



Surface, Pressure Independent Flow Controller 5000 psi

SF5000C



Operations and
Maintenance Manual

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ABOUT SKOFLO

Our experience and track record speak for itself. SkoFlo has delivered over 20,000 valves since 1988. We are the only company that proves our products by testing in surface applications before deploying them subsea. The result is that SkoFlo products have amassed over 25 million continuous operating hours. This level of experience is unparalleled and provides the basis for being the solution provider to our served market.

GENERAL INFORMATION

Product Overview

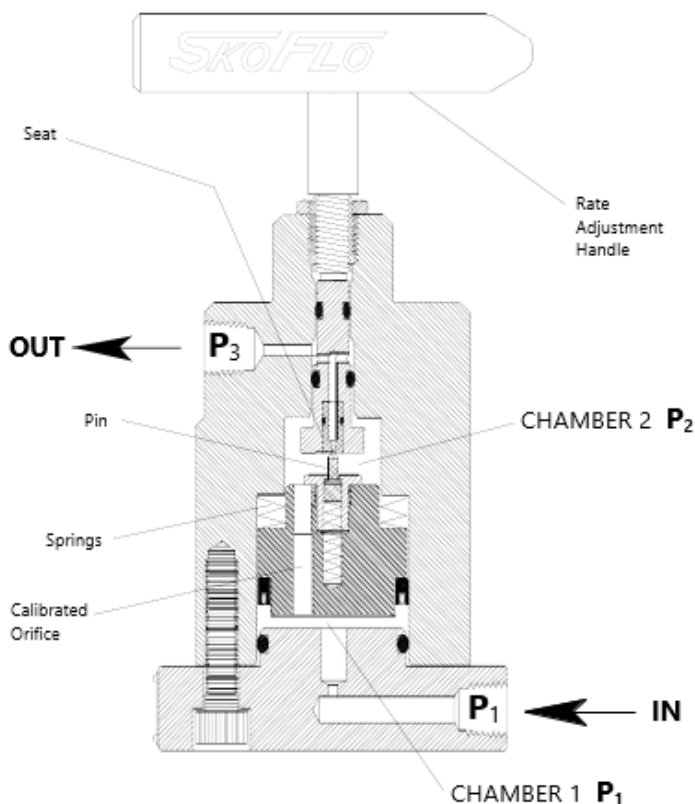


Figure 1 – SF5000C Cross Section View

The SkoFlo valve is a pressure independent flow control valve used in the petroleum industry to accurately inject chemicals. The valve consists of a body, a base plate that is bolted to the body, and a flow rate adjustment handle.

The principle of operation of the SkoFlo valve is that it maintains a constant differential pressure across a fixed calibrated orifice, thus resulting in a constant flow through that orifice. We install the orifice into a piston and then use springs to set a constant differential pressure across the piston/orifice assembly, thus maintaining a constant

flow. Flow rate changes through the valve can only be made by adjusting the spring force on the piston by turning the rate adjustment handle.

Fluid enters the valve base plate at pressure P_1 . It flows through the base plate into chamber 1. It then flows through the calibrated orifice into chamber 2 where the springs are located.

These springs put a force against the piston based on how much the springs are deflected. The spring force against the piston is set by the rate adjustment handle. This spring force establishes the pressure P_2 in chamber 2. Flow then exits the valve after passing through the seat. The flow through the seat is held back by the pin that mates with the seat. As the pressure builds, the pin moves away from the seat and allows flow to the valve outlet at pressure P_3 . The flow rate remains constant after the equilibrium flow through the valve is established.

The SkoFlo model SF5000C valve requires a minimum differential pressure across the valve ($P_1 - P_3$) of 200 psi (14 bar) to achieve full rated flow.

Operation Notes and Warnings

The SkoFlo valve has hard seats and is not designed to provide complete "bubble-tight" shut off. Separate isolation valves should be used for shutting off the flow. The SkoFlo valve will reach its minimum flow before the handle is bottomed out. **Overtightening the handle will not further reduce flow.** If flow rate does not decrease when turning the handle in, see "Trouble Shooting Improper Valve Performance".

Quick opening or closing of valves upstream or downstream of the SkoFlo valve can cause the internal parts to move extremely fast and flow rate may surge. Valves upstream and downstream should be opened slowly to allow internal pressures to balance and minimize shock to valves and piping.

The SkoFlo Valve is designed for flow in one direction only. Do not flow backwards through the SkoFlo valve. Some internal seals are designed for one direction only and could possibly become dislodged. The valve will not control in the reverse direction. SkoFlo Industries, Inc. recommends installation of a check valve in the outlet line **within 5 feet** from the SkoFlo valve (see "Multi-Point System Sample Schematic") to avoid reverse flow of process fluids into the chemical system.

Guidelines for Using this Manual

The following instructions are provided to ensure a safe and proper installation and operation.

