Installation, Operation, and Maintenance Manual for the PRATT PIK Series

RACK AND PINION PNEUMATIC ACTUATORS

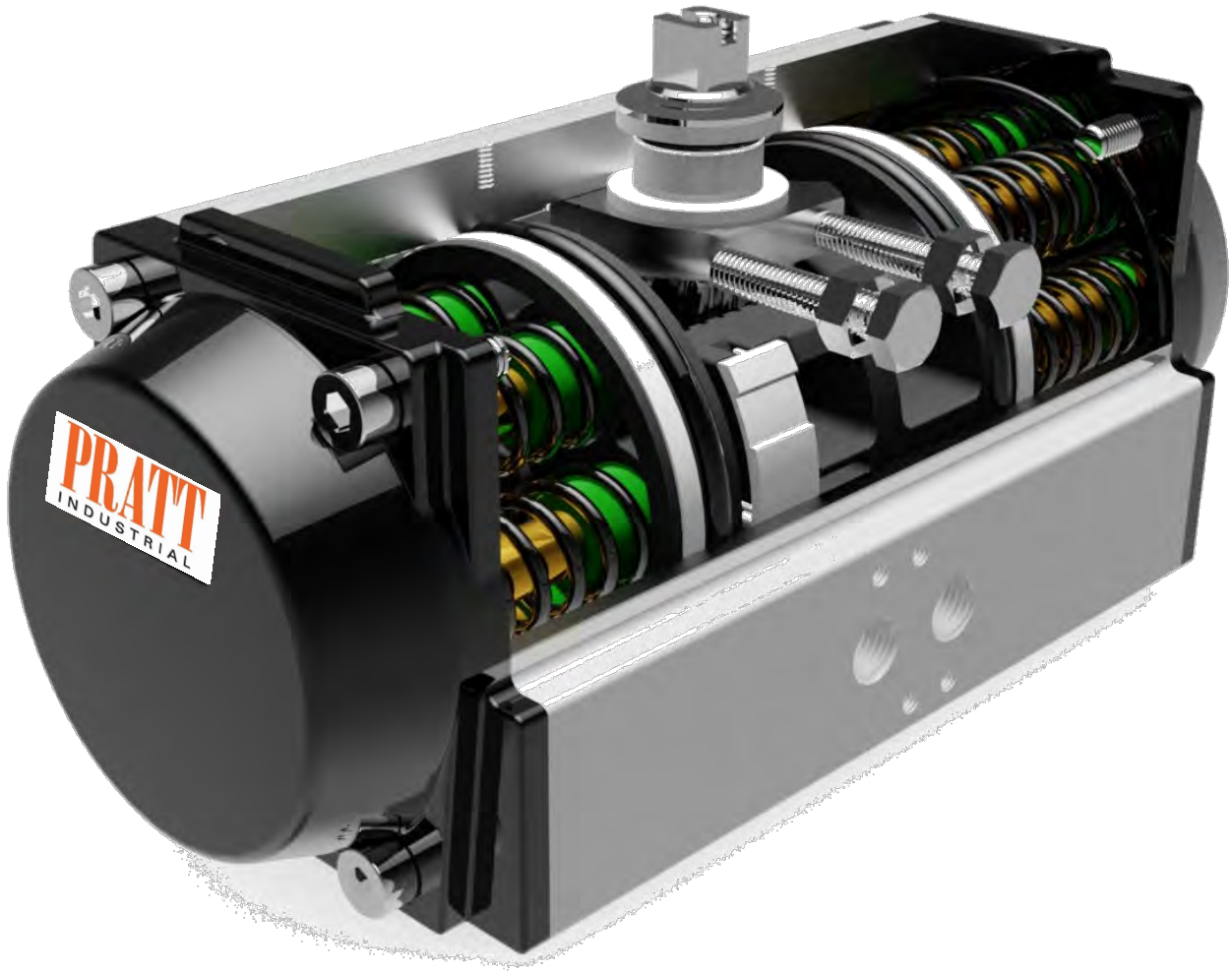


TABLE OF CONTENTS

TABLE OF CONTENTS

I. Introduction

PRATT offers one of the largest ranges of pneumatic rack and pinion actuators on the market. PRATT actuators are designed to operate with pressurized air, but will function equally as well with hydraulic fluid, water or inert fluids. Our actuators are designed to operate within the pressure range of 20 PSIG to 150 PSIG and are offered in two styles: the Double Acting model and the Spring Return. The double acting model is available in 90°, 120°,135° and 180° versions. The Spring Return version is available only as a 90° model. The double acting and spring return actuators can easily be field converted to other configurations by insertion or removal of the unique patented PRATT spring cartridges.

A. Storage

All PRATT actuators are factory lubricated for 2,000,000 cycles under normal operating conditions. The actuator ports are plugged to prevent liquids or other materials from entering the actuator during shipment. If the actuators are to be stored for a long period of time before installation, the units should be stroked periodically to prevent the seals from setting. (Note: the plugs must be removed in order to stroke actuator.) Recommended storage is indoors, and the units should be protected against weather and other harmful elements.

II. Identification

A. General Identification

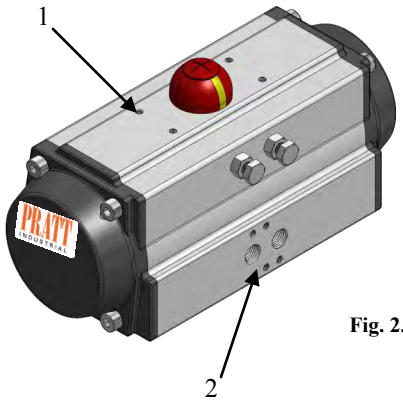


Fig. 2.1

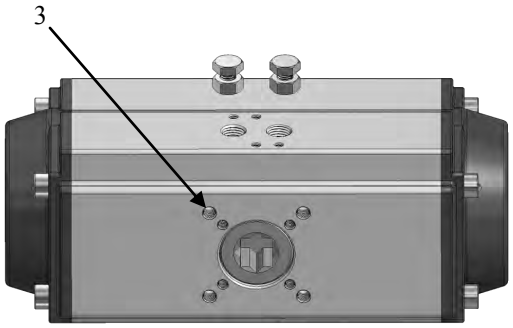


Fig. 2.2

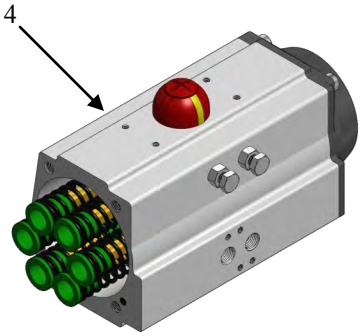


Fig. 2.3

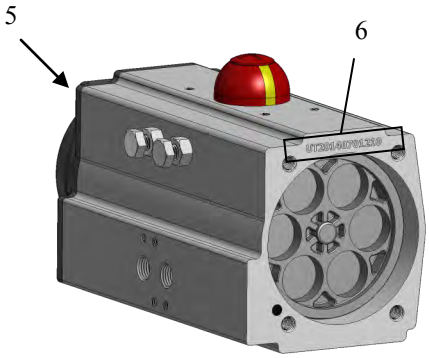
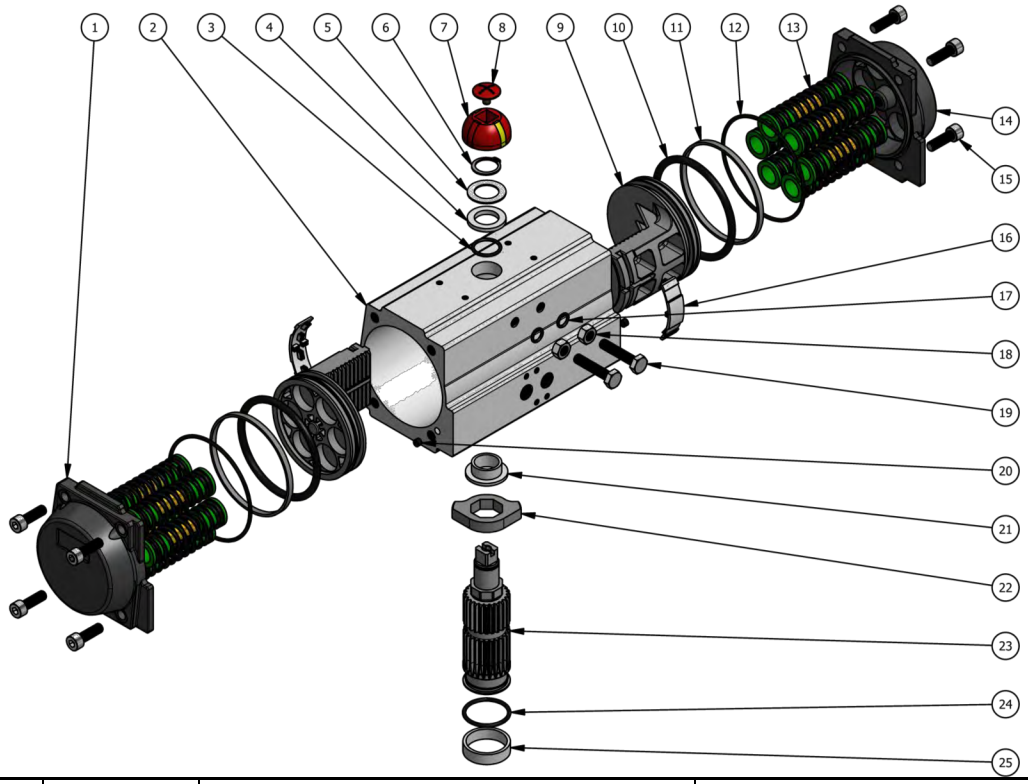


Fig. 2.4

Fig. 2.5

1: Top auxiliaries interface. (VDI/VDE 3845; NAMUR)
2: Solenoid interface (VDI/VDE 3845; NAMUR)
3: Valve interface (ISO 5211, DIN 3337 patterns/w UNC threads)
4: Spring return actuator (Closed)
5: Double Acting actuator (Open)
6: Actuator Serial Number
7: End Cap (Identical for spring return and double acting models)

B. Actuator Part Identification



ITEM #	Qty	Description	Material
1	1	Left End Cap	ASTM 384 Cast Aluminum
2	1	Body	6005T5 Extruded Aluminum
3	1	Upper Pinion O-Ring	NBR
4	1	Flange Bearing	Delrin
5	1	Pinion Washer	Stainless Steel
6	1	Pinion Circlip	Stainless Steel
7	1	Indicator	ABS
8	1	Indicator Screw	ABS
9	2	Piston	Anodized ASTM A23320
10	2	Piston O-Ring	NBR
11	2	Piston Guide	Bronze Impregnated PTFE
12	2	End Cap O-Ring	NBR
13	0-12	Spring Cartridge	Epoxy Coated Spring Steel
14	1	Right End Cap	ASTM 384 Cast Aluminum
15	8	End Cap Socket Head Cap Screw	Stainless Steel
16	2	Piston Skate	Delrin
17	2	Stop O-Ring	NBR
18	2	Stop Nut	Stainless Steel
19	2	Stop Bolt	Stainless Steel
20	2	Air Channel Plug	NBR
21	1	Thrust Bearing	Delrin
22	1	Pinion Cam	Electroless Nickel/Forged 1045 Carbon Steel
23	1	Pinion	Electroless Nickel/Alloy Steel
24	1	Lower Pinion O-Ring	NBR
25	1	Lower Pinion Bearing	Delrin

III. Specification

A. Actuator Weights

"PIK" Series Weights (lbs)			
Size	Weight For DA	Weight For K55	Single Spring Weight
10	2.00	-	-
20	3.00	3.30	0.03
34	4.65	5.05	0.04
48	5.75	6.25	0.05
75	7.65	8.65	0.10
105	10.45	11.95	0.15
157	13.25	14.75	0.15
237	21.00	23.50	0.25
331	26.85	30.35	0.35
406	30.05	34.55	0.45
633	45.05	51.55	0.65
1009	72.45	82.95	1.05
1260	87.20	104.70	1.75
1831	124.00	149.00	2.50
2928	180.00	222.00	4.20

B. Air Volume and Consumption

"PIK" Series Air Volume (in^3)			
Size	Opening Stroke	Closing stroke	Per cycle
10	4.27	5.49	9.76
20	5.49	11.59	17.09
34	8.54	15.87	24.41
48	13.43	23.19	36.61
75	20.75	32.34	53.09
105	30.51	56.75	87.26
157	46.99	72.62	119.61
237	76.28	104.96	181.24
331	111.06	163.54	274.60
406	131.81	195.28	327.09
633	206.87	294.74	501.61
1009	341.12	484.53	825.65
1260	405.20	642.58	1047.78
1831	590.71	994.08	1584.79
2928	911.08	1502.40	2413.49

Actual air consumption will vary depending on air pressure, acting type, and frequency of operation. Use the Variable Key and the formulas below to determine air consumption for your specific application.

Variable Key

V_O = Volume of opening stroke (in^3)
V_C =Volume of closing stroke (in^3)
PSI = Pressure at which the actuator is operated (PSI).
CPM= Cycles per minute (1 cycle being both opening and closing the actuator)
SCIM= Air consumption in Standard Cubic Inches per Minute*
SCFM= Air consumption in Standard Cubic Feet per Minute*

Air Consumption for Double Acting:

$$(V_O + V_C) \times \frac{(PSI + 14.7)}{14.7} \times CPM = SCIM$$

Air Consumption for Spring Return:

$$V_O \times \frac{(PSI + 14.7)}{14.7} \times CPM = SCIM$$

To convert to SCFM:

$$\frac{SCIM}{1728} = SCFM$$

*Standard Conditions are defined as 14.7psia and 60° F

C. Speed of Operation*

PIK Series Speed of Operation (sec)						
Size	Double Acting Models			Spring Return Models		
	Opening Stroke	Closing stroke	Per cycle	Opening Stroke	Closing stroke	Per cycle
10	0.2	0.2	0.4	-	-	-
20	0.2	0.2	0.4	0.3	0.3	0.6
34	0.3	0.3	0.6	0.3	0.4	0.7
48	0.3	0.4	0.7	0.4	0.5	0.9
75	0.4	0.5	0.9	0.5	0.6	1.1
105	0.6	0.6	1.2	0.7	0.9	1.6
157	0.8	0.8	1.6	0.9	1.1	2.0
237	0.9	1.1	2.0	1.2	1.4	2.6
331	1.2	1.3	2.5	1.4	1.5	2.9
406	1.4	1.4	2.8	1.5	1.8	3.3
633	1.7	1.8	3.5	1.8	2.1	3.9
1009	2.4	2.5	4.9	2.5	2.8	5.3
1260	2.7	3.2	5.9	3.5	4.0	7.5
1831	3.5	4.0	7.5	4.1	4.6	8.7
2928	4.0	4.5	8.5	4.5	5.0	9.5

*These times are for reference only; operation speed will vary with field conditions and application.

