

CRANE[®]

Energy Flow Solutions

CRANE Air Rack & Pinion Pneumatic Actuator Installation, Operation & Maintenance Manual



CRANE *Air*

CRANE Air Rack & Pinion Pneumatic Actuator IOM Manual



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CHAPTER 1 PRODUCT DESCRIPTION

1.0 PRODUCT DESCRIPTION

CRANE Air offers a broad range of pneumatic rack & pinion actuators. CRANE Air actuators are designed to operate with dry or lubricated air media, but will function equally well with non-corrosive and inert gas or light hydraulic oil. The actuators are offered in two different configurations: double acting and spring return. Each actuator can be easily converted from double acting to spring return (or vice versa) by insertion (or removal) of spring cartridges.

CRANE Air actuators are equipped in the standard configuration with the following unique features:

- Double travel stops
- External open/closed indication
- Pre – loader springs of non – metallic material
- Stainless steel pinion up to CA04, carbon steel electroless nickel coated for larger sizes
- Shaft bearings isolate the pinion gear from the housing and support the shaft for high cycle application
- All bodies are internally lapped
- All internal and external surfaces are anodized for corrosion resistance
- End caps and pistons are epoxy powder coated for corrosion resistance
- Angle of rotation: 90° - 120° - 135° - 150° - 180° (240° on request)
- All air line connections are ¼" NPT
- "NAMUR" VDI/VDE 3845 and ISO 5211 dimensions on all sizes



CHAPTER 2

Actuator Technical Features & Data



CHAPTER 2 TECHNICAL FEATURES & DATA

2.0 TECHNICAL FEATURES & DATA

2.1 METHOD OF OPERATION

AIR TO CLOSE Clockwise Rotation

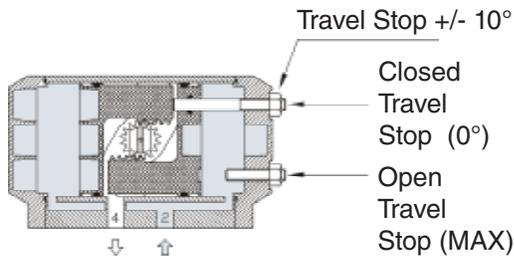


Figure A

AIR TO OPEN Counter Clockwise Rotation

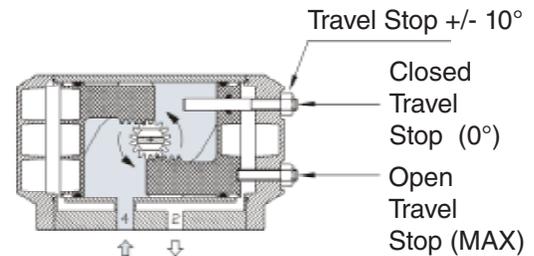


Figure B

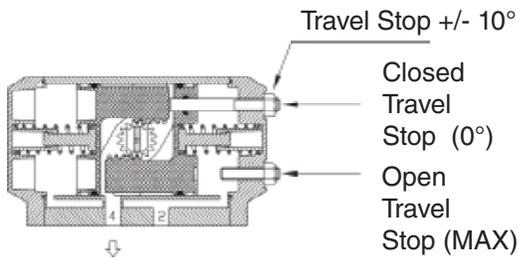


Figure C

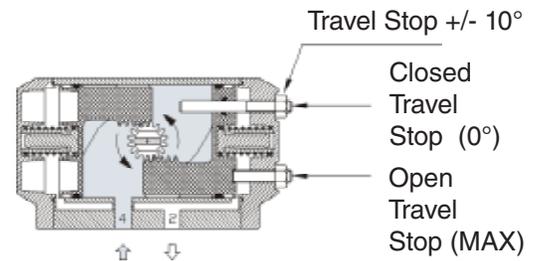


Figure D

DOUBLE ACTING

Note: The bracketed numbers refer to the actuator exploded view – page 14.

Rotation occurs when compressed air is supplied to the actuator through Port 4, connected to the interior cavity between the pistons (ref. 7 & 12), or through Port 2, connected to the end cap area (ref. 2 & 16).

As shown in Figure A, pressure to Port 2 fills the outboard cavities pushing both pistons (ref. 7 & 12) inward and exhausting air through Port 4. As the pistons retract, they rotate the pinion (ref. 22) clockwise (when viewed from the top of the actuator).

