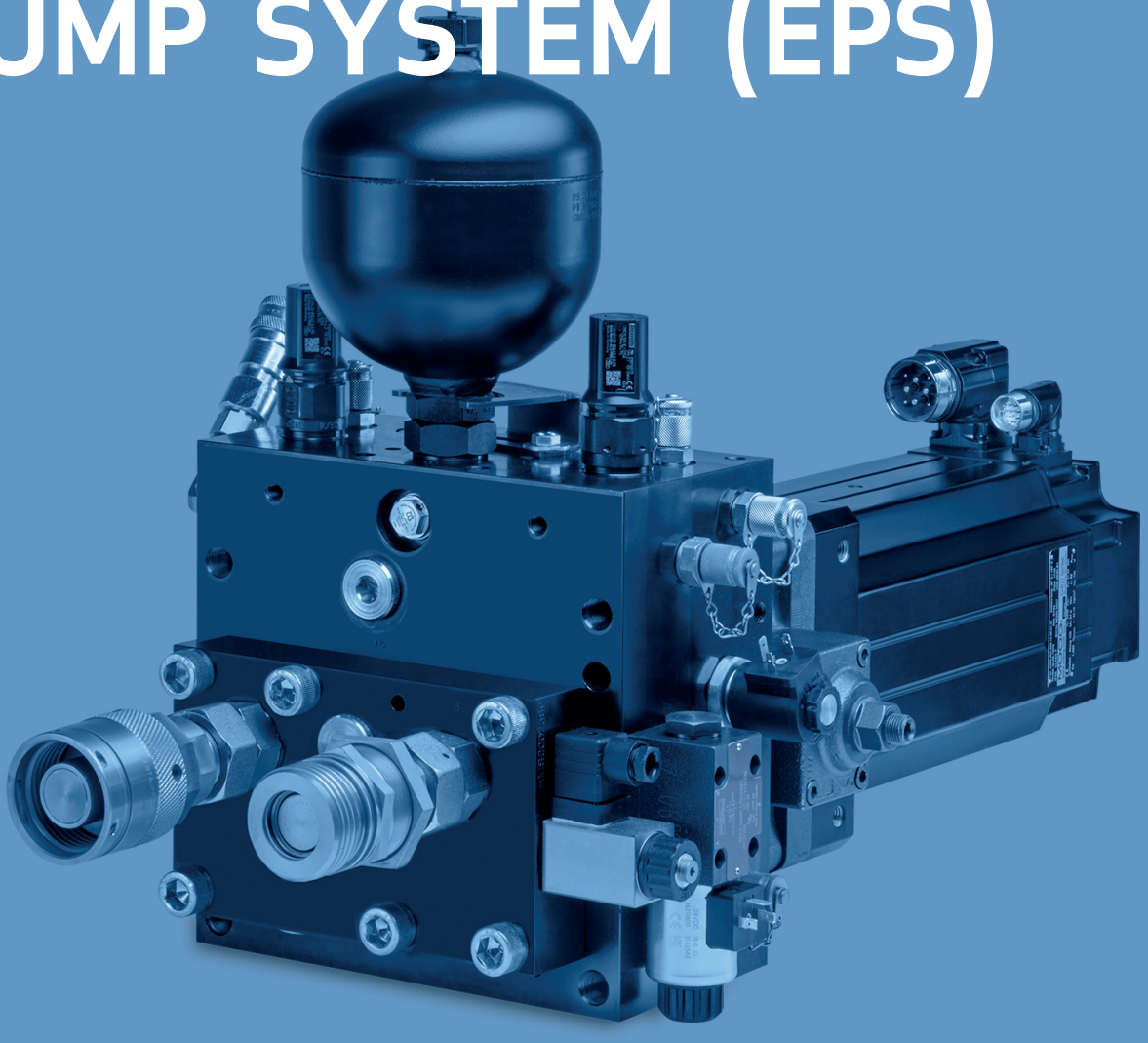
ELECTROHYDROSTATIC PUMP SYSTEM (EPS)



Rev. A, November 2023

MODULAR AND ENERGY-EFFICIENT DRIVE SOLUTION WITH A HIGH DEGREE OF FREEDOM FOR USERS AND OPERATORS.

WHAT MOVES YOUR WORLD

MOOG

If demanding motion systems and highly flexible designs are required, then Moog expertise is here to assist you. Through our collaborative approach, our creativity and first class technology, we help you to solve even the most complex motion tasks, increase the performance of your products and create solutions that far exceed today´s expectations.

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ELECTROHYDROSTATIC PUMP SYSTEM (EPS)

The Electrohydrostatic Pump System (EPS) enhances Moog's portfolio of electrohydrostatic components and drive systems by providing a modular and energy-efficient drive solution that offers users and operators a remarkable level of flexibility. It is an excellent choice for industrial machine builders in search of compact and energy-saving alternatives to conventional hydraulic or electromechanical motion control solutions.

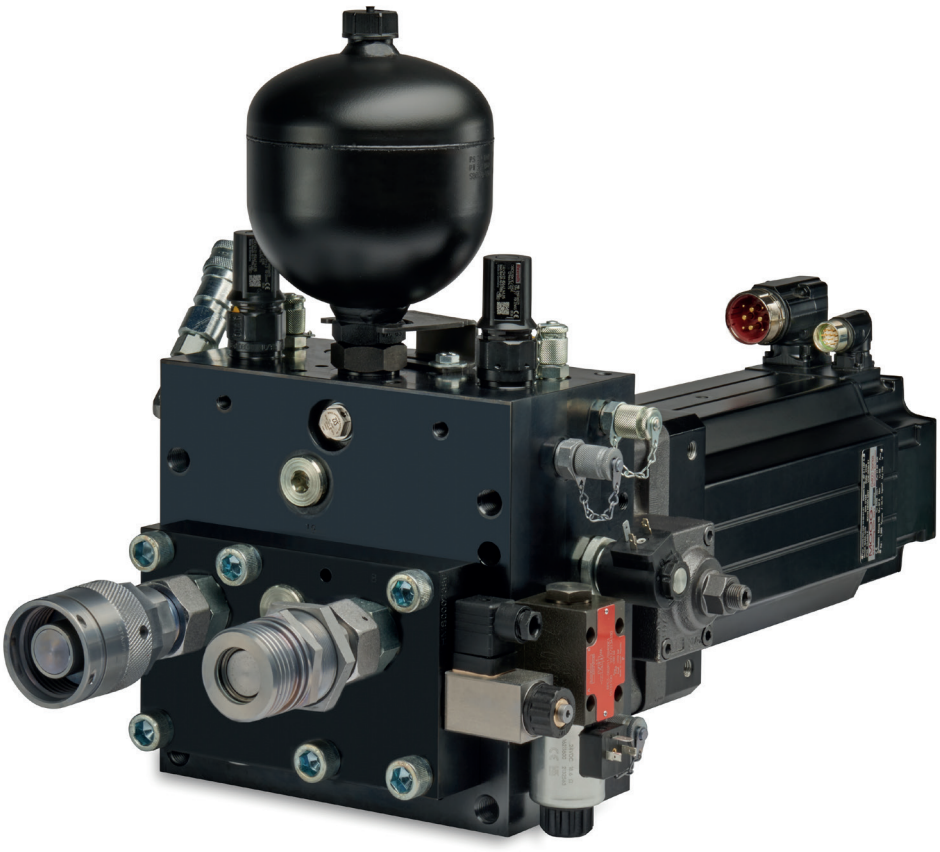
Comprised of an Electrohydrostatic Pump Unit (EPU) and a standardized manifold with a hydraulic accumulator, the EPS is a complete system that does not include an actuator. It can be easily integrated into machine concepts, whether they are retrofit projects or new developments.