D. Temperature Specifications

PIK Series Temperature Specifications					
Temperature Designation	Temperature Range (F°)	Temperature Range (C°)	Bearing Material	O-ring Material	Grease
Standard Temp	-4° to 176°	-20° to 80°	Delrin/Bronze Impregnated PTFE	NBR	Standard
High Temp	5° to 320°	-15°to 160°	PPSU/Bronze Impregnated PTFE	Viton	High Temp
Low Temp	-58° to 176°	-50° to 70°	Delrin/Bronze Impregnated PTFE	Low Temp NBR	Standard

IV. Operation

A. Principals of Operation (Double Acting)

The PRATT pneumatic actuator has simple operational characteristics. Port A is connected to the interior cavity between the pistons. Port B is connected to the end cap cavities (See Figures 4.1-4.2 below). If port A is pressurized (Fig. 4.1), air flows between the two pistons pushing them apart. Air is, in turn, exhausted out of port B and the pinion is rotated until the pinion cam is stopped by the open limit stop, resulting in the open position of the actuator. In order to rotate the actuator back to the closed position, air pressure must be removed from port A and applied to port B. Pressurizing port B (Fig. 4.2) will allow air to move into the cavities between the pistons and the endcaps pushing them together. Air is, in turn, exhausted out of port A and the pinion is rotated until the pinion cam is stopped by the closed limit stop bolt, resulting in the closed position of the actuator.

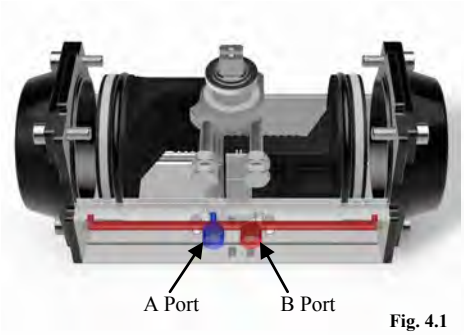


Fig. 4.1

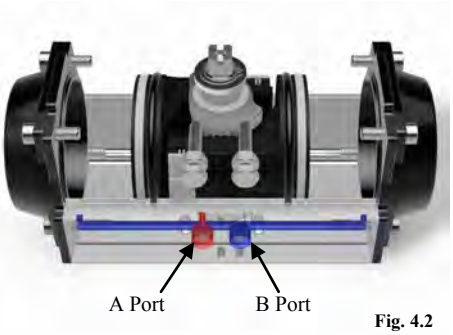


Fig. 4.2

The above illustrations show the paths taken by the pressurized air (blue), the exhausting air (red), and the resulting state of the actuator.

B. Principals of Operation (Spring Return)

The opening stroke of the spring return model functions just like the double acting model. By pressurizing port A as shown in Fig. 4.3 the actuator opens, exhausts air like the double acting model, and compresses the springs. However, to close the actuator, air pressure is removed from port A and allowed to exhaust. Once this is done the encapsulated springs will return the actuator to its closed position and air will be exhausted out of the A port as detailed in Fig. 4.4 below.

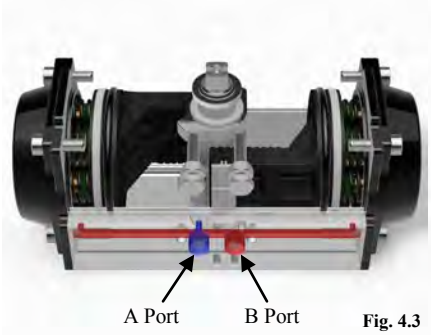


Fig. 4.3

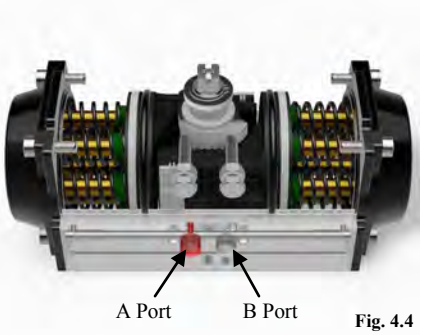


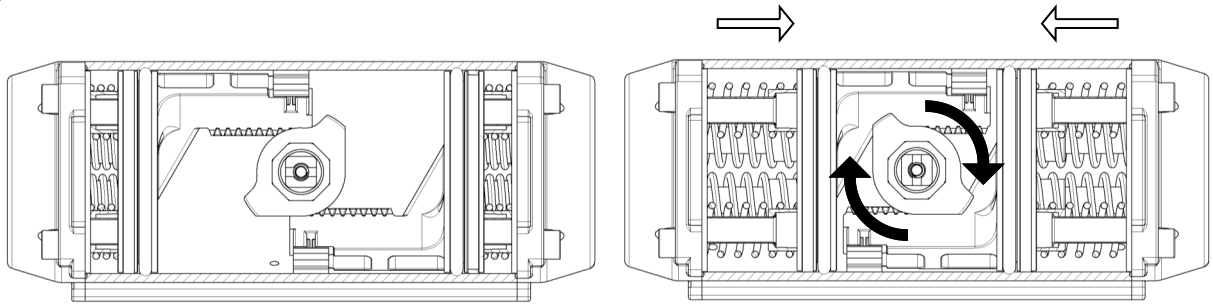
Fig. 4.4

The above illustrations show the paths taken by the pressurized air (blue), the exhausting air (red) and the resulting state of the actuator.

NOTE: In the case of a spring return model even though port A is the only port that needs to be pressurized in order to operate the actuator, air still must be allowed to enter and exit through port B unobstructed for proper operation. PRATT both recommends and supplies filters or recirculation blocks that will maintain airflow but prevent debris from entering the actuator. Consult PRATT for specific applications and more information.

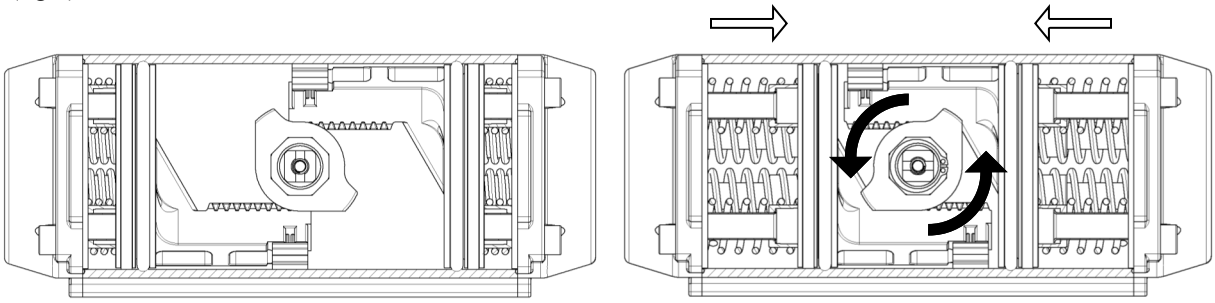
C. Fail Positions

The PRATT actuator standard operation is counterclockwise to open and clockwise to close. This is referred to as a "fail clockwise" configuration or FCW. However, it is also available in an FCCW or "fail counterclockwise" configuration. Figures 4.5 & 4.6 show the same actuator with the piston and pinion orientation changed to convert the actuator from the FCW to the FCCW configuration. FCW is referred to as "fail closed" and FCCW as "fail open" due to its intended effect on the valve. In the diagrams below, the hollow arrows show the direction the pistons move due to the spring force, and the solid arrows show rotation of the pinion as it travels to the fail position.



FCW (Fail Closed) Fig.4.5

Fig. 4.5 shows a FCW, spring return actuator going from the open position (left) to the fail, or closed, position (right).



FCCW (Fail Opened) Fig.4.6

Fig. 4.6 shows a FCCW, spring return actuator going from the open position (left) to the fail, or closed, position (right).

Acting Type	Configuration Type	Fail Position
Double acting	FCW	Last
	FCCW	**Last**
Spring Return	FCW	Closed
	FCCW	**Open**

NOTE: All statements above assume the valve is a quarter turn valve that opens counterclockwise and closes clockwise. Further, it also assumes that the actuator is spring return Since a double acting actuator will always fail in its last position (discounting any forces the valve may exert on the actuator). See also Table below.

V. Mounting and Installation

A. Actuator Mounting Specifications

The PRATT actuator is designed to be easily installed. The standard PIK series comes with an bottom mounting pattern and double D drive and round & keyed on the pinion allowing for simpler coupling fabrication. Additional valve mounting patterns are available upon request.

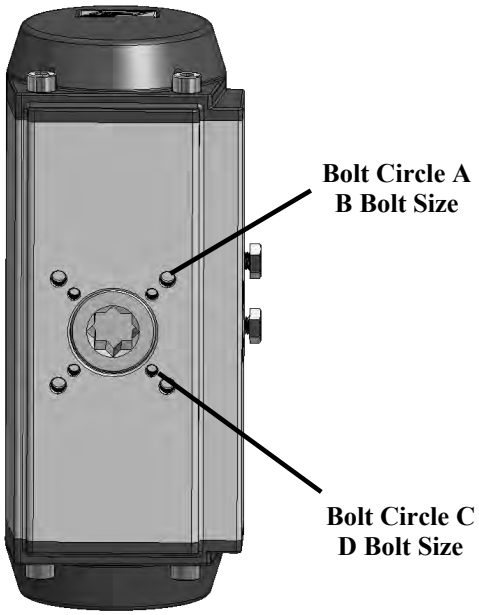


Fig. 5.1
Bottom View of the PRATT actuator with dimensions.

MOUNTING DIMENSIONS
ISO dimensions represent actuator mounting bolt circle.

Model	A Bolt Circle	B Bolt Size	C Bolt Circle	D Bolt Size
10	1.97	1/4-20	1.42	10-32
20	1.97	1/4-20	1.42	10-32
20	1.65	10-32	-	-
34	2.76	5/16-18	1.97	1/4-20
48	3.25	3/8-16		
75	3.25	3/8-16		
105	3.25	3/8-16		
157	3.25	3/8-16		
237	3.25	3/8-16		
331	3.25	3/8-16	5.00	1/2-13
406	3.25	3/8-16	5.00	1/2-13
633	5.00	1/2-13		
1009	5.00	1/2-13	-	-
1260	5.00	1/2-13	-	-
1831	6.50	3/4-10	-	-
2928	6.50	3/4-10	-	-

B. Actuator Installation

WARNING!
Never attempt to assemble, disassemble, or otherwise modify an actuator while still in service! Disconnect both pneumatic and electrical power from the actuator and ensure it's completely exhausted before making any adjustments!

Note: The PRATT PIK Series actuator is designed to be installed, commissioned, and maintained using commonly available tools such as hex keys, crescent wrenches, circlip pliers, and socket wrenches.

During assembly to the valve, do not use a hammer on the pinion top. This can damage the pinion and thrust bearing causing premature failure.

Before mounting the actuator on the valve or valve bracket, be sure to understand the valve and actuator's failure position and rotation characteristics.

1. Remove handle nut, handle, lock washer, and etc. from the valve if required.

2. Visually check to ensure the valve is CLOSED.

View After the Valve Handle Has Been Removed

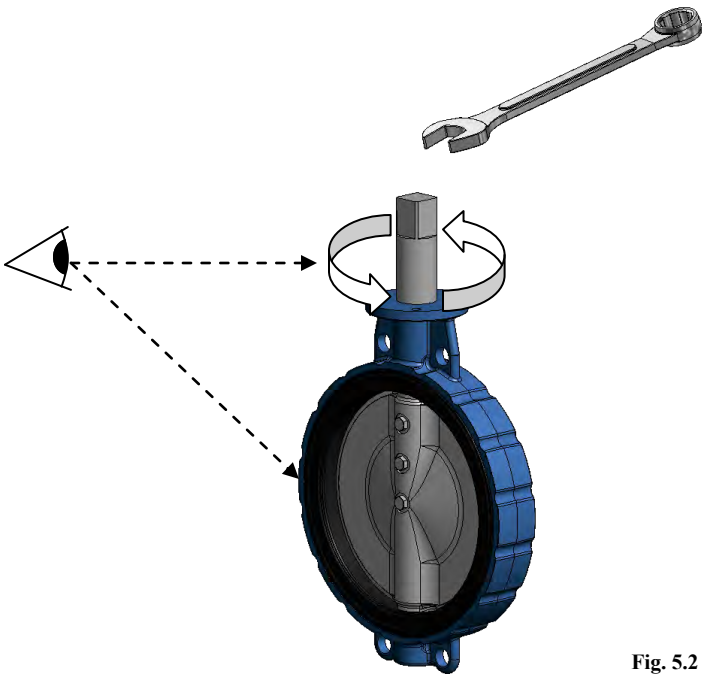


Fig. 5.2

3. If required, use a plastic mallet and carefully tap the insert into position.

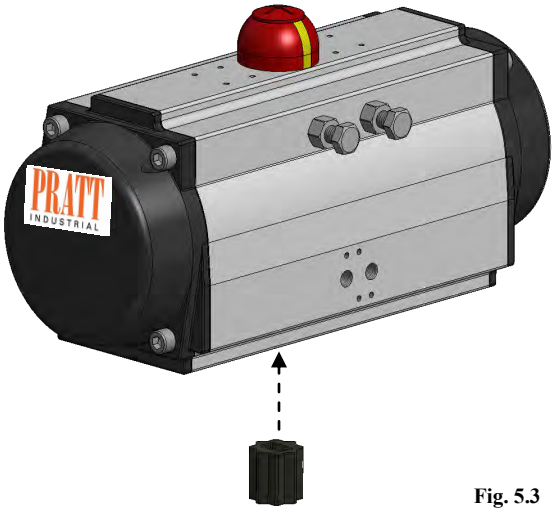
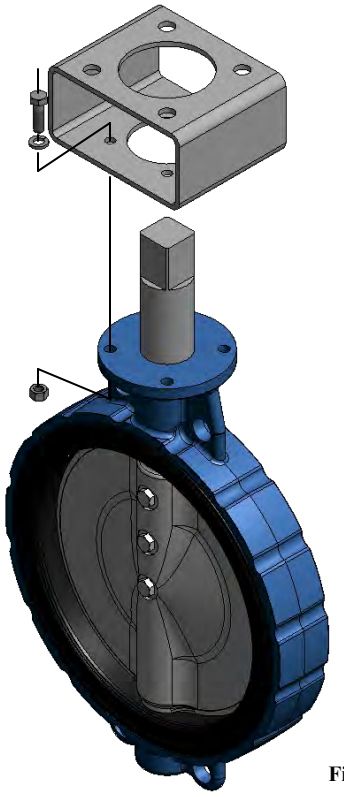


Fig. 5.3

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



Note: In some cases direct mounting is available. Please consult PRATT or a distributor if a bracket and coupling has not been provided.

