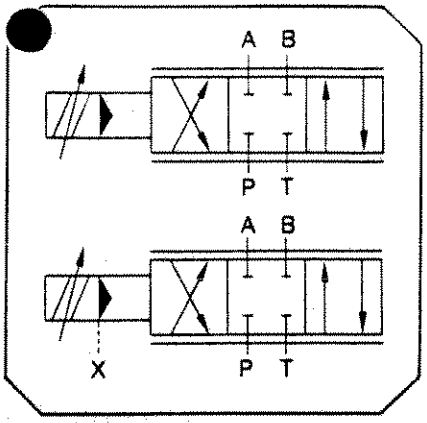
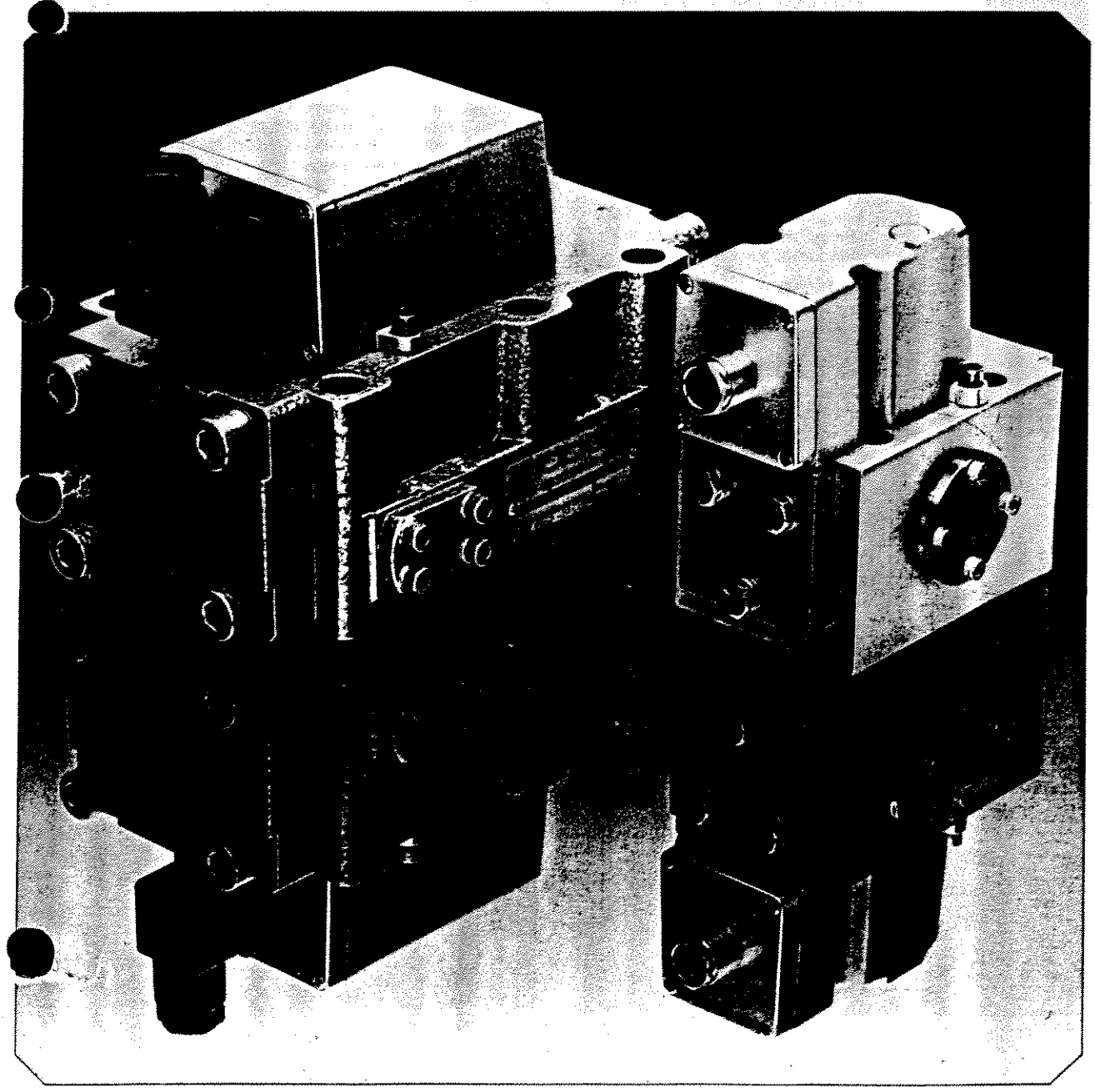
MOOG



