



Installation and Maintenance Instructions for Grinnell GRP Pneumatic Rack and Pinion Actuators



Introduction

The Grinnell GRP Pneumatic Actuator is a compact, rack & pinion design, conforming to Grinnell standard or direct mount standards or EN ISO 5211 mounting configuration, depending on the drive adaptor installed.

General Pneumatic Systems Recommendations

All Grinnell GRP Actuators are factory lubricated with Molyrace LT2, which is a molybdenum disulfide (MoS₂) grease and, unless the operating environment is extremely harsh, do not require re-lubrication. To maintain maximum efficiency with this, or other pneumatic actuators, we advise that the following basic system recommendations are followed:

1. Where air pipelines are subjected to extremes of temperature, the system should be fitted with suitable air drying equipment.
2. Air control lines should be fitted in accordance with a 'Recommended Piping Practice' and should not have loops, which may trap condensate.
3. All air connection pipe ends should be thoroughly cleaned and deburred after cutting, to ensure that the pipeline is clear of debris.
4. If pipelines are hydraulically tested, then the lines should be "blown down" with pressurized air to clear all traces of water, prior to connecting lines to the actuator.
5. Where pipe fitting sealants are used, they should be applied to the male threads only, to avoid excess compound being forced into the actuator control lines.
6. Where Air Filter Equipment is used, the air filters should be situated in positions that allow easy access to maintain and/or drain.
7. Where pneumatic valve positioners, or pneumatic controllers are fitted to valve actuator assemblies, oil mist lubricated air should not be used unless the manufacturer states specifically that the controllers are compatible with lubricated air.

Note: GRP actuators are rated for air pressure in the range 40psig to 120psig and will withstand a maximum of 150psig.

Construction

GRP actuators are designed to be mounted to quarter turn valves either directly or using the correct mounting brackets/adaptors and sizing procedures.

All models are of the opposed piston type. Each piston incorporates an integral rack which engages with a one piece drive pinion shaft. The drive shaft is Nitrotech(TM) treated for maximum protection and fitted with "engineered polymer" bearings. The actuator body is of extruded aluminum, hard anodized and electrostatic powder coated.

The design features bolt on mounting plate and air connection plate for maximum adaptability. O-rings are used for piston and shaft seals.

For Spring Return actuators, up to four springs per piston can be fitted between the piston head and end cap to suit the available operating air pressure, up to 80 psig with boosters to give 100psig.

Adjustable travel stops are provided for each end of travel to ensure that the actuator will open and close the valve precisely.

The output drive can be either a keyed bore or female square (star) conforming to EN ISO 5211.

Standard Installation - Double & Single Acting Units

These instructions assume that the actuators are installed with the cylinder axis parallel to the axis of the valve bore (In Line).

Single acting actuators are supplied as FAIL-CLOSE units as standard.
Reverse acting, (FAIL-OPEN), must be specified at the time of order.

1. Ensure that the valve and actuator are in the following corresponding positions:

- Double Acting units and Spring Return units, (Fail-closed):
Valve closed, actuator fully clockwise.
- Double Acting units and Spring Return units, (Fail-open):
Valve open, actuator fully counter-clockwise

Mounting to valves (via bracket)

- 2a. Secure the mounting bracket to the underside of the actuator, using four bolts and washers, as shown in Fig 1
- 3a. Install the appropriate coupling onto the valve stem. The coupling should be lightly tapped or pressed onto the valve stem. The use of a lubricant is recommended.
- 4a. Mount the actuator and bracket onto the valve top flange using the appropriate bolts.

Mounting to valves

- 2b. Screw the actuator mounting studs tightly into the actuator base plate.
- 3b. Push the adaptor, if required, into the actuator drive bore, using the keyway which aligns the adaptor drive with the valve stem drive.
- 4b. Mount the actuator onto the valve top flange and secure using a lockwasher and nut on each mounting stud.