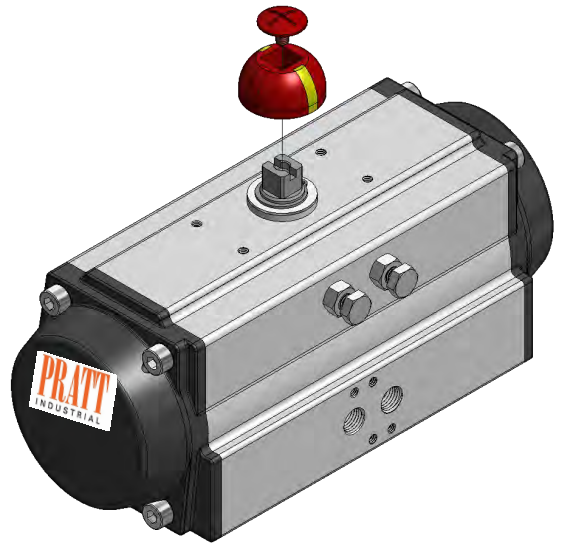
Fig. 5.4

5. Install the actuator to the bracket. Tighten all bolts.

6. When required, mount or adjust the visual indicator as seen below.

Indicator Mounting

In Line Mounting



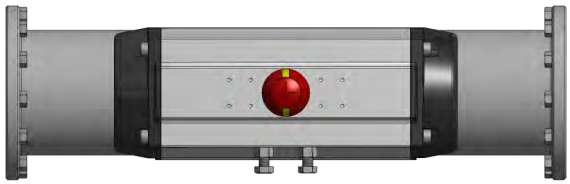
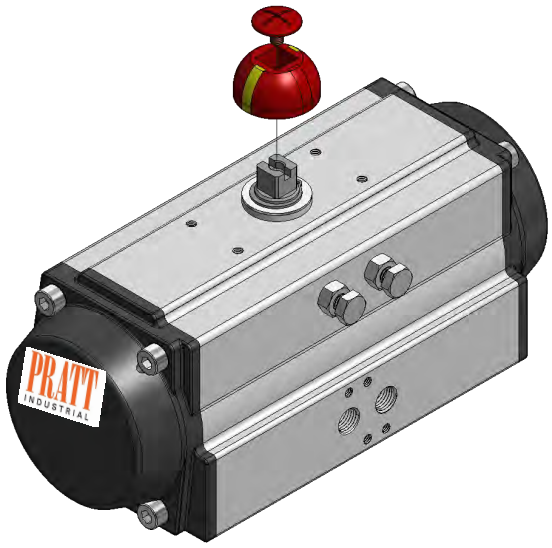


Fig. 5.5

Across Line Mounting



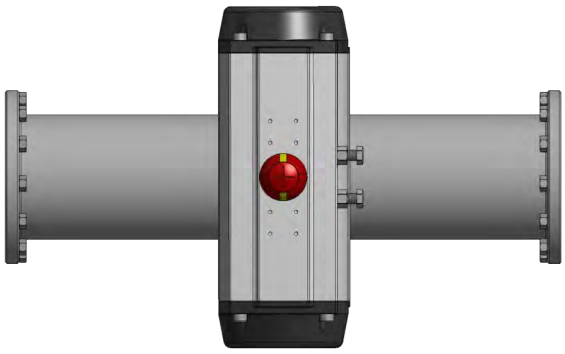


Fig. 5.6

After all mounting procedures are completed, it is necessary to set the travel stops to ensure proper rotation. The PRATT travel stop allows a travel range of 100° (from +95° to -5° with 10 degrees of adjustment at open and close). If a larger range is necessary, consult your PRATT representative for information on extended travel limit stops.

NOTE: IMPROPER SETTING OF TRAVEL STOPS CAN REDUCE THE VALVE AND ACTUATOR'S LIFE.

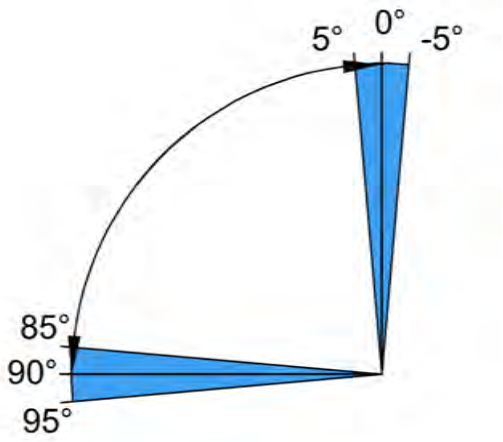


Fig. 5.7

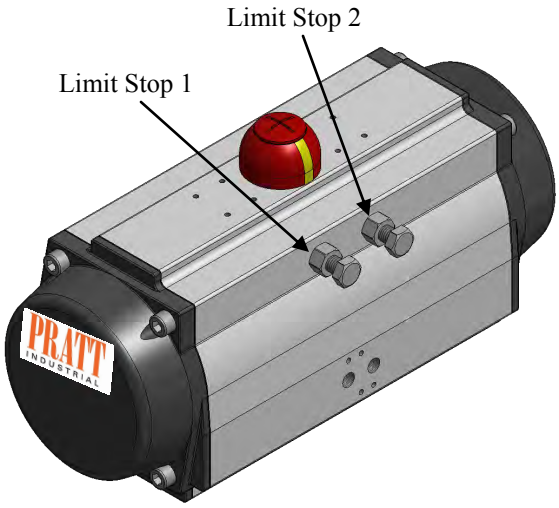
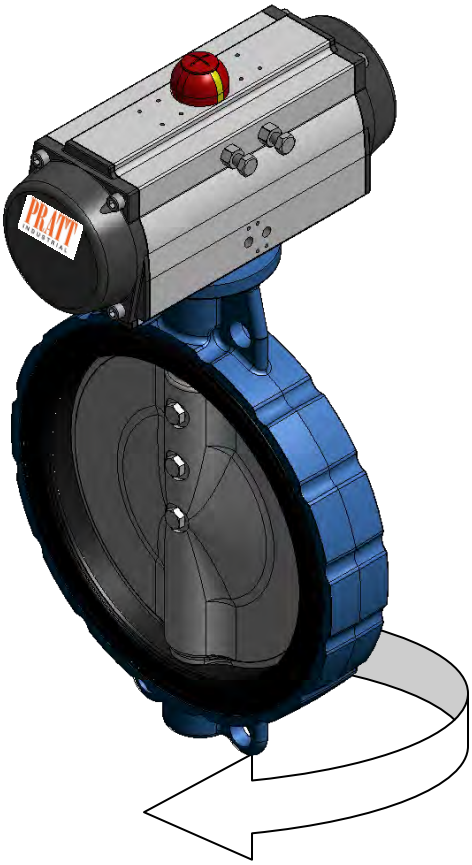


Fig. 5.8

The figure below shows an actuator properly installed on a butterfly valve, and its affect on the valve at different stages of operation. The actuator is direct mounted in line with the pipe and the valve is operating in the FCW configuration.



Valve Closed

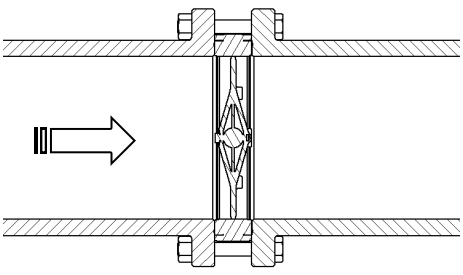
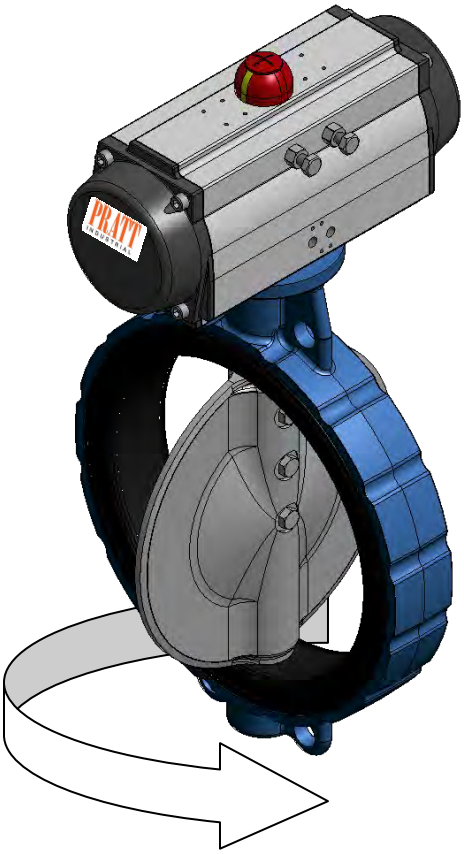


Fig. 5.9



Valve Open

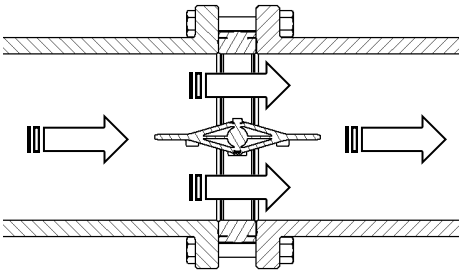


Fig. 5.10

VI. Travel Stop Adjustment

PRATT actuators have open and close travel stops for +5°/-5° of travel.

A. Setting The Stops on Double Acting Units

1. Operate the actuator assembly to the closed position.
2. Remove/lockout the air supply to the actuator.
3. Loosen the locknut on the closed stop.
4. Turn the closed stop clockwise to reduce or counterclockwise to increase the travel.
5. Retighten the locknut.
6. Reconnect the air supply to check that the position desired is correct. If not repeat.
7. Operate the actuator assembly to the open position.
8. Remove/lockout the air supply to the actuator.
9. Loosen the locknut on the open stop.
10. Turn the top clockwise to reduce or counterclockwise to increase the travel.
11. Retighten the locknut.
12. Reconnect the air supply to check that the position desired is correct. If not repeat. items 7-11.

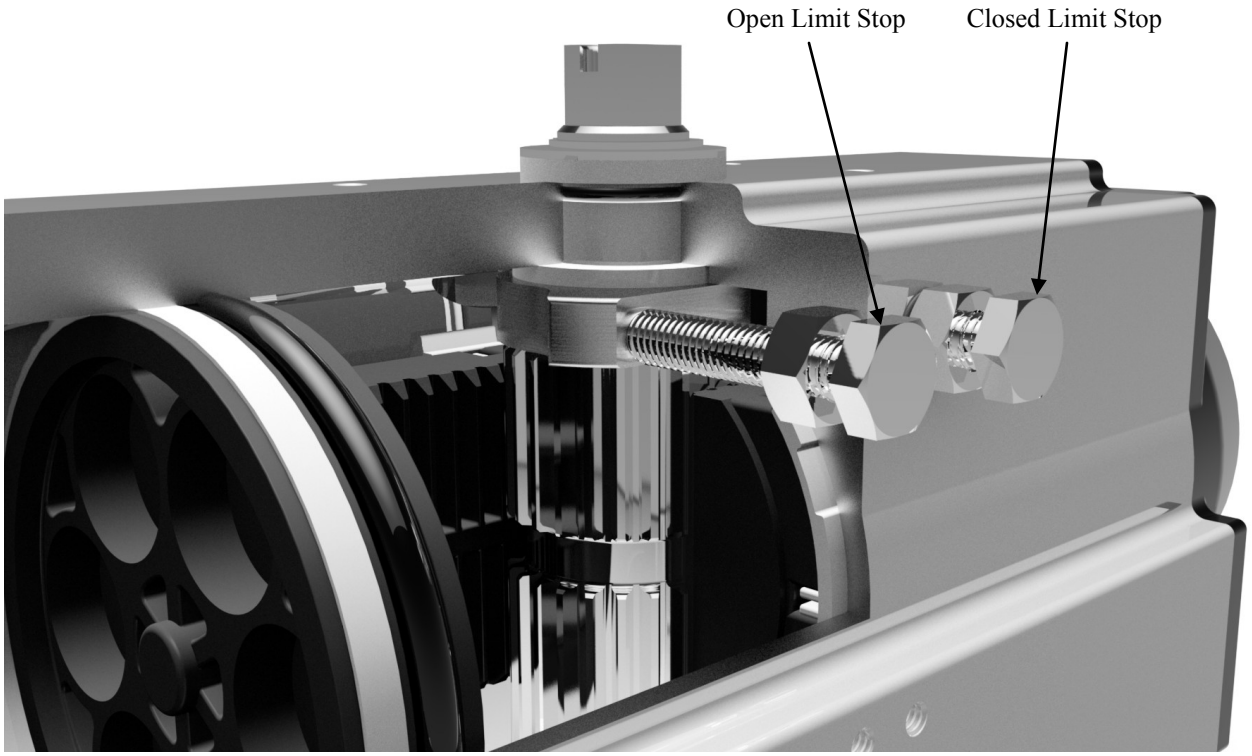


Fig. 6.1

The above illustration shows a double acting actuator in the open position and identifies the opening and closing limit stops.

B. Setting The Stops on Spring Return Units (Fail Closed)

1. Remove the air supply to the A port. Actuator will move to the closed position. Please note the position of the actuator.
2. Apply air to open the actuator. Please note the position of the actuator in the open position.
3. While the air supply is maintained carefully loosen the locknut on the closed stop and adjust the stop to the correct position desired.
4. Retighten the locknut.
5. Remove the air supply and the actuator will go to the closed position desired.
6. If the correct position is not achieved repeat 1-5.
7. Loosen the locknut on the open stop and adjust the travel desired. (Clockwise adjustment decreases travel.)
8. Retighten the locknut.
9. Apply air and check the open position. If not correct repeat instructions 5-8.

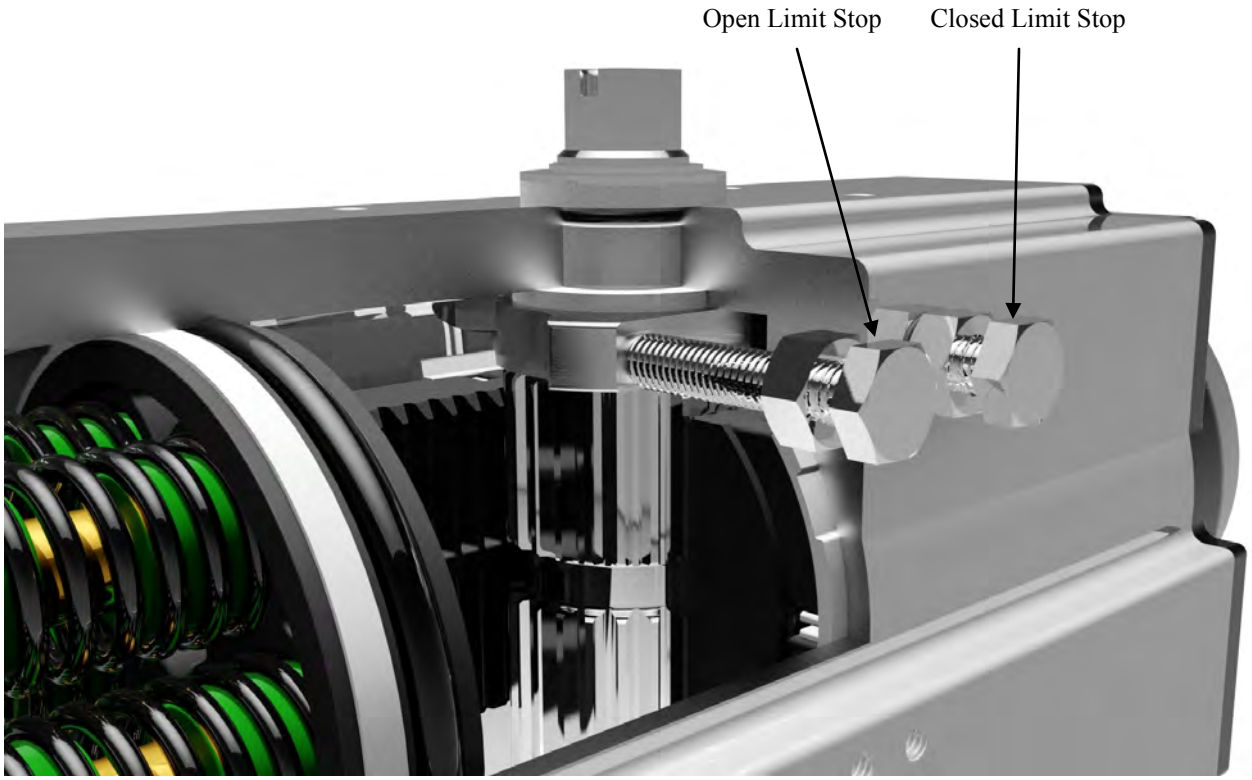


Fig. 6.2

The above illustration shows a spring return actuator (FCW configuration) in the open position and identifies the opening and closing limit stops.

