				5		



Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start <sup>1</sup> Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery <sup>2</sup> or Frequent <sup>3</sup> Inspection	Annual <sup>4</sup> (Yearly) Inspection	Every 2 Years
Swing Brakes				5		
Boom Synchronization/Sequencing Systems					5	
Manual Descent or Auxiliary Power				5	5	
<b>Power System</b>	9					
Engine Idle, Throttle, and RPM				3	3	
Engine Fluids (Oil, Coolant, Fuel)	11	9,11		11	11	
Air/Fuel Filter		1,7		7	7	
Exhaust System			1,9	9	9	
Batteries	5	1,9			19	
Battery Fluid		11		11	11	
Battery Charger		5			5	
Fuel Reservoir, Cap, and Breather	11,9		2	1,5	1,5	
<b>Hydraulic/Electric System</b>	9					
Hydraulic Pumps		1,9		1,2,9		
Hydraulic Cylinders		1,9,7	2	1,2,9	1,2,9	
Cylinder Attachment Pins and Pin Retainers		1,9		1,2	1,2	
Hydraulic Hoses, Lines, and Fittings		1,9	12	1,2,9,12	1,2,9,12	
Hydraulic Reservoir, Cap, and Breather	11	1,9	2	1,5	1,5	24
Hydraulic Filter		1,9		7	7	
Hydraulic Fluid	11			7,11	7,11	
Electrical Connections		1		20	20	
Instruments, Gauges, Switches, Lights, Horn		1			5,23	
<b>General</b>						
Operators and Safety Manuals in Storage Box	21			21	21	
ANSI and EMI Manuals/Handbooks Installed					21	
Capacity Decals Installed, Secure, Legible	21			21	21	
All Decals/Placards Installed, Secure, Legible	21			21	21	
Walk-Around Inspection Performed	21					
Annual Machine Inspection Due				21		
No Unauthorized Modifications or Additions				21	21	
All Relevant Safety Publications Incorporated				21	21	
General Structural Condition and Welds				2,4	2,4	
All Fasteners, Pins, Shields, and Covers				1,2	1,2	
Grease and Lubricate to Specifications				22	22	



## SECTION 2 - GENERAL

**Table 2-3. Inspection and Preventive Maintenance Schedule**

AREA	INTERVAL					
	Pre-Start <sup>1</sup> Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery <sup>2</sup> or Frequent <sup>3</sup> Inspection	Annual <sup>4</sup> (Yearly) Inspection	Every 2 Years
Function Test of All Systems	21			21	21, 22	
Paint and Appearance				7	7	
Stamp Inspection Date on Frame					22	
Notify JLG of Machine Ownership					22	
Footnotes: <sup>1</sup> Prior to use each day; or at each Operator change <sup>2</sup> Prior to each sale, lease, or delivery <sup>3</sup> In service for 3 months or 150 Hours; or Out of service for 3 months or more; or Purchased used <sup>4</sup> Annually, no later than 13 months from the date of the prior inspection						
Performance Codes: 1 - Check for proper and secure installation 2 - Visual inspection for damage, cracks, distortion or excessive wear 3 - Check for proper adjustment 4 - Check for cracked or broken welds 5 - Operates Properly 6 - Returns to neutral or "off" position when released 7 - Clean and free of debris 8 - Interlocks function properly 9 - Check for signs of leakage 10 - Decals installed and legible 11 - Check for proper fluid level 12 - Check for chafing and proper routing 13 - Check for proper tolerances 14 - Properly lubricated 15 - Torqued to proper specification 16 - No gouges, excessive wear, or cords showing 17 - Properly inflated and seated around rim 18 - Proper and authorized components 19 - Fully charged 20 - No loose connections, corrosion, or abrasions 21 - Verify 22 - Perform 23 - Sealed Properly 24 - Drain, Clean, Refill						



## SECTION 3. TURNTABLE

### 3.1 TILT ALARM SWITCH

#### **⚠ CAUTION**

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

#### Manual Adjustment

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

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

2. Level the base of the indicator by tightening the three flange nuts through approximately one quarter of its spring travel. DO NOT ADJUST THE "X" NUT DURING THE REMAINDER OF THE PROCEDURE.
3. With the electrical connections complete, using bubble level on top of indicator, slowly tighten or loosen the three flange nuts until indicator is level.
4. Individually push down on one corner at a time; there should be enough travel to cause the switch to trip. If the switch does not trip in all three tests, the flange nuts have been tightened too far. Loosen the "X" nut and repeat steps (2). through (4).

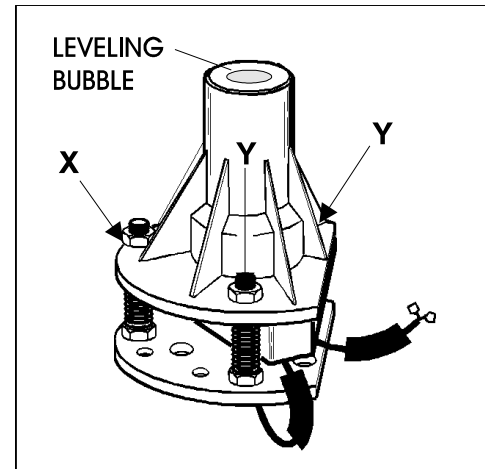


Figure 3-1. Tilt Switch Adjustment



### 3.2 THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ

#### General

The throttle control system on the Deutz engine includes the positional controller and the actuator.

Four LEDs are incorporated in the controller. They are as follows:

- Red - failure: signals a problem with the system - needs service or adjustment
- Green - clutch engaged; operation normal while system is powered.
- Amber - motor extend
- Amber - motor retract

The controller is designed so that when the system voltage reaches 10.5 volts, the actuator clutch will be released and the motor drive turned off in order to prevent unpredictable operation from occurring.

When a failure condition occurs (i.e. position time-out) the controller will release the clutch and turn off the actuator motor. This will prevent unnecessary motor wear.

**Table 3-1. Position Controller Truth Table**

Control Wiring				Actuator Position
Black	Red	White	Green	
GND	OFF	X	X	OFF POSITION (Freewheel)
GND	+12 VDC	OFF	OFF	POSITION 1 (See Adjustments)
GND	+12 VDC	+12 VDC	OFF	POSITION 2 (See Adjustments)
GND	+12 VDC	OFF	+12 VDC	POSITION 3 (See Adjustments)
GND	+12 VDC	+12 VDC	+12 VDC	POSITION 4 (See Adjustments)

GND = POWER SUPPLY OR BATTERY GROUND

OFF = GROUND OR OPEN CIRCUIT

X = DON'T CARE

+12 VDC = +12 VOLT POWER SUPPLY OR BATTERY SYSTEM, VIA A 5 AMP FUSE OR CIRCUIT BREAKER

#### TRIMMER ADJUSTMENTS

- 1 - POSITION 1 CW=RETRACT
- 2 - POSITION 2 CW=RETRACT
- 3 - POSITION 3 CW=RETRACT
- 4 - POSITION 4 CW=RETRACT

#### LED INDICATORS

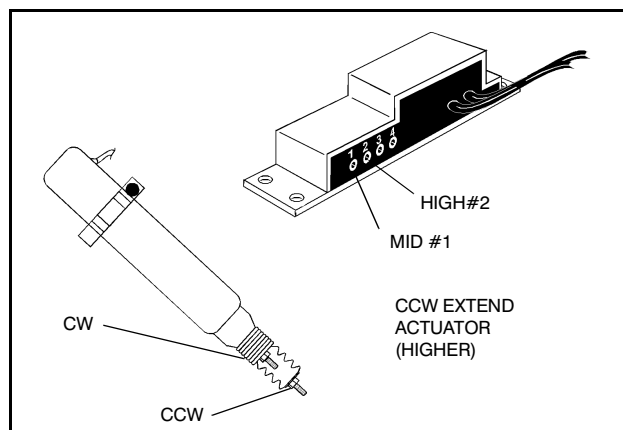
- R - RETRACT INDICATOR (AMBER)  
 E - EXTEND INDICATOR (AMBER)  
 C - CLUTCH INDICATOR (GREEN)  
 F - FAILURE INDICATOR (RED)

#### Procedure

**NOTE:** Never run fuel tank dry. Diesel engines cannot be restarted after running out of fuel until fuel system has been air-vented or bled of air. See Deutz Instruction Manual for procedure.

1. Power the ignition switch at the ground control panel. Set the mid rpm.
2. Supply 12 volts of power to the white wire on the controller. Set the high engine rpm.

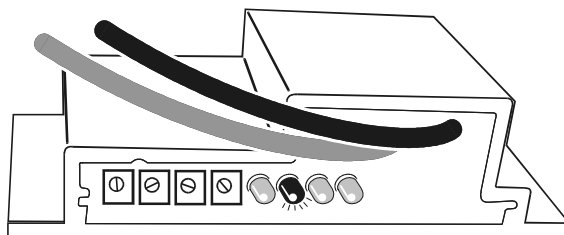
**NOTE:** Actuator rod travel must stop slightly before lever makes contact with throttle lever stop. Failure to do so will burn out actuator.



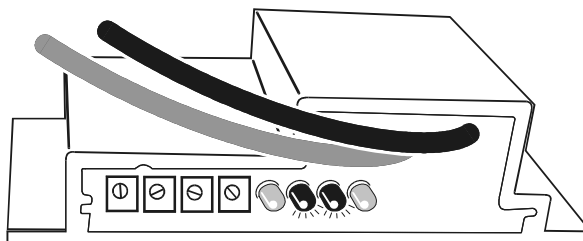
**Figure 3-2. Addco Adjustments**

#### Controller Status

Clutch engaged no actuator movement

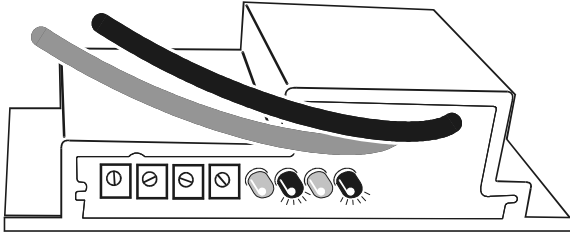


Clutch engaged actuator extending

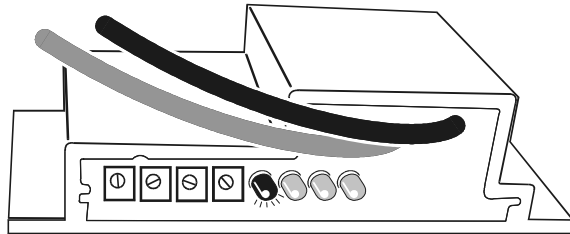




Clutch engaged actuator retracting

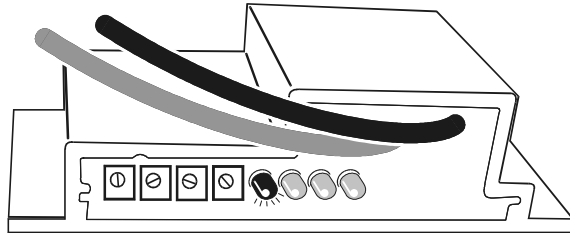


Controller fault - clutch disengaged and no actuator movement



### Failure Modes

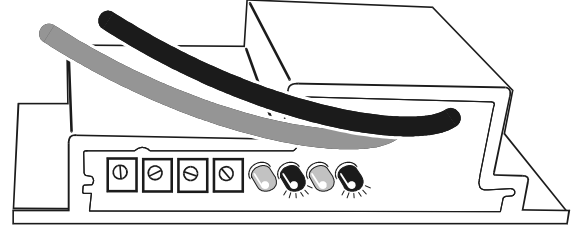
Immediate Red Light



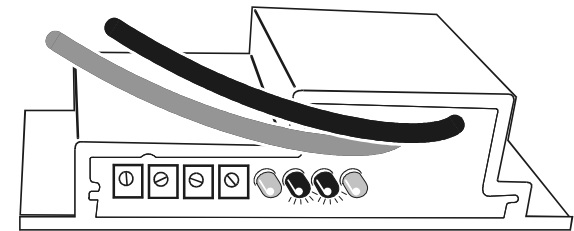
Action:

1. Recycle power to determine if the problem is intermittent.
2. The input voltage must be greater than 10.5 Vdc.
3. Check wiring for any damage and correct.
4. Disconnect engine harness and actuator connections.
5. If problem reoccurs return unit.

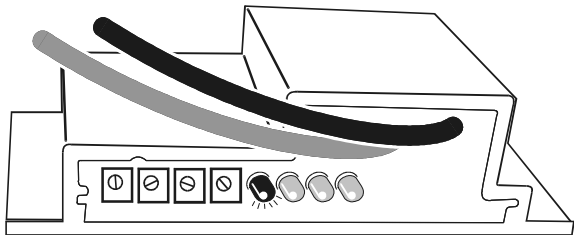
Green and either Amber light followed by a red light



or



then



Action:

1. Inspect and clean wiring connections.
2. Examine throttle linkage for any damage or bent components and correct.
3. With linkage disconnected, check each potentiometer for operation.
4. Reconnect linkage and reset each potentiometer for correct operation.
5. If failure continues to occur, replace unit.



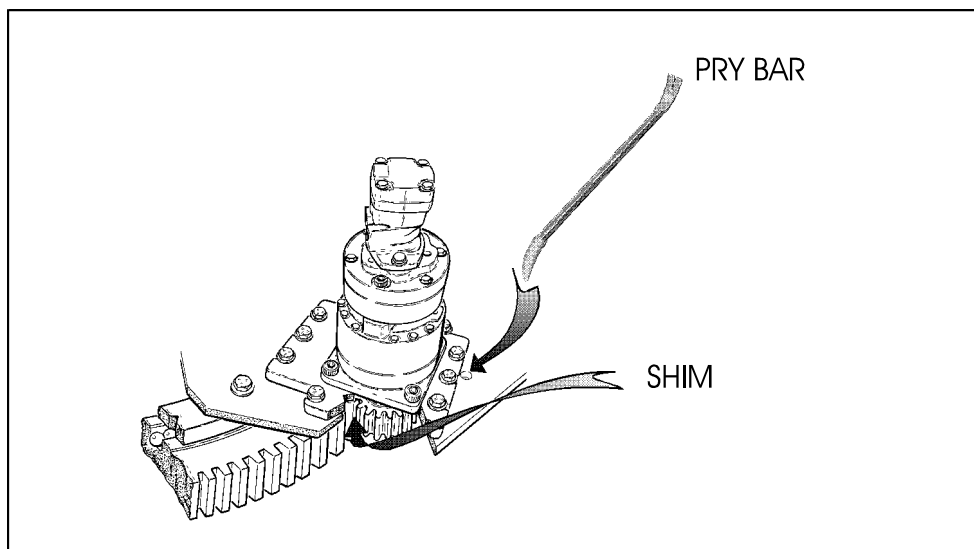
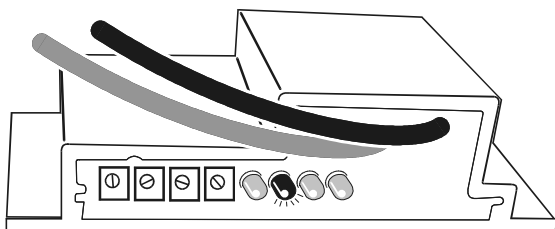


Figure 3-3. Swing Torque Hub Adjustment

Only green light on and no actuator movement



Action:

1. Adjust trim potentiometers.
2. If problem continues, replace unit.

### 3.3 SWING HUB

#### Adjustment Procedures

1. Ensure swing drive is located on bearing gear max eccentric tooth (high spot).
2. With mounting free to slide, shim between pinion and bearing gear teeth to achieve 0.008 - 0.012" (0.203 - 0.304 mm) backlash.
3. Install a pry bar into hole in turntable base plate and pry swing hub back tight against shim and bearing.
4. Torque bolts according to the torque chart in Section 1.

### 3.4 SWING BEARING

#### Turntable Bearing Mounting Bolt Condition Check

**NOTE:** This check is designed to replace the existing bearing bolt torque checks on JLG Lifts in service. This check must be performed after the first 50 hours of machine operation and every 600 hours of machine operation thereafter. If during this check any bolts are found to be missing or loose, replace missing or loose bolts with new bolts and torque to the value specified in the torque chart, after lubricating the bolt threads with loctite #271. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.

1. Check the frame to bearing. Attach bolts as follows:
  - a. Elevate the fully retracted boom to 70 degrees (full elevation).
  - b. At the positions indicated on Figure 3-4. try and insert the .0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
  - c. Assure that the .0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
  - d. Swing the turntable 90 degrees, and check some selected bolts at the new position.
  - e. Continue rotating the turntable at 90 degree intervals until a sampling of bolts have been checked in all quadrants.



2. Check the turntable to bearing. Attach bolts as follows:
  - a. Elevate the fully retracted boom to 70 degrees (full elevation).
  - b. At the positions indicated on Figure 3-4. try and insert the .0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
  - c. Lower the boom to horizontal and fully extend the boom.
  - d. At the position indicated on Figure 3-4. try and insert the .0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

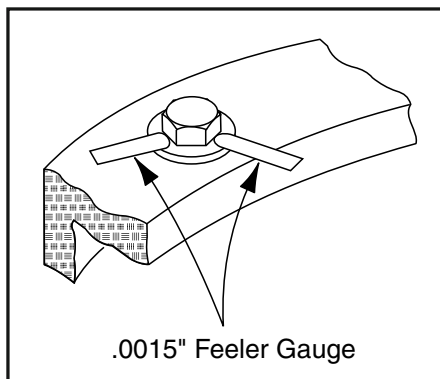


Figure 3-4. Swing Bearing Bolt Feeler Gauge Check

### Wear Tolerance

1. From the underside of the machine, at rear center, with the boom fully elevated and fully retracted, as shown in A, Figure 3-6., Swing Bearing Tolerance Boom Placement, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-5., Swing Bearing Tolerance Measuring Point.)
2. At the same point, with the boom at horizontal and fully extended, and the tower boom fully elevated as shown in (Figure 3-6., Swing Bearing Tolerance Boom Placement) B, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-5., Swing Bearing Tolerance Measuring Point.)
3. If a difference greater than 0.057 in. (1.40 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.057 in. (1.40 mm) is determined, and any of the following conditions exist, the bearing should be removed, disassembled, and inspected for the following:
  - a. Metal particles in the grease.
  - b. Increased drive power required.

- c. Noise.
  - d. Rough rotation.
5. If bearing inspection shows no defects, reassemble and return to service.

### IMPORTANT

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

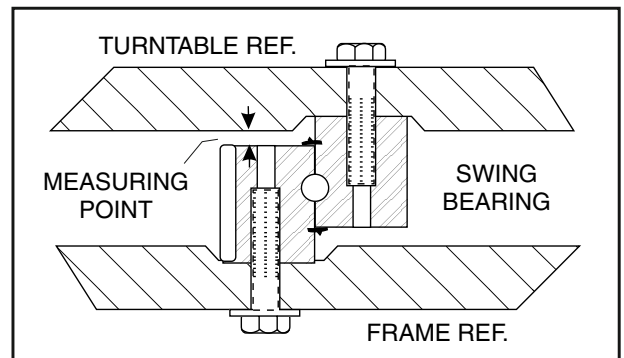


Figure 3-5. Swing Bearing Tolerance Measuring Point

### Swing Bearing Replacement

1. Removal.
  - a. From Ground Control station, operate the boom adequately to provide access to frame opening or, if equipped, to rotary coupling.

### ⚠ WARNING

NEVER WORK BENEATH THE BOOM WITHOUT FIRST ENGAGING BOOM SAFETY PROP OR PROVIDING ADEQUATE OVERHEAD SLING SUPPORT AND/OR BLOCKING.

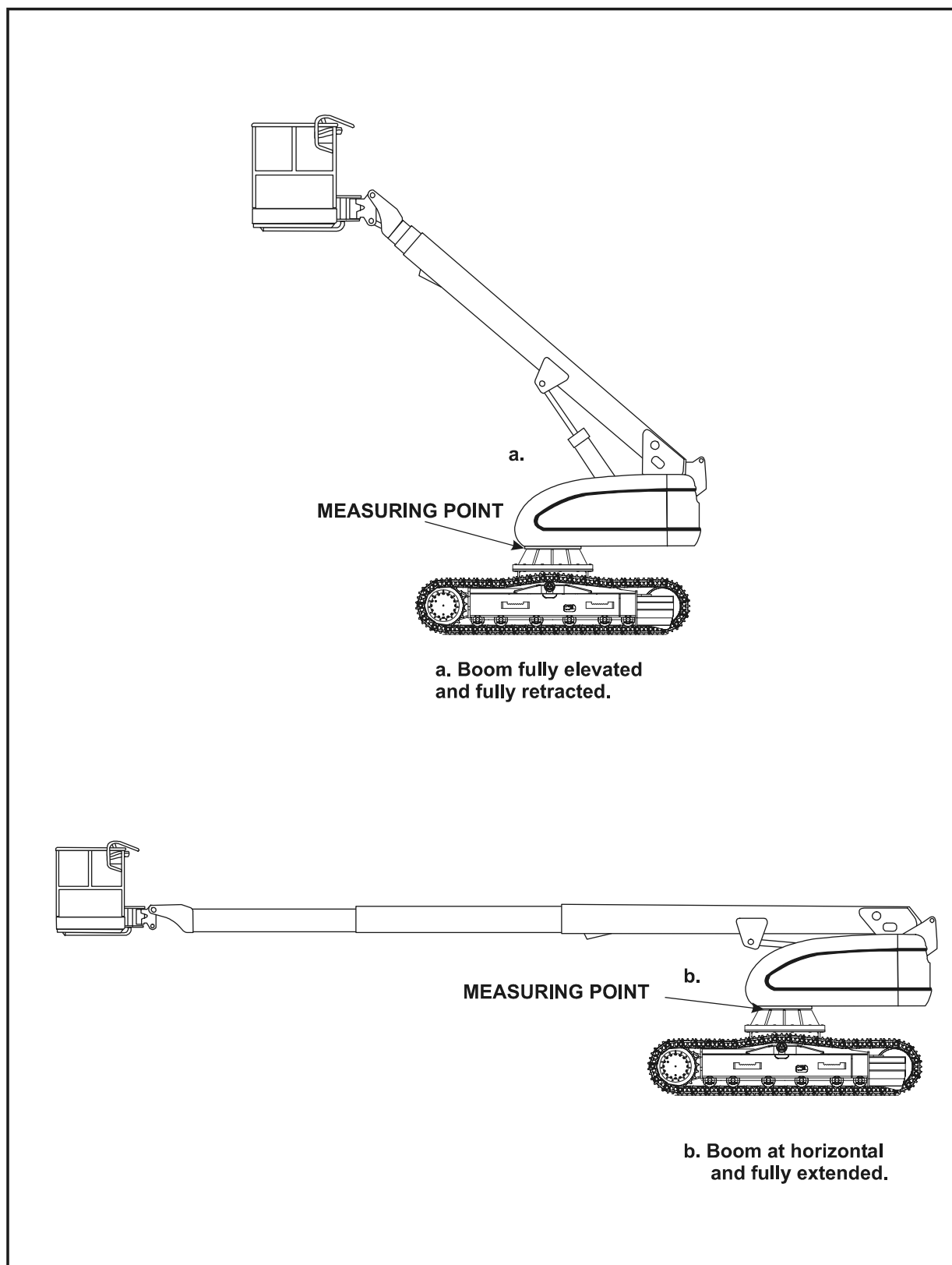
- b. Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.
  - c. From inside turntable, remove mounting hardware which attach rotary coupling retaining yoke brackets to turntable.

### IMPORTANT

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

- d. Tag and disconnect the hydraulic lines from the fittings on the top of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.





**Figure 3-6. Swing Bearing Tolerance Boom Placement**



- e. Attach suitable overhead lifting equipment to the base of the turntable weldment.
  - f. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the turntable to the bearing inner race. Discard the bolts.
  - g. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame-mounted components.
  - h. Carefully place the turntable on a suitably supported trestle.
  - i. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing from the frame, then move the bearing to a clean, suitably supported work area.
2. Installation.
- a. Using suitable lifting equipment, carefully lower the swing bearing into position on the frame. Ensure the scribed line of the outer race of the bearing aligns with the scribed line on the frame. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the frame.

**⚠ CAUTION**

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

- b. Apply a light coating of Loctite #271 to the new bearing bolts, and loosely install the bolts and washers through the frame and outer race of bearing.

**⚠ CAUTION**

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

- c. Refer to the Torque Sequence diagram as shown in Figure 3-7., Swing Bearing Torque

Sequence. Spray a light coat of Safety Solvent 13 on the new bearing bolts. Then apply a light coating of Loctite #271 to the new bearing bolts, and install the bolts and washers through the frame and outer race of the bearing. Tighten the bolts to an initial torque of 240 FT. LBS. (326 Nm) w/Loctite.

- d. Remove the lifting equipment from the bearing.
- e. Using suitable lifting equipment, carefully position the turntable assembly above the machine frame.
- f. Carefully lower the turntable onto the swing bearing, ensuring that the scribed line of the inner race of the bearing aligns with scribed line on the turntable. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the turntable.
- g. Spray a light coat of Safety Solvent 13 on the new bearing bolts. Then apply a light coating of Loctite #271 to the new bearing bolts, and install the bolts and washers through the turntable and inner race of the bearing.
- h. Following the Torque Sequence diagram shown in Figure 3-7., Swing Bearing Torque Sequence, tighten the bolts to a torque of 240 ft. lbs. (326 Nm) w/Loctite.
- i. Remove the lifting equipment.
- j. Install the rotary coupling retaining yoke brackets, apply a light coating of Loctite #242 to the attaching bolts and secure the yoke to the turntable with the mounting hardware.
- k. Connect the hydraulic lines to the rotary coupling as tagged prior to removal.
- l. At ground control station, use boom lift control to lower boom to stowed position.
- m. Using all applicable safety precautions, activate the hydraulic system and check the swing system for proper and safe operation.

**Swing Bearing Torque Values.**

- 1. Outer Race - 240 ft. lbs. (326 Nm) w/Loctite, 220 ft. lbs. (298 Nm) dry.
- 2. Inner Race - 240 ft. lbs. (326 Nm) w/Loctite, 220 ft. lbs. (298 Nm) dry.
- 3. See Swing Bearing Torquing Sequence.

**⚠ WARNING**

**CHECK THE INNER AND OUTER SWING BEARING BOLTS FOR MISSING OR LOOSENESS AFTER FIRST 50 HOURS OF OPERATION, AND EVERY 600 HOURS THEREAFTER.**



### 3.5 SWING BRAKE - MICO

#### Disassembly

1. With shaft protrusion downward, remove end cover (13) by removing capscrews (12).

#### **⚠ CAUTION**

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 2000 POUNDS (881 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENEED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (1362 KG) MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Remove case seal (11) from housing (7) then remove bleeder screw (14) from end cover (52).
3. Remove piston (22) from end cover (13).
4. Remove o-ring (17), back-up ring (16), o-ring (19) and back-up ring (18) from piston (22).
5. Remove separators (10) from housing (52).
6. Remove stack assembly, consisting of discs (21), return plate (8) and friction discs (20) from housing (52).
7. Remove dowel pins (15), springs (5 & 6) from housing (52).
8. Remove retaining ring (3) from housing (52).

9. Remove shaft by pressing or using a soft mallet on male end of shaft (51).
10. Remove retaining ring (54) bearing (2) from shaft (51).
11. Press rotary seal (1) from housing (51).

#### Inspection

1. Clean all parts thoroughly.
2. Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.
3. Discard seals and o-rings.
4. Closely inspect bearings and bearing contact surfaces. Replace as necessary.

**NOTE:** Bearings may be reused if, after thorough inspection, they are found to be in good condition.

#### Assembly

**NOTE:** Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.

1. Press new rotary seal (1) into housing (52). Note the direction of seal.
2. Install new bearing (2) on shaft (51).
3. Install shaft assembly and retaining ring (3) into housing (52).

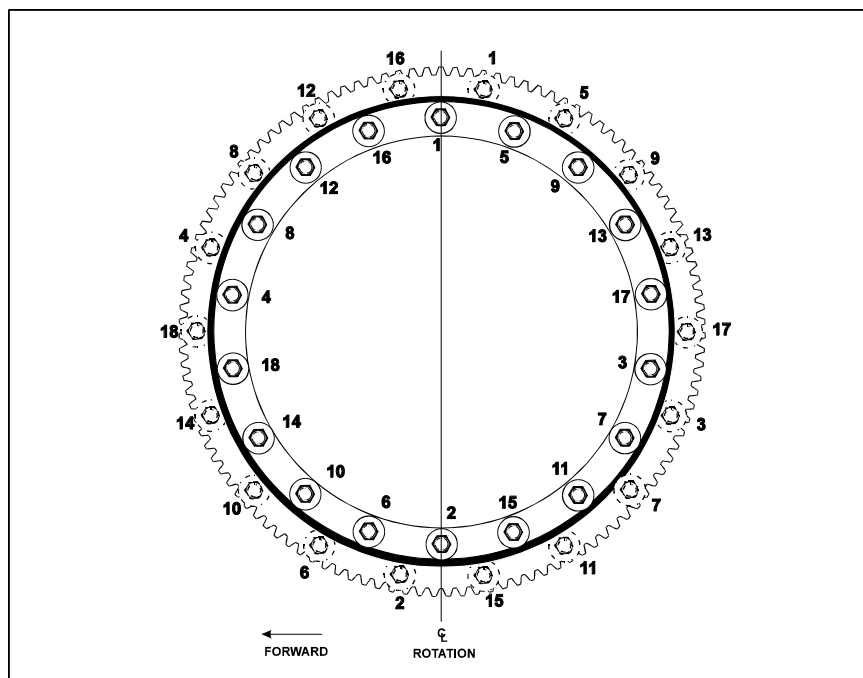


Figure 3-7. Swing Bearing Torque Sequence



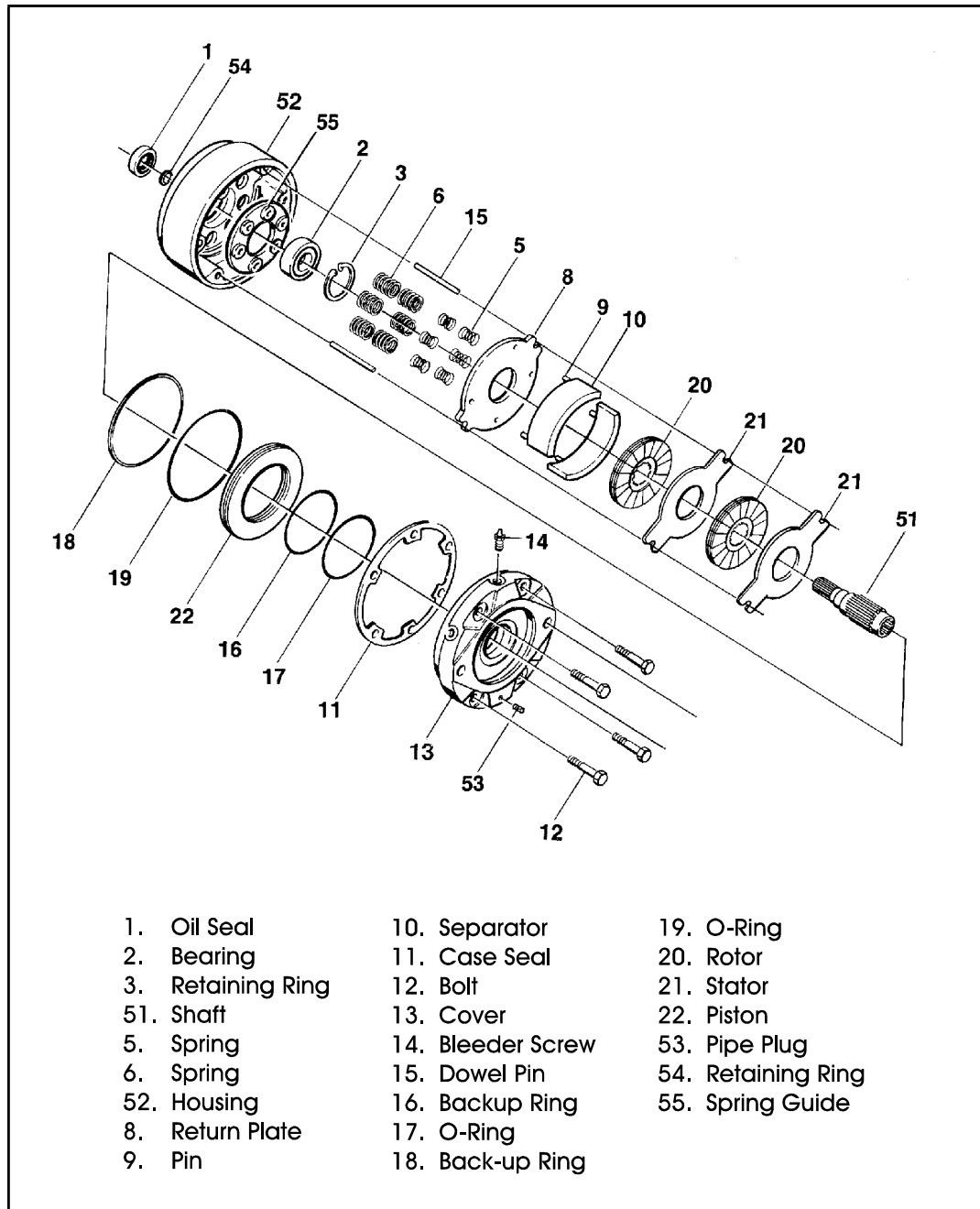


Figure 3-8. Swing Brake Assembly (Mico)



### SECTION 3 - TURNTABLE

---

4. Install dowel pins (15), spring retainer (55), and springs (5 & 6) into housing (52).

**NOTE:** *Be sure to use the same number of springs and spring pattern as recorded during disassembly.*

5. Position new large diameter return plate (8) in housing with tabs guided by dowel pins (15) until disc rests on springs (5 & 6).

**NOTE:** *Discs (21 & 8) and friction discs (20) should remain dry during installation. Oil will contaminate disc surfaces.*

6. Place new disc (20) on shaft (51) until it contacts return plate (8).

7. Add additional discs (21) as required to complete assembly.

8. Insert separators (10) in holes of return plate (8).

9. Install new o-ring (17), new back-up ring (16), new o-ring (19) and new back-up ring (18) on piston (22). Insert piston (22) into end cover (13), being careful not to shear o-rings or back-up rings.

10. Install new case seal (11) in housing (52), then install bleeder screw (14) in end cover.

11. Position end cover (13) on housing (52), aligning dowel pins (15) with holes in end cover.

12. Insert capscrews (12) and tighten evenly to draw end cover (13) to housing (52). Torque capscrews to 55 ft. lbs. (75 Nm).



SECTION 4. BOOM & PLATFORM

4.1 PLATFORM

Platform Sections Replacement

The platform is made up of five sections: floor, right side, left side, back (console box mounting,) and gate. The sections are secured with huck magna grip fastener and collars. Replace damaged platform sections as follows:

1. Support the huck collar with a sledge hammer or other suitable support.
2. Using a hammer and chisel, remove the collar from the fastener as shown in the diagram below.

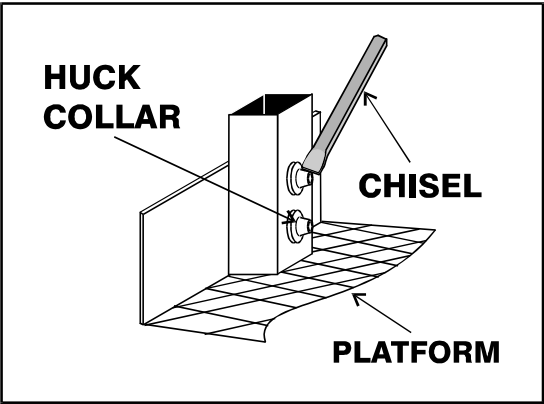


Figure 4-1. Platform Section Replacement

3. When installing new section of platform replace huck fasteners with 1/4 x 20 NC x 2 1/4" grade 5 bolts, flatwashers and locknuts.
4. When installing a new gate to platform, replace rivets with 1/4 x 20 NC x 2 "grade 5 bolts, flatwashers and locknuts.

4.2 BOOM ROPE TORQUING PROCEDURES

Torque Procedures

1. Position boom in fully down and fully retracted position.

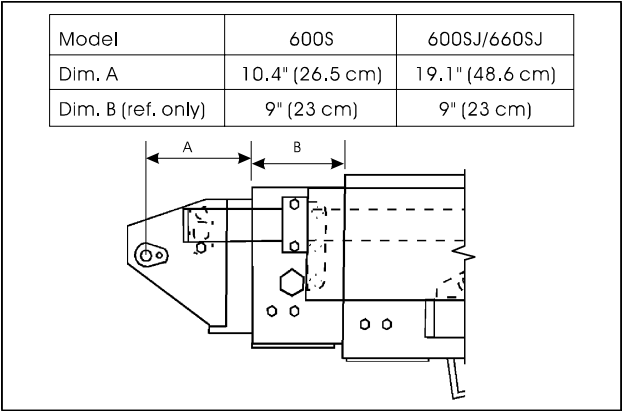


Figure 4-2. Dimensions of Boom Sections

2. Clamp both threaded ends of wire rope to prevent rotation.

**NOTE:** Do not clamp on threads.

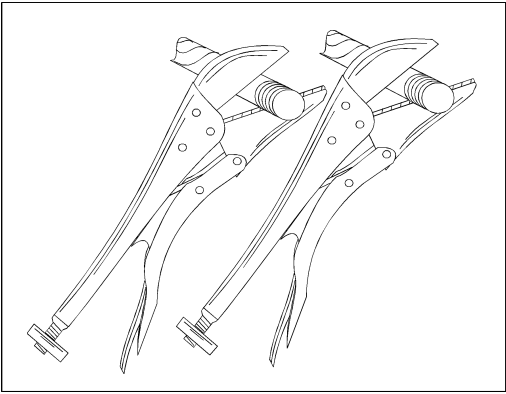


Figure 4-3. Clamping Wire Ropes

3. Install adjusting nuts (or remove nylon collar locknuts if re-adjusting) to both retract and extend wire ropes.
4. Torque retract adjusting nuts (platform end) to 15 ft. lbs. (20 Nm) alternating between the two wire ropes and keeping approximately the same amount of thread beyond the adjusting nut.

**NOTE:** Do not allow wire rope to rotate. This may damage the wire rope.



## SECTION 4 - BOOM & PLATFORM

5. Repeat the torque procedure in step #4 to the extend wire ropes (turntable end).
6. Extend the boom 2 - 3 feet using the telescope function. Repeat step #4.
7. Retract the boom 1 - 2 feet using the telescope function. Do not bottom out telescope cylinder. Repeat step #5.
8. Extend the boom approximately 2 - 3 feet again and check torque on the retract wire ropes.
9. Retract the boom without bottoming out telescope cylinder and check torque on the extend wire ropes.

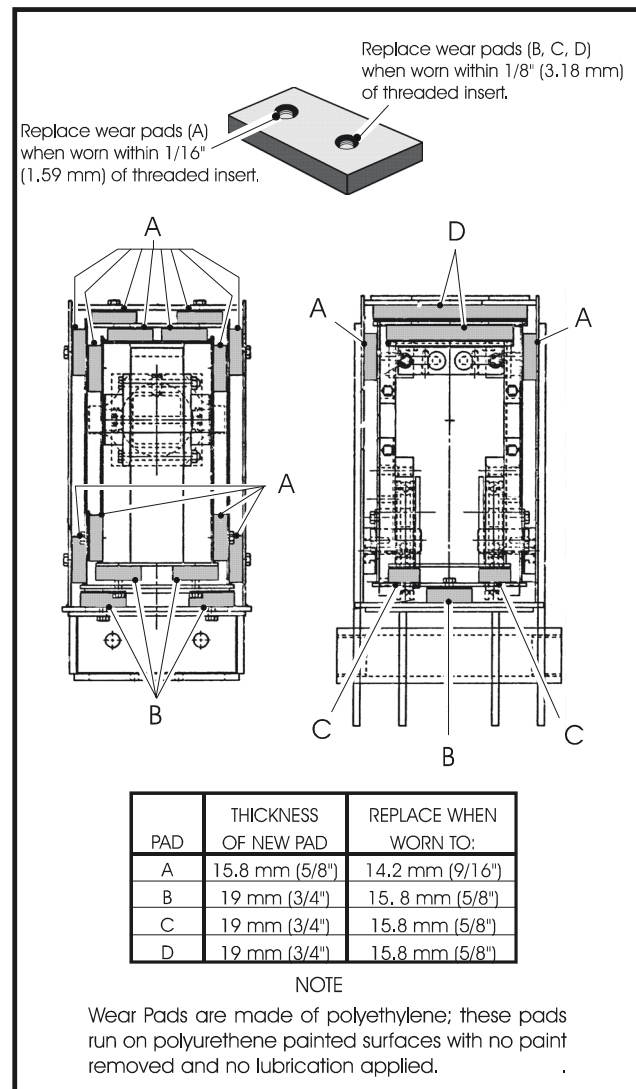
**NOTE:** Step #8 and #9 may need to be repeated to equalize the torque on all 4 wire ropes.

10. After all wire ropes have been properly torqued, install nylon collar locknuts. Remove all clamping devices and install all covers and guards. Check the boom for proper function.

### 4.3 WEAR PADS

#### Main Boom

1. Shim up wear pads to within 1/32 inch (.79 mm) tolerance between wear pad and adjacent surface.
2. Replace wear pads when worn within 1/16 inch (1.59 mm) and 1/8 inch (3.18 mm) - B, C, D of threaded insert. See Location and Thickness Of Wear Pads.
3. Adjusting wear pads, removing or adding shims, bolt length must also be changed.
  - a. When adding shims, longer bolts must be used to ensure proper thread engagement in insert.
  - b. When shims are removed, shorter bolts must be used so bolt does not protrude from insert and come into contact with boom surface.



**Figure 4-4. Location and Thickness of Wear Pads**



## 4.4 WIRE ROPE

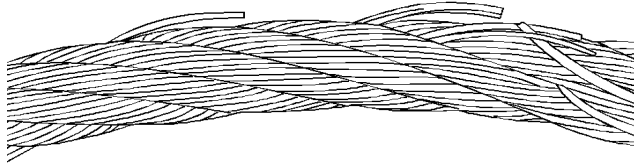
Each day before using the machine:

1. Raise the main boom to approximately horizontal.
2. Extend and retract the boom sections.
3. Check for delayed movement of the fly section, which indicates loose wire ropes.

### Inspection

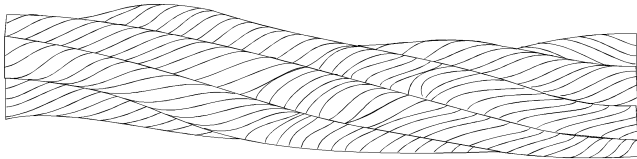
**NOTE:** The pictures in this paragraph are just samples to show the replacement criteria of the rope.

1. Inspect ropes for broken wires, particularly valley wire breaks and breaks at end terminations.



**Flexing a wire rope can often expose broken wires hidden in valleys between strands.**

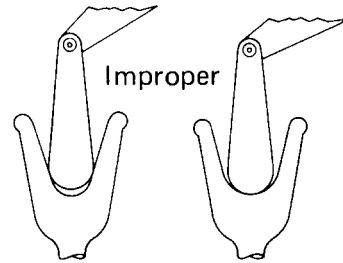
2. Inspect ropes for corrosion.
3. Inspect ropes for kinks or abuse.



**A kink is caused by pulling down a loop in a slack line during improper handling, installation, or operation.**

4. Inspect sheaves for condition of bearings/pins. (See Dimension Of Sheaves for proper dimension.)
5. Inspect sheaves for condition of flanges. (See Dimension Of Sheaves for proper dimension.)

6. Inspect sheaves with a groove wearout gauge for excessive wear.



**Observe the groove so that it may be clearly seen whether the contour of the gauge matches the contour of the bottom of the groove.**

7. Ropes passing inspection should be lubricated with wire rope lubricant before reassembly.

### Three Month Inspection

1. Remove boom covers and visually (with flashlight) inspect the ropes for rust, broken wires, frays, abuse, or any signs of abnormalities.
2. Check rope tension by deflecting the ropes by hand...properly tensioned ropes should have little or no movement.

### 12 Year or 7000 Hour Replacement

1. Mandatory wire rope and sheave replacement.

Additional inspection required if:

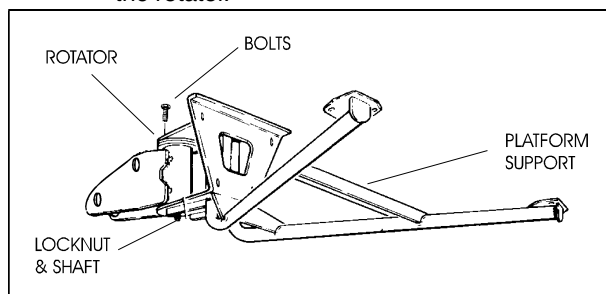
- a. Machine is exposed to hostile environment or conditions.
- b. Erratic boom operation or unusual noise exists.
- c. Machine is idle for an extended period.
- d. Boom is overloaded or sustained a shock load.
- e. Boom exposed to electrical arc...wires may be fused internally.

### Additional Replacement Criteria

1. Sheaves and wire rope must be replaced as sets.
2. Rusted or corroded wire ropes.
3. Kinked, "bird caged", or crushed ropes.
4. Ropes at end of adjustment range.
5. Sheaves failing wearout gage inspection.
6. Ropes with 6 total broken wires in one rope lay, 3 in one strand in one rope lay, 1 valley break, or 1 break at any end termination.

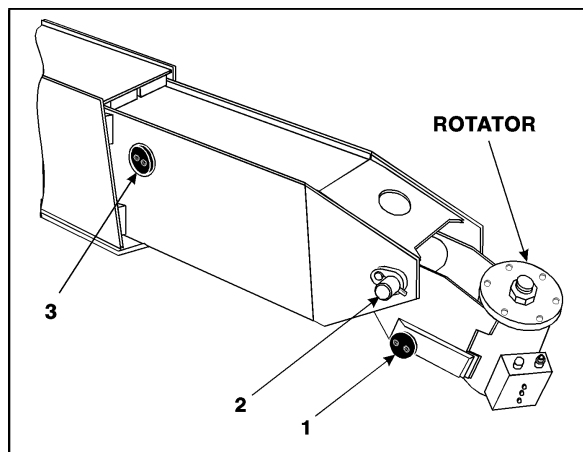


- e. Using a suitable brass drift and hammer, remove the rotator shaft, then remove the support from the rotator.



**Figure 4-5. Location of Components - Platform Support**

2. Remove the rotator and slave level cylinder from the fly boom as follows:
  - a. Tag and disconnect hydraulic lines to rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
  - b. Remove hardware from pin #1. Using a suitable brass drift and hammer remove pin #1 from the fly boom.
  - c. Supporting the rotator, remove the hardware from pin #2. Using a suitable brass drift and hammer, remove pin #2 from the fly boom and remove the rotator.
  - d. Telescope the fly section out approximately 20 inches (50.8 cm) to gain access to the slave leveling cylinder.
  - e. Supporting the slave, cylinder remove the hardware from pin #3. Using a suitable brass drift and hammer remove pin #3 from the fly boom.
  - f. Tag and disconnect hydraulic lines to the slave leveling cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports. Remove the slave cylinder.



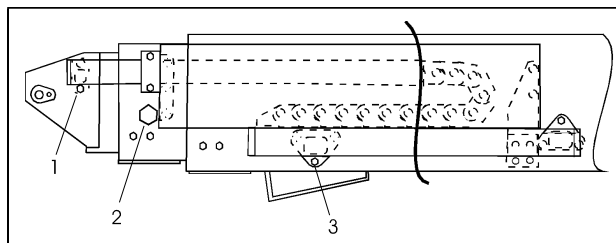
**Figure 4-6. Location of Components - Rotator and Leveling Cylinder**

3. Remove the powertrack from the boom as follows:
  - a. Disconnect wiring harness from ground control box.

### **CAUTION**

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

- b. Tag and disconnect hydraulic lines from boom to control valve. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
- c. Disconnect the dual capacity indicator limit switch from side of boom section.
- d. Remove hydraulic lines and electrical cables from powertrack.
- e. Using a suitable lifting equipment, adequately support powertrack weight along entire length.
- f. Remove bolts #1 securing the push tube on the fly boom section.
- g. Remove bolts #2 securing the push tube on the mid boom section.
- h. With powertrack support and using all applicable safety precautions, remove bolts #3 and #4 securing rail to the base boom section. Remove powertrack from boom section.



**Figure 4-7. Location of Components - Boom Powertrack**

4. Remove boom assembly from machine as follows:
  - a. Using suitable lifting equipment, adequately support boom assembly weight along entire length.

### **CAUTION**

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

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



- c. Remove hardware securing the lift cylinder rod end to the base boom section.
- d. Using a suitable brass drift and hammer, remove the lift cylinder pin from the base boom.
- e. Remove hardware securing the master cylinder rod end to the base boom section.
- f. Using a suitable brass drift and hammer, remove the master cylinder pin from the base boom.
- g. Remove hardware securing the pushbar to the turntable upright.

**⚠ CAUTION**

**WHEN REMOVING PIN FROM PUSHBAR, CARE MUST BE TAKEN NOT TO DROP THE PUSHBAR ONTO THE WIRE ROPE ADJUSTMENT THREADS. FAILURE TO DO SO WILL RESULT IN DAMAGING THREADS.**

- h. Using a suitable brass drift and hammer, remove the push bar pin from the turntable upright.
- i. Remove hardware securing the boom pivot pin to the turntable upright.
- j. Using a suitable brass drift and hammer, remove the pivot pin from the turntable upright.
- k. Using all applicable safety precautions, carefully lift boom assembly clear of turntable and lower to ground or suitably supported work surface.

### Disassembly of Boom Sections

1. Remove hardware securing the push bar to aft end of the telescope cylinder, then remove pin from cylinder.
2. Remove hardware securing the cover plate on the bottom front of the base boom section.

**NOTE:** Do not allow wire rope to rotate. This may damage the wire rope.

3. Clamp both threaded ends of wire rope to prevent rotation.

**NOTE:** Do not clamp on threads. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.

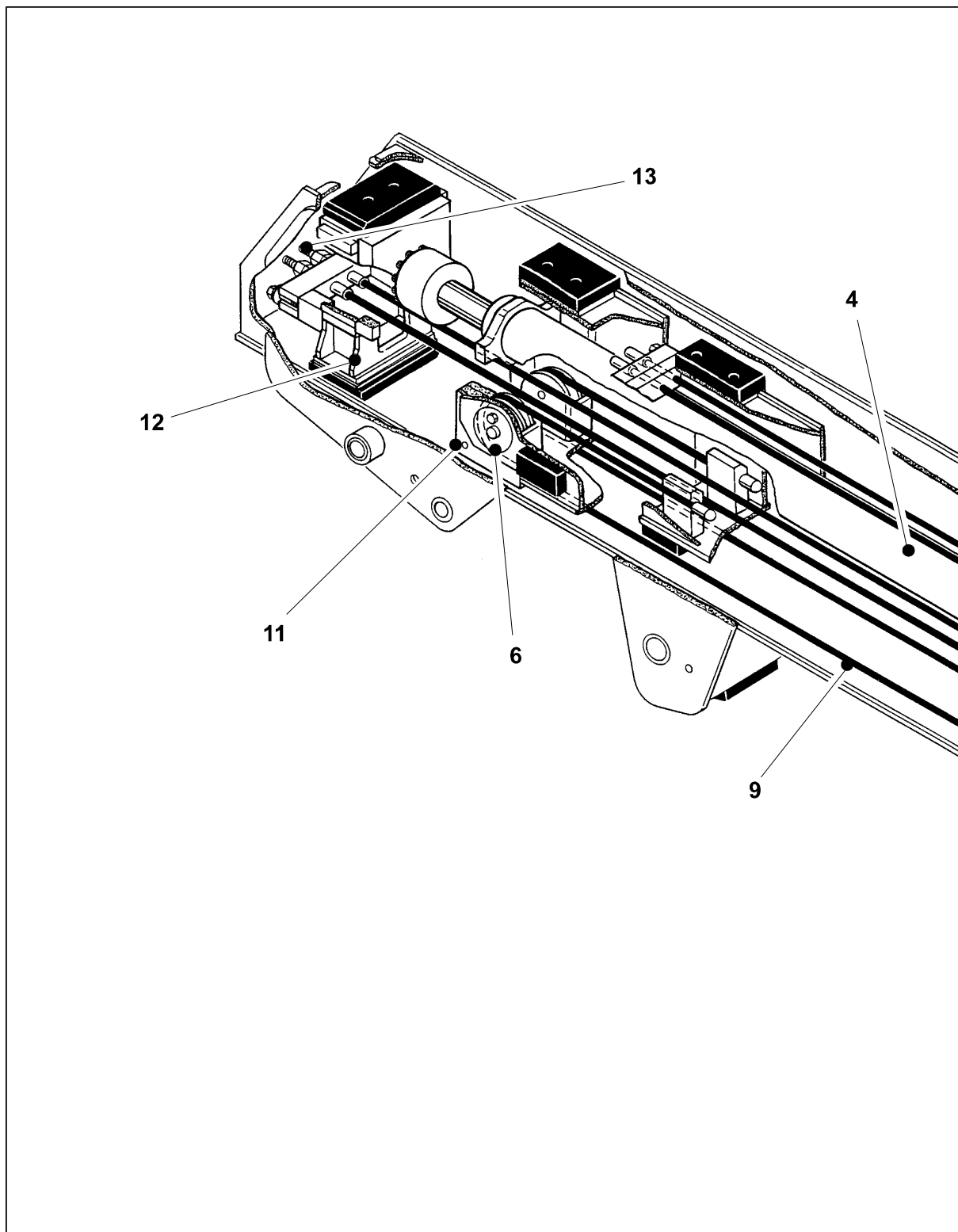
4. Remove hardware securing the wire rope adjustment block to aft end of the base boom section and remove the block.
5. Remove hardware securing the telescope cylinder to aft end of the mid boom section.

**⚠ CAUTION**

**WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY FROM THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.**

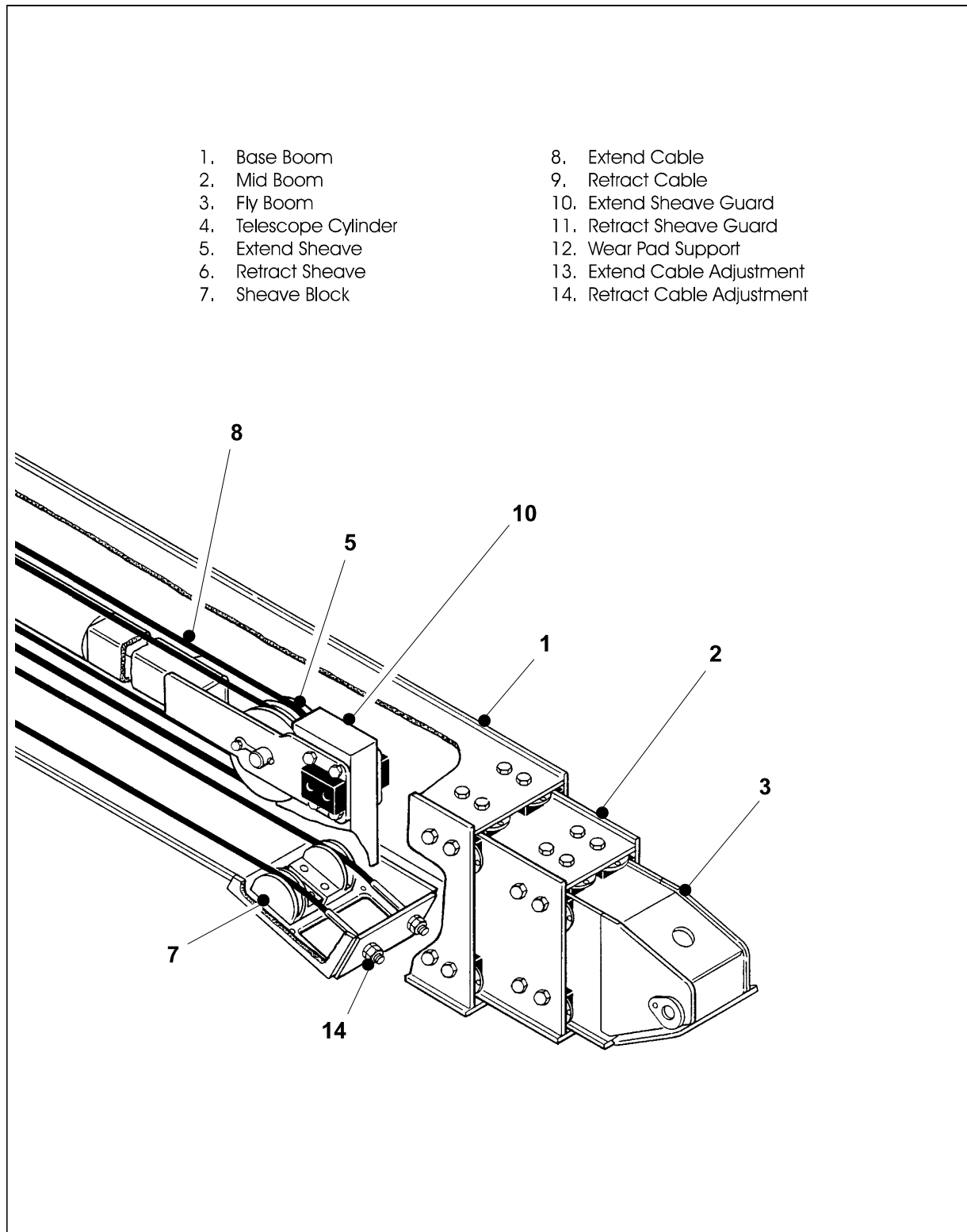
6. Remove bolts securing wire rope attach bar to top of fly boom section.
7. Pull the telescope cylinder and wire ropes partially from aft end of the base boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.





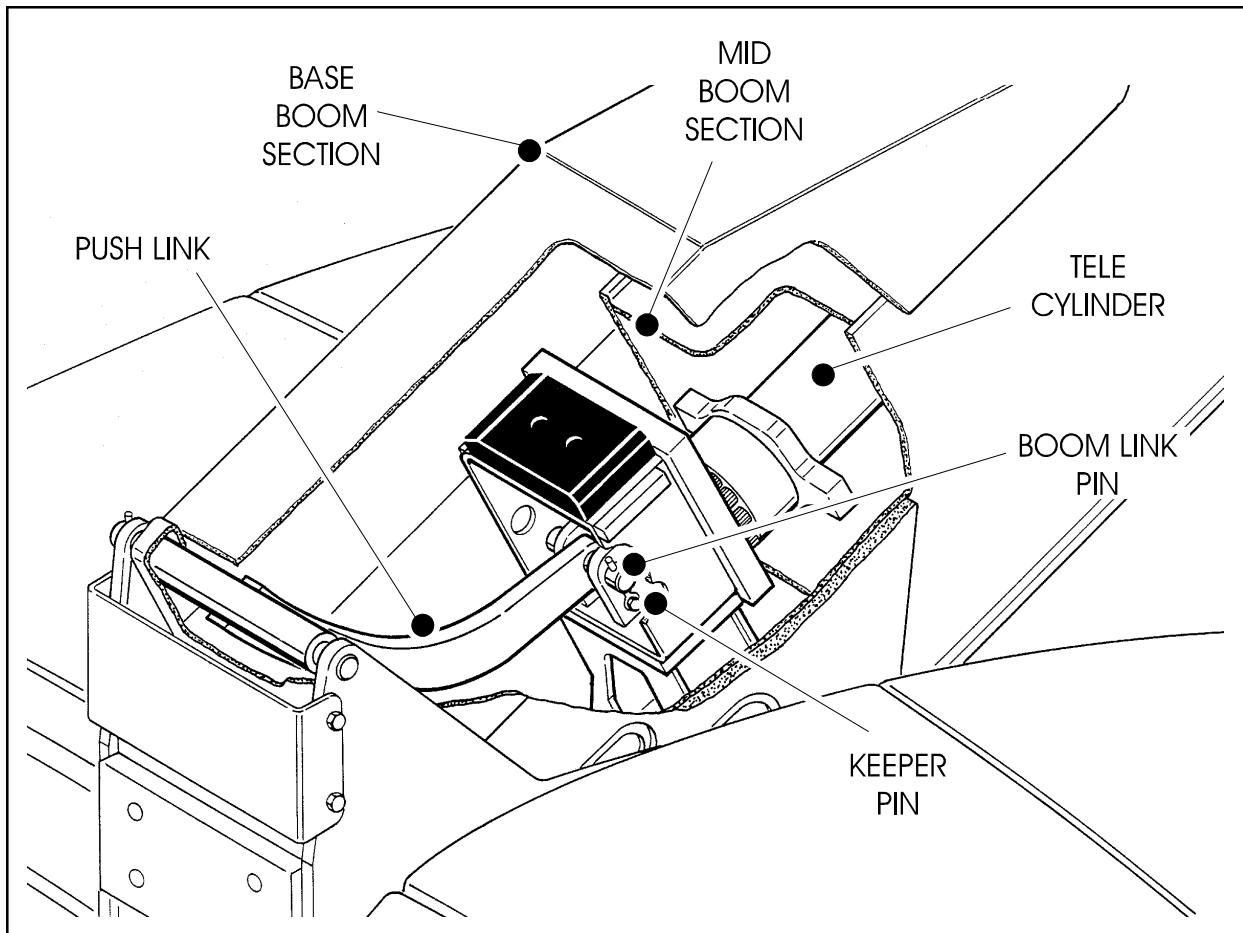
**Figure 4-8. Boom Assembly Cutaway - S Models - Sheet 1 of 3**





**Figure 4-9. Boom Assembly Cutaway - S Models - Sheet 2 of 3**



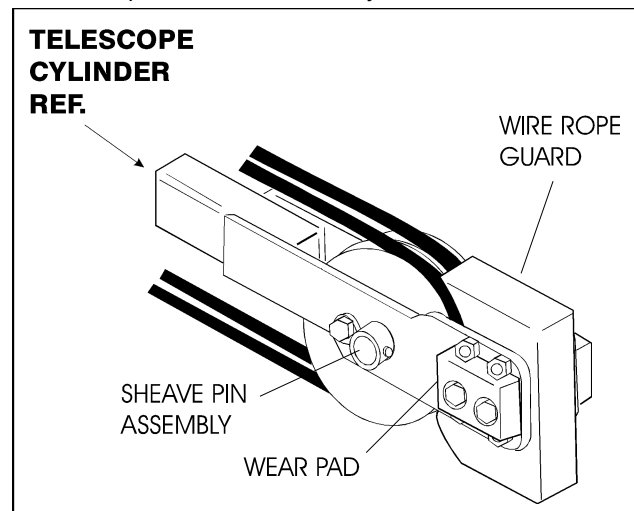


**Figure 4-10. Boom Assembly Cutaway - S Models - Sheet 3 of 3**

8. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.

- a. Remove hardware from the wear pads; remove wear pads from cylinder.
- b. Remove hardware from the wire rope guard; remove guard from cylinder.

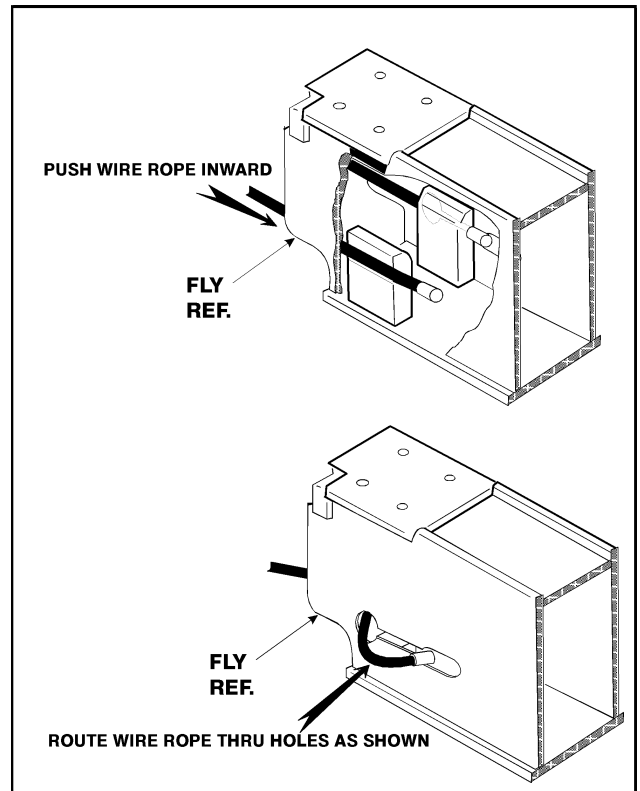
c. Remove hardware from the sheave pin; remove pin and sheave from cylinder.



**Figure 4-11. Disassembly of Sheave Assembly**



9. Remove hardware which secures the wear pads to the front of base boom section; remove wear pads from the top, sides and bottom of the base boom section.
10. Using an overhead crane or suitable lifting device, remove mid and fly boom sections from base section. Note: When removing mid and fly boom sections from base boom section, retract wire rope must be dragged along with boom sections.
11. Remove hardware which secures the wear pads to the aft end of mid boom section; remove the wear pads from the top, sides and bottom of the mid boom section.
12. Remove hardware which secures the sheave guards and sheave assemblies to mid boom section, remove sheave assemblies from mid boom section.
13. Remove hardware which secures the wear pads to the front of mid boom section; remove wear pads from the top, sides and bottom of the mid boom section.
14. Using an overhead crane or suitable lifting device, remove fly boom section from mid section. Note: When removing fly boom section from mid boom section, retract wire rope must be dragged along with fly boom section.
15. Remove hardware which secures the wear pads to the aft end of fly boom section; remove wear pads from the top, sides and bottom of the fly boom section.
16. When removing wire rope from fly boom section, push the cable into fly boom. Route wire rope back through holes in the side of the fly boom section.



**Figure 4-12. Disassembly Wire Rope Routing Process**

### Inspection

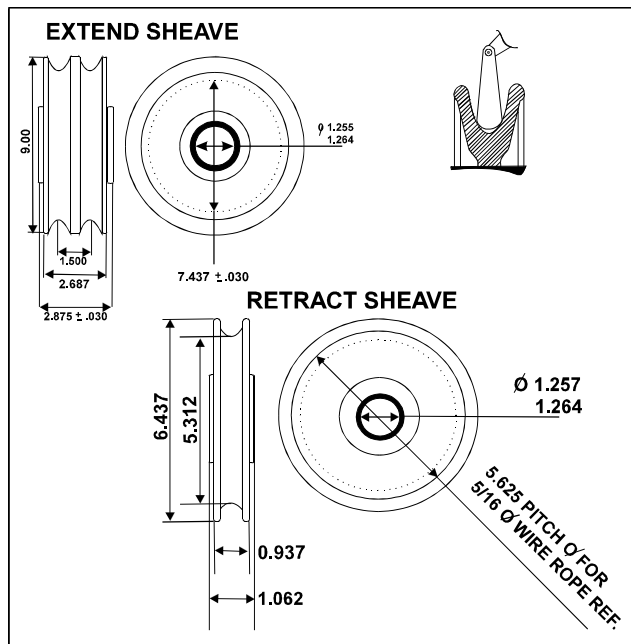
**NOTE:** When inspecting pins and bearings Ref. to Pins and Composite Bearing Repair Guidelines in Section 2.

1. Inspect all sheaves (extend and retract wire ropes and telescope cylinder) for excessive groove wear, burrs or other damage. Replace sheaves as necessary.



## SECTION 4 - BOOM & PLATFORM

**NOTE:** To check the size, contour and amount of wear, a groove gauge is used. Replace the sheave if worn as shown in the following drawing.



**Figure 4-13. Dimension of Sheaves When New**

2. Inspect extend and retract wire rope sheave bearings for wear, scoring, or other damage, and for ovality.
3. Inspect extend wire rope and retract wire rope sheave pins for scoring, tapering and ovality. Replace pins as necessary.
4. Inspect telescope cylinder sheave pin for scoring, tapering and ovality. Replace pins as necessary.
5. Inspect boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
6. Inspect telescope cylinder attach point for scoring, tapering and ovality. Replace pins as necessary.
7. Inspect upper lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
8. Inspect inner diameter of boom pivot bushing for scoring, distortion, wear, or other damage. Replace bearing as necessary.
9. Inspect all wear pads for excessive wear or other damage. Replace pads when worn to within 1/8 inch (3.2 mm) of threaded insert.
10. Inspect extend and retract wire rope attach point components for cracks, stretching, distortion, or other damage. Replace components as necessary.
11. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
12. Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

### Assembly

**NOTE:** When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.

1. Measure inside dimensions of the base and mid sections to determine the number of shims required for proper lift.
2. Measure inside dimensions of the mid section to determine the number of shims required for proper lift.
3. Install side, top and bottom wear pads to the aft end of fly section; shim evenly to the measurements of the inside of mid section.



4. Install retract wire ropes into aft end of fly section, route wire ropes thru holes in side of fly boom section and pull into slot.

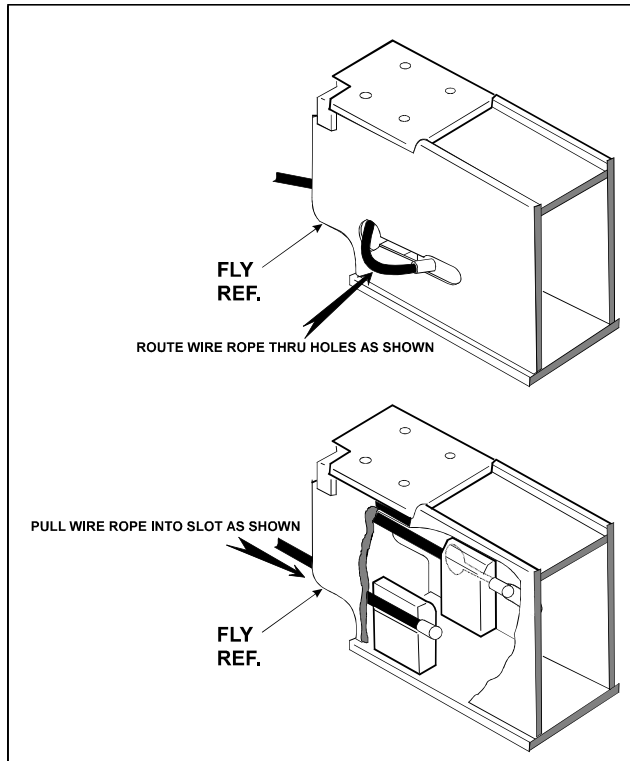


Figure 4-14. Routing Installation of Retract Wire Ropes

5. Install side, top and bottom wear pads to the aft end of mid section; shim evenly to the measurements of the inside of mid section.

**⚠ CAUTION**

**WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.**

6. Shim the insides of the boom sections for a total of 1/16 inch (0.062) clearance (if the action is centered, there will be 1/32 clearance on each side).
7. Slide fly boom section into the mid boom section. Shim boom, if necessary, for a total of 1/16 inch (0.062) clearance.

8. Install wear pads into the forward position of the mid boom section. Shim boom, if necessary, for a total of 2/10 inch (0.20 m) clearance.
9. Properly position the retraction wire rope sheaves assemblies at the aft end of the mid boom section; ensure all sheave-to-mounting block attachment holes align. Install the sheave pins and secure them with mounting hardware. Position retract wire ropes onto the sheaves.
10. Install sheave guards to aft end of mid boom section and secure with mounting hardware.
11. Slide mid boom section into the base boom section. Allow the retraction wire ropes to trail between the bottom surfaces of boom sections. Shim boom, if necessary, for a total of 1/16 inch (0.062) clearance.
12. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 2/10 inch (0.20) clearance.
13. Install sheave block to bottom of base boom section and adjust block so that retract wire ropes do not come into contact with boom surfaces.
14. Install wire rope threaded ends thru attachment holes in the bottom of base boom section. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.
15. Align the telescope cylinder barrel-to-sheave attachment point. Install extend sheave pin through the telescope cylinder barrel and sheave assembly; secure pin with mounting hardware.
16. Route extend wire ropes around extend sheave and secure wire ropes to the telescope cylinder.
17. Install extend wire rope mounting blocks to threaded ends of wire ropes. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.