Proportional Control Valves

Rated flows 3,8 to 135 l/min
Operating pressures up to 210 (350) bar

Series D 631
Series D 632
Series D 632 HR



MOOG Proportional Control Valves
Series D 631
Series D 632
Series D 632 HR version

MOOG proportional control valves fill the gap between the customary control valves and servovalves.
With this development in valves, it is possible to obtain stepless proportional control at a price significantly less than that of comparable units.
The proportional valves are basically characterised by the familiar "frictionless" double-nozzle pilot stage employed in all MOOG servovalves. This pilot stage overcomes the problems of friction and jamming typical of spool valves. In addition, the drift and null shift problems associated with unsymmetrical designs having a single nozzle do not occur.
The proportional valves have the same feedback as MOOG servovalves. The feedback arrangement, together with a dry torque motor isolated through a flexible tube, results in reliability proven through years of successful applications.

Description

MOOG series D631 and D632 proportional valves consist of an electromagnetic torque motor (direct-current, rotating-armature, permanent-magnet motor), a double-nozzle pilot stage and a spool as the main stage.
An electrical current in the torque motor causes a proportional displacement of the spool in the second stage, resulting in a proportional flow to the load.

Torque Motor

The torque motor comprises coils, pole-pieces, magnets and an armature. The armature is combined with a flexure tube which permits limited rotation. At the same time the flexible tube serves to isolate fluid in the hydraulic part of the valve from the electromagnetic part.

Pilot Stage

The flapper is fixed to the middle of the armature, and passes down through the flexure tube. A nozzle is located on either side of the flapper. Movement of the flapper changes the nozzle exit area. Oil at pressure is supplied to the nozzles via a filter and a pair of fixed orifices. The pressure difference resulting from the movement of the flapper between the nozzles acts on the ends of the spool.

Main Stage

The four-way spool controls the flow from the pressure port to one of the two control ports. At the same time the other control port is connected to the return port.
Through movement of the spool the flow areas change and throttle the flow to the load. When the dimensions of these areas are varied, valves of differing rated flows result.

Operation

An electrical current (input signal) into the coils of the torque motor results, according to polarity, in either a clockwise or counter-clockwise torque on the armature. This torque displaces the flapper between the pair of nozzles. Consequently the exit area of one nozzle is increased, and that of the other is decreased.
The resulting pressure difference acts on the ends of the spool and causes a displacement of it. A feedback wire fixed to the armature engages in a slot in the spool, and is bent by displacement of the spool. Displacement of the spool stops when the feedback torque equals the electromagnetic torque. In this condition, the armature-flapper assembly becomes re-centred (i. e. hydraulic balance). The spool remains at this position until the magnitude of the electrical input signal changes. As a result, spool displacement is directly proportional to the electrical input signal into the torque motor. The actual flow from the valve to load is dependent upon the pressure dr across the valve.

Mechanical Override

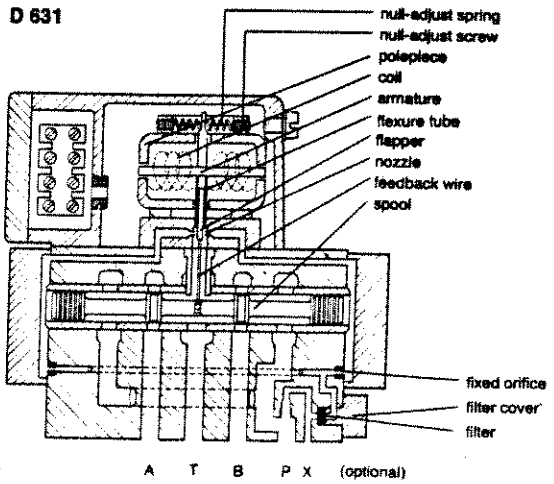
A mechanical override feature is available as an optional addition. This is provided for applications where standby operation is required in the event of electrical failure. On valves with mechanical override, a lever is located on the motor cap. Rotation of this lever causes a force to be applied to the flapper via springs. The force is proportional to the angle of rotation of the lever. and it acts to displace the spool.

