SERVOVALVE OPERATING PRINCIPLES

The two-stage electrohydraulic flow control servovalve converts an electrical signal to precise proportional hydraulic flow. The servovalve can be separated into two stages:

- The first stage pilot includes the torque motor, projector jet and receiver
- The second stage body includes the spool and sleeve assembly

Hydraulic fluid at system pressure travels through the first stage wire mesh filter into a feedtube (Figure 1a) and out the projector jet. The projector jet directs this hydraulic fluid stream at two receivers, each of which is connected to the second stage spool end chambers.

The first stage torque motor receives an electrical signal applied as current to the coils, and converts it into a mechanical torque on the armature and jet pipe assembly. The torque output is directly proportional to the input current. As more current is applied to the valve, greater forces are exerted to rotate the armature assembly around its pivot point.
SERVO VALVE OPERATION

At first stage null, the jet is directed exactly between the two receivers, making the pressures on both sides of the spool equal. The force balance created by equal pressures in both end chambers holds the spool in a stationary position. (See Figure 1a.)

As the jet pipe and armature of the torque motor rotate around the pivot point (the result of input current), the fluid jet is directed to one of the two receivers creating a higher pressure in the spool end chamber connected to that receiver. The differential pressure created across the spool moves it in the direction opposite to the jet displacement. (See Figure 1b.)

Connected to the spool and jet pipe is a feedback spring assembly, which translates spool position into a force that is applied on the jet pipe in a proportional manner. Increased spool displacement away from null, increases the force exerted on the jet pipe. Forces transmitted from the spool to the jet pipe are opposing the forces trying to turn the armature jet pipe assembly. When the feedback spring force is equal to the forces from the torque motor, the jet is returned to a position exactly between the two receivers. As mentioned before, such a position creates a pressure balance between the end chambers; then the spool will hold its position. (See Figure 1c.)

Since the torque motor forces are proportional to input current and the feedback forces are proportional to spool position, the resulting spool position is proportional to input current. Increasing current to the torque motor shifts the spool from null position.

Reversing polarity of the applied current, reverses forces on the armature and jet pipe. The hydraulic jet flow impinges on the other receiver, creating an imbalance in spool end chamber forces. The spool moves in an opposite direction until a first stage force balance is achieved by the feedback spring. Jet flow is then directed between the receivers and equal pressure holds the spool in position.
Figure 2a illustrates flow out A of a four-way servovalve when the first stage pilot displaces the spool to the right. This movement opens slotted ports in the sleeve and fluid is metered from the supply pressure port to control port A, and from control port B to the return pressure port T.

Reversing spool motion to the left of the null position (Figure 2b) directs fluid from the supply pressure port to control port B and from control port A to the return pressure port T.

SPOOL PORTING

Square slotted ports with the above spool motion gives a proportional flow output. This is demonstrated with Figure 3: Flow vs. Current Plot. Flow output of the servovalve changes in magnitude directly proportional to the level and polarity of the input current.
The torque motor is located in the servovalve first stage and provides a means of converting an electrical input to a mechanical output. The term “torque” refers to the armature rotational motion around its pivot point, resulting from electrical and magnetic forces. This torque is instrumental in the servovalve electrical to mechanical power transfer.

The torque motor has an armature mounted on a torsion pivot spring and suspended in the air gaps of a magnetic field (Figure 4a). The two pole pieces, one polarized north and the other south by the permanent magnets, form the framework around the armature and provide paths for magnetic flux flow. When current flows through the coils, the armature becomes polarized and each end is attracted to one pole piece and repelled by the other (Figure 4b). The torque exerted on the armature is restrained by the torsion spring upon which the armature is mounted. This torsion spring makes armature output motion proportional to input current.

The rotational torque created is directly proportional to the amount of polarization or magnetic charge of the armature - increased armature polarization creates a higher force attraction to the pole pieces. Since the amount of polarization of the armature is proportional to the magnetic flux created by the current through the coils, torque output of the torque motor is proportional to the coil input current. The magnetic flux created by the coils is dependent on two factors: the number of coil wire turns and the strength of current that is applied. In other words, the torque of the motor is dependent on the ampere turns applied.