The EPS represents a compelling solution for the industrial machine manufacturing market, combining the advantages of electrohydraulic and electromechanical technology. Automation engineers who prioritize energy efficiency, environmental cleanliness, and the high-power density of electrohydraulic actuation will find the EPS to be an attractive solution.

The standardized system allows the use of existing customer components such as hydraulic cylinders. The standardized connections and components facilitate easy integration and scaling, reducing development, design and assembly times for faster time-to-market.

Key features of the EPS include outstanding energy efficiency and virtually wearless operation. Its high flexibility, scalability, and adaptability make it suitable for a wide range of industrial machinery.

The EPS offers a versatile solution, positioned between Moog's EPU and Electrohydrostatic Actuation Systems (EAS), empowering customers to tailor the system to their specific requirements. It provides a range of motor-pump units and power classes, along with various cooling options and additional features like functional safety.



TECHNOLOGY OVERVIEW

In electromechanical actuation systems a frequency-controlled servo motor drives a mechanical actuator via a mechanical gearbox. In electrohydraulic resistance control systems, a central hydraulic power unit (HPU) drives one or more hydraulic actuators (cylinder, hydraulic motor), controlled by servo or proportional valves. Electrohydrostatic Pump Systems (EPS) feature a frequency-controlled servo motor that can drive a hydraulic actuator via hydrostatic transmission, thereby combining the advantages of electromechanical and electrohydraulic technology.

Principally, this allows for the electrical coupling of several machine axes in a common electrical intermediate circuit (DC-Bus), and enables demand driven energy distribution that includes an energy recovery capability.

Depending on the required performances, installation interfaces, work environment, we support the customer in selection of the most appropriate solution. Our global engineering teams can help customers select and integrate these standardized modules able to meet a range of unique application requirements across a number of industries.

Optimal design of the system peripherals can reduce the size and power of electronic components thus the connected load. In combination with an intelligent energy management system, this leads to significant savings in total energy consumption. Moog offers a wide range of suitable power electronics and software solutions to exploit this potential.

Applications

The EPS is highly versatile and compatible with various industrial machinery. It can be effectively utilized across a wide range of applications, including but not limited to:

- Die cushion systems
- Test and simulation platforms
- Metal forming and presses
- Hydraulic pressure intensifiers
- Marine and offshore
- Mobile machines with hybrid or electric drive concepts
- Plastics machinery
- Heavy industry

Electrohydrostatic Portfolio

Depending on our customers' needs, we offer a range of options within our portfolio. In terms of scope and flexibility, the EPS positions itself between the EPU and the Electrohydrostatic Actuation Systems (EAS).

Moog product	Advantages
Compact EAS, Modular EAS, Customized EAS	• Low hydraulic know-how required • Plug and Play solutions
EPS	• Flexibility in system design and integration • Use of customer components • Cost optimization due to standardization
EPU	• Customer can develop and build system by himself • High flexibility in machine integration

FEATURES AND BENEFITS

Features	Benefits
High force capability and power density	Provides an attractive alternative to EH and EM actuation, allowing for more efficient and effective machine operation
Low noise emission	Quieter machine operation for improved working conditions and reduced noise pollution
More environmentally clean due to lower oil requirement	Lower maintenance and operating costs, as well as reduced fire insurance costs, while also being more environmentally friendly
Wear-resistant and overload-safe drive	Longer lifetime of drive components and moving parts, as well as quick and easy machine or equipment restarts after an overload occurs
Few electrical interfaces	Low startup effort and cost, with no need for staff with knowledge of hydraulics, reducing overall costs
Decentralized drive system	Self-contained system that eliminates the need for an external hydraulic power pack and elaborate piping, reducing procurement and maintenance costs
Simple and compact design with no classic valve and control technology	Less energy required for operation, reduced commissioning, training, and maintenance costs, and a smaller machine footprint
One base manifold for each size	Reduced spare unit and spare part costs
Filtering and cooling connection prepared	Direct connection of filtering and cooling unit possible, increasing product lifetime due to filtering and bringing away internal losses
Closed and half open system possible	Easy to integrate in existing infrastructure
Standardization in regards of used components	Fast lead time and streamlined maintenance and repairs
Direct connection with cylinder possible	Enables a compact and self-contained system design
High energy efficiency	Low energy consumption with low cooling requirements

GENERAL TECHNICAL DATA

Size			**019**	**032**	**080**	**140**	**250**
Maximum pump flow			85 l/min (22.5 gpm)	118 l/min (32.2 gpm)	216 l/min (57.1 gpm)	322 l/min (85.1 gpm)	450 l/min (118.9 gpm)
Maximum system pressure			350 bar (5,076 psi)				
Maximum pump housing pressure			10 bar (145 psi)				
Maximum pre pressure			• 10 bar (145 psi) for self-contained system • 25 bar (363 psi) for half-open system				
Motor Pump Unit		Pump version	Radial Piston Pump, fixed or dual displacement				
		Motor version	Brushless servo motor, natural, fan or liquid cooled (oil/water)				
Temperature range		Ambient	-15 to +40 °C (5 to 104 °F)				
		Fluid	-15 to +80 °C (5 to 176 °F)				
Seal material			NBR, FKM				
Pre pressure type			Self-contained system, half-open system				
Operating fluid			Mineral oil according to DIN 51524, HFD and others upon request				
Viscosity			Permissible viscosity operational range from 12 to 100 mm^2/s (12 to 100 cSt).				
System filtration			• NAS 1638, class 9 • ISO 4406 class 20/18/15; obtained with filter fineness of β20 = 75				
Standard pressure sensor			• 0 to 400 bar (0 to 5,802 psi), 4 to 20 mA • 0 to 25 bar (0 to 363 psi), 4 to 20 mA				
Standard temperature sensor			-50 to 150 °C (-58 to 302 °F), 4 to 20 mA				
Mounting option to cylinder			Piping or hoses				
Hoses / pipes	**Length**		Maximum 1.5 m				
	Flow rate	A- and B-port	6 to 8 m/s (recommended				
		T- and L-port	2 to 4 m/s (recommended)				
Mounting option to frame			Flange mounting interface				
Installation position			Any				
Installation note			To avoid pump damage the housing pressure p_L must not exceed the pressure in the low-pressure line (p_A or p_B) by more than 1 bar. Design the drain line with the lowest possible pressure losses. Maximal pump speed is preload pressure dependent on suction line for self-contained system. Preload pressure on the boost HPU should be monitored for half-open system. The fluid temperature in the tank shall not exceed the temperature of the pump by more than +25 °C (+77 °F). If this should occur, the pump shall be jog started for intervals of approximately 1 to 2 seconds until pump casing has heated up.				

