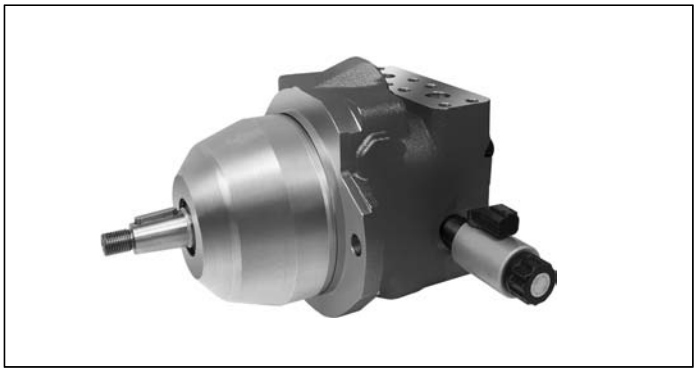
Reversible axial piston variable motor
A10VER series 52
for hydrostatic fan drives

RE 91706
Issue: 09.2015
Replaces: –.–



- Sizes 30 to 45
- Nominal pressure 280 bar
- Maximum pressure 350 bar
- Open circuit

Features

- Variable motor with axial piston rotary group in swash-plate design for hydrostatic fan drives in open circuits
- The output speed is proportional to the inlet flow
- The output torque increases proportionally with the pressure difference between the high- and low-pressure sides and increasing displacement
- Specially developed for hydrostatic fan drives
- The A1OVER variable motor is equipped with a rotary group of the overcenter type with a maximum displacement of +/- 100% $V_{g\,max}$. This permits reversing operation without the need for costly additional components for air flow reversal and the cleaning of contaminated coolers, and thus achieves fuel savings by means of improved cooling performance.
- The energy efficiency of hydraulic fan drives is increased due to the elimination of external reversing valves.
- Stable storage for long service life
- High permissible output speed
- Favorable power-to-weight ratio – compact dimensions
- Low noise

Contents

Ordering code

01	02	03	04	05		06	07		08	09	10	11	12	13	14
A10V	**E**	**R**			**/**	**52**	**R**	**–**	**V**		**F**				

Axial piston unit

		30	37	45	
01	Variable swashplate design, nominal pressure 280 bar, maximum pressure 350 bar	●	●	●	**A10V**

Operation mode

02	Motor, plug-in version, open circuit	**E**
03	Reversible +/– 100%	**R**

Size (NG)[1)]

		30	37	45
04	For geometric displacement, see table of values, page 6	**30**	**37**	**45**

Control device

				30	37	45	
05	Two-point control	U = 12 V	with shifting time orifice	●	●	●	**EZ6**
	electric with switching solenoid	U = 24 V	with shifting time orifice	●	●	●	**EZ7**

Series

06	Series 5, Index 2	**52**

Direction of rotation[2)]

07	Viewed on drive shaft	clockwise (cooling operation)	**R**

Sealing material

08	FKM (fluoroelastomer)	**V**

Drive shaft

09	Conical shaft with woodruff key and UNF threaded bolt	●	●	●	**C**
	Conical shaft with woodruff key and metric threaded bolt	●	●	●	**Y**

Mounting flanges

10	Special flange similar to SAE J744 101-2 (B)	2-hole	**F**

Working port

11	SAE flange port fastening thread, metric	same side	●	●	●	**10N00**
	Threaded port, metric	same side	○	○	○	**16N00**
	SAE flange port fastening thread, UNF	same side	●	●	●	**60N00**
	Threaded port, UNF	same side	○	○	○	**66N00**

Valves

12	without	●	●	●	**0**
	integrated anti cavitation valve	●	●	●	**2**
	integrated anti cavitation valve and pressure relief valve	○	○	○	**4**

Speed sensing

13	without speed sensing	●	●	●	
	Inductive speed sensor mounted DSA[3)]	○	○	○	**B**
	Inductive speed sensor mounted DSM[3)]	○	○	○	**M**

Connector for solenoids

14	DEUTSCH – molded connector, 2-pin – without suppressor diode (for electric controls)	**P**

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

Note

Observe the project planning notes on page 16 or the project planning and commissioning instructions 90363.

