SERVO VALVES
3-STAGE FLOW CONTROL
79 SERIES

FOR DEPENDABLE, LONG LIFE OPERATION WHERE
POSITION, SPEED, PRESSURE OR FORCE CONTROL
SYSTEMS HAVE HIGH DYNAMIC RESPONSE
REQUIREMENTS

WHAT MOVES YOUR WORLD

MOOG
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.

The flow value \( Q \) calculated in this way should not exceed an average flow velocity of 100 ft/s in ports P, A, B and T.

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

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

If large flow rates with high valve pressure drops are required, an appropriate higher pilot pressure has to be chosen to overcome the flow forces. An approximate value can be calculated as follows:

\[
p_x \geq 5.6 \cdot 10^2 \cdot \frac{Q}{A_k} \cdot \sqrt{\Delta p}
\]

- \( p_x \) [psi] = pilot pressure
- \( A_k \) [in²] = spool drive area
- \( \Delta p \) [psi] = valve pressure drop with \( Q \)

The pilot pressure \( p_x \) has to be at least 215 psi above the return pressure of the pilot stage.

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.
79 SERIES
GENERAL TECHNICAL DATA

Operating Pressure
Main Stage*
Ports P, A and B
with X internal up to 5,000 psi with High Pressure Pilot
with X external up to 5,000 psi
Port T with Y internal up to 3,000 psi
Port T with Y external up to 5,000 psi
Pilot valve (76X series)*
Ports P, A and B up to 5,000 psi
Port T up to 3,000 psi

Temperature Range
Fluid 0°F to 180°F
Ambient 0°F to 180°F

Seal Material Viton, others on request

Operating Fluid Mineral oil based hydraulic fluid (to DIN 51524), others on request

Recommended viscosity 60-450 SUS @ 100°F

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 valve.

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

System Filtration
Pilot valve: High pressure filter (without bypass, but with dirt alarm) mounted in the main flow and if possible, directly upstream of the servo valve.
Main stage: High pressure filter as for the pilot stage. In combination with a fast regulating VD-pump, a bypass filter is possible.

Filter Rating recommended
For normal operation \( \beta_i \geq 75 \text{ (10 µm absolute)} \)
For longer life \( \beta_i \geq 75 \text{ (5 µm absolute)} \)

Installation Options
Any position, fixed or moveable.

Vibration 30 g, 3 axes

Weight

Shipping Plate Delivered with an oil sealed shipping plate.

* Maximum special order is 5,000 psi

3 stage Servo Valve
79-1XXX Series with a 76X Series pilot valve
### 79-1XXX SERIES
TECHNICAL DATA

**Model . . . Type**

ISO, but X and Y do not correspond to ISO

**Mounting Pattern**

ISO 10372-06-05-0-92

**Valve Body Version**

4-way 3-stage with spool-bushing assembly

**Pilot Valve**

2-stage, 76X series

**Pilot Connection**

Optional, internal or external

**Mass**

24 lbs [10.9 kg]

**Rated Flow**

(± 10%) at \(\Delta p_N = 1,000\) psi [gpm] 30 60

**Response Time**

for 0 to 100% stroke [ms] 14 14

**Threshold**

[\%] < 0.5%

**Hysteresis**

[\%] < 1.0%

**Null Shift**

with \(\Delta T = 50^\circ C\) [\%] < 2.5%

**Null Leakage Flow**

total, max. [gpm] 0.8

**Main Spool Stroke**

[\text{in}] 0.075

**Main Spool Drive Area**

[\text{in}^2] 0.442

* measured at 3,000 psi pilot or operating pressure, respectively, and fluid viscosity 32 mm$^2$/s

**Typical Characteristic Curves** measured at 3,000 psi pilot or operating pressure, respectively, and fluid kinematic viscosity of 32 mm$^2$/s.

**Set-up and Operation**

Frequency Response for valves with different rated flows and different pilot valves

Valve Flow Diagram

Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.
79-2XXX SERIES
TECHNICAL DATA

Model . . . Type
Mounting Pattern
Valve Body Version

Pilot Valve
Pilot Connection
Mass
Rated Flow
Response Time*
Threshold*
Hysteresis*
Null Shift
Null Leakage Flow*

Main Spool Stroke
Main Spool Drive Area

* measured at 3,000 psi pilot or operating pressure, respectively, and fluid viscosity 32 mm²/s

Typical Characteristic Curves measured at 3,000 psi pilot or operating pressure, respectively, and fluid kinematic viscosity of 32 mm²/s.

Frequency Response
for valves with different rated flows and different pilot valves.

Valve Flow Diagram

Rated pressure drop ∆p = 1,000 psi Valve pressure drop ∆p. (psi)
Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.
The mounting Manifold must conform to ISO 10372-06-05-0-92.