Pressure to Port 4, as shown in Figure B, fills the inboard cavity pushing both pistons (ref. 7 & 12) outward and exhausting air through Port 2. As the pistons extend they rotate the pinion (ref. 22) counter clockwise (when viewed from the top of the actuator).

SPRING RETURN

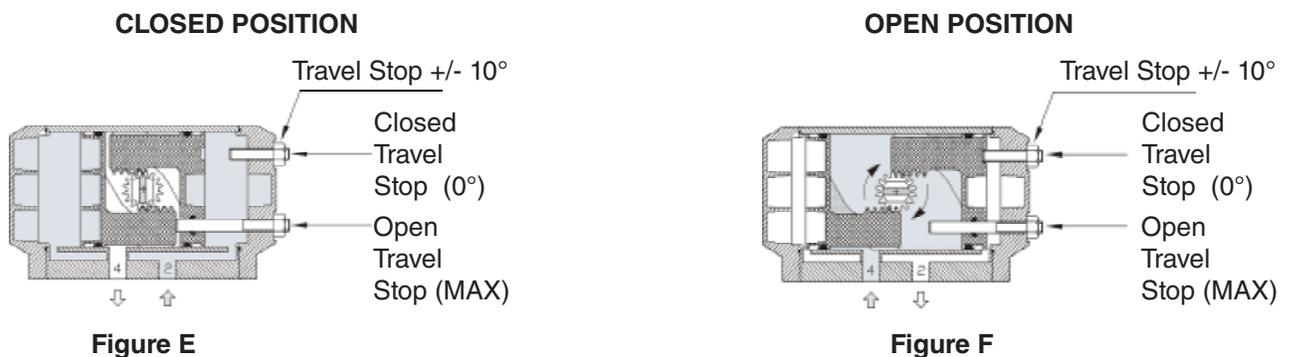
Note: The bracketed numbers refer to the actuator exploded view – page 14.

In this configuration, the closed position occurs with spring cartridges (ref. 4), which are located between the pistons and end caps.

Relieving pressure from the inboard cavity through Port 4, as shown in Figure C, allows the spring cartridges (ref. 4) to push both pistons (ref. 7 & 12) inward. As the pistons retract, they rotate the pinion (ref. 22) clockwise (when viewed from the top of the actuator).

Pressure to Port 4, see Figure D, fills the inboard cavity pushing both pistons outward and exhausting air through Port 2. As the pistons (ref. 7 & 12) extend they rotate the pinion (ref. 22) counter clockwise (when viewed from the top of the actuator) and compress all the spring cartridges (ref. 4).

Although CRANE Air actuator typically operates counter clockwise to open and clockwise to close, it is possible to change this style of operation. Figure E and F show the same double acting actuator with the piston orientation changed to convert the actuator from a fail clockwise actuator to a fail counter clockwise unit (as described in Chapter 4.5).



2.2 TECHNICAL DATA & WORKING CONDITIONS

Operating Media – Dry or lubricated air, non-corrosive and inert gas or light hydraulic oil.

Air supply: 30 PSIG (2 Bar) to 150 PSIG (10 Bar) maximum. A safety valve is normally recommended.

Temperature: Standard from -10°F to $+176^{\circ}\text{F}$. Higher temperature ($+250^{\circ}\text{F}$ continuous and $+300^{\circ}\text{F}$ cyclic) and lower temperature (-55°F) available on request.

Lubrication: Factory lubricated for life under normal working conditions with Exxon CAZAR K2 or equivalent.

Application: Suitable for both indoor and outdoor applications.

2.3 SPECIAL CONDITIONS

When the actuator is to be operated with oxygen, the actuator must be perfectly clean and specially lubricated.

Operating the actuator beyond its designed temperature limitations may damage internal and external components and, therefore, could prove potentially dangerous for operating and maintenance personnel.

Operating the actuator beyond its designated pressure limitations may result in either an actuator malfunction or an actuator explosion and, therefore, could prove potentially dangerous for operating and maintenance personnel.

Note: Do not disassemble the actuator end caps when air pressure is applied to the actuator.