1) Additional sizes available on request
2) Additional directions of rotation available on request
3) Specify ordering code of sensor in accordance with data sheet 95132 – DSM or 95133 – DSA separately and observe the requirements for the electronics.

Hydraulic fluids

The A10VER variable motor is designed for operation with HLP mineral oil according to DIN 51524. For more hydraulic fluids please contact us.
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

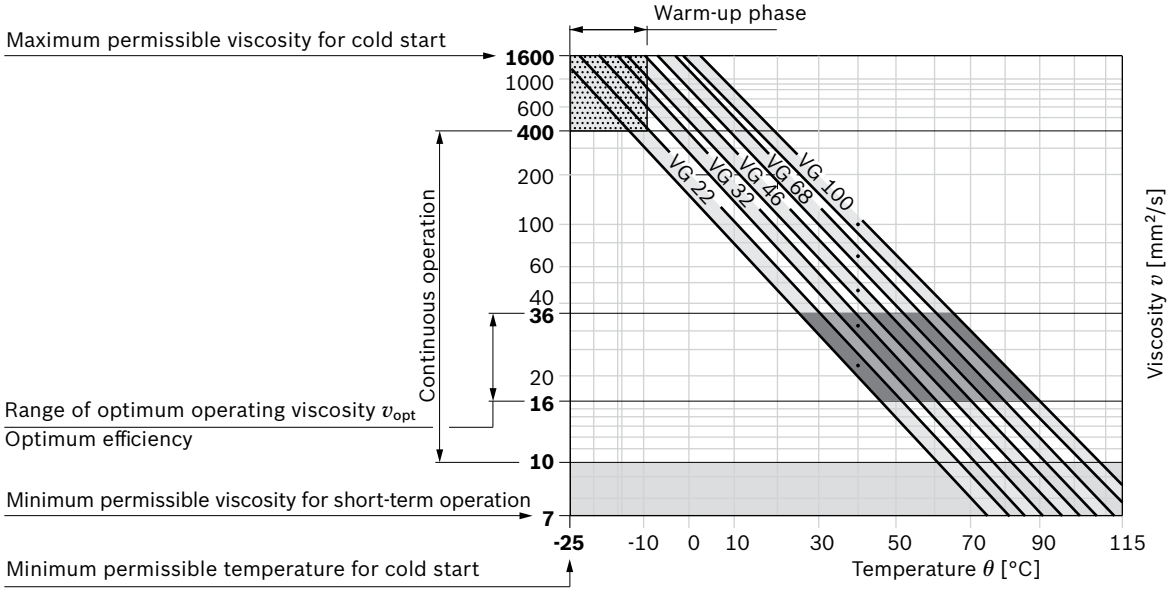
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range (v_{opt}, see selection diagram).

Note
At no point on the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature[1)]	Comment
Cold start	$v_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -25$ °C	$t \leq 1$ min, without load ($p \leq 30$ bar), $n \leq 1{,}000$ rpm
permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$v < 1600$ to 400 mm²/s	$\theta = -25$ °C to -10 °C[1)]	Observe the detailed information on operation at low temperatures, see data sheet 90300-03-B
Continuous operation	$v = 400$ to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram page 3)
		$\theta = -25$ °C to +110 °C	measured at port **L** Observe the permissible temperature range of the shaft seal (ΔT = approx. 5 K between the bearing/shaft seal and port **L**)
	$v_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$v_{min} \geq 7$ mm²/s		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



1) At temperatures from -40° C to -25° C please contact us

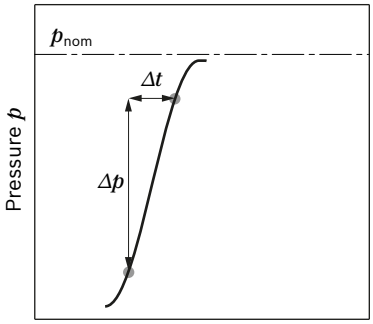
Filtration of the hydraulic fluid

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 very high hydraulic fluid temperatures (90 °C to maximum 115 °C), at least cleanliness level 19/17/14 according to ISO 4406 is necessary.
Please contact us if the above classes cannot be observed.

