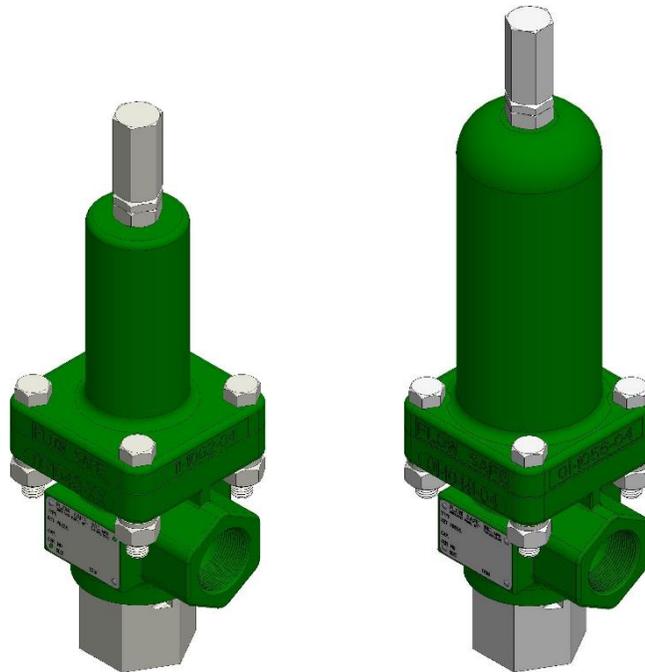




**F88 SERIES
SPRING-OPERATED
SAFETY RELIEF VALVE (GAS/LIQUID)**

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



**INSTALLATION,
OPERATION, & MAINTENANCE MANUAL**

Revision:
Date of Issue:
Approved By:

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A handwritten signature in black ink, reading "Andrew Roberts".

Andrew Roberts
Director of Engineering & Quality



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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 F88 Series safety 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 soft goods. FLOW SAFE recommends soft goods 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 a valve is removed from a system for maintenance, proper training of personnel is required.

Do **not** attempt to accomplish these tasks without adequate training and understanding of the valve operation.

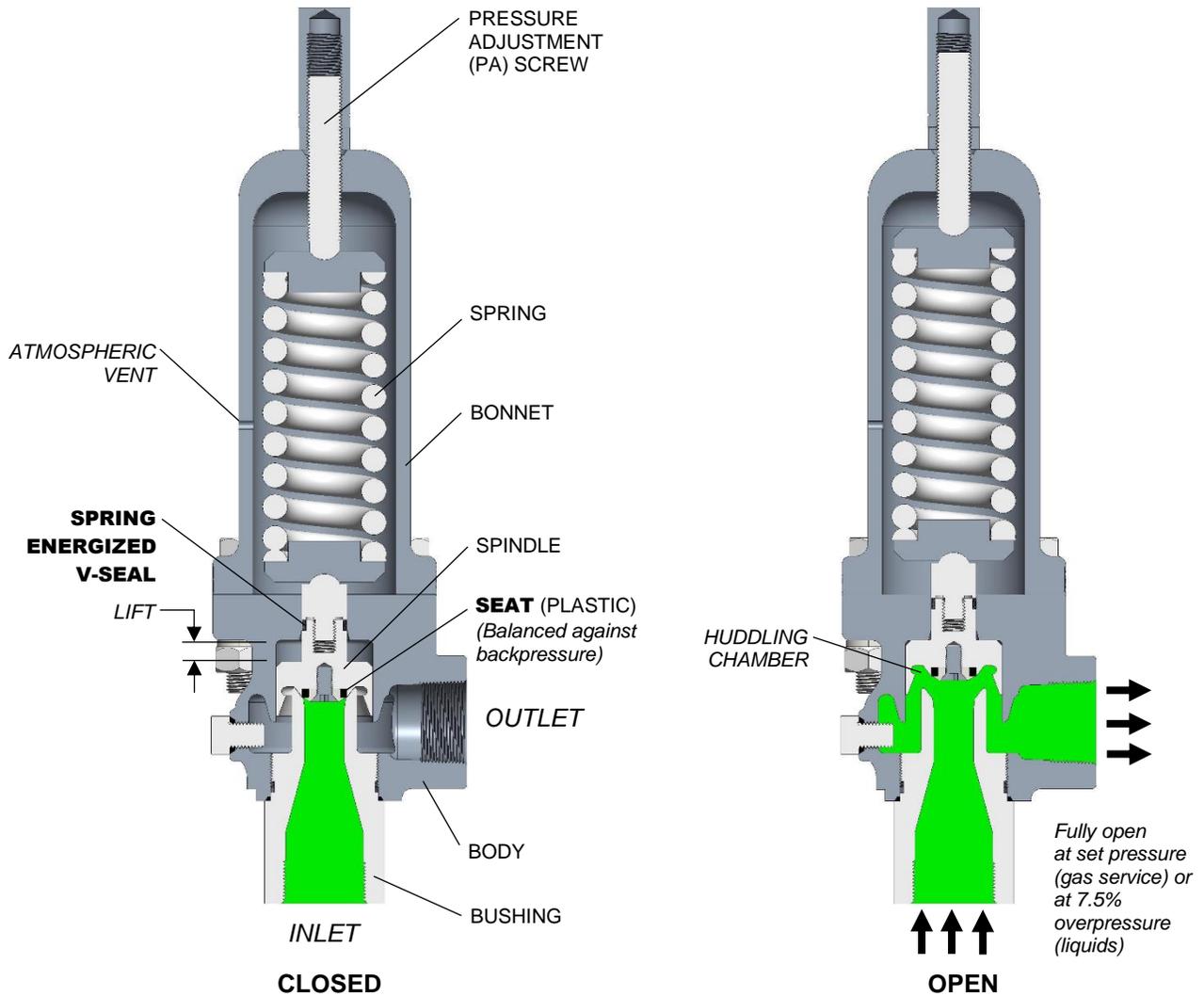
- 4) Any and all stated or implied warranties that are in effect during the purchase of a new FLOW SAFE valve are null and void once the valve has been disassembled by someone other than approved FLOW SAFE personnel.

