PREFACE

The procedures included in this book are to be performed in conjunction with the requirements and recommendations outlined in API Specifications. Any repairs to the equipment covered by this book should be done by an authorized Cameron service representative. Cameron will not be responsible for loss or expense resulting from any failure of equipment or any damage to any property or death or injury to any person resulting in whole or in part from repairs performed by anyone other than authorized Cameron personnel. Such unauthorized repairs shall also serve to terminate any contractual or other warranty, if any, on the equipment and may also result in equipment no longer meeting applicable requirements.

File copies of this manual are maintained. Revisions and/or additions will be made as deemed necessary by Cameron. The drawings in this book are not drawn to scale, but the dimensions shown are accurate.

This book covers Cameron products.

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I. GENERAL

• Keep this manual for future reference.
• Please keep this manual near the actuator so that it is available for consultation.
• For questions or clarifications please contact cameron.slb.com
• To get / request new copies of the manual please contact cameron.slb.com
• The manufacturer reserves the right to modify, without prior notice, the characteristics of the equipment described in this publication and is not obligated to update any products and manuals previously issued.

A. Legend for Safety Symbols

Explanation of Warning Symbols (Where Applicable)

Before carrying out any operation on the actuator, the electric power supply (if present) must be shut-off.

Risk of explosion: before carrying out any operation on the actuator, the actuator must be isolated from the hydraulic supply source.

Before carrying out any operation on the actuator, the control group (if present) must be discharged from the pressure therein trapped, particular care shall be taken on storage tanks and pressure filters.

Every operation on the actuator must be performed by qualified personnel, equipped with safety clothes and devices (gloves, helmet, glasses, etc.).

During the operation on the actuator, the operator must pay attention to the presence of liquids potentially noxious for the health and the environment.
B. Original Spare Parts

The use of any non-genuine Cameron spare parts by customer exempts Cameron from any responsibility for indemnity on claims.

C. Operative Staff

The maintenance-staff assigned to Cameron's Ledeen products must have the qualified technical preparation to perform the function. The lack of the above-mentioned preparation, included therein the unavailability to attend adequate training courses by specialized Cameron technicians at its workshop, cannot be charged to the company Cameron, who will be considered exempt from any responsibility on claims. Also the lack of knowledge, by the operative personnel, of the manuals and instruction books supplied by Cameron in the languages indicated in the supply contract, cannot be imputed to Cameron.

D. Damages Derived From Use

Any damage derived from corrosion, fouling, pollution, oxidation, wear, or gradual deterioration of the materials, for which the customer did not specify the adaptability limits, will be at the Customer's own loss.

E. Interruptions and suspending

Damages derived from a period of instrument use failure, during which the instrument wasn't in maintenance condition to assure a perfect preservation, will be at the customer's own loss.

F. Modification of The Actuator

Damages derived from any modification made by the customer without prior authorization from Cameron, especially if not in accordance to the initial conditions established in the buying order, will be at the customer's own loss.

G. Actuator Disposal

To finally dispose the actuator at the end of its operating life, please carry out the following operations:

- Open the frame enclosure.
- Remove the lubricants taking care not to pollute the environment.
- Clean the frame internally using a mixture of water and degreasing soap.
- Dispose of the cleaning fluid and lubricants extracted from the actuator according to the local laws regarding the disposal of waste material.
- After the actuator's disposal, all casings must be sent to the scrapping service.
- In case of replacement of any part, it must be handled and disposed of as listed in the owner's manual.
If the actuator is provided with spring container:

**Warning:**

**DO NOT OPEN AND/OR FORCE THE SPRING CONTAINER**

The spring container contains one or more compressed springs. A forced or non-controlled opening of the container can cause the non-controlled and violent ejection of material potentially harmful to people and/or capable of causing damage to property. The opening and disposal of the spring container must be carried out only by authorized personnel. Please contact Cameron in case of any doubt or for further information.

H. **Safety of the Power Supply Connection (If Applicable)**

Before carrying out any operation on the actuator, check that the power supply is off.

Before connecting the actuator:

- Verify the absence of the power supply and always connect the ground cable to the actuator first.
- Check that the power supply line characteristics are in accordance with the nameplate and installation manual data.

I. **Safety Recommendations**

Check that the ground resistance complies with the limits allowed by the National Laws relevant to the country where the actuator is installed.

If the actuator is stored/installed in a hazardous area, do not use open flames and/or devices that could cause sparks.

At the end of any intervention on the actuator please check that all the boxes and covers are properly closed.

The operators assigned to the actuator’s maintenance must be authorized personnel or otherwise must have attended a training course dedicated to the use and maintenance of the actuator.

J. **Electrostatic Discharges Prevention**

The actuator handling must be carried out using the handling ring supplied with the actuator. In order to prevent the electro-static charges storage, attention must be paid during the cleaning of any external component made from plastic material.

The plastic material must be cleaned only with a damp cloth or with antistatic products.
K. Actuator Marking (According to 2014/34/EU Directive)

Please refer to the following example of actuator marking:

\[\text{CE \ Ex II 2 G c Tx}\]

Where:

- CE = symbol of conformity to the EU applicable directives
- Ex = ATEX symbol
- II = group II (surface)
- 2 = apparatus of category 2
- G = explosive atmosphere with presence of gas, vapours, fogs
- c = type of protection
- Tx = temperature class

<table>
<thead>
<tr>
<th>Hazardous area</th>
<th>Installation category according to ATEX Directive No. 2014/34/EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas, fog or vapours</td>
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<tr>
<td></td>
<td>2 G</td>
</tr>
<tr>
<td>Gas, fog or vapours</td>
<td>Zone 2</td>
</tr>
<tr>
<td></td>
<td>3 G</td>
</tr>
</tbody>
</table>
L. Actuator Name plate description

The actuator nameplate shows the following data:

