1 Contents

2 Introduction

The following Installation and Operation Manual is a living document and will continuously be updated as the implementation of the 3R Scotch Yoke Actuators occurs. If you have any questions on the 3R Scotch Yoke Actuators, please contact A-T Controls.

NOTES:

- This manual is also applicable to the Series 2R 2500 and 3500 Scotch Yoke Actuators.
- For the sake of this document, the Drive Shaft may be referred to as the Pinion. Any instances of these two terms are referring to the Drive Shaft (3) in Bill of Materials.
- Throughout this document numbers may be seen in parentheses after a component. These numbers correspond to the numbers in the Bill of Materials that can be found toward the end of the document.

3 Design

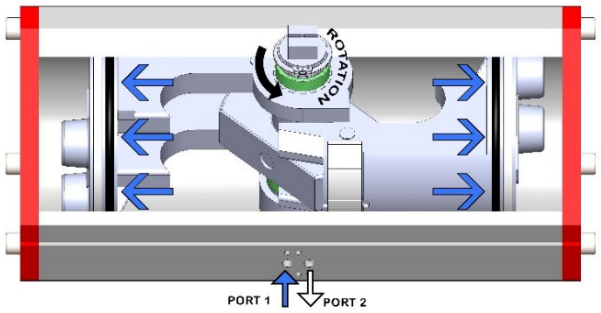
Triac 3R2500 & 3R3500 Scotch Yoke Actuators are designed and engineered to provide high cycle-life to meet the demands needed. They are offered in both double acting and spring return configurations that feature:

- Dual Travel Stops for open and close adjustment of 0±5° to 90±5°
- Multiple Temperature options
  - Standard working temperature (-5°F to 175°F)
  - Low temperature (-45°F to 175°F)
  - High temperature (0°F to 300°F)
- Maximum working pressure 150 psi
- Air Supply Pressure of 40 - 150 psi
- Operating media - clean dry air, nitrogen, non-corrosive gas or light hydraulic oil.
- NAMUR - VDI/VDE 3845 accessory mounting
- ISO 5211 Valve mounting

4 Operation

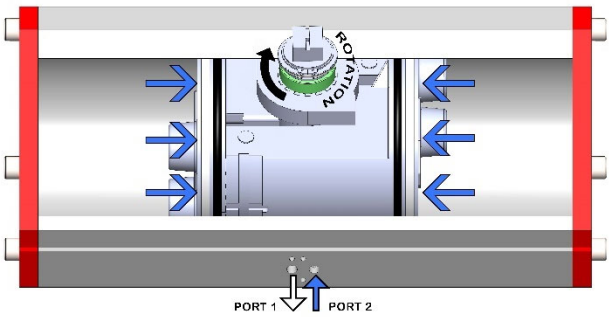
4.1 Double Acting (DA)

4.1.1 CCW Movement



Applying air pressure to Port 1 pressurizes the inside chamber and drives the piston(s) of the actuator outward. This action results in the counterclockwise rotation of the drive shaft. As the piston(s) are driven outward, air is exhausted from the outside chamber(s) through Port 2.

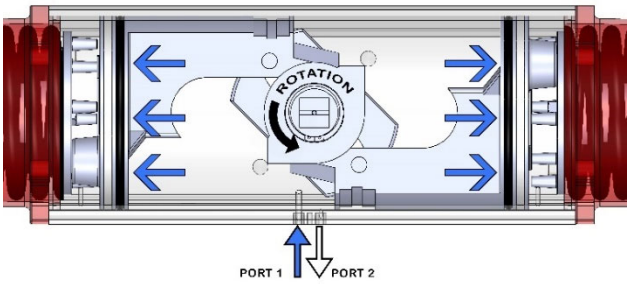
4.1.2 CW Movement



Applying air pressure to Port 2 pressurizes the outside chamber(s) and drives the piston(s) of the actuator inward. This action results in the clockwise rotation of the drive shaft. As the piston(s) are driven inward, air is exhausted from the inside chamber through Port 1.

