ISO Registered Company

MODEL 521

TOTAL TFE, GLOBE-PATTERN CONTROL VALVE BODY IOM

SECTION I

I. DESCRIPTION AND SCOPE

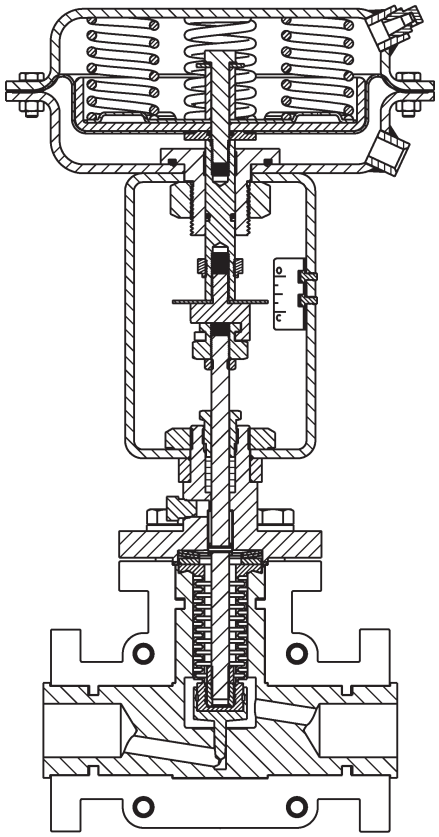
The Model 521 is a bellows sealed, globe-style control valve fabricated from a tee-block of isostatically compacted virgin TFE. Sizes are 1/2", 1", 1-1/2" and 2". The split body jacket is CF8 (304 SST) material. All wetted internal parts are of isostatically compacted TFE material. The standard stem material is of 316 SST; two optional Hastelloy C-276 stem material constructions are available.

End connections are available to mate with 150#, 300# or DIN PN16, 25 or 40 flanges. Each flange is drilled and tapped to receive stud bolting only.

The valve is designed for chemical service with fluids that are normally corrosive to metallic materials.

For application pressure vs. temperature zone refer to Model 521-TB, Graph No. 1 (pg. 3).

Actuators that may be mounted to a Model 521 body are Cashco Model C27 or Model C53, both field reversible.



Model 521
with ATO - FC Actuator

SECTION II

II. REFERENCES

Refer to Technical Bulletin 521-TB for complete technical specifications of a Model 521 coupled with either Cashco Actuator C27 or C53.
www.cashco.com/techbulletins/521.pdf

Refer to following Installation, Operation & Maintenance Manuals (IOM's) for either actuator and/or devices that maybe mounted to a Model 521:

Actuators: www.cashco.com/IOM/C27-C53.pdf
Positioners:
P/P: www.cashco.com/techbulletins/9540l.pdf
I/P: www.cashco.com/techbulletins/srd991.pdf
I/P: www.cashco.com/iom/PS2iom.pdf

ABBREVIATIONS

SST..... Cast or Wrought Stainless Steel
HC ..... Wrought Hastelloy C-276
ATO-FC ... Air-to-Open, Fail Close
ATC-FO ... Air-to-Close, Fail Open
CCW ..... Counter Clockwise
CW..... Clockwise
D or DIR... Direct Acting
R or REV.. Reverse Acting
IAS..... Instrument Air Supply
IOM..... Installation, Operation and Maintenance Manual
SIG ..... Output Signal from Instrument
LOAD..... Positioner Output Air Pressure
V ..... Vent

SECTION III

III. INSTALLATION

A. Orientation

1. Recommended orientation when installed is in a horizontal pipeline with the stem vertical. Valves may be installed in a vertical or horizontal pipeline with the stem between vertical and horizontal.

2. Outdoors, all installations may be oriented at any angle from horizontal-to-vertical, as per A.1. above.

3. Model 521 valves should not be installed with the stem oriented below horizontal/ downwards.

4. In no case is additional weight to be applied to the actuator assembly when installed in an orientation other than vertical.

WARNING

The valve/actuator unit should not be used as a "step" to support personnel. Failure to comply may cause leakage at the bonnet/body joint, allowing possible contact with harmful fluids.

B. Piping System

1. It is recommended that the control valve unit be installed with a double-block and bypass as indicated in Figure 1. This arrangement is recommended especially where maintenance will be done on the valve body while still installed in the pipeline.

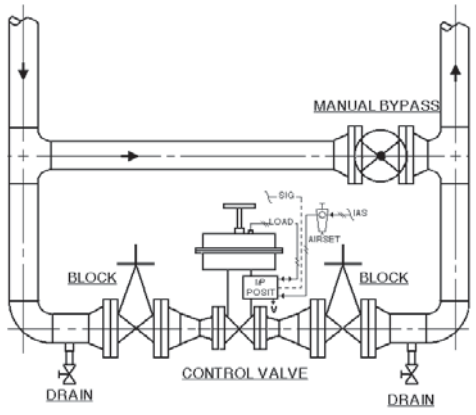


Figure 1: Typical Control Valve Station

2. If pipe reducers are located before and/or after the valve body, keep the reducers as close as practical to the valve body; this is especially important where the reducers are more than one line size larger than the valve body size, which is common in gaseous service.

3. Clean the piping of all foreign debris, including chips, weld scale, weld splatter, oil, grease, sand or dirt prior to installing the control valve; THIS IS AN ABSOLUTE REQUIREMENT.

4. Field hydrostatic testing the completed piping system, including the Model 521, to 1-1/2 x CWP indicated on Model 521 nameplate is acceptable. If hydro test pressure exceeds the 1-1/2 x CWP limit, the 521 must be removed for such testing. Before pressurization, the valve plug should be lifted from the seat if of reverse, ATO-FC action.

5. Flow Direction: Install so the flow direction matches the arrow cast on the valve body.

6. Valves are not to be direct buried underground.

7. Insulation may be applied as indicated in Figure 2. Drainage from the packing area must be ensured when fully installed, sealed and lagged for outdoors installation. Vented pipe plug (12) should not be covered.

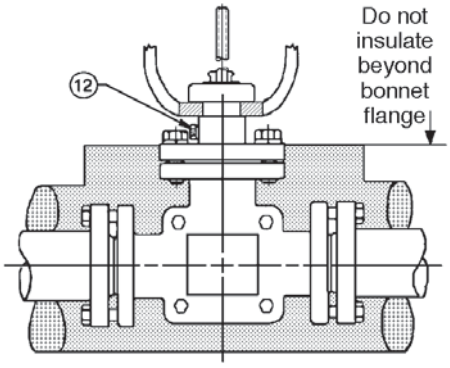


Figure 2: Body Insulation

8. Undue piping stress/strain or bending torques may not be transmitted through the control valve body. One pipe (inlet or outlet) should be anchored rigidly for piping that is "hot" or "cold" with respect to

ambient temperature; the remaining pipe (inlet or outlet) should be supported and guided to ensure unidirectional expansion/ contraction. Properly align prior to installing valve with required flange bolting.

9. The Model 521 is designed for a flanged connection that is gasketless. The raised face portion of end connection flange serves as the gasket.

10. An ANSI/DIN adapter gasket (17) is supplied with all Model 521 valves provided with DIN 16/25/40 end connections. See Figure 3. The purpose of this adapter gasket (17) is to ensure proper compression of the body's TFE core (1.2) when used with DIN piping.

    To assist during installation, place pipe thread sealant on one side of adapter gasket (17), and press the sealant covered side of the adapter gasket over the exposed TFE of the body core (1.2) end connection. The sealant will hold the adapter gasket (17) to its proper location prior to joining with a piping flange.

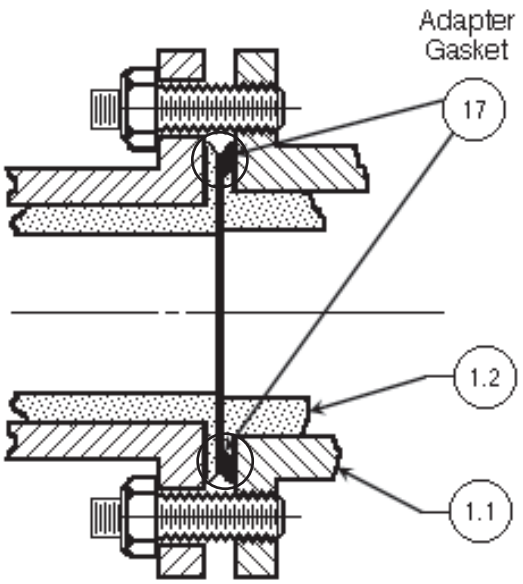


Figure 3: ANSI/DIN Adapter Gasket

11. Flange bolting must be of the stud-type. Each flange is drilled and tapped to accept studs. The studs should be of a length to penetrate the full depth of the bolt hole through the flange; DO NOT USE STUDS/BOLTS OF TOO SHORT LENGTH. See Table 1 for stud size/thread/length requirements.