C. Setting The Stops on Spring Return Units (Fail Open)

1. Remove/lockout the air supply to the actuator and it will drive to the open position. Note the position of the actuator.
2. Apply air to close the actuator. Note the position of the actuator while the air supply is maintained, loosen the locknut on the open stop and adjust the stop to the correct position desired.
3. Retighten the locknut.
4. Remove/lockout the air supply to the actuator so that it opens, if it is not the correct position repeat items 1-3.
5. Loosen the locknut on the close stop and adjust the travel by the amount desired to give the correct position. (Clockwise adjustment decreases travel.)
6. Retighten the locknut.
7. Reapply air and check the closed position. If not desired closed position repeat items 1-5.

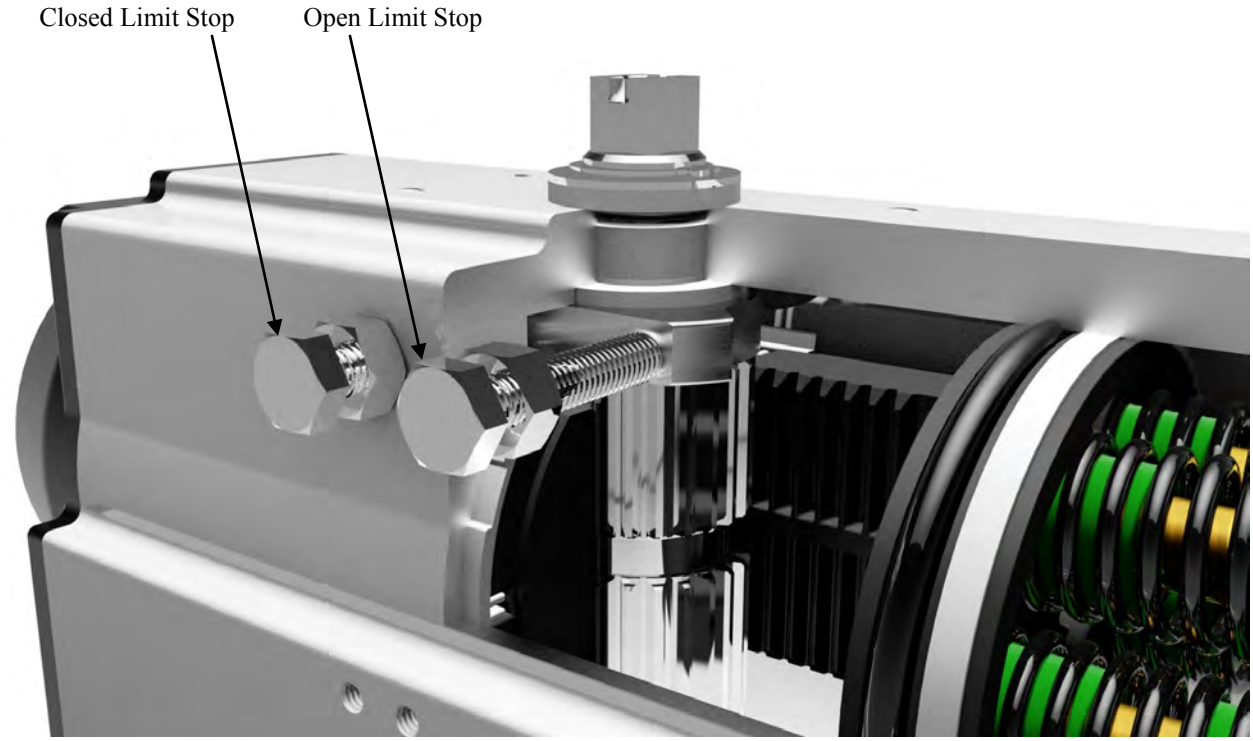


Fig. 6.3

The above illustration shows a spring return actuator (FCCW configuration) in the open position and identifies the opening and closing limit stops.

VII. Actuator Disassembly

A. Steps to Actuator Disassembly

1. Disconnect all electrical and air supplies from the actuator.

2. Ensure the actuator is depressurized and in the fail position.

3. Remove actuator from mounting bracket and coupling, and any limit switches, manual overrides, positioners and other pneumatic accessories (where applicable), and place in a clean environment.

4. Place actuator on end and evenly loosen all end cap screws until you are able to remove the end cap.

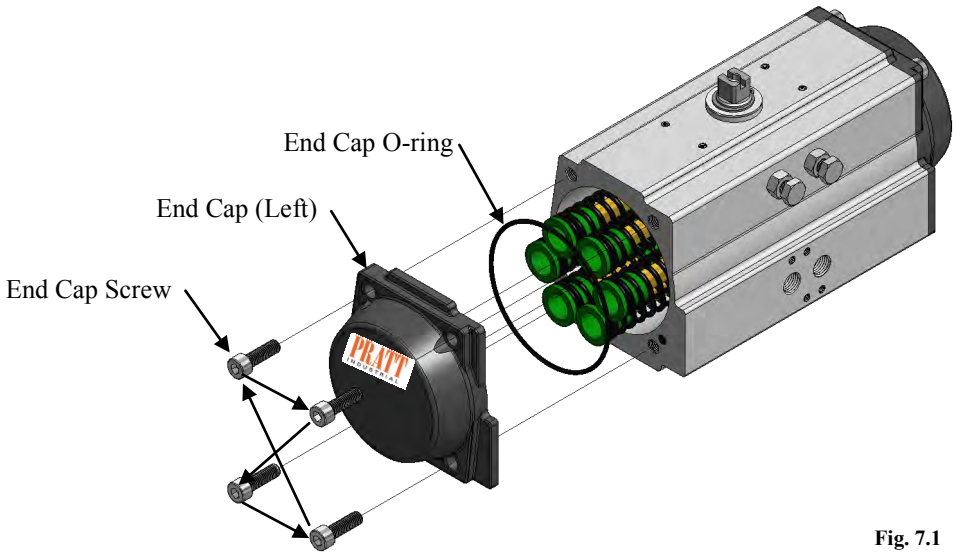


Fig. 7.1

NOTE: After 4-6 turns of the end cap bolt, the springs should be decompressed.

WARNING!
Never attempt to assemble, disassemble, or otherwise modify an actuator while still in service! Disconnect both pneumatic and electrical power from the actuator and ensure it's completely exhausted before making any adjustments!

5. Remove any springs and repeat for the other side.

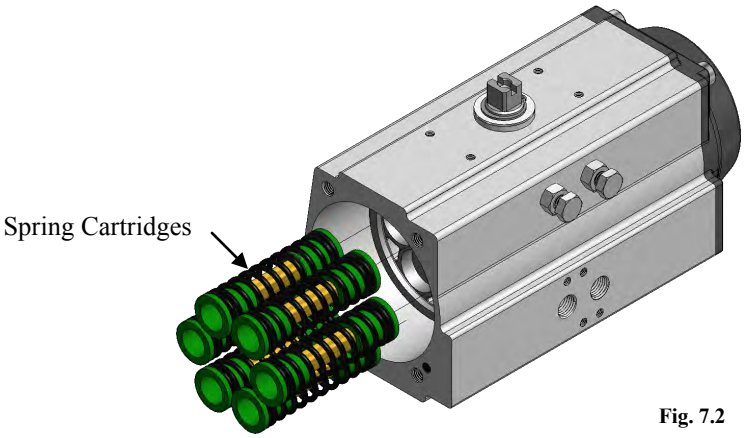


Fig. 7.2

6. Loosen both limit stop nuts then remove both limit stop bolts to allow full rotation of the pinion.

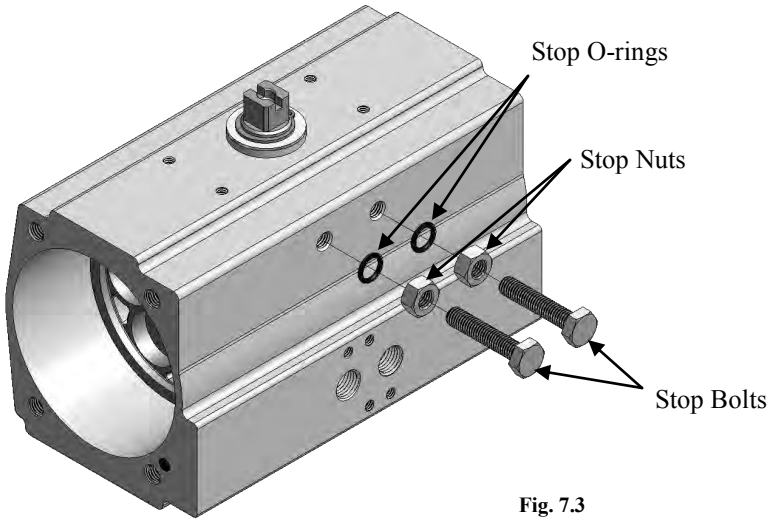


Fig. 7.3

7. Rotate the pinion counterclockwise to push the pistons away from each other until they completely disengage from the pinion. (NOTE: This is for standard FCW configuration actuators. For non-standard units rotation may be reversed. For possible actuator configurations see pg.11)

8. Remove both pistons noting their orientation so they can be replaced in the same orientation during reassembly.

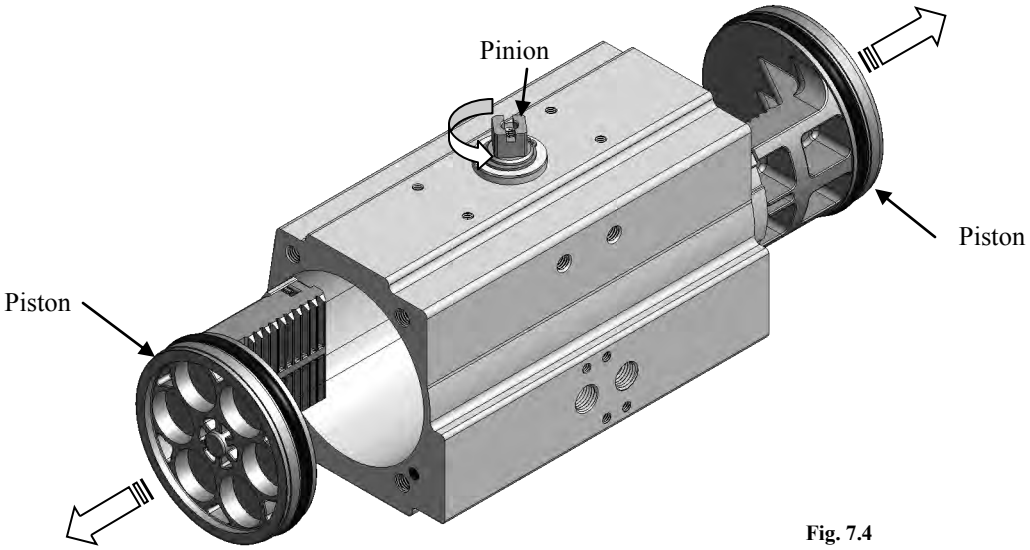


Fig. 7.4

9. Remove pinion circlip, pinion washer, and flange bearing from top of pinion.

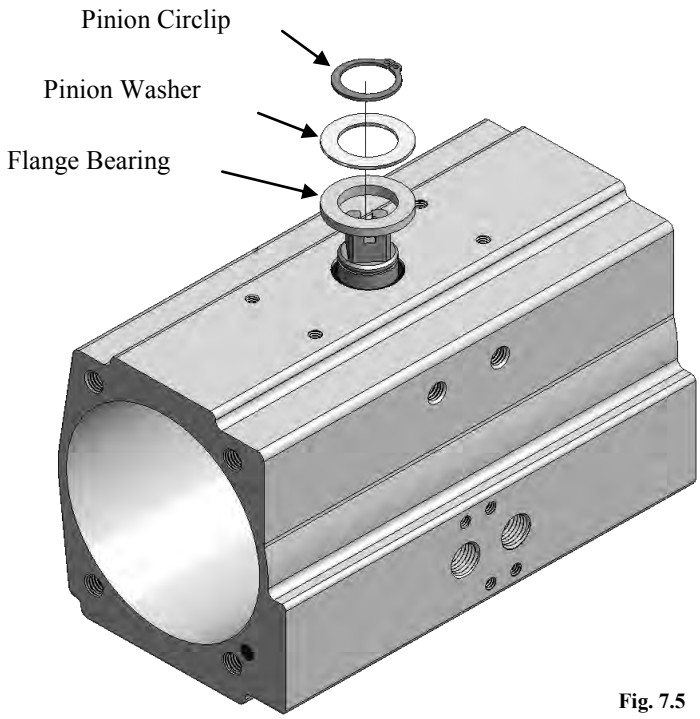


Fig. 7.5

10. Slide pinion down through the bottom of the actuator until you can remove the pinion cam, thrust bearing, and upper pinion o-ring from the top of the pinion. Note the orientation of the pinion cam so it can be replaced in the same position during reassembly.

