



FLOW SAFE

High Performance Safety Relief Valves

F84L SERIES LIQUID RELIEF VALVE

- **PLASTIC SEATED**
- **- 2, - 3, - 4, - 8, - G, - J Orifices**



INSTALLATION, OPERATION, & MAINTENANCE MANUAL

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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 F84L Series liquid relief 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.

During routine maintenance the internal components of the valve should be inspected for damage or abnormal wear. The valve should also be inspected for excessive corrosion. A corrosion allowance of 0.06" (1.5 mm) is designed into all carbon steel components subject to corrosion. Operating the valve with corrosion exceeding this allowance is not recommended.

Cycling the valve at least once a year is considered to be good practice to verify operation and to confirm that parts are not seized.

- 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.

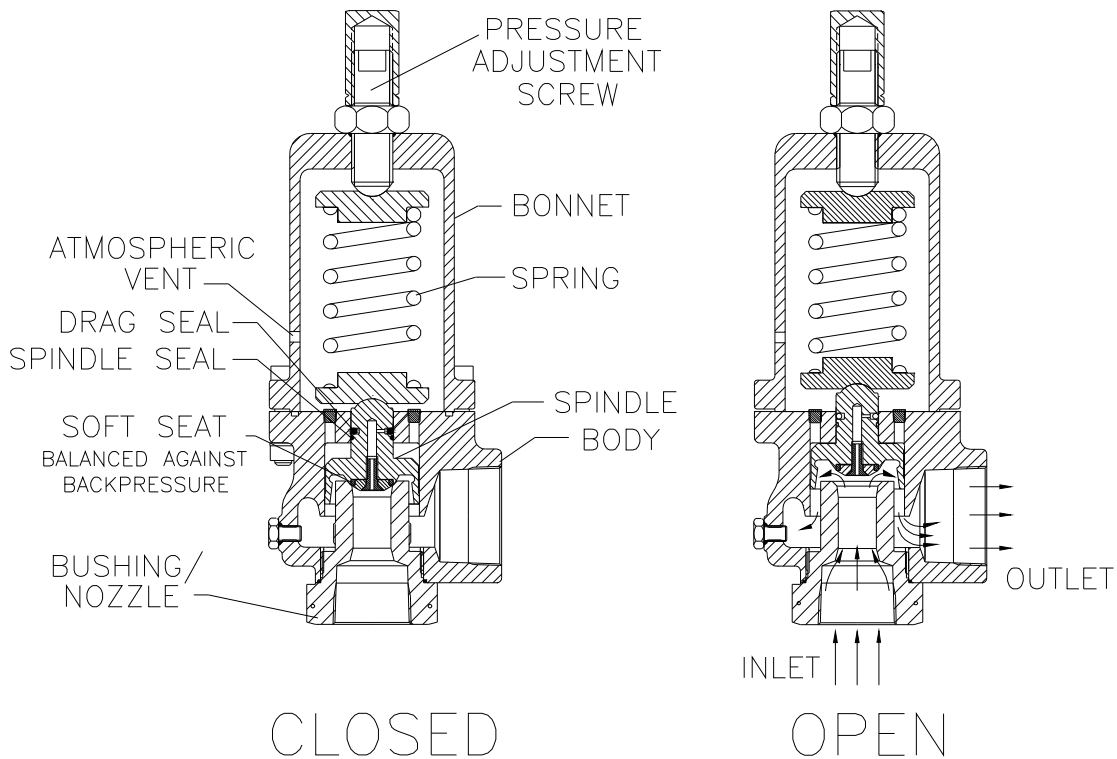
- 4) Any and all stated or implied warranties that are in effect during the purchase of a new FLOW SAFE valve are null and void once the valve has been disassembled by someone other than approved FLOW SAFE personnel.

All repair and resetting of "UV"-stamped safety relief valves should be performed either by FLOW SAFE, Inc., or by a National Board-certified valve repair shop holding a "VR" (Valve Repair) stamp.

- 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 in Orchard Park NY or (832) 678-2070 in Houston TX. For more detailed technical assistance, contact the FLOW SAFE Engineering department at (716) 662-2585.

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

2.1 DESCRIPTION / OPERATION



The FLOW SAFE F84L Series liquid relief valve is a direct-acting spring-loaded relief valve, suitable for liquid service. The Type F84L is plastic-seated with elastomeric seals.

Orifice sizes are available in -2, -3, -4, -8, -G, and -J with set pressures from 30 to 24,277 psig (depending on the orifice size).

Blowdown is nonadjustable, designed to be a maximum of 20% for the -3, -4, -8, -G, and -J. For the -2 orifice, blowdown may approach 30-35% whether the valve pops fully open or partially opens at low flow rates.

