RE 92650/2020-03-03
Replaces: 12.2017

rexroth
A Bosch Company

Axial piston variable pump A1VO Series 10

- For load-sensing systems in smaller working machines
- Sizes 18, 28, 35
- Nominal pressure 250 bar
- Maximum pressure 280 bar
- Open circuit

Features

- Variable displacement pump with axial piston rotary group of swashplate design for hydrostatic drives in open circuit
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by controlling the swashplate angle.
- Significant fuel savings up to 15% compared to fixed systems
- Optimized efficiency, though same power at less fuel consumption
- Increased service life compared to gear pumps
- Compact design by integrated controller
- A wide range of highly adaptable control devices for all important applications
- Low noise
- High power density
- Excellent suction characteristics
- High flexibility through interchangeable through drive adapters

Contents

Type code

01	02	03	04	05	06	07	08		09	10	11	12	13	14	15	16	17		18
A1V	**O**				**2**		**0**	**/**	**10**			**V**					**00**	**–**	**0**

Axial piston unit

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

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see technical data on page 7	**018**	**028**	**035**

Control device

				18	**28**	**35**	
04	Pressure controller	Setting range 100 to 250 bar		●	●	●	**DR**
		with load-sensing		●	●	●	**DRS0**
		Setting range 20 to 100 bar		●	●	●	**DN**
		with load-sensing		●	●	●	**DNS0**
		with override, electrically proportional, negative control	*U* = 12 V	●	●	●	**D3**
			U = 24 V	●	●	●	**D4**

Controller design and mounting

		18	**28**	**35**	
05	Mounted (only possible with control valve D3 and D4)	●	●	●	**A**
	Cartridge (only possible with control valve DR, DRS0, DN and DNS0)	●	●	●	**C**

Setting

		18	**28**	**35**	
06	Adjustable				**2**

Connector for solenoids[1] (see page 22)

		18	**28**	**35**	
07	Without connector (without solenoid, only for hydraulic control)	●	●	●	**0**
	DEUTSCH - molded connector, 2-pin, without suppressor diode	●	●	●	**P**

Additional function

08	Without additional function	**0**

Series

09	Series 1, index 0	**10**

Version of port and fastening threads

		18	**28**	**35**	
10	Threaded ports according to ISO 11926-1 with O-ring seal (ANSI), Metric fastening thread according to DIN 13 on the through drive	●	●	●	**B**
	Threaded ports, metric, according to ISO 6149-01 with O-ring seal, Metric fastening thread according to DIN 13 on the through drive	●	●	●	**M**

Direction of rotation

			18	**28**	**35**	
11	Viewed on drive shaft	clockwise	●	●	●	**R**
		counter-clockwise	●	●	●	**L**

Sealing material

12	FKM (fluoroelastomer)	**V**

Mounting flange

			18	**28**	**35**	
13	ISO 3019-1 (SAE J744)	82-2	●	●	–	**A2**
		101-2	●	●	●	**B2**
	ISO 3019-2 (metric)	80-2	●	●	–	**K2**

1) Connectors for other electric components may deviate

01	02	03	04	05	06	07	08		09	10	11	12	13	14	15	16	17		18
A1V	**O**				**2**		**0**	**/**	**10**			**V**					**00**	**–**	**0**

Drive shaft (permissible input torque, see page 8)

					18	28	35	
14	Splined shaft ANSI B92.1a (Bosch Rexroth recommends selecting the respectively larger drive shaft for through drive units)			3/4 in 11T 16/32DP	●	●	–	**S3**
				7/8 in 13T 16/32 DP[2)]	●	●	●	**S4**
				1 in 15T 16/32DP	–	–	●	**S5**
	Parallel keyed shaft Through drive not permissible	ISO 3019-1	SAE	Ø 19-1	●	●	–	**K3**
		ISO 3019-2	metric	Ø 20	●	●	–	**P3**

Working port

		18	28	35	
15	Threaded ports B and S, lateral, on opposite sides	●	●	●	**1**
	Threaded ports B and S, rear, not for through drive	●	●	○	**9**

Through drives (for mounting options, see page 20)

16	Flange SAE J744			Hub for splined shaft[3)]						
	Diameter	Mounting[4)]	Designation	Diameter		Designation	18	28	35	
	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**

Reduction of geometric displacement

17	Without reduction	**00**

Standard/special version

18	Standard version	**0**

● = Available ○ = On request – = Not available

Notes

Note the project planning notes on page 25.

