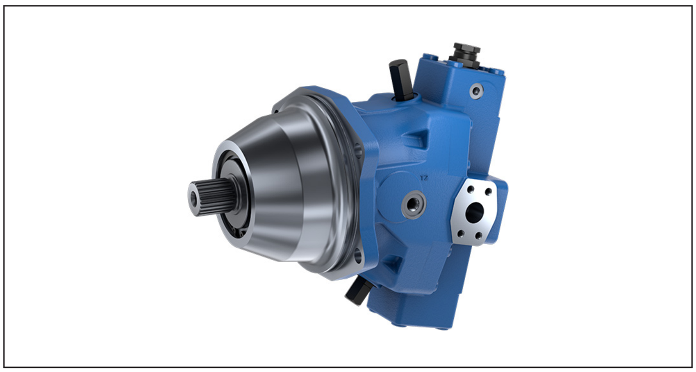
rexroth
A Bosch Company

Variable plug-in motor A6VE series 63



- High-pressure motor for integration in mechanical gearboxes
- Size 250
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- Open and closed circuit

Features
- Variable plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- Far-reaching integration in mechanical gears due to recessed mounting flange located in the center of the case (extremely space-saving construction)
- Easy to install, simple to plug into the mechanical gearbox (no configuration specifications to be observed)
- Tested unit ready to install
- For use preferably in mobile applications
- High control range (can be swiveled to zero)
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The output speed depends 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 sides and with increasing displacement.

Contents

Type code

01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16
A6V	**E**	**250**				**/**	**63**	**W**		**–**	**V**	**Z**	**M**				

Axial piston unit

01	Bent-axis design, variable displacement	**A6V**

Operating mode

02	Plug-in motor	**E**

Size (NG)

03	Geometric displacement, see "Technical data" on page 7	**250**

Control device

				250	
04	Proportional control, hydraulic		Δp_{St} = 10 bar	●	**HD1**
			Δp_{St} = 25 bar	●	**HD2**
	Proportional control, electric (as standard, with HIRSCHMANN connector – without suppressor diode)		U = 12 V	●	**EP1**
			U = 24 V	●	**EP2**
	Two-point control, hydraulic			●	**HZ**
	Two-point control, electric (as standard, with HIRSCHMANN connector – without suppressor diode)		U = 12 V	○	**EZ1**
			U = 24 V	●	**EZ2**
	Automatic control, high-pressure related	With minimum pressure increase	Δp ≤ approx. 10 bar	●	**HA1**
		With pressure increase	Δp = 100 bar	●	**HA2**
	Automatic control, speed related p_{St}/p_{HD} = 3/100, hydraulic travel direction valve			●	**DA**

Pressure control (only for HD and EP)

		250	
05	Without pressure control/override	●	
	Pressure control, fixed setting[1]	●	**D**

Pressure control/override

		250	
06	Without pressure control/override	●	
	Override of the HA1 and HA2 controls, hydraulic remote controlled, proportional	●	**T**

Series

		250	
07	Series 6, index 3	●	**63**

Direction of rotation

		250	
08	Viewed on drive shaft, bi-directional	●	**W**

Setting range for displacement[2]

			250	
09	$V_{g\,min}$ = 0 to 0.4 $V_{g\,max}$	$V_{g\,max}$ = $V_{g\,max}$ to 0.8 $V_{g\,max}$	●	**1**
	$V_{g\,min}$ > 0.4 $V_{g\,max}$ to 0.8 $V_{g\,max}$	$V_{g\,max}$ = $V_{g\,max}$ to 0.8 $V_{g\,max}$	●	**2**

Sealing material

		250	
10	FKM (fluoroelastomer) shaft seal	●	**V**

Drive shaft

		250	
11	Splined shaft DIN 5480	●	**Z**

Mounting flange

			250	
12	Based on ISO 3019-2	4-hole	●	**M**

● = Available ○ = On request **–** = Not available

1) Second pressure setting option available as standard for version D

2) Please specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... cm^3, $V_{g\,max}$ = ... cm^3

01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16
A6V	**E**	**250**				**/**	**63**	**W**		**–**	**V**	**Z**	**M**				

Working port

					250	
13	SAE working ports **A** and **B** at side, opposite, fastening thread, metric	**02**	Without additional valves	**0**	●	**020**
			Flushing and boost-pressure valve, mounted	**7**	●	**027**
		38	Port plate for mounting a counterbalance valve MHB32, with 1-stage pressure relief valve (pilot operated)[3]	**0**	●[4]	**380**
			Port plate with mounted counterbalance valve MHB32, with 1-stage pressure relief valve (pilot operated)[3]	**8**	●[4]	**388**

Speed sensor (see page 23)

		250	
14	Without speed sensor (without code)	●	
	Prepared for speed sensor DSA/20	●	**W**
	Speed sensor DSA/20 mounted[5]	●	**C**

Beginning of control

		250	
15	At $V_{g\ min}$ (standard for HA)	●	**A**
	At $V_{g\ max}$ (standard for HD, HZ, EP, EZ, DA)	●	**B**

Standard/ special version

		250	
16	Standard version (without code)	●	
	Special version	●	**-S**

● = Available ○ = On request **–** = Not available

Notice
- ▶ Note the project planning notes on page 26.
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.
- ▶ Please note that not all type code combinations are available although the individual functions are marked as being available.

3) Not possible in conjunction with control DA
4) Counterbalance valve MHB32, please contact us.
5) Specify type code of the sensor acc. to data sheet 95126 (DSA/20) separately and observe the requirements for the electronics.

Hydraulic fluids

The axial piston unit is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluid selection, behavior during operation as well as disposal and environmental protection 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

Selection of hydraulic fluid
Bosch Rexroth evaluates hydraulic fluids on the basis of the Fluid Rating according to the technical data sheet 90235.
Hydraulic fluids with positive evaluation in the Fluid Rating are listed in the following data sheet:

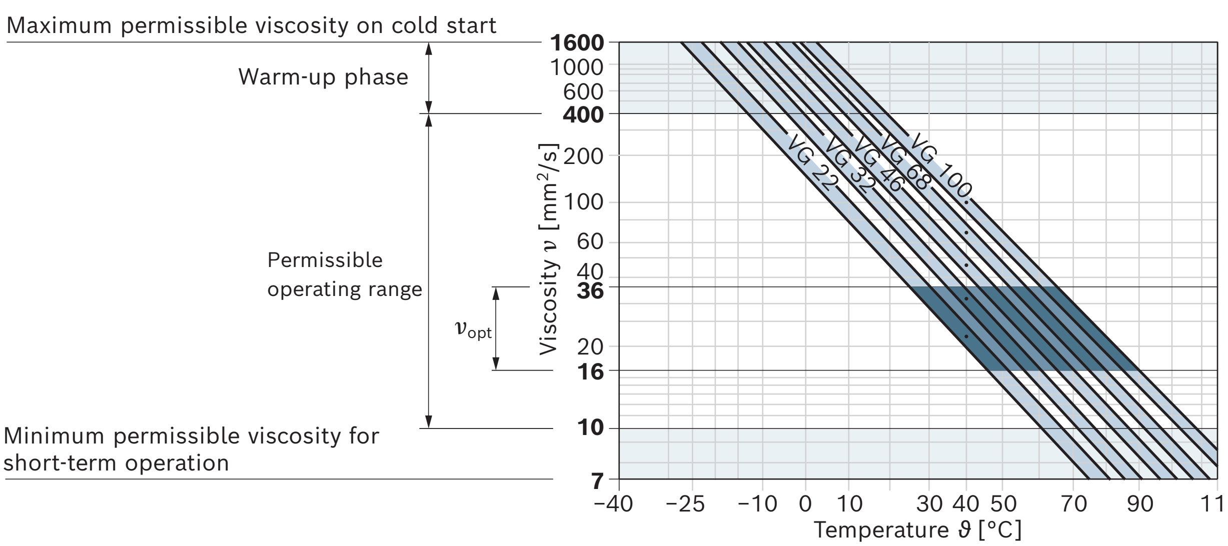
- 90245: Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)

The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}; see selection diagram).

Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature[4]	Remarks
Cold start	$\nu_{max} \le 1600$ mm²/s	NBR[2]	$\vartheta_{St} \ge -40$°C	$t \le 3$ min, without load ($p \le 50$ bar), $n \le 1000$ rpm
		FKM	$\vartheta_{St} \ge -25$°C	Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
Warm-up phase	$\nu = 1600 \ldots 400$ mm²/s			$t \le 15$min, $p \le 0.7 \times p_{nom}$ and $n \le 0.5 \times n_{nom}$
Permissible operating range	$\nu = 400 \ldots 10$ mm²/s[1]	NBR[2]	$\vartheta \le +78$°C	Measured at port **T**
		FKM	$\vartheta \le +103$°C	
	$\nu_{opt} = 36 \ldots 16$ mm²/s			Optimal operating viscosity and efficiency range
Short-term operation[3]	$\nu_{min} = 10 \ldots 7$ mm²/s	NBR[2]	$\vartheta \le +78$°C	$t \le 3$ min, $p \le 0.3 \times p_{nom}$, measured at port **T**
		FKM	$\vartheta \le +103$°C	

▼ **Selection diagram**



1) This corresponds, for example on the VG 46, to a temperature range of +4 °C to +85 °C (see selection diagram)
2) Special version, please contact us
3) Please contact us.
4) If the temperature at extreme operating parameters cannot be adhered to, please contact us.