When armature polarization is reversed by input current polarity, the armature is attracted to the opposite pole pieces and the jet deflects to the opposite receiver.

**TORQUE MOTOR SCHEMATIC**
### JET PIPE SERVO VALVES

#### GENERAL TECHNICAL DATA

**Operating Pressure**
- Ports P, X, A, and B: 3,000 psi (210 bar)
  (optional 5000 psi (350 bar))
- Port T: up to 3,000 psi (210 bar)

**Temperature Range**
- Fluid: -4°F to 176°F
- Ambient: -4°F to 250°F

**Seal Material**
- Viton A, 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 affects 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

**Recommended Filter Rating**
- For normal operation: β₁₀ ≈ 75 (10 µm absolute)
- For longer life: β₅ ≈ 75 (5 µm absolute)

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

**Vibration**
- 30 g, 3 axes

**Degree of Protection**
- EN 50529P: class IP65, with mating connector mounted.

**Shipping Plate**
- Delivered with an oil sealed shipping plate.

### STATIC PERFORMANCE

**Rated Flow**
- @ 1000 psid ± 10%

**Null Bias**
- <± 2%

**Null Flow Gain**
- 50 to 150% nominal

**Linearity**
- < 7%

**Hysteresis**
- < 3%

**Threshold**
- < 0.2%

**Temperature Null Shift**
- <± 2% with 100°F variation (56°C)

**Supply Pressure Null Shift**
- <± 2% with 1000 psi change (70 bar)

**Return Pressure Null Shift**
- <± 2% from 0 to 100 psi (7 bar)

**Pressure Gain**
- >30% of supply pressure @ 1% rated current

---

*Maximum special order is 5,000 psi*
ELECTRICAL CHARACTERISTICS

A wide choice of coils is available for a variety of rated current requirements. The four torque motor coil leads are attached to the connector so external connections can provide series, parallel or single coil operation. Servovalve coils should be driven with current to provide consistency throughout the temperature range.

<table>
<thead>
<tr>
<th>Ohms</th>
<th>Series mA</th>
<th>Series V</th>
<th>Parallel mA</th>
<th>Parallel V</th>
<th>Single mA</th>
<th>Single V</th>
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<tbody>
<tr>
<td>27</td>
<td>50</td>
<td>2.7</td>
<td>100</td>
<td>1.4</td>
<td>100</td>
<td>2.7</td>
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<tr>
<td>80</td>
<td>25</td>
<td>4.0</td>
<td>50</td>
<td>2.0</td>
<td>50</td>
<td>4.0</td>
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<td>81</td>
<td>20</td>
<td>3.2</td>
<td>40</td>
<td>1.6</td>
<td>40</td>
<td>3.2</td>
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<td>250</td>
<td>10</td>
<td>5.0</td>
<td>20</td>
<td>2.5</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>1000</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>5.0</td>
<td>10</td>
<td>10.0</td>
</tr>
</tbody>
</table>

