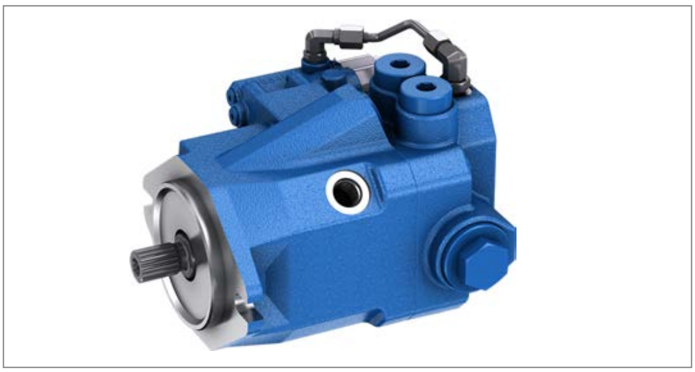
Axial piston variable pump A10VWO Series 52



- Sizes 28 and 45
- Nominal pressure 250 bar
- Maximum pressure 280 bar
- Open circuit

Features

- Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- Flow is proportional to drive speed and displacement up to the pressure relief/deflection point.
- Flow can be infinitely varied by controlling the swashplate angle.
- Alternating drive direction with constant pressure output and integrated rectifier circuit
- Compact design
- Streamlined arrangement of the valve technology in the port plate
- Constant flow specification regardless of rotational speed

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Type code

01	02	03	04		05	06		07	08	09	10	11		12
A10VW	**O**		**DFR1**	**/**	**52**	**W**	**–**	**V**		**C**		**N00**	**–**	**S0157**

Axial piston unit

01	Swashplate design, variable, nominal pressure 250 bar, maximum pressure 280 bar	**A10VW**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see table of values on page 6	**028**	**045**

Control device

				028	**045**	
04	Constant volume controller	hydraulic	X-T plugged, with flushing function	●	●	**DFR1**

Series

05	Series 5, index 2	**52**

Direction of rotation

			028	**045**	
06	Viewed on drive shaft	variable	●	●	**W**

Sealing material

		028	**045**	
07	FKM (fluoroelastomer)	●	●	**V**

Drive shaft

			028	**045**	
08	Splined shaft according to ISO 3019-1	Standard shaft	●	●	**S**
		Reduced diameter, permissible input torque see page 7	●	●	**U**

Mounting flange

			028	**045**	
09	ISO 3019-1	2-hole	●	●	**C**

Working port

			028	**045**	
10	Threaded ports rear	UN thread (ISO 11926)	●	●	**64**
		Pipe thread (DIN ISO 228)	●	●	**70**

Through drive

		028	**045**	
12	Without through drive	●	●	**N00**

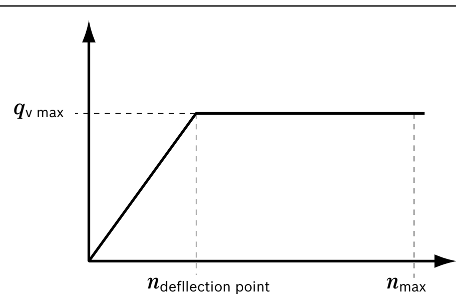
Standard/special version

		028	**045**	
13	Preset quantity limitation via orifice in the **B** channel	●	●	**S0157**

● = Available ○ = On request – = Not available

Project planning note!

When ordering, specify:



Rotational speed [rpm]	n_{max}	
	$n_{deflection\ point}$	
Pressure [bar]	p_{max}	
Flow [l/min]	$q_{v\ max}$	

Notice

▶ Also note the project planning notes on page 16.