2. Purchase Order No.
3. Customer item
4. Valve and Actuator Tag Number
5. Actuator S/N
6. Actuator model
7. Valve size and rating
8. Actuator supply pressure (*)
9. Action on oil failure
10. Ambient temperature range
11. Year of manufacturing
12. “CE” mark (*)
13. Explosion-proof marking, followed by the apparatus group and category
14. ATEX Technical File No. (*)
15. Name and complete address of the manufacturer

(*) where applicable

See for reference the nameplate drawing below.
II. RECEIVING, STORAGE AND HANDLING

A. Preliminary Verification Upon Receipt of Material

**Warning:**

At receipt of the material:

1. Check the completeness of the supply, by referring to the packing list;
2. Check the tag number, serial number and technical information in the nameplate with reference to the order acknowledgement.
3. The actuators are delivered with plugged connections. Which must remain plugged if not utilized or must be re-plugged with the relevant plug or reconnected after any testing operation.
4. Carry out a preliminary verification in order to ensure:
   - The integrity of the material and the absence of damages;
   - The integrity of the painting. If necessary, carry out the paint touch up, by following the instructions of the painting specification (please refer to the technical documentation);
   - The presence of the plugs on all the hydraulic and (where present) electric connections.

B. Storage and Preservation

**Warning:**

If the storage of the actuator is necessary, please follow these instructions.

**Storage conditions**

The actuator must be stored in a warehouse adequately protected against harmful environment.

- The recommended ambient temperature is: Minimum -20°C / Maximum 70°C
- Relative Humidity: Maximum +90%

**Indoor storage**

- Restore the paintwork of the components that have been damaged during transport
- Place the actuators on a wood surface pallet so as to prevent direct contact with the ground.
- Keep the electric components (where present) perfectly dry.

**Outdoor storage**

- Restore the paintwork of the components that have been damaged during transport
- Place the actuators above the ground level.
To store the actuator at temperatures below of –30°C and up to +70°C, it is necessary to carry out additional checks and tests from time to time, depending on the ambient conditions.

Preservation conditions
The procedures that must be performed to the equipment during storage to assure proper operation of the equipment after installation are the following:

- Place the actuators on a wood surface pallet so as to prevent direct contact with the ground.
- Protect all unpainted parts with grease.

**Note:** Before installing the actuator, perform one complete operation (opening and closing) to verify it strokes properly.
C. Handling

Proper Lifting, Weights and Dimensions, Fastener Torque Chart

*Warning:* 

*Important:* These instructions refer to the lifting of the actuator only, not assembled on the valve.

Do not attempt to lift the actuator-valve assembly by using the lifting points of the actuator:

The lifting equipment consists on commercial chains and slings of adequate dimensions, according to the weight of the actuator.

Refer to the following sheets for standard commercial equipment.
LIFTING DEVICES MAXIMUM WORKLOAD

Chains

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<thead>
<tr>
<th>Chain Diameter (mm)</th>
<th>CMU/Tonn 1 Arm</th>
<th>CMU/Tonn 2 Arms</th>
<th>CMU/Tonn 3 and 4 Arms</th>
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LIFTING DEVICES MAXIMUM WORKLOAD

Slings

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<th>200%</th>
<th>140% From 7° to 45°</th>
<th>80%</th>
<th>100% From 45° to 60°</th>
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WORKING LENGTH
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Note: - Column Mat.(1) applicable to the following materials : A193 B7M, A320 L7M, A453 Gr.660B, BS 4882, A193 B7 ( > M 100)
- Column Mat.(2) applicable to the following materials : A320 L7, A320 L43, A193 B7, 39NiCrMo3 ( <= M 100)
- Column Mat.(3) applicable to the following materials : A193 B8 Classte 2 ( <= M 39)
- Load required for the hydraulic pre-tightening is calculated based on the stress applied to the tie rod (% Sn), this load shall be increased on the base of the load lost during the pre-tightening (Cp).
Cp value reported in the table is for reference only and should be better to calculate it again before every application.
III. OPERATION

This series hydraulic actuator is designed for on-off and control service and is applicable over a wide range of pressure, temperature and environments. The scotch yoke mechanism converts the linear motion of hydraulic piston into valve rotation by the actuator shaft. The symmetric scotch yoke mechanism generates high torque at start (0° degree) and the end (90° degree) of the valve stroke. The canted scotch yoke mechanism generates very high torque when valve is closed.

Pressure is applied via supply ports in either end of the cylinder assembly onto pistons running within the cylinder liner. This enables the scotch yoke mechanism of the actuator to drive in both directions.

IV. COMMISSIONING

A. Mounting to Valve (With Adaptor Piece)

The actuator can be assembled on top of the valve flange either by using the actuator-housing flange with threaded holes, or by the interposition of a proper mounting hardware.

Warning:

Note: No special tools are required for these operations, but only some Allen wrenches and hexagonal wrenches of the required sizes.

Before the installation, please check that the actuator was not damaged during the transportation.

The actuator along with the adapter assembly is shipped to mount on the valve. In case it is necessary to assemble the actuator onto the valve, proceed as follows:

The actuator drive sleeve is generally connected to the valve stem by an insert bush or a stem extension. The assembly position of the actuator, with reference to the valve, must comply with the plant requirements (cylinder axis parallel or perpendicular to the pipeline axis).

a. Check that the coupling dimensions of the valve flange and those of the valve stem meet the coupling dimensions of the actuator.

b. Clean the flange of the valve and remove anything that may prevent a perfect adherence to the actuator.

c. Lubricate the shaft of the valve with oil or grease.
d. Set the actuator position same as that of the valve position, either open or close.

e. Lift the actuator by means of adequate slings as per the weight of the actuator to render the perfect horizontal (this is very important for easy coupling) utilizing the existing lifting point on the actuator. (refer to page no. 12-16)

f. Clean the adapter piece flange and remove anything that may prevent a perfect adherence to the valve.

g. Lower the actuator onto the valve in such a way that the adapter, assembled on the valve stem, enters the actuator drive sleeve. This coupling must take place without forcing and only with the weight of the actuator.