TABLE 1

Body Size		End Connection Flange Bolting		
In.	(DN)	150#	300#	DIN 16/25/40
1/2"	DN15	1/2" Ø - 1-3/4" 13 UNC-2B	1/2" Ø - 1-3/4" 13 UNC-2B	14 mm Ø - 45 mm M12x1.75-6H
1"	DN25	1/2" Ø - 2" 13 UNC-2B	5/8 Ø - 2" 11 UNC-2B	14 mm Ø - 52 mm M12x1.75-6H
1-1/2"	DN40	1/2" Ø - 2-1/2" 13 UNC-2B	3/4" Ø - 2-3/4" 10 UNC-2B	18 mm Ø - 70 mm M16x2.0-6H
2"	DN50	5/8" Ø - 2-1/2" 11 UNC-2B	5/8" Ø - 2-3/4" 11 UNC-2B	18 mm Ø - 70 mm M16x2.0-6H
No. Bolt Holes		4	4 or 8 *	4
* 2" - 300 # requires 8 bolt holes; all others 4.				

12. Tighten flange stud nuts uniformly in a crossing pattern. Ensure flange facing alignment. Do not use flange bolting to "pull" flanges into alignment. Tighten flange bolting to torque levels of Table 2 in increments of 1/2 revolution to ensure uniform loading of valve's raised facing.

TABLE 2

Body Size		End Connection Flange Bolting		
In.	(DN)	ANSI-150	ANSI-300	DIN 16/25/40
1/2"	DN15	10 - 12 ft-#	10 - 12 ft-#	15 - 18 N-m
1"	DN25	10 - 12 ft-#	12 - 14 ft-#	21 - 25 N-m
1-1/2"	DN40	10 - 12 ft-#	14 - 17 ft-#	18 - 22 N-m
2"	DN50	35 - 40 ft-#	17 - 20 ft-#	50 - 60 N-m

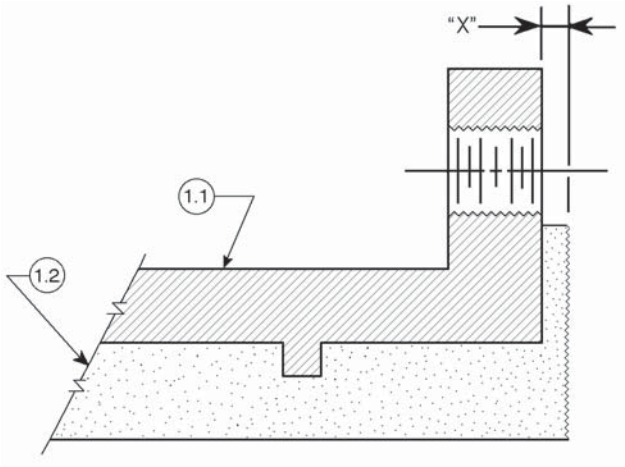


Figure 4: End Connection - Partial Section

NOTE: If the installed Model 521 has had the flange bolting over-torqued, distortion of TFE core (1.2) will occur. If dimension "X" in Figure 4 is 0.040" (1 mm) or less, a gasket is recommended upon reinstallation. If dimension "X" is less than 0.020" (0.5 mm), body replacement is recommended.

C. Auxiliary Detection:

1. When a fluid is known to permeate TFE over a finite time period and the fluid is lethal or is subject to stringent limits of fugitive emissions, the vented pipe plug (12) should be removed and one of, or a combination of, the following methods should be considered to monitor the integrity of the internal primary stem (9) seal – the bellows sub-assembly (8):

   a. gas detector with alarm
   b. pressure indicating gauge
   c. pressure switch with alarm
   d. inert gas, constant flow purge.

SECTION IV

IV. STARTUP

A. General:

1. Ensure that the Model 521 unit has been properly adjusted and calibrated, including the positioner, if installed.

2. Recommend startup to be in “manual” mode. This procedure assumes double block (isolation) and bypass valves for the “control valve station" per Figure 1.

3. Start with either of the two block valves closed, with the other open. The bypass valve should be closed. Pressurize system if possible/practical.

4. Back out the airset’s adjusting screw until loose.

5. Turn on air supply pressure.

6. Adjust the air supply airset (filter-regulator) to the proper level as indicated in the technical bulletin 521-TB. DO NOT STROKE THE CONTROL VALVE WITH AN AIR SUPPLY PRESSURE SETTING GREATER THAN RECOMMENDED MAXIMUM PRESSURE!

7. Place loop controller into “manual” mode. Vary setting from minimum – mid-range—maximum SIG output. Observe response of control valve unit to these changes of input SIG. The valve should fully stroke at the variation from minimum SIG to maximum SIG; the mid-range SIG should have the valve stem travel at/near 1/2 open.

8. Confirm that action of controller and positioner – direct or reverse – are producing the desired response in the control unit. Confirm that the control valve “fail” position is as required.

9. Hereafter, the procedure assumes that actual fluid flow may be established. This may not be practical/possible in all cases; if so, vary procedure as required.

   Always “heat” or “cool” down the system piping SLOWLY by opening the control valve station bypass valve in small increments.

10. With one of the control valve station block valves still closed, and the loop controller still in “manual” mode, open bypass valve and vary flow rate manually to observe the response of the controller and control valve unit together.

11. Attempt to develop manual control of the loop by opening/closing the manual bypass as required, or by manually controlling mainstream flow as required.

12. When the control valve is partially open, crack open, slowly, the closed block valve while simultaneously closing the bypass valve; it may be necessary/desirable to vary the manual output SIG from the controller simultaneously also. Continue this procedure until the bypass is closed and the block valves are both fully open. The system is still under “manual” mode control, but all flow is passing through the control valve.

CAUTION

DO NOT WALK AWAY AND LEAVE A MANUALLY CONTROLLED CONTROL VALVE UNATTENDED!

13. Vary controller “manual” SIG output until matching the “automatic” SIG output, then change the mode of the controller over to “automatic”, and the loop will experience a minimum of upset conditions, and will be in automatic control.

V. MAINTENANCE

WARNING

Model 521 control valves frequently are installed in hazardous/lethal fluid services. Before removal from pipeline or any level of disassembly, consult the Owner's safety procedures for proper flushing, cleaning and handling of a valve exposed to potentially hazardous fluids during de-pressurization and removal. Owner's safety procedures preempt any statements or recommendations contained in this IOM.

A. General:

1. Once fluid pressure has been isolated by block valves, and piping flange bolting has been only loosened, carefully remove vented pipe plug (12) from the bonnet (2), applying the detection procedures of C. 1. above, as a small quantity of fluid may be "trapped" in the void space of the bellows (8) interior due to permeation. The plug (12) has a "groove" notched in its threads to assure venting prior to the threads fully disengaging. Once fully vented and/or purged as required by safety procedures, reinstall the plug (12) using a fluid compatible lubricant . DO NOT USE THREAD SEALANT FOR VENTED PIPE PLUG (12) ON REINSTALLATION.

2. **Maintenance procedures hereinafter are based upon removal of the valve/actuator unit from the pipeline where installed.**

3. Owner should refer to Owner's procedures for removal, handling and cleaning of nonreusable parts and suitable solvents, etc.

4. Valves supplied from the factory do not use any sealing aids for the gasket such as oil, sealant, or pipe dope in the wetted portions of the valve body assembly. Sealing aids should not be required and are not recommended.

5. All indicated Item Numbers that are with respect to actuator assembly (AA) will be in parenthesis and underscored; i.e. (20). All Item Numbers that are with respect to the body assembly (BA) are not underscored; i.e. (32). Reference with respect to the positioner is in double parentheses; i.e. ((AP)).

6. The stem sub-assembly (9) is designed for non-rotation when installed. DO NOT ATTEMPT TO ROTATE WITH THE STEM SUB-ASSEMBLY INSTALLED; FAILURE TO HEED MAY CAUSE DAMAGE TO THE STEM SUB-ASSEMBLY (9), THE BELLOWS SUB-ASSEMBLY (8), THE PLUG (3) AND/OR THE BODY ASSEMBLY (1). Exhibit special care when handling the stem (9) surface where it contacts the packing (6).