Hydraulic fluids

The A10VWO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
See the following data sheets for application instructions and requirements for hydraulic fluids before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons

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 provided in the following technical data sheet:

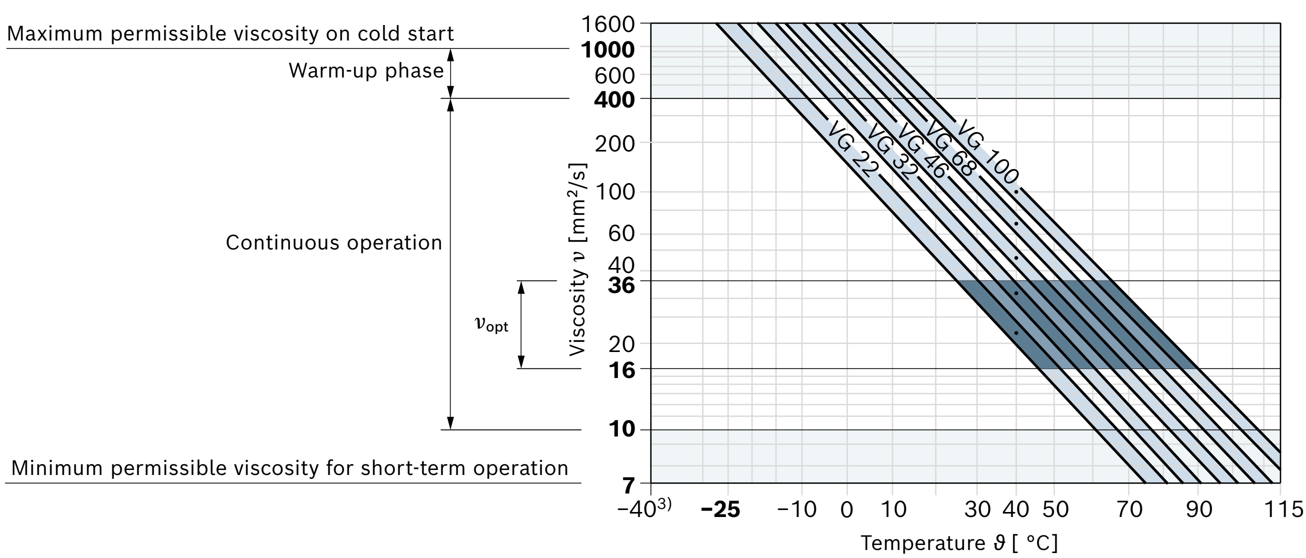
- 90245: Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)

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[2)]	Comment
Cold start	$\nu_{max} \leq 1600\ mm^2/s$	FKM	$\vartheta_{St} \geq -25°C$	$t \leq 3$ min, without load ($p \leq 30$ bar), $n \leq 1000$ rpm Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
Warm-up phase	$\nu = 1600 \ldots 400\ mm^2/s$			$t \leq 15$ min, $p \leq 0.7 \times p_{nom}$ and $n \leq 0.5 \times n_{nom}$
Continuous operation	$\nu = 400 \ldots 10\ mm^2/s$[1)]	FKM	$\vartheta \leq +110°C$	Measured at port $\mathbf{L_X}$
	$\nu_{opt} = 36 \ldots 16\ mm^2/s$			Optimal operating viscosity and efficiency range
Short-term operation	$\nu_{min} = 7\ mm^2/s$	FKM	$\vartheta \leq +110°C$	$t \leq 1$ min, $p \leq 0.3 \times p_{nom}$, measured at port $\mathbf{L_X}$

▼ **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) If the temperature at extreme operating parameters cannot be adhered to, please contact us.

3) Special version, 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 under ISO 4406 should be maintained.

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

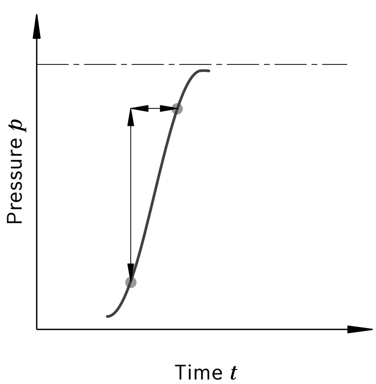
For example, viscosity is 10 mm^2/s at:

- HLP 32 a temperature of 73 °C
- HLP 46 a temperature of 85 °C

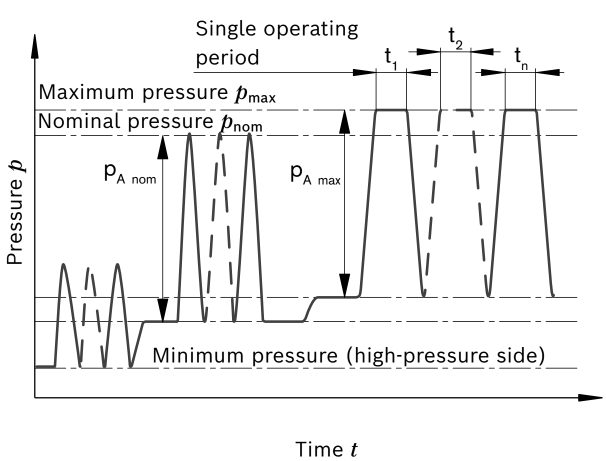
Working pressure range

Pressure at working port B			Definition
Nominal pressure p_{nom}		250 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}		280 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.
	Single operating period	2.5 ms	
	Total operating period	300 h	
Minimum pressure $p_{B\ abs}$ (high-pressure side)		10 bar	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 pressure build-up and reduction speed during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)			
Minimum pressure $p_{S\ min}$	Standard	1.0 bar absolute	Minimum pressure at suction port **S** (inlet) which is required to prevent damage to the axial piston unit. The axial piston unit is self-priming, an increase in inlet pressure is not permissible.
Case pressure at port L, L_1			
Maximum pressure $p_{L\ max}$		2 bar absolute	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{L\ max}$. A drain line to the reservoir is required.

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



▼ **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.

Flow direction
S to **B**

Technical data, standard unit

Size		**NG**		**28**	**45**
Geometric displacement, per revolution		$V_{g\ max}$	cm³	28	45
Rotational speed maximum [1)2)4)5)]	**with reduced pressure p_{nom} ≤100 bar**	$n_{max\ perm}$	rpm	4000	2850
Rotational speed maximum [1)2)4)5)]	**with pressure p_{nom} >100 bar**	n_{max}	rpm	3000	1500
Volume flow (in flow mode) [2)3)5)]	maximum	$q_{v\ max}$	l/min	50	50
Power at $q_{v\ max}$ and Δp = 250 bar	with n_{nom}, $V_{g\ max}$	P_{max}	kW	21	21
Torque with $V_{g\ max}$ and	Δp = 250 bar	M_{max}	Nm	111	179
	Δp = 100 bar	M	Nm	45	72
Rotary stiffness of drive shaft	S	c	Nm/rad	22300	37500
	U	c	Nm/rad	16700	30000
Moment of inertia of the rotary group		J_{TW}	kgm²	0.0017	0.0033
Maximum angular acceleration[6)]		α	rad/s²	5500	4000
Case volume		V	l	0.3	0.5
Weight (approx.)		m	kg	18	25.5

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

Key

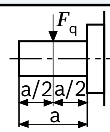
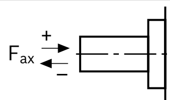
V_g	=	Displacement per revolution [cm³]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{hm}	=	Hydraulic-mechanical efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

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. Bosch Rexroth recommends checking the loading by means of test or calculation / simulation and comparison with the permissible values.

1) The values are applicable:
   – for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
   – with hydraulic fluid on the basis of mineral oils
2) The values are applicable:
   – At an absolute pressure p_{abs} = 1.0 bar at the suction port **S**
3) $q_{v\ max}$ must not be exceeded.
4) The maximum flow volume is attained from "$n_{deflection\ point}$" (see type code on page 2), as rotational speed continues to rise, the maximum flow volume must not increase further (V_g much less than $V_{g\ max}$ or at zero stroke)
5) A load collective (Q over n) allows a detailed rating of requirements. System acceptance is urgently recommended.
6) The data are valid for values between the minimum required and maximum permissible rotational speed. It applies for external stimuli (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 connection parts must be considered.

Permissible radial and axial loading of the drive shaft

Size		NG		28	45
Maximum radial force at a/2		$F_{q\ max}$	N	1200	1500
Maximum axial force		$\pm F_{ax\ max}$	N	1000	1500

Notice

- The values given are maximum values and do not apply to continuous operation. All loads of the drive shaft reduce the bearing service life! The drive with radial loading (pinion, V-belt) is not permissible!

