Surface, Pressure Independent Flow Controller
15000psi

SF15000NMFE

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

Figure 1 – SF15000NMFE Cross Section View

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 SF15000NMFE 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 orifice thus resulting in a constant flow rate through that orifice.

The pressure that is generated by flow through the orifice 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 SF15000NMFE 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, high 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.

- 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 Industries, Inc.
- Prior to use, educate personnel in the proper installation, operation, and maintenance of this product.
- Only use replacement parts specified by SkoFlo Industries, Inc.

Product Overview

The SF15000NMFE is a pressure independent chemical injection and metering valve (CIMV), used in the petroleum industry to accurately control chemical injection rates. The SF15000NMFE regulates flow to counter pressure changes on the inlet and outlet of the unit. This is referred to as “pressure independence”.

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
- **GPM** Gallons Per Minute
- **NMFE** Needle Medium Flow Generation E
- **NPT** National Pipe Thread
- **SHCS** Socket Head Cap Screw
- **P/N** Part Number
- **psi** Pounds per Square Inch

**HYDRAULIC RATINGS**

**WARNING**

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

**NOTICE**

OPERATING VALVE WITH CONTINUOUS DIFFERENTIAL PRESSURES ABOVE 6000 PSI / 415 BAR MAY CAUSE PREMATURE INTERNAL WEAR AND MUST BE AVOIDED.

**NOTICE**

THE SF15000NMFE REQUIRES A MINIMUM DIFFERENTIAL PRESSURE ACROSS THE VALVE OF 500 PSI (35 BAR) TO ACHIEVE FULL RATED FLOW.

Max Working Pressure: 15,000 psi (1034 bar)

Hydro-Pressure: 22,500 (1551 bar)

Flow Rate Ranges:

- 0.1 – 2 GPM
- 0.25 – 12 GPM

Min Differential Pressure: 500psi (35 bar)

**STORAGE**

**NOTICE**

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

The SF15000NMFE 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 connection will be furnished with plastic blanking plugs.

It is important not to store the SF15000NMFE 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

**WARNING**
CHEMICAL COMPATIBILITY SHALL BE DONE AND CHECKED BEFORE USE, EXCEPT FOR MEG AND WATER MIXTURES.

**WARNING**
THE SF15000NMFE SHALL NOT BE INSTALLED SUBSEA.

1. Mounting
The SF15000NMFE can be panel or side mounted. The SF15000NMFE can be panel mounted via the four M8x1.25 holes on the top of the valve, or the two M12x1.75 holes on each side. See Appendix B for more details.

If panel mounting, unscrew the handle fastener with a 4mm Allen wrench and remove the handle. Mount the valve, then replace the handle and tighten the fastener in place.

2. Hydraulic Installation
Install the SF15000NMFE 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 SF15000NMFE. Clean chemicals and proper filtering are very important. Omitting the filter can cause the valve to become plugged. A 200 micron size filter is recommended. Note: if coarser filters are used, the adjustment handle may need to be periodically opened to flush out any debris.

A pulsation dampener is recommended to be installed on the inlet header supplying the SF15000NMFE 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 SF15000NMFE 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 SF15000NMFE (within 5 feet) to prevent well fluids entering the valve. 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 $\frac{1}{2}$ a 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 SF15000NMFE 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, however, it must be capable of withstanding the process pressure.

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 1.

Table 1 – SF15000NMFE Spares Kit Part Numbers

<table>
<thead>
<tr>
<th>ITEM</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPDM Seal Kit</td>
<td>27413</td>
</tr>
<tr>
<td>FFKM Seal Kit</td>
<td>27416</td>
</tr>
<tr>
<td>FKM Seal Kit</td>
<td>27412</td>
</tr>
<tr>
<td>HNBR Seal Kit</td>
<td>23008</td>
</tr>
<tr>
<td>0.1-2 GPM Stem Kit</td>
<td>31063</td>
</tr>
<tr>
<td>0.25-12 GPM Stem Kit</td>
<td>22294</td>
</tr>
<tr>
<td>Large Spring Set</td>
<td>31061</td>
</tr>
<tr>
<td>Cup Seal Installation Tool</td>
<td>30066</td>
</tr>
</tbody>
</table>

Table 2 – Tools and Parts

<table>
<thead>
<tr>
<th>Tools and Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vise</td>
</tr>
<tr>
<td>Torque wrench (up to 300ft.lbs)</td>
</tr>
<tr>
<td>Various wrenches</td>
</tr>
<tr>
<td>Various hex wrenches</td>
</tr>
<tr>
<td>1-3/8 in Crowfoot Wrench Drive</td>
</tr>
<tr>
<td>Wrench for specialized hubs (See Table 3)</td>
</tr>
<tr>
<td>Brass hooked probe</td>
</tr>
<tr>
<td>Parker Super Lube (or equivalent)</td>
</tr>
<tr>
<td>Dynatex Anti-Seize and Lubricating Compound (or equivalent)</td>
</tr>
<tr>
<td>Medium Strength Locking Compound</td>
</tr>
</tbody>
</table>