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 a hydraulic fluid viscosity of less than 10 mm^2/s (e.g. due to high temperatures during short-term operation), a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

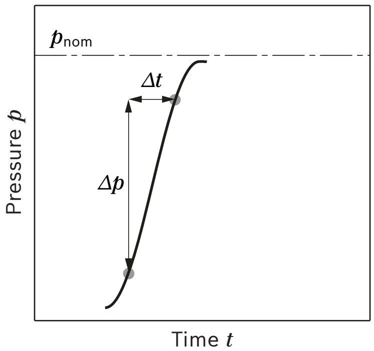
Examples of temperatures of hydraulic fluids at a viscosity of 10 mm^2/s:

- 73°C at HLP 32
- 85°C at HLP 46

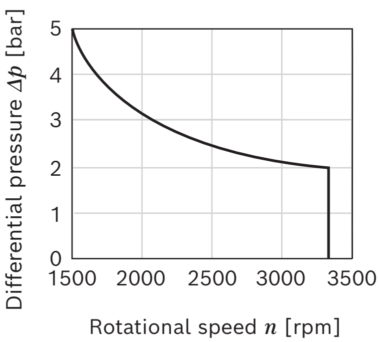
Working pressure range

Pressure at working port A or B		**Definition**
Nominal pressure p_{nom}	350 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	400 bar	The maximum pressure corresponds to the maximum working pressure within a single operating period. The sum of single operating periods must not exceed the total operating period. Within the total operating period of 300 h, a maximum pressure of 400 bar is permissible for a limited period of 50 h.
Single operating period	10 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** and **B**) which is required to prevent damage to the axial piston unit.
Minimum pressure – operation as a pump (inlet)	See diagram on page 6	To prevent damage to the axial piston motor during operation as a pump (change of the high-pressure side with constant direction of rotation, e.g. during brake applications) a minimum pressure has to be ensured at the working port (inlet). The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Summation pressure p_{Su} (pressure **A** + pressure **B**)	700 bar	The summation pressure is the sum of the pressures at the ports for the working lines (**A** and **B**).
Rate of pressure change $R_{A\ max}$		Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
With integrated pressure relief valve	9000 bar/s	
Without pressure relief valve	16000 bar/s	
Case pressure at port T		
Continuous differential pressure $\Delta p_{T\ cont}$	2 bar	Maximum, averaged differential pressure at the shaft seal (case to ambient pressure)
Maximum differential pressure $\Delta p_{T\ max}$	See diagram on page 6	Permissible differential pressure at the shaft seal (case pressure to ambient pressure)
Pressure peaks $p_{T\ peak}$	10 bar	$t < 0.1$ s

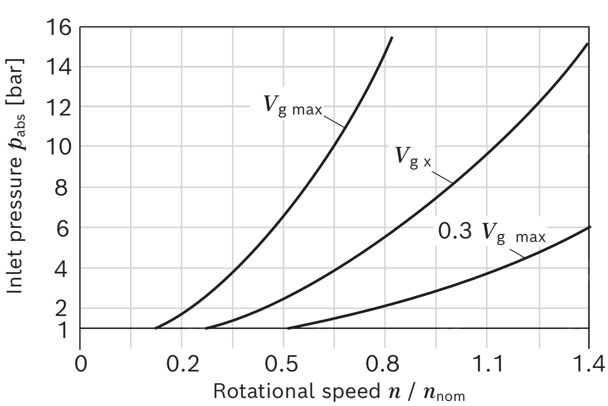
▼ **Rate of pressure change $R_{A\ max}$**



▼ **Maximum differential pressure at the shaft seal**



▼ **Minimum pressure – operation as a pump (inlet)**

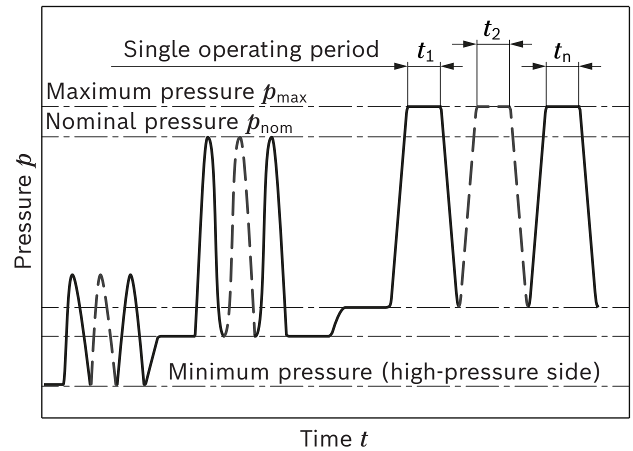


This diagram is only valid for the optimum viscosity range of ν_{opt} = 36 to 16 mm^2/s.
If the above-mentioned conditions cannot be ensured, please contact us.

Flow direction

Direction of rotation, viewed on drive shaft	
Clockwise	Counter-clockwise
A to **B**	**B** to **A**

▼ **Pressure definition**



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

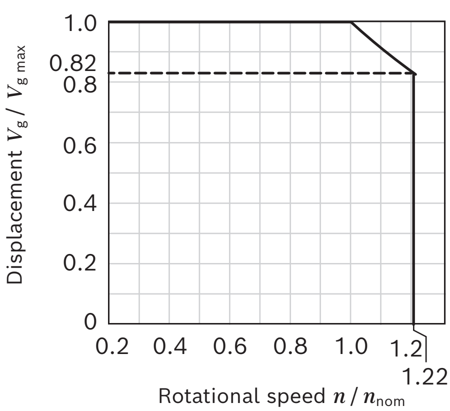
Notice
- Working pressure range applies when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.
- In addition to the hydraulic fluid and the temperature, the service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the case pressure.
- The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
- The case pressure must be greater than the external pressure (ambient pressure) at the shaft seal.

Effect of case pressure on beginning of control
An increase in case pressure affects the beginning of control of the variable motor when using the following control options: HD, EP, HA.T: Increase
DA: Reduction
The factory setting for the beginning of control is made at p_{abs} = 1 bar case pressure.

Technical data

Size		NG		250
Geometric displacement, per revolution[1]		$V_{g\ max}$	cm³	250
		$V_{g\ min}$	cm³	0
		$V_{g\ x}$	cm³	205
Maximum rotational speed[2] (complying with the maximum permissible inlet flow)	At $V_{g\ max}$	n_{nom}	rpm	2700
	At $V_g < V_{g\ x}$ (see diagram on page 6)	n_{max}	rpm	3300
	At $V_{g\ 0}$	n_{max}	rpm	3300
Inlet flow	At n_{nom} and $V_{g\ max}$	$q_{v\ max}$	l/min	675
Torque[3]	At $V_{g\ max}$ and Δp = 350 bar	M	Nm	1391
Rotary stiffness	$V_{g\ max}$ to $V_g/2$	c_{min}	kNm/rad	60
	$V_g/2$ to 0 (interpolated)	c_{min}	kNm/rad	181
Moment of inertia of the rotary group		J_{TW}	kgm²	0,061
Case volume		V	l	3.0
Weight approx.	With port plate 02	m	kg	110

▼ **Permissible displacement depending on the rotational speed**



Notice

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

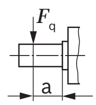
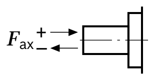
Determination of the operating characteristics			
Inlet flow	q_v	$= \dfrac{V_g \times n}{1000 \times \eta_v}$	[l/min]
Rotational speed	n	$= \dfrac{q_v \times 1000 \times \eta_v}{V_g}$	[rpm]
Torque	M	$= \dfrac{V_g \times \Delta p \times \eta_{hm}}{20 \times \pi}$	[Nm]
Power	P	$= \dfrac{2\ \pi \times M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

Key

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

1) The minimum and maximum displacement can be steplessly varied, see type code on page 2. (Standard setting size 250 if ordering code is missing: $V_{g\ min} = 0.2 \times V_{g\ max}$, $V_{g\ max} = V_{g\ max}$).
2) The values are applicable:
   - for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
   - with hydraulic fluid based on mineral oils
3) Torque without radial force, with radial force see page 8.