Mounting to valves (with EN ISO 5211 mounting)

- 2c. Screw the actuator mounting studs tightly into the actuator base plate.
- 3c. Mount the actuator onto the valve top flange and secure using a lockwasher and nut on each mounting stud.

All 1/4 turn valve types

5. Before installing the valve/actuator assembly in a piping system, the valve operation should be verified and adjusted, if necessary, using the travel stop screws (see detailed instructions for travel setting)
6. When installing the valve/actuator assembly into pipeline, ensure that the specific instructions relating to the valve installation are followed.

Note: Some valves may require to be fitted into the pipeline prior to mounting the actuator.
Fail Safe butterfly valves are an example of this.

Non Standard Installation - Double & Single Acting Units

All 1/4 turn valve types

In circumstances where the actuator is required to be installed in the transverse position i.e. at right angles to the valve bore (Across Line), the actuator must be rotated through 90°. This is achieved in the following manner:

1. For direct mounted versions, fit the drive adaptor into the second keyway of the drive pinion to align the adaptor drive with the valve stem drive when the actuator is transverse to the pipeline.
2. Remove the actuator from the valve or the bracket by removing the 4 fixing bolts/nuts and withdraw it vertically from the valve.
3. Rotate the actuator through 90°.
4. For bracket mounting the actuator can be mounted transversely and the coupling will locate in the actuator drive shaft using the second keyway

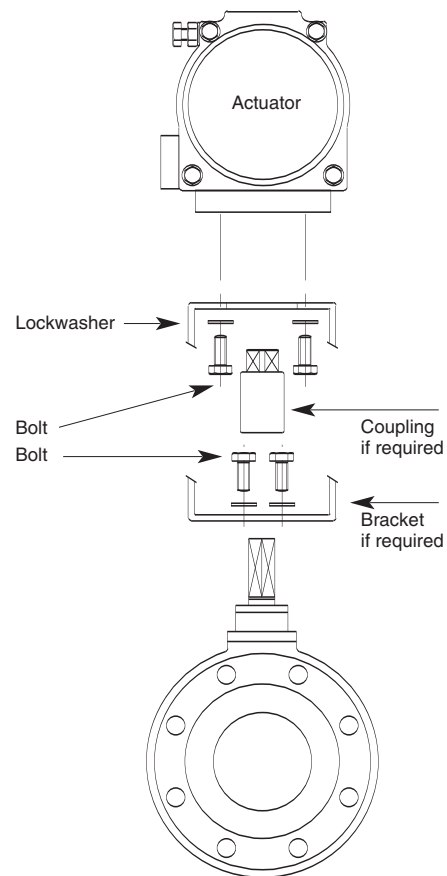


Figure 1

Typical installation on ball or high performance butterfly valves, using bracket mounting.

