

Model DFO Linear Actuator

Operation, Parts, and Instruction Manual



Figure 1 DF2000 Control Valve & DFO Actuator

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NOTICE

These instructions are meant to be used with the Dyna-Flo DFC / DFO Technical Bulletin as they refer to Figures and Tables therein. If you do not have the Technical Bulletin, contact Dyna-Flo immediately, or visit www.dynaflo.com

Each control valve is factory checked. Check the calibration for the specific application, before a valve is put into service.

It is the intention of this document to provide users with an accurate guide for safe installation and maintenance of the DFO Valve Actuator. Revisions and updates are available at above mentioned website.

GENERAL

The following instructions are to be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Work on this equipment should be done by experienced personnel. Throughout the manual, safety and caution notes appear and must be strictly followed to prevent serious injury or equipment malfunction.

SCOPE

This manual will provide detailed information on the complete disassembly and reassembly of the Model DFO pneumatic actuator. Refer to separate instruction manuals for the installation of positioners and all other accessories used with these actuators. Do not apply any other conditions to the actuator without first contacting your Dyna-Flo sales office.

This manual is written to be a practical and useful guide to successfully using the Dyna-Flo Model DFO for many years.

SAFETY CAUTION

Only well trained experienced technicians should perform these procedures. Use safe work practices and lock out procedures when isolating valves and actuators. It is also important to wear the proper protective equipment when performing any installation or maintenance activity. Use only parts and materials rated for the process being used, operating conditions, and environmental conditions products will be used in.

To avoid personal injury or installation damage as a result of the sudden release of process pressure or damage to equipment, do not install the actuator assembly where service conditions could exceed the limits stated in this manual, sales bulletin or on the equipment nameplates. Use government codes, accepted industry standards and good piping practices, and select proper pressure-relieving equipment for protection of your installation. Always be aware of flammable process and instrument gas.

Always be aware of the hazards of actuators, especially spring-loaded actuators. Be sure that the actuator is de-energized or in the failed position before performing any maintenance procedure.

These valves have dangerous pinch points. Never put your hands inside the valve unless you are certain that the plug and stem will not move.

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Table 1

SPECIFICATION		ACTUATOR SIZE							
		1046	1069	2069	2105	2156	3105	3156	3220 ⁽¹⁾
Nominal Effective Area	inch ²	46	69	69	105	156	105	156	220
	cm ²	297	445	445	677	1006	677	1006	1419
Yoke Boss Diameter	inch	2-1/8	2-1/8	2-13/16	2-13/16	2-13/16	3-9-16	3-9/16	3-9/16
	mm	54	54	71	71	71	90	90	90
Acceptable Valve Stem Diameter	inch	3/8	3/8	1/2	1/2	1/2	3/4	3/4	3/4
	mm	9.5	9.5	12.7	12.7	12.7	19.1	19.1	19.1
Maximum Allowable Output Thrust	lb	2300	2300	2700	5650	7550	5650	6800	8800
	N	10,231	10,231	12,010	25,132	33,584	25,132	30,248	39,144
Maximum Travel ⁽²⁾	inch	3/4	1-1/8	1-1/2	2	2	2	2	3 ⁽³⁾
	mm	19	29	38	51	51	51	51	76
Maximum Casing Pressure for Actuator Sizing ⁽⁴⁾	Psig	125	65	65	50	40	50	40	55
	kPag	862	448	448	345	276	345	276	379
Maximum Diaphragm Casing Pressure ^(4,5)	Psig	140	75	75	60	50	60	50	65
	kPag	965	517	517	414	345	414	345	448
Approximate Weight	lbs	36	48	51	82	107	92	116	235
	Kg	16	22	23	37	49	42	53	107
Material Temperature Capabilities	Nitrile Elastomers	-40 to 180°F (-40 to 82°C)							

NOTES:

- 1 These values also apply to the DFO Size 3220-4 actuator.
- 2 Actuator travel may be less than the value listed after connected to the valve.
- 3 Maximum actuator travel for the 3220-4 is 4 inches (102 mm).
- 4 The Operating Diaphragm Pressure must not exceed the Maximum Diaphragm Casing Pressure and must not produce a force on the actuator stem greater than the maximum allowable valve stem load.
- 5 This Maximum Casing Pressure is not to be used for normal operating pressure. Its purpose is to allow for typical regulator supply settings and/or relief valve tolerances. The maximum casing pressure is the pressure that can be applied to the actuator when the actuator is at less than full travel. Damage to the actuator may occur if this pressure is exceeded before the full travel is reached.



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UNPACKING VALVE FROM SHIPPING CONTAINER

Special Tools Required:

- Properly Rated Lifting Straps (2 – 4 Straps) See Table 1 for actuator weights.
- Lifting Device (Example: Crane)

Check the packing list, verify that the list includes all the materials in the shipping container before unpacking. Valve information can be found on the nameplate (Key 27). Refer to Figure 2 for nameplate location.

When lifting the valve from shipping container, place properly rated lifting straps securely around the neck of the actuator, refer to Figure 2 for strap placement. Straps should be placed to avoid damage to tubing and other mounted accessories.

Lift the valve/actuator assembly using proper lifting techniques.

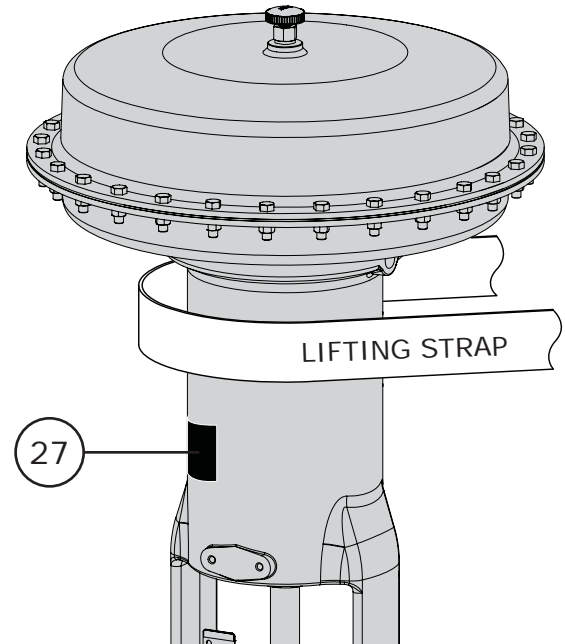


Figure 2 Actuator Lifting Suggestions

INSTALLATION

Before You Begin:

- Read the General and Scope section of this manual (Page 2).
- Read Safety Caution (Page 2).
- Sudden movement of actuator can cause damage or injury. It helps to have the actuator de-energized.
- Use safe work practices and lock out procedures before placing valve in-line.
- Standard actuators accept ¼" (6 mm) NPT connections.
- **Warning:** Do not use operating pressure that exceeds the Maximum Casing Pressure. Also, be sure the operating pressure does not create a force on the actuator stem (Key 9) that is greater than the Maximum Allowable Output Thrust. Refer to Table 1.
- **WARNING:** Property damage, environmental harm, and personal injury can result from the use of supply gas other than clean, non-corrosive, oil and moisture free air.

Actuators are typically shipped from factory as an assembly already mounted to the valve. Follow the appropriate valve installation instructions to install the actuator/valve assembly inline.

If the actuator was shipped separately, it will be necessary to mount the actuator to the valve prior to installation, refer to the Actuator Mounting section (Page 7). Before the actuator can be mounted, ensure that the actuator travel has been checked and that the actuator has been properly bench set. Refer to the Bench Setting section (Page 5) for information on verifying actuator travel and bench setting instructions.

Operating medium must be controlled and directed, if a positioner was not ordered or unavailable, use a loading device such as a 4-way switching valve (not provided with the actuator). For more information on positioner installation and operation, refer to the appropriate positioner instruction manual for your positioner type. For information regarding instrument mounting for DFO actuators, refer to Pages 31 & 32.

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AIR PIPING

Before You Begin:

Note: Standard actuators accept 1/4" (6 mm) NPT connections. Size 220 actuators have a threaded reducer bushing (Key 16) that reduces the casing (Key 13) NPT connection from 1/2" (12.7 mm) to 1/4" (6 mm), the bushing fitting is removable (Refer to Figure 20).

Piping Installation Steps:

- 1 Use 3/8" (10 mm) outside diameter SST tubing (or equivalent) for air lines. Keep length of tubing as short as possible to prevent transmission lag in the control signal.
- 2 Install the required line vents, valves, drains, seals, and filters to the actuator.

BENCH SETTING ACTUATOR

NOTE: To prevent damage to the valve stem (Key V), it is recommended that bench setting be performed with the actuator removed from the valve. If the actuator cannot be removed from the valve, disconnect the actuator stem (Key 9) from the valve stem and place the valve into its closed position.

- 1 The following procedures must be completed before installing the connecting block (Key 17). If the connecting block is still attached to the actuator stem (Key 9), remove it by removing the connector cap screws (Key 18). Refer to Figures 10 & 11.
- 2 To properly verify the bench set, 3 pieces of information are required:
 - A Upper Bench Set Loading Pressure.
 - B Lower Bench Set Loading Pressure (example: for a 6-22 Psig bench set, 6 is the lower and 22 Psig the upper).
 - C Travel.

This information is available on the actuator nameplate (Key 27). If the information is missing or incomplete, contact your Dyna-Flo Sales Office.

- 3 Before applying pressure to the diaphragm casing, make sure that the spring (Key 8) is properly seated onto the spring seat (Key 3). This step is not required for a new, factory assembled actuator.
- 4 Connect an operating medium supply line with a gauge (that can accurately measure both 0 Psi and the upper bench set pressure limit) to the actuator. Refer to Figure 3.



Figure 3 Supply Line and Gauge

- 5 Apply the maximum casing pressure to the actuator to verify seal integrity. Use a soapy solution to check for any air leaks from the diaphragm (Key 12). This step will have been performed at the factory and will not be required for new actuators.
- 6 Set the actuator loading pressure to 0 Psi (0 kPa). Slowly raise the loading pressure heading towards the lower bench set limit. Make note of at what pressure the actuator stem (Key 9) starts to move, the actuator stem should start to move once you reach the lower bench set pressure.

If actuator stem movement occurs before or after the lower bench set limit, adjust the spring adjuster as indicated below:

If stem travel starts before lower bench set limit: Adjust the spring adjuster (Key 2) to the left (clockwise) to decrease the bench set pressure required. It may be necessary to lower the loading pressure to make adjustments to the spring adjuster. Refer to Figure 5.

If stem travel starts after the lower bench set limit: Adjust the spring adjuster (Key 2) to the right (counter-clockwise) to increase the bench set pressure required. It may be necessary to lower the loading pressure to make adjustments to the spring adjuster. Refer to Figure 5.



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BENCH SETTING ACTUATOR (Continued)

- 7 Increase the loading pressure to the upper bench set limit, the actuator stem (Key 9) should lower towards the direction of the valve (if a valve were installed). Mark the position of the bottom of the actuator stem using the method shown in Figure 5 or equivalent.
- 8 Decrease the loading pressure to the lower bench set limit and mark the position of the bottom of the actuator stem (Key 9).
- 9 The measurement between the marked upper and lower bench set limits should equal the travel indicated on the nameplate (Key 27) to within 1/16" (1.6 mm). If the measurements match then the bench set is complete, proceed to the ACTUATOR MOUNTING section.

If the measurements do not match then an incorrect or damaged spring may be the problem. Contact Dyna-Flo Control Valve Services for more information.

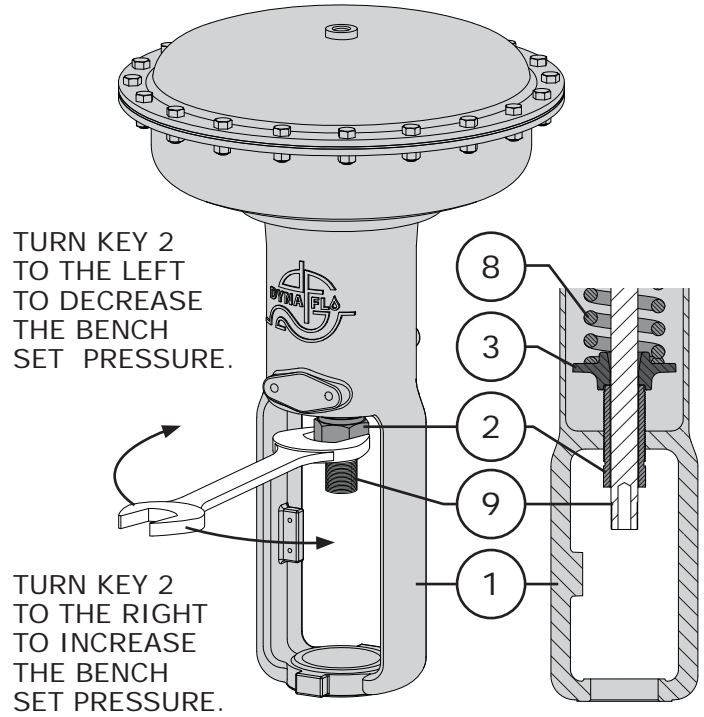


Figure 4 Spring Adjustment

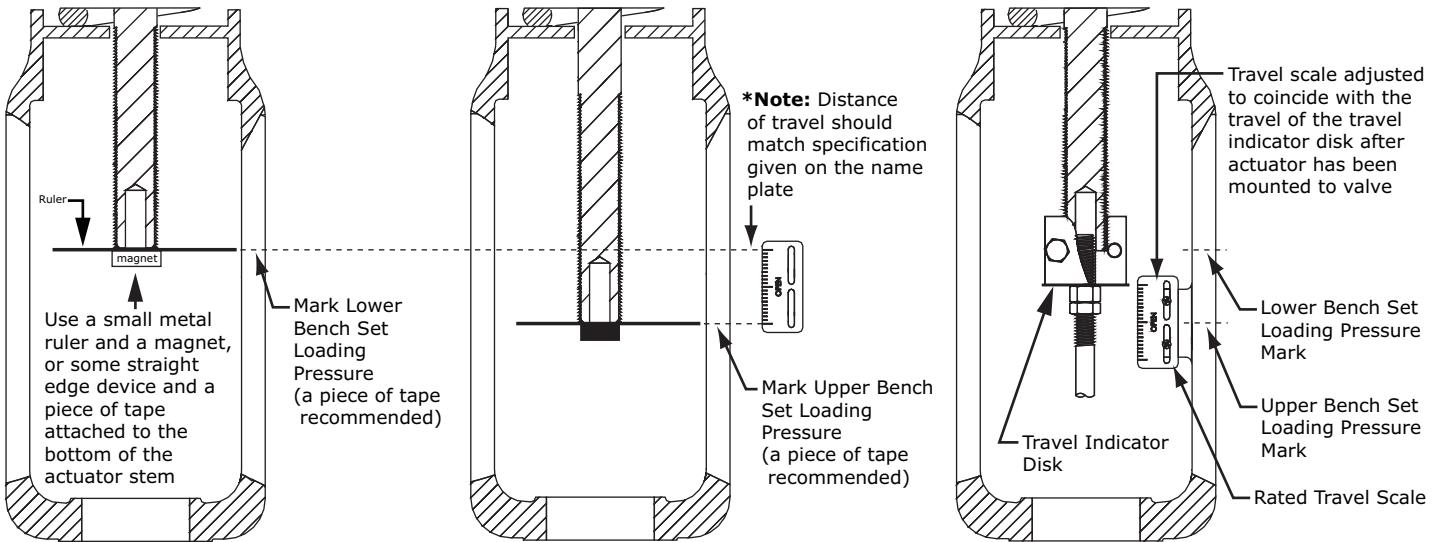


Figure 5 Bench Set Travel Adjustment Diagram

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ACTUATOR MOUNTING

Before You Begin:

- Read the General and Scope section of this manual (Page 2).
- Read Safety Caution (Page 2).
- Use safe work practices and lock out procedures before placing valve in-line.
- Standard actuators accept 1/4" (6 mm) NPT connections.
- **WARNING:** Property damage, environmental harm, and personal injury can result from the use of supply gas other than clean, non-corrosive, oil and moisture free air.
- Sudden movement of actuator can cause damage or injury. It helps to have the actuator de-energized but it may be necessary to apply operating pressure temporarily to move the actuator stem (Key 9) towards the valve stem during mounting. Also, place the valve into its closed position to allow for more clearance between stems.

Use caution when lowering the actuator onto the valve body to avoid damage to stems and threads.

- 1 Secure the valve assembly in place on a flat work surface that will support the weight of the combined valve and actuator assembly.
- 2 Remove any positioners and/or instrumentation installed on the actuator.
- 3 Completely thread the jam nut (Key 25) and hex nut (Key 24) onto the valve stem (Key V).
- 4 Set the yoke locknut (Key 26) inside the yoke (Key 1) of the actuator, or have the yoke locknut ready to be placed between the actuator stem (Key 9) and valve stem (Key V) while lowering the actuator into place on the valve. Have the travel disc (Key 23) ready to be placed on the valve stem as well.
- 5 Carefully lift and lower the actuator into place on the valve body as shown in Figure 6. Refer to UNPACKING VALVE FROM SHIPPING CONTAINER (Page 4) for information on proper lifting techniques. As the yoke passes over the valve stem, insert the yoke locknut (Key 26) and travel disc (Key 23) between the actuator stem (Key 9) and valve stem (Key V) as shown in Figure 6. The travel disc should be placed on top of the hex nut (Key 24) concave side facing towards the valve body.
- 6 Completely lower the actuator into place on the valve. Orientate the actuator with the window of the yoke (Key 1) parallel with the front of the valve body and the lower instrument mounting boss facing the front of the valve as shown in Figure 7.