B. Pressure Boundary Leakage Shop Test:

1. Secure the body assembly (BA) in a vise with the valve stem (9) oriented vertically.

2. Remove vented pipe plug (12).

3. Install a pipe nipple, test pressure gauge and isolation valve into the 1/8"-NPT (female) opening. (See Figure 5.)

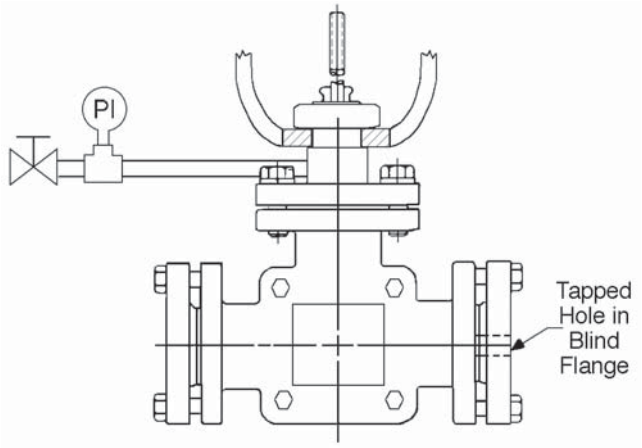


Figure 5: Pressure Boundry Testing Configuration

4. Place a suitable adhesive tape ("duct tape") around the perimeter of the bonnet/body flange. Place tape on the "joint lines" of the shell halves (1.1) (see Figure 10). Place blind flanges over the flanged end connections and bolt down; one of the blind flanges must have a hole through the face; place tape over the opening of the blind flange.

5. Using a source of acceptable fluid such as nitrogen gas, pressurize the bellows "void zone" to 30 psig (2.1 Barg). Tightly close off the isolation valve of 3. above. Disconnect the pressure source.

6. Poke small holes in the tape at the bonnet/body flange and at the opening in the blind flange.

7. For units with Reverse Action (ATO-FC) actuators pressurize to a level sufficient to initiate travel to approximately mid-stroke to hold the plug (3) away from the body (1) seat.

8. Apply leak detection fluid to all the potential leak paths:
   a. Packing gland nut (5). (Tighten as necessary.)
   b. Body (1)-to-bonnet (2) flange tape hole.
   c. Body (1) and bonnet (2) bolting (13, 14, 1.3, 1.4, 1.5).
   d. End connection blind flange tape hole.
   e. Test pressure piping connections.

9. If leakage occurs at:
   a. a. above, there is a packing (6) or a packing (6) /stem sub-assembly (9) failure.
   b. b. above, there is a bonnet gasket (11) failure.
   c. c. above, there is a bonnet gasket (11), or TFE core (1.2) failure.
   d. d. above, there is a bellows sub-assembly (8) failure.

10. Following this test procedure may help to solve maintenance problems when combined with visual examination of disassembled body assembly (BA).

C. Separation of Body/Actuator:

1. Reference the Actuator IOM-C27-C53 for item number call outs and drawings for actuator.

2. Secure the body in a vise with the actuator assembly (AA) oriented vertically. Place matchmarks between the body (1) bonnet flange, the bonnet (2) flange, and the yoke (3) to assist in final orientation when the body is disassembled and/or the actuator removed. If actuator has handwheel - see Actuator IOM for removal instructions.

3. Secure and rig the actuator assembly (AA) for a vertical lift using an overhead hoist. Remove slack from rigging.

4. This procedure assumes that the body assembly (BA) has been fully assembled through the bonnet (2), including the packing gland nut (5) and packing (6).

5. Remove vented pipe plug (12) from body.

6. Loosen stem nut (20) by rotating nut CW (viewed from above) to base of threads.

7. Loosen packing (6) by turning packing gland nut (5) CCW 2-3 revolutions.

8. Rotate yoke nut (15) CCW to fully loosen nut.

9A. **For ATO-FC Reverse Action Actuators**:

   a. **Connect a temporary air source to the actuator and pressurize the actuator to upper limit of the bench range specified on the valve name plate.** (Pressure will lift the plug head (3) away from the body's (1) integral seat until the plug (3) is 100% open.)
   b. Place a wrench on the hex surface of the swivel lower knuckle (44) and rotate knuckle CCW (viewed from above actuator) until lower knuckle dis-engages from stem (9). Keep track of the number of full revolutions to dis-engage and record here. _____
   c. Maintain lift support from above the actuator assembly (AA). Dis-engage (slide) the swivel lower knuckle (44) out of the upper knuckle (43) slot.

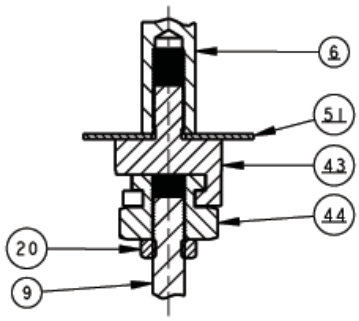


Figure 6: Swivel-Type Connector

9B. **For ATC-FO Direct Action Actuators**:

   a. Place a wrench on the hex surface of the swivel lower knuckle (44) and rotate knuckle CCW (viewed from above actuator) until lower knuckle dis-engages from stem (9). Keep track of the number of full revolutions to dis-engage and record here. _____
   b. Maintain lift support from above the actuator assembly (AA). Dis-engage (slide) the swivel lower knuckle (44) out of the upper knuckle (43) slot.

10. Raise the actuator assembly (AA) over stem (9). Release any actuator air pressure. Lay actuator assemby aside on work surface.

D. Body Disassembly:

1. Access to body assembly (BA) internals may be accomplished with the actuator assembly (AA) intact with the bonnet (2) (i.e. locknut (15) is still fully tightened), or with the body assembly (BA) separated as per above paragraph V.C. Steps 1-10.

2. Maintenance procedures hereinafter are based upon the actuator assembly (AA) fully interconnected with the valve stem assembly (9) during disassembly.

3. Secure the body in a vise with the actuator assembly (AA) oriented vertically upwards. Place matchmarks between the body (1) bonnet flange and the bonnet (2) flange to assist in final orientation when the body is disassembled and/or the actuator removed.

4. Secure and rig the actuator assembly (AA) for a vertical lift using an overhead hoist. Remove slack from rigging.

5. Loosen all bonnet cap screws (14) approximately 1/4" (6 mm) by rotating CCW (viewed from above).

6. Raise actuator assembly (AA) with overhead hoist approximately 1/8" (3 mm).

7. Continue to loosen and remove bonnet cap screws (14 and lockwashers (13).

8. Using overhead hoist, lift the actuator assembly (AA) with the interconnected valve stem sub-assembly (9), bellows sub-assembly (8), bonnet (2), bonnet spacer (19), locknut (15), packing gland nut (5), packing rings (6), Belleville spring washers (7), bonnet gasket (11), plug (3) and plug retainer (4). Lay this assembly down on a horizontal work surface carefully, so as to not damage the valve's internals.

9. Make a visual inspection of the body sub-assembly (1) exterior, which includes two shell halves (1.1), TFE core (1.2), and four body cap screws (1.3) with body nuts (1.4) and lockwashers (1.5).
NOTE: ***DO NOT DISASSEMBLE THE PARTS OF THE BODY SUB-ASSEMBLY (1)!***
The valve body (1) is machined after the shell halves (1.1) have been bolted (1.3, 1.4, 1.5) around the TFE core (1.2). Disassembly of the body sub-assembly (1) will create alignment problems during reassembly. The TFE core (1.2) is not replaceable, except as a body sub-assembly (1).

10. Make a visual inspection of the trim portions still interconnected to the actuator assembly (AA) for obvious problems.

11. Hand-grasp the bellows sub-assembly (8) and rotate CCW (viewed from plug (3) end) to removal. **Do not use any wrench, vise, etc., for grasping the bellows sub-assembly (8)!** The bellows (8) should only be hand-tight.

12. Loosen packing gland nut (5) 2-3 revolutions out of the bonnet (2) by rotating CCW (viewed from stem (9) end).

13. Loosen jam nut (20) 1-2 revolutions.

14. Grasp the valve's stem sub-assembly (9) in the lower area (normally surrounded by the bellows (8.1)) using soft jawed pliers to prevent marring stem surface. Place a wrench on the hex surface of the swivel lower knuckle (44) and rotate knuckle CW (viewed from plug (3) end) until lower knuckle dis-engages from stem (9). Keep track of the number of full revolutions to dis-engage and record here. _____

15. Retract the stem sub-assembly (9) downwards through the bonnet (2) until stopped by locknut (20). Rotate locknut (20), CCW until it is removed.

16. Fully withdraw stem sub-assembly (9).

17. Visually inspect parts for wear, general corrosion, localized corrosion, dirty service fluid, uneven alignment, seat leakage wire drawing, excess plug-to-seat loading, flange facings, looseness of plug-to-bellows connection, primary seal at TFE Core (1.2) -to-bellows (8.1) joint, secondary seat at bonnet gasket (11) (See Figure 9), blisters on TFE surfaces, etc.

