



USER INSTRUCTIONS

LPS Pneumatic Heavy-Duty Actuator Series Single Acting & Double Acting

FCD LFENIM0001-05-A4 09/18

*Installation
Operation
Maintenance*



Experience In Motion

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1 Standard Information




Using Flowserve Valves, Actuators and Accessories Correctly

The following instructions are designed to assist in unpacking, installing and performing maintenance as required on the LPS Actuator Series. Product users and maintenance personnel should thoroughly review this bulletin prior to installing, operating or performing any maintenance.

In most cases Flowserve actuators and accessories are designed for specific applications with regard to medium, pressure and temperature. For this reason they should not be used in other applications without first contacting the manufacturer.

1.1 Terms Concerning Safety

The safety terms **DANGER**, **WARNING**, **CAUTION** and **NOTE** are used in these instructions to highlight particular dangers and/or to provide additional information on aspects that may not be readily apparent.

-  **DANGER:** indicates that death, severe personal injury and/or substantial property damage will occur if proper precautions are not taken.
-  **WARNING:** indicates that death, severe personal injury and/or substantial property damage can occur if proper precautions are not taken.
-  **CAUTION:** indicates that minor personal injury and/or property damage can occur if proper precautions are not taken.
- NOTE:** indicates and provides additional technical information, which may not be very obvious, even to qualified personnel.

Compliance with other, not particularly emphasized notes, with regard to transport, assembly, operation and maintenance and with regard to technical documentation (e.g., in the operating instruction, product documentation or on the product itself) is essential, in order to avoid faults, which in themselves might directly or indirectly cause severe personal injury or property damage.

1.2 General Usage

To prolong actuator life, use only clean, dry pneumatic supply fluids. Lubricated fluids are not required for LPS actuators. Pay attention to follow positioner and other control prescriptions, regarding supply fluid instrument air.

The LPS actuator standard ambient temperature range is: -29°C to 100°C (-20°F to 212°F). Low temperature -60°C (-76°F) and High temperature 160°C (320°F) ranges (polar, cold, arid and tropical temperature requirements in accordance with IEC 60721) are available with different materials of construction. In any case, please refer to the temperature range located in the actuator nameplate.

NOTE: For PED certified applications the standard operating temperature range is -20°C to 100°C (-4°F to 212°F). For lower temperature applications the range can be extended to -40°C to +100°C (-40°F to 212°F) or -50°C to +100°C (-58°F to 212°F) with different materials of construction. In any case, please refer to the temperature range specified on the actuator nameplate.

It is the end user's responsibility to guarantee that the ambient temperature is in accordance with the actuator nameplate indications.

▲ WARNING: Do not exceed the minimum and maximum allowable temperatures indicated on the actuator nameplate. Additional factors like the valve and pipe temperatures, sun direct exposure and other environmental conditions shall be considered, not to exceed the temperature range.

▲ WARNING: Do not exceed the allowable pressure range of the supply fluid, as stated in the actuator nameplate. It is very important to make the standard maintenance at all safety components. In case of PED certified cylinders the value of design pressure of the cylinder is indicated on a specific and separate nameplate; it is necessary to verify that the supply line to the actuator does not exceed the design pressure stated in the cylinder nameplate.

NOTE: The standard supply fluids are instrument air and nitrogen. Different types of fluids may be used only after Flowserve verification. In case of PED certified cylinders the type of fluid is indicated on the specific nameplate on the cylinder.

▲ WARNING: Only use the recommended type of fluid that is indicated on the nameplate (PED cylinders) and/or in the contract.

NOTE: The supply fluid must be properly filtered. In case of positioner and/or other components installed on the control panel, take care that the cleanliness, the filtration and the dehydration of the supply fluid are in accordance with the requirements of these accessories indicated on their own maintenance and user manuals.

NOTE: The actuators meet the number of cycles required by Standard EN15714.

1.3 Protective Clothing

Flowserve products are often used in dangerous applications (e.g., extremely high pressures, flammable, combustible, toxic or corrosive media). When performing service, inspection or repair operations, always ensure that the valve and actuator are depressurized and that the valve has been cleaned and is free from harmful substances. In such cases pay particular attention to personal protection equipment (protective clothing, gloves, glasses, etc.).

1.4 Qualified Personnel

Only qualified personnel should perform installation, operation or maintenance activities. Qualified personnel are people who, on account of their training, experience, instruction and their knowledge of relevant standards, specifications, accident prevention regulations and operating conditions, have been authorized by those responsible for the safety of the plant to perform the necessary work and who can recognize and avoid possible dangers.

1.5 Other Requirements for In-plant Installation

- Pipelines must be correctly aligned to ensure that the valve is not fitted under tension.
- If not expressly agreed, fire protection is not supplied along with the actuator and it must be provided by the user.

1.6 Spare Parts

Use only Flowserve brand original spare parts. Flowserve cannot accept responsibility for any damages that occur from using spare parts or fastening materials from other manufacturers. If Flowserve products (especially sealing materials) have been in storage for long periods, check these for corrosion or deterioration before using these products. A table with the list of the main spare parts for standard ON/OFF applications with the interval times can be found in Paragraph 4.5 at Table 1.

1.7 Service/Repair

To avoid injury to personnel or damage to products, safety terms must be strictly adhered to. Modifying this product, substituting non-factory parts, or using maintenance procedures other than as outlined in this instruction could drastically affect performance and be hazardous to personnel and equipment, and may void existing warranties.

Between actuator and valve there are moving parts. To avoid injury, Flowserve provides pinch-point-protection in the form of cover plates, especially where side-mounted positioners are fitted. These protections are according to Machine Directive 2006/42/EC recommendations. If these plates are removed for inspection, service or repair special attention is required. After completing work the cover plates must be refitted.

In addition to the operating instructions and the obligatory accident prevention directives valid in the country of use, all recognized regulations for safety and good engineering practices must be followed.

- ▲ **WARNING:** Before products are returned to Flowserve for repair or service, Flowserve must be provided with a certificate which confirms that the product has been decontaminated and is clean. Flowserve will not accept deliveries if a certificate has not been provided (a form can be obtained from Flowserve).

1.8 Actuator Lifting and Handling

Only Allen wrenches and hexagonal wrenches of the few sizes are required for the overall operations. The lifting equipment consists on commercial chains and slings of adequate dimensions.

In order to prevent damage to actuator accessories, before starting the lifting operations, ensure that the lifting tools, like chain and clevis hook, are in the correct position and don't interfere with the control panel and related tubing.

- ▲ **CAUTION:** Lifting and handling of the actuator should be done by qualified personnel and in compliance with the laws and regulations in force.
- ▲ **WARNING:** The lifting lugs or eyebolts are appropriate for actuator lifting only. They are not designed to support the combined weight of the valve and actuator assembly together. During the lifting operations do not stand under the actuator. The actuator should be handled with appropriate lifting equipment. The weight of the actuator is reported on the packing slip and on the overall-dimensions drawing furnished with the documents accompanying the actuator.

For actuator weight, please, refer to Figure 29 in the Annex section. For the general actuator dimensions please refer to LPS technical bulletin LFENTB0001, available on www.flowserve.com.

▲ WARNING: ONLY for LPS-30 model and larger sizes



Figure 1: Lifting Lug for Spring Can Lifting Only

⚠ DANGER: For lifting and handling, use the eyebolts on the housing. The eyebolt on the spring can is only for the mounting/dismounting steps or eventually for balancing the actuator.

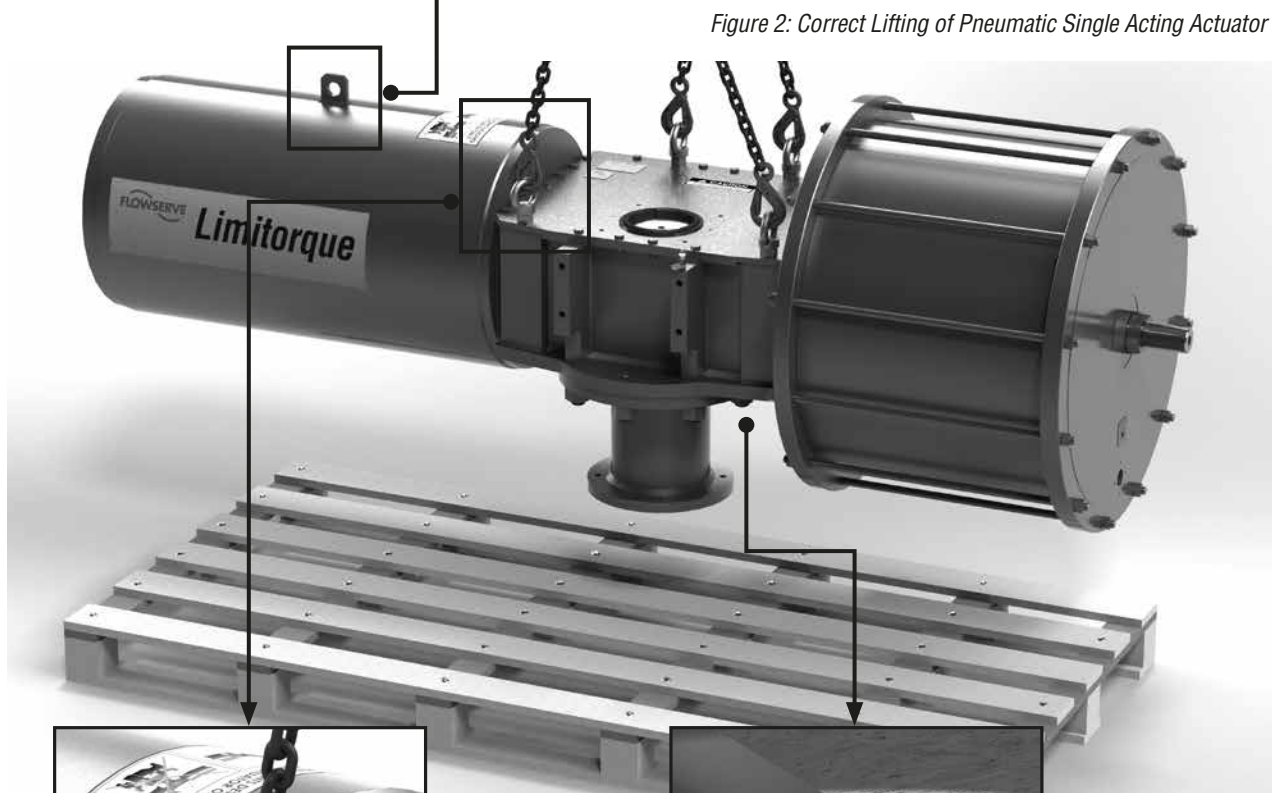


Figure 2: Correct Lifting of Pneumatic Single Acting Actuator



Figure 3: Use of Eyebolt for the Scotch Yoke Housing Cover

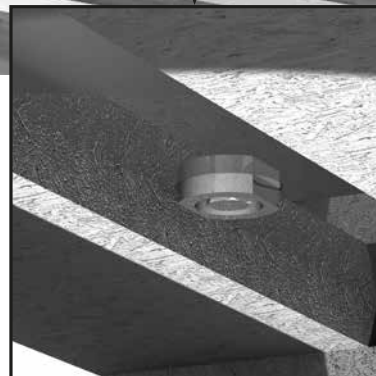


Figure 4: Vent Valve Correct Position

⚠ WARNING: ONLY for LPS-15, LPS-20 and LPS-25 model sizes

☠ DANGER: For lifting and handling, use the appropriate lifting lug located on the pneumatic cylinder and the lifting lug on the spring can.