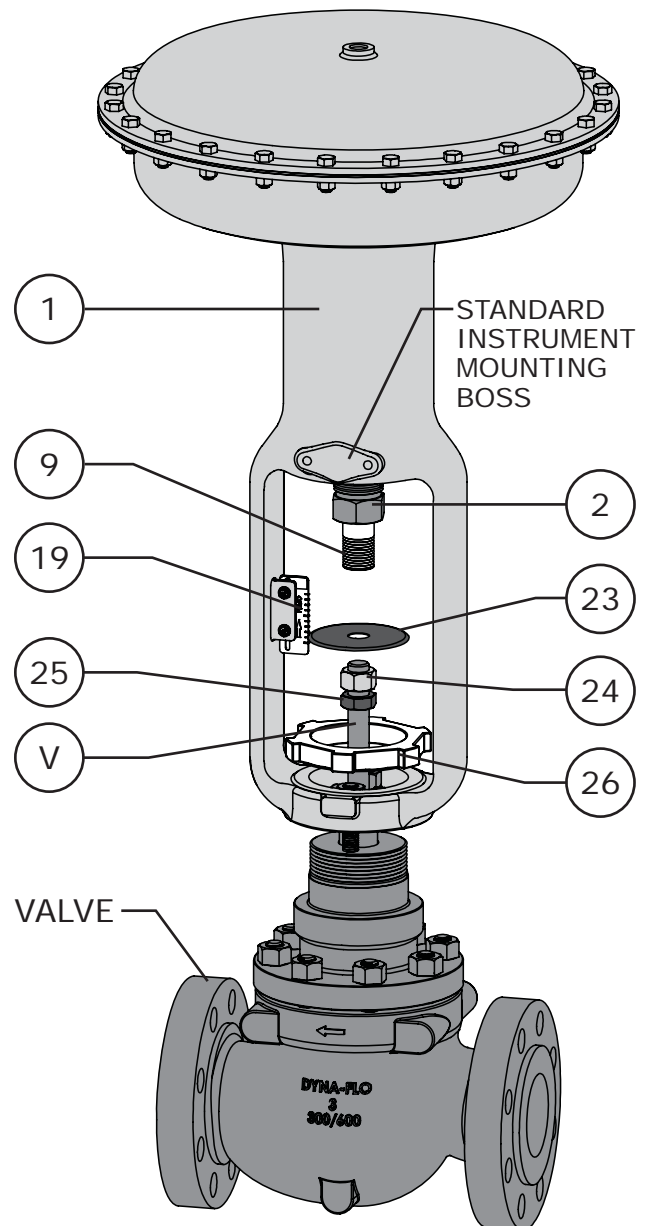


Figure 6 Actuator Mounting



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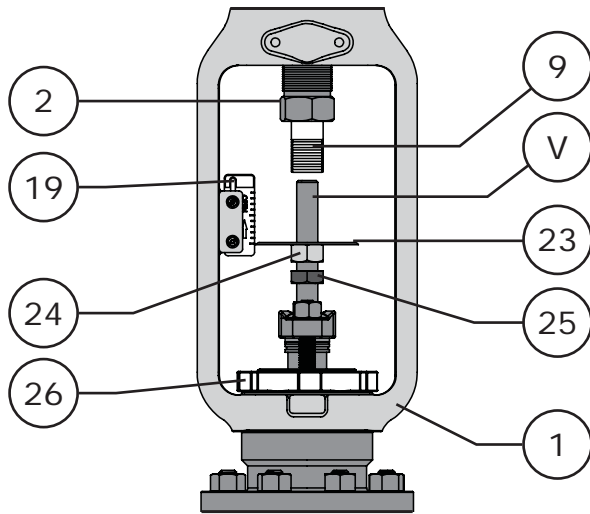


Figure 7 Actuator Mounting Detail

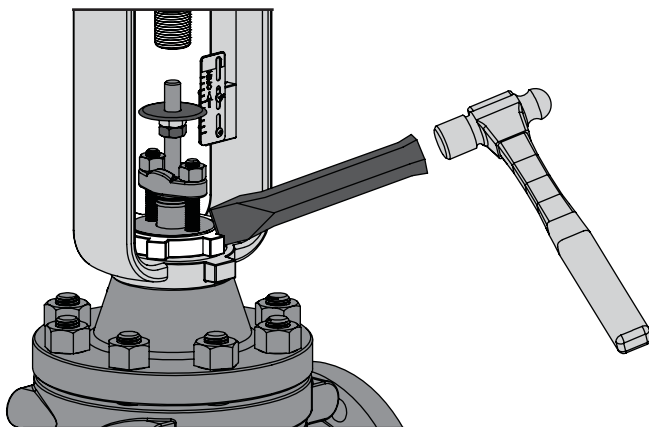


Figure 8 Yoke Locknut Tightening Detail

ACTUATOR MOUNTING (Continued)

- Secure the actuator to the valve by tightening the yoke locknut (Key 26) on the valve bonnet. Refer to Figure 8.

CONNECTING BLOCK INSTALLATION

WARNING: It is important that the valve stem not be rotated while the valve plug is seated during stem connector installation. Valve plug and stem rotation can cause damage to the seating surface and stem threads.

NOTE: The threads of the actuator stem (Key 9) and valve stem (Key V) should engage the threads of the connecting block (Key 17) by a distance equal to that of the diameter of the stem or greater. Refer to Figure 9.

- Make sure that the valve has been placed into its closed position by pushing the valve stem (Key V) into the valve body. Lower the jam nut (Key 25), hex nut (Key 24), and travel disc (Key 23) as far down the valve stem (Key V) as possible.
- Loosely install the travel scale (Key 19) using the speed nuts (Key 22) and machine screws (Key 20). Adjust the jam nut (Key 25), hex nut (Key 24), and travel disc (Key 23) so that the travel disc is set to the lowest mark (closed position) of the travel scale.
- Adjust the travel disc (Key 23) from the lowest mark of the travel scale (Key 19) to the highest mark of the travel scale by adjusting the hex nut (Key 24) and jam nut (Key 25).
- Align the connecting block (Key 17) with the window of the yoke (Key 1) and install the connecting block using cap screws (Key 18), refer to Figure 10. Be careful to achieve proper thread engagement between the stems and the connecting block, avoid cross-threading any threads. A slight change to operating pressure may be necessary to help with alignment. Tighten the cap screws to the torque value listed in Table 4.
- Adjust the jam nut (Key 25), hex nut (Key 24), and travel disc (Key 23) so that the travel disc is touching the bottom of the connecting block (Key 17). Lock the travel disc in place using the hex nut and jam nut, do not overtighten the nuts.
- Re-position the travel scale (Key 19) so that the travel disc (Key 23) is aligned with the top mark (open position) of the travel scale.

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ACTUATOR MOUNTING (Continued)

CONNECTING BLOCK INSTALLATION

7 Stroke the actuator and valve to verify that the travel and travel scale are accurate. If the travel is not correct it may be necessary to repeat the stem connector installation or bench set procedures.

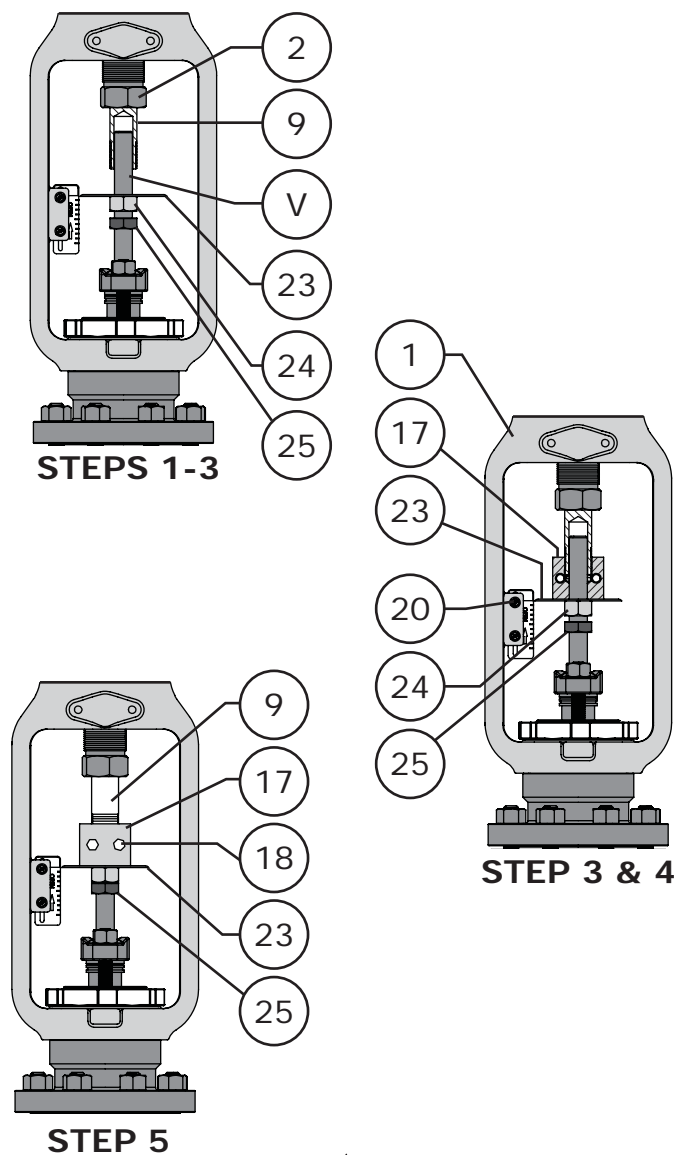


Figure 9 Connecting Block Installation

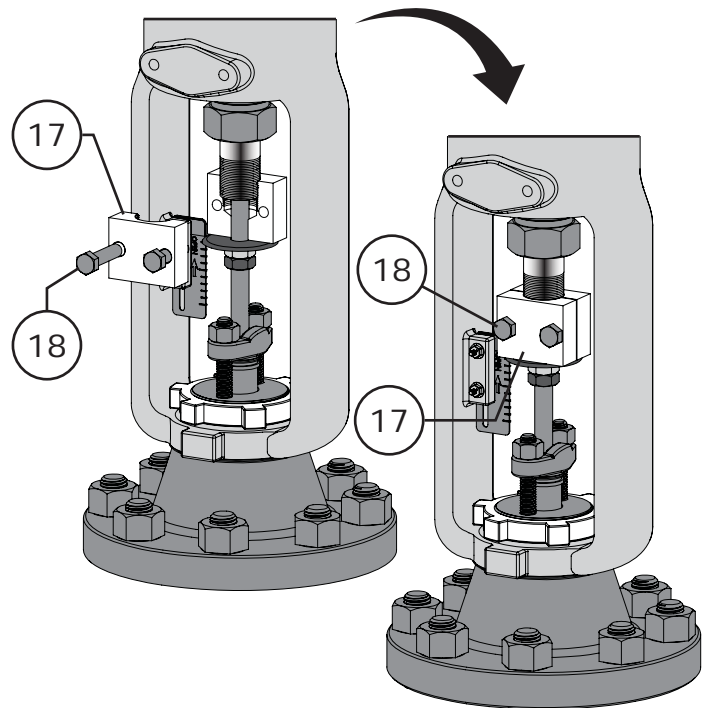


Figure 10 Standard DFO Connecting Block Assembly

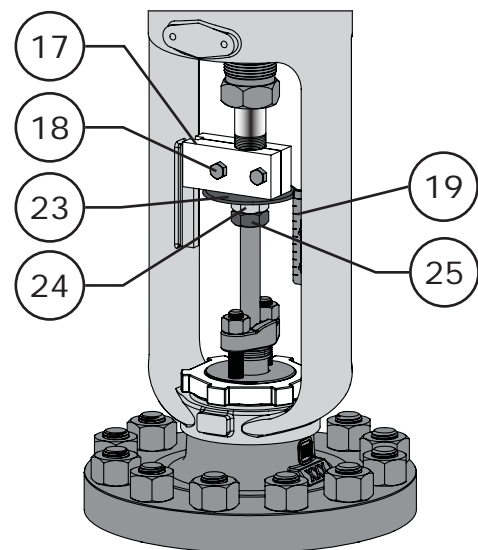


Figure 11 Size 3220 & 3220-4 DFO Connecting Block Detail



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ACTUATOR DISASSEMBLY

Before You Begin:

- Read the General and Scope section of this manual (Page 2).
- Read Safety Caution (Page 2).
- Sudden movement of actuator can cause damage or injury. De-energize the actuator before disassembly.
- Use safe work practices and lock out procedures.
- Standard actuators accept ¼" (6 mm) NPT connections.
- **Warning:** Do not use operating pressure that exceeds the Maximum Casing Pressure. Also, be sure the operating pressure does not create a force on the actuator stem (Key 9) that is greater than the Maximum Allowable Output Thrust. Refer to Table 1.
- **WARNING:** Property damage, environmental harm, and personal injury can result from the use of supply gas other than clean, non-corrosive, oil and moisture free air.
- Relieve process pressure and drain the process fluid from up and down stream of valve.
- Be aware of potentially hazardous process material that may be present in-line and in-valve. Isolate the valve from process pressure. Use a bypass or block valve if necessary, or completely shut off the process. Refer to the appropriate valve instruction manual.

- 1 Disconnect any tubing, piping, or instrumentation from the actuator.
- 2 Remove all spring tension by turning the spring adjuster (Key 2) counter-clockwise (to the left) until removed from the yoke (Key 1). Refer to Figure 4. For handwheels or travel stops, refer to Page 18.
- 3 For complete actuator disassembly it will not be necessary to remove the actuator from the valve. For inspection or maintenance purposes only disassemble the actuator as far as necessary and then begin re-assembly from that point on.
- 4 If required, separate the actuator from the valve:
 - A Loosen the jam nut (Key 25) and hex nut (Key 24). Lower the jam nut, hex nut, and travel disc (Key 23) away from the connecting block (Key 17). Refer to Figures 9 -11.

- B Remove the connecting block cap screws (Key 18) and separate and remove the connecting block (Key 17).
- C Secure the actuator for hoisting using the procedures mentioned in the UNPACKING section (Page 4). Using a heavy blunted chisel or metal rod and a hammer, loosen the yoke locknut as shown in Figure 8.
- D Carefully lift the actuator from the valve, remove the yoke locknut (Key 26) from between the valve and actuator as the actuator is lifted.
- E Secure the actuator in a clamping device that will support the weight of the actuator.

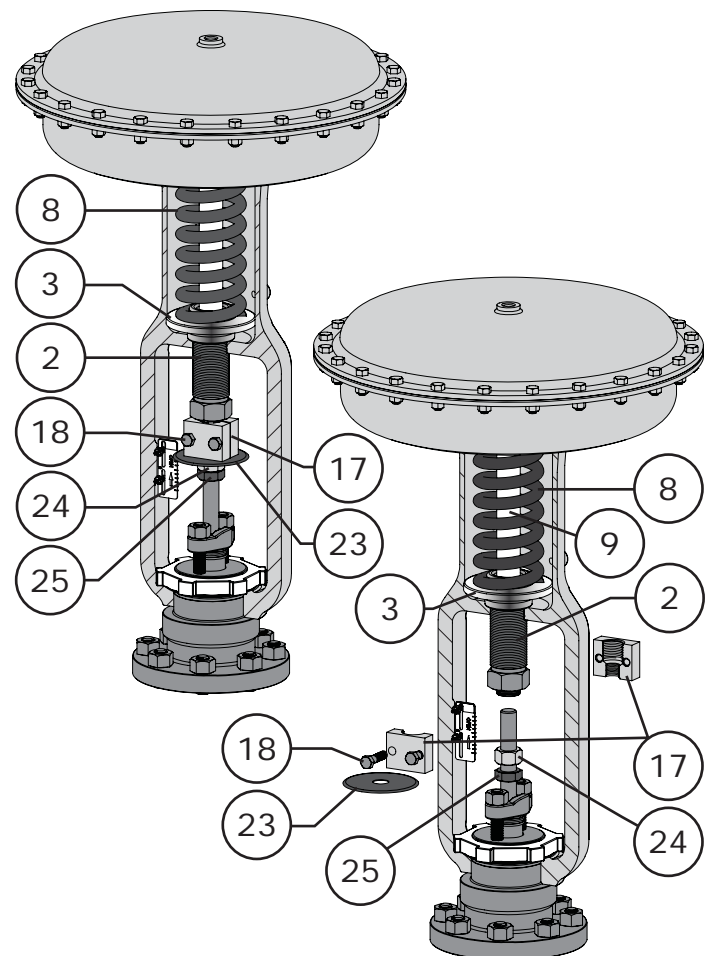


Figure 12 Actuator Disassembly - Removing Spring Tension

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ACTUATOR DISASSEMBLY (Continued)

UPPER DIAPHRAGM CASING DISASSEMBLY

NOTE: For information on top-mounted handwheels and travel stops refer to Page 18.

- 1 Carefully remove the casing cap screws (Key 14) and nuts (Key 15). Spring tension should have been removed prior to removing the casing cap screws but caution should be taken should there be any residual tension putting force on the upper diaphragm casing (Key 13). Refer to Figures 13 and 14.
- 2 Remove the upper diaphragm casing (Key 13).
- 3 Remove the diaphragm (Key 12).
- 4 Remove the diaphragm plate/actuator stem assembly (Keys 9, 10, & 11) from the yoke (Key 1). Refer to Figure 14.
- 5 Remove the spring (Key 8) from inside the yoke (Key 1).
- 6 Remove the spring seat (Key 3) from inside the yoke (Key 1).
- 7 Inspect all parts for damage and wear. Replace or repair parts as necessary.

