

ONYX VALVE CO MODEL DAC - PFC Installation & Maintenance

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Storage

Correct storage procedures extend valve life. The rubber sleeve in the valve is perishable. Ideal storage conditions are 50°F and 60% relative humidity.

1. Keep valves and spare sleeves as cool as possible. They can be stored in an unheated area but allow maximum ventilation in storage areas subject to high ambient summer temperatures. Truck trailers and storage sheds become incredibly hot during summer months. Avoid such locations.
2. Avoid sunlight. Ultra-violet light accelerates the deterioration of rubber. Leave the valve in its box. If not feasible to box the valve, cover the sleeve with black plastic.
3. Avoid ozone. DO NOT STORE valve near active electrical equipment. For long-term storage, coat the face and inside the sleeve twice yearly with silicone spray or liquid.

Design Criteria

The **maximum process temperature** that the valve can tolerate is based on the elastomer used to fabricate the sleeve.

Poly Isoprene	Chloroprene	EPDM Ethylene Propylene	Nitrile	Butyl	Fluorocarbon
PGR Pure Gum Rubber	Neoprene	Nordel	Buna-N	Butyl	Viton
-30°→+180° F -34°→+82° C	-20°→+220° F -29°→+104° C	-40°→+300° F -40°→+150° C	-30°→220° F -34°→104° C	-30°→+225° F -34°→+106° C	-15°→+375° F -26°→+190° C

The **maximum safe process pressure** that the valve sleeve and housing can tolerate is based on valve size and flange rating. For Onyx model DEC valves with 150# flanges maximum process pressure:

Size	2	2½ & 3	4	6	8	10	12	14	16	18	20	24	30
P _{max} psi	200	175	150		100		75						

Notes:

1. Higher pressure ratings are available on special order.
2. This is the maximum safe pressure that the valve body can safely handle. The actuator is sized to close against the line pressure stipulated on the customer's PO and in most cases is significantly lower than max rated housing pressure shown here. Check name tag on the valve for maximum operating pressure based on actuator available thrust.

Inspection & Identification

Inspect the valve before installation. Report any shipping damage before installation. **DO NOT INSTALL A VALVE KNOWN TO HAVE BEEN DAMAGED IN SHIPMENT.** Check inside the valve to make sure no foreign objects are present.

1. Identification:

Part#.

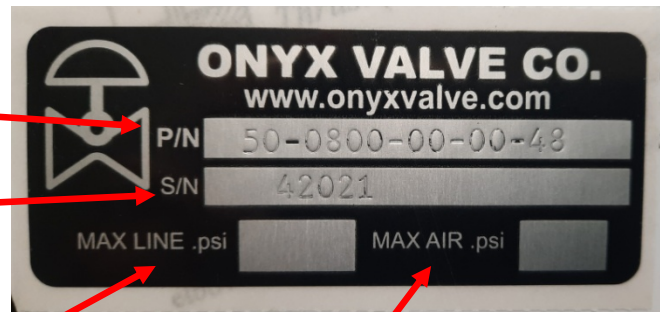
Use this number when ordering spare/replacement parts.

Sales #:

Previous sales number for last order

This is the pressure that the valve was tested at the factory prior to shipping.

This is the maximum compressed air pressure feeding the actuator.



2. Safety:

- a) Leakage: Consider the possibility of leakage. Pinch valves handle abrasive fluids; it is reasonable to expect the rubber sleeve to eventually wear out and leak. Precautions should be taken where liquids may spray out or drip down onto electrical equipment or plant personnel or combustible fluid may drain into a dangerous area.
- b) After shutting down: Pinch valves can hold pressure in a system for a considerable length of time. Means should be provided to safely relieve pressure and drain lines.

3. Flanges:

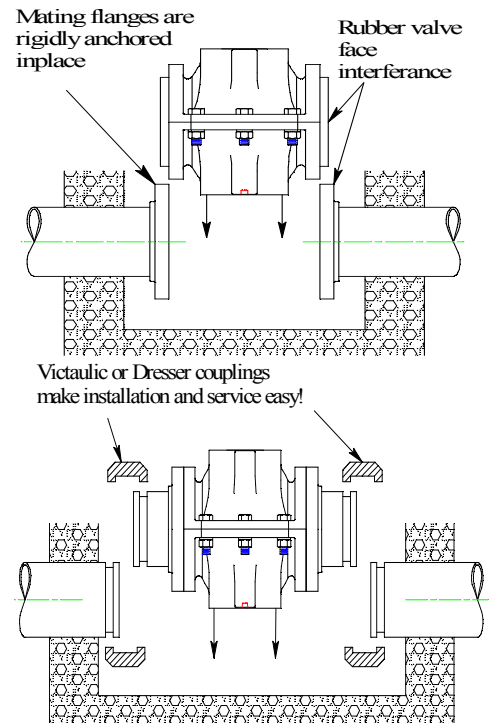
- a. Onyx pinch valves are designed to work with standard ANSI 150# (or 300#) flanges.
- b. No gasket is required; the sleeve face *is* the gasket.
- c. Make sure the inside edges of mating flanges are filed or ground smooth. Any sharp edges on the inside corner of mating flanges will cut the rubber sleeve causing premature failure.
- d. Valve flanges have through holes and are designed to have an ANSI hex (not heavy hex) nut behind the flange. Flange bolts must be inserted from the mating flange side.
- e. Use **flat face flanges**. Do NOT use raised face flanges. Raised face flanges cut into the rubber sleeve damaging it.
- f. Flange bolts must be installed through the mating flanges. Flange bolts **cannot** be inserted from the valve side of the flange assembly.



Installation Design & Engineering:

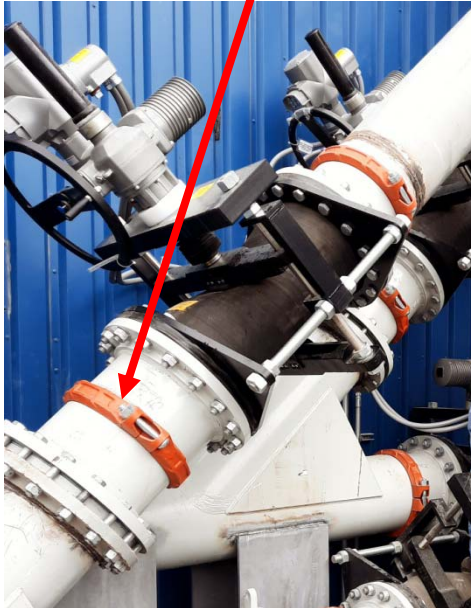
If the valve is at the end of a pipe run, you must install a flange ring on the discharge end of the valve to seal the air properly.

