ACTREG

POWER IN AUTOMATION

PNEUMATIC SCOTCH YOKE ACTUATOR SERIES

Installation and Operating Manual

CE

Ex II 2 G D

Safety Integrity Level SIL 3

IEC 61508 / IEC 61511

INDEX

1. INTRODUCTION

This manual provides the users all the necessary information for the correct manipulation and operation the Scotch Yoke pneumatic actuator series. Also provides the maintenance procedures and the safety warnings to prevent accidents and actuator malfunctioning.

2. STANDARDS AND REGULATIONS

Actuators destined for European member states have been designed, built and tested according to the Quality Control System, in compliance with the EN ISO 9001:2015 standard and with the following regulations/directive.

- 2006/42/EC: European Machinery Directive
- 2014/68/EU: Pressure Equipment Directive (PED)
- 2014/34/EU: Directive for safety equipment and systems to be used in potentially explosive atmospheres (ATEX)
- EN ISO 12100: Machinery Safety Directive
- ISO 80079-36: Non-electrical equipment for explosive atmospheres - Basic method and requirements
- EN 1127–1: Explosive atmospheres – Explosion prevention and protection
- ISO 12490: Petroleum and natural gas industries – Mechanical integrity and sizing of actuators and mounting kits for pipeline valves
- EN13445: Unfired Pressure Vessels
- EN15714-3: Pneumatic part-turn actuators for industrial valves – Basic requirements
- IEC 61508/SIL: Functional safety of electrical/electronic/programmable electronic safety-related systems
- UNE-EN 60529: Degrees of protection provided by enclosures (IP Code)
- ISO 15848-1: Measurement, test and qualification procedures for fugitive emissions
- ISO 9001: Quality management systems

3. GENERAL INFORMATION

This manual is produced to enable the user to install, operate and maintain the actuator. It is compulsory to read and follow the instructions to manipulate the actuators. The Scotch Yoke actuators are designed to actuate 1/4 turn valves, such as ball valves, butterfly valves or plug valves installed on pipelines for all kind of industries.

Maintenance and operation must be carried out in accordance with the National Legislation and Statutory Provisions relating to the safe use of this equipment, applicable to the site of installation. The operators must read all the recommendations to know how to manipulate actuators properly and safety. Operators must always wear appropriate Personal Protection Devices (PPDs) in line with the existing plant regulations.

Improper use can damage the equipment or cause dangerous situations for health and safety. Actreg declines any responsibility for damage to people and/ or objects resulting from the use of the equipment for applications different from those described in the present manual.

4. Model reference, Labels and Nameplates

4.1 Model Reference

SY01 F2530 450 SR 3 FC – L HW

Actuator type:
SY01: Pneumatic

Flange Connection:
F1416 up to F4860

Cylinder Size:
200 up to 1000 (SY01)

Acting type:
SR: Spring Return
DA: Double Acting

Spring Cylinder (only for SR):
3 / 4 / 5 / 6

Optional features:
HW: Handwheel Override
HY: Hydraulic Override

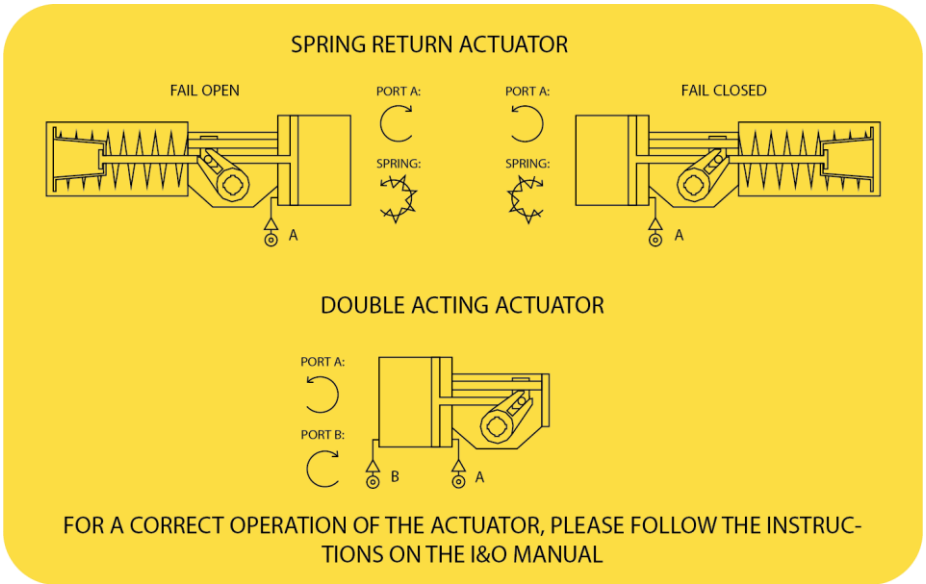
Temperature Operating Range:

High (H):	- 20 / 120°C
Standard:	- 20 / 80°C
Low (L):	- 40 / 80°C
Extreme Temp (E):	- 50 / 80°C
Extreme Low (EL):	- 60 / 80°C

Fail Position (only for SR):
FC: Fail position CLOSE
FO: Fail position OPEN

4.2 Labels

This label shows the different types of actions that the actuators perform depending on the supply port through which they are being operated.