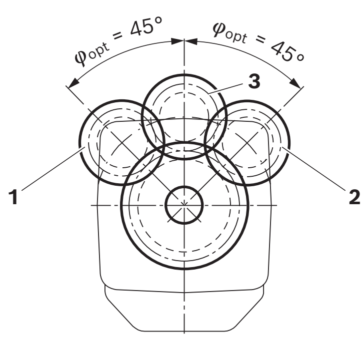
Permissible radial and axial loading on the drive shafts

Size		NG		250
Drive shaft				W50
Maximum radial force[1) at distance a (from shaft collar)		$F_{q\ max}$	N	1200[2)]
		a	mm	41
Maximum torque at $F_{q\ max}$		$T_{q\ max}$	Nm	[3)]
Maximum differential pressure at V_{gmax} and $F_{q\ max}$		$\Delta p_{q\ max}$	bar	[3)]
Maximum axial force at standstill or depressurized operation		$+ F_{ax\ max}$	N	0
		$- F_{ax\ max}$	N	1200
Permissible axial force per bar working pressure		$+ F_{ax\ perm/bar}$	N/bar	[3)]

Effect of radial force F_q on bearing service life

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 bearing service life. Recommended position of mating gear is dependent on the direction of rotation. Examples:

▼ **Gear output drive**



1 "Counter-clockwise" rotational direction, pressure at port **B**
2 "Clockwise" rotation, pressure at port **A**
3 Bi-directional direction of rotation

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

1) With intermittent operation
2) When at standstill or when axial piston unit working in depressurized conditions. Higher forces are permissible under pressure, please contact us.
3) Please contact us.

HD – Proportional control, hydraulic

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

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

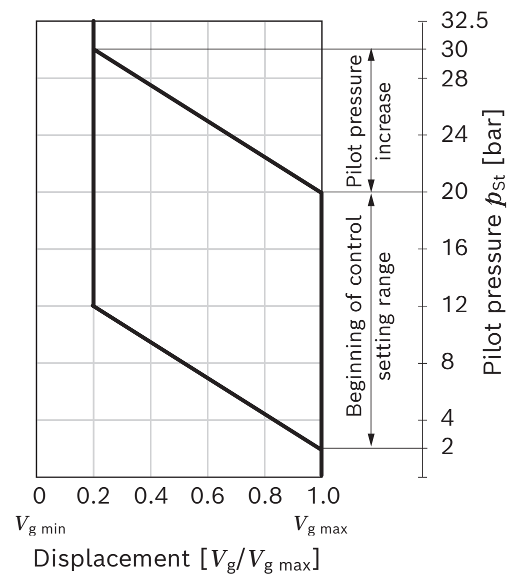
Please note

- Maximum permissible pilot pressure: p_{St} = 100 bar
- The control fluid is internally taken out of the high-pressure passage of the motor (**A** or **B**).
  For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us.
  Please note that at port **G** up to 400 bar can occur.
- Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 10 bar.
- The beginning of control and the HD-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 curve.
- A leakage flow of maximum 0.3 l/min can occur at port **X** due to internal leakage (working pressure > pilot pressure). The external control is to be suitably configured to avoid an independent build-up of pilot pressure.

Stroking time damping
The stroking time damping impacts the swivel behavior of the motor and consequently the machine response speed.
HD1, HD2 with nozzle (⌀1.2 mm)
HD.D, HD.G with adjustable stroking time limiting valve

HD1 – pilot pressure increase Δp_{St} = 10 bar
A pilot pressure increase of 10 bar at port **X** results in a decrease in displacement from $V_{g\ max}$ to 0.2 $V_{g\ max}$.
Beginning of control, setting range 2 to 20 bar
Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

▼ **Characteristic curve HD1**

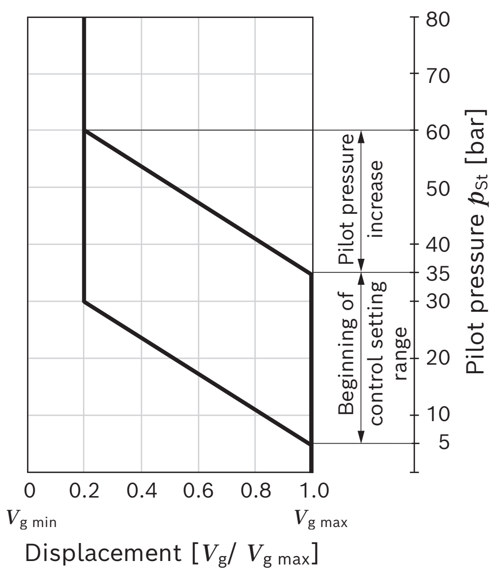


HD2 – pilot pressure increase Δp_{St} = 25 bar

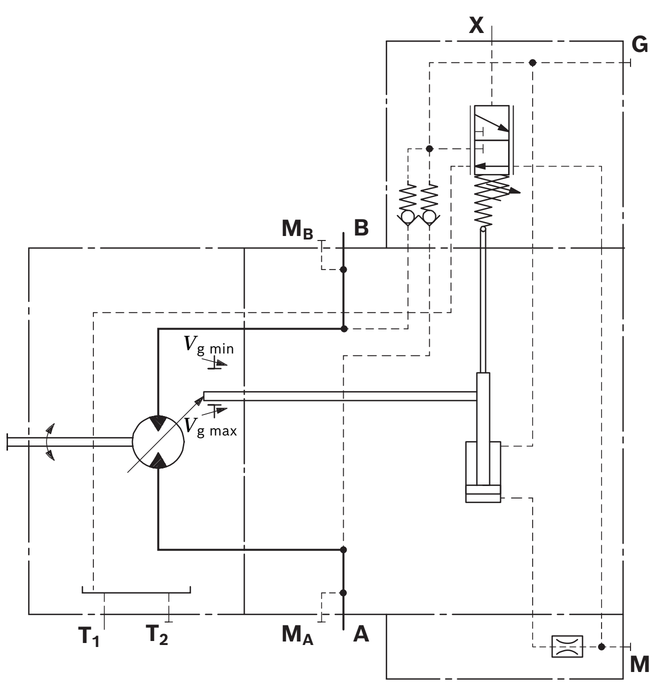
A pilot pressure increase of 25 bar at port **X** results in a decrease in displacement from $V_{g\ max}$ to 0.2 $V_{g\ max}$.

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

▼ **HD2 characteristic curve**



▼ **Circuit diagram HD1, HD2**

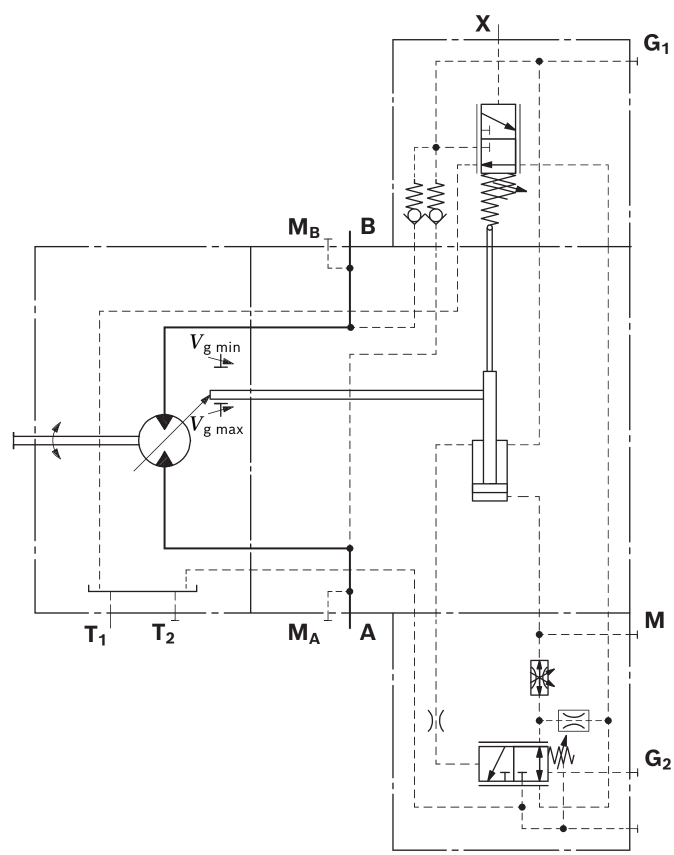


HD.D Pressure control, fixed setting

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

- Setting range of the pressure control valve
  80 to 350 bar

▼ **Circuit diagram HD.D**



Pressure control with 2nd pressure setting available as standard with HD.D.
By connecting an external pilot pressure at port **G**$_2$, the setting of the pressure controller can be overridden and a 2nd pressure setting can be realized.