CHAPTER 3

Actuator Installation



CHAPTER 3 ACTUATOR INSTALLATION

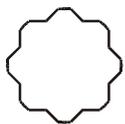
3.0 INSTALLATION

CRANE Air actuators can be fitted on many styles of quarter-turn valves, including ball, butterfly, plug and dampers in accordance with the instructions contained in this chapter. CRANE Air actuators are designed to be easy to install, for this purpose the mounting flange is equipped with ISO 5211 drilling in order to allow a male/female or female/male coupling with the valve.

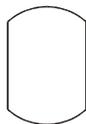


Figure G
Bottom view of CRANE Air actuator

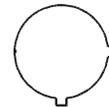
The pinion presents a double – square female drive to allow a large flexibility in mounting; it allows the assembling on valves stem, or coupling, with square key at 45° or at 90° indifferently. On request, bottom pinion female key may be done as double D or cylindrical with one or two keyways.



Double Square Key



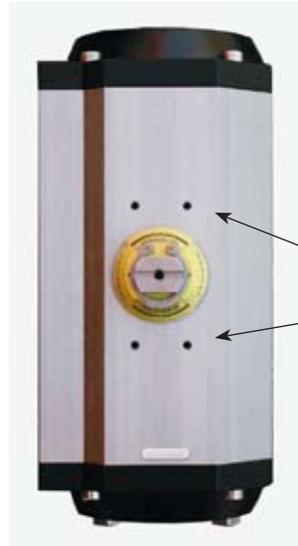
Double D Key



Keyways Key

On the top face of CRANE Air actuators there is a NAMUR standard mounting pattern for easy installation of accessories for position survey and/or control devices (Micro Switch Boxes, Positioners, etc.)

Figure H shows an actuator in the normal position (closed) with the pinion flats and the indicator – drive milling perpendicular to the body.



NAMUR drilling:
Limit Switch and Positioner
mounting area.

Figure H
Top view of CRANE Air actuator

The Ports are NAMUR standard for easy solenoid valve connection

Installation procedure:

1. Check the coupling female pinion drive – valve stem.
2. Make sure that the valve and the actuator are both in the closed position before proceeding (see Figure H).
3. Install mounting bracket on the valve and hand tighten all fasteners; be sure not to fully torque bolts until entire assembly is correctly aligned and installed.
- 4a. Mounting with brackets: Place coupling on valve stem and the actuator on mounting bracket. Align valve and actuator in order to eliminate forces on the system; tighten all the assembly fasteners.
- 4b. Direct mounting: Position the actuator on valve; use caution while inserting the valve stem into the double square female pinion drive. Insert the screws from the bottom side of flange and manually tighten them and align the assembly in order to eliminate the forces on the system; tighten all assembly fasteners.
5. Actuate the unit several times to ensure that it works properly. If the unit does not work properly, disassemble the unit and repeat steps 1 – 4. If the problem persists, contact your local CRANE Air representative.
6. After the completion of the mounting operations, it is necessary to set the actuator stroke through the travel stops to ensure that the valve works properly. CRANE Air actuators have a regulation range from -10° to $+10^{\circ}$ and from 80° to 100° ($\pm 10^{\circ}$ in both open and close directions). (See Chapter 4.3 for information on actuator positioning phase).
7. Rotate actuator and valve assembly to desired degree.



