"Apollo" Valves | INDUSTRIAL PRODUCTS

AD/AD Actuators

installation, operation & maintenance manual

www.apollovalves.com

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contents

This section explains:

- Base safety procedures.
- Where to find detailed information relating safety.
- Storage guidelines.

Installation, adjustment, putting into service, use, assembly, disassembly and maintenance of the pneumatic actuator must be performed by qualified personnel.

NOTE
Failure to follow the above guidelines will void warranty.

⚠ CAUTION ⚠
Actuator must be isolated both pneumatically and electrically before any (dis)assembly starts.
Before mounting or (dis)assembly, the actuator consult the relevant sections of this manual.

1.1 INSTALLATION, OPERATION AND MAINTENANCE REFERENCE DOCUMENTS

Before you start, read all chapters in this manual.

NOTE
Failure to read the Safety Guide will void the warranty.

Not following the instructions of the Safety Guide can lead to failure of the product and harm to personnel or equipment.

1.2 WAREHOUSE STORAGE

- All actuators should be stored in a clean, dry warehouse, free from excessive vibration and rapid temperature changes.
- All actuators should not be stored directly to the floor surface - it must be placed in racks/shelves or use a pallet.

1.3 ON-SITE STORAGE

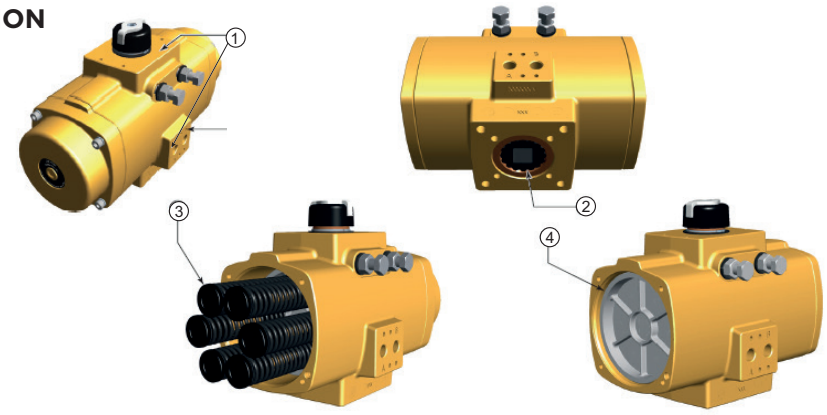
- All actuators should be stored in a clean, dry warehouse, free from excessive vibration and rapid temperature changes.
- Prevent moisture or dirt from entering the actuator. Plug or seal both air connection ports.

NOTE
Failure to follow the above guidelines (Warehouse and On Site Storages) will void warranty.

2.1 IDENTIFICATION

- The Apollo Rack and Pinion actuators are available as double-acting or spring-return versions. 13 models are available, ranging from 12 Nm to 4000 Nm (106 to 35,000 lb.in) nominal torque output.
- The Apollo actuators use standardized interfaces for solenoid, switchbox or positioner mounting (VDI/VDE3845; NAMUR). The valve interface is equipped with an insert in the pinion bottom that allows both ISO5211 or DIN3337 mounting.
- The springs in the spring-return version allow a fail action in case of loss of air supply pressure (Fail-to-Close or Fail-to-Open).
- As from size AD0150 double-acting versions have flat end caps to reduce actuator length and internal air volume.

IDENTIFICATION
FIGURE 1



Size	End Cap Design [5]	Spring Design [6]
0012	SR DA	Left Right Maximum 2 Loose Springs
0025 - 0100	SR DA	Left Right Maximum 12 Spring Cartridges
0150 - 0600	SR DA	Left Right Maximum 12 Spring Cartridges
0950 - 2500	SR DA	Left Right Maximum 6 Loose Springs
4000	SR DA	Left Right Maximum 6 Loose Springs

Notes
1. *Top auxiliaries and Solenoid interface (VDI/VDE 3845; NAMUR) for size 0025 to 4000.*
2. *Valve interface available according ISO5211.*
3. *Spring-Return actuators: - with springs*
4. *Double-Acting actuators: - no springs*
5. *Actuator sizes 0025 to 0100 have high end caps for double-acting and spring-return models. Actuator sizes 0012 and 0150 to 4000 have low end caps for double-acting models and high end caps for spring-return models.*
6. *Actuator size 0012 is fitted with a maximum of 2 loose springs. Actuator sizes 0025 to 0600 are fitted with a maximum of 12 spring cartridges. Actuator sizes 0950 to 4000 are fitted with a maximum of 6 loose springs.*

2.2 INTENDED USE

The Apollo Rack and Pinion actuators are intended for the automation and operation of quarter-turn valves like butterfly, ball and plug valves.

Rack and Pinion actuators can also be used to operate dampers or any other quarter-turn applications.

2.3 SPECIFICATIONS

PRESSURE RANGE

TABLE 1

ACTUATOR TYPE	PRESSURE
Double-Acting	0.2 to 8.3 barg (2.9 to 120 psig)
Spring-Return	6 to 8.3 barg (87 to 120 psig), with maximum spring set
	3 to 8.3 barg (43.5 to 120 psig), reduced spring quantity

OPERATING MEDIA

TABLE 2

ACTUATOR TYPE	OPERATING MEDIA
Double-Acting and Single-Acting	Air, dry or lubricated and inert gases
	Dew point at least 10K below ambient temperature
	For sub-zero applications, take appropriate measures
	Mentioned pressure levels are "gauge pressures". Gauge pressure is equal to absolute pressure minus atmospheric pressure.

Recommended air quality according ISO 8573-1 for normal operation: 7-5-4.

NOTE

Use of filters, pressure regulators, lubricator and an oil/water separator mounted in the air supply line, will allow a smooth and durable operation of the actuator.

For lubricated supply air, it is recommended to use a non-detergent oil without aggressive additives, VG32, group 2 (ISO 3448).

TEMPERATURE RANGE

TABLE 3

ACTUATOR TYPE	TEMPERATURE
Standard	-20°C to +80°C (-4°F to +176°F)
Option: Low Temperature	-40°C to +80°C (-40°F to +176°F)
Option: High Temperature	-10°C to +120°C (+14°F to +250°F)

AIR VOLUMES AND CONSUMPTION
TABLE 4

ACTUATOR VOLUMES:			
ACTUATOR MODEL	MAXIMUM VOLUME (IN LITERS)		
	CENTRAL[1] CHAMBER	END CAP[2] CHAMBER	DISPLACED[3] VOLUME
0012	0.05	0.06	0.04
0025	0.14	0.20	0.08
0040	0.26	0.37	0.15
0065	0.40	0.56	0.22
0100	0.6	0.9	0.3
0150	1.0	0.8	0.5
0200	1.3	1.0	0.7
0350	2.1	1.9	1.2
0600	3.6	3.3	2.1
0950	4.9	4.6	3.2
1600	7.9	7.3	5.4
2500	12.6	11.9	8.3
4000	21.7	19.0	13.5

CONSUMPTION PER STOKE (IN LITERS, PRESSURE IN BARG)					
OUTWARD STROKE			INWARD STROKE		
DOUBLE-ACTING AND SPRING-RETURN			DOUBLE-ACTING ONLY		
2.0 BARG	4.0 BARG	8.0 BARG	2.0 BARG	4.0 BARG	8.0 BARG
0.14	0.24	0.44	0.16	0.28	0.52
0.36	0.64	1.2	0.48	0.88	1.7
0.67	1.2	2.2	0.89	1.6	3.1
1.02	1.8	3.4	1.3	2.4	4.7
1.5	2.7	5.0	2.0	3.8	7.2
2.4	4.3	8.1	2.1	3.6	6.7
3.2	5.7	11	2.8	4.9	9.1
5.5	9.8	18	5.0	8.8	16
9.4	17	31	8.7	15	28
13	23	43	12	22	40
21	37	69	20	35	64
34	59	109	32	56	104
57	100	187	52	89	165

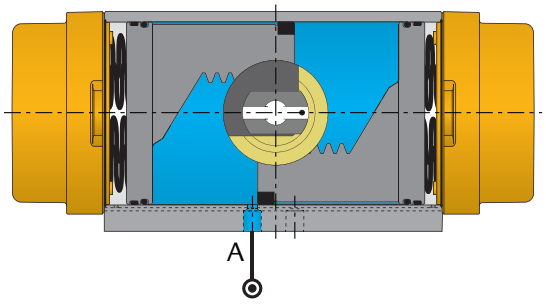
ACTUATOR VOLUMES:			
ACTUATOR MODEL	MAXIMUM VOLUME (CU.IN.)		
	CENTRAL[1] CHAMBER	END CAP[2] CHAMBER	DISPLACED[3] VOLUME
0012	3.1	3.7	2.5
0025	8.5	12.2	4.7
0040	15.9	23	8.9
0065	24	34	13.5
0100	36	53	19.9
0150	58	47	32
0200	76	64	44
0350	131	115	76
0600	222	201	129
0950	301	279	196
1600	484	447	328
2500	769	728	508
4000	1324	1159	825

CONSUMPTION PER STOKE (IN CU.IN., PRESSURE IN PSIG)					
OUTWARD STROKE			INWARD STROKE		
DOUBLE-ACTING AND SPRING-RETURN			DOUBLE-ACTING ONLY		
40 PSIG	80 PSIG	120 PSIG	40 PSIG	80 PSIG	120 PSIG
11	19	28	13	23	33
28	52	75	38	72	106
53	96	140	71	133	196
81	148	215	107	200	294
118	216	314	165	310	455
192	352	512	163	293	424
255	466	676	220	397	573
436	796	1157	392	709	1025
742	1354	1967	683	1237	1790
1025	1854	2682	966	1735	2505
1662	2997	4331	1560	2792	4024
2630	4751	6873	2515	4523	6530
4477	8130	11782	4022	7219	10416

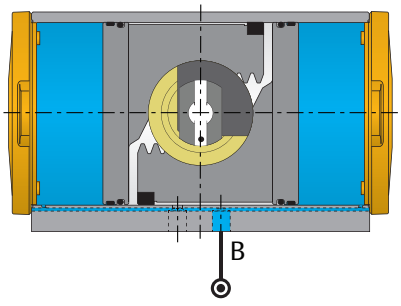
Notes
1. *Pistons at 90° outward position.*
2. *Pistons at 0° inward position.*
3. *Stroke is 90°.*

ACTUATOR AIR VOLUMES
FIGURE 2

Central Air Chamber Volume
Double-Acting and Spring-Return



End Cap Air Chamber Volume
Double-Acting Only



AD/AD ACTUATOR IOM

SECTION 3 - PART NUMBER MATRIX

PART NUMBER MATRIX

A	S	0100	N	04	A	C	A
PREFIX	ACTION	SIZE	SEAL OPTION	SPRING SET	INSERTS	FAIL POSITION	REVISION
A	D - DOUBLE ACTING	0012	N - NITRILE NORMAL TEMP RANGE: -4°F - 175°F	00 (DA)	A - STANDARD SQUARE	C - FAIL CLOSED (FC)	A
	S - SPRING RETURN	0025		02	B - WITHOUT INSERT	F - FAIL OPEN (FO)	
	K - KIT	0040		03		D - NO SPRING (DOUBLE ACTING FAIL LAST POSITION)	
		0065	H - FLUOROCARBON HIGH TEMP RANGE: -4°F - 250°F	04			
		0100		05			
		0150		06			
		0200	L - SILICONE LOW TEMP RANGE: -40°F - 175°F				
		0350					
		0600					
		0950					
		1600					
		2500					
		4000					

EXAMPLE: AS0100N04ACA = Spring Return, 0100 Size, Nitrile Seals, 04 Spring Set, Standard Square Drive, Fail Closed

This section explains:

- The actuator rotation direction.
- In which position the actuator will end after a failure.
- Principles of operation:
  - Solenoid operation.
  - Double acting and spring return operation.
- Assembly codes.
- Actuator to valve assembly.

4.1 BEFORE YOU START

⚠ *CAUTION* ⚠

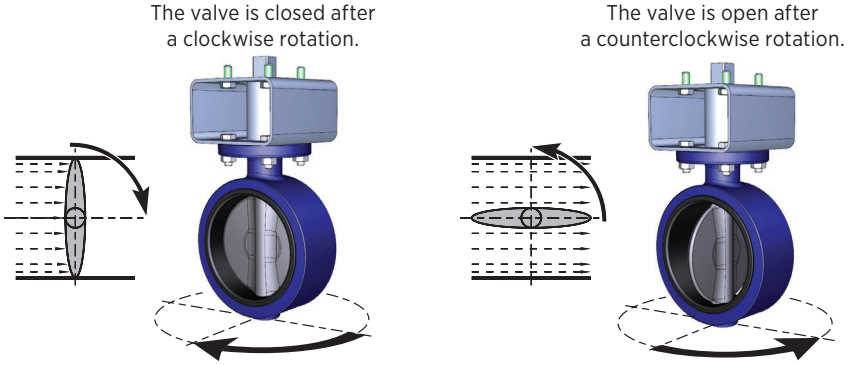
In case of an air or electrical failure, it is important to know the behavior of the actuator. Before mounting the actuator on a valve, consult the following sections below.

4.2 ACTUATOR ROTATION DIRECTION

4.2.1 VALVE ROTATION

For the following paragraphs we assume that valves rotate as indicated in Figure 3.

NORMAL VALVE ROTATION
FIGURE 3



4.2.2 POSITION AFTER FAILURE

The position of the actuator after a failure depends on the:

1. Principle of operation.
2. Assembly code.
3. Kind of failure. Refer to the table below.

POSITION AFTER FAILURE
TABLE 5

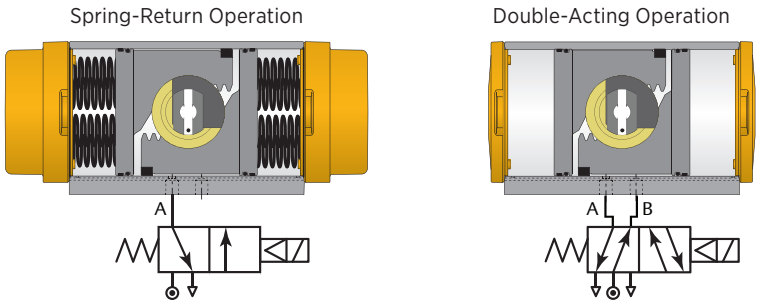
PRINCIPLE OF OPERATION	ASSEMBLY CODE	KIND OF FAILURE	POSITION
Double-Acting Actuator	CW	Pressure	Not defined
		Signal	Closed
		Supply Voltage	Closed
	CC	Pressure	Not defined
		Signal	Open
		Supply Voltage	Open
Single-Acting (Spring-Return) Actuator	CW	Pressure	Closed
		Signal	Closed
		Supply Voltage	Closed
	CC	Pressure	Open
		Signal	Open
		Supply Voltage	Open

4.3 PRINCIPLES OF OPERATION

4.3.1 SOLENOID VALVE

All actuators can be either piped with solid or flexible tubing with the solenoid valve mounted remotely from the actuator or by mounting a VDI/VDE 3845 (NAMUR) designed solenoid valve DIRECTLY onto the NAMUR mounting pad on the side of the actuator.

TYPICAL SOLENOID OPERATION
FIGURE 4



OPERATING SPEED
TABLE 6

CYCLE TIME IN SECONDS				
ACTUATOR SIZE	SPRING-RETURN		DOUBLE-ACTING	
	A-PORT PRESSURIZED	SPRING STROKE	A-PORT PRESSURIZED	B-PORT PRESSURIZED
0012	0.4	0.4	0.4	0.4
0025	0.5	0.4	0.5	0.4
0040	0.6	0.5	0.6	0.5
0065	0.7	0.5	0.6	0.6
0100	0.8	0.6	0.8	0.7
0150	1.0	0.8	0.9	0.8
0200	1.3	0.9	1.0	1.0
0350	1.9	1.3	1.4	1.5
0600	3.2	1.9	2.2	2.2
0950	6.6	2.2	2.4	2.0
1600	10.6	3.5	3.6	3.3
2500	16.9	5.7	5.8	5.2
4000	29.1	9.2	9.2	9.0

Operating time is average with actuator under load and solenoid valve fitted.

Test conditions:
1. Solenoid with flow capacity: *0.6 m^3/hr*
2. Pipe diameter: *6mm*
3. Medium: *clean air*
4. Supply pressure: *5.5 bar (80psi)*
5. Load: *with average load*
6. Stroke: *90°*
7. Temperature: *room temperature*

4.3.2 INGRESS PROTECTION (IP) RATING

Apollo actuators are IP66/IP67 rated. In case of IP66 or IP67 requirements, take precautions that comply with the IP66/IP67 requirements to prevent moisture or dust from entering the actuator through the open air exhaust port(s), either directly on the actuator or at the exhaust ports of the connected solenoid valve.

We recommend to connect tubing to the exhaust(s) and lead this into a dry and dust free area, or to use check valves in the exhaust.