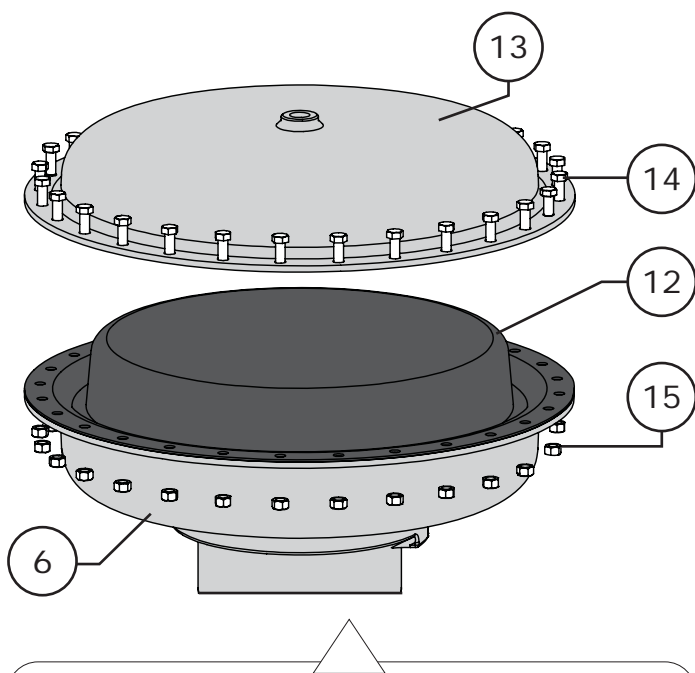


Figure 13 Upper Diaphragm Casing Disassembly Steps 1 & 2

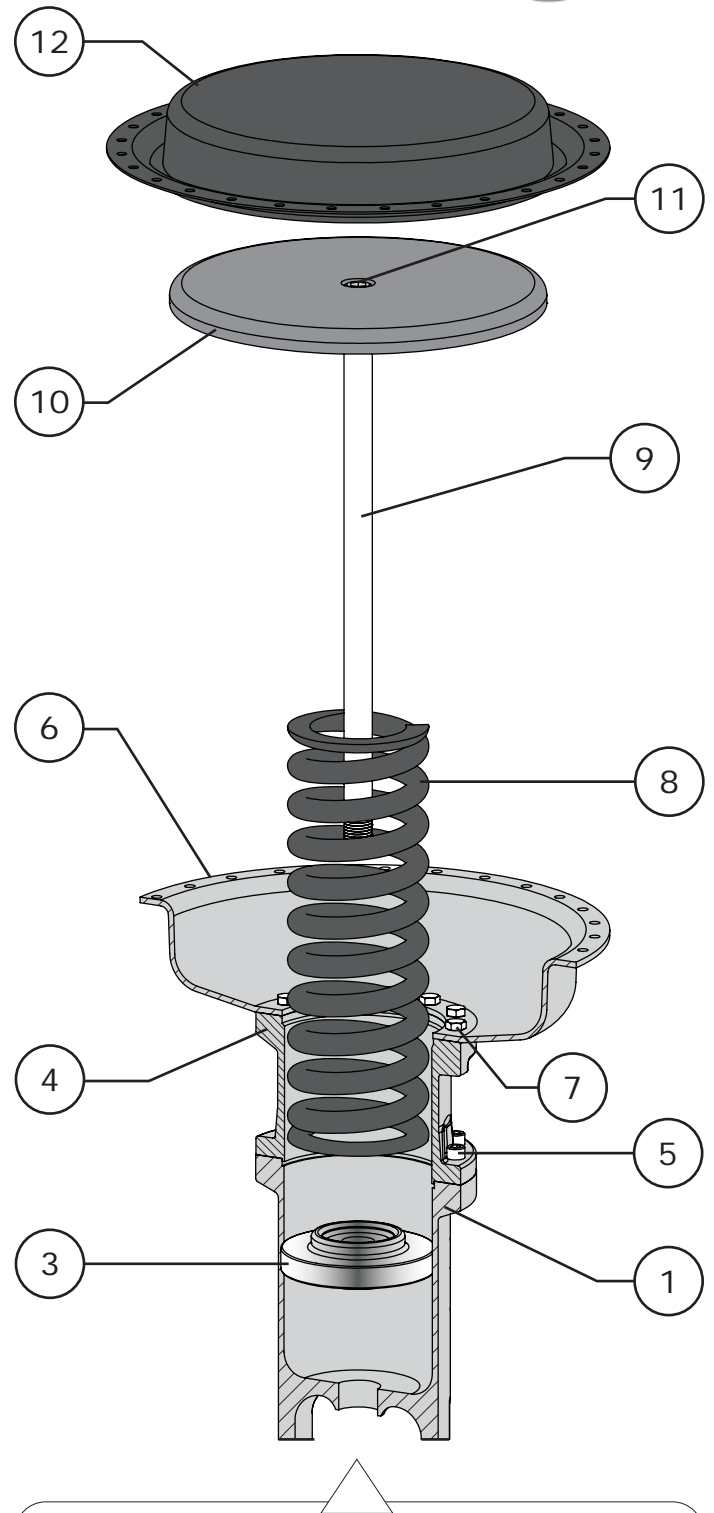


Figure 14 Upper Diaphragm Casing Disassembly Steps 3 to 6



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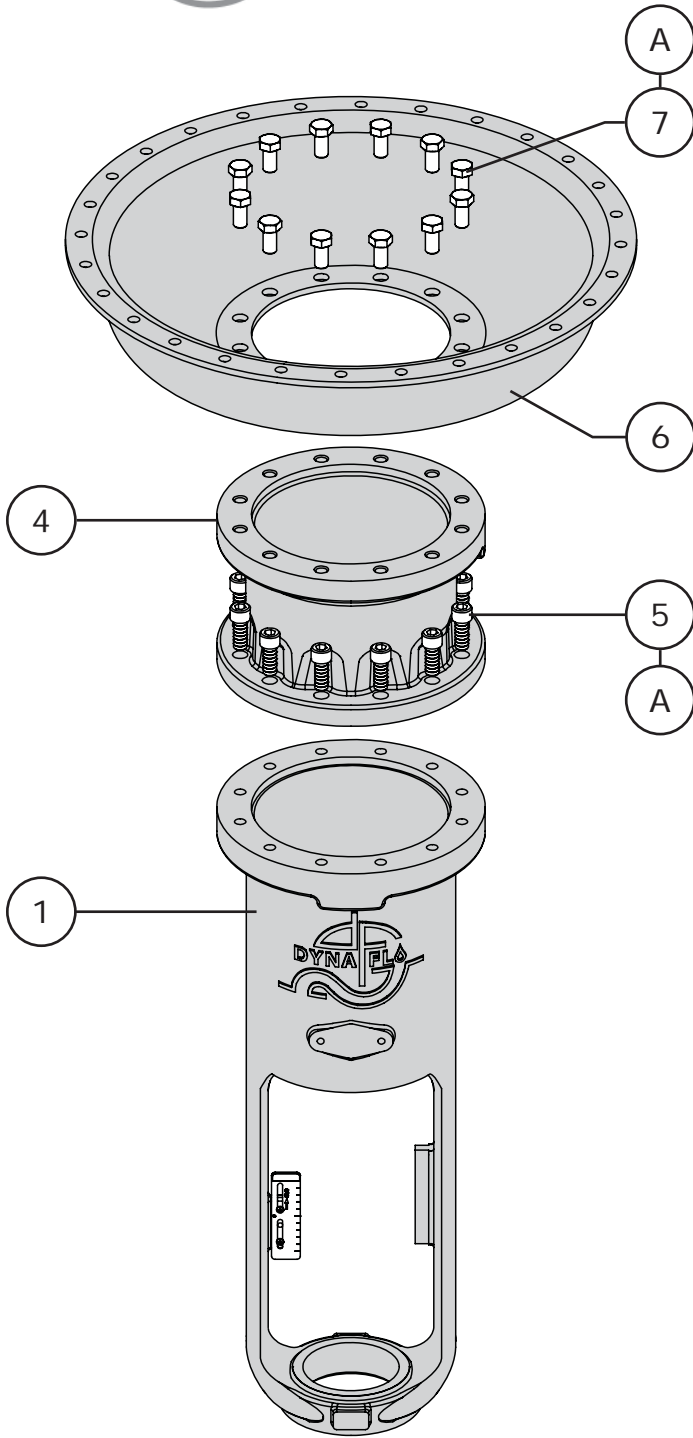


Figure 15 Lower Diaphragm Casing Disassembly

ACTUATOR DISASSEMBLY (Continued)

LOWER DIAPHRAGM CASING DISASSEMBLY

- 1 Remove the cap screws (Key 7) and lower diaphragm casing.
- 2 **For Size 3220-4 Actuators:** Remove the ferry head cap screws (Key 5) from the spring case adapter (Key 4). Separate the spring case adapter from the yoke (Key 1).
- 3 Inspect all parts for damage and wear. Replace or repair parts as necessary.

DIAPHRAGM PLATE/STEM DISASSEMBLY

NOTE: To separate the actuator stem (Key 9) from the diaphragm plate (Key 10) it will be necessary to secure the stem or plate in a clamping device. Use caution not to damage the actuator stem when clamping.

- 1 Remove the socket head cap screw (Key 11) from the actuator stem (Key 9).
- 2 Separate the diaphragm plate (Key 10) from the actuator stem (Key 9).
- 3 Inspect all parts for damage and wear. Replace or repair parts as necessary.

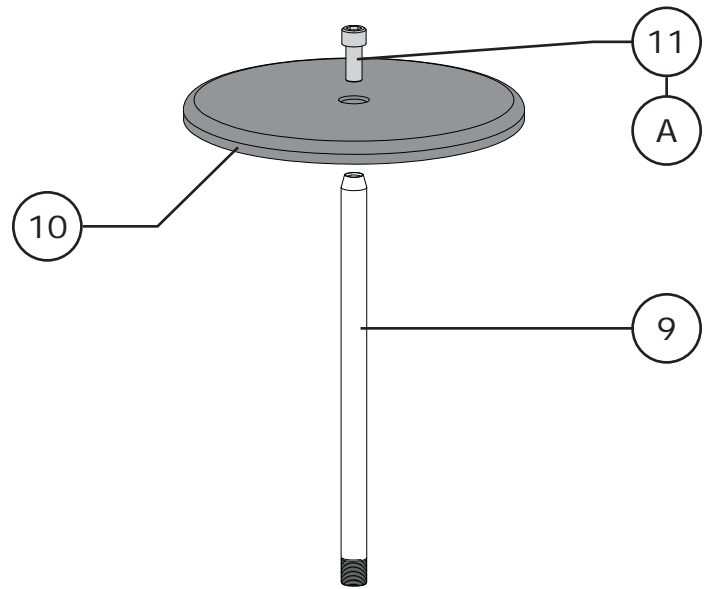


Figure 16 Diaphragm Plate/Actuator Stem Disassembly

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ACTUATOR ASSEMBLY

Before You Begin:

- Read the General and Scope section of this manual (Page 2).
- Read Safety Caution (Page 2).
- Use safe work practices and lock out procedures.
- Standard actuators accept 1/4" (6 mm) NPT connections.
- **Warning:** Do not use operating pressure that exceeds the Maximum Casing Pressure. Also, be sure the operating pressure does not create a force on the actuator stem (Key 9) that is greater than the Maximum Allowable Output Thrust. Refer to Table 1.
- **WARNING:** Property damage, environmental harm, and personal injury can result from the use of supply gas other than clean, non-corrosive, oil and moisture free air.
- Clean and inspect all parts.
- Replace or repair damaged parts. Replace all soft parts (Seals, o-rings, gaskets).

Lubricants Required:

- Permatex® Nickel Anti-Seize or equivalent (Key A)
- Dow Corning Molykote® 111 or equivalent (Key B)
- Lubriplate® No. 105 Grease or equivalent (Key C)

SIZE 3220-4 SPRING CASE ADAPTER ASSEMBLY

Size 3220-4 actuators have extended travel and as such are constructed with a spring case adapter (Key 4) installed between the lower diaphragm casing (Key 6) and the yoke (Key 1).

- 1 Place the spring case adapter (Key 4) on top of the yoke (Key 1) as shown in Figure 15. Make sure the NPT connection is to the right of the front of the yoke (Key 1).
- 2 Apply Permatex® Nickel Anti-Seize to the threads of the ferry head cap screws (Key 5).
- 3 Thread the ferry head cap screws (Key 5) through the spring case adapter (Key 4) and into the yoke (Key 1). Completely tighten the ferry head cap screws.

LOWER DIAPHRAGM CASING ASSEMBLY

- 1 Place the lower diaphragm casing (Key 6) on top of the yoke (Key 1) or spring case adapter (Key 4). Refer to Figure 17.

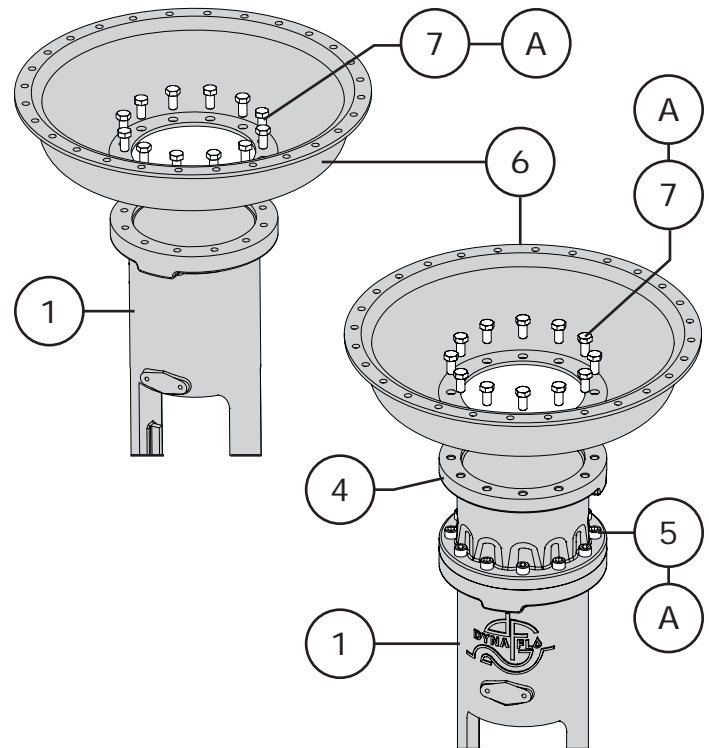


Figure 17 Lower Diaphragm Casing Assembly

- 2 Apply Permatex® Nickel Anti-Seize to the threads of the cap screws (Key 7) and thread them through the lower diaphragm casing (Key 6) and into the yoke (Key 1) or spring case adapter (Key 4).
- 3 Tighten the cap screws (Key 7) to the torque specification listed in Table 4.

DIAPHRAGM PLATE/STEM ASSEMBLY

NOTE: To secure the actuator stem (Key 9) to the diaphragm plate (Key 10) it may be necessary to secure the stem in a clamping device. Use caution not to damage the actuator stem when clamping.

- 1 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the socket head cap screw (Key 11).
- 2 Place the diaphragm plate (Key 10) on top of the actuator stem (Key 9) as shown in Figure 16.



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ACTUATOR ASSEMBLY (Continued)

DIAPHRAGM PLATE/STEM ASSEMBLY (Continued)

- 3 Thread the socket head cap screw (Key 11) through the diaphragm plate (Key 10) and into the actuator stem (Key 9). Tighten the socket head cap screw to the torque specification listed in Table 4.

SPRING INSTALLATION

- 1 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the spring adjuster (Key 2).
- 2 Thread the spring adjuster (Key 2) into the hole at top of the yoke window (Key 1) until there is enough of the spring adjuster sticking into the spring barrel portion of the yoke to locate the spring seat (Key 3) on to. Refer to Figure 18.
- 3 Install the spring seat (Key 3) into the yoke (Key 1) and center it onto the spring adjuster (Key 2). Refer to Figure 18.
- 4 Lift and lower the spring (Key 8) into the yoke (Key 1) and seat the spring onto the spring seat (Key 3).

UPPER DIAPHRAGM CASING ASSEMBLY

- 1 Install the diaphragm plate/actuator stem assembly (Keys 9, 10, & 11) through the top of the actuator assembly as show in Figure 19. Use caution sliding the actuator stem through the spring adjuster (Key 2), and make sure that the diaphragm plate seats properly on the spring (Key 8).
- 2 Place the diaphragm (Key 12) on the diaphragm plate (Key 10) and align the holes of the diaphragm with those of the lower diaphragm casing (Key 6).

NOTE: For information on Top-Mounted Handwheels and Travel Stops refer to Page 18.

- 3 Place the upper diaphragm casing (Key 13) on top of the actuator assembly and align the holes with those of the lower diaphragm casing (Key 6) and diaphragm (Key 12).
- 4 Install the cap screws (Key 14) through the holes in the upper and lower diaphragm casings (Keys 6 & 13), if it becomes difficult to install the cap screws it may be necessary to use vise grips or pliers to pull the diaphragm (Key 12) into a more co-operative position.