- a. Design the installation so the valve can be removed and reinstalled later. Pinch valve sleeves wear out and have to be replaced. The rubber sleeve is molded longer than the housing to provide enough compression in the rubber to prevent leaks. If mating pipe flanges are rigidly anchored in concrete or welded in place, you might be able to remove the valve from the line but there will be hell to pay when you attempt to reinstall it. The protruding rubber faces of the sleeve will thwart any attempt to get the valve back into place.

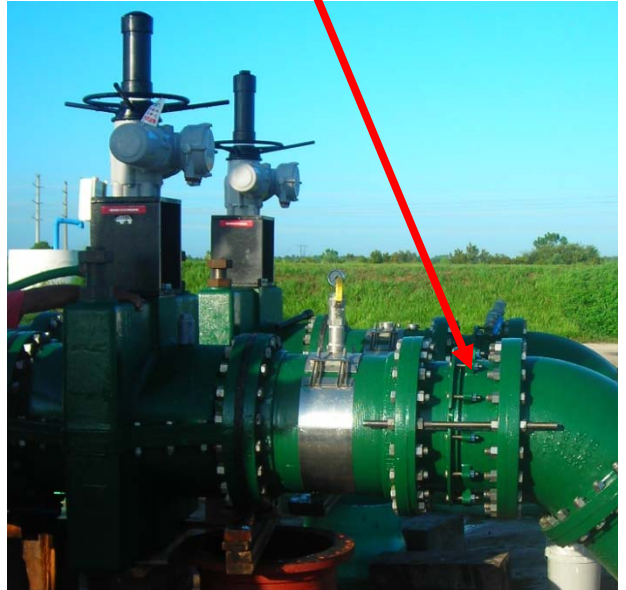


- b. Using a Victaulic or Dresser coupling will facilitate removal and makes it easy to reinstall the valve later. By using split couplings, the mating flanges can be attached to the valve first and tightened prior to installation. Then the entire assembly can be dropped into place and secured with the split couplings.

Victaulic couplings.



Dresser coupling



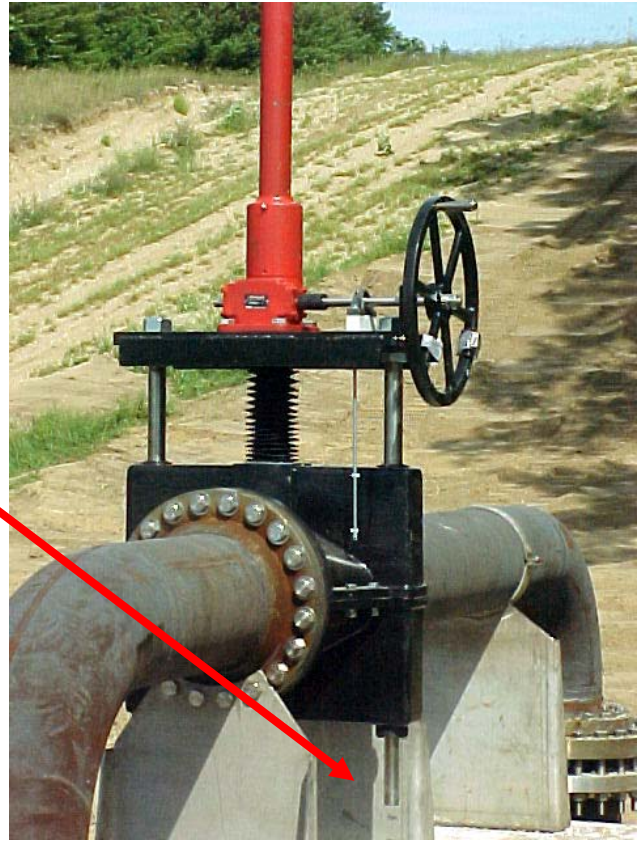
- c. When installing series-D pinch valve make sure there is ample clearance for guide rods. These are the two rods that slide in and out of the lower housing to raise and lower the pinch bar. Make sure there is sufficient clearance **under the valve** for these rods to extend all the way without hitting anything. Check catalogue literature for required clearance dimension.

Wrong ➔

Insufficient clearance under the valve. The first time you attempt to open the pinch valve the rods are going to crash into the support beam.



Good design. Note generous clearance under the valve for guide rods.



4. On valves **for modulating service**: Allow at least 2-pipe diameters straight run into throttling valves as a minimum.

Good ↓



Better ↓

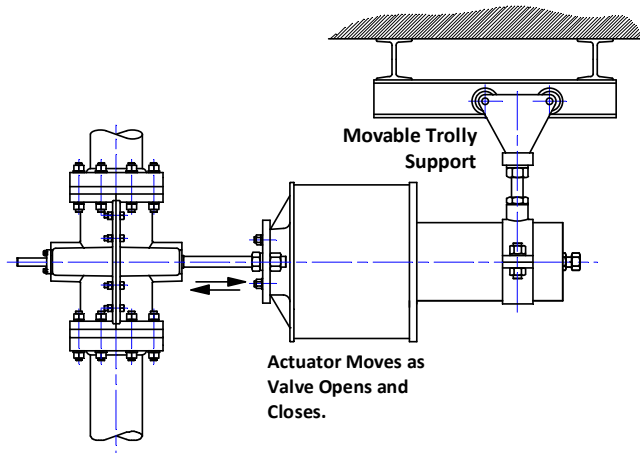


7. Valves for **On/Off service** can be connected directly to adjacent pipe fittings without straight run in or out.

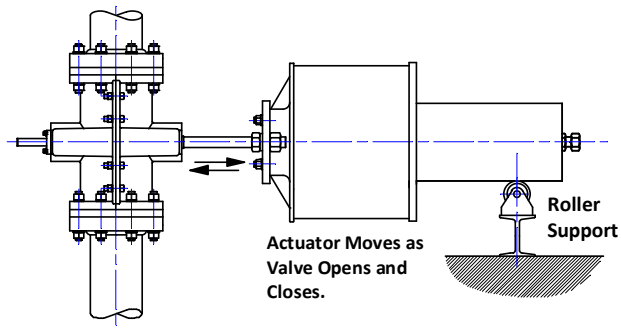


8. Actuator Support for valves installed in vertical pipe. 3-ways:

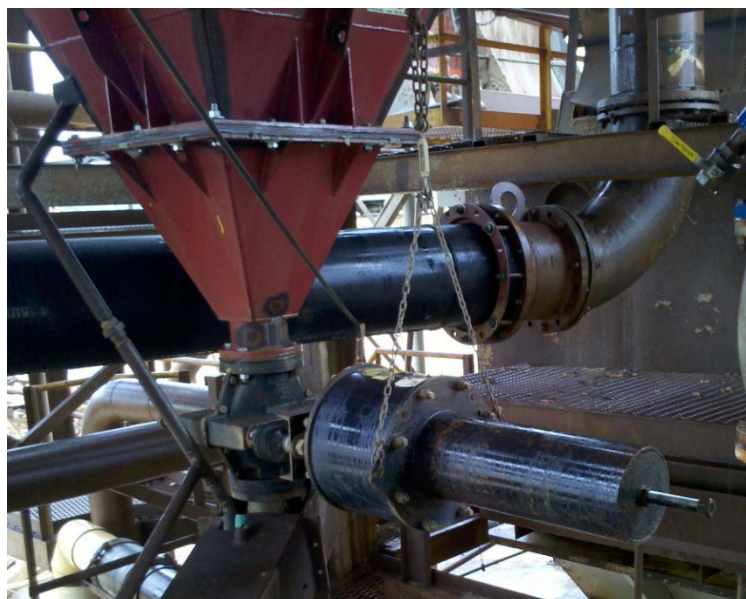
a. Overhead Trolley



b. Roller underneath:



c. Cable or chain suspension:



