

# Grove RT530E-2

## Service/Maintenance Manual



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**SECTION 9 . . . . . Lubrication**

- General . . . . . 9-1
- Lubrication Intervals. . . . . 9-1
  - Arctic Conditions Below -18°C (0°F) . . . . . 9-1
  - Arctic Conditions Down To -40° C (-40°F) . . . . . 9-1
  - Surface Protection For Cylinder Rods . . . . . 9-2
- Wire Rope Lubrication . . . . . 9-2
- Lubrication Points . . . . . 9-3
  - CraneLUBE . . . . . 9-3
  - Safety . . . . . 9-3
  - Steering and Suspension . . . . . 9-4
  - Axles . . . . . 9-6
  - Drive Train . . . . . 9-8
  - Drive Train (continued) . . . . . 9-10
  - Outriggers . . . . . 9-12
  - Turntable . . . . . 9-14
  - Boom. . . . . 9-16
  - Boom (continued) . . . . . 9-18
  - Hoist . . . . . 9-20
  - Hydraulic . . . . . 9-22
- Carwell® Rust Inhibitor . . . . . 9-24
  - Protecting Cranes From Rusting. . . . . 9-24
  - Cleaning Procedures . . . . . 9-24
  - Inspection and Repair. . . . . 9-25
  - Application . . . . . 9-25
  - Areas of Application . . . . . 9-25

Reference Only

TOC

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

Always use new locking devices on components which have moving parts.

When installing lockwashers on housings made of aluminum, use a flat washer between the lockwasher and the housing.

## Wires and Cables

Batteries should always be disconnected prior to working on the electrical system.

When removing or disconnecting a group of wires or cables, tag each one to ensure proper identification during assembly.

## Shims

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

## Bearings

### Antifriction Bearings

When an antifriction bearing is removed, cover it to keep out dirt and abrasives. Wash bearings in non-flammable cleaning solution and allow them to drain dry. The bearing may be dried with compressed air BUT do not spin the bearing. Discard the bearings if the races and balls or rollers are pitted, scored, or burned. If the bearing is serviceable, coat it with oil and wrap it in clean waxed paper. Do not unwrap new bearings until time of installation. The life of an antifriction bearing will be shortened if not properly lubricated. Dirt in an antifriction bearing can cause the bearing to lock resulting in the shaft turning in the inner race or the outer race turning within the cage.

### Double Row, Tapered Roller

Double row, tapered roller bearings are precision fit during manufacture and components are not interchangeable. The cups, cones, and spacers are usually etched with the same serial number and letter designator. If no letter designators are found, wire the components together to assure correct installation. Reusable bearing components should be installed in their original positions.

### Heating Bearings

Bearings which require expansion for installation should be heated in oil not to exceed 121 °C (250 °F). When more than one part is heated to aid in assembly, they must be allowed to cool and then pressed together again. Parts often separate as they cool and contract.

## Installation

Lubricate new or used bearings before installation. Bearings that are to be preloaded must have a film of oil over the entire assembly to obtain accurate pre-loading. When installing a bearing, spacer, or washer against a shoulder on a shaft, be sure the chamfered side is toward the shoulder.

When pressing bearings into a retainer or bore, uniformly apply pressure to the outer race. If the bearing is pressed on the shaft, uniformly apply pressure on the inner race.

## Preload

Preload is an initial load placed on the bearing at the time of assembly. Whether a tapered roller bearing should have preload could depend on any of several conditions: rigidity of the housings and shaft, bearing spread, speed of operation, etc.

To determine whether a bearing requires preload or end clearance, consult the disassembly and assembly instructions pertaining to that bearing.

Care should be exercised in applying preload. Misapplication of preload to bearings requiring end clearance can result in bearing failure.

## Sleeve Bearings

Do not install sleeve bearings with a hammer. Use a press and be sure to apply the pressure directly in line with the bore. If it is necessary to drive on a bearing, use a bearing driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part.

## Gaskets

Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If it is necessary to make gaskets, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage.

When removed, always install new cylinder head and manifold gaskets using recommended gasket compound on head gaskets to allow uniform sealing.

## Batteries

Clean batteries by scrubbing them with a solution of baking soda and water. Rinse with clear water. After cleaning, dry thoroughly and coat terminals and connections with an anti corrosion compound or grease.

If the machine is to be stored or not used for an extended period of time, the batteries should be removed. Store the batteries in a cool (not subfreezing), dry place, preferably on wooden shelves. Never store on concrete. A small charge should be introduced periodically to keep the specific gravity rating at recommended level.

- General corrosion.
- Broken or cut strands.
- Number, distribution and type of broken wires.
- Evidence of core failure.
- End fitting wear/abrasion.

Pay particular attention to areas of the rope where wear and other damage is likely to occur:

- **Pick-up Points:** Sections of wire rope that are repeatedly stressed during each lift, such as those sections in contact with sheaves.
- **End Attachments:** The point where a fitting is attached to the wire rope or the point where the wire rope is attached to the drum.
- **Abuse Points:** The point where the wire rope is subjected to abnormal scuffing and scraping.

### **Periodic Inspection**

Wire rope should be inspected periodically/annually or at a shorter time interval if necessitated by environmental or other adverse conditions, and shall cover the entire length of the wire rope. Only the outer surface of the wire rope need be inspected, and no attempt should be made to open the rope. Periodic inspection should include all items listed under frequent inspection plus the following:

1. Inspect for reduction of rope diameter below nominal diameter.
2. Inspect for severely corroded or broken wires at end connections.
3. Inspect for severely corroded, cracked, bent, worn, or improperly applied end connections.
4. Inspect wire rope in areas subjected to rapid deterioration such as:
  - Sections in contact with saddles, equalizer sheaves, or other sheaves where wire rope travel is limited.
  - Sections of wire rope at or near terminal ends where corroded or broken wires may protrude.
5. Inspect boom nose sheaves, hook block sheaves, boom extension/jib sheaves, auxiliary boom nose sheaves, and hoist drums for wear. Damaged sheaves or hoist drums can accelerate wear and cause rapid deterioration of the wire rope.

### **Wire Rope Inspection (Boom Extension and Retraction Cables)**

#### **Periodic Inspection**

It is recommended that a periodic inspection of all boom extension and retraction cables be performed using the

following guidelines. This inspection shall cover the entire length of the extension and retraction cables. This inspection should be used to monitor progressive degradation and to discover severe damages necessitating wire rope replacement or equipment repair. Inspection criteria are as follows:

1. Inspect for reduction of rope diameter below nominal diameter.
2. Inspect for severely corroded or broken wires at end connections.
3. Inspect for severely corroded, cracked, bent, worn, or improperly applied end connections.
4. Inspect wire rope in areas subjected to rapid deterioration such as:
  - Sections in contact with saddles, equalizer sheaves, or other sheaves where wire rope travel is limited.
  - Sections of wire rope at or near terminal ends where corroded or broken wires may protrude.
  - Sections of wire rope in contact with stationary surfaces where abrasion or chafing may take place as a result of equipment vibration.
5. Inspect for damaged or wobbly boom extension and retraction sheaves that may cause rapid deterioration of the wire rope.
6. Inspect for unusual cable sag/stretch and be sure cables used in sets all have an equal tension applied. Repeated need for adjustment of an individual cable is evidence of cable stretch and indicates the need for additional and more thorough inspection in order to determine and correct the cause.

### **Wire Rope Inspection/Replacement (All Wire Rope)**

No precise rules can be given for determination of the exact time for replacement of wire rope since many variable factors are involved. Determination regarding continued use or replacement of wire rope depends largely upon the good judgement of an appointed and qualified person who evaluates the remaining strength in a used rope after allowance for any deterioration disclosed by inspection.

Wire rope replacement should be determined by the following information excerpted from a National Consensus Standard as referenced by Federal Government Agencies and as recommended by Grove Worldwide. All wire rope will eventually deteriorate to a point where it is no longer usable. Wire rope shall be taken out of service when any of the following conditions exist:

1. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure.
2. Evidence of any heat damage from any cause.

limits. If this condition exists, the spool and body must be replaced as an assembly.

### **Valve Leakage**

Dripping hydraulic oil indicates some type of external leakage. The machine should be removed from service for immediate repairs. External leaks sometimes develop at fittings and seals. Seals may be damaged by temperatures that are too high, or by dirt or paint accumulation on the spool. Damaged or torn seals must be replaced.

A component functioning at reduced efficiency may indicate that the control valve for that component is leaking internally. If preliminary check-out reveals that adequate volume is being supplied to the affected valve bank, relief valves are properly adjusted, and the component is not at fault, check the valve for scored or worn parts. Scoring is a sign of the number one problem in hydraulics - contamination (external contamination by dust or internal contamination by debris from deteriorating components or oxidized hydraulic oil). Scored or severely worn valve components must be replaced.

Check valves in the control valves are designed to permit a flow of hydraulic oil in one direction only. If a piece of dirt or rust has worked its way into the check valve and lodges

between the poppet and seat, it will keep the valve open and allow a return flow of hydraulic oil. The remedy is to clean the valve, but it is also a good idea to follow through and ensure the hydraulic system filter is still serviceable.

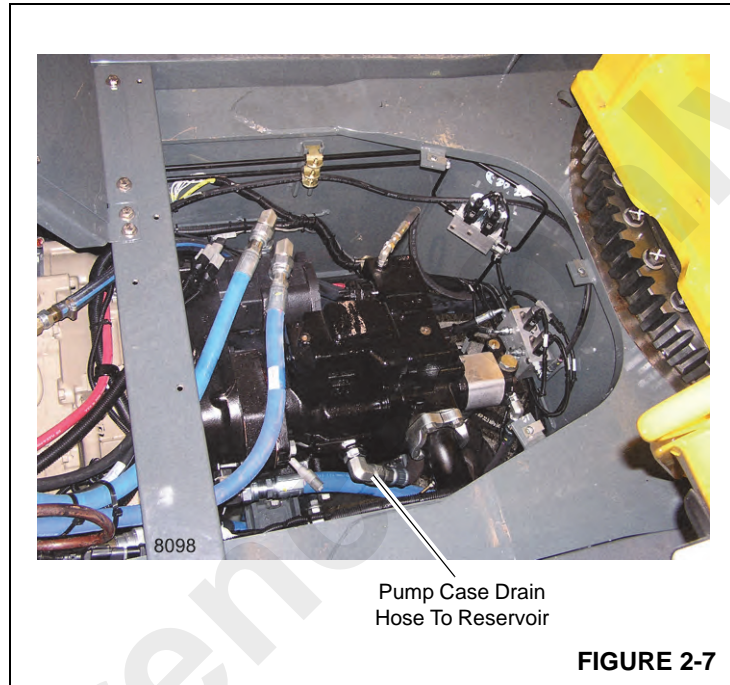
### **Binding Spools**

Some of the most common causes for stiff spool movement or jammed spool action are system overheating, excessive pressure, contaminated or deteriorated hydraulic oil, or warped mountings. When scorched, deteriorated hydraulic oil or contamination is the cause, flushing the system and replenishing with clean hydraulic oil may solve the problem. If the spool bores are badly scored or galled, the valve must be removed for servicing.

Warping occurs when mounting plates are not level or they become distorted from machine damage. As mentioned previously, the valve can be shimmed level.