18. Attempt to determine the reason for a failure. Evaluate if process conditions need correction, if alternate materials are required for the stem sub-assembly (9), or if effects

of possible permeation need considerations similar to those outlined in Section III.C.1.

E. Plug, Bellows, or Both Replacement:

1. Disassemble the body assembly (BA) per V.D.1.-11. previous.

2. Hand-grasp the bellows sub-assembly (8) and hand-rotate the plug head (3) until the plug retainer strip (4) ends come into view through the slot located on the side of the plug head (3).

3. Using a pointed end pick tool, get under one end of the plug retainer strip (4) and extract through the plug's (3) slot. Manually rotate the plug head (3) end to allow more of the plug retainer strip (4) to be extracted. When able to grasp with needle nose pliers, lightly pull the plug retainer strip (4) and rotate the plug head (3) as necessary until the strip (4) is fully removed.

4. Slide plug head (3) off the stub-end of the bellows sub-assembly (8).

5. Discard the plug head (3), if worn. Always discard the plug retainer strip (4); only use a new plug retainer strip (4) at reassembly.

6. Do not attempt to field remove embedded nut (8.2) from inside the bellows (8.1); these parts are only available as a sub-assembly (8). If embedded nut (8.2) is badly corroded, replace the entire bellows sub-assembly (8) and give strong consideration to alternate materials for stem sub-assembly (9) and bellows nut (8.2). If embedded nut (8.2) is "loose", consider potential causes and replace bellows sub-assembly (8).

7. If bellows sub-assembly (8) is to be reused, thoroughly clean the valleys of the bellows (8.1) convolutions (inside and outside) for the smallest of debris. Clean the grooves of the bellows (8.1) and the plug head (3) where the plug retainer strip (4) locates.

8. Place the plug head (3) over the bellows sub-assembly (8) end. Insert a new TFE plug retainer strip (4) into the slot/groove. Rotate the plug head (3) as necessary while feeding the strip (4) until the strip (4) is fully located into the groove. (No cutting of the strip (4) should be required.)

F. Packing Ring Replacement:

1. Disassemble the body assembly (BA) per V.C. previous, including separation of body assembly (BA) from actuator assembly (AA).

2. Loosen packing gland nut (5) until fully dis-engaged from bonnet (2) by rotating CCW (viewed from stem (9) end). Remove packing rings (6) from packing box (recess) in bonnet (2).

3. Examine wall surface inside the bonnet (2) for any sign of corrosion.

4. Hone the bonnet's (2) packing box to a #16 RMS finish. Burnish the stem sub-assembly (9) to a #4 RMS finish in the packing (6) contact area.

G. Reassembly of Body Assembly:

1. Place body assembly (BA) (1) in a vise with the bonnet (2) end directed upwards.

2. Join the stem sub-assembly (9) to the bellows sub-assembly (8) (with new plug head (3) already installed) by rotating the stem's (9) lower end into embedded nut (8.2) CW (viewed from bellows (8.1) open end). Rotate the stem sub-assembly (9) as far as possible while hand-grasping the bellows (8.1) **DO NOT USE A WRENCH IN THIS OPERATION.** A light coat of Fluorolube (™ of Occidental Chemical Co.) lubricant may be applied to the engaged (threaded) end of the stem sub-assembly (9) if fluid compatible.

3. Place spacer washer (10) over the threaded upper end of stem sub-assembly (9).

4. Referring to Figure 7 for proper orientation and quantity of Belleville spring washers (7), place the spring washers (7) over the upper end of stem sub-assembly (9).

5. Position a new bonnet gasket (11) into recess of body sub-assembly (1).

6. Observe the underneath side of bonnet (2) where square recess is located. Position combined bellows sub-assembly (8) and stem sub-assembly (9) so that the anti-rotation "stop" (square part of stem) is aligned to slip into the bonnet's (2) square recess.

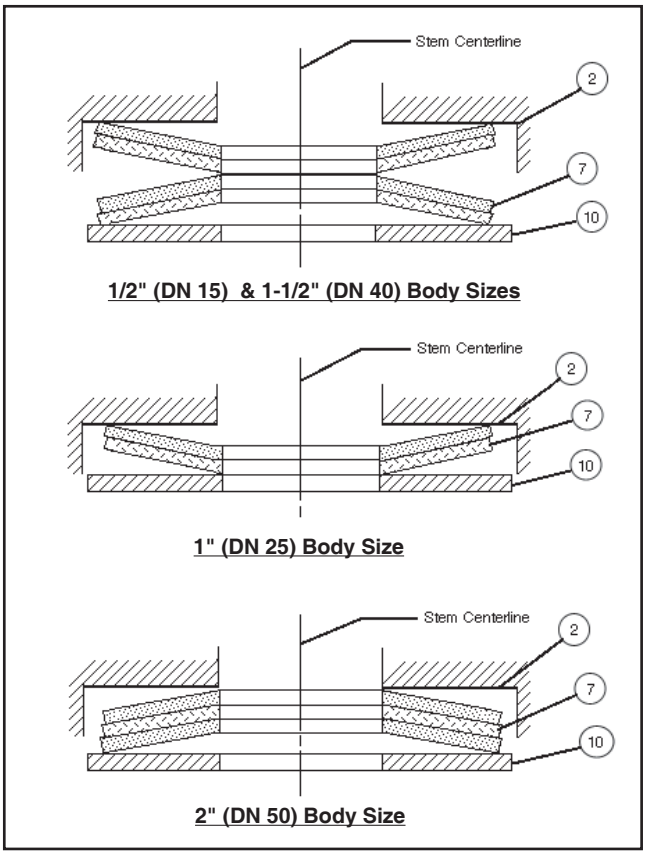


Figure 7: Belleville Spring Washer Orientation

7. Center the loose parts (10) (7) surrounding the stem (9) as close as possible.

8. Position the bonnet (2) over the exposed upper stem sub-assembly (9), ensuring that the anti-rotation "stop" (square or flat surface of the stem) is properly engaged into the bonnet (2) square recess.

9. Place a temporary spacer device (screwdriver blade, nuts, plain washers, etc.) equally spaced on the body (1) flange to hold the bonnet (2) up, as bonnet is lowered into the body, maximizing the gap between the bonnet flanges (1) (2).

10. Place anti-seize thread lubricant on bonnet cap screws (14). Engage all bonnet cap screws (14) with lockwashers (13) approximately 1-1/2 revolutions.

11. Visually observing the gap between the bonnet (2) lower flange surface and the body sub-assembly (1) bonnet flange, apply downward force tending to seat the plug end (3). This will pull the bellows (8.1) into proper position for the primary bonnet seal.

12. When visually satisfied of concentricity and alignment of parts (10) (8) (11) (7), remove temporary spacer while continuing downward force on the stem (9) while simultaneously holding the bonnet (2) from dropping downwards.

13. Lower bonnet (2) carefully downwards into the recess of the body sub-assembly (1) while continually applying downward force on the stem (9).

14. At this point, downward force on stem (9) may be exchanged for downward force on the bonnet (2). Hand-tighten all bonnet cap screws (14); relax downward force on bonnet once cap screws have taken up all slack.

15. Using a torque wrench, tighten bonnet cap screws (14) in alternating cross-pattern in 1/4 revolution increments to 40 ft-# (55 N-M).

CAUTION

Improper bonnet bolting torques may lead to premature failure of the primary and secondary bonnet seals.

16. Engage threaded, vented pipe plug (12) into the 1/8" NPT tap on the bonnet (2) if it was removed. If a lubricating oil is compatible with the fluid, a light coating will aid in preventing galling of the plug (12). Ensure that the tip of the notch on the threads is in the bonnet (2) at least 1-1⁄2 revolutions. **Do not** over-tighten to minimize chances of galling.
Do not use thread sealing compound that might "fill in" the notch and negate the purpose of the notch.

17. The packing ring set (6) design is identical for all unit body sizes. It consists of seven V-rings (6.1) and one each male (6.2) and female (6.3) adapter. (See Figure 8.) The purpose of the packing rings (6) is to minimize moisture ingress, and to serve as a secondary stem seal in the event of bellows sub-assembly (8) failure.
Carefully install rings (6) as indicated in Figure 8, one at a time, using a hollow tool to press the rings (6) to their final position. Take care in slipping the rings (6) over the threaded end of the stem (9) so as to not mar the ring's (6) internal surfaces. **Do not** reverse orientation for vacuum service. **Do not** "split" rings (6) for ease in replacement. **Do not** reuse removed packing rings (6).