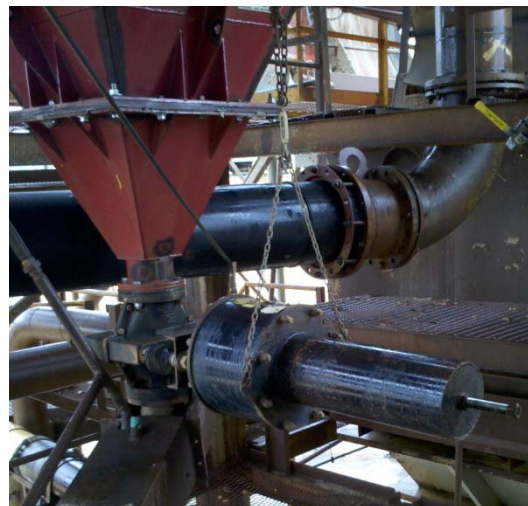
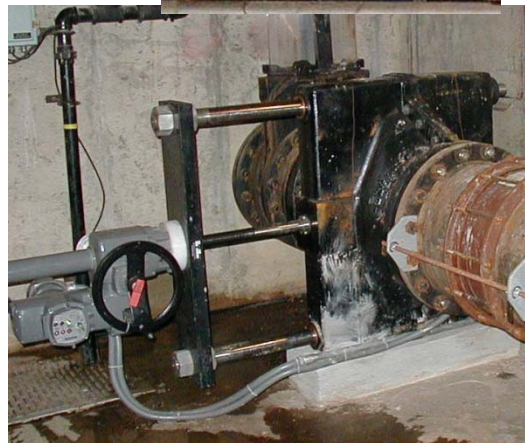
Orientation

There are 4-ways to install a pinch valve. 1 thru 3 are good. #4 is bad.

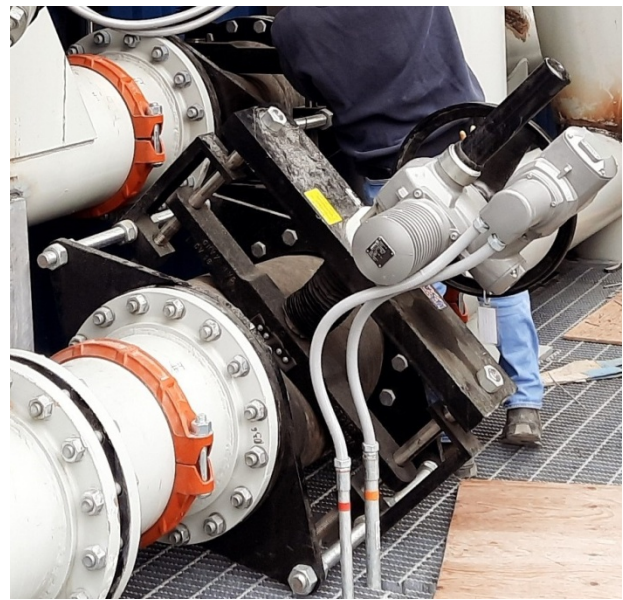
1. Valve upright in horizontal pipe.
 - i. OK for liquid applications.
 - ii. OK for dry bulk applications.

2. Valve 90° from vertical in horizontal pipe.
 - i. OK for liquid.
 - ii. Do **NOT** install this way on **dry bulk** conveying!

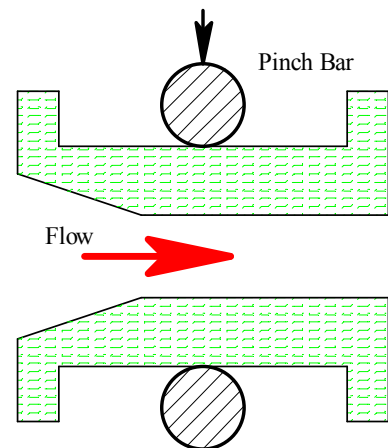
3. Valve upright in horizontal pipe.
 - i. OK for liquid.
 - ii. OK for dry bulk applications.



- 4. Valve at intermediate angle.
 - i. Trouble brewing. Don't do this.



- g. Locate the valve where it can be reached for service and sleeve replacement. Allow access by technicians who may have to calibrate automatic valves. Allow access to the auxiliary hand wheel if valve was so equipped.
- h. Be sure pipeline is clean. Foreign material left in the pipeline can damage valves. Clean the mating flanges of adjacent pipe. Remove any old gasket material.
- i. Most pinch valves can be installed with flow in either direction.
 - i. The exception: modulating valves with Trumpet Mouth (Taper-Inlet-Only) design. In this case there will be a Flow Arrow on the valve showing correct flow direction. The correct flow direction is always from the tapered end towards the non-tapered end.
- j. Do not install valve next to a source of extreme heat.



Installation Tips

1. Close valve prior to installation.
2. Make sure adjacent pipe is properly aligned.
3. Adjacent pipe must have sufficient travel to insert valve and draw tight to compress sleeve faces; valve will not stretch.
4. Coat faces of valve sleeve with silicone lubricant to facilitate installation and later removal of the valve and to preserve the resiliency of the rubber.
5. Bolt valve into pipeline. Snug up the bolts gently in a crisscross pattern. It may be necessary to re tighten bolts later after the rubber has taken set.

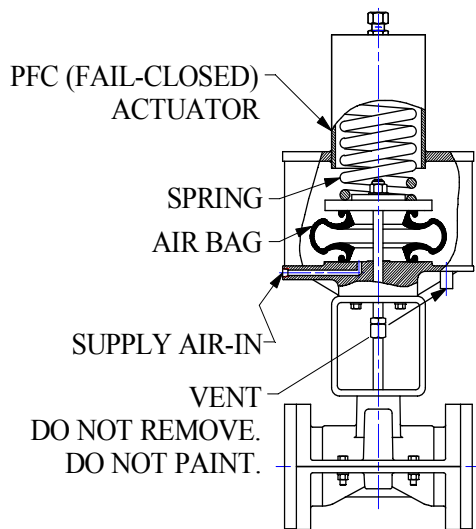
Bolt Torque in ft-lb			
Flange	# bolts	Pinch & Duckbill Valves	
		1st hit *	2nd hit *
1	4	30	50
1.5			
2			
2.5			
3			
4	8	45	65
5			
6			
8			
10	12	50	80
12			
14			
16	16	60	95
18			
20	20	65	150
24			
30	28	75	175
36			

Operation

This is a single acting actuator. The Onyx series DAC-PFC pinch valves fail closed on loss of air. This simple spring and air bag arrangement drives a pair of pinch bars to close a rubber sleeve bubble tight. Positive opening tabs molded into the sleeve attached to the pinch bar insure complete opening.