GENERAL TECHNICAL DATA

Additional Functions Half-open (Standard Orifice Configuration)

Size	019	032	080	140	250
Flushing flow [1)]	2 l/min	3 l/min	4.1 l/min	6.3 l/min	10.4 l/min
HPU minimum flow at 50 °C fluid temperature [1)]	6 l/min	8 l/min	14.5 l/min	29 l/min	45 l/min

[1)] Values referred to a pre-pressure of 10 bar

Functional Safety

Functional safety Performance Level c is realized for safe stop function with a 2-way seat valve, which closed the selected cylinder chamber. With this additional function, the stop function for Performance Level c is possible as well as pressure close in cylinder chamber.
If pressure close in cylinder chamber should be monitored, please choose the additional pressure sensor for pressure close.

Sensor Configuration

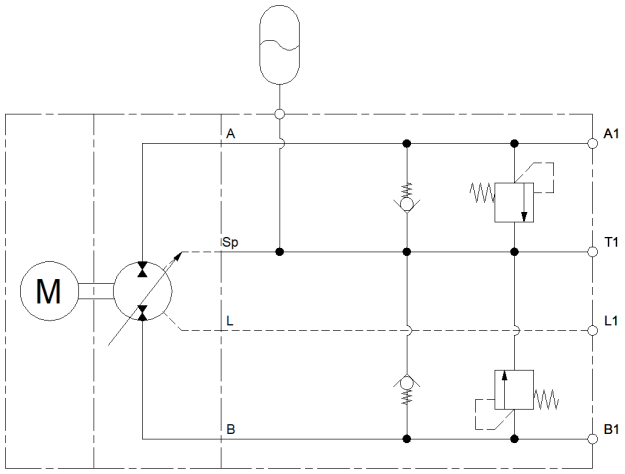
If additional pressure close sensor is desired, please select the functional safety valve in the same port as well.

Attachments

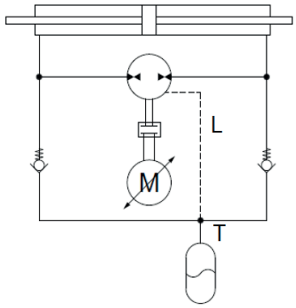
Size	019	032	080	140	250
Bypass between cylinder chambers	E.g. for short-circuiting of the cylinder chambers, to unload the system while external forces are active. Pressure equalizes.				
Additional pressure relief of cylinder chambers	Not necessary, function always integrated in basis manifold, cause of logic circuit		• Only necessary, if stop function valves are integrated in basis manifold (Performance Level c) • Needed for high hanging masses on cylinder"		
Bypass between pressure side and accumulator side	Not available				

PRE-PRESSURE TYPES

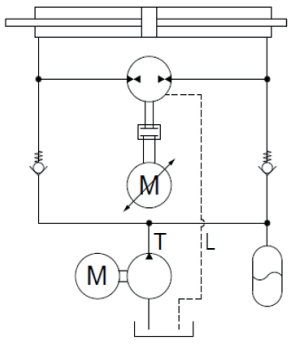
Basic Circuit and Hydraulic Outlets



Self-contained System

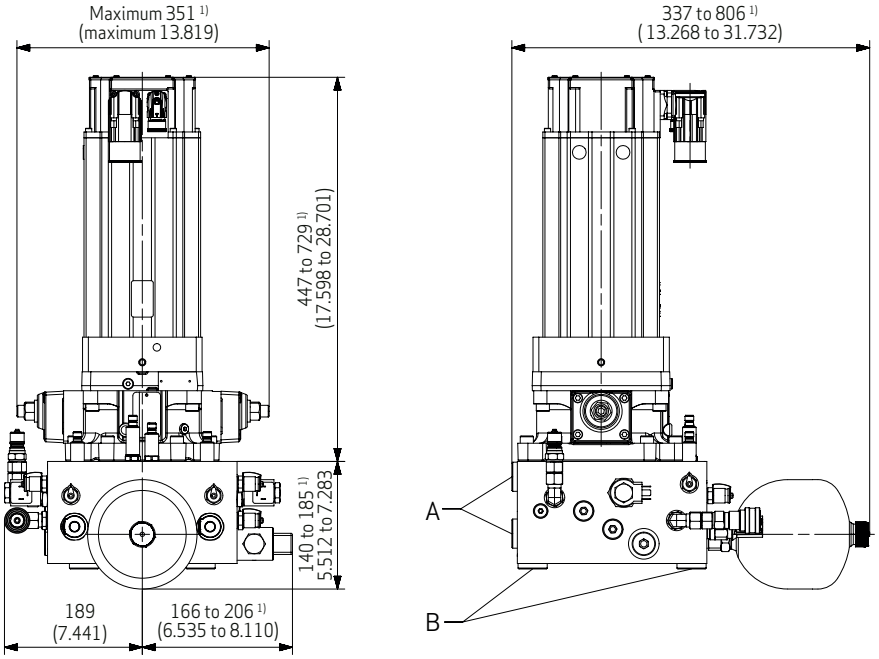


Half-open System

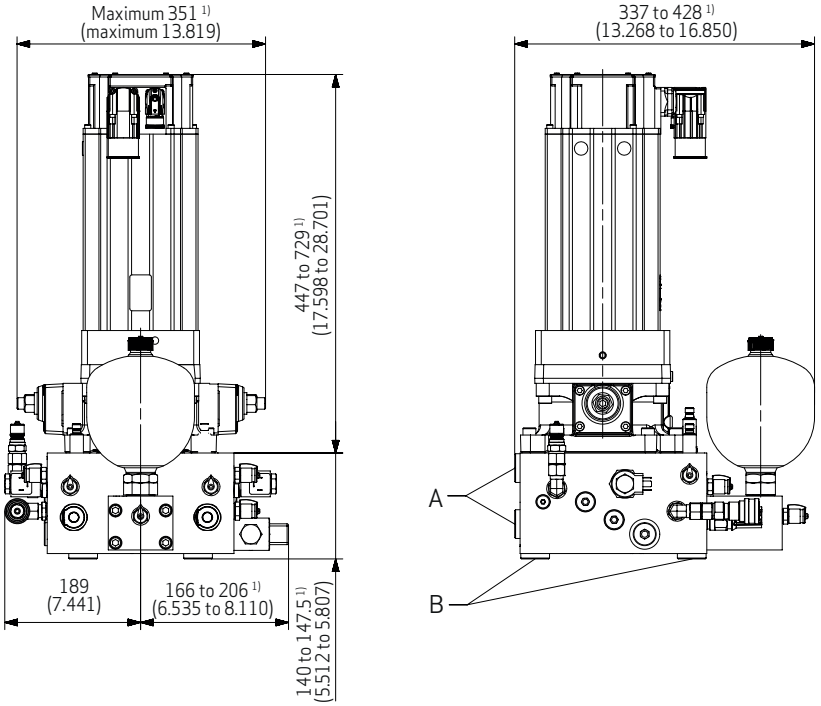


DIMENSIONS SIZE 19

Orthogonal Orientation of Accumulator



Parallel Orientation of Accumulator



A: Distance washer for radial connection 1)
B: Distance washer for axial connection 1)