Conversion From Internal to External Pressure Supply of the Pilot Stage

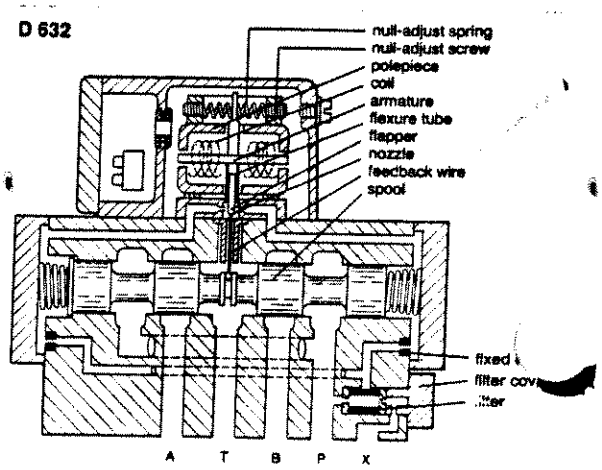
For many applications it is advantageous or necessary to supply the pilot stage separately with hydraulic fluid.
The series **D631** proportional valves can be supplied with optional internal or external pilot stage supply. The required configuration must be indicated when ordering through the ordering information, because a subsequent conversion is possible.
The series **D632** can be supplied wi optional internal or external pilot stage supply. The required configuration is likewise indicated through the ordering information. A subsequent conversion is, however, accomplished simply on site:

Remove the filter cover. Insert an M 8 screw into the filter end plate and use the screw to pull out the filter. Withdraw the screw, rotate the filter 180° about its transverse axis and relocate it. Replace the filter cover.

D 631



D 632



Design Features

International mounting dimensions – to DIN 24340 [illegible] A 10 and A 25.
[illegible]gh driving forces on the spool – ensuring reliable positioning of the spool.
Dry electrical torque motor – prevents contamination of the magnets by particles carried in the fluid.
Simple mechanical spool feedback – only one feedback wire without complex mechanisms.
Integral pilot-stage filter (40 μm nominal, 75 μm absolute), improves reliability.

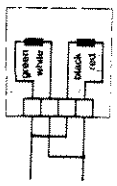
Symmetrical construction – ensures minimum nullshift resulting from changes in temperature and pressure.
Mechanical null adjustment – permits convenient adjustment of the system.
Low electrical power – (0,14 watt maximum) means negligible loading of the supply and increased reliability and life for electrical controllers.
Mechanical override – (optional addition) permits direct operation of the pilot stage in case of an electrical failure.

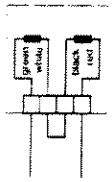
Technical Data

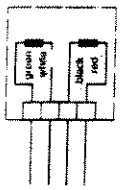
	D 631	D 632
Rated flow at 10 bar valve pressure drop	3,8 – 7,6 – 15,1 – 22,7 – 30,2 l/min (±10%) (values are based on axis-cut spools, and will be reduced according to the amount of overlap)	19 – 38 – 76 – 135 l/min (±15%)
Overlap	Axis – cut (with linear signal-flow characteristic) ±10% (with linear signal-flow characteristic) ±15% (with curvilinear signal-flow characteristic)	±15% with 19 and 38 l/min rated flow ±25% with 76 and 135 l/min rated flow
Null flow at 70 bar	< 1,3 to 2,3 l/min according to rated flow, when axis – cut	< 3 l/min
Flow of pilot stage at 70 bar	1 l/min	1 l/min
Operating pressure mainstage		
Standard version	15 to 210 bar	15 to 280 bar
High-pressure version	15 to 350 bar	–
HR version	–	35 to 210 bar
Operating pressure pilot stage		
Standard version	210 bar or 350 bar on request	up to 280 bar
HR-version	–	up to 210 bar
Return pressure	maximum 20% of operating pressure	maximum 20% of operating pressure
Return pressure spikes	up to 140 bar	up to 140 bar
Threshold at 140 bar	< 1%	< 3%
Hysteresis at 140 bar	< 5%	< 5%
Null bias	< 3%	< 5%
Null shift		
for 55° C change in temperature	< 5%	< 5%
Temperature range	–20°C to + 95°C	–20°C to + 95°C
External leakage	none	none
Operating fluid	mineral-based hydraulic oil, 2,5 °E (15 cSt) to 6 °E (45 cSt)	mineral-based hydraulic oil, 2,5 °E (15 cSt) to 6 °E (45 cSt)
Seal material	Buna N (others on request)	Buna N (others on request)
System filter	Full flow filter without bypass valve	Full flow filter without bypass valve
Filter rating		
– minimum (for operation)	25 μm absolute ($\beta_{25} \geq 75$)	25 μm absolute ($\beta_{25} \geq 75$)
– recommended (for long life)	15 μm absolute ($\beta_{15} \geq 75$) or better	15 μm absolute ($\beta_{15} \geq 75$) or better
Installation options	any position, stationary or movable	any position, stationary or movable
Weight	2,2 kg	10 kg
Degree of protection (DIN 40050)	IP 65	IP 65
Null setting		
increase in flow from port A when rotating null adjust screw	clockwise	counterclockwise

