

COMPACT

PNEUMATIC ACTUATOR

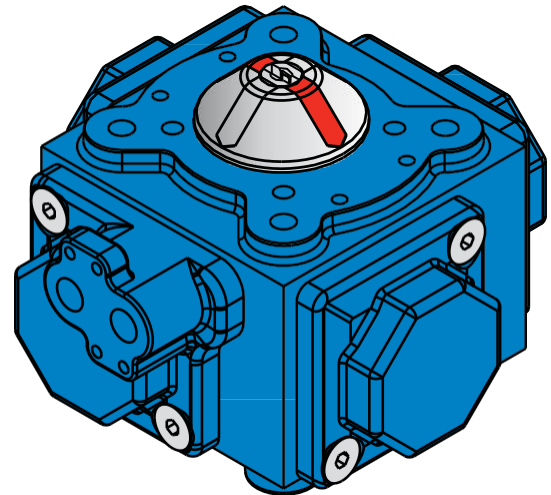
Installation, Operating & Maintenance

COMPACT

4 Piston Pneumatic Actuator

Series included:

**C15, C20, C25, C30, C30M,
C35,C35M,C45, C45M,C60,
C60M, C75, C90M**



1. General

This Installation, Operation & Maintenance manual covers the instructions required for safe use of the Compact pneumatic actuator. Read the entire IOM before using this product.

Warnings & safety instructions

The user of this product must know and follow all applicable industry specifications for the safe installation and use of these types of actuators. Improper use of the product may result in injuries or property damage. Refer to the Habonim Compact catalogue for additional product safety information or contact Habonim.

- Assure that the actuator is isolated from the air supply or electrical ancillaries before attempting to perform any maintenance.
- Before disconnecting the actuator from a valve, always be sure the line has been depressurized and drained. Cycle the valve a few times to relieve any pressure that could be trapped in the body cavity.
- Utmost caution must be taken when handling the actuator. Only trained and qualified maintenance personnel who have read these instructions should disassemble or assemble the actuator.
- Before operating an actuator which is connected to a valve in the pipeline make sure you know the valve function.
- Do not attempt to remove the actuator pistons by use of air pressure when the covers have been removed.
- Do not leave any grip key or shaft connection attached to the actuator, or try to manually operate the actuator while it is still connected to the air pressure.
- Use the actuator within the pressure and temperature limits indicated on the nameplate or as specified in the product catalogue and IOM.
- The operator must follow and observe any national or local safety laws and regulations.
- Any product warranty will be invalidated in the case of improper operation resulting from misapplication or faulty maintenance.
- The warranty does not cover hi- cycle installations. Hi cycle applications is defined as 1 cycle/minute on average measured on an hourly basis.
- Every 500,000 cycles you should replace all the soft parts of the actuator with original Repair Kits.
- Habonim bears no responsibility for external accessories attached to the Compact actuator.

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2. SIL

Under normal operating conditions the Habonim valve should be inspected for proper functioning and signs of deterioration every 50,000 cycles or 6 month (whichever comes first). Under severe operating conditions inspection should be more frequently; detected defects should be repaired promptly.

Severe operating conditions can be defined as:

- Application temperature less than -20 deg C
- Application temperature higher than +80 deg C
- 2 cycle/minute on average, measured on an hourly basis.

Habonim recommend a proof test interval of 12 months; in case of Fail to Open ESD system, a partial stroke is acceptable to confirm that the installation is functioning properly.

For ESD systems with a Fail-To-Close demand, it is necessary to plan a system shut-down; de-energize the system and inspect the valve turning to its fully closed position.

It is essential to log-in the following parameters on site QA records as a proof for preserving SIL capabilities: date, hour, name and signature of the responsible engineer, air pressure on site, time to close the valve, time to open the valve.

Habonim recommend actuator full maintenance operation every **500,000 cycles or 5 years**, whichever comes first (refer to Para. 7 in this IOM for maintenance instructions). The combined corrosion and erosion allowance for the actuator body wall thickness is 1 mm. When this allowance has been eroded or corroded, mechanically removed or otherwise, the actuator should no longer be used. Inspect the actuator wall thickness every time the valve is maintained.

The estimated mean time to repair (MTTR) a actuator, i.e. time net (line draining or cooling down time excluded from the actuator MTTR) of replacing old actuator with a new one is 60 minutes. Maintenance team must read and understand the Habonim product IOM before starting the operation. In case of a doubt please consult the Habonim engineering team.

When an actuator has been repaired or any maintenance was performed, check the actuator for proper function (proof testing). Any failures affecting functional safety should be reported to the Habonim factory.

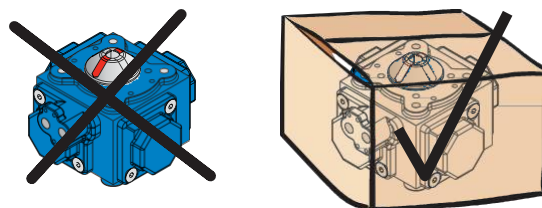
Client should consult the Habonim factory in order to obtain the product assessment, FMEDA report, and other associated statistical data to satisfy SIL level.

Special condition for safe use

When connected to an actuator the maximum rubbing speed of any component within the valve must not exceed 1ms-1.

Storage

The Compact actuator has been packaged to provide protection during shipment, however, it can be damaged in transport. Prior to storage, inspect the actuator for shipping damage. Keep the actuators in their original packing box during storage. It is recommended to keep the actuators in a clean and dry environment until ready for use. The actuator has two air ports, which should be plugged during storage to prevent liquids or other materials from entering the actuator during storage. If the actuators are to be stored for a long period of time before installation, it is recommended to cycle them periodically to prevent setting of the seals. Store the actuators indoors to protect them from humidity and dust.



Operating conditions

Lubricants

The actuators come lubricated from the factory and under normal operating conditions do not require re-lubrication. In the event of actuator maintenance it is recommended to use the following lubricants:

For NBR O-rings use EP1.

The lubricant is suitable for use from -20°C (-4°F) to +80°C (+176°F)

with an AIT/ flashpoint > (T-class + 50K).

For Viton O-rings use Molykote 111 or OKS 1110 or Phalanx EP1.

The lubricants are suitable for use from -20°C (-4°F) to +150°C (+302°F).

For EPDM O-rings use only Silicone grease (i.e. Molykote 111 or OKS 110).

The lubricants are suitable for use from -40°C (-40°F) to +140°C (+284°F).

For LT O-rings use KLT-2 The lubricant is suitable for use from -60°C to +140°C

3. ATEX – Explosive Environment

Pneumatic equipment shall comply with the requirements of ISO 4414. The Compact can be installed in any appropriate potentially explosive hazardous area as listed on the identification nameplate on the actuator. The Compact is certified to category 1 according to the ATEX Directive 2014/34/EU (Equipment intended for use in Potentially Explosive Atmospheres).

Special condition for safe use.

1. Any electrical equipment (solenoid valves/limit switches) shall be suitably certified as specified by the manufacturer.
2. The air compressor must incorporate a filter on the intake system and contain only lubricants that are resistant to ignition or carbonization at anticipated temperatures.
3. The air delivery must not be provided by hoses that are manufactured from elastomeric materials that can carbonize and form glow particles in anticipated temperatures.
4. The supply of air must come from a safe area and contain no explosive gas or dust.
5. The temperature class is based on the maximum process temperature. The end user must ensure that the process temperature does not exceed the temperature classification limitations.
6. The ball valves have been assessed as simple equipment within the assessment performed for the actuator. When used separately from the actuator, the ball valves shall be used within the parameters permitted for the actuator.
7. No charging mechanism stronger than a manual rub shall be applied to external non-metallic materials.
8. The actuator shall only be used in locations where a propagating brush discharge is not possible.
9. The actuators must have a cycle rate of ≤ 1 cycle per minute.
10. It is the user's responsibility to ensure that the system/internal parts of the actuator are suitably purged of explosive gas. In addition, before using the actuator, the users must enter into the actuator non-explosive gas, to ensure that there is no potential for ignition.
11. During maintenance, the end user shall ensure that any lubrication used has an auto-ignition greater than 50K above the maximum surface temperature (80°C for T6, 95°C for T5 and 130°C for T4) and shall also be resistant to carbonization.