When equipped with a positioner, the DAC valves are efficient reliable control valves. These actuators are designed and manufactured by Onyx Valve Co. They are available in two configurations: The PFO, which fails open, and the PFC, which fails closed. The air bag actuator has no piston rings and no diaphragm, assuring the user high efficiency, low hysteresis and good sealing characteristics.

PFC Actuators are Rated for 125-psi Maximum Supply Air Pressure.



It has a sintered metal breather vent on the bottom. Actuator cannot operate properly if this vent is not functional.

Do not paint the breather fitting!

Spring Adjustment

All Onyx pinch valves are tested to customer specifications before shipment. Unless otherwise specified, all valves are shipped assembled with all accessories piped, mounted, and calibrated. The spring tension is adjusted at the factory to provide sufficient force to close the valve drop tight against the line pressure specified on the original valve purchase order.

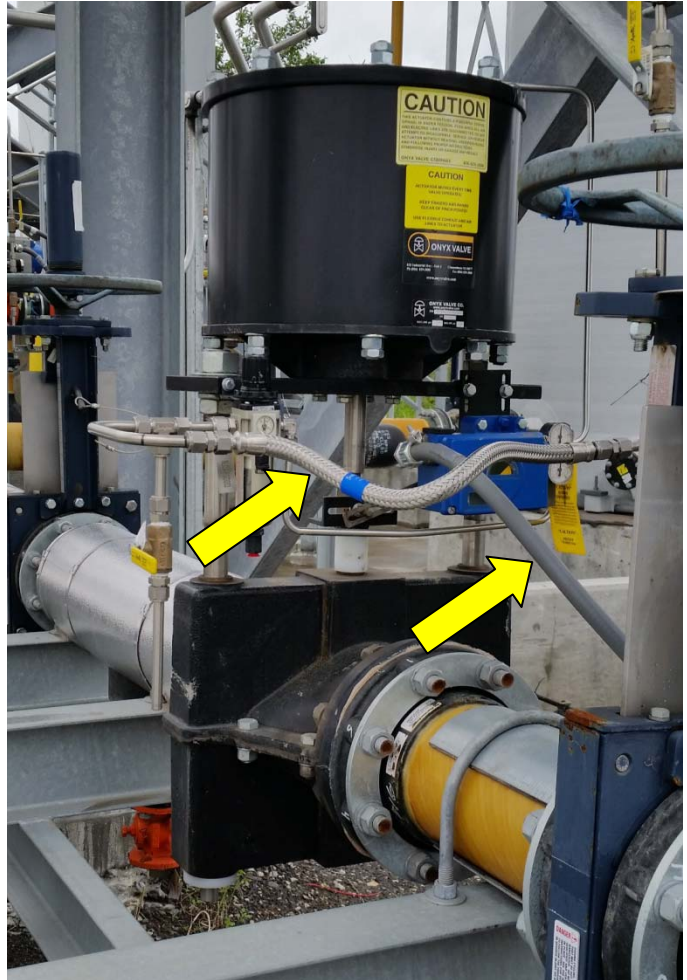
The spring normally requires no further adjustment. However, during shipment and installation, jarring to the valve may necessitate a slight re-adjustment of the spring, or, if the valve has to close against a higher line pressure than originally specified re-adjustment may be required. Refer to the actuator assembly drawing at the end of this I&M for part number indications.

To increase spring tension (close valve tighter) loosen jam-nut (#21D) and turn jack-bolt (#21B) clockwise. Tighten spring in small increments; not more than ¼ turn at a time. Tighten the jack bolt a little bit; check the valve, and if it is still leaking turn the jack bolt another ¼ turn. Do not over tighten. If the jack bolt requires more than 5 turns to hold line pressure, stop, look and listen: This might indicate the elastomer sleeve needs to be replaced or there is something binding in the valve mechanism. After completing jack bolt adjustment, re-tighten the jam nut.

Electrical Connections

All wiring must be performed by a qualified electrician in accordance with local and national electrical codes. If your valve is equipped with a solenoid valve or a positioner or limit switches:

On the model DAC pinch valve, **the actuator moves up and down as the valve operates.** Actuator travel equals half nominal valve size, e.g.: on a 10" valve, the actuator moves up & down 5 inches. **You must use flexible conduit and flexible air line** with sufficient movement to accommodate this vertical translation. Do NOT use rigid conduit.



Refer to instruction manual supplied with your solenoid valve, positioner or limit switches for details on these accessories.

Maintenance

1. Lubrication Schedule

a. At start up: Construction activities can create a lot of abrasive dust so it's a good idea clean and oil the stem and guide rods at start up.

b. Yearly: Clean and oil the stem and guide rods.

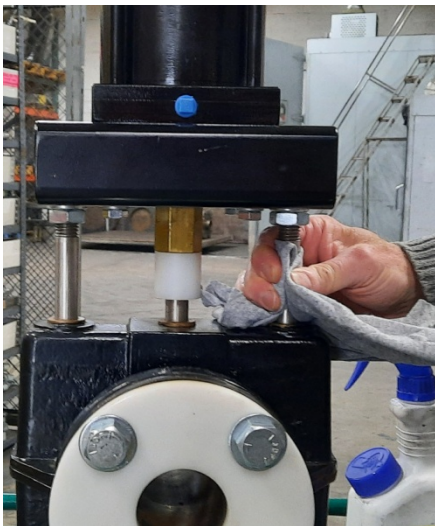
1-Spray stem & rods with WD-40.



2-Spray lower guide rods with WD-40



3-Wipe clean with a soft rag.



4-spray with WD-40 again but this time do not wipe it off. Allow oil to soak into bearings.



Start Up

Duty Cycle and What to Watch For:

Every Onyx pneumatic actuated valve is tested at final assembly. The valve is flanged and pressurized to max working pressure stated on Order Acknowledgement + 10%. Limit switches (if provided) are set here at the factory. Positioners and position re-transmitters are calibrated here at the factory and should not require any adjustment in the field.

Valve should be Plug & Play. You should only have to connect electric power and/or command signals and valve should be ready to operate. Pneumatic actuators can cycle at high speed, continuously, with no mandatory rest period.

