MOOG

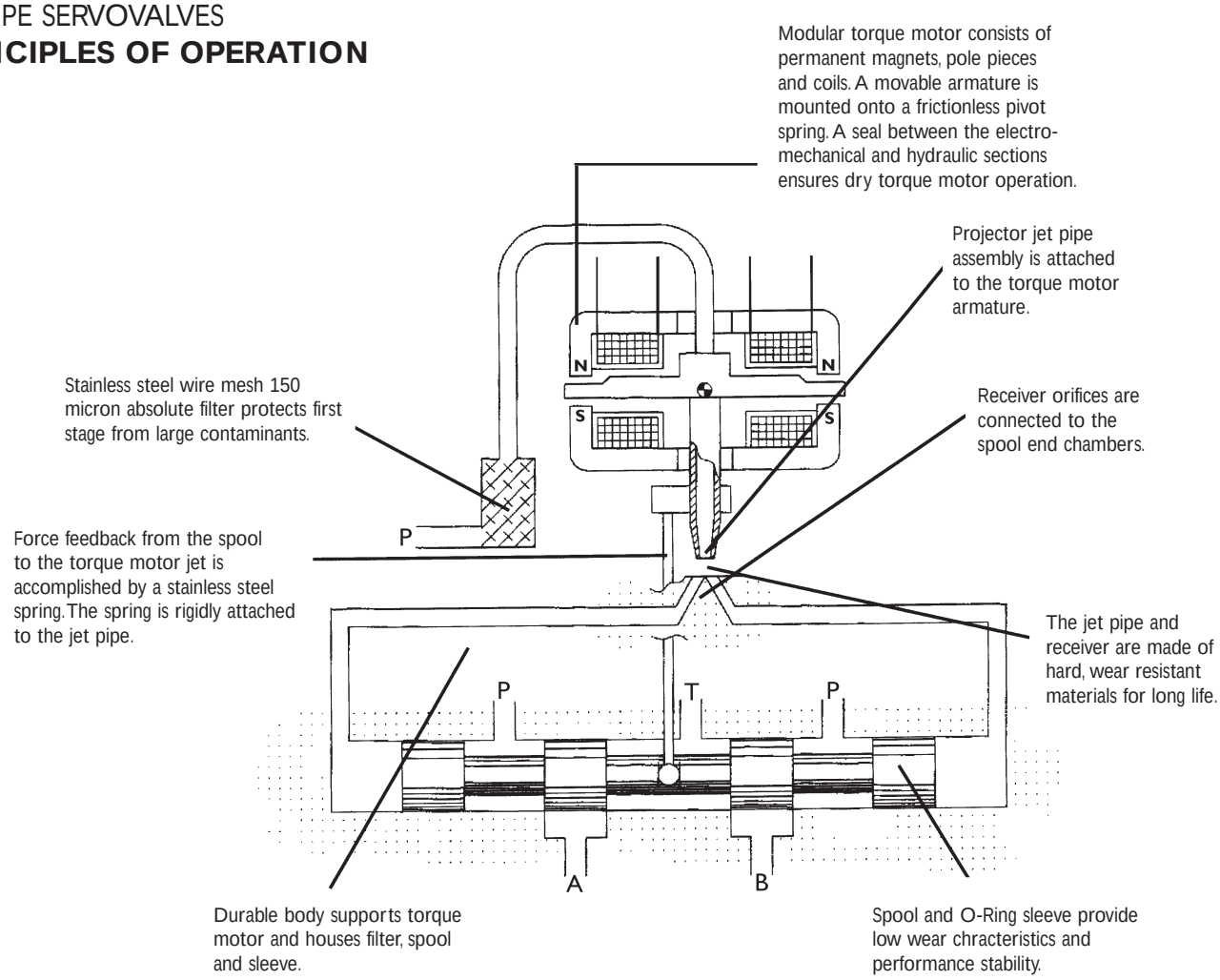
ATCHLEY CONTROLS

Jet Pipe Servovalves

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES

PRINCIPLES OF OPERATION



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.

SERVOVALVE 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.)

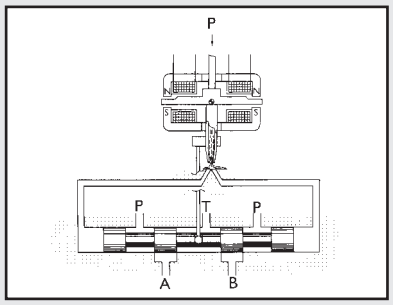


Figure 1a - At Neutral

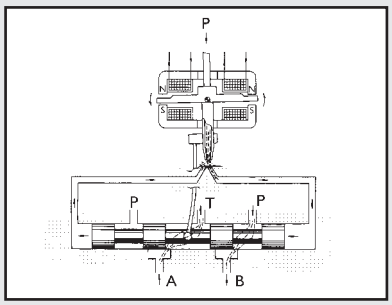


Figure 1b - With Input Current

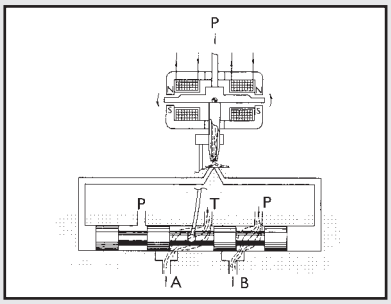


Figure 1c - Stabilized with Current

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

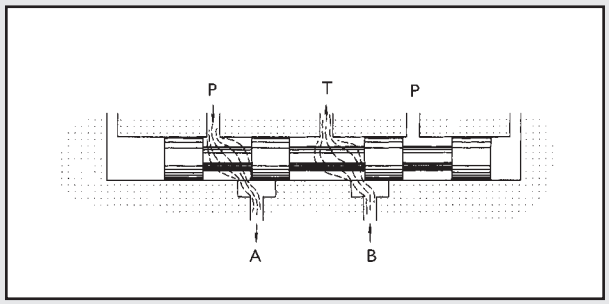


Figure 2a - Flow out A

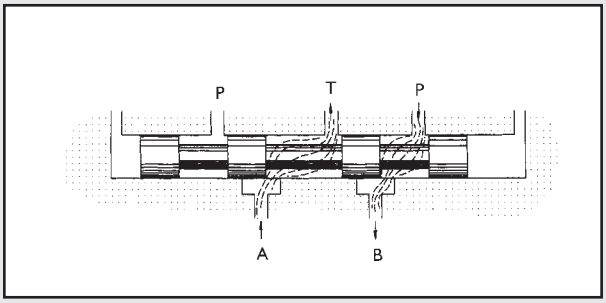


Figure 2b - Flow out B

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.

