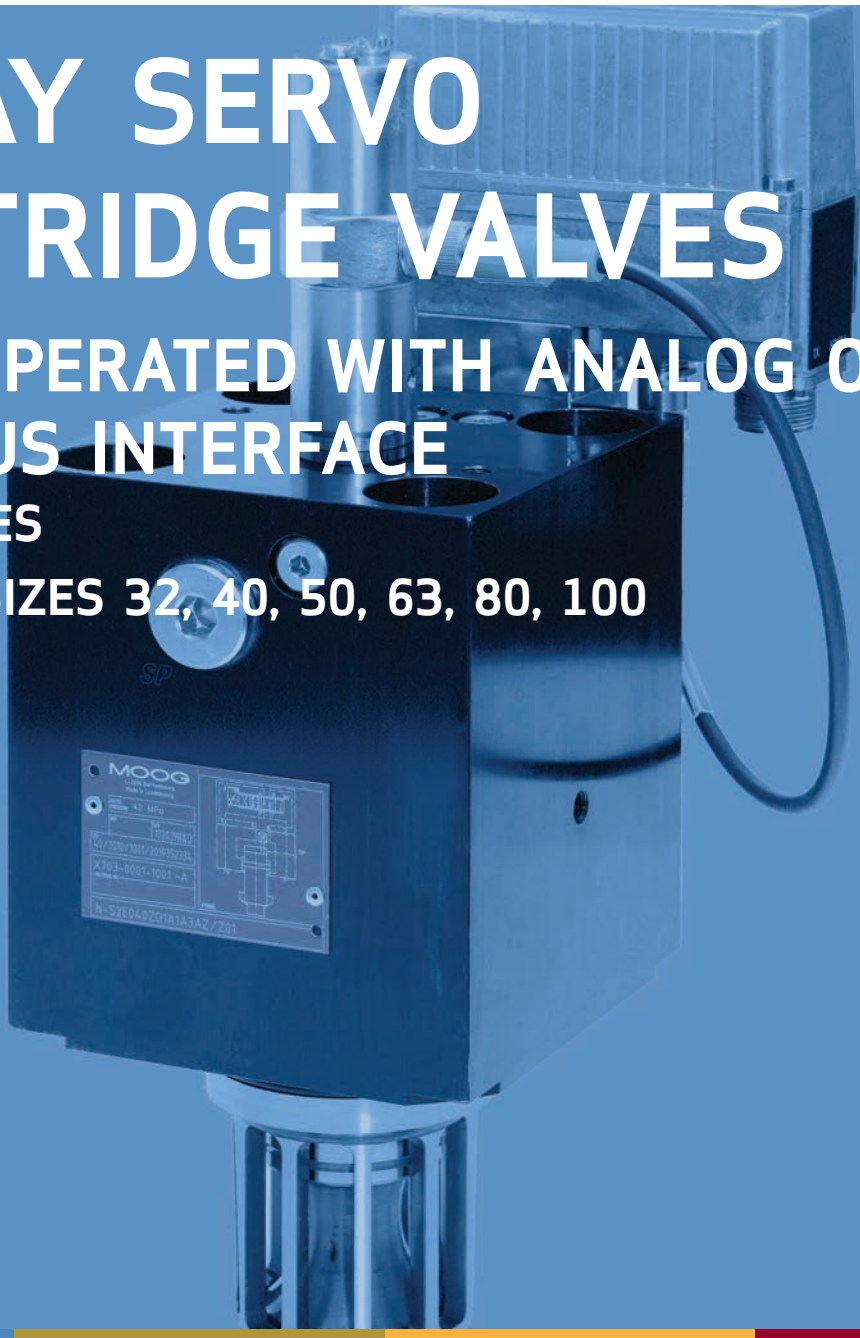
2-WAY SERVO CARTRIDGE VALVES

PILOT OPERATED WITH ANALOG OR FIELDBUS INTERFACE

X700 SERIES

ISO 7368 SIZES 32, 40, 50, 63, 80, 100



Rev. B, September 2023

HIGH PRODUCTIVITY FOR DEMANDING APPLICATIONS THAT REQUIRE HIGH FLOWS AND A DYNAMIC RESPONSE

WHAT MOVES YOUR WORLD

MOOG

Whenever the highest levels of motion control performance and design flexibility are required, you'll find Moog expertise at work. Through collaboration, creativity and world-class technological solutions, we help you overcome your toughest engineering obstacles. Enhance your machine's performance, and help take your thinking further than you ever thought possible.

PRODUCT OVERVIEW

Moog's X700 Series Servo Cartridge Valves are throttle valves for use in 2-way applications. These valves are suitable for electrohydraulic control systems, including those with high dynamic response requirements. The seated poppet design ensures that the connection between the A and B ports is sealed off leakage free when closed. This product family is equipped with integrated electronics and closed-loop position control for the main stage cartridge poppet. For maximum flexibility, customers can choose to have an analog or fieldbus interface, or both combined in the same valve.

The X700 are two-stage Servo Cartridge Valves with a Moog D636 or D637 Direct Drive Valve as a pilot stage. The D636 and D637 Valve Series have a world class, robust design that offers proven reliability for demanding applications such as oil rigs, offshore wind turbines and steel mills. The D636 and D637 have superior dynamics and offer high energy efficiency due to their low level of internal leakage.

The new innovative design of the main stage cartridge valve results in very high flow performance. Due to its robustness, the Moog X700 Series provides reliable control for die casting machines, metal presses and heavy industrial equipment, as well as other applications. This product family is easily integrated and configurable to meet your exact application and performance requirements. Moog experts, with their considerable experience in providing hydraulic motion control solutions for a range of industrial applications, can help you select the version that best meets your needs.

For applications with safety requirements fail-safe options are available that ensure a defined, safe main stage position to avoid uncontrolled machine movements.

	X702	**X703**	**X704**	**X705**	**X706**	**X707**
Valve design	2-Way Servo Cartridge Valve, seat design					
Size according to ISO 7368	Size 32	Size 40	Size 50	Size 63	Size 80	Size 100
Mounting pattern	ISO 7368-09-5-1-16	ISO 7368-10-7-1-16	ISO 7368-11-9-1-16	ISO 7368-12-11-1-16	ISO 7368-13-13-1-16	ISO 7368 -14-14-1-16
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)					
Rated flow at Δp_N 5 bar (75 psi); flow direction B-A[1)]	1,300 l/min (343 gpm)	1,900 l/min (502 gpm)	2,700 l/min (713 gpm)	4,800 l/min (1,268 gpm)	7,300 l/min (1,928 gpm)	12,200 l/min (3,223 gpm)
Recommended maximum flow[1)]	2,700 l/min (713 gpm)	4,100 l/min (1,083 gpm)	6,300 l/min (1,664 gpm)	9,000 l/min (2,377 gpm)	16,800 l/min (4,438 gpm)	25,500 l/min (6,736 gpm)
Step response time according to ISO 10770-1 (p_x = 210 bar)[2)]	11 ms	13 ms	16 ms	20 ms	29 ms	37 ms

[1)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s . Values valid for the use with recommended cavity diameters (cavity type B) of A- and B-port (see sections "Cavity Dimensions").
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

DESCRIPTION OF OPERATION

Electric Feedback Valves

Moog's X700 Series 2-Way Servo Cartridges are closed-loop hydraulic valves. They are electrical feedback valves (EFBs), which means that the position control loop for the main stage cartridge poppet (3) and the pilot valve (6), is closed through a position transducer (4) by the integrated valve electronics.

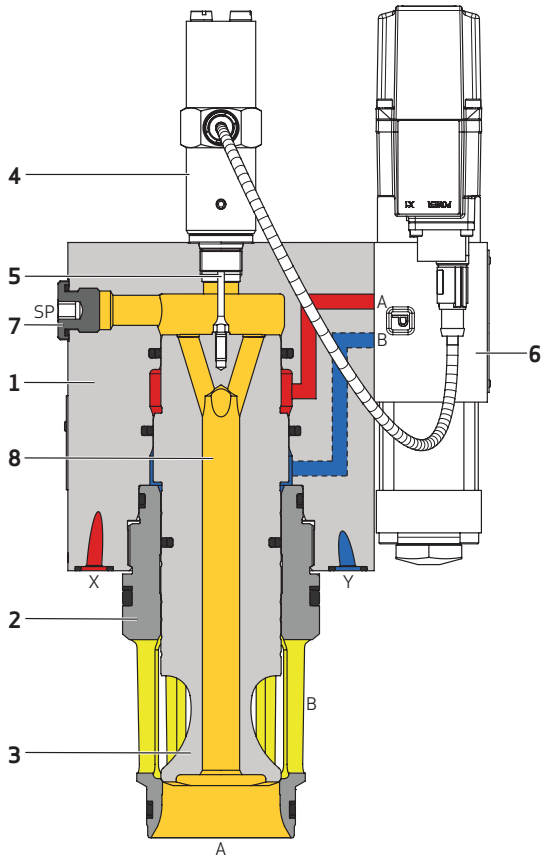
An electric command signal (poppet position set point) is applied to the valve electronics. A position transducer (LVDT) measures the actual position of the poppet. The electronics compare the poppet position and the command signal, and control the pulse width modulated (PWM) current to the linear force motor of the pilot valve. The pilot valve moves the main stage cartridge poppet to the desired position, and the position of the main stage cartridge poppet is therefore proportional to the electric command signal.

The valves allow the use of analog or digital fieldbus interfaces like EtherCAT, CANopen, or combined analog and digital interfaces.

The hydraulic flow can pass from port A to B, or from port B to A of the main stage cartridge valve. The poppet closes and opens at 2 % of the command value. Below this value, the direct drive pilot valve presses the main stage cartridge poppet on the sleeve's metallic seat, closing the connection between ports A and B without leakage.

Valves with the flow characteristic ordering code D1 have a linear flow characteristic with a progressive fine control range of approximately 13 % of the total valve stroke. This permits both high accuracy at lower flow levels, and high flow performance at full valve stroke.

Moog also offer a flow characteristic D2 that provides an increased fine regulation area up to 20 % and less flow in comparison to the D1. This allows customers to more easily replace existing DSHR servo cartridges with the new series.



1. Cover
2. Sleeve
3. Poppet
4. Position transducer (LVDT)
5. LVDT rod
6. Pilot valve with integrated digital electronics
7. Suction port
8. Counterbalance bore

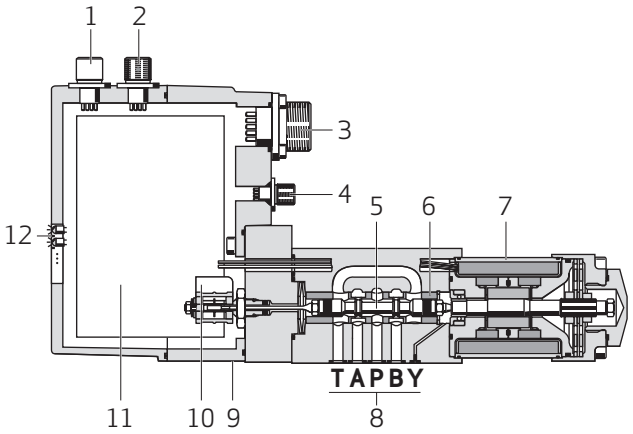
Features and Benefits

Features	**Benefits**
Flow-optimized design with highest nominal flows	• Downsizing of valve size • High cylinder speed possible
Robust design for a nominal pressure of 420 bar (6,000 psi)	Highest load capability
Fast response time	High machine dynamics
Reduced internal leakage of pilot valve	Increased energy efficiency
Progressive flow characteristic	Smooth start of axis movement
No alignment of sleeve in manifold required	• Flexibility in manifold design • Easier assembly
Standardized product portfolio	Easy selection of required valve
Optional fieldbus interface	Installation within a fieldbus environment (IoT ready)

DESCRIPTION OF OPERATION

Direct Drive Pilot Valve with Integrated Digital Electronics

- Direct drive with permanent magnet linear force motor that provides high actuating force and works in two directions.
- Direct operated - no pilot oil required.
- Pressure independent dynamic response.
- Low hysteresis and high response characteristics.
- Diagnostic capabilities: Integrated monitoring of important ambient and internal parameters; valve parameters may be changed on site or remotely.
- Flexibility: Since parameters may be downloaded using the fieldbus or a high level PLC program, valve parameters may be tuned during a machine cycle while the machine is operating.



1. Fieldbus connector X4
2. Fieldbus connector X3
3. Valve connector X1
4. Service connector X10
5. Spool
6. Bushing
7. Linear force motor
8. Ports
9. Electronic housing
10. Position transducer (LVDT)
11. Digital electronics
12. LED

DESCRIPTION OF OPERATION

Applications with Safety Requirements (Fail-safe)

When using the X700 Series 2-Way Servo Cartridges on machines that are subject to safety regulations, fail-safe versions can ensure that the cartridge poppet moves to a defined safe position in the event of a failure. Depending on the application, this safe position can be the closed or open position.

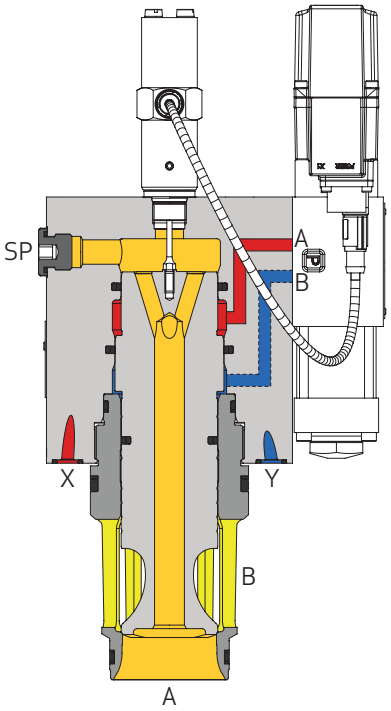
Moog offers several fail-safe options for the X700 Series Servo Cartridge Valves to suit the needs of different applications.

Biased Pilot Valves

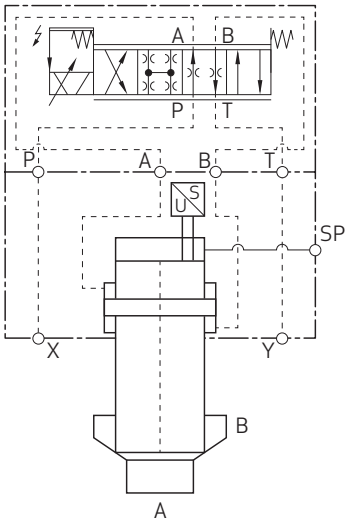
Biased pilot valves move the main stage cartridge poppet to an end position (fail-safe functions A and B). The spring centered position of the pilot valve is either P → A or P → B. Thus, if electrical power fails and the hydraulic supply is still available, the pilot valve will hydraulically move the main stage cartridge poppet to the closed or the open position.

The main stage cartridge is not equipped with a mechanical spring. Therefore, if the electric and hydraulic power supplies fail the main stage cartridge poppet position is not defined.

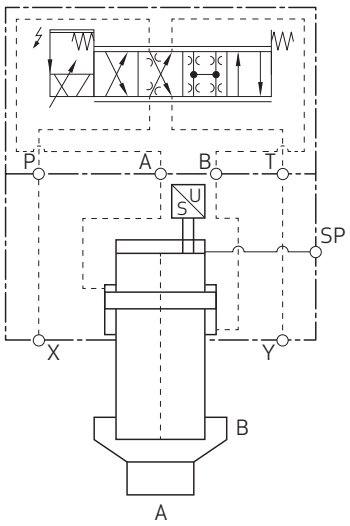
Servo Cartridge for Fail-safe Functions A and B with Biased Pilot Valve



Hydraulic Symbol Fail-safe Function A (Normally Closed)



Hydraulic Symbol Fail-safe Function B (Normally Open)



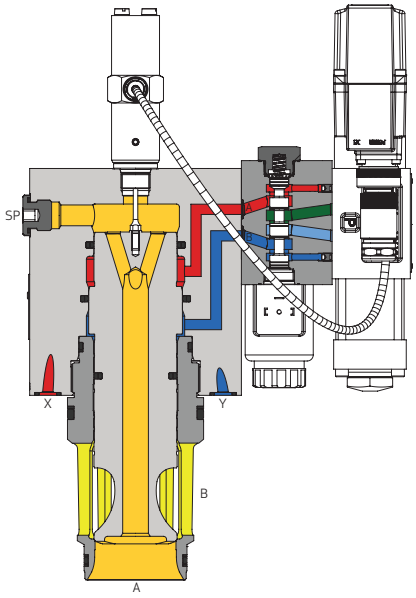
DESCRIPTION OF OPERATION

Applications with Safety Requirements (Fail-safe)

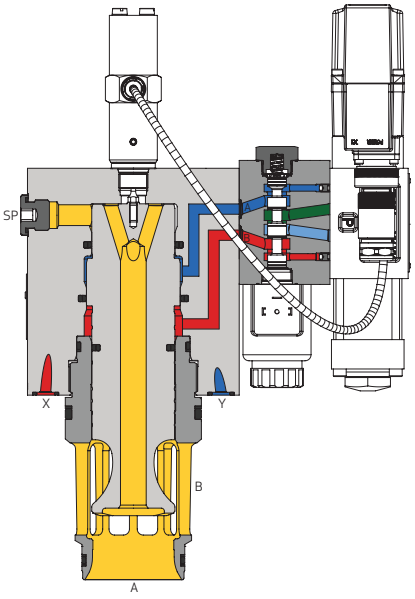
Additional Solenoid Valve

A 6/2-way solenoid valve is used to uncouple and override the pilot valve (fail-safe functions C and D). When the solenoid valve is de-energized, the hydraulic pilot supply is routed directly to the main stage cartridge, and will move the poppet to the required safe position. The main stage cartridge poppet position is now independent from the command signal, and from the pilot valve or the integrated valve electronics. Depending on the application, the defined cartridge poppet position is either fully opened or fully closed.

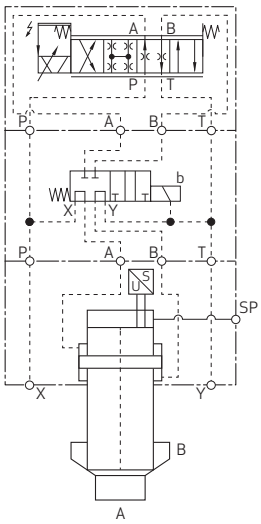
Fail-safe Function C (Normally Closed)



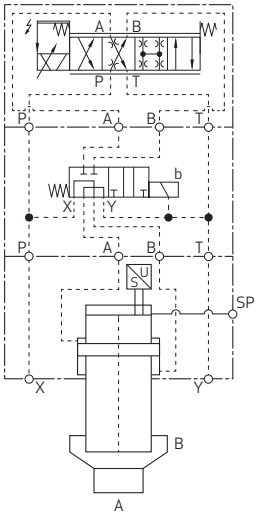
Fail-safe Function D (Normally Open)



Hydraulic Symbol Fail-safe Function C (Normally Closed)



Hydraulic Symbol Fail-safe Function D (Normally Open)



DESCRIPTION OF OPERATION

Applications with Safety Requirements (Fail-safe)

Moog offers the X700 Series with various fail-safe functions. The performance of the valve in a fail-safe situation depends on the fail-safe function selected, on the pilot valve and the actual pilot pressure, the electrical supply of the valve electronics and the 6/2-way valve. The table below provides further details on the best fail-safe function for your machine.

The spool positions of the main stage in the event of any valve electronics, control pressure or power supply failure are as follows:

Fail-safe function	**Pilot pressure**	**Valve electronics**	**6/2-way valve**	**Position of the main stage cartridge poppet**
A	On	On	-	Normal operation
	On	Off	-	Closed position
	Off	On	-	Undefined
	Off	Off	-	Undefined
B	On	On	-	Normal operation
	On	Off	-	Open position
	Off	On	-	Undefined
	Off	Off	-	Undefined
C	On	On	On	Normal operation
	On	On	Off	Closed position
	On	Off	On	Closed position
	On	Off	Off	Closed position
	Off	On	On	Undefined
	Off	On	Off	Undefined
	Off	Off	On	Undefined
	Off	Off	Off	Undefined
D	On	On	On	Normal operation
	On	On	Off	Open position
	On	Off	On	Open position
	On	Off	Off	Open position
	Off	On	On	Undefined
	Off	On	Off	Undefined
	Off	Off	On	Undefined
	Off	Off	Off	Undefined

SIZE 32 – X702

General Technical Data

Valve design	2-Way Servo Cartridge Valve, seat design
Pilot valve	D636 direct operated
Pilot connection X and Y	External through valve interface
Mounting pattern	ISO 7368-09-5-1-16
Installation position	Any
Weight	18.5 kg (40.8 lb)
Weight including fail-safe valve	20.9 kg (46.1 lb)
Storage temperature range	-40 to 80 °C (-40 to 176 °F)
Ambient temperature range	-20 to 60 °C (-4 to 140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions, 3 ms
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data [1)]

Pilot valve: minimum operating pressure	20 bar (290 psi) above pressure in port Y
Pilot valve: minimum pilot pressure in relation to the main stage pressure	50 % of main stage pressure
Pilot valve: maximum pressure X port	350 bar (5,000 psi)
Pilot valve: maximum pressure Y port [2)]	50 bar (725 psi)
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)
Rated flow at Δp_N 5 bar (75 psi); flow direction A→B [3)]	D1: 1,850 l/min (489 gpm); D2: 1,100 l/min (291 gpm)
Rated flow at Δp_N 5 bar (75 psi); flow direction B→A [3)]	D1: 1,300 l/min (343 gpm); D2: 1,000 l/min (264 gpm)
Recommended maximum flow [3), 4)]	2,700 l/min (713 gpm) (cavity type B)
Flow directions	B → A, A → B
Pilot leakage flow (pilot pressure p_X = 100 bar)	< 0.9 l/min (< 0.24 gpm)
Peak pilot flow for 100 % step	50 l/min (13.2 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.
Seal material / fluid compatibility	NBR: mineral oil-based, HFB, HFC fluids
	FKM: mineral oil-based, HFD fluids
	Other fluids on request
Temperature range	-20 to 80 °C (-4 to 176 °F)
Recommended viscosity range at 40 °C (104 °F)	15 to 45 mm^2/s (cSt)
Maximum permissible viscosity range at 40 °C (104 °F)	5 to 400 mm^2/s (cSt)
Recommended cleanliness class as per ISO 4406 for functional safety [5)]	18/15/12
Recommended cleanliness class as per ISO 4406 for longer service life [5)]	17/14/11

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Pressure peaks up to 210 bar (3,000 psi) permissible.
[3)] Values valid for use with recommended cavity diameters.
[4)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s.
[5)] The cleanliness of the hydraulic fluid strongly affects functional safety (e.g. safe positioning of the poppet, high resolution) and wear of lands of the pilot valve (e.g. pressure gain, leak losses).

SIZE 32 – X702

Typical Static and Dynamic Data [1)]

Pilot valve	D636 direct operated
Step response time according to ISO 10770-1 (p_x = 210 bar) [2)]	D1 and D2: 11 ms
Fail-safe time: biased pilot valve	Approximately 110 ms
Fail-safe time: additional fail-safe subplate valve	Approximately 70 ms
Threshold, typical	< 0.05 %
Threshold, maximum	< 0.1 %
Hysteresis, typical	< 0.1 %
Hysteresis, maximum	< 0.2 %
Null shift at ΔT = 55 K (131 °F)	< 1.5 %

[1)] Technical data and characteristic curves measured with a pilot pressure p_x of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

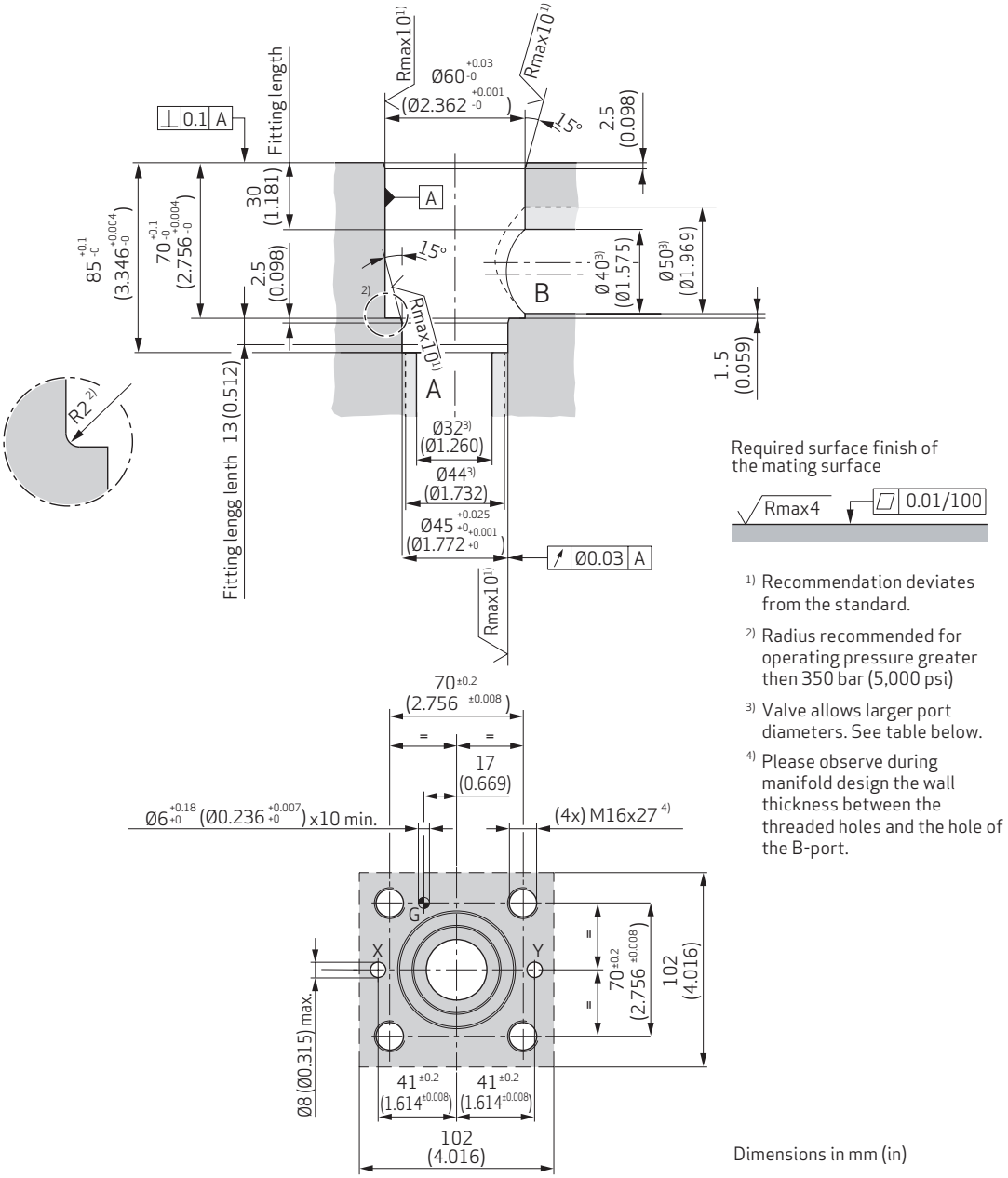
Electrical Data

Duty cycle	100 %
Degree of protection according to IEC/EN 60529	IP65 with mounted mating plugs
Supply voltage [1)]	24 V_{DC}, min. 18 V_{DC}, max. 32 V_{DC}
Supply voltage, 6/2-way fail-safe valve	24 V ±10 % (plug-in connector according to DIN 43650)
Permissible ripple of supply voltage [2)]	2.4 V_{RMS}
Maximum current consumption dynamic [3)]	1.7 A
Fuse protection, external, per valve	2 A (slow)
EM compatibility	• Emitted interference as per DIN EN 61000-6-4 • Immunity to interference as per DIN EN 61000-6-2 (evaluation criterion A)

[1)] All connected circuits must be isolated from the main supply by „electrical separation" in accordance with IEC/EN 61558-1 and IEC/EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.
[2)] Frequency from 50 Hz to 10 kHz.
[3)] Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V.

