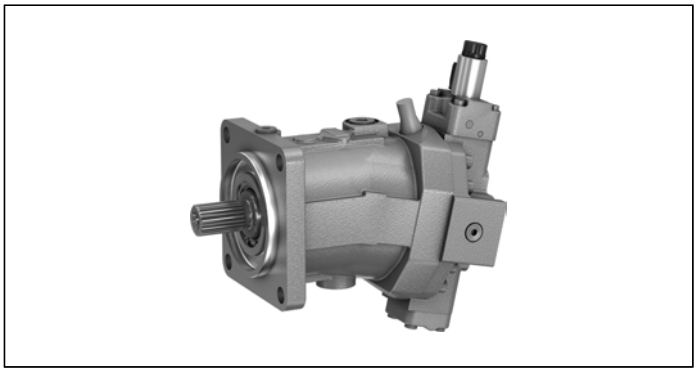
# Axial piston variable motor
# A6VM series 71

## Americas

**RE-A 91610**
Edition: 12.2015
Replaces: 04.2013



- Sizes 60 to 215
- Nominal pressure 6500 psi (450 bar)
- Maximum pressure 7250 psi (500 bar)
- Open and closed circuits

**Features**

- Variable motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuit
- For use in mobile and stationary applications
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement can be infinitely varied from $V_{g\,max}$ to $V_{g\,min}$ = 0.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high and low-pressure side and with increasing displacement.
- Wide control range with hydrostatic transmissions
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust motor with long service life
- High power density
- Good starting efficiency
- Version with 9-piston rotary group
- Good low speed characteristics
- High uniformity

**Contents**

## Type 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** | **0** | | | **/** | **71** | **A** | **W** | **V** | **0** | | | | | | **–** | |

**Axial piston unit**

| | | |
|---|---|---|
| 01 | Bent-axis design, variable, nominal pressure 6500 psi (450 bar), maximum pressure 7250 psi (500 bar) | **A6V** |

**Operating mode**

| | | |
|---|---|---|
| 02 | Motor | **M** |

**Size (NG)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 03 | Geometric displacement, see technical data on page 8 | in $cm^3$/rev | **060** | **085** | **115** | **150** | **170** | **215** |
| | | in $in^3$/rev | **3.66** | **5.19** | **7.02** | **9.15** | **10.37** | **13.12** |

| **Control device** | | | | **060** | **085** | **115** | **150** | **170** | **215** | |
|---|---|---|---|---|---|---|---|---|---|---|
| 04 | Proportional control hydraulic | positive control | $\Delta p_{St}$ = 145 psi (10 bar) | ● | ● | ● | ● | ● | ● | **HP1** |
| | | | $\Delta p_{St}$ = 365 psi (25 bar) | ● | ● | ● | ● | ● | ● | **HP2** |
| | | negative control | $\Delta p_{St}$ = 145 psi (10 bar) | ● | ● | ● | ● | ● | ● | **HP5** |
| | | | $\Delta p_{St}$ = 365 psi (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 | $\Delta p$ ≤ approx. 145 psi (10 bar) | ● | ● | ● | ● | ● | ● | **HA1** |
| | | with pressure increase | $\Delta p$ = 1450 psi (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** | **0** | | | **/** | **71** | **A** | **W** | **V** | **0** | | | | | | **–** | |

**Additional function 1**

| | | |
|---|---|---|
| 07 | Without additional function | **0** |

**Additional function 2**

| | | |
|---|---|---|
| 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)]

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | $V_{g\,max}$-setting screw | $V_{g\,min}$-setting screw | **060** | **085** | **115** | **150** | **170** | **215** | |
| | 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 | ANSI, port threads with O-ring sealing according to ISO 11926 | **A** |

**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 | SAE J744 | 127-4 | ● | ● | – | – | – | – | **C4** |
| | | 127-2 | – | ● | – | – | – | – | **C2** |
| | | 152-4 | – | – | ● | ● | ● | – | **D4** |
| | | 165-4 | – | – | – | – | – | ● | **E4** |

● = 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** | **0** | | | **/** | **71** | **A** | **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 1/2 in 17T 12/24 DP | – | ● | – | – | – | | **S9** |
| | | 1 3/4 in 13T 8/16 DP | – | – | ● | ● | – | – | **T1** |
| | | 2 in 15T 8/16 DP | – | – | – | ○ | ● | ● | **T2** |

| **Port plate for working ports** | | | 060 | 085 | 115 | 150 | 170 | 215 | |
|---|---|---|---|---|---|---|---|---|---|
| 18 | SAE working ports A and B at rear | | ● | ● | ● | ● | ● | ● | **1** |
| | SAE working ports 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 63 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<br>Flushing on both sides<br>Flushing flow at:<br>$\Delta p = p_{ND} - p_G$ = 365 psi (25 bar) and<br>$v$ = 60 SUS (10 mm²/s)<br>($p_{ND}$ = low pressure, $p_G$ = case pressure)<br>Only possible with port plates 1 and 2 | **Flushing flow $q_v$ [gpm (l/min)]** | | | | | | | | |
| | | 0.9 | (3.5) | ● | ● | ● | – | – | – | **A** |
| | | 1.3 | (5) | ● | ● | ● | – | – | – | **B** |
| | | 2.1 | (8) | ● | ● | ● | ● | ● | ● | **C** |
| | | 2.6 | (10) | ● | ● | ● | ● | ● | ● | **D** |
| | | 3.7 | (14) | ● | ● | ● | – | – | – | **F** |
| | | 4.0 | (15) | – | – | ●[5] | ● | ● | ● | **G** |
| | | 4.8 | (18) | – | – | ●[5] | ● | ● | ● | **I** |
| | | 5.5 | (21) | – | – | ●[5] | ● | ● | ● | **J** |
| | | 7.1 | (27) | – | – | ●[5] | ● | ● | ● | **K** |
| | | 8.2 | (31) | – | – | ●[5] | ● | ● | ● | **L** |
| | | 9.7 | (37) | – | – | – | ● | ● | ● | **M** |

| **Speed sensor** (see page 69) | | 060 | 085 | 115 | 150 | 170 | 215 | |
|---|---|---|---|---|---|---|---|---|
| 20 | Without speed sensor | ● | ● | ● | ● | ● | ● | **0** |
| | Prepared for 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

**Notes**

- ▶ Note the project planning notes on page 74.
- ▶ When ordering, please provide the relevant technical data additionally to the type code

3) Only possible in conjunction with HP, EP and HA control. Note the restrictions described on page 65.

4) State ordering code for counterbalance valve separately in accordance with data sheet 95522 for BVD or 95525 for BVE. Note the restrictions described on page 65.

5) Not for EZ7, EZ8 and HZ7.

6) State ordering code for sensor separately in accordance with data sheet 95132 for DSM or 95133 for 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 acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90223: Fire-resistan, water-containing hydraulic fluids (HFAE, HFAS, HFB, HFC)

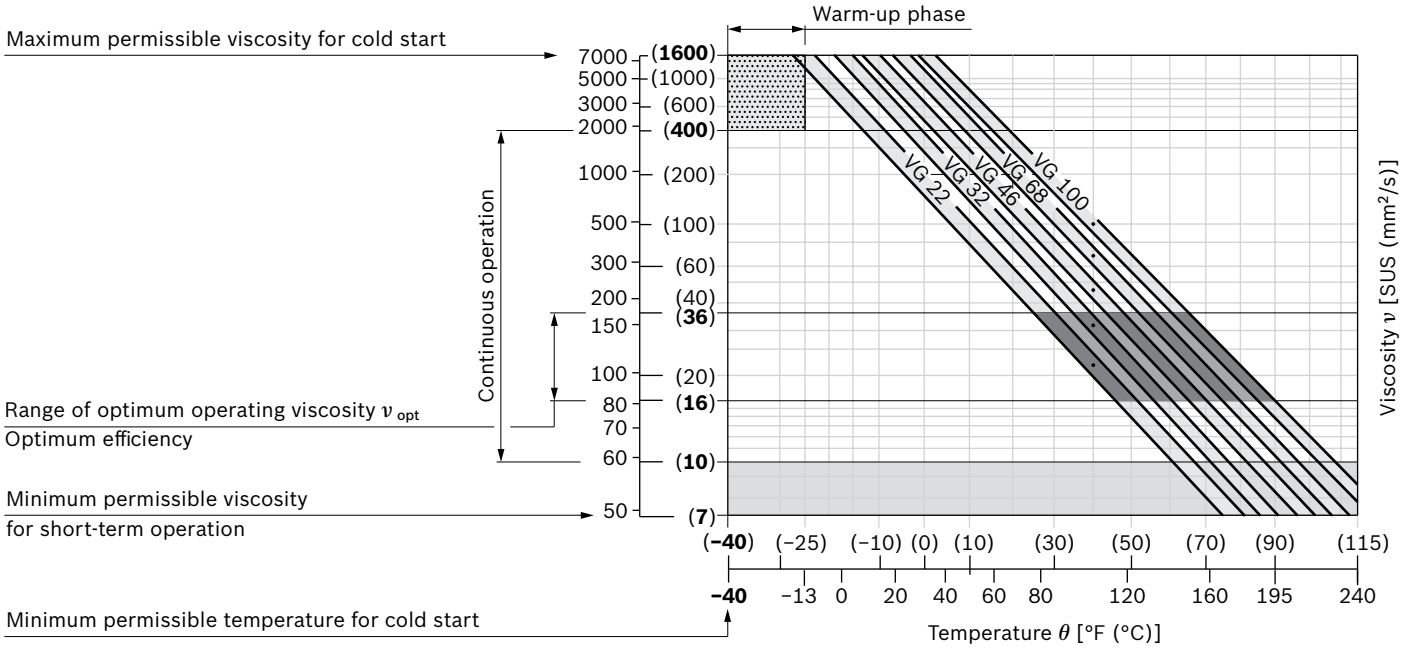
**Details regarding the selection of hydraulic fluid**
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range ($v_{opt}$ see selection diagram).

**Note**
At no point of the component may the temperature be higher than 240 °F (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 flushing the case at port **U** or using a flushing and boost pressure valve (see page 63).

**Viscosity and temperature of hydraulic fluids**

| | Viscosity | | Temperature | | Comment |
|---|---|---|---|---|---|
| Cold start | $v_{max}$ ≤ | 7400 SUS (1600 mm²/s) | $\theta_{St}$ ≥ | −40 °F (−40 °C) | $t$ ≤ 3 min, $n$ ≤ 1000 rpm, without load $p$ ≤ 725 psi ($p$ ≤ 50 bar) |
| Permissible temperature difference | | | $\Delta T$ ≤ | 45 °F (25 K) | between axial piston unit and hydraulic fluid in the system |
| Warm-up phase | $v$ < | 7400 to 1850 SUS (1600 to 400 mm²/s) | $\theta$ = | −40 °F to −13 °F (−40 °C to −25 °C) | at $p$ ≤ 0.7 × $p_{nom}$, $n$ ≤ 0.5 × $n_{nom}$ and $t$ ≤ 15 min |
| Continuous operation | $v$ = | 1850 to 47 SUS (400 to 10 mm²/s) | | | This corresponds, for example on the VG 46, to a temperature range of +41 °F to + 185 °F (+5 °C to +85 °C)(see selection diagram) |
| | | | $\theta$ = | −13 °F to +217 °F (−25 °C to +103 °C) | measured at port **T**<br>Note the permissible temperature range of the shaft seal ($\Delta T$ = approx. 22 °F (12 K) between the bearing/shaft seal and port **T**) |
| | $v_{opt}$ = | 167 to 81 SUS (36 to 16 mm²/s) | | | Range of optimum operating viscosity and efficiency |
| Short-term operation | $v_{min}$ ≥ | 49 SUS (7 mm²/s) | | | $t$ < 3 min, $p$ < 0.3 × $p_{nom}$ |

▼ **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 (195 °F (90 °C) to maximum 217 °F (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 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 $p_{abs}$ = 30 psi (2 bar) case pressure.

## Flow direction

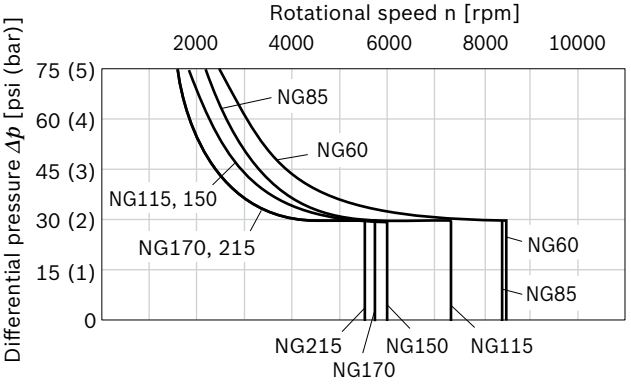
| Direction of rotation, viewed on drive shaft | |
|---|---|
| clockwise (cw) | counter-clockwise (ccw) |
| **A** to **B** | **B** to **A** |

## 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 145 psi (10 bar) are permitted. 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.

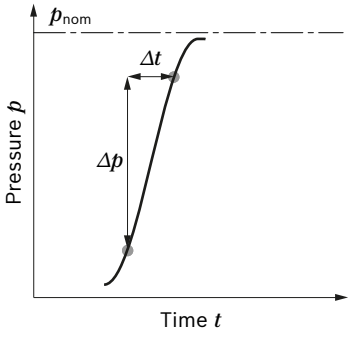



The FKM shaft seal may be used for leakage temperatures from -13 °F to +240 °F (-25 °C to +115 °C). For application cases below -13 °F (-25 °C), an NBR shaft seal is required (permissible temperature range:
-40 °F to +195 °F (-40 °C to +90 °C)).

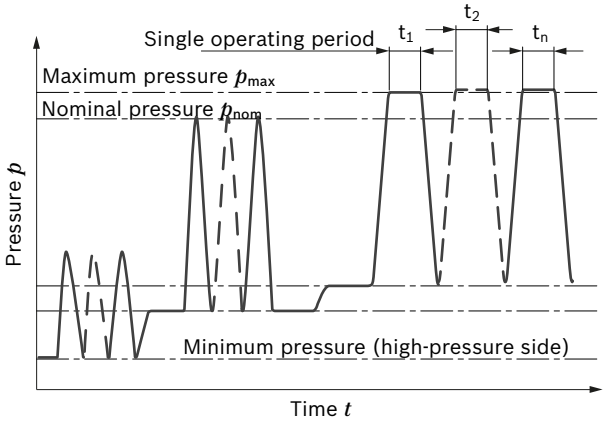
## Operating pressure range

| Pressure at working port A or B | | Definition |
|---|---|---|
| Nominal pressure $p_{nom}$ | 6500 psi (450 bar) | The nominal pressure corresponds to the maximum design pressure. |
| Maximum pressure $p_{max}$ | 7250 psi (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) | 365 psi (25 bar) | 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 working 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**) | 10150 psi (700 bar) | The summation pressure is the sum of the pressures at both working ports (**A** and **B**) |
| Rate of pressure change $R_{A\,max}$ | | Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range. |
| With integrated pressure-relief valve | 130530 psi/s (9000 bar/s) | |
| Without pressure-relief valve | 232060 psi/s (16000 bar/s) | |

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

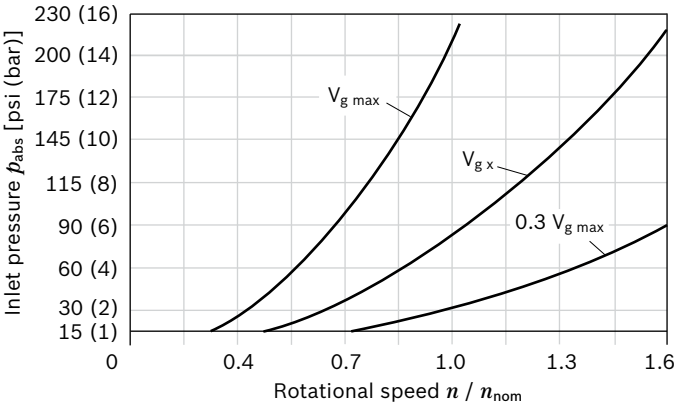



▼ **Pressure definition**




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 $v_{opt}$ = 170 to 73 SUS (36 to 16 mm²/s).
Please contact us if these conditions cannot be satisfied.

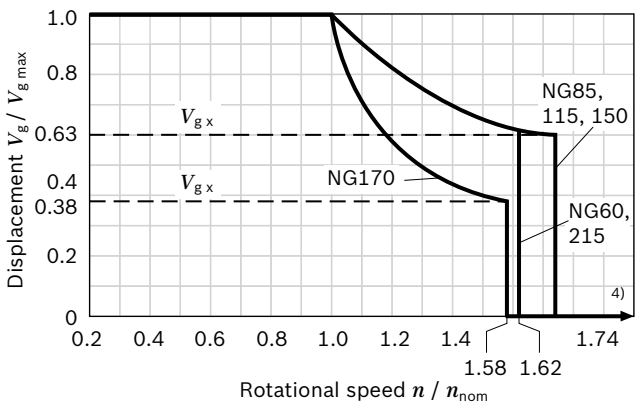
**Note**

Operating 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 | 160 | 170 | 215 |
|---|---|---|---|---|---|---|---|---|---|
| Displacement geometric, per revolution | | $V_{g\,max}$ | in³ | 3.78 | 5.20 | 7.05 | 9.28 | 10.48 | 13.21 |
| | | | cm³ | 62.0 | 85.2 | 115.6 | 152.1 | 171.8 | 216.5 |
| | | $V_{g\,min}$ | in³ | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | cm³ | 0 | 0 | 0 | 0 | 0 | 0 |
| | | $V_{g\,x}$ | in³ | 2.26 | 3.11 | 4.21 | 5.55 | 3.97 | 5.00 |
| | | | 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 | 4800 |
| | at $V_{g\,0}$ | $n_{max}$ | rpm | 8400 | 8350 | 7350 | 6000 | 5750 | 5500 |
| Inlet flow[2] | at $n_{nom}$ and $V_{g\,max}$ | $q_{v\,max}$ | gpm | 73 | 88 | 108 | 131 | 141 | 166 |
| | | | l/min | 276 | 332 | 410 | 494 | 533 | 628 |
| Torque[3] | at $V_{g\,max}$ and $\Delta p$ = 6500 psi (450 bar) | $T$ | lb-ft | 326 | 448 | 608 | 800 | 903 | 1139 |
| | | | Nm | 444 | 610 | 828 | 1089 | 1230 | 1550 |
| Rotary stiffness | $V_{g\,max}$ to $V_g/2$ | $c_{min}$ | lb-ft/rad | 10695 | 16521 | 27511 | 32084 | 38279 | 51334 |
| | | | kNm/rad | 14500 | 22400 | 37300 | 43500 | 51900 | 69600 |
| | $V_g/2$ to 0 (interpolated) | $c_{min}$ | lb-ft/rad | 33412 | 49785 | 76559 | 91458 | 115355 | 144267 |
| | | | kNm/rad | 45300 | 67500 | 103800 | 124000 | 156400 | 195600 |
| Moment of inertia for rotary group | | $J_{TW}$ | lb-ft² | 0.1020 | 0.1709 | 0.2610 | 0.4295 | 0.5055 | 0.7190 |
| | | | kgm² | 0.0043 | 0.0072 | 0.0110 | 0.0181 | 0.0213 | 0.0303 |
| Maximum angular acceleration | | $\alpha$ | rad/s² | 21000 | 17500 | 15500 | 11000 | 11000 | 10000 |
| Case volume | | $V$ | gal | 0.21 | 0.26 | 0.40 | 0.45 | 0.61 | 0.74 |
| | | | l | 0.8 | 1.0 | 1.5 | 1.7 | 2.3 | 2.8 |
| Weight, approx. | | $m$ | lbs | 62 | 79 | 101 | 134 | 137 | 172 |
| | | | kg | 28 | 36 | 46 | 61 | 62 | 78 |

▼ **Permissible displacement in relation to speed**




**Notes**

- Theoretical values, without efficiency levels 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.

**Determining the operating characteristics**

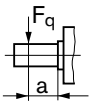
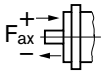
| | | | |
|---|---|---|---|
| Inlet flow | $q_v = \frac{V_g \times n}{231 \times \eta_v}$ | [gpm] | $\left(\frac{V_g \times n}{1000 \times \eta_v}\right)$ [l/min] |
| Rotational speed | $n = \frac{q_v \times 231 \times \eta_v}{V_g}$ | [rpm] | $\left(\frac{q_v \times 1000 \times \eta_v}{V_g}\right)$ [rpm] |
| Torque | $T = \frac{V_g \times \Delta p \times \eta_{mh}}{24 \times \pi}$ | [lb-ft] | $\left(\frac{V_g \times \Delta p \times \eta_{mh}}{20 \times \pi}\right)$ [Nm] |
| Power | $P = \frac{2\pi \times T \times n}{33000} = \frac{q_v \times \Delta p \times \eta_t}{1714}$ | [HP] | $\left(\frac{2\pi \times T \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600}\right)$ [kW] |

Key

| | | |
|---|---|---|
| $V_g$ | = | Displacement per revolution [in³ (cm³)] |
| $\Delta p$ | = | Differential pressure [psi (bar)] |
| $n$ | = | Rotational speed [rpm] |
| $\eta_v$ | = | Volumetric efficiency |
| $\eta_{mh}$ | = | Mechanical-hydraulic efficiency |
| $\eta_t$ | = | Total efficiency ($\eta_t = \eta_v \bullet \eta_{mh}$) |

1) The values are valid:
   - For the optimum viscosity range from $\nu_{opt}$ = 170 to 75 SUS (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 65).
3) Torque without radial force, With radial force see page 9.
4) Values in this range on request

### Permissible radial and axial forces of the drive shafts

| Size | NG | | 60 | 85 | 115 | 150 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|---|---|
| Drive shaft | | in | 1 1/4 | 1 1/2 | 1 3/4 | 1 3/4 | 2 | 2 | 2 |
| Maximum radial force[1] at distance a (from shaft collar)  | $F_{q\,max}$ | lb | 1713 | 2802 | 3350 | 3585 | 3917 | 4355 | 5081 |
| | | N | 7620 | 12463 | 14902 | 15948 | 17424 | 19370 | 22602 |
| | a | in | 0.94 | 1.06 | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 |
| | | mm | 24.0 | 27.0 | 33.5 | 33.5 | 33.5 | 33.5 | 33.5 |
| Torque maximum at $F_{q\,max}$ | $T_{max}$ | lb-ft | 229 | 439 | 611 | 656 | 803 | 679 | 939 |
| | | Nm | 310 | 595 | 828 | 890 | 1089 | 1230 | 1445 |
| Differential pressure maximum at $V_{g\,max}$ and $F_{q\,max}$ | $\Delta p_{max}$ | psi | 4550 | 6400 | 6500 | 5350 | 6500 | 6500 | 6100 |
| | | bar | 315 | 440 | 450 | 370 | 450 | 450 | 420 |
| Maximum axial force, at standstill or pressure-free operation  | + $F_{ax\,max}$ | lb | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | − $F_{ax\,max}$ | lb | 112 | 160 | 202 | 232 | 232 | 252 | 281 |
| | | N | 500 | 710 | 900 | 1030 | 1030 | 1120 | 1250 |
| Permissible axial force per psi (bar) operating pressure | + $F_{ax\,perm/bar}$ | lb/psi | 0.12 | 0.15 | 0.18 | 0.21 | 0.21 | 0.23 | 0.26 |
| | | N/bar | 7.5 | 9.6 | 11.3 | 13.3 | 13.3 | 15.1 | 17.0 |

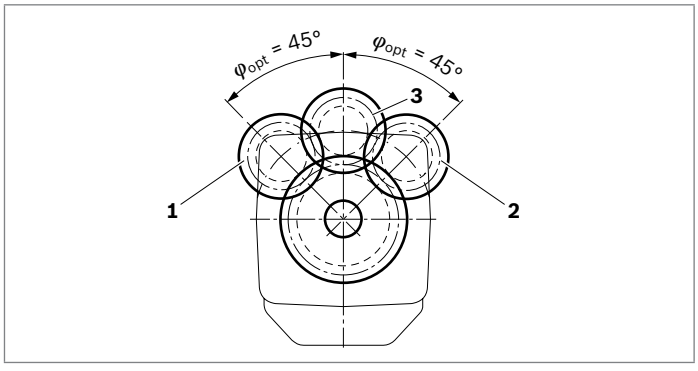
### Effect of radial force $F_q$ on the service life of bearings

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:

**Notes**

- The values given are maximum values and do not apply to continuous operation.
- The permissible axial force in $-F_{ax}$ direction is to be avoided, because thereby the bearing life 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

1) With intermittent operation

## HP – Proportional hydraulic control

The proportional hydraulic control provides infinite adjustment of the displacement. The 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)

**Note**

- Maximum permissible pilot pressure: $p_{St}$ = 1450 psi (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 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (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 7250 psi (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 145 psi (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 6) and thus a parallel displacement of the characteristic.
- A leakage flow of maximum 0.08 gpm (0.3 l/min) can escape at port **X** due to internal leakage (operating 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 is influencing the stroke characteristics of the motor and thus the reaction speed of the machine.

**Standard with Size 60 to 215**

HP without damping.

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

**Option with Size 60 to 215**

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

▼ **Overview Throttle Pins**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.018 | 0.018 | 0.022 | 0.022 | 0.022 | 0.026 |
| | [mm] | 0.45 | 0.45 | 0.55 | 0.55 | 0.55 | 0.65 |

**HP1, HP5 pilot pressure increase $\Delta p_{St}$ = 145 psi (10 bar)**

**HP1 positive control**

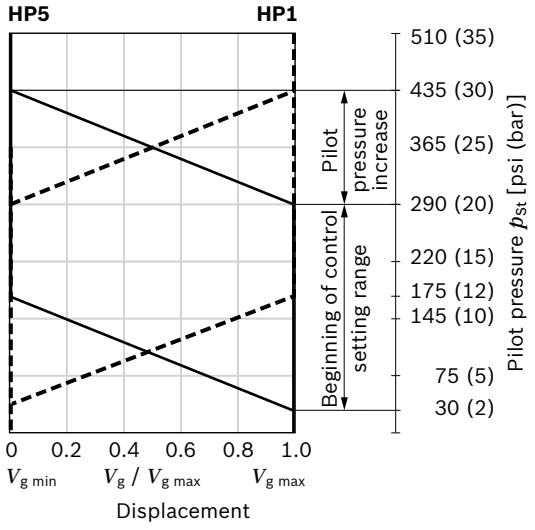
A pilot pressure increase of 145 psi (10 bar) at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

**HP5 negative control**

A pilot pressure increase of 145 psi (10 bar) at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

- Beginning of control, setting range 30 to 290 psi (2 to 20 bar)
- Standard setting:
  Beginning of control at 45 psi (3 bar) (end of control at 190 psi (13 bar))

▼ **Characteristic curve**



**HP2, HP6 pilot pressure increase $\Delta p_{St}$ = 365 psi (25 bar)**

**HP2 positive control**

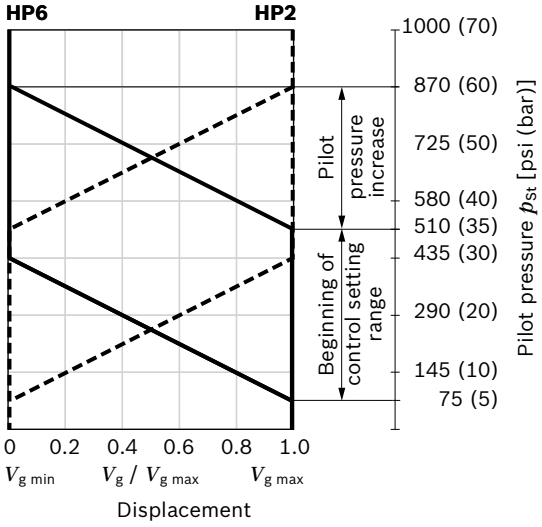
A pilot pressure increase of 365 psi (25 bar) at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

**HP6 negative control**

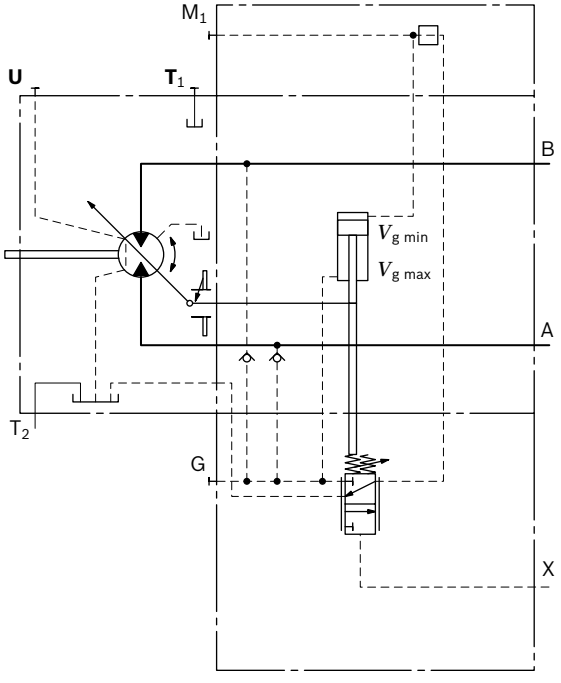
A pilot pressure increase of 365 psi (25 bar) at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

- Beginning of control, setting range 75 to 725 psi (5 to 50 bar)
- Standard setting:
  Beginning of control at 145 psi (10 bar) (end of control at 510 psi (35 bar))

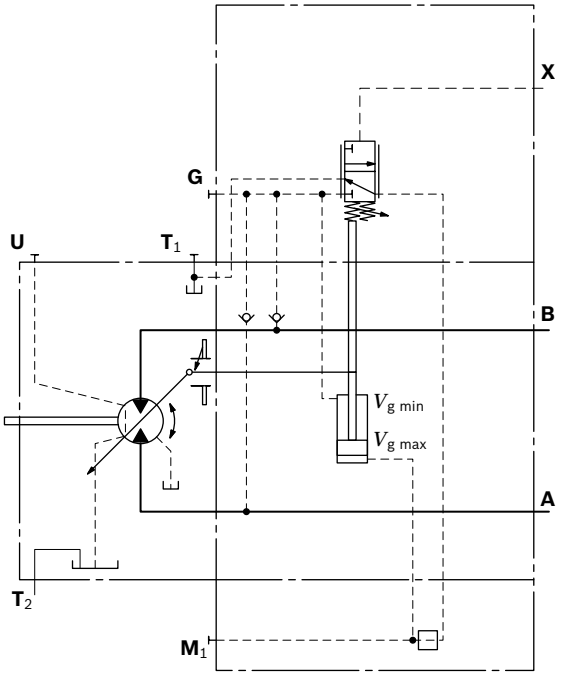
▼ **Characteristic curve**




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



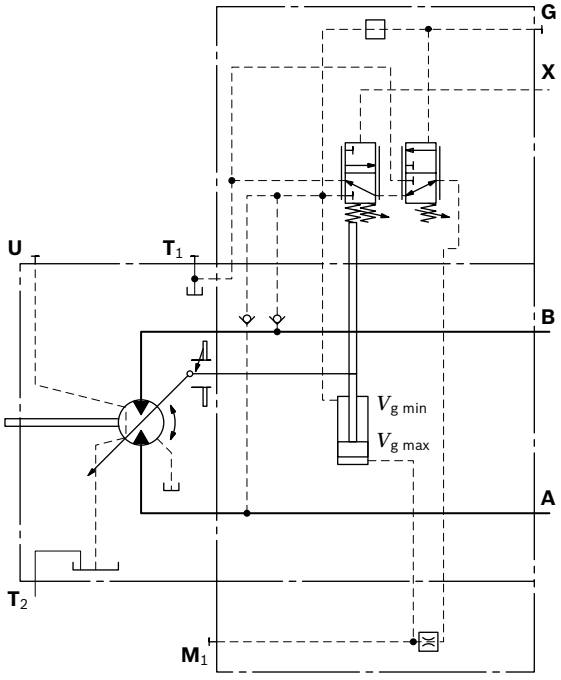

▼ **Circuit diagram HP5, HP6 (negative control)**



**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 1150 to 6500 psi (80 to 450 bar)

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



## EP – Proportional electric control

The proportional electric control provides infinite setting of the displacement. Control is proportional to the electric control current applied to the solenoid.

