Axial Piston Variable Pump
A1VO Series 10

RE 92650
Issue: 02.2013
Replaces: 01.2012

- Size 35
- Nominal pressure 250 bar
- Maximum pressure 280 bar
- Open circuit

Features

- Variable pump in axial piston swashplate design for hydrostatic drives in an open circuit
- The flow is proportional to the drive speed and displacement.
- The volume flow can be infinitely varied by adjusting the swashplate angle.
- A wide range of highly adaptable control devices with different pilot and regulating functions, for all important applications.
- Compact design
- High efficiency
- High power density
- Low noise

Contents

Ordering code

01	02	03	04	05	06	07	08		09	10	11	12	13	14	15	16	17		18
A1V	**O**	**035**		**C**	**2**		**0**	**/**	**10**	**B**		**V**	**B2**		**1**		**0**	**–**	**0**

Axial piston unit

01	Swashplate design, variable, nominal pressure 250 bar, maximum pressure 280 bar	**A1V**

Operating mode

02	Pump, open circuit	**O**

Sizes (NG)

03	Geometric displacement, see table of values on page 7	**035**

Control devices

04	Pressure controller		●	**DR**
	with override, electrically proportional, negative control	*U* = 12 V	○	**D3**
		U = 24 V	○	**D4**
	with load sensing		●	**DRS0**

Controller design and mounting

05	Cartridge	**C**

Setting

06	Adjustable	**2**

Connector for solenoids[1)]

07	Without connector (without solenoid, only for hydraulic control)	●	**0**
	DEUTSCH – molded connector, 2-pin, without suppressor diode (see page 16)	○	**P**

Auxiliary function

08	Without additional function	**0**

Series

09	Series 1, index 0	**10**

Configuration of ports and fastening threads

10	ANSI, port threads with O-ring seal according to ISO 11926, metric fastening thread on through drive version	**B**

Directions of rotation

11	Viewed on drive shaft	cw	**R**
		ccw	**L**

Seals

12	FKM (fluor-caoutchouc)	**V**

Mounting flange

13	SAE J744	101-2	**B2**

Drive shafts (for permissible input torque, see page 8)

14	Splined shaft, ANSI B92.1a	7/8 in 13T 16/32 DP, not for through drive	**S4**
		1 in 15T 16/32DP	**S5**

● = Available ○ = On request

1) Connectors for other electric components can deviate

Ordering code

01	02	03	04	05	06	07	08		09	10	11	12	13	14	15	16	17		18
A1V	**O**	**035**		**C**	**2**		**0**	**/**	**10**	**B**		**V**	**B2**		**1**		**0**	**–**	**0**

Service line ports

15	Threaded connections A/B and S on opposite sides	**1**

Through drives (for fitting options, see page 15)

	Flange SAE J744			Coupling for splined shaft[2]			
		Fitting variant					
	Diameter	Symbol[3]	Designation	Diameter		Designation	
16	Without through drive						**0000**
	82-2 (A)	o-o	A2	5/8 in	9T 16/32 DP	S2	**A2S2**
				3/4 in	11T 16/32 DP	S3	**A2S3**
				7/8 in	13T 16/32 DP	S4	**A2S4**
	101-2 (B)	o-o	B2	7/8 in	13T 16/32 DP	S4	**B2S4**
				1 in	15T 16/32 DP	S5	**B2S5**

Auxiliary function

17	Without additional function	**0**

Standard / special version

18	Standard version	**0**

● = Available ○ = On request

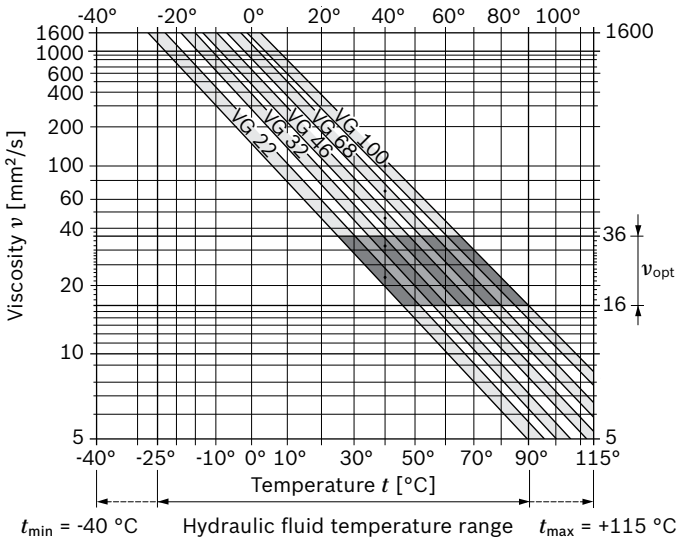
2) Coupling for splined shaft according to ANSI B92.1a
3) Configuration of securing holes when viewed to through drive, with service line port B on right.

Hydraulic fluid

Prior to project planning, please refer to the detailed information in our data sheet RE 90220 (mineral oil) concerning the choice of hydraulic fluid and application conditions.

Further hydraulic fluids only after approval examination. Please contact us.

