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Introduction

This manual provides service information for the Eaton Model X70 Plug-In 2 Speed axial piston motor. Step by step instructions for the complete disassembly, inspection, and reassembly of the motor are given. The following recommendations should be followed to insure successful repairs.

- Remove the motor from the vehicle.
- Cleanliness is extremely important.
- Clean the port areas thoroughly before disconnecting the hydraulic lines.
- Plug the motor ports and cover the open hydraulic lines immediately after they’re disconnected.
- Drain the oil and clean the exterior of the motor before making repairs.
- Wash all metal parts in clean solvent.
- Use compressed air to dry the parts. Do not wipe them dry with paper towels or cloth.
- The compressed air should be filtered and moisture free.
- Always use new seals / gaskets when reassembling hydraulic motors.
- For replacement parts and ordering information refer to parts list.
- Lubricate the new rubber seals with a petroleum jelly (Vaseline) before installation.
- Torque all bolts over gasket joints, then repeat the torquing sequence to make-up for gasket compression.
- Verifying the accuracy of motor repairs on an authorized test stand is essential.
Unit Identification

Identification numbers

Serial Number Code
Required Tools

- 5/16 in. Hex Key (Allen)
- ¼ in. Hex Key (Allen)
- 3/16 in. Hex key (Allen)
- Ball peen hammer
- O-ring Pick
- Soft face hammer
- Arbor Press
- Seal Driver
- 9/16 in. Socket
- Torque Wrench
- Flat tip screw driver
- Light Petroleum jelly
- External retaining ring Pliers (Straight, tip size = 0.030)
- External retaining ring Pliers (Flat tip)
- Motor mounting Fixture

Special tools

- Swash plate retainer
Typical Cross section of Motor (Cutaway)
Typical Cross section of Motor (Side View)
Exploded View Drawing

Part List:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Qty</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Housing</td>
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<tr>
<td>2</td>
<td>Dowel pin</td>
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</tr>
<tr>
<td>3</td>
<td>Swash bearing</td>
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</tr>
<tr>
<td>4</td>
<td>Swash plate</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Drive shaft</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Internal retaining ring-shaft seal</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Shaft seal adapter</td>
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<tr>
<td>8</td>
<td>Seal</td>
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<td>9</td>
<td>O-ring, shaft seal adapter</td>
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<td>10</td>
<td>Cylindrical roller bearing, housing</td>
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<tr>
<td>11</td>
<td>Retaining ring, external</td>
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</tr>
<tr>
<td>12</td>
<td>Rotating kit S/A</td>
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<table>
<thead>
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<th>Item No.</th>
<th>Description</th>
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<tr>
<td>13</td>
<td>End Cover S/A</td>
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<td>Valve plate</td>
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<tr>
<td>16</td>
<td>Gasket</td>
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</tr>
<tr>
<td>17</td>
<td>Bolts, end cover (2 in long)</td>
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</tr>
<tr>
<td>18</td>
<td>Bolts, end cover (2.25 in long)</td>
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</tr>
<tr>
<td>19</td>
<td>Plug Assembly</td>
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<tr>
<td>20</td>
<td>Control piston</td>
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<tr>
<td>21</td>
<td>Piston Ring</td>
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<td>22</td>
<td>Bias Spring</td>
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<td>23</td>
<td>Connector pin</td>
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<tr>
<td>24</td>
<td>External Retaining ring</td>
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</table>
Disassembly

- Before attempting to disassemble, clean the motor exterior. Dispose of leakage oil and oily cloths in an environmentally responsible manner. All parts within the unit must be kept clean during the overhaul process.
- Handle each part with great care, marking as necessary to ensure proper reassembly. The close tolerance of the parts makes this requirement very important. Clean all parts that are removed from the unit with a commercial solvent that is compatible with the system fluid. Compressed air may be used in the cleaning process. However, it must be filtered to remove water and other contamination.

1. Position the motor into a motor mounting fixture, clamping onto the outer portion of the front flange, with the rear section up. Mark the relationship of the working ports (for reassembly identification). Remove the four cap screws retaining the end cover sub assembly.

