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1.1 Introduction

This Manual provides the Installation, Periodic Maintenance, Troubleshooting, Service and Specifications for Cascade E-Series Revolving Clamps.

E-Series Clamps are designed for three-shift-a-day continuous-duty operations with minimal maintenance. They offer exceptional visibility for the lift truck driver and provide optimized clamp force and load handling.

In any communication about the Clamp, refer to the product I.D. number stamped on the nameplate as shown. If the nameplate is missing, the numbers can be found stamped on the back of the baseplate.

**IMPORTANT:** All hoses, tubes and fittings on E-Series Clamps are JIC.

**NOTE:** Specifications are shown in both U.S. and (Metric) units.

1.2 Special Definitions

The statements shown appear throughout this Manual where special emphasis is required. Read all WARNINGS and CAUTIONS before proceeding with any work.

Statements labeled IMPORTANT and NOTE are provided as additional information of special significance or to make the job easier.

**WARNING** - A statement preceded by WARNING is information that should be acted upon to prevent bodily injury. A WARNING is always inside a ruled box.

**CAUTION** - A statement preceded by CAUTION is information that should be acted upon to prevent machine damage.

**IMPORTANT** - A statement preceded by IMPORTANT is information that possesses special significance.

**NOTE** - A statement preceded by NOTE is information that is handy to know and may make the job easier.
2.1 Truck System Requirements

E-Series Revolving Clamps will provide maximum operating capability when the following requirements are met.

WARNING: Rated capacity of the truck/attachment combination is a responsibility of the original truck manufacturer and may be less than that shown on the attachment nameplate. Consult the truck nameplate.

Truck Relief Setting

2300 psi (160 bar) Recommended
2600 psi (180 bar) Maximum

Truck Flow Volume

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Recommended</th>
<th>Max.</th>
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<tbody>
<tr>
<td>30E, 33E</td>
<td>5 GPM</td>
<td>7.5 GPM</td>
<td>10 GPM</td>
</tr>
<tr>
<td>40E, 45E</td>
<td>(19 L/min.)</td>
<td>(28 L/min.)</td>
<td>(38 L/min.)</td>
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</table>

① Cascade E-Series Revolving Clamps are compatible with SAE 10W petroleum base hydraulic fluid meeting Mil. Spec. MIL-0-5606 or MIL-0-2104B. Use of synthetic or aqueous base hydraulic fluid is not recommended. If fire resistant hydraulic fluid is required, special seals must be used. Contact Cascade.

② Flow less than recommended will result in a rotate speed of less than 2 RPM and possible unequal arm movement.

③ Flow greater than maximum can result in excessive heating, reduced system performance and reduced hydraulic system life.

Carriage Mount Dimension (A) ITA (ISO)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
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<tbody>
<tr>
<td>Class II</td>
<td>14.94 in. (380.0 mm)</td>
<td>15.00 in. (381.0 mm)</td>
</tr>
<tr>
<td>Class III</td>
<td>18.68 in. (474.5 mm)</td>
<td>18.74 in. (476.0 mm)</td>
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Carriage

Clean carriage bars and inspect for damaged notches

Auxiliary Valve Functions

Check for compliance with ITA (ISO) standards:

- Tilt Forward
- Tilt Back
- Hoist Up
- Hoist Down
- Rotate CCW
- Rotate CW
- Release
- Clamp

221093 Rev. 0
2.2 **Recommended Hydraulic Supply Options**

E-Series Revolving Clamps can be operated with any of the hydraulic supply arrangements shown below. Refer to Cascade Hose & Cable Reel Selection Guide, Part No. 212199, to select the correct hose reel for the mast and truck. The hose and fitting requirements are:

- Hoses and fittings for the CLAMP function should be No. 6 with 9/32 in. (7 mm) minimum I.D.
- Hoses and fittings for the ROTATE function should be No. 8 with 13/32 in. (10 mm) minimum I.D.

**A and B**
RH and LH THINLINE™ 2-port hose reel groups.

**OR**

**A**
Solenoid Adaption using RH 6-N-1 Cable/Hose Reel Group

**OR**

**A and C**
RH THINLINE™ 2-Port Hose Reel Group for ROTATE function, and Mast Single Internal Hose Reewing Group for CLAMP function.
2.3 Installation Procedure

Follow the steps shown to install the Revolving Clamp on the truck. Read and understand all WARNING and CAUTION statements. If you don’t understand a procedure, ask your supervisor, or call the nearest Cascade Service Department for assistance.

1. Attach overhead hoist
   - A Remove banding, set Revolving Clamp upright on pallet. Use lifting eyes and multiple chains to stabilize Clamp while lifting.
   - B Remove bolt-on lower mounting hooks (if equipped).

2. Unlock Quick-Change lower mounting hooks
   - A Move hooks into unlocked position.
   - B Reinstall pin in lower hole.

NOTE: Guides can be reversed to reduce hook-to-carriage clearance (See Step 7).

WARNING: Make sure overhead hoist has rated capacity of at least 3500 lbs. (1600 kg).

Tighten Capscrews:
Class II / III Mounting – 165 ft.-lbs. (225 Nm)

Guide

LH lower Hook

Pin

5/8-in. (16 mm) offset on top provides max. clearance.
3 Prepare Hoses
   A Determine hose lengths required for hydraulic supply configuration of truck.
   B Cut hoses to length, install end fittings.

   CAUTION: Use hoses that are working pressure rated to 2600-psi (18,000 kPa) for all Attachment functions.

RH & LH 2-PORT THINLINE™ HOSE REELS:

Solenoid Adaption Using RH 6-N-1 Cable/Hose Reel:

4 Flush hydraulic supply hoses
   A Install hoses as shown.
   B Operate auxiliary valves for 30 sec.
   C Remove union fittings, hoses.
   D Connect hoses to Revolving Clamp fittings as shown in Step 3 above.

5 Check oil level and remove rubber vent cover
   Oil level must be up to fill plug hole.
   Remove rubber vent cover.

If necessary, fill gearbox with Cascade Gear Lube 6656300 or equivalent SAE 90 wt. gear lube (AGMA 'mild' 6EP Gear Oil).
6 Mount Clamp on truck carriage

A Center truck behind Revolving Clamp.
B Tilt mast forward and raise carriage into position.
C Engage upper mounting hooks with carriage. Make sure locator tab on left hook engages closest notch on top carriage bar.
D Lift Revolving Clamp 2 in. (5 cm) off pallet. Make sure lower index block (if equipped) engages fork slot on lower carriage bar.

**IMPORTANT:**
Hoses must be connected to revolving connection before mounting unit on truck carriage.

**ITAs:**
- **Class II** – 0.60–0.66 in. (15–17 mm)
- **Class III** – 0.72–0.78 in. (18–20 mm)

7 Install and engage lower hooks

**BOLT-ON TYPE**

- Slide hook up to engage bar, install pin in locked position. (upper hole.)
- Tap tight into position.
- Engage locator tab.
- Tighten Capscrews:
  - **Class II / III Mounting** – 165 ft.-lbs. (225 Nm)

**QUICK-CHANGE TYPE** (optional)

- Inspect hooks for excessive clearance. (Reverse guides to reduce clearance – See Step 2.)
- 3/16 in. (5 mm) Max.
- Lower Carriage Bar
8 Connect hoses prepared in Step 3 to hose terminals

9 Install stop block kit
- Preheat each stop block and carriage bar weld area to 325°F (180°C).
- Use AWS E7018 low hydrogen rod and weld a 1/4-in (6 mm) fillet around each stop block.

10 Install solenoid control knob – (solenoid-equipped units)

11 Install wiring – (Solenoid-equipped units)
12 Check Revolving Clamp functions

WARNING: Make sure all personnel are clear of the Clamp during testing.

- With no load, cycle CLAMP and ROTATE functions several times.
- Check functions for operation in accordance with ITA (ISO) standards.
- Clamp and rotate a maximum load, check for equal arm movement and normal rotation. If necessary, adjust 180-degree stop valve and relief valve cartridges (see Step 13).
- Check for leaks at fittings, revolving connection and cylinders.