ELECTRICAL STANDARDS

**Rated Current**
- 50, 20, 10 mA (standard)

**Coil Resistance**
- 80, 250, 1000 ohms per coil (standard)

**Connector**
- MS3102E-14S-2P

**Polarity**
- A+B- flow out cylinder Port B
- C+ D- flow out cylinder Port B

**Connector**
- PC02H-8-4P

**Polarity**
- A+B- flow out cylinder Port A
- C+ D- flow out cylinder Port A
JET PIPE SERVO VALVES
MODEL 208A

TECHNICAL SPECIFICATIONS

208A-505 TYPICAL CHARACTERISTIC CURVES

**Rated Flow**
0.25 to 5 GPM @ 1000 psi drop

**Internal Leakage**
< 0.25 GPM @ 1000 psi

**Connector Location**
Port B (standard)

**Weight**
1.1 lbs. (0.50 kg)

**Mounting Bolt**
Thread: #10-32 UNF (M5)
Length: 2.0 in. (50 mm)

INSTALLATION DRAWING

**Port Size**
Ø 0.173 (Ø 4.4)

**O-Ring**
MS28775-011

**Pilot Port**
Ø 0.093 (Ø 2.4)

**O-Ring**
MS28775-010
**TECHNICAL SPECIFICATIONS**

**Rated Flow**
0.1 to 5 GPM @ 1000 psi drop

**Internal Leakage**
< 0.25 GPM @ 1000 psi

**Field Replaceable Filter**
75 micron absolute
P/N 55319

**Weight**
0.88 lbs. (0.40 kg)

**Mounting Bolt**
Thread: #10-32 UNF (M5)
Length: 1.5 in. (40 mm)

---

**209-505 TYPICAL CHARACTERISTIC CURVES**

**Step Response**

- **Stroke (%)**
  - Time (milliseconds)
  - 0 to 100

- **Amplitude Ratio (DB)**
  - Frequency (HZ)
  - 3000 psi (210 bar)
  - ±20% Input Current
  - ±100% Input Current

**Frequency Response**

- **Phase Lag (degrees)**
  - ±20% Input Current
  - ±100% Input Current
  - 3000 psi (210 bar)

---

**INSTALLATION DRAWING**

**Port Size**
Ø 0.169 (Ø 4.1)

**O-Ring**
MS28775-011
TECHNICAL SPECIFICATIONS

**Rated Flow**
0.1 to 10 GPM @ 1000 psi drop

**Internal Leakage**
< 0.25 GPM @ 1000 psi

**Connector Location**
Port B (standard)

**Weight**
1.1 lbs. (0.50 kg)

**Mounting Bolt**
Thread: #10-32 UNF (M5)
Length: 2.0 in. (50 mm)

211A-510
**TYPICAL CHARACTERISTIC CURVES**

**IN INSTALLATION DRAWING**

Port size
Ø 0.281 (Ø 7.14)

O-Ring
MS28775-011

Pilot Port
Ø 0.093 (Ø 2.4)

O-Ring
MS28775-010
**Rated Flow**  
0.1 to 10 GPM @ 1000 psi drop

**Internal Leakage**  
< 0.25 GPM @ 1000 psi

**Field Replaceable Filter**  
75 micron absolute  
P/N 55396

**Weight**  
0.938 lbs. (0.42 kg)

**Mounting Bolt**  
Thread: #10-32 UNF (M5)  
Length: 1.5 in. (40 mm)

---

**214-510**  
**TYPICAL CHARACTERISTIC CURVES**

- **Step Response**
  - Time (milliseconds)
  - Stroke (%)
  - 3000 psi (210 bar)

- **Frequency Response**
  - Frequency (HZ)
  - Amplitude Ratio (DB)
  - Phase Lag (degrees)

---

**INSTALLATION DRAWING**

- **Port size**  
  Ø 0.242 (Ø 6.1)

- **O-Ring**  
  MS28775-011

- **Pilot Port**  
  Ø 0.093 (Ø 2.4)

- **O-Ring**  
  MS28775-010
**JET PIPE SERVO VALVES**

**MODEL 215A**

**TECHNICAL SPECIFICATIONS**

- **Rated Flow**
  2.5 to 15 GPM @ 1000 psi drop

- **Internal Leakage**
  < 0.35 GPM @ 1000 psi

- **Connector Location**
  Port B (standard)

- **Weight**
  2.0 lbs. (0.91 kg)

- **Mounting Bolt**
  Thread: 5/16-18 (M8)
  Length: 2.0 in. (50 mm)

**215A-515 TYPICAL CHARACTERISTIC CURVES**

![Graphs showing step and frequency response.]

