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Release – June 2019

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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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VIII. SPARE PARTS ................................................................................................................................. 44
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 pneumatic 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:

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

Where:

\[ \text{CE} \quad = \quad \text{symbol of conformity to the EU applicable directives} \]

\[ \text{Ex} \quad = \quad \text{ATEX symbol} \]

\[ \text{II} \quad = \quad \text{group II (surface)} \]

\[ 2 \quad = \quad \text{apparatus of category 2} \]

\[ G \quad = \quad \text{explosive atmosphere with presence of gas, vapours, fogs} \]

\[ c \quad = \quad \text{type of protection} \]

\[ \text{Tx} \quad = \quad \text{temperature class} \]

<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>
<td>Zone 1</td>
</tr>
<tr>
<td>Gas, fog or vapours</td>
<td>Zone 2</td>
</tr>
</tbody>
</table>
L. Actuator Name plate description

The actuator nameplate shows the following data:

2. Order No.
3. Item No.
4. Actuator model
5. Valve size
6. Year of manufacturing
7. Actuator Serial No.
8. Actuator Tag No.
9. 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 pneumatic 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.
• It is recommended to store the actuator in a covered, closed crate, along with suitable rust protector.
• 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:*

<table>
<thead>
<tr>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram showing incorrect lifting method" /></td>
<td><img src="image2" alt="Diagram showing correct lifting method" /></td>
</tr>
</tbody>
</table>

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

![Diagram of lifting devices with chains and angles](image)

<table>
<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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<td>45° &lt; β ≤ 60°</td>
<td>0° &lt; α ≤ 90°</td>
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<td>Factor 1.12</td>
<td>Factor 2.1</td>
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<td>1.12</td>
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LIFTING DEVICES MAXIMUM WORKLOAD

Slings

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<th>Width</th>
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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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<td>1000</td>
<td>2000</td>
<td>1400</td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>1.5 T</td>
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<td>1200</td>
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<td>28,000</td>
<td>16,000</td>
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</table>
GS DOUBLE ACTING

LIFTING POINT

MAX 45°

GS SPRING RETURN WITH HAND WHEEL

LIFTING POINT

MAX 45°

LIFTING POINT

Rope

MAX 45°

LIFTING POINT

MAX 45°

LIFTING POINT

MAX 45°

LIFTING POINT

MAX 45°

ATTENTION: LOCATE SLINGS SUCH THAT THEY WILL NOT IMPACT OR OTHERWISE IMPOSE FORCES ON TUBING DURING LIFTING OPERATIONS

INSTRUCTION APPlicable TO THE FOLLOWING MODELS:

GS 2

GS 6

CENTER OF GRAVITY
### Non Teflon-Coated Tie-Rods

<table>
<thead>
<tr>
<th>Tie Rod Type</th>
<th>Pitch mm</th>
<th>Tightening Torque - Nm (±5%)</th>
<th>Mat. (1)</th>
<th>Mat. (2)</th>
<th>Mat. (3)</th>
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</table>

### Teflon-Coated Tie-Rods

<table>
<thead>
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<th>Tie Rod Type</th>
<th>Pitch mm</th>
<th>Tightening Torque - Nm (±5%)</th>
<th>Mat. (1)</th>
<th>Mat. (2)</th>
<th>Mat. (3)</th>
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**Note:**
- Column Mat.(1) applicable to the following materials: A193 B7M, A320 L7M, A453 Gr.660B, B3 4682, A193 B7 (M > M 100)
- Column Mat.(2) applicable to the following materials: A320 L7, A320 L43, A193 B7, 39NC/Mo3 (M < M 100)
- Column Mat.(3) applicable to the following materials: A193 B8 Classe 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 pneumatic 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 pneumatic 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)

Warning: 

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

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).