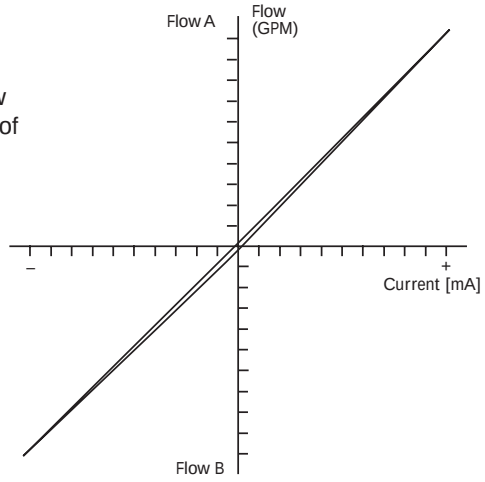


Figure 3 - Flow vs. Current Plot

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

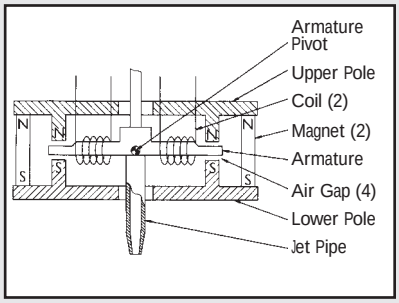


Figure 4a - Neutral Position

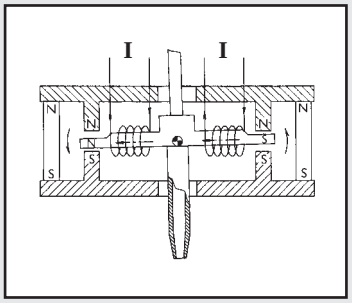


Figure 4b - Energized Position

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES

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:	-40°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 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

Recommended Filter Rating

For normal operation	$ß_{10} \geq 75$ (10 µm absolute)
For longer life	$ß_5 \geq 75$ (5 µm absolute)

Installation Operations Any position fixed or movable.

Vibration 30 g, 3 axes

Degree of Protection EN50529P: class IP65, with mating connector mounted.

Shipping Plate Delivered with an oil sealed shipping plate.

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

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

ELECTRICAL CHARACTERISTICS

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.

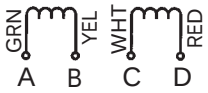
	Series		Parallel		Single	
Ohms	mA	V	mA	V	mA	V
27	50	2.7	100	1.4	100	2.7
80	25	4.0	50	2.0	50	4.0
81	20	3.2	40	1.6	40	3.2
250	10	5.0	20	2.5	20	5.0
1000	5	10	10	5.0	10	10.0

ELECTRICAL STANDARDS

Rated Current
50, 20, 10 mA (standard)

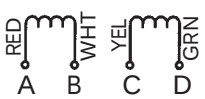
Coil Resistance
80, 250, 1000 ohms per coil (standard)

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

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 208A

TECHNICAL SPECIFICATIONS

Rated Flow
0.25 to 5 GPM @ 1000 psi drop

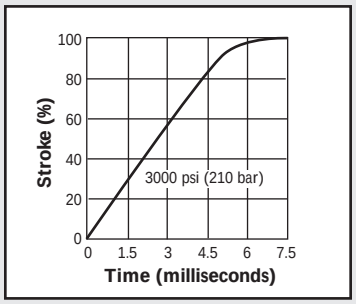
Internal Leakage
< 0.25 GPM @ 1000 psi

Connector Location
Port B (standard)

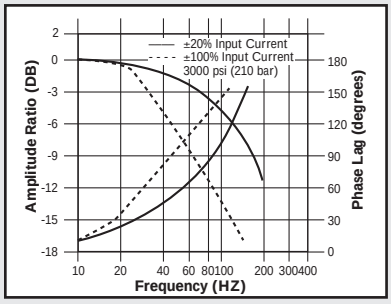
Weight
1.1 lbs. (0.50 kg)