2) For size 35, not for through drive
3) In accordance with ANSI B92.1a
4) Mounting holes pattern viewed on through drive with working port B on right.

Hydraulic fluid

The axial piston unit A1VO 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

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:

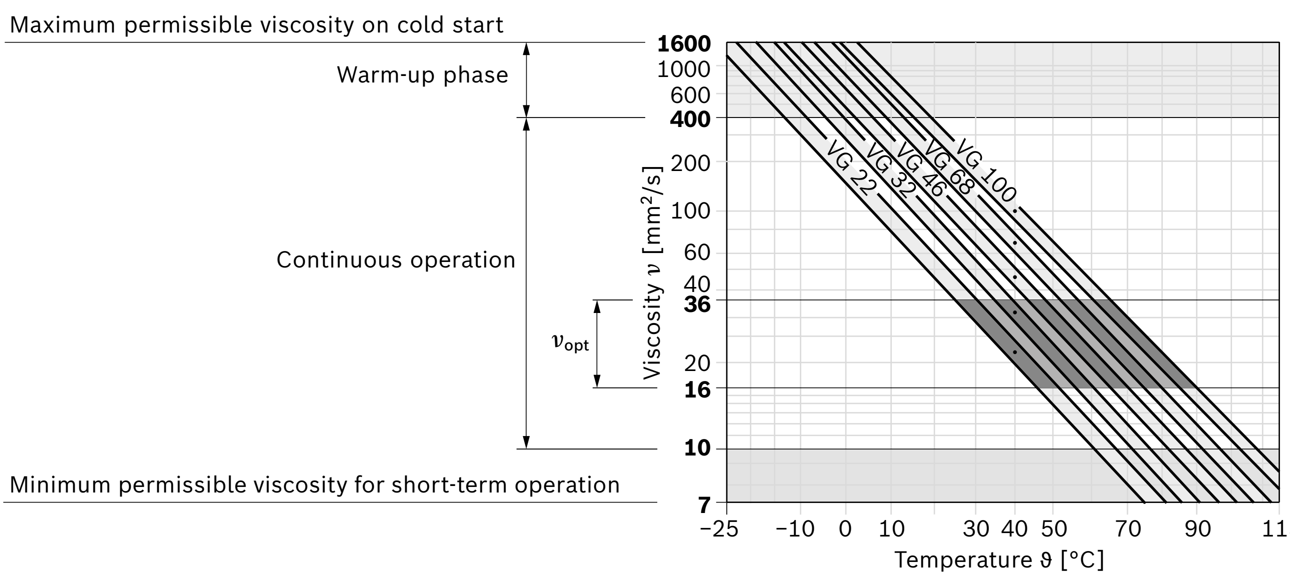
- 90245: Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)

Selection of hydraulic fluid shall make sure 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	ν_{max} ≤ 1600 mm²/s	FKM	ϑ_{St} ≥ -25 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
Warm-up phase	ν = 1600 ... 400 mm²/s			t ≤ 15 min, p ≤ 0.7 × p_{nom} and n ≤ 0.5 × n_{nom}
Continuous operation	ν = 400 ... 10 mm²/s[1)]	FKM	ϑ ≤ +90 °C	measured at port **L**
	ν_{opt} = 36 ... 16 mm²/s			optimal operating viscosity and efficiency range
Short-term operation	ν_{min} = 10 ... 7 mm²/s	FKM	ϑ ≤ +90 °C	t ≤ 1 min, p ≤ 0.3 × p_{nom} , measured at port **L**

▼ **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.