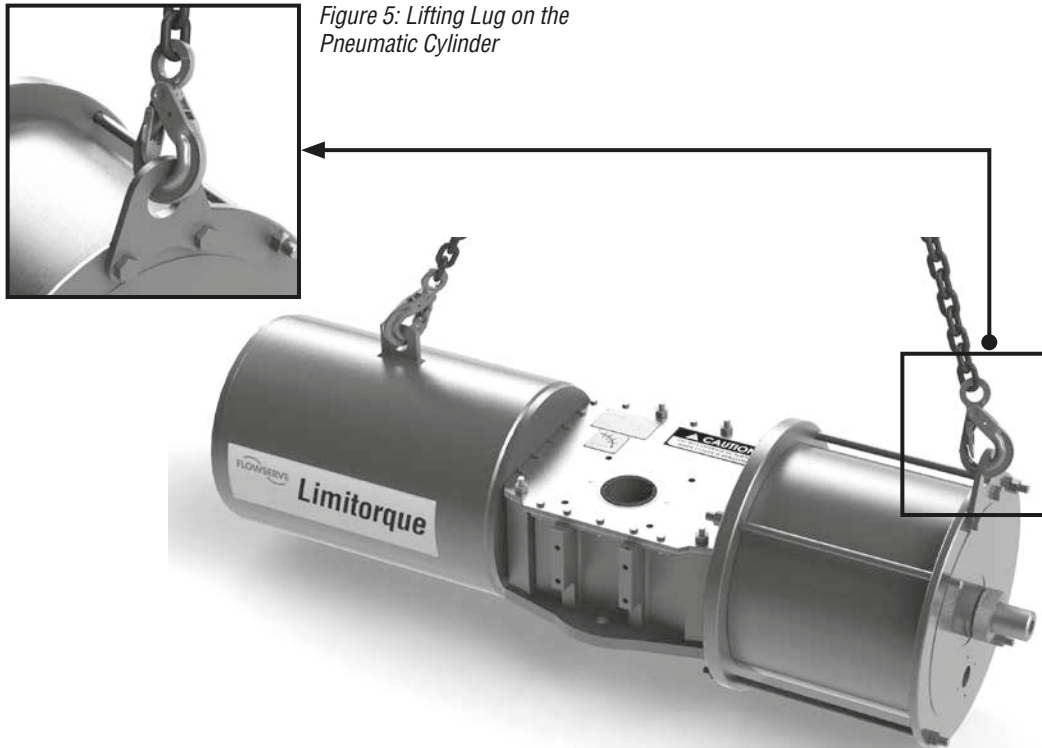


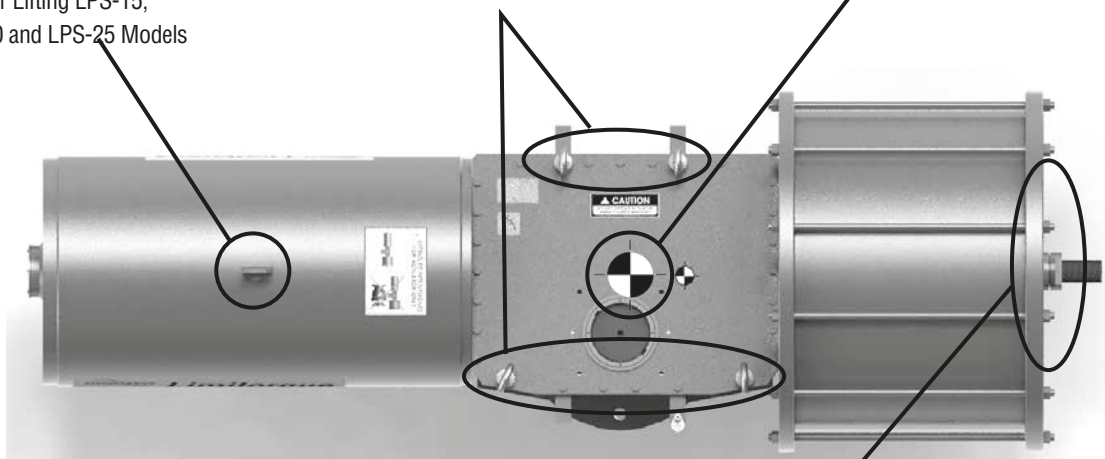
Figure 5: Lifting Lug on the Pneumatic Cylinder

Figure 6: Correct Lifting of LPS-15, LPS-20 and LPS-25 Pneumatic Single Acting Actuator Models

Lifting Lug for Spring Can and Actuator Balancing
Only for Lifting LPS-15,
LPS-20 and LPS-25 Models

Eyebolts for Actuator Lifting

Center of Mass



Lifting Lug Location for LPS-15,
LPS-20 and LPS-25 Models Only

Figure 7: Single Acting Actuator Center of Gravity Position and Lifting Arrangement

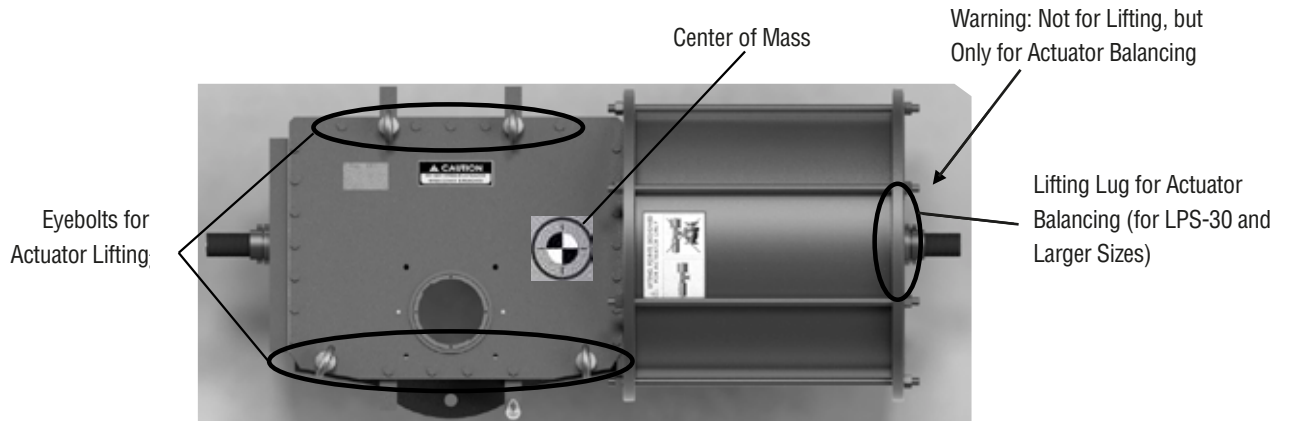


Figure 8: Actuator Center of Gravity Position and Lifting Arrangement of LPS-30 and Larger Double Acting Models

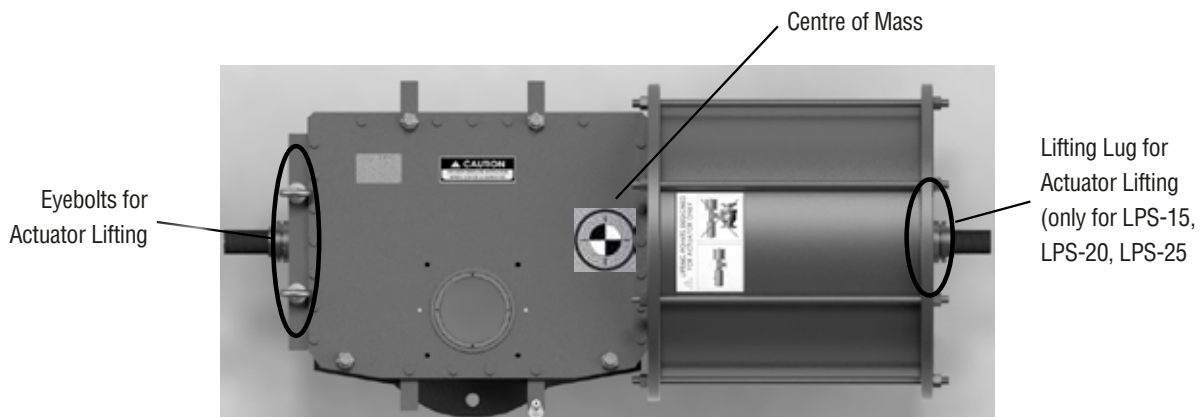


Figure 8b: Actuator Center of Gravity Position and Lifting Arrangement of LPS-15, LPS-20 and LPS-25 Double Acting Models

▲ WARNING: For lifting and handling use the appropriate lifting arrangement. Do not lift the actuator with the valve assembled.

▲ WARNING: After transportation, inspect the components to look for any damage.

1.9 Storage

Flowserve actuators are typically provided with an epoxy resin coating or with other painting systems as agreed with the customer. This means that Flowserve products are well protected from corrosion. Nevertheless, in order to maintain good working conditions and a good finish, until the actuator is installed in the plant, it is necessary to follow a few rules during the storage period:

- 1.9.1 Flowserve products must be stored adequately in a clean, dry environment.
- 1.9.2 Ensure that plastic caps are fitted to protect the pneumatic connections and the cable entries, to prevent the ingress of foreign materials. These caps should not be removed until the product is actually mounted into the system.

- 1.9.3 If the storage is outdoors, or if long-term storage is necessary (more than four months), the plastic protection plugs must be replaced with metal plugs, because the plastic plugs are not weatherproof, whereas the metal ones guarantee weatherproof protection.
- 1.9.4 The actuator must be placed on a wooden pallet, in order to not damage the coupling base and avoid the other surfaces resting on the ground.

In case of long-term storage (more than four months), additionally perform the following measures:

- a. Coat the coupling parts (spool piece base, flanges, bushings, joints) with protective oil or grease.
- b. If possible, blank off the spool piece base flange with a protection disk.
- c. Provide a tarpaulin cover or some other means of protection, especially if the storage is outdoors.
- d. It is important to periodically operate the actuator with filtered, dehydrated and lubricated air while in storage.



Figure 9: Actuator's Safe Packed Position on Wooden Pallet

1.10 Valve and Actuator Variations

These instructions cannot claim to cover all details of all possible product variations, nor can they provide information for every possible example of installation, operation or maintenance. If there are any uncertainties in this respect particularly in the event of missing product-related information, clarification must be obtained via the appropriate Flowserve sales office.

1.11 Unpacking

- 1.11.1 Each delivery includes a packing slip. When unpacking, check all delivered actuators and accessories using this packing slip.
- 1.11.2 Report transportation damage to the carrier immediately.
- 1.11.3 In case of discrepancies, contact your nearest Flowserve location.
- 1.11.4 If necessary, retouch minor damage to the paint coating which may have occurred during transport or storage.

▲ WARNING: Ensure that the addendum “ATEX/PED/Machinery Directive Safety Manual - LPS-LDG-LGO-LHS-LHH Actuators” (doc. LFENEU000A) accompanies this manual, when the actuator is under one (or more) of the following European Directives:

- 2006/42/EC - Machinery Directive
- 2014/34/EU - ATEX Directive
- 2014/68/EU - PED Directive

If this addendum is not available to you, please contact Flowserve.

NOTE: When the actuator has SIL requirements according to IEC 61508, ensure that the “LPS Series Functional Safety Manual” accompanies this manual and is referred to for equipment usage.

NOTE: Pneumatic cylinder design is based on seismic acceleration of 0.5 g provided as reference by EN 1998-1:2004. It is under user's responsibility to verify that seismic loads of the geographical installation region of the actuator are in conformity with the reference acceleration value of 0.5 g. For any support, please contact your Flowserve Limitorque representative.

2 Installation Instructions

The LPS Series is a fully modular design, Scotch yoke actuator; with torque range up to 550.000 Nm (up to 405.000 ft-lbs), with a mounting base in compliance with ISO 5211 and Figure 30 “Mounting Interface Dimensions”. It may also be customized, if required.

The LPS pneumatic Scotch yoke spring return actuators adopt a push-to-compress spring design.

▲ WARNING: Actuator operation/pressure limitations must be in accordance with Technical Bulletin (LFENTB0001); contact Flowserve to get the last version.

2.1 Valve and Actuator Check

⚠ DANGER: Before installation check the order-no., serial-no. and/or the tag-no. to ensure that the valve/actuator is correct for the intended application.

Figure 10:
Fail CW Plate, According to
EN 15714-3 Standard



Figure 11:
Nameplate Sample

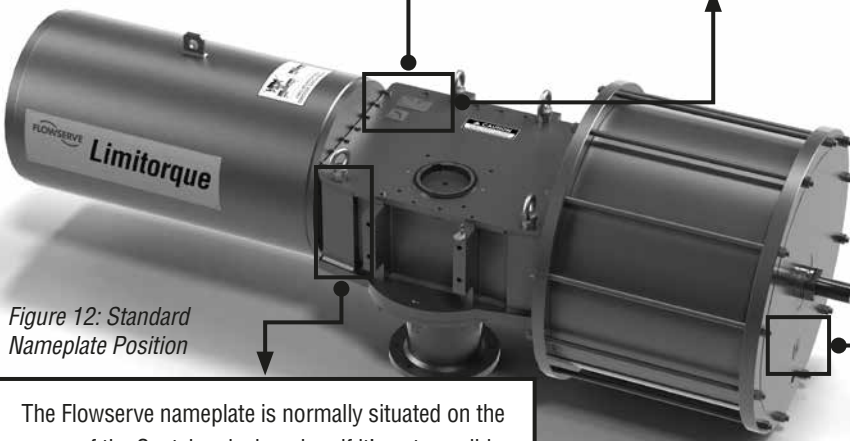


Figure 12: Standard
Nameplate Position



Figure 13:
Air Supply Plate

The Flowserve nameplate is normally situated on the cover of the Scotch yoke housing; if it's not possible, it could be situated in the front zone or in the rear zone of the Scotch yoke housing.