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

208A-505 TYPICAL CHARACTERISTIC CURVES

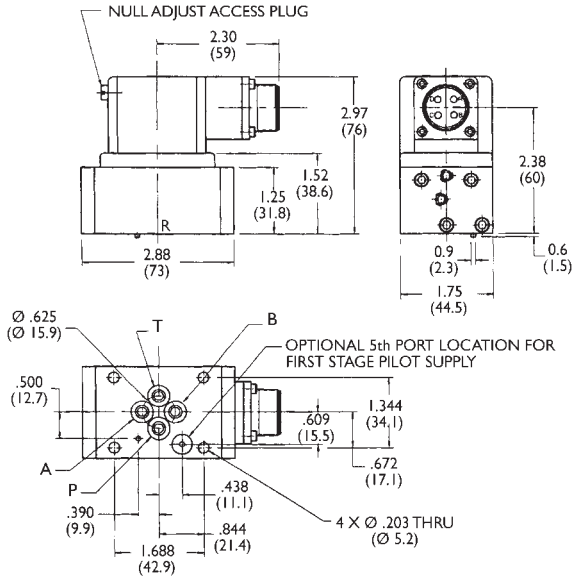


Step Response



Frequency Response

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

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 209

TECHNICAL SPECIFICATIONS

Rated Flow
0.1 to 5 GPM @ 1000 psi drop

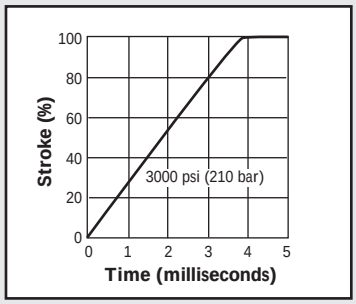
Internal Leakage
< 0.25 GPM @ 1000 psi

Field Replaceable Filter
75 micron absolute
P/N 55319

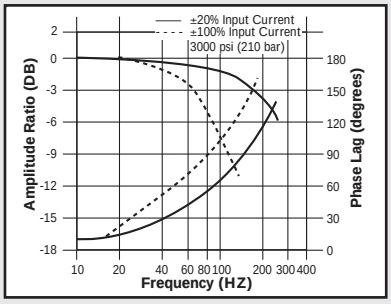
Weight
0.88 lbs. (0.40 kg)

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

209-505 TYPICAL CHARACTERISTIC CURVES

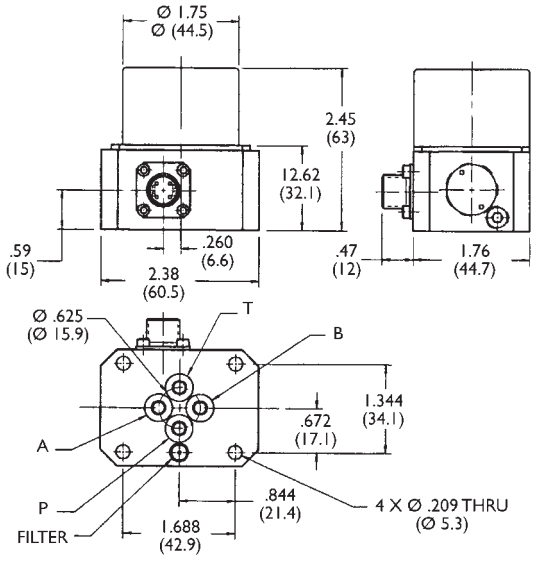


Step Response



Frequency Response

INSTALLATION DRAWING



Port Size
Ø 0.169 (Ø 4.1)

O-Ring
MS28775-011

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 211A

TECHNICAL SPECIFICATIONS

Rated Flow
0.1 to 10 GPM @ 1000 psi drop

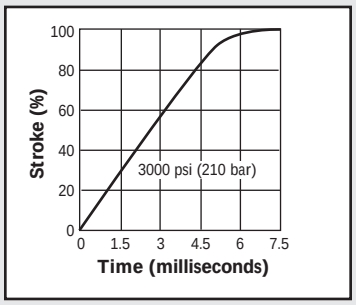
Internal Leakage
< 0.25 GPM @ 1000 psi

Connector Location
Port B (standard)

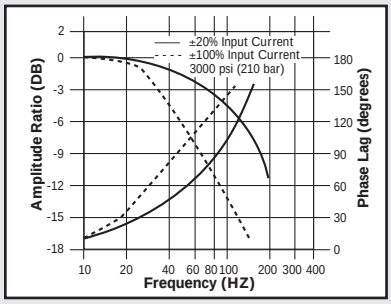
Weight
1.1 lbs. (0.50 kg)

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

211A-510 TYPICAL CHARACTERISTIC CURVES

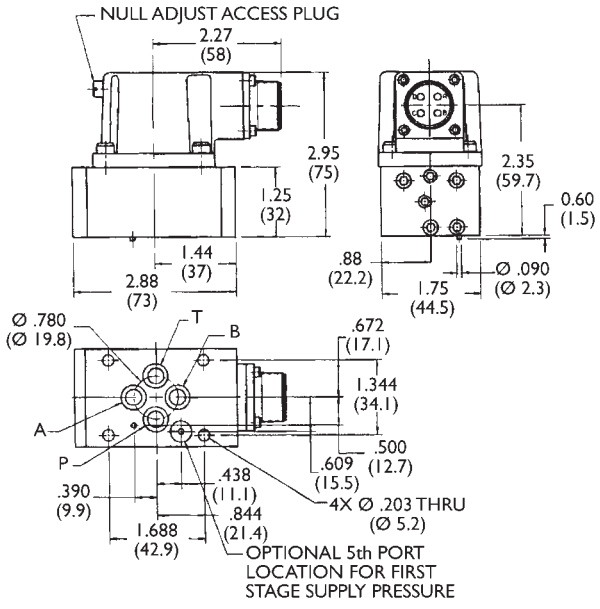


Step Response



Frequency Response

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

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 214

TECHNICAL SPECIFICATIONS

Rated Flow
0.1 to 10 GPM @ 1000 psi drop

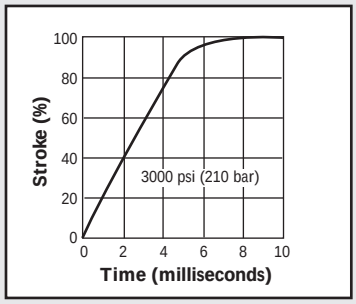
Internal Leakage
< 0.25 GPM @ 1000 psi

Field Replaceable Filter
75 micron absolute
P/N 55396

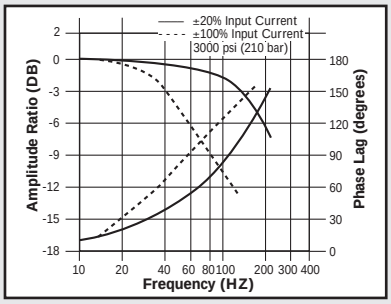
Weight
0.938 lbs. (0.42 kg)