**Note:** Caution should be taken while connecting the adapter piece on to the valve stem.

h. Check if the holes of the valve flange and adapter flange meets as well as any dowel pins (if provided). If yes secure the actuator to the valve using correctly sized fasteners.

i. Uniformly tighten the fasteners of the adapter flange. (refer to page no. 17 for tightening torque of fasteners).

B. Adjustment

**Warning:**

**Note:** No special tools are required for these operations, but only some hexagonal wrenches of the required sizes.

**Important:** The actuator is shipped with a preliminary adjustment and not on the real valve stroke. If it is necessary to change the adjustment, proceed as follows:

a) **Adjustment of mechanical stops**

   After having removed relevant cap nut (item 23 for opening side & item 42 for closing side) & loosening locking nut (item 24 for opening side & item 39 for closing side) rotate the mechanical stops (item 22 for opening side & item 52 for closing side) clockwise or counter-clockwise for adjusting the angular stroke.

   By rotating the mechanical stops (item 22 for opening side & item 52 for closing side) clockwise, the angular stroke is reduced. Rotating counter-clockwise, the angular stroke is increased.
Double acting actuator

**Note:** For Spring return actuators, before adjusting the mechanical stops on the hydraulic cylinder, it is necessary to pressurize the same with required pressure in order to reduce the pressure provided by the spring thrust against the mechanical stop to be adjusted.
When the end cap seals need to be replaced (DA & SR) follow the instructions below:

1. Place the actuator in fail safe position.
2. Remove any electric power and pressure supply.
3. Remove the cap nut (item 42) and clean the surface in contact with the lock nut (item 39) and the internal thread.
4. Remove the locking nut paying attention that the mechanical stop (item 52) does not move from the original position.
5. Remove the existing O-rings (item 36) and clean both surfaces and the thread.
6. Clean the surface of the end flange of the cylinder.
7. Install the new o-rings and apply a grease film.
   (suggested grease: Parker super-o-lube or equivalent)
8. Install the locking nut, applying 45-50Nm torque.
9. Install the cap nut, applying 45-50Nm torque.
10. Restore the normal working condition and pressurize the actuator, checking for leakages through the parts.
11. Restore, if necessary, the paint layer as per the original paint specification.
12. Follow the same instruction for spring container (if available).
b). Verification of Position Indicator

**Warning:**

**Note:** No special tools are required for these operations, but only some Allen wrenches and hexagonal wrenches of the required sizes.

**Position indicator alignment**
Verify the correct indication of the actuator position by the local position indicator:

- **OPEN** when the actuator is in open position. Pointer will be parallel to the axis of the actuator.

- **CLOSED** when the actuator is in closed position. Pointer will be indicating perpendicular to the axis of the actuator.
C. Actuator Start up

a. Arrangement for start-up

**Warning:**

**Note:** No special tools are required for these operations, but only some Allen wrenches and hexagonal wrenches of the required sizes.

Hydraulic connections:

a. Before connecting the actuator to the hydraulic supply line, check that pipes and fittings are according to the applicable plant specifications, in order to guarantee the required oil flow for the operation of the actuator and to avoid that the supply pressure drops below the minimum allowable value.

b. Clean the inside of the pipes used for connection by washing them with suitable detergent and by blowing air into them. Take every precaution to remove any solid or liquid foreign matter from the pipe work to the actuator, so as to avoid possible damages to the actuator itself or loss of performance.

c. Fasten the piping in a right way, in order not to cause loosening of threaded connections, in the event that the system may be subject to strong vibrations.

d. After the completion of the hydraulic connections, operate the actuator in order to ensure that it works correctly. Also check that its operating times are in accordance with those specified in the test certificate and that there are not leakages in the hydraulic connections.

Electric connections:

a. Introduce connection cables.

b. Make the connections in compliance with applicable wiring diagrams on the documentation supplied.

c. Tighten the cable gland.

d. Replace the plastic plugs of unused entries with metal plugs.

b. Start-up

**Warning:**

**Note:** No special tools are required for these operations, but only some Allen wrenches and hexagonal wrenches of the required sizes.

a) Carry out the electrical in accordance with the electrical wiring diagram. Protect the cables by means of a flexible tubing, explosion proof type (if applicable).

b) Check that the pressure of the process supply, as well as its quality (filtering degree, dehydration) are as prescribed.
c) Check that the feed voltage values of the electric components (solenoid valves coils, micro switches, pressure switches etc., if applicable) are as prescribed.

d) Check that the actuator controls, such as remote control, local control, emergency control etc. (if applicable), are properly working in accordance with the schematic diagram.

e) Check that the required remote signals (valve position, oil pressure, etc.) are correct.

f) The setting of the components of the actuator control unit is according to the requirements of the plant.

g) Check that there are no leaks in the hydraulic connections. If necessary tighten the fittings.

h) Bleed the air from the cylinder, if necessary, by removing the plug mounted on the flange.

i) Check the correct working of the actuator with the hydraulic supply and the spring (if applicable) in open and closed direction.

j) Check the correct working of the actuator by means of the manual override hand pump (if applicable).

k) Check the correct hydraulic piping seal.

l) Restore the paintwork of the components which may have been damaged during transportation or commissioning after having removed the rust.

a. Actuators equipped with Hand-Pump

If the hand pump working is not effective, carry out the following draining procedure (refer to DWG. STC212):

a) Completely lift the hand pump lever (1);

b) Loosen the socket head screw (2), in order to exhaust the air from the pump;

c) Completely lower the hand pump lever (1);
d) Tighten the socket head screw (2);
e) Repeat points from a) to d) until the oil drops out from the socket head screw (2).
V. MAINTENANCE

Every maintenance operation on the actuator must be carried out only after having closed the pressure taps in order to prevent undesired operation and enable the operating personnel to work in safe conditions.