Permissible input torques

Size				28	45
Torque at $V_{g\ max}$ and Δp = 250 bar[1]		M_{max}	Nm	111	179
Maximum input torque on drive shaft[2]					
	S	$M_{E\ max}$	Nm	198	319
		Ø	in	7/8	1
	U	$M_{E\ max}$	Nm	105	188
		Ø	in	3/4	7/8

1) Efficiency not considered
2) For drive shafts with no radial force

Functional description

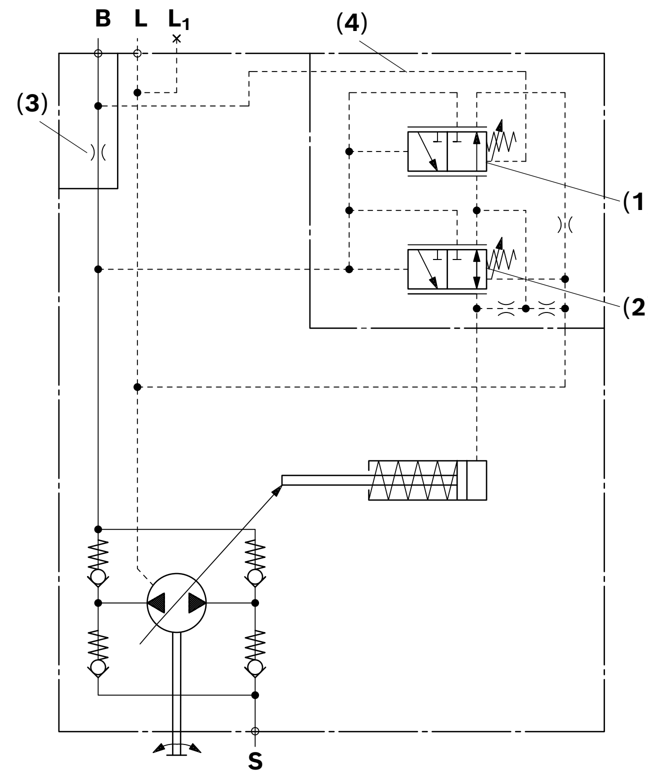
A differential pressure is set via an orifice (**3**) installed in the pressure duct **B** of the pump.

Notice
- The nozzle diameter of the orifice (nozzle) (**3**) is calculated using the ordering details on page 2 "Project planning note". This information is absolutely required.

This differential pressure is sent to the flow controller in the pump, which specifies the necessary flow volume by changing the displacement (swivel angle).
Depending on requirements, from a certain pump speed (vehicle speed), a constant volume is made available.
The A10VWO can be operated with alternating direction of rotation whereby the flow direction **S** to **B** always remains the same.

Notice
To prevent damage, complete air bleed of the axial piston unit and the suction line is required.
For further information about installation positions, please refer to page 14.

▼ **Schematic A10VWO...DFR1**



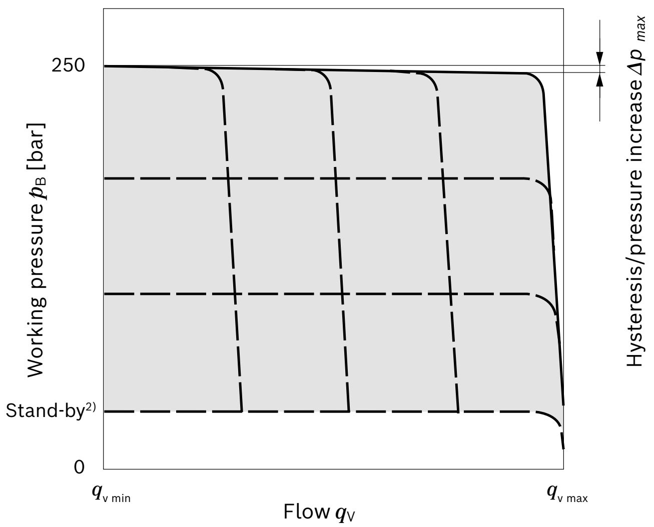
1 Constant volume controller (**FR**).
2 Pressure controller (**DR**)
3 Orifice (for constant volume)
4 Piping