Table 3 – Hub Wrenches

<table>
<thead>
<tr>
<th>Hub Type</th>
<th>Wrench Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>FKO</td>
<td>30mm Extra Long Socket</td>
</tr>
<tr>
<td>¾ MP AE</td>
<td>1-1/4 Crowfoot Wrench Drive</td>
</tr>
<tr>
<td>Graylock 1GR4/5/7</td>
<td>1-3/8 in Crowfoot Wrench Drive</td>
</tr>
</tbody>
</table>

Figure 2 – Valve Components

6. Replacing the Stem Assembly

6.1 Remove SkoFlo valve from system.

6.2 Secure the valve in a vise.

6.3 The set screw in the handle was fixed in place with medium strength locking compound and will resist movement but will break loose with firm steady pressure. Unscrew the set screw (71002937) in the handle and pull the handle (20693) off the stem. – 4mm Allen Wrench
6.4 Remove the adjustment handle retainer lock bolt (28722-002). Remove the retainer lock plate (20677). – 6mm Allen Wrench

6.5 Unscrew the stem retainer nut (20675) and pull the stem and nut out of the body. The stem retainer nut (20677) and the stem will remain together during this step. – 1-3/8 Wrench

6.6 Rotate the stem clockwise to release it from the stem retainer nut.

6.7 Screw the replacement stem into the stem retainer through the bottom of the retainer.

6.8 Lubricate the replacement O-rings with Parker Super Lube or similar.

6.9 Place the backup rings onto the stem so the contour faces the O-ring. Install per Figure 4.

6.10 Place the handle onto the replacement stem such that the set screw will land on the flat of the stem.

6.11 Put medium strength locking compound onto the set screw. Place it into the handle and tighten.

6.12 Follow steps 7.8-7.10 to install adjustment handle stem assembly.

### 7. Replacing the Stem Assembly Seals

7.1 Follow steps 6.1-6.5 to remove the stem assembly.

7.2 Pull out the stem trim (see Figure 5). Use care to avoid damage to the internal surfaces of the SkoFlo valve. – Brass hooked probe

7.3 Remove the old O-rings and backup rings on the stem and trim.

7.4 Lubricate the replacement O-rings with Parker Super Lube or similar.

7.5 Install the backup rings so that the contour faces the O-ring.

7.6 Install the stem backup rings and O-rings per Figure 4.

7.7 Install the external backup rings and O-rings per Figure 6.
7.8 Place the stem trim and adjustment handle assembly into the body.

7.9 Orient the stem retainer so that the retainer lock plate and retainer lock bolt will fit in place.
   – 1-3/8 Wrench

7.10 Install the lock bolt into the body to retain the lock plate. – 6mm Allen Wrench

8. **Replacing Base Cap Seals**

   8.1 Remove SkoFlo valve from system.

   8.2 Secure the valve in a vise.

   8.3 Unscrew and remove the base cap locking screw (28722-002). – 6mm Allen Wrench

   8.4 Unscrew and remove the base cap (27357). – 1.5in or 38mm Socket or Wrench

   8.5 Unscrew the seal retainer (27353). – large flat head screwdriver

   8.6 Remove the internal backup ring and cup seal. – Brass hooked probe

   8.7 Lubricate the replacement cup seal (71001862) with Parker Super Lube or similar.

8.8 Install the retaining ring (26827) such that the ridge faces away from the hex.

8.9 Install the cup seal into the base cap with the spring side facing towards the hex.

8.10 Install the backup ring (26836).

8.11 Thread the seal retainer (27353) into the base cap and tighten with a large flathead screwdriver.

8.12 Remove old external O-ring and backup ring.

8.13 Lubricate replacement O-ring with Parker Super Lube or equivalent.

8.14 Install the backup rings so that the concave contour faces the O-ring. Install the backup ring and O-ring per Figure 7.

8.15 Go to 13. Closing the valve.

9. **Replacing Piston Seals**

   9.1 Follow steps 8.1-8.4

   9.2 Carefully pull out the piston assembly and the large spring stack (see Figure 8).

   9.3 Remove piston snap ring retainer (71005981), seal retainer (27355), and cup seal (71001872).

   9.4 Lubricate new piston cup seal with Parker Super Lube or equivalent.

   9.5 Slide cup seal onto piston, then the seal retainer. Be sure to orient the seals correctly – the spring side of the cup seal should face the
base of the valve, the seal retainer ridged edge should face the cup seal spring (see Figure 8).

9.6 Install the snap ring (71005981).

9.7 Go to 13. Closing the valve.

10. Replacing large springs


10.2 Remove the large washer springs (71005990).

10.3 Place replacement large washer springs onto the piston assembly such that they oppose each other – concave to concave, convex to convex (see Figure 9).