2.2 SERVICE ENVELOPE

	BODY SIZE	ORIFICE SIZE					
		- 2	- 3	- 4	- 8	- G	- J
Minimum Set Pressure, psig (barg)	All	50 (3.45)	50 (3.45)	30 (2.1)	30 (2.1)	30 (2.1)	30 (2.1)
Maximum Set Pressure, psig (barg)	2-pc. Micro body	24,277 (1674)	----	----	----	----	----
	C, D, E Body w/ small bonnet	----	720 (49.6)	720 (49.6)	720 (49.6)	668 (46)	298 (20.5)
	C, D, E Body w/ XL bonnet	----	4292 (296)	4292 (296)	4292 (296)	3705 (255)	2700 (186)
	C Body w/ XXL bonnet	----	8382 (578)	8382 (578)	----	----	----

SOFT GOODS	Temperature, °F (°C)	
	MAX.	MIN. *
F84L Seats		
PI / PAI / Vespel	500 (260)	-65 (-54)
PEEK	525 (273)	0 (-18)
Teflon (PTFE)	400 (204)	-65 (-54)
Kel-F (PCTFE)	400 (204)	-65 (-54)
F84L Spindle Seals		
Buna-N	275 (135)	-30 (-34)
Viton	400 (204)	-30 (-34)
EPR	325 (163)	-65 (-54)
Kalrez	525 (273)	0 (-18)
Polyurethane	225 (107)	-65 (-54)

* Confirm service / application with factory.

2.3 INSTALLATION

Prior to installation, check that the set pressure on the nameplate is as required, and meets the system requirements.

The F84L Series liquid relief valve should be installed in the upright position per the figure on the next page, as close as possible to the pressure source, to minimize pressure losses between the system and the valve. This should be in accordance with accepted piping practices, as set forth in the API 520 Part II, which recommends that inlet piping pressure losses should not exceed 3% of the set pressure when the valve is flowing.

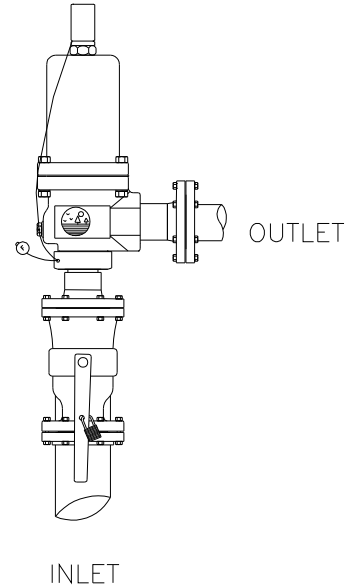
The valve discharge pipe should be sufficiently large so that backpressure does not exceed system design conditions when relieving. High backpressure may diminish capacity below the value assumed during the valve's sizing and selection process.

F84L Series valves are balanced against superimposed backpressure, so that the set pressure will not change with backpressure.

Make sure that the inlet piping/flanges have an opening equal to or greater than the valve's inlet diameter. Make sure that there are no obstructions like gaskets, fittings, etc., in the flow path to restrict the flow or cause chatter. Also, misaligned piping connections may result in leaks or induce stresses in the valve assembly that interfere with good operation. Discharge stacks exposed to the elements should be configured so as to avoid the accumulation of snow and ice.

If a block valve is used below the relief valve, it should be opened before pressurizing the system. This block valve should be locked open during normal system operation.

Use only the wrench flats on the valve inlet bushing, taking care not to make any wrench marks, for tightening and installation. Do not wrench on the cast body or bonnet.



F84L SERIES
TYPICAL INSTALLATION

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.

Pressure can be applied to the valve as system pressure increases, or by opening the block valve (if there is one) after the system has attained operating pressure. Verify the valve seat is leak-tight, in accordance with Section 4.4.

The valve is now ready for service. Inspection and maintenance should be performed on a regular basis, typically once a year, depending on the service conditions.

3.0 VALVE MAINTENANCE

WARNING: It is extremely dangerous to attempt to disassemble any valve while it remains in service with incoming line pressure. Also, improper assembly of the valve may result in leakage or failure of the valve when returned to service.

