631 SERIES SERVO VALVES

The 631 Series flow control servovalves are throttle valves for 3- and preferably 4-way applications. They are a medium performance, two-stage design that covers the range of rated flows from 2.5 to 40 gpm at 1,000 psi valve drop. The output stage is a closed center, four-way sliding spool. The pilot stage is a symmetrical double-nozzle and flapper, driven by a double air gap, dry torque motor. Mechanical feedback of spool position is provided by a cantilever spring. The valve design is simple and rugged for dependable, long life operation.

These valves are suitable for electrohydraulic position, speed, pressure or force control systems with high dynamic response requirements.

Principle of operation
An electrical command signal (flow rate set point) is applied to the torque motor coils and creates a magnetic force which acts on the ends of the pilot stage armature. This causes a deflection of armature/flapper assembly within the flexure tube. Deflection of the flapper restricts fluid flow through one nozzle which is carried through to one spool end, displacing the spool.

Movement of the spool opens the supply pressure port (P) to one control port, while simultaneously opening the tank port (T) to the other control port. The spool motion also applies a force to the cantilever spring, creating a restoring torque on the armature/flapper assembly. Once the restoring torque becomes equal to the torque from the magnetic forces, the armature/flapper assembly moves back to the neutral position, and the spool is held open in a state of equilibrium until the command signal changes to a new level.

In summary, the spool position is proportional to the input current and with constant pressure drop across the valve, flow to the load is proportional to the spool position.

VALVE FEATURES

- 2-stage design with dry torque motor
- Low friction double nozzle pilot stage
- High spool driving forces
- D05 port pattern for 4-ports (external pilot supply is not per ISO 4401 location)
- Rugged, long-life design
- High resolution, low hysteresis
- Completely set-up at the factory
- Optional fifth port for separate pilot supply
- Field replaceable pilot filter

The actual flow is dependent upon electrical command signal and valve pressure drop. The flow for a given valve pressure drop can be calculated using the square root function for sharp edge orifices:

\[ Q = Q_N \sqrt{\frac{\Delta p}{\Delta p_N}} \]

- \( Q \) [gpm] = calculated flow
- \( Q_N \) [gpm] = rated flow
- \( \Delta p \) [psi] = actual valve pressure drop
- \( \Delta p_N \) [psi] = rated valve pressure drop

This catalog is for users with technical knowledge. To ensure that all necessary characteristics for function and safety of the system are given, the user has to check the suitability of the products described here. In case of doubt, please contact Moog Inc.
631 SERIES
GENERAL TECHNICAL DATA

**Operating Pressure***
- ports P, X, A and B: up to 3,000 psi
- port T: up to 2,000 psi

**Temperature Range**
- Fluid: 0°F to 200°F
- Ambient: -40°F to 275°F

**Seal Material**
- Viton, others on request

**Operating Fluid**
- Compatible with common hydraulic fluids, other fluids on request.
  - Recommended viscosity: 60 – 450 SUS @ 100°F

**System Filtration:** High pressure filter (without bypass, but with dirt alarm) mounted in the main flow and, if possible, directly upstream of the valve.

**Class of Cleanliness:** The cleanliness of the hydraulic fluid greatly effects the performance (spool positioning, high resolution) and wear (metering edges, pressure gain, leakage) of the servovalve.

**Recommended Cleanliness Class**
- For normal operation: ISO 4406 < 14/11
- For longer life: ISO 4406 < 13/10

**Filter Rating**
- For normal operation: β₁₀ ≥ 75 (10 µm absolute)
- For longer life: β₁₀ ≥ 75 (5 µm absolute)

**Installation Operations**
- Any position, fixed or movable.

**Vibration**
- 30 g, 3 axes

**Weight**
- 4.6 lbs

**Degree of Protection**
- EN 50529P: class IP65, with mating connector mounted.
  - Delivered with an oil sealed shipping plate.

---

* Special order 4,500 psi

---

Valve Flow Diagram
Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.
631 SERIES
TECHNICAL DATA

Model...Type
Mounting Pattern
Valve Body Version

Pilot Stage
Pilot Connection
Rated Flow

Optional, Internal or External
(±10%) at Δp = 1,000 psi

Standard [gpm] 2.5 5.0 10.0 15.0 20.0
High Response [gpm] 2.5 5.0 10.0 15.0 20.0

Response Time*

Standard [ms] 40 40 40 40 40
High Response [ms] 15 15 15 15 15

Threshold*

[%] < 1

Hysteresis*

[%] < 5

Null Shift

at ΔT = 100°F [%] < 3

Null Leakage Flow‡

max. [gpm] 0.35 to .55

* Measured at 3,000 psi pilot or operating pressure
‡ Measured at 1,000 psi pilot or operating pressure

Typical Characteristic Curves with ±5% and ±100% input signal, measured at 3,000 pilot or operating pressure.

Standard Valves

High Response Valves

631-........