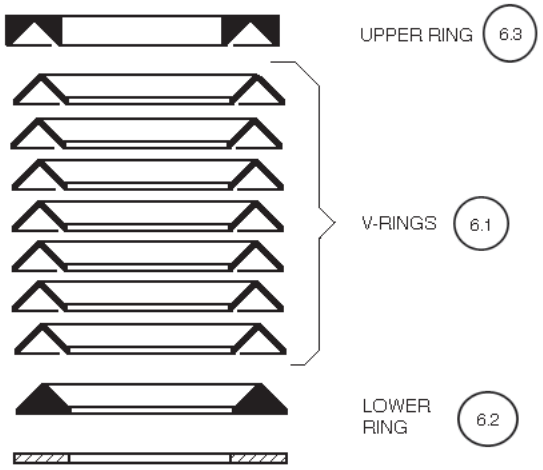


Figure 8: **Packing Ring Set**

18. Place anti-seize thread lubricant on threads of packing gland nut (5). Place gland nut (5) over the stem (9) end and engage with the bonnet (2) by rotating CW (viewed from exposed stem (9) end); continue finger-tightening to the point of resistance. Wrench tighten gland nut (5) 1/8 revolution past the manual tightening resistance point.

19. Place bonnet spacer (19) down over threaded portion of the bonnet (2).

20. Valve body assembly (BA) is completed, and may be pressure tested up to 275 psig x 1.5 = 413 psig (19.0 Barg x 1.5 = 28.5 Barg) at ambient temperature. Before pressurizing for hydro, ensure that plug (3) is away from body (1) seat. ***NOTE:*** *Use soft gaskets on body assembly (BA) end flanges to prevent distortion of TFE flange facings.*

H. Mounting Actuator Assembly to Body Assembly:

1. Reference Actuator IOM-C27-C53 for item number call outs and drawings for actuator. This procedure assumes that accessory plate ((AP)) or indicating washer (51) was not removed or has been secured to the actuator stem(6) by the swivel upper knuckle (43) - tighten with 20-30 ft.lbs. (27-40 N M). **DO NOT** allow actuator stem (6) to rotate. Secure flats on bottom of stem (6) when rotating knuckle (43).

2. Secure the body assembly (BA) in a vise with the valve stem (9) oriented vertically.

3. Rig actuator assembly (AA) to be supported from above.

4. This procedure assumes that bonnet (2) has been bolted to the body sub-assembly (1).

5. Engage stem jam nut (20) to body assembly's stem (9) by rotating CW (viewed from valve stem (9) end). Rotate jam nut (20) all the way to root of the stem (9) threads.

6. Lower actuator assembly (AA) until the opening of the actuator yoke (1) is at the level of jam nut (20).

7. Place yoke nut (15) over valve stem (9) and lower the nut to rest upon the yoke (3).

8. Push valve stem (9) downward towards seating position. ***NOTE:*** *The valve bellows (8) may give "spring action" to keep the plug (3) partially away from the seat.*

9. **For Direct Action ATO-FC Only**: Connect a temporary air supply hose that has an adjustable airset with gauge connected at the lower actuator inlet. Pressurize actuator to a sufficient level to the upper pressure level of the bench setting; i.e. for 5–15 psig (.34–1.03 Barg) range, set pressure at 15 psig (1.03 Barg).

10. Apply Loctite Nickel Anti-Seize to grove and top surface of swivel lower knuckle. Engage (slide) the lower knuckle (44) into the upper knuckle (43) saddle.

11. Continue lowering the actuator assembly (AA) until the swivel lower knuckle (44) connector and the valve's stem (9) just touch. ***NOTE:*** *For ATO-FC may need to slowly reduce air pressure in the actuator to connect the stem and knuckle.*

12. Thread yoke nut (15) onto bonnet (2) threads by hand as far as possible to help stabilize topworks. Wrench-tighten one-half (1/2) extra revolution.

13. Engage valve stem (9) threads to swivel lower knuckle (44). Rotate swivel knuckle (44) CW (viewed from actuator end) to engage with valve stem (9), refer to V.C. Steps 9A or 9B for the number of revolutions recorded to dis-engage the lower knuckle.

14. Remove overhead rigging to allow actuator assembly (AA) to fully rest on the bonnet (2). Refer back to V.C. Step 2 for alignment of match marks. Hand-tighten yoke nut (15).

15. **For Direct Action ATC-FO Only:** Release all air pressure from actuator assembly (AA), see step 9 previous and remove temporary air supply.

16. Re-tighten packing gland nut (5).

17. Tighten yoke nut (15) to 85 ft--# (115 N-M)

18. Calibrate actuator to valve per Section VI.

SECTION VI

VI. CALIBRATION

A. General:

1. This section only covers calibration of this control valve with Actuator Models C27-C53.

2. Positioner, if installed, requires reference to the specific positioner model IOM for proper calibration procedure.

3. All indicated Item Numbers that are with respect to IOM-C27-C53 will be in parenthesis and underscored; i.e. (20). All Item Numbers that are with respect to this IOM-521 are not underscored; i.e. (32).

B. Procedure – Reverse Action, ATO-FC:

1. Reference the nameplate (40) attached to the actuator yoke (3). Determine the bench setting of the installed range springs (10) from the nameplate (40).

2. Connect a temporary air supply with an in-line adjustable airset regulator and gauge to the lower actuator connection. **DO NOT LOAD** with any air pressure at this point.

3. To determine when stem/plug (9) begins to lift out of the seat, touch the stem below the jam nut with one finger. (Stem will begin to move when actuator pressure exceeds the spring load.)

4. Slowly pressurize the actuator to a pressure equal to the lower pressure level of the bench setting; i.e. for 5-15 psig (.34–1.03 Barg) range, set pressure at 5 psig (.34 Barg). Take note of pressure reading when the stem first begins to move.

5. If the loading pressure for the start of stem movement **is below the lower end** of the desired bench setting, then the combined stem (9, 6) length is too short.
   a. Rotate jam nut (20) down to base of threads on stem (9).
   b. Increase pressure in the actuator to approximately mid range of the bench setting.
   c. Rotate lower knuckle (44) CCW to increase the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Release all pressure from the actuator and repeat Step 4 previous.

6. If the loading pressure for the start of stem movement **is above the lower end** of the desired bench setting, then the combined stem (9, 6) length is too long.
   a. Rotate jam nut (20) down to base of threads on stem (9).
   b. Increase pressure in the actuator to approximately mid range of the bench setting.
   c. Rotate lower knuckle (44) CW to shorten the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Release all pressure from the actuator and repeat Step 4 previous.

7. Observe the location of the indicating washer (51) to the "C" mark on the indicator plate (23), making sure to use the “top edge” of the indicating washer (51) as the reference point. Adjust indicator plate as needed.

8. Remove vented pipe plug (12) from the neck of the bonnet (2).

9. Slowly increase the pressure in the actuator until the indicating washer (51) is in alignment with the "O" mark on the indicator plate. As pressure increases, through the hole where the vented pipe plug (12) was removed, watch for the anti-rotational "stop" (square or flat surface of the stem) to appear.

NOTE: *This "stop" should not function as an up travel stop and push up against the bonnet (2) (metal to metal). A gap of approximately 1/16" (1-1/2 mm) should exist between these two surfaces.*
NOTE: *The purpose of a correct calibration of the stem stroke is to cause the up travel to be limited by the actuator travel stop nut.*

10. To limit the up travel, rotate the travel stop nut (52) CW and secure to bottom of attachment hub (4).
    NOTE: *Secure the actuator stem (6) by the flats when rotating the travel stop nut.*
    NOTE: *"Stroke" length is indicated on the nameplate (40), and is the distance between the "C" and "O" marks of the indicator plate (23).*
    NOTE: *The proper calibration of the actuator / valve unit will occur when at the lower pressure level of bench setting the valve plug (3) will just begin to travel from the "C" position. At the upper level of the bench setting, the actuator pressure should be within ±8% of the upper bench range for the desired stroke length.*

11. Engage threaded, vented pipe plug (12) into the 1/8" NPT tap on the bonnet (2). If a lubricating oil is compatible with the fluid, a light coating will aid in preventing galling of the plug (12). Ensure that the tip of the notch on the threads is in the bonnet (2) at least 1-1⁄2 revolutions.
    Do not over-tighten to minimize chances of galling.
    Do not use thread sealing compound that might “fill in” the notch and negate the purpose of the notch.

12. Release all pressure from actuator.

C. Procedure – Direct Action, ATC-FO:

1. Reference the nameplate (40) attached to the actuator yoke (3). Determine the bench setting of the installed range springs (10) from the nameplate (40).

2. Connect a temporary air supply with an in-line adjustable airset regulator and gauge to the upper actuator connection. **DO NOT LOAD** with any air pressure at this point.

3. To determine when stem/plug (3) makes contact with the seat and travel stops, touch the stem below the jam nut with one finger. (Stem movement will stop when the plug engages the seat.)