4.3 NAMEPLATES

Name Plates for the Actuator Cylinder and Body with the necessary info to identify them:

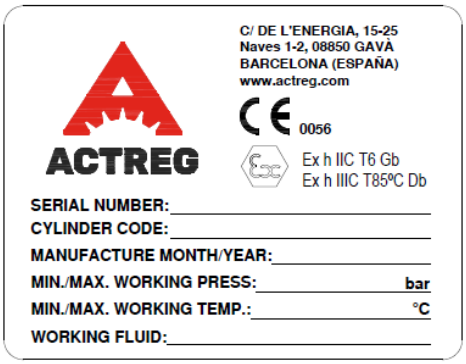


PLATE 1

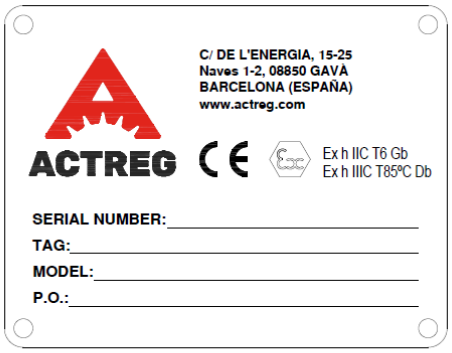
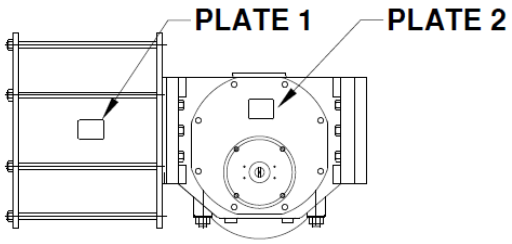


PLATE 2

Nameplate position:



5. WORKING CONDITIONS AND OPERATING LIMITS

Some internal parts of the actuator are made of different materials depending on the ambient temperature range in which have to operate:

- High temperature: -20 °C to 120 °C
- Standard Temperature: -20 °C to 80 °C
- Low Temperature: -40 °C to 80 °C
- Extreme Temperature: -50 °C to 80 °C
- Extreme Low Temperature: -60 °C to 80 °C

The operating pressure is the range of pressure where the actuator can operate and ensure the lifetime of the actuator. The design pressure is the maximum pressure that can resist the actuator, in static conditions, without danger.

- Operating pressure: up to 8 bar.
- Design pressure: 12 bar.

The operating medium of the actuator is Gas. For best possible service life and trouble-free operation, according to ISO 8573-1, Actreg recommends quality class 5.4.4 for indoor operating, and 5.3.4 for outdoor operating. This means 40µm filter, dew point +3°C for indoor operation or -20°C for outdoor operating and oil concentration 5.0mg oil/m³.

Quality Class	Solid Particles		Water		Oil
	Particle size (µm)	Max. concentration (mg/m³)	Max. press. dew point (°C)	Quantity (g/m³)	Max. concentration (mg/m³)
1	0.1	0.1	-70	0,003	0.01
2	1	1	-40	0,11	0.1
3	5	5	-20	0,88	1.0
4	15	8	+3	6	5.0
5	40	10	+7	7,8	25
6	-	-	+10	9,4	-

Actuators are factory lubricated for the lifetime in normal working conditions and do not require any further lubrication.

Recommended tightening torque (Class A2/A4 bolts) Coef. friction 0.3								
Thread size	Torque for A2-70	Torque for A4-70	Thread size	Torque for A2-70	Torque for A4-70	Thread size	Torque for A2-70	Torque for A4-70
M5	6,1 Nm	8 Nm	M12	88 Nm	117 Nm	M20	439 Nm	586 Nm
M6	10,4 Nm	13,9 Nm	M14	141Nm	188 Nm	M22	582 Nm	776 Nm
M8	25,5 Nm	33,9 Nm	M16	218 Nm	291 Nm	M24	724 Nm	966 Nm
M10	51 Nm	69 Nm	M18	380 Nm	411 Nm	M27	-	-

⚠ Do not use the equipment outside its operating limits. Verify operating limits on the labels or nameplates of the actuator.

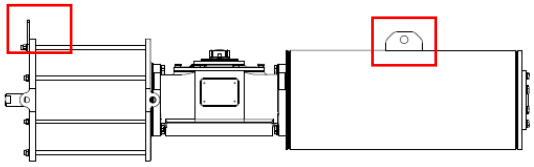
6. LIFTING AND HANDLING

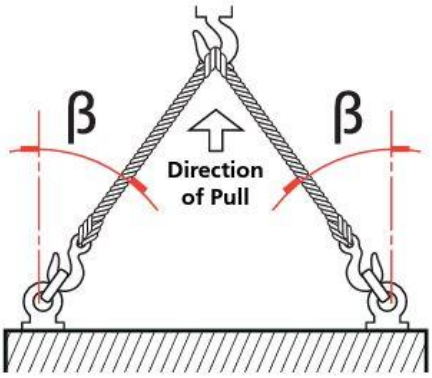
The actuators that weigh above 25 kg are supplied with lugs to lift them. Only certified operators can lift the actuators with cranes or other lifting devices.

