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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
The SF5000HTVA is a pressure independent chemical injection and metering valve (CIMV), used in the petroleum industry to accurately control chemical injection rates. The SF5000HTVA regulates flow to counter pressure changes on the inlet and outlet of the unit. This is referred to as “pressure independence”.

Pressure Independence
SkoFlo defines pressure independence as the percent (%) of reading change for each 1,000 psi (69 bar) change in supply or outlet pressure.

Pressure independence in the SF5000HTVA is a completely mechanical process, requiring zero power.

The principle of pressure independence is that the valve maintains a constant differential pressure (dP) across an internal orifice (the ‘gate’), thus resulting in a constant flow rate through that orifice.

The pressure that is generated by flow through the gate is applied to either side of a spring balanced piston that carries a regulating pin. The piston will travel to a position where the spring force equals the pressure force.

Minimum Differential Pressure
For the SF5000HTVA to provide pressure independent performance, a minimum differential pressure (min dP) is required across the valve to allow the spring-balanced piston to move to a truly balanced location.

In general, higher flows and/or viscosities require a higher min dP across the valve. Refer to the product datasheet for specific information.

Guidelines for Using this Manual
The following instructions are provided to ensure a safe and proper installation and operation.

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
CIMV Chemical Injection and Metering Valve
dP Differential Pressure
GA General Arrangement
GPD Gallons Per Day
HTV High Turn-Down Valve
LPH Liters Per Hour
SHCS Socket Head Cap Screw
psi Pounds per Square Inch
HYDRAULIC RATINGS

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFER TO THE GENERAL SECTION OF THE PRODUCT DATASHEET FOR DESIGN PRESSURE DETAILS.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE SF5000HTVA REQUIRES A MINIMUM DIFFERENTIAL PRESSURE ACROSS THE VALVE OF 300 PSI (20.7 BAR) TO ACHIEVE FULL RATED FLOW.</td>
</tr>
</tbody>
</table>

Max Working Pressure: 5,000 psi (345 bar)
Hydro-Pressure: 7,500 psi (518 bar)
Flow Ranges:
- 0.6 to 700 GPD (0.09 to 110 LPH)
- 50 to 2500 GPD (7.8 to 394 LPH)
Min Differential Pressure: 300 psi

STORAGE

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT IS RECOMMENDED TO STORE THE ASSEMBLIES IN THE SHIPPING CRATE, IF POSSIBLE.</td>
</tr>
</tbody>
</table>

The SF5000HTVA 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 SF5000HTVA 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

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEMICAL COMPATIBILITY SHALL BE DONE AND CHECKED BEFORE USE, EXCEPT FOR MEG AND WATER MIXTURES.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE SF5000HTVA SHALL NOT BE INSTALLED SUBSEA.</td>
</tr>
</tbody>
</table>

1. Mounting

The SF5000HTVA can be panel or base mounted in any orientation. See Appendix B for more details.

If panel mounting, unscrew the handle fastener with a 2mm Allen wrench 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 M12 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 34 ft.lbf [46 Nm].

2. Hydraulic Installation

Install the SF5000HTVA so that the flow is in the proper direction. The IN (inlet) and OUT (outlet) connections are marked respectively. See Appendix B for details.

Install an inline filter upstream of the SF5000HTVA. Clean chemicals and proper filtering are very important. Omitting the filter can cause the valve to become plugged. Table 1 lists the filter requirements for the various flow ranges. Note: if coarser filters are used, the adjustment handle may need to be periodically opened to flush out any debris.

Table 1 – Filter Specification

<table>
<thead>
<tr>
<th>Flow Range</th>
<th>Filter Micron Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 to 10 GPD</td>
<td>40</td>
</tr>
<tr>
<td>10 to 700 GPD</td>
<td>80</td>
</tr>
<tr>
<td>&gt; 700 GPD</td>
<td>200</td>
</tr>
</tbody>
</table>
A pulsation dampener is recommended to be installed on the inlet header supplying the SF5000HTVA for improved longevity and set point consistency. A bladder type pulsation dampener is preferred over a piston type. Reactive dampeners that use baffles will do little to dampen the pressure over the full flow range of the valve.