▼ **Selection diagram**



Notes on the choice of hydraulic fluid

Choosing the correct hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature, in an open circuit the reservoir temperature.
The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.
Example: at an ambient temperature of X °C the operating temperature is 60 °C. In the optimum operating viscosity range (ν_{opt}, shaded area), this corresponds to the viscosity classes VG 46 or VG 68. To be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the reservoir temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.
Please contact us if the above conditions cannot be maintained due to extreme operating parameters.

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		T_{min} ≥ -50 °C T_{opt} = +5 °C to +20 °C	Factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up	ν_{max} = 1600	T_{St} ≥ -25 °C	t ≤ 1 min, without load (p ≤ 30 bar), n ≤ 1000 rpm
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400		At p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 5 K	between hydraulic fluid in the bearing and at port L
Maximum temperature		115 °C	in the bearing
		110 °C	measured at port L
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port L, no restriction within the permissible data
Short-term operation	ν_{min} ≥ 10	T_{max} = +110 °C	measured at port L, t < 1 min, p < 0.3 • p_{nom}
FKM shaft seal		T ≤ +115 °C	See page 5

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. To ensure the functional reliability of the axial piston unit, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.
At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

The FKM shaft seal is permissible for case drain temperatures of -25 °C to +115 °C.

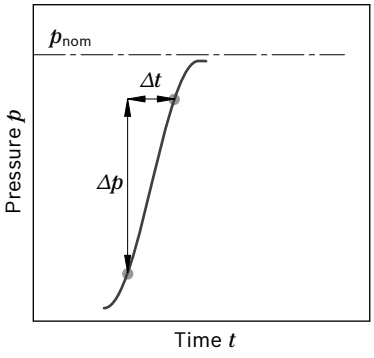
Note

For the temperature range below -25 °C, the values in the table on page are4 to be observed.

Operating pressure range

Pressure at service line port B		Definition
Nominal pressure p_{nom}	250 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	280 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period (maximum number of cycles: approx. 1 million).
Single operating period	0.05 s	
Total operating period	14 h	
Minimum pressure (high-pressure side)	14 bar[1)] absolute	Minimum pressure on the high-pressure side (B) that 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 builld-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\,min}$	0.8 bar absolute	Minimum pressure at suction port S (inlet) that is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\,max}$	5 bar absolute	
Case drain pressure at port L_1, L_2		
Maximum pressure $p_{L\,max}$	2 bar absolute	Maximum 0.5 bar higher than inlet pressure at port S, but not higher than $p_{L\,max}$.

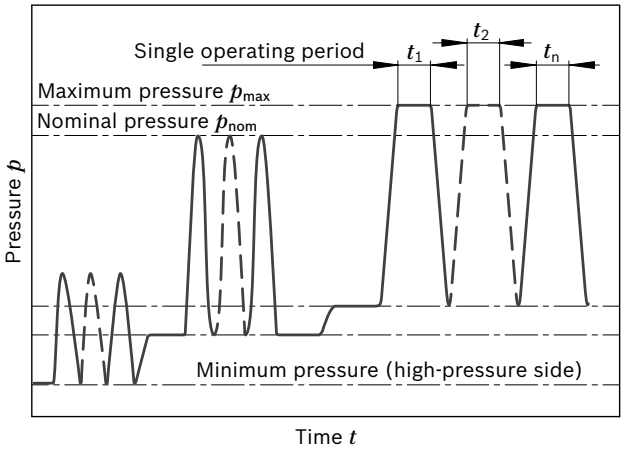
▼ **Rate of pressure change $R_{A\,max}$**



Note

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

▼ **Pressure definition**



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

1) Please contact us about lower pressures

Technical data

Size		NG		35
Geometric displacement, per revolution		$V_{g\,max}$ $V_{g\,min}$	cm^3 cm^3	35 0
Rotational speed, maximum[1)2)]	at $V_{g\,max}$[3)] at $V_g \leq V_{g\,max}$[4)]	n_{nom} n_{max}	rpm rpm	3000 3000
Flow	at n_{nom} and $V_{g\,max}$	q_v	L/min	105
Power	At n_{nom}, $V_{g\,max}$ and Δp = 250 bar	P	kW	44
Torque	at $V_{g\,max}$ and Δp = 250 bar	T	Nm	139
Rotary stiffness	Drive shaft S4	c	kNm/rad	18.6
	Drive shaft S5	c	kNm/rad	22.9
Moment of inertia for rotary group		J_{TW}	kgm^2	0.00159
Angular acceleration, maximum[5)]		α	rad/s^2	5000
Case volume		V	L	0.6
Weight (without through drive) approx.		m	kg	16.9

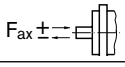
Formulas			
Flow	$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$		[L/min]
Torque	$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$		[Nm]
Power	$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t}$		[kW]
Key			
V_g	=	Displacement per revolution in cm^3	
Δp	=	Differential pressure in bar	
n	=	Speed in rpm	
η_v	=	Volumetric efficiency	
η_{mh}	=	Mechanical-hydraulic efficiency	
η_t	=	Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)	

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. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

1) The following values apply:
   – For the optimum viscosity range from v_{opt} = 36 to 16 mm^2/s
   – For hydraulic fluid based on mineral oils
2) If pressure $p_{suction}$ < 1 bar absolute at suction port S, please contact us.
3) These values are applicable at absolute pressure $p_{suction}$ ≥ 1 bar at suction port S.
4) Maximum rotational speed (limit speed) at $V_g \leq V_{g\,max}$.
5) The data are valid for values between the minimum required and maximum permissible speed. Valid for external excitation (e. g. engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limit value applies for a single pump only. The load capacity of the connection parts must be considered.