**REVOLVING CLAMP**
(Driver's view)

- A Counterclockwise (CCW)
- B Clockwise (CW)
- C Release Arms
- D Clamp Arms

**SOLENOID-ACTIVATED CLAMP**

- A Counterclockwise (CCW)
- B Clamp Arms (press knob button)

**AUXILIARY VALVE FUNCTIONS**

Check for compliance with ITA (ISO) standards:

- Hoist Down
- Tilt Forward
- Hoist Up
- Tilt Back
13 Adjust 180-degree stop valve (if equipped)

- The 180-degree stop valve requires readjustment of the Factory setting if the Clamp does not slowly stop rotation. See Section 5.9-1 for adjustment procedure.

14 Adjust cross-over relief valve

- For over-pressure protection, the cross-over relief valve for the CLAMP function should be adjusted to match the truck hydraulic flow rate. See Section 5.6-4 for adjustment procedure.
3.1 100-Hour Maintenance

Every time the lift truck is serviced or every 100 hours of truck operation, whichever comes first, complete the following maintenance procedures:

- Check for loose or missing bolts, worn or damaged supply hoses and hydraulic leaks.
- Inspect cylinder rod anchors for wear. Anchors operate with a loose clearance and require no lubrication.
- Check for equal arm movement.
- Lubricate plungers on 180° stop valve (if fitted).
- Tighten stop block capscrews (if fitted) to 390–400 ft.-lbers. (530–540 Nm).
- Check decals and nameplate for legibility.

3.2 500-Hour Maintenance

After each 500 hours of truck operation, in addition to the 100-hour maintenance, perform the following procedures:

- Tighten baseplate-to-rotation bearing capscrews to 70–75 ft.-lbers. (95–105 Nm).
- Remove access plug on upper left back of baseplate. Tighten rotation bearing-to-faceplate capscrews to 95–100 ft.-lbers. (130–135 Nm).
- Tighten upper hook capscrews to 235 ft.-lbers. (320 Nm).
- Check clearance between lower mounting hooks and truck carriage bar:
  - Quick-Change Hooks – 3/16 in. (5 mm) max.
  - Bolt-On Hooks – Tight against lower carriage bar.
  
  If adjustment is necessary, refer to Installation Step 7. Tighten lower hook capscrews to 165 ft.-lbers. (225 Nm).
- Lubricate rotation bearing assembly with wheel bearing grease. Rotate one full turn during procedure.
- Check that rotator drive gearcase lubricant level is at bottom of fill plug hole. If necessary, fill with Cascade Rotator Drive Lubricant, Part No. 656300 or SAE 90 wt. gear lube (AGMA 'mild' 6 EP Gear Oil). Replace plug.
- Inspect top and bottom arm bearings for wear or damage. Lubricate with silicon spray or light grease.
- Check clamp force (Cascade Clamp Force Indicator Part No. 680072 is available for this procedure).

3.2 1000-Hour Maintenance

- Tighten visible faceplate-to-cylinder/T-bar capscrews as follows:
  - 30E, 33E – 75 ft.-lbers. (100 Nm) – M12
  - 40E, 45E – 195 ft.-lbers (265 Nm) – M16
- Tighten cylinder rod anchor bar capscrews as follows:
  - 30E, 33E – 30 ft.-lbers. (40 Nm)
  - 40E, 45E – 50 ft.-lbers. (65 Nm)
4.1 General Procedures

4.1-1 Truck System Requirements

- Truck hydraulic pressure should be within the range shown in Specifications, Section 6.1. **PRESSURE TO THE CLAMP MUST NOT EXCEED 2600 psi (180 bar).**
- Truck hydraulic flow should be within the range shown in Specifications, Section 6.1.
- Hydraulic fluid supplied to the Clamp must meet the requirements shown in Specifications, Section 6.1.

4.1-2 Tools Required (metric)

In addition to a normal selection of hand tools, the following are required:

- 20 GPM (75 L/min) inline flow meter. (Cascade Flow Meter Kit, Part No. 671477.)
- 3000 psi (200 bar) pressure gauge. (Cascade Pressure Gauge Kit, Part No. 671212.)
- Assorted fittings, lines, drain hoses and quick-couplers as required.

4.1-3 Troubleshooting Chart

**Determine All The Facts** – It is important to gather all the facts about the problem before beginning any service procedures. The first step is to talk to the equipment operator. Ask for a complete description of the malfunction. Guidelines below and on the following pages can then be used as a starting point to begin troubleshooting.

**Clamp Circuit**

- Clamp drops load after load is picked up.
- Clamp will not carry load to rated capacity.
- Clamp arms have uneven travel.
- Clamp arms travel slowly.
- Clamp arms will not move.

To correct these problems, see Sections 4.3-1 and 4.3-2.

**NOTE:** Some Clamps have a regenerative hydraulic circuit that opens the arms faster than when closing. This is a normal Clamp function.

**Rotate Circuit**

- Clamp rotates in one direction only.
- Clamp will not rotate load to rated capacity.
- Clamp will not rotate.

To correct these problems, see Sections 4.4-1 and 4.4-2.

**NOTE:** Some Clamps have a regenerative hydraulic circuit that opens the arms faster than when closing. This is a normal Clamp function.

**WARNING:** Before servicing any hydraulic component, relieve pressure in the system. Turn the truck off and move the truck auxiliary control valves several times in both directions.

After completing any service procedure, always test the Clamp through several cycles. First test the Clamp empty to bleed any air trapped in the system to the truck tank. Then test the Clamp with a load to be sure it operates correctly before returning to the job.

Stay clear of the load while testing. Do not raise the load more than 4 in. (10 cm) off the floor while testing.

**Flow Meter Kit 671477**

(2) No. 8-12 JIC/O-Ring

**Pressure Gauge Kit 671212**

<table>
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<th>No. 4-6 Pipe/JIC Reducer</th>
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<td>No. 6-8 JIC Swivel Tee</td>
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**Diagnostic Quick-Couplers**

**Male Straight Thread**

- O-Ring Coupler:
  - No. 4 (Part No. 212282)
  - No. 5 (Part No. 210387)
  - No. 6 (Part No. 678592)

**Female JIC Thread**

- Coupler:
  - No. 4 (Part No. 210385)
  - No. 6 (Part No. 678591)

**NOTE:** Diagnostics Kit 394382 includes all of the above.
4.2 Plumbing

4.2-1 Hosing Diagram

- **Clamp Arms, Release Arms, Rotate CW, Rotate CCW**
- **Pressure**
- **Return**

- **Clamp Port**
- **Open Port**
- **Manifold**
- **Rotator Drive**
- **CW**
- **CCW**
- **Solenoid Valve**
- **Hose/Cable Reel or Internal Rebounding**
- **Truck Auxiliary Valve (CLAMP)**
- **Truck Auxiliary Valve (ROTATE)**
- **Revolving Connection**
- **Cylinders (4)**
- **Hose Reels (2) or Internal Reeling**
- **Solenoid Adaptation**
- **Rotate CW / Clamp (PRESSURE Port)**
- **Rotate CCW / Release (TANK Port)**
- **CW**
- **CCW**

[Diagram of Plumbing System]
4.2-2 Hydraulic Circuit
### 4.3 Clamp Function

There are five potential problems that could affect the CLAMP function:

- Incorrect hydraulic pressure or flow from the lift truck.
- External leaks.
- Defective solenoid coil or valve (if equipped).
- Worn/defective cartridge valves or cylinder seals.

#### 4.3-1 Supply Circuit Test

1. Check the pressure supplied by the truck at the carriage hose terminal. Pressure must be within the range shown in Specifications, Section 6.1. **PRESSURE TO THE CLAMP MUST NOT EXCEED 2600 PSI (180 bar).**
2. Check the flow volume at the carriage hose terminal. Flow must be within the range shown in Specifications, Section 6.1.
3. Close the arms fully, holding the lever in the CLAMP position for a few seconds. Release the lever and check for external leaks at fittings, hoses, revolving connection and manifolds.

#### 4.3-2 Clamp Circuit Test

1. Press the solenoid button (if equipped) and listen for a ‘click’ at the solenoid valve. If no sound is heard, first check the fuse, wiring and coil. Assure that the valve is not jammed (see Section 5.8).

   **IMPORTANT:** Solenoid-operated valves must be plumbed so that the solenoid is **energized** during the CLAMP/RELEASE function.

2. Open and close the arms fully. If the arms move slowly or not at all, the CLAMP relief cartridge (see illustration next page) may be faulty. Replace the cartridge. If the arms move unequally, the flow divider cartridge (see illustration next page) may be faulty. Replace the cartridge.

3. Position the arms to mid-stroke. Turn the truck off and connect a 3000 psi (200 bar) pressure gauge to both the LH and RH TEST ports on the revolving connection (No. 4 O-ring fittings required).

