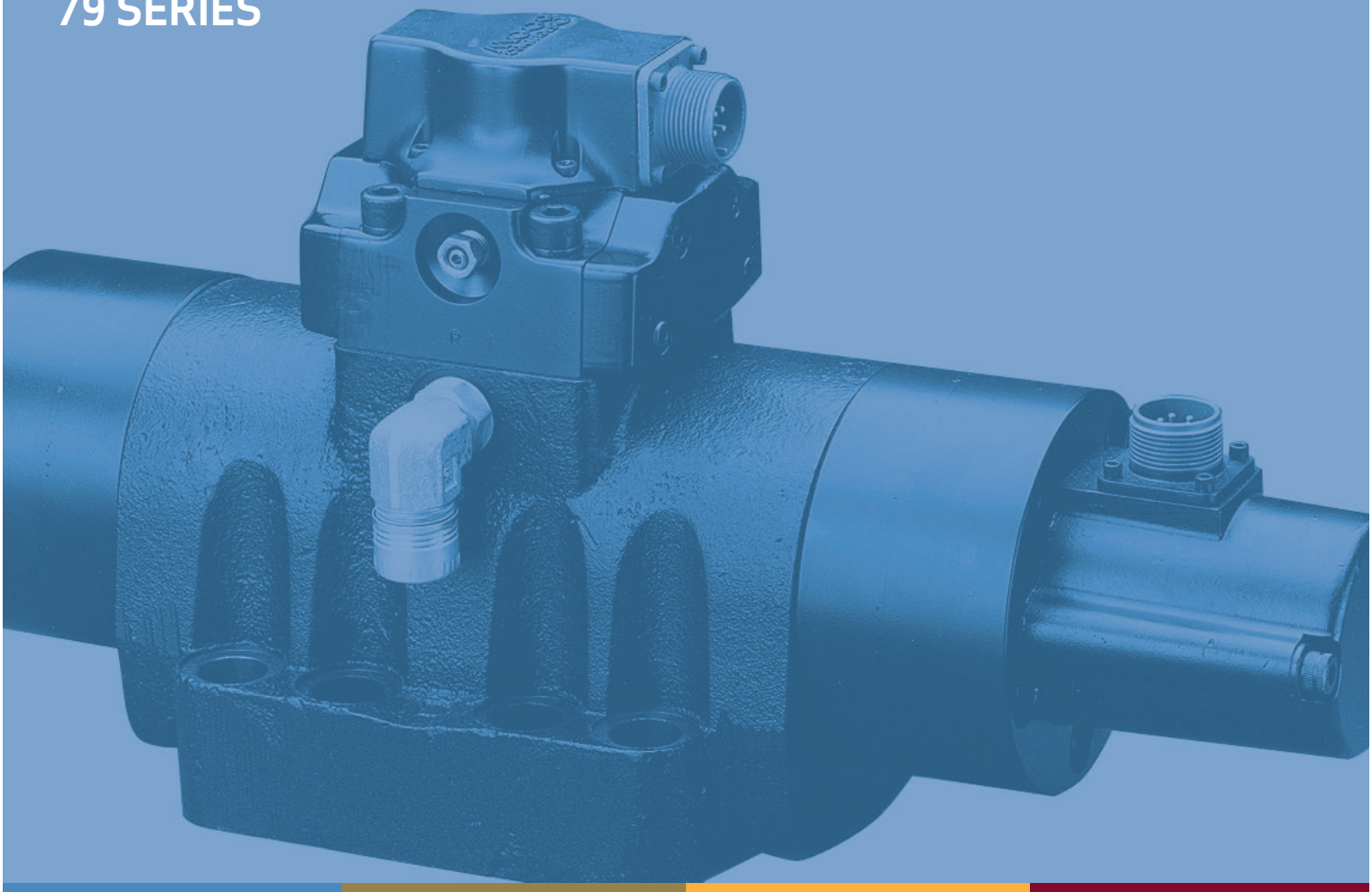
SERVO VALVES

3-STAGE FLOW CONTROL

79 SERIES



Rev. L, September, 2019

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

79 SERIES SERVO VALVES

The 79 Series flow control servo valves are throttle valves for 3 and preferably 4-way applications. These three stage servo valves were developed for applications that require high flow rates and high performance. The 79 series covers the range of rated flow from 30 to 200 gpm at 1,000 psi valve drop. These valves are offered with 76X Series pilot valves, in either Standard, High, or Very High performance configurations.