NOTE: The air supply port and discharge are indicated by dedicated plates positioned close to the ports, as shown in Figure 13. In case of a double acting actuator, the ports for the air supply are identified by a number, according to ISO 5599-2.

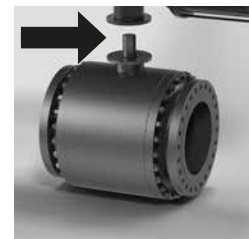
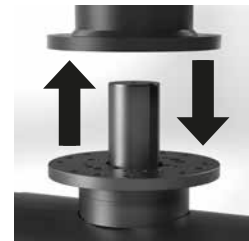
NOTE: The fail safe direction of rotation is identified by a dedicated plate, as shown in Figure 10, in accordance with EN 15714-3.

Before mounting the actuator to the valve, manually open and close valve (if possible), to ensure it is not stuck. Be sure valve and Limitorque actuator rotate in the same direction and are in the same position (i.e., valve closed, actuator closed). The assembly position of the actuator, with reference to the valve, has to be in accordance with the plant requirements (actuator axis parallel or perpendicular to the pipeline axis).

2.2 Connection With Valve and Mounting Kit

The LPS actuator is usually supplied with the spool piece already assembled. To assemble the actuator onto the valve, perform the following steps:

- 2.2.1 Check the mounting surfaces, the stem adaptor and the spool piece to assure proper fit. Clean the flanges of the valve and spool piece to remove oils and greases since the torque is transmitted by friction. Also, remove any rust that may have occurred during storage.
- 2.2.2 Secure the valve (possibly with the stem vertical) in the Close position in case of Single Acting Fail Close actuator and in Open position in case of Single Acting Fail Open actuator; in case of Double Acting Fail Last actuator, secure the valve in the same Close/Open position as the actuator that will be installed onto the valve.
- 2.2.3 Lift the actuator by the specific lift points (eyebolts), using a proper lifting system. Position the actuator over the valve and lower to engage the stem adaptor to the actuator bore. Continue to lower until the spool piece sits on valve mounting surface. This coupling has to take place without force and only with the weight of the actuator. The mounting bolts (or studs) of the valve should easily fit into the bolt holes of the spool piece without any binding. If needed, turn or stroke the actuator a few degrees and/or adjust the actuator travel-stops.
- 2.2.4 The mounting nuts (or bolts) connecting the base of the spool piece to the valve flange must be evenly tightened according to tightening torque table without lubricant (Table 2 in Annex section).



NOTE: In some cases, the coupling between valve and actuator can be direct, without the need of a spool piece. In these cases, Flowserve can provide an intermediate adaptor flange (fitted under the actuator base) and a special bushing to be inserted into the yoke bore.

- ▲ **WARNING:** In case of spool piece (or adapter flange) installation by the client, it is mandatory to refer to Figure 30 “Mounting Interface Dimensions”, or to follow more specific instructions included in the job documentation supplied along with the actuator. These assembling instructions include details of prescribed stud bolts and their maximum allowable threaded length, in addition to the Loctite type to be used for a perfect sealing of Scotch yoke housing.
- ▲ **CAUTION:** The actuator lifting and handling should be made by qualified personnel and in compliance with the laws and provisions in force.
- ▲ **WARNING:** The lifting lugs or eyebolts are appropriate for actuator lifting only. They are not designed to support the combined weight of the valve and actuator assembly together. During the lifting operations do not stand under the actuator. The actuator should be handled with appropriate lifting means. The weight of the actuator is reported on the packing slip and on the overall-dimensions drawing furnished with the documents accompanying the actuator.

2.3 Travel-stop Bolts and Accessories

All actuated valves require accurate travel-stop adjustments at both ends of the stroke to obtain optimum performance and valve seat life. Adjust the travel-stop bolts of the actuator for the proper open and close valve positions, per valve manufacturer’s recommendations.

The LPS actuators have travel-stop adjustments in both the clockwise and counter-clockwise directions. The +/- 5-degree adjustment feature provides shaft rotation from 80 to 100 degrees overall.

The adjustment of the travel-stops is performed in accordance with the following steps. After the adjustment of the travel-stop, pneumatically stroke the actuator several times to assure proper operation. The stem adaptor should not bind during operation. If the actuator is equipped with a switch, positioner or other accessories, adjust them at this time.

WARNING: Before performing any maintenance operation it’s mandatory to remove the pressure inside the cylinder. Make sure that the pneumatic connection ports of the cylinder are disconnected and open to the ambient. Also make sure that all pneumatic supplies to the control unit and all power supplies are disconnected. Make sure that the actuator is in the fail position, i.e., that it is not locked in a position with the spring compressed because of jams or by means of locking tools.

2.3.1 Pneumatic cylinder travel-stop bolt adjustment

Refer to figure 14 for next instructions and descriptions:

If necessary in order to facilitate unscrewing of the cylinder stopper bolt and only for spring return actuator, feed the pneumatic cylinder from the air connection port placed on the tail flange (the flange where the stopper is screwed) at minimum necessary pressure (starting from 0 barg and increasing the pressure slowly up to max 2 barg in order to facilitate unscrewing);

DANGER: refer to Table 7 and Figure 33 for maximum distance “A”, Table 8 for stopper length in order to have a safety engagement of the stopper bolt in the tail flange during this operation. In case of need to fully remove the travel stop, when exceed the maximum distance “A” it is mandatory to don’t have the pressure inside the cylinder in order to avoid risks for the operators.

Note: the following procedure can be applied even for the adjustment of the stop bolt installed on the center body for double effect actuators.

- 2.3.1.1 Using appropriate wrench, hold still the stopper bolt (g) and using a second screw, unscrew the stopper nut (h).
- 2.3.1.2 Fully remove the stopper nut (h).
- 2.3.1.3 Fully remove the gasket ring (i), (if present in your version) and the o-ring (l).
- 2.3.1.4 Manually screw or unscrew the stopper bolt (g) in the flange (m) using appropriate wrench until desired position has been reached. Do not use automatic devices (e.g. electric/air screwier, etc...);
- 2.3.1.5 Manually drive the new o-ring (l) properly in front of flange (m).

NOTE: Do not use stopper nut (h) or gasket ring (i) to drag the o-ring (l) on the stopper bolt (g);

- 2.3.1.6 Screw the gasket ring (i) (if present in your version) in front of flange (m);

NOTE: If the tail flange (m) presents a chamfer mount the gasket ring (i) with the flat side in contact with the flange; otherwise mount the gasket ring (i) with the chamfer in contact with the flange;

2.3.1.7 Screw the stopper nut (h);

2.3.1.8 Using appropriate wrench, hold still the stopper bolt (g) and using a second screw, tighten the stopper nut (h).

NOTE: Always replace the O-Ring (l) during travel stop adjustment

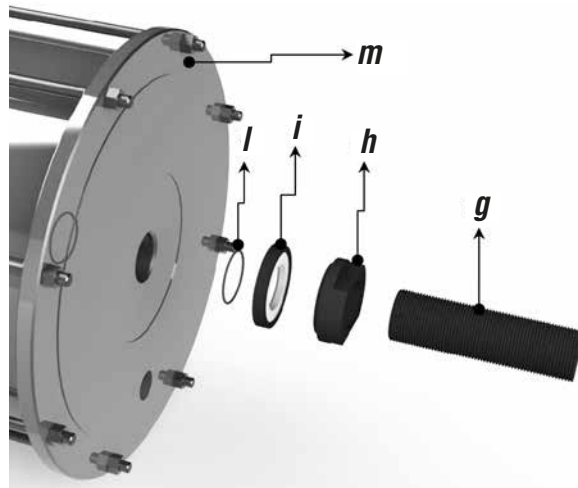


Figure 14: Standard Stopper Exploded View

2.3.2 Spring container travel-stop bolt adjustment

Refer to figure 24 for next instructions and descriptions

2.3.2.1 Using appropriate wrench, unscrew the hex screws (10) and remove the stop bolt cap (9).

2.3.2.2 Manually screw or unscrew the end stop (7) using appropriate Allen key until desired position has been reached.

2.3.2.3 Reinstall the stop bolt cap (9) and tighten the hex screws (10).

2.3.3 Pneumatic cylinder travel-stop bolt adjustment (version with enclosed stopper bolt protection) Refer to figure 14a for next instructions and descriptions

If necessary in order to facilitate unscrewing of the cylinder stopper bolt and only for spring return actuator, feed the pneumatic cylinder from the air connection port placed on the tail flange (the flange where the stopper is screwed) at minimum necessary pressure (starting from 0 barg and increasing the pressure slowly up to max 2 barg in order to facilitate unscrewing);

DANGER: refer to Table 7 and Figure 33 for maximum distance “A”, Table 8 for stopper length in order to have a safety engagement of the stopper bolt in the tail flange during this operation. In case of need to fully remove the travel stop, when exceed the maximum distance “A” it is mandatory to don’t have the pressure inside the cylinder in order to avoid risks for the operators.

Note: the following procedure can be applied even for the adjustment of the stop bolt installed on the center body for double effect actuators.

- 2.3.3.1 Using appropriate wrench, hold still the stopper bolt protection (b) and using a second screw, unscrew the protection plug (a).
- 2.3.3.2 Remove the o-ring of the protection plug (c).
- 2.3.3.3 Fully remove the stopper bolt protection (b).
- 2.3.3.4 Remove the o-ring of the stopper bolt protection (d).
- 2.3.3.5 Manually screw or unscrew the stopper bolt (e) in the flange using appropriate wrench until desired position has been reached. Do not use automatic devices (e.g. electric/air screwier, etc...);
- 2.3.3.6 Insert the o-ring of the stopper bolt protection (d).
- 2.3.3.7 Screw the stopper bolt protection (b)
- 2.3.3.8 Using appropriate Allen key, hold still the stopper bolt (e) and using a second screw, tighten the stopper bolt protection (b).
- 2.3.3.9 Insert the o-ring of the protection plug (c).
- 2.3.3.10 Manually screw the protection plug (a) on the stopper bolt protection (b).
- 2.3.3.11 Using appropriate wrench, hold still the stopper bolt protection (b) and using a second screw, tighten the plug (a).

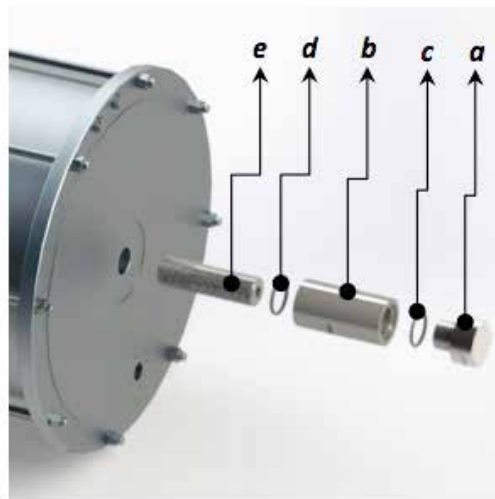


Figure 14a: Enclosed Stopper Exploded View

2.4 Grounding System

For the actuator earthing, use the grounding kit, shown in Figures 15a, 15b and 16:

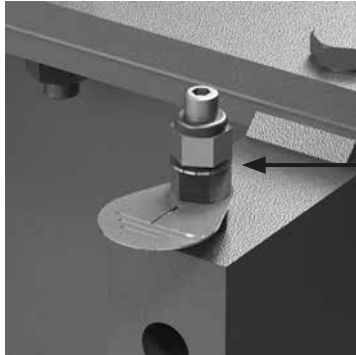


Figure 15a: Grounding Kit Detail

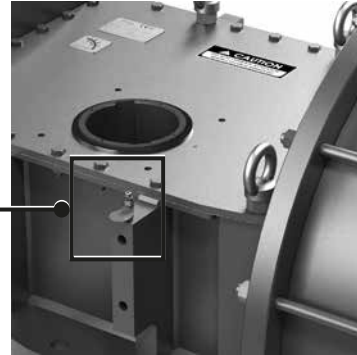


Figure 15b: Grounding Kit Assembled

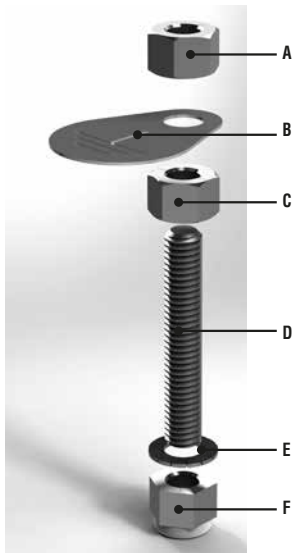


Figure 16: Grounding Kit – Exploded Lettered View

Letter	Description
A	High Nut
B	Ground Nameplate
C	High Nut
D	Grub Screw
E	Lock Washer
F	High Locking Nut With Nylon Insert

2.5 Initial Operation

Before initial operation of the actuator, perform the following checks:

- 2.5.1 Check that all electrical supply, control and signal lines are properly connected, by following the dedicated customer procedures.
- 2.5.2 Check that the pressure and quality of the supply fluids are as prescribed.
- 2.5.3 Check the absence of leaks in the pneumatic connections. If necessary, tighten the pipe fittings.
- 2.5.4 Check that the environmental conditions are compatible with the design conditions. For information, contact Flowserve.