3.1 DISASSEMBLY

(See Illustrations on Pages 13 through 15)

- 1) Remove the valve from service, or adequately and safely block the incoming pressure before disassembling the valve and performing maintenance. NOTE: If bushing remains connected to the system piping, then the valve's spindle will fall out of the body as it is removed.
- 2) Cut and remove the lockwire.
- 3) For valves with lift lever, first remove the lock nut and lift lever. Slowly unscrew the bushing, holding shaft. Unscrew the lift lever housing.
- 4) Remove the pressure adjusting (PA) screw cap. Measure the height of the PA screw above the body and record value. For valves with lift lever, measure the distance from the jam nut to top of threaded lifting rod. Then remove jam nut and lift nut.
- 5) Loosen the PA screw lock nut. Loosen PA screw until the spring load is removed.
- 6) a.) Bolted-bonnet valves: Unscrew and remove the four bolts, nuts, and lockwashers between the body and bonnet. Remove spring washer(s) and spring, and lifting rod subassembly (if applicable). Remove the bonnet, including attached bonnet base if an older F84L-4 or -8 "large body," where these two pieces are joined by a retaining ring.
b.) F84L-2 Two-piece Micro body: Unscrew the bonnet from the body. Remove spring washers and spring.
- 7) For the -G and -J orifices, make sure the four small pipe plugs are securely in place in the top of the body.
- 8) Unscrew and remove the bushing, using wrench flats.
- 9) Remove the spindle assembly.
- 10) a.) For the bolted-bonnet valve sizes and -2 with retained seat, remove retainer screw, retainer, and seat. Existing O-rings may be removed by carefully prying them out of the spindle grooves.
b.) For the F84L-2 with push-in seat, remove the seat by prying it out with a sharp-edged tool or small screwdriver. It may first need to be drilled through the center using a 1/16" or 3/32" diameter drill bit. To remove the two spindle seal O-rings, which are situated in small grooves in the body, a sharp pointed metal tool must be used to carefully pry them out. Try not to gouge the surrounding metal surfaces.
- 11) Replace the softgoods per the instructions in Section 3.2.
 - Replacement parts may be found in the appropriate FLOW SAFE softgoods kit, as listed in Section 5.0 of this manual.

3.2 REASSEMBLY

- 1) Reassembly of these valves is basically the reverse of the disassembly.

NOTE: Care must be taken in the handling of all items, particularly softgoods.
- 2) Inspect condition of nozzle seating surface and spindle guide surface inside body. Buff out or polish any scratches that may interfere with a good seal, or replace part if necessary.
- 3) Apply Neverseez or DuPont Krytox (for oxygen service) to all straight threads.
- 4) Install the seat dry. For bolted-bonnet valves, insert the plastic seat, seat retainer, and retainer screw into the spindle. Apply Loctite or Vibra-tite to retainer screw threads. As screw is tightened, ensure that it meets firm resistance against the locking Heli-Coil in spindle. For the F84L-2 with push-in seat, the radiused or chamfered edge of the seat must be facing out; push the seat squarely into the spindle cavity using a clean finger or other soft surface. Do not nick or scratch the sealing edge.

- 5)
 - a.) Bolted-bonnet valve sizes and -2 with retained seat: Carefully install new drag seal / spindle seal(s) in grooves on spindle. Desco 600 grease should be applied to the outside of these O-rings, except that, for all -2 valves and -3, -4, and -8 valves below 100 psig, Dow Corning Molykote 33 or equivalent should be used.
 - b.) F84L-2 with push-in seat: Carefully push new spindle seal O-rings lubricated with Dow Corning Molykote 33 into the body grooves using a blunt-tipped instrument or small screwdriver. Even though they may initially twist, they can be gently worked back and forth until they drop into the groove.
- 6) Insert the spindle assembly into the body, making sure that it travels freely on the guide surface.
- 7) Position the bushing seal on the appropriate shoulder of the bushing.
- 8) Screw the bushing / seal assembly into the body and tighten using the wrench flats.
- 9) Assemble the spring washer(s), spring, and lifting rod subassembly (if applicable) into the bonnet.
- 10)
 - a.) For bolted-bonnet valve sizes, assemble the bonnet, adapter plate (for XXL "C" bonnet), bolts, nuts, and lockwashers to the body. Torque main bonnet bolts to following value:

12-15 ft-lbs	--	3/8-in bolts marked "B8" on 'C' body
25-30 ft-lbs	--	1/2-in bolts marked "B8" on 'D' or 'E' body
65-70 ft-lbs	--	1/2-in bolts marked " B8 " on 'D' or 'E' body
 - b.) For the F84L-2, ensure that the body and bonnet threads are clean. Then, firmly screw the bonnet onto the body.
- 11) Screw the PA screw and lock nut into the top of the body, with top of screw at previously recorded value.
- 12) For lift levers, assemble PA screw and lock nut around lifting rod. Then reassemble the lift nut and jam nut to previously recorded position. Assemble the lift lever housing and then the bushing, crush rings, shaft, lift lever, and lock nut.
- 13) Ensure that the rear bolt and seal are secured in the back of the body (except F84L-2).
- 14) The valve is now completely assembled and ready to be tested. See Section 4.0.