Also, check the valve for rust. Rust or dirt collecting on the valves can prevent free movement of the spool, and keep it from the true center position. Excessive system pressure can create both internal and external leaks in valves that are otherwise sound. Only qualified technicians using the correct equipment should make pressure adjustments when pressure adjustments are needed.

Item	Description
1	Pump No. 1 - Piston Pump
2	Pump No. 2 - Gear Pump
3	Pump No. 3 - Gear Pump
4	Transmission
5	Engine



## PRESSURE SETTING PROCEDURES

The following procedures should be used to properly check, adjust and set the hydraulic system pressures.

**NOTE:** A Digital Pressure Gauge and accessories may be purchased through Manitowoc Crane Care.

The following equipment is required for checking the hydraulic pressure settings.

- Pressure Gauge
- Three dial gauge 0-34.5 MPa (0-5000 psi)
- Pressure check diagnostic quick disconnect - Grove P/N 9999101806 and straight adapter fitting 7447040401
- ORFS reducers as required to attach work port hoses to the gauge.

**NOTE:** When checking the directional control valve relief settings, unless otherwise specified, start with the engine at idle RPM and move the controller to its fully stroked position. Then slowly accelerate the engine to the specified RPM. Read gauge and make adjustments to specified setting.

When checking the outrigger relief valve setting, start with the engine at idle RPM and activate and hold the extend switch. Then slowly accelerate the engine to the specified RPM. Read gauge and make adjustment as required.

**NOTE:** GP (gauge Port) and number corresponds to gauge ports on the valve and on the hydraulic schematic.

## VALVES

### General

This subsection provides descriptive information for all the hydraulic valves used on this crane. For a listing of all valves, the circuit they are used in, and their physical location, refer to (Table 2-2). Refer to (Figure 2-14) for valve locations. The

description of each valve given here is for the valve itself. For information on how each valve functions in the individual circuits, refer to the description and operation procedures of that circuit.

**NOTE:** On each valve illustration in this section, each item number in table correlates to location on the valve, and to the valve hydraulic schematic.

**Table 2-2**  
**Valve Usage Table**

Valve Name	Circuit Used In	Physical Location
Directional Control Valves	Boom Lift/Telescope(s)/Hoist(s) Swing/Steer	Superstructure Right Side Plate Superstructure Right Side Plate
Steering Control Valve	Front Axle Steer Control	Cab Steering Column
Front Steer/Swing/Accessory Manifold	Front Axle Steer Supply Swing Directional Control Swing Brake Release Pilot Supply	Superstructure Right Side Plate
Tandem Brake Valve with Treadle	Service Brakes	Cab Floor
Dual Accumulator Charging Valve	Service Brakes	Superstructure Left Side Plate
Accumulator(s)	Service Brake	Rear Superstructure
Holding Valves	Boom Lift Telescope (3) Counterweight Removal (2)	Lift Cylinder (Bolt on Manifold) Cylinder Port Blocks (Cartridge style) Cylinder Port Blocks (Cartridge style)
Axle Lockout, Rear Steer and Oil Cooler Fan Motor Control Manifold	Axle Lockout Control Rear Steer Control Oil Cooler Motor Control	Left Hand Carrier Frame Rail
Solenoid Valves: Cross Axle Differential Lock	Differential Lock (Optional)	Carrier Inside Right Side Rail
Hoist Motor Control Valve	Hoist(s)	Both Hoists (see Hoist section)
Check Valves	Return Circuit	One in Parallel With Oil Cooler
Outrigger Control Manifold	Outrigger	On Front and Rear Face of Carrier Frame Front and Rear Cross Member
Pilot Operated Check Valve	Outrigger	Port Block of each Jack Cylinder (4)
Cross Axle Differential Lock Valve	Differential Lock (Optional)	Carrier Bulkhead Plate Forward Of The Engine
Range Shift and Parking Brake Valve	Parking Brake Axle Disconnect	Center of Rear Frame

## DUAL ACCUMULATOR CHARGE VALVE

### Description

The load sensing dual accumulator charging valve is located on the inside of the left superstructure side plate. The purpose of the valve is to provide pressure regulation to the service brake circuit.

The dual accumulator charge valve consists of an inlet main check valve, a load sense control section with a pilot spool that controls the pump stroke and an inverted shuttle that controls the accumulator charging (Figure 2-19).

When the valve is charging the accumulators, the load sense control section is in neutral position, connecting the load to the pump by way of the load sense line. This brings the piston pump No. 1 on stroke to supply fluid for charging. Fluid passes through the main check valve connecting to the pilot end and through the spool onward to the inverted shuttle that connects the accumulators.

When the control pilot spool bias spring senses the low limit pressure of 13,445 kPa/134 bar (1950 psi), the spool shifts to the neutral position, allowing the pump to charge the accumulators to a maximum of 16,000 kPa/160 bar (2320 psi). The inverted shuttle cartridge senses the pressure in the accumulators to pilot the cartridge closed when maximum charge pressure is reached. Maximum charge

pressure also pilots the control pilot spool to open the load sense line to tank, destroking the piston pump No. 1.

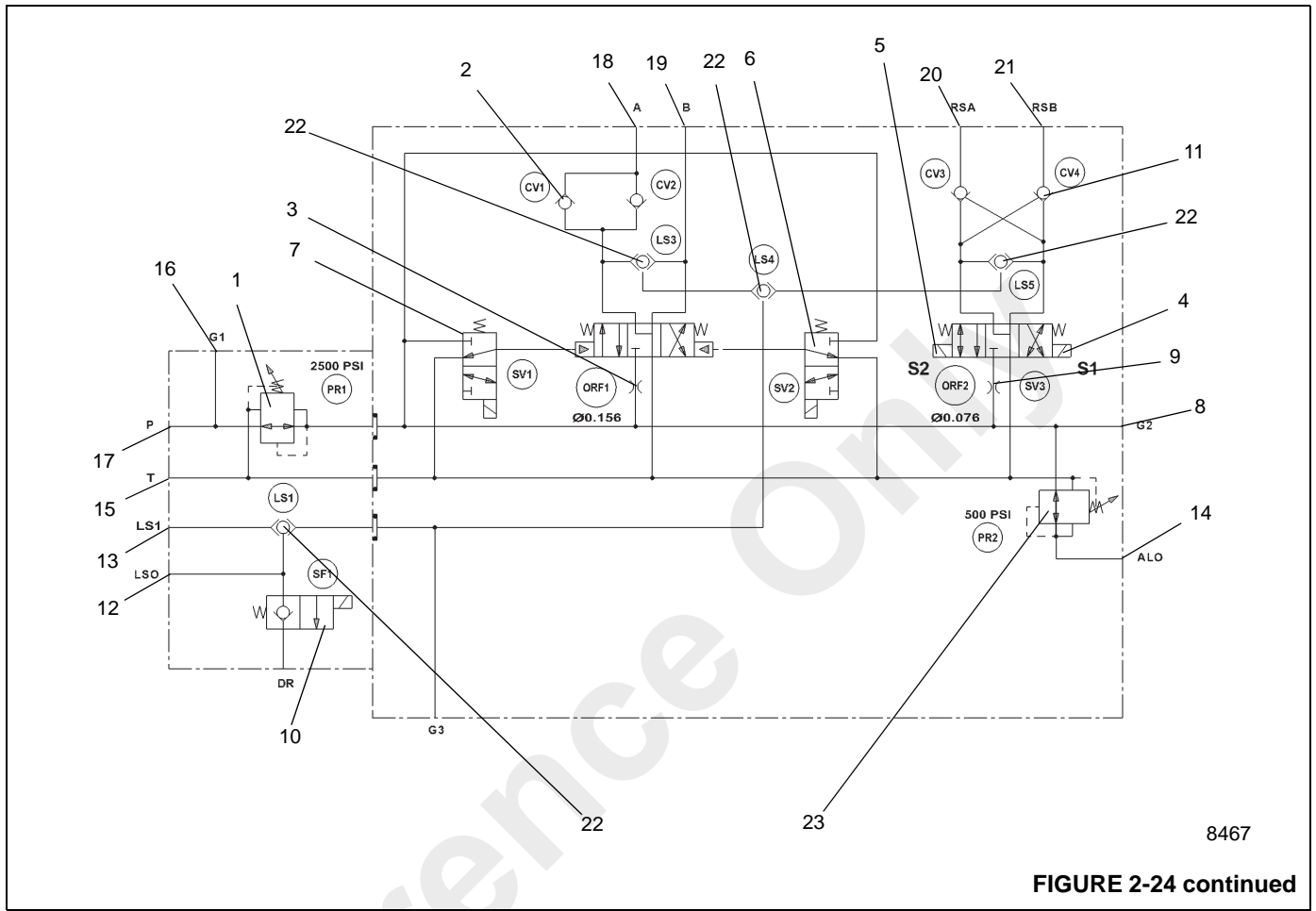
### Maintenance

#### Removal

1. Tag and disconnect the hydraulic hoses from the valve. Cap or plug the lines and ports.
2. Remove the capscrews, flatwashers and lockwashers securing the valve to the turntable. Remove the valve.

#### Installation

1. Position the valve on the turntable and secure with the capscrews, flatwashers, and lockwashers. Torque capscrews see Fasteners and Torque Values (pg 1- 12).
2. Connect the hydraulic hoses to the valve ports as tagged during removal.
3. Start the engine and check for leaks. Make repairs as needed.
4. Depress the brake pedal several times to cause the brake valve to charge. Make several turns with the steering wheel, and swing the superstructure left and right. Verify the brakes, swing, and front steering work properly.



8467

FIGURE 2-24 continued

Item	Description
1	Pressure Reducing Valve - PR1
2	Check Valve - CV1
3	Orifice - ORF1
4	Solenoid Valve - Rear Steer S1
5	Solenoid Valve - Rear Steer S2
6	Solenoid Valve - SV2
7	Solenoid Valve - SV1
8	Gauge Port - G2
9	Orifice - ORF2
10	Solenoid - SF1
11	Check Valve - CV4

Item	Description
12	Load Sense - LS0
13	Load Sense - LS1
14	Port ALO - To Axle Lockout Valve
15	Port T - Tank
16	Port G1 - Gauge Port
17	Port P - Pressure From Pump #1
18	Port A - Outrigger Retract
19	Port B - Outrigger Extend
20	Port RSA - Left Rear Steer
21	Port RSB - Right Rear Steer
22	Load Sense Shuttle valve
23	Pressure Reducing Valve - PR2

## LIFT CYLINDER

### Description

The lift cylinder (Figure 2-28) has a bore of 22.8 cm (9.0 inches). The retracted length of the cylinder from the center of the barrel bushing to the center of the rod bushing is 265.1cm (104.4 inches). The extended length of the cylinder from the center of the barrel bushing to the center of the rod bushing is 464.5 cm (182.9 inches). Its stroke is 199.3 cm (78.5 inches). A wiper ring prevents foreign material from entering the cylinder. O-rings and other seals prevent internal and external leakage.

The cylinder weighs approximately 521 kg (1149 lb).

### Maintenance

#### Disassembly

**NOTE:** Any maintenance requiring disassembly of the cylinders should include replacement of all seals and rings. A seal kit will supply the required items.

