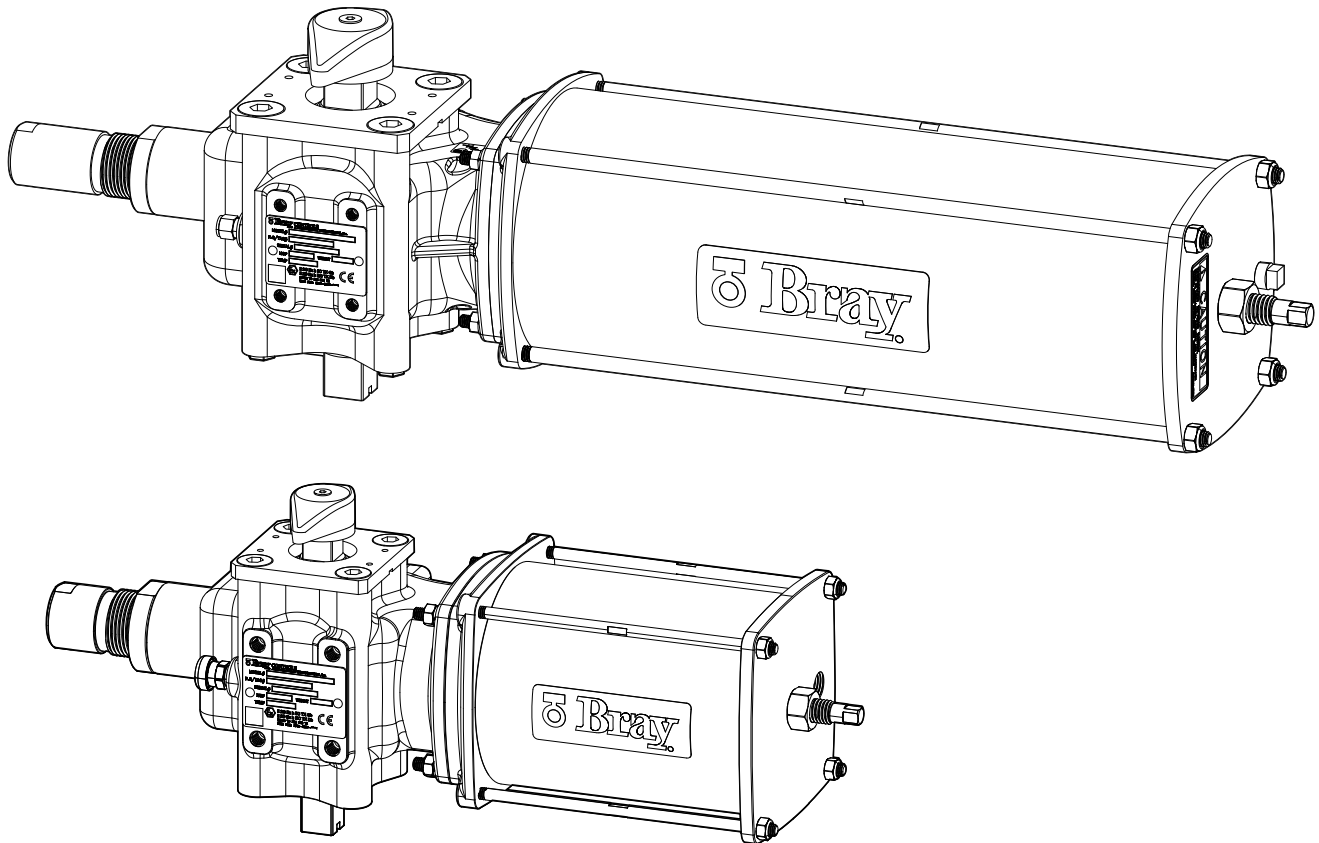

SERIES 98C

COMPACT SCOTCH YOKE ACTUATOR

Installation, Operation and Maintenance Manual



Bray[®]

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**READ AND FOLLOW THESE INSTRUCTIONS CAREFULLY.
SAVE THIS MANUAL FOR FUTURE USE.**

1.0 DEFINITION OF TERMS

All information within this manual is relevant to the safe operation and proper care of your Bray actuator. Please understand the following examples of information used throughout this manual.

1.0 IDENTIFIES CHAPTER HEADING

1.00 Identifies and explains sequential procedure to be performed.

NOTE: Provides important information related to a procedure.

SAFETY STATEMENTS: To prevent unwanted consequences.
Standard symbols and classifications are:



DANGER

Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.



NOTICE

Used without the safety alert symbol, indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage.

2.0 INTRODUCTION

The instructions and guidelines in this manual enable competent technicians to install, operate, adjust and carry out routine maintenance activities on Series 98C pneumatic actuators. Responsibility lies with the user to follow the instructions in this and in any additional documentation related to the product and accessories supplied with it.

User shall ensure the equipment is installed and operated in the environment that it is intended for and effective protections are provided against exposure to pressure and temperature in excess of maximum rating. Failing to do so may affect the product warranty. Only trained personnel, aware of precautions in hazardous environments and health and safety in the workplace should service the equipment.

Series 98C Compact Scotch Yoke Actuators are designed for quarter turn rotary valves, in configurations as:

- > **DA** - Double Acting with a single cylinder
- > **SR** - Spring Return Fail Close (CW) and Spring Return Fail Open (CCW)

Standard actuators have a mounting base to ISO 5211.

Shaft driven accessories mounting adaptation available as per VDE 3845/NAMUR standard

The operating pressure range of the Series 98C Pneumatic Actuators is 40 to 150 psig, depending upon the size and configuration. Refer to the MOP (maximum operating pressure) charts or the name plate on the actuator for the maximum operating pressure.

Operating media for S98C pneumatic shall be clean and dry compressed air, in accordance to ISO 8573-1 Class 2:3:4 filtered to 5 microns or better, with pressure dew point of -20°C (-4°F) or at least 10°C (18°F) below ambient temperature.

The user shall plan and implement a periodic maintenance program to ensure the service conditions continue as intended and the actuator is monitored and maintained per manufacturer's recommendations.

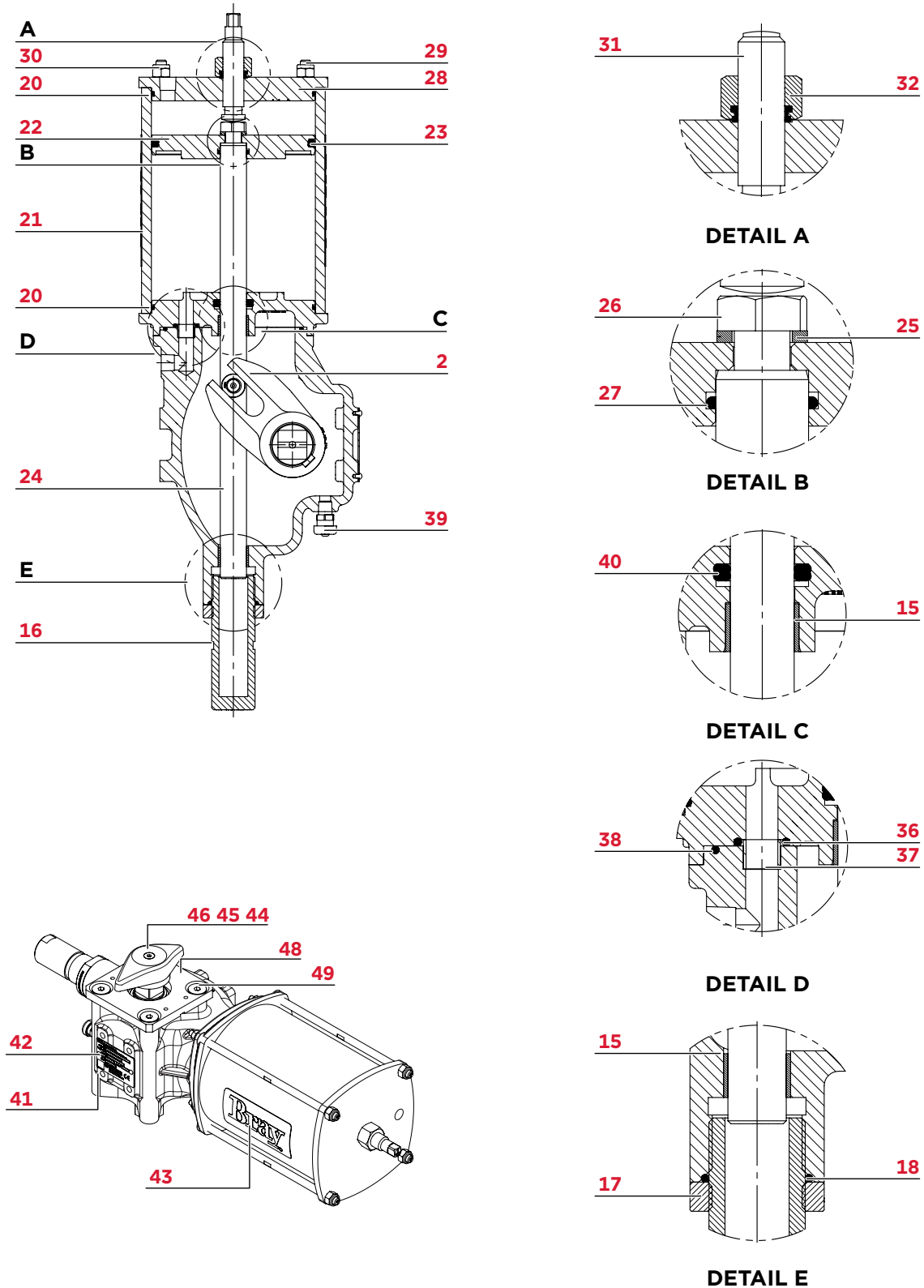
Information on certification documentation is available on the Bray website or by contacting your local Bray Sales Representative.

2.1 Abbreviations

CW - Clockwise

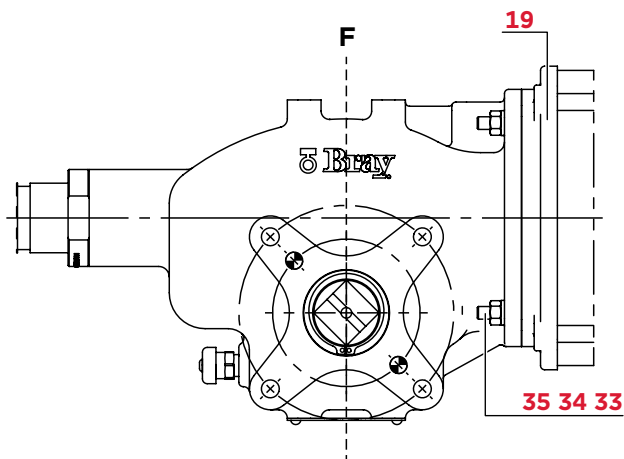
CCW - Counter Clockwise

3.0 PARTS CALLOUT AND MATERIALS OF CONSTRUCTION - DOUBLE ACTING ACTUATOR

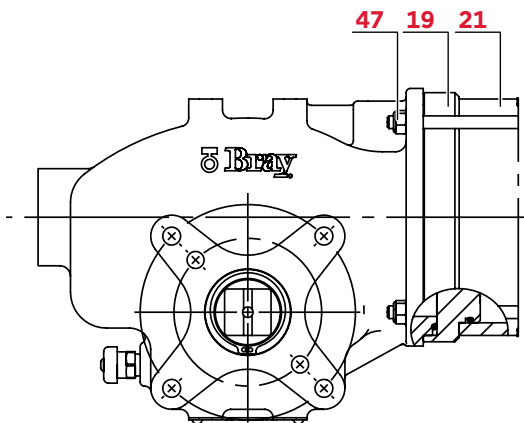


FOR REFERENCE ONLY. PLEASE REFER TO ES-00897 DRAWING FOR CURRENT INFORMATION.