Lubricated seals

Habonim recommend replacing all seals every **500,000 cycles or 5 years**, whichever comes first. All new seals should be lubricated. See "Lubricants" paragraph to identify which lubricant to use.

Bearings/soft parts

Habonim recommend replacing all bearings and soft parts every **500,000 cycles or 5 years**, whichever comes first.

Springs

Habonim recommend replacing all springs every **500,000 cycles**.

Drive – Air Supply

- Use clean dry air according to ISO 4414.
- The air compressor must incorporate a filter on the intake system and contain only lubricants that are resistant to ignition or carbonization at anticipated temperatures.
- The air delivery must not be provided by hoses that are manufactured from elastomeric materials that can carbonize and form glow particles in anticipated temperatures.
- Supply Pressure for the Compact actuators are as follows:
Double-acting: 2-8 barg (30-120 psig).
Spring-return: 3-8 barg (40-120 psig).

For IIB, other inert gases may be used such as nitrogen, argon and sweet natural gas.

Thin hydraulic oil can also be used. Do not use water as a supply medium.

Severe operation

The ATEX does not cover Severe operating conditions:

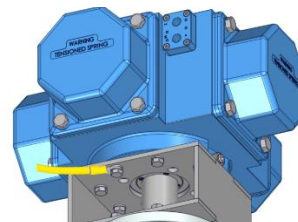
- Application temperature less than -50 deg C
- Application temperature higher than +120 deg C

Certification standards: EN ISO 80079-36:2016 & EN ISO 80079-37:2016

Earthing/grounding

Electrical earthing / grounding must be done during actuator installation.

Use one of the actuator's bottom mounting screws to connect grounding wire.



Special condition for spring return/air to spring

All spring return actuator models shall have a Namur breather block or a solenoid valve that acts as a breather fitted to both port A and B as shown in the manufacturer's drawings. When the solenoid valve is used in place of the breather, it shall replicate the breather block in terms of preventing an internal atmosphere only the solenoid is directly installed into port A and B.

When the actuator is operated on start up or from being off with no pressurisation, the end user must purge the internal parts of the actuator in accordance with the IOM manual to ensure there has not been a build-up of an internal explosive atmosphere; to enhance safety a Specific Condition of use to that effect applies (Prior to putting the equipment into operation, the internal chambers of the actuator shall be purged with clean, dry air from a non – hazardous area or an inert gas; refer to equipment IOM manual). Once purging has been completed, the end user shall start the actuator by supplying air pressure to port A. At this point, a V-shaped gasket at the breather block device moves to the left and allows non-explosive instrumentation air filling the inner chamber of the actuator. At the same time the air, which is in the spring chamber, will be pushed out by the piston's movement through the actuator's port B and out to the exit orifice. The outer atmosphere will no longer enter the actuator and the actuator will only contain non-explosive instrumentation air in both chambers.

Closing the actuator by stopping the pressure supply to port A. At this point, the V-shaped gasket will move to the right due to the instruments air pressure in the internal chamber and redirect it from the inner chamber towards the exit orifice. At the same time the outgoing air will fill the spring chambers.

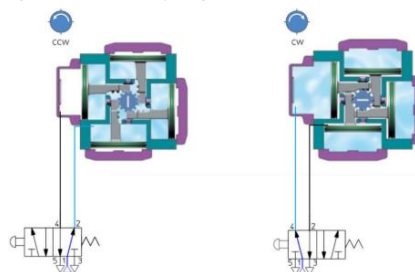


Fig. 1 –DA actuator connection via 5/2 pneumatic switch (solenoid)

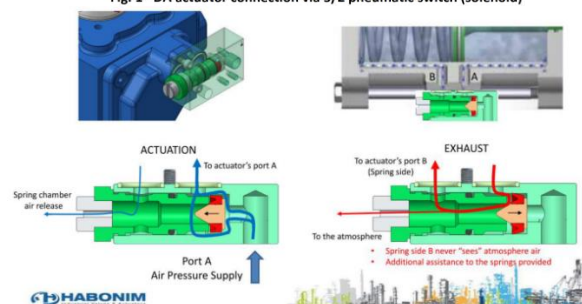


Fig. 2 –SR actuator connection via breather block

Air Supply

Use clean dry air according to DIN.ISO 8573-1 class 4. Other inert gases may be used such as nitrogen, argon and sweet natural gas. Thin hydraulic oil can also be used. Do not use water as a supply medium.

Oxygen or hydrogen must NOT BE USED.

The operating medium is to be filtered to a particle size of 30 microns or less. Always consult with a representative of Compact for suitability and recommended practice.

Piping connected to the actuator or accessories should be fitted according to recommended instrumentation piping practice.

Prior to connection make sure all lines have no loops and are free of water, oil or other contaminants that may be trapped in the pipes. Pipes must be flushed with air to clean the passages.

Where sealants have been used for threaded connections, care must be taken to avoid excess material being forced into the actuator ports.

Supply Pressure

The supply pressure for the Compact actuators are as follows: Double-acting: 2-8 barg (30-120 psig).

Spring-return: 3-8 barg (40-120 psig).

Spring-return actuators can also operate with air pressure of 2 barg (30 psig) by using the appropriate spring configuration as shown in the Compact catalogue. When sizing an actuator to the available air supply, make sure you have adequate power in the actuator to allow the valve to complete its operation and leave enough power for safety margin.

Temperature

The standard temperature limits for the Compact actuators are

-20°C (-4°F) to +80°C (+176°F). For temperatures below or above these figures special preparation and materials are required such as grease, O-rings, pinion bearings and pads.

The Compact maximum working temperature is 130°C (266°F) when used with Viton O-rings and HT grease.

The Compact minimum working temperature is -53°C (-63°F) when being used with LT O-rings and LT grease.

When used in sub-zero temperatures it is essential to use an air dryer on the air supply line to prevent moisture.

Always consult with a representative of Compact for suitability and recommended practice.

Humidity – Corrosion

In corrosive environments or in high humidity environments it is recommended to use a Breather Block to avoid contaminated air from the environment entering the actuator. (See Bulletin B370 Namur Breather Block).

Reducers

Habonim recommends using reducers to properly control the opening / closing speed of Compact actuators, especially if mounted on Butterfly valves or Dumpers.

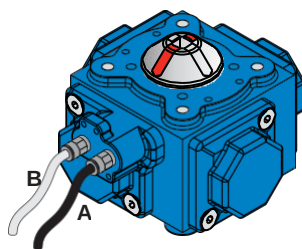
Principle of operation

The Compact actuator is a pneumatic quarter-turn rack & pinion actuator. Air pressure applied to the piston surface area generates thrust which transforms linear motion to rotary motion of the pinion. The Compact has four pistons centrally located around one pinion. This means that the actuator can generate twice the torque of dual piston actuators, is lightweight, occupies minimum space and has minimal air consumption.

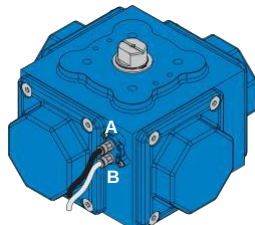
Air Connections

The actuator air connections are marked **A** and **B**. Port B connects via a series of holes to all the four pistons. The air passes into the Namur cover (or insert) and through holes which are connected to the two neighboring pistons. Each piston receives the air flow from two directions which ensures a quick response.

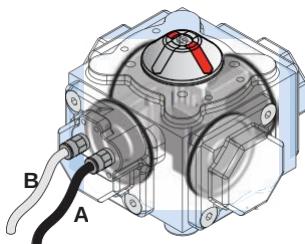
In sizes C15 to C45/C45M port **A** is to the right and port **B** to the left.



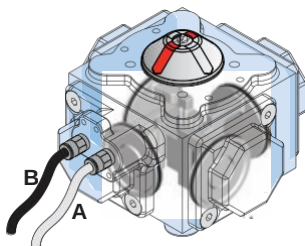
In sizes C60/C60M to 90M the air connections are vertical where port **A** is above port **B**.