1. Disconnect the tube assembly from the holding valve.
2. Remove the capscrews and washers securing the holding valve and remove the holding valve from the cylinder barrel.
3. Using a spanner wrench or chain wrench, unscrew the head from the barrel.



#### DANGER

Do not use air pressure to remove the rod. Use only a source of controlled hydraulic oil pressure if the rod is hard to move.

#### CAUTION

Exercise extreme care when handling or setting down the rod. Damage to the rod surface may cause unnecessary maintenance and expense.

4. Remove the rod and attached parts from the barrel.

**NOTE:** Cover the barrel opening to avoid contamination.

#### CAUTION

When removing seals and rings, avoid scratching the grooved and gland surfaces.

5. Remove the two hydrolock seals and guidelock ring from the outside of the piston.

**NOTE:** Arranging discarded seals and rings in the order of disassembly will aid in installation of new seals and rings. Pay attention to how each seal and ring is installed to avoid installing replacement seals and rings improperly.

6. Remove the set screw securing the piston to the rod.
7. Unscrew the piston from the rod.
8. Remove the O-ring and two backup rings from the inside of the piston.
9. Remove the head from the rod.
10. Remove the O-ring and the backup ring from the outside of the head and the wear rings, buffer seal, rod seal, and wiper ring from the inside of the head.

#### Inspection

1. Clean all parts with solvent and dry with compressed air. Inspect all parts for serviceability.
2. Inspect the barrel carefully for scoring. If barrel is scored, it must be repaired or replaced.
3. Check piston for damage. If piston is damaged, determine if it can be repaired or must be replaced.
4. Inspect rod for straightness. Determine if it can be straightened or must be replaced.

#### CAUTION

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

5. Stone out minor blemishes and polish with a fine crocus cloth.
6. Clean with solvent and dry with compressed air any parts that have been stoned and polished.

#### Assembly

#### CAUTION

When installing new seals and rings, avoid stretching seals or scratching the grooved or gland surfaces. Make sure parts are clean before and during assembly. Make sure seals and rings are installed in the proper order.

**NOTE:** Lubricate seals and rings with clean hydraulic oil.

7. Stone out minor blemishes and polish with a fine crocus cloth.
8. Clean with solvent and dry with compressed air any parts that have been stoned and polished.

### Assembly

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#### CAUTION

When installing new seals and rings, avoid stretching seals or scratching the grooved or gland surfaces. Make sure parts are clean before and during assembly. Make sure seals and rings are installed in the proper order.

**NOTE:** Lubricate seals and rings with clean hydraulic oil.

1. Install the replacement wiper ring, lip seal, buffer seal and wear ring in the inside of the head.
2. Install the replacement O-rings and backup ring on the outside of the head.
3. Install the lip seals and wear ring onto the outside of the piston.
4. Lubricate the rod with clean hydraulic oil.
5. Slide the head, onto the rod. Tap the head with a rubber mallet to engage the seals. Push the head about half way down the length of the rod assembly.
6. Remove the cover from the barrel.

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#### CAUTION

Exercise extreme care when handling the rod. Damage to the rod surface may cause unnecessary maintenance and expense. Also, take care to avoid damaging grooved or gland surfaces or rings or seals during rod insertion.

7. With a hoist, raise the rod assembly back into a vertical position taking care not to damage the OD seals on the head and piston.
8. Lubricate the OD seals on the piston and head with clean light oil and lower the assembly into the barrel. Stop just before the head enters the barrel.
9. Place a spanner wrench on the head and turn counterclockwise until the thread clicks, then reverse direction to clockwise and thread in until there is no gap between the head shoulder and top of barrel.
10. Install the retaining ring onto the rod.
11. Install the setscrew into the head.

---

#### CAUTION

Do not use air pressure to cycle or pressurize the cylinder.

12. Pressurize and cycle the cylinder with hydraulic oil pressure. Test the cylinder at 25,856 kPa/259 bar (3750 psi). Check for proper operation and any leakage. Make repairs as needed.

## SECTION 3 ELECTRIC SYSTEM

### SECTION CONTENTS

<b>Description</b> .....	<b>3-1</b>	Troubleshooting Accessories .....	3-5
General .....	3-1	Alternator Replacement .....	3-6
Alternator .....	3-1	Starter Replacement .....	3-6
Batteries .....	3-1	Battery Replacement .....	3-7
Fuse Panel .....	3-2	Relay Panel Component Replacement .....	3-7
Relays .....	3-3	Rocker Switch Replacement .....	3-8
<b>Maintenance</b> .....	<b>3-4</b>	Ignition Switch Replacement .....	3-8
General .....	3-4	Turn Signal Lever and Transmission Shift Lever Replacement .....	3-9
General Troubleshooting .....	3-4	Windshield Wiper Assembly Replacement .....	3-11
Troubleshooting Swivel-Caused Electrical Problems .....	3-4	Windshield Washer Assembly Replacement .....	3-12
Connector Troubleshooting .....	3-4	Skylight Wiper Assembly Replacement .....	3-13
Troubleshooting Engine Starting Problems .....	3-4	Appendix A: Crane Control System (CCS)	
Troubleshooting Engine Charging Problems .....	3-5	Fault Codes .....	3-15

3

### DESCRIPTION

#### General

The electrical system is 24-volt operation with 24-volt starting, consisting of an alternator and two lead-acid batteries. The system is the single wire ground return type, using the machine's structure as ground

#### Alternator

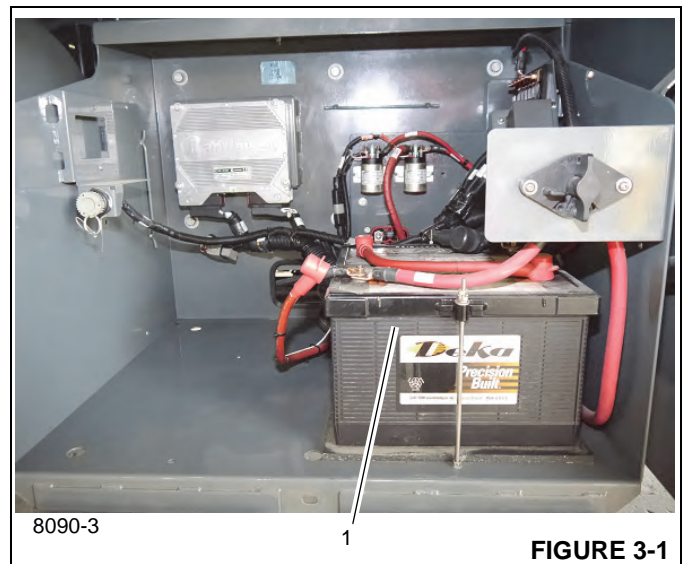
The alternator is mounted on the engine and is belt driven. It is a 70 ampere alternator with an integral transformer - rectifier unit. When the engine is running, and the alternator is turning, the alternator's 24-volt output terminal supplies the crane's electrical circuits. The output terminal also supplies current to recharge the batteries and maintains them at a full state of charge.

#### Batteries

The batteries (1) (Figure 3-1) are located in a box on the left side of the crane. The batteries are the maintenance free type and completely sealed except for a small vent hole in the side. The vent hole allows what small amount of gases that are produced in the battery to escape. On some batteries, a test indicator located on the top of the battery is

used to determine if the battery can be tested in case of a starting problem.

There is a battery disconnect switch (1) (Figure 3-2) located on the right of the battery box. To disconnect the batteries, turn the battery disconnect switch to OFF. Turn the switch to ON to connect the batteries.



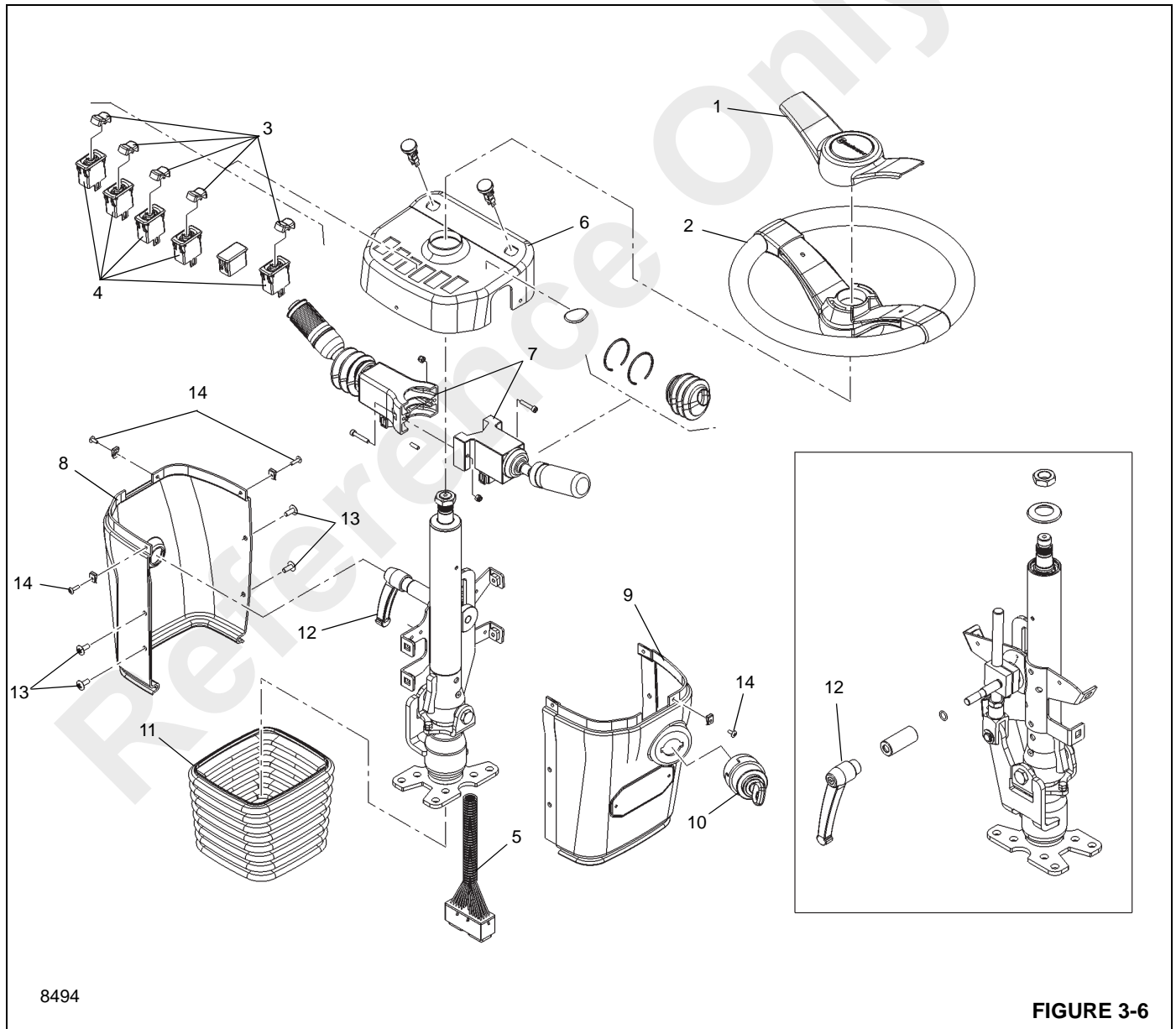
**FIGURE 3-1**

8. Install the left side cover (8) on the steering column.
9. Secure the switch cover (6) to the left and right side covers (8, 9) using six screws (14).
10. Secure the left and right side covers (8, 9) together using four screws (13).
11. Install the steering wheel (2); torque the securing nut to 40 Nm  $\pm$ 5 (30 lb-ft  $\pm$ 4).
12. Install the steering wheel cap (1).
13. Install the lever (12) and spacer that locks/unlocks the steering column tilt/telescope function.