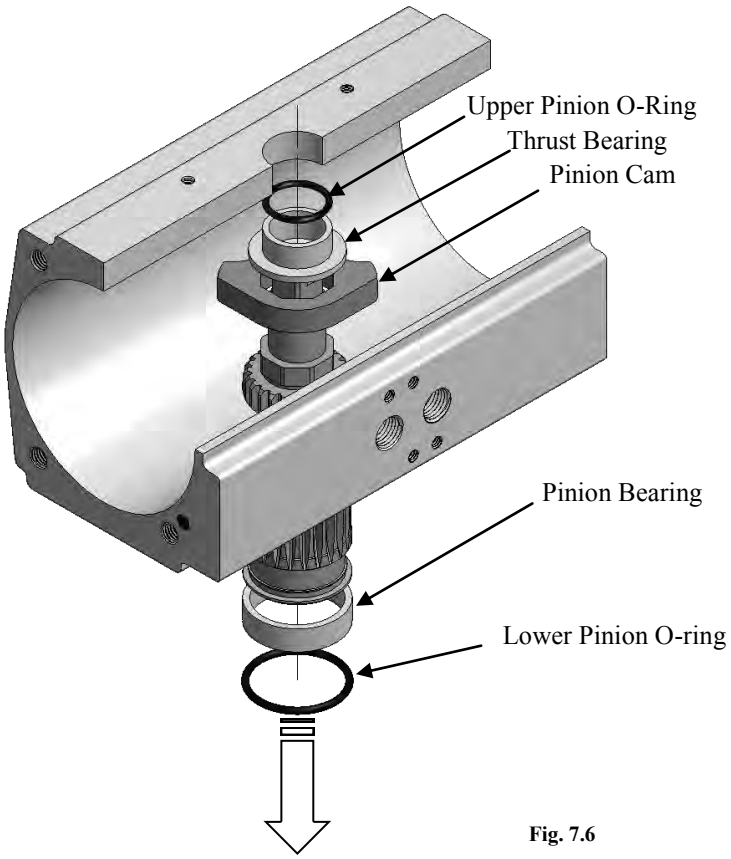


Fig. 7.6

VIII. Maintenance and Temperature Change

A. Repair Kit Overview

Any time maintenance is preformed on an actuator, it is necessary to replace all O-rings, grease, and bearings to insure the longest life. During maintenance all parts should be wiped clean of grease using a clean cloth, and parts should be lubricated with the fresh grease for the correct temperature application before reassembly. Below are diagrams showing the assembly of these parts and the contents of a PRATT repair kit.

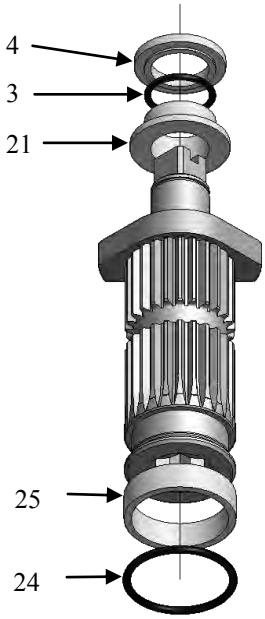


Fig. 8.1

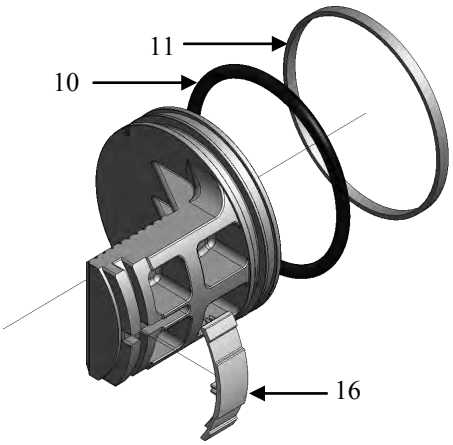


Fig. 8.2

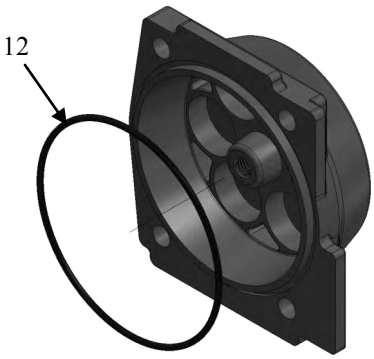


Fig. 8.3

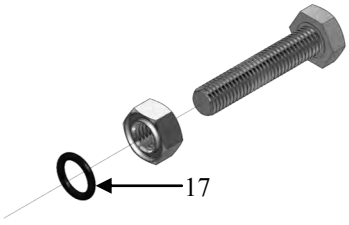


Fig. 8.4

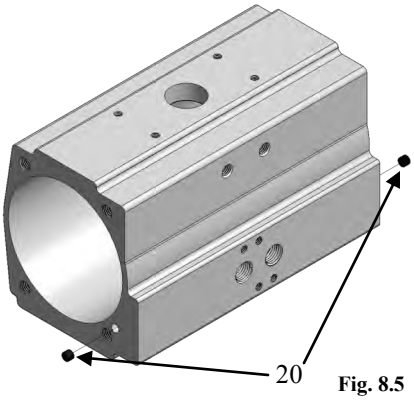


Fig. 8.5

Parts List for PRATT Repair Kit			
Item	Qty	Part	Material
3	1	Upper Pinion O-ring	NBR*
4	1	Flange Bearing	Delrin**
10	2	Piston O-ring	NBR*
11	2	Piston Guide	Bronze Impregnated PTFE
12	2	End Cap O-ring	NBR*
17	2	Stop O-ring	NBR*
16	2	Piston Skate	Delrin**
20	2	Air Channel Plug	NBR*
21	1	Thrust Bearing	Delrin**
24	1	Lower Pinion O-ring	NBR*

*Material will change to Viton for High temperature applications and a low temp NBR blend for low temperature applications.
**Material will change to PPSU for high temperature applications.

B. Installing Repair Kit or Changing Temperature Rating

Follow the listed steps to install a repair kit or change temperature applications. For reference the various temperature specifications and materials can be found on pg. 9 of this manual.

1. Disassemble actuator as described in on pg. 21-24.

2. Remove the O-rings and bearings from the various actuator components:
   (See fig. 8.1-8.5 on the previous page for list of parts to be replaced and their locations)
   a. Piston O-rings (2)
   b. End Caps (2)
   c. Upper Pinion O-ring (1)
   d. Lower Pinion O-ring (1)
   e. Air Passage Plugs (2)
   f. Stop O-rings (2)
   g. Pinion Bearing (1)
   h. Thrust bearing (1)
   i. Flange Washer (1)

3. Using mineral spirits (or other mild solvent), remove the lubrication from each actuator component. (Note: clean all surfaces thoroughly prior to installation of new O-ring set.)

4. Separate O-rings and determine the locations for installation:
   a. Piston O-rings: will be the thickest O-rings (2 pieces), (#10 fig. 8.2)
   b. End Cap O-rings: will have the largest O-ring diameter (2 pieces), (#12 fig. 8.3)
   c. Pinion O-rings: of the remaining O-rings, the largest is installed in the lower pinion O-ring groove (#24 fig. 8.1). The second largest is installed on the top of the pinion (#3 fig. 8.1).
   d. Air Channel Plugs: the small cylinders fit in the ends of the body (2 pieces), (#20 fig. 8.5).
   e. Stop O-rings: will have the smallest O-ring diameter (#17 fig. 8.4).
   (Note: if these O-rings are not properly seated, they may be pinched during reassembly and subsequently leak.)

5. Identify bearing parts and their installation locations:
   a. Piston Skates (#16 fig. 8.2)
   b. Thrust Bearing (#5 fig. 8.1)
   c. Flange Bearing (#4 fig. 8.4)

6. Apply light grease to the internal portions of the actuator for ease of reassembly:
   a. Inner bore of actuator.
   b. Piston wear surfaces (piston skate, piston bearing & piston O-Ring).
   c. Piston rack (apply on the full length of the piston rack).
   d. Pinion gear teeth.
   e. Pinion wear surfaces and O-rings (both upper and lower areas).

7. Assemble actuator as described on pg. 27-31. If the O-rings are difficult to install, the O-rings may be slightly stretched and lubricated to ease installation. (Note: be sure to use the lubricant provided when lubricating the O-rings.) When installing the end cap O-rings, be sure to seat the O-ring properly, a thin layer of grease will help hold the O-ring in place.

IX. Actuator Assembly

A. Steps to Actuator Assembly

The directions below assume the actuator has been disassembled. Please refer to pg. 21 if this process has not been completed.

1. Inspect all wear surfaces for excessive wear or possible damage.

2. Install all bearings and o-rings as follows (PRATT recommends if an actuator has been in service to replace all seals and guides. Please refer to pg.25 for available kits):
    a. Pinion: Install lower pinion bearing and lower pinion o-ring. (Fig. 9.1)
    b. Pistons: On each piston install the bearing, o-ring, and skate. (Fig. 9.2)
    c. Body: Insert the thrust bearing into the top pinion hole as shown. (Fig 9.3)

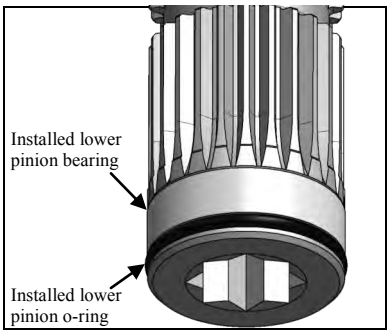


Fig. 9.1

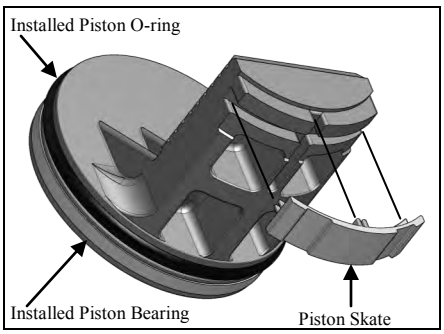


Fig. 9.2

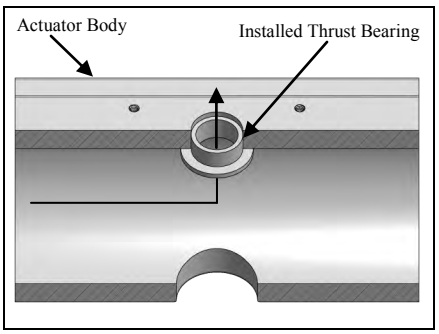


Fig. 9.3

3. Using the correct grease, (consult your PRATT representative for your specific temperature application) lubricate the inside of the cylinder, all o-rings, piston skates, piston and pinion guides. The teeth of the racks and pinion should be greased so that the grooves between teeth are roughly half filled with grease while all previously mentioned surfaces should be lightly coated.

4. Slide the top half of the pinion into the bottom of the actuator, orient the cam on top of the pinion according to desired operating direction (see Fig 9.4 and 9.5 below) then slide the pinion the rest of the way through the body until it stops. (see pg.11 for more information about possible configurations).

Fig. 9.4

Fig. 9.5

Both illustrations above show standard orientation of the cam/pinion at the actuator fail position (the pinion cam has been colored blue for contrast). In fig. 9.4 the cam configuration shown is intended for fail closed applications. In Fig. 9.5 the configuration shown is intended for fail open applications. It is important to note that the above cutaway view assumes that the stops and air ports of the actuator are facing the viewer. Once installed, look down the bore of the actuator and ensure that the cam is aligned properly with both the top of the pinion and the pinion drive in both the closed and open positions.

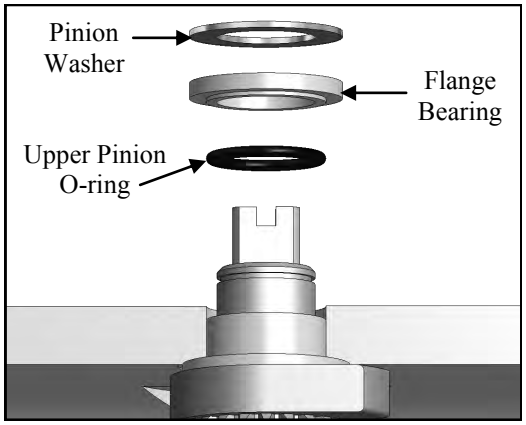


Fig. 9.6

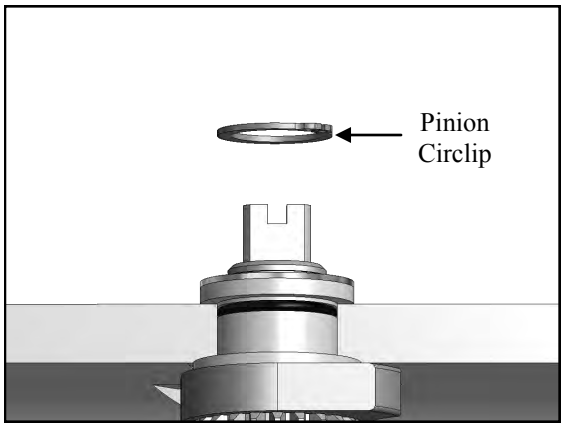


Fig. 9.7

5. Press the top pinion o-ring into the inset around the top of the pinion then install the flange bearing and top pinion washer (Fig. 9.6). Use a pair of circlip pliers to install the pinion circlip (Fig. 9.7) Be careful not to expand the circlip too much as it may be damaged if over expanded.

6. Assemble the actuator stop screws by threading the stop nut onto the stop bolt and fitting the stop o-ring into the groove on the stop nut.

7. Using the proper sized crescent wrench on the pinion, rotate the pinion to the (actuator) closed position. Check the cam to make sure of correct orientation before threading in the closed limit stop until it touches the pinion cam. Tighten the locknut to secure the stop in place. This will ensure that the cam remains in the correct orientation during the installation process.