4. Start the truck and close the arms fully, holding the lever in the CLAMP position for a few seconds.

---

**WARNING:** Before removing hydraulic lines or components, relieve pressure in the hydraulic system. Turn the truck off and open the truck auxiliary control valves several times in both directions.
4.4 Rotation Function

There are six potential problems that could affect the ROTATE function:
- Incorrect hydraulic pressure or flow from the lift truck.
- External leaks.
- Defective solenoid coil or valve (if equipped).
- Worn/defective hydraulic rotator motor.
- Worn/defective drive box or rotation bearing assembly.

4.4-1 Supply Circuit Test

1. Check the pressure supplied by the truck at the carriage hose terminal. Pressure must be within the range shown in Specifications, Section 6.1. **PRESSURE TO THE CLAMP MUST NOT EXCEED 2600 PSI (180 bar).**

2. Check the flow volume at the carriage hose terminal. Flow must be within the range shown in Specifications, Section 6.1.

3. Rotate clockwise (CW) or counterclockwise (CCW) to the stops, holding the lever in the ROTATE position for a few seconds. Release the lever and check for external leaks at fittings, hoses, revolving connection and manifolds.

5. Release the lever and watch the pressure gauge:
   - If the pressure drop is less than 150 psi (10 bar) initially, and additional drop does not exceed 25 psi (1.7 bar) per minute, the problem is not hydraulic (see Section 4.1-3).
   - If the pressure drop is more than 150 psi (10 bar) initially, and additional drop exceeds 25 psi (1.7 bar) per minute, the CLAMP check valve cartridges may be faulty. Replace the cartridges.

6. Close the arms fully and hold the lever in the CLAMP position for a few seconds. If the pressure still drops as before, the cylinders are faulty and must be serviced (see Section 5.6).

**WARNING:** Before removing hydraulic lines or components, relieve pressure in the hydraulic system. Turn the truck off and open the truck auxiliary control valves several times in both directions.
### 4.4-2 Rotation Circuit Test without Load

1. Press the solenoid button (if equipped) and listen for a ‘click’ at the solenoid valve. If no sound is heard, first check the fuse, wiring and coil. Assure that the valve is not jammed (see Section 5.8).
   
   **IMPORTANT:** Solenoid-operated valves must be plumbed so that the solenoid is **not energized** during the ROTATE function.

2. Turn the truck off and connect a 3500 psi (240 bar) pressure gauge to each rotator motor fitting as shown.

3. Rotate the Clamp without a load and note pressure readings of both gauges.
   - If the Clamp rotates in one direction faster than the other, or rotates in one direction only, the check valve assembly may need repair (see Section 5.5).
   - If the lower gauge reading exceeds 500 psi (35 bar), there is excessive back pressure in the supply circuit. Check for restrictions such as as numerous fittings, 90-degree fittings, or hose sizes less than No.8.

### 4.4-3 Rotation Circuit Test with Load

1. Rotate a load requiring approximately three-fourths (3/4) of the Clamp’s maximum torque capacity:
   - **30E, 33E** – 72,000 in.-lbs. @ 2000 psi
   - **40E, 45E** – (8136 Nm @ 140 bar).

   Note gauge readings during rotation:
   - If the higher gauge reading is substantially **less** than the truck pressure as measured at the carriage hose terminal, the rotator motor geroler set may need repair (see Section 5.4).
   - If the higher gauge reading is **close** to truck pressure as measured at the carriage hose terminal and no rotation occurs, the rotator motor output shaft or drive box may need repair. Continue trouble-shooting.

2. Remove the motor from the drive box assembly as described in Section 5.4.

3. Reinstall the hoses to the rotator motor fittings. Actuate the ROTATE circuit.
   - If the rotator motor shows rotational output, the drive box may require service (see Section 5.3).
   - If the rotator motor shows little or no rotational output, the rotator motor requires service (see Section 5.4).
4.5 Electrical Circuit (Solenoid-equipped Clamps)

Use the electrical schematic and diagram shown and follow the steps below:

1. Check the control knob circuit fuse. Replace if necessary.

2. Check for loose electrical connections at the truck ignition switch, control knob button, solenoid coil terminals and diode.

3. Remove the diode from the solenoid coil terminal. Test with an ohmmeter for high resistance in one direction and no resistance in the other direction. If there is no resistance in both directions, replace the diode.

   **NOTE:** When replacing the diode, the banded (+) end must be connected to the coil and wiring as shown.

4. Disconnect the electrical leads from the solenoid coil terminals. Use a voltmeter to determine if voltage is present at the electrical leads when the button is depressed.
   - If there is **no current** to the solenoid, troubleshoot the electrical circuit for shorts.
   - If there is **current** to the solenoid, test for coil continuity.

5. Test for coil continuity by placing an ohmmeter test lead on each solenoid coil terminal (ohmmeter on Rx1 scale).
   - If there is an ohmmeter reading, the coil is good.
   - If the coil is good, but the solenoid does not ‘click’ when the control knob button is depressed, the solenoid cartridge may be jammed. Refer to Section 5.6.
   - If there is no ohmmeter reading, the coil is defective and should be replaced. Refer to Section 5.6.
5.1 Revolving Clamp Removal

1 Position the Clamp’s arms to the width of the frame.

**WARNING:** Before removing hydraulic lines, relieve pressure in the hydraulic system. Turn the truck off and move the truck auxiliary control valves several times in both directions.

2 Disconnect and plug the hydraulic supply hoses to the Clamp. Tag hoses for reassembly.

3 Disconnect the lower hooks:
   - **Quick-Change Hooks** – Remove the locking pins and drop the hooks into the unlocked position. Replace the pins in the lower holes. For reassembly, remove the pins and slide the hooks up to the locked position. Replace the pins in the top holes.
   - **Bolt-On Hooks** – Remove the capscrews and mounting hooks. For reassembly, tighten the capscrews as follows:
     - **Class II/III Mounting** – 165 ft.-lbs. (225 Nm).

4 Lower the Clamp onto a pallet. Tilt the mast forward and lower the carriage to disengage the upper hooks.

5 For Clamp installation, reverse the above procedures except as follows:
   - Refer to Section 2 for complete installation procedure.
5.2 Arms

5.2-1 Arm Assemblies – Removal and Installation

The following procedures can be performed with the Revolving Clamp mounted on the truck.

1. Position the arms to frame width. Lower the Clamp to position the arms 1/2 in. (13 mm) above the floor.

2. Remove the upper and lower cylinder rod anchor bars on the arm to be removed. Slowly power the cylinder rods open to expose the rod end. For reassembly, apply Loctite 242 (Blue) and tighten the anchor bar capscrews to the following torque value:
   - 20E, 30E, 33E – 50 ft.-lbs. (65 Nm).
   - 40E, 45E – 80 ft.-lbs. (105 Nm).

3. Slide the rod end toward the cylinder to remove the split-ring keepers. Slide the rod end off the cylinder rod. Inspect rod end and keepers for wear.

4. Retract the cylinder rods fully.

---

**WARNING:** Make sure the hoist used to remove the arm has a rated capacity of at least 1000 lbs. (450 kg.)

5. Attach an overhead hoist and chain to the arm assembly. Position the chain clear of the arm bearing surfaces. **CAUTION:** Use a second chain and lift eyebolt on the contact pad to stabilize the arms.

6. Slide the arm assembly out of the frame. Do not damage the bearings when removing the arm.

7. For reassembly, reverse the above procedures with the following exceptions:
   - Inspect the upper and lower bearing strips for wear. Bearing thickness should not be less than 1/8 in. (3 mm) as measured on the bottom or sides of the strip. Install new bearings as required.
   - Inspect the arm bar bearing contact surface and chamfered areas for nicks or damage. Break any sharp edges and polish with 400-grit emery paper as necessary.
   - Lubricate with silicone spray or light grease.

---

**CAUTION:** Use a second chain and lift eyebolt on the contact pad to stabilize the arms.
5.2-2 Drum Arm Contact Pad – Surface Replacement

The following procedures can be performed with the Revolving Clamp mounted on the truck.

Single Drum Arms.

1. Drill out the rivets using a 3/16-in (5 mm) drill bit. Drill from the back side of the arm. Align the new contact surface to the arm. Drill through using the 3/16 (5 mm) drill bit. Rivet the contact surface to the arm.