**NOTE:** When installing wire ropes, care must be taken not to twist or cross the wire ropes.



## SECTION 4 - BOOM & PLATFORM

18. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the boom assembly.

### **⚠ CAUTION**

WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

19. Align the cylinder with the slots at aft end of mid boom section, then secure cylinder with mounting hardware.
20. Align holes in aft end of the fly boom section with holes in wire rope mounting block, then secure with mounting hardware.
21. Align holes in aft end of the mid boom section with holes in wire rope mounting block, then secure with mounting hardware.

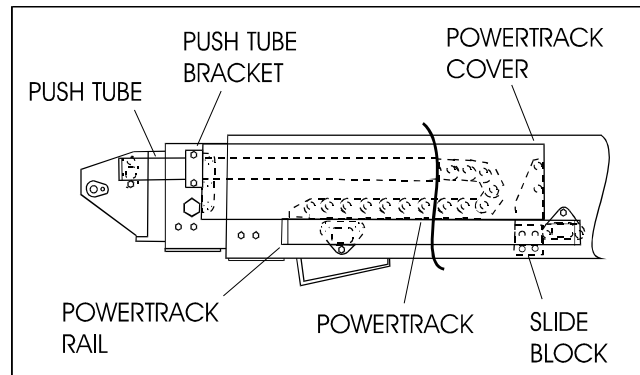
**NOTE:** Boom wire ropes must be torqued after installation of the boom assembly.

22. Align holes in rod end of the telescope cylinder with holes in push bar. Install push bar pin and secure with mounting hardware.
23. Install the hydraulic lines and electrical cables, and the harnessing powertrack components as follows:
  - a. Align holes in powertrack rail with attachment holes in side of the base boom section. Secure the rail with mounting hardware.

- b. Install powertrack to rail with mounting hardware.
- c. Attach push tube bracket to the side of the mid boom section with mounting hardware.

**NOTE:** Do not over tighten attach bolt on push tube bracket. It should pivot freely.

- d. Install slide block and wear pads to the powertrack rail with mounting hardware.
- e. Install powertrack to push tube with mounting hardware.
- f. Carefully feed the hoses and electrical cables through the aft end of the powertrack rail, powertrack and push tube.
- g. Ensure all hoses and cables are properly routed through the powertrack rail, powertrack and push tube. Tighten or install all clamping or securing apparatus to the hoses or cables, as necessary.
- h. Install powertrack cover and push tube rods with mounting hardware.



**Figure 4-15. Reassembly of Components - Boom Powertrack Assembly**



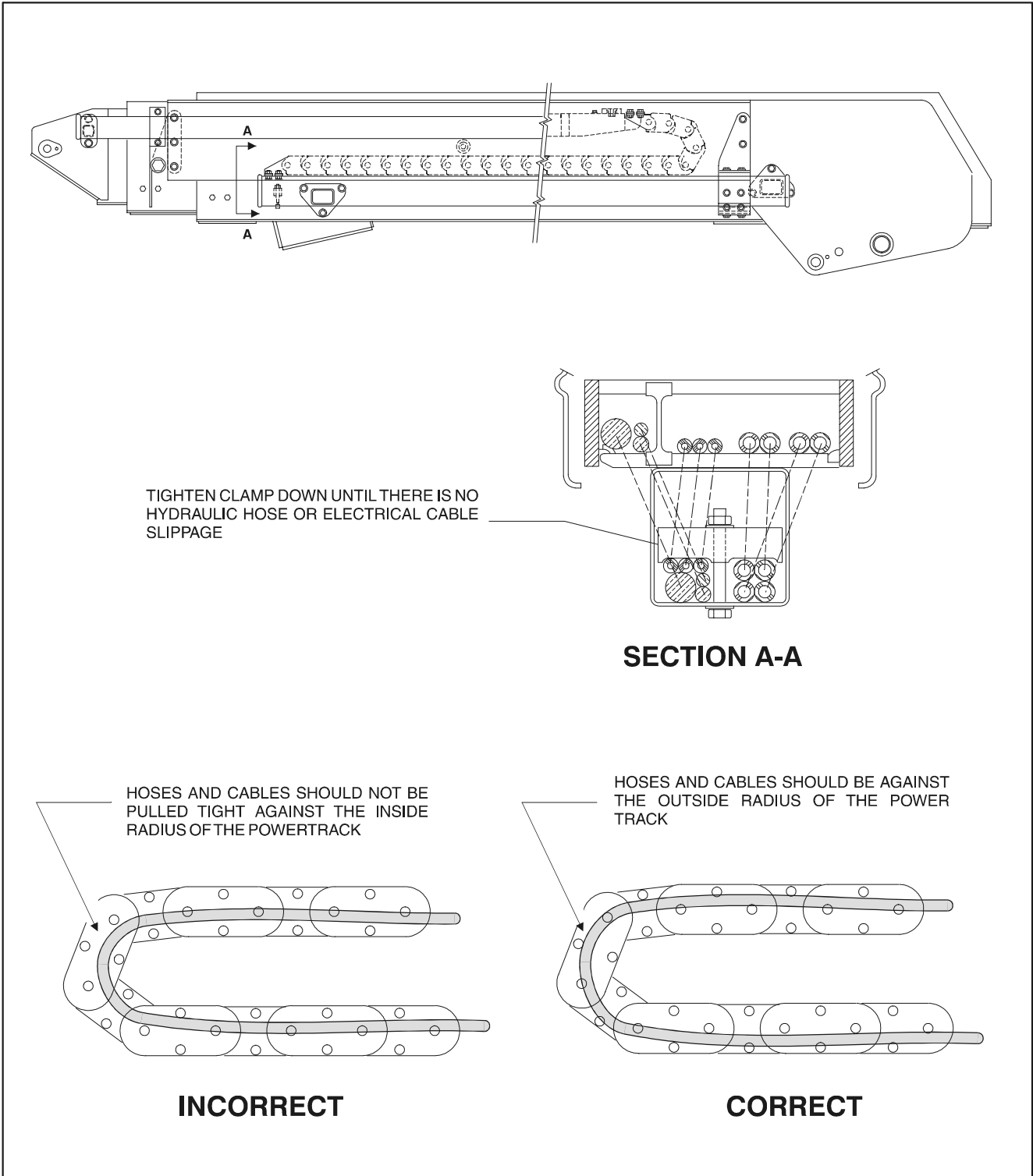


Figure 4-16. Boom Powertrack Installation



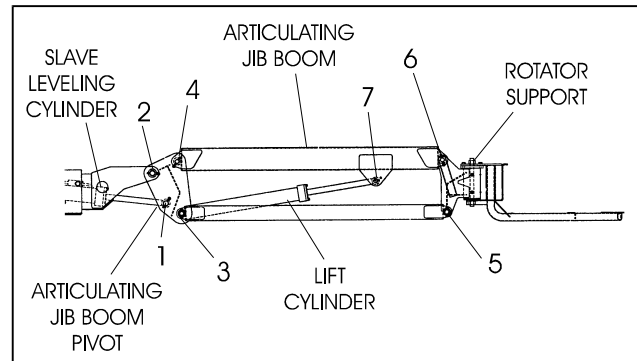
### Installation

1. Using a suitable lifting device, position boom assembly on turntable so that the pivot holes in both boom and turntable are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on turntable.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
4. Align push bar pivot hole with pivot holes in turntable. Install push bar pivot pin, ensuring that location of hole in pin is aligned with attach point on turntable.
5. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
6. Connect all wiring to the ground control box.
7. Connect all hydraulic lines running along side of boom assembly.
8. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
9. Align holes in boom structure with hole in master cylinder. Insert the master cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
10. Adjust retract and extend cables to the proper torque. Refer to Boom Cable Torque Procedures.
11. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
12. Retract and lower boom, noting the performance of the retraction cycle.

### 4.6 ARTICULATING JIB BOOM

#### Removal

1. For platform/support removal see platform/support removal diagram. See Section 4.5, Boom Maintenance.
2. Position the articulating jib boom level with ground.
3. Remove mounting hardware from slave leveling cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.



**Figure 4-17. Location of Components - Articulating Jib Boom**

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

#### Disassembly

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



### **Inspection**

---

**NOTE:** *When inspecting pins and bearings refer to Pins and Composite Bearing Repair Guidelines in Section 2.*

1. Inspect articulating fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect articulating fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of articulating fly boom pivot bearings for scoring, distortion, wear, or other damage. Replace bearings as necessary.
4. Inspect lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of rotator attach point bearings for scoring, distortion, wear, or other damage. Replace bearing as necessary.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of articulating jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.
3. Align bottom tubes with attach holes in rotator support. Using a soft head mallet, install rotator support pin #5 into articulating jib boom and secure with mounting hardware.
4. Align articulating jib boom with attach hole in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin #4 into articulating jib boom and secure with mounting hardware.
5. Align bottom tubes with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin #3 into articulating jib boom pivot weldment and secure with mounting hardware.
6. Align articulating jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin #2 into fly boom assembly and secure with mounting hardware.
7. Align the slave leveling cylinder with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install slave leveling cylinder pin #1 into articulating jib boom pivot weldment and secure with mounting hardware.

### **Assembly**

---

**NOTE:** *For location of components See Section 4-17., Location of Components - Articulating Jib Boom.*

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

---

### **4.7 LIMIT SWITCH ADJUSTMENT**

Adjust switches and cam valve as shown in Limit Switches Adjustment.



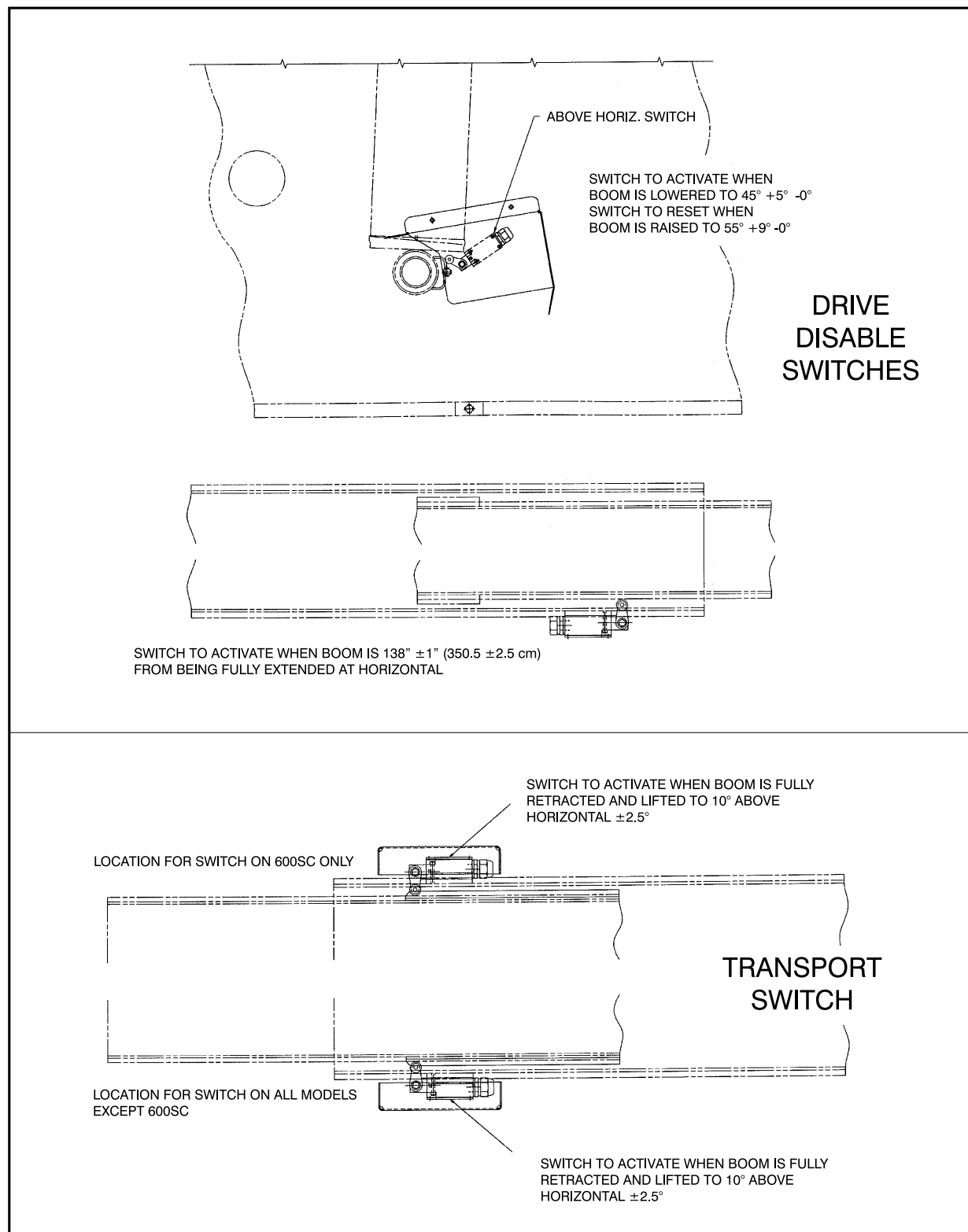


Figure 4-18. Limit Switches Adjustments



## 4.8 ROTATOR - HELAC

### Disassembly

1. Place actuator on a clean workbench.
2. Remove all hydraulic fittings.
3. Using a suitable hammer and chisel remove the portion of end cap securing setscrew.

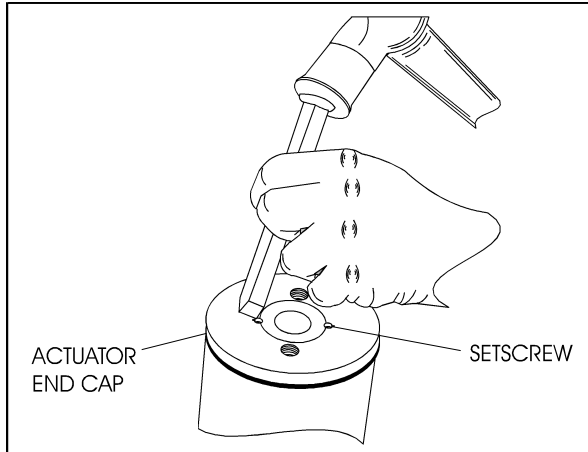


Figure 4-20. Removing Portion of End Cap

4. Using a torch, apply heat to the setscrews on the bottom of actuator.

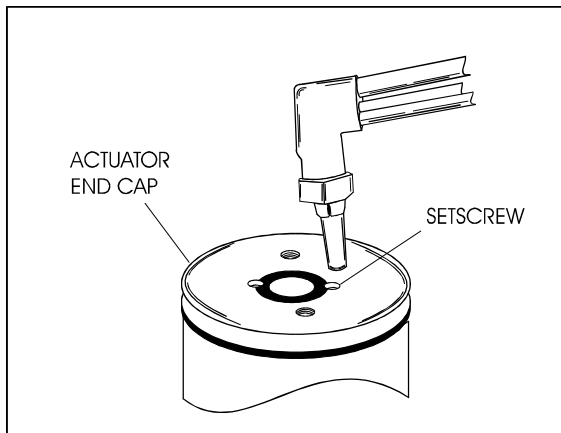


Figure 4-21. Heating Setscrew

5. Remove the two (2) setscrew (4) from bottom of actuator (1). Discard setscrew.

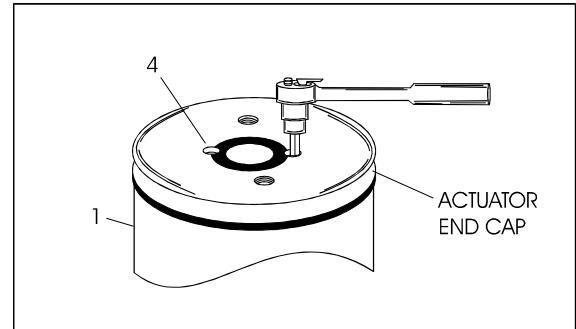


Figure 4-22. Removing Setscrew

6. Place two (2) 3/8"x16NC bolts in threaded holes in bottom of the actuator. Using a suitable bar, unscrew the end cap (5). Remove the end cap from actuator (1).

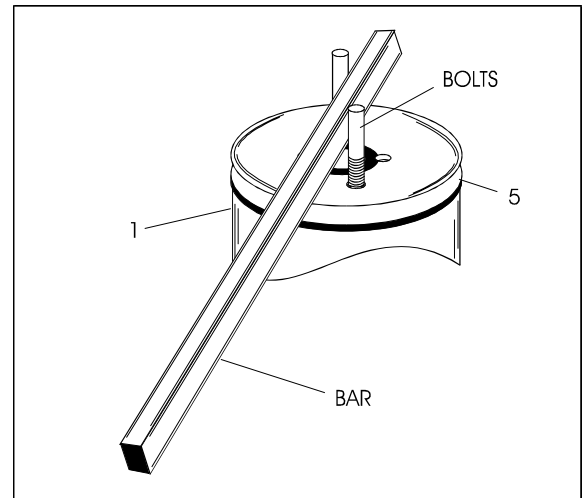


Figure 4-23. Removing End Cap



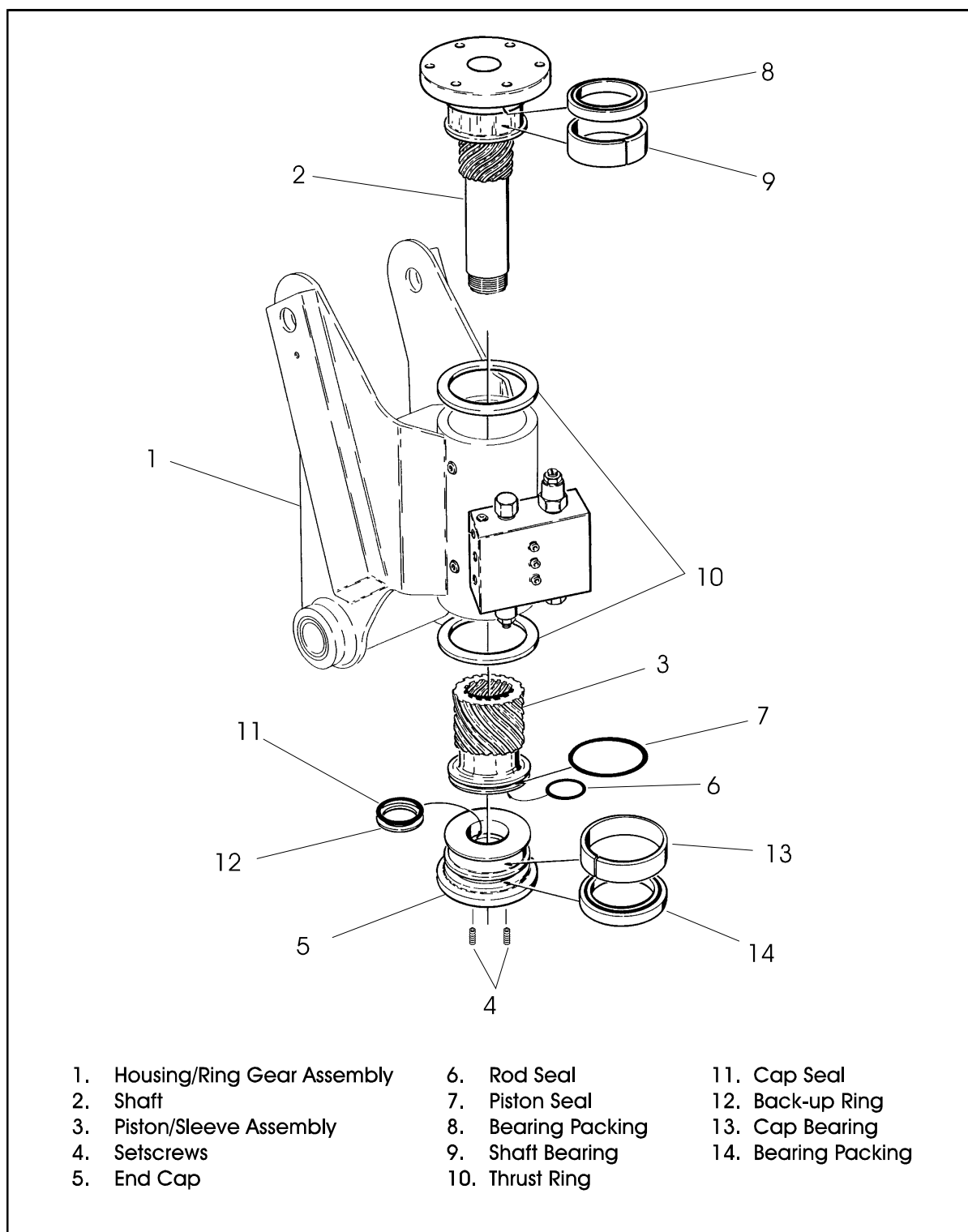


Figure 4-19. Rotator Assembly (Helac)



7. Remove the shaft (2) from piston sleeve (3) and the actuator housing (1).

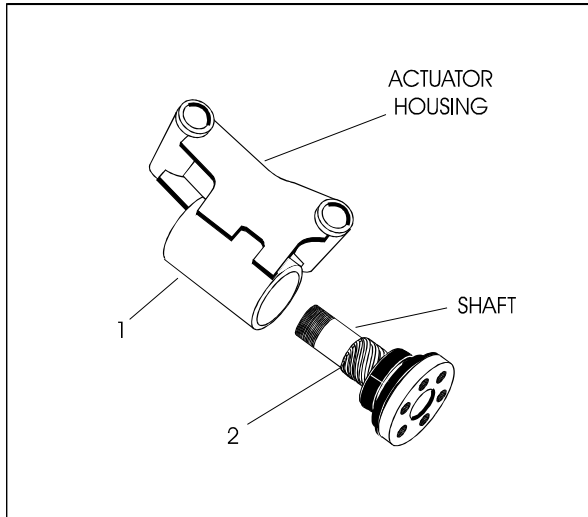


Figure 4-24. Removing Shaft from Housing

8. Remove piston sleeve (3) from housing (1).

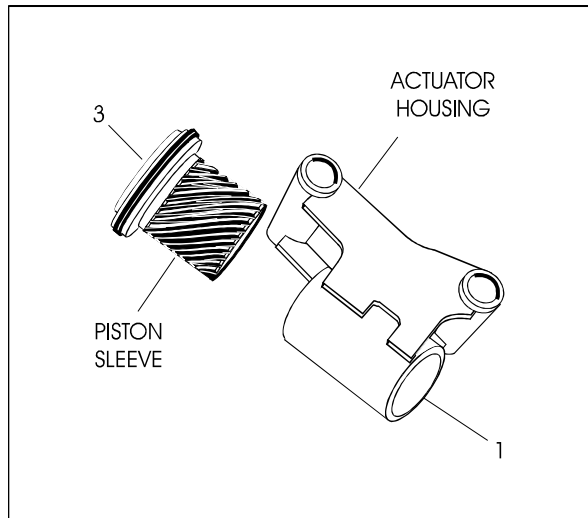


Figure 4-25. Removing Sleeve from Housing

9. Remove all seals and bearings from grooves. Discard seals.

## Inspection

1. Clean all parts thoroughly.
2. Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.

**NOTE:** A small amount of wear in the spline teeth will have little effect on the actuator strength. New spline sets are manufactured with a backlash of about 0.005 in. per mating set. After long service, a backlash of about 0.015 per set may still be acceptable in most cases, depending on the required accuracy of the application.

3. Check the ring gear for wear and weld damage to the pins.
4. Inspect the cylinder bore for wear and scratches.

## Assembly

**NOTE:** Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.

1. Install new seal (7) and bearing (6) on the piston sleeve (3).

**NOTE:** Apply a coat of grease to the thrust ring before sliding onto the shaft.

2. Install new seal (8), thrust ring (10) and bearing (9) on shaft (2).

**NOTE:** Apply a coat of grease to the thrust ring before sliding onto the end cap.

3. Install new seals (11), back-up ring (12), cap bearing (13), bearing packing (14) and thrust ring (10) on end cap (5).

4. Place the actuator in the vertical position, install the piston sleeve (3) in timed relation to the housing (1).

## CAUTION

**DO NOT MISALIGN THE SLEEVE TOO MUCH ANY ONE WAY, AS IT WILL MARK THE CYLINDER BORE.**



**NOTE:** The timing marks (the small punch marks on the face of each gear), must be aligned for proper shaft orientation. (See Actuator Timing.)

5. Install the shaft (2) into housing (1) by aligning the proper punched timing marks. (See Actuator Timing.)
6. Temporarily tape the threaded portion of the shaft will help installation past the shaft seals (masking tape).
7. The end cap (5) is torqued to 40 - 50 ft. lbs. (54 - 68 Nm), such that the actuator begins rotation at approximately 100 psi (6.895 Bar) pressure.
8. The end cap must be secured against the shaft by installing axial set screws (4).

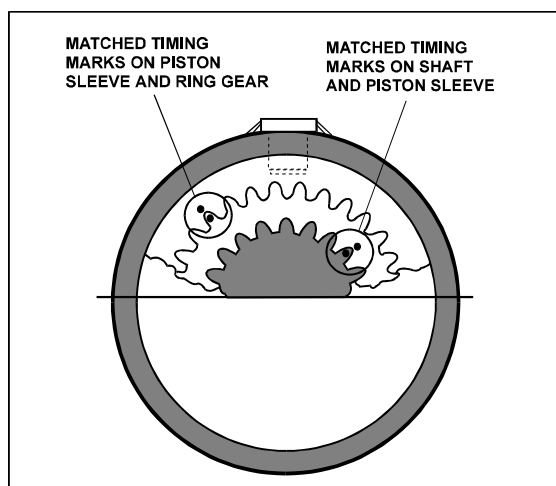


Figure 4-26. Actuator Timing

### 4.9 FOOT SWITCH ADJUSTMENT

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

## 4.10 SUPERFLEX CONTROLLER

### System Overview

The SUPERFLEX Controller is a stand alone control system that electrically drives the machine's electrohydraulic valves.

It receives input, electrical signals, from OEM's proprietary "DIGISENSOR", as well as pressure, temperature, flow, angle, length, load cell, and strain gauge transducers. The input signals can "condition" the DC outputs, via software, if desired. It provides four (4) Pulse Width Modulated (PWM) DC outputs, as well as a 5th channel for use as a discrete (on/off) signal. Dual coil, single coil, and flow control type valves can be controlled in a bidirectional or unidirectional mode of operation.

The SUPERFLEX has been designed with the following user benefits in mind:

- a. Easy to use
- b. Easy to adjust
- c. Fast set-up
- d. Self diagnostics

### System Elements

The SUPERFLEX System is composed of several components:

1. SUPERFLEX Controller
2. DIGISENSOR and Joysticks
3. OPTIMIZER

### SUPERFLEX CONTROLLER

The SUPERFLEX Controller is a microprocessor-based electronic device, which converts the changing input values from the Joystick/DIGISENSORS, analog sensors, tachometers, and on/off contact closures into digital signals which are used by the computer in the SUPERFLEX controller. The controller will then provide [PWM] outputs to electrohydraulic valves and coils. The desired output (PWM) signals are fine tuned independently in each direction. The OEM "OPTIMIZER" is used to perform this tuning.

### DIGISENSOR AND JOYSTICKS

Joysticks actuate special sensors (DIGISENSORS) which transmit joystick position information to the SUPERFLEX Controller via two wires. The proper polarity must be used as indicated on the wiring diagrams. The uniqueness of this sensor allows it to be remote, up to 500 feet, from the SUPERFLEX Controller. It can operate in hostile EMI/RFI environments.



## OPTIMIZER

The hand-held programmer provides a simple means of optimizing the contra of the equipment. The sixteen (16) function, membrane keypad, in conjunction with a two (2) line liquid crystal display (LCD) of sixteen characters each, connects to the SUPERFLEX Controller via a pluggable terminal strip. The OPTIMIZER performs the following functions:

1. **Optimizes** - Changes/modifies the operating parameters for each joystick handle direction.
2. **Tests** - Checks the SUPERFLEX Controller's operations from end-to-end (self-test). Inputs, outputs and internal functions are tested to verify proper operation.
3. **Displays** - All operational settings, conditions and test results.
4. **Collects** - Information for later evaluation.
5. **Downloads** - Allows the Superflex Controller to be programmed.
6. **Interfaces** - Facilitates the communications path between the SUPERFLEX and a personal computer.

## General Description

Inputs are under software control. Their functions can change depending on what software is employed. In a typical application, the DIGISENSOR operated by a joystick connected to Input (terminals 1 and 2), produces a proportional PWM output on (terminals 13 and 14). The DIGISENSOR connected to Input (terminals 3 and 4), produces a proportional PWM output on (terminals 15 and 16). Inputs #3 and 4 can be used to further condition outputs depending on the software programmed into the SUPERFLEX.

The SUPERFLEX controller has an eighteen (18) point terminal strip. Terminals 1 through 12 are for "inputs and power" and terminals 13 through 17 are used for outputs. In a typical application, a DIGISENSOR operated by a joystick, is connected to terminals 1 and 2 (Input Signal #1). Another DIGISENSOR is connected to terminals 3 and 4 (Input Signal #2). The Input Signal #1 produces a proportional PWM output on terminals 13 or 14, and Input Signal #2 produces a proportional PWM output on terminals 15 or 16.

Additional inputs can be connected to allow for "application specific functions". A "toggle switch", when wired to terminals 7 and 10, can produce a Hi/Low Range "PWM Output" at terminals 13 or 14. Also, an additional toggle switch wired to terminals 9 and 10 can similarly produce a Hi/Low Range at terminals 15 or 16. Terminal 17 produces a +12VDC output whenever an input is turned on. Terminal 17 can be used to advance a throttle or dump valve.



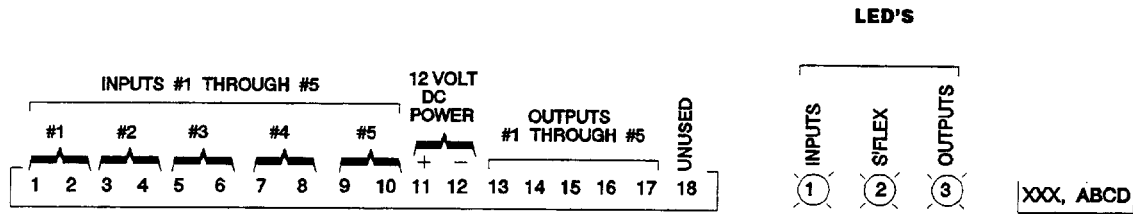


Figure 4-27. SUPERFLEX Terminal Identification

## SUPERFLEX Terminal Identification

Refer to Figure 4-27., SUPERFLEX Terminal Identification.

## SUPERFLEX Terminal Assignments

- |  |                                  |
|--|----------------------------------|
| 1. DIGiSENSOR Input #1 - BLACK         | 10. Specified Output             |
| 2. DIGiSENSOR Power Source - RED       | 11. +12VDC Power Supply          |
| 3. DIGiSENSOR Input #2 - BLACK         | 12. Power Supply Return (Ground) |
| 4. DIGiSENSOR Power Source - RED       | 13. Output A}                    |
| 5. Special Input #3                    | 14. Output B} Output # 1         |
| 6. Special input #4 - Power source     | 15. Output A}                    |
| 7. Hi-Range for Input #1 at Terminal 1 | 16. Output B} output # 2         |
| 8. Specified Output                    | 17. Output - Switched            |
| 9. Hi-Range for Input #2 at Terminal 3 | 18. Not Used                     |
- xxxx - Factory Use  
A,B,C,D - OPTIMIZER - Connections

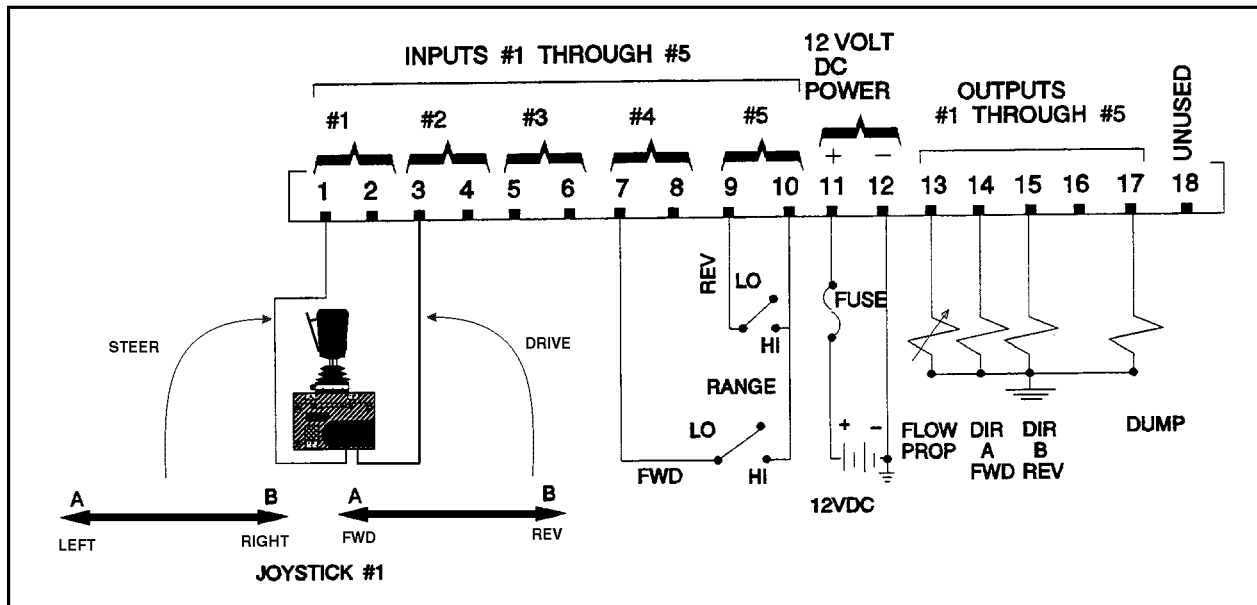


Figure 4-28. Wiring Diagram - Single Coil Uni-Directional Flow Control Valve - 1 Axis



Setup and Tuning

The operating parameters of the system: Threshold, Max Out, Low Range, Ramp up, Ramp Down are preadjusted at the factory with preset values, called default settings. For optimum machine performance, these settings may require fine-tuning. This section describes the procedures for charging the settings of each of the five (5) functions for each direction of handle movement.

These setting adjustments can be made in two (2) ways: Normal-Active or Bench-Static. In the Normal-Active mode, the adjustments will be made with the equipment and joystick operational. In the Bench-Static mode, Joystick/DIGISENSORS may or may not be wired to the SUPERFLEX Controller. For best results, it is recommended that all adjustments be made in the Normal-Active mode.

In the Normal-Active mode, set-up and tuning of all adjustments are active (live) and the equipment will respond accordingly, if hydraulic and electrical power are applied to the electrohydraulic valves. The operator is cautioned to be in an area clear of obstructions and to be cautious during the set-up procedure, as changes in the data can cause sudden motion of the equipment.

To make Normal-Active adjustments, move the joystick handle in a direction. Controller #1 or #2 and Direction A or B will be shown on the OPTIMIZER LCD display. For best results, operate and make adjustments for all functions in both directions of handle travel.

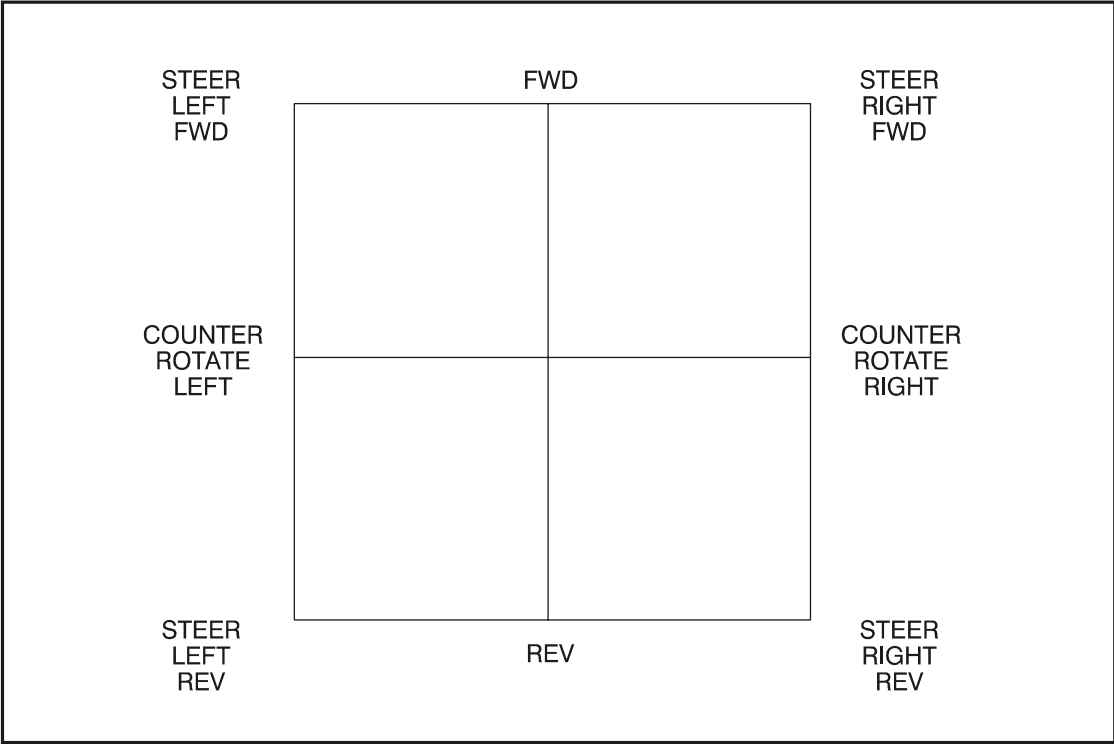


Figure 4-29. Controller Pattern



### How to Perform the Normal-Active Tuning Process

Attach the "OPTIMIZER" programmer with the 4 wire cord & connector to the SUPERFLEX controller terminals A, B, C, D). Refer to Figure 4-34., OPTIMIZER Keypad and Figure 4-33., Typical SUPERFLEX System Wiring Diagram.

#### ADJUST THRESHOLD

Threshold is the initial current flow to a valve when the joystick handle is moved approximately 4 degrees from its neutral position. The Threshold point is normally adjusted such that the control function does not move at 4 degrees, but further increase in joystick position causes movement to begin. To adjust Threshold:

**Table 4-1. Adjusting Threshold**

Perform the following:	Action and display:
Connect 12 VDC power to the (+) and (-) terminals of the SUPERFLEX Controller	The center LED located at the SUPERFLEX Controller will blink. The OPTIMIZER display will read: RUN MODE, NORMAL CONTROLLERS OFF
Operate a joystick in any direction & maintain it in an operated position, at threshold point of 4° handle movement	Display reads: RUN: CONTROL 1 (or 2) XX %, DIR A (or B.)
Operate a joystick in the opposite direction and maintain it in an operated position (Note that the display changes.)	Display reads: RUN: CONTROL 1 (or 2) XX %, DIR B (or A)
Press THRESHOLD] To begin tuning (Joystick must be operated)	Display reads: THRESHOLD 1 (or 2) XX %, DIR A (or B.)
Press [+]	Display shows the increase in %.
Press [-]	Display shows the decrease in %.
If Threshold settings are OK for both directions of handle movement, proceed to save new data and run the equipment.	
Press [ENTER]	This will save new values in the SUPERFLEX.
Press [RUN]	This places SUPERFLEX in operation.

#### ADJUST MAX OUT

Max Out determines the maximum current flow to the valve when the joystick handle is at its fullest deflection. Max Out should be adjusted so that the function runs at fun speed with the joystick handle fully deflected, but starts to slow down as soon as the handle is moved away from fun deflection. To change the Max Out setting in both directions, perform the same procedure as that for Threshold, just substitute the Max Out for Threshold.

#### ADJUST LOW RANGE

Low Range determines the maximum amount of current to be supplied to a valve with the joystick at full deflection, and the **High/Low Range Switch** in the low position. The adjustment is identical to that of Threshold and Max Out. If the Low Range function is not used, be sure that the Low Range setting is set for 100%. The Low Range current will be equal to the "Thresholds current plus a percentage (0 to 100%) of the difference between Max Out and Threshold.

In the event of a loss of voltage at the Low Range input, the SUPERFLEX will automatically revert to the Low Range setting.

The Low Range Adjustment is indicated in the same units as Max Out and Threshold. Its range of adjustment extends from the threshold setting to the maximum output setting. By design, this setting is dependent on the threshold and maxout settings. It may require readjusting.

#### ADJUST RAMP UP

Ramp up determines the time it will take to accelerate from Threshold to Max Out when the joystick handle is moved abruptly. This function prevents sudden, jerky movements of the machinery. The adjustment is identical to that for Threshold. The ramp time is adjustable in 0.1 second steps. The time adjustment range is application dependent.

#### ADJUST RAMP DOWN

Ramp Down specifies the amount of time it will take to decelerate from Max Out to Threshold when a joystick handle is returned to neutral. The adjustment of the Ramp Down function is done in 0.1 second steps in the same manner as that for Ramp up. (Press RUN button on OPTIMIZER to return to normal operation and store the new setting).



### RECORD THE VALUES SELECTED

When all adjustments are finalized for desired machine performance, the values of each setting, in both directions of joystick handle travel, should be recorded for future use.

**Table 4-2. Adjustment Values**

	Joystick 1 Handle Direction		Joystick 2 Handle Direction	
	A	B	A	B
THRESHOLD	_____	_____	_____	_____
MAX OUT	_____	_____	_____	_____
LOW RANGE	_____	_____	_____	_____
RAMP UP	_____SEC	_____SEC	_____SEC	_____SEC
RAMP DOWN	_____SEC	_____SEC	_____SEC	_____SEC

**Table 4-3. Factory Defaults**

	Default Setting	Assembly Setting
THRESHOLD	15%	15%
MAX OUT (HIGH)	85%	50%
LOW RANGE	50%	67%
RAMP UP	0	0
RAMP DOWN	0	0

### DANGER

**ENSURE THE MAXIMUM OUTPUT IS ADJUSTED TO 50% PRIOR TO OPERATING THE DRIVE FUNCTION.**

**NOTE:** When joystick is actuated the OPTIMIZER displays direction.

### How to make Bench-Static Adjustments

It is not necessary to operate any joysticks. First apply 12VDC power to the SUPERFLEX Controller. Then, connect an OPTIMIZER to the SUPERFLEX using terminal strip A.B.C.D. Adjustments can now be made.

### MAKING ADJUSTMENTS

1. Joystick/DIGISENSOR #1 [called Controller #1] is input terminals (1) and (2).
2. Joystick/DIGISENSOR #2 [called Controller #2] is input terminals (3) and (4).

Press [SELECT]

Display reads:  
CONTROLLER 1 (or 2)  
USE +/- TO CHANGE

Press [+] or [-]

Display reads:  
CONTROLLER 2 (or 1)

Press [DIRECTION A/B]  
DIR  
A/B

Display will not change until a function is selected, i.e., "Threshold" display will read:  
THRESHOLD 1 (or 2)  
XX%, DIR A (or B)

Additional pressing + or - will change readout accordingly

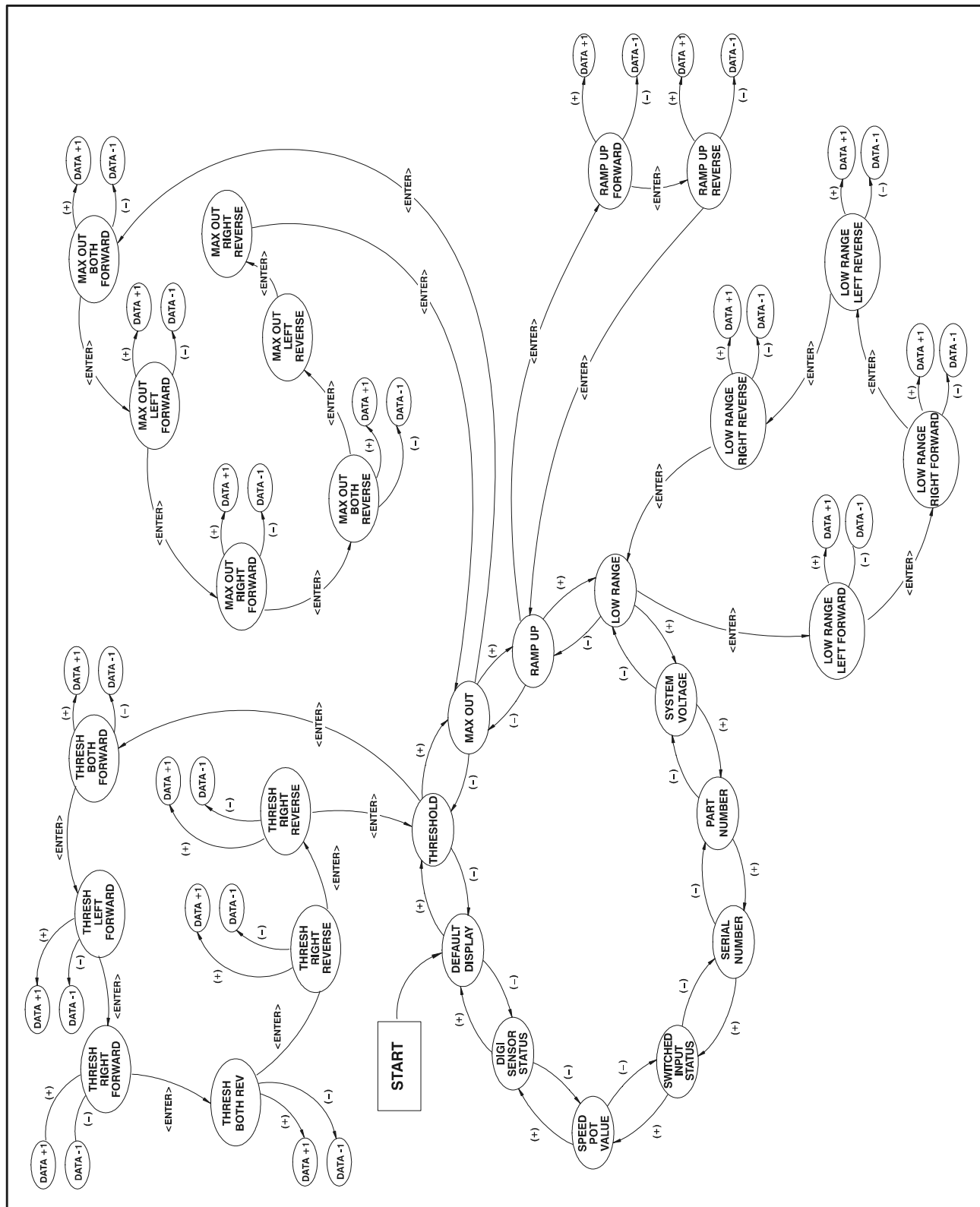
### QUICK SUMMARY OF ADJUSTMENTS (NORMAL-ACTIVE SET UP)

"OPTIMIZER" Keypad Adjustment Procedure. Refer to Figure 4-30., Calibration Flow Diagram.

To make precise adjustments, the following steps are required:

1. Operate a Joystick.
2. Press the desired function [Threshold, Max Out, Low Range, Ramp up, Ramp Down].
3. Press the [+] key to increase the function.
4. Press the [-] key to decrease the function.
5. When all adjustments are made in both directions (A/B), press the "ENTER" key and the "RUN" key to save the new settings.







## Troubleshooting

### TOOLS REQUIRED (INSTALL/REPLACE)

Screwdriver (Flat blade), Voltmeter, Wire Stripper, OEM OPTIMIZER, and cable - 4 conductor

### GENERAL DESCRIPTION

The SUPERFLEX Control System has been designed to perform in the harsh environments that are present in the mobile equipment industry. Experience shows that the most common problems encountered are external to the system. Broken wires, loose connections, defective connections, wiring errors, wiring shorts, and the improper supply voltage are the major source of field problems.

Three (3) diagnostic LED's are provided on the SUPERFLEX Controller. To help isolate an internal or external problem, use Figure 4-31., Testing the SUPERFLEX to determine the fault condition.

### How To Troubleshoot the SUPERFLEX Controller

Refer to Figure 4-31., Testing the SUPERFLEX, and follow the "TO TEST" instructions. These are located on the gold cover of the SUPERFLEX.

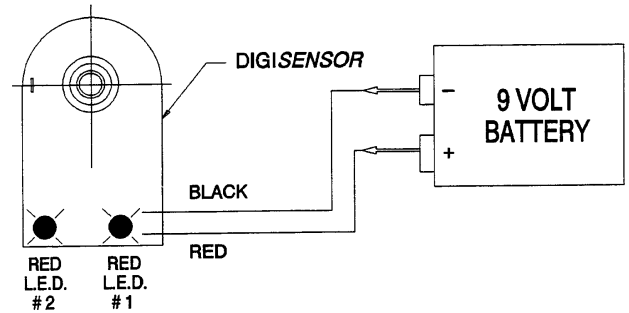
### How to Troubleshoot the Digisensor

To check for proper DIGISENSOR operation, the following simple test with a 9 VDC battery or 12 VDC power source will work:

1. Connect +9V(or 12VDC) to the red wire and the negative terminal to the black wire.

2. Observe the LEDs located in opposite corners. A correctly functioning DIGISENSOR, when properly applied, will always have one or both LEDs turned on. If in the following tests, both LEDs turn off while power is present, the DIGISENSOR must be replaced.

**NOTE:** If no LED activity is observed, check the battery voltage to assure the battery is O.K.



3. DIGISENSOR test steps while powered, refer to the drawing above.
  - a. Warn the shaft fully clockwise (C.W.). LED #1 must be turned on and LED #2 must be turned off.
  - b. Turn the shaft fully counter-clockwise (C.C.W.). LED #1 Must be turned off and LED #2 must be turned on.
  - c. To find the center of shaft rotation, turn the shaft slowly to find a point at which both LED #1 and LED #2 turn on simultaneously. This position occurs in a narrow transition location between steps A and B.

# SUPER FLEX

**TO TEST: OPERATE ONE JOYSTICK AT A TIME AND OBSERVE LED'S**

LED	INDICATION	STATUS	ACTION
① (INPUTS #1 & #2)	BLINKS OFF  STEADY ON	OK MALFUNCTION MALFUNCTION MALFUNCTION	NONE CHECK 12 VOLT POWER, MUST BE 8 TO 15 VOLTS DC CHECK WIRING FROM INPUT TO JOYSTICK/DIGISENSOR FOR "OPEN" CHECK WIRING FROM INPUT TO JOYSTICK/DIGISENSOR FOR REVERSED POLARITY CHECK WIRING FROM INPUT TO JOYSTICK/DIGISENSOR FOR "SHORT" BETWEEN WIRES OR FROM WIRES TO CHASSIS SWAP JOYSTICK/DIGISENSOR WITH KNOWN WORKING JOYSTICK/DIGISENSOR
② (SUPERFLEX)	BLINKS OFF STEADY ON	OK MALFUNCTION MALFUNCTION	NONE CHECK 12 VOLT POWER, MUST BE 8 TO 15 VOLTS DC REPLACE SUPER/FLEX
③ (OUTPUTS #1 - #5)	BLINKS OFF STEADY ON	OK MALFUNCTION MALFUNCTION	NONE CHECK 12 VOLT POWER, MUST BE 8 TO 15 VOLTS DC CHECK WIRING FROM ACTIVE OUTPUT(S) TO "LOAD" FOR "SHORT" TO CHASSIS

DO NOT REMOVE COVER

INPUTS #1 THROUGH #5

LED'S

ALL ADJUSTMENTS ARE MADE WITH  
OEM CONTROLS "OPTIMIZER"

OPTIMIZER CONNECTION  
A B C D

09/25/92 REV. B

SUBJECT TO CHANGE

Figure 4-31. Testing the SUPERFLEX



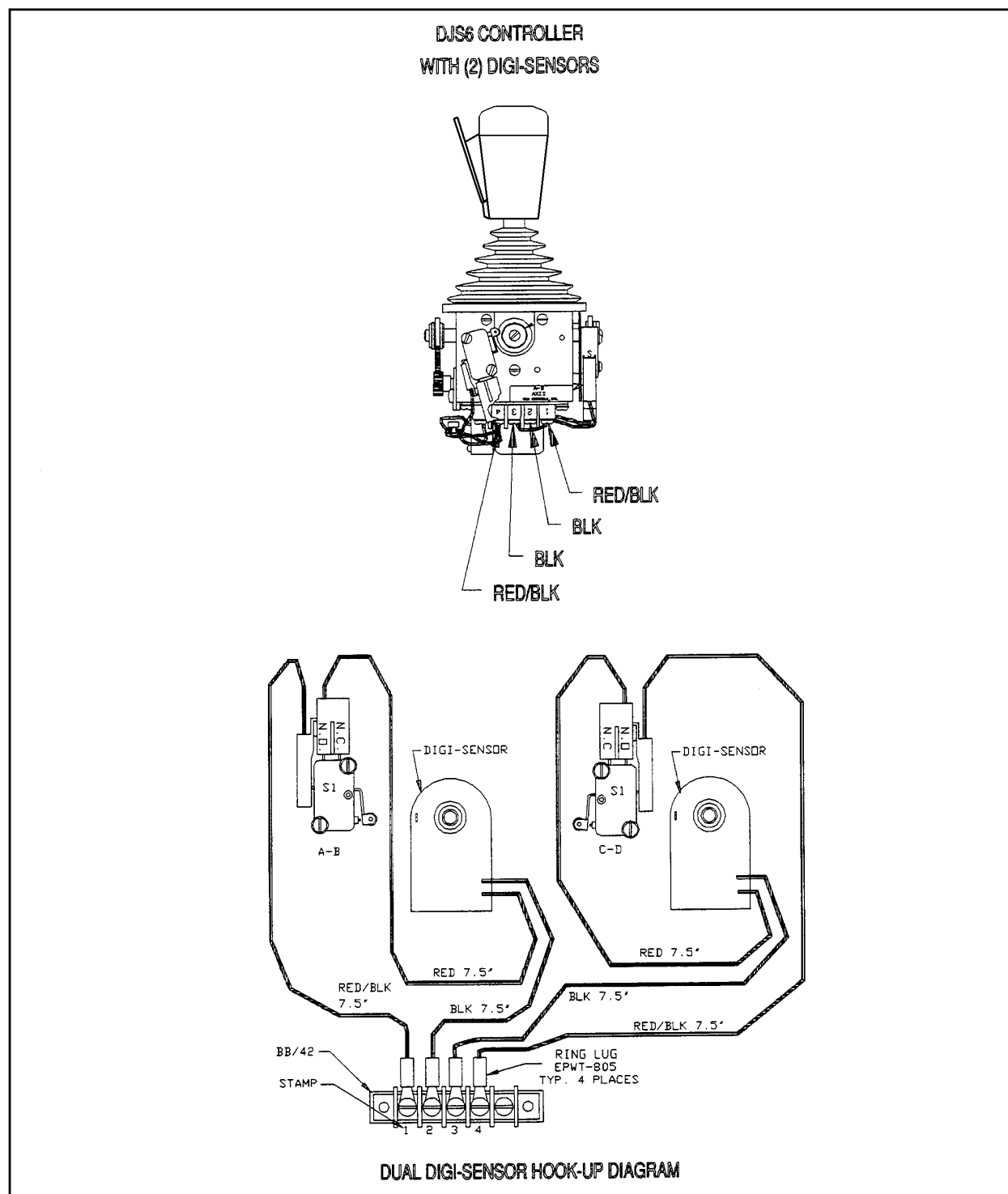
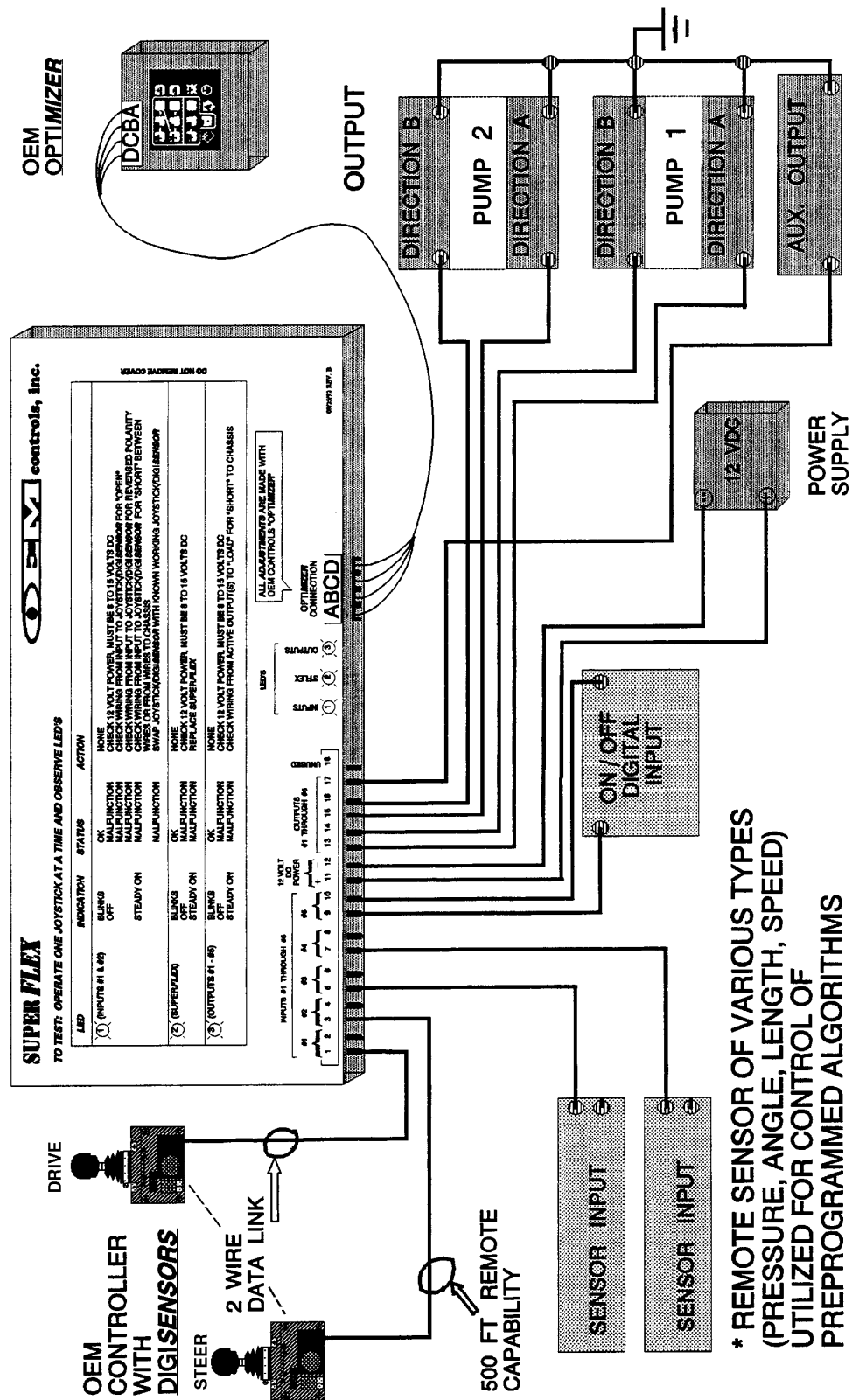


Figure 4-32. Digsensor Troubleshooting





**Figure 4-33. Typical SUPERFLEX System Wiring Diagram**



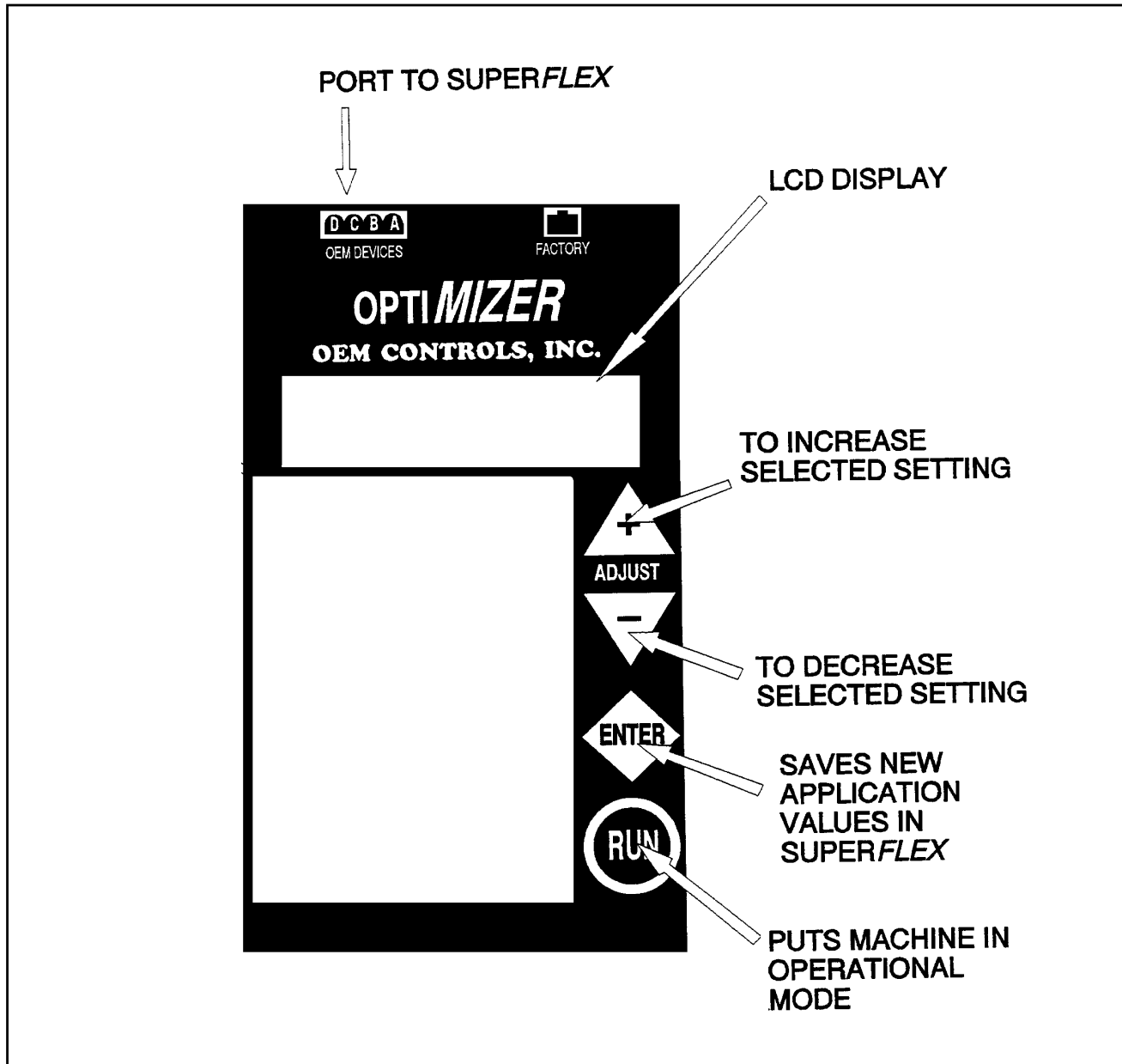


Figure 4-34. OPTIMIZER Keypad



## Important Reminders

### OPTIMIZER:

- *The Optimizer only has (3) usable keys during the scrolling and data entering steps these keys are; (+) (-) (ENTER). (RUN) does not work with the Crawler Series, also the other keys are covered with a white decal.*
- Always keep your foot on the footswitch to read the Optimizer display while checking from the platform or MTB; failure to do so will clear the screen display.
- Static checks on the unit using the Optimizer can be accomplished in the platform, it's tricky to run the engine and change the settings from the platform. Once the drive/steer joystick is brought back to the neutral position, you only have seconds to adjust your settings, if you cannot accomplish this, what ends up happening the timer times out and now you will have to remove your foot from the foot switch to reset, causing your optimizer to clear and return to it's original start-up default setting.
- If possible two people can adjust the machine settings easily and quickly, plugging the optimizer at the MTB, this way the optimizer will never clear it's display as long as the operator in the platform has his foot on the footswitch while the engine is running, all adjustments can be made from the technician at the MTB, while the operator in the platform can test the new settings to the controls.
- During the scanning of the menus on the Optimizer, there is no way to back up to a certain setting if you mistakenly passed it up, you must scroll through the (+) key to get where you want.
- Always remember to keep the Superflex powered up when storing data using the ENTER key, failure to do so will lose all changed data back to original default settings.
- For any reason the Optimizer shows an INITIALIZING SYSTEM displayed, check the power connections between the Optimizer and the Superflex, a poor communication link maybe the problem, check for proper wiring hook ups at both Optimizer connections, drive/steer joystick and drive pump EDC connections.

### DIGISENSOR:

- When you lift the lid on the control panel there will be two digisensors with two red LED's on each one, they are positioned one vertically and one horizontally, the one vertical is (DRIVE) (DS2), the one horizontally is STEER (DS1).
- When you activate STEER the way the LED's are positioned you would think the left LED on the horizontal digisensor would light? It doesn't the right one does, the digisensor moves CCW when using left and CW using right, the same applies for DRIVE. To check to see if a digisensor is any good, try a resistance check. Remove the plug from the micro switch follow the red wires from digisensors on the drive/steer controller, also remove the main plug which holds the ground wires (black from the digisensor), next set your voltmeter to ohm's install your positive lead into the plug where you will see two red wires loaded into the same connector install the lead here, next take your ground and install it into two individually separate ground pins in the other plug following the black wires coming out of the digisensors, the first pin at the top of the plug should read approximately 8.5 ohms the second pin should read approximately 8.8 ohms, remember this is without any movement of the joystick.
- The field has two types of digisensors installed on our Crawlers, early version is a gray plastic appearance with two led's, and current production which is a gold colored metal version with two red led's, neither one is waterproof.



### Crawler Tracking Adjustments

**NOTE:** Before making any tracking adjustments, make sure the tracks are free of debris and adjusted per Service Manual.

To properly adjust the tracks on the Crawler, you will need a stopwatch, pencil & paper and two fixed landscape objects to use as a guide for centering the tracks. The guide tube mounted on the top front of the base boom is used as a cross hair for centering the machine between the two fixed landscape objects. To achieve proper adjustment of the tracks we must first set the tracks to drive in a straight line in FWD & REV. in both speeds low and high. Use the following default settings as a starting point, once everything is entered in the Optimizer, mark off a 50 ft. (low) and a 200 ft. (high) start to finish point to use as a measurement.

#### ADJUSTMENT EXAMPLE:

Position your machine inline with the two fixed landscape objects, using the guide tube as your crosshair, now squeeze the trigger on your joystick and operate the machine in a straight line through the 50 ft. start to finish line, checking the position of the machine and the amount of seconds it took to drive 50 ft. Now record the low range settings, take time to think things out, for example if your machine is positioned too far to the left and timed out too slow in low drive in the direction you were testing, you will want to increase the settings on your low range adjustment up and decrease the settings on your right track. Remember the direction you moved, this will determine which setting to change on the Optimizer, you will be able to judge which track is moving faster when your testing your machine, focus your attention to the links on the tracks. Write the information down, so you won't forget!

#### THRESHOLD:

Always keep in mind when adjusting Threshold, both tracks have to operate simultaneously!

Controller Adjustment	Optimizer Default Setting	Optimizer Manufacturing Setting
Threshold	15%	15%
Max Out (High)	85%	50%
Low Range	50%	70%
Ramp Up	0%	0.5%
Ramp Down	0%	0.5%

Drive Speed	Feet	Seconds
High	200 ft.	85-90
Low	50 ft.	80-85

Maximum drive speed: 1.6 MPH

#### (STEER) (FWD) TRACK CHARACTERISTICS:

COUNTER STEERING: One track moves in the reverse direction, the other the forward direction

GRADUAL STEER: One track comes to a stop, the opposite track moves forward

(STEER) (REV) Is just the opposite of FWD.

### Drive & Steer Function Check

#### IMPORTANT

**BEFORE PLUGGING IN OPTIMIZER MAKE SURE THE WIRES ARE INSTALLED CORRECTLY, ALSO KEYSWITCH IN PLATFORM POSITION ONLY!!!!**

**Optimizer Plug:** Red (1) Black (2) White (3) Green (4)

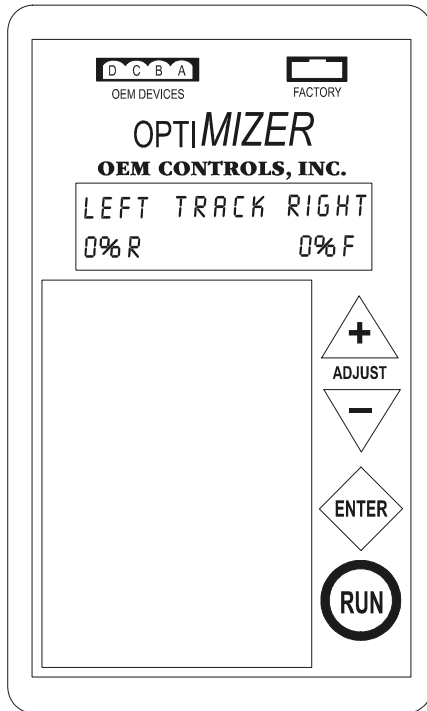
**JLG Harness At Platform Control Box Optimizer Connection:** Wht/Blk 58-1 (1) Orn/Red 49-2 (2) Orn/Red 49-3 (3) Wht/Red 57-1 (4)

The Superflex Controller is a rugged, microprocessor-controlled device that can directly operate four bi-directional electric over hydraulic valves. The Superflex receives inputs from Digisensors mounted on the dual axis controller (Drive/Steer) and converts these signals into proportional PWM outputs to the EDC drive pumps A & B. Each output signal can be independently fine-tuned and calibrated using the hand held Optimizer.

- THE FOLLOWING STEPS ARE VIEWING THE PERCENTAGE OF INPUT, TRAVELING INTO THE SUPERFLEX. THE FOLLOWING CAN BE DONE WITH OR WITHOUT THE ENGINE RUNNING.
- THE FOLLOWING DEFAULT SETTING NUMBERS ARE APPROXIMATE VALUES; THE SETTINGS YOU WILL SEE ON YOUR UNIT MAY NOT BE IDENTICAL, THIS IS DUE TO FRICTION, PART TOLERANCES AND HOURS OF OPERATION.
- DRIVE AND STEER FUNCTIONS WILL REQUIRE ONE TRACK TO MOVE SLOWER AND THE OPPOSITE DIRECTION TO ACHIEVE PROPER TRACKING.

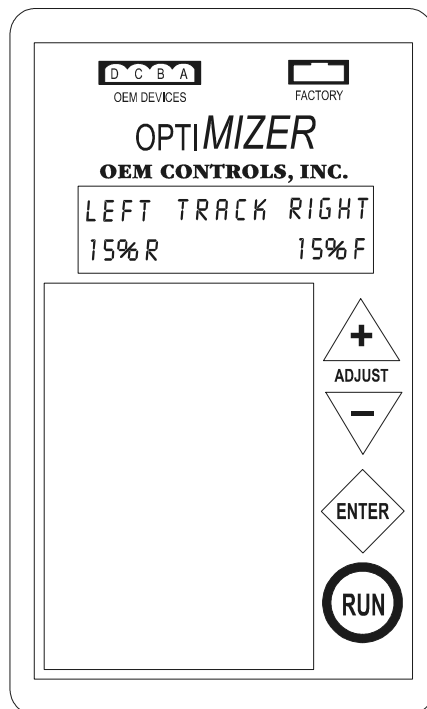


1. When the optimizer is first plugged in, the following will be displayed.



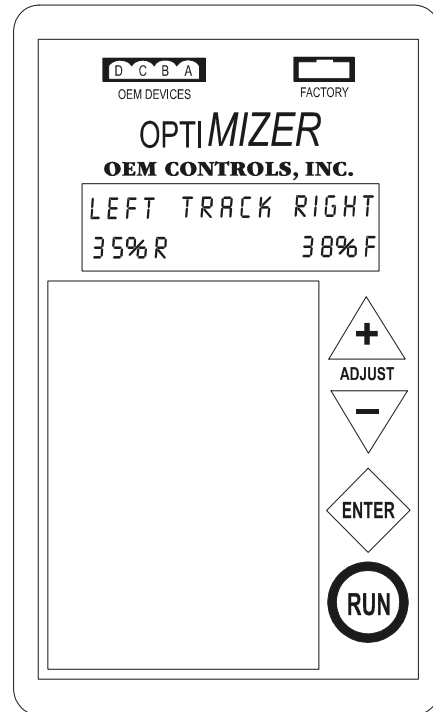
2. Next, move the joystick into the left or right positions (STEER) (DS2), this will tell you the percentage of input traveling into the Superflex, the range of travel is 15% at *Threshold* to 23% *Max Out*.