These valves are suitable for electrohydraulic position, speed, pressure or force control systems with high dynamic response requirements.

Principle of operation
An electrical command signal (set point, input signal) is applied to the external control amplifier which drives a current through the pilot valve coils. The pilot valve produces differential pressure in its control ports. This pressure difference results in a pilot flow which causes main spool displacement.

The position transducer, which is excited via an oscillator, measures the position of the main spool (actual value, position voltage). The signal then is demodulated and fed back to the control amplifier where it is compared with the command signal. The control amplifier drives the pilot valve until the error between command signal and feedback signal is zero. Thus, the position of the main spool is proportional to the electrical command signal.

VALVE FEATURES

- Electrical feedback on the main spool for low hysteresis and excellent linearity
- Optional external pilot supply and return connections
- High spool control forces
- High dynamics
- Rugged, long-life design
- High resolution, low hysteresis
- Completely set-up at the factory
- Excellent null stability

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
Δp [psi] = actual valve pressure drop
Δp_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:

$$p_x \geq 5.6 \cdot 10^{-2} \cdot \frac{Q}{A_K} \cdot \sqrt{\Delta p}$$

Q [gpm] = max. flow
Δp [psi] = valve pressure drop with Q
A_k [in^2] = spool drive area
p_x [psi] = pilot pressure

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

ISO 9001 CERTIFIED

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.

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

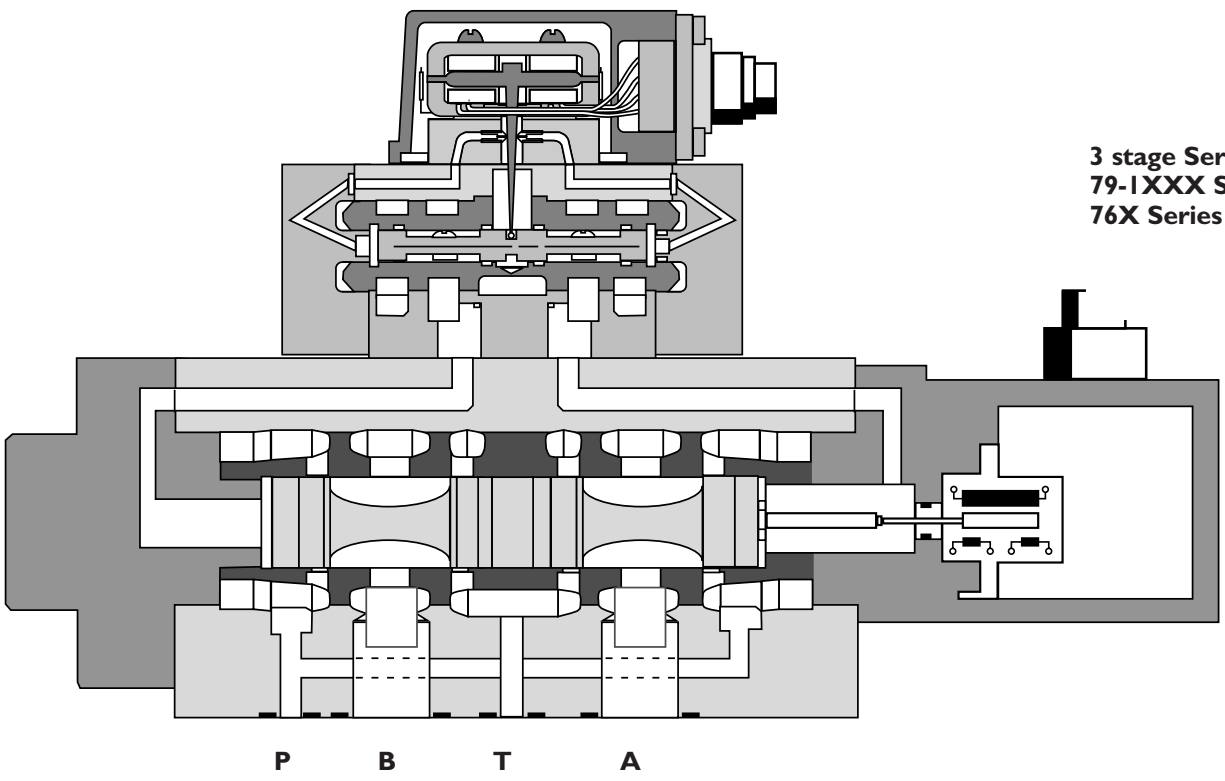
Installation Options Any position, fixed or moveable.