Multiple Drum Arms

2. Remove the snap ring, pivot pin, thrust washers and contact pads to provide access to the rivets. Replace the contact surfaces as in Step 1. Reinstall the contact pads.
5.2-3  **Rigid Arm Contact Pad – Replacement or Rotation**

The following procedures can be performed with the Revolving Clamp mounted on the truck.

**NOTE:** Contact pad surfaces that are worn or damaged over the entire pad area will require pad replacement. If only the lower surface is worn, the pads can be rotated 180° and swapped side-for-side.

1. Extend the arms to frame width. Lower the Clamp so that the contact pads just touch the floor.

2. Remove the capscrews and nuts fastening the contact pad to the arm. Remove the contact pads. For reassembly, tighten the capscrews to 50 ft.-lbs. (65 Nm).

3. Install new pads, or rotate the pads 180° and swap side-for-side and reinstall.

4. For reassembly, reverse the above procedures with the following exceptions:
   - Inspect contact pad mounting holes for wear or elongation. Repair using Hole Service Kit 676841.
5.2-4 Clamps without Arms

Customer-supplied arms can be welded to the vertical bases that connect the Revolving Clamp’s parallel sliding arm bars. Sliding arm assemblies must be removed from the Clamp to accomplish this procedure.

**WARNING:** Use a certified welder and proper welding procedures when welding custom arms to the sliding arm bases.

1. Remove the sliding arm bar assemblies as described in Section 5.2-1.

2. Using approved welding procedures, weld the custom arm to the vertical base connecting the sliding arm bars.

   **CAUTION:** Weld fabricated arms to the vertical arm bases only. Do not weld or bolt special-built arms or forks directly to the arm bars. Surface flatness on the arm base must remain within .010 in. (0.25 mm).

3. Assure that the sliding arm bars remain parallel over their entire length, using the dimensions shown.

4. For reassembly, reverse the above procedures with the following exceptions:
   - Check that the arms slide free manually.

---

Arm bar base material is AISI C-1020 steel with the following specifications:

- **Tensile Strength** – 61,000 psi
- **Yield Strength** – 43,000 psi
- **Carbon Content** – 23 % Max.

---

**Dimension A**

- **30E** – 14.3 in. ±.040 in. (363 mm ± 1 mm)
- **33E** – 14.3 in. ±.040 in. (363 mm ± 1 mm)
- **40E** – 16.0 in. ±.040 in. (408 mm ± 1 mm)
- **45E** – 16.0 in. ±.040 in. (408 mm ± 1 mm)
5.2-5 **Arm Bearings – Removal and Installation**

The following procedure can be performed with the arms in place and the Revolving Clamp mounted on the truck.

**NOTE:** Normally only the long bearing segments need to be replaced due to wear. If inspection reveals wear on the short bearing segments, replace them also.

**IMPORTANT:** Remove and replace the bearings from the rod end of each cylinder. Start at the uppermost arm bearing as shown and work down, replacing one bearing at a time to keep the Clamp arms fully supported.

1. Raise the Clamp off the floor and close the arms.
2. Remove the arm bearing retainer.
3. Slowly open the arms to drag the top bearing out of the bearing way.
4. If the bearings are tight, close the arms and attach clamp-type pliers to the end of the bearing. Slowly open the arms to drag the bearing out.
5. Close the arms. Using a 1/8 to 3/16-in. (3 to 5 mm) thick piece of rod or flat stock, drive the shorter bearing segment out of the bearing way as the arms are slowly opened.
6. Open the arms to the mid-way position.

**WARNING:** Make sure that a safety person is at the truck controls at all times if this maintenance procedure is done with the truck running.

7. Install new bearing segments. Slowly close the arms to drag the bearing segments into the bearing way.
8. Remove and replace the bottom bearing set on the same arm.
9. Install the arm bearing retainer. Apply Loctite 242 (Blue) to the capscrew threads and tighten the cap-screw to 15 ft.-lbs. (20 Nm).

10. Replace the remaining arm bearings by following the same procedure as in Steps 2 through 9. Lubricate the bearings with silicone spray or light grease. Cycle the arms and check for freedom of movement.
5.3 Drive Group

5.3-1 Drive Group – Removal and Installation

1. Remove the Revolving Clamp from the truck as described in Section 5.1.
2. Remove the four capscrews fastening the drive group to the baseplate. For reassembly, tighten the capscrews to 65–75 ft.-lbs. (90–100 Nm).
3. For reassembly, reverse the above procedures with the following exceptions:
   - After the drive group has been reinstalled, check the gearcase lubricant level. Lubricant must be up to the bottom of the fill plug hole. If necessary, fill with Cascade Gear Lube Part No. 656300, or SAE 90 wt. gear lube (AGMA ‘mild’ 6 EP Gear Lube).

5.3-2 Drive Group – Disassembly and Service

1. Remove the drive group from the baseplate as described in Section 5.3-1.
2. Lay the drive group, pinion down, on two 4 x 4 wood blocks placed on both sides of the pinion.
3. Remove the four capscrews fastening the cover plate to the housing.
4. Remove the center capscrew plug from the cover plate and install a 3/8-in. NC capscrew with a minimum of 2 in. (5 cm) thread length. Remove the cover plate by turning the capscrew clockwise while lightly tapping around the sides of the cover plate.
5. Drain the lubricant from the housing.
6. Remove the three capscrews fastening the end cover to the housing.
7. Remove the drive motor as described in Section 5.4-1.
5.3-2  Drive Group – Disassembly and Service (Continued)

8 Tap the worm and bearing assembly out through the end-cover side of the housing. Remove the opposite outer bearing race through the motor side of the housing.

9 Press the pinion gear, pinion bearings and worm gear out of the housing as an assembly.

10 Remove the snap ring from the pinion gear shaft. Press the pinion gear and housing/pinion bearing from the worm ring gear and cover plate/pinion bearing. Remove the pinion shaft key.

11 Press the pinion gear out of the housing/pinion bearing.

12 Clean and inspect all components. Remove all dried sealant residue. Replace all worn items. Remove burrs and sharp edges with emery cloth.
5.3-3 Drive Group Reassembly

1. Apply Loctite sealant 515 (Cascade Part No. 668184) to the pinion shaft seating area and shoulder for the housing/pinion bearing. Install the housing/pinion bearing. Remove excess sealant.

2. Install the key, worm gear, cover plate/pinion bearing and snap ring on the pinion.

3. Apply Loctite sealant 515 (Cascade Part No. 668184) to the housing seating area and shoulder for the housing/pinion bearing. Install the pinion assembly in the housing. Remove excess sealant.

4. Install the worm outer bearing race in the drive motor side of the housing. Make sure the race taper is inward.

5. Install the drive motor as described in Section 5.4-1.

6. Install the worm and bearings in the housing. Fully engage the worm with the drive motor shaft. Install the remaining outer bearing race. Make sure the taper is inward.
5.3-3 Drive Group Reassembly
(Continued)

7 Temporarily install the end cover without shims. Tighten the capscrews sequentially in 10 ft.-lb. (15 Nm) increments to 20–25 ft.-lbs. (30–35 Nm).

8 Measure the gap between the end cover and housing in three places with a feeler gage or plasti-gage and determine the minimum gap.

9 Choose a combination of end cover shims equal to the minimum gap measured plus the next higher .005 in. (.12 mm) increment. See examples below:

(For .020–.024 in. measured gap, use .025 in. total shim thickness.)

(For .025–.029 in. measured gap, use .030 in. total shim thickness.)

NOTE: Use only one blue (.005 in./.12 mm) shim in the shim pack. Shim Service kit 670578 contains the following shims:

<table>
<thead>
<tr>
<th>Qty</th>
<th>Part No.</th>
<th>Color</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>671758</td>
<td>Yellow</td>
<td>.020 in. (.50 mm)</td>
</tr>
<tr>
<td>2</td>
<td>671757</td>
<td>Pink</td>
<td>.015 in. (.39 mm)</td>
</tr>
<tr>
<td>1</td>
<td>670574</td>
<td>Brown</td>
<td>.010 in. (.25 mm)</td>
</tr>
<tr>
<td>1</td>
<td>674537</td>
<td>Blue</td>
<td>.005 in. (.12 mm)</td>
</tr>
</tbody>
</table>

10 Remove the end cover. Apply Loctite sealant 515 (Cascade Part No. 668184) to both surfaces of the shims. Install the shim pack and end cover. Tighten the capscrews to a torque of 55–65 ft.-lbs. (75–90 Nm). Remove excess sealant.