*Note:* The valve plate may stick to end cover. Use caution so valve plate does not fall off.

2. Lift end cover straight up off shaft and housing. Remove valve plate from end cover or from rotating kit assembly, still in housing.

3. Remove gasket from housing or end cover.
4. Install the swash plate retainer tool and tighten the cap screw to housing. This will prevent the swash plate from falling out or moving while removing the rotating kit assembly. Note:- Make sure that the swash plate retaining tool is touching the forged surface & not damaging the shoe running face.

5. To remove rotating kit assembly, tilt the motor mounting fixture 90° as shown in picture. Remove rotating kit assembly by hand, keep that on table aside.

6. Refer to Appendix A for disassembly and inspection of rotating kit.

7. Rotate back the motor mounting fixture to normal position, remove swash retainer tool & remove swashplate subassembly from housing and control piston from swashplate, if needed.

8. Remove Dowel pins from housing.
9. Remove the motor housing from motor mounting fixture, rotate it 180° and keep it on fixture.

**Note:** Cradle bearing may stick to the housing. Use caution while rotating it. Cradle bearing may fall off.

10. Use flat tip screw driver to remove internal retaining ring.

11. Use M4 bolt to screw it to the holes provided on the shaft seal adapter and pull the adapter assembly out of housing.

12. Pull the shaft subassembly out of motor housing.
Appendix A

Rotating Kit Assembly

Part List

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Part Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pin Keeper</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Loading pin</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Piston Assy</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Spider</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Piston Block</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Spider Pivot</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Washer</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Retaining Ring</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Spring</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Wave Washer</td>
<td>1</td>
</tr>
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</table>
Disassembly – Rotating Kit Assembly

Disassembly of rotating assembly is required for inspection only.

1. Remove the nine piston assemblies, shoe retainer, and shoe retainer pivot from cylinder barrel. The piston block assembly doesn’t need to be disassembled unless the internal pins or spring are damaged. Note:- Wave washer should be replaced once the Rotating Kit is disassembled.

2. To remove spring, place one of the flat washers over the 3/8 in. x 3-1/4 in. cap screw. Put cap screw through the center of the cylinder barrel and apply the second washer. Let washer rest on the three pins and retain with nut. Turning nut and compressing spring inside the barrel. Use a pair of retaining ring pliers and remove the internal retaining ring. Remove the washer, spring, second washer, three pins, and pin keeper at the same time.

Inspection

- Inspect cylinder block face for wear, scratches, and/or erosion. If cylinder block condition is questionable, replace the entire rotating group.
- Check each cylinder block bore for excessive wear. Use the piston and shoe S/A for this purpose. The pistons should be a very close fit and slide in and out of the cylinder block bores. NO BINDING CAN BE TOLERATED. If binding occurs, clean the cylinder block and pistons. Lubricate the cylinder block bores with clean fluid and try again. Even minor contamination of the fluid may cause a piston to freeze up in a cylinder bore.
- Inspect each of the nine piston and shoe subassemblies for a maximum end play of 0.005 inch between the piston and shoe. Also check the face dimension of each shoe. The face dimension must be within 0.001 inch.
- Inspect spider and spider pivot for wear and/or scratches. If condition is questionable, replace entire rotating group.

Reassembly – Rotating Kit Assembly

To reassemble the rotating kit assembly complete the following steps:

1. Compress the pin keeper and install in the spline of the cylinder barrel. Install the three pins with head end to the inside of the barrel and position in the special grooves of the cylinder barrel spline.

2. Install the washer, spring, and second washer into the cylinder barrel. Use the two 3/8 in. I.D. washers, nut, and 3/8 in. x 3-1/4 in. cap screw to compress the spring and retain with retaining ring. Remove the nut, cap screw, and the two washers.

3. Install the pivot and wave washer onto the three pins, shoe retainer on the pivot, and piston assemblies thru the shoe retainer and into cylinder barrel, resting on shoe retainer.