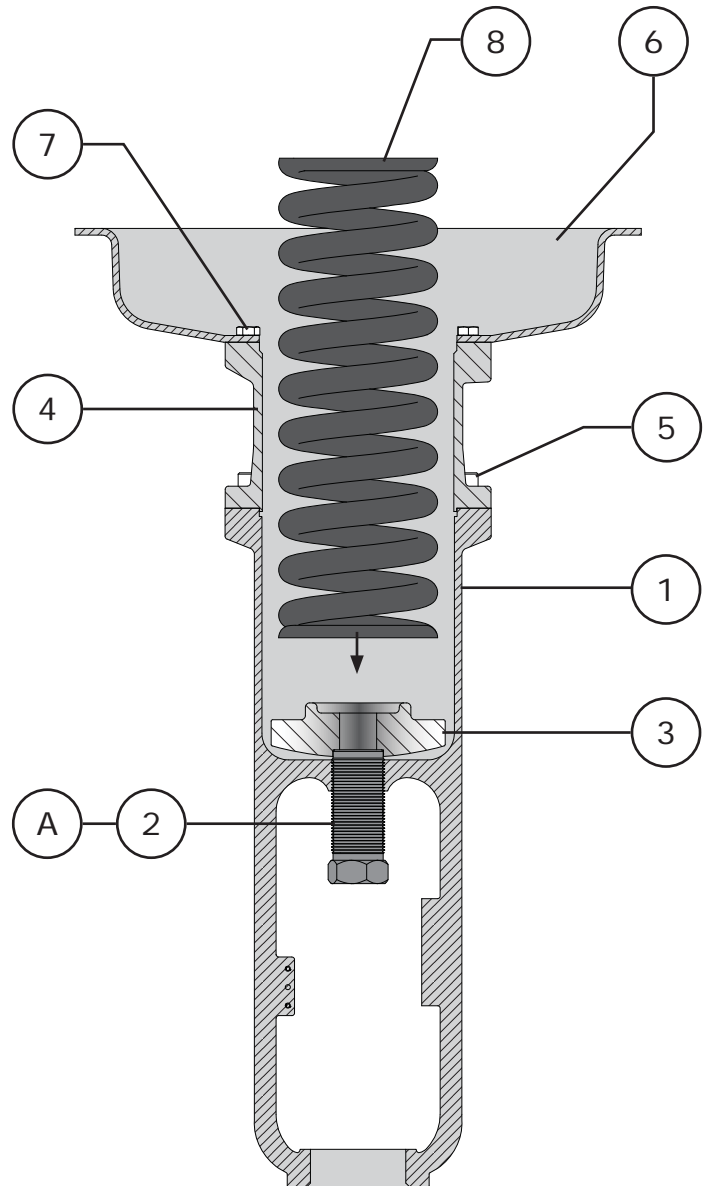


Figure 18 Spring Installation

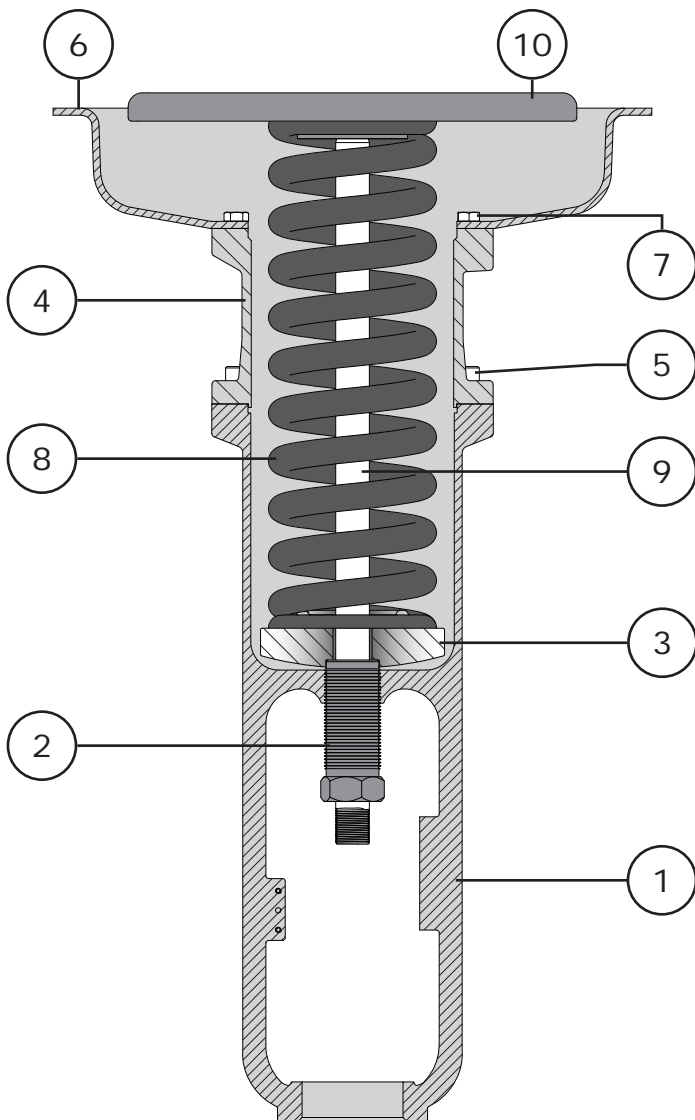


Figure 19 Spring Installation

ACTUATOR ASSEMBLY (Continued)

UPPER DIAPHRAGM CASING ASSEMBLY (Continued)

- 6 Install and tighten all the hex nuts (Key 15) evenly in a crisscross pattern to half the torque specification listed in Table 4. Then tighten the hex nuts again, using the same alternating pattern, to the full torque specification.
- 7 Install the reducer bushing (Key 16 – for size 220 actuators only) if it was removed or damaged.
- 8 Refer to the BENCH SETTING ACTUATOR section on Page 5 for instructions on adjusting the actuator after assembly is complete.

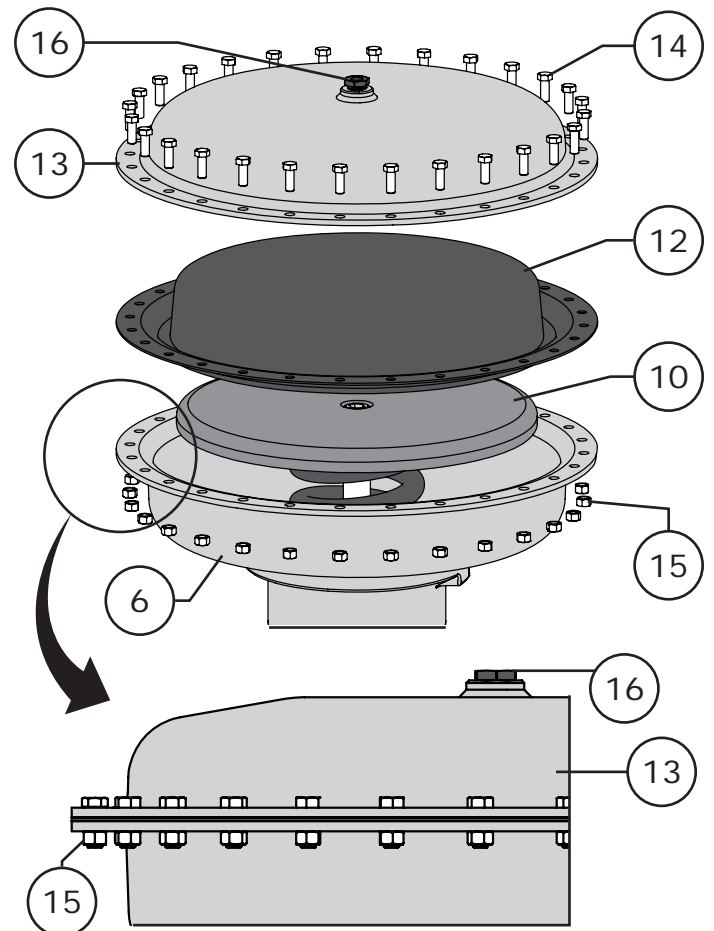


Figure 20 Upper Diaphragm Casing Installation



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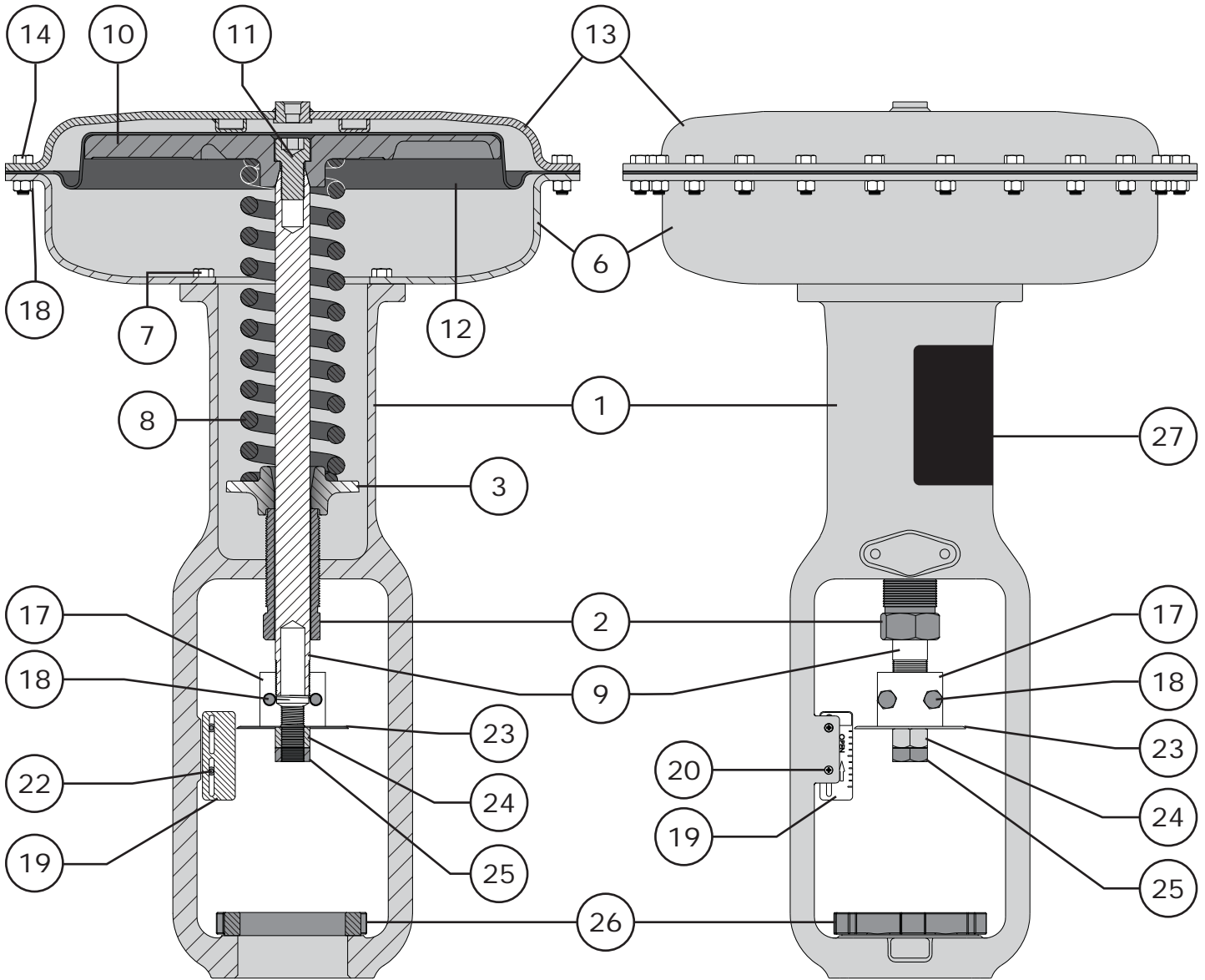


Figure 21 Cross Section - Sizes 046, 069, 105, and 156

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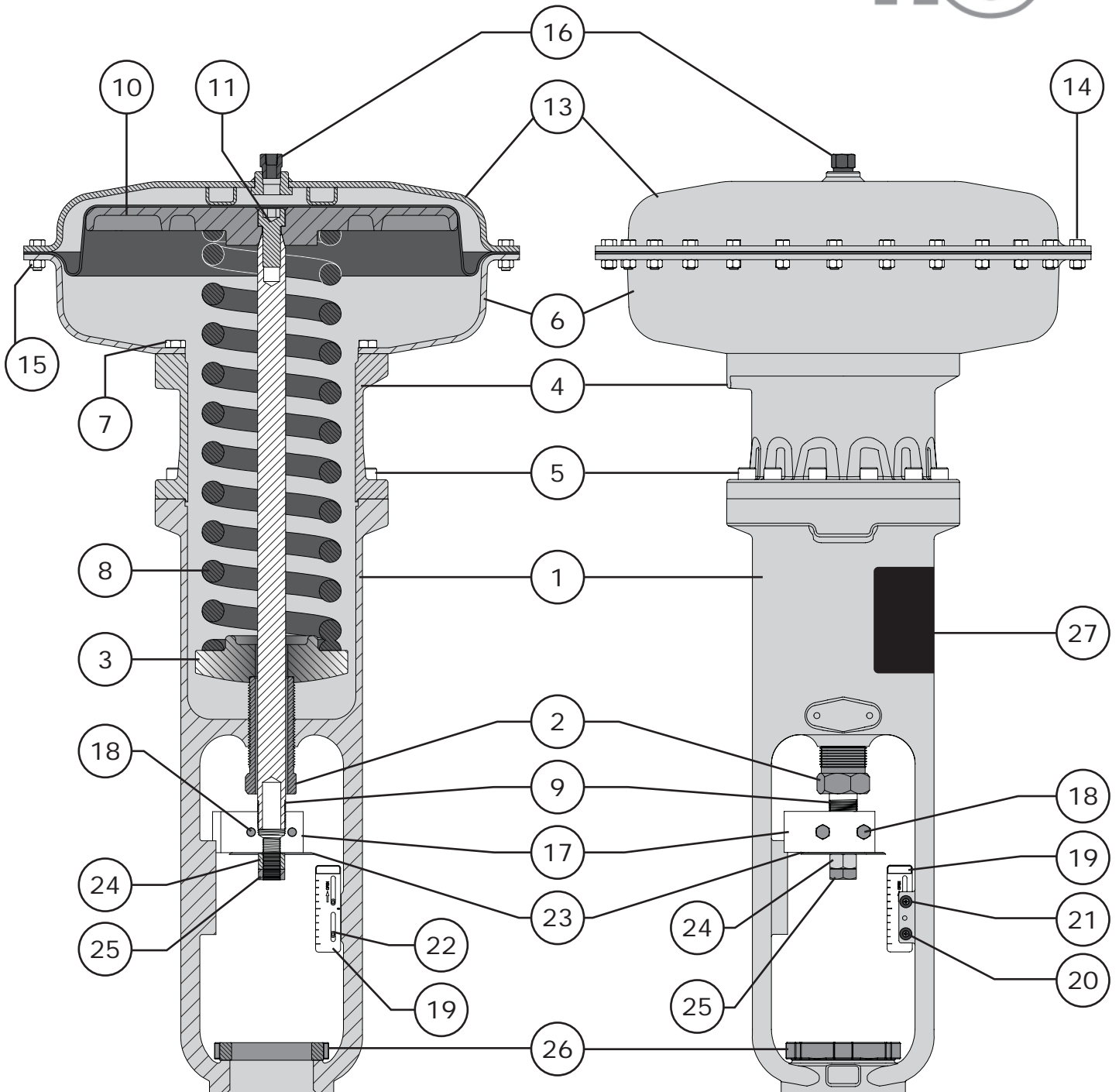


Figure 22 Cross Section - Size 220



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PRINCIPLES OF OPERATION AND ADJUSTMENT – HANDWHEELS AND TRAVEL STOPS

TOP-MOUNTED HANDWHEELS (Refer to Figure 23 & 24)

DFO Top-Mounted Handwheel assemblies are attached to a modified upper diaphragm casing (Key 100) using cap screws (Key 308). Top-Mounted Handwheels are typically used as an adjustable up travel stop which limit the full extension of the actuator stem (Key 9). If frequent manual operation of the handwheel is to be expected, it is recommended that a Side-Mounted Handwheel be used instead of the Top-Mounted Handwheel. Side-Mounted Handwheels are designed for frequent manual operation.

Using the handwheel as a travel stop:

Stem travel limits can be adjusted and set by rotating the handwheel to a desired position and then tightening the lock nut (Key 309) into the body (Key 305) of the handwheel (refer to Figures 23 & 24). By extending the stem (Key 303) and then locking it in place by tightening the lock nut, the length of travel can be shortened.

To compress the spring (Key 8) and move the actuator stem (Key 9) down:

Rotating the handwheel (Key 310) clockwise into the upper diaphragm casing (Key 100) forces the pusher plate (Key 301) into the diaphragm (Key 12)/diaphragm plate (Key 10) to compress the spring.

To decompress the spring (Key 8) and allow the actuator stem (Key 9) to move up:

Rotating the handwheel (Key 310) counterclockwise away from the upper diaphragm casing (Key 100) allows the spring to decompress which lets the diaphragm (Key 12)/diaphragm plate (Key 10) move upward.

ADJUSTABLE UP TRAVEL STOPS (Refer to Figures 25 & 26)

Adjustable up travel stops are used to limit the actuator stroke in the upward direction.

To adjust Type 1 up travel stop position:

- 1 Relieve actuator loading pressure.
- 2 Remove the closing cap (Key 103). **Note:** The closing cap is a pressure containing part, use caution when removing.
- 3 Loosen the lock nut (Key 102).