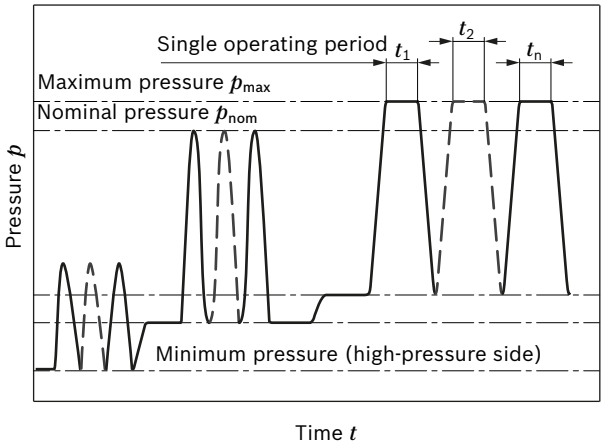
Operating pressure range

Pressure at service line port B		**Definition**
Nominal pressure p_{nom}	280 bar absolute	The nominal pressure corresponds to the maximum design pressure. **The series control of motors is not permissible.**
Maximum pressure p_{max}	350 bar absolute	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	2.5 ms	
Total operating period	300 h	
Minimum pressure $p_{MD\ abs}$ (high-pressure side)	20 bar absolute	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\ max}$	16000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at low-pressure port A		
Minimum pressure $p_{ND\ min}$ Standard	2 bar absolute	Minimum pressure at low-pressure port **A** (outlet) that is required in order to avoid damage to the axial piston unit.
Maximum pressure $p_{ND\ max}$	10 bar absolute[1)]	
Leakage pressure at port L		
Maximum pressure $p_{L\ max}$ Operation as a motor, open circuit	2 bar absolute	

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



▼ **Pressure definition**



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

1) Higher pressures on request

Note

Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

Flow direction

Direction of rotation Motor with unchanged pressure side B	**at $V_{g\ max}$ + + 100%**	**$V_{g\ max}$ – - 100%**
(de-energized) clockwise	**B** to **A**	
(energized) counter-clockwise		**B** to **A**

Technical data

Size		NG		30	37	45
Displacement geometric, per revolution		+ 100% $V_{g\,max}$	cm^3	30	37	45
		– 100% $V_{g\,max}$	cm^3	30	37	45
Maximum rotational speed[1]	at $V_{g\,max}$	n_{nom}	rpm	2400	2200	2000
Minimum rotational speed[1]	at permanent operation	n_{nom}	rpm	250	250	250
Torque	at $V_{g\,max}$ and Δp = 280 bar	T	Nm	133.5	165	200
Rotary stiffness of drive shaft	C	c	Nm/rad	32380	32380	32380
	Y	c	Nm/rad	32380	32380	32380
Moment of inertia for rotary group		J_{TW}	kgm^2	0.0033	0.0033	0.0033
Maximum angular acceleration[2]		α	rad/s^2	4000	4000	4000
Case volume		V	l	0.7	0.7	0.7
Weight without through drive (approx.)		m	kg	18	18	18

Determining the operating characteristics				
Inlet flow	q_v	$= \frac{V_g \times n}{1000 \times \eta_v}$		[l/min]
Torque	T	$= \frac{1.59 \times V_g \times \Delta p \times \eta_{hm}}{100}$		[Nm]
or	T	$= T_K \times \Delta p \times \eta_{hm}$		
Power	P	$= \frac{2 \pi \times T \times n}{60000}$	$= \frac{q_v \times \Delta p \times \eta_t}{600}$	[kW]
Output speed	n	$= \frac{q_v \times 1000 \times \eta_v}{V_g}$		[rpm]

Key

V_g	=	Displacement per revolution [cm^3]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{hm}	=	Hydraulic mechanical efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)
T_K	=	Torque constant

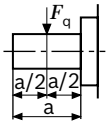
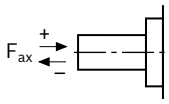
Note

- Theoretical values, without efficiency and tolerances; values rounded
- Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. Bosch Rexroth recommends testing the load by means of experiment or calculation / simulation and comparison with the permissible values.