16.1 LIFTING INSTRUCTIONS

- The lifting device and the sling must be suitable rated for the actuator weight and dimensions.
- Do not use damaged slings.
- The sling must not be shortened with knots or bolts or any other makeshift device.
- For lifting purposes, use only suitable lifting tools.
- Do not drill holes, weld eye bolts or add any other type of lifting device on the actuator external surface.
- Do not lift the actuator and valve combination with the actuator lugs.
- Every assembly must be estimated separately for safe and correct lifting.
- Avoid pulls or abrupt movements during lifting. Avoid pushing the load.

- During lifting operations, do not handle the sling and/or the actuator.
- The actuator must be horizontal and the load balanced.
- The angle β must be between 0° and 45° as shown below.





⚠ Prior to lifting the actuator, make sure is not electrically or pneumatically connected.

7. SAFETY AND PRECAUTIONS

Before installing the equipment make sure you have read all the possible risks and the actuator is suitable for the intended application. It is recommended that only trained and experienced operators shall install this kind of equipment, always using the proper PPE required on every working environment.

7.1 PRECAUTIONS

- During the installation and commissioning or the disassembly assure the actuator cannot be operated remotely. Prior to starting, remove pneumatic supply, vent the pressure vessels and remove electrical power.
- The actuator must be correctly fitted on the valve or the mounting kit, assure all the mounting parts are tightened before connecting any electrical power or air supply.
- All the fittings must be properly sealed to avoid the pressurized fluid ejection during the operation.
- Do not disassemble the actuator in case of malfunctioning. Follow instructions in the present manual and contact Actreg to know how to proceed.
- Take care of the surface of the actuator, this can reach very high or very low temperatures if the valve is working with hot or cold fluids. Also take care with the environmental temperatures and the elements exposed to the sun light directly can increase the surface temperatures. To avoid the accidents, it is recommended to use protective gloves.
- In the presence of dust, equipment surface temperature must not exceed 2/3 of the ignition temperature of the dust. Dust ignition temperature is reduced by 75 °C if a 5 mm thick coating builds up. Keep equipment surfaces clean by planning regular cleaning maintenance using a suitable wet anti-static cloth.

- Operators should wear ear protections if the noise is higher than 85 dB during the operation.
- Foresee periodic maintenance procedure to verify tightening.

8. INSTALLATION ON VALVE

Before proceeding, read and understand the *Safety and Precautions* information. Also, prior to performing any operations check the operating description in this manual or other specified documents.

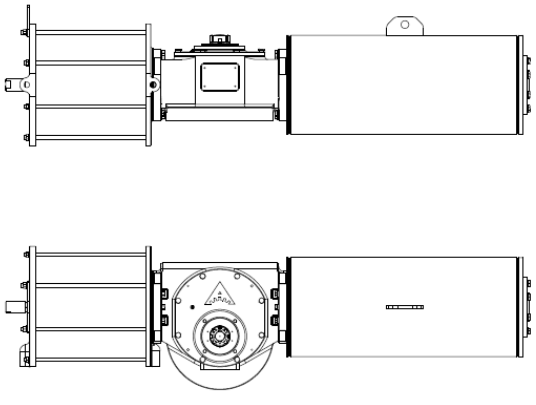
Actuators should be installed in such a way that they are easy to access in order to do the periodic inspections and corresponding maintenance operations necessary to guarantee the performance qualities that they have been designed for.

Actuators must not support unexpected stress. It is important to do the assemble with a correct alignment and parallelism to guarantee that it is not submitted to unexpected stress.

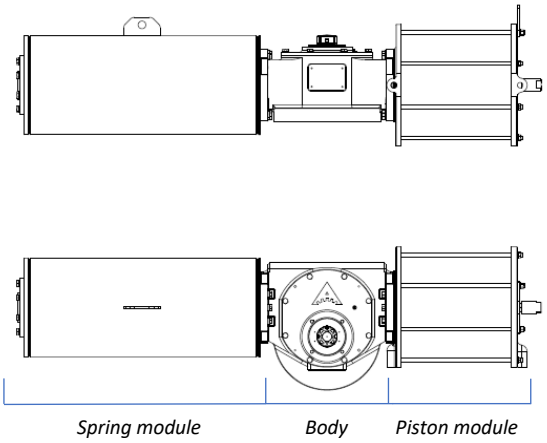
8.1 PRELIMINARY ACTIONS

- Verify the ATEX classification of the actuator is compatible with the plant zoning.
- Check the mounting drawings to ensure the position of the actuator with the valve and the pipeline.
- Ensure all fasteners are adequately tightened, to avoid loosening during operation, considering vibrations induced by the dynamics of the pipeline. Also ensure tubing runs are adequately fastened and supported to avoid leaks from any gas connections.
- If the actuator has a failure position, ensure the valve is in the failure position before mounting the actuator.

Fail close position



Fail open position



8.2 INSTRUCTIONS

The actuator assembly on valve should be performed by using a mounting bracket and a coupling adapter between the actuator and the valve.