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:

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, with the complete adapter assembly already bolted (the valve stem adapter is held in place by a spigot), 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. 12-15)

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 valve stem enters the actuator adapter. 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.*

![Diagram of Valve Stem Adapter and Adapter](image)

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. 16 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 loosened the cap nuts (item 360) rotate the travel stops (item 150) clockwise or counter-clockwise for adjusting the angular stroke,

By rotating the travel stops (item 150) clockwise, the angular stroke is reduced. Rotating counter-clockwise, the angular stroke is increased.

Note: In case of Spring return actuators, before adjusting the travel stop relevant to the cylinder, it is necessary to pressurize the same with low pressure in order to reduce the pressure provided by the spring thrust against the travel stop to be adjusted.
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: ![Safety Symbol]

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

Pneumatic connections:

a. Before connecting the actuator to the pneumatic supply line, check that pipes and fittings are according to the applicable plant specifications, in order to guarantee the required air 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 pneumatic 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 pneumatic 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: ![Safety Symbol]

**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.

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, air 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 pneumatic connections. If necessary tighten the fittings.

h) Check the correct working of the actuator with the pneumatic supply in open and closed direction.

i) Restore the paintwork of the components which may have been damaged during transportation or commissioning after having removed the rust.
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 pneumatic 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 pneumatic cylinder, disassemble, clean the O-ring grooves and substitute the O-ring if damaged.

b) If there is a leakage from the pneumatic 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. 17). 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 pneumatic 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. 17) 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:

• Unscrew the nuts from the tie rods.
• Remove the end flange (item 50) from liner.
• Gradually remove the liner (item 10) from head flange.
• Remove the O-ring (item 320), and the guide slider (item 80) from piston (item 20). 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 screw the nuts on the tie rod

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 seals: (See Figure 2)

After removing the liner (as per the description of point “a”) for replacing piston rod seal proceed as described here below:

- Unscrew the hexagonal nut of the piston.
- Pull the Piston out of the Rod.
- Remove the O-ring (item 380), Clean the groove and brush with grease.
- Replace the O-ring and to reassemble the actuator, follow the disassembly procedure in reverse order.
c) Replacement Piston rod seal in head flange: (See Figure 3)

After removing the piston (as per the description of point “b”) for replacing piston rod seal in head flange proceed as described here below:

- Remove the position indicator arrow from the top of the frame by unscrewing the lock screw.
- Remove the frame cover (item 2) followed by gasket (item 8) by unscrewing the ten number of bolts (item 14).
- Unscrew the 4 bolts (item 30) which hold the head flange to the frame.
- Pull the head flange out of the frame (item 1) (housing) and from the piston rod.
- Remove the O-ring (item 300), Clean the groove and brush with grease.
- Replace the O-ring and to reassemble the actuator, follow the disassembly procedure in reverse order.

![Figure 3](image-url)
## VI. TROUBLE SHOOTING & REMEDIES

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<thead>
<tr>
<th>Problems</th>
<th>Possible cause</th>
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<td>Check supply line.</td>
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<td>Defective main valve</td>
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<td>Failure of the control group</td>
<td>Consult Cameron Ledeen.</td>
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<td>Actuator is incorrectly sized for torque output against the Valve torque.</td>
<td>Check the sizing criteria for both the Actuator and the Valve.</td>
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<td>Undersized tubing or components on pneumatic circuit</td>
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<td>Piston binding in cylinder</td>
<td>Remove cylinder. Check piston o-ring for wear, change if necessary. Grease, Reassembly and test.</td>
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<td>Faulty Valve</td>
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<td>Incorrect speed control settings</td>
<td>Adjust speed controls to increase flow</td>
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<td>Exhaust port blocked</td>
<td>Remove and clean the exhaust port silencers and replace</td>
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<td>The valve is jammed</td>
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<td>Tighten loose fittings Consult Cameron Ledeen.</td>
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<td>Damage to fittings</td>
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<td>Leakages on pneumatic cylinder</td>
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<tr>
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<td>Wrong adjustment of mechanical stops</td>
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<td>Wrong electric limit switches indication.</td>
<td>Re-adjust setting.</td>
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VII. 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.

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.