Permissible radial and axial forces of the drive shafts

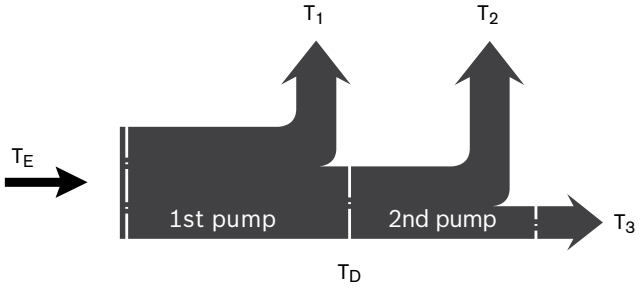
Size		NG		35	35
Drive shaft			in	7/8	1
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	Please consult us if radial and/or axial forces occur.	
		a	mm		
Maximum axial force		$+ F_{ax\,max}$	N		
		$- F_{ax\,max}$	N		

Note
For drives with radial loading (pinion, V-belt drives), please contact us!

Permissible input and through-drive torques

Size			NG		35
Torque at $V_{g\,max}$ and Δp = 250 bar[1]			T_{max}	Nm	139
Input torque at drive shaft, maximum[2]					
	S4	7/8 in	$T_{E\,max}$	Nm	198
	S5	1 in	$T_{E\,max}$	Nm	319
Maximum through-drive torque			$T_{D\,max}$	Nm	139[1]

▼ **Torque distribution**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

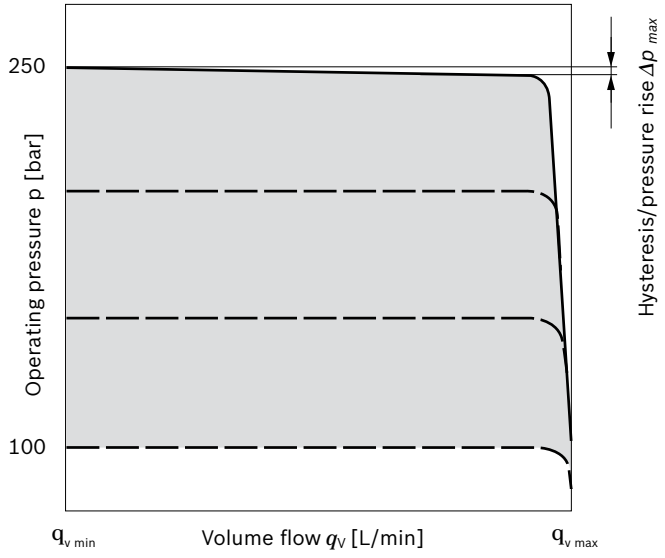
1) Efficiency not considered
2) For drive shafts without radial force

DR – Pressure control

The pressure control limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

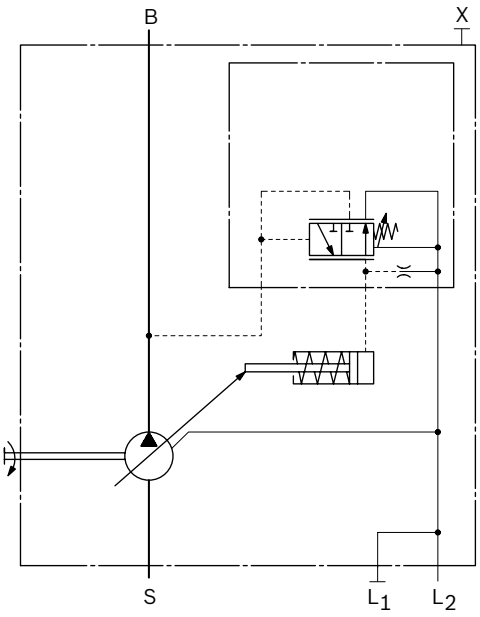
- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1)] for pressure control: 100 to 250 bar.

▼ **Characteristic DR**



Characteristic valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.