Notice
The axial piston unit is not suitable for operation with water-free HF hydraulic fluids / HF hydraulic fluids containing water / HFx hydraulic fluids.

Filtration of the hydraulic fluid

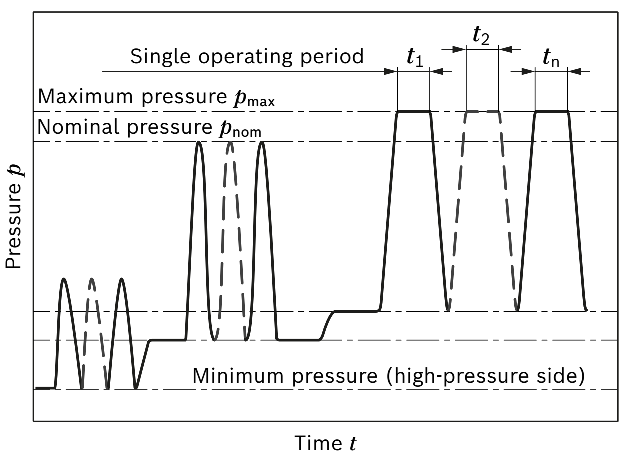
Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At a hydraulic fluid viscosity of less than 10 mm²/s (e.g. due to high temperatures during short-term operation), a cleanliness level of at least 19/17/14 according to ISO 4406 is required.
For example, the viscosity is 10 mm²/s at:

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

Working pressure range

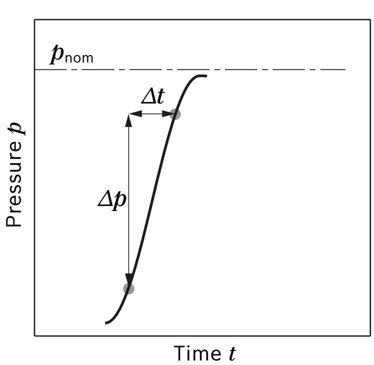
Pressure at working port B		Definition
Nominal pressure p_{nom}	250 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	280 bar	The maximum pressure corresponds to the maximum working pressure within a single operating period. The sum of the single operating 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 $p_{B\ abs}$ (high-pressure side)	14 bar[1]	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 $p_{S\ min}$	0.8 bar abs.	Minimum pressure at suction port **S** (inlet) which is required to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Maximum pressure $p_{S\ max}$	5 bar abs.	
Case pressure at port L_1, L_2		
Maximum pressure $p_{L\ max}$	2 bar abs.	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{L\ max}$.

▼ **Pressure definition**



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

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



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 case pressure must not be below the ambient pressure.

1) Please contact us about lower pressures

Technical data

Size			NG		18	28	35
Geometric displacement, per revolution			$V_{g\ max}$ $V_{g\ min}$	cm^3 cm^3	18 0	28 0	35 0
Maximum rotational speed[1)2)]	at $V_{g\ max}$		n_{nom}	rpm	3300	3200	3000
Flow	at n_{nom} and $V_{g\ max}$		q_v	l/min	59	89	105
Power	at n_{nom}, $V_{g\ max}$ and Δp = 250 bar		P	kW	25	37	44
Torque	at $V_{g\ max}$ and Δp = 250 bar		M	Nm	72	111	139
Rotary stiffness Drive shaft	3/4 in 11T 16/32DP	S3	c	kNm/rad	9.78	9.78	–
	7/8 in 13T 16/32 DP	S4	c	kNm/rad	12.88	12.88	18.6
	1 in 15T 16/32DP	S5	c	kNm/rad	–	–	22.9
	Ø 20 mm	P3	c	kNm/rad	16.49	16.49	–
	Ø 19.05 mm	K3	c	kNm/rad	17.27	17.27	–
Moment of inertia of the rotary group			J_{TW}	kgm^2	0.000686	0.000737	0.00159
Maximum angular acceleration[3)]			α	rad/s^2	6800	5500	5000
Case volume			V	l	0.5	0.5	0.6
Weight (**without** through drive) approx.			m	Kg	12.3	12.3	18.4
Weight (**with** through drive) approx.			m	Kg	13.5	13.5	19.8

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

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 ($\eta_t = \eta_v \times \eta_{hm}$)

Notice

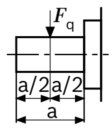
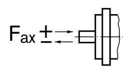
- ▶ Theoretical values, without efficiency and tolerances; values rounded.
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing loads through experimentation or calculation/simulation and comparing them with the permissible values.