14. Pull the rubber boot (11) up and over the bottom of the left and right side covers (8, 9).
15. Turn the battery disconnect switch to the ON position.

**Check**

1. Operate the turn signal lever or transmission shift lever per the Operator's Manual. Verify each of its functions work.
2. As needed, troubleshoot further any system or circuit malfunction not corrected by repair or replacement of the switch or associated wiring.



Fault Code	Component Description
5912	Derricking Down pressure switch
5913	Derricking Up pressure switch
5914	Telescoping Extend pressure switch
5915	Telescoping Retract pressure switch
5916	Hydraulic Oil Temp switch
5917	Brake Pressure switch
5918	AC Clutch Required switch
5919	Swing Right pressure switch
5920	Swing Left pressure switch
5921	Swing Brake pressure switch
5922	Hydraulic Oil Filter pressure switch
5923	Steering Pressure low switch
5924	Boom Section Locked redundant switch
5925	Left Tele Cylinder Locked redundant switch
5926	Right Tele Cylinder Locked redundant switch
5927	Left Tele Cylinder Pins Low switch
5928	Left Tele Cylinder Pins High switch
5929	Boom Section Locked switch
5930	Boom Section Unlocked switch
5931	Left Tele Cylinder Pin Unlocked switch
5932	Right Tele Cylinder Pin Unlocked switch
5933	Left Tele Cylinder Pin Locked switch
5934	Right Tele Cylinder Pin Locked switch
5935	Right Tele Cylinder Pins Low switch
5936	Right Tele Cylinder Pins High switch
5937	Jib mounted & folded switch
5938	Turntable Locked switch
5939	Turntable Unlocked switch
5940	Pump 1 Pressure analog input
5941	Telescoping Pressure analog input
5942	Slewing Pressure analog input
5943	Hoist Limiter (A2B) analog input
5944	Piston Length Sensor analog input
5945	8.5V External Feedback analog input
5946	Accumulator pressure sensor analog input
5947	Mechanical locking head TUSL switch
5948	Mechanical locking head TLSL switch
5949	Mechanical locking head TLSU switch

Fault Code	Component Description
8400	Eeprom
8401	CPU watchdog
8402	Data Flash
8600	RCL Boom Length
8601	RCL Slewing Range
8602	RCL Outrigger
8603	RCL Jib
8700	Telescoping Length Sensor Comparison
8701	Pinning Proxy Switches Left
8702	Pinning Proxy Switches Right
8900	Engine Type Selection (eeprom setting)
10100	Proximity Sensor Drum 0 (A)
10101	Proximity Sensor Drum 0 (B)
10102	Proximity Sensor Drum 1 (A)
10103	Proximity Sensor Drum 1 (B)
10104	Proximity Sensor Drum 2 (A)
10105	Proximity Sensor Drum 2 (B)
10106	Proximity Sensor Drum 3 (A)
10107	Proximity Sensor Drum 3 (B)
10108	Proximity Sensor Drum 4 (A)
10109	Proximity Sensor Drum 4 (B)
10110	Proximity Sensor Drum 5 (A)
10111	Proximity Sensor Drum 5 (B)
10112	Proximity Sensor Drum 6 (A)
10113	Proximity Sensor Drum 6 (B)
10114	Proximity Sensor Drum 7 (A)
10115	Proximity Sensor Drum 7 (B)
10116	Proximity Sensor Drum 8 (A)
10117	Proximity Sensor Drum 8 (B)
10118	Proximity Sensor Drum 9 (A)
10119	Proximity Sensor Drum 9 (B)
10120	Luffing Jib Min
10121	Luffing Jib Max
10123	Fixed Jib Confirm
10125	Boom Strap Load Cell Right
10126	Boom Strap Load Cell Left
10130	Proximity Sensor Output (V+) Drum 0
10131	Proximity Sensor Output (V+) Drum 1

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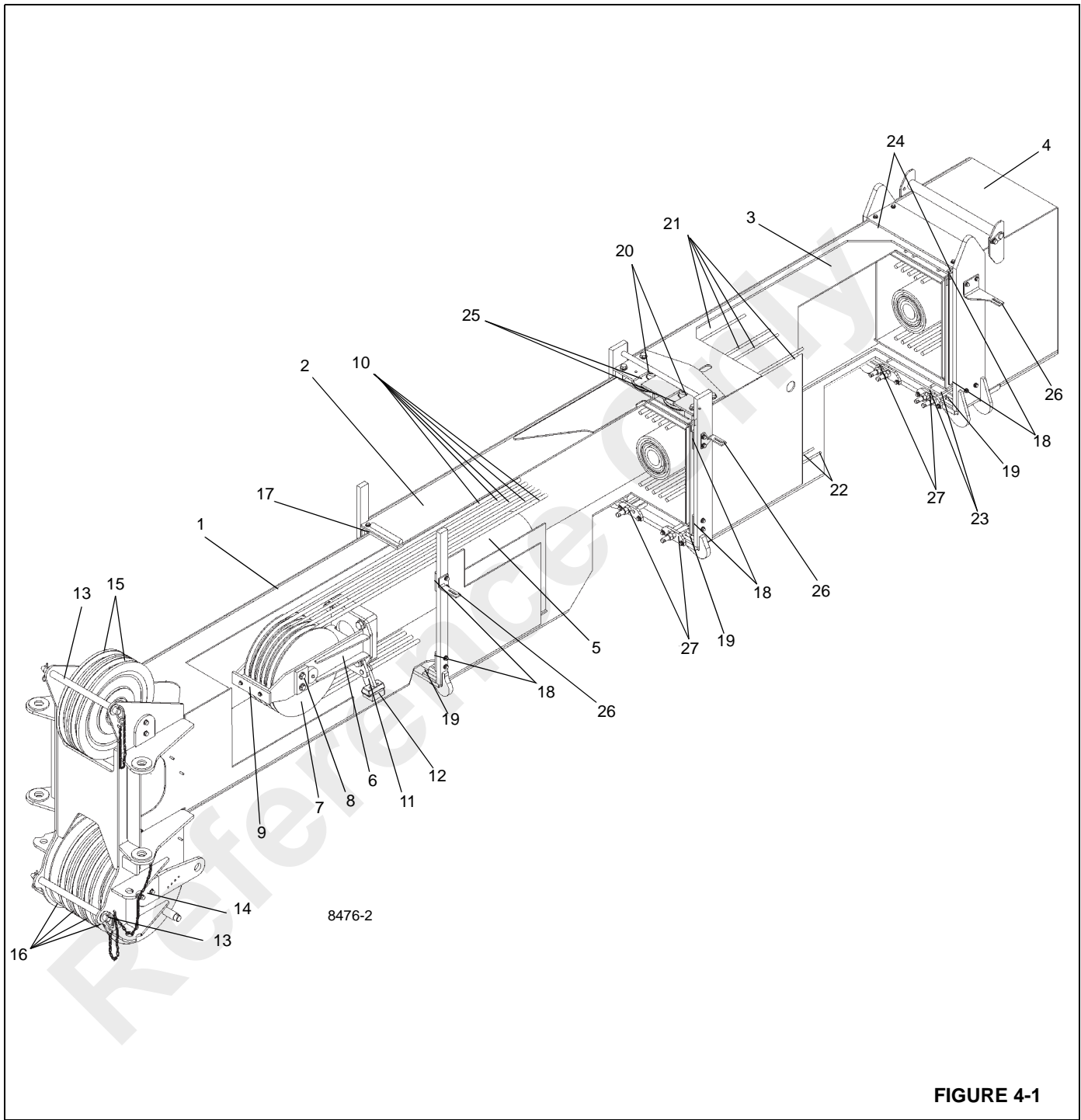


FIGURE 4-1

11. Refer to BOOM EXTENSION AND RETRACTION CABLE MAINTENANCE in this section for cable inspection.

### Boom Nose Sheaves

**NOTE:** Refer to BOOM NOSE SHEAVES in this section.

## BOOM ASSEMBLY

### CAUTION

When adjusting cables, hold the cable end and turn the nut. do not turn cable. Turning cable while adjusting will result in damage or failure of cable.

### CAUTION

Install cables in their natural untwisted condition. Do not twist cable. Twisting of cable will result in damage or failure of cable.

**NOTE:** Apply Loctite 243 to the threads of all attaching hardware except cable ends and cable lock nuts.

**NOTE:** Apply multipurpose grease (MPG) to all wear pads and the surfaces the wear pads slide on.

**NOTE:** Use standard torque values specified in Section 1-INTRODUCTION of this Manual unless otherwise specified.

**NOTE:** When installing upper and lower side wear pad, use shims as necessary so wear pad is within 1.5 mm (0.06 inch) from side plate of next inner section. Use equal number of shims on each side.

### Install Telescope Cylinder

1. Measure and mark the center line of the fly section. This mark will be used to set the adjustable wear pads after the section is installed in the outer mid section.
2. If removed from the telescope cylinder (3) assembly, install the sheave mounting assembly (1) with four cap screws and washers (2). Do not tighten lower two cap screws at this time. They will be torqued later.

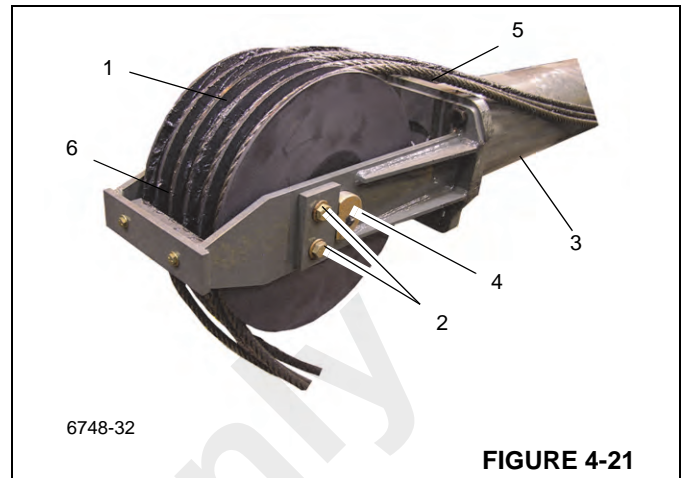


FIGURE 4-21

3. Install the telescope sheave assembly to the telescope cylinder as follows:
  - a. Using the extend sheave shaft, install the extend cable sheave assembly with spacer on each side, on the sheave mounting assembly.
  - b. Install grease fitting (4) (Figure 4-21) in shaft.
  - c. Lubricate sheave.
4. Route the five extension cables (5) (Figure 4-21) up and around the extend cable sheave assembly about one foot on to cylinder. To aid in assembly, secure the cables to the top end of the cylinder by wrapping tape around the cylinder.
5. Position the cable retainer (6) (Figure 4-21) over the sheave shaft and secure it to the sheave mounting assembly with four cap screws and washers. The retainer secures the sheave shaft.
6. Install the lower rear side wear pads and shims (1) on the fly section with two cap screws (2) each (Figure 4-22).