Inspection

- This dimension must be maintained in all nine shoes within 0.001 inch.
Appendix B

End Cover with loop flushing valve

Part List

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Part Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Back plate</td>
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</tr>
<tr>
<td>2</td>
<td>Needle Bearing</td>
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</tr>
<tr>
<td>3</td>
<td>Pin, Roll</td>
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<tr>
<td>4</td>
<td>Piston, Shuttle</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Poppet</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Cylindrical Compression Spring</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Sleeve, Dash Pot</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Plug Assy</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Poppet</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Spring, Lift, Check</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Plug Assy</td>
<td>1</td>
</tr>
</tbody>
</table>
Disassembly – End cover subassembly

- Remove plug (8) and sleeve (7) from both the side.
- Remove spring (6) and poppet (5) from end cover.
- Remove sleeve form one side.
- Remove plug (11) from the bottom of end cover.

**Note:** Spring (10) & poppet (9) may fall down.
- Removal of needle bearing (2) and dowel pin (3) is not required.

Inspection

- Inspect the shuttle, poppet and spring for cut, wear and scoring. Replace it if found damages.

Reassembly – End cover subassembly

- Install shuttle (4) from one side and hold it from other side, install poppet (5) spring (6) & sleeve (7) and tight the plug.
- Install poppet (5) spring (6) & sleeve (7) from other side and tight the plug.
- Install poppet (9) & spring (10) form bottom and tight the plug.
Inspection, repair & Part replacement

End cover and associate parts:

- Inspect end cover for erosion, cracks, and burrs. Clean up minor burrs with an India stone. If erosion or cracks are found, replace the end cover.
- Check the bearing (press fit) in end cover. If needles remain in cage, move freely, and setting is at the dimension shown in figure 28, removal not required.
- Check roll pin in end cover. If tight and set to the dimension shown in figure 28, removal not required.
- Inspect roller bearing and bearing race for nicks and pitting. Make sure the roller bearing turns freely within the bearing race. If the roller bearing needs replacement, both the roller bearing and the bearing race must be replaced.

- Inspect valve plate for erosion, excessive wear, heavy scratches, and cracks. If any of the above conditions are found, replace the valve plate.

Swashplate Parts:

- The finish on the piston shoe surfaces of the swashplate should show no signs of scoring. Check the swashplate hubs and bearing surfaces for wear and cracks and surface for coating transfer from shoes. Replace if defective.
- Inspect cradle bearing surfaces for wear, pitting, and smooth operation. Replace if necessary.
- Inspect control piston for burrs, scratches and cracks. Clean up minor scratches with 500 grit paper. Remove burrs with an India stone. The control piston should move freely in the bore of end cover.
- Inspect the control piston ring for any cuts, wear & scoring. Replace the piston ring if found damage.
- Use flat tip screw driver for removal of piston ring.
- For installation of piston ring follow the sequence shown in figure 29 & 30.

Note: piston ring can be install easily if it is greased or oiled.

- Once the piston ring is assembled on the piston, pass it through the end cover bore for 3 to 4 times for setting the piston ring.

Shaft/housing parts:

- Inspect drive shaft for wear, stripped splines, and burrs. Remove burrs with an India stone. Replace the drive shaft if wear or scoring is greater than 0.005 T.I.R. (total indicator reading).
- Inspect drive shaft bearing for roughness, pitting of rollers, and excessive end play. Replace, if defective. If the bearing needs to be replaced, remove retaining ring (part no 11) and replace the outer cone and rollers as shown below. If inner cone has scoring or pitting entire shaft sub assembly has to be replaced.

- Inspect housing mounting flange for nicks and burrs. Remove minor nicks and burrs with an India stone. Also check the housing for damaged or stripped threads. If any thread is damaged, replace the housing.
- Check remaining motor parts for excessive wear, damaged threads, burrs, cracks and erosion. Replace any part that is in questionable condition.
Reassembly

- All parts should be cleaned and critical moving parts lubricated before reassembly.
- Refer to Appendix A for reassembly of rotating kit assembly.
- Keep the motor housing on motor mounting fixture. And install shaft subassembly from the front of the housing.