▼ **Circuit diagram DR**



Controller data

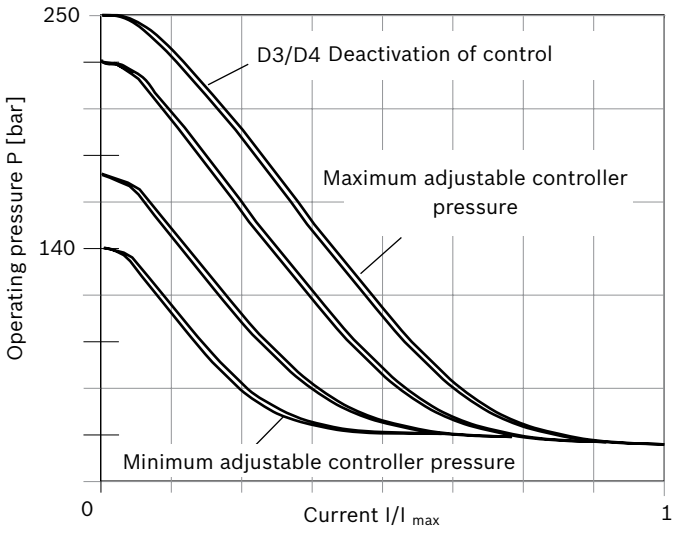
NG	35
Hysteresis and repeat precision Δp	Maximum 5 bar
Pilot fluid consumption	Maximum approx. 3 L/min

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. Lower values on request

D3/D4 – Pressure control with override

With electric pressure adjustment using a proportional solenoid, the high pressure can be freely adjusted depending on the solenoid current. When the load pressure is changed at the consumer, the pump flow volume is adjusted so that the specified pressure is achieved again. If the solenoid current drops below the start of control, the unit will go to the set maximum pressure. The same thing applies if the pilot signal is lost.

▼ **Current-pressure characteristic (negative characteristic)**



Characteristic measured with pump in zero stroke.
Further information on request.

DRS0 – Pressure control with load sensing

In addition to the pressure control function (DR), the load-sensing controller works as a flow controller that operates as a function of the load pressure to regulate the pump displacement to match the consumer flow requirement. The load-sensing controller compares pressure before and after the sensing orifice and keeps the pressure drop (differential pressure Δp) across the orifice – and therefore the flow constant.

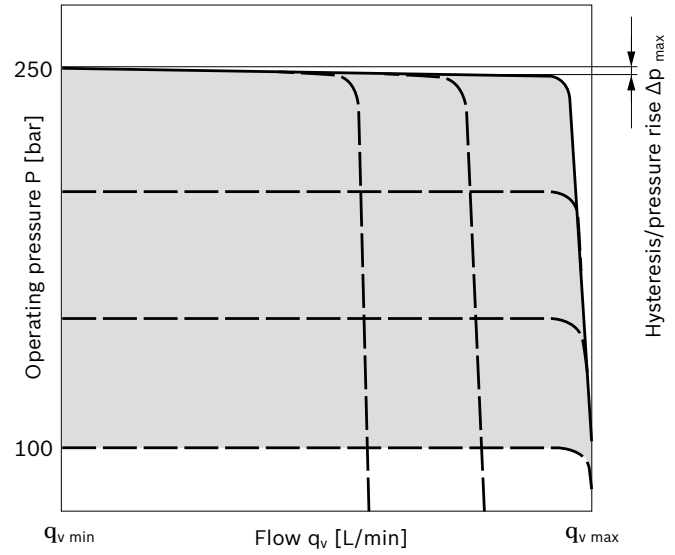
The swiveling in due to the pressure or flow controller will always take priority.

▶ Setting range[1)] for pressure control: 100 to 250 bar.

Note

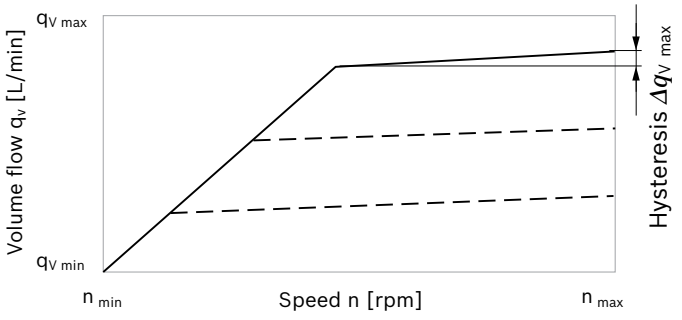
The DRS0 version has no connection from **X** to the reservoir so the LS relief has to be incorporated into the system.

▼ **Characteristic DRS0**

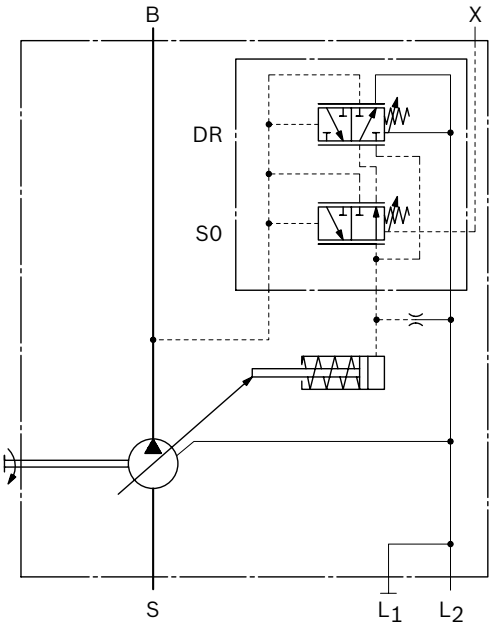


Characteristic valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.