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Refer to the Spring return actuator assembly drawing below.

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Refer to the Spring return actuator sectional assembly drawing below:

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<td>14</td>
<td>SCOKET HEAD CAP SCREW</td>
<td>29</td>
<td>O-RING</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECTION A-A**
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 43.

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. 12-15) in horizontal orientation and place the actuator assembly on a suitable work bench resting on its base.

2. Remove the air piping and electric wiring of the accessories carefully and then remove the accessory devices from the actuator.
a. Removing Position Indicator assembly from Frame:
b. **Removal of Spring Container from Frame**: (See the Exploded view below)

(Refer pages 30 & 31 for sectional assembly drawings)

- Remove frame cover fasteners (item 300).
- Remove the frame cover (item 20) with gasket (item 90) and place it on table away from the actuator.
- If desired, remove the inspection hole flange (item 120) with the gasket (item 100) from frame cover by unscrewing the four hexagonal head bolts (item 310) and place the parts on table away from actuator.
- If desired, remove the dowel pin (item 380) from frame.
- Support the spring container with proper lifting devices (Refer to page 12-15) for removing the spring container assembly from frame. Now, unscrew the four socket head screws (item 80) which holds the spring container to the frame (item 10). Remove the spring container assembly out of the frame with the lifting devices.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
<td>SPRING CONTAINER</td>
</tr>
<tr>
<td>70</td>
<td>1</td>
<td>DU BEARING</td>
</tr>
<tr>
<td>80</td>
<td>4</td>
<td>SOCKET HEAD SCREW</td>
</tr>
<tr>
<td>90</td>
<td>1</td>
<td>PUSHER ROD</td>
</tr>
</tbody>
</table>
• Place the cylinder assembly on table away from the frame.

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

• Remove pusher rod from frame and place it away from the actuator.

c. **Removal of Cylinder sub assembly from Frame & disassembly:**
   (Refer to Frame Exploded view in Page 38)

• Remove frame cover fasteners (item 300).
• Remove the frame cover (item 20) with gasket (item 90) and place it on table away from the actuator.
• If desired, remove the inspection hole flange (item 120) with the gasket (item 100) from frame cover by unscrewing the four hexagonal head bolts (item 310) and place the parts on table away from actuator.
• If desired, remove the dowel pin (item 380) from frame.
• Rotate the Scotch yoke (item 30) until the hexagonal flats on piston rod besides the guide block (item 80) is accessible.

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

• Unscrew the piston rod from the guide block using a wrench. Place the wrench on the tool kit away from actuator.
• Support the cylinder with proper lifting devices (Refer to pages 12-15) for removing the cylinder assembly from frame. Now, unscrew the four hexagonal head bolts (item 30) which holds the cylinder to the frame (item 10). 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>
<th>QTY</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>CYLINDER LINER</td>
<td>1</td>
<td>90</td>
<td>TIE ROD</td>
<td>4</td>
<td>300</td>
<td>O-RING</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>PISTON</td>
<td>1</td>
<td>170</td>
<td>SOCKET HEAD SCREW</td>
<td>4</td>
<td>310</td>
<td>O-RING</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
<td>ROD</td>
<td>4</td>
<td>200</td>
<td>HEX NUT</td>
<td>4</td>
<td>320</td>
<td>O-RING</td>
<td>1</td>
</tr>
<tr>
<td>40</td>
<td>HEAD FLANGE</td>
<td>1</td>
<td>210</td>
<td>WASHER</td>
<td>4</td>
<td>340</td>
<td>HEX NUT</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td>END FLANGE</td>
<td>1</td>
<td>230</td>
<td>PLUG</td>
<td>2</td>
<td>380</td>
<td>O-RING</td>
<td>1</td>
</tr>
<tr>
<td>80</td>
<td>GUIDE SLIDER</td>
<td>1</td>
<td>240</td>
<td>DU BEARING</td>
<td>1</td>
<td>420</td>
<td>LIFT TAB</td>
<td>1</td>
</tr>
</tbody>
</table>
1. Place cylinder on a suitable work bench in a vertical orientation by resting head flange (item 40) at the bottom to disassemble the cylinder assembly.