4.0 VALVE TESTING AND ADJUSTMENT

The following tests and adjustments are necessary for F84L liquid service valves: set pressure and seat tightness. Blowdown is not adjustable, and is fixed at approximately 15 - 20% (20 – 35% for -2 orifice size) of set pressure.

4.1 TEST EQUIPMENT

Where practical, the F84L should be set using water or other suitable liquid. To obtain full-flow conditions and observe blowdown, a sufficiently large pressure vessel will be needed. Setting the valve on air may damage the seat and is not recommended.

4.2 SETTING / ADJUSTMENT TOLERANCES

<u>Set Pressure:</u>	<u>Set Pressure</u>	<u>Tolerance</u>
	> 70 psig	± 3% of specified set pressure
	≤ 70 psig	± 2 psi

Seat Tightness: There should be ZERO leakage with inlet pressure at or below:

- For F84L -3, -4, -8, -G, -J:
- **0.90 x set pressure**, if set pressure > 100 psig
- **0.80 x set pressure**, if set pressure ≤ 100 psig
- For F84L-2:
- **0.90 x set pressure**, if set pressure > 500 psig
- **0.80 x set pressure**, if set pressure ≤ 500 psig

4.3 SET PRESSURE ADJUSTMENT

- NOTES:
1. Set pressure is defined as 93% of the “gush” (pop) pressure. This corresponds to the first steady stream if valve is being set on a low-capacity test system.
 2. If the set pressure is being changed, then the spring, spring washer, PA screw, and bonnet may need to be changed. Consult the factory or an authorized FLOW SAFE assembler for the correct parts.

- 1) Remove the PA screw cap (if installed), loosen the PA screw lock nut, and screw the PA screw in (clockwise) most of the way.
- 2) Increase the inlet pressure to 1.075 ($1 \div 0.93$) of the nameplate set pressure, and then unscrew (counterclockwise) the PA screw until the valve “gushes” liquid. Full rated flow for the valve will occur within 110% of set pressure (approx. 102% of “gush” pressure). Tighten down the lock nut and retest. Readjust as required.
- 3) Install and tighten down the PA screw cap or lift lever housing. Test valve one more time.

4.4 SEAT TIGHTNESS

- 1) After any repairs and set pressure adjustments, seat tightness should meet the criteria stated in Section 4.2.
- 2) If the valve leaks after repair, refer to the troubleshooting guide on Pages 11 & 12. Check for:
 - Even seating between the spindle and bushing. With the F84L’s, you should be able to see a full circular line contact on the bushing surface. Make sure that the seat is installed all the way in the spindle and that the retainer is tight.
 - Foreign particles trapped between the seat and bushing. If found, they may have damaged the seat, requiring that it be replaced.
 - Scratches in the beveled seating area of the nozzle (bushing).

4.5 LIFT LEVER OPERATION

CAUTION: Do not operate a lift lever unless valve inlet pressure is at least 75% of nameplate set pressure. Prepare the system as necessary to handle a discharge from the valve.

NOTE: The lift lever enables verification that the valve spindle and seat can open freely, but does not allow set pressure to be verified.

- 1) With inlet pressure as stated in the above CAUTION, rotate the lift lever handle clockwise or counterclockwise until it meets resistance.
- 2) Continue rotating the handle slowly until there is indication of flow through the valve. NOTE that, if inlet pressure is greater than reseal pressure (approx. 80% of set pressure), the valve may develop full flow (gush) and will stay open long enough to blow down to that pressure.
- 3) Return the lift lever handle to the down position. If flow through valve could not be achieved, or if the valve does not close, have the valve disassembled and serviced by a qualified organization.

5.0 **ACCESSORIES**

1) **Softgoods Kits**

Orifice	Std. Kit P/N	Lift Lever Kit P/N
- 2	F84L-2-XY	N/A
- 3 / - 4 / - 8	F84L-C-XY	F84L-CL-XY
- G	F84L-G-XY	F84L-GL-XY
- J	F84L-J-XY	F84L-JL-XY

Code	X = Seat Material	Y = Seal Material (Spindle)
T	Teflon	---
K	PCTFE / Kel-F	---
W	PI / PAI / Vespel	---
P	PEEK	---
F	Ekonol-filled Teflon	---
B	---	Buna-N
V	---	Viton
U	---	Polyurethane
E	---	EPR / EPDM
Z	---	Kalrez
C	---	Chemraz
N	---	Lo-temp nitrile

*Most common materials listed; contact Flow Safe for availability of other materials.
Bushing seal and rear seal are Teflon.*