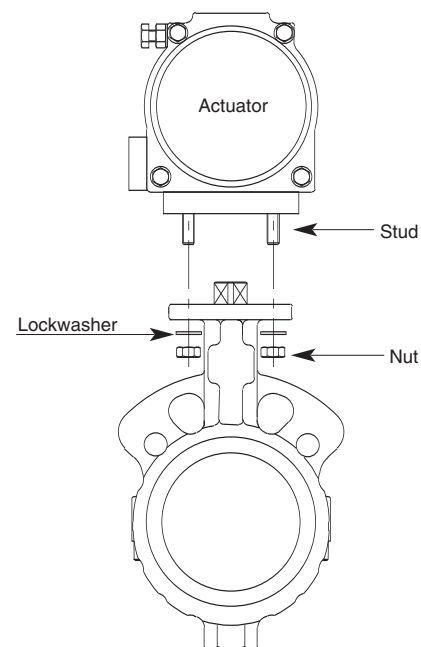
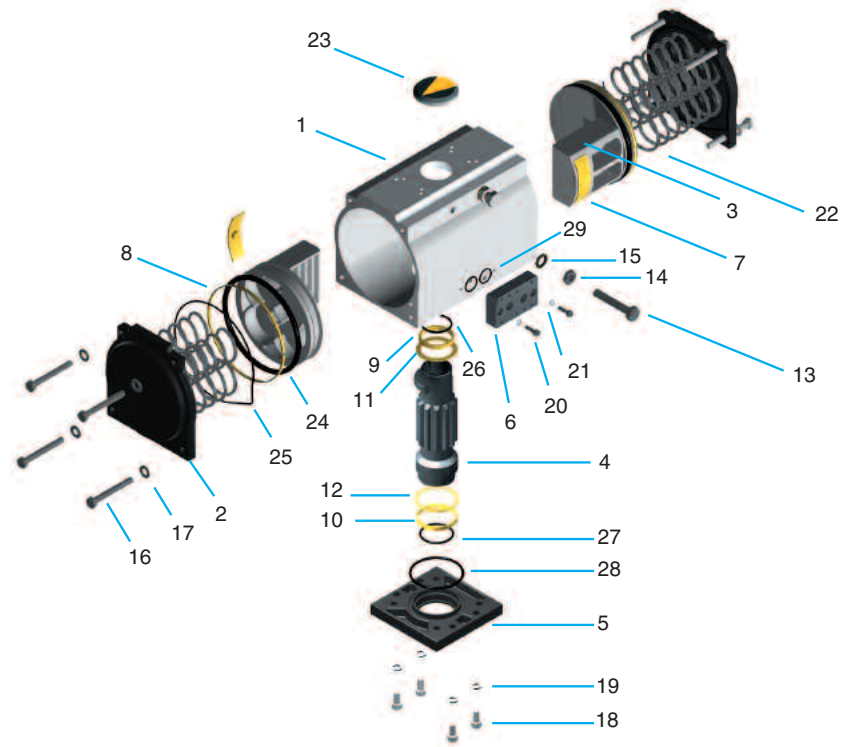


Figure 2

Typical installation on resilient seated butterfly valves.

Grinnell GRP Pneumatic Rack and Pinion Actuators

Installation and Maintenance Instructions - Parts Identification



Materials of construction

No	Item	Material	Material		Finish
			US material std	DIN / BS Material std	
1	Body	Extruded aluminum	ASTM B221	BS 1474 6000 T5/6	Hard Anodize + ESPC* or SNP**
2	End Cap	Die cast aluminum	ASTM B85	DIN 1725-231	Chromate + ESPC* or SNP**
3	Piston	Die cast aluminum	ASTM B85	DIN 1725-231	Anodize or SNP**
4	Pinion shaft	Carbon steel	ASTM A108	BS 970: 1983 212A42	Nitrotech™*** or SNP**
5	Base plate	Die cast aluminum	ASTM B85	DIN 1725-231	Chromate + ESPC* or SNP**
6	Air connection plate	Die cast aluminum	ASTM B85	DIN 1725-231	Chromate + ESPC* or SNP**
7	Piston backing pad	Devlon-V™			Natural
8	Piston support ring	Devlon-V™			Natural
9	Top bearing	Devlon-V™			Natural
10	Bottom bearing	Devlon-V™			Natural
11	Top spacer	Devlon-V™			Natural
12	Bottom spacer	Devlon-V™			Natural
13	Stop bolt	304 Stainless steel	ASTM A193	BS 3692-A2-304	Natural
14	Lock nut	304 Stainless steel	ASTM A193	BS 3692-A2-304	Natural
15	Sealing washer	304 Stainless steel	ASTM A193	BS 4320-A2-304	Natural
16	End cap bolt	304 Stainless steel	ASTM A193	BS 3692-A2-304	Natural
17	End cap washer	304 Stainless steel	ASTM A193	BS 4320-A2-304	Natural
18	Base plate bolt	304 Stainless steel	ASTM A193	BS 3692-A2-304	Natural
19	Base plate washer	304 Stainless steel	ASTM A193	BS 4320-A2-304	Natural
20	Air connection plate bolt	304 Stainless steel	ASTM A193	BS 3692-A2-304	Natural
21	Air connection plate washer	304 Stainless steel	ASTM A193	BS 4320-A2-304	Natural
22	Spring	Spring steel	ASTM A877	BS 2806 685 A55 HDR3	Oil Dip
23	Indicator	ABS			Natural
24	Piston O-ring	Rubber-NBR or FPM			Natural
25	End cap O-ring	Rubber-NBR or FPM			Natural
26	Shaft top O-ring	Rubber-NBR or FPM			Natural
27	Shaft bottom O-ring	Rubber-NBR or FPM			Natural
28	Base plate O-ring	Rubber-NBR or FPM			Natural
29	Air connection plate O-ring	Rubber-NBR or FPM			Natural