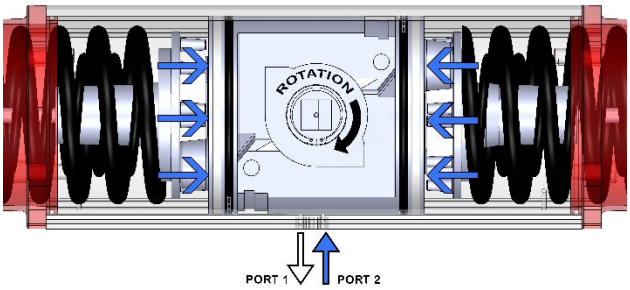
4.2 Spring Return (SR)

4.2.1 CCW Movement



Applying air pressure to Port 1 pressurizes the inside chamber and drives the piston(s) of the actuator outward. This action results in the counterclockwise rotation of the drive shaft. As the piston(s) are driven outward, the spring(s) are compressed, storing energy, and air is exhausted from the outside chamber(s) through Port 2.

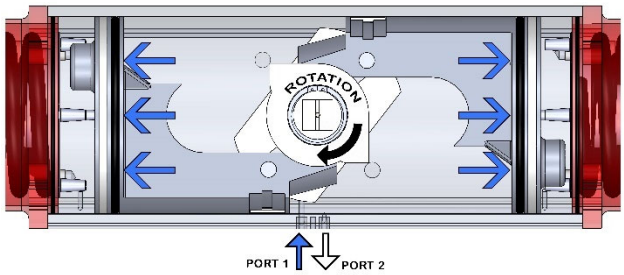
4.2.2 CW Movement



- **With no air assist**: Exhausting air from the inside chamber through Port 1 allows the stored energy in the compressed spring(s) to force the piston(s) inward. This action results in the clockwise rotation of the drive shaft.
- **With air assist**: Applying air pressure to the outside chamber(s) through Port 2 forces the piston(s) inward. This action results in the clockwise rotation of the drive shaft. As the piston(s) are driven inward, from the stored energy in the compressed spring(s) and air pressure, air is exhausted from the inside chamber through Port 1.

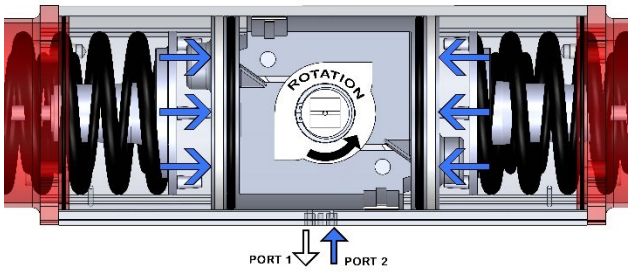
4.3 Spring Return (SO)

4.3.1 CW Movement



Applying air pressure to Port 1 drives the piston(s) outward, which compresses the spring(s) and turns the drive shaft clockwise as the air volume on the outside of the piston(s) exhausts through Port 2.

4.3.2 CCW Movement



- **With no air assist:** Exhausting air from the inside chamber through Port 1 allows the stored energy in the compressed spring(s) to force the piston(s) inward. This action results in the counterclockwise rotation of the drive shaft.
- **With air assist:** Applying air pressure to the outside chamber(s) through Port 2 forces the piston(s) inward. This action results in the counterclockwise rotation of the drive shaft. As the piston(s) are driven inward, from the stored energy in the compressed

spring(s) and air pressure, air is exhausted from the inside chamber through Port 1.

5 Installation

5.1 Installation on Valves

WARNING: FOR YOUR SAFETY, IT IS IMPORTANT THAT THE FOLLOWING PRECAUTIONS BE TAKEN BEFORE ANY DISASSEMBLY OF THE ACTUATOR OCCURS.

- Depressurize the lines and cylinder of the actuator before removing any components.
- On spring return actuators, be careful to loosen the end cap bolts evenly due to the preload on the springs.

Triac actuators are mounted directly to valves or adapted to the valve by means of an intermediate bracket and coupler. The coupler adapts the output of the actuator to the valve shaft. Pipelines can be horizontal, vertical, or other positions. When mounting the actuator to a valve using a mounting kit; the drive shaft, coupling device and valve stem should be centered and concentric to prevent any side loading to the bottom pinion radial bearing and valve stem seal area. After mounting, it may be necessary to adjust the end of travel stop for proper open or closed valve position. Pneumatically stroke the actuator several times to assure proper operation with no binding of the coupler.