Pressure entering port **A** into the center chamber pushes the pistons outward and rotates the pinion CW.

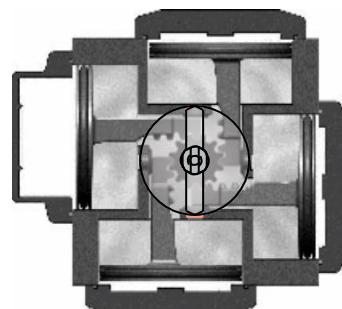
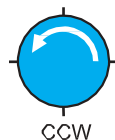


Pressure entering port **B** into the outer chambers pushes the pistons inward and rotates the pinion CW.



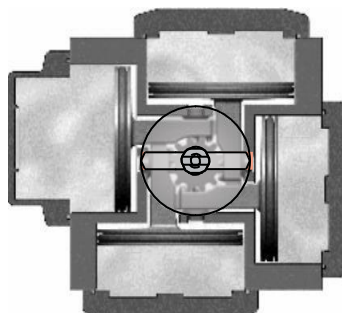
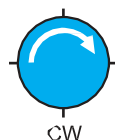
Double Acting (DA)

Pressure entering Port A to open:
Center chamber pressurized. Pistons move outward and the pinion rotates counterclockwise (CCW).



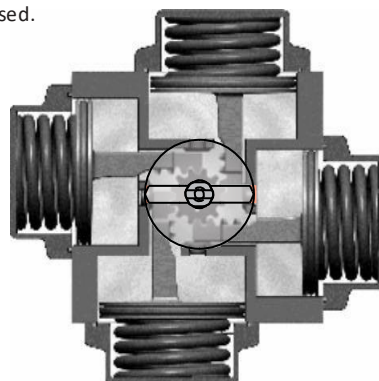
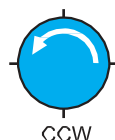
Pressure entering Port B to close:

Outside chambers pressurized. Pistons move inward and the pinion rotates clockwise (CW).



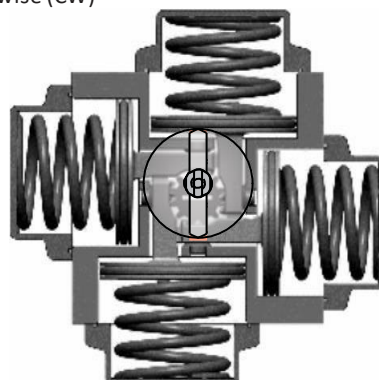
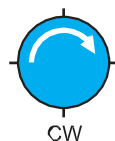
Spring Return (SR)

Pressure entering Port A to open:
Center chamber pressurized. Pistons move outward and the pinion rotates counterclockwise (CCW).
Springs are compressed.



Pressure exiting Port A to close:

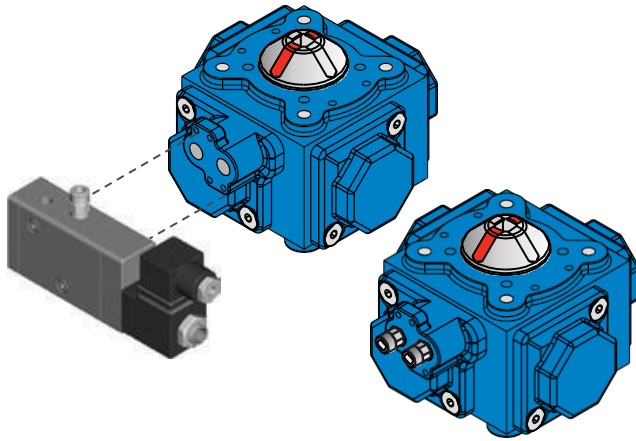
Air released from center chamber. Springs drive pistons inward. Pinion rotates clockwise (CW).



NAMUR Solenoid Mounting

Connection of the air supply is accomplished by mounting a solenoid directly onto the Namur cover which has a mounting pad conforming to the Namur standards. (Only Solenoids made to the NAMUR standard can be mounted in this way.)

The Compact actuator can also be piped with solid or flexible tubing from remote solenoid valves.



ISO 5211

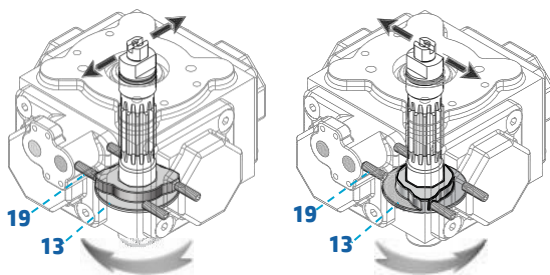
The actuator bottom flange is in accordance with ISO 5211 international standard and incorporates a star shaped female drive for flexibility to fit various valve output shafts. The valve can be attached by a bracket or mounted directly onto the actuator using one of the various ISO hole patterns.

Travel Adjustment

The actuator comes factory adjusted to produce a 90° rotation. The rotation is restricted by the stop (13) and four adjustment screws (19) which provide fine tuning or a limiting stroke.

The screws are threaded into the actuator body and are diametrically opposed to create simultaneous and equal forces on opposite sides of the stop to eliminate off-center forces.

New actuator adjustment screws are locked in place by using Loctite 221. Any change of screws position must be repeated with renewal of the glue over the screws thread.

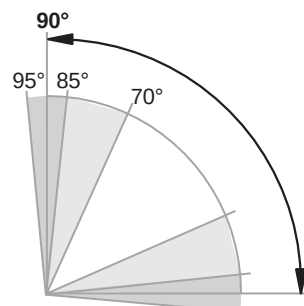


The standard stop screws allow adjustment of +/-5° in the travel limits.

Other Intermediate positions can be achieved with a longer set of stop screws which will enable travel from 0° to 20° and from 90° to 70° rotation.

Warning:

Any changes of screws position must be repeated with renewal of the glue over the screws thread.



Indicator & Puck

All actuators are assembled with a highly visible indicator or puck. The indicator and puck have interchangeable "snap-on" flow direction arrows to identify valve position.

The arrows can be arranged to provide any pattern according to the valve ports.

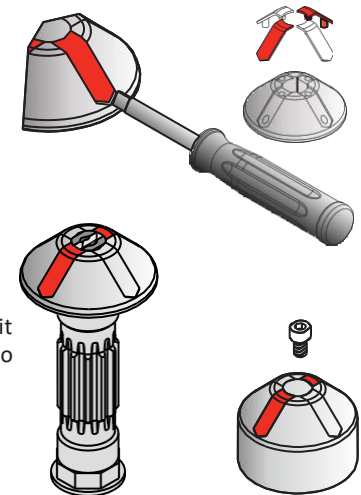


Use a screw driver or sharp instrument at the arrow head to push it out and reposition as necessary.

The puck has three contact screws to allow signaling of any position. The puck is screwed to the pinion Namur thread.

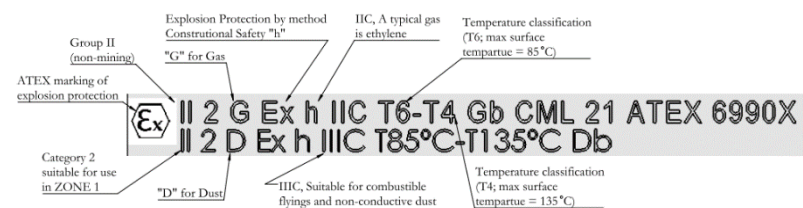
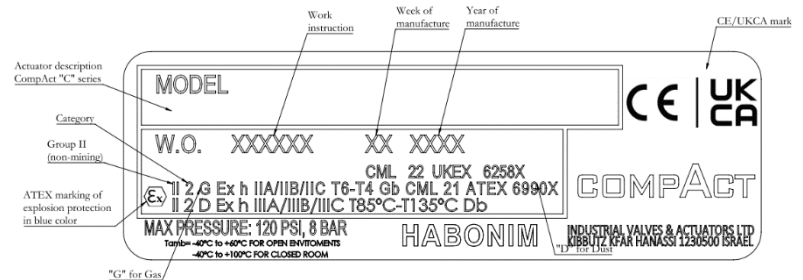
(The indicator snaps to the pinion with its Namur interface projecting above it and enabling any ancillary to connect to the pinion).