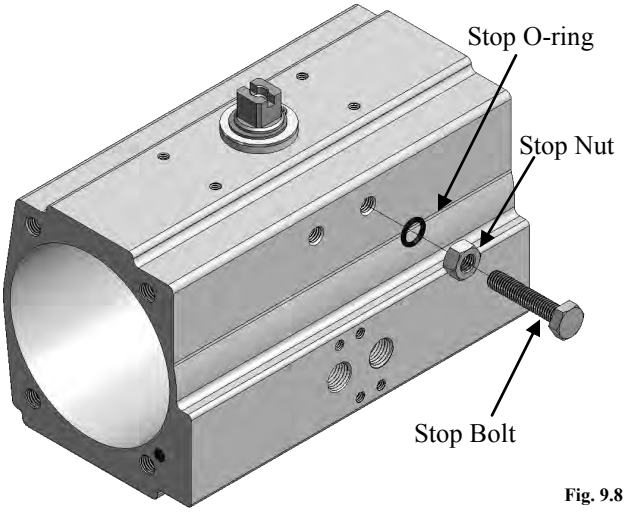


Fig. 9.8

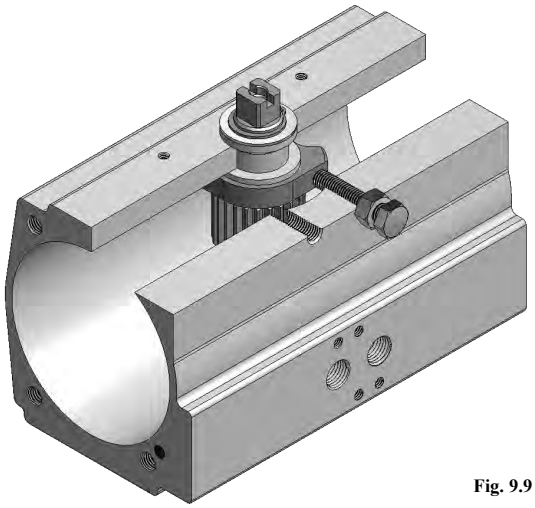


Fig. 9.9

8. Rotate the pinion to the open position. Orient the pistons correctly according to your operation type and slide them into the body until both racks engage with the pinion. (For correct orientation of pistons refer to p.34 of this manual)

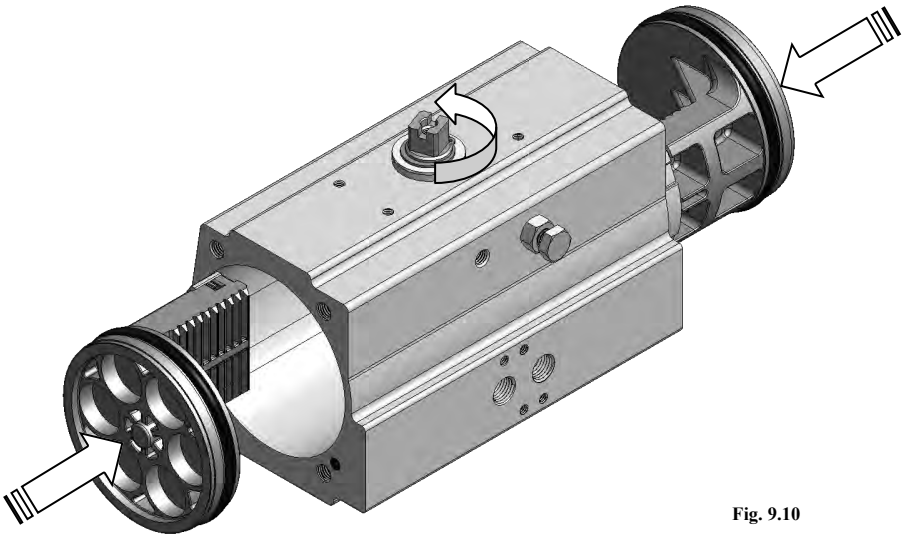


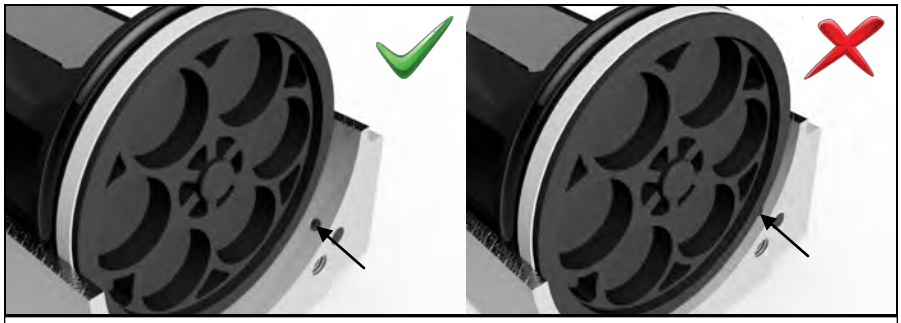
Fig. 9.10

9. Check closed position. Likely, the actuator will stop before the closed position either because of uneven engagement of the racks or because of improper orientation of the pinion. In either case, turn the actuator on end and while applying light but firm pressure to the top piston rotate to pinion so that it slowly backs the pistons out of the actuator until you feel the pinion skip a tooth. Apply even pressure to both pistons and recheck closing position. Max over travel at close (closed stop disengaged) should be roughly 5 degrees. Repeat until the actuator operates correctly. Before proceeding use the checklist below entitled “Piston Calibration Checklist” to ensure correct operation of the actuator. If the answer to any question below is “no”, disengage the pinion from the pistons and repeat from step 8.

Piston Calibration Checklist

To ensure pistons are aligned correctly check the following

-Closed position:	Does the actuator close with the pinion correctly aligned?
-Travel:	Does the actuator travel a full 90°?
-Open position:	At fully opened position is the pinion aligned correctly?
	At fully opened position is the air inlet blocked? (See Below)
-Pistons:	Are both pistons equal distances inside the body?



The arrow in both illustrations above points to the air inlet while the actuator is in the fully open position.
In the illustration on the left the air inlet is unobstructed and the actuator will function normally.
In the illustration on the right the inlet is obstructed and the pistons need to be realigned.

10. After you have ensured the pistons are correctly installed in the actuator, move the actuator to the open position, set the open stop the same way as the closing stop in step 8, then close the actuator.

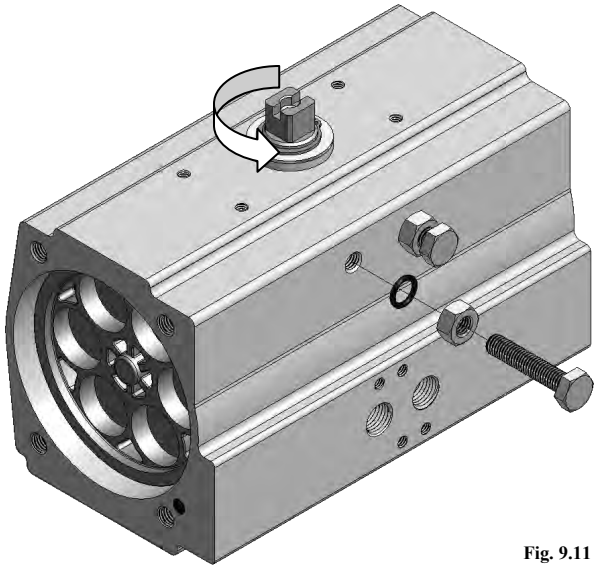


Fig. 9.11

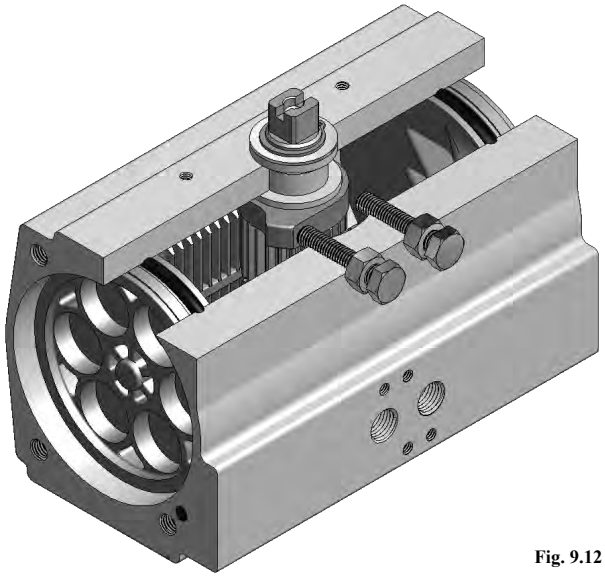


Fig. 9.12

11. At this point, if the actuator is a spring return type, install any springs that are to be used. See pg. 32 for correct spring configurations and designations. If the actuator is double acting, proceed to the next step.

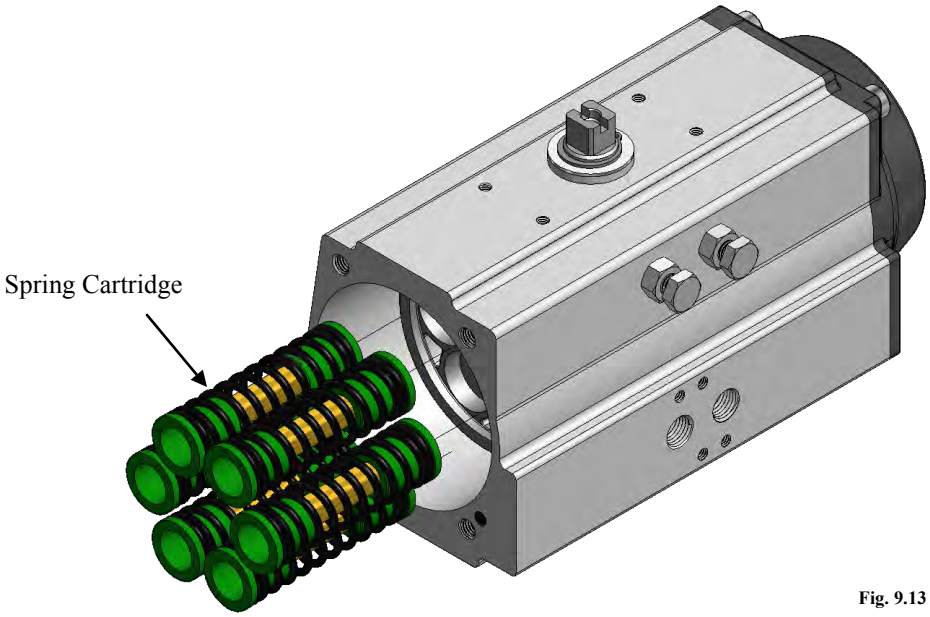


Fig. 9.13

12. After ensuring the end cap O-ring is in place and lubricated, place the end cap on the actuator and tighten it using the end cap screws. Tighten the screws incrementally in the pattern shown below (Fig. 9.14) to evenly seat the end cap onto the actuator, then repeat this for the opposing end cap.

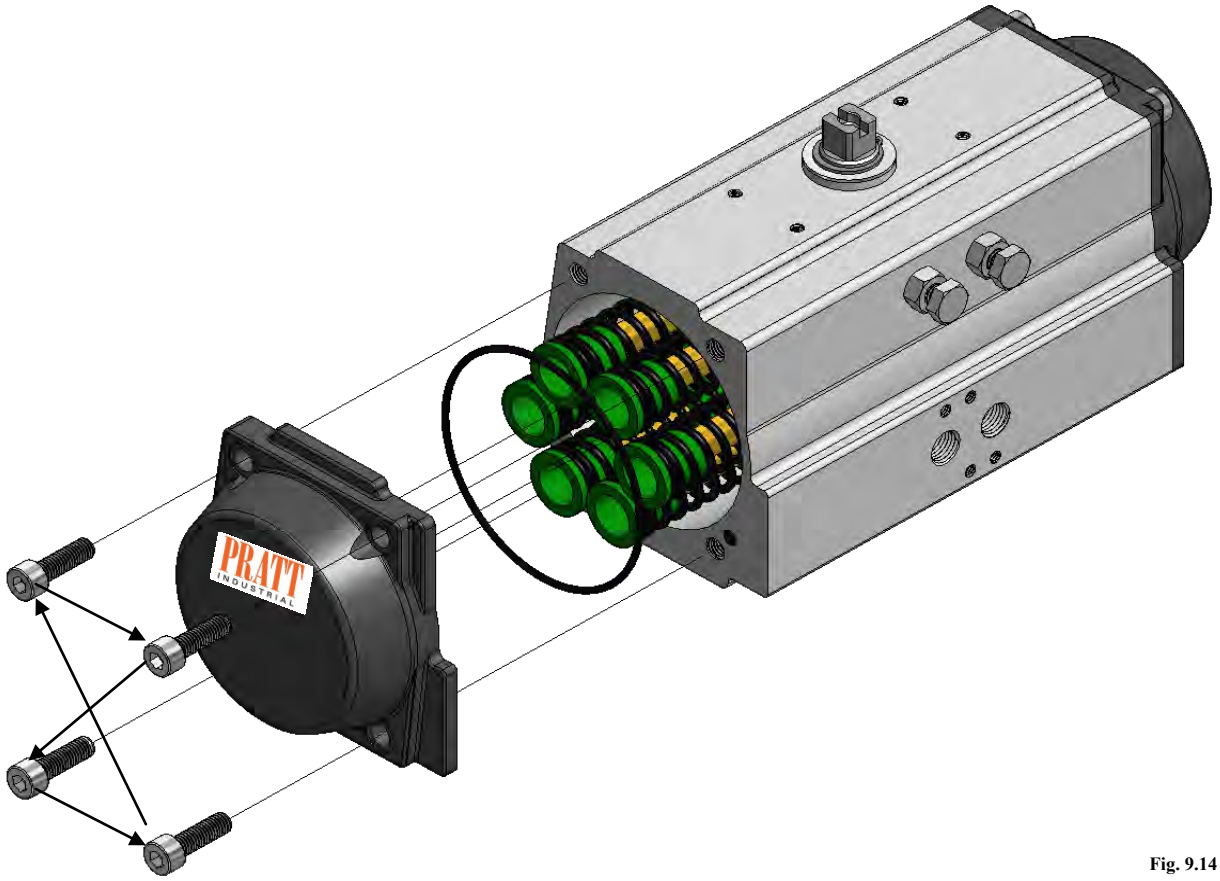
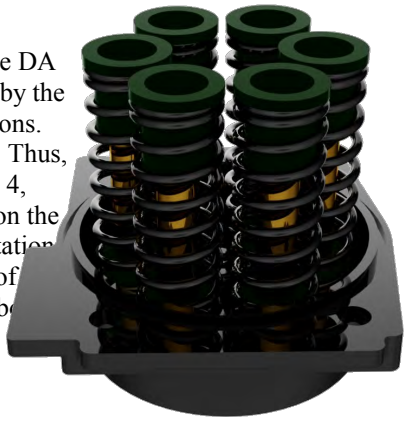


Fig. 9.14

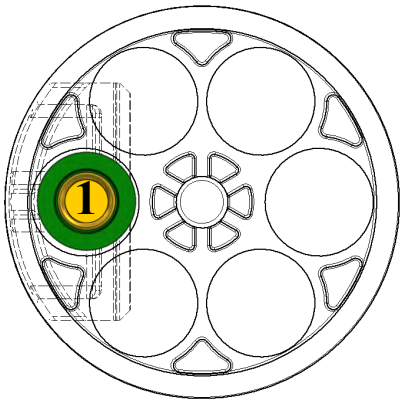
13. Once assembled, the actuator must be tested as outlined on pg. 33 before returning to service.

B. Spring Configurations

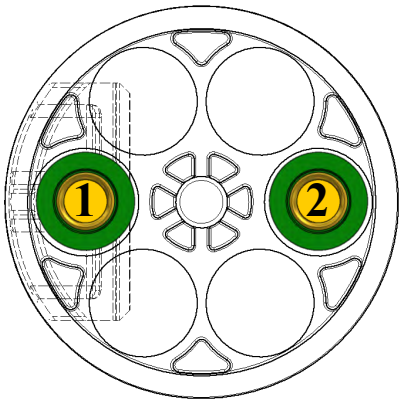


The PRATT PIK series actuator uses fully encapsulated, preloaded spring cartridges that are easily configured for adjustable spring return torque. While DA (double acting) refers to an actuator without springs, the letter "K" followed by the number of springs in each end cap is used for the different spring configurations. Below are the proper spring configurations as seen from the back of a piston. Thus, a K11, K22, and K33 actuator will have 1, 2, and 3 springs ***per piston*** (i.e. 2, 4, and 6 springs ***per actuator***) respectively. Note the dotted outline of the rack on the left side of the piston illustrations below. The rack location determines orientation of the springs, and the configurations below allow for the most efficient use of spring force as well as balancing it across the face of the pistons. Doing this b increases the efficiency and the life of the PRATT actuator.