SOFTGOODS KIT CONTENTS (See Pages 13 through 15)

Standard SG Kit:

Qty.	-2	-3 to -J	Description
1	1		Seat
1	1		Bushing seal
--	1		Rear seal
--	1		Drag seal
2	1		Spindle seal

Lift Lever SG Kit (includes Std. items):

Qty.	Description
2	Shaft crush ring
1	Bushing crush ring

2) **Lift Lever Kits**

Contact factory

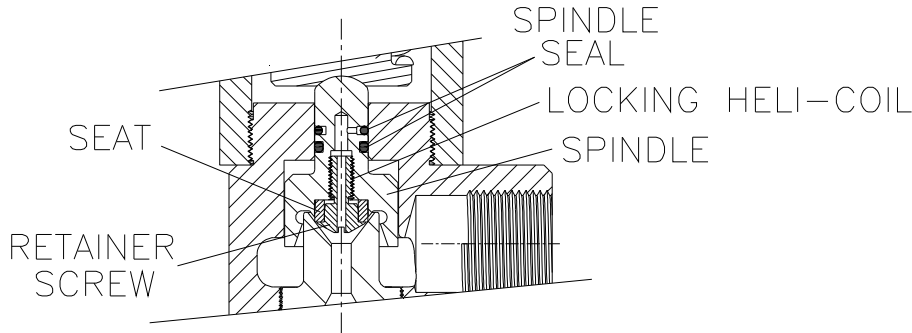
6.0 TROUBLESHOOTING GUIDE:

Symptom	Possible Cause	Remedy
The valve leaks around the bushing.	Inadequate bushing torque.	Tighten until the bushing bottoms firmly on the body.
	Sealing surface on body or bushing is damaged.	Inspect and polish sealing surfaces.
	Bushing seal is damaged or contaminated.	Remove bushing seal. If damaged, replace with new seal. If contaminated, clean and replace.
The valve leaks through the outlet.	Seat or nozzle seating surface is damaged or contaminated.	Disassemble the valve, remove the spindle, and examine the seat and seating surface under magnification. If damaged, replace with new seat; if contaminated, clean and reinstall.
	Uneven torque on body-to-bonnet bolts.	Torque bolts evenly (see Section 3.2 for values)
	Operating pressure is too close to set pressure.	Operating pressure should be less than 90% of set pressure for F84L's at most pressures, but less than 80-85% of set pressures below 500 psig for the F84L-2 or 100 psig for the bolted-bonnet sizes.
The valve leaks through the atmospheric vent hole in bonnet.	Worn / damaged spindle or seals.	Disassemble valve, remove spindle assembly, and inspect spindle and two seals on upper neck. Look for nicks, tears, or flat spots. Replace as necessary.
	Pipe plugs are not installed properly.	Tighten or reinstall plug(s).
The valve does not close.	The spindle is stuck.	Disassemble and check for binding. Deburr or replace parts.
The valve opens below the designated set point.	The spring preload is low due to misadjustment, vibration, or other.	Adjust pressure adjusting screw in (clockwise). Ensure PA screw lock nut and cap are tight.
	The seat leaks due to possible damage, allowing early simmer and pop.	Disassemble and inspect seat; replace if damaged.
	Spring washer is not in proper contact with spindle.	Ensure that dimpled area of spring washer is aligned with top of spindle.
The valve opens above the designated set point.	The spring preload is high.	Adjust PA screw out (counterclockwise).
	The spindle is stuck or sticking.	Disassemble and check for binding. Deburr or replace parts.