1) The values apply:
– At absolute pressure p_{abs} = 2 bar at low-pressure port **A**
– For the optimal viscosity range of v_{opt} = 36 to 16 mm^2/s
– For hydraulic fluid based on mineral oils

2) The data are valid for values between the minimum necessary and the maximum permissible drive speeds. Valid for external excitation (e. g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

Permissible radial and axial forces of the drive shafts

Size		NG		30	37	45
Maximum radial force at a/2		$F_{q\,max}$	N	1500	1500	1500
Maximum axial force		$\pm F_{ax\,max}$	N	1500	1500	1500

Note

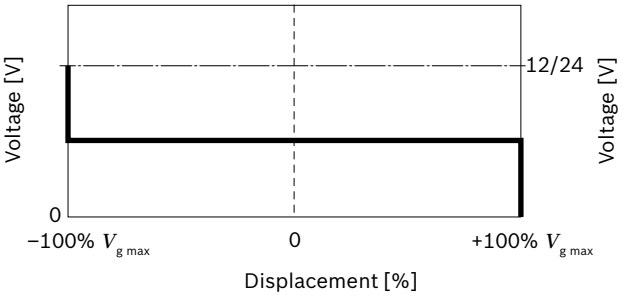
- The values given are maximum values and do not apply to continuous operation. For drives with radial loading (pinion, V-belt drives), please contact us!

EZ. – Two-point control, electric

The variable motor is set to $V_{g\,max}$ +100% or $V_{g\,max}$ –100% by actuating the solenoid of the control valve. When de-energized, the axial piston units swivels to $V_{g\,max}$ +100%, when energized, to $V_{g\,max}$ –100%.
The response time is extended via the in-built orifice, thus enabling smooth swiveling.

With each direction of rotation of the motor, the control pressure is taken at the high-pressure side **B**.

▼ **Characteristic curve EZ**

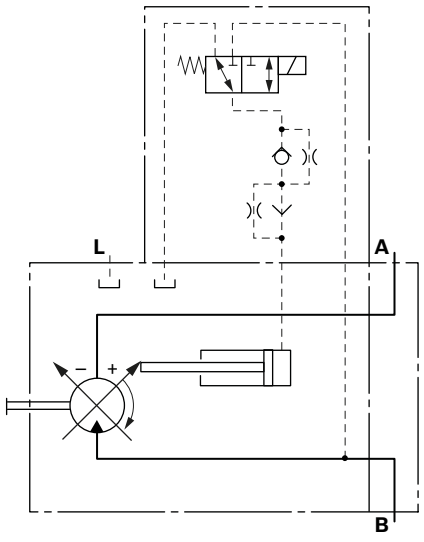


Influencing the swivel position

Swivel direction + 100%		**Swivel cradle position**
De-energized	≙	$V_{g\,max+}$
Swivel direction – 100%		
Energized	≙	$V_{g\,max-}$

Note
Observe the project planning notes on page 16 or the project planning and commissioning instructions 90363.