1) Project dependent

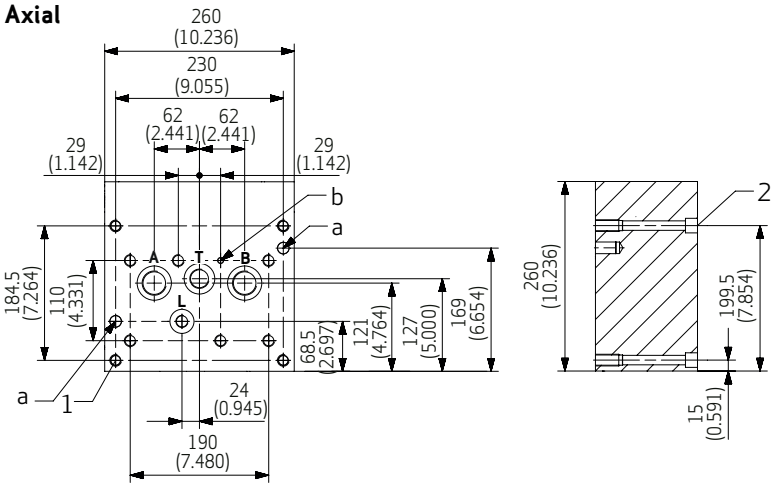
All dimensions in mm, all dimensions for orientation

DIMENSIONS SIZE 19

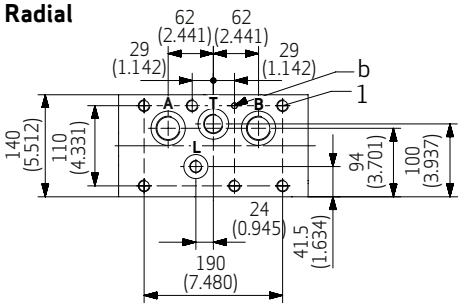
Mounting Pattern

Mounting pattern

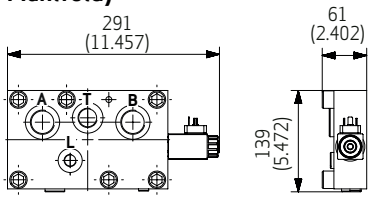
Axial



Radial



Attachment Bypass between Cylinder Chambers (Interface similar to Basic Manifold)

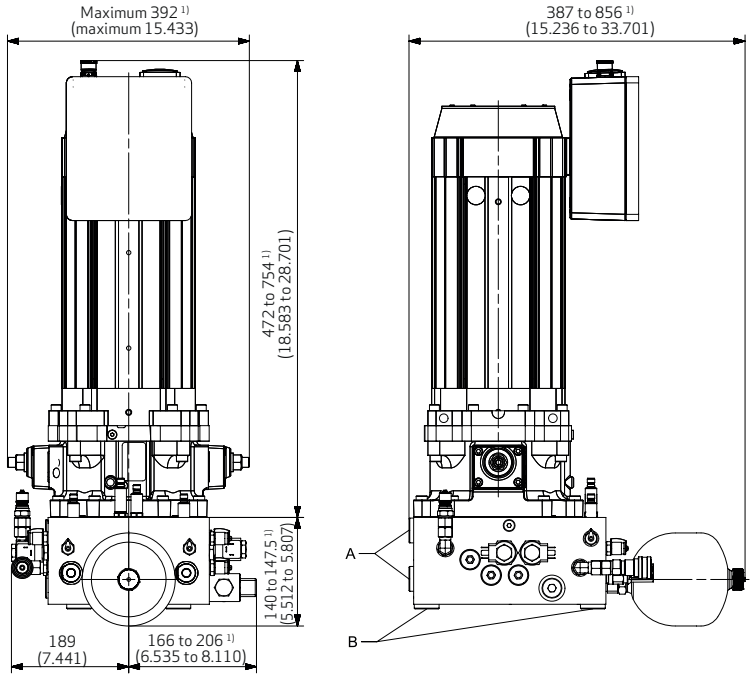


A, B	G1
T	G3/4
L	G3/8
1	M16, 24 deep Recommended: Use 6 screws M16 with Nord-Lock Steel Washer (property class 10.9); tightening torque 310 Nm
2	M12 Recommended: Use 4 cylinder head screws M12 with Nord-Lock Steel Washer (property class 10.9, minimum length 150 mm) according to ISO 4762; tightening torque 125 Nm
a	Cylindrical pin with nominal diameter of 16m6x60 St according to ISO 2338
b	Cylindrical pin with nominal diameter of 8m6x32 St according to ISO 2338

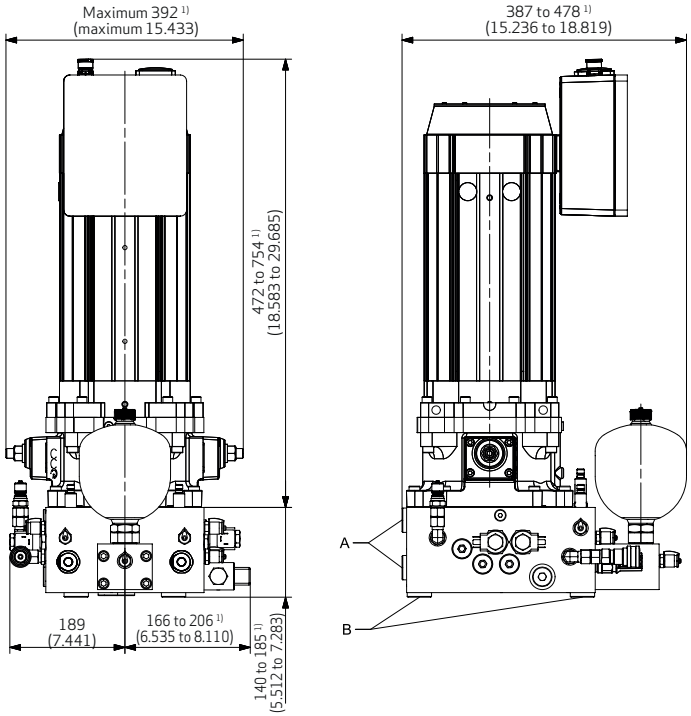
All dimensions in mm, all dimensions for orientation

DIMENSIONS SIZE 32

Orthogonal Orientation of Accumulator



Parallel Orientation of Accumulator



A: Distance washer for radial connection 1)
B: Distance washer for axial connection 1)