For **on-off** service operation, you want maximum speed. Sleeve wear is caused primarily by turbulence that occurs when the valve is in the near-closed position. Moving the valve as quickly as possible through this transition zone maximizes sleeve life. Actuators for on-off service should cycle open-closed in less than 4 seconds. If your valve can not stroke this fast you might be well advised to change out to a solenoid valve with larger ports or a higher Cv.

The following are a few notes on modulating operation valves:

Valve goes unstable and continuously oscillates back and forth. There are 2 possible reasons for this:

1. **Too much gain:** Inside your SCADDA system is a unique PID module dedicated to controlling every modulating valve in the plant. This PID module has to be “tuned” to match each individual valve’s response characteristic. To do this, the programmer in charge of the SCADDA system adjusts the gain in the PID module. The natural tendency is to crank up the gain (also known as reducing dead band) in the PID module. This improves accuracy. However, **increasing the gain forces the electric actuator to cycle more frequently.**
2. **The valve port is oversized.** The valve seems to control the flow well enough, but even at maximum flow it never goes more than 20% open. When the valve operates close to the seat the high velocity accelerates sleeve wear, requiring more frequent sleeve replacement. The sweet spot is 15% to 90% open. **Operating too close to the seat (< 20% Open) makes flow control unstable, forcing the actuator to cycle more frequently.**

Sleeve Replacement

WARNING: Before attempting to disassemble the valve housing the stem must be in the retracted position. Failure to retract the stem could result in equipment damage and/or serious personal injury.

1. Relieve process pressure and drain process line.
2. Disconnect air and electric lines. Label and record connections so the valve can be reconnected in the same manner.
3. Remove valve from process line.
4. Disconnect any accessories attached to the stem or coupling.
5. Use a temporary air line to maintain pressure in the actuator to retract the stem. Keep the valve in the open position. Disassemble valve bonnet assembly (#2) by removing bolts, nuts, and washers (#2A, 2B, 2C).
6. Separate upper and lower bonnet halves (#2).
7. Remove positive opening tabs from lower pinch bar (#10) by removing bolts, nuts and washers (#8A, 8B, 8C).
8. Remove the lower pinch bar by removing hex nuts (#23A) from the guide rods (#23).

After the lower pinch bar is removed, **slowly** bleed the air from the actuator. This will push the upper pinch bar down to extract the sleeve.

9. Remove the valve stem (#7) by loosening the coupling jam nut (#13A) and coupling (#13). Valve stem threads are left-handed, so you have to turn the coupling and jam nut the 'wrong' way to loosen them.

10. If sleeve (#1) is provided with positive opening tabs (integrally molded tabs bolted to the pinch bar), follow steps 'a' through 'e' below. If no positive opening tabs are provided, proceed directly to step 11.



- a) Remove bolts, nuts and washers that secure the positive opening tabs to the pinch bar (8A, 8B, 8C). The sleeve (#1) is now free from the both pinch bars (#9 & 10). Discard old sleeve. Prepare new sleeve for installation.
- b) Punch holes through the positive opening tabs using a gasket or pliers type punch. The diameter of the holes in tabs should be approximately equal to hole diameter in pinch bar.
- c) Positive opening tab holes must be in proper alignment with respect to the flange face holes, or there will be hell to pay when you reinstall the valve. It is very difficult to twist the rubber sleeve to align these holes later.
- d) Replace tab bolts, nuts and washers (#8A, 8B & 8C). Use flat washers on every hole. If you replace bolts (#8A), cut or grind flush with nut (#8C) so bolts do not puncture sleeve in closed position



- e) Trim the tabs even with the top surface of the pinch bar.
11. Apply a coat of silicone valve sealant to the mating flanges of the bonnet halves.
 12. Coat the stem (#7) where it passes through the bearing with a light application of grease or machine oil.
 13. Reinsert the valve stem (#7), and replace jam nut and coupling (#13, 13A). Make sure the pinch bar is in the bonnet track.
 14. Insert new sleeve and reattach the lower pinch bar. (You will have to reapply pressure to the actuator to do this.) Replace the nuts on the guide rods.
 15. Replace the lower bonnet. Bonnets are matched and must be oriented as they were originally or guide rods will not line up properly. Replace bonnet hardware (#2A, 2B & 2C).
 16. Replace any accessories that were previously removed. Tighten all fittings and gauges.
 17. Reinstall valve in process line.
 18. Reconnect air lines.

Stop Collar Adjustment

Any time you replace the valve sleeve or perform any other maintenance on the model DEC valve you should check the Stop Collar (#7A) position.

What this Collar Does:

The Stop Collar insures that the valve closes precisely on Center-Line. If the valve does not close on Center-Line, this will place undue stress on the sleeve leading to premature sleeve failure.

What Goes Wrong?

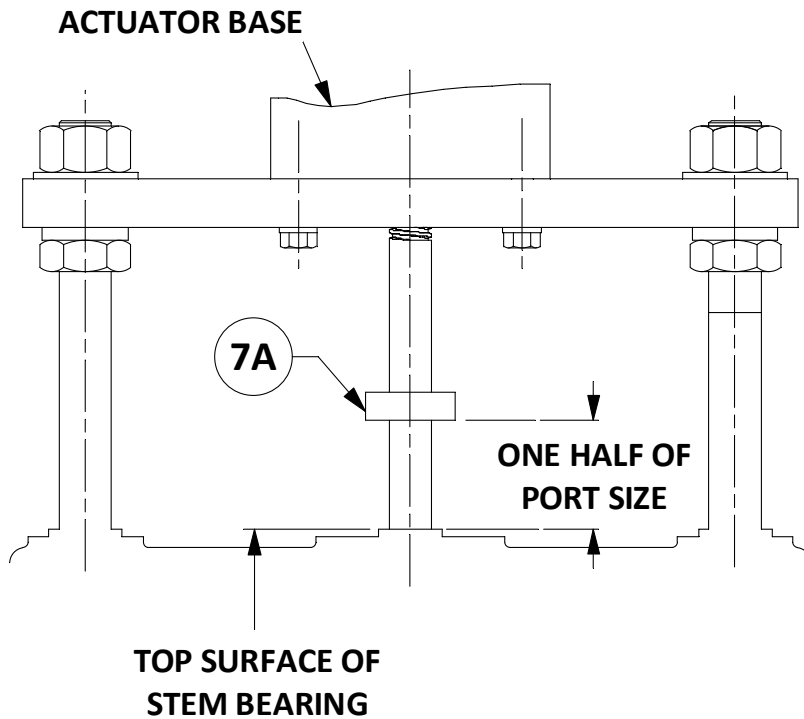
- a) The Stop Collar works loose and slides too far up the stem, or...
- b) The Stop Collar disappears for some mysterious reason.
- c) If the Stop Collar is either missing or out of adjustment, when the valve attempts to close, due to the weight of the Actuator the Lower Pinch Bar (#10) just sits on the ribs inside the valve housing and never moves. The Upper Pinch Bar (#9) starts moving in the downward direction but instead of stopping at Center-Line it continues through its target and moves all the way to the bottom of its stroke. Now you have over-stretched the rubber sleeve on the ventral surface line and you rip the flanges out of the sleeve. This generally doesn't happen right away but closing the valve a few hundred cycles beyond where its designed to close will eventually tear the sleeve apart.