- Required pilot pressure at port **G**$_2$: p_{St} ≥ 100 bar

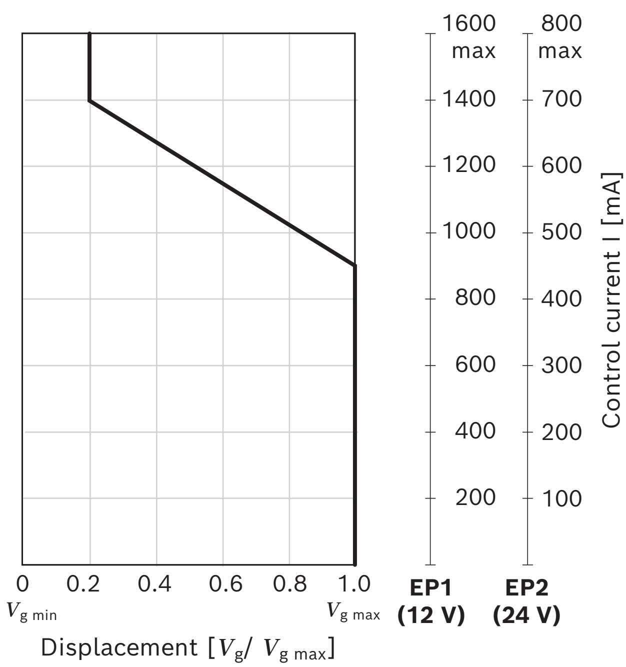
When ordering, please specify the 2nd pressure setting in plain text.

EP – Proportional control, electric

The electric proportional control with proportional valve provides infinite adjustment of the displacement. Control is proportional to the electric control current applied to the solenoid.
An external control fluid supply is connected to port **P** with a pressure of p_{min} = 30 bar is required (p_{max} = 100 bar).

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

▼ **Characteristic curve EP**



Please note

- The control fluid is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Please note that at port **G** up to 400 bar can occur.
- The beginning of control and the EP 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 shift of the characteristic curve.

Stroking time damping

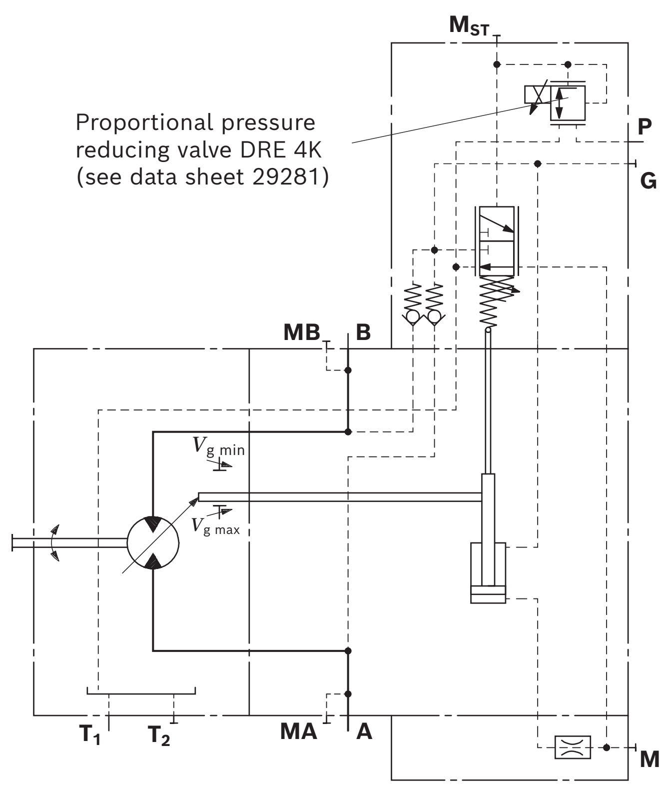
The stroking time damping impacts the swivel behavior of the motor and consequently the machine response speed.
EP1, EP2 with nozzle (⌀1.2 mm)
EP.D, EP.G with adjustable stroking time limiting valve

▼ **Technical data, proportional valve**

Technical data, solenoid	EP1	EP2
Voltage	12 V (±20%)	24 V (±20%)
Start of control at $V_{g\,max}$	900 mA	450 mA
End of control at $V_{g\,min}$	1400 mA	700 mA
Current limit	2.2 A	1.00 A
Nominal resistance (at 20°C)	2.4 Ω	12 Ω
Duty cycle	100%	100%
Type of protection: see connector version page 21		

See also proportional pressure reducing valve DRE 4K (data sheet 29281)

▼ **Circuit diagram EP1, EP2**



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

- Setting range of the pressure control valve 80 to 350 bar

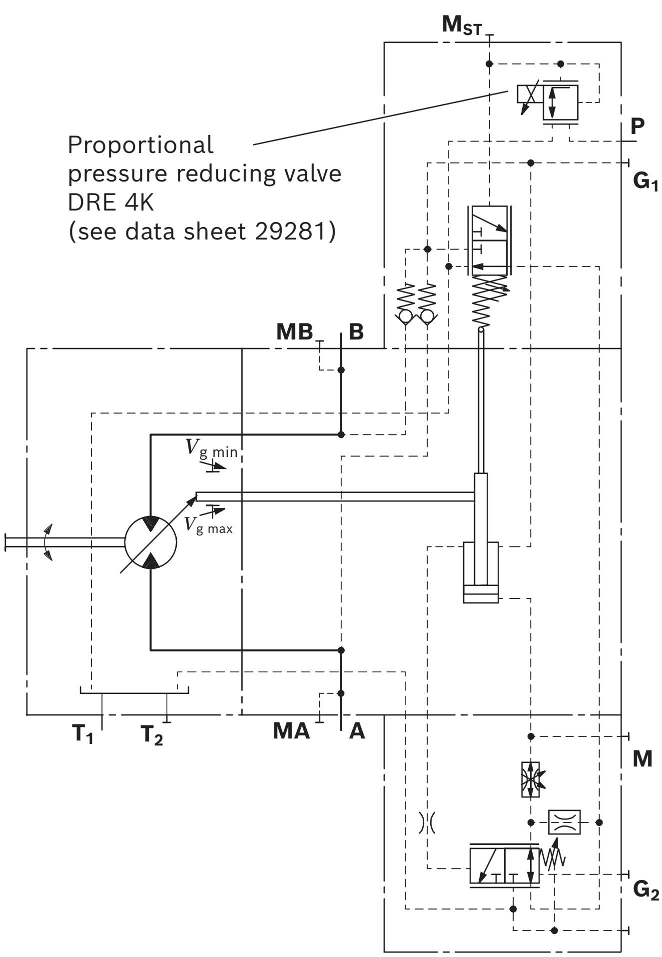
Pressure control with 2nd pressure setting is available as standard with EP.D control.

By connecting an external pilot pressure at port **G**$_2$, the setting of the pressure controller can be overridden and a 2nd pressure setting can be realized.

- Required pilot pressure at port **G**$_2$: p_{St} ≥ 100 bar.

When ordering, please specify the 2nd pressure setting in plain text.

▼ **Circuit diagram EP.D**

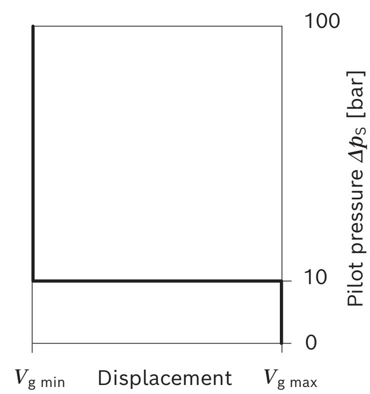


HZ – Two-point control, hydraulic

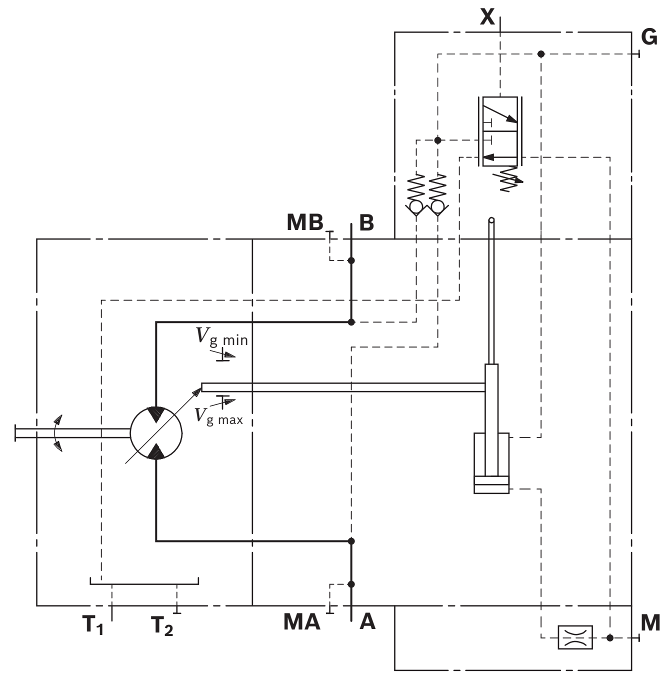
The hydraulic two-point control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port **X** on or off.