The assembly position of the actuator must be in accordance with the actuator design, plant requirements and the valve model. To assemble the actuator on the valve, proceed as follows:

- Verify the dimensions of the valve flange and stem; they must meet the coupling and bracket dimensions.
- Actuator is supplied in the failure position (for single-acting). Set the valve in the right position per the actuator fail position. Check the position of the actuator by means of the position indicator on the centre body or on the limit switch box (if present).
- Clean the coupling flange of the valve and remove anything that might prevent adherence to the actuator flange. Grease shall be completely removed.
- Inspect, clean and apply grease on the coupling hole (valve side of coupling joint).
- Lubricate the valve stem with oil or grease, to facilitate assembling.
- Lift the actuator according to instructions reported in *Lifting and Handling.*
- If possible, place the valve stem in a vertical position to facilitate assembling.
- If the assembly is done using an adapter and coupling joint, assemble the coupling joint onto the valve stem before proceeding with the assembly of the actuator.
- Do no exert any force while lowering the actuator onto the valve.
- Fix the actuator to the valve and the bracket by means of threaded connections (bolts, stud bolts and nuts).
- Tighten bolts or nuts of the connecting stud bolts to the correct torque, in accordance with the size and material characteristics of the bolts installed by the customer.
- Support the actuator until fully installed and fixing bolts are correctly tightened.
- Check for possible damage to the paint-work and repair is necessary, according to painting specification.

Installation must be performed by qualified personnel.

9. REMOVAL FROM VALVE

The end user is in charge of removing the actuator from the valve. Removal shall be performed only by qualified staff, wearing/using appropriate PPDs.

To disassemble the actuator from the valve, proceed as follows:

- Cut off electrical power supply.
- Cut off pneumatic supply.
- Release any pressure from the control group.
- Remove the supply pipes from the actuator.
- Remove control and signal lines from electric components (if any).
- Sling the actuator in the line with the instructions given in *Lifting and Handling.*
- Unscrew bolts or nuts from the stud bolts fixing the actuator to the valve or the bracket.
- Lift and remove the actuator from the valve or the bracket.

Do not remove the actuator if the valve is blocked in the intermediate position.

10. OPERATION

The following instructions must be followed and integrated into End User safety program when installing and using Actreg products. Read and save all instructions prior to installing, operating and servicing this product.

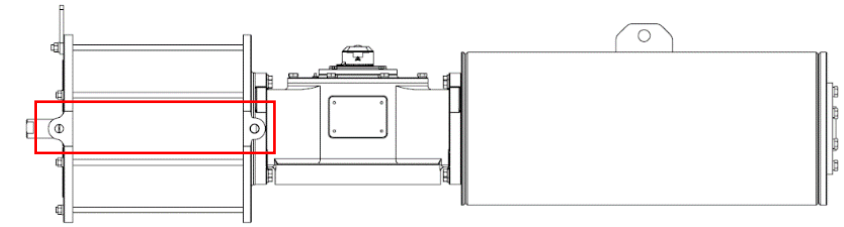
Follow all warnings, cautions and instructions marked on and supplied with the product. Install equipment as specified in Actreg installation instructions and as per applicable local and national codes of practice. Connect all products to the proper pipeline gas sources.

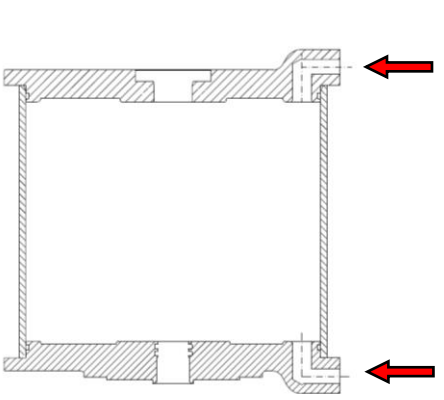
When replacement parts are required, ensure that the qualified service technician uses only replacement parts specified by Actreg.

Substitutions will invalidate any hazardous area certification and may result in fire, electrical shock, other hazards or improper operation.

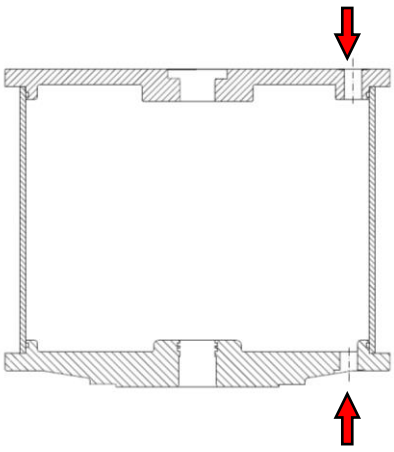
10.1 PRESSURE CONNECTIONS

On the SY01 the pneumatic connections are located on both endcaps of the cylinder on 2 different configurations according to the images bellow.





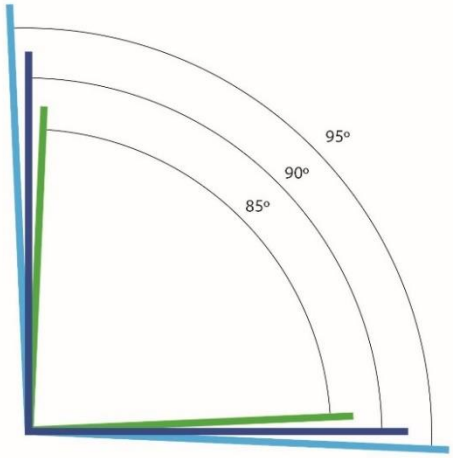
From size 200 to 500



From size 550 to 1000

10.2 Stroke Adjustment

ACTREG pneumatic actuators are provided with bi-directional travel stops. Top located stops allow a full ±5° travel adjustment between 85° and 95°. Adjustment of the counter clockwise and clockwise rotation limits is accomplished by unscrewing the locking nuts.

