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Many L20 actuator applications have several pinch points with the potential for severe injuries. Use extreme caution and remain clear of all rotating components when bleeding the hydraulic system and whenever the machine is in operation.

After rebuilding or repairing an actuator, it is necessary to bleed all air from the actuator as well as the hydraulic system of the machine. See page 25 for bleeding instructions.

Exercise extreme caution while bleeding the actuator -- keep hands, fingers, and other limbs a safe distance from all rotating components.
Each Helac actuator is individually serial numbered. The serial number is a five or six digit number and must be provided before parts and/or service issues can be addressed.

The serial number can be found on the Identification (ID) Tag that is affixed to all actuators. The tag is a thin, silver colored, plastic material with a self-adhesive backing. Information is imprinted in black. The tag is located either on the side plate or on the housing tube of the actuator. In some cases, the ID tag may be painted over by the OEM (Original Equipment Manufacturer). Typical sample tag locations are seen below. Note that the model number may begin with either "HP" or "L20".

Additionally, the serial number of the actuator is stamped onto the side plate or the housing tube. It may be necessary to remove paint to expose the serial number.

If the ID tag is not attached to the actuator and/or the stamped serial number cannot be located, the basic actuator model can be identified by measuring the outer diameter of the drilled and tapped shaft flange.

<table>
<thead>
<tr>
<th>Model</th>
<th>Flange Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>L20-4.5</td>
<td>4.10&quot; (104.14 mm)</td>
</tr>
<tr>
<td>L20-8.2</td>
<td>4.60&quot; (116.84 mm)</td>
</tr>
<tr>
<td>L20-15</td>
<td>5.60&quot; (142.24 mm)</td>
</tr>
<tr>
<td>L20-25</td>
<td>6.70&quot; (170.18 mm)</td>
</tr>
<tr>
<td>L20-30</td>
<td>7.20&quot; (182.88 mm)</td>
</tr>
<tr>
<td>L20-39</td>
<td>7.70&quot; (195.58 mm)</td>
</tr>
</tbody>
</table>
The L20 Series rotary actuator is a simple mechanism that uses Helac's sliding spline technology which converts axial piston motion into powerful shaft rotation. As seen in the illustration below left, each actuator is composed of a housing with an integral ring gear (1) and only two moving parts: the central shaft (2), and the annular piston sleeve (3). Note the L20 actuator shaft features an integral mounting flange and bearing which are not shown in the illustration. Helical spline teeth machined on the shaft engage matching splines on the inside diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage the matching splines of the housing's ring gear.

As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while, simultaneously, the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the housing, preventing piston movement and locking the shaft firmly in position.

The shaft is supported radially by the large upper radial bearing and the lower radial bearing (see drawings on pages 8 and 9). Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

The L20 Series is available in several different sizes. All L20 Series actuators have the same internal design and basic components, though configurations of parts may be slightly different depending on model.

Many L20 actuators are equipped with factory installed counterbalance valves, which performs four major functions:

- Protects the actuator in the event of overload
- Enables the actuator to hold position without drifting when external loads are applied
- Reduces hydraulic backlash by pressuring the hydraulic fluid
- Provides a constant controlled rate of rotation in over-center load conditions

Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary. For clarity, the shaft flange, bearings, and end cap are not shown.

Applying fluid pressure will displace the piston axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston. Applying pressure to the opposite port will return the piston and shaft to their original starting positions.
MAKING A SEAL TOOL

The seal tool is merely a customized standard flat head screwdriver.

1. **Heat the flat end with a torch until it glows.**
2. **Secure the heated end of the screwdriver in a vise and bend the heated end to a slight radius.**
3. **Round off all sharp edges of the heated to a polished finish. The tool may be modified slightly to your own personal preference.**

Tools Required

Several basic tools are required for the disassembly and reassembly of the actuator. The tools and their intended functions are outlined below:

1. **PIPE VISE**
2. **HEX WRENCH**
   - Removal and replacement of port plugs and set screws.
3. **ASSORTED SCREWS**
4. **SAFETY GLASSES**
5. **END CAP REMOVAL TOOLS** (provided with Helac seal kit).
6. **DRILL**
7. **FLASHLIGHT**
   - Helps in locating and examining timing marks, component failure and overall condition.
8. **RUBBER MALLET**
   - Removal and installation of shaft and piston sleeve assembly.
9. **PLASTIC MANDREL**
10. **PRY BAR**
    - Removal of end cap and manual rotation of shaft.
11. **FELT MARKER**
    - Highlights timing marks and outlines troubled areas. Permanent ink is recommended.
12. **T-HANDLE SCREW EXTRACTOR**
13. **HEX WRENCH SET**
    - Removal and replacement of port plugs and set screws (106, 110).
14. **SEAL TOOLS**
    - Removal and installation of seals and wear guides. Directions on making a seal tool are provided at bottom.
15. **PUNCH**
16. **DOWEL PINS**
    - Removal and installation of end cap.
Spare Parts