- Read all instructions prior to installation and operation of this product.
- Follow all warning and caution notes.
- Install this product as specified in the instructions provided by SkoFlo.
- Prior to use, educate personnel in the proper installation, operation, and maintenance of this product.
- Only use replacement parts specified by SkoFlo.

Warning, Caution, Notice

Throughout this manual there are steps and procedures which, if not followed, may result in a hazard. The following flags are used to identify the level of potential hazard.

! WARNING



WARNING IS USED TO INDICATE THE PRESENCE OF A HAZARD WHICH CAN CAUSE SEVERE INJURY, DEATH, OR SUBSTANTIAL PROPERTY DAMAGE IF THE WARNING IS IGNORED.

! CAUTION



CAUTION IS USED TO INDICATE THE PRESENCE OF A HAZARD WHICH CAN CAUSE INJURY OR PROPERTY DAMAGE IF THE WARNING IS IGNORED.

! NOTICE



NOTICE IS USED TO NOTIFY PEOPLE OF INSTALLATION, OPERATION, OR MAINTENANCE INFORMATION, WHICH IS IMPORTANT BUT NOT HAZARD RELATED.

Abbreviations and Acronyms

Kg/m	Kilograms per Meter
NPT	National Pipe Thread
P/N	Part Number
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch Gauge

HYDRAULIC RATINGS

! WARNING



REFER TO THE GENERAL SECTION OF THE PRODUCT DATASHEET FOR DESIGN PRESSURE DETAILS.

! NOTICE



THE SF5000C REQUIRES A MINIMUM DIFFERENTIAL PRESSURE ACROSS THE VALVE OF 200 PSI (14 BAR) TO ACHIEVE FULL RATED FLOW.

Max Working Pressure: 5,000 psi (345 bar)

Hydro-Pressure: 7,500 psi (518 bar)

STORAGE

! NOTICE



IT IS RECOMMENDED TO STORE THE ASSEMBLIES IN THE SHIPPING CRATE, IF POSSIBLE.

The SF5000C should be stored in a shelter and be protected from moisture and particulates. Storage temperatures shall be between -50°F and 158°F (-45°C and 70°C).

Any open hydraulic connections will be furnished with plastic blanking plugs.

It is important not to store the SF5000C with production chemicals in the unit. These chemicals can settle, possibly resulting in damage to the unit. SkoFlo recommends that the valve be stored with a mixture of glycol in water as the preservation fluid.

INSTALLATION

1. Mounting

The SF5000C can be panel or base mounted in any orientation. See Appendix B for more details.

If panel mounting, unscrew and remove the handle. Mount the valve, then replace the handle and tighten the fastener in place.

The base plate can be rotated in 90-degree increments to offer various inlet/outlet configurations:

- 1.1 Loosen and remove the four M8 socket head cap screws (SHCSs) attaching the base.
- 1.2 Rotate the base to the desired orientation.
- 1.3 Replace the four fasteners and tighten in opposite pairs to 15 ft.lbf [20 Nm].

2. Hydraulic Installation

1. Install valve so that the flow is in the proper direction. The "IN" and the "OUT" connections are 1/4" NPT and are marked respectively.
2. Install an inline filter upstream of the SkoFlo Valve. Clean chemicals and proper filtering are very important. Omitting the filter can cause the SkoFlo Valve to become plugged. Following are recommended filter sizes:

Table 1: Filter Sizes

SkoFlo Dash Number	Filter Micron Size
2 thru 75	40
100 thru 400	90
500 and above	200

3. Start Up Procedures

1. Back out (rotate counterclockwise) the rate adjustment handle on the flow controller at least four turns.
Note: At this position the flow controller is not controlling (out of range).
2. Open the supply isolation valve to the flow controller slowly. This will allow pressures within the flow controller to equalize slowly and valve will stabilize quickly.

3. When flow controller is equalized, turn the rate adjustment handle clockwise until the flow reduces noticeably. Then turn the rate adjustment handle approximately 1/4 turn farther. The flow controller is now controlling at the full rated flow range of the unit.
4. Turn the rate adjustment handle clockwise until you are at the desired flow rate.
5. The flow controller is now set, and further adjustments are not required. Tighten the lock nut on the handle to avoid inadvertent changes to the adjustment.

4. Adjustment and Calibration

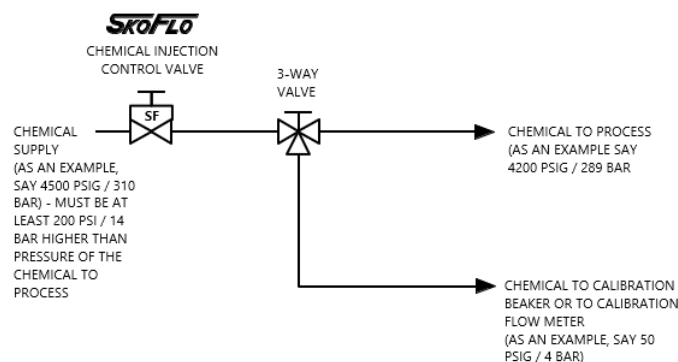


Figure 2 – Typical Calibration System

The SkoFlo Valve is a pressure independent flow control valve. Once the valve is set at a desired flow rate, that flow rate is maintained even though the pressure conditions upstream and/or downstream of the valve may change considerably.