CHAPTER 4

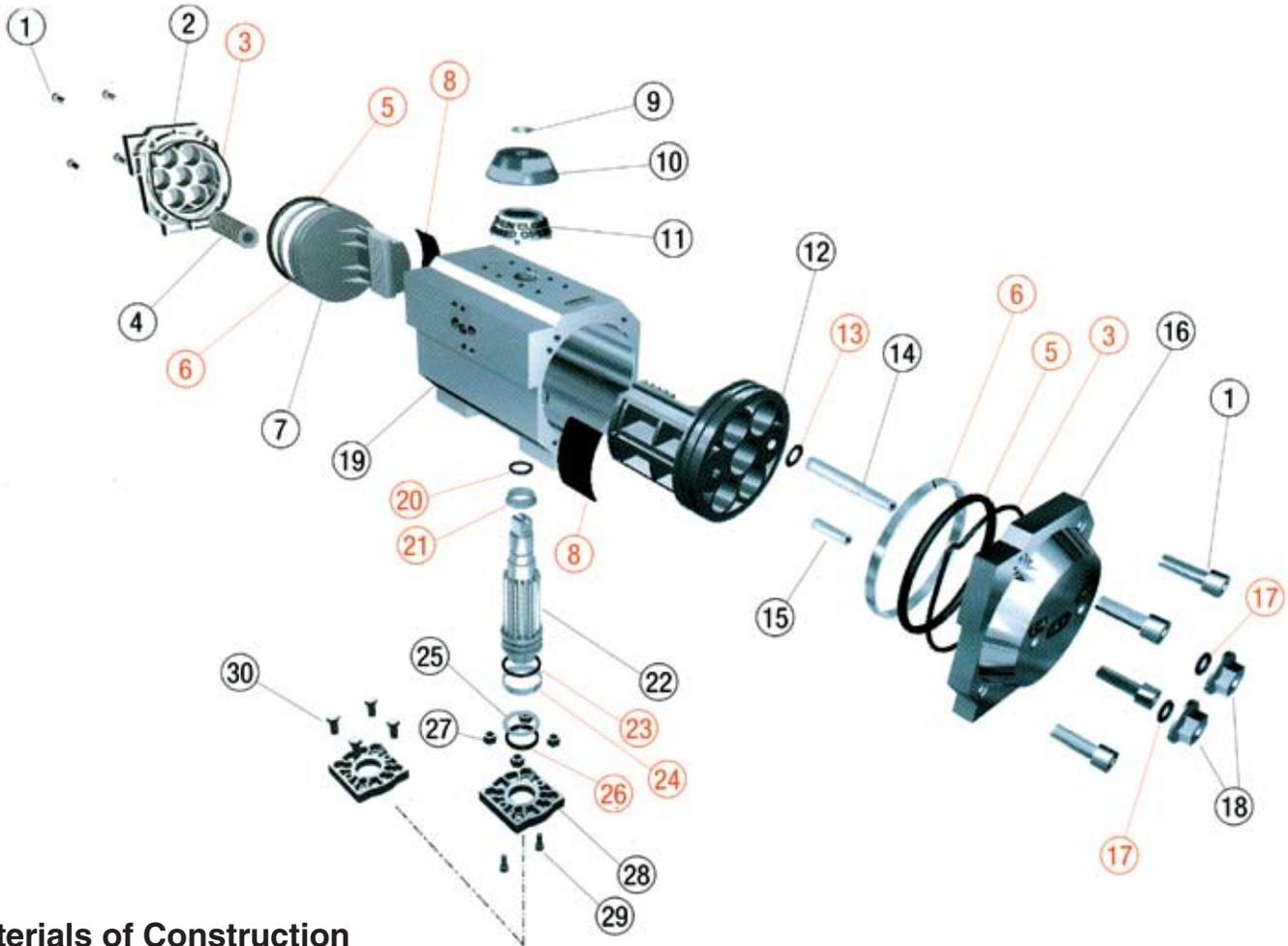
Actuator Maintenance



CHAPTER 4 ACTUATOR MAINTENANCE

4.0 MAINTENANCE

Maintenance instructions provide the end user with necessary information for standard examination of O-Rings and soft parts for wear. Repair kits consisting of all soft parts are readily available.



Materials of Construction

ITEM	DESCRIPTION	MATERIALS
1	End Cap Screw	AISI 304 Stainless Steel
2	Left End Cap	*
3	End Cap O-Ring	BUNA-N
4	Spring Cartridge	Spring Steel Epoxy Coated
5	Piston O-Ring	BUNA-N
6	Guide Ring	Techno-Polymer
7	Left Piston	*
8	Piston Thrust Block	Techno-Polymer
9	Indicator Snap Ring	AISI 304 Stainless Steel
10	Indicator (Rotating Part)	Techno-Polymer
11	Indicator (Fix Part)	Techno-Polymer
12	Right Piston	*
13	Regulation O-Ring	BUNA-N
14	Internal Reg. Screw	AISI 304 Stainless Steel
15	Stop Bolt	AISI 304 Stainless Steel
16	Right End Cap	Die Cast Aluminum