▼ **Characteristic at variable speed**



▼ **Circuit diagram DRS0**



Differential pressure Δp

Standard setting: 14 bar. If another setting is required, please state in clear text.

Controller data

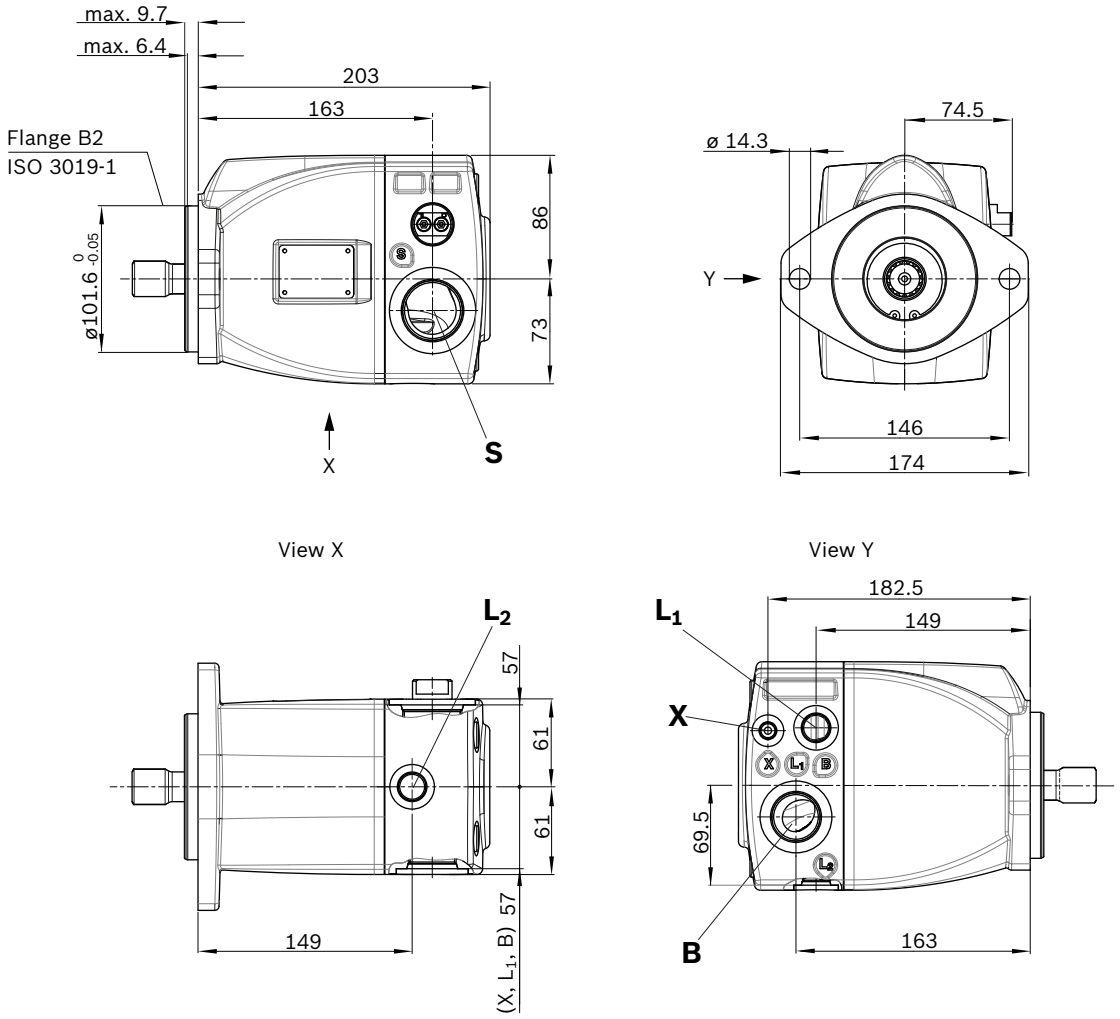
For data for the pressure control DR, please refer to page 9. Maximum flow differential (hysteresis and increase) measured at drive speed n = 1500 rpm and t_{fluid} = 50 °C

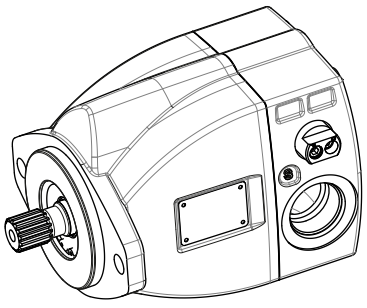
NG	35
Volume flow difference $\Delta q_{V\,max}$	3 L/min
Maximum control fluid consumption, approx.	4 L/min

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. Lower values on request

Dimensions, size 35

DR – Pressure control / DRS0 – Pressure control with load sensing,
clockwise rotation