ISO 4401-05-05-0-94 (for 4 ports)
4-way
2-stage with spool–bushing assembly
Nozzle/Flapper, Highflow

X

Model...Type
Mounting Pattern
Valve Body Version
**CONVERSION INSTRUCTION**

For operation with internal or external pilot connection.

<table>
<thead>
<tr>
<th>P</th>
<th>A</th>
<th>B</th>
<th>T</th>
<th>X*</th>
<th>F₀</th>
<th>F₁</th>
<th>F₂</th>
<th>F₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø0.45</td>
<td>Ø0.45</td>
<td>Ø0.45</td>
<td>Ø0.25</td>
<td>M6</td>
<td>M6</td>
<td>M6</td>
<td>M6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>x</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.06</td>
<td>0.66</td>
<td>1.47</td>
<td>0.13</td>
<td>-0.35</td>
<td>0</td>
<td>2.13</td>
<td>2.13</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>y</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.84</td>
<td>0.84</td>
<td>1.20</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>1.81</td>
<td>1.81</td>
</tr>
</tbody>
</table>

**The mounting manifold must conform to ISO 4401-05-05-0-94*.**

*Note: Location of X port in valve body does not correspond to ISO standards. Mounting surface needs to be flat within 0.001(0.03) TIR and a $\Delta\Delta$ finish.

---

**631 SERIES**

**INSTALLATION DRAWINGS**

The mounting manifold must conform to ISO 4401-05-05-0-94.*

*Note: Location of X port in valve body does not correspond to ISO standards. Mounting surface needs to be flat within 0.001(0.03) TIR and a $\Delta\Delta$ finish.
**Rated current and coil resistance**
A variety of coils are available for 631 Series Servovalves, which offer a wide choice of rated current. See Table 1.

**Coil connections**
A four-pin electrical connector (that mates with an MS310614S-2S) is standard. All four torque motor leads are available at the connector so external connections can be made for series, parallel, or differential operation.

631 Series Servovalves can be supplied on special order with other connectors or a pigtail.

**Servoamplifier**
The servovalve responds to input current, so a servoamplifier that has high internal impedance (as obtained with current feedback) should be used. This will reduce the effects of coil inductance and will minimize changes due to coil resistance variations.

---

**ELECTRICAL CONNECTIONS**

(Examples with typical 631 series coils)

**Connector MS310614S-2S**

<table>
<thead>
<tr>
<th>Coils</th>
<th>Rated Current</th>
<th>Inductance</th>
<th>Electrical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel</td>
<td>14 ±100</td>
<td>0.2</td>
<td>.14</td>
</tr>
<tr>
<td>Series</td>
<td>56 ±50</td>
<td>0.8</td>
<td>.14</td>
</tr>
<tr>
<td>Single</td>
<td>28 ±100</td>
<td>0.2</td>
<td>.28</td>
</tr>
</tbody>
</table>

**Note:** Before applying electrical signals, the pilot stage has to be pressurized.

---

**TABLE 1**

<table>
<thead>
<tr>
<th>Nominal Resistance Per Coil at 77°F (25°C)</th>
<th>Recommended Rated Current-mA</th>
<th>Approximate Coil Inductance*–Henry's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parallel, Differential or Single Coil Operation</td>
<td>Series Coils</td>
</tr>
<tr>
<td>28</td>
<td>±100</td>
<td>±50</td>
</tr>
<tr>
<td>300</td>
<td>±30</td>
<td>±15</td>
</tr>
</tbody>
</table>

* Measured at 50 Hz
# 631 SERIES

## ORDERING INFORMATION

### SPARE PARTS AND ACCESSORIES

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-Rings (included in delivery), FPM 85 Shore for P, T, A and B</td>
<td>ID 0.472 x 0.079</td>
<td>G2141-12-20</td>
</tr>
<tr>
<td>for X</td>
<td>ID 0.315 x 0.079</td>
<td>G2141-8-20</td>
</tr>
<tr>
<td>Mating Connector, waterproof IP 65 (not included in delivery)</td>
<td>P/N 49054F145ZS (MS3106F145-2S)</td>
<td></td>
</tr>
<tr>
<td>Flushing Block</td>
<td>P/N B67728-002</td>
<td></td>
</tr>
<tr>
<td>Mounting Bolts (not included in delivery) 1/4 - 20 N C x 2-3/4 long (4 pieces)</td>
<td>P/N A31324-144B</td>
<td></td>
</tr>
<tr>
<td>Replaceable Filter</td>
<td>P/N A67999-100</td>
<td></td>
</tr>
<tr>
<td>Filter Replacement Kit (includes service manual)</td>
<td>P/N B52555RK69K1</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>City</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>Mulgrave</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>São Paulo</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>Cöpenhagen</td>
<td></td>
</tr>
<tr>
<td>England</td>
<td>Tewkesbury</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>Espoo</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>Rungis</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>Böblingen</td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Hong Kong</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Bangalore</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>Ringaskiddy</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>Malnate</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>Hiratsuka</td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>Seoul</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>Baguio</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>Singapore</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>O rio</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Askim</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>East Aurora</td>
<td></td>
</tr>
</tbody>
</table>