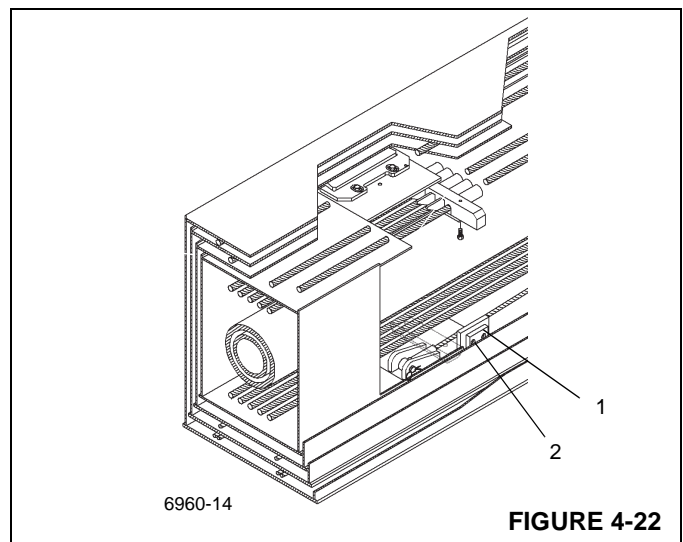


FIGURE 4-22

SYMPTOM	PROBABLE CAUSE	SOLUTION
2. Erratic operation of retracting telescoping cylinder.	a. Low hydraulic oil level.	a. Replenish hydraulic oil to proper level.
	b. Damaged relief valve.	b. Repair or replace relief valve.
	c. Air in cylinder.	c. Bleed by lowering telescoping cylinder below horizontal and cycle telescope cylinder.
	d. Low engine rpm.	d. Increase engine rpm to recommended setting.
	e. Lack of lubrication.	e. Properly lubricate all boom sections.
	f. Check valve malfunctioning.	f. Repair or replace check valve.
	g. Improper boom alignment caused from side loading.	g. Reduce and properly hoist load.
	h. Extremely tight boom retraction sheave.	h. Inspect and properly lubricate.
	i. Distorted boom section.	i. Replace distorted section.
	j. Worn boom wear pads.	j. Replace wear pads and properly lubricate.
	k. Bent cylinder rod(s).	k. Replace cylinder rod(s) and all cylinder seals.
	l. Scored cylinder barrel.	l. Repair or replace cylinder barrel.
	m. Damaged piston seals.	m. Replace all cylinder seals.
	n. Loose or damaged piston(s).	n. Replace all seals and re-torque or replace piston(s).
3. Telescope cylinder will not extend.	a. Low hydraulic oil level.	a. Replenish oil to proper level.
	b. Relief valve malfunctioning.	b. Repair or replace relief valve.
	c. Excessive load.	c. Reduce load.
	d. Clogged hose and fittings.	d. Replace hose or fittings. (Refer to Manitowoc Crane Care Parts Manual).
	e. Broken valve spool.	e. Replace valve.
	f. Damaged piston seals.	f. Replace all cylinder seals.
	g. Damaged piston(s).	g. Replace piston(s) and all cylinder seals.
	h. Bent boom section(s).	h. Replace damaged boom section(s).
	i. Broken hydraulic pump coupling.	i. Replace broken hydraulic pump coupling.
	j. Worn or damaged hydraulic pump section.	j. Repair or replace pump section.

**DANGER**

Do not modify the attachment points to permit the installation of the attachment pins.

**DANGER**

Do not place blocking under the boom extension sheave wheel.

10. Install the top left side attachment pin and clip pin into the upper anchor and attachment fittings of the boom nose.
11. Extend the boom extension alignment jack until the lower left side boom nose and boom extension adapter lugs are aligned.
12. Install the bottom left side attachment pin and clip pin into the lower anchor and attachment fittings of the boom nose.
13. Release pressure on the boom extension alignment jack and properly stow the jack handle.
14. Extend and lower the boom until blocking can be placed under the swingaway. Remove the rope from the tip of the boom extension.
15. Lower the swingaway onto the cribbing. Remove and stow the pins securing the swingaway to the boom nose.
16. Retract the boom, freeing the swingaway from the boom nose.

**Installation**

1. Position the crane so the swingaway lies in front of the crane with the swingaway base facing the crane. Fully extend and set the outriggers.
2. Extend and lower the boom to engage the anchor and attachment fittings on the swingaway.
3. Install the four attachment pins and clip pins to secure the swingaway to the boom nose. Raise the boom, lifting the swingaway from the cribbing on which it was resting. (Use boom extension alignment jack if required, see step 11 above.)
4. Attach a length of rope to the boom extension tip.
5. Raise the boom to horizontal.
6. Extend the boom approximately 51 to 64 cm (20 to 25"). Make certain that the boom extension stowage lugs will

line up in front of the guide pins and ramp on the stowage brackets when the boom extension is positioned to the side of the boom.

7. Ensure the hitch pin and clip pin are removed from the rear stowage bracket.
8. Extend the boom extension alignment jack until the bottom left side attachment pin is free. Remove the bottom left side boom extension clip pin and attachment pin.
9. Release pressure on the boom extension alignment jack. Completely retract the jack and properly stow the jack handle.
10. Remove the top left side attachment pin and clip pin from the upper anchor and attachment fittings of the boom nose.

**DANGER**

When stowing the boom extension, ensure that all personnel and equipment are kept clear of the swing path.

**CAUTION**

Do not allow the boom extension to slam into the stowage bracket when swinging into the stowed position.

11. Using the rope attached to the tip of the boom extension, manually swing the extension to the side of the boom.
12. Align the stowage lugs on the boom extension with the guide pins and ramp on the stowage brackets and fully retract the boom.
13. Install the hitch pin and clip pin securing the boom extension to the rear stowage bracket.
14. Remove the attachment pins and clip pins from the anchor and attachment fittings on the right side of the boom nose and stow them in the base of the swingaway. Stow left side attachment pins and clips in outside attachment fittings on swingaway.
15. On the rear stowage bracket, remove the retainer pin securing the sliding support in the "OUT" position. Push in on the handle to push the swingaway against the rear of the boom and disengage the swingaway anchor fittings from the boom nose attachment lugs. Install the retainer pin securing the sliding support in the "IN" position.
16. Rig the boom nose and hoist cable as desired and operate the crane using normal operating procedures.

- Using a protractor, lay it on the vertical line on the hoist drum so the string line is in the center of the protractor. The string line will be at the 90 degree mark on the protractor if the hoist is straight with the boom nose sheave. If it is not at the 90 degree mark, the hoist mounting bolts will have to be loosened and the hoist moved so it is.

**NOTE:** This test is for cable leaving gaps while spooling.

### CAUTION

Do not alter holes or stop blocks on the crane mounting plate, as very small adjustments result in large angular changes. Extreme care should be taken to avoid over-correction.

- Elevate the boom above 45 degrees boom angle to check if the hoist is level. Reposition the hoist drum and tighten the cord so you can have the cord in the center of the protractor at the 90 degree mark. If the cord is not at the 90 degree mark, the hoist will have to be shimmed until the cord is at the 90 degree mark.

**NOTE:** This test is for cable piling up on one side of the hoist drum.

## PISTON MOTOR AND CONTROL VALVE

### Description

The piston motor is a bent axis, bidirectional, variable displacement heavy-duty motor. The motor is bolted to the hoist and is geared directly to the hoist planetary.

The motor control valve is bolted to the motor.

### Maintenance

#### Removal

- Thoroughly clean the external surfaces of the drum and motor with steam or clean solvent and blow dry.
- Tag and disconnect the hydraulic lines connected to the hoist motor and the motor control valve.
- Remove the capscrews and lockwashers that secures the motor and motor control valve to the hoist.

**NOTE:** The HP15C-17G hoist motor weighs approximately 28 kg (62 lb).

- Place the motor and motor control valve in a clean, dry suitable work area.

#### Installation

**NOTE:** Care must be taken to assure the primary thrust plate remains properly located in its counterbore when the motor is re-installed. If the winch is

operated with the primary thrust plate wedged between the primary gears and the planet carrier, or with a thrust washer out of position severe damage to internal winch components could result.

- Install a new O-ring on the motor pilot then lubricate with petroleum jelly or gear oil. Engage the motor shaft with the brake clutch inner race and lower into place.
- Apply Loctite No. 243 to the mounting bolts, and install the bolts and lockwashers. Torque the bolts to 102 Nm (75 lb-ft).
- Connect the hydraulic lines as tagged during removal.
- Fill the drum with oil. Refer to Section 9 - LUBRICATION in this manual.
- Idler Drum and Cable Follower

### Description

The main and auxiliary hoists are equipped with an idler drum on the forward side of the hoist. The main hoist idler drum is used to keep the hoist cable from coming in contact with the boom. When the crane is also equipped with an auxiliary hoist, the idler drum on the auxiliary hoist is used to keep the hoist cable from coming in contact with the main hoist. The cable follower is mounted on the rear side of its respective hoist. The cable follower applies a downward spring pressure against the cable onto the hoist drum, to ensure that the cable will be uniformly wound onto the hoist drum, and also prevent cable from jumping under abnormal line conditions.

### Maintenance

#### Idler Drum

##### Removal and Disassembly

- Remove the bolt, washer, and lockwasher from the right side of the idler roller (Figure 5-5).
- Support the idler roller and withdraw the shaft from the left side. Take care not to lose the dowel pin on the end.
- Remove the roller from between the side plates.

##### Cleaning and Inspection

- Clean all rust and dirt from the shaft.
- Inspect the shaft and roller for cracks, scoring, or grooving. Replace if necessary.

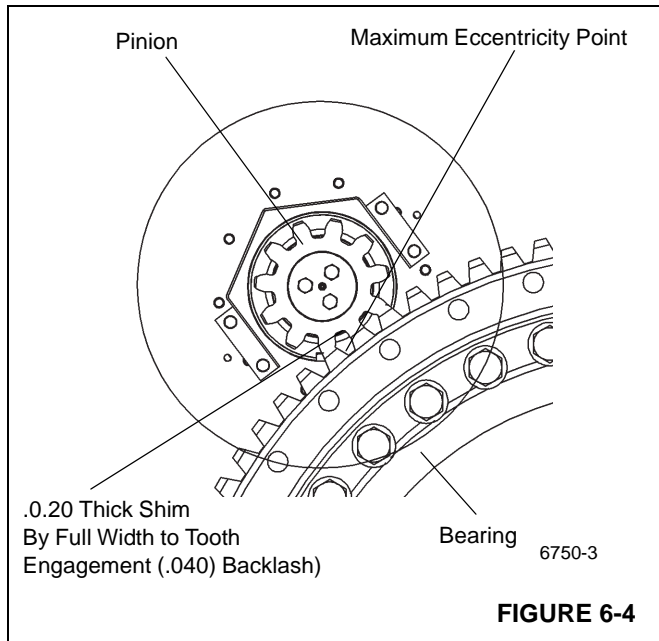
##### Assembly and Installation

- Position the roller between the side plates
- Install the shaft through the left side plate and the roller. Ensure the flat on the shaft end aligns with the stop welded on the side plate, align the dowel pin.