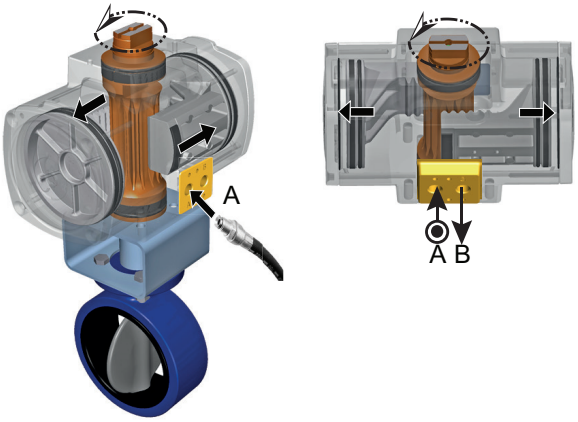
4.3.3 DOUBLE-ACTING ACTUATORS

The operating principle, as explained here, is applicable for actuators with assembly code CW (direct acting).

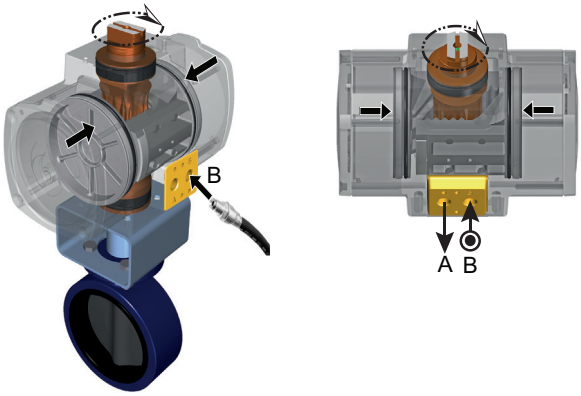
- Applying supply pressure to port A will move the pistons outward to the “Open” position of the valve.
- Applying supply pressure to port B will move the pistons inward to the “Close” position of the valve.
- For assembly codes CC, the operating principle is reversed (reverse acting).

DOUBLE-ACTING OPERATION
FIGURE 5

Outward Stoke



Inward Stoke



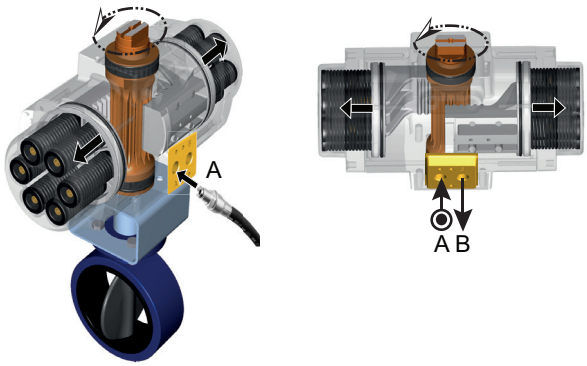
4.3.4 SPRING-RETURN ACTUATORS

The operating principle, as explained here, is applicable for actuators with assembly code CW (direct acting).
.

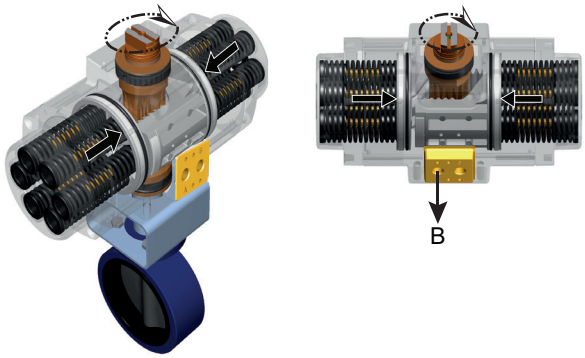
- Applying supply pressure to port A will move the pistons outwards to the “Open” position of the valve.
- Venting the supply pressure from port A will cause the springs to move the pistons inwards to the “Close” position of the valve.
- For assembly codes CC, the operating principle is reversed (reverse acting).

SPRING-RETURN OPERATION
FIGURE 6

Outward Stoke



Inward Stoke



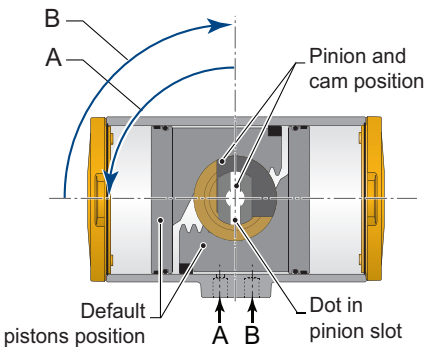
4.4 ACTUATOR ASSEMBLY CODE

ASSEMBLY CODE - DOUBLE-ACTING

FIGURE 7

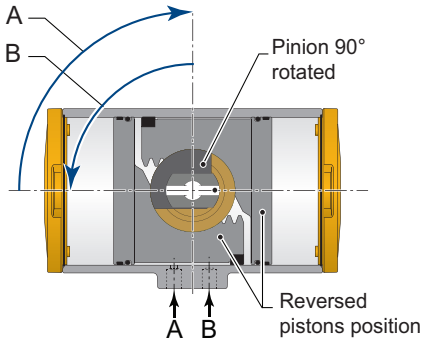
ASSEMBLY CODE: CW

Standard, clockwise-to-close rotation
Fail-to-close



ASSEMBLY CODE: CC

Standard, counterclockwise-to-close rotation
Fail-to-open

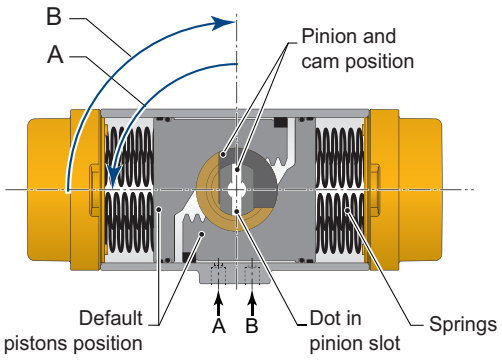


ASSEMBLY CODE - SPRING-RETURN

FIGURE 8

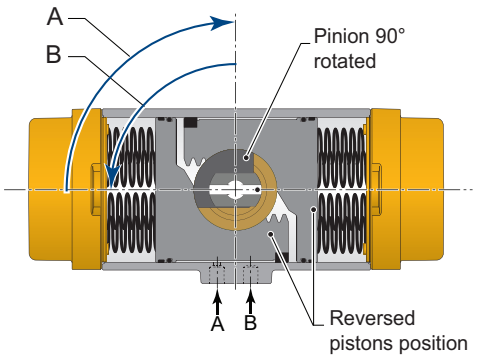
ASSEMBLY CODE: CW

Standard, clockwise-to-close rotation
Fail-to-close



ASSEMBLY CODE: CC

Standard, counterclockwise-to-close rotation
Fail-to-open



A = Rotation when central air chamber is pressurized.
B = Rotation when end cap air chambers are pressurized.

All views are from above. Pistons are shown in inward position.

4.5 ACTUATOR TO VALVE INSTALLATION

⚠ CAUTION ⚠

Actuator must be isolated pneumatically and electrically before any (dis)assembly starts.
Stay away from moving parts to prevent serious injuries. When test cycling the actuator and valve assembly by applying pressure to the A or B port, be aware that there are moving parts like pinion top, actuator to valve coupling and the valve- blade, ball, plug, etc.

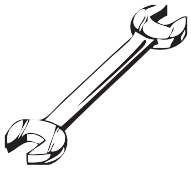
NOTICE

The actuator is designed to be installed, commissioned and maintained using generic tools like wrenches, Allen keys and screwdrivers. For the removal of inserts, a special extractor tool can be supplied on request.

During assembly to the valve, do not hit with hammer on pinion top. This can damage the pinion top washer and cause premature failure.
Before mounting the actuator on the valve or valve bracket, be sure that both the actuator and the valve are in the same closed or open position.

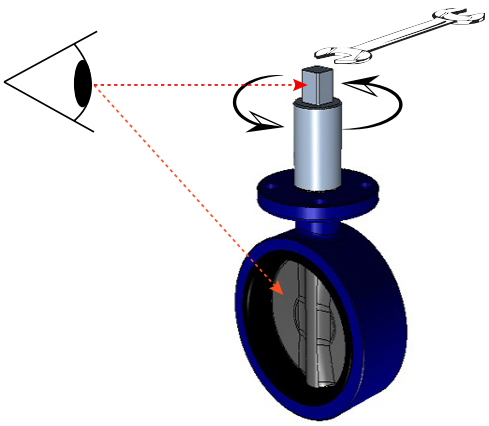
Refer to appendix B, Tool and Torque tables, for using the right size tool.

TOOLS
TABLE 7

SYMBOL	TOOL
	Wrench - All Types & Sizes. Metric and Imperial
	Circlip Pliers
	Allen Key

1. Remove handle nut, handle, lock washer, and etc. from the valve if required.
2. Visually check to make sure the valve is CLOSED.

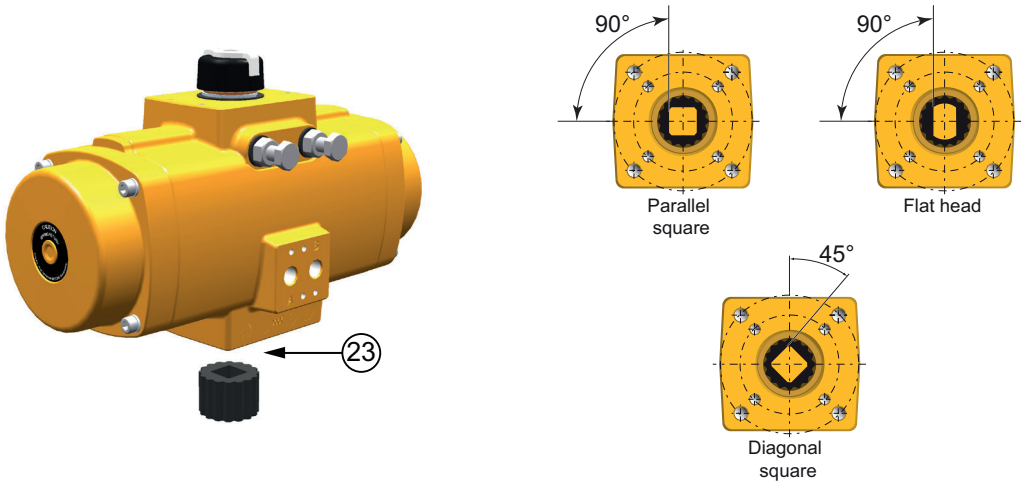
VALVE HANDLE REMOVAL
FIGURE 9



3. When required, check if the insert drive (23) is mounted. If not, use a plastic mallet and tap slightly until the reducer square is in the required position.

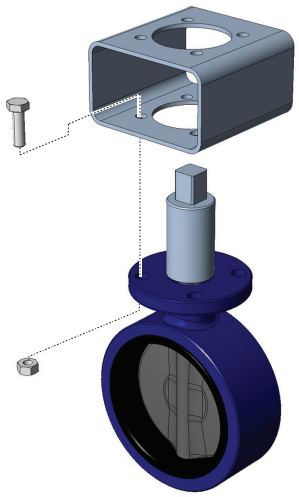
   Be sure that the insert is mounted at 90° or 45°. It is possible to mount the insert turned 22.5°. This way the valve will not open or close the right way.

INSERT DRIVE INSTALLATION
FIGURE 10



4. Install the bracket to the valve flange. Tighten all bolts and nuts and apply the correct torque.

BRACKET INSTALLATION
FIGURE 11



5. Install the actuator to the bracket. Tighten all bolts and apply the correct torque (refer to Table 8).

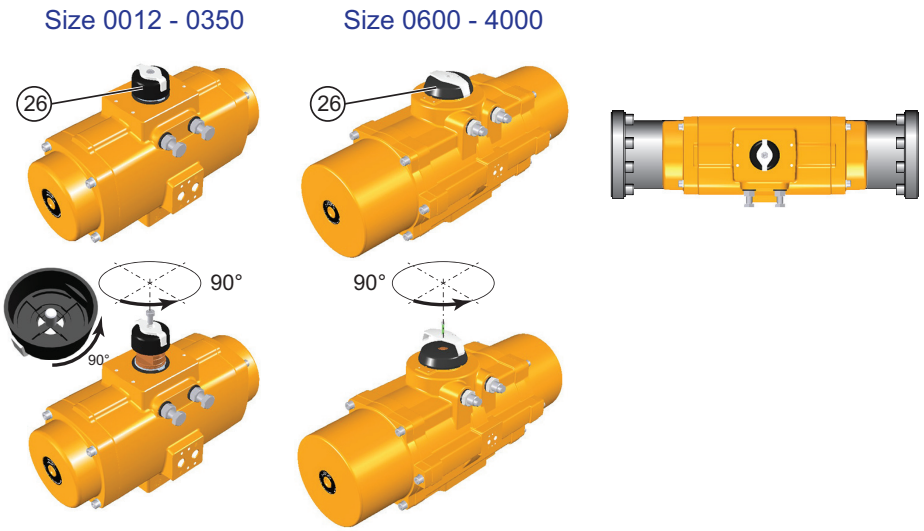
BOTTOM FLANGE TORQUE VALUES
TABLE 8

ACTUATOR SIZE	ISO PATTERN	TORQUE (LB.FT)		
		THREAD	MIN.	MAX.
0012	F04	10-24UNC	3.3	3.7
0025	F03 inner pattern	10-24UNC	1.5	2.2
	F05 outer pattern	1/4"-20	3.3	3.7
0040, 0065, 0100	F05 inner pattern	1/4"-20	3.3	3.7
	F07 outer pattern	5/16"-18	7.7	9.2
0150, 0200, 0350	F07 inner pattern	5/16"-18	7.7	9.2
	F10 outer pattern	3/8"-16	15.5	18.1
0600	F10 inner pattern	3/8"-16	15.5	18.1
	F12 outer pattern	1/2"-13	25.4	31.7
0950	F10 inner pattern	3/8"-16	15.5	18.1
	F14 outer pattern	5/8"-11	66.4	76.7
1600, 2500	F16 inner pattern	3/4"-10	125.4	150.5
	F25* outer pattern	4x 5/8"-11	66.4	76.7
4000	F16 inner pattern	3/4"-10	125.4	150.5
	F25 outer pattern	8x 5/8"-11	66.4	76.7

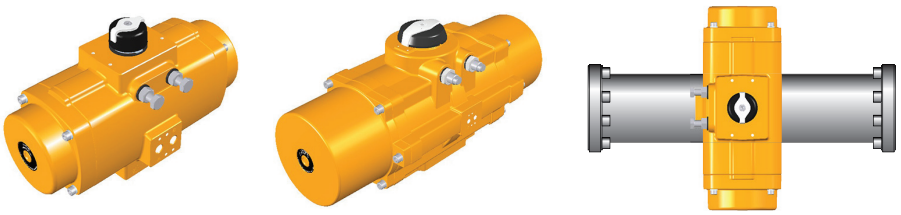
6. When required, mount or adjust the visual indicator (26).

INDICATOR MOUNTING
FIGURE 12

INDICATOR MOUNTING "IN-LINE"



INDICATOR MOUNTING "ACROSS-LINE"



4.6 MOUNTING OF CONTROL AND FEEDBACK ACCESSORIES

Solenoid valve and or switch boxes can now be mounted to the actuator. Check the instructions as shipped with these components for installation, operating and maintenance instructions.

We recommend to test-cycle the complete assembly to check correct operation.

4.7 RECOMMENDED TUBING SIZES

In case the solenoid valve is mounted remotely (i.e. in a central solenoid cabinet) and in order to supply sufficient flow of air supply to the actuator, the following tubing sizes are recommended.

TUBING SIZES
TABLE 9

ACTUATOR SIZE	RUNS UP TO		RUNS OVER TO	
	1.2 METERS	4 FEET	1.2 METERS	4 FEET
0025, 0040, 0065	6 mm	1/4 inch	6 mm	1/4 inch
0100, 0150, 0200, 0350, 0600	6 mm	1/4 inch	8 mm	5/16 inch
0950, 1600, 2500, 4000	6 mm	1/4 inch	10 mm	3/8 inch

This section explains:
- What mechanical stroke adjustment is.
- What the factory settings are.
- How to adjust the travel stops.

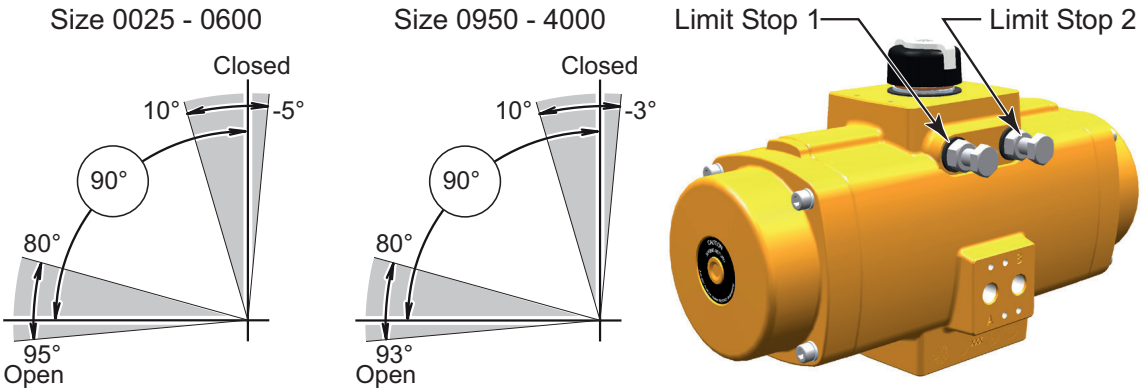
Apollo actuator sizes 0025 to 4000 have two stroke adjustment stops for adjusting accurately the stroke of the actuator/ valve assembly in open and closed position.