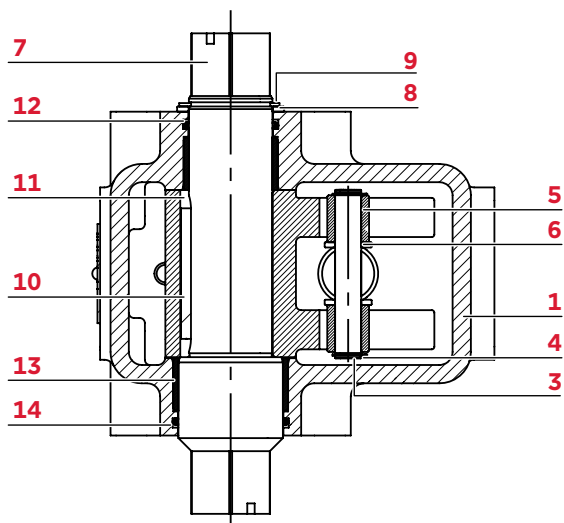
**3.0 PARTS CALLOUT AND MATERIALS OF CONSTRUCTION - DOUBLE ACTING ACTUATOR
(CONTINUED)**



STANDARD Adaptor



SANDWICH TYPE Adaptor



SECTION VIEW - F

FOR REFERENCE ONLY. PLEASE REFER TO ES-00897 DRAWING FOR CURRENT INFORMATION.

3.0 PARTS CALLOUT AND MATERIALS OF CONSTRUCTION - DOUBLE ACTING ACTUATOR (CONTINUED)

ITEM	DESCRIPTION	MATERIAL	QTY.
1	Yoke Housing	Ductile Iron	1
2	Yoke	Carbon Steel	1
3	Yoke Pin	Alloy Steel	1
4¹	Retaining Ring (Yoke Pin)	Spring Steel	2
5¹	Roller	Steel	2
6	Roller Washer	Steel	2
7	Drive Shaft	Alloy Steel	1
8	Drive Shaft Washer	Stainless Steel	1
9¹	Retaining Ring (Drive Shaft)	Stainless Steel	1
10	Key (Drive Shaft)	Carbon Steel	1
11¹	Bearing (Smaller Dia-Drive Shaft)	Steel / Self-Lubricating Bronze	1
12²	O-ring (Smaller Dia-Drive Shaft)	BUNA-N	1
13¹	Bearing (Bigger Dia-Drive Shaft)	Steel / Self-Lubricating Bronze	1
14²	O-ring (Bigger Dia-Drive Shaft)	BUNA-N	1
15¹	Bearing (Piston Rod)	Steel / Self-Lubricating Bronze	2
16	Travel Stop Sleeve	Carbon Steel	1
17	Travel Stop Lock Nut	Carbon Steel	1
18²	O-ring (Travel Stop Sleeve)	BUNA-N	1
19	Adaptor	Ductile Iron / Carbon Steel	1
20²	O-ring (Barrel)	BUNA-N	2
21	Barrel	Carbon Steel	1
22	Piston	Carbon Steel	1

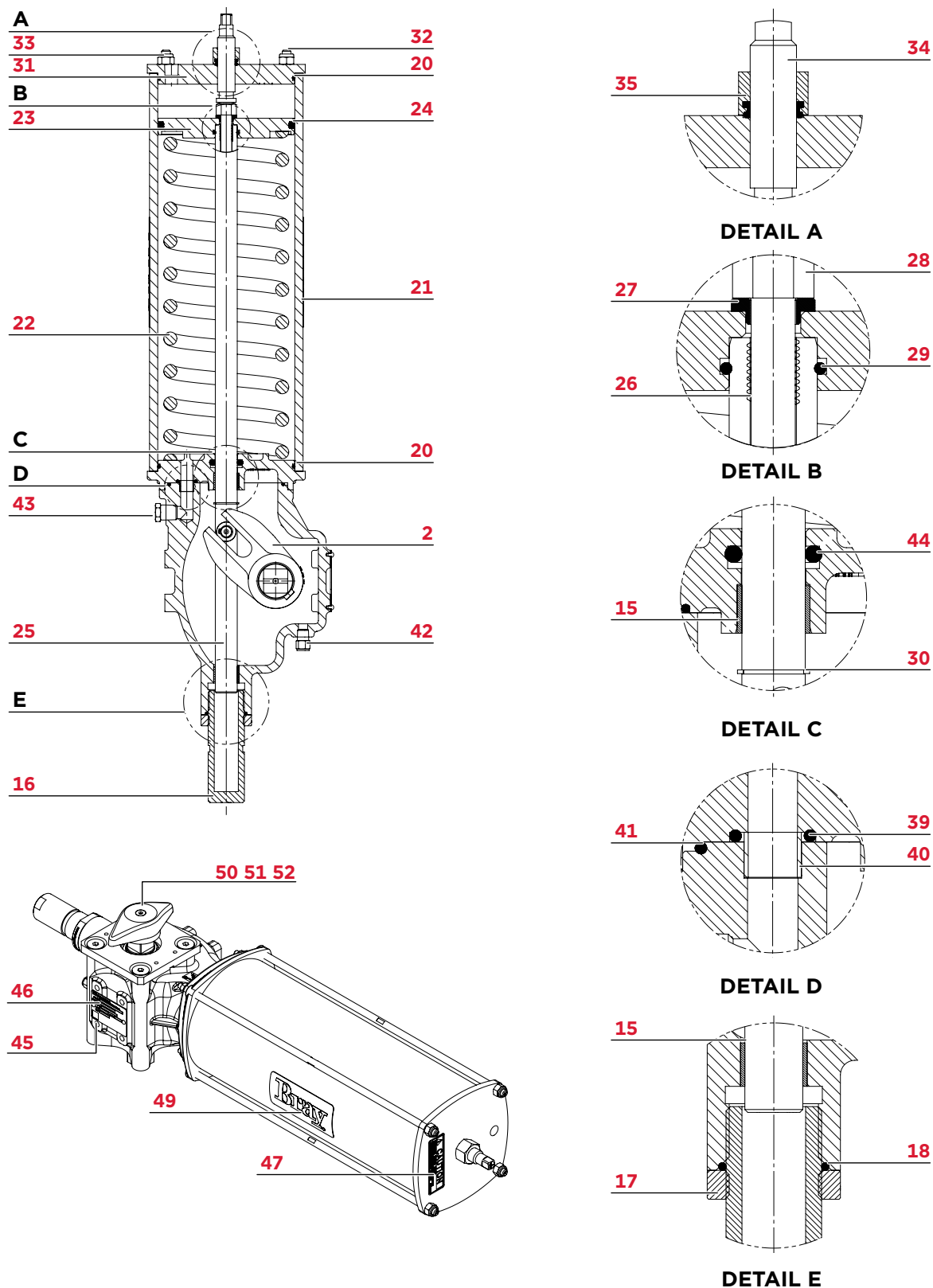
ITEM	DESCRIPTION	MATERIAL	QTY.
23²	Quad Seal (Piston)	BUNA-N	1
24	Piston Rod	Alloy Steel	1
25	Washer (Wedge Lock)	Steel	1
26	Bolt	Carbon Steel	1
27²	O-ring Piston Rod	BUNA-N	1
28	End Cap Plate	Carbon Steel	1
29	Tie Rod	Alloy Steel	4
30	Lock Nut, Nylock	Steel	4
31	Travel Stop Bolt	Steel	1
32²	Seal Nut	Steel	1
33³	Stud	Steel	4
34³	Spring Washer	Carbon Steel	4
35³	Nut	Steel	4
36²	O-ring (Tube)	BUNA-N	1
37	Tube	Stainless Steel	1
38²	O-ring (Module)	BUNA-N	1
39	Vent Relief Valve	Stainless Steel	1
40²	Quad Seal (Piston Rod)	BUNA-N	1
41	Name Plate	Stainless Steel	1
42	Rivets	Stainless Steel	2
43	Label, Logo	Metallized Polyester	2
44	Position Indicator	Plastic	1
45	Indicator Adaptor	Plastic	1
46	Cap Screw, Flat Head, Hex	Steel	1
47⁴	Lock Nut, Nylock	Steel	4
48	NAMUR Adaptor Plate	Carbon Steel	1
49	Cap Screw (NAMUR Kit)	Steel	4

NOTES:

1. Parts in seal kits and repair kits
2. Parts in seal kits only
3. Applicable for standard adaptor
4. Not applicable for standard actuator

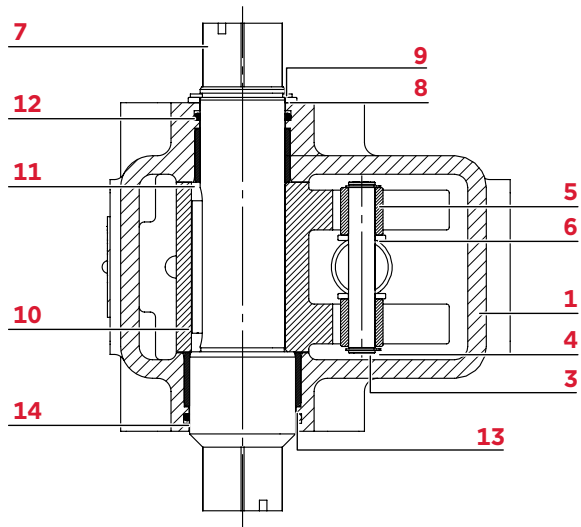
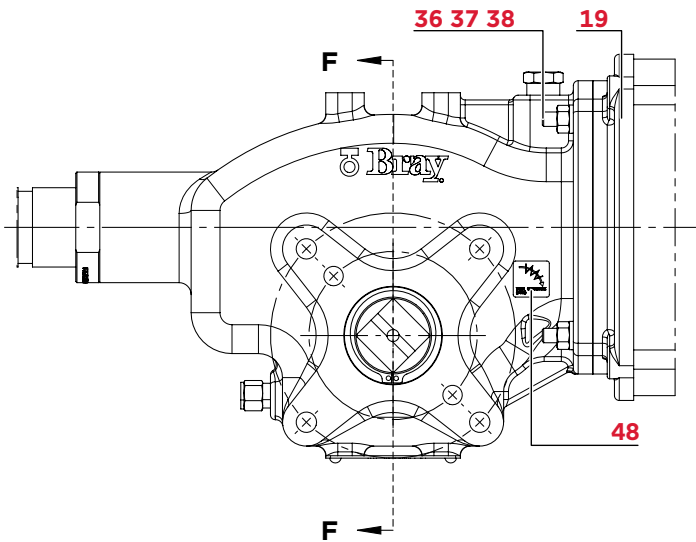
FOR REFERENCE ONLY. PLEASE REFER TO ES-00897 DRAWING FOR CURRENT INFORMATION.

4.0 PARTS CALLOUT AND MATERIALS OF CONSTRUCTION - SPRING RETURN ACTUATOR



FOR REFERENCE ONLY. PLEASE REFER TO ES-00895 DRAWING FOR CURRENT INFORMATION.

**4.0 PARTS CALLOUT AND MATERIALS OF CONSTRUCTION - SPRING RETURN ACTUATOR
(CONTINUED)**



SECTION VIEW - F

FOR REFERENCE ONLY. PLEASE REFER TO ES-00895 DRAWING FOR CURRENT INFORMATION.