If present, shut-off the electric power supply and check the absence of hazardous atmosphere near the actuator.

A. Routine Maintenance

*Warning:*

Every 6 months:

a) Check the correct valve position signalling on the control panel.

b) Check the correct working of the actuator with hydraulic supply by manually stroking the same for a small percentage not to affect the flow in the main line. The actuator shall be operated back to its initial position just after the partial stroke end line is reached. This operation can be automatically performed by means of the partial stroke test facility, if any.

c) If provided with a manual override (hand wheel or hand pump) check the correct working by operating the actuator for a small percentage not to affect the flow in the main line. The actuator shall be operated back to its initial position just after the partial stroke end line is reached.

Every year:

a) Check the lubrication of the scotch yoke and if necessary lubricate with SHELL GADUS S5 or equivalent grease.

b) Check that there is no leakage from the piston rod of the cylinder.

c) Remove, if any, the condensation in the housing, by actuating the pressure relief valve placed on the bottom of the housing.

Every 3 year:

a) If provided with a hand pump override check that the oil is in good condition and that it is always clear.

b) Ensure the oil is changed as per the oil manufacturer’s Material Safety Data Sheet.

*Important: In case of oil change, the replaced oil must be disposed of as special waste, in accordance to the laws applicable in the country where the actuator is installed.*

c) A replacement of all the soft seals in the control panel (where applicable) is suggested.
B. Extraordinary Maintenance

**Warning:**

a) In case of leakage from the hydraulic cylinder, disassemble, clean the O-ring grooves and substitute the O-ring if damaged.

b) If there is a leakage from the hydraulic piping, tighten the fittings, or if necessary, change them if damaged.

c) In case of malfunction or leakage from the actuator, disassemble referring to the disassembly section (from page no. 32). Clean with care and replace damaged components.

**Important:** In case that the actuator or any of its part must be replaced, please follow the instructions of the “Actuator Disposal”.

C. Instruction for replacement of Dynamic seals

**Warning:**

If there are leaks in the hydraulic cylinder or a malfunction in the mechanical components, or in case of scheduled preventative maintenance, the actuator must be disassembled and seals must be replaced with reference to the disassembly section (from page no. 32) and adopting the following procedure.

**Note:** When the seals need to be replaced, it is necessary to check before assembly, that their seats are clean and lubricated.

a) Replacement of Piston seal: (See Figure 1)

For replacing piston seal proceed as described here below:

- Ensure that all pressure is relieved from the cylinder.
- Remove the hex nuts (item 40) and washer (item 41) from the tie rods.
- Remove the end flange (item 32) from liner (item 28).
- Gradually remove the liner from head flange (item 31).
- Remove the O-ring (item 35), and the guide slider (item 37) from piston (item 29). Carefully clean the relative piston grooves.
- Replace the seals and lubricate them with a grease film.

Taking care not to damage the seals, proceed with the reassembling as follows:

- Reassemble the liner and the end flange.
- Uniformly tighten the hex nuts on the tie rod after installing the washers.

Carry out a few operations with the actuator, in order to check that the movement is regular and that there are no leakages through the seals.
b) Replacement Piston rod seal in head flange: (See Figure 1 & 2)

For replacing piston rod seal in head flange proceed as described below:

- Remove the hex nuts (item 40) and washer (item 41) from the tie rods.
- Remove the end flange (item 32) from liner (item 28).
- Gradually remove the liner from head flange (item 31).
- Remove the piston (item 29) from piston rod (item 30) by unthreading it.
- Remove the position indicator assembly from the top of the frame by unscrewing the four socket head screws.
- Remove the frame cover (item 2) with gasket (item 8) by unscrewing the bolts (item 10).
- Remove the 4 bolts (item 44) which holds the head flange to the frame.
- Pull the head flange (item 31) out of the frame (item 1) (housing) and from the piston rod (item 30).
- Remove the O-ring (item 34), Clean the groove and brush with grease.
- Replace the O-ring and to reassemble the actuator, follow the procedure in reverse order.
VI. GREASE AND HYDRAULIC OIL SPECIFICATIONS

A. Grease specification
Manufacturer: Shell
Trade name: Gadus S5 V460 1.5
Colour: Light Brown
Soap type: Lithim Complex
Consistency (NLGI GRADE): 1.5
Cone penetration, Worked at 25°C - ASTM D217: 29-320
Dropping point – IP 396: 260
Oil type: Synthetic
Kinematic Viscosity at 40°C: 460 cSt
Kinematic Viscosity at 100°C: 45 cSt
Equivalent to: Parker, Super-O-Lube

B. Hydraulic oil specification
Manufacturer: Shell
Trade name: Tellus S2 V
Kinematic Viscosity at 40°C: 32 cSt
Kinematic Viscosity at 100°C: 6.1 cSt
Viscosity index – ISO2909: 143
ISO grade: 32
Pour point: -39°C
## VII. TROUBLE SHOOTING & REMEDIES