- 4 Rotate the stem (Key 101) clockwise to decrease the limit of upward travel. Rotate the stem counterclockwise to increase the limit of upward travel.
- 5 Once the stem (Key 101) has been adjusted to the desired travel length, tighten the lock nut (Key 102) into the body (Key 305) of the travel stop.
- 6 Re-install the closing cap (Key 103)

ADJUSTABLE DOWN TRAVEL STOPS (Refer to Figure 27)

Adjustable down travel stops are used to limit the actuator stroke in the downward direction.

To adjust Type 2 down travel stop position:

- 1 Relieve actuator loading pressure.
- 2 Remove the closing cap (Key 209).
- 3 Loosen the jam nut (Key 206) and hex nut (Key 207).
- 4 Adjust the hex nut (Key 207) to the desired length of travel. During operation the hex nut will make contact with the body (Key 205) of the travel stop and limit downward travel, the distance set between the top of the body and the bottom of the hex nut will be the length of travel.
- 5 Lock the hex nut (Key 207) in place using the jam nut (Key 206).
- 6 Re-install the closing cap (Key 209).

MAINTENANCE - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS

Maintenance should be performed if actuator loading pressure appears to be leaking from either the handwheel or travel stop. It is possible that either the o-rings (Keys 208, 306, & 307) or closing cap (Key 103, & 209) need to be replaced.

Before disassembling the handwheel or travel stop to replace o-rings, perform the following steps:

- Tighten the closing cap (Key 103, 209). If tightening the closing cap does not stop the leak, apply thread sealant to the threads of the closing cap.
- Lubricate the threads of the stem (Key 101, 200, 303) with Mobil Unirex™ Lotemp Grease (Key D), stroke the device a couple times after application. Size 220 Hand wheels and Travel Stops have a grease fitting (Key 316) available for lubricating the stem.

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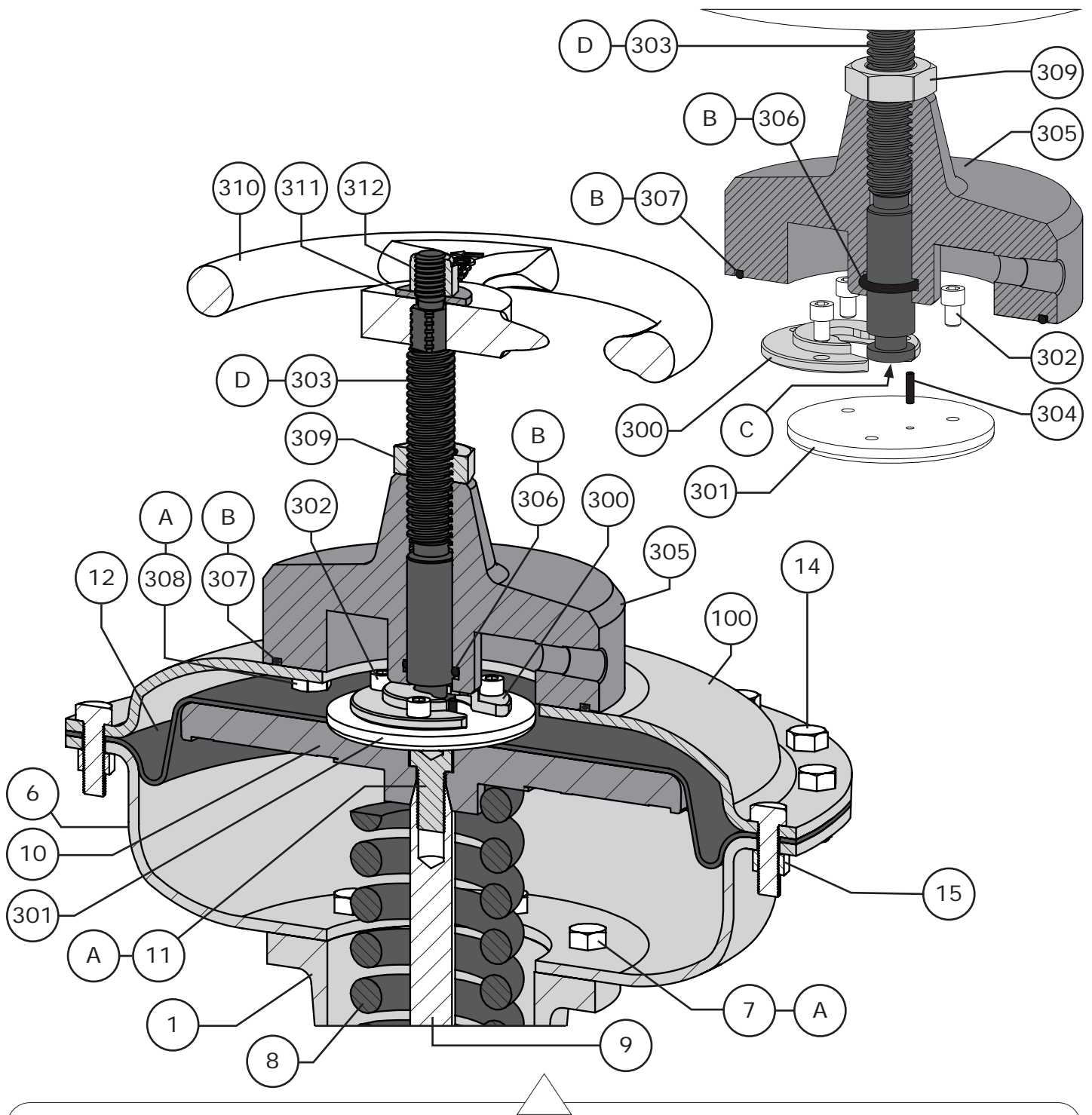


Figure 23 Top-Mounted Handwheel Cross Section (Size 069, 105, and 156 Actuators)



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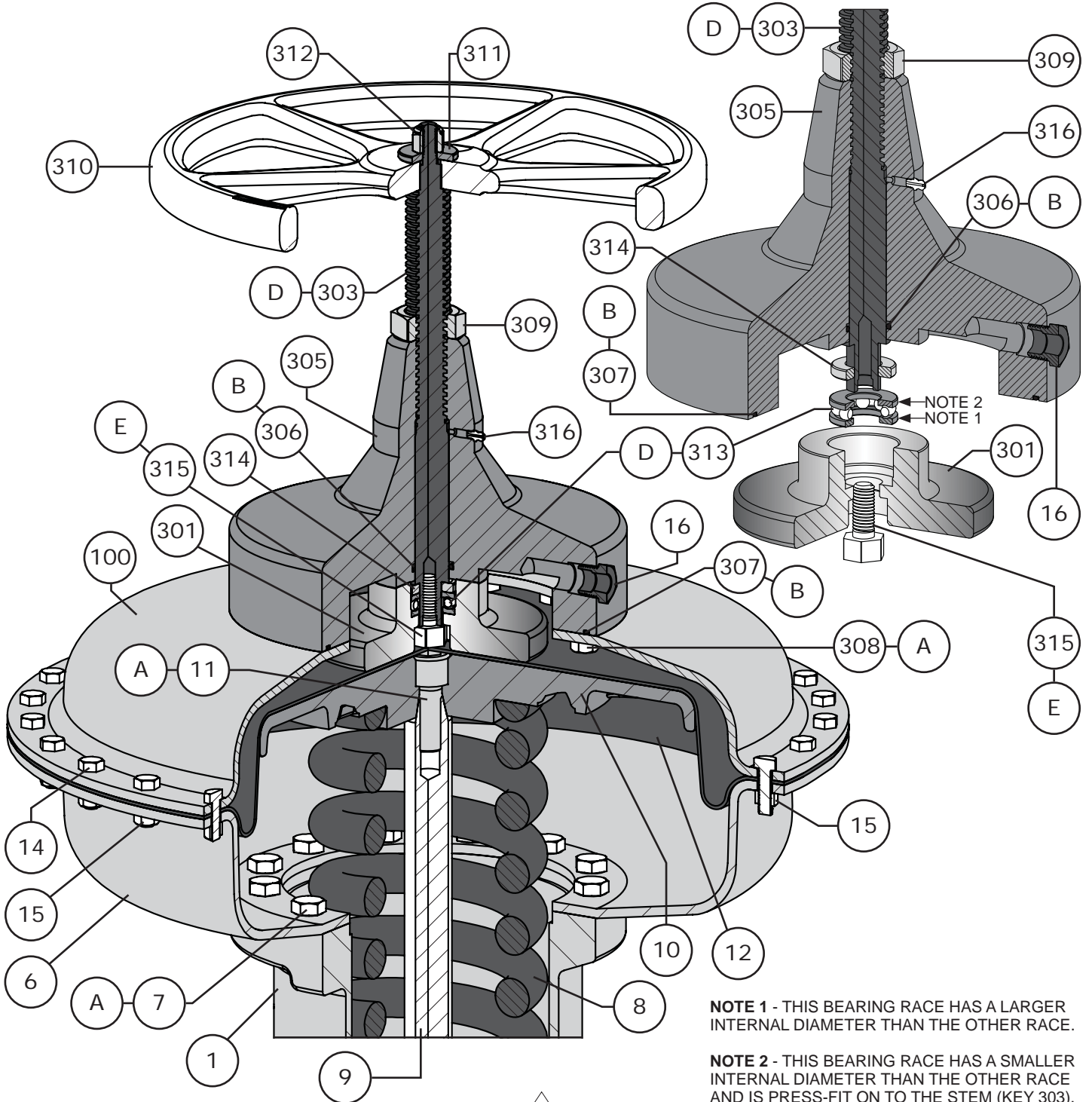


Figure 24 Top-Mounted Handwheel Cross Section (Size 220 Actuators)

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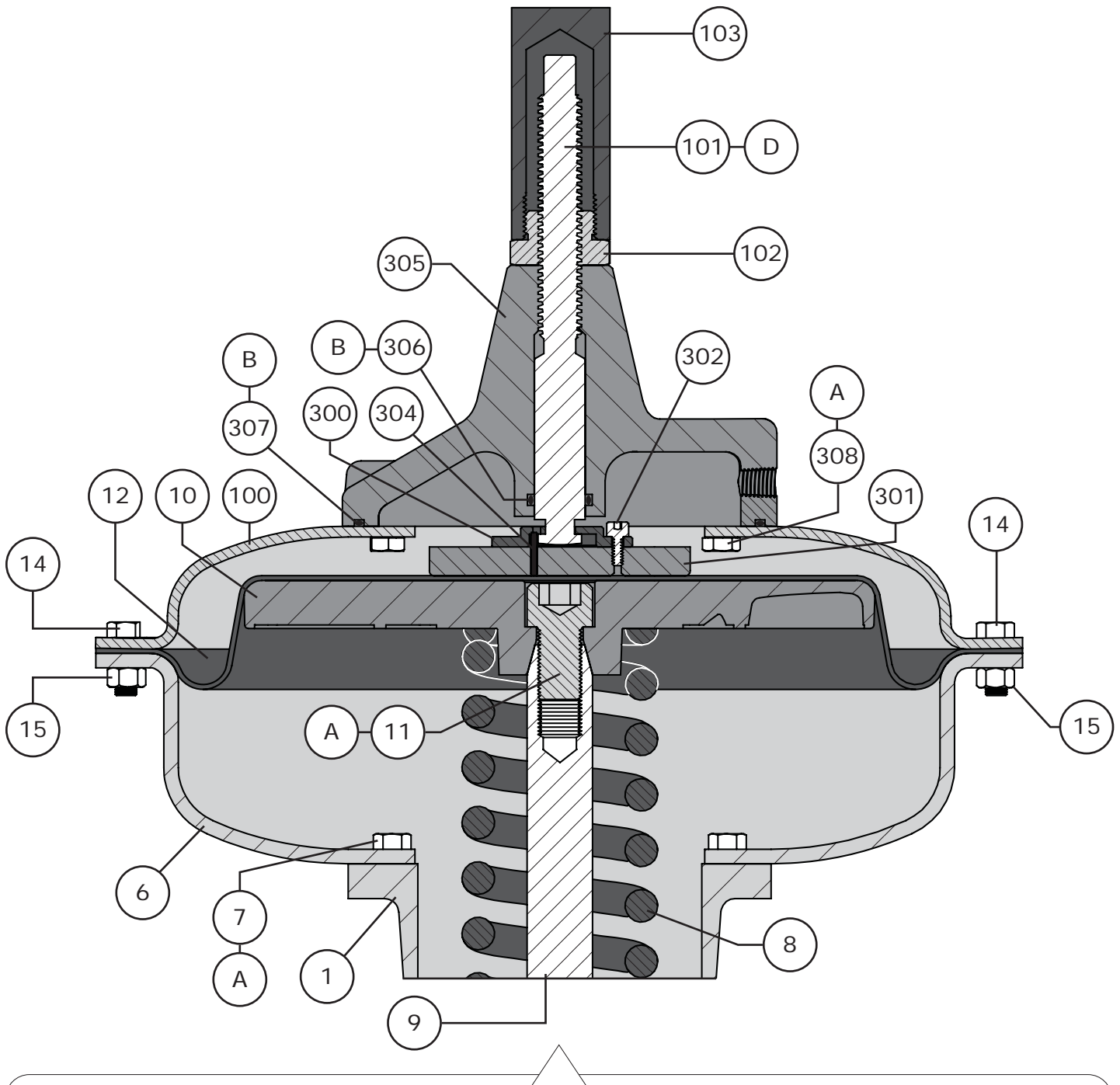


Figure 25 Type 1 Up Travel Stop Cross Section (Size 069, 105, and 156 Actuators)



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NOTE - THE THRUST BEARING (KEY 313) IS PRESS-FIT ONTO THE STEM (KEY 101). ONE RACE OF THE THRUST BEARING HAS A SMALLER INTERNAL DIAMETER THAN THE OTHER, REFER TO FIGURE 24 FOR DETAILS.

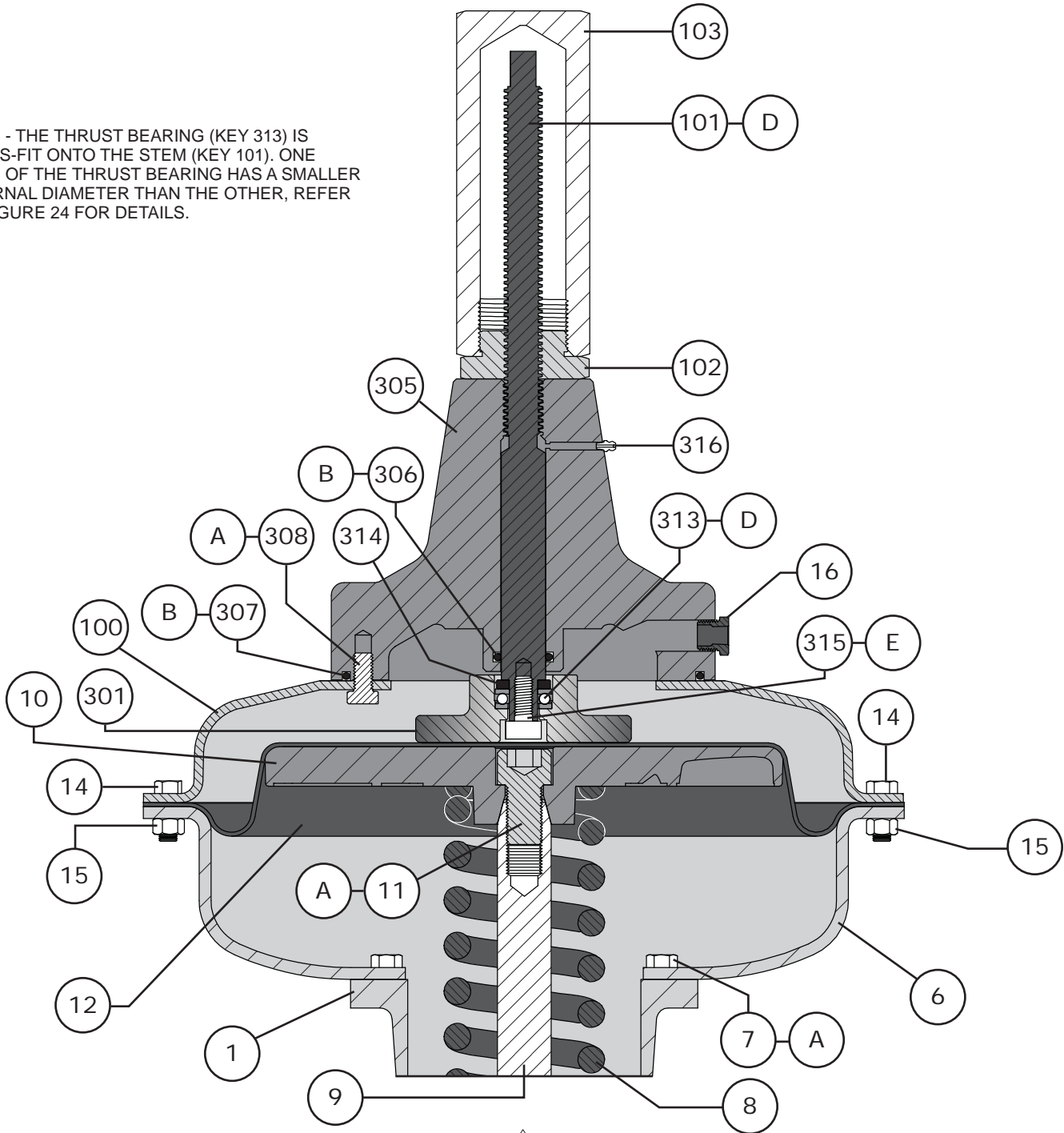


Figure 26 Type 1 Up Travel Stop Cross Section (Size 220 Actuators)