Ex: **Threshold** R= Rear F= Forward



3. Next move the joystick into the forward or reverse position (DRIVE) (DS1), this will tell you the percentage of input traveling into the Superflex, the range of travel is 17% at *Threshold* to 38% *Max Out*.

Ex: **Max Out**



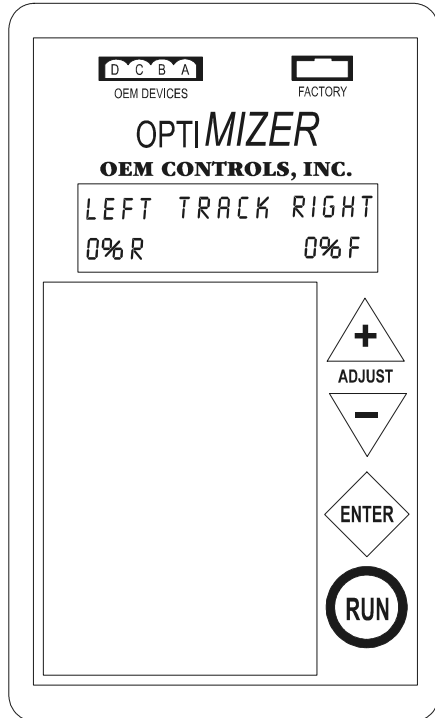


## SECTION 4 - BOOM & PLATFORM

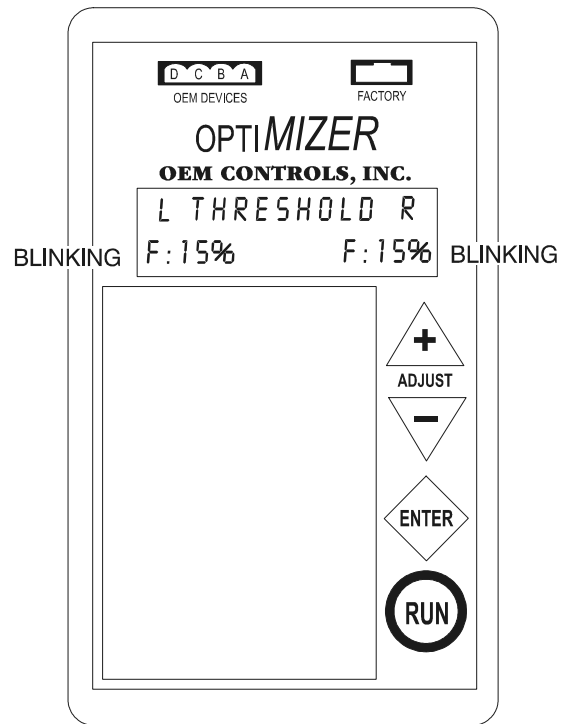
**NOTE:** The following steps are adjusting parameters.

### THRESHOLD/ MAX OUT/ RAMP UP/ RAMP DOWN/ LOW RANGE / TACHOMETER

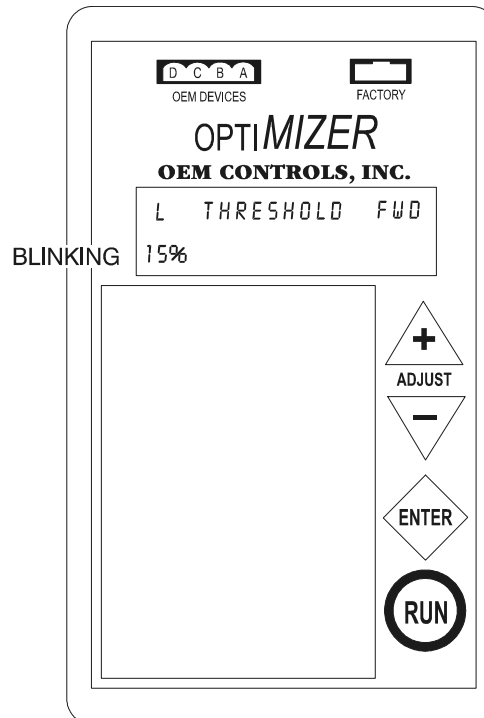
1. With the machine EMS up, foot switch pressed on, you will now see the following display;



2. Next push the (+) key. This should bring you to THRESHOLD, now push the ENTER key you should now see on the display BOTH THRESHOLD F and the default settings blinking.

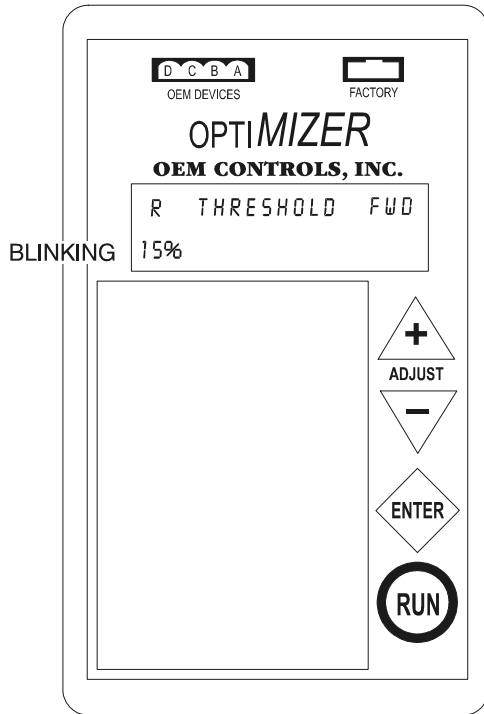


3. Next push the ENTER key, this will now show the individual THRESHOLD settings.

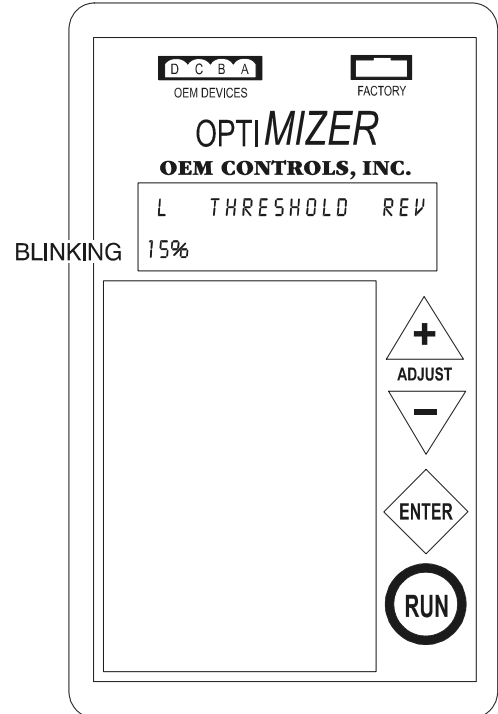




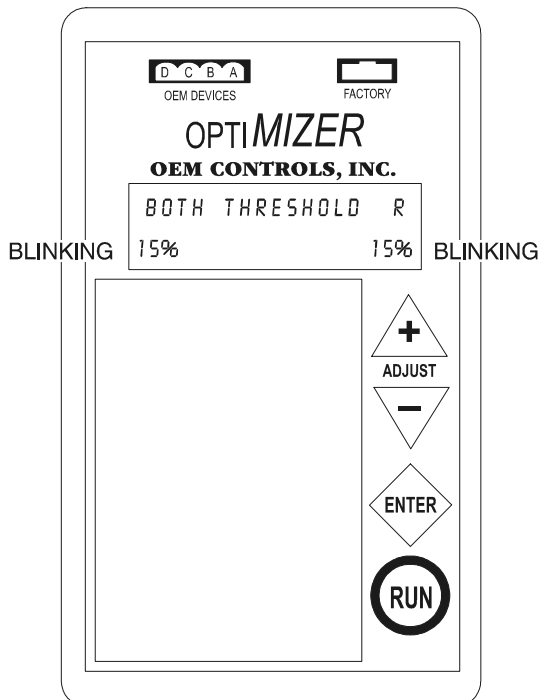
4. Next push the ENTER key, this will now show the RIGHT FWD THRESHOLD setting in the display, the default setting will blink now letting you know you can adjust.



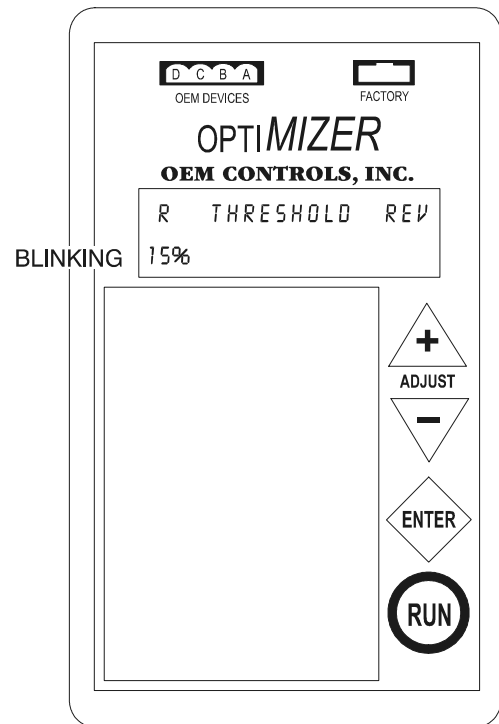
6. Next push the ENTER key, this will show the LEFT REV THRESHOLD setting on the display, the default setting will blink now letting you know you can adjust.



5. Next push the ENTER key, this will now show BOTH of the REV THRESHOLD settings on the display, the default setting will blink now letting you know you can adjust.



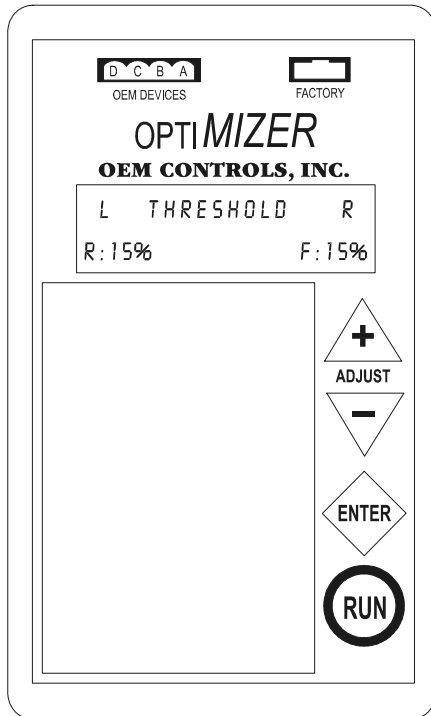
7. Next push the ENTER key this will show RIGHT REV THRESHOLD setting on the display, the default setting will blink now letting you know you can adjust.



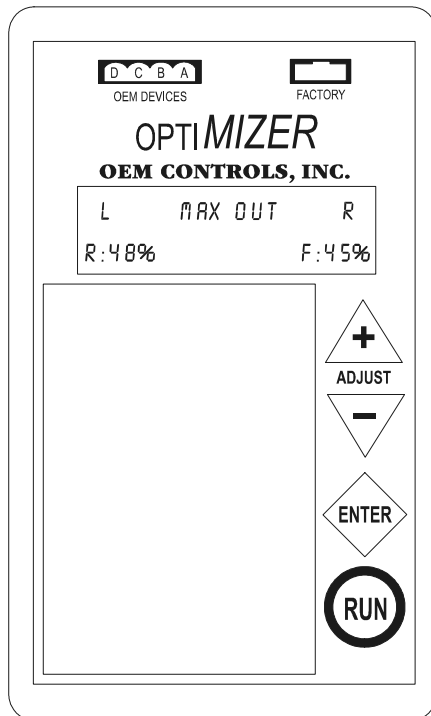


## SECTION 4 - BOOM & PLATFORM

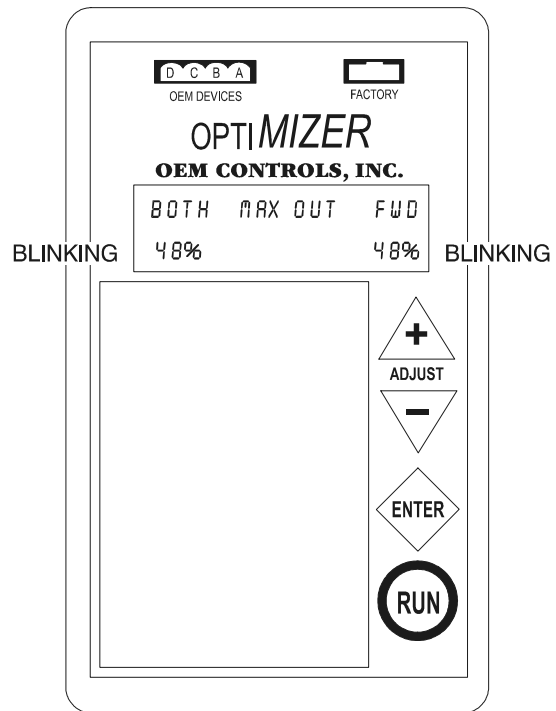
8. Next push the ENTER key, this will now show the newly adjusted settings if you chose to change them.



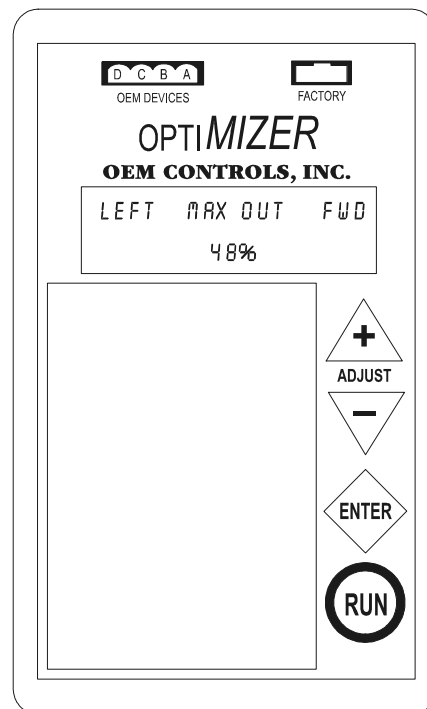
9. Now push the (+) key, this should show you the MAX OUT adjustment mode.



10. Next push the ENTER key, this will now show you the BOTH MAX OUT FWD setting on the display, the default setting will blink now letting you know you can adjust.

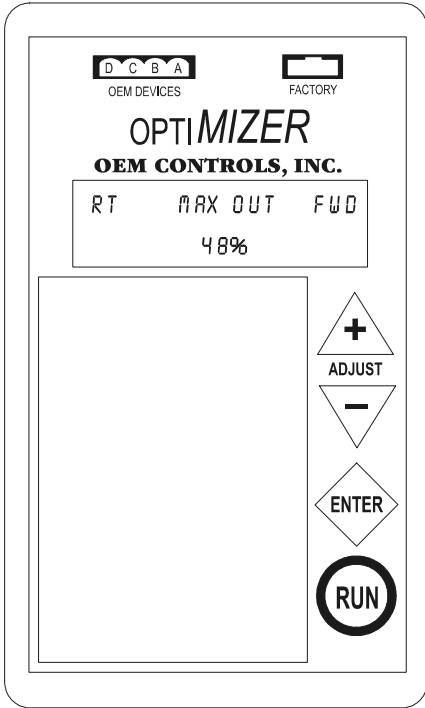


11. Next push the ENTER key, this will now show you the LEFT MAX OUT FWD setting on the display, the default setting will blink now letting you know you can adjust.

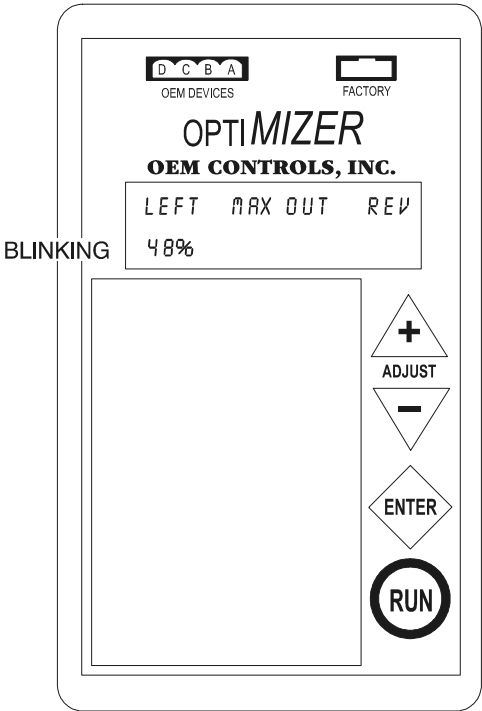




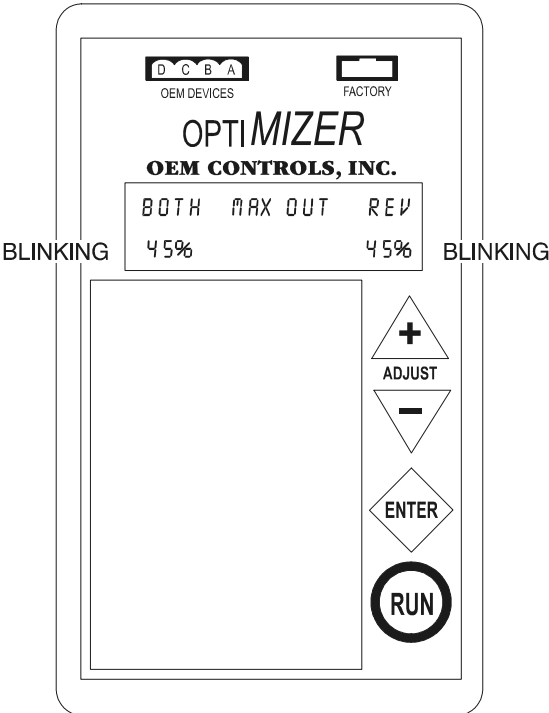
12. Next push the ENTER key, this will now show you the RIGHT MAX OUT FWD setting on the display, the default setting will blink now letting you know you can adjust.



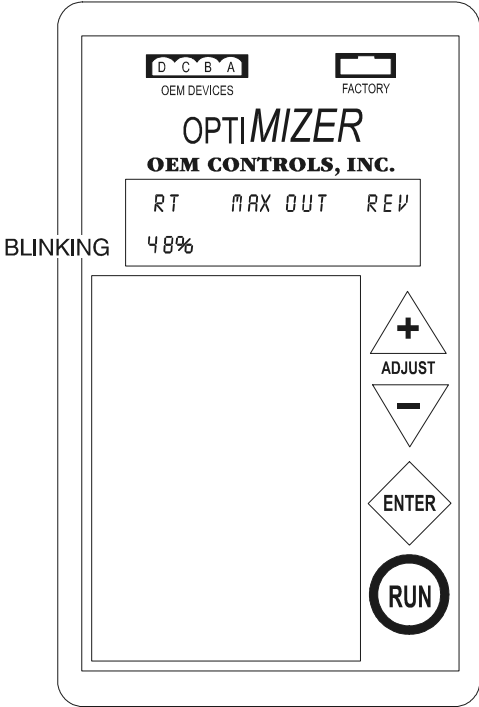
14. Next push the ENTER key, this will now show you the LEFT MAX OUT REV settings on the display, the default settings will now blink letting you know you can adjust.



13. Next push the ENTER key, this will now show you the BOTH MAX OUT REV settings in the display, the default settings will now blink letting you know you can adjust.



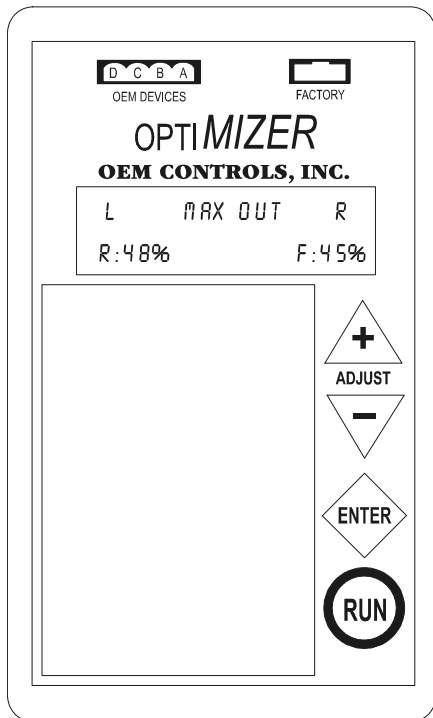
15. Next push the ENTER key, this will show you the RIGHT MAX OUT REV settings on the display, the default settings will now blink letting you know you can adjust.



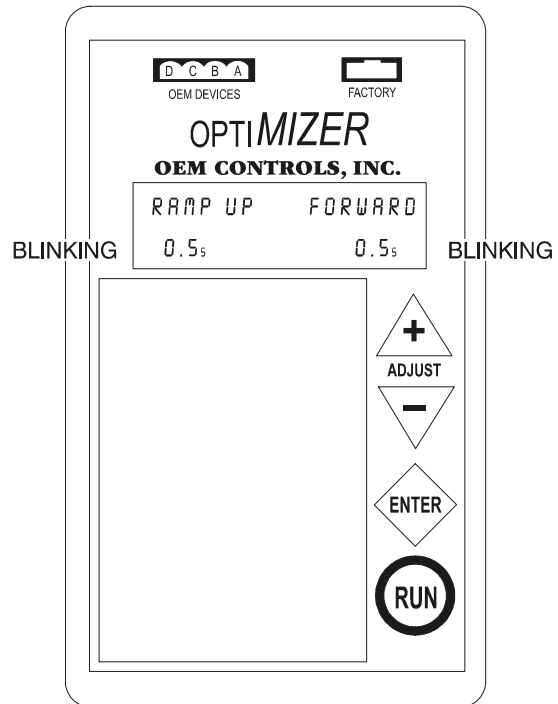


## SECTION 4 - BOOM & PLATFORM

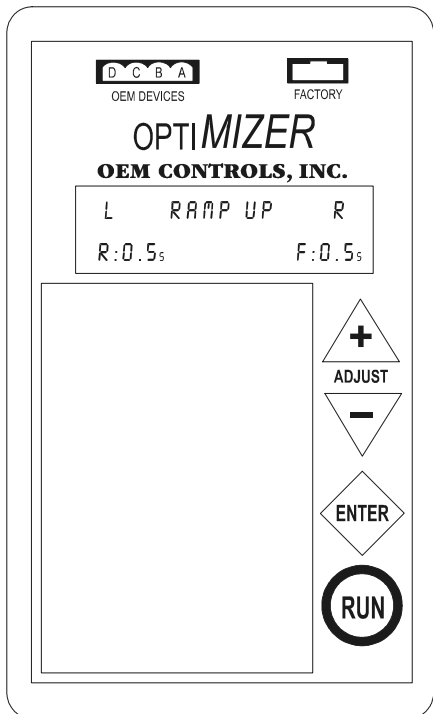
16. Next push the ENTER key, this will now show the newly adjusted settings if you chose to change them.



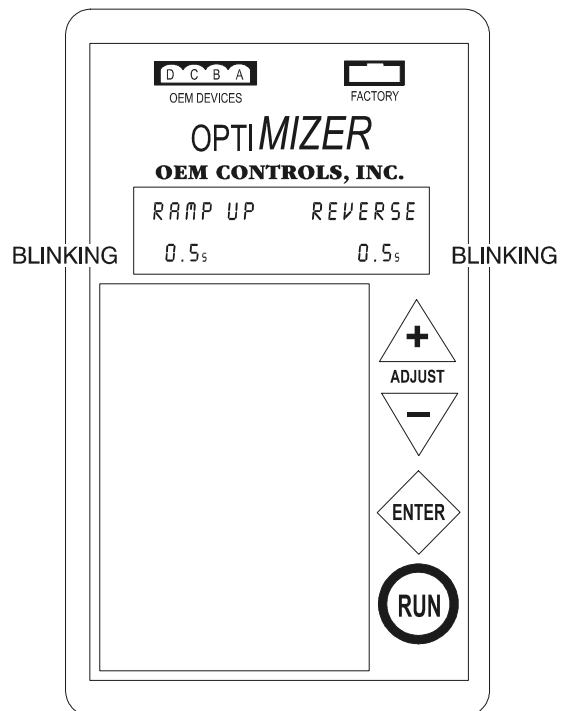
18. Next push the ENTER key this will now show you the RAMP UP FWD settings on the display, the default settings will blink now letting you know you can adjust.



17. Now push the (+) key this should put you in the RAMP UP mode.

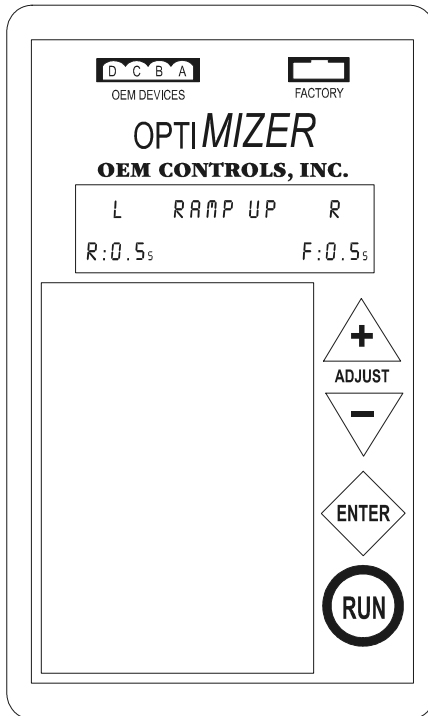


19. Next push the ENTER key, this will now show you the RAMP UP REV settings on the display, the default settings will now blink letting you know you can adjust.

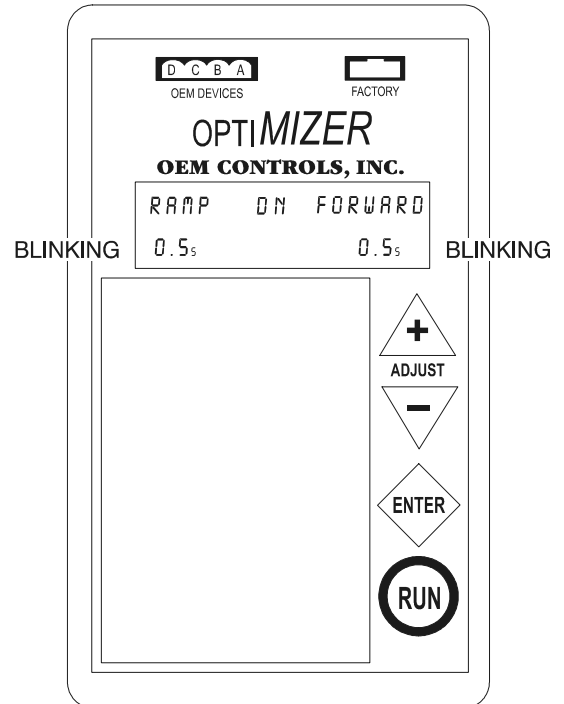




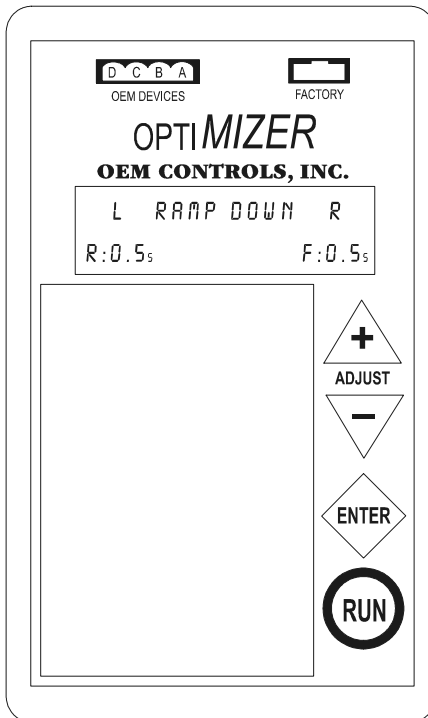
20. Next push the ENTER key, this will now show the newly adjusted settings if you chose to change them.



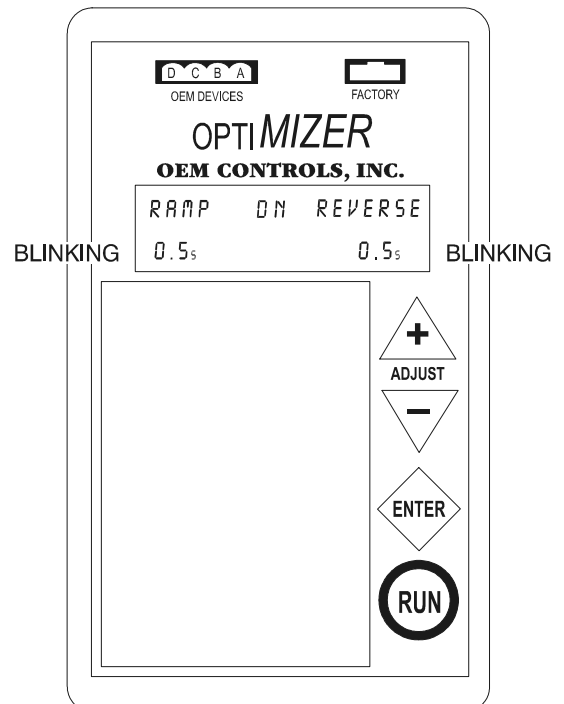
22. Now push the ENTER key, this will now show the RAMP DOWN FWD setting on the display, the default setting will blink now letting you know you can adjust.



21. Now push the (+) key this should put you in the RAMP DOWN mode.



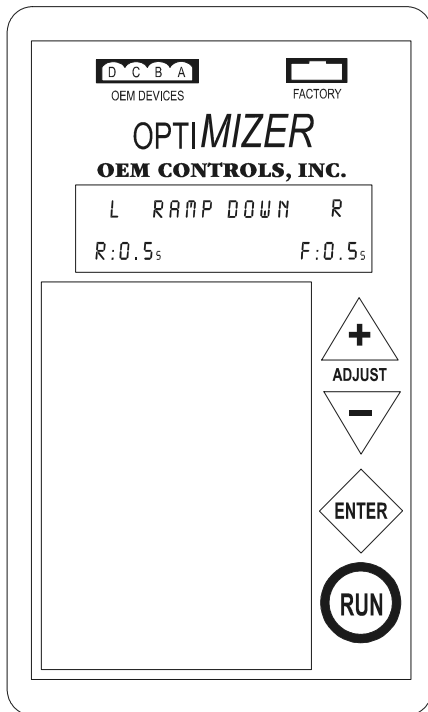
23. Next push the ENTER key, this will show the RAMP DOWN REVERSE setting on the display, the default setting will blink now letting you know you can adjust.



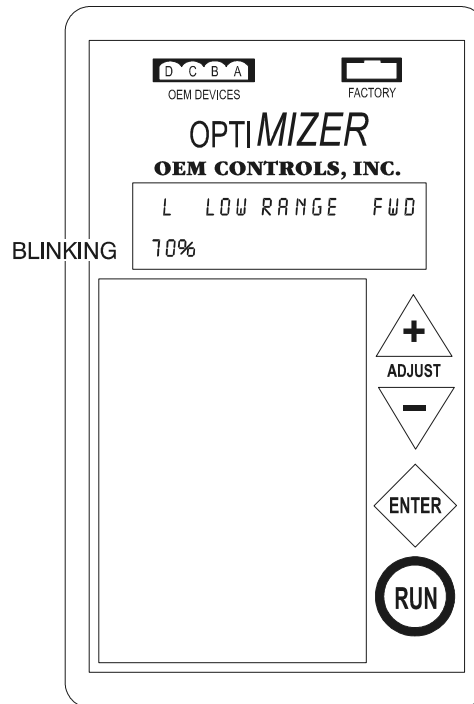


## SECTION 4 - BOOM & PLATFORM

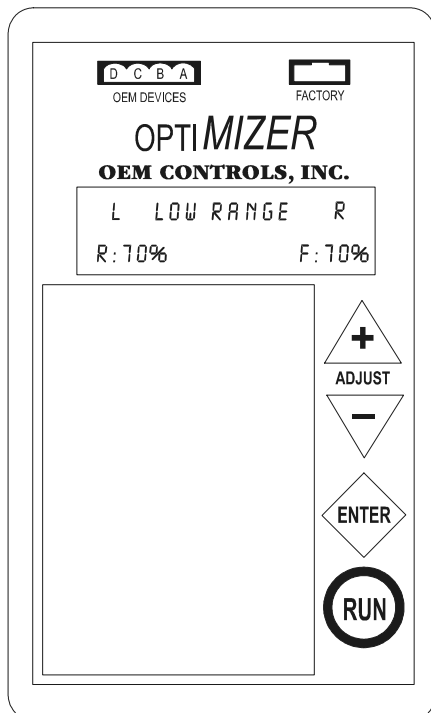
24. Next push the ENTER key, this will now show the newly adjusted settings if you chose to change them.



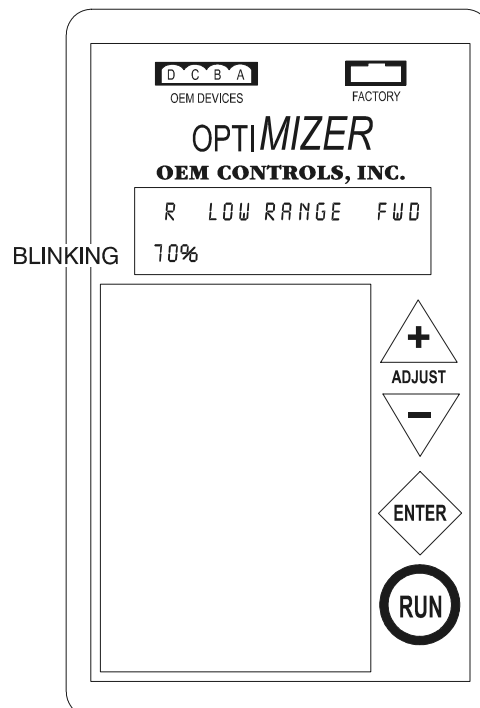
26. Next push the ENTER key, this will now show the LEFT LOW RANGE FWD setting on the display, the default setting will blink now letting you know you can adjust.



25. Next push the (+) key, this should put you in the LOW RANGE mode.

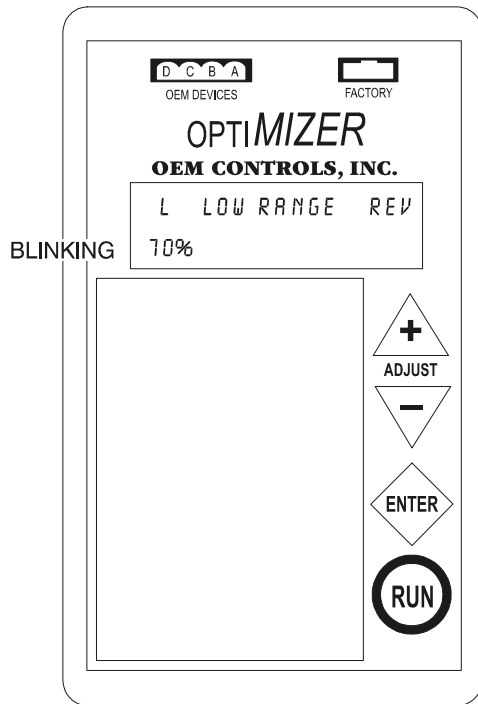


27. Next push the ENTER key this will now show the RIGHT LOW RANGE FWD setting on the display, the default setting will blink now letting you know you can adjust.

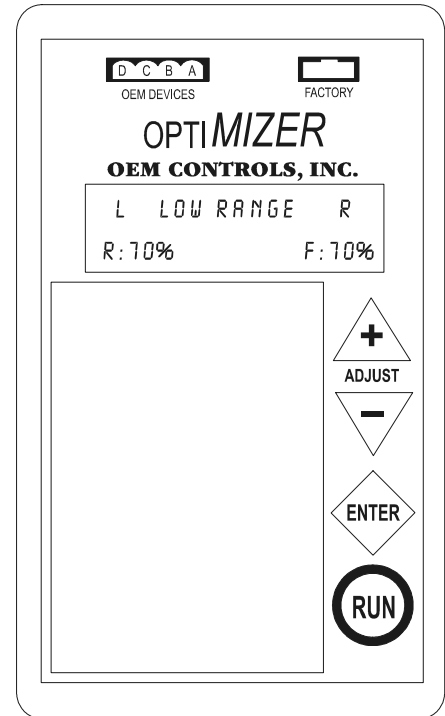




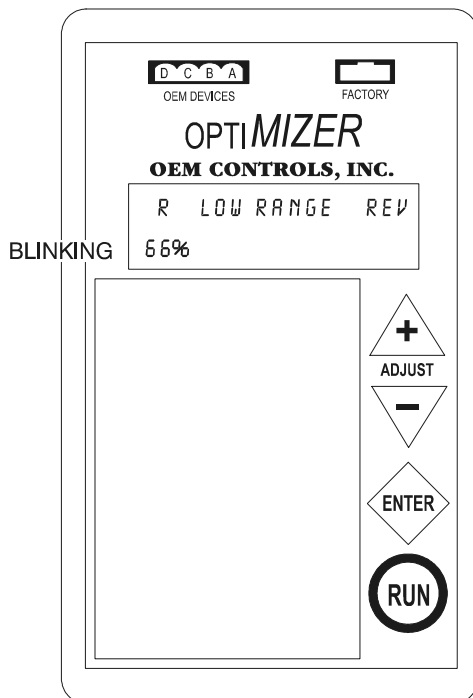
28. Next push the ENTER key, this will now show the LEFT LOW RANGE REV settings on the display, the default setting will blink now letting you know you can adjust.



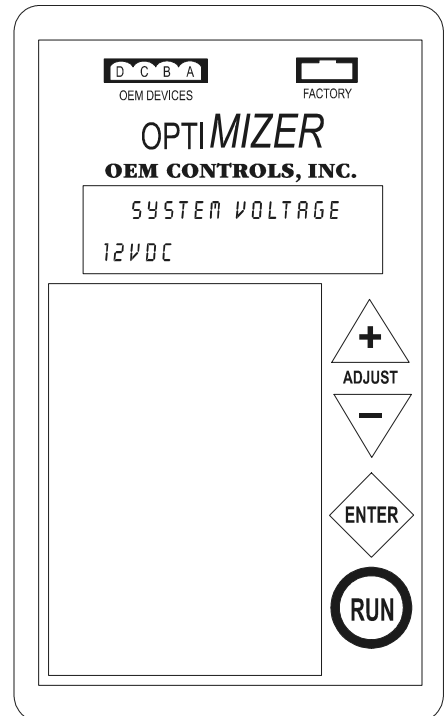
30. Next push the ENTER key, this will now show the newly adjusted settings if you chose to change, remember to push the RUN key before shutdown of the Superflex



29. Next push the ENTER key, this will show the RIGHT LOW RANGE REV settings on the display, the default setting will blink now letting you know you can adjust.



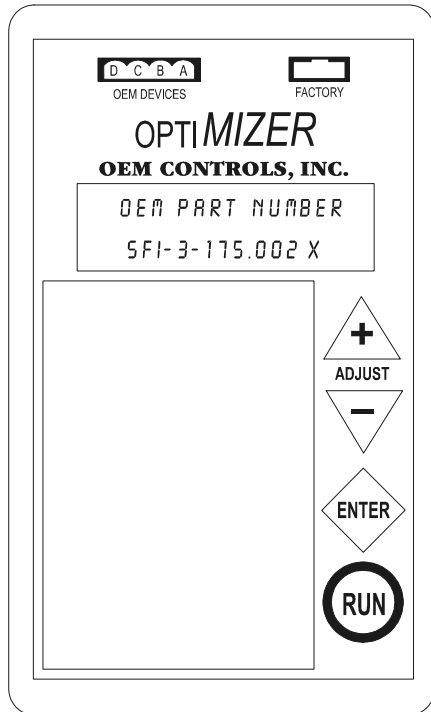
31. Next push the (+) key this should put you in the SYSTEM VOLTAGE mode this is a read only mode.





## SECTION 4 - BOOM & PLATFORM

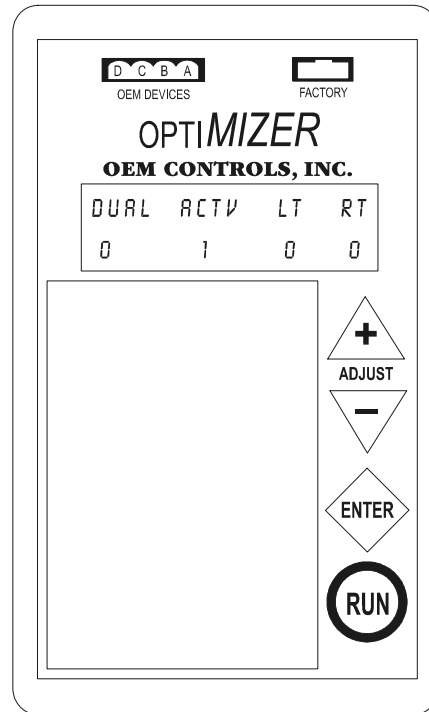
32. Next push the (+) key this will now show you the OEM PART NUMBER of the Superflex.



33. Next push the (+) key this will now show the SERIAL NUMBER of the Superflex.

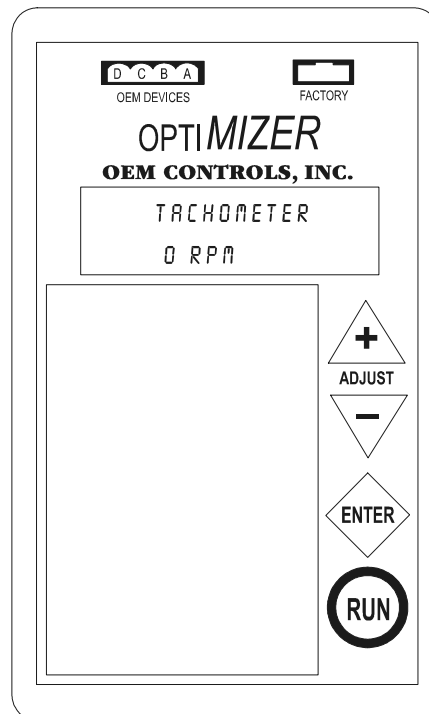


34. Now push the (+) key, this will now show you the DUAL ACTIVATED LEFT & RIGHT mode.



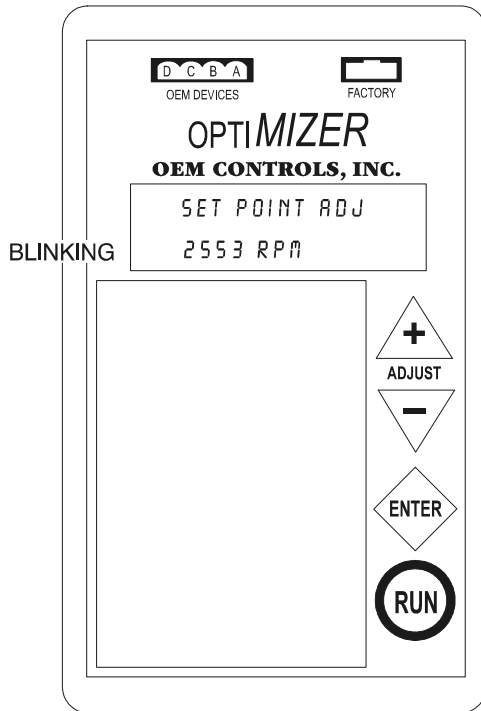
Currently this mode does not apply to the Crawler.

35. Next push the (+) key, this will put you in the TACHOMETER mode.

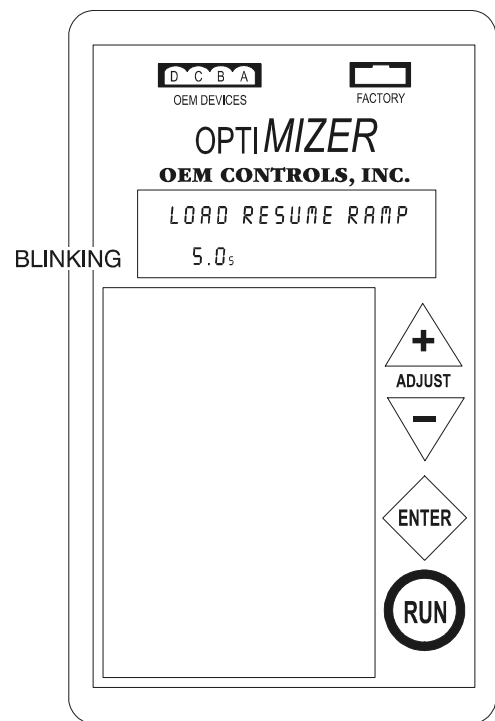




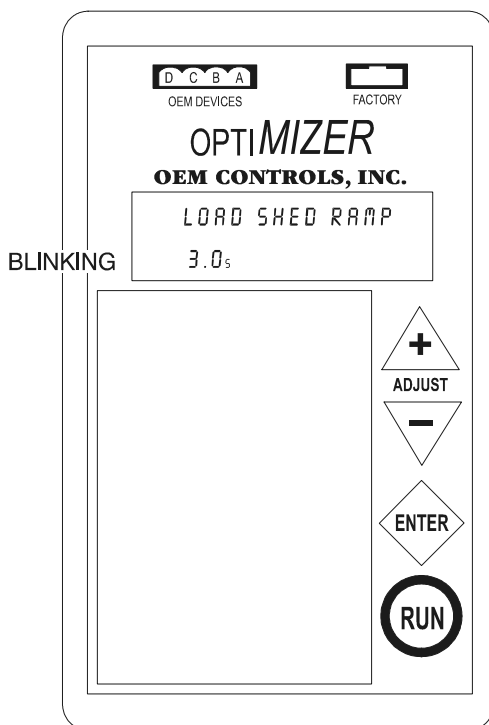
36. Next push the ENTER key, this will now show you the SET POINT ADJUSTMENT setting on the display, the default setting will blink now letting you know you can adjust.



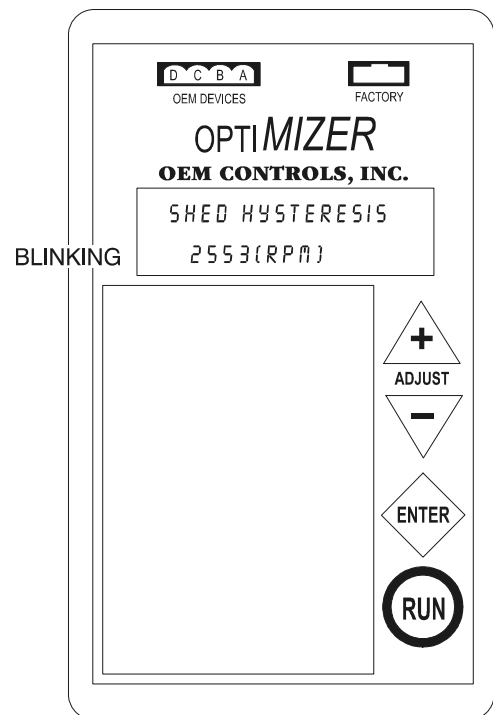
38. Next push the ENTER key, this will now show you the LOAD RESUME RAMP settings on the display, the default display will blink letting you know you can adjust.



37. Next push the ENTER key, this will now show you the LOAD SHED RAMP setting on the display, the default setting will blink letting you know you can adjust.



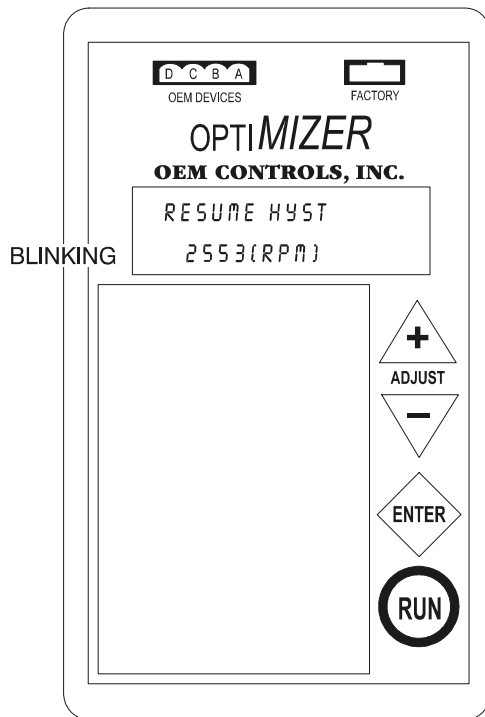
39. Next push the ENTER key, this will show the SHED HYSTERESIS setting on the display, the default setting will blink letting you know you can adjust.



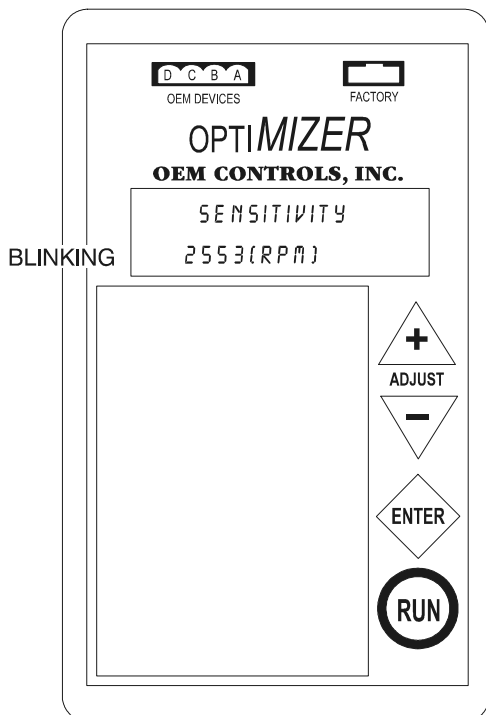


## SECTION 4 - BOOM & PLATFORM

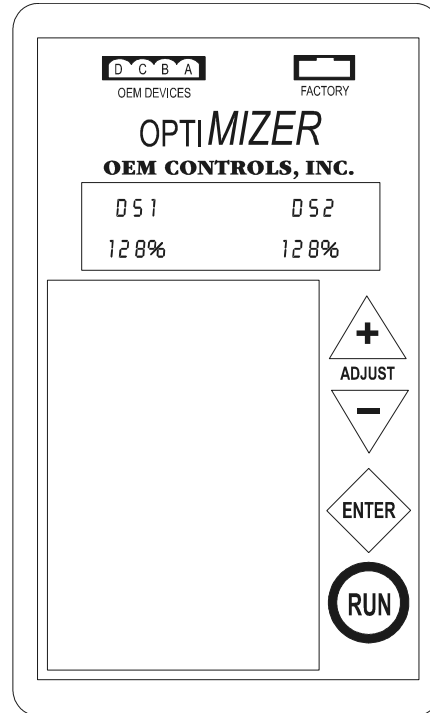
40. Next push the ENTER key, this will show you the RESUME HYSTERESIS setting on the display, the default setting will blink letting you know that you can adjust.



41. Next push the ENTER key, this will show the SENSITIVITY settings on the display, the default settings will blink letting you know you can adjust.



42. Next push the ENTER key this will bring you back to the TACHOMETER mode with the new settings if you chose to change them.
43. Next push the (+) key this will now show you the DS1 and DS2 settings, these are digisensor inputs that can be tested with or without the engine running.



DEFAULT SETTINGS		TACHOMETER	
Threshold	15%	Set Point Adj.	2553 (RPM)
Max Out	48%	Load Shed	3.0 seconds
Ramp Up	0.5 seconds	Load Resume Ramp	5.0 seconds
Ramp Down	0.5 seconds	Shed Hysteresis	2553 (RPM)
Low Range	70%	Resume Hysteresis	2553 (RPM)
DS1 & DS2	128%	Sensitivity	2553 (RPM)



## Superflex Inputs And Outputs

### 18 Pin Connector (Green)

#### Inputs

#1	(Red Wire)	<i>Digisensor (Steer)</i>
#2	(Not Used)	
#3	(Red Wire)	<i>Digisensor (Drive)</i>
#4	(Not Used)	
#5	(Red)	<i>Tach Input-Speed</i>
#6	(Not Used)	
#7	(Yel/Red)	<i>Horsepower Input</i>
#8	(Not Used)	
#9	(Red)	<i>Hi-Speed Input for Drive Digisensor</i>
#10		<i>Specified Output</i>

#### 12 Volt Power

#11	(Yel/Red)	<i>Positive</i>
#12	(Black)	<i>Negative</i>

#### Outputs

#13	(Red)	<i>Left Track Fwd</i>
#14	(Red)	<i>Left Track Rev.</i>
#15	(Red)	<i>Right Track Fwd.</i>
#16	(Red)	<i>Right Track Rev.</i>
#17	(Red)	<i>Auxiliary (Dump Valve)</i>

### Optimizer Plug

A	(Wht/Blk)	58-2
B	(Org/Red)	49-21
C	(Org/Red)	49-22
D	(Wht/Red)	57-2

### Superflex LED's

- The Superflex has 3 LED's the top is input, the center is power, and the bottom is out put.
- Footpedal pressed and joystick trigger engaged, you will light up the center LED on the Superflex, also their will be 12 volts at #11 & #12 on the 18 pin plug, once you release the pedal the 12VDC will disappear.
- Once the joystick is moved in any position, the 3 LED's will chase each other letting you know the Superflex has received the input and that it is sending it out to the drive pumps EDC.

### Amperage & Ohm Values (Approximate Values)

<b>(Engine Bell Housing) EDC:</b>		<b>Resistance: 16.0 ohms</b>
Steer: (Left)	Wire Org. 7/3	60 – 63 ma
Steer: (Right)	Wire Org. 8/3	60 – 63 ma
Drive: (Fwd)	Wire Org. 7/3	100 – 103 ma
Drive: (Rev)	Wire Org. 8/3	100 – 103 ma
<b>(Pump Side) EDC:</b>		<b>Resistance: 16.0 ohms</b>
Steer: (Left)	Wire Org. 7/4	60 – 63 ma
Steer: (Right)	Wire Org. 8/4	60 – 63 ma
Drive: (Fwd)	Wire Org. 8/4	100 - 103 ma
Drive: (Rev)	Wire Org. 7/4	100 – 103 ma



**This page left blank intentionally.**



## SECTION 5. HYDRAULICS

### 5.1 CYLINDERS - THEORY OF OPERATION

#### Systems Incorporating Double Acting Cylinders

Cylinders are of the double acting type. Systems incorporating double acting cylinders are as follows: Slave Level, Master Level, Lift, Telescope, Articulating Jib Boom Lift. A double acting cylinder is one that requires oil flow to operate the cylinder rod in both directions. Directing oil (by actuating the corresponding control valve to the piston side of the cylinder) forces the piston to travel toward the rod end of the barrel, extending the cylinder rod (piston attached to rod). When the oil flow is stopped, movement of rod will stop. By directing oil to the rod side of the cylinder, the piston will be forced in the opposite direction and the cylinder rod will retract.

#### Systems Incorporating Holding Valves

Holding valves are used in the - Lift, Telescope, Lockout, Slave Level and Articulating Jib Boom Lift circuits to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

### 5.2 VALVES - THEORY OF OPERATION

#### Solenoid Control Valve - Rexroth

Control valves used are four-way three-position solenoid valves of the sliding spool design. When a circuit is activated and the control valve solenoid energizes, the spool is shifted and the corresponding work port opens to permit oil flow to the component in the selected circuit with the opposite work port opening to reservoir. Once the circuit is deactivated (control returned to neutral) the valve spool returns to neutral (center) and oil flow is then directed through the valve body and returns to reservoir. A typical control valve consists of the valve body, sliding spool, and two solenoid assemblies. The spool is machine fitted in the bore of the valve body. Lands on the spool divide the bore into various chambers, which, when the spool is shifted, align with corresponding ports in the valve body open to common flow. At the same time other ports would be blocked to flow. The spool is spring loaded to center position, therefore when the control is released, the spool automatically returns to neutral, prohibiting any flow through the circuit.

#### Relief Valves

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

### 5.3 CYLINDER CHECKING PROCEDURE

**NOTE:** Cylinder check must be performed anytime a system component is replaced or when improper system operation is suspected.

#### Cylinders Without Counterbalance Valves - Master Cylinder and Steer Cylinder

1. Using all applicable safety precautions, activate engine and fully extend cylinder to be checked. Shut down engine.
2. Carefully disconnect hydraulic hoses from retract port of cylinder. There will be some initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge, there should be no further drainage from the retract port.
3. Activate engine and extend cylinder.
4. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to port and retract cylinder. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repair must be made.
5. With cylinder fully retracted, shut down engine and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate engine and retract cylinder. Check extend port for leakage.
7. If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, then activate cylinder through one complete cycle and check for leaks. If leakage continues at a rate of



6-8 drops per minute or more, cylinder repairs must be made.

### Cylinders With Single Counterbalance Valve

Upper Lift Cylinder.

#### **IMPORTANT**

**OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.**

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

#### **⚠ WARNING**

**WHEN WORKING ON THE MAIN LIFT CYLINDER, RAISE THE BOOM TO HORIZONTAL AND PLACE A BOOM PROP APPROXIMATELY 1 INCH (2.54 CM) BELOW THE MAIN BOOM. DO NOT WORK ON THE CYLINDER WITHOUT A SUITABLE PROP IN PLACE.**

2. Shut down hydraulic system and allow machine to sit for 10-15 minutes. If machine is equipped with bang-bang or proportional control valves, turn IGNITION SWITCH to ON, move control switch or lever for applicable cylinder in each direction, then turn IGNITION SWITCH to OFF. If machine is equipped with hydraulic control valves, move control lever for applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines. Carefully remove hydraulic hoses from appropriate cylinder port block.
3. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.
4. To check piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge, there should be no further leakage from the ports. If leakage occurs at a rate of 6-8 drops per minute or more, the piston seals are defective and must be replaced.
5. If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully connect hydraulic hoses to cylinder port block.
6. If used, remove lifting device from upright or remove prop from below main boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

### Cylinders With Dual Counterbalance Valves

(Articulating Jib Boom Lift, and Slave), Slave Level, Lower Lift, Upright level, Main Telescope and Tower Telescope.

#### **IMPORTANT**

**OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.**

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

#### **⚠ WARNING**

**IF WORKING ON THE TOWER BOOM LIFT CYLINDER, RAISE TOWER BOOM HALFWAY, FULLY ELEVATE MAIN BOOM WITH TELESCOPE CYLINDER FULLY RETRACTED AND ATTACH AN OVERHEAD CRANE TO THE UPRIGHT FOR SUPPORT, LEAVING APPROXIMATELY 1 INCH (2.54 CM) OF SLACK IN CHAIN OR SLING FOR TEST PURPOSES. IF WORKING ON THE UPRIGHT LEVEL, RAISE THE TOWER BOOM HALFWAY, THEN RAISE MAIN BOOM TO HORIZONTAL AND POSITION A SUITABLE BOOM PROP APPROXIMATELY 1 INCH (2.54 CM) BELOW MAIN BOOM. IF WORKING ON THE PLATFORM LEVEL CYLINDER, STROKE PLATFORM LEVEL CYLINDER FORWARD UNTIL PLATFORM SITS AT A 45 DEGREES ANGLE.**

2. Shut down hydraulic system and allow machine to sit for 10-15 minutes. If machine is equipped with bang-bang or proportional control valves, turn IGNITION SWITCH to ON, move control switch or lever for applicable cylinder in each direction, then turn IGNITION SWITCH to OFF. If machine is equipped with hydraulic control valves, move control lever for applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines. Carefully remove hydraulic hoses from appropriate cylinder port block.
3. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.
4. To check piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge, there should be no further leakage from the ports. If leakage occurs at a rate of 6-8 drops per minute or more, the piston seals are defective and must be replaced.
5. If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully connect hydraulic hoses to cylinder port block.
6. If used, remove lifting device from upright or remove prop from below main boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.



## 5.4 CYLINDER REPAIR

**NOTE:** The following are general procedures that apply to all of the cylinders on this machine. Procedures that apply to a specific cylinder will be so noted.

### Disassembly

#### IMPORTANT

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

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

#### WARNING

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

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

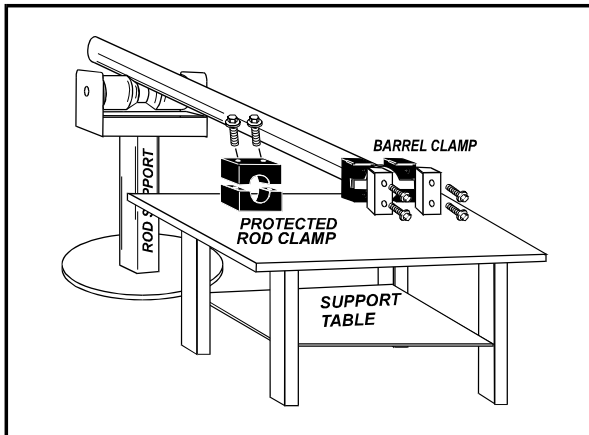


Figure 5-1. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen

the eight (8) cylinder head retainer cap screws, and remove cap screws from cylinder barrel.

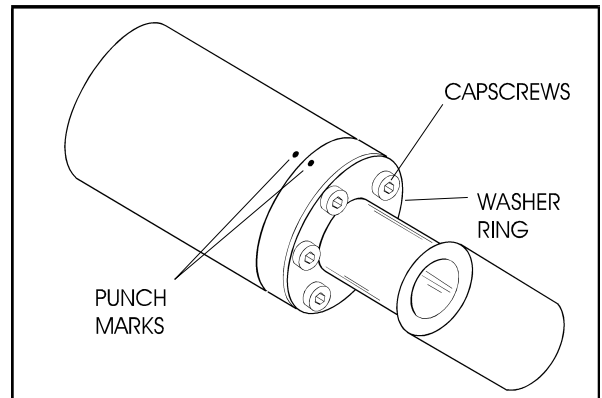


Figure 5-2. Cap Screw Removal

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

#### IMPORTANT

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

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

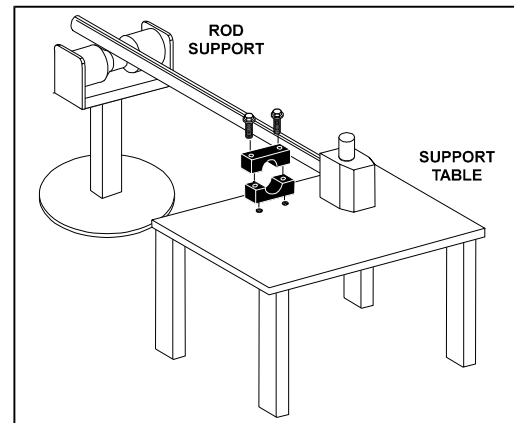
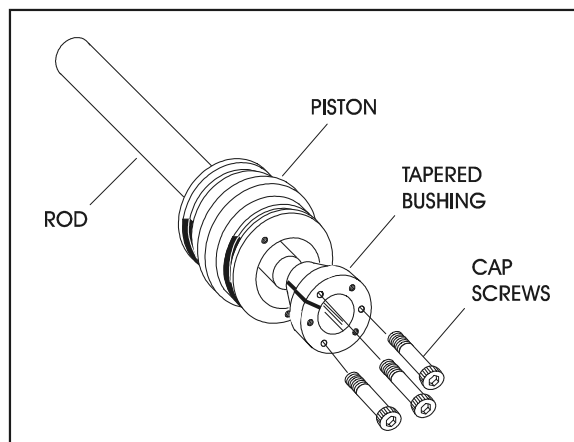


Figure 5-3. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.



9. Loosen and remove the cap screw(s), if applicable, which attach the tapered bushing to the piston.
10. Insert the cap screw(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the cap screw(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.



**Figure 5-4. Tapered Bushing Removal**

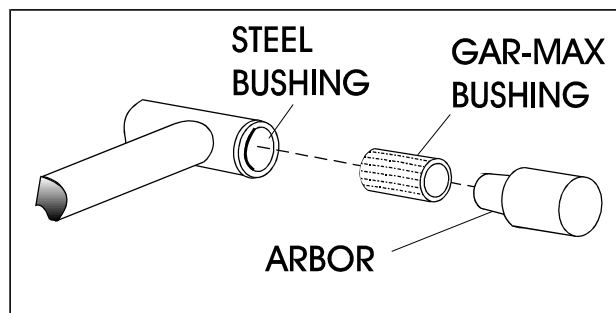
12. Screw the piston CCW, by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer plate, if applicable. Discard the o-rings, back-up rings, rod seals, and wiper seals.

### Cleaning and Inspection

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

7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
  - a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
  - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
  - c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
  - d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

**NOTE:** Install pin into the Gar-Max bearing dry. Lubrication is not required with nickel plated pins and bearings.



**Figure 5-5. Gar-Max Bearing Installation**

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



17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

### Assembly

**NOTE:** Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.

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

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

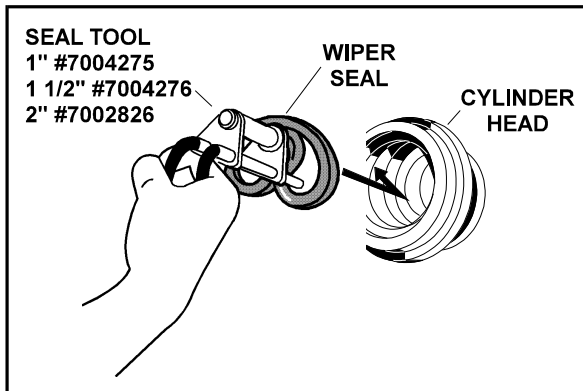


Figure 5-6. Rod Seal Installation

### IMPORTANT

WHEN INSTALLING 'POLY-PAK' PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO WIPER SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

### IMPORTANT

WHEN INSTALLING THE WIPER SEAL ON THE LOWER (TOWER) LIFT CYLINDER, APPLY LOCTITE #609 ON THE WIPER SEAL IN THREE EVENLY SPACED PLACES TO AID IN RETENTION OF THE SEAL.

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

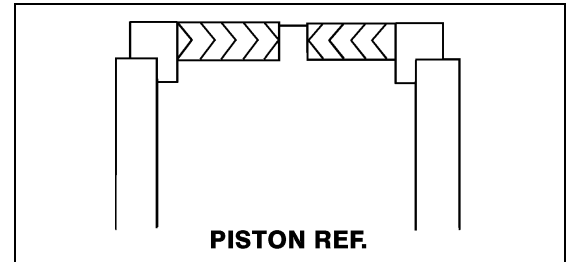


Figure 5-7. Poly-Pak Piston Seal Installation

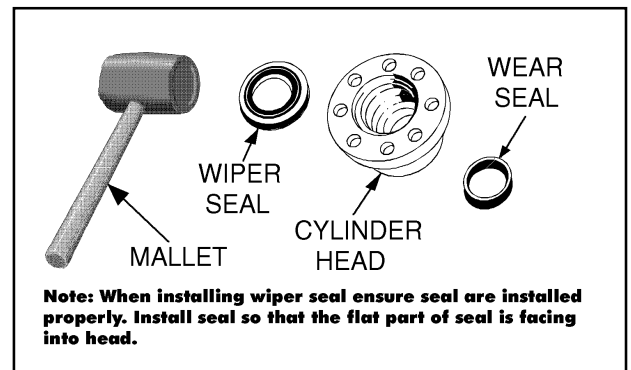
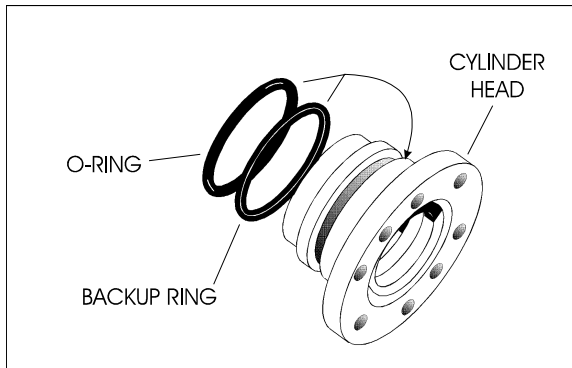


Figure 5-8. Wiper Seal Installation



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



**Figure 5-9. Installation of Head Seal Kit**

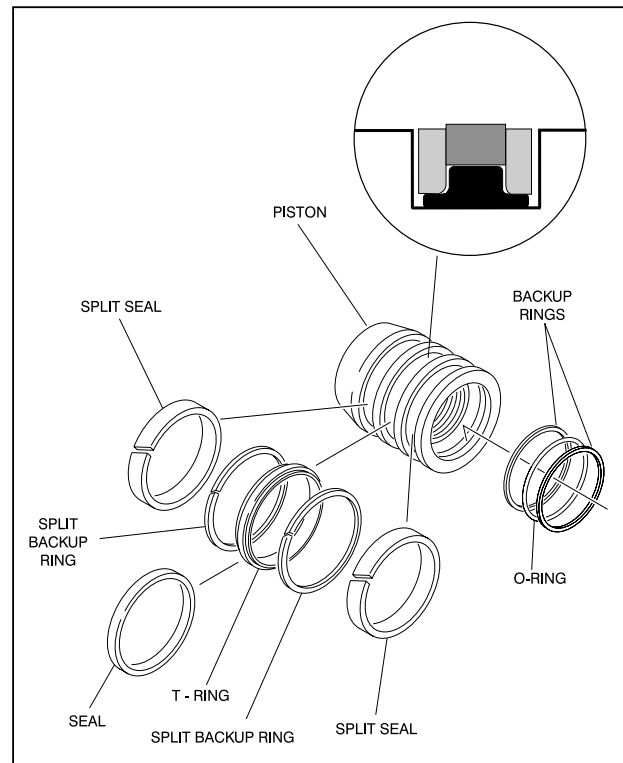
- Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
- Carefully slide the piston spacer on the rod.

**NOTE:** Upper telescope cylinder piston has an o-ring installed inside the spacer.

- If applicable, correctly place new o-ring in the inner piston diameter groove. (The backup ring side facing the O-ring is grooved.)

- If applicable, correctly place new seals and guide lock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal.)

**NOTE:** The backup rings for the solid seal have a radius on one side. This side faces the solid seal. (See magnified insert in Figure 5-10.) The split of seals and backup rings are to be positioned so as not to be in alignment with each other.



**Figure 5-10. Piston Seal Kit Installation**

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

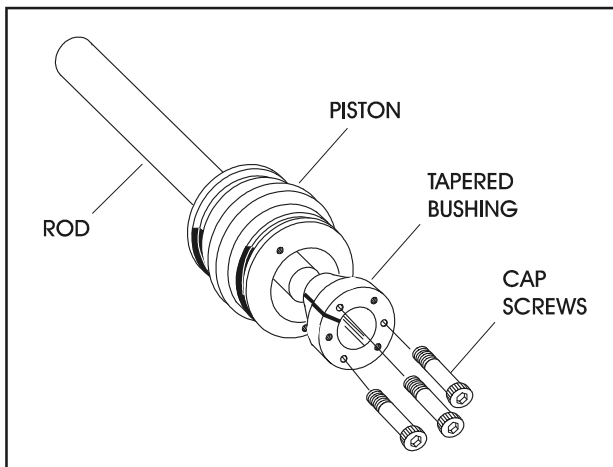


**NOTE:** When installing the tapered bushing, piston and mating end of rod must be free of oil.

**⚠ WARNING**

WHEN REBUILDING THE MASTER, SLAVE, LOWER LIFT, UPPER LIFT, ARTICULATING FLY BOOM LIFT, UPRIGHT LEVEL, TOWER TELESCOPE, OR UPPER TELESCOPE CYLINDERS, TIGHTEN SECURELY. (SEE TABLE 2-1 AND 2-3. TORQUE SPECIFICATIONS).