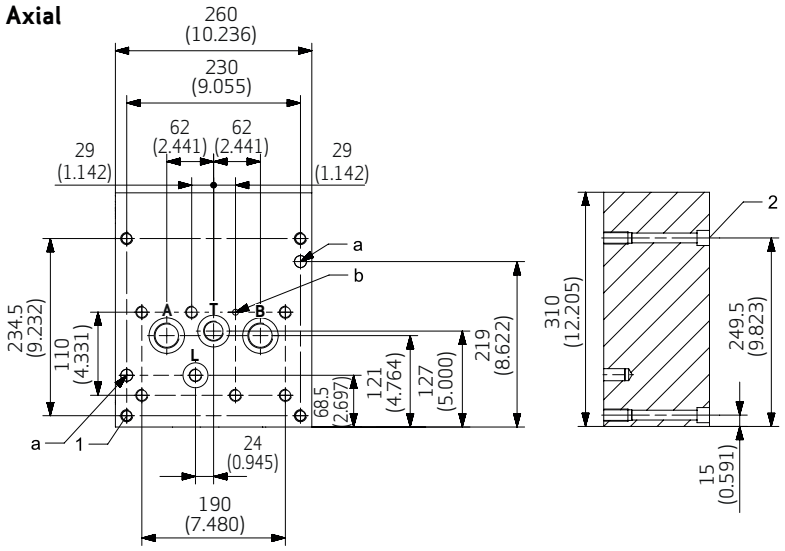
1) Project dependent

All dimensions in mm, all dimensions for orientation

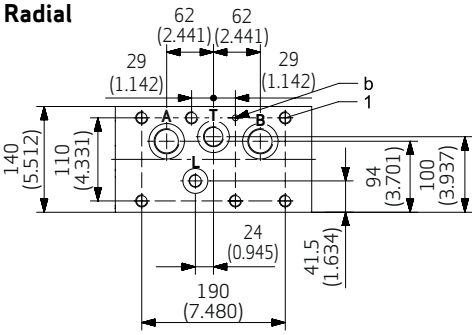
DIMENSIONS SIZE 32

Mounting Pattern

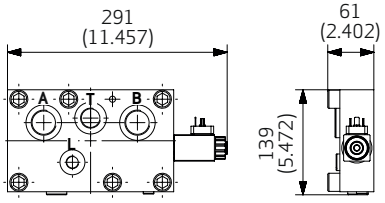
Axial



Radial



Attachment Bypass between Cylinder Chambers



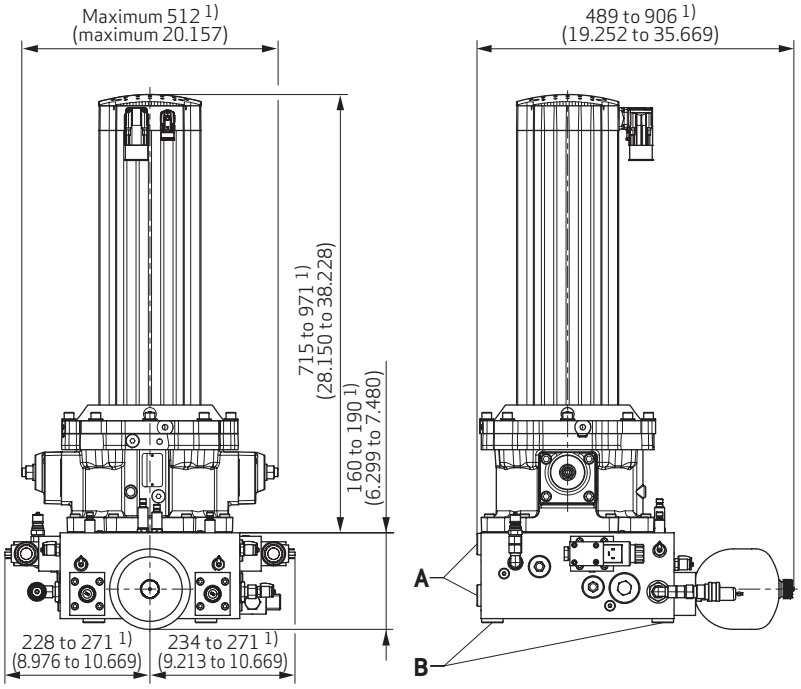
Interface similar to basic manifold

A, B	G1
T	G3/4
L	G3/8
1	M16, 24 deep Recommended: Use 6 screws M16 with Nord-Lock Steel Washer (property class 10.9); tightening torque 310 Nm
2	M12 Recommended: Use 4 cylinder head screws M12 with Nord-Lock Steel Washer (property class 10.9, minimum length 150 mm) according to ISO 4762; tightening torque 125 Nm
a	Cylindrical pin with nominal diameter of 16m6x60 St according to ISO 2338
b	Cylindrical pin with nominal diameter of 8m6x32 St according to ISO 2338

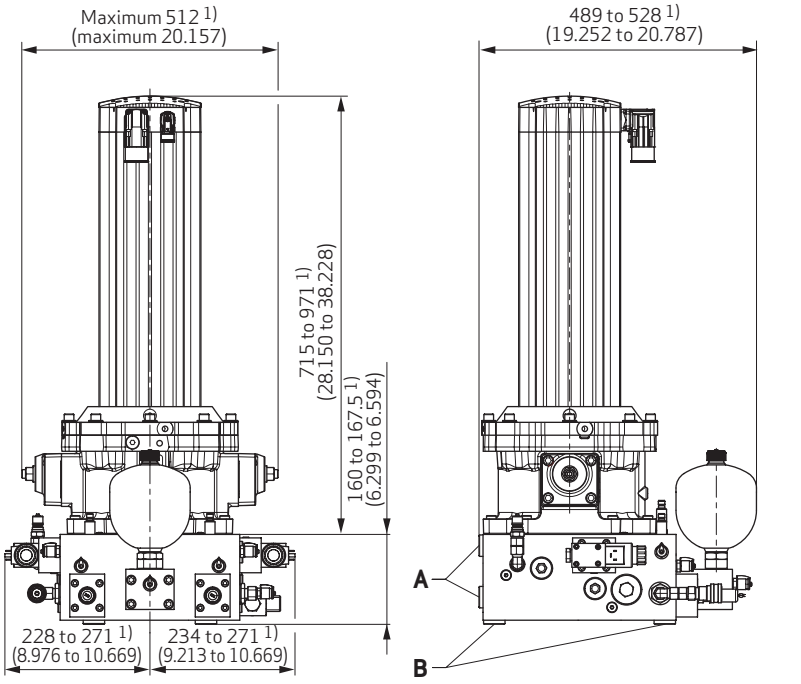
All dimensions in mm, all dimensions for orientation

DIMENSIONS SIZE 80

Orthogonal Orientation of Accumulator



Parallel Orientation of Accumulator



A: Distance washer for radial connection 1)
B: Distance washer for axial connection 1)