DFR1 – constant volume controller

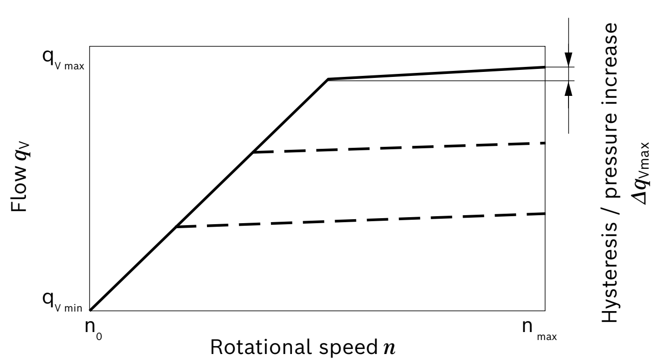
Via an orifice (**3**) in the pressure channel **B** of the pump, a differential pressure is generated and fed to the constant volume controller FR (**1**).
The pump is thus set to a defined quantity, independent of speed. The set volume is available in both directions of rotation.
The function of the pressure controller (**2**) takes priority over the constant volume controller.
The internal orifice diameter is calculated using the ordering data on page 2 "Project planning note".

- Basic position in depressurized state $V_{g\ max}$
- Setting range up to 250 bar[1)]

▼ **Characteristic curve**

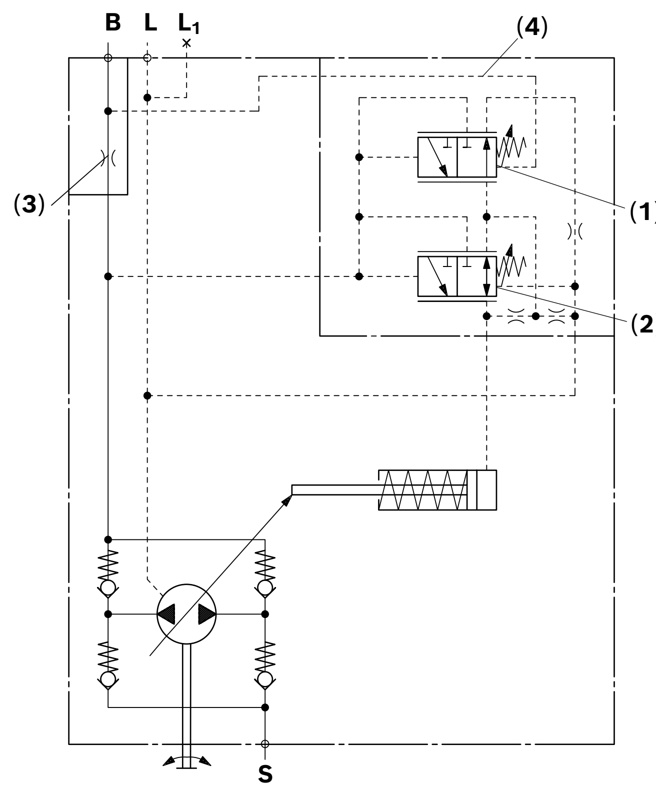


▼ **Characteristic curve at variable rotational speed**



Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ **Schematic DFR1, sizes 28 and 45**