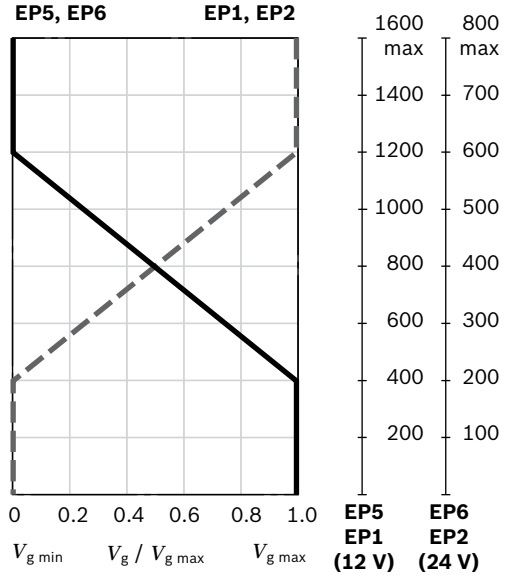
**EP1, EP2 positive control**

- 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**




**Note**

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 435 psi (30 bar) is necessary in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port **G** using an external check valve. For lower pressures, please contact us.
Please note that pressures up to 7250 psi (500 bar) can occur at port **G**.

**Response time damping**

The response time damping is influencing the stroke characteristics of the motor and thus the reaction speed of the machine.

**Standard with Size 60 to 215**

EP without damping.
EP.D with throttle pin on both sides, symmetrical (as to table)

**Option with Size 60 to 115**

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

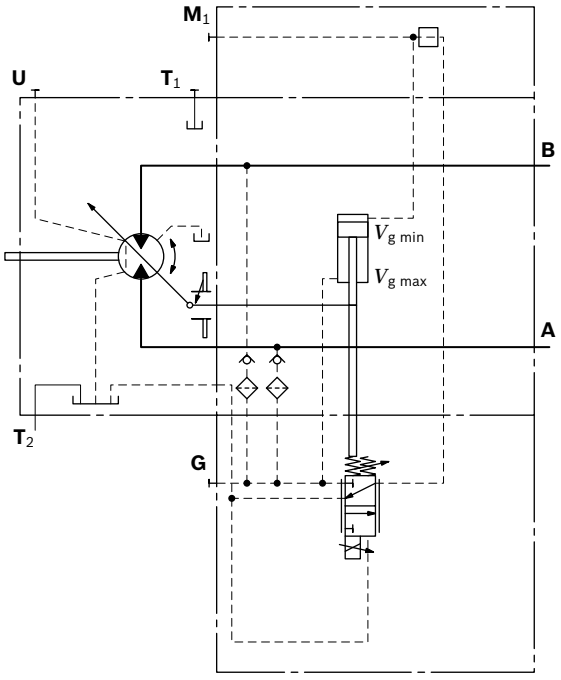
▼ **Overview Throttle Pins**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.018 | 0.018 | 0.022 | 0.022 | 0.022 | 0.026 |
| | [mm] | 0.45 | 0.45 | 0.55 | 0.55 | 0.55 | 0.65 |

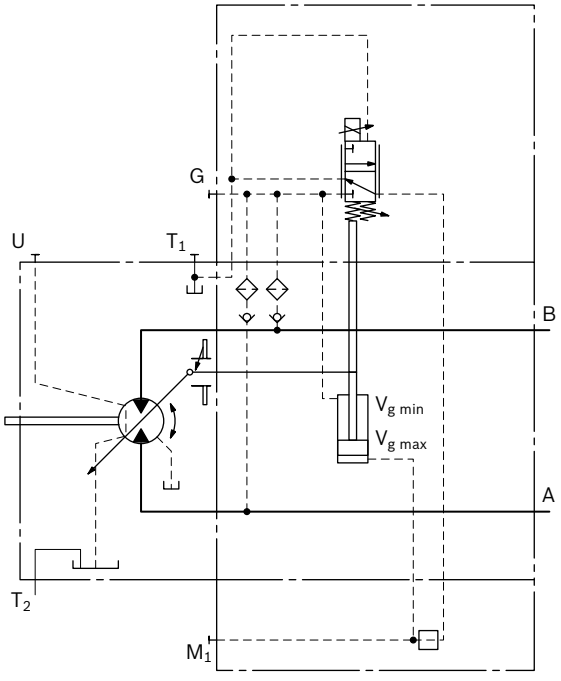
| Technical data, solenoid | EP1, EP5 | EP2, EP6 |
|---|---|---|
| Voltage | 12 V (±20 %) | 24 V (±20 %) |
| Control current | | |
| Beginning of control | 400 mA | 200 mA |
| End of control | 1200 mA | 600 mA |
| Current limit | 1.54 A | 0.77 A |
| Nominal resistance (at 68 °F (20 °C)) | 5.5 Ω | 22.7 Ω |
| Dither frequency | 100 Hz | 100 Hz |
| 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.

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




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



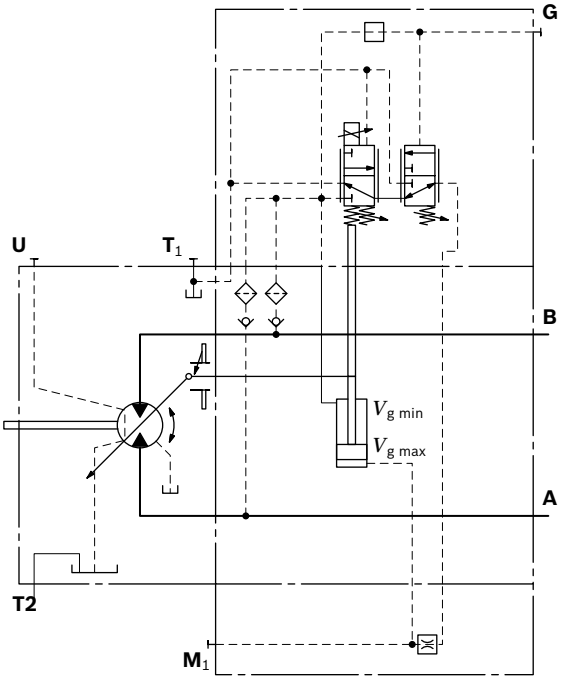

**EP5D1, EP6D1 Pressure control, fixed setting**

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 1150 to 6500 psi (80 to 450 bar)

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



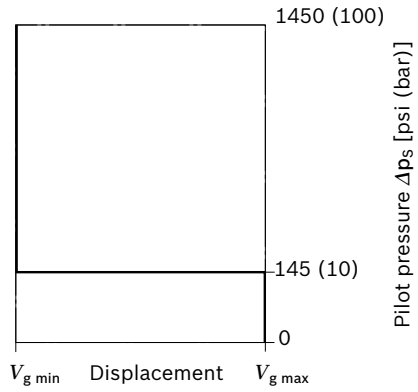
## HZ – Two-point hydraulic control

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 > 145 psi (10 bar) activated, minimum torque, maximum permissible speed)

▼ **Characteristic curve HZ5, HZ7**




### Note

- Maximum permissible pilot pressure: 1450 psi (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 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (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 7250 psi (500 bar) can occur at port **G**.

### Response time damping

The response time damping is influencing the stroke characteristics of the motor and thus the reaction speed of the machine.

**Standard with Size 150 to 215**

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

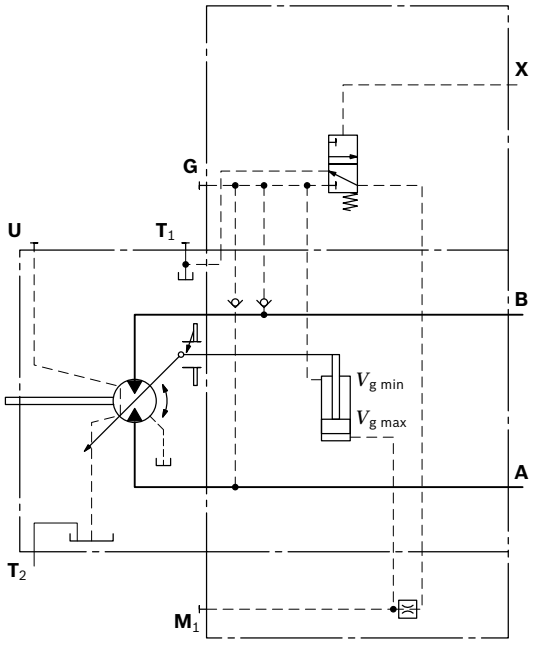
**Standard with Size 60 to 115**

HZ7 (Synchronizing piston) with throttle pin on both sides, symmetrical (as to table)

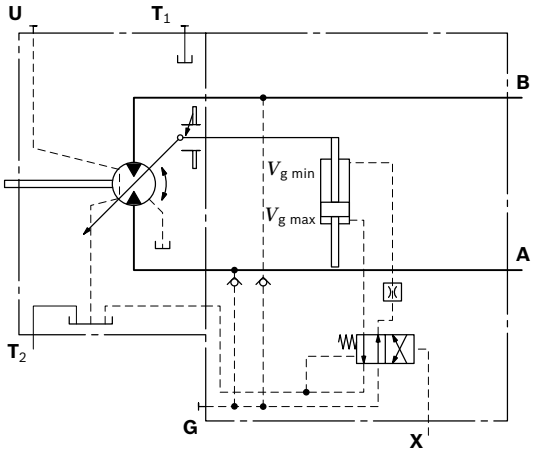
▼ **Overview Throttle Pins**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.012 | 0.012 | 0.012 | 0.022 | 0.022 | 0.026 |
| | [mm] | 0.30 | 0.30 | 0.30 | 0.55 | 0.55 | 0.65 |

▼ **Circuit diagram HZ5 (negative control) size 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.

**Note**

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 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (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 7250 psi (500 bar) can occur at port **G**.

**Response time damping**

The response time damping is influencing the stroke characteristics of the motor and thus the reaction speed of the machine.

**Standard with Size 150 to 215**

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

**Option with Size 60 to 115**

EZ7, EZ8 (Synchronizing piston) with throttle pin on both sides, symmetrical (as to table)

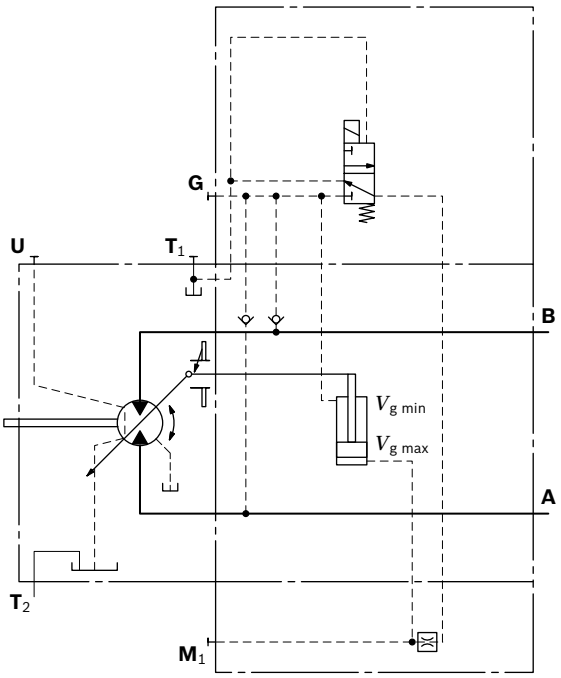
▼ **Overview Throttle Pins**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.012 | 0.012 | 0.012 | 0.022 | 0.022 | 0.026 |
| | [mm] | 0.30 | 0.30 | 0.30 | 0.55 | 0.55 | 0.65 |

**Sizes 150 to 215**

| Technical data, solenoid with DIA37 | 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 68 °F (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 | | |

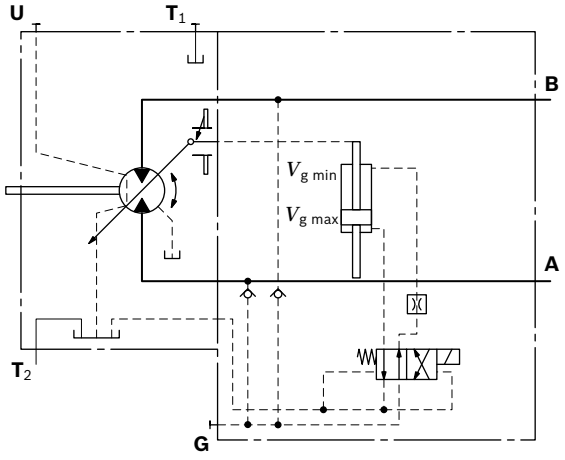
▼ **Circuit diagram EZ5, EZ6 (negative control) size 150 to 215**




**Sizes 60 to 115**

| Technical data, solenoid with DIA45 | 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 68 °F (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) size 60 to 115**



## 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 unit internally measures 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)

**Note**

- 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 out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (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 7250 psi (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 6) and thus a parallel shift of the characteristic.

**Response time damping**
The response time damping is influencing the stroke characteristics of the motor and thus the reaction speed of the machine.

**Standard with Size 60 to 215**
HA1,2 with one-sided throttle pin, the throttling occurs from $V_{g\,min}$ to $V_{g\,max}$. (as to table)

▼ **Overview Throttle Pins**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.018 | 0.018 | 0.022 | 0.022 | 0.022 | 0.022 |
| | [mm] | 0.45 | 0.45 | 0.55 | 0.55 | 0.55 | 0.65 |

**Standard with Size 60 to 215**
HA1, 2 with one sided throttle pin effects the stroking time of
the motor from Vg min to Vg max. (as to table)

▼ **Overview Throttle Screw**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 |
| | [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 $\Delta p$ ≤ approx. 145 psi (10 bar) results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

Beginning of control, setting range 1150 to 5100 psi (80 to 350 bar)

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 4350 psi (300 bar).

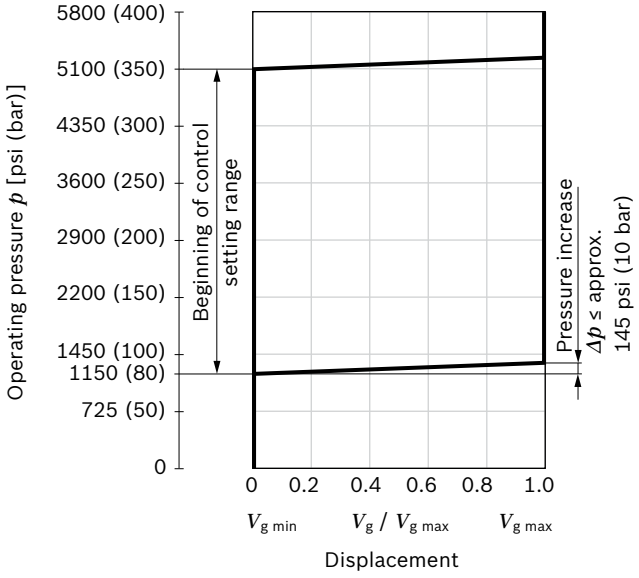
**HA2 with pressure increase, positive control**

An operating pressure increase of $\Delta p$ ≤ approx. 1450 psi (100 bar) results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

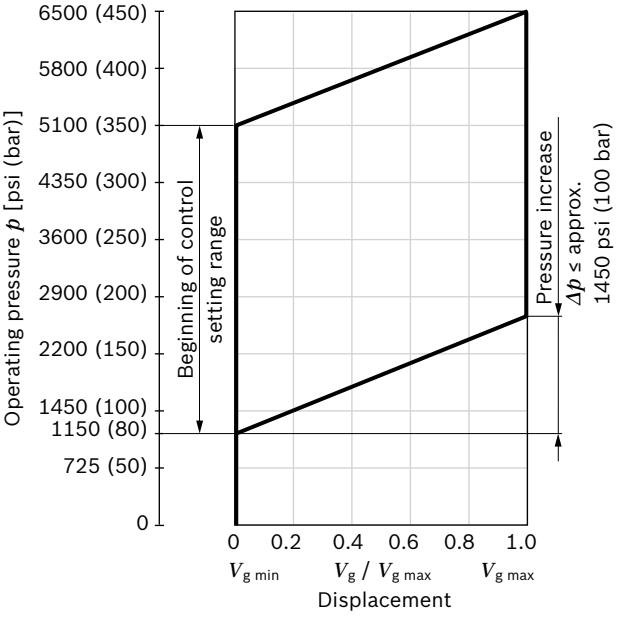
Beginning of control, setting range 1150 to 5100 psi (80 to 350 bar)

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 2900 psi (200 bar)

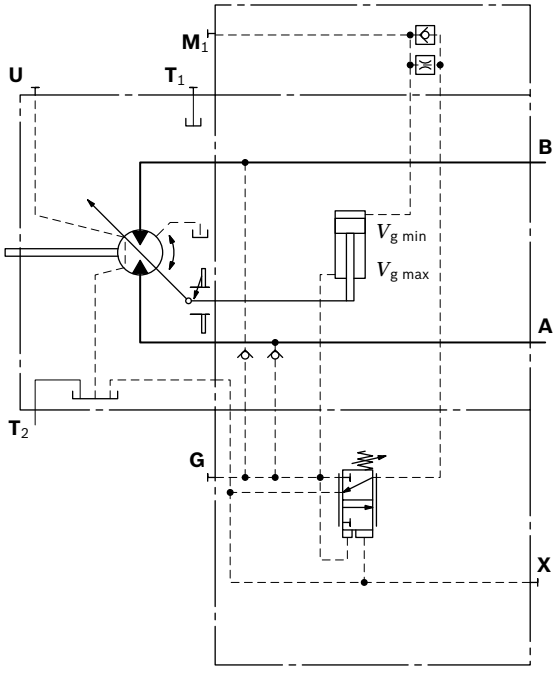
▼ **Characteristic curve HA1**



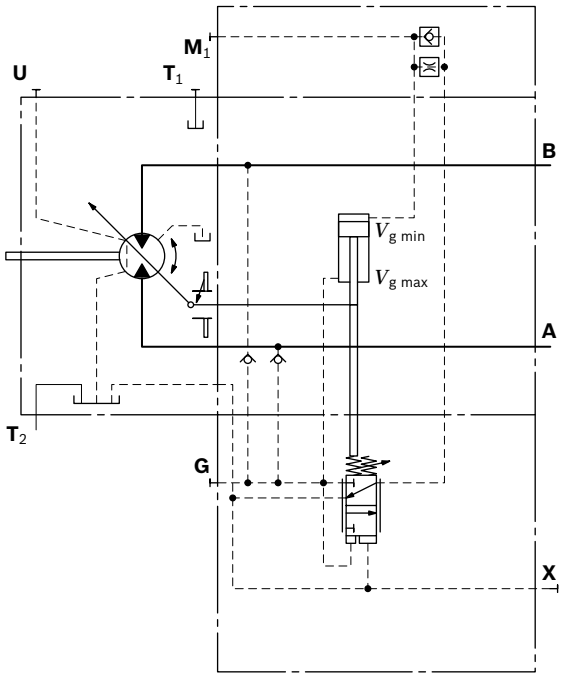

▼ **Characteristic curve HA2**




▼ **Circuit diagram HA1**




▼ **Circuit diagram HA2**

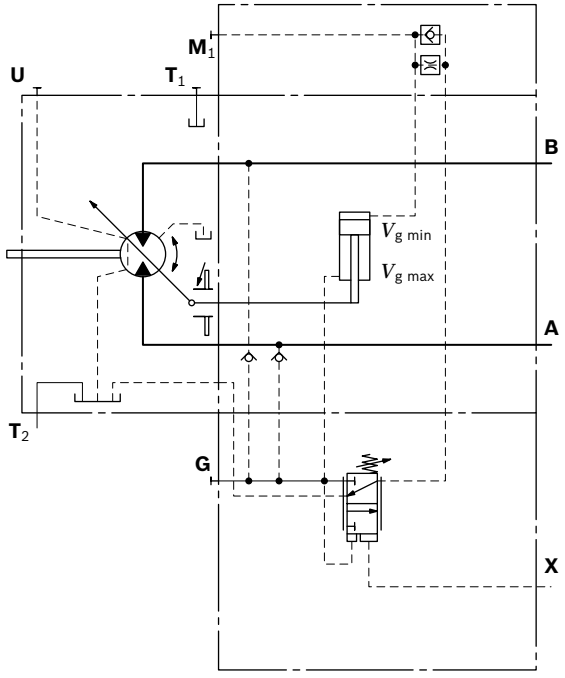


**HA.T3 hydraulic override, remote control, proportional**
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port **X**.
For each 15 psi (1 bar) of pilot pressure increase, the beginning of control is reduced by 250 psi (17 bar).

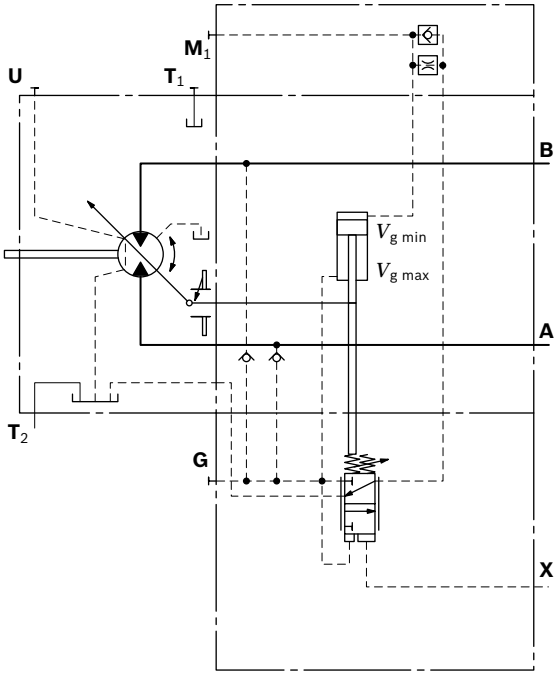
| **Beginning of control setting** | **4350 psi (300 bar)** | **4350 psi (300 bar)** |
|---|---|---|
| Pilot pressure at port **X** | 0 psi | 145 psi |
| | 0 bar | (10 bar) |
| Beginning of control at | 4350 psi | 1900 psi |
| | (300 bar) | (130 bar) |

**Note**
Maximum permissible pilot pressure 1450 psi (100 bar).

▼ **Circuit diagram HA1.T3**




▼ **Circuit diagram HA2.T3**



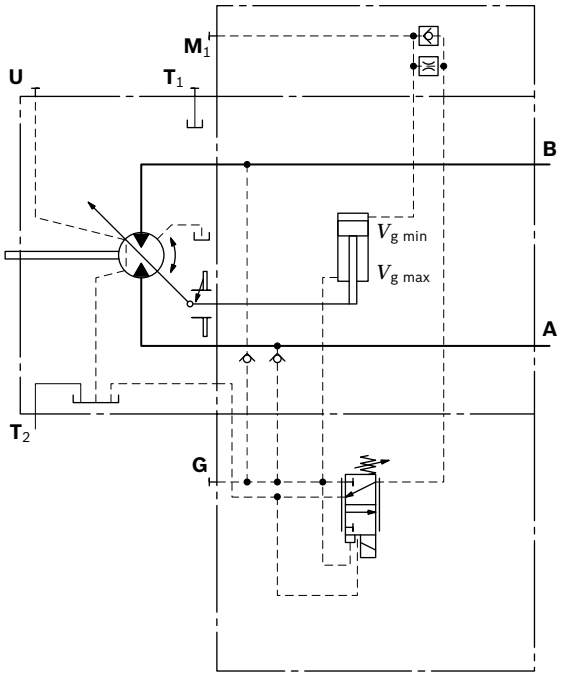
### HA.U1, HA.U2 electric override, two-point

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.

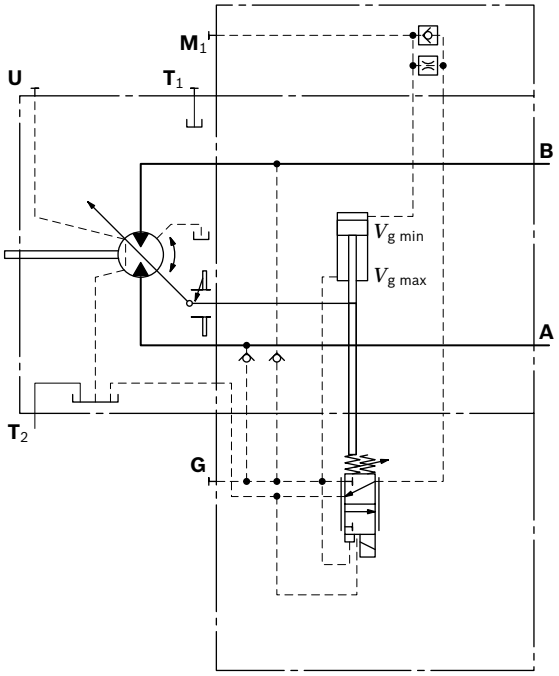
The beginning of control can be set between 1150 and 4350 psi (80 and 300 bar) (specify required setting in plain text when ordering).

| Technical data, solenoid with DIA45 | U1 | U2 |
|---|---|---|
| Voltage | 12 V (±20 %) | 24 V (±20 %) |
| No override | de-energized | de-energized |
| Position $V_{g\,max}$ | energized | energized |
| Nominal resistance (at 68 °F (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 24) is either pressure spring or switched by energizing switching solenoid **a**, depending on the direction of rotation (travel direction).

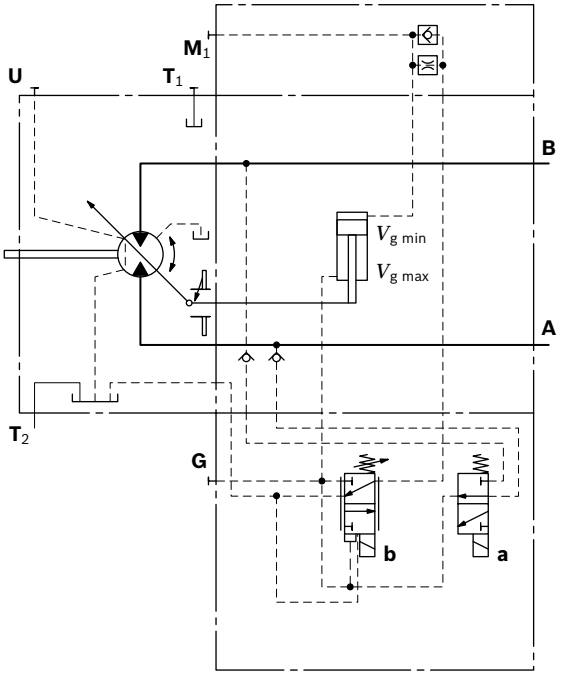
### Electric override

| Technical data, solenoid b with DIA45 | R1 | R2 |
|---|---|---|
| Voltage | 12 V (±20 %) | 24 V (±20 %) |
| No override | de-energized | de-energized |
| Position $V_{g\,max}$ | energized | energized |
| Nominal resistance (at 68 °F (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 | | |

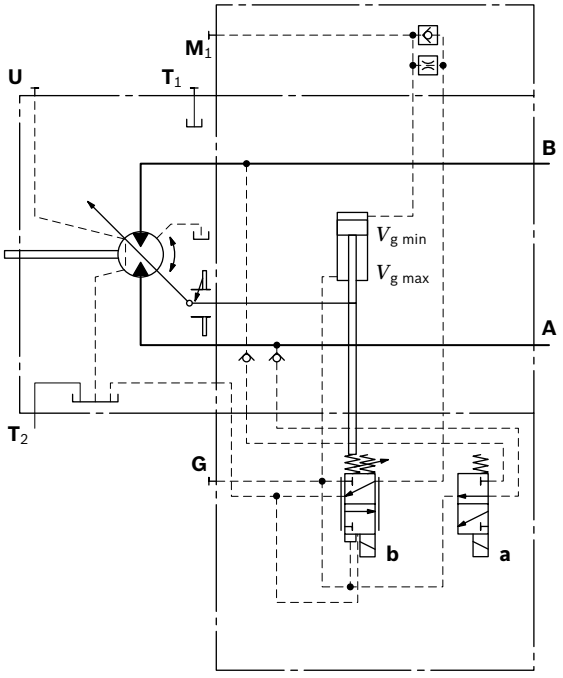
### Travel direction valve, electric

| Technical data, solenoid a with DIA37 | | 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 68 °F (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.