11 With the gearcase laying flat, fill with 2-1/2 cups (600 ml) of Cascade Gear Lube Part No. 656300, or SAE 90 wt. gear lube (AGMA 'mild' 6EP Gear Lube).

12 Install the cover plate and gasket. Install the four cover plate capscrews and tighten to 10–15 ft.-lbs. (15–20 Nm). Install the center hole plug.

13 Reinstall the drive group on the rotator baseplate as described in Section 5.3-1.
5.4 Drive Motor

5.4-1 Drive Motor – Removal and Installation

1. Remove the Revolving Clamp from the lift truck as described in Section 5.1.

2. Remove the drive group from the Clamp as described in Section 5.3-1.

3. Remove the fill plug and drain the lubricant from the drive group.

4. Lay the drive group, pinion down, on two 4 x 4 (10 x 10 cm) wood blocks placed on both sides of the pinion gear.

5. Remove the four capscrews fastening the check valve assembly to the drive motor. Keep track of the two O-rings between the check valve assembly and drive motor. For reassembly, tighten the capscrews to 20 ft.-lbs. (25 Nm).

6. Remove the three capscrews fastening the adapter plate to the gearcase housing. Tap on the drive motor with a rubber mallet to separate the drive motor/adapter plate assembly from the gearcase housing.

7. Remove the four capscrews fastening the adapter plate to the drive motor and separate the motor from the adapter plate.

8. For reassembly, reverse the above procedures except as follows:
   - Apply Loctite sealant 515 (Cascade Part No. 668184) to both sides of the drive motor/adapter plate gasket. Apply sealant to the threads of the four drive motor capscrews. Install the gasket and adapter plate to the drive motor. Tighten capscrews to 30–40 ft.-lbs. (50–55 Nm).
   - Apply sealant to both sides of the adapter plate/gearcase housing gasket. Apply sealant to the threads of the three adapter plate capscrews. Install the drive motor/adapter plate assembly and gasket to the gearcase housing. Tighten the capscrews to 55–65 ft.-lbs. (75–90 Nm).
   - Fill the drive group with 2-1/2 cups (600 ml) Cascade Gear Lube Part No. 656300, or SAE 90 wt.gear lube (AGMA ‘mild’ 6 EP Gear Lube).

WARNING: Before removing hydraulic lines or components, relieve pressure in the Attachment hydraulic system. Turn the truck off and move the auxiliary control valves several times in both directions.
5.4-2 Drive Motor Disassembly

Cascade provides service replacement parts for the unshaded parts only. Due to cost, if other parts need replacement, the complete drive motor assembly should be replaced.

1. Remove the drive motor from the drive group as described in Section 5.4-1.

   IMPORTANT: Clean the outside of the drive motor and service in a clean, dust-free work area. Use a soft-jawed vise for all service procedures.

2. Drain the hydraulic fluid from the drive motor by rotating the shaft. Plug the ports.

3. Clamp the drive motor in a vise across the flange with the shaft downward.

4. Remove the capscrews/seal washers, end cap/seal, Geroler set/seal, spacer plate/seal, splined drive, shaft, needle thrust bearing and bearing race.

5. Turn the drive motor over, clamping the housing across the port area with the flange upward.

6. Remove the four capscrews from the flange. Do not use an impact wrench (see CAUTION below).

   CAUTION: Thread-locker used on the capscrews may require that a small amount of heat be applied to the housing (400°F / 200°C), to remove the capscrews. Use a temperature indicator to prevent overheating the housing.

7. Remove the flange from the housing.

8. Remove the exclusion seal and pressure seal from the flange using a seal removal tool or modified screwdriver as shown.

   CAUTION: Do not scratch either of the seal cavities.

9. Using an Allen wrench, remove the metal plug and seal from the housing.
5.4-3 Drive Motor Inspection

- Remove all Loctite residue from the threaded holes.
- Clean all parts with solvent and blow dry. Do not use paper or cloth towels.
- Inspect all parts for small nicks or burrs. Remove any small nicks or burrs with emery cloth. Replace parts with scratches or burrs that could cause leakage.
- Inspect the flange seal seats for scratches. Check for cracks in the flange area that could cause leakage.

5.4-4 Drive Motor Reassembly

1. Clamp the housing with the flange side upward.
2. Install the plug and seal into housing if it was removed. Push plug into housing until flush with housing surface. Do not damage the seal.
3. Install the flange without the exclusion seal and pressure seal. Use two capscrews only.
4. Turn the housing over and clamp across the flange.
5. Lubricate the needle thrust bearing, bearing race and shaft with hydraulic fluid. Install the needle thrust bearing and bearing race on the shaft. Install the shaft into the housing. The bearing race must rotate freely in position.
   **IMPORTANT:** Do not allow hydraulic fluid to get into the housing threaded holes.
6. Install the splined drive into the shaft with the longer splined end (if applicable) down.
7. Install the seal and spacer plate to the housing.
   **IMPORTANT:** Line up the timing mark on the shaft with a threaded capscrew hole. Mark the hole. Make sure the slots in the spacer plate provide passage for hydraulic fluid. If the spacer plate is flipped, the motor will not operate.
8 Install the seal and Gerotor set on the spacer plate.

IMPORTANT: Make sure a lobe point on the geroler set matches up with the reference threaded capcrew hole marked in Step 7.

9 Install the seal and end cap, seal washers and capcrews. Pre-tighten the capscrews to a torque of 15–40 in.-lbs. (2–5 Nm). Make sure the housing and geroler seals are properly seated. Final-tighten the capscrews using a criss-cross tightening pattern to 200 in.-lbs. (22 Nm).

10 Turn the housing over and clamp across the port area with the shaft upward.

11 Remove the flange from the housing.

12 Lubricate the exclusion seal with petroleum jelly and press into the flange.

13 Place the pressure seal on the shaft, flush against the bearing race. Lubricate the outer surface of the seal with petroleum jelly.

14 Place the flange on the shaft flush against the pressure seal. Install the four capscrews and tighten each capcrew one rotation at a time. The pressure seal must enter the flange seat evenly. Alternately tighten until the flange is tight against the housing.

15 Remove the flange from the housing and inspect the pressure seal for proper seating into the flange.

16 Clean the four capscrews and their corresponding threaded holes in the housing. Use a non-petroleum based solvent and blow dry. Apply Loctite Primer 'NF' to the holes and allow to dry 1 minute minimum.

17 Apply 4 drops of Loctite 601 sealant to the threads of each of the four housing holes. Wipe away any excess sealant. Do not let the sealant dry more than 15 minutes before installing the capscrews.

18 Apply a liberal amount of petroleum jelly to the exclusion seal, pressure seal and shaft.

19 Install the flange seal into the flange, and install the flange to the housing. Install the four capscrews and tighten in a criss-cross pattern to 250 in.-lbs. (28 Nm).

IMPORTANT: The capscrews must be clean and dry.
5.5 Drive Check Valve

5.5-1 Check Valve Service

**WARNING:** Before removing hydraulic lines or components, relieve pressure in the hydraulic system. Turn the truck off and move the truck auxiliary control valves several times in both directions.

1. Disconnect the hydraulic hoses to the drive group. Tag the hoses for reassembly.
2. Remove the four capscrews fastening the check valve to the drive group. Keep track of the two O-rings between the check valve and drive motor. For reassembly, tighten the capscrews to 20 ft.-lbs. (27 Nm).
3. Remove all plug fittings and check valve internal parts.
4. Clean all parts with kerosene or solvent. Remove any burrs or sharp edges with emery cloth.
5. Inspect the internal ball seats for imperfections that would keep the balls from seating fully.
6. For reassembly, reverse the above procedures except as follows:
   - Note the correct direction of the internal conical springs.
5.6 Revolving Connection, Manifold

5.6-1 Removal and Installation

NOTE: The revolving connection body can be serviced with the Attachment mounted on the truck. If service is required on the end block or shaft, the Attachment must be removed from the truck.

Removing body only:

1. Position the arms to at least frame width.

2. Remove the spiral snap ring on the front of the revolving connection shaft. **CAUTION:** Remove all burrs and paint from the exposed shaft surface prior to removal from the body. **CAUTION:** DO NOT OVERTIGHTEN CAPSCREWS.