10.4 Go to 13. Closing the valve.

11. Replacing Seat Retainer Seals

11.1 Follow steps 9.1-9.2.

11.2 Remove seat retainer assembly (27354).

11.3 Remove the old external seals.

11.4 Remove internal snap ring (71005980), seal retainer (27358), cup seal (71005976), and backup ring.

11.5 Lubricate the replacement cup seal with Parker Super Lube or equivalent.

11.6 Install the replacement backup ring, then the replacement cup seal with spring side visible. – Cup Seal Installation Tool (30066)

11.7 Install seal retainer (27358) with the raised ridge against the cup seal spring.

11.8 Install the snap ring.

11.9 Lubricate the replacement O-rings with Parker Super Lube or equivalent.

11.10 Install the backup rings so that the contour faces the O-ring. Install the replacement backup rings and O-rings per Figure 10.

11.11 Go to 13. Closing the valve.

12. Replacing Seat Seals

12.1 Follow steps 11.1-11.2.

12.2 Remove the seat retainer.
12.3 Carefully remove the seat (see Figure 11). – Brass hooked probe
12.4 Remove the old O-ring and backup ring.
12.5 Lubricate the replacement O-ring with Parker Super Lube or equivalent.
12.6 Install the backup ring so that the concave contour faces the O-ring. Install the backup ring and O-ring per Figure 12.

**Figure 12 – Seat Assembly**

12.7 Insert the seat into the body by slowly pushing with a tool which will not chip the ceramic seat. Orient the seat with smallest diameter end into the body (see Figure 11).
12.8 Go to 13. Closing the valve.

13. Closing the valve

13.1 If needed, ensure that the seat is placed in the valve per Figure 11.
13.2 If needed, re-install seat retainer so that the internal seals are facing the seat.
13.3 If needed, re-install piston with large springs (see Figure 8 - Piston Assembly, Figure 9 – Spring Orientation).
13.4 Screw base plug into body until fully seated, adjust the base cap to align the cutout on the cap with the locking screw. Install the base plug locking screw. – 6mm Allen Wrench

14. Replace hex plug seal

14.1 Remove hex plug (20485) (see Figure 13). – 3/8in Socket & Torque Wrench
14.2 Remove the old O-ring (3-906).
14.3 Lubricate the replacement O-ring with Parker Super Lube or equivalent and place onto hex plug.
14.4 Torque hex plug to 60 ft.lbf [81Nm]. – 3/8in Socket & Torque Wrench

15. Replace hub seals

15.1 Remove the hubs (see Figure 13). – Torque Wrench & see Table 3 – Hub Wrenches
15.2 Remove the old O-rings.
15.3 Lubricate the replacement O-rings with Parker Super Lube or equivalent and place onto hubs.
15.4 Screw the hubs into body.
15.5 Torque the hubs to 300 ft.lbf [271Nm]. – Torque Wrench & see Table 3 – Hub Wrenches
TROUBLESHOOTING

NO FLOW

SUPPLY VALVE IS SHUT OFF

OPEN VALVE SLOWLY

UPSTREAM FILTER IS PLUGGED

CLEAN OR REPLACE FILTER ELEMENT

DISCHARGE LINE IS SHUT OFF

OPEN VALVE

INTERNAL PASSAGE IN VALVE BODY BETWEEN INLET AND PIETON CHAMBER IS PLUNKED

Dismantle the valve and clean the passage

PISTON SPRINGS ARE NOT INSTALLED PROPERLY

INSTALL SPRINGS OPPOSED TO EACH OTHER, NOT NESTED

SEAT OR PIN IS WORN OR DAMAGED

REPLACE SEAT HOLDER OR PIN

SUPPLY PRESSURE IS NOT ADEQUATE

THE FLOW CONTROLLER REQUIRES A MINIMUM OF 500 PSI (35 BAR) DIFFERENTIAL PRESSURE ACROSS THE VALVE FOR FULL RATED FLOW. VALVES DESIGNED FOR SPECIAL HIGH FLOW RATE MAY REQUIRE A HIGHER DIFFERENTIAL PRESSURE.

IMPROPER VALVE PERFORMANCE

SYMPTOM

FLUCTUATIONS IN FLOW RATES

CAUSE
APPENDIX A – 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 5 feet of the SkoFlo Valve.
Surface, Pressure Independent Flow Controller

Operations and Maintenance Instructions

NOTES CONTINUED:
10) COAT ALL THREADS WITH DYNATEX ANTI-SEIZE & LUBRICATING COMPOUND
OR SIMILAR) UNLESS OTHERWISE STATED
11) LUBRICATE ALL SEALS WITH PARKER SLUBE 884-4 (OR SIMILAR)
12) SEE SF15000NMFE-SK FOR SPARES KITS PART LISTS
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