The SF5000HTVA is not a positive shut off device, therefore, a valve on the inlet or outlet will be required to meet shut off specifications. The preferred location of the shut off valve is on the outlet of the SkoFlo valve to minimize the shock to internal parts during start up.

A check valve shall be installed immediately downstream of the SF5000HTVA (within 6 inches) to prevent damage to the piston cup seal and to prevent well fluids entering the valve. The 6-inch maximum is required to eliminate stored pressure build up during startup. Check valve cracking pressure is recommended to be under 10 psi to enhance longevity of check valve seats.

An example of a typical chemical injection system is given in Appendix A.

3. Start Up Procedures

3.1 Open the supply isolation valve to the SkoFlo valve slowly (> 1 second). This will allow pressures within the unit to equalize slowly, the valve will stabilize quickly.

3.2 Turn the rate adjustment handle clockwise until you are at the desired flow rate.

3.3 Always start at a flow rate above the desired flow and decrease to the desired setting (turn handle clockwise to decrease flow rate).

   - For the most consistent set point results, rotate handle ½ turn clockwise to reach the set point.

3.4 The flow controller is now set, and further adjustments are not required.

4. Adjustment and Calibration

The SF5000HTVA is a pressure independent flow control device. 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 flow rate can be set using an inline flow meter, such as the SkoFlo SF5000PDFMA, however, it must be capable of withstanding the process pressure. Another method of calibrating the SF5000HTVA is with a 3-way valve and a line to a calibration beaker. Once the flow rate is set, the 3-way valve is switched to direct the chemical to the process (see Figure 1).

Since the SkoFlo valve regulates the flow independent of the pressure differential across it, the flow rate to the process is the same as the flow rate set using the beaker. Overall monitoring of the flow is done by taking inventory of the usage from the supply tank.

An example of a typical chemical injection system is given in Appendix A.

Figure 1 – Valve Calibration Schematic

MAINTENANCE

! WARNING
ANY SERVICE REPAIR SHALL BE PERFORMED BY TRAINED PERSONNEL.

! NOTICE
IF ANY ABNORMALITIES ARE FOUND THROUGHOUT THE MAINTENANCE, PLEASE REPORT TO THE RESPECTIVE ENGINEERS.

5. General

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

<table>
<thead>
<tr>
<th>Table 2 – SF5000HTV Spares Kit Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITEM</td>
</tr>
<tr>
<td>Seal Kit</td>
</tr>
<tr>
<td>0.6-700 GPD Stem Assembly Kit</td>
</tr>
<tr>
<td>50-2500 GPD Stem Assembly Kit</td>
</tr>
<tr>
<td>Piston Assembly Kit</td>
</tr>
<tr>
<td>Gate Pad</td>
</tr>
<tr>
<td>Washer Spring Stack</td>
</tr>
<tr>
<td>O-ring Installation Tool Kit</td>
</tr>
</tbody>
</table>
Table 3 – Maintenance Tool Requirements

