Axial piston variable motor
A6VM series 71

RE 91610
Edition: 06.2016
Replaces: 06.2014

- All-purpose high pressure motor
- Sizes 60 to 215
- Nominal pressure 450 bar
- Maximum pressure 500 bar
- Open and closed circuits

Features

- Robust motor with long service life
- Approved for very high rotational speeds
- High starting efficiency
- Excellent slow-running characteristics
- Variety of controls
- High control range (can be swiveled to zero)
- High torque
- Optionally with flushing and boost-pressure valve mounted
- Optionally with mounted high-pressure counterbalance valve
- Bent-axis design

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Ordering code

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**						**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A6V**

Operating mode

02	Motor	**M**

Size (NG)

03	Geometric displacement, see technical data on page 9	**060**	**085**	**115**	**150**	**170**	**215**	

Control device				**060**	**085**	**115**	**150**	**170**	**215**	
04	Proportional control hydraulic	positive control	Δp_{St} = 10 bar	●	●	●	●	●	●	**HP1**
			Δp_{St} = 25 bar	●	●	●	●	●	●	**HP2**
		negative control	Δp_{St} = 10 bar	●	●	●	●	●	●	**HP5**
			Δp_{St} = 25 bar	●	●	●	●	●	●	**HP6**
	Proportional control electrical	positive control	U = 12 V DC	●	●	●	●	●	●	**EP1**
			U = 24 V DC	●	●	●	●	●	●	**EP2**
		negative control	U = 12 V DC	●	●	●	●	●	●	**EP5**
			U = 24 V DC	●	●	●	●	●	●	**EP6**
	Two-point control hydraulic	negative control		–	–	–	●	●	●	**HZ5**
				●	●	●	–	–	–	**HZ7**
	Two-point control electrical	negative control	U = 12 V DC	–	–	–	●	●	●	**EZ5**
			U = 24 V DC	–	–	–	●	●	●	**EZ6**
			U = 12 V DC	●	●	●	–	–	–	**EZ7**
			U = 24 V DC	●	●	●	–	–	–	**EZ8**
	Automatic control high-pressure related, positive control	with minimum pressure increase	Δp ≤ approx. 10 bar	●	●	●	●	●	●	**HA1**
		with pressure increase	Δp = 100 bar	●	●	●	●	●	●	**HA2**
	Automatic control speed related, negative control p_{St} / p_{HD} = 5/100	hydr. travel direction valve		●	●	●	●	●	●	**DA0**
		electric travel direction valve + electric $V_{g\,max}$ circuit	U = 12 V DC	●	●	●	●	●	●	**DA1**
			U = 24 V DC	●	●	●	●	●	●	**DA2**

Pressure control/override				**060**	**085**	**115**	**150**	**170**	**215**	
05	Without pressure control/override			●	●	●	●	●	●	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6			●	●	●	●	●	●	**D1**
	Override of controls HA1 and HA2	hydraulic remote control, proportional		●	●	●	●	●	●	**T3**
		electric, two-point	U = 12 V DC	●	●	●	●	●	●	**U1**
			U = 24 V DC	●	●	●	●	●	●	**U2**
		electric and travel direction valve, electric	U = 12 V DC	●	●	●	●	●	●	**R1**
			U = 24 V DC	●	●	●	●	●	●	**R2**

Connector for solenoids[1] (see page 62)

06	Without connector (without solenoid, only for hydraulic control)	**0**
	DEUTSCH - molded connector, 2-pin, without suppressor diode	**P**

● = Available ○ = On request – = Not available

1) Connectors for other electric components can deviate.

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**						**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Neutral position switch (see page 63)

		060	085	115	150	170	215	
07	Without additional function	●	●	●	●	●	●	**0**
	Neutral position switch	–	●	●	●	●	●	**N**

Additional function

08	Without additional function	**0**

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		**0**
	Damping	HP, EP, HP5,6D. and EP5,6D., HZ, EZ, HA with counterbalance valve BVD/BVE	**1**
		One-sided in inlet to large stroking chamber (HA)	**4**
		One-sided in outlet from large stroking chamber (DA)	**7**

Setting range for displacement[2)]

			060	085	115	150	170	215	
10	$V_{g\,max}$-setting screw	$V_{g\,min}$-setting screw							
	Without setting screw	short (0-adjustable)	●	●	●	●	●	●	**A**
		medium	●	●	●	●	●	●	**B**
		long	●	●	●	●	●	●	**C**
		extra long	–	–	●	●	●	●	**D**
	Short	short (0-adjustable)	●	●	●	●	●	●	**E**
		medium	●	●	●	●	●	●	**F**
		long	●	●	●	●	●	●	**G**
		extra long	–	–	●	●	●	●	**H**
	Medium	short (0-adjustable)	●	●	●	●	●	●	**J**
		medium	●	●	●	●	●	●	**K**
		long	●	●	●	●	●	●	**L**
		extra long	–	–	●	●	●	●	**M**

Series

11	Series 7, index 1	**71**

Configuration of ports and fastening threads

12	Metric, port threads with O-ring sealing according to ISO 6149	**M**

Direction of rotation

13	Viewed on drive shaft, bidirectional	**W**

Sealing material

14	FKM (fluoroelastomer)	**V**

Drive shaft bearing

15	Standard bearing	**0**

Mounting flange

			060	085	115	150	170	215	
16	ISO 3019-2	125-4	●	–	–	–	–	–	**M4**
		140-4	–	●	–	–	–	–	**N4**
		160-4	–	–	●	–	–	–	**P4**
		180-4	–	–	–	●	●	–	**R4**
		200-4	–	–	–	–	–	●	**S4**

● = Available ○ = On request – = Not available

2) The settings for the setting screws can be found in the table (see pages 70 and 71).

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**						**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Drive shaft			060	085	115	150	170	215	
17	Splined shaft ANSI B92.1a	1 1/4 in 14T 12/24 DP	●	–	–	–	–	–	**S7**
		1 124 in 17T 12/24 DP	–	●	–	–	–	–	**S9**
		1 3/4 in 13T 8/16 DP	–	–	●	●	–	–	**T1**
		2 in 15T 8/16 DP	–	–	–	○	●	●	**T2**
	Splined shaft DIN 5480	W35×2×16×9g	●	–	–	–	–	–	**Z8**
		W40×2×18×9g	–	●	●	–	–	–	**Z9**
		W45×2×21×9g	–	–	–	●	●	–	**A1**
		W50×2×24×9g	–	–	–	–	–	●	**A2**

Working Port			060	085	115	150	170	215	
18	SAE working port **A** and **B** at rear		●	●	●	●	●	●	**1**
	SAE working port **A** and **B** at side, opposite		●	●	●	●	●	●	**2**
	Port plate with 1-stage pressure limitation valves for mounting a counterbalance valve[3]	BVD20	●	●	●	–	–	–	**7**
		BVD25, BVE25	–	–	●	●	●	●	**8**

Valve (see pages 64 to 68)			060	085	115	150	170	215	
19	Without valve		●	●	●	●	●	●	**0**
	With counterbalance valve BVD/BVE mounted[4]		●	●	●	●	●	●	**W**
	With flushing and boost pressure valve, mounted Flushing on both sides Flushing flow at: $\Delta p = p_{ND} - p_G = 25$ bar and $v = 10$ mm²/s (p_{ND} = low pressure, p_G = case pressure) Only possible with port plates 1 and 2	**Flushing flow q_v [l/min]**							
		3.5	●	●	●	–	–	–	**A**
		5	●	●	●	–	–	–	**B**
		8	●	●	●	●	●	●	**C**
		10	●	●	●	●	●	●	**D**
		14	●	●	●	–	–	–	**F**
		17	–	–	–	●	●	●	**G**
		20	–	–	●[5]	●	●	●	**H**
		25	–	–	●[5]	●	●	●	**J**
		30	–	–	●[5]	●	●	●	**K**
		35	–	–	–	●	●	●	**L**
		40	–	–	–	●	●	●	**M**

● = Available ○ = On request – = Not available

3) Only possible in conjunction with HP, EP and HA control. Note the restrictions described on page 66.

4) State ordering code for counterbalance valve separately in accordance with data sheet 95522 – BVD or 95525 – BVE. Note the restrictions described on page 66.

5) Not for EZ7, EZ8 and HZ7.

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**						**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Speed sensor (see page 69)

		060	085	115	150	170	215	
20	Without speed sensor	●	●	●	●	●	●	**0**
	Prepared with speed sensor DSM/DSA	●	●	●	●	●	●	**U**
	With speed sensor DSM/DSA mounted[6)]	●	●	●	●	●	●	**V**

Standard / special version

21	Standard version	**0**
	Standard version with installation variants, e.g. **T** ports against standard open and closed	**Y**
	Special version	**S**

● = Available ○ = On request – = Not available

Notice

▶ Note the project planning notes on page 74.

6) State ordering code for sensor separately in accordance with data sheet 95132 – DSM or 95133 – DSA and note the requirements relating to the electronics.

Hydraulic fluids

The variable motor A6VM is designed for operation with mineral oil HLP according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally friendly hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90225: Axial piston units for operation with water-free and water-containing fire-resistant hydraulic fluids (HFDR, HFDU, HFB, HFC).

The variable motor A6VM is not suitable for operation with HFA fluids. If operating with HFB-, HFC- and HFD or environmentally acceptable hydraulic fluids, the limitations regarding technical data or other seals must be observed.

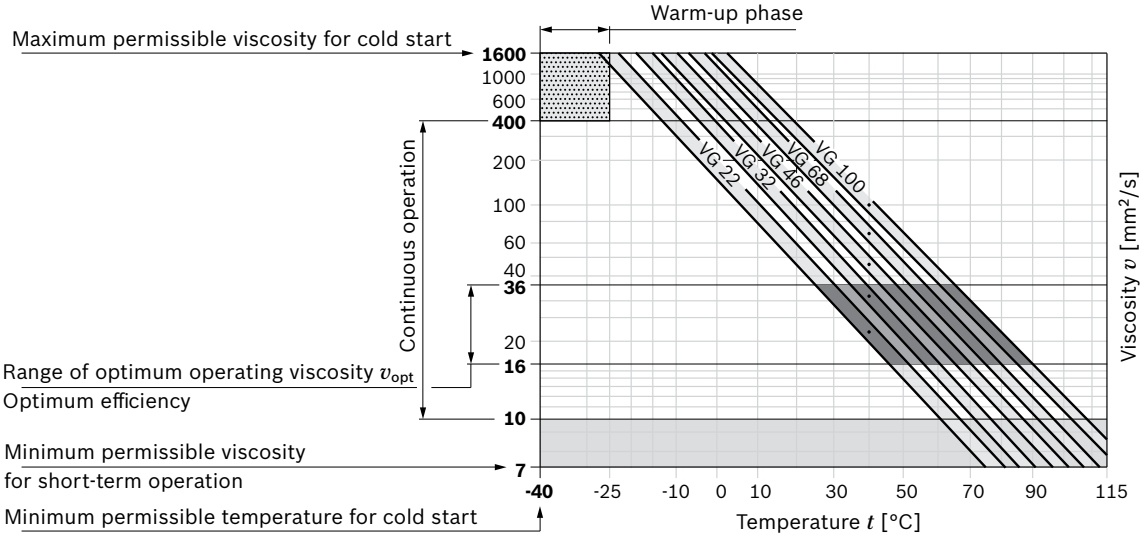
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (v_{opt} see selection diagram).

Notice
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, we recommend the use of a flushing and boost-pressure valve (see page 64).

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$v_{max} \leq 1600$ mm²/s	$\theta_{St} \geq$ -40 °C	$t \leq 3$ min, $n \leq 1000$ rpm, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$v =$ 1600 bis 400 mm²/s	$\theta =$ -40 °C bis -25 °C	at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	$v =$ 400 bis 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta =$ -25 °C bis +103 °C	measured at port **T** Note the permissible temperature range of the shaft seal (ΔT = approx. 12 K between the bearing/shaft seal and port **T**)
	$v_{opt} =$ 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$v_{min} \geq$ 7 mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at port **T**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

- HP, HA.T3: increase
- DA: decrease

With the following settings, an increase in case pressure will have no effect on the beginning of control:

HA.R and HA.U, EP, HA

The factory setting of the beginning of control is made at p_{abs} = 2 bar case pressure.

Flow direction

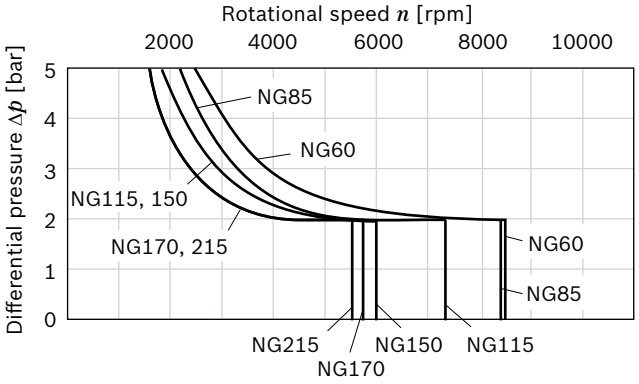
Direction of rotation, viewed on drive shaft	
cw	ccw
A to **B**	**B** to **A**

Shaft seal

Permissible pressure loading

The service life of the shaft seal will be influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary pressure spikes (t < 0.1 s) of up to 10 bar are permitted. Case pressures of a continuous 2 bar maximum are permitted to be able to utilize the entire speed range. Higher case pressures are permissible at lower rotational speeds (see diagram). The service life of the shaft seal decreases with increasing frequency of pressure spikes and increasing mean differential pressure.

The case pressure must be equal to or higher than the ambient pressure.

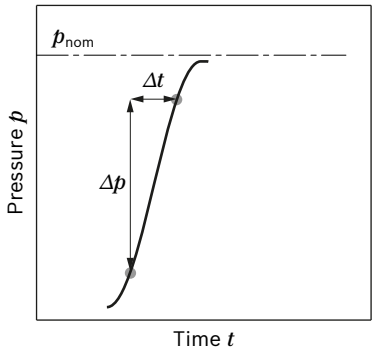


The FKM shaft seal may be used for leakage temperatures from -25 °C to +115 °C. For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).

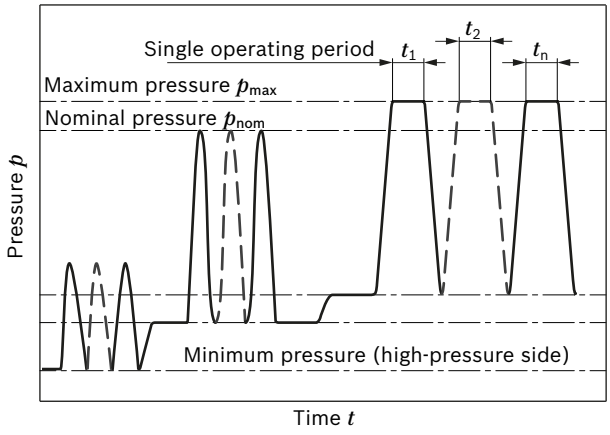
Operating pressure range

Pressure at service line port A or B		Definition
Nominal pressure p_{nom}	450 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	500 bar	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar absolute	Minimum pressure at the high-pressure side (**A** or **B**) which is required in order to prevent damage to the axial piston unit.
Minimum pressure – pump operating mode (inlet)	See the diagram below	To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e.g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve)
Summation pressure p_{Su} (pressure **A** + pressure **B**)	700 bar	The summation pressure is the sum of the pressures at both service line ports (**A** and **B**)
Rate of pressure change $R_{A\,max}$		Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
With integrated pressure-relief valve	9000 bar/s	
Without pressure-relief valve	16000 bar/s	

▼ **Rate of pressure change $R_{A\,max}$**

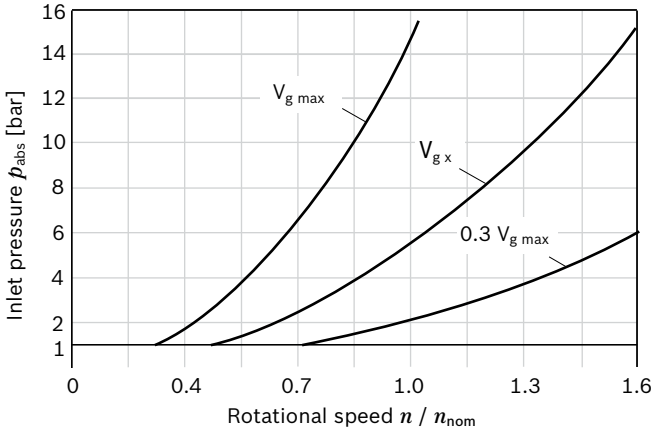


▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

▼ **Minimum pressure – pump operating mode (inlet)**



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.

Please contact us if these conditions cannot be satisfied.

Notice

Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		60	85	115	150	170	215
Displacement geometric, per revolution		$V_{g\,max}$	cm³	62.0	85.2	115.6	152.1	171.8	216.5
		$V_{g\,min}$	cm³	0	0	0	0	0	0
		$V_{g\,x}$	cm³	37	51	69	91	65	82
Maximum speed[1] (complying with the maximum permissible inlet flow)	at $V_{g\,max}$	n_{nom}	rpm	4450	3900	3550	3250	3100	2900
	at V_g < $V_{g\,x}$ (see diagram)	n_{max}	rpm	7200	6800	6150	5600	4900	4600
	at $V_{g\,0}$	n_{max}	rpm	8400	8350	7350	6000	5750	5500
Inlet flow[2]	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	l/min	275	332	410	494	533	628
Torque[3]	at $V_{g\,max}$ and Δp = 450 bar	T	Nm	444	610	828	1089	1230	1550
Rotary stiffness	$V_{g\,max}$ to $V_g/2$	c_{min}	kNm/rad	15	22	37	44	52	70
	$V_g/2$ to 0 (interpolated)	c_{min}	kNm/rad	45	68	104	124	156	196
Moment of inertia for rotary group		J_{GR}	kgm²	0.0043	0.0072	0.0110	0.0181	0.0213	0.0303
Maximum angular acceleration		α	rad/s²	21000	17500	15500	11000	11000	10000
Case volume		V	l	0.8	1.0	1.5	1.7	2.3	2.8
Weight, approx.		m	kg	28	36	46	61	62	78

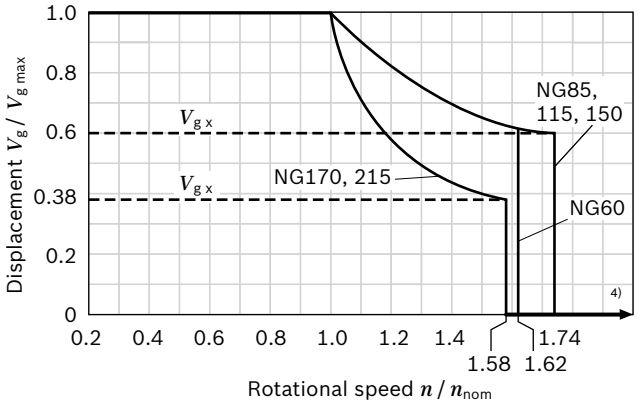
Speed range

The minimum rotational speed n_{min} is not limited. For applications with requirements on the evenness of the rotation at low rotational speeds, please contact us.

Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

▼ **Permissible displacement in relation to speed**



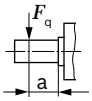
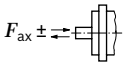
Determining the operating characteristics			
Inlet flow	q_v	$= \frac{V_g \times n}{1000 \times \eta_v}$	[l/min]
Rotational speed	n	$= \frac{q_v \times 1000 \times \eta_v}{V_g}$	[rpm]
Torque	T	$= \frac{V_g \times \Delta p \times \eta_{mh}}{20 \times \pi}$	[Nm]
Power	P	$= \frac{2 \pi \times T \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600}$	[kW]

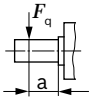
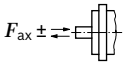
Key

V_g	=	Displacement per revolution [cm³]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{mh}	=	Mechanical-hydraulic efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \bullet \eta_{mh}$)

1) The values are valid:
   – For the optimum viscosity range from v_{opt} = 36 to 16 mm²/s
   – with hydraulic fluid on the basis of mineral oil
2) Note inlet flow limitation due to counterbalance valve (see page 66).
3) Torque without radial force, With radial force see page 10.
4) Values in this range on request

Permissible radial and axial forces of the drive shafts

Size	NG		60	60	85	85	115	115	150	150	150
Drive shaft			1 1/4 in	W35	1 1/2 in	W40	1 3/4 in	W40	1 3/4 in	2 in	W45
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	N	7620	10266	12463	12323	14902	16727	15948	17424	19534
	a	mm	24.0	20.0	27.0	22.5	33.5	22.5	33.5	33.5	25.0
Maximum torque at $F_{q\,max}$	$T_{q\,max}$	Nm	310	444	595	610	828	828	890	1089	1089
Maximum differential pressure at V_{gmax} and $F_{q\,max}$	$\Delta p_{q\,max}$	bar	315	450	440	450	450	450	370	450	450
Maximum axial force at standstill or depressurized operation 	+ $F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
	− $F_{ax\,max}$	N	500	500	710	710	900	900	1300	1300	1300
Permissible axial force per bar operating pressure	+ $F_{ax\,perm/bar}$	N/bar	7.5	7.5	9.6	9.6	11.3	11.3	13.3	13.3	13.3

Size	NG		170	170	215	215
Drive shaft			2 in	W45	2 in	W50
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	N	19370	21220	22602	25016
	a	mm	33.5	25.0	33.5	27.5
Maximum torque at $F_{q\,max}$	$T_{q\,max}$	Nm	1230	1200	1445	1550
Maximum differential pressure at V_{gmax} and $F_{q\,max}$	$\Delta p_{q\,max}$	bar	450	440	420	450
Maximum axial force at standstill or depressurized operation 	+ $F_{ax\,max}$	N	0	0	0	0
	− $F_{ax\,max}$	N	1120	1120	1250	1250
Permissible axial force per bar operating pressure	+ $F_{ax\,perm/bar}$	N/bar	15.1	15.1	17.0	17.0

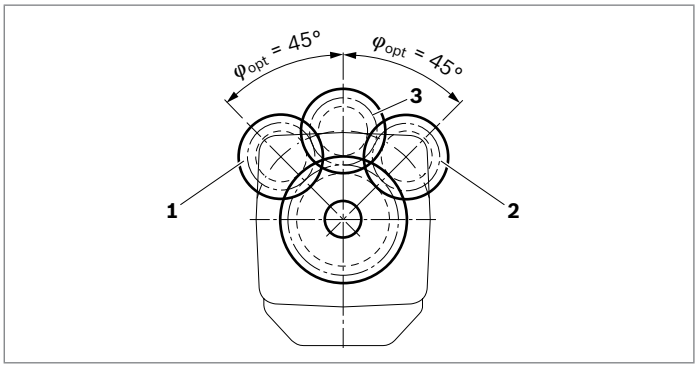
Effect of radial force F_q on the service life of bearings

By selecting a suitable direction of radial force F_q, the load on the bearings, caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

Notice

- The values given are maximum values and do not apply to continuous operation.
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- Special requirements apply in the case of belt drives. Please contact us.

▼ **Toothed gear output drive**



1 Direction of rotation " counter-clockwise", pressure at port **B**
2 Direction of rotation "clockwise", pressure at port **A**
3 Bidirectional direction of rotation

HP – Proportional hydraulic control

The proportional hydraulic control provides infinite adjustment of the displacement. Control is proportional to the pilot pressure applied to port **X**.

HP1, HP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum pilot pressure)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum pilot pressure)

HP5, HP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Notice

- Maximum permissible pilot pressure: p_{St} = 100 bar
- The control oil is internally taken from the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port **G**.
- Please state the desired beginning of control in plain text when ordering, e.g.: beginning of control at 10 bar.
- The beginning of control and the HP characteristic curve are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 7) and thus a parallel shift of the characteristic.
- A leakage flow of maximum 0.3 l/min can occur at port **X** due to internal leakage (working pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

Response time damping

The response time damping impacts the swivel behavior of the motor and consequently the machine response speed.

Standard for sizes 60 to 215

HP without damping.