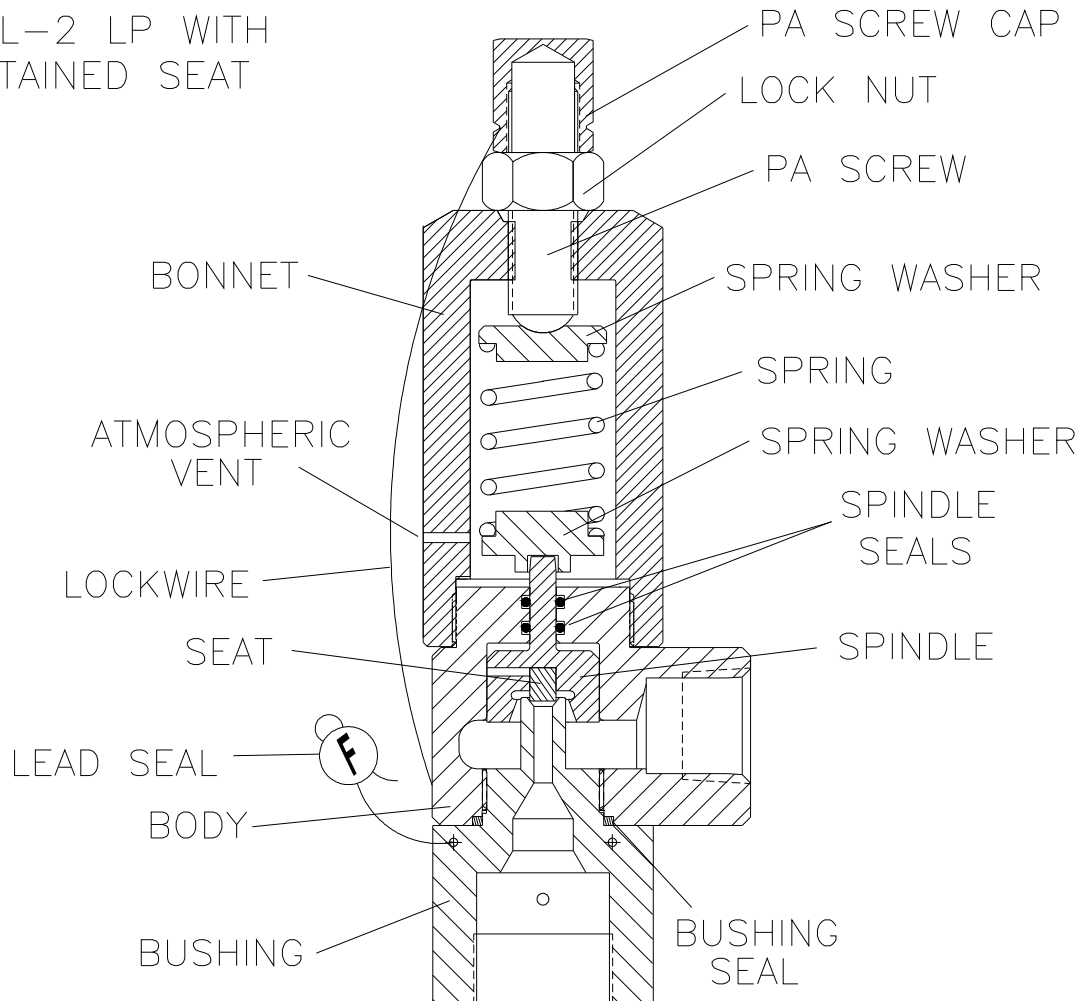
6.0 TROUBLESHOOTING GUIDE (continued):

Symptom	Possible Cause	Remedy
The valve does not open.	Spindle is stuck closed.	Disassemble the valve and examine the sliding surfaces. If damaged, replace. If contaminated, clean.
	Nozzle is stuck to seat.	Disassemble and check seat for permanent impression(s). Harder seat material may be needed.
	The set pressure has not been reached.	Increase inlet pressure. Confirm pressure gage is calibrated.
	Isolation valve is closed.	Open isolation (block) valve.
The valve chatters or rapid-cycles.	The valve is oversized for the application.	Install smaller valve.
	The inlet is choked.	Increase size of inlet piping to be equal to or greater than the valve orifice. Check for piping restrictions or partially closed valves.
	Too much built-up backpressure due to excessive flow, or outlet piping undersized or too long.	Reduce backpressure by reducing flow rate or reworking outlet piping (increase size; shorten; reduce number of turns). It is recommended that outlet piping size be equal to or greater than the valve outlet size.