The indicator assembles on the pinion with its Namur interface projecting above the pinion enabling the connection of ancillary devices to the pinion.



Identification

Compact actuators are supplied with a nameplate located on the side of the body. The information includes actuator size, model, type, spring set, threads, indicator, additional options, date of manufacture, protection rating, pressure limits and company logo.



Maximum process temperature (°C)	Associated temperature class
80°C	T6 and T85°C
95°C	T5 and T100°C
130°C	T4 and 135°C

1. Disassembly

General

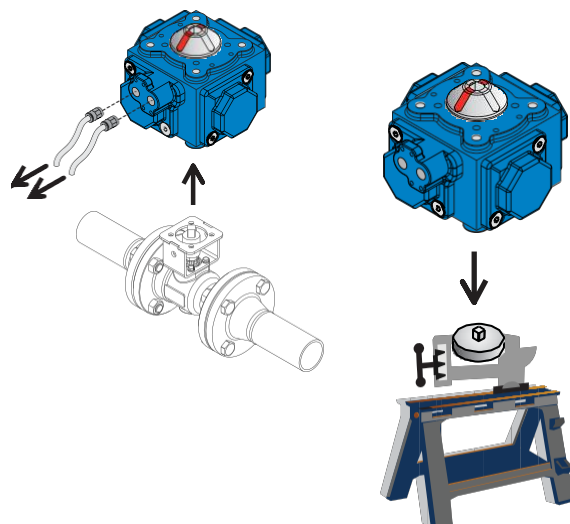
Before any disassembly, make sure you read all the warnings and safety instructions in this leaflet.

Do not attempt to disassemble the actuator while it is still connected to the valve or to any ancillary device.

Verify that the actuator is not pressurized. Check that the air ports are vented and that spring return actuators are in the fail close position.

Work in a clean area, free of dust, debris, grease, corrosives and moisture. For security and comfort perform repairs on a table equipped with a vice and an available air supply. Clamp an adaptor to the vice and place the actuator drive on it.

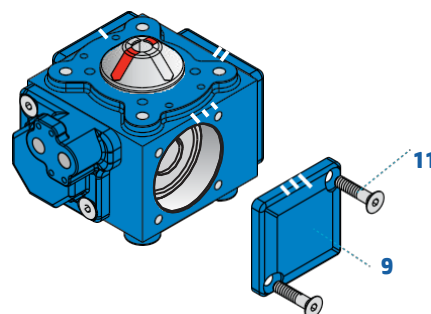
Use only Metric hex head wrenches and ensure the edges are not blunt.



2. Disassembly of Double Acting Covers

- 2.1. Before disassembly mark the covers (9) with the body. This is recommended so as to reassemble each cover to its original position when re-assembling the actuator.
- 2.2. Remove the cover screws (11). If initially the screws are jammed, strike the head lightly with a flat pin to loosen them.
- 2.3. Remove the covers making sure not to damage the O-ring seals (7, 7A, 10). When removing the Namur cover (8A) ensure that the O-ring connecting to the inner chamber is secure in its groove. To convert to a SR actuator, go to Section 7 for instructions.

DA Cover Removal



3. Disassembly of Spring Return Covers

Caution: Springs in the actuator are under tension.

The compact actuator has 2 types of spring assemblies.

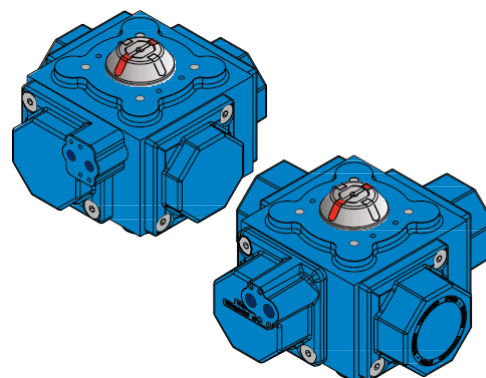
The standard spring assembly – used in models: C15, C20, C25, C30, C35, C45, C60, C75.

The loaded cartridge spring assembly – used in the M models: C30M, C35M, C45M, C60M, C90M.

Before disassembling a SR actuator you must identify the model type of the actuator according to the following:

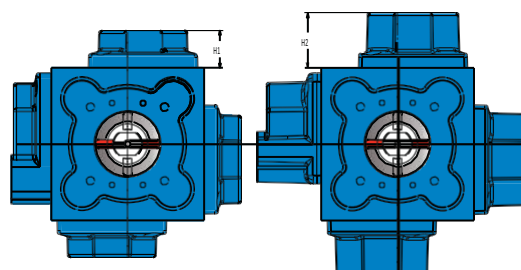
1. Identify by the attached tag.
2. Cartridge spring actuators can be identified by the "tensioned springs" warning on the Covers.
3. Cartridge spring actuators have a longer cup cover according to the following table:

Standard spring assembly	Cover height H1 (mm)	Cartridge spring assembly	Cover height H2 (mm)
C15	18.8	N/A	N/A
C20	22.5	N/A	N/A
C25	26.5	N/A	N/A
C30	30.1	C30M	45.1
C35	36.2	C35M	50.0
C45	43.2	C45M	60.2
C60	58.3	C60M	73.3
C75	71.0	C75M	86.0



Standard Spring Assembly

Cartridge Spring Assembly



After identifying the actuator type, use the following disassembly instruction:

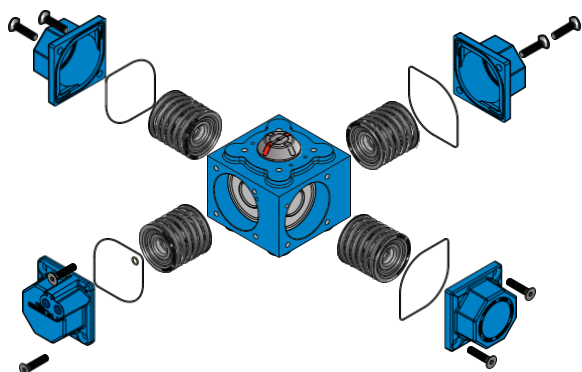
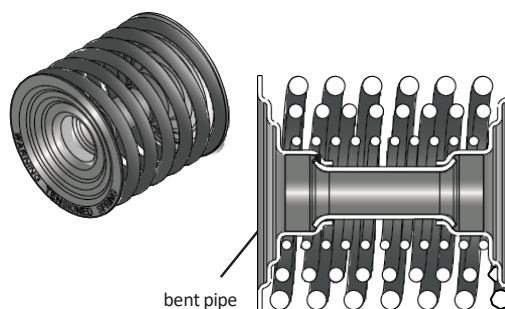
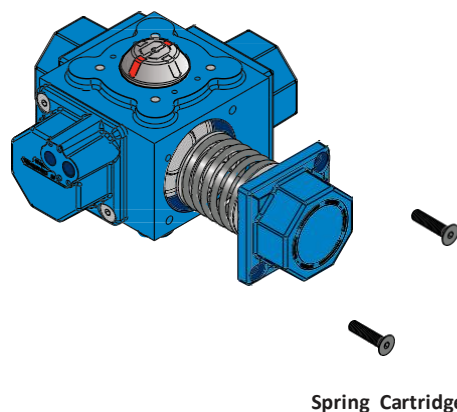
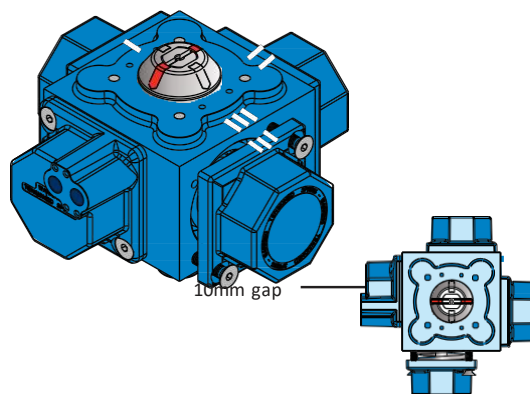
- For spring cartridge type CxxM – follow the disassembly instructions in Section 3.1-3.8
- For standard spring assembly type Cxx – follow the disassembly instructions in Section 4

Disassembly of Spring Return Covers for Cartridge Spring Assembly C30M, C35M, C45M, C60M, C90M

Caution: Springs in the actuator are under tension.