HP.D with throttle pin on both sides, symmetrical (see table)

Optional for sizes 60 to 215

HP with throttle pin on both sides, symmetrical (see table)

▼ **Throttle pin overview**

Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65

HP1, HP5 pilot pressure increase Δp_{St} = 10 bar

HP1 positive control

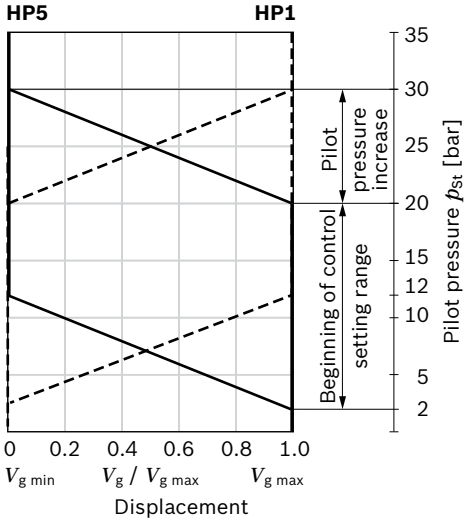
A pilot pressure increase of 10 bar at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control

A pilot pressure increase of 10 bar at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

- Beginning of control, setting range 2 to 20 bar
- Standard setting: beginning of control at 3 bar (end of control at 13 bar)

▼ **Characteristic curve**



HP2, HP6 pilot pressure increase Δp_{St} = 25 bar

HP2 positive control

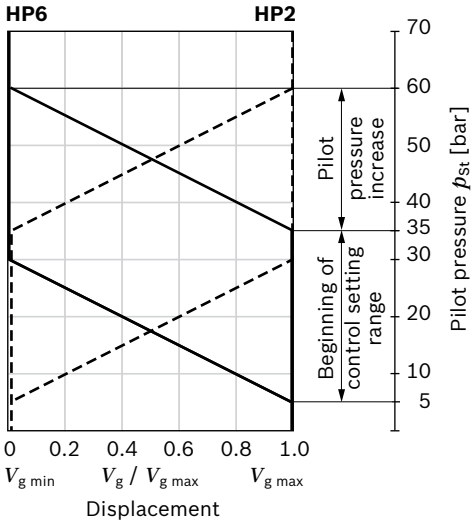
A pilot pressure increase of 25 bar at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP6 negative control

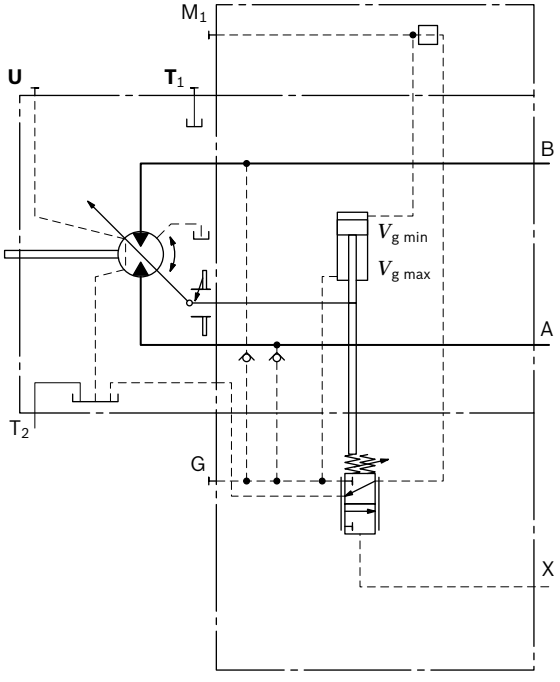
A pilot pressure increase of 25 bar at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

- Beginning of control, setting range 5 to 35 bar
- Standard setting: beginning of control at 10 bar (end of control at 35 bar)

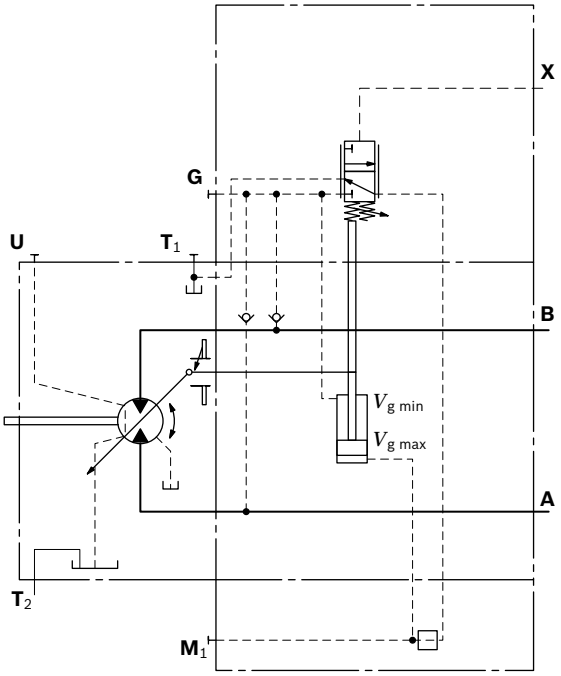
▼ **Characteristic curve**



▼ **Circuit diagram HP1, HP2 (positive control)**



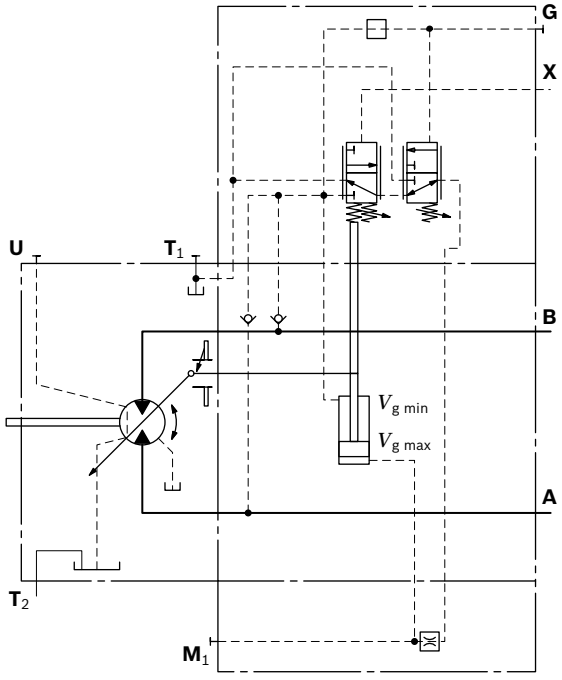
▼ **Circuit diagram HP5, HP6 (negative control)**



HP5D1, HP6D1 Pressure control, fixed setting

The pressure control overrides the HP control function.
If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control, the motor will swivel towards a larger displacement.
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease.
With the increase in displacement the motor develops more torque, while the pressure remains constant.
Setting range of the pressure control valve 80 to 450 bar

▼ **Circuit diagram HP5D1, HP6D1 (negative control)**



EP – Proportional electric control

The proportional electric control, type EP, provides infinite adjustment of the displacement, proportional to the control current applied to the solenoid.

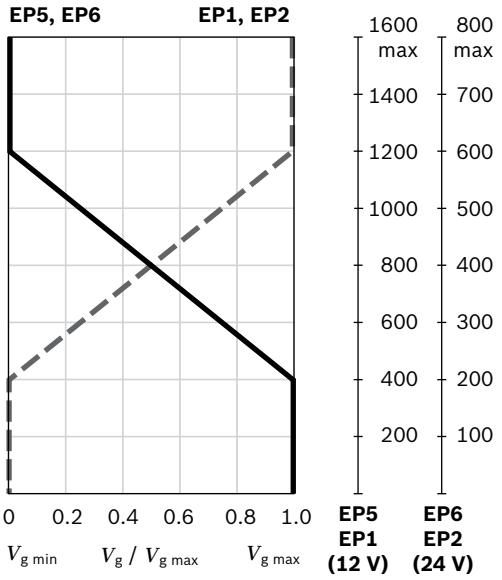
EP1, EP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum control current)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum control current)

EP5, EP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum control current)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum control current)

▼ **Characteristic curve**



Notice

The control oil is internally taken from the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** via an external check valve. For lower pressures, please contact us.

Please note that pressures up to 500 bar can occur at port **G**.

Response time damping

The response time damping impacts the swivel behavior of the motor and consequently the machine response speed.

Standard for sizes 60 to 215

EP without damping.

EP.D with throttle pin on both sides, symmetrical (see table)

Optional for sizes 60 to 215

EP with throttle pin on both sides, symmetrical (see table)

▼ **Throttle pin overview**

Nenngröße	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65

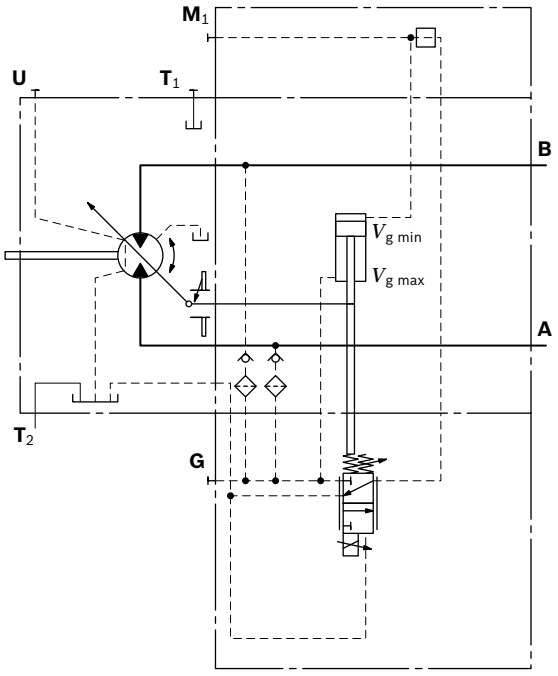
Technical data, solenoid, sizes	EP1, EP5	EP2, EP6
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
Minimum oscillation range[1)]	240 mA	120 mA
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

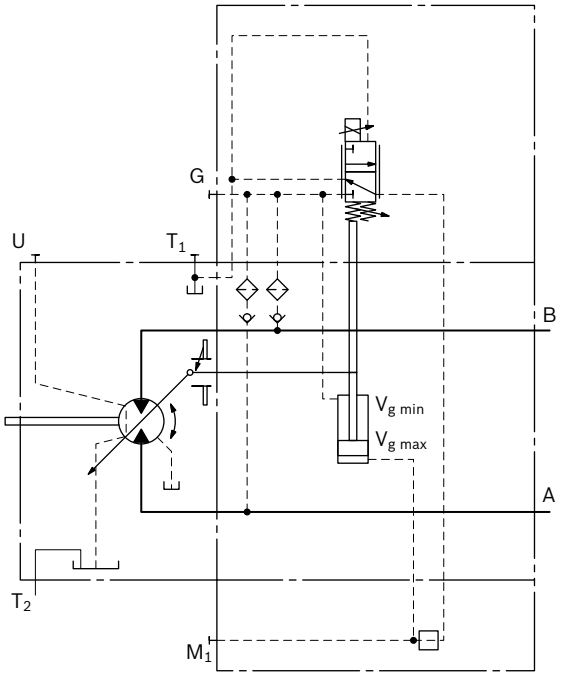
Further information can also be found on the internet at www.boschrexroth.com/mobile-electronics.

1) Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

▼ **Circuit diagram EP1, EP2 (positive control)**



▼ **Circuit diagram EP5, EP6 (negativ control)**



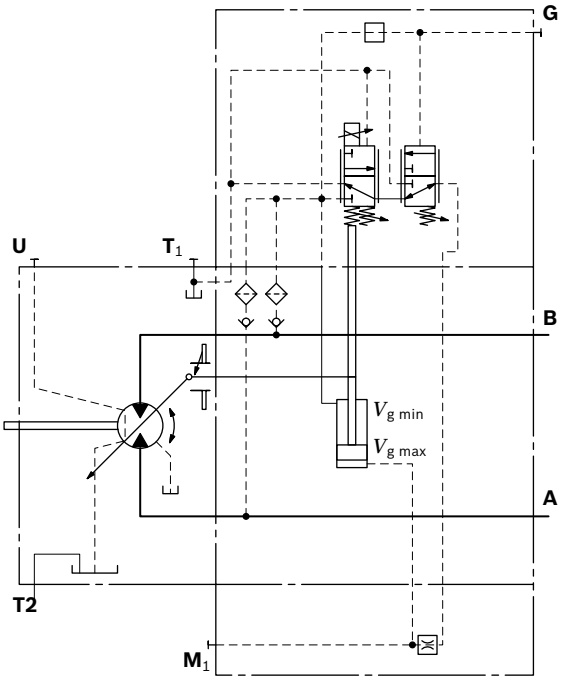
EP5D1, EP6D1 Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve 80 to 450 bar

▼ **Circuit diagram EP5D1, EP6D1 (negativ control)**



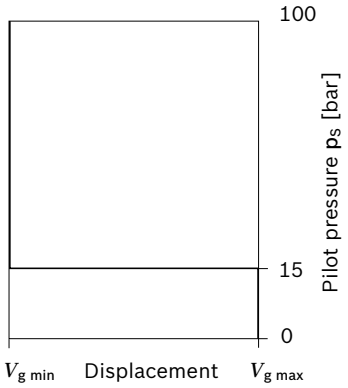
HZ – Two-point hydraulic control

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port **X** on or off.

HZ5, HZ7 negative control

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\,min}$ (with pilot pressure > 15 bar activated, minimum torque, maximum permissible speed)

▼ **Characteristic curve HZ5, HZ7**



Notice

- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port **G**.
- At port **X** a leakage flow of maximum 0.3 l/min occurs (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port **X** to the reservoir.

Response time damping

The response time damping impacts the swivel behavior of the motor and consequently the machine response speed.

Standard for szes 150 to 215

HZ5 with throttle pin on both sides, symmetrical (see table)

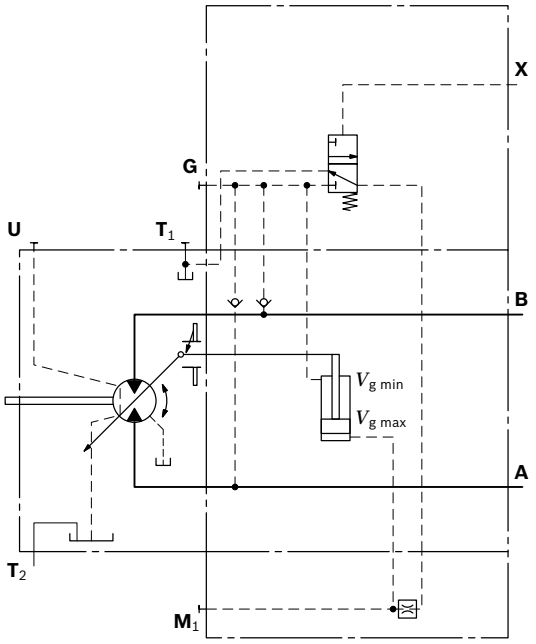
Standard for sizes 60 to 115

HZ7 (synchronous piston) with throttle pin on both sides, symmetrical (see table)

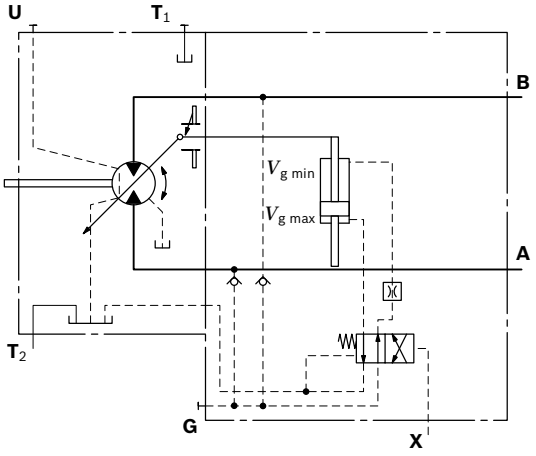
▼ **Throttle pin overview**

Sizes	60	85	115	150	170	215
Groove size [mm]	0.30	0.30	0.30	0.55	0.55	0.65

▼ **Circuit diagram HZ5 (negative control) sizes 150 to 215**



▼ **Circuit diagram HZ7 (negative control) size 60 to 115**



EZ – Two-point electric control

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

Notice

The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** via an external check valve. For lower pressures, please contact us.

Please note that pressures up to 500 bar can occur at port **G**.

Response time damping

The response time damping impacts the swivel behavior of the motor and consequently the machine response speed.

Standard for sizes 150 to 215

EZ5, EZ6 with throttle pin on both sides, symmetrical (see table)

Standard for sizes 60 to 115

EZ7, EZ8 (synchronous piston) with throttle pin on both sides, symmetrical (see table)

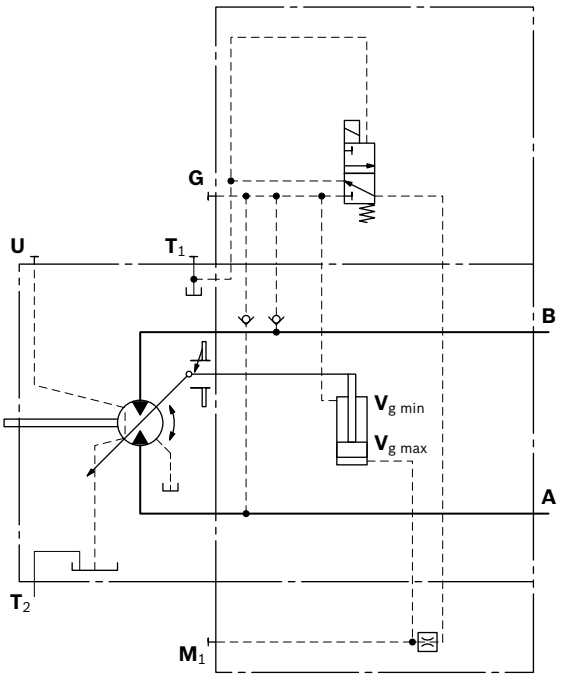
▼ **Throttle pin overview**

Size	60	85	115	150	170	215
Groove size [mm]	0.30	0.30	0.30	0.55	0.55	0.65

Sizes 150 to 215

Technical data, solenoid with ø37	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

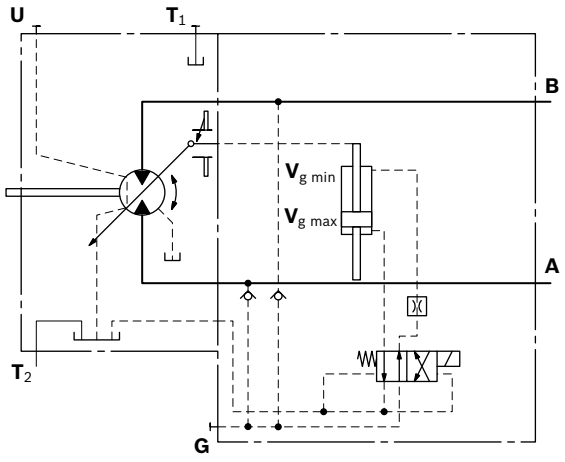
▼ **Circuit diagram EZ5, EZ6 (negative control)**



Sizes 60 to 115

Technical data, solenoid with ø45	EZ7	EZ8
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

▼ **Circuit diagram EZ7, EZ8 (negative control)**



HA – Automatic high-pressure related control

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.
The displacement of the A6VM motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control device measures internally the operating pressure at **A** or **B** (no control line required) and upon reaching the set beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of operating pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

HA1, HA2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum speed)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed)

Notice

- For safety reasons, winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).
- The control oil is internally taken from the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port **G**.
- The beginning of control and the HA.T3 characteristic curve are influenced by case pressure. An increase in case pressure causes an increase in the beginning of control (see page 7) and thus a parallel shift of the characteristic.
- At port **X** a leakage flow of maximum 0.3 l/min occurs (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port **X** to the reservoir. **Only with HA.T control**.

Response time damping

The response time damping impacts the swivel behavior of the motor and consequently the machine response speed.

Standard for sizes 60 to 215

HA1,2 with one-sided throttle pin, throttling occurs from $V_{g\,min}$ to $V_{g\,max}$. (see table)
HA3 and HA3T3 with BVI and throttle pin on both sides, 0.30, symmetrical

▼ **Throttle pin overview**

Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65

Standard for sizes 60 to 215

HA with BVD or BVE counterbalance valve, with throttle screw (see table)

▼ **Throttle screw**

Size	60	85	115	150	170	215
Diameter [mm]	0.80	0.80	0.80	0.80	0.80	0.80

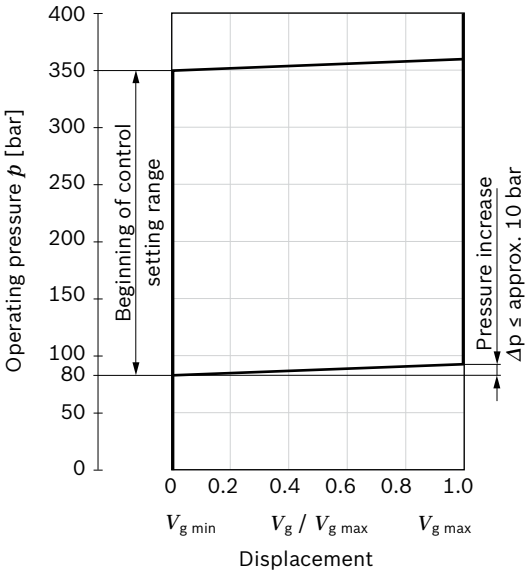
HA1 with minimum pressure increase, positive control

An operating pressure increase of Δp ≤ approx. 10 bar results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

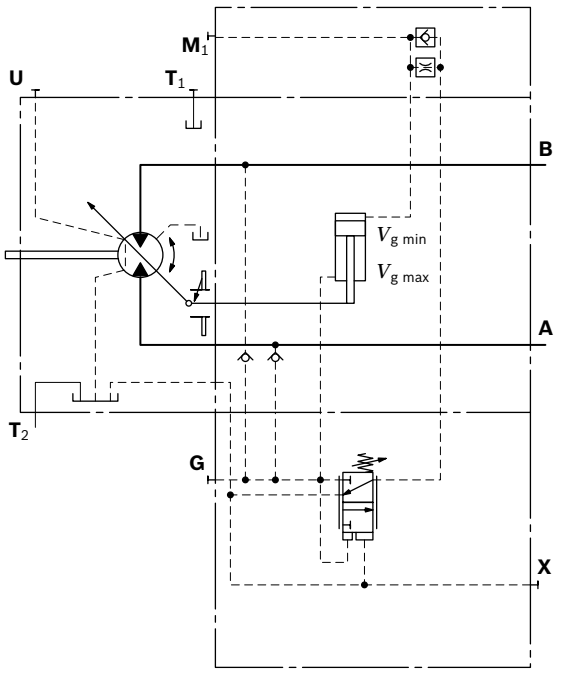
Beginning of control, setting range 80 to 350 bar

Please state the desired beginning of control in plain text when ordering, e.g.: beginning of control at 300 bar.

▼ **Characteristic curve HA1**



▼ **Circuit diagram HA1**



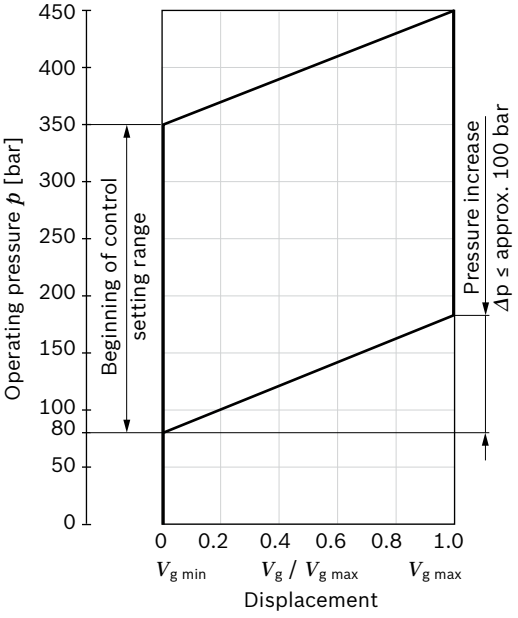
HA2 with pressure increase, positive control

An operating pressure increase of Δp approx. 100 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

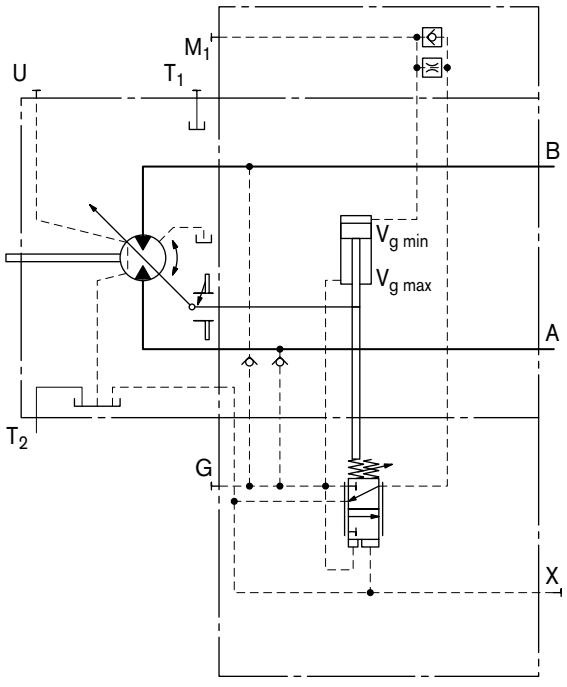
Beginning of control, setting range 80 to 350 bar

Please state the desired beginning of control in plain text when ordering, e.g.: beginning of control at 200 bar

▼ **Characteristic curve HA2**



▼ **Circuit diagram HA2**



HA.T3 override, hydraulic, remote controlled, proportional

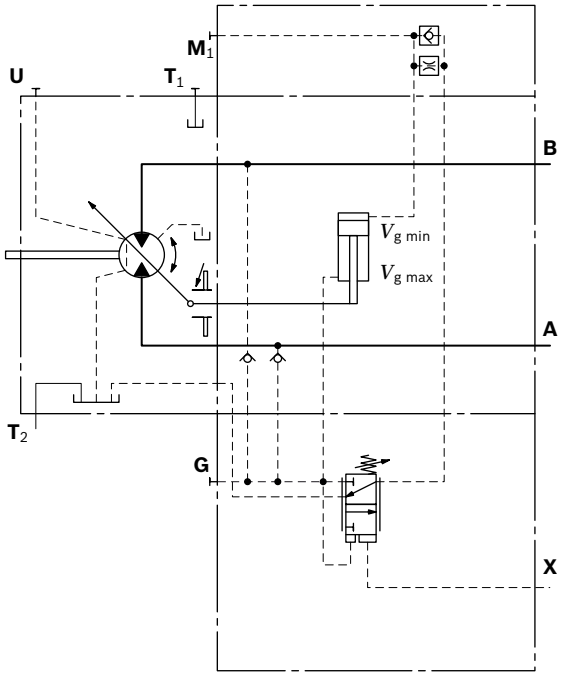
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port **X**.
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar.

Beginning of control setting	300 bar	300 bar
Pilot pressure at port **X**	0 bar	10 bar
Beginning of control at	300 bar	130 bar

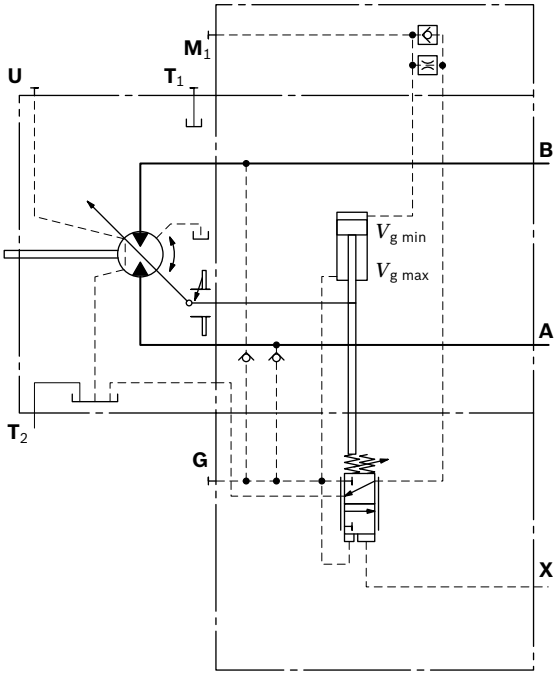
Notice

Maximum permissible pilot pressure 100 bar.

▼ **Circuit diagram HA1T3**



▼ **Circuit diagram HA2T3**



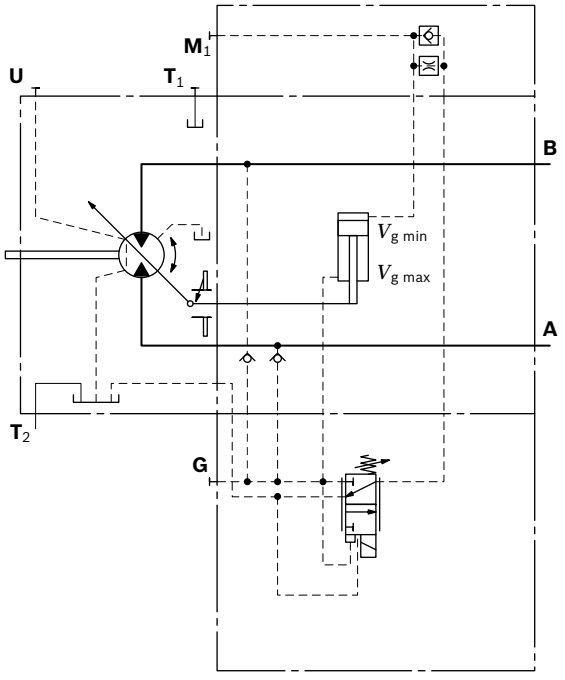
HA.U1, HA.U2 electric override, two-point

With the HA.U1 or HA.U2 control, the beginning of control can be overridden by an electric signal to a switching solenoid. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

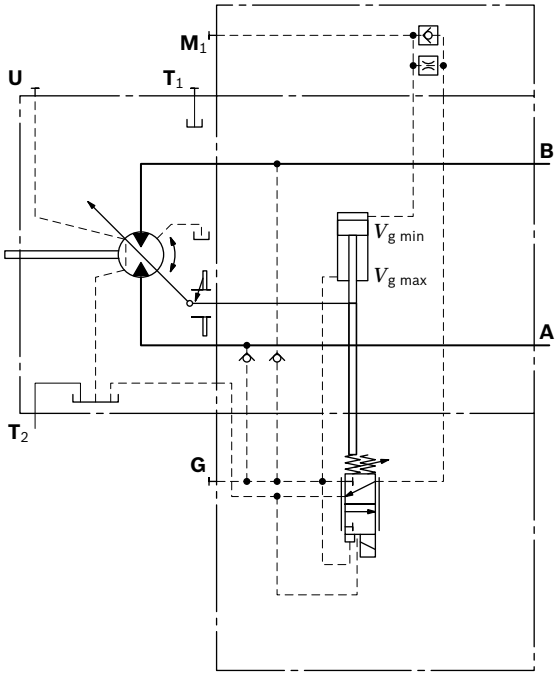
The beginning of control can be set between 80 and 300 bar (specify required setting in plain text when ordering).