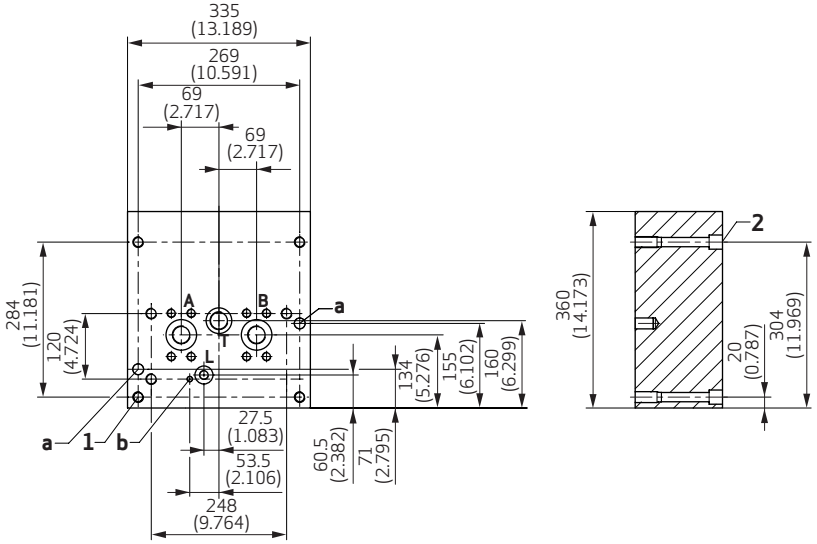
1) Project dependent

All dimensions in mm, all dimensions for orientation

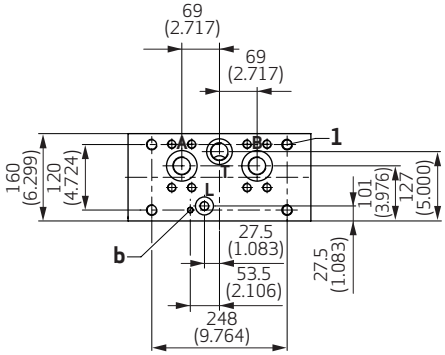
DIMENSIONS SIZE 80

Mounting Pattern

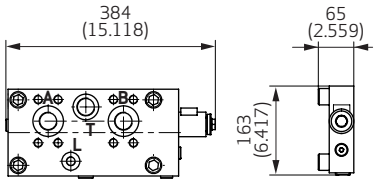
Axial



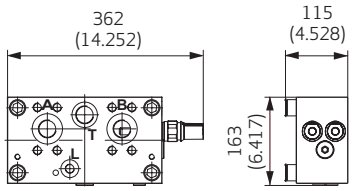
Radial



Attachment Bypass between Cylinder Chambers (Interface similar to Basic Manifold)



Attachment Pressure Relief (Interface similar to Basic Manifold)

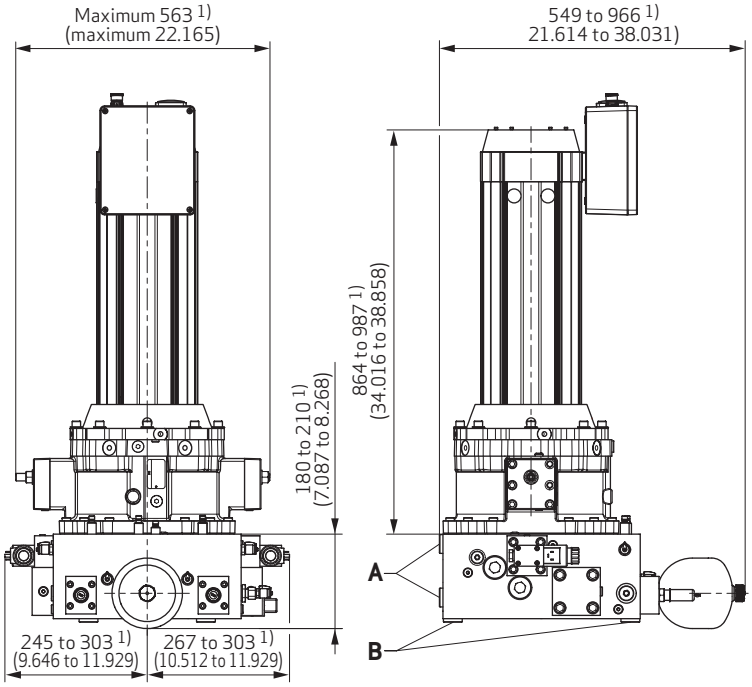


A, B	G1 and SAE 1-1/2"-6,000 psi
T	G1
L	G3/8
1	M20, 30 deep Recommended: Use 4 screws M20 with Nord-Lock Steel Washer (property class 10.9); tightening torque 610 Nm
2	M16 Recommended: Use 4 cylinder head screws M16 with Nord-Lock Steel Washer (property class 10.9, minimum length 170 mm) according to ISO 4762; tightening torque 310 Nm
a	Cylindrical pin with nominal diameter of 20m6x70 St according to ISO 2338
b	Cylindrical pin with nominal diameter of 10m6x50 St according to ISO 2338

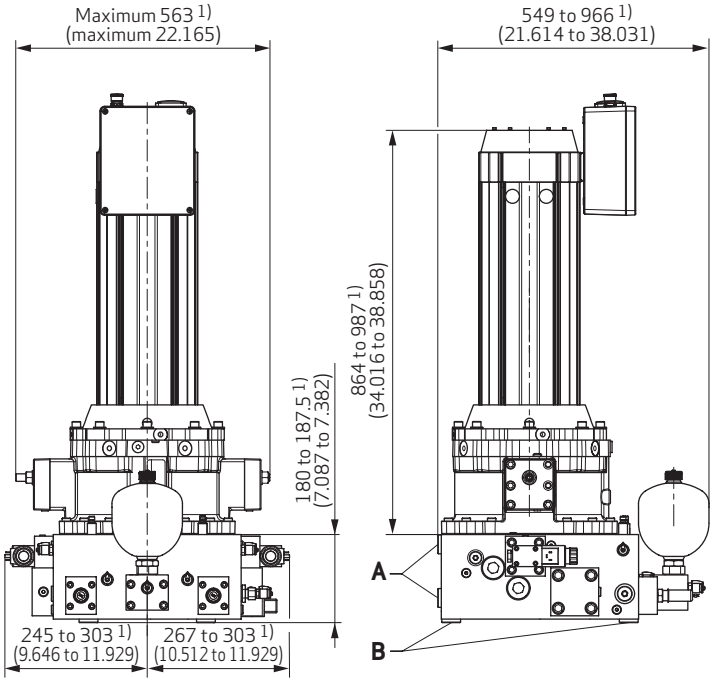
All dimensions in mm, all dimensions for orientation

DIMENSIONS SIZE 140

Orthogonal Orientation of Accumulator



Parallel Orientation of Accumulator



A: Distance washer for radial connection [1)]
B: Distance washer for axial connection [1)]