2. Remove the end flange fasteners (item 200,210) along with the lifting bracket (item 420) from the end flange (item 50) and place the parts on table away from cylinder assembly.

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

3. Remove the end flange (item 50) from liner (item 10) by using the nylon hammer to tap uniformly around the end flange. Place the end flange on table away from cylinder assembly.

4. If desired, remove the seal (item 310) from end flange.

5. Remove the piston and rod subassembly from cylinder liner and place the parts on table away from work bench.

6. Place the piston resting on its bottom on a suitable work bench for removing the piston (item 20) from piston rod (item 30). Hold the hexagonal slot end of the piston rod and unscrew the piston nut (item 340) with the help of a box spanner. Place the parts on table away from work bench.

7. 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.

8. If desired, remove the seal (item 320) and the guide slider (item 80) from piston.

9. If desired, remove the seal (item 380) from piston rod.

10. Gradually remove the cylinder liner (item 10) from head flange (item 40) and place it carefully without damaging the inside surface, away from the work bench.

11. Remove the tie-rods (item 90) one by one from the head flange (item 40) by unscrewing it.

12. If desired, remove the external seal (item 310) and internal seal (item 300) from head flange.
e. Frame sub assembly: (See the Exploded view below)
Disassembly of Frame:

1. In order to remove the closing flange (item 3840) from the frame which is at the opposite side of the pneumatic cylinder, unscrew and remove the closing flange fasteners (item 3850 & 3860).
2. Now remove the seals which were present in between the closing flange and the frame.
3. Remove the guide bar (item 130) completely out of the frame by hammering in to the other side (Use Nylon hammer).
4. If desired, remove the seal (item 470) from guide bar.
5. Remove scotch yoke (item 30) from the frame along with the guide block assembly (item 60) and place it on table away from the frame.
6. Remove the guide block assembly from scotch yoke and individually remove the bronze sliding block (item 50) and place on table away from the frame.
7. If desired, remove the position indicator drive bar (Ref page 33) from scotch yoke.
8. If desired, remove the seal (item 460) from scotch yoke.
9. Finally remove the end stroke dowel (item 140) after removing the cap nut (item 360) and place on table away from the frame.
10. If desired, remove the seal (item 2310) from cap nut.
11. Disassembly of the actuator is now completed.

B. Reassembly:

a. Frame sub assembly (Refer the page 38 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 10) on a suitable work bench in horizontal orientation resting on its base.
- Locate two sliding blocks (item 50) and install it into the guide block (item 60) and mount the guide block assembly into the scotch yoke.
- Locate scotch yoke seals (item 460). Place the seal in its grooves on the outside of scotch yoke (item 30).
- Locate the position indicator drive bar and its roll pins. 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 40) placed in the actuator frame.
- Locate guide bar (item 130).
- Locate two guide bar seals (item 470) and place it in the grooves of guide bar.
- Lightly grease the outside diameter of the guide bar. Install the guide bar into the appropriate opening on the side of the frame where pneumatic 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.
- Locate the end stroke dowels (item 140), cap nuts (item 360) and its seals (item 2310).
- Lightly grease the threads on the frame where end stroke assembly is going to be assembled.
- Install the two end stroke dowel pins in position of actuator frame and set the stroke required by the actuator. Rotating the dowel pins clockwise reduces the angular stroke and rotating them counter-clockwise increases the angular stroke.
- Install the cap nut seal in its grooves and apply grease film (Suggested grease: Parker super-o-lube or equivalent).
- Clean the surface in contact with the frame and install both the cap nuts into the corresponding dowel pins applying 45-50 Nm torque.

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 into frame** (Refer to pages 30-31 for sectional assembly drawings)

**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 40) 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 and internal seals and carefully place it in its grooves.
3. Locate the piston rod seal (item 380). Install the seal in its grooves.
4. Locate piston (item 20). Install the piston seal (item 320) and guide slider to the piston and gradually install the piston assembly into the piston rod.