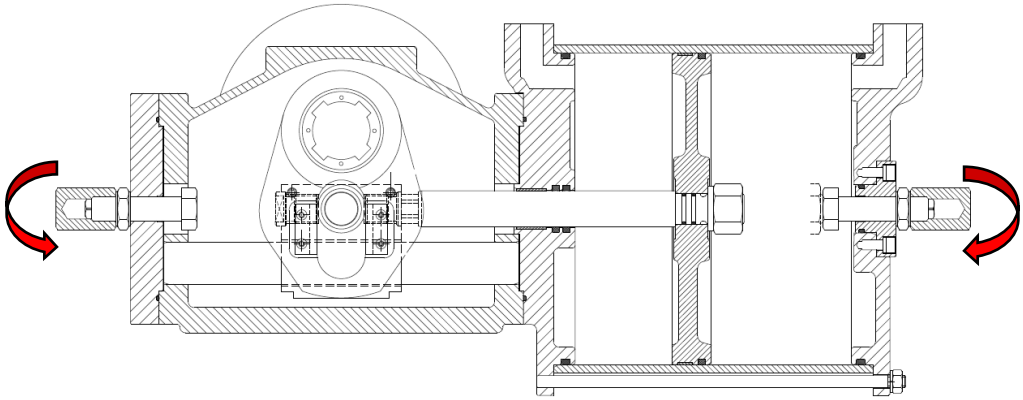


To adjust the stroke of the actuator, proceed as follows:

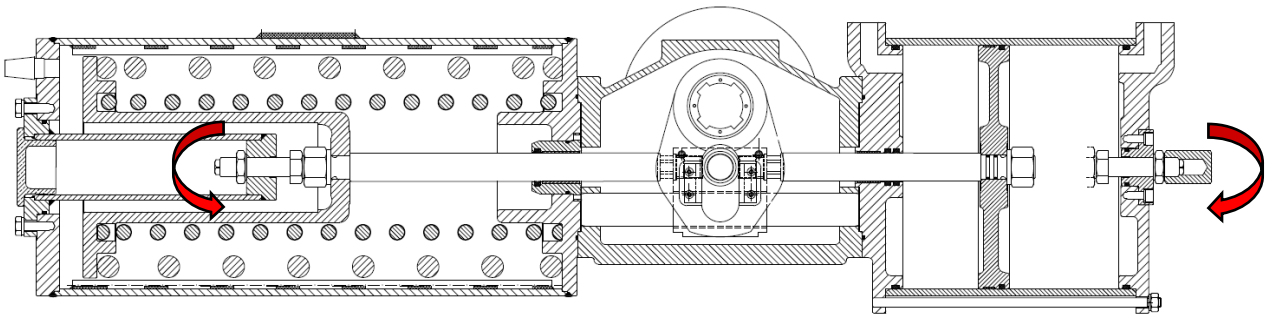
- Ensure the actuator is not pressurized.
- Loose the nut of the adjustment screw.
- Screw in to reduce the stroke and out to increase it.
- Tight again the nut to fix the position of the adjusting screw.

⚠ Do not adjust more than ± 5° in the travel of the actuator or internal parts may be damaged.

For the single acting actuators, the screw from the air cylinder screw (right on the image) adjusts the open position and the body cap screw (left on the image) the closed position.



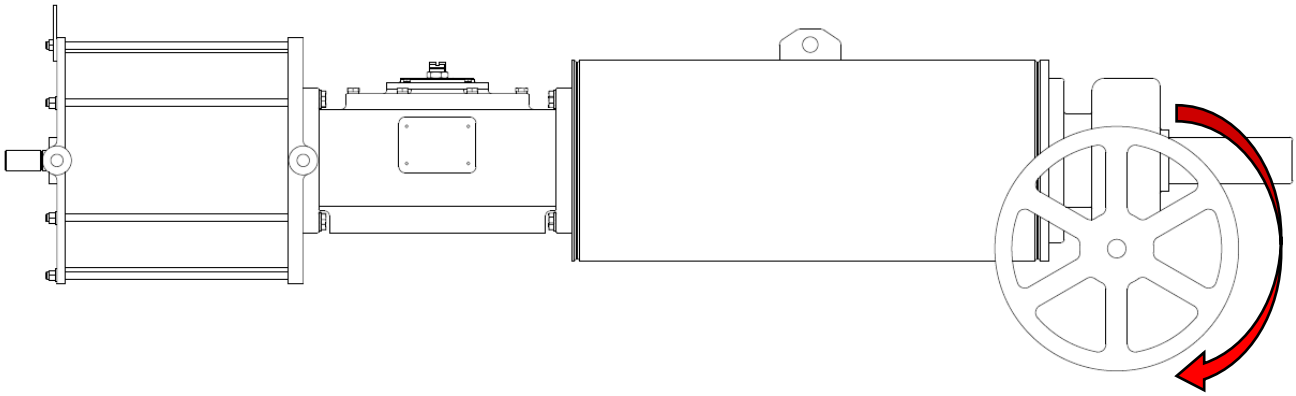
For the single acting actuators the screw from the air cylinder screw (right on the image) adjusts the open position and the spring cylinder screw (left on the image) the closed position.