<table>
<thead>
<tr>
<th>Problems</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actuator doesn't work properly</strong></td>
<td>Lack of hydraulic supply</td>
<td>Check supply line.</td>
</tr>
<tr>
<td></td>
<td>Oil of wrong Viscosity</td>
<td>Refer Page no.30 (or) Consult Cameron Ledeen</td>
</tr>
<tr>
<td></td>
<td>Defective main valve</td>
<td>Consult valve manufacturer documentation.</td>
</tr>
<tr>
<td></td>
<td>Failure of the control group</td>
<td>Consult Cameron Ledeen</td>
</tr>
<tr>
<td></td>
<td>Actuator is incorrectly sized for torque output</td>
<td>Check the sizing criteria for both the Actuator and the Valve.</td>
</tr>
<tr>
<td><strong>Jerky Movement</strong></td>
<td>1. Low hydraulic supply</td>
<td>1. Check hydraulic reservoir.</td>
</tr>
<tr>
<td></td>
<td>2. Air clog in the cylinder</td>
<td>2. Bleed-off the air in oil flow.</td>
</tr>
<tr>
<td></td>
<td>Undersized tubing or components on hydraulic circuit</td>
<td>Consult Cameron Ledeen</td>
</tr>
<tr>
<td></td>
<td>Piston binding in cylinder</td>
<td>Remove cylinder. Check piston &quot;O&quot;-ring for wear, change if necessary. Grease, Reassembly and test.</td>
</tr>
<tr>
<td></td>
<td>Misplaced or broken spring(s) (only for spring return actuator)</td>
<td>Consult Cameron Ledeen After sales service</td>
</tr>
<tr>
<td></td>
<td>Faulty valve.</td>
<td>Consult valve manufacturer documentation.</td>
</tr>
<tr>
<td><strong>Actuator too slow</strong></td>
<td>Low supply pressure</td>
<td>Adjust supply pressure.</td>
</tr>
<tr>
<td></td>
<td>Incorrect speed control settings</td>
<td>Adjust speed controls to increase flow</td>
</tr>
<tr>
<td></td>
<td>Exhaust fluid line is blocked</td>
<td>Remove and clean the exhaust port breathers and replace.</td>
</tr>
<tr>
<td></td>
<td>The valve is jammed</td>
<td>Consult valve manufacturer documentation.</td>
</tr>
<tr>
<td><strong>Actuator too fast</strong></td>
<td>High supply pressure</td>
<td>Reset pressure regulator to suitable pressure</td>
</tr>
<tr>
<td></td>
<td>Incorrect speed control settings</td>
<td>Adjust speed controls to decrease flow</td>
</tr>
<tr>
<td><strong>Leakages on hydraulic circuits</strong></td>
<td>Deterioration and/or damage to gaskets and or loosened fittings</td>
<td>Tighten loose fittings</td>
</tr>
<tr>
<td></td>
<td>Damage to fittings</td>
<td>Consult Cameron Ledeen</td>
</tr>
<tr>
<td><strong>Leakages on hydraulic cylinder</strong></td>
<td>Damage to seals (Rod / Piston / Gasket)</td>
<td>Replace cylinder seals</td>
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<tr>
<td><strong>Foaming of Oil in System</strong></td>
<td>Water in Oil</td>
<td>Check filter breather on reservoir.</td>
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<td>Wrong kind of oil being used</td>
<td>Use oil recommended by manufacturer</td>
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<tr>
<td><strong>Incorrect position of the valve</strong></td>
<td>Wrong adjustment of mechanical stops</td>
<td>Re-adjust setting</td>
</tr>
<tr>
<td></td>
<td>Wrong electric limit switches indication.</td>
<td>Re-adjust setting</td>
</tr>
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</table>
VIII. DISASSEMBLY AND REASSEMBLY

Warning: 

Note: No special tools are required for these operations, but only some Allen wrenches, hexagonal wrenches of the required sizes, Ratchet wrench with extension and Swivel wrench, Torque wrench and Circlip plier.

Note: If the RFID tag has been provided on the actuator that identifies each actuator with a unique number and when any disassembly process is undertaken, all components removed from within the actuator assembly must be reinstalled within that specific actuator during the reassembly process. DO NOT mix components from one actuator assembly with those of a different actuator assembly.
Refer to the Double acting actuator assembly drawing below.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>FRAME SUB ASSEMBLY</td>
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<tr>
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<td>HYDRAULIC CYLINDER SUB ASSEMBLY</td>
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</table>
Refer to the Spring return actuator assembly drawing below.

<table>
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<th>QTY</th>
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<tr>
<td>10</td>
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<tr>
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<td>HYDRAULIC CYLINDER SUB ASSEMBLY</td>
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<th>DESCRIPTION</th>
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<th>DESCRIPTION</th>
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Refer to the Spring return actuator sectional assembly drawing below:

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<td>GUIDE SLIDER</td>
<td>55</td>
<td>CAP NUT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A. Disassembly:

Note: Before removing the actuator from the process piping for inspection by disassembly, check that the operating pressure is at atmospheric pressure. Also check that the pressure within the valve main unit is at atmospheric pressure to assure safety.

Note: If the control valve is intended for the control of fluid containing drastic chemicals that are harmful to human body, be sure to check that the inside of the control valve is washed completely before starting the work.

Note: Before starting disassembly, ensure spare parts seal kit is available as indicated on page 49.

Note: If bearing replacement is expected, contact Cameron for additional instructions.

- Detach the actuator from the valve assembly as the first step before starting to disassemble the actuator and the next step is to remove all the accessories.

1. Ensure that the actuator is in the failed position (i.e., at the end of spring stroke) to disassemble the actuator from the valve assembly. Then lift the actuator (Refer to page no. 12-16) in horizontal orientation and place the actuator assembly on a suitable work bench resting on its base.

2. Remove the hydraulic piping and electric wiring of the accessories carefully and then remove the accessory devices from the actuator.

a. Removing Position Indicator assembly from Frame:

![Diagram of the actuator with labeled parts]

Position indicator
Position indicator o-ring
Hexagonal socket head cap screw
Position indicator flange
Circlip
Position indicator drive bar
Roll pin

Ref: Top of scotch yoke
(Item no: 3
Ref. Sectional assy drg.)
b. **Removal of Spring Container from Frame:** (See the Exploded view below)
(Refer to page 35 for sectional assembly drawing, page 39 for exploded view)

**Note:** Before commencing any disassembly of the actuator, ensure that the actuator is isolated from the supply pressure and mechanical end stops are released.

- Remove frame cover fasteners (item 10).

- Remove the frame cover (item 2) with gasket (item 8) and place it on table away from the actuator.

- If desired, remove the inspection hole flange (item 15) with the gasket (item 16) from frame cover by unscrewing the fasteners (item 17) and place the parts on table away from actuator.