1) The values are applicable:
– for the optimum viscosity range from ν_{opt} = 36 to 16 mm^2/s
– with hydraulic fluid on the basis of mineral oils
– at a pressure of $p_S \geq 1$ bar abs.at suction port **S**.

2) For a pressure $p_S < 1$ bar at suction port **S**, please contact us.

3) The data are valid for values between the minimum required and maximum permissible rotational speed. 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 connection parts must be considered.

Permissible radial and axial forces of the drive shaft

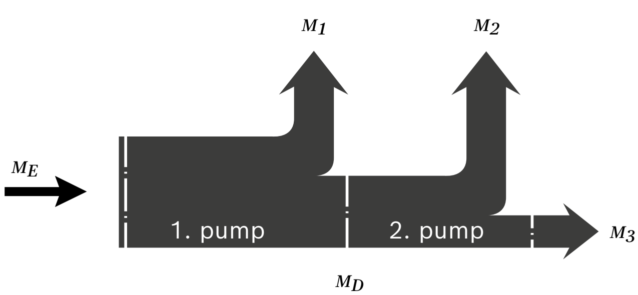
Size		NG		18	28	35
Maximum radial forces a/2		$F_{q\ max}$	N	150	150	650
Maximum axial forces		$\pm F_{ax\ max}$	N	400	400	650

Note
- The values given are maximum values and do not apply to continuous operation. All shaft loads affect bearing life!

Permissible input and through-drive torques

Size					18	28	35
Torque at $V_{g\ max}$ und Δp = 250 bar[1]			M_{max}	Nm	72	111	139
Maximum input torque on drive shaft[2]							
	S3	3/4 in	$M_{E\ max}$	Nm	143	143	–
	S4	7/8 in	$M_{E\ max}$	Nm	198	198	198
	S5	1 in	$M_{E\ max}$	Nm	–	–	319
	P3	Ø 20 mm	$M_{E\ max}$	Nm	151	151	–
	K3	Ø 19.05 mm	$M_{E\ max}$	Nm	147	147	–
Through-drive torque, maximum							
	S3	3/4 in	$M_{D\ max}$	Nm	87	87	–
	S4	7/8 in	$M_{D\ max}$	Nm	87	87	139
	S5	1 in	$M_{D\ max}$	Nm	–	–	139

▼ **Distribution of torques**



Torque at 1st pump	M_1		
Torque at 2nd pump	M_2		
Torque at 3rd pump	M_3		
Input torque	M_E	=	$M_1 + M_2 + M_3$
	M_E	<	$M_{E\ max}$
Through-drive torque	M_D	=	$M_2 + M_3$
	M_D	<	$M_{D\ max}$

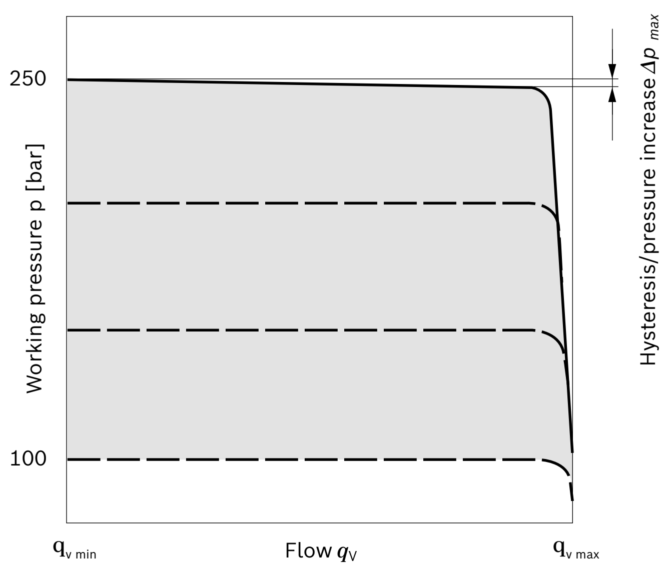
1) Efficiency not considered
2) For drive shafts free of radial force