3. Remove the six (6) capscrews fastening the revolving connection body to the manifolds.

4. Remove the revolving connection body from the front of the Clamp. Note the eight (8) O-rings between the revolving connection body and the manifolds. For reassembly, tighten the capscrews to 15 ft.-lbf. (20 Nm).

**CAUTION:** DO NOT OVERTIGHTEN CAPSCREWS.

5. For reassembly, reverse the above procedures with the following exceptions:

   • Service revolving connection as described in Section 5.6-3.
   • Install eight (8) new O-rings between revolving connection body and manifolds. **NOTE:** use petroleum jelly to hold O-rings in place during installation.
   • Use a shaft/seal loader to reinstall body onto shaft/end block assembly.

Removing complete revolving connection (Attachment off truck):

Remove the revolving connection using the same procedure as in Section 5.6-1, with the following exception:

- After completing Step 2, remove the shaft/end block assembly from the rear of the body.

WARNING: Before removing any hydraulic lines or components, relieve pressure in the Attachment hydraulic system. Turn the truck off and move the auxiliary control valve several times in both directions.

**WARNING:** Before removing any hydraulic lines or components, relieve pressure in the Attachment hydraulic system. Turn the truck off and move the auxiliary control valve several times in both directions.
5.6-2 **Manifold Removal and Installation**

**IMPORTANT:** Removing the hydraulic manifolds requires that the Attachment be removed from the truck and the complete base unit be removed from the Attachment.

1. Remove the Attachment from the truck as described in Section 5.1.
2. Remove the revolving connection as described in Section 5.6-1.
3. Remove the baseplate as described in Section 5.8.
4. Remove the capscrews fastening the manifolds to the cylinders and remove the manifolds. Keep track of the eight (8) O-rings. **NOTE:** 40E/45E Revolving Clamps require the removal of two spacer plates, to provide access to all manifold capscrews. For reassembly, tighten all capscrews to 20 ft-lbs. (30 Nm).

**CAUTION:** DO NOT OVERTIGHTEN CAPSCREWS.

5. For reassembly, reverse the above procedures with the following exceptions:
   - Install eight (8) new O-rings between the manifolds and the cylinders. Use petroleum jelly to keep the O-rings in place during assembly.

**CAUTION:** Make sure the eight (8) O-rings are properly located prior to assembly to prevent leakage.

**WARNING:** Before removing any hydraulic lines or components, relieve pressure in the hydraulic system. Turn the truck off and move the truck auxiliary control valves several times in both directions.
5.6-3 Revolving Connection Service

IMPORTANT: Service the revolving connection in a clean and dust-free work area.

1 Remove the revolving connection from the Clamp as described in Section 5.6-1.

2 Remove the cross-over relief valve cartridge from the end block. Remove the O-rings and back-up rings.

3 Remove the four (4) two-piece seals from the revolving connection body using a hook-type brass seal removal tool (Cascade Part No. 674424).

NOTE: Do not scratch or damage the grooved surfaces in the valve body.

4 Remove the clamp check valve cartridges (2) and the flow divider. Remove O-rings and back-up rings.

5 Clean all parts with cleaning solvent or kerosene and inspect the following:
- **Shaft** – Check the sealing surface of the shaft for minor surface imperfections. Remove with 320-grit emery paper. Sand the shaft radially (around), not along the length. Break the edges on the outer end of the shaft and the snap ring grooves with 320-grit emery paper. If severely worn, replace the shaft.
- **Body** – Check the seal grooves in the body for sharp nicks or projections. Remove minor imperfections with 320-grit emery paper. If severely worn, replace the body.
6 For reassembly, reverse the previous procedure with the following exceptions:

- Install new O-rings and back-up rings on all valve cartridges (see illustration below).

**CAUTION:** The shaft seals must be installed dry to work properly.

Clean all traces of hydraulic fluid and moisture from the seal grooves inside the revolving connection body using a non-petroleum based electronics contact cleaner. Clean hands thoroughly.

- Install the square rubber rings into the grooves in the revolving connection body.
- Install the Teflon rings over the rubber rings.

**NOTE:** Use seal installation tool (Cascade part number 599512) when installing internal seals. If seals are installed by hand, form into 'kidney' shape to avoid sharp bends that can cause permanent damage to seals.

- Lubricate shaft and body with STP or petroleum jelly prior to reassembly.
- Insert shaft loader if available into body and carefully install shaft, displacing loader. **NOTE:** Rotate body to ease installation and prevent damage to seals.

**CAUTION:** The shaft seals must be installed dry to work properly.

- Clean all traces of hydraulic fluid and moisture from the seal grooves inside the revolving connection body using a non-petroleum based electronics contact cleaner.
- Clean hands thoroughly.

- Install the square rubber rings into the grooves in the revolving connection body.
- Install the Teflon rings over the rubber rings.

**NOTE:** Use seal installation tool (Cascade part number 599512) when installing internal seals. If seals are installed by hand, form into 'kidney' shape to avoid sharp bends that can cause permanent damage to seals.

- Lubricate shaft and body with STP or petroleum jelly prior to reassembly.
- Insert shaft loader if available into body and carefully install shaft, displacing loader. **NOTE:** Rotate body to ease installation and prevent damage to seals.
5.6-4 Cross-Over Relief Valve Adjustment

For Attachment over-pressure protection, the cross-over relief valve cartridge for the CLAMP function should be adjusted to match the truck hydraulic flow rate. 

**MAXIMUM RELIEF VALVE SETTING = 2600 psi (180 bar).**

**WARNING:** Before removing hydraulic lines or components, relieve pressure in the Attachment hydraulic system. Turn the truck off and move the auxiliary control valve several times in both directions.

1. Confirm that the truck pressure is between 2300–2600 psi (160–180 bar) at the carriage hose terminal.
2. Install a 3000-psi (200 bar) pressure gauge to both the RH and LH TEST ports on the revolving connection (No. 4 O-ring fittings required).
3. Cycle arms to full open. Slowly close arms while clamping a maximum rigid load (or clamp force indicator). Hold lever in the CLAMP position and accelerate engine to develop full system pressure.
4. Adjust the crossover relief cartridge for an indicated 2300 psi (160 bar). Turn clockwise to increase pressure, counterclockwise to decrease pressure. Tighten jam nut and replace cap.

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**Front View**

- Pressure gauges connected to both TEST ports on revolving connection

**Back (Driver's) View**

- CLAMP Cross-over Relief Valve Cartridge
5.7 Cylinders

5.7-1 Cylinder Service

The cylinders can be serviced with the Attachment mounted on the truck by using the following procedure. If preliminary inspection reveals external damage, replace the complete cylinder (see Section 5.7-5).

5.7-2 Cylinder Disassembly

NOTE: All four cylinders should be serviced if trouble-shooting reveals that one cylinder is faulty or leaking.

1. Close the arms completely.
2. Remove the capscrews fastening the cylinder rod anchor bars to the arms.
3. Slowly power the cylinder rods outward 3 in. (7 cm) to expose the rod end and split ring keepers.
4. Slide the rod end inward to remove the split ring keepers. Slide the rod end off the cylinder rod.

Purging cylinders of hydraulic fluid

5. Completely retract the cylinders, then bump the control valve open to release any trapped pressure behind the check valves.

WARNING: Before disconnecting hoses, relieve pressure in the Attachment hydraulic system. Turn the truck off and move the auxiliary control valve several times in both directions.

6. At the hose terminal, disconnect the supply hose to the revolving connection OPEN port and plug the supply. Route the hose end to a drain bucket. NOTE: This hose bleeds air into the cylinders when purging. Make sure the hose end is not submerged in hydraulic fluid.

7. Install a No. 4 O-ring fitting and drain hose to both the LH and RH TEST ports on the revolving connection. Route the hose ends to a drain bucket.

8. Starting with the bottom cylinder fully retracted, manually pull the cylinder rod fully out to remove hydraulic fluid from the shell. Leave the cylinder fully extended. Repeat the procedure for each cylinder, progressing to the next cylinder above.
5.7-2 **Cylinder Disassembly**  
(Continued)

9 Place a towel or drip pan under the cylinder retainer.

10 Scribe a mark on the cylinder retainer and shell for alignment during reassembly.

11 Use a 6 mm Allen hex extension to remove the cap-screws fastening the cylinder retainer to the shell. Be prepared to collect a small amount of hydraulic fluid from the cylinder cavity when the retainer is loosened from the shell. Remove the retainer.