**Note**
The beginning of control and the DA characteristic curve are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

**Response time damping**
The response time damping is influencing the stroke characteristics of the motor and thus the reaction speed of the machine.
**Standard with Size 60 to 215**
DA with one sided throttle pin effects the stroking time of the motor from $V_{g\,min}$ to $V_{g\,max}$. (as to table)

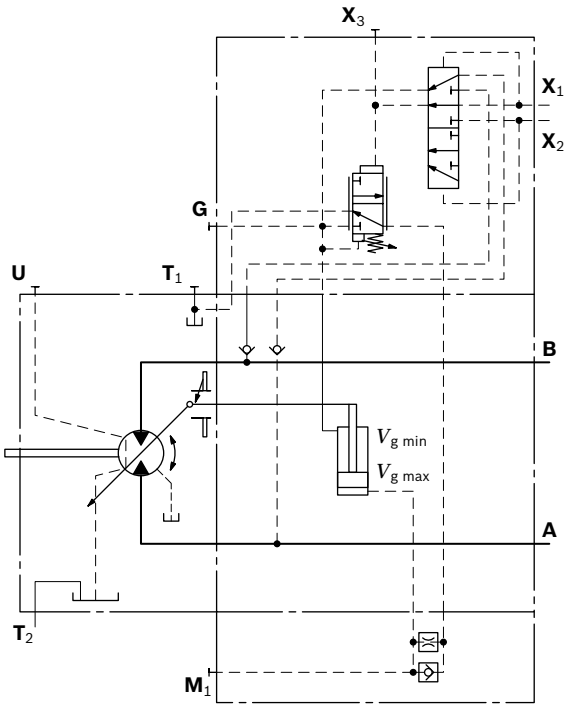
▼ **Overview Throttle Pins**

| Size | | 60 | 85 | 115 | 150 | 170 | 215 |
|---|---|---|---|---|---|---|---|
| Groove size | [inch] | 0.018 | 0.018 | 0.022 | 0.022 | 0.022 | 0.022 |
| | [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 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).

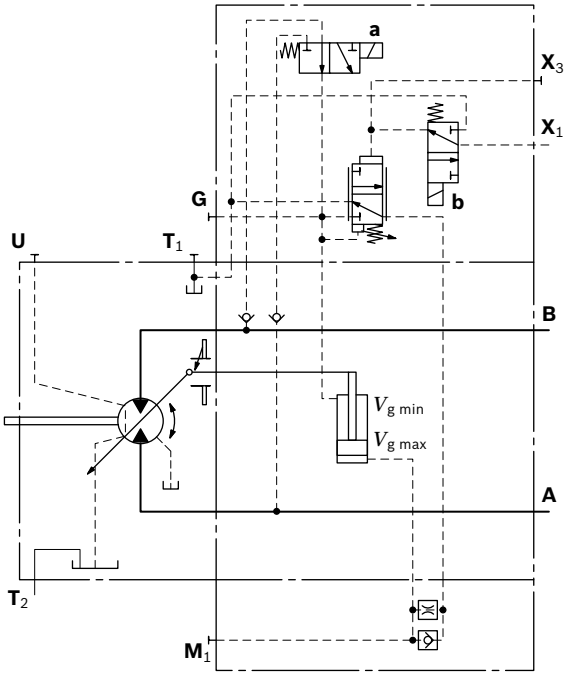
### Travel direction valve, electric

| Technical data, solenoid a with DIA37 | | 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 68 °F (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 DIA37 | DA1 | DA2 |
|---|---|---|
| Voltage | 12 V (±20 %) | 24 V (±20 %) |
| No override | de-energized | de-energized |
| Position $V_{g\,max}$ | energized | energized |
| Nominal resistance (at 68 °F (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 DA1, DA2**



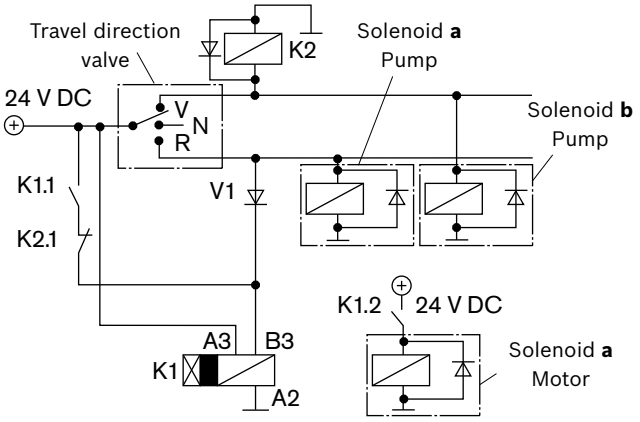
## Electric travel direction valve (for DA, HA.R)

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.

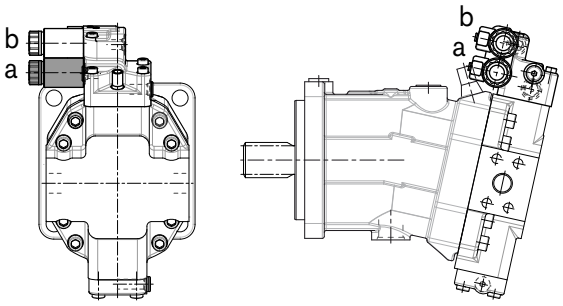
As a result, jerky deceleration or braking is prevented in both cases.

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

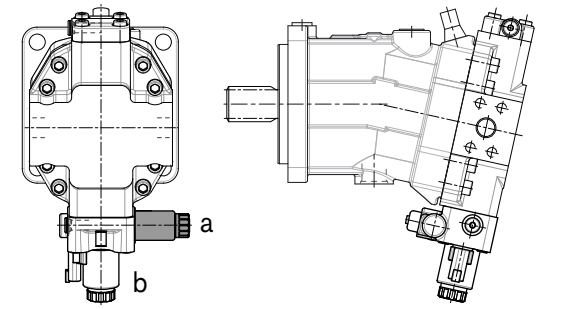



The diodes and relays shown are not included in the scope of delivery of the motor.

▼ **Control DA1, DA**




▼ **HA1R., HA2R. control**

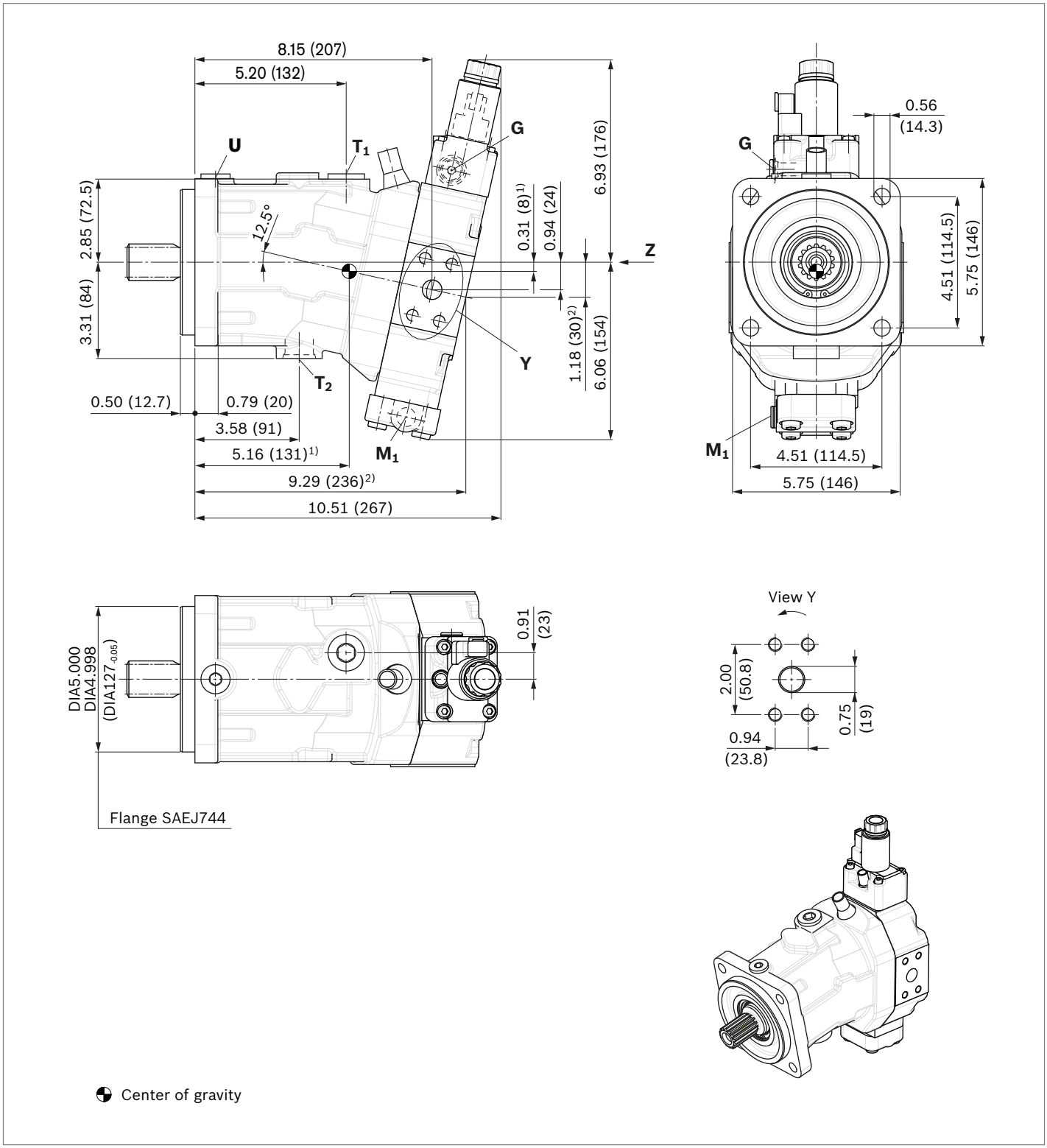



Switching solenoid **a** on the travel direction valve

## Dimensions size 60

### EP5, EP6 – Proportional electric control, negative control

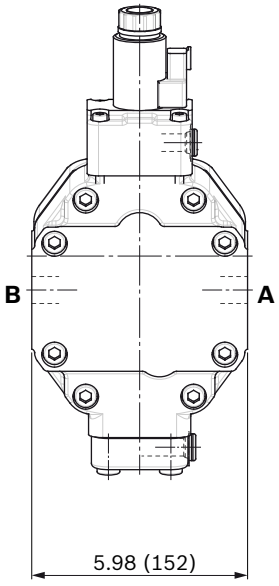
Port plate 2 – SAE working ports **A** and **B** at side, opposite



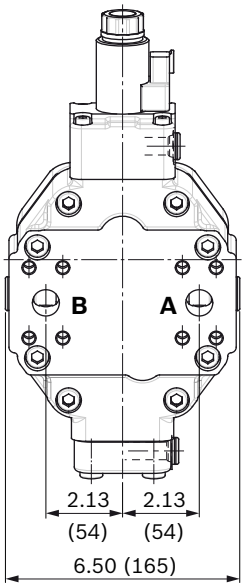

1) Port plate 1 – SAE working ports **A** and **B** at rear

▼ **Location of working ports on port plates** (view **Z**)

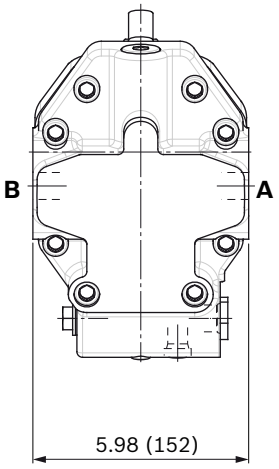
**2** SAE working port
**A** and **B** at side, opposite



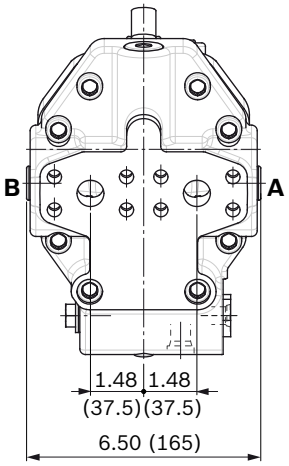

**1** SAE working port
**A** and **B** at rear




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

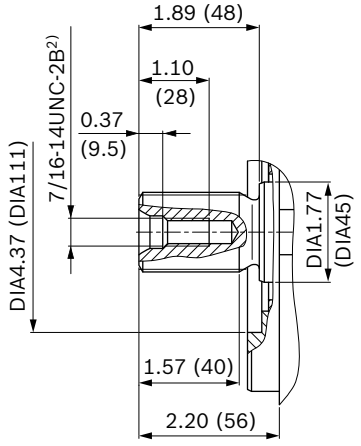



**1** SAE working port
**A** and **B** at rear
only HZ7, EZ7/8




▼ **Splined shaft SAE J744**

**S7 –** 1 1/4 in 14T 12/24DP[1)]

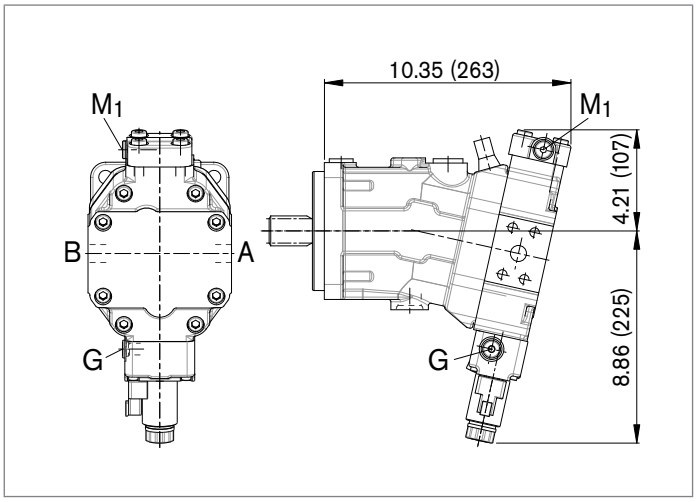



1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1

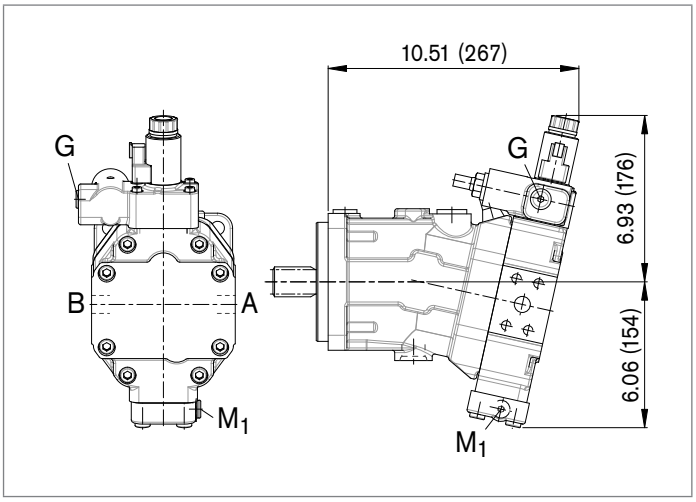
| Ports | | Standard | Size | $p_{max}$ [psi (bar)][1] | Status[6] |
|---|---|---|---|---|---|
| **A, B**[4] | Working port<br>Mounting bolt A/B, screw grade 8 with hardened washer | SAE J518[2]<br>ASME B1.1 | 3/4 in<br>3/8 in - 16 UNC-2B; 0.83 (21) deep | 7250 psi (500 bar) | O |
| **$T_1$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | X[3] |
| **$T_2$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | O[3] |
| **G** | Synchronous control | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |
| **U** | Bearing flushing | ISO11926[5] | 7/8 in -14 UNF-2B; 0.67 (17) deep | 45 (3) | X |
| **X** | Pilot signal (HP, HZ, HA1T/HA2T) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 1450 (100) | O |
| **X** | Pilot signal (HA1, HA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 45 (3) | X |
| **$X_1$, $X_2$** | Pilot signal (DA0) | ISO 8434-1 | SDSC-L8×M12-F | 580 (40) | O |
| **$X_1$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | O |
| **$X_3$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | X |
| **$M_1$** | Measuring stroking chamber | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |

1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518.
3) Depending on installation position, $T_1$ or $T_2$ must be connected (see also installation instructions on page 72).
4) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

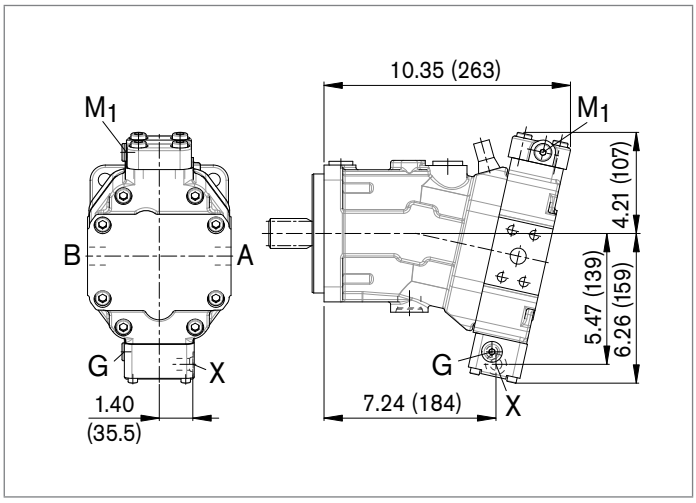
▼ **EP1, EP2** – Electric proportional control, positive control



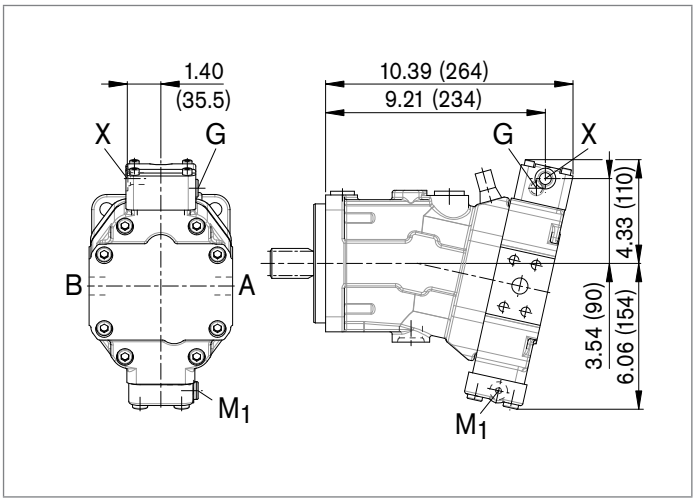

▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



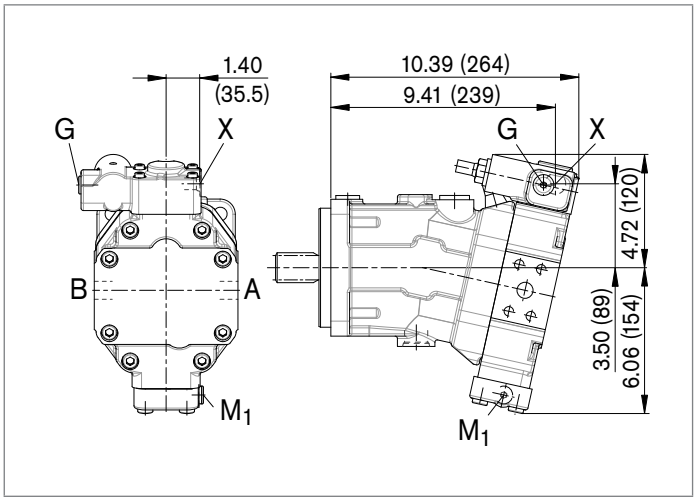

▼ **HP1, HP2** – Hydraulic proportional control, positive control



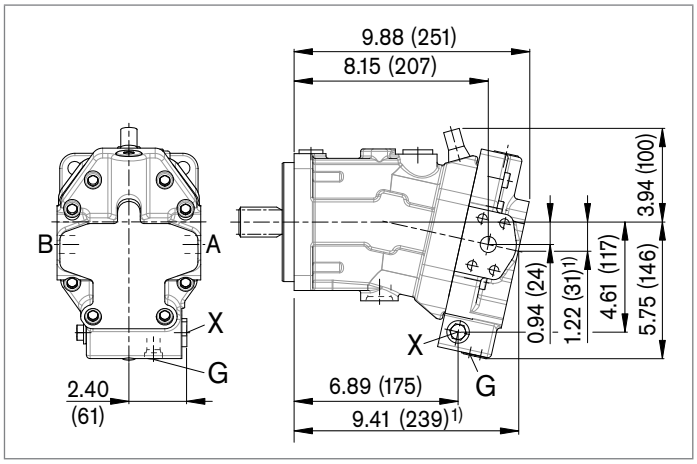

▼ **HP5, HP6** – Hydraulic proportional control, negative control



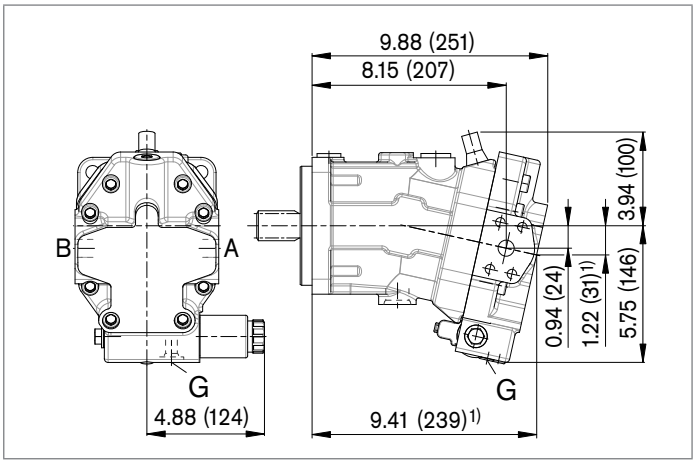

▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



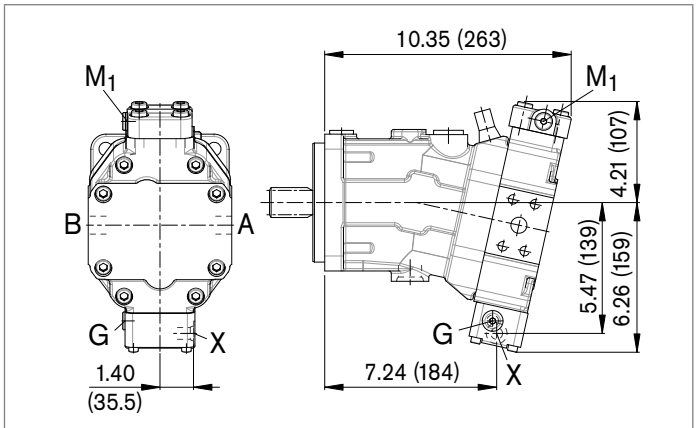
▼ **HZ7** – Hydraulic two-point control, negative control




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

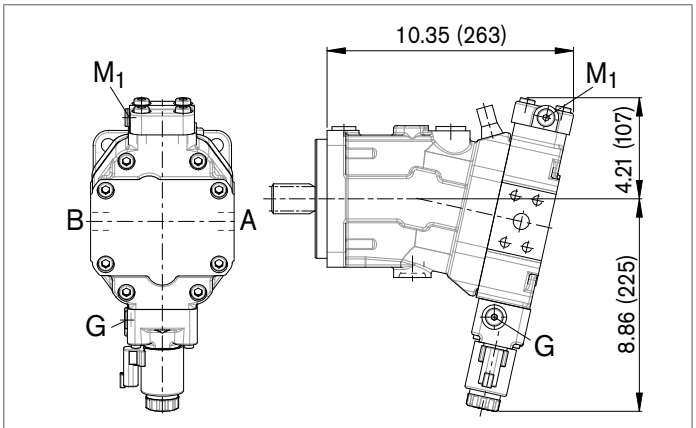



▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

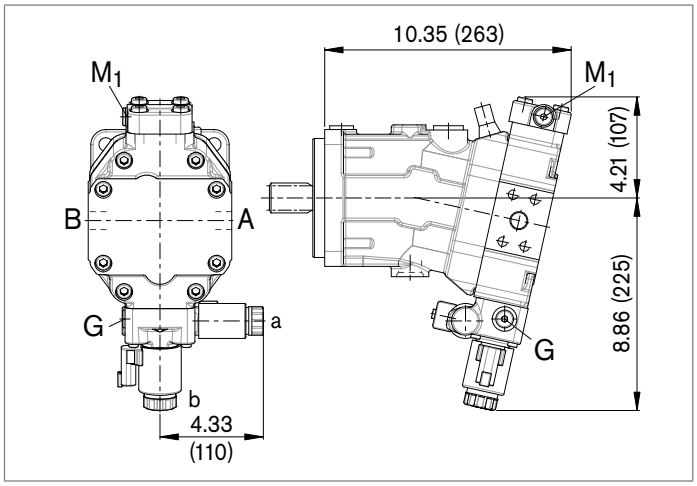



HA1 and HA2, X plugged
HA1T and HA2T, X open

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

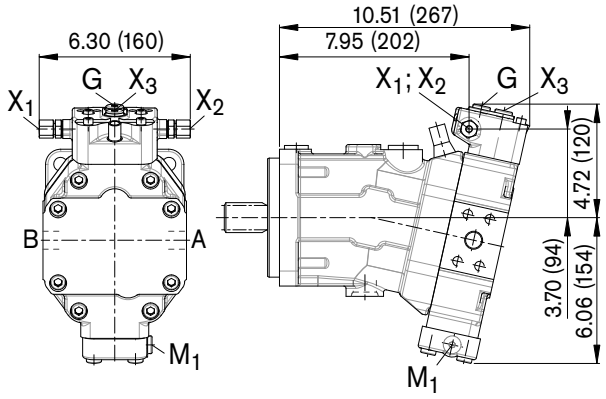



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric




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

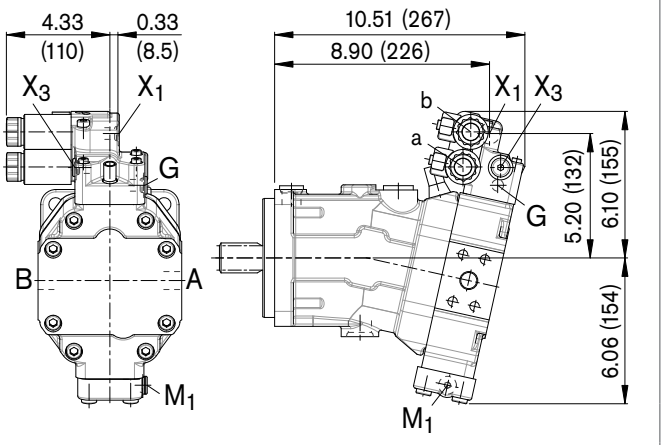
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve




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

Use assembled fitting!