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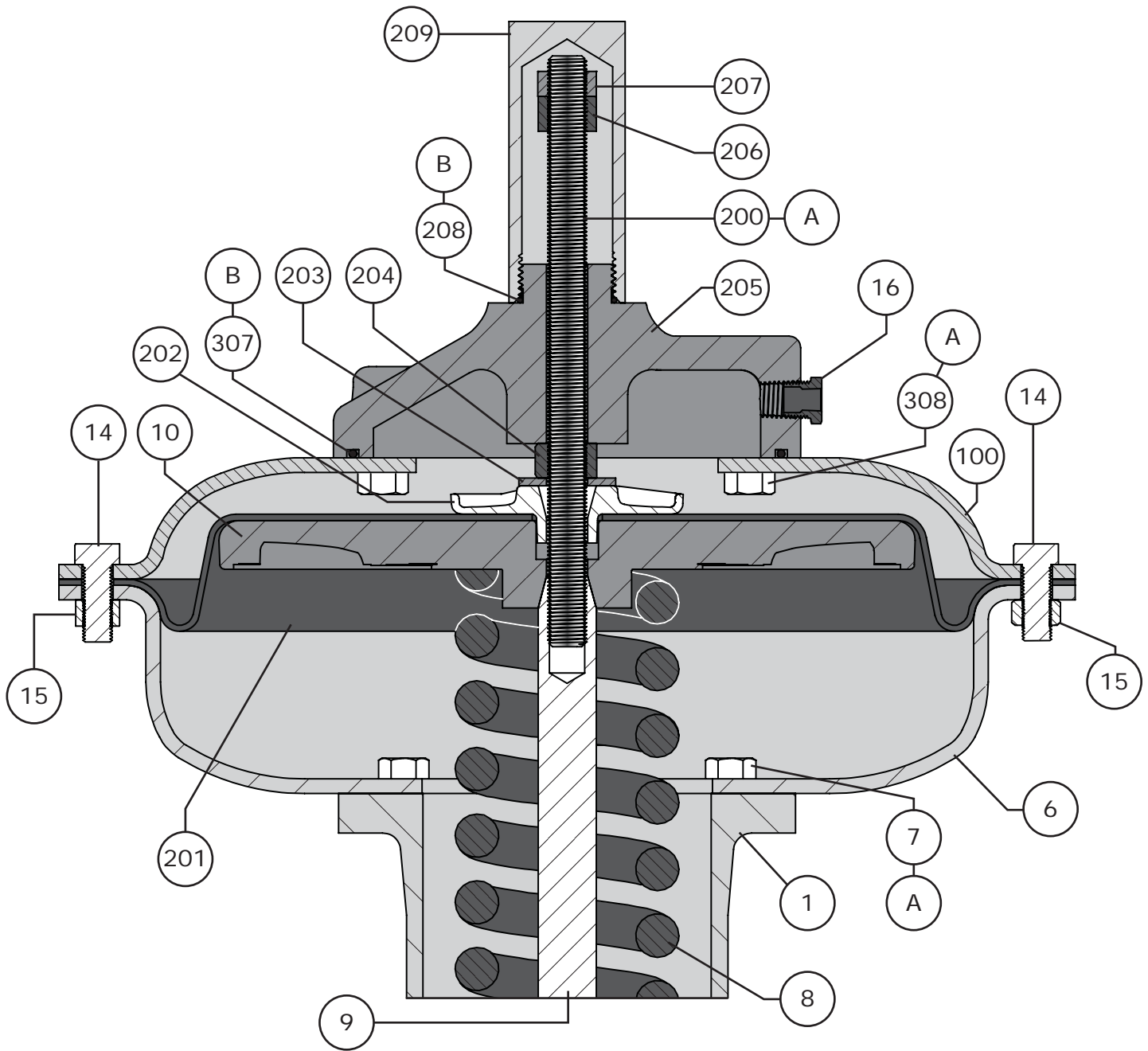


Figure 27 Type 2 Down Travel Stop Cross Section



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DISASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS

Before You Begin:

- Read the General and Scope section of this manual (Page 2).
- Read Safety Caution (Page 2).
- Sudden movement of actuator can cause damage or injury. De-energize the actuator before disassembly.
- Use safe work practices and lock out procedures.
- Standard actuators accept ¼" (6 mm) NPT connections.
- **Warning:** Do not use operating pressure that exceeds the Maximum Casing Pressure. Also, be sure the operating pressure does not create a force on the actuator stem (Key 9) that is greater than the Maximum Allowable Output Thrust. Refer to Table 1.
- **WARNING:** Property damage, environmental harm, and personal injury can result from the use of supply gas other than clean, non-corrosive, oil and moisture free air.
- Relieve process pressure and drain the process fluid from up and down stream of valve.
- Be aware of potentially hazardous process material that may be present in-line and in-valve. Isolate the valve from process pressure. Use a bypass or block valve if necessary, or completely shut off the process. Refer to the appropriate valve instruction manual.

SIZE 069, 105, & 156 TOP-MOUNTED HANDWHEELS DISASSEMBLY:

- 1 Relieve any actuator loading pressure. Disconnect any tubing, piping, or instrumentation from the actuator.
- 2 Completely rotate the handwheel (Key 310) counter-clockwise to decompress the spring (Key 8).
- 3 Remove all spring tension by turning the spring adjuster (Key 2) counter-clockwise (to the left) until removed from the yoke (Key 1). Refer to Figure 4.
- 4 Refer to the ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Steps 1 & 2 on Page 11 and remove the upper diaphragm casing/handwheel assembly (Keys 100, 305, and 310).
- 5 Separate the handwheel assembly from the upper diaphragm casing (Key 100) by remove the cap screws (Key 308). Refer to Figure 23.

- 6 Remove the o-ring (Key 307) from the body (Key 305).
- 7 Loosen the lock nut (Key 309).
- 8 Remove the nylock nut (Key 312), washer (Key 311), and handwheel (Key 310).
- 9 Remove the lock nut (Key 309) and rotate the stem (Key 303) clockwise out of the body (Key 305).
- 10 If required, remove the pin (Key 304) and separate the stem (Key 303) from the pusher plate (Key 301). Refer to Figure 23.
- 11 If required, remove the cap screws (Key 302) from the pusher plate retainer (Key 300). Separate the pusher plate retainer from the pusher plate (Key 301).
- 12 Using a mechanics pick, carefully remove the o-ring (Key 306) from inside the body (Key 305).
- 13 Inspect all parts for damage and wear. Replace or repair parts as necessary, all o-rings should be replaced.
- 14 Refer to ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Step 3 on Page 11 as starting reference to continue the actuator disassembly.

SIZE 220 TOP-MOUNTED HANDWHEELS DISASSEMBLY:

- 1 Relieve any actuator loading pressure. Disconnect any tubing, piping, or instrumentation from the actuator.
- 2 Completely rotate the handwheel (Key 310) counter-clockwise to decompress the spring (Key 8).
- 3 Remove all spring tension by turning the spring adjuster (Key 2) counter-clockwise (to the left) until removed from the yoke (Key 1). Refer to Figure 4.
- 4 Refer to the ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Steps 1 & 2 on Page 11 and remove the upper diaphragm casing/handwheel assembly (Keys 100, 305, and 310).
- 5 Separate the handwheel assembly from the upper diaphragm casing (Key 100) by remove the cap screws (Key 308). Refer to Figure 24.
- 6 Remove the o-ring (Key 307) from the body (Key 305).

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DISASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS (Continued)

SIZE 220 TOP-MOUNTED HANDWHEELS DISASSEMBLY (Continued):

- 7 Loosen the lock nut (Key 309).
- 8 Remove the nylock nut (Key 312), washer (Key 311), and handwheel (Key 310).
- 9 Remove the lock nut (Key 309) and rotate the stem (Key 303) clockwise out of the body (Key 305).
- 10 Remove the cap screw (Key 315) from inside the pusher plate (Key 301).
- 11 Separate the pusher plate (Key 301) from the stem (Key 303). Carefully remove the thrust bearing (Key 313) and thrust washer (Key 314). **NOTE:** The thrust bearing is press-fit onto the stem (Key 303) and may be difficult to remove, use caution when removing.
- 12 Using a mechanics pick, carefully remove the o-ring (Key 306) from inside the body (Key 305).
- 13 If required, remove the grease fitting (Key 316) and reducer bushing (Key 16).
- 14 Inspect all parts for damage and wear. Replace or repair parts as necessary, all o-rings should be replaced.
- 15 Refer to ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Step 3 on Page 11 as starting reference to continue the actuator disassembly.

SIZE 069, 105, & 156 TYPE 1 UP TRAVEL STOP DISASSEMBLY:

- 1 Relieve any actuator loading pressure. Disconnect any tubing, piping, or instrumentation from the actuator.
- 2 **NOTE:** Pressure may become trapped in the closing cap (Key 103), carefully loosen and remove the closing cap.
- 3 Remove the lock nut (Key 102) and rotate the stem (Key 101) counterclockwise and remove any spring tension applied by the up stop.

- 4 Remove all spring tension by turning the spring adjuster (Key 2) counter-clockwise (to the left) until removed from the yoke (Key 1). Refer to Figure 4.
- 5 Refer to the ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Steps 1 & 2 on Page 11 and remove the upper diaphragm casing/travel stop assembly (Keys 100, 101, and 305).
- 6 Separate the travel stop assembly from the upper diaphragm casing (Key 100) by removing the cap screws (Key 308).
- 7 Remove the o-ring (Key 307) from the body (Key 305).
- 8 Rotate the stem (Key 101) clockwise out of the body (Key 305).
- 9 If required, remove the pin (Key 304) and separate the stem (Key 101) from the pusher plate (Key 301). Refer to Figures 23 and 25.
- 10 If required, remove the cap screws (Key 302) from the pusher plate retainer (Key 300). Separate the pusher plate retainer from the pusher plate (Key 301).
- 11 Using a mechanics pick, carefully remove the o-ring (Key 306) from inside the body (Key 305).
- 12 Inspect all parts for damage and wear. Replace or repair parts as necessary, all o-rings should be replaced.
- 13 Refer to ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Step 3 on Page 11 to complete the actuator disassembly.

SIZE 220 TYPE 1 UP TRAVEL STOP DISASSEMBLY:

- 1 Relieve any actuator loading pressure. Disconnect any tubing, piping, or instrumentation from the actuator.
- 2 **NOTE:** Pressure may become trapped in the closing cap (Key 103), carefully loosen and remove the closing cap.
- 3 Remove the lock nut (Key 102) and rotate the stem (Key 101) counterclockwise and remove any spring tension applied by the up stop.
- 4 Remove all spring tension by turning the spring adjuster (Key 2) counter-clockwise (to the left) until removed from the yoke (Key 1). Refer to Figure 4.



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DISASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS (Continued)

SIZE 220 TYPE 1 UP TRAVEL STOP DISASSEMBLY (Continued):

- 5 Refer to the ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Steps 1 & 2 on Page 11 and remove the upper diaphragm casing/travel stop assembly (Keys 100, 101, and 305).
- 6 Separate the travel stop assembly from the upper diaphragm casing (Key 100) by remove the cap screws (Key 308). Refer to Figure 26 and 24.
- 7 Remove the o-ring (Key 307) from the body (Key 305).
- 8 Rotate the stem (Key 101) clockwise out of the body (Key 305).
- 9 Remove the cap screw (Key 315) from inside the pusher plate (Key 301).
- 10 Separate the pusher plate (Key 301) from the stem (Key 101). Carefully remove the thrust bearing (Key 313) and thrust washer (Key 314). **NOTE:** The thrust bearing is press-fit onto the stem (Key 101) and may be difficult to remove, use caution when removing.
- 11 Using a mechanics pick, carefully remove the o-ring (Key 306) from inside the body (Key 305).
- 12 If required, remove the grease fitting (Key 316) and reducer bushing (Key 16).
- 13 Inspect all parts for damage and wear. Replace or repair parts as necessary, all o-rings should be replaced.
- 14 Refer to ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Step 3 on Page 11 as starting reference to continue the actuator disassembly.

TYPE 2 DOWN TRAVEL STOP DISASSEMBLY:

Refer to Figure 27.

- 1 Relieve any actuator loading pressure. Disconnect any tubing, piping, or instrumentation from the actuator.
- 2 **NOTE:** Pressure may become trapped in the closing cap (Key 209), carefully loosen and remove the closing cap and o-ring (Key 208).
- 3 Remove the jam nut (Key 207) and hex nut (Key 206) from the stem (Key 200).
- 4 Remove all spring tension by turning the spring adjuster (Key 2) counter-clockwise (to the left) until removed from the yoke (Key 1). Refer to Figure 4.
- 5 Refer to the ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Steps 1 & 2 on Page 11 and remove the upper diaphragm casing/travel stop assembly (Keys 101, 205).
- 6 Remove the o-ring (Key 307) from the body (Key 205).
- 7 Loosen the hex nut (Key 204) and washer (Key 203).
- 8 Unscrew the stem (Key 200) from the actuator stem (Key 9).
- 9 Remove the upper diaphragm plate (Key 202) and diaphragm (Key 201).
- 10 Inspect all parts for damage and wear. Replace or repair parts as necessary, all o-rings should be replaced.
- 11 Refer to ACTUATOR DISASSEMBLY - Upper Diaphragm Casing Disassembly instructions, Step 3 on Page 11 as starting reference to continue the actuator disassembly.

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ASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS

Before You Begin:

- Read the General and Scope section of this manual (Page 2).
- Read Safety Caution (Page 2).
- Use safe work practices and lock out procedures.
- Standard actuators accept ¼" (6 mm) NPT connections.
- **Warning:** Do not use operating pressure that exceeds the Maximum Casing Pressure. Also, be sure the operating pressure does not create a force on the actuator stem (Key 9) that is greater than the Maximum Allowable Output Thrust. Refer to Table 1.
- **WARNING:** Property damage, environmental harm, and personal injury can result from the use of supply gas other than clean, non-corrosive, oil and moisture free air.
- Clean and inspect all parts.
- Replace or repair damaged parts. Replace all soft parts (Seals, o-rings, gaskets).

Lubricants Required:

- Permatex® Nickel Anti-Seize or equivalent (Key A)
- Dow Corning Molykote® 111 or equivalent (Key B)
- Lubriplate® No. 105 Grease or equivalent (Key C)
- Mobil Unirex™ Lotemp Grease or Equivalent (Key D)
- Loctite® 242® Threadlocker or Equivalent (Key E)

SIZE 069, 105, & 156 TOP-MOUNTED HANDWHEELS ASSEMBLY:

NOTE: Begin the following handwheel assembly instructions after completing ACTUATOR ASSEMBLY instructions to UPPER DIAPHRAGM CASING ASSEMBLY, Step 2, Page 14.

- 1 Connect the pusher plate retainer (Key 300) to the pusher plate (Key 301) using the socket head cap screws (Key 302).
- 2 Apply Lubriplate® No. 105 Grease (Key C) to the bottom surface of the stem (Key 303). Slide the pusher plate retainer/pusher plate assembly (Keys 300, 301, 302, & 303) onto the end of the stem as shown in Figure 23.
- 3 Secure the stem (Key 303) in place by installing the pin (Key 304) into the pusher plate (Key 301) as shown in Figure 23.

- 4 Lubricate the o-ring (Key 306) with Dow Corning Molykote® 111 (Key B) and install it into the o-ring groove inside the body (Key 305).
- 5 Apply Mobil Unirex™ Lotemp Grease (Key D) to the threads of the stem (Key 303) and thread the stem up through the body (Key 305) until the top of the pusher plate retainer (Key 300) makes contact with the body.
- 6 Apply Dow Corning Molykote® 111 (Key B) to the o-ring (Key 307) and install it into the o-ring groove of the body (Key 305).
- 7 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the cap screws (Key 308) and use them to attach the body (Key 305) to the upper diaphragm casing (Key 100). Refer to Table 4 for cap screw torque specifications.
- 8 Install the lock nut (Key 309) onto the stem (Key 303).
- 9 Place the handwheel (Key 310) onto the top of the stem (Key 303). Install the washer (Key 311) on top of the handwheel.
- 10 Thread the nylock nut (Key 312) onto the end of the stem (Key 303) and completely tighten the nylock nut.
- 11 Carefully place the handwheel assembly on to the actuator assembly so that the NPT connection of the body (Key 305) is parallel to the window of the yoke (Key 1) and to the right of the front of the actuator (to the right of the lower mounting boss).

Align holes in the upper diaphragm casing (Key 100) align with the holes of the diaphragm (Key 12) and lower diaphragm casing (Key 6).

- 12 Refer to the ACTUATOR ASSEMBLY – Upper Diaphragm Casing Assembly instructions, Step 4 on Page 15 as starting reference to continue the actuator disassembly.
- 13 Refer to the PRINCIPLES OF OPERATION AND ADJUSTMENT section on Page 18 for information on adjusting the Top-Mounted Handwheel after Bench Setting Actuator has been completed.



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ASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS (Continued)

SIZE 220 TOP-MOUNTED HANDWHEELS ASSEMBLY:

NOTE: Begin the following handwheel assembly instructions after completing ACTUATOR ASSEMBLY instructions to UPPER DIAPHRAGM CASING ASSEMBLY, Step 2, Page 14.