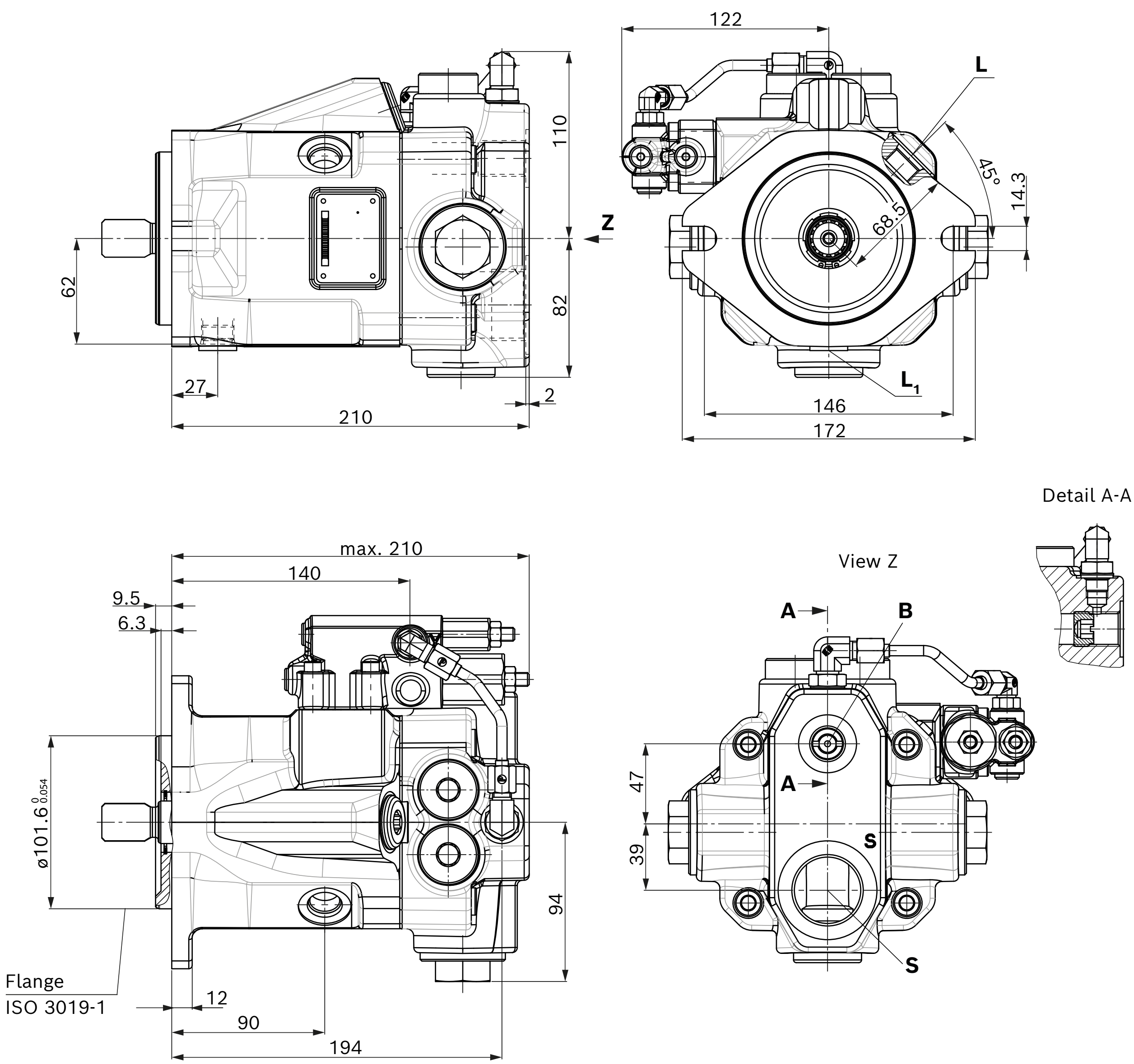


1 Constant volume controller (**FR**).
2 Pressure controller (**DR**)
3 Orifice (for constant volume)
4 Piping

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded.
The range of possible settings at the valve is higher.
2) Zero stroke pressure from pressure setting Δp on controller (**2**)

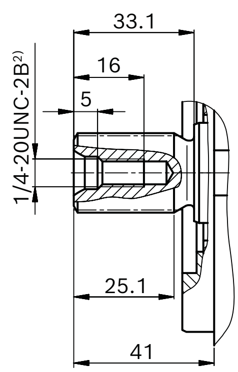
Dimensions, size 28

DFR1 – constant volume controller, hydraulic



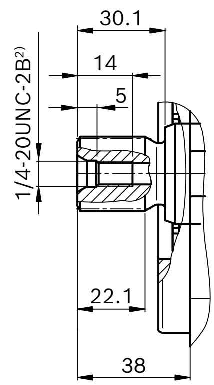
▼ **Splined shaft 7/8 in (22-4 (ISO 3019-1))**

S – 13T 16/32DP[1)]



▼ **Splined shaft 3/4 in (19-4 (ISO 3019-1))**

U – 11T 16/32DP[1)]