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

Model . . . Type			**79-1XXX**	
Mounting Pattern	ISO, but X and Y do not correspond to ISO		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		X and Y	
Mass			24 lbs [10.9 kg]	
Rated Flow	(± 10%) at Δp^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 ΔT = 50°C	[%]	< 2.5%	
Null Leakage Flow*	total, max.	[gpm]	0.8	1.6
Main Spool Stroke		[in]	.075	
Main Spool Drive Area		[in²]	0.442	

* 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.

Set-up and Operation

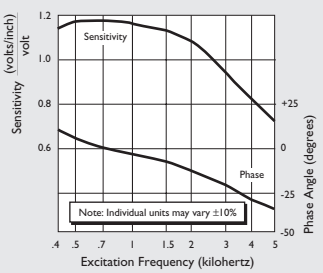
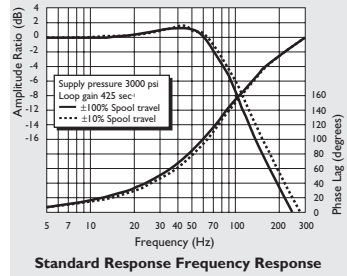
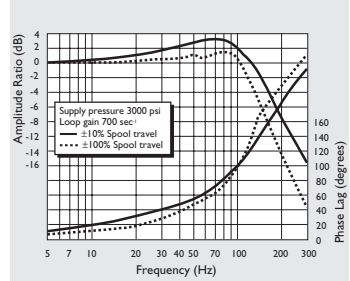


Figure 1

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

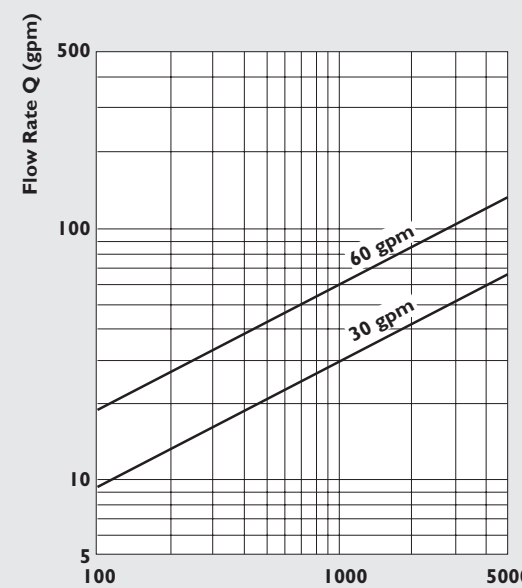


Standard Response Frequency Response



Optional High Response Frequency Response

Valve Flow Diagram



Rated pressure drop Δp_N= 1,000 psi Valve pressure drop Δp_N [psi]

Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.

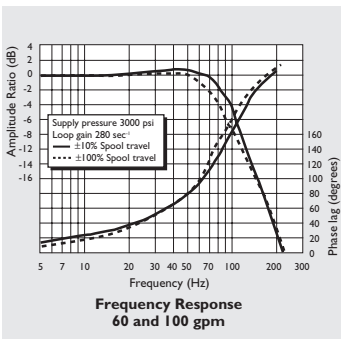
Model . . . Type			**79-2XXX**		
Mounting Pattern			Moog Standard		
Valve Body Version			4-way		
			3-stage with spool-bushing assembly		
Pilot Valve			2-stage, 76X series		
Pilot Connection	Optional, internal or external		X and Y		
Mass			35.5 lbs. [16.1 kg]		
Rated Flow	(± 10%) at Δp^N = 1,000 psi	[gpm]	100	200	250
Response Time*	for 0 to 100% stroke Standard	[ms]	15	15	15
	High Response	[ms]	6	6	6
Threshold*		[%]	< 0.5%		
Hysteresis*		[%]	< 0.5%		
Null Shift	with ΔT = 50°C	[%]	< 2.0%		
Null Leakage Flow*	total, max.	[gpm]	2.5	2.5	2.5
Main Spool Stroke		[in]	0.130		
Main Spool Drive Area		Standard [in²]	1.107		
		High Response [in²]	0.442		

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

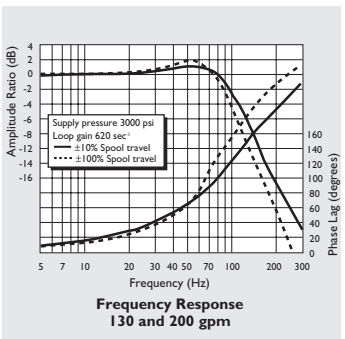
Typical Characteristic Curves measured at 3,000 psi pilot or operating pressure, respectively, and fluid kinematic viscosity of 32 mm²/s.