Technical data, solenoid with ø45	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

▼ **Circuit diagram HA1U1, HA1U2**



▼ **Circuit diagram HA2U1, HA2U2**



HA.R1, HA.R2 electric override, electric travel direction valve

With the HA.R1 or HA.R2 control, the beginning of control can be overridden by an electric signal to switching solenoid **b**. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor (**A** or **B**) is always connected to the HA control, and thus determines the swivel angle, even if the high-pressure side changes (e.g. -travel drive during a downhill operation). This thereby prevents undesired jerky deceleration and/or braking characteristics.

The travel direction valve (see page 25) is either pressure spring or switched by energizing switching solenoid **a**, depending on the direction of rotation (travel direction).

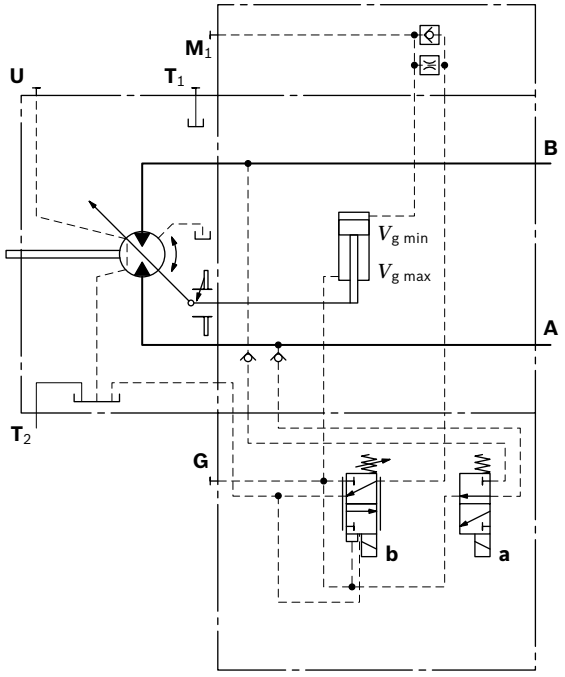
Electric override

Technical data, solenoid b with ø45	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

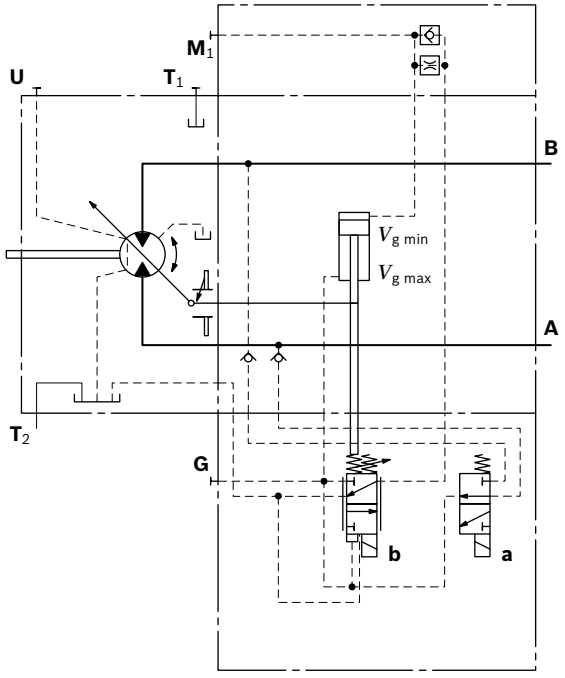
Travel direction valve, electric

Technical data, solenoid a with ø37		R1	R2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	**B**	energized	energized
cw	**A**	de-energized	de-energized
Nominal resistance (at 20 °C)		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required active current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection: see connector version on page 62			

▼ **Circuit diagram HA1R1, HA1R2**



▼ **Circuit diagram HA2R1, HA2R2**



DA – Automatic speed-related control

The variable motor A6VM with automatic speed-related control, type DA, is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.
A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.
Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.
If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

- Pressure ratio p_{St}/p_{HD} = 5/100

DA closed loop control is only suitable for certain types of drive systems and requires review of the engine and vehicle parameters to ensure that the motor is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.
Detailed information is available from our sales organization.

Notice
The beginning of control and the DA characteristic curve a influenced by case pressure. An increase in case pressure causes an decrease in the beginning of control (see page 7) and thus a parallel shift of the characteristic.

Response time damping
The response time damping impacts the swivel behavior of the motor and consequently the machine response speed.
Standard for sizes 60 to 215
DA with throttle pin on one side, throttling occurs from $V_{g\,min}$ to $V_{g\,max}$ (see table).

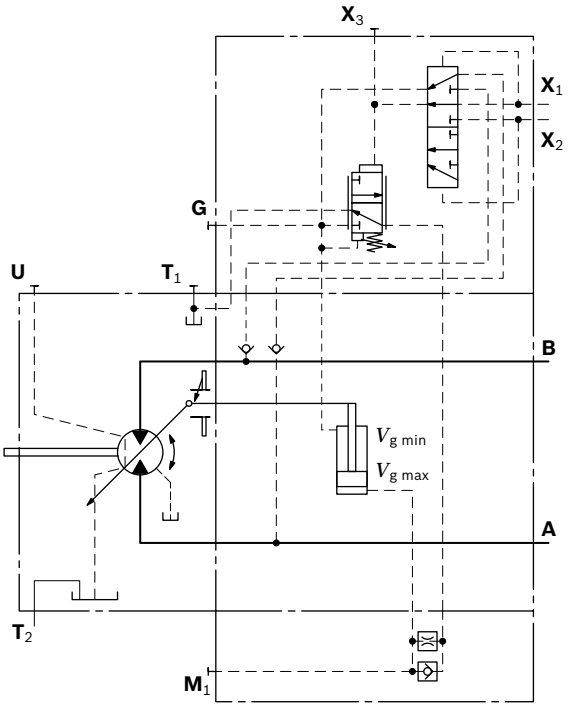
▼ **Throttle pin overview**

Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65

DA0 hydraulic travel direction valve, negative control
Depending on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections **X**$_1$ or **X**$_2$.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	**A**	**X**$_1$
ccw	**B**	**X**$_2$

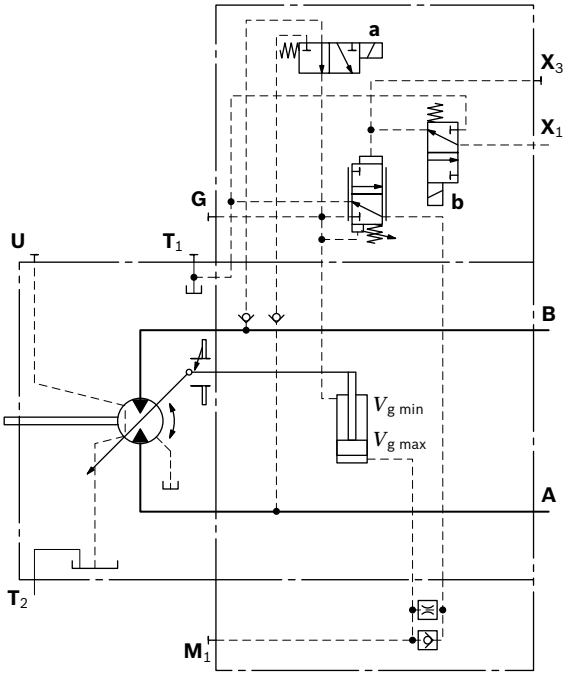
▼ **Circuit diagram DA0**



DA1, DA2 electric travel direction valve + electric $V_{g\,max}$ circuit, negative control

The travel direction valve is either pressure spring offset or switched by energizing switching solenoid **a**, depending on the direction of rotation (travel direction).
When the switching solenoid **b** is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\,max}$-circuit).

▼ **Circuit diagram DA1, DA2**



Travel direction valve, electric

Technical data, solenoid a with ø37		DA1	DA2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	**B**	de-energized	de-energized
cw	**A**	energized	energized
Nominal resistance (at 20 °C)		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required active current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection: see connector version on page 62			

Electric override

Technical data, solenoid b with ø37	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

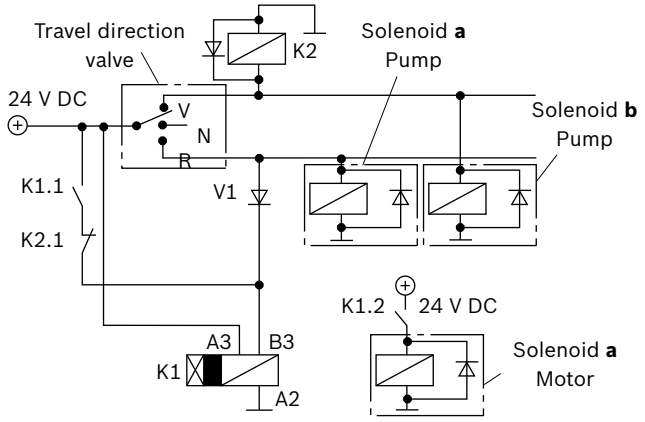
Electric travel direction valve (for DA, HA.R)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e.g. A4VG with DA control valve).
If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.
When the travel direction valve of the pump (e.g. 4/3-directional valve of the DA-control) is switched to

- the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.
- Reversing,
  the travel direction valve causes the travel direction valve of the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

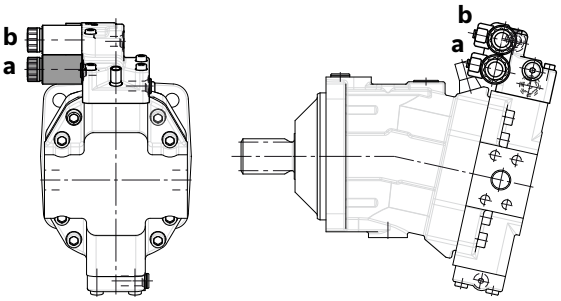
As a result, jerky deceleration or braking is prevented in both cases.

▼ **Circuit diagram - electric travel direction valve**

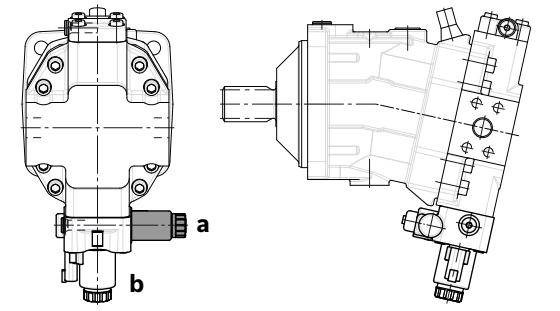


Notice
The shown diodes and relays are not included in the scope of delivery of the motor.

▼ **Control DA1, DA**



▼ **Control HA1R., HA2R.**

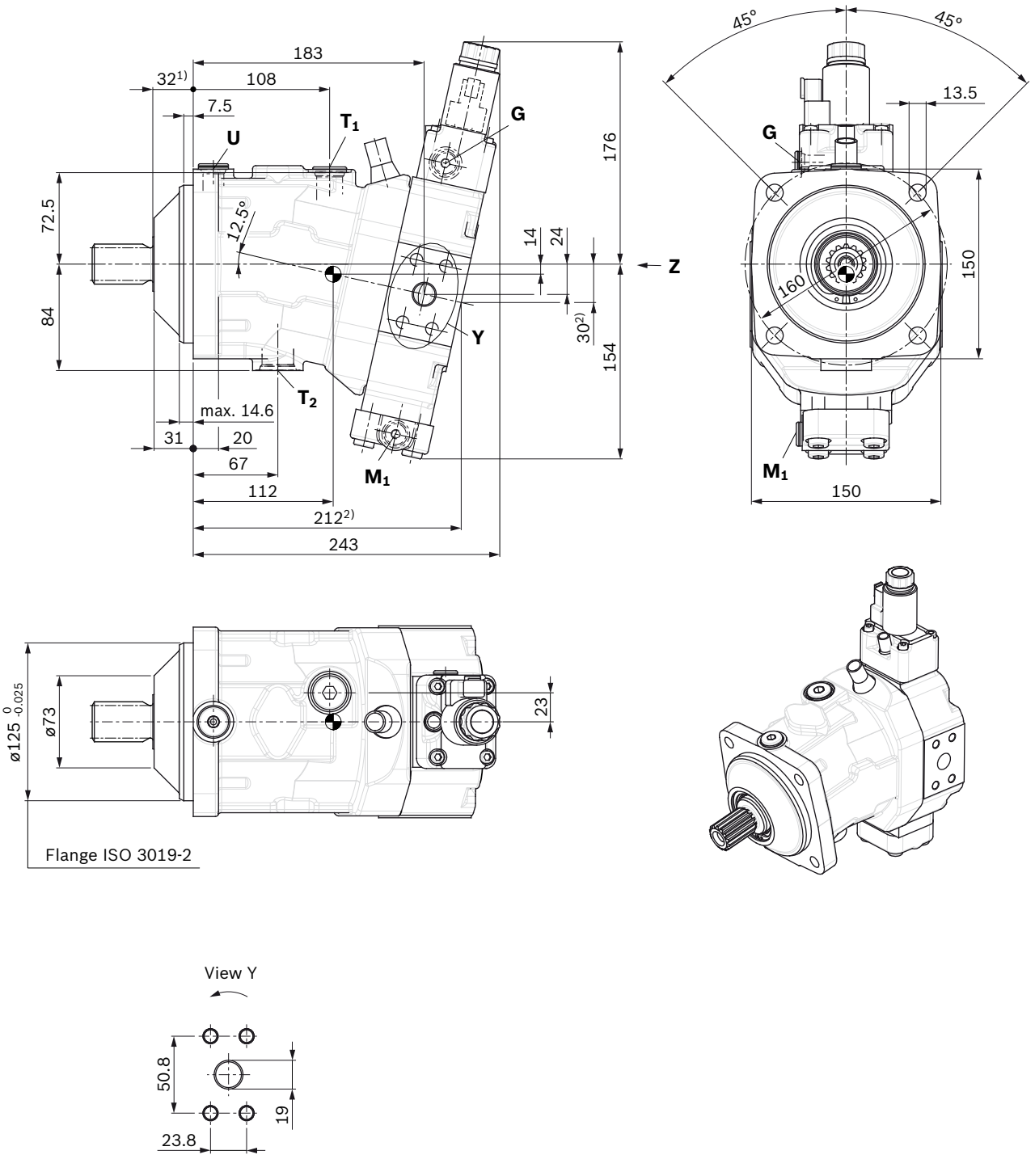


Switching solenoid **a** on the travel direction valve

Dimensions size 60

EP5, EP6 – Proportional electric control, negative control

Port plate 2 – SAE working port **A** and **B** at side, opposite

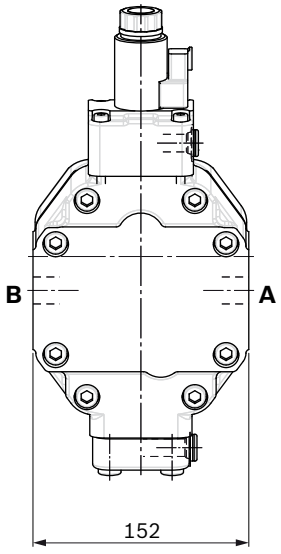


Center of gravity

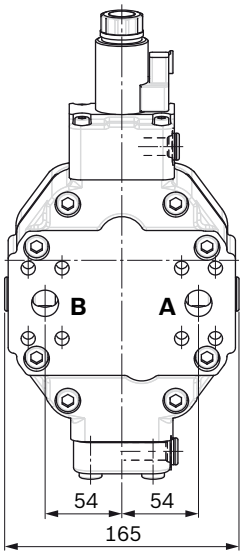
1) To shaft collar
2) Port plate 1 – SAE working port **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

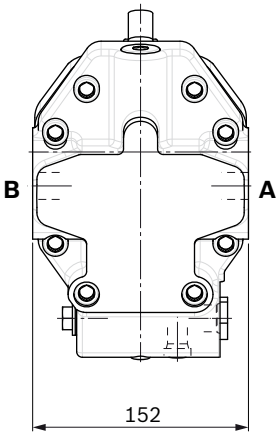
2 SAE working port
A and **B** at side, opposite



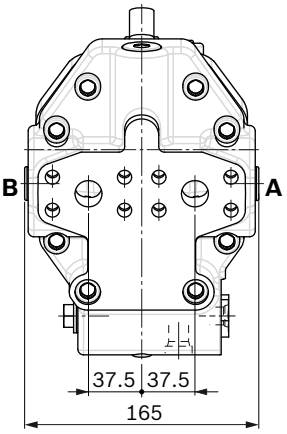
1 SAE working port
A and **B** at rear



2 SAE working port
A and **B** at side, opposite
only HZ7, EZ7/8

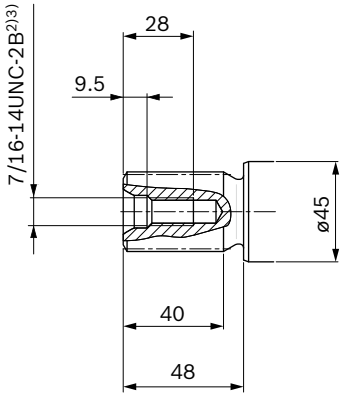


1 SAE working port
A and **B** at rear
only HZ7, EZ7/8



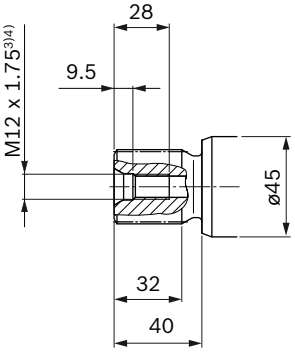
▼ **Splined shaft SAE J744**

S7 – 1 1/4 in 14T 12/24DP[1)]



▼ **Splined shaft DIN 5480**

Z8 – W35×2×16×9g

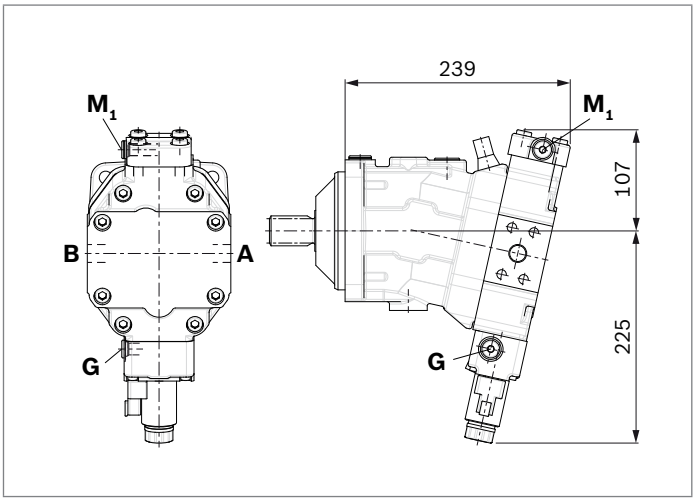


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

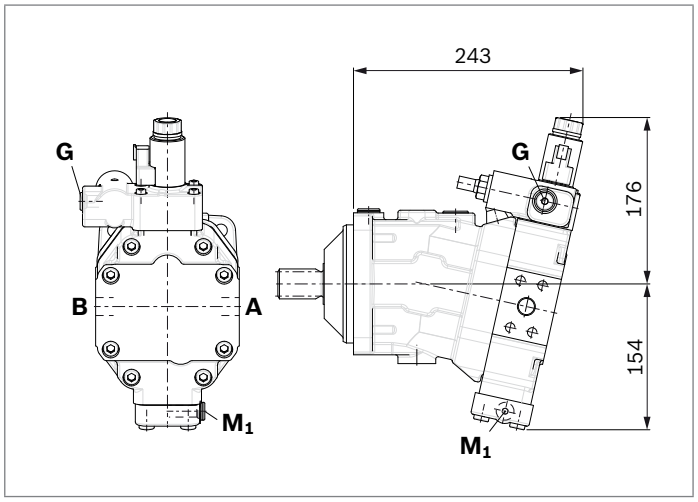
Ports		Standard	Size[1]	p_{max} [bar][2]	Status[6]
A, B	Working port Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 × 1.5; 17 deep	500	O
T_1	Drain port	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 × 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Stroking chamber measurement	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
2) Depending on the application, momentary pressure peaks can occur.
3) Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 72).
6) The countersink can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

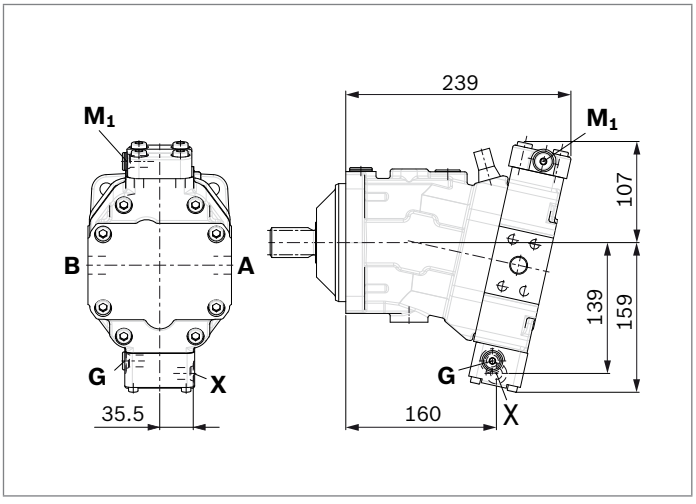
▼ **EP1, EP2** – Electric proportional control, positive control



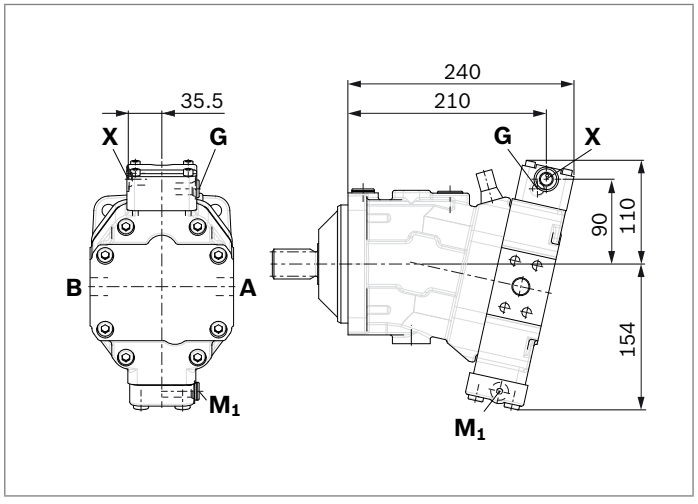
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



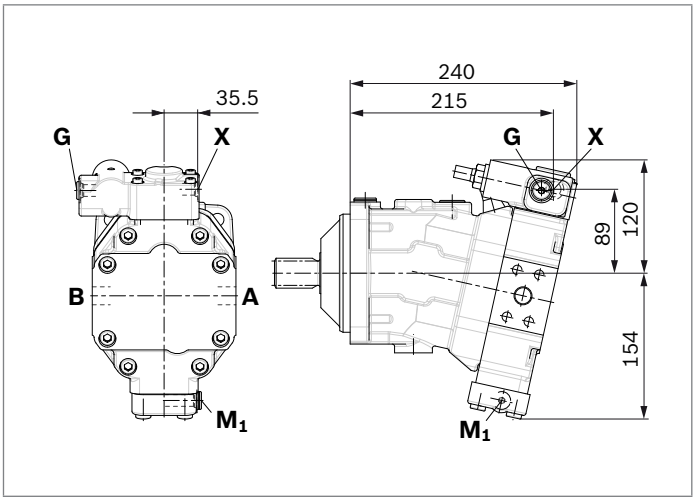
▼ **HP1, HP2** – Hydraulic proportional control, positive control



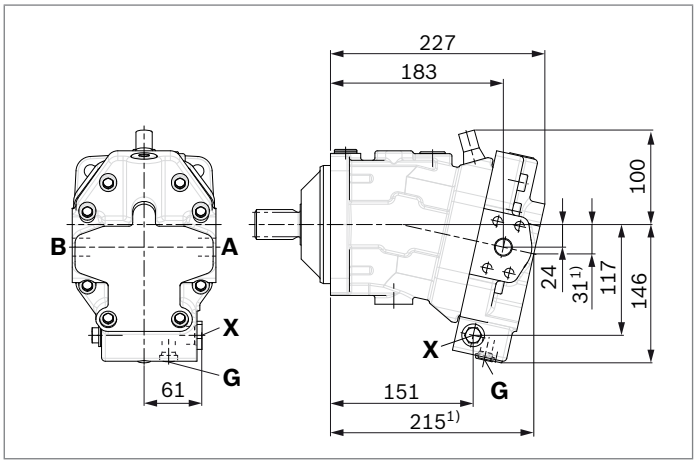
▼ **HP5, HP6** – Hydraulic proportional control, negative control



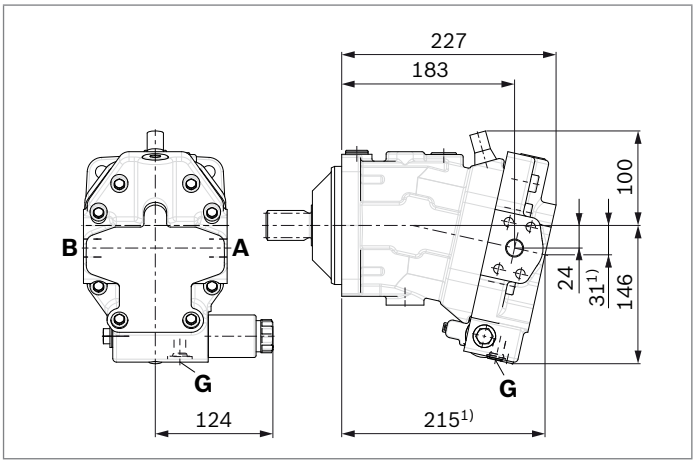
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



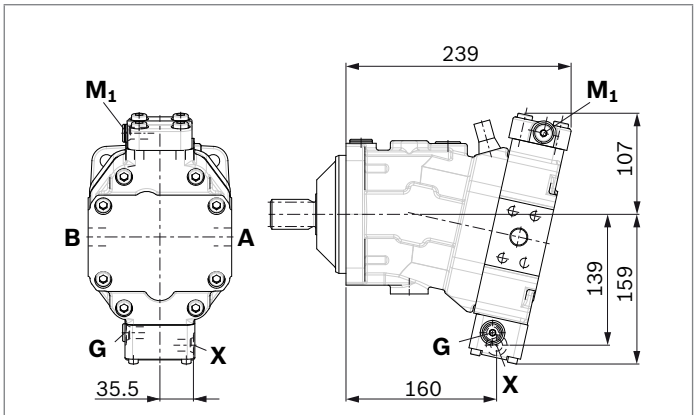
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control