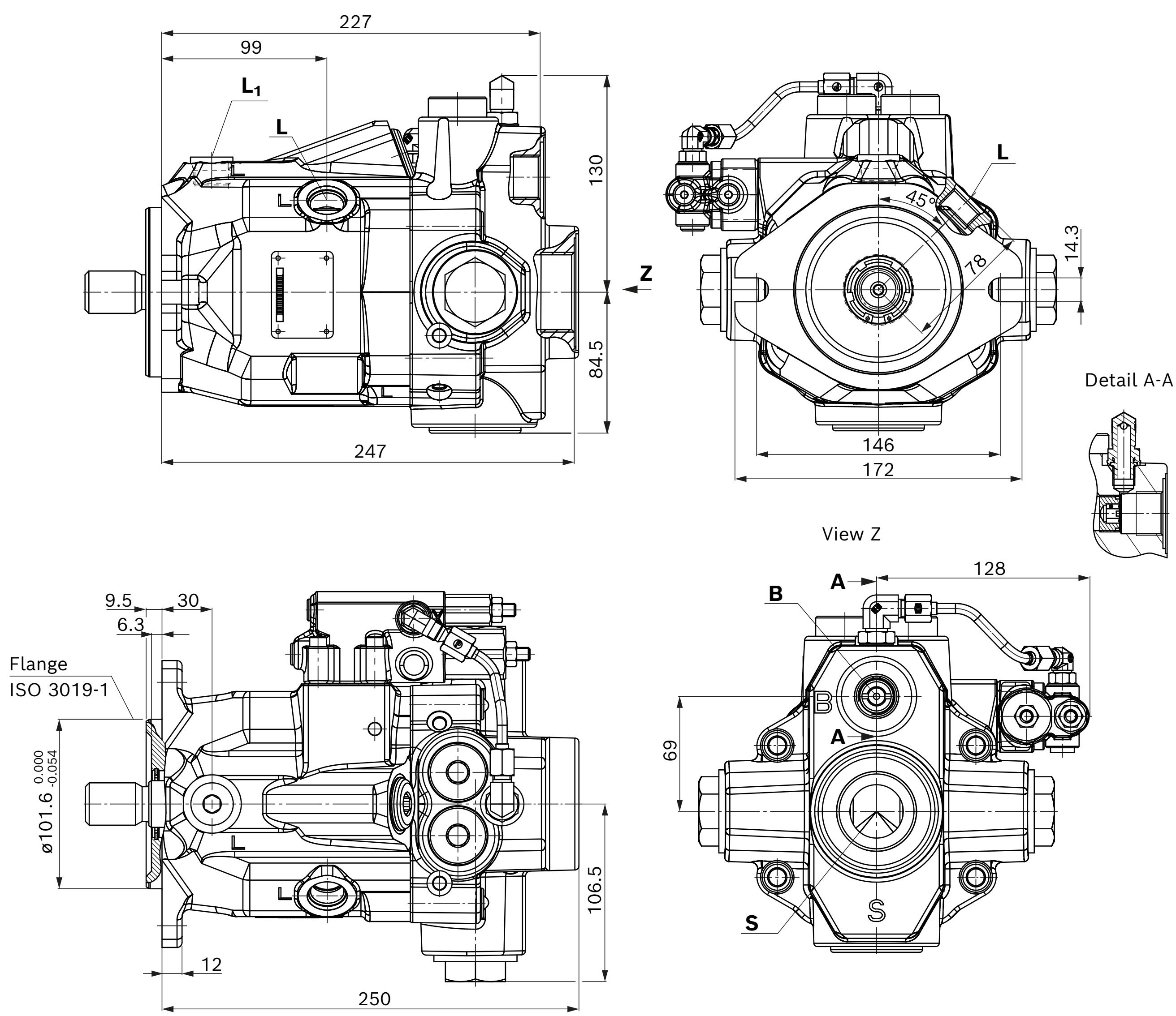


Ports			Standard	Size	$p_{\text{max abs}}$ [bar][3)]	State[6)]
B	Working port	Port plate 64	ISO 11926	1 1/16 in 12UN-2B; 20 deep	280	O
		Port plate 70	DIN EN ISO 228	G 1/2; 28 deep	280	O
S	Suction port	Port plate 64	ISO 11926	1 5/8 12UN-2B; 20 deep	1	O
		Port plate 70	DIN EN ISO 228	G 1 1/4; 20 deep	1	O
L	Drain port		ISO 11926[4)]	3/4-16 UNF-2B; 12 deep	2	O[5)]
L_1	Drain port		ISO 11926[4)]	3/4-16 UNF-2B; 11 deep	2	X[5)]