Notes

- * ESPC = Electrostatic Powder Coating
- ** SNP = Special Nickel Protection finish
- *** Nitrotech™ = Proprietary corrosion resistant finish

Disassembly procedure

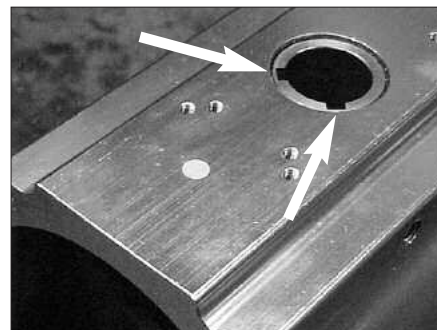
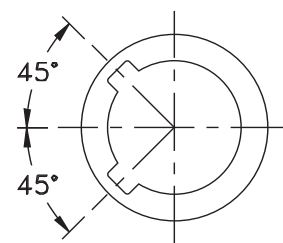
CAUTION! Remove air pressure and observe normal safety precautions, including the use of eye protection.

1. Remove indicator pointer (23) or NAMUR top adaptor (not shown).
2. Remove travel stop bolts, (13) after loosening the lock nuts.
3. Remove end caps (2) by unscrewing the four hexagon head bolts on each end cap. For spring return versions use the progressive diagonal method for unscrewing these bolts.
4. Using a suitable wrench in the top of the pinion shaft (4), turn the shaft counter clockwise to drive the pistons (3) apart. Remove the pistons from the body (1).
5. Remove the base plate (5) by unscrewing the four cap head bolts and spring washers.
6. The pinion shaft (4) can now be withdrawn from the bottom of the actuator body (1).
7. The top and bottom bearing rings, spacers and o-rings can now be removed from the pinion shaft or from the recesses in the body and base plate.
8. The air connection plate (6) can be removed from the body if necessary by unscrewing the two cap head bolts.
9. Remove o-rings and support rings from the piston heads
10. Remove the backing pads from the piston legs

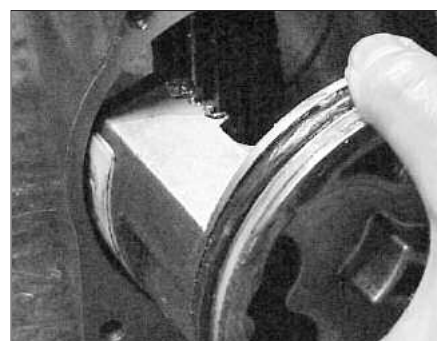
Assembly procedure (refer to illustration on page 3)