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum rotational speed)
- Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible rotational speed)

▼ **Characteristic curve HZ**



▼ **Circuit diagram HZ**



Please note

- Maximum permissible pilot pressure: 100 bar
- The control fluid is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Please note that at port **G** up to 400 bar can occur.
- A leakage flow of maximum 0.3 l/min can occur at port **X** due to internal leakage (working pressure > pilot pressure). The external control is to be suitably configured to avoid an independent build-up of pilot pressure.

Stroking time damping

The stroking time damping impacts the swivel behavior of the motor and consequently the machine response speed. Standard with nozzle (⌀1.2 mm)

EZ – Two-point control, electric

The electric two-point control with on/off valve with enables the displacement to be adjusted to $V_{g\,min}$ or $V_{g\,max}$ by applying or canceling the electric current at the on/off valve.

Please note

The control fluid is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Please note that at port **G** up to 400 bar can occur.

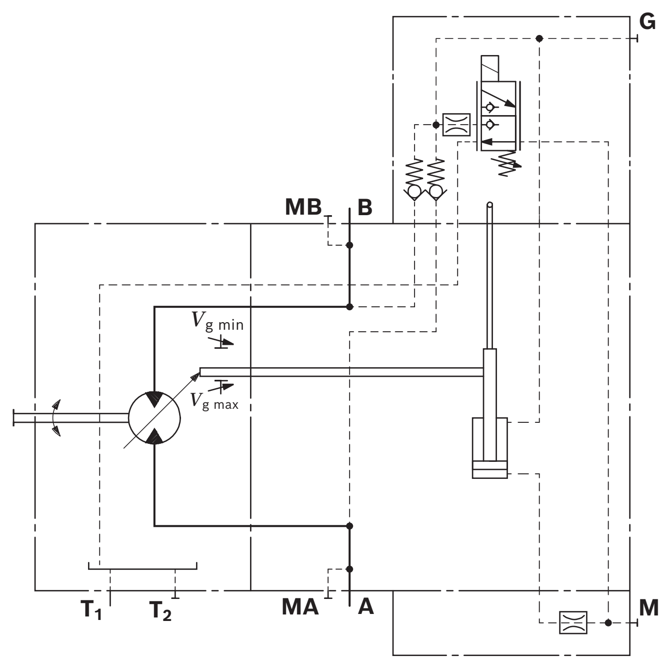
Stroking time damping

The stroking time damping impacts the swivel behavior of the motor and consequently the machine response speed. Standard with nozzle (⌀1.2 mm)

▼ **Technical data**

On/off valve	EZ2
Voltage	24 V (±20%)
Position $V_{g\,max}$	De-energized
Position $V_{g\,min}$	Energized
Nominal resistance (at 20°C)	23 Ω
Nominal power	26 W
Minimum active current required	1.04 A
Duty cycle	100%
Type of protection: see connector version page 21	

▼ **Circuit diagram EZ2**



HA – Automatic control, high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the working pressure.
The beginning of control of the A6VE motor with HA control is $V_{g\,min}$ (maximum rotational speed and minimum torque). The control device measures internally the working pressure at **A** or **B** (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$.
The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$ depending on the load.

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

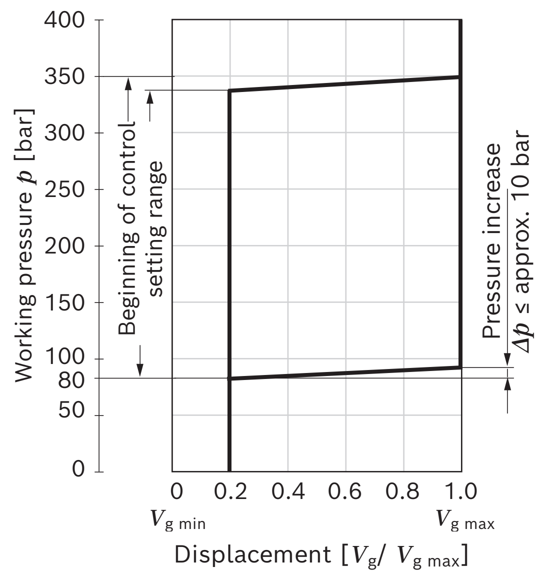
Please note

- For safety reasons, lifting winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).
- The control fluid is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us.
  Please note that at port **G** up to 400 bar can occur.
- The beginning of control and the HA 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 shift of the characteristic curve. Only for HA.T control.
- A leakage flow of maximum 0.3 l/min occurs at port **X** (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure must be relieved from port **X** to the reservoir. Only for HA.T control.

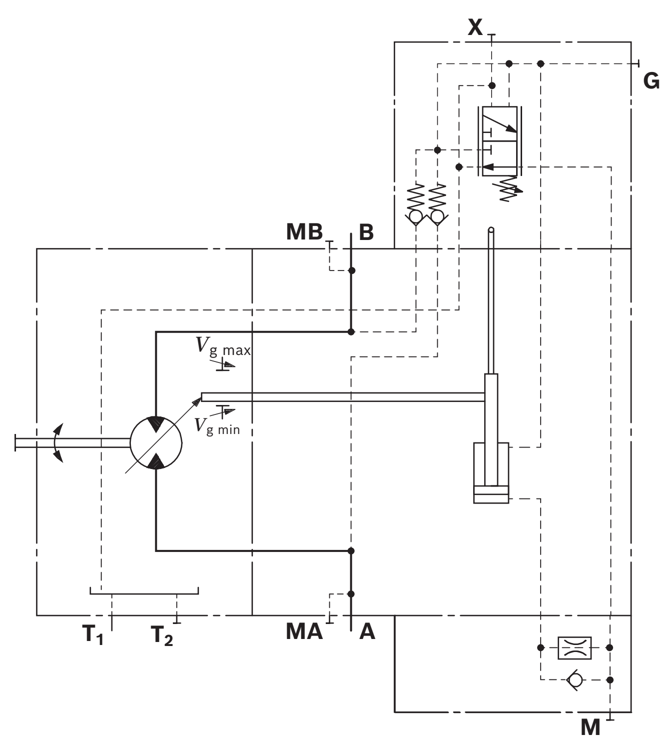
Stroking time damping
The stroking time damping impacts the swivel behavior of the motor and consequently the machine response speed.
Standard with nozzle (⌀1.2 mm)

HA1 with minimum pressure increase, positive control
A working pressure increase of $\Delta p \le$ approx. 10 bar results in an increase in displacement from 0.2 $V_{g\,max}$ to $V_{g\,max}$.
Beginning of control, setting range 80 to 340 bar.
Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 300 bar.

▼ **Characteristic curve HA1**



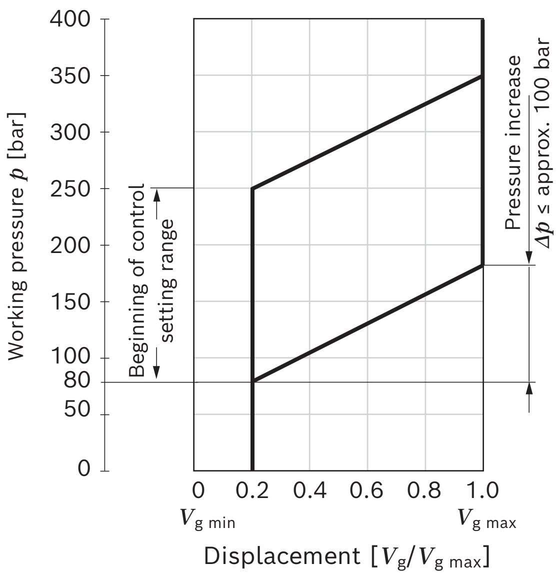
▼ **Circuit diagram HA1**



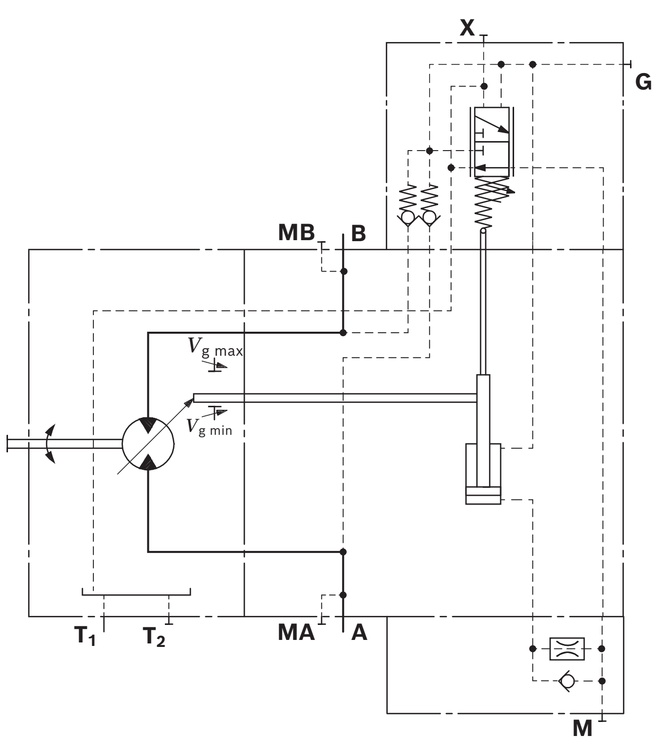
HA2 with pressure increase, positive control

A working pressure increase of Δp approx. 100 bar results in an increase in displacement from 0.2 $V_{g\ max}$ to $V_{g\ max}$.
Beginning of control, setting range 80 to 250 bar.
Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 200 bar.