Electrical connection

	Parallel connection	Series connection	Single coils
Total resistance ±10% (at 25° C)	14 Ω	56 Ω	28 Ω
Rated current	± 100 mA	± 50 mA	± 100 mA
Voltage for rated current	± 1,4 V =	± 2,8 V =	± 2,8 V =
[illegible]ductance	0,2 Henry	0,8 Henry	0,25 Henry
[illegible]ated electrical power	0,14 watt	0,14 watt	0,28 watt
Valve connections for flow out of port A.	red and white (+) green and black (–)	green (–), red (+) white and black connected	white (+), green (–) or red (+), black (–)

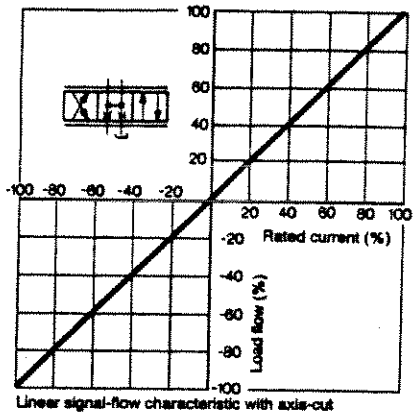




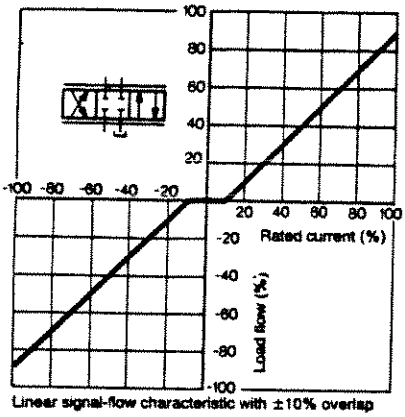


Flow curves

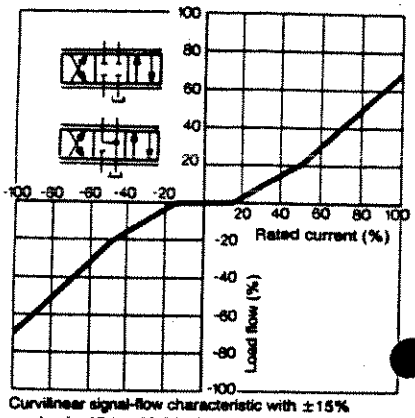
D 631



Linear signal-flow characteristic with axis-cut

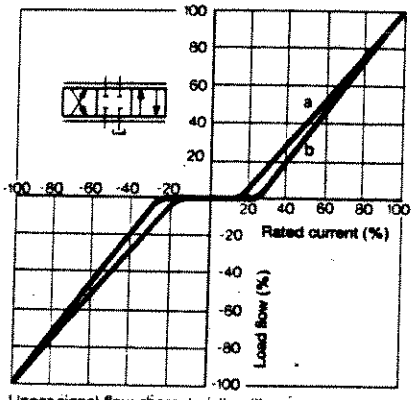


Linear signal-flow characteristic with ±10% overlap

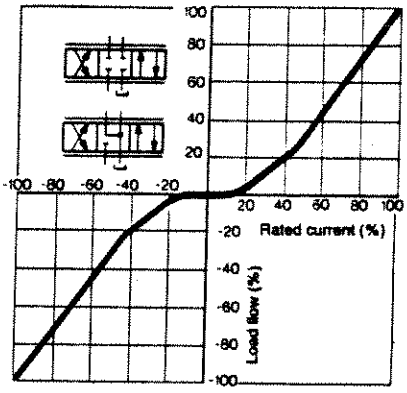


Curvilinear signal-flow characteristic with ±15% overlap for 15,1 to 30,2 l/min rated flow