Spare parts must be ordered through the vehicle/machine OEM. Seals and bearings are available as complete kits only! In order to obtain the correct parts, it is essential to provide the serial number of the actuator to be repaired, see Product Identification section on page 4. To identify spare parts required, refer to the Assembly Drawing on page 8 and Parts List on page 10.

Technical Support

Technical support is available from Helac Corporation, Monday through Friday 7 am to 4 pm Pacific Standard Time by calling 800-327-2589. If possible, please have the serial number of the actuator available. (The serial number is stamped into the housing of the actuator-see page 4).
Typical L20 Series Actuator
Clevises and/or Output Shaft Flange Configurations May Be Different

OPTIONAL VALVE MANIFOLD
COUNTERBALANCE, ITEM #401
MOTION CONTROL, ITEM #403
Exploded View
# Parts List

## Spare Parts

Spare parts must be ordered through the vehicle/machine OEM. Seals and bearings are available as complete kits only! In order to obtain the correct parts, it is essential to provide the serial number for the actuator to be repaired. See Product Identification on Page 4. To identify spare parts required, refer to the Assembly Drawing, Exploded View Drawing and the Parts List.

<table>
<thead>
<tr>
<th>Parts</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
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<tr>
<td></td>
<td>1</td>
<td>HOUSING</td>
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<tr>
<td></td>
<td>2</td>
<td>SHAFT</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>PISTON SLEEVE</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>END CAP</td>
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**Hardware**

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<tr>
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<tbody>
<tr>
<td>103.1</td>
<td>SCREW (OPTIONAL)</td>
<td>1</td>
</tr>
<tr>
<td>103.2</td>
<td>WASHER (OPTIONAL)</td>
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</tr>
<tr>
<td>106.1</td>
<td>PORT PLUG</td>
<td>1</td>
</tr>
<tr>
<td>106.2</td>
<td>PORT PLUG</td>
<td>1</td>
</tr>
<tr>
<td>109</td>
<td>LOCK PIN</td>
<td>2</td>
</tr>
<tr>
<td>113</td>
<td>SET SCREW</td>
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</tr>
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</table>

**Seals**

<table>
<thead>
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<th>Item</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>200</td>
<td>T-SEAL</td>
<td>1</td>
</tr>
<tr>
<td>202</td>
<td>T-SEAL</td>
<td>1</td>
</tr>
<tr>
<td>204</td>
<td>O-RING</td>
<td>1</td>
</tr>
<tr>
<td>205</td>
<td>CUP SEAL</td>
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</tr>
<tr>
<td>207</td>
<td>BACK-UP RING</td>
<td>1</td>
</tr>
<tr>
<td>304.1</td>
<td>EXCLUSION SEAL</td>
<td>2</td>
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**Bearings**

<table>
<thead>
<tr>
<th>Item</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>302</td>
<td>WEAR GUIDE</td>
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</tr>
<tr>
<td>304</td>
<td>THRUST WASHER</td>
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</table>

**Accessories**

<table>
<thead>
<tr>
<th>Item</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>400</td>
<td>STOP TUBE (OPTIONAL)</td>
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</tr>
<tr>
<td>401</td>
<td>COUNTERBALANCE VALVE</td>
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</tr>
<tr>
<td>403</td>
<td>MOTION CONTROL VALVE</td>
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</tr>
</tbody>
</table>

HYDRAULIC FLUID: ISO-VG-46
Before Disassembly

All numbers that appear in parenthesis ( ) refer to items in parts list on page 10.

Inspect the actuator for corrosion prior to disassembly. Severe corrosion can make it difficult to remove the lock pins (109) and unthread the end cap (04). If corrosion is evident, soak the lock pins and end cap with penetrating oil for several hours before disassembling.

Disassembly is considerably easier if the actuator is firmly secured to the work bench. A pipe vise or mounting fixture work well.