1. Clean all disassembled items and replace any damaged items such as o-rings, bearings, support rings, and backing pads.
2. Grease the body bore with Molyrace LT2 lubricant.
3. Place the base plate (5) flat on the assembly bench and fit the o-ring (28) into the groove on the top face of the base plate.
4. Fit the bottom spacer (12), then the bottom bearing (10), then the bottom o-ring (27) over the bottom of the shaft and coat with Molyrace LT2 lubricant.
5. Carefully insert the shaft along with the spacer, bearing and o-ring into the base plate bore, finishing with a firm push to ensure full location.
6. Fit the top spacer (11), then the top bearing (9), then the top o-ring (26) over the top of the shaft and coat with Molyrace LT2 lubricant.
7. Carefully lower the body over the shaft and on to the base plate, finishing with a firm push to ensure that the o-ring and bearing locate fully into the top recess of the body.
8. Secure the base plate to the body using the cap head screws and spring washers (18/19).
9. Grease the pinion shaft teeth with Molyrace LT2 lubricant. Rotate the pinion shaft until the keyways, in the shaft top, are at 45 degrees as shown in the illustration (See 1 opposite).
10. Fit o-rings (24), support rings (8) and backing pads (7) to the pistons and then grease the rack teeth using Molyrace LT2 lubricant.
11. Insert the pistons into the actuator body as follows:
 - a) **Double Acting and Spring To Close models.**
With the piston rack on the left side of the body bore, when viewed from the o-ring end of the piston, as shown (opposite 2).
 - b) **Spring To Open models.**
With the piston rack on the right side of the body bore, when viewed from the o-ring end of the piston.

Locate the assembly on the bench with one piston head on the bench and the other upwards. Push firmly on the top piston to cause both piston rack profiles to engage with the pinion teeth.
12. Position the assembly with the base plate on the bench. Using a suitable wrench, turn the pinion shaft clockwise (Double Acting and Spring To Close models), or counter-clockwise (Spring To Open), as far as it will go. The keyways, at the top of the shaft, should be approximately 4 to 5 degrees clockwise, or counter-clockwise, past the axial and transverse centre lines of the body.
13. Smear the o-ring groove in each end cap with Molyrace LT2 lubricant. Fit the o-rings (24) into the grooves and position the actuator body with one end downwards on the bench.
14. **Double Acting models:**
 - a. Carefully locate one end cap (2) on the uppermost end of the body and secure using four hexagon head bolts and plain washers (16/17).
 - b. Repeat for the other end cap.
- Spring Return models:**
 - a. Locate the correct number of springs (22) in the cavities on the piston head which is uppermost. (See 3 opposite)
 - b. Carefully locate one end cap over the springs so that the springs fit into the cavities in the end cap.
 - c. Using the four hexagon head bolts and plain washers, compress the springs following the diagonal progression technique, until the end cap is fully tightened down against the end of the body.
 - d. Repeat for the other end cap.
15. Locate the o-rings (29) into the recesses on the air connection plate and secure the plate to the actuator body using the two cap head bolts and spring washers (20/21). Ensure that the port marked "Port 2" is to the right hand side as shown. (See 4 opposite)
16. Fit the lock nuts and sealing washers (14/15) to the travel stops and then screw the travel stops into the body.



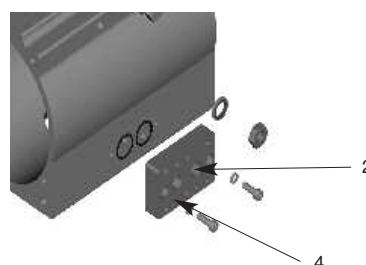
1. Position of keyways prior to fitting pistons



2. Fitting pistons into body



3. Locating of springs in piston head cavities



4. Fitting air connection plate

17. For double acting versions, ensure that the pinion shaft is rotated fully clockwise and then screw in the right hand travel stop until the shaft keyways are in line with the major axes of the body and then tighten the lock nut to secure.
18. Turn the pinion shaft fully counter-clockwise and then screw in the left hand travel stop, until the shaft keyways are in line with the major axes of the body. Tighten the locknut to secure.

Note:- For single acting versions, it is not advisable to use the travel stop screws to move the pinion as this may damage the cam faces or the stop screw ends.