DR/DN – Pressure controller

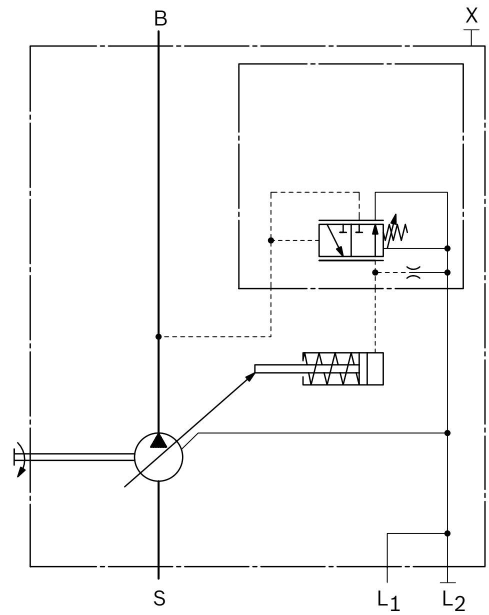
The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the working pressure exceeds the pressure command value at the pressure valve, the pump will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

- Basic position in depressurized state: $V_{g\ max}$.
- **DR**
  Setting range[1)] for pressure control 100 to 250 bar.
  Standard is 250 bar
  DN
  Setting range[1)] for pressure control 20 to 100 bar.
  Standard is 100 bar

▼ **Characteristic curve DR**



▼ **Circuit diagram DR**



Controller data

NG	18	28	35
Hysteresis and repeat precision Δp	Maximum 5 bar		
Pilot fluid consumption	Approx. 3 l/min maximum		

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

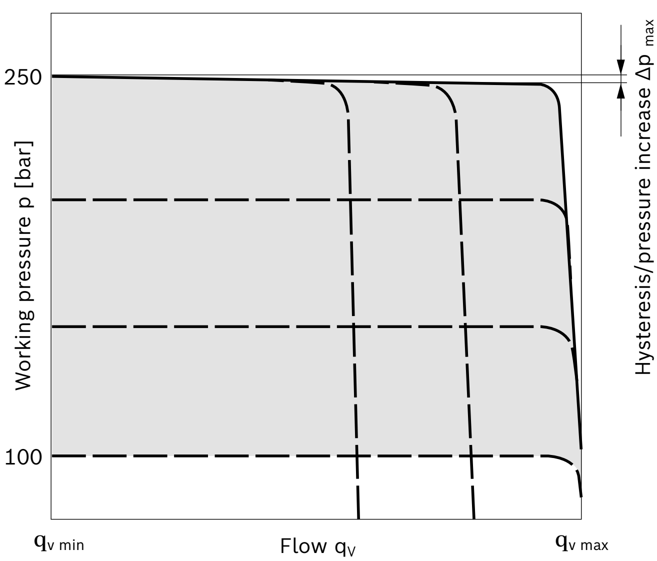
DRS0/DNSO – Pressure controller with load-sensing

In addition to the pressure controller function (DR), the load-sensing controller works as load pressure guided flow controller and adjusts the displacement of the pump to the quantity required by the consumer. The load-sensing controller compares the pressure upstream the metering orifice to the one downstream the orifice and keeps the pressure drop (differential pressure Δp) occurring here and thus the flow constant.
The swinging in by the pressure or the flow controller always takes priority.