The standard Multi-Point SkoFlo valve is set by manually adjusting the rate adjustment handle. When the desired flow rate is set, the lock nut on the handle is tightened down, and the valve remains at that fixed flow rate until the rate adjustment handle is turned to a new setting.

The flow rate can be set using a flow meter in the line to the process. However, a flow meter in this line must be capable of withstanding the process pressure. This normally limits the availability of this type flow meter.

The most common method of calibrating the SkoFlo Valve is with a 3-way valve and a line to a calibration beaker or to a low pressure flow meter. Once the flow rate is set, the 3-way valve is switched to direct the chemical to the process.

Since the SkoFlo Valve flows at the set rate independent of the pressure differential across the SkoFlo Valve, the flow rate to the process is the same as the flow rate set using the beaker or flow meter. Overall monitoring of the flows is done by taking inventory of the usage from the supply tank.

In the above example, the SkoFlo Valve is set with a differential pressure of 4450 psi / 306 bar across the valve. The flow rate set will remain the same when the chemical is routed to process and the SkoFlo Valve has a differential pressure of 300 psi / 21 bar.

MAINTENANCE

! WARNING



WARNING IS USED TO INDICATE THE PRESENCE OF A HAZARD WHICH CAN CAUSE SEVERE INJURY, DEATH, OR SUBSTANTIAL PROPERTY DAMAGE IF THE WARNING IS IGNORED.

! NOTICE



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5. General

Spares kits available for typical maintenance items are listed in Table 2.

Table 2: SF5000C Spares Kit Part Numbers

Max Flow Rate (GPD)	Item 22 (Piston Assy)	Seat Holder Assy
2	21919	22001
10	21931	
50	21970	22004
200	21981	
750	21989	

Table 3: SF5000C Seal Kits

FKMLT	EPDM	FFKM	FKM	FKMB	HNRB
20357	22068	22069	22070	22283	22284

6. Replacing Seals

When replacing valve seals, it is recommended that the Piston Seal Installer Tool (P/N SF10000-T2) and the O-Ring Installation Kit (P/N SF5000-T3) be used.

1. Remove SkoFlo valve from system.
2. Remove the base plate and the adjustment handle. Slowly push the internal parts out using a rod, hex driver, or similar tool. Use care to avoid damage to the internal surfaces of the SkoFlo valve. (See Figure 3).

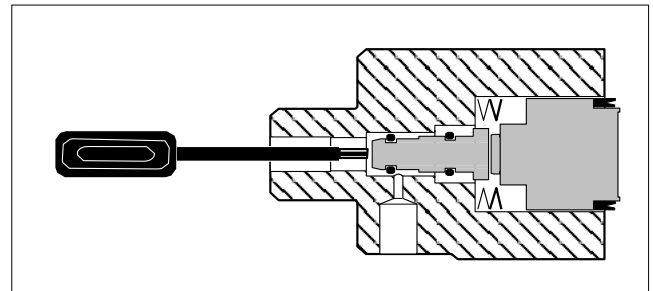


Figure 3 – Internal Parts Removal

3. Lubricate seat holder seals with Parker Super Lube or equivalent. Slide seals onto seat holder using the O-ring Installation Kit (See Figure 4). Install backup ring on low pressure side of O-ring. Make sure the backup ring is lined up at the joint.

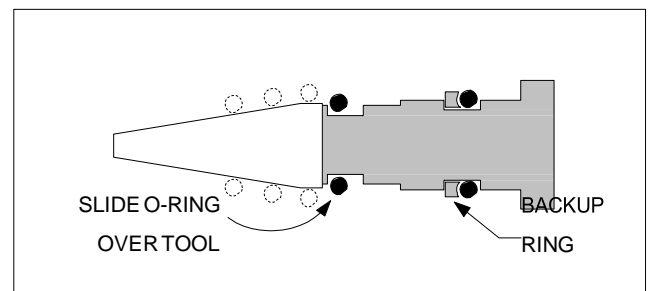


Figure 4 – Seat Holder O-Ring Installation

- Using your finger, guide seat holder into the body. Use caution not to push too fast which can damage the seal. (See Figure 5).