19. For single acting versions, screw in the left hand travel stop to an estimated position and then apply pressure to open the actuator. Check the actual position of the pinion shaft, release the air pressure and re-set the travel stop to compensate for any error. Repeat until the correct position is achieved. Tighten the lock nut to secure.
20. Apply pressure to open the actuator and screw in the right hand travel stop to an estimated position and then release the pressure. Check the actual position of the pinion shaft. Re-apply the pressure and re-set the travel stop to compensate for any error. Repeat until the correct position is achieved. Tighten the lock nut to secure.

Setting of Internal Travel Stops

GRP actuators are fitted with integral end of travel stops to enable setting of exact travel for the valve being operated.

These stops allow travel adjustment, as follows:

Over Travel (at each end) of $\pm 5^\circ$

Under Travel (at each end) of $\pm 10^\circ$

Increased under travel is available, on request.

To Set the Stops (Double acting units)

1. Operate valve/actuator assembly to the closed position.
2. Remove air supply.
3. Loosen locknut on the close travel stop.
4. Turn the stop clockwise to reduce travel or counter-clockwise to increase travel.
5. Re-Tighten locknut.
6. Reconnect air supply and check that the position is correct. If not, repeat from instruction 2.
7. Apply air to operate to the open position.
8. Remove air supply.
9. Adjust open travel stop screw as per instructions 3 to 6, above.

To Set the Stops (Single acting units) Air Fail Close

1. Remove air supply so that actuator drives to closed position. Note actual position.
2. Apply air to open the actuator. Note actual position.
3. While the air supply is maintained loosen the locknut on the close stop and adjust the stop screw by an amount estimated to give correct position. (clockwise adjustment decreases travel).
4. Re-tighten lock nut.
5. Remove air so that actuator closes. If correct closed position is not achieved repeat from instruction 2.
6. Loosen locknut on the open stop and adjust the travel by an amount estimated to give correct position. (clockwise adjustment decreases travel).
7. Re-tighten locknut.
8. Apply air and check open position. If correct open position is not achieved. Repeat from instruction 5.

Warnings!

Under no circumstances must the travel stop bolts be totally withdrawn from the actuator whilst compressed air is being applied.

Travel stop bolts must not be used for manual override.

Accessories mounted to the top of Actuators must be re-adjusted accordingly after setting the travel stops.

To Set the Stops (Single acting units) Air Fail Open

1. Remove air supply so that actuator drives to open position. Note actual position.
2. Apply air to close the actuator. Note actual position.
3. While the air supply is maintained loosen the locknut on the open stop and adjust the stop screw by an amount estimated to give correct position. (clockwise adjustment decreases travel).
4. Re-tighten lock nut.
5. Remove air so that actuator opens. If correct open position is not achieved repeat from instruction 2.
6. Loosen locknut on the close stop and adjust the travel by an amount estimated to give correct position. (clockwise adjustment decreases travel).
7. Re-tighten locknut.
8. Apply air and check close position. If correct close position is not achieved. Repeat from instruction 5.

Grinnell GRP Pneumatic Rack and Pinion Actuators

Installation and Maintenance Instructions

Maintenance

Provided that basic pneumatic system procedures are adhered to, the actuator will require little or no maintenance for many thousands of cycles.

Troubleshooting

If the actuator fails to operate the valve correctly, carry out the following checks.

1. Check that the air supply is at the required pressure.
2. Ensure that the air supply is not restricted in any way.
3. Check for air leakage on supply lines to the actuator.
4. Check for leakage at the top and bottom of the pinion shaft. Such leakage could be caused by a dirty air supply.
5. Check for leakage across the piston seals by applying pressure to "Port 4" and looking for leakage from "Port 2".
6. Check that the valve torque has not increased because of problems with the valve itself.
Note:- refer to disassembly and assembly procedures for gaining access to o-rings and actuator internals if required.