2.6 Fail Open and Fail Close Configuration

The actuator is designed for work in both configurations: fail open and fail close. For conversion from one configuration to the other, refer to next paragraph.

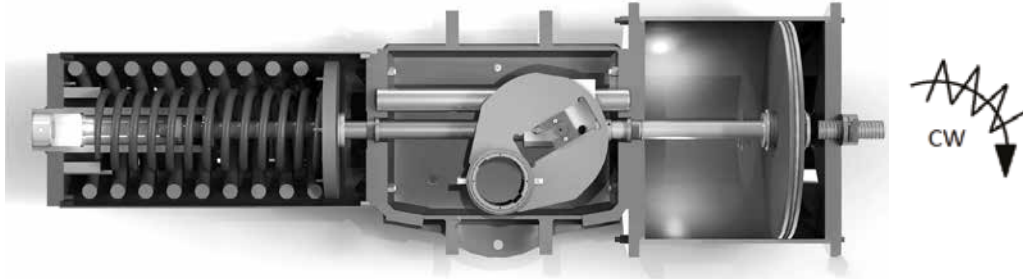


Figure 17: Single Acting Actuator Configuration: Fail Close – Fail Clockwise

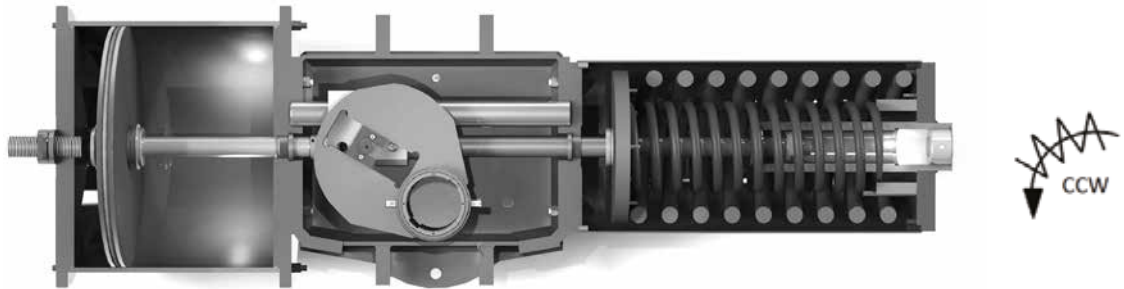


Figure 18: Single Acting Actuator Configuration: Fail Open – Fail Counter Clockwise

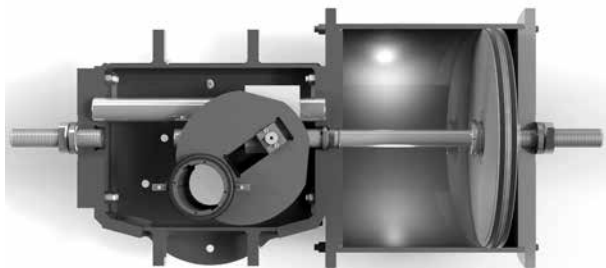


Figure 19: Double Acting Actuator Configuration – Close Position

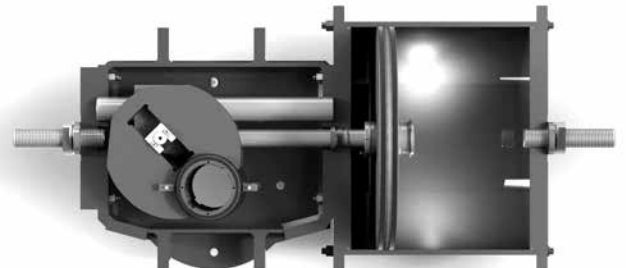


Figure 20: Double Acting Actuator Configuration – Open Position



Figure 21: Single Acting LPS With Valve



Figure 22: Double Acting LPS With Valve

3 Field Conversion

Field Conversion From Fail Clockwise to Fail Counter Clockwise or Vice Versa (for Spring Return Actuators)

NOTE:

- The clockwise/counter clockwise designation needs to be changed on the nameplate.
- Additional adapters are required for field conversion from Fail CW to CCW and vice versa.

There are two different situations, requiring different sequences of instructions:

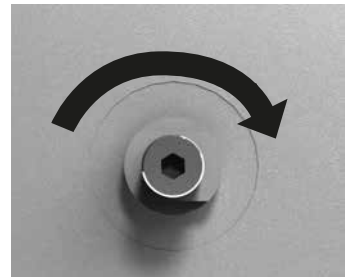
- The actuator is already disassembled from the valve.
- The actuator is assembled on the valve.

The reference drawings are Figures 24, 25, 26 and 27.

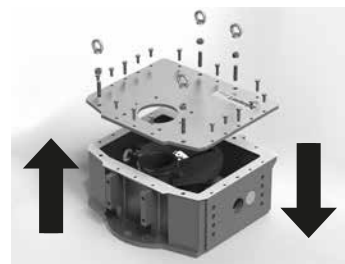
3.1 Actuator Disassembled From the Valve

▲ WARNING: Ensure that the pneumatic connection ports of the cylinder are disconnected. Also make sure that all pneumatic supplies to the control unit and all power supplies are disconnected. Finally, make sure that the actuator is in fail position, i.e., that it is not locked in a position with the spring compressed by means of locking devices.

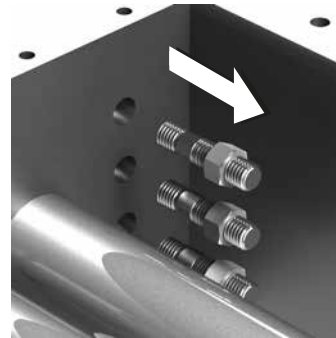
3.1.1 Unscrew and remove the end stop (25) from the pneumatic cylinder. For removing the stop, refer to paragraph 2.3. If necessary, feed the pneumatic cylinder from the port on the head flange (19) at minimum necessary pressure to facilitate the movement of the Scotch yoke and assure the total retraction of the piston rod (20). Remove the pressure. In this way the spring is fully extended.



3.1.2 Remove the cover (46) from the housing by unscrewing all of the locking components: hex screws (45), hex head shoulder bolts (44) and eyebolts (42) plus upper nuts (43). Leave the studs (41) screwed into the housing (51).



- 3.1.3 Remove the spring can, carefully following the instructions given in paragraph 4.2. Manually rotate the yoke (36) counterclockwise (or clockwise, depending on the original fail configuration) up to a position of approximately 45°. Locate the studs (57) that connect the pneumatic cylinder to the housing. With the Scotch yoke rotated of 45°, it is possible to easily access these studs. Carefully unscrew the nuts (56). Pull out the whole pneumatic cylinder with the studs (57) screwed inside it (the stem is fully retracted).



NOTE: Take care during removal, so as not to damage the piston rod or the stud threads.

- 3.1.4 Change the adapter kit. Replace the adapters (54 and 55) designed for fail close (open) action, with the new ones designed for the opposite action.

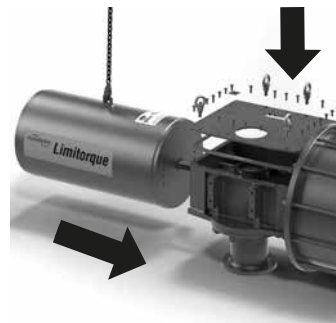


NOTE: Take care to choose the adapter kit suitable for the Scotch yoke type in use (symmetric or canted).

Reassemble the pneumatic cylinder with adapter, using the reverse procedure as described in point 4.3.

NOTE: You can identify the cylinder adapter to the spring can adapter through the three grub screws (53).

- 3.1.5 Manually rotate the Scotch yoke (36) until the guide block (48) is in contact with the piston rod adapter (54), in correspondence of the relevant slot.



Reassemble the spring can, as instructed in paragraph 4.2. Reposition the cover, taking care to replace the cover gasket (47) and tighten the screws in according with the torque table 2 and table 3. Readjust the stops, as instructed in paragraph 2.3. Operate the actuator few times to check the functioning in the new fail configuration.

3.2 Actuator Connected to the Valve (and the valve can be stroked)

NOTE: If the valve cannot be stroked, due to the requirements of the plant, the actuator must be removed from the valve and the procedure described in paragraph 3.1 shall be followed. Then the actuator should be reinstalled in the same position of the valve, following the instructions given in paragraph 2.2.

▲ WARNING: Ensure that the pneumatic connection ports of the cylinder are disconnected. Also make sure that all pneumatic supplies to the control unit and all power supplies are disconnected. Finally, make sure that the actuator is in fail position, i.e., that it is not locked in a position with the spring compressed by means of locking devices.

- 3.2.1 Apply the minimum necessary pressure to the cylinder pneumatic port on the end flange and move the actuator to approximately 45°. If the actuator is provided with a manual override, you can use it to perform this operation.

3.2.2 Measure the position of the spring can end stop (7) before removing it (this information will be useful when reassembling), and then lock the spring in the compressed position by means of a specifically designed locking tool (provided by Flowserve upon request) for this maintenance. This tool shall be inserted in the opening of the spring can end flange (11) where the spring-end travel-stop (7) has been removed. Screw the special tool to the spring shaft and follow other detailed instructions provided with the special tool. Then remove pressure from the pneumatic cylinder.

▲ WARNING: At this point the spring is compressed and the spring module contains a large quantity of stored energy. Failure to properly engage the specifically designed locking tool or failure to handle the spring carefully could result in release of the spring with potential damage to equipment or injury to personnel.

3.2.3 Unscrew and remove the travel-stop of the pneumatic cylinder (25). For removing the stop, refer to paragraph 2.3. Feed the pneumatic cylinder from the port on the head flange (19) at minimum necessary pressure up to totally retract the piston rod (20).

3.2.4 Remove the cover (46) from the Scotch yoke housing by unscrewing all of the locking components: hex screw (45), hex head shoulder bolts (44) and eyebolts (42) plus upper nuts (43). Leave the studs (41) screwed into the Scotch yoke housing (51).

3.2.5 Remove the spring can, carefully following the instructions given in paragraph 4.2.

3.2.6 Locate the studs (57) that connect the Scotch yoke housing to the cylinder. With the Scotch yoke (36) rotated 45°, it is possible to easily access these studs. Carefully unscrew the nuts (56). Pull out the whole pneumatic cylinder. The stem has to be fully retracted.

NOTE: Take care during removal, so as not to damage the piston rod or the stud threads.

3.2.7 Change the adapter kit. Replace the adapters (54 and 55) designed for fail close (open) action, with the new ones designed for the opposite action. Take care to choose the adapter kit suitable for the Scotch yoke type in use (symmetric or canted). The guide block (48) of the symmetric Scotch yoke is marked with the “S” letter on the top face, while the guide block of the canted Scotch yoke is marked with a “C” letter on the top face, as shown in the pictures at right.



NOTE: The spring can adapter (55) and cylinder adapter (54) can be inserted in the guide block in one way only, inserted on the Fail Close (CW) or Fail Open (CCW) configuration. Component numbers are referred to Figures 26 and 27.

3.2.8 Reassemble the spring can, as instructed in paragraph 4.2.

3.2.9 Reassemble the pneumatic cylinder with adapter, following the reverse procedure as described in point 4.3.

3.2.10 Apply the minimum pressure necessary to the pneumatic cylinder from the port on the end flange (27) until the piston rod moves the guide block (48) and partially compresses the spring. In this condition it will be possible to remove the special tool from the spring can.

3.2.11 Remove the pressure, checking that the actuator goes in the correct new fail safe position.

3.2.12 Reposition the cover, taking care to replace the cover gasket (47).

3.2.13 Readjust the travel-stops, as instructed in paragraph 2.3.

4

Maintenance Instructions

LPS Series actuators are designed to offer the greatest ease of operation during assembly, disassembly and maintenance. The maintenance and disassembly do not require special equipment or special or large wrenches. Furthermore the joints among the moving parts of the actuator are made exclusively through pins and screws not needing to be tightened with specific torques.

LPS actuators do not need maintenance for long periods, even when working in severe conditions. The LPS actuators features a 25-year design life, under proper conditions of service, installation, operation and recommended maintenance. For the maintenance of any installed accessory and/or control equipment installed on the actuator, follow the recommendation of individual technical bulletins and Instruction Manuals.