The smallest actuator, size 0012, does not have limit stops.

The factory setting of the stroke is 90°. Most quarter-turn valve applications will not require readjustment of these settings.

If required the stroke can be adjusted by means of two-stroke adjustment bolts.

FACTORY SETTING
FIGURE 13



5.1 TRAVEL STOP ADJUSTMENT

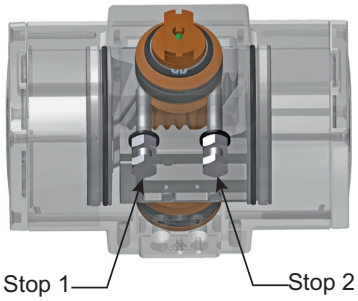
⚠ CAUTION - PRESSURIZED ACTUATOR ⚠

Do not turn out the travel stops completely when the actuator is pressurized.
When adjusting the travel stops and the actuator is still pressurized, the travel stops can be "shot" away when completely turned out.

5.1.1 DOUBLE-ACTING ACTUATORS

1. Operate valve/actuator assembly to the required "Closed" position.
2. Remove air supply.
3. Slacken locknut on the "closed" stop (2).

DOUBLE-ACTING ACTUATORS TRAVEL STOPS
FIGURE 14

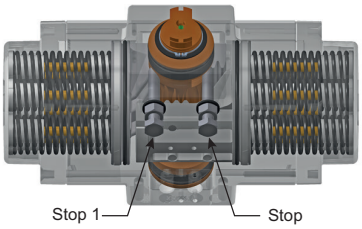


4. Turn the "closed" stop clockwise to reduce or counterclockwise to increase the travel. Consult chapter 5.1.3 (angular displacement of the pinion), to define how far the limit stop must be turned in or out.
5. Tighten the lock nut.
6. Connect air and cycle the actuator to check that the position is correct. If not repeat from 2.
7. Remove air supply.
8. For adjusting the open position repeat steps 1 to 7, but now for the open position and "open" stop (1).

5.1.2 SPRING-RETURN ACTUATORS

1. Connect air supply to the A port. Actuator will move to the open position.
2. Slacken locknut (24) on the "closed" stop (2).

SPRING-RETURN ACTUATORS TRAVEL STOPS
FIGURE 15



3. Turn the "closed" stop clockwise to reduce or counterclockwise to increase the travel. Consult chapter 5.1.3 (angular displacement of the pinion), to define how far the limit stop must be turned in or out.
4. Remove air supply. Actuator will move to the closed position.
5. Check whether the actuator valve assembly is in the required position. If not repeat steps 1 to 5.
6. Remove air supply.
7. For adjusting the open position repeat steps 1 to 6, but now for the open position and "open" stop (1).

LIMIT STOP DIMENSIONS
TABLE 10

ACTUATOR SIZE	THREAD	BOLT WRENCH SIZE (MM)	NUT WRENCH SIZE (MM)
0025	M 6	10	10
0040	M 8	13	13
0065	M 10	17 (16)[1,2]	17 (16)[1,2]
0100	M 10	17 (16)[1,2]	17 (16)[1,2]
0150	M 10	17 (16)[1,2]	17 (16)[1,2]
0200	M 12	19 (18)[1,2]	19 (18)[1,2]
0350	M 16	24	24
0600	M 20	30	30
0950	M 22	12	32
1600	M 24	14	36
2500	M 27	17	41
4000	M 22	12	32

1. *Default dimension according DIN933 standard.*
2. *Dimensions in brackets according ISO4017 standard.*
3. *Actuator size 0012 is not available with limit stops.*

5.1.3 ANGULAR DISPLACEMENT

Below table identifies, per actuator size, what the angular displacement of the pinions is, when using the limit stop screws.

- Turn the limit stop clockwise reduces the stroke.
- Turn the limit stop counterclockwise to increase the stroke.

ANGULAR DISPLACEMENT LIMIT STOP
TABLE 11

ACTUATOR SIZE	TURNS FOR 5° ADJUSTMENT OF THE PINION	360° REVOLUTION OF LIMIT STOP SCREW WILL ADJUST
0012	Actuator size 0012 is not available with limit stops	
0025	0.7	7.1°
0040	0.8	6.3°
0065	0.6	8.3°
0100	0.7	7.1°
0150	1.2	4.2°
0200	1.0	5.0°
0350	0.8	6.3°
0600	0.8	6.3°
0950	1.1	4.7°
1600	1.3	4.1°
2500	1.5	3.4°
4000	3.2	1.6°

NOTICE
In case of air leakage over the limit stop bolts, turn the lock nut of the limit stop bolts tighter, until leakage stops.

This section explains:

- When and how to do maintenance.
  - Normal maintenance.
  - Extraordinary maintenance.
- What to do when replacing springs.
- What the availability is of spare parts, action conversion kits and temperature conversion kits.

⚠ CAUTION ⚠

Actuator must be isolated pneumatically and electrically before any (dis)assembly starts. Before mounting or (dis)assembling the actuator, consult the relevant sections of this manual.

6.1 NORMAL MAINTENANCE

Apollo actuators are designed to operate without maintenance for their normal working life. Normal working life is 500,000 cycles* for sizes up to 01600 and 250,000 for sizes 2500 and 4000.

For actuators with the optional low temperature silicon seals, we advise to replace these seals after 250,000 cycles*.
**Cycles = one open stroke and one close stroke.*

We recommend regular inspections to make certain that the actuator/valve assembly operates smoothly and to check that there are no visible or audible defects. We advise to perform the following checks upon each proof test interval complying with the rules and regulations of the country of final installation:

- Visually check the entire actuator as well as the control system (where foreseen).
- Ensure there are no leaks on the actuator parts under pressure.
- Check pneumatic connections for leaks. Tighten tube fittings as required.
- Check if manual override (where foreseen) is regular.
- Check if pneumatic filter cartridge (where foreseen) is sound and filter bowl (where foreseen) has been cleaned properly.
- Check the setting of the relief valves (where foreseen).
- Verify that the power fluid supply pressure value is within the required range.
- Remove built-up dust and dirt from all actuator surfaces.
- Inspect actuator paint work for damages to ensure continued corrosion protection. Touch-up as required in accordance with the applicable paint specification.
- Operate the actuator/valve assembly for 2 complete open/close cycles with complete closing of the valve.
- Verify the correct performing of open – close operations (e.g. check locally, or automatically via Logic solver, the correct movement of the actuator).

All actuators are supplied with sufficient lubrication for their normal working life. If required, see Section 9.1 (Grease instructions) for the recommended grease.

For mounting the parts of the repair kit follow the instruction of the Decommission, Disassembly and Reassembly chapters of this manual.

6.2 INSPECTION AND REPAIR

Replacement of internal seals and bearings allows you to extend the normal working life. Service kits, containing all necessary spare parts (like seals, bearings, grease and instructions) can be obtained.

6.2.1 SERVICE KITS

All soft seals, bearings, and nonreusable parts are included in the recommended service kit. The service kit is identical for both the double-acting and the spring-return models.

6.2.2 SPRING-RETURN ACTUATOR

For the spring-return models, we recommend a set of spare springs for each different model in addition to the recommended spare parts kit.

On spring-return actuators, the spring cartridges can be replaced. **SPRING CARTRIDGES SHOULD ALWAYS BE REPLACED IN COMPLETE SETS.**

This section explains:

- How to decommission an actuator in a safe way.

7.1 BEFORE YOU START

⚠ *CAUTION - MOVING PARTS* ⚠

Actuator must be isolated pneumatically and electrically before any (dis)assembly starts. Before mounting or (dis)assembling the actuator consult the relevant sections of this manual.

Actuator can move when removing supply pressure and/or electrical control signal of actuators. If not already there, a spring-return actuator will cycle to its fail position.

When removing any ball valve or plug valve assemblies from a pipe system, isolate the piping system on which the Actuator is installed and relieve any media pressure that may be trapped in the valve cavities before removing the actuator for maintenance.

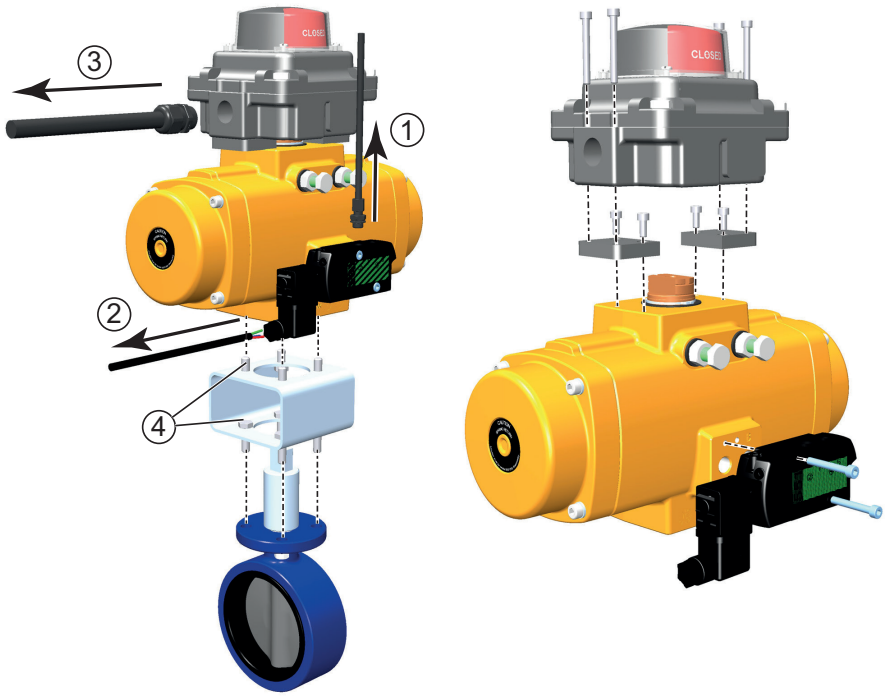
A spring-return actuator mounted on a valve, which is stuck in mid stroke, contains a high spring load which will cause a sudden rotation of the actuator versus the valve or valve bracket during disassembly. This can cause serious injury to personnel or damage to property.

Refer to Appendix A for instructions to safely remove the spring load before disassembling the spring-return actuator from valve or bracket.

7.2 REMOVING THE ACTUATOR FROM THE VALVE

1. Disconnect all air supply hoses (Ports A and B or solenoid).
2. Disconnect all electrical wirings of the switch box.
3. Disconnect the electrical wiring of the solenoid valve.
4. Remove the bolts and nuts from the valve flange.
5. Remove the bracket from the actuator.
6. Remove the switch box and solenoid valve.
   Refer to the documentation of the switch box and solenoid valve for safe disassembly.

REMOVING ACTUATOR FROM VALVE
FIGURE 16



AD/AD ACTUATOR IOM

SECTION 8 - DISASSEMBLY

This section explains:

- How to disassemble an actuator safely.

The instructions of this section can be used for maintenance or reconfiguration like spring set change or maintenance.

Reference numbers for components refer to the exploded view in section 11.

In case of maintenance, discard all the used soft parts like O-ring seals, guide bands, wear strips, and circlip.

⚠ *CAUTION* ⚠

Actuator must be isolated pneumatically and electrically before any (dis)assembly starts. Before mounting or (dis)assembling the actuator, consult the relevant sections of this manual.

⚠ *CAUTION - SPRING FORCE* ⚠

Spring-return actuators contain springs in a compressed state. Follow these instructions to release the spring force safely.

The end caps of spring-return actuators sizes 0025 to 0600 should be free of the spring load after 10 full turns (crosswise relaxing) of the end cap screws. If there is still spring load on the end cap, this might indicate a broken spring cartridge. Stop this disassembly procedure immediately. Continuing might cause the end cap to be “shot” away causing serious injury.

Spring return actuator size 0950 to 4000 have long end cap screws to release the spring load safely.

Refer to Appendix A for instructions to safely remove the spring load before disassembling the end cap of a spring-return actuator with a broken spring cartridge.

NOTICE

The actuator is designed to be installed, commissioned and maintained using generic tools like wrenches, Allen keys and screwdrivers.

Refer to the tables in this section or refer to appendix B Tool and Torque tables.

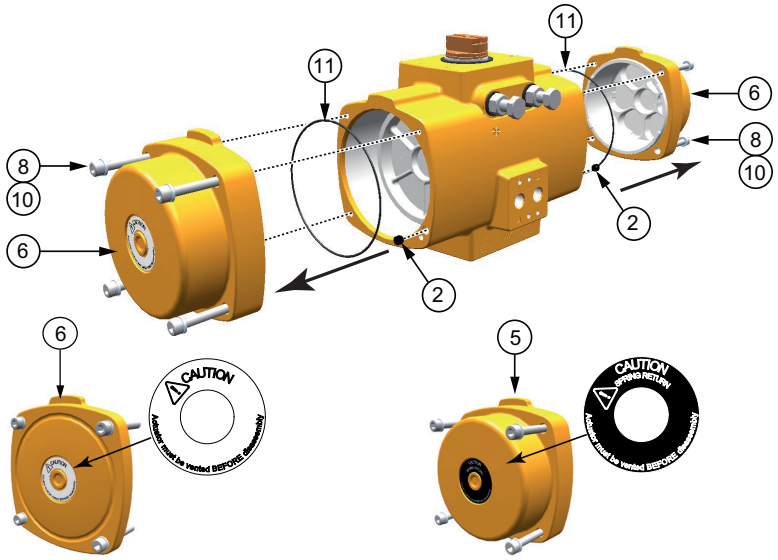
8.1 REMOVING END CAPS (SIZES 0025 TO 0600)

DOUBLE-ACTING ACTUATORS

1. Remove the screws (8) and washers (10) of the end caps (6).

2. Remove the o-ring (11) and "B" port seal (2). Discard these parts.

END CAPS REMOVAL - DOUBLE-ACTING (SIZES 0025 TO 0600)
FIGURE 17



Double acting end caps (6) are fitted with a white warning sticker.

Spring return end caps (5) are fitted with a black warning sticker.

Actuator sizes 0025 to 0100 have high end caps for double-acting and spring-return models.

Actuator sizes 0150 to 4000 have low end caps for double-acting models and high end caps for spring return models.

SPRING-RETURN ACTUATORS

1. Tip: For actuators with assembly code CW, turn back the right hand limit stop screw (30) 2 full turns.

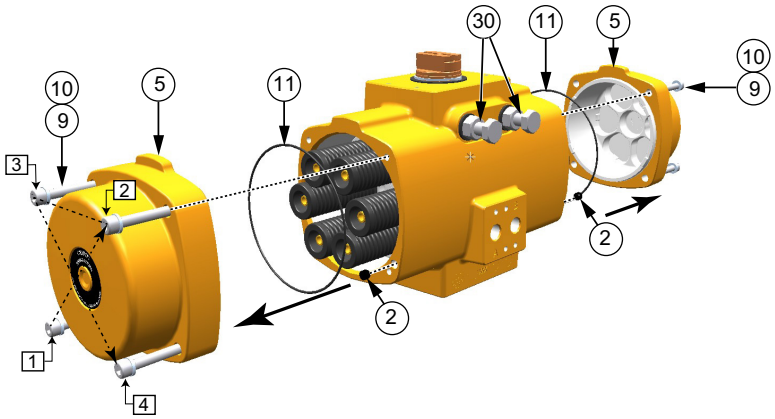
   For actuators with assembly code CC, turn back the left hand limit stop screw (30) 2 full turns.

   This will lower the spring force on the end cap and reduces the screw out length of the end cap screws.

2. Uniformly loosen the screws (9) of the end caps (5) 1/4 - 1/2 turns at a time, in sequence, as per figure 18, to relieve the pre-load of the springs.