General information

1. As standard, applying air to "Port 2" will cause the actuator to rotate in a counter clockwise direction to open the valve.
2. Applying air to "Port 4" will cause the actuator to rotate in a clockwise direction to close the valve (double acting versions only).
3. **Warning:- It is not recommended to "air assist" single acting actuators as this may apply excess load to the valve stem and cause damage.**

Spring ratings versus air pressure

There is one size of spring per actuator for 'balance' against air pressures up to 80 psig. Springs are used in multiples depending on the air pressure. The following table shows the springs needed to give balance at varying air pressures. 'Balance' means that air start torque = spring start torque.... and that air finish torque = spring finish torque.

Air pressure	Number of springs	
	Piston 1	Piston 2
40 psig	2	2
50 psig	3	2
60 psig	3	3
70 psig	4	3
80 psig	4	4

For balance against higher pressures booster springs are fitted inside the standard springs of the 80 psig build as follows:

Air pressure	Number of booster springs	
	Piston 1	Piston 2
90 psig	2	2
100 psig	4	4

Bolt tightening torques for end caps

When re-assembling the end caps, use the following figures for bolt tightening.

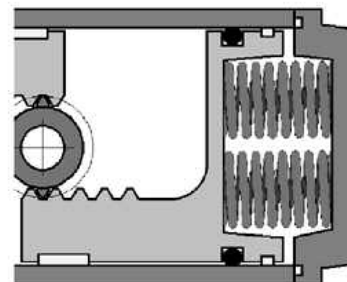
Actuator size	Bolt size	Tightening torque (lbf. ins)
002	M5	28.3
004	M5	28.3
009	M6	64.6
014	M6	64.6
025	M8	116
037	M8	116
045	M10	232
069/070	M12	400
087/088	M12	400
180	M16	960

Grinnell provides the information herein in good faith but makes no representation as to its comprehensiveness or accuracy. This data sheet is intended only as a guide to Grinnell products and services. Individuals using this data sheet must exercise their independent judgment in evaluating product selection and determining product appropriateness for their particular purpose and system requirements. GRINNELL MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT(S) TO WHICH THE INFORMATION REFERS. ACCORDINGLY, GRINNELL WILL NOT BE RESPONSIBLE FOR DAMAGES (OF ANY KIND OR NATURE, INCLUDING INCIDENTAL, INDIRECT, OR CONSEQUENTIAL DAMAGES) RESULTING FROM THE USE OF OR RELIANCE UPON THIS INFORMATION. Patents and Patents Pending in the U.S. and foreign countries. Grinnell reserves the right to change product designs and specifications without notice.

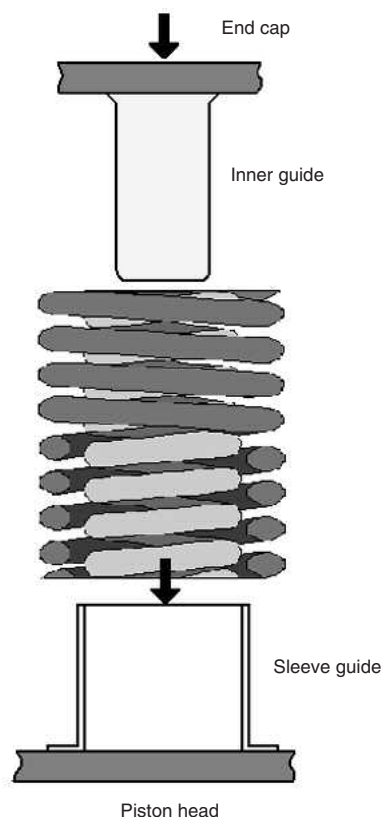
Supplementary instructions for guided springs

Sizes GRP-004, -009, -037, and -070 need spring guides as a precaution against possible buckling of the inner springs.

1. Locate sleeve guides in piston head recesses.
2. Locate outer springs round outside of sleeve guides and inner springs inside sleeve guides.
3. Fit end cap so that inner guides locate inside inner springs.
4. Tighten end cap to body as previously described.



Spring location



4607 New West Drive • Pasadena, Texas 77507
Phone: (877) 791-3208 • Fax: (281)-291-8808
www.grinnellvalves.com