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1.0 GENERAL

- 1) This manual is intended to provide users with direction and guidance for the maintenance of FLOW SAFE F70U Series valves. This manual indicates the proper method of valve disassembly, soft goods replacement, and valve reassembly. FLOW SAFE provides this manual as a guideline and reference only. It is not intended to serve as a training manual or manufacturing guide. FLOW SAFE assumes no responsibility for personal or property damage that may occur in conjunction with this manual.
- 2) FLOW SAFE recommends that all valves be placed on a regular maintenance schedule that includes the routine replacement of softgoods. FLOW SAFE recommends softgoods replacement every three years but cautions that each customer make their own determination and set their own schedule based upon use and environment. FLOW SAFE believes that when maintenance and reassembly is performed as outlined in this manual there is no safety hazard.

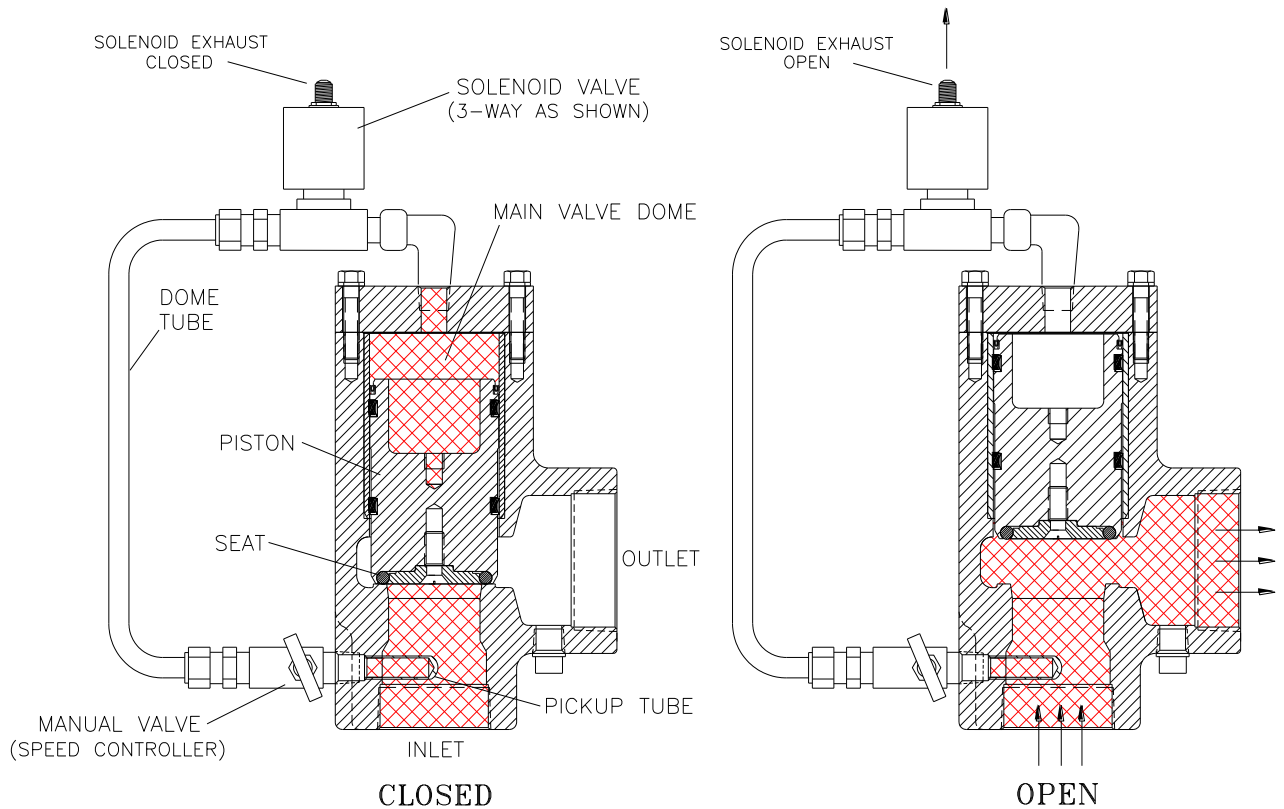
Cycling the valve at least once a year is considered to be good practice to verify operation.
- 3) When a new valve leaves FLOW SAFE, it has been manufactured and tested by trained and experienced personnel. When you remove a valve from your system and perform the maintenance tasks that are outlined herein you will need proper training.