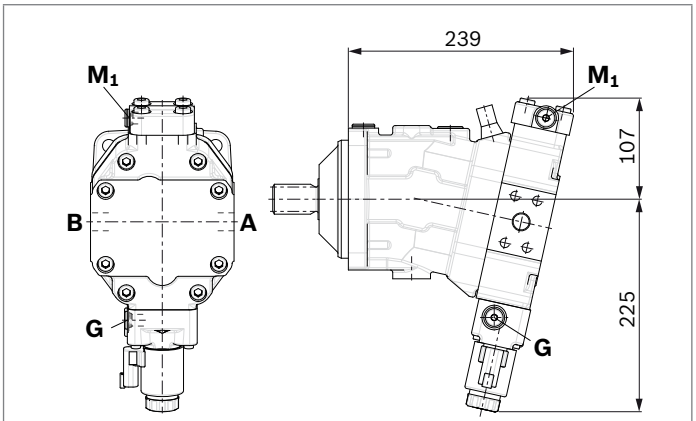
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



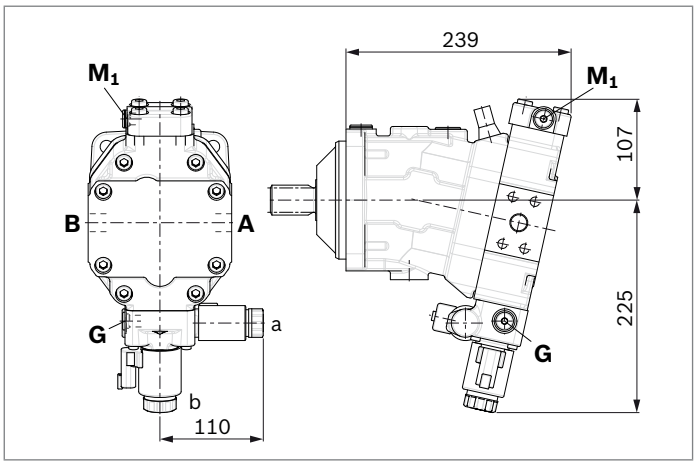
HA1 and HA2, **X** plugged

HA1T and HA2T, **X** open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

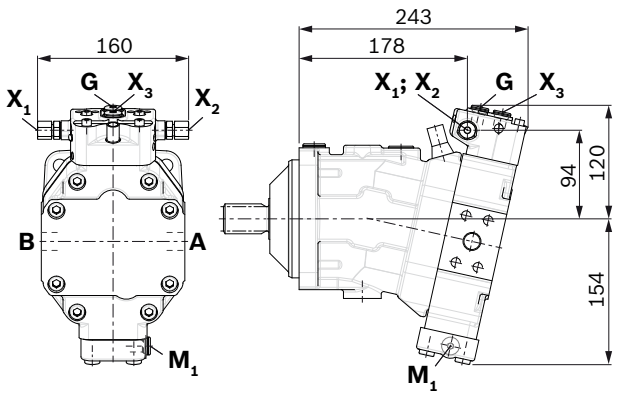


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE working port **A** and **B** at rear

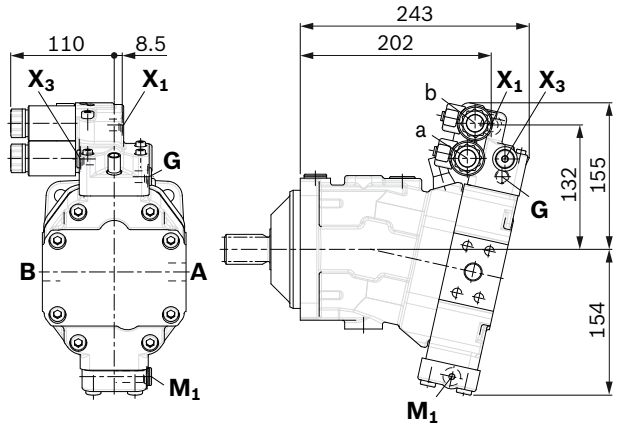
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

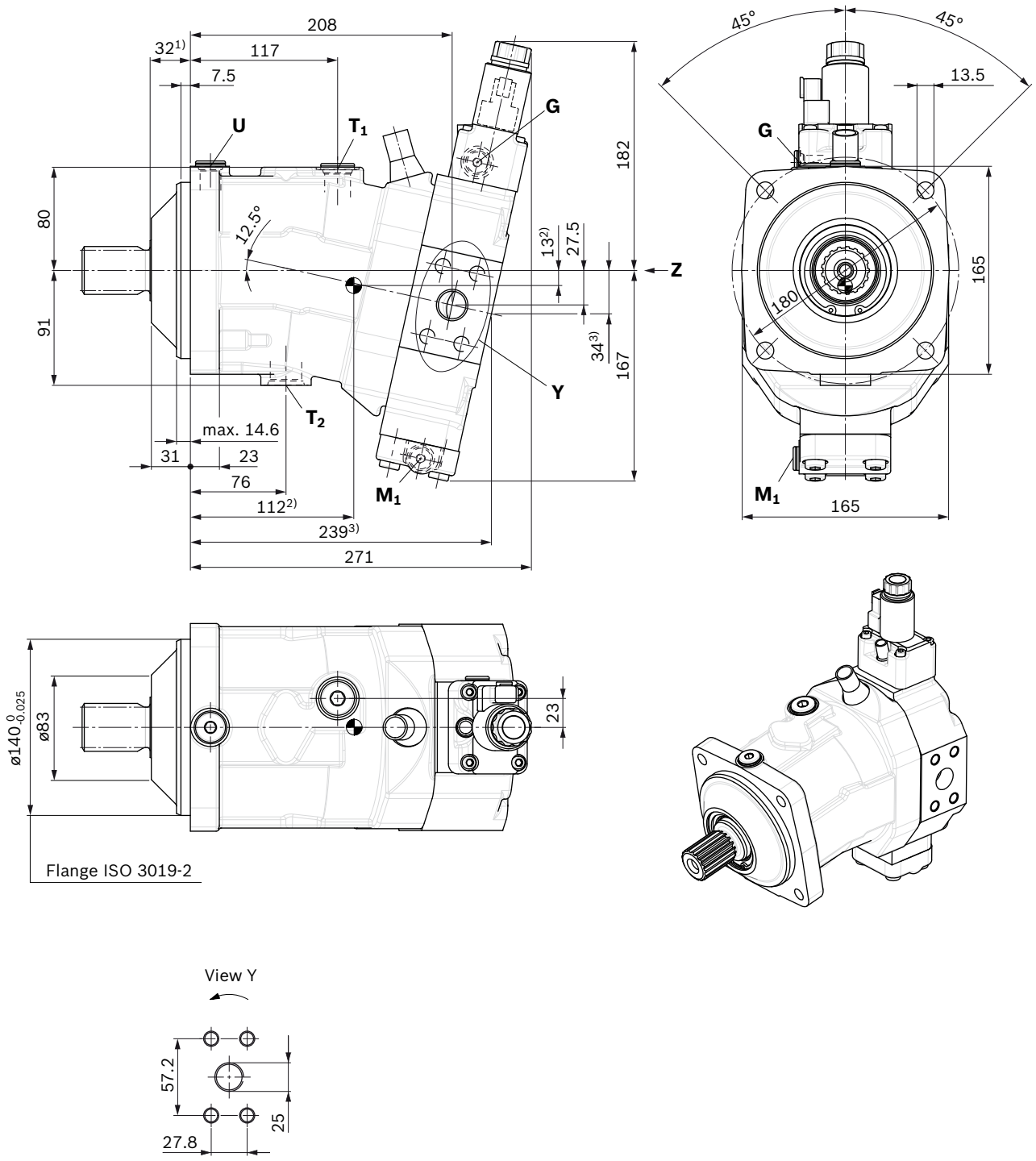
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit



Dimensions size 85

EP5, EP6 – Proportional electric control, negative control

Port plate 2 — SAE working port **A** and **B** at side, opposite

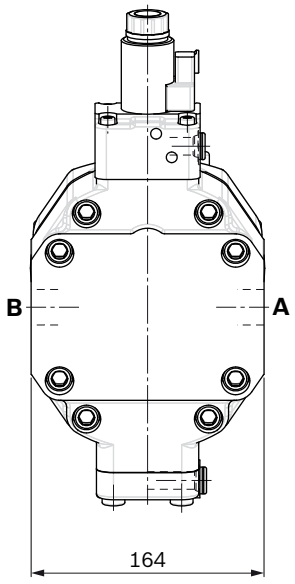


Center of gravity

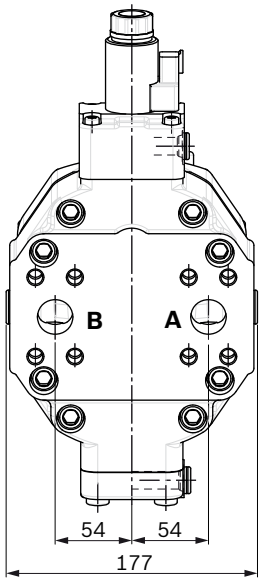
1) To shaft collar
2) Port plate 1 — SAE working port **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

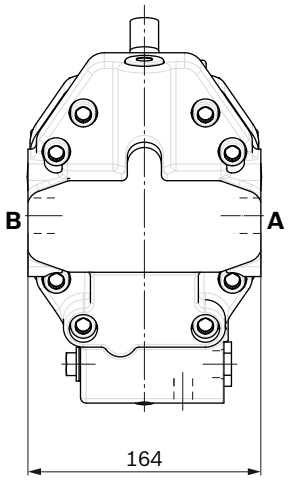
2 SAE working port **A** and **B** at side, opposite



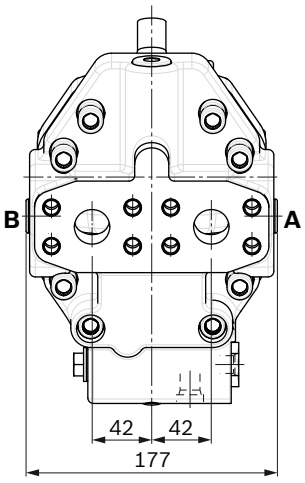
1 SAE working port **A** and **B** at rear



2 SAE working port **A** and **B** at side, opposite only HZ7, EZ7/8

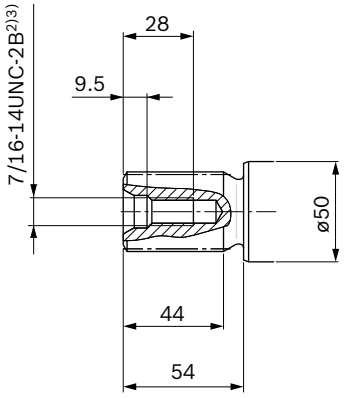


1 SAE working port **A** and **B** at rear only HZ7, EZ7/8



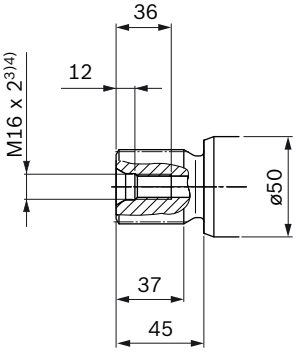
▼ **Splined shaft SAE J744**

S9 – 1 1/2 in 17T 12/24DP[1)]



▼ **Splined shaft DIN 5480**

Z9 – W40×2×18×9g

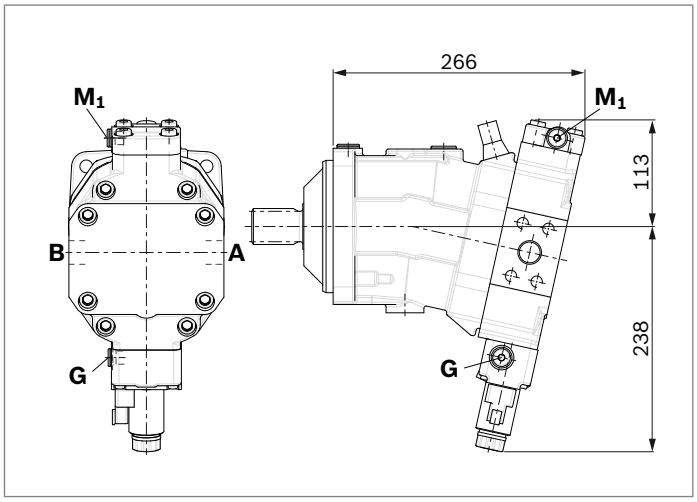


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

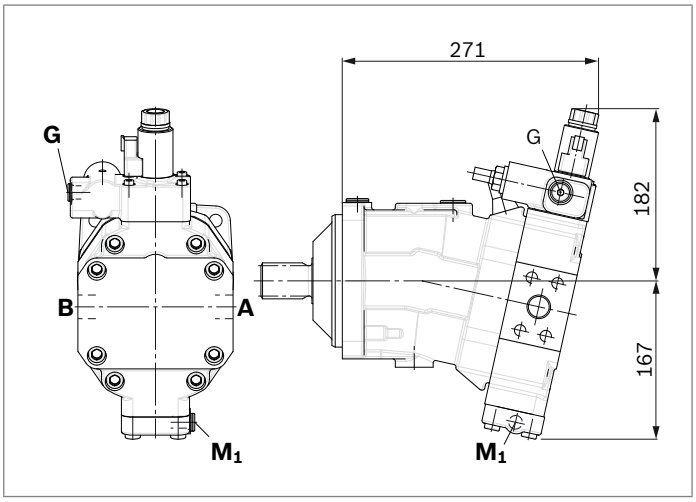
Ports		Standard	Size[1]	p_{max} [bar][2]	Status[6]
A, B	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 × 1.75; 17 deep	500	O
T_1	Drain port	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 × 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Stroking chamber measurement	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
2) Depending on the application, momentary pressure peaks can occur.
3) Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 72).
6) The countersink can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

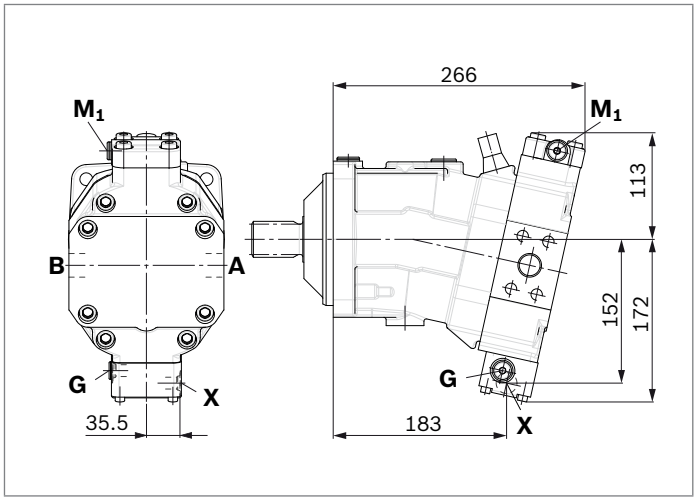
▼ **EP1, EP2** – Electric proportional control, positive control



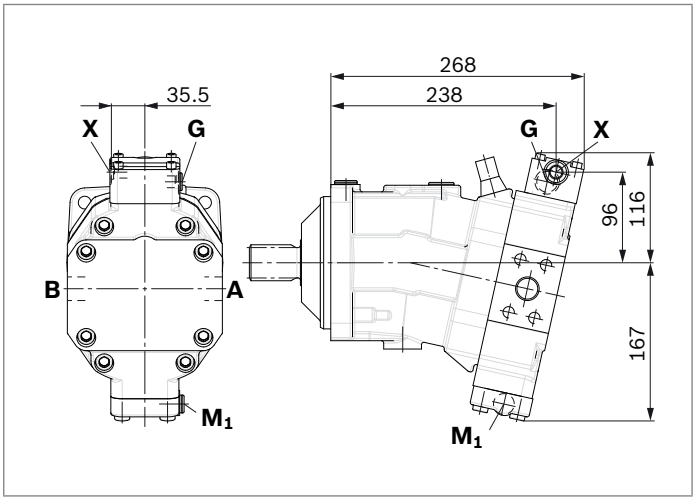
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



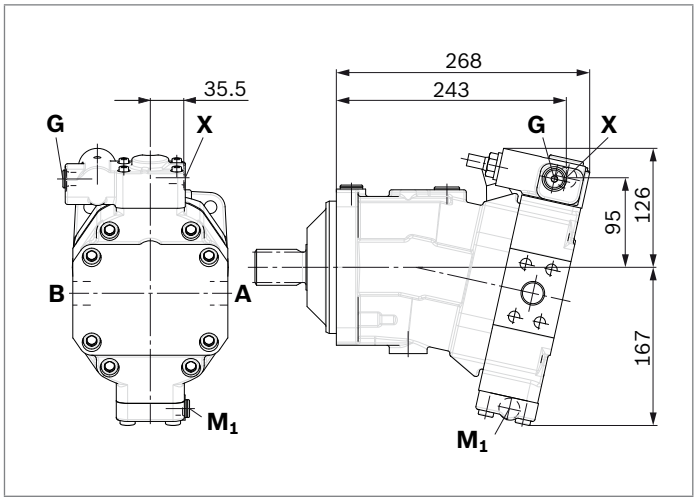
▼ **HP1, HP2** – Hydraulic proportional control, positive control



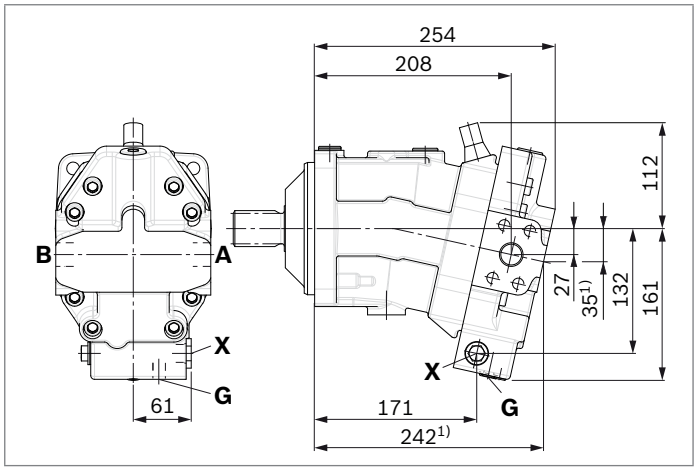
▼ **HP5, HP6** – Hydraulic proportional control, negative control



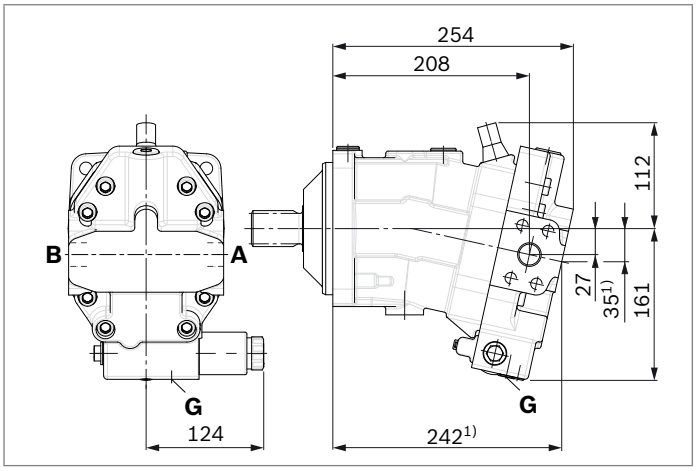
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



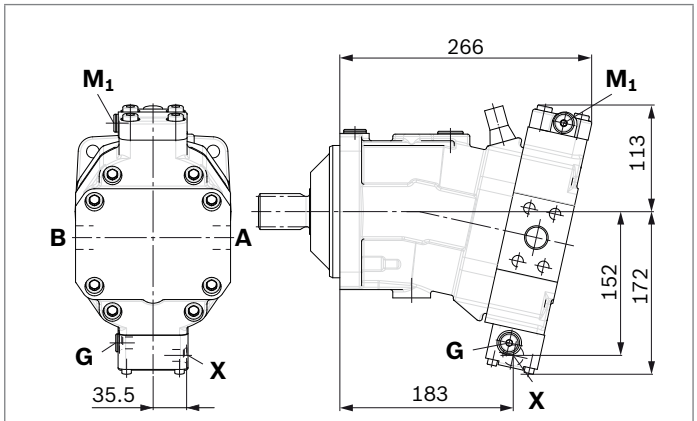
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control

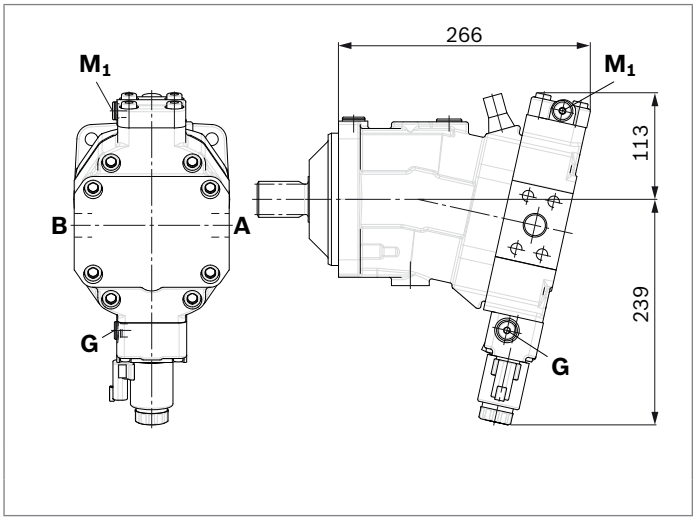


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

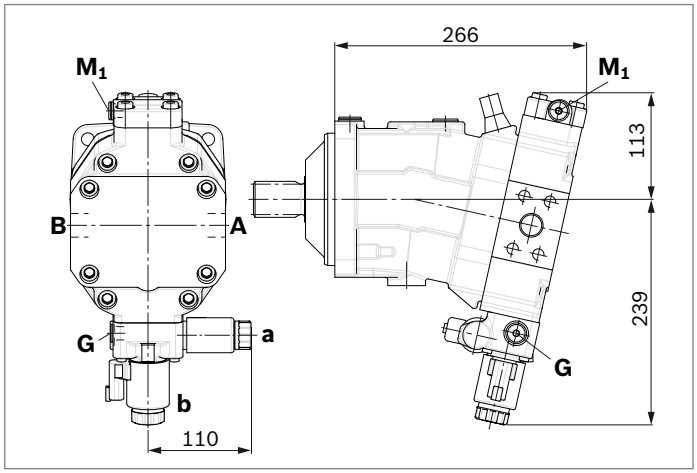


HA1 and HA2, **X** plugged
HA1T and HA2T, **X** open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

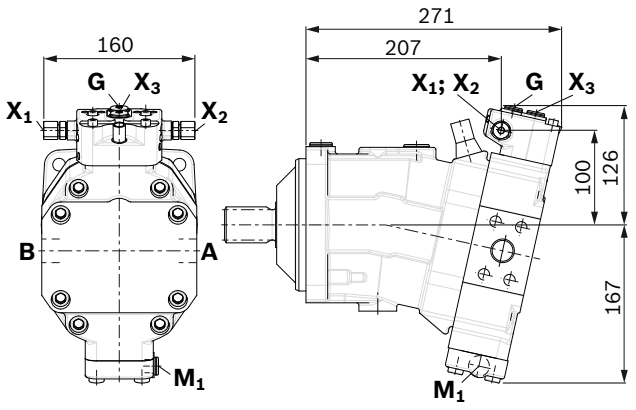


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE working port **A** and **B** at rear

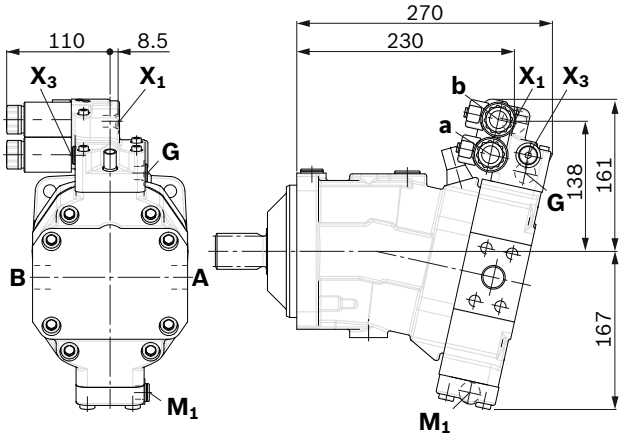
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

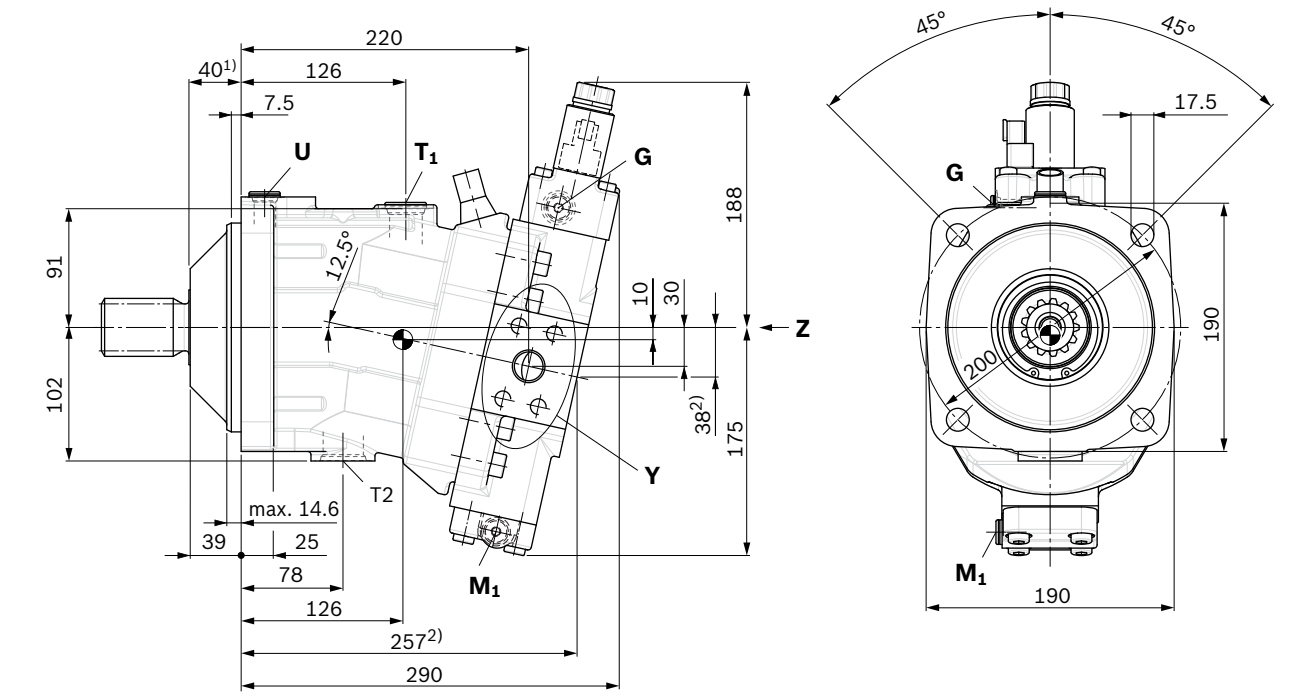
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit

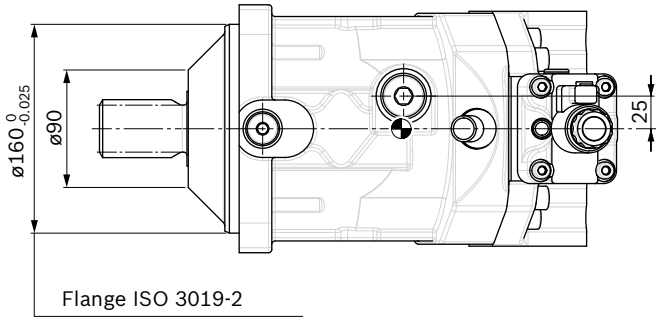


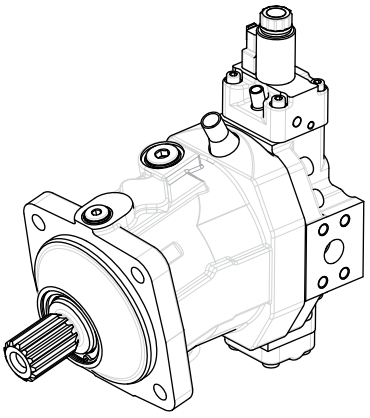
Dimensions size 115

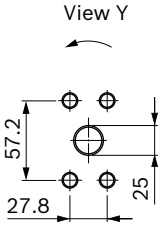
EP5, EP6 – Proportional electric control, negative control

Port plate 2 — SAE working port **A** and **B** at side, opposite







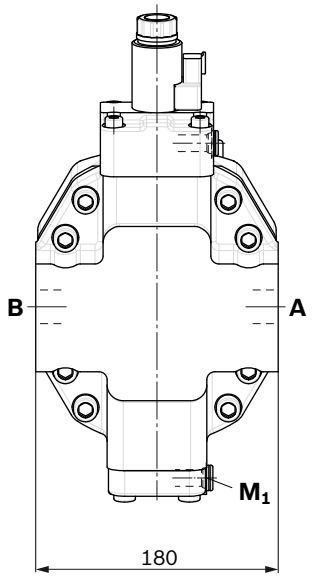


Center of gravity

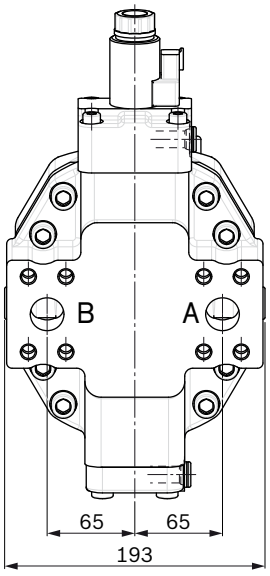
1) To shaft collar
2) Port plate 1 — SAE working port **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

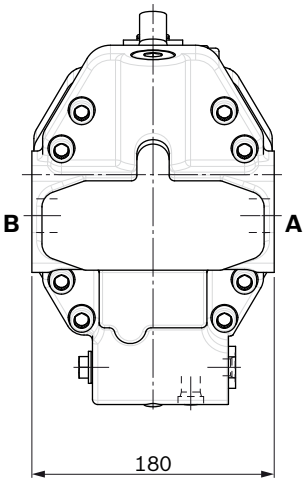
2 SAE working port
A and **B** at side, opposite



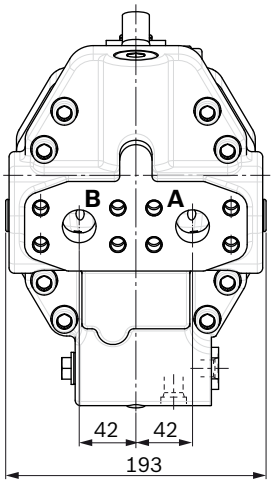
1 SAE working port
A and **B** at rear



2 SAE working port
A and **B** at side, opposite
only HZ7, EZ7/8

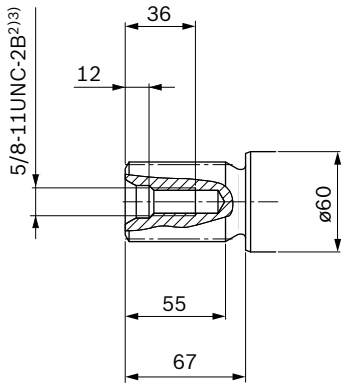


1 SAE working port
A and **B** at rear
only HZ7, EZ7/8



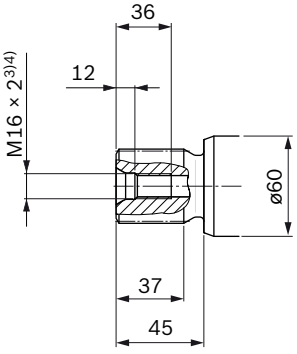
▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/13DP[1)]



▼ **Splined shaft DIN 5480**

Z9 – W40×2×18×9g

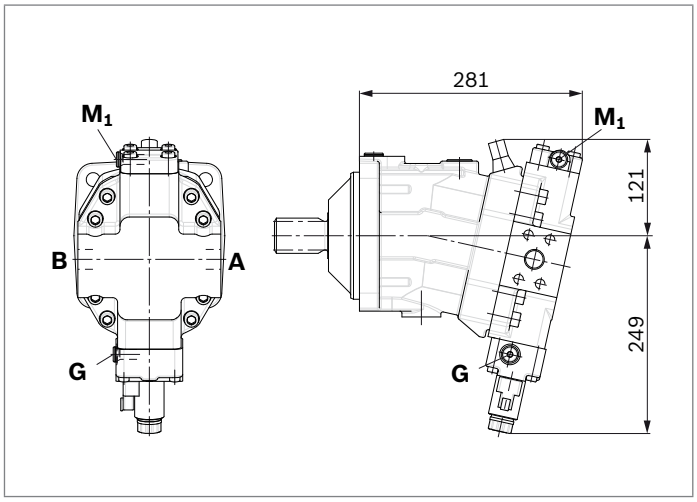


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

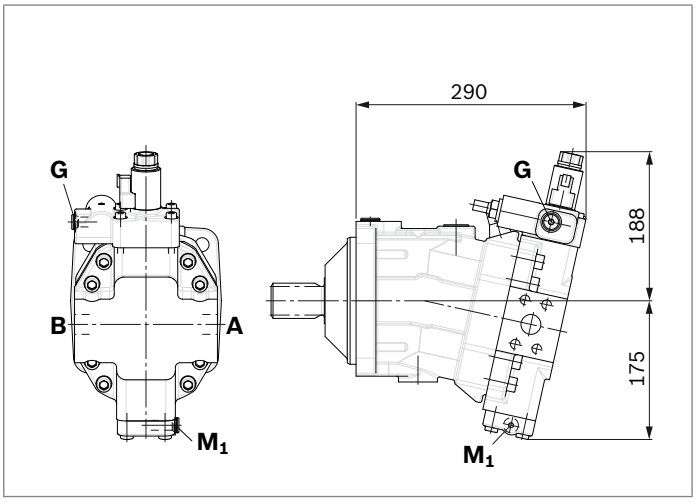
Ports		Standard	Size[1]	p_{max} [bar][2]	Status[6]
A, B	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 × 1.75; 17 deep	500	O
T_1	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 × 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Stroking chamber measurement	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
2) Depending on the application, momentary pressure peaks can occur.
3) Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 72).
6) The countersink can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

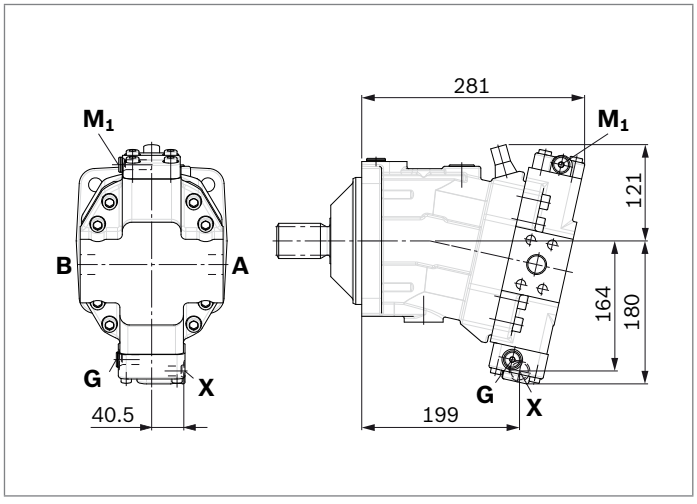
▼ **EP1, EP2** – Electric proportional control, positive control



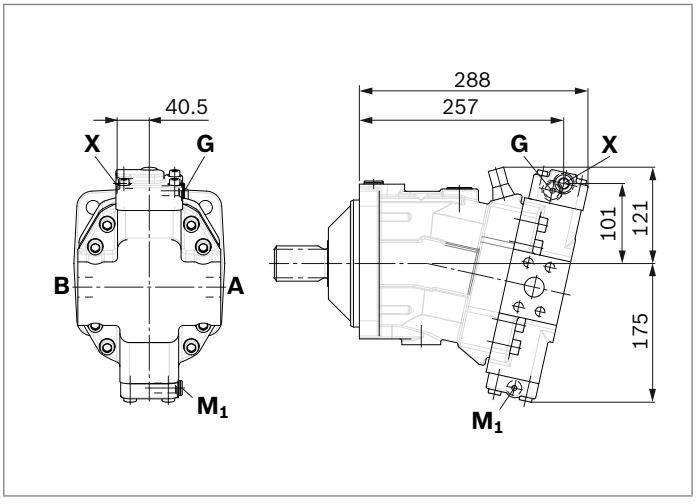
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



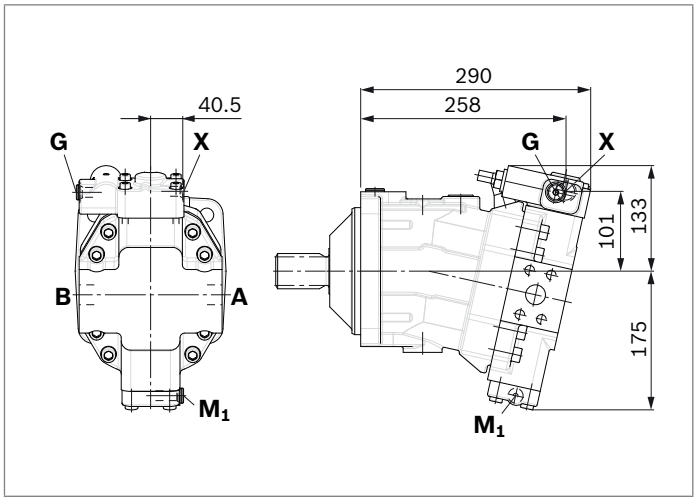
▼ **HP1, HP2** – Hydraulic proportional control, positive control



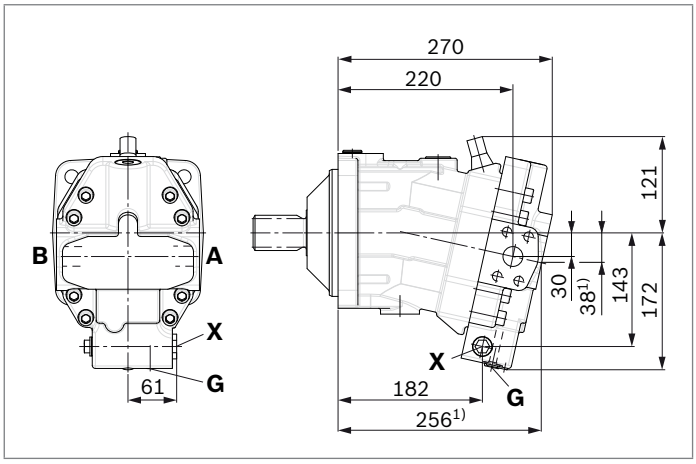
▼ **HP5, HP6** – Hydraulic proportional control, negative control



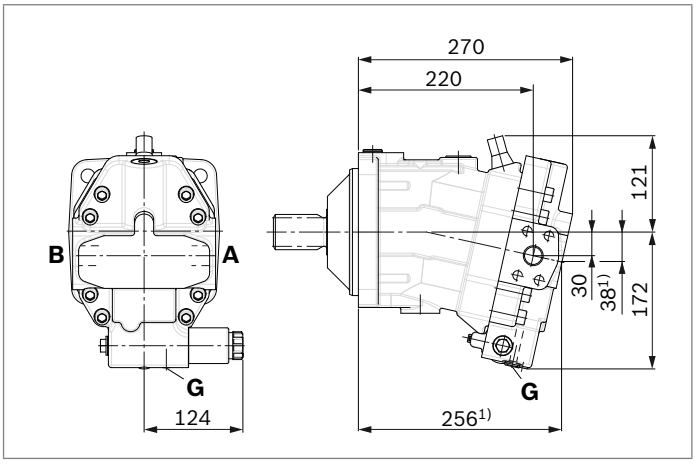
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



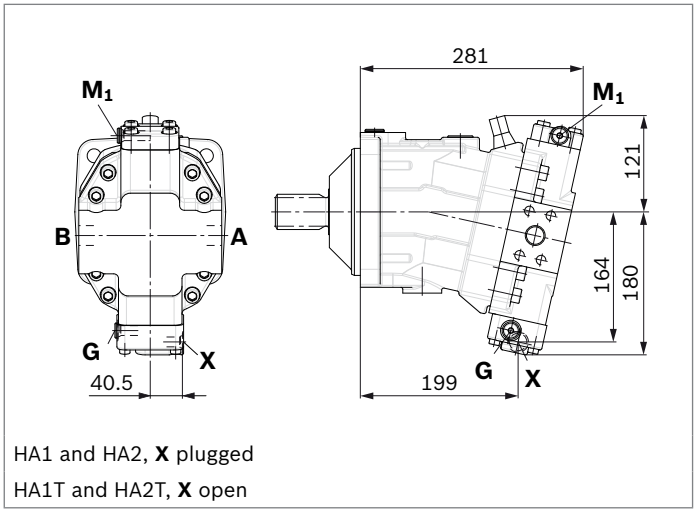
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control

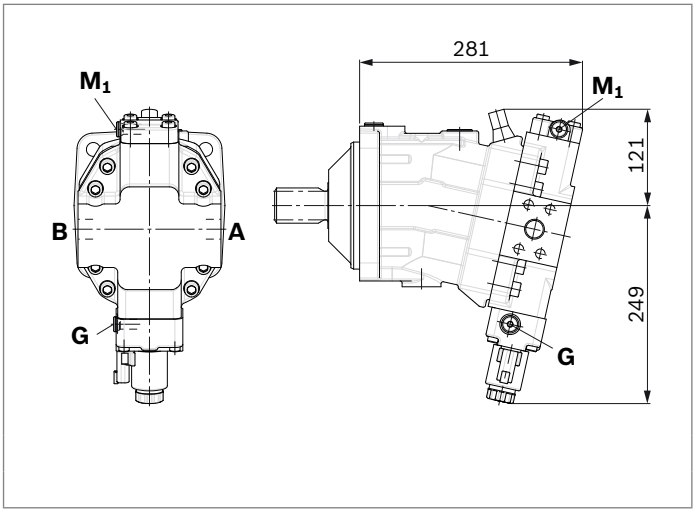


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

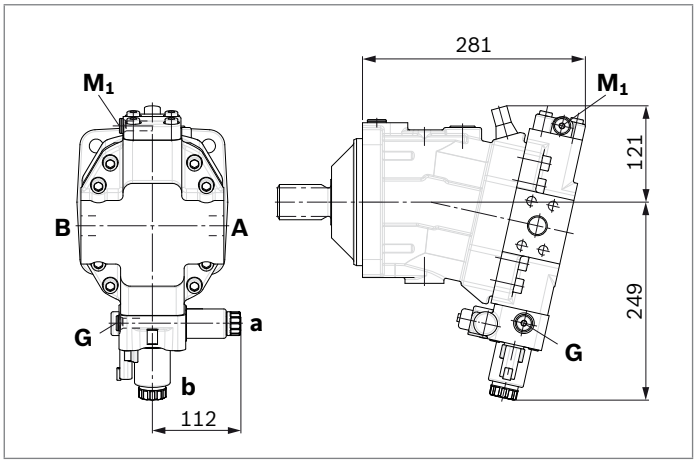


HA1 and HA2, **X** plugged
HA1T and HA2T, **X** open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

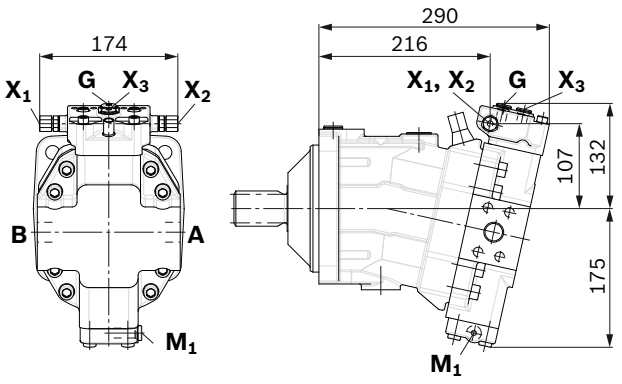


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



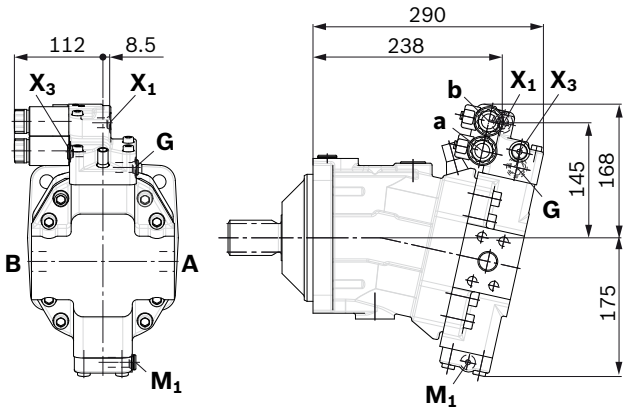
1) Port plate 1 – SAE working port **A** and **B** at rear

▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1
Use assembled fitting!

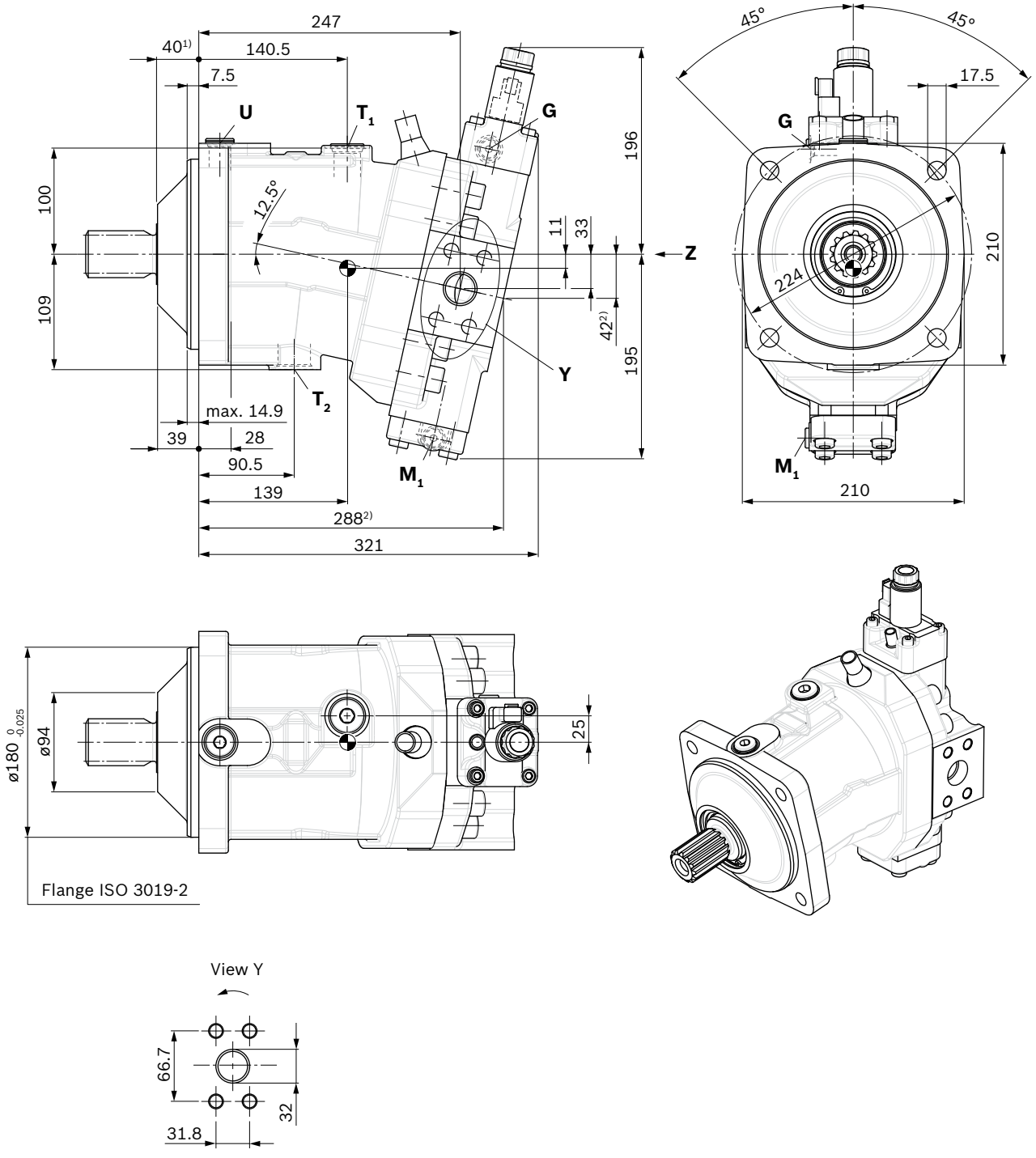
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit



Dimensions size 150

EP5, EP6 – Proportional electric control, negative control

Port plate 2 — SAE working port **A** and **B** at side, opposite

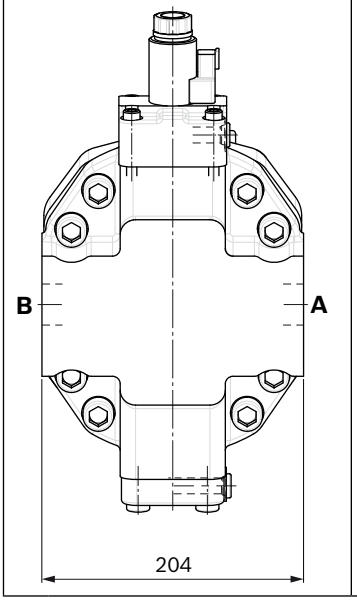


Center of gravity

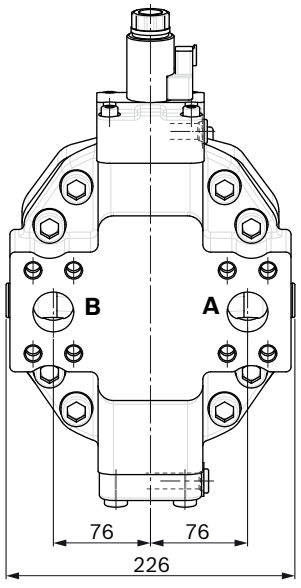
1) To shaft collar
2) Port plate 1 — SAE working port **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

2 SAE working port **A** and **B** at side, opposite

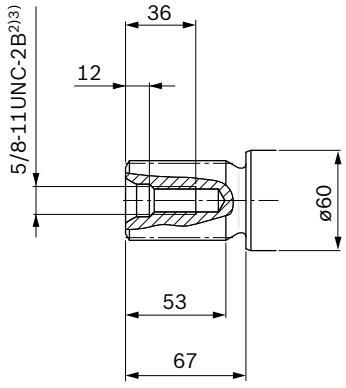


1 SAE working port **A** and **B** at rear



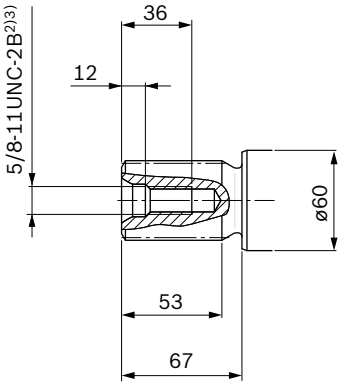
▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/16DP[1)]



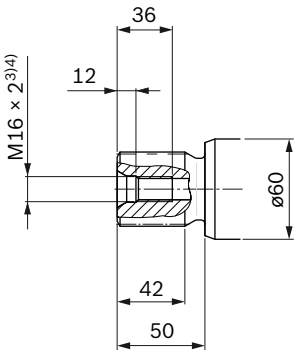
▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9g

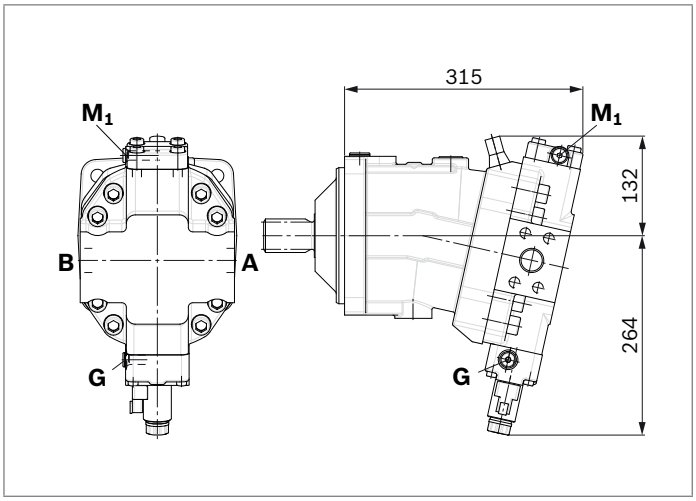


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

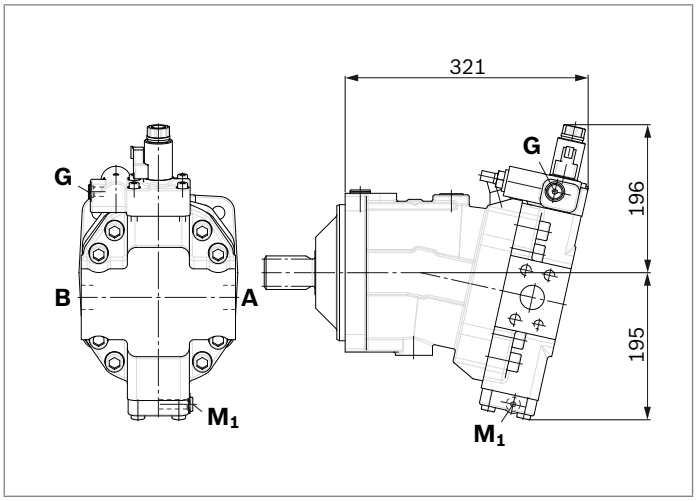
Ports		Standard	Size[1]	p_{max} [bar][2]	Status[6]
A, B	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
T_1	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Stroking chamber measurement	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
2) Depending on the application, momentary pressure peaks can occur.
3) Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 72).
6) The countersink can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

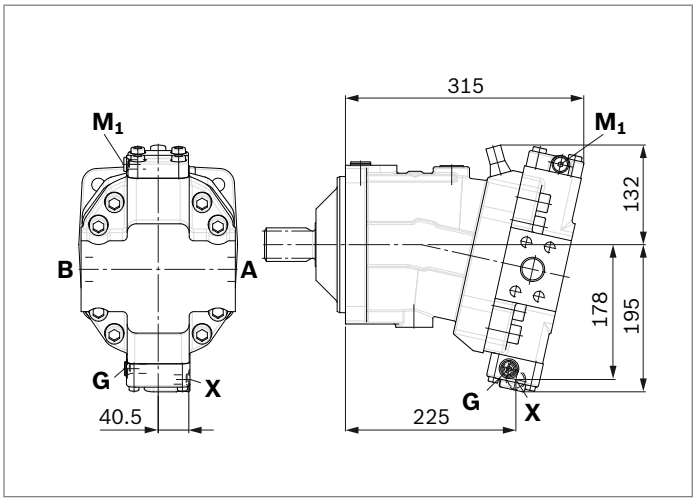
▼ **EP1, EP2** – Electric proportional control, positive control