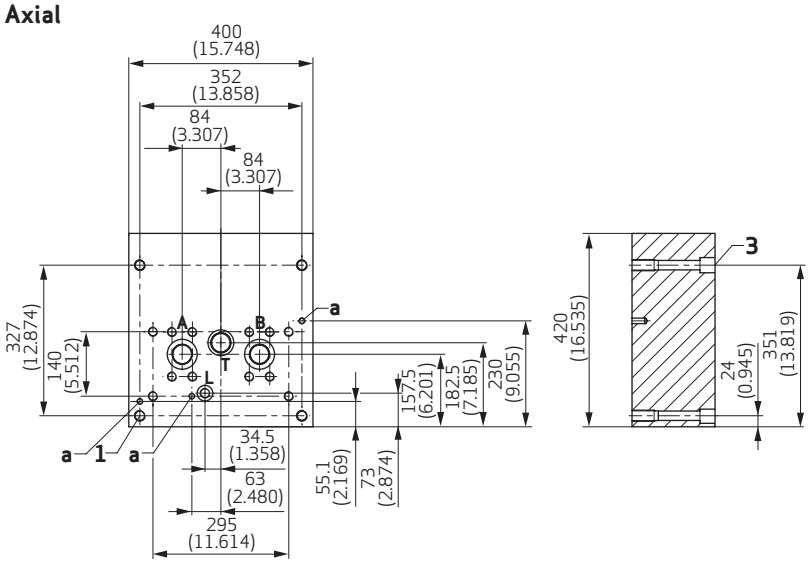
[1)] Project dependent

All dimensions in mm, all dimensions for orientation

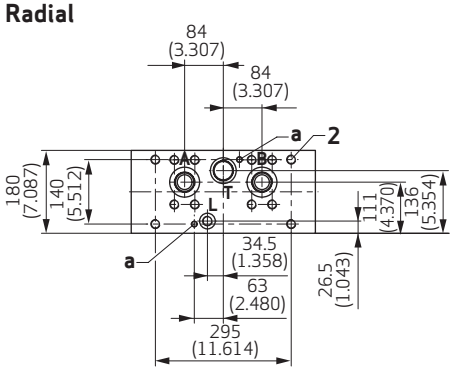
DIMENSIONS SIZE 140

Mounting Pattern

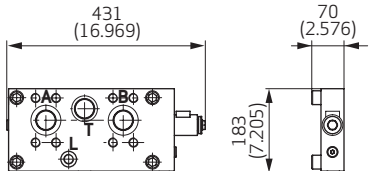
Axial



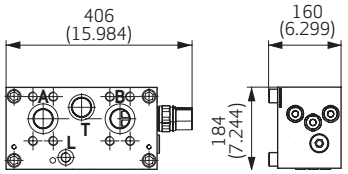
Radial



Attachment Bypass between Cylinder Chambers (Interface similar to Basic Manifold)



Attachment Pressure Relief (Interface similar to Basic Manifold)

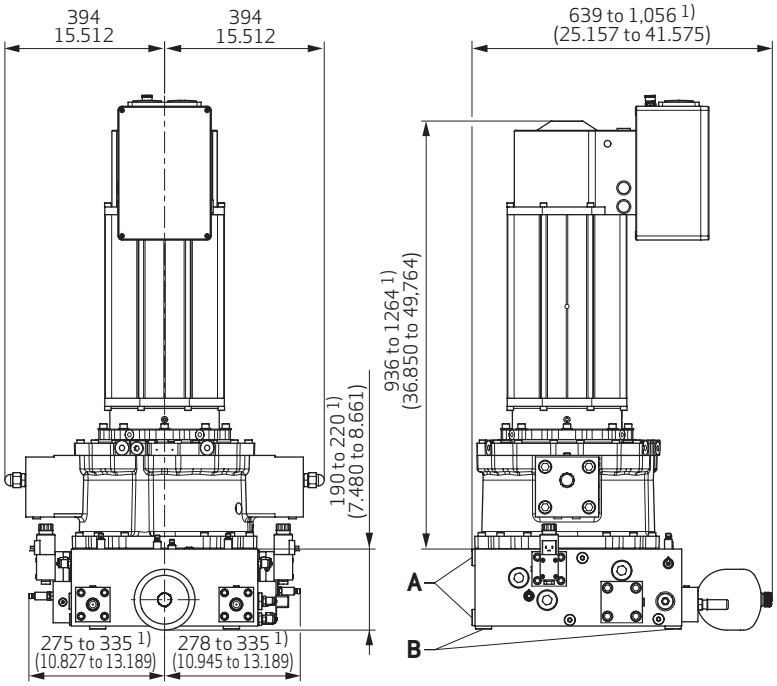


A, B	M42x2 and SAE 2"-6,000 psi
T	M42x2
L	G1/2
1	M24, 48 deep Recommended: Use 6 screws M24 with Nord-Lock Steel Washer (property class 10.9); tightening torque 1,050 Nm
2	M20, 33 deep Recommended: Use 4 cylinder head screws M20 with Nord-Lock Steel Washer (property class 10.9); tightening torque 610 Nm
3	M20 Recommended: Use 4 cylinder head screws M20 with Nord-Lock Steel Washer (property class 10.9, minimum length 190 mm) according to ISO 4762; tightening torque 610 Nm
a	Cylindrical pin with nominal diameter of 12m6x60 St according to ISO 2338
b	Cylindrical pin with nominal diameter of 8m6x32 St according to ISO 2338

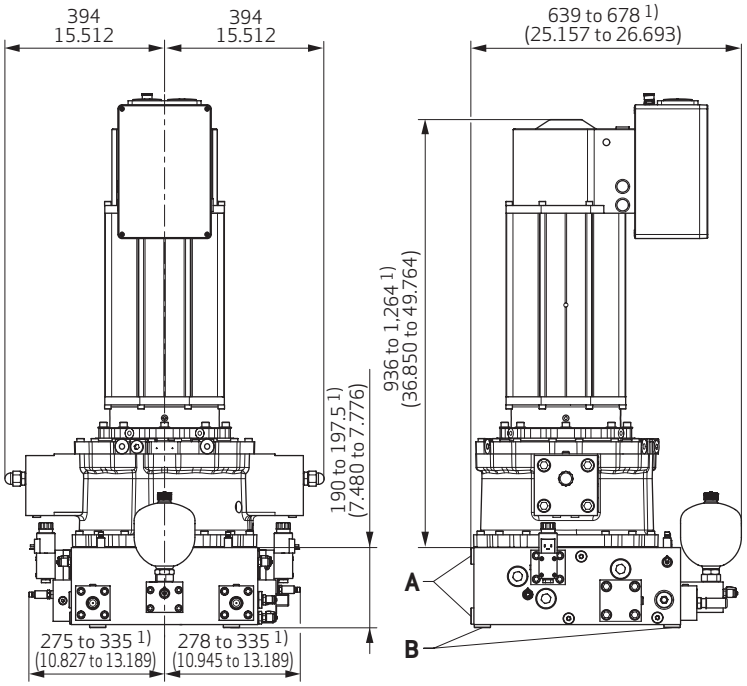
All dimensions in mm, all dimensions for orientation

DIMENSIONS SIZE 250

Orthogonal Orientation of Accumulator



Parallel Orientation of Accumulator



A: Distance washer for radial connection 1)
B: Distance washer for axial connection 1)