Do **not** attempt to accomplish these tasks without adequate training and understanding of the valve operation.
- 4) Any and all stated or implied warranties that are in effect during the purchase of a new FLOW SAFE valve are null and void once the valve has been disassembled by someone other than approved FLOW SAFE personnel.
- 5) It is highly recommended that all instructions herein be read in full prior to any assembly, disassembly, or operation of this equipment.
- 6) The noted manufacturer's standard lubricants should be used only if compatible with process fluid and application.
- 7) Specific design details described in this document are subject to change without notice.
- 8) Should the need arise for general assistance, contact the FLOW SAFE Sales department at (716) 662-2585 or (800) 828-1036. For more detailed technical assistance, contact the FLOW SAFE Engineering department at (716) 667-3640.

2.0 DESCRIPTION, OPERATION, SERVICE ENVELOPE, INSTALLATION, and STARTUP

2.1 DESCRIPTION / OPERATION

Typical valve assembly (1-1/2" x 2" size shown):



The FLOW SAFE F70U Series unloader valve provides a means to control flow for a variety of process flow applications, such as compressor and blower unloading. It is designed to be repeatedly cycled at full pressure throughout its range of rated temperatures.

System pressure is routed from below the valve through the pickup tube to the dome cavity above the main piston. This dome pressure, acting on a differential area between the top and bottom of the piston, creates a downward force on the seat to keep it closed.

Control valves in the dome tubing usually include an automatic (electric or pneumatic) valve to exhaust dome pressure and thus open the main valve, and a manual valve to adjust the rate of dome loading (pressurization) desired for the closing cycle.

The F70U uses an elastomeric O-ring as the main seat to achieve tight seating. A dynamic piston seal guards against leakage from the dome cavity to the discharge. Wear rings on the piston help to provide smooth and consistent operation, particularly for high-cycle conditions. Standard construction of the main valve assembly includes threaded (in the 1-1/2 x 2 size) or ANSI/ASME Class 150 flanged connections rated to 285 psig.

2.2 SERVICE ENVELOPE

SEAT MATERIAL	PROCESS TEMP. (° F)		UNLOADING PRESSURE	
	Min.	Max.	Min.	Max.
Buna-N	-20	275	5 psig	285 psig
Viton	-20	400	5 psig	285 psig

2.3 INSTALLATION

Prior to installation, check that the valve size and pressure rating meet system requirements. The F70U unloader valve should be installed in accordance with accepted piping practices and, if applicable, governing electrical codes. An upright orientation is preferred for maximum seal life.

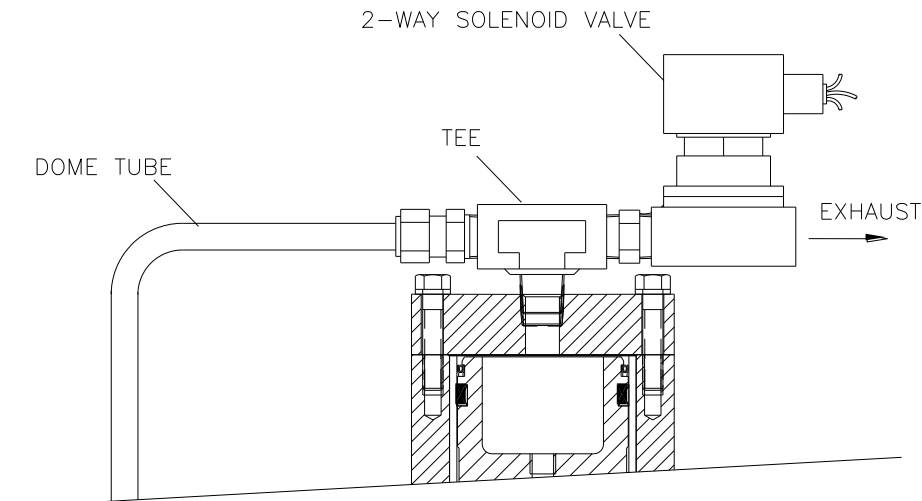
F70U unloader valves may be furnished with dome tubing and control valves assembled at the factory, based on customer specification. Guidelines in the next paragraphs should be followed if an F70U main valve only has been provided for installation.