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

Standard Valves

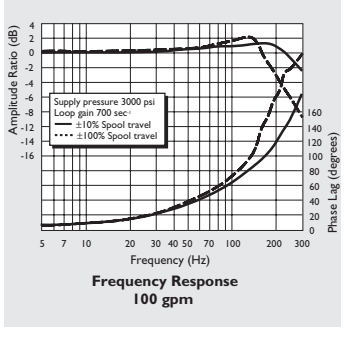


Frequency Response 60 and 100 gpm

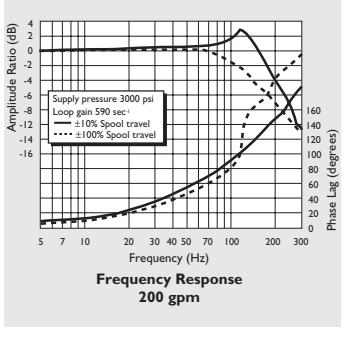


Frequency Response 130 and 200 gpm

High Response Valves

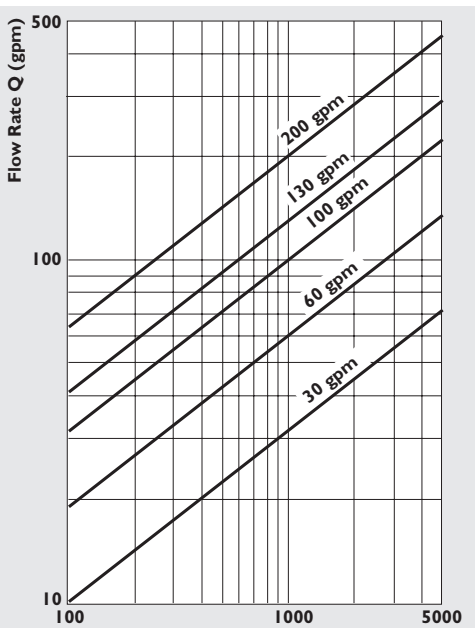


Frequency Response 100 gpm



Frequency Response 200 gpm

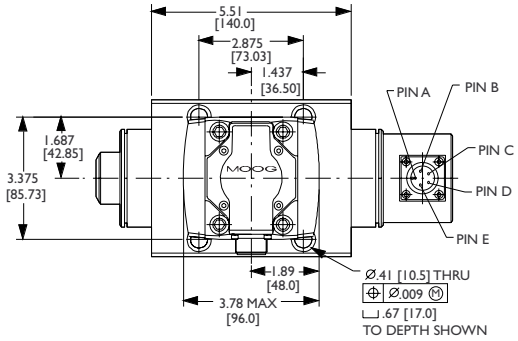
Valve Flow Diagram

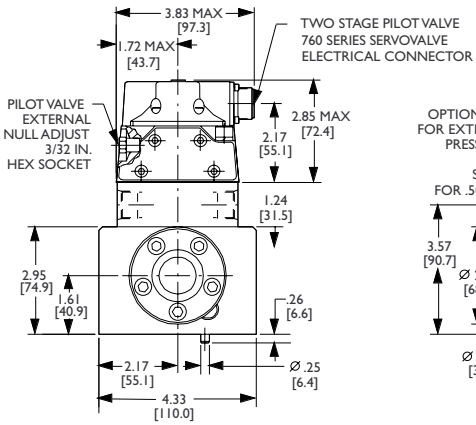


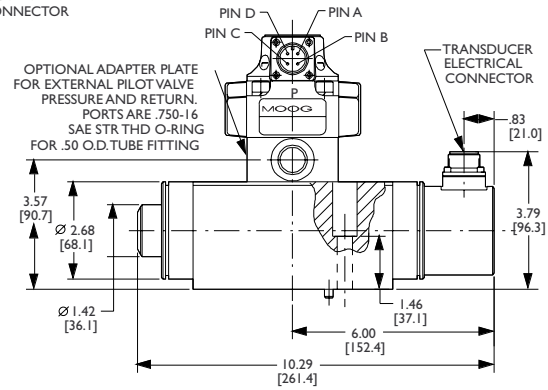
Rated pressure drop Δp_N = 1,000 psi Valve pressure drop Δp_N [psi]

Valve flow for maximum valve opening (100% command signal) as a function of the valve pressure drop.