5.2 Air Supply

Pneumatic piping to the actuator and associated accessories should follow the best practices for instrument pneumatic piping systems:

- Line shall be free of water, oil, pipe sealant or other contaminants.
- Operating medium is to be filtered dry air or inert gas which is filtered to 50-micron particles size or less.
- Actuator shall be supplied with proper air pressure and air volume.
- Triac 3R Scotch Yoke Actuators shall not exceed a maximum working pressure of 150 psi.
- Spring Return Models:

Note: If exhaust port is not piped, it is important that the exhaust port is not exposed to a corrosive atmosphere.

Please contact A-T Controls for possible solutions if non-typical conditions exist.

5.3 Lubrication

Triac 3R Scotch Yoke Actuators are lubricated from the factory and no additional lubrication is required unless the actuator will be performing more than 100,000 cycles.

- If more than 100,000 cycles will be performed, an oil mist lubricator is recommended.[1] [2]
  - Use oil type VG32 Class in temperature range from 15 to 158°F
  - Set oil mist lubricator to lowest setting.

[1]: If a Triac Scotch Yoke Actuator has been in operation with oil mist lubrication, it cannot be discontinued.

[2]: If the actuator is equipped with a pneumatic positioner or controller, oil mist lubricated air shall not be used unless the instrument manufacturer indicates that used instrument is compatible with lubricated air.

5.4 Travel Adjustment

WARNING: TO AVOID CATASTROPHIC FAILURE TO ACTUATOR, AIR MUST BE REMOVED FROM ACTUATOR BEFORE ANY TRAVEL ADJUSTMENTS ARE MADE.

The Triac 3R Scotch Yoke Actuators have travel stop adjustments in both the clockwise and counterclockwise directions. A 5° overtravel feature provides adjustments from -5° to +5° at the 0° clockwise

position, and from 85° to 95° at the 90° counterclockwise position.

All actuated valves require accurate travel stop adjustments at both ends of the stroke to obtain optimum performance and valve seat life. The accumulation of tolerances in the adaption of actuators to valves is such that there must be a range of adjustment for both ends of the stroke to achieve the expected performance. See the valve manufacturer's IOM on how the travel should be adjusted. The following are typical features seen:

- **Ball & Plug Valves:** require precise adjustment at the open and closed position. This is to protect the seat from the flow media and to assure absolute shut-off in the closed position.
- **Butterfly Valves:** require precise adjustment at the open and closed position. This is to assure full shut-off, to prevent disc overtravel which can damage the seat in the closed position, and to assure maximum flow in the open position.
- **Tee Assemblies:** where two valves are operated in tandem through a single operator, (3-way configuration) require precise adjustment at both ends of the stroke. This is to assure the seating of both valves.

6 Disassembly Procedures

WARNING: FOR YOUR SAFETY, IT IS IMPORTANT THAT THE FOLLOWING PRECAUTIONS BE TAKEN BEFORE ANY DISASSEMBLY OF THE ACTUATOR OCCURS.

- Depressurize the lines and cylinder of the actuator before removing any components.
- On spring return actuators, be careful to loosen the end cap bolts evenly due to the preload on the springs.
- Disconnect electrical supplies

6.1 Removing End Caps

6.1.1 DA & DR Models

1. Loosen both the Clockwise (Right) and Counterclockwise (Left) Travel Stop Bolt Nuts (12).
2. Back out Travel Stops Bolts (11) about six turns so the Travel Stop Cam (7) does not interfere with the Travel Stop Bolts.
3. Using a 14mm hex key wrench remove the 4 End Cap Bolts (23) from each side.
4. Remove End Caps (22) away from the Actuator Body (33).

6.1.2 SR & SO Models

1. Loosen both the Clockwise (Right) and Counterclockwise (Left) Travel Stop Bolt Nuts (12).
2. Back out Travel Stop Bolts (11) about six turns so the Travel Stop Cam (7) does not interfere with the Travel Stop Bolts.
3. Using a 14mm hex key wrench remove the 4 End Cap Bolts (23) from each side.
4. Remove End Caps (22) away from the Actuator Body (33).

CAUTION! Make sure to remove end cap bolts evenly as there is preload from the spring.

WARNING! Do NOT touch the Pre-Tensioning Bolt (29) or the Pre-Tensioning Nut (25). The Spring Assembly is preset from the factory. Any adjustments could result in injury or death.