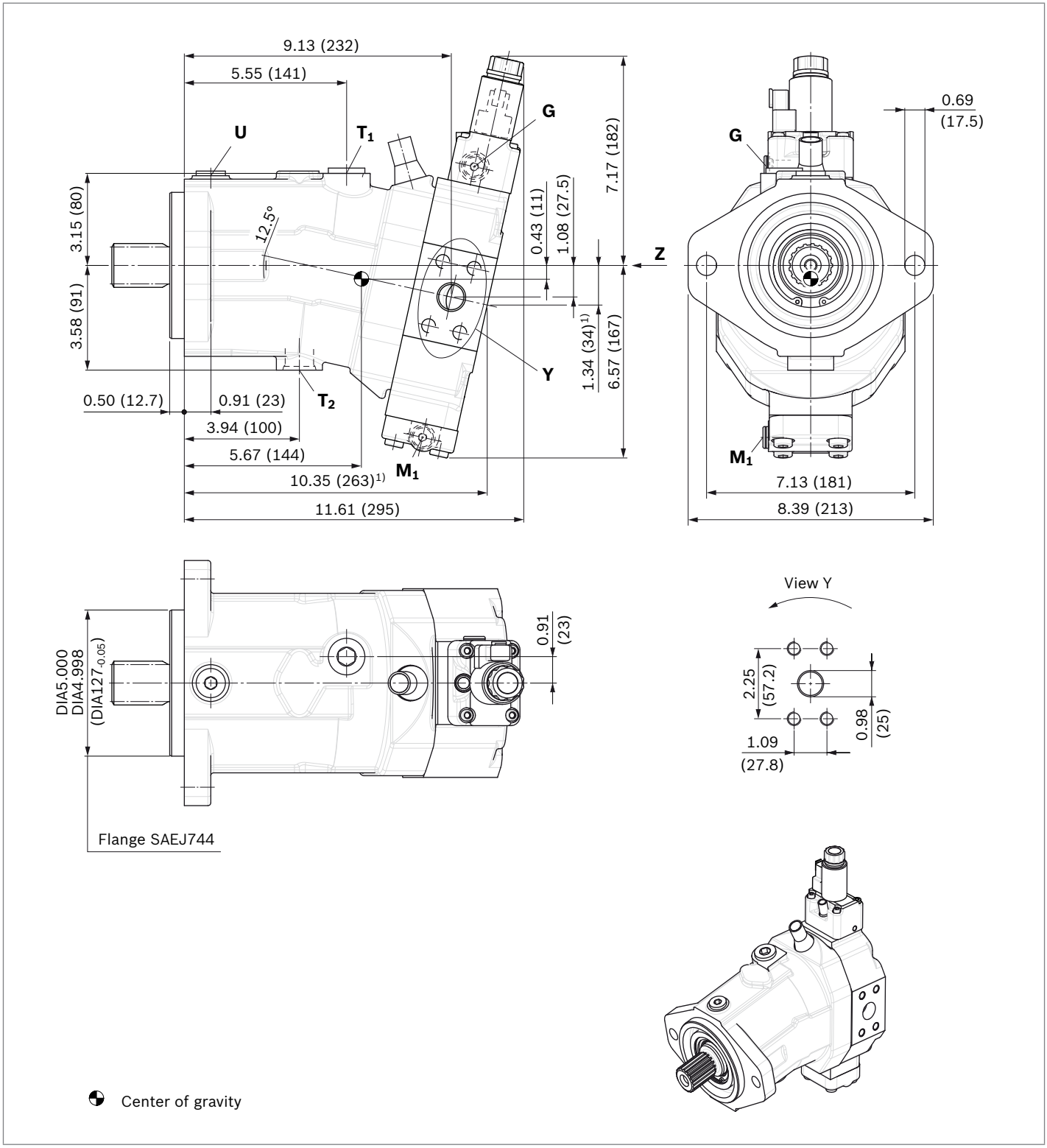
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ switch



## Dimensions size 85

**EP5, EP6 – Proportional electric control, negative control, with Mounting flange C2**

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

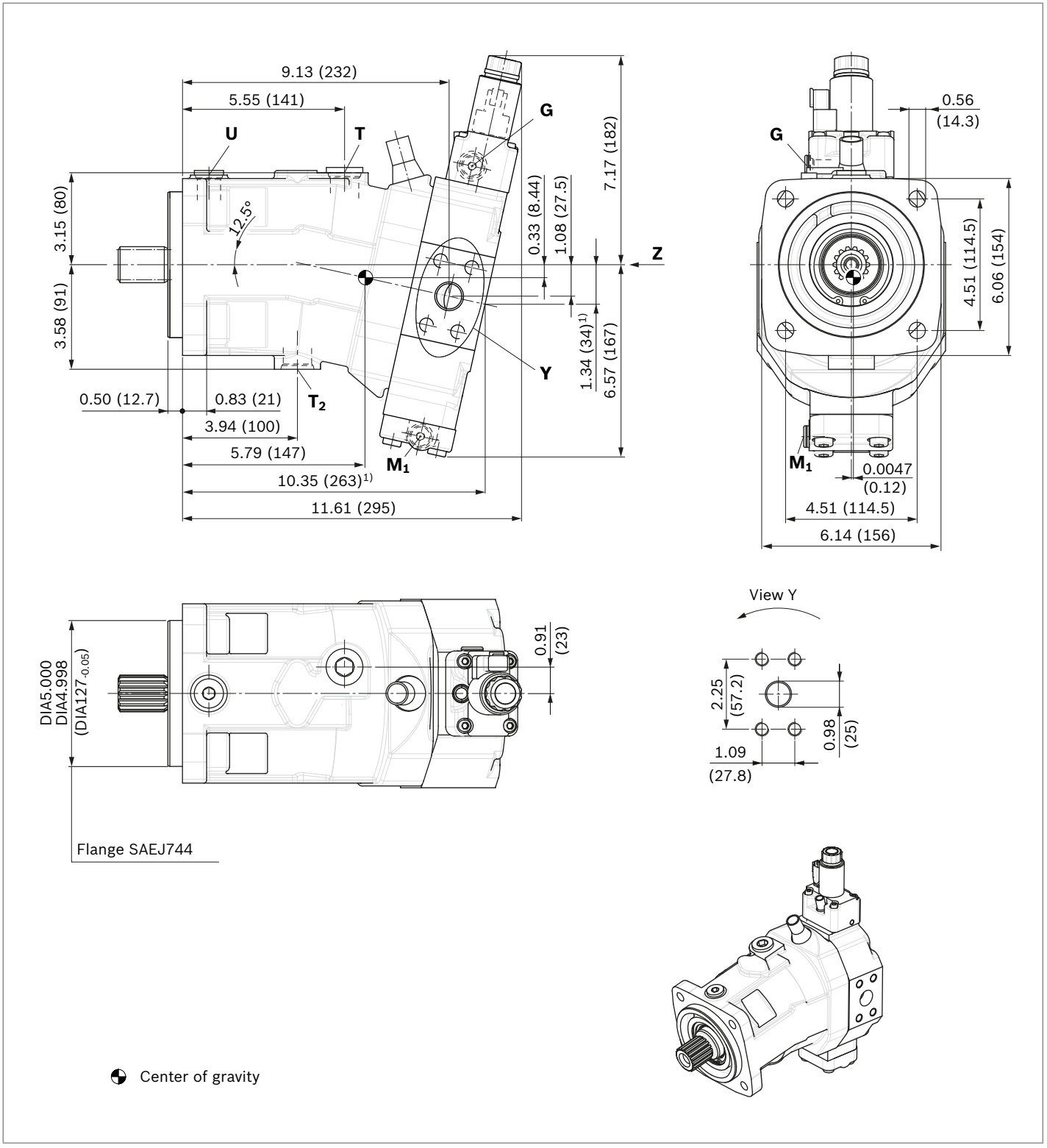



1) Port plate 1 – SAE working ports **A** and **B** at rear

## Dimensions size 85

**EP5, EP6 – Proportional electric control, negative control, with Mounting flange C4**

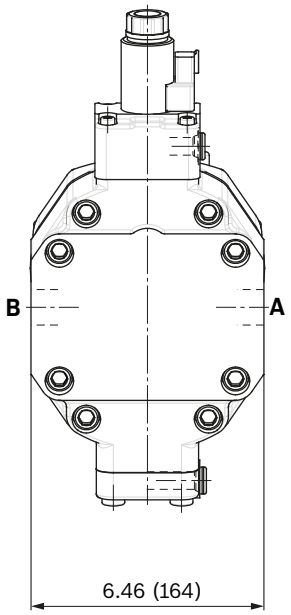
Port plate 2 – SAE working ports **A** and **B** at side, opposite



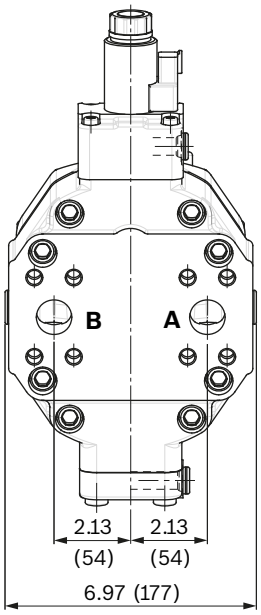

1) Port plate 1 – SAE working ports **A** and **B** at rear

▼ **Location of working ports on port plates** (view **Z**)

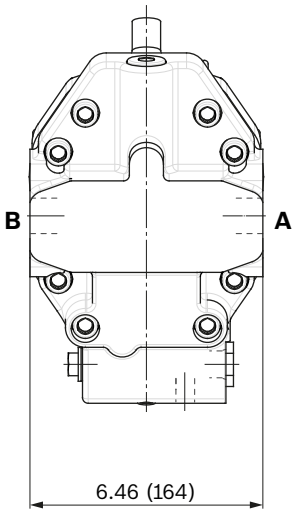
**2** SAE working port **A** and **B** at side, opposite



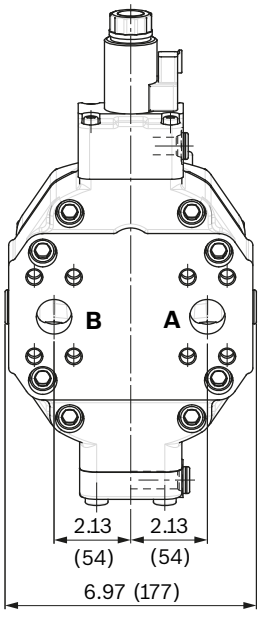

**1** SAE working port **A** and **B** at rear




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

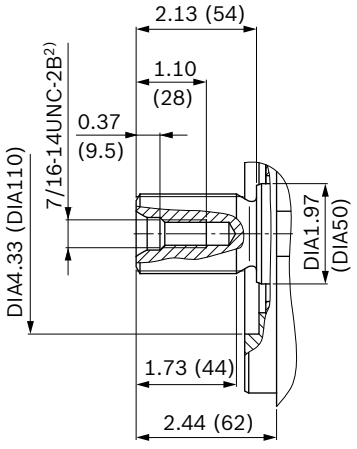



**1** SAE working port **A** and **B** at rear only HZ7, EZ7/8




▼ **Splined shaft SAE J744**

**S9 –** 1 1/2 in 17T 12/24DP[1)]



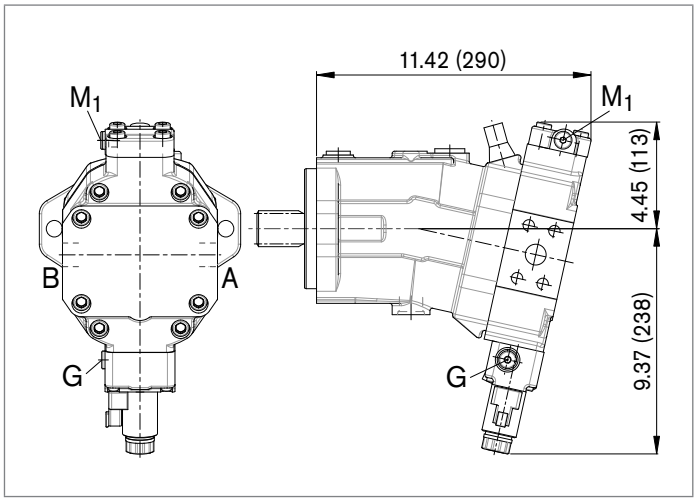

1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

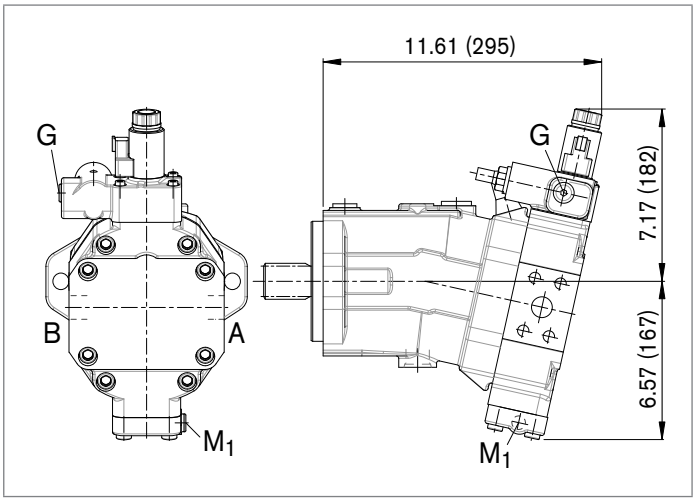
| Ports | | Standard | Size | $p_{max}$ [psi (bar)][1] | Status[6] |
|---|---|---|---|---|---|
| **A, B**[4] | Working port<br>Mounting bolt A/B, screw grade 8 with hardened washer | SAE J518[2]<br>ASME B1.1 | 1 in<br>7/16 in -14 UNC-2B; 0.87 (22) deep | 7250 psi (500 bar) | O |
| **$T_1$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | X[3] |
| **$T_2$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | O[3] |
| **G** | Synchronous control | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |
| **U** | Bearing flushing | ISO11926[5] | 7/8 in -14 UNF-2B; 0.67 (17) deep | 45 (3) | X |
| **X** | Pilot signal (HP, HZ, HA1T/HA2T) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 1450 (100) | O |
| **X** | Pilot signal (HA1, HA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 45 (3) | X |
| **$X_1$, $X_2$** | Pilot signal (DA0) | ISO 8434-1 | SDSC-L8×M12-F | 580 (40) | O |
| **$X_1$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | O |
| **$X_3$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | X |
| **$M_1$** | Measuring stroking chamber | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |

1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518.
3) Depending on installation position, $T_1$ or $T_2$ must be connected (see also installation instructions on page 72).
4) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

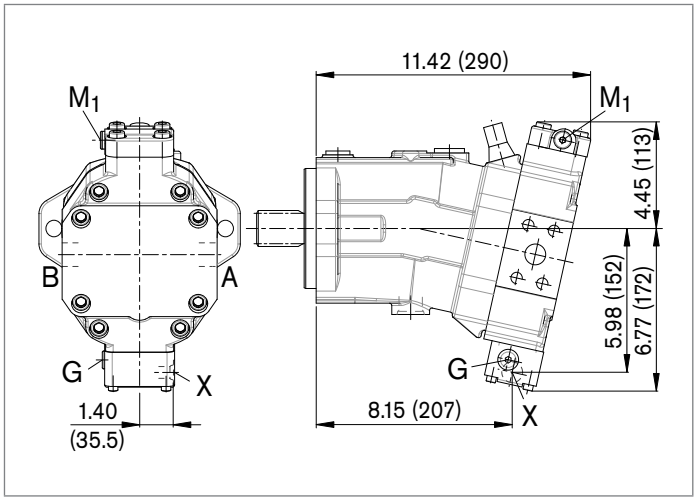
▼ **EP1, EP2** – Electric proportional control, positive control



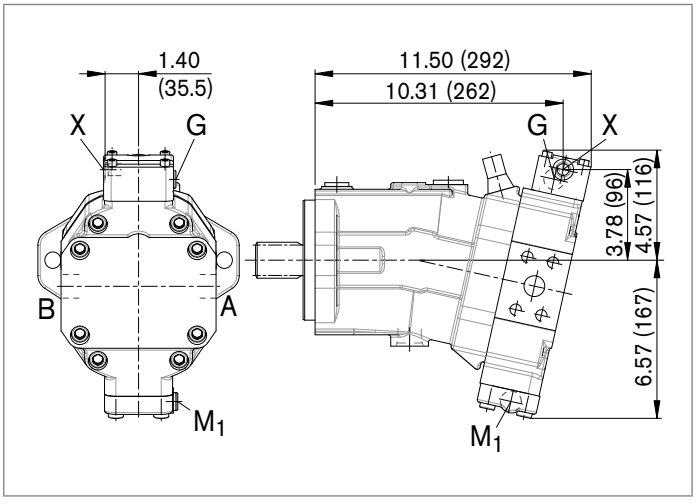

▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



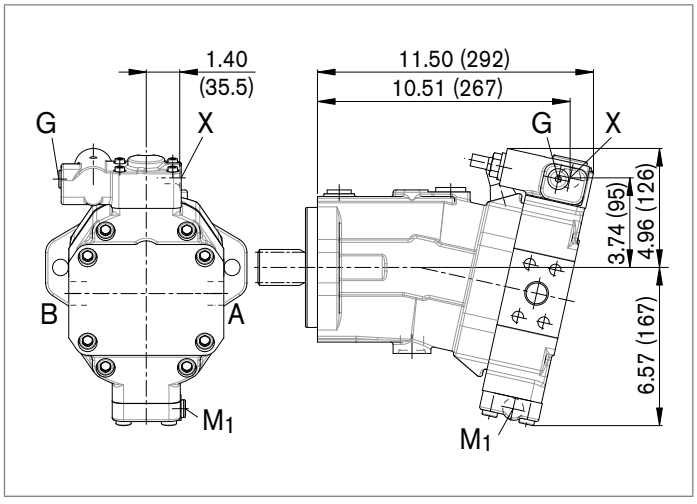

▼ **HP1, HP2** – Hydraulic proportional control, positive control



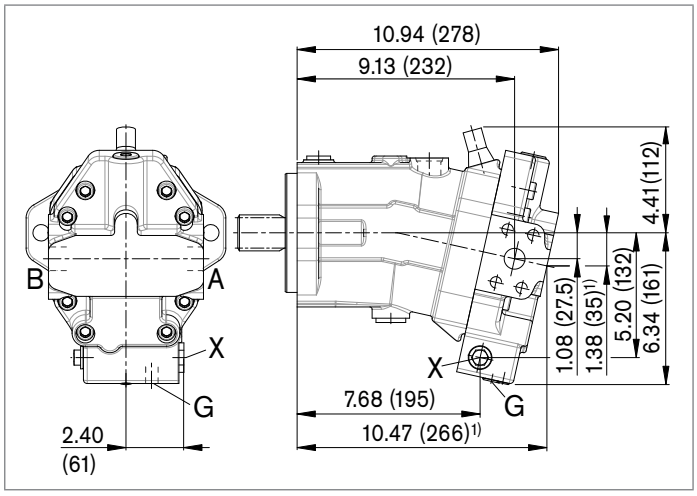

▼ **HP5, HP6** – Hydraulic proportional control, negative control



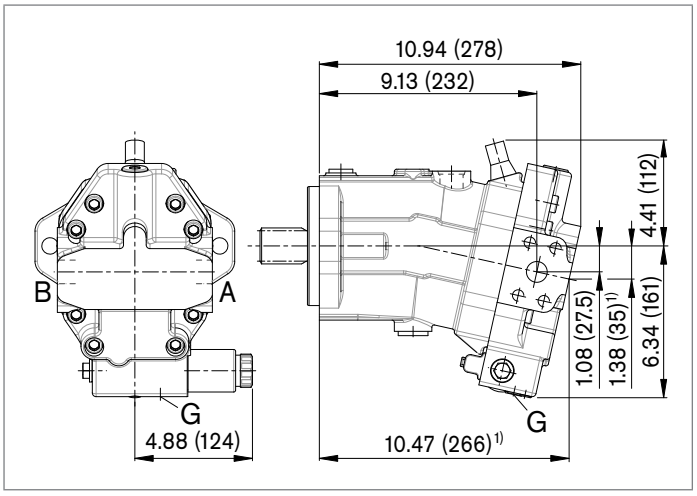

▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



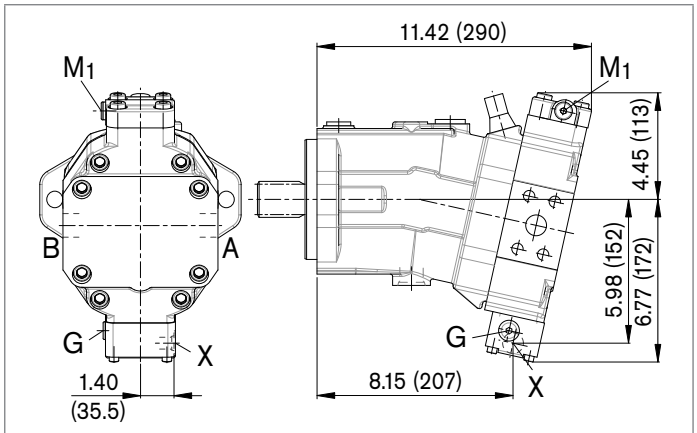
▼ **HZ7** – Hydraulic two-point control, negative control




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

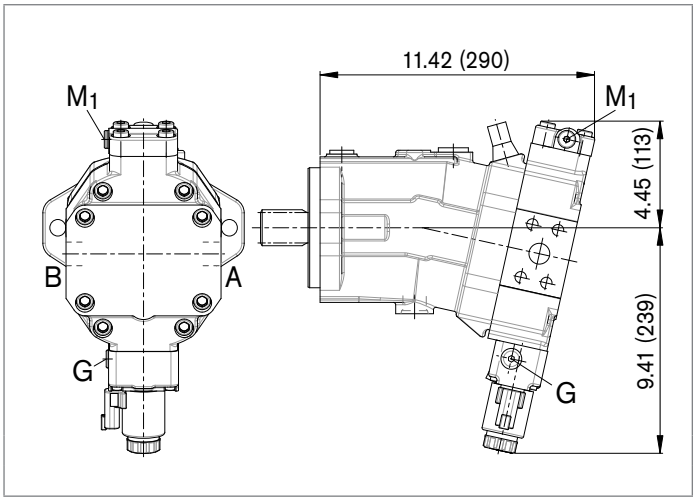



▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

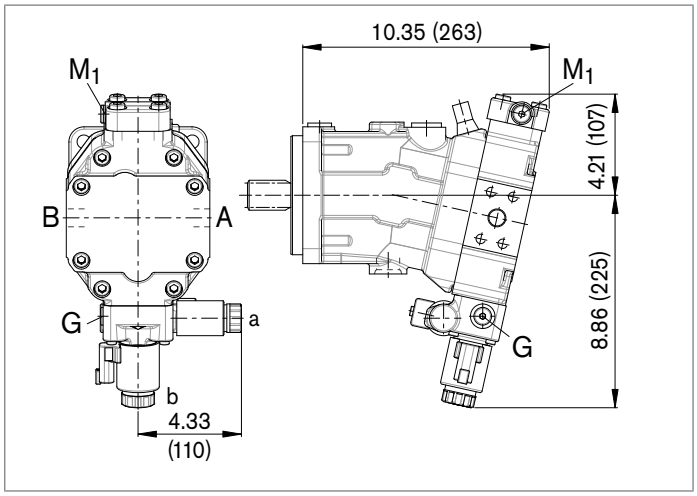



HA1 and HA2, X plugged
HA1T and HA2T, X open

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

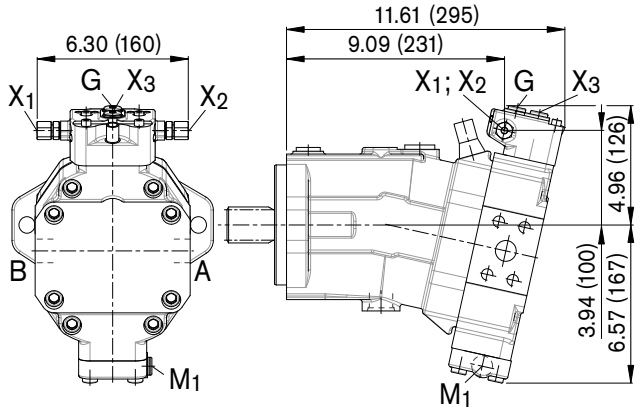



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric




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

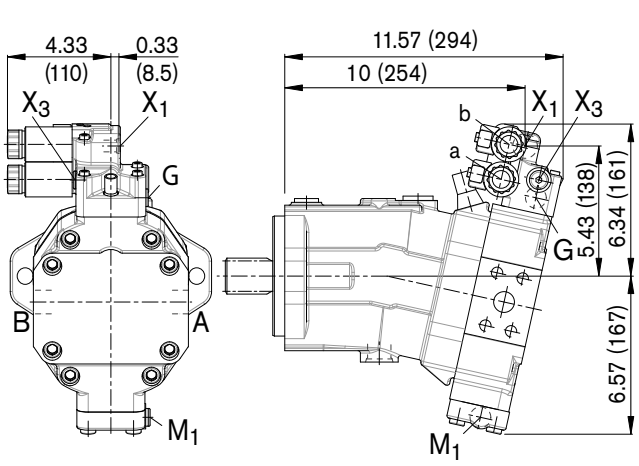
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve




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

Use assembled fitting!

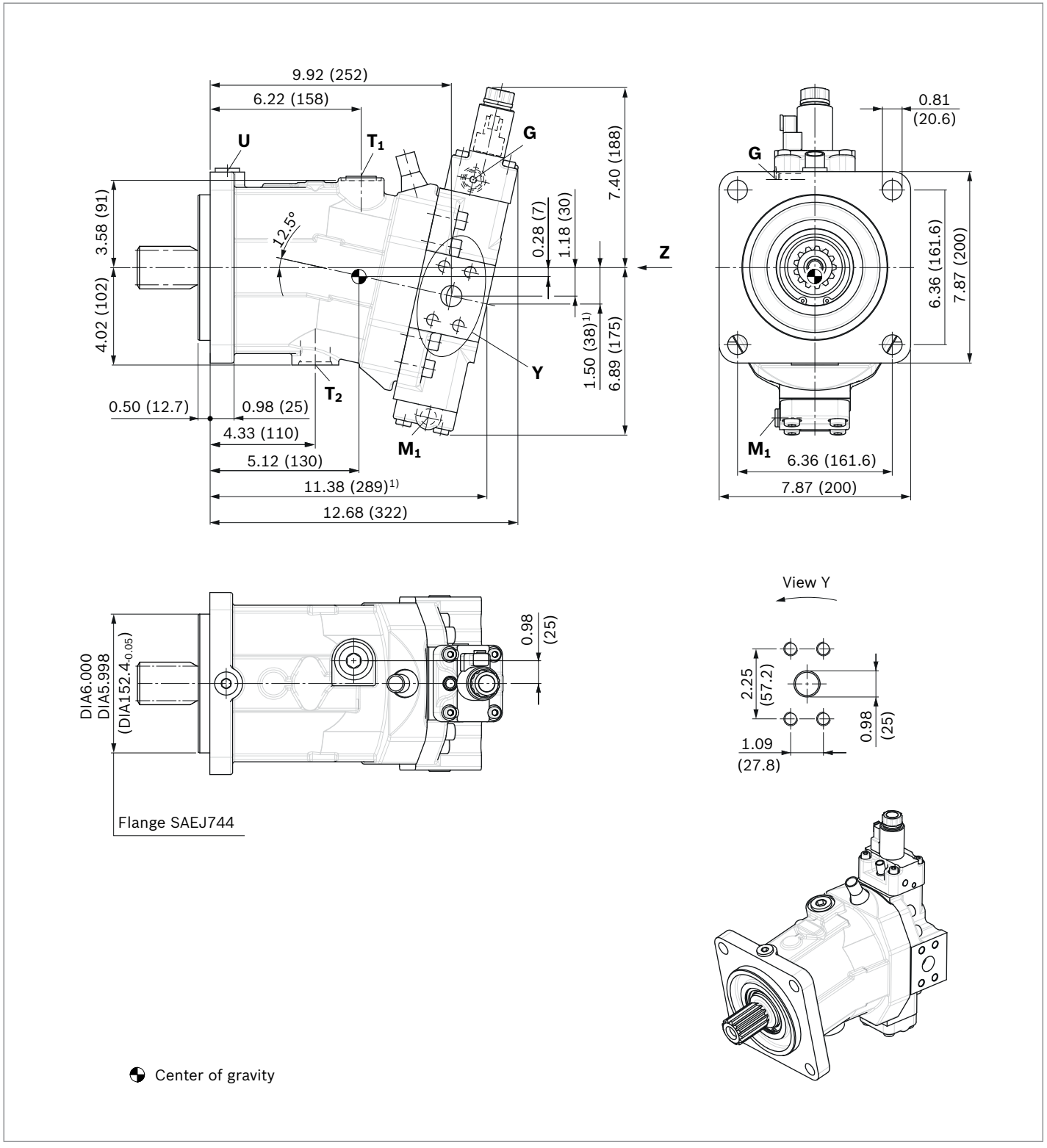
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ switch



## Dimensions size 115

### EP5, EP6 – Proportional electric control, negative control

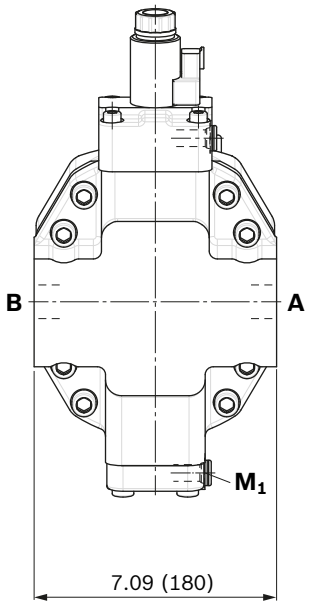
Port plate 2 — SAE working ports **A** and **B** at side, opposite



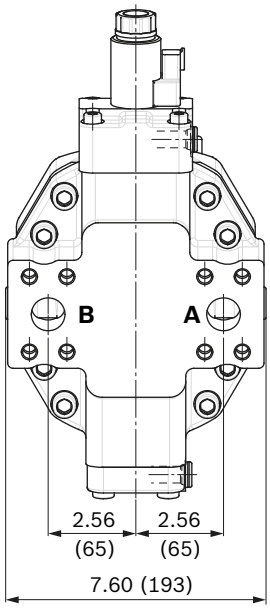

1) Port plate 1 — SAE working ports **A** and **B** at rear

▼ **Location of working ports on port plates** (view **Z**)

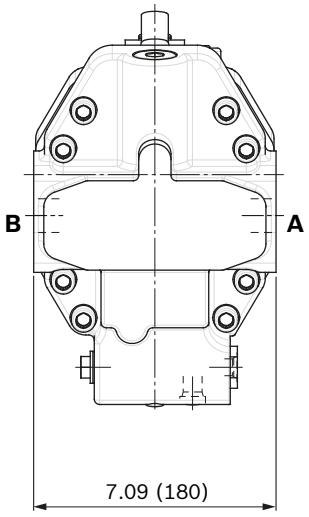
**2** SAE working port **A** and **B** at side, opposite