- If desired, remove the dowel pin (item 11) from frame.

- Support the spring container with proper lifting devices (Refer to pages 12-16) for removing the spring container assembly from frame. Now, remove the four socket head screws (item 60), which holds the spring container to the frame (item 1).

- Remove the spring container assembly out of the frame with the lifting devices.

**Note:** Spring pusher is neither connected to guide block nor to the spring container. Care should be take while pulling out the spring container.

- Place the spring container assembly on table away from the frame.

- Remove spring pusher (item 58) from bush of guide block and place it away from the actuator.

- Remove bush from guide block by unthreading it.

- Remove cap nut (item 55) followed by lock nut (item 56) and mechanical stop (item 54) from the spring container flange and place it away from the table.

- If desired remove seal (item 57) from the lock nut.
Spring container exploded view

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>SPRING CONTAINER</td>
<td>1</td>
</tr>
<tr>
<td>54</td>
<td>MECHANICAL STOP</td>
<td>1</td>
</tr>
<tr>
<td>55</td>
<td>CAP NUT</td>
<td>1</td>
</tr>
<tr>
<td>56</td>
<td>LOCK NUT</td>
<td>1</td>
</tr>
<tr>
<td>57</td>
<td>O-RING</td>
<td>2</td>
</tr>
<tr>
<td>58</td>
<td>SPRING PUSHER</td>
<td>1</td>
</tr>
<tr>
<td>59</td>
<td>DU BEARING</td>
<td>1</td>
</tr>
<tr>
<td>60</td>
<td>SOCKET HEAD SCREW</td>
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</tr>
<tr>
<td>61</td>
<td>BUSHING FOR CYL. CENTERING</td>
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</tr>
<tr>
<td>62</td>
<td>BUSH SPRING CONTAINER SIDE</td>
<td>1</td>
</tr>
</tbody>
</table>
c. **Removal of Cylinder sub assembly from Frame & disassembly:**

   (Refer to page: 35 for sectional assembly drawing)

- Remove frame cover fasteners (item 10).
- Remove the frame cover (item 2) with gasket (item 8) and place it on table away from the actuator.
- If desired, remove the inspection hole flange (item 15) with the gasket (item 16) from frame cover by unscrewing the fasteners (item 17) and place the parts on table away from actuator.
- If desired, remove the dowel pin (item 11) from frame.
- Rotate the scotch yoke (item 3) until the hexagonal flats on piston rod (Item 30) besides the guide block (item 7) is accessible.

   **Note:** While using the Wrench, care should be taken that the surface of the Piston Rod is not damaged.

- Unthread the piston rod from the bush of the guide block using a wrench. Place the wrench on the tool kit away from actuator.
- Unthread the bush from the guide block by using wrench. Place the wrench on the tool kit away from actuator.
- Support the cylinder with proper lifting devices (Refer to page 12-16) for removing the cylinder assembly from frame. Now, unscrew the four hexagonal head bolts (item 44) which holds the cylinder to the frame (item 1).
- Remove the cylinder assembly out of the frame with the lifting devices.
- Place the cylinder sub assembly on table away from the frame.
d. **Cylinder sub assembly:**

(See the Exploded view below)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
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<th>DESCRIPTION</th>
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<tr>
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<td>CYLINDER LINER</td>
<td>1</td>
<td>37</td>
<td>GUIDE SLIDER</td>
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<td>46</td>
<td>PLUG</td>
<td>2</td>
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<tr>
<td>29</td>
<td>PISTON</td>
<td>1</td>
<td>38</td>
<td>TIE ROD</td>
<td>4</td>
<td>47</td>
<td>BACKUP RING</td>
<td>2</td>
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<tr>
<td>30</td>
<td>ROD</td>
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<td>39</td>
<td>LOCK NUT</td>
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<td>51</td>
<td>BUSH</td>
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<td>HEAD FLANGE</td>
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<td>40</td>
<td>HEX.NUT</td>
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<td>52</td>
<td>MECHANICAL END STOP</td>
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<tr>
<td>32</td>
<td>END FLANGE</td>
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<td>33</td>
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<td>42</td>
<td>CAP NUT</td>
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<tr>
<td>34</td>
<td>ROD SEAL</td>
<td>1</td>
<td>43</td>
<td>DU-BEARING</td>
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<tr>
<td>35</td>
<td>PISTON SEAL</td>
<td>1</td>
<td>44</td>
<td>SOCKET HEAD CAP SCREW</td>
<td>4</td>
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<tr>
<td>36</td>
<td>O-RING</td>
<td>2</td>
<td>45</td>
<td>PLUG</td>
<td>2</td>
<td></td>
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</tr>
</tbody>
</table>
1. Place cylinder on a suitable work bench in a vertical orientation by resting head flange (item 31) at the bottom to disassemble the cylinder assembly.

2. Remove the cap nut (item 42) & locking nut (item 39) from the mechanical end stop (item 52). Then unthread and remove the mechanical stop by using Allen key and place the parts on table away from work bench.

Note: If Hammering is desired on to the machined parts, use nylon hammer.

3. If desired, remove the seal (item 36) from locking nut.

4. Remove the end flange fasteners (item 40 & 41) from the end flange (item 32) and place the parts on table away from cylinder assembly.

5. Remove the end flange (item 32) from liner (item 28) by using the nylon hammer to tap uniformly around the end flange. Place the end flange on table away from cylinder assembly.

6. If desired, remove the seal (item 33) from end flange.

7. Gradually remove the cylinder liner (item 28) from head flange (item 31) and place it carefully without damaging the inside surface, away from the work bench.

8. Remove bush (item 51) from piston rod (item 30) by unthreading it.

9. Remove the piston and rod subassembly from head flange and place the parts on table away from work bench.

10. Hold the piston (item 29) for unthreading it from piston rod (item 30). Holds the hexagonal slot end of the piston rod and unthread it from piston.