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

214-510 TYPICAL CHARACTERISTIC CURVES

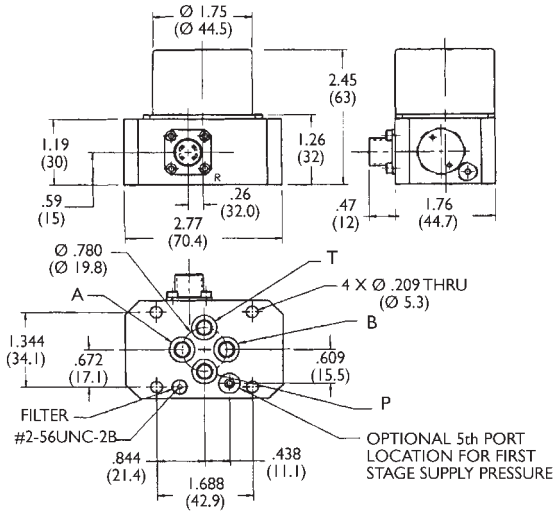


Step Response



Frequency Response

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

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 215A

TECHNICAL SPECIFICATIONS

Rated Flow
2.5 to 15 GPM @ 1000 psi drop

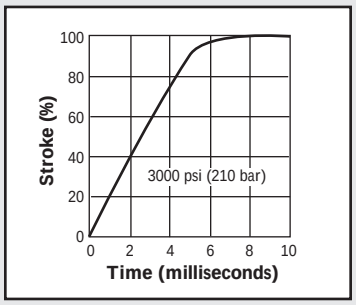
Internal Leakage
< 0.35 GPM @ 1000 psi

Connector Location
Port B (standard)

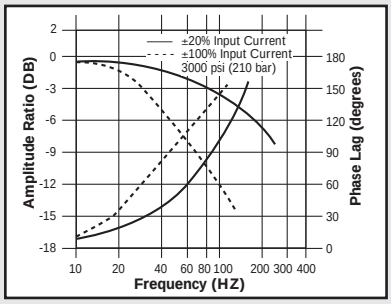
Weight
2.0 lbs. (0.91 kg)

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

215A-515 TYPICAL CHARACTERISTIC CURVES

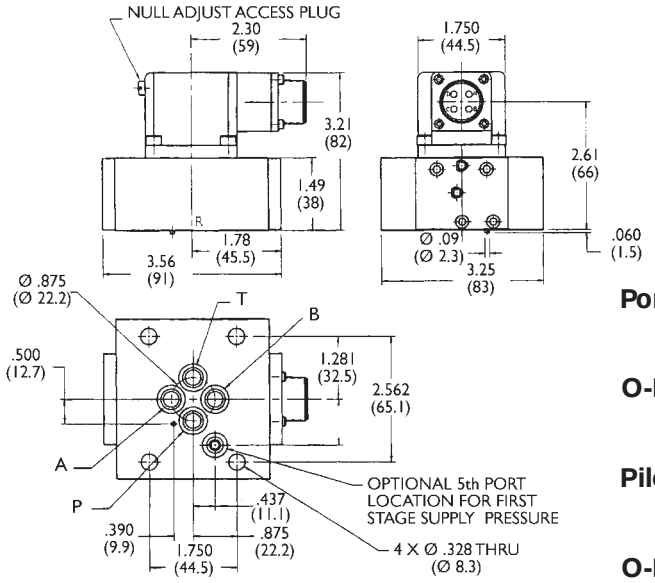


Step Response



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

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 218

TECHNICAL SPECIFICATIONS

Rated Flow
2.5 to 15 GPM @ 1000 psi drop

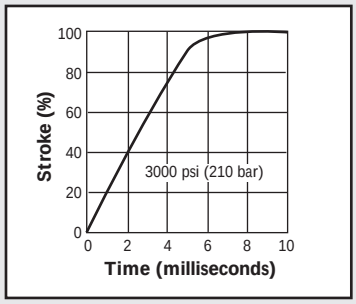
Internal Leakage
< 0.35 GPM @ 1000 psi

Connector Location
Port B (standard)

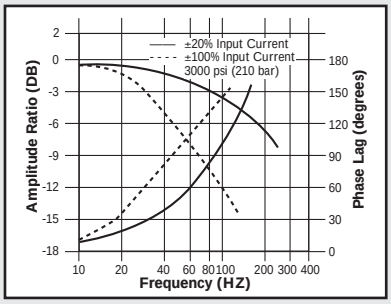
Weight
1.80 lbs. (0.82 kg)

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

218-515 TYPICAL CHARACTERISTIC CURVES

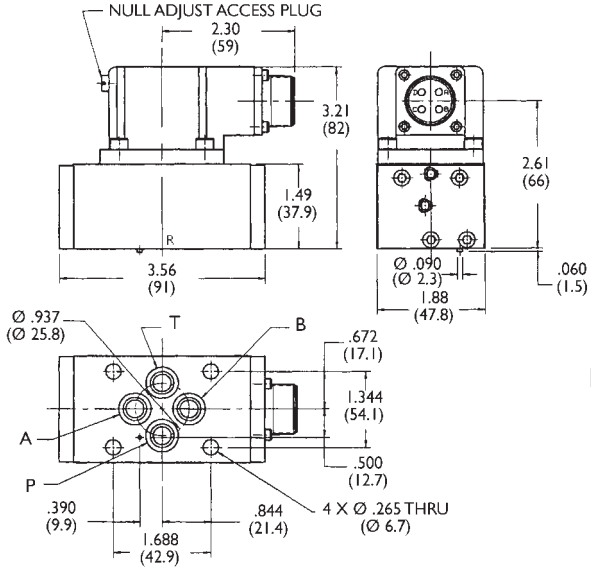


Step Response



Frequency Response

INSTALLATION DRAWING



Port Size
Ø 0.312 (Ø 7.9)