<table>
<thead>
<tr>
<th>Tools and Parts</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vise</td>
<td>1</td>
</tr>
<tr>
<td>250 ft.lb [340 Nm] Torque wrench</td>
<td>1</td>
</tr>
<tr>
<td>50 ft.lb [68 Nm] Torque wrench</td>
<td>1</td>
</tr>
<tr>
<td>Socket extension</td>
<td>1</td>
</tr>
<tr>
<td>22mm socket</td>
<td>1</td>
</tr>
<tr>
<td>13mm deep socket</td>
<td>1</td>
</tr>
<tr>
<td>12mm socket</td>
<td>1</td>
</tr>
<tr>
<td>10mm Allen socket</td>
<td>1</td>
</tr>
<tr>
<td>Pliers</td>
<td>1</td>
</tr>
<tr>
<td>2mm Allen wrench</td>
<td>1</td>
</tr>
<tr>
<td>Brass Rod</td>
<td>1</td>
</tr>
<tr>
<td>Circlip Pliers (.035” Tip Diameter)</td>
<td>1</td>
</tr>
<tr>
<td>SF5000HTV O-Ring Installation Kit (P/N: 30641)</td>
<td>1</td>
</tr>
<tr>
<td>Pick or small flat head electrical screwdriver</td>
<td>1</td>
</tr>
<tr>
<td>Parker Super Lube (or equivalent)</td>
<td>1</td>
</tr>
<tr>
<td>Dynatex Anti-Seize &amp; Lubricating Compound (or equivalent)</td>
<td>1</td>
</tr>
</tbody>
</table>

6. Replacing the Gate Pad Assembly

6.1 Remove the valve from the system.
6.2 Secure the valve in a vise.
6.3 Unscrew the gate pad plug (30426) – 22mm socket.
6.4 Remove the spring (71007048) and old gate pad assembly – A brass rod can be used to aid pad assembly removal.

7. Replacing the Stem Assembly

6.5 Insert the replacement gate pad assembly followed by the spring (71007048).
6.6 Lubricate the gate pad plug O-ring with Parker Super Lube and the gate pad plug thread with Dynatex Anti-Seize & Lubricating Compound.
6.7 Screw the gate pad plug (30426) into the body. Torque to 55 ft.lbf [75 Nm] – 22mm socket, torque wrench.
7.1 Remove the valve from the system.
7.2 Secure the valve in a vise.
7.3 Unscrew the gate pad plug (30426) – 22mm socket.
7.4 Remove the spring (71007048) and pad assembly – A brass rod can be used to aid pad assembly removal.
7.5 Remove the base cap – 10mm Allen socket.
7.6 Remove the piston assembly and Belleville springs – Pliers.
7.7 Rotate the handle clockwise until you reach the bottom stop.
7.8 Unscrew the handle fastener (71007037) and remove the handle (30453) from the stem – 2mm Allen wrench.
7.9 Place a 12mm socket over the seat retainer (30433) and rotate counter-clockwise until you can withdraw the old stem assembly from the body – 12mm socket, socket extension.
7.10 Lubricate the O-rings on the replacement stem assembly with a thin coat of Parker Super Lube and the stem thread with Dynatex Anti-Seize & Lubricating Compound.
7.11 Insert the replacement stem assembly into the body.
7.12 Rotate the stem until the gate profile is visible through the gate pad hole. See Figure 7 for more details.
7.13 Place your finger on the gate (through the gate pad hole) to prevent the gate from rotating. Place a 12mm socket over the seat retainer (30433) and rotate clockwise until you reach the top stop – 12mm socket, socket extension.

7.14 Ensure the gate profile is still visible through the gate pad hole.

7.15 Insert the gate pad assembly and spring.

7.16 Lubricate the gate pad plug O-ring with Parker Super Lube and the gate pad plug thread with Dynatex Anti-Seize & Lubricating Compound.

7.17 Screw the gate pad plug (30426) into the body. Torque to 55 ft.lb [75Nm] – 22mm socket, torque wrench.

7.18 Insert the Belleville spring stack (30513) into the valve. The springs should be assembled as shown in Figure 9 with the outside edge contacting the bottom of the piston bore.

7.19 Lubricate the piston cup seal (71006962) with Parker Super Lube.

7.20 Insert the piston assembly into the valve bore. Apply gentle pressure until the piston seats against the springs.

7.21 Coat the base fasteners (71006909) with a thin coat of Dynatex Anti-Seize & Lubricating Compound.

7.22 Install the base and tighten the four M12 cap head screws. The fasteners should be tightened in opposite pairs to 34 ft.lb [46Nm] – 10mm Allen socket, torque wrench.