12 Remove the rod/piston assembly from the cylinder. Place a towel in the cylinder bore to absorb any remaining hydraulic fluid.

13 Remove the cylinder end cap.

14 Remove the seals, O-rings, and bearing from the piston, retainer and end cap by prying them out with a brass O-ring tool and cutting with diagonal cutters. **CAUTION:** Do not scratch the seal grooves.

5.7-3 **Cylinder Inspection**

- Inspect the rod, piston and retainer for nicks or burrs. Minor nicks and burrs may be removed with 320 emery cloth. If they cannot be removed, replace the part.
- Inspect the cylinder bore and remove any minor nicks or burrs with a butterfly. If they cannot be removed, replace the part.
- Inspect the outside of the shell for any deformities or cuts that could impair performance or cause leaks under pressure. If necessary, replace the part.
5.7-4 Cylinder Reassembly

1. Lubricate all new seals and O-rings with petroleum jelly.
2. Note the direction of the U-cup seals. Pressure seals must be installed with the lip toward the high pressure side of the cylinder.

3. Install new seals on the piston, retainer and end cap. Install the piston seal from the rod side of the piston. Hook one side of the seal in the groove and carefully work the seal over the piston.

4. Apply a thick film of petroleum jelly to the inside of the cylinder shell and piston seals.
5. Using a rubber mallet, tap the rod assembly into the cylinder shell.
6. Apply a thick film of petroleum jelly to the retainer.
7. Slide the retainer onto the rod and align with the scribe mark and shell holes. Install the end cap. Install and tighten the retainer and end cap capscrews to 20 ft.-lbf. (30 Nm).
5.7-4 Cylinder Reassembly (Continued)

8 Inspect the rod end anchor parts for wear and replace if necessary. Reassemble the rod end, split rings and anchor bar to the arm. Apply Loctite No. 242 (Blue) to the capscrew threads and tighten to:

- 30E, 33E – 30 ft.-lbs. (40 Nm).
- 40E, 45E – 50 ft.-lbs. (65 Nm).

9 Reconnect the OPEN supply hose to the carriage hose terminal. Remove the drain hoses and fittings from the valve TEST ports. Replace the plugs.

10 Start the truck and operate the Clamp through ten (10) complete cycles to remove trapped air from the hydraulic system. Check for leaks. Check the Clamp for proper operation (Refer to Section 2, Step 12).
### 5.7-5 Cylinder Replacement

The following procedure requires that the Attachment be removed from the truck, and that the baseplate and bearing assembly be removed.

1. With the Clamp mounted on the truck, remove the arm attached to the cylinder to be replaced, as described in Section 5.2-1.
2. Purge the cylinders of hydraulic fluid. Refer to Section 5.7-2, Steps 5 through 8.
3. Remove the Clamp from the truck as described in Section 5.1.

**WARNING:** Make sure Attachment is stable on pallet. Use a stabilizing chain if required to prevent Attachment from tipping over.

4. Remove the baseplate and bearing assembly from the Clamp as described in Section 5.8.
5. Remove the two (2) Allen head capscrews that fasten the hydraulic manifold to the cylinder being replaced. For reassembly, tighten the capscrews to 15 ft.-lbs. (20 Nm).
6. Remove the capscrews that fasten the cylinder to the faceplate. For reassembly, tighten the capscrews using the following technique:
   - A) Tighten to 1/2 the final torque value by starting at the center and working outward.
   - B) Tighten to the final torque value using the same pattern, then double-torque by backing off 1/2 turn and immediately retightening to the final torque value:
     - \(30E, 33E\) – 75 ft.-lbs. (100 Nm) – All except T-Bars.
     - 195 ft.-lbs. (265 Nm) – T-Bars.
     - \(40E, 45E\) – 195 ft.-lbs. (265 Nm) – All.

**CAUTION:** Make sure the two (2) O-rings between the manifold and cylinder are properly located prior to assembly to prevent leakage.

7. Remove the cylinder and bearings from the front of the faceplate. Plug the ports in the manifold.
8. Keep track of the two O-rings between the cylinder and manifold section.
9. For reassembly, reverse the above procedures with the following exceptions:
   - Clean all mating surfaces and remove imperfections and paint before installing the cylinder.
   - Install new O-rings between the cylinder and manifold section. Use petroleum jelly to keep the O-rings in place during assembly.
   - Install new arm bearings if necessary (see Section 5.2-5.).

**NOTE:** Number of cylinder capscrews varies depending on Clamp model.
Base Unit

5.8  Rotation Bearing Assembly – Removal and Installation

1 Remove the Attachment from the truck as described in Section 5.1.
2 Remove the drive group as described in Section 5.3-1.
3 Remove the upper mounting hooks. For reassembly, tighten the capscrews to 125 ft.-lbs. (165 Nm).
4 Remove the revolving connection retainer yoke. For reassembly, tighten the capscrew to 30 ft.-lbs. (40 Nm)

5 Attach two eyebolts to the baseplate. Attach an overhead hoist to the baseplate and take up the slack in the chain.

6 Remove the capscrews fastening the baseplate to the bearing assembly and lift the baseplate away. For reassembly, tighten the capscrews using the following technique:
   A) Tighten to 35 ft.-lbs. (50 Nm) using an alternating cross-pattern sequence as shown.
   B) Tighten to the final torque of 75 ft.-lbs. (100 Nm) using the alternating cross-pattern, then double-torque by backing off 1/2 turn and immediately retightening to 75 ft.-lbs. (100 Nm).

CAUTION: Do not reuse the old capscrews. Use the new capscrews supplied when installing a new bearing assembly.

WARNING: Make sure the hoist used to remove the baseplate has a rated capacity of at least 1000 lbs. (450 kg).
5.8-1 **Rotation Bearing Assembly – Removal and Installation (Continued)**

7 Attach two eyebolts to the outer race on the bearing assembly. Attach an overhead hoist to the bearing and take up the slack in the chain.

8 Remove the capscrews fastening the bearing assembly to the faceplate. For reassembly, tighten the capscrews using the following technique:
   
   **A)** Apply Loctite 242 (blue) and tighten to 35 ft.-lbs. (50 Nm) using the alternating cross-pattern as shown.
   
   **B)** Tighten to the final torque of 75 ft.-lbs. (100 Nm) using the alternating cross-pattern, then double-torque by backing off 1/2 turn and immediately retightening to 75 ft.-lbs. (100 Nm).

**CAUTION:** Do not reuse the old capscrews. Use the new capscrews supplied when installing a new bearing assembly.

9 For reassembly, reverse the above procedures with the following exceptions:
   
   - When installing the rotation bearing assembly on the faceplate, align and position the heat-treated overlap zone ‘R’ on the ring gear with the outer race grease fitting as shown at 30° above horizontal.
   - Check the condition of the faceplate center hole seal. Replace if necessary.
   - Apply NLGI No. 0 grease to the teeth of the bearing assembly ring gear.
   - After remounting the Clamp on the truck, apply chassis grease to the bearing assembly grease fitting. Rotate the Clamp slowly during the procedure.
5.9 180-Degree Stop Group

5.9-1 Stop Valve Adjustment

**WARNING:** Make sure all personnel are clear of the Clamp during adjustment.

The stop valve slowly stops Clamp rotation as it approaches the hard stops at the 180° positions. Operation is by cam-operated plungers that slowly shut off the rotator drive hydraulic supply. If the Clamp does not slowly stop rotation, adjust the valve as follows:

1. Loosen the jam nut on the stop valve adjustment screw and turn the screw OUT (counterclockwise) until a groove marking the maximum-out position is visible.

   **IMPORTANT:** Do not back the adjustment screw out past the groove or fluid leakage will result.

2. Using a load that: A) is the heaviest to be lifted, or B) requires maximum motor torque, rotate the Clamp back and forth to the stops at full speed for 1–2 minutes before making adjustments. Note if the Clamp fully completes its rotation slowly into the hard stop.

3. If rotation does not continue into the hard stop, rotate the stop valve off the cam and turn the adjustment screw IN (clockwise) one-quarter turn. Test for complete rotation slowly into the hard stop.

4. Repeat Step 3 until the Clamp fully completes its rotation slowly into the hard stop. Tighten the jam nut on the adjustment screw.

5. Check the torque on the stop block capscrews and tighten to 390–400 ft.-lbs. (530–540 Nm) if necessary.

**WARNING:** Make sure all personnel are clear of the Clamp during adjustment.
5.9-2 Stop Valve Service

**WARNING:** Before removing hydraulic lines, relieve pressure in the hydraulic system. Turn the truck off and open the truck auxiliary control valves several times in both directions.