3. Remove the o-rings (11) and “B” port seals (2). Discard these parts.

END CAPS REMOVAL - SPRING-RETURN (SIZES 0025 TO 0600)
FIGURE 18



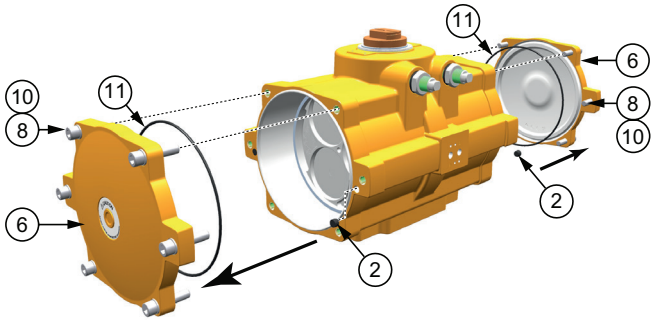
8.2 REMOVING END CAPS (SIZES 0950 TO 4000)

DOUBLE-ACTING ACTUATORS

1. Remove the screws (8) and washers (10) of the end caps (6).

2. Remove the o-ring (11) and "B" port seal (2). Discard these parts.

END CAPS REMOVAL - DOUBLE-ACTING (SIZES 0950 TO 4000)
FIGURE 19



SPRING-RETURN ACTUATORS

1. Tip: For actuators with assembly code CW, turn back the right hand limit stop screw (30) 2 full turns.

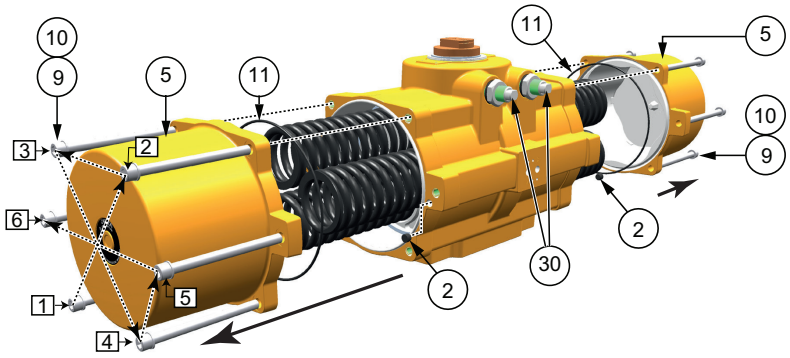
   For actuators with assembly code CC, turn back the left hand limit stop screw (30) 2 full turns.

   This will lower the spring force on the end cap and reduces the screw out length of the end cap screws.

2. Uniformly loosen the screws (9) of the end caps (5) 1/4 - 1/2 turns at a time, in sequence, as per figure 20, to relieve the pre-load of the springs.

3. Remove the o-rings (11) and "B" port seals (2). Discard these parts.

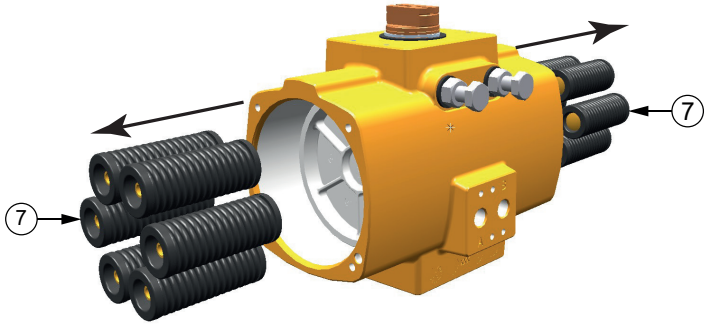
END CAPS REMOVAL - SPRING-RETURN (SIZES 0950 TO 4000)
FIGURE 20



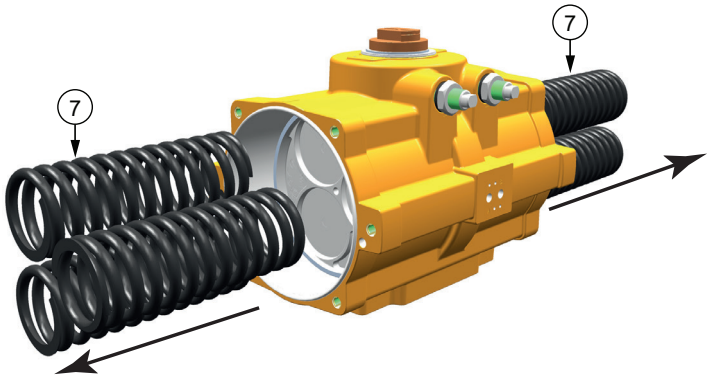
8.3 REMOVING SPRING CARTRIDGES OR SPRINGS

1. Remove the spring cartridges or springs (7).

SPRING CARTRIDGES REMOVAL - SIZES 0025 TO 0600
FIGURE 21



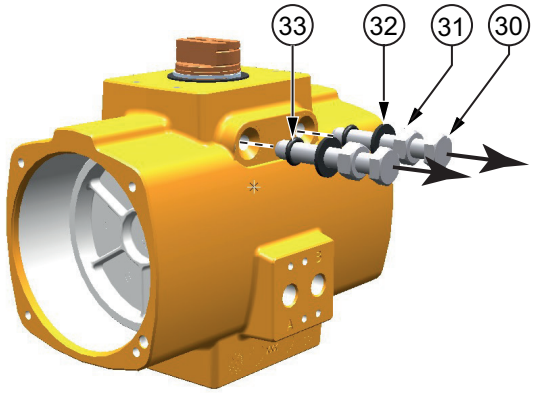
SPRING CARTRIDGES REMOVAL - SIZES 0950 TO 4000
FIGURE 22



8.4 REMOVING LIMIT STOP SCREWS

1. Remove the limit stop screws (30), limit stop nuts (31), limit stop washers (32) and limit stop o-rings (33). Discard the o-rings.

LIMIT STOP SPRINGS REMOVAL
FIGURE 23

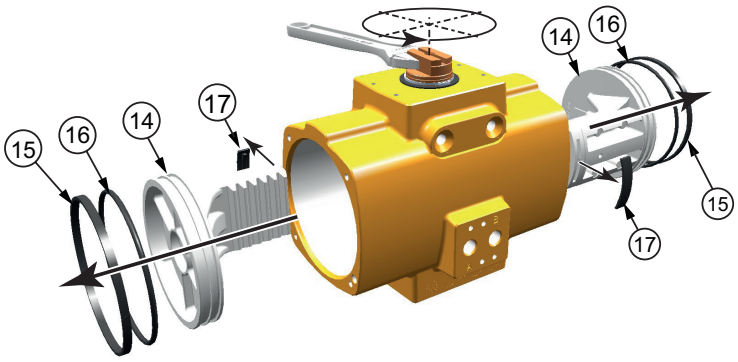


8.5 REMOVING PISTONS

1. Use a wrench and turn the pinion counterclockwise until the pistons (14) come out of the body.

2. Remove the piston bearings (15), piston rack bearing strips (17) and piston o-ring seals (16). Discard these parts.

PISTON REMOVAL
FIGURE 24



8.6 REMOVING PINION

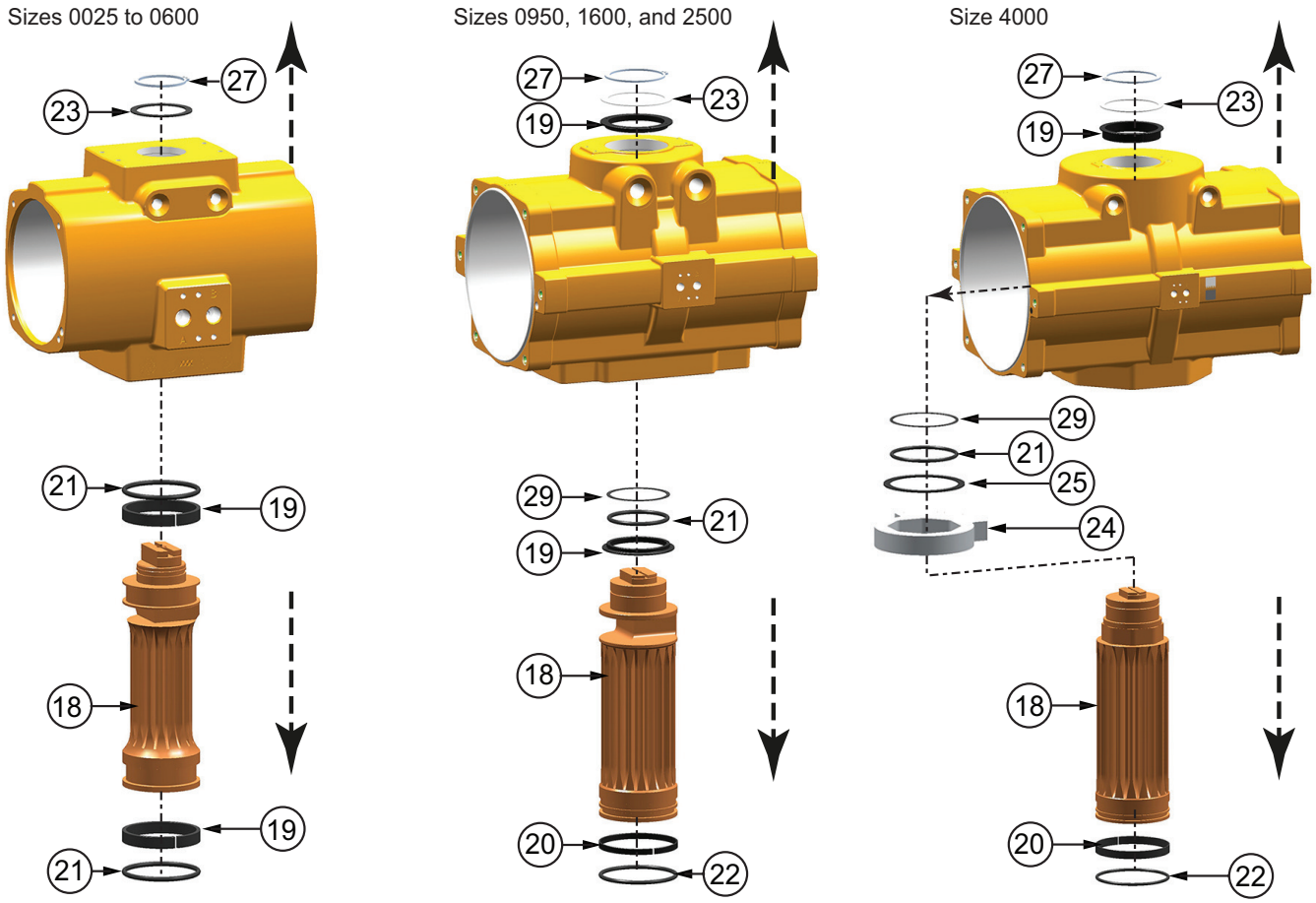
1. Remove the circlip (27) and thrust bearing (23) on top of the pinion assembly.
   For sizes 0950 to 4000 remove also the top pinion bearing (19).

2. Remove the pinion (18) by pushing it downwards.
   For Size 4000, remove the backup ring (29), O-ring pinion top (21) the cam (24) and cam thrust washer (25) through the main bore of the housing.

3. Remove the pinion O-ring seals (21/22) and the pinion bearings (19/20).
   For Size 0950 to 2500, remove also the backup ring (29).

4. Discard all of these parts.

PINION REMOVAL
FIGURE 25



RECOMMENDED CIRCLIP PLIERS ACCORDING DIN 5254 (OR EQUAL) FOR SHAFT CIRCLIPS
TABLE 12

ACTUATOR SIZE	PINION TOP DIAMETER		PLIERS ACCORDING DIN 5254
0012	16 mm	0.630"	A1
0025 - 0100	22 mm	0.866"	A2
00150 - 0350	36 mm	1.417"	A3
0600	55 mm	2.165"	A3

ACTUATOR SIZE	PINION TOP DIAMETER		PLIERS ACCORDING DIN 5254
0950	65 mm	2.559	A3
1600	75 mm	2.953	A3
2500	95 mm	3.74	A4
4000	96 mm	3.78	A4

8.7 CLEANING THE COMPONENTS

In case of maintenance, use a clean dry cloth and thoroughly wipe clean and remove old grease from:

- The inside and outside of the body including thread holes and crevices/grooves
- The pinion gears
- The pistons

This section explains:

- Which parts and how to grease them.
- How to reassemble a complete actuator.
- How to set the stroke adjustment bolts after reassembly.
- How to do a basic function and air leak test.

The instructions of this section can be used for maintenance or reconfiguration like spring set change or maintenance. Reference numbers for components refer to the exploded view in section 11.

In case of maintenance, discard all used soft parts like O-ring seals, guide bands and wear strips and circlip and replace them with the parts as supplied in the repair kit.

In case of reconfiguration replace the parts as supplied in the conversion kit (see also chapter 6).

NOTICE

The actuator is designed to be installed, commissioned and maintained using generic tools like wrenches, Allen keys and screwdrivers.

Refer to the tables in this section or refer to Appendix B Tool and Torque tables.

9.1 GREASE INSTRUCTIONS

Check the product coding on the product labels and chapter 3 of this manual, to define which type of grease to use.

- For standard actuators (-20°C to +80°C / -4°F to +176°F):
  Castrol High Temperature grease (or equivalent).

- For low temperature operation (-40°C to +80°C / -40°F to +176°F):
  Castrol Tribol GR TT 1 PD (previously known as Castrol OPTITEMP TT1) or LG2 grease (or equivalent).

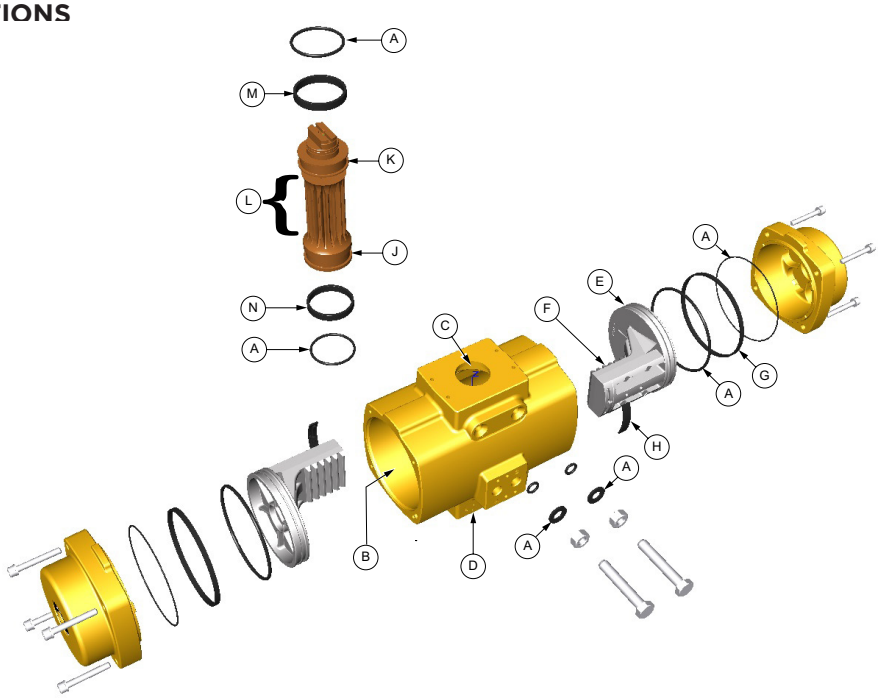
- For high temperature operation (-10°C to +120°C / +14°F to +250°F):
  Castrol High Temperature grease (or equivalent).

We recommend using a suitable sized paint brush to apply the required amount of grease on the parts as per Table 12 and Figure 23.

GREASE INSTRUCTIONS
TABLE 13

PART		SECTION OF PART	AMOUNT OF GREASE
O-rings:	A	Completely	Light film
Housing Parts:	B	Piston bore	Light film
	C	Top pinion bore	Light film
	D	Bottom pinion bore	Light film
Piston Parts:	E	O-ring & bearing groove	Light film
	F	Rack teeth	Half the teeth depth full with grease
	G	Piston bearing	Light film on outside
	H	Piston rack bearing strip	Light film
Piston Parts:	J	Pinion bottom & O-ring groove	Light film
	K	Pinion top & O-ring groove	Light film
	L	Gear teeth	Half the teeth depth
	M	Pinion top bearing	Light film (inside and out)
	N	Pinion bottom bearing	Light film (inside and out)

GREASE INSTRUCTIONS
FIGURE 26



9.2 REASSEMBLY OF THE PINION

1. Grease the pinion parts according to chapter 9.1.

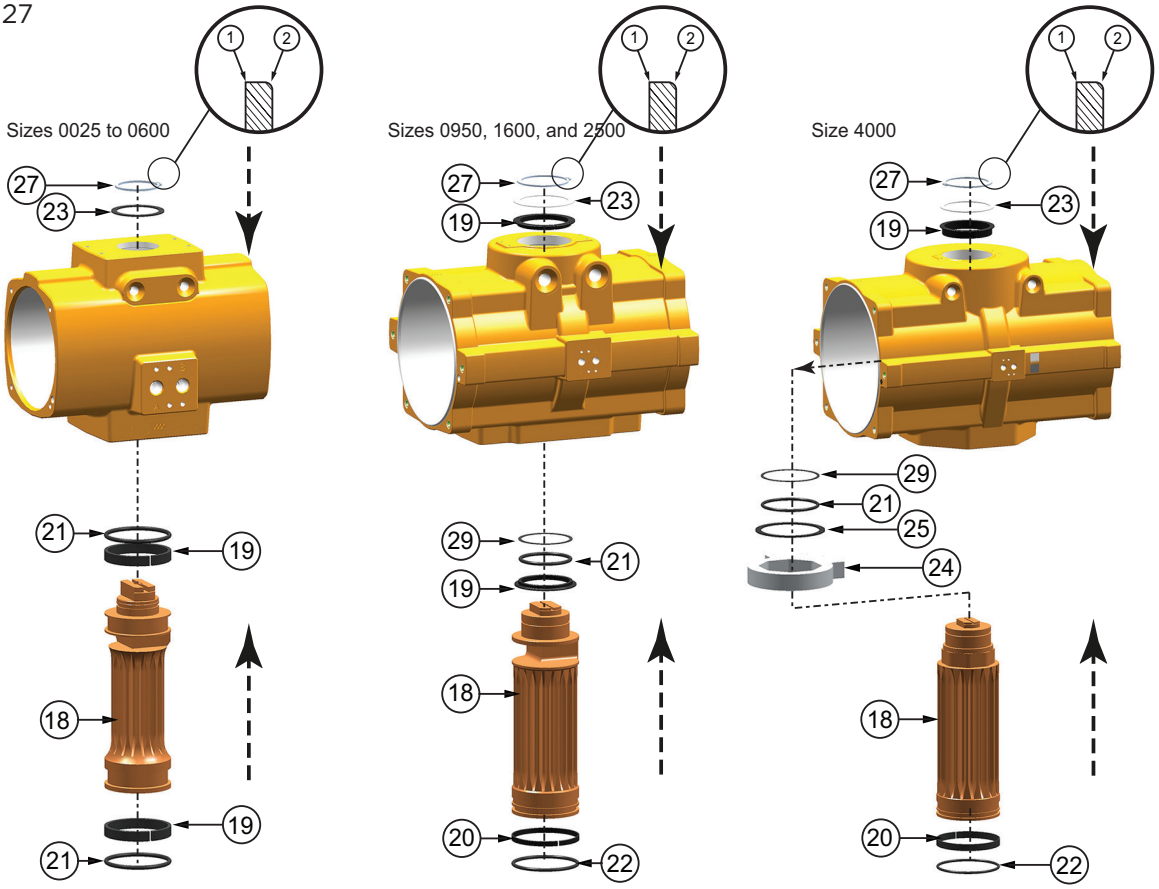
2. Install the pinion bearings (19/20) and the O-ring seals (21/22) on the pinion (18)
   For Size 0950 to 2500, install also the the backup ring (29).