ITEM	DESCRIPTION	MATERIALS
17	Washer	AISI 304 Stainless Steel
18	Stop Bolt Nut	AISI 304 Stainless Steel
19	Actuator Body	Extruded Aluminum ASTM B210 (6063)
20	Upper Pinion O-Ring	BUNA-N
21	Upper Pinion Bearing	Techno-Polymer
22	Pinion	ASTM A314 (303) Stainless Steel or SAE 11L14 Nickel Plated acc. ASTM B733
23	Lower Pinion O-Ring	BUNA-N
24	Lower Pinion Bearing	Techno-Polymer
25	Washer	Quenched and Tempered Steel
26	Flange Bearing	Techno-Polymer
27	Flange Nuts	AISI 304 Stainless Steel
28	Mounting Flange	Die Cast Aluminum
29	Flange Retainer Bolts	AISI 304 Stainless Steel
30	Optional Flange Bolts	(upon request only)

NOTES: * Techno-Polymer thru CA02, die cast aluminum for larger sizes. Items in red are wear parts.

4.1 DISASSEMBLING PROCEDURE FOR THE SUBSTITUTION OF O-RINGS BEARINGS, GUIDE RINGS & THRUST BLOCK

 **CAUTION! PLEASE READ CAREFULLY:**

Before carrying out any maintenance on CRANE Air actuators, it is essential that the actuator is not under pressure and is free of any accessories. For your safety, it is absolutely necessary, before disassembling a spring return Actuator, that the unit is in the failsafe position (springs extended and not compressed).

1. Disconnect all electrical and air supplies from the actuator.
2. Remove the actuator from the mounting bracket and place in a clean environment.
3. After removing the end cap screws (ref. 1), remove the end caps (ref. 2 and 16).
4. Remove O-Rings (ref. 3) from the end caps and inspect their wear and lubrication.
5. Remove the internal regulation screw (ref. 14) and the stop bolt (ref. 15), located in the right end cap.
6. Using a wrench on the appropriate mill on the upper part of pinion (ref. 22), turn the pinion counter-clock wise until the pistons (ref. 7 & 12) protrude further out from the cylinder to be removed.
7. Remove the pistons by hand or with pliers, taking the pistons from the spring grooves and using caution not to damage the pistons' surfaces. Note: If actuator is fail counter-clockwise (mounting B), pinion must be rotated in the opposite direction.
8. Remove O-Rings (ref. 5), guide ring (ref. 6) and thrust block (ref. 8) from the left and right pistons.
9. Remove the bolts (ref. 29) from the bottom side of the flange (ref. 28) and turn over the actuator. Firmly tap the upper part of the pinion on a wood surface, to prevent damage of the pinion. Remove the unit flange pinion through the bottom of the body (ref. 19).
10. Remove the pinion from the flange.
11. Remove the washer (ref. 25).
12. Remove the O-Rings and the bearings (ref. 20, 21, 23 and 24) from the pinion.
13. Inspect and replace the following wearing parts as necessary:

GENERAL	REFERENCE	DETAIL	QUANTITY
End Cap (ref. 2 & 16)	3	End Cap O-Rings	2
Piston (ref. 7 & 12)	5	Piston O-Ring	1
	6	Piston Guide Ring	2
	8	Piston Trust Block	1
Travel Stop (ref. 14 & 15)	13 17	Stop Bold O-Ring	1
Pinion (ref. 22)	20	Pinion O-Ring (upper)	1
	21	Pinion Bearing (upper)	1
	23	Pinion O-Ring (lower)	1
	24	Pinion Bearing (lower)	1

All these soft parts are included in CRANE Air repair kits.

CHAPTER 4 ACTUATOR MAINTENANCE

4.2 LOW/HIGH TEMPERATURE O-RINGS INSTALLATION

1. Disassemble the actuator as described in chapter 4.1.
2. Using a screw driver, remove the following O-Rings from the actuator:
 - a. Pistons (ref. 5).
 - b. End caps (ref. 3).
 - c. Upper pinion (ref. 20).
 - d. Lower pinion (ref. 23).
3. Using alcohol, or another mild solvents, remove the lubrication from each actuator parts and carefully clean all the surfaces before inserting a new set of O-Rings.
4. Divide the O-Rings and indicate their position of installation:
 - a. Piston O-Rings: they are the thickest O-Rings (ref. 5)
 - b. End cap O-Rings: they have the biggest diameter (ref. 3)
 - c. Pinion O-Rings: of the remaining O-Rings, the large diameter O-Rings goes on the Lower O-Ring groove (ref. 23) and the smaller diameter on the Upper O-Ring groove (ref. 20)
 - d. Stop bolt O-Ring (ref. 13)
5. Install the low/high temperature O-Ring set. If this operation is too difficult, the O-Rings can be slightly stretched and greased to ease installation. When installing the end cap O-Ring be sure to seat them properly, otherwise they might be pinched during the end cap installation (ref. 1 & 16).
6. Apply grease to the following internal part of actuator:
 - a. Inner bore of actuator
 - b. Piston wear surfaces (O-Ring, guide ring and thrust block)
 - c. Piston rack
 - d. Pinion gear teeth
 - e. Pinion wear surfaces and O-Rings
7. Assemble the actuator as described in chapter 4.3.