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) The countersink can be deeper than specified in the standard.
5) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page14).
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

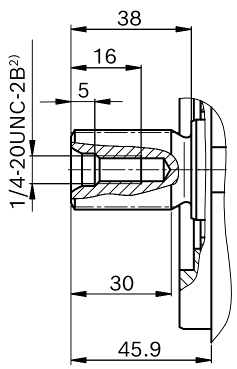
Dimensions, size 45

DFR1 – constant volume controller, hydraulic



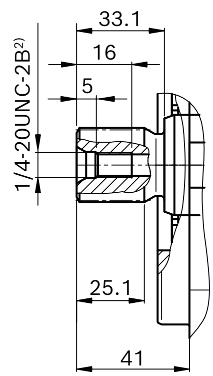
▼ **Splined shaft 1 in (25-4 (ISO 3019-1))**

S – 15T 16/32DP[1)]



▼ **Splined shaft 7/8 in (22-4 (ISO 3019-1))**

U – 13T 16/32DP[1)]



Ports			**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[3)]	**State**[6)]
B	Working port	Port plate 64	ISO 11926	1 1/16 in 12UN-2B; 20 deep	280	O
		Port plate 70	DIN EN ISO 228	G 3/4; 16 deep	280	O
S	Suction port	Port plate 64	ISO 11926	1 7/8 in 12UN-2B; 20 deep	1	O
		Port plate 70	DIN EN ISO 228	G 1 1/2; 22.2 deep	1	O
L	Drain port		ISO 11926[4)]	7/8-14 UNF-2B; 13 deep	2	O[5)]
$\mathbf{L_1}$	Drain port		ISO 11926[4)]	7/8-14 UNF-2B; 14.5 deep	2	X[5)]

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) The countersink can be deeper than specified in the standard.
5) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 14).
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

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.
Particularly with the "drive shaft up/down" installation position, 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 available drain port (**L**, **L_1**).
For combination pumps, the leakage must be drained off at each single pump.
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, if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The minimum suction pressure at port **S** must also not fall below 1 bar absolute during operation and during a cold start.
When designing the reservoir, ensure adequate distance between the suction line and the drain line. This prevents the heated return flow from being drawn directly back into the suction line.

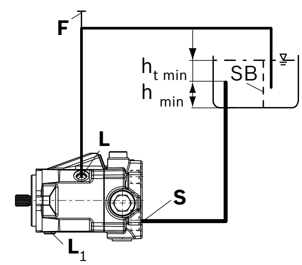
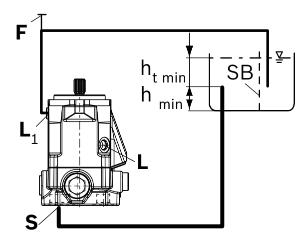
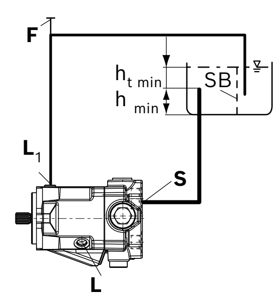
For key, see page 15.

Installation position

See the following examples **1** to **3**.
Further installation positions are available upon request.
Recommended installation position: **1** and **3**

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 	**L**	**F**
2 	**L_1**	**F**
3 	**L_1**	**F**

Key	
F	Filling / Air bleeding
S	Suction port
L; L_1	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)
$h_{ES\ min}$	Minimum height required to prevent axial piston unit from draining (25 mm)

Notice

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

Project planning notes

- The A10VWO axial piston variable pump is intended to be used in open circuit.
- 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 appropriate instruction manual thoroughly and in full. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes contained herein 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 which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in safety functions according to ISO 13849. Please consult the proper contact 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 a direct voltage signal (DC) to solenoids does not create electromagnetic interference (EMI) nor is the solenoid affected by EMI. A possible electromagnetic interference (EMI) exists if the solenoid is supplied with modulated direct current (e.g. PWM signal). Electromagnetic interference (EMI) potential exists when operating and controlling a solenoid with a modulated direct voltage signal (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.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure 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 designed to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burning 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 should test whether additional measures are required on the machine for the relevant application in order to bring the driven consumer into a safe position (e.g., safe stop) and make sure any measures are properly implemented.

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