3. Insert the pinion (18) in the housing. For size 4000: mount first the cam (24), cam thrust washer (25), pinion top O-ring (21) and backup ring (29) through the mainbore onto the pinion (18).

4. For sizes 0950 to 4000 install first the top pinion bearing (19).
   For all sizes, install the thrust washer (23) and mount the circlip (27) on the pinion top.

   - Install the new circlip onto its mating groove on the top shaft extension and with the non-sharp edge (2) towards the housing and the sharp edge (1) towards the top of the shaft.

REASSEMBLE THE PINION
FIGURE 27



RECOMMENDED CIRCLIP PLIERS ACCORDING DIN 5254 (OR EQUAL) FOR SHAFT CIRCLIPS
TABLE 14

ACTUATOR SIZE	PINION TOP DIAMETER		PLIERS ACCORDING DIN 5254
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00150 - 0350	36 mm	1.417"	A3
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ACTUATOR SIZE	PINION TOP DIAMETER		PLIERS ACCORDING DIN 5254
0950	65 mm	2.559	A3
1600	75 mm	2.953	A3
2500	95 mm	3.74	A4
4000	96 mm	3.78	A4

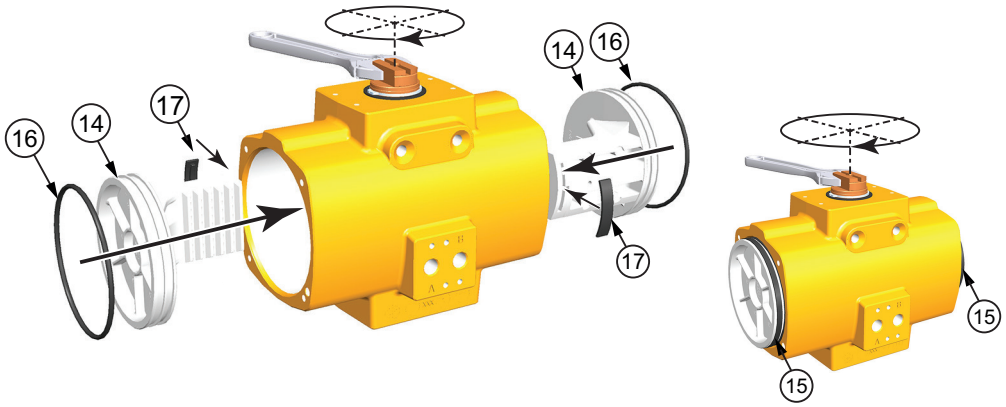
9.3 REASSEMBLY OF THE PISTONS

1. Grease the piston parts according to step 9.1.

2. Install the piston rack bearing strips (17) and piston O-ring seals (16) on the pistons (14). Ensure all these parts are kept in place during assembly.

> ***NOTICE***
> Before reassembling the pistons, check the required assembly code (see section 4.2).

REASSEMBLE THE PISTONS
FIGURE 28



3. Align the pinion (see Figure 28) so that the teeth on the pinion will pick up the pistons rack teeth when turning the pinion. The position of the pinion top slot and the cam on the pinion top:

   - For standard or Spring-to-Close: Assembly Code CW.
   - For reverse or Spring-to-Open: Assembly Code CC.

4. Slightly push the pinion inward to engage with the pinion.

   - Ensure that smooth movement and 90-degree operation can occur without moving the pistons out of the actuator body.
   - For larger pistons, use a rubber mallet and slightly hitting the pistons inward to engage with the pinion.

5. When the pistons are moved 90° inwards, check that the pinion slot on the pinion top is:

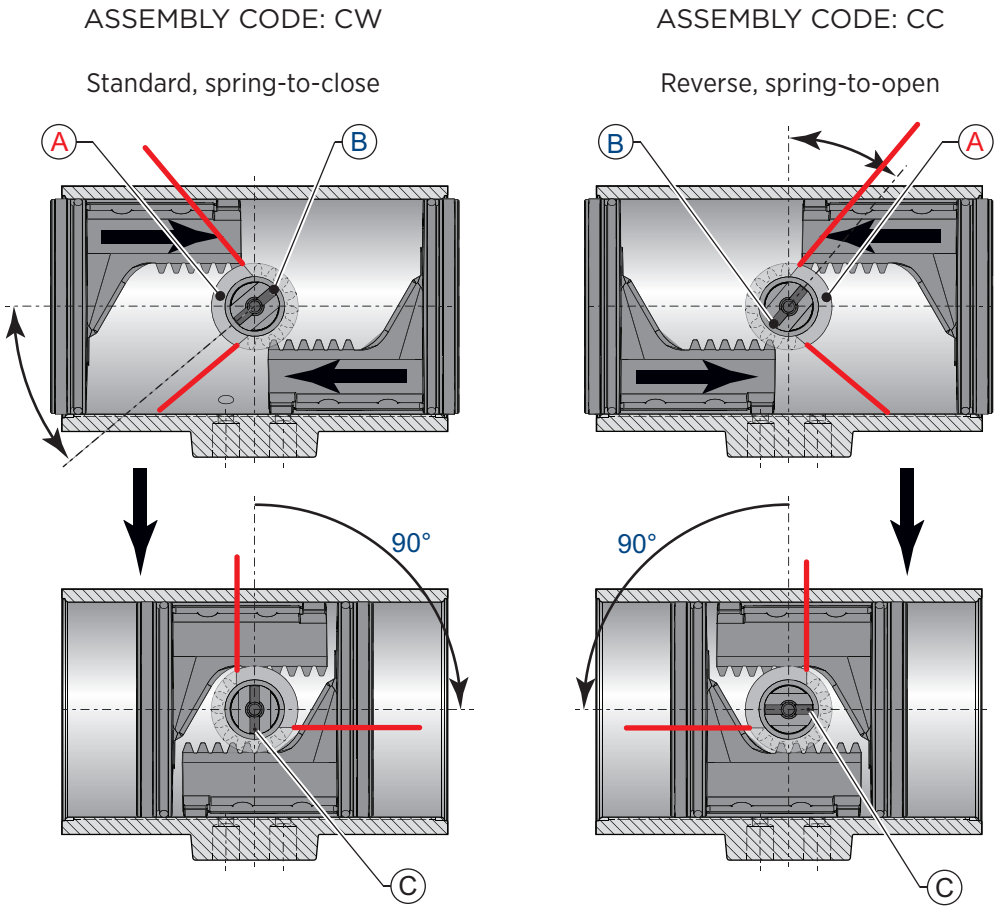
   - Perpendicular to the length centre line of the house for assembly code CW.
   - In line to the length centre line of the house for assembly code CC.

6. If not, turn pinion to move the pistons outward until they disengage from the pinion. Shift one tooth of the pinion, reassemble and check again.

7. Move the pistons outward so that just the bearing groove sticks out of the housing. Fold the piston bearings (15) around the piston and hold the bearing ends in place while moving the pistons inwards.

   - For larger pistons, use a rubber mallet and slightly hitting the pistons inward to engage with the pinion.

POSITION OF THE SLOT AND THE CAM ON THE PINION TOP
FIGURE 29



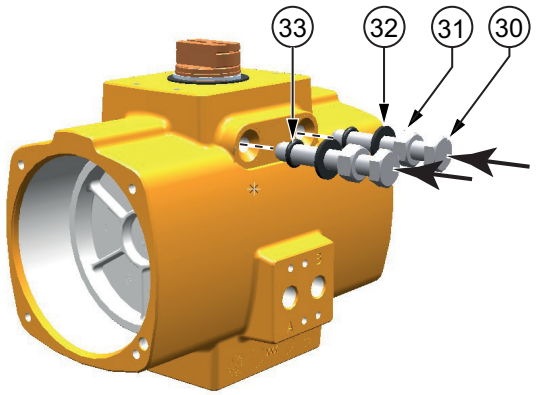
NOTICE
When the pistons are completely moved inwards, the pinion top will show a 5° over travel.

A = Position of cam
B = Position of slot and dot in pinion
C = Final position of pinion dot

9.4 REASSEMBLY AND SETTING OF THE LIMIT STOPS

1. Install the limit stop screws (30), limit stop nuts (31), limit stop washers (32) and limit stop O-rings (33).

INSTALL LIMIT STOP BOLTS
FIGURE 30



2. Move the pistons inward until the slot in the top of the pinion is pendicular to centerline of the housing.

3. Double check if the position of the slot and the cam on the pinion top is in the correct position (see figure 30). Screw in the right hand travel stop until it comes into contact with the pinion stop face.

4. Move the pistons outward until the slot in the top of the pinion is in line with the centerline of the housing.

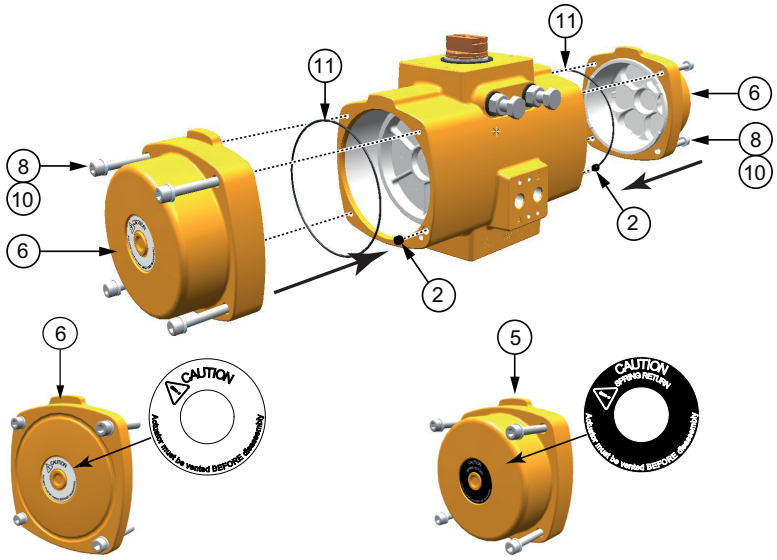
5. Screw in the left hand travel stop until it comes into contact with the pinion stop face.
   - For accurate travel stop adjustment of the actuator on the valve, see section 5.

9.5 REASSEMBLY OF THE END CAPS

9.5.1 DOUBLE-ACTING ACTUATORS

1. Grease the O-ring seals (11) and B port seals (2) according to step 9.1.
2. Ensure that O-ring seals (11) and B port seals (2) are kept in place during assembly.
3. Install the end caps (6) and tighten the end cap screws (8). Refer to Table 15 for the correct torque.

END CAPS REASSEMBLY - DOUBLE-ACTING
FIGURE 31



Double acting end caps (6) are fitted with a white warning sticker.

Spring return end caps (5) are fitted with a black warning sticker.

Actuator sizes 0025 to 0100 have high end caps for double-acting and spring-return models.

Actuator sizes 0150 to 4000 have low end caps for double-acting models and high end caps for spring return models.

END CAP SCREW TORQUE
TABLE 14

ACTUATOR SIZE	THREAD	TOOL	SIZE	TORQUE (NM)			TORQUE (LB.FT)		
				TARGET	MIN.	MAX.	TARGET	MIN.	MAX.
0012	M4	Allen key	SW 3	1.1	0.8	1.3	0.8	0.6	1.0
0025	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0040	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0065	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0100	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0150	M6		SW 5	3.3	2.6	5.1	2.4	1.9	3.8
0200	M6		SW 5	3.3	2.6	5.1	2.4	1.9	3.8
0350	M8		SW 6	8.4	6.7	12.2	6.2	4.9	9.0
0600	M10		SW 8	15.3	12.2	24.8	11.3	9.0	18.3
0950	M12		SW10	24.3	19.4	41.6	17.9	14.3	30.7
1600	M12		SW10	24.3	19.4	41.6	17.9	14.3	30.7
2500	M12		SW10	24.3	19.4	41.6	17.9	14.3	30.7
4000	M14		SW12	43.5	34.8	66.4	32.1	25.7	49.0

9.5.2 SPRING-RETURN ACTUATORS (SIZES 0025 TO 0600)

NOTICE

Apollo spring return actuators are supplied with springs on each side of the actuator. Throughout the size range, there are three different spring designs:

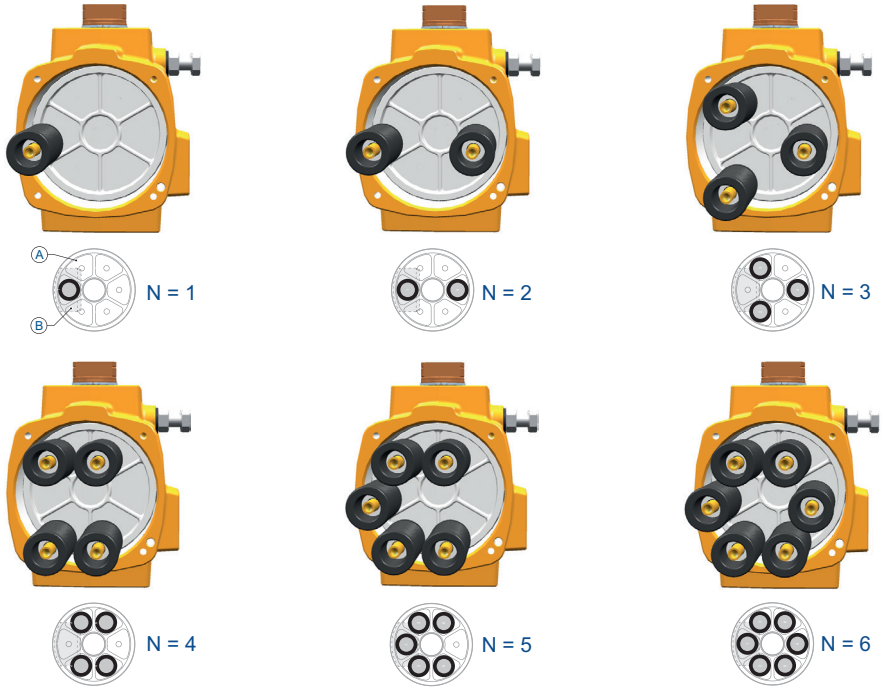
Size 0012 has only 1 spring on each side.
Sizes 0025 to 0600 have 6 springs on each side (see figure 32).
Sizes 0950 to 4000 have 3 springs on each side (see chapter 9.5.3).

Check below figures to see where to place the spring cartridges in case of spring set conversion.

When replacing spring cartridges in a spring-return actuator, ensure that the cartridges are replaced in their identical position from where they were removed.

Before assembling the spring cartridges and end caps, make sure that the pistons are completely inwards.