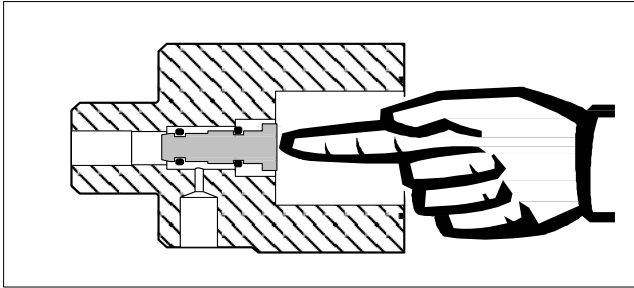


Figure 5 – Seat Holder Installation

- Lubricate piston seal with Parker Super Lube or equivalent. Slide seal onto piston (orient seal correctly). Place piston spring stack on piston / pin holder assembly (orient as shown in "Assembly Section / Parts List"). Carefully slide the complete assembly into the valve body. Do not allow the springs to come off the assembly or they may not line up correctly. Using Piston Seal Installer Tool, push seal and piston assembly into body to clear base plate (See Figure 6).

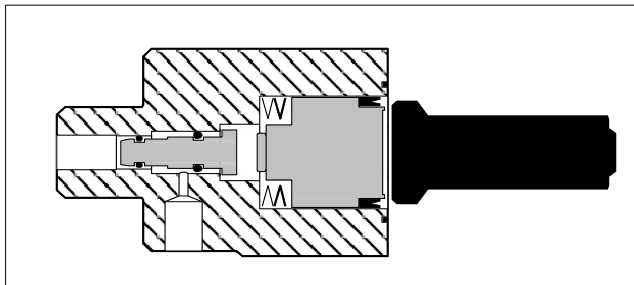


Figure 6 – Piston Installation

- Lubricate base O-ring with Parker Super Lube or equivalent. Place O-ring into O-ring groove of base. Install backup ring on low pressure side of O-ring. Make sure the backup ring is lined up at the joint.
- Place base plate on body in desired orientation. Reinstall screws and tighten in a crisscross pattern, loosely at first, then torque to 15 foot-pounds (2 kg-m). Be careful not to overtighten.
- Install adjustment handle into the body.

7. Replacing Seat Holder Assembly

- Disassemble and reassemble the SkoFlo valve using new seals as described in the "Replace Seals" section above.

8. Replacing Piston / Pin Assembly

- Disassemble and reassemble the SkoFlo valve using new seals and piston assembly as described in the "Replace Seals" section above.
- When installing pin holder into piston, hold piston in a manner where the surface finish will not be damaged. Torque pin holder to 100 inch-pounds (1.15 kg-m).

9. Changing Orientation of Base Plate

- Remove SkoFlo valve from system.
- Place valve with handle located down at bottom, and base plate at top. Remove 4 screws in base plate. Carefully remove baseplate without disturbing the base plate O-ring.
- Reorient the base plate as desired.
- Reinstall screws and tighten in a crisscross pattern, loosely at first, then torque to 15 foot-pounds (2 kg-m). Be careful not to overtighten.

10. Orifice Back Flushing Procedure:

1. Install seat holder in body. Handle may be installed or removed. (See Figure V).

Figure 7 – Orifice Back Flushing Orientation

2. Install the piston seal on the piston backwards from the normal position. (The spring face of the seal will be toward the piston).
3. Install the piston in the body backwards from the normal position.
4. Install the valve base plate.
5. Apply clean chemical (or water) to the valve inlet. The fluid flow is in the reverse direction to the normal flow thus back flushing the orifice in the piston.
6. If plugging is not relieved by back flushing, the piston/orifice must be replaced.