The exhaust path from the dome should be free from restrictions (additional valves, filters, etc.) for the fastest main valve opening times. If a filter is used, it should be installed in the dome tube between the main valve inlet and solenoid or tee fitting at the cap.

A 3-way solenoid valve should be installed as shown on Page 4, with its pressure port connected to the dome tube, the cylinder port connected to the main valve dome (cap), and the exhaust port open or connected to an appropriate discharge system.

If a 2-way solenoid valve is used to control dome pressurization, it must be installed on a separate branch from the dome tube connection to the main valve cap, such as at the open end of a tee (see below).

For any electric or pneumatic control valve, a “normally closed” or “normally open” configuration should be selected based on the control system used and the control valve manufacturer’s specifications.



2.4 STARTUP

Foreign particles or dirt can damage the valve and make it inoperative. Prior to installation, clean out the piping thoroughly. If the valve is not installed immediately, inlet and outlet connections should be protected and covered.

With the solenoid or pneumatic valve in its proper state to allow the main valve dome to pressurize, the F70U assembly is ready for service and system pressure can be increased to the operating range.

Inspection and maintenance should be performed on a regular basis, typically once a year, depending on the service conditions.

3.0 MAIN VALVE MAINTENANCE

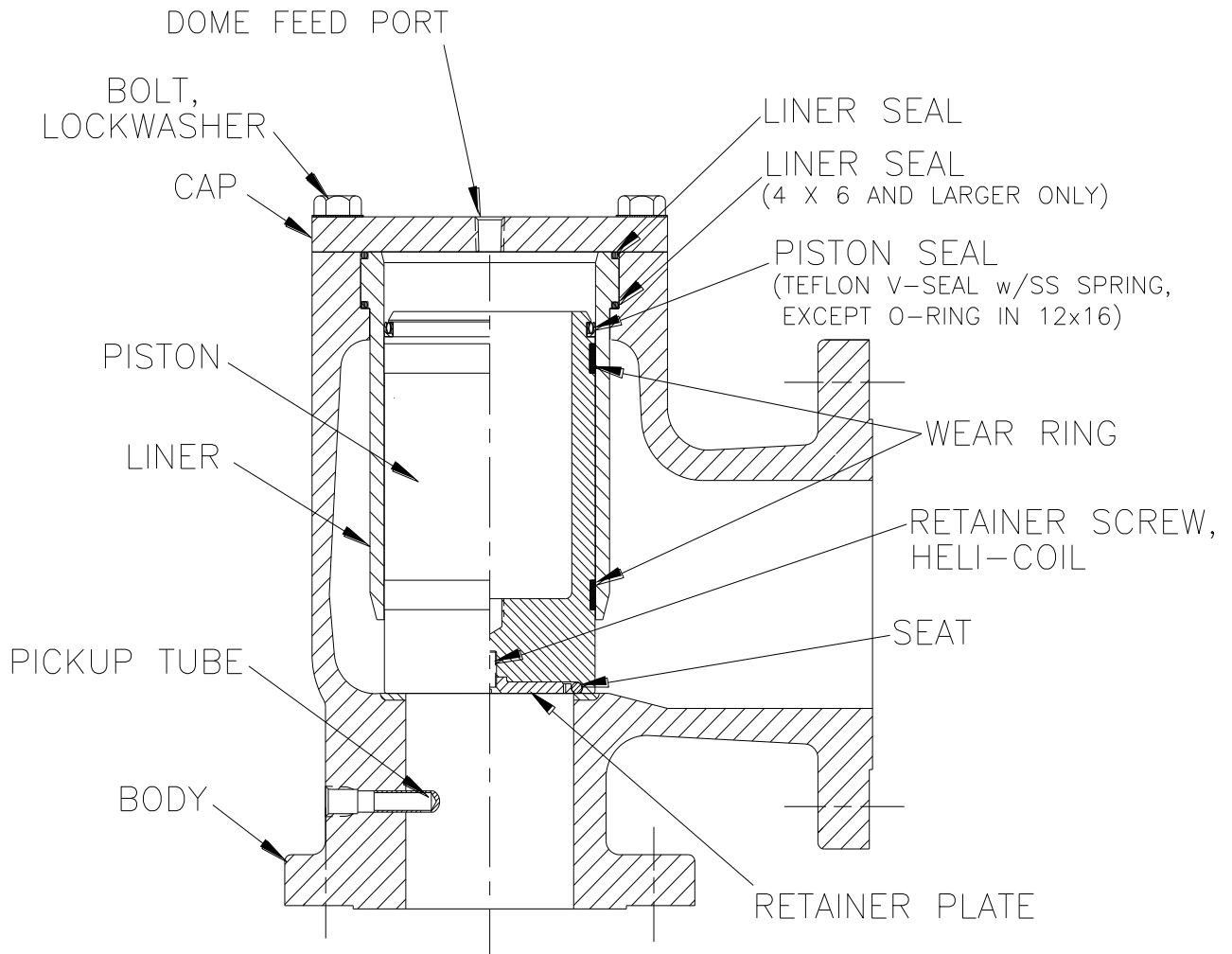
3.1 DISASSEMBLY OF THE F70U SERIES MAIN VALVE