**INSTALLATION DRAWING**

- **Port size**
  Ø 0.332 (Ø 8.4)

- **O-Ring**
  MS28775-013

- **Pilot Port**
  Ø 0.093 (Ø 2.4)

- **O-Ring**
  MS28775-012
### TECHNICAL SPECIFICATIONS

**Rated Flow**
- 2.5 to 15 GPM @ 1000 psi drop

**Internal Leakage**
- < 0.35 GPM @ 1000 psi

**Connector Location**
- Port B (standard)

**Weight**
- 1.80 lbs. (0.82 kg)

**Mounting Bolt**
- Thread: 1/4-28 (M6)
- Length: 2.25 in. (60 mm)

### TYPICAL CHARACTERISTIC CURVES

**TYPICAL CHARACTERISTIC CURVES**

- Step Response
- Frequency Response

### INSTALLATION DRAWING

**Port Size**
- Ø 0.312 (Ø 7.9)

**O-Ring**
- MS28775-013
TECHNICAL SPECIFICATIONS

240-520 TYPICAL CHARACTERISTIC CURVES

Rated Flow
20 to 40 GPM @ 1000 psi drop

Internal Leakage
< 0.6 GPM @ 1000 psi

Connector Location
Port B (standard)

Weight
4.7 lbs. (2.14 kg)

Mounting Bolt
Thread: 5/16-18 (M8)
Length: 3.0 in. (75 mm)

INSTALLATION DRAWING

Port Size
Ø 0.562 (Ø 14.3)

O-Ring
MS28775-018
**JET PIPE SERVOVALVES**

**MODEL 242**

---

**TECHNICAL SPECIFICATIONS**

**Rated Flow**
- 20 to 40 GPM @ 1000 psi drop

**Internal Leakage**
- < 0.4 GPM @ 1000 psi

**Connector Location**
- Port B (standard)

**Weight**
- 4.7 lbs. (2.14 kg)

**Mounting Bolt**
- Thread: 5/16-18 (M8)
- Length: 1.25 in. (35mm)

---

**TYPICAL CHARACTERISTIC CURVES**

**Step Response**
- Stroke (%)
  - 0 to 100
- Time (milliseconds)
  - 0 to 30
- 3000 psi (210 bar)

**Frequency Response**
- Amplitude Ratio (DB)
  - 0 to 2
- Phase Lag (degrees)
  - 0 to 180
- Frequency (HZ)
  - 0 to 200

---

**INSTALLATION DRAWING**

**Port Size**
- Ø 0.500 (Ø 12.7)

**O-Ring**
- MS28775-016

---

**242-540**
TECHNICAL SPECIFICATIONS

261-560
TYPICAL CHARACTERISTIC CURVES

Rated Flow
20 to 60 GPM @ 1000 psi drop

Internal Leakage
< 0.8 GPM @ 1000 psi

Connector Location
Port B (standard)

Weight
7.5 lbs. (3.4 kg)

Mounting Bolt
Thread: 3/8-24 (M10)
Length: 2.0 in. (50 mm)

INSTALLATION DRAWING

Port Size
Ø 0.625 (Ø 15.9)

O-Ring
MS28775-019

Pilot Port
Ø 0.125 (Ø 3.2)

O-Ring
MS28775-012
The Model 162A has the same bore, stroke and stall force as the Model 162, but has an increased no-load velocity of 3.5 inches per second (89 mm per second).

The increased flow rate (4.5 SCFM) controls larger actuators for heavier movements like heads and arms. Input signals of ±20 mA or ±5 volts gives proportional output flow. Tube fittings built into the body permit quick plumbing connections.

This model has the same features as the Model 162, but is available with a 2.0 inch (50.8 mm) bore diameter actuator and 2.0 inch (50.8 mm) stroke for a maximum stall force of 250 pounds (113 kg) at 80 psi (5.5 bar).

The increased flow rate (4.5 SCFM) controls larger actuators for heavier movements like heads and arms. Input signals of ±20 mA or ±5 volts gives proportional output flow. Tube fittings built into the body permit quick plumbing connections.