Warning: Only Habonim personal authorized to replace the spring cartage.

- 3.1. Before disassembly, mark each of the non-Namur covers (29) with the body. This is recommended to identify each cover and to reassemble it in its original position when re-assembling the actuator.
- 3.2. Open a gap of 10 mm maximum between the cover and the actuator body. Release the cover screws in sequence by turning each opposing screw two rotations at a time. After opening the gap there should be no tension on the cover, make sure the cover can be moved freely. **Warning:** If after opening a 10mm gap the cover is still under tension, close the cover by retightening the screws and contact Habonim. **DO NOT** release the cover completely.
- 3.3. Only after ensuring that the cover is loose, release the cover screw and remove the cover while supporting the spring cartridge to prevent it from falling out of cover.
- 3.4. Make sure that the Cover O-ring (7,7A) is secure in its groove. When removing the Namur cover (29A) make sure the air supply O-ring (10) is also secure in its groove.
- 3.5. Carefully examine the spring cartridge and make sure it's not damaged, special attention must be given to the bent pipe at the center which holds the complete unit together. **In case cracks or any other severe damage is observed, close the cover by retightening the screws and contact Habonim.**
- 3.6. **Warning:** Under **NO** circumstances should the spring cartridge be cut or disassembled in order to change the spring set. The only way to change the spring set is by changing to a different spring cartridge.
- 3.7. Place the spring cartridge in the cover for assembly with the seals.
- 3.8. Follow the same procedure for all four cylinders. **To replace only the seal or the spring configuration or to convert it to a DA actuator, go to Section 7.16 for instructions.**

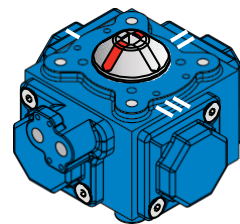


4. Disassembly of Spring Return Covers for Standard spring assembly C15, C20, C25, C30, C35, C45, C60, C75.

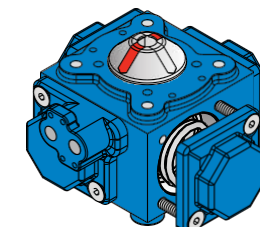
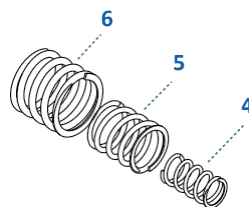
Caution: Springs in the actuator are under tension.

- 4.1. Before disassembly, mark each of the non-namur covers (8) with the body. This is recommended to identify each cover and to reassemble it in its original position when re-assembling the actuator.
- 4.2. Remove the cover screws in sequence by turning each opposing screw two rotations at a time. When removing the Namur cover (8A) ensure that the O-ring connecting to the inner chamber is secure in its groove. Before the screws leave the threads the springs become free of tension. The springs should be free of tension before the threads of the cover screws are completely undone. If during initial rotation the screws are jammed, strike them lightly on the head with a flat pin to loosen them. When there are 4 screws as described previously.
- 4.3. Remove the covers making sure not to damage the cover seals.
- 4.4. Remove the springs (4,5,6) from the cylinder and lay them together in their covers ready for the assembly stage.
- 4.5. Follow the same routine on all four cylinders.
To replace the spring configuration or to convert to DA actuator, go to Section 7.16 for instructions.

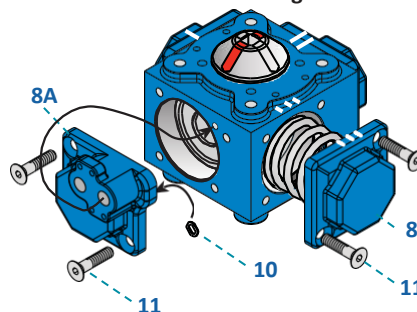
Mark the covers



SR covers Removal

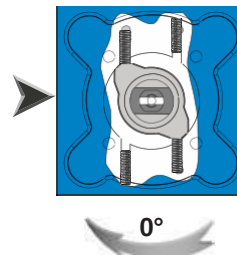
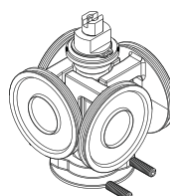
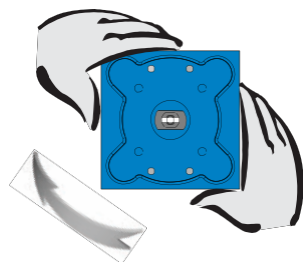
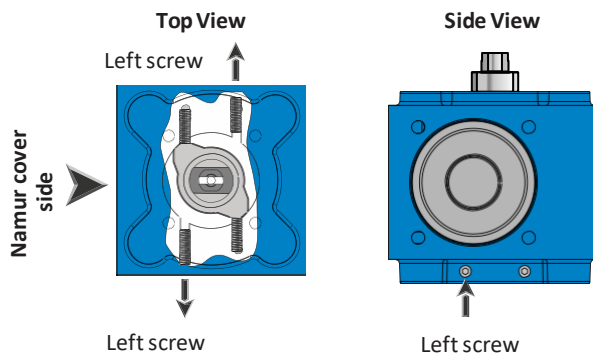


Namur cover facing air hole



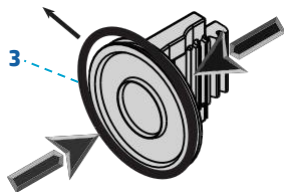
5. Piston Disassembly

- 5.1. Looking at the actuator as shown to the left, back off the left most of each pair of stroke adjustment screws (19) approximately 6-10 mm outward. This will enable the stop to rotate beyond its 90° limit so the pistons can come out. It may require a little force to release the adjustment screws as they are assembled with a thin layer of Loctite® 221.
- 5.2. Grip the actuator body with both hands and rotate it in the CW direction to eject the 4 pistons from their cylinders. The 4 pistons will exit the actuator body as demonstrated to the right.



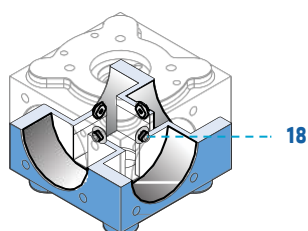
As the body is rotated CW, the piston moves out of the cylinder

- 5.3. Remove the piston O-rings (3) by pressing them slightly from both sides of the piston, creating a loop and pull them out of their groove. Do not use a sharp object to pry them out.



- 5.4. Push the four pads (18) in towards the pinion with a tool and remove them from body.

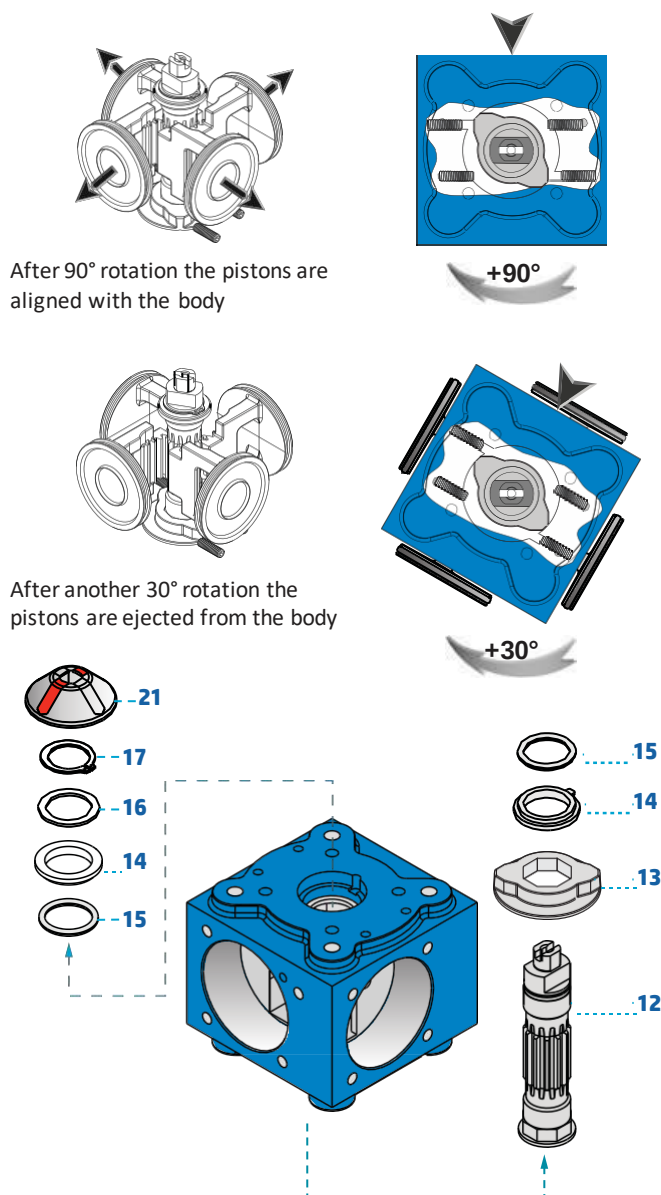
Note: Usually it is not required to remove the pads.