4. Slowly pressurize the actuator to a pressure equal to the upper pressure level of the bench setting; i.e. for a 5-15 psig (.34 -1.0 Barg) range, set pressure at 15 psig (1.0 Barg). Take note of the pressure reading when stem travel actually stops.

5. If the loading pressure, when stem movement stops, **is below the upper end** of the desired bench setting, then the combined stem (9, 6) length is too long.
   a. Rotate jam nut (20) down to base of threads on stem (9).
   b. Decrease pressure in the actuator to approximately mid range of the bench setting.
   c. Rotate lower knuckle (44) CCW to shorten the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Release all pressure from the actuator and repeat Step 4 previous.

6. If the loading pressure, when stem movement stops, **is above the upper end** of the desired bench setting, then the combined stem (9, 6) length is too short.
   a. Rotate jam nut (20) down to base of threads on stem (9).
   b. Decrease pressure in the actuator to approximately mid range of the bench setting.
   c. Rotate lower knuckle (44) CW to increase the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Release all pressure from the actuator and repeat Step 4 previous.

7. Increase pressure in the actuator to the upper pressure level of the bench setting.

8. Observe the location of the indicating washer (51) to the "C" mark on the indicator plate (23), making sure to use the “top edge” of the indicating washer (51) as the reference point. Adjust indicator plate as needed.

8. Remove vented pipe plug (12) from the neck of the bonnet (2).

9. Slowly release air pressure in actuator until indicating washer (51) is in alignment with the “O” mark on the indicator plate (23).

As pressure decreases, through the hole in the bonnet where the vented plug (12) was removed, watch for the anti-rotational "stop" (square or flat surface of the stem) to appear.

NOTE: *This "stop" should not function as an up travel stop and push up against the bonnet (2) (metal to metal). A gap of approximately 1/16" (1-1/2 mm) should exist between these two surfaces.*

NOTE: *The purpose of a correct calibration of the stem stroke is to cause the up travel to be limited by the actuator travel stop nut.*

10. To limit the up travel, rotate the travel stop nut (52) CW and secure to bottom of attachment hub (4).

    NOTE: *Secure the actuator stem (6) by the flats when rotating the travel stop nut.*

    NOTE: *"Stroke" length is indicated on the nameplate (40), and is the distance between the "C" and "O" marks of the indicator plate (23).*

    NOTE: *The proper calibration of the actuator / valve unit will occur when at the upper pressure level of bench setting, the valve plug (3) will be in the "C" position. At the lower level of the bench setting, the actuator pressure should be within ±8% of the lower bench range for the designed stroke length.*

11. Reinstall vented pipe plug (12) using “Fluorolube” grease on threads.

12. Release all pressure from actuator.

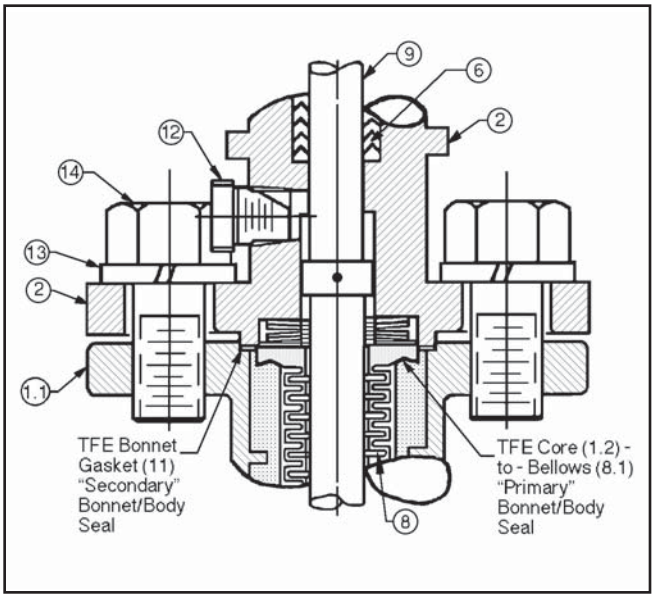


Figure 9: Primary & Secondary Body/Bonnet

SECTION VII

VII. TROUBLE-SHOOTING GUIDE:

1. Valve is "jumpy" in stroking.	
Possible Causes	**Remedies**
A. Excess packing friction.	A1. Re-align body--stem--actuator. A2. Packing follower too tight; back packing gland nut out. A3. Install positioner. A4. Increase bench set by changing to stiffer actuator range spring. May require positioner if not installed. May require different airset.
B. Installed backwards.	B. Install per flow arrow. Direction is only FTO.

2. Valve/actuator makes "screeching" noise.	
Possible Causes	**Remedies**
A. Excess pressure drop.	A. Bring pressure drop within design limits.

3. Valve exhibits "excess" vibration.	
Possible Causes	**Remedies**
A. Excess pressure drop.	A. Bring pressure drop within design limits.
B. Excessive cavitation in liquid service.	B. Change operation parameters to relieve causes of cavitation.
C. High outlet velocity.	C1. Reduce flow rate and/or pressure drop. C2. Use multiple valves in series or parallel. C3. Increase outlet pipe size. C4. Use larger valve body with reduced trim.

4. Valve exhibits "excess" seat leakage.	
Possible Causes	**Remedies**
A. Excess pressure drop.	A1. Reduce pressure drop conditions. A2. Convert to reduced trim. A3. Increase actuator thrust by changing actuator range spring.
B. Excess body and/or plug wear.	B1. Oversized valve operating too close to seat; go to reduced trim. B2. Remove abrasive particulate. B3. Possible excess cavitation in liquid service. Change operation parameters. B4. Replace body assembly if seat is badly worn. Replace plug if badly worn.

5. Bonnet gasket leakage.	
Possible Causes	**Remedies**
A. Improper bonnet bolting drawdown.	A1. Remove bonnet taking necessary safety precautions. Inspect bellows to determine if primary seal at body/bellows is damaged. If bellows is damaged, replace bellows. A2. Inspect secondary seal bonnet gasket for uneven thickness. Replace bonnet gasket. A3. Draw down bonnet bolting evenly and in a cross pattern; use bonnet bolting torque levels indicated herein.
B. Cantilevered actuator.	B1. Do not allow use of the actuator as a "step" upon which personnel may climb. B2. Do not "set" any added weight on the actuator. B3. Install vertically.

6. Body flange leakage.	
Possible Causes	**Remedies**
A. Over-tightening flange bolting.	A. Loosen bolting, replace/install new gasket, retighten flange bolting in s cross-pattern evenly.
B. Improper pipe supports and anchors.	B. Provide piping anchors and guides at control valve station. Restrain bending movements.
C. Corroded flange bolting.	C. Replace with corrosion resistant flange bolting.
D. Used outside pressure/temperature limits.	D. Bring process variables within range of application; see Graph 1 in 521-TB.

7. Bellows failure.	
Possible Causes	**Remedies**
A. Overstroke of actuator.	A. Recalibrate valve/actuator unit.
B. Abrasive particulate in fluid.	B. Remove all fluid particulate.
C. Pressure, temperature, or pressure drop outside limits.	C. Bring process variables within range of application; see Graph 1 in 521-TB..
D. Fluid absorption.	D1. Reduce pressure/temperature if possible. D2. Reduce number of startups/shutdowns, or rapid depressurizations.
E. Frequent stroking causing fatigue failure of TFE material.	E1. Stabilize input SIG. E2. Stabilize positioner output LOAD. E3. Stabilize process variations to steady state, steady flow. E4. Excess "play" in actuator swivel adapter; replace adapter. E5. Cycle life reached; replace bellows.
F. Corrosion of embedded nut.	F1. Consult factory. F2. Use alternate stem material.

8. Corrosion of stem sub-assembly at packing area.	
Possible Causes	**Remedies**
A. Loose packing.	A. Disassemble valve and replace stem. Reassemble and tighten packing.
B. Fluid permeation of bellows.	B1. Bring process variables within range of application; see Graph 1 in 521-TB. B2. Use alternate stem materials construction. B3. Locate, or position valve to be out of ambient moisture. B4. Modify insulation if "trapping" moisture around packing gland nut. B5. Purge "void zone".
C. Bellows failure.	C. See No. 7 of this section.

9. Corrosion of silver soldered joint in sub-assembly (1-1/2" or 2" sizes only).	
Possible Causes	**Remedies**
A. Fluid permeation with chemical attack of silver solder.	A1. Use alternate stem materials construction. A2. Purge "void zone".

10. Corrosion surrounding vented pipe plug on bonnet.	
Possible Causes	**Remedies**
A. Fluid permeation and loose vented pipe plug.	A1. Tighten plug. A2. Replace corroded plug. A3. Purge "void zone".
B. Bellows Failure.	B. Replace bellows.