SIZE 32 -X702

Cavity Dimensions



Required surface finish of the mating surface

1) Recommendation deviates from the standard.

2) Radius recommended for operating pressure greater then 350 bar (5,000 psi)

3) Valve allows larger port diameters. See table below.

4) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

Dimensions in mm (in)

Relationship between Flow Performance and Cavity Dimensions

Beside the standard ISO cavity (cavity type A), Moog recommends two additional cavity types with different main port diameters to achieve the maximum flow performance for the preferred flow directions A → B or B → A.

Rated flow at Δp_N 5 bar (75 psi)

Cavity type	Diameter A-port [mm (in)]	Diameter B-port [mm (in)]	Preferred for flow direction	Flow at direction [l/min (gpm)]			
				D1		D2	
				A to B	B to A	A to B	B to A
A[1)]	32 (1.26)	40 (1.57)	-	1,400 (370)	1,000 (264)	980 (259)	840 (222)
B	44 (1.73)	50 (1.97)[2)]	B to A	1,400 (370)	1,300 (343)	980 (259)	980 (259)
C	32 (1.26)	50 (1.97)[2)]	A to B	1,850 (489)	1,000 (264)	1,100 (291)	840 (222)

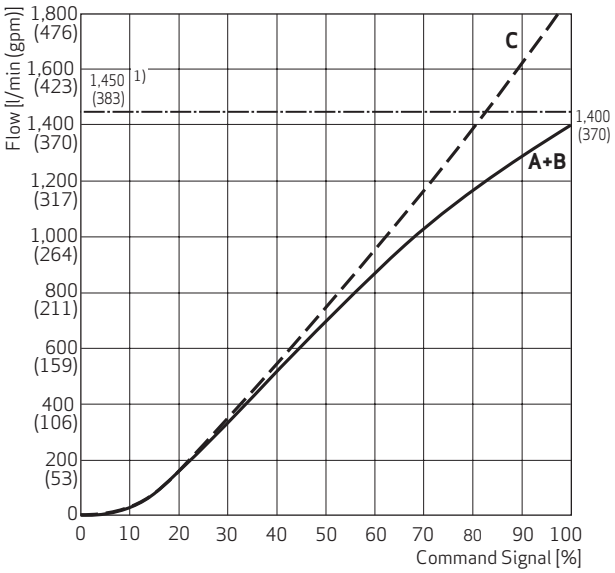
1) Standard ISO cavity

2) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

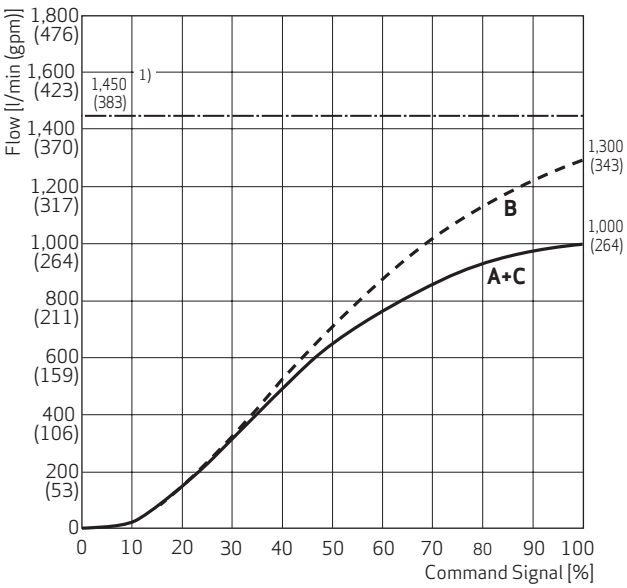
SIZE 32 – X702

Characteristic Curves D1

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



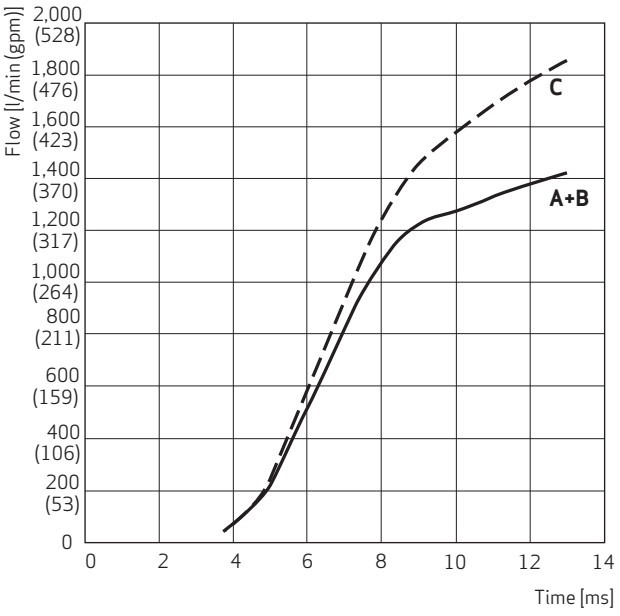
Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



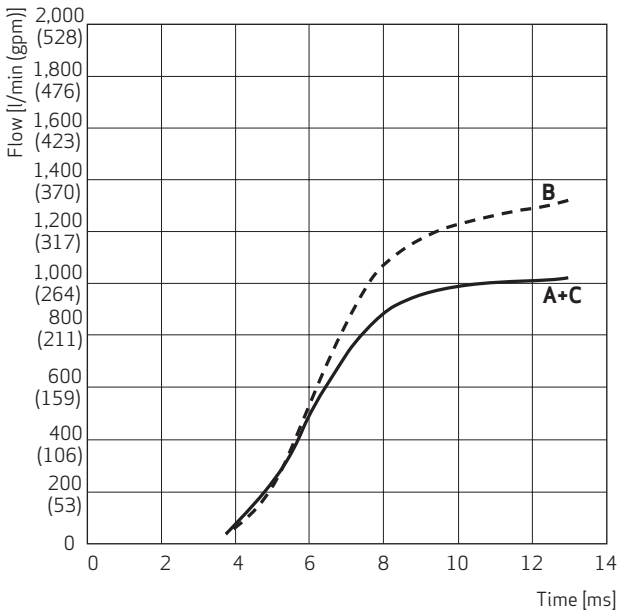
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A-port of an ISO cavity (cavity type A) exceeds 30 m/s.

Flow Response A → B
(Cavity Types A, B, C; Δp = 5 bar)



Flow Response B → A
(Cavity Types A, B, C; Δp = 5 bar)

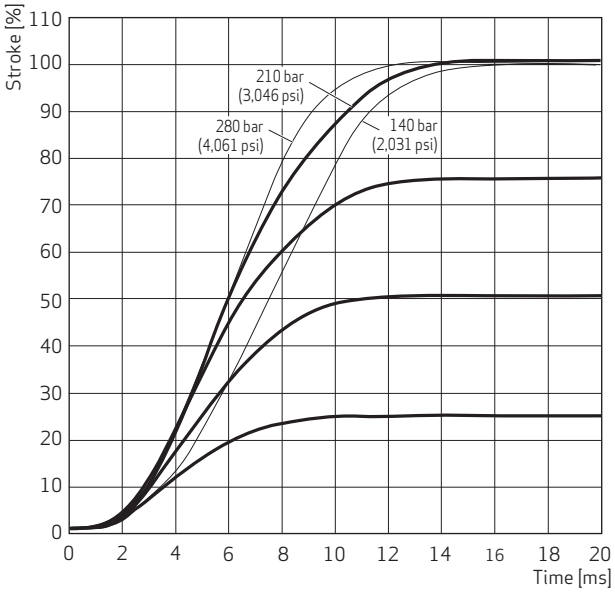


Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

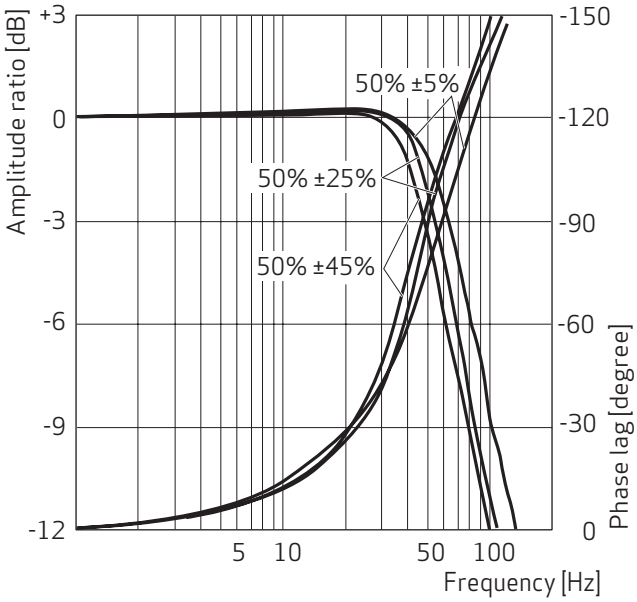
SIZE 32 – X702

Characteristic Curves D1

Step response

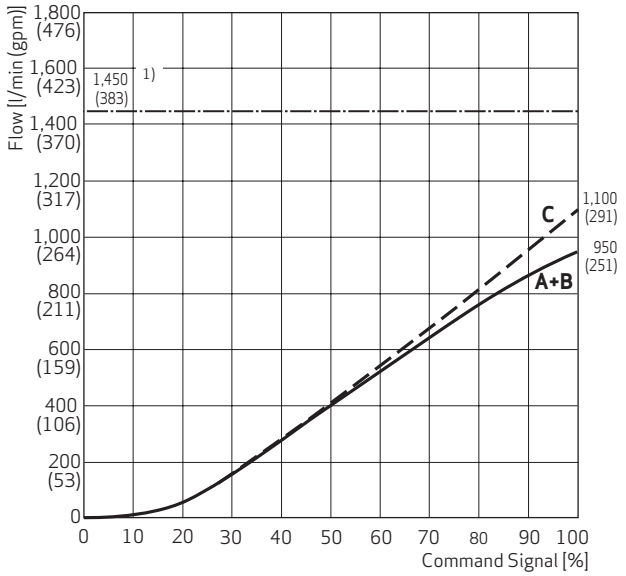


Frequency Response
(Pilot Pressure p_X 210 bar)

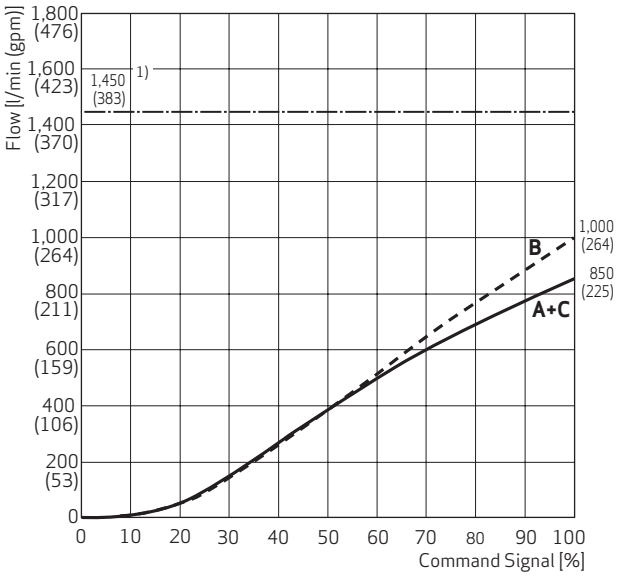


Characteristic Curves D2

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



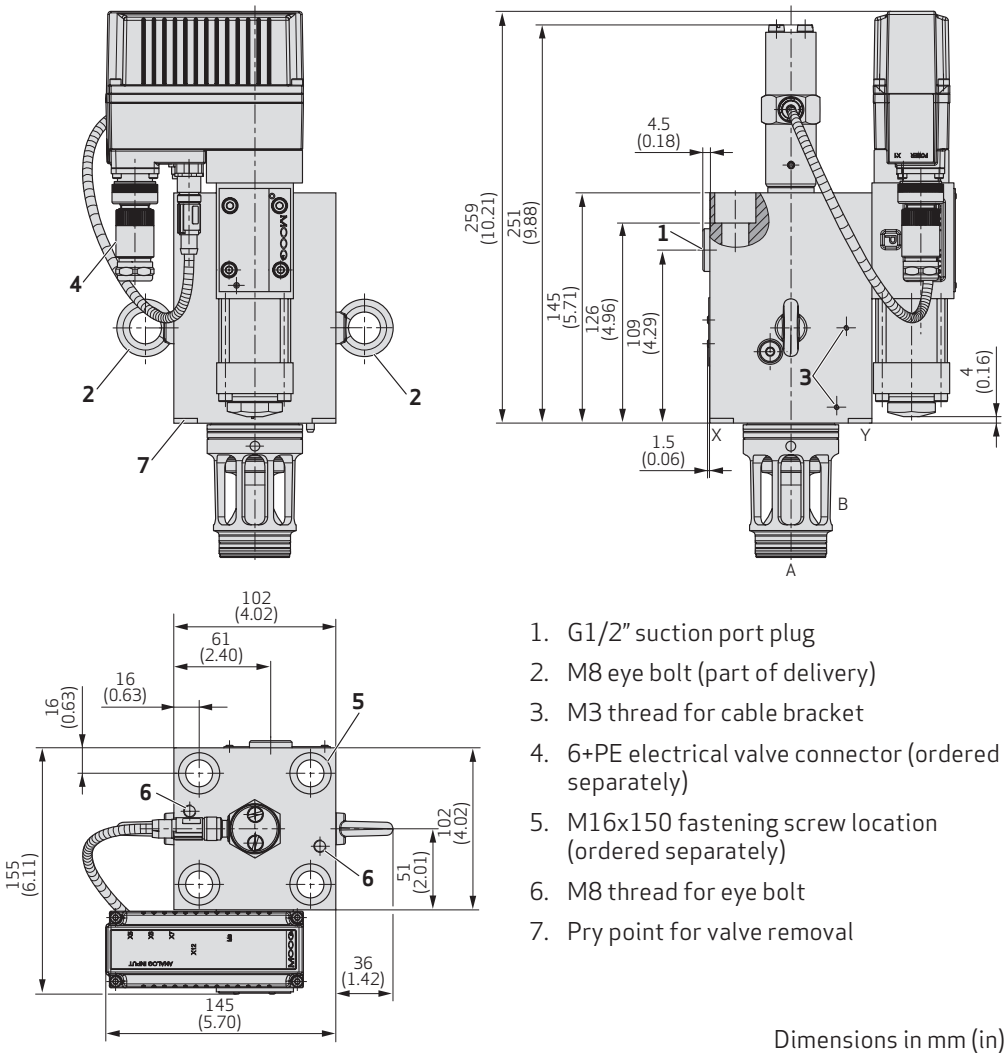
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A-port of an ISO cavity (cavity type A) exceeds 30 m/s.

Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

SIZE 32 – X702

Installation Drawing for Fail-safe Options A and B

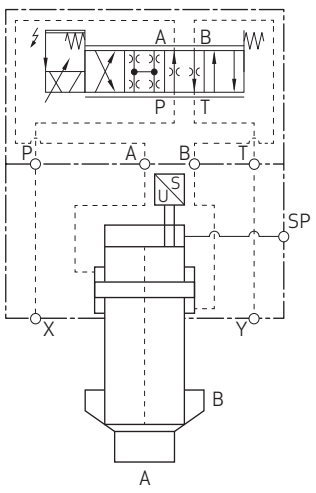


1. G1/2" suction port plug
2. M8 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M16x150 fastening screw location (ordered separately)
6. M8 thread for eye bolt
7. Pry point for valve removal

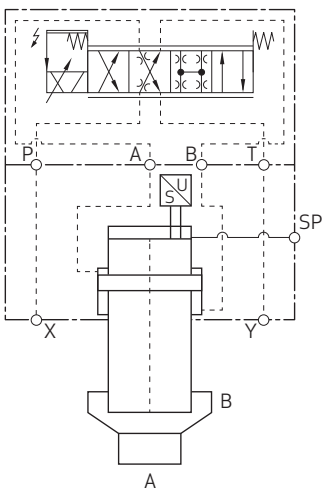
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version A (Normally Closed)

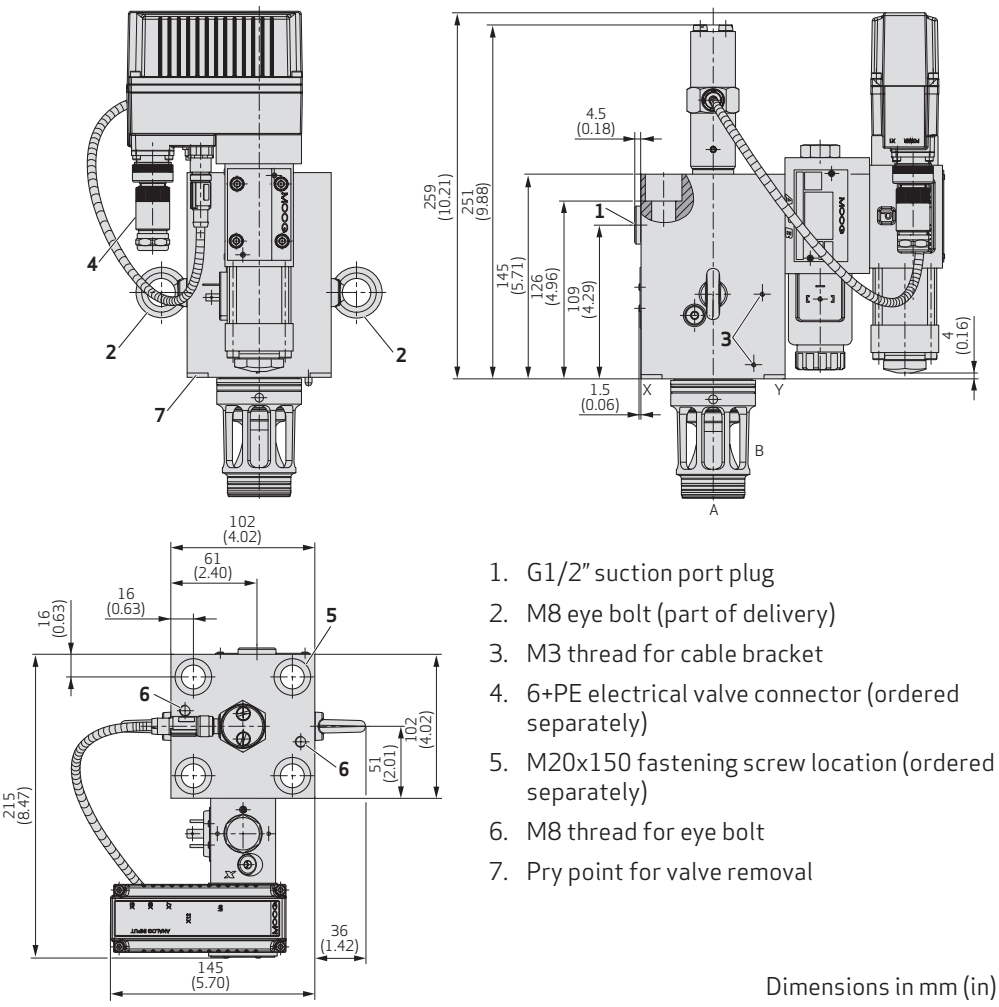


Fail-safe Version B (Normally Open)



SIZE 32 – X702

Installation Drawing for Fail-safe Options C and D

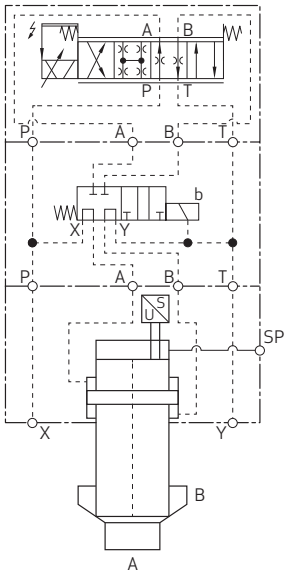


1. G1/2" suction port plug
2. M8 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M20x150 fastening screw location (ordered separately)
6. M8 thread for eye bolt
7. Pry point for valve removal

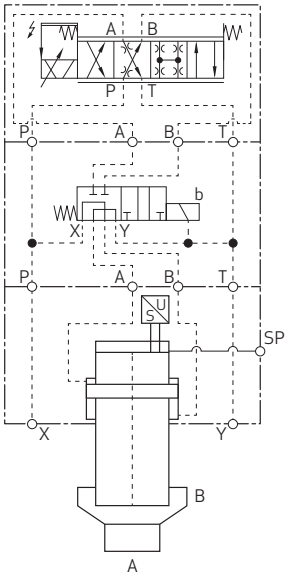
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version C (Normally Closed)



Fail-safe Version D (Normally Open)



SIZE 40 – X703

General Technical Data

Valve design	2-Way Servo Cartridge Valve, seat design
Pilot valve	D636 direct operated
Pilot connection X and Y	External through valve interface
Mounting pattern	ISO 7368-10-7-1-16
Installation position	Any
Weight	24.6 kg (54.2 lb)
Weight including fail-safe valve	27 kg (59.5 lb)
Storage temperature range	-40 to 80 °C (-40 to 176 °F)
Ambient temperature range	-20 to 60 °C (-4 to 140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions, 3 ms
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data[1)]

Pilot valve: minimum operating pressure	20 bar (290 psi) above pressure in port Y
Pilot valve: minimum pilot pressure in relation to the main stage pressure	50 % of main stage pressure
Pilot valve: maximum pressure X port	350 bar (5,000 psi)
Pilot valve: maximum pressure Y port[2)]	50 bar (725 psi)
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)
Rated flow at Δp_N 5 bar (75 psi); flow direction A→B[3)]	D1: 2,600 l/min (687gpm); D2: 1,550 l/min (409 gpm)
Rated flow at Δp_N 5 bar (75 psi); flow direction B→A[3)]	D1: 1,900 l/min (502 gpm); D2: 1,400 l/min (370 gpm)
Recommended maximum flow[2)]	4,100 l/min (1,083 gpm) (cavity type B)
Flow directions	B → A, A → B
Pilot leakage flow (pilot pressure p_X = 100 bar)	< 0.9 l/min (< 0.24 gpm)
Peak pilot flow for 100 % step	60 l/min (15.9 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.
Seal material / fluid compatibility	NBR: mineral oil-based, HFB, HFC fluids
	FKM: mineral oil-based, HFD fluids
	Other fluids on request
Temperature range	-20 to 80 °C (-4 to 176 °F)
Recommended viscosity range at 40 °C (104 °F)	15 to 45 mm^2/s (cSt)
Maximum permissible viscosity range at 40 °C (104 °F)	5 to 400 mm^2/s (cSt)
Recommended cleanliness class as per ISO 4406 for functional safety[5)]	18/15/12
Recommended cleanliness class as per ISO 4406 for longer service life[5)]	17/14/11

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Pressure peaks up to 210 bar (3,000 psi) permissible.
[3)] Values valid for use with recommended cavity diameters.
[4)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s.
[5)] The cleanliness of the hydraulic fluid strongly affects functional safety (e.g. safe positioning of the poppet, high resolution) and wear of lands of the pilot valve (e.g. pressure gain, leak losses).