10.3 Manual Operation Way

The manual operating is for an emergency or in case of an energy failure. Runs by a bevel gear operator, turning the hand wheel to control the valve position by screwing in & out. After manual operation, screw out the system when it changes to auto-operation way, to ensure the auto-operation smoothly realized.

For the Scotch Yoke Series of actuators there are 2 different systems that are used depending of the actuator size. For actuators from F1416 to F4048 the standard system is a bevel gear with a hand wheel as seen on the image bellow:



The actuator can be modified to achieve a 100% full travel regulation. The limitation is only for one stroke direction, from 0% to the percentage that the client needs to open or close the valve. The regulation system is a screw with a bevel gear and a hand wheel to operate it.

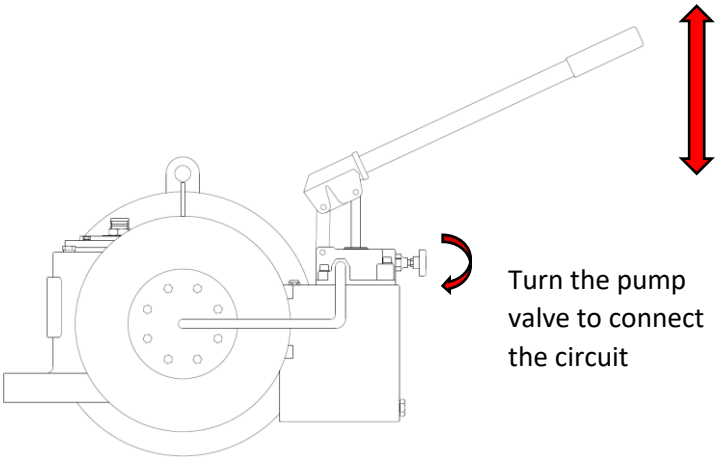
⚠ Ensure the actuator is not pressurized before start to manipulate the adjusting screws.

The manual operating is for an emergency or in case of an energy failure. Some of the systems to manually operate the actuators are mechanical, most of them for actuators that give small and medium torques, and another way is to use a hydraulic manual pump system that helps to run over very high torques.

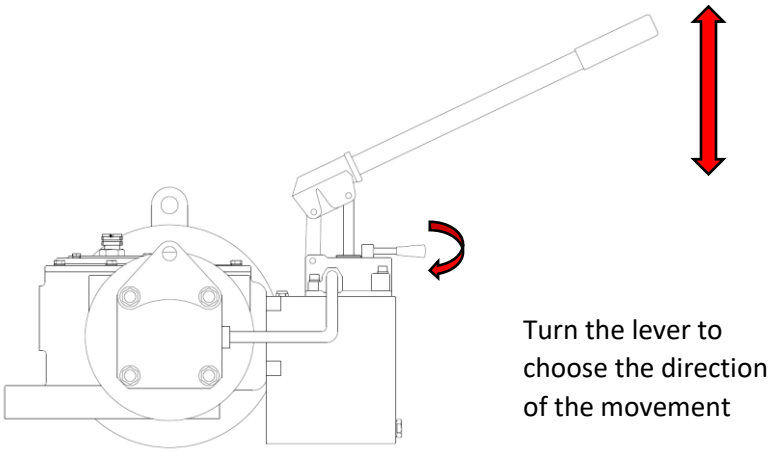
This range of sizes can also be equipped with a hydraulic override system; it includes a hydraulic piston inside the spring cylinder for the single acting and a complete hydraulic cylinder for the double acting actuators. For the size F4860 this is the only available system.

If the user needs more information, Actreg can provide a specific manual for using the hydraulic manual override, to avoid malfunctioning and any accidents.

To use the single acting hydraulic override, release the air firstly, connect the hydraulic circuit by turning the valve on the pump, and then place the pump lever (located on the body of the actuator) and operate it.



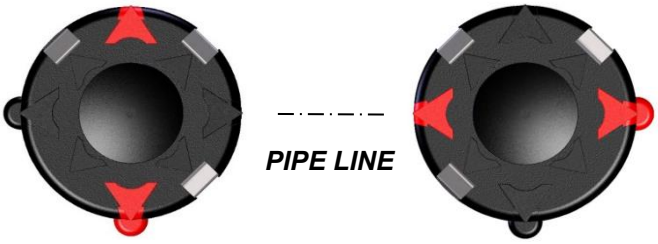
To use the double acting hydraulic override, release the air firstly, connect the hydraulic circuit by selecting the direction of the fluid with the small lever on the pump, and then place the pump lever (located on the body of the actuator) and operate it.



⚠ Before start operating the actuator manually release the pressure of the inside of the actuator. When the operation is finished, make sure to change pump into disengage position before supply air pressure again to the actuator in order to protect the system.

10.4 ACTUATOR POSITION INFORMATION AND TRANSMITTING

The standard actuator has a visual position indicator on the top of the actuator. This position indicator has different colour arrows to indicate if the valve is closed or open, and the way to know this information is explained below:



Closed position ***Opened position***

The position indicator must be in accordance with the pipe line orientation. The position indicator also has a different design, that is much clearer to know the valve position.