O-Ring
MS28775-013

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 240

TECHNICAL SPECIFICATIONS

Rated Flow
20 to 40 GPM @ 1000 psi drop

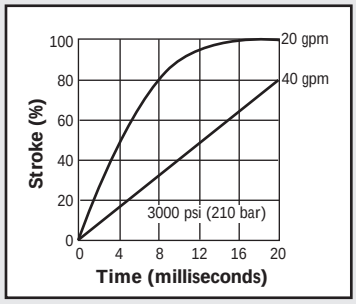
Internal Leakage
< 0.6 GPM @ 1000 psi

Connector Location
Port B (standard)

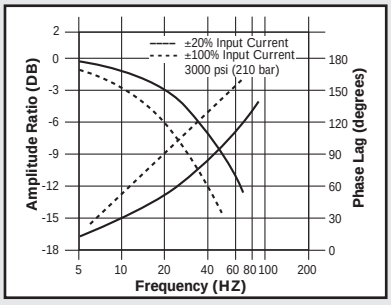
Weight
4.7 lbs. (2.14 kg)

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

240-520 TYPICAL CHARACTERISTIC CURVES

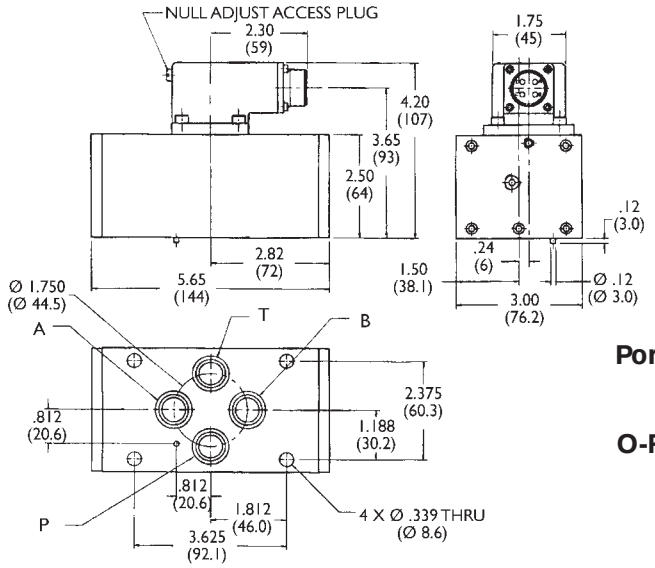


Step Response



Frequency Response

INSTALLATION DRAWING



Port Size
Ø 0.562 (Ø 14.3)

O-Ring
MS28775-018

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 242

TECHNICAL SPECIFICATIONS

Rated Flow
20 to 40 GPM @ 1000 psi drop

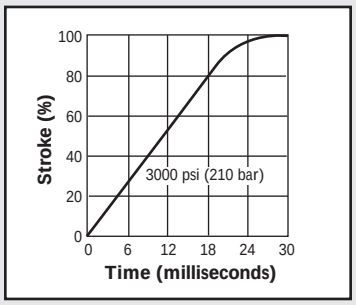
Internal Leakage
< 0.4 GPM @ 1000 psi

Connector Location
Port B (standard)

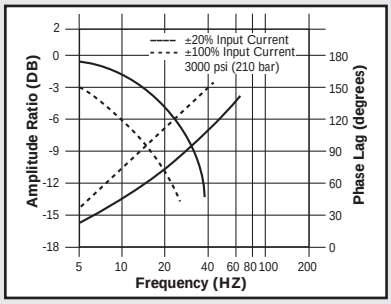
Weight
4.7 lbs. (2.14 kg)

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

242-540 TYPICAL CHARACTERISTIC CURVES

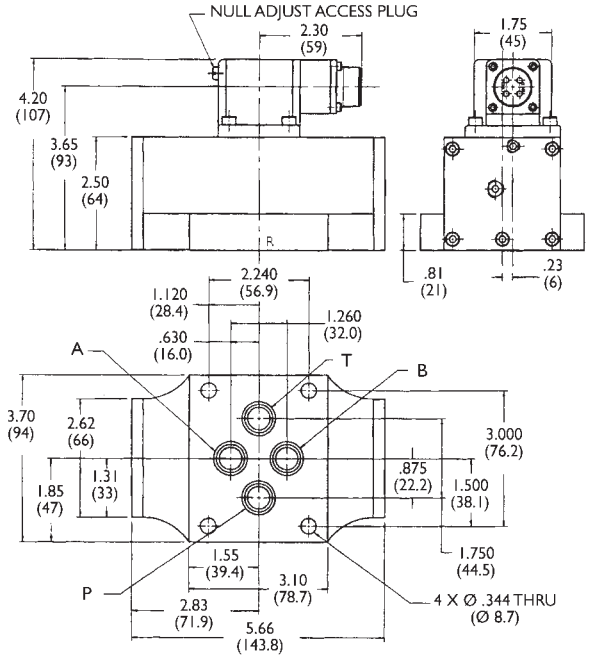


Step Response



Frequency Response

INSTALLATION DRAWING



Port Size
Ø 0.500 (Ø 12.7)

O-Ring
MS28775-016

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
MODEL 261

TECHNICAL SPECIFICATIONS

Rated Flow
20 to 60 GPM @ 1000 psi drop

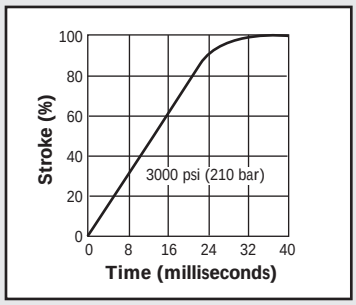
Internal Leakage
< 0.8 GPM @ 1000 psi

Connector Location
Port B (standard)

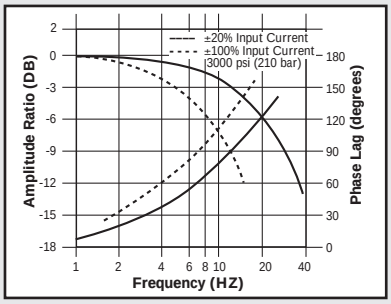
Weight
7.5 lbs. (3.4 kg)