Disassembly

1. Remove port plugs (106.1) (106.2) and drain oil. Inspect oil for signs of contamination, i.e. water, metal shavings.

2. Remove the cap screws (113) that cover the end cap lock pins (109).

3. Using a 1/8" (3 mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/16" (5 mm).
Disassembly

4. Remove the lock pins using a screw extracting tool such as an “Easy Out” (a size #2 is shown).

   If the pin cannot be removed with the screw extractor, use a 5/16” bit to drill out the entire pin. Do not drill deeper than 1/2” (12.7 mm).

5. Install the end cap removal tools provided with the Helac seal kit. (1/4-20)

6. Using a metal bar or similar tool, unthread the end cap (4) by turning it counterclockwise.

7. Remove the end cap (4) and carefully set aside for later inspection.
8. Remove the stop tube (400) if the actuator is equipped with one. The stop tube is an available option that limits the rotation of the actuator.

9. Every actuator has two sets of small punched timing marks that indicate timing between the gear sets. The location and appearance of the marks can vary slightly between models. One set indicates the timing between the piston sleeve (3) and the housing (1) (photo at left), the second set between the piston and the shaft (lower photo). To ensure correct rotation and accurate end positions, it is essential that the actuator be correctly timed when it is reassembled. The punched timing marks can be used, but it is easier to highlight punched marks with a marker before disassembly as outlined in the steps below.

10. Prior to removing the shaft (2), use a felt marker to clearly indicate the timing between shaft and piston sleeve (3). This will greatly simplify timing when the actuator is reassembled.
11. Remove the shaft (2) by rotating counterclockwise. As the shaft is rotated, it will disengage from the piston sleeve (3) and can be removed. It may be necessary to strike the threaded end of the shaft with a rubber mallet.

12. As in step 9 above, before removing the piston (3), mark the housing (1) ring gear in relation to the piston outside diameter gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).

13. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston and housing bore are not damaged.

14. At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.
15. Remove the O-ring (204) and backup ring (207) from end cap (4).

**NOTICE**

To avoid damage to machined parts: Carefully remove seals using removal tools with rounded edges.

16. Remove the wear guide (302) from the end cap (4) and shaft (2).

17. Remove the main pressure seal (205).

18. Remove the thrust washer (304) from the end cap (4) and shaft (2).
19. Remove the O-ring (304.1) from its groove in the end cap (4) and shaft (2).

20. Remove the outside diameter piston seal (202) from the piston.

21. Remove the inside diameter piston seal (200).
Inspection

Prior to assembly of actuator, these steps must be closely followed to insure proper operation of the actuator.

1. Clean all parts in a solvent tank and dry with compressed air prior to inspecting.
2. Carefully inspect all critical areas for any surface finish abnormalities: Seal grooves, bearing grooves, thrust surfaces, shaft surface, housing bore and gear teeth.

Small or minor surface scratches can be carefully polished.
1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.

2. Coat the thrust washers (304) with a generous amount of Lithium grease. Install the thrust washer (304) onto shaft (2) and end cap (4).

3. Install the exclusion seal (304.1) into the appropriate grooves on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).
4. Using a seal tool (see Tools Required on page 6) install the main pressure seal (205) onto shaft (2) and end cap (4). Use the seal tool in a circular motion.

5. Install the wear guide (302) on the end cap (4) and shaft (2).

6. Install the O-ring (204) and back-up ring (207) into the inner seal groove on the end cap (4).

7. Install the inner T-seal (200) into the appropriate groove in the piston (3). Use a circular motion to insure the seal is correctly seated in the groove.
   Install the outer T-seal (202) by stretching it around the groove in a circular motion.
   Each T-seal has 2 back-up rings (see Assembly Drawing on page 8 for orientation).
(cont'd) Beginning with the inner seal (200) insert one end of backup ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly.

Insert the other back up ring in upper groove.

Repeat both of these steps for the outer seal (202).

8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) contacts the inside housing bore.

9. Looking into the housing bore from the shaft flange end, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly align as shown. Using a rubber mallet, tap the piston into the housing until the gear teeth contact.

10. Looking into the bore from the opposite end of the housing (1) be sure the timing marks align correctly. Rotate the piston as necessary until aligned, then gently tap the piston (3) into the housing until the gear teeth mesh together. Tap the piston into the housing until it completely bottoms out against the ring gear.
11. Insert the shaft (2) into the piston (3). Be careful not to damage the piston seals. Do not engage the piston gear teeth yet.

12. Looking at the actuator from the end opposite the shaft flange, use the existing timing marks to align the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). When the marks align, gently tap the flange end of the shaft with a rubber mallet until the gear teeth engage.