6.2 Removing Piston(s)

NOTE: Make sure to designate or mark the positions of the piston(s) and pinion during disassembly. The piston and yoke positions will change relative to their original positions.

1. If End Caps (22) are not removed, see Removing End Caps Section for procedure to remove the End Caps before continuing.
2. Rotate the Pinion (3) until the Piston(s) (16) are at the end of the Actuator Body (33). This can be done by turning the Pinion (3) with a wrench on the flats located at the top of the pinion.
3. Remove the Piston(s) (16) from the cylinder.

6.3 Removing the Pinion

1. If End Caps (22) and Piston(s) (16) are not removed, see Removing End Caps Section and Removing Piston(s) for procedures to remove the End Caps and Piston(s) before continuing.
2. Set the Actuator Body on an end.
3. Rotate the Pinion (3) until the flat side of the Yoke Pin (6) is facing upward.

NOTE: There are two different sides to the Yoke Pin (6). A flat smother side and a side that is peened.

4. Using a punch rod on the flat side of the Yoke Pin (6), knock out the Yoke Pin.

CAUTION: Do not damage the Yoke (5).

5. Remove Drive Shaft Snap Ring (35), Support Washer (36) and Support Bushing (37) located at top of the Pinion (3).
6. Tap the top of the Pinion (3) ***lightly*** with a plastic mallet to remove the Pinion from the upper and lower drive shaft bushings (2, 9).

WARNING: When removing the Pinion (3), the Travel Stop Cam (7) and Yoke (5) must be guided off the Pinion and removed from the Actuator Body (33) cylinder while removing the Pinion.

7 Changing Configurations

7.1 3R2500 Fail CW to Fail CCW (DA to DR, SR to SO)

NOTE: Make sure to designate or mark the positions of the piston(s) and pinion during disassembly. The piston and yoke positions will change relative to their original positions.

1. If End Caps (22) and Piston(s) (16) are not removed, see Removing End Caps Section and Removing Piston(s) for procedures to remove the End Caps and Piston(s) before continuing.
2. Set Actuator Body (33) on its end so the short side of the body is facing upward.
3. Rotate the Pinion (3) until the flat side of the Yoke Pin (6) is facing upward.

NOTE: There are two different sides to the Yoke Pin (6). A flat smother side and a side that is peened.

4. Using a punch rod on the flat side of the Yoke Pin (6), knock out the Yoke Pin and remove from Actuator Body (33) cylinder.

CAUTION: Do not damage the Yoke (5).

5. Without rotating the Pinion (3), rotate the Yoke (5) 180°.
6. Replace the Yoke Pin (6) by putting the flat side in first and hitting the pin on the peened side.
7. Grease cylinder surface with multi-purpose grease.
8. Rotate the Piston (16) 180° from original position so that the Piston Roller (32) is properly seated in the Yoke (5).
9. Rotate the Pinion (3) 90° counterclockwise to confirm proper alignment.

10. See Assembling End Cap Section and Setting Stop Bolts Section to complete configuration change.

7.2 3R3500 Fail CW to Fail CCW (DA to DR, SR to SO)

NOTE: Make sure to designate or mark the positions of the piston(s) and pinion during disassembly. The piston and yoke positions will change relative to their original positions.

1. If End Caps (22) and Piston(s) (16) are not removed, see Removing End Caps Section and Removing Piston(s) for procedures to remove the End Caps and Piston(s) before continuing.
2. Grease Actuator Body (33) cylinder surface with multi-purpose grease.
3. With the Pinion (3) in the counterclockwise position when the Piston(s) (16) were removed, rotate the Piston(s) 180° from original position.
4. Push the Piston(s) (16) into the Actuator Body (33) making sure the Piston(s) Roller Bearings (32) are properly seated in the Yoke (5).
5. Rotate the Pinion (3) 90° counterclockwise to confirm proper alignment.
6. See Assembling End Cap Section and Setting Stop Bolt Section to complete configuration change.