79-1XXX SERIES
INSTALLATION DRAWINGS WITH PILOT VALVES 76X SERIES

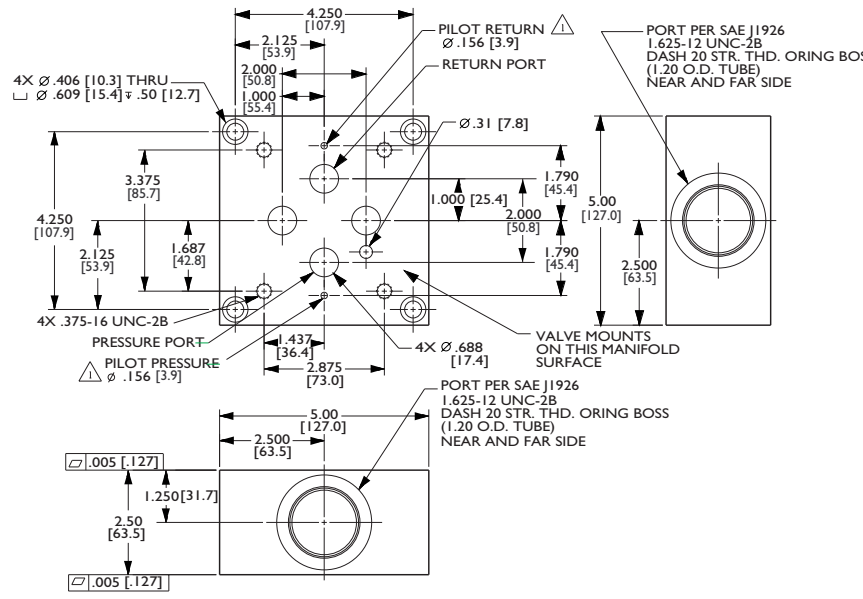






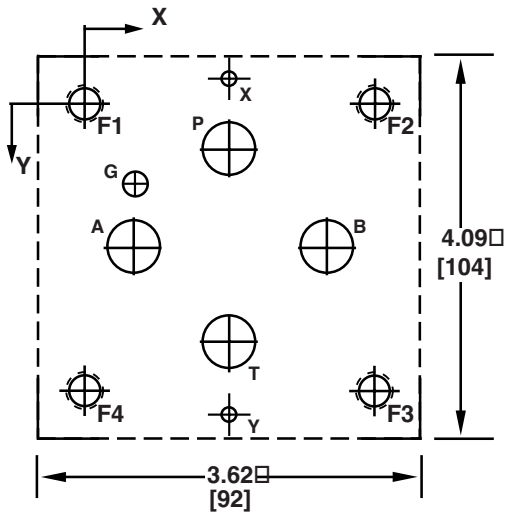
The mounting Manifold must conform to ISO 10372-06-05-0-92.
Note: The X port to ISO Standard must **not** be machined. The X and Y ports of Moog valve body do **not** correspond to ISO Standard.

Surface to which valve is mounted requires a $\sqrt{32}$ [ΔΔ] finish, flat within 0.001[0.03] TIR.



NOTES:
1. EXTERNAL PILOT SUPPLY AND RETURN PORTS SHOWN FOR REFERENCE ONLY. MANIFOLD P/N 22236AM3 IS NOT PROVIDED WITH PORTS.

