MOOG®
Models DO79-120 and 121
High Response Flow Control Servo valves

Features
- same manifold mounting as Moog 72 Series servo valve
- modular pilot valve
- optional five-port and six-port configurations available to isolate pilot supply
- typical dynamic response $\leq 2$ db to 100 Hz
- optional 4000 psi configuration available
- electrical feedback allows convenient change in rated flow to help optimize system performance
- spool position LVDT electrically isolated from hydraulic fluid
- long life, hardened CRES spool and sleeve

These three-stage servo valves provide high dynamic response for precision control of position, velocity, or force in systems requiring about 15 hp to 75 hp. Maximum rated flow for the two models is 30 gpm and 60 gpm at 1000 psi drop. Operating supply pressure can be as high as 4000 psi (3000 psi maximum is standard).

The two-stage pilot valve is a special, high response Series 76 servo valve. Electrical feedback of third-stage spool position is provided by an LVDT. A separate oscillator, demodulator and servoamplifier are necessary to close the spool position servoloop.
**Performance**

![Graph 1](image1.png)

*Fig. 1 Power Valve Flow Gain @ 1000 PSI Valve Drop*

---

**PILOT VALVE SPECIFICATIONS**

Model Number ....... 76-557
Rated Flow at 1000 psi .... 2.5 gpm
Rated Input
  series coils .............. ±20 ma
  parallel coils ............ ±40 ma
Coil Resistance at +25°C .... 80Ω each (±10%)
Approximate Coil Inductance
  series coils ............. 0.66 Henrys
  parallel coils ........... 0.18 Henrys

---

**POWER VALVE SPECIFICATIONS**

Spool End Area ........... 0.44 in²
Spool Flow Gain at 1000 psi (in linear region)
  D079-120 ........... 2.31 × 10³ in³/sec inch
  D079-121 ........... 5.48 × 10³ in³/sec inch
Approximate Spool Stroke to stops ........... ±0.075 inch

---

![Graph 2](image2.png)

*Fig. 2 Large Amplitude Frequency Response At Constant Loop Gain*

![Graph 3](image3.png)

*Fig. 3 Small Amplitude Frequency Response*

![Graph 4](image4.png)

*Fig. 4 Step Response*
Servocontroller and Servovalve Wiring Schematic

SPOOL POSITION TRANSDUCER SPECIFICATIONS

Type ........................................... LVDT*

Excitation Frequency
  minimum .................................. 400 Hz
  maximum .................................. 5000 Hz
  recommended ............................. 2000 to 4000 Hz

Maximum Excitation Voltage .......... 15 vrms

Approximate Excitation Power ........ 6.5 x 10^-4 va/volt
  (at 2000 Hz)

Recommended Load
  Impedance ................................ ≥ 50 K Ω

Output Sensitivity and
  Phase Shift .............................. See Figure 5

*linear variable differential transformer

Fig. 5 Nominal LVDT Output Characteristics
Set-up and Operation

SERVOAMPLIFIER

The Model 121-114 is a convenient servoamplifier for use with the D079-120 and 121 servovalves. An optional plug-in circuit card, the Model 123-125, contains an oscillator and demodulator for operation of the spool position LVDT.

The ac excitation is nominally 6.3 vrms (adjustable) and the carrier frequency is 2000 Hz. The 2000 Hz frequency is recommended to achieve best servovalve response, however a lower frequency may be necessary if a long cable run is required.

With the nominal excitation of 6.3 vrms at 2000 Hz, the spool position LVDT will have a sensitivity of (from Figure 5) 1.07 x 6.3 = 6.74 vrms/inch. The demodulator gain of the Model 123-125 circuit card is 4.3 vdc/vrms.

SERVOVALVE LOOP GAIN

The inner loop gain of the D079-120 servovalve when operating with 3000 psi pilot supply pressure and with the coils of the pilot valve in parallel is determined by:

\[
K_{IL} = \frac{K_A K_{PV} K_D K_X}{A_S}
\]

where

- \(K_{IL}\) = servovalve inner loop gain sec\(^{-1}\)
- \(K_A\) = servoamplifier gain ma/vdc
- \(K_{PV}\) = pilot valve gain
- \(K_D\) = demodulator gain = 4.3 vdc/vrms
- \(K_X\) = LVDT gain = 6.74 vrms/inch
- \(A_S\) = power spool end area = 0.44 in\(^2\)

For the recommended maximum inner loop gain of 700 sec\(^{-1}\):

\[
K_A = \frac{700 \times 0.44}{0.42 \times 4.3 \times 6.74} = 25.3 \text{ ma/vdc}
\]

LOOP GAIN SET-UP

- Connect amplifier terminals 19 and 20 to the pilot valve electrical connector per the schematic on Page 3.
- Monitor terminal 13 (output of \(A_{01}\)) and adjust the BIAS pot on the front panel to obtain first +1.0 vdc, then −1.0 vdc.
- Monitor the valve current by either reading the front panel meter (±50 ma full scale) or by measuring the voltage drop across the 20Ω sensing resistor R23 (terminal 19 to terminal 5). The latter is the more accurate method.
- Adjust the \(A_{02}\) GAIN pot located on the back of the servocontroller board to obtain the desired amplifier gain. Note that 25.3 ma/vdc is a maximum recommended value. It is recommended that the amplifier gain be turned down the first time supply pressure is applied. It may not be possible to operate with satisfactory valve stability at the maximum amplifier gain as both the pilot valve and LVDT have about ±10% gain tolerances.