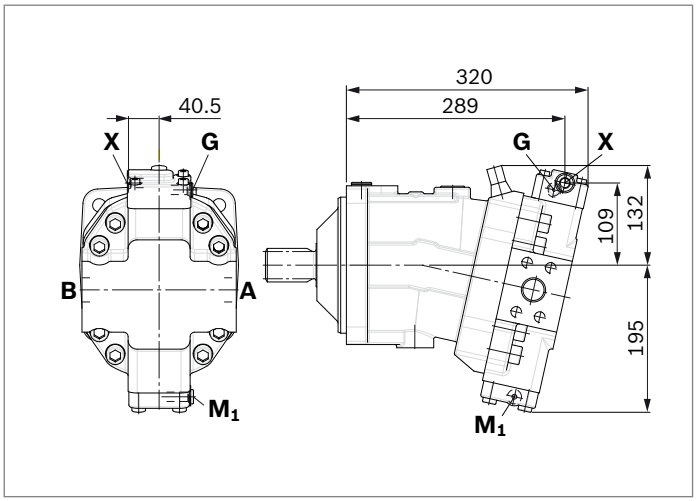
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



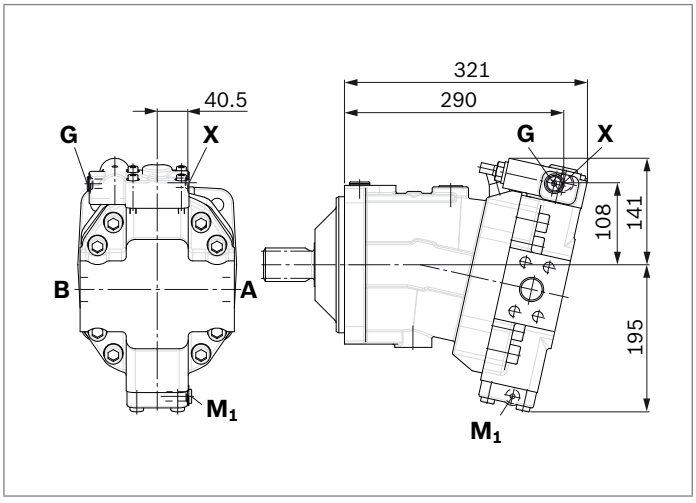
▼ **HP1, HP2** – Hydraulic proportional control, positive control



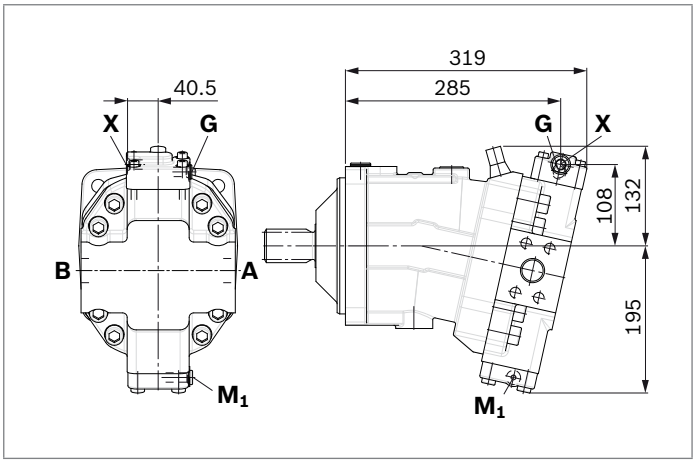
▼ **HP5, HP6** – Hydraulic proportional control, negative control



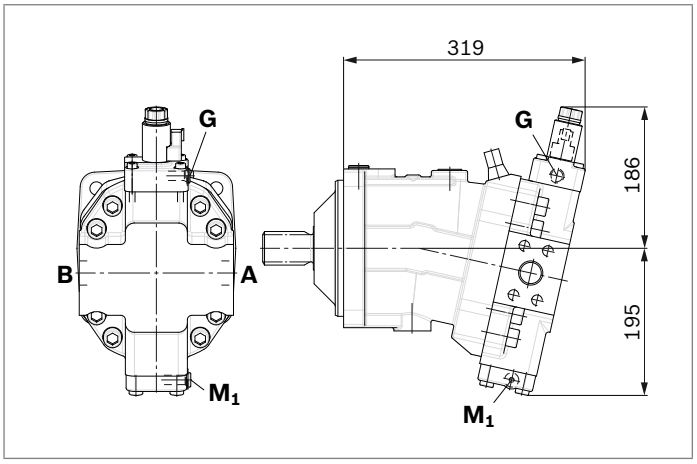
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



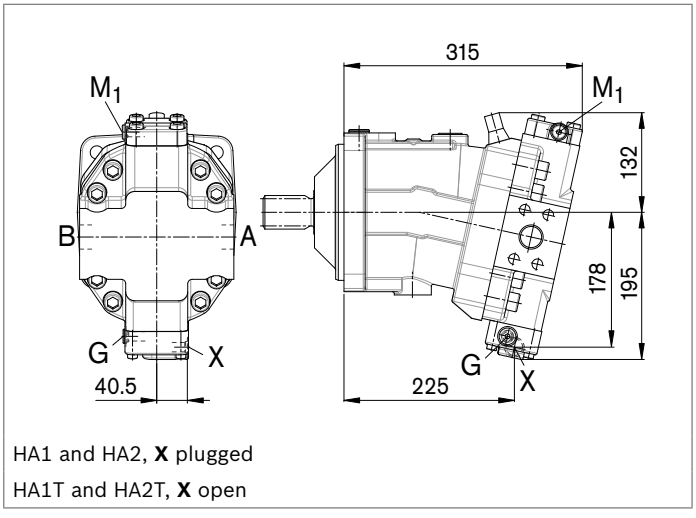
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control

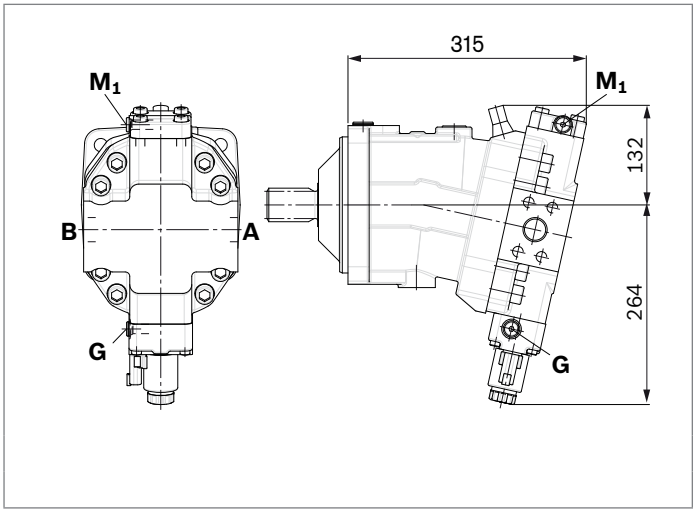


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

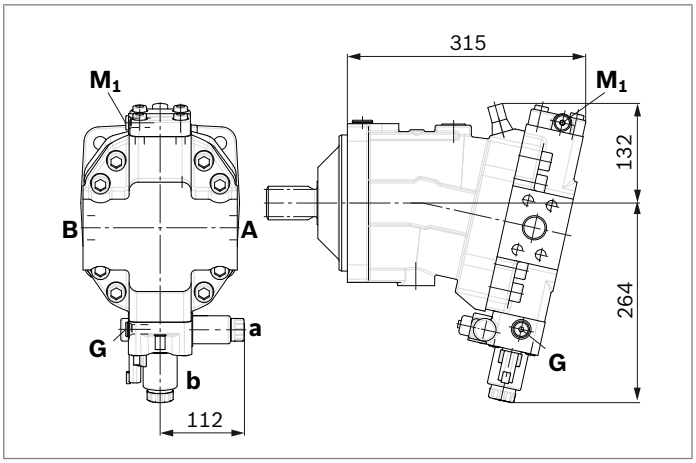


HA1 and HA2, **X** plugged
HA1T and HA2T, **X** open

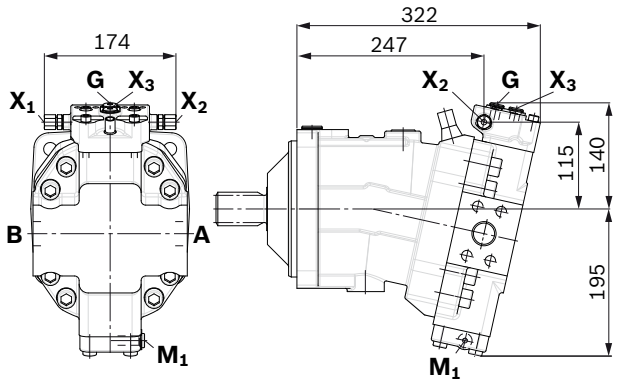
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



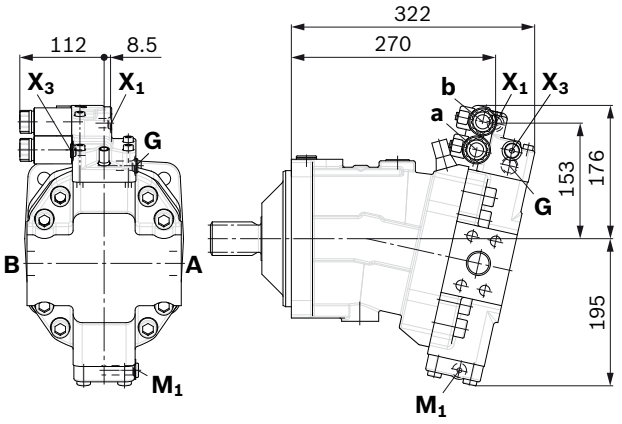
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

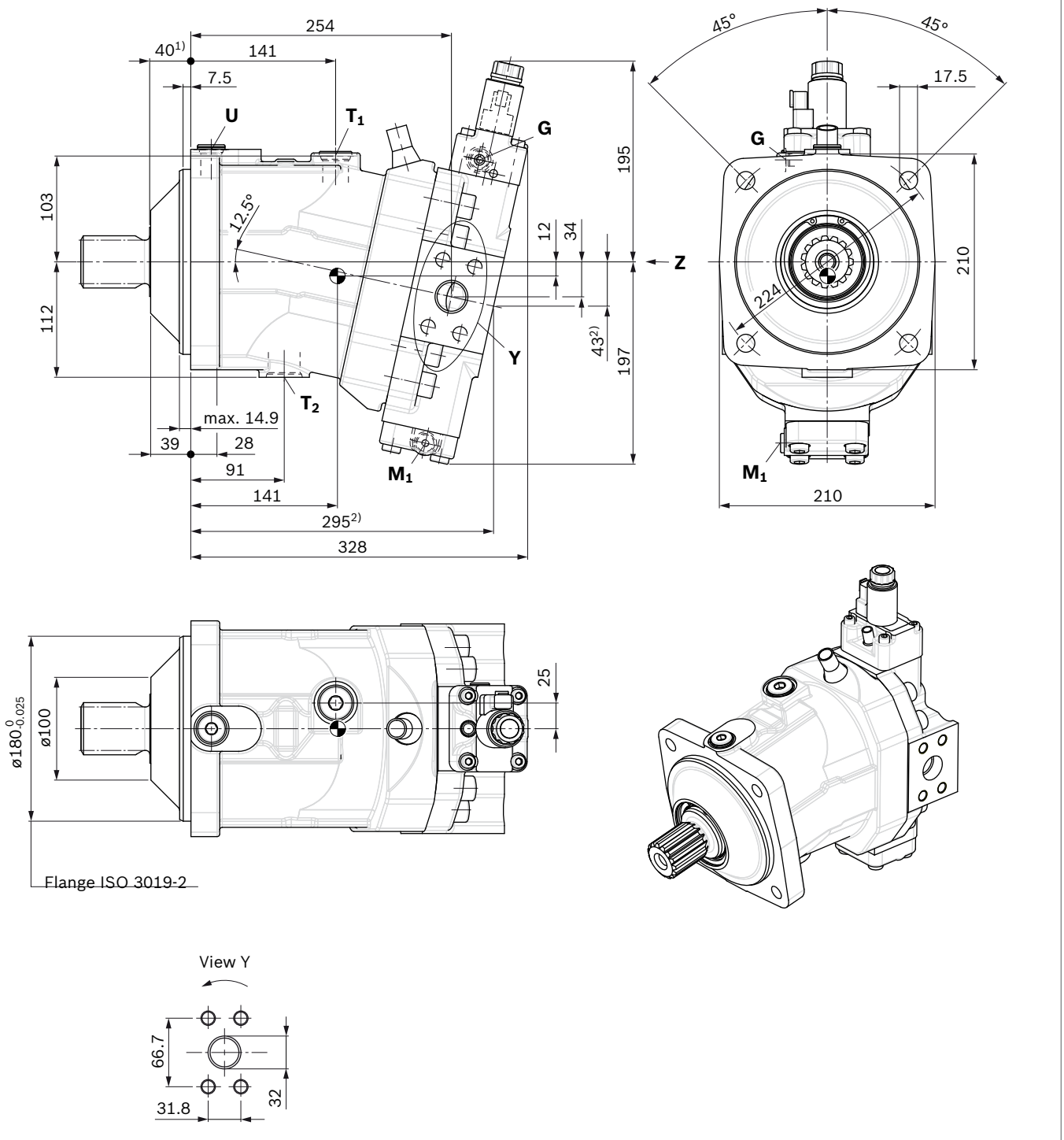
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit



Dimensions size 170

EP5, EP6 – Proportional electric control, negative control

Port plate 2 – SAE working port **A** and **B** at side, opposite

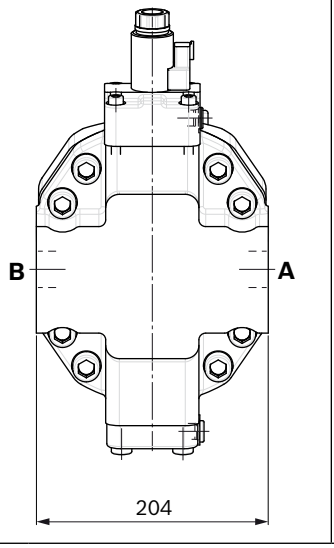


Center of gravity

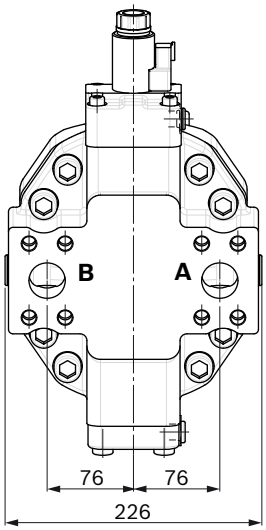
1) To shaft collar
2) Port plate 1 – SAE working port **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

2 SAE working port **A** and **B** at side, opposite

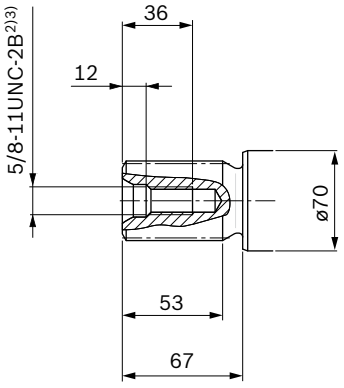


1 SAE working port **A** and **B** at rear



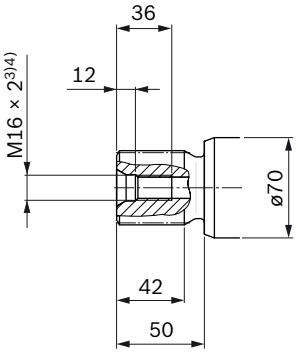
▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9g

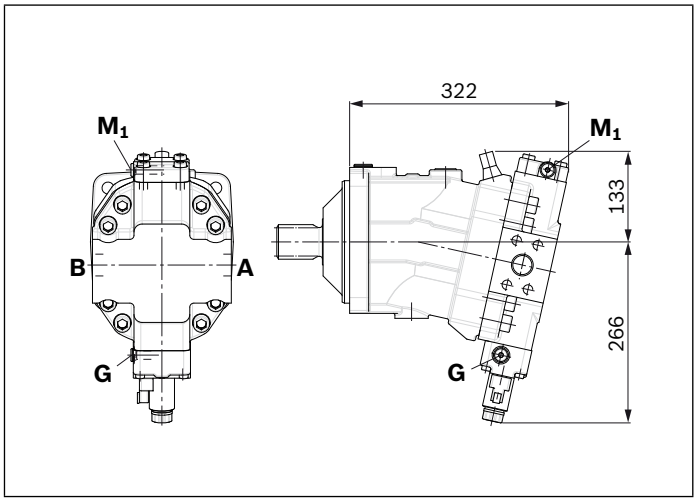


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

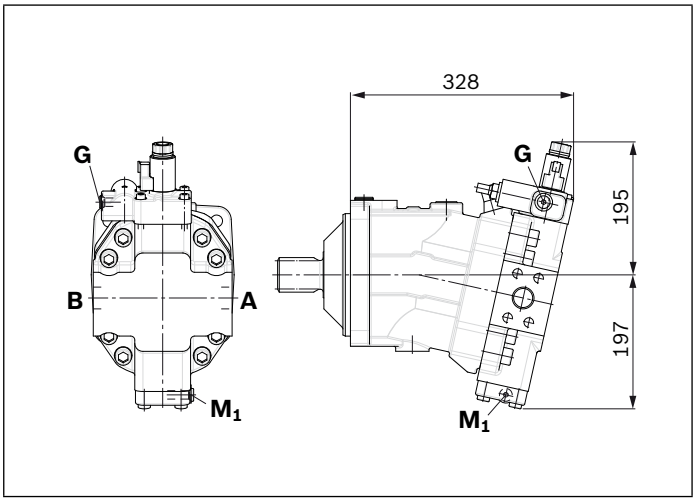
Ports		Standard	Size[1]	p_{max} [bar][2]	Status[6]
A, B	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
T_1	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Stroking chamber measurement	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
2) Depending on the application, momentary pressure peaks can occur.
3) Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 72).
6) The countersink can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

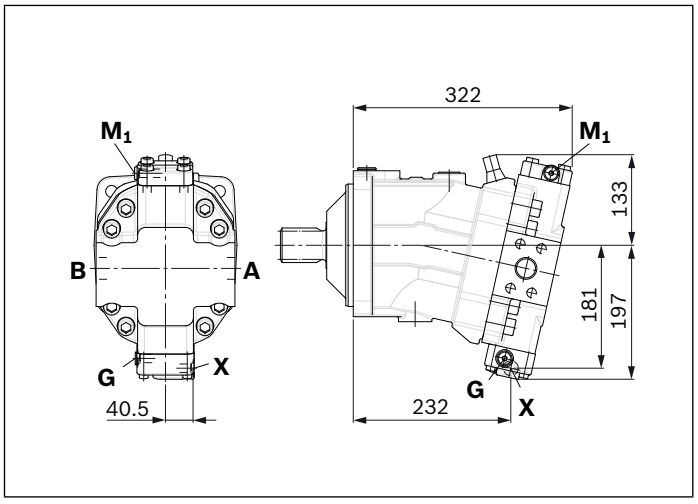
▼ **EP1, EP2** – Electric proportional control, positive control



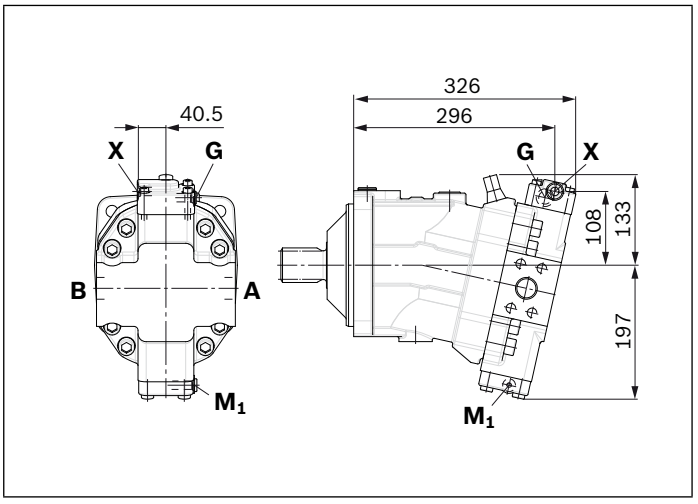
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



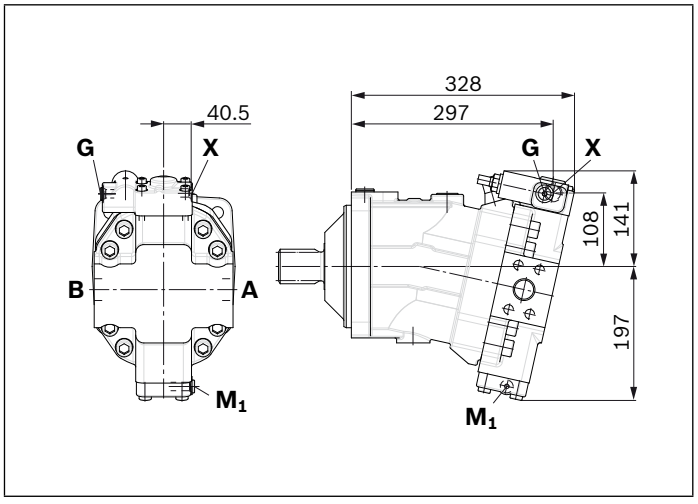
▼ **HP1, HP2** – Hydraulic proportional control, positive control



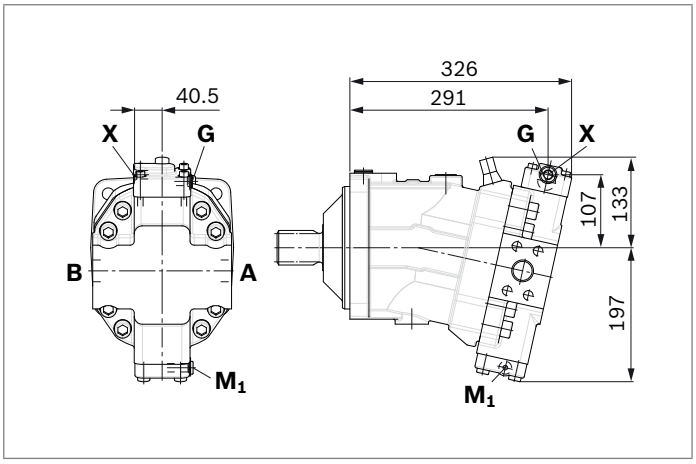
▼ **HP5, HP6** – Hydraulic proportional control, negative control



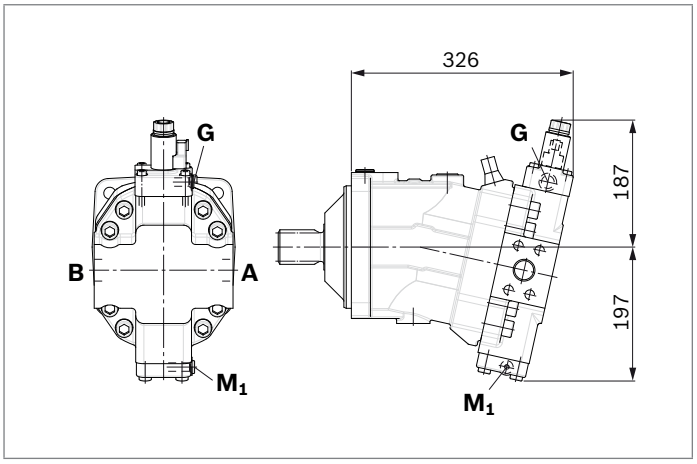
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



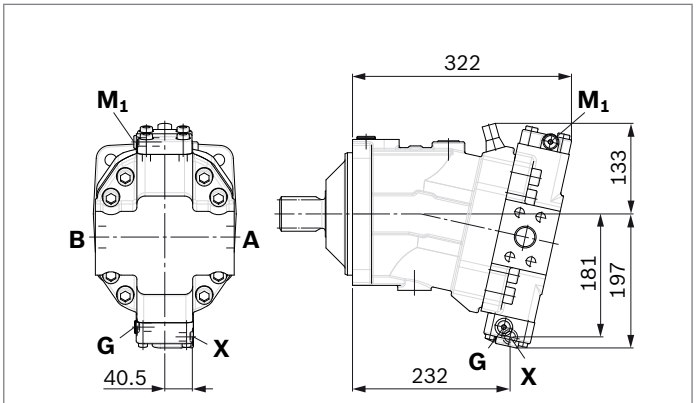
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control



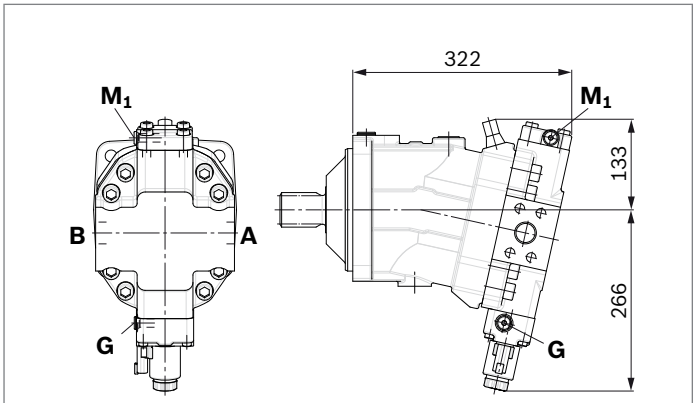
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



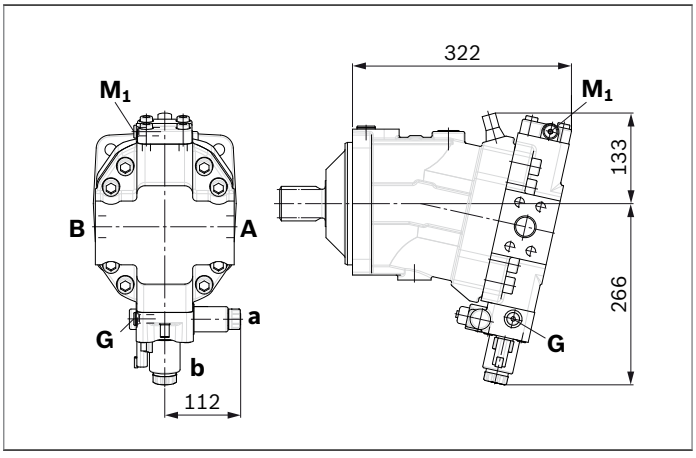
HA1 and HA2, **X** plugged

HA1T and HA2T, **X** open

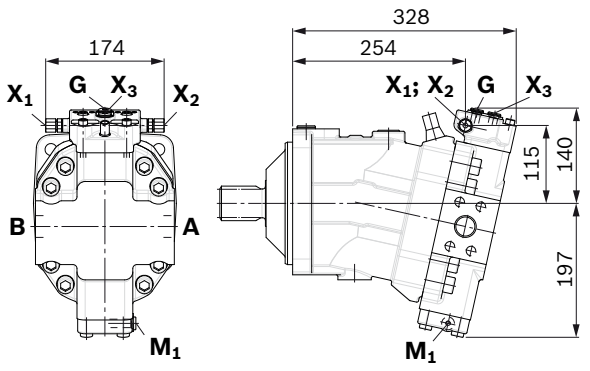
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