11. Remove the piston from piston rod and carefully place the parts on table away from the work bench without damaging the surfaces of the piston.

12. If desired, remove the seal (item 35) and the guide slider (item 37) from piston.

13. Remove the tie-rods (item 38) one by one from the head flange (item 31) by unthreading it.

14. If desired, remove the external seal (item 33) and internal seal (item 34) from head flange.
e. Frame sub assembly: (See the Exploded view below)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
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<th>ITEM</th>
<th>DESCRIPTION</th>
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<td>2</td>
<td>COVER</td>
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<td>15</td>
<td>FLANGE</td>
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<td>SCOTCH YOKE</td>
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<td>GASKET</td>
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<td>4</td>
<td>BUSHING</td>
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<td>SCREW</td>
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<td>5</td>
<td>SLIDING BLOCK</td>
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<td>6</td>
<td>SLIDING PIN</td>
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<td>MICRO SWITCH PLATE</td>
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<td>7</td>
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<td>21</td>
<td>ROLL PIN</td>
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<td>FRAME SEAL</td>
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<td>END STOP</td>
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<tr>
<td>9</td>
<td>GUIDE BAR</td>
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<td>23</td>
<td>CAP NUT</td>
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<td>10</td>
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<tr>
<td>11</td>
<td>DOWEL PIN</td>
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<td>LOCK NUT</td>
<td>1</td>
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<tr>
<td>12</td>
<td>CIRCLIP</td>
<td>2</td>
<td>26</td>
<td>BUSHING</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>DU-BEARING</td>
<td>2</td>
<td>27</td>
<td>SOCKET HEAD CAP SCREW</td>
<td>4</td>
</tr>
</tbody>
</table>
Disassembly of Frame sub assembly:

**Note:** Point 1 – 3 is for Double acting models. For Spring return skip these points 1 – 3.

1. In order to remove the end stroke assembly from the frame which is at the opposite side of the hydraulic cylinder, remove the fasteners (item 27) of plate for end stroke (item 19) and remove.
2. Now loosen and remove the cap nut (item 23), locking nut (item 24) and mechanical stop (item 22) from plate. Place the parts on table away from the frame.
3. If desired, remove the seal (item 25) from locking nut.
4. Remove bush (item 26) from guide block (item 7) by unthreading it.
5. Remove the guide bar (item 9) completely out of the frame by hammering into the other side (Use Nylon hammer).
6. Remove scotch yoke (item 3) from the frame along with the guide block assembly and place it on table away from the frame.
7. Remove the external circlip which hold the guide block assembly to scotch yoke with proper tool. Then remove the sliding block (item 5) and sliding pin (item 6) from guide block (item 7) and place the parts on table away from the frame.
8. If desired, remove the position indicator drive bar (item 20 ref page 49) from scotch yoke.
9. Disassembly of the actuator is now complete.

**B. Reassembly:**

a. Frame sub assembly (Refer the page 43 for frame exploded view)

**Note:** With the actuator fully disassembled into its component parts, each part should be thoroughly cleaned and inspected. Any parts damaged or worn out should be replaced. It is recommended as a minimum to replace all sealing components, and to replace the internal components if any damage or erosion is present.

**Note:** Ensure that all parts and all necessary tools are available and are clean. Ensure the cleanliness of the work bench.

**Note:** During seal assembling, remove dust from the groove and apply grease.

- Place the actuator frame (item 1) on a suitable work bench in horizontal orientation resting on its base.
- Locate two sliding blocks (item 5) and circlips (item 12). Install it into the guide block (item 7).
- Check the bearing inside the guide block and apply grease film. Mount the guide block assembly into the scotch yoke (item 3).
- Locate scotch yoke seals (item 18). Place the seals in top and bottom bushings (item 4) assembled on the frame bottom plate & cover.
• Locate the position indicator drive bar (item 20) and its roll pins (item 21). Install it on to the scotch yoke in appropriate position.

• Lift the scotch yoke assembly and align over the bore of actuator frame.

• Slowly lower scotch yoke assembly into the bore of the actuator frame ensuring that the scotch yoke assembly completely engages within the bushing (item 4) placed in the actuator frame.

• Locate guide bar (item 9).

• Lightly grease the outside diameter of the guide bar. Install the guide bar into the appropriate opening on the side of the frame where hydraulic cylinder is meant to be assembled.

• Position the guide block assembly bore in a way such that it is aligned with guide bar.

• Use nylon hammer to push the guide bar gradually until it seats on the other side of the frame. Ensure that the guide bar enters through the guide block assembly before reaching the other end of the frame.

• Ensure the smooth rotation of scotch yoke and linear movement of guide block assembly before proceeding to further assembly.

**Note:** For double acting actuator follow the below steps before mounting the hydraulic cylinder, otherwise skip these steps.

• Locate the mechanical stop (item 22), cap nut (item 23), plate for end stroke (item 19) and lock nut with seals (item 24).

• Lightly grease the threads on the plate where mechanical stop is going to be assembled.

• Install the mechanical stop in position of actuator frame and set the stroke required by the actuator. Rotating the mechanical stop clockwise reduces the angular stroke and rotating it counter-clockwise increases the angular stroke.

• Install the lock nut seal in its grooves and apply grease film. (Suggested grease: Parker super-o-lube or equivalent) Install the lock nut by screwing into the mechanical stops by applying 45-50 Nm torque.

• Finally install the cap nut by screwing in to the mechanical stop.

**Note:** Frame shall not be closed with frame cover at this stage, Once the cylinder sub assembly & spring container (If available) is assembled, the frame shall be closed.

b. Cylinder sub assembly (Refer page 41 for hydraulic cylinder exploded view)

**Note:** Ensure that all parts and all necessary tools are available and are clean. Ensure the cleanliness of the work bench.