The colours per standard for the two different positions are green and red, this can be changed per customer requirements.

If the actuator is going to be mounted with limit switch boxes, inductive sensors, positioners or other position transmitters, the mounting interface for the attachments of ancillaries according to EN 15714-3.

11. DISMANTLING AND DISPOSAL

The first step is to ensure that there is no longer any pressure on any part of the team.

Waste fats and oils will be managed in accordance with local legislation.

- When disassembling the actuator, it is essential to correctly separate the components that make it up according to the type of material.
- Components of a metallic nature such as iron, aluminium or scrap will be disposed of for recovery if possible.
- Eliminate components such as rubber, PVC, resins, etc. separately in accordance with the current regulations of the territory in which the cutting is carried out.
- Electric components are to be separately disposed of on specialized disposal sites.

12. MAINTENANCE

12.1 PREVENTIVE MAINTENANCE

This basically consists in a periodic inspection to check the actuator function. Actuators must be operated at least once every six months. However, depending on the application of the actuator, this may be done within shorter periods.

It is the end user's responsibility to establish these operation plans depending on the working conditions.

FAILURE	POSSIBLE CAUSES	CORRECTIVE MEASURES
Incorrect valve position	Fault of pipeline valve	Consult the valve manufacturer's documentation
Incorrect indication of valve position	Incorrect signal from limit switches	Check limit switches position
Incorrect movement	Irregular supply of the operating medium	Verify the supply pressure adjust as necessary
	Worn parts	Contact Actreg aftersales department
	Fault in control panel equipment (if present)	Contact Actreg aftersales department
	Fault of pipeline valve	Consult the valve manufacturer's documentation
Valve stroke not fully completed	Insufficient gas flow	Increase gas supply flow
	Incorrect assembly between actuator and valve	Perform assembling according to INSTALLATION ON VALVE, *page 7*
	Valve blocked	Consult the valve manufacturer's documentation
	Stop bolts wrong setting	Adjust stop bolting setting following instructions in STROKE ADJUSTMENT, *page 10*
Leakages on valve	Stop bolts wrong setting	Adjust stop bolting setting following instructions in STROKE ADJUSTMENT, *page 10*
	Worn seals	Replace seals if possible. Consult the valve manufacturer's documentation.
Actuator moves too fast	No pressure on pipeline	Restore pipeline pressure
	Supply pressure greater than allowed range values	Verify the supply pressure and adjust as necessary
Actuator moves too slow	Fault on pipeline valve (valve hardened)	Contact the valve manufacturer's documentation
	Supply pressure lower than allowed range values	Verify the supply pressure and adjust as necessary
	Possible internal undue friction	Contact Actreg aftersales department
Loss of power	Inadequate supply pressure	Ensure that the supply pressure is above the minimum operating pressure of the actuator and that the output torque produced at the supply pressure exceeds the required valve torque
	Leakage from cylinder	Replace seals, if possible, recommended spare parts in *page 16*

For other problems, please contact Actreg aftersales department.

12.2 PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE ACTIVITY	PERIODICITY
Visual check of external components and control groups	6 months*
Breathing cleaning	6 months*
Check pneumatic connections for leaks. Tighten pipe fittings as required	6 months*
Cleaning	1 year*
Visual check of painting. Verify absence of damages. Repair, if necessary, per painting specification.	1 year*
Functional test	1 year*
Functional test by manual override (if present)	1 year*
Check electrical components (if present) and grounding connections	1 year*
Check threaded connections (bolts, studs and nuts) with valve. If necessary, tighten to the recommended torque, in accordance with the size and the characteristics of the fastener material installed by the costumer.	1 year*

(*) The time between maintenance task will vary depending on the medium and service conditions. Refer to end user plant preventive maintenance program for specific task periodicity.

Specific maintenance could be necessary for specific application. Refer to job documentation for eventual additional maintenance task. It is recommended to replace the critical parts of the actuator when an in-depth revision of the installation is made.