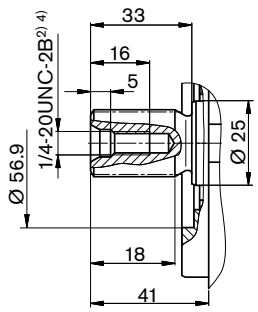




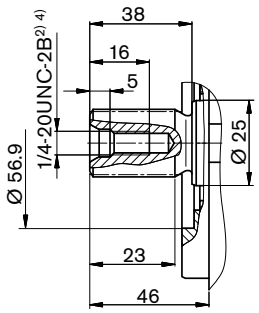
Drive shafts

Splined shaft SAE J744

S4 7/8 in 13T 16/32DP[1)]



S5 1 in 15T 16/32DP[1)]



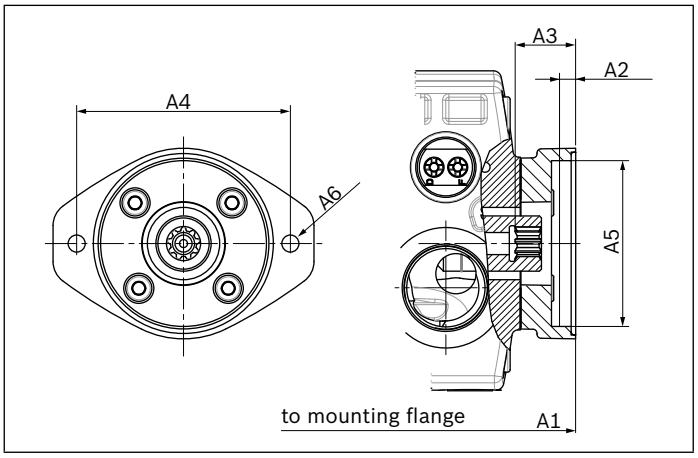
Ports

Designation	Port for	Standard[3)]	Size[4)]	p_{max} [bar][5)]	State[8)]
B	Service line	ISO 11926	1 5/16-12UN-2B; 20 deep	280	O
S	Suction line	ISO 11926	1 5/8-12UN-2B; 20 deep	5	O
L_1	Case drain fluid	ISO 11926	3/4-16UNF-2B; 15 deep	10	O[6)]
L_2	Case drain fluid	ISO 11926	3/4-16UNF-2B; 15 deep	10	X[6)]
X	Load sensing	ISO 11926	7/16-20UNF-2B; 12 deep	280	O[7)]

1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) The spot face can be deeper than specified in the appropriate standard.
4) Observe the general instructions on page20 concerning the maximum tightening torques.
5) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) Depending on the installation position, L or L1 L2 must be connected (see also installation instructions on page 17).
7) Only if an S0 controller is present.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, through drive

Flange SAE J744			Coupling for splined shaft[1]			Short designation
Diameter	Fitting variant					
	Symbol[2]	Designation	Diameter		Designation	
Without through drive						0000
82-2 (A)	⚯	A2	5/8 in	9T 16/32 DP	S2	A2S2
			3/4 in	11T 16/32 DP	S3	A2S3
			7/8 in	13T 16/32 DP	S4	A2S4
101-2 (B)	⚯	B2	7/8 in	13T 16/32 DP	S4	B2S4
			1 in	15T 16/32 DP	S5	B2S5



Short des.	NG	A1	A2	A3	A4	A5	A6[3]
A2S2	35	227.6	8	32	106.4	82.55	M10 x 1.5
A2S3	35	227.6	8	38	106.4	82.55	M10 x 1.5
A2S4	35	227.6	8	41	106.4	82.55	M10 x 1.5
B2S4	35	227.6	8	41	146	101.6	M12 x 1.75
B2S5	35	227.6	8	46	146	101.6	M12 x 1.75

1) Coupling for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Configuration of securing holes when viewed to through drive, with service line port B on right.
3) Continuous thread according to DIN 13; observe the general instructions on page20 concerning the maximum tightening torques.

Overview of fitting options

Through drive[1]			Fitting options – 2nd pump							
Flange	**Coupling for splined shaft**	**Short des.**	**A1VO BR10 NG**	**A4VG BR32 NG**	**A10VG BR10 NG**	**A10VO BR52/53 NG**	**A10VNO BR52/53 NG**	**A10VWO BR52 NG**	**A10V(S)O BR31 NG**	**External gear pump**
82-2 (A)	5/8 in	A2S2	–	–	–	10 (U), 18 (U)	–	–	18 (U)	Series F[2]
	3/4 in	A2S3	–	–	–	10 (S), 18 (S, R)	28 (R)	–	18 (S, R)	–
101-2 (B)	7/8 in	B2S4	–	–	18 (S)	28 (S, R)	–	28 (S)	28 (S, R)	Series N[2] Series G[2]
	1 in	B2S5	35 (S5)	28 (S)	28 (S)	–	–	–	–	–

Combination pumps A1VO + A1VO

Total length A

A1VO (1st pump)	A1VO (2nd pump)
	NG35
NG35	431

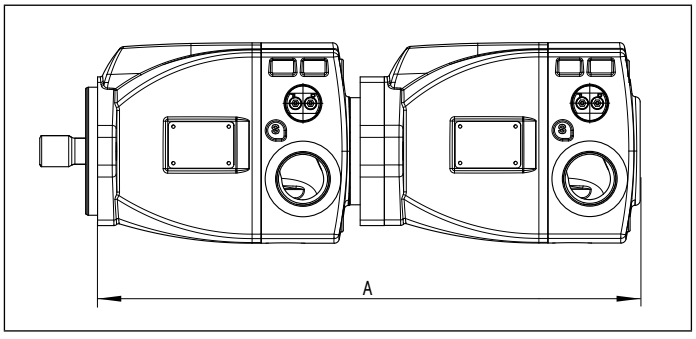
By using combination pumps, it is possible to have several independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a "**+**".