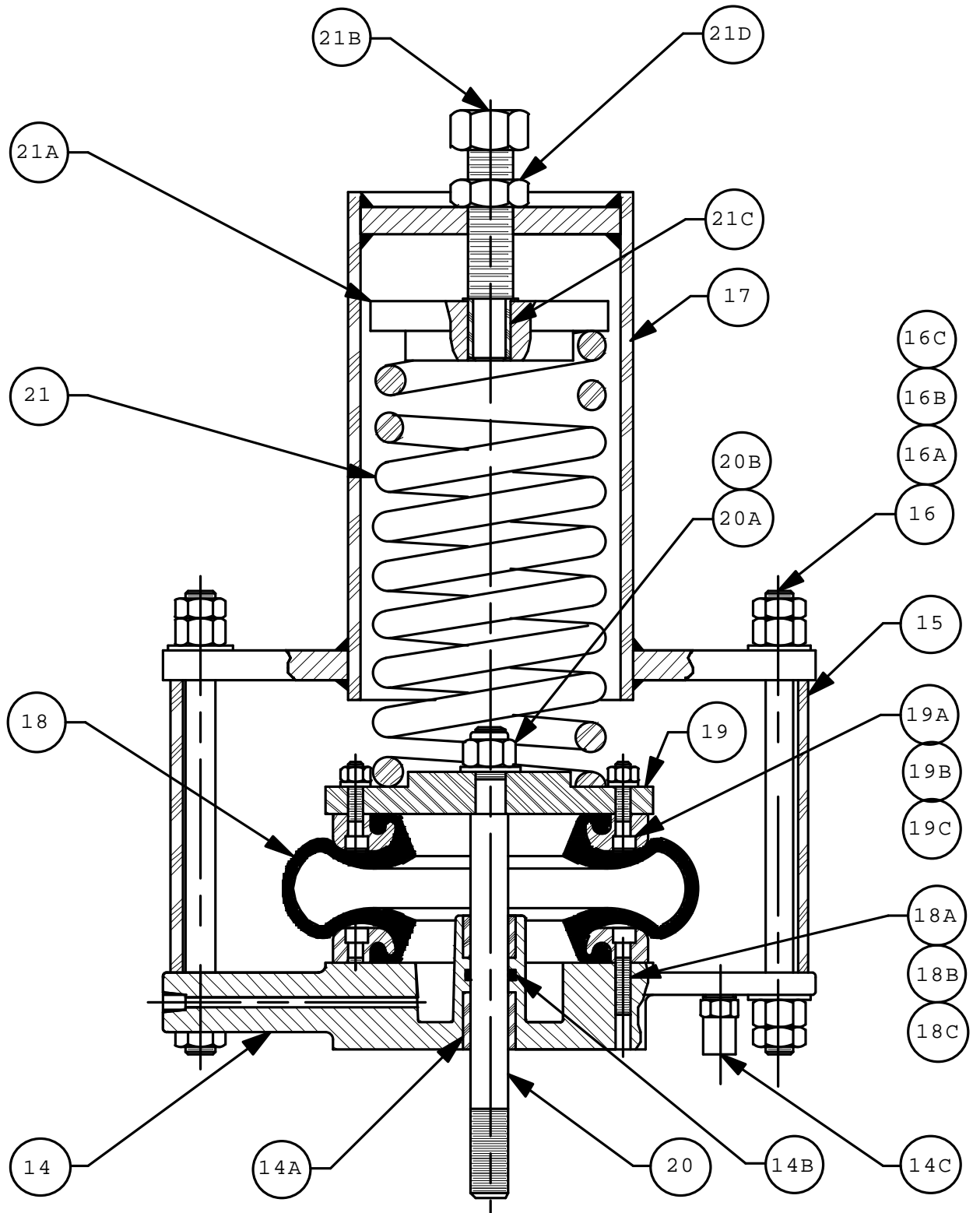
Where Should the Stop Collar be Positioned?

The Stop Collar (#7A) should be firmly clamped to the Valve Stem (#7) so that – when the valve is in the full **OPEN** position – the gap between the bottom surface of the Collar and the top surface of the Stem Bearing is = $\frac{1}{2}$ valve port size. For example:

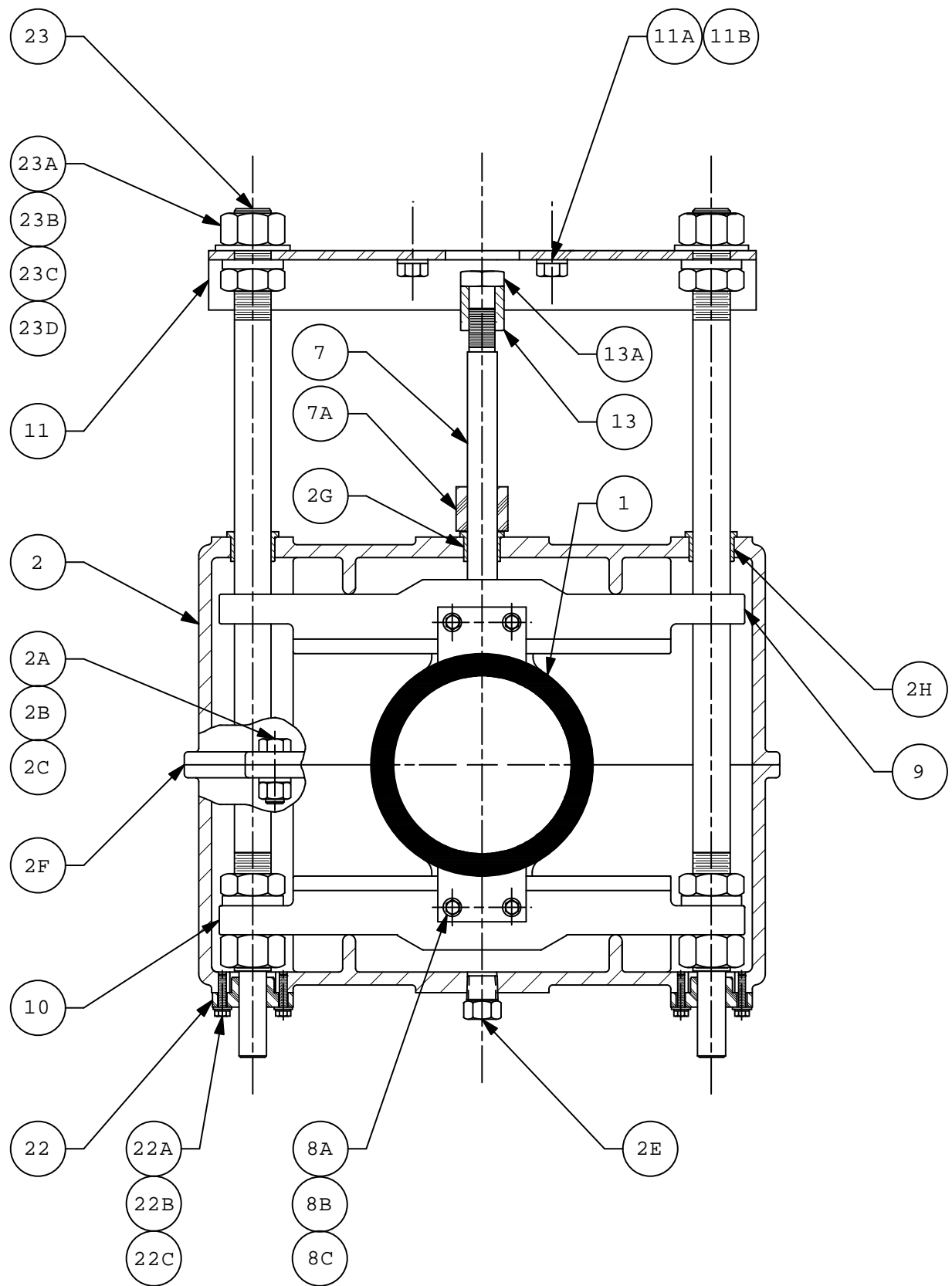
If you have a 3” full port valve, there should be a 1½” gap.

