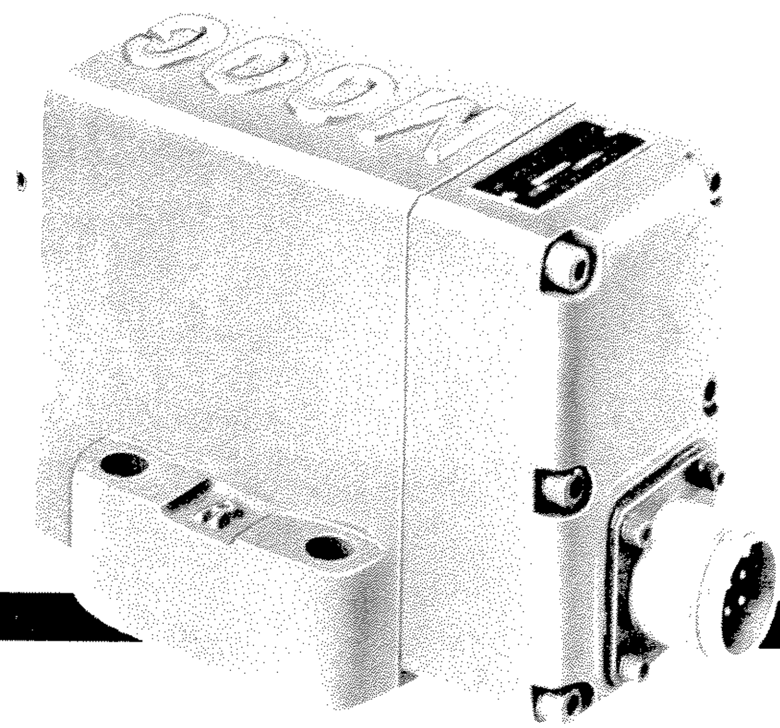
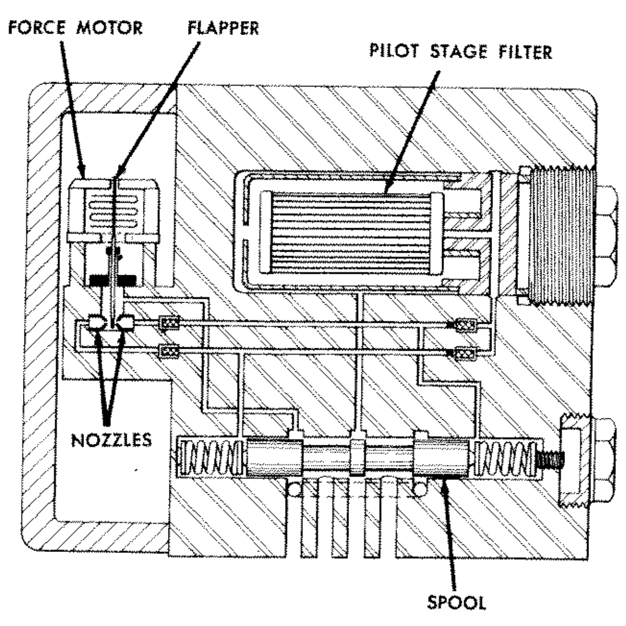
SERIES 71 INDUSTRIAL SERVOVALVE



Series 71 Industrial flow-control servovalves are pilot operated, closed center four-way sliding spool valves in which the output flow to a constant load is proportional to electrical input current. These servovalves feature a large capacity field-replaceable pilot stage filter for added protection. Servovalves are normally used in closed loop control systems to provide precise control at high power levels.

INDUSTRIAL DIVISION



Moog Series 71 servovalves consist of a polarized electrical force motor and two stages of hydraulic power amplification. The motor armature or flapper passes through a tubular flexure pivot which acts also as a seal between the electro-magnetic and hydraulic sections of the valve. At the end opposite to the motor, the flapper passes between two nozzles, creating two variable orifices between the nozzle tips and the flapper. Filtered pressure oil is supplied to these orifices through two fixed upstream orifices and the intermediate chamber pressures are vented to either end of the output stage spool. The spool is of a conventional four-way design and is spring centered. Output flow from the valve, at a fixed valve pressure drop, is proportional to spool displacement.