F84L SERIES VALVE ASSEMBLY ILLUSTRATIONS

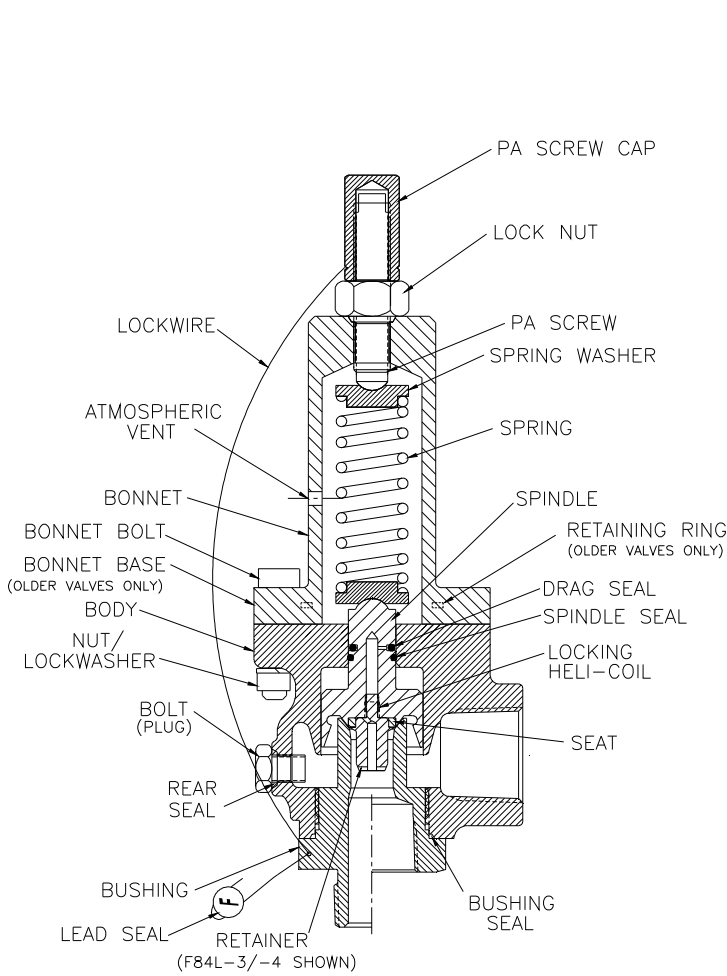


F84L-2 LP WITH
RETAINED SEAT



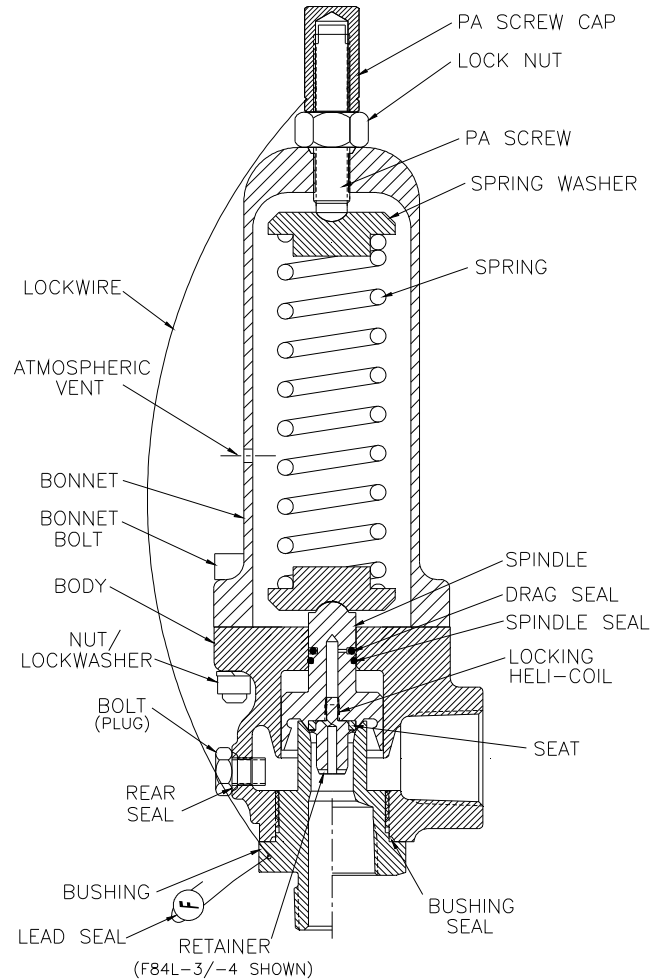
F84L-2
2-PC. MICRO BODY

F84L SERIES VALVE ASSEMBLY ILLUSTRATIONS
(continued)



F84L-3/-4/-8

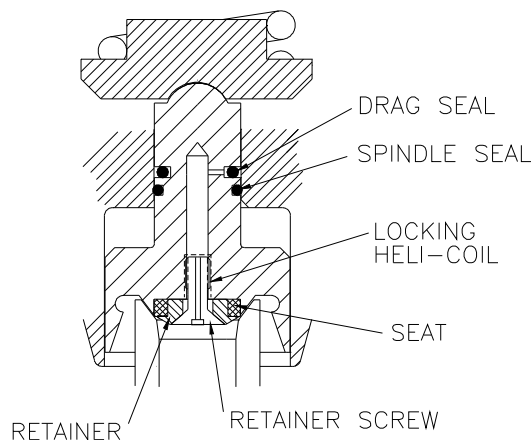
'C' BODY W/ SMALL BONNET (30-720 psig)