Actuator Ordinary Maintenance

It is recommended to periodically check the actuator (every 6 years), performing the following steps:

- Carry out a few opening and closing operations, involving all the components of the control unit, checking that the actuator operates correctly and within the required operating times, without increasing noise or jamming during the stroke.
- If installed, check the functionality of the manual override.
- Check that all signals (pneumatic and electric) arrive correctly to the actuator.
- Check that the pressure of the supply fluid is within the required range.
- Check for the absence of leaks in the pneumatic connections. If necessary, tighten the fittings of the pipes.
- Visually inspect all surfaces and external seals of the actuator.
- Check the paint coating. If some areas are damaged due to accidental events, retouch them according to the painting specifications.

Actuator Extraordinary Maintenance

In case of extraordinary or scheduled preventive maintenance that involve the removal of actuator parts, refer to the following maintenance instructions, which cover the main components of the actuator (pneumatic cylinder and main body) and refer to the notes mentioned in paragraph 1.2.

The actuator is pre-lubricated with a sufficient amount of lubricant for its entire life cycle. However, during scheduled maintenance or in the case of extraordinary maintenance, when necessary it is possible to lubricate the parts of the central body with the following greases and oil:

For standard temperature conditions (-29 to +100°C)

Grease Characteristics*	
Worked Penetration [dmm]	280
Dropping Point ASTM [°C]	190
Base Oil Viscosity at 40°C [mm ² /s]	100

* Grease suggested: AGIP MUP2 or equivalent

For low temperature conditions (-60°C to +100°C)

Grease Characteristics*	
Worked Penetration [dmm]	296
Dropping Point ASTM [°C]	260+
Base Oil Viscosity at -40°C [mm ² /s]	1150

* Grease suggested: AEROSHELL 7 or equivalent

(CONT.....)

**For high temperature conditions
(-29 to +160°C)**

Grease Characteristics*	
Worked Penetration [dmm]	280
Dropping Point ASTM [°C]	290
Base Oil Viscosity at 40°C [mm ² /s]	220

* Grease suggested: ENI GREASE LCX 2/220 or equivalent

**For all temperature conditions
(-60°C to +160°C)**

Oil Characteristics*	
Flashpoint [°C]	198
Density [kg/m ³] at 15 °C	1.074
Base Oil Viscosity at +40°C [mm ² /s]	222

* Oil suggested: SHELL OMALA S4WE220 or equivalent

For different conditions, contact your local Flowserve representative.

4.1 General Disassembly Instructions

The LPS Series actuator is available in two different configurations, single acting and double acting, composed by the main parts shown in Figure 23.

- 4.1.1 Disconnect all air and electrical supplies from actuator;
- 4.1.2 Before dismounting the actuator remove all accessories from actuator;
- 4.1.3 The reference drawings for the instructions reported in the following paragraphs are the exploded views of single acting and double acting actuators, included as Figures 24, 25, 26 and 27.

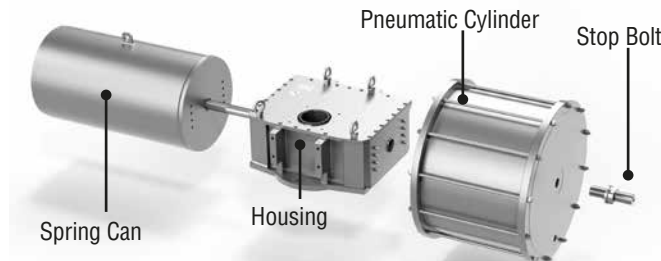


Figure 23: The Three Main Modules of LPS Actuators

4.2 Spring Container Maintenance

The spring container does not require maintenance. Lubrication of internal parts is carried out during assembly and is not necessary during the normal life of the actuator. The substitution of the spring container is not expected over the entire actuator life. However, accidental events may result in damage to this component. In these cases, proceed as described in the following steps.

The spring container is a single welded module. In case of damage, the whole container must be disassembled from the actuator and replaced with a new one equal to the original.

The removal of the spring container from the actuator has to be performed through the following steps. The reference drawing is Figure 25.

- ▲ **WARNING:** Ensure that the pneumatic connection ports of the cylinder are disconnected. Also make sure that all pneumatic supplies to the control unit and all power supplies are disconnected. Finally, make sure that the actuator is in the fail safe position.
- 4.2.1 Unscrew and remove the travel-stop of the pneumatic cylinder (25). For removing the stop, refer to paragraph 2.3. If necessary, feed the pneumatic cylinder from the port on the head flange (19) at minimum necessary pressure to facilitate the movement of the Scotch yoke and assure the total retraction of the piston rod (20). Remove the pressure. This way the spring is fully extended.

- 4.2.2 Remove the cover (46) from the housing by unscrewing all of the locking components: hex screw (45), hex head shoulder bolts (44) and eyebolts (42) plus upper nuts (43). Leave the studs (41) screwed into the Scotch yoke housing (51).
- 4.2.3 Hook and hold in tension the spring container using the specific lifting lug located on the top of the spring can (shown in the above picture). Care should be taken to choose lifting equipment. Locate the studs (57) that connect the Scotch yoke housing with the spring container. Carefully un-screw the nuts (56). Pull out the whole spring container with the studs (57) screwed inside.
- NOTE:** Take care to horizontally support the spring module during removal, so as not to damage the spring rod or the stud threads.
- 4.2.4 Before reassembling the new spring module to body, make sure stud threads are free of any dirt, shavings, or other debris. Clean threads with rag and solvent if necessary. Assemble the new spring can, following the reverse procedure as described in points 4.2.1 to 4.2.3. Readjust the travel stop (25) of the pneumatic cylinder and the travel stop (7) of the spring container, as instructed in paragraph 2.3.

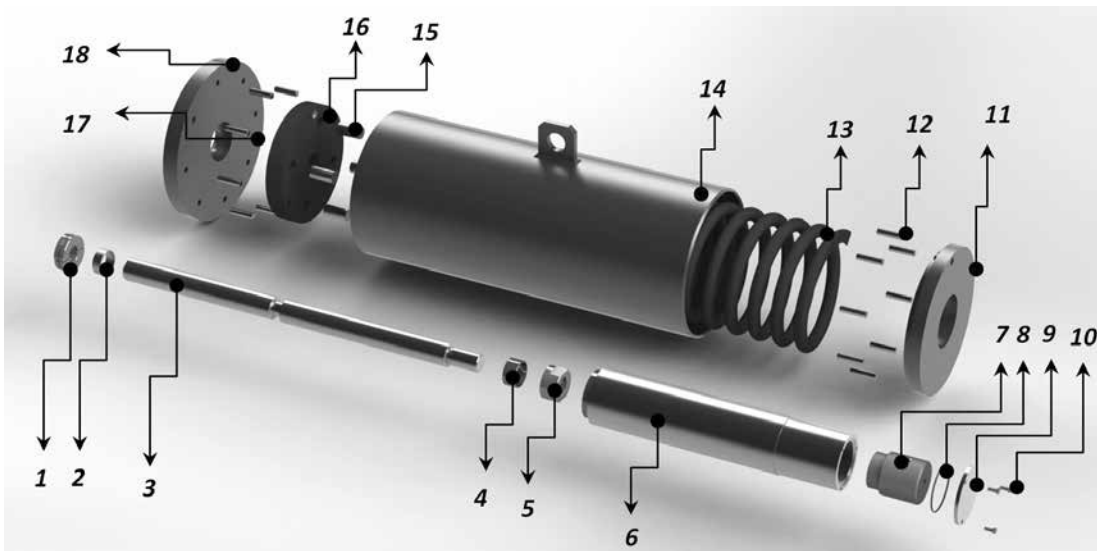


Figure 24: Spring Can Exploded View

Num	Description	Qty	Spare Parts*	Num	Description	Qty	Spare Parts*
1	Split Ring	1		10	Hex Screw	1	
2	Bushing	1		11	Spring Can End Flange	1	
3	Spring Rod	1		12	Bar Pin	8 **	
4	Bushing	1		13	Spring	1	
5	Spring Rod End Nut	1		14	Spring Can	1	
6	Spring Guide	1		15	Bar Pin	4 **	
7	Spring Stop Bolt	1		16	Spring Plate	1	
8	O-Ring	1		17	Bar Pin	8 **	
9	Stop Bolt Cap	1		18	Spring Can Head Flange	1	

* Standard maintenance spare parts for on/off applications

** Variable number depending on spring container model

4.3 Pneumatic Cylinder Maintenance

The pneumatic cylinder maintenance mainly consists in the replacement of those parts that may degrade over time, even in the absence of faults. These components are the o-rings and the sliding elements of the piston.

The substitution of cylinder components (or of the whole cylinder) is not expected over the entire actuator life. However, accidental events may result in damage to these components. In these cases, proceed as described in the following steps.

There are two possible types of maintenance: standard maintenance which can be performed in the field without the need to remove the pneumatic cylinder from the actuator, and a more thorough maintenance, following unexpected events, which can be performed only after removing the cylinder from the actuator.

DANGER: Do not attempt this maintenance operation with cylinder under pressure.

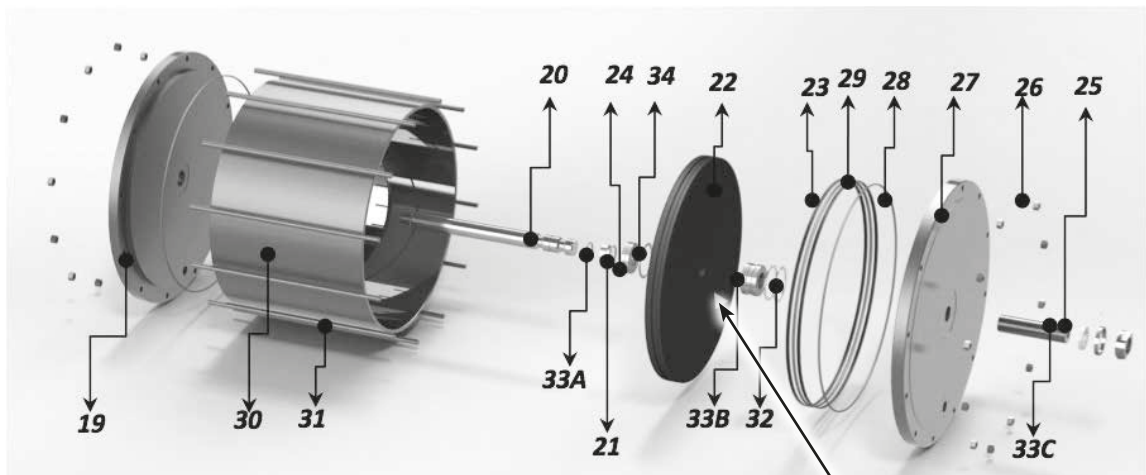
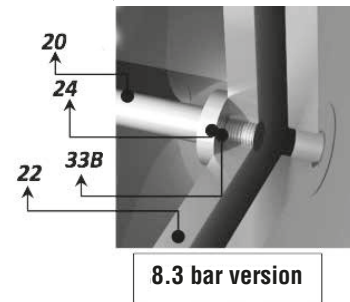


Figure 25: Exploded View of Pneumatic Cylinder



Num	Description	Qty	Spare Parts*
19	Cylinder Head Flange	1	
20	Piston rod	1	
21	Bushing	1	
22	Piston	1	
23	Tape Guide	2**	X •
24	Split Ring	2**	
25	Stop Bolt Assembly	1	
26	Hex Nut (High)	12**	
27	Cylinder End Flange	1	

Num	Description	Qty	Spare Parts*
28	O-Ring	2	X •
29	O-Ring	1	X •
30	Tube	1	
31	Tie Rod	12**	
32	Spiral Retaining Shaft Ring	2**	
33A	O-Ring	1	X •
33B	O-Ring	1	X •
33C	O-Ring	1	X •
34	Spacer (if necessary)	1	

* Standard maintenance spare parts for on/off applications
 ** Variable number depending on pneumatic cylinder model

X Spare parts that can be replaced
 • Spare parts that can be replaced without removing the actuator from the valve

▲ **WARNING:** Before performing any maintenance operation on the cylinder it's mandatory to remove the pressure inside the cylinder itself. Make sure that the pneumatic connection ports of the cylinder are disconnected and open to the ambient. Also make sure that all pneumatic supplies to the control unit and all power supplies are disconnected. Make sure that the actuator is in the fail position, i.e., that it is not locked in a position with the spring compressed because of jams or by means of locking tools as the one described (at paragraph 3.2.2).

▲ **WARNING:** Use the pneumatic cylinder only for the intended function it has been designed for.

WARNING: In the case of PED cylinders, for any maintenance operations that involve the partial or total removal of the cylinder (not including adjustment operations of the end stopper) contact Flowserve to maintain PED certification.