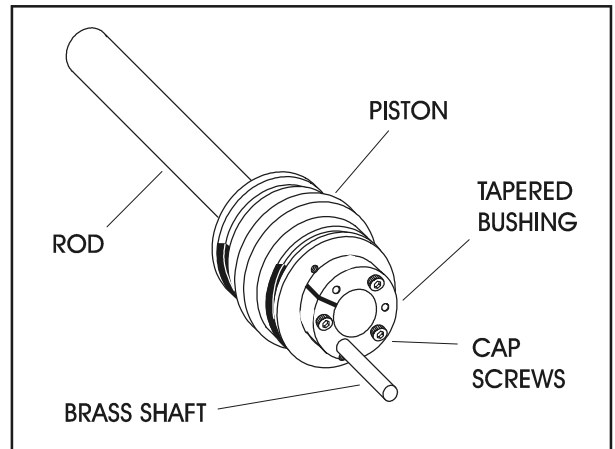
11. Assemble the tapered bushing loosely into the piston and insert JLG capscrews (not vendor capscrews) through the drilled holes in the bushing and into the tapped holes in the piston.



**Figure 5-11. Tapered Bushing Installation**

12. Tighten the capscrews evenly and progressively in rotation to the specified torque value. (See Table 5-1, Cylinder Head and Tapered Bushing Torque Specifications.
13. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
  - a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

- b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.



**Figure 5-12. Seating the Tapered Bearing**

14. Retorque the capscrews evenly and progressively in rotation to the specified torque value. (See Table 5-1, Cylinder Head and Tapered Bushing Torque Specifications.)
15. Remove the cylinder rod from the holding fixture.
16. Place new guide locks and seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 5-10.)
17. Position the cylinder barrel in a suitable holding fixture.

**IMPORTANT**

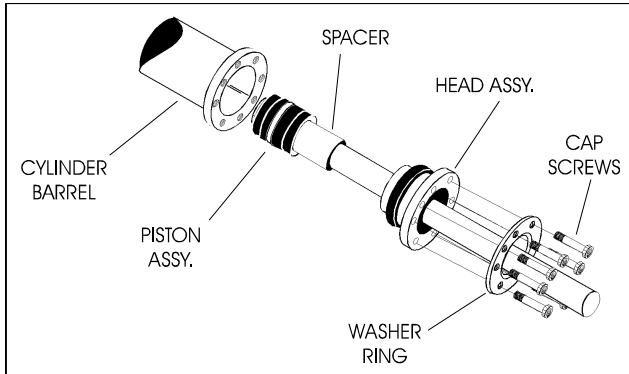
**EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.



## SECTION 5 - HYDRAULICS

20. Secure the cylinder head gland using the washer ring and socket head bolts. (See Table 5-1 .)



**Figure 5-13. Rod Assembly Installation**

21. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. (See Table 5-2, Holding Valve Torque Specifications).

**Table 5-1. Cylinder Head and Tapered Bushing Torque Specifications.**

Description	Head Torque Value (Wet)	Tapered Bushing Torque Value (Wet)
Lift Cylinder	275 ft. lbs. (373 Nm)	30 ft. lbs. (41 Nm)
Articulating Lift Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Slave Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Master Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Telescope Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Lockout Cylinder	80 ft. lbs. (109 Nm)	N/A
Articulating Slave Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Articulating Master Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)

**Table 5-2. Holding Valve Torque Specifications**

Description	Torque Value
SUN - 7/8 HEX M20 X 1.5 THDS.	30-35 ft. lbs. (41-48 Nm)
SUN - 1 1/8 HEX 1 -14 UNS THDS.	45-50 ft. lbs. (61-68 Nm)
SUN - 1 1/4 HEX M36 X 2 THDS.	150-160 ft. lbs. (204-217 Nm)
RACINE - 1 1/8 HEX 1 1/16 - 12 THDS.	50-55 ft. lbs. (68-75 Nm)
RACINE - 1 3/8 HEX 1 3/16 - 12 THDS.	75-80 ft. lbs. (102-109 Nm)
RACINE - 1 7/8 HEX 1 5/8 - 12 THDS.	100-110 ft. lbs. (136-149 Nm)

### **⚠ CAUTION**

**IF THE CYLINDER IS TO BE TESTED PRIOR TO INSTALLATION ON THE MACHINE, EXTREME CARE SHOULD BE USED TO INSURE THAT THE OUTER END OF THE ROD IS SUPPORTED. USE EITHER A TRAVELING OVERHEAD HOIST, FORK-LIFT, OR OTHER MEANS TO SUPPORT THE OVERHANGING WEIGHT OF THE EXTENDING ROD.**



## 5.5 CYLINDER REMOVAL AND INSTALLATION

### Main Boom Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position.
2. Shut down engine. Support main boom basket end with a prop. (See Figure 5-14., Boom Positioning and Support, Cylinder Repair).

#### **CAUTION**

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

3. Tag and disconnect hydraulic lines to telescope cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
4. Remove the hardware securing cover plate on bottom of the base boom section and remove cover.

**NOTE:** Do not allow cable to rotate. This may damage the cable.

5. Clamp both threaded ends of cable to prevent rotation. Note: Do not clamp on threads. Remove jam nuts and loosen adjustment nuts so there is slack in the cables. Remove the hardware securing push bar to turntable and telescope cylinder.
6. Using a suitable brass drift, carefully drive the push bar pins from the telescope cylinder rod and turntable.
7. Remove hardware securing cable adjustment block to aft end of the base boom section and remove block.

8. Remove hardware securing telescope cylinder to aft end of the mid boom section.

#### **CAUTION**

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION: DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

9. Remove bolts securing cable attach bar to top of fly boom section.
10. Pull the telescope cylinder and cables partially from aft end of the base boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
11. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.

### Main Boom Telescope Cylinder Installation

1. Route extend cables around extend sheave and secure cables to the telescope cylinder.
2. Install extend cables mounting blocks to threaded ends of cables. Loosely install nuts and jam nuts onto the threaded end of cables.

**NOTE:** When installing cables care must be taken not to twist or cross the cables.

3. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the boom assembly.

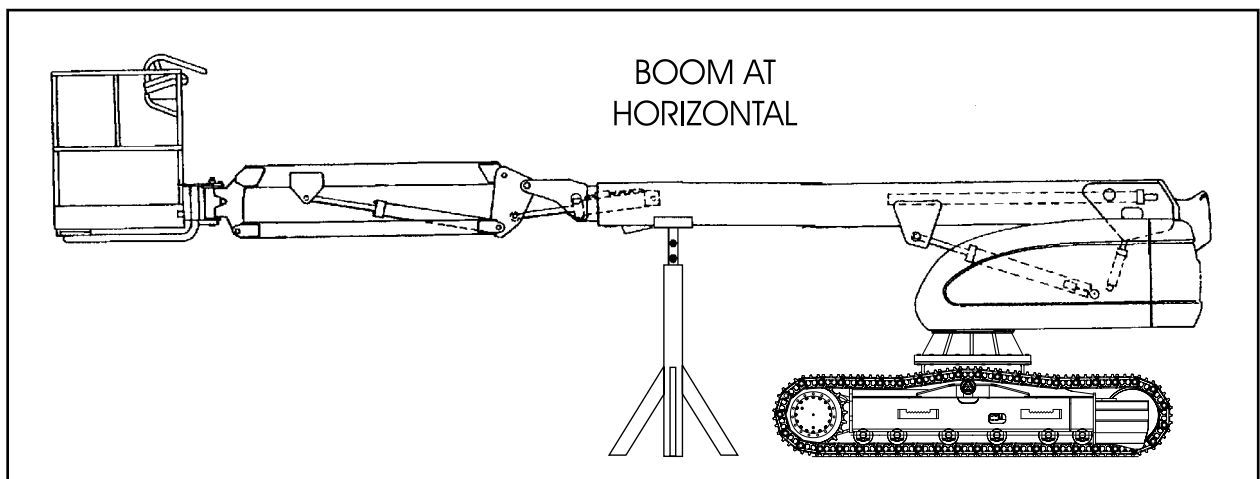


Figure 5-14. Boom Positioning and Support, Cylinder Repair



4. Install extend cable mounting blocks to threaded ends of cables. Loosely install nuts and jam nuts onto the threaded ends of cables.

**NOTE:** When installing cables, care must be taken not to twist or cross the cables.

5. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the boom assembly.

### CAUTION

WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION: DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

6. Carefully install the telescope cylinder barrel end support into slots in mid boom and secure with blocks and bolts. Use Loctite #242 on bolts.
7. Align holes in aft end of the fly boom section with holes in cable mounting block, then secure with mounting hardware.
8. Align holes in aft end of the base boom section with holes in cable mounting block, then secure with mounting hardware.
9. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
10. Align holes in rod end of the telescope cylinder with holes in push bar. Install push bar pin and secure with mounting hardware.
11. Align holes in push bar with holes in turntable. Install push bar pin and secure with mounting hardware.

**NOTE:** Boom cables must be torqued after installation of the telescope cylinder. (See Section 4 - Boom & Platform)

## Main Boom Lift Cylinder Removal

---

1. Place the machine on a flat and level surface. Start the engine and place the main boom in the horizontal position. Shut down engine and prop the boom. (See Figure 5-14., Boom Positioning and Support, Cylinder Repair)
2. Remove the hardware retaining the cylinder rod attach pin to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
3. Using auxiliary power, retract the lift cylinder rod completely.
4. Disconnect, cap and tag the main boom lift cylinder hydraulic lines and ports.
5. Remove barrel end attach pin retaining hardware. Using a suitable brass drift drive out the barrel end attach pin from the turntable.
6. Remove the cylinder from the turntable and place in a suitable work area.

## Main Boom Lift Cylinder Installation

---

1. Install lift cylinder in place using suitable slings or supports, aligning attach pin mounting holes on the turntable.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the turntable. Secure in place with the pin retaining hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using auxiliary power, extend the cylinder rod until the attach pin hole aligns with those in the boom. Using a suitable soft mallet, drive the cylinder rod attach pin through the boom and lift cylinder. Secure the pin in place with attaching hardware.
5. Remove boom prop and overhead crane. Activate hydraulic system.
6. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
7. Check fluid level of hydraulic tank and adjust as necessary.



## 5.6 PRESSURE SETTING PROCEDURES

### Main Relief, Steer, Swing and Lift Down

1. Install pressure gauge at quick disconnect on port MP on main valve.
2. With the aid of an assistant, activate telescope in.
3. While monitoring pressure gauge, adjust main relief to 3000 PSI (206.85 Bar).
4. With the aid of an assistant, activate steer left.
5. While monitoring pressure gauge, adjust steer left relief to 1800 PSI (124.1 Bar).
6. With the aid of an assistant, activate steer right.
7. While monitoring pressure gauge, adjust steer right relief to 1800 PSI (124.1 Bar).
8. With the aid of an assistant, activate swing left or right.
9. While monitoring pressure gauge, adjust swing relief to 1700 PSI (117.2 Bar).
10. With the aid of an assistant, activate lift down.
11. While monitoring pressure gauge, adjust lift down relief to 1500 PSI (103.4 Bar).

### Platform Level

1. Install pressure gauge at quick disconnect on port M3 on main valve.
2. With the aid of an assistant, activate platform level forward.
3. While monitoring pressure gauge, adjust platform level relief to 2800 PSI (193.06 Bar).
4. Install pressure gauge at quick disconnect on port M4 on main valve.
5. With the aid of an assistant, activate platform level backward.
6. While monitoring pressure gauge, adjust platform level relief to 1800 PSI (124.11 Bar).

### Articulating Jib Boom (If Equipped)

1. Install pressure gauge at quick disconnect on articulating valve.
2. With the aid of an assistant, activate articulating jib up.
3. While monitoring pressure gauge, adjust articulating jib up relief to 2500 PSI (172.4 Bar).
4. With the aid of an assistant, activate articulating jib down.
5. While monitoring pressure gauge, adjust activate articulating jib down relief to 1200 PSI (82.7 Bar).

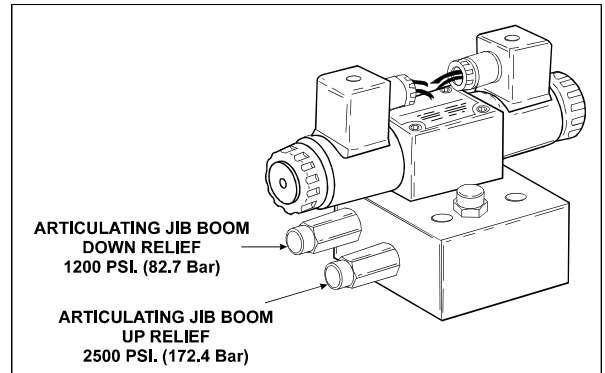
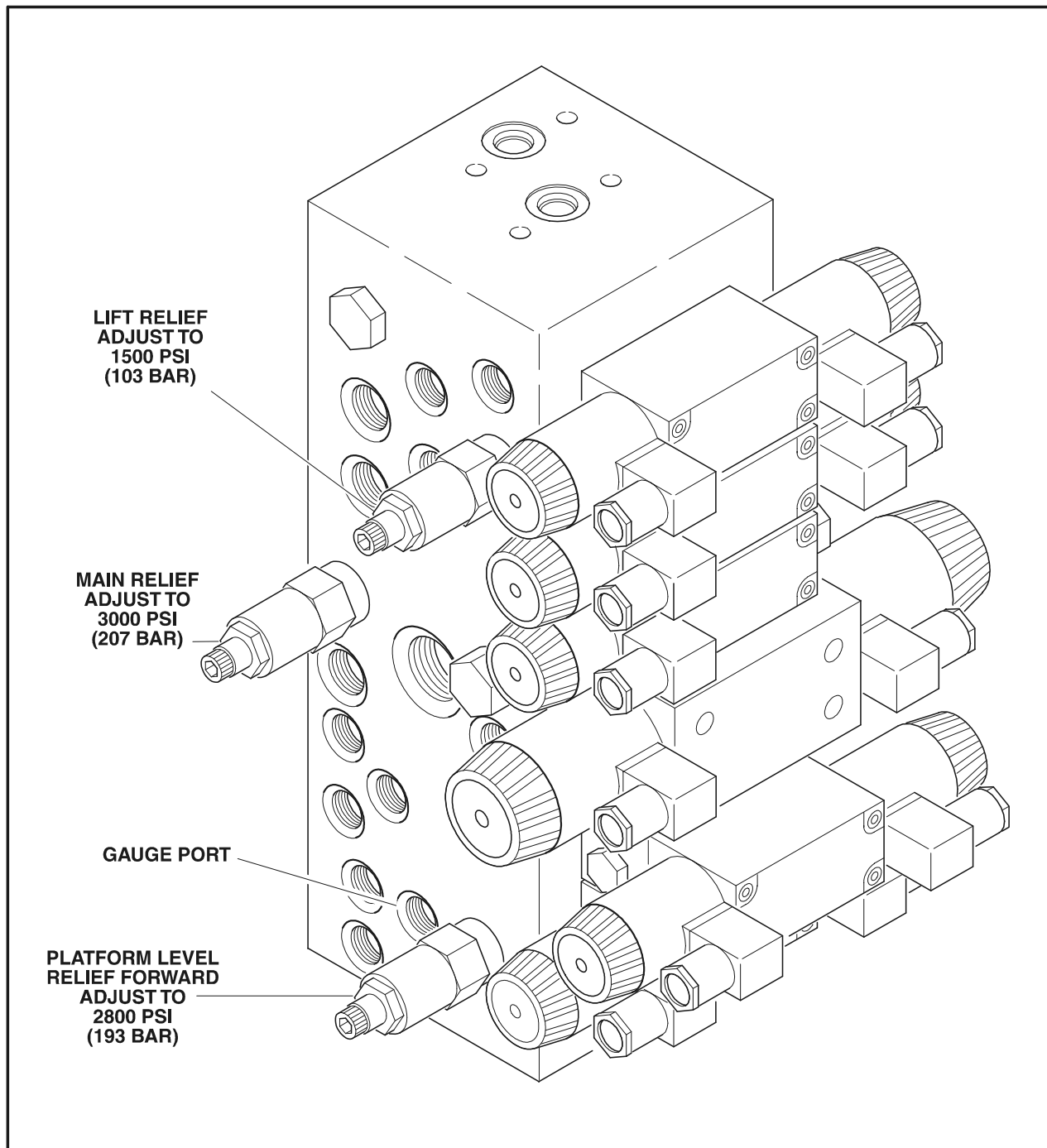


Figure 5-15. Articulating Jib Boom Pressure Adjustments





**Figure 5-16. Main Control Valve Pressure Adjustments - Sheet 1 of 2**



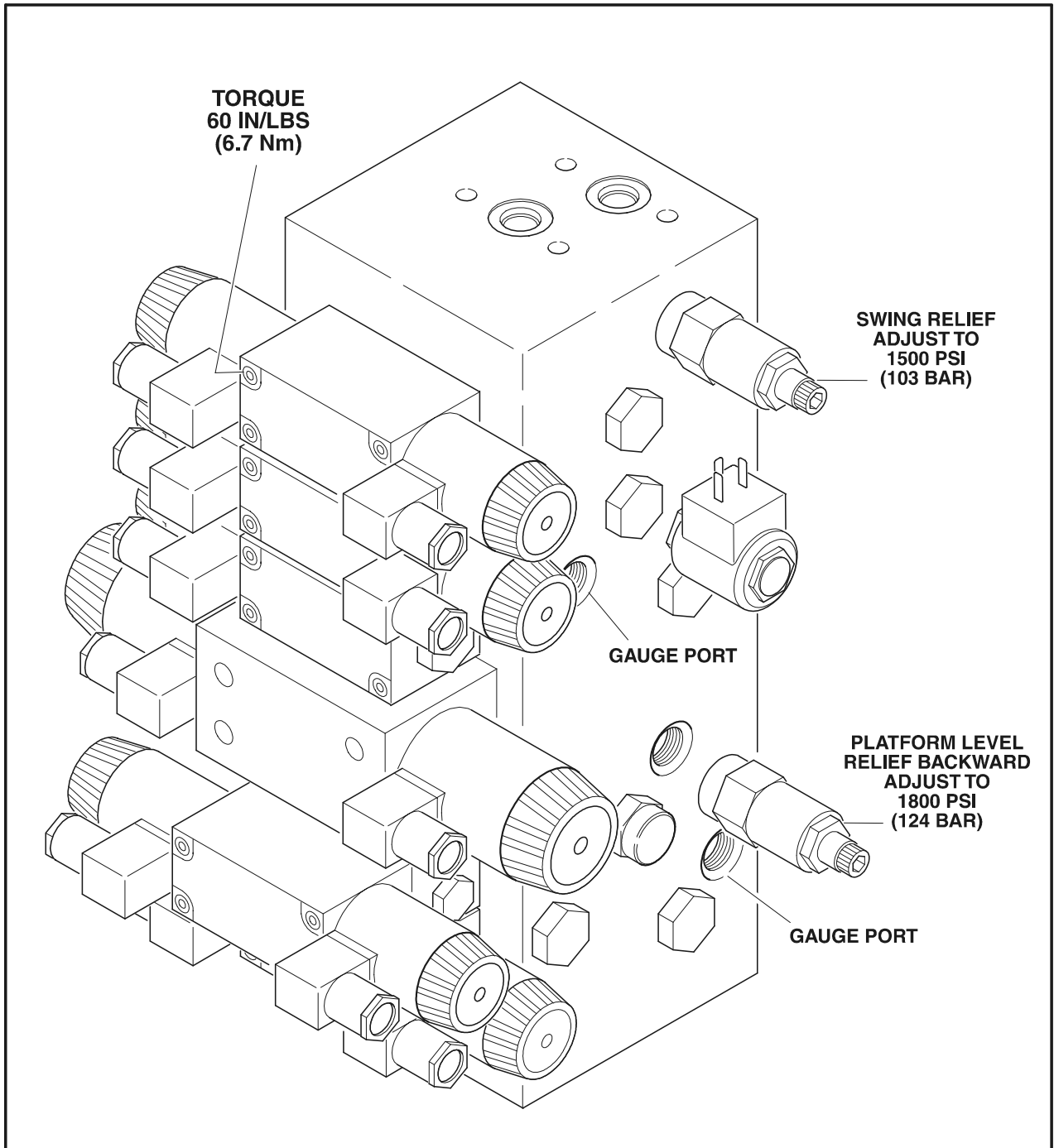


Figure 5-17. Main Control Valve Pressure Adjustments - Sheet 2 of 2



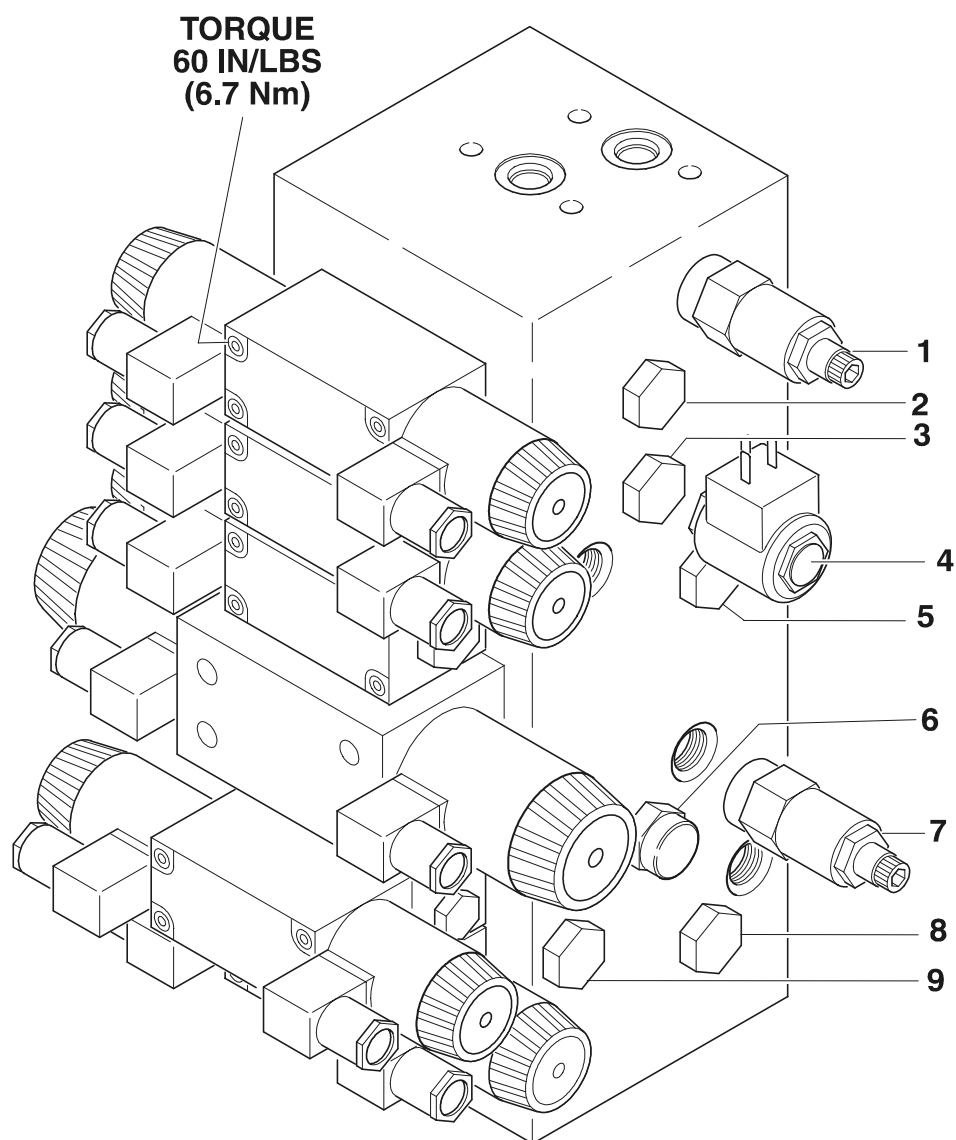


Figure 5-18. Location of Components - Main Control Valve (Sheet 1)



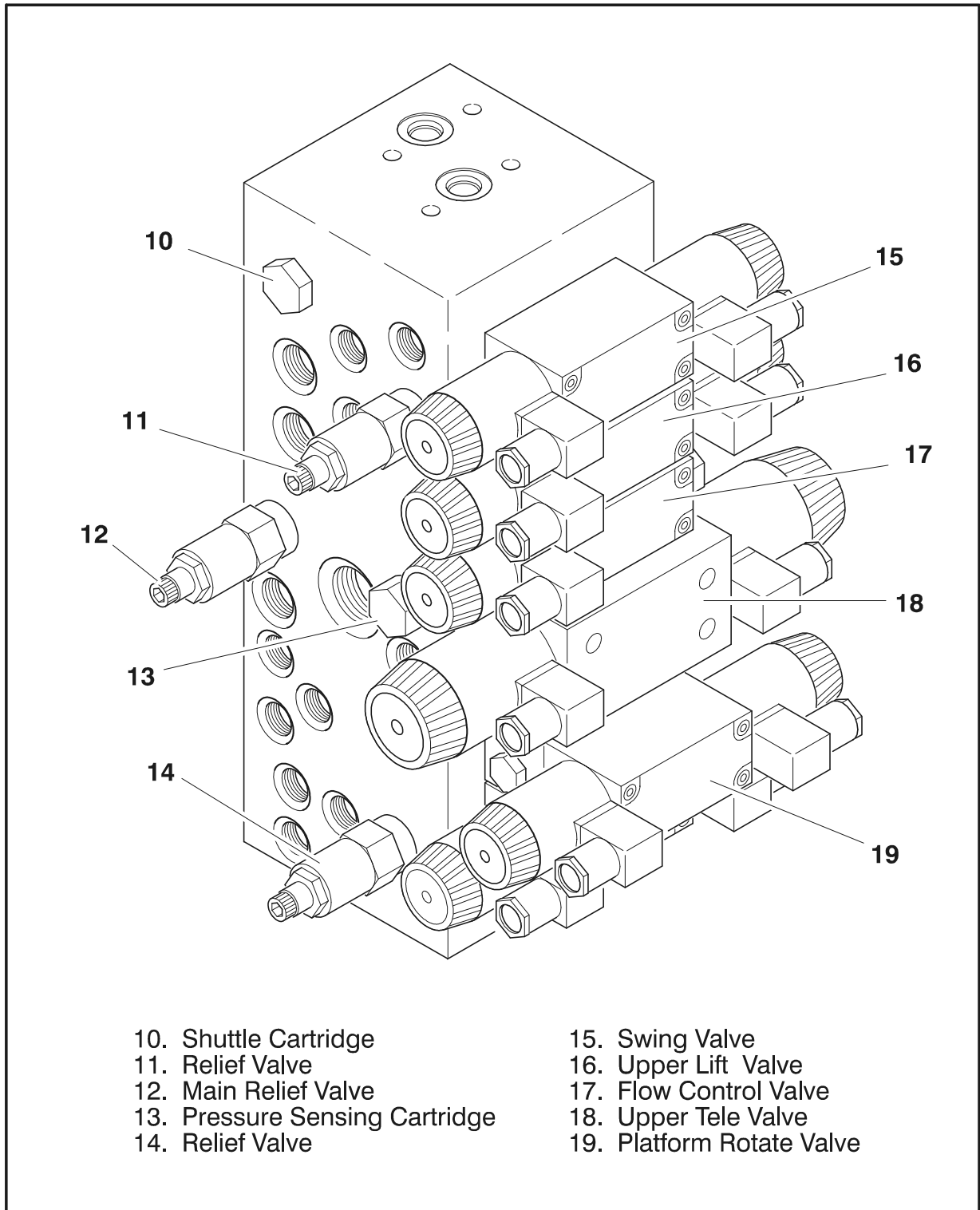


Figure 5-19. Location of Components - Main Control Valve (Sheet 2)



### 5.7 HYDRAULIC PUMP W/HAYES PUMP DRIVE COUPLING LUBRICATION

Any time pump or pump drive coupling is removed coat, pump and drive coupling splines with Lithium Soap Base Grease (TEXACO CODE 1912 OR EQUIVALENT) coupling is greased prior to assembly.

### 5.8 HYDRAULIC COMPONENT START-UP PROCEDURES AND RECOMMENDATIONS

From a hydrostatic component standpoint, the goal at system start up is to put into functional operation, the hydrostatic system in such a way as to preserve the designed life span of the system. The following start-up procedure should be adhered to whenever a new pump or motor is initially installed into a machine, or a system is restarted after either a pump or motor has been removed and/or replaced.

#### WARNING

**THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, WORK FUNCTIONS DISCONNECTED, ETC.) WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE VEHICLE/MACHINE.**

Prior to installing the pump and/or motor, inspect the unit(s) for damage that may have been incurred during shipping and handling. Make certain that all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement.

**NOTE:** *If a pump or motor is being replaced due to internal damage, the remaining units (pump or motors) need to be inspected for damage and contamination, and the entire hydraulic system will need to be flushed and the fluid replaced. Failure to do so may cause considerable damage to the entire system.*

The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check the inlet line for property tightened fittings and make sure it is free of restrictions and air leaks.

**NOTE:** *In most cases, the reservoir is above the pump inlet so that the pressure head created by the higher oil level helps to keep the inlet pressures within an*

*acceptable range and prevent high vacuum levels. However, due to hose routing or low reservoir locations, there may be air trapped within this line. It is important to assure that the air is bled from this line. This can be accomplished by loosening the hose at the fitting closest the pump. When oil begins to flow, the line is full, the air has been purged, and the fitting can be retightened to its specified torque. If the tank needs to be pressurized in order to start the flow of oil, a vacuum reading should be taken at the inlet of the pump during operation in order to verify that the pump is not being asked to draw an inlet vacuum higher than it is capable of.*

Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start up. Fill the housing by pouring filtered oil into the upper case drain port.

**NOTE:** *It is highly recommended to use the highest possible case drain port, this ensures that the housing contains as much oil as possible and offers the greatest amount of lubrication to the internal components.*

**NOTE:** *In initial start-up conditions, it may be convenient to fill the housing, just prior to installing the case drain line. Component, (especially motor), location may be such that access to the case drain port after installation is not realistic.*

**NOTE:** *Make certain that the oil being used to fill the component housing is as clean as possible, and store the fill container in such a way as to prevent it from becoming contaminated.*

Install a 60 bar (or 1000 psi) pressure gauge in the charge pressure gauge port in order to monitor the charge pressure during start-up.

It is recommended that the external control input signal, (electrical connections for EDC), be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

#### WARNING

**DO NOT START THE ENGINE UNLESS PUMP IS IN THE NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.**

"Jog" or slowly rotate the engine until charge pressure starts to rise. Start the engine and run at the lowest possible RPM until charge pressure has been established. Excess air should be bled from the system lines as close to the motors as possible.

**NOTE:** *With the engine on low idle, "crack", (loosen-don't remove), the system lines at the motor(s). Continue to run the engine at low idle and tighten the system*



*lines as soon as oil is observed to leak from them. When oil is observed to "leak" at the motor the line is full, the air has been purged, and the system hoses should be retightened to their specified torque.*

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be as indicated in the pump model code. If charge pressure is inadequate, shut down and determine the cause for improper pressure.

**⚠ WARNING**

**INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR'S ABILITY TO CONTROL THE MACHINE.**

Shut down the engine and connect the external control input signal. Also reconnect the machine function(s), if disconnected earlier. Start the engine, checking to be certain the pump remains in neutral. With the engine at normal operating RPM, slowly check for forward and reverse machine operation.

Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down engine, remove gauges, and plug ports. Check reservoir level and add filtered fluid if needed.

The machine is now ready for operation.



**This page left blank intentionally.**



## SECTION 6. UNDERCARRIAGE

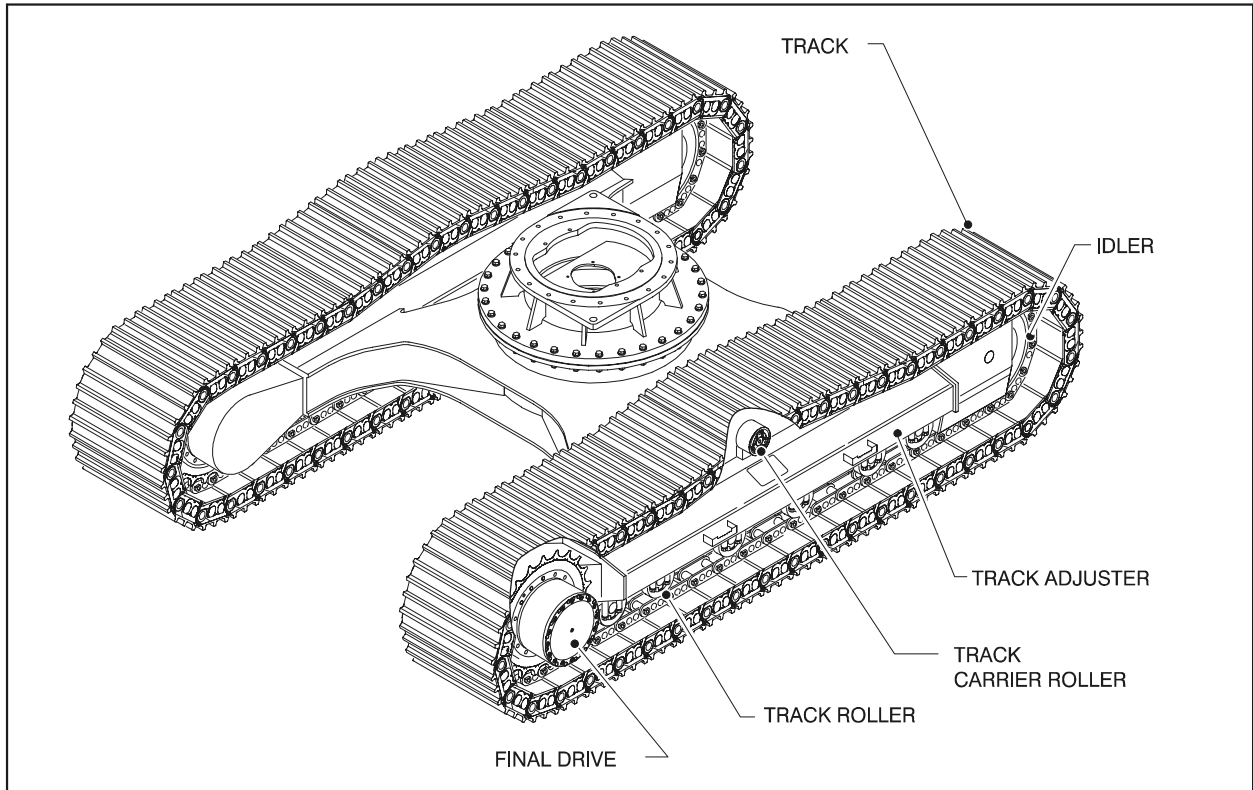


Figure 6-1. Undercarriage Components

## 6.1 TRACK CARRIER ROLLER

## Removal

Table 6-1. Track Carrier Roller Required Tools - Removal and Installation

Tool	Part #	Description	Qty.
A	8T-5225	Hydraulic Jack	2

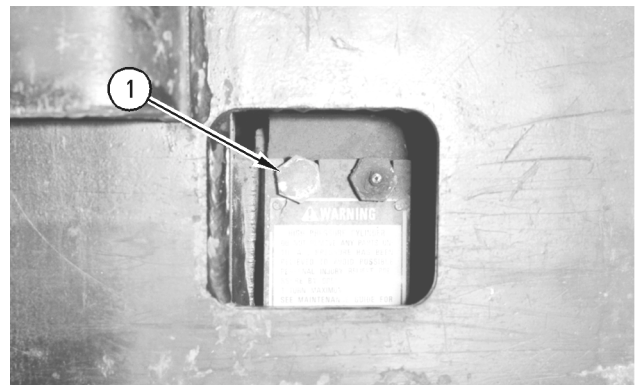
**⚠ WARNING**

PERSONAL INJURY OR DEATH CAN RESULT FROM GREASE AND OIL COMING OUT OF THE RELIEF VALVE.

GREASE AND OIL ARE UNDER HIGH PRESSURE COMING OUT OF THE RELIEF VALVE AND CAN PENETRATE THE BODY.

DO NOT WATCH THE RELIEF VALVE TO SEE IF GREASE IS ESCAPING. WATCH THE TRACK OR TRACK ADJUSTMENT TO SEE IF THE TRACK IS BEING LOOSENED.

1. Put the machine on a flat level surface.

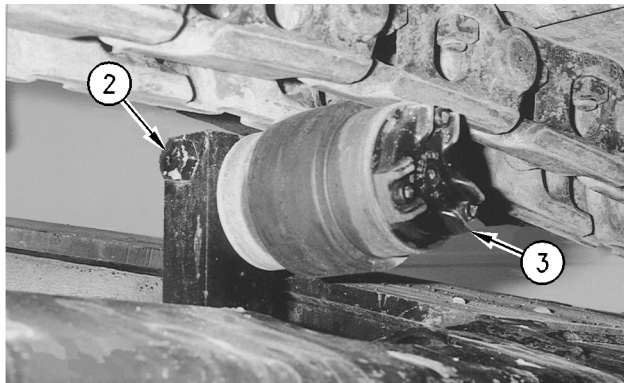


2. Release the tension on the track. Loosen relief valve (1) for one turn only. If the track does not loosen

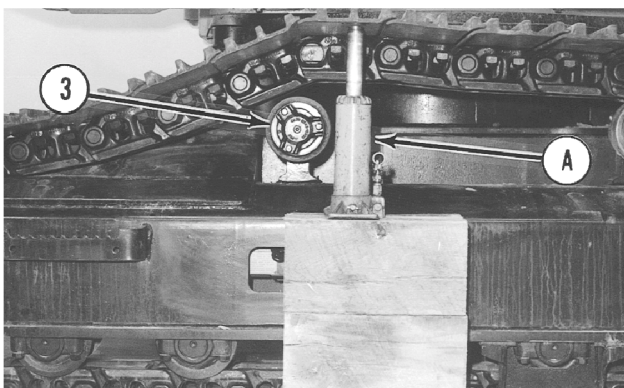


## SECTION 6 - UNDERCARRIAGE

after opening the relief valve, move the machine forward and backward until the tension is released.



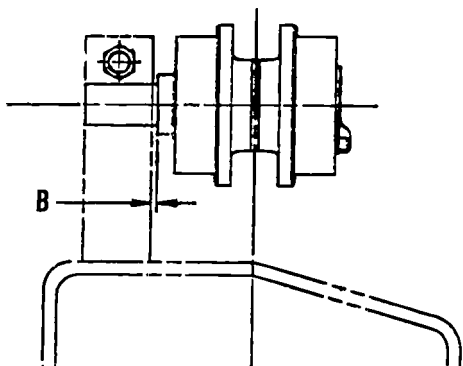
3. Loosen bolt (2) that holds track carrier roller (3) to the mounting bracket to the undercarriage frame.



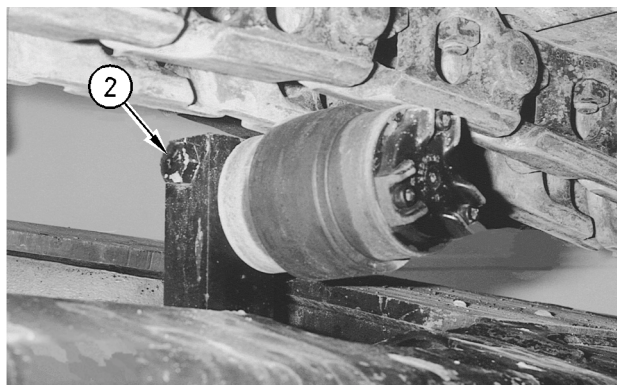
4. Put wood blocks and tooling (A) under the track assembly as shown. Lift the track assembly off the track carrier roller. Remove track carrier roller (3). The weight of the track carrier roller is 26 lb. (12 kg).

### Installation

1. Be sure the shaft of the track carrier roller and the bore in the mounting bracket on the undercarriage frame are clean and free of dirt.



2. Put the track carrier roller in position in the mounting bracket. Adjust the carrier roller until distance B, the distance between the outside face of the mounting bracket and the carrier roller is  $(0.28 \pm 0.02 \text{ inch})$  ( $7.0 \pm 0.5 \text{ mm}$ ).



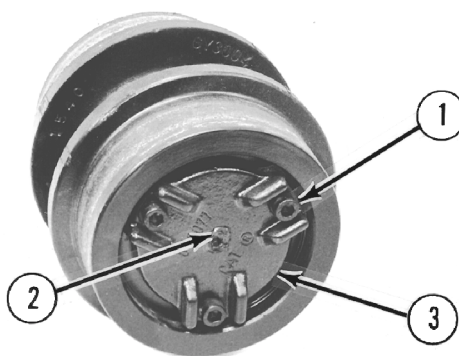
3. After adjusting the position of the carrier roller in the mounting bracket, tighten bolt (2).
4. Be sure that the carrier roller rotates smoothly by hand. Slowly lower the track assembly to the carrier roller with tooling (A).
5. Tighten the tension of the track.

### Disassembly

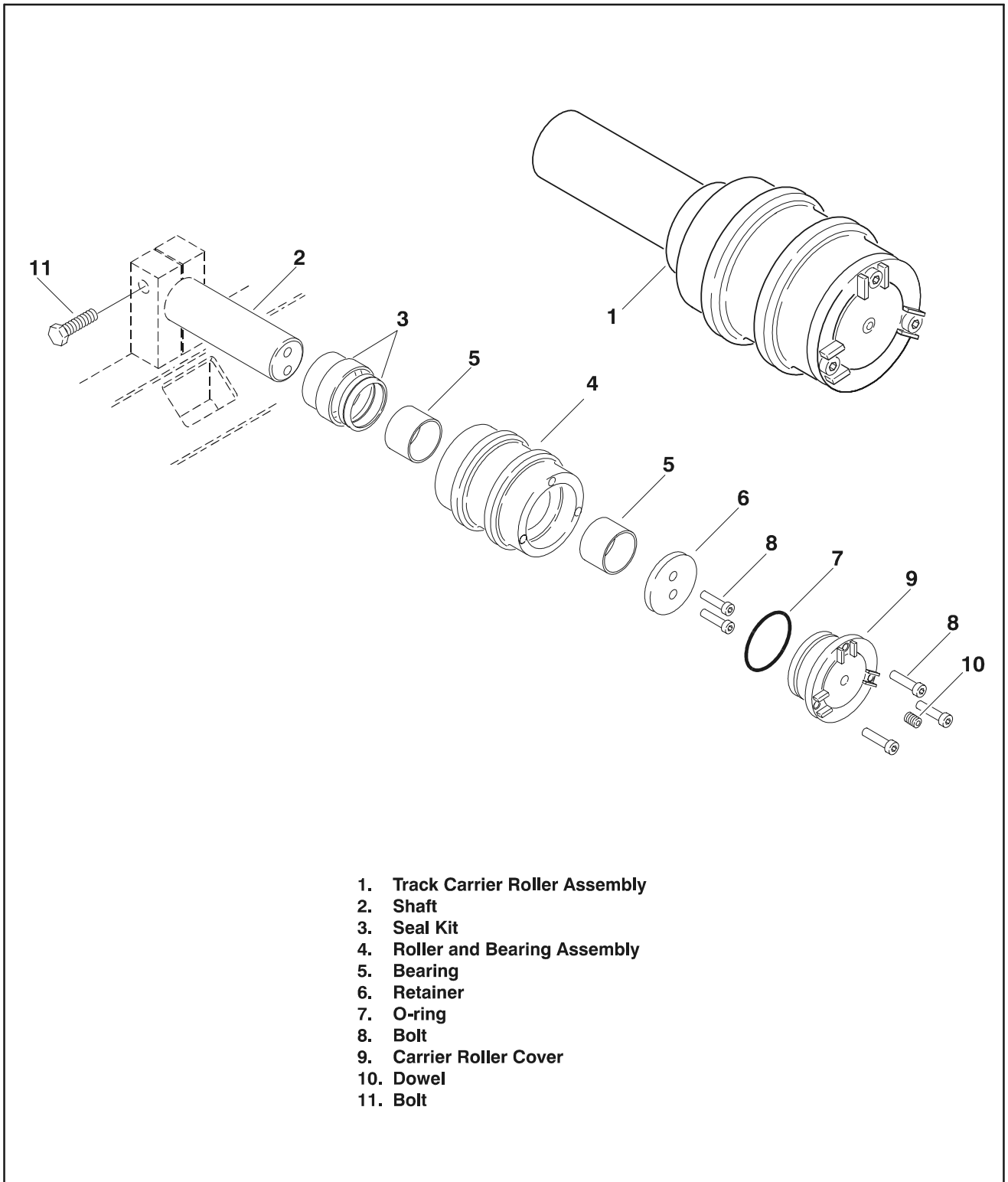
1. Thoroughly clean the outside of the track carrier roller prior to disassembly.

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

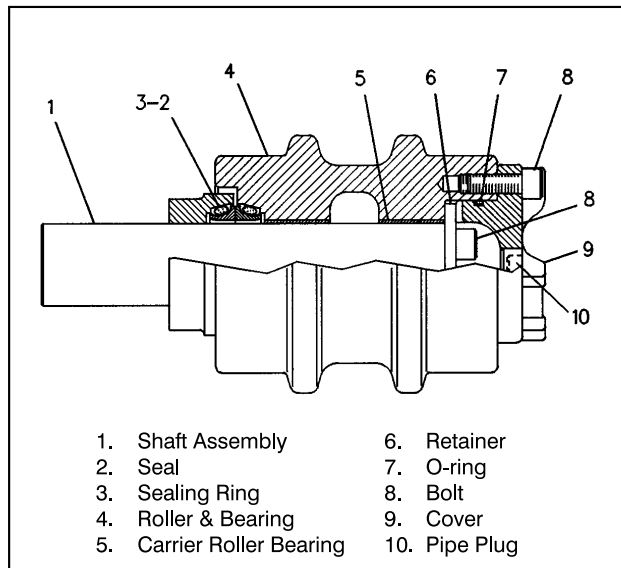






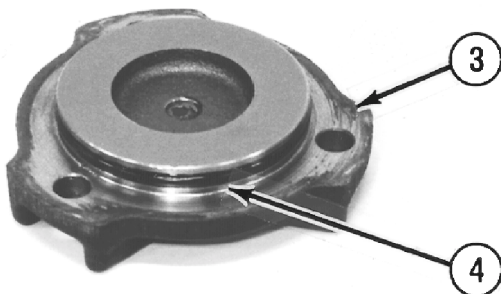
**Figure 6-2. Track Carrier Roller - Exploded View**



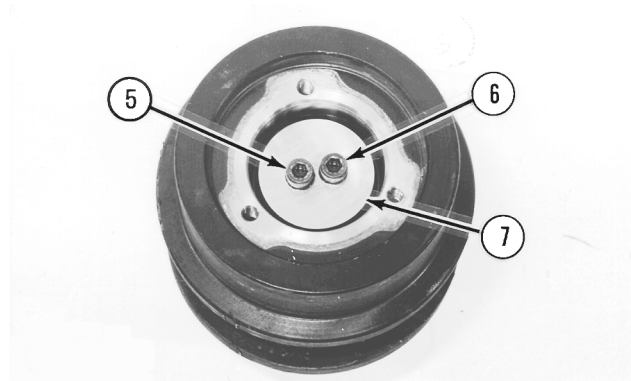


**Figure 6-3. Track Carrier Roller**

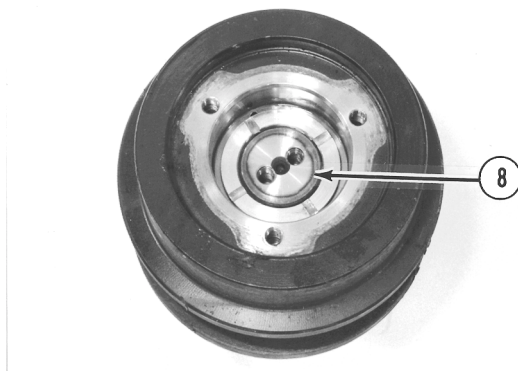
2. Remove plug (2). Drain the oil from the carrier roller into a suitable container for disposal. The capacity of the track carrier roller is  $4.08 \pm 0.17$  oz. ( $120 \pm 5$  mL).
3. Remove the three socket head bolts (1) and cover (3) from the track carrier roller.



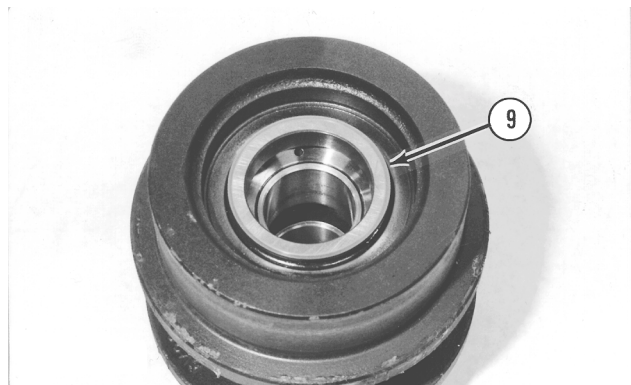
4. Remove the O-ring seal (4) from the cover (3).



5. Remove socket head bolts (5) and (6) and retainer (7) from the end of the shaft assembly.

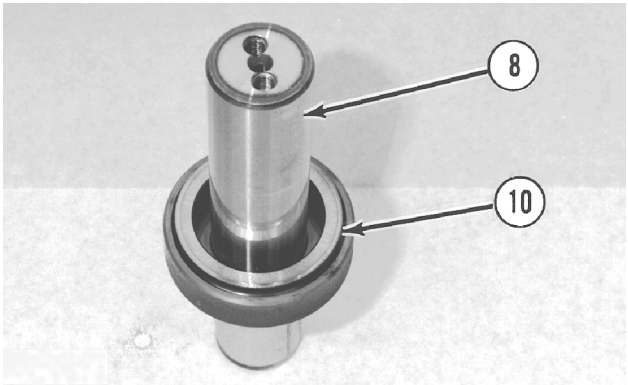


6. Carefully remove the shaft assembly (8) from the track carrier roller.

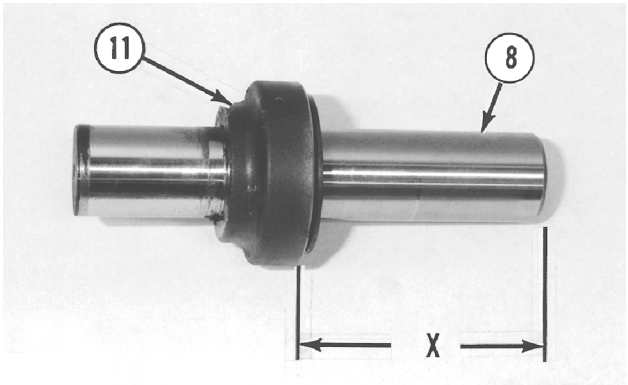




7. Remove Duo-cone seal kit (9) from the track carrier roller.

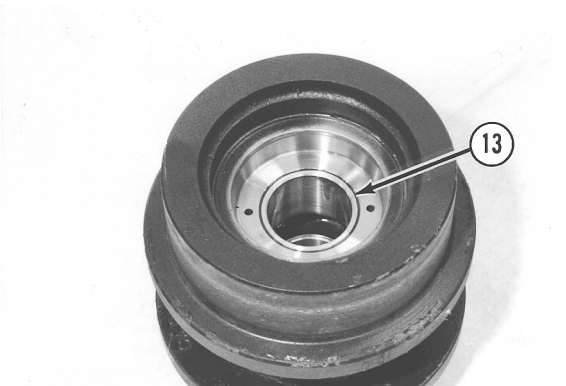
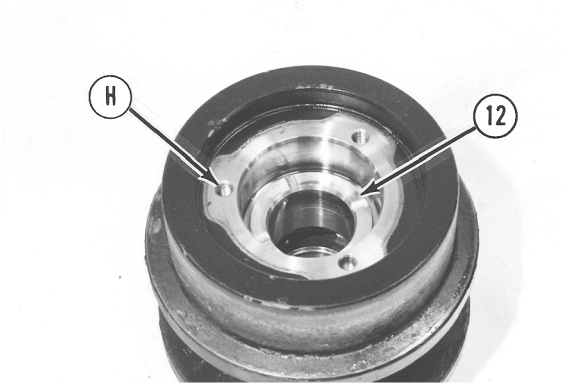


8. Remove Duo-cone seal kit (10) from the shaft assembly.



9. Measure the distance (X) on the shaft assembly. Record this dimension for assembly purposes. Use a press to push the shaft (8) out of collar (11).

Remove the O-ring seal from the inside of the collar.



10. Remove bearings (12) and (13) from the track carrier roller.

**Assembly**

**Table 6-2. Track Carrier Roller Required Tools - Assembly**

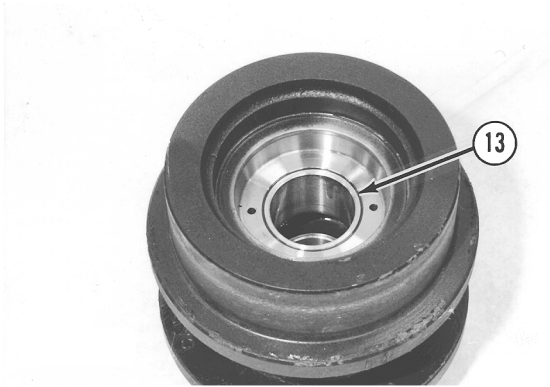
Tool	Part #	Description	Qty.
A	1P-0510	Driver Group	1
B	9U-5985	Seal Installer	1
C	8T-5096	Dial Indicator	1

1. Thoroughly clean all parts of the track carrier roller prior to assembly.



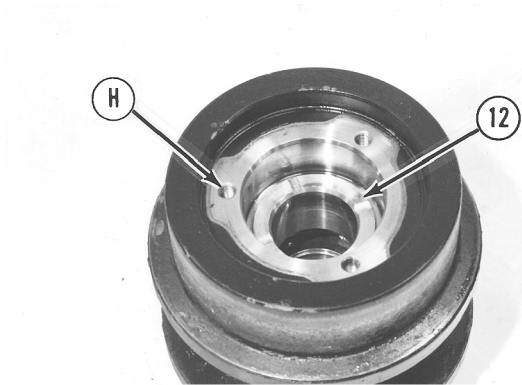
## SECTION 6 - UNDERCARRIAGE

**NOTE:** Do not reuse bearings (12) and (13). Use new parts for replacement.



**NOTE:** Bearing (13) is a straight bearing.

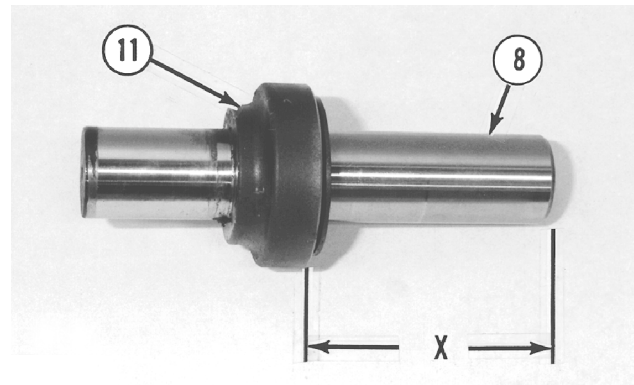
2. Lower the temperature of the bearing (13). Use tooling (A) and a press to install bearing (13) in the inside bore of the carrier roller. Install the bearing until the bearing is even with the shaft counterbore in the carrier roller.



**NOTE:** Bearing (12) has a flange.

3. Lower the temperature of the bearing (12). Use tooling (A) and a press to install bearing (12) in the outside bore of the carrier roller. The outside bore can be identified by three threaded holes (H) in the track carrier roller. Install the bearing until the flange on

the bearing makes contact with the counterbore in the track carrier roller.



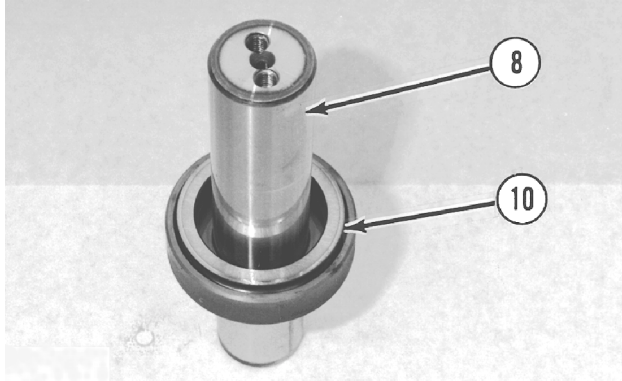
4. Replace the o-ring seal that is used in collar (11) with a new o-ring seal. Install the o-ring seal in the collar. Put clean oil on the o-ring seal.
5. Use a press to install collar (11) on shaft (8). Install collar (11) until dimension (X) is  $5.09 \pm 0.01$  inch ( $129.2 \pm 0.2$  mm).
6. Use the following procedure to determine shaft end play.

**NOTE:** Do not install the Duo-cone seal kits in the track carrier roller or collar (11) at this time.

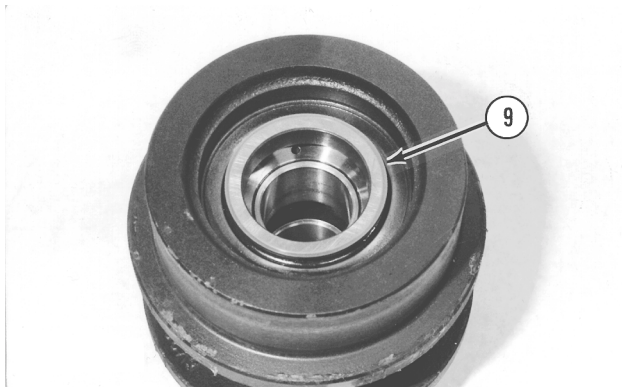
- a. Install shaft assembly (8) in the track carrier roller without Duo-Cone seal kits.
- b. Install retainer (7) and socket head bolts (5) and (6) on the end of the shaft assembly (8).
- c. Use tooling (C) to measure the end play of the shaft assembly (8). The end play of the shaft assembly must be 0.008 inch to 0.030 inch (0.20 to 0.75 mm). Bearing (12) controls the amount of end play.
- d. Disassemble the track carrier roller, but do not remove collar (11) from shaft (8).



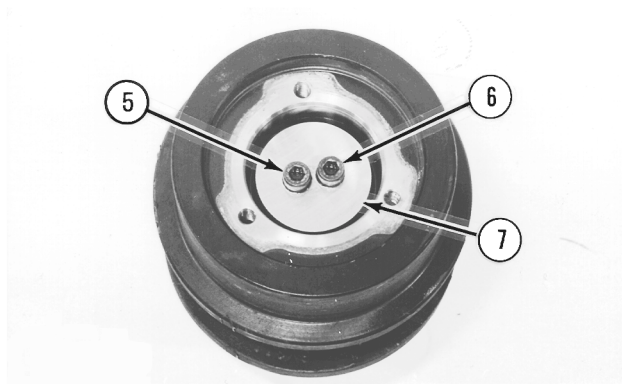
**NOTE:** The rubber seal and all surfaces that make contact with the seals must be clean and dry. After installation of the seals, apply clean SAE 30 oil on the contact surfaces of the metal seals.



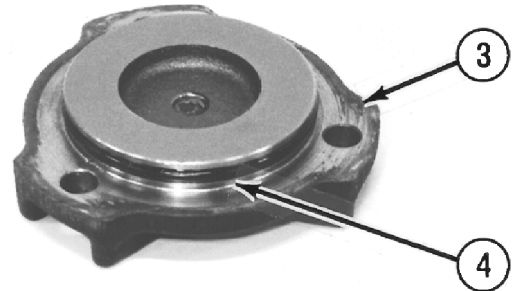
7. Install Duo-Cone seal kit (10) in collar (11) with tooling (B).



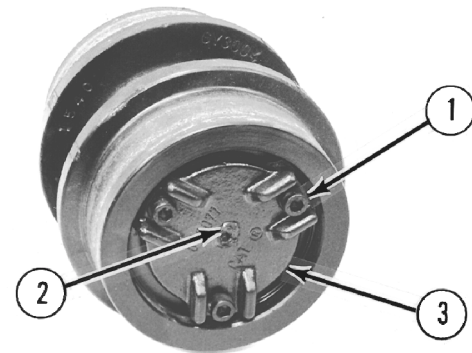
8. Install Duo-Cone seal kit (9) in the track carrier roller on the side without three threaded holes with tooling (B).



9. Carefully install shaft assembly (8) in the track carrier roller. Install retainer (7) and socket head bolts (5) and (6).



10. Replace o-ring (4) that is used on cover (3) with a new o-ring seal. Put clean oil on O-ring seal (4). Install the o-ring on cover (3).



11. Install cover (3) on the track carrier roller and three socket head bolts (1).
12. Put the track carrier roller in a vertical position. Fill the track carrier roller with  $4.08 \pm 0.17$  oz. ( $120 \pm 5$  mL) of clean SAE 30 oil. Apply 5P-3413 Pipe Sealant on the threads of plug (2). Install plug (2).
13. Install the track carrier rollers.



### 6.2 TRACK ROLLER

#### Removal

Table 6-3. Track Roller Required Tools - Removal

Tool	Part #	Description	Qty.
A	8S-7640	Stand	2
	8S-7611	Tube	2
	8S-7615	Pin	2
B	FT-1310	Track Roller Lifting Fork	1

**NOTE:** There is a track guide on each side of the machine. The procedure which follows is for the removal of the track roller with the guide.

#### **⚠ WARNING**

**PERSONAL INJURY OR DEATH CAN RESULT FROM GREASE AND OIL COMING OUT OF THE RELIEF VALVE.**

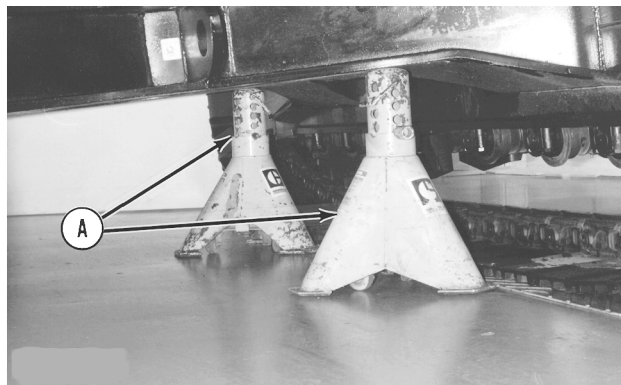
**GREASE AND OIL ARE UNDER HIGH PRESSURE COMING OUT OF THE RELIEF VALVE AND CAN PENETRATE THE BODY.**

**DO NOT WATCH THE RELIEF VALVE TO SEE IF GREASE IS ESCAPING. WATCH THE TRACK OR TRACK ADJUSTMENT TO SEE IF THE TRACK IS BEING LOOSENEED.**

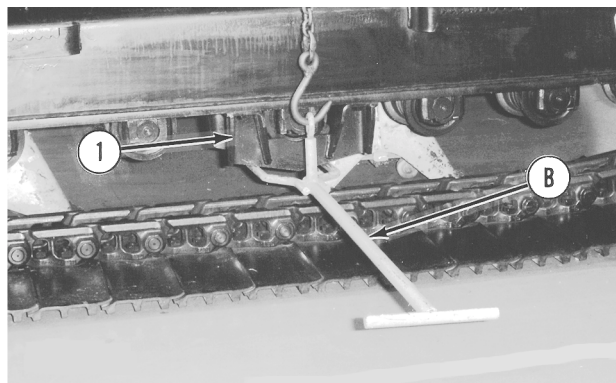
**MAKE SURE THE VENT HOLES ARE CLEAN BEFORE THE TENSION IS RELEASED ON THE TRACK.**

1. Put the machine on a flat level surface.
2. Release the tension on the track. Loosen the relief valve for one turn only. If the track does not loosen after opening the relief valve, move the machine forward and backward until the tension is released.

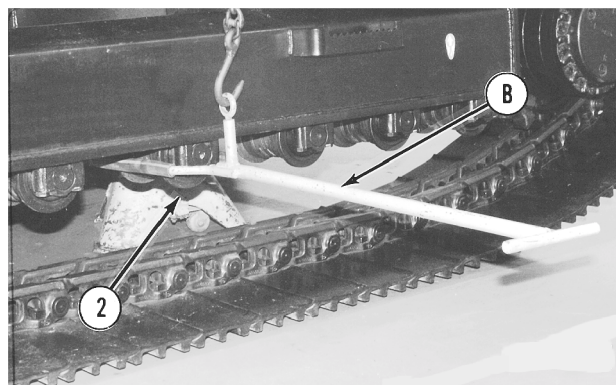
**NOTE:** Adjust the height of tooling (A) so there is sufficient clearance for the removal of the track rollers.



3. Lift the side of the machine. Install tooling (A) under the frame as shown.



4. Loosen the four bolts that hold track guide (1) to the undercarriage frame. Do not remove the bolts at this time.
5. Fasten a hoist to tooling (B). Put tooling (B) in position under track guide (1), as shown. Remove the bolts that hold the guide. The weight of the track guide is approximately 110 lb. (50 kg).



**NOTE:** The fork end of tooling (B) is slightly wider than the diameter of the track roller. Prior to using tooling (B) for the removal of the track roller, slide two pieces of rubber hose over the fork end of the tool. The two pieces of rubber will provide the fit that is necessary for the track roller.

6. Loosen the four bolts that hold track roller (2) to the undercarriage frame. Do not remove the bolts at this time.
7. Fasten a hoist to tooling (B). Put tooling (B) in position under track roller (2), as shown. Remove the bolts that hold the track roller. Remove the track roller. The weight of the track roller is 75 lb. (34 kg).



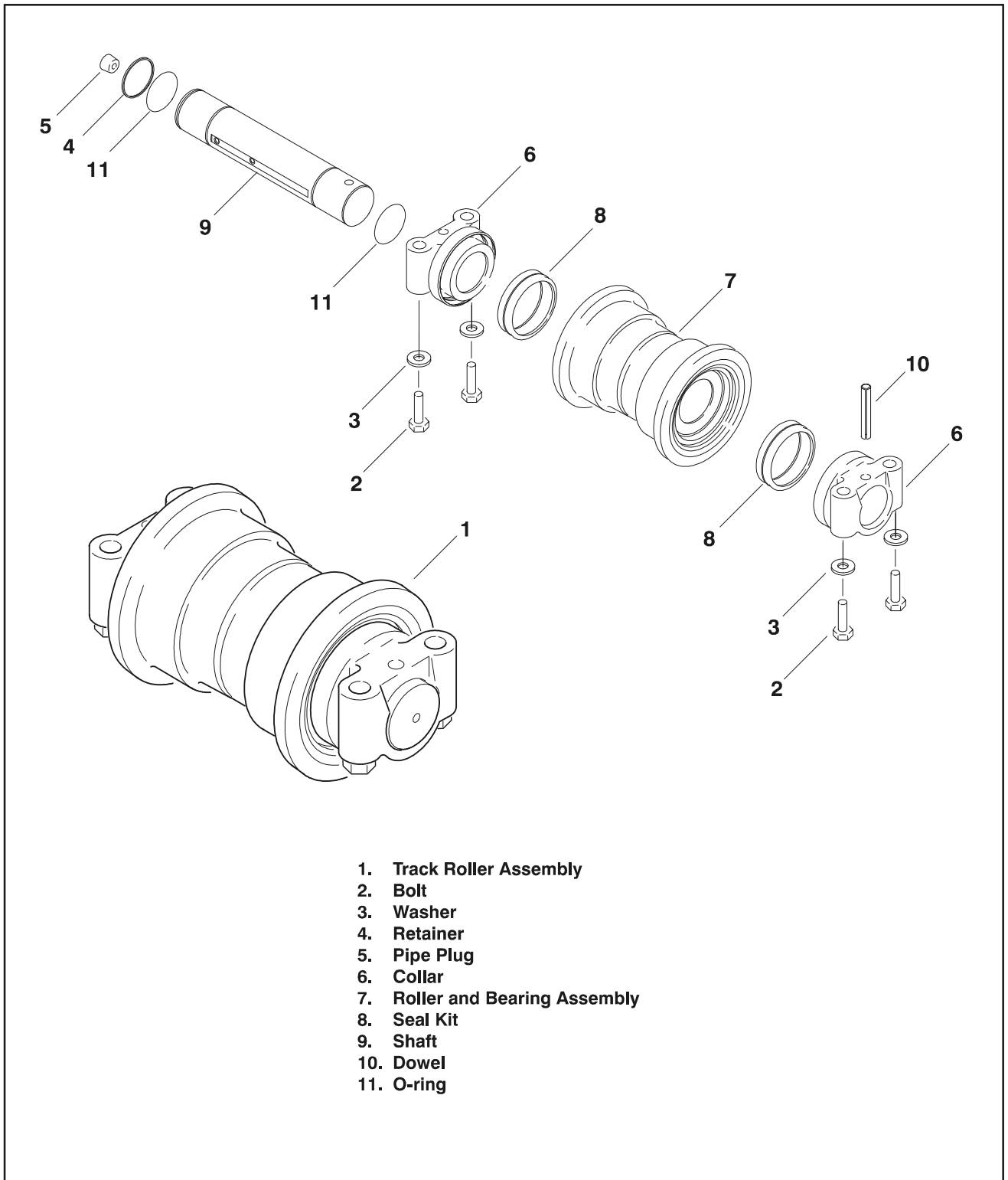
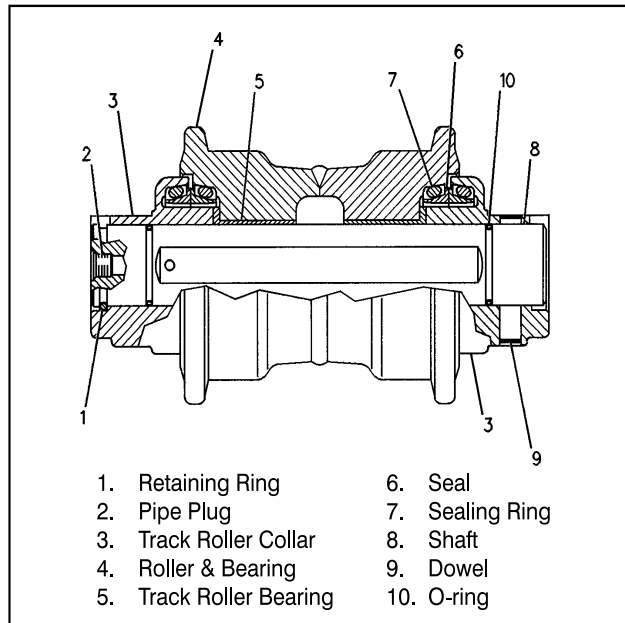


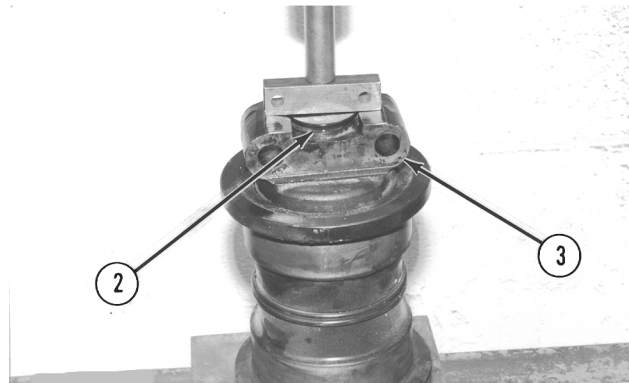
Figure 6-4. Track Roller - Exploded View





**Figure 6-5. Track Roller**

container for disposal. The capacity of the track roller is  $7.70 \pm 0.34$  oz. ( $225 \pm 10$  mL).