Ordering example:

A1VO035DRS0C100/10BRVB2S51B2S500+
A1VO035DRS0C100/10BRVB2S51000000

It is permissible to use a combination of two single pumps of the same size (tandem pump), considering a dynamic mass acceleration of maximum 10 *g* (= 98.1 m/s^2) without additional support brackets.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque.



1) Additional through drives are available on request
2) Bosch Rexroth recommends special versions of the external gear pumps. Please contact us.

Connector for solenoids

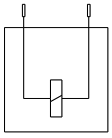
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

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

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

▼ **Circuit symbol**



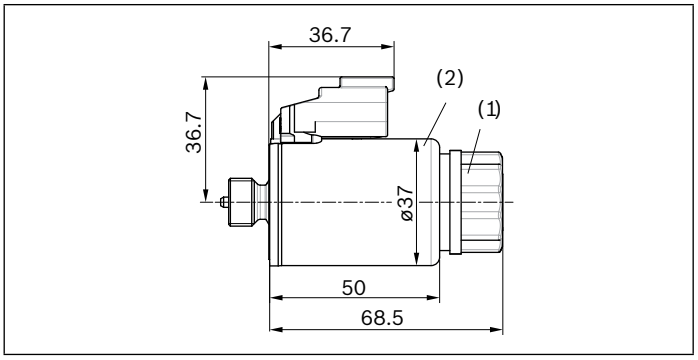
Mating connector

DEUTSCH DT06-2S-EP04

Bosch Rexroth material number R902601804

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 delivery contents. This can be supplied by Bosch Rexroth on request.



Changing connector orientation

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

- Loosen the mounting nut (**1**) of the solenoid. To do this, turn the mounting nut (**1**) one turn counter-clockwise.
- Turn the solenoid body (**2**) to the desired orientation.
- Retighten the mounting nut.
  Tightening torque: 5+1 Nm.
  (size WAF 26, 12kt DIN 3124)

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

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 relatively long standstill as the axial piston unit may drain back to the reservoir 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 case drain fluid in the case interior must be directed to the reservoir via the highest available drain port (**L_1**, **L_2**).

When multiple units are combined, make sure that the case pressure of each unit is not exceeded. In the event of pressure differences at the reservoir ports of the units, the shared reservoir line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate reservoir lines must be laid as required.

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

In all operating conditions, the suction line and case drain line must flow into the reservoir below the minimum fluid level . The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.

Installation position

See the following examples 1 to 11.

Additional installation positions are available upon request.

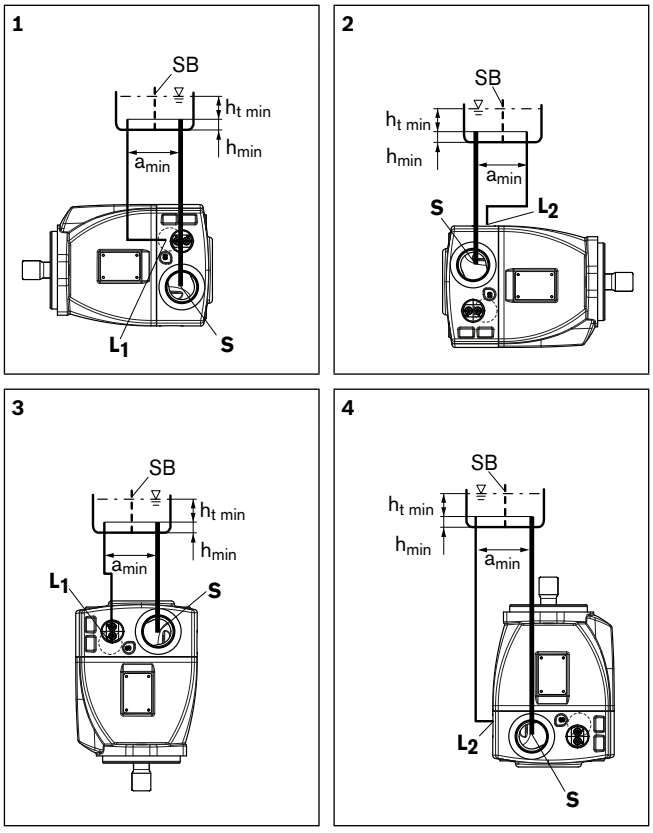
Recommended installation positions: 1 and 2

Note

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

Below-reservoir installation (standard)