11. External corrosion of jacket halves, bonnet, and body and bonnet bolting.	
Possible Causes	**Remedies**
A. Corrosive ambient environment.	A1. Determine location of corrosive fluid and maintain cause of leakage. A2. Coat exposed portions with suitable corrosive resistant epoxy to degree able,

12. Blisters on TFE internals.	
Possible Causes	**Remedies**
A. Effects of absorption.	A1. Reduce pressure/temperature levels. A2. Reduce startups/shutdowns and rapid depressurizations. A3. Replace body assembly.

13. General corrosion of internals in "void zone", including Belleville washers ,embedded nut, bonnet, anti-rotation stop, and stem.	
Possible Causes	**Remedies**
A. Permeation together with ingress of moisture in "void zone".	A1. Remove moisture source to greatest degree possible. A2. Purge "void zone".

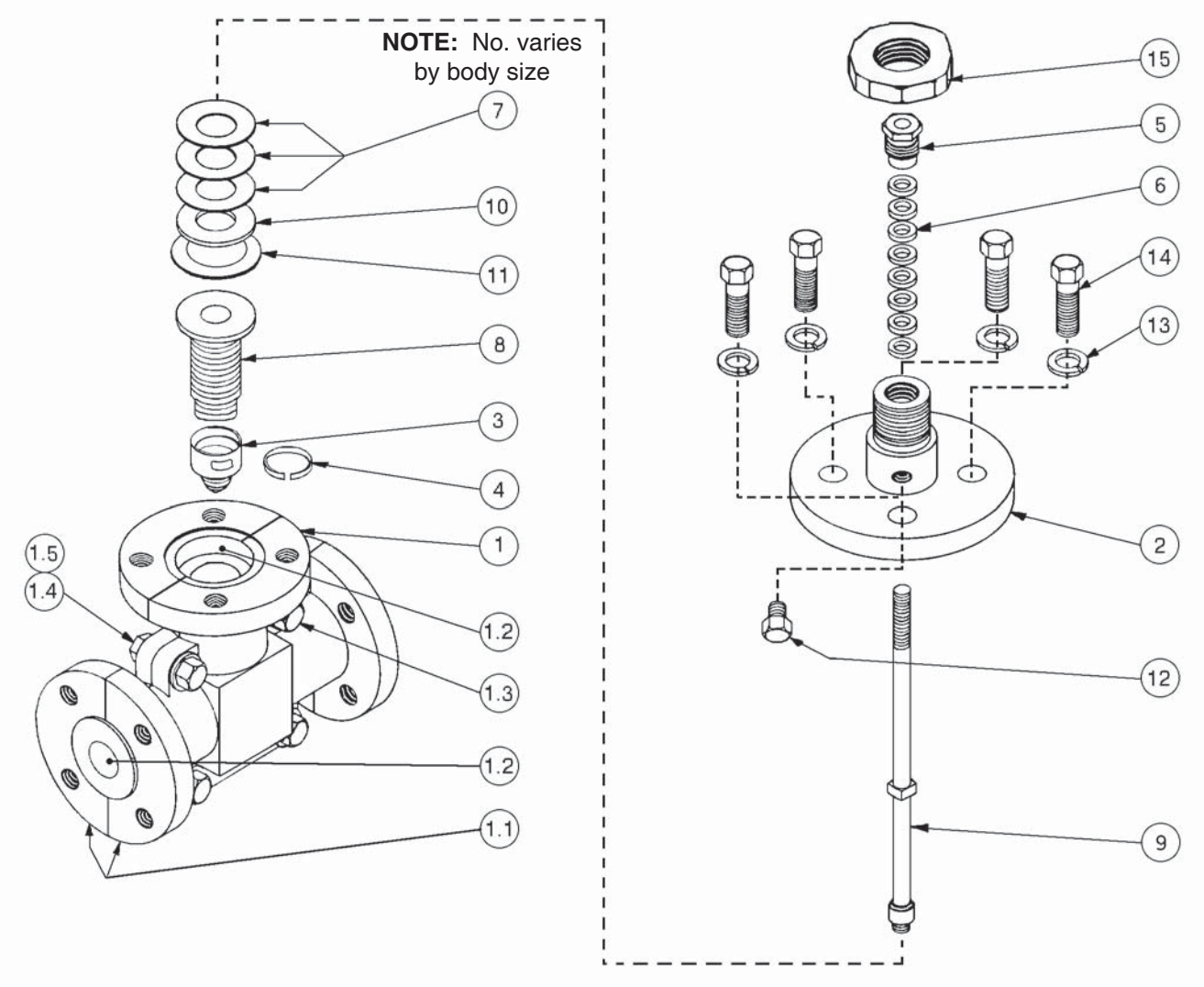


Figure 10: Control Valve Internals

ITEM NO.	DESCRIPTION
1	Body Sub-Assembly
1.1	* Half Shell
1.2	* TFE Core
1.3	* Cap Screw
1.4	* Nut
1.5	* Lockwasher
2	Bonnet
3	Plug Head
4	Plug Retainer Strip
5	Packing Gland Nut
6	Packing Set

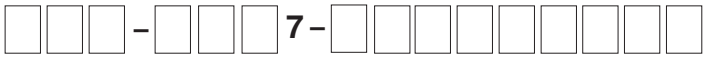
ITEM NO.	DESCRIPTION
7	Belleville Spring Washer
8	Bellows Sub-Assembly
9	Stem Sub-Assembly
10	Spacer
11	Bonnet Gasket
12	Vented Pipe Plug
13	Lockwasher
14	Bonnet Cap Screw
15	Yoke nut
Not Shown	
18	Rating Tag
19	Bonnet Spacer
20	Jam Nut

* Sub-level parts that make up the body sub-assembly; **NOTE:** DO NOT DISASSEMBLE THE PARTS OF THE BODY SUB-ASSEMBLY (1)! The valve body (1) is machined after the shell halves (1.1) have been bolted (1.3, 1.4, 1.5) around the TFE core (1.2). Disassembly of the body sub-assembly (1) will create alignment problems upon completed reassembly. The TFE core (1.2) is not replaceable, except as a body sub-assembly (1).

SECTION VIII

VIII. ORDERING INFORMATION:
NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

To obtain a quotation or place an order, please retrieve the Serial Number and Product Code that was stamped on the metal name plate and attached to the unit. This information can also be found on the Bill of Material ("BOM"), a parts list that was provided when unit was originally shipped. (Serial Number typically 6 digits). Product Code typical format as follows: (last digit is alpha character that reflects revision level for the product).



NEW REPLACEMENT UNIT:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. With this information they can provide a quotation for a new unit including a complete description, price and availability.

⚠ CAUTION

Do not attempt to alter the original construction of any unit without assistance and approval from the factory. All purposed changes will require a new name plate with appropriate ratings and new product code to accommodate the recommended part(s) changes.

PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. Identify the parts and the quantity required to repair the unit from the "BOM" sheet that was provided when unit was originally shipped.

NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

A Local Sales Representative will provide quotation for appropriate Kit Number, Price and Availability.

TO RETURN A VALVE FOR REPAIR: (RGA)

Before returning this Model - Contact Cashco Inc. for permission to return the unit (as a whole or any part of) and to obtain an "RGA" identification number. This number must be marked clearly on the outside of the returned container. In addition, affix to the outside of the container a signed statement attesting to the fact that the valve and/or parts has been flushed out for a specific period of time using an "OSHA"acceptable neutralizing agent. The name of the agent, the manufacturer's company name and the total concentration level must be included for both the valve service medium, as well as the neutralizing agent.

NO returns will be accepted at Cashco Inc. without an M.S.D.S. (Material Safety Data Sheet) affixed to the outside of the returned container.