4.0 PARTS CALLOUT AND MATERIALS OF CONSTRUCTION - SPRING RETURN ACTUATOR (CONTINUED)

ITEM	DESCRIPTION	MATERIAL	QTY.
1	Yoke Housing	Ductile Iron	1
2	Yoke	Carbon Steel	1
3	Yoke Pin	Alloy Steel	1
4¹	Retaining Ring (Yoke Pin)	Spring Steel	2
5¹	Roller	Steel	2
6	Roller Washer	Steel	2
7	Drive Shaft	Alloy Steel	1
8	Drive Shaft Washer	Stainless Steel	1
9¹	Retaining Ring (Drive Shaft)	Stainless Steel	1
10	Key (Drive Shaft)	Carbon Steel	1
11¹	Bearing (Smaller Dia-Drive Shaft)	Steel / Self-Lubricating Bronze	1
12²	O-ring (Smaller Dia-Drive Shaft)	BUNA-N	1
13¹	Bearing (Bigger Dia-Drive Shaft)	Steel / Self-Lubricating Bronze	1
14²	O-ring (Bigger Dia-Drive Shaft)	BUNA-N	1
15¹	Bearing (Piston Rod)	Steel / Self-Lubricating Bronze	2
16	Travel Stop Sleeve	Carbon Steel	1
17	Travel Stop Lock Nut	Carbon Steel	1
18²	O-ring (Travel Stop Sleeve)	BUNA-N	1
19	Adaptor	Ductile Iron	1
20²	O-ring (Barrel)	BUNA-N	2
21	Barrel	Carbon Steel	1
22	Spring, Compression	Alloy Steel	1
23	Piston	Carbon Steel	1
24²	Quad Seal (Piston)	BUNA-N	1
25	Piston Rod	Alloy Steel	1
26	Thread Insert	Stainless Steel	1

ITEM	DESCRIPTION	MATERIAL	QTY.
27	Piston Bolt Spacer	Carbon Steel	1
28	Hex Bolt	Alloy Steel	1
29²	O-ring (Piston Rod)	BUNA-N	1
30	Retainer Ring (Piston Rod)	Carbon Steel	1
31	End Cap Plate	Carbon Steel	1
32²	Tie Rod	Alloy Steel	4
33	Lock Nut, Nylock	Steel	4
34	Travel Stop Bolt	Steel	1
35²	Seal Nut	Steel	1
36	Stud	Steel	4
37	Spring Washer	Carbon Steel	4
38	Nut	Steel	4
39²	O-ring (Tube)	BUNA-N	1
40	Tube	Stainless Steel	1
41²	O-ring (Module)	BUNA-N	1
42	Plug	Stainless Steel	1
43	Breather Vent	Stainless Steel	1
44²	O-ring / Quad seal (Piston-Piston Rod)	BUNA-N	1
45	Name Plate	Stainless Steel	1
46	Rivets	Stainless Steel	2
47	Label, Caution	Metallized Polyester	1
48	Orientation Sticker	Metallized Polyester	1
49	Label, Logo	Metallized Polyester	2
50	Position Indicator	Plastic	1
51	Indicator Adaptor	Plastic	1
52	Cap Screw, Flat Head, Hex	Steel	1
53	NAMUR Adaptor Plate	Carbon Steel	1
54	Cap Screw (NAMUR Kit)	Steel	4

NOTES:

1. Parts in seal kits and repair kits
2. Parts in seal kits only

FOR REFERENCE ONLY. PLEASE REFER TO ES-00895 DRAWING FOR CURRENT INFORMATION.

5.0 SAFETY INFORMATION

Actuator assemblies with the accessories and controls in shipped condition, are safe for the intended use. Before installing the supplied assemblies, ensure the operating environment conditions are within the equipment's service limits.

Instructions contained within this manual shall be adhered to and executed by skilled and competent personnel trained in such equipment operation and maintenance tasks.

For the safety of personnel working on these actuators, the procedures for maintenance and safe disassembly/ reassembly shall be reviewed and adhered to. **DANGERS, WARNINGS, CAUTIONS** and **NOTICES** stated in this manual shall be specifically noted and close attention paid to them (refer to **page 3**). Suitable PPE (Personal Protection Equipment) shall always be worn by the operators and technicians, per the plant regulations.

No modifications and alterations shall be carried out on the supplied equipment as it would violate product certifications and render the warranty invalid.

Maintenance and operation shall be in accordance with the local statutory codes/provisions related to safe use of such equipment. The service instructions here do not supersede or override any site safety or work procedures of the customer. In event of conflicting instructions, differences need be resolved first, between authorized representatives of parties involved.

End user shall devise and implement mitigation measures for residual risks arising from the installation site environment or from normal operation of the equipment. Risks types such as thermal, noise, health, mechanical, magnetic, radiation, etc. that may be present at the equipment installation site shall be addressed with use of proper PPEs and use of plant safety procedures, including lockout/tag out and other safety work instructions for remotely operable equipment.

6.0 HAZARD-FREE USE

This device left the factory in proper condition to be safely installed and operated in a hazard-free manner. The notes and warnings in this document must be observed by the user if this safe condition is to be maintained and hazard-free operation of the device assured.

- > Take all necessary precautions to prevent damage due to rough handling, impact, or improper storage. Do not use abrasive compounds to clean, or scrape its surfaces with any objects.
- > Configuration and calibration procedures are described in this document. Proper configuration and calibration is required for the safe operation of this product.
- > The control system in which the unit is installed must have proper safeguards to prevent injury to personnel, or damage to equipment, should failure of system components occur.
- > This document does not cover every detail about every version of the product described. It cannot take into account every potential occurrence in installation, operation, maintenance and use.
- > If situations transpire that are not documented in sufficient detail, please request the required information from the Bray Distributor or Representative responsible for your area.

7.0 QUALIFIED PERSONNEL

A qualified person in terms of this document is one who is familiar with the installation, commissioning and operation of the product and who has appropriate qualifications, such as:

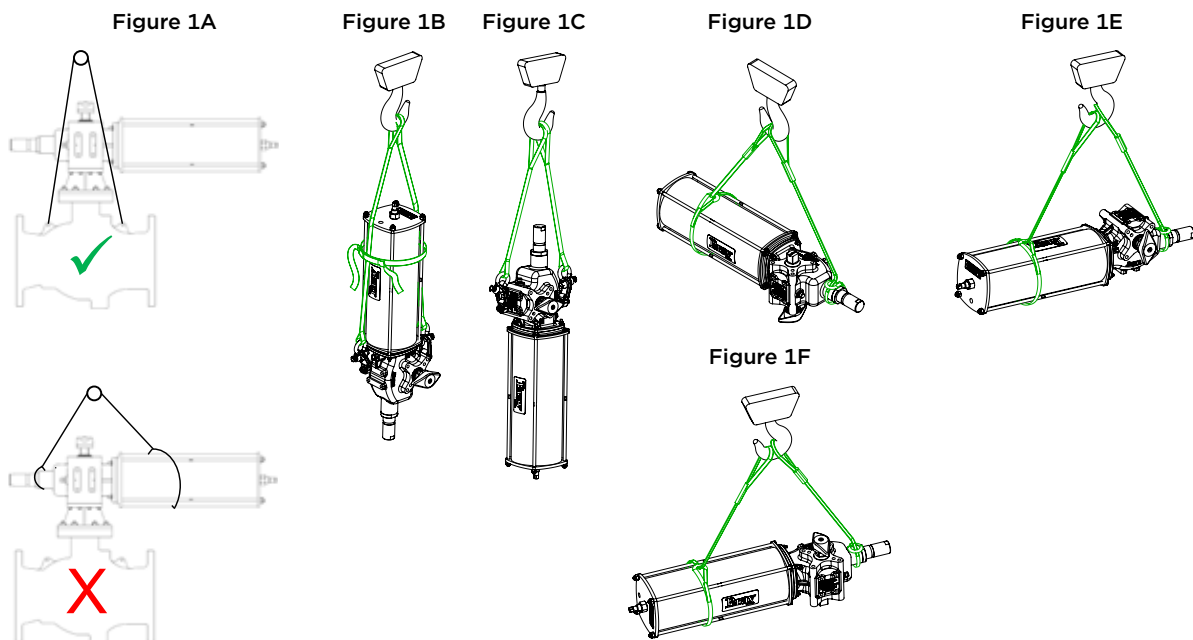
- > Is trained in the operation and maintenance of pneumatic and hydraulic pressure equipment and systems in accordance with established safety practices.
- > Is trained or authorized to energize, de-energize, ground, tag and lock electrical circuits and equipment in accordance with established safety practices.
- > Is trained in the proper use and care of personal protective equipment (PPE) in accordance with established safety practices.
- > Is trained in first aid.
- > In cases where the device is installed in a potentially explosive (hazardous) location – is trained in the operation, commissioning, and maintenance of equipment in hazardous locations.

8.0 HANDLING REQUIREMENTS

8.1 Lifting Recommendations/ Instructions

- > Use appropriate tackles and slings to lift the actuator. Refer to Technical Data table for the approximate actuator weight.
- > Do not use damaged slings.
- > For lifting purposes, use only suitable lifting tools.
- > Do not make any ad hoc arrangements such as, welding lifting lugs or drilling holes on the actuator for lifting.
- > Avoid abrupt or sudden movements during lifting.
- > Isolate all the energy sources, prior to lifting the actuator.
- > For different actuator mounting orientations, use the below recommended lifting methods. Contact Bray for any assistance.

8.2 Figure 1: Lifting Illustrations



9.0 STORAGE

Bray Series 98C is not weatherproof until the unit is properly installed, or all conduits and applicable port connections are sealed off and prepared for storage. The units may be shipped with temporary covers to prevent foreign matter from entering through the conduit openings; however, the user is responsible for replacing with the proper sealing plugs to support its NEMA/IP ratings.

To prevent condensation from forming inside the unit, maintain a near constant external temperature and store indoors in a well ventilated, clean, dry room. The temperature shall be between 40°F (4°C) and 85°F (29°C), with a relative humidity less than 70%. Store units away from vibration and direct sunlight exposure, and place units on a shelf or wooden pallet in order to protect against dampness. Keep units covered to protect against dust and dirt; if storing for long term, placing the unit inside a plastic sealed bag may be preferred.

Bray cannot accept responsibility for deterioration caused on-site once the cover is removed or due to improper storage.

10.0 INSTALLATION

The S98C actuators are assembled, tested and delivered per the configuration ordered. The mounting of the actuator requires a mounting kit that would include a bracket, coupler, and fasteners.



WARNING

Use appropriate tackles and slings to lift the actuator. Refer to Technical Data table for the approximate actuator weight.



NOTICE

- > Actuators do not have any built-in pressure limiting devices. Such devices must be incorporated in the pressure supply lines as part of the controls system.
- > The user shall ensure installation in intended service conditions and that the actuator is not covered with dirt/dust or other substances that may affect any heat dissipation capability, resulting in exceeding the maximum temperature rating of the actuator.
- > To prolong actuator seal life use only permitted media of recommended quality.
- > The actuator shall not be installed in hazardous areas incompatible with the defined gas groups and temperature class.
- > When using manual override sandwich gearbox, ensure the gearbox has over travel at least equal to that of the actuator.
- > The actuators can be mounted on valves in different positions, but care shall be taken to reorient suitably, some accessories like filter regulation units, hydraulic override power pack reservoirs, etc. that are gravity dependent for functioning.

10.1 MAXIMUM TEMPERATURE RANGE FOR POTENTIAL EXPLOSIVE AREAS

The actuators are intended for use in classified zone 1, zone 2 and/or zone 21, zone 22.

Table 1 - Service Temperature

Ambient Range	Surface Temperature (Tx)	Actuator MOC Trim
-29°C to 93°C -20°F to 200°F	T103°C T217°F	Standard Temperature
-46°C to 60°C -51°F to 140°F	T70°C T158°F	Low Temperature
-10°C to 149°C 14°F to 300°F	T159°C T318°F	High Temperature

The specified values are valid with the following conditions: the actuator operating at one cycle per second at a maximum frequency of 50 cycles per hour and at rated load. ATEX Type of Protection: Constructional safety “c”.

NOTE:

1. The actuator’s surface temperature shall be maintained within the stated limit of temperature to prevent autoignition when used in hazardous zones.
2. Ensure the actuator surfaces are periodically cleaned to prevent dust deposit that could cause rise in surface temperature.



CAUTION

Potential electrostatic charging hazard.

10.2 MOUNTING BRACKET COMPATIBILITY

Before proceeding with installation, physically verify the mounting bracket compatibility with the actuator and valve bolting pattern. Also check the coupler fitment to the actuator shaft drive end and the valve stem.

- > If valve has an existing actuator mounting bracket attached that is not designed for the Series 98C actuator, this bracket must be removed.
- > Attach appropriate Series 98C mounting bracket to the valve.
- > Ensure the actuator depressurized completely by venting the ports of S98C pneumatic actuator to atmosphere and any power sources to accessories are disconnected.
- > Ensure the valve and actuator are aligned to the same position (i.e., valve closed - actuator closed or both in open). For spring return actuators, align the valve to the fail safe position of the actuator. If a sandwich gearbox manual override is used, then make sure it is also aligned with the valve and actuator position.