## Maintenance

## Troubleshooting

Symptom	Probable Cause	Solution
1. Boom swing operation erratic in either direction.	a. Damaged relief valve.	a. Replace relief valve.
	b. Swing brake dragging (not releasing properly).	b. Readjust and/or replace necessary parts.
	c. Low engine rpm.	c. Increase engine rpm to obtain smooth swing operation.
	d. Low hydraulic oil.	d. Replenish hydraulic oil to proper level.
	e. Improper movement of control to neutral.	e. Feather controls to neutral to maintain smooth stopping action.
	f. Insufficient lubricant on swing bearing.	f. Lubricate bearing properly. Refer to Section 9 - LUBRICATION.
	g. Crane not level.	g. Level crane using outriggers.
	h. Damaged swing motor.	h. Repair or replace swing motor.
	i. Excessive overload.	i. Reduce load. Refer to load capacity chart.
	j. Restricted or partly clogged hydraulic hose or fittings.	j. Replace hose or fittings.
	k. Pump cavitation in swing section.	k. Tighten suction hose or replace any damaged fitting. Check hydraulic tank level.
	l. Improperly torqued turntable bolts.	l. Torque turntable bolts evenly.
	m. Excessive preload on upper and lower pinion shaft bearing.	m. Adjust as necessary.
	n. Improperly torqued swing motor attachment bolts.	n. Torque swing motor attachment bolts.
	o. Malfunction of the swing box.	o. Remove swing box and make necessary repairs.
	2. Boom swing operation erratic in one direction only.	p. Worn or damaged pump.
q. Damaged swing directional control valve.		q. Repair or replace swing directional control valve.
r. Damaged swing pinion.		r. Replace pinion.
s. Damaged turntable bearing.		s. Replace turntable bearing.
a. Crane not level.		a. Level crane using outriggers.
b. Turntable bearing binding due to continuous limited swing. (Example: concrete pourer.)		b. Rotate machine 360 degrees in both directions several times and lubricate bearing.
c. Restricted hose or fitting.		c. Replace hose or fitting.
d. Damaged swing directional control valve.		d. Replace swing directional control valve.
e. Damaged swing pinion.		e. Replace pinion.
f. Damaged turntable bearing.		f. Replace turntable bearing.



Orient ring gear such that its point of max eccentricity (“high point”) is located between the swing drives. Position swing drives so that pinion is centered within cutout in base plate and motor ports face towards the outboard side as shown.

### CAUTION

#### Do Not Clamp Over Pinion.

- Using shims, set backlash by moving the swing drive assemblies toward the bearing in order to mesh the pinion with the ring gear teeth (see Figure 6-5).
- Check tooth engagement squareness and vertical tooth engagement.
- Remove backlash shims and recheck backlash.

5. Apply Loctite 271 to the capscrews. Position the two retainer plates on the bottom of hydraulic swivel spool, engaging the lugs on the carrier frame, and secure them to the spool with four capscrew retainers and bolts. Torque the bolts 298 to 322 Nm (220 to 237 pounds-foot). Bend all the retainer tabs to make contact with the bolt heads.
6. Plug the swivel wiring harness connectors into the carrier receptacles. Secure the ground wire to the ground stud using a washer, lockwasher, and nut.
7. Install the clamp securing the swivel wiring harness to the retainer plate on the bottom of the hydraulic swivel.
8. Connect all water and hydraulic lines to the ports on the bottom of the swivel as tagged during removal.
9. Install the boom and lift cylinder following the procedures outlined in Section 4, BOOM.

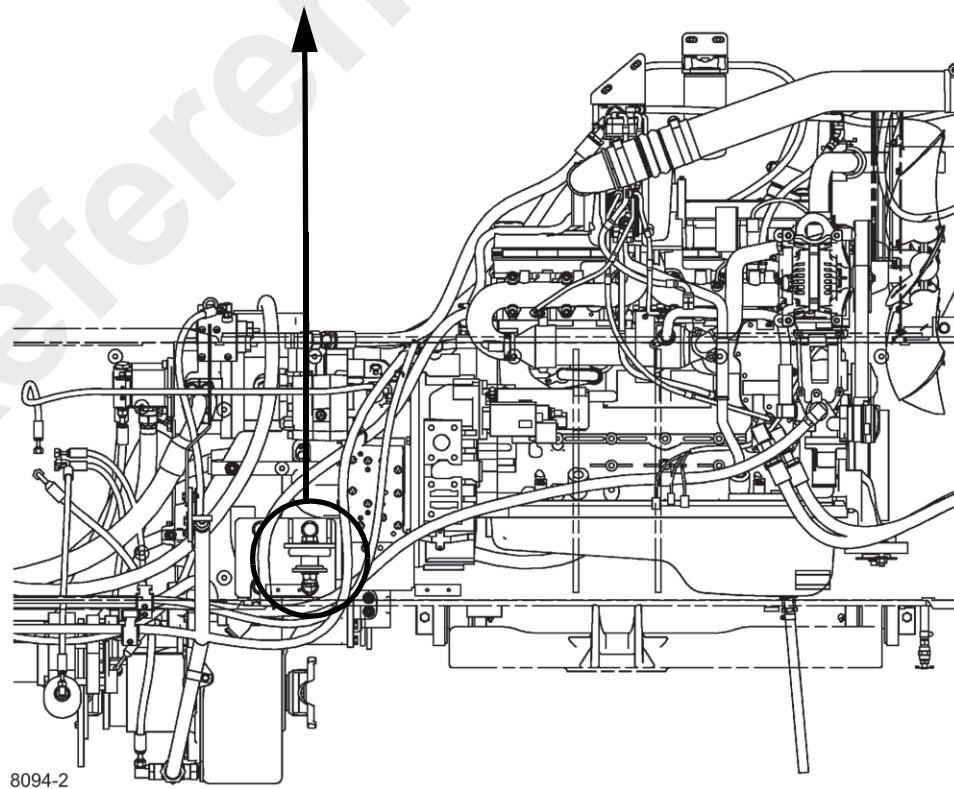
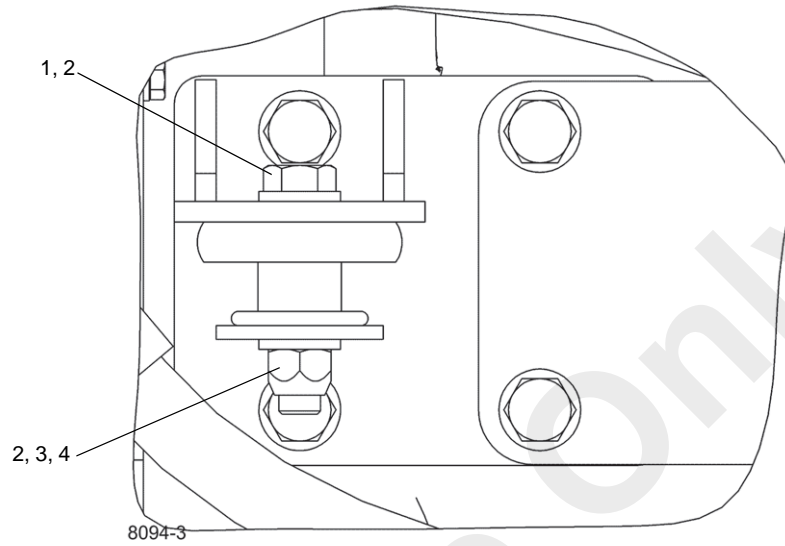
**NOTE:** The counterweight structure weighs approximately 3818 kg (8417 lb).

10. Install the counterweight and auxiliary hoist following procedures outlined in Section 4 of the Operator’s Manual.
11. Reconnect the batteries.
12. Check the slew potentiometer in the electrical swivel for proper orientation. Refer to SWIVELS in this Section

### Testing

Activate the crane and check for proper function.

**NOTE:** If the superstructure does not turn freely after bearing and pinion replacement, contact your local distributor.



View Of Engine

FIGURE 7-1

### Charge-Air Cooler System

The charge-air cooler (CAC) (Figure 7-8) is used to cool engine air after it has passed through a turbocharger, but before it enters the engine. The charge-air cooler provides better horsepower, increased fuel efficiency, and reduces engine emissions.

The CAC system consists of the ducting to and from the charge-air cooler and a hydraulically driven fan. The charge-air cooler system must be air-tight in order to work efficiently.

The ducting consists of metal tubing, hose clamps and bellows. The recommended installation torque of the spring

loaded T-bolt clamps is 11.3 Nm (100 lb-in). Do not compress the spring completely, the bellows and/or clamp may be damaged from thermal expansion of the CAC tube.

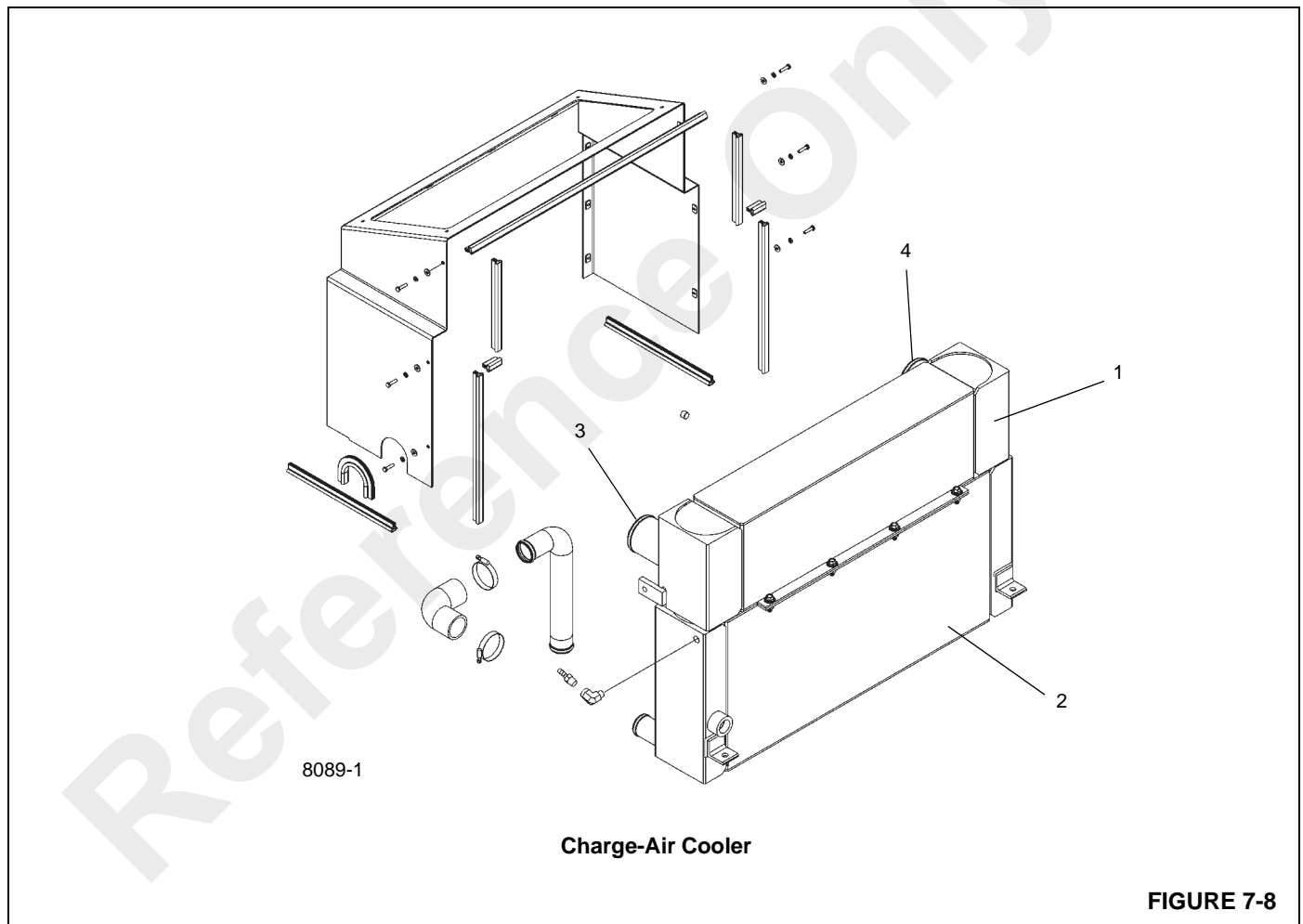
### Maintenance

Check the hose clamps for proper torque.