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) or "T/O" (Test Only) stamp. For any repair or resetting of "UV"-stamped valves outside the scope mentioned in the prior sentence, contact Flow Safe for more information.

- 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 shall 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 or Service 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, & STARTUP

2.1 DESCRIPTION / OPERATION



The FLOW SAFE F88 Series safety relief valve is a direct-acting spring-loaded relief valve, suitable for gas and/or liquid service. The Type F88 is plastic-seated with a plastic seal.

Orifice sizes are available in -3, -4, -8, -G, and -J with set pressures as referenced in 2.2.

Blowdown is nonadjustable, designed to be approximately 20%. At low flow rates on liquids, the valve tends to modulate and will reclose with this approximate blowdown value.

2.2 SERVICE ENVELOPE

Body Size	Min/Max Set Pressure psig (barg)	ORIFICE SIZE				
		- 3	- 4	- 8	- G	- J
C Body Standard Bonnet	Min	50 (3.45)	50 (3.45)	50 (3.45)	---	---
	Max	720 (49.6)	720 (49.6)	720 (49.6)	---	---
C Body XL Bonnet	Min	721 (49.7)	721 (49.7)	721 (49.7)	---	---
	Max	4292 (295.9)	4292 (295.9)	4292 (295.9)	---	---
C Body XXL Bonnet¹	Min	4293 (296)	4293 (296)	---	---	---
	Max	8382 (578)	8382 (578)	---	---	---
D Body Standard Bonnet	Min	---	---	---	50 (3.45)	---
	Max	---	---	---	668 (46.0)	---
D Body XL Bonnet	Min	---	---	---	669 (46.1)	---
	Max	---	---	---	3705 (255.5)	---
E Body Standard Bonnet	Min	---	---	---	---	50 (3.45)
	Max	---	---	---	---	298 (20.5)
E Body XL Bonnet	Min	---	---	---	---	299 (20.6)
	Max	---	---	---	---	2700 (186.2)

¹ Liquid service only

SOFT GOODS	Temperature, °F (°C)	
	MIN.¹	MAX.
F88 Seats (Plastic)		
Teflon® (PTFE)	-423 (-252)	400 (204)
Kel-F (PCTFE)	-423 (-252)	400 (204)
Polyimide or Polyamide-imide: Vespel®, Duratron®, or equal	-423 (-252)	500 (260)
Polyetheretherketone (PEEK)	0 (-18)	525 (274)
F88 Spindle Seal (Plastic)		
Teflon® (PTFE)	-423 (-252)	400 (204)

¹ Confirm service / application with factory.

2.3 STORAGE AND HANDLING

1) STORAGE

Prior to installation, Flow Safe valve assemblies and parts shall be stored in a clean, dry environment. Inlet and outlet connections shall remain covered until the item is ready for installation.