(See illustrations on Pages 7 and 8.)

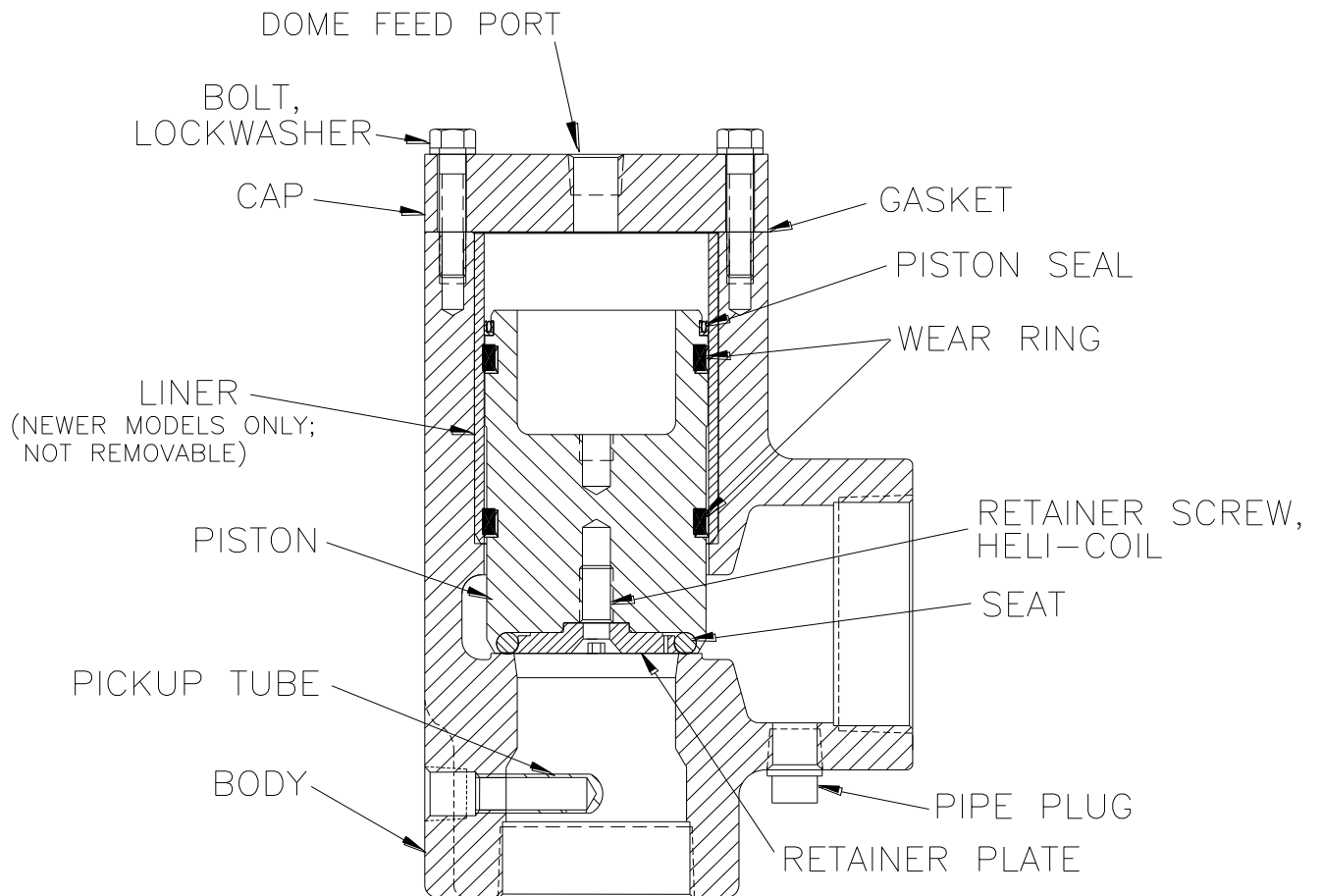
CAUTION: Depressurize the system or safely block incoming line pressure before attempting to disassemble or remove any valve from the installation.