4.3 ASSEMBLY PROCEDURE

1. Insert O-Rings (ref. 20 & 23) and bearings (ref. 21 & 24) on pinion (ref. 22).
2. Insert nuts (ref. 27) and the washer (ref. 25) in the appropriate grooves of the flange (ref. 28): this operation reduces friction and wear.
3. Insert the pinion in the flange.
4. Insert the unit pinion–flange into the actuator body (ref. 19) pushing until the flange is completely inserted into the body.
5. Tighten the flange bolts (ref. 29).
6. Intermediate test: using a wrench and acting on the appropriate mill on the upper part of the pinion. Manually rotate the pinion to make sure it freely rotates.
7. Insert the O-Rings (ref. 5), the guide ring (ref. 6) and the thrust block (ref. 8) on the left and right pistons (ref. 7 & 12).

8. Piston insertion: This operation can be performed in two different ways in order to obtain either a fail clockwise actuator (mounting A - FCW) or a fail counter clockwise actuator (mounting B - FCCW). "Right piston" is the piston which contains a hole, as opposed to the "left piston" which does not contain a hole. While facing the supply holes of the actuator body, insert the left piston on the left end of body and right piston on the right end.

8a. Mounting A:

Left piston insertion.

- Place the actuator in a stand up position on its right side with the flange facing you and the supply holes on your right.
- To obtain the counter clockwise rotation (mounting A) it is necessary to insert the rack of the piston to the left of the pinion.
- Insert the left piston applying pressure with hands until the piston is completely in the body.

Right piston insertion.

- Place the actuator in a stand up position on its left side with the flange facing you.
- Insert the rack of the piston to the left of the pinion.
- Insert the right piston applying pressure with hands until the piston is completely in the body.

8b. Mounting B: follow the same steps as above, but inserting the rack of both pistons on the right of the pinion.

9. Actuator positioning phase:

9a. Place the actuator in a stand up position on a flat surface with the upper part of the pinion on the right side.

9b. Manually apply pressure to the piston, as this will assist to compress the opposite piston.

9c. While continuing to apply pressure, use a wrench on the appropriate mill of the upper portion of the pinion and rotate the pinion counter clockwise. At this point there must be clicking sound due to the interlocking between the piston rack and the pinion tooth. Make sure to create an individual sound per tooth.

9d. After each individual sound, rotate the pinion clockwise; verify that the pinion NAMUR mill is about 10° beyond the perpendicular to the body axis. If problematic, repeat step 9c.

9e. Double-check the correct assembly of the actuator, confirming that the open position pistons are of equal distance from the cylinder border.

10. End cap mounting:

10a. Insert the end cap O-Rings (ref. 3) into their grooves by following the shape of the grooves with a finger to ensure that the O-Rings are properly seated.

10b. Insert the stop bolt (ref. 15) and the internal regulation screw (ref.14) into the right end cap (ref. 16) from the external side of the end cap. Screw clockwise until they appear inside the end cap.

10c. Insert the O-Rings (ref. 13), the washer (ref. 17) and the nuts (ref. 18).

10d. Insert the end cap screws (ref. 1) and tighten them in an alternating order to the factory torque standard (see Table A).

ACTUATOR TYPE	TORQUE In-lb. (Nm)
CA02	70 (8)
CA04 - CA05	106 (12)
CA06 - CA07 CA08 - CA09	133 (15)
CA10 - CA11 CA12 - CA13	193 (22)

Table A

11. Adjustment

Supply low-pressure compressed air to Port 2 (see drawings Chapter 2.1). Using a hex key wrench, turn the internal regulation screw until the pinion shaft is perpendicular to the actuator axis (0° position); tighten the nut to the respective standard of the torque listed in Table A.