**Note:** During seal assembling, remove dust from the groove and brush with grease.
1. Place the cylinder head flange (item 31) on a suitable work bench in horizontal orientation (if cylinder must be mounted on spring return actuator arrange the head flange directly on frame side). Make sure that seal groove side face is visible.

2. Locate the head flange external (item 33) and internal seals (item 34) and carefully place it in its grooves.

3. Locate piston (item 29). Install the piston seal (item 35) and guide slider (item 37) to the piston and gradually screw the piston assembly into the piston rod.

*Note: While threading the piston rod in the piston apply Loctite 243 for thread fixing.*

4. Install the piston and rod assembly in a vertical position in such a way that the piston rod projects out of the head flange. Care should be taken not to damage the cylinder liner as well as the piston seals. (If cylinder must be mounted on double acting actuator go to point “3 in c” to assemble piston rod into the guide block of the frame)

5. Locate the liner (item 28). Slide the liner over the piston seal and the head flange seal without damaging the seals.

6. Locate the tie rods (item 38) and thread them into head flange.

7. Locate the end flange seal and install the seal in the end flange groove.

8. Locate the end flange (item 32) and slowly lower it into the cylinder liner and in the tie rods. Ensure the oil supply ports are properly oriented with the oil supply ports on the head flange.

9. Locate the tie rod nuts, Install and tighten to secure the end flange, once adjustments have been made to ensure proper alignment of end flanges and that the tie-rods are perpendicular (square) to the end flanges.

10. Locate the mechanical stop (item 52), lock nut (item 39) with seals (item 36)

11. Lightly grease the threads on the end flange where mechanical stop is going to be assembled.

12. Install the mechanical stop in position of end flange and set the stroke required by the actuator. Rotating the mechanical stop clockwise reduces the angular stroke and rotating it counter-clockwise increases the angular stroke.

13. Install the lock nut seal in its grooves and apply grease film. (Suggested grease: Parker super-o-lube or equivalent) Install the lock nut by threading onto the mechanical stops (applying 45-50 Nm torque) followed by cap nut.

c. **Assembling Cylinder sub assembly in to the Frame sub assembly:**

(Refer page 35-36 for sectional assembly drawing)

1. Place the actuator frame assembly in a vertical position to admit the cylinder assembly into the frame bore.

2. Gradually lower the cylinder assembly into the frame bore.

3. Thread the bush (item 51) into the guide block by using a wrench. Ensure that the bush threaded correctly and does not skip threads.
**Note:** While threading the bush into the guide block apply Loctite 243 for thread fixing.

While using the wrench, care should be taken that the surface of the Piston Rod is not damaged.

4. Thread the piston rod into the bush of the guide block by using a wrench. Ensure that the piston rod threaded correctly and does not skip threads.

5. Locate the hexagonal socket head screws (item 44).

6. Secure the cylinder sub assembly in position by means of fasteners (item 44).

**Note:** If it is a Spring return Actuator proceed directly to point d. "Assembling Spring container assembly in to the Frame assembly".

If it is a Double acting actuator continue with the below steps.

7. Place the actuator assembly on a suitable work bench in a horizontal orientation with the actuator frame resting on its base.

8. Locate the frame gasket (item 8) and frame cover (item 2) assembly.

9. Check the bushing in frame cover and apply grease film.

10. Slowly lower the frame cover and place in position by means of locating pins and fasteners.

11. Locate the position indicator assembly and install it in position of frame cover in the same axis as that of the scotch yoke.

12. Ensure that the position indicator shaft is correctly located into the position indicator drive bar.

13. Reassembly of the double acting actuator is now complete.

d. Assembling Spring container assembly in to the Frame assembly:

(Refer page 35-36 for sectional assembly drawing)

1. Lift and turn the actuator in a vertical orientation, Place it on the hydraulic cylinder flange on a wooden or rubber support.

2. Thread the bushing (item 62) into the guide block by using a wrench.

**Note:** While threading the bushing into the guide block apply Loctite 243 for thread fixing.

3. Guide the spring pusher (item 58) through frame side bore and assemble it into the bushing of the guide block in a vertical position.

4. Gradually lower the spring container assembly guiding the pusher rod into the bushing of the spring container bore.
5. Locate the hexagonal socket head screws (item 60).
6. Secure the spring container assembly in position by means of fasteners (item 60).
7. Place the actuator assembly on a suitable work bench in a horizontal orientation with the actuator frame resting on its base.
8. Locate the frame gasket (item 8) and frame cover (item 2) assembly.
9. Check the bushing in frame cover and apply grease film.
10. Slowly lower the frame cover and place in position by means of locating pins and fasteners.
11. Locate the position indicator assembly and install it in position of frame cover in the same axis as that of the scotch yoke.
12. Ensure that the position indicator shaft is correctly located into the position indicator drive bar.
13. Reassembly of the spring return actuator is now complete.

C. Adjustment after assembly:

Check the following when assembly is completed. If satisfactory result is not obtained, disassemble the actuator again, find the cause, and assemble it back together.

1. Check valve opening and closing positions
2. Performance Check and Adjustment
   • Check that the actuator operates smoothly when specified oil pressure is applied to it.
   • Check for leakages through the cylinder and frame seals.
IX. SPARE PARTS

1. **Frame sub Assembly**
   (Refer to frame assembly exploded view on page 43):
   
   - Item 8, qty. 1
   - Item 16, qty. 1
   - Item 18, qty. 2

2. **End stroke Assembly (For double acting actuator)**
   (Refer to frame assembly exploded view on page 43):
   
   - Item 24, qty. 2

3. **Cylinder sub Assembly**
   (Refer to hydraulic cylinder assembly exploded view on page 41):
   
   - Item 33, qty. 2
   - Item 37, qty. 1
   - Item 35, qty. 1
   - Item 34, qty. 1
   - Item 36, qty. 2
   - Item 47, qty. 2

4. **Spring container Assembly**
   (Refer to spring container assembly exploded view on page 39):
   
   - Item 57, qty. 2