Note: The X port to ISO Standard must not be machined. The X and Y ports of Moog valve body do not correspond to ISO Standard.

Surface to which valve is mounted requires a $\frac{3}{32}$ [0.10] finish, flat within 0.001[0.03] TIR.
**79-1XXX SERIES**

**TYPICAL SUBPLATE MANIFOLD**

![Diagram of typical subplate manifold]

<table>
<thead>
<tr>
<th>US</th>
<th>P</th>
<th>A</th>
<th>T</th>
<th>B</th>
<th>G</th>
<th>X*</th>
<th>Y*</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
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<tbody>
<tr>
<td></td>
<td>Ø.63</td>
<td>Ø.63</td>
<td>Ø.63</td>
<td>Ø.63</td>
<td>Ø.32</td>
<td>0.156</td>
<td>0.156</td>
<td>3/8-16</td>
<td>3/8-16</td>
<td>3/8-16</td>
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<tr>
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<table>
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<tr>
<th>METRIC</th>
<th>P</th>
<th>A</th>
<th>T</th>
<th>B</th>
<th>G</th>
<th>X*</th>
<th>Y*</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
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<tr>
<td></td>
<td>Ø16</td>
<td>Ø16</td>
<td>Ø16</td>
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<td>Ø8</td>
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<td>M10</td>
<td>M10</td>
<td>M10</td>
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<td>0</td>
<td>85.7</td>
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</table>

THE MOUNTING MANIFOLD MUST CONFORM TO ISO 10372-06-05-0-92

*NOTE: The X port to the ISO standard must not be machined.
The X and Y ports of the Moog valve do not correspond to ISO standard.
Surface to which the valve is mounted requires a 32 finish (ΔΔ), flat within .0001 [.03] TIR.

**SPARE PARTS AND ACCESSORIES FOR 79-1XXX SERIES**

<table>
<thead>
<tr>
<th>O-rings (included in delivery)</th>
<th>for P, T, A, B</th>
<th>4 pieces</th>
<th>ID 0.800 x 0.070</th>
<th>42082-040</th>
</tr>
</thead>
<tbody>
<tr>
<td>for X, Y</td>
<td>2 pieces</td>
<td>ID 0.301 x 0.070</td>
<td>42082-012</td>
<td></td>
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<tr>
<td>Mating connector, waterproof IP 65 (not included in delivery)</td>
<td>pilot valve</td>
<td>-49054F0145002S (MS3106F14S-2S)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>LVDT</td>
<td>-49054F0145005S (MS3106F14S-5S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flushing plate</td>
<td></td>
<td>G4321AM001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting bolts (not included in delivery)</td>
<td>3/8 - 16 UNC x 2.25</td>
<td>4 pieces</td>
<td>required torque 50 lb.-ft.</td>
<td>A31324-336B</td>
</tr>
</tbody>
</table>
79-2XXX SERIES (STANDARD)  
INSTALLATION DRAWING WITH PILOT VALVE 76X SERIES

**TYPICAL SUBPLATE MANIFOLD**

*Note:* The X and Y tubes have to be connected to the Moog valve body by fittings. 
Surface to which valve is mounted requires a $\frac{\text{1/8}}{[0.03]}$ TIR.
79-2XXX SERIES (HIGH RESPONSE)
INSTALLATION DRAWINGS
WITH PILOT VALVES 76X SERIES

O-rings (included in delivery)
for P, T, A, B
4 pieces
ID 1.418 x 0.138
42082-264

Mating connector, waterproof IP 65 (not included in delivery)
pilot valve
LVDT
49054F014S002S (MS3106F14S-2S)
49054F014S005S (MS3106F14S-5S)

Flushing Block Kit
-43949-001K002

Mounting bolts (not included in delivery)
5/8 - 11 UNC x 2.25
8 pieces
required torque 215 lb.-ft. B40052-218B

SPARE PARTS AND ACCESSORIES FOR 79-2XXX SERIES
SERVOS CONTROLLER

The Moog Model N121-132A is a convenient servo controller for use with 79 Series servo valves. The Model N123-134 exciter/demodulator is available for operation of the spool position LVDT.

The AC excitation is adjustable between ±10 and ±14 volts peak-to-peak. The recommended frequency is 2000 Hz (N123-134) to achieve good servo valve response; however, a lower frequency may be necessary if a long cable run is required.

The sensitivity of the spool position LVDT can be determined from Figure 1; the demodulated gain of the N123-134 can be determined from its data sheet.