1. Disconnect the hydraulic tubing from the stop valve.
2. Remove the capscrews and stop valve from the angle bracket on the baseplate. For reassembly, tighten the capscrews to 10–15 ft.-lbs. (15–20 Nm).
3. Remove the end plugs, adjustment screw and all internal parts from the valve body.
4. Clean all parts with kerosene or solvent.
5. For reassembly, reverse the above procedures with the following exceptions:
   - Replace the seals and O-rings.

5.10 Solenoid Valve

5.10-1 Coil Service

1. Remove the cover from the valve assembly.
2. Disconnect the wires and diode from the coil terminals.
3. Loosen the end cover capscrews. Remove the end cover and coil. Note the position of the coil terminals.
4. Install the new coil and end cover. Assure that the terminals are positioned correctly.
5. For reassembly, reverse the above procedures except as follows:
   - Refer to the electrical schematic in Section 4.5 for correct wire and diode installation.

5.10-2 Valve Service

- Check the plunger within the valve body for freedom of movement. If jammed or damaged, replace the solenoid valve as a complete assembly.
6.1 Specifications

6.1-1 Hydraulics

Truck Relief Setting
2300 psi (160 bar) Recommended
2600 psi (180 bar) Maximum

Truck Flow Volume

<table>
<thead>
<tr>
<th>Class</th>
<th>Minimum</th>
<th>Recommended</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>30E, 33E</td>
<td>5 GPM (19 L/min.)</td>
<td>7.5 GPM (28 L/min.)</td>
<td>10 GPM (38 L/min.)</td>
</tr>
<tr>
<td>40E, 45E</td>
<td>30E, 33E</td>
<td>40E, 45E</td>
<td></td>
</tr>
</tbody>
</table>

1. Cascade E-Series Revolving Clamps are compatible with SAE 10W petroleum base hydraulic fluid meeting MIL Spec. MIL-0-5606 or MIL-0-2104B. Use of synthetic or aqueous base hydraulic fluid is not recommended. If fire resistant hydraulic fluid is required, special seals must be used. Contact Cascade.

2. Flow less than recommended will result in a rotate speed of less than 2 RPM and possible unequal arm movement.

3. Flow greater than maximum can result in excessive heating, reduced system performance and reduced hydraulic system life.

Hoses and Fittings
CLAMP function: At least No. 6, min. I.D. of 9/32 in. (7 mm).
ROTATE function: No. 8, min. I.D. of 11/32 in. (10 mm).

6.1-2 Auxiliary Valve Functions
Check for compliance with ITA (ISO) standards:

6.1-3 Truck Carriage

<table>
<thead>
<tr>
<th>Carriage Mount Dimension (A)</th>
<th>ITA (ISO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Class II</td>
<td>14.94 in. (380.0 mm)</td>
</tr>
<tr>
<td>Class III</td>
<td>18.68 in. (474.5 mm)</td>
</tr>
</tbody>
</table>
6.1-4  Torque Values

Fastener torque values for E-Series Revolving Clamps are shown in the table below in both U.S. and Metric units. All torque values are also called out in each specific service procedure section throughout the Manual. **NOTE:** Torque values given are for lubricated threads. If thread locker is used, it will act as the lubricant.

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Fastener</th>
<th>Size</th>
<th>Ft.-lbs.</th>
<th>Nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bearing retainer-to-bearing way (4)</td>
<td>M-8</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>End cap-to-cylinder (5 per cyl.)</td>
<td>M-8</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Piston retainer-to-cylinder (4 per cyl.)</td>
<td>M-8</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Anchor bar, cylinder rod-to-arm (8)</td>
<td>M-10</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M-12</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>5</td>
<td>Contact pad-to-arm (4)</td>
<td>M-12</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>End block-to-revolving connection (2)</td>
<td>M-8</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Retainer yoke-to-baseplate</td>
<td>M-10</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>8</td>
<td>Baseplate-to-rotation bearing assy. (22)</td>
<td>M-12</td>
<td>75</td>
<td>105</td>
</tr>
<tr>
<td>9</td>
<td>Quick-Change hook-to-baseplate (4)</td>
<td>M-16</td>
<td>165</td>
<td>225</td>
</tr>
<tr>
<td>10</td>
<td>Bolt-on lower hook-to-baseplate (4)</td>
<td>M-16</td>
<td>165</td>
<td>225</td>
</tr>
<tr>
<td>11</td>
<td>Cylinder/bearing way-to-baseplate (+)</td>
<td>M-12</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M-16</td>
<td>195</td>
<td>265</td>
</tr>
<tr>
<td>12</td>
<td>Upper hook-to-baseplate (4)</td>
<td>M-20</td>
<td>235</td>
<td>320</td>
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<tr>
<td>13</td>
<td>Rotation bearing assy.-to-faceplate (24)</td>
<td>M-12</td>
<td>100</td>
<td>135</td>
</tr>
<tr>
<td>14</td>
<td>Index block-to-baseplate (2)</td>
<td>M-12</td>
<td>75</td>
<td>105</td>
</tr>
<tr>
<td>15</td>
<td>180° stop cam-to-faceplate (2)</td>
<td>M-12</td>
<td>75</td>
<td>105</td>
</tr>
<tr>
<td>16</td>
<td>Manifold-to-cylinder (8)</td>
<td>M-8</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>17</td>
<td>Gearbox cover plate (4)</td>
<td>M-8</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>18</td>
<td>Rotator drive assy.-to-baseplate (4)</td>
<td>M-12</td>
<td>75</td>
<td>105</td>
</tr>
<tr>
<td>19</td>
<td>Stop block-to-faceplate (2)</td>
<td>M-20</td>
<td>400</td>
<td>540</td>
</tr>
</tbody>
</table>

* Number of fasteners varies depending on Model
■ Use Loctite 242 (Blue)
▲ Double-torque (tighten, loosen 1/2-turn, retighten)
(Capscrews accessed through plug)
Do you have questions you need answered right now?
Call your nearest Cascade Service Department.
Visit us online at www.cascorp.com

AMERICAS
Cascade Corporation
U.S. Headquarters
2201 NE 201st
Fairview, OR 97024-9718
Tel: 800-CASCADE (227-2233)
Fax: 888-329-8207
Cascade Canada Inc.
5570 Timberlea Blvd.
Mississauga, Ontario
Canada L4W-4M6
Tel: 905-629-7777
Fax: 905-629-7785
Cascade do Brasil
Rua João Guerra, 134
Macuco, Santos - SP
Brasil 11015-130
Tel: 55-13-2105-8800
Fax: 55-13-2105-8899

EUROPE-AFRICA
Cascade Italia S.R.L.
European Headquarters
Via Dell’Artigianato 1
37050 Vago di Lavagno (VR)
Italy
Tel: 39-045-8989111
Fax: 39-045-8989160
Cascade (Africa) Pty. Ltd.
PO Box 625, Isando 1600
60A Steel Road
Sparton, Kempton Park
South Africa
Tel: 27-11-975-9240
Fax: 27-11-394-1147

ASIA-PACIFIC
Cascade Japan Ltd.
2-23, 2-Chome,
Kukuchi Nishimachi
Amagasaki, Hyogo
Japan, 661-0978
Tel: 81-6-6420-9771
Fax: 81-6-6420-9777
Cascade Korea
1218 9L Namdong Ind. Complex, 691-8 Gojan-Dong
Namdong-Ku
Inchon, Korea
Tel: +82-32-821-2051
Fax: +82-32-821-2055
Cascade-Xiamen
No. 668 Yangguang Rd.
Xinyang Industrial Zone
Haicang, Xiamen City
Fujian Province
P.R. China 361026
Tel: 86-592-651-2500
Fax: 86-592-651-2571
Cascade Australia Pty. Ltd.
1445 Ipswich Road
Rocklea, QLD 4107
Australia
Tel: 1-800-227-223
Fax: +61 7 3373-7333
Cascade New Zealand
15 Ra Ora Drive
East Tamaki, Auckland
New Zealand
Tel: +64-9-273-9136
Fax: +64-9-273-9137
Sunstream Industries
Pte. Ltd.
18 Tuas South Street 5
Singapore 637796
Tel: +65-6795-7555
Fax: +65-6863-1368

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2-99
Part Number 221093