Inspect the bellows for cracks or holes.

Clean the charge-air cooler, removing any dirt or debris.

Verify the fan is operating correctly and there are no hydraulic leaks.



Item	Description
1	CAC
2	Engine Coolant Radiator
3	CAC Hot Air Inlet
4	CAC Cold Air Outlet

Troubleshooting Procedures

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Low clutch pressure.	a. Low oil level.	a. Fill to proper level. Refer to Section 9 - LUBRICATION.
	b. Clutch pressure regulating valve spool stuck open.	b. Clean valve spool and housing.
	c. Faulty charging pump.	c. Replace pump.
	d. Broken or worn clutch shaft or piston sealing rings.	d. Replace clutch shaft or sealing rings, as applicable.
	e. Clutch piston bleed valve stuck open.	e. Clean bleed valves thoroughly.
2. Low converter charging pump pressure.	a. Low oil level.	a. Fill to proper level.
	b. Suction screen plugged.	b. Clean suction screen.
	c. Defective oil pump.	c. Replace pump.
3. Overheating.	a. Worn oil sealing rings.	a. Remove, disassemble, and rebuild converter assembly.
	b. Worn oil pump.	b. Replace pump.
	c. Low oil level.	c. Fill to proper level.
4. Noisy converter.	a. Worn oil pump.	a. Replace pump.
	b. Worn or damaged bearings.	b. A complete disassembly will be necessary to determine what bearing is faulty.
5. Lack of power.	a. Low engine RPM at converter stall.	a. Tune engine and check governor.
	b. See "Overheating" and make same checks.	b. Make corrections as explained in "Overheating."

**Removal**

1. Extend and set the outriggers just enough to take up the slack in the outrigger pads. Chock the wheels.
2. Position the boom over the side and stop the engine.
3. Remove the engine and transmission/torque converter from the crane as an assembly. Refer to ENGINE in this Section.
4. Remove the hydraulic pumps from the transmission/torque converter. Cover all openings. Refer to Hydraulic Pumps in Section 2 for removal of the pump.

**NOTE:** The transmission/torque converter weighs approximately 374 kg (824.5 lb) dry.

5. Attach an adequate lifting device to the transmission/torque converter and take up any slack.
6. Remove the hardware securing the drive plate assembly to the flywheel.

7. Remove the hardware securing the transmission/torque converter housing to the engine flywheel housing.

**Installation**

**NOTE:** The transmission/torque converter assembly weighs approximately 374 kg (824.5 lb) dry.

1. If a new transmission/torque converter is to be installed, remove all fittings and brackets from the old one and install them in the same locations on the new transmission/torque converter.
2. Install the piston and single section hydraulic pumps on the transmission/torque converter. Refer to Hydraulic Pumps in Section 2 for installation of the hydraulic pump.
3. Position the transmission/torque converter to the engine with the lifting device.
4. Remove all burrs from the flywheel mounting face and nose pilot bore. Clean the drive plate surface with solvent (Figure 7-11).

## Wheels and Tires

### Description

The standard tire size for this unit is 20.5 x 25 -24 ply. A size 16.00 x 25 -28 ply tire is also available.



### WARNING

#### Possible equipment damage and/or personal injury!

Driving the crane with a tire under inflated at 80% or less of its recommended pressure can cause the wheel and/or tire to fail. Per OSHA Standard 1910.177(f)(2), when a tire has been driven under inflated at 80% or less of its recommended pressure, it must first be completely deflated, removed from the axle, disassembled, and inspected before re-inflation.

### CAUTION

Do not mix tires and rims of different manufacturers.

Each wheel assembly (tire and rim) is mounted on the planetary hub with 12 grade 8 lug nuts.

**NOTE:** The tire diameters, widths, and weights may vary slightly depending on the tire manufacturer.

Off-highway tires are designed to operate with a certain sidewall deflection or bulge. Correct air pressure ensures proper deflection which, in turn, ensures proper traction, flotation, support of load, and prevents excessive flexing of the tire. Over inflation increases rim stresses, which results in lowered rim life.

Refer to and adhere to the inflation pressures in the Load Chart Book in the crane cab.

## Maintenance

### DANGER

Do not attempt to demount or mount tires without proper training. The high pressures involved can cause tire and rim parts and tools to fly with explosive force, if proper procedures are not used, causing severe injury or death to personnel and damage to the crane and surrounding area.

### Mounting Wheel Assemblies

**NOTE:** Do not lubricate the wheel studs or lug nuts.

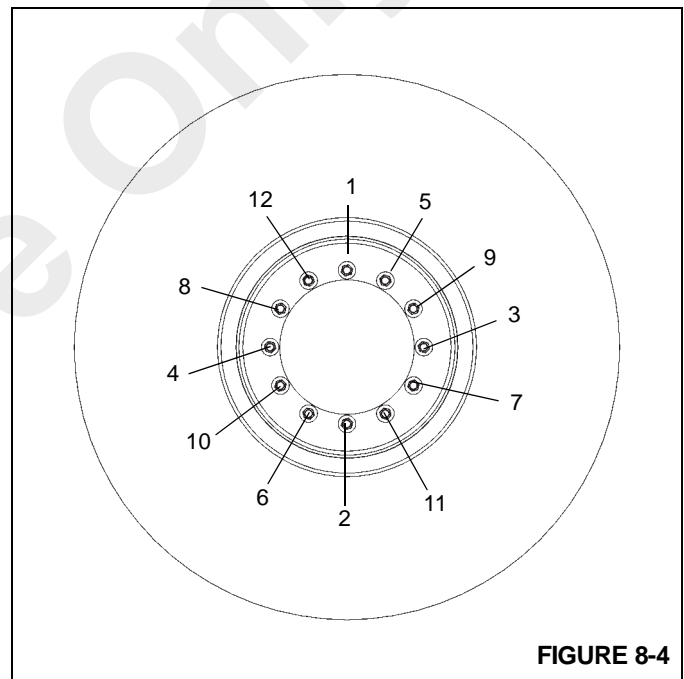


FIGURE 8-4

**NOTE:** Prior to wheel installation, remove any dirt or grease from wheel mounting surface.

1. Position the wheel assembly on the mounting studs being careful not to damage threads. Install the lug nuts and tighten them to 68 Nm (50 lb-ft) in the sequence shown in (Figure 8-4)
2. Ensure the wheel assembly is positioned properly on the hub.
3. Torque the lug nuts 461 to 488 Nm (340 to 360 lb-ft) in the sequence shown in (Figure 8-4).
4. Retorque lug nuts after approximately one hour of travel.

**Caliper**

1. Disconnect the hydraulic brake line from the inlet fitting on the caliper. Cap or plug all openings.
2. Remove the linings as described previously.
3. Remove the bolts securing the caliper housing to the mounting bracket. Remove the caliper housing from the mounting bracket. If shims are used mark the position of the shims.

**Disassembly****Caliper**

1. Remove the inlet fitting and o-ring from the cylinder cap.
2. Drain and discard the brake fluid.
3. Clean the outside of the housing with isopropyl alcohol. Dry the housing with a clean cloth.
4. If installed, remove the bolts that secure the end plates to the housing. Remove the end plates and linings.
5. Remove the pistons from the side of the housing opposite the mounting plate according to the following procedure.
  - a. Use a C-clamp to hold a 12.7 mm (0.5 in) block of wood against two pistons on the mounting side of the housing. Ensure the C-clamp is not in the area in front of the piston bore (Figure 8-6).

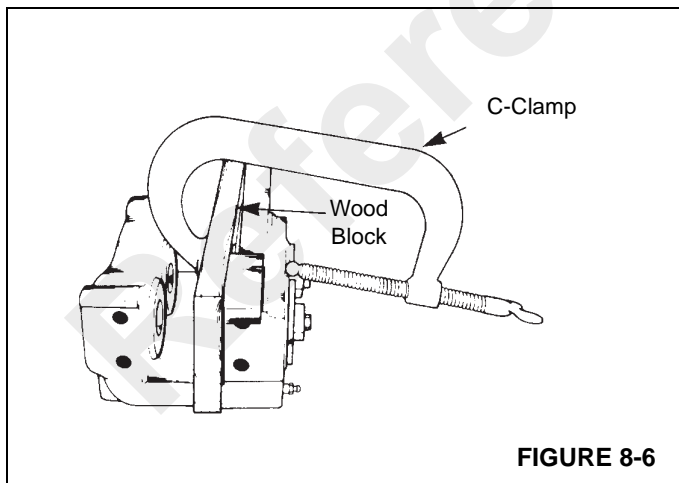


FIGURE 8-6

**DANGER**

Do not place hand in front of pistons when forcing them out. Serious personal injury may occur.

- b. Apply compressed air to the inlet fitting to force the pistons out of the other housing. If one piston comes out before the other piston, put a piece of wood in front of the piston that comes out first. Apply compressed air to force the other piston out of the housing (Figure 8-7).

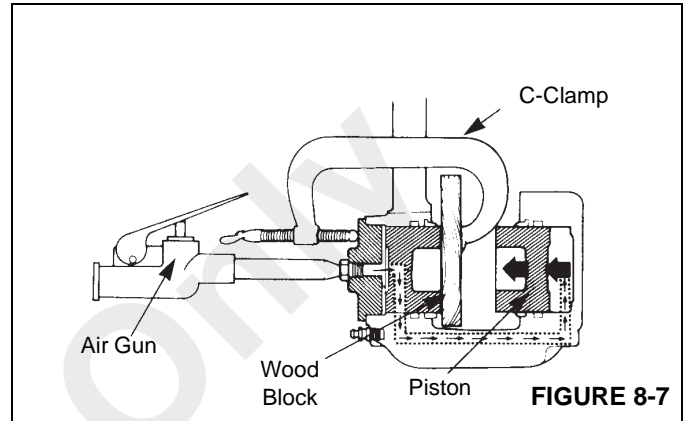


FIGURE 8-7

- c. Remove the wood block and the C-clamp from the housing.
  - d. Remove the pistons from the bores that are opposite from the mounting plate.
6. Remove the two bleeder screws from the housing.
  7. Remove the cylinder caps from the housing using an open end wrench. Remove and discard the O-rings (Figure 8-8).