INNER LOOP GAIN SET-UP

- Connect the pilot valve coils to servo controller terminals 12 and 13 per the schematic below.
- Ground servo controller terminal 7 and apply a +1.0 VDC signal to servo controller terminal 6 (with the LVDT demodulated signal from the N123-134 disconnected).
- Monitor the valve current by measuring the voltage drop across the 20 Ω sensing resistor R31 (test point lsv to TP11). The valve current scale factor is 50 mA per volt measured at lsv.
- Adjust the GAIN 2 pot to obtain the desired servocontroller gain (see equations to the right). It may not be possible to operate with satisfactory valve stability at the maximum servo controller gain as both the pilot valve and LVDT have ±10% gain tolerances. It is recommended that the servo controller gain be turned down the first time pressure is applied.

STANDARD ELECTRICAL CONFIGURATION

The summing section of the model N121-132A servo controller can be used for summing the load servo command and feedback signals. The GAIN 1 pot provides a convenient loop gain adjustment.

SERVO VALVE LOOP GAIN

The inner loop gain of the 79 Series Servo Valves, when operating with 3,000 psi pilot supply pressure and with the pilot valve coils wired in parallel, can be determined by:

\[ K_{IL} = \frac{K_A K_P K_V K_X}{\Delta x} \]

where:
- \( K_{IL} \) = servo valve inner loop gain (sec⁻¹)
- \( K_A \) = servo controller gain (mA/VDC)
- \( K_P \) = pilot valve gain (mA/sec)
- \( K_V \) = LVDT gain (in/sec)
- \( K_X \) = power spool end area = 1.107 in² for 79-200 standard = 0.442 in² for 79-200 High Response
- \( Z \) = 2.5 for 79-100, 5.0 for 79-200 standard, and 4.0 for 79-200 High Response.

The required servo controller gain can be found by:

\[ K_A = \frac{K_{IL}}{K_P K_V K_X} \]

OUTER SERVO LOOP GAIN

The nominal gain of the 79 Series for the outer loop will be:

\[ K_{VAL} = \frac{K_A}{K_0 K_X} \]

where:
- \( K_{VAL} \) = overall valve gain (in/sec/VDC)
- \( K_0 \) = power spool flow gain (VDC/vrms, see specifications)
- \( K_X \) = LVDT gain (vrms/inch)

Note that the power spool flow gain is specified for operation at 1000 psi supply. This gain must be corrected for operation at other supply pressures by multiplying it by a correction factor of the square root of the available hydraulic pressure divided by 1000 psi.
## 79 SERIES

### ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Type Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-1, 79-2</td>
<td>* * * * * * * * *</td>
</tr>
</tbody>
</table>

**Model Designation**  
Assigned at the factory

**Valve Version**  
- **S** Standard response  
- **H** High response (200 only)

**Rated Flow**  
<table>
<thead>
<tr>
<th>Qn[gpm] at ΔpN = 1,000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (gpm) Series</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>99</td>
</tr>
</tbody>
</table>

**Maximum Operating Pressure p_p and Body Material**  
- **F** 3,000 psi  
- **J** 4,500 psi at p_x ≤ 4,000 psi (X and Y external) operating pressure in ports P, A, B and T up to 5,000 psi possible  
- **K** 5,000 psi steel

**Main Spool Type**  
- **O** 4-way / axis cut / linear characteristic  
- **X** Special spool*  
- **B** 3 way/A port active

**Pilot Stage**  
- **P** 76X Standard  
- **Q** 76X High response  
- **K** 76X Super high response

**LVDT Electrical Connector**  
- **4** 4 pin XDCR: 4 pin Pilot  
- **5** 5 pin XDCR: 4 pin Pilot

**Seal Material**  
- **V** FPM (Fluorocarbon)  
- Others on request*

**Pilot Connections and Pressure**  
<table>
<thead>
<tr>
<th>Supply [X]</th>
<th>Return [Y]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>internal</td>
</tr>
<tr>
<td>1</td>
<td>external</td>
</tr>
<tr>
<td>2</td>
<td>external</td>
</tr>
<tr>
<td>6</td>
<td>external</td>
</tr>
</tbody>
</table>

**Spool Position without Electrical Signal**  
<table>
<thead>
<tr>
<th>Position</th>
<th>Pilot Pressure [psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Undefined</td>
</tr>
<tr>
<td>A</td>
<td>P = B, A = T</td>
</tr>
<tr>
<td>B</td>
<td>P = A, B = T</td>
</tr>
</tbody>
</table>

Preferred configurations highlighted.  
All combinations may not be available.  
Options may increase price and delivery.  
Technical changes are reserved.

* Optional designs are available with special spool bushing lap configuration.  
Available seal materials: Fluorocarbon (Std), BUNA or EPR.
TAKE A CLOSER LOOK

Motion Control solutions from Moog are available around the world. For more information, visit our web site or contact one of the locations below.

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