13. Install two bolts in the threaded holes in the flange. Using a metal bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.

**NOTICE** As the shaft is rotated, be careful not to disengage the piston and housing gearing.

14. Install the stop tube (400) onto the shaft end if necessary. Stop tubes are an available option to limit the rotation of an actuator.
15. Coat the threads on the end of the shaft with anti-seize grease to prevent galling.

16. Thread the end cap (4) onto the shaft (2). Make sure the wear guide remains in place on the end cap as it is threaded into the housing (1).

17. Tighten the end cap (4) using a metal bar. In most cases the original holes for the lock pins will align.

18. Insert the lock pins (109) provided with the Helac seal kit into the holes with the dimple side up. Then, using a punch, tap the lock pins to the bottom of the hole.
19. Insert the set screws (113) over the lock pins. Tighten to 25 in-lbs. (2.8 Nm).

---

**Greasing Thrust Washers**

1. After the actuator is assembled but before it is put into service, the thrust washer area must be packed with Lithium grease.

   There are two grease ports located on both the shaft flange and the end cap. They are plugged with cap screws (113) or set screws. Remove the grease port screws from the shaft flange and end cap. (See exploded view on page 9)

   If a hydraulic test bench is not available, the actuator can be rotated by hand, open the pressure ports and use a pry bar with cap screws inserted into the shaft flange to turn the shaft in the desired direction.

   Insert the tip of a grease gun into one port and apply grease to the shaft flange. Continue applying until grease flows from the opposite port. Cycle the actuator five times and apply grease again. Repeat this process on the end cap. Insert the cap screws into the grease ports and tighten to 25 in-lbs. (2.8 Nm).
If the equipment is available, the actuator should be tested on a hydraulic test bench. The breakaway pressure — the pressure at which the shaft begins to rotate — should be approximately 400 psi (28 bar). Cycle the actuator at least 25 times at 3000 psi (210 bar) pressure. After the 25 rotations, increase the pressure to 4500 psi (315 bar) to check for leaks and cracks. Perform the test again at the end of the rotation in the opposite direction.

**Testing the Actuator for Internal Leakage**

If the actuator is equipped with a counterbalance valve, plug the valve ports. Connect the hydraulic lines to the housing ports. Bleed all air from the actuator (see *Installation and Bleeding* on page 25) Rotate the shaft to the end of rotation at 3000 psi (210 bar) and maintain pressure. Remove the hydraulic line from the non-pressurized side.

Continuous oil flow from the open housing port indicates internal leakage across the piston. Replace the line and rotate the shaft to the end of rotation in the opposite direction. Repeat the test procedure outlined above for the other port. If there is an internal leak, disassemble, inspect and repair.
After installation of the actuator on the equipment, it is important that all safety devices such as tie rods or safety cables are properly reattached.

To purge air from the hydraulic lines, connect them together to create a closed loop and pump hydraulic fluid through them. Review the OEM’s operating manual and/or hydraulic schematic to determine which hydraulic lines to connect. The linear feet and inside diameter of the hydraulic supply lines together with pump capacity will determine the amount of pumping time required to fully purge the hydraulic system.

Bleeding may be necessary if excessive backlash is exhibited after the actuator is connected to the hydraulic system. The OEM does not specify all actuators with bleed nipples, see the drawing below for their location. The following steps are recommended when a minimum of two gallons (8 liters) is purged.

1. Connect a 3/16” inside diameter x 5/16” outside diameter x 5 foot clear, vinyl drain tube to each of the two bleed nipples. Secure them with hose clamps. Place the vinyl tubes in a clean 5-gallon container to collect the purged oil. The oil can be returned to the reservoir after this procedure is completed.

2. With an operator in the platform, open both bleed nipples a ¼ turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a ½ gallon of fluid to be purged from the actuator.

3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional ½ gallon of fluid is pumped into the container.

4. Repeat steps 2 & 3. After the last ½ gallon is purged, close both bleed nipples before rotating away from the end position.
# Troubleshooting Guide

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>SEE CAUSES AND SOLUTIONS BELOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft rotates slowly or not at all</td>
<td>1 - 6</td>
</tr>
<tr>
<td>Operation is erratic or not responsive</td>
<td>7</td>
</tr>
<tr>
<td>Shaft will not fully rotate</td>
<td>8, 9</td>
</tr>
<tr>
<td>Selected position cannot be maintained</td>
<td>3, 4, 7</td>
</tr>
</tbody>
</table>

## CAUSE                                  SOLUTION

1. Insufficient torque output
   - Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.

2. Low rate of fluid flow
   - Inspect ports for obstructions and hydraulic lines for restrictions and leaks.

3. Control or counterbalance valve has internal leak
   - Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.

4. Piston and/or shaft seal leak
   - Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.

5. Corrosion build-up on the thrust surfaces
   - Re-build the actuator. Remove all rust then polish.*

6. Swollen seals and composite bearings caused by incompatible hydraulic fluid (Standard actuators only)
   - Re-build the actuator. Use fluid that is compatible with seals and bearings. Contact Helac Corporation for more information.