SIZE 40 – X703

Typical Static and Dynamic Data[1)]

Pilot valve	D636 direct operated
Step response time according to ISO 10770-1 (p_x = 210 bar) [2)]	D1: 13 ms; D2: 10 ms
Threshold, typical	< 0.05 %
Fail-safe time: biased pilot valve	Approximately 110 ms
Fail-safe time: additional fail-safe subplate valve	Approximately 70 ms
Threshold, maximum	< 0.1 %
Hysteresis, typical	< 0.1 %
Hysteresis, maximum	< 0.2 %
Null shift at ΔT = 55 K (131 °F)	< 1.5 %

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

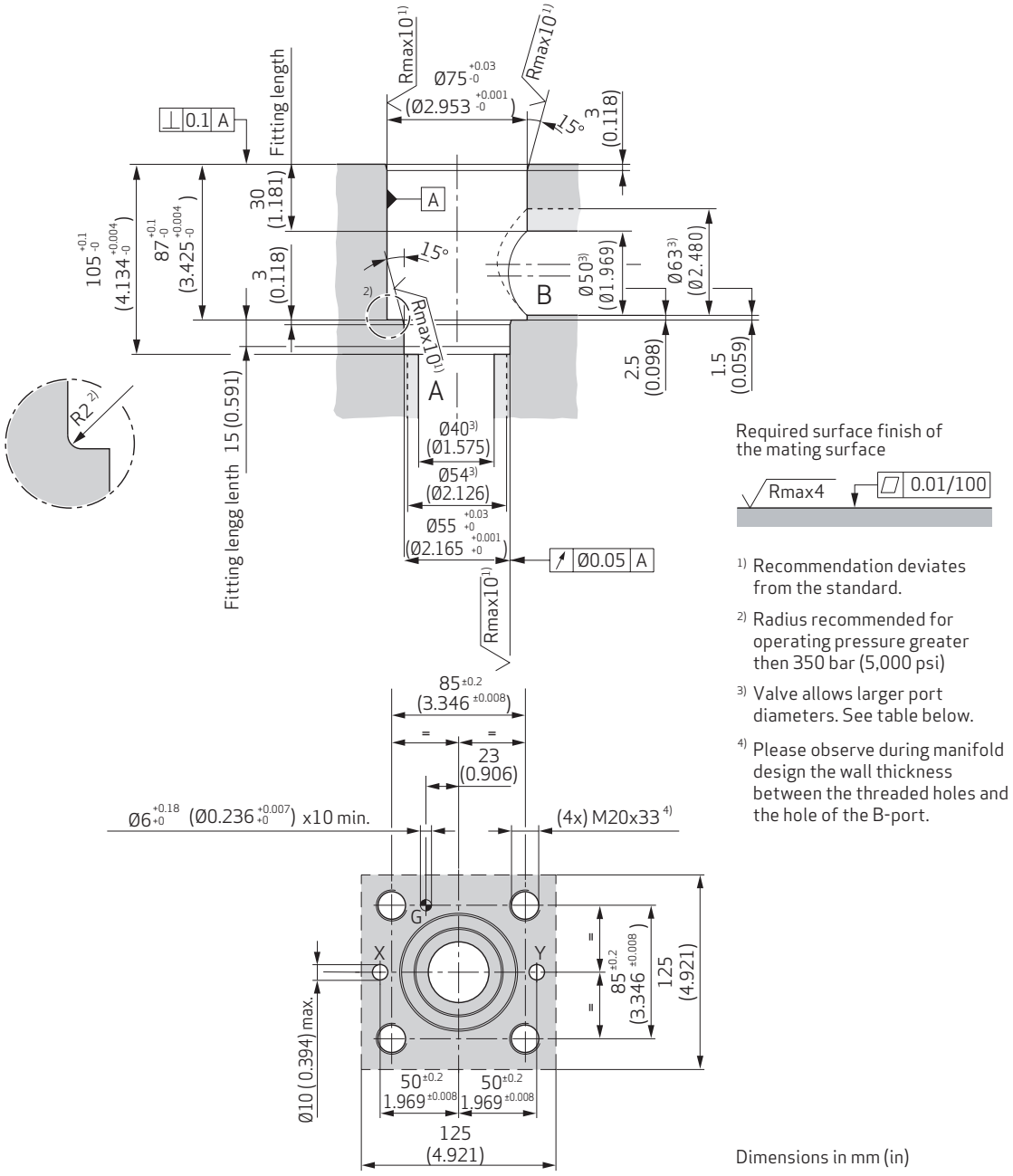
Electrical Data

Duty cycle	100 %
Degree of protection according to IEC/EN 60529	IP65 with mounted mating plugs
Supply voltage [1)]	24 V_{DC}, min. 18 V_{DC}, max. 32 V_{DC}
Supply voltage, 6/2-way fail-safe valve	24 V ±10 % (plug-in connector according to DIN 43650)
Permissible ripple of supply voltage [2)]	2.4 V_{RMS}
Maximum current consumption dynamic [3)]	1.7 A
Fuse protection, external, per valve	2 A (slow)
EM compatibility	• Emitted interference as per DIN EN 61000-6-4 • Immunity to interference as per DIN EN 61000-6-2 (evaluation criterion A)

[1)] All connected circuits must be isolated from the main supply by „electrical separation" in accordance with IEC/EN 61558-1 and IEC/EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.
[2)] Frequency from 50 Hz to 10 kHz.
[3)] Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V.

SIZE 40 - X703

Cavity Dimensions



Required surface finish of the mating surface

1) Recommendation deviates from the standard.

2) Radius recommended for operating pressure greater then 350 bar (5,000 psi)

3) Valve allows larger port diameters. See table below.

4) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

Dimensions in mm (in)

Relationship between Flow Performance and Cavity Dimensions

Beside the standard ISO cavity (cavity type A), Moog recommends two additional cavity types with different main port diameters to achieve the maximum flow performance for the preferred flow directions A → B or B → A.

Rated Flow at Δp_N 5 bar (75 psi)

Cavity type	Diameter A-port [mm (in)]	Diameter B-port [mm (in)]	Preferred for flow direction	Flow at direction [l/min (gpm)]			
				D1		D2	
				A to B	B to A	A to B	B to A
A[1)]	40 (1.57)	50 (1.97)	-	2,000 (528)	1,600 (423)	1,400 (370)	1250 (330)
B	54 (2.13)	63 (2.48)[2)]	B to A	2,000 (528)	1,900 (502)	1,400 (370)	1,400 (370)
C	40 (1.57)	63 (2.48)[2)]	A to B	2,600 (687)	1,600 (423)	1,550 (409)	1,250 (330)

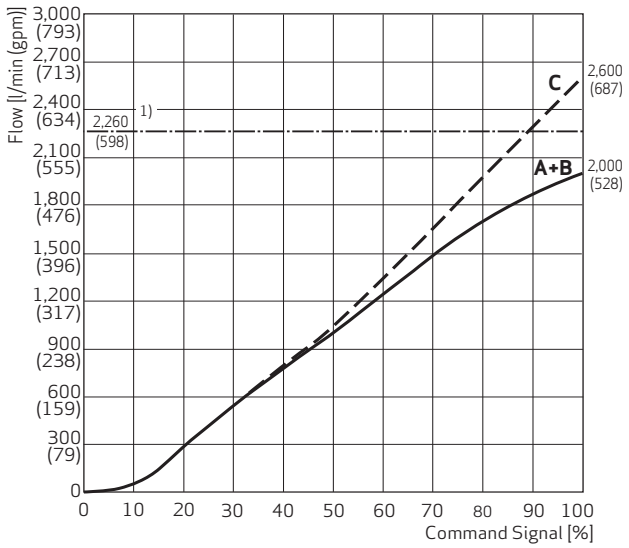
1) Standard ISO cavity

2) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

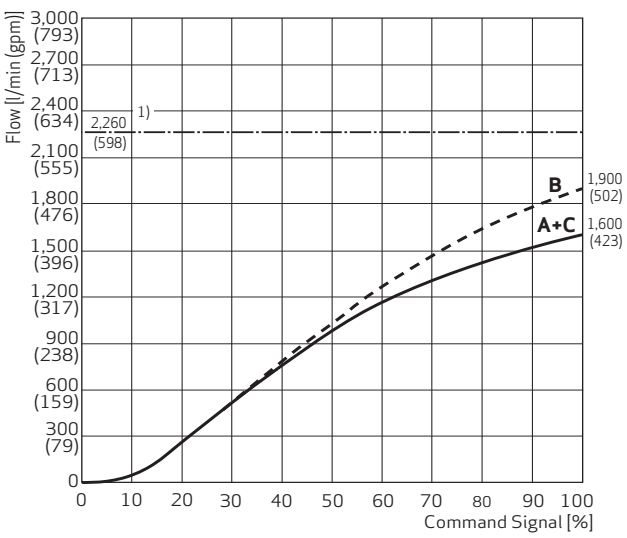
SIZE 40 - X703

Characteristic Curves D1

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



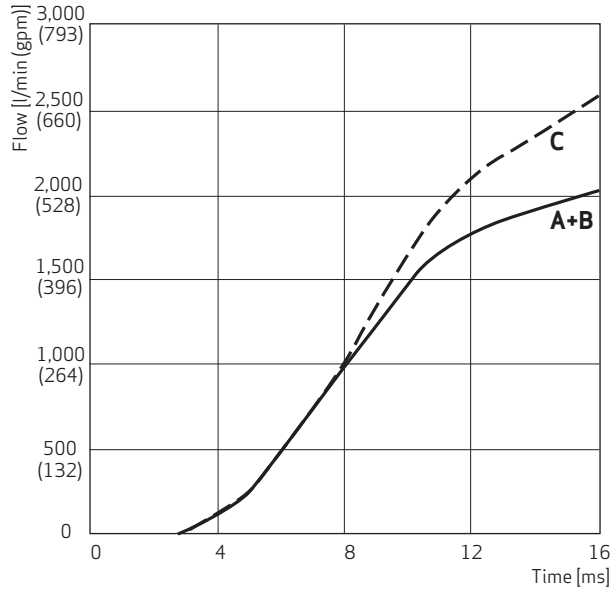
Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



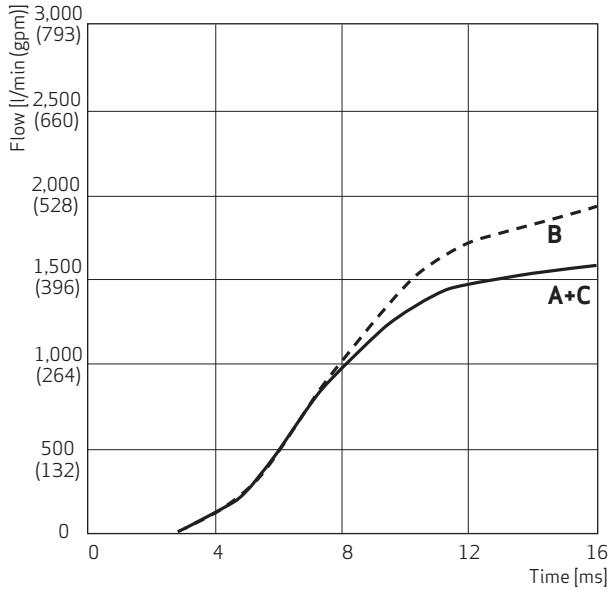
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Flow Response A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Response B → A
(Cavity Types A, B, C; Δp=5 bar)

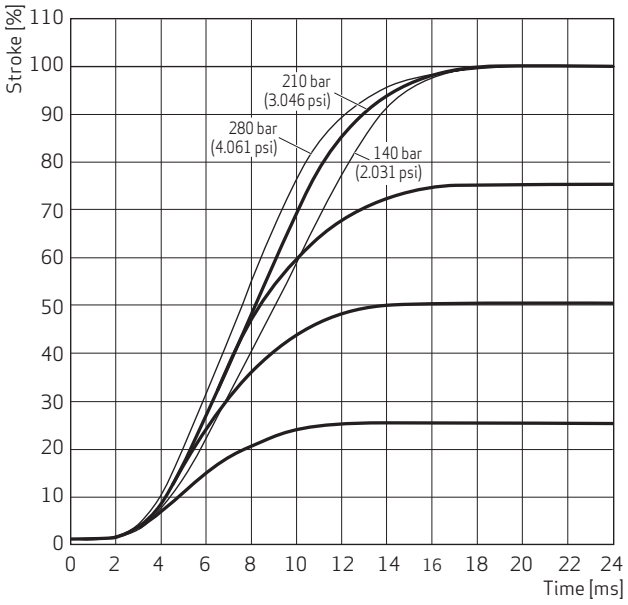


Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

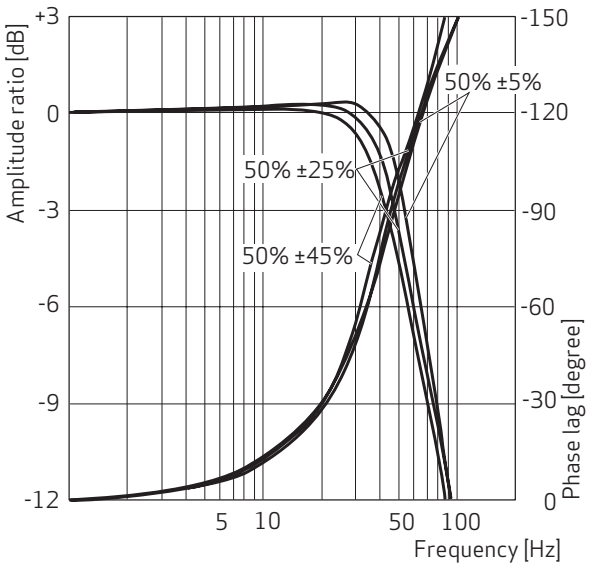
SIZE 40 - X703

Characteristic Curves D1

Step Response

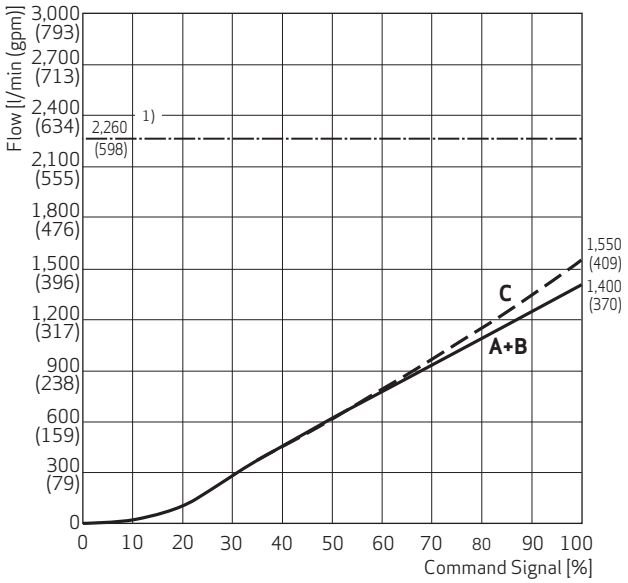


Frequency Response
(Pilot Pressure p_X 210 bar)

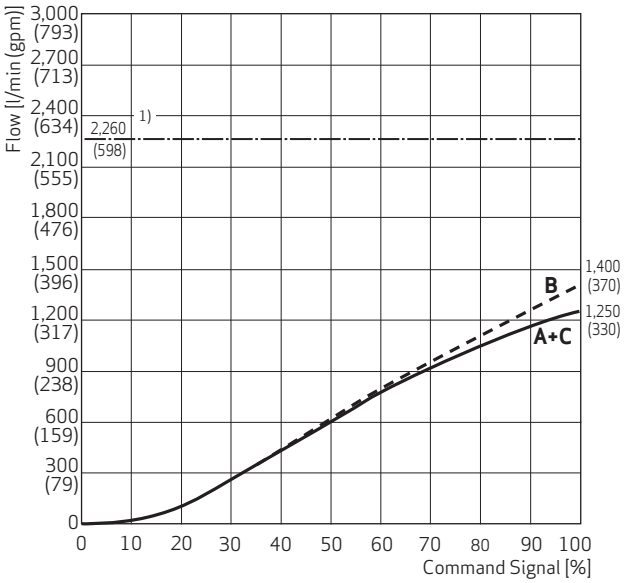


Characteristic Curves D2

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)

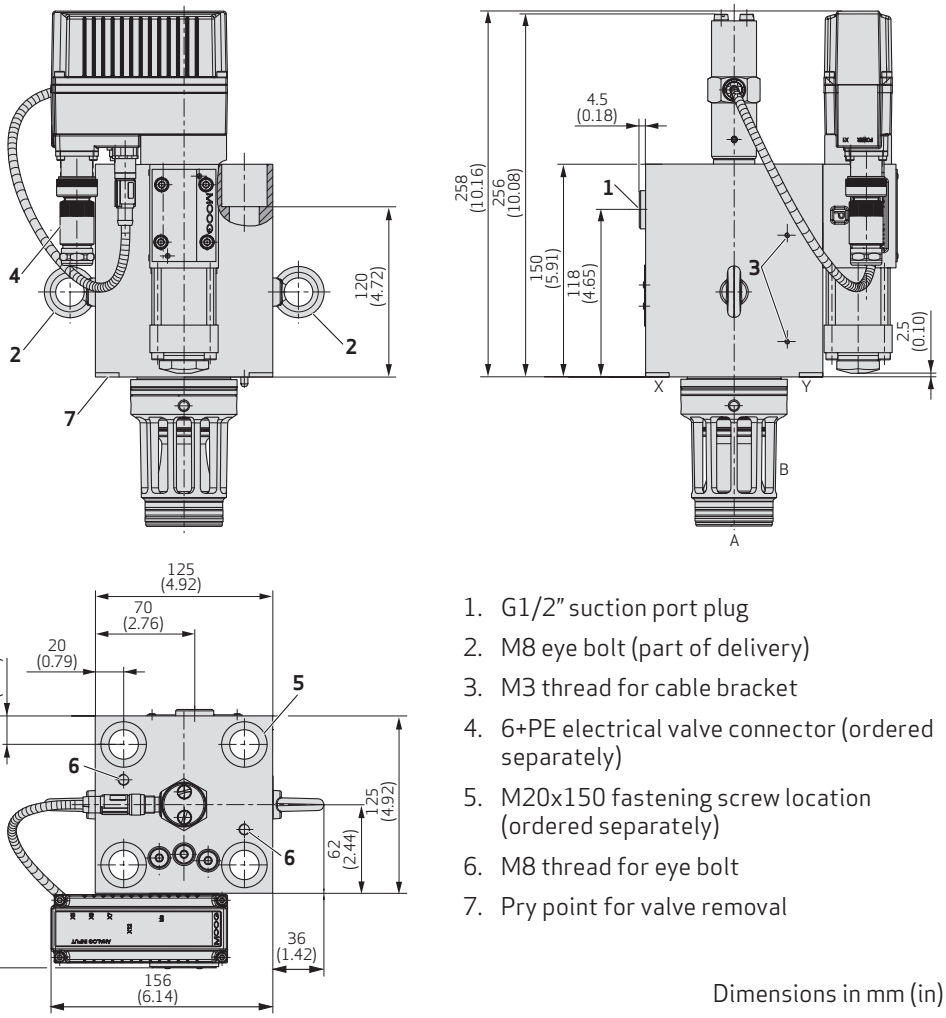


Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X210 bar (except step response)

SIZE 40 - X703
Installation Drawing for Fail-safe Options A and B

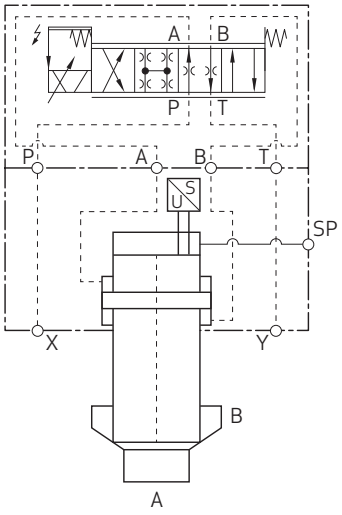


1. G1/2" suction port plug
2. M8 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M20x150 fastening screw location (ordered separately)
6. M8 thread for eye bolt
7. Pry point for valve removal

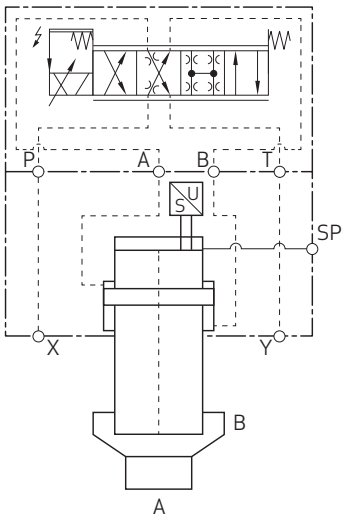
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version A (Normally Closed)

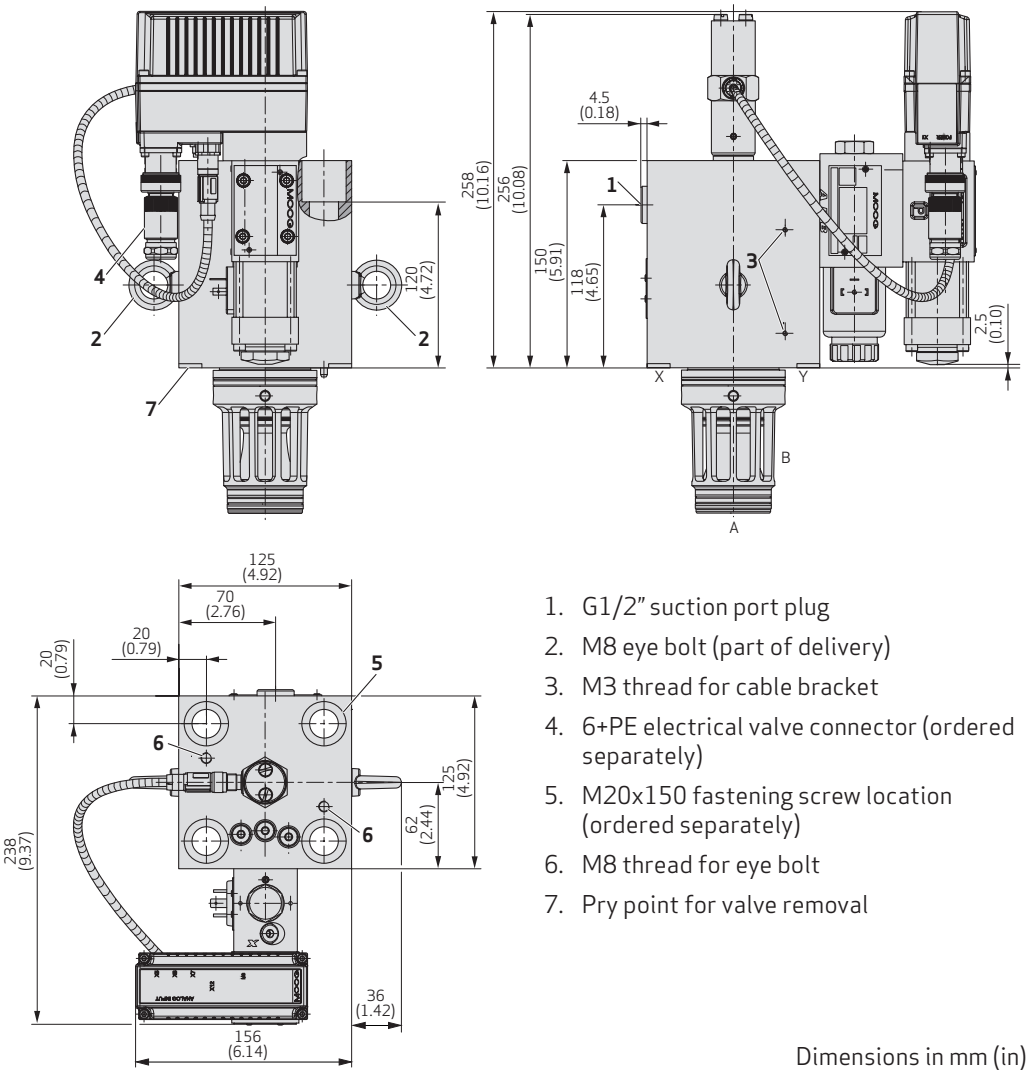


Fail-safe Version B (Normally Open)



SIZE 40 - X703

Installation Drawing for Fail-safe Options C and D

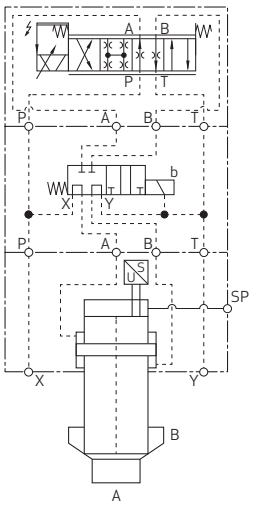


1. G1/2" suction port plug
2. M8 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M20x150 fastening screw location (ordered separately)
6. M8 thread for eye bolt
7. Pry point for valve removal

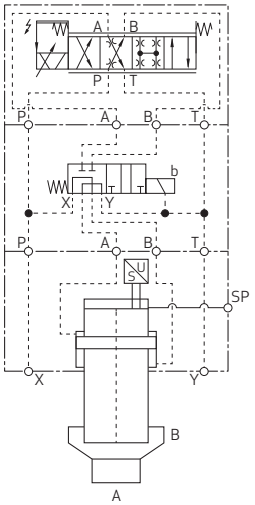
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version C (Normally Closed)



Fail-safe Version D (Normally Open)



SIZE 50 – X704

General Technical Data

Valve design	2-Way Servo Cartridge Valve, seat design
Pilot valve	D636 direct operated
Pilot connection X and Y	External through valve interface
Mounting pattern	ISO 7368-11-9-1-16
Installation position	Any
Weight	30 kg (66.1 lb)
Weight including fail-safe valve	32.4 kg (71.4 lb)
Storage temperature range	-40 to 80 °C (-40 to 176 °F)
Ambient temperature range	-20 to 60 °C (-4 to 140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions, 3 ms
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data[1)]

Pilot valve: minimum operating pressure	20 bar (290 psi) above pressure in port Y
Pilot valve: minimum pilot pressure in relation to the main stage pressure	50 % of main stage pressure
Pilot valve: maximum pressure X port	350 bar (5,000 psi)
Pilot valve: maximum pressure Y port[2)]	50 bar (725 psi)
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)
Rated flow at Δp_N 5 bar (75 psi); flow direction A→B[3)]	D1: 3,600 l/min (951 gpm); D2: 2,150 l/min (568 gpm)
Rated flow at Δp_N 5 bar (75 psi); flow direction B→A[3)]	D1: 2,700 l/min (713 gpm); D2: 1,900 l/min (502 gpm)
Recommended maximum flow[4)]	6,300 l/min (1,664 gpm) (cavity type B)
Flow directions	B → A, A → B
Pilot leakage flow (pilot pressure p_X = 100 bar)	< 0.9 l/min (< 0.24 gpm)
Peak pilot flow for 100 % step	60 l/min (15.9 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.
Seal material / fluid compatibility	NBR: mineral oil-based, HFB, HFC fluids
	FKM: mineral oil-based, HFD fluids
	Other fluids on request
Temperature range	-20 to 80 °C (-4 to 176 °F)
Recommended viscosity range at 40 °C (104 °F)	15 to 45 mm^2/s (cSt)
Maximum permissible viscosity range at 40 °C (104 °F)	5 to 400 mm^2/s (cSt)
Recommended cleanliness class as per ISO 4406 for functional safety[5)]	18/15/12
Recommended cleanliness class as per ISO 4406 for longer service life[5)]	17/14/11

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Pressure peaks up to 210 bar (3,000 psi) permissible.
[3)] Values valid for use with recommended cavity diameters.
[4)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s.
[5)] The cleanliness of the hydraulic fluid strongly affects functional safety (e.g. safe positioning of the poppet, high resolution) and wear of lands of the pilot valve (e.g. pressure gain, leak losses).