- > Secure the valve, bolt the mounting bracket to the valve. Coat the Coupler/ Valve stem with suitable oil/grease and slide the coupler on to the valve stem. Ensure the actuator's seating face is clean and coat coupler/drive shaft square end with suitable oil/grease. Position the actuator to align the drive shaft square end to the coupler, until its seats on the bracket mounting surface.
- > When using a manual override sandwich gearbox between the actuator and valve, first couple and fix the gearbox on the valve following the gearbox installation procedure. Back off the gearbox travel stop bolts. Mount the actuator on the gearbox using the supplied mounting kit.
- > In order to align the bolt holes, it may be necessary to loosen the valve-bracket bolting slightly. The actuator mounting bolts should easily thread into the actuator base without side loading on the bracket (or the valve top flange). If needed, turn the actuator a bit and/or adjust the actuator travel stops. Bolt up the actuator to the bracket / gearbox flange / valve as the case may be. Refer to the Bolting Torque table for recommended torque values. Refer to **Section 11**.
- > Before operating the actuator, disengage the manual override, if present. The travel stops of the actuator shall limit the stroke and not those on the gearbox/valve, if present.
- > Adjust the travel stop bolts of the actuator for the proper open and closed valve positions, per valve manufacturer's recommendations. Refer to the Series 98C specifications for the travel adjustment range.
- > Tighten the travel stop bolts lock nuts after adjusting the stop bolts. Ensure the travel stops on gearbox or valve, if provided, are now adjusted and locked to fractionally lag the actuator's stop position.

NOTE: When used for actuating torque seated valves or swing disc type of valves, ensure that the stop bolt is sufficiently backed off to permit the valve disc to seat.

- > Ensure the manual overrides are set for the normal pneumatic operation before putting the actuator to test in power operation mode.
- > Stroke the actuator a few times at not more than MOP to check for proper and smooth operation. If the actuator is equipped with a switchbox or other accessories, adjust them at this time.



NOTICE

It is recommended to ground the actuator assembly against any buildup of static electricity.

11.0 OPERATION GUIDELINES

Series 98C actuators operate well in both on-off and modulating applications. The accessories, control elements, tubing and fittings shall be chosen for adequate flow rates so as not to constrict flow or cause high pressure drop affecting the performance of the actuator.

Maximum Operating Pressure (MOP) of the actuator is mentioned on the nameplate and shall not be exceeded. Suitable pressure regulator and safety valve shall be incorporated in the supply line, if the line pressure is higher than this.



CAUTION

Do not pressurize from the adapter port of the spring return actuator. On the pneumatic actuator, this port is normally fitted with a breather filter. If there is a possibility of the actuator being submerged temporarily in water due to flooding, then this port must be provided with an extension pipe with the breather filter on the pipe end, at a safe height above the water level.

Spring Return actuators work on pressure stroke or spring stroke by pressurizing or venting respectively, the end cap side port. A 3/2 way valve is typically used.

DA models require alternate ports to be pressurized and vented for stroking. A 5/2 or 5/3 way direction control valve or two 3/2 way valves may be used.

Table 2 - Actuator & Mounting Kit Bolting Torques

Bolt Size	Torque	
	N m	lbf-in
M8	30	265
M10	60	530
M12	110	975
M16	260	2300

12.0 MAINTENANCE

Series 98C actuators are designed for long service periods between maintenance, in demanding conditions. However, a preventative maintenance program is essential for ensuring good performance, safe operation, extended life of equipment and to avoid expensive down time.

The service conditions, load and cycling frequency may vary largely, which would require the maintenance program to be suitably designed, with sound judgment of the working conditions. Contact manufacturer for assistance.

In general, the scheduled service shall include replacement of all seals and wear parts.

Seals are recommended to be replaced if the actuator is in storage or inactive for long periods of time to avoid leakage due to the seal set. Actuators inactive or in storage for >6 months may be checked for leaks first.

12.1 Lubricants and Maintenance Consumables

The standard actuators use the following lubricants and consumables, refer to **Appendix B - Lubricants** or contact factory for information on high/low temperature actuator lubricants.

12.2 Disassembly, Service & Reassembly of Actuators



WARNING

Prior to disassembly of the actuator, disconnect all air/hydraulic and electrical power from actuator, remove the relevant accessories from actuator and dismount actuator from valve (or override gearbox, if present). Do not open when an explosive atmosphere is present.



NOTICE

Replacement of the press fitted bushings may require workshop infrastructure to remove the worn bearings from their housing and to press fit new ones, without damaging the housings. We recommend sending the actuator to our factory for overhauls/major repairs.

References:

- > Drawing # ES-00895 - GENERAL ASSEMBLY, SERIES 98C, SPRING RETURN ACTUATOR
- > Drawing # ES-00897- GENERAL ASSEMBLY, SERIES 98C, DOUBLE ACTING ACTUATOR

(Refer to the Bray website for current revisions of the drawings)

12.3 Disassembling the Double acting actuator.

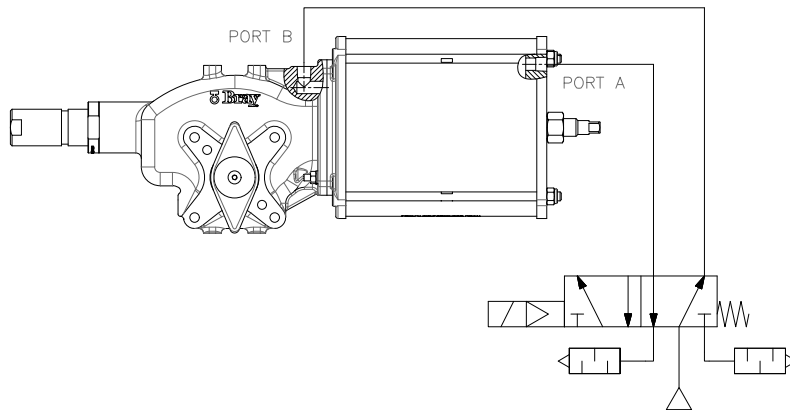


WARNING

Prior to disassembly of the actuator depressurize and disconnect electrical power from actuator, remove the relevant accessories, actuator position indicator and mounting bracket from actuator. Failure to do so could cause severe injury.

Note: Refer to ES-00897, Double Acting Actuator Assembly drawing.

Figure 2: Double Acting Actuator



12.3.1 Disassembling the Standard Adaptor Double Acting Actuator

1. Mark the set position of the Travel Stop Bolts (31) & Travel Stop Sleeve (16) and back off fully both the Travel Stop Bolts & Travel Stop Sleeve.
2. Apply low pressure 5-7 psi to the end cap port (Port A) to move the piston to adaptor side and depressurize.
3. Unscrew the Seal Nut (32).
4. Unscrew the Tie Rod Lock Nuts (30).
5. Gently tap the End Cap (28) off the cylinder Barrel (21) with a mallet and remove the End Cap.
6. Tie Rods (29) may be unscrewed from the Adaptor Plate / Yoke Housing (sandwich type).
7. Slide the Barrel over and off the Adaptor (19) and Piston (22), being careful not to scratch or dent the inner surface of the barrel.
8. Unscrew Bolt (26) and pull off the Piston (22) from Piston Rod (24).
9. Remove the Adaptor Nuts (35) and Spring washers (34). Pull off the Adaptor (19) from Yoke housing, sliding it off the Piston Rod (24).
10. Slide out the Piston Rod-Roller assembly from Yoke housing (1).
11. Remove Retainer rings (4), Roller (5), Roller washers (6) and pull out the Yoke Pin (3) from the Piston Rod.
12. Remove Position Indicator (44, 45, 46) and Namur Kit assembly (48, 49).
13. Remove Drive Shaft Retaining ring (9) and Drive Shaft Washer (8).
14. Gently tap the Drive Shaft end (Retaining ring side) with a mallet and push the Drive shaft (7) out of the Yoke housing (1).
15. Remove the Yoke (2) out of the Yoke Housing's (1) side opening.
16. Remove the Travel Stop Sleeve (16) from Yoke Housing.
17. Remove Tube (37) from Yoke Housing (1).

12.3.2 Disassembling the Double Acting Actuator Adaptor (sandwich type)

1. Follow steps 1 to 5 from section 12.3.1.
2. Unscrew the Tie Rod Lock Nuts (47) (Yoke housing side) and remove Tie Rods (29).
3. Hold Adaptor (19) and slide the Barrel (21) over and off the Adaptor (19) and Piston (22), being careful not to scratch or dent the inner surface of the barrel.
4. Unscrew Bolt (26) and pull off the Piston (22) from Piston Rod (24).

5. Remove Adaptor (19) from Yoke housing (1).
6. Follow steps 10 to 17 from section 12.3.1.

12.3.3 Service & Reassembly of the Double Acting Actuator



NOTICE

The wear parts (all seals, seal nuts, rollers, retaining rings and bearings in the Repair Kit) shall be replaced during the maintenance cycle. Ensure the replacement seals are suitable for the service temperature. Remove old seals and clean all the parts thoroughly. Use recommended lubricants and consumables as mentioned in Appendix B.

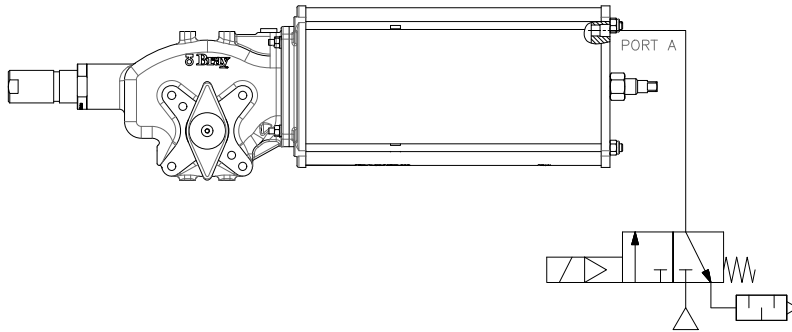
1. Replace the Bearings in the Yoke Housing (11, 13, 15) and Adaptor (15) with suitable pressing tools. Make sure to apply a thin coat of Bearing Retaining compound on the Bearing OD. Contact factory for more information.
2. Lubricate and install the O-rings (12 & 14) into the Yoke Housing groove and EP grease the bearings.
3. Lubricate the Yoke Bore, top & bottom surfaces, and the Yoke slots.
4. Insert Yoke (2) from Yoke Housing (1) side opening. And align Yoke bore to Yoke Housing bore.
5. Apply a thin coat of EP Grease on Drive shaft (7) & Key (10) and place the key into drive shaft keyway and insert small end of the drive shaft through the bigger bore of Yoke Housing, aligning the Key to the keyway in the Yoke. Slide it carefully all the way through the Yoke housing.
6. Apply EP Grease on top and bottom of Drive Shaft Washer (8) and insert Drive Shaft Washer into Drive Shaft (7). Secure the assembly with supplied Retaining Ring (9).
7. Ensure free rotation of Drive Shaft, CCW-CW, 2 to 3 cycles by using Spanner.
8. Lubricate with EP grease and Insert Yoke Pin (3) into Piston Rod (24).
9. Insert Roller Washers (6), supplied Rollers (5) and Retainer Rings (4) into Yoke Pin.
10. Turn the Drive shaft to CW end (Yoke slots towards flange). Grease on Piston Rod (24) OD and Apply EP grease generously on both Roller's (5), Roller Washer's (6). Insert Piston Rod-Roller assembly into Yoke slot and Bearing (15).
11. Lubricate with O-ring grease on the yoke housing and locate Tube (37) & O-ring (36) into the Yoke Housing (1).
12. Lubricate with O-ring grease and install the Piston Rod Quad Seal (40) into the Adaptor (19).
13. Lubricate with O-ring grease and locate O-ring (38) onto Adaptor counter bore.