Next, supply low-pressure compressed air to Port 4 to open the actuator. The pinion shaft must be at a 90° position (with respect to the 0° position), aligned with the actuator axis. If it is not aligned, act on the stop bolt and tighten the nut to the respective standard of the torque listed in Table A.

4.4 SPRING CARTRIDGE INSERTION

CRANE Air actuators can be easily converted from Double Acting to Spring Return by changing the spring number and configuration inside the end cap. CRANE Air actuators can accept up to 5 springs in the right end cap and 7 in the left end cap. We advise the insertion of at least two spring cartridges in each end cap in order to have a uniform distribution of forces on the pistons. The number of the springs loaded affects the torque value the actuator will be able to generate during its working cycle. See the CRANE Air data sheet to properly size a spring return actuator.

Springs Installation Procedure:

1. Remove the four end cap screws (ref. 1) from the right and left end caps;
2. Remove the end caps;
3. Insert the correct number of spring cartridges into each end cap (i.e. CA05SC4 = 4 + 4 springs) referring to Table B. It is strongly advised to insert the plastic part of the cartridge containing the deep hole into the appropriate table reference end cap seat.

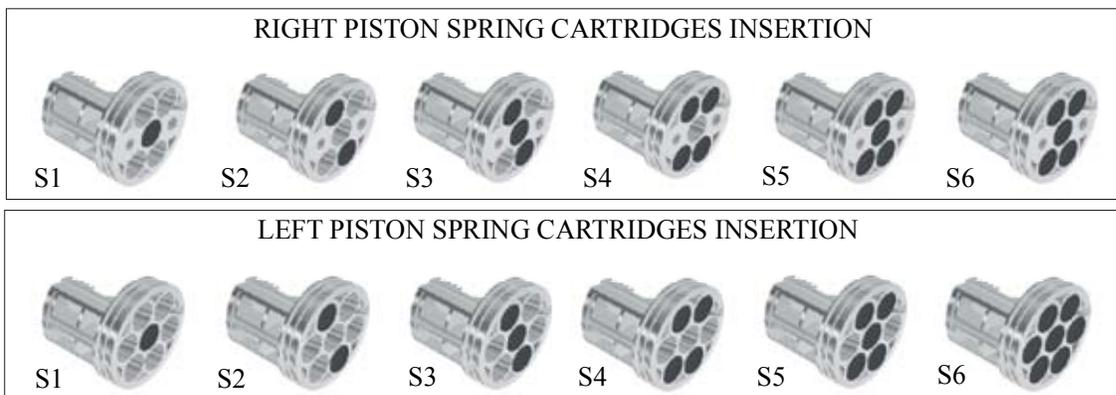


Table B



CHAPTER 5

Warranty



5.0 WARRANTY

CRANE provides the following warranty regarding CRANE Air actuators . THE WARRANTY STATED HEREIN IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESSED OR IMPLIED, OR STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. CRANE warrants the CRANE Air actuators to be free from defects in materials and workmanship when these products are used for the purpose for which they were designed and manufactured. CRANE does not warrant the CRANE Air actuators against chemical or stress corrosion or against any other failure other than from defects in materials or workmanship. The warranty period is for twelve (12) months from installation date or eighteen (18) months from shipment date, whichever date comes first. Any claims regarding this warranty must be in writing and received by CRANE before the last effective date of the warranty period. Upon CRANE receipt of a warranty claim, CRANE reserves the right to inspect the product(s) in question at either the field location or at CRANE St. Louis. If, after inspection of the product(s) in question, CRANE determines that the purchaser's claim is covered by this warranty, CRANE's sole liability and the purchaser's sole remedy under this warranty is limited to the refunding of the purchase price or repair or replacement thereof a CRANE Air option. CRANE will not be liable for any repairs, labor, material or other expenses that are not specifically authorized in writing by CRANE, and in no event shall CRANE be liable for any direct or consequential damages arising out of any defect from any cause whatsoever. If any CRANE Air product is modified or altered at any location other than CRANE – St. Louis, Missouri without the express written authorization of CRANE are not covered by this warranty. The warranty for such products shall be subject only to the warranty relief, if any, provided by the suppliers and/or manufacturers of such products.

CRANE

Energy Flow Solutions

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CRANE Air Rack & Pinion Pneumatic Actuator IOM Manual

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