▼ **Characteristic curve HA2**



▼ **Circuit diagram HA2**



HA.T override, hydraulic,, remote controlled, proportional

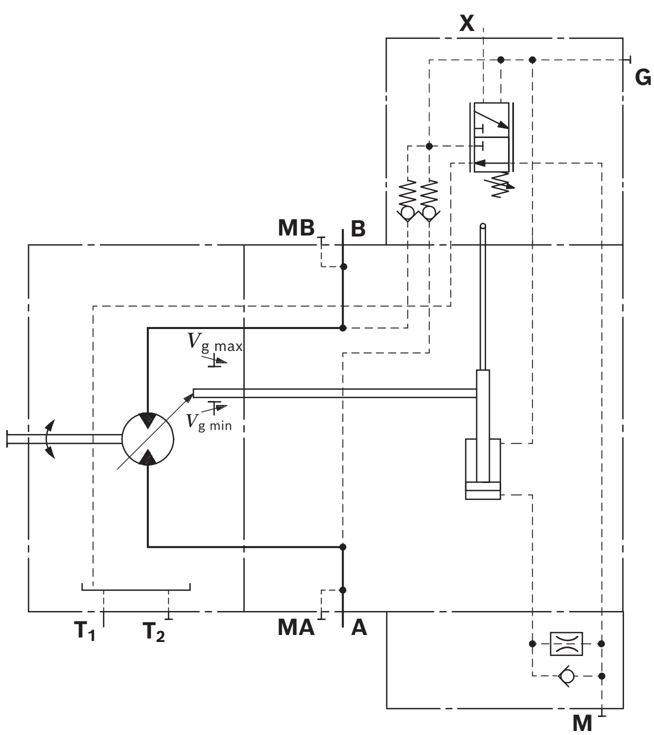
With the HA.T control, the beginning of control can be influenced by applying a pilot pressure to port **X**.
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 8 bar.
If the pilot pressure is sufficiently high, the motor swivels to $V_{g\ max}$ regardless of the working pressure.
(Requirement for safe adjustment: minimum working pressure of 30 bar)

Beginning of control setting	**300 bar**	**300 bar**	**300 bar**
Pilot pressure at port **X**	0 bar	10 bar	40 bar[1)]
Beginning of control at	300 bar	220 bar	0 bar

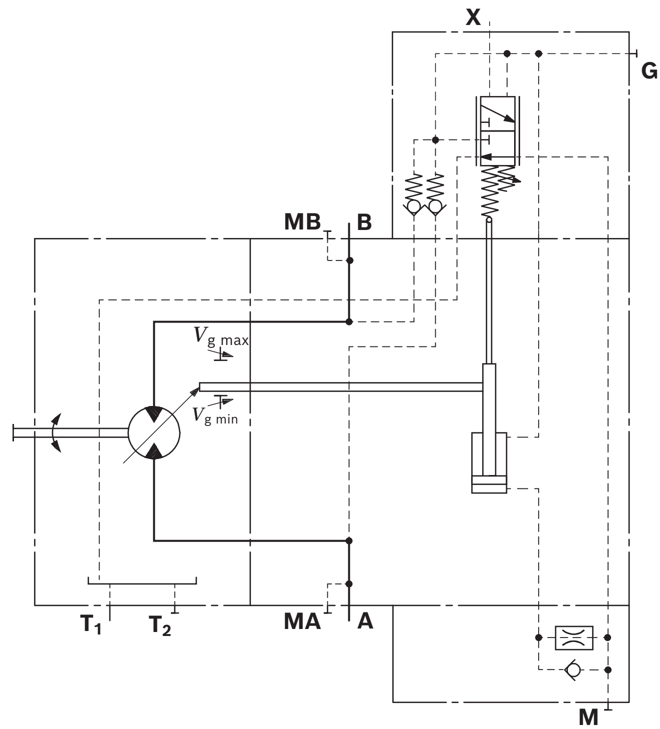
Please note

Maximum permissible pilot pressure 100 bar.

▼ **Circuit diagram HA1.T**



▼ **Circuit diagram HA2.T**



1) HA control overridden; motor at $V_{g\ max}$

DA – Automatic control, speed related

The variable motor A6VM with automatic speed-related control 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 working pressure, regulates the swivel angle of the hydraulic motor.
Increasing drive speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher rotational speed), depending on the working pressure.
If the working pressure exceeds the pressure command value of the controller, the variable motor swivels to a larger displacement (higher torque, lower rotational speed).

- Pressure ratio p_{St}/p_{HD} = 3/100

DA control is only suitable for certain types of travel drive systems and requires review of the motor 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.
Our Sales department will provide you detailed information.

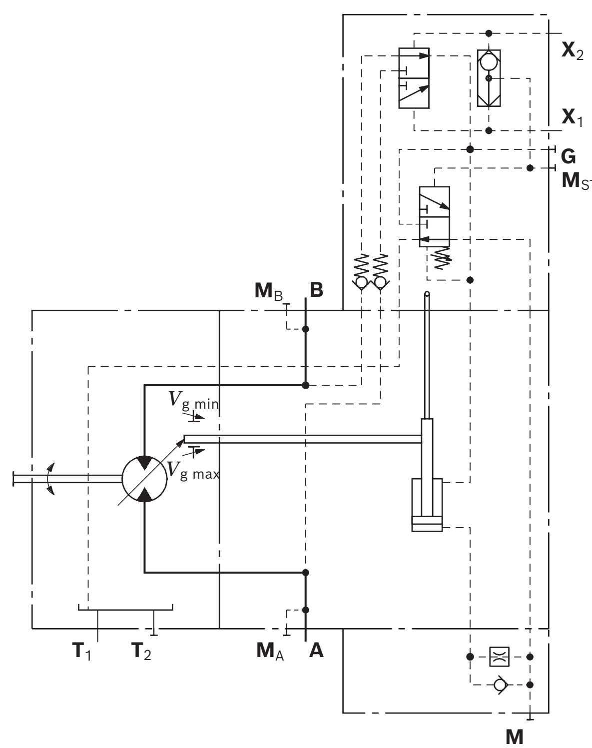
Please note
The beginning of control and the DA characteristic curve are influenced by case pressure. An increase in case pressure causes a reduction in the beginning of control (see page 6) and thus a parallel shift of the characteristic curve.

Stroking time damping
The stroking time damping impacts the swivel behavior of the motor and consequently the machine response speed.
Standard with nozzle (Ø1.2 mm)

DA hydraulic travel direction valve
Depending on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressure ports $\mathbf{X_1}$ or $\mathbf{X_2}$.

Direction of rotation	Working pressure in	Pilot pressure in
Clockwise	**A**	$\mathbf{X_1}$
Counter-clockwise	**B**	$\mathbf{X_2}$

