MOOG

Model 79-500
High Flow Servovalve

Features
- symmetrical, four-way, closed-center flow control
- modular pilot valve
- separate pilot supply and return ports
- rugged, cast iron, power valve body
- long life, hardened spool and bushing
- electrical feedback allows convenient change in rated flow to help optimize system performance
- spool position LVDT electrically isolated from hydraulic fluid
- optional DCDT
- small amplitude dynamic response to 80 Hz

These three-stage servovalves provide high dynamic response for precision control of position, velocity, or force in systems requiring from 150 hp to 1000 hp. Maximum rated flow for these servovalves is 750 gpm at 1000 psi drop. Operating supply pressure can be as high as 4000 psi.

Electrical feedback of power valve spool position is provided by an LVDT. A separate exciter, demodulator and servoamplifier are necessary to close the spool position servoloop.

Alternatively, an optional dc to dc transducer can be supplied. This DCDT has a self-contained exciter and demodulator which simplifies the external electronics.
Performance

![Graph showing power valve flow gain at 1000 psi valve drop](Fig. 1)

**Pilot Valve Specifications**

- **Model Number**: AO70-232
- **Rated Flow at 1000 psi**: 5.0 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**: 1.57 in²
- **Spool flow gain at 1000 psi**
  (in low flow region): \(1.6 \times 10^4 \text{ in}^3/\text{sec inch}\)

Spool stroke
- For 425 gpm rated flow: ± 0.125 in.
- For 720 gpm rated flow: ± 0.275 in.

![Graph showing frequency response with 280 sec⁻¹ loop gain and 3000 psi pilot supply](Fig. 2)

![Graph showing frequency response with 200 sec⁻¹ loop gain and 1000 psi pilot supply](Fig. 3)

![Graph showing small amplitude step response](Fig. 4)
Servocontroller and Servovalve Wiring Schematic

SPOOL POSITION TRANSUDER SPECIFICATIONS

Type .................................. LVDT*
Excitation Frequency
minimum ................................ 400 Hz
maximum ................................ 5000 Hz
recommended ............................ 2000 to 4000 Hz
Maximum Excitation Voltage ............... 15 vrms
Approximate Excitation Power
(at 2000 Hz) ............................ 6.5 x 10^{-4} va/volt
Recommended Load
Impedance ................................ ≥ 50 K Ω
Output Sensitivity and
Phase Shift ......................... See Figure 5

*LVDT = linear variable differential transformer
DCDT (direct current differential transformer) available on special order

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

SERVOAMPLIFIER

The Model 121-114 is a convenient servoamplifier for use with the 79-500 servovalve. An optional plug-in circuit card, the Model 123-125, contains an exciter 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 (from Figure 5) of 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 79-500 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

\[ K_{IL} = \text{servovalve inner loop gain sec}^{-1} \]

\[ K_A = \text{servoamplifier gain ma/vdc} \]

\[ K_{PV} = \text{pilot valve gain} \]

\[ = \frac{5.0 \text{ gpm} \times 3.85}{40 \text{ ma}} \] \[ \frac{\text{in}^3/\text{sec}}{\text{gpm}} \] \[ \sqrt{\frac{3000 \text{ psi}}{1000 \text{ psi}}} \]

\[ = 0.83 \text{ in}^3/\text{sec} \text{ ma} \]

\[ K_D = \text{demodulator gain} = 4.3 \text{ vdc/vrms} \]

\[ K_X = \text{LVDT gain} = 6.74 \text{ vrms/inch} \]

\[ A_S = \text{power spool end area} = 1.57 \text{ in}^2 \]

For the recommended maximum inner loop gain of 280 sec \(^{-1} \):

\[ K_A = \frac{280 \times 1.57}{0.83 \times 4.3 \times 6.74} = 18.3 \text{ ma/vdc} \]

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 A01) and adjust the BIAS pot on the front panel to obtain first 1.0 vdc, then -1.0 vdc.
- Monitor the valve current by 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 A02 GAIN pot located on the back of the servocontroller board to obtain the desired amplifier gain with the -1.0v bias input. Note that the 18.3 ma/vdc is a calculated maximum 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 loop gain as both the pilot valve and LVDT have about ±10% gain tolerances.

OUTER SERVOLOOP GAIN

The gain of the 79-500 servovalve in the outer loop will be:

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

where

\[ K_{VAL} = \text{overall valve gain} \frac{\text{in}^3/\text{sec}}{\text{vdc}} \]

\[ K_S = \text{power valve flow gain} \]

(see Specifications, Page 2)

\[ K_D = \text{demodulator gain} \text{ vdc/vrms} \]

\[ K_X = \text{LVDT gain} \text{ vrms/inch} \]

\[ K_{VAL} = \frac{1.6 \times 10^4}{4.3 \times 6.74} = 550, \frac{\text{in}^3/\text{sec}}{\text{vdc}} \]

Note that the power valve flow gain is specified for operation at 1000 psi supply. This gain must be corrected for operation at other supply pressures by multiplying the square root of the ratio of supply pressures.