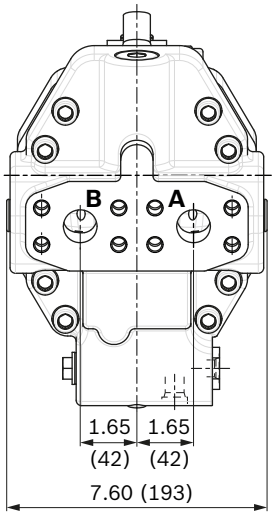

**1** SAE working port **A** and **B** at rear




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

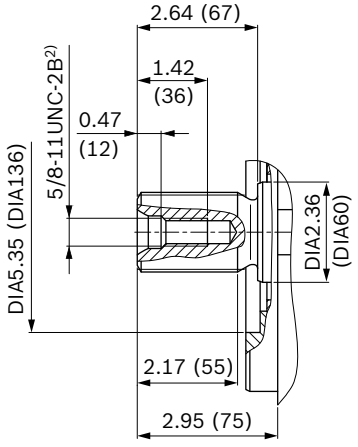



1 SAE working port **A** and **B** at rear only HZ7, EZ7/8




▼ **Splined shaft SAE J744**

**T1** – 1 3/4 in 13T 8/16 DP[1)]



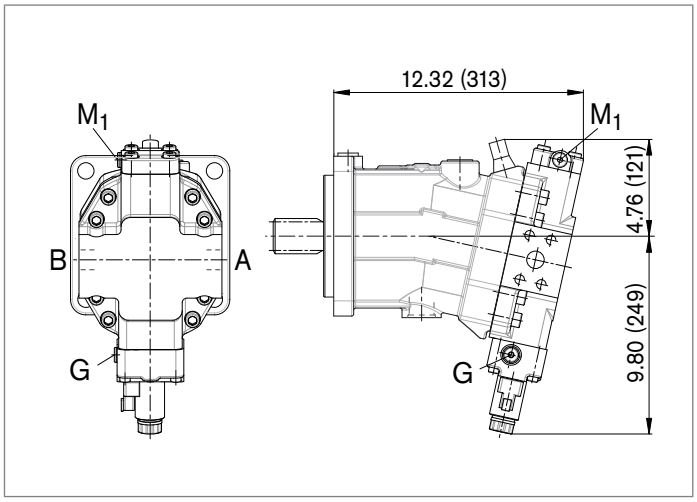

1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

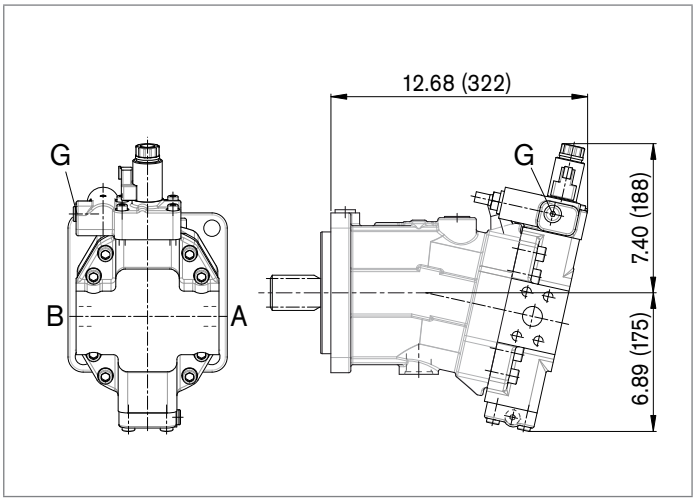
| Ports | | Standard | Size | $p_{max}$ [psi (bar)][1] | Status[6] |
|---|---|---|---|---|---|
| **A, B**[4] | Working port<br>Mounting bolt A/B, screw grade 8 with hardened washer | SAE J518[2]<br>ASME B1.1 | 1 in<br>7/16 in -14 UNC-2B; 0.87 (22) deep | 7250 psi (500 bar) | O |
| **$T_1$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | X[3] |
| **$T_2$** | Drain port | ISO 11926[5] | 1 5/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | O[3] |
| **G** | Synchronous control | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |
| **U** | Bearing flushing | ISO11926[5] | 7/8 in -14 UNF-2B; 0.67 (17) deep | 45 (3) | X |
| **X** | Pilot signal (HP, HZ, HA1T/HA2T) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 1450 (100) | O |
| **X** | Pilot signal (HA1, HA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 45 (3) | X |
| **$X_1$, $X_2$** | Pilot signal (DA0) | ISO 8434-1 | SDSC-L8×M12-F | 580 (40) | O |
| **$X_1$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | O |
| **$X_3$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | X |
| **$M_1$** | Measuring stroking chamber | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |

1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518.
3) Depending on installation position, $T_1$ or $T_2$ must be connected (see also installation instructions on page 72).
4) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

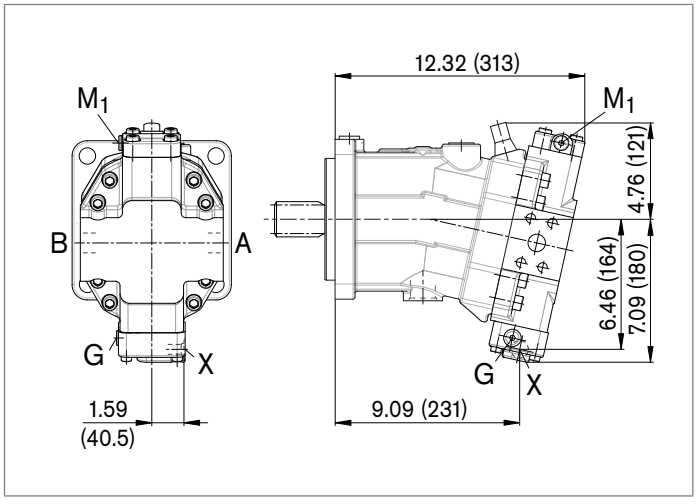
▼ **EP1, EP2** – Electric proportional control, positive control



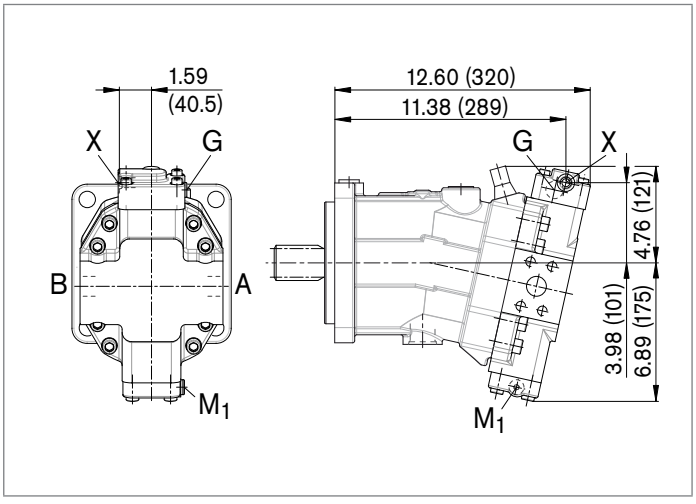

▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



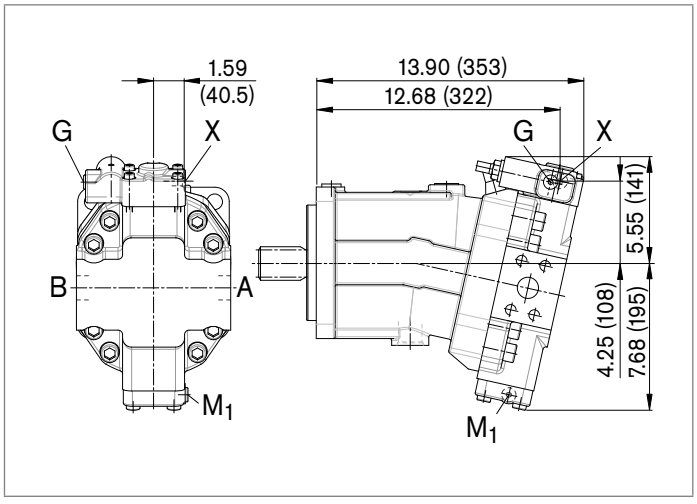

▼ **HP1, HP2** – Hydraulic proportional control, positive control



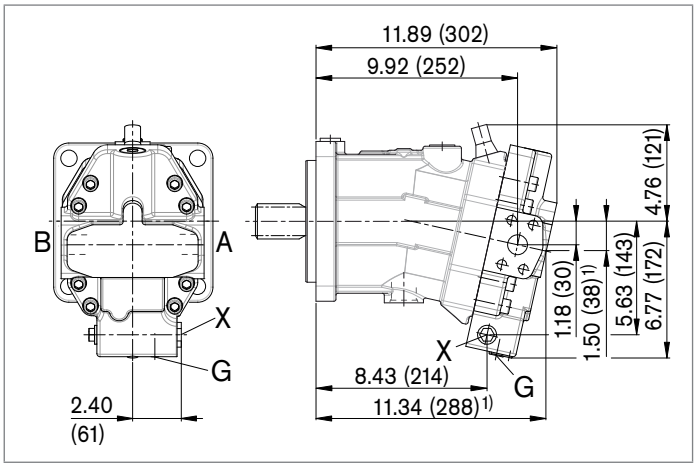

▼ **HP5, HP6** – Hydraulic proportional control, negative control



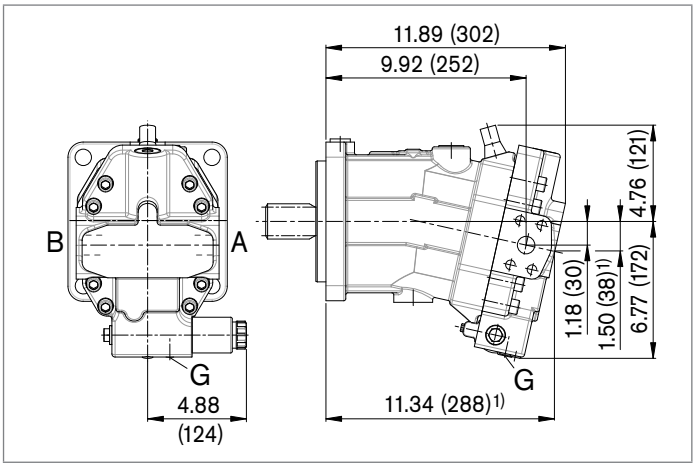

▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



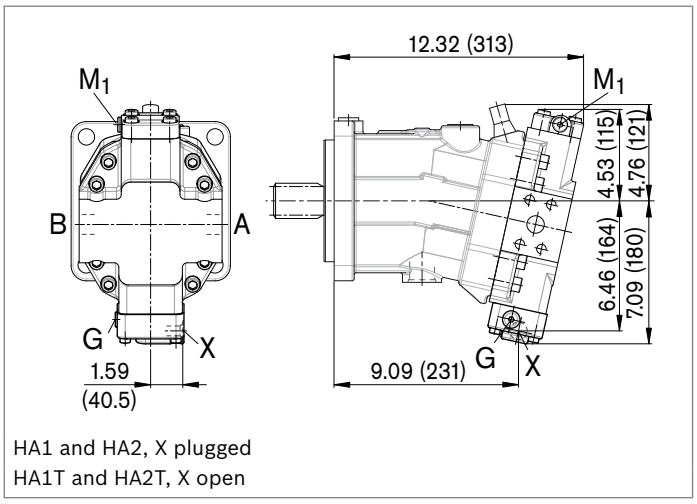
▼ **HZ7** – Hydraulic two-point control, negative control




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

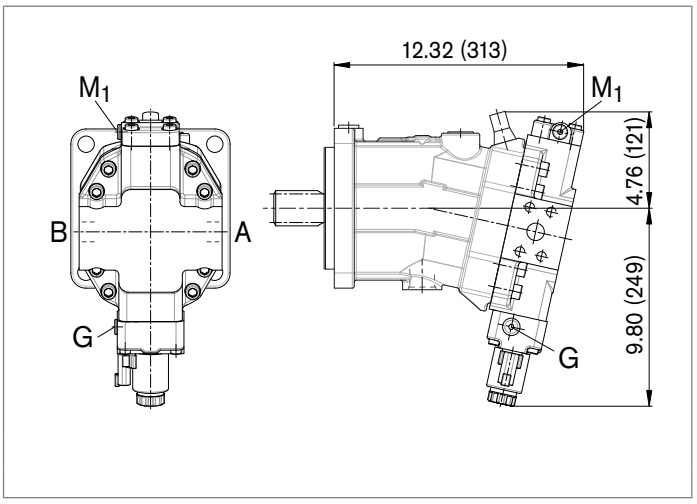



▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

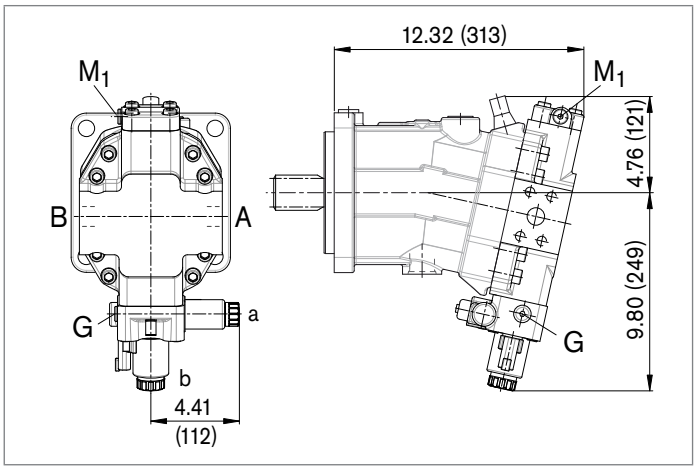



HA1 and HA2, X plugged
HA1T and HA2T, X open

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

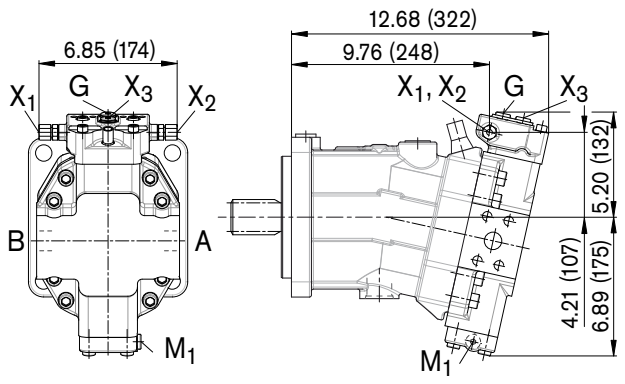



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



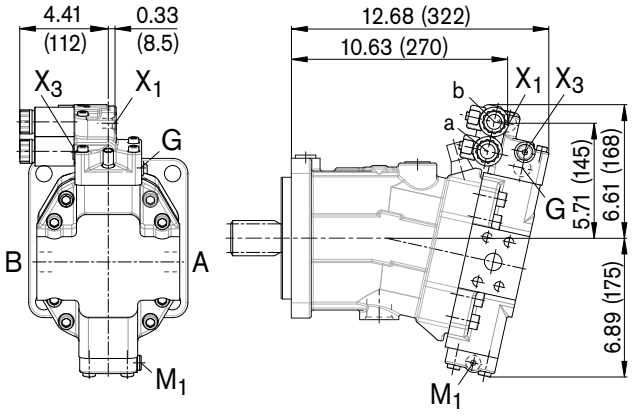

1) Port plate 1 – SAE working ports **A** and **B** at rear

▼ **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!

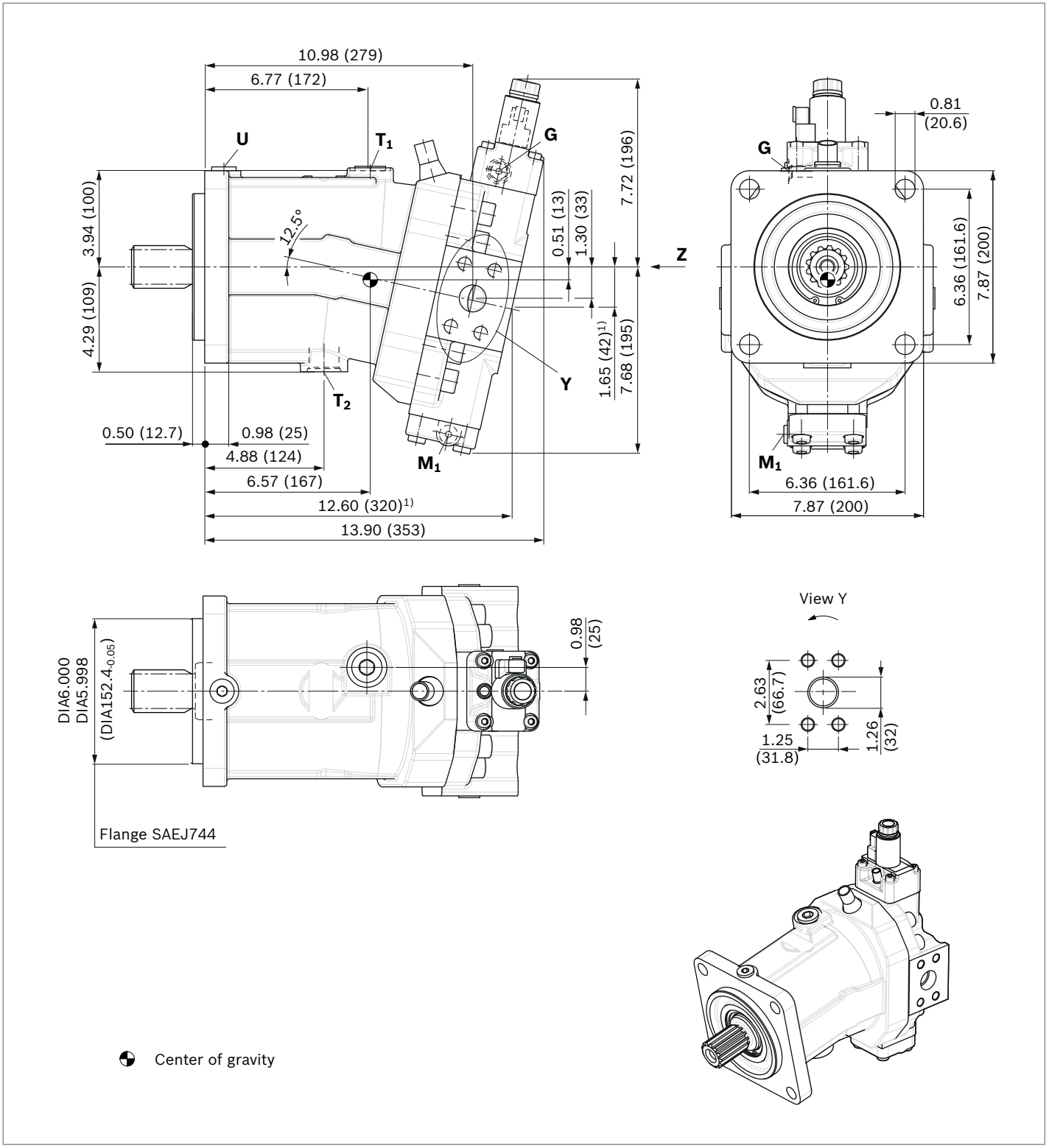
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ switch



## Dimensions size 150

### EP5, EP6 – Proportional electric control, negative control

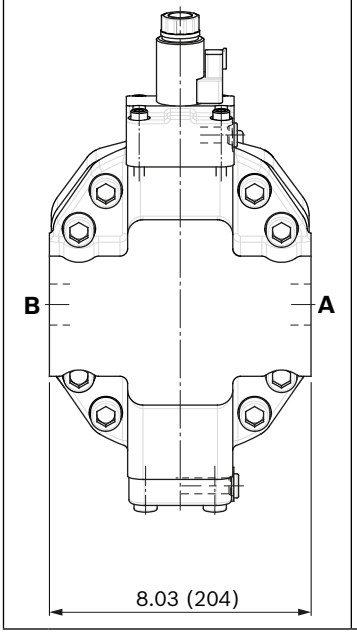
Port plate 2 — SAE working ports **A** and **B** at side, opposite



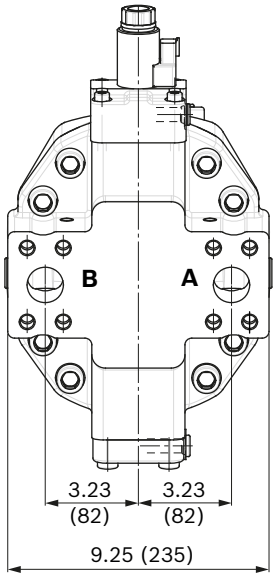

1) Port plate 1 — SAE working ports **A** and **B** at rear

▼ **Location of working ports on port plates** (view **Z**)

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

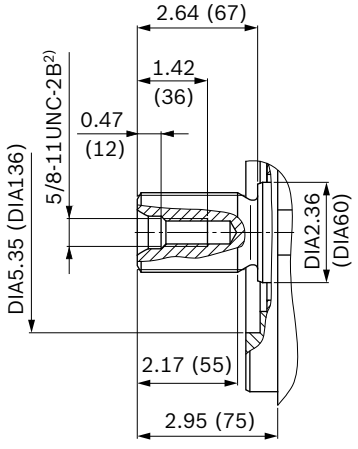



**1** SAE working port **A** and **B** at rear




▼ **Splined shaft SAE J744**

**T1 –** 1 3/4 in 13T 8/16DP[1)]



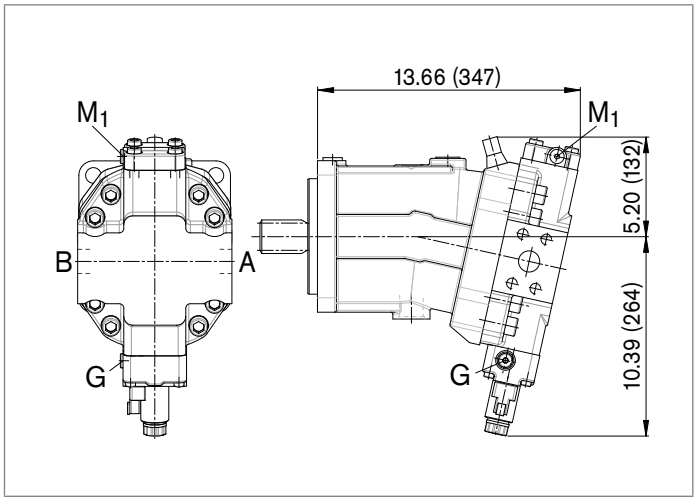

1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

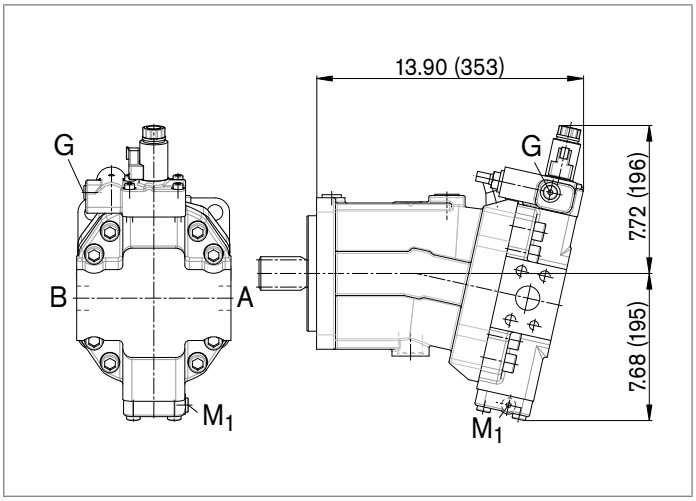
| Ports | | Standard | Size | $p_{max}$ [psi (bar)][1] | Status[6] |
|---|---|---|---|---|---|
| **A, B**[4] | Working port<br>Mounting bolt A/B, screw grade 8 with hardened washer | SAE J518[2]<br>ASME B1.1 | 1 1/4 in<br>1/2 in -13 UNC-2B; 0.75 (19) deep | 7250 psi (500 bar) | O |
| **$T_1$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | X[3] |
| **$T_2$** | Drain port | ISO 11926[5] | 1 5/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | O[3] |
| **G** | Synchronous control | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |
| **U** | Bearing flushing | ISO11926[5] | 7/8 in -14 UNF-2B; 0.67 (17) deep | 45 (3) | X |
| **X** | Pilot signal (HP, HZ, HA1T/HA2T) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 1450 (100) | O |
| **X** | Pilot signal (HA1, HA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 45 (3) | X |
| **$X_1$, $X_2$** | Pilot signal (DA0) | ISO 8434-1 | SDSC-L8×M12-F | 580 (40) | O |
| **$X_1$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | O |
| **$X_3$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | X |
| **$M_1$** | Measuring stroking chamber | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |

1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518.
3) Depending on installation position, $T_1$ or $T_2$ must be connected (see also installation instructions on page 72).
4) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

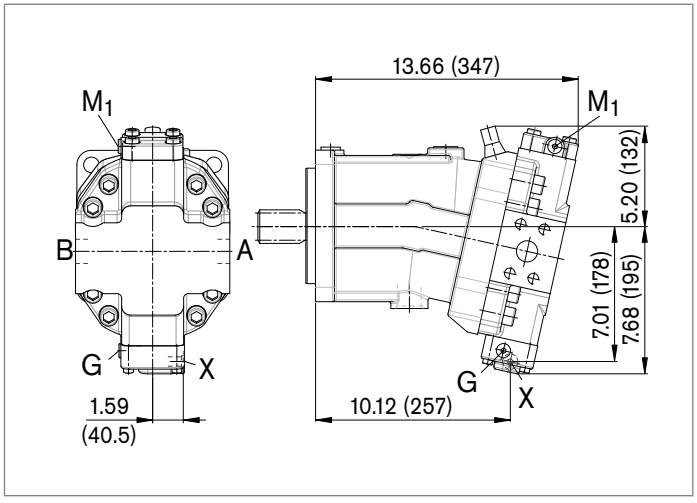
▼ **EP1, EP2** – Electric proportional control, positive control



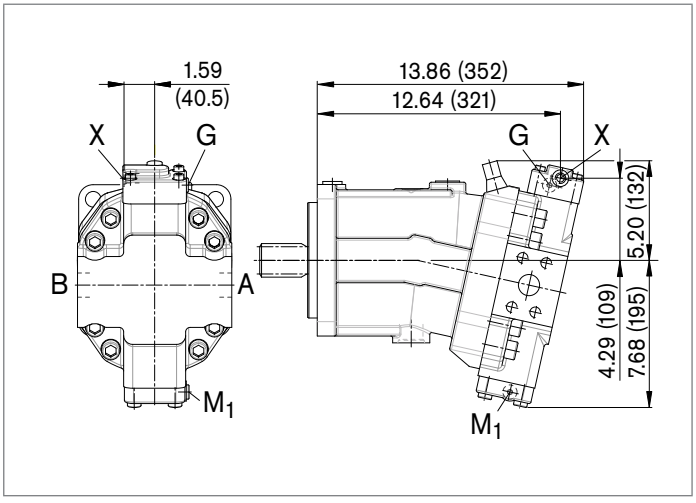

▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



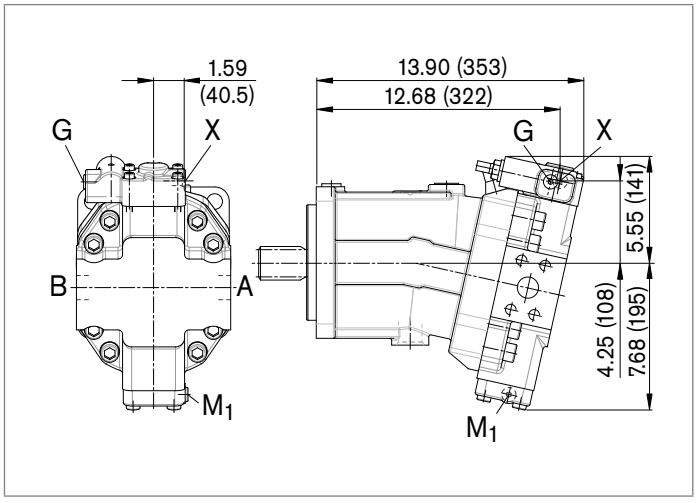

▼ **HP1, HP2** – Hydraulic proportional control, positive control



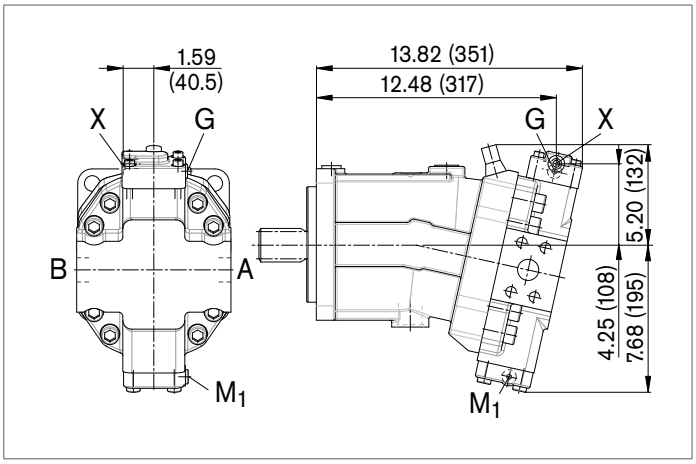

▼ **HP5, HP6** – Hydraulic proportional control, negative control



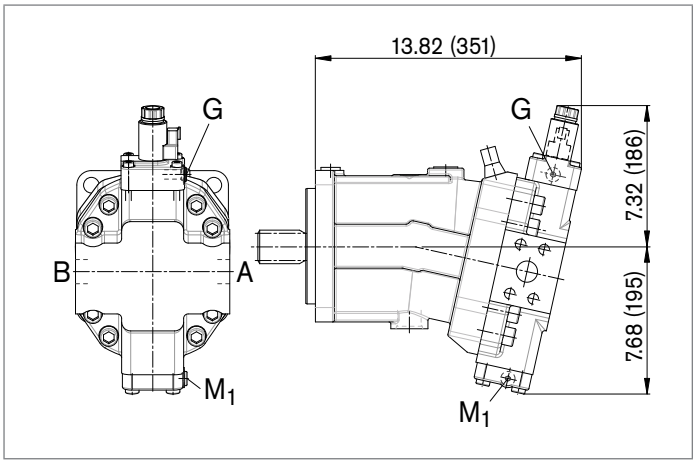

▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



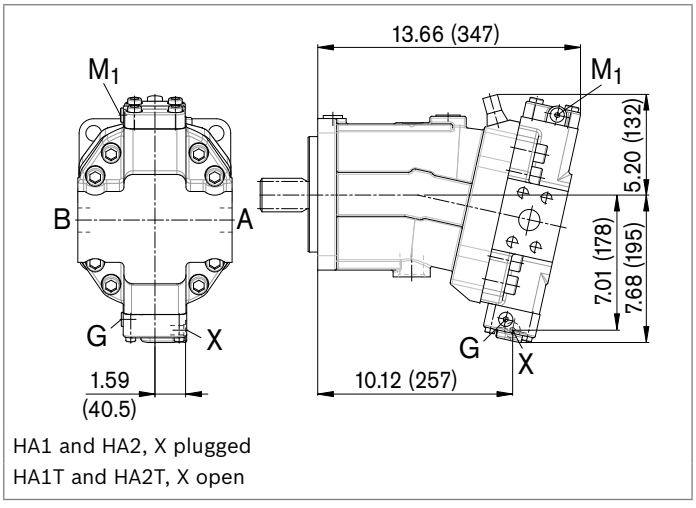
▼ **HZ5** – Hydraulic two-point control, negative control