12.3 SPARE PART KIT FOR MAINTENANCE

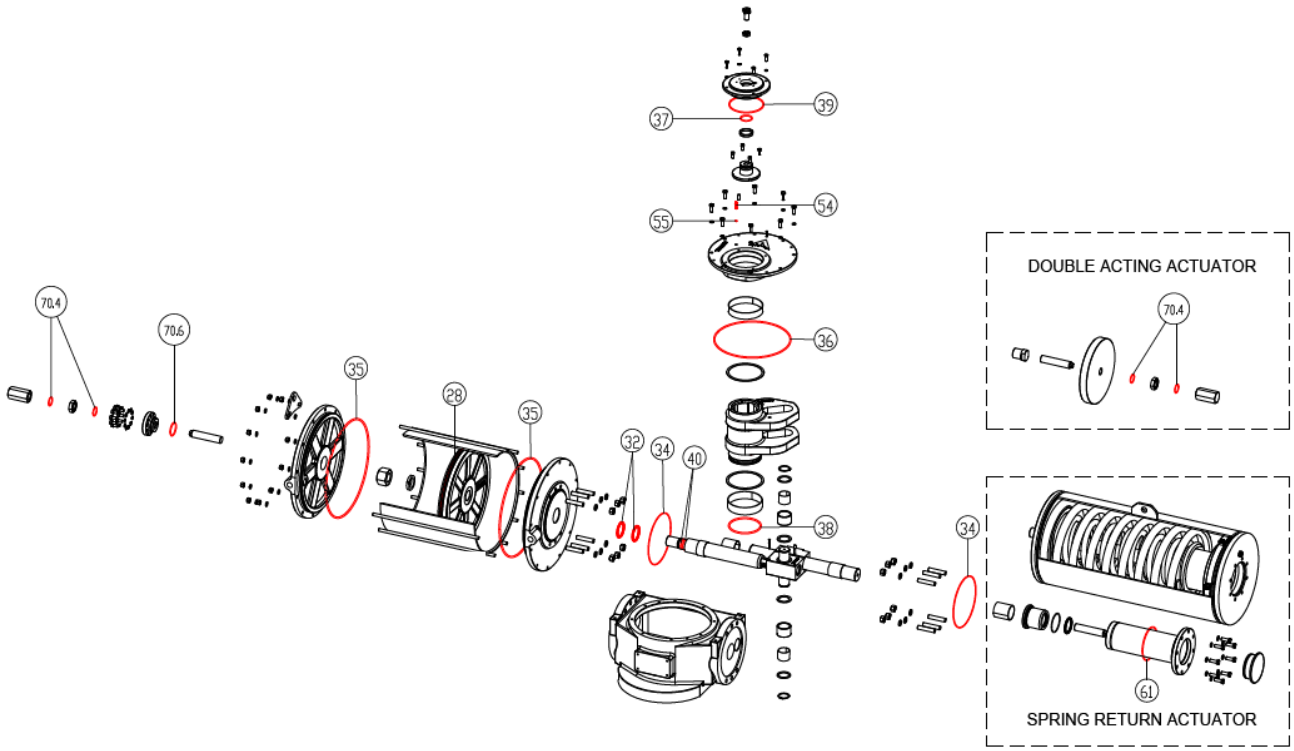
The repair kit is a set of soft parts that can wear and tear with the continuous working actions of the actuator.

These parts of the actuator can be delivered as maintenance kit. Actreg recommends to use this repair kit to prevent malfunction in the future. The standard lifetime of these parts is 2 years, if the actuator has been working or not, it is recommended to change these parts to ensure the proper work in actuator.

If the actuator starts to malfunction or the actuator has been working for a very long time it is recommended to change the listed parts to ensure a correct functionality through the time. Depending on the size of the actuator depend on how many cycles of lifetime has the actuator this time may be shorter.

To get this spare part kits please contact after sales Actreg department. The list of the spare parts is for every type of the actuator, but it is needed to know which model of actuator is purchased to deliver the proper spare part kit to the end user.

Spare part list is described below:



Pos.	Denomination	Qty.
70.6	O-Ring - Bushing	1
70.4	O-Ring – Stop Adjust Bolt	4
61	O-Ring – SR End Cap	1
55	O-Ring – Security valve	1
54	Security valve	1
40	O-Ring – Piston	2
39	O-Ring – Cap Stem	1
38	O-Ring - Yoke	1
37	O-Ring – False Shaft	1
36	O-Ring – Body cover	1
35	O-Ring – End Cap of Cylinder	2
34	O-Ring – Side of body	2
32	Quad-Ring – Air Stem	2
28	Quad-Ring – Piston	1

The materials of this parts are different depending on what type of actuator is manufactured. Depends on the temperature range and the housing material of the actuator.

13. STORAGE

All actuators must be examined upon delivery to ensure that they have not suffered any damage during transport. Inform the supplier immediately if there is any damage. As standard, actuators will leave the factory in closed position. Open position configuration must be specially requested.

Actuators must be stored under cover and protected from inclement weather conditions and dampness with air conducts properly covered and should not be unpacked until their definitive installation, except for inspection purposes.

In order to keep the actuator in good conditions until installation, at least the following measures are recommended:

- Check presence and assembling of dust plugs.
- Keep the actuator on shipping boxes or pallet until installation, never put the actuator directly on the ground.
- Protect the valve coupling area (adapter flange and coupling joint) with rust preventive oil.
- Protect against weather action, covering the actuators with appropriate polyethylene sheets.
- Check the actuator condition every 6 months and verify the above protection measures remain in place.

After the installation carry out a final operational check of the actuator by making some opening and closing operations to ensure that it works properly. The use of dry air increases the lifetime of the actuators, as well as the lifetime of their accessories, solenoids and other pneumatic accessories.

14. LONG TERM STORAGE

If long term storage is necessary, further operations must be carried out to maintain the actuator in a good working condition:

- Replace the plastic plugs with metal plugs.
- Stroke the actuator every 12 months:
    - Cycle the actuator (using filtered, dehydrated air) to the working pressure, never exceed 8 bar.
    - Cycle the actuator with all the existing controls (i.e., two complete strokes – one open, one closed) at least 5 times.
    - Cycle the actuator fitted with the mechanical manual override for 4 complete strokes.
- Disconnect the pneumatic and electric (if present) supply from the actuator, and carefully close all the threaded connections of the actuator.
- Remove electrical components covers (if present) to ensure control terminals are clean and free from oxidation and humidity. Reassemble the covers.
- In case of storage for over 12 months prior to installation, it is recommended to operate the actuator to verify correct operation.