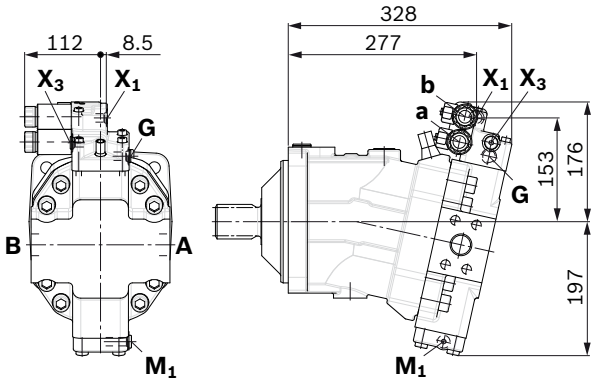
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

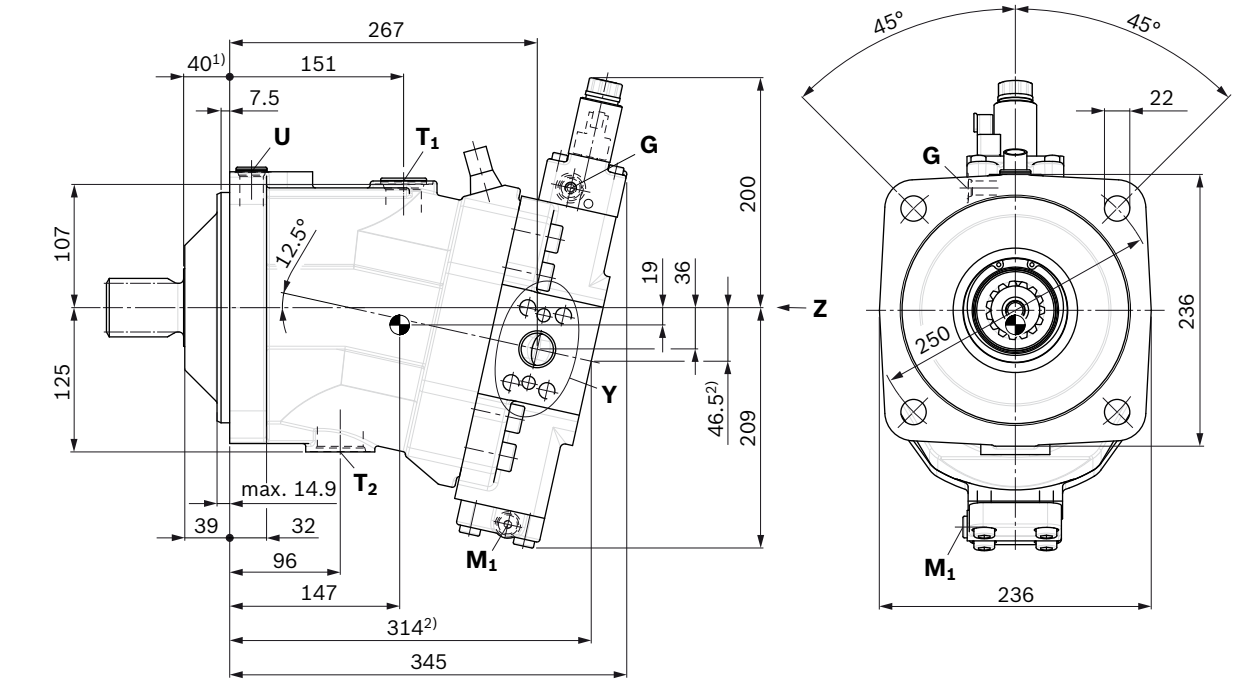
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit

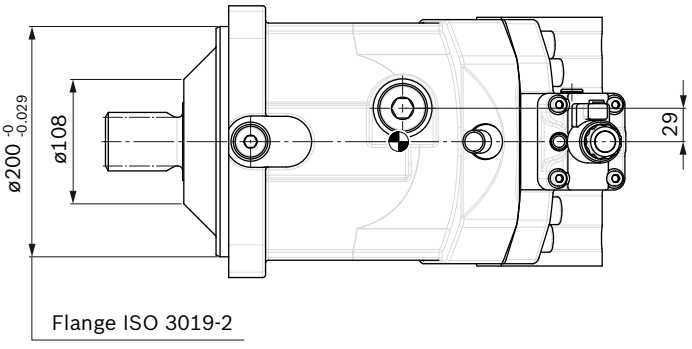


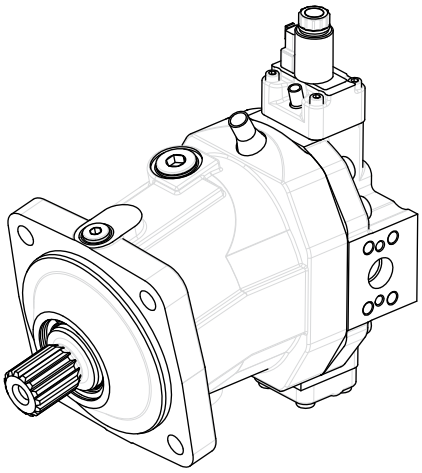
Dimensions size 215

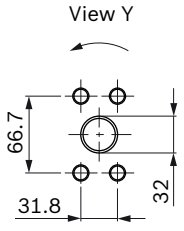
EP5, EP6 – Proportional electric control, negative control

Port plate 2 – SAE working port **A** and **B** at side, opposite







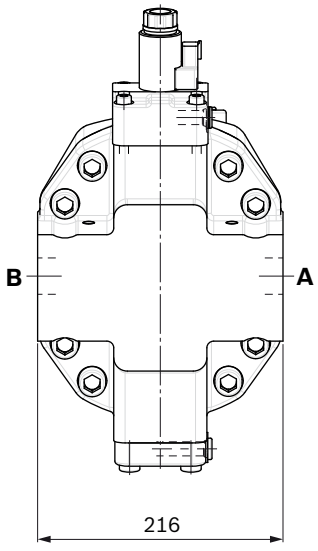


Center of gravity

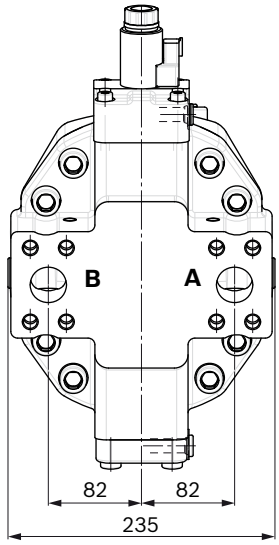
1) To shaft collar
2) Port plate 1 – SAE working port **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

2 SAE working port **A** and **B** at side, opposite

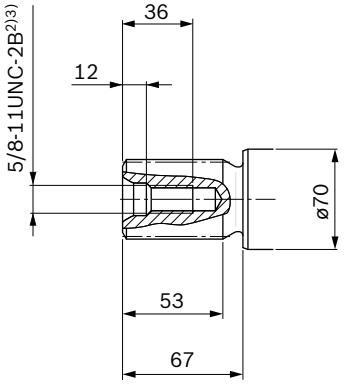


1 SAE working port **A** and **B** at rear



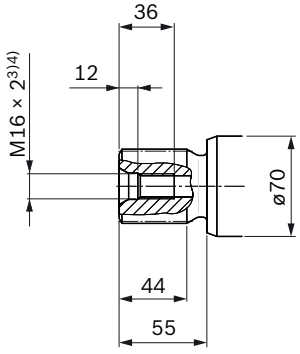
▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A2 – W50×2×24×9g

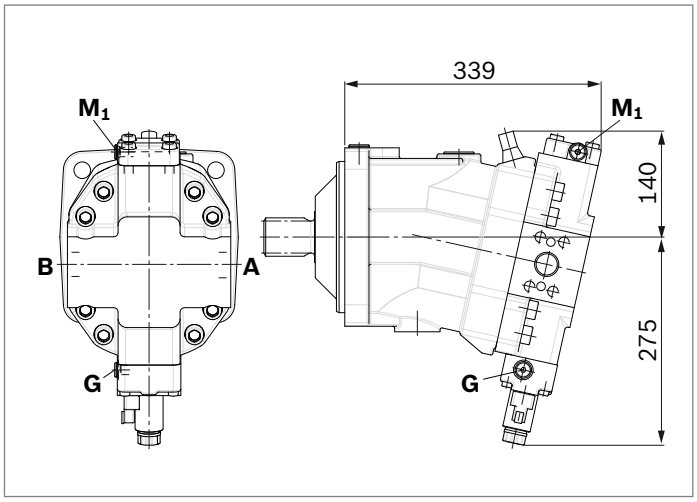


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

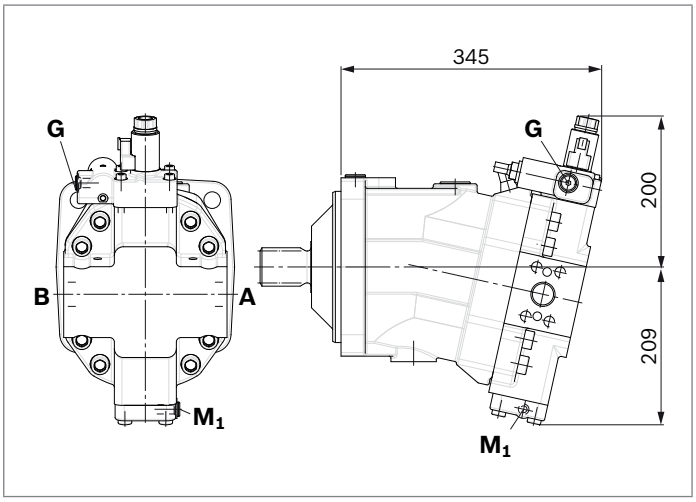
Ports		Standard	Size[1]	p_{max} [bar][2]	Status[6]
A, B	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
T_1	Drai port	ISO 6149[5]	M33 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M42 × 2; 19.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Stroking chamber measurement	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
2) Depending on the application, momentary pressure peaks can occur.
3) Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 72).
6) The countersink can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

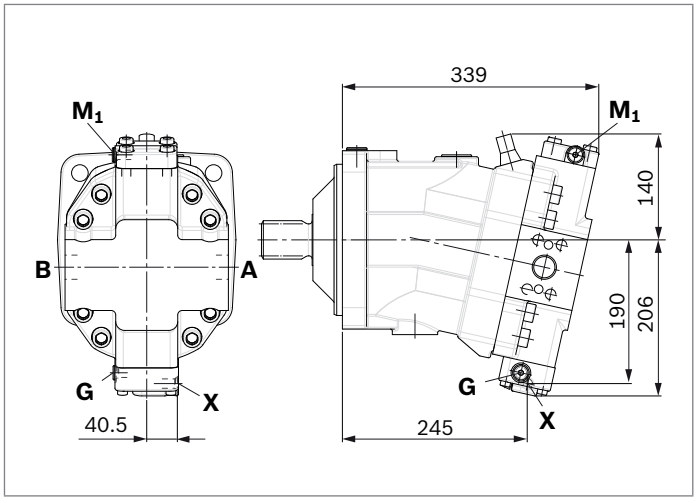
▼ **EP1, EP2** – Electric proportional control, positive control



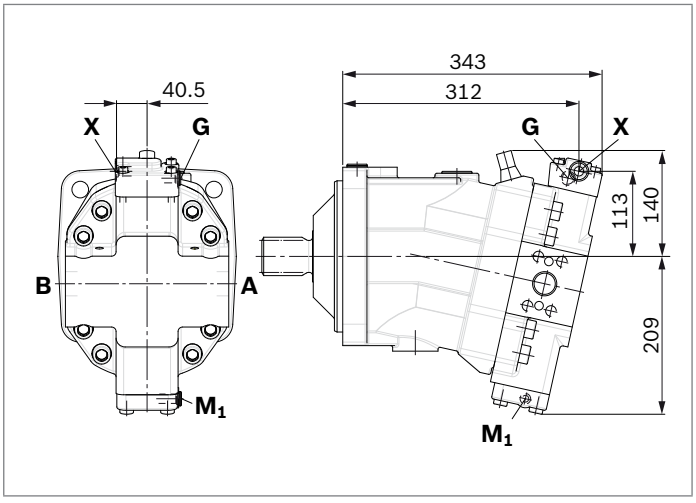
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



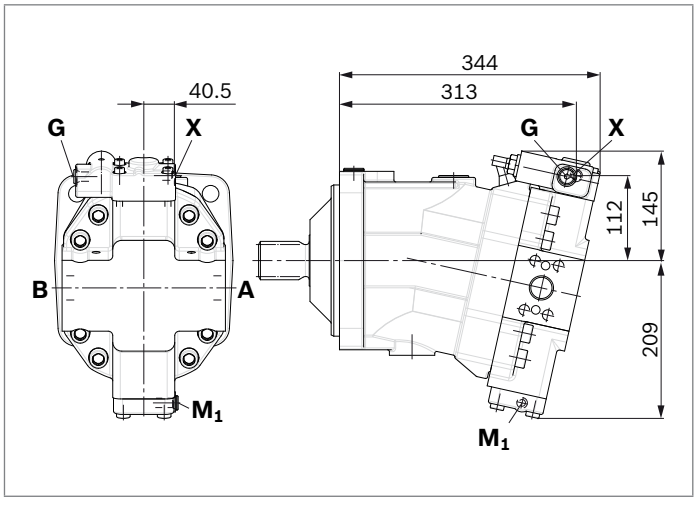
▼ **HP1, HP2** – Hydraulic proportional control, positive control



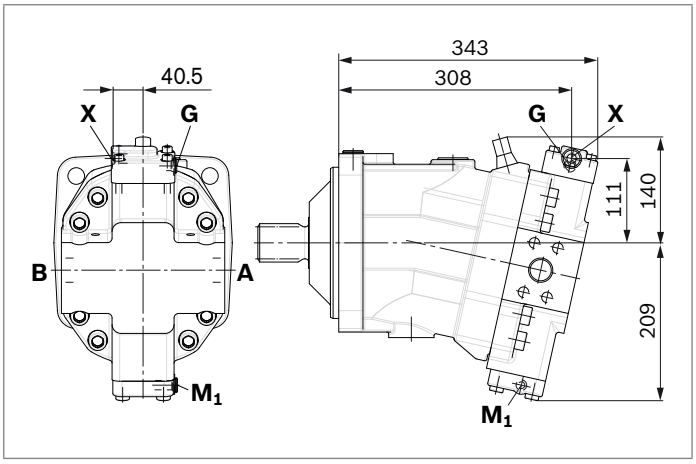
▼ **HP5, HP6** – Hydraulic proportional control, negative control



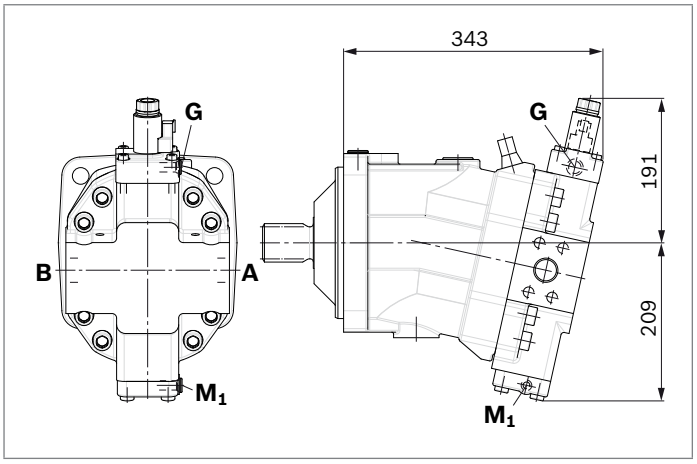
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



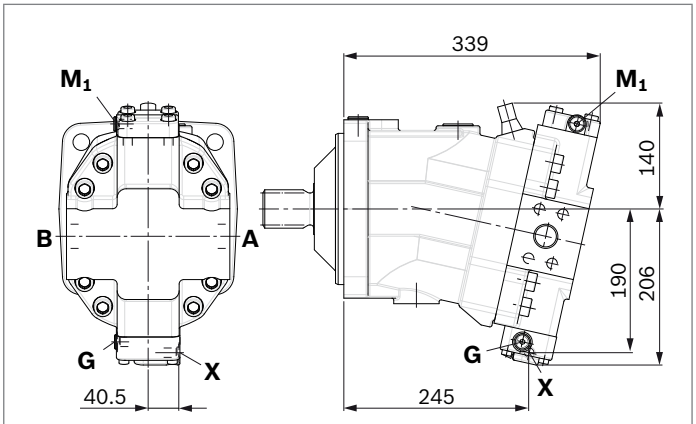
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control

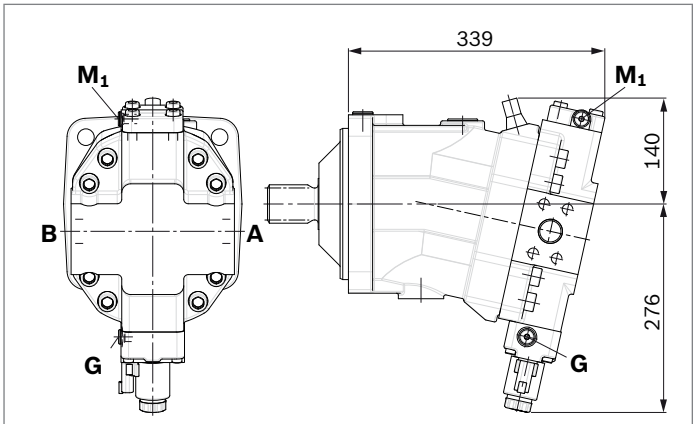


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

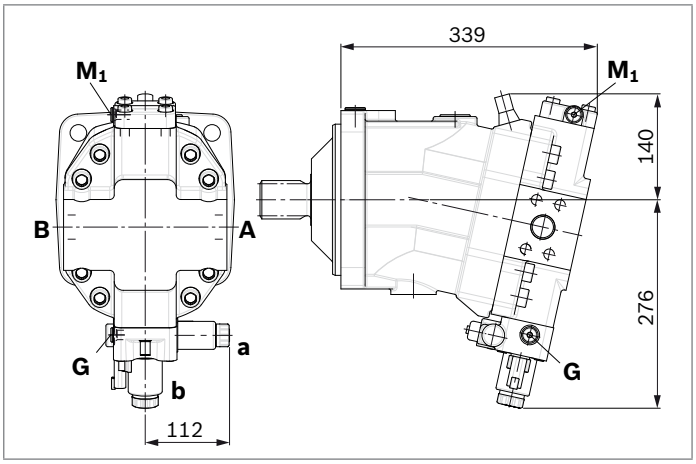


HA1 and HA2, **X** plugged
HA1T and HA2T, **X** open

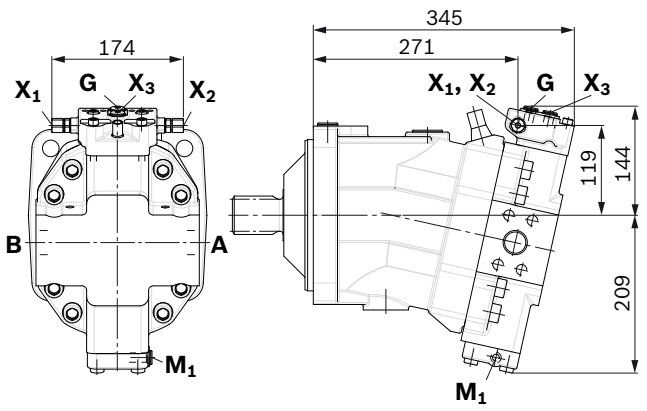
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



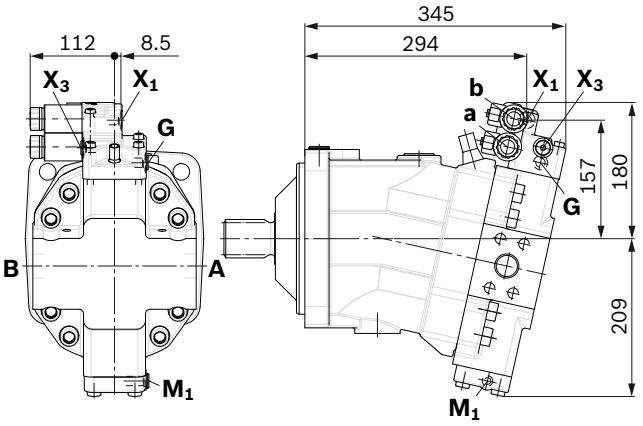
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit



Connector for solenoids

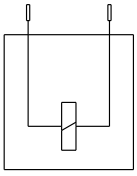
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Circuit symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

- If necessary, you can change the position of the connector by turning the solenoid.
- The procedure is defined in the instruction manual.

Neutral position switch

The neutral position switch NLS electronically detects the neutral position of the A6VM, thereby ensuring the torque freedom of the motor. The use of the NLS in a transmission control provides a faster switching cycle in the drive. In addition, the switch reliability is improved and thereby the service life of the drive is increased. Type code, technical data, dimensions and parameters for the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95152 – NLS.

Technical data

Type		NLS
Recommended operating voltage		5 V
Maximum voltage	not actuated	32 V
	actuated	11.5 V
Minimum permissible current		0 mA
Maximum permissible current		10 mA
Maximum switching cycle number		1 million
Contact type		normally open contact (open in unactuated state)
Type of protection (with mating connector plugged)		IP67/IP69K
Temperature range of sensor (medium and ambient temperature)[1)]		-40 °C ... 125 °C
Temperature range of thread seal ring FKM[1)]		-15 °C ... 125 °C
Pressure resistance	nominal	3 bar
	maximum (momentary peaks)	10 bar[2)]

Notice
The minimum swivel angle is dependent on the $V_{g\,min}$-stop

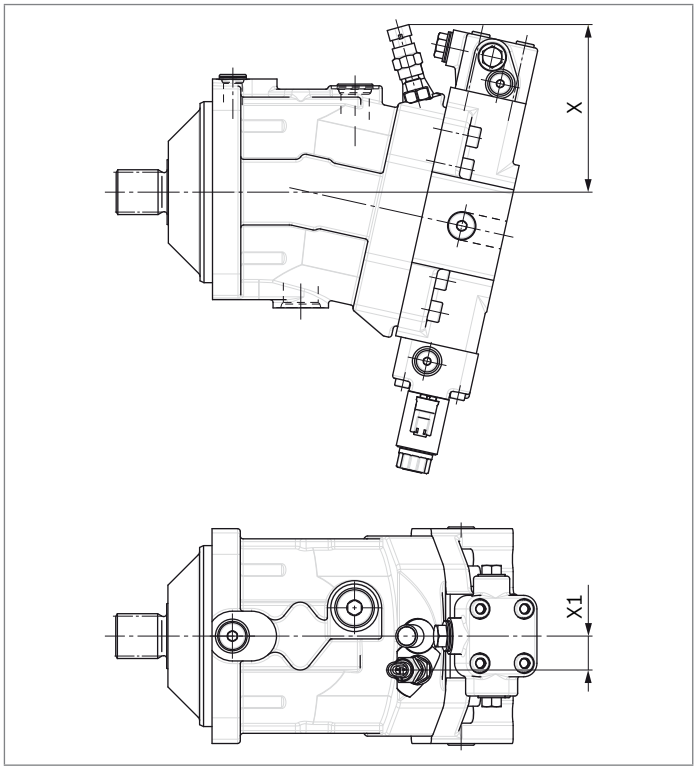
▼ **Mating Connector**

Consisting of	Material number
1 housing	282080
1 socket contact	282403-1

The mating connector is not included in the scope of delivery. This mating connector can be ordered from AMP.

▼ **Dimensions**

Version “N” with neutral position switch mounted



Size	Adjustable angle		X [mm]		X1 [mm]
	min.	max.	at min angle	at max angle	
85	0°	2°	144.7	141.4	28.0
115	0°	4°	148.1	140.4	30.0
150	0°	1°	153.1	150.9	30.0
170	0°	0°		153.1	30.0
215	0°	0°		159.1	30.0

1) Observe the permissible temperature range of the axial piston motor.
2) Observe the permissible viscosity range of the axial piston motor. At oil viscosities >1800 mm²/s, the switch may be unintentionally actuated by case pressure peaks of > 10 bar.