▼ **Circuit diagram EZ6/EZ7**



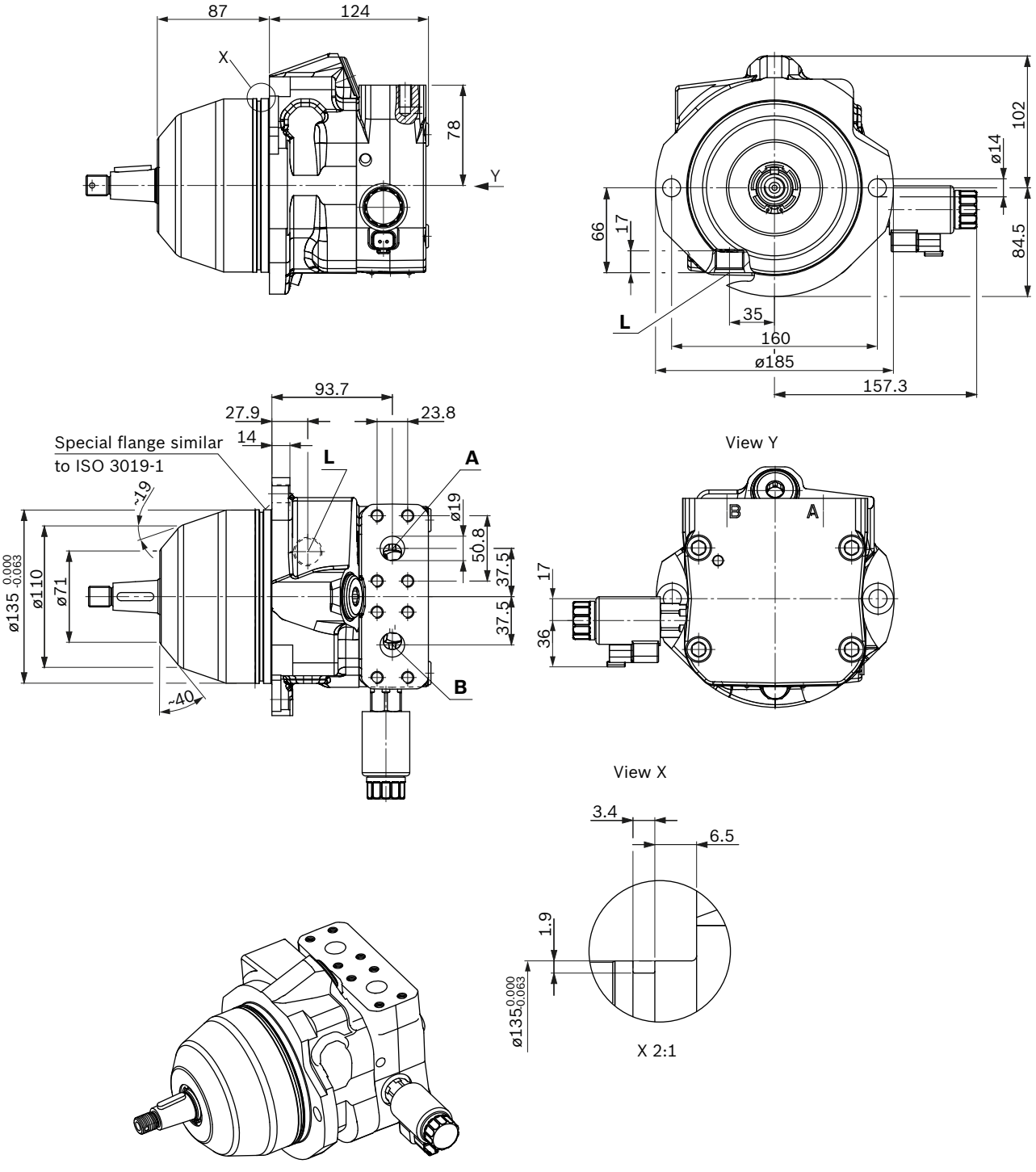
Solenoid data

Technical data, solenoids	**EZ6**	**EZ7**
Nominal voltage	12 V DC	24 V DC
Nominal current (at 20 °C)	1.5 A	0.8 A
Duty cycle	100%	100%
Type of protection: see connector version page 13		
Ambient temperature range -20 °C to +60 °C Please contact us if these temperatures cannot be observed.		

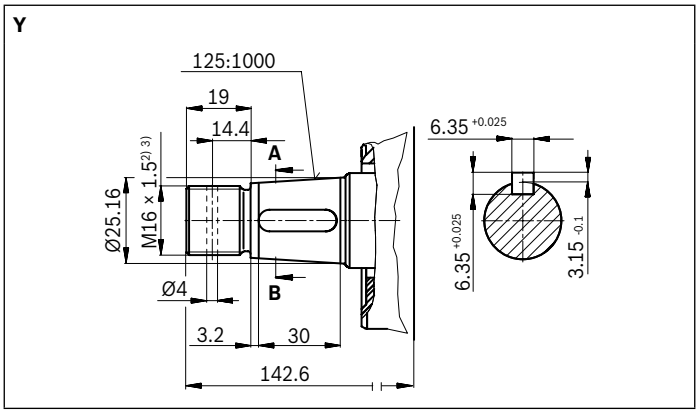
Dimensions sizes 30, 37 and 45

EZ6/EZ7 – Two-point control, electrically with DEUTSCH connector, clockwise rotation, series 52