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

261-560 TYPICAL CHARACTERISTIC CURVES

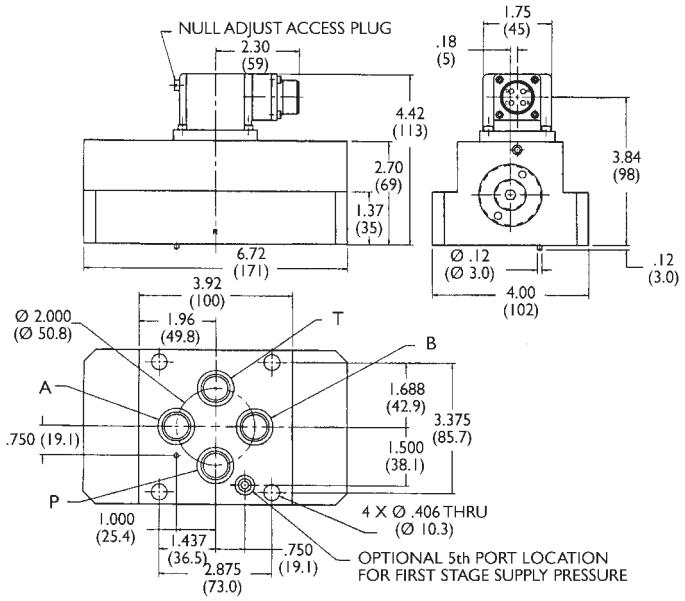


Step Response



Frequency Response

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

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
PNEUMATIC SERVO PRODUCTS

200PN
SINGLE-STAGE SERVOVALVE

The low flow rate (0.5 SCFM) and small package size makes the Model 200PN perfectly suited for controlling animatronic head movements (lips, eyes, mouth, etc.), while keeping the figure's head size and weight to a minimum. A proportional input signal of ±20 mA or ±5 volts provides variable pneumatic flow control. Standard hose fittings screw into the valve body for ease of installation.

204PN
TWO-STAGE SERVOVALVE

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.

161
MECHANICAL FEEDBACK ACTUATOR

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).

162
MECHANICAL FEEDBACK ACTUATOR

This model has the same features as the Model 161, 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).

162A
MECHANICAL FEEDBACK ACTUATOR

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).

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES

MODEL 161 - PNEUMATIC MECHANICAL FEEDBACK ACTUATOR

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

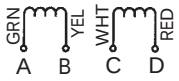
Hysteresis
3% max of rated current

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

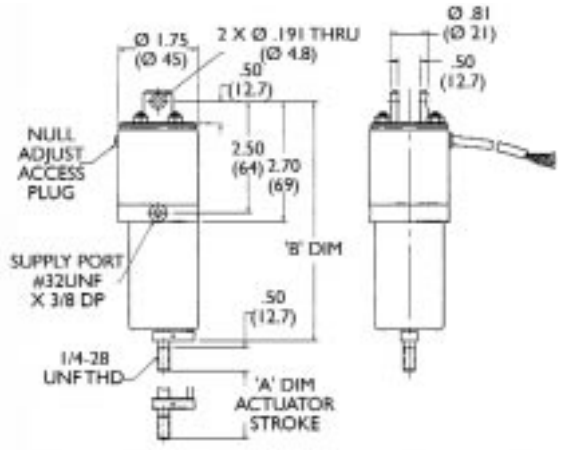
Extend	0.785 in^2
Retract	0.736 in^2

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

Model #	'A' DIM ± .032 Stroke	'B' DIM ± .060 Retracted
161-0.5-YYY	0.5 inch	4.64 inch
161-1.0-YYY	1.0 inch	5.14 inch
161-1.5-YYY	1.5 inch	5.64 inch
161-2.0-YYY	2.0 inch	6.14 inch

JET PIPE SERVOVALVES

MODEL 162 & 162A - PNEUMATIC MECHANICAL FEEDBACK ACTUATORS

162 MFB SPECIFICATIONS

Flow into Valve
0.8 SCFM @ 100 psi

Piston Diameter
2.00 inches

Rod Diameter
0.25 inches

Effective Area

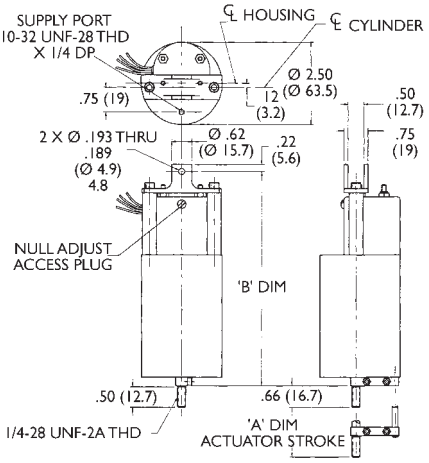
Extend	3.14 in^2
Retract	3.09 in^2

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 Stroke	'B' DIM ± .060 Retracted
162-2.0-YYY	2.0 inch	6.40 inch

162A MFB SPECIFICATIONS

Flow into Valve
2.0 SCFM @ 100 psi

Piston Diameter
2.00 inches

Rod Diameter
0.25 inches

Effective Area

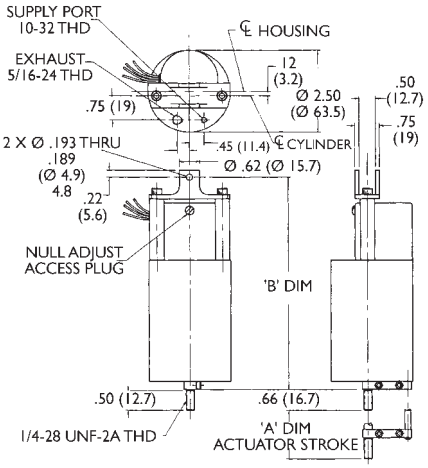
Extend	3.14 in^2
Retract	3.09 in^2

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 Stroke	'B' DIM ± .060 Retracted
162A-2.0-YYY	2.0 inch	6.40 inch