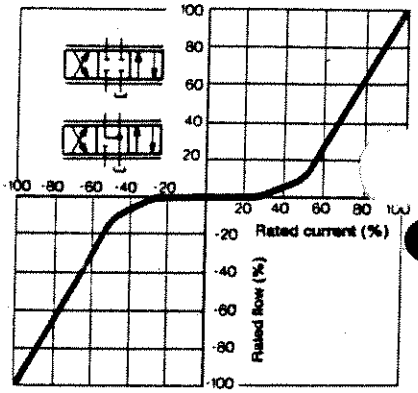
D 632



Linear signal-flow characteristic with overlap
Curve a ±15% for 19 and 38 l/min rated flow
Curve b ±25% for 76 and 135 l/min rated flow



Curvilinear signal-flow characteristic with ±15% overlap for 19 and 38 l/min rated flow



Curcilinear signal-flow characteristic with ±25% overlap for 76 and 135 l/min rated flow

Rated flow

The values of rated flow given on page 3 are for axis-cut valves at 100% electrical input signal and 10 bar valve pressure drop. For valves series D 631 with overlap the rated flow is reduced according to the amount of overlap. The actual flow depends on the electrical input signal and the valve pressure drop, the valve pressure drop p_V being the difference between the net operating pressure (supply pressure p_S minus return pressure p_R) and the load pressure drop p_L.

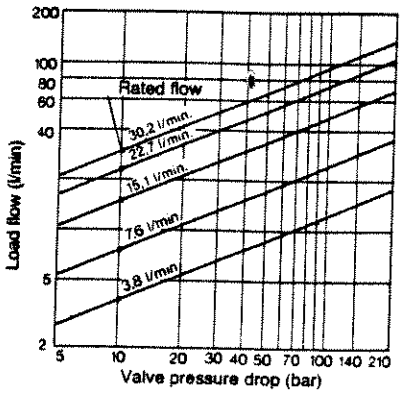
$$p_V = (p_S - p_R) - p_L$$

For different values of valve pressure drop, the two diagrams below show the values of full flow. These values may be determined by the quadratic relationship for a sharp-edged orifice:

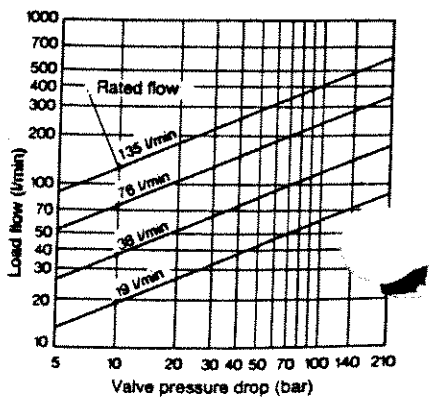
$$Q_1 = Q_2 \sqrt{\frac{\Delta p_1}{\Delta p_2}}$$

where Q_2 denotes the specific value of rated flow Q_N of the proportional valve chosen, Δp_2 the rated valve pressure drop ($\Delta p_2 = 10$ bar), and Δp_1 the value of valve pressure drop p_V derived from the equation given.

D 631



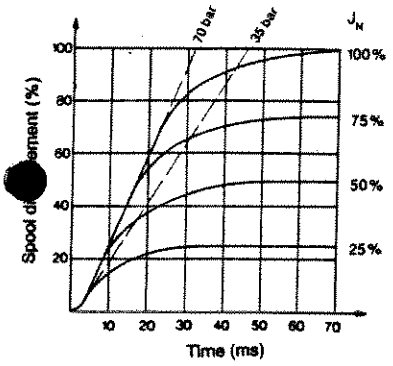
D 632

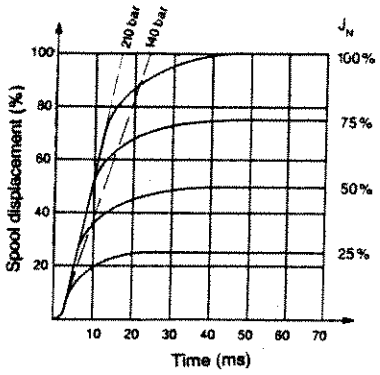


Step response

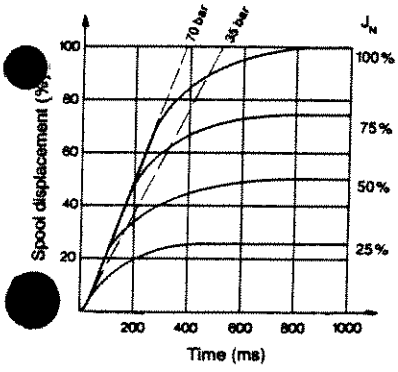
The following diagrams show typical step responses, which depend upon the operating pressure and the magnitude of the square–wave electrical input signal.