NOTE: During the maintenance operation inside the cylinder it's suggested to have a visual check of the internal parts of the cylinder in order to guarantee their integrity.

Perform the following steps:

- 4.3.1 Unscrew and remove the travel stop of the pneumatic cylinder. For removing the stop, refer to the indications given in paragraph 2.3.
- 4.3.2 Remove at least two of the tie rods (31) positioned on the upper part of the cylinder by unscrewing the nuts on the sides of the end flange and of the head flange (or unscrewing the tie rods from the head flange if threaded into the flange.) This operation provides two free holes to be used for lifting the end flange (27). Screw two male eyebolts in these two holes and connect the end flange to a lifting system. Care should be taken to choose a lifting system suitable for the weight of the cylinder. Refer to the weight table shown in Figure 29. Remove all other tie rods (31), following the same procedure described herein. Then remove the end flange (27) from the tube (30).
- 4.3.3 Finally, remove the tube (30). Take care not to scratch or dent the honed and plated inner surface of the tube. Remove the O-rings (28) from the head flanges; remove the O-ring of the piston (29) and finally the guide tapes (23) from the piston. Clean all surfaces of piston and flanges in contact with these components with rag and solvent. Brush the O-ring grooves with a light oil film and install the new O-rings. Spread a thin layer of grease on the bottom of the guide tape grooves and install the new guide tapes (23). Clean the internal surface of the tube (30) and lubricate with a protective oil film.
- 4.3.4 Reassemble the parts of the cylinder with the reverse procedure as described from point 4.3.1 to 4.3.3. The tie rods should be tightened using a torque wrench, alternating between opposite holes, applying a torque according to Tables 3, 4 and 5 included in Chapter 7. Readjust the stops as instructed in paragraph 2.3.

4.4 Scotch Yoke Housing Maintenance

Maintenance of the Scotch yoke housing may take place in the field, without the need to disassemble the spring container or the pneumatic cylinder. Perform the following steps. The reference drawings are Figures 26 and 27.

▲ WARNING: Ensure that the pneumatic connection ports of the cylinder are disconnected. Also make sure that all pneumatic supplies to the control unit and all power supplies are disconnected. Finally, make sure that the actuator is in fail position.

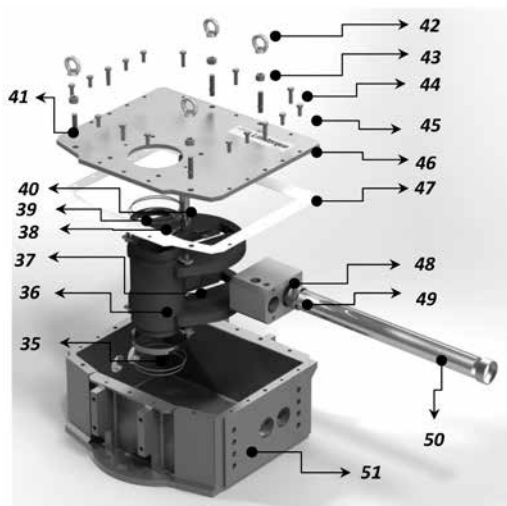


Figure 26: Exploded View of Housing

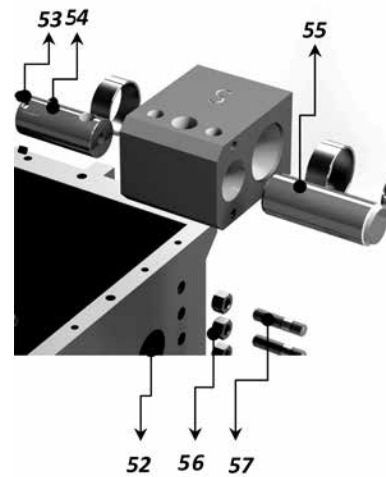


Figure 27: Exploded View of Assembling Kit

Num	Description	Qty	Spare Parts*
35	Bushing	2	
36	Scotch Yoke	1	
37	Slider Block	2	
38	O-Ring	2	X •
39	O-Ring	2	X •
40	Guide Pin	1	
41	Stud	4	
42	Eyebolt	4	
43	Hex Nut (High)	4	
44	Hex Head Shoulder Bolt	11 **	
45	Hex Head Screw	2 **	
46	Cover	1	
47	Cover Gasket	1	X •

* Standard maintenance spare parts for on/off applications
 ** Variable number depending on pneumatic cylinder model

Num	Description	Qty	Spare Parts*
48	Guide Block	1	
49	Bushing	2	
50	Guide Bar	1	
51	Scotch Yoke Housing	1	
52	Center Ring	2	
53	Grub Screw	3	
54	Cylinder Adapter	1	
55	Spring Adapter	1	
56	Hex Nut (High)	8 **	
57	Studs	8 **	
58 ¹	Guide Adaptor Pin	1	
59 ¹	Hex Head Screw	1	

X Spare parts that can be replaced

• Spare parts that can be replaced without removing the actuator from the valve

1 Only in double acting actuators

4.4.1 Remove the position indicators or other accessories, if fitted. Remove the cover (46) from the housing (51) by unscrewing all the locking components: hex screw (45), hex head shoulder bolts (44) and eyebolts (42) plus upper nuts (43). Leave the studs (41) screwed into the Scotch yoke housing (51). Remove the worn internal O-ring (39) of the bushing (35) inserted in the cover (46). Clean the O-ring groove and the sliding area of the bushing and after having brushed these surfaces with a light oil film, install the new internal O-ring (39).

CW/CCW Conversion Kit Sample

Num	Description	Qty	Spare Parts*
49	Bushing	2	
54	Cylinder Adapter	1	
55	Spring Adapter	1	
56	Hex Nut (High)	8 **	
57	Studs	8 **	

** Variable number depending on pneumatic cylinder model

4.4.2 Apply a generous layer of grease on the sliding surfaces of the accessible moving parts inside the housing. In particular, grease the guide bar (50) and the surfaces of the slots of the wings of the Scotch yoke (36), in which the slider blocks (37) run. Reposition the cover, taking care to replace the cover gasket (47).

The LPS actuator is designed for easy on-site maintenance and increased actuator life cycle. For this reason, specific instructions and equipment were created to allow the replacement of all parts of the Scotch yoke housing without removing the actuator from the valve. For these instructions, contact Flowserve.

NOTE: The spring can and pneumatic cylinder must be removed before disassembling the components located in the Scotch yoke housing.

4.5 Spare Parts

The main possible spare parts for ON/OFF applications are listed in the table below.

To obtain spare parts lists specific for each job/order, please contact your Flowserve Limatorque representative. Part numbers are referred to in Figures 25 and 26.

Number	Description	Qty
23	Tape Guide	2**
28	O-Ring	2
29	O-Ring	1
33A	O-Ring	1
33B	O-Ring	1
33C	O-Ring	1
38	O-Ring	2
39	O-Ring	2
47	Cover Gasket	1

** Variable number depending on pneumatic cylinder model

Table 1: Spare Parts List for Standard ON/OFF Applications

5

Troubleshooting

To prevent the actuator from not functioning properly or a reduction in performance, first ensure that the installation and the adjustment operations are carried out completely in accordance with this manual.

▲ WARNING: When attempting to identify faults, it is very important to observe all the regulations and instructions about safety. Read all the paragraphs of this manual concerning maintenance before opening for inspection or starting to repair any actuator components. If in doubt, choose **SAFETY FIRST**.

The following table lists potential problems along with corresponding causes and possible solutions. If a malfunction cannot be identified and eliminated using the table, please contact a Flowserve representative.

Troubleshooting Table		
Problem	Possible Cause	Solution
The actuator does not move.	Actuator has not been properly installed.	Check that all the pneumatic connections and that all the pneumatic components have been installed correctly, and are in accordance with the actuator operating mode.
		Check that the actuator is properly connected to the valve and that there aren't problems in the mounting kit.
	Supply pressure problems.	Check that sufficient supply pressure is available at actuator inlet port. If possible, place a gage in line and monitor the pressure level, in order to discover unexpected pressure drops.
	Problems in the control panel (if present).	Check the correct functioning of the control panel. In particular, check all the pneumatic and electric connections.
		Check the correct level of supply voltage for solenoid valves and other electrical/electronic components.
	The valve is blocked.	Check that valve is free to rotate. If necessary, disassemble the actuator from the valve.
	Exhaust port(s) obstructed.	Screw cap(s) must be disengaged. Ensure vent ports are free. If not, clean them of any obstructions and clean the dust excluders, if present.
Problems with lubricants.	Ensure that the actuator is properly lubricated, and that there is no solidified grease among sliding parts or rotating parts. If actuator lubrication is inadequate or improper, apply a uniform lubricant layer. Follow the instructions for Scotch yoke housing and cylinder maintenance par. 4.3 and 4.4. Consult Flowserve for proper oil and grease to be used.	

Troubleshooting Table		
Problem	Possible Cause	Solution
The actuator does not move.	A moving part is seized up.	Check if any moving part is blocked. If so, follow the maintenance instructions given in paragraphs 4.2, 4.3 and 4.4.
	Leakages of the pneumatic cylinder.	A significant air leak may prevent the actuator from operating. Ensure that there aren't any external leaks of the pneumatic cylinder. If possible, detect them using a leak finder spray. Check also that there are not leaks across the piston. If leaks are present, follow the cylinder maintenance instructions given in paragraph 4.3.
	The actuator model is not the correct one, or is not suitable for the plant conditions.	Check the actuator nameplate and the plant requirements. If there are mismatches, contact Flowserve Service Department.
	Spring problems (if actuator is a single acting model).	Check the proper functioning of the spring can. If problems are found, contact the Flowserve Service Department.
		Perform the following test: disassemble the actuator from the valve and measure the minimum pressure values necessary to move and compress the spring. Compare the measured values with the ones reported on the Testing Certificate. If there are significant differences you should contact Flowserve Service Department.
A lockout device has been inserted and forgotten in that position.	Disconnect the lockout module.	
The valve does not shut off properly and there are leaks.	The actuator is not correctly adjusted.	Adjust the end stops of the pneumatic cylinder and of the spring can until the valve is leak-tight across the seat. Follow the instructions given in the paragraph about Travel-stop bolts (2.3).
The valve does not fully perform the stroke, during opening or closing.	The actuator is not correctly adjusted.	As above, check the position of the end stop in opening and closing direction. If necessary, adjust them. Follow the instructions given in paragraph 2.3.
	Exhaust port(s) obstructed.	Screw cap(s) must be disengaged. Ensure vent ports are free. If not, clean them of any obstructions and clean the dust excluders, if present.
	Actuator torque lower than required.	In order to do a check it is necessary to perform the following test: disassemble the actuator from the valve and measure the minimum pressure values necessary to move and compress the spring (if the actuator is a single acting model) or the minimum values necessary to move the actuator yoke and perform a stroke (for double acting models). Compare the measured values with the ones reported on the Testing Certificate. If there are significant differences you should contact Flowserve Service Department.
During the stroke the actuator exhibits excessive amounts of backlash.	Some components are excessively worn.	Identify and replace these components, according to the procedure described in paragraphs 4.2, 4.3 and 4.4.
In case of other problems not listed in this table, you should contact the Flowserve Service Department.		

6 Disposal of Decommissioned Actuators

▲ WARNING: Before disassembling the actuator from the valve and before any decommissioning activity ensure that the pneumatic connection ports of the cylinder are disconnected and open to the ambient. Also make sure that power and pneumatic supplies are turned off, and bleed any pressurized parts of the actuator, control panel and pneumatic tubing (including air tanks, if present). Verify that the actuator is in fail safe position, i.e., that it is not locked in a position with the spring compressed by means of locking devices.

Spring Return Actuators that are to be decommissioned permanently must have the stored energy in the spring neutralized. For LPC and LPS actuators, the spring module can be safely disassembled from the actuator if the supply pressure has been removed and the actuator is in its fail safe position: in fact, in this condition, any residual spring preload is not transmitted to the actuator. To disassemble the spring module from the actuator follow the instructions provided at Paragraph 4.2 of this manual.

Once the spring module is disassembled from the actuator, the spring inside can be neutralized in different ways depending on the equipment available on-site. Please contact your Flowserve Limatorque representative to receive a dedicated procedure for Spring Module disassembly, in order to safely perform this operation in the most appropriate way according to available equipment and tools.

▲ WARNING: Failure to neutralize the spring contained in the actuator's spring module or to follow these instructions could lead to injury to personnel or property damage.

No other specific actions need be taken on other portions/parts of the actuator for decommissioning. To disassemble pneumatic cylinder and Scotch yoke housing, follow the instructions provided respectively at Paragraph 4.3 and 4.4 of this manual.