- 1) Remove the control valve(s) and dome tube.
- 2) Remove the bolts and lockwashers that hold the cap in place.
- 3) With the cap removed, remove the top liner seal or gasket. Newer valves of the 1-1/2" x 2" size have a press-in liner. In older 1-1/2 x 2's, which do not have a liner, the piston seal and wear rings bear directly against a machined bore within the body casting.
- 4) Carefully remove the piston assembly. Newer pistons may have an interior threaded hole into which a cap bolt can be inserted to use for lifting. Note that the liner may come out with the piston assembly. Care must be taken during this removal because any damage might result in an eventual sealing problem when the valve is reassembled.
- 5) If the piston seal is in need of replacement, pry from underneath using a flat-blade screwdriver and work the seal over the edge of its retaining lip at the top of the piston.
- 6) The liner may then be removed (except in 1-1/2 x 2 size); again, care must be taken not to damage the liner. Do not attempt to pry or force the liner out as you may score the surface and cause a sealing problem. Note that on valves 4" x 6" and larger, there is a second liner O-ring seal in the main valve counterbore where the liner is supported.
- 7) To remove the seat, first remove the retainer screw. As the screw is held in the piston with the aid of a locking Heli-Coil thread insert, considerable torque should be required to loosen it.
- 8) Remove the retainer plate and then the seat. If required, pry the retainer plate using the center hole. Do not pry where the plate OD contacts the O-ring seat.
- 9) As required, install new main valve softgoods and reassemble valve per the instructions in Section 3.2. Replacement parts are referenced in Section 7.0 of this manual.

Assembly illustration, F70U main valve (2 x 3 and larger):



Assembly illustration, F70U main valve (1-1/2 x 2):



3.2 REASSEMBLY OF THE F70U SERIES MAIN VALVE

(See illustrations on Pages 7 and 8.)

- 1) Prepare new softgoods for installation. Take care in handling of all seats, seals, gaskets, and metal sealing surfaces. All parts should be clean and free of any debris or contaminants.
- 2) Reinstall the liner (except 1-1/2 x 2) and liner seal(s) into the body. Do not nick or excessively stretch the liner seal O-rings. The bottom O-ring (for 4 x 6 and larger) may be carefully set in its sealing area in the body before the liner is inserted, or it may be fitted onto the liner and, if necessary, held in place with a suitable lubricant (e.g., Dow Corning 33 or Molykote). For 2 x 3 and larger valves, the top liner seal should be lightly pressed into place in its groove, such that it is evenly spread around the liner circumference and will not be pinched when reinstalling the valve cap. For the 1-1/2 x 2 size, position the gasket on top of the body.
- 3) Insert the seat into the bottom of the piston, using care to position the seat completely within the groove. Ensure that there are no scratches, gouges, or particles on the seat, and that it is not twisted. Carefully position the retainer plate over the seat.
- 4) Apply Vibra-tite or Loctite to the retainer screw threads. Insert the screw(s) into the piston and tighten firmly, as follows:

<u>Valve size</u>	<u>Retainer screw size</u>	<u>Torque</u>
1-1/2x2, 2x3, 3x4	1/4-20UNC	80 – 90 in-lbs
4x6, 6x8, 8x10	1/2-20UNF	30 – 35 ft-lbs
12x16	3/8-24UNF	12 – 15 ft-lbs

IMPORTANT: Retainer screw must meet firm resistance against locking Heli-Coil in piston, and require a wrench to completely install. Replace Heli-Coil if worn or damaged.

- 5) For all sizes except 12 x 16, install the Teflon piston seal by pressing it evenly over the beveled retaining lip at the top of the piston. For the 12 x 16, lightly lubricate the O-ring piston seal with Dow Corning 33 or equivalent and fit into its groove.
- 6) Fit the wear rings in their grooves around the piston assembly. While holding the wear rings (especially the free ends) in place, carefully lower the piston assembly into the liner. The piston should move freely up and down, with some resistance from the seal and wear rings. It is critically important that this installation result in even seating of the soft seat onto the machined nozzle surface in the valve body.
- 7) After checking placement of the top liner seal or gasket [See Step (2)], as applicable, the cap may then be positioned on top of the body.
- 8) The cap bolts, with washers, can then be reinserted. Apply anti-seize compound to bolt threads. The following torque values are recommended:

<u>Valve Size</u>	<u>Cap Bolt Size</u>	<u>Torque (ft-lbs)</u>
1-1/2x2	1/4-20UNC	8 - 10
2x3, 3x4	1/2-13UNC	55 - 60
4x6	1/2-20UNF	55 - 60
6x8	5/8-18UNF	80 - 90
8x10, 12x16	3/4-16UNF	150 - 160

- 9) The main valve is now assembled. It should be tested per Section 4.0 before reinstalling control valve(s) and dome tube, at which time tests described in Section 5.0 should be performed prior to return to service.

4.0 TESTING OF THE MAIN VALVE ASSEMBLY

When main valve has been reassembled, it should be tested for leakage and piston lift on a test stand according to the following. Refer to the figures on Pages 7 and 8.

- 1) Connect a pressure source to the dome feed port. Plug any openings in the outlet area, such as the drain.
- 2) To test the piston seal and liner seal(s) or gasket, pressurize the dome with at least 5 psig (and not greater than 285 psig) of air.
- 3) With a bubble tester or wet paper towel over the outlet, verify that there is no leakage. Also verify no leakage around the cap and cap bolts by spraying the area thoroughly with soapy water and checking for bubble formation.
- 4) To test the main valve seat, block off the pickup tube opening in the body by inserting a pipe plug.

CAUTION: Pressurizing the inlet to a higher value than dome pressure may cause the main piston to open.

Repressurize the dome as in (2), and introduce pressure at the inlet up to the value of dome pressure. Check for leakage at the main valve outlet.

- 5) With the dome feed port open, pressurize the inlet up to approximately 5 psig. The piston should open slightly, allowing air to discharge through the outlet of the valve.
- 6) To check for full piston lift, install a blind flange on the valve outlet. Again pressurize the inlet up to 5 psig. The piston should fully lift and hit the bottom of the cap, as indicated by sound or a rod placed through the dome feed port. If this test is not feasible, attempt to confirm free piston travel by reaching in the main valve outlet and manually lifting the piston.
- 7) If leakage is noted past any seal or seat, disassemble the valve and examine the parts for contamination or damage, or refer to the troubleshooting guide in Section 6.0.
- 8) Proceed to the next section for testing of the complete valve assembly.