- Install the new shaft seal in to the adapter with the help of arbor press. 
  **Note:** The diameter of the press tool should not be less than that of shaft seal outer diameter.

- Install shaft seal adapter subassembly with the help of arbor press. Change the O-ring of shaft seal adapter subassembly. 
  **Note:** Inspect the O-ring for any cuts after pressing into housing.

- Open the spiral retaining ring & insert one tip in housing groove & simultaneously push and rotate it inside the housing groove.
• Once the shaft assembly is installed, rotate the motor as flange face downward and keep it on motor mounting fixture. Install cradle bearing.

**Note:** The cradle bearings are asymmetric by design. Observe the orientation & assembly. The longer side towards the control piston side as shown in figure.

- Insert the bias spring into the piston subassembly and connect it to swash plate by passing a connecting pin through eye of swash plate & piston. Secure both ends of connector pin by attaching external retaining rings as shown.

- Install this swash plate assembly into the motor and bolt the swash retainer tool to the motor housing. Coat bushing surface with hydraulic oil before installation.

- Refer to Appendix A for reassembly of rotating kit subassembly.
- To install rotating kit assembly, rotate motor mounting fixture 90°, place rotating kit assembly over shaft and into housing until pistons are against swash plate. Make sure all parts are in housing completely and properly positioned. Return the motor mounting fixture to the original position.
• Install dowel pins and gasket onto the motor housing.

• Lightly coat the back plate side of the valve plate with petroleum jelly for retention during assembly. Install the valve plate over the small slot on the outside of the valve plate with the dowel pin in the back plate.

• Install end cover assembly onto housing assembly. Make sure ports are positioned correctly, valve plate and gasket stay in place. Tight four cap screws.

• Refer start-up procedure before starting the motor.
Assembly Torque Value

39.4 - 48.4 ft lbs

35.1 - 42.9 ft lbs

14.4 - 17.6 ft lbs

12.0 - 14.0 ft lbs

9.9 - 12.1 ft lbs

39.4 - 48.4 ft lbs
Start-Up Procedure

When initially starting a new or a rebuilt transmission system, it is extremely important that the start-up procedure be followed. It prevents the chance of damaging the unit which might occur if the system was not properly purged of air before start-up.

1. After the transmission components have been properly installed, fill the motor housing at least half with filtered system oil. Connect all hydraulic lines and check to be sure they are tight.
2. Install and adjust all control linkage.
3. Fill the reservoir with approved oil that has been filtered through a 10 micron filter. Refer to Eaton Hydraulics Technical Data sheet number 3-401 titled Hydraulic Fluid Recommendations.
4. Gasoline or L.P. engines: remove the coil wire and turn the engine over for 15 seconds. Diesel engines: shut off the fuel flow to the injectors and turn the engine over for 15 seconds.
5. Replace the coil wire or return the fuel flow to the injectors. Place the transmission unit in the neutral position, start the engine and run it at a low idle. The charge pump should immediately pick up oil and fill the system. If there is no indication of fill in 30 seconds, stop engine and determine the cause.
6. After the system starts to show signs of fill, slowly move pump Swashplate to a slight cam angle. Continue to operate system slowly with no load on motors until system responds fully.
7. Give supply to the control port of the motor to see if the motor responds to the signal.
8. Remove the control port pressure and observe if the motor comes to original speed/displacements.
9. If not, troubleshoot the motor as per Eaton repair manual
10. Check fluid level in the reservoir and refill if necessary to the proper level with approved filtered oil.
11. Check all line connections for leaks and tighten if necessary.
12. The machine is now ready to be put into operation.
13. Frequent filter changes are recommended for the first two changes after placing the machine back into operation. Change the first filter in 3-5 hours and the second at approximately 50 hours approx. hours. Routinely scheduled filter changes are recommended for maximum life of the hydraulic system.

Testing

Perform functional test on motor according to Eaton test procedure.