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

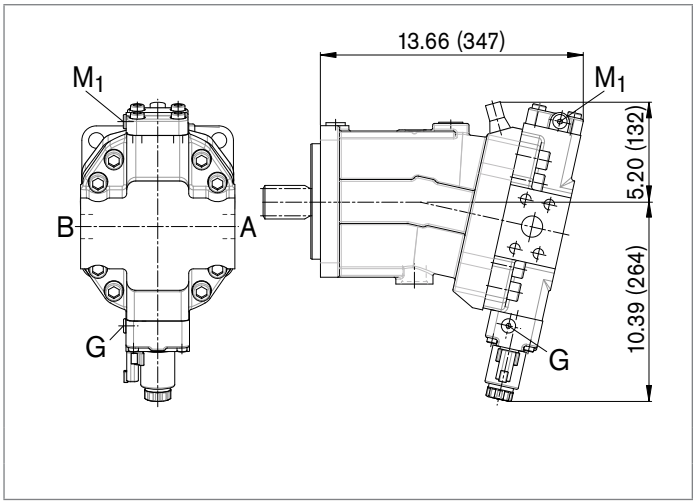



▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

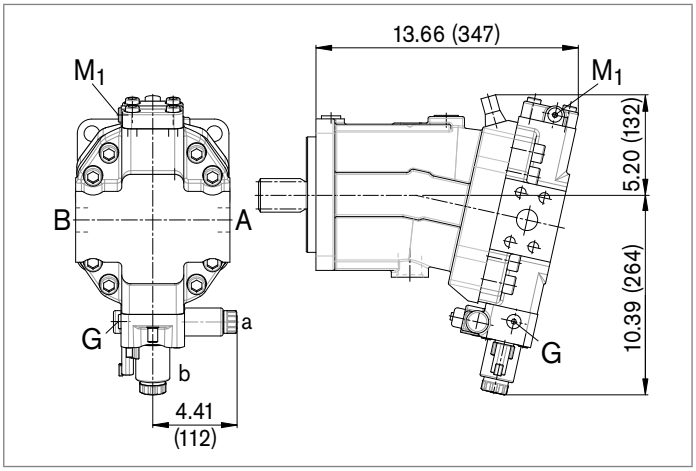



HA1 and HA2, X plugged
HA1T and HA2T, X open

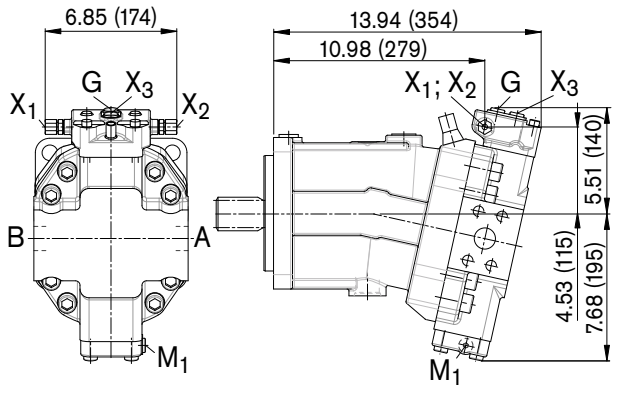
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point




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

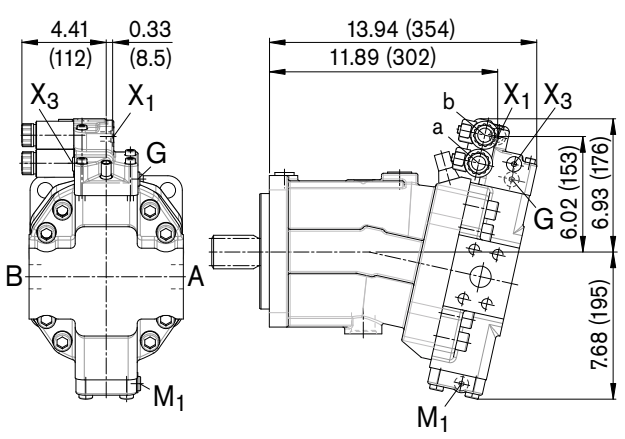


▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve




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

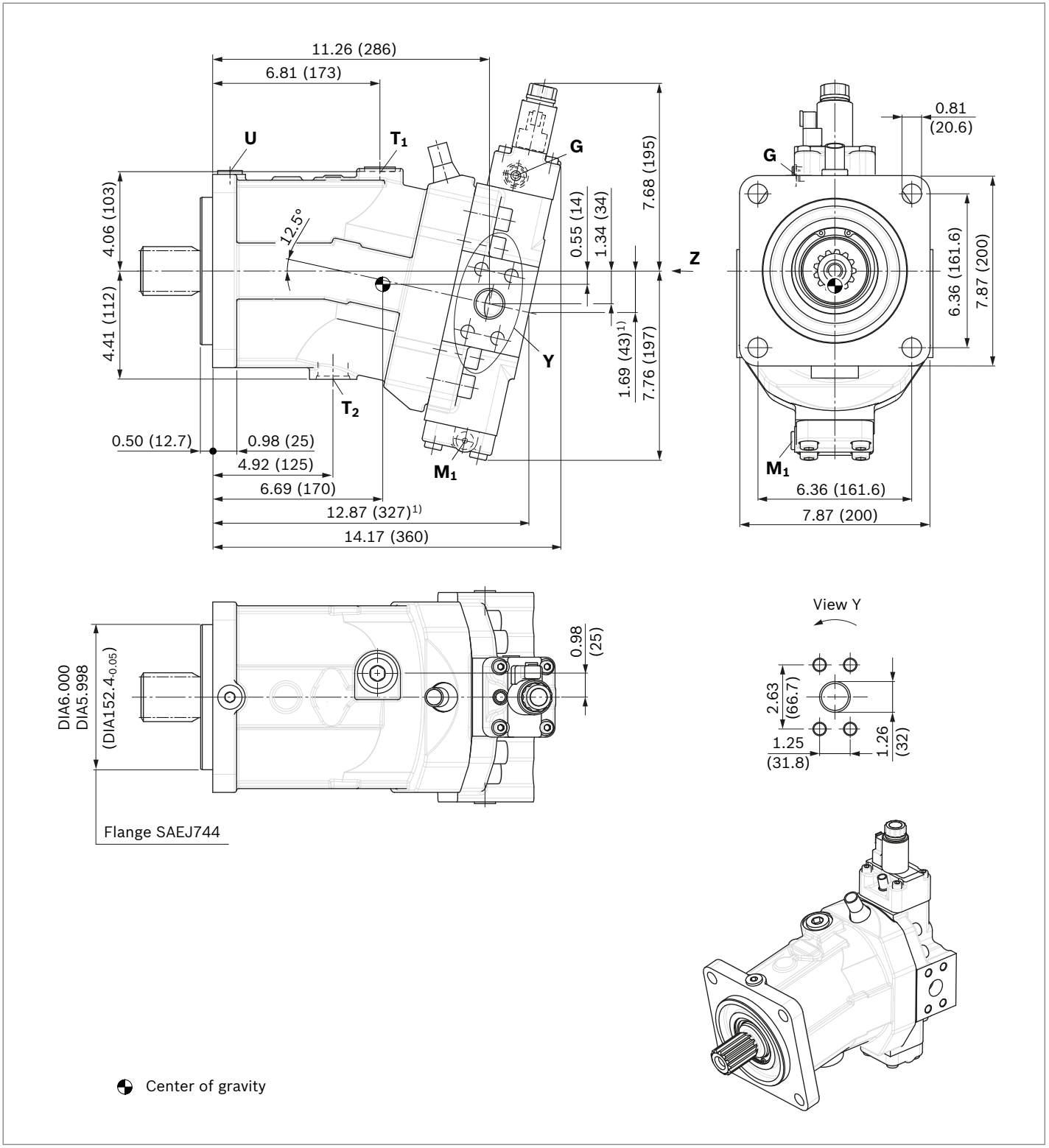
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ switch



## Dimensions size 170

### EP5, EP6 – Proportional electric control, negative control

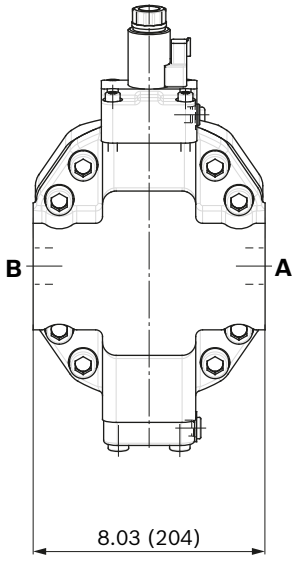
Port plate 2 — SAE working ports **A** and **B** at side, opposite



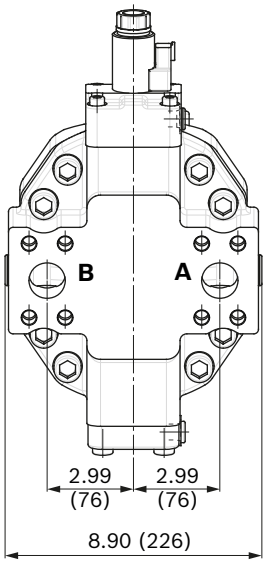

1) Port plate 1 — SAE working ports **A** and **B** at rear

▼ **Location of working ports on port plates** (view **Z**)

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

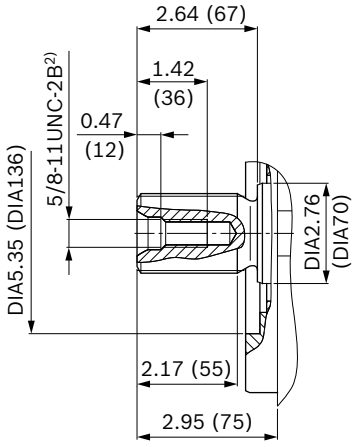



**1** SAE working port **A** and **B** at rear




▼ **Splined shaft SAE J744**

**T2 –** 2 in 15T 8/16DP[1)]

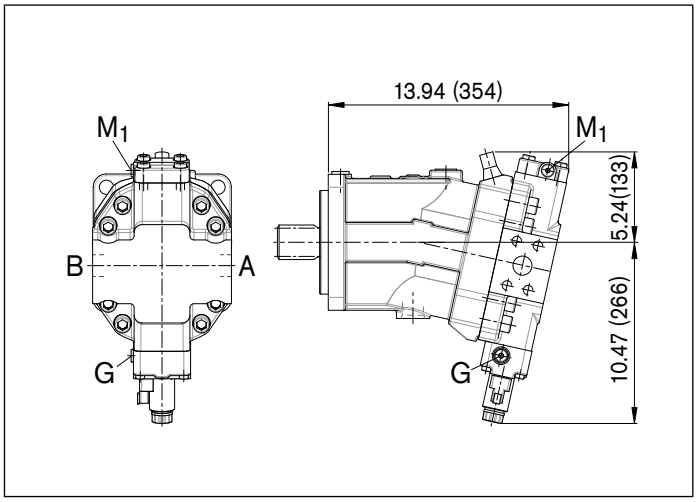



1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1

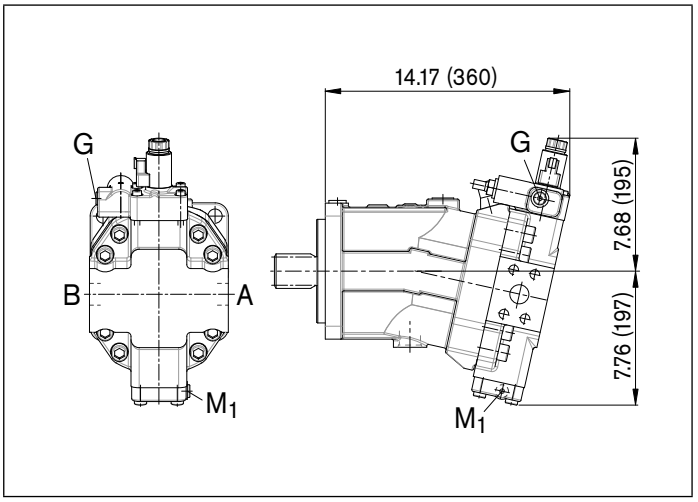
| Ports | | Standard | Size | $p_{max}$ [psi (bar)][1] | Status[6] |
|---|---|---|---|---|---|
| **A, B**[4] | Working port<br>Mounting bolt A/B, screw grade 8 with hardened washer | SAE J518[2]<br>ASME B1.1 | 1 1/4 in<br>1/2 in -13 UNC-2B; 0.75 (19) deep | 7250 psi (500 bar) | O |
| **$T_1$** | Drain port | ISO 11926[5] | 1 1/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | X[3] |
| **$T_2$** | Drain port | ISO 11926[5] | 1 5/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | O[3] |
| **G** | Synchronous control | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |
| **U** | Bearing flushing | ISO11926[5] | 7/8 in -14 UNF-2B; 0.67 (17) deep | 45 (3) | X |
| **X** | Pilot signal (HP, HZ, HA1T/HA2T) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 1450 (100) | O |
| **X** | Pilot signal (HA1, HA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 45 (3) | X |
| **$X_1$, $X_2$** | Pilot signal (DA0) | ISO 8434-1 | SDSC-L8×M12-F | 580 (40) | O |
| **$X_1$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | O |
| **$X_3$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | X |
| **$M_1$** | Measuring stroking chamber | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |

1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518.
3) Depending on installation position, $T_1$ or $T_2$ must be connected (see also installation instructions on page 72).
4) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

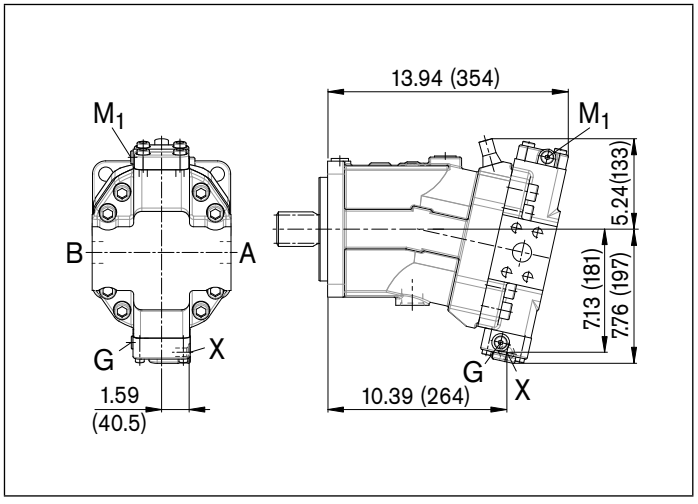
▼ **EP1, EP2** – Electric proportional control, positive control



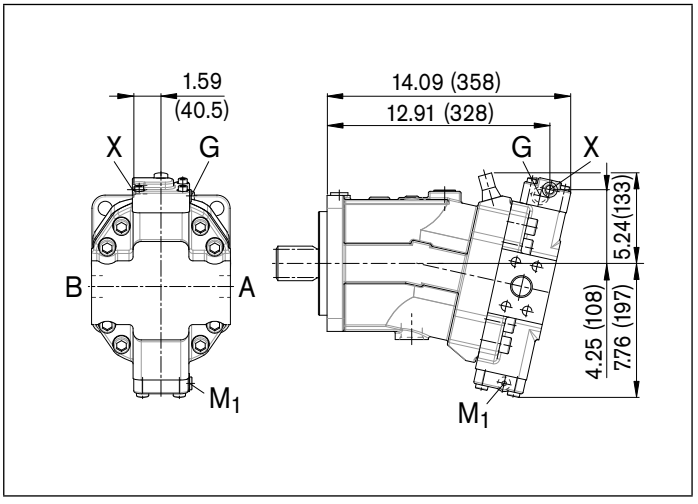

▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



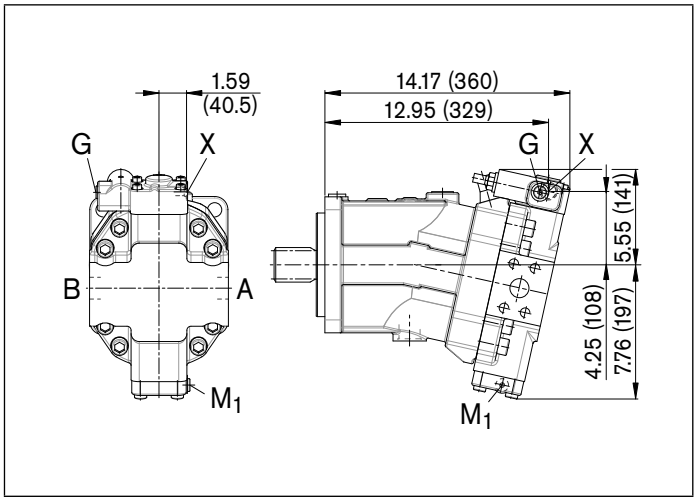

▼ **HP1, HP2** – Hydraulic proportional control, positive control



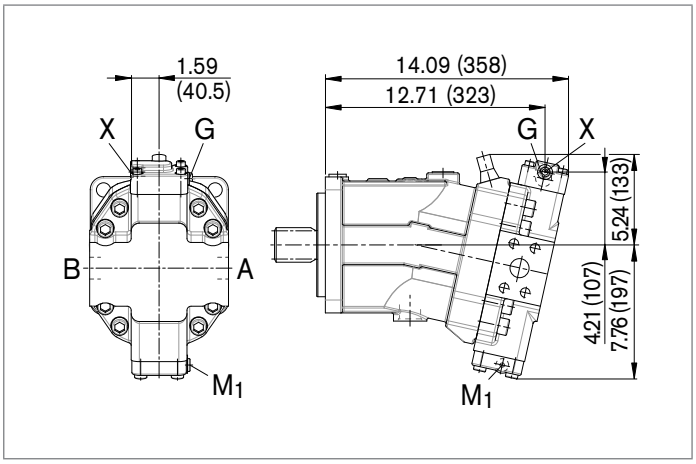

▼ **HP5, HP6** – Hydraulic proportional control, negative control



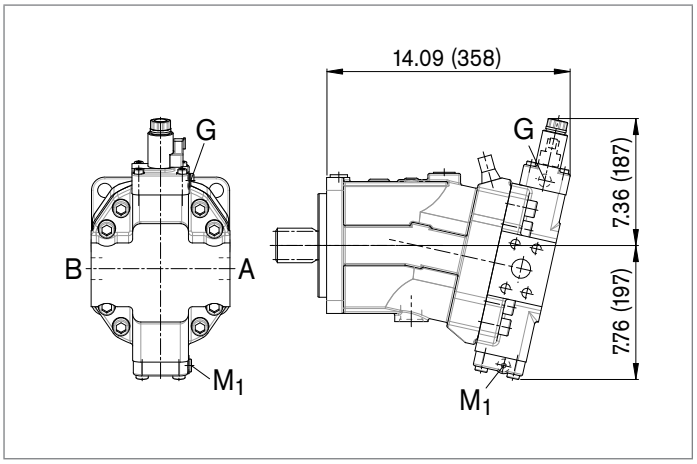

▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



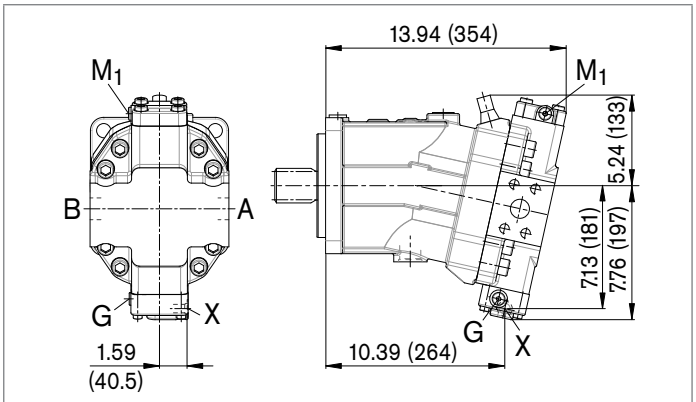
▼ **HZ5** – Hydraulic two-point control, negative control




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



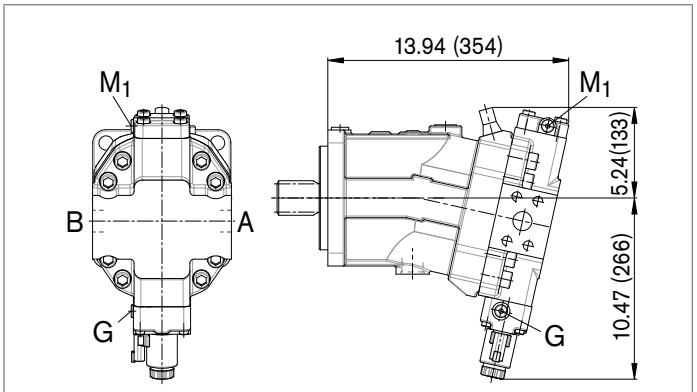

▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



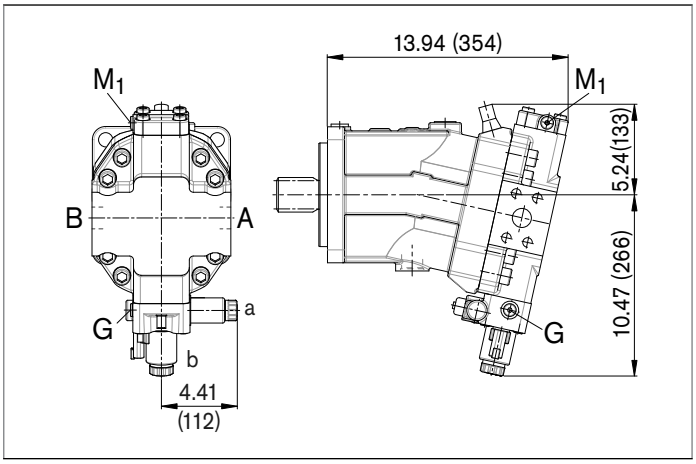

HA1 and HA2, X plugged

HA1T and HA2T, X open

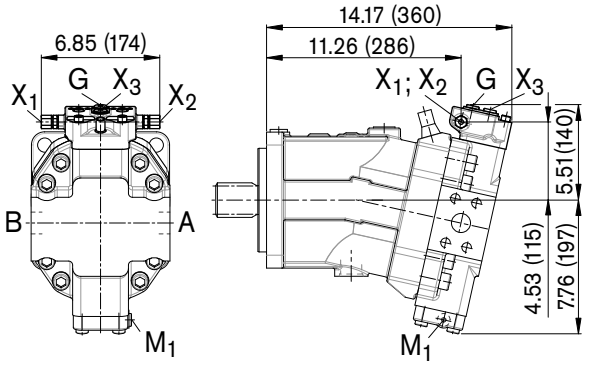
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point




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



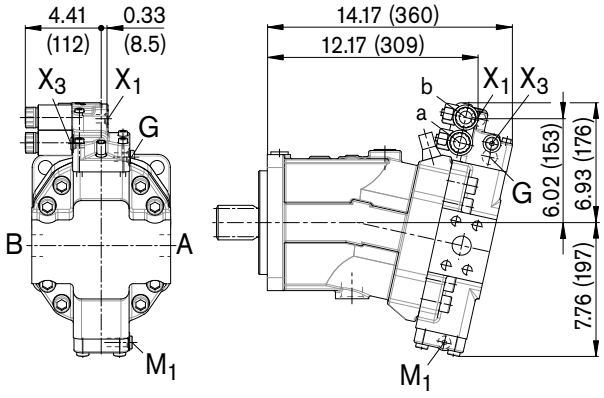
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve




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

Use assembled fitting!

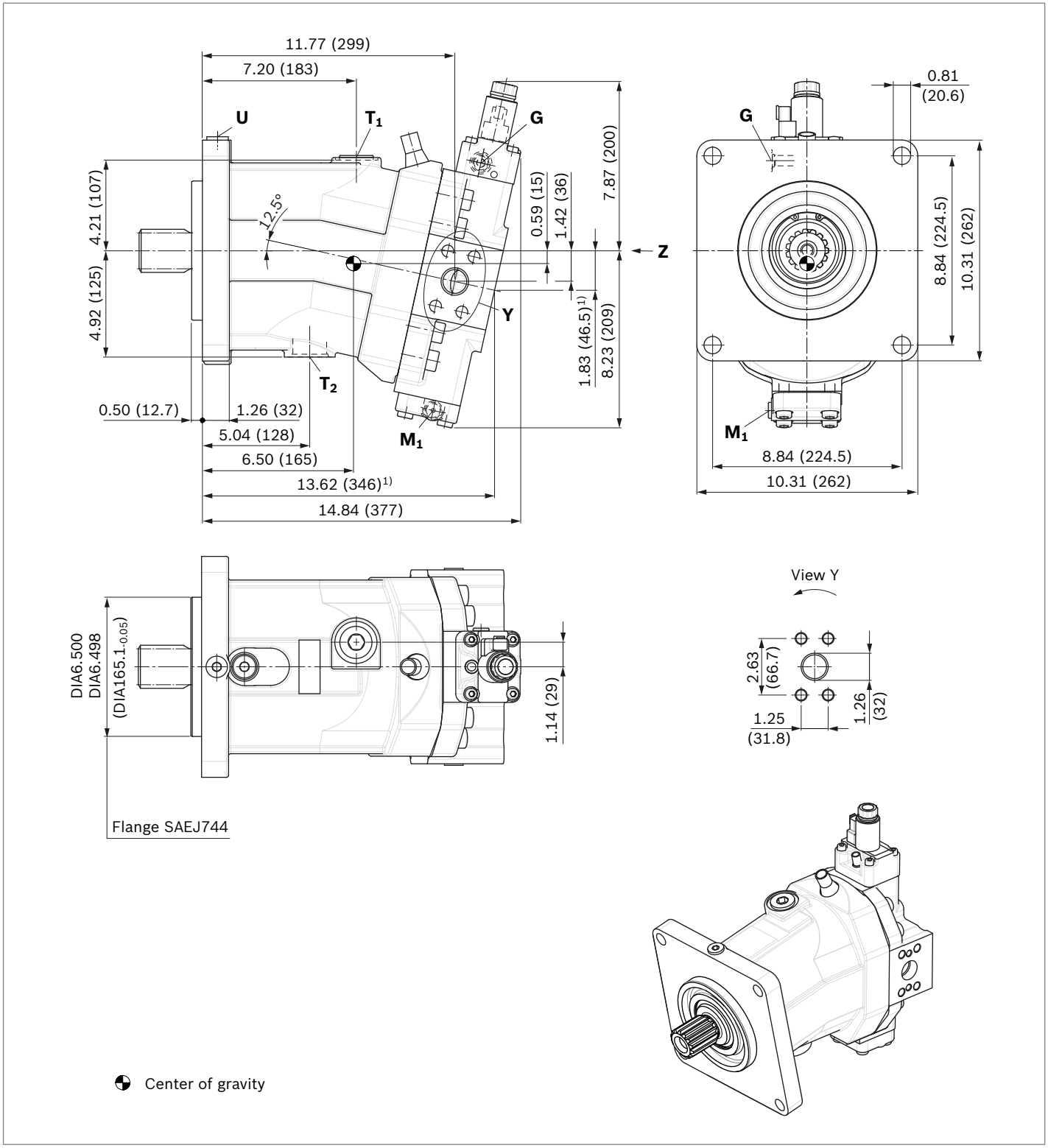
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ switch



## Dimensions size 215

### EP5, EP6 – Proportional electric control, negative control

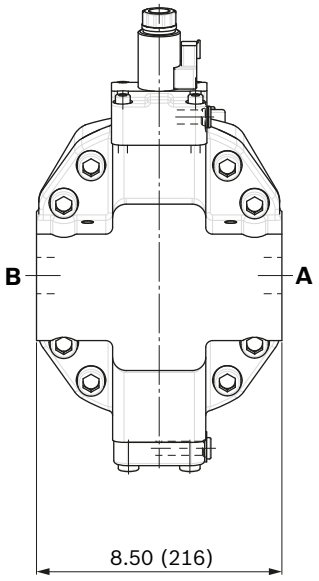
Port plate 2 — SAE working ports **A** and **B** at side, opposite