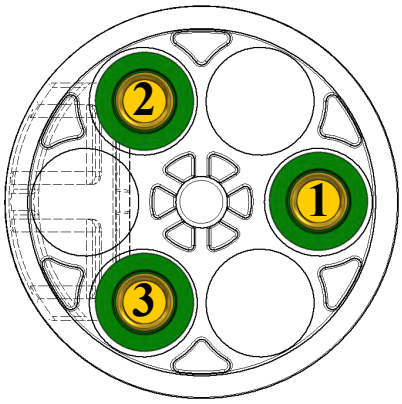
K11



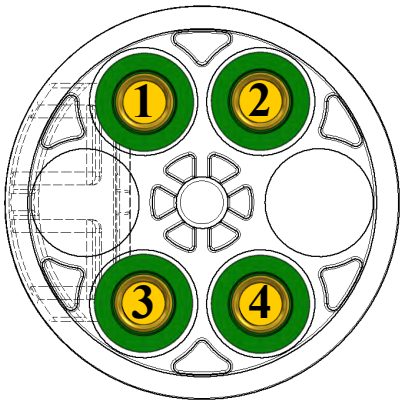
K22



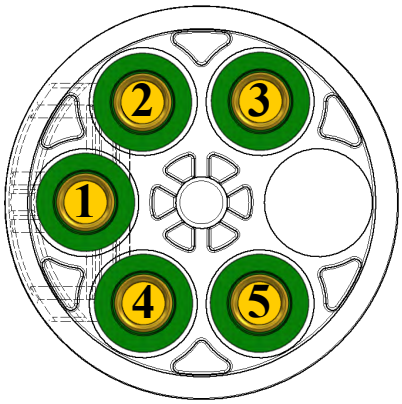
K33



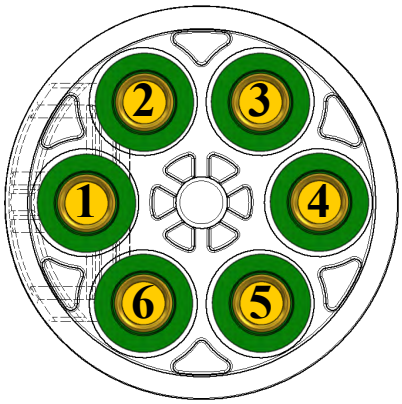
K44



K55



K66



C. Air Leak Test

Any time the actuator is modified or undergoes maintenance, a leak test needs to be completed to insure the actuator is air tight and working correctly.

To perform an air leak test:

1. Use a soap and water mixture to coat the actuator at the designated points below:
    a. Around the base of the pinion neck (1).
    b. Around the base of the stops (2).
    c. Endcaps (3)
    d. The pinion base (4).

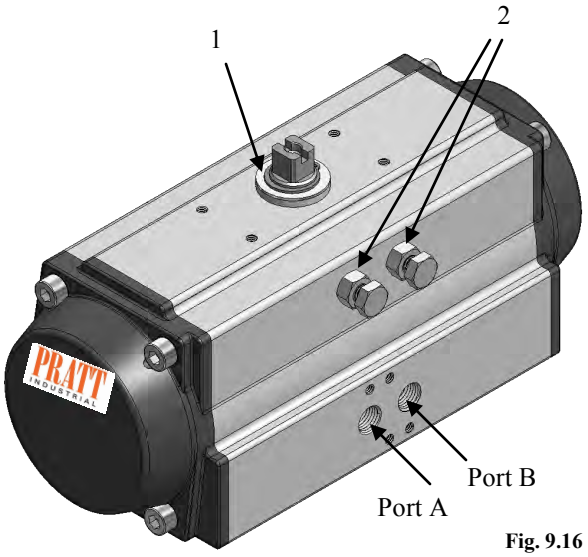


Fig. 9.16

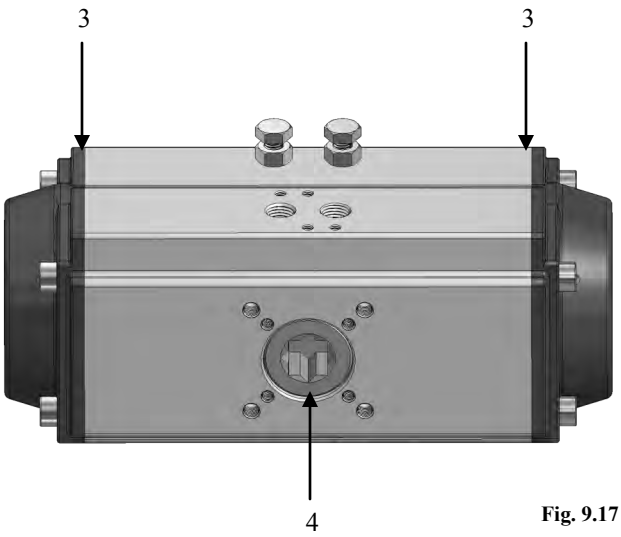


Fig. 9.17

2. Apply air pressure to ports A and B (max 8bar/120psi). Any air leaks will be indicated with the soap bubbling.

3. In case of leakage around:
    a. The limit stop bolts: check for o-ring damage, if none is found, turn the lock nut tighter until it no longer leaks.
    b. The endcaps: Disassemble the endcaps and check the o-ring for damage, if none is found ensure the endcaps are properly seated and tightened.
    c. The pinion top or bottom disassemble the actuator, replace the o-rings and reassemble.

D. Changing Fail Configurations

Follow these steps to change the fail configuration of the actuator:

1. Disassemble the actuator as described on pg.21 steps 1-7.
2. Using the proper size crescent wrench, rotate the pinion to its new orientation when in the "fail" position (actuator closed), and set the new closed stop.
3. Check the cam to make sure the flat side of the cam is making contact with the stop.
4. Rotate the pinion to the new open position.
5. Rotate the pistons 180 degrees from their original orientation and insert them into the actuator.
6. Finish assembling the actuator as described on pg. 29 starting at step 10.

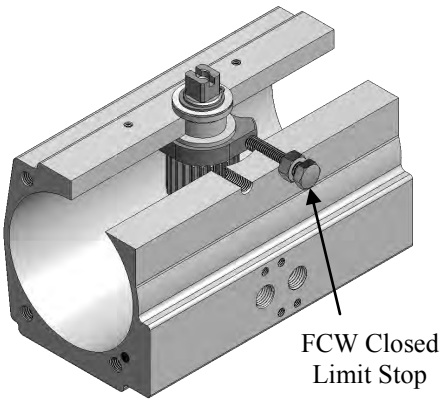


Fig. 9.18

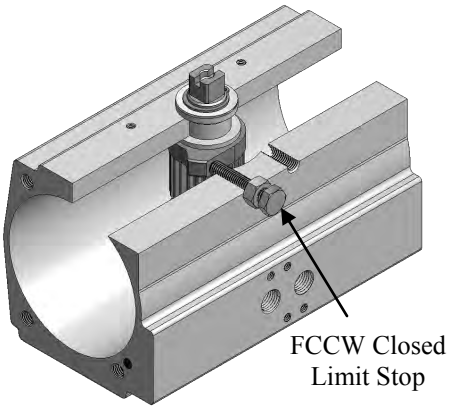


Fig. 9.19

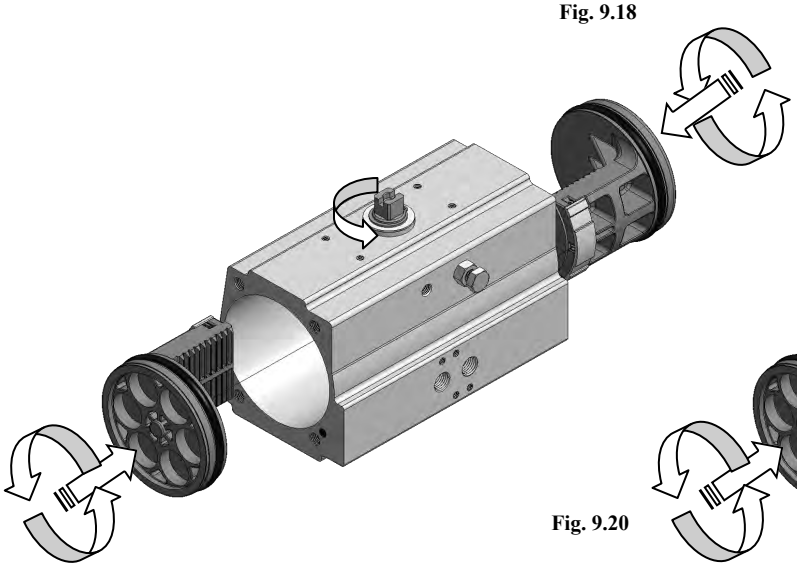


Fig. 9.20

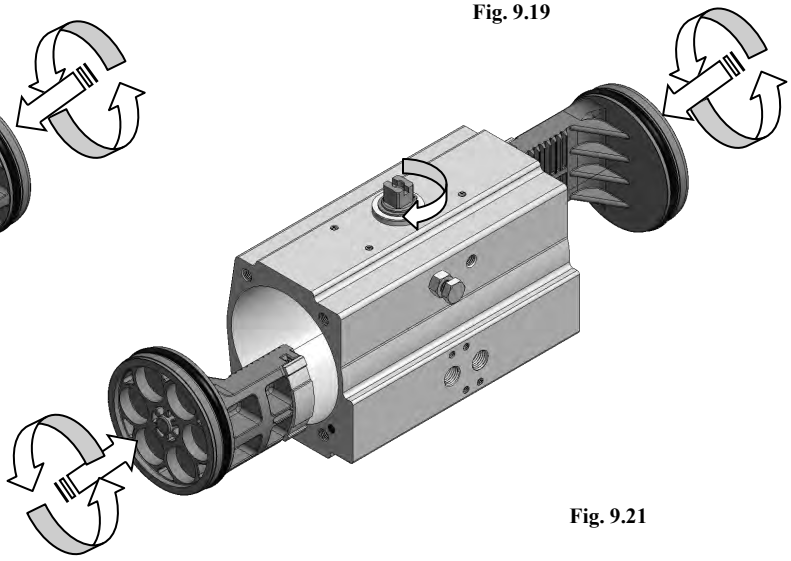


Fig. 9.21

The illustrations above show the "fail" orientation of the pinion for the FCW configuration (Fig. 9.18) and the FCCW configuration (Fig. 9.19) as described in step 2 above. Also shown above is the correct location for the closed limit stops for each configuration. Figs. 9.20-9.21 illustrate adjustments that must be made when going from FCCW to FCW (Fig. 9.20) or when going from FCW to FCCW (Fig. 9.21). Note pinion has been rotated to its new opening position and the pistons have been rotated 180° from their original position before being inserted into the body.

X. Automation Accessories

A. Speed Control

The PRATT Speed Control
(UT-SC)

The Tamper Resistant PRATT Speed Control
(UT-SC-TR)

The PRATT Speed Controller accurately adjusts the speed of the actuator for precise control of the open/close speed for the valve. The UT-SC can be mounted directly on the actuator or can be used with a Namur solenoid valve and/or positioner. Speed controllers can be used with spring return or double acting actuators. The PRATT speed control also comes in a tamper resistant version, the UT-SC-TR. The UT-SC-TR offers the same precise speed control along with a tamper proof design. Adjustments must be made with a flat head screw driver, providing extra protection against inadvertent operation.

B. Purge Block/Rebreather

The PRATT Purge Block/Rebreather

The UT-PB provides an air purge function that prevents external air from being drawn into the spring chamber during the actuator stroke. This can significantly increase the service life of the actuator by protecting the internal components, springs and seals from corrosive outside contaminates. The UT-PB purge valve also provides a quick exhaust function that increases the fail position speed of spring return actuators. Air is directly exhausted from the module without having to flow through the solenoid valve. The module is easily wafer mounted between a NAMUR style solenoid and actuator without the need for tubing or fittings. The air inlet includes a ¼" NPT thread design for use with different solenoid valves.

C. Airlock

The PRATT Airlock
(UT-AL)

The UT-AL airlock “block and vent” device blocks the supply of air from both the solenoid valve and the actuator while it vents all compressed air from the actuator. This allows for safer operation when manual control of the valve is necessary. An option for added lockout safety per OSHA requirements is available.

XI. Series Torque Information

NOTE: For help with sizing contact PRATT or use the sizing calculator online found at www.PRATTINDL.com.

A.

PIK Series Double Acting Torques (in-lbs)										
PRATT Size	Air Supply Pressure									
	30PSI	40PSI	50PSI	60PSI	70PSI	80PSI	90PSI	100PSI	110PSI	120PSI
10	42	57	71	85	99	113	127	141	155	170
20	72	96	119	143	167	191	215	239	263	287
34	128	170	213	255	298	340	383	425	468	510
48	181	241	301	361	422	482	542	602	663	723
75	277	369	461	553	646	738	830	922	1014	1107
105	408	544	680	816	952	1088	1224	1360	1496	1632
157	590	787	984	1181	1377	1574	1771	1968	2165	2361
237	892	1190	1487	1784	2082	2379	2676	2974	3271	3569
331	1244	1658	2073	2487	2902	3316	3731	4145	4560	4974
406	1526	2035	2543	3052	3561	4069	4578	5087	5595	6104
633	2374	3166	3957	4749	5540	6332	7123	7914	8706	9497
1009	3787	5049	6312	7574	8836	10099	11361	12624	13886	15148
1260	4723	6297	7871	9445	11020	12594	14168	15742	17316	18891
1831	6869	9158	11448	13737	16027	18316	20606	22895	25185	27475
2928	10981	14641	18301	21962	25622	29282	32942	36603	38250	43923