79-1XXX SERIES
TYPICAL SUBPLATE MANIFOLD



US	P	A	T	B	G	X*	Y*	F1	F2	F3	F4
	Ø.63	Ø.63	Ø.63	Ø.63	Ø.32	Ø.156	Ø.156	3/8-16	3/8-16	3/8-16	3/8-16
X	1.44	0.44	1.44	2.44	0.44	1.44	1.44	0	2.87	2.87	0
Y	0.69	1.69	2.69	1.69	0.94	-0.1	3.48	0	0	3.37	3.37

METRIC	P	A	T	B	G	X*	Y*	F1	F2	F3	F4
	Ø16	Ø16	Ø16	Ø16	Ø8	Ø4	Ø4	M10	M10	M10	M10
X	36,5	11,1	36,5	61,9	11,1	36,5	36,5	0	73	73	0
Y	17,5	42,9	68,3	42,9	23,8	-2,5	88,3	0	0	85,7	85,7

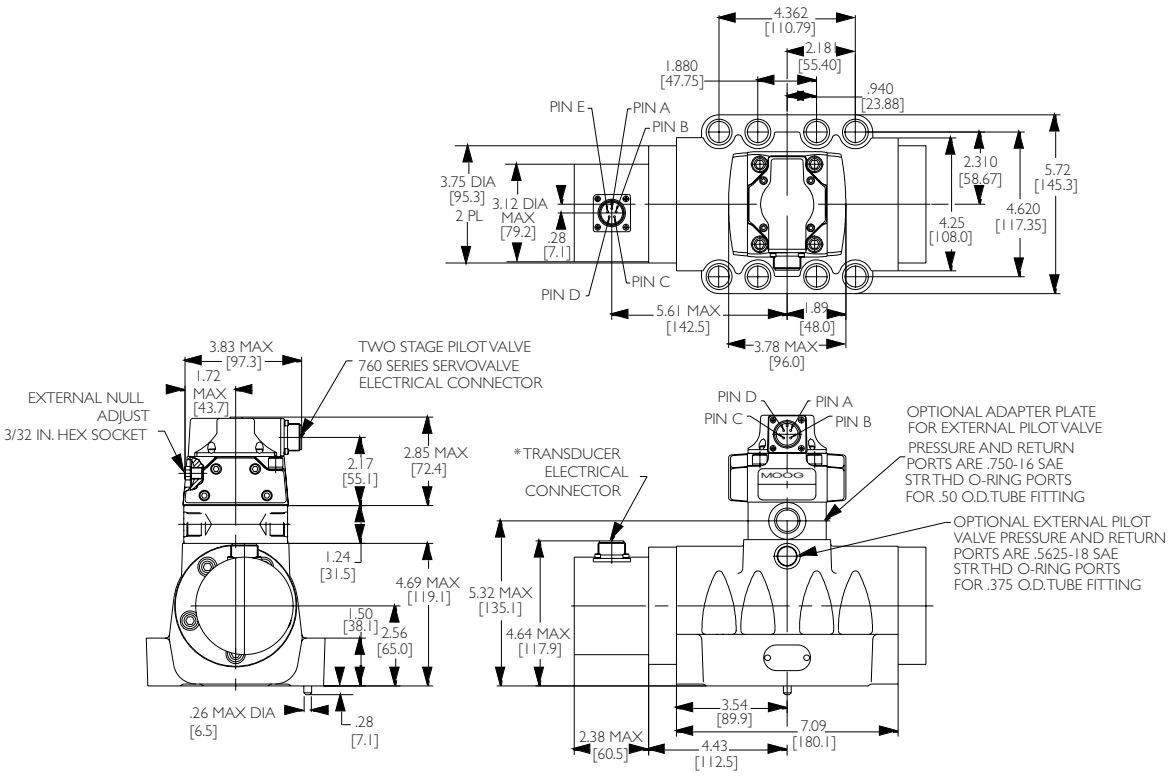
THE MOUNTING MANIFOLD MUST CONFORM TO ISO 10372-06-05-0-92
* NOTE: The X port to the ISO standard must not be machined.
The X and Y ports of the Moog valve do **not** correspond to ISO standard.

Surface to which the valve is mounted requires a 32 finish [ΔΔ], flat within .0001 [.03] TIR.