14. Lubricate the Piston Rod (24) OD and carefully slide the Adaptor-Stud assembly through the Rod seal and Rod Bearing in the Adaptor (19). Ensure the O-rings (36 & 38) are not displaced. Locate the studs in the Yoke housing flange holes, install spring washers (34) and tighten nuts (35) evenly to seat the mounting faces uniformly all around. Apply tightening torque on Nut uniformly. **(Refer to section 14)**
Note: For sandwich Adaptor Double acting actuator, lubricate the Piston Rod (24) OD and carefully slide the Piston Rod (24) through the adaptor (19) , Rod seal (40) and Rod Bearing (15). Ensure the O-rings (36 & 38) are not displaced. And locate adaptor on to Yoke housing flange.
15. Lubricate with O-ring grease and install the Barrel O-ring (20) onto the Adaptor (19).
16. Lubricate with O-ring grease and install Piston Rod O-ring (27) into Piston (22) Groove.
17. Lubricate the Piston bore and slide the Piston (22) into the Piston Rod (24).
18. Insert Wedge Lock Washer (25) into Bolt (26) and Thread in Bolt into Piston Rod (24). Tighten the Bolt to the recommended torque values. **(Refer to section 14)**
19. Lubricate with O-ring grease and install the Quad Seal (23) on the Piston (22).
20. Coat Barrel (21) ID with O-ring grease and carefully slide the Barrel on the Piston and Quad Seal, all the way down to the Adaptor face, slipping the Barrel over the Barrel O-ring (20) installed on the Adaptor (19).
21. Make sure the threads on the Adaptor and Tie Rods are clean. Apply thread lock compound on the Tie Rod (29) threads and thread them into the Adaptor (19).
22. Lubricate with O-ring grease and install the O-ring (20) onto the End Cap Plate (28).
23. Locate the End Cap Plate (28) through Tie Rods (29). Push in the End Cap on the Barrel face, ensure to align ports A & B.
24. Thread in the Lock Nuts (30) on the Tie Rod (29) ends, tighten in cross pattern and torque evenly to recommended value with a calibrated torque wrench. **(Refer to section 14)**
25. Set the Travel Stops to previously marked positions and hold the Travel Stop Bolt A/F with the spanner and apply O-ring grease on to the Seal Nut sealing surface and tighten it into Travel Stop Bolt.
26. Lubricate with O-ring grease and insert O-ring (18) carefully over Travel Stop Sleeve (16) threads and apply anti-seize on to the Travel Stop Sleeve and insert the assembly into Yoke Housing (1). Set the Travel Stop Sleeve to previously marked positions.
27. Fit the Namur kit & Indicator on the drive shaft.

28. Apply 10-15 psi air pressure to ports alternately to check for smooth stroking for 5-10 cycles and then raise to 80 psi and hold the pressure to check for any leaks past the Piston, through the Rod Seal and the Barrel O-rings.
29. Leak test the piston seal by bubble test at 80 psi pressure using a 1/4" ID tube and for other seals check visually using commercial leak check fluids (Snoop or equivalent).
30. The actuator shall have no visible or detectable external leakages. Internal leakage of Piston seal/Rod seal shall not be higher than 1-2 bubbles per minute.
31. Stroke the piston a few times to set the seals if leakage is higher and repeat the bubble test. If still not within the limits, dismantle the actuator to examine the cause.
32. If no abnormalities are seen the actuator is ready for reassembly of removed accessories and mounting brackets.

12.4 Disassembling the Spring Return Actuator

Figure 3: Spring Return Actuator



DANGER

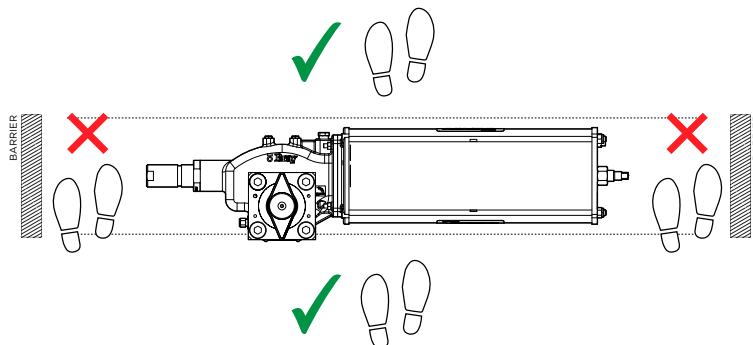
1. Energized spring is inside the cylinder.
2. Don't stand in axis of the travel stops during disassembly / assembly of actuator.
3. Don't exceed recommended bolt tightening torques.
4. Use proper Safety Guard/Barrier Shield during spring disassembly/assembly.



STORED ENERGY

Compressed springs store significant potential energy that can be dangerous if released suddenly. To prevent injury or equipment damage, it is mandatory to follow all instructions and safety procedures.

Figure 4: Spring Return Actuator Caution



WARNING

Preliminary Checks, any of the following conditions contact factory or authorized service center.

1. Any abnormal noise observed inside the actuator during the cycle.
2. If Travel Stop bolt is not free to turn at the end of the turn (Section 12.4, step no 2)
3. If Tie Rod Lock Nuts are loaded by spring while unscrewing. (Section 12.4, step no 3).
4. Pull the Piston rod from the Travel Stop Sleeve end, if the Piston Rod is free to move without any load.

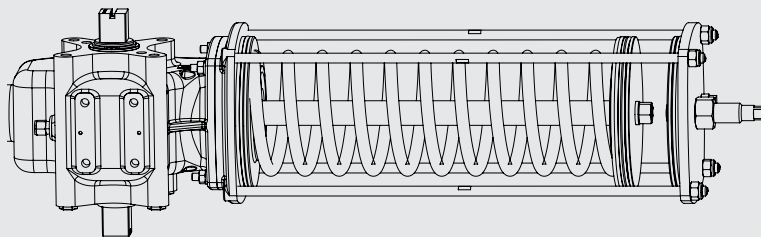
Note: Refer to ES-00895, Spring Return Actuator Assembly drawing.

1. Mark the set position of the Travel Stop Bolts (34) & Travel Stop Sleeve (16) and back off fully both the Travel Stop Bolts & Travel Stop Sleeve.
2. Unscrew the Seal Nut (35).
3. Unscrew the Tie Rod Lock Nuts (33).
4. Gently tap the End Cap (31) off the cylinder Barrel (21) with a mallet and remove the End Cap
5. Tie Rods (32) may be unscrewed from the Adaptor Plate/ Yoke housing (Sandwich type)
6. Slide the Barrel over and off the Adaptor (19) and Piston (23), being careful not to scratch or dent the inner surface of the barrel.



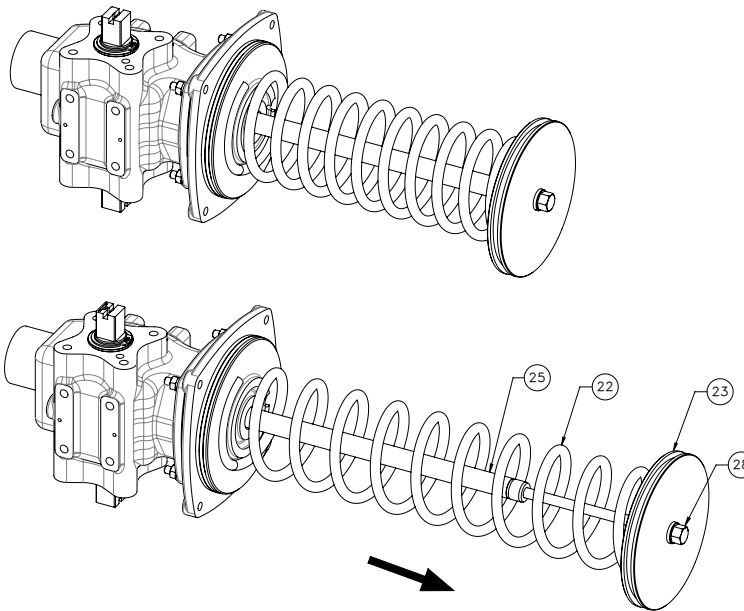
CAUTION

1. Its recommended to use assembly bench press to disassemble the springs.
2. Don't unscrew the Hex Bolt using impact wrenches.
3. During unscrew use torque wrench, if it exceeds Max allowed torque specified in the table 3, do not disassemble further. Send the actuator to factory.
4. If assembly bench press not available, use End Cap as shown. If unscrew torque doesn't exceeds Max allowed torque, remove End cap continue disassembly.



5. During disassembly if Thread Insert loosens, do not disassemble further. Send the actuator to the factory.

7. Unscrew Bolt (28) slowly, pull off the Piston (23) from Piston Rod (25) and remove Spring (22)



8. Remove the Adaptor Nuts (38) and Spring washers (37). Pull off the Adaptor (19) from Yoke housing, sliding it off the Piston Rod (25).
9. Slide out the Piston Rod-Roller assembly from Yoke housing (1).
10. Remove Retainer rings (4), Roller (5), Roller washers (6) and pull out the Yoke Pin (3) from the Piston Rod.

11. Remove Position Indicator (50, 51, 52) and Namur Kit assembly (53, 54).
12. Remove Drive Shaft Retaining ring (9) and Drive Shaft Washer (8).
13. Gently tap the Drive Shaft end (Retaining ring side) with a mallet and push the Drive shaft (7) out of the Yoke housing (1).
14. Remove the Yoke (2) out of the Yoke Housing's (1) side opening.
15. Remove the Travel Stop Sleeve (16) from Yoke Housing.
16. Remove Tube (40) from Yoke Housing (1).

12.4.1 Service & Reassembly of the Spring Return actuator



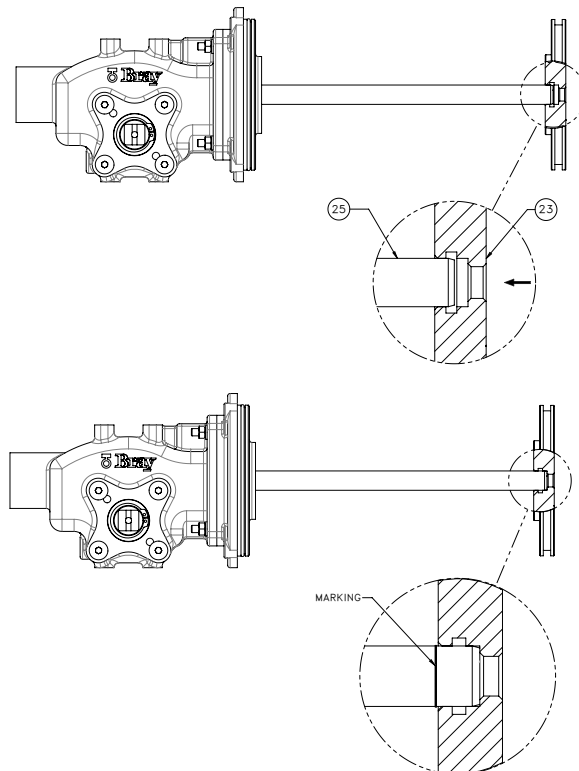
NOTICE

The wear parts (all Seals, Seal Nuts, Rollers, retaining rings and Bearings in the Repair Kit) shall be replaced during the maintenance cycle. Ensure the replacement seals are suitable for the service temperature. Remove old seals and clean all the parts thoroughly. Use recommended lubricants and consumables as mentioned in Appendix B.

1. Replace the Bearings in the Yoke Housing (11, 13, 15) and Adaptor (15) with suitable pressing tools. Make sure to apply a thin coat of Bearing Retaining compound on the Bearing OD. Contact factory for more information.
2. Lubricate and install the O-rings (12 & 14) into the Yoke Housing groove and EP grease the bearings.
3. Lubricate the Yoke Bore, top & bottom surfaces, and the Yoke slots.
4. Insert Yoke (2) from Yoke Housing (1) side opening. And align Yoke bore to Yoke Housing bore.
5. Apply a thin coat of EP Grease on Drive shaft (7) & Key (10) and place the key into drive shaft keyway and insert small end of the drive shaft through the bigger bore of Yoke Housing, aligning the Key to the keyway in the Yoke. Slide it carefully all the way through the Yoke housing.
6. Apply EP Grease on top and bottom of Drive Shaft Washer (8) and insert Drive Shaft Washer into Drive Shaft (7). Secure the assembly with supplied Retaining Ring (9).
7. Ensure free rotation of Drive Shaft, CCW-CW, 2 to 3 cycles by using Spanner.
8. Lubricate with EP grease and Insert Yoke Pin (3) into Piston Rod (25).
9. Insert Roller Washers (6), supplied Rollers (5) and Retainer Rings (4) into Yoke Pin.

10. Turn the Drive shaft to CW end (Yoke slots towards flange). Grease on Piston Rod (25) OD and Apply EP grease generously on both Roller's (5), Roller Washer's (6). Insert Piston Rod-Roller assembly into Yoke slot and Bearing (15).
11. Lubricate with O-ring grease on the yoke housing and locate Tube (40) & O-ring (39) into the Yoke Housing (1).
12. Lubricate with O-ring grease and install the Piston Rod Quad-ring (44) into the Adaptor (19).
13. Lubricate with O-ring grease and locate O-ring (41) onto Adaptor counter bore.
14. Lubricate the Piston Rod (25) OD and carefully slide the Adaptor-Stud assembly through the Rod seal and Rod Bearing in the Adaptor (19). Ensure the O-rings (39 & 41) are not displaced. Locate the studs in the Yoke housing flange holes, install spring washers (37) and tighten nuts (38) evenly to seat the mounting faces uniformly all around. Apply tightening torque on Nut uniformly. **(Refer to Section 14)**
15. Lubricate with O-ring grease and install the Barrel O-ring (20) onto the Adaptor (19).
16. Insert the Piston (23) on the Piston Rod (25) end and the mark the Piston position on the Piston rod with marker. After marking, pull out the Piston.