8 Assembly Procedure

8.1 Assembling Pinion

1. Inspect all parts for wear and replace any worn parts as needed. Make sure all parts are greased with multi-purpose grease.
2. If rebuilding, on the Pinion (3) replace:
   a. Drive Shaft Lower O-ring (1)
   b. Drive Shaft Lower Bushing (2)
   c. Drive Shaft Upper Bushing (9)
   d. Drive Shaft Upper O-ring (10)
3. Install the Drive Shaft Middle Bushing (4) that goes below the Yoke (5) onto the Pinion (3).
4. With the Yoke (5) being supported in the Actuator Body (33) cylinder, insert the Pinion (3) through the bottom Actuator Body cylinder opening, Yoke (5), Drive Shaft Middle Bushing (4) that goes above the Yoke, Travel Stop Cam (7) and then through Actuator Body (33) cylinder top opening.

NOTE: Make sure that the Travel Stop Cam (7) is oriented for correct configuration.

5. Install the existing, or if rebuilding new, Support Bushing (37), Support Washer (36) and Drive Shaft Snap Ring (35).
6. Verify the orientation of the Yoke (5) and align the Yoke Pin (6) hole on the Yoke with corresponding hole on the Pinion (3).
7. Relace the Yoke Pin (6) by putting the flat side in first and hitting the Yoke Pin on the peened side.

8.2 Assembling Piston(s)

1. Inspect all parts for wear and replace any worn parts as needed. Make sure all parts are greased with multi-purpose grease.
2. If rebuilding, on the Piston(s) (16) replace:
   a. Piston O-Ring (17)
   b. Piston Guide Ring (18)
3. Verify the orientation of the Piston(s) (16) as needed for designed operation.
4. Push the Piston(s) (16) into the Actuator Body (33) cylinder making sure the Piston(s) Roller Bearing(s) (32) are properly seated in the Yoke (5).
5. Rotate the Pinion (3) 90° counterclockwise to confirm proper alignment.

8.3 Assembling End Caps

1. Inspect all parts for wear and replace any worn parts as needed.
2. Install the existing End Cap O-ring (27) or replace the End Cap O-ring if rebuilding.
3. Verify the Pinion (3) is rotated so that Piston(s) are as far into the Actuator Body (33) cylinder as possible.
4. Install the Spring Assembly End Cap (22) or End Cap onto the cylinder body.

- **Spring Return**: Thread the 4 End Cap Bolts (23) down evenly, moving between the bolts, until the End Cap (22) and Actuator Body (33) contact. Repeat for opposite End Cap.
- **Double Acting:** Thread the 4 End Cap Bolts (23) until the End Cap (22) and Actuator Body (33) contact. Repeat for opposite End Cap.