For outside storage, protection from the elements is required. Exposed carbon steel surfaces shall remain coated with a suitable rust inhibitor until the assembly is ready for installation.

Even though elastomers and lubricants in the relief valve typically have a long shelf life and can be used in environments down to -40 °F/-40 °C, operability of the main piston shall be checked before placing the valve in service after extended storage. See Section 2.4.

2) HANDLING

Flange facings and other gasket sealing surfaces shall be isolated from contact with other hard objects through the use of cardboard or other soft materials. Placing flanged surfaces directly on wooden skids shall be avoided.

2.4 INSTALLATION

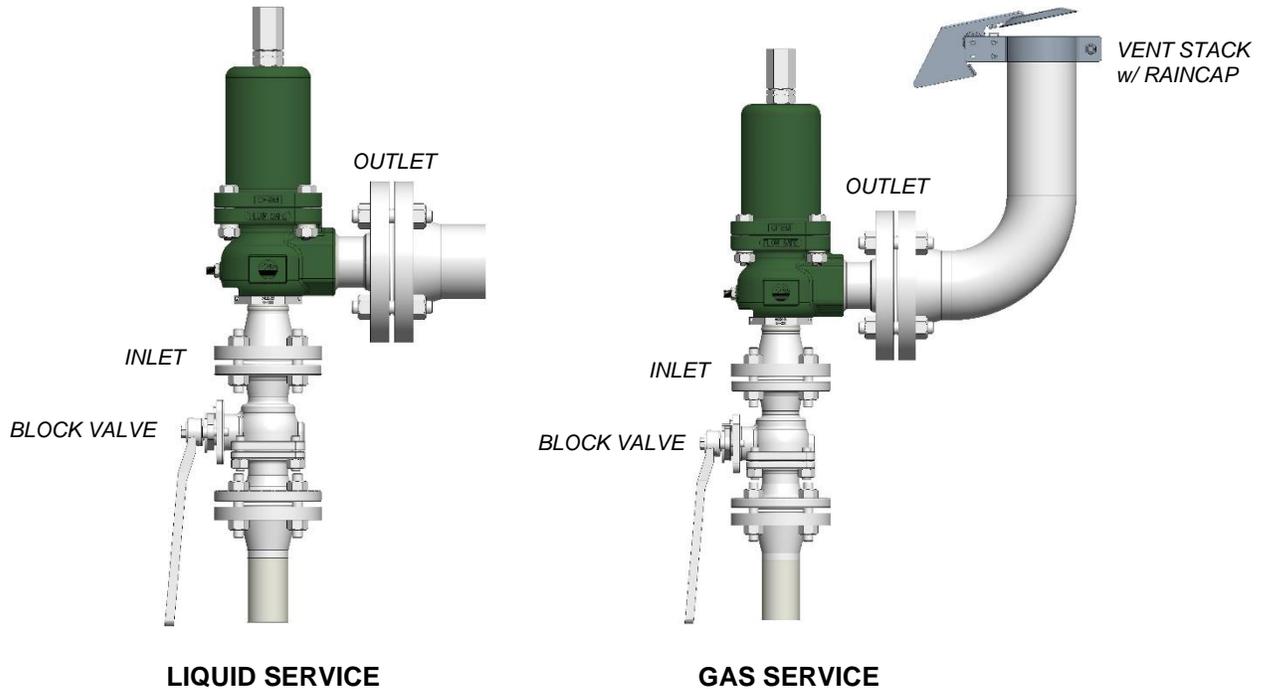
Prior to installation, check that the set pressure on the nameplate is as required, and meets the system requirements.

The F88 Series safety relief valve shall be installed in the upright position per the figure below with the inlet facing down, as close as possible to the pressure source, to minimize pressure losses between the system and the valve. This shall 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 built-up 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.

F88 Series valves are balanced against superimposed backpressure, so that the set pressure will not change with backpressure.

F88 SERIES TYPICAL INSTALLATION



Ensure 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 such as 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 ice and snow.

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.

2.5 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 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 15 through 18)

- 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 internal components (spring, washer, 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) 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 F88-4 or -8 with the base held to the bonnet by a retaining ring).
- 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. Remove retainer screw, retainer, and seat. Remove spindle cap, using the wrench flats, and spindle seal.
- 10) Replace the soft goods per the instructions in Section 3.2.
 - Replacement parts may be found in the appropriate FLOW SAFE soft goods kit, as listed in Section 5.0 of this manual.

3.2 REASSEMBLY

NOTE: Care must be taken in the handling of all items, particularly soft goods.