6. Pinion Disassembly

For C35/C35M to C75/C75M go to section 8.0

- 6.1. Remove the indicator (21). Use two screwdrivers to pry it off the pinion. Do not apply force to the indicator.
- 6.2. Remove the circlip (17).
- 6.3. Push the pinion (12) down and remove it from the body.
- 6.4. The stop plate (13), bottom bearing (14) and pinion O-ring (15) will drop out with the pinion. There is no need to separate the stop from the pinion. Make sure the stop and pinion stay together in the same orientation they came out.
- 6.5. Remove the disc bearing (16), upper bearing (14) and O-ring (15) from the body.



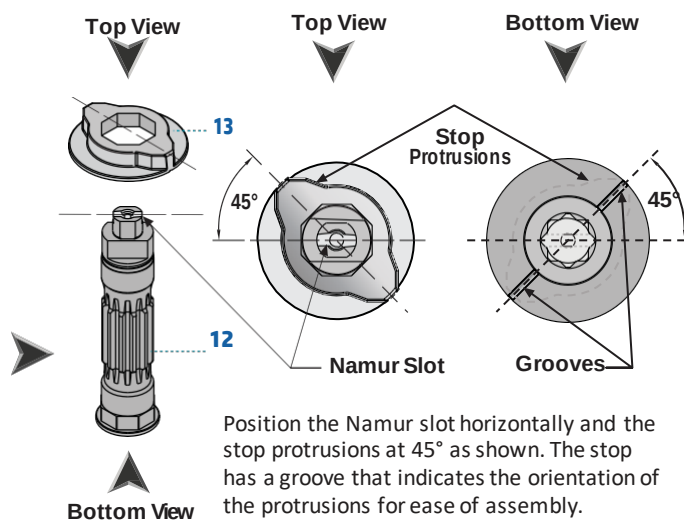
7. ASSEMBLY

General

Before assembling assembly, clean the grease in the cylinders and all the actuator parts. Check the cylinder for any scratches. The surface should be smooth and without any damage, debris, rust or other contaminants. Apply grease to all the parts prior to assembly.

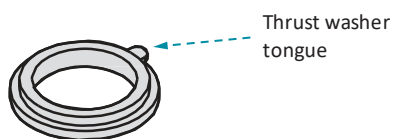
- 7.1. If you have removed the pads, push them back into their holes as shown in section 5.4.
- 7.2. If the stop (13) has been removed from the pinion (12), re-insert it while ensuring that sure the orientation of the two stop protrusions are at 45° to the Namur slot as shown in the drawing to the right. Use the two grooves which are cast on the bottom of the stop to identify the stop's orientation.
- 7.3. Fit the thrust washer (14) and pinion O-ring (15) to the pinion (12) and stop (13).

For C35/C35M to C75/C75M go to section 8.0



Position the Namur slot horizontally and the stop protrusions at 45° as shown. The stop has a groove that indicates the orientation of the protrusions for ease of assembly.

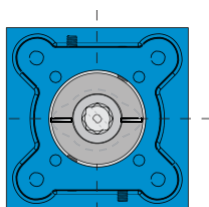
- 7.4. Insert the pinion assembly into the body. Ensure that the thrust washer tongue engages the opposing groove in the body.



- 7.5. When inserting the pinion in the body, bring the grooves of the stop perpendicular to the adjustment screws to ensure the correct angle of rotation. Rotate the pinion CCW until the flats of the protrusion hit the adjustment screws and the grooves line up with the threaded holes as shown below.

Step 1

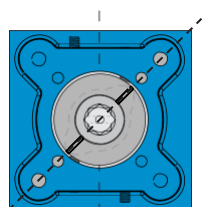
Grooves perpendicular to adjustment screws



Bottom View

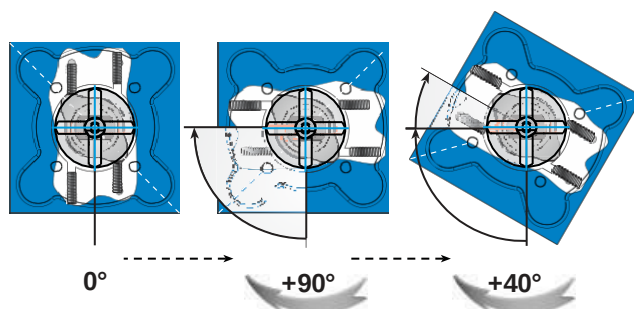
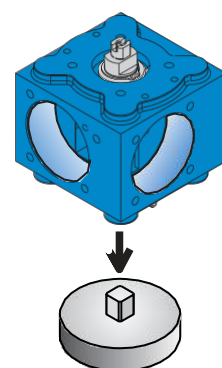
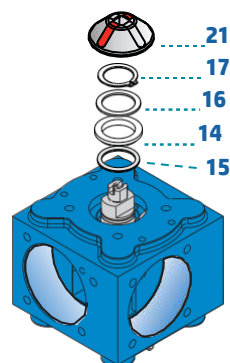
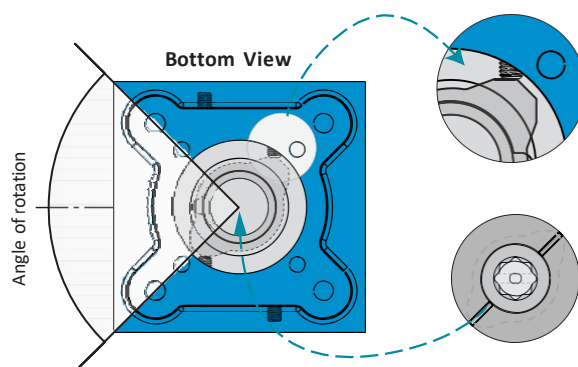
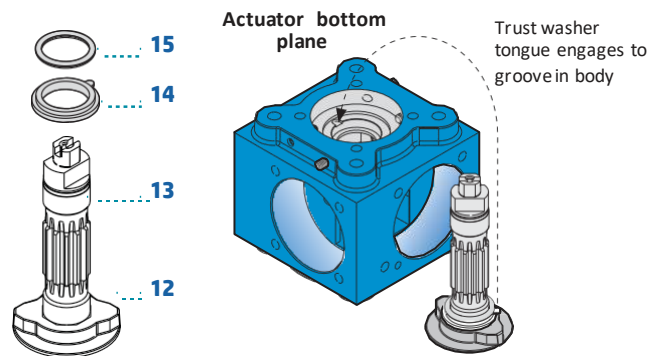
Step 2