If you have a 10 x 6 valve (10” body x 6” Port) there should be a 3” gap.





ITEM	NOMENCLATURE
14	ACTUATOR BOTTOM
14A	BEARING, ACTUATOR BOTTOM
14B	"O" RING, ACTUATOR BOTTOM
14C	EXHAUST FILTER
15	ACTUATOR COVER TUBE
16	ACTUATOR TIE ROD
16A	WASHER, TIE ROD
16B	NUT, TIE ROD
16C	JAM NUT, TIE ROD
17	ACTUATOR TOP ASSEMBLY
18	AIR BAG
18A	SCREW, AIR BAG
18B	LOCK WASHER, AIR BAG
18C	NUT, AIR BAG
19	ACTUATOR SPRING CAP
19A	SCREW, AIR BAG
19B	LOCK WASHER, AIR BAG
19C	NUT, AIR BAG
20	ACTUATOR STEM
20A	THREADSEAL, ACTUATOR STEM
20B	LOCK NUT, ACTUATOR STEM
21	SPRING
21A	ACTUATOR SPRING BUTTON
21B	ACTUATOR JACK BOLT
21C	BEARING, JACK BOLT
21D	JAM NUT, JACK BOLT



ITEM	NOMENCLATURE
1	SLEEVE
2	BONNET ASSEMBLY
2A	BOLT, BONNET
2B	LOCK WASHER, BONNET
2C	NUT, BONNET
2E	PLUG, BONNET
2F	SEALANT, BONNET
2G	BEARING, BONNET - STEM
2H	BEARING, BONNET - GUIDE ROD
7	STEM, VALVE
7A	MECHANICAL STOP, VALVE
8A	BOLT, POF
8B	WASHER, POF
8C	NUT, POF
9	UPPER PINCH BAR
10	LOWER PINCH BAR
11	YOKE
11A	BOLT, YOKE - ACTUATOR
11B	LOCK WASHER, YOKE - ACTUATOR
13	COUPLING
13A	JAM NUT, COUPLING - STEM
22	ALIGNMENT BEARING
22A	BOLT, ALIGNMENT BEARING
22B	WASHER, ALIGNMENT BEARING
22C	LOCK WASHER, ALIGNMENT BEARING
23	GUIDE ROD
23A	NUT, GUIDE ROD
23B	WASHER, GUIDE ROD
23C	LOCK WASHER, GUIDE ROD
23D	JAM NUT, GUIDE ROD

Actuator Replacement

Actuator Removal

1. Use a temporary air line to pressurize actuator to retract stem.
2. Remove bolts (#11A) and lock washers (#11B).
3. **CAUTION:** Slowly bleed air from actuator. Actuator will move away from the yoke.
4. Loosen coupling jam nut (#13A) and remove coupling (#13).

NOTE: Valve stems have left hand threads. Turn jam nut and coupling the 'wrong' way to remove.

Actuator Installation

1. Thread jam nut (#13A) onto valve stem (#7).
2. Lower actuator stem (#20) through yoke (#11) and sandwich the coupling (#13) between the actuator stem and valve stem. Engage both stems simultaneously. Turn coupling clockwise until stems are drawn against each other.
3. Turn jam nut (#13A) clockwise to lock coupling.
4. Slowly pressurize actuator until actuator bottom rests on top of yoke.
5. Replace actuator bolts and lock washers (#11A, 11B).
6. Slowly bleed pressure from lower chamber. Stem will extend and close valve.

PFC Air Bag Replacement

NOTE: We recommend replacing O- ring and thread-seal when servicing air bag. O-ring and thread-seal should be obtained before beginning air bag replacement.

1. Turn off and disconnect air supply.
2. Measure and record length of adjusting screw (#21B) projecting from cylinder head.
3. Remove the spring adjusting screw (#21B) by loosening jam nut (#21D) and turning screw counterclockwise.
4. Obtain 2 tie rods the same diameter as rods (#16), but at least 10 inches longer than original cylinder rods.

5. Remove 2 tie rods (#16) on opposite sides of the actuator by loosening jam nuts and hex nuts (#16B, 16C). Temporary insert the two longer threaded rods in their place. Snug up nuts on the temporary rods.
6. Remove remaining tie rods (#16).
7. Slowly loosen rod nuts, alternating from one rod to the other. Walk cylinder head (#17) off cover tube, until cylinder head is no longer under spring tension. Remove threaded rods, washers and nuts.
8. Remove plastic cylinder cover (#15).
9. Remove spring button (#21A) and spring (#21).
10. Remove stem lock nut (#20B) and thread-seal (#20A).
11. Remove stem (#20).
12. Remove spring cap (#19) from air bag (#18) by loosening nuts and lock washers (#19B, 19C).
13. Remove air bag screws (#18A, 18B, 18C).
14. Remove air bag (#18) from actuator bottom (#14).
15. Remove O-ring (#14B) from actuator bottom.
16. Inspect actuator bearings (#14A). Replace if worn.
17. Install new O-ring (#14B) in actuator bottom.
18. Position new air bag (#18) on actuator bottom (#14).
19. Replace air bag hardware (#18A, 18B, 18C).
20. Insert stem (#20) up through the actuator bottom (#14).
21. Place spring cap (#19) over stem (#20) and air bag (#18).
22. Replace air bag screws, nuts, and lock washers (#19A, 19B, 19C).
23. Replace stem thread-seal (#20A).
24. Replace stem lock nut (#20B).
25. Replace spring (#21). Replace spring button (#21A).
26. Replace cover tube (#15).