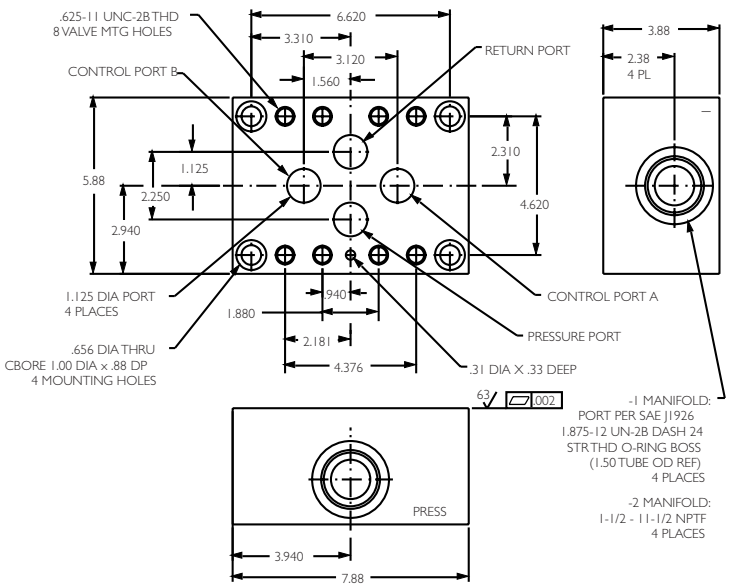
SPARE PARTS AND ACCESSORIES FOR 79-1XXX SERIES

O-rings (included in delivery)			
for P, T, A, B	4 pieces	ID 0.800 x 0.070	42082-040
for X, Y	2 pieces	ID 0.301 x 0.070	42082-012
Mating connector, waterproof IP 65 (not included in delivery)		pilot valve	-49054F014S002S (MS3106F14S-2S)
		LVDT	-49054F014S005S (MS3106F14S-5S)
Flushing plate			G4321AM001
Mounting bolts (not included in delivery)			
3/8 - 16 UNC x 2.25	4 pieces	required torque 50 lb.-ft.	A31324-336B

79-2XXX SERIES (STANDARD) INSTALLATION DRAWING WITH PILOT VALVE 76X SERIES



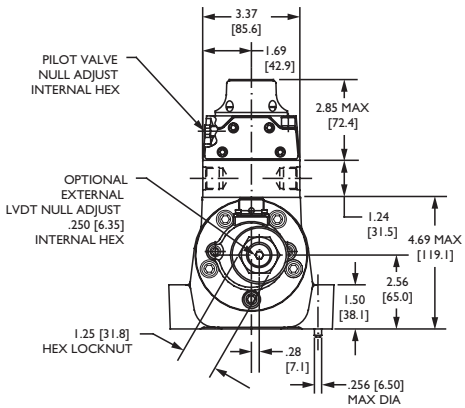
TYPICAL SUBPLATE MANIFOLD

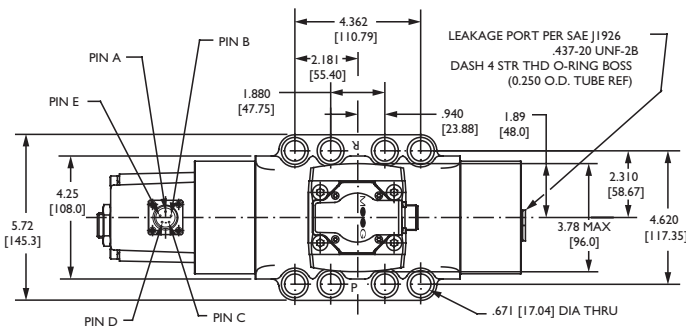


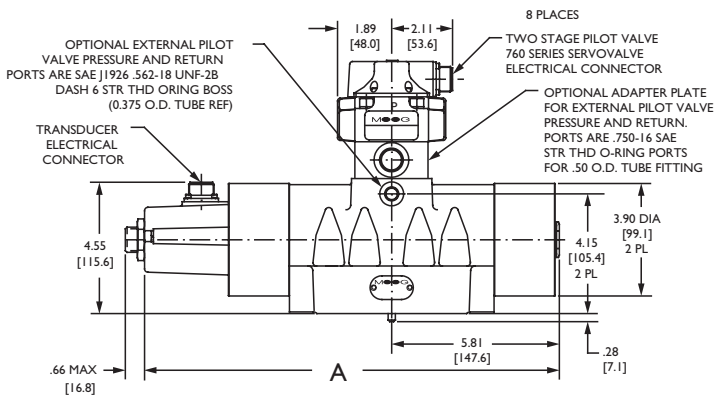
Note: The X and Y tubes have to be connected to the Moog valve body by fittings.

Surface to which valve is mounted requires a 32 [ΔΔ] finish, flat within 0.001 [0.03] TIR.

79-2XXX SERIES (HIGH RESPONSE)
INSTALLATION DRAWINGS
WITH PILOT VALVES 76X SERIES







SPARE PARTS AND ACCESSORIES FOR 79-2XXX 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	-49054F014S002S (MS3106F14S-2S)
		LVDT	-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

SET-UP AND OPERATION

Servo 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.