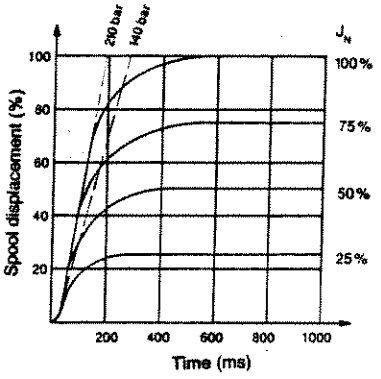
D 631



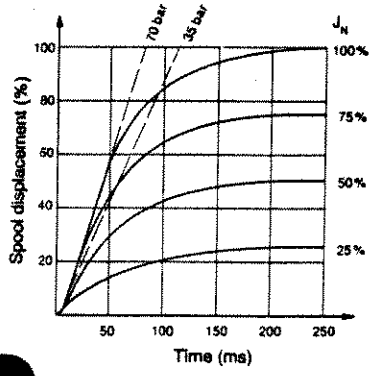


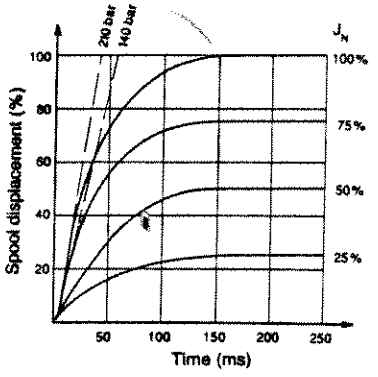
D 632





D 632 HR version

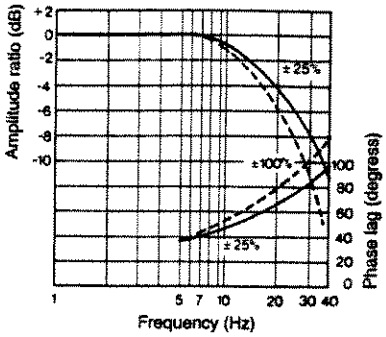




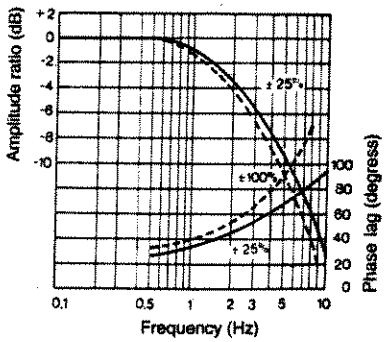
Frequency response

The diagrams below show the typical frequency response of the valves to a sinusoidal input signal, for an operating pressure of 140 bar.

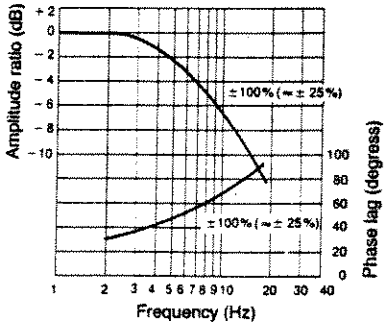
D 631



D 632



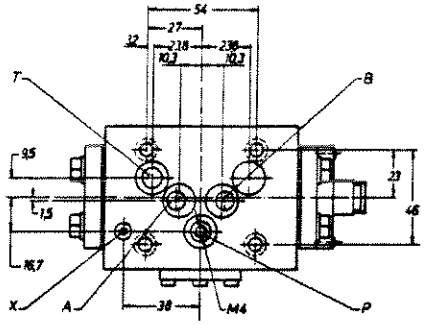
D 632 HR version



Mounting pattern to DIN 24340 form A 10

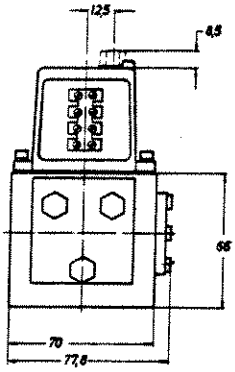
Mounting surface flat to within 0,02 mm average.
Surface finish value Ra better than 1 μm.