F84L-3/-4/-8

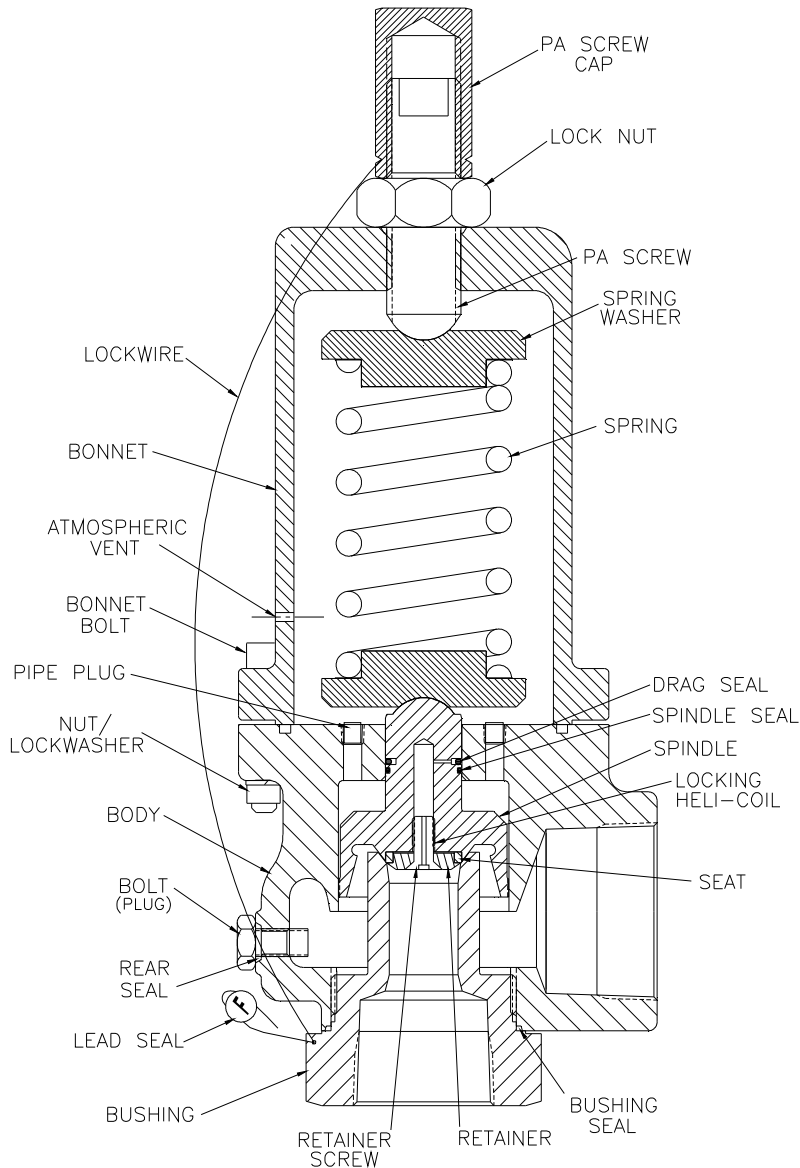
'C' BODY W/ 'XL' BONNET (721-4292 psig)

See Page 15 for typical lift lever assembly.

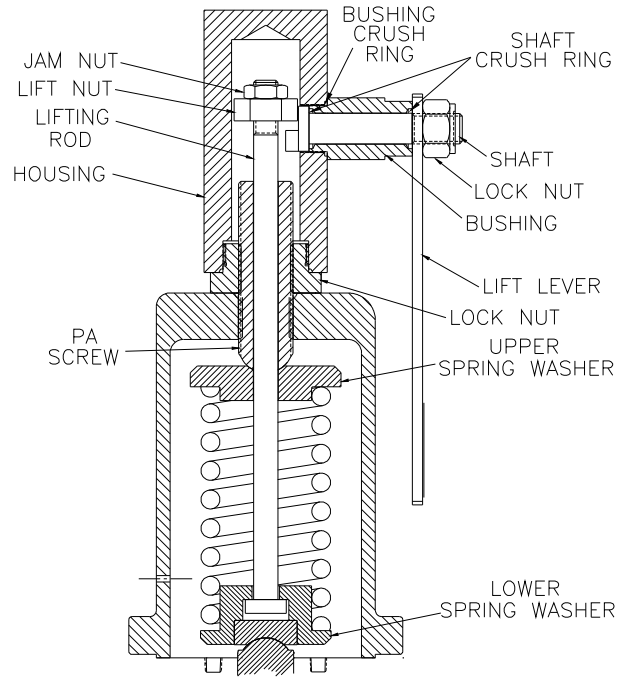


F84L-8 SEAT/RETAINER DETAIL

F84L SERIES VALVE ASSEMBLY ILLUSTRATIONS
(continued)



F84L-G/-J "D" / "E" BODY



F84L LIFT LEVER ASSEMBLY