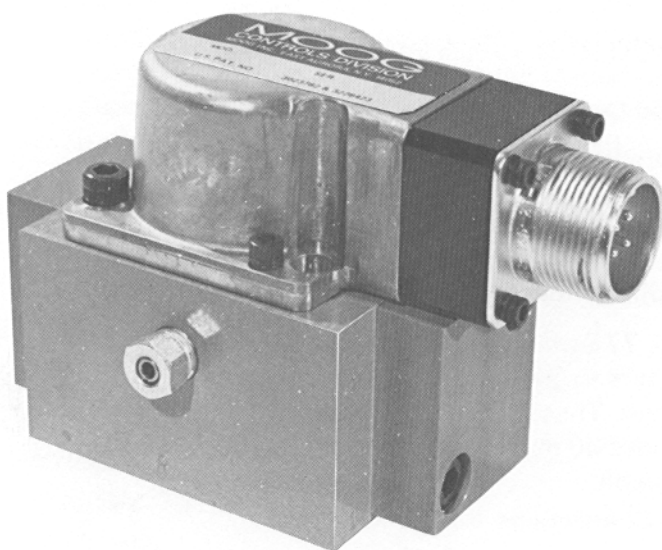


MOOG®

77 Series

Flow Control Servovalves



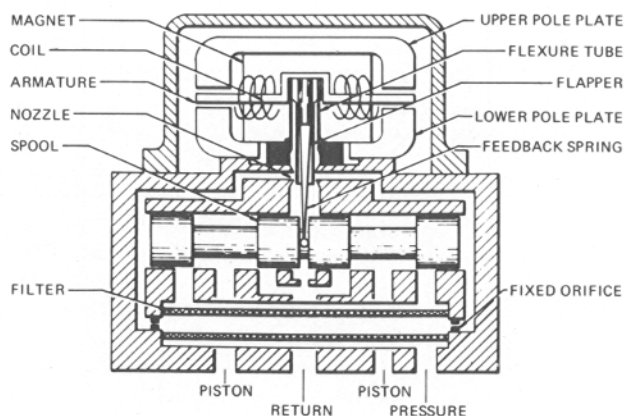
The 77 Series are custom designed industrial servovalves that are interchangeable with certain aerospace standard port patterns. These servovalves offer the attractive combination of high performance and low cost achieved by the standard Moog 76 Series industrial servovalves.

A special model of the 77 Series can be created to duplicate the performance of almost any servovalve (of 15 gpm or lower flow capacity) now in use. This permits changeover to the Moog industrial servovalve without disrupting nor modifying the mounting manifold, the electronics, loop gains, etc.

All 77 Series servovalves use the same torque motor, pilot stage, spool-sleeve assembly, and mechanical feedback as the standard 76 Series. This provides the cost and technical advantages of an established production design.

Design Features*

- rugged aluminum body
- o-ring floated, center pinned bushing with convenient null adjust
- dry torque motor in sealed compartment
- frictionless, flexure tube supported armature-flapper
- modular torque motor and pilot stage assembly
- balanced, double coil, double air gap torque motor
- mechanical feedback with simple cantilever spring
- spool-bushing diametral tolerances held within 35 microinches (1 micron)
- motor coils protected during thermal and vibration extremes by resilient potting
- pilot stage filter flushed by second stage flow