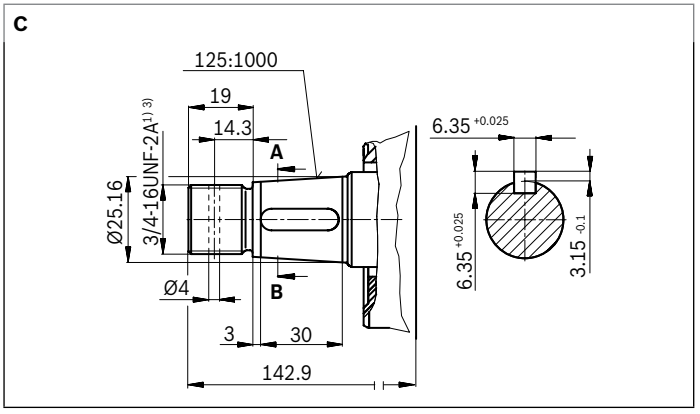
▼ **Port plate 10N00/60N00**



▼ **Tapered shaft with shaft key, metric threaded bolt**



▼ **Tapered shaft with shaft key, imperial threaded bolt**



Ports		Standard	Size[3]	$p_{max\ abs}$ [bar][4]	State[7]
Port plate 10					
A	Service line port (high-pressure series) Fastening thread	SAE J518[5] DIN 13	3/4 in M10 × 1.5; 17 deep	10	O
B	Service line port (high-pressure series) Fastening thread	SAE J518[5] DIN 13	3/4 in M10 × 1.5; 17 deep	350	O
L	Drain port	ISO 11926[6]	7/8-14UNF-2B; 17 deep	2	O
Port plate 60					
A	Service line port (high-pressure series) Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 21 deep	10	O
B	Service line port (high-pressure series) Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 21 deep	350	O
L	Drain port	ISO 11926[6]	7/8-14UNF-2B; 17 deep	2	O

1) Thread according to ASME B1.1
2) Thread according to DIN 13
3) For the maximum tightening torques, see instruction manual.
4) Depending on the application, temporary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Metric fastening thread is a deviation from standard
6) The spot face can be deeper than as specified in the standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Anti cavitation valve

Without pressure cut-off
Order option ...N002
When switching off the system, the anti cavitation valve ensures the motor of heavy-duty drives (e.g. hydrostatic fan drives) is supplied with hydraulic fluid until it comes to a standstill.
The valve is integrated in the port plate.

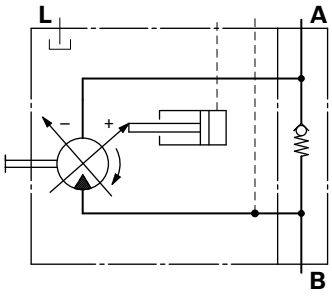
Note

- Observe the direction of rotation of the unit during project planning.
- The standard rotation of direction is clockwise. Please contact us regarding counter-clockwise rotation.

The external unit dimensions correspond to the standard version, see the unit dimensions for the length dimensions.