▼ **Circuit diagram DA**

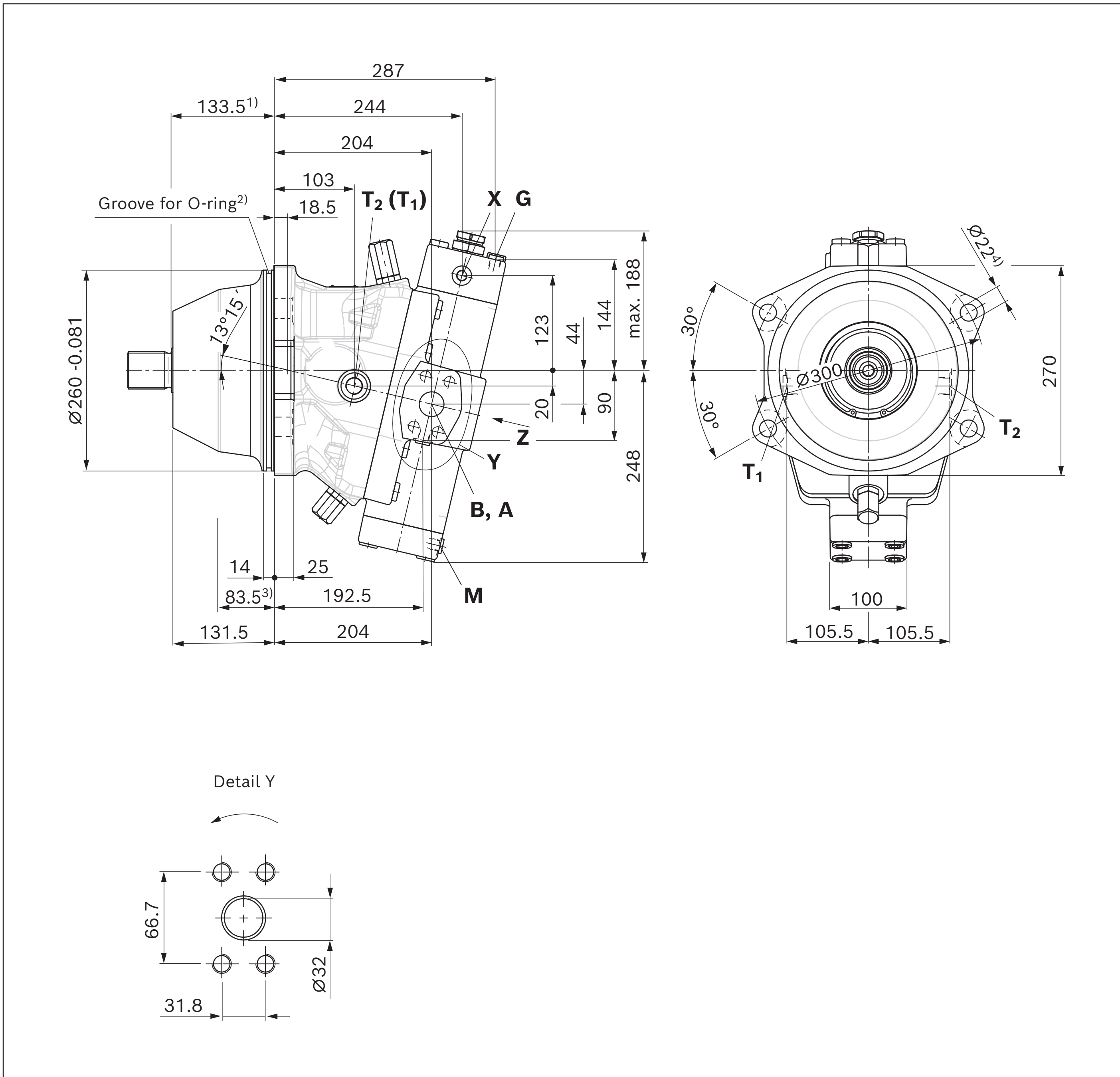


Dimensions

Size 250

HD1, HD2 – Proportional control, hydraulic

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



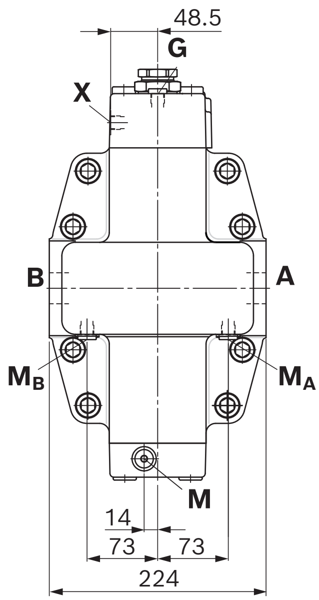
1) To shaft collar
2) The O-ring is not included in the scope of delivery
3) Difference in dimension of mounting flange A6VM to A6VE
4) Mounting hole Ø22 with countersink Ø39.5, 2 deep

Notice

- Dimensions of the control devices, see data sheet 91604.

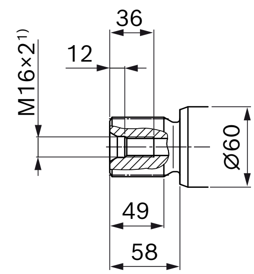
▼ **Location of working ports on the port plates** (View **Z**)

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



▼ **Drive shaft**

Z – W50×2×24×9g



Ports		Standard	Size	p_{max} [bar][4]	State[6]
A, B	Working port Fastening thread A/B	SAE J518[2] DIN 13	1 1/4 in M14 × 2; 19 deep	400	O
T_1	Drain port	DIN 3852[3]	M22 × 1.5; 15.5 deep	3	X[5]
T_2	Drain port	DIN 3852[3]	M22 × 1.5; 15.5 deep	3	O[5]
G	Synchronous control	DIN 3852[3]	M14 × 1.5; 12 deep	400	X
X	Pilot pressure port (HD, HZ, HA1T, HA2T)	DIN 3852[3]	M14 × 1.5; 12 deep	100	O
X	Pilot pressure port (HA1, HA2)	DIN 3852[3]	M14 × 1.5; 12 deep	3	X
X_1, X_2	Pilot pressure port (DA)	DIN 2353-CL	8B-ST	40	O
M	Measuring port, control pressure	DIN 3852[3]	M14 × 1.5; 12 deep	400	X
M_A M_B	Measuring port working pressure	DIN 3852[3]	M14 × 1.5; 12 deep	400	X

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
3) The countersink may be deeper than specified in the standard.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 24).
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

HIRSCHMANN DIN EN 175 301-803-A /ISO 4400
Without bidirectional suppressor diode
Type of protection:

- IP65 (DIN/EN 60529)

The seal ring in the cable fitting is suitable for lines of diameter 4.5 mm to 10 mm.
The mating connector is included in the scope of delivery.

Notice

- If necessary, you can change the position of the connector by turning the solenoid body.
- The procedure is defined in the instruction manual 91606-01-B.

Flushing and boost-pressure valve

The flushing and boost-pressure valve is used to remove heat from the hydraulic circuit.
In an open and closed circuit, it is used for flushing the housing and additionally safeguarding the minimum boost pressure in a closed circuit.
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. In the closed circuit, the removed hydraulic fluid must be replaced by cooled hydraulic fluid supplied by the boost pump.
The valve is mounted on the port plate.

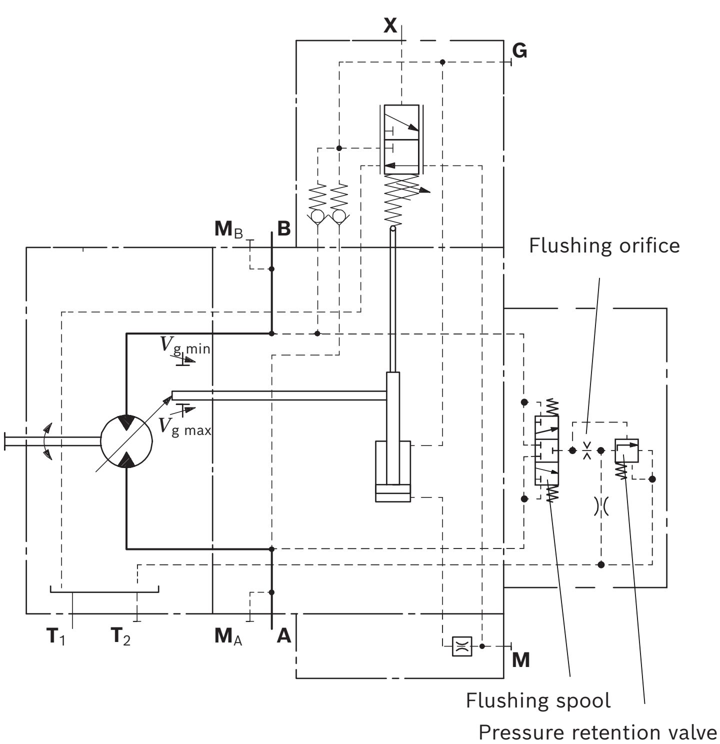
Cracking pressure of pressure retention valve
(observe when setting the primary valve)
- fixed setting 16 bar

Switching pressure of flushing spool Δp
- 8±1 bar

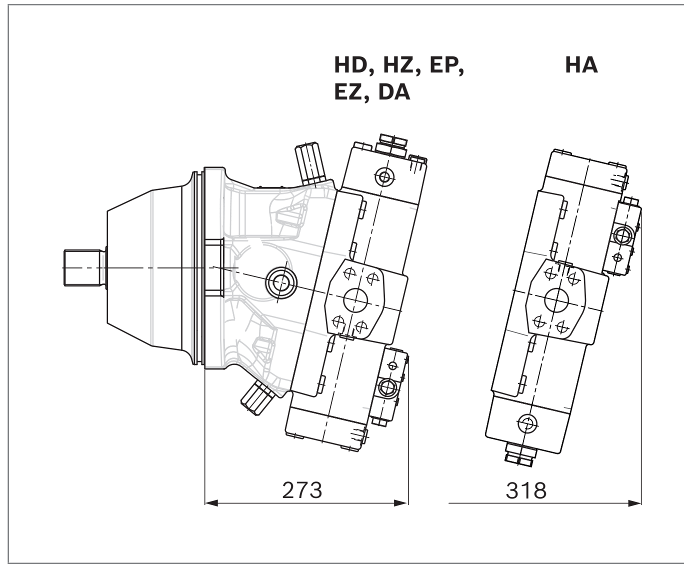
Flushing flow q_v
Orifices can be used to adjust the flushing flows as required. The following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 25 bar and ν = 10 mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Material number of orifice	Ø [mm]	q_v [l/min]
R902290110	2.0	10