Flushing and boost pressure valve

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.
In a closed circuit, it is used for flushing the case and safeguarding the minimum boost pressure.
Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the leakage. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.
The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when adjusting the primary valve)

- Sizes 60 to 215, fixed setting 16 bar

Switching pressure of flushing spool Δp

- Sizes 60 to 115 (small flushing valve) 8±1 bar
- Sizes 115 to 215 (medium and large flushing valve) 17.5±1.5 bar

Flushing flow q_v

Orifices can be used to adjust the flushing flows as required. The following information is based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 25 bar and ν = 10 mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 60 to 115

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909651766	1.2	3.5	A
R909419695	1.4	5	B
R909419696	1.8	8	C
R909419697	2.0	10	D
R909444361	2.4	14	F

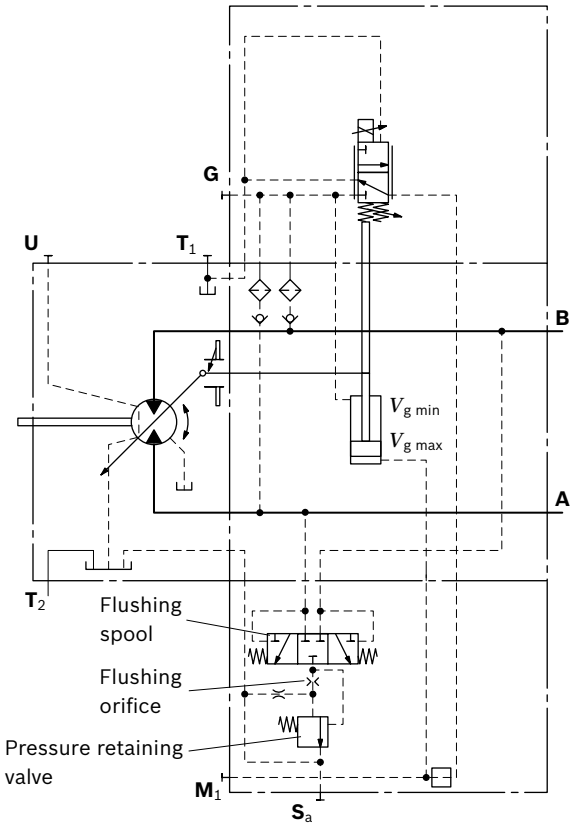
Medium flushing valve for size 115

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909431310	2.8	18	I
R909435172	3.5	27	K
R909449967	5.0	31	L

Large flushing valve for sizes 150 to 215

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909449998	1.8	8	C
R909431308	2.0	10	D
R909431309	2.5	15	G
R909431310	2.8	18	I
R902138235	3.1	21	J
R909435172	3.5	27	K
R909436622	4.0	31	L
R909449967	5.0	37	M

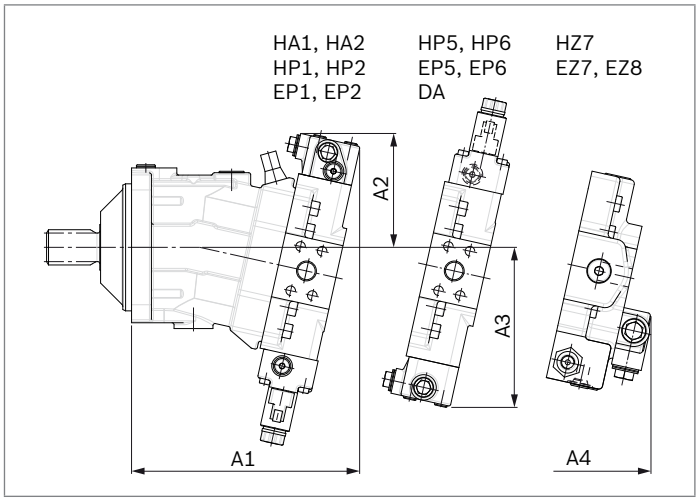
▼ **Circuit diagram EP**



Notice

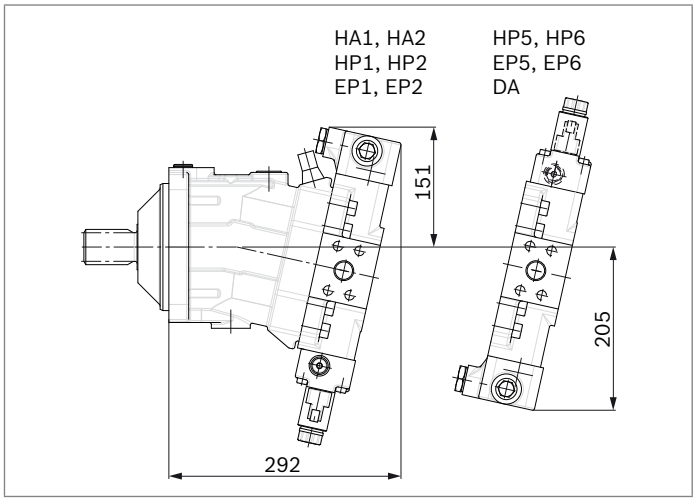
- Port **S**a only for sizes 150 to 215
- For a flushing flow of 35 l/min, it is recommended that port **S**a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

▼ **Dimensions of sizes 60 to 115 (small flushing valve)**

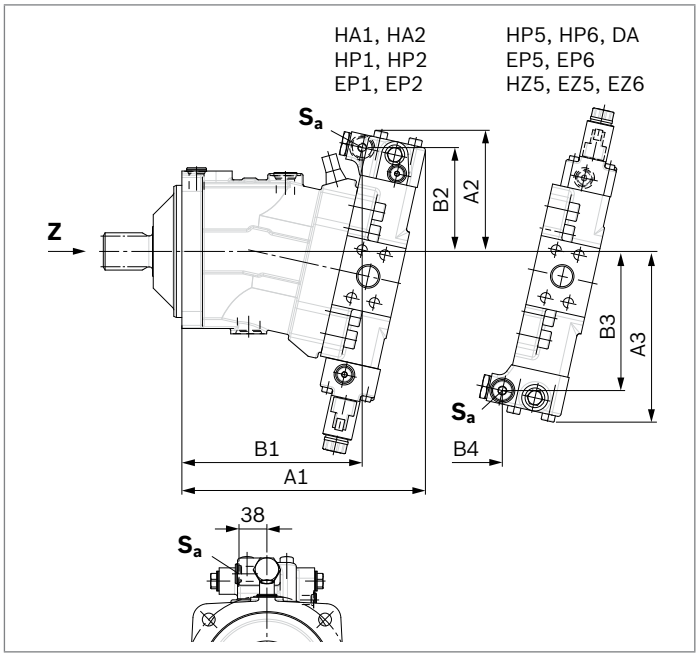


NG	A1	A2	A3	A4
60	245	137	183	236
85	273	142	194	254
115	287	143	202	269

▼ **Dimensions of size 115 (medium flushing valve)**



▼ **Dimensions for sizes 115 to 215 (large flushing valve)**



NG	A1	B1	A2	B2	A3	B3	B4	Sa[1)]
150	325	239	165	142	230	187	166	M22 × 1.5; 15.5 deep
170	332	246	165	142	233	190	172	M22 × 1.5; 15.5 deep
215	349	263	172	148	244	201	185	M22 × 1.5; 15.5 deep

1) ISO 6149, ports plugged (in normal operation)
For notes on tightening torques, see instruction manual.
The spot face may be deeper than that specified in the standard.

Counterbalance valve BVD and BVE

Function

Counterbalance valves for travel drives and winches operations are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if, during braking, when driving downhill or during the load-lowering process, the motor speed is greater than it should be for the given inlet flow and thus the supply pressure collapses.
If the supply pressure falls below the level specified for the relevant counterbalance valve, the counterbalance valve piston moves into the closed position.
The cross-sectional area of the counterbalance valve return duct is thenreduced, creating a bottleneck in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the rotational speed of the motor is again as it should be for the given inlet flow.

Notice

- BVD available for sizes 60 to 215 and BVE available for sizes 115 to 215.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set.
  Ordering example: A6VM085HA1T30004A/71MWV0N4S 97W0-0 + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, controls with beginning of control at $V_{g\ min}$ (e.g. HA) are not permissible for winch drives!
- Counterbalance valves must be optimized during prototype commissioning to prevent unacceptable operating conditions and compliance with the specification must be verified.
- The counterbalance valve does not replace the mechanical service brake and holding brake.
- Observe the detailed notes on the counterbalance valve in data sheet 95522 – BVD and in data sheet 95525 – BVE!
- For the design of the brake release valve, we require the following data for the mechanical holding brake:
  - the cracking pressure
  - the volume of the counterbalance spool between minimum travel (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Permissible inlet flow or pressure when using DBV and BVD/BVE

Motor	Without valve		Limited values when using DBV and BVD/BVE							
			DBV[1]				BVD[2]/BVE[3]			
NG	p_{nom}/p_{max} [bar]	$q_{V\ max}$ [l/min]	NG	p_{nom}/p_{max} [bar]	q_V [l/min]	Code	NG	p_{nom}/p_{max} [bar]	q_V [l/min]	Code
60	450/500	276	22	350/420	240	7	20 (BVD)	350/420	220	7W
85		332								
115		410	32		400					
115		410				8	25 (BVD/BVE)		320	8W
150		494								
170		533								
215		628	On request							

Mounting of the counterbalance valve

When delivered, the counterbalance valve is fastened to the motor with two tacking screws (transport lock). The tacking screws may not be removed while mounting the working lines! If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be fastened to the motor port plate using the provided tacking screws.

The counterbalance valve is finally mounted to the motor by fitting the SAE flange
The screws to be used and the instructions for mounting can be found in the instruction manual.

1) Pressure-relief valve
2) Counterbalance valve, double-acting
3) Counterbalance valve, one-sided

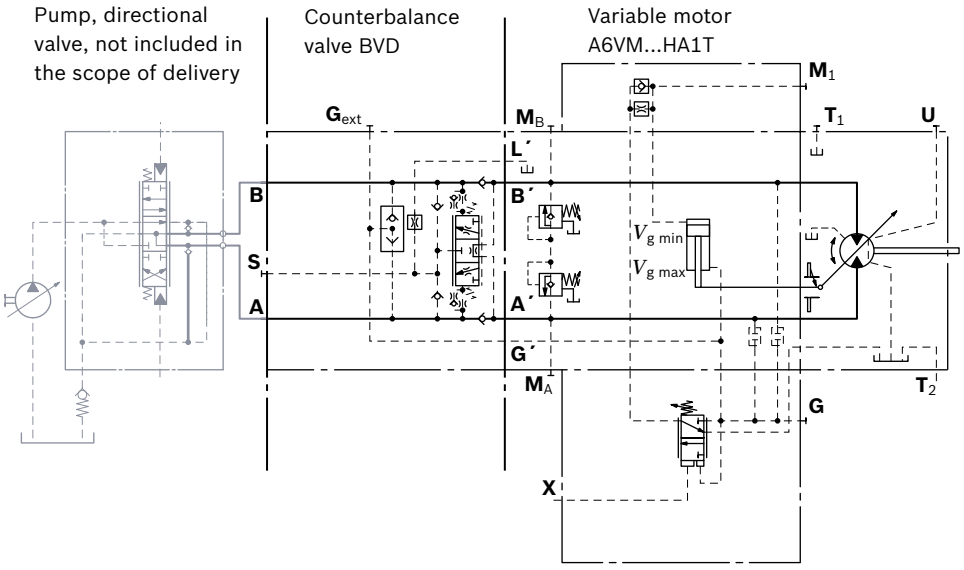
Counterbalance valve for travel drive BVD...F

Application option

- Travel drive for wheeled excavators (BVD and BVE)

▼ **Example circuit diagram for travel drive on wheeled excavators**

A6VM085HA1T30004A/71MWV0N4S97W0-0 + BVD20F27S/41B–V03K16D0400S12



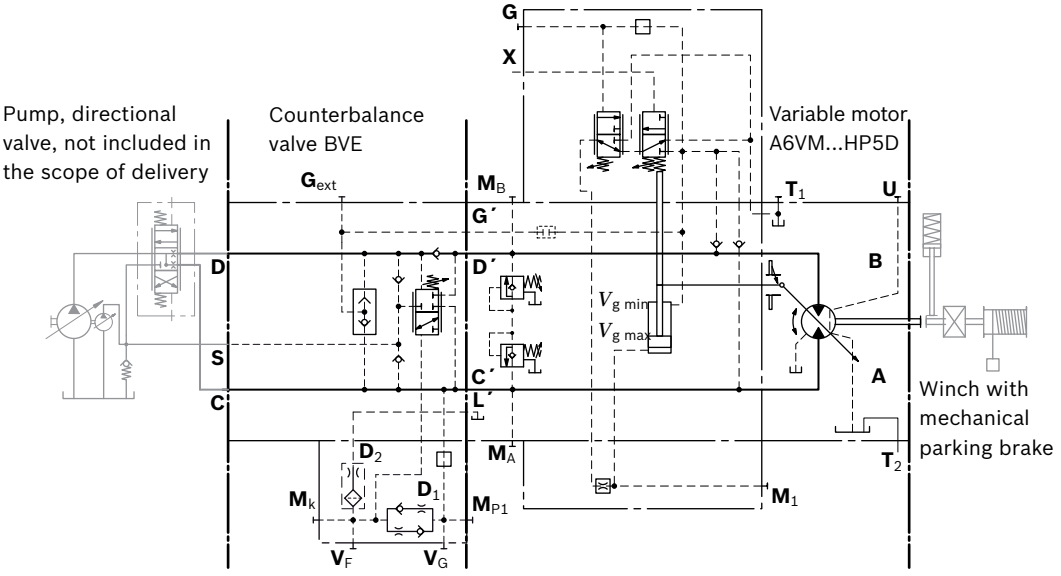
Counterbalance valve for winches and track drives BVD...W and BVE

Application option

- Winch drives in cranes (BVD and BVE)
- Track drive in excavator crawlers (BVD)

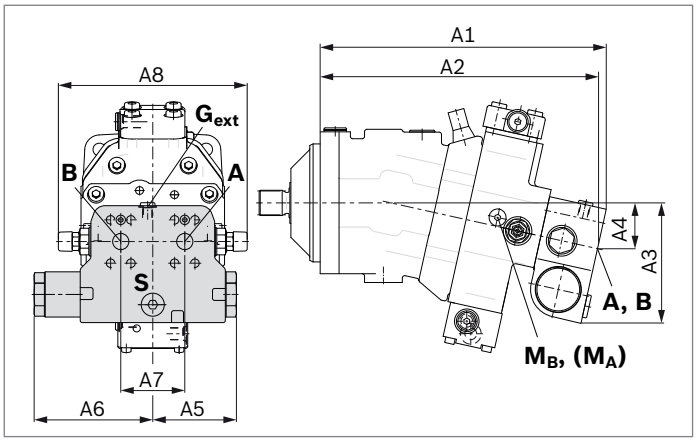
▼ **Example circuit diagram for winch drive in cranes**

A6VM085HP5D10001A/71MWV0N4S97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0

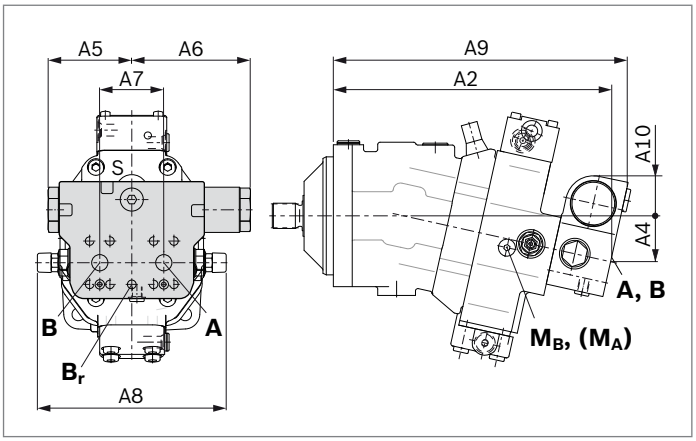


Dimensions

▼ **A6VM...HA, HP1, HP2 and EP1, EP2**



▼ **A6VM...HP5, HP6 and EP5, EP6**[1)]



A6VM	Counterbalance valve											
NG...plate	Type	Ports	Dimensions									
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
60...7	BVD20...17	3/4 in	311	302	143	50	98	139	75	222	326	50
85...7	BVD20...27	1 in	340	331	148	55	98	139	75	222	355	46
115...7	BVD20...28	1 in	362	353	152	59	98	139	84	234	377	41
115...8	BVD25...38	1 1/4 in	380	370	165	63	120.5	175	84	238	395	56
150...8	BVD25...38	1 1/4 in	411	401	168	67	120.5	175	84	238	426	53
170...8	BVD25...38	1 1/4 in	417	407	170	68	120.5	175	84	238	432	51
215...8	BVD25...38	1 1/4 in	448	438	176	74	120.5	175	84	299	463	46
115...8	BVE25...38	1 1/4 in	380	370	171	63	137	214	84	238	397	63
150...8	BVE25...38	1 1/4 in	411	401	175	67	137	214	84	238	423	59
170...8	BVE25...38	1 1/4 in	417	407	176	68	137	214	84	238	432	59
215...8	BVE25...38	1 1/4 in	448	438	182	74	137	214	84	299	463	52

Ports		Version	A6VM plate	Standard	Size[2)]	P_{max} [bar][3)]	Status[5)]
A, B	Working port			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4)]	M22 × 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4)]	M27 × 2; 16 deep	30	X
B_r	Brake release, reduced high pressure	L	7	DIN 3852[4)]	M12 × 1.5; 12.5 deep	30	O
			8	DIN 3852[4)]	M12 × 1.5; 12 deep	30	O
G_{ext}	Brake release, high pressure	S		DIN 3852[4)]	M12 × 1.5; 12.5 deep	420	X
M_A, M_B	Pressure measurement **A** and **B**			ISO 6149[4)]	M18 × 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations **A** and **B** on the BVD counterbalance valve do not correspond with the port designation of the A6VM motor.
The designation of the ports on the installation drawing of the motor is binding!

2) For notes on tightening torques, see instruction manual

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

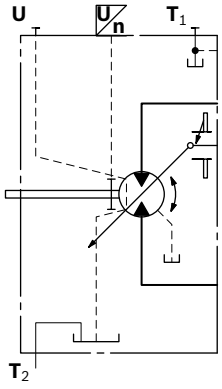
4) The countersink can be deeper than as specified in the standard.

5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Speed sensor

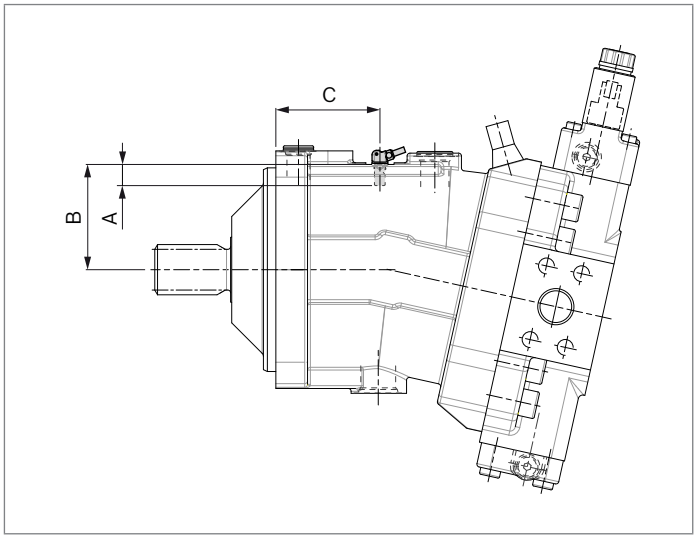
Version A6VM...U ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.
A signal proportional to motor speed can be generated with the fitted DSA/DSM speed sensor. The DSA/DSM sensor registers the speed and direction of rotation.
Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (95132 – DSM, 95133 – DSA).
The sensor is mounted on the port provided for this purpose with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.
We recommend ordering the A6VM variable motor complete with mounted sensor.

▼ **Circuit diagram EP**



▼ **Dimensions**

"V" design with mounted speed sensor



Size		60	85	115	150	170	215
Number of teeth		54	58	67	72	75	80
A	Insertion depth (tolerance -0.25)	18.4	18.4	18.4	18.4	18.4	18.4
B	Contact surface	75	79	88	93	96	101
C		66.2	75.2	77.2	91.2	91.7	95.2

Setting range for displacement

	60				85				115			
	$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)		$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)		$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to
A	62.0	62.0	0.0	15.0	85.2	85.2	0.0	9.0	115.6	115.6	0.0	24.0
	without screw		M10 × 60 R909154690		without screw		M12 × 60 R909083530		without screw		M12 × 70 R909085976	
B	62.0	62.0	> 15.0	30.5	85.2	85.2	> 9.0	28.0	115.6	115.6	> 24.0	47.5
	without screw		M10 × 70 R909153779		without screw		M12 × 70 R909085976		without screw		M12 × 80 R909153075	
C	62.0	62.0	> 30.5	43.0	85.2	85.2	> 28.0	47.0	115.6	115.6	> 47.5	71.0
	without screw		M10 × 80 R909154058		without screw		M12 × 80 R909153075		without screw		M12 × 90 R909154041	
D	x		x		85.2	85.2	> 47.0	59.0	115.6	115.6	> 71.0	80.0
					without screw		M12 × 90 R909154041		without screw		M12 × 100 R909153975	
E	< 62.0	47.5	0.0	15.0	< 85.2	77.0	0.0	9.0	< 115.6	93.5	0.0	24.0
	M10 × 60 R909154690		M10 × 60 R909154690		M12 × 60 R909083530		M12 × 60 R909083530		M12 × 70 R909085976		M12 × 70 R909085976	
F	< 62.0	47.5	> 15.0	30.5	< 85.2	77.0	> 9.0	28.0	< 115.6	93.5	> 24.0	47.5
	M10 × 60 R909154690		M10 × 70 R909153779		M12 × 60 R909083530		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 80 R909085976	
G	< 62.0	47.5	> 30.5	43.0	< 85.2	77.0	> 28.0	47.0	< 115.6	93.5	> 47.5	71
	M10 × 60 R909154690		M10 × 80 R909154058		M12 × 60 R909083530		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 90 R909154041	
H	x		x		< 85.2	77.0	> 47.0	59.0	< 115.6	93.5	> 71.0	80.0
					M12 × 60 R909083530		M12 × 90 R909154041		M12 × 70 R909085976		M12 × 100 R909153975	
J	< 47.5	33.0	0.0	15.0	< 77.0	58.0	0.0	9.0	< 93.5	71.0	0.0	24.0
	M10 × 70 R909153779		M10 × 60 R909154690		M12 × 70 R909085976		M12 × 60 R909083530		M12 × 80 R909153075		M12 × 70 R909085976	
K	< 47.5	33.0	> 15.0	30.5	< 77.0	58.0	> 9.0	28.0	< 93.5	71.0	> 24.0	47.5
	M10 × 70 R909153779		M10 × 70 R909153779		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 80 R909153075	
L	< 47.5	33.0	> 30.5	43.0	< 77.0	58.0	> 28.0	47.0	< 93.5	71.0	> 47.5	71.0
	M10 × 70 R909153779		M10 × 80 R909154058		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 90 R909154041	
M	x		x		< 77.0	58.0	> 47.0	59.0	< 93.5	71.0	> 71.0	80.0
					M12x70 R909085976		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 100 R909153975	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering:

- $V_{g\,min}$ = ... cm³, $V_{g\,max}$ = ... cm³

Theoretical, maximum setting:

- for $V_{g\,min}$ = 0.7 × $V_{g\,max}$
- for $V_{g\ max}$ = 0.3 × $V_{g\,max}$

Settings that are not listed in the table may lead to damage.
Please contact us.

	150				170				215			
	$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)		$V_{g\,max}$ (cm³/U)		$V_{g\,min}$ (cm³/U)		$V_{g\,max}$ (cm³/U)		$V_{g\,min}$ (cm³/U)	
	from	to	from	to	from	to	from	to	from	to	from	to
A	152.1	152.1	0.0	44.0	171.8	171.8	0.0	35.0	216.5	216.5	0.0	44.5
	without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
B	152.1	152.1	> 44.0	69.0	171.8	171.8	> 35.0	63.5	216.5	216.5	> 44.5	80.0
	without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
C	152.1	152.1	> 69.0	99.0	171.8	171.8	> 63.5	98.0	216.5	216.5	> 80.0	115.0
	without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975	
D	152.1	152.1	> 99.0	106.0	171.8	171.8	> 98.0	120.0	216.5	216.5	> 115.0	150.0
	without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212	
E	< 152.1	111.0	0.0	44.0	< 171.8	139.0	0.0	35.0	< 216.5	175.0	0.0	44.5
	M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M10 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
F	< 152.1	111.0	> 44.0	69.0	< 171.8	139.0	> 35.0	63.5	< 216.5	175.0	> 44.5	80.0
	M12 × 80 R909153075		M12 × 90 R909085976		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
G	< 152.1	111.0	> 69.0	99.0	< 171.8	139.0	> 63.5	98.0	< 216.5	175.0	> 80.0	115.0
	M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975	
H	< 152.1	111.0	> 99.0	106.0	< 171.8	139.0	> 98.0	120.0	< 216.5	175.0	> 115.0	150.0
	M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212	
J	< 111.0	87.0	0.0	44.0	< 139.0	112.0	0.0	35.0	< 175.0	141.0	0.0	44.5
	M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 111.0	87.0	> 44.0	69.0	< 139.0	112.0	> 35.0	63.5	< 175.0	141.0	> 44.5	80.0
	M12 × 90 R909154041		M12 × 90 R909154041		M12 x 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041	
L	< 111.0	87.0	> 69.0	99.0	< 139.0	112.0	> 63.5	98.0	< 175.0	141.0	> 80.0	115.0
	M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975	
M	< 111.0	87.0	> 99.0	106.0	< 139.0	112.0	> 98.0	120.0	< 175.0	141.0	> 115.0	150.0
	M12 × 90 R909154041		M12 × 110 R909154212		M12 × 90 R909154041		M12 × 110 R909154212		M12 × 90 R909154041		M12 × 110 R909154212	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering:

- $V_{g\,min}$ = ... cm³, $V_{g\,max}$ = ... cm³

Theoretical, maximum setting:

- for $V_{g\,min}$ = 0.7 × $V_{g\,max}$
- for $V_{g\ max}$ = 0.3 × $V_{g\,max}$

Settings that are not listed in the table may lead to damage.
Please contact us.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the fluid from the axial piston unit may drain back to the reservoir via the hydraulic lines.

Particularly in the installation position "drive shaft upwards" filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The leakage in the motor housing must be directed to the reservoir via the highest available drain port (**T_1**, **T_2**).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the maximum permissible case pressure of all connected units is not exceeded at any operational conditions. If this is not possible, separate drain lines must be laid.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

Notice

In certain installation positions, an influence on the control characteristic can be expected. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in response time.

Key	
F	Filling / air bleeding
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

Installation position

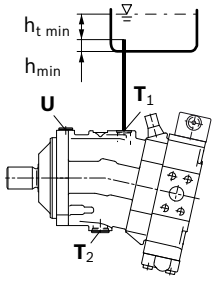
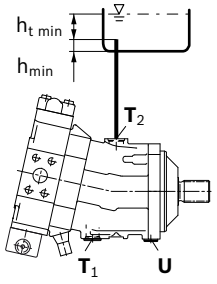
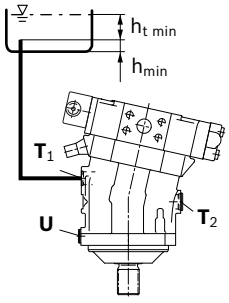
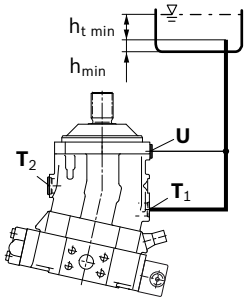
See examples **1** to **8** below.

Additional installation positions are available upon request.

Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

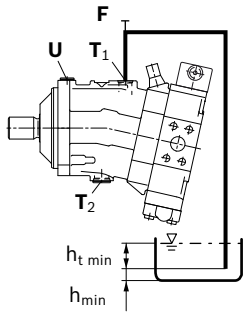
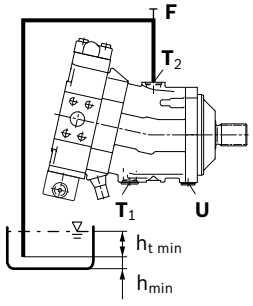
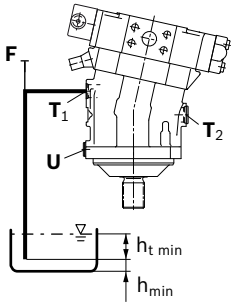
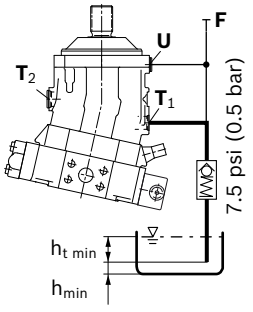
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position	Air bleed	Filling
1 		**T_1**
2 		**T_2**
3 		**T_1**
4 	**U**	**T_1**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Recommendation for installation position 8 (drive shaft upward):

A check valve in the drain line (cracking pressure 0.5 bar) can prevent draining of the motor housing.

Installation position	Air bleed	Filling
5 	**U** (**F**)	T_1 (**F**)
6 	**F**	T_2 (**F**)
7 	**F**	T_1 (**F**)
8 	**U**	T_1 (**F**)

Notice

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The motor A6VM is designed to be used in open and closed circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- For safety reasons, controls with beginning of control at $V_{g\,min}$ (e.g. HA) are not permissible for winch drives, e.g. anchor winches.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve pistons) can, under certain circumstances get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk.
  The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.
- Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid). This can result in restriction or loss of the load holding function in lifting winches.
  The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.
- When using the axial piston motor in winch drives, make certain that the technical limit values are not exceeded under all operating conditions. If the axial piston motor is extremely overloaded (e.g. if the maximum permissible rotational speeds are exceeded during weighing of the anchor while the ship is in motion), the rotary group may be damaged and, in the worst case, the axial piston motor may burst. The machine manufacturer / system manufacturer is to undertake additional measures, up to and including encapsulation.

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