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES

PNEUMATIC SERVOVALVES - TUBE MOUNT

GENERAL SPECIFICATIONS

System Filtration
25 micron

Fluid
Dry clean gas

Temperature Range
-40° to 160°F

Coil Resistance
250 ohms per coil

Pressure

Operating	80 to 160 psi
Proof	250 psi
Burst	425 psi

Rated Current
±20 mA

Electrical Connection
#26 AWG color coded leads

Polarity
Green+, Yellow-, flow out CYL Port 2
White+, Red-, flow out CYL Port 2

Hysteresis
3% max of rated current

Seals
Viton

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

Threshold
0.02% max of rated current

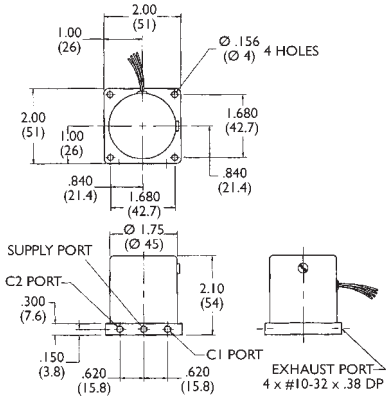
90° Phase Lag
200 Hz @ 100 psi supply

-3dB Amplitude Ratio
150 Hz @ 100 psi supply

Ports
#10-32 x .38 deep tapped holes

Mounting
4 holes .156 diameter

INSTALLATION DRAWING



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 Gain
30% of supply pressure @ 2% change of rated current

Hysteresis
3% max of rated current

Threshold
0.2% max of rated current

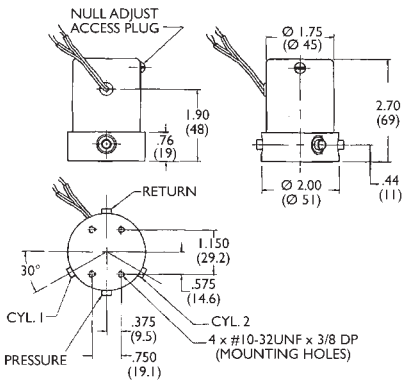
90° Phase Lag
30 Hz @ 100 psi supply

-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

INSTALLATION DRAWING



MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES

PNEUMATIC SERVOVALVES - MANIFOLD MOUNT

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

Hysteresis
3% max of rated current

Seals
Viton

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

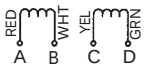
-3dB Amplitude Ratio
150 Hz @ 100 psi supply

Electrical Connection
Bendix Pygmy PCO2H-8-4P

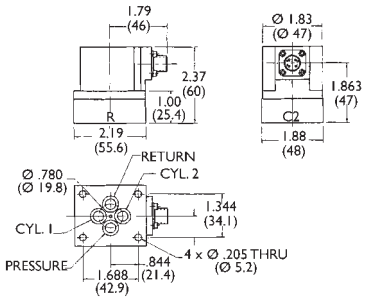
Ports
0.12 diameter

Port O-Ring Size
MS28775-012

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



INSTALLATION DRAWING



Port Size
Ø 0.187 (Ø 4.7)

O-Ring
MS28775-012

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

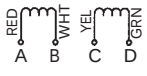
-3dB Amplitude Ratio
40 Hz @ 100 psi supply

Electrical Connector
MS3102E-14S-2P

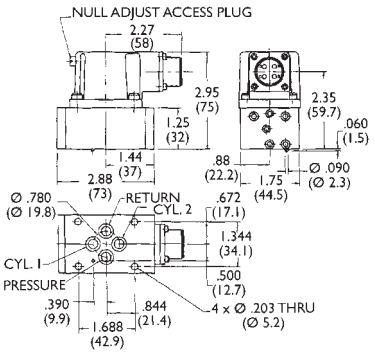
Ports
.281 diameter

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 DRAWING



Port Size
Ø 0.281

O-Ring
MS28775-011

MOOG
ATCHLEY CONTROLS

JET PIPE SERVOVALVES
INSTALLATION PROCEDURES

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 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:
l Screwdriver
l Allen wrench (1/16")

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:
l 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 drift stops. 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 AND MANIFOLD SELECTION

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
- Overlap or underlap
- Dual flow gain
- Shaped flow gain

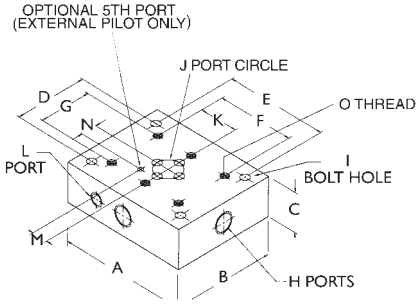
Conditioning - Underwater Service
- Vented torque motor cover
- Pigtails