▼ **Circuit diagram**

Clockwise rotation



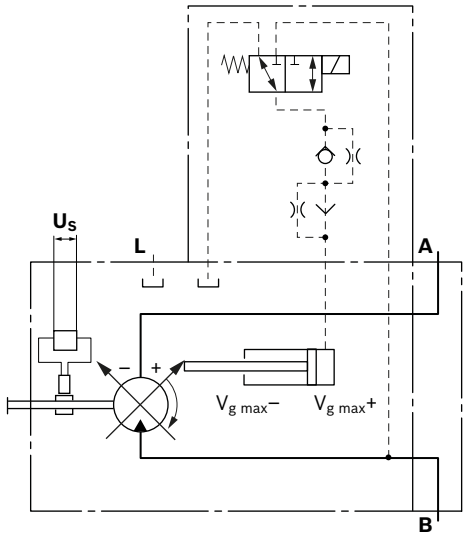
Speed pickup

Order option ...B or M

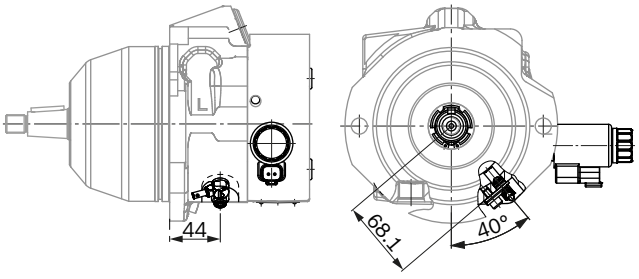
A signal proportional to the motor speed can be generated with the fitted DSA (B)/DSM (M) speed sensor. The DSA/DSM sensor measures the speed and/or direction of rotation. Ordering code, technical data, dimensions, and details on the connector, plus safety information about the sensor can be found in the relevant data sheet 95132 – DSM and 95133 – DSA.

The sensor is mounted on the port provided for this purpose with a mounting bolt.

▼ **Circuit diagram**



▼ **Dimensions**



Connector for solenoids

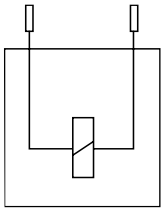
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

The following type of protection ensues with a mounted mating connector:

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

▼ **Switching 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 connector orientation by turning the solenoid housing.
The procedure is defined in the instruction manual.

System solution for hydrostatic fan drives with reversing function

AFC30 software

The BODAS AFC30 is a standard software solution integrated in the RC4-5/30 control unit from Rexroth for controlling hydrostatic fan drives with fixed or variable hydraulic pumps. The AFC30 is designed to control a fan drive in an open hydraulic circuit. The performance requirement of the fan can be modified for up to 6 temperature signals (analog//J1939). The AFC30 can be used with 12 V and 24 V systems. Since the AFC30 provides cooling capacity according to requirements, fuel consumption is significantly reduced compared with fan drive systems that are not proportionally controlled.

Further information on this can be found in data sheets

- 95362 (application software fan speed control AFC30) and
- 95205 (BODAS controller RC4-5, series 30)

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 drain in the housing area must be discharged to the reservoir via the highest available tank port (**L**). If this is not possible, separate drain lines must be installed if necessary.

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 characteristic can be expected. Gravity, dead weight and case pressure can cause minor shifts in characteristics and changes in response time.

For key, see page 15.

Installation Position

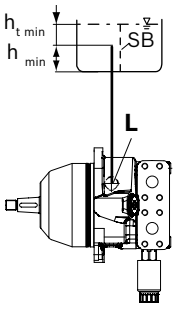
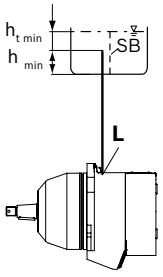
See the following examples **1** to **4**.

Additional installation positions are available upon request.

Recommended installation position: **2**

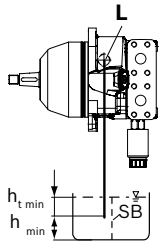
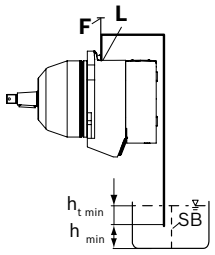
Below-reservoir installation (standard)

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

Installation Position		Air bleeding	Filling
1		–	**L**
2		–	**L**

Above-reservoir installation

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

Installation position	Air bleeding	Filling
3 	–	**L**
4 	**F**	**L**

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

Note

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

Project planning notes

- The A10VER variable motor is designed for fan drives used in open circuits.
- The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of 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. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. A pressure relief valve is to be provided in the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the intended operating conditions (pressure, flow, hydraulic fluid, temperature) and the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.
- Further specific information on this product can be found in the project planning note 90363.

Safety instructions

- During and shortly after operation, there is a risk of burning on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or torque build-up of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must check whether additional measures on the machine are required for the relevant application in order to bring the powered load into a safe position (e.g. safe stop) and ensure all appropriate measures are taken.

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