- 1) 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.
- 2) Apply Neverseez or DuPont Krytox (for oxygen service) to all straight threads.
- 3) Insert the plastic seat, seat retainer, and retainer screw into the spindle. Install the seat dry. 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.
- 4) Carefully install new spindle seal in recess on spindle, with spring side facing spindle shoulder. Ensure that spindle cap tightens firmly against its locking Heli-Coil. Desco 600 grease should be applied to the outside of the spindle seal, except for cryogenic service or for -3, -4, and -8 valves below 100 psig, Dow Corning Molykote 33 (or 55) should be used.
- 5) Insert the spindle assembly into the body, making sure that it travels freely on the guide surface.
- 6) Position the bushing seal on the appropriate shoulder of the bushing.
- 7) Screw the bushing / seal assembly into the body and tighten using the wrench flats.



- 8) Assemble the spring washer(s), spring, and lifting rod subassembly (if applicable) into the bonnet.
- 9) Assemble the bonnet, adapter plate (for XXL "Z" 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
- 10) Screw the PA screw, lock nut, and seal into the top of the body, with top of screw at previously recorded value.
- 11) 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, seals, shaft, lift lever, and lock nut.
- 12) Ensure that the rear bolt and seal are secured in the back of the body.
- 13) The valve is now completely assembled and ready to be tested. See Section 4.0.

4.0 VALVE TESTING, ADJUSTMENT, & MARKING

The following tests and adjustments are necessary for F88 safety relief valves: set pressure and seat tightness. Blowdown is not adjustable, and is fixed at approximately 10%-30% of set pressure, depending on valve size, service media and set pressure.

4.1 TEST EQUIPMENT

F88's for gas service should be set using air. F88's for liquid service 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. Testing on liquid is required for a liquid service repair under the National Board VR & T/O programs.

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 is to be conducted per API 527. ZERO leakage is permitted during a 1-minute period, with inlet pressure maintained at or above the following values:

For gas service:

- **0.90 x set pressure**

For liquid service:

- **0.90 x set pressure**, if set pressure > 100 psig
- **0.80 x set pressure**, if set pressure ≤ 100 psig

4.3 SET PRESSURE ADJUSTMENT

- NOTES:
1. 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.
 2. Set pressure for F88's on liquid service 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. For gas or vapor service, set pressure is "pop".

- 1) Remove the PA screw cap (if installed), loosen the PA screw lock nut, and screw the PA screw in (clockwise) to approximately the height recorded in 3.1.4.
- 2) FOR GAS SERVICE VALVES:
Increase the inlet pressure until the valve opens then let the pressure drop until the valve re-seats. Properly isolate the test valve from the inlet pressure, deplete pressure remaining between isolation valve and test valve, and make PA screw adjustments based on the previous pop (i.e. if the initial pop was low, screw the PA screw inwards [clockwise] and if the initial pop was high, screw the PA screw outwards [counterclockwise]). Continue to readjust as required until the valve demonstrates consistent opening operation at set point per 4.2

FOR LIQUID SERVICE VALVES:

Increase the inlet pressure until the valve fully "gushes" test liquid then let the pressure drop until the valve reseats. Properly isolate the test valve from the inlet pressure, deplete pressure remaining between the isolation valve and test valve, and make PA screw adjustments based on the previous pop (i.e. if the initial pop was low, screw the PA screw inwards [clockwise] and if the initial pop was high, screw the PA screw outwards [counterclockwise]) Continue to readjust as required until the valve demonstrates consistent opening operation at set point per 4.2, then tighten down the lock nut. Nameplate set pressure is defined as 93% of "gush."

- 3) Tighten down the lock nut and retest. Readjust as required.
- 4) Install and tighten down the PA screw cap or lift lever housing. Test valve at least one more time to verify set pressure.

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 in Section 6.0. Check for:
 - Even seating between the spindle and bushing. With the F88's, a full circular witness mark should be visible on the conical 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.

4.6 WIRING, TAGGING, MARKING, & DOCUMENTATION

- 1) Where applicable, repair organization standard operating procedures regarding the lock wire, tagging (including the creation and affixing of a new "VR" nameplate), marking, and valve documentation shall be followed.