TROUBLESHOOTING

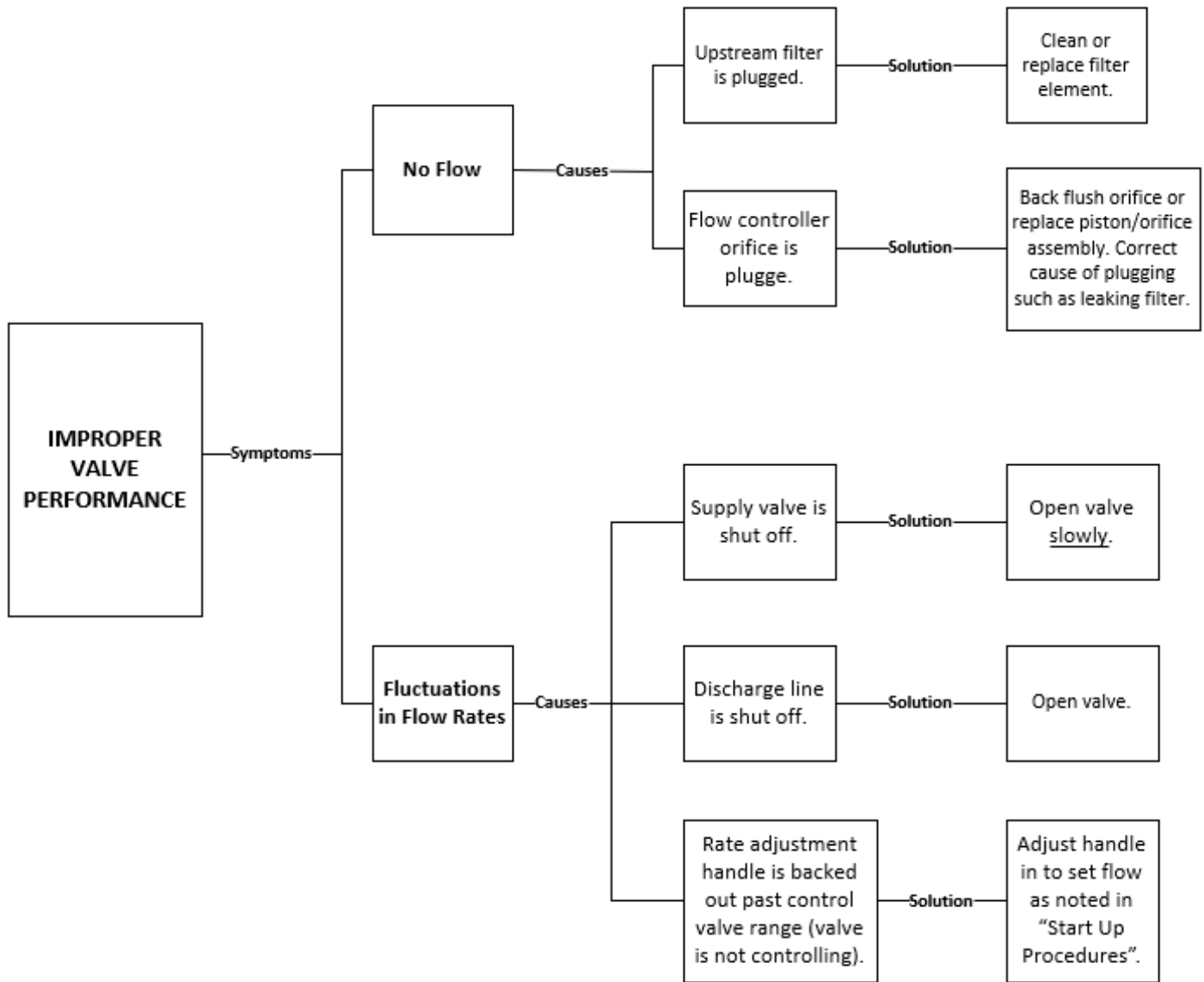
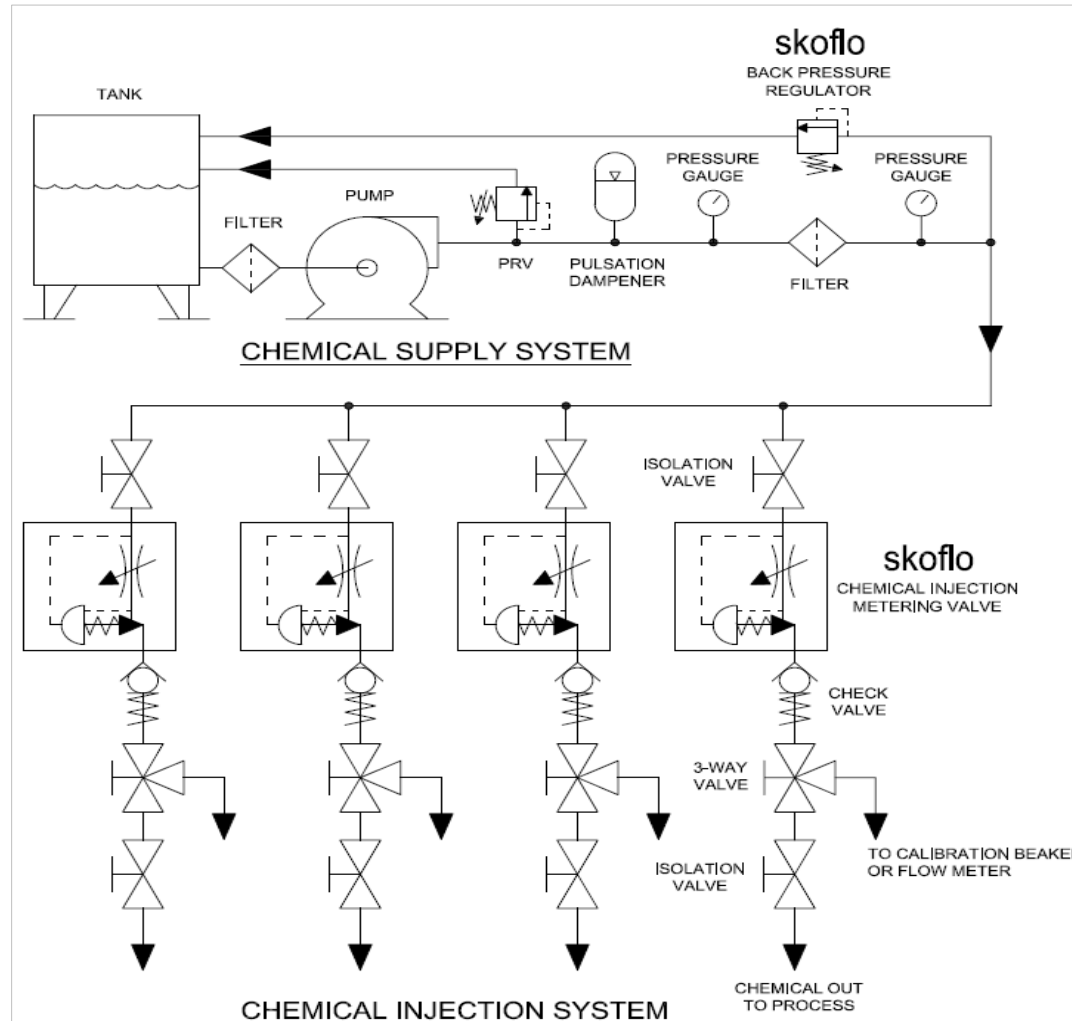