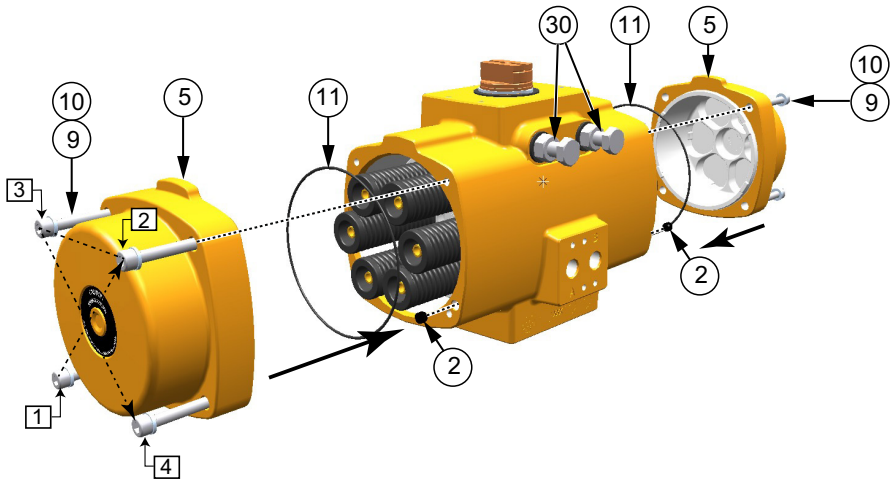
SPRING PLACEMENT (SIZES 0025 TO 0600)
FIGURE 32



A = Piston top view
B = Position of gear rack

1. Grease the O-ring seals (11) and B port seals (2) according to step 9.1.
2. Ensure that O-ring seals (11) and B port seals (2) are kept in place during assembly.
3. Place the spring cartridges in actuator as per required spring set (see Figure 32).
4. Put the end cap screw washer (10) on the end cap screw (9) and tighten each end cap screw in small equal turns and in the sequence as per Figure 33. Refer to Table 15 for the correct torque. We recommend to use some grease on the screws for easier fastening.

END CAPS REASSEMBLY - SPRING-RETURN (SIZES 0025 TO 0600)
FIGURE 33



9.5.3 SPRING-RETURN ACTUATORS (SIZES 0950 TO 4000)

NOTICE

Apollo spring return actuators are supplied with springs on each side of the actuator. Throughout the size range, there are three different spring designs:

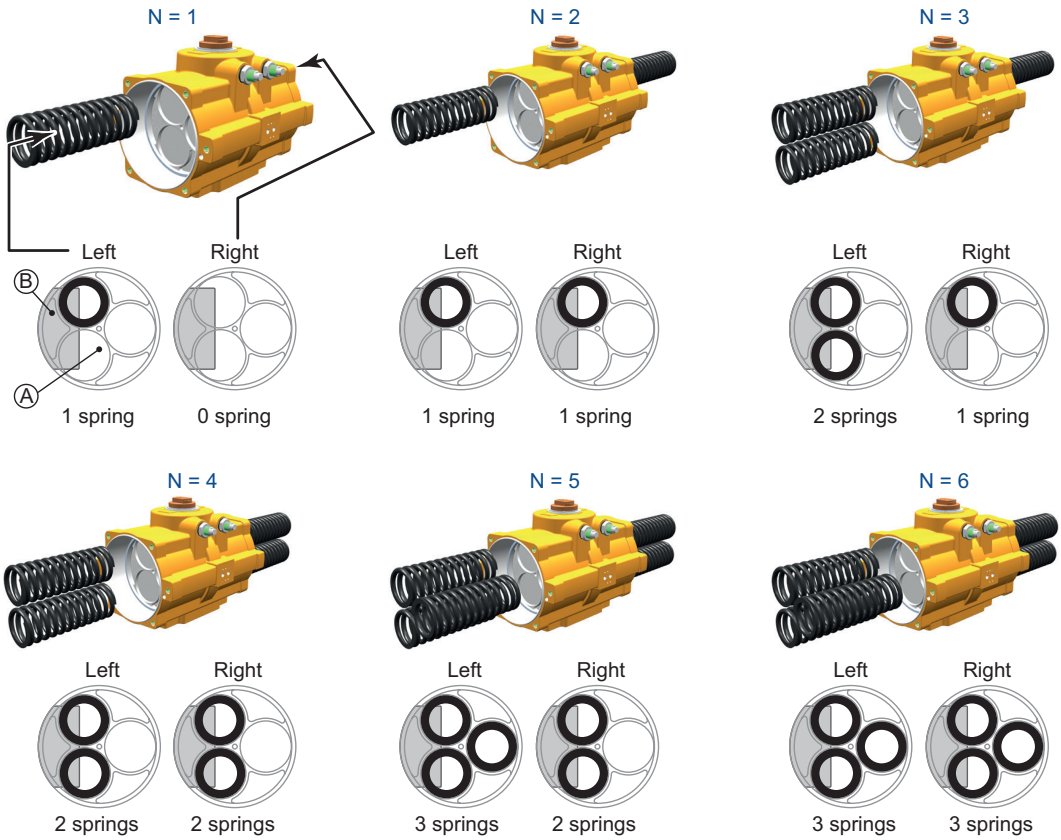
Size 0012 has only 1 spring on each side.
Sizes 0025 to 0600 have 6 springs on each side (see chapter 9.5.2).
Sizes 0950 to 4000 have 3 springs on each side (see figure 34).

Check below figures to see where to place the spring cartridges in case of spring set conversion.

When replacing spring cartridges in a spring-return actuator, ensure that the cartridges are replaced in their identical position from where they were removed.

Before assembling the spring cartridges and end caps, make sure that the pistons are completely inwards.

SPRING PLACEMENT (SIZES 0950 TO 4000)
FIGURE 34

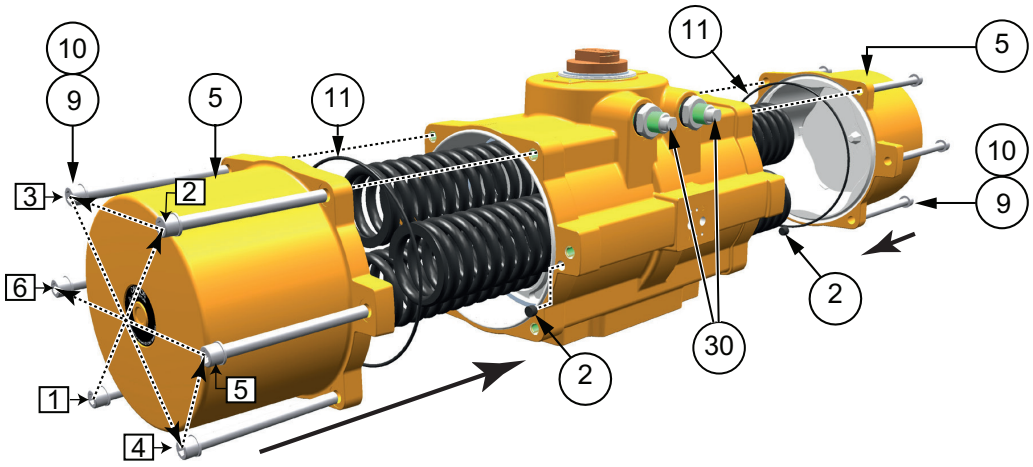


A = Piston top view
B = Position of gear rack

1. Grease the O-ring seals (11) and B port seals (2) according to step 9.1.
2. Ensure that O-ring seals (11) and B port seals (2) are kept in place during assembly.
3. Place the spring in actuator as per required spring set (see Figure 34).
4. Put the end cap screw washer (10) on the end cap screw (9) and tighten each end cap screw in small equal turns and in the sequence as per Figure 35.

   Refer to Table 15 for the correct torque. We recommend to use some grease on the screws for easier fastening.

END CAPS REASSEMBLY - SPRING-RETURN (SIZES 0950 TO 4000)
FIGURE 35



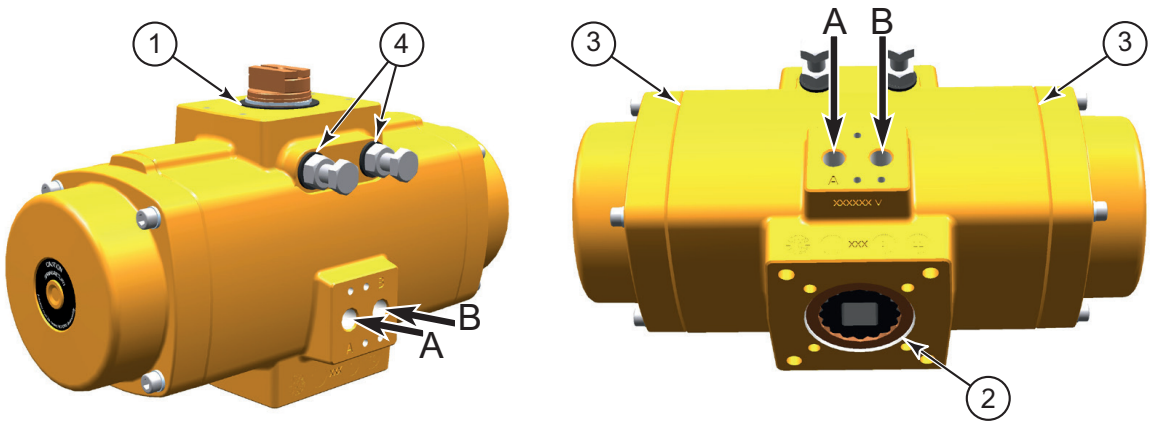
9.6 BASIC FUNCTION AND AIR LEAK TEST

1. Apply pressure (max. 8 bar/120 psi) to ports A and B. Use some soap suds at the indicated points: around pinion top (1), pinion bottom (2), the end caps (3) and limit stops (4).

2. In case of leakage around:
   a. The limit stop bolts: Turn the lock nut of the bolts tighter, until the leakage stops.
   b. The end caps: Disassemble the end caps, replace o-rings and reassemble.
   c. The pinion top or bottom and A- or B- port: Disassemble the complete actuator, replace o-rings and reassemble.

⚠ *CAUTION - MOVING PARTS* ⚠
Applying pressure to the actuator will cause the actuator/valve assembly to operate.

BASIC FUNCTION AND AIR LEAK TEST
FIGURE 36



10.1 MECHANICAL PROBLEMS

PROBLEM	POSSIBLE ERROR	SOLUTION	WHERE TO FIND
Feedback position and actual position are not the same.	Actuator and valve are mounted 90° rotated in relation to each other.	Remove actuator from valve. Check assembly code of actuator. Put both valve and actuator in "Closed" position. Mount actuator on valve.	Section 4
Valve is in "Closed" position, actuator is in "Open" position and will not move anymore.			
Valve does not reach the completely "Closed" or "Open" position.	Limit stop screws are not set correctly.	Readjust the limit stop screws.	Section 5
	Insert is not mounted properly.	Mount the insert in the right position. Remark: Rotate insert to one cam = 22.5°.	Section 4.5
	Pressure to low.	Apply pressure as per sizing.	
	Sizing is wrong.	Check valve torque data with actuator torque data.	
	Pinion is mounted in the wrong position.	Re-assemble actuator.	Section 9
Actuator rotates, valve does not.	No coupling between actuator shaft and valve spindle.	Install a coupling between actuator shaft and valve spindle.	Section 4.5
Actuator does not rotate or does not rotate smoothly.	Broken gearing on pistons or pinion.	Contact Apollo representative to replace actuator.	
	Spring or Spring cartridge is broken.	Contact Apollo representative to replace actuator.	Appendix A.
Limit stop screws cannot be turned out anymore.	Limit stop screws is bend.	Contact Apollo representative to replace actuator.	

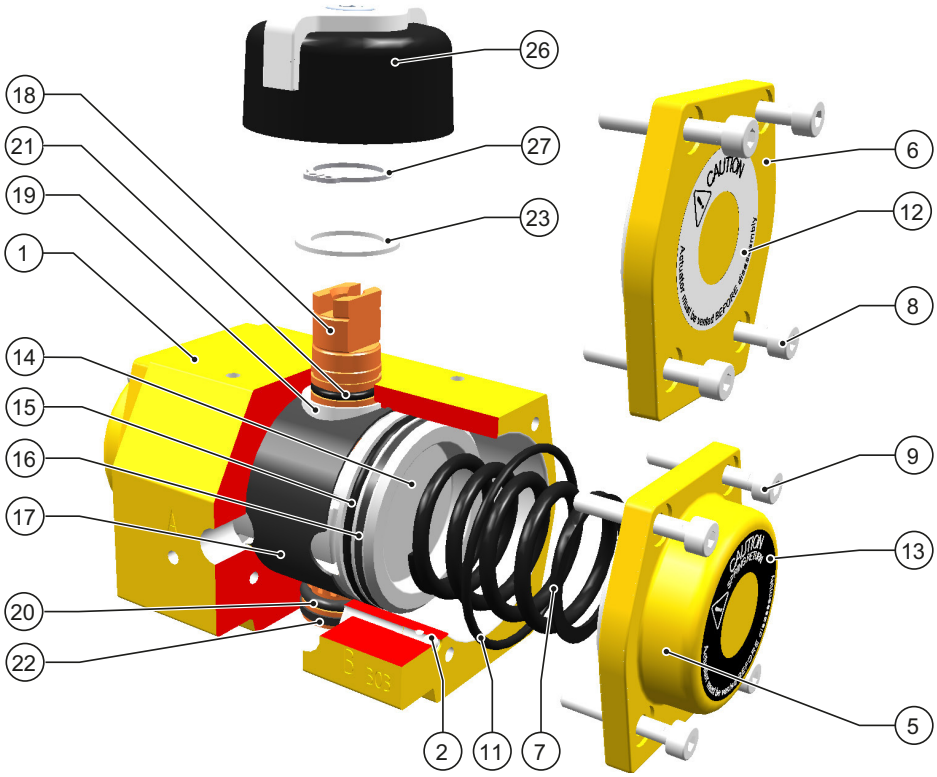
10.2 PNEUMATIC PROBLEMS

PROBLEM	POSSIBLE ERROR	SOLUTION	WHERE TO FIND
Actuator does not react to electrical control signal.	There is no supply pressure at the actuator.	Supply the right pressure to the actuator.	Section 2.3 Check that the actual supply pressure is higher than the sizing pressure.
Actuator does not react good to electrical control signal.	There is sufficient supply air pressure but insufficient supply air capacity.	Take care the supply air tubing has the right dimensions.	Section 4.6
	Supply pressure too low, causing pilot operated solenoid valve to fail.	Check that supply pressure at the actuator and solenoid is sufficient to operate the actuator.	Section 2.3 Check that the actual supply pressure is higher than the sizing pressure.
	Solenoid valve is not mounted properly.	Check the solenoid valve mounting.	Instructions shipped with the solenoid valve.
	Speed control throttle (if present) blocks air flow.	Turn the speed control more open.	Instructions shipped with the speed control valve.
	Manual override (if present) on the Solenoid Valve is locked.	Unlock manual override on the solenoid valve.	Instructions shipped with the manual override.
Air leakage between actuator and solenoid valve.	Sealing between solenoid valve and actuator is not mounted air tight.	Reassemble solenoid valve taking care, that all seals are in place.	Instructions shipped with the solenoid valve.
Double-acting actuator will only move to "open" position.	Actuator has wrong solenoid valve configuration.	Mount a solenoid valve suitable for double-acting actuators (4/2 or 5/2 function).	Instructions shipped with the solenoid valve.
		Check that conversion plate on solenoids, that have both 3/2 and 5/2 functions, is in the right position.	Instructions shipped with the solenoid valve.
Leakage notice on the actuator.	Seals on the limit stops screws are not air tight.	Turn the lock nut of the bolts tighter; until the leakage stops.	Section 9.6
	Seals on the end caps are not air tight.	Disassemble the end caps, replace O-rings and reassemble. Consider to replace all O-ring seals and bearings.	Section 9.6 or Section 6
	Seals on the pinion top and bottom are not air tight.	Disassemble the complete actuator, replace O-rings and reassemble. Consider to replace all O-ring seals and bearings.	Section 9.6 or Section 6

10.3 ELECTRICAL PROBLEMS

PROBLEM	POSSIBLE ERROR	SOLUTION	WHERE TO FIND
Actuator does not react to control signals.	Control wiring. Power supply wiring or feedback wiring are not right connected.	Connect all wiring in the right way.	Instructions of the control or feedback accessories.
	The power supply voltage is not is not the same as the voltage of the applicable solenoid valve.	Connect the right power supply voltage.	Instructions of the solenoid valve.
There are problems with position feedback after sending the actuator to either the "Open" or "Closed" position.	The wiring of the feedback signals may be switched.	Connect the feedback wiring in the right way.	Instructions of the feedback device.