SIZE 50 – X704

Typical Static and Dynamic Data [1)]

Pilot valve	D636 direct operated
Step response time according to ISO 10770-1 (p_x = 210 bar) [2)]	D1: 16 ms; D2: 12 ms
Fail-safe time: biased pilot valve	Approximately 140 ms
Fail-safe time: additional fail-safe subplate valve	Approximately 70 ms
Threshold, typical	< 0.05 %
Threshold, maximum	< 0.1 %
Hysteresis, typical	< 0.1 %
Hysteresis, maximum	< 0.2 %
Null shift at ΔT = 55 K (131 °F)	< 1.5 %

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

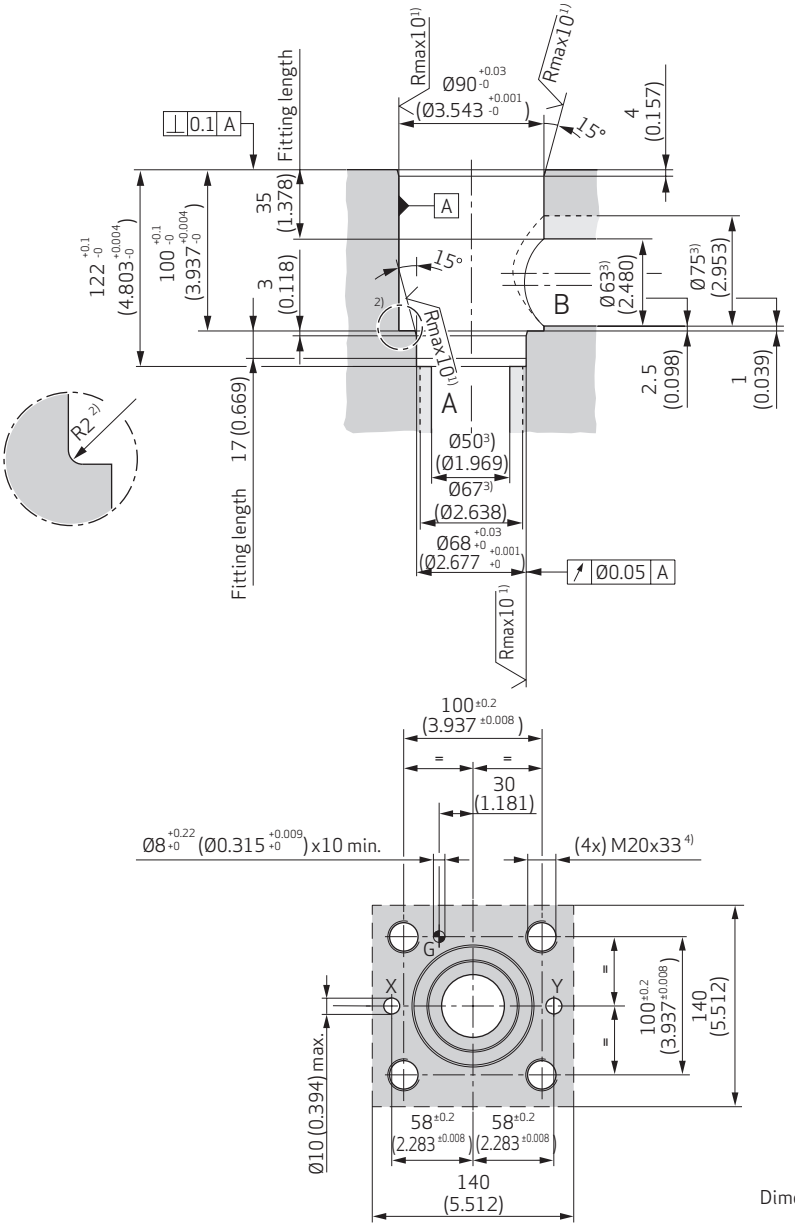
Electrical Data

Duty cycle	100 %
Degree of protection according to IEC/EN 60529	IP65 with mounted mating plugs
Supply voltage [1)]	24 V_{DC}, min. 18 V_{DC}, max. 32 V_{DC}
Supply voltage, 6/2-way fail-safe valve	24 V ±10 % (plug-in connector according to DIN 43650)
Permissible ripple of supply voltage [2)]	2.4 V_{RMS}
Maximum current consumption dynamic [3)]	1.7 A
Fuse protection, external, per valve	2 A (slow)
EM compatibility	• Emitted interference as per DIN EN 61000-6-4 • Immunity to interference as per DIN EN 61000-6-2 (evaluation criterion A)

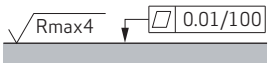
[1)] All connected circuits must be isolated from the main supply by „electrical separation" in accordance with IEC/EN 61558-1 and IEC/EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.
[2)] Frequency from 50 Hz to 10 kHz.
[3)] Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V.

SIZE 50 - X704

Cavity Dimensions



Required surface finish of the mating surface



1) Recommendation deviates from the standard.

2) Radius recommended for operating pressure greater then 350 bar (5,000 psi)

3) Valve allows larger port diameters. See table below.

4) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

Dimensions in mm (in)

Relationship between Flow Performance and Cavity Dimensions

Beside the standard ISO cavity (cavity type A), Moog recommends two additional cavity types with different main port diameters to achieve the maximum flow performance for the preferred flow directions A → B or B → A.

Rated flow at Δp_N 5 bar (75 psi)

Cavity type	Diameter A-port [mm (in)]	Diameter B-port [mm (in)]	Preferred for flow direction	Flow at direction [l/min (gpm)]			
				D1		D2	
				A to B	B to A	A to B	B to A
A[1)]	50 (1.97)	63 (2.48)	-	3,100 (819)	2,300 (608)	2,000 (528)	1,800 (476)
B	67 (2.64)	75 (2.95)[2)]	B to A	3,000 (793)	2,700 (713)	2,000 (528)	1,900 (502)
C	50 (1.97)	75 (2.95)[2)]	A to B	3,600 (951)	2,300 (608)	2,100 (555)	1,800 (476)

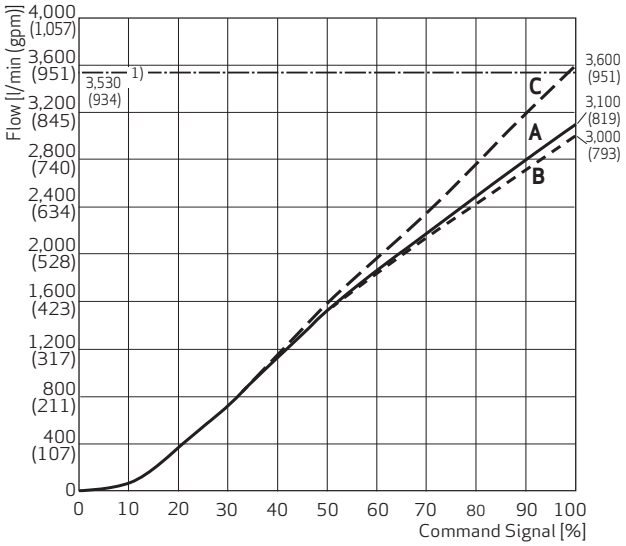
1) Standard ISO cavity

2) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

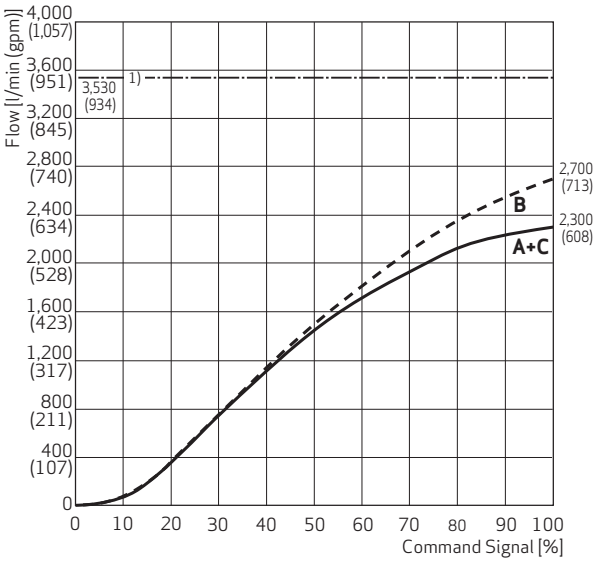
SIZE 50 - X704

Characteristic Curves D1

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



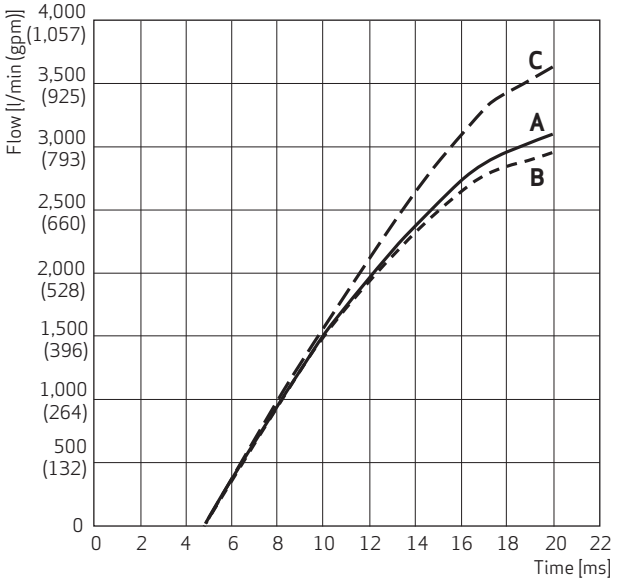
Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



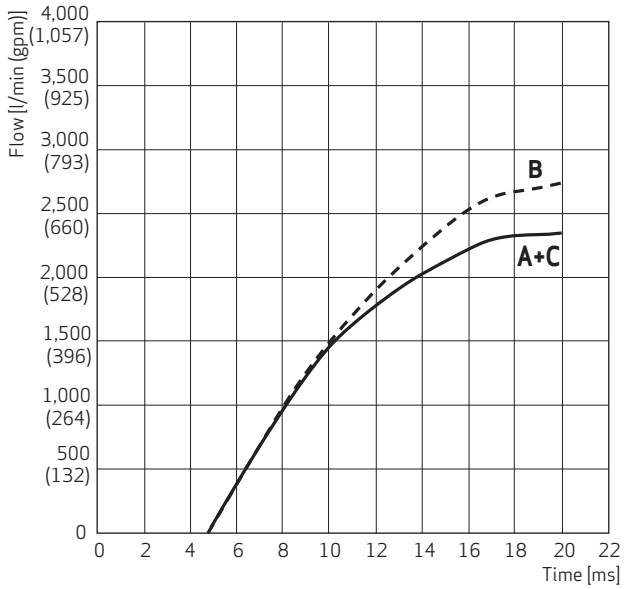
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Flow Response A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Response B → A
(Cavity Types A, B, C; Δp=5 bar)

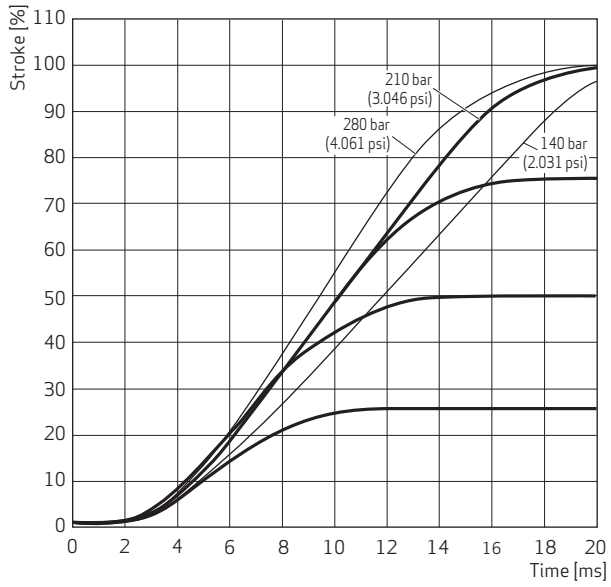


Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

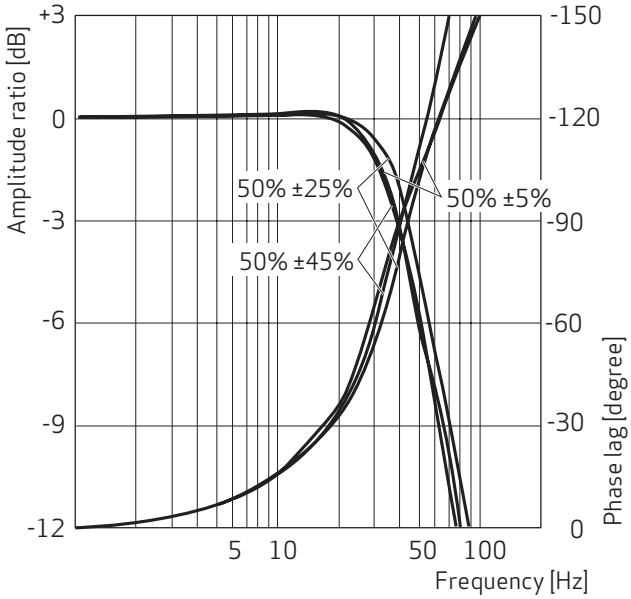
SIZE 50 - X704

Characteristic Curves D1

Step Response

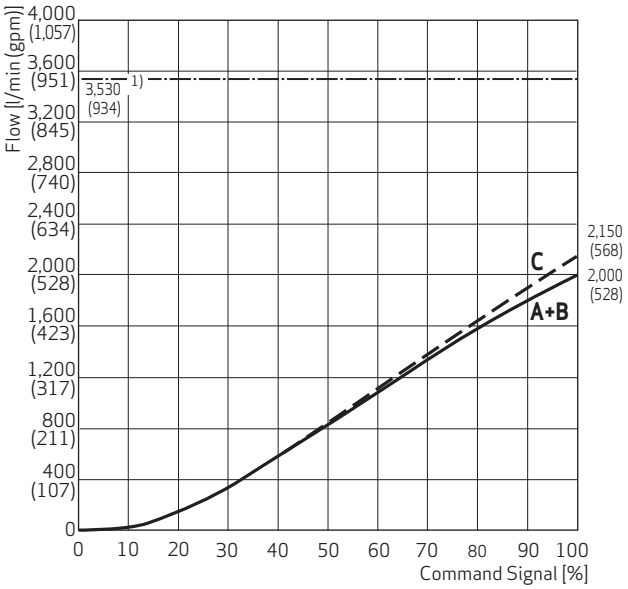


Frequency Response
(Pilot Pressure p_X 210 bar)

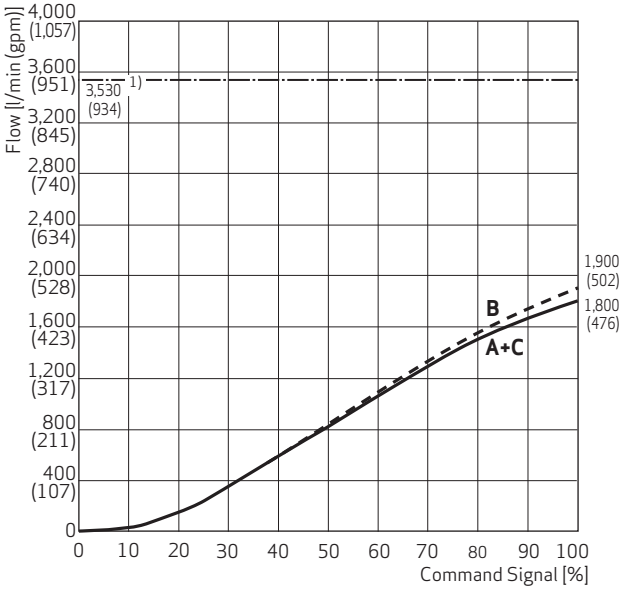


Characteristic Curves D2

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



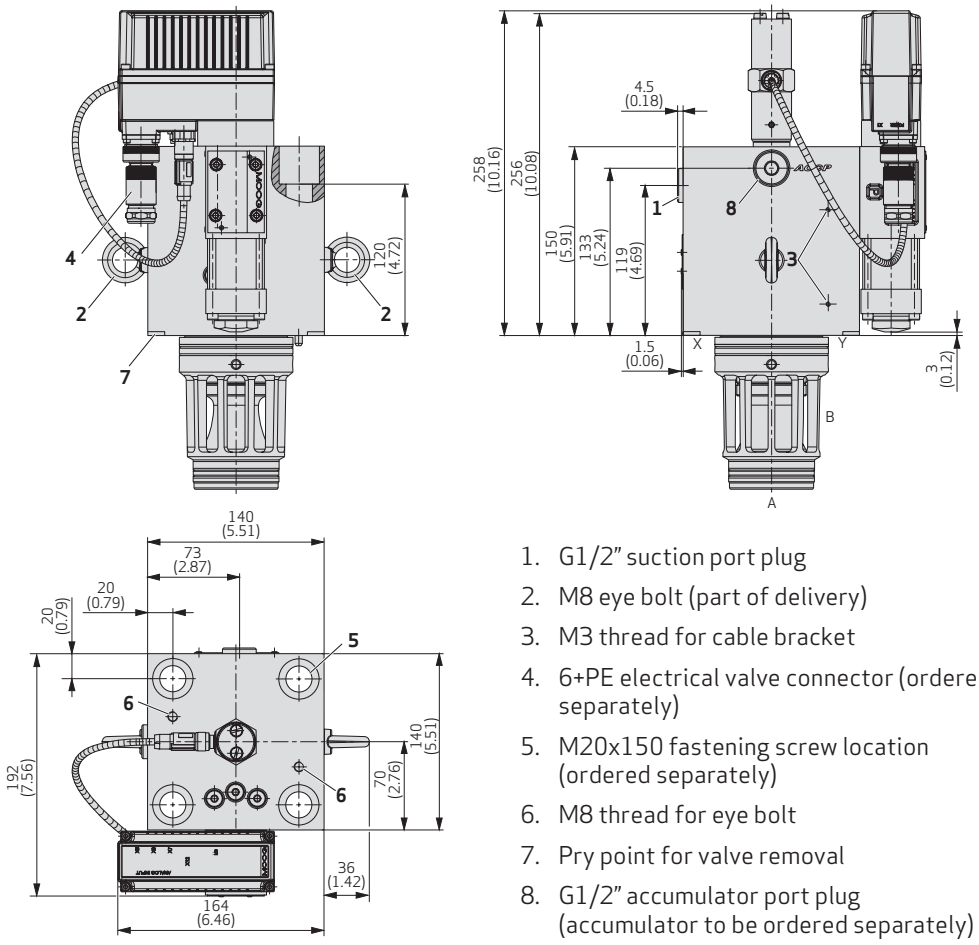
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

SIZE 50 - X704

Installation Drawing for Fail-safe Options A and B

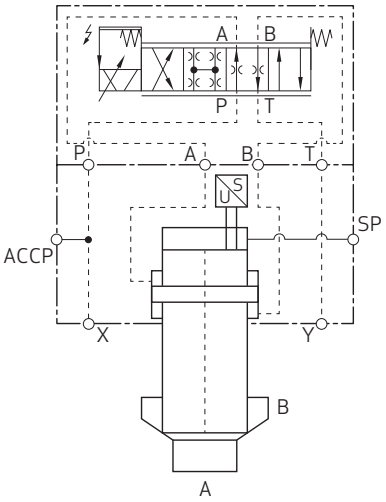


1. G1/2" suction port plug
2. M8 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M20x150 fastening screw location (ordered separately)
6. M8 thread for eye bolt
7. Pry point for valve removal
8. G1/2" accumulator port plug (accumulator to be ordered separately)

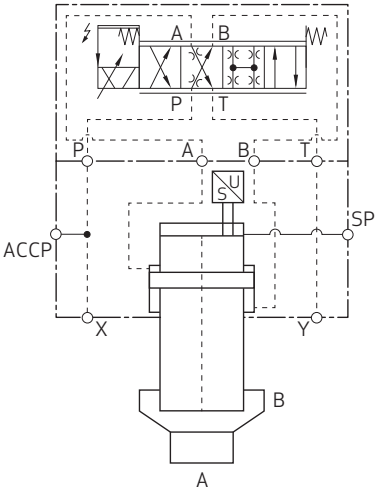
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version A (Normally Closed)

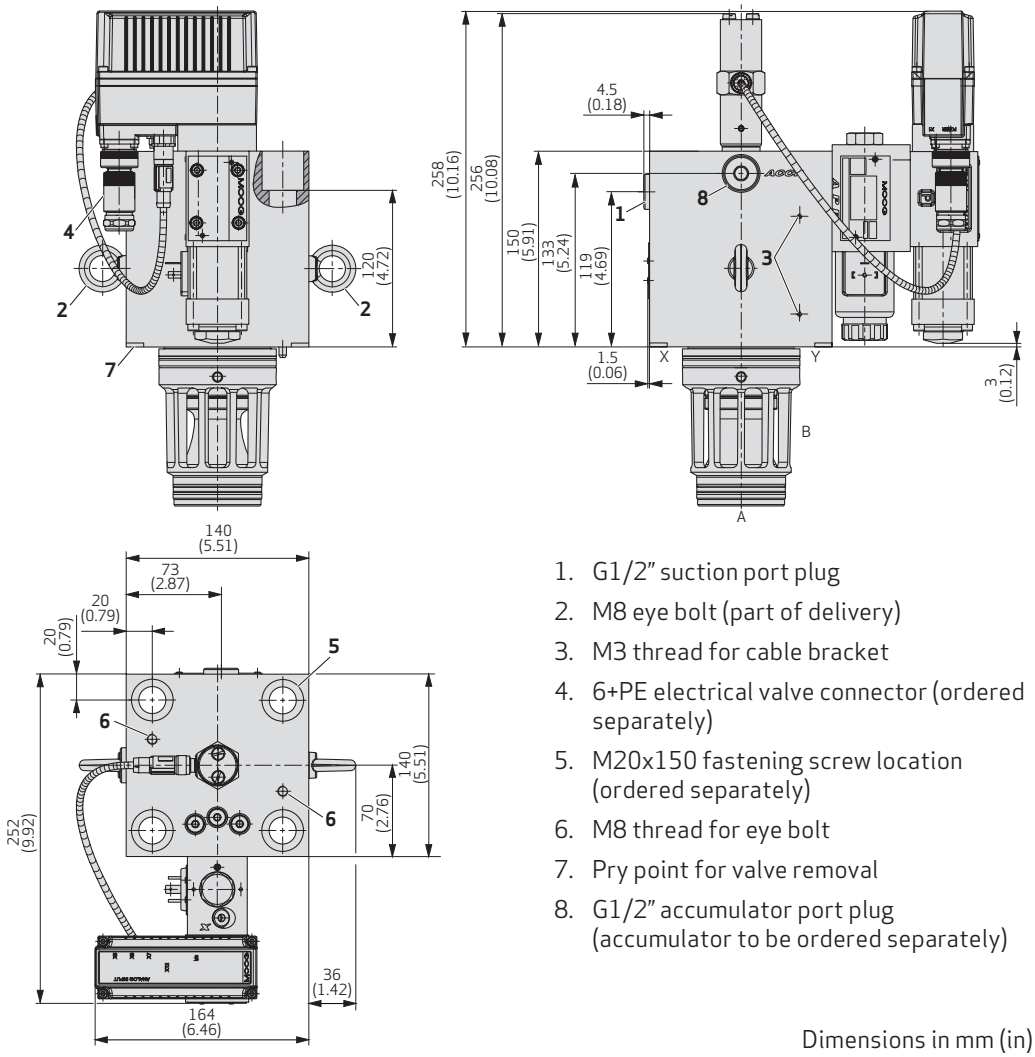


Fail-safe Version B (Normally Open)



SIZE 50 - X704

Installation Drawing for Fail-safe Options C and D

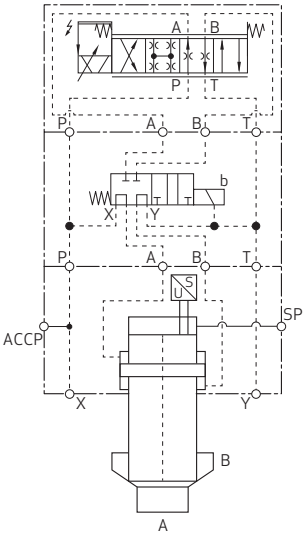


1. G1/2" suction port plug
2. M8 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M20x150 fastening screw location (ordered separately)
6. M8 thread for eye bolt
7. Pry point for valve removal
8. G1/2" accumulator port plug (accumulator to be ordered separately)

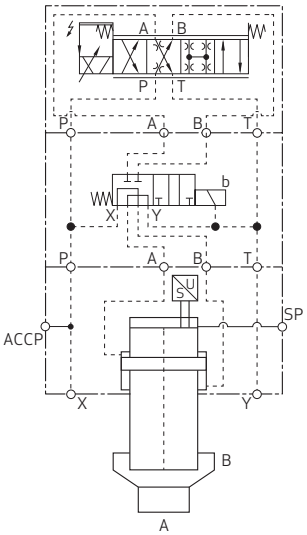
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version C (Normally Closed)



Fail-safe Version D (Normally Open)



SIZE 63 – X705

General Technical Data

Valve design	2-Way Servo Cartridge Valve, seat design
Pilot valve	D637 direct operated
Pilot connection X and Y	External through valve interface
Mounting pattern	ISO 7368-12-11-1-16
Installation position	Any
Weight	65.4 kg (144.2 lb)
Weight including fail-safe valve	74.1 kg (163.4 lb)
Storage temperature range	-40 to 80 °C (-40 to 176 °F)
Ambient temperature range	-20 to 60 °C (-4 to 140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions, 3 ms
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data[1)]

Pilot valve: minimum operating pressure	20 bar (290 psi) above pressure in port Y
Pilot valve: minimum pilot pressure in relation to the main stage pressure	50 % of main stage pressure
Pilot valve: maximum pressure X port	350 bar (5,000 psi)
Pilot valve: maximum pressure Y port[2)]	50 bar (725 psi)
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)
Rated flow at Δp_N 5 bar (75 psi); flow direction A→B[3)]	D1: 6,550 l/min (1,730 gpm); D2: 4,000 l/min (1,057 gpm)
Rated flow at Δp_N 5 bar (75 psi); flow direction B→A[3)]	D1: 4,800 l/min (1,268 gpm); D2: 3,600 l/min (951 gpm)
Recommended maximum flow[4)]	9,000 l/min (2,377 gpm) (cavity type B)
Flow directions	B → A, A → B
Pilot leakage flow (pilot pressure p_X = 100 bar)	< 1.4 l/min (< 0.37 gpm)
Peak pilot flow for 100 % step	128 l/min (33.8 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.
Seal material / fluid compatibility	NBR: mineral oil-based, HFB, HFC fluids
	FKM: mineral oil-based, HFD fluids
	Other fluids on request
Temperature range	-20 to 80 °C (-4 to 176 °F)
Recommended viscosity range at 40 °C (104 °F)	15 to 45 mm^2/s (cSt)
Maximum permissible viscosity range at 40 °C (104 °F)	5 to 400 mm^2/s (cSt)
Recommended cleanliness class as per ISO 4406 for functional safety[5)]	18/15/12
Recommended cleanliness class as per ISO 4406 for longer service life[5)]	17/14/11

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Pressure peaks up to 210 bar (3,000 psi) permissible.
[3)] Values valid for use with recommended cavity diameters.
[4)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s.
[5)] The cleanliness of the hydraulic fluid strongly affects functional safety (e.g. safe positioning of the poppet, high resolution) and wear of lands of the pilot valve (e.g. pressure gain, leak losses).