5.0 ACCESSORIES

1) Soft Goods Kits

NOTE: Provide valve serial number(s) whenever possible when ordering soft goods kits

Orifice	Std. Kit P/N	Lift Lever Kit P/N
- 3 / - 4 / - 8	F88-C- <i>XT</i>	F88-CL- <i>XT</i>
- G	F88-G- <i>XT</i>	F88-GL- <i>XT</i>
- J	F88-J- <i>XT</i>	F88-JL- <i>XT</i>

Code	X = Seat Material	Y = Seal Material (Spindle)
T	Teflon	---
K	PCTFE / Kel-F	---
W	Vespel / PI / PAI	---
P	PEEK	---
F	Ekonal-filled Teflon	---

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

SGK Contents (See pages 15 through 18)

Qty.	Description
1	Seat
1	Bushing Seal
1	Spindle V-Seal
1	Rear Seal
1*	Bushing Crush Ring
2*	Shaft Crush Ring

* Included with lift lever soft good kits only.

2) Lift Lever Kits

Contact factory

6.0 TROUBLESHOOTING GUIDE:

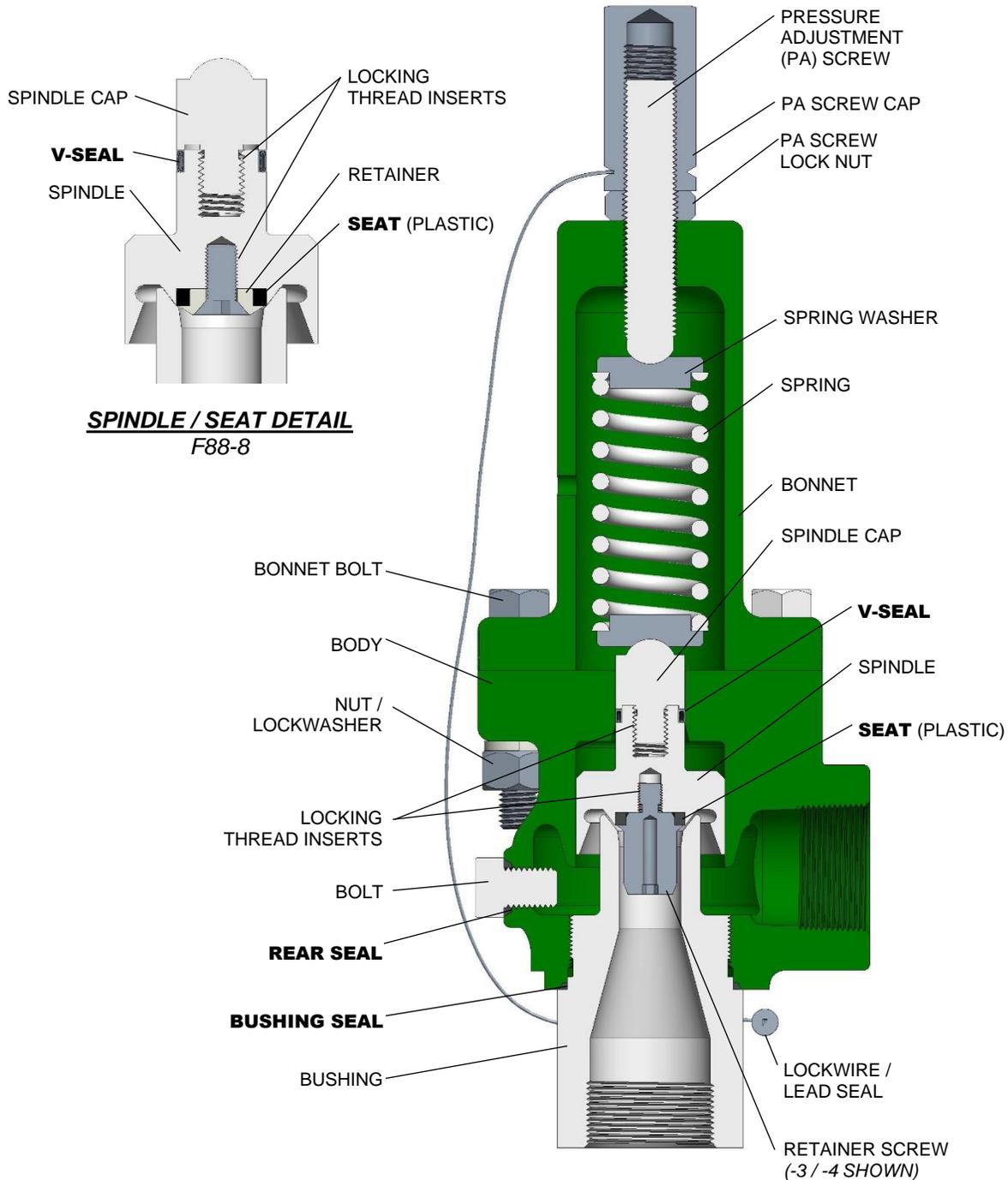
Symptom	Possible Cause	Remedy
The valve leaks around the bushing.	Inadequate bushing torque.	Tighten until the bushing bottoms firmly on the body.
	Sealing surface on body or bushing is damaged.	Inspect and polish sealing surfaces.
	Bushing seal is damaged or contaminated.	Remove bushing seal. If damaged, 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)
The valve leaks through the atmospheric vent hole in bonnet.	Worn / damaged spindle seal.	Disassemble valve, remove spindle assembly, and inspect spindle and seal 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.