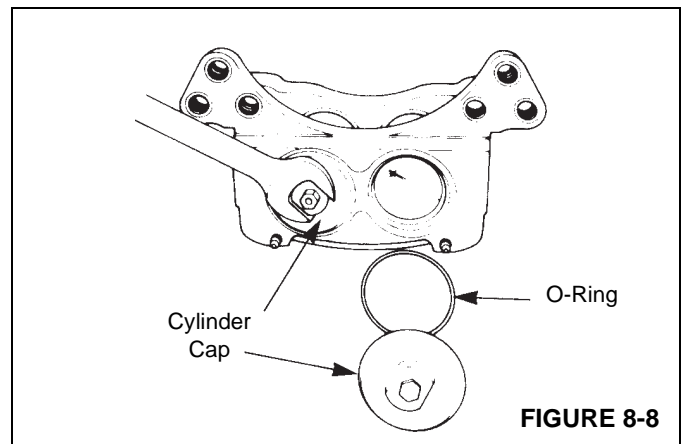


FIGURE 8-8

8. Remove the pistons from the mounting plate side of the housing. Push on the ends of the pistons to force them out of the disc side of the housing (Figure 8-9).

Symptom	Probable Cause	Solution
5. Outrigger jack cylinder slow or erratic.	a. Low in hydraulic oil.	a. Replenish oil to proper level.
	b. Damaged main relief valve.	b. Repair or replace valve.
	c. Damaged holding valve seals.	c. Replace holding valve seals.
	d. Bent cylinder rod.	d. Replace cylinder rod and seals.
	e. Bent outrigger housing.	e. Repair or replace outrigger housing.
	f. Excessive material on beams.	f. Clean outrigger beams.
	g. Sticking solenoid valve spool.	g. Repair or replace valve spool.
	h. Damaged wiring to solenoid.	h. Repair or replace wiring.
	i. Weak brush springs on collector rings.	i. Replace brush springs.
	j. Collector ring dirty or glazed.	j. Clean or deglaze collector ring.
	k. Directional selector switch sticking.	k. Clean or replace switch.
	l. Main hydraulic pump cavitation.	l. Replace or tighten hose and fittings.
	m. Worn or damaged hydraulic pump section.	m. Repair or replace pump section.
6. Outrigger jack cylinder retracts under load.	a. Damaged piston seals.	a. Replace all cylinder seals.
	b. Damaged holding valve seals.	b. Replace seals.
	c. Damaged holding valve.	c. Replace valve assembly.
	d. Scored cylinder barrel.	d. Repair or replace cylinder.
	e. Cracked or damaged piston.	e. Replace piston and all cylinder seals.
7. Outrigger jack cylinder extends while machine is traveling.	a. Damaged piston seals.	a. Replace all cylinder seals.
	b. Scored cylinder barrel.	b. Replace jack cylinder.
	c. Cracked or damaged piston.	c. Replace piston and seals.
	d. Piston loose on cylinder rod.	d. Replace seal and retorque.
8. Outrigger system will not activate (from stowed or extended and down position).	a. Hydraulic oil low.	a. Replenish system.
	b. Loose or broken wire on switch.	b. Repair or replace wiring.
	c. Clogged, broken, or loose lines or fittings.	c. Clean, tighten, or replace lines or fittings.
	d. Damaged relief valve or damaged control valve.	d. Repair or replace valve.

## SECTION 9 LUBRICATION

### SECTION CONTENTS

<b>General</b> .....	<b>9-1</b>	Drive Train (continued) .....	9-10
<b>Lubrication Intervals</b> .....	<b>9-1</b>	Outriggers .....	9-12
Arctic Conditions Below -18°C (0°F) .....	9-1	Turntable .....	9-14
Arctic Conditions Down To -40° C (-40°F) .....	9-1	Boom .....	9-16
Surface Protection For Cylinder Rods .....	9-2	Boom (continued) .....	9-18
<b>Wire Rope Lubrication</b> .....	<b>9-2</b>	Hoist .....	9-20
<b>Lubrication Points</b> .....	<b>9-3</b>	Hydraulic .....	9-22
CraneLUBE .....	9-3	<b>Carwell® Rust Inhibitor</b> .....	<b>9-24</b>
Safety .....	9-3	Protecting Cranes From Rusting .....	9-24
Steering and Suspension .....	9-4	Cleaning Procedures .....	9-24
Axles .....	9-6	Inspection and Repair .....	9-25
Drive Train .....	9-8	Application .....	9-25
		Areas of Application .....	9-25

### GENERAL

Following the designated lubrication procedures is important in ensuring maximum crane lifetime and utilization. The procedures and lubrication charts in this section include information on the types of lubricants used, the location of the lubrication points, the frequency of lubrication, and other information.

### LUBRICATION INTERVALS

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions. For information on extreme condition lubrication, contact your local Grove distributor or Manitowoc Crane Care.

#### CAUTION

Chassis grease lubricants must not be applied with air pressure devices as this lubricant is used on sealed fittings.

The multipurpose grease installed during manufacture is of a lithium base. Use of a noncompatible grease could result in damage to equipment.

### Arctic Conditions Below -18°C (0°F)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid, check with your authorized Grove distributor or Manitowoc Crane Care.

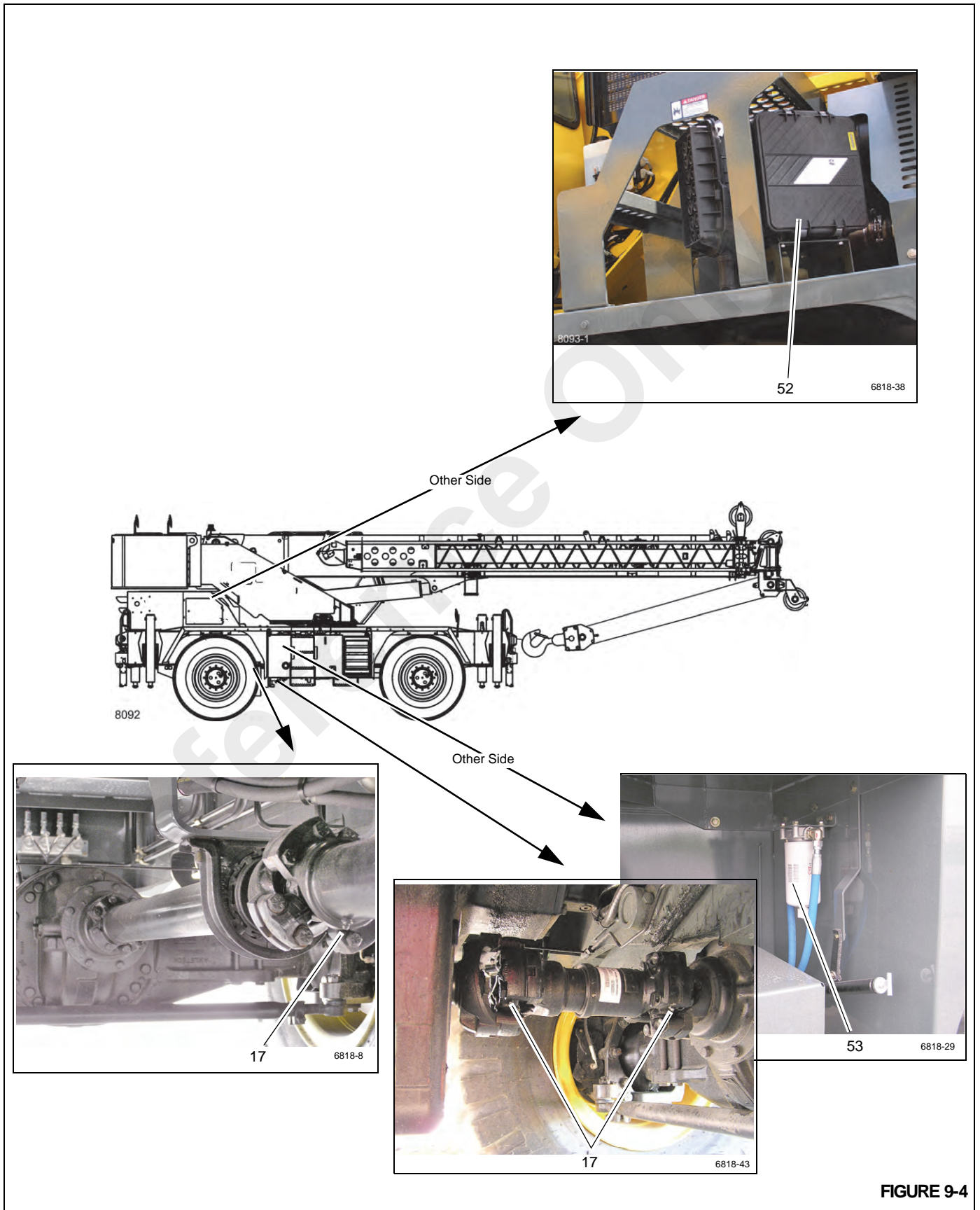
**NOTE:** All fluids and lubricants may be purchased by contacting the Manitowoc Crane Care Parts Department.

Regardless of temperature and oil viscosity, always use suitable start-up procedures to ensure adequate lubrication during system warm-up.

### Arctic Conditions Down To -40° C (-40°F)

#### ***ALL Weather Package & Lubricants***

Engineering recommends the following lubricants for components for ambient temperatures to -40°C (-40°F). Special lubricants alone are not sufficient to operate at extreme low temperatures. We also recommend the use of appropriately sized heaters for the hydraulic tank, engine oil pan, engine jacket water and batteries. The operator needs to follow the guide lines as stated in the operator's manual. We assume that the customer has take steps for use of an appropriate engine antifreeze coolant, have taken care of the



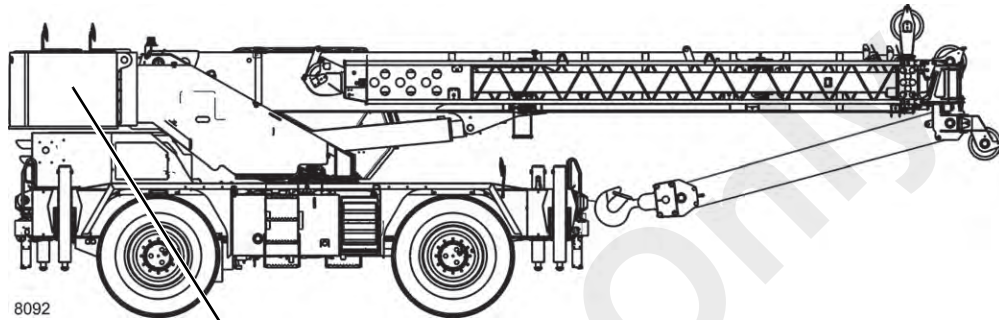


FIGURE 9-9

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