NOTE: Marking is not applicable if the Piston Rod is supplied with a marking groove.

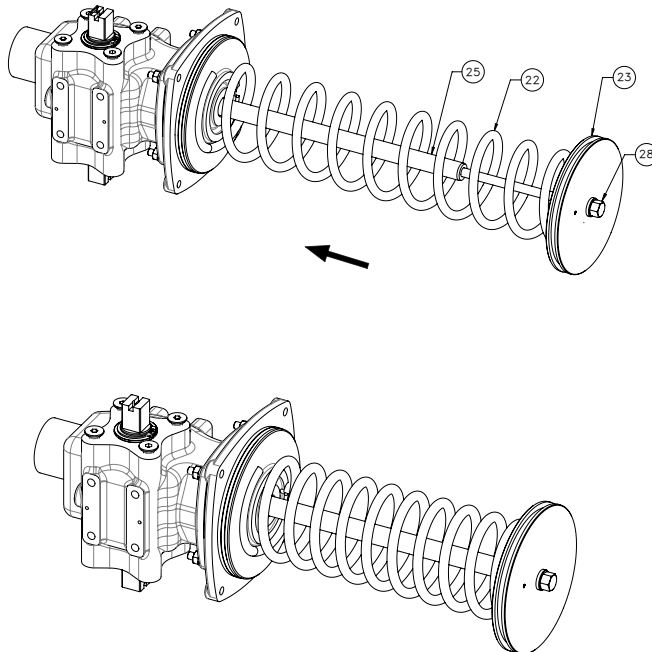


17. Apply EP Grease on Spring (22) and guide into the spring locator on Adaptor (19).
18. Lubricate with O-ring grease and install Piston Rod O-ring (29) into Piston (23) Groove.
19. Locate the spring ID on to the piston and insert the Piston Bolt Spacer (27) into Piston (23) and Insert Hex Bolt (28) through Piston Bolt Spacer.
20. Thread in the Hex Bolt (28) into Piston Rod (25). Slowly compress the Spring by tightening the bolt by using torque wrench until Piston reaches the marking on Piston Rod. Apply tightening torque on piston bolt. **(Refer to section 14)**



DANGER

Don't exceed recommended bolting tightening torques.



21. Lubricate with O-ring grease and install the Quad Seal (24) on the Piston (23).
22. Coat Barrel (21) ID with O-ring grease only for the Piston movement area and carefully slide the Barrel on the Piston and Quad Seal, all the way down to the Adaptor face, slipping the Barrel over the Barrel O-ring (20) installed on the Adaptor (19).
Note: Ensure while assembling Barrel, applied O-ring grease on the End cap side of the Barrel.
23. Make sure the threads on the Adaptor and Tie Rods are clean. Apply thread lock compound on the Tie Rod (32) threads and thread them into the Adaptor (19).
24. Lubricate with O-ring grease and install the O-ring (20) onto the End Cap Plate (31).
25. Locate the End Cap Plate (31) through Tie Rods (32). Push in the End Cap on the Barrel face, ensure to align ports A & B.

26. Thread in the Lock Nuts (33) on the Tie Rod (32) ends, tighten in cross pattern and torque evenly to recommended value with a calibrated torque wrench. **(Refer to section 14)**
27. Set the Travel Stops to previously marked positions and hold the Travel Stop Bolt A/F with the spanner and apply O-ring grease on to the Seal Nut sealing surface and tighten it into Travel Stop Bolt.
28. Lubricate with O-ring grease and insert O-ring (18) carefully over Travel Stop Sleeve (16) threads and apply anti-seize on to the Travel Stop Sleeve and insert the assembly into Yoke Housing (1). Set the Travel Stop Sleeve to previously marked positions.
29. Fit the Namur kit & Indicator on the drive shaft.
30. Apply MOP to Port A to check for smooth stroking for 5-10 cycles. Hold the pressure and check for any leaks from the End Cap Barrel O-ring and Seal Nut using commercial leak check fluids (Snoop or equivalent).
31. Remove the Breather (43) and connect 1/4" ID tube for bubble test. Hold the pressure to 80 psi and check for any leaks past the Piston.
32. The actuator shall have no visible or detectable external leakages. Internal leakage of Piston seal shall not be higher than 1-2 bubbles per minute.
33. Stroke the piston a few times to set the seals if leakage is higher and repeat the bubble test. If still not within the limits, dismantle the actuator to examine the cause.
34. If no abnormalities are seen the actuators is ready for reassembly of removed accessories and mounting brackets.

13.0 FIELD CONVERSIONS

Prior to configuration change, refer to the torque charts and ensure the actuator's torques would be suitable for the new application.

The Series 98C spring return actuator is designed to work in both configurations. For conversion from one configuration to the other, refer to the below images.

Figure 5: Spring Return Fail Close (CW)

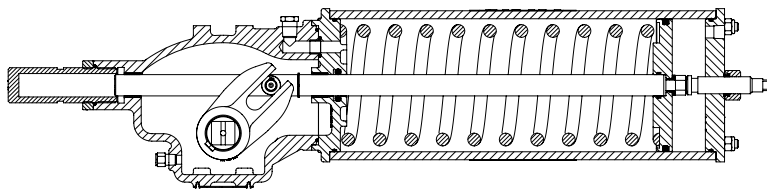
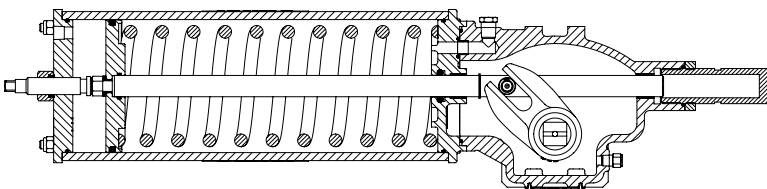


Figure 6: Spring Return Fail Open (CCW)



Field Conversion from Fail Close (CW) to Fail Open (CCW) and vice versa, refer to following steps

NOTE:

- > An additional mounting kit is not required for field conversion
- > Disassemble the actuator from the valve before carrying out the conversion



CAUTION

Ensure the ports are depressurized before disassembly of Actuator. Failure to do so could cause severe injury.

1. Ensure the actuator-valve assembly in fail safe condition (Fail CW). See Figure 7.
2. Remove the actuator from the valve, keeping the mounting bracket installed onto the valve.
3. Remove Namur mounting plate
4. Flip the actuator as in Figure 8.
5. Install Namur Mounting Plate onto top of actuator.
6. Pressure the actuator endcap port to actuate it to CW end position
7. In this pressurized condition, carefully mount the actuator onto the valve and tighten the mounting bolts/nuts to the recommended torque.

Figure 7: Valve-Mounting kit and Actuator Fail Close

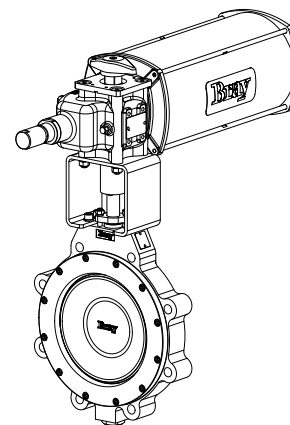
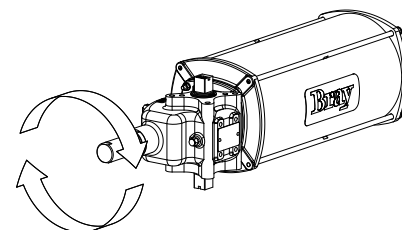


Figure 8: Flipping actuator from Valve-Mounting kit



8. Depressurize the actuator to actuate the assembly to fail safe condition (now Fail CCW)
9. Check actuator for proper operation, at the rated working pressure.
10. Similar steps will apply for conversion from fail open (CCW) to fail close (CW).

14.0 BOLTING TORQUES AND TOOLS

14.1 Table 3: Actuator & Mounting Kit Bolting Torques

MODEL	25E1				50E1				10E2					20E2				
ISO Base	F07				F10				F12					F14				
Base Bolting Size	M8				M10				M12					M16				
Module Mounting Stud- Nut Size	M6				M6				M8					M10				
Spanner Size, mm	10				10				13					16				
Torque, Nm	10				10				25					55				
Indicator Screw	M6				M6				M6					M6				
Allen Key,mm	4				4				4					4				
Action	DA		SR		DA		SR		DA		SR			DA		SR		
Piston Bolt Size	M10		M8		M12		M10		M16		M12			M20		M16		
Spanner Size, mm	16		13		18		16		24		21			30		27		
Torque, Nm	30		15		40		30		70		40			90		70		
Max allowed Torque, Nm*	-		30		-		60		-		80			-		140		
Cylinder Size, mm	80	100	125	140	100	125	140	160	125	140	160	180	200	140	160	180	200	220
Tie Rod thread	M6	M6	M8	M8	M6	M8	M8	M8	M8	M8	M10	M10	M12	M10	M10	M10	M12	M12
Spanner Size, mm	10	10	13	13	10	13	13	13	13	13	16	16	18	16	16	16	18	18
Torque, Nm	7	7	15	15	7	15	15	15	15	15	30	30	40	30	30	30	40	40


DANGER

*Don't exceed recommended Max allowed torque.

15.0 TECHNICAL DATA

15.1 Table 4 - S98C Double Acting Actuators

Model	Maximum Operating Pressure		Volume				Actuator Weight		Assembly Weight (approx)									
	psi	bar	cu.in		Lts		Lbs	Kg	w/Extended Travel Stop						w/Jackscrew Override			
			Rod End	Cap End	Rod End	Cap End			Pressure Module		Torque Module		Torque Module & Pressure Module	Hand Wheel		Hex Nut		
									Lbs	Kg	Lbs	Kg	Lbs	Kg	Lbs	Kg	Lbs	Kg
25E1-80	132	9.1	24	28	0.4	0.5	24	11	24	11	26	12	26	12	29	13	29	13
25E1-100	84	5.8	39	45	0.6	0.7	29	13	29	13	31	14	31	14	31	14	31	14
25E1-125	54	3.7	62	70	1.0	1.2	35	16	35	16	37	17	37	17	39	17.5	37	17
50E1-100	124	8.5	50	56	0.8	0.9	40	18	40	18	42	19	42	19	42	19	42	19
50E1-125	79	5.5	81	90	1.3	1.5	46	21	46	21	49	22	49	22	49	22	49	22
50E1-140	63	4.3	102	114	1.7	1.9	55	25	55	25	57	26	57	26	57	26	57	26
10E2-125	125	8.6	99	115	1.6	1.9	73	33	75	34	75	34	77	35	82	37	79	36
10E2-140	100	6.9	126	147	2.1	2.4	82	37	84	38	84	38	86	39	90	41	88	40
10E2-160	76	5.3	168	192	2.8	3.1	90	41	93	42	93	42	95	43	98	44.5	97	44
10E2-180	60	4.2	215	243	3.5	4.0	101	46	104	47	104	47	106	48	110	50	108	49
20E2-140	150	10.3	140	164	2.3	2.7	108	49	110	50	112	51	115	52	126	57	NA	NA
20E2-160	134	9.2	189	222	3.1	3.6	128	58	130	59	132	60	134	61	146	66	NA	NA
20E2-180	106	7.3	243	281	4.0	4.6	139	63	141	64	143	65	146	66	157	71	NA	NA
20E2-200	86	5.9	304	348	5.0	5.7	150	68	152	69	154	70	157	71	170	77	NA	NA
20E2-220	71	4.9	371	421	6.1	6.9	163	74	165	75	168	76	170	77	183	83	NA	NA