**F88 SERIES VALVE
ASSEMBLY ILLUSTRATION**

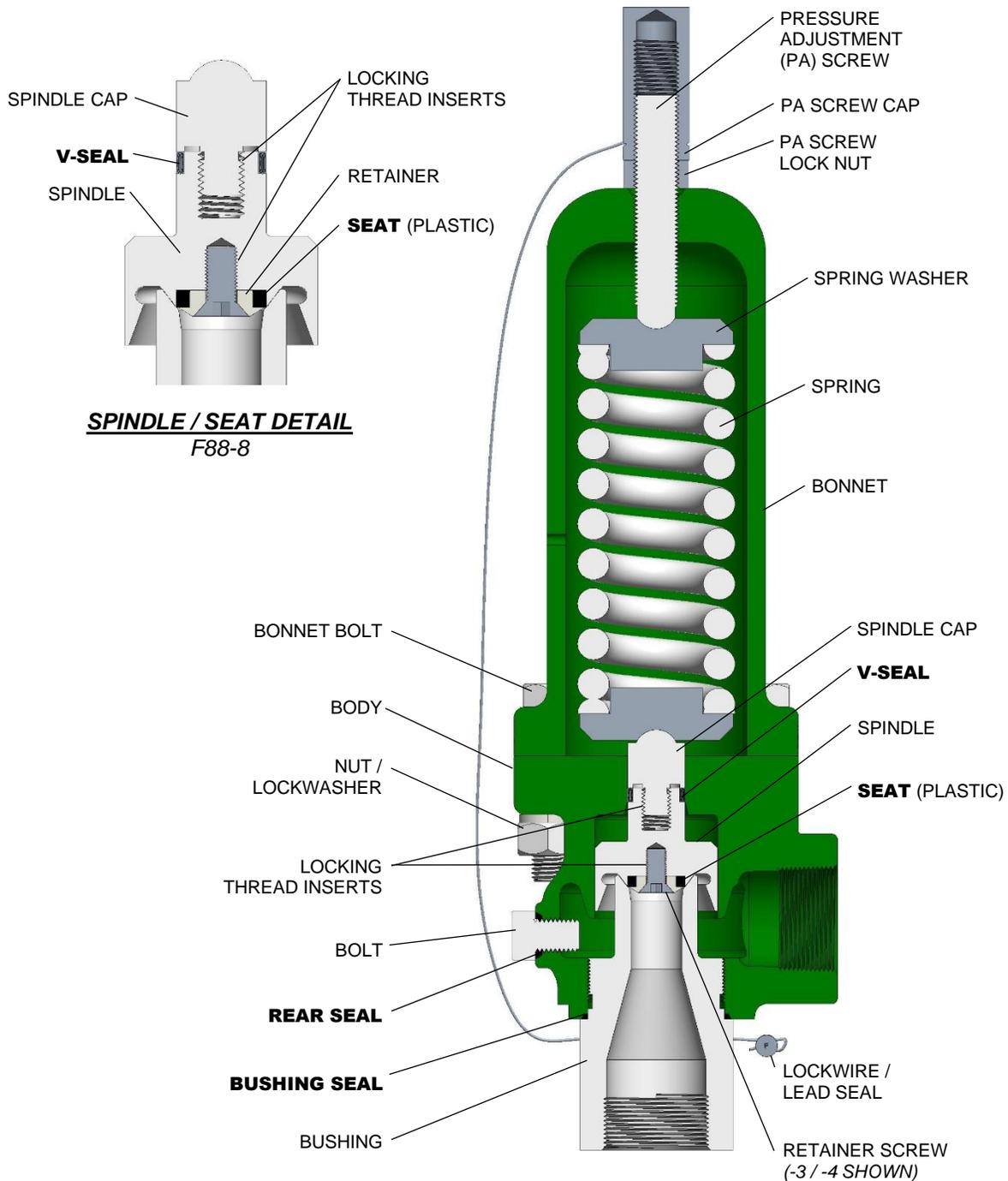
F88-3 / -4 / -8, "C" Body (Low Pressure, Bolted Bonnet)