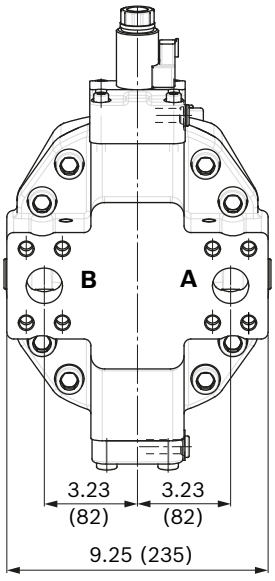

1) Port plate 1 — SAE working ports **A** and **B** at rear

**Location of working ports on port plates** (view **Z**)

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

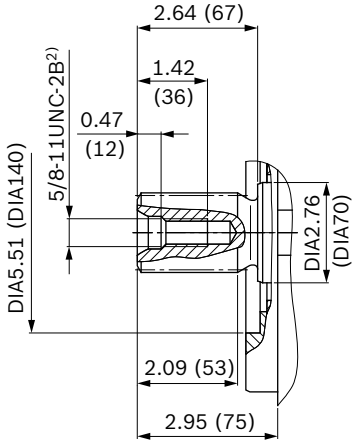



**1** SAE working port **A** and **B** at rear




▼ **Splined shaft SAE J744**

**T2 –** 2 in 15T 8/16DP[1)]



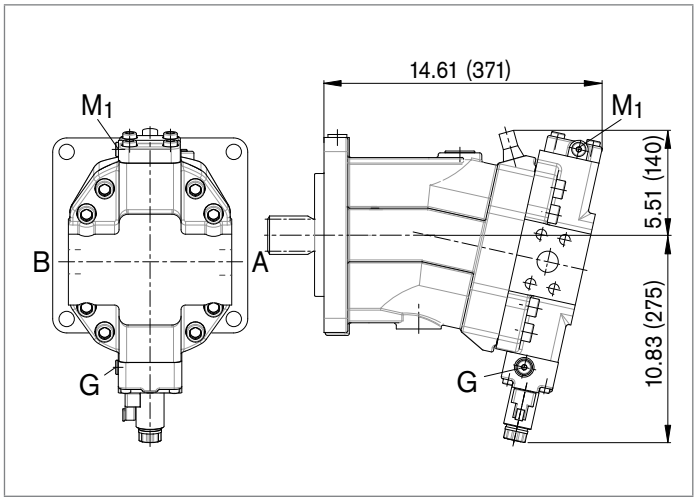

1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

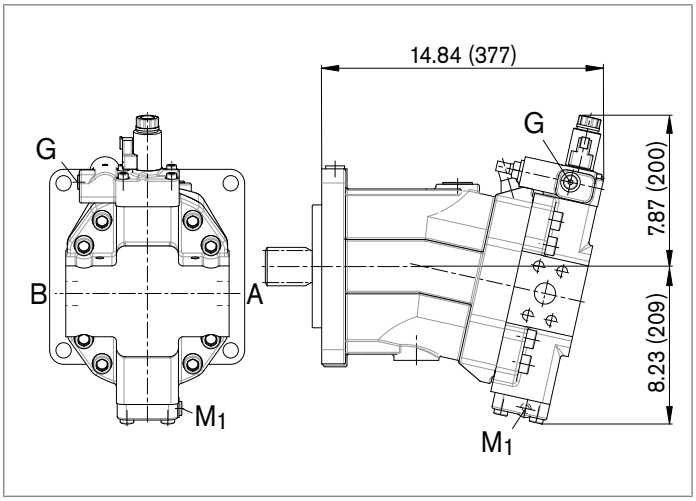
| Ports | | Standard | Size | $p_{max}$ [psi (bar)][1] | Status[6] |
|---|---|---|---|---|---|
| **A, B**[4] | Working port<br>Mounting bolt A/B, screw grade 8 with hardened washer | SAE J518[2]<br>ASME B1.1 | 1 1/4 in<br>1/2 in -13 UNC-2B; 0.75 (19) deep | 7250 psi (500 bar) | O |
| **$T_1$** | Drain port | ISO 11926[5] | 1 5/16 in -12 UN-2B; 0.79 (20) deep | 45 (3) | X[3] |
| **$T_2$** | Drain port | ISO 11926[5] | 1 5/8 in -12 UN-2B; 0.79 (20) deep | 45 (3) | O[3] |
| **G** | Synchronous control | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |
| **U** | Bearing flushing | ISO11926[5] | 7/8 in -14 UNF-2B; 0.67 (17) deep | 45 (3) | X |
| **X** | Pilot signal (HP, HZ, HA1T/HA2T) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 1450 (100) | O |
| **X** | Pilot signal (HA1, HA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 45 (3) | X |
| **$X_1$, $X_2$** | Pilot signal (DA0) | ISO 8434-1 | SDSC-L8×M12-F | 580 (40) | O |
| **$X_1$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | O |
| **$X_3$** | Pilot signal (DA1, DA2) | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 580 (40) | X |
| **$M_1$** | Measuring stroking chamber | ISO 11926[5] | 9/16 in -18 UNF-2B; 0.51 (13) deep | 7250 psi (500 bar) | X |

1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518.
3) Depending on installation position, $T_1$ or $T_2$ must be connected (see also installation instructions on page 72).
4) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

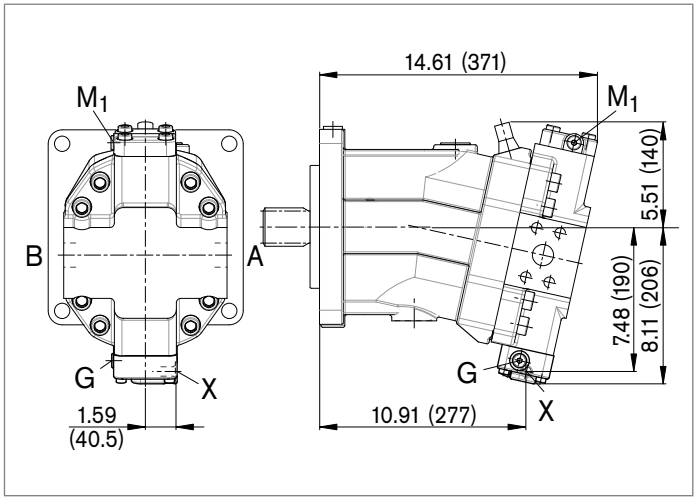
▼ **EP1, EP2** – Electric proportional control, positive control



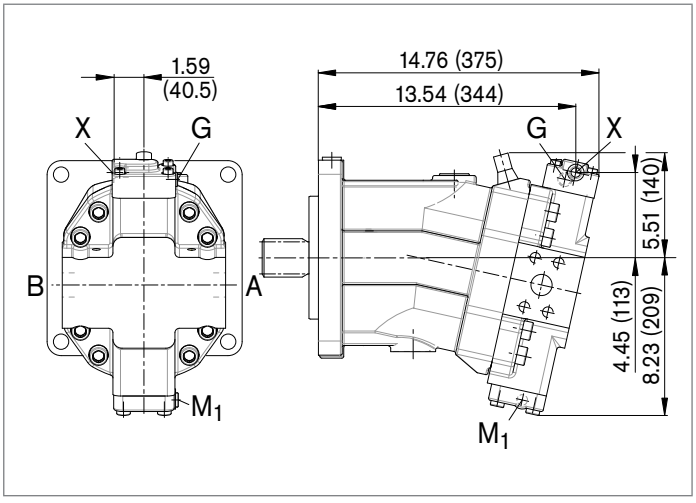

▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



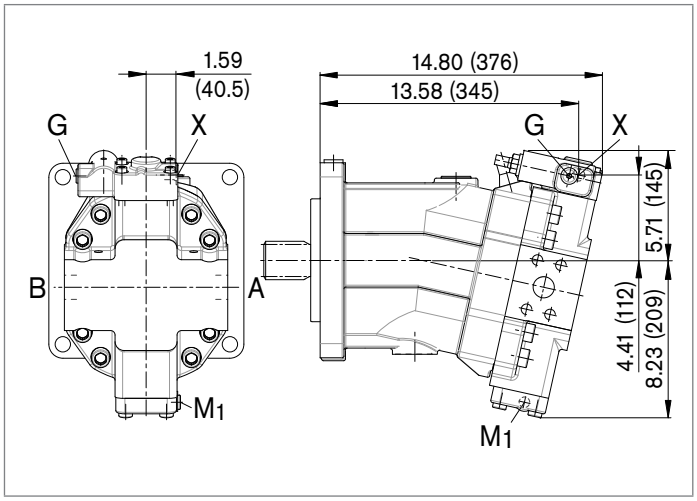

▼ **HP1, HP2** – Hydraulic proportional control, positive control



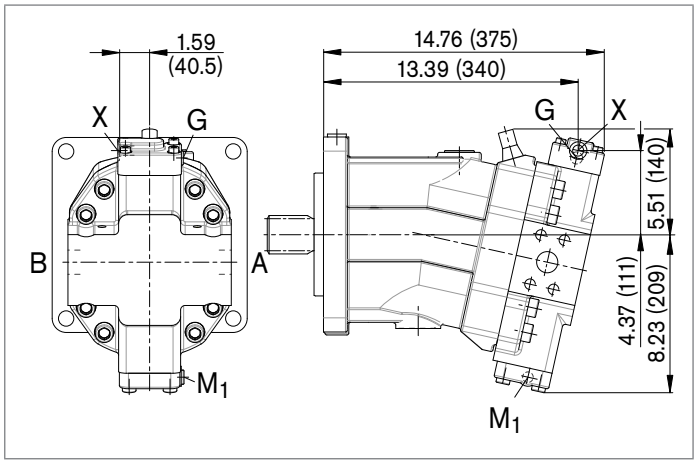

▼ **HP5, HP6** – Hydraulic proportional control, negative control



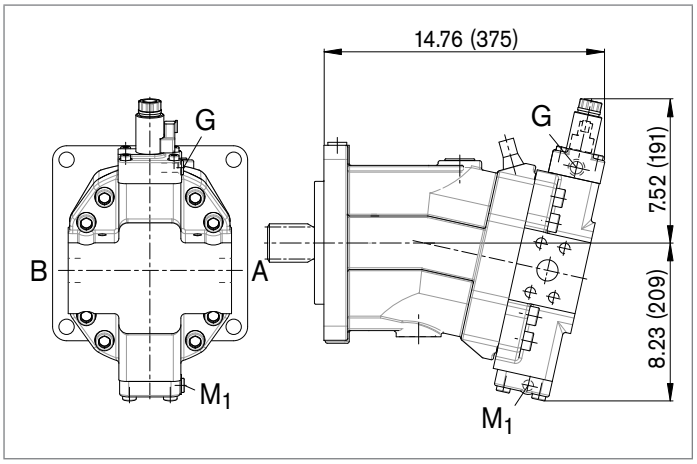

▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



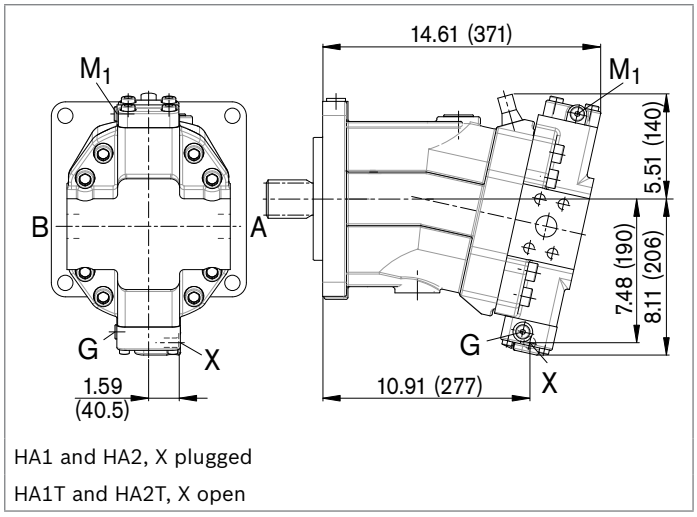
▼ **HZ5** – Hydraulic two-point control, negative control




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



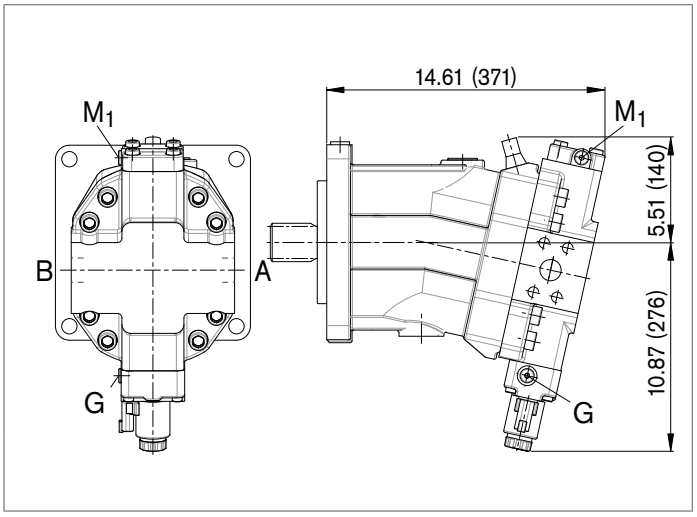

▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



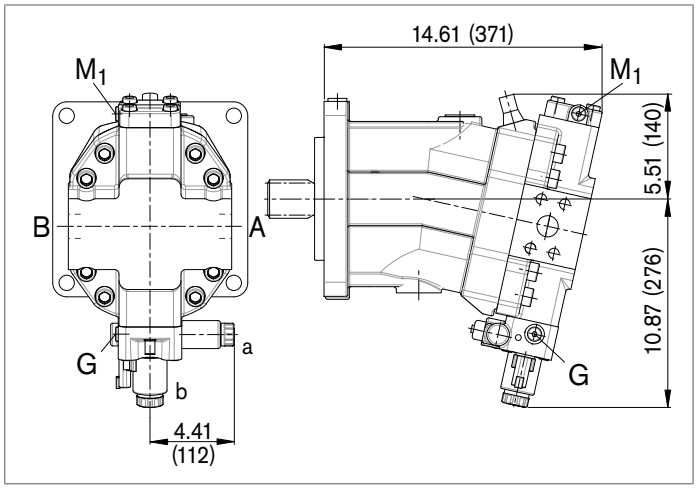

HA1 and HA2, X plugged

HA1T and HA2T, X open

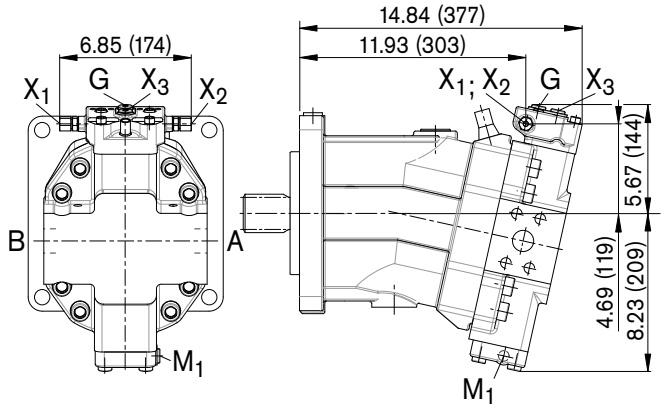
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point




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



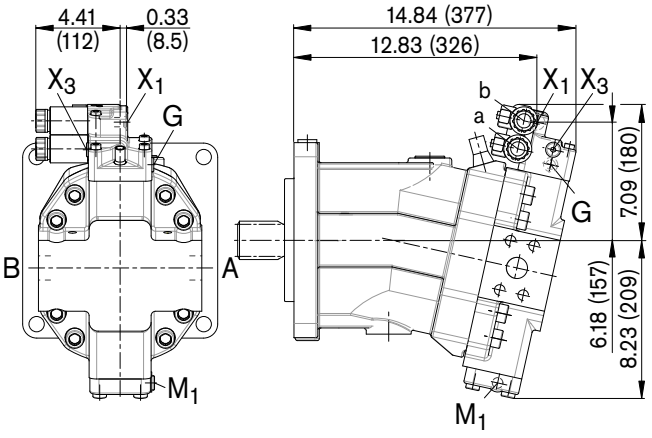
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve




**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 $V_{g\,max}$ switch



## Connector for solenoids

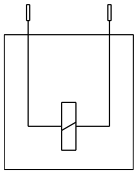
**DEUTSCH DT04-2P-EP04**

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).

**Note**

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

## 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 230 psi (16 bar)

**Switching pressure of flushing spool $\Delta p$**

- Sizes 60 to 215 (small flushing valve) 115±15 psi (8±1 bar)
- Sizes 115 to 215 (medium and large flushing valve) 254±22.5 psi (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:
$\Delta p_{ND} = p_{ND} - p_G$ = 365 psi (25 bar) and $\nu$ = 60 SUS (10 mm²/s)
($p_{ND}$ = low pressure, $p_G$ = case pressure)

**Small flushing valve for sizes 60 to 115**

| Material number of orifice | DIA [inch] (ø [mm]) | $q_v$ [gpm (l/min)] | Code |
|---|---|---|---|
| R909651766 | 0.047 (1.2) | 0.9 (3.5) | A |
| R909419695 | 0.055 (1.4) | 1.3 (5) | B |
| R909419696 | 0.071 (1.8) | 2.1 (8) | C |
| R909419697 | 0.079 (2.0) | 2.6 (10) | D |
| R909444361 | 0.094 (2.4) | 3.7 (14) | F |

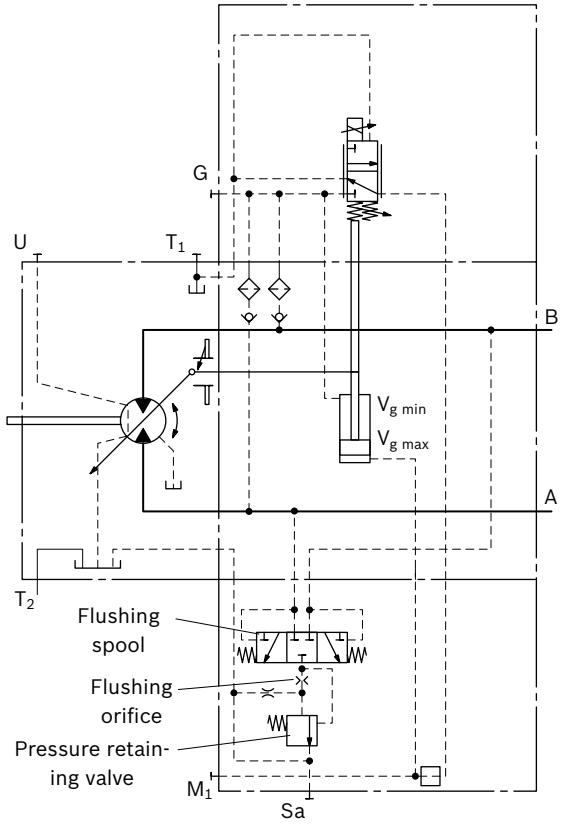
**Medium flushing valve for size 115**

| Material number of orifice | DIA [inch] (ø [mm]) | $q_v$ [gpm (l/min)] | Code |
|---|---|---|---|
| R909449997 | 0.055 (1.4) | 1.3 (5) | B |
| R909449998 | 0.071 (1.8) | 2.1 (8) | C |
| R909431308 | 0.079 (2.0) | 2.6 (10) | D |
| R909431309 | 0.10 (2.5) | 3.9 (15) | G |
| R909431310 | 0.11 (2.8) | 4.8 (18) | I |
| R902138235 | 0.12 (3.1) | 5.5 (21) | J |
| R909435172 | 0.14 (3.5) | 7.1 (27) | K |
| R909436622 | 0.16 (4.0) | 8.2 (31) | L |

**Large flushing valve for sizes 150 to 215**

| Material number of orifice | DIA [inch] (ø [mm]) | $q_v$ [gpm (l/min)] | Code |
|---|---|---|---|
| R909449997 | 0.055 (1.4) | 1.3 (5) | B |
| R909449998 | 0.071 (1.8) | 2.1 (8) | C |
| R909431308 | 0.079 (2.0) | 2.6 (10) | D |
| R909431309 | 0.10 (2.5) | 3.9 (15) | G |
| R909431310 | 0.11 (2.8) | 4.8 (18) | I |
| R902138235 | 0.12 (3.1) | 5.5 (21) | J |
| R909435172 | 0.14 (3.5) | 7.1 (27) | K |
| R909436622 | 0.16 (4.0) | 8.2 (31) | L |
| R909449967 | 0.20 (5.0) | 9.7 (37) | M |

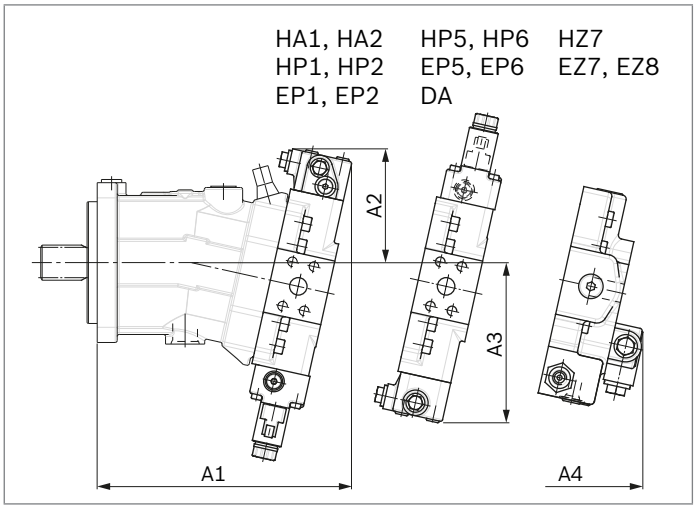
▼ **Circuit diagram EP**




**Information**

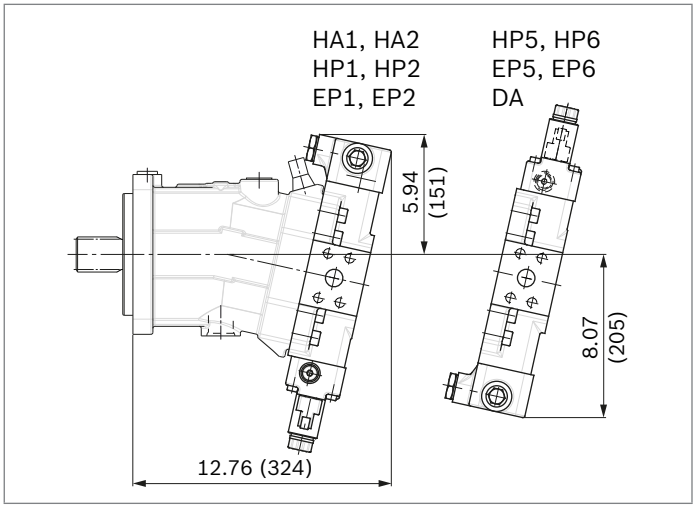
- Port **$S_a$** only for sizes 150 to 215
- For a flushing flow greater than 9.2 gpm (35 l /min), it is recommended that port **$S_a$** be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

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

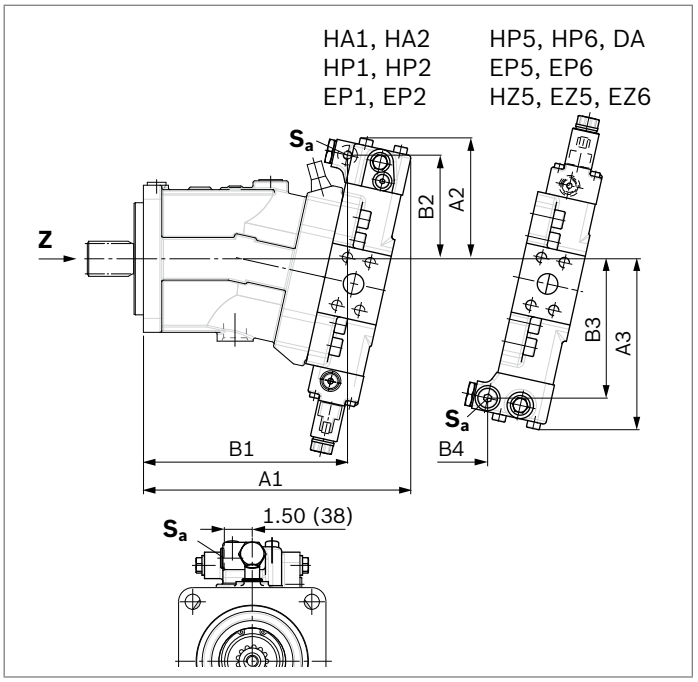



| NG | A1 | A2 | A3 | A4 |
|---|---|---|---|---|
| 60 | 10.51 | 5.39 | 6.93 | 10.24 |
| | (267) | (137) | (176) | (260) |
| 85 | 11.69 | 5.59 | 7.64 | 10.94 |
| | (297) | (142) | (194) | (278) |
| 115 | 12.56 | 5.63 | 7.95 | 11.85 |
| | (319) | (143) | (202) | (301) |

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




▼ **Dimensions for sizes 150 to 215 (large flushing valve)**




| NG | A1 | B1 | A2 | B2 | A3 | B3 | B4 |
|---|---|---|---|---|---|---|---|
| 150 | 14.06 | 10.67 | 6.50 | 5.59 | 9.06 | 7.36 | 7.80 |
| | (357) | (271) | (165) | (142) | (230) | (187) | (198) |
| 170 | 14.33 | 10.94 | 6.50 | 5.59 | 9.17 | 7.48 | 8.03 |
| | (364) | (278) | (165) | (142) | (233) | (190) | (204) |
| 215 | 15.00 | 11.61 | 6.77 | 5.83 | 9.61 | 7.91 | 8.54 |
| | (381) | (295) | (172) | (148) | (244) | (201) | (217) |

| NG | $S_a$ [1)] |
|---|---|
| 150 | 7/8-14UNF-2B; 0.67 (17) deep |
| 170 | |
| 215 | |

1) ISO 11926, ports plugged (in normal operation)
The spot face can be deeper than as specified in the standard.

## Counterbalance valve BVD and BVE

### Function

Counterbalance valves for drives and winches should reduce the danger of overspeed and cavitation in open circuits of axial piston motors. Cavitation occurs if, during braking, when going downhill or during the load-lowering process, the motor speed is greater than it should be for the given inlet flow and thus the inlet pressure collapses. If the inlet 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 then reduced, creating a restriction in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the speed of the motor reaches the specified value for the given inlet flow.

### Note

- BVD available for sizes 60 to 215 and BVE available for sizes 115 to 215.
- The BVD counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set.
  Order example:A6VM085HA1T30004A/71AWV0C2 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 parking brake.
- Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525.
- 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 brake spool between minimum stroke (brake closed) and maximum stroke (brake released with 305 psi (21 bar))
  - the required closing time for a warm device (oil viscosity approx. 69.6 SUS (15 mm²/s))

**Permissible input 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 | $p_{nom}/p_{max}$ [psi (bar)] | $q_{V\ max}$ [gpm (l/min)] | NG | $p_{nom}/p_{max}$ [psi (bar)] | $q_V$ [gpm (l/min)] | Code | NG | $p_{nom}/p_{max}$ [psi (bar)] | $q_V$ [gpm (l/min)] | Code |
| 60 | 6500 /7250 (450/500) | 73 (276) | 22 | 5100/6100 (350/420) | 63 (240) | 7 | 20 (BVD) | 5100/6100 (350/420) | 58 (220) | 7W |
| 85 | | 88 (332) | | | | | | | | |
| 115 | | 108 (410) | 32 | | 106 (400) | | | | | |
| 115 | | 108 (410) | | | | 8 | 25 (BVD/BVE) | | 85 (320) | 8W |
| 150 | | 131 (494) | | | | | | | | |
| 170 | | 141 (533) | | | | | | | | |
| 215 | | 166 (628) | On request | | | | | | | |

### Mounting of the counterbalance valve

When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport lock). The tacking screws may not be removed while mounting the working ports. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The final mounting of the counterbalance valve on the motor is done with screw fitting of the SAE flange.
The screws to be used and the procedure mountings can be found in the instruction manual.