7. Air in actuator
   - Purge air from actuator. See bleeding procedures outlined on page 25.

8. Twisted or chipped gear teeth
   - Check for gear binding. Actuator may not be able to be re-built and may need to be replaced. Damage could be a result of overload or shock.

9. Port fittings are obstructing the piston
   - Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.

* Replacement parts may be needed.
Hydraulic Rotary Actuator Product Warranty

Standard Warranty Information

Helac Corporation warrants its manufactured products to be free from defective material and factory workmanship. Helac Corporation shall replace or repair such products, which under normal use and service disclose such defects, and return the repaired or replacement products to the purchaser prepaid. Claims under this warranty will be satisfied only by repair or replacement of the unit or any defective part thereof. No cash payment or credit will be made for defective materials, workmanship, labor or incidental charges. Products under warranty shall be returned to Helac Corporation’s manufacturing facility at 225 Battersby Avenue, Enumclaw, Washington 98022 USA, transportation prepaid by the purchaser, for inspection by Helac Corporation, whose opinion as to defects shall be conclusive.

The warranty period shall be 12 months from the date of shipment from Helac Corporation’s manufacturing facility for Helac Corporation approved applications. This warranty shall be voided as to any products which have been repaired, worked upon, or altered by persons not authorized by Helac Corporation, or which have been subject to misuse, negligence, accident, or overload. In no event shall Helac Corporation be liable for any incidental or consequential damages.

Helac Corporation reserves the right to make changes in the design or construction of any of its products at any time without incurring any obligations to make changes or alterations to products previously sold.

This warranty is in lieu of all other and/or prior warranties, expressed or implied, and no other company or person is authorized to represent or assume for Helac Corporation any liability in connection with the sale of Helac Corporation products other than set forth herein.

Return and Debit Policy for Actuators

Unless agreed to in advance, all actuators will be shipped to Helac Corporation, freight prepaid within seven days after receipt of return authorization. Prior to any returns, a Return Material Authorization (RMA) form is to be requested from an authorized Helac Corporation representative. Upon receipt of the RMA form, the customer is to provide when applicable, the part number, serial number, failure date, description of problem and the customer claim or reference number. All shipments to Helac Corporation are to include the completed RMA form.

Upon receipt of the actuator(s) at the Helac Corporation facilities, an inspection will be performed and an authorized representative will provide a written quote. This quote will list the findings of the inspection and will state whether or not the warranty claim has been accepted. Actuators returned for credit may be subject to the Helac Corporation re-stocking fee.

If Helac Corporation does not receive a response to their quote within 30 calendar days, the actuator will be either scrapped or returned and an invoice for the debit amount, including the freight charges, will be sent to the claim originator.

Return and Debit Policy for Service Parts

Return of service parts, normally stocked by Helac Corporation, must be authorized in advance. This will include seal and bearing kits as well as any and all fabricated parts. Return of any special order parts will be authorized on a case-by-case basis. All returns are to be shipped to Helac Corporation freight prepaid within seven days after receipt of return authorization. Helac Corporation has a minimum re-stocking fee of 20 percent.

Prior to any returns, Return Material Authorization (RMA) form is to be requested from an authorized Helac Corporation representative. Upon receipt of the RMA form, the customer is to provide part number, receipt date, description of problem and the customer claim number. All shipments to Helac Corporation are to include the completed RMA form.
About Helac Corporation

As a leader in the fluid power industry for over 30 years, Helac Corporation manufactures a comprehensive line of hydraulic rotary actuators used as component parts for OEMs and aftermarket attachments for the construction equipment industry. Helac rotary actuators are best known for their tremendous torque output, compact dimensions, exceptional load bearing capability and rugged, reliable performance. Helac PowerTilt and PowerGrip, two specialty products, increase the utilization of backhoes and excavators. Over 1,000 worldwide customers in diverse markets depend on Helac's product line to provide product quality, reliability, ease of use and durability.