Grooves aligned to adjustment screws

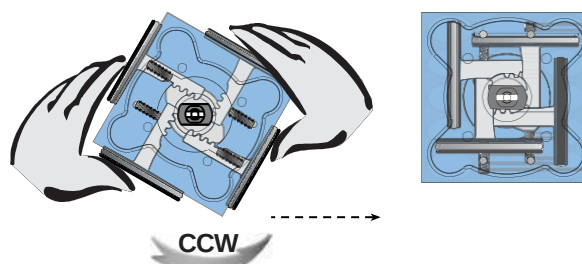


Bottom View

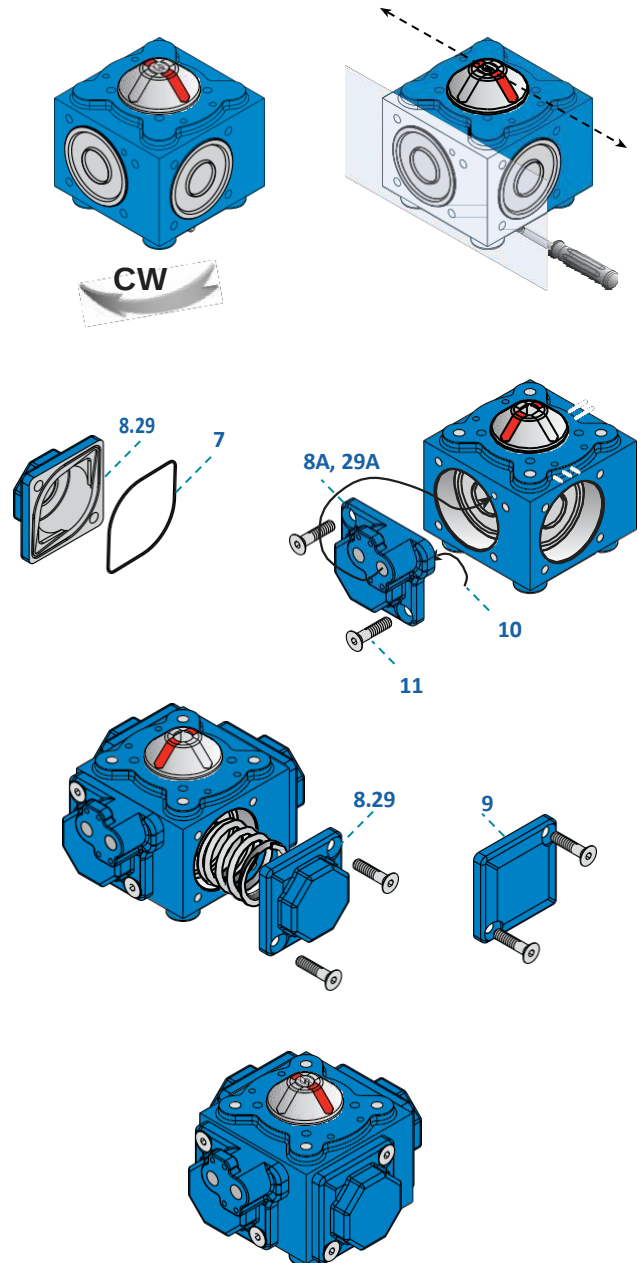
- 7.6. Fit the pinion O-ring (15), thrust washer (14) and disc bearing (16) to the pinion. Make sure that the thrust washer tongue engages the opposing groove in the body.
- 7.7. Always use a new circlip (17). Assemble it onto the pinion. If the pinion does not protrude enough, check that the bottom thrust bearing tongue has properly engaged into the body groove and the stop is recessed in the body. Clip the indicator (21) back onto the pinion.
- 7.8. Place the assembled body with the pinion on the rig with the adaptor for inserting the pistons back in the cylinders.
- 7.9. Looking from the top of the actuator, rotate the body 90° CW and another 40° to bring it to the position for inserting the pistons.
- 7.10. Fit the O-rings on the pistons.
- 7.11. Apply grease in the body cylinders, to the groove and rack of the pistons, and to the piston O-rings.
- 7.12. Insert the four pistons into the cylinders, keeping the orientation of the racks so the teeth engage with the pinion teeth.



- 7.13. Holding all 4 pistons with both hands as shown, rotate the body CCW until it stops against the adjustment screws and all 4 pistons are pulled inside. Make sure that all 4 pistons have reached the same position in the cylinder.



- 7.14. Rotate the body back 90° CW to the open position so the pistons are now almost flush with the actuator body. Apply a drop of Loctite® 221 to the two adjustment screws thread and screw them until they both touch the stop. Adjust them until you visually see that the pinion flats are parallel with the body plane.
- 7.15. Rotate the body back and forth till the pistons run smoothly in the cylinders.
- 7.16. Bring the pistons in to the closed position and once again apply grease in the cylinders behind the pistons.
- 7.17. Apply grease to all the spring sets.
- 7.18. Push the cover O-rings (7) in the groove of the covers (8,9,29). If needed, replace them with a new set. Note that the Namur cover (8A, 29A) has an additional small O-ring (10) that should be in place.
- 7.19. Lubricate the cover screws (11).
- 7.20. Assemble the Namur cover fi (8A, 29A). If this is a SR actuator, place the spring set in the cover and then tighten the cover (8,29).
- 7.21. Always tighten the screws in sequence.
- 7.22. Assemble the DA covers (9). Make sure the covers are put back according to the marks made during disassembly.
- 7.23. Assemble the SR covers with the spring set. The screws are long enough to engage the threads before the springs begin to compress. Tighten the screws in sequence only two turns at a time.
- 7.24. Finally torque the screws to the set fi es in the table below.



Actuator Screws Torque Figures

Actuator Size	Screw	NM	Lb-ft	Lb-in
C15 - C20	M5	3.5	2.5	30
C25 - C30/C30M	M8	9.0	6.5	80
C35/C35M	M10	18.0	13.0	160
C45/C45M - C75/C75M	M12/M16	40.0	30.0	360

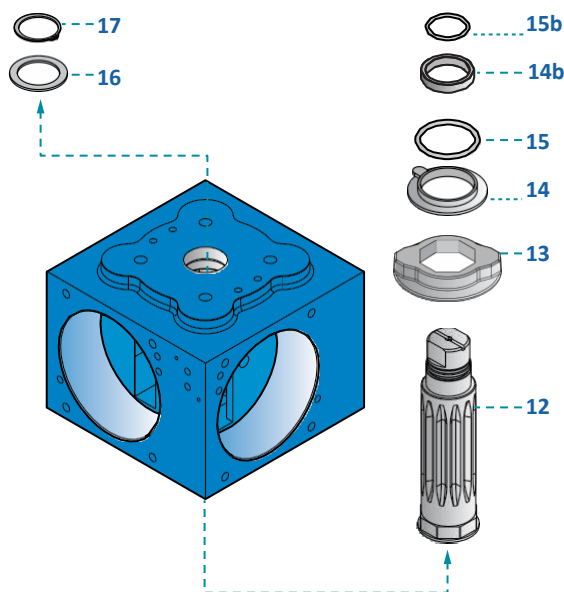
8. Sizes C35/C35M - C75-C90M

Sizes C35/C35M, C45/C45M, C60/C60M, C75/C75M and C90M have a slightly different pinion assembly than the smaller sizes. The top bearing, O-ring disc bearing and circlip are smaller in diameter than those on the bottom. The top bearing and O-ring are assembled from the bottom and not the top as with the smaller sizes. The instructions below highlight the assembly differences.

Pinion Disassembly

- 8.1. Remove the circlip (17) and the disc bearing (16).
- 8.2. Push the pinion (12) down very carefully and remove it from the body.
- 8.3. The top bearing (14b) is inserted in the body and the top O-ring (15b) is fitted to the pinion. They should both come out with the pinion from the bottom.

- 8.4. The stop plate (13), bottom bearing (14) and bottom O-ring (15) will drop out with the pinion. There is no need to separate the stop from the pinion. Make sure the stop and pinion stay together in the same orientation they came out. The C75/C75M and C90M has an integral stop and will not separate. For Assembly, return to section 7



9. Pinion Assembly for C35/C35M to C75/C75M and C90M

- 9.1. Assemble the stop (13), bottom bearing (14) and O-ring (15) as described in section 6.2.
 - 9.2. Assemble the top bearing (14b) on the pinion (12) shoulder.
 - 9.3. Fit the top O-ring (15b) on the pinion in its groove. Apply grease.
 - 9.4. Insert the pinion assembly into the body. Make sure that the thrust washer tongue engages the opposing groove in the body. Be careful not to harm the top O-ring.
 - 9.5. When inserting the pinion to the body, bring the grooves of the stop perpendicular to the adjustment screws to ensure the correct angle of rotation. Rotate the pinion CCW until the protrusion flats hit the adjustment screws and the grooves line up with the threaded holes as shown below. See illustrations in section 6.3.
 - 9.6. Fit the disc bearing (16) to the pinion.
 - 9.7. Always use a new circlip (17). Assemble it on the pinion. If the pinion does not protrude enough, ensure that the tongue of the bottom thrust bearing has properly engaged the body groove and the stop is recessed in the body.
 - 9.8. Place the assembled body with the pinion on the rig with the adaptor for inserting the pistons back in the cylinders.
- Return to section 7.9**

Actuator testing

After the actuator has been completely assembled, the following test procedures are necessary to ensure that it has been assembled correctly and to minimize personal risk.