This integral package contains servovalve, actuator and feedback mechanism to provide closed-loop position control without the need for an electrical feedback transducer. An input signal of 0 to 10 volts gives a directly proportional actuator position which corrects for any load changes. This cost effective package is available with a 1.0 inch (25.4 mm) bore diameter actuator and stroke lengths of 0.5 inch (12.7 mm), 1.0 inch (25.4 mm), 1.5 inches (38.1 mm) and 2.0 inches (50.8 mm). The 1.0 inch bore has a 62 pound (28 kg) stall force at 80 psi (5.5 bar).

The increased flow rate (4.5 SCFM) controls larger actuators for heavier movements like heads and arms. Input signals of ±20 mA or ±5 volts gives proportional output flow. Tube fittings built into the body permit quick plumbing connections.
GENERAL SPECIFICATIONS
The following specifications apply to models 161, 162 and 162A.

**System Filtration**
- 25 micron

**Fluid**
- Dry clean gas

**Temperature Range**
- 40° to 160°F

**Pressure**
- Operating: 40 to 160 psi
- Proof: 250 psi
- Burst: 425 psi

**Hysteresis**
- 3% max of rated current

**Rated Current**
- 0 to 40 mA (0 to 10v)

**Coil Resistance**
- 250 ohms per coil

**Seals**
- Viton

**Polarity**
- Actuator extends with polarity shown

**Electrical Connection**
- #26 AWG color coded leads

**Zero Current Stroke**
- at retract position

**161 MFB SPECIFICATIONS**

**Flow into Valve**
- 0.8 SCFM @ 100 psi

**Piston Diameter**
- 1.00 inch

**Rod Diameter**
- 0.25 inches

**Effective Area**
- Extend: 0.785 in²
- Retract: 0.736 in²

**Stall Load**
- Extend: 62 lbs min @ 100 psi supply
- Retract: 58 lbs min @ 100 psi supply

**No Load Velocity**
- 4.0 in/sec min @ 100 psi supply

**INSTALLATION DRAWING**

**STROKE CHART**

<table>
<thead>
<tr>
<th>Model #</th>
<th>'A' DIM ±0.032</th>
<th>'B' DIM ±0.060</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Stroke</td>
<td>Retracted</td>
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<tr>
<td>161-0.5-YYY</td>
<td>0.5 inch</td>
<td>4.64 inch</td>
</tr>
<tr>
<td>161-1.0-YYY</td>
<td>1.0 inch</td>
<td>5.14 inch</td>
</tr>
<tr>
<td>161-1.5-YYY</td>
<td>1.5 inch</td>
<td>5.64 inch</td>
</tr>
<tr>
<td>161-2.0-YYY</td>
<td>2.0 inch</td>
<td>6.14 inch</td>
</tr>
</tbody>
</table>
162 MFB
SPECIFICATIONS

Flow into Valve
0.8 SCFM @ 100 psi

Piston Diameter
2.00 inches

Rod Diameter
0.25 inches

Effective Area
- Extend: 3.14 in²
- Retract: 3.09 in²

Stall Load
- Extend: 250 lbs min @ 100 psi supply
- Retract: 240 lbs min @ 100 psi supply

No Load Velocity
1.0 in/sec min @ 100 psi supply

INSTALLATION DRAWING

STROKE CHART
Model #: 'A' DIM ± .023
'B' DIM ± .060

<table>
<thead>
<tr>
<th>Stroke</th>
<th>Retracted</th>
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<tbody>
<tr>
<td>162-2.0-YYY</td>
<td>2.0 inch</td>
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</table>

162A MFB
SPECIFICATIONS

Flow into Valve
2.0 SCFM @ 100 psi

Piston Diameter
2.00 inches

Rod Diameter
0.25 inches

Effective Area
- Extend: 3.14 in²
- Retract: 3.09 in²

Stall Load
- Extend: 250 lbs min @ 100 psi supply
- Retract: 240 lbs min @ 100 psi supply