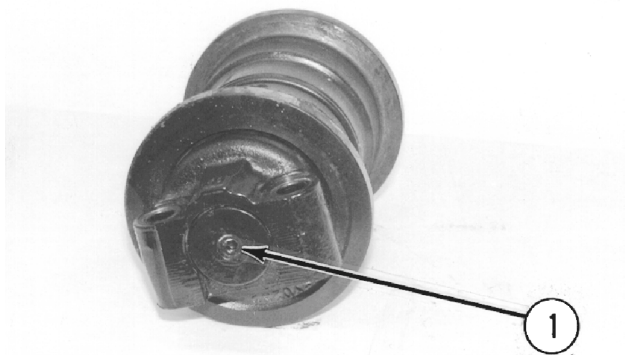


3. Put the track roller in a press, as shown. The weight of the track roller is 75 lb. (34 kg). Press on end collar (3). Remove retaining ring (2). Release the pressure on the end collar. Remove the end collar (3).
4. Remove plug (1) from the inside of the track roller.

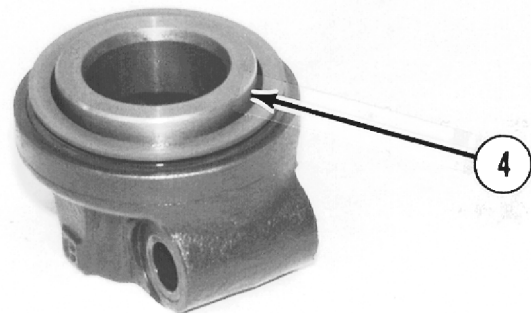
### Disassembly

1. Thoroughly clean the outside of the track roller prior to disassembly.

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

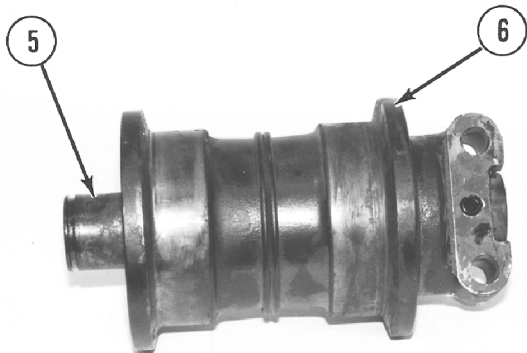


2. Drive plug (1) into the stopper in the end of the track roller. Drain the oil from the track roller into a suitable

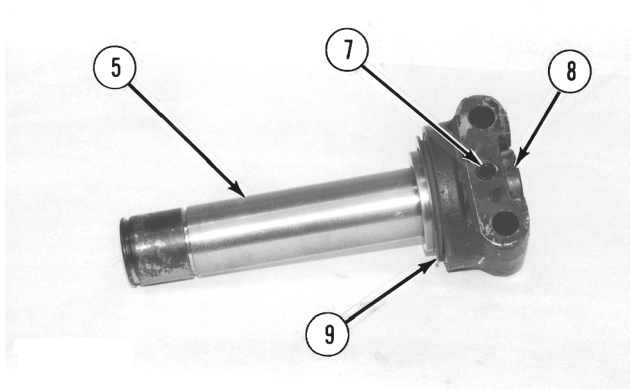


5. Remove Duo-cone seal kit (4) from end collar (3).

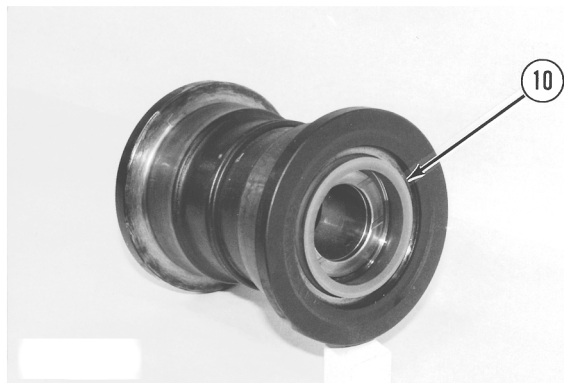




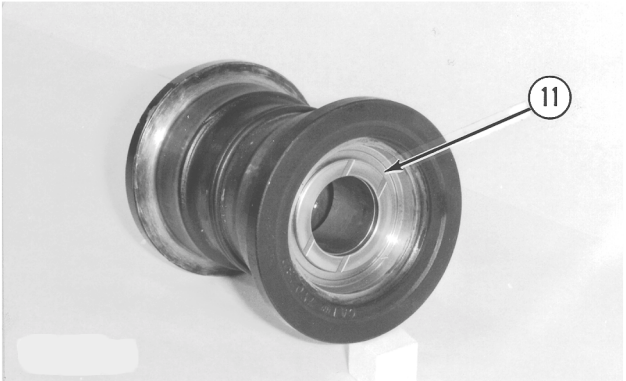
6. Remove the o-ring seal from shaft (5). Remove shaft (5) from roller (6).



7. Remove Duo-cone seal kit (9) from end collar (8).
8. Remove spring pin (7) from end collar (8) and shaft (5). Use a press to remove shaft (5) from end collar (8). Remove the remaining o-ring seal from shaft (5).



9. Remove Duo-cone seal kit (10) from each end of the track roller.



10. Use a press to remove bearing (11) from each end of the track roller.

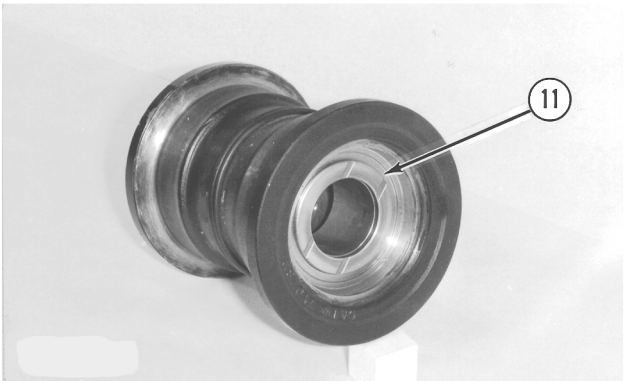
### Assembly

Table 6-4. Track Roller Required Tools - Assembly

Tool	Part #	Description	Qty.
A	9U-5985	Seal Installer	1
B	8T-5096	Dial Indicator	1

1. Thoroughly clean all parts of the track roller prior to assembly.

**NOTE:** Do not reuse bearings (11). Use new parts for replacement.



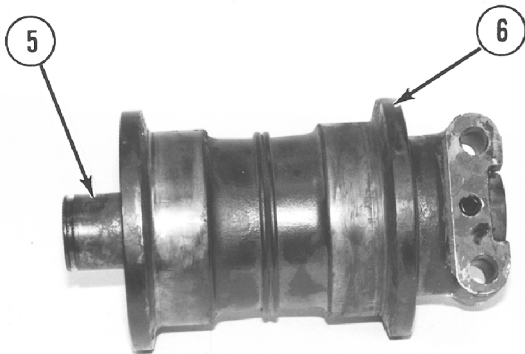
2. Lower the temperature of bearings (11), and install one in each end of the track roller with a press. Install the bearings until the bearings make contact with the counterbore in the track roller.
3. Use the following procedure to determine the shaft end play.



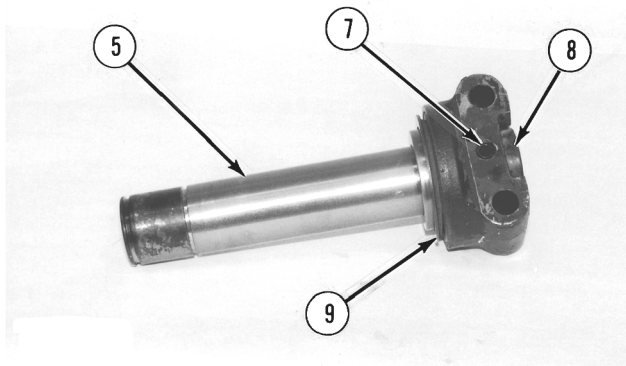
## SECTION 6 - UNDERCARRIAGE

**NOTE:** Do not install the Duo-cone seal kit in the track roller or end collars at this time.

**NOTE:** Replace the o-ring seals that are used on shaft (5) with new o-ring seals.

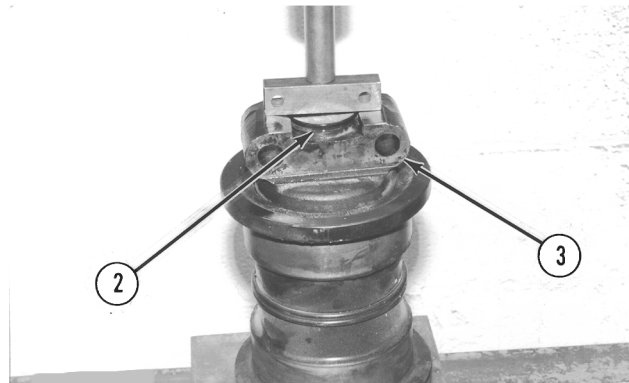
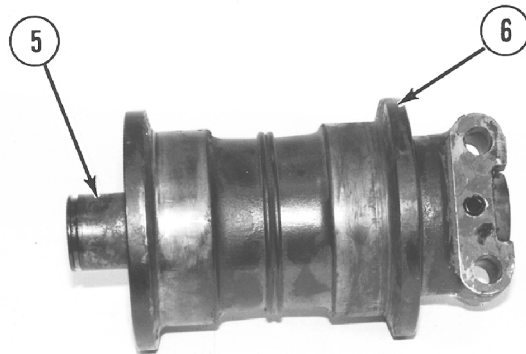


- a. Install an o-ring seal in shaft (5) at the end that has the spring pin hole. Lubricate the o-ring seal with clean oil.



- b. Lubricate the bore in end collar (8) with clean oil. Use a press to install shaft (5) in end collar (8). Be sure that the spring pin hole in the shaft is aligned with the spring pin hole in the end collar.

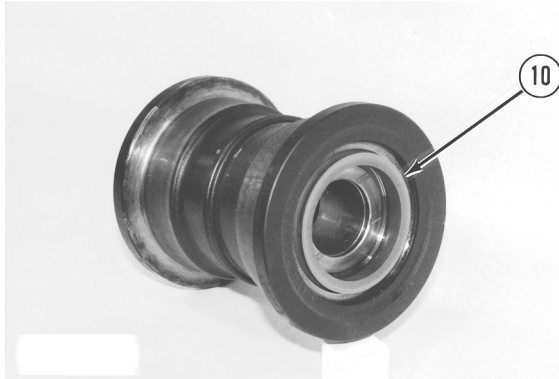
Install spring pin (7) in the end collar.



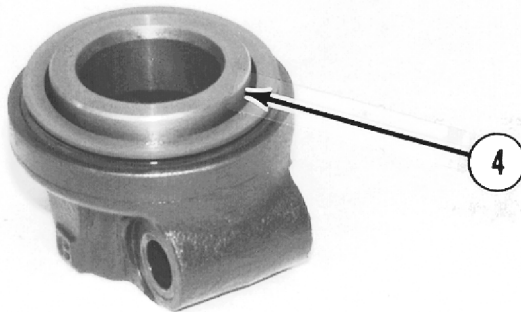
- c. Install shaft kit (5) in track roller (6) without Duo-cone seal kits. Install end collar (3) without the Duo-cone seal kits. Install retaining ring (2).
- d. Use tooling (B) to measure the end play of shaft (5). The end play of the shaft must be 0.10 to 0.49 inch (0.25 to 1.25 mm). Bearings (11) control the amount of shaft end play.
- e. Disassemble the track roller, but do not remove shaft (5) from end collar (8).



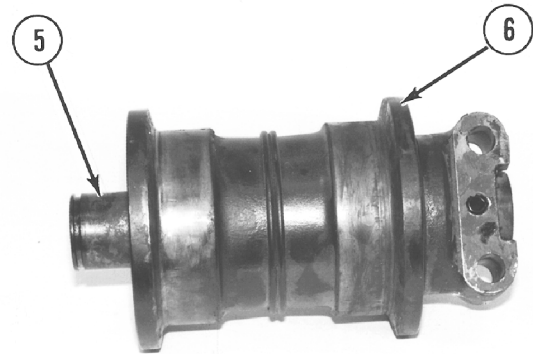
**NOTE:** The rubber seals and all surfaces that make contact with the seals must be clean and dry. After installation of the seals, apply clean SAE 30 oil on the contact surfaces of the metal seals.



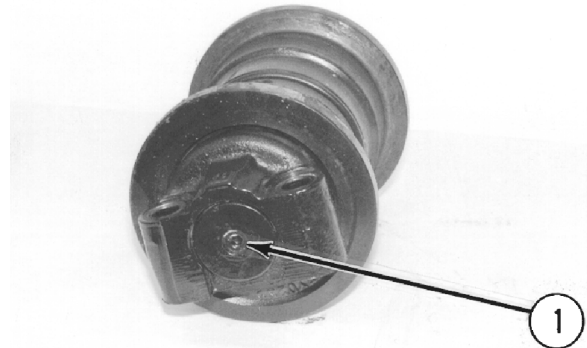
4. Install a Duo-cone seal kit (10) in each end of the track roller with tooling (A).
5. Install Duo-cone seal kit (9) in end collar (8) with tooling (A).



6. Install Duo-cone seal kit (4) in end collar (3) with tooling (A).



7. Install shaft (5) with end collar (8) in track roller (6).
8. Install the o-ring seal in the groove on the end of shaft (5). Lubricate the o-ring seal with clean oil.
9. Lubricate the bore in end collar (3) with clean oil.
10. Put the track roller in a press. Install end collar (3) on the end of the shaft (5). Push down on end collar (3) with the press, and install retaining ring (2).



11. Put the track roller in a vertical position. Fill the track roller with  $7.70 \pm 0.34$  oz. ( $225 \pm 10$  mL) of the proper oil. Install a new plug (1) in the stopper end of the track roller. The plug should be installed even with the end of the stopper protruding 0.2 inch (5 mm) above the end of the stopper. Be sure the plug is not recessed below the surface of the stopper after the plug is installed.

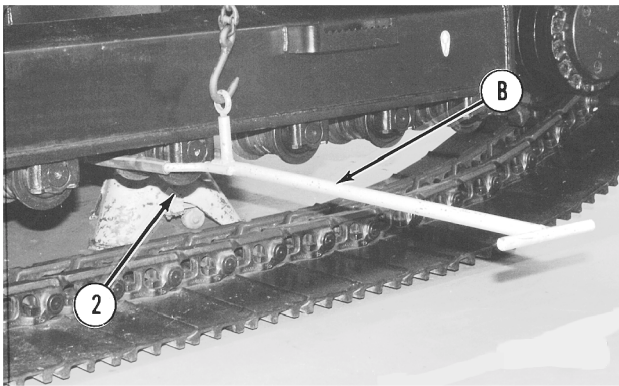


### Installation

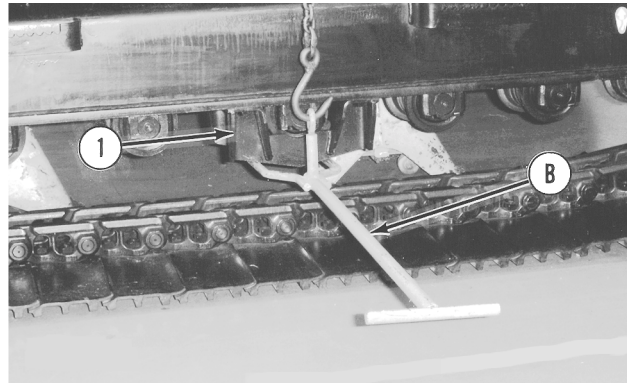
**Table 6-5. Track Roller Required Tools - Removal**

Tool	Part #	Description	Qty.
A	8S-7640	Stand	2
	8S-7611	Tube	2
	8S-7615	Pin	2
B	FT-1310	Track Roller Lifting Fork	1

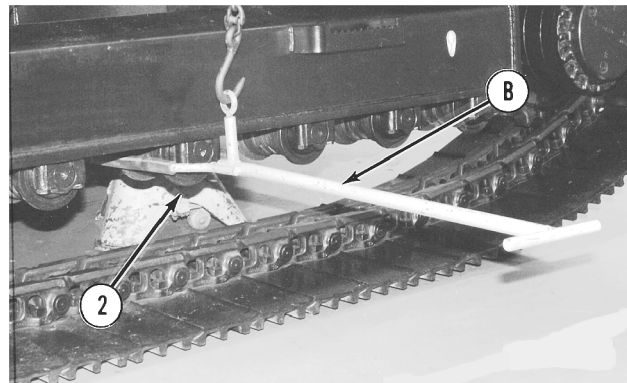
1. Be sure the mounting surface on the track roller, the track guide, and the undercarriage frame are clean and free of dirt and debris prior to installing the track roller and the track guide.



2. Use tooling (B) to put the track roller (2) in position on the undercarriage frame. The weight of the track roller is 75 lb. (34 kg). Make sure the plug in the roller is facing toward the outside of the undercarriage frame. Install the four bolts that hold the roller in position.



3. Use tooling (B) to put track guide (1) in position on the undercarriage frame. The weight of the track guide is approximately 110 lb. (50 kg). Install the four bolts that hold the guide.
4. Prior to lowering the machine to the ground and tightening the track, be sure that all of the track rollers rotate smoothly by hand.



5. Lift the machine off tooling (A). Remove tooling (A) from the machine. Lower the machine to the floor.
6. Tighten the tension of the track.



## 6.3 TRACK

### Separate

Table 6-6. Track Required Tools - Separate

Tool	Part #	Description	Qty.
A	5P-6214	Track Block Assembly	1
B	1U-7631	Socket	1

1. Put the machine on a flat level surface.

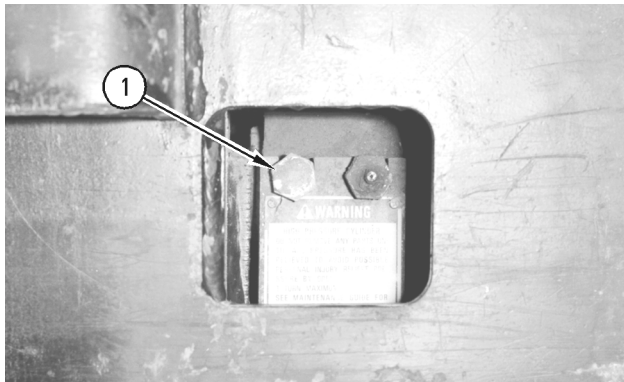
### **⚠ WARNING**

PERSONAL INJURY OR DEATH CAN RESULT FROM GREASE AND OIL COMING OUT OF THE RELIEF VALVE.

GREASE AND OIL ARE UNDER HIGH PRESSURE COMING OUT OF THE RELIEF VALVE AND CAN PENETRATE THE BODY.

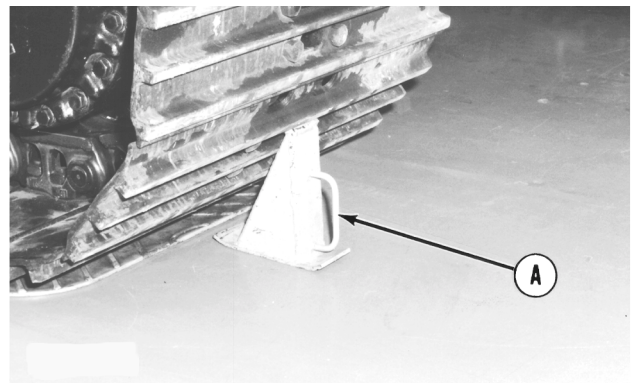
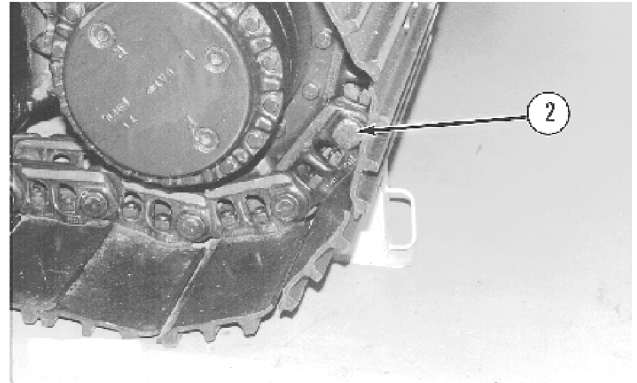
DO NOT WATCH THE RELIEF VALVE TO SEE IF GREASE IS ESCAPING. WATCH THE TRACK OR TRACK ADJUSTMENT CYLINDER TO SEE IF THE TRACK IS BEING LOOSENED.

MAKE SURE THE VENT HOLES ARE CLEAN BEFORE THE TENSION IS RELEASED ON THE TRACK.



2. Release the tension on the track assembly. Loosen relief valve (1) for one turn only. If the track assembly does not loosen after opening the relief valve, move the machine forward and backward until the tension

is released.



**NOTE:** To provide additional clearance for removal of the master pin, the track shoe on each side of the master pin may be removed. Use tooling (B) to remove the track bolts.

3. Move the track assembly until master pin (2) is in position that is shown. Put tooling (A) under the track grouser, as shown. Move the track assembly onto tooling (A).





### **⚠ WARNING**

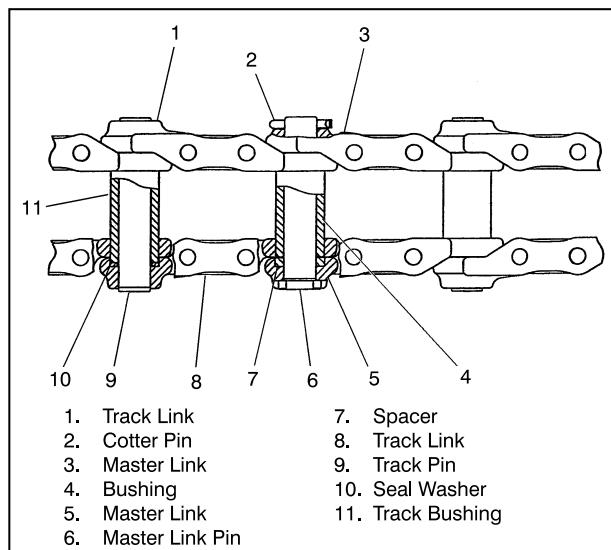
PERSONAL INJURY CAN RESULT FROM THE TRACK COMING OFF OF THE ROLLER FRAME.

THE TRACK CAN MOVE OFF THE TRACK ROLLER FRAME VERY QUICKLY WHEN A SEPARATION OF THE TRACK IS MADE.

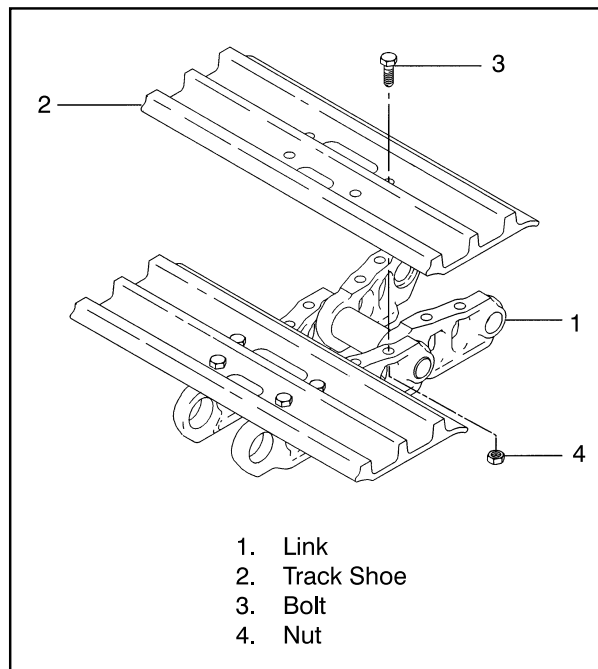
KEEP AWAY FROM THE FRONT OF THE MACHINE WHEN THE TRACK IS REMOVED FROM THE TRACK ROLLER FRAME.

**NOTE:** The track bushings will fall out of the track links when the track assembly is separated.

4. Remove cotter pin (3) from the master pin. Use a hammer and a punch to remove the master pin (2) from the track links. Separate the track links, and locate the two track bushings. Move the machine slowly forward until the track assembly is off the sprocket, the track carrier rollers and the front idler.
5. Fasten a hoist to the rear of the track. Raise the track assembly off tooling (A). Remove tooling (A) from the track assembly. Lower the rear of the track assembly to the floor.



**Figure 6-6. Track Link Assembly**

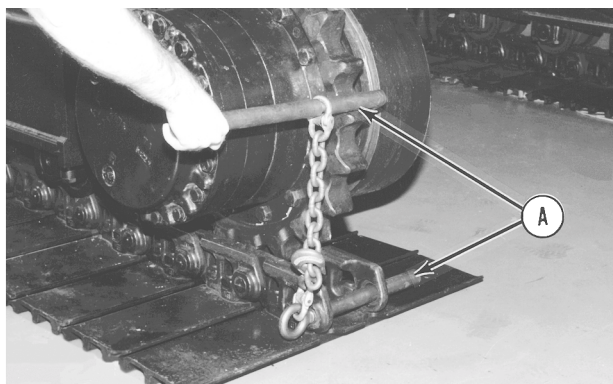


**Figure 6-7. Track Shoe**

### **Connect**

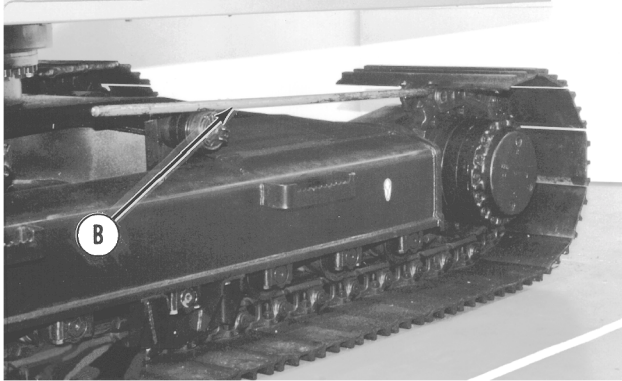
**Table 6-7. Track Required Tools - Connect**

Tool	Part #	Description	Qty.
A	1P-3545	Coupling Tool	1
B	1P-3533	Carrier Bar	1
C	1P-7402	Coupling Tool	1
D	5P-6214	Track Block Assembly	1
E	1U-7631	Socket	1

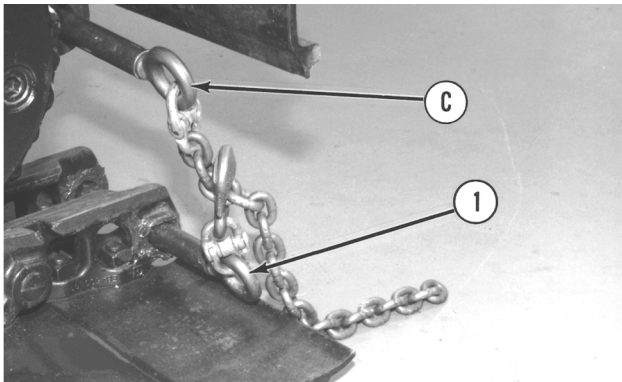




1. Install tooling (A) in the track link and on the sprocket as shown.
2. Start the machine. Move the sprocket forward until the track assembly is pulled on the sprocket. Move the sprocket forward until the end of the track assembly is past a vertical line through the center of the sprocket. Remove tooling (A).

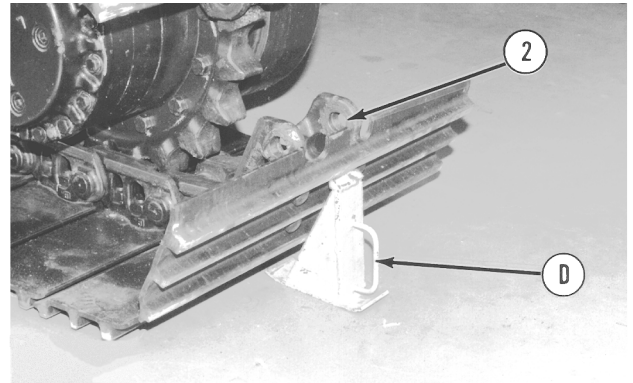


3. Install tooling (B) between the first bushing in the track link and the sprocket as shown.
4. Move the sprocket forward. Use tooling (B) to guide the track assembly over the carrier rollers and the front idler.



5. Install tooling (C) between the track links in the end of the track assembly as shown. Install 1P-3570 Hook (1) between the track links in the end of the

track assembly as shown. Hook (1) is part of tooling (A).



6. Move the track assembly forward or backward until the separation in the track assembly is below a horizontal line through the center of the sprocket.
7. Apply Molybdenum Grease on two track bushings (2). Install the bushings in the track links as shown. The grease will hold the bushings in place.
8. Install tooling (D) under the rear of the track assembly as shown. Move the track assembly backward until the separation in the track assembly closes and the pin bores in both ends of the track assembly are in alignment with each other. The machine may be moved back and forth in order to align the pin bores.
9. Apply Molybdenum Grease in the master pin bores in the track assembly and on the master pin. Install the master pin with a hammer. Install the cotter pin in the master pin. Remove tooling (D) from the rear of the track assembly.
10. If the track shoe on each side of the master pin was removed, reinstall the track shoes. Use tooling (E) to reinstall the track bolts.
11. Tighten the tension of the track.

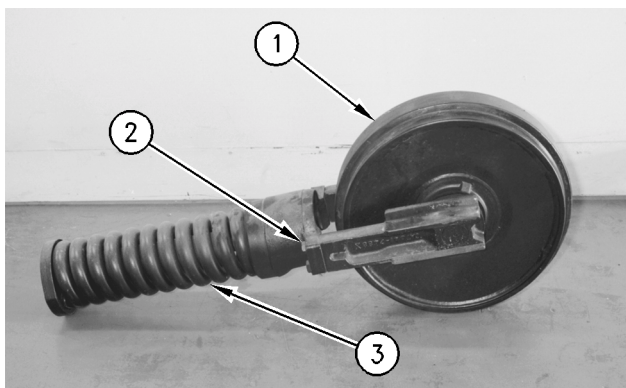


### 6.4 FRONT IDLER AND RECOIL SPRING

#### Removal



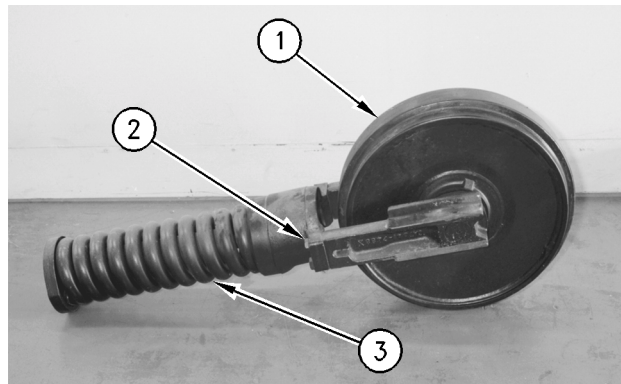
1. Fasten a suitable lifting device to front idler (1), as shown. Slide front idler (1) out of the undercarriage frame as a unit. The weight of the unit is approximately 265 lb. (120 kg).



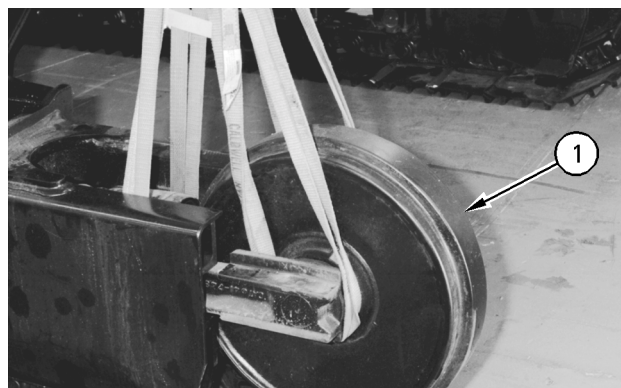
2. Remove four bolts (2) that hold front idler (1) to the front support for recoil spring (3). Separate front idler (1) from recoil spring (3). The weight of the front idler is approximately 150 lb. (67 kg). The weight of the recoil spring is approximately 120 lb. (53 kg).

#### Installation

**NOTE:** Make sure the mating surfaces of the front idler and the mating surfaces of the recoil spring are clean and free of dirt and debris prior to reassembly. Make sure the two bearings for the front idler are clean and free of dirt and debris prior to reassembly.



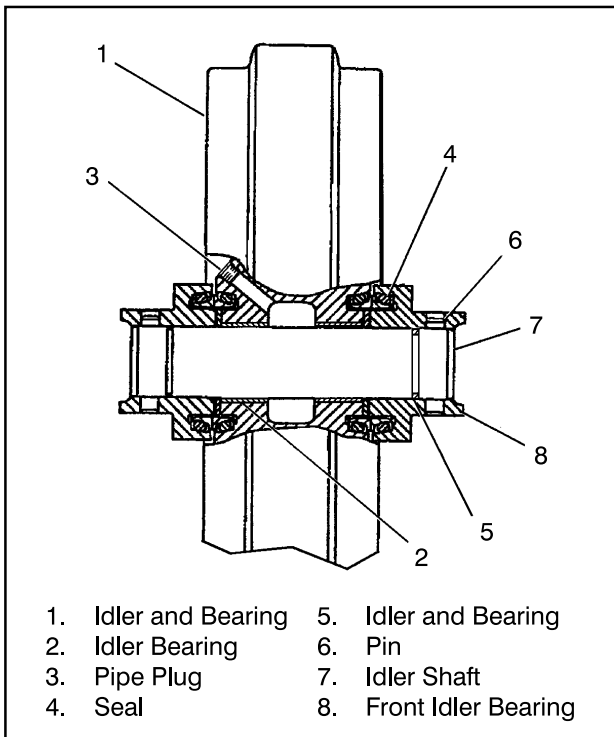
1. Position recoil spring (3) and front idler (1) together. Temporarily install four bolts (2).



2. Fasten a suitable lifting device to the front idler and to the recoil spring. Slide the front idler and the recoil spring partially into the undercarriage frame. Make sure the bolts (2) are exposed. Remove the lifting device from the unit. Tighten bolt (2).
3. Use a pry bar to slide the front idler and the recoil spring into the undercarriage frame.



## Front Idler Disassembly



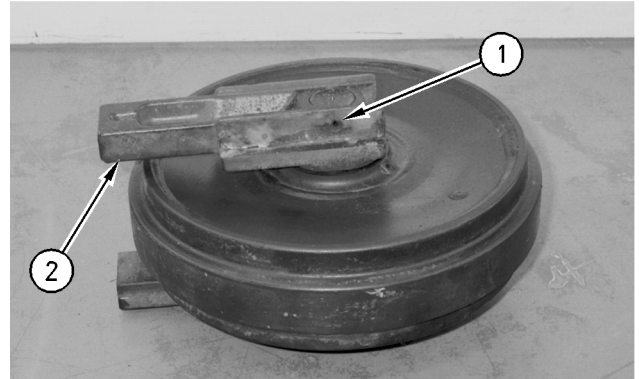
**Figure 6-8. Front Idler Assembly**

1. Thoroughly clean the outside of the front idler prior to assembly.

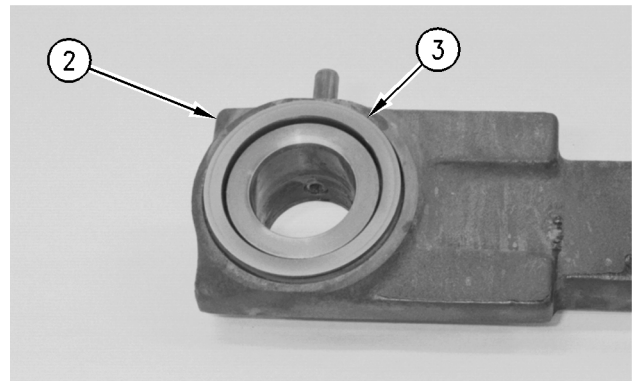
**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose all fluids according to local regulations and mandates.

2. Remove the fill/drain plug from the front idler. Drain the oil from the idler into a suitable container for disposal. The capacity of the idler is 5.07 oz. (150 mL).

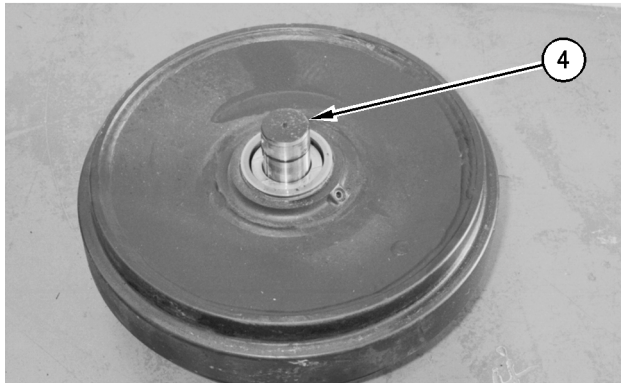


3. Put the front idler on one side as shown. The weight of the front idler is approximately 150 lb. (67 kg).
4. Remove two spring pins (1) from bearings (2). Remove the bearings from the shaft of the front idler. The weight of each bearing is approximately 15 lb. (7 kg).

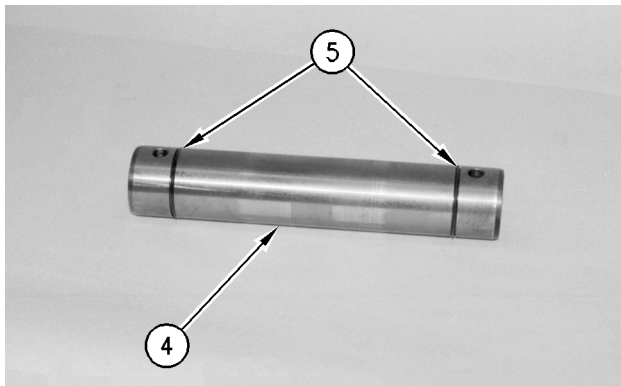


5. Remove Duo-cone seal kits (3) from bearings (2).

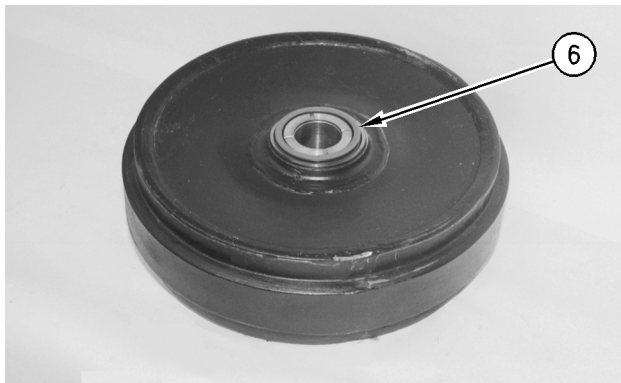




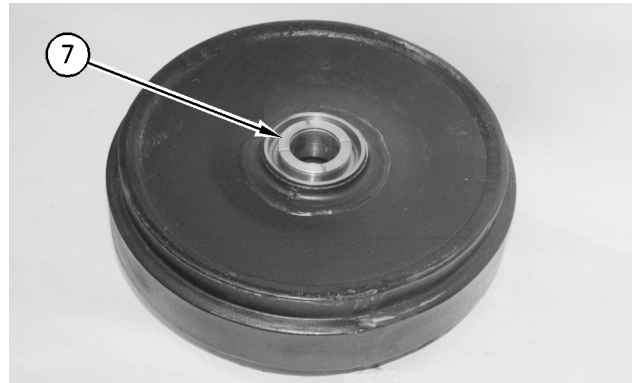
6. Remove shaft (4) from the front idler.



7. Remove two o-ring seals (5) from shaft (4).



8. Remove the Duo-cone seal kit (6) from each side of the front idler.



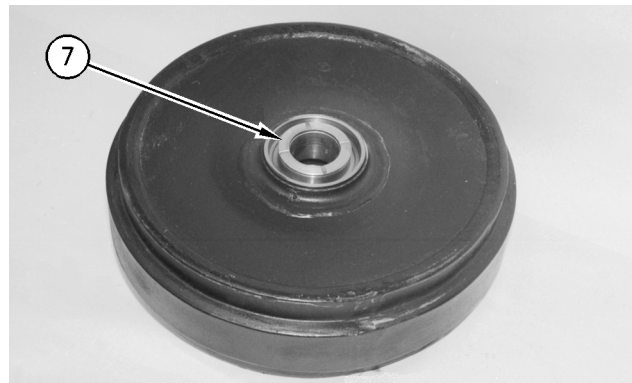
9. Remove bushings (7) from each side of the idler.

### Front Idler Assembly

Table 6-8. Front Idler Required Tools - Assembly

Tool	Part #	Description	Qty.
A	1U-6146	Seal Installer	1
B	8T-5096	Dial Indicator	1

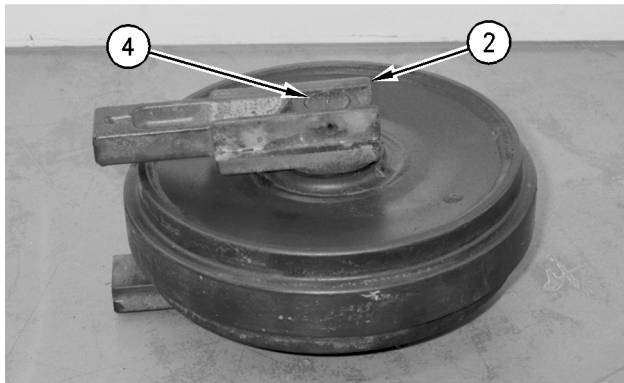
1. Thoroughly clean all parts of the front idler prior to assembly.



2. Check the condition of bushings (7). If the bushings are worn or damaged, use new parts for replacements.

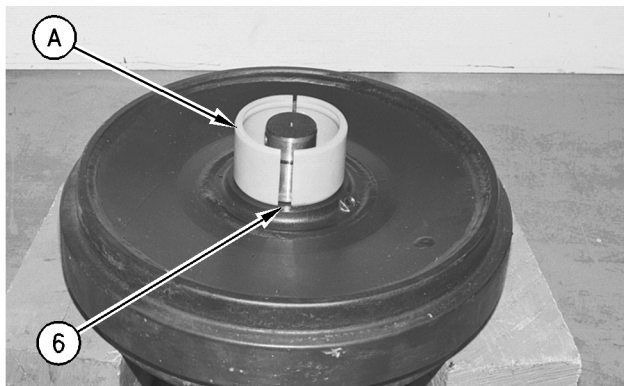


3. Lower the temperature of bushings (7), and install one in each side of the front idler with a press.

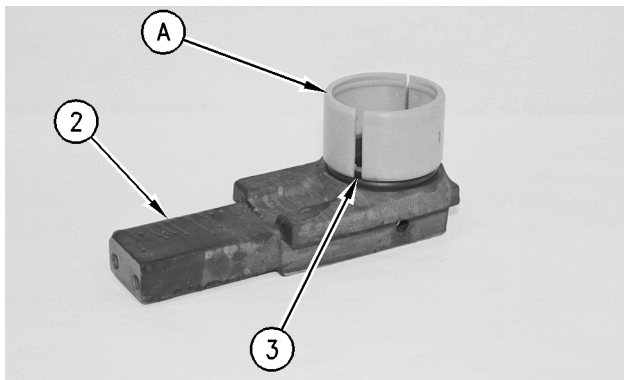


4. Temporarily install a bearing (2) on shaft (4). Install the shaft in the front idler. Install the other bearing (2) on the shaft. The shaft end play must be 0.002 inch (0.06 mm) to 0.042 inch (1.06 mm). Remove two bearings (2) and shaft (4) from the front idler.

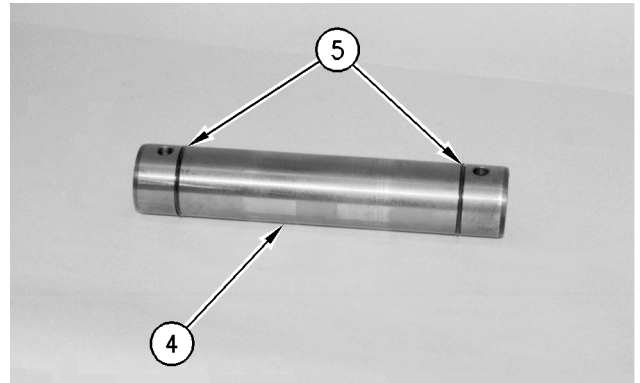
**NOTE:** The rubber seals and all of the surfaces that make contact with the seals must be clean and dry. After installation of the seals, put clean SAE30 oil on the contact surfaces of the metal seals.



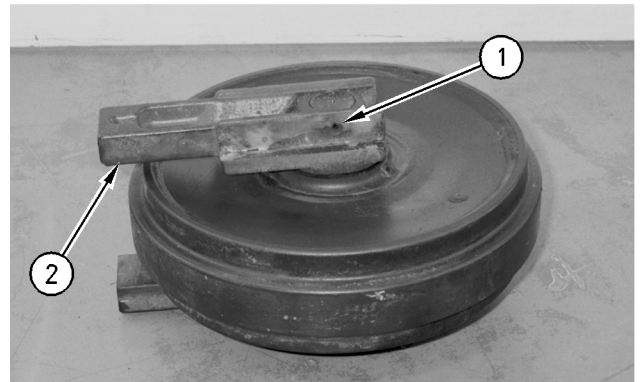
5. Install a Duo-cone seal kit (6) in each side of the idler with tooling (A).



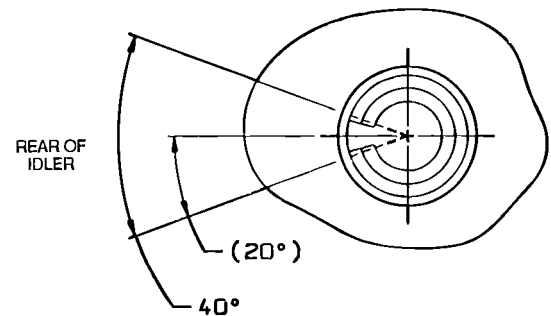
6. Install a Duo-cone seal kit (3) in each bearing (2) with tooling (A).



7. Replace o-ring seals (5) that are used on shaft (4) with new o-ring seals.
8. Install two o-ring seals (5) on shaft (4). Put clean SAE 30 oil on the o-ring seals.



9. Check the condition of spring pins (1) that are used to hold bearings (2) to shaft (4). If the spring pins are worn or damaged, use new parts for replacement.



10. Install shaft (4) in either bearing (2). Be sure that the spring pin hole in the shaft is aligned with the spring pin hole in the bearing. Make sure that the marking "R" and the milled surface of the shaft is toward the rear of the bearing.



## SECTION 6 - UNDERCARRIAGE

11. Install spring pin (1). The illustration above shows the positioning of the slit in spring pin (1).
12. Install the shaft and the bearing in the front idler.
13. Repeat step 10 in order to install the bearing on the opposite side of the shaft (4).
14. Be sure that the spring pin hole in the shaft is aligned with the spring pin hole in the bearing.

**NOTE:** Do not reuse spring pin (1). Use a new part for replacement.

15. Install spring pin (1).
16. Check the front idler for air leaks. Apply 36 to 37 psi (245 to 256 kPa) of air pressure to the idler for 30 seconds. If the pressure remains constant for 30 seconds, assume that there are no leaks in the front idler.
17. Put the front idler in a vertical position. Fill the front idler with 5.07 oz. of clean SAE30 oil.
18. Put a thin coat of thread lock compound on the threads of the fill/drain plug. Install the fill/drain plug.

### Recoil Spring Disassembly

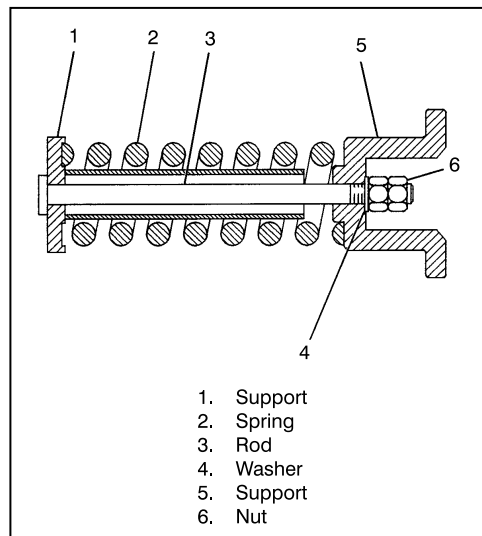


Figure 6-9. Recoil Spring Assembly

Table 6-9. Recoil Spring Required Tools - Disassembly

Tool	Part #	Description	Qty.
A	4C-9540	Bench	1
B	8S-7172	Hydraulic Cylinder	1
	3S-6224	Electric Hydraulic Pump	1
	8T-0820	Pressure Gauge	1
	3B-7722	Bushing	2
	1P-2376	Coupler Assembly	2
	1P-2377	Plug	2
	8F-0024	Hose Assembly	2
C	8S-9971	Ram Adapter	1
D	9U-6545	46mm Socket	1

### **⚠ WARNING**

**PERSONAL INJURY OR DEATH CAN RESULT FROM RECOIL SPRING FORCE.**

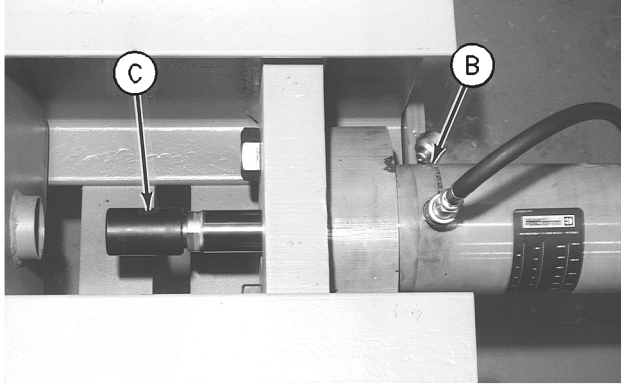
**RECOIL SPRING FORCE, IF NOT RELIEVED, CAN RESULT IN PERSONAL INJURY OR DEATH.**

**RELIEVE SPRING FORCE BEFORE REMOVING THREADED RETAINER, PERFORMING REPAIRS ON RECOIL SPRING HOUSING, OR REMOVING RECOIL SPRING.**

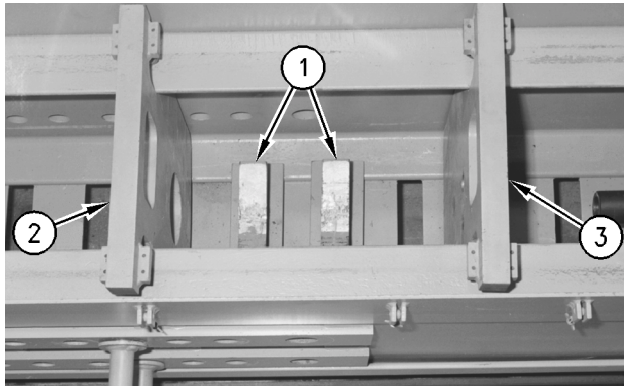
**MAXIMUM RECOIL PRESSURE IS 3,000 PSI (20,700 KPA).**



1. Prior to disassembling and assembling the recoil spring assembly, make sure that tooling (A) is on a level surface.
2. Thoroughly clean the outside surface of the recoil spring assembly prior to disassembly.



3. Install tooling (C) on tooling (B), as shown.



**NOTE:** Two adjustable supports (1), reaction plate (2), and movable plate (3) are part of tooling (A).

4. Position two supports (1) of tooling (A) in order to support the recoil spring assembly. Make sure the two supports are level.

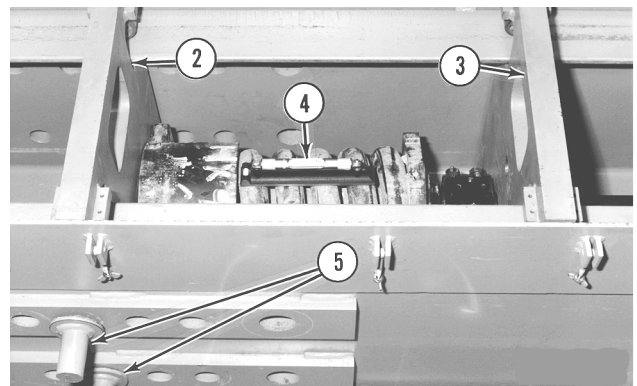
5. Adjust the spacing between reaction plate (2) and movable plate (3) so that the spacing is approximately the same length as the recoil spring assembly.



**NOTE:** Do not remove the lifting device from the recoil spring assembly until the unit is leveled, centered and locked in tooling (A).

**NOTE:** The recoil spring assembly may be installed in tooling (A) from the end. In this case, reaction plate (2) must be removed. Then reinstall the reaction plate after the recoil spring assembly is in place on two adjustable supports (1).

6. The weight of the recoil spring assembly is 117 lb. (53 kg). Fasten a suitable lifting device to the recoil spring assembly. Put the recoil spring assembly in position on two adjustable supports (1) in tooling (A). Adjust the two adjustable supports until the centerline of the recoil spring assembly and the centerline of tooling (A) are aligned.

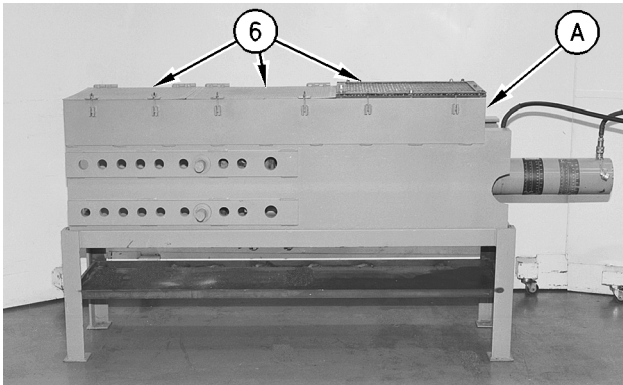


**NOTE:** The lifting device is removed from the recoil spring assembly for photographic purposes.



## SECTION 6 - UNDERCARRIAGE

- Put a level gauge (4) on the recoil spring assembly. Reposition the recoil spring assembly until the recoil spring assembly is level. Reposition the recoil spring assembly until the retaining rod for the recoil spring and the nut for the recoil spring assembly are centered in the hole in reaction plate (2). After the recoil spring assembly is leveled and centered, install two pins (5) on the back side of reaction plate (2), as shown. Operate tooling (B) enough to hold the recoil spring assembly in position between reaction plate (2) and movable plate (3). Make sure that the recoil spring assembly is level and centered.



### **⚠ WARNING**

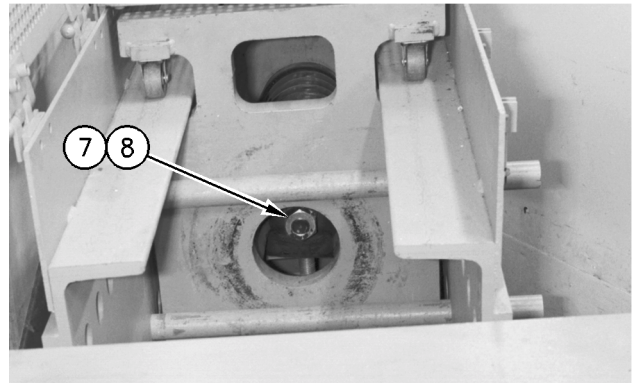
**PERSONAL INJURY OR DEATH CAN RESULT FROM RECOIL SPRING FORCE.**

**RECOIL SPRING FORCE, IF NOT RELIEVED, CAN RESULT IN PERSONAL INJURY OR DEATH.**

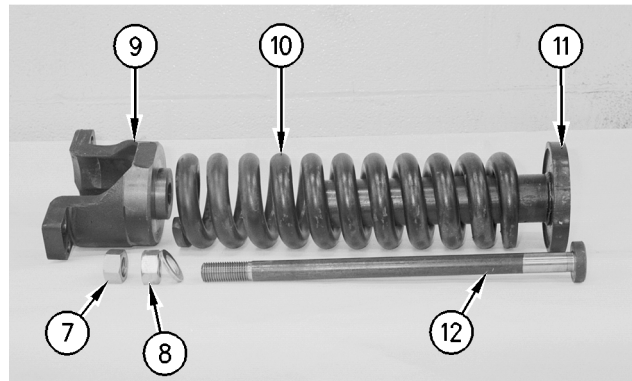
**RELIEVE SPRING FORCE BEFORE REMOVING THREADED RETAINER, PERFORMING REPAIRS ON RECOIL SPRING HOUSING, OR REMOVING RECOIL SPRING.**

**MAXIMUM RECOIL SPRING PRESSURE IS 3000 PSI (20,700 KPA).**

- Close covers (6) on tooling (A). Use tooling (B) to compress the recoil spring assembly slightly.



- Use tooling (D) to remove locknut (7), nut (8) and the washer from the end of the retaining rod of the recoil spring assembly.
- Open covers (6) on tooling (A). Fasten a suitable lifting device to the disassembled recoil spring assembly. Remove reaction plate (2) in order to remove the recoil spring assembly from tooling (A).



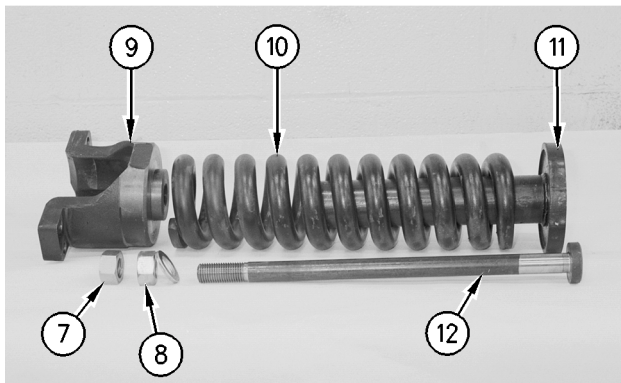
- Separate the components of the recoil spring assembly. Remove retaining rod (12), plate (11), spring (10), and support (9).



## Recoil Spring Assembly

**Table 6-10. Recoil Spring Required Tools - Assembly**

Tool	Part #	Description	Qty.
A	4C-9540	Bench	1
B	8S-7172	Hydraulic Cylinder	1
	3S-6224	Electric Hydraulic Pump	1
	8T-0820	Pressure Gauge	1
	3B-7722	Bushing	2
	1P-2376	Coupler Assembly	2
	1P-2377	Plug	2
	8F-0024	Hose Assembly	2
C	8S-9971	Ram Adapter	1
D	9U-6545	46mm Socket	1



1. Check the condition of the threads on retaining rod (12), nut (7), and nut (8). If any of the threads are worn or damaged, use new parts for replacement.

### **⚠ WARNING**

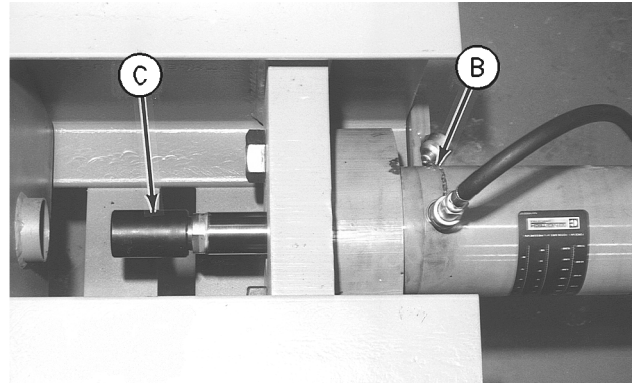
**PERSONAL INJURY OR DEATH CAN RESULT FROM RECOIL SPRING FORCE.**

**RECOIL SPRING FORCE, IF NOT RELIEVED, CAN RESULT IN PERSONAL INJURY OR DEATH.**

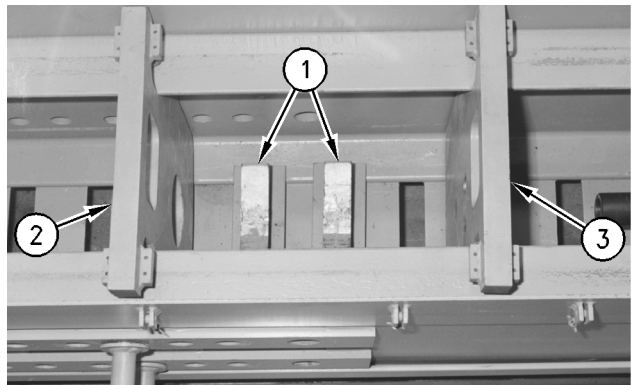
**RELIEVE SPRING FORCE BEFORE REMOVING THREADED RETAINER, PERFORMING REPAIRS ON RECOIL SPRING HOUSING, OR REMOVING RECOIL SPRING.**

**MAXIMUM RECOIL SPRING PRESSURE IS 3000 PSI (20,700 KPA).**

2. Loosely assemble the recoil spring assembly. Install retaining rod (12) in plate (11), in spring (10) and in support (9).



3. Install tooling (C) on tooling (B), as shown.



**NOTE:** Two adjustable supports (1), reaction plate (2) and movable plate (3) are part of tooling (A).

4. Position two supports (1) of tooling (A) in order to support the recoil spring assembly. Make sure the two supports are level.
5. Adjust the spacing between reaction plate (2) and movable plate (3) so the spacing is approximately the same length as the recoil spring assembly.





## SECTION 6 - UNDERCARRIAGE

**NOTE:** Do not remove the lifting device from the recoil spring assembly until the unit is leveled, centered, and locked in tooling (A)

**NOTE:** The recoil spring assembly may be installed in tooling (A) from the end. In this case, reaction plate (2) must be removed. Then reinstall the reaction plate after the recoil spring assembly is in place on two adjustable supports.

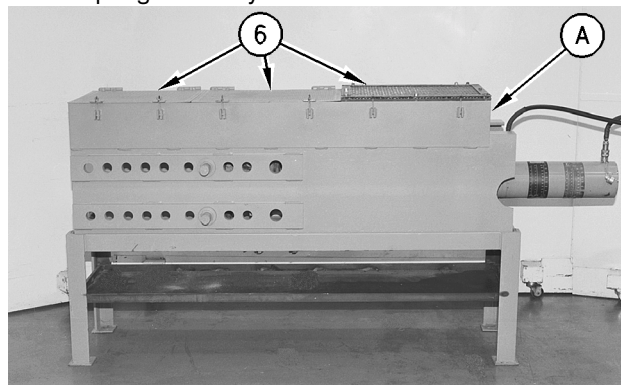
6. The weight of the recoil spring assembly is 117 lb. (53 kg). Put the recoil spring assembly in position on two adjustable supports (1) in tooling (A). Adjust the two adjustable supports until the centerline of the recoil spring assembly and the centerline of tooling (A) are aligned.



**NOTE:** The lifting device is removed from the recoil spring assembly for photographic purposes.

7. Put a level gauge (4) on the recoil spring assembly. Reposition the recoil spring assembly until the recoil spring assembly is level. Reposition the recoil spring assembly until the retaining rod for the recoil spring and the nut for the recoil spring assembly are centered in the hole in reaction plate (2). After the recoil spring assembly is leveled and centered, install two pins (5) on the back side of reaction plate (2), as shown. Operate tooling (B) enough to hold the recoil spring assembly in position between reaction plate

(2) and movable plate (3). Make sure that the recoil spring assembly is level and centered.



### **⚠ WARNING**

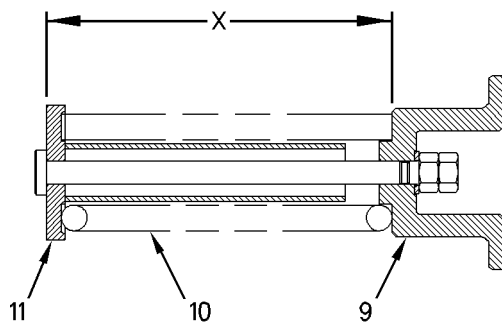
**PERSONAL INJURY OR DEATH CAN RESULT FROM RECOIL SPRING FORCE.**

**RECOIL SPRING FORCE, IF NOT RELIEVED, CAN RESULT IN PERSONAL INJURY OR DEATH.**

**RELIEVE SPRING FORCE BEFORE REMOVING THREADED RETAINER, PERFORMING REPAIRS ON RECOIL SPRING HOUSING, OR REMOVING RECOIL SPRING.**

**MAXIMUM RECOIL SPRING PRESSURE IS 3000 PSI (20,700 KPA).**

8. Close covers (6) on tooling (A). Use tooling (B) to compress the recoil spring assembly slightly.



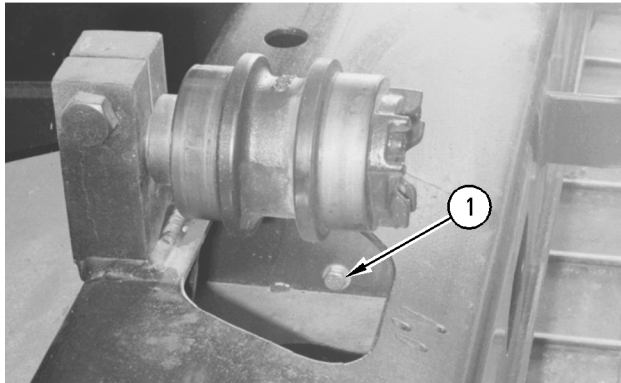
9. Open the covers (6) on tooling (A). Measure dimension (X). The compressed length of dimension (X) must be  $18.03 \pm 0.04$  inch ( $458 \pm 1$  mm). If the compressed length of dimension (X) is not correct, close covers (6) on tooling (A) and adjust the length with tooling (B). Adjust the length of dimension (X) until the compressed length of dimension (X) is correct.
10. Apply a rust inhibitor to the threads of rod (12). Install the washer and nut (8). Install nut (7). Tighten nut (7) to a torque of  $350 \pm 37$  ft. lbs. ( $470 \pm 50$  Nm).



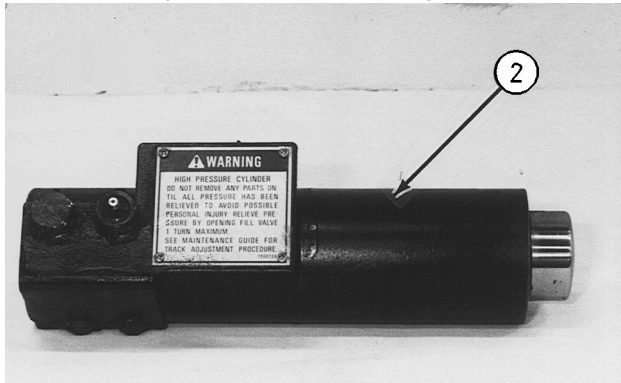
11. Fasten a suitable lifting device to the recoil spring assembly. The weight of the recoil spring assembly is 117 lb. (53 kg). Remove the recoil spring assembly from tooling (A).

## 6.5 TRACK ADJUSTER

### Removal

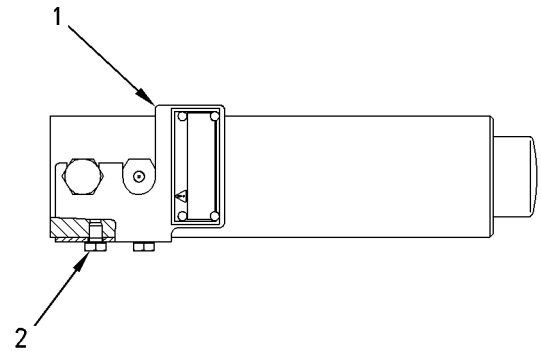


1. Remove two bolts (1) and the washers that hold the track adjuster to the undercarriage frame.

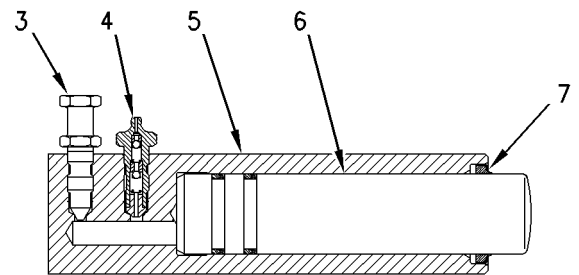


2. Remove the track adjuster.

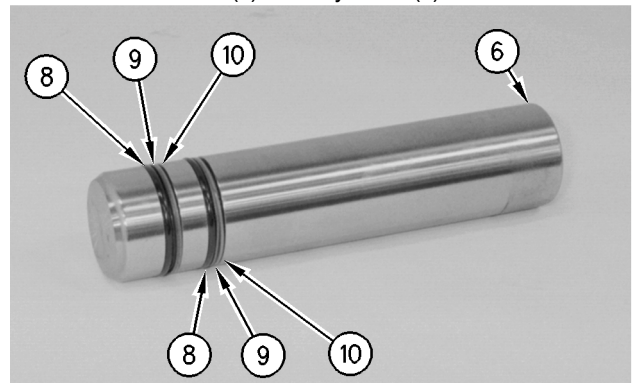
### Disassembly



1. Remove two bolts (2). Remove plate assembly (1).



2. Remove relief valve (3). Remove fill valve (4).
3. Remove piston (6) from cylinder (5).
4. Remove seal (7) from cylinder (5).



5. Remove two o-ring seals (8) from piston (6).
6. Remove two rings (9) and remove two rings (10) from piston (6).



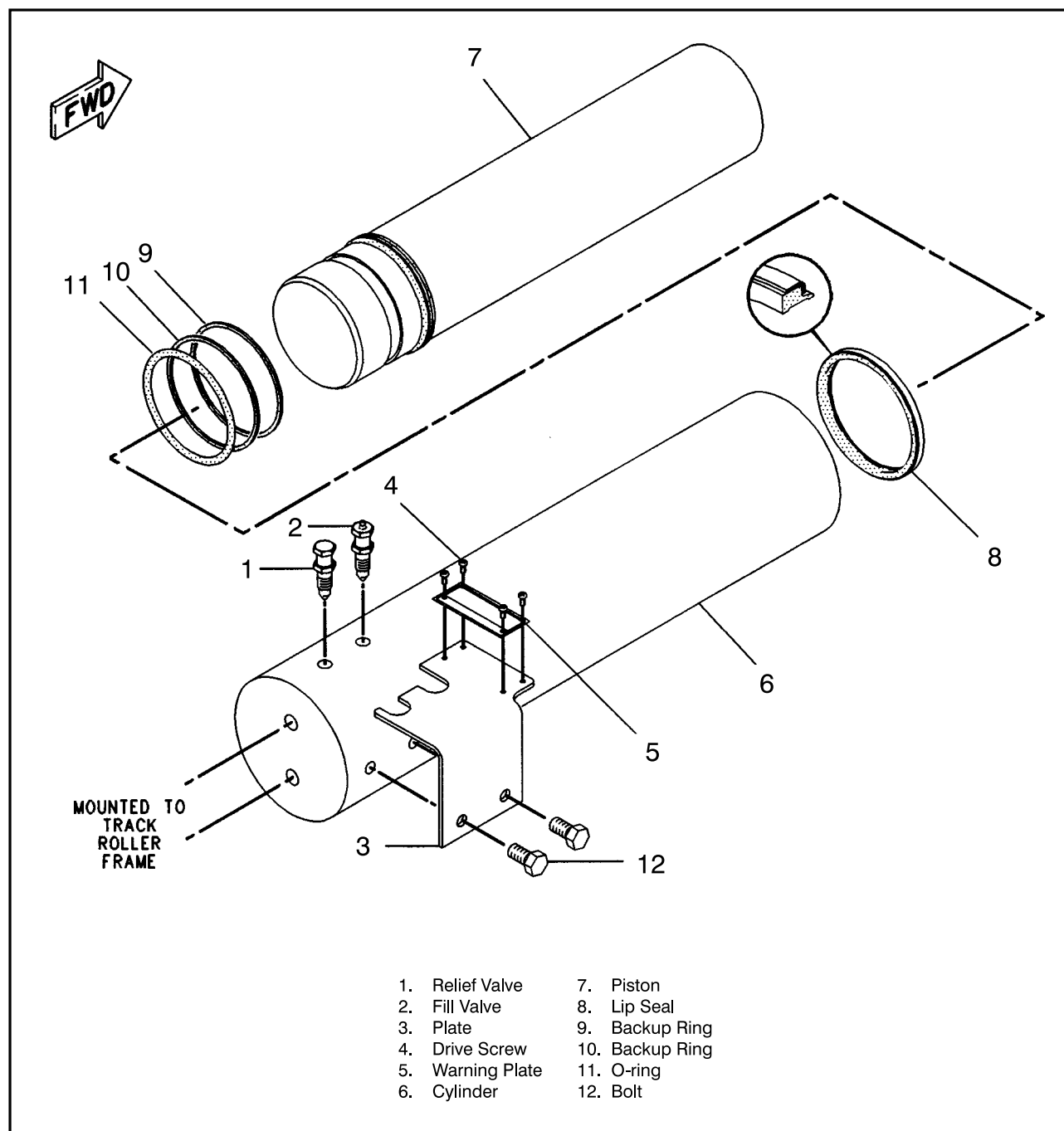


Figure 6-10. Track Adjuster



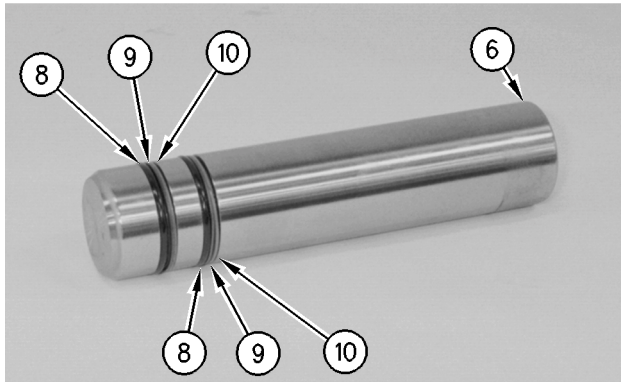
## Assembly

**Table 6-11. Track Adjuster Required Tools - Assembly**

Tool	Part #	Description	Qty.
A	1P-0520	Driver Group	1

**NOTE:** Make sure that all of the parts of the hydraulic track adjuster are clean and free of dirt and debris prior to assembly.