See Page 18 for typical lift lever assembly

**F88 SERIES VALVE
ASSEMBLY ILLUSTRATION**

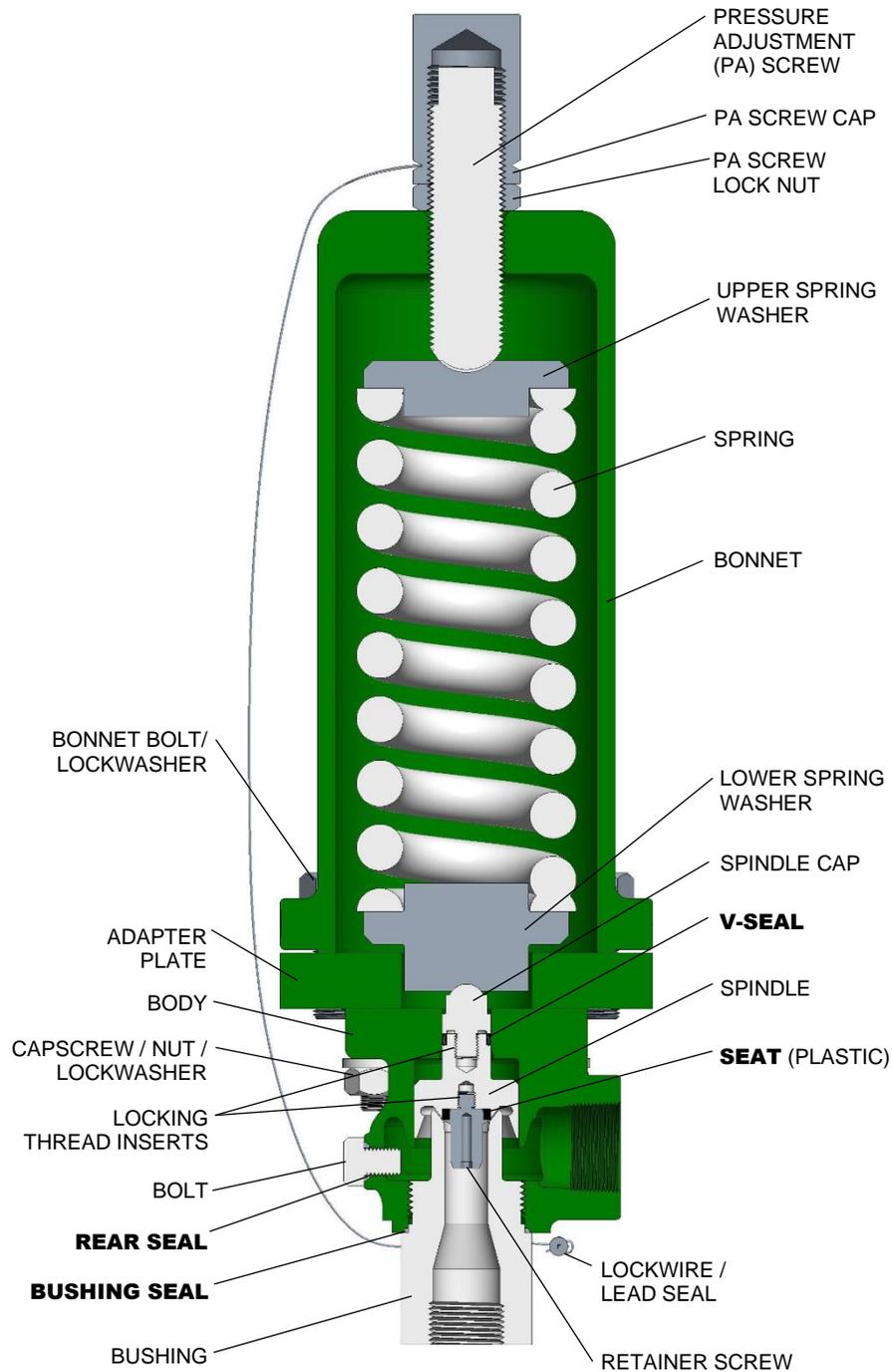
F88-3 / -4 / -8, "X" Body (High Pressure XL, Bolted Bonnet)