Servovalve Schematic

*Patent Numbers 3,023,782 and 3,228,423

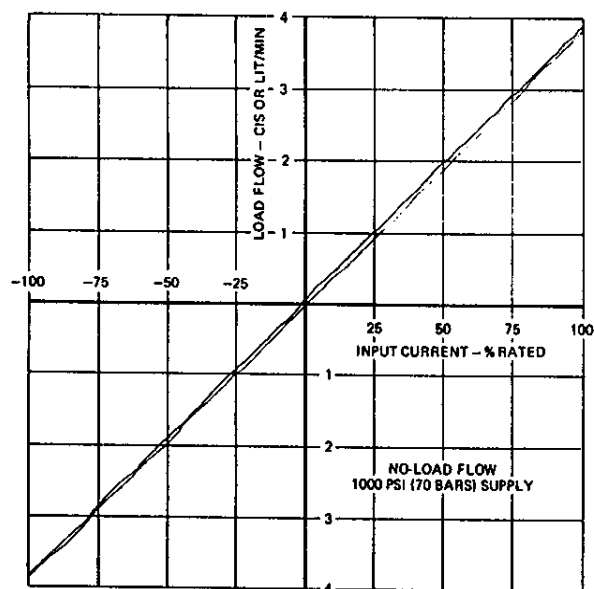


Figure 1. Typical Flow Plot for Low Flow 77 Series

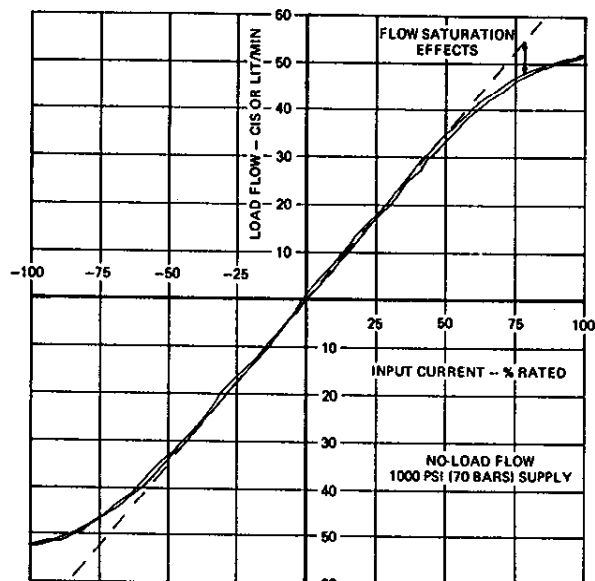


Figure 2. Typical Flow Plot for High Flow 77 Series

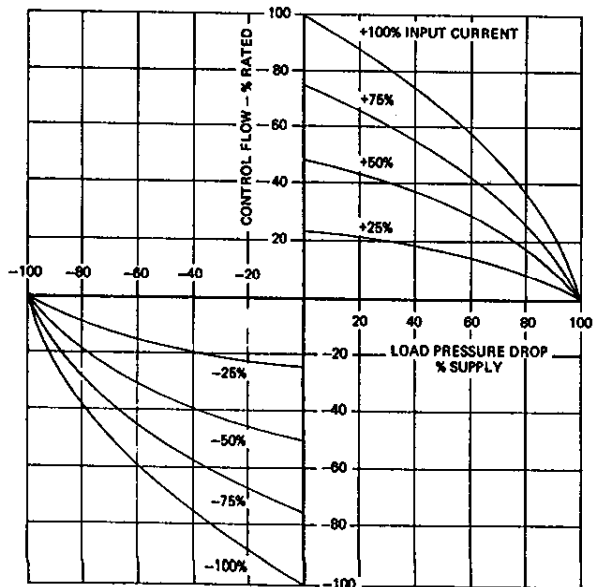


Figure 3. Change in Control Flow With Current and Load Pressure

General Specifications

Rated Supply Pressure	100 psi (7 bars) minimum 3000 psi (210 bars) maximum
Proof Pressure	
at pressure port	150% supply
at return port	100% supply
Fluid*	petroleum base hydraulic fluids 60 to 450 SSU at 100° F
Filtration Required	10 μ nominal, 25 μ absolute (or better)
Operating Temperature Range	-65° F to +275° F (-54° C to +135° C) (or as limited by fluid)
External Leakage	none
Weight	2 pounds (0.9 Kg)

Electrical Characteristics

Rated Current & Coil Resistance

A variety of coils are available for 77 Series servo-valves, so there is a wide choice of rated current. See Table I. It is possible to derate a coil to give a lower rated current than listed, thus rated current may be 8 ma differential for a 1000 ohm/coil valve.

Also, 77 Series valves can be supplied with internal resistors to give higher resistance for a given rated current. Thus 670 ohm resistors with 130 ohm coils will give 30 ma rated differential current with 800 ohm/coil.

Coil Connections

The two coils of the 77 Series servovalve may be connected in several different ways as shown in Table II. Usually a four-pin connector (that mates with an MS3106-14S-2S) is supplied, although MS connectors with fewer pins, or Bendix Pigmy connectors, or pigtails are also available.

Servoamplifier

The servovalve responds to input current, so a servo-amplifier that has high internal impedance (as obtained with current feedback) should be used. This will reduce the effects of coil inductance and will minimize changes due to coil resistance variations.

Quiescent Current

If used, it is recommended that quiescent current not exceed 100% rated current.

Dither

A small amplitude dither signal may improve system performance. If used it is recommended that dither frequency be 200 to 400 Hz and less than 20% rated current amplitude.

*Buna-N Seals generally used

Flow Rating

Rated Flow will be limited by port pattern and valve pressure drop. Maximum rated flow can be increased by allowing higher nonlinearity due to flow saturation effects. See Figure 2.