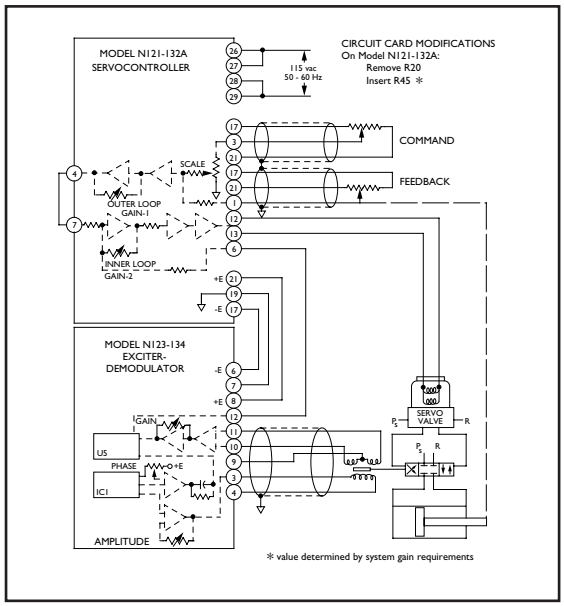
The AC excitation is adjustable between ±10 and ±14 volts peak-to-peak. The recommended frequency is 2000 Hz (N123-134) to achieve good servo valve response; however, a lower frequency may be necessary if a long cable run is required.

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.

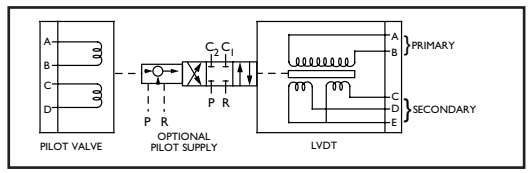
Inner Loop Gain Set-up

- 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



Typical Valve Schematic*



*Refer to specific model installation for wiring details.

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:

$$K_{IL} = \frac{K_A K_{PV} K_D K_X}{\Delta_X}$$

where:

K_{IL} = servo valve inner loop gain (sec^{-1})
K_A = servo controller gain (mA/VDC)
K_{PV} = pilot valve gain $\left(\frac{in^3/sec}{mA}\right)$

$$= \frac{Z \text{ gpm} \times 3.85 \; \frac{in^3/sec}{gpm} \sqrt{\frac{3000 \text{ psi}}{1000 \text{ psi}}}}{15 \text{ mA}}$$

where Z = 2.5 for 79-100, 5.0 for 79-200 standard, and 4.0 for 79-200 High Response.

K_D = demodulator gain (VDC/vrms)
K_x = LVDT gain (vrms/inch)
Δ_X = power spool end area = 1.107 in^2 for 79-200 standard
= 0.442 in^2 for 79-200 High Response and 79-100

The required servo controller gain can be found by:

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

Outer Servoloop Gain

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

$$K_{VAL} = \frac{K_S}{K_D K_X}$$

where:

K_{VAL} = overall valve gain $\left(\frac{in^3/sec}{VDC}\right)$
K_S = power spool flow gain (see specifications)
K_D = demodulator gain (VDC/vrms)
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.

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.

79 SERIES
ORDERING INFORMATION

Model Number

79-1, 79-2 • • •

Type Designation

• • • • • • • • • • • •

Model Designation	
	Assigned at the factory

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

Rated Flow		
	Q_N[gpm] at Δp_N = 1,000 psi	
	Standard (gpm)	Series
10	30	(100 only)
25	60	(100 only)
40	100	(200 only)
80	200	(200 only)
99	260	(200 only)

Maximum Operating Pressure p_p and Body Material	
F	3,000 psi
J	4,500 psi at $p_X \leq$ 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

Valve Electronics	
7	Customer Supplied Electronics

Signal for 100% Spool Stroke		
	Command	
H	±15 mA	(single coil)
L	±40 mA	(single coil)

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			
	Supply [X]	Return [Y]	
0	internal	internal	
1	external	internal	(adapter plate)
2	external	external	(adapter plate)
6	external	external	(ports in body)

Spool Position without Electrical Signal		
	Position	Pilot Pressure [psi]
O	Undefined	≥ 215
A	P ➡ B, A ➡ T	≥ 215
B	P ➡ A, B ➡ T	≥ 215

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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info.china@moog.com

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