▼ **Circuit diagram**



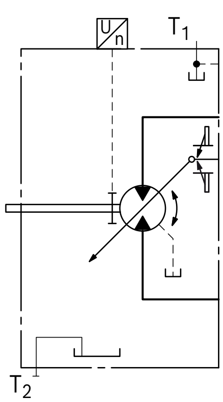
▼ **Dimensions**



Speed sensor

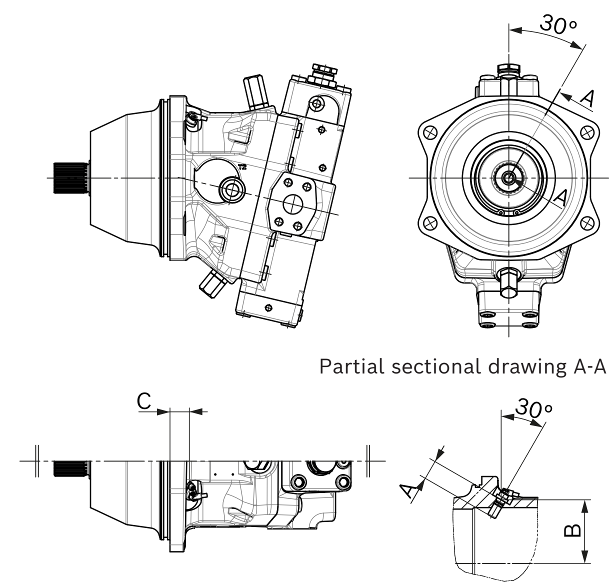
The A6VE...W version ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.
On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.
The motor speed can be recorded by the mounted speed sensor DSA/20. The proportional frequency signal required is generated by splines at the rotary group.
In addition to the rotational speed, the DSA sensor detects the direction of rotation of the motor and the temperature at the installation location.
Type code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95126 (DSA/20).
The sensor is mounted on the port provided for this purpose with a mounting bolt.
We recommend ordering the A6VE variable motor complete with mounted sensor.

▼ **Circuit diagram**



▼ **Dimensions**

Version "C" with mounted speed sensor



Size		250
Number of teeth		78
A	Installation depth (tolerance ±0.1)	32.5
B	Contact surface	105.4
C		32

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 may empty via the hydraulic lines.
The leakage in the housing area must be directed to the reservoir via the highest drain port ($\mathbf{T}_1$, $\mathbf{T}_2$).
If a shared drain line is used for several units, make sure that the respective case pressure in each unit is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating condition, particularly at cold start. If this is not possible, separate drain line must be laid.
To prevent the transmission of structure-borne noise, use elastic elements to decouple all connecting lines from all vibration-capable components (e.g., reservoir, frame parts).
Under all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

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

Key	
F	Filling/air bleeding
$\mathbf{T}_1$, $\mathbf{T}_2$	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)

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

Installation position

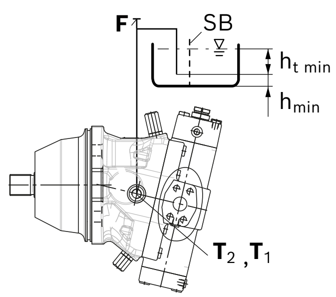
See the following examples **1** to **6**.
Further installation positions are available upon request.
Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

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

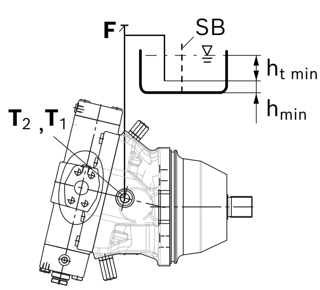
▼ **Installation position 1**

Air bleed	Filling
F	$\mathbf{T}_2$, $\mathbf{T}_1$ (**F**)



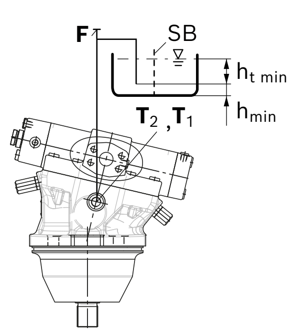
▼ **Installation position 2**

Air bleed	Filling
F	$\mathbf{T}_2$, $\mathbf{T}_1$ (**F**)



▼ **Installation position 3**

Air bleed[1)]	Filling
F	$\mathbf{T}_2$, $\mathbf{T}_1$ (**F**)



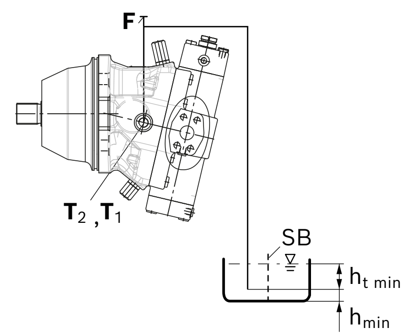
1) Because complete air bleeding and filling are not possible in this position, the motor should be air bled and filled in a horizontal position before installation.

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

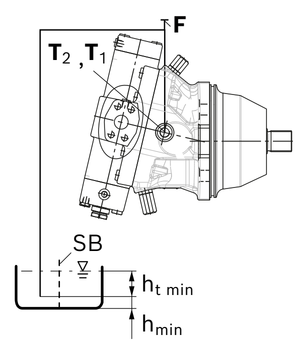
▼ **Installation position 4**

Air bleed	Filling
F	$\mathbf{T}_2$, $\mathbf{T}_1$, (**F**)



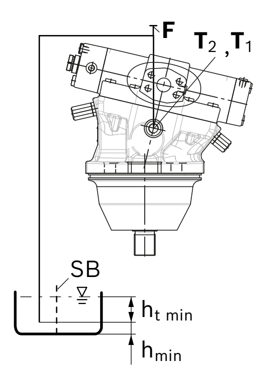
▼ **Installation position 5**

Air bleed	Filling
F	$\mathbf{T}_2$, $\mathbf{T}_1$, (**F**)



▼ **Installation position 6**

Air bleed[1)]	Filling
F	$\mathbf{T}_2$, $\mathbf{T}_1$, (**F**)



Project planning notes

- The motor A6VE is designed to be used in open and closed circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- For safety reasons, controls with beginning of control at $V_{g\,min}$ (e.g., HA) are not permissible for winch drives, e.g. anchor winches!
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservation protection for a maximum of 12 months. If longer preservation protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all configuration 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. Direct current (DC) supply of electromagnets does not generate electromagnetic interferences (EMI), nor does it affect the electromagnet with EMI. Potential electromagnetic interference (EMI) exists if the solenoid is energized with a modulated direct current (e.g. 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.
- The pressure control (hydraulic or electronic) is not an adequate safeguard against pressure overload. Therefore, a pressure relief valve must be provided in the hydraulic system (integrated into the pump or externally in the system). In this connection, observe the technical limits of the pressure relief valve.
- Please note that a hydraulic system is an oscillating system. This can lead, for example, to the stimulation the natural frequency within the hydraulic system during operation at constant rotational speed over a long period of time. The frequency of the motor to be observed is 7 times the rotational speed frequency. This can be prevented, for example, with suitably designed hydraulic lines.
- Please note the details regarding the tightening torques of port threads and other screw connections in the instruction manual.
- The ports and fastening threads are designed for the p_{max} permissible pressures of the respective ports, see the connection tables. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The service ports and function ports are only intended to accommodate hydraulic lines.
- Please note that the series connection of motors and the operation under summation pressure affect the efficiency of the units.
- The control behavior of the motor can change slightly due to natural influences such as running-in or setting behavior over time. Calibration may be required.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take the appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. contaminated hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator’s specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk.
  The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.
- In certain conditions, moving parts in high-pressure relief valves might get stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid). 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.

Related documentation

Product-specific documentation

Document type	Title	Document number
Data sheet	Speed sensor DSA, series 20	95126
	Technical Data for Torsional Vibration Calculation	90261
	Proportional pressure reducing valve	29281
	Axial piston variable motor A6VM series 63	91604
	Storage and preservation of axial piston units	90312
Instruction manual	Axial piston plug-in motor A6VE series 63	91606-01-B

Documentation for hydraulic fluids

Document type	Title	Document number
Data sheet	Hydraulic fluids based on mineral oils and related hydrocarbons	90220
	Environmentally acceptable hydraulic fluids	90221
	Rating of hydraulic fluids used in Rexroth hydraulic components (pumps and motors)	90235
	Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)	90245

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