SIZE 63 – X705

Typical Static and Dynamic Data[1)]

Pilot valve	D637 direct operated
Step response time according to ISO 10770-1 (p_x = 210 bar) [2)]	D1: 20 ms; D2: 18 ms
Fail-safe time: biased pilot valve	Approximately 35 ms
Fail-safe time: additional fail-safe subplate valve	Approximately 120 ms
Threshold, typical	< 0.05 %
Threshold, maximum	< 0.1 %
Hysteresis, typical	< 0.1 %
Hysteresis, maximum	< 0.3 %
Null shift at ΔT = 55 K (131 °F)	< 1.5 %

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

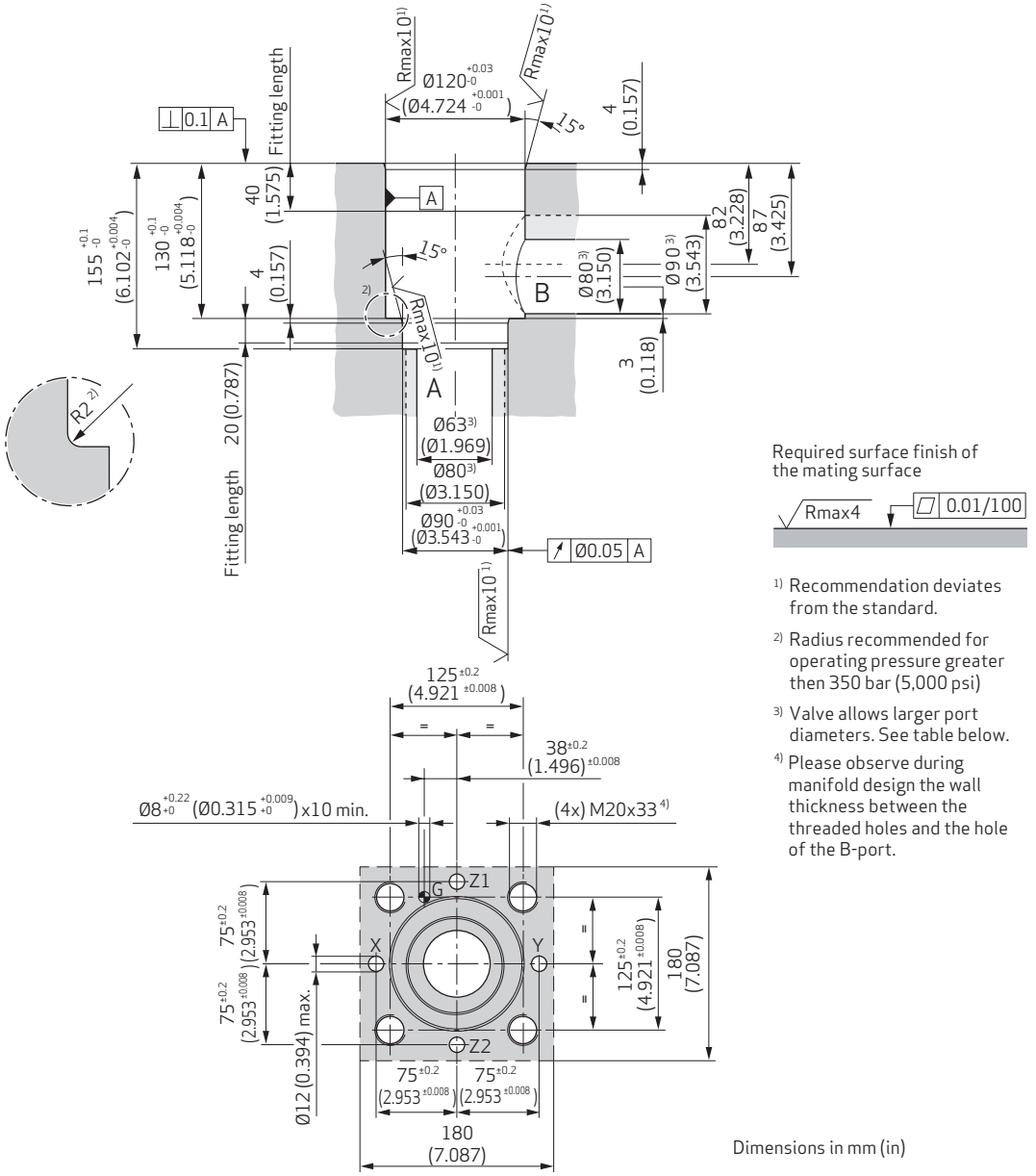
Electrical Data

Duty cycle	100 %
Degree of protection according to IEC/EN 60529	IP65 with mounted mating plugs
Supply voltage [1)]	24 V_{DC}, min. 18 V_{DC}, max. 32 V_{DC}
Supply voltage, 6/2-way fail-safe valve	24 V ±10 % (plug-in connector according to DIN 43650)
Permissible ripple of supply voltage [2)]	2.4 V_{RMS}
Maximum current consumption dynamic [3)]	3.0 A
Fuse protection, external, per valve	3.15 A (slow)
EM compatibility	• Emitted interference as per DIN EN 61000-6-4 • Immunity to interference as per DIN EN 61000-6-2 (evaluation criterion A)

[1)] All connected circuits must be isolated from the main supply by „electrical separation" in accordance with IEC/EN 61558-1 and IEC/EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.
[2)] Frequency from 50 Hz to 10 kHz.
[3)] Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V.

SIZE 63 - X705

Cavity Dimensions



Required surface finish of the mating surface

1) Recommendation deviates from the standard.

2) Radius recommended for operating pressure greater then 350 bar (5,000 psi)

3) Valve allows larger port diameters. See table below.

4) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

Dimensions in mm (in)

Relationship between Flow Performance and Cavity Dimensions

Beside the standard ISO cavity (cavity type A), Moog recommends two additional cavity types with different main port diameters to achieve the maximum flow performance for the preferred flow directions A → B or B → A.

Rated flow at Δp_N 5 bar (75 psi)

Cavity type	Diameter A-port [mm (in)]	Diameter B-port [mm (in)]	Preferred for flow direction	Flow at direction [l/min (gpm)]			
				D1		D2	
				A to B	B to A	A to B	B to A
A[1)]	63 (2.48)	80 (3.15)	-	5,830 (1,540)	4,000 (1,057)	3,730 (985)	3,250 (859)
B	80 (3.15)	80 (3.15)	B to A	4,800 (1,268)	4,830 (1,276)	3,430 (906)	3,570 (943)
C	63 (2.48)	90 (3.54)	A to B	6,550 (1,730)	4,000 (1,057)	3,970 (1,049)	3,250 (859)

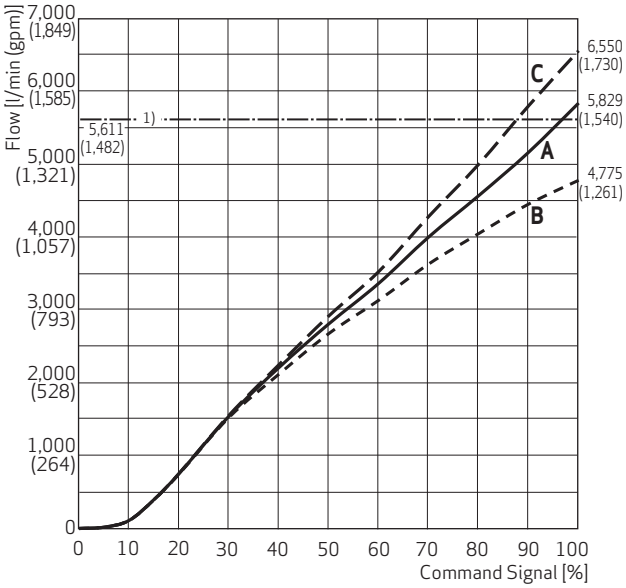
1) Standard ISO cavity

2) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

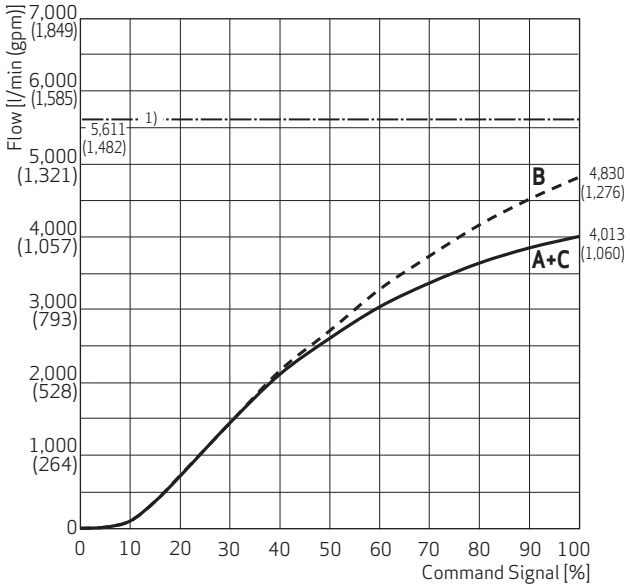
SIZE 63 - X705

Characteristic Curves D1

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



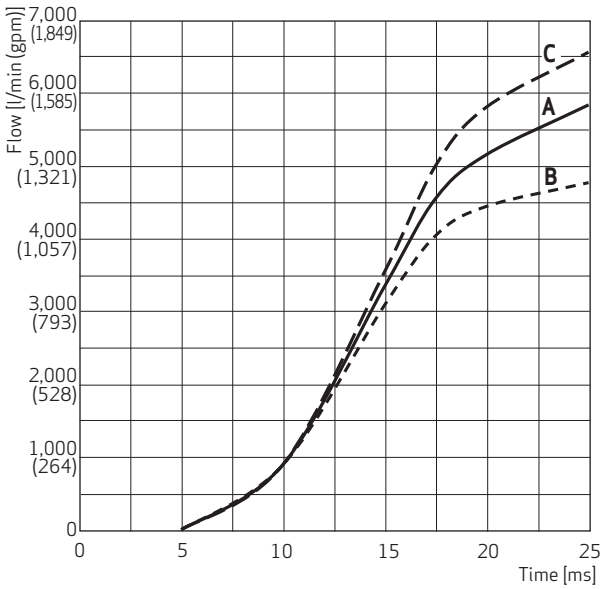
Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



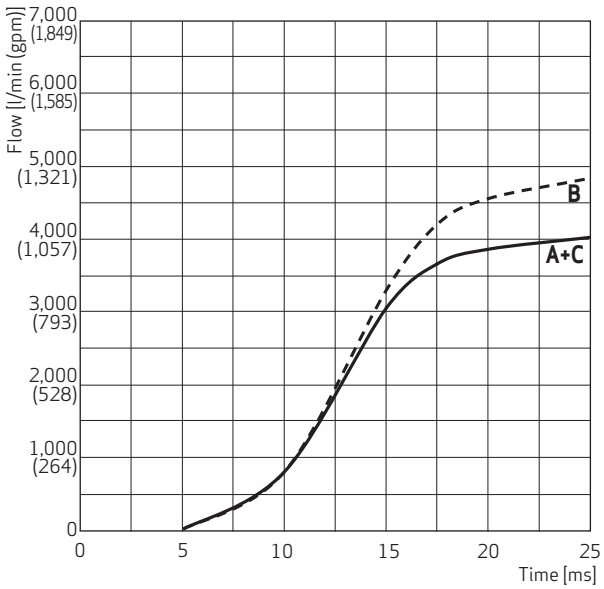
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Flow Response A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Response B → A
(Cavity Types A, B, C; Δp=5 bar)

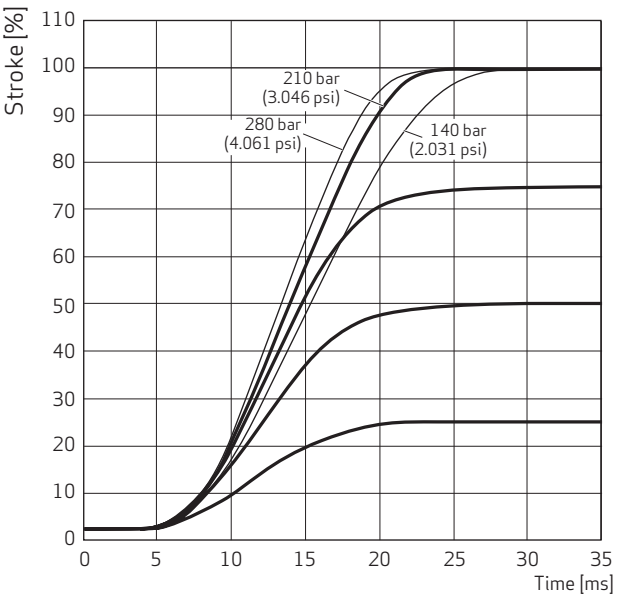


Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

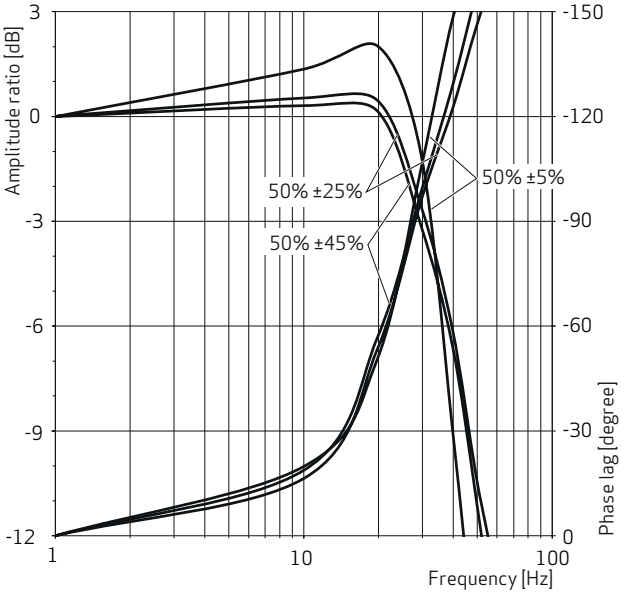
SIZE 63 - X705

Characteristic Curves D1

Step Response

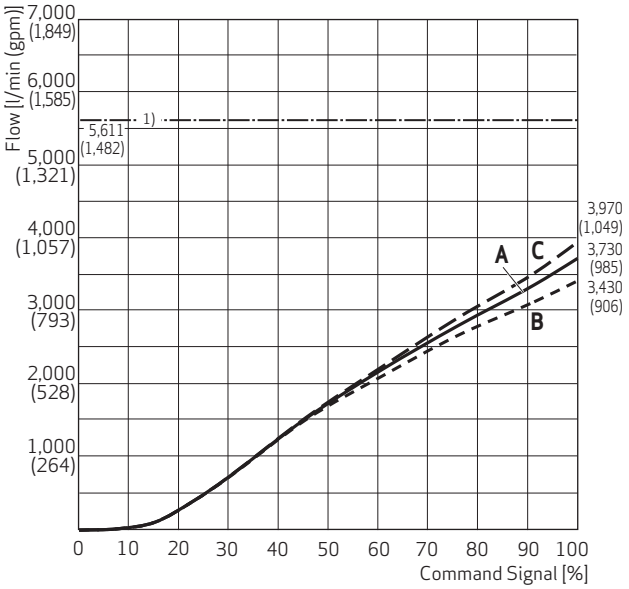


Frequency Response
(Pilot Pressure p_X 210 bar)

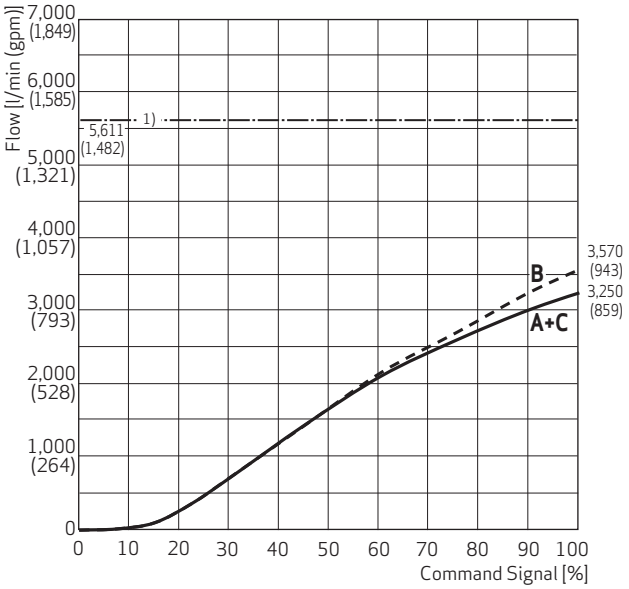


Characteristic Curves D2

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



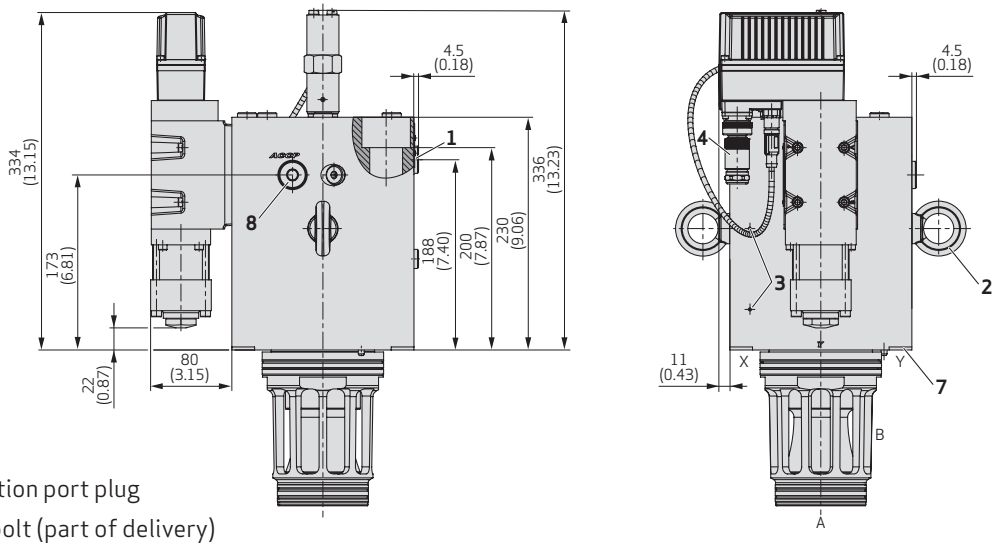
Note: Cartridge opening point set to 2 % command signal

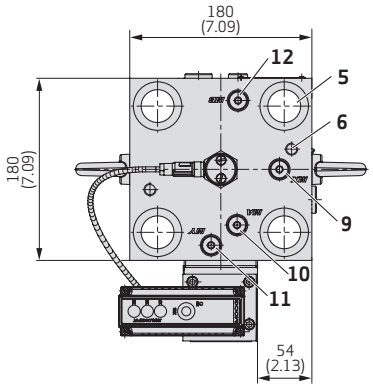
[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

SIZE 63 - X705

Installation Drawing for Fail-safe Options A and B



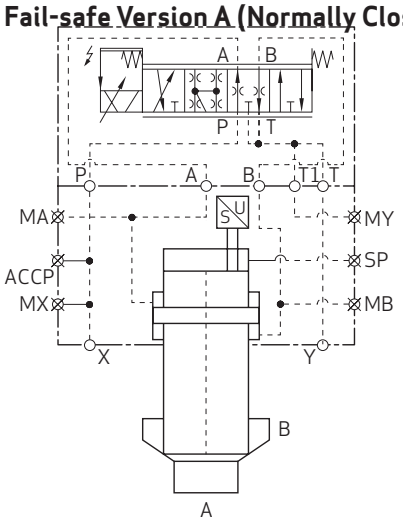


1. G1/2" suction port plug
2. M12 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M30x240 fastening screw location (ordered separately)
6. M12 thread for eye bolt
7. Pry point for valve removal
8. G1/2" accumulator port plug (accumulator to be ordered separately)
9. G1/4" test port plug (MX)
10. G1/4" test port plug (MA)
11. G1/4" test port plug (MY)
12. G1/4" test port plug (MB)

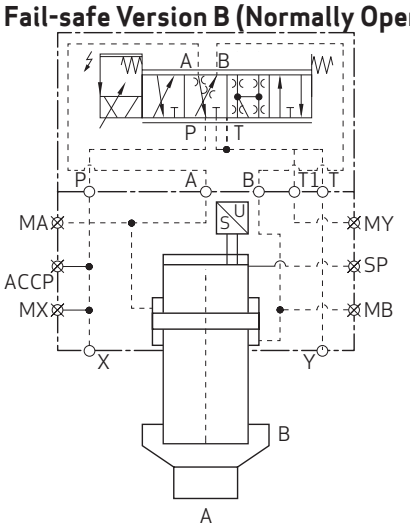
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version A (Normally Closed)

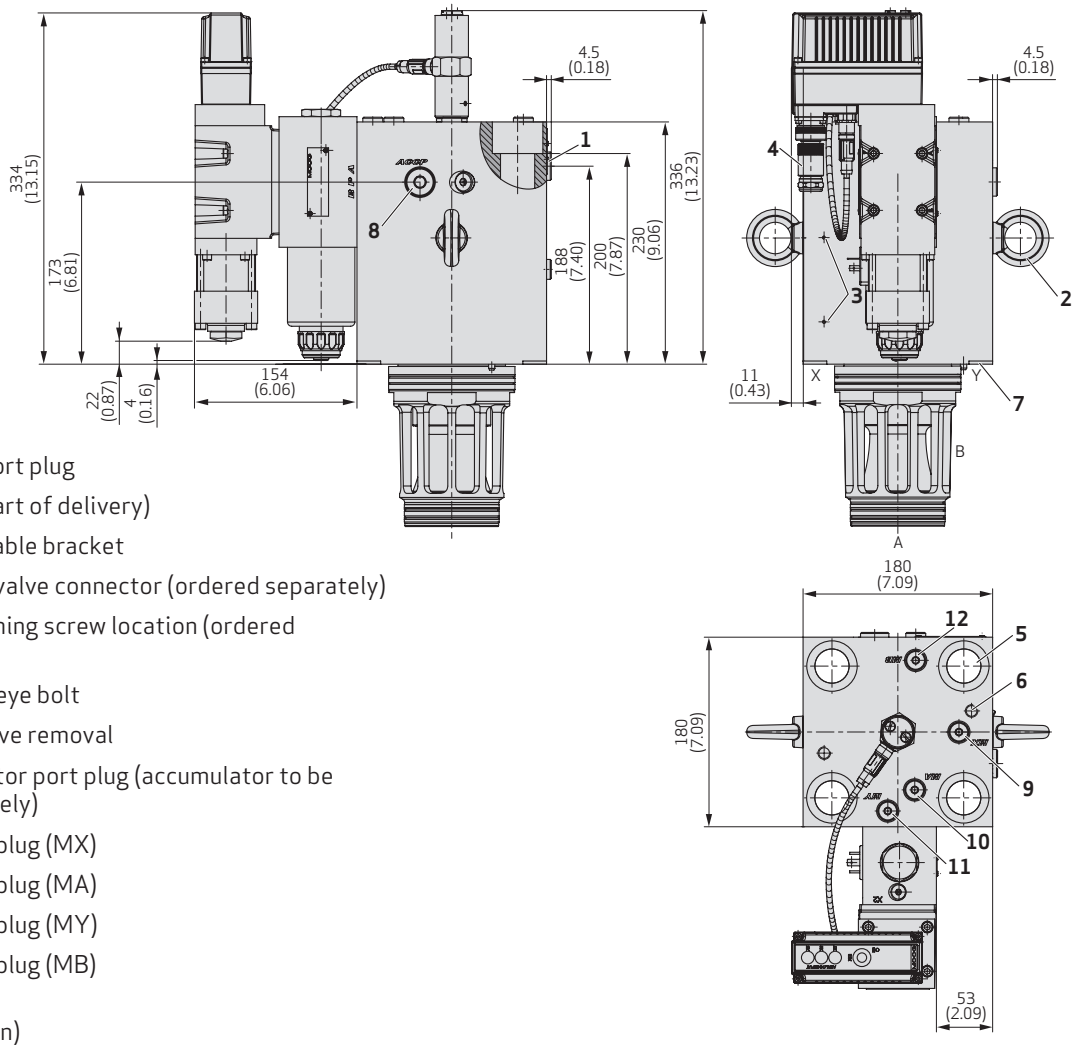


Fail-safe Version B (Normally Open)



SIZE 63 - X705

Installation Drawing for Fail-safe Options C and D

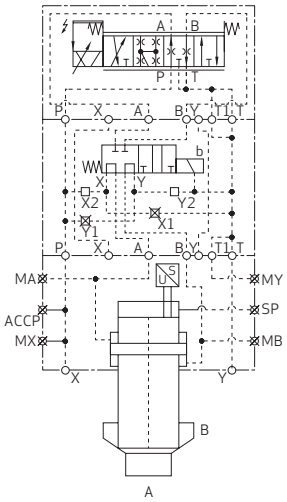


1. G1/2" suction port plug
2. M12 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M30x240 fastening screw location (ordered separately)
6. M12 thread for eye bolt
7. Pry point for valve removal
8. G1/2" accumulator port plug (accumulator to be ordered separately)
9. G1/4" test port plug (MX)
10. G1/4" test port plug (MA)
11. G1/4" test port plug (MY)
12. G1/4" test port plug (MB)

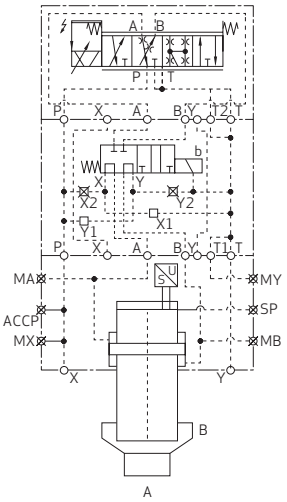
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version C (Normally Closed)



Fail-safe Version D (Normally Open)



SIZE 80 – X706

General Technical Data

Valve design	2-Way Servo Cartridge Valve, seat design
Pilot valve	D637 direct operated
Pilot connection X and Y	External through valve interface
Mounting pattern	ISO 7368-13-13-1-16
Installation position	Any
Weight	122 kg (269 lb)
Weight including fail-safe valve	129 kg (284.40 lb)
Storage temperature range	-40 to 80 °C (-40 to 176 °F)
Ambient temperature range	-20 to 60 °C (-4 to 140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions, 3 ms
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data[1)]

Pilot valve: minimum operating pressure	20 bar (290 psi) above pressure in port Y
Pilot valve: minimum pilot pressure in relation to the main stage pressure	50 % of main stage pressure
Pilot valve: maximum pressure X port	350 bar (5,000 psi)
Pilot valve: maximum pressure Y port [2)]	50 bar (725 psi)
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)
Rated flow at Δp_N 5 bar (75 psi); flow direction A→B [3)]	D1: 9,400 l/min (2,483 gpm); D2: 6,200 l/min (1,638 gpm)
Rated flow at Δp_N 5 bar (75 psi); flow direction B→A [3)]	D1: 7,300 l/min (1,928 gpm); D2: 5,600 l/min (1,479 gpm)
Recommended maximum flow[4)]	16,800 l/min (4,438 gpm) (cavity type B)
Flow directions	B → A, A → B
Pilot leakage flow (pilot pressure p_X = 100 bar)	< 1.4 l/min (< 0.37 gpm)
Peak pilot flow for 100 % step	128 l/min (33.8 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.
Seal material / fluid compatibility	NBR: mineral oil-based, HFB, HFC fluids
	FKM: mineral oil-based, HFD fluids
	Other fluids on request
Temperature range	-20 to 80 °C (-4 to 176 °F)
Recommended viscosity range at 40 °C (104 °F)	15 to 45 mm^2/s (cSt)
Maximum permissible viscosity range at 40 °C (104 °F)	5 to 400 mm^2/s (cSt)
Recommended cleanliness class as per ISO 4406 for functional safety[5)]	18/15/12
Recommended cleanliness class as per ISO 4406 for longer service life[5)]	17/14/11

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Pressure peaks up to 210 bar (3,000 psi) permissible.
[3)] Values valid for use with recommended cavity diameters.
[4)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s.
[5)] The cleanliness of the hydraulic fluid strongly affects functional safety (e.g. safe positioning of the poppet, high resolution) and wear of lands of the pilot valve (e.g. pressure gain, leak losses).