5.0 FINAL ASSEMBLY TESTING

- 1) Reinstall dome tube and any control valves.
- 2) With the solenoid or pneumatic valve connected to the normal power or air supply, verify that it operates according to its “normally closed” or “normally open” configuration. Leave this valve in its normal position for system operation, to enable the main valve dome to pressurize.
- 3) Ensure that the manual valve (speed controller) is open.
- 4) Verify that main piston is down in the seated position.
- 5) Pressurize the main valve inlet to approx. 10 psig.
- 6) Verify that the main piston remains closed and is leak-tight.
- 7) Actuate the solenoid or pneumatic valve and verify that dome exhausts and main piston opens.
- 8) Restore the solenoid or pneumatic valve to its normal position and verify that dome repressurizes and the main piston closes.
- 9) Adjust the manual valve (speed controller), if desired, to change the rate of dome repressurization. Repeat Steps (5) through (8).

6.0 TROUBLESHOOTING GUIDE

Symptom	Possible Cause	Remedy
The main valve leaks around the cap or cap bolts.	Cap bolt(s) loose, or insufficient / uneven bolt torque.	Retighten the cap bolts per Section 3.2.
	Sealing surface on cap is damaged.	Repair defect or replace cap.
	Upper liner seal or gasket is damaged or contaminated.	If damaged, replace with new seal(s). If contaminated, clean and reinstall.
	Air trapped in cap bolt hole(s).	Wait until leakage stops (applicable to very recent cap reinstallation only).
The main valve leaks through the outlet.	Damage to, or contamination on: piston seat or main valve nozzle, piston seal / sealing surface, or lower liner seal / sealing surface.	Disassemble the valve, remove the piston and liner, and examine the seat, seals, and sealing surfaces under magnification. If damaged, replace with new part(s); if contaminated, clean and reinstall.
The main valve does not close.	Dome tube, pickup tube, or filter damaged or plugged.	Clean / unplug, or replace if damaged.
	Pickup tube is oriented incorrectly.	Ensure intake port in tube is facing upstream (toward flow to the inlet).
	Control valve(s) not functioning properly.	Check valves for proper position, orientation, and control connections.
	Piston seal is leaking.	Perform test described in Section 4.0, Steps (1) – (3).
	Contamination between liner and piston.	Disassemble valve. Clean surfaces; remove any burrs/gouges if possible or replace damaged parts.
The main valve does not open.	Outlet piping is obstructed or too small.	Check outlet piping for obstructions. Pipe size should be at least the nominal size of the valve outlet.
	Dome pressure exhaust path blocked.	Check control valve(s) for proper operation; clear exhaust path of any blockage.
	Piston seized.	Check piston and liner surfaces and wear rings for contamination or damage. Clean or replace parts as necessary.
	Inlet or outlet blocked.	Clear blockage in a safe manner.

7.0 ACCESSORIES

7.1 SOFTGOODS KITS

Valve Size	Softgoods Kit Part Number
1-1/2 x 2	UN-15X02-7XY
2 x 3	UN-02X03-7XY
3 x 4	UN-03X04-7XY
4 x 6	UN-04X06-7XY
6 x 8	UN-06X08-7XY
8 x 10	UN-08X10-7XY
12 x 16	UN-12X16-7XY

<u>X = Seat Material</u>	
<u>Y = Liner Seal / Gasket Material</u>	
Code	
B	Buna-N
V	Viton
E	EPR / EPDM
Z	Kalrez
C	Chemraz
N	Lo-temp nitrile

*Most common elastomers listed; contact Flow Safe for availability of other materials.
Piston seal is Teflon with stainless steel spring.*

Softgoods Kit contents
(See illustrations on Pages 7 & 8)

	Qty.
Seat	1
Wear ring	2
Liner seal (2 x 3, 3 x 4)	1
(4 x 6 and up)	2
Gasket (1-1/2 x 2 only)	1
Piston seal	1

7.2 INTERNALS KITS

Applicable to most common F70U sizes; contact factory for other replacement parts.

	Kit P/N
1-1/2 x 2	02-3003
2 x 3	02-3001
3 x 4	02-3002

Internals Kit contents
(See illustrations on Pages 7 & 8)

	Qty.
Piston	1
Retainer plate	1
Retainer screw	1
Liner (except 1-1/2 x 2)	1