No Load Velocity
3.5 in/sec min @ 100 psi supply

INSTALLATION DRAWING

STROKE CHART
Model #: 'A' DIM ± .023
'B' DIM ± .060

<table>
<thead>
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<th>Stroke</th>
<th>Retracted</th>
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<tbody>
<tr>
<td>162A-2.0-YYY</td>
<td>2.0 inch</td>
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### GENERAL SPECIFICATIONS

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<th>Specification</th>
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<td><strong>System Filtration</strong></td>
<td>25 micron</td>
</tr>
<tr>
<td><strong>Fluid</strong></td>
<td>Dry clean gas</td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
<td>-40°F to 160°F</td>
</tr>
<tr>
<td><strong>No Load Cylinder Flow</strong></td>
<td>0.5 SCFM @ 100 psi supply</td>
</tr>
<tr>
<td><strong>Pressure Recovery</strong></td>
<td>&gt;80% of supply pressure</td>
</tr>
<tr>
<td><strong>Hysteresis</strong></td>
<td>3% max of rated current</td>
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<tr>
<td><strong>Rated Current</strong></td>
<td>±20 mA</td>
</tr>
<tr>
<td><strong>Electrical Connection</strong></td>
<td>#26 AWG color coded leads</td>
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<table>
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<tr>
<th>Specification</th>
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<tbody>
<tr>
<td><strong>System Filtration</strong></td>
<td>25 micron</td>
</tr>
<tr>
<td><strong>Fluid</strong></td>
<td>Dry clean gas</td>
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<tr>
<td><strong>Temperature Range</strong></td>
<td>-40°F to 160°F</td>
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<tr>
<td><strong>No Load Cylinder Flow</strong></td>
<td>4.5 SCFM @ 100 psi supply</td>
</tr>
<tr>
<td><strong>Pressure Recovery</strong></td>
<td>30% of supply pressure @ 2% change of rated current</td>
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<tr>
<td><strong>Hysteresis</strong></td>
<td>3% max of rated current</td>
</tr>
</tbody>
</table>

### INSTALLATION DRAWING

#### 200PN SPECIFICATIONS

- **Design**: Single-stage
- **Flow into Valve**: 0.8 SCFM @ 100 psi supply
- **No Load Cylinder Flow**: 0.5 SCFM @ 100 psi supply
- **Pressure Recovery**: >80% of supply pressure
- **Hysteresis**: 3% max of rated current

#### 204PN SPECIFICATIONS

- **Design**: Two-stage
- **Flow into Valve**: 0.17 SCFM @ 100 psi supply
- **No Load Cylinder Flow**: 4.5 SCFM @ 100 psi supply
- **Pressure Recovery**: 30% of supply pressure @ 2% change of rated current
- **Hysteresis**: 3% max of rated current

#### INSTALLATION DRAWING

- **Threshold**: 0.2% max of rated current
- **90° Phase Lag**
  - 200 Hz @ 100 psi supply
  - 150 Hz @ 100 psi supply
- **-3dB Amplitude Ratio**: 30 Hz @ 100 psi supply
- **Ports**: #10-32 x .38 deep tapped holes
- **Mounting**: 4 holes .156 diameter

- **Threshold**: 0.02% max of rated current
- **90° Phase Lag**
  - 200 Hz @ 100 psi supply
  - 150 Hz @ 100 psi supply
- **-3dB Amplitude Ratio**: 30 Hz @ 100 psi supply
- **Ports**: 1/4” Legris instant fittings for 1/4” diameter plastic tube
- **Mounting**: Four #10-32 x 3/8 tapped holes
GENERAL SPECIFICATIONS