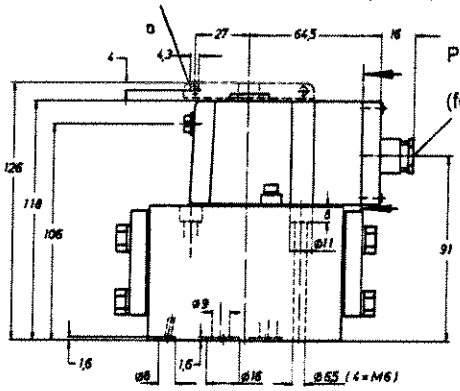
Torque on screw fasteners M 6 DIN 912 according to class, thus:
8.8 1,0 daNm (~kpm)
10.9 1,4 daNm (~kpm)
12.9 1,7 daNm (~kpm)



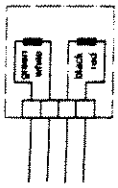
Optional

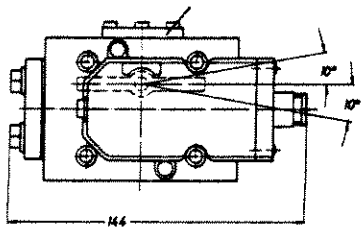
Mechanical override (optional) — 50–70% OF MAX. FLOW.



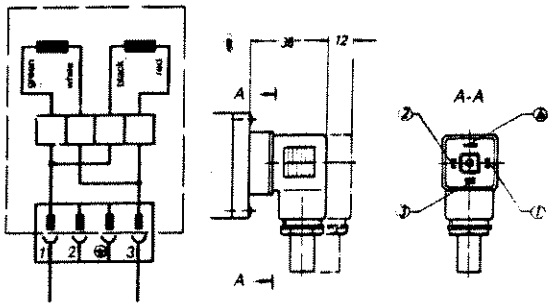


PG 9 – cable screw fitting to DIN 64320 (for cable dia 6–8 mm)

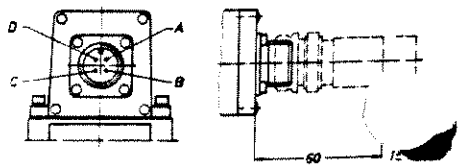




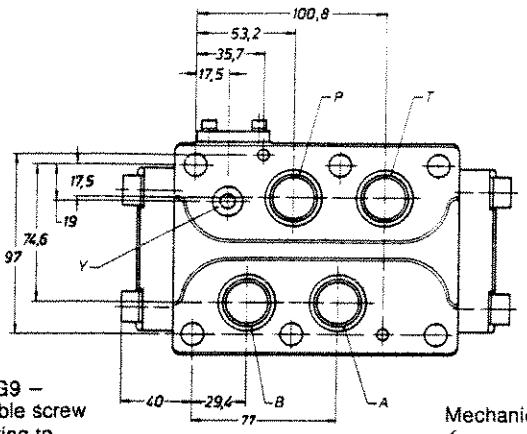
Optional connector versions



Connection to DIN 43650
(only with internal parellel connection)



Connector MS 3102 E–14 S–2 P



Mounting pattern to DIN 24340 form A 25

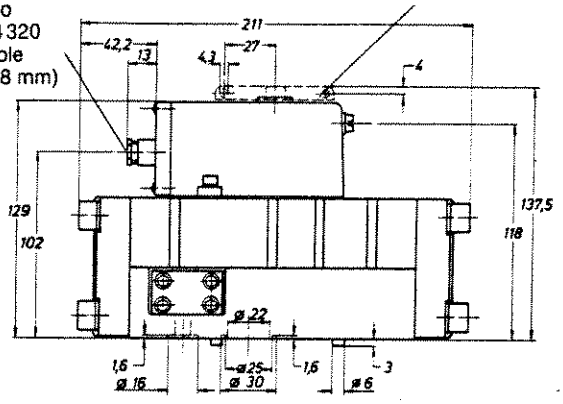
Mounting surface flat to within 0,02 mm average surface finish value Ra better than 1 μm.

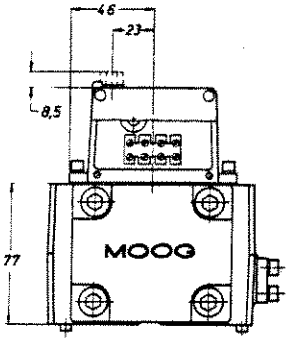
Torque on screw fasteners M12 DIN 912 according to class, 8.8 5,5 daNm (~kpm).