- 1 Lubricate the thrust bearing (Key 313) with Mobil Unirex™ Lotemp Grease (Key D) and set the thrust bearing into the pocket of the pusher plate (Key 301). **NOTE:** Set the bearing into the pocket of the pusher plate so that the bearing race with the smaller inside diameter is facing up, refer to Figure 24.
- 2 Install the the thrust washer (Key 314) into the pocket of the pusher plate (Key 301) so that it sits on top of the thrust bearing (Key 313).
- 3 Slide the stem (Key 303) through the thrust washer (Key 314), thrust bearing (Key 313), and pusher plate (Key 301) as shown in Figure 24. Apply Loctite® 242® Threadlocker (Key E) to the threads of the cap screw (Key 315) and thread it into the stem. Tighten the cap screw completely. **NOTE:** The The top and bottom bearing races have different size internal diameters, the top bearing race will need to be press fit onto the stem using the cap screw. Refer to Figure 24.
- 4 Lubricate the o-ring (Key 304) with Dow Corning Molykote® 111 (Key B) and install the o-ring into the o-ring groove inside the body (Key 305).
- 5 Apply Mobil Unirex™ Lotemp Grease (Key D) to the threads of the stem (Key 303) and thread the pusher plate/stem assembly (Keys 301, 303, 313, 314, & 315) through the bottom of the body (Key 305) until the pusher plate (Key 301) makes contact with the body.
- 6 Lubricate the o-ring (Key 307) with Dow Corning Molykote® 111 (Key B) and install it into the o-ring groove of the body (Key 305).
- 7 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the cap screws (Key 308) and use them to connect the upper diaphragm casing (Key 100) with the body assembly (Keys 301, 303, 313, 314, & 315).
- 8 Install the lock nut (Key 309) onto the stem (Key 303).

- 9 Place the handwheel (Key 310) onto the top of the stem (Key 303). Install the washer (Key 311) on top of the handwheel.
- 10 Thread the nylock nut (Key 312) onto the end of the stem (Key 303) and completely tighten the nylock nut.
- 11 Carefully place the handwheel assembly on to the actuator assembly so that the NPT connection of the body (Key 305) is parallel to the window of the yoke (Key 1) and to the right of the front of the actuator (to the right of the lower mounting boss).

Align holes in the upper diaphragm casing (Key 100) align with the holes of the diaphragm (Key 12) and lower diaphragm casing (Key 6).
- 12 Install the grease fitting (Key 316) and reducer bushing (Key 16) using good piping practices.
- 13 Refer to the ACTUATOR ASSEMBLY – Upper Diaphragm Casing Assembly instructions, Step 4 on Page 15 as starting reference to continue the actuator disassembly.
- 14 Refer to the PRINCIPLES OF OPERATION AND ADJUSTMENT section on Page 18 for information on adjusting the Top-Mounted Handwheel after Bench Setting Actuator has been completed.

SIZE 069, 105, & 156 TYPE 1 UP TRAVEL STOP ASSEMBLY:

NOTE: Begin the following travel stop assembly instructions after completing ACTUATOR ASSEMBLY instructions to UPPER DIAPHRAGM CASING ASSEMBLY, Step 2, Page 14.

- 1 Connect the pusher plate retainer (Key 300) to the pusher plate (Key 301) using the socket head cap screws (Key 302).
- 2 Apply Lubriplate® No. 105 Grease (Key C) to the bottom surface of the stem (Key 101). Slide the pusher plate retainer/pusher plate assembly (Keys 300, 301, & 302) onto the end of the stem as shown in Figure 25 and 23.
- 3 Secure the stem (Key 101) in place by installing the pin (Key 304) into the pusher plate (Key 300) as shown in Figure 23 and 25.
- 4 Lubricate the o-ring (Key 306) with Dow Corning Molykote® 111 (Key B) and install it into the o-ring groove inside the body (Key 305).

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ASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS (Continued)

SIZE 069, 105, & 156 TYPE 1 UP TRAVEL STOP

ASSEMBLY (Continued):

- 5 Apply Mobil Unirex™ Lotemp Grease to the threads of the stem (Key 101) and thread the stem up through the body (Key 305) until the top of the pusher plate retainer (Key 300) makes contact with the body.
- 6 Apply Dow Corning Molykote® 111 (Key B) to the o-ring (Key 307) and install it into the o-ring groove of the body (Key 305).
- 7 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the cap screws (Key 308) and use them to attach the body (Key 305) to the upper diaphragm casing (Key 100). Refer to Table 4 for cap screw torque specifications.
- 8 Install the lock nut (Key 102) onto the stem (Key 101).
- 9 Install the closing cap (Key 103).
- 10 Carefully place the handwheel assembly on to the actuator assembly so that the NPT connection of the body (Key 305) is parallel to the window of the yoke (Key 1) and to the right of the front of the actuator (to the right of the lower mounting boss).

Align holes in the upper diaphragm casing (Key 100) align with the holes of the diaphragm (Key 12) and lower diaphragm casing (Key 6).

- 12 Refer to the ACTUATOR ASSEMBLY – Upper Diaphragm Casing Assembly instructions, Step 4 on Page 15 as starting reference to continue the actuator disassembly.
- 13 Refer to the PRINCIPLES OF OPERATION AND ADJUSTMENT section on Page 18 for information on adjusting the Travel Stop after Bench Setting Actuator has been completed.

SIZE 220 TYPE 1 UP TRAVEL STOP ASSEMBLY:

NOTE: Begin the following travel stop assembly instructions after completing ACTUATOR ASSEMBLY instructions to UPPER DIAPHRAGM CASING ASSEMBLY, Step 2, Page 14.

- 1 Lubricate the thrust bearing (Key 313) with Mobil Unirex™ Lotemp Grease (Key D) and set the thrust bearing into the pocket of the pusher plate (Key 301). **NOTE:** Set the bearing into the pocket of the pusher plate so that the bearing race with the smaller inside diameter is facing up, refer to Figure 26 and 24.

- 2 Install the the thrust washer (Key 314) into the pocket of the pusher plate (Key 301) so that it sits on top of the thrust bearing (Key 313).
- 3 Slide the stem (Key 101) through the thrust washer (Key 314), thrust bearing (Key 313), and pusher plate (Key 301) as shown in Figure 23 and 25. Apply Loctite® 242® Threadlocker (Key E) to the threads of the cap screw (Key 315) and thread it into the stem. Tighten the cap screw completely. **NOTE:** The The top and bottom bearing races have different size internal diameters, the top bearing race will need to be press-fit onto the stem using the cap screw. Refer to Figure 24 and 26.
- 4 Lubricate the o-ring (Key 306) with Dow Corning Molykote® 111 (Key B) and install the o-ring into the o-ring groove inside the body (Key 305).
- 5 Apply Mobil Unirex™ Lotemp Grease (Key D) to the threads of the stem (Key 101) and thread the pusher plate/stem assembly (Keys 101, 301, 313, 314, 315) through the bottom of the body (Key 305) until the pusher plate (Key 301) makes contact with the body.
- 6 Lubricate the o-ring (Key 307) with Dow Corning Molykote® 111 (Key B) and install it into the o-ring groove of the body (Key 305).
- 7 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the cap screws (Key 308) and use them to connect the upper diaphragm casing (Key 100) with the body assembly (Keys 101, 301, & 305).
- 8 Install the lock nut (Key 102) onto the stem (Key 101).
- 9 Install the closing cap (Key 103).
- 10 Carefully place the handwheel assembly on to the actuator assembly so that the NPT connection of the body (Key 305) is parallel to the window of the yoke (Key 1) and to the right of the front of the actuator (to the right of the lower mounting boss).

Align holes in the upper diaphragm casing (Key 100) align with the holes of the diaphragm (Key 12) and lower diaphragm casing (Key 6).

- 11 Install the grease fitting (Key 316) and reducer bushing (Key 16) using good piping practices.



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ASSEMBLY - TOP-MOUNTED HANDWHEELS AND TRAVEL STOPS (Continued)

SIZE 220 TYPE 1 UP TRAVEL STOP ASSEMBLY (Continued):

- 12 Refer to the ACTUATOR ASSEMBLY – Upper Diaphragm Casing Assembly instructions, Step 4 on Page 15 as starting reference to continue the actuator disassembly.
- 13 Refer to the PRINCIPLES OF OPERATION AND ADJUSTMENT section on Page 18 for information on adjusting the Travel Stop after Bench Setting Actuator has been completed.

TYPE 2 DOWN TRAVEL STOP ASSEMBLY:

Refer to Figure 27.

NOTE: Begin the following travel stop assembly instructions after completing ACTUATOR ASSEMBLY instructions to UPPER DIAPHRAGM CASING ASSEMBLY, Step 1, Page 14.

- 1 Carefully remove the cap screw (Key 11) from the actuator stem (Key 9).
- 2 Place the diaphragm (Key 201) onto the actuator assembly so that the holes of the diaphragm align with the holes in the lower diaphragm casing (Key 6). **NOTE:** The diaphragm required for the Type 2 Down Stop assembly with have a hole in the center.
- 3 Install the upper diaphragm plate (Key 202) through the hole in the top of the diaphragm (Key 201).
- 4 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the stem (Key 200) and thread it into the top of the actuator stem (Key 9).
- 5 Slide the washer (Key 203) over the stem (Key 200) so that it sits on top of the upper diaphragm plate (Key 202).
- 6 Thread the hex nut (Key 204) onto the stem (Key 200) and tighten it down onto the washer (Key 203). Torque the hex nut to the torque value specified in Table 4.
- 7 Lubricate the o-ring (Key 307) with Dow Corning Molykote® 111 (Key B) and install it into the o-ring groove of the body (Key 205).
- 8 Apply Permatex® Nickel Anti-Seize (Key A) to the threads of the cap screws (Key 308) and use them to attach the body (Key 205) to the upper diaphragm casing (Key 100). Torque the cap screws to the torque value specified in Table 4.
- 9 Carefully slide the upper diaphragm casing/body assembly (Keys 100, 205, 307, & 308) over the stem (Key 200) and down onto the actuator assembly. Align the holes of the upper diaphragm casing (Key 100) with the holes of the diaphragm (Key 201) and lower diaphragm casing (Key 6).
- 10 Refer to the ACTUATOR ASSEMBLY – Upper Diaphragm Casing Assembly instructions, Step 4 on Page 15 as starting reference to continue the actuator disassembly.
- 11 Install the hex nut (Key 206) and jam nut (Key 207) on to the stem (Key 200).
- 12 Lubricate the o-ring (Key 208) with Dow Corning Molykote® 111 (Key B) and install it on to the body (Key 205).
- 13 Install the closing cap (Key 209).
- 14 Refer to the PRINCIPLES OF OPERATION AND ADJUSTMENT section on Page 18 for information on adjusting the Travel Stop after Bench Setting Actuator has been completed.

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***NOTE:** The lower instrument mounting pad of the actuator yoke (Key 1) is the standard mounting pad and should typically be orientated to face the side of the valve with the flow arrow.

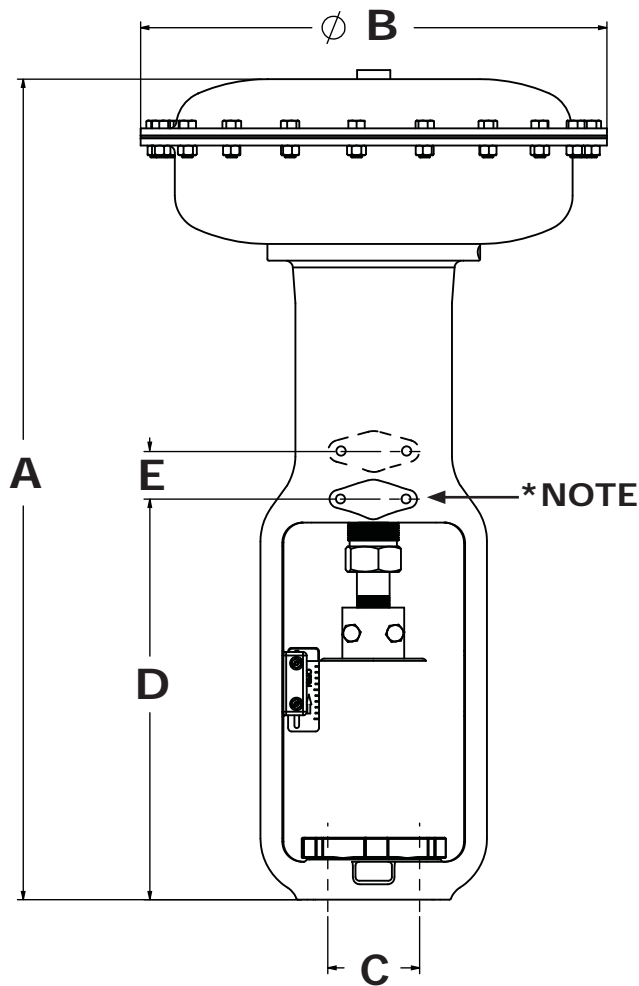


Figure 28 Model DFO Dimensions

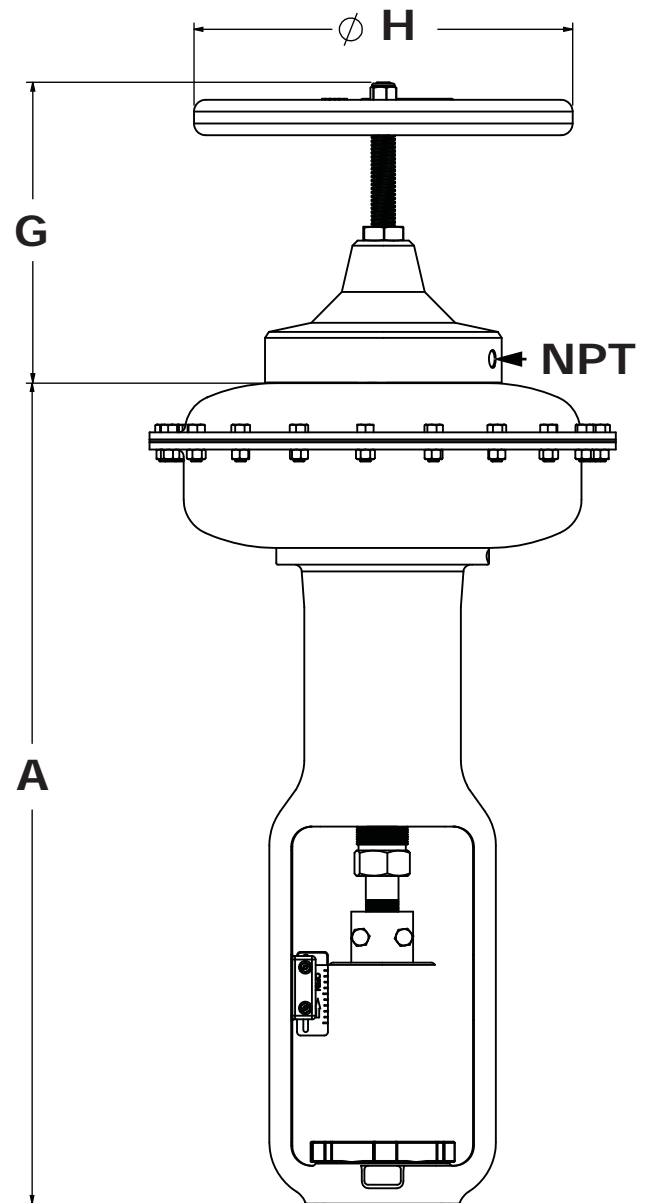


Figure 29 Model DFO with Top-Mounted Handwheel Dimensions



Model DFO Linear Actuator

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Table 2					
Model DFO Outline Dimensions (Refer to Figure 27)					
Actuator Size	Dimension Reference Inch (mm)				
	A	B	C (Yoke Boss)	D	E
1046	17.31 (440)	11.38 (289)	2-1/8 (54.0)	8.38 (213)	—
1069	19.25 (489)	13.12 (333)	2-1/8 (54.0)	8.75 (222)	1.00 (25.4)
2069	21.20 (538)	13.12 (333)	2-13/16 (71.4)	10.69 (272)	1.00 (25.4)
2105	25.72 (653)	16.00 (406)	2-13/16 (71.4)	11.44 (291)	1.50 (38.1)
2156	25.72 (653)	18.62 (473)	2-13/16 (71.4)	11.44 (291)	1.50 (38.1)
3105	28.10 (714)	16.00 (406)	3-9/16 (90.5)	13.94 (354)	1.50 (38.1)
3156	28.10 (714)	18.62 (473)	3-9/16 (90.5)	13.94 (354)	1.50 (38.1)
3220	32.69 (830)	21.12 (536)	3-9/16 (90.5)	16.00 (406)	1.50 (38.1)
3220-4	38.90 (988)	21.12 (536)	3-9/16 (90.5)	16.00 (406)	1.50 (38.1)

Table 3		
Model DFO Handwheel Outline Dimensions (Refer Figure 28)		
Actuator Size	Dimension Reference Inch (mm)	
	G	H
1046	7.00 (178)	8.75 (222)
1069	7.00 (178)	8.75 (222)
2069	7.00 (178)	8.75 (222)
2105	8.70 (221)	8.75 (222)
2156	8.70 (221)	8.75 (222)
3105	8.70 (221)	8.75 (222)
3156	8.70 (221)	8.75 (222)
3220	12.60 (320)	14.00 (356)
3220-4	-	14.00 (356)

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Table 4

Model DFO Actuator Torque Chart

Cap Screw - (Key 11)

Actuator Size	lbf-ft.	N•m
046	30	41
069	70	95
105, 156, 220	135	183

Cap Screw Torque (Keys 7)

Actuator Size	lbf-ft.	N•m
046 to 105	17	23
156 to 220	29	39

Cap Screw Torque (Keys 308)