**System Filtration**
- 25 Micron

**Fluid**
- Dry clean gas

**Temperature Range**
- -40° to 160°F

**Pressure**
- Operating: 80 to 160 psi
- Proof: 250 psi
- Burst: 425 psi

**Seals**
- Viton

**Hysteresis**
- 3% max of rated current

**202PN SPECIFICATIONS**

**Design**
- Single-stage

**Flow into Valve**
- 2.0 SCFM @ 100 psi supply

**No Load Cylinder Flow**
- 1.25 SCFM @ 100 psi supply

**Pressure Recovery**
- >80% of supply pressure

**Rated Current**
- ±40% mA

**Coil Resistance**
- 250 ohms per coil

**Threshold**
- 0.02% max of rated current

**90° Phase Lag**
- 200 Hz @ 100 psi supply

**-3dB Amplitude Ratio**
- 150 Hz @ 100 psi supply

**Electrical Connection**
- Bendix Pygmy PCO2H-8-4P

**Ports**
- 0.12 diameter

**Port O-Ring Size**
- MS28775-012

**Electrical Connector**
- MS3102E-14S-2P

**Ports**
- .281 diameter

**Port O-Ring size**
- MS28775-011 (5th port -010)

**Polarity**
- A+ B- flow out CYL Port 1
- C+ D- flow out CYL Port 1

**211APN SPECIFICATIONS**

**Design**
- Two-stage

**Rated Flow**
- 12 SCFM @ 100 psi pressure drop

**Leakage**
- Internal: 0.2 SCFM @ 100 psi
- External: none

**Pressure Gain**
- 30% supply min @ 2% rated input

**90° Phase Lag**
- >40 Hz @ 100 psi supply

**-3dB Amplitude Ratio**
- 40 Hz @ 100 psi supply

**Electrical Connector**
- MS3102E-14S-2P

**Ports**
- .281 diameter

**Port O-Ring size**
- MS28775-011 (5th port -010)

**Polarity**
- A+ B- flow out CYL Port 2
- C+ D- flow out CYL Port 2
INSTALLATION PROCEDURES

JET PIPE SERVOVALVES

SYSTEM FLUSHING
Cleaning the hydraulic fluid prior to initial installation of the servovalve onto a new or overhauled servo system, ensures extended valve operating life. Circulating hydraulic fluid through the system filters and manually exercising load actuators, will remove trapped particles and built-in contamination.

A new system is especially susceptible to contamination because particles clinging to new components can break away when initially washed with fluid flow. Hoses must sustain many hours of flow to flush all residue, and piping must be pickled and passivated. Piping with welded joints likely contains unwanted welding beads. Chunks of O-Ring, lint, metal chips and moisture are a few forms of contamination contributing to component failure in a new hydraulic system.

IMPORTANT NOTE
Start-up failures can be substantially reduced by following proper flushing procedures prior to installing servovalves or other sensitive components. A typical flushing procedure incorporates the following:

1. Install a flushing fixture that is servovalve footprint compatible. The flushing fixture should interconnect the control ports (A and B).
2. Install new filter elements.
3. Circulate the hydraulic fluid at system operating pressure for a minimum of 8 hours. The length of system flushing time determines fluid cleanliness.
4. Monitor filter indicators while flushing and change the elements when indicators show excessive contamination levels.
5. Stroking cylinders or motors while flushing dislodges particles trapped in these components.
6. When flushing is complete, remove all filter elements and replace with new ones.
7. Install servovalves.

ADJUSTING SERVOVALVE NULL
Moog Atchley Controls servovalves are null adjusted at the factory and installation onto a system may require readjustment. Optimum null adjustment can be achieved when done with the equipment upon which the servovalve will be used. Control electronics must be stable and fluid must be at normal operating temperature and pressure.

To determine if the servovalve null needs adjustment, disconnect the electrical cable from the valve. If the actuator drifts excessively in either direction, the valve null can be adjusted to stop the drift. It may be impossible to stop actuator drift completely and this should not be a concern. The servovalve null adjustment is not meant to be an absolute zeroing mechanism. Slowing the drift to a minimum allows the control electronics to achieve servovalve zero and maintain drift control throughout system operation.