All disassembled parts of the actuator shall be separated according to their material type (metal, rubber, plastic, oil and grease, electric and electronic equipment ...). Dispose them with support of differentiated waste collection sites, as provided for by the laws and provisions in force.

7 Annex

Example Model	Series	Body Size	Yoke	Cylinder	Temp. Range	Fail Action	Spring combination	Options		
	LPS	20	A	535	B	FC	4 - 1	JL		
<p>LPS - Limitorque Pneumatic Scotch-yoke actuators LHS - Limitorque Hydraulic Scotch-yoke actuators LHH - Limitorque High Hydraulic pressure scotch-yoke LDG - Limitorque Direct Gas scotch-yoke actuators</p>										
<p>15, 20, 25, 30, 35, 40, 50, 60</p>										
<p>A - Symmetric Scotch Yoke B - Custom Scotch Yoke C - Canted Scotch Yoke</p>										
<p>'50, 55, 60, 65 [...] 485, 535, 585, 635 [...] 1500, 1600, 1700, 1800</p>										
<table border="0"> <tr> <td style="vertical-align: top;"> <p>PNEUMATIC 12 BARG (175 PSIG) DIRECT GAS AND HYDRAULIC CYLINDERS</p> <p>B - Buna Seals temp range: -20°C ; +100°C [-4°F;+212°F]</p> <p>S - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>F - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>Required: EN-10204 3.1</p> <p>L - Fluorosilicone Seals temp range: -50°C ; + 100°C [-58°F;+212°F]</p> <p>Z - Fluorosilicone Seals temp range: -60°C ; + 100°C [-76°F;+212°F]</p> <p>V - Viton® Seals temp range: -29°C ; + 160°C [-20°F;+320°F]</p> </td> <td style="vertical-align: top;"> <p>PNEUMATIC 8.3 BARG (120 PSIG) CYLINDERS</p> <p>A - Buna Seals temp range: -20°C ; +100°C [-4°F;+212°F]</p> <p>R - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>E - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>Required: EN-10204 3.</p> <p>K - Fluorosilicone Seals temp range: -50°C ; + 100°C [-58°F;+212°F]</p> <p>Y - Fluorosilicone Seals temp range: -60°C ; + 100°C [-76°F;+212°F]</p> <p>U - Viton® Seals temp range: -29°C ; + 160°C [-20°F;+320°F]</p> </td> </tr> </table>									<p>PNEUMATIC 12 BARG (175 PSIG) DIRECT GAS AND HYDRAULIC CYLINDERS</p> <p>B - Buna Seals temp range: -20°C ; +100°C [-4°F;+212°F]</p> <p>S - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>F - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>Required: EN-10204 3.1</p> <p>L - Fluorosilicone Seals temp range: -50°C ; + 100°C [-58°F;+212°F]</p> <p>Z - Fluorosilicone Seals temp range: -60°C ; + 100°C [-76°F;+212°F]</p> <p>V - Viton® Seals temp range: -29°C ; + 160°C [-20°F;+320°F]</p>	<p>PNEUMATIC 8.3 BARG (120 PSIG) CYLINDERS</p> <p>A - Buna Seals temp range: -20°C ; +100°C [-4°F;+212°F]</p> <p>R - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>E - Fluorosilicone Seals temp range: -40°C ; +100°C [-40°F;+212°F]</p> <p>Required: EN-10204 3.</p> <p>K - Fluorosilicone Seals temp range: -50°C ; + 100°C [-58°F;+212°F]</p> <p>Y - Fluorosilicone Seals temp range: -60°C ; + 100°C [-76°F;+212°F]</p> <p>U - Viton® Seals temp range: -29°C ; + 160°C [-20°F;+320°F]</p>
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<p>D1 - Double acting, Single Cylinder (STD) D2 - Double Acting Double Cylinders DD - Double Acting, Tandem Cylinders FC - Spring Fail Close FO - Spring Fail Open</p>										
<p>'1-1, 1-2, 1-3 [...] 2-1, 2-2, 2-3, 2-4 [...] 3-1, 3-2, 3-3 [...] 4-1, 4-2, 4-3, 4-4 [...] 5-1, 5-2, 5-3, 5-4 [...]</p>										
<p>JL - Jackscrew Light Handwheel JS - Enclosed Jackscrew Handwheel BG - Bevel Gear Handwheel HP - Hydraulic Manual Hand Pump [...]</p>										

Figure 28: LPS Model Selection Table

Screws	Torque [Nm]
M3	1,1
M4	2,5
M5	5,0
M6	8,6
M8	21,0
M10	42,0
M12	72,0
M14	116,0
M16	180,0
M18	250,0
M20	354,0
M22	487,0

Screws	Torque [Nm]
M24	609,0
M27	901,0
M30	1222,0
M33	1660,0
M36	2131,0
M39	2766,0
M42	3414,0
M45	4273,0
M48	5161,0
M52	6646,0
M56	8277,0
M60	10283,0
M64	12373,0

Table 2: Tightening Torques for Screws Without Threads Lubricant (Tie Rods Excluded)

Tie Rods Diameter	Torque [Nm]
M10	30
M12	65
M16	170
M20	340
M24	500
M27	780
M30	1150

Table 3: Tightening Torque Table for 12 bar Standard (not PED certified) Cylinder Tie Rods. Without Threads Lubricant.

Tie Rods Diameter	Torque [Nm]
M10	20
M12	50
M16	125
M20	250
M24	430
M30	860

Table 5: Tightening Torque Table for 8.3 bar Standard Cylinder (not PED certified) and for 8.3 bar PED Cylinder Tie Rods. Without Threads Lubricant.

Tie Rods Diameter	Torque [Nm]
M10	30
M12	50
M16	125
M20	250
M24	425
M27	610
M30	860

Table 4: Tightening Torque Table for 12 bar PED Certified Cylinder Tie Rods. Without Threads Lubricant.

Figure 30: Mounting Interface Dimensions

LPS/LDG/LGO/LHS/LHH Series Coupling Dimensions													
Model	ISO 5211 Flange Interface (reference)	ØA	B	C	No of holes n	Hole Diameter ØD	P.C.D. [mm(inch)] ØE	F	ØG	ØH	I	L	P
LPS/LDG/LGO/LHS/LHH 15	F16	65	10	70,6	4	M20	165 (6,50)	18	86	78	161	8	155
LPS/LDG/LGO/LHS/LHH 20	F25	86	12	91,6	8	M16	254 (10)	16	130	112	178	4.5	205
LPS/LDG/LGO/LHS/LHH 25	F30	100	18	108,8	8	M20	298 (11,73)	18	150	133	201	6	230
LPS/LDG/LGO/LHS/LHH 30	F35	130	28	138,6	8	M30	356 (14,02)	28	168	152	261	10	305
LPS/LDG/LGO/LHS/LHH 35	F40	150	36	166,8	8	M36	406 (15,98)	33	199	185	323	9	405
LPS/LDG/LGO/LHS/LHH 40	F48	185	45	205,8	12	M36	483 (19,02)	38	244	230	338	10	450
LPS/LDG/LGO/LHS/LHH 50	F60	230	50	252,8	20	M36	603 (23,74)	48	292	275	500	18	550
LPS/LDG/LGO/LHS/LHH 60	n.a.	270	45	290,8	20	M42	800 (31,49)	58	372	350	620	16	650

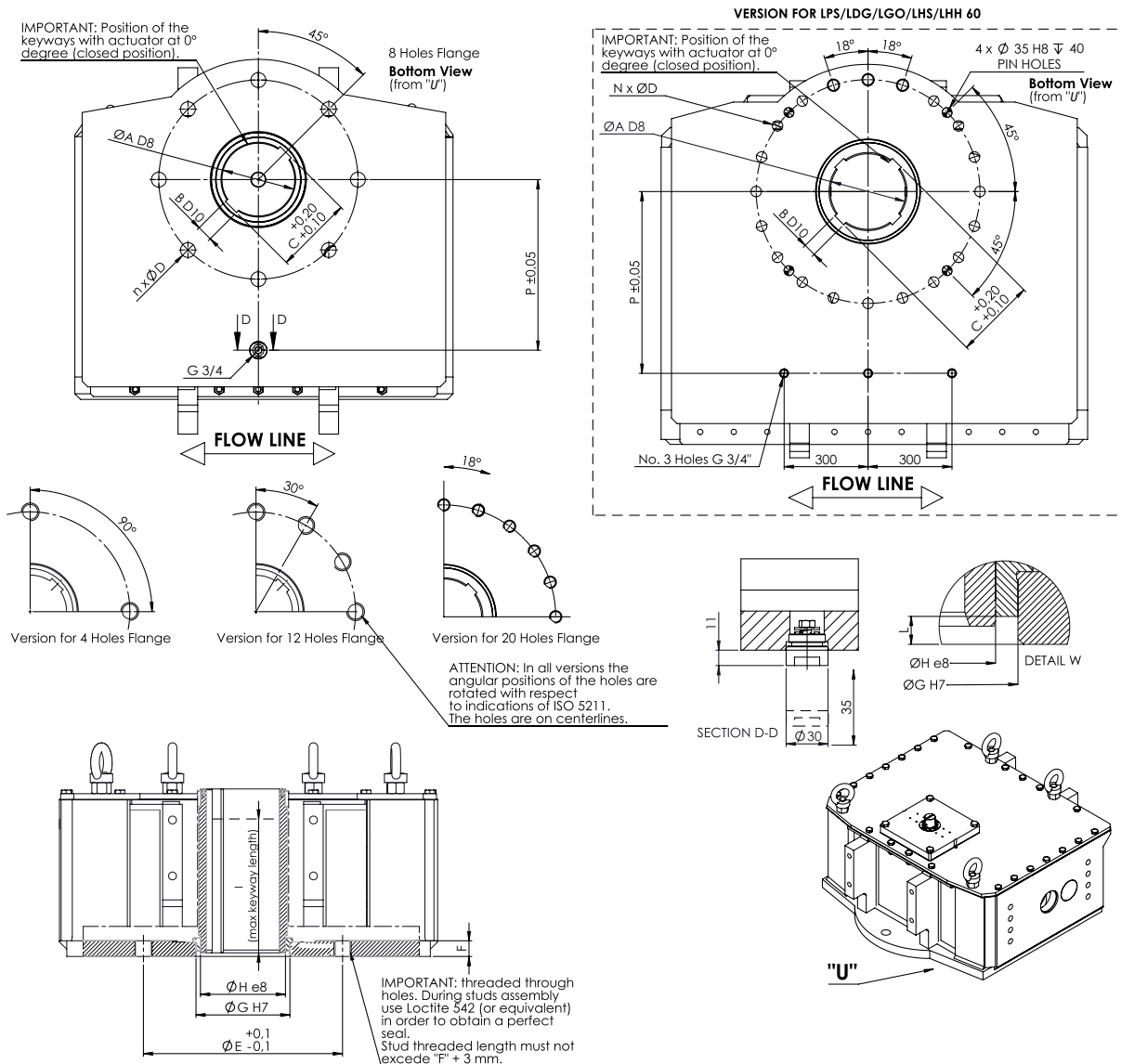


Figure 31: Details of Namur VDE/VDI 3845 Adaptor Kit, Available Upon Request

<p>LPS/LDG/LGO/LHS/LHH Series Coupling Dimensions</p> <p>THE DETAIL BELOW REFERS TO LPS/LDG/LGO/LHS/LHH Actuators Models 15/20/25/30/35/40/50/60</p>