7.23 Place the handle (30435) on the stem and align the holes.

7.24 Insert the handle fastener (71007037) and tighten – 2mm Allen wrench.

8. Replacing Stem Seals

! NOTICE
IT IS CRITICAL THAT THE GATE PAD IS REMOVED BEFORE THE STEM. FAILURE TO DO SO WILL RESULT IN DAMAGE TO THE STEM GUIDE RINGS.

8.1 When replacing stem seals, it is recommended that the O-Ring Installation Kit (P/N: 30641) be used.

8.2 Remove the SkoFlo valve from the system.

8.3 Follow steps 7.2 to 7.9 to remove the stem assembly from the valve.

8.4 Remove the spiral wound ring (71007136) that retains the stem bushing (30427) – Circlip pliers (.035” Tip Diameter).

8.5 Unscrew the stem bushing (30427) – 13mm deep socket.

8.6 Remove old stem seals and backup rings from the body and stem.

8.7 Install O-ring guide tool as shown in Figure 10.
8.8 Lubricate new O-rings with Parker Super Lube.

8.9 Slide a new 2-011 O-ring followed by the new backup ring (71006998) over O-ring installation tool (the backup ring should be on the handle side of the O-ring) as shown in Figure 11.

8.10 Remove the O-ring guide tool.

8.11 Place a new backup ring (71006999), followed by a new 2-905 O-ring and then another backup ring over the stem.

8.12 Place the O-ring press tool over the stem and screw it into the body by hand, taking care not to cut the stem O-ring. If the tool will not bottom out by hand, carefully, use a wrench to press the stack into the groove.

8.13 Insert the stem assembly into the valve body. Press firmly to ensure the stem is fully home.

8.14 Make sure the gate profile is visible through the gate pad hole.

8.15 Make sure the gate profile is visible through the gate pad hole.

8.16 Follow steps 7.14 to 7.24 to reassemble the rest of the valve.
## Frequently Asked Questions

Table 4 – Frequently Asked Questions

<table>
<thead>
<tr>
<th>ALL CIMVs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question</strong></td>
</tr>
<tr>
<td>CIMV Shutoff Ability</td>
</tr>
<tr>
<td>Protection Against Reverse Flow</td>
</tr>
<tr>
<td>Minimum Differential Pressure to Operate</td>
</tr>
<tr>
<td>Excessive Pressure Drop</td>
</tr>
<tr>
<td>Fluid Cavitation</td>
</tr>
<tr>
<td>Chemical Filming</td>
</tr>
<tr>
<td>Blowout Proof Stem</td>
</tr>
</tbody>
</table>
TROUBLESHOOTING

Flow Rate Set Point Drifts Over Time
- Handle has not been rotated ½ turn clockwise to reach set point.
  - Solution: Turn handle counterclockwise ½ rotation then clockwise ½ rotation to set point.
- Gate is plugging.
  - Solution: Flush the gate passages by turning handle counterclockwise until flow increases to near full scale. Take apart and clean if this does not work. Correct the cause of plugging such as a leaking filter.

IMPROPER VALVE PERFORMANCE

Fluctuations in Flow Rates
- Piston Springs are not installed properly.
  - Solution: Install springs in accordance with Figure 8.
- Seat or pin worn/damaged.
  - Solution: Replace stem assembly and/or piston assembly.
- Supply pressure is not adequate.
  - Solution: The valve requires a minimum of 300 psi [21 bar] differential pressure across the valve for full rated flow.

No Flow
- Upstream filter is plugged.
  - Solution: Clean or replace filter element
- Gate is plugged.
  - Solution: Flush the gate passages by turning handle counterclockwise until flow increases to near full scale. Take apart and clean if this does not work. Correct the cause of plugging such as a leaking filter.
- Supply valve is shut off.
  - Solution: Open valve slowly.
- Discharge line is shut off.
  - Solution: Open valve.

Figure 13 – Troubleshooting
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 – SF5000HTVA GA AND BOM DRAWING