Actuator Size	lbf-ft.	N•m
046 to 156	29	39
220		

Connecting Block (Key 18)

Actuator Size	lbf-ft.	N•m
046 to 156	17	23
220	29	39

Casing Cap Screw Torque (Keys 14 & 15)

All Sizes	lbf-ft.	N•m
Full Torque	20	27



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Parts

Key	Description	Part Number
1	Yoke, Cast Iron	
	Size 1046	3E79261904D
	Size 1069	2E86961904D
	Size 2069	3E80701904D
	Sizes 2105 & 2156	2E90371904D
	Sizes 3105 & 3156	3E83231904D
	Size 3220	DFO32201X1D
2	Spring Adjuster, Zinc Plated Steel	
	Size 046	1E79292410D
	Size 069	1E80732410D
	Sizes 105 & 156	1E83262410D
	Size 220	1N12972410D
3	Spring Seat, Zinc Plated Steel	
	Size 046	1U42562657D
	Size 069	1R17992312D
	Sizes 105 & 156	1R18002312D
	Size 220	1N12961905D
4	Spring Case Adapter, Cast Iron	
	Size 3220-4 Only	3R67581904D
5	Ferry Head Cap Screw, Zinc Plated Steel	
	(12 Required) Size 3220-4 Only	FHCZ12.112
6	Lower Diaphragm Casing, Steel	
	Size 046	2E79222506D
	Size 069	2E80632506D
	Size 105	3E83162899D
	Size 156	2E84742506D
	Size 220	2N12712506D
7	Hex Head Cap Screw, Zinc Plated Steel	
	Size 046 (6 Required)	H5CZ38.034
	Size 069 (6 Required)	H5CZ38.034
	Sizes 105 & 156 (8 Required)	H5CZ38.034
	Size 220 (12 Required)	H5CZ38.034
8	Spring, Steel	Refer to Table 6
9	Actuator Stem, Zinc Plated Steel	Refer to Table 5
10	Diaphragm Plate	
	Size 046 (Cast Iron)	2E88041904D
	Size 069 (Aluminum)	31B2029X01D
	Size 105 (Aluminum)	41B2030X01D
	Size 156 (Cast Iron)	2E84751904D
	Size 220 (Cast Iron)	2N12701904D
11	Socket Head Cap Screw	Refer to Table 5
	Alloy Steel	

Key	Description	Part Number
12	Diaphragm, Nitrile/Nylon	
	Size 046	2E79190220D
	Size 069	2E67000220D
	Size 105	2E85950220D
	Size 156	2E85970220D
	Size 220	2N12690220D
13	Upper Diaphragm Casing, Steel	
	Size 046	2E79152899D
	Size 069	2E80602899D
	Size 105	3E83092899D
	Size 156	2E84722899D
14	Hex Head Cap Screw, Upper/Lower Diaphragm Casing	
	Zinc Plated Steel	
	Size 046 (12 Required)	H5FZ38.100
	Size 069 (16 Required)	H5FZ38.100
	Size 105 (20 Required)	H5FZ38.100
	Size 156 (24 Required)	H5FZ38.100
15	Hex Nut, Upper/Lower Diaphragm Casing	
	Zinc Plated Steel	
	Size 046 (12 Required)	NHFZ38
	Size 069 (16 Required)	NHFZ38
	Size 105 (20 Required)	NHFZ38
	Size 156 (24 Required)	NHFZ38
16	Reducer bushing, S31600/S31603 Dual Grade	
	Size 220	1C37902623D
17	Connecting Block, Zinc Plated Steel	
	Sizes 1046 & 1069	18A1243X01D
	Size 2069	18A1668X01D
	Sizes 2105 & 2156	18A1671X01D
	Sizes 3105 & 3156	18A1672X01D
	Size 3220	DFOCB320X1D
18	Cap Screw, Connecting Block, Zinc Plated Steel	
	Included as part of the Connecting Block (2 Required)	
19	Travel Scale, S30400	Refer to Table 5
20	Travel Scale Screw, Travel Scale, 18-8 (2 Required)	
	Sizes 1046, 1069, 2105, 2156	DFCOTSS632D
	Sizes 3105, 3156, 3220, 3220-4	DFCOTSS832D
21	Flat Washer, Travel Scale, 18-8 (2 Required)	
	Size 220	1E8730X001D

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Parts (Continued)

Key	Description	Part Number
22	Travel Scale Nut, 18-8 (2 Required)	
	Sizes 1046, 1069, 2105, 2156	DFCOTSN632D
	Sizes 3105, 3156, 3220, 3220-4	DFCOTSN832D
23	Travel Disc, S30400	
	Sizes 1046 & 1069	1E79313899D
	Sizes 2069, 2105, & 2156	1E80753899D
	Sizes 3105 & 3156	1E83283899D
	Sizes 3220 & 3220-4	1E83283899D
24	Hex Nut, Zinc Plated Steel	
	Part of Valve Assembly	
25	Jam Nut, Zinc Plated Steel	
	Part of Valve Assembly	
26	Yoke Lock Nut, Zinc Plated Steel	
	Part of Valve Assembly	
27	Nameplate, S30400	NAMEXSRACTD

Parts (Continued)

Type 1 Up Travel Stop (Refer to Figures 25 & 26)

Key	Description	Part Number
100	Upper Diaphragm Casing, Steel	
	Size 046	2E80112506D
	Size 069	2E68262506D
	Size 105	3E84532506D
	Size 156	3E84772506D
	Size 220	2N13102506D
101	Stem, Bronze	
	Size 069	DFO11608X1D
	Size 105	DFO13608X1D
	Size 156	DFO13608X1D
	Size 220	Contact Dyna-Flo
102	Lock Nut, S31600/S31603 Dual Grade	
	Sizes 069, 105, & 156	DFC60510X1D
	Size 220	Contact Dyna-Flo
103	Closing Cap, Steel	
	Size 069	1F59781401D
	Sizes 105 & 156	DFO13602X1D
	Size 220	

Parts (Continued)

Type 2 Down Travel Stop (Refer to Figure 27)

Key	Description	Part Number	
200	Stem, 18-8		
	Size 069	1F75333503D	
	Sizes 105 & 156	DFO50102X1D	
200	Size 220	DFO30502X1D	
	201	Diaphragm, Nitrile/Nylon	
		Size 046	2E80000220D
Size 069		2E66990220D	
Size 105		2E85960220D	
Size 156		2E85980220D	
Size 220	2N13090220D		
202	Upper Diaphragm Plate, Zinc Plated Steel		
	Size 069	1F88582409D	
	Sizes 105 & 156	1F89092409D	
202	Size 220	1N13152409D	
203	Flat Washer, Zinc Plated Steel		
	Size 069	FWZ12	
	Sizes 105 & 156	FWZ34	
	Size 220 (Spacer)	DFO30504X1D	
204	Hex Nut, Zinc Plated Steel		
	Size 069	NHFZ12	
	Sizes 105, 156, & 220	NHFZ34	
205	Body, Cast Iron		
	Size 069	1K72351901D	
	Sizes 105 & 156	DFC50101X1D	
	Size 220	DFO30501X1D	
206	Hex Nut, Zinc Plated Steel		
	Size 069	NHFZ12	
	Sizes 105, 156, & 220	NHFZ34	
207	Jam Nut, Zinc Plated Steel		
	Size 069	NHJFZ12	
	Sizes 105, 156, & 220	NHJFZ34	
208	O-Ring, Nitrile		
	Size 069	122N	
	Sizes 105, 156, & 220	DF10217X01D	



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Parts (Continued)

Type 2 Down Travel Stop (Refer to Figure 27)

Key	Description	Part Number
209	Closing Cap, Steel	
	Size 069	1F59781401D
	Sizes 105 & 156	DFC50103X1D
	Size 220	DFO30503X1D

Parts (Continued)

Top-Mounted Handwheel (Refer to Figure 23 & 24)

Key	Description	Part Number
300	Pusher Plate Retainer, Zinc Plated Steel	
	Sizes 046, 069, 105, & 156	DFO60111X1D
301	Pusher Plate, Zinc Plated Steel	
	Sizes 046 & 069	DFO60103X1D
	Sizes 105 & 156	DFO20103X1D
	Size 220	DFO30103X1D
302	Socket Head Cap Screw, Steel	
	Sizes 046 & 069 (3 Required)	DFO20114X1D
	Sizes 105 & 156 (3 Required)	DFO60114X1D
303	Stem, Bronze	
	Sizes 046 & 069	DFO60102X1D
	Sizes 105 & 156	DFO20102X1D
	Size 220	DFO30102X1D
304	Pin, Steel	
	Sizes 046 & 069	DFO60115X1D
	Sizes 105 & 156	DFO20115X1D
305	Body, Cast Iron	
	Sizes 046 & 069	DFO60101X1D
	Sizes 105 & 156	DFO20101X1D
	Size 220	DFO30101X1D
306	O-Ring, Stem/Body, Nitrile	
	Sizes 046 & 069	1D23750699D
	Sizes 105 & 156	1B8855X004D
	Size 220	1E73690699D

Parts (Continued)

Top-Mounted Handwheel (Refer to Figure 23 & 24)

Key	Description	Part Number
307	O-Ring, Body/Upper Diaphragm Casing, Nitrile	
	Sizes 046 & 069	1D26730699D
	Sizes 105 & 156	1D54710699D
	Size 220	1D26910699D
308	Cap Screw, Zinc Plated Steel	
	Sizes 046 & 069 (6 Required)	H5CZ38.034
	Sizes 105 & 156 (8 Required)	H5CZ38.034
	Size 220 (12 Required)	H5CZ12.034
309	Lock Nut, Zinc Plated Steel	
	Sizes 046, 069, 105, & 156 (Zinc Plated Steel)	DFO60107X1D
	Size 220 (S31600/S31603 Dual Grade)	DFO30107X1D
310	Handwheel, Cast Iron	
	Sizes 046 & 069	DFO40106X1D
	Sizes 105 & 156	DFO30106X1D
	Size 220	DFO70106X1D
311	Flat Washer, Zinc Plated Steel	
	Sizes 046, 069, 105, & 156	DFO60110X1D
	Size 220	DFO30111X1D
312	Nylock Nut, Zinc Plated Steel	
	All Sizes	DFO30109X1D
313	Thrust Bearing, Steel	
	Size 220 Only	DFO30105X1D
314	Thrust Washer, Zinc Plated Steel	
	Size 220 Only	DFO30104X1D
315	Cap Screw, Steel	
	Size 220 Only	DFO30108X1D
316	Grease Fitting, Zinc Plated Steel	
	Size 220 Only	DFO30110X1D

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Table 5

Keys 9, 11, & 19 Actuator Stem/Socket Head Cap Screw and Travel Scale

Actuator Size	Standard Travels inch (mm)	Socket Head Cap Screw (Key 11)	Travel Scale (Key 19)	Stem (Key 9)
1046	3/4 (19)	1E79203298D	1E79363899D	1E79272410D
1069	3/4 (19)	1E76043299D	1E79363999D	1E87292410D
2069	3/4 (19)	1E76043299D	1E80813899D	1E80712410D
	1-1/8 (29)	1E76043299D	1E80823899D	
	1-1/2 (38)	1E76043299D	1E80833899D	
2105	3/4 (19)	1E77543298D	1E80813899D	1J33292410D
	1-1/8 (29)	1E77543298D	1E80823899D	
	1-1/2 (38)	1E77543298D	1E80833899D	
	2 (51)	1E77543298D	1R44453898D	
2156	3/4 (19)	1E77543298D	1E80813899D	1J33292410D
	1-1/8 (29)	1E77543298D	1E80823899D	
	1-1/2 (38)	1E77543298D	1E80833899D	
	2 (51)	1E77543298D	1R44453898D	
3105	3/4 (19)	1E77543298D	1E83313899D	1E83242410D
	1-1/8 (29)	1E77543298D	1E83323899D	
	1-1/2 (38)	1E77543298D	1E83333899D	
	2 (51)	1E77543298D	1E83343899D	
3156	3/4 (19)	1E77543298D	1E83313899D	1E83242410D
	1-1/8 (29)	1E77543298D	1E83323899D	
	1-1/2 (38)	1E77543298D	1E83333899D	
	2 (51)	1E77543298D	1E83343899D	
3220	3/4 (19)	1E77543298D	1E83313899D	1N12942410D
	1-1/8 (29)	1E77543298D	1E83323899D	
	1-1/2 (38)	1E77543298D	1E83333899D	
	2 (51)	1E77543298D	1E83343899D	1N13252410D
	3 (76)	1E77543298D	1N12983899D	
	4 (102)	1E77543298D	13A5660X01D	



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Table 6

Key 8 Actuator Spring Chart

Actuator Size	Standard Travels inch (mm)	Diaphragm Pressure Range Psig (kPag)	
		3-15 (21-103)	6-30 (41-207)
1046	3/4 (19)	1F17682709D (silver)*	1E79242708D
1069	3/4 (19)	1E80582708D (light grey)	1E80522708D (orange & red)
2069	3/4 (19)	1E80582708D (light grey)	1E80522708D (orange & red)
	1-1/8 (29)	1E80532709D (dark grey)	1E80552708D (dark blue)
	1-1/2 (38)	1E80562709D (dark green)	1E80582708D (light grey)
2105	3/4 (19)	1E82622708D (light green)	1E82552708D (aluminum & red)
	1-1/8 (29)	1E82612708D (dark grey)	1E82642708D (light grey)
	1-1/2 (38)	1E82662708D (orange)	1E82622708D (light green)
	2 (51)	1E82692708D (dark green)	1E82652708D (red)
2156	3/4 (19)	1E82572708D (brown)	1E82602708D (bronze)
	1-1/8 (29)	1E82622708D (light green)	1E82552708D (aluminum & red)
	1-1/2 (38)	1E82652708D (red)	1E82572708D (brown)
	2 (51)	1E82702708D (aluminum & dark blue)	1E82632708D (aluminum & dark green)
3105	3/4 (19)	1E82622708D (light green)	1E82552708D (aluminum & red)
	1-1/8 (29)	1E82612708D (dark grey)	1E82642708D (light grey)
	1-1/2 (38)	1E82662708D (orange)	1E82622708D (light green)
	2 (51)	1E82692708D (dark green)	1E82652708D (red)
3156	3/4 (19)	1E82572708D (brown)	1E82602708D (bronze)
	1-1/8 (29)	1E82622708D (light green)	1E82552708D (aluminum & red)
	1-1/2 (38)	1E82652708D (red)	1E82572708D (brown)
	2 (51)	1E82702708D (aluminum & dark blue)	1E82632708D (aluminum & dark green)
3220	3/4 (19)	1N12792708D (red)	---
	1-1/8 (29)	1N71932708D (white)	1N12812708D (brown)
	1-1/2 (38)	1N12872708D (yellow)	1N12792708D (red)
	2 (51)	1N12842708D (light green)	1N12852708D (light blue)
	3 (76)	1N12862708D (dark grey)	1N12872708D (yellow)
	4 (102)	-	1R67602708D (red)

NOTES: * - Diaphragm Pressure Range is 3-11 Psig (21-76 kPag).

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Model DFO Linear Actuator

MODEL NUMBERING SYSTEM

SAMPLE PART NUMBER: DFO-2105-A0630IN-NY

ACTION						DFO		
DFO	FAIL OPEN						DFO	
DFO4	FAIL OPEN (EXTENDED TRAVEL)							
VALVE YOKE						2		
1	2-1/8 INCH	2	2-13/16 INCH	3	3-9/16 INCH			
ACTUATOR SIZE						069		
046	46 INCH ²	069	69 INCH ²	105	105 INCH ²		156	156 INCH ²
220	220 INCH ²							
PAINT						-		
-	DFPS-01 (STANDARD)			2	DFPS-02 (SEVERE SERVICE)			
3	DFPS-03 (HIGH TEMPERATURE)							
TRAVEL						A		
P	3/8 INCH	L	7/16 INCH	K	1/2 INCH		J	5/8 INCH
A	3/4 INCH	M	7/8 INCH	I	1 INCH		B	1-1/8 INCH
R	1-1/4 INCH	C	1-1/2 INCH	T	1-5/8 INCH		D	2 INCH
N	2-1/8 INCH	S	2-1/4 INCH	E	2-1/2 INCH		F	3 INCH
Q	3-3/8 INCH	G	3-1/2 INCH	H	4 INCH			
LOWER BENCH SET						06		
ACTUAL VALUE (PSI)			EXAMPLE: 03, 06, 17, 21, ETC.					
UPPER BENCH SET						30		
ACTUAL VALUE (PSI)			EXAMPLE: 27, 09, 15, 30, ETC.					
INPUT SIGNAL (AIR TO DIAPHRAGM)						I		
	0 - 18 PSIG		0 - 33 PSIG	I	3 - 15 PSIG		I	6 - 30 PSIG
HANDWHEEL AND TRAVEL STOPS						N		
N	NONE (STANDARD)			S	SIDE MOUNTED HANDWHEEL			
T	TOP MOUNTED HANDWHEEL			1	TYPE 1 UP STOP - DFO			
2	TYPE 2 DOWN STOP - DFO							
CONNECTING BLOCK OPTIONS						-		
-	NONE			T	TAPPED 1/4" - 20 UNC			
B	TAPPED 3/8" - 16 UNC			F	TAPPED 5/8" - 18 UNC			
CONSTRUCTION OPTIONS						N		
N	NONE			S	STAINLESS STEEL FASTENERS			
YOKE OPTIONS						Y		
	NONE			Y	TAPPED 5/16" - 18 UNC			

Our Commitment to Quality

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