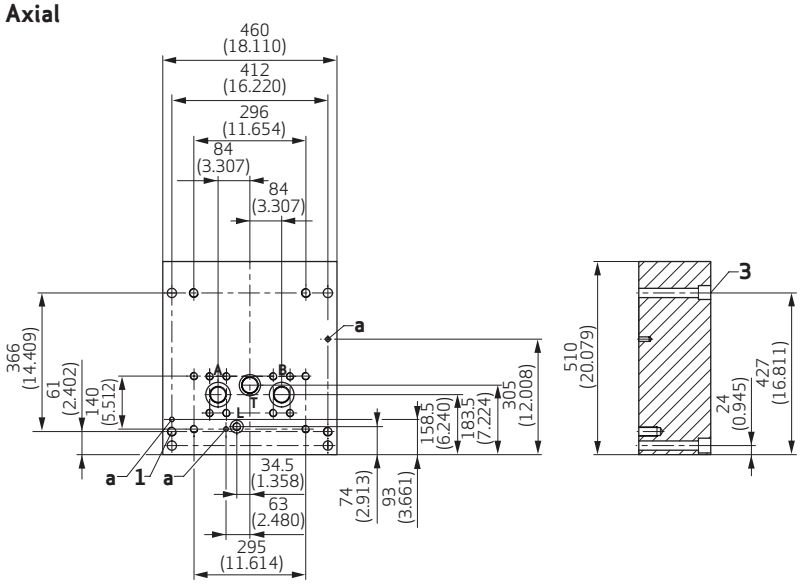
1) Project dependent

All dimensions in mm, all dimensions for orientation

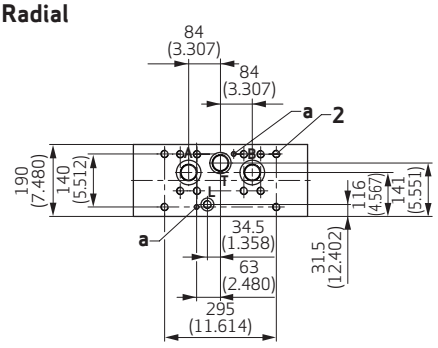
DIMENSIONS SIZE 250

Mounting Pattern

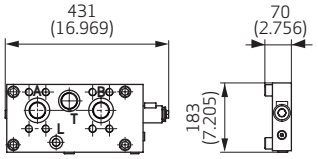
Axial



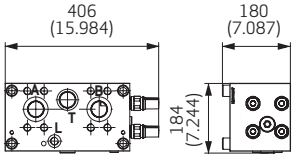
Radial



Attachment Bypass between Cylinder Chambers (Interface similar to Basic Manifold)



Attachment Pressure Relief (Interface similar to Basic Manifold)

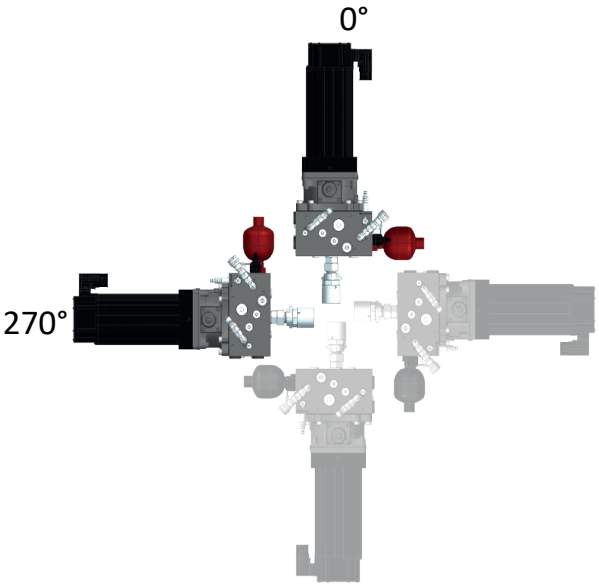


A, B	M42x2 and SAE 2"-6,000 psi
T	M42x2
L	G1/2
1	M24, 48 deep Recommended: Use 4 screws M24 with Nord-Lock Steel Washer (property class 10.9); tightening torque 1,050 Nm
2	M20, 33 deep Recommended: Use 4 screws M20 with Nord-Lock Steel Washer (property class 10.9); tightening torque 610 Nm
3	M24 Recommended: Use 4 cylinder head screws M24 with Nord-Lock Steel Washer (property class 10.9, minimum length 210 mm) according to ISO 4762; tightening torque 1,050 Nm
b	Cylindrical pin with nominal diameter of 12m6x60 St according to ISO 2338

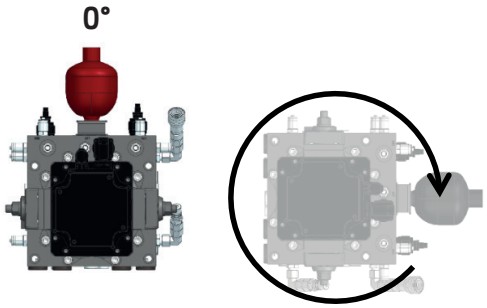
All dimensions in mm, all dimensions for orientation

INSTALLATION

Preferred Mounting Position for Bleeding 0° and 270° (Clockwise)



Preferred Mounting Position Lying for Bleeding 0°



ACCESSORIES

Cooling and Filling Connection

Part name	Type code	Part number				
		019	032	080	140	250
Hydraulic coupling (male)	H3-63-BSPP	HMS0000655			-	-
Hydraulic coupling (female)	H3-62-BSPP	HMS0000654			-	-

ABOUT MOOG

Hydraulic Solutions

Since Bill Moog invented the first commercially viable servo valve in 1951, Moog has set the standard for world-class hydraulic technology. Today, Moog products are used in a variety of applications - providing high power, enhanced productivity and ever better performance for some of the world's most demanding applications.

Electric Solutions

Clean operation, low noise generation, less maintenance and reduced power consumption make Moog electric solutions ideal for applications worldwide. Moog is the ideal partner for applications where transitioning technologies requires special expertise.

Hybrid Solutions

By incorporating the advantages of existing hydraulic and electric technologies - including modular flexibility, increased efficiency and cleanliness - into innovative hybrid solutions, Moog offers new performance potential in specialized applications.

Simulation Table

Flight Simulation

ORDERING CODE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	R									N	NN						

1	**Product**
WS	Electrohydrostatic Pump System

2	**Design**
R	Servomotor + Radial Piston Pump + Manifold

3	**Nominal Displacement**
019	19 cm^3
032	32 cm^3
080	80 cm^3
140	140 cm^3
250	250 cm^3

4	**Pump Adjustment**
BC	Fixed displacement
NL	Dual displacement - initial V_{min}
NH	Dual displacement - initial V_{max}

5	**Motor Performance Class**
S0	Small performance class
M0	Medium performance class
H0	High performance class

6	**Motor Cooling**
C	Convection
F	Fan
W	Liquid

7	**Pressure Class (Pressure Relief Setting)**
25	250 bar
31	315 bar (standard)
34	340 bar

8	**Pre-pressure Type**
S	Self-contained (standard)
H	Half open (standard orifice configuration)

9	**Bypass between Cylinder Chambers**
N	Without (standard)
A	Pressure equalization A to B (normally open)
B	Pressure equalization A to B (normally closed)

10	**Additional Pressure Relief of Cylinder Chambers**
1	Without (standard)
2	Pressure relief Performance Level c (only for sizes 80 to 250)

11	**Bypass between Pressure Side and Accumulator Side**
N	Without

13	**Functional Safety** [1]
1N	Without
1C	Performance Level c - valve in A
2C	Performance Level c - valve in B
3C	Performance Level c - valve in A and B

14	**Sensor Configuration**
1	Standard (4 to 20 mA)
2	Standard + additional pressure close sensor in A
3	Standard + additional pressure close sensor in B
4	Standard + additional pressure close sensor in A and B

15	**Accumulator Orientation**
N	Without accumulator
R	Orthogonal
P	Parallel

16	**Accumulator Size**
N	Without
B	0.5 l
D	1.4 l
F	2.8 l
G	3.5 l
K	6 l

17	**Hydraulic Interface Direction**
A	Axial
R	Radial

18	**Mechanical Interface Direction**
A	Axial
R	Radial

[1] According to EN ISO 13849-1 for function "safe stop".

When ordering, always specify the ordering code of the Electrohydrostatic Pump Unit (EPU) (see respective catalog) as a comment.

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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Moog Electrohydrostatic Pump System (EPS)
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