See Page 18 for typical lift lever assembly

**F88 SERIES VALVE
ASSEMBLY ILLUSTRATION**

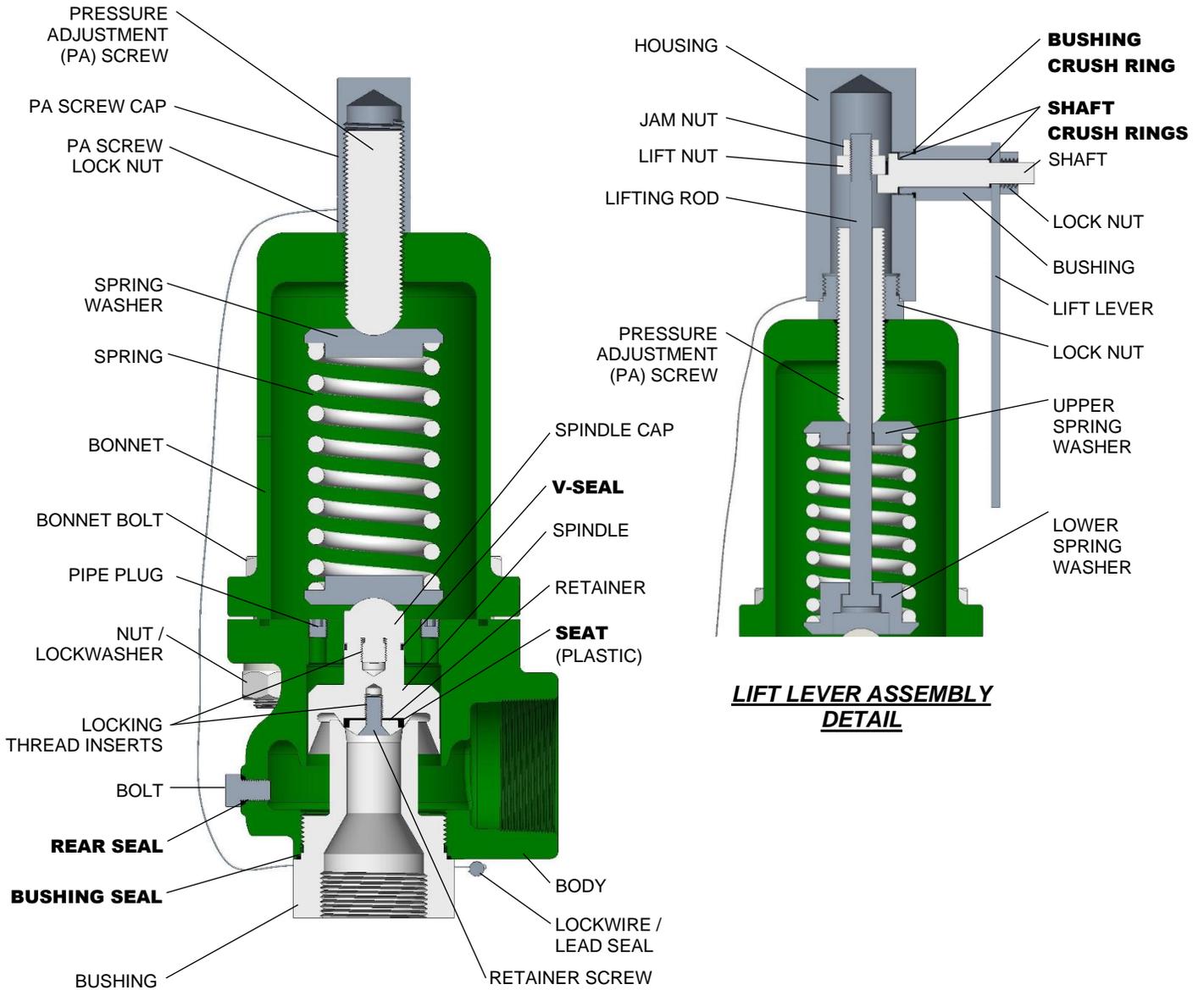
F88-3 / -4, "Z" Body (Extra High Pressure XXL, Bolted Bonnet)



See Page 18 for typical lift lever assembly

***F88 SERIES VALVE
ASSEMBLY ILLUSTRATION***

*F88-G, "D" or "X" Body (Bolted Bonnet)
F88-J, "E" or "X" Body (Bolted Bonnet)*



INSTALLATION, OPERATION, & MAINTENANCE MANUAL



TITLE: F88 Series Safety Relief Valve

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