15.2 Table 5 - S98C Spring Return Pneumatic Actuators

Model	Spring #	MOP		Volume		Actuator Weight		Assembly Weight (approx)									
		psi	bar	Cap end		Lbs	Kg	w/Extended Travel Stop						w/Jackscrew Override			
				cu.in	Lts			Pressure Module		Torque Module		Torque Module & Pressure Module		Hand Wheel		Hex Nut	
								Lbs	Kg	Lbs	Kg	Lbs	Kg	Lbs	Kg	Lbs	Kg
25E1-100	1	106	7.3	45	0.7	37	17	37	17	40	18	40	18	39	18	37	17
25E1-125		68	4.7	70	1.2	39	18	49	22	49	22	49	22	50	23	49	22
25E1-140		54	3.7	88	1.4	39	18	62	28	62	28	62	28	62	28	61	28
25E1-100	2	115	7.9	45	0.7	47	22	40	18	40	18	40	18	40	18	39	18
25E1-125		74	5.1	70	1.2	49	22	49	22	51	23	51	23	50	23	49	22
25E1-140		59	4.1	88	1.4	50	23	62	28	64	29	64	29	63	29	62	28
25E1-100	3	128	8.8	45	0.7	61	27.5	40	18	40	18	40	18	40	18	39	18
25E1-125		82	5.6	70	1.2	62	28.0	51	23	51	23	51	23	51	23	50	23
25E1-140		65	4.5	88	1.4	62	28.0	62	28	64	29	64	29	63	29	62	28
50E1-125	1	98	6.7	90	1.5	61	28	62	28	62	28	64	29	63	29	62	28
50E1-140		78	5.4	114	1.9	62	28	75	34	77	35	77	35	77	35	76	35
50E1-160		60	4.1	148	2.4	64	29	86	39	86	39	88	40	86	39	85	39
50E1-125	2	106	7.3	90	1.5	75	34	62	28	64	29	64	29	64	29	63	29
50E1-140		84	5.8	114	1.9	76	35	77	35	77	35	79	36	77	35	76	35
50E1-160		65	4.4	148	2.4	78	36	86	39	86	39	88	40	87	40	86	39
50E1-125	3	119	8.2	90	1.5	85	39	64	29	66	30	66	30	65	30	64	29
50E1-140		95	6.5	114	1.9	85	39	79	36	79	36	82	37	79	36	78	36
50E1-160		72	5.0	148	2.4	87	40	88	40	88	40	88	40	89	41	88	40
10E2-140	1	125	8.6	147	2.4	110	50	112	51	112	51	44	20	116	52.5	114	51.5
10E2-160		96	6.6	192	3.1	121	55	123	56	123	56	126	57	128	58	125	56.5
10E2-180		76	5.2	243	4.0	136	61.5	137	62	139	63	139	63	142	64.5	139	63
10E2-200		61	4.2	300	4.9	151	68.5	152	69	154	70	154	70	158	71.5	154	70
10E2-140	2	138	9.5	147	2.4	114	51.5	115	52	117	53	117	53	119	54	117	53
10E2-160		106	7.3	192	3.1	125	56.5	137	62	137	62	139	63	130	59	128	58
10E2-180		83	5.8	243	4.0	139	63	141	64	141	64	143	65	144	65.5	142	64.5
10E2-200		68	4.7	300	4.9	154	70	157	71	157	71	159	72	160	72.5	158	71.5
10E2-140	3	146	10.1	147	2.4	115	52	117	53	117	53	119	54	120	54.5	118	53.5
10E2-160		112	7.7	192	3.1	127	57.5	128	58	130	59	130	59	132	60	130	59
10E2-180		89	6.1	243	4.0	141	64	143	65	143	65	146	66	147	66.5	143	65
10E2-200		72	4.9	300	4.9	157	71	159	72	159	72	161	73	162	73.5	159	72
10E2-140	4	150	10.3	147	2.4	116	52.5	117	53	119	54	119	54	121	55	119	54
10E2-160		121	8.3	192	3.1	128	58	130	59	130	59	132	60	133	60.5	130	59
10E2-180		96	6.6	243	4.0	141	64	143	65	143	65	146	66	148	67	144	65.5
10E2-200		78	5.3	300	4.9	157	71	159	72	159	72	161	73	163	74	160	72.5

SERIES 98C COMPACT SCOTCH YOKE ACTUATOR

Installation, Operation and Maintenance Manual



15.2 Table 5 - S98C Spring Return Pneumatic Actuators (continued)

Model	Spring #	MOP		Volume		Actuator Weight		Assembly Weight (approx)									
		psi	bar	Cap end		cu.in	Lts	Lbs	Kg	w/Extended Travel Stop				w/Jackscrew Override			
				Pressure Module	Torque Module					Torque Module & Pressure Module		Hand Wheel		Hex Nut			
										Lbs	Kg	Lbs	Kg	Lbs	Kg	Lbs	Kg
20E2-160	1	150	10.3	222	3.6	171	78	174	79	176	80	179	81	181	82	NA	NA
20E2-180		138	9.5	281	4.6	184	84	187	85	190	86	192	87	194	88	NA	NA
20E2-200		112	7.7	348	5.7	201	91	203	92	205	93	207	94	209	95	NA	NA
20E2-220		92	6.4	421	6.9	217	99	220	100	223	101	225	102	227	103	NA	NA
20E2-160	2	150	10.3	222	3.6	174	79	176	80	179	81	181	82	183	83	NA	NA
20E2-180		149	10.2	281	4.6	187	85	190	86	192	87	194	88	196	89	NA	NA
20E2-200		120	8.3	348	5.7	204	93	207	94	209	95	212	96	214	97	NA	NA
20E2-220		100	6.9	421	6.9	220	100	223	101	225	102	227	103	229	104	NA	NA
20E2-160	3	150	10.3	222	3.6	193	88	196	89	198	90	201	91	203	92	NA	NA
20E2-180		150	10.3	281	4.6	207	94	209	95	212	96	214	97	216	98	NA	NA
20E2-200		128	8.8	348	5.7	225	102	227	103	229	104	231	105	234	106	NA	NA
20E2-220		106	7.3	421	6.9	243	110	245	111	247	112	249	113	251	114	NA	NA
20E2-160	4	150	10.3	222	3.6	196	89	198	90	201	91	203	92	216	98	NA	NA
20E2-180		150	10.3	281	4.6	211	96	214	97	216	98	218	99	220	100	NA	NA
20E2-200		137	9.4	348	5.7	228	104	231	105	234	106	236	107	238	108	NA	NA
20E2-220		113	7.8	421	6.9	246	112	249	113	251	114	254	115	256	116	NA	NA

16.0 SERIES 98C GENERAL SPECIFICATIONS AND FEATURES

General Specifications - Range

Model	ISO Base	Rated Torque		Spring End Torque Nm		Spring End Torque lbf-in		Drive Shaft Square Dimension		Drive Shaft Engagement	Over Travel
		Nm	lbf-in	Min	Max	Min	Max	mm	inch	mm	± Degrees
25E1	F07	250	2,213	55	119	490	1,053	17.0	0.67	23	5
50E1	F10	500	4,425	100	232	883	2,050	22.0	0.87	24	5
10E2	F12	1,000	8,851	166	497	1,468	4,396	27.0	1.06	32	5
20E2	F14	2,000	17,701	431	1,008	3,811	8,921	36.0	1.42	38	5

Configurations

DA	Double Acting
SR-CW	Spring Return- Fail CW
SR-CCW	Spring Return- Fail CCW

Operating Conditions

Pressure Range	40 - 150 psi 2.8 - 10.3 bar		
Media	Dry Compressed Air / Inert Gas / Natural Gas		Contact factory for other media
Temperature Range	Standard : -20°F to 200°F (-29°C to 93°C)		PED & Non-PED Contact factory for extended ranges
- Standard Options	High Temp : 14°F to 300°F (-10°C to 149°C)		
	Low Temp : -50°F to 140°F (-46°C to 60°C)		

Compliances

Torque Base	Mounting dimensions as per ISO 5211: 2001(E)
Accessories	Shaft Driven Accessories mounting per NAMUR-VDE
Performance Testing	In accordance with EN 15714-3:2022
Ingress Protection	IP66, IP67M & IP68 per IEC 60529
Safety	ATEX, SIL 3 suitable, PED, API 6DX

17.0 SERIES 98C SEAL KITS AND REPAIR KITS

17.1 Table 6 - Seal and Repair Kits

Model		25E1	50E1	10E2	20E2
80	Seal Kit	98C-P08P-21900-0S0			
	Repair Kit	98C-P08P-21901-0S0			
100	Seal Kit	98C-P10P-21900-0S0	98C-P10Q-21900-0S0		
	Repair Kit	98C-P10P-21901-0S0	98C-P10Q-21901-0S0		
125	Seal Kit	98C-P12P-21900-0S0	98C-P12Q-21900-0S0	98C-P12R-21900-0S0	
	Repair Kit	98C-P12P-21901-0S0	98C-P12Q-21901-0S0	98C-P12R-21901-0S0	
140	Seal Kit	98C-P14P-21900-0S0	98C-P14Q-21900-0S0	98C-P14R-21900-0S0	98C-P14S-21900-0S0
	Repair Kit	98C-P14P-21901-0S0	98C-P14Q-21901-0S0	98C-P14R-21901-0S0	98C-P14S-21901-0S0
160	Seal Kit	98C-P16Q-21900-0S0		98C-P16R-21900-0S0	98C-P16S-21900-0S0
	Repair Kit	98C-P16Q-21901-0S0		98C-P16R-21901-0S0	98C-P16S-21901-0S0
180	Seal Kit	98C-P18R-21900-0S0			98C-P18S-21900-0S0
	Repair Kit	98C-P18R-21901-0S0			98C-P18S-21901-0S0
200	Seal Kit	98C-P20R-21900-0S0			98C-P20S-21900-0S0
	Repair Kit	98C-P20R-21901-0S0			98C-P20S-21901-0S0
220	Seal Kit	98C-P22S-21900-0S0			
	Repair Kit	98C-P22S-21901-0S0			

TRIM CODE

-0S0 is standard temperature trim

-0L0 is low temperature trim

-0H0 is high temperature trim

Example

98C-P08P-21900-0S0 = standard temperature trim

98C-P08P-21900-0L0 = low temperature trim

NOTE: The repair kit includes the seal kit

18.0 JACKSCREW OVERRIDE

Jackscrews provide an economical manual override option on actuators for use in case of air failure. These jackscrews are available in two types: direct drive Hand Wheel operated or direct drive Hex Nut to be operated with a wrench or spanner. Both types of override incorporate a rotating screw threading into a bronze nut. Spring Return actuators have the jackscrew located on the spring side of the actuator. In this arrangement, the jackscrew compresses the spring to override the fail safe operation. On Double Acting actuators there will be a jackscrew installed on both ends of the actuator so the actuator may be operated in the CW and CCW direction.

18.1 Installation

Jackscrew overrides are usually factory installed on the actuator. Override units are shipped with the jackscrew assembly installed on the actuator so that the actuator is ready for installation in the auto operation mode. No additional customer installation is required.

18.2 Operating Spring Return Jackscrew Override

1. To test / operate the override, shut off the main air supply and turn the 3 position valves on the pneumatic cylinder ports to vent the actuator ports to atmosphere.
2. Turn the hand wheel/hex nut on the jackscrew to advance the screw into the spring module (see direction markers on the hand wheel/hex nut).
3. Resistance will be felt when the thrust head of the jackscrew touches the end of the spring rod.
4. Turning the hand wheel further will compress the spring and simultaneously turn the actuator.

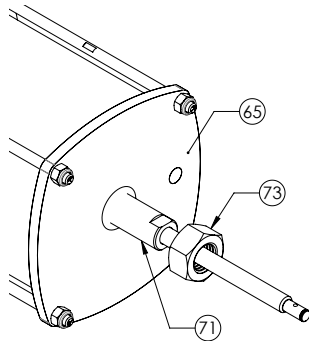


NOTICE

The spring constantly loads on the jackscrew and returns the actuator to fail safe state when the jackscrew is fully retracted. To resume normal actuator operation, fully retract the jackscrew bringing the actuator to fail safe position. Next, turn the 3 position valve on the cylinder port to connect the air supply and restore actuator to auto operation mode.

18.3 Travel Stop Adjustment on Spring Return with Jackscrew Override

1. Spring Return actuators have the jackscrew located on the spring module.
2. Jackscrew override acts as a manual override as well as travel stop bolt.
3. To adjust the travel stop on spring module, loosen the Seal Nut (73) and adjust Nut ACME (71) to required position. Hold the Nut ACME Bolt A/F with the spanner and tighten in Seal Nut.