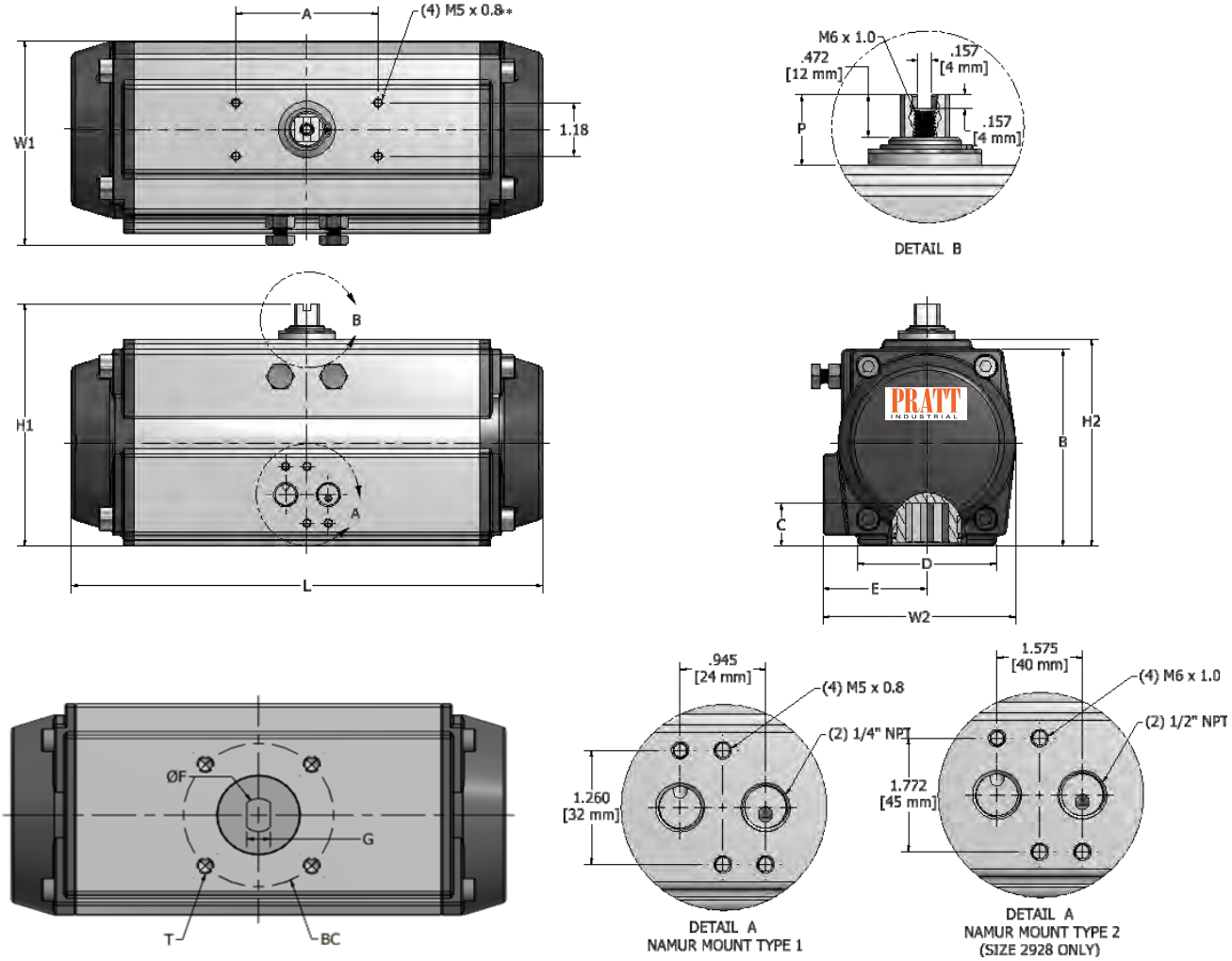
B.

PIK Series Spring Return Torques (in-lbs)													
PRATT Size	Spring Designation	Actuator Air Torques										Actuator Spring Torques	
		40PSI		60PSI		80PSI		100PSI		120PSI			
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
20	K11	81	75	129	122	177	170	225	218	272	266	21	14
	K22	67	53	115	101	162	149	210	197	258	245	42	29
	K33	53	32	100	80	148	128	196	176	244	224	63	43
	K44	38	11	86	59	134	107	182	155	229	203	84	57
	K55	-	-	72	38	120	86	167	134	215	181	105	71
	K66	-	-	58	17	105	65	153	113	201	160	126	86
34	K11	145	133	229	217	314	301	398	385	482	469	36	23
	K22	122	97	206	181	290	265	375	349	459	434	71	46
	K33	99	61	183	145	267	230	352	314	436	398	107	69
	K44	76	26	160	110	244	194	328	278	413	362	143	92
	K55	-	-	137	74	221	158	305	242	390	327	178	115
	K66	-	-	114	39	198	123	282	207	367	291	214	138
48	K11	203	189	322	308	441	428	561	547	680	666	49	36
	K22	167	140	287	259	406	378	525	498	644	617	99	71
	K33	132	91	251	210	370	329	490	448	609	568	148	107
	K44	96	41	216	161	335	280	454	399	573	518	197	142
	K55	-	-	180	111	299	231	419	350	538	469	246	178
	K66	-	-	145	62	264	181	383	301	502	420	296	213

PIK Series Spring Return Torques (in-lbs)													
PRATT Size	Spring Designation	Actuator Air Torques										Actuator Spring Torques	
		40PSI		60PSI		80PSI		100PSI		120PSI			
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
75	K11	312	287	494	469	677	652	860	834	1042	1017	78	53
	K22	259	208	441	391	624	573	806	756	989	939	157	106
	K33	206	130	388	312	571	495	753	678	936	860	235	160
	K44	152	52	335	234	517	417	700	599	883	782	314	213
	K55	-	-	282	156	464	338	647	521	829	703	392	266
	K66	-	-	229	77	411	260	594	442	776	625	470	319
105	K11	460	421	729	690	998	960	1267	1229	1536	1498	117	79
	K22	381	304	650	573	919	843	1189	1112	1458	1381	234	157
	K33	303	187	572	456	841	726	1110	995	1379	1264	351	236
	K44	224	70	493	339	762	609	1031	878	1301	1147	468	314
	K55	-	-	415	222	684	492	953	761	1222	1030	585	393
	K66	-	-	336	105	605	374	874	644	1143	913	702	471
157	K11	673	611	1062	1001	1452	1391	1841	1780	2231	2170	168	107
	K22	566	444	956	833	1345	1223	1735	1612	2124	2002	335	213
	K33	459	276	849	666	1239	1055	1628	1445	2018	1834	503	320
	K44	353	109	742	498	1132	888	1522	1277	1911	1667	671	426
	K55	-	-	636	330	1025	720	1415	1110	1805	1499	838	533
	K66	-	-	529	163	919	552	1309	942	1698	1331	1006	639
237	K11	1013	922	1608	1517	2202	2111	2797	2706	3392	3301	268	177
	K22	836	654	1431	1249	2026	1844	2620	2438	3215	3033	535	353
	K33	659	386	1254	981	1849	1576	2444	2171	3038	2765	803	530
	K44	483	119	1078	713	1672	1308	2267	1903	2862	2498	1071	707
	K55	-	-	901	446	1496	1040	2090	1635	2685	2230	1339	883
	K66	-	-	724	178	1319	773	1914	1367	2508	1962	1606	1060
331	K11	1439	1282	2268	2111	3097	2940	3926	3769	4755	4598	376	219
	K22	1221	906	2050	1735	2879	2564	3708	3393	4537	4223	752	438
	K33	1002	531	1831	1360	2660	2189	3489	3018	4318	3847	1128	656
	K44	783	155	1612	984	2441	1813	3270	2642	4099	3471	1503	875
	K55	-	-	1393	608	2222	1437	3051	2266	3880	3095	1879	1094
	K66	-	-	1174	232	2004	1061	2833	1890	3662	2719	2255	1313
406	K11	1745	1596	2763	2614	3780	3631	4797	4648	5815	5666	438	289
	K22	1456	1158	2473	2175	3491	3193	4508	4210	5525	5227	877	579
	K33	1166	720	2184	1737	3201	2754	4219	3772	5236	4789	1315	868
	K44	877	281	1894	1298	2912	2316	3929	3333	4946	4351	1754	1158
	K55	-	-	1605	860	2622	1877	3640	2895	4657	3912	2192	1447
	K66	-	-	1316	422	2333	1439	3350	2456	4368	3474	2630	1737
633	K11	2680	2438	4255	4013	5829	5587	7404	7162	8979	8737	712	469
	K22	2210	1726	3785	3301	5360	4876	6935	6450	8509	8025	1423	939
	K33	1741	1014	3316	2589	4890	4164	6465	5739	8040	7313	2135	1408
	K44	1272	303	2846	1877	4421	3452	5996	5027	7570	6602	2847	1878
	K55	-	-	2377	1166	3951	2741	5526	4315	7101	5890	3558	2347
	K66	-	-	1907	454	3482	2029	5057	3604	6631	5178	4270	2817
1009	K11	4376	3998	6901	6523	9426	9047	11950	11572	14475	14097	1051	673
	K22	3703	2947	6228	5471	8753	7996	11277	10521	13802	13045	2103	1346
	K33	3030	1895	5555	4420	8080	6945	10604	9469	13129	11994	3154	2019
	K44	2357	844	4882	3368	7406	5893	9931	8418	12456	10943	4206	2692
	K55	-	-	4209	2317	6733	4842	9258	7366	11783	9891	5257	3366
	K66	-	-	3535	1266	6060	3790	8585	6315	11110	8840	6308	4039

PIK Series Spring Return Torques (in-lbs)													
PRATT Size	Spring Designation	Actuator Air Torques										Actuator Spring Torques	
		40PSI		60PSI		80PSI		100PSI		120PSI			
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
1260	K11	5371	5002	8520	8150	11668	11299	14817	14447	17965	17596	1295	926
	K22	4446	3707	7594	6856	10743	10004	13891	13152	17040	16301	2590	1851
	K33	3520	2412	6669	5561	9817	8709	12966	11858	16114	15006	3885	2777
	K44	2595	1117	5743	4266	8892	7414	12040	10563	15188	13711	5180	3702
	K55	-	-	4818	2971	7966	6119	11114	9268	14263	12416	6475	4628
	K66	-	-	3892	1676	7040	4824	10189	7973	13337	11121	7769	5553
1831	K11	7729	7185	12285	11741	16840	16296	21396	20852	25951	25407	1926	1382
	K22	6348	5260	10903	9815	15459	14371	20014	18926	24570	23482	3851	2763
	K33	4966	3334	9522	7890	14077	12445	18633	17000	23188	21556	5777	4145
	K44	3585	1408	8140	5964	12696	10519	17251	15075	21807	19630	7703	5526
	K55	-	-	6759	4038	11314	8594	15870	13149	20425	17705	9628	6908
	K66	-	-	5377	2113	9932	6668	14488	11224	19043	15779	11554	8289
2928	K11	11953	11162	18872	18080	25790	24999	32709	31917	39628	38836	2676	1884
	K22	10069	8486	16987	15404	23906	22323	30825	29242	37743	36160	5352	3769
	K33	8184	5810	15103	12729	22022	19647	28940	26566	35859	33485	8027	5653
	K44	6300	3134	13219	10053	20137	16971	27056	23890	33974	30809	10703	7537
	K55	-	-	11334	7377	18253	14296	25171	21214	32090	28133	13379	9422
	K66	-	-	9450	4701	16368	11620	23287	18539	30206	25457	16055	11306

XII. Dimensional Information



Size	L	W1	W2	H1	H2	P	BC1	T1	BC2	T2	A	B	C	D	E	F	G
PIK 10	4.91	3.11	2.38	3.17	2.38	0.79 (20mm)	1.417 (F03)	#10-32 UNF	1.969 (F05)	1/4-20 UNC	3.15		0.55	1.89	1.44	0.433 (11mm)	
PIK 20	5.79	3.15	2.80	3.62	2.83	0.79 (20mm)	1.417 (F03)	#10-32 UNF*	1.969 (F05)	1/4-20 UNC*	3.15		0.59	2.09	1.61	0.433 (11mm)	
PIK 34	6.69	3.50	3.30	4.24	3.46	0.79 (20mm)	1.417 (F03)	1/4-20 UNC	2.756 (F07)	5/19-18 UNC	3.15	3.19	0.71	2.67	1.85	0.551 (14mm)	
PIK 48	7.32	3.90	3.74	4.71	3.93	0.79 (20mm)	3.25	3/8-16 UNC X 0.59 DP			3.15	3.70	1.30	3.07	2.09	0.57	0.38
PIK 75	8.35	4.43	4.06	5.08	4.29	0.79 (20mm)	3.25	3/8-16 UNC X 0.59 DP			3.15	3.88	1.30	3.07	2.25	0.76	0.51
PIK 105	10.43	4.72	4.27	5.38	4.59	0.79 (20mm)	3.25	3/8-16 UNC X 0.59 DP			3.15	4.37	1.32	3.07	2.30	0.76	0.51
PIK 157	10.67	5.16	4.78	6.06	5.28	0.79 (20mm)	3.25	3/8-16 UNC X 0.59 DP			3.15	4.84	1.34	3.62	2.52	0.76	0.51
PIK 237	12.28	5.87	5.61	7.32	6.14	1.18 (30mm)	3.25	3/8-16 UNC X 0.59 DP			3.15/5.12**	5.75	2.32	3.94	2.93	1.13	.25 key
PIK 331	15.04	6.08	5.75	7.68	6.50	1.18 (30mm)	3.25	3/8-16 UNC X 0.59 DP	5.00	1/2-13 UNC X 0.71 DP	3.15/5.12**	6.10	2.36	4.33	2.95	1.13	.25 key
PIK 406	15.51	6.24	5.98	7.99	6.81	1.18 (30mm)	3.25	3/8-16 UNC X 0.59 DP	5.00	1/2-13 UNC X 0.71 DP	3.15/5.12**	6.36	2.32	4.72	3.03	1.13	.25 key
PIK 633	18.11	7.26	6.85	8.98	7.80	1.18 (30mm)	5.00	1/2-13 UNC X 0.71 DP			3.15/5.12**	7.26	2.36	4.72	3.43	1.13	.25 key
PIK 1009	20.87	8.78	8.11	10.28	9.09	1.18 (30mm)	5.00	1/2-13 UNC X 0.71 DP			5.12	8.52	3.11	5.12	4.06	1.63	.38 key
PIK 1260	21.50	9.70	8.90	11.26	10.08	1.18 (30mm)	5.00	1/2-13 UNC X 0.71 DP			5.12	9.29	3.11	5.12	4.45	1.63	.38 key
PIK 1831	25.28	11.42	10.24	12.64	11.46	1.18 (30mm)	6.50	3/4-10 UNC X 1.18 DP			5.12	10.45	3.62	6.30	5.12	1.88	.50 key
PIK 2928	29.13	12.48	11.57	14.17	12.99	1.18 (30mm)	6.50	3/4-10 UNC X 1.18 DP			5.12	11.85	3.62	6.30	5.79	1.88	.50 key

*The size 20 is also available with an F04 (#10-32 UNF on a 1.654 B.C.) mounting pattern in place of the F03/F05.

**Sizes 237-633 have 3.15 x 1.18 and a 5.12 x 1.18 top mounting with (8) M5 x 0.8 threaded holes.

WARRANTY

THE SELLER WARRANTS ITS PRODUCTS AGAINST DEFECTS IN MATERIALS OR WORKMANKSHIP, WHEN USED ON THOSE SERVICES APPROVED BY THE SELLER, FOR A PERIOD OF ONE YEARS FROM THE DATE OF ORIGINAL SHIPMENT. THE SELLER'S LIABILITY UNDER THIS WARRANTY SHALL BE LIMITED TO REPAIR OR REPLACEMENT AT SELLER'S OPTION OF SUCH PRODUCTS. F.O.B. FACTORY, UPON PROOF OF DEFECTS SATISFACTORY TO SELLER. SELLER MAKES NO WARRANTIES, EITHER EXPRESSED OR IMPLIED, EXCEPT AS PROVIDED HEREIN, INCLUDING WITHOUT LIMITATION THEREOF, WARRANTIES AS TO MARKETABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, OR AGAINST INFRINGMENT OF ANY PATENT. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY DIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE, OR LOSES OR EXPENSES RESULTING FROM ANY DEFECTIVE PRODUCTS OR THE USE OF ANY PRODUCT.

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