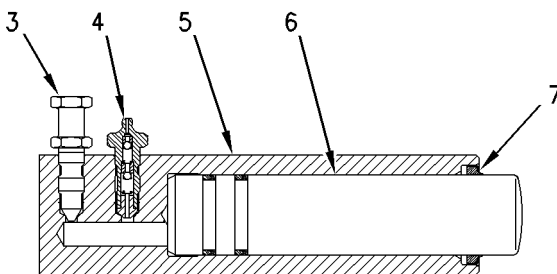
1. Replace all o-ring seals with new o-ring seals.



**NOTE:** Completely fill the seal grooves in the piston with Molybdenum Grease. The grease will displace air when the o-rings and the backup rings are installed.

2. Install two backup rings (10), two backup rings (9) and two o-ring seals (8) on piston (6).

**NOTE:** O-rings and backup rings must be installed in the correct position in order to ensure the correct operation of the hydraulic track adjuster. Backup rings are distinguished by the color of the ring. Backup rings (10) are black in color. Backup rings (9) are brown in color.



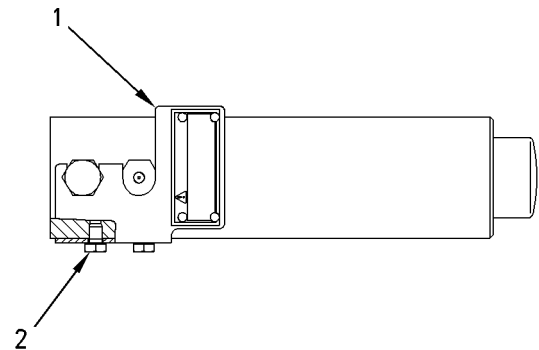
3. Apply Molybdenum Grease in the groove for lip seal (7). Use tooling (A) to install lip seal (7). Install lip seal (7) until the seal is  $0.02 \pm 0.02$  inch ( $0.5 \pm 0.5$

mm) below the surface of cylinder (5). Install lip seal (7) with the lip toward the outside of cylinder (5).

4. Make sure that all of the passages in cylinder (5) are filled with Molybdenum Grease. Make sure that air is not trapped in the passages in cylinder (5).
5. Install relief valve (3) in the body of the cylinder. Do not tighten the relief valve.
6. Install fill valve (4) in the body of the cylinder. Tighten the fill valve snugly. Do not torque the fill valve.
7. Fill the cavity of cylinder (5) with Molybdenum Grease.
8. Put a small amount of Molybdenum grease on the sliding surface of piston (6). Put a minimum of 4 in<sup>3</sup> (60cc) of Molybdenum grease on the end of the piston (6). This grease will prevent air from displacing grease in the cylinder during installation of the piston. Make sure that the grease covers backup rings (10) and (9) and o-rings (8).
9. Center piston (6) in cylinder (5). Insert the piston into the cylinder.

**NOTE:** It may be necessary to use a soft faced hammer to install the piston into the cylinder.

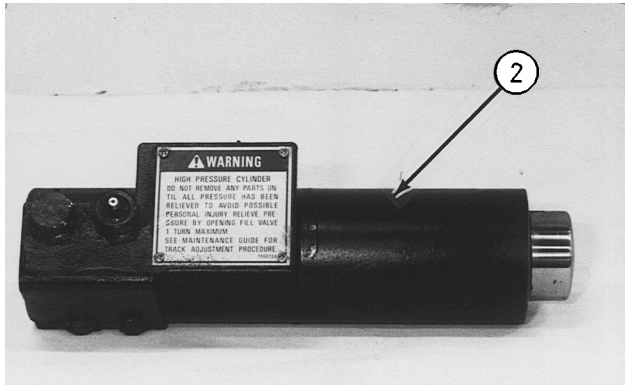
10. Make sure that grease is expelled from the vent hole for the relief valve. Tighten relief valve (3) to a torque of  $25 \pm 4$  lb. ft. ( $34 \pm 5$  Nm).
11. Add approximately 0.3 in<sup>3</sup> (5 cc) of Molybdenum Grease through fill valve (4). Apply a force to piston (6) and open fill valve (4) in order to purge all the air from the hydraulic track adjuster.
12. Tighten fill valve (4) to a torque of  $34 \pm 5$  Nm ( $25 \pm 4$  ft. lb.).



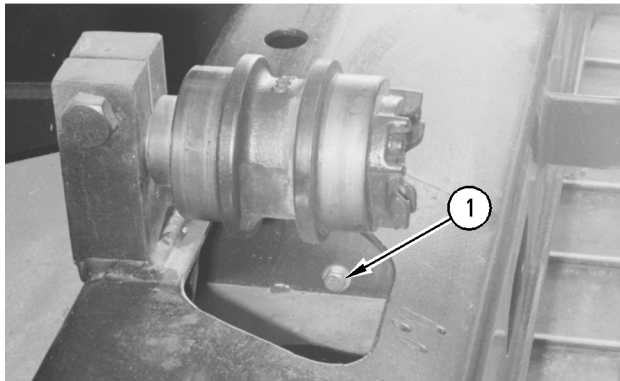
13. Install plate assembly (1). Install two bolts (2).
14. Install the track adjuster. Refer to Disassembly and Assembly, "Track Adjuster - Install" in this manual.



### Installation



1. Position track adjuster (2) in the undercarriage frame of the machine.



2. Install the washers and two bolts (1) that hold the track adjuster to the undercarriage frame.
3. Install the front idler and the recoil springs. Refer to Disassembly and Assembly, "Front Idler and Recoil Spring - Install" in this manual.

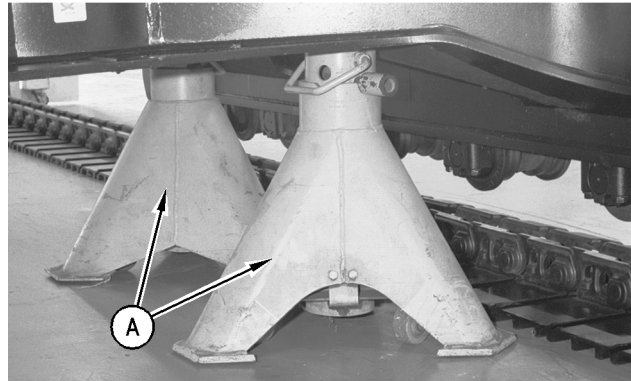
### 6.6 FINAL DRIVE SPROCKET

#### Removal

**Table 6-12. Final Drive Sprocket Required Tools - Removal**

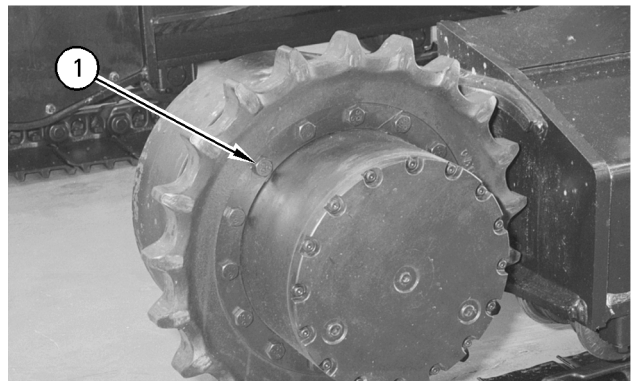
Tool	Part #	Description	Qty.
A	8S-7640	Stand	2
	8S-7611	Tube	2
	8S-7615	Pin	2
B	138-7574	Link Bracket	1

Separate the track assembly. Refer to Disassembly and Assembly, "Track - Separate" in this manual.



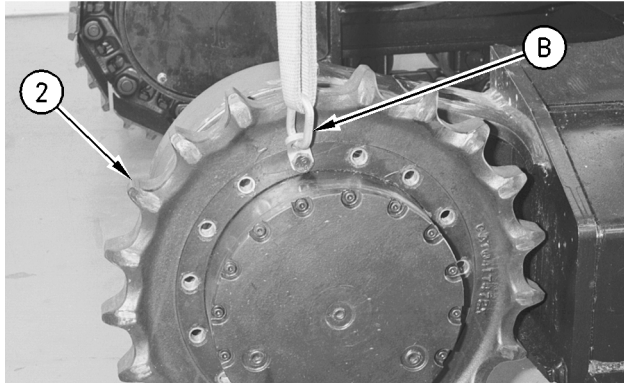
**NOTE:** Adjust the height of Tooling (A) so that there is sufficient clearance between the sprocket and the track links for the removal of the sprocket.

1. Lift the side of the machine. Install tooling (A) under the frame, as shown.





2. Remove 15 bolts (1) that hold the sprocket to the final drive.



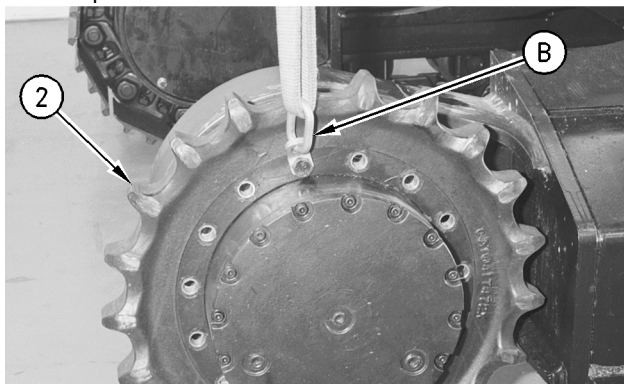
3. Fasten Tooling (B.) and a suitable lifting device to sprocket (2), as shown. Remove the sprocket. The weight of the sprocket is 82 lb (37 kg).

## Installation

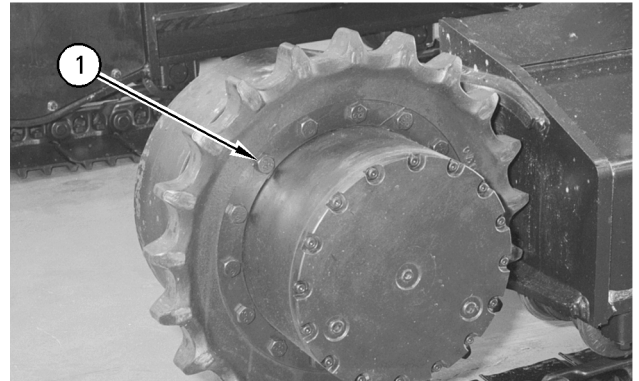
**Table 6-13. Final Drive Sprocket Required Tools - Installation**

Tool	Part #	Description	Qty.
A	8S-7640	Stand	2
	8S-7611	Tube	2
	8S-7615	Pin	2
B	138-7574	Link Bracket	1

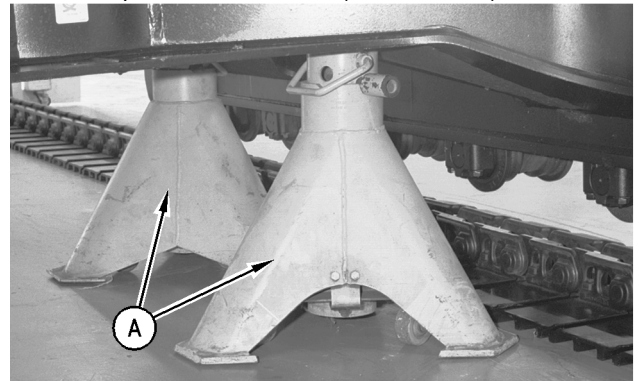
1. Thoroughly Clean the mating surfaces of the sprocket and final drive prior to installation of the sprocket.



2. Fasten tool (B) and a suitable lifting device to sprocket (2). Place the sprocket in position on the final drive.



3. Put a thin coat of Thread Lock Compound on the threads of 15 bolts (1) that hold the sprocket to the final drive. Install bolts t1). Tighten the bolts to a torque of  $200 \pm 30$  ft lb ( $270 \pm 40$  Nm).



4. Raise the machine. Remove Tooling (A) from the frame.
5. Connect the track assembly. Refer to Disassembly and Assembly, "Track - Connect" in this manual.



### 6.7 TRAVEL BRAKE VALVE

#### Removal

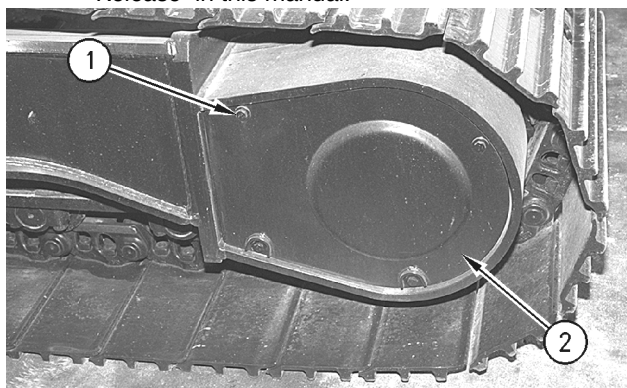
#### **⚠ WARNING**

AT OPERATING TEMPERATURE, THE HYDRAULIC OIL IS HOT AND UNDER PRESSURE. HOT OILS CAN CAUSE BURNS.

TO PREVENT POSSIBLE PERSONAL INJURY, RELEASE THE PRESSURE IN THE IMPLEMENT HYDRAULIC CIRCUIT (BOOM, STICK, BUCKET, AND SWING), TRAVEL CIRCUITS, AND THE HYDRAULIC OIL TANK AT THE FILLER CAP BEFORE ANY HYDRAULIC LINES OR COMPONENTS ARE DISCONNECTED OR REMOVED.

REMOVE THE FILLER CAP ONLY WHEN THE ENGINE IS STOPPED AND THE FILLER CAP IS COOL ENOUGH TO TOUCH.

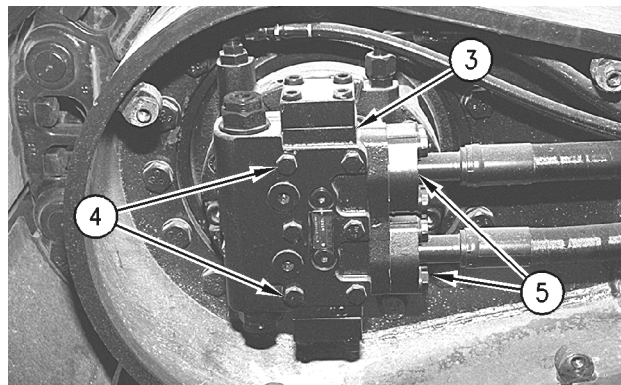
1. Release the hydraulic system pressure. Refer to Disassembly and Assembly, Hydraulic System Pressure - Release" in this manual.



2. Remove four bolts (1) and the washers that hold cover assembly (2). Remove cover assembly (2).

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.



3. When two hose assemblies (5) are disconnected from the travel brake valve, oil will flow from the hose assemblies. Collect the drain oil in a suitable container. Disconnect two hose assemblies (5) from travel brake valve (3). Put plugs in the ends of the hose assemblies. Plugs prevent oil loss. Plugs prevent contaminating the hydraulic system.
4. Remove six bolts (4) that hold travel brake valve (3) to the travel motor. Remove the travel brake valve.
5. Remove the three O-ring seals from the travel motor.

### 6.8 TRAVEL MOTOR

#### Removal

Table 6-14. Travel Motor Required Tools - Removal

Tool	Part #	Description	Qty.
A	138-7574	Link Bracket	1
B		254 mm (10 inch) of M16 x20 Threaded Rod	2

Start by removing the travel brake valve. Refer to Disassembly and Assembly, "Travel Brake Valve - Remove" in this manual.

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.



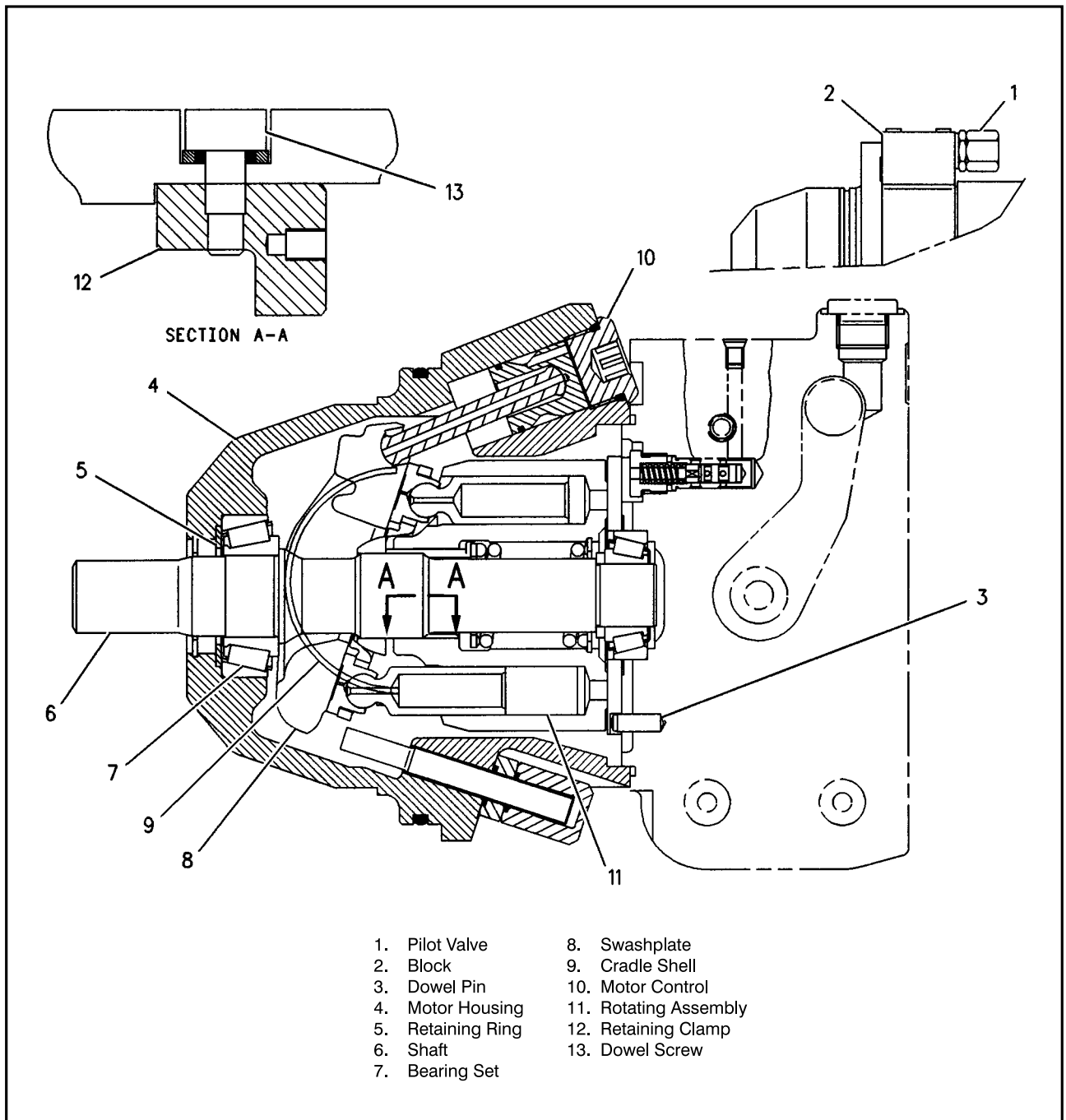
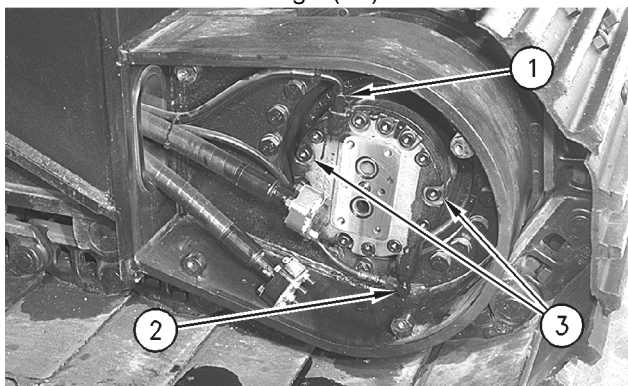


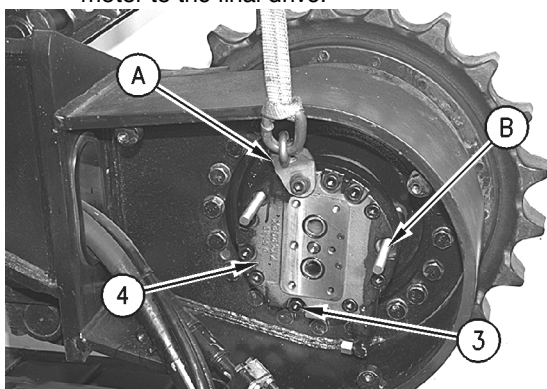
Figure 6-11. Travel Motor



1. Drain the oil from the final drive into a suitable container for storage or disposal. The capacity of the final drive is 2.1 US gal (8 L).



2. A small amount of oil will drain from hose assemblies (1) and (2) when the hose assemblies are disconnected from the travel motor. Place a pan under the travel motor in order to contain the drain oil. Disconnect hose assemblies (1) and (2) from the travel motor. Put plugs in the ends of the hose assemblies. Plugs prevent oil loss. Plugs prevent contaminating the hydraulic system.
3. Remove two of the three bolts (3) that hold the travel motor to the final drive.



4. Install tooling (B) in the place of the two bolts that were removed. Fasten Tooling (A) and a suitable lifting device to travel motor (4), as shown. Remove the remaining bolt (3). Carefully pull travel motor (4) from the machine. The weight of the travel motor is approximately 110 lb (50 kg).
5. Remove the O-ring seal from the body of the travel motor.

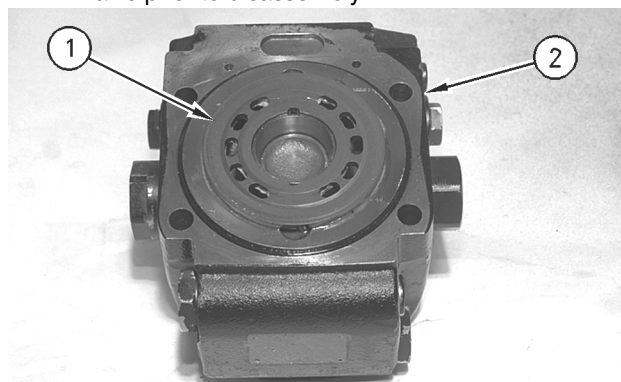
### 6.9 TRAVEL BRAKE VALVE

#### Disassembly

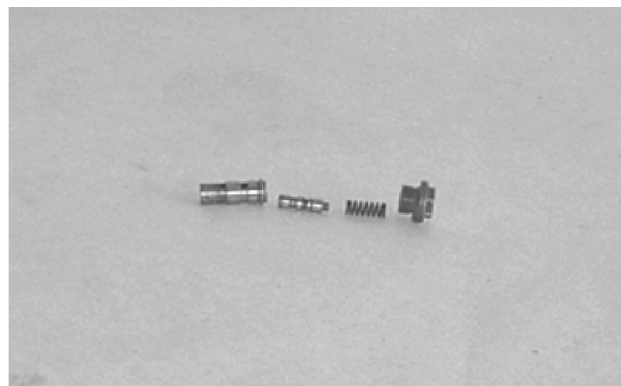
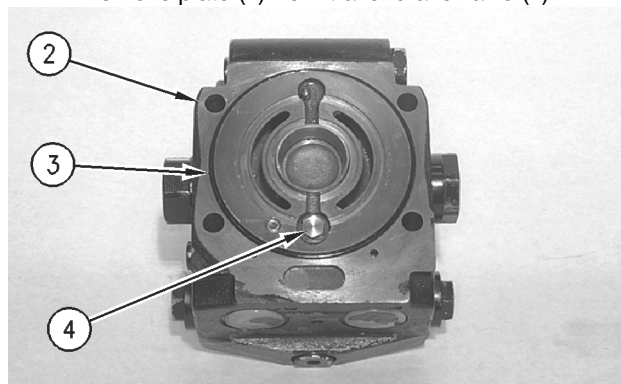
Start by removing the travel brake valve. Refer to Disassembly and Assembly, "Travel Brake Valve - Remove and Install" in this manual.

**NOTE:** Mark all of the components during the disassembly of the travel brake valve. Make sure that the marks are used during the assembly of the travel brake valve. Do not mix the parts.

1. Thoroughly Clean the outside of the travel brake valve prior to disassembly.

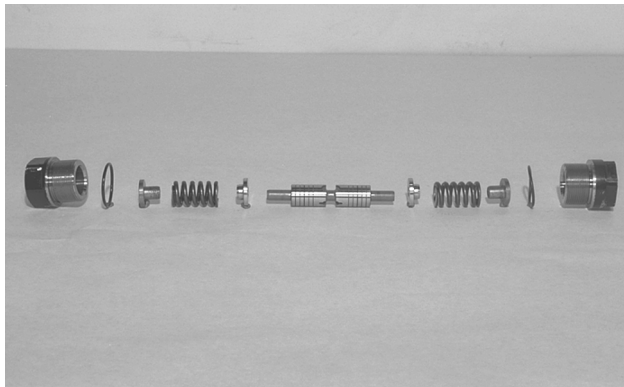
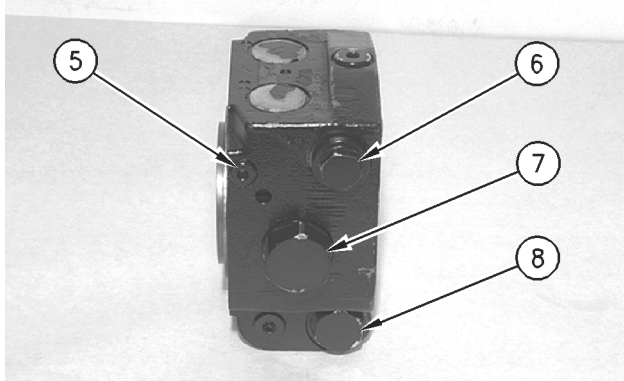


2. Remove plate (1) from travel brake valve (2).





3. Remove O-ring seal (3) from travel brake valve (2).  
Remove brake valve (4) from the travel brake valve.



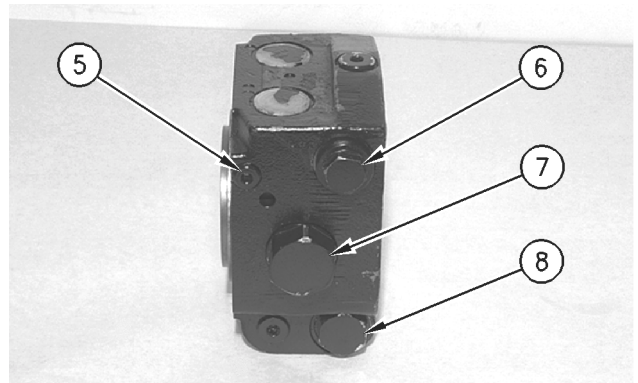
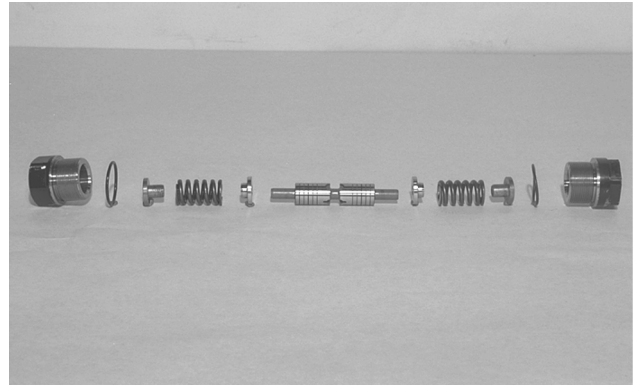
4. Remove valve (5) from travel brake valve (2).  
Remove two check valves (6) from the travel brake valve. Remove brake valve (7) from the travel brake valve. Remove two relief valve (8) from the travel brake valve.

## 6.10 TRAVEL BRAKE VALVE

### Assembly

1. Thoroughly clean all of the parts of the travel brake valve prior to assembly.

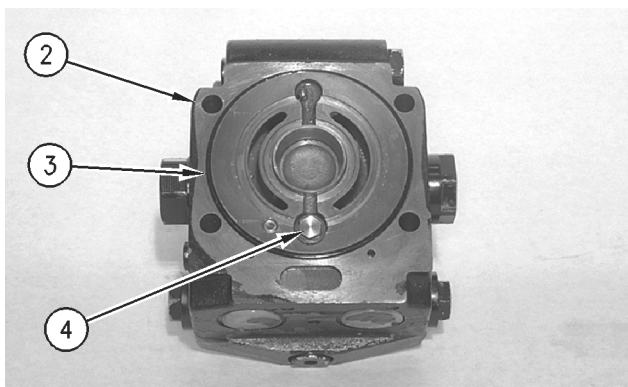
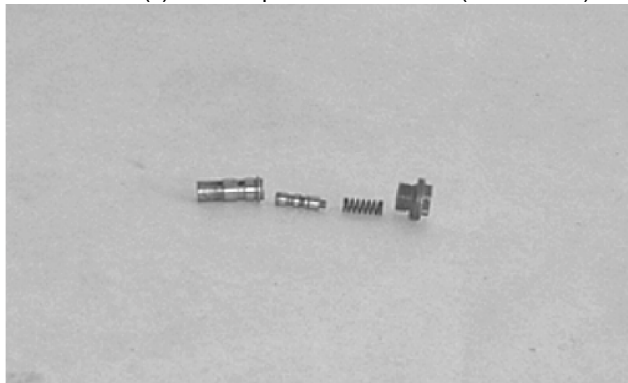
**NOTE:** Make sure that all parts are marked during the disassembly of the travel brake valve. Make sure that the marks are used during the assembly of the travel brake valve. Do not mix the parts.



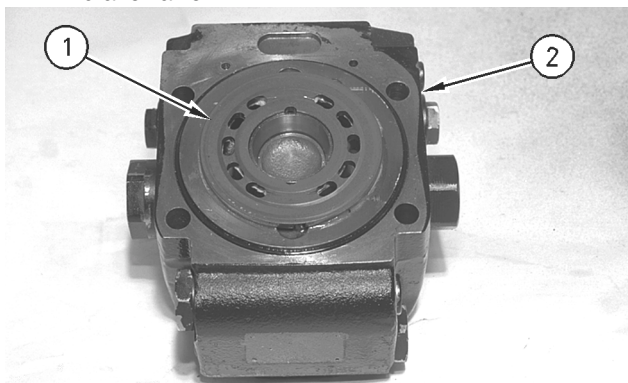
2. Install two relief valve (8) in travel brake valve (2).  
Tighten two relief valves (8) to a torque of  $110 \pm 9$  ft.lb. ( $150 \pm 12$  Nm).
3. Install brake valve (7) in travel brake valve (2).  
Tighten brake valve (7) to a torque of  $175 \pm 15$  ft.lb. ( $240 \pm 20$  Nm).
4. Install two check valves (6) in travel brake valves (2).  
Tighten two check valves (6) to a torque of  $110 \pm 9$  lb ft ( $150 \pm 12$  Nm).



5. Install valve (5) in travel brake valve (2). Tighten valve (5) to a torque of  $15 \pm 1$  ft.lb. ( $20 \pm 2$  Nm).



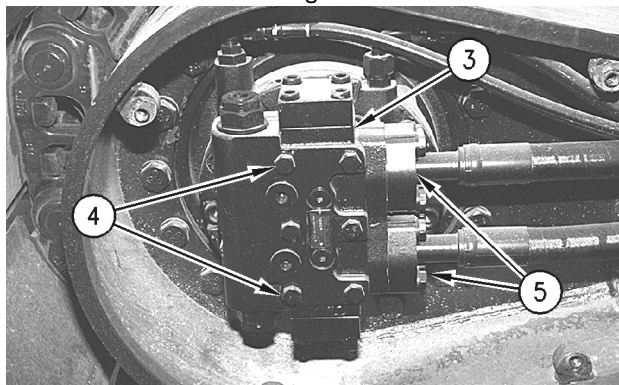
6. Install brake valve (4) in travel brake valve (2). Tighten brake valve (2) to a torque of  $20 \pm 2$  Nm ( $15 \pm 1$  ft. lb.). Install O-ring seal (3) on the travel brake valve.



7. Install plate (1) on travel brake valve (2).
8. Install the travel brake valve. Refer to Disassembly and Assembly, "Travel Brake Valve - Remove and Install" in this manual.

### Installation Procedure

1. Make sure that the mating surfaces of the travel motor and the travel brake valve are thoroughly clean.
2. Check the condition of the three O-ring seals that are used between the travel motor and the travel brake valve. If the O-ring seals are damaged, use new parts for replacement.
3. Install the three O-ring seals in the travel motor.



4. Place travel brake valve (3) in position on the travel motor. Install six bolts (4). Tighten the six bolts to a torque of  $60 \pm 6$  ft.lb. ( $80 \pm 7$  Nm).

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

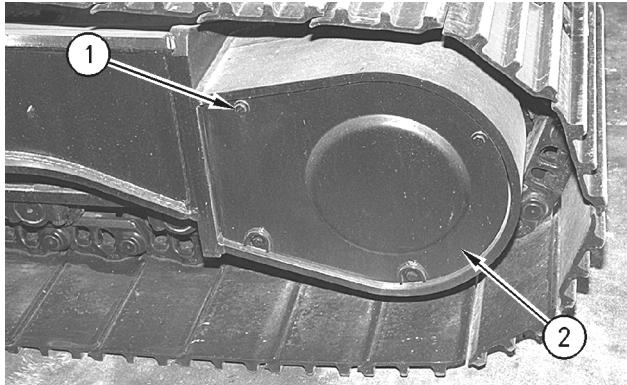
5. Check the condition of the O-ring seals that are used in the ends of two hose assemblies (5). If the O-ring seals are damaged, use new parts for replacement.
6. Connect two hose assemblies (5) to the travel brake valve. Tighten the hose assemblies to a torque of  $60 \pm 5$  ft. lb. ( $80 \pm 7$  Nm).

**NOTE:** Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the proper filling procedure and the proper levels for the hydraulic system.

7. Fill the hydraulic oil tank with hydraulic oil to the correct level.



8. Start the machine and check for leaks. Check the operation of the travel motors.



9. Install cover (2). Install the washers and four bolts (1). Tighten the four bolts to a torque of  $95 \pm 7$  ft. lb. ( $130 \pm 10$  Nm).

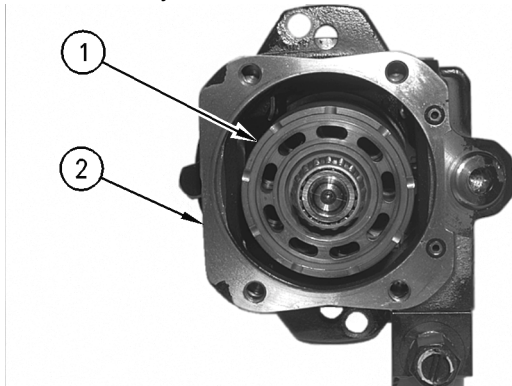
## 6.11 TRAVEL MOTOR

### Disassembly

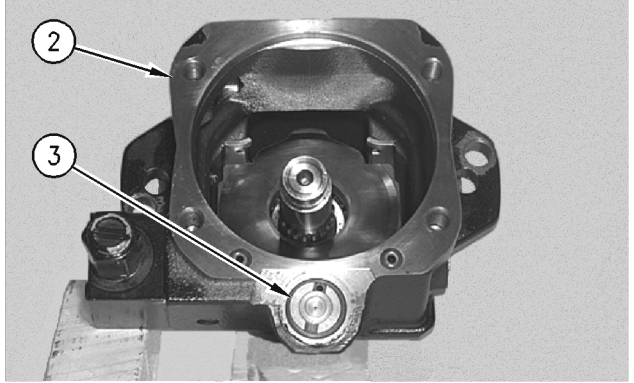
Table 6-15. Travel Motor Required Tools - Disassembly

Tool	Part #	Description	Qty.
A	154-9327	Pliers	1
B	9S-9152	Pulling Attachment	1

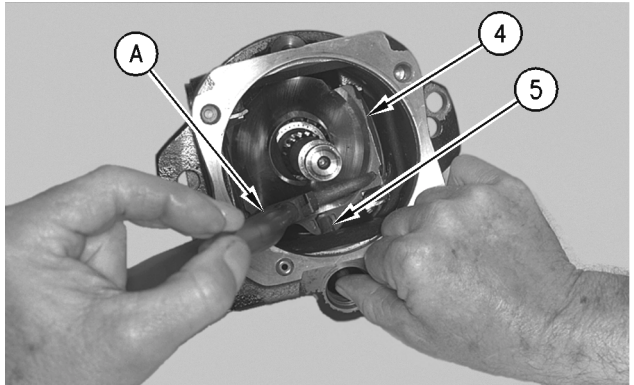
Start by removing the travel motor. Refer to Disassembly and Assembly, "Travel Motor - Remove" in this manual.



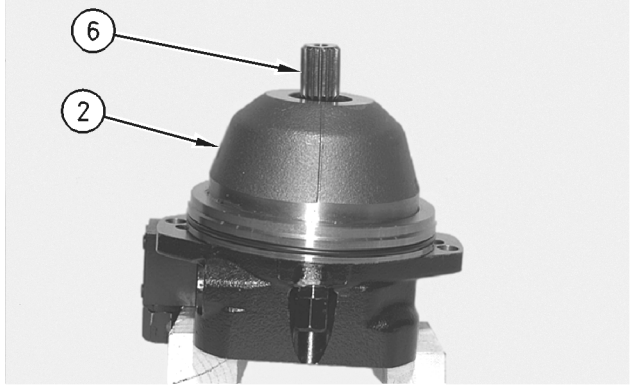
1. Remove rotary assembly (1) from motor housing (2).



2. Remove control unit (3) from motor housing (2).



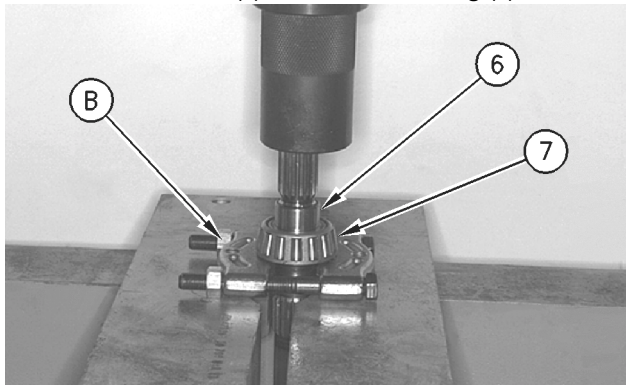
3. Use Tooling (A) to remove swash plate (4). Remove piston rod (5).



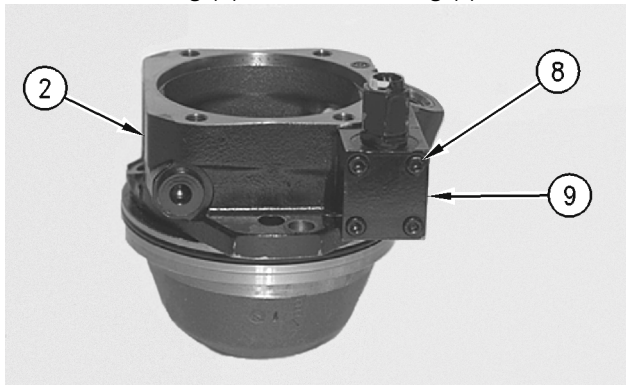


## SECTION 6 - UNDERCARRIAGE

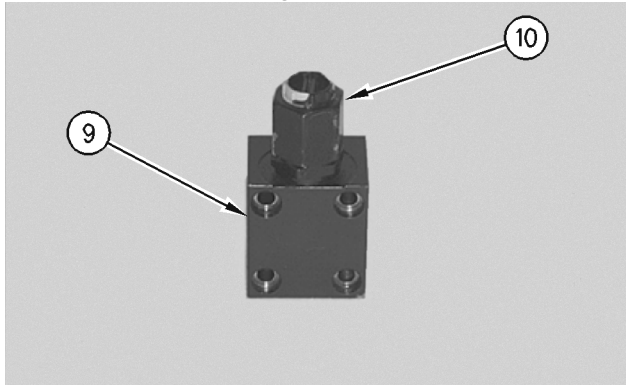
4. Remove shaft (6) from motor housing (2).



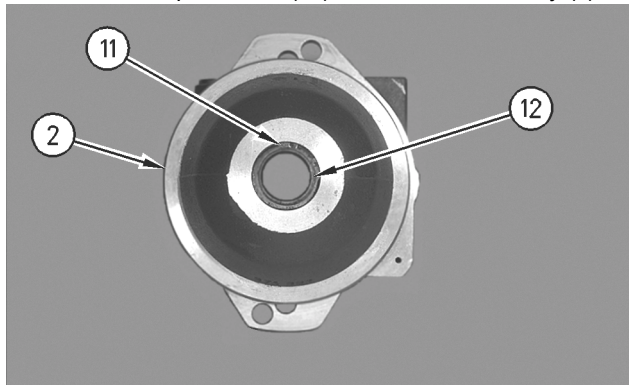
5. Use tooling (B) to remove bearing (7) from shaft.



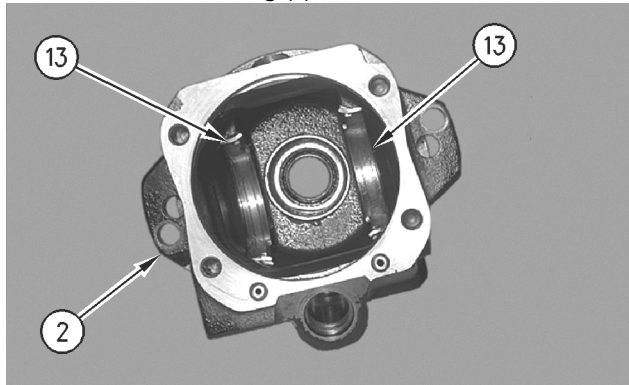
6. Remove four bolts (8). Remove block assembly (9) from motor housing (2).



7. Remove pilot valve (10) from block assembly (9).



8. Use the correct retaining ring pliers in order to remove retaining ring (11). Remove seal (12) from the motor housing (2).

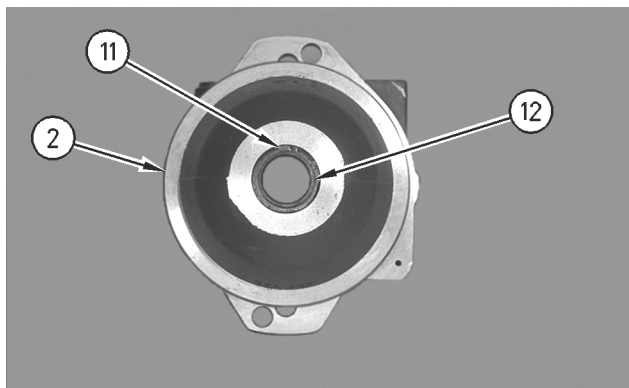


9. Remove cradles (13) from motor housing (2).

### Assembly

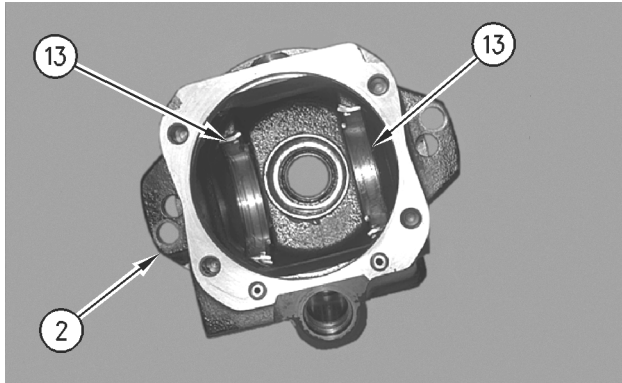
Table 6-16. Travel Motor Required Tools - Assembly

Tool	Part #	Description	Qty.
A	154-9327	Pliers	1

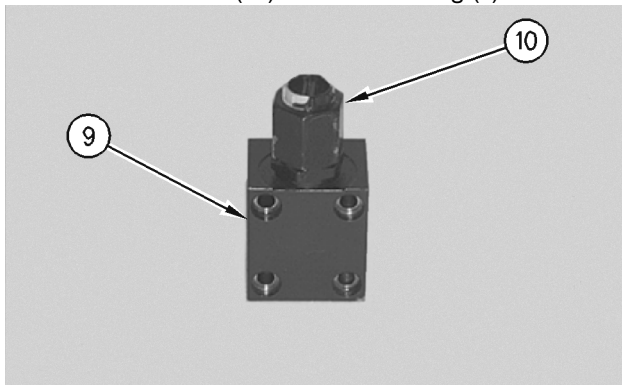




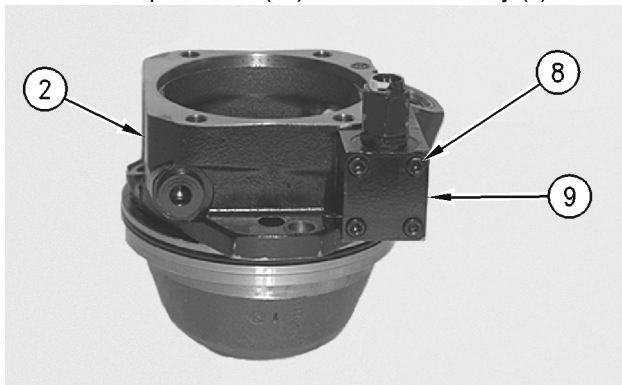
1. Install seal (12) in motor housing (2). Use the correct retaining ring pliers in order to install retaining ring (11).



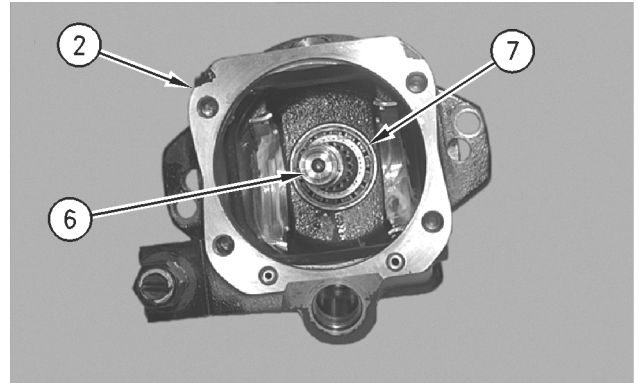
2. Install cradles (13) in motor housing (2).



3. Install pilot valve (10) on block assembly (9).

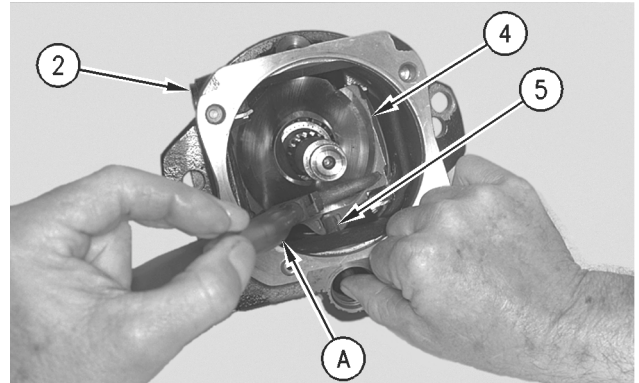


4. Position block assembly (9) on motor housing (2). Install four bolts (8). Tighten the bolts to a torque of  $9 \pm 4$  ft.lb. ( $12 \pm 5$  Nm).

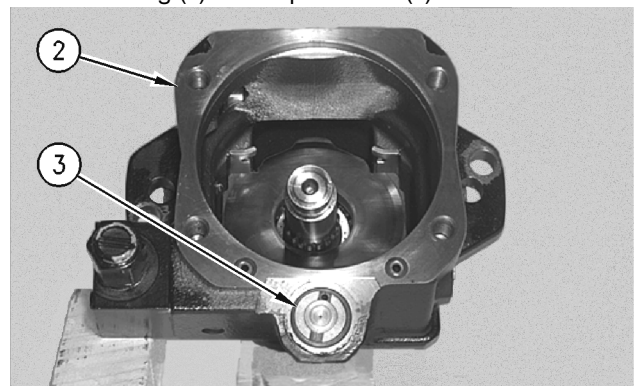


5. Raise the temperature of bearing (7). Install bearing (7) on shaft (6).

6. Install shaft (6) in motor housing (2).

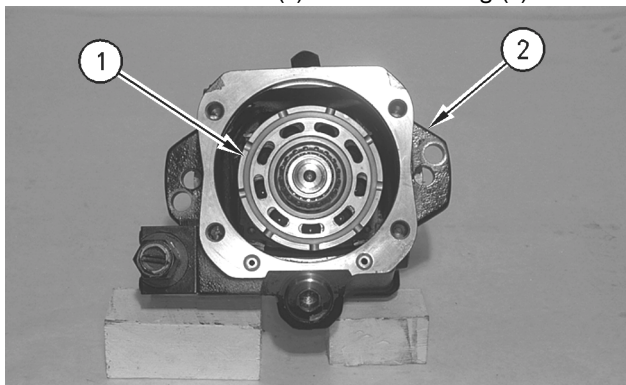


7. Use tooling (A) to install swash plate (4) in motor housing (2). Install piston rod (5).





8. Install control unit (3) in motor housing (2).



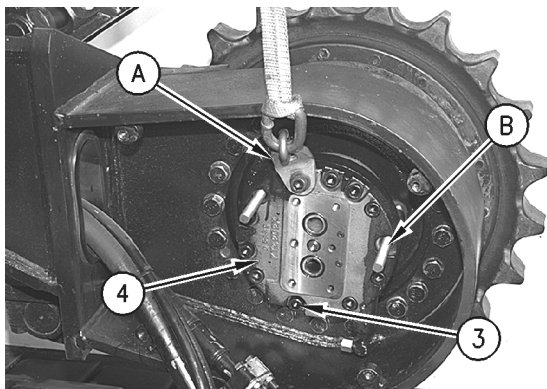
9. Install rotary assembly (1) in motor housing (2).
10. Install the travel motor. Refer to Disassembly and Assembly, "Travel Motor - Install" in this manual.

### Installation

**Table 6-17. Travel Motor Required Tools - Installation**

Tool	Part #	Description	Qty.
A	138-7574	Link Bracket	1
B		254 mm (10 inch) of M16x20 Threaded Rod	1

1. Make sure that the mating surfaces of the travel motor and the final drive are thoroughly clean.
2. Replace the O-ring seal that is used between the travel motor and the final drive with a new O-ring seal.
3. Install the O-ring seal on the body of the travel motor. Apply clean hydraulic oil to the O-ring seal.

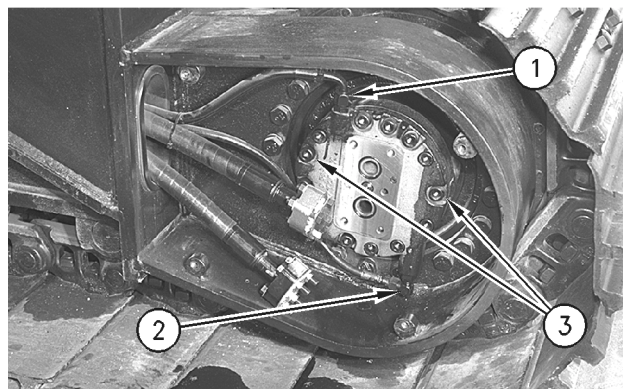


4. Fasten Tooling (A) and a suitable lifting device to travel motor (4). Carefully position the travel motor on Tooling (B). Slide the travel motor into the final drive.

5. Install one of the three bolts (3) that hold the travel motor to the final drive. Remove Tooling (B). Install two remaining bolts (3).

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.



6. Install new O-ring seals in the ends of hose assemblies (1) and (2). Connect hose assemblies (1) and (2) to the travel motor. Tighten the two hose assemblies to a torque of  $60 \pm 5$  ft. lb. ( $80 \pm 7$  Nm).
7. Fill the final drive with oil to the correct level. Refer to Operation and Maintenance Manual for the correct filling procedure.
8. Install the travel brake valve. Refer to Disassembly and Assembly, "Travel Brake Valve - Install" in this manual.



## 6.12 FINAL DRIVE

### Removal

Table 6-18. Final Drive Required Tools - Removal

Tool	Part #	Description	Qty.
A	138-7574	Link Bracket	1

Start by separating the track assembly. Refer to Disassembly and Assembly, "Track - Separate".

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

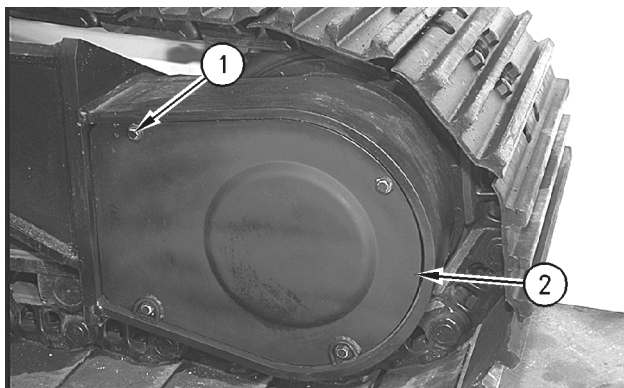
### **⚠ WARNING**

AT OPERATING TEMPERATURE THE HYDRAULIC OIL IS HOT AND UNDER PRESSURE. HOT OILS CAN CAUSE BURNS.

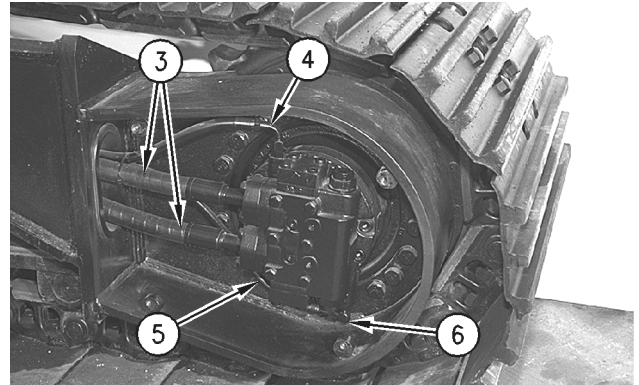
TO PREVENT POSSIBLE PERSONAL INJURY, RELEASE THE PRESSURE IN THE IMPLEMENT HYDRAULIC CIRCUIT (BOOM, STICK, BUCKET, AND SWING), TRAVEL CIRCUITS, AND THE HYDRAULIC OIL TANK AT THE FILLER CAP BEFORE ANY HYDRAULIC LINES OR COMPONENTS ARE DISCONNECTED OR REMOVED.

REMOVE THE TILLER CAP ONLY WHEN THE ENGINE IS STOPPED AND THE FILLER CAP IS COOL ENOUGH TO TOUCH.

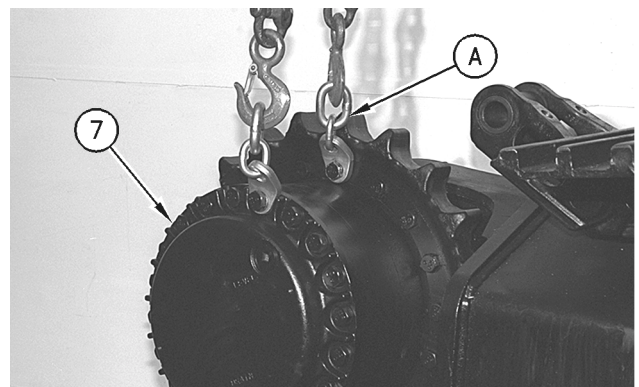
1. Release the hydraulic system pressure. Refer to Disassembly and Assembly, Hydraulic System Pressure - Release" in this manual.



2. Remove four bolts (1) and the washers. Remove cover (2) from the inside rear of the undercarriage frame.



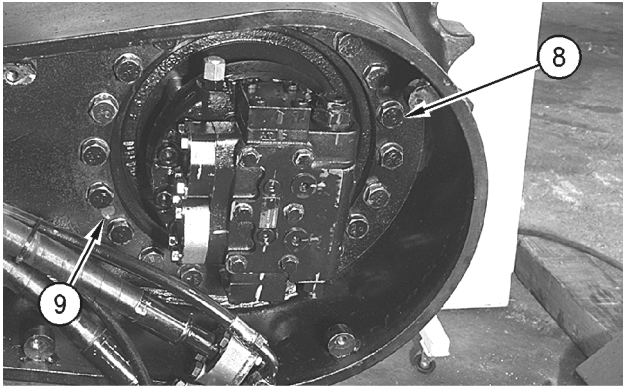
3. When two tube assemblies (3) are disconnected from the travel brake valve, oil will flow from the tube assemblies. Place a suitable pan under the tube assemblies in order to collect the drain oil. Disconnect two tube assemblies (3) from the travel brake valve. Put plugs in the ends of the tube assemblies. Plugs prevent hydraulic oil loss. Plugs prevent contaminating the hydraulic system.
4. When hose assembly (4) and hose assembly (5) are disconnected from the travel motor, oil will flow from the hose assemblies. Place a suitable pan under the hose assemblies in order to collect the drain oil. Disconnect tube assembly (4). Disconnect tube assembly (5). Put plugs in the ends of the hose assemblies. Plugs prevent hydraulic oil loss. Plugs prevent contaminating the hydraulic system.
5. Remove elbow (6) from the travel motor.



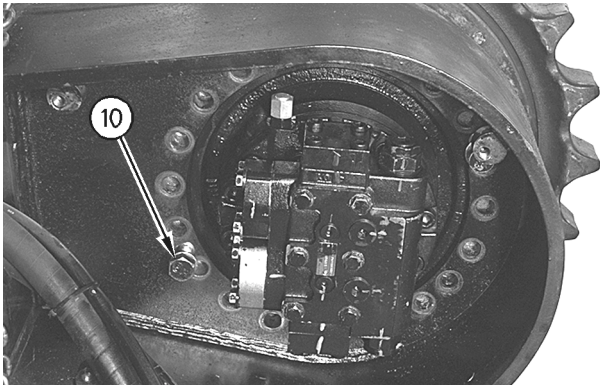


## SECTION 6 - UNDERCARRIAGE

6. Fasten tooling (A) and a suitable lifting device to final drive (7), as shown. Put a slight lifting tension on the final drive.



7. Remove two plugs (9) from the forcing bolt holes in the undercarriage frame.
8. Remove 20 bolts (8) and the washers that hold the final drive to the undercarriage frame.



9. Install two suitable sized forcing bolts (10) in the forcing bolt holes that are located in the undercarriage frame. Tighten the two forcing bolts evenly in order to force the final drive from the undercarriage frame.
10. Carefully remove final drive (7) from the undercarriage frame. The Combined weight of the final drive, travel brake valve and travel motor is approximately 990 lb (450 kg).
11. Remove two forcing bolts (10) from the undercarriage frame.
12. Remove the travel motor from the final drive. Refer to Disassembly and Assembly, "Travel Motor - Remove" in this manual.

## Disassembly

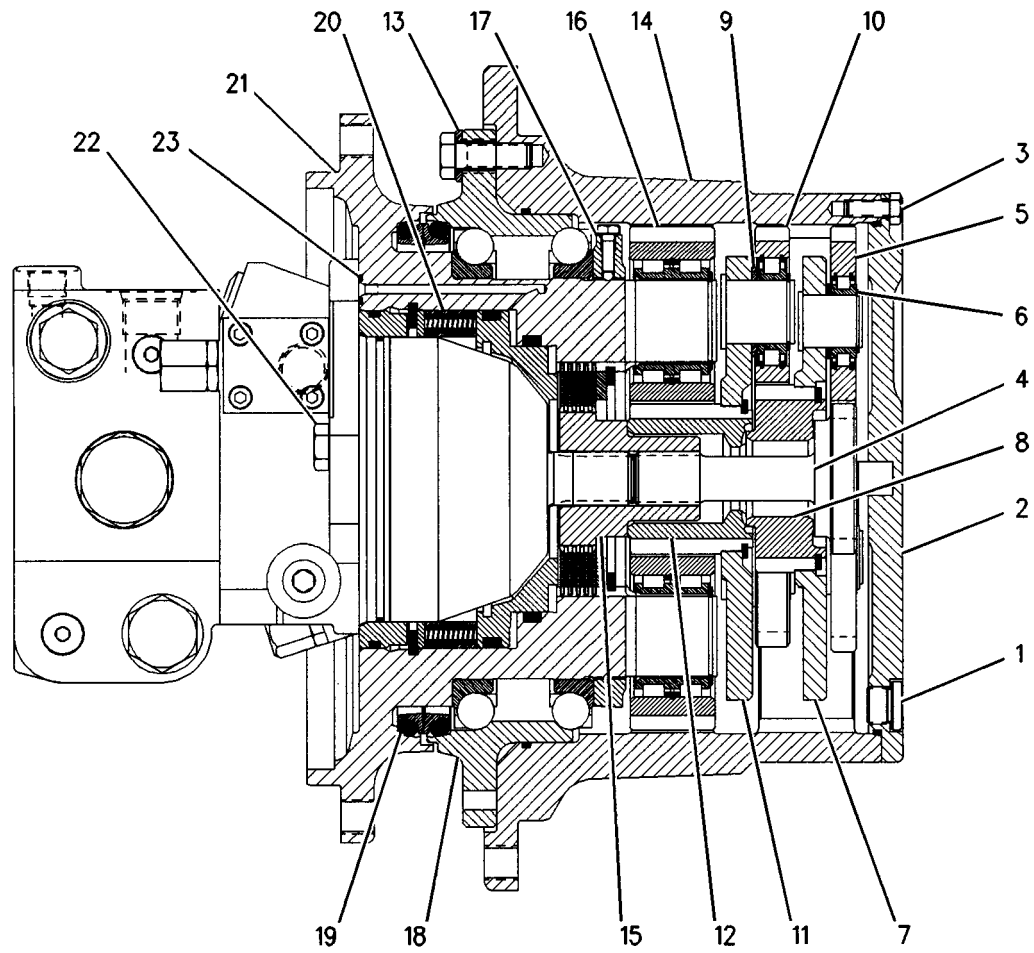
Table 6-19. Final Drive Required Tools - Disassembly

Tool	Part #	Description	Qty.
A	1P-2420	Repair Stand	1
B	9S-7338	Crossblock	1
	3H-0465	Push Puller Plate	2
	154-9326	Spring Compressor Plate	1
	154-9323	Spacer	2
C	5P-4758	Internal Pliers	1
D	138-7575	Link Bracket	2
E	1U-5839	Puller	1
F	165-1670	Socket	1
	165-1671	Reaction Shaft	1
	132-8119	Torque Wrench	1
	132-8223	110V Power Pack	1
	132-8231	220V Power Pack	1
G	154-9315	Thread File	1

Start by removing the final drive. Refer to Disassembly and Assembly, "Final Drive - Remove" in this manual.

1. Thoroughly clean the outside of the travel motor and the final drive prior to disassembly.





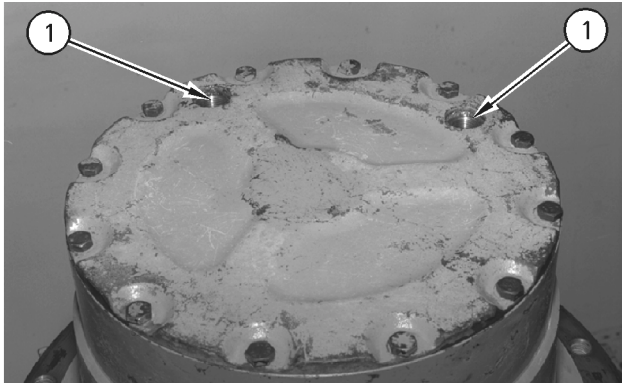
- |                    |                    |                   |                   |
|--------------------|--------------------|-------------------|-------------------|
| 1. Drain Plug      | 7. Planet Carrier  | 13. Gear Fastener | 19. Duo Cone Seal |
| 2. Cover           | 8. Sun Gear        | 14. Ring Gear     | 20. Brake Kit     |
| 3. Cover Fastener  | 9. Support Disc    | 15. Shaft Link    | 21. Spindle       |
| 4. Sun Gear Shaft  | 10. Planet Gear    | 16. Gear          | 22. Bolt          |
| 5. Planet Gear Kit | 11. Planet Carrier | 17. Shaft Nut     | 23. O-ring        |
| 6. Support Disc    | 12. Sun Gear       | 18. Bearing Kit   |                   |

Figure 6-12. Final Drive

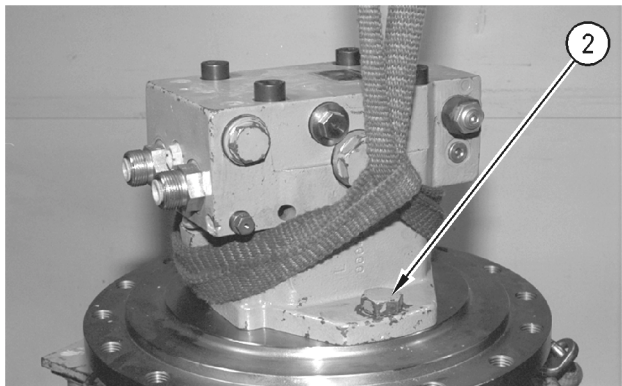


## SECTION 6 - UNDERCARRIAGE

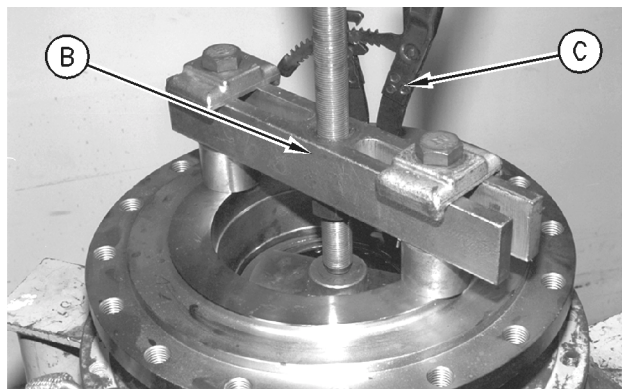
2. Put an alignment mark across the sections of the travel motor and the final drive for assembly purposes. The parts must be reinstalled in the original locations of the parts.



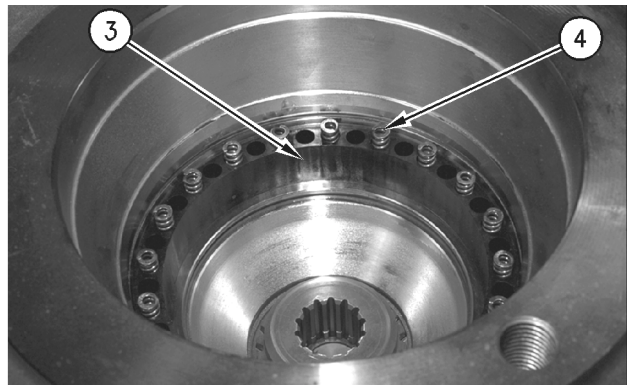
3. Fasten the travel motor and the final drive to tooling (A) with the travel motor in the up position. Remove drain plugs (1) in order to drain the oil. The capacity of the final drive is 0.66 US gal (2.5 L).



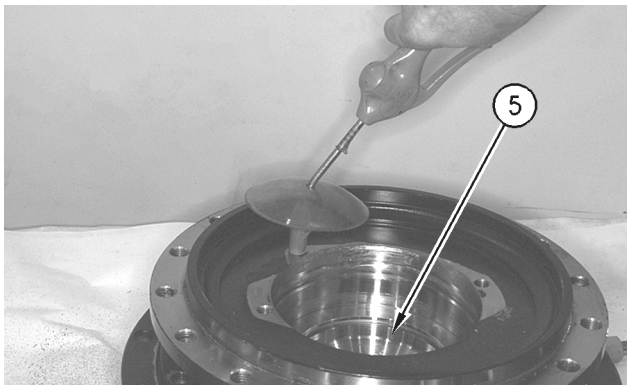
4. Remove the bolts (2) and use the lifting strap in order to remove the travel motor from the final drive.



5. Use tooling (B) to compress the brake assembly and remove the retaining ring.



6. Remove spacer ring (3) and twenty springs (4).

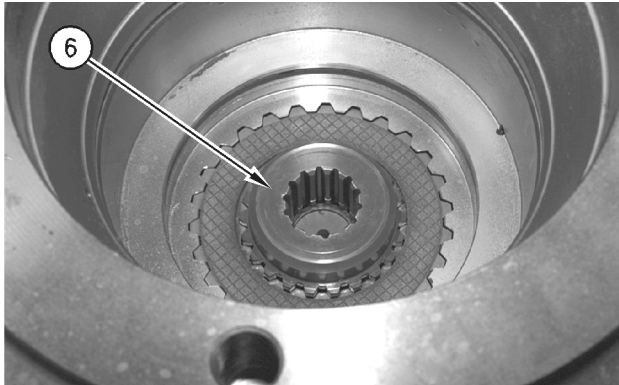


7. Use suitable tooling in order to apply air pressure in the oil passage in order to partially remove piston (5).

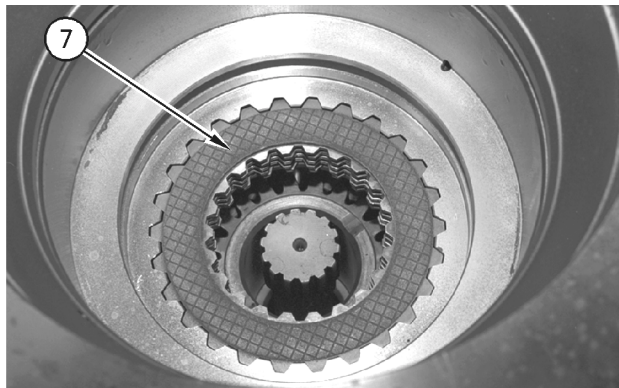




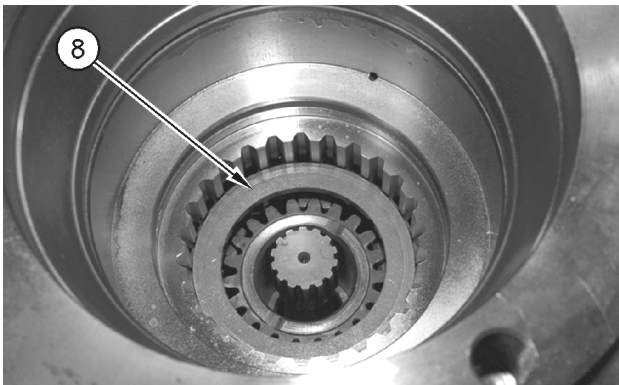
8. Remove Piston (5).