Port Circle Diameter		Max. Rated Flow at 1000 psi (70 bars)			
in.	mm	<5% nonlinearity		<10% nonlinearity	
		gpm	lit/min	gpm	lit/min
0.625	15.8	8	30	10	38
0.780	19.8	10	38	12	46
0.937	23.8	12	46	15	58

Flow-load Characteristics

Control flow to the load will change with load pressure drop and electrical input as shown in Figure 3. These characteristics follow closely the theoretical square-root relationship for sharp-edged orifices, which is

$$Q_L = K i \sqrt{P_V}$$

Q_L = control flow

K = valve sizing constant

i = input current

P_V = valve pressure drop

Static Performance

rated flow tolerance	±10%
hysteresis	<3%
threshold	<1/2%
null	externally adjustable
internal leakage at 1000 psi (70 bars)	<1.4 cis (1.4 lit/min)
pressure gain	>50% supply for 1% input
null shift with temp. (100°F variation)	<2%
null shift with pressure (±20% supply variation)	<2%

Dynamic Response

amplitude ratio (with pp no peaking
input = 40% rated)

90° phase lag >100 Hz for lower rated flows

>60 Hz for higher rated flows

step response, 50% input <15 ms for lower rated flows
(at 1000 psi or 70 bars supply) <30 ms for higher rated flows

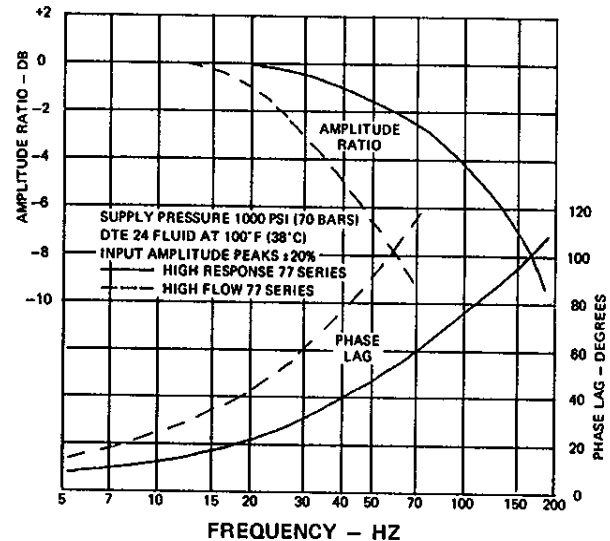


Figure 4. Typical Frequency Response

Table I. Available Coils for 77 Series Servovalves

Nominal Resistance Per Coil At 70°F (21°C) Ohms	Recommended Rated Current — ma		Approx. Inductance Per Coil* Henries
	Differential, Parallel, or Single Coil Configuration	Series Coils	
40	50	25	0.15
80	40	20	0.30
130	30	15	0.55
200	20	10	0.80
500	15	7.5	2.2
1000	10	5	4.5
1500	8	4	6.5

*Approximate inductance at 50 Hz; servovalve pressurized; total coil inductance will be approximately three times value given.

Table II. Standard Coil Connections
Alternate Connections and Polarities Can Be Supplied

COIL CONFIGURATION	DIFFERENTIAL COILS	SERIES COILS	PARALLEL COILS	SINGLE COILS
CONNECTOR PINS PIGTAIL COLORS	B grn A red C blu	B grn A red	B grn A red	B grn A red D yel C blu
INPUT CURRENT FOR FLOW OUT CONTROL PORT C1	for A+, when current A to B < A to C; for A-, when current B to A > C to A; for series coils use B to C.	with B+, A-	with B+, A-	with B+, A- or D+, C-; for differential coils tie A to D; for series coils tie A to D; for parallel coils tie A to C and B to D.

Installation Details

Three standard designs are available

	Port Circle Diameter		Port Diameter		O-rings				Mounting Bolt Size	
	in	mm	in	mm	Section		ID		in	mm
77-100 Series	0.625	15.8	0.191	4.85	0.070	1.78	0.239	6.07	$\left. \begin{array}{l} 10-24 \times 2.0 \\ \text{or} \\ 10-32 \times 2.0 \\ \text{or} \\ \frac{1}{4}-28 \times 2.0 \end{array} \right\}$	$\left. \begin{array}{l} 5 \times 50 \\ \text{or} \\ 6 \times 50 \end{array} \right\}$
77-200 Series	0.780	19.8	0.260	6.60	0.070	1.78	0.364	9.25		
77-500 Series	0.937	23.8	0.312	7.93	0.070	1.78	0.426	10.82		