11.1 ACTUATOR SIZE 0012

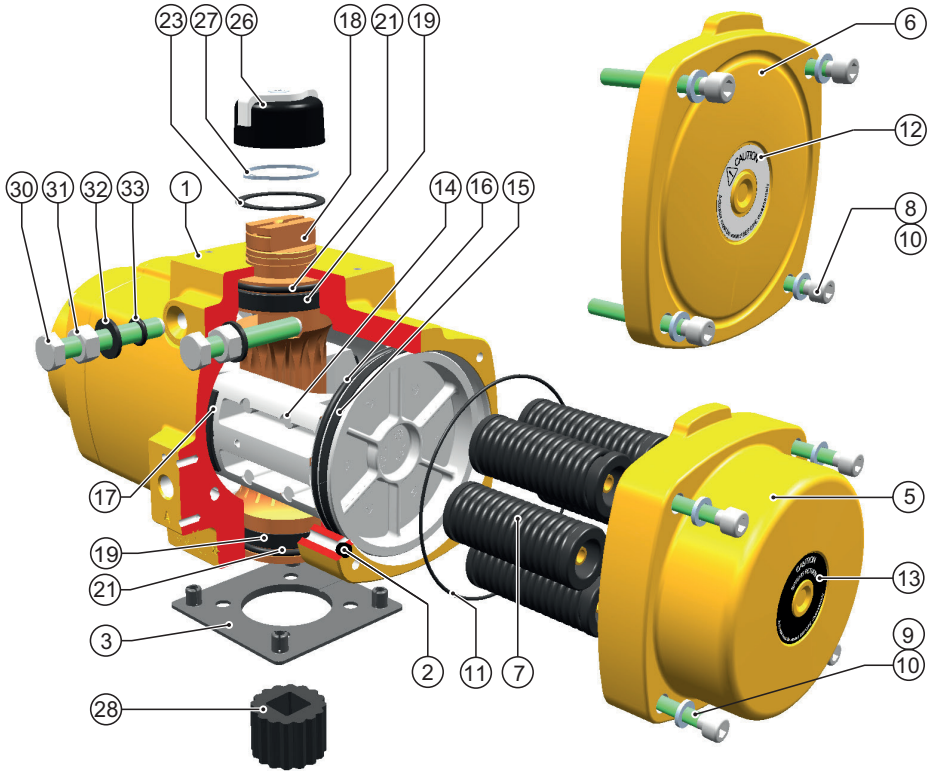


PARTS LIST
SIZE 0012

POS.	QTY	NOTES	DESCRIPTION	MATERIAL
1	1		House	Extruded aluminium alloy
2	2	1	B-port ball	Steel
5	2		End cap SR (DA)	Cast aluminium alloy
6	2		End cap DA	Cast aluminium alloy
7	Max. 2		Springs	Spring steel
8	8		End cap screw DA	Stainless steel
9	8		End cap screw SR	Stainless steel
11	2	1	O-ring end cap	Nitrile rubber
12	2		Warning sticker DA	Polyester
13	2		Warning sticker SR	Polyester
14	2		Piston	Cast aluminium alloy
15	2	1	Bearing piston	PTFE 25% carbon-filled
16	2	1	O-ring piston	Nitrile rubber
17	1	1	Guide band	Nylatron
18	2		Pinion	High grade aluminium
19	1	1	Bearing pinion top	POM
20	1	1	Bearing pinion bottom	POM
21	1	1	O-ring pinion top	Nitrile rubber
22	1	1	O-ring pinion bottom	Nitrile rubber
23	1	1	Thrust bearing pinion	POM, black UV stabilized
26	1		Indicator assembly	ABS + stainless steel screw
27	1	1	Circlip	Spring steel

Notes:
1. Included in service kit.

11.2 ACTUATOR SIZES 0025 TO 0600

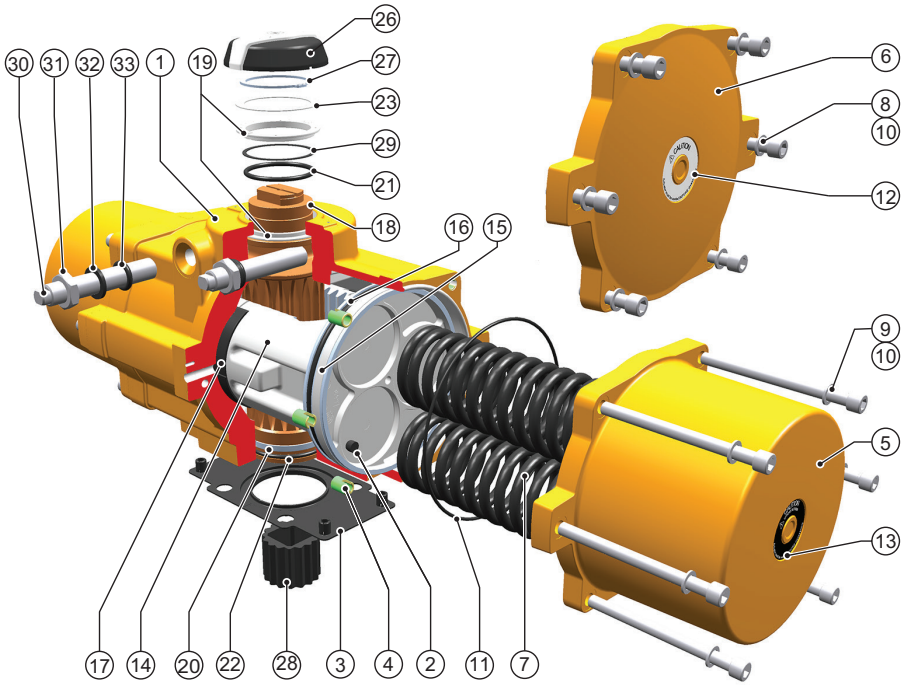


PARTS LIST
SIZES 0025 TO 0600

POS.	QTY	NOTES	DESCRIPTION	MATERIAL
1	1		House	Cast aluminium alloy
2	2	1	B-port seal	Nitrile rubber
3	1		Center plate (option)	Nylon PA6, Black
5	2	2	End cap SR (DA)	Cast aluminium alloy
6	2	2	End cap DA	Cast aluminium alloy
7	Max. 12		Spring cartridge	Spring steel
8	8		End cap screw DA	Stainless steel
9	8		End cap screw SR	Stainless steel
10	8		End cap screw washer	Stainless steel
11	2	1	O-ring end cap	Nitrile rubber
12	2		Warning sticker DA	Polyester
13	2		Warning sticker SR	Polyester
14	2		Piston	Cast aluminium alloy
15	2	1	Bearing piston	PTFE 25% carbon-filled
16	2	1	O-ring piston	Nitrile rubber
17	2	1	Bearing strip piston rack	POM
18	2		Pinion	High grade aluminium
19	2	1	Bearing pinion	POM
21	2	1	O-ring pinion	Nitrile rubber
23	1	1	Thrust bearing pinion	POM, black UV stabilized
26	1		Indicator assembly	ABS + stainless steel screw
27	1	1	Circlip	Spring steel
28	1		Drive insert	Aluminium
30	2		Limit stop screw	Stainless steel
31	2		Limit stop nut	Stainless steel
32	2	1	Limit stop washer	PA66
33	2	1	O-ring limit stop	Nitrile rubber

Notes:
1. *Included in service kit.*
2. *Actuator sizes 0025 to 00100 have high end caps for double-acting and spring-return models.*
   Actuator sizes 0150 to 4000 have low end caps for double-acting models and high end caps for spring-return models.

11.3 ACTUATOR SIZES 0950 TO 2500

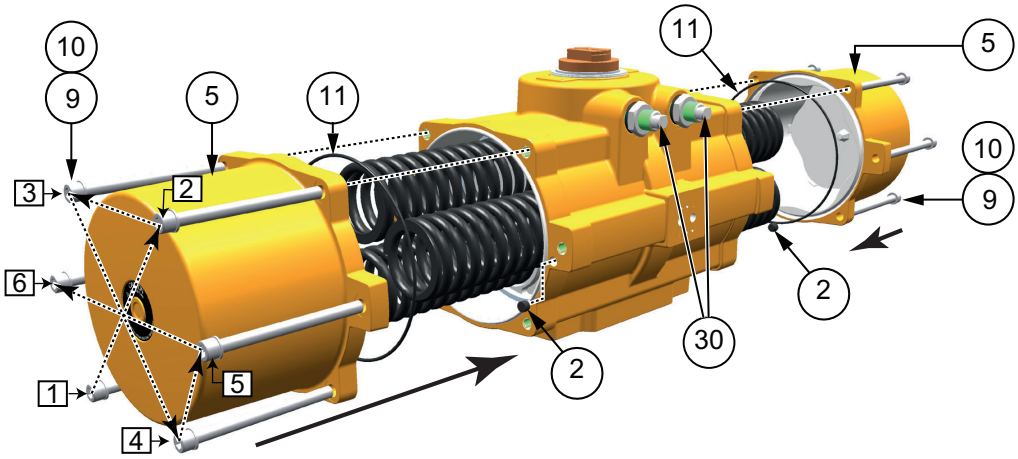


PARTS LIST
SIZES 0950 TO 2500

POS.	QTY	NOTES	DESCRIPTION	MATERIAL
1	1		House	Cast aluminium alloy
2	2	1	B-port seal	Nitrile rubber
3	1		Center plate (option)	Nylon PA6, Black
4	12		Thread insert	Steel
5	2		End cap SR	Cast aluminium alloy
6	2		End cap DA	Cast aluminium alloy
7	Max. 6		Springs	Spring steel
8	12		End cap screw DA	Stainless steel
9	12		End cap screw SR	Stainless steel
10	12		End cap screw washer	Stainless steel
11	2	1	O-ring end cap	Nitrile rubber
12	2		Warning sticker DA	Polyester
13	2		Warning sticker SR	Polyester
14	2		Piston	Cast aluminium alloy
15	2	1	Bearing piston	PTFE 25% carbon-filled
16	2	1	O-ring piston	Nitrile rubber
17	2	1	Bearing strip piston rack	POM
18	1		Pinion	High grade aluminium
19	2	1	Bearing pinion top	POM
20	1	1	Bearing pinion bottom	POM
21	1	1	O-ring pinion top	Nitrile rubber
22	1	1	O-ring pinion bottom	Nitrile rubber
23	1	1	Thrust bearing pinion	POM, black UV stabilized
26	1		Indicator assembly	ABS + stainless steel screw
27	1	1	Circlip	Spring steel
28	1		Drive insert	Aluminium
29	1	1	Backup ring	POM
30	2		Limit stop screw	Stainless steel
31	2		Limit stop nut	Stainless steel
32	2	1	Limit stop washer	PA66
33	2	1	O-ring limit stop	Nitrile rubber

Notes:
1. *Included in service kit.*
2. *Actuator sizes 0025 to 00100 have high end caps for double-acting and spring-return models.*
   Actuator sizes 0150 to 4000 have low end caps for double-acting models and high end caps for spring-return models.

11.4 ACTUATOR SIZE 4000



PARTS LIST
SIZE 4000

POS.	QTY	NOTES	DESCRIPTION	MATERIAL
1	1		House	Cast aluminium alloy
2	2	1	B-port seal	Nitrile rubber
3	1		Center plate (option)	Nylon PA6, Black
4	12		Thread insert	Steel
5	2		End cap SR	Cast aluminium alloy
6	2		End cap DA	Cast aluminium alloy
7	Max. 6		Springs	Spring steel
8	12		End cap screw DA	Stainless steel
9	12		End cap screw SR	Stainless steel
10	12		End cap screw washer	Stainless steel
11	2	1	O-ring end cap	Nitrile rubber
12	2		Warning sticker DA	Polyester
13	2		Warning sticker SR	Polyester
14	2		Piston	Cast aluminium alloy
15	2	1	Bearing piston	PTFE 25% carbon-filled
16	2	1	O-ring piston	Nitrile rubber
17	2	1	Bearing strip piston rack	POM
18	1		Pinion	High grade aluminium
19	2	1	Bearing pinion top	POM
20	1	1	Bearing pinion bottom	POM
21	1	1	O-ring pinion top	Nitrile rubber
22	1	1	O-ring pinion bottom	Nitrile rubber
23	1	1	Thrust bearing pinion	POM, black UV stabilized
26	1		Indicator assembly	ABS + stainless steel screw
27	1	1	Circlip	Spring steel
28	1		Drive insert	Aluminium
29	1	1	Backup ring	POM
30	2		Limit stop screw	Stainless steel
31	2		Limit stop nut	Stainless steel
32	2	1	Limit stop washer	PA66
33	2	1	O-ring limit stop	Nitrile rubber

Notes:
1. Included in service kit.

AD/AD ACTUATOR IOM
APPENDIX A - SPRING LOAD REMOVAL

This section explains:
How to remove the spring load safely of spring-return actuators in case:

- The valve gets "stuck" in mid position.
- One of the spring cartridges is broken.

⚠ CAUTION - MOVING PARTS ⚠

A spring-return actuator mounted on a valve, which is stuck in mid stroke, contains a high spring load which will cause a sudden rotation of the actuator versus the valve during disassembly. This can cause serious injury to personnel or damage to material.

On spring-return actuators with a broken spring cartridge, the end cap can be "shot" away during disassembly of the actuator. This can cause serious injury to personnel or damage to material.

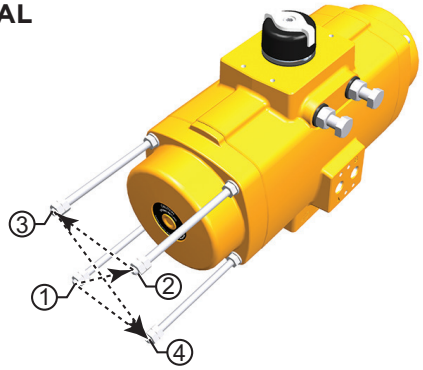
A.1 SPRING LOAD RELIEF

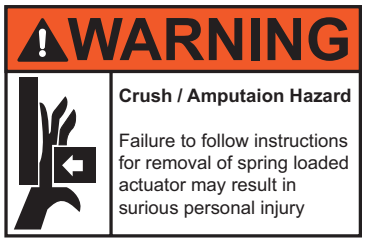
⚠ CAUTION - ROTATING ACTUATOR ⚠

A spring-return actuator mounted on a valve, which is stuck in mid stroke, contains a high spring load which will cause a sudden rotation of the actuator versus the valve during disassembly. This can cause serious injury to personnel or damage to material.

On spring-return actuators with a broken spring cartridge, the end cap can be "shot" away during disassembly of the actuator. This can cause serious injury to personnel or damage to material.

SPRING LOAD REMOVAL
FIGURE A-1



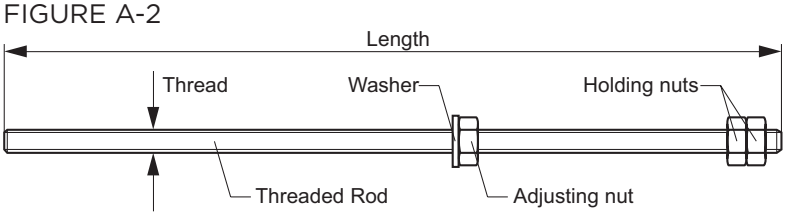


1. Depressurize the actuator completely.
2. Based on the actuator size, choose the correct threaded rod kit from Table A-1.
3. Replace one by one each end cap screw for the threaded rod kit and turn down the adjusting nut until it touches the end cap.
4. Once all for end cap screws have been replaced, gradually turn the adjustment nuts on threaded rod in CCW direction by turning the nuts half turn at a time. Make sure the rod itself does not turn. Continue this until the load of springs are relieved.
5. Repeat the same procedure for the end cap screws on the other size of the actuator as shown in figure A-1.
6. In case of an actuator/valve assembly "stuck" in mid position: The actuator now can be disassembled from Valve, by removing the mounting studs/bolts.

THREAD ROD DIMENSIONS (MM)
TABLE A-1

ACTUATOR SIZE	THREAD	THREADED ROD LENGTH	
		(MM)	(INCH)
0012	M4	132	5.2
0025	M5	140	5.5
0040	M5	140	5.5
0065	M5	140	5.5
0100	M5	140	5.5
0150	M6	145	5.7
0200	M6	145	5.7
0350	M8	185	7.3
0600	M10	185	7.3
0950	M12	498	19.6
1600	M12	498	19.6
2500	M12	498	19.6
4000	M14	600	23.6

SPRING LOAD REMOVAL ROD DIMENSIONS
FIGURE A-2



AD/AD ACTUATOR IOM
APPENDIX B - TOOL & TORQUE TABLES

This section explains:
- Which tools to use for the indicated fasteners.
- The recommended amount of torque to apply on the indicated fasteners.