Pneumatic Leak Test

The pneumatic test checks that there is no leakage across the pistons or to the environment.

Use commercial leak testing solution to check leakage to the atmosphere. A minimal leakage of one bubble every 10 seconds is considered acceptable. The pressure for the leak test will be 80 psig (5.5 barg). Use a calibrated pressure regulator to apply pressure to the actuator.

WARNING: Do not exceed the maximum operating pressure rating listed on the nameplate.

Cycle the actuator at least 5 times to allow the seals to find their position before commencing with the leak test.

Piston leakage

Any leakage across the piston is not acceptable.

1. Apply the pressure to port A and leave port B open.
2. Apply a leak testing soap solution to port B and check for leakage.
3. For DA actuators repeat this while applying pressure to port B and check port A for leakage.
4. If leakage is observed, disassemble the actuator again and check the seals, surface finish and cleanliness of the internal parts to find the cause of leakage.
5. After doing the repair work, the leakage test must be performed again.

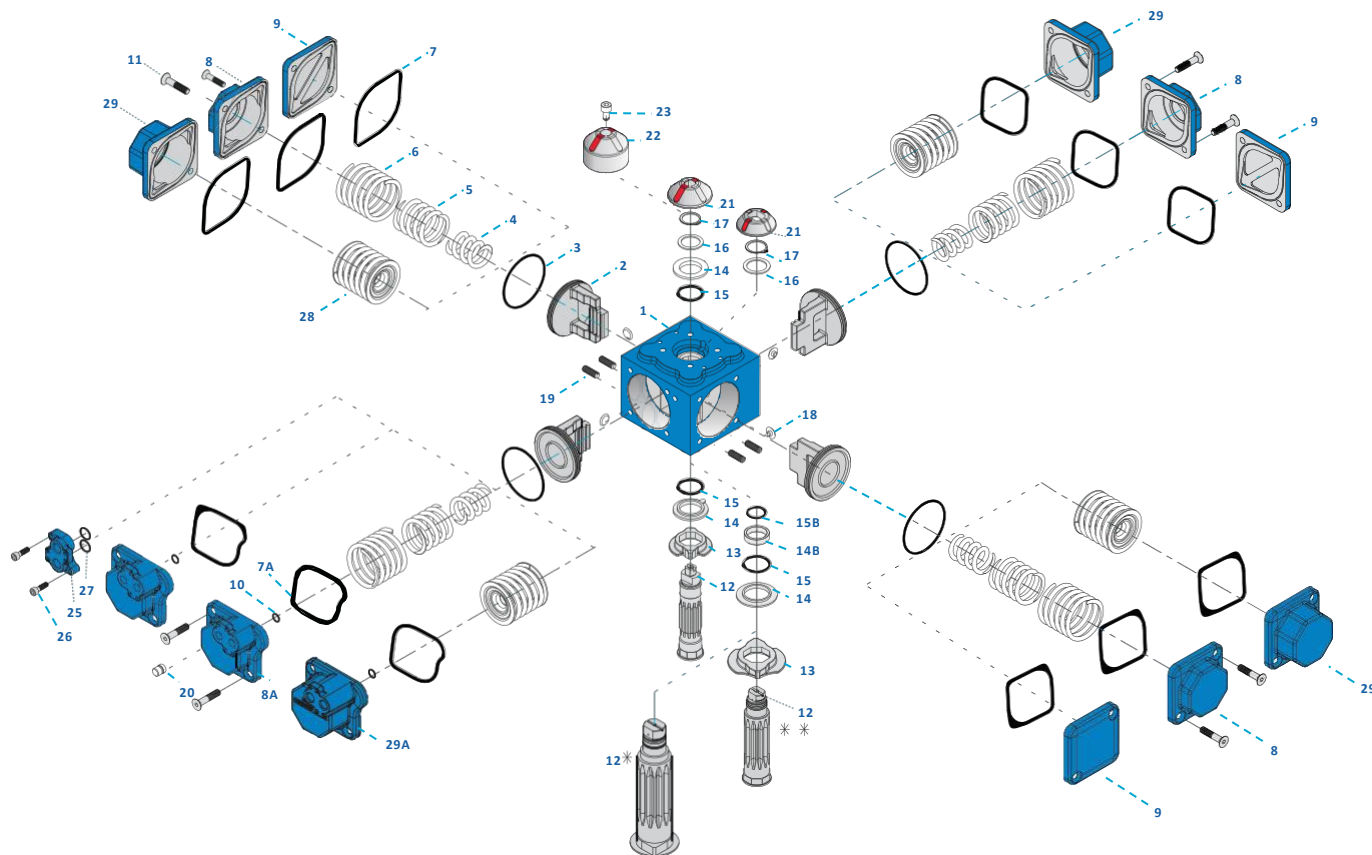
External leakage

For SR actuators apply the pressure to port A and leave port B open.

For DA actuators apply the pressure to port A and B.

After applying pressure, wait a few seconds to let the pistons stabilize and then check for leakage. Apply the leak testing solution to the pinion output. For DA actuators apply the leak testing solution to the covers.

Part list



*NOTE: C75/C75M and C90M PINION (12) & STOP PLATE (13) ARE ONE PIECE

** Pinion Assembly for Actuators C35/C35M - C75/C75M and C90M

Item	Description	Qty.	Material	Item	Description	Qty.	Material
	Body	1	AL 356-T6	15*	Pinion O-Ring	2	Buna N. Viton, EPDM, HNBR
2	Piston	4	AL 356/380	15B*	Top Pinion O-Ring	1	Buna N. Viton. EPDM, HNBR
	Piston O-Ring	4	Buna N. Viton, EPDM, HNBR	16*	Disc Bearing	1	ST.ST / Delrin
4	Inner Spring	4	Springsteel, Painted	17*	Circlip	1	ST.ST, spring Steel Zinc Coated
	Middle Spring	4	Springsteel. Painted	18*	Pad	4	Delrin, CF PTFE, UHMWPE
6	Outer Spring	4	Springsteel. Painted	19	Stroke Adjustment Screw	4	ST.ST
	Cover O-Ring	3	Buna N, Viton, EPDM, HNBR	20	Exhaust Plug (Silencer)	1	Delrin, (Brass)
7a*	Namur Cover O-Ring	1	Buna N, Viton. EPDM, HNBR	21	Indicator	1	Plastic (ABS), Red & White
	Spring Return Cover	3	AL 380	22	Puck	1	Plastic (ABS), Red & White
8a	Namur Cover	1	AL 380	23	Indicator Screw	1	ST.ST
	Double Acting Cover	3	AL 380	24	Tag (not shown)	4	ST.ST
10*	Air Supply O-Ring	1	Buna N, Viton, EPDM, HNBR	25	Namur insert	1	AL 380
	Cover Screw	8-16	ST. ST.	26	Insert screw	2	ST.ST
12	Pinion	1	Steel E.N.Coated	27*	Namur Insert O-Ring	2	Buna, Viton, EPDM, HNBR
	stop plate	1	STST 316	28	Spring Cassette	4	Spring steel, Painted
14*	Thrust Washer	2	Delrin, CF PTFE, UHMWPE	29	Spring Return Cover for M series	3	AL 380
					Namur Cover for M series	1	AL 380

*spare parts included in standard repair kit

NOTE: C90M - Body, pistons, covers and bluck namur made of W