Isolated Pilot Supply Pressure Port
- Accepts external pilot supply

Rated for 5000 PSI Operation
- Stainless steel body

Magnetic Null Adlustment
- Ease of adjustment
- Isolates torque motor

SUBPLATE DRAWING



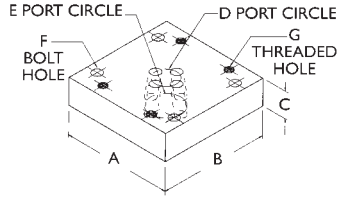
SUBPLATE CHARTS

Model #	A Length	B Width	C Height	D Mounting	E Mounting	F Mounting	G Mounting	H Ports SAE J514	I Bolt Hole	J Port Circle
208/209 500-206-X	5.0 (127.0)	4.0 (101.6)	1.5 (38.1)	2.875 (73.0)	4.00 (101.6)	1.688 (42.87)	1.688 (42.87)	-4 to -12	.344 (8.7)	.625 (15.88)
211A/214 500-205-X	5.0 (127.0)	4.0 (101.6)	1.5 (38.1)	2.875 (73.0)	4.00 (101.6)	1.688 (42.87)	1.344 (34.14)	-4 to -12	.344 (8.7)	.780 (19.81)
215A 500-215-X	5.0 (127.0)	4.0 (101.6)	1.5 (38.1)	2.875 (73.0)	4.00 (101.6)	1.750 (44.45)	2.562 (65.07)	-4 to -12	.344 (8.7)	.875 (22.22)
218 500-218-X	5.0 (127.0)	4.0 (101.6)	1.5 (38.1)	2.875 (73.0)	4.00 (101.6)	1.688 (42.87)	1.344 (34.14)	-4 to -12	.344 (8.7)	.937 (23.80)
225 500-225-X	5.0 (127.0)	4.0 (101.6)	1.5 (38.1)	3.25 (82.5)	4.00 (101.6)	3.500 (88.90)	1.75 (44.45)	-8 to -12	.344 (8.7)	1.375 (34.93)
231/242 500-231-X	6.0 (152.4)	6.0 (152.4)	2.0 (50.8)	4.0 (101.6)	5.0 (127.0)	2.24 (56.90)	3.000 (76.20)	-8 to -16	.344 (8.7)	Diamond
240 500-240-X	6.0 (152.4)	5.0 (127.0)	1.87 (47.5)	4.0 (101.6)	4.5 (114.3)	3.625 (92.07)	2.375 (60.32)	-10 to -24	.390 (9.9)	1.750 (44.45)
261 500-261-X	7.0 (177.8)	6.0 (152.4)	2.0 (50.8)	4.75 (120.6)	4.5 (114.3)	2.875 (73.02)	3.375 (85.72)	-12 to -32	.531 (13.5)	2.000 (50.80)
290 500-290-X	7.0 (177.8)	6.0 (152.4)	2.0 (50.8)	4.75 (120.6)	4.5 (114.3)	2.75 (69.75)	3.375 (85.72)	-24 to -40	.531 (13.5)	Diamond

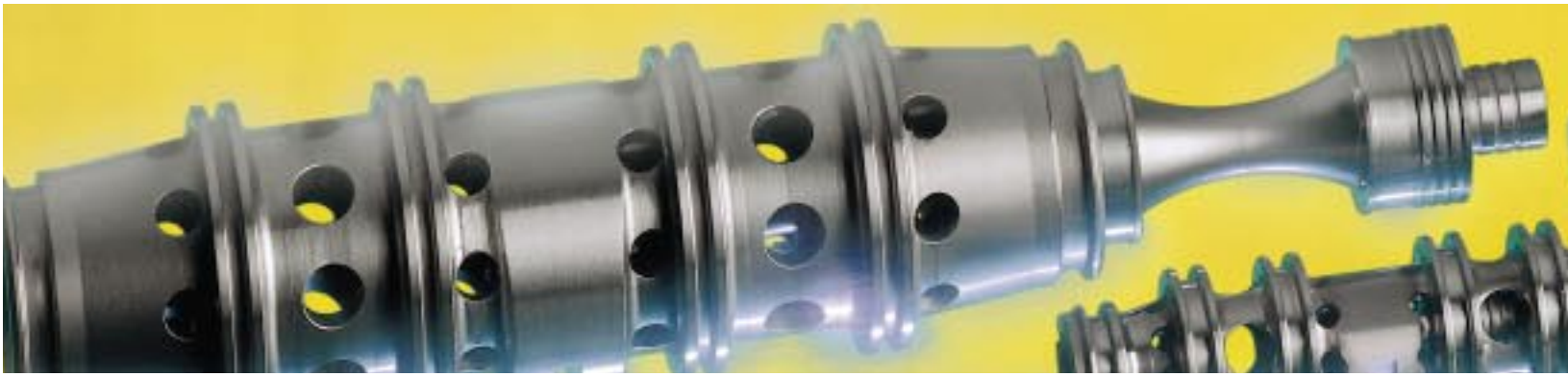
Servovalve Model Subplate Model	208/209 500-206-C-X	211A/214 500-205-C-X	215A 500-215-C-X	218 500-218-C-X	225 500-225-C-X	242 500-231-C-X	240 500-240-C-X	261 500-261-C-X	290 500-290-C-X
L SAE J514	-4	-4	-4	–	-4	–	–	-4	-4
M	.438 (11.13)	.438 (11.13)	.438 (11.13)	–	.781 (19.84)	–	–	.750 (19.05)	1.375 (34.93)
N	.609 (15.47)	.609 (15.47)	.937 (23.80)	–	.875 (22.22)	–	–	1.500 (38.10)	1.450 (36.83)

ADAPTER PLATE

	A Length	B Width	C Height	D from Port Circle	E to Port Circle	F Bolt Hole	G Thread
Model 53781 from .780 to .875	3.25 (82.55)	2.5 (63.50)	.588 (14.73)	.780 (19.81)	.875 (22.22)	.344 (8.74)	10-32



Australia	Mulgrave
Brazil	São Paulo
China	Hong Kong
	Shanghai
Denmark	Cöpenhagen
England	Tewkesbury
Finland	Espoo
France	Rungis



Germany	Böblingen
India	Bangalore
Ireland	Ringaskiddy
Italy	Brescia
	Malnate
Japan	Hiratsuka
Korea	Seoul
Luxembourg	Luxembourg City
Philippines	Baguio
Singapore	Singapore
Spain	Orio
Sweden	Askim
USA	East Aurora

MOOG
ATCHLEY CONTROLS

Moog Inc., East Aurora, NY 14052-0018
Telephone: 716/655-3000
Fax: 716/655-1803
Toll Free: 1-800-272-MOOG
http://www.moog.com

CDL6684 Rev B 500-374 300