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

5. Locate hexagonal nut (item 340) (piston nut). Assemble the piston into the piston rod by means of this hexagonal nut and apply Loctite 243.
6. 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 3.c on page 47 to assemble piston rod into the guide block of the frame)
7. Locate the liner (item 10). Slide the liner over the piston seal and the head flange seal without damaging the seals.
8. Locate the tie rods (item 90) and mount them by screwing it into head flange.
9. Locate the end flange seals and install the seal in the end flange groove.
10. Locate the end flange (item 50) and slowly lower it into the cylinder liner and in the tie rods. Ensure the air supply ports are properly oriented with the air supply ports on the head flange.
11. Locate the tie rod nuts, Install and tighten to secure the end flange.

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

(For points 1-5, refer to pages 36 & 38 for Exploded view)

1. Place the actuator frame assembly in a vertical position to admit the cylinder assembly into the frame bore.
2. Locate the frame side seals (items 2580 and 2590) and place them into frame grooves.
3. Gradually lower the cylinder assembly into the bushing of the frame bore.
4. Screw the piston rod into the guide block by using a wrench.
Note: While using the wrench, care should be taken that the surface of the Piston Rod is not damaged.

5. Locate the hexagonal socket head screws (item 170).
6. Secure the cylinder assembly in position by means of fasteners (item 170).

Note: If it is a Spring return Actuator proceed directly to point D. “Assembling Spring container assembly in to the Frame assembly”.

(For below points, refer to pages 30 for Sectional view & 38 for frame Exploded view)

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 closing flange (item 3840), fasteners (item 3850 & 3860) and seals of closing flange.
9. Install seals and then mount the closing flange in the frame in such a way that it serves as a blowout proof for the guide bar (item 140) thereby closing the guide bar slot in the frame.
10. Carefully apply the tightening torque to the closing flange fasteners (item 3850 & 3860) so that the seals are not damaged.
11. Locate the frame gasket (item 90) and frame cover (item 20) assembly and slowly lower and place in position by means of pins (item 380) and fasteners (item 300).
12. Locate the position indicator assembly and install it in position of frame cover in the same axis as that of the scotch yoke.
13. Ensure that the position indicator shaft is correctly located into the position indicator drive bar.
14. Reassembly of the double acting actuator is now complete.

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

(For points 1-5, refer page 34 & 38 for Exploded view)

1. Lift and turn the actuator in a vertical orientation, Place it on the pneumatic cylinder flange on a wooden or rubber support.
2. Place the pusher rod (item 90) on to guide through frame side bore and assembly into guide block in a vertical position.
3. Locate the frame side seals (items 2580 and 2590) and place them into frame grooves.
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 80)
6. Secure the spring container assembly in position by means of fasteners (item 80).
(For below points, refer to pages 30-31 for Sectional view & 38 for frame Exploded view)

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 90) and frame cover (item 20) assembly and slowly lower and place in position by means of pins (item 380) and fasteners (item 300).

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

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

11. 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 air pressure is applied to it.
   - Check for leakages through the cylinder and frame seals.
VIII. SPARE PARTS

1. Frame sub Assembly
   (Refer to frame assembly exploded view on page 38):
   - Item 70, qty. 1
   - Item 110, qty. 1
   - Item 450, qty. 2
   - Item 460, qty. 2
   - Item 470, qty. 2
   - Item 2310, qty. 2
   - Item 2580, qty. 8
   - Item 2590, qty. 2

2. Cylinder sub Assembly
   (Refer to pneumatic cylinder assembly exploded view on page 36):
   - Item 80, qty. 1
   - Item 300, qty. 1
   - Item 310, qty. 2
   - Item 320, qty. 1
   - Item 380, qty. 1

3. Spring container Assembly
   (Refer to spring container assembly exploded view on page 34):
   - No spares required.