SIZE 80 – X706

Typical Static and Dynamic Data[1)]

Pilot valve	D637 direct operated
Step response time according to ISO 10770-1 (p_x = 210 bar)[2)]	D1: 29 ms; D2: 22 ms
Fail-safe time: biased pilot valve	Approximately 100 ms
Fail-safe time: additional fail-safe subplate valve	Approximately 120 ms
Threshold, typical	< 0.05 %
Threshold, maximum	< 0.1 %
Hysteresis, typical	< 0.1 %
Hysteresis, maximum	< 0.3 %
Null shift at ΔT = 55 K (131 °F)	< 1.5 %

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

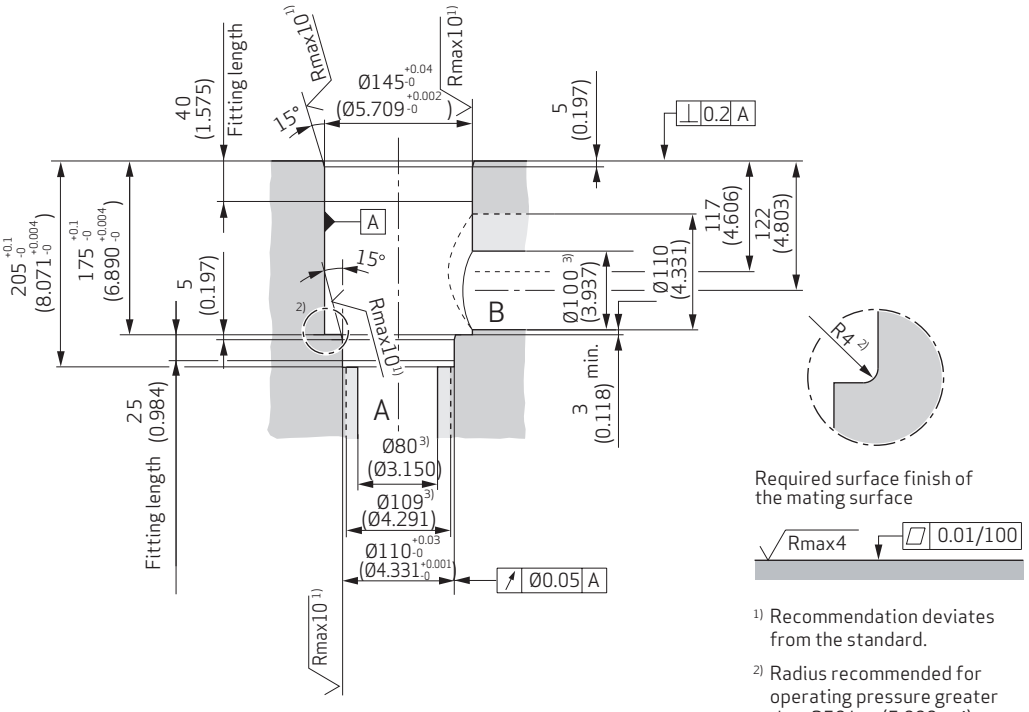
Electrical Data

Duty cycle	100 %
Degree of protection according to IEC/EN 60529	IP65 with mounted mating plugs
Supply voltage[1)]	24 V_{DC}, min. 18 V_{DC}, max. 32 V_{DC}
Supply voltage, 6/2-way fail-safe valve	24 V ±10 % (plug-in connector according to DIN 43650)
Permissible ripple of supply voltage[2)]	2.4 V_{RMS}
Maximum current consumption dynamic[3)]	3.0 A
Fuse protection, external, per valve	3.15 A (slow)
EM compatibility	• Emitted interference as per DIN EN 61000-6-4 • Immunity to interference as per DIN EN 61000-6-2 (evaluation criterion A)

[1)] All connected circuits must be isolated from the main supply by „electrical separation" in accordance with IEC/EN 61558-1 and IEC/EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.
[2)] Frequency from 50 Hz to 10 kHz.
[3)] Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V.

SIZE 80 - X706

Cavity Dimensions



1) Recommendation deviates from the standard.

2) Radius recommended for operating pressure greater then 350 bar (5,000 psi)

3) Valve allows larger port diameters. See table below.

4) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

Dimensions in mm (in)

Relationship between Flow Performance and Cavity Dimensions

Beside the standard ISO cavity (cavity type A), Moog recommends two additional cavity types with different main port diameters to achieve the maximum flow performance for the preferred flow directions A → B or B → A.

Rated flow at Δp_N 5 bar (75 psi)

Cavity type	Diameter A-port [mm (in)]	Diameter B-port [mm (in)]	Preferred for flow direction	Flow at direction [l/min (gpm)]			
				D1		D2	
				A to B	B to A	A to B	B to A
A 1)	80 (3.15)	100 (3.94)	-	8,400 (2,219)	6,200 (1,638)	5,900 (1,559)	5,150 (1,360)
B	109 (4.29)	110 (4.33)	B to A	7,500 (1,981)	7,330 (1,936)	5,500 (1,453)	5,570 (1,471)
C	80 (3.15)	110 (4.33)	A to B	9,400 (2,483)	6,200 (1,638)	6,200 (1,638)	5,200 (1,374)

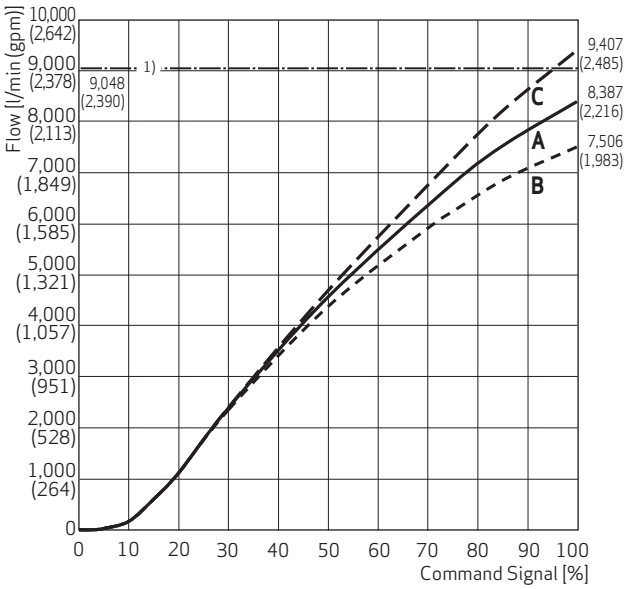
1) Standard ISO cavity

2) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

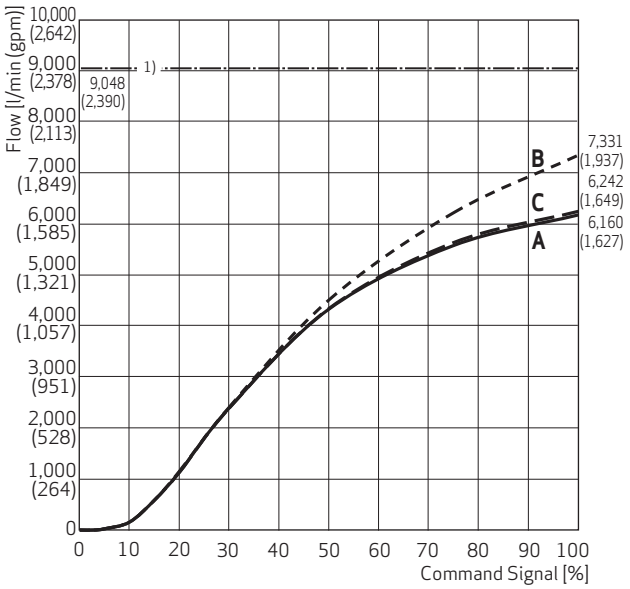
SIZE 80 - X706

Characteristic Curves D1

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



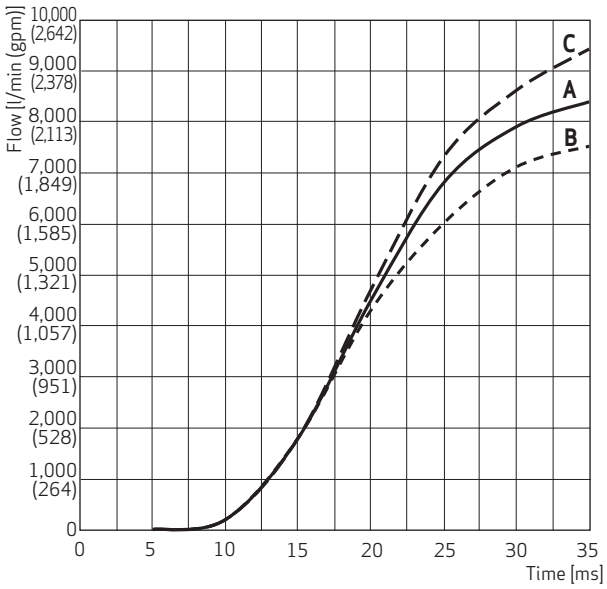
Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



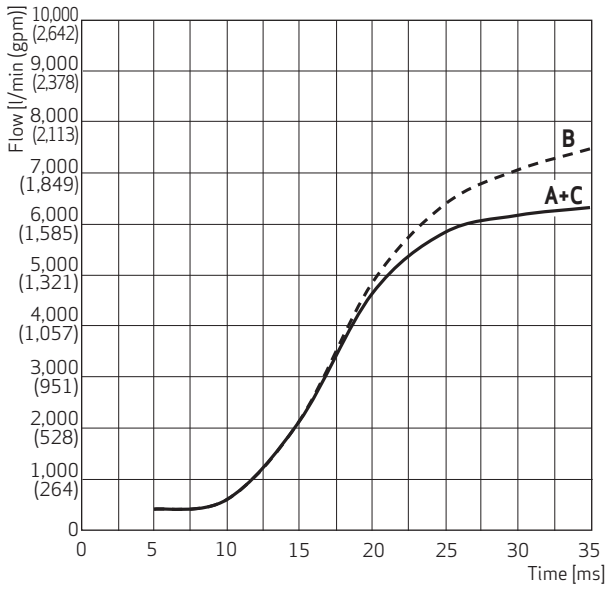
Note: Cartridge opening point set to 2 % command signal

[1)] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Flow Response A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Response B → A
(Cavity Types A, B, C; Δp=5 bar)

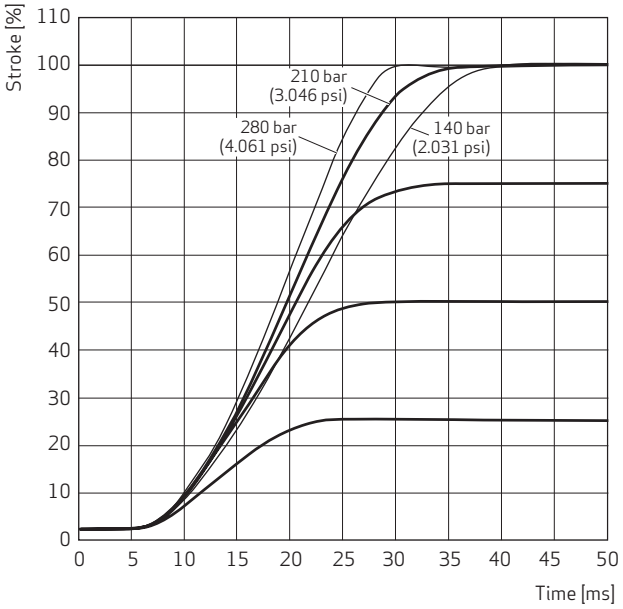


Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

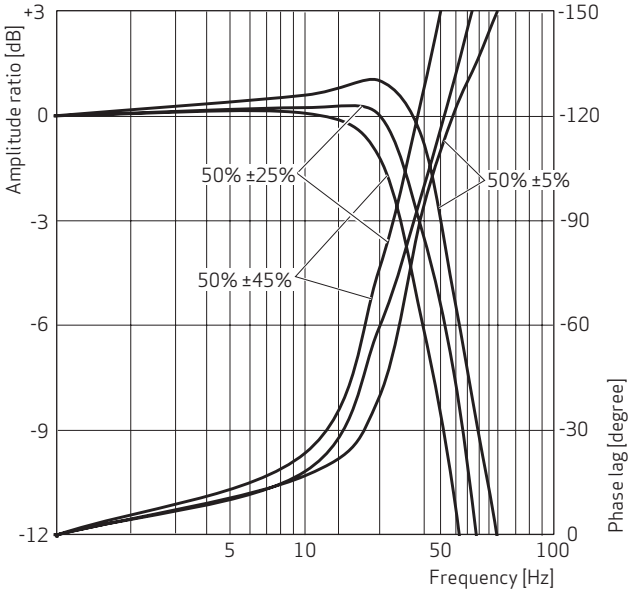
SIZE 80 - X706

Characteristic Curves D1

Step Response

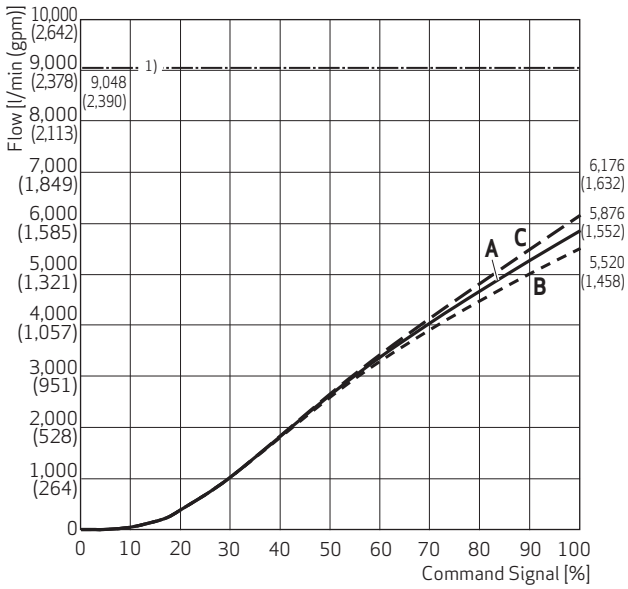


Frequency Response
(Pilot Pressure p_X 210 bar)

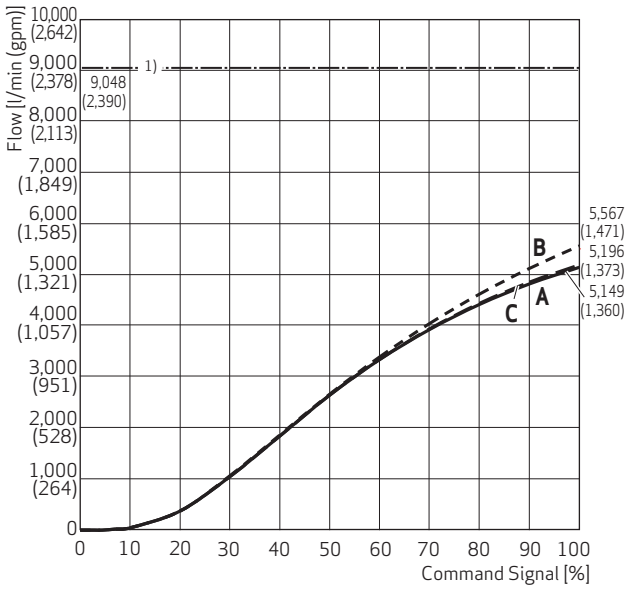


Characteristic Curves D2

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



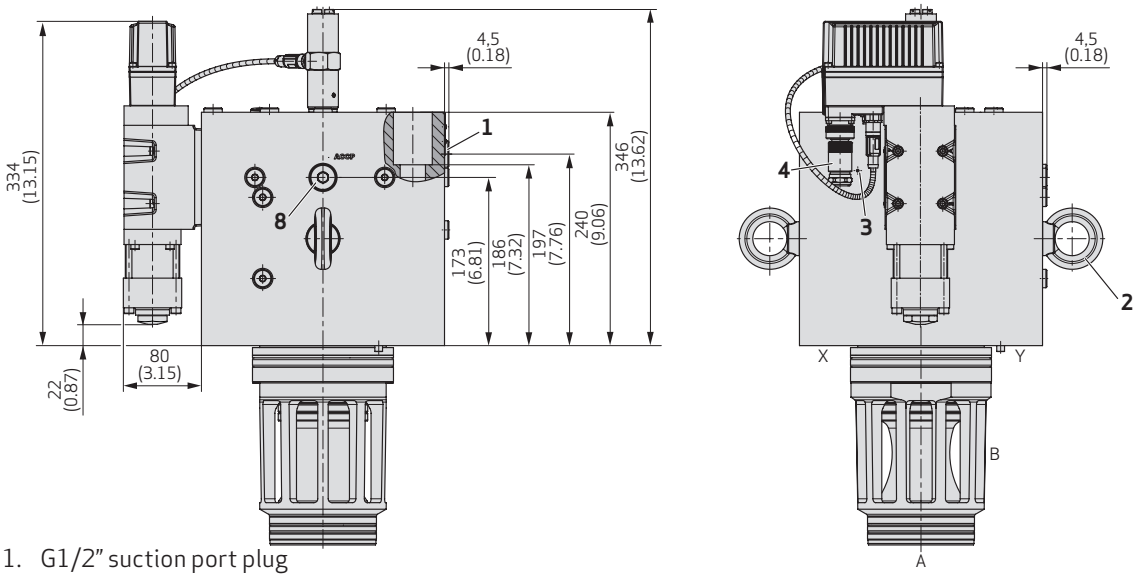
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

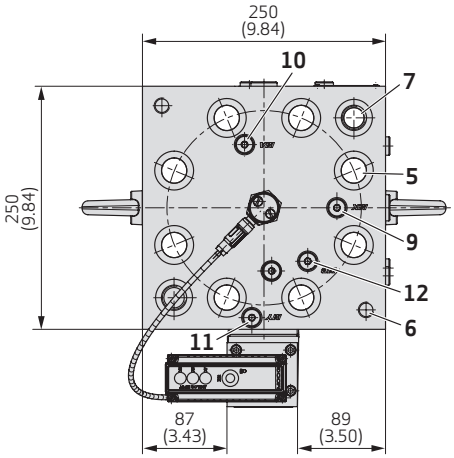
Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

SIZE 80 - X706

Installation Drawing for Fail-safe Options A and B



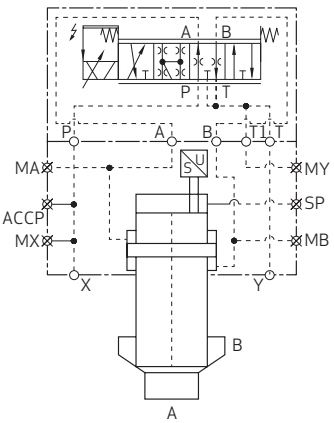
1. G1/2" suction port plug
2. M16 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M24x220 fastening screw location (ordered separately)
6. M16 thread for eye bolt
7. M24 thread for pull screw
8. G1/2" accumulator port plug (accumulator to be ordered separately)
9. G1/4" test port plug (MX)
10. G1/4" test port plug (MA)
11. G1/4" test port plug (MY)
12. G1/4" test port plug (MB)



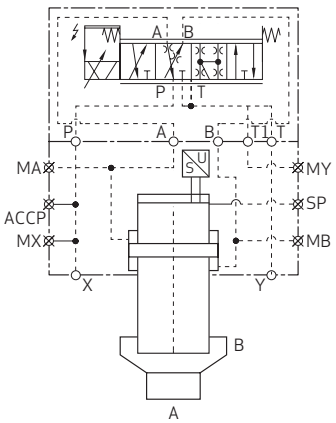
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version C (Normally Closed)

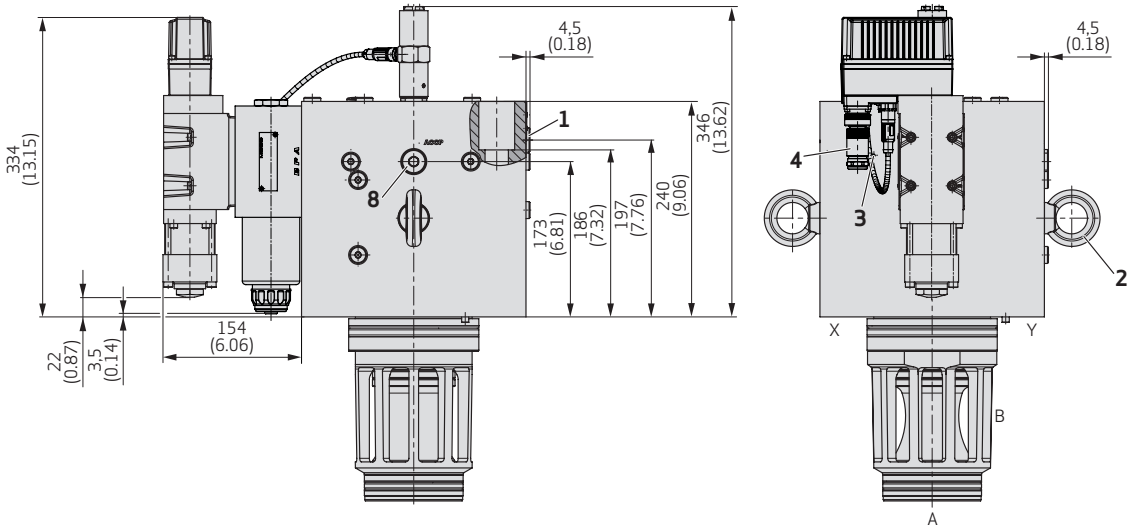


Fail-safe Version D (Normally Open)

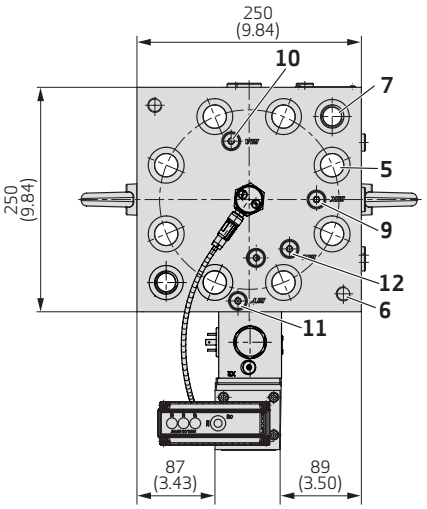


SIZE 80 - X706

Installation Drawing for Fail-safe Options C and D



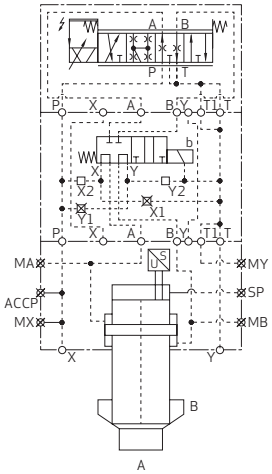
1. G1/2" suction port plug
2. M16 eye bolt (part of delivery)
3. M3 thread for cable bracket
4. 6+PE electrical valve connector (ordered separately)
5. M24x220 fastening screw location (ordered separately)
6. M16 thread for eye bolt
7. M24 thread for pull screw
8. G1/2" accumulator port plug (accumulator to be ordered separately)
9. G1/4" test port plug (MX)
10. G1/4" test port plug (MA)
11. G1/4" test port plug (MY)
12. G1/4" test port plug (MB)



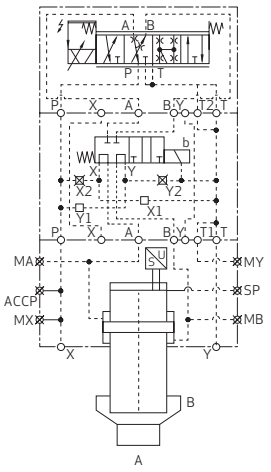
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version A (Normally Closed)



Fail-safe Version B (Normally Open)



SIZE 100 – X707

General Technical Data

Valve design	2-Way Servo Cartridge Valve, seat design
Pilot valve	D637 direct operated
Pilot connection X and Y	External through valve interface
Mounting pattern	ISO 7368 -14-14-1-16
Installation position	Any
Weight	207 kg (456.4 lb)
Weight including fail-safe valve	215 kg (474 lb)
Storage temperature range	-40 to 80 °C (-40 to 176 °F)
Ambient temperature range	-20 to 60 °C (-4 to 140 °F)
Vibration resistance	30 g, 3 axis, 10 Hz to 2 kHz
Shock resistance	50 g, 6 directions, 3 ms
$MTTF_d$ value according to EN ISO 13849-1	150 years

Hydraulic Data[1)]

Pilot valve: minimum operating pressure	20 bar (290 psi) above pressure in port Y
Pilot valve: minimum pilot pressure in relation to the main stage pressure	50 % of main stage pressure
Pilot valve: maximum pressure X port	350 bar (5,000 psi)
Pilot valve: maximum pressure Y port [2)]	50 bar (725 psi)
Main stage: maximum operating pressure of main stage port A, B	420 bar (6,000 psi)
Rated flow at Δp_N 5 bar (75 psi); flow direction A→B [3)]	D1: 16,000 l/min (4,227 gpm); D2: 10,200 l/min (2,695 gpm)
Rated flow at Δp_N 5 bar (75 psi); flow direction B→A [3)]	D1: 12,200 l/min (3,223 gpm); D2: 9,200 l/min (2,430 gpm)
Recommended maximum flow [4)]	25,500 l/min (6,736 gpm) (cavity type B)
Flow directions	B → A, A → B
Pilot leakage flow (pilot pressure p_X = 100 bar)	< 1.4 l/min (< 0.37 gpm)
Peak pilot flow for 100 % step	128 l/min (33.8 gpm)
Hydraulic fluid	Hydraulic oil as per DIN 51524 parts 1 to 3 and ISO 11158. Other fluids upon request.
Seal material / fluid compatibility	NBR: mineral oil-based, HFB, HFC fluids
	FKM: mineral oil-based, HFD fluids
	Other fluids on request
Temperature range	-20 to 80 °C (-4 to 176 °F)
Recommended viscosity range at 40 °C (104 °F)	15 to 45 mm^2/s (cSt)
Maximum permissible viscosity range at 40 °C (104 °F)	5 to 400 mm^2/s (cSt)
Recommended cleanliness class as per ISO 4406 for functional safety [5)]	18/15/12
Recommended cleanliness class as per ISO 4406 for longer service life [5)]	17/14/11

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Pressure peaks up to 210 bar (3,000 psi) permissible.
[3)] Values valid for use with recommended cavity diameters.
[4)] The maximum flow velocity in the A-port of the cavity should not exceed 30 m/s.
[5)] The cleanliness of the hydraulic fluid strongly affects functional safety (e.g. safe positioning of the poppet, high resolution) and wear of lands of the pilot valve (e.g. pressure gain, leak losses).