PROCEDURE
ALL SERVOVALVES EXCEPT 231

Please read “Adjusting Servovalve Null” before starting.
Required tools:
1 Allen wrench (1/16")
1 Screwdriver

The servovalve null adjustment is located on the valve torque motor and can be reached by using a screwdriver to remove the access hole brass plug on the cover. A 1/16” Allen wrench can be inserted into the null adjustment access hole and, when engaged in the null adjustment, can be rotated in either direction. If turning one direction increases actuator drift speed, reverse turning direction. If actuator drift slows while rotating the Allen wrench, keep turning in that direction until actuator stops moving. If actuator drifts into a stop, it may be necessary to re-connect the electrical cable and bring the actuator to center position again.

IMPORTANT NOTE
Always remember to replace the null adjustment access screw. This keeps dirt from entering the torque motor and extends the operating life of the servovalve.

Re-connect electrical cable after adjustment is complete.

PROCEDURE
FOR MODEL 231

Please read “Adjusting Servovalve Null” before starting.
Required tools:
1 Allen wrench (3/16")

The servovalve null adjustment is located on the valve body end cap nearest the torque motor. The null adjustment is a 3/16” Allen screw in the center of the spool end cap. A 3/16” Allen wrench can be inserted into the null adjustment and rotated either direction if turning one direction increases actuator drift, reverse turning direction. If actuator drift slows while rotating the Allen wrench, keep turning in that direction until actuator stops moving. Continue adjustment until drift direction changes and then turn Allen wrench in opposite direction until actuator stops moving if actuator drifts into a stop. It may be necessary to re-connect the electrical cable and bring the actuator to center position again.

IMPORTANT NOTE
Less than one turn is sufficient to null the servovalve. If two turns fail to achieve null, further system troubleshooting is necessary to correct the problem.

Re-connect electrical cable after adjustment is complete.

PROCEDURE
OPTIONAL MAGNETIC NULL ADJ.

Please read “Adjusting Servovalve Null” before starting.
Required tools:
1 Allen wrench (.050 “)

The servovalve magnetic null adjustment is a knurled knob located on top of the valve torque motor cover. Null adjustment is made by loosening the two locking screws with a .050” Allen wrench and rotating the knurled knob. If turning one direction increases actuator drift, reverse turning direction. If actuator drift slows while rotating the adjustment, keep turning in that direction until actuator drift stops. Continue adjustment until drift direction changes and then turn knurled knob in opposite direction until actuator stops moving if actuator drifts into a stop. It may be necessary to re-connect the electrical cable and bring the actuator to center position again.

Less than one turn is sufficient to null the servovalve. If one turn fails to achieve null, further system troubleshooting is necessary to correct the problem.

When adjustment is complete, tighten the locking screws to prevent knurled knob from inadvertent rotation. Re-connect electrical cable after adjustment is complete.
OPTIONS

Electrical Connectors
- MS mating connector P/N 91075
- Bendix Model PC02H-8-4P (mating connector P/N 91716)
- Bendix Model PC02H-8-4P connector in body (209 & 214 only)
- Pigtails (4 wires, specify length)

Coils
- Intrinsically safe coils (FM certified Class 1, Groups A, B, C and D; Class II, Group G)
- High Temperature rated coils (350°F)
- A wide selection of electrical current and resistance combinations
- Triple redundant coils

Special Flow Configurations
- O verlap or underlap
- Dual flow gain
- Shaped flow gain

Conditioning - Underwater Service
- Vented external pilot supply
- Stainless steel body

Isolated Pilot Supply Pressure Port
- Accepts external pilot supply

Rated for 5000 PSI Operation
- Stainless steel body

Magnetic Null Adjustment
- Ease of adjustment
- Isolates torque motor

SUBPLATE DRAWING

SUBPLATE CHARTS

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<th>E Mounting</th>
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JET PIPE SERVO VALVES
OPTIONS AND MANIFOLD SELECTION