18.4 Operating Double Acting Jackscrew Override

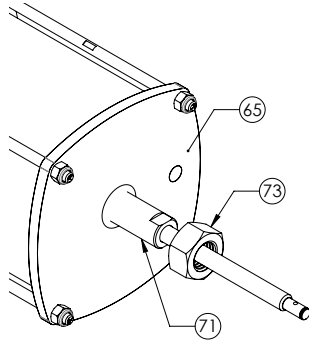
1. To test / operate the override, shut off the main air supply and turn the 3 position valves on the pneumatic cylinder ports to vent the ports to atmosphere.
2. Double Acting actuators are fitted with jackscrews on both ends of the actuator or Torque Module and Pressure Module.
3. Based on required direction, operate Jackscrew on either the Pressure Module or Torque Module.
4. Turn the Hand Wheel/Hex Nut on the jackscrew to advance the screw into the Pressure Module / Torque Module (see direction markers on the Hand Wheel/Hex Nut).

Note: Before operating jackscrew, ensure the opposing jackscrew is backed off fully.

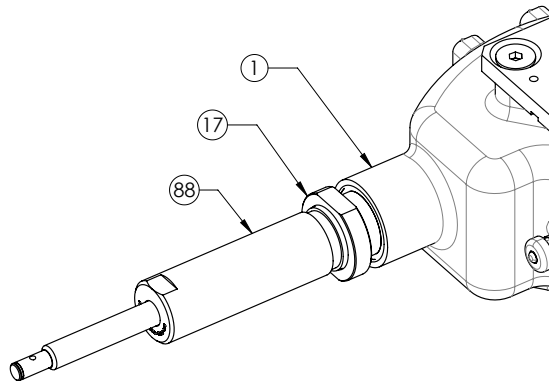
5. Resistance will be felt when the thrust head of the jackscrew touches the piston rod.
6. Turning the Hand Wheel/ Hex Nut further will turn the actuator.
7. To resume normal pneumatic operation, back off the jackscrew(s) completely and restore air supply.

18.5 Travel Stop Adjustment on Double Acting with Jackscrew Override

1. Double Acting actuators, have a jackscrew located on both ends of the actuator or Torque Module and Pressure Module.
2. To adjust the travel stop on Pressure Module, loosen the Seal Nut (68) and adjust Nut ACME (71) to required position. Hold the Nut ACME Bolt A/F with the spanner and tighten in Seal Nut.



3. To adjust the travel on Torque Module, Loosen the Travel Stop Lock Nut (17) and adjust Nut ACME (88) to required position. Hold the Nut ACME Bolt A/F with the spanner and tighten in Travel Stop Lock Nut.

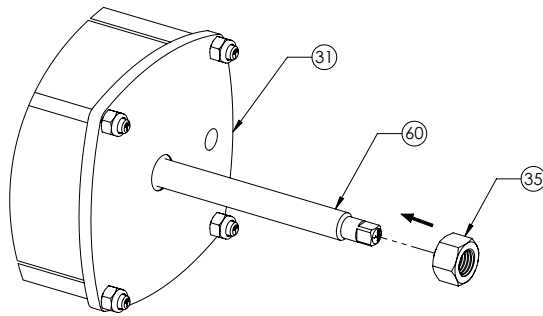


19.0 EXTENDED TRAVEL STOPS

Extended Travel Stops are used to provide additional travel stop range beyond the standard actuator travel stops. Each Travel Stop is adjustable for 0-90 degrees of travel.

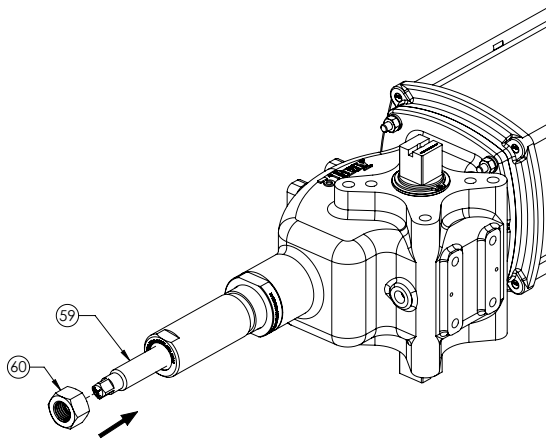
19.1 Travel Stop Adjustment on Pressure/Spring Module side

Adjust Travel Stop Bolt (60) to the required length and hold the Stop Bolt A/F with the spanner and tighten in Seal Nut (35).



19.2 Travel Stop Adjustment on Torque Module side

Adjust Travel Stop Bolt (59) to the required length and hold the Stop Bolt A/F with the spanner and tighten in Seal Nut (60).



20.0 APPENDIX A - LUBRICANTS FOR SERIES 98C ACTUATORS

	Temperature Range		
	Standard -20°F to 199°F -29°C to 93°C	Low Temperature -50°F to 140°F -46°C to 60°C	High Temperature 14°F to 300°F -10°C to 149°C
Yoke Housing & Spring	Shell Gadus S2 V220 (Alvania Grease EP(LF)2) or Mobiltemp SHC 100 or Mobil XHP222 or Vistony EP Lithium Grease NLGI Grade-2	Mobiltemp SHC 100 or Mobilith SHC 100 {-40°F (-40°C)}	Mobiltemp SHC 100 or Shell Gadus S3 T220-2 or Mobil XHP222
Cylinder & Seals	Dow Corning Molykote 55		
Consumables for Series 98C Actuators			
Thread Sealant	Loctite 577 / Loctite 570		
Thread Lock	Loctite 243		
Anti-Seize	Loctite LB 771 / DNC Ultra-Grease Anti-Seize/ Molykote P-37	Loctite LB 771	Loctite LB 771 / DNC Ultra-Grease Anti-Seize/ Molykote P-37
Bearing Retaining	Loctite 641		

21.0 TROUBLE SHOOTING POTENTIAL PROBLEMS

21.1 Table 7 - Troubleshooting

Fault	Possible Causes	Recommended Actions
Erratic Movement	Inconsistent supply /dirty operating media/clogged filters	Check media supply pressure and line filters, correct as necessary. Refer to Section 2 (Introduction) in this manual for operating media requirements.
	Compromised lubrication due to condensate inside pneumatic cylinder(S98C) or over extended maintenance cycles	Disassemble and service the actuator after eliminating problems with operating media quality. Refer to Section 12 (Maintenance) in this manual for lubricant specs.
	Worn/damaged parts	Disassemble and inspect. Replace worn/damaged parts. Refer to Section 12.3 & 12.4 (Disassembly, Service & Reassembly of Actuator) in this manual.
	Seal set due to long periods of inactivity	Operate for 5-10 cycles and check. Replace seals if not resolved. Refer to the procedures under Section 12.3 & 12.4 (Disassembly, Service & Reassembly of Actuator) section in this manual, for replacement and testing procedures.
	Mechanical problems with Valve/ Actuator/ Mounting Kits /Accessories - bearing/seal friction, damaged parts	Refer to valve manufacturer's IOM. To resolve problems with valve. Refer to Section 12 (Maintenance) of this manual for disassembly of actuator to investigate any issues in the actuator.
Incomplete Stroke	Travel stop set incorrectly	Check and adjust.
	Foreign object left inside during maintenance	Disassemble, inspect for damages and correct.
	Manual override in wrong position	Check and fully retract manual override devices for proper automatic operation.
	Valve problem - Restriction, friction, incorrect valve travel stop	Refer to valve manufacturer's IOM.
	Piston Rod / Spring Rod partially loosened	Check/ tighten rods to required torque.
Loss of power	Supply pressure inadequate	Check and correct supply pressure to operating pressure.
	Inadequate flow	Check flow control devices and adjust for sufficient flow. Repair any kinked tubing.
	Actuator seals leaking	Check leaks and replace seals. Refer to the procedures under Section 12.2 (service and reassembly of actuator) in this manual, for replacement and testing procedures.
	Defective Accessories/ Inadequate capacity	Refer to accessory manufacturer's IOM manual and specs.
	Valve jammed or requires higher torque	Refer to valve manufacturer's IOM.

21.1 Table 7 - Troubleshooting (continued)

Fault	Possible Causes	Recommended Actions
No response to actuation signal	Altered schematic	Check if the control circuit is as per the supplied schematic. Correct the circuit, if altered.
	Solenoid valve/positioner/ control elements malfunction	Check /Refer to accessory manufacturer's IOM manual for troubleshooting.
	Disengaged piston rod/ broken connection/ jammed mechanism	Refer to Section 12 (Maintenance) for actuator disassembly procedures
	Valve problem - jammed	Refer to valve manufacturer's IOM.
Fails to go to the failsafe position	Altered schematics	Check if the control circuit is as per the supplied schematic. Correct the circuit, if altered.
	Control component malfunction/failure	Check and replace
	Choked exhaust silencer/ foreign object blocking exhaust line	Remove vent to confirm normal operation. Clean/ replace exhaust silencer.
	Piston rod disengaged/ connection broken	Refer to Section 12 (Maintenance) for actuator disassembly procedures
	Valve problem - jammed	Refer to valve manufacturer's IOM.

21.2 Table 8 - Precaution

Potential Misuse	Prevention Measures
Use in unintended conditions	Refer to Introduction & Installation sections in this manual and supporting product documentation. If in doubt, contact manufacturer.
Supply pressure greater than the actuator MOP to compensate for valve problems / incorrect selection.	Use of appropriate pressure limiting devices in the supply pressure line to limit the pressure to actuator's MOP is highly recommended and shall be ensured by the end user. Refer to the Maximum Operating Pressure sections in this manual. Actuator MOP is printed on the name plate for ready reference.
Actuator subjected to temperatures out of permissible limits	Refer to name plate and to General Specifications section for the limits of service temperature of the supplied trim. Ensuring the environmental conditions do not cause over the limit temperatures, is end user's responsibility.
Used with operating media that does not conform to specification	Clean dry media of instrumentation grade for pneumatic and for the hydraulic actuator, only the recommended grade of fluids shall be used. Refer to Introduction section of this manual for specs.
Lifting actuator-valve-accessories assembly using lifting lugs on actuator that are meant only for the actuator	Read Warnings in the Installation section of this manual and on the stickers pasted on actuators. Use slings and tackles of sufficient capacity appropriately for lifting assemblies. Actuator weight is printed on the name plate for ready reference.
Pressurizing cap end port on spring return actuators to overcome valve jamming or to compensate valve sealing problems	Refer to Operation Guidelines section of this manual. Pressurizing cylinder to aid spring may cause over load on valve stem and actuator parts resulting in damages to valve/actuator. Do not substitute the vent provided on cap end port of cylinder with a pipe fitting.
Maintenance by unauthorized personnel	See Safety Information section. Do not permit anyone, other than qualified technicians who have read and fully understood the installation and maintenance instructions, to perform any maintenance/adjustments on the actuator.
Maintenance without de-energizing	Refer to Section 12.2 (Disassembly, Service & Reassembly of Actuators) of this manual. Under no circumstances shall attempt be made to disassemble the actuator or any fastener/plug be loosened, without isolating supply pressure and venting the cylinder ports to atmosphere.
Operating the actuator without end covers	Never operate the actuator in partially disassembled condition.
Altering the design to increase spring end load for compensating valve seating problems	Strictly prohibit change of any component design or adding spacers to increase the spring end load. The Spring Rod thread engagement will be compromised and this can have disastrous consequences resulting in equipment damage and/or severe personal injury.

21.3 Table 9 - Residual Risks

Residual Risks
This document does not cover every detail about every version of the product described. It cannot take into account every potential occurrence in installation, operation, maintenance and use.
End user shall devise and provide adequate protection against hazards such as: > External Fire > Impacts during installation/servicing > Hazardous emissions when Natural Gas is operating media > Contact with metal surfaces due to high/low ambient temperatures or conduction/ radiation > Static electricity.
Pressure and Temperature Monitoring/Controlling/Limiting Devices are in the scope of schematic and piping design

22.0 PERIODIC MAINTENANCE SCHEDULE

Maintenance Action	Inspection Frequency (Years)	Refer
Operation Guidelines	1*	Section 11
Inspect pneumatic lines for any leakage and secure all pipe fittings as needed	1*	-
Visual audit of external parts, paint surfaces	1*	-
Manual Override functional test	1*	Section 18.2 & 18.4
Seal Kit replacement	5*	Section 12.3 & 12.4

(*) Maintenance timing depends on the medium, service conditions, application, cycle frequencies. Check the End User's Preventive Maintenance Program for the applicable inspection and service intervals.

For SIL applications refer to Safety Manual.

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