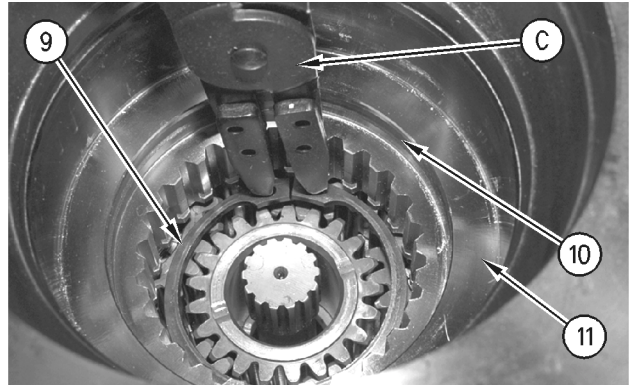
9. Remove shaft link (6).



10. Remove brake disks (7).

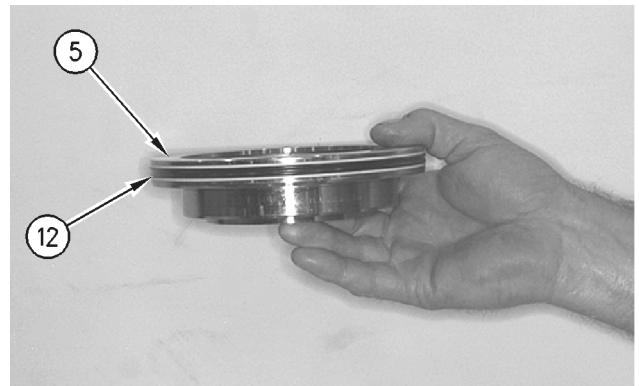


11. Remove supporting ring (8).



12. Use tooling (C) to remove snap ring (9).

13. Remove seal (10) from spindle (11).

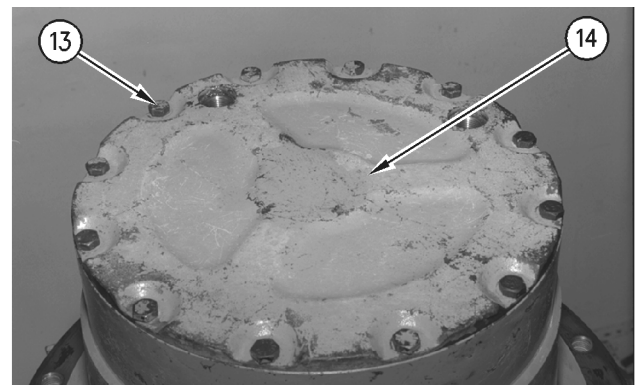


14. Remove seals (12) from piston (5).

15. Use lifting straps and tooling (D) in order to lift the final drive off tooling (A).

16. Carefully rotate the final drive so that the planetary cover is up.

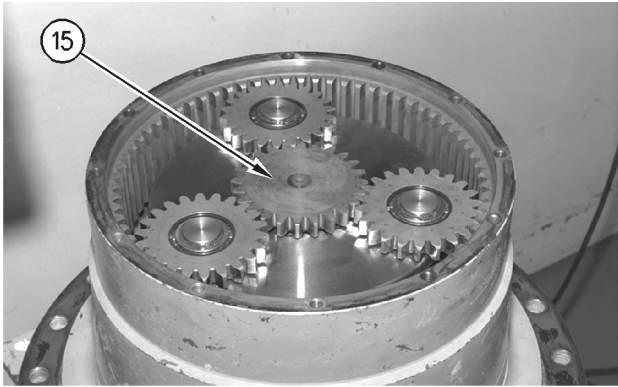
17. Fasten the final drive to tooling (A).



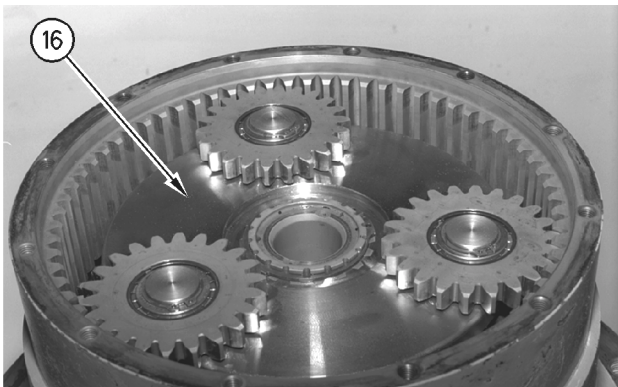


## SECTION 6 - UNDERCARRIAGE

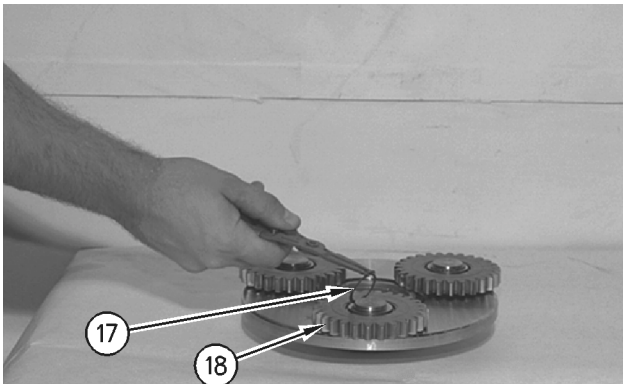
18. Remove twelve bolts (13) that secure cover (14) to the final drive. Remove the O-ring seal from the cover.



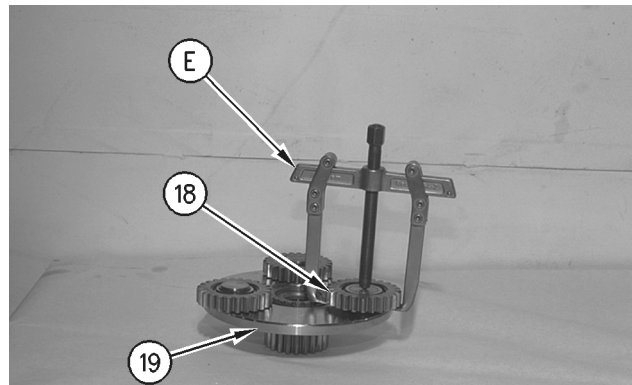
19. Remove sun gear shaft (15) from the final drive.



20. Remove the first stage of planetary gear assembly (16) from the final drive.

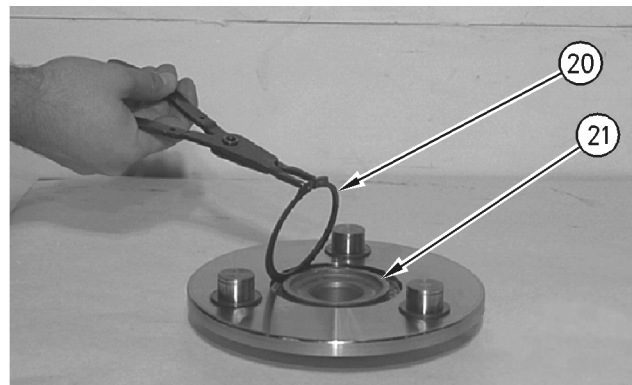


21. Use snap ring pliers to remove snap ring (17) that secures planetary gear (18) to the planetary carrier.

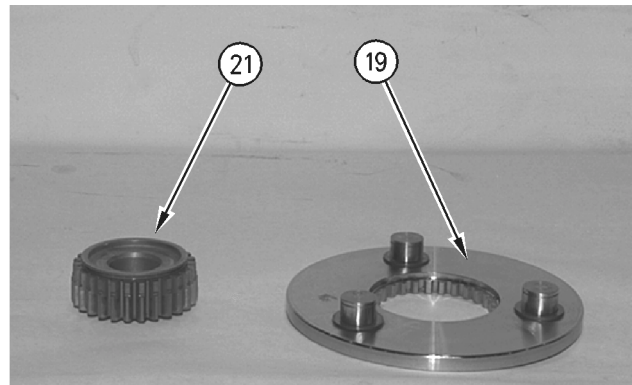


22. Use Tooling (E) in order to remove planetary gear (18). Remove the disk from planetary carrier (19).

23. Repeat Step 21 and Step 22.

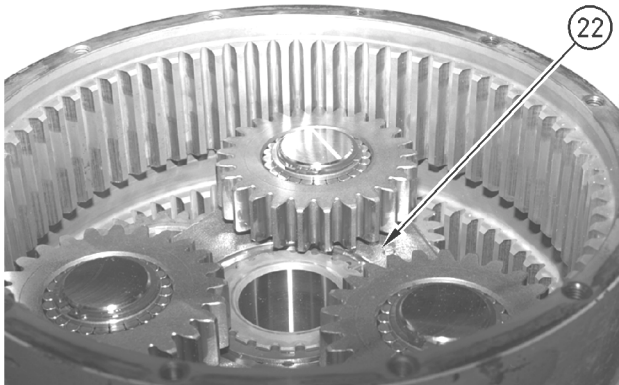


24. Use snap ring pliers to remove snap ring (20) from sun gear (21).

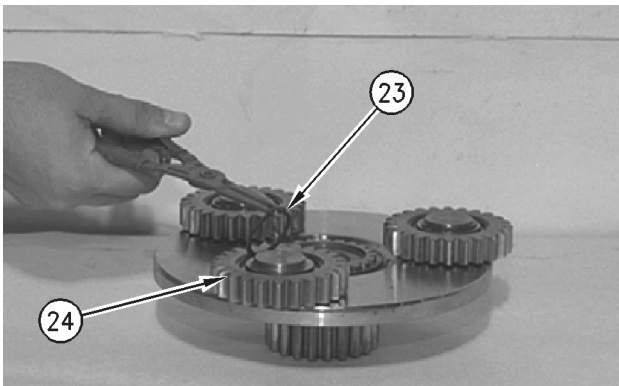




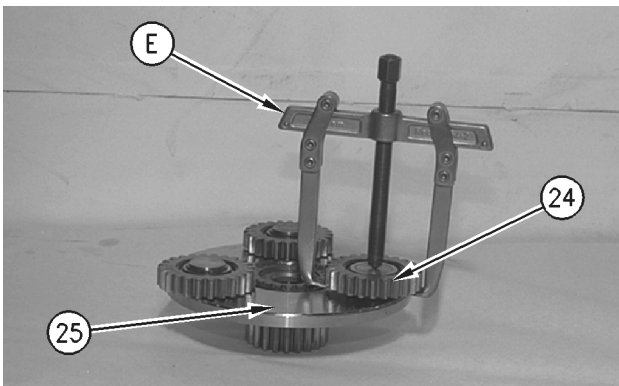
25. Remove sun gear (21) from planetary carrier (19).



26. Remove the second stage of planetary gear assembly (22) from the final drive.

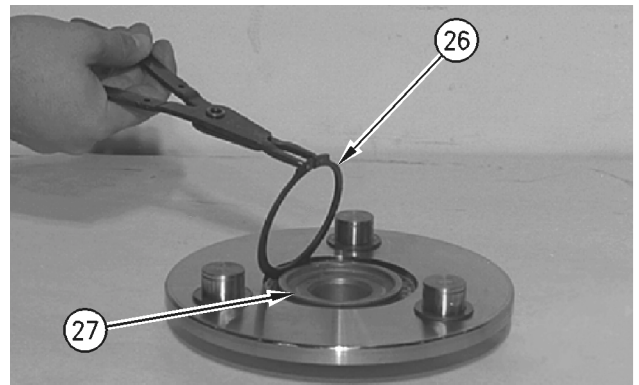


27. Use snap ring pliers to remove snap ring (23) from planetary gear (24).

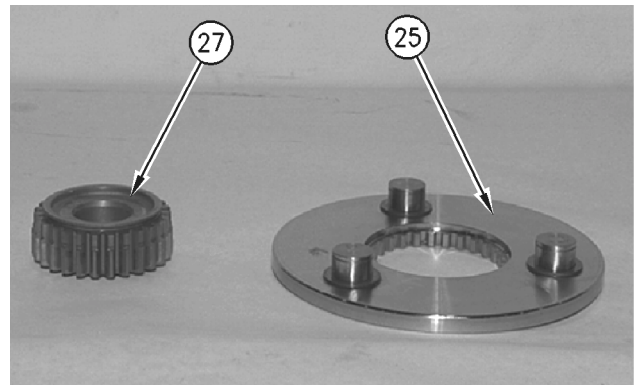


28. Use tooling (E) to remove planetary gear (24). Remove the disk from planetary carrier (25).

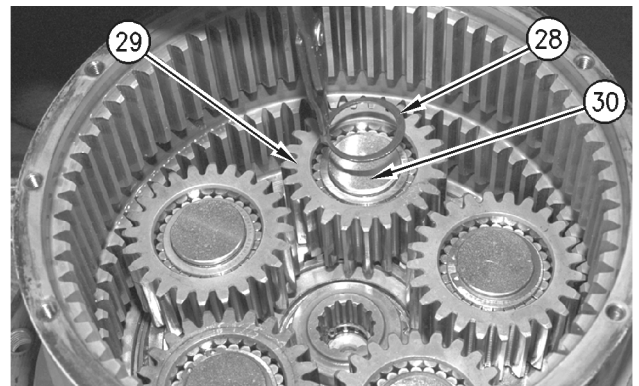
29. Repeat Steps 27 and 28 for the other two planetary gears and disks.



30. Use snap ring pliers to remove snap ring (26) from sun gear (27).



31. Remove sun gear (27) from planetary carrier (25).



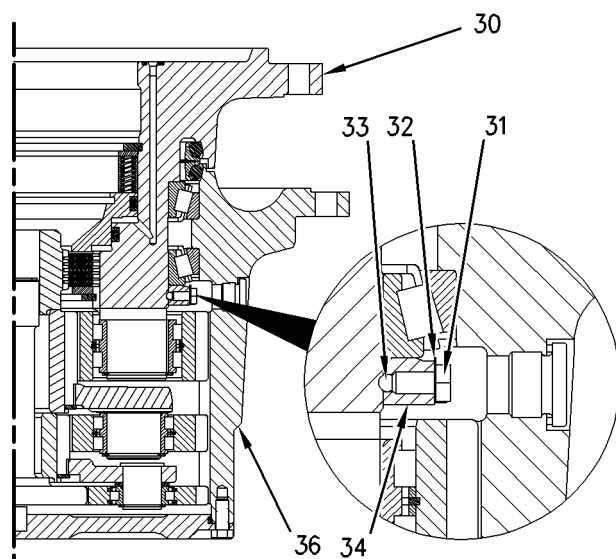
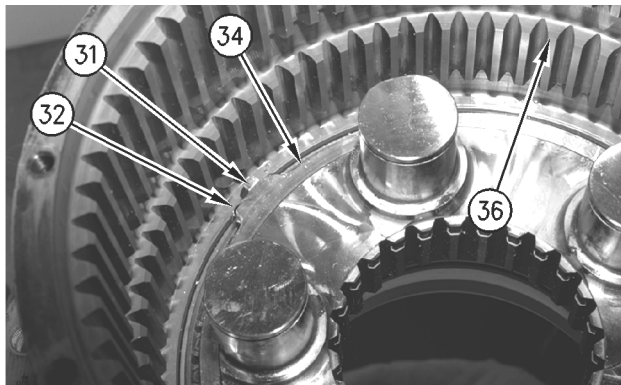
32. Use snap ring pliers to remove snap ring (28) that secures planetary gear (29) to spindle (30).

33. Use tooling (E) to remove planetary gear (29) from spindle (30).



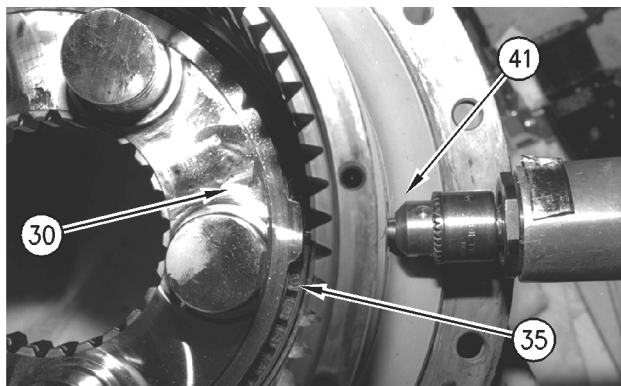
## SECTION 6 - UNDERCARRIAGE

34. Repeat Steps 32 and 33 for the other four planetary gears.



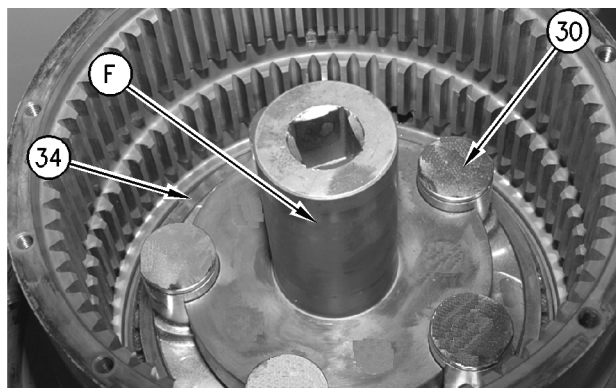
35. Remove bolt (31), tab (32) and ball (33) from spindle nut (34).

**NOTE:** Use the access hole in ring gear (35) to access bolt (31). Ring gear (35) can be rotated in order to align the access hole with bolt (31).

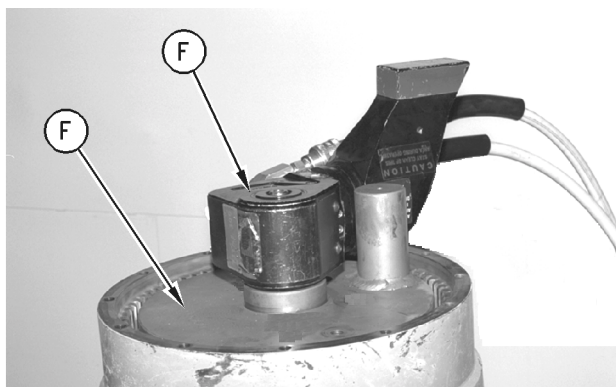


**NOTE:** The procedure for drilling will create a small amount of steel chips. Do not allow the chips to fall into bearing kit (35).

36. Use a 4.76 mm (.188 inch) drill bit (4t) to remove the damaged portion of threads which was caused by ball (33). This will require drilling into spindle (30) to a depth of approximately 1.5 mm (.06 inch).
37. Clear the steel chips from the hole. Do not allow the chips to fall into bearing kit (35).
38. Repeat Steps 35 through 37 in order to remove the remaining bolt assembly.



39. Install the reaction shaft from tooling (F) on spindle (30), as shown.

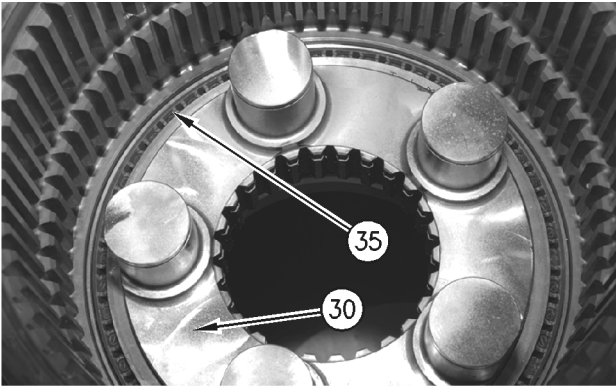


40. Install the socket from tooling (F) over spindle nut (34), as shown.

**NOTE:** The "notches" of the socket from Tooling (F) fit over the "ears" of spindle nut (34).

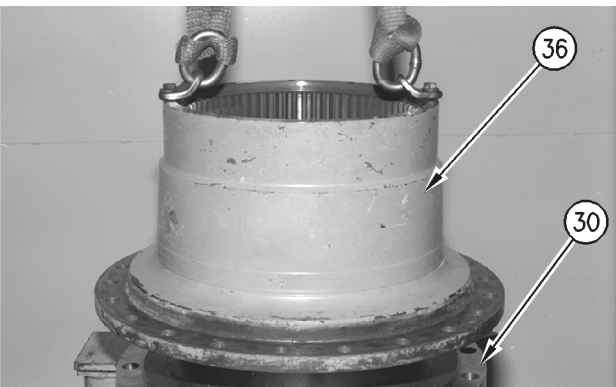


41. Use tooling (F) to remove spindle nut (34). The torque that is required to remove the spindle nut is approximately 1100 ft.lb. (1500 Nm).



42. Remove bearing kit (35) from spindle (30).

**NOTE:** It may be necessary to remove bearing kit (35) by pulling bearing kit (35) with ring gear (36).



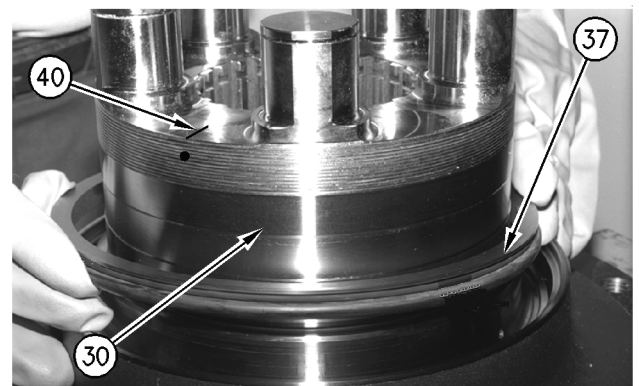
43. Remove ring gear (36) from spindle (30).



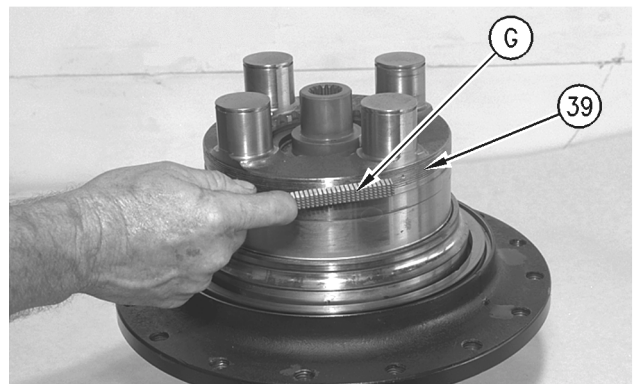
44. Remove one half of Duo-cone seal kit (37) from ring gear (36).



45. Remove bearing kit (38) from ring gear (36).



46. Remove the second half of Duo-cone seal kit (37) from spindle (30).



47. Use tooling (G) to shape spindle threads (39), if the threads appear damaged.

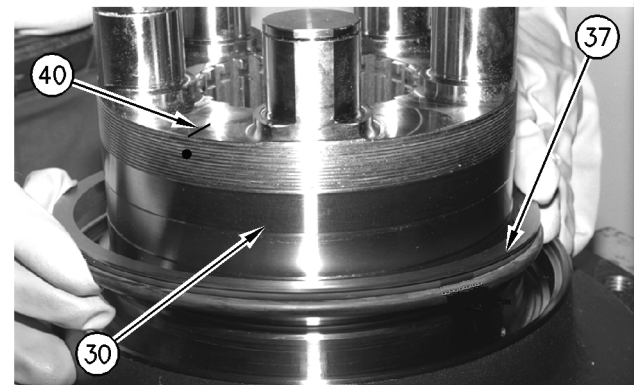
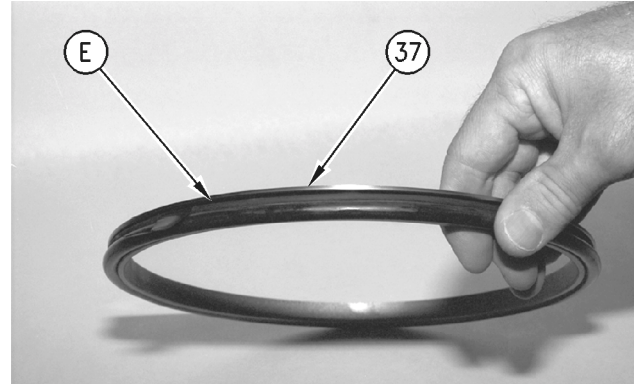


### Assembly

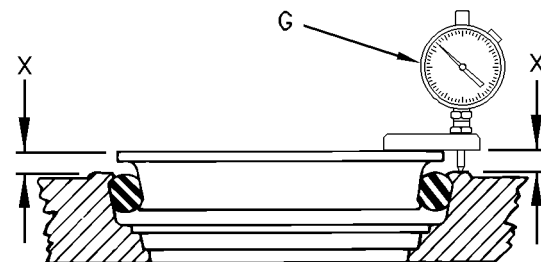
**Table 6-20. Final Drive Required Tools - Assembly**

Tool	Part #	Description	Qty.
A	1P-2420	Repair Stand	1
B	9S-7338	Crossblock	1
	3H-0465	Push Puller Plate	2
	154-9326	Spring Compressor Plate	1
	154-9323	Spacer	2
C	5P-4758	Internal Pliers	1
D	138-7575	Link Bracket	2
E	161-4350	Duo-Cone Seal Kit	1
F	165-1670	Socket	1
	165-1671	Reaction Shaft	1
	132-8119	Torque Wrench	1
	132-8223	110V Power Pack	1
	132-8231	220V Power Pack	1
G	6V-3075	Dial Indicator	1
	6V-6167	Contact Point	1
	3P-1565	Indicator Collet	1
	165-8958	Plastic Base for Indicator	1
H	165-3977	Punch	1
J	155-1709	Hydraulic Test Adapter	1
	3J-1907	O-ring Seal	1
	6V-3965	Nipple Assembly	1
	6V-4143	Coupler Assembly	2
	6V-3014	Hose Assembly	1
	8T-0855	Pressure Gauge	1
	1U-5230	Hand Pump	1
	5S-2403	Fitting	1
	1S-8937	Valve	1
	2D-7325	Tee	1
	6V-3966	Nipple Assembly	1

**NOTE:** Make sure that all of the parts of the final drive and the travel motor are thoroughly clean and free of dirt and debris prior to assembly. Replace all o-ring seals that are used in the final drive with new o-ring seals. Reassemble the final drive and the travel motor on tooling (A).



1. Use tooling (E) to install one half of Duo-cone seal kit (37) into spindle (30).
2. Put a mark (40) on spindle (30). The mark indicates the position of the original balls (33). The mark is used in Step 18.





3. Use tooling (G) to check assembled height (X) in at least four places at 90 degree intervals. The difference in height around the ring must not be more than 0.04 inch (1.0 mm).

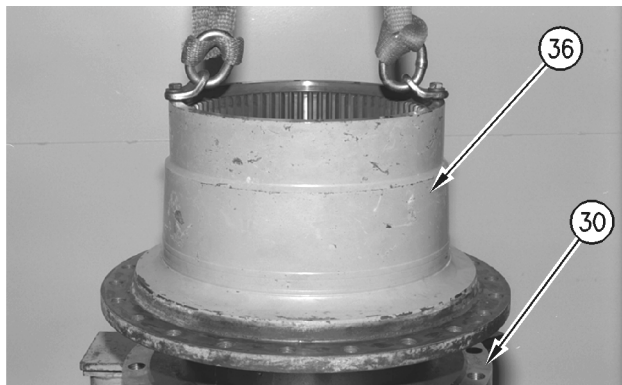


4. Install bearing kit (38) into ring gear (36).

**NOTE:** Check the condition of the bearing kit. If the bearing kit is worn or damaged, use a new bearing kit.



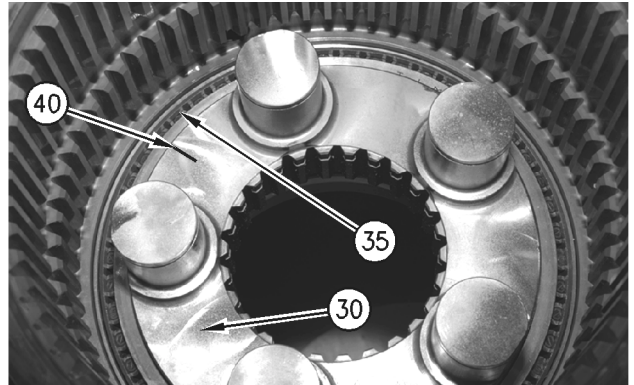
5. Use tooling (E) to install the second one half of Duo-cone seal kit (37) into ring gear (36).
6. Repeat step 3.



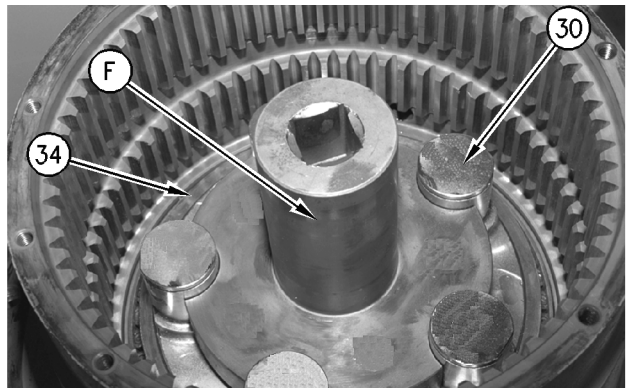
7. Install spindle (30) onto tooling (A).

**NOTE:** Turn over ring gear (36) very carefully. Make sure that Duo-cone seal kit (37) is not dislodged.

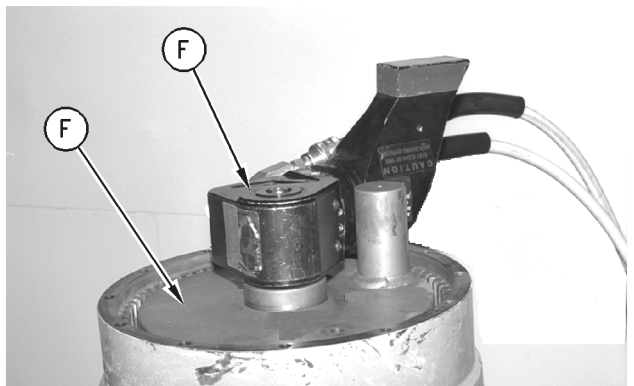
8. Install ring gear (36) onto spindle (30).



9. Install bearing kit (35) onto spindle (30).



10. Install the reaction shaft from tooling (F) on spindle (30) as shown.



**NOTE:** Lubricate the spindle nut threads with oil before installation. Use caution. The spindle nut threads are easy to cross thread.

11. Install spindle nut (34) onto spindle (30).
12. Install the socket from tooling (F) on spindle nut (34).



## SECTION 6 - UNDERCARRIAGE

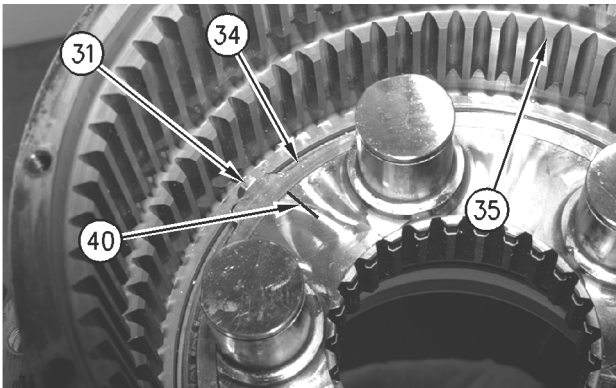
**NOTE:** The notches of tooling (F) fit over the ears of spindle nut (34).

**NOTE:** Rotate the spindle in one direction during the tightening procedure in order to seat the bearings properly.

13. Use tooling (F) to tighten spindle nut (34) to a torque of 1100 ft. lbs. (1500 Nm).
14. Mark spindle nut (34) in relationship to spindle (30).

**NOTE:** Do not confuse this mark with mark (40) for the location of balls (33).

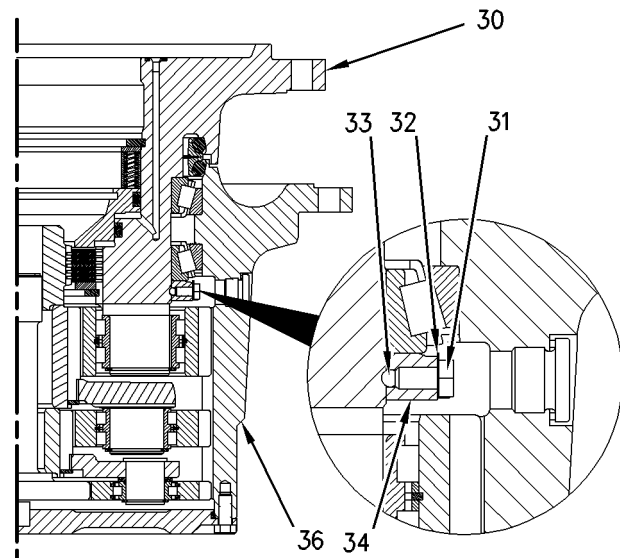
15. Tighten spindle nut (34) to a torque of 1840 ft. lbs. (2500 Nm).
16. Loosen spindle nut (34) so that the mark on the spindle nut is 5 to 10 degrees from the mark on the spindle.
17. Tighten spindle nut (34) to a torque of 1100 ft.lbs. (1500 Nm).



18. Measure the distance from the new bolt (31) to mark (40). The distance must be at least 0.4 inch (10 mm). If the distance is less than 0.4 inch (10 mm), use a new spindle nut (34).



19. Use tooling (H) topeen the threads of spindle (30).



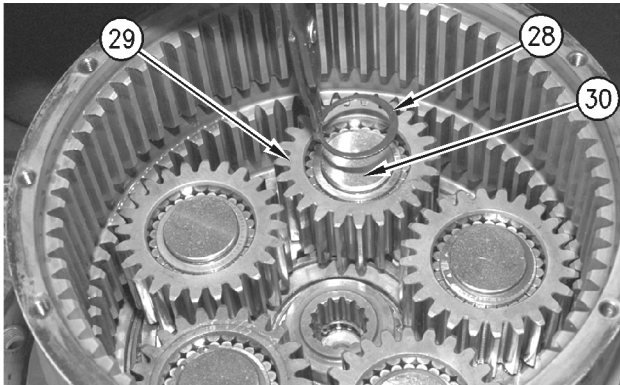
20. Install bolt (31), tab (32), and ball (33) into spindle nut (34). Tighten bolt (31) to a torque of 6 ft.lbs. (8.5 Nm).

**NOTE:** Use the access hole in ring gear (35) to install bolt (31). Ring gear (35) can be rotated in order to align the access hole with bolt (31).

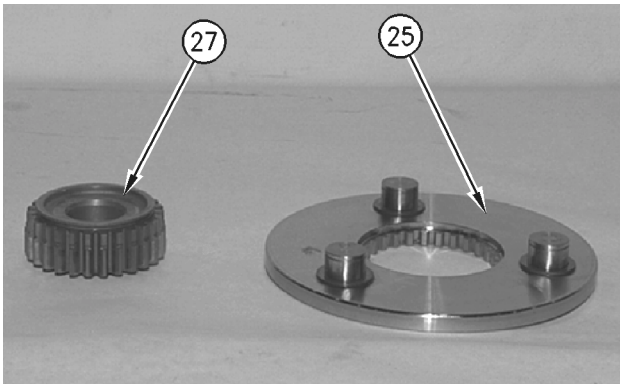
**NOTE:** Bend the long tab on tab (32) over the ear of ring gear (35). Bend the short tab of tab (32) over bolt (31).



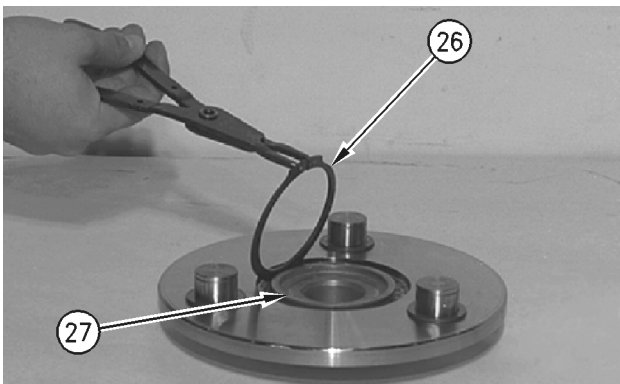
21. Repeat step 19 and 20 in order to install the remaining bolt assembly.



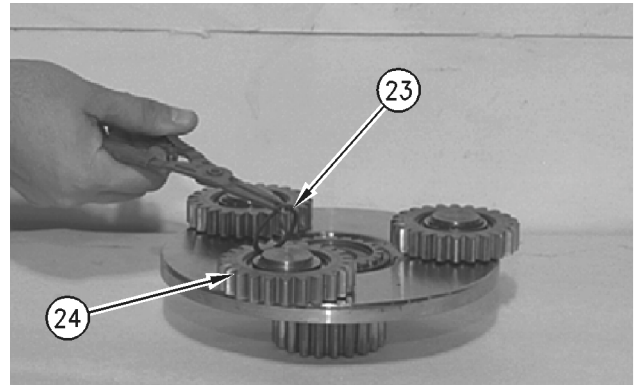
22. If necessary, heat gears (29) to 275° F (135° C). Install gears (29) on spindle (30). Use snap ring pliers to install snap ring (28) that secures planetary gear (29) to spindle (30).



23. Install sun gear (27) into planetary carrier (25).

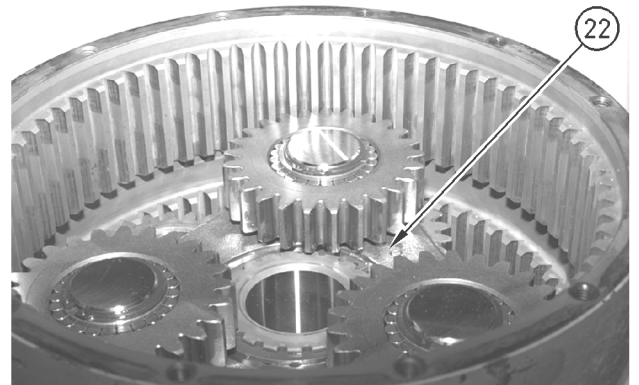


24. Use snap ring pliers to install snap ring (26) on sun gear (27).

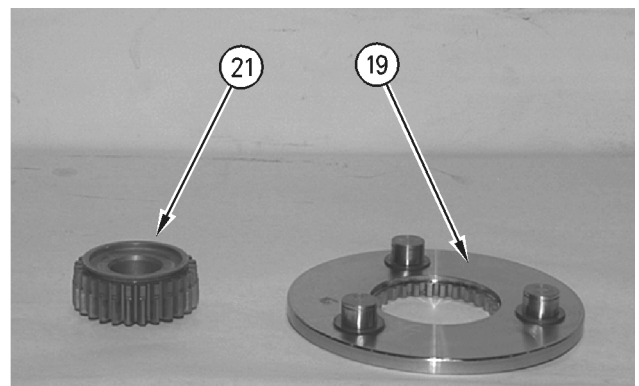


25. If necessary, heat planetary gears (24) to 275° F (135° C). Install the disks and planetary gears (24) onto the planetary carrier.

26. Use snap ring pliers to install snap rings (23) onto planetary gears (24).



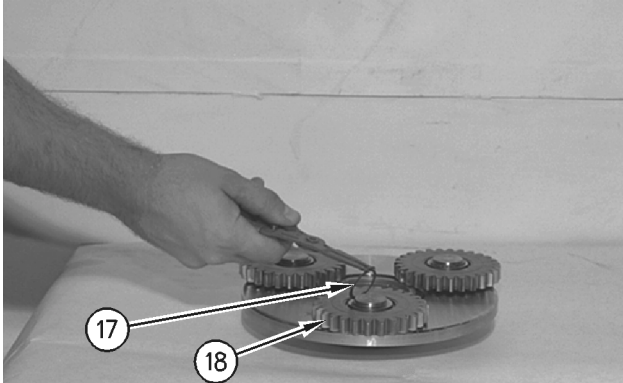
27. Install the second stage of the planetary gear assembly (22) into final drive.



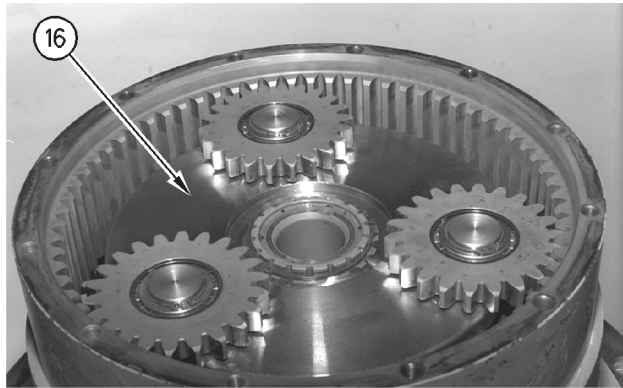


## SECTION 6 - UNDERCARRIAGE

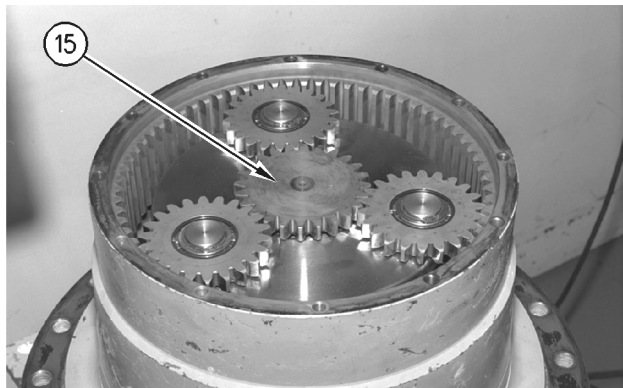
28. Install sun gear (21) into planetary carrier (19).



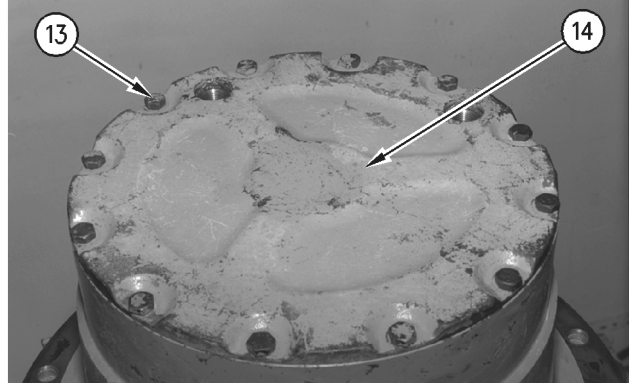
29. If necessary, heat planetary gears (18) to 275° F (135° C). Install three planetary gears (18) on the planetary carrier. Use snap ring pliers to install three snap rings (17) that secure three planetary gears (18) to the planetary carrier.



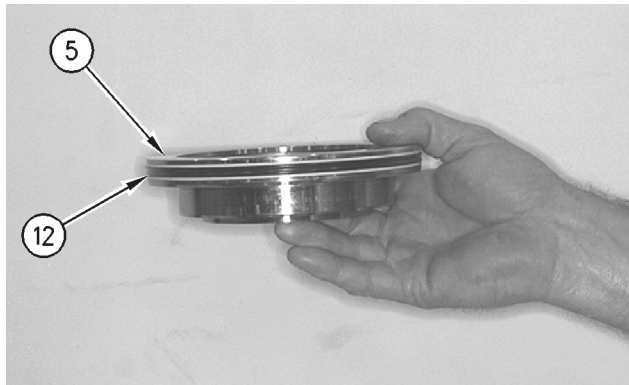
30. Install the first stage of planetary gear assembly (16) into the final drive.



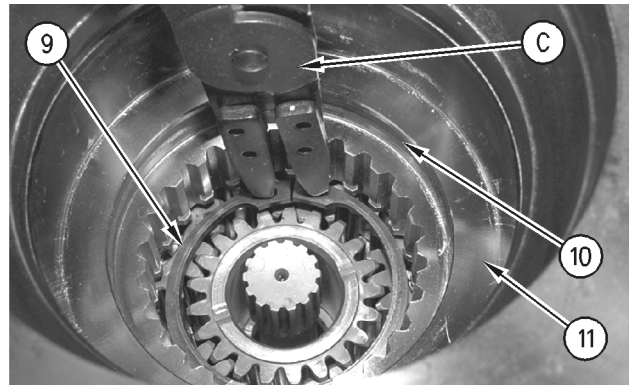
31. Install sun gear shaft (15) into the final drive.



32. Install a new O-ring seal into cover (14). Install twelve bolts (13) that secure cover (14) to the final drive. Tighten twelve bolts (13) to a torque of  $25 \pm 6\text{Nm}$  ( $18 \pm 4\text{ ft.lbs.}$ ).
33. Use lifting straps and Tooling (D) in order to lift the final drive off tooling (A).
34. Carefully rotate the final drive so that the brake is up.
35. Fasten the final drive to tooling (A).



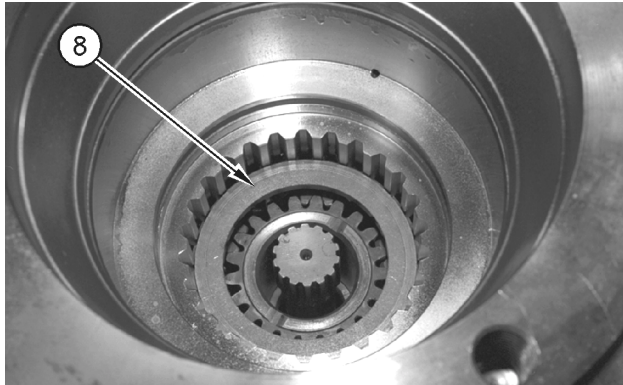
36. Install seals (12) into piston (5).



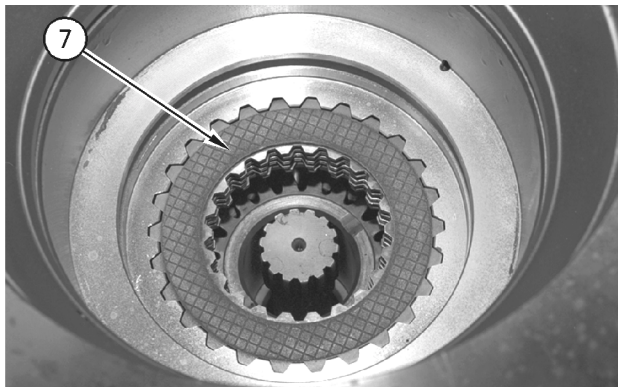
37. Install seal (10) into spindle (11).



38. Use tooling (C) to install snap ring (9).

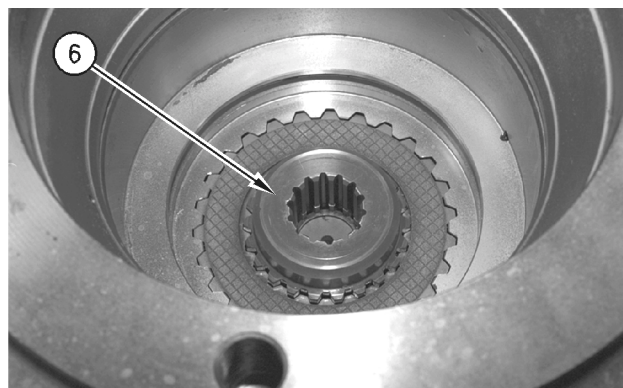


39. Install supporting ring (8).

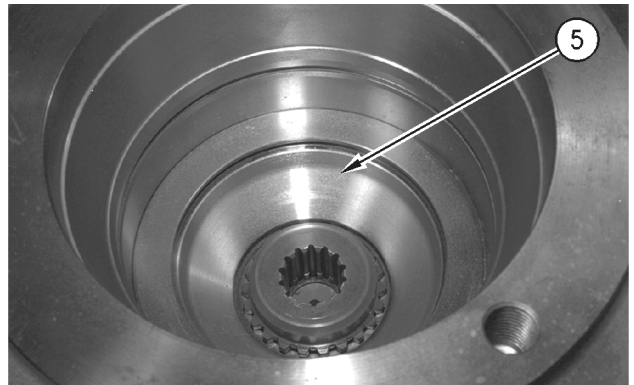


40. Install brake disks and plates (7).

**NOTE:** There are six disks and five plates. Start the installation with a disk. Alternate between disks and plates. End the installation with a disk.

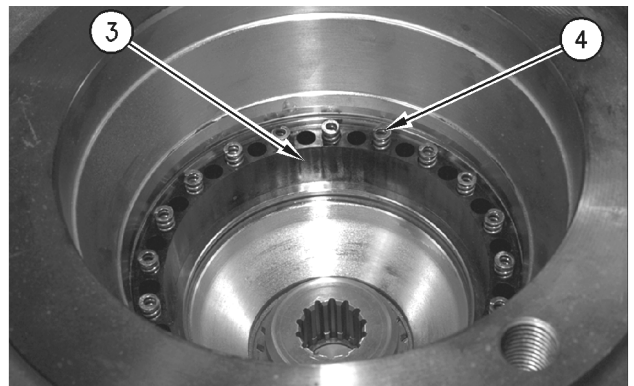


41. Install shaft link (6).

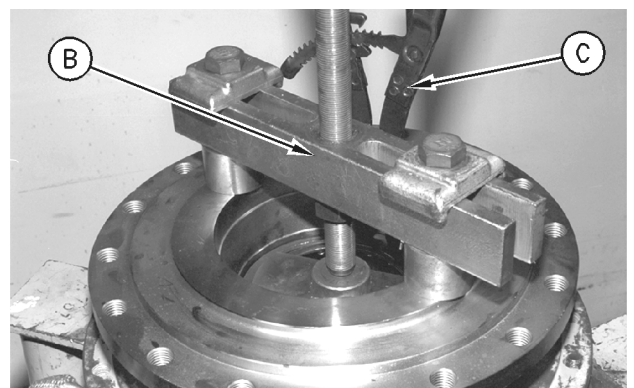


**NOTE:** Lubricate the seals before installing the piston. Install the piston carefully in order to prevent damage to the seals.

42. Install piston (5).



43. Install spacer ring (3) and twenty springs (4).





## SECTION 6 - UNDERCARRIAGE

44. Use Tooling (B) to compress the brake assembly.  
Use Tooling (C) to install the retaining ring.

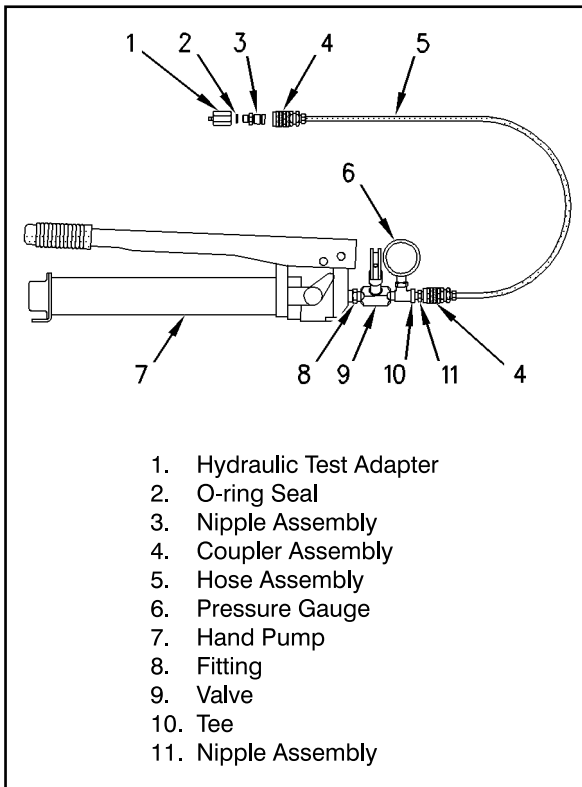
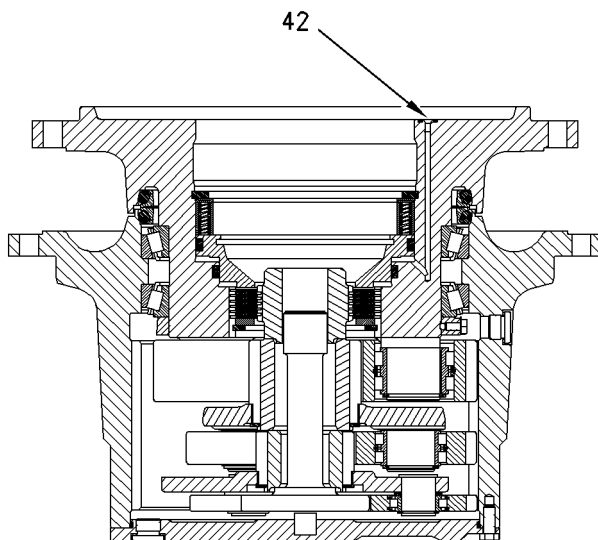
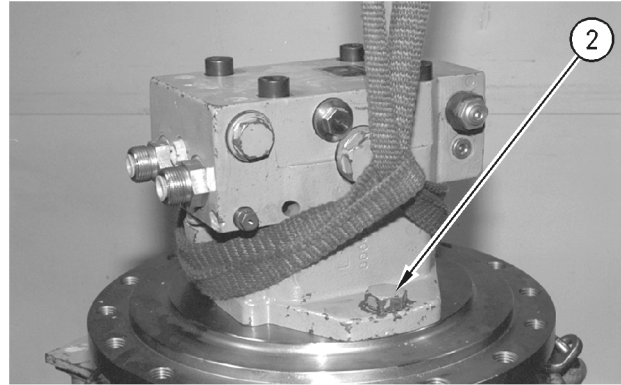


Figure 6-13. Tooling (J)



45. Install Tooling (J) into the oil supply port (42).

46. Apply 510 psi (3495 kPa) for a minimum of 3 minutes. If the pressure falls, the piston seals must be checked.



47. Install the travel motor on the final drive. Install two bolts (2).
48. Fill the final drive with hydraulic oil. The capacity of the final drive is 2.5 L (.66 US gal). Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct filling procedure and the correct level for the final drive.
49. Install the final drive. Refer to Disassembly and Assembly, "Final Drive - Install" in this manual.

### Installation

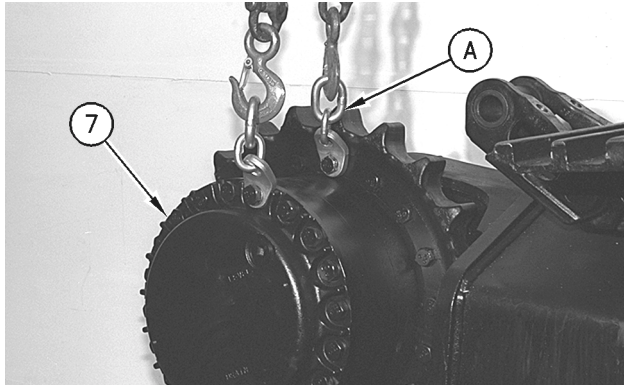
Table 6-21. Final Drive Required Tools - Installation

Tool	Part #	Description	Qty.
A	138-7574	Link Bracket	2

1. Make sure that the mating surfaces of the final drive and the travel motor are thoroughly clean and free of dirt and debris.
2. Install the travel motor on the final drive. Refer to Disassembly and Assembly, "Travel Motor -Install" in this manual.



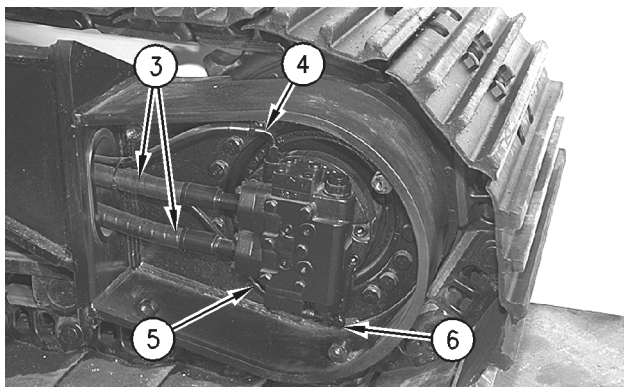
3. Make sure that the mating surfaces of the final drive and the undercarriage frame are thoroughly clean and free of dirt and debris.



4. Fasten Tooling (A) and a suitable lifting device to final drive (7), as shown. Carefully position the final drive in the undercarriage frame. The combined weight of the final drive, travel brake valve and travel motor is approximately 990 lb. (450 kg).
5. Apply Thread Lock Compound on the threads of 20 bolts (8). Install 20 bolts (8) that hold the final drive to the undercarriage frame. Tighten the bolts evenly in a cross pattern.
6. Install two plugs (9) in the forcing bolt holes in the undercarriage frame.

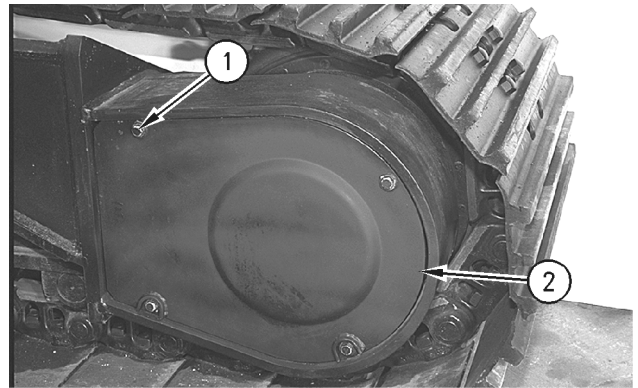
**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.



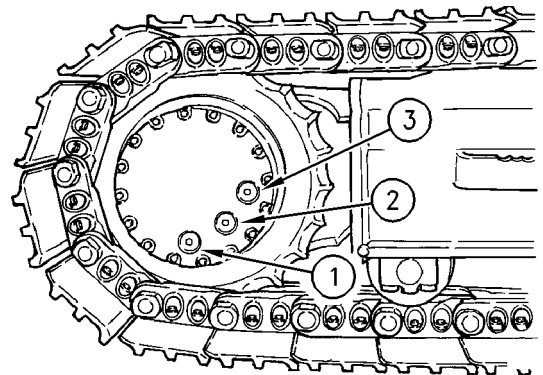
7. Install new O-ring seals in the ends of tube assemblies (3). Install new O-ring seals in the ends of the hose assembly (4) and hose assembly (5). Install a new O-ring seal in elbow (6).

8. Install elbow (6) in the travel motor. Tighten the elbow to a torque of  $40 \pm 5$  Nm ( $30 \pm 4$  ft.lb.). Make sure that the elbow is oriented correctly.
9. Connect hose assembly (4) and hose assembly (5) to the travel motor.
10. Connect two tube assemblies (3) to the travel brake valve.
11. Check the oil level in the hydraulic oil tank. Fill the hydraulic oil tank to the correct level.
12. Start the machine and check for leaks.



13. Install cover (2). Install the washers and four bolts (1). Tighten the bolts to a torque of  $95 \pm 7$  ft.lb. ( $130 \pm 10$  Nm).
14. Connect the track assembly. Refer to Disassembly and Assembly, "Track - Connect".

### Final Drive Oil - Change



1. Position one final drive so that oil drain plug (1) is at the bottom.
2. Remove drain plug (1) and level plug (3). Allow the oil to drain into a suitable container.
3. Clean the plugs and inspect the O-ring seals. If wear or damage is evident, replace the drain plug, the level plug, and/or the O-ring seals.
4. Install drain plug (1).

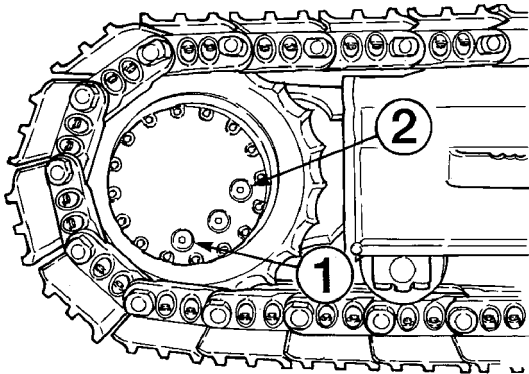


5. Fill the final drive to the bottom of the opening on level plug (3). See Operation and Maintenance Manual, "Lubricant Viscosities" and Operation and Maintenance Manual, "Refill Capacities".

**NOTE:** Plug (2) may also be used to fill the final drive with oil in case the opening under level plug (3) is obstructed by a gear.

6. Install level plug (3).
7. Perform Step 1 to Step 6 on the other final drive. Use a different container for the oil so that the oil samples from the final drives will be separate.
8. Completely remove the oil that has spilled onto surfaces.
9. Start the engine and allow the final drives to run through several cycles.
10. Stop the engine. Check the oil level.
11. Check the drained oil for metal chips or for particles. If there are any chips or particles, consult your JLG Distributor dealer.
12. Properly dispose of the drained material. Obey local regulations for the disposal of the material.

### Final Drive Oil Level Check



1. Position one final drive so that oil drain plug (1) is at the bottom.

2. Remove oil level plug (2).
3. Check the oil level. The oil should be near the bottom of the level plug opening.
4. Add oil through the level plug opening, if necessary.

### **⚠ CAUTION**

**OVERFILLING THE FINAL DRIVE WILL CAUSE THE SEALS ON THE TRAVEL MOTOR TO ALLOW HYDRAULIC OIL OR WATER TO ENTER THE FINAL DRIVE. THIS MAY CONTAMINATE THE FINAL DRIVE.**

5. Clean oil level plug (2). Inspect the O-ring seal. Replace the O-ring seal if the O-ring seal is worn or damaged.
6. Install oil level plug (2).
7. Repeat the procedure for the other final drive.

## 6.13 SWIVEL

### Removal

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

### **⚠ WARNING**

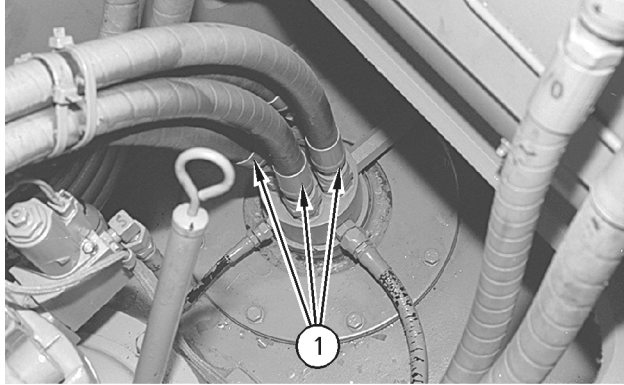
**AT OPERATING TEMPERATURE THE IMPLEMENT HYDRAULIC OIL TANK IS HOT AND UNDER PRESSURE. HOT OIL CAN CAUSE BURNS.**

**TO PREVENT POSSIBLE INJURY, RELEASE THE PRESSURE IN THE IMPLEMENT HYDRAULIC SYSTEM BEFORE HYDRAULIC LINES OR COMPONENTS ARE DISCONNECTED OR REMOVED.**

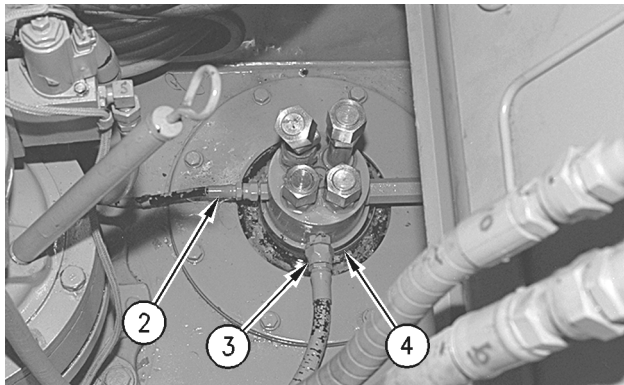
1. Release hydraulic system pressure.



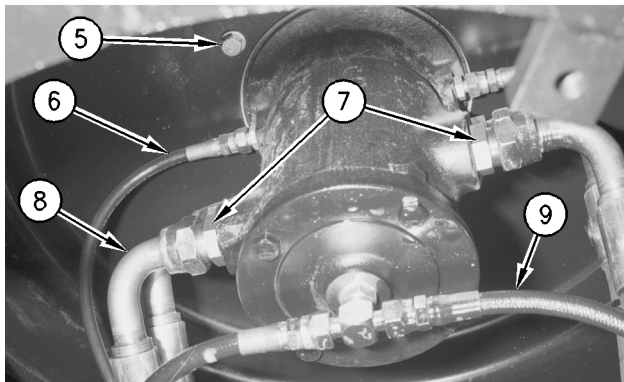
**NOTE:** Put marks on all of the hose assemblies. The marks are used to identify the hose assemblies for the installation procedure.



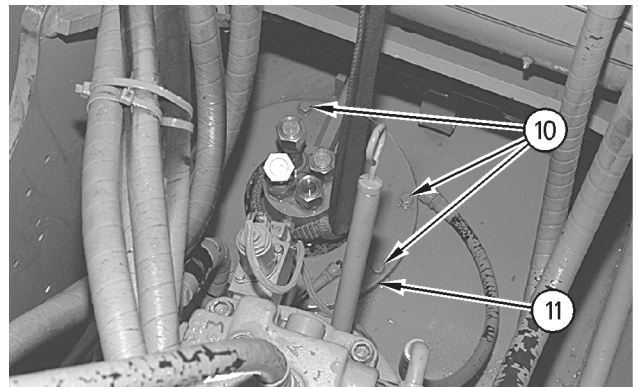
2. Disconnect four hose assemblies (1) from the top of the swivel joint. Put plugs in the ends of the hose assemblies in order to keep dirt and debris out of the hydraulic system.



3. Disconnect two hose assemblies (2) and (3) from the swivel joint. Put plugs in the ends of the hose assemblies in order to keep dirt and debris out of the hydraulic system.
4. Loosen and remove hose clamp (4) from the swivel joint.



5. Remove two hose assemblies (6) from the swivel joint.
6. Remove four hose assemblies (8) from the swivel joint.
7. Remove two hose assemblies (g) from the bottom of the swivel joint.
8. Remove fittings (7) in order to create extra clearance for removing the boot from the swivel joint.
9. Remove four bolts (5) and the washers that secure the swivel joint to the undercarriage frame.



10. Remove eight bolts (10) that secure flange (11) and the boot to the frame.
11. Fasten lifting slings to the swivel joint and remove the swivel joint from the machine. The weight of the swivel joint is 65 lb (29 kg).



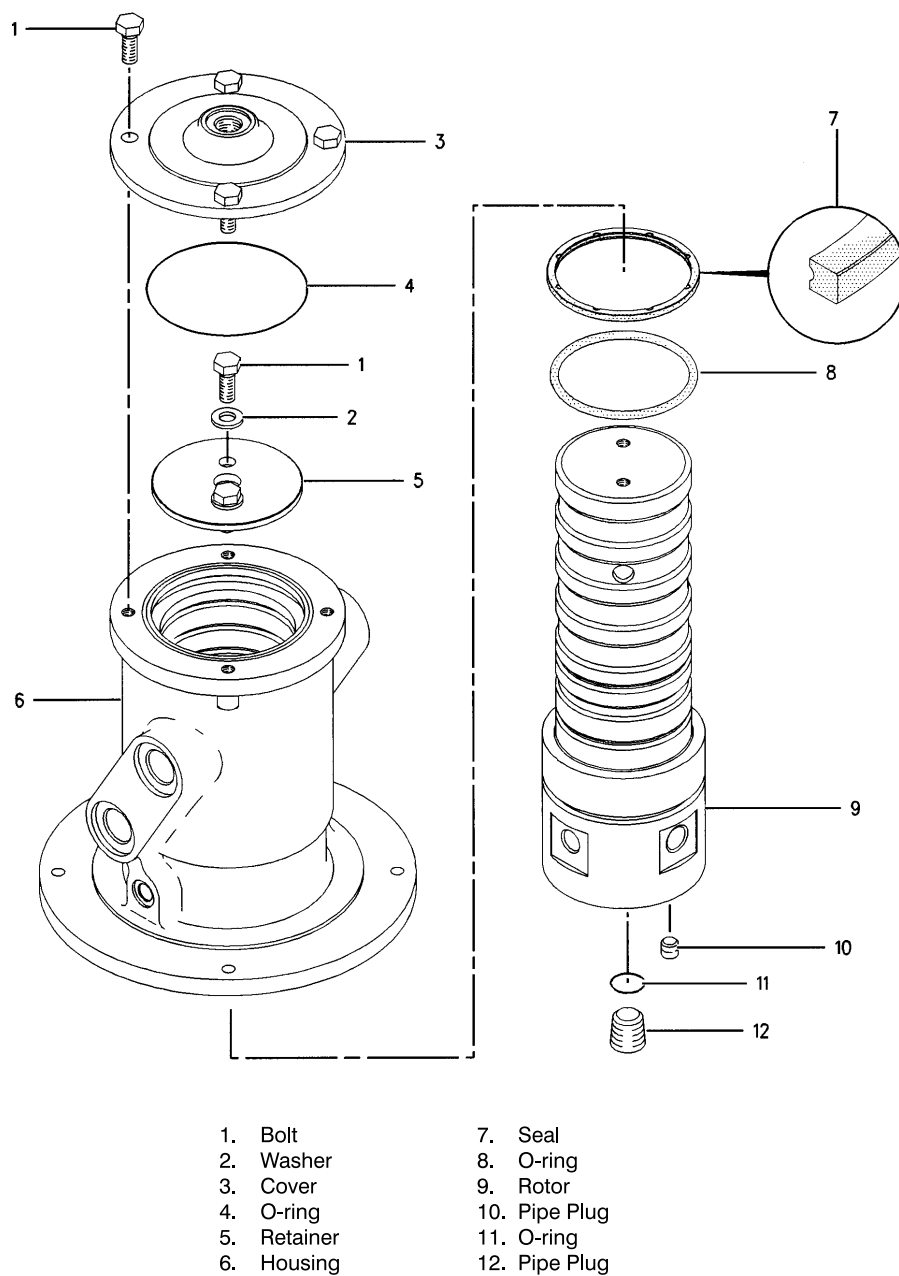


Figure 6-14. Swivel Assembly



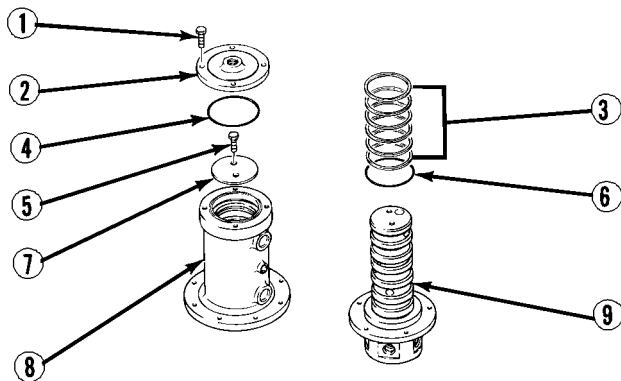
## Disassembly

Start by removing the swivel joint. Refer to Disassembly and Assembly, "Swivel - Remove" in this manual.

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

1. Make sure that the outside of the swivel joint is thoroughly clean prior to disassembly.



2. Remove four bolts (1) and remove cover (2) from outside housing (8). Remove O-ring seal (4) from outside housing (8).
3. Remove two bolts (5), the washers and retainer (7) from rotor (9). Remove outside housing (8) from the rotor (9).
4. Turn the outside housing upside-down and remove O-ring seal (6) and seals (3) from the outside housing.

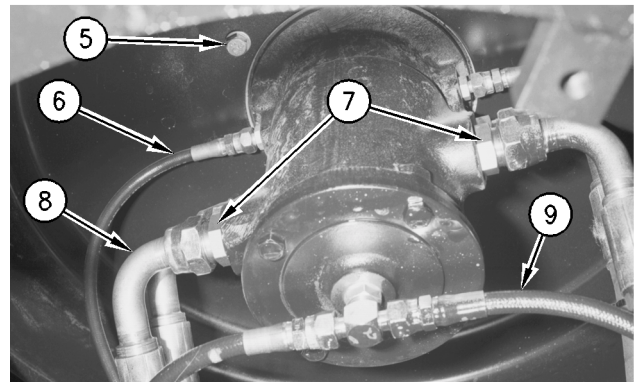
## Assembly

1. Make sure that all of the parts of the swivel joint are thoroughly clean and free of dirt and debris.
2. Check the condition of seals (3) and O-ring seals (6). If the seals or O-ring seals are worn or damaged, use new parts for replacement.
3. Install seals (3) and O-ring seals (6) in outside housing (8). Apply Molybdenum Grease on seals (3) and O-ring seals (6).
4. Install outside housing (8) over rotor (9). Install retainer (7), two bolts (5) and the washers that hold the retainer.