SIZE 100 – X707

Typical Static and Dynamic Data[1)]

Pilot valve	D637 direct operated
Step response time according to ISO 10770-1 (p_x = 210 bar)[2)]	D1: 37 ms; D2: 29 ms
Fail-safe time: biased pilot valve	Approximately 80 ms
Fail-safe time: additional fail-safe subplate valve	Approximately 120 ms
Threshold, typical	< 0.05 %
Threshold, maximum	< 0.1 %
Hysteresis, typical	< 0.1 %
Hysteresis, maximum	< 0.3 %
Null shift at ΔT = 55 K (131 °F)	< 1.5 %

[1)] Technical data and characteristic curves measured with a pilot pressure p_X of 210 bar (3,000 psi), oil viscosity 32 mm^2/s (32 cSt) and oil temperature +40 °C (+104 °F).
[2)] Step response time for 0 to 90 % at 0 to 100 % step.

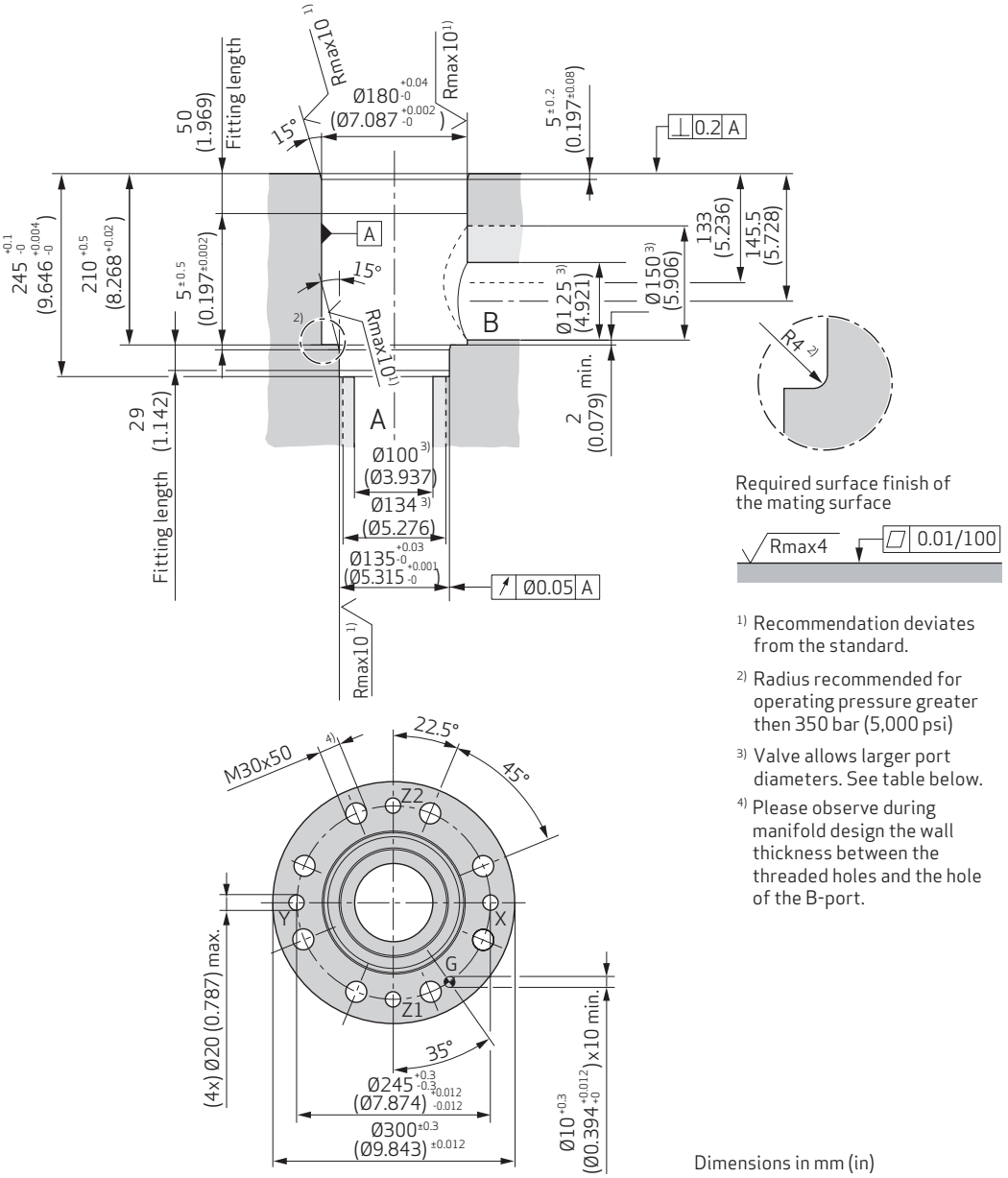
Electrical Data

Duty cycle	100 %
Degree of protection according to IEC/EN 60529	IP65 with mounted mating plugs
Supply voltage [1)]	24 V_{DC}, min. 18 V_{DC}, max. 32 V_{DC}
Supply voltage, 6/2-way fail-safe valve	24 V ±10 % (plug-in connector according to DIN 43650)
Permissible ripple of supply voltage [2)]	2.4 V_{RMS}
Maximum current consumption dynamic [3)]	3.0 A
Fuse protection, external, per valve	3.15 A (slow)
EM compatibility	• Emitted interference as per DIN EN 61000-6-4 • Immunity to interference as per DIN EN 61000-6-2 (evaluation criterion A)

[1)] All connected circuits must be isolated from the main supply by „electrical separation" in accordance with IEC/EN 61558-1 and IEC/EN 61558-2-6. Voltages must be limited to the safety extra-low voltage range in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.
[2)] Frequency from 50 Hz to 10 kHz.
[3)] Measured at ambient temperature 25 °C (77 °F) and supply voltage 24 V.

Size 100 – X707

Cavity Dimensions



1) Recommendation deviates from the standard.

2) Radius recommended for operating pressure greater then 350 bar (5,000 psi)

3) Valve allows larger port diameters. See table below.

4) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

Dimensions in mm (in)

Relationship between Flow Performance and Cavity Dimensions

Beside the standard ISO cavity (cavity type A), Moog recommends two additional cavity types with different main port diameters to achieve the maximum flow performance for the preferred flow directions A → B or B → A.

Rated flow at Δp_N 5 bar (75 psi)

Cavity type	Diameter A-port [mm (in)]	Diameter B-port [mm (in)]	Preferred for flow direction	Flow at direction [l/min (gpm)]			
				D1		D2	
				A to B	B to A	A to B	B to A
A 1)	100 (0.33)	125 (0.41)	-	13,150 (3,474)	10,000 (2,642)	9,300 (2,457)	8,370 (2,211)
B	134 (0.44)	150 (0.52)	B to A	12,530 (3,310)	12,250 (3,236)	9,000 (2,378)	9,240 (2,441)
C	100 (0.33)	150 (0.52)	A to B	16,000 (4,227)	10,300 (2,721)	10,500 (2,774)	8,370 (2,211)

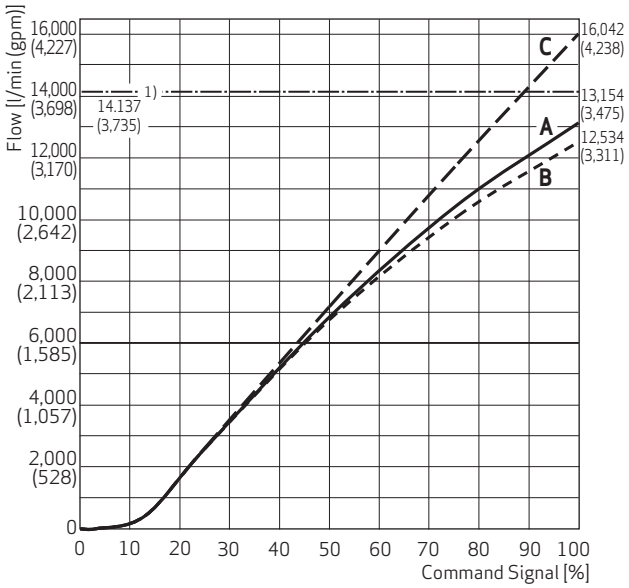
1) Standard ISO cavity

2) Please observe during manifold design the wall thickness between the threaded holes and the hole of the B-port.

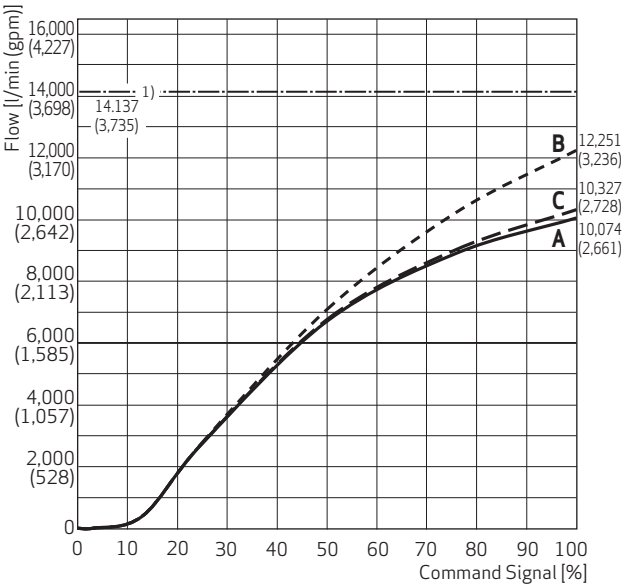
Size 100 – X707

Characteristic Curves D1

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



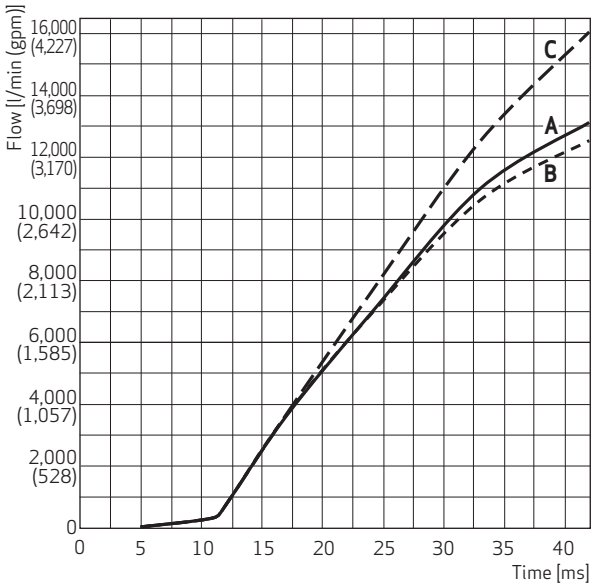
Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



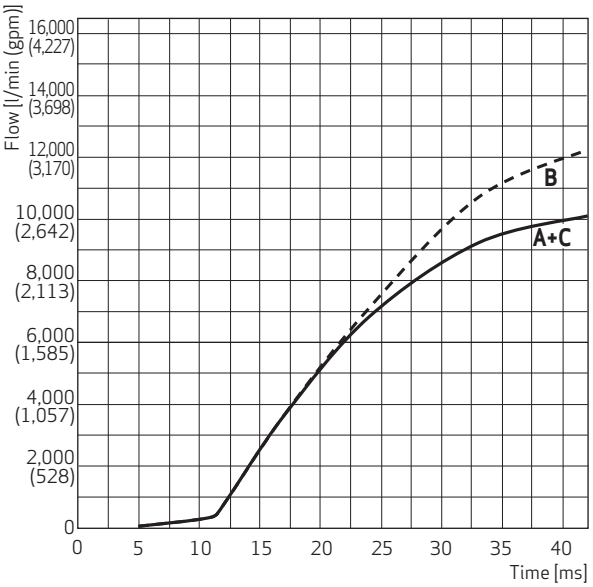
Note: Cartridge opening point set to 2 % command signal

[1] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Flow Response A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Response B → A
(Cavity Types A, B, C; Δp=5 bar)

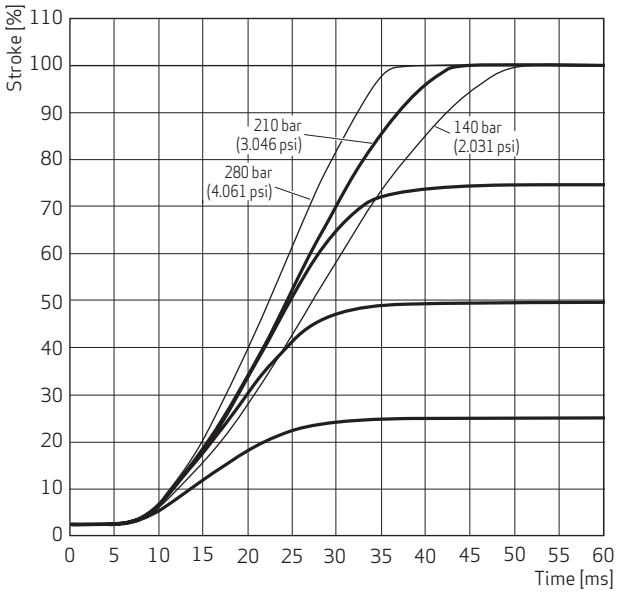


Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

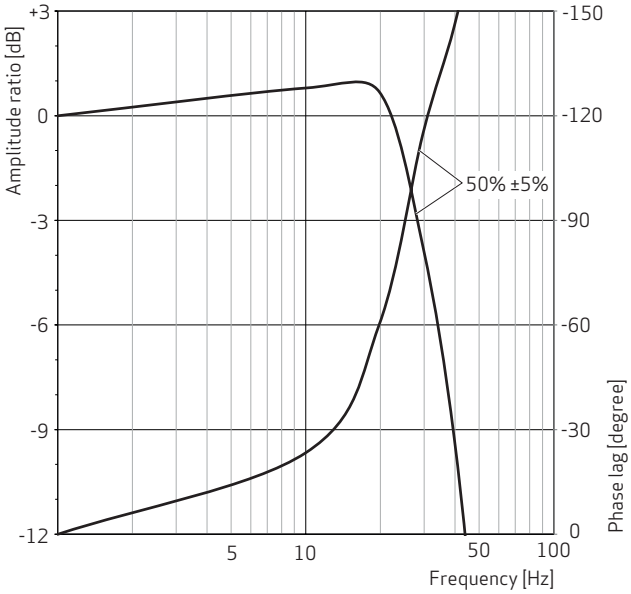
Size 100 – X707

Characteristic Curves D1

Step Response

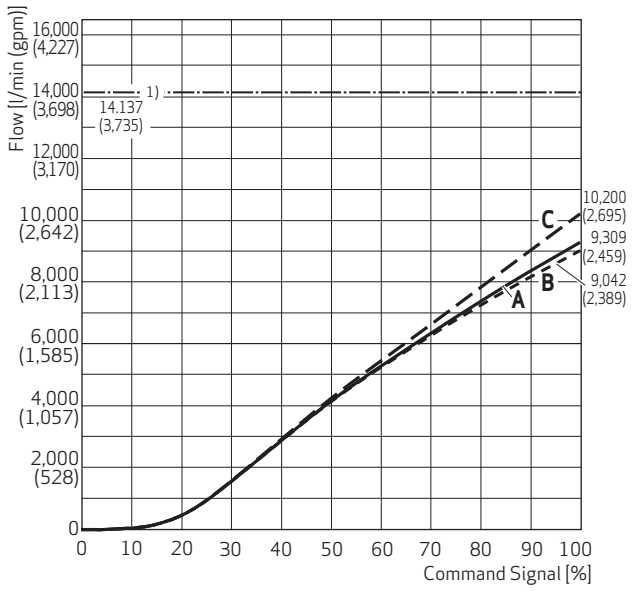


Frequency Response
(Pilot Pressure p_X 210 bar)

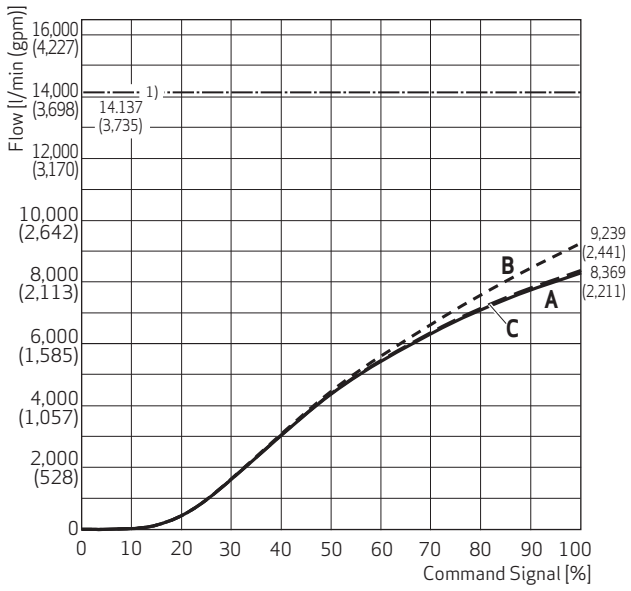


Characteristic Curves D2

Flow Signal Curve A → B
(Cavity Types A, B, C; Δp=5 bar)



Flow Signal Curve B → A
(Cavity Types A, B, C; Δp=5 bar)



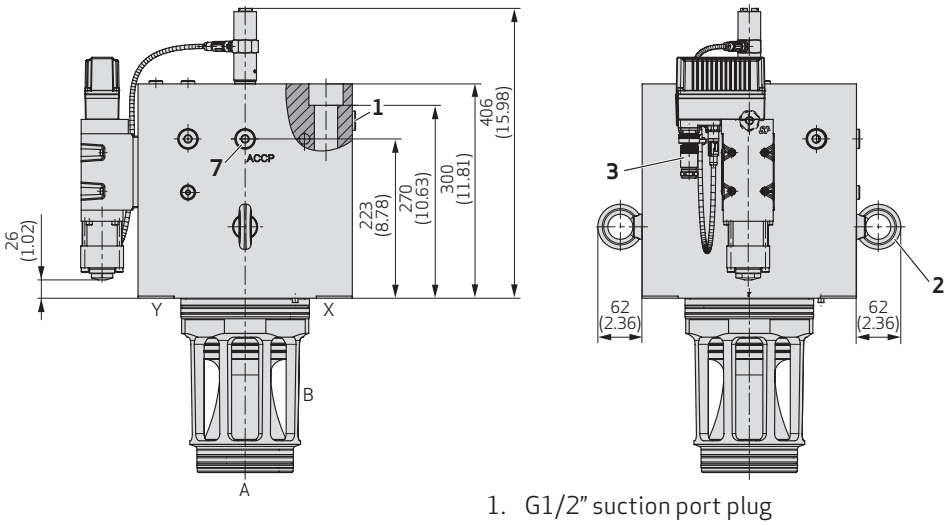
Note: Cartridge opening point set to 2 % command signal

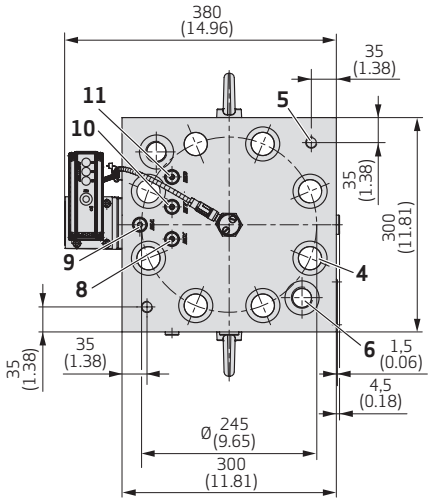
[1)] The dashed dotted line indicates the flow restriction at which the oil velocity in the A port of an ISO cavity (cavity type A) exceeds 30 m/s.

Note: All curves measured with HLP32 at 40 °C ± 5 °C fluid temperature. Pilot pressure p_X 210 bar (except step response)

Size 100 – X707

Installation Drawing for Fail-safe Options A and B



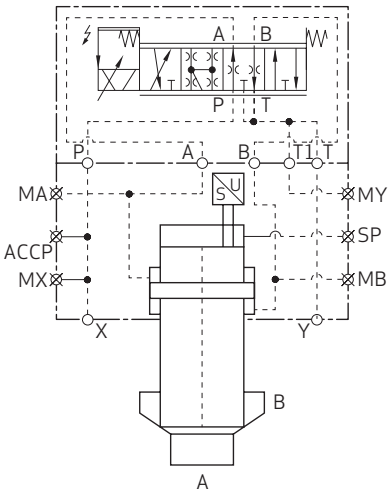


1. G1/2" suction port plug
2. M16 eye bolt (part of delivery)
3. 6+PE electrical valve connector (ordered separately)
4. M30x310 fastening screw location (ordered separately)
5. M16 thread for eye bolt
6. M30 thread for pull screw
7. G1/2" accumulator port plug (accumulator to be ordered separately)
8. G1/4" test port plug (MX)
9. G1/4" test port plug (MA)
10. G1/4" test port plug (MY)
11. G1/4" test port plug (MB)

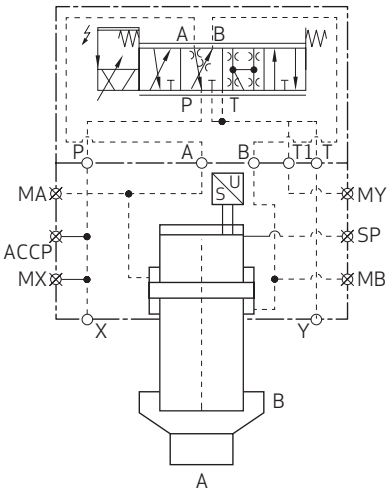
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version C (Normally Closed)

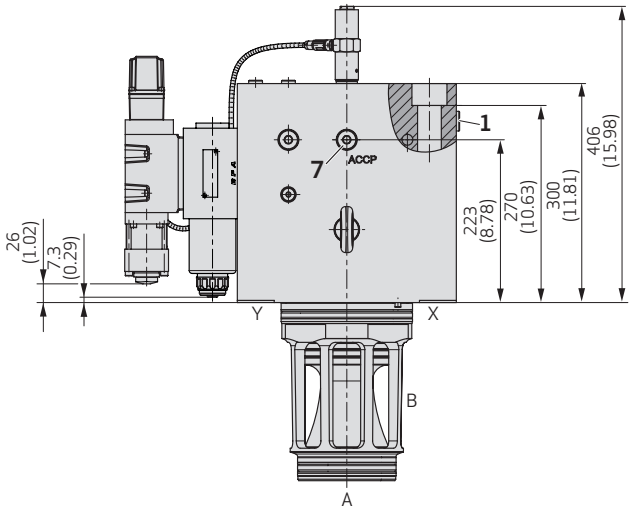


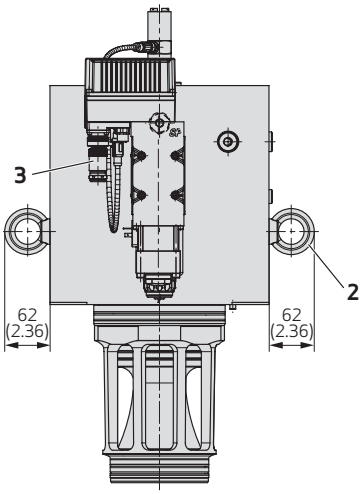
Fail-safe Version D (Normally Open)

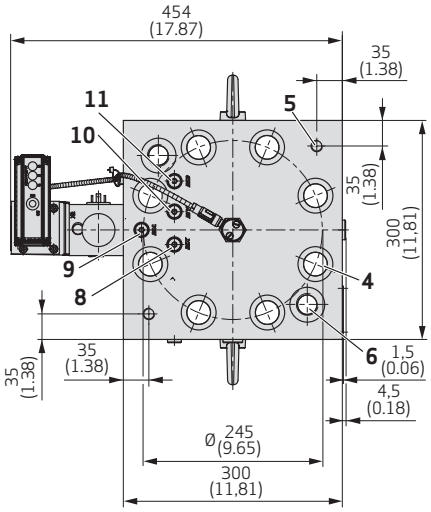


Size 100 – X707

Installation Drawing for Fail-safe Options C and D





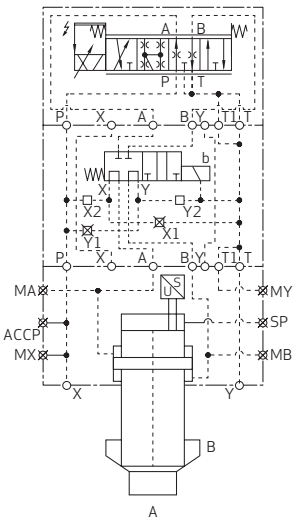


1. G1/2" suction port plug
2. M16 eye bolt (part of delivery)
3. 6+PE electrical valve connector (ordered separately)
4. M30x310 fastening screw location (ordered separately)
5. M16 thread for eye bolt
6. M30 thread for pull screw
7. G1/2" accumulator port plug (accumulator to be ordered separately)
8. G1/4" test port plug (MX)
9. G1/4" test port plug (MA)
10. G1/4" test port plug (MY)
11. G1/4" test port plug (MB)

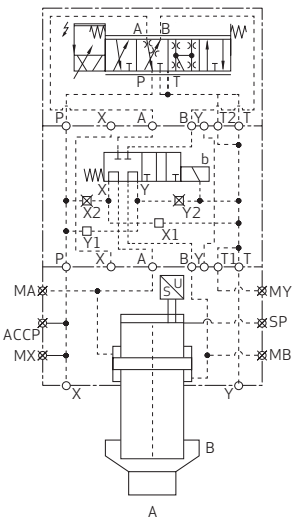
Dimensions in mm (in)

Hydraulic Symbols

Fail-safe Version A (Normally Closed)



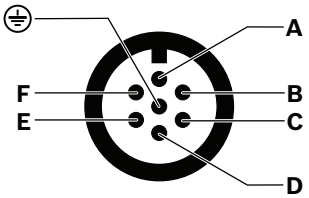
Fail-safe Version B (Normally Open)



ELECTRONICS

Pin Assignment for Valves with 6-pole + PE Connector, Pin Contacts (X1)

According to EN 175201-804, mating connector (type R or S, metal) with preleading protective earth pin (⏚)



Pin	Pin assignment	Signal type [1]	
		Voltage floating	Current floating [3]
A	Supply voltage	U_{Supply} = 24 V_{DC} (18 to 32 V_{DC}) referenced to GND (reverse polarity protected against GND)	
B	GND	Power ground/signal ground	
C	Enable input	U_{CB} > 8.5 to 32 V_{DC} referenced to GND: Valve ready for operation (enabled) U_{CB} < 6.5 V_{DC} referenced to GND: Valve disabled The input resistance is > 5 kΩ	
D	Command signal - spool position	U_{in} = U_{DE} R_{in} = 200 kΩ	I_{in} = I_D = -I_E R_{in} = 200 Ω I_{max} = ±25 mA
E	Reference point input rated command	Reference for pin D [2]	
F	Actual value - spool position	U_{F-B} = 0 to 10 V; U_{F-B} is proportional to the poppet position	I_{out} = 4 to 20 mA referenced to GND; I_{out} is proportional to the poppet position; the output is short-circuit-proof; R_L = 0 to 500 Ω
⏚	Protective earth (PE)	Connected with valve body	

[1] Signal ranges see next page.
[2] The potential difference between pins D or E referenced to pin B must be between -15 and +32 V.
[3] Command signals I_{in} < 3 mA (due to cable break, for example) indicates a failure of 4 to 20 mA signals. The valve reaction to this failure may be customized and activated by the customer.