27. Set actuator top (#17) in place on spring button. Insert the 2 long tie rods through the actuator assembly, and use them to pull the actuator top down into place. Replace remaining tie rods (#16).
28. Reattach hex nuts (#16B) and jam nuts (# 16C).

Important:

- Hex nuts first!
 - Do not over-tighten. **Max torque = 5 ft-lb!**
 - Then the thinner jam nuts go on.
 - Use two wrenches to counter tighten jam nuts against the hex nuts. Tighten the hex nuts and jam nuts against each other to 40 ft-lb. Do not tension the tie rods during this operation.
29. Replace jack bolt and jack bolt jam nut (#21B, 21D). Turn the jack bolt in to the same depth as before. Tighten jam nut.
 30. Remove the temporary tie rods, and reinstall the original tie rods. If valve fails to seat against line pressure, loosen jam nut and turn jack bolt in 1/4 turn at a time until valve holds line. Do not over tighten.
 31. Valve should now be ready for service.

Trouble-Shooting

Symptom:	Diagnosis	How to fix:
Process fluid is leaking out from around the stem and guide rods.	Sleeve is ruptured	Replace sleeve.
Process fluid is leaking through valve when it's supposed to be fully closed.	Wire draw failure through sleeve.	Replace sleeve.

ONYX VALVE CO

WARRANTY

The following statement of our Warranty and Claims Policy is intended to assist our customers in understanding the terms of our warranty, the circumstances under which we will honor claims, and the procedure for making claims.

1 Warranty on Products Manufactured by Us.

We warrant Products manufactured by us to be free from defects in material and workmanship for a period of one year from the date of shipment from our factory or warehouse.

Our liability under this warranty or in connection with any other claim relating to our Products is limited to the repair, or at our option, the replacement or refund of the purchase price of any products or parts or components which are returned to us freight prepaid which are defective in material or workmanship. Products or parts or components that are repaired or replaced by us will be returned to our customer freight collect.

With regards to rubber components, Onyx Valve does not guarantee resistance to erosion, abrasion or other sources of failure, nor does Onyx Valve guarantee a minimum length of service or that the product shall be fit for any particular service.

2. Products of Other Manufacturers.

We make no warranty with regard to any products not manufactured by us. The only warranty that attaches to such Products is that warranty, if any, of the manufacturer of such Products. Our Customer Service Department should be consulted if our customers have questions as to whether particular products are covered by our warranty or are separately warranted by their manufacturers.

3 Limitation of Liability.

The only warranty that we make to our customers is that summarized above.

WE DO NOT MAKE ANY OTHER EXPRESS WARRANTIES OR ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE.

In addition, we do not assume and we expressly disclaim any liability for (i) any special, indirect, incidental, or consequential damages which anyone may suffer as the result of the sale, delivery, servicing, use, or loss of use, of any Product, or (ii) any charges or expenses of any nature that are incurred without our express written consent.

Our total liability under our warranty or in connection with any claim involving any Product is expressly limited to the purchase price of the Product in respect of which damages are claimed.

Failure of purchaser to give prompt written notice of any alleged defect under this guarantee forthwith upon its discovery, or use, and possession thereof after an attempt has been made and completed to remedy defects therein, or failure to return product or part for replacement as herein provided, or failure to install and operate said products and parts according to instructions furnished by Onyx Valve, or failure to pay entire contract price when due, shall be a waiver by purchaser of all rights under these representations. All orders accepted shall be deemed accepted subject to this warranty which shall be exclusive of any other or previous warranty, and shall be the only effective guarantee or warranty binding on Onyx Valve.

4. What Is Not Covered By Our Warranty; Types of Damages and Claims For Which We Are Not Responsible.

The following are examples of the kinds of defects which are not covered by our warranty: defects which are caused by improper installation, improper or abnormal use or operation, or improper storage or handling; defects caused by our customer's failure to perform normal preventive maintenance; defects caused by the use of replacement parts not manufactured or supplied by us; defects caused by repairs by persons not authorized by us; defects caused by modifications or alterations made by our customer, and any damage to our Product occurring while it is in our customer's possession. Since these are examples and not a complete list, we suggest that our customers contact our Customer Service Department if they have any questions concerning the scope of our warranty.

Additional costs incurred by our customers because of delays in delivery are consequential damages for which we are not responsible.

Risk of loss or damage to our Products passes to our customer when we tender our Products to the carrier. Although we cannot process transit damage claims with any carrier on a customer's behalf, we will provide reasonable assistance to our customers when such claims arise.

5. Consultations with Customers.

When so requested, our engineers and other personnel may consult with our customers concerning our Products. While our employees offer their best judgment on any question, the ultimate responsibility for selecting that Product which will perform the functions and applications desired by the customer rests with the customer. As noted above, we make no warranty, express or implied, as to the fitness of any Product for any particular purpose or use.

6. How to Make a Claim.

Within the limits of the terms and conditions set forth on our quotation and acknowledgment forms and in this Warranty and Claims Policy, we will honor reasonable and justified claims when adequate evidence is provided to show that our Product was defective.

Whenever a customer has a claim concerning a Product, the customer should contact the Customer Service Department. **CUSTOMERS SHOULD NOT RETURN ANY PRODUCTS OR PARTS OR COMPONENTS TO US WITHOUT FIRST CONTACTING US.**

When contacting us, customers should have the following information available:

1. Customer name, location, purchase order number and date of purchase.
2. Serial number.
3. Product/Model number.
4. Equipment installation date.
5. Equipment failure date.
6. Application or service of unit.
7. Details of claim.

We shall have the option of requiring the return of the defective product to our factory, with transportation charges prepaid, to establish the claim and our liability shall be limited to the repair or replacement of the

defective product, F.O.B. our factory. Onyx Valve Co will not assume costs incurred to remove or install defective products nor shall we incur back charges or liquidated damages as a result of warranty work.

We will notify the customer whether it will be necessary to return the Product or part or component to us. If so, we will issue the customer an "AUTHORIZED RETURN GOODS NUMBER" that must be attached to the Product or part or component before returning it. All items returned to us must be returned freight prepaid.

If we determine that the Product or part or component is defective and that the defect is covered by our warranty, we will, as explained above, correct the defect or refund the purchase price.

Customers should promptly inspect all Products upon delivery. Customers must make claims for shortages within 20 days after the date of shipment from our factory or warehouse. We suggest that shortages be noted on the bill of lading or packing list, which should then be sent to our Customer Service Department for verification.

All other claims must be submitted within 60 days after the date of shipment from our factory or warehouse, or in the case of an alleged breach of warranty, within 60 days after the date within the warranty period on which the defect is or should have been discovered.

Claims may not be deducted from payments made to us unless we have so agreed in writing in advance.