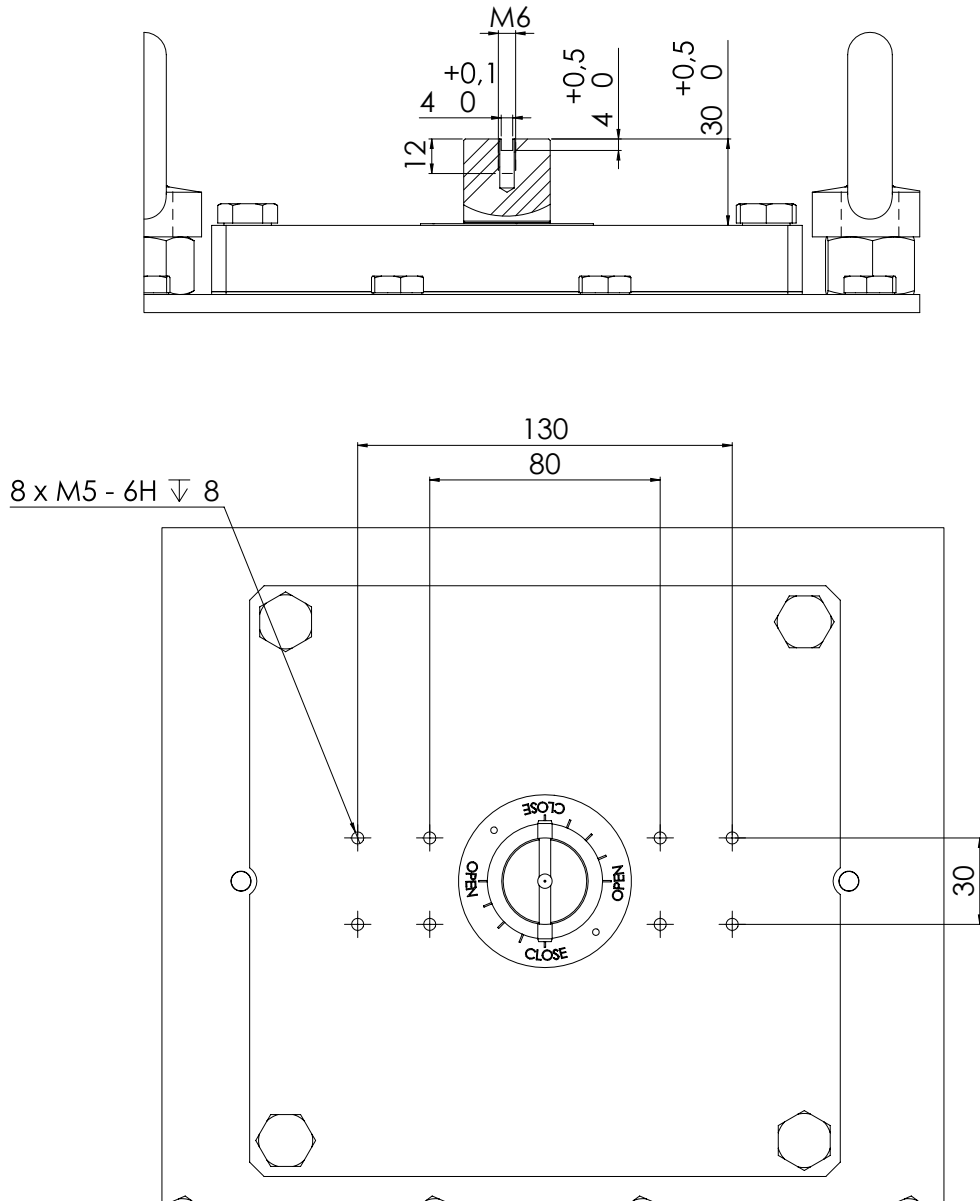
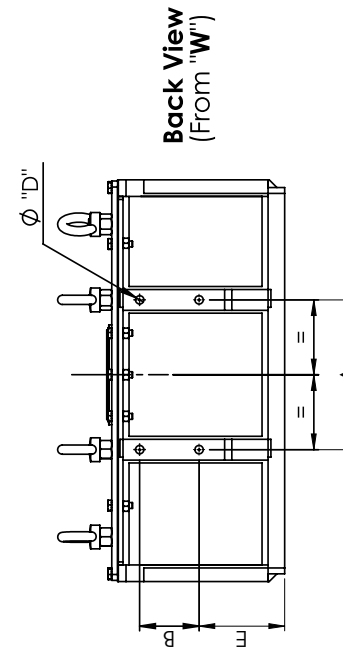
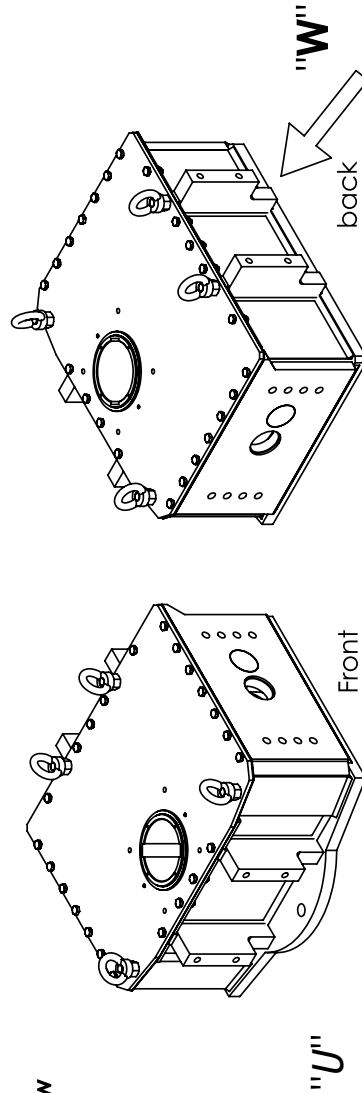
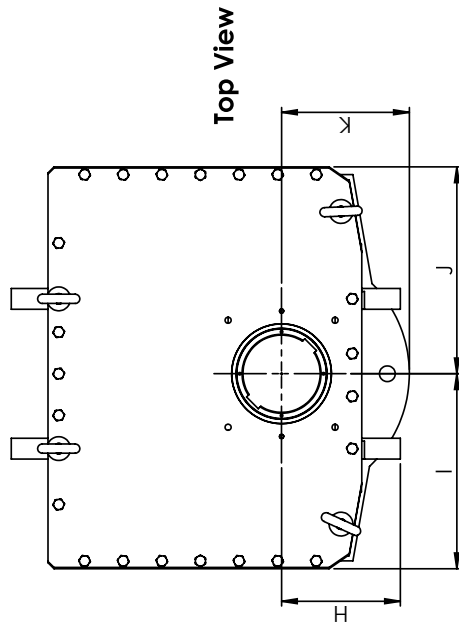
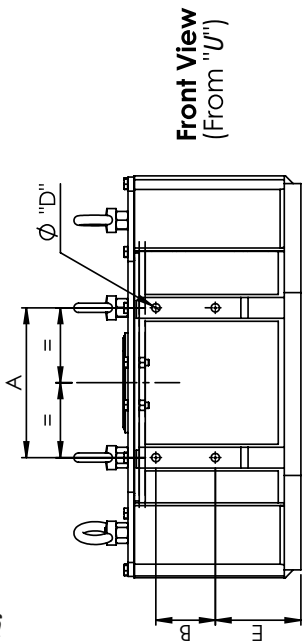


Figure 32: Center Body Mounting Holes

LPS/LDG/LGO/LHS/LHH Series Center Body Mounting Holes									
Model	A	B	D		E	H	I	J	K
			Ø	Thread length					
LPS/LDG/LGO/LHS/LHH 15	104	55	M10	12	85	113	164	174	120
LPS/LDG/LGO/LHS/LHH 20	131	70	M12	18	90	135	219	222	150
LPS/LDG/LGO/LHS/LHH 25	211	73	M12	15	105	179	249	267	188
LPS/LDG/LGO/LHS/LHH 30	252	100	M16	20	144	200	328	348	215
LPS/LDG/LGO/LHS/LHH 35	270	110	M20	25	190	269	413	433	260
LPS/LDG/LGO/LHS/LHH 40	345	140	M24	30	200	285	519	543	290
LPS/LDG/LGO/LHS/LHH 50	355	220	M33	40	250	369	633	649	343
LPS/LDG/LGO/LHS/LHH 60	500	220	M24	48	417	396	738	783	455



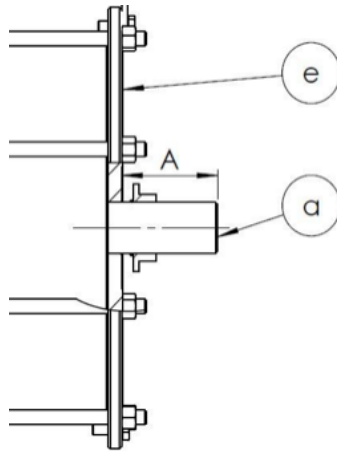


Figure 33- LPS -Distance “A” with standard stopper bolt mounted.

DANGER: the table below is valid only for standard LPS actuator without manual override.

The table is not valid for modular stock order. Please refer to the order documentation and contact Flowserve for any suspected situation that may differ from the cases described here.

A - LPS - Cylinder - Max Stopper Safety Engagement Length (mm)										
		Actuator Size								
		LPS-15	LPS-20	LPS-25	LPS-30	LPS-35	LPS-40	LPS-50		
LPS - CYLINDER SIZE	155	104	-	-	-	-	-	-	M42x3*	LPS - STOPPER BOLT -SIZE
	175	104	-	-	-	-	-	-		
	200	104	-	-	-	-	-	-		
	235	104	104	-	-	-	-	-		
	255	102	102	-	-	-	-	-		
	285	99	99	121	-	-	-	-		
	300	99	99	121	-	-	-	-		
	335	94	116	116	136	-	-	-		
	360	94	116	116	136	-	-	-		
	385	94	116	116	136	-	-	-		
	435	-	111	111	131	166	-	-		
	485	-	106	126	126	161	-	-		
	535	-	141	141	141	171	206	-		
	585	-	-	136	136	166	201	-		
	635	-	-	131	131	161	196	-		
	685	-	-	-	156	156	191	-		
	735	-	-	-	151	151	186	-		
	785	-	-	-	-	196	196	196		
	835	-	-	-	-	191	191	191		
	885	-	-	-	-	186	186	186		
935	-	-	-	-	186	186	186			
985	-	-	-	-	190	296	296			
1050	-	-	-	-	210	291	291			
1150	-	-	-	-	-	276	276			
1200	-	-	-	-	-	276	276			
1300	-	-	-	-	-	295	296			
1350	-	-	-	-	-	-	291			
1400	-	-	-	-	-	-	281			
1500	-	-	-	-	-	-	276			

* = for actuators built from modular stock the dimension can be greater

Table 6- LPS - Cylinder - Max stopper safety engagement length (mm)

DANGER: the table below is valid only for standard LPS actuator without manual override.

Please refer to the order documentation and contact Flowserve for any suspected situation that may differ from the cases described here.

LPS - Cylinder Stopper Length (mm)*										
		Actuator size								
		LPS-15	LPS-20	LPS-25	LPS-30	LPS-35	LPS-40	LPS-50		
LPS - CYLINDER SIZE	155	123	-	-	-	-	-	-	M42x3*	LPS - STOPPER BOLT -SIZE
	175	123	-	-	-	-	-	-		
	200	123	-	-	-	-	-	-		
	235	123	123	-	-	-	-	-		
	255	123	123	-	-	-	-	-		
	285	123	123	145	-	-	-	-		
	300	123	123	145	-	-	-	-		
	335	123	145	145	165	-	-	-		
	360	123	145	145	165	-	-	-		
	385	123	145	145	165	-	-	-		
	435	-	145	145	165	200	-	-		
	485	-	145	165	165	200	-	-		
	535	-	180	180	180	210	245	-		
	585	-	-	180	180	210	245	-		
	635	-	-	180	180	210	245	-		
	685	-	-	-	210	210	245	-		
	735	-	-	-	210	210	245	-		
	785	-	-	-	-	265	265	265		
	835	-	-	-	-	265	265	265		
	885	-	-	-	-	265	265	265		
	935	-	-	-	-	265	265	265		
	985	-	-	-	-	-	370	370		
	1050	-	-	-	-	-	370	370		
	1150	-	-	-	-	-	370	370		
1200	-	-	-	-	-	370	370			
1300	-	-	-	-	-	-	400			
1350	-	-	-	-	-	-	400			
1400	-	-	-	-	-	-	400			
1500	-	-	-	-	-	-	400			

* = for actuators built from modular stock the dimension can be greater

Table 7 - LPS - Stopper length of standard actuators.



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visit www.flowserve.com or call:
USA +1 800 225 6989
International +1 972 910 0774**

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**Flowserve Limitorque
Fluid Power Systems
Product Sales**

Via Rio Vallone 17
20883 Mezzago (MB), Italy
Phone: +39 039 62060 1
Fax: +39 039 62060 213
Email: lfpsinfo@flowserve.com

**Flowserve Limitorque
Fluid Power Systems
Manufacturing and Operations**

Via Rio Vallone 17
20883 Mezzago (MB), Italy
Phone: +39 039 62060 1
Fax: +39 039 62060 213
Email: lfpsinfo@flowserve.com

**Flowserve Limitorque
Fluid Power Systems
Research and Development**

Via Belizzi 40/42
29122 Piacenza (PC), Italy
Email: lfpsinfo@flowserve.com

**Flowserve U.S. Inc.
Valve Automation Center**

14219 Westfair,
West I Houston, Texas 77041, U.S.A.
Email: VACHouston@flowserve.com

Flowserve - India

Plot n.4 1A
Export Promotion Industrial Park
Whitefield, 560066
Bangalore, India
Email:
BGA_applications@flowserve.com

Flowserve - China

Hanwei Plaza 7,
Guanghua Road, Chaoyang District,
Beijing 100004, China
Email:
AutomationAPAC@flowserve.com
AutomationChina@flowserve.com