OUTER SERVOLOOP GAIN

The nominal gain of the D079-120 or D079-121 for the outer loop will be:

\[
K_{VAL} = \frac{K_S}{K_D K_X}
\]

where

- \(K_{VAL}\) = overall valve gain in\(^3\)/sec vdc
- \(K_S\) = power spool flow gain (see Specifications, Page 2)
- \(K_D\) = demodulator gain vdc/vrms
- \(K_X\) = LVDT gain vrms/inch

\[
K_{VAL} = \frac{K_S}{4.3 \times 6.74} = \frac{K_S}{29} \text{ in}^3/\text{sec}\]

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 by the square root of the ratio of supply pressures.

The input amplifier, \(A_{01}\), of the Model 121-114 can be used for summing the load servo command and feedback signals. The \(A_{01}\) GAIN control (accessible on the front panel) provides a convenient loop gain adjustment.
Specifications

<table>
<thead>
<tr>
<th>Nominal rated flow at 1000 psi valve drop</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 gpm</td>
<td>60 gpm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Internal leakage at 1000 psi supply</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.8 gpm</td>
<td>&lt;1.6 gpm</td>
</tr>
</tbody>
</table>

Recommended supply pressures

<table>
<thead>
<tr>
<th>Pilot valve</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 psi minimum</td>
<td></td>
</tr>
<tr>
<td>3000 psi max. standard</td>
<td></td>
</tr>
<tr>
<td>4000 psi special order</td>
<td></td>
</tr>
<tr>
<td>4000 psi max. standard</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>MODEL</td>
</tr>
<tr>
<td>100°F</td>
<td></td>
</tr>
<tr>
<td>Fluids</td>
<td>MODEL</td>
</tr>
<tr>
<td>Petroleum base</td>
<td></td>
</tr>
<tr>
<td>60 to 450 SUS @ 100°F</td>
<td></td>
</tr>
<tr>
<td>(10 to 97 cSt @ 38°C)</td>
<td></td>
</tr>
</tbody>
</table>

Buna N seals standard;
Viton A and EPR seals available on special order

Recommended supply filtration

<table>
<thead>
<tr>
<th>10μ nominal, 25μ absolute, or better</th>
<th>MODEL</th>
</tr>
</thead>
</table>

| Weight (without optional pilot porting) | 24 pounds |

Performance Summary
(with 3000 psi Pilot Pressure and Valve Loop Gain of 700 sec⁻¹)

<table>
<thead>
<tr>
<th>servovalve scaled for full power valve output at:</th>
</tr>
</thead>
<tbody>
<tr>
<td>+0.025 inch spool stroke</td>
</tr>
<tr>
<td>15 gpm</td>
</tr>
<tr>
<td>35 gpm</td>
</tr>
</tbody>
</table>

Flow at 1000 psi supply

<table>
<thead>
<tr>
<th>Flow at 1000 psi supply</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>D079-120</td>
<td>D079-121</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Linearity</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow symmetry</td>
<td></td>
</tr>
<tr>
<td>Flow gain at null (within ±5% of rated input)</td>
<td></td>
</tr>
<tr>
<td>Typical blocked load pressure gain at null</td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td></td>
</tr>
<tr>
<td>Null Shift with 500 psi change in pilot supply pressure</td>
<td></td>
</tr>
<tr>
<td>with 500 psi change in pilot return pressure</td>
<td></td>
</tr>
<tr>
<td>with 50°C change in fluid temperature</td>
<td></td>
</tr>
<tr>
<td>Dynamic response at ±100% input amplitude</td>
<td></td>
</tr>
<tr>
<td>&lt; ±2 db amplitude ratio</td>
<td></td>
</tr>
<tr>
<td>approximate frequency for 90° phase lag</td>
<td></td>
</tr>
</tbody>
</table>

See Figure 1

50% to 200% of nominal

15% to 20% Pₐ/0.001 inch spool travel

< 1%

< 0.5%

< ±4% | < ±2%
< ±4% | < ±2%
< ±5% | < ±2.5%

< ±2 dB amplitude ratio | 90 Hz to 125 Hz
approximate frequency for 90° phase lag | 70 Hz to 90 Hz
Accessories

Mounting Manifold
4 ports (SAE 1-5/8 – 12 UN straight thread ports) for 1-1/4 dia. tubing
for 3000 psi .................................................. 100-22236-1
for 4000 psi .................................................. 100-22236-3

Flushing Block .............................................. 100-23720
(interconnects the four power stage ports)

Replacement O-rings (Buna N 90 durometer)
power stage base (4 required) ......................... 080-45122-40
pilot stage base (4 required) ......................... 080-45122-22
optional pilot supply manifold
3 required .................................................. 080-45122-22
1 required .................................................. 080-45122-8

Mating Electrical Connectors
pilot valve (MS 3106F14S-2S) ....................... 061-49054F14S-2S
LVDT (MS 3106F14S-5S) ................................. 061-49054F14S-5S