The input amplifier, A01, of the Model 121-114 can be used for summing servo command and feedback signals. The A01 GAIN control (accessible on the front panel) provides a convenient outer loop gain adjustment.
Specifications

Maximum rated flow at 1000 psi valve drop ......................................................... 750 gpm
Internal leakage at 1000 psi supply ................................................................. < 17.0 gpm
Recommended supply pressures
  pilot valve ...................................................................................... 1000 psi minimum
  .................................................................................. 3000 psi max. standard
  .................................................................................. 4000 psi special order
  third-stage power valve ........................................................................ 4000 psi max.
Operating temperature ...................................................................................... -10° C to +80° C
Fluids .............................................................................................................. petroleum base
  60 to 450 SUS @ 100° F
  (10 to 97 cSt @ 38° C)
Seals .............................................................................................................. Buna-N seals standard
  Viton seals available on special order
Recommended supply filtration ................................................................. 10μm nominal, 25μm absolute or better
Weight ............................................................................................................ 120 pounds

Performance Summary

(with 3000 psi Pilot Pressure and Valve Loop Gain of 280 sec⁻¹)

<table>
<thead>
<tr>
<th>Spool Stroke</th>
<th>Servo Loop Scaled for Full Power Valve Output at:</th>
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<tbody>
<tr>
<td>± 0.125 inch</td>
<td>425 gpm</td>
</tr>
<tr>
<td>± 0.250 inch</td>
<td>720 gpm</td>
</tr>
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Flow at 1000 psi supply ....................................................................................
Linearity ............................................................................................................. See Figure 1
Flow symmetry ...................................................................................................</p>
Spool Overlap ......................................................................................... ±0.003 inch
Typical blocked load pressure gain at null ........................................................ 10% to 30% P₁/₀.₀₀₁ inch spool travel
Hysteresis ...................................................................................................... < 0.6%
Threshold ......................................................................................................... < 0.3%
Null Shift
  with 500 psi change in pilot supply pressure ................................................. < ±1.5% < ±0.7%
  with 500 psi change in pilot return pressure .................................................. < ±1.5% < ±0.7%
  with 50° change in fluid temperature .............................................................. < ±1.5% < ±0.7%
Dynamic response at ±100% input amplitude
  < ±2 db amplitude ratio ................................................................................ to 48 Hz to 28 Hz
  approximate frequency for 90° phase lag ....................................................... 46 Hz 34 Hz
Installation Details

NOTES:

1 Dimensions in brackets are in millimeters.

2 Power Valve Ports are 2125 O.D. x 1.75 I.D. x 0.101 deep (6.35 x 44.62 x 0.257) for MS 28716-225 O-rings and
   0.760 O.D. x 0.44 I.D. x 0.074 deep (19.35 x 11.22 x 1.88) for MS 28715-113 O-rings

△ Manifold Ports are SAE B (0.25 x 15 UNF straight thread) for 0.50 O.D. tubing.

△ Valve Phasing - flow from P2 to Port A results with: B & C common, A plus, C minus parallel coils: A & C plus, B & D minus

△ LVDT Phasing - flow out Port A; A & C common, B & D are in phase.

STANDARD MODELS:

MODEL 70-500

A 425 gpm rated flow @ 1000 psi valve drop (10.125 in. power valve stroke)

B 720 gpm rated flow @ 1000 psi valve drop (12.275 in. power valve stroke)

△ Pilot Valve Manifold not supplied

△ Pilot Valve Manifold with pilot supply port only

△ Pilot Valve Manifold with pilot supply and return ports

Accessories

Mounting Manifold (to 400 gpm) .......................................................... A31954-1

4 SAE-32 (2¼-12 UN Straight Thread) for 2" Tubing

2 SAE-8 (¾-16 UNF Straight Thread) for 1¼" Tubing

Mounting Manifold (> 400 gpm) ........................................................... A31973-1

5 Weld Flanges; 2 3/8-18 NPT

Flange, Weld Neck (5 required) ......................................................... A31974-1

Flushing Block .................................................. A37150-1

Mounts in place of servo valve for flushing system

Replacement O-Rings (Buna-N 70 Durometer)

power valve base (4 required) .................................................. 080-58532-92

power valve base (2 required) .................................................. 080-58532-16

pilot valve base (4 required) .................................................. 080-58532-22

pilot manifold (3 required) .................................................. 080-58532-22

pilot manifold (1 required) .................................................. 080-58532-8

Mating Electrical Connectors

pilot valve (MS 3106F14S-2S) .................................................. 061-49054F14S-2S

LVDT (MS 3106F14S-5S) .................................................. 061-49054F14S-5S