5. Check the condition of O-ring seal (4). If the O-ring seal is worn or damaged, use new parts for replacement.
6. Apply Molybdenum Grease on O-ring seal (4). Install the O-ring seal in the outside housing.
7. Install cover (2) and four bolts (1) that hold the cover.
8. Check the swivel joint for leaks. Plug the drain ports of the inside body. Apply shop air pressure in the top of the swivel joint to check for leaks.
9. Install the swivel joint. Refer to Disassembly and Assembly, "Swivel - Install" in this manual.

## Installation

1. Make sure that the threaded holes in the undercarriage frame for mounting the swivel joint are clean and free of dirt and debris.
2. Apply Liquid Gasket to the surface of the undercarriage frame for the mounting of the swivel joint.
3. Fasten a suitable lifting device to the swivel joint. The weight of the swivel joint is 65 lb (29 kg). Place the swivel joint in swivel joint's original position in the undercarriage frame. Make sure that the identification mark on the bottom face of the swivel joint is toward the front of the machine.



4. Put Thread Lock Compound on the threads of four bolts (5). Install the washers and four bolts (5) in the bottom of the swivel joint.

**NOTE:** Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

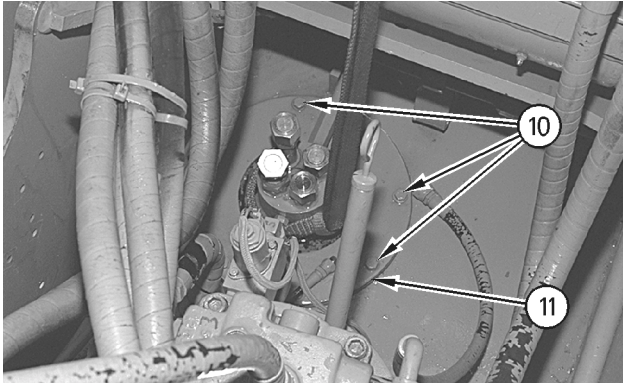
Dispose of all fluids according to local regulations and mandates.



## SECTION 6 - UNDERCARRIAGE

**NOTE:** Replace the O-ring seals that are used in the ends of the eight hose assemblies with new O-ring seals. The eight hose assemblies connect to the bottom of the swivel joint.

5. Install fittings (7) in the swivel joint. Install two hose assemblies (6), four hose assemblies (8) and two hose assemblies (9) in the bottom of the swivel joint. Make sure that the hose assemblies are connected in the correct location.



6. Install the boot and flange (11) over the swivel joint. Position flange (11) in order to install bolts (10) that secure the flange to the frame.

**NOTE:** Replace the O-ring seals that are used in the ends of the two hose assemblies with new O-ring seals. The two hose assemblies connect to the top of the swivel joint.

7. Connect two hose assemblies (2) and (3). Make sure that the hose assemblies are connected in the correct location. Install hose clamp (4).

**NOTE:** Replace the O-ring seals that are used in the ends of the four hose assemblies with new O-ring seals. The four hose assemblies connect to the top of the swivel joint.

8. Connect four hose assemblies (1). Make sure that the hose assemblies are connected in the correct locations.
9. Fill the hydraulic oil tank to the correct level with oil. Refer to Operation and Maintenance Manual, "Lubricant Viscosities and Refill Capacities" for the correct filling procedure and the correct levels.

### 6.14 TOWING INFORMATION

#### Towing the Machine

#### **⚠ WARNING**

**PERSONAL INJURY OR DEATH COULD RESULT WHEN TOWING A DISABLED MACHINE INCORRECTLY.**

**BLOCK THE MACHINE TO PREVENT MOVEMENT BEFORE FINAL DRIVES ARE DISENGAGED. THE MACHINE CAN ROLL FREE IF IT IS NOT BLOCKED. WITH FINAL DRIVES DISENGAGED, THE MACHINE CANNOT BE STOPPED OR STEERED.**

**FOLLOW THE RECOMMENDATIONS BELOW, TO PROPERLY PERFORM THE TOWING PROCEDURE.**

**RELIEVE THE HYDRAULIC TANK AND LINE PRESSURE BEFORE ANY DISASSEMBLY.**

**REMOVING THE PLUGS FROM THE BRAKE COVER OF THE TRAVEL MOTOR WITHOUT FIRST RELIEVING THE INTERNAL PRESSURE WILL CAUSE HYDRAULIC OIL TO SQUIRT OUT.**

**EVEN AFTER THE MACHINE HAS BEEN TURNED OFF, THE HYDRAULIC OIL CAN STILL BE HOT ENOUGH TO BURN. ALLOW THE HYDRAULIC OIL TO COOL BEFORE DRAINING.**

**NOTE:** To tow the machine, both final drives must be disengaged.

**NOTE:** Do not operate the travel motors with the final drives disengaged. Damage could result.

These towing instructions are for moving a disabled machine for a short distance at low speed. Move the machine at a speed of 2 km/h (1.2 mph) or less to a convenient location for repair. Always haul the machine if long distance moving is required.

Shields must be provided on both machines. This will protect the operator if the tow line or the tow bar breaks.

Do not allow an operator to be on the machine that is being towed.

Before you tow the machine, make sure that the tow line or the tow bar is in good condition. Make sure that the tow line or the tow bar has enough strength for the towing procedure that is involved. The strength of the tow line or of the tow bar should be at least 150 percent of the gross weight of the towing machine. This requirement is for a disabled machine that is stuck in the mud and for towing on a grade.

Attach the cable to the towing eye on the front of the machine if you are towing the machine forward. Attach the cable to the drawbar pin on the rear of the machine if you are towing the machine backward.



Do not use a chain for pulling a disabled machine. A chain link can break. This may cause personal injury. Use a wire rope cable with ends that have loops or rings. Put an observer in a safe position in order to watch the pulling procedure. The observer can stop the procedure if the wire rope cable starts to break. Stop pulling whenever the towing machine moves without moving the towed machine.

Keep the tow line angle to a minimum. Do not exceed a 30 degree angle from the straight ahead position.

Quick machine movement could overload the tow line or the tow bar. This could cause the tow line or the tow bar to break. Gradual, steady machine movement will be more effective.

Normally, the towing machine should be as large as the disabled machine. Make sure that the towing machine has enough brake capacity, enough weight, and enough power. The towing machine must be able to control both machines for the grade that is involved and for the distance that is involved.

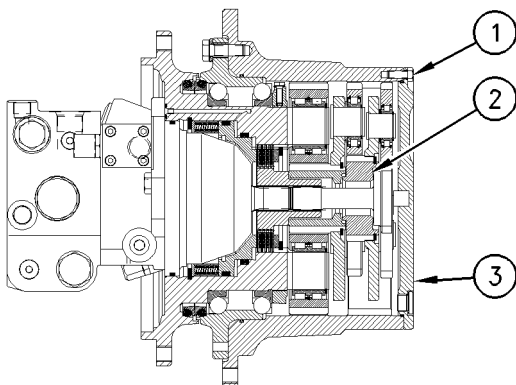
You must provide sufficient control and sufficient braking when you are moving a disabled machine downhill. This may require a larger towing machine or additional machines that are connected to the rear of the disabled machine. This will prevent the machine from rolling away out of control.

All situation requirements cannot be listed. Minimal towing machine capacity is required on smooth, level surfaces. On inclines or on surfaces in poor condition, maximum towing machine capacity is required.

Do not tow a loaded machine.

Consult your JLG Distributor for the equipment that is necessary for towing a disabled machine.

### Final Drive Sun Gear Removal



1. Thoroughly clean the area around the final drive. Make sure that you also clean the track shoes that are positioned above the final drive.

2. Drain the final drive oil into a suitable container. See Operation and Maintenance Manual, "Final Drive Oil - Change" for the procedure.
3. Remove sixteen cover bolts (1) and final drive cover (3).
4. Remove sun gear (2) from the final drive.
5. Install final drive cover (3) and cover bolts (1). These parts were removed previously.
6. Fill the final drive with clean oil, Refer to Section 6.12, Final Drive.
7. Repeat the procedure for the other final drive.

### **⚠ WARNING**

**WITHOUT THE SUN GEAR IN PLACE, THE BRAKES ARE INEFFECTIVE. PERSONAL INJURY OR DEATH COULD RESULT. PROVIDE OTHER MEANS TO HOLD OR STOP THE MACHINE.**

### 6.15 TRACK ADJUSTMENT - ADJUST

### **⚠ WARNING**

**PERSONAL INJURY OR DEATH CAN RESULT FROM GREASE UNDER PRESSURE.**

**GREASE COMING OUT OF THE RELIEF VALVE UNDER PRESSURE CAN PENETRATE THE BODY CAUSING INJURY OR DEATH.**

**DO NOT WATCH THE RELIEF VALVE TO SEE IF GREASE IS ESCAPING. WATCH THE TRACK OR TRACK ADJUSTMENT CYLINDER TO SEE IF THE TRACK IS BEING LOOSENED.**

**LOOSEN THE RELIEF VALVE ONE TURN ONLY.**

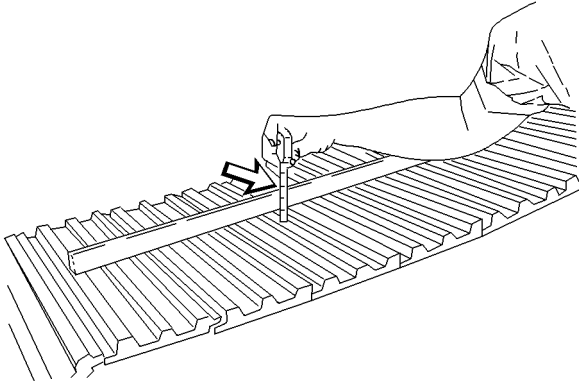
**IF TRACK DOES NOT LOOSEN, CLOSE THE RELIEF VALVE AND CONTACT YOUR JLG DISTRIBUTOR.**

**NOTE:** *Keeping the track properly adjusted will increase the service life of the track and drive components.*

*The track tension must be set according to the current operating conditions. Keep the track as slack as possible if the soil is heavy.*



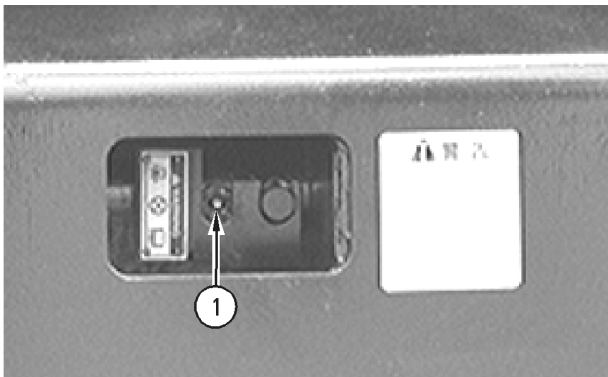
### Measuring Track Tension



1. Place a straight edge on the tracks. The straight edge should be long enough to reach from the idler to the carrier roller.
2. Measure the maximum amount of sag in the track. The sag is measured from the highest point of the track grouser to the bottom of the edge. A track that is properly adjusted will have a slack of 40 to 55 mm (1 5/8 to 2 1/8 inch).

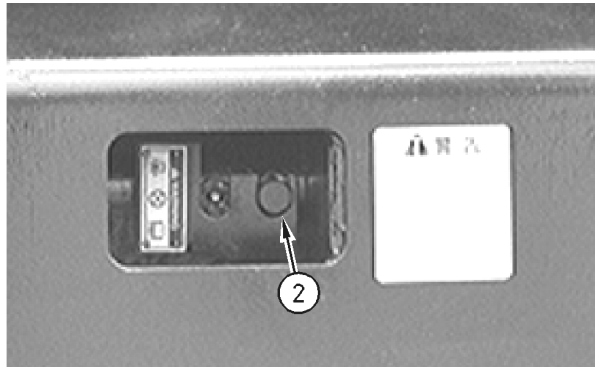
### Tightening the Track

Wipe the fitting before you add grease.



1. Add grease through valve fitting (1) until the correct track tension is reached.
2. Operate the machine back and forth in order to equalize the pressure.
3. Check the amount of sag. Adjust the track, as needed.

### Loosening the Track



1. Loosen relief valve (2) Carefully until the track begins to loosen. One turn should be the maximum.
2. Tighten relief valve (2) to 34 N m (25 lb ft) when the desired track tension is reached.
3. Operate the machine back and forth in order to equalize the pressure.
4. Check the amount of sag. Adjust the track, as needed.

If the correct adjustment cannot be achieved, Consult your JLG Distributor.

### Track Adjustment - Inspect

Check the track adjustment. Check the track for wear and for excessive dirt buildup.

If the track appears to be too tight or too loose, see Operation and Maintenance Manual, "Track Adjustment-Adjust".

## 6.16 UNDERCARRIAGE- CHECK

1. Check the carrier rollers, the track rollers, and the idler wheels for possible leakage.
2. Check the surface of the track, the carrier rollers, the track rollers, the idler wheels, the track shoes, and the drive sprockets. Look for signs of wear and loose mounting bolts.
3. Listen for any abnormal noises while you are moving slowly in an open area.
4. If abnormal wear exists or abnormal noises or leaks are found, consult your JLG Distributor.



## **SECTION 7. SCHEMATICS**

---

### **7.1 GENERAL**

This section contains troubleshooting information to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

---

### **7.2 TROUBLESHOOTING**

It should be noted that there is no substitute for a thorough knowledge of the equipment and related systems.

It should be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems.

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

---

### **7.3 HYDRAULIC CIRCUIT CHECKS**

The reference for improper function of a hydraulic system, where the cause is not immediately apparent, should be the Troubleshooting Chart. The best place to begin the problem analysis is at the power source (pump). Once it is determined that the pump is serviceable, then a systematic check of the circuit components, beginning with the control, would follow. For aid in troubleshooting, refer to the Illustrated Parts Manual for hydraulic diagrams of the various circuits.



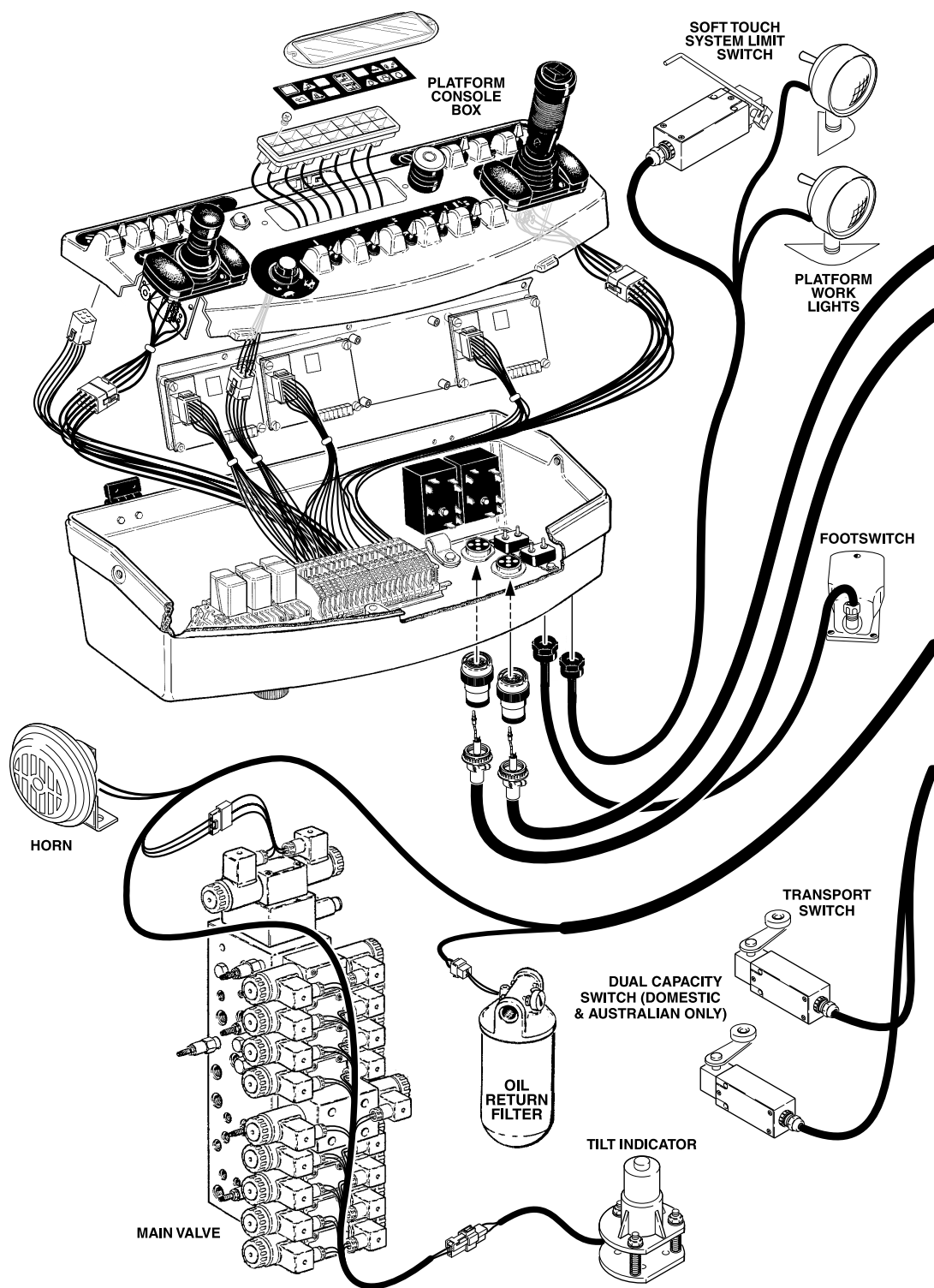


Figure 7-1. Electrical Components Installation - Sheet 1



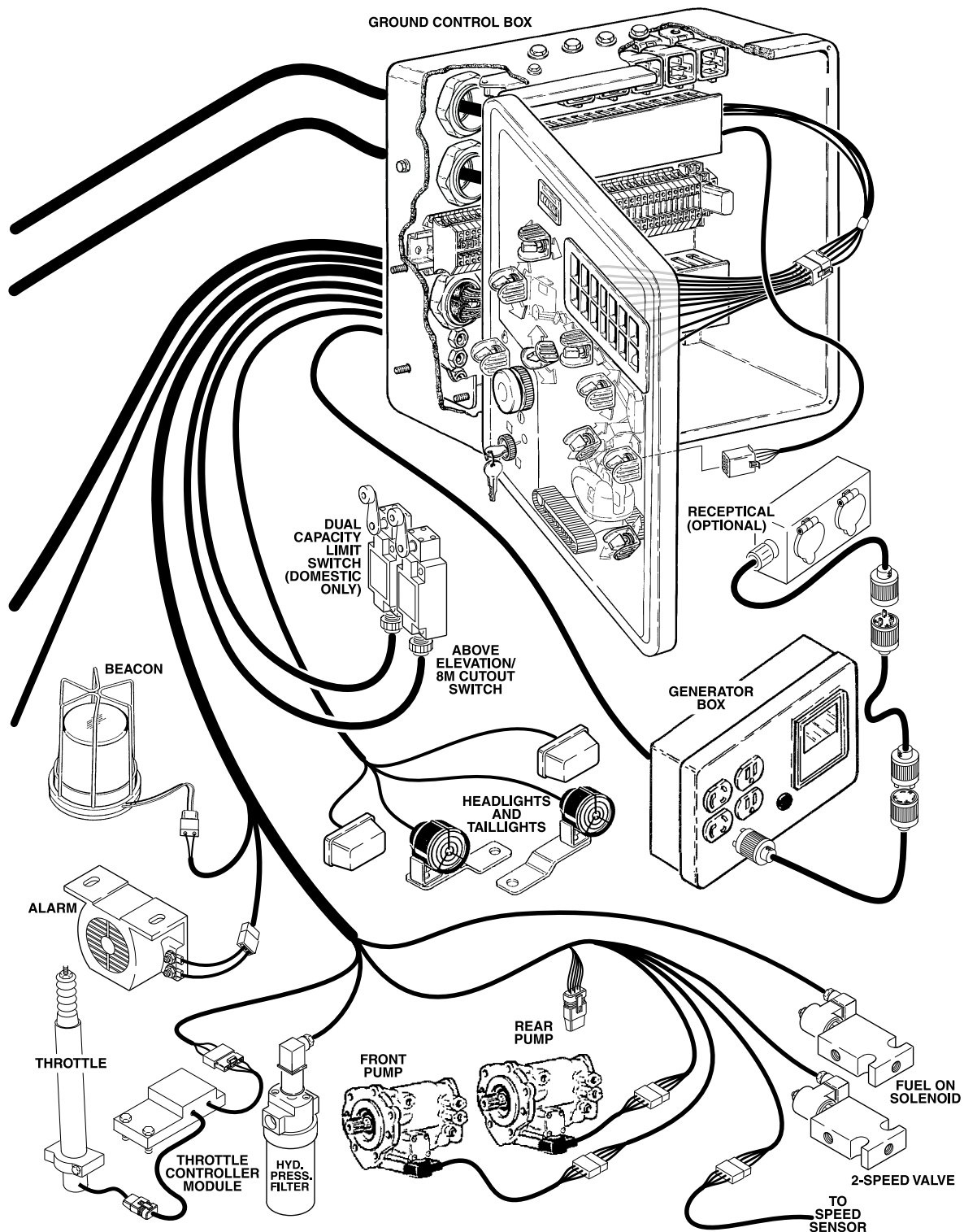


Figure 7-2. Electrical Components Installation - Sheet 2



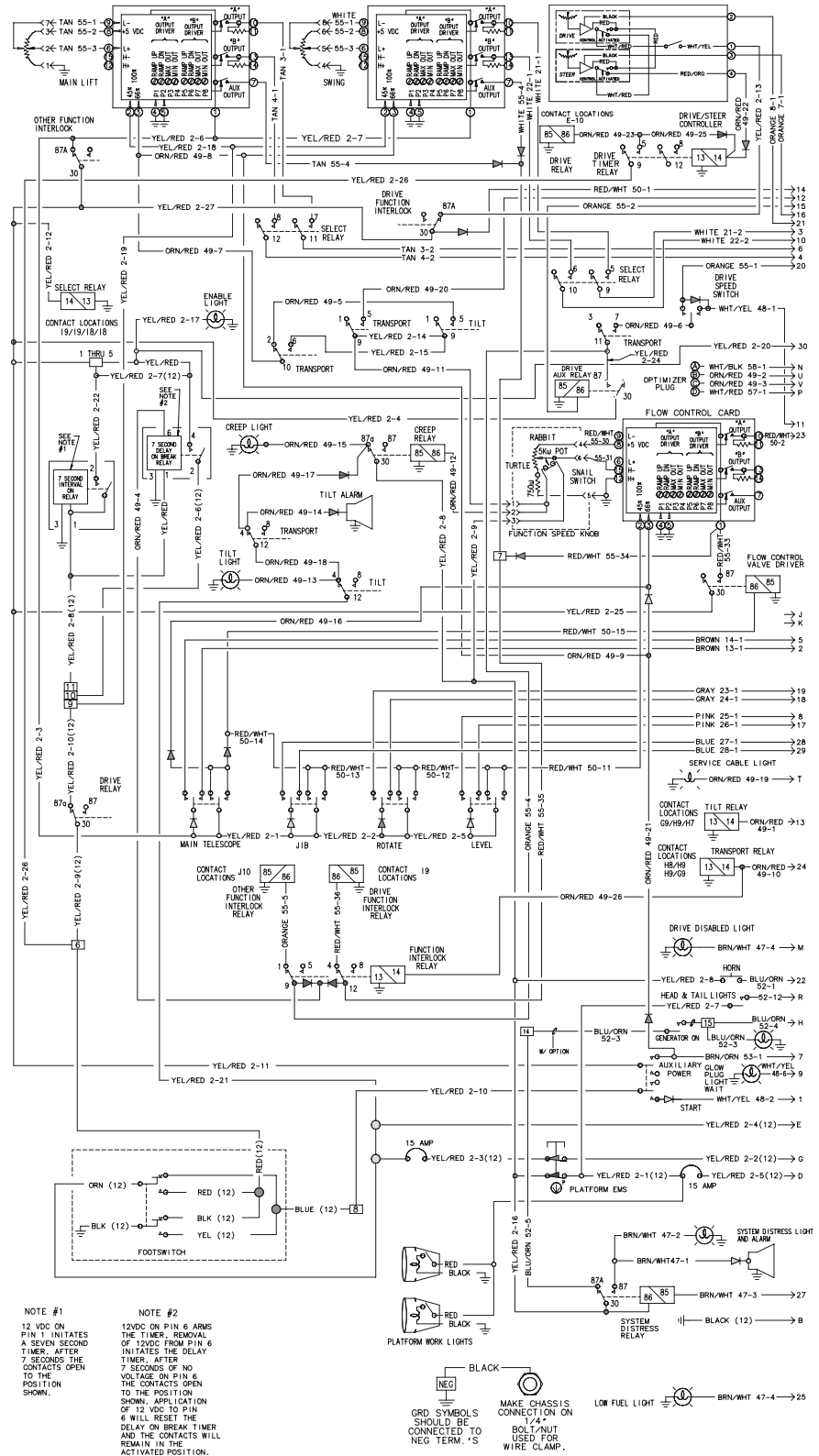
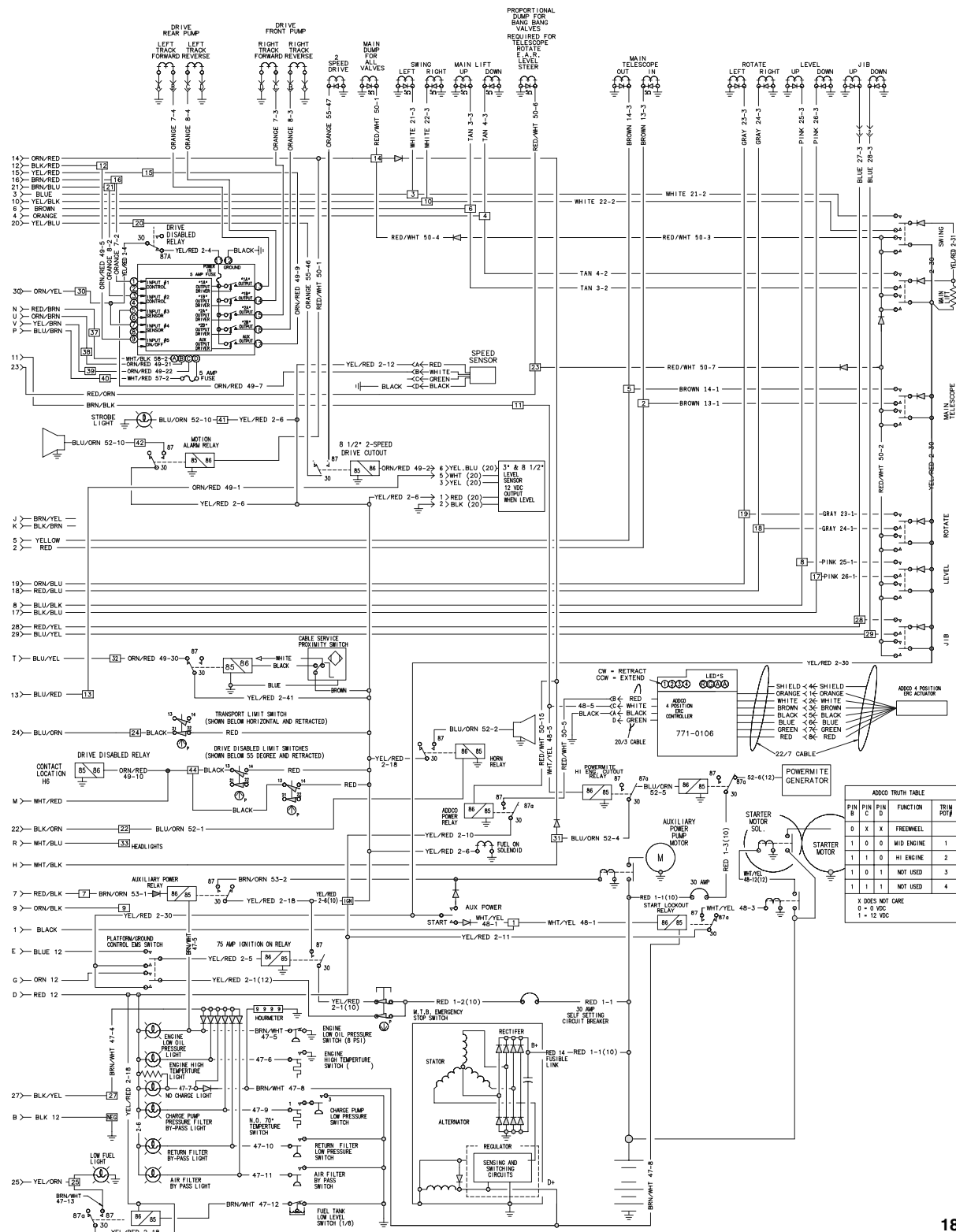


Figure 7-3. Electrical Schematic - Deutz or Isuzu - Sheet 1 of 2





1870111 A

Figure 7-4. Electrical Schematic - Deutz or Isuzu - Sheet 2 of 2



## SECTION 7 - SCHEMATICS

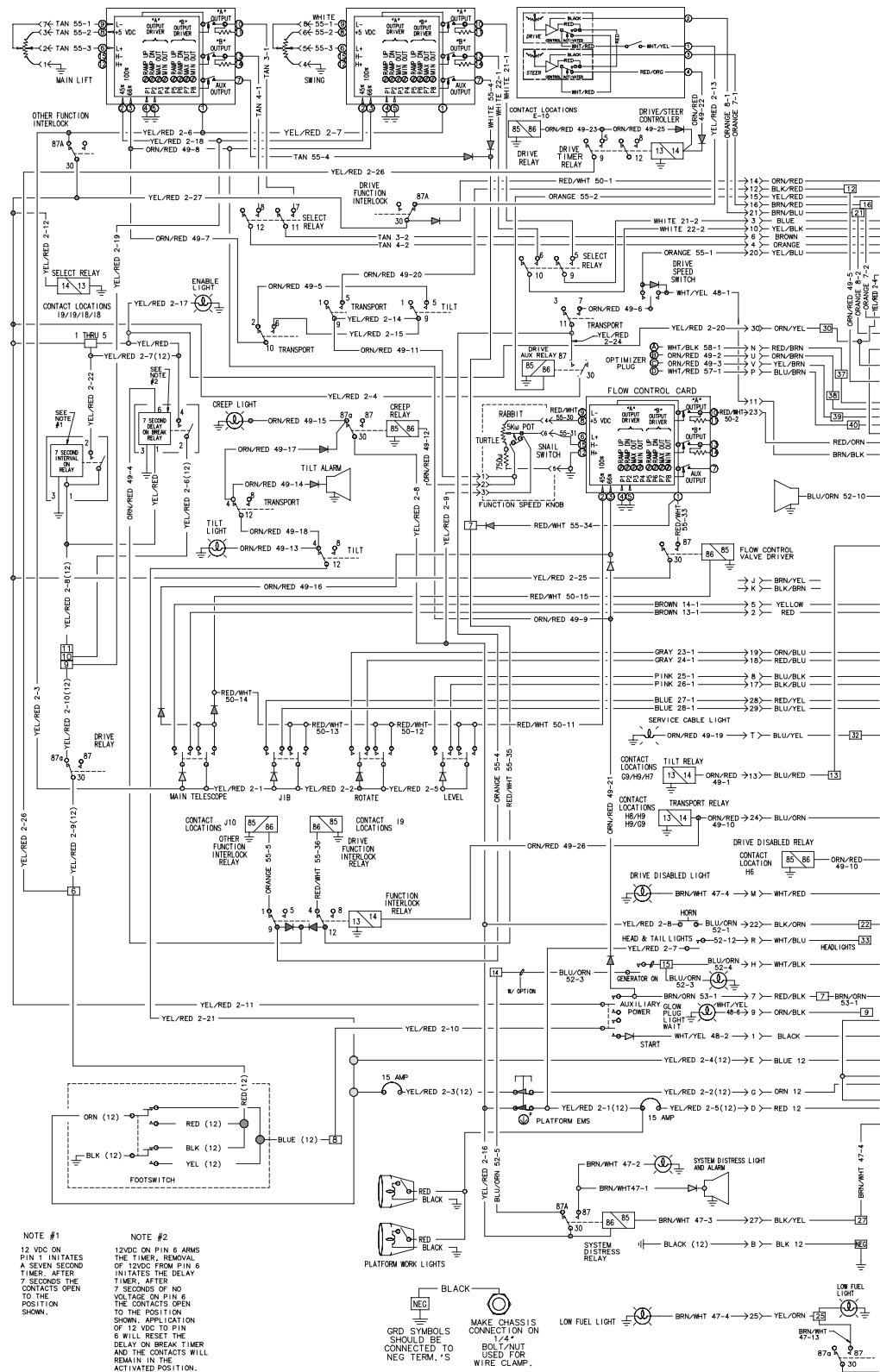
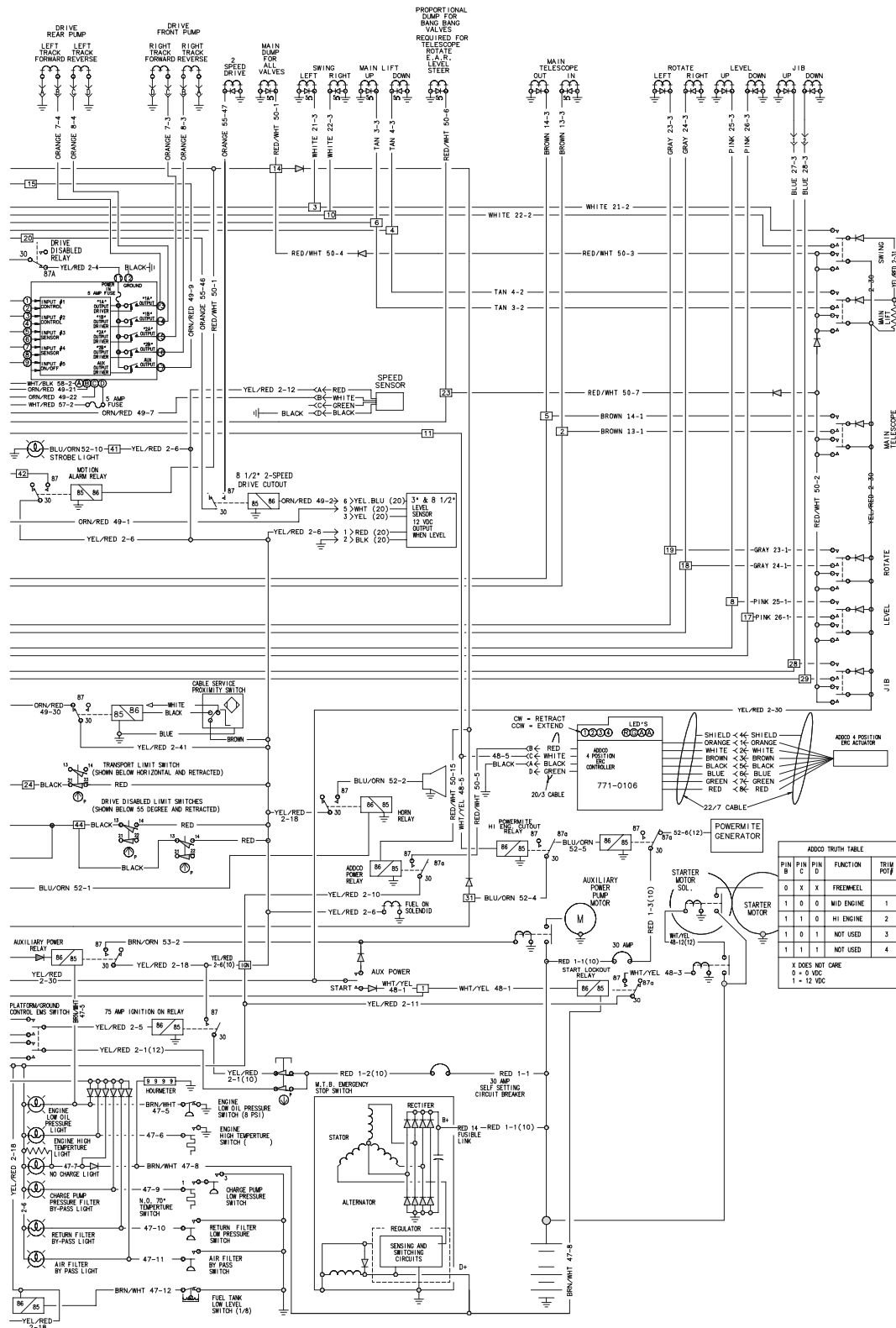


Figure 7-5. Electrical Schematic - Australian w/Deutz or Isuzu - Sheet 1 of 2





1870128 A

Figure 7-6. Electrical Schematic - Australian w/Deutz or Isuzu - Sheet 2 of 2



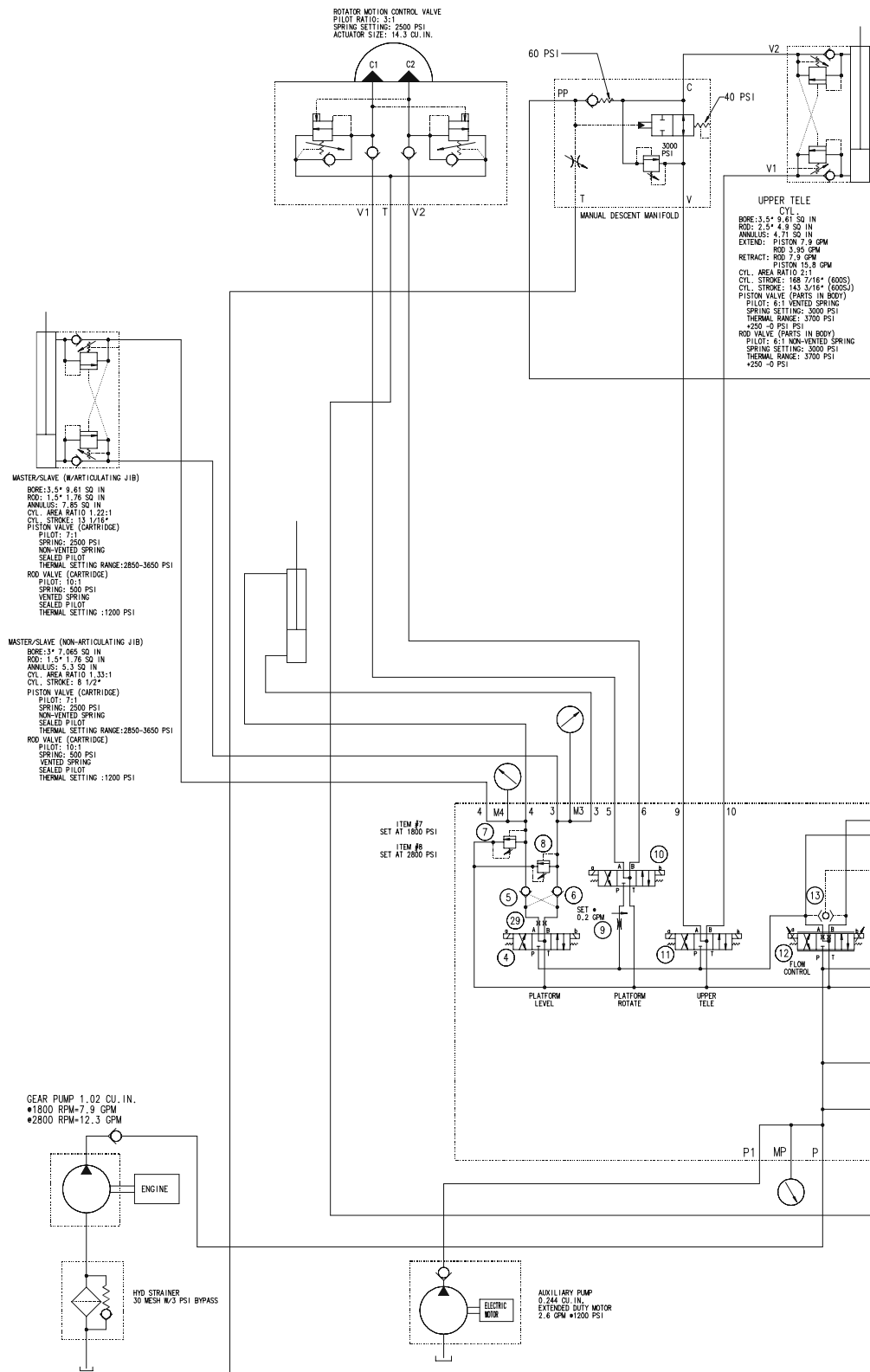
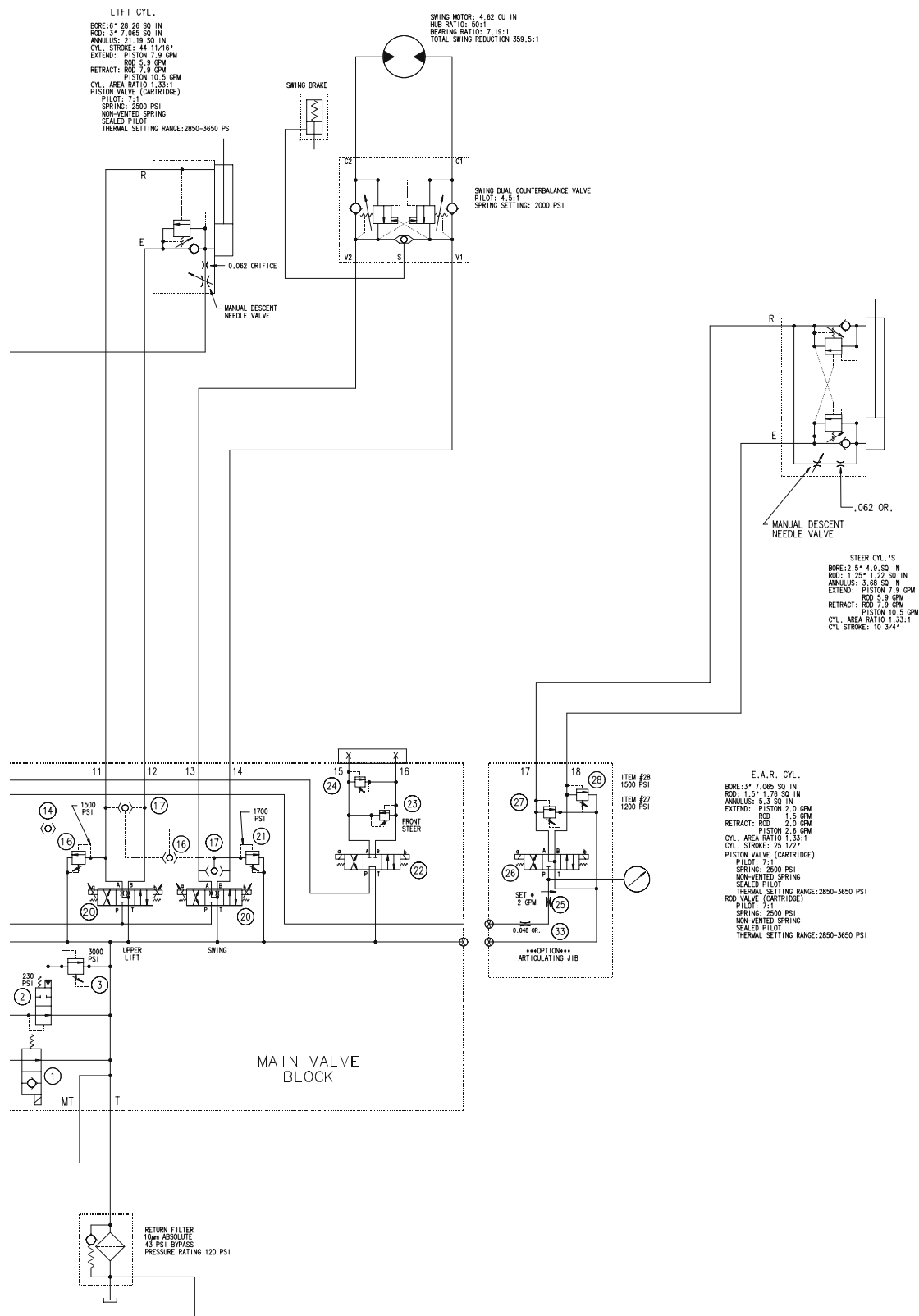


Figure 7-7. Hydraulic Schematic - Sheet 1 of 4





**Figure 7-8. Hydraulic Schematic - Sheet 2 of 4**

**2792323C**



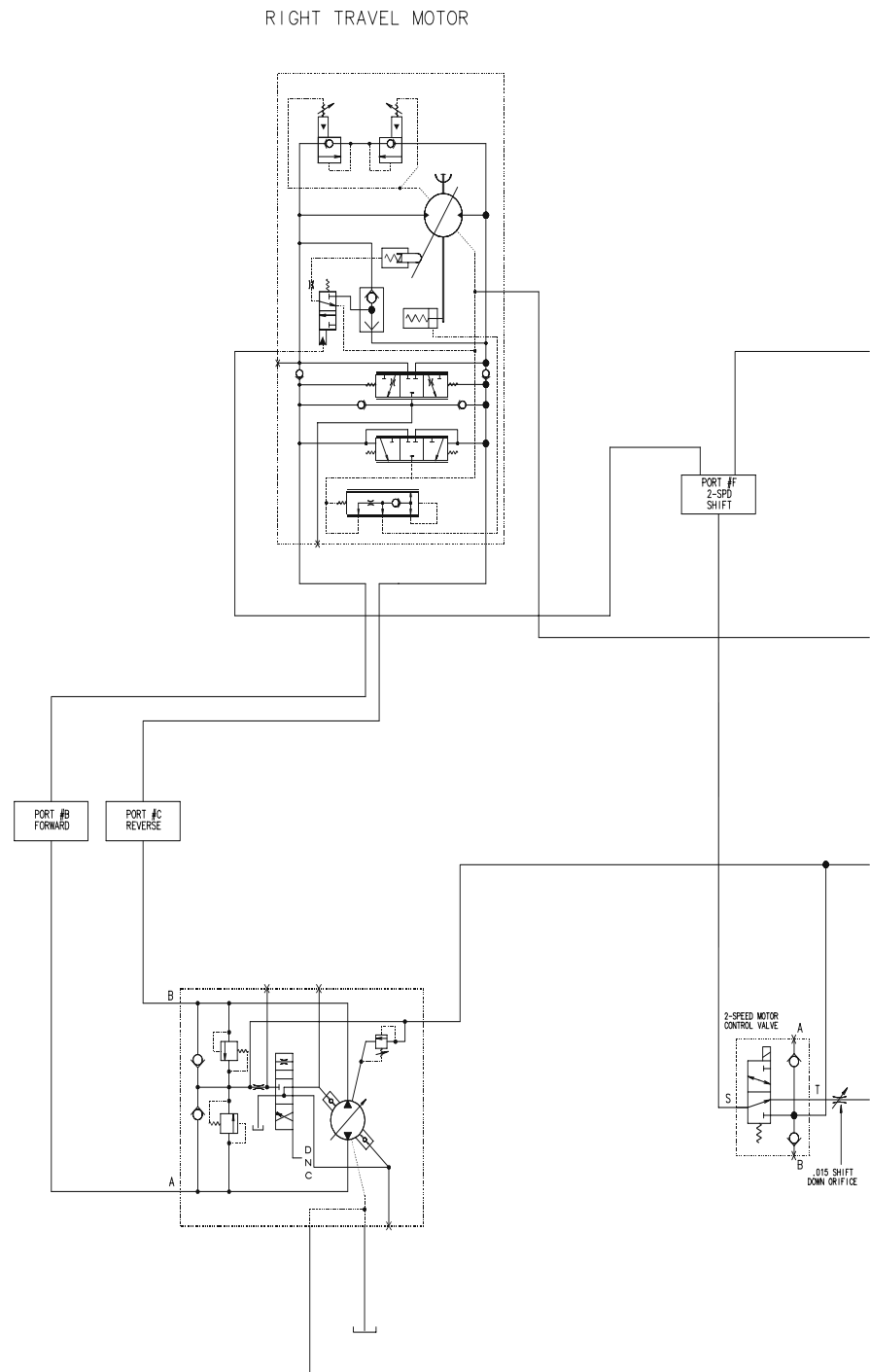
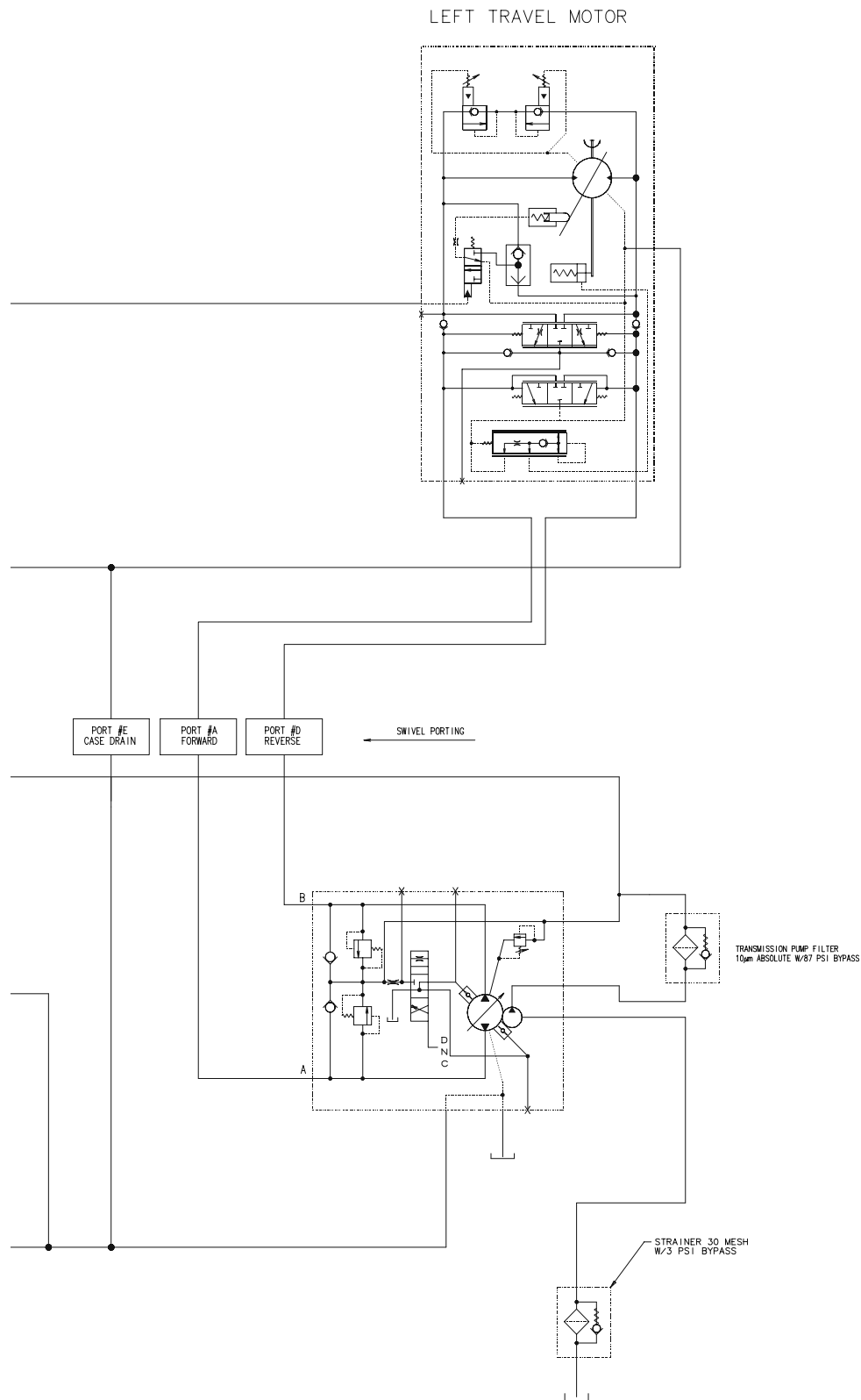


Figure 7-9. Hydraulic Schematic - Sheet 3 of 4





2792323 C

Figure 7-10. Hydraulic Schematic - Sheet 4 of 4



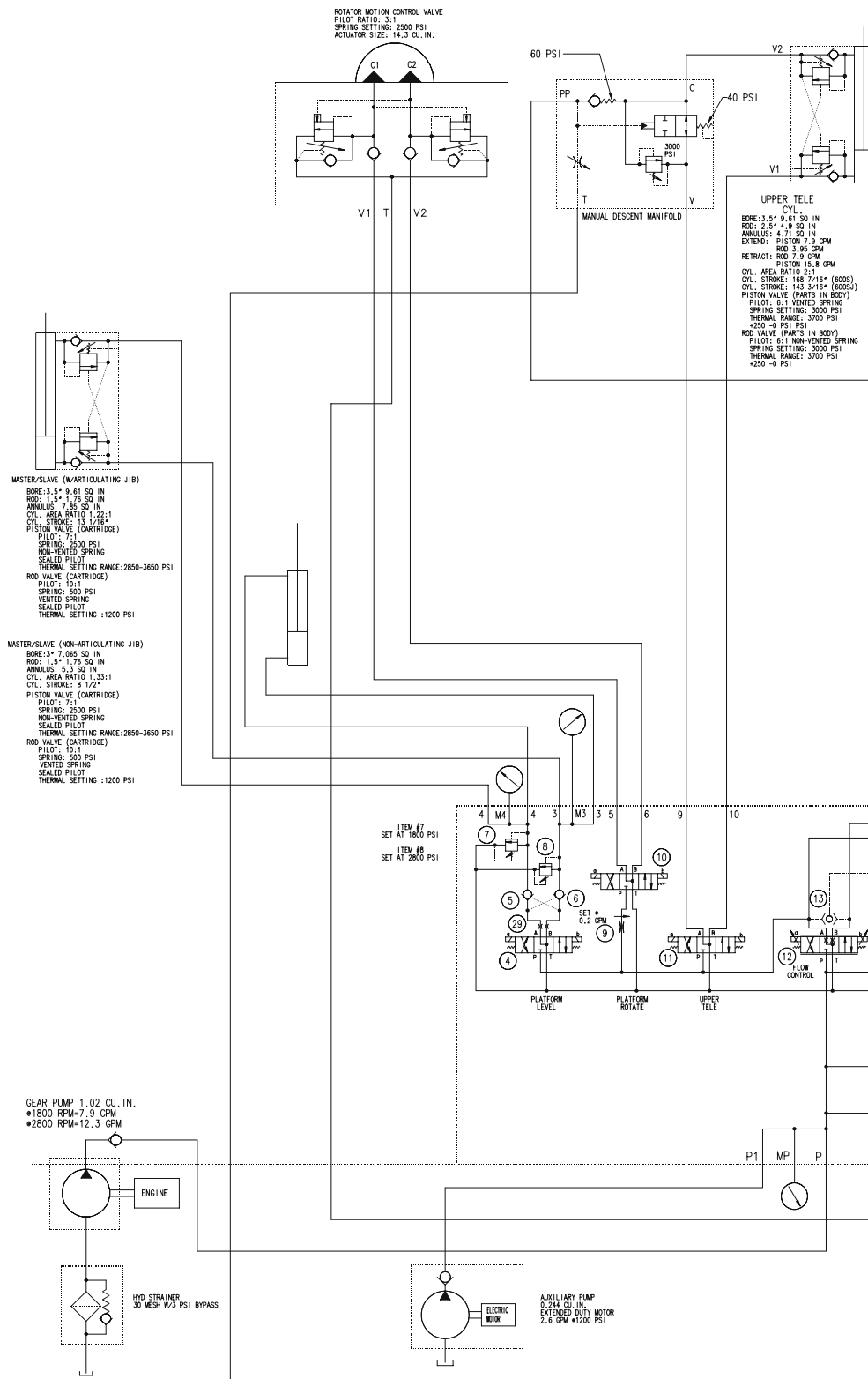


Figure 7-11. Hydraulic Schematic w/GFT24 Drive - Sheet 1 of 4



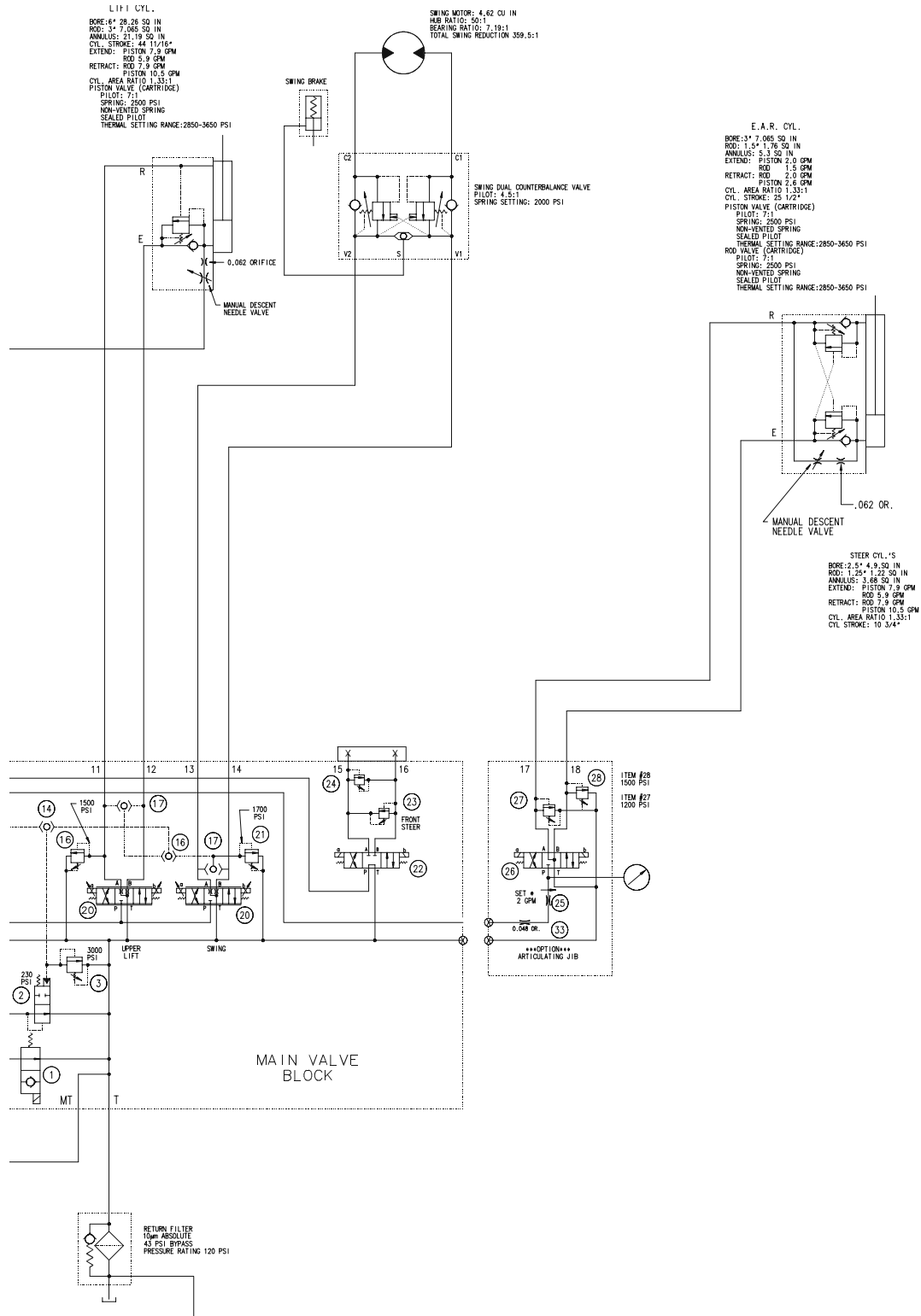


Figure 7-12. Hydraulic Schematic w/GFT24 Drive - Sheet 2 of 4

2792550 A



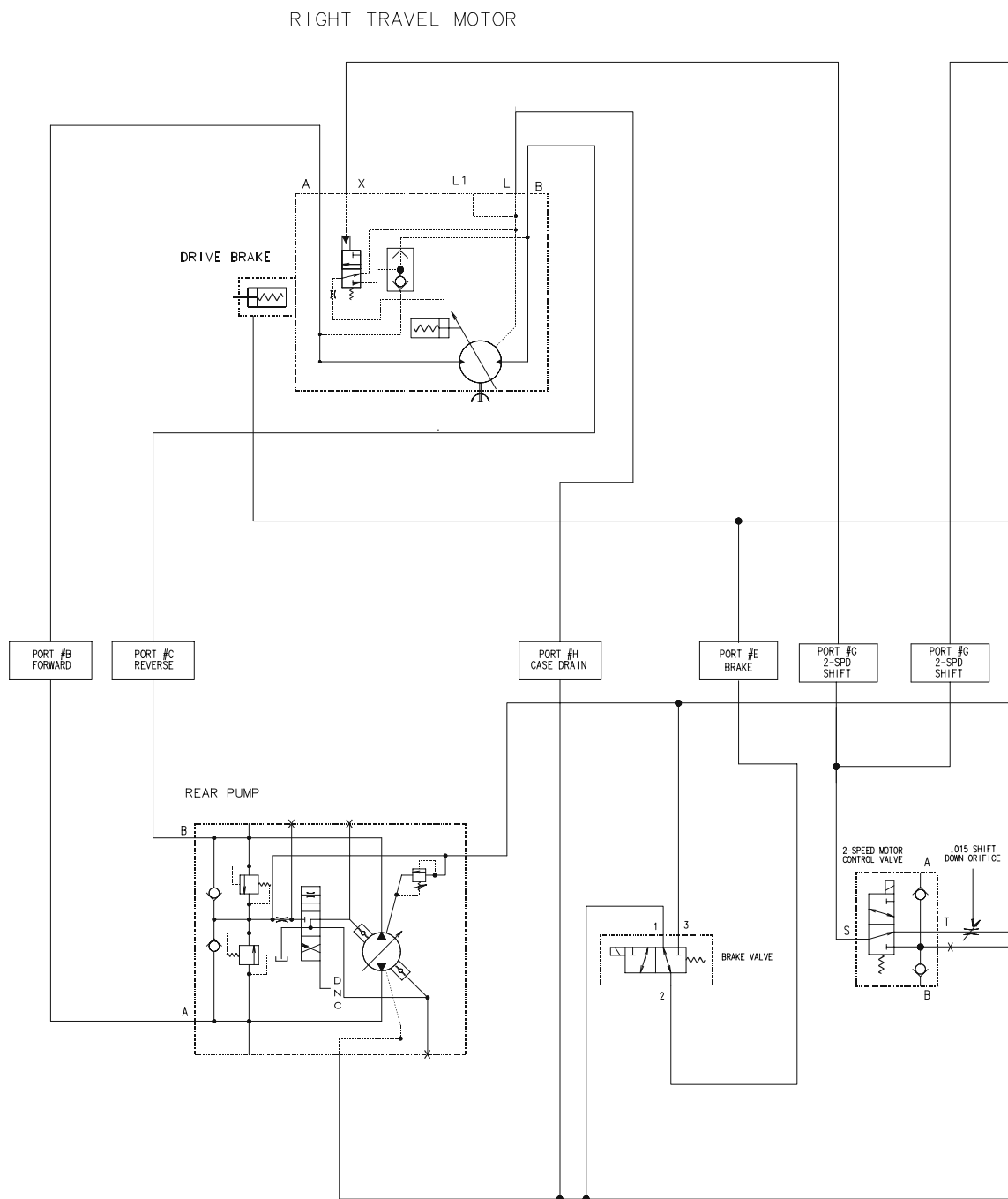
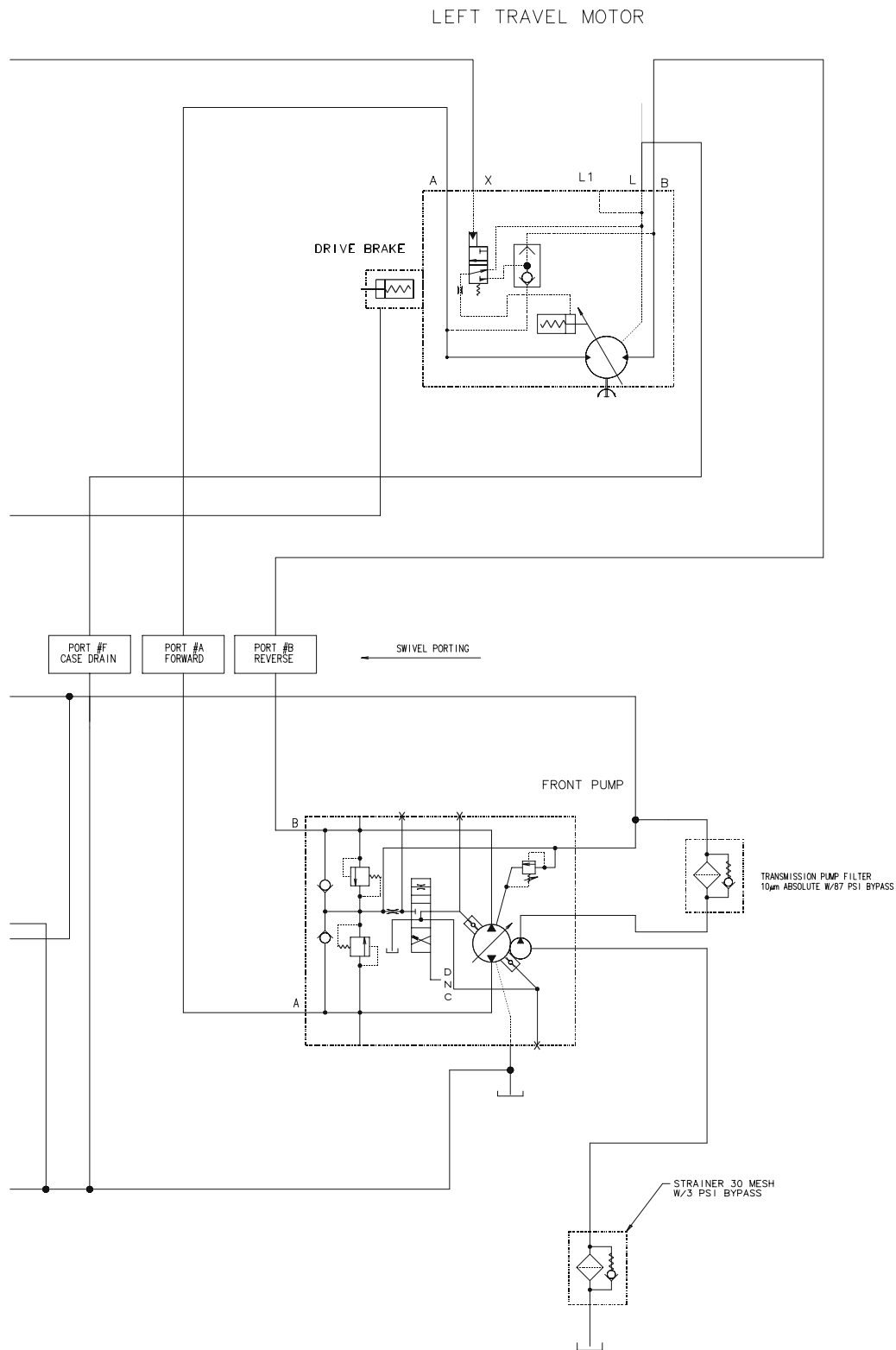


Figure 7-13. Hydraulic Schematic w/GFT24 Drive - Sheet 3 of 4





2792550 A

Figure 7-14. Hydraulic Schematic w/GFT24 Drive - Sheet 4 of 4



**This page left blank intentionally.**









3120898



An Oshkosh Corporation Company

**Corporate Office**  
**JLG Industries, Inc.**  
**1 JLG Drive**  
**McConnellsburg PA. 17233-9533**  
**USA**  
☎ **(717) 485-5161 (Corporate)**  
☎ **(800) 554-5438 (Service)**  
☎ **(717) 485-6417**

## JLG Worldwide Locations

JLG Industries  
358 Park Road  
Regents Park  
NSW 2143  
Sydney 2143  
Australia  
☎ +6 (12) 87186300  
☎ +6 (12) 65813058  
Email: techservicesaus@jlg.com

JLG Ground Support Oude  
Bunders 1034  
Breitwaterstraat 12A  
3630 Maasmechelen  
Belgium  
☎ +32 (0) 89 84 82 26  
Email: emeaservice@jlg.com

JLG Latino Americana LTDA  
Rua Antonia Martins Luiz, 580  
Distrito Industrial Joao Narezzi  
Indaiatuba-SP 13347-404  
Brasil  
☎ +55 (19) 3936 7664 (Parts)  
☎ +55 (19) 3936 9049 (Service)  
Email: comercialpecas@jlg.com  
Email: servicos@jlg.com

Oshkosh-JLG (Tianjin)  
Equipment Technology LTD  
Shanghai Branch  
No 465 Xiao Nan Road  
Feng Xian District  
Shanghai 201204  
China  
☎ +86 (21) 800 819 0050

JLG Industries Dubai  
Jafza View  
PO Box 262728, LB 19  
20th Floor, Office 05  
Jebel Ali, Dubai  
☎ +971 (0) 4 884 1131  
☎ +971 (0) 4 884 7683  
Email: emeaservice@jlg.com

JLG France SAS  
Z.I. Guillaume Mon Amy  
30204 Fauillet  
47400 Tonniens  
France  
☎ +33 (0) 553 84 85 86  
☎ +33 (0) 553 84 85 74  
Email: pieces@jlg.com

JLG Deutschland GmbH  
Max Planck Str. 21  
27721 Ritterhude - Ihlpohl  
Germany  
☎ +49 (0) 421 69350-0  
☎ +49 (0) 421 69350-45  
Email: german-parts@jlg.com

JLG Equipment Services Ltd.  
Rm 1107 Landmark North  
39 Lung Sum Avenue  
Sheung Shui N. T.  
Hong Kong  
☎ +(852) 2639 5783  
☎ +(852) 2639 5797

JLG Industries (Italia) S.R.L.  
Via Po. 22  
20010 Pregnana Milanese (MI)  
Italy  
☎ +39 (0) 2 9359 5210  
☎ +39 (0) 2 9359 5211  
Email: ricambi@jlg.com

JLG EMEA B.V.  
Polaris Avenue 63  
2132 JH Hoofdorf  
The Netherlands  
☎ +31 (0) 23 565 5665  
Email: emeaservice@jlg.com

JLG NZ Access Equipment &  
Services  
2B Fisher Crescent  
Mt Wellington 1060  
Auckland, New Zealand  
☎ +6 (12) 87186300  
☎ +6 (12) 65813058  
Email: techservicesaus@jlg.com

JLG Industries  
Vahutinskoe shosse 24b.  
Khimki  
Moscow Region 141400  
Russia Federation  
☎ +7 (499) 922 06 99  
☎ +7 (499) 922 06 99

Oshkosh-JLG Singapore  
Technology Equipment Pte Ltd.  
35 Tuas Avenue 2  
Jurong Industrial Estate  
Singapore 639454  
☎ +65 6591 9030  
☎ +65 6591 9045  
Email: SEA@jlg.com

JLG Iberica S.L.  
Trapadella, 2  
Pol. Ind. Castellbisbal Sur  
08755 Castellbisbal Barcelona  
Spain  
☎ +34 (0) 93 772 47 00  
☎ +34 (0) 93 771 1762  
Email: parts\_iberica@jlg.com

JLG Sverige AB  
Enkopingsvagen 150  
176 27 Jarfalla  
Sweden  
☎ +46 (0) 8 506 595 00  
☎ +46 (0) 8 506 595 27  
Email: nordicsupport@jlg.com

JLG Industries (UK) Ltd.  
Bentley House  
Bentley Avenue  
Middleton, Greater  
Manchester  
M24 2GP  
United Kingdom  
☎ +44 (0) 161 654 1000  
☎ +44 (0) 161 654 1003  
Email: ukparts@jlg.com