As signal is applied to the motor, a force is developed upon the flapper, causing it to pivot and to move between the nozzles. This motion causes one orifice to open as the other closes, resulting in a differential pressure between the nozzle chambers. The pressure difference, acting upon the nozzle projected areas, results in a feedback force upon the flapper to balance the motor force. The pressure differential aslo acts upon the second stage spool, resulting in a displacement and, hence, output flow proportional to electrical signal input.

SERVOVALVE TERMINOLOGY

NULL is the term used to define the position of the second-stage spool which produces zero differential load pressure and zero load flow.

NULL LEAKAGE is composed of pilot or first-stage flow and second-stage null leakage. Normal first-stage flows are less than 0.35 cis. Second-stage null leakage flow is related to the maximum valve flow at rated system pressure and is normally maintained less than 3% of this flow.

NULL BIAS CURRENT is the input current required to bring the valve to null. Null bias current is a function of valve hysteresis, temperature, applied acceleration, valve centering adjustment, and supply and return pressure. It is expressed in ma.

NULL SHIFT is the change in the null bias current that may occur for particular environmental variables. It is expressed in ma or percent of rated current. Normal null shifts are as follows:

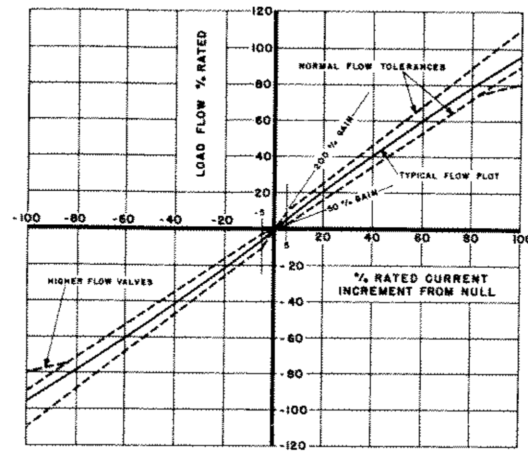
	Range	Maximum null shift
Temperature	50° — 200°F.	5%
Supply pressure	80 to 110%	2%
Acceleration	10 g	5%
Quiescent current	50 to 150% of Rated current	5%

NULL PRESSURE GAIN is the slope at null of of a plot of blocked cylinder port differential pressure versus input current (with zero load flow). It is expressed as psi/ma. Null pressure gain normally exceeds 30% of supply pressure for 1% of rated current. Cylinder port pressures at null are normally held between ⅓ and ⅔ of system pressure.

HYSTERESIS is the total difference in differential currents required to produce zero load flow as the valve is cycled between rated positive and negative current. It is measured with zero load pressure and expressed as ma or percent of rated current. Hysteresis is normally less than 4% of rated current.

RESOLUTION is the maximum increment of input current required to produce a change in valve output flow. It is expressed in ma, or percent of rated current. Valves available from stock have resolution less than 1%.

DITHER is a small amplitude a-c input current sometimes utilized to improve system resolution. If dither is used, peak-to-peak amplitudes less than 20% of rated current at any frequency below approximately 700 cps are recommended.



NORMAL FLOW GAIN TOLERANCE

FIGURE 1

RATED FLOW is load flow specified for conditions of rated valve pressure drop and rated current. The Series 71 servovalves available from stock are rated at 1000 psi valve drop. Flows at other pressure drops can be determined from the load flow-pressure curve, Figure 2. Flow is expressed as cubic inches per second (cis) or gallons per minute (GPM). Servovalves having a rated flow other than the indicated flows of the four stock valves shown may be obtained on special order.

NOMINAL FLOW GAIN is the slope of a line connecting the origin to the rated flow-rated current point on a plot of load flow versus input current at constant valve pressure drop. Flow gain is expressed as cis/ma or GPM/ma. Flow gain tolerances are most practically specified by an envelop on a plot of load flow versus input current. Figure 1 shows normal flow tolerances. Flow gain in the zero flow region is determined by the relationship of the spool and bushing metering edges. Stock valves maintain this relationship effectively as line-to-line. Other relationship can be obtained on special order.

INPUT CURRENT is normally considered the differential current to the two valve coils. Quiescent current levels from zero to twice rated current may be used. The total coil may be operated in series aiding with zero quiescent current, in which case the input current required to produce rated flow would be one-half the rated differential current.