ELECTRONICS

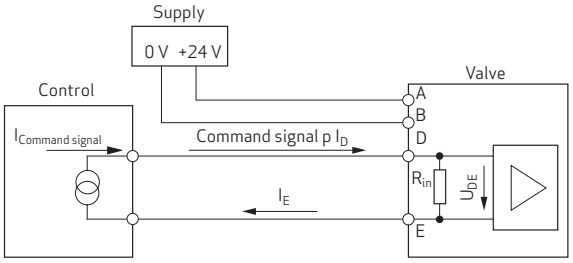
Ordering Codes and Signals for Valves with 6-pole + PE Connector (X1)

Ordering Code	Command signal 0...100 % poppet position		Actual value 0...100 % poppet position	
B	I_D	4 to 20 mA	I_F	4 to 20 mA
A	U_D - U_E	0 to +10 V	U_F - U_B	0 to 10 V

Note: See inside back cover for complete ordering information.

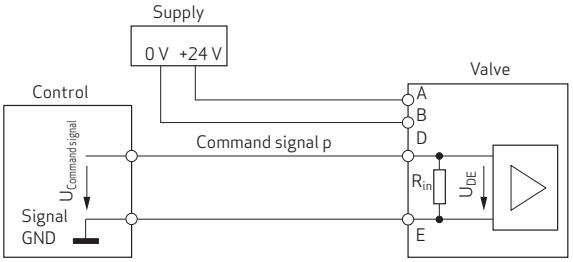
Command Signal Current Floating, Ordering Code B

The poppet position is proportional to I_D = - I_E. For a command signal I_D = 20 mA the poppet moves to 100 % open. For a command signal I_D = 4 mA the poppet is in the closed position.



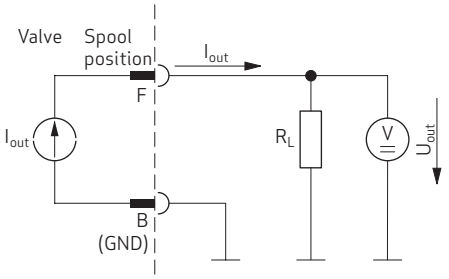
Command Signal Voltage Floating, Ordering Code A

The poppet position is proportional to U_D – U_E. For a command signal U_D – U_E = +10 V the poppet moves to 100 % open. For a command signal U_D – U_E = 0 V the poppet is in the closed position.



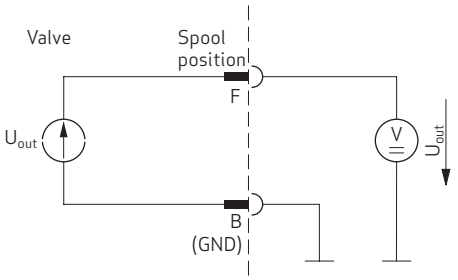
Actual Value 4 to 20 mA, Ordering Code B

The signal can be used for monitoring and fault detection purposes. The spool position is proportional to I_{out}. The spool position corresponds to 4 to 20 mA. 20 mA corresponds to 100 % valve opening. A cable fault is detected by I_{out} = 0 mA. Optional use: Actual value U_{out} = 2 to 10 V with resistor R_L = 500 Ω (0.25 W) provided by customer.



Actual Value 0 to 10 V, Ordering Code A

The signal can be used for monitoring and fault detection purposes. The poppet position is proportional to U_{out}. The poppet position corresponds to 0 to 10 V. 10 V corresponds to 100 % valve opening.



Note: For more information see Technical Notes TN 353 „Protective Grounding and Electrical Shielding of Valves“ and TN 494 „Maximum Permissible Length of Electric Cables for Valves with Integrated Electronics“. Visit www.moog.com/industrial/literature to download document.

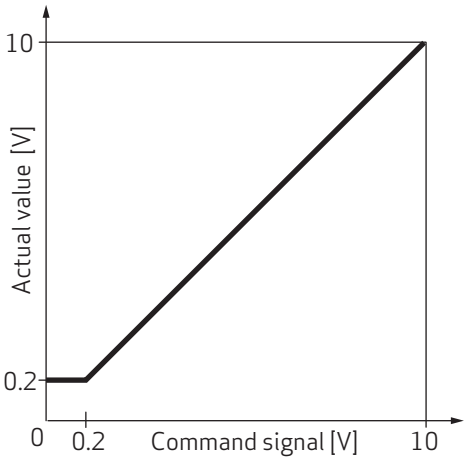
ELECTRONICS

Signal Ranges

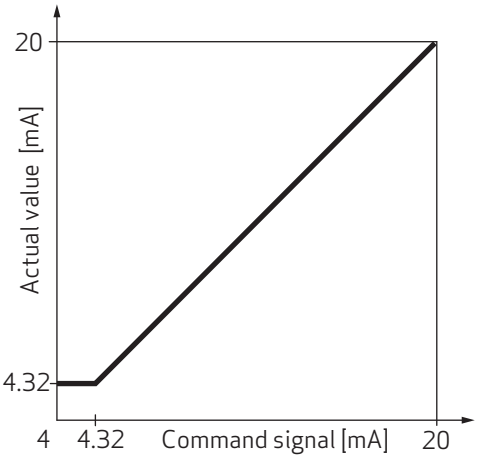
The poppet closes and opens at 2 % of the command value. Below this value, the direct drive pilot valve presses the main stage cartridge poppet on the sleeve's metallic seat, closing the connection between ports A and B without leakage.

Above 2 % command signal the poppet position (actual value) follows the command value.

Command Signal 0 to 10 V (0 to 100 %)



Command Signal 4 to 20 mA (0 to 100 %)



Electronics Logic Functions

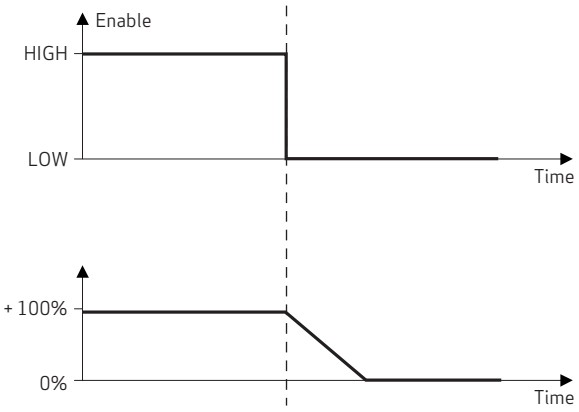
The onboard electronics of the X700 Valve Series are equipped with several logic functions. Short descriptions of these functions are given in the following.

Enable Input

The enable input is used to activate or deactivate the valve while the electric supply is powered. If the enable input is switched to HIGH, the valve is in normal operation mode. If the enable input is switched to LOW, there are two possible modes depending on the option chosen for position 11 "Fail-safe function" of the ordering code:

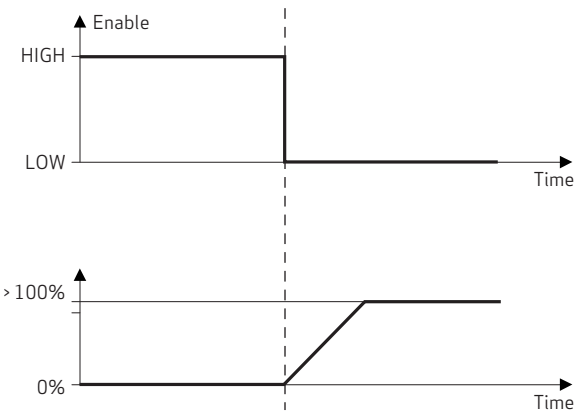
1. The main stage cartridge poppet moves to the closed position. To achieve this, the control current to the linear force motor of the pilot valve is switched off and the pilot valves spool moves to its spring centered position, which is about 10 to 20 % open towards P → A.

Move main stage cartridge to closed position



2. The main stage cartridge poppet moves to the fully opened position. To achieve this, the control current to the linear force motor of the pilot valve is switched off and the pilot valves spool moves to its spring centered position, which is about 10 to 20 % open towards P → B.

Move main stage cartridge to opened position



ELECTRONICS

Installation Drawings Electronic Housing

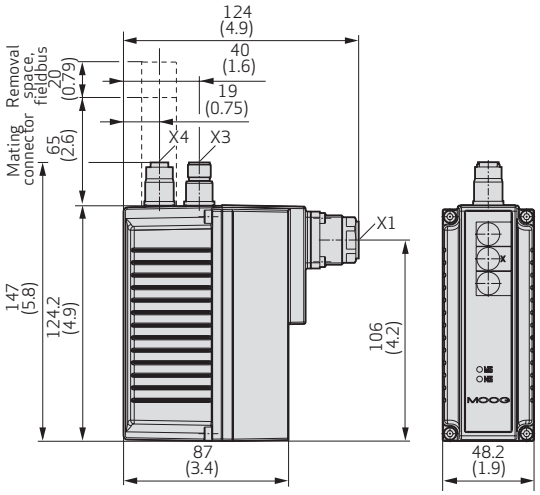
Installation Drawing for Valves with CANopen Fieldbus Connector

Ordering code C: CANopen

X1 Valve connector

X3 Fieldbus connector

X4 Fieldbus connector



Installation Drawings for Valves with EtherCAT Fieldbus Connector

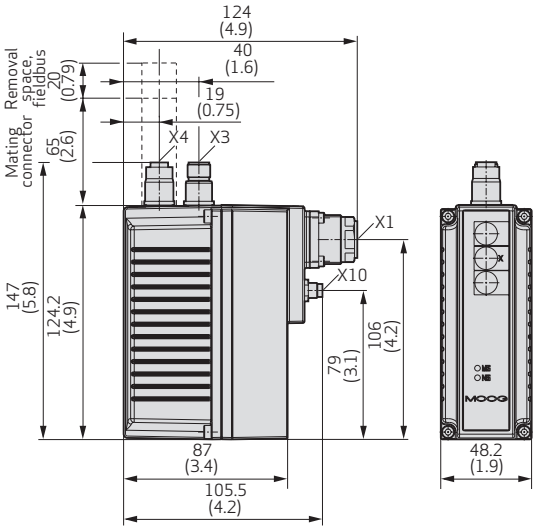
Ordering code E: EtherCAT

X1 Valve connector

X3 Fieldbus connector

X4 Fieldbus connector

X10 Service connector

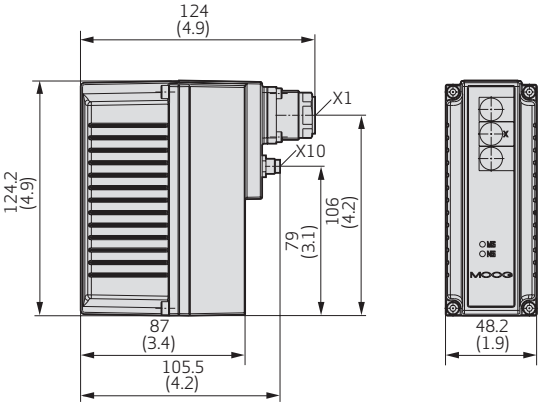


Installation Drawing for Valves with Analog Activation

Ordering code Z: Without fieldbus connector

X1 Valve connector

X10 Service connector



ELECTRONICS

Fieldbus Connectors

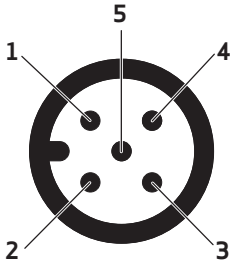
CANopen Connectors (X3, X4)

- Ordering code[1] C: CANopen
- Coding A
- Thread M12x1
- 5-pole

Pin	Signal X3, X4	Description
1	CAN_SHLD	Shield
2	CAN_V+	Not connected in the valve
3	CAN_GND	Mass
4	CAN_H	Transceiver H
5	CAN_L	Transceiver L

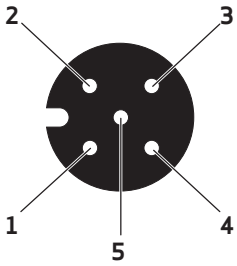
[1] See Ordering Code position 12

External thread, pin contact



View on CAN connector X3

Internal thread, socket contact



View on CAN connector X4

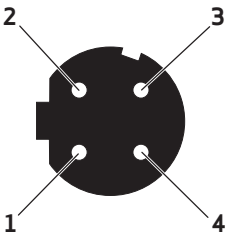
EtherCAT IN/OUT Connectors (X3, X4)

- Ordering code[1] E: EtherCAT
- Coding D
- Thread M12x1
- 4-pole

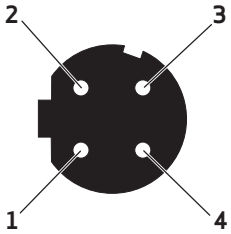
Pin	Signal X4 IN	Signal X3 OUT	Description
1	TX + IN	TX + OUT	Transmit
2	RX + IN	RX + OUT	Receive
3	TX – IN	TX – OUT	Transmit
4	RX – IN	RX – OUT	Receive

[1] See Ordering Code position 12

Internal thread, socket contact



Internal thread, socket contact



ELECTRONICS

Digital Valve Electronics

The valve electronics is based on microprocessor hardware with corresponding A/D-D/A converters for analog input and output signals. All functions of the valve are integrated in the firmware. The digital electronics offer the following advantages over conventional analog electronics:

- Greater flexibility: Ability to change the valve parameters easily using configuration software and the possibility of linearizing flow curves
- Higher reliability due to integrated monitoring functions
- Easier maintenance due to diagnostic capability and recording the fault history
- Remote maintenance and setup

Using the optional fieldbus interface cuts down the amount of wiring needed and eliminates the need for control interfaces in the PLC.

In the basic version the valve has a standard connector, and service connector and does not include the fieldbus interface. In this case the valve is actuated via an analog command signal.

The service connector offers the possibility to connect the valve to a PC or notebook via an USB-to-CAN adaptor (see accessories). Its CANopen interface offers access to the valve parameters, which can be changed and monitored, as well as diagnosing valve performance and possible faults.

The flexibility of the integrated firmware enables the user to optimize the valve characteristic onsite as required by the application:

- Adapting the valve flow curve to the needs of the controlled system
- Adjusting the maximum valve opening
- Defining fault reactions

The results obtained by the parameter changes can be viewed and analyzed directly using the built-in data logger. The parameters optimized during commissioning can be saved and copied. When the valve is replaced or used for series applications no tuning is required. The valves are supplied with a predefined parameter set if required.

Optional Fieldbus Interface

When the valves are operated with a fieldbus, they are parameterized, activated and monitored via the fieldbus. CANopen or EtherCAT interfaces are available. Other fieldbus communication protocols are available upon request. The fieldbus interface is equipped with two bus connectors (IN/OUT) for cost-effective wiring. Valves can be integrated directly into the bus without any external T-joints. The electrically isolated fieldbus interface ensures reliable data transfer. Data from additional analog inputs or from SSI and encoders can be transmitted via fieldbus (inputs available upon request).

ELECTRONICS

Fieldbus Interface

Modern automation technology is characterized by an increasing decentralization of processing functions via serial data communication systems. The use of serial bus systems in place of analog signal transfer guarantees greater system flexibility with regard to alterations and expansions.

There is also considerable potential for saving project planning and installation costs in many areas of industrial automation. Further possibilities of parameterization, better diagnostics and a reduction of the number of variants are advantages which have only been made possible by the use of fieldbuses.

VDMA Profile Fluid Power Technology

In a working group within the VDMA (German Machinery and Plant Manufacturers' Association), a device profile was created in collaboration with numerous well-known hydraulic system manufacturers. This profile describes the communication between hydraulic components via a fieldbus and defines uniform functions and parameters. In this way, a standardized exchange format covering all manufacturers was created.

The Moog X700 Series Servo Cartridges can be equipped with the following fieldbus interfaces: CANopen or EtherCAT.

CANopen

According to ISO 11898, IEC/EN 61800-7 CAN bus was originally developed for use in automobiles, but has also been used for years in a variety of industrial applications.

The CAN bus is primarily designed for transmission reliability and speed.

The CAN bus has the following general features:

- Multi-master system: Each node can transmit and receive
- Topology: Line structure with short stub cables
- Network expansion and transmission rates:
  - Up to 25 m (80.4 ft) at 1 Mbit/s
  - Up to 5,000 m (16,090 ft) at 25 kbit/s
- Addressing type: Message-orientated via identifiers. Priority assignment of messages possible via identifiers
- Safety: Hamming distance=6, i.e. up to 6 individual errors per message are detected
- CiA408: Device profile fluid power technology for proportional valves and hydrostatic transmissions
- Other used CiA specifications: CiA102, CiA301, CiA303, CiA305 and CiA306
- Bus physics: ISO 11898
- Maximum number of nodes: 127

EtherCAT

According to IEC 61800-7 EtherCAT was developed as an industry bus based on Ethernet to meet the increasing demands for faster cycle times. The EtherCAT bus is designed for high data transmission rates and fast cycle times.

The EtherCAT bus has the following features:

- Single-master system: The master initiates communication. The slaves react only upon request
- Topology: Line, star, tree and ring structure based on the daisy chain principle
- Network expansion and transmission rates: 100 m (321.8 ft) between two nodes at 100 Mbit/s
- Addressing type: Address-orientated, one telegram for all nodes
- Bus physics: Fast Ethernet 100 Base Tx
- Maximum number of nodes: 65,535

CONFIGURATION SOFTWARE

The Moog Valve and Pump Configuration Software is a Microsoft Windows®-based software to configure digital Moog valves and pumps (DCV / ACV / RKP-D).

It allows the user to control and exchange data between a PC and a Moog Digital Control Servo Valves, Axis Control Valves as well as Moog Radial Piston Pumps.

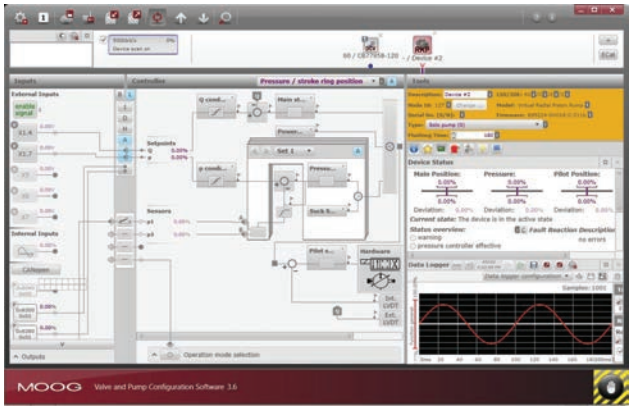
System parameters can be set, monitored, recorded and visualized with a flexible graphical user interface.

Download Page

The software is provided by Moog free of charge on the download page.

Various manuals and the configuration files for fieldbus masters (EDS, ESI, XDD and GSD) are also available there.

https://www.moogsoftwaredownload.com/valves-pumps.html



System Requirements / Minimum Requirements

- PC / Notebook with Windows 7/8.1/10
- Internet Explorer 9
- 1 GB RAM
- 1 GB free hard disk space
- Monitor resolution 1024 x 768 pixels
- Keyboard, mouse

Equipment

To connect the software with a device, the following additional equipment is required.

Setup 1: Connection via USB-TO-CAN-Adapter

- CANopen fieldbus interface or CANopen service interface at the Moog valve/pump
- A free USB port at service PC
- USB-TO-CAN-adapter with driver. Interface card IXXAT USB-to-CAN compact V2 recommended (Moog order code C43094-001)
- CAN-cable (Sub-D9 to M12; with termination resistor) recommended (Moog order code TD3999-137). Optional M8 to M12, A-coded Adapter (Moog order code CA40934-001) .

Setup 2: Connection via EtherCAT-Master-Mailbox-Interface (TwinCAT)

- LAN connection to an EtherCAT-Master-Mailbox-Interface (TwinCAT)

ACCESSORIES AND SPARE PARTS

Series-specific

Spare Parts

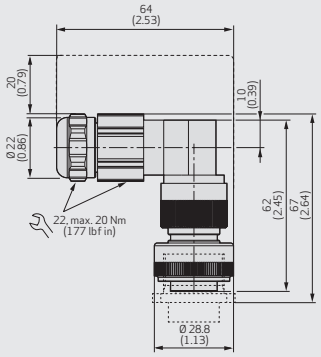
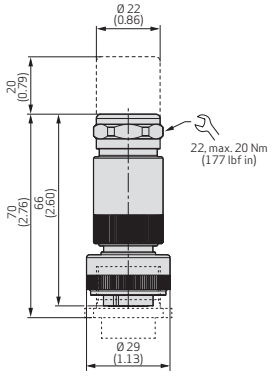
Part designation	Description	Material	Part number
Customer seal kit X702 (size 32)[1)]	O-ring and backup-rings for main stage cartridge, cover and pilot valve	FKM	X702DC001V
		NBR	X702DC001N
Customer seal kit X703 (size 40)[1)]		FKM	X703DC001V
		NBR	X703DC001N
Customer seal kit X704 (size 50)[1)]		FKM	X704DC001V
		NBR	X704DC001N
Customer seal kit X705 (size 63)[1)]		FKM	X705DC001V
		NBR	X705DC001N
Customer seal kit X706 (size 80)[1)]		FKM	X706DC001V
		NBR	X706DC001N
Customer seal kit X707 (size 100)[1)]		FKM	X707DC001V
		NBR	X707DC001N
Customer seal kit D636 pilot valve (X702, X703, X704)	O-rings for ports P, T, A, B and Y	FKM	XEB19161-000V00
		NBR	XEB19161-000N00
Customer seal kit D637 pilot valve (X705, X706, X707)		FKM	XEB19517-000V00
		NBR	XEB19517-000N00
Service seal kit fail-safe sandwich valve (X702, X703, X704)	O-rings for ports P, T, A, B and solenoid, plugs	FKM	XEB18320D000V00
		NBR	XEB18320D000N00
Service seal kit fail-safe sandwich valve (X705, X706, X707)		FKM	XEB19447D000V00
		NBR	XEB19447D000N00

[1)] Only seals and plugs accessible from outside

ACCESSORIES AND SPARE PARTS

Series-specific

Accessories

Part designation	Description	Image	Part number
Mating connector, elbow 6-pole + PE	In accordance with EN 175201-804, type S, metal, IP65, cable Ø 8 to 12 mm (0.31 to 0.47 in)		B97069-061
Mating connector, straight 6-pole + PE	In accordance with EN 175201-804, type R, metal, IP65, crimp contact Ø 0.75 to 1.5 mm² (0.0012 to 0.0023 in²), conus Ø 12.2 mm (0.48 in), cable Ø 9 to 12 mm (0.35 to 0.47 in), sealing element Ø 9 to 13 mm (0.35 to 0.51 in)		B97007-061
Service and commissioning set	Adapter for service connector X10, M8x1 to M12x1	-	CA40934-001
	Configuration/commissioning cable 2 m (6.4 ft), M12x1 to EIA-232	-	TD3999-137
	USB to CAN adapter (IXXAT)	-	C43094-001
	Moog Valve and Pump Configuration Software	-	-

Documents [1)]

Part designation	Description	Part number
Manual	Mounting and Installation Notes X700 Series Servo Cartridge Valve	CC95778-001

[1)] Visit www.moog.com/industrial/literature to download a document using the part number in a search

ORDERING CODE

Model number (assigned at the factory)

Type designation

X702-X707	-	....	-	....

1	2	3	4	5	6	7	8	9	10	11	12	/	13
	-												

X702	Size 32
X703	Size 40
X704	Size 50
X705	Size 63
X706	Size 80
X707	Size 100

Specification status	
-	Series specification

Model designation

Variants

1	**Seal material**
N	NBR
V	FPM/FKM

2	**Valve type**
S2	2-Way Servo Cartridge with digital electronics

3	**Installation type**
E	Manifold installation

4	**Size**
032	ISO 7368-09-5-1-16
040	ISO 7368-10-7-1-16
050	ISO 7368-11-9-1-16
063	ISO 7368-12-11-1-16
080	ISO 7368-13-13-1-16
100	ISO 7368 -14-14-1-16

5	**Series**
A	Release status

6	**Flow characteristic**
D1	Standard, linear, 3 % overlap and 10 % progressive fine control
D2	Linear, 5 % overlap, 15 % progressive fine control [1]

7	**Pilot valve**
A	Standard pilot valve D636, CETOP3 for valve sizes 32, 40 and 50
B	Standard pilot valve D637, CETOP 5 for valve sizes 63, 80 and 100

8	**Valve connector**
1	6 + PE EN 175201 part 804

9	**Analog signals**
A	Command: 0 - 10 V, feedback 0 - 10 V
B	Command: 4 - 20 mA, feedback 4 - 20 mA

10	**Pilot pressure**
1	> 20 bar to 70 bar
2	> 70 bar to 140 bar
3	> 140 bar to 210 bar
4	> 210 bar to 280 bar
5	> 280 bar to 350 bar

11	**Fail-safe function**
A	Biased pilot valve, cartridge closed
B	Biased pilot valve, cartridge open
C	6/2 fail-safe valve, cartridge closed
D	6/2 fail-safe valve, cartridge open

12	**Fieldbus**
C	CANopen, EN 50325-4
E	EtherCat, IEC/PAS 62407
Z	Without Fieldbus

13	**Modification (assigned by Moog)**
Z_	Special design

[1] Lower rated flow for better backwards compatibility with Moog DSHR series

Options partly only against surcharge

Not all combinations available

Preferred options are highlighted in gray

MORE PRODUCTS. MORE SUPPORT.

Moog designs a range of motion control products to complement those featured in this document. Moog also provides service and support for all of our products. For more information, contact the Moog facility closest to you.

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