END CAP SCREW TORQUE
TABLE B-1

ACTUATOR SIZE	THREAD	TOOL	SIZE	TORQUE (NM)			TORQUE (LB.FT)		
				TARGET	MIN.	MAX.	TARGET	MIN.	MAX.
0012	M4	Allen key	SW 3	1.1	0.8	1.3	0.8	0.6	1.0
0025	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0040	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0065	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0100	M5		SW 4	2.0	1.6	3.0	1.5	1.2	2.2
0150	M6		SW 5	3.3	2.6	5.1	2.4	1.9	3.8
0200	M6		SW 5	3.3	2.6	5.1	2.4	1.9	3.8
0350	M8		SW 6	8.4	6.7	12.2	6.2	4.9	9.0
0600	M10		SW 8	15.3	12.2	24.8	11.3	9.0	18.3
0950	M12		SW10	24.3	19.4	41.6	17.9	14.3	30.7
1600	M12		SW10	24.3	19.4	41.6	17.9	14.3	30.7
2500	M12		SW10	24.3	19.4	41.6	17.9	14.3	30.7
4000	M14		SW12	43.5	34.8	66.4	32.1	25.7	49.0

BOTTOM FLANGE
TABLE B-2

ACTUATOR SIZE	ISO PATTERN	IMPERIAL THREAD	TORQUE (LB.FT)	
			MIN.	MAX.
0012	F04	10-24UNC	3.3	3.7
0025	F03 inner pattern	10-24UNC	1.5	2.2
	F05 outer pattern	1/4"-20	3.3	3.7
0040, 0065, 0100	F05 inner pattern	1/4"-20	3.3	3.7
	F07 outer pattern	5/16"-18	7.7	9.2
0150, 0200, 0350	F07 inner pattern	5/16"-18	7.7	9.2
	F10 outer pattern	3/8"-16	15.5	18.1
0600	F10 inner pattern	3/8"-16	15.5	18.1
	F12 outer pattern	1/2"-13	25.4	31.7
0950	F10 inner pattern	3/8"-16	15.5	18.1
	F14 outer pattern	5/8"-11	66.4	76.7
1600, 2500	F16 inner pattern	3/4"-10	125.4	150.5
	F25* outer pattern	4x 5/8"-11	66.4	76.7
4000	F16 inner pattern	3/4"-10	125.4	150.5
	F25 outer pattern	8x 5/8"-11	66.4	76.7

Sizes 1600 and 2500: Only 4 holes of the ISO5211 F25 drilling pattern are available.

NAMUR (VDE/VDI 3845) FLANGES
TABLE B-3

FLANGE	IMPERIAL THREAD	TORQUE (LB.FT)	
		MIN.	MAX.
Solenoid flange screw threads	10-24UNC	1.5	2.2
Top flange screw threads	10-24UNC	1.5	2.2

LIMIT STOP DIMENSIONS
TABLE B-4

ACTUATOR SIZE	THREAD	BOLT WRENCH SIZE (MM)	NUT WRENCH SIZE (MM)
0025	M 6	10	10
0040	M 8	13	13
0065	M 10	17 (16)[1,2]	17 (16)[1,2]
0100	M 10	17 (16)[1,2]	17 (16)[1,2]
0150	M 10	17 (16)[1,2]	17 (16)[1,2]
0200	M 12	19 (18)[1,2]	19 (18)[1,2]
0350	M 16	24	24
0600	M 20	30	30
0950	M 22	12	32
1600	M 24	14	36
2500	M 27	17	41
4000	M 22	12	32

1. *Default dimension according DIN933 standard.*
2. *Dimensions in brackets according ISO4017 standard.*
3. *Actuator size 0012 is not available with limit stops.*

RECOMMENDED CIRCLIP PLIERS ACCORDING DIN 5254 (OR EQUAL) FOR SHAFT CIRCLIPS
TABLE B-5

ACTUATOR SIZE	PINION TOP DIAMETER		PLIERS ACCORDING DIN 5254
0012	16 mm	0.630"	A1
0025 - 0100	22 mm	0.866"	A2
00150 - 0350	36 mm	1.417"	A3
0600	55 mm	2.165"	A3

ACTUATOR SIZE	PINION TOP DIAMETER		PLIERS ACCORDING DIN 5254
0950	65 mm	2.559	A3
1600	75 mm	2.953	A3
2500	95 mm	3.74	A4
4000	96 mm	3.78	A4

ANGULAR DISPLACEMENT LIMIT STOP
TABLE B-6

ACTUATOR SIZE	TURNS FOR 5° ADJUSTMENT OF THE PINION	360° REVOLUTION OF LIMIT STOP SCREW WILL ADJUST
0012	Actuator size 0012 is not available with limit stops	
0025	0.7	7.1°
0040	0.8	6.3°
0065	0.6	8.3°
0100	0.7	7.1°
0150	1.2	4.2°
0200	1.0	5.0°

ACTUATOR SIZE	TURNS FOR 5° ADJUSTMENT OF THE PINION	360° REVOLUTION OF LIMIT STOP SCREW WILL ADJUST
0350	0.8	6.3°
0600	0.8	6.3°
0950	1.1	4.7°
1600	1.3	4.1°
2500	1.5	3.4°
4000	3.2	1.6°

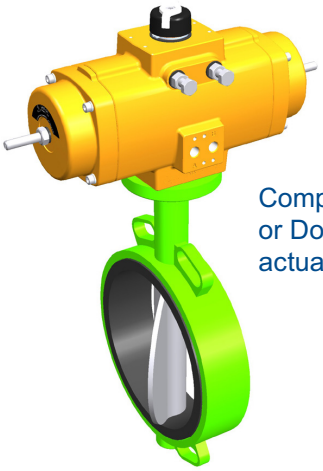
This section explains:
This section explains:
- How to mount the Full Stroke Adjustment option to an actuator
- How to adjust the Full Stroke Adjustment option to a required rotation angle.

C.1 FULL STROKE ADJUSTMENT OPTION

The Full Stroke Adjustment option is available as a complete actuator or as an end cap conversion kit in order to upgrade a standard actuator into a Full Stroke Adjustment version.

The option is available for sizes 0025 to 0600 and both the double acting kit and spring return kit use the spring return end cap.

AVAILABILITY FORMATS OF THE FULL STROKE ADJUSTMENT OPTION
FIGURE C-1



Complete Spring Return or Double Acting actuator

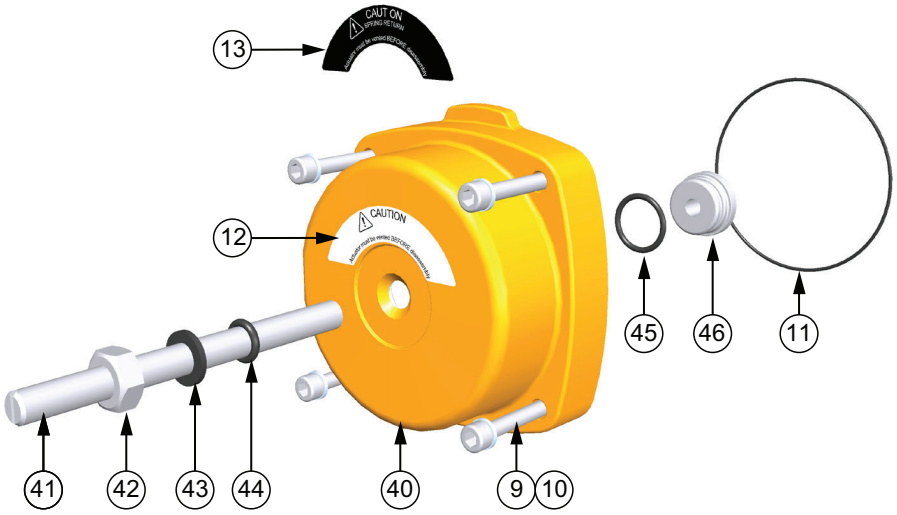
Spring Return Full Stroke Adjustment kit

Double Acting Full Stroke Adjustment Kit

C.2 CONVERT A STANDARD ACTUATOR INTO A FULL STROKE ADJUSTMENT VERSION

Before starting to assemble the Full Stroke adjustment kit, please check the kit for completeness. See figure C-2.

FULL STROKE ADJUSTMENT KIT CONTENTS
FIGURE C-2



FULL STROKE ADJUSTMENT KIT CONTENTS
TABLE C-1

POS.	QTY	NOTES	DESCRIPTION	MATERIAL
40	2	1	End cap - Full stroke adjustment	Cast aluminium alloy
41	2		Full Stroke adjustment screw	Stainless steel
42	2		Full Stroke adjustment Nut	Stainless steel
43	2		Full Stroke adjustment washer	PA66
44	2		O-Ring - Full Stroke adjustment screw	Nitrile rubber
45	2		O-Ring - Thread bush	Nitrile rubber
46	2		Thread bush	Aluminium
9	8		End cap screw	Stainless steel
10	8		Washer end cap screw	Stainless steel
11	2		O-ring end cap	Nitrile rubber
12	2		Warning sticker DA Full Stroke adjustment	Polyester
13	2		Warning sticker SR Full Stroke adjustment	Polyester

Notes:
1. The same full stroke adjustment end cap is used for both double acting and spring return actuators (flat double acting actuator end caps with full stroke adjustment options are not available).

C.2.1 PROCEDURE

1. Remove the existing end caps of a standard actuator.
   - Follow the instructions of Section 8 to remove both the end caps of the actuator.
   - For spring return actuators; note the original positions of the spring cartridges.

2. Mount the Full Stroke Adjustment End cap kit to the actuator.
   - The stroke adjustment screw (41) is factory set at the 90° position.

3. Grease the O-ring seals (11) and B port seals (2) according to section 9.1.

4. Ensure that O-ring seals (11) and B port seals (2) are kept in place during assembly.

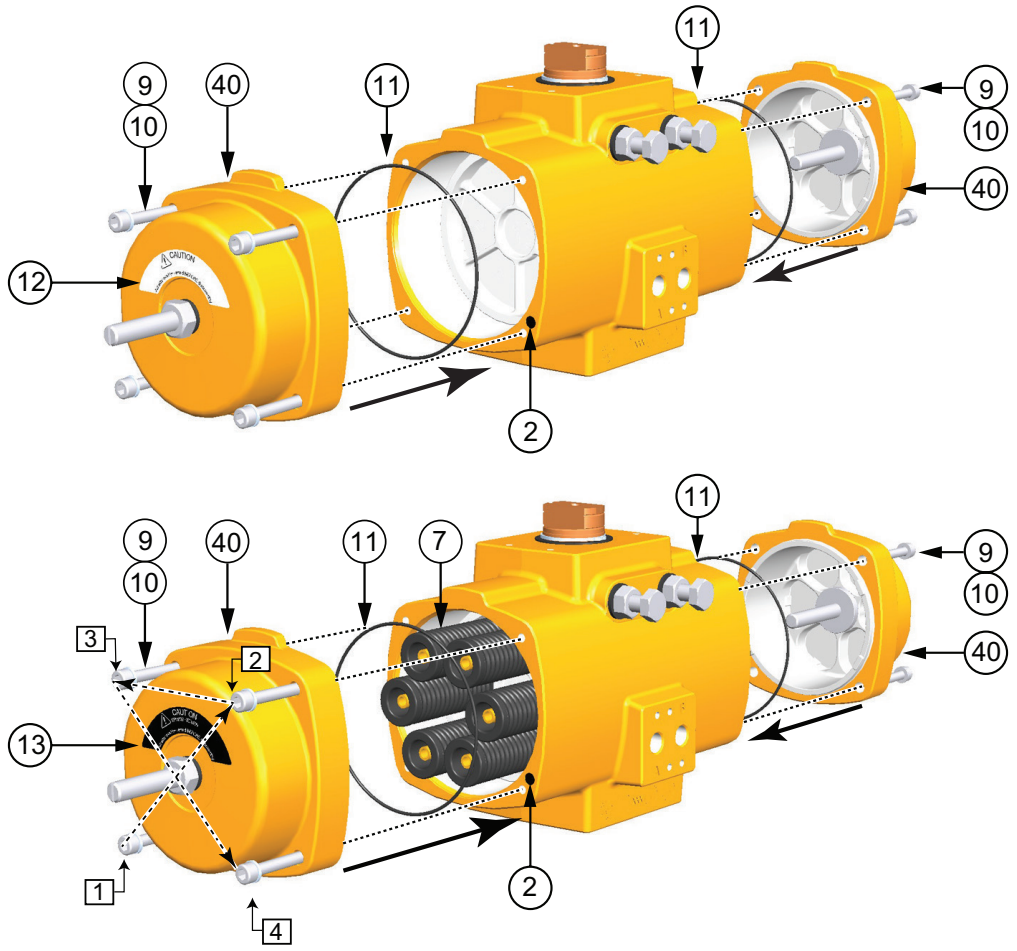
5. For spring return actuators; place the spring cartridges (7) back in their original positions.

6. Install the Full Stroke end cap kits and tighten the end cap screws (9,10). For spring return units; tighten each end cap screw (9,10) in small equal turns and in the sequence as per Figure C-3.

   Refer to Appendix B, Table B-1 for the correct torque.

7. For Spring Return units, place the black warning sticker (13) on the end cap.
   For Double Acting units, place the white warning sticker (12) on the end cap.

ASSEMBLY OF FULL STROKE ADJUSTMENT END CAP KIT
FIGURE C-3



C.3 FULL STROKE ADJUSTMENT SETTING

NOTICE
Standard actuators or actuators with the Full Stroke Adjustment option are shipped by default with a rotation setting of 90° +/-0.5°.

The stroke adjustment setting procedure can be two steps:

1. Setting the Full Stroke Adjustment screw to the 90° (factory) position.
   - This step can be applicable if a standard actuator needs to be converted with a Full Stroke Adjustment end cap kit or if the position of the Full Stroke Adjustment screw is somehow lost.

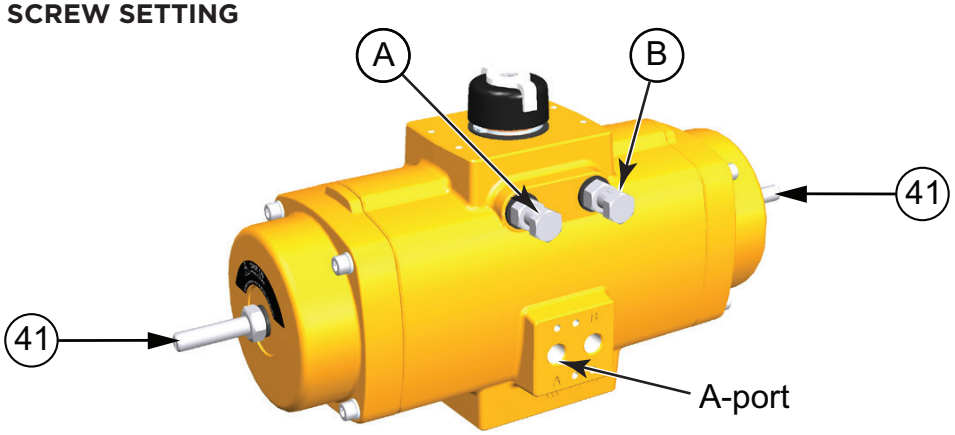
2. Setting the Full Stroke Adjustment screw to the required angle.

C.3.1 FACTORY SETTING PROCEDURE

1. In order to set the Full Stroke Adjustment Screws accurately to the outward position:
   - Do not change the setting of the DSA limit stop screws (A and B) located above the air connection interface.
   - Move the pistons of the actuator outwards by applying pressure to the A-port.

2. Screw in both the Full Stroke Adjustment Screws (41) until the screws touch the pistons. You will feel an obstruction. **Important: Do not overtighten the screws.**

DSA LIMIT STOP SCREW SETTING
FIGURE C-4



You have now set the adjustment screw to the factory setting

Notes:
1. Only the outward stroke can be adjusted with the Full Stroke Adjustment screws.
   - In case of assembly code CW, the left side limit stop (A) is redundant.
   - In case of assembly code CC, the right side limit stop (B) is redundant.

2. For the inward stroke the standard limit stops can be used:
   - The right side limit stop (B) for assembly code CW
   - The left side limit stop (A) for assembly code CC

C.3.2 SETTING THE FULL STROKE ADJUSTMENT SCREW TO THE REQUIRED ANGLE.

1. Move the pistons of the actuator inwards.
   - For Spring Return actuators this happens automatically when the actuator is vented.
   - For double acting actuators vent the A-port and apply pressure to the B-port.

2. In order to set the actuator to the required angle, use next table to define the number of revolutions which you have to turn in the Full Stroke Adjustment Screws.

3. Turn in both the adjustment screws (41) as defined in step 2. Both the adjustment screws should be turned in with the same length or number of revolutions.

⚠ *CAUTION - DO NOT SET SCREWS UN-EQUAL* ⚠

Screwing in only one adjustment screw or un-equal setting of both the screws will lead to high point loads on the pistons and can cause premature failure of the actuator.

4. Test cycle the actuator to check if the correct rotation angle is set. If required, repeat steps 1 to 3 to adjust the rotation angle to the required angle.

ACTUATOR ANGLE ROTATION PER FULL REVOLUTION OF FULL STROKE ADJUSTMENT SCREW
TABLE C-2

ACTUATOR SIZE	STROKE		FLATHEAD SCREW DRIVER	SCREW		ACTUATOR ANGLE ROTATION PER FULL REVOLUTION OF SCREW
	MM	INCH		THREAD	PITCH (MM)	
0025	15.7	0.62	1.0 x 5.5	M6	1	5.7°
0040	18.8	0.74	1.2 x 6.5	M8	1.25	6.0°
0065	22.0	0.87	1.2 x 6.5	M8	1.25	5.1°
0100	25.1	0.99	1.2 x 6.5	M10	1.5	5.4°
0150	31.4	1.24	1.2 x 6.5	M10	1.5	4.3°
0200	37.7	1.48	1.2 x 6.5	M10	1.5	3.6°
0350	37.7	1.48	1.2 x 6.5	M12	1.75	4.2°
0600	44.0	1.73	1.2 x 6.5	M16	2	4.1°