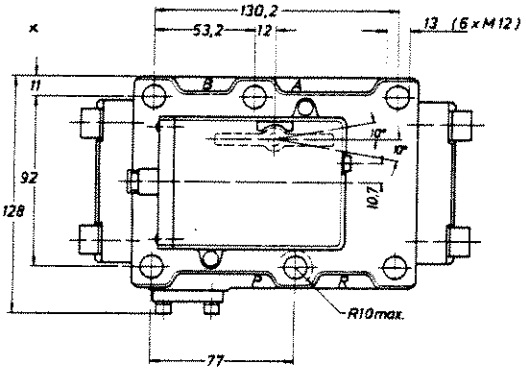
Note:
for separate supply of the pilot stage port Y must be used.

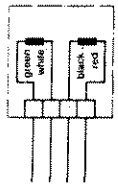
PG9 – cable screw fitting to DIN 64320 (for cable dia 6–8 mm)

Mechanical override (optional)

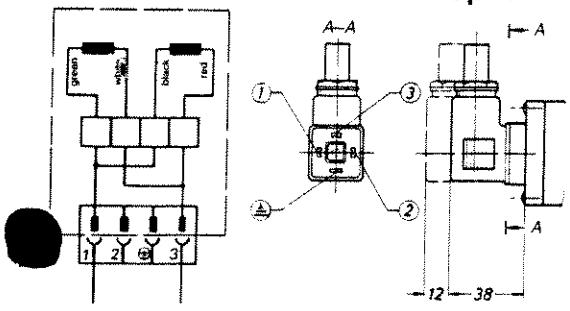




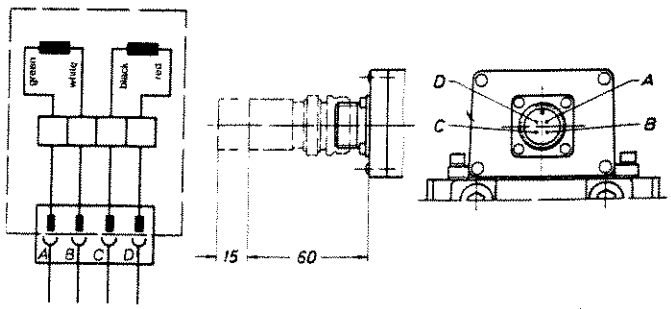




Optional connector versions



Connection to DIN 43650
(only with internal parallel connection)



Connector MS 3102E–14S–2P

Ordering Information

Model No. **Type designation**

D 63 X – XXX X X XXX X X 50 X N X

Mounting pattern to DIN 24340

1	Form A 10
2	Form A 25

Model designation (assigned at the factory and contains all specifications)

Factory identification

Type designation

P	D631 and D632
H	D632 HR version

Rated Flow (l/min) at a valve pressure drop of

		10 bar	70 bar
D631	010	3,8	10
	020	7,6	20
	040	15,1	40
	060	22,7	60
	080	30,2	80
D632	050	19	50
	100	38	100
	200	76	200
	360	135	360

Flow curves

	Cylinder connection closed	Cylinder connection open	Rated flow (l/min)	*For valves with overlap the rated flow is reduced accord to the amount of overlap
D631	O	–	3,8 to 30,2	Linear nullcut
	D	–	3,8 to 30,2	Linear ±10% overlap*
	R	T	15,1 to 30,2	Curvilinear ±15% overlap*
D632	E	–	19 and 38	Linear ±15% overlap
	F	–	76 and 135	±25% overlap
	R	T	19 and 38	Curvilinear ±15% overlap
	S	U	76 and 135	±25% overlap

Maximum operating pressure

F	210 bar (standard for D631 and D632 HR version)
H	280 bar (standard for D632)
K	350 bar (only for D631)

Pilot stage supply

I	internal (standard)
E	external (via fifth-port X on D631) (via port Y on D632)

Seal material

N	Buna N (others on request)

Electrical Connection

Terminal strip* (standard)	Mating connector* MS-3102E-14S-2P	Connection to DIN 43650**	Mechanical Override
2	0	3	without
7	5	8	with

*PG 9 - cable screw fitting **Only with internal parallel connection

Accessories

	D631	D632
Flushing block	76046–002	76047
Mating connector for MS-connector	76197–002	76197–002

Replacement parts

	D631	D632
Filter with O-ring	58746–003–040	A 25239
Filter for nozzle block (2 ×)	—	67106–001
O-rings for ports		
P–T (R)–A–B	66117–012–020	66117–026–020
X	66117–004–020	—
Y	—	66117–012–020
Parts for external pilot supply		
internal hexagon screw	66098–040–006	—
seal ring	76425–040	—

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