Figure 8 – Improper Valve Performance

APPENDIX A – TYPICAL CHEMICAL INJECTION SYSTEM

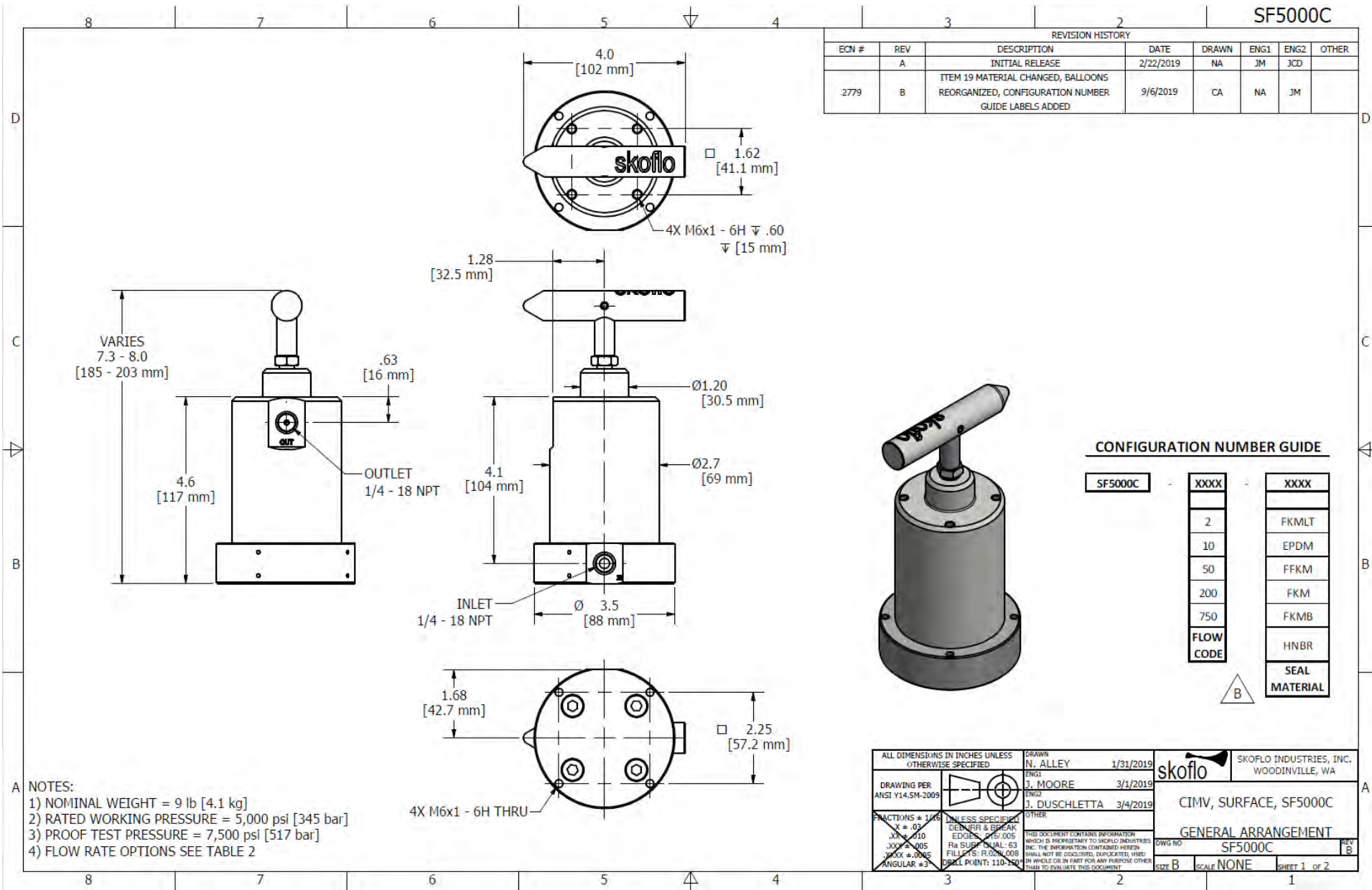


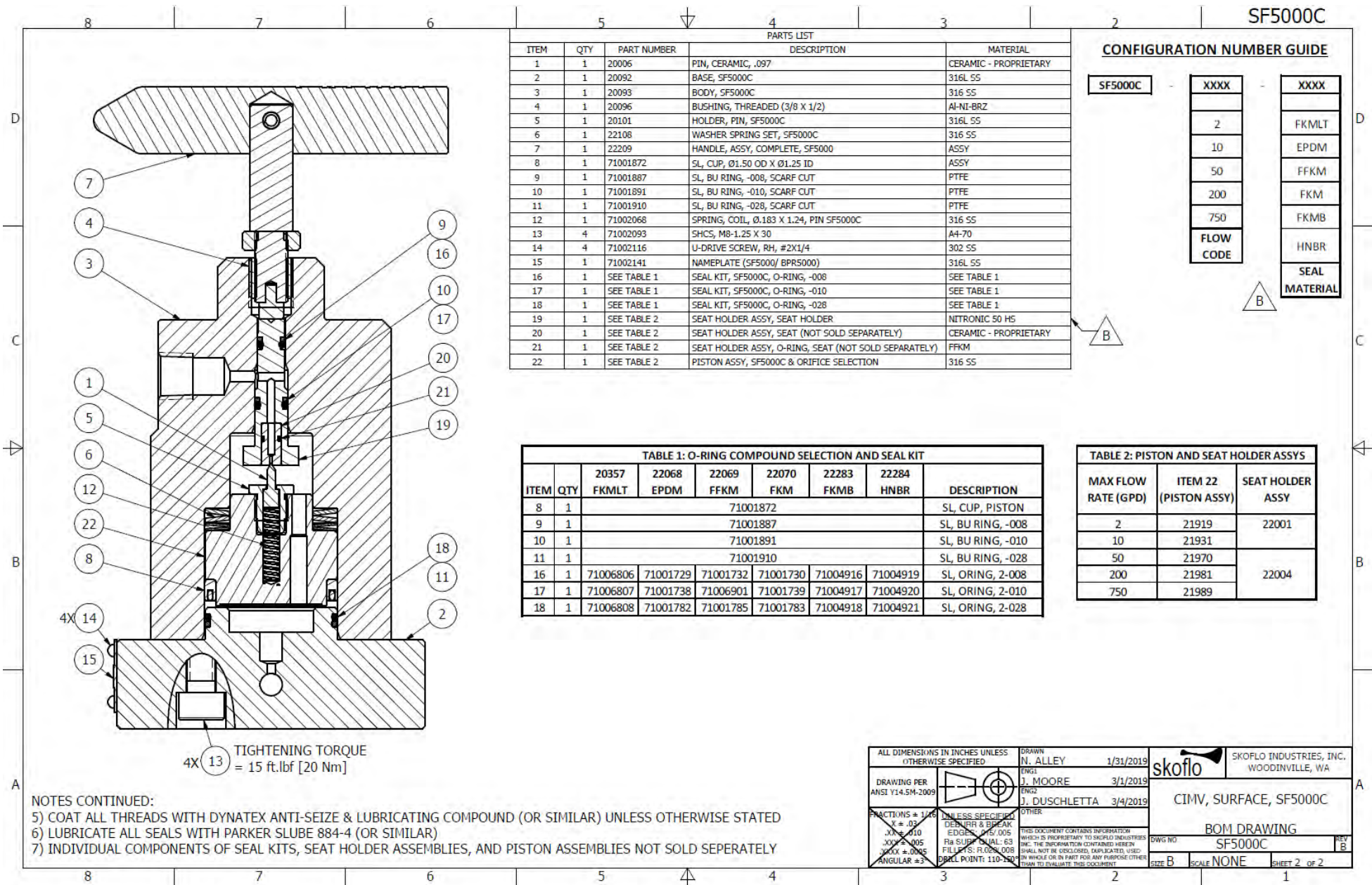
NOTES

Any number of injection points can be served by a single pump and header system. The only limitation is the flow capability of the pump.

Check valve shall be installed within 6 inches of the SkoFlo CIMV.