RATED CURRENT is the specified differential input current required to produce rated flow. It is expressed in milliamperes (ma). Valves available from stock have a rated current of 15 ma. Valves with rated currents ranging from 6 to 100 milliamperes can be furnished on special order.

COIL IMPEDANCE may be determined from the d-c coil resistance and the coil inductance. For stock valves, these values are approximately 200 ohms and 1 henry respectively. Inductance is determined under pressurized operating conditions and is greatly influenced by reflected hydromechanical impedance. At signal frequencies below 100 cps, inductance is essentially linear.

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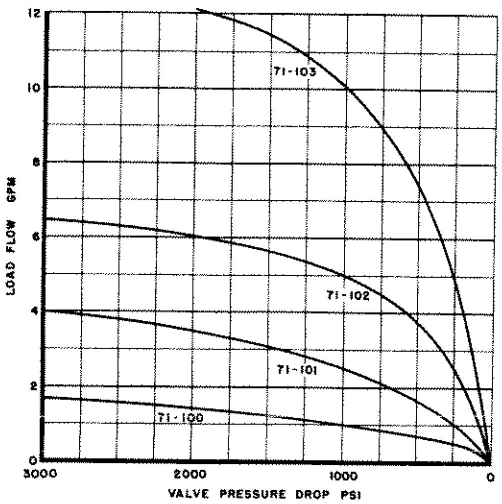
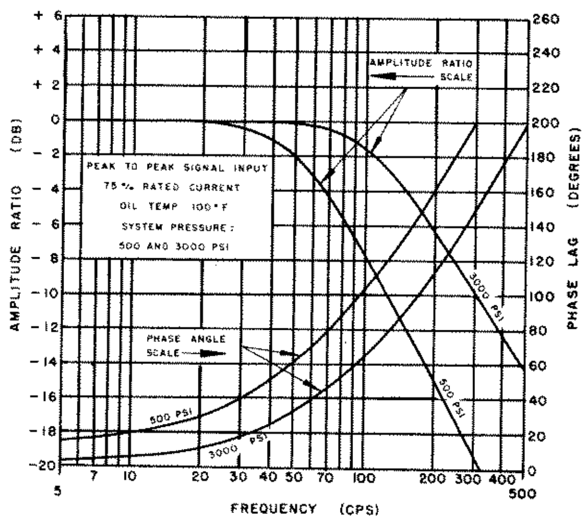


LOAD FLOW-PRESSURE CHARACTERISTICS

FIGURE 2

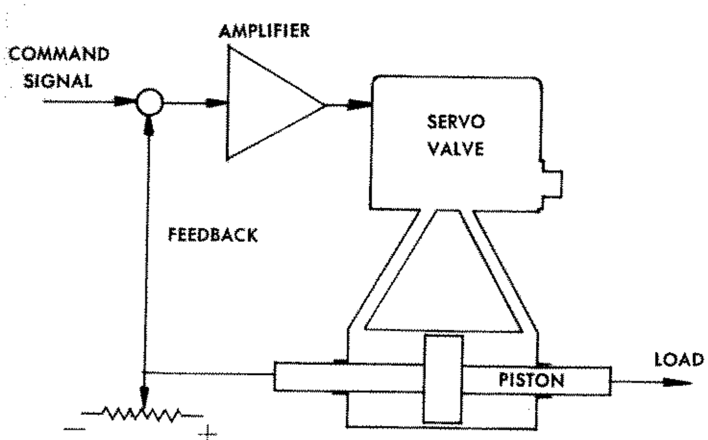
LOAD FLOW - PRESSURE CHARACTERISTICS are shown in Figure 2. These characteristics are a function of valve rated flow capacity and vary from those approximating theoretical orifice square-root relationship for low flow capacity valves to those exhibiting a degree of pressure compensation for the higher flow capacity valves.