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



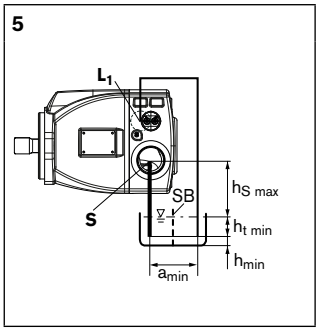
Installation position	Air bleed	Filling
1	L_1	S + L_1
2	L_2	S + L_2
3	L_1 or L_2	S + L_1 or L_2
4[1)]	L_1 or L_2	S + L_1 or L_2

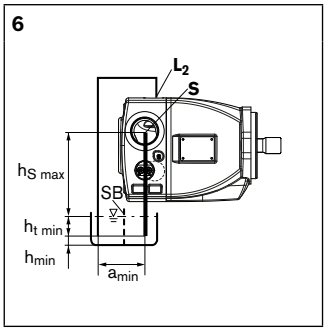
For key, see page 18.

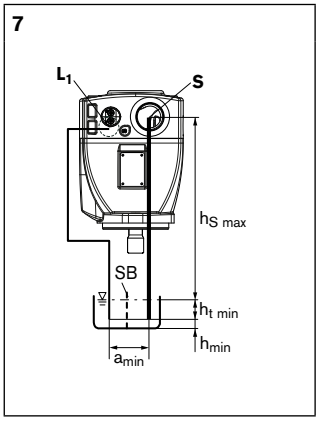
1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

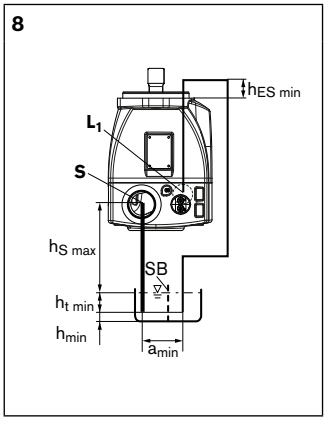
Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\,max}$ = 800 mm.









Installation position	Air bleed	Filling
5	L_1	L_1
6	L_2	L_2
7	L_1 or S	L_1 or S
8[1)]	L_1	L_1

Key	
L	Filling / air bleeding
S	Suction port
SB	Baffle (baffle plate)
$\mathbf{h_{t\,min}}$	Minimum required immersion depth (200 mm)
$\mathbf{h_{min}}$	Minimum required spacing to reservoir bottom (100 mm)
$\mathbf{h_{ES\,min}}$	Minimum necessary height needed to protect the axial piston unit from draining (25 mm).
$\mathbf{h_{S\,max}}$	Maximum permissible suction height (800 mm)
$\mathbf{a_{min}}$	When designing the reservoir, make sure that there is sufficient spacing between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

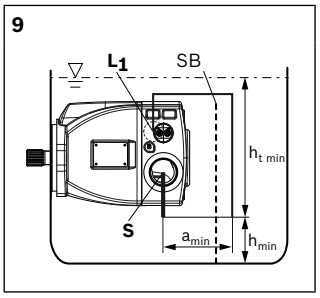
Inside-reservoir installation

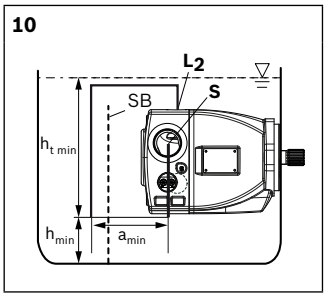
Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.

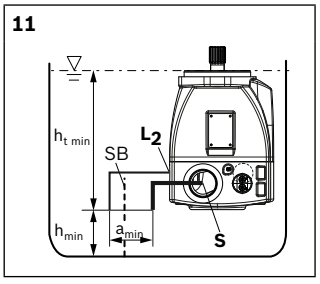
If the minimum fluid level is equal to or below the upper edge of the pump, see chapter "Above-reservoir installation".

Note

Axial piston units with electrical component must not be installed below the hydraulic fluid level.







Installation position	Air bleed	Filling
9	L_1	L_1 or S
10	L_2	L_2 or S
11[1)]	L_2	L_2 or S

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

General instructions

- The A1VO pump is designed to be used in open circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports are only designed to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- Before finalizing your design, request a binding installation drawing.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. If you require characteristic values relating to reliability (e.g. $MTTF_d$) for functional safety, please consult the responsible contact person at Bosch Rexroth.
- Pressure controls are not backups against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instructions regarding the tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque for the individual case according to VDI 2230.
  - Female threads of the axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the female threads and must not be exceeded. For values, see the following table.
  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports		**Maximum permissible tightening torque of the female threads $M_{G\ max}$**	**Required tightening torque of the threaded plugs M_V**	**WAF Hexagon socket for the threaded plugs**
Standard	**Thread size**			
ISO 11926	7/16-20UNF-2B	40 Nm	18 Nm	3/16 in
	3/4-16 UNF-2B	160 Nm	70 Nm	5/16 in
	1 5/16-12 UN-2B	540 Nm	270 Nm	5/8 in
	1 5/8-12 UN-2B	960 Nm	320 Nm	3/4 in

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