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

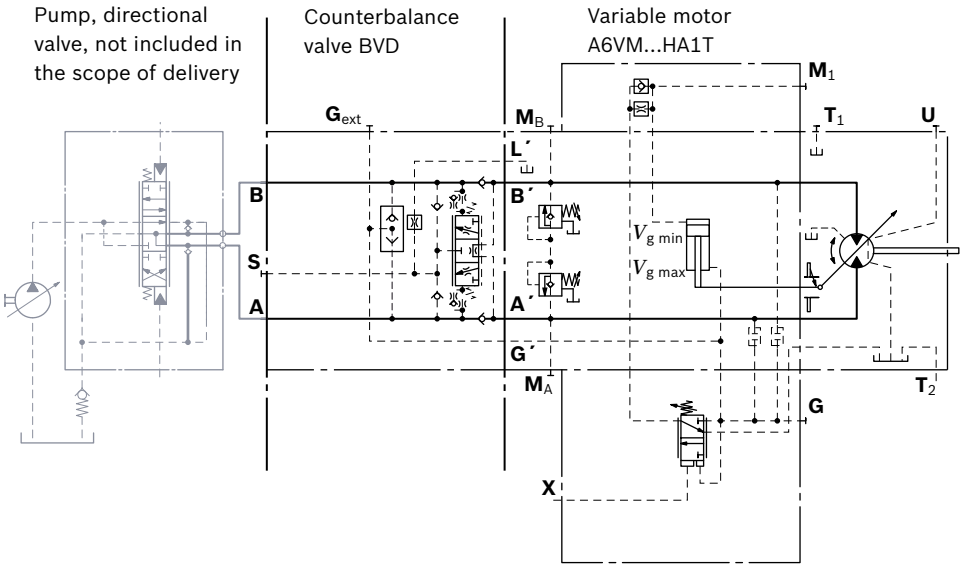
### Counterbalance valve for travel drive BVD...F

Application option

- Travel drive for wheeled excavators (BVD and BVE)

▼ **Example schematic for travel drive on wheeled excavators**

A6VM085HA1T30004A/71AWV0C2S97W0-0 + BVD20F27S/41B–V03K16D0400S12



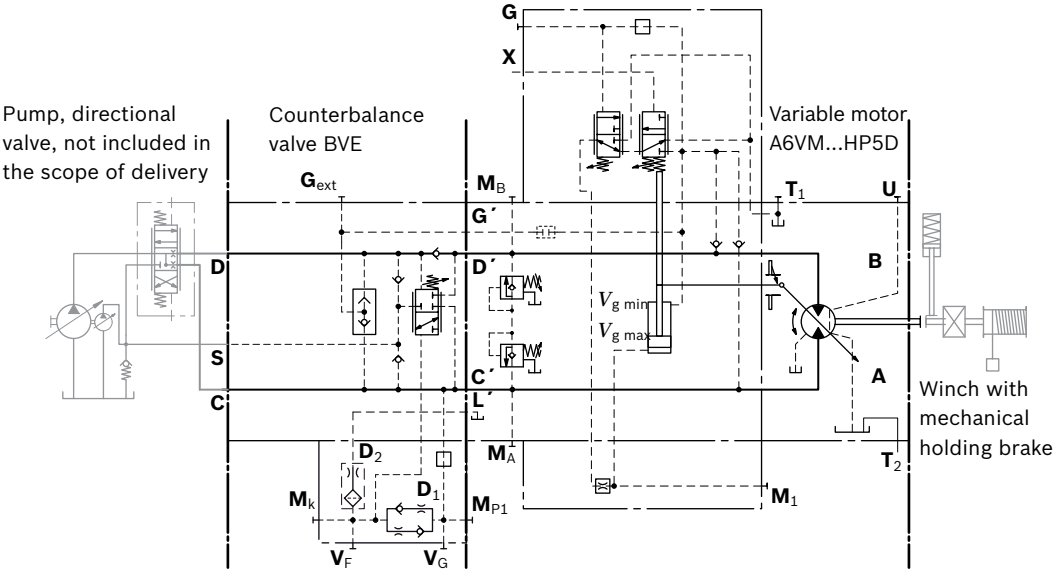

### Counterbalance valve for winches and track drives BVD...W and BVE

Application option

- Winch drives in cranes (BVD and BVE)
- Track drive in crawler excavators (BVD)

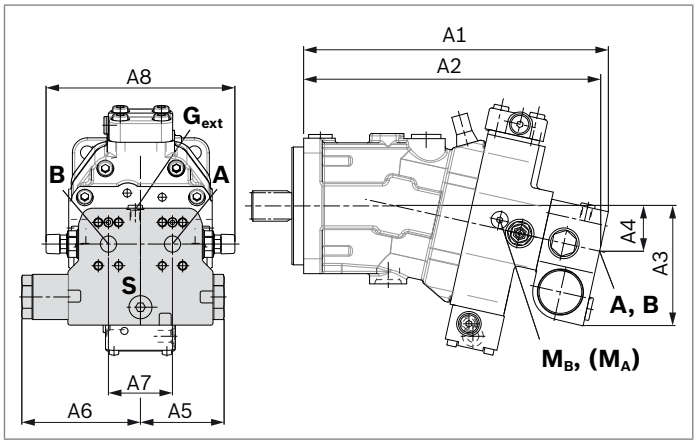
▼ **Example schematic for winch drive in cranes**

A6VM085HP5D10001A/71AWV0C2S97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0

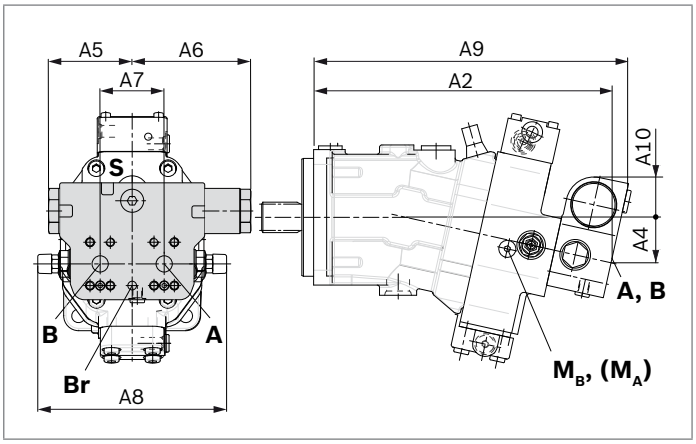


## Dimensions

▼ **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 | 13.19 (335) | 12.83 (326) | 5.63 (143) | 1.97 (50) | 3.86 (98) | 5.47 (139) | 2.95 (75) | 8.74 (222) | 13.78 (350) | 1.97 (50) |
| 85...7 | BVD20...27 | 1 in | 14.33 (364) | 13.98 (355) | 5.83 (148) | 2.17 (55) | 3.86 (98) | 5.47 (139) | 2.95 (75) | 8.74 (222) | 14.92 (379) | 1.81 (46) |
| 115...7 | BVD20...28 | 1 in | 15.51 (394) | 15.16 (385) | 5.98 (152) | 2.32 (59) | 3.86 (98) | 5.47 (139) | 3.31 (84) | 9.21 (234) | 16.10 (409) | 1.61 (41) |
| 115...8 | BVD25...38 | 1 1/4 in | 16.22 (412) | 15.83 (402) | 6.50 (165) | 2.48 (63) | 4.74 (120.5) | 6.89 (175) | 3.31 (84) | 9.37 (238) | 16.81 (427) | 2.20 (56) |
| 150...8 | BVD25...38 | 1 1/4 in | 17.44 (443) | 17.01 (433) | 6.61 (168) | 2.64 (67) | 4.74 (120.5) | 6.89 (175) | 3.31 (84) | 9.37 (238) | 18.03 (458) | 2.09 (53) |
| 170...8 | BVD25...38 | 1 1/4 in | 17.68 (449) | 17.28 (439) | 6.69 (170) | 2.68 (68) | 4.74 (120.5) | 6.89 (175) | 3.31 (84) | 9.37 (238) | 18.27 (464) | 2.01 (51) |
| 215...8 | BVD25...38 | 1 1/4 in | 18.90 (480) | 18.50 (470) | 6.93 (176) | 2.91 (74) | 4.74 (120.5) | 6.89 (175) | 3.31 (84) | 11.77 (299) | 19.49 (495) | 1.81 (46) |
| 115...8 | BVE25...38 | 1 1/4 in | 16.22 (412) | 15.83 (402) | 6.73 (171) | 2.48 (63) | 5.39 (137) | 8.43 (214) | 3.31 (84) | 9.37 (238) | 16.89 (429) | 2.48 (63) |
| 150...8 | BVE25...38 | 1 1/4 in | 17.44 (443) | 17.01 (433) | 6.89 (175) | 2.64 (67) | 5.39 (137) | 8.43 (214) | 3.31 (84) | 9.37 (238) | 17.91 (455) | 2.32 (59) |
| 170...8 | BVE25...38 | 1 1/4 in | 17.68 (449) | 17.28 (439) | 6.93 (176) | 2.68 (68) | 5.39 (137) | 8.43 (214) | 3.31 (84) | 9.37 (238) | 18.27 (464) | 2.32 (59) |
| 215...8 | BVE25...38 | 1 1/4 in | 18.90 (480) | 18.50 (470) | 7.17 (182) | 2.91 (74) | 5.39 (137) | 8.43 (214) | 3.31 (84) | 11.77 (299) | 19.49 (495) | 2.05 (52) |

| Ports | | Version | A6VM plate | Standard | Size | $p_{max\ perm}$ [psi (bar)][2)] | Status |
|---|---|---|---|---|---|---|---|
| **A, B** | Working line | | | SAE J518 | see table above | 6100 (420) | O |
| **S** | Infeed | BVD20 | | DIN 3852[3)] | M22 × 1.5; 14 deep | 435 (30) | X |
| | | BVD25, BVE25 | | DIN 3852[3)] | M27 × 2; 16 deep | 435 (30) | X |
| $B_r$ | Brake release, reduced high pressure | L | 7 | DIN 3852[3)] | M12 × 1.5; 12.5 deep | 435 (30) | O |
| | | | 8 | DIN 3852[3)] | M12 × 1.5; 12 deep | 435 (30) | O |
| $G_{ext}$ | Brake release, high pressure | S | | DIN 3852[3)] | M12 × 1.5; 12.5 deep | 6100 (420) | X |
| $M_A$, $M_B$ | Measuring pressure A and B | | | ISO 6149[3)] | M18 × 1.5; 14.5 deep | 6100 (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 counterbalance valve BVD do not correspond with the connection drawing of the A6VM motor. The designation of the ports on the installation drawing of the motor is binding!

2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

3) The spot face can be deeper than as specified in the standard.

O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

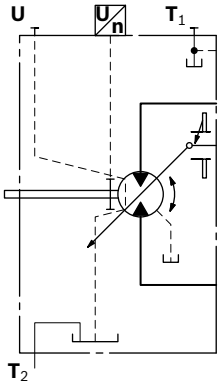
**Mounting the counterbalance valve**

When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport lock). The tacking screws may not be removed while mounting the working ports! If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The final mounting of the counterbalance valve on the motor is done with screw fitting of the SAE flange.
The screws to be used and the procedure mounting can be found in the instruction manual.

## Speed sensor

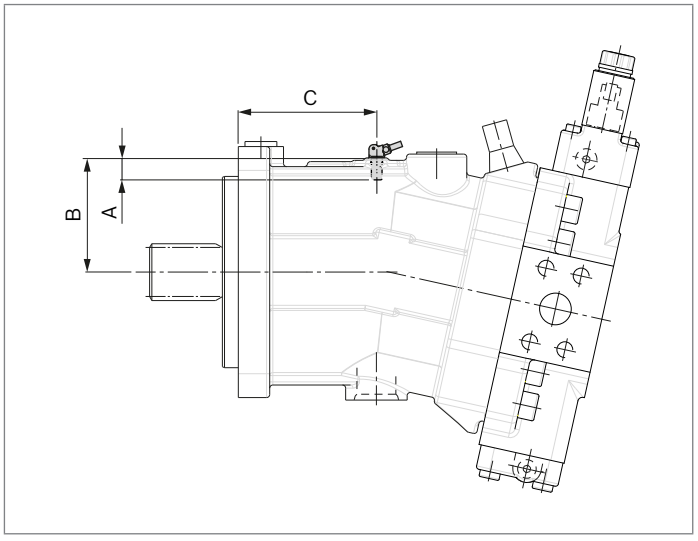
Version A6VM...U ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.
A signal proportional to motor speed can be generated with the fitted DSA/DSM speed sensor. The DSA/DSM sensor registers the speed and direction of rotation.
Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (95132 for DSM, 95133 for 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 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 |
| (tolerance -0.0098 (-0.25)) | (18.4) | (18.4) | (18.4) | (18.4) | (18.4) | (18.4) |
| B Contact surface | 2.95 | 3.11 | 3.46 | 3.66 | 3.78 | 3.98 |
| | (75) | (79) | (88) | (93) | (96) | (101) |
| C | 3.55 | 3.91 | 4.30 | 4.85 | 4.87 | 5.01 |
| | (90.2) | (99.2) | (109.2) | (123.7) | (123.7) | (127.2) |

## Setting range for displacement

| | 60 | | | | 85 | | | | 115 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{g\,max}$ [in³/rev (cm³/rev)] | | $V_{g\,min}$ [in³/rev (cm³/rev)] | | $V_{g\,max}$ [in³/rev (cm³/rev)] | | $V_{g\,min}$ [in³/rev (cm³/rev)] | | $V_{g\,max}$ [in³/rev (cm³/rev)] | | $V_{g\,min}$ [in³/rev (cm³/rev)] | |
| | from | to | from | to | from | to | from | to | from | to | from | to |
| **A** | 3.78 (62.0) | 3.78 (62.0) | 0.0 (0.0) | 0.92 (15.0) | 3.35 (85.2) | 3.35 (85.2) | 0.0 (0.0) | 0.55 (9.0) | 7.05 (115.6) | 7.05 (115.6) | 0.0 (0.0) | 1.46 (24.0) |
| | without screw | | M10 × 60 R909154690 | | without screw | | M12 × 60 R909083530 | | without screw | | M12 × 70 R909085976 | |
| **B** | 3.78 (62.0) | 3.78 (62.0) | > 0.92 (> 15.0) | 1.86 (30.5) | 3.35 (85.2) | 3.35 (85.2) | > 0.55 (> 9.0) | 1.71 (28.0) | 7.05 (115.6) | 7.05 (115.6) | > 1.46 (> 24.0) | 2.90 (47.5) |
| | without screw | | M10 × 70 R909153779 | | without screw | | M12 × 70 R909085976 | | without screw | | M12 × 80 R909153075 | |
| **C** | 3.78 (62.0) | 3.78 (62.0) | > 1.86 (> 30.5) | 2.62 (43.0) | 3.35 (85.2) | 3.35 (85.2) | > 1.71 (> 28.00) | 2.87 (47.0) | 7.05 (115.6) | 7.05 (115.6) | > 2.90 (> 47.5) | 4.33 (71.0) |
| | without screw | | M10 × 80 R909154058 | | without screw | | M12 × 80 R909153075 | | without screw | | M12 × 90 R909154041 | |
| **D** | x | | x | | 3.35 (85.2) | 3.35 (85.2) | > 2.87 (> 47.0) | 3.60 (59.0) | 7.05 (115.6) | 7.05 (115.6) | > 4.33 (> 71.0) | 4.88 (80.0) |
| | | | | | without screw | | M12 × 90 R909154041 | | without screw | | M12 × 100 R909153975 | |
| **E** | < 3.78 (< 62.0) | 2.90 (47.5) | 0.0 (0.0) | 0.92 (15.0) | 3.35 (85.2) | 3.03 (77.0) | 0.0 (0.0) | 0.55 (9.0) | < 7.05 (< 115.6) | 5.71 (93.5) | 0.0 (0.0) | 1.46 (24.0) |
| | M10 × 60 R909154690 | | M10 × 60 R909154690 | | M12 × 60 R909083530 | | M12 × 60 R909083530 | | M12 × 70 R909085976 | | M12 × 70 R909085976 | |
| **F** | < 3.78 (< 62.0) | 2.90 (47.5) | > 0.92 (> 15.0) | 1.86 (30.5) | 3.35 (85.2) | 3.03 (77.0) | > 0.55 (> 9.0) | 1.71 (28.0) | < 7.05 (< 115.6) | 5.71 (93.5) | > 1.46 (> 24.0) | 2.90 (47.5) |
| | M10 × 60 R909154690 | | M10 × 70 R909153779 | | M12 × 60 R909083530 | | M12 × 70 R909085976 | | M12 × 70 R909085976 | | M12 × 80 R909153075 | |
| **G** | < 3.78 (< 62.0) | 2.90 (47.5) | > 1.86 (> 30.5) | 2.62 (43.0) | 3.35 (85.2) | 3.03 (77.0) | > 1.71 (> 28.00) | 2.87 (47.0) | < 7.05 (< 115.6) | 5.71 (93.5) | > 2.90 (> 47.5) | 4.33 (71.0) |
| | M10 × 60 R909154690 | | M10 × 80 R909154058 | | M12 × 60 R909083530 | | M12 × 80 R909153075 | | M12 × 70 R909085976 | | M12 × 90 R909154041 | |
| **H** | x | | x | | 3.35 (85.2) | 3.03 (77.0) | > 2.87 (> 47.0) | 3.60 (59.0) | < 7.05 (< 115.6) | 5.71 (93.5) | > 4.33 (> 71.0) | 4.88 (80.0) |
| | | | | | M12 × 60 R909083530 | | M12 × 90 R909154041 | | M12 × 70 R909085976 | | M12 × 100 R909153975 | |
| **J** | < 2.90 (< 47.5) | 2.01 (33.0) | 0.0 (0.0) | 0.92 (15.0) | < 3.03 (< 77.0) | 2.28 (58.0) | 0.0 (0.0) | 0.55 (9.0) | < 5.71 (< 93.5) | 4.33 (71.0) | 0.0 | 1.46 (24.0) |
| | M10 × 70 R909153779 | | M10 × 60 R909154690 | | M12 × 70 R909085976 | | M12 × 60 R909083530 | | M12 × 80 R909153075 | | M12 × 70 R909085976 | |
| **K** | < 2.90 (< 47.5) | 2.01 (33.0) | > 0.92 (> 15.0) | 1.86 (30.5) | < 3.03 (< 77.0) | 2.28 (58.0) | > 0.55 (> 9.0) | 1.71 (28.0) | < 5.71 (< 93.5) | 4.33 (71.0) | > 1.46 (> 24.0) | 2.90 (47.5) |
| | M10 × 70 R909153779 | | M10 × 70 R909153779 | | M12 × 70 R909085976 | | M12 × 70 R909085976 | | M12 × 80 R909153075 | | M12 × 80 R909153075 | |
| **L** | < 2.90 (< 47.5) | 2.01 (33.0) | > 1.86 (>30.5) | 2.62 (43.0) | < 3.03 (< 77.0) | 2.28 (58.0) | > 1.71 (> 28.00) | 2.87 (47.0) | < 5.71 (< 93.5) | 4.33 (71.0) | > 2.90 (> 47.5) | 4.33 (71.0) |
| | M10 × 70 R909153779 | | M10 × 80 R909154058 | | M12 × 70 R909085976 | | M12 × 80 R909153075 | | M12 × 80 R909153075 | | M12 × 90 R909154041 | |
| **M** | x | | x | | < 3.03 (< 77.0) | 2.28 (58.0) | > 2.87 (> 47.0) | 3.60 (59.0) | < 5.71 (< 93.5) | 4.33 (71.0) | > 4.33 (> 71.0) | 4.88 (80.0) |
| | | | | | M12 × 70 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: $V_{g\,min}$ = ... in³ (cm³), $V_{g\,max}$ = ... in³ (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 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{g\,max}$ [in³/rev (cm³/rev)] | | $V_{g\,min}$ [in³/rev (cm³/rev)] | | $V_{g\,max}$ [in³/rev (cm³/rev)] | | $V_{g\,min}$ [in³/rev (cm³/rev)] | | $V_{g\,max}$ [in³/rev (cm³/rev)] | | $V_{g\,min}$ [in³/rev (cm³/rev)] | |
| | from | to | from | to | from | to | from | to | from | to | from | to |
| **A** | 9.28 (152.1) | 9.28 (152.1) | 0.0 (0.0) | 2.68 (44.0) | 10.48 (171.8) | 10.48 (171.8) | 0.0 (0.0) | 2.14 (35.0) | 13.21 (216.5) | 13.21 (216.5) | 0.0 (0.0) | 2.72 (44.5) |
| | without screw | | M12 × 80 R909153075 | | without screw | | M12 x 80 R909153075 | | without screw | | M12 × 80 R909153075 | |
| **B** | 9.28 (152.1) | 9.28 (152.1) | > 2.68 (> 44.0) | 4.21 (69.0) | 10.48 (171.8) | 10.48 (171.8) | > 2.14 (> 35.0) | 3.87 (63.5) | 13.21 (216.5) | 13.21 (216.5) | > 2.72 (> 44.5) | 4.88 (80.0) |
| | without screw | | M12 × 90 R909154041 | | without screw | | M12 × 90 R909154041 | | without screw | | M12 × 90 R909154041 | |
| **C** | 9.28 (152.1) | 9.28 (152.1) | > 4.21 (> 69.0) | 6.04 (99.0) | 10.48 (171.8) | 10.48 (171.8) | > 3.87 (> 63.5) | 5.98 (98.0) | 13.21 (216.5) | 13.21 (216.5) | > 4.88 (> 80.0) | 7.02 (115.0) |
| | without screw | | M12 × 100 R909153975 | | without screw | | M12 × 100 R909153975 | | without screw | | M12 × 100 R909153975 | |
| **D** | 9.28 (152.1) | 9.28 (152.1) | > 6.04 (> 99.0) | 6.04 (106.0) | 10.48 (171.8) | 10.48 (171.8) | > 5.98 (> 98.0) | 9.15 (120.0) | 13.21 (216.5) | 13.21 (216.5) | > 7.02 (> 115.0) | 9.15 (150.0) |
| | without screw | | M12 × 110 R909154212 | | without screw | | M12 × 110 R909154212 | | without screw | | M12 × 110 R909154212 | |
| **E** | < 9.28 (<152.1) | 6.77 (111.0) | 0.0 (0.0) | 2.68 (44.0) | < 10.48 (< 171.8) | 8.48 (139.0) | 0.0 (0.0) | 2.14 (35.0) | < 13.21 (< 216.5) | 10.68 (175.0) | 0.0 (0.0) | 2.72 (44.5) |
| | M12 × 80 R909153075 | | M12 × 80 R909153075 | | M12 × 80 R909153075 | | M12 x 80 R909153075 | | M12 × 80 R909153075 | | M12 × 80 R909153075 | |
| **F** | < 9.28 (<152.1) | 6.77 (111.0) | > 2.68 (> 44.0) | 4.21 (69.0) | < 10.48 (< 171.8) | 8.48 (139.0) | > 2.14 (> 35.0) | 3.87 (63.5) | < 13.21 (< 216.5) | 10.68 (175.0) | > 2.72 (> 44.5) | 4.88 (80.0) |
| | M12 × 80 R909153075 | | M12 × 90 R909154041 | | M12 × 80 R909153075 | | M12 × 90 R909154041 | | M12 × 80 R909153075 | | M12 × 90 R909154041 | |
| **G** | < 9.28 (<152.1) | 6.77 (111.0) | > 4.21 (> 69.0) | 6.04 (99.0) | < 10.48 (< 171.8) | 8.48 (139.0) | > 3.87 (> 63.5) | 3.86 (98.0) | < 13.21 (< 216.5) | 10.68 (175.0) | > 4.88 (> 80.0) | 7.02 (115.0) |
| | M12 × 80 R909153075 | | M12 × 100 R909153975 | | M12 × 80 R909153075 | | M12 × 100 R909153975 | | M12 × 80 R909153075 | | M12 × 100 R909153975 | |
| **H** | < 9.28 (<152.1) | 6.77 (111.0) | > 6.04 (> 99.0) | 6.47 (106.0) | < 10.48 (< 171.8) | 8.48 (139.0) | > 3.86 (> 98.0) | 7.32 (120.0) | < 13.21 (< 216.5) | 10.68 (175.0) | > 7.02 (> 115.0) | 9.15 (150.0) |
| | M12 × 80 R909153075 | | M12 × 110 R909154212 | | M12 × 80 R909153075 | | M12 × 110 R909154212 | | M12 × 80 R909153075 | | M12 × 110 R909154212 | |
| **J** | < 6.77 (< 111.0) | 5.31 (87.0) | 0.0 (0.0) | 2.68 (44.0) | < 8.48 (< 139.0) | 6.83 (112.0) | 0.0 (0.0) | 2.14 (35.0) | < 10.68 (< 175.0) | 8.60 (141.0) | 0.0 (0.0) | 2.72 (44.5) |
| | M12 × 90 R909154041 | | M12 × 80 R909153075 | | M12 × 90 R909154041 | | M10 x 80 R909153075 | | M12 × 90 R909154041 | | M12 × 80 R909153075 | |
| **K** | < 6.77 (< 111.0) | 5.31 (87.0) | > 2.68 (> 44.0) | 4.21 (69.0) | < 8.48 (< 139.0) | 6.83 (112.0) | > 2.14 (> 35.0) | 3.87 (63.5) | < 10.68 (< 175.0) | 8.60 (141.0) | > 2.72 (> 44.5) | 4.88 (80.0) |
| | M12 × 90 R909154041 | | M12 × 90 R909154041 | | M12 × 90 R909154041 | | M12 × 90 R909154041 | | M12 × 90 R909154041 | | M12 × 90 R909154041 | |
| **L** | < 6.77 (< 111.0) | 5.31 (87.0) | > 4.21 (> 69.0) | 6.04 (99.0) | < 8.48 (< 139.0) | 6.83 (112.0) | > 3.87 (> 63.5) | 5.98 (98.0) | < 10.68 (< 175.0) | 8.60 (141.0) | > 4.88 (> 80.0) | 7.02 (115.0) |
| | M12 × 90 R909154041 | | M12 × 100 R909153975 | | M12 × 90 R909154041 | | M12 × 100 R909153975 | | M12 × 90 R909154041 | | M12 × 100 R909153975 | |
| **M** | < 6.77 (< 111.0) | 5.31 (87.0) | > 6.04 (> 99.0) | 6.47 (106.0) | < 8.48 (< 139.0) | 6.83 (112.0) | > 5.98 (> 98.0) | 7.32 (120.0) | < 10.68 (< 175.0) | 8.60 (141.0) | > 7.02 (> 115.0) | 9.15 (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: $V_{g\,min}$ = ... in³ (cm³), $V_{g\,max}$ = ... in³ (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

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit empty 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 housing area must be directed to the reservoir via the highest 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.

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

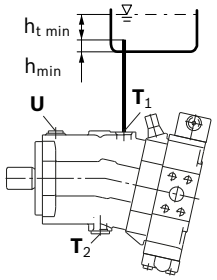
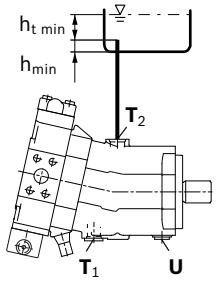
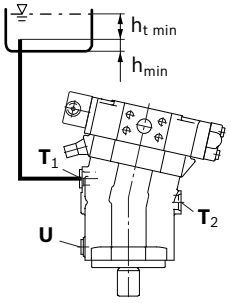
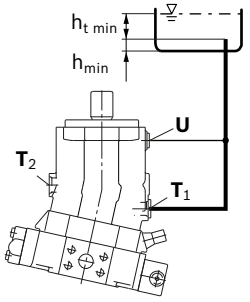
| Key | |
|---|---|
| **U** | Bearing flushing / air bleed port |
| **F** | Filling / air bleeding |
| **$T_1$, $T_2$** | Drain port |
| $h_{t\,min}$ | Minimum required immersion depth (7.87 inch (200 mm)) |
| $h_{min}$ | Minimum required distance to tank base (3.94 inch (100 mm)) |

### Installation position

See examples **1** to **8** below.
Additional installation positions are available upon request.
Recommended installation position: **1** and **2**

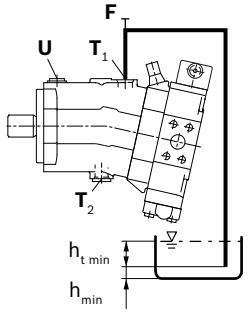
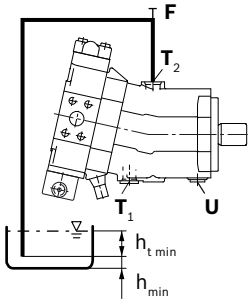
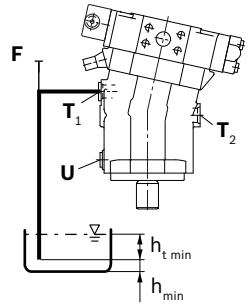
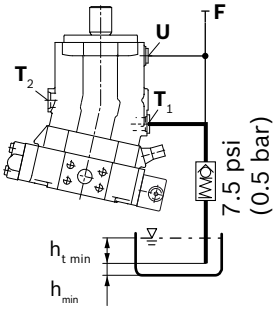
### Below-reservoir installation (standard)

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 7.5 psi (0.5 bar)) can prevent draining of the motor housing.

| Installation position | Air bleed | Filling |
|---|---|---|
| 5   | **U** (**F**) | **T1** (**F**) |
| 6   | **F** | **T2** (**F**) |
| 7   | **F** | **T1** (**F**) |
| 8   | **U** | **T1** (**F**) |

**Note**

Port **F** is not part of the motor and can be provided by the customer 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 person.
- 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, request a binding installation drawing.
- The data and notes contained herein must be adhered to.
- For safety reasons, control systems 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 condition of the axial piston unit (operating pressure, fluid temperature), the characteristic 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 times apply under optimal storage conditions, details of these conditions can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions 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. Applying the recommended direct voltage signal (DC) to solenoids does not create electromagnetic interference (EMI) nor is the solenoid affected by EMI. Electromagnetic interference (EMI) potential exists when operating and controlling a proportional electrohydraulic coil with a Pulse Width Modulated (PWM) signal. Appropriate testing and measures should be taken by the machine manufacturer to ensure other components or operators (e.g. with pacemaker) are not affected by this potential.
- Please note the details regarding the tightening torques of port threads and other threaded joints
- Working ports
  - The ports and fixing threads are designed for the specified peak pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, volume flow, hydraulic fluid, temperature) with the required safety factors.
  - The service and function ports are only designed to accommodate hydraulic lines

## Safety instructions

- During and shortly after operation, there is a risk of burns 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 blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the flow of hydraulic fluid and the build-up of momentum in the axial piston unit can no longer meet the operator's specifications. Even the use of various filter elements (external or internal flow filtering) cannot rule out errors, but can only help minimize risks. The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to bring the powered load into a safe position (e.g. safe stop) and ensure any measures are properly put into practice.
- In certain conditions, moving parts in high pressure relief valves might get stuck in an undefined position due to contamination. This can result in restriction or loss of load holding functions in lifting winches. Therefore it is the machine and/or system manufacturers responsibility to make sure that the load can always be put in a safe mode if needed. Also, he needs to ensure that these measures 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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