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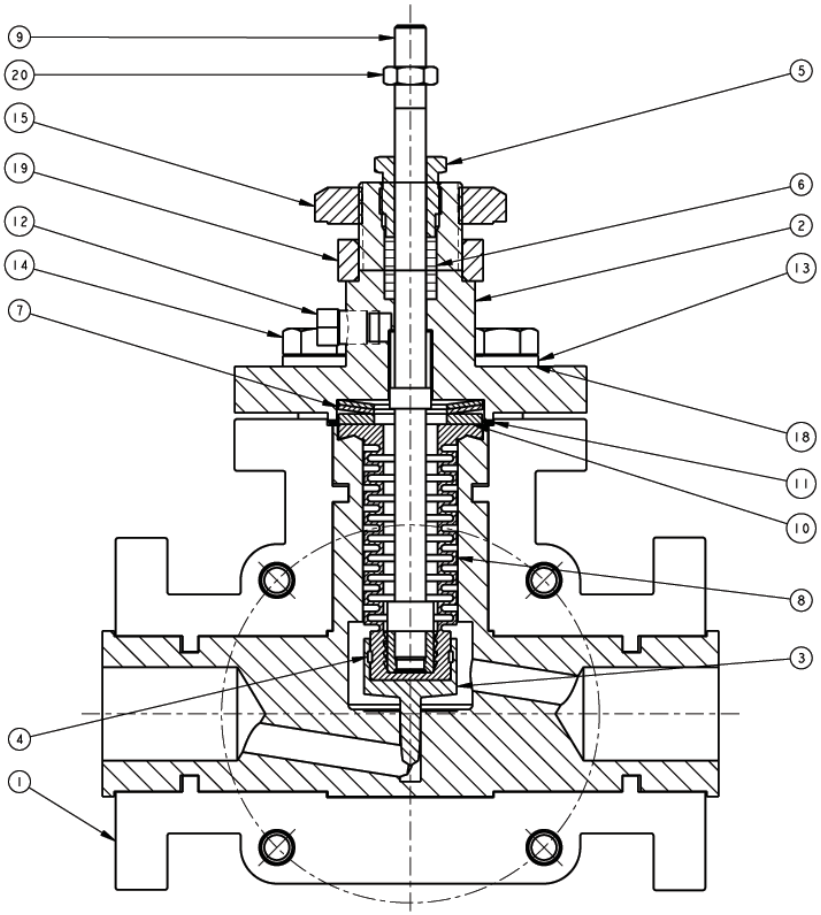
Cashco, Inc. does not assume responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use and maintenance of any Cashco, Inc. product remains solely with the purchaser.



Note: End flange tapped bolt holes straddle horizontal and vertical centerlines.

Figure 11: Body Assembly (BA)

ITEM NO.	DESCRIPTION
1	Body Sub-Assembly
2	Bonnet
3	Plug Head
4	Plug Retainer Strip
5	Packing Gland Nut
6	Packing
7	Belleville Spring Washer
8	Bellows Sub-Assembly

ITEM NO.	DESCRIPTION
9	Stem Sub-Assembly
10	Spacer
11	Bonnet Gasket
12	Vented Pipe Plug
13	Lockwasher
14	Bonnet Cap Screw
15	Yoke nut
18	Rating Tag
19	Bonnet Spacer
20	Jam Nut
Not Shown	
17	ANSI/DIN Adapter Gasket
43	Upper knuckle See Fig. 6
44	Lower knuckle See Fig. 6
51	Indicating Washer See Fig. 6

ATEX 94/9/EC: Explosive Atmospheres and Cashco Inc. Regulators

NOTICE

Only for Product Codes wherein hazard category ATEX has been selected.

These valves satisfy the safety conditions according to EN 13463-1 and EN 13463-5 for equipment group IIG 2 c.

Caution: Because the actual maximum temperature depends not on the equipment itself, but upon the fluid temperature, a single temperature class or temperature cannot be marked by the manufacturer.

Specific Precaution to Installer: Electrical grounding of valve must occur to minimize risk of effective electrical discharges.

Specific Precaution to Installer: Atmosphere vent holes should be plugged to further minimize the risk of explosion.

Specific Precaution to Maintenance: The Valve Body/ Housing must be regularly cleaned to prevent buildup of dust deposits.

Specific Precaution to Maintenance: Conduct periodic Continuity Check between Valve Body/ Housing and Tank to minimize risk of electrical discharges.

Attention: When repairing or altering explosion-protected equipment, national regulations must be adhered to. For maintenance and repairs involving parts, use only manufacturer's original parts.

ATEX requires that all components and equipment be evaluated. Cashco pressure regulators are considered components. Based on the ATEX Directive, Cashco considers the location where the pressure regulators are installed to be classified Equipment-group II, Category 3 because flammable gases would only be present for a short period of time in the event of a leak. It is possible that the location could be classified Equipment-group II, Category 2 if a leak is likely to occur. Please note that the system owner, not Cashco, is responsible for determining the classification of a particular installation.

Product Assessment

Cashco performed a conformity assessment and risk analysis of its pressure regulator and control valve models and their common options, with respect to the Essential Health and Safety Requirements in Annex II of the ATEX directive. The details of the assessment in terms of the individual Essential Health and Safety Requirements, are listed in Table 1. Table 2 lists all of the models and options that were evaluated and along with their evaluation.
Models and options not listed in Table 2 should be assumed to not have been evaluated and therefore should not be selected for use in a potentially explosive environment until they have been evaluated.
Standard default options for each listed model were evaluated even if they were not explicitly listed as a separate option in the table. Not all options listed in the tables are available to all models listed in the tables. Individual TB's must be referenced for actual options.
When specifying a regulator that is to be used in a potentially explosive environment one must review the evaluations in Table 1 and 2 for the specific model and each and every option that is being specified, in order to determine the complete assessment for the unit.
A summary of the models and options found to have an impact on ATEX assessment due to potential ignition sources or other concerns from the ATEX Essential Health and Safety Requirements, are listed below.

1. The plastic knob used as standard on some models, (P1, P2, P3, P4, P5, P7, 3381, 4381, 1171, and 2171) is a potential ignition source due to static electricity. To demonstrate otherwise, the knob must be tested to determine if a transferred charge is below the acceptable values in IEC 60079-0 Section 26.14 (See items 25, 27, and 28 in Appendix A). Until the plastic knob has been shown to be acceptable, then either the metal knob option, or a preset outlet pressure option is required to eliminate this ignition source (See items 45 and 64 in Tables).

2. The pressure gauges offered as options on a few of the regulator models (DA's, P1-7, D, 764, 521), use a plastic polycarbonate window that is a potential ignition source due to static electricity. To demonstrate that the gauges are not a potential source of ignition, the gauges would need to be tested to determine if a transferred charge is below the acceptable values in IEC 60079-0 Section 26.14 or the pressure gauge supplier must provide documentation indicating the gauge is compliant with the ATEX Directive (See items 26, 27, and 28 in Appendix A). Until compliance is determined, regulators should not be ordered with pressure gauges for use in potentially explosive environments.

3. Tied diaphragm regulators with outlet ranges greater than 100 psig should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere (See item 6 in Table 1).

4. Regulators must be ordered with the non-relieving option (instead of the self-relieving option) if the process gas they are to be used with is hazardous (flammable, toxic, etc.). The self-relieving option vents process gas through the regulator cap directly into the atmosphere while the non-relieving option does not. Using regulator with the self- relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.

5. Regulators with customer supplied parts are to be assumed to not have been evaluated with regard to ATEX and thus are not to be used in a potentially explosive environment unless a documented evaluation for the specific customer supplied parts in question has been made. Refer to Table 1 for all models and options that have been evaluated.

Product Usage

A summary of ATEX related usage issues that were found in the assessment are listed below.

1. Pressure regulators and control valves must be grounded (earthed) to prevent static charge build-up due to the flowing media. The regulator can be grounded through any mounting holes on the body with metal to metal contact or the system piping can be grounded and electrical continuity verified through the body metal seal connections. Grounding of the regulator should follow the same requirements for the piping system. Also see item 30 in Table 1.

2. The system designer and users must take precautions to prevent rapid system pressurization which may raise surface temperatures of system components and tubing due to adiabatic compression of the system gas.

3. Heating systems installed by the user could possibly increase the surface temperature and must be evaluated by the user for compliance with the ATEX Directive. User installation of heating systems applied to the regulator body or system piping that affects the surface temperature of the pressure regulator is outside the scope of this declaration and is the responsibility of the user.

4. The Joule-Thomson effect may cause process gases to rise in temperature as they expand going through a regulator. This could raise the external surface temperature of the regulator body and downstream piping creating a potential source of ignition. Whether the Joule-Thomson effect leads to heating or cooling of the process gas depends on the process gas and the inlet and outlet pressures. The system designer is responsible for determining whether the process gas temperature may rise under any operating conditions. If a process gas temperature rise is possible under operating conditions, then the system designer must investigate whether the regulator body and downstream piping may increase in temperature enough to create a potential source of ignition.

The process gas expansion is typically modeled as a constant enthalpy throttling process for determining the temperature change. A Mollier diagram (Pressure – Enthalpy diagram with constant temperature, density, & entropy contours) or a Temperature – Entropy diagram with constant enthalpy lines, for the process gas, can be used to determine the temperature change. Helium and hydrogen are two gases that typically increase in temperature when expanding across a regulator. Other gases may increase in temperature at sufficiently high pressures.

Product Declaration

If the above issues are addressed by selecting options that do not have potential sources of ignition, avoiding options that have not been assessed, and by taking the proper usage issue precautions, then Cashco regulators can be considered to be a mechanical device that does not have its own source of ignition and thus falls outside the scope of the ATEX directive.

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