TYPICAL FREQUENCY RESPONSE

FIGURE 3

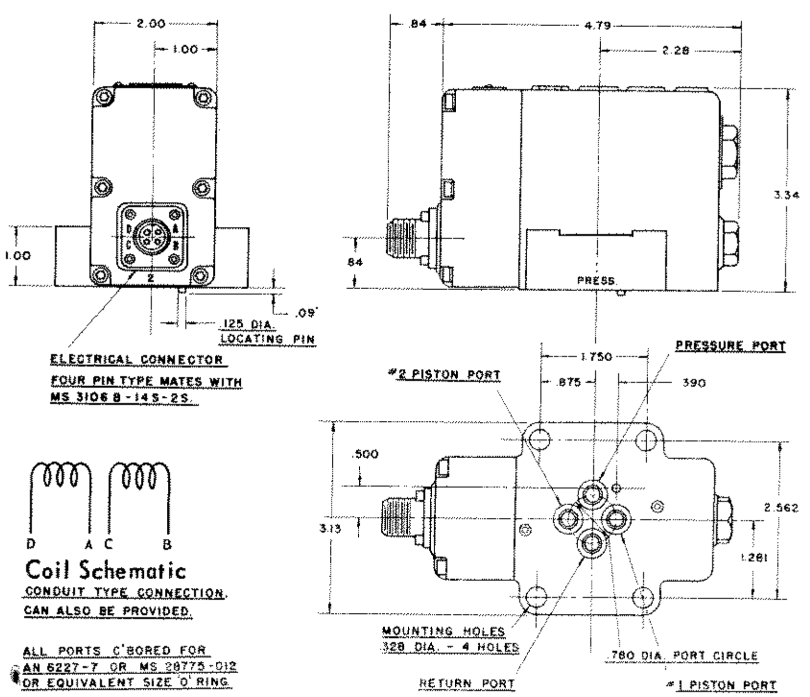
FREQUENCY RESPONSE is defined as the relationship of output flow (at zero load pressure) to input current when the current is made to vary sinusoidally at constant amplitude over a range of frequencies. Relationship is given in terms of amplitude ratio and phase angle. Amplitude ratio, expressed in db, is the ratio of flow output amplitude at any frequency to that at a specified reference frequency (usually 5 cps). Frequency response is most practically defined by curves (see Figure 3). Frequency response is somewhat dependent on signal amplitude and supply pressure, but is virtually unaffected by fluid temperature in the normal industrial application range.



In a conventional position closed-loop control system, valve flow is applied to a hydraulic piston or motor, driving a load. Load position is measured electrically and fed back for comparison with a signal representing the desired position. Resulting error signal is amplified, providing current input to the valve to control flow.

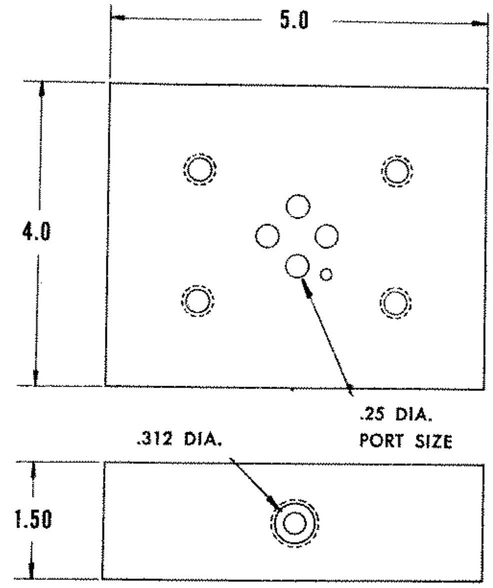
The Series 71 Servovalve is available from stock in four sizes at 1000 psi valve drop: 1.0, 2.5, 5 and 10 gpm. Figure 2 shows the flow versus load curves for the four valve sizes at maximum rated signal.

Operating Supply Pressures	500 — 3000 psi
Rated Input Signal (differential current)	15 ma.
Coil Resistance — two equal resistance coils,	each 200 ± 25 ohms.
Rated Flow with 1000 psi Valve Drop	
Model 71-100	1 gpm
Model 71-101	2.5 gpm
Model 71-102	5 gpm
Model 71-103	10 gpm
Temperature Range	0 — 250°F.
External Leakage	none
Recommended System Filtration	10 microns
Weight	7.25 lbs.
Hysteresis	less than 4%
Resolution	less than 1%



INSTALLATION AND OVERALL DIMENSIONS

MANIFOLDS



Mating manifolds for the Series 71 servovalve are available from stock with either SAE straight or NPTF threads. The mounting surface is flat to within 0.002 TIR and has a surface finish of 32 microinches or better to seal against the fully retained "O" rings located in grooves in the base of the servovalve.

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