5. Tighten End Cap Bolts (23) to 1,440 in-lbs using a 14mm hex key wrench.

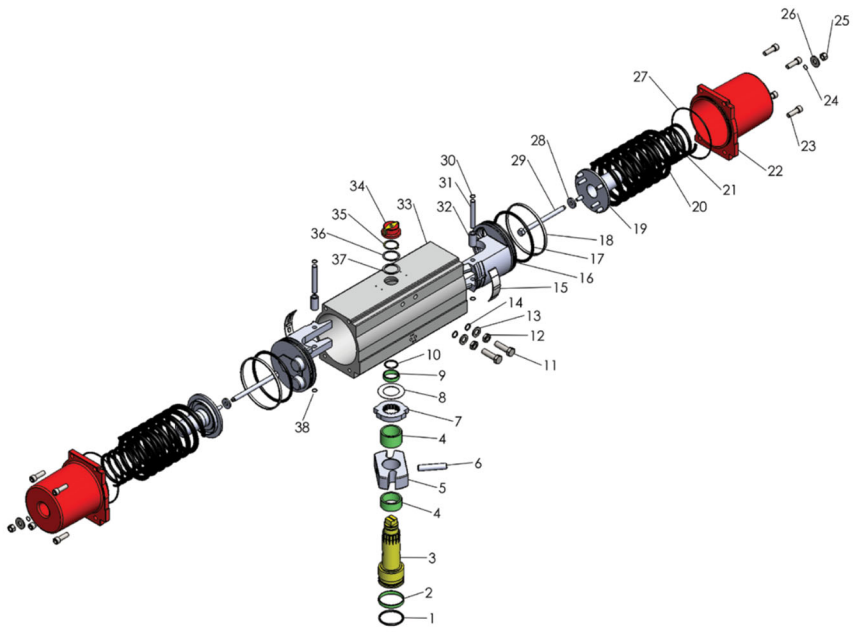
8.4 Setting Stop Bolts

1. If rebuilding, replace the Travel Stop O-Ring (14) on the Travel Stop Bolt (11).
2. Rotate the actuator to the desired clockwise position.
3. Tighten the Clockwise (Right) Travel Stop Bolt (11) until contact with the Travel Stop Cam (7).
4. While holding the Clockwise (Right) Travel Stop Bolt (11), tighten the Travel Stop Nut (12) until the Travel Stop Washer (13) contacts the Actuator Body (33); compressing the Travel Stop O-ring (14).
5. Rotate the Actuator to the desired counterclockwise position.
6. Tighten the Counterclockwise (Left) Travel Stop Bolt (11) until contact with the Travel Stop Cam (7).
7. While holding the Counterclockwise (Left) Travel Stop Bolt (11), tighten the Travel Stop Nut (12) until the Travel Stop Washer (13) contacts the Actuator Body; compressing the Travel Stop O-ring (14).

9 Spare Parts

Actuator Size	Buna Repair Kit -20°F to 175°F	Viton Repair Kit 0°F to 300°F	Silicone Repair Kit -58°F to 175°F	Spring Cartridges	
				Left	Right
3R2500	3RKB2500	3RKV2500	3RKL2500	3R-SP2500	N/A
3R3500	3RKB3500	3RKV3500	3RKL3500	3R-SP-3500-L	3R-SP-3500-R

10 Bill of Materials



3R2500 & 3R3500

No.	Description	Qty.	Material	Remarks	Repair Kit
1	DRIVE SHAFT LOWER O-RING	1	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	✓
2	DRIVE SHAFT LOWER BUSHING	1	Nylon 4/6 (TP-601)		✓
3	DRIVE SHAFT	1	S45C-D	Zinc/Chromate Plating	
4	DRIVE SHAFT MIDDLE BUSHING	2	Nylon 4/6 (TP-601)		
5	YOKE	1	S45C-D	Nitriding	
6	YOKE PIN	1	S45C-D		
7	TRAVEL STOP CAM	1	SCM21	Nickel Phosphorus Coated	
8	STOP CAM SPACER	1	PTFE		✓
9	DRIVE SHAFT UPPER BUSHING	1	Nylon 4/6 (TP-601)		✓
10	DRIVE SHAFT UPPER O-RING	1	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	✓
11	TRAVEL STOP BOLT	2	304 Stainless Steel		
12	TRAVEL STOP NUT	2	304 Stainless Steel		
13	TRAVEL STOP WASHER	2	304 Stainless Steel		✓
14	TRAVEL STOP O-RING	2	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	✓
15	PISTON GUIDE PLATE	2	NYLON6		✓
16	PISTON	2	AC2B-F		
17	PISTON O-RING	2	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	✓
18	PISTON GUIDE RING	2	PTFE		✓
19	SPRING GUIDE	2	AC2B-F		
20	OUTER SPRING	*	SUP 10		
21	INNER SPRING	*	SUP 10		
22	END CAP	2	AC2B-F	Epoxy Coated	
23	END CAP BOLT	8	304 Stainless Steel		
24	PRE-TENSIONING O-RING	2	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	✓
25	PRE-TENSIONING NUT	2	304 Stainless Steel		
26	PRE-TENSIONING WASHER	2	SPCC	Electroless Nickel Plated	
27	END CAP O-RING	2	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	
28	SPRING GUIDE WASHER	2	SPCC	Electroless Nickel Plated	
29	PRE-TENSIONING BOLT	2	SCM435	Electroless Nickel Plated	
30	PISTON PIN SNAP RING	2	Steel	Zinc Plated	
31	PISTON PIN	2	S45C-D	Nitriding	
32	PISTON ROLLER	2	Bearing Steel	Nitriding	
33	ACTUATOR BODY	1	A6NO1ST5	Hard Anodized	
34	POSITION INDICATOR	1	Polyethylene		
35	DRIVE SHAFT SNAP RING	1	SK5	Zinc Plated	✓
36	SUPPORT WASHER	1	304 Stainless Steel		✓
37	SUPPORT BUSHING	1	RTFE		✓
38	HOLE SEAL	2	Nitrile Buna (NBR)	Option: Viton® (FKM) & Silicone	

*Varies by size and pressure rating.

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For product specifications go to http://a-tcontrols.com/Downloads/

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