APPENDIX B – SF5000C GA AND BOM DRAWING





PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
1	1	20006	PIN, CERAMIC, .097	CERAMIC - PROPRIETARY
2	1	20092	BASE, SF5000C	316L SS
3	1	20093	BODY, SF5000C	316 SS
4	1	20096	BUSHING, THREADED (3/8 X 1/2)	AI-NI-BRZ
5	1	20101	HOLDER, PIN, SF5000C	316L SS
6	1	22108	WASHER SPRING SET, SF5000C	316 SS
7	1	22209	HANDLE, ASSY, COMPLETE, SF5000	ASSY
8	1	71001872	SL, CUP, Ø1.50 OD X Ø1.25 ID	ASSY
9	1	71001887	SL, BU RING, -008, SCARF CUT	PTFE
10	1	71001891	SL, BU RING, -010, SCARF CUT	PTFE
11	1	71001910	SL, BU RING, -028, SCARF CUT	PTFE
12	1	71002068	SPRING, COIL, Ø.183 X 1.24, PIN SF5000C	316 SS
13	4	71002093	SHCS, M8-1.25 X 30	A4-70
14	4	71002116	U-DRIVE SCREW, RH, #2X1/4	302 SS
15	1	71002141	NAMEPLATE (SF5000/ BPRS5000)	316L SS
16	1	SEE TABLE 1	SEAL KIT, SF5000C, O-RING, -008	SEE TABLE 1
17	1	SEE TABLE 1	SEAL KIT, SF5000C, O-RING, -010	SEE TABLE 1
18	1	SEE TABLE 1	SEAL KIT, SF5000C, O-RING, -028	SEE TABLE 1
19	1	SEE TABLE 2	SEAT HOLDER ASSY, SEAT HOLDER	NITRONIC 50 HS
20	1	SEE TABLE 2	SEAT HOLDER ASSY, SEAT (NOT SOLD SEPARATELY)	CERAMIC - PROPRIETARY
21	1	SEE TABLE 2	SEAT HOLDER ASSY, O-RING, SEAT (NOT SOLD SEPARATELY)	FFKM
22	1	SEE TABLE 2	PISTON ASSY, SF5000C & ORIFICE SELECTION	316 SS

CONFIGURATION NUMBER GUIDE

SF5000C	XXXX	XXXX
	2	FKMLT
	10	EPDM
	50	FFKM
	200	FKM
	750	FKMB
FLOW CODE		HNBR
		SEAL MATERIAL

TABLE 1: O-RING COMPOUND SELECTION AND SEAL KIT

ITEM	QTY	20357 FKMLT	22068 EPDM	22069 FFKM	22070 FKM	22283 FKMB	22284 HNBR	DESCRIPTION
8	1	71001872						SL, CUP, PISTON
9	1	71001887						SL, BU RING, -008
10	1	71001891						SL, BU RING, -010
11	1	71001910						SL, BU RING, -028
16	1	71006806	71001729	71001732	71001730	71004916	71004919	SL, ORING, 2-008
17	1	71006807	71001738	71006901	71001739	71004917	71004920	SL, ORING, 2-010
18	1	71006808	71001782	71001785	71001783	71004918	71004921	SL, ORING, 2-028

TABLE 2: PISTON AND SEAT HOLDER ASSYS

MAX FLOW RATE (GPD)	ITEM 22 (PISTON ASSY)	SEAT HOLDER ASSY
2	21919	22001
10	21931	
50	21970	
200	21981	22004
750	21989	

4X 13 TIGHTENING TORQUE = 15 ft.lbf [20 Nm]

- NOTES CONTINUED:
- 5) COAT ALL THREADS WITH DYNATEX ANTI-SEIZE & LUBRICATING COMPOUND (OR SIMILAR) UNLESS OTHERWISE STATED
 - 6) LUBRICATE ALL SEALS WITH PARKER SLUBE 884-4 (OR SIMILAR)
 - 7) INDIVIDUAL COMPONENTS OF SEAL KITS, SEAT HOLDER ASSEMBLIES, AND PISTON ASSEMBLIES NOT SOLD SEPARATELY

ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED	DRAWN N. ALLEY 1/31/2019	SKOFLIO INDUSTRIES, INC. WOODINVILLE, WA
DRAWING PER ANSI Y14.5M-2009	ENGR J. MOORE 3/1/2019	
FRACTURES ± 10% X ± .010 .XX ± .005 .XXX ± .0005 ANGULAR ± 3°	ENGR J. DUSCHLETTA 3/4/2019	CIMV, SURFACE, SF5000C
	UNLESS SPECIFIED DIMENSION & BREAK EDGES: .015/.005 Ra SURF: .012/.008 FILLETS: R.025/.008 DRILL POINTS: 110°/90°	THIS DOCUMENT CONTAINS INFORMATION WHICH IS PROPRIETARY TO SKOFLIO INDUSTRIES INC. THE INFORMATION CONTAINED HEREIN SHALL NOT BE DISCLOSED, REPLICATED, USED IN WHOLE OR IN PART FOR ANY PURPOSE OTHER THAN TO EVALUATE THIS DOCUMENT.



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