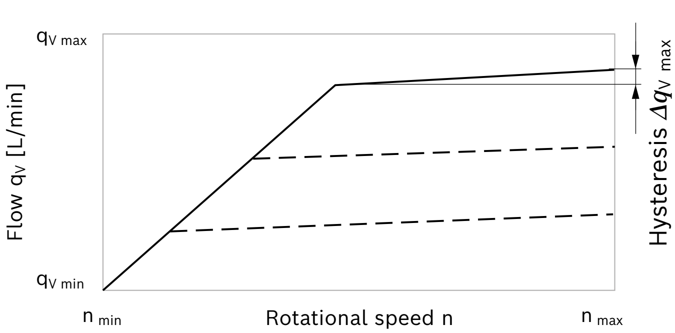
- **DRS0**
  Setting range[1)] for pressure control 100 to 250 bar.
- **DNS0**
  Setting range[1)] for pressure control 20 to 100 bar.

Notice
Version DRS0/DNSO does not have any connection from **X** to the reservoir; thus, the LS must be unloaded in the system.

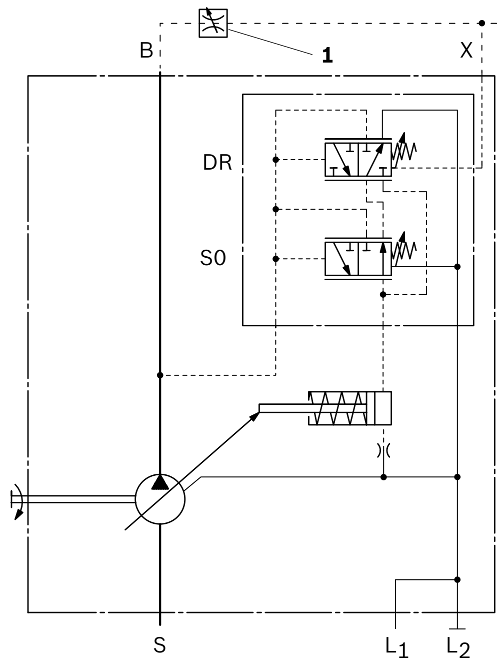
▼ **Characteristic curve DRS0**



▼ **Characteristic curve at variable rotational speed**



▼ **Circuit diagram DRS0**



1 The metering orifice (control block) is not included in the scope of delivery.

Differential pressure Δp

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

Controller data

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

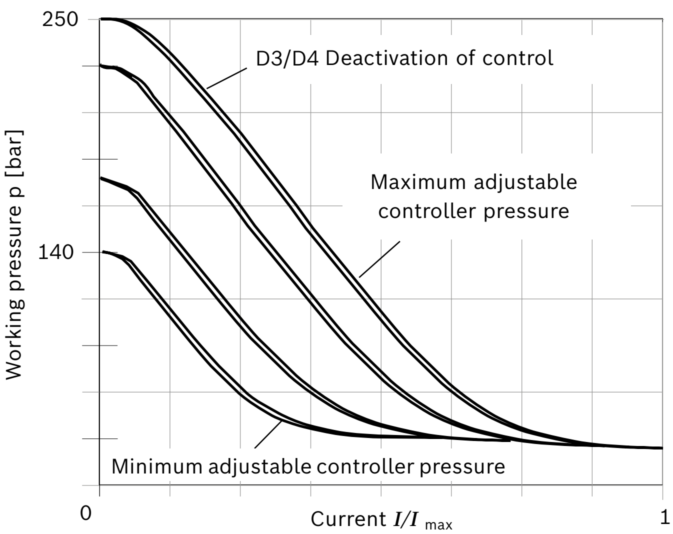
NG	18	28	35
Volume flow difference $\Delta q_{V\,max}$		3 l/min	
Maximum pilot fluid consumption approx.		4 l/min	

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

D3/D4 – Pressure controller with override

With the electric pressure adjustment with proportional solenoid, the high pressure can be continuously set depending on the solenoid current. If the load pressure at the consumer changes, the delivery rate of the pump is adjusted so that the specified pressure is reached again. If the solenoid current falls below the beginning of control, the unit will switch to the set maximum pressure. The same is true if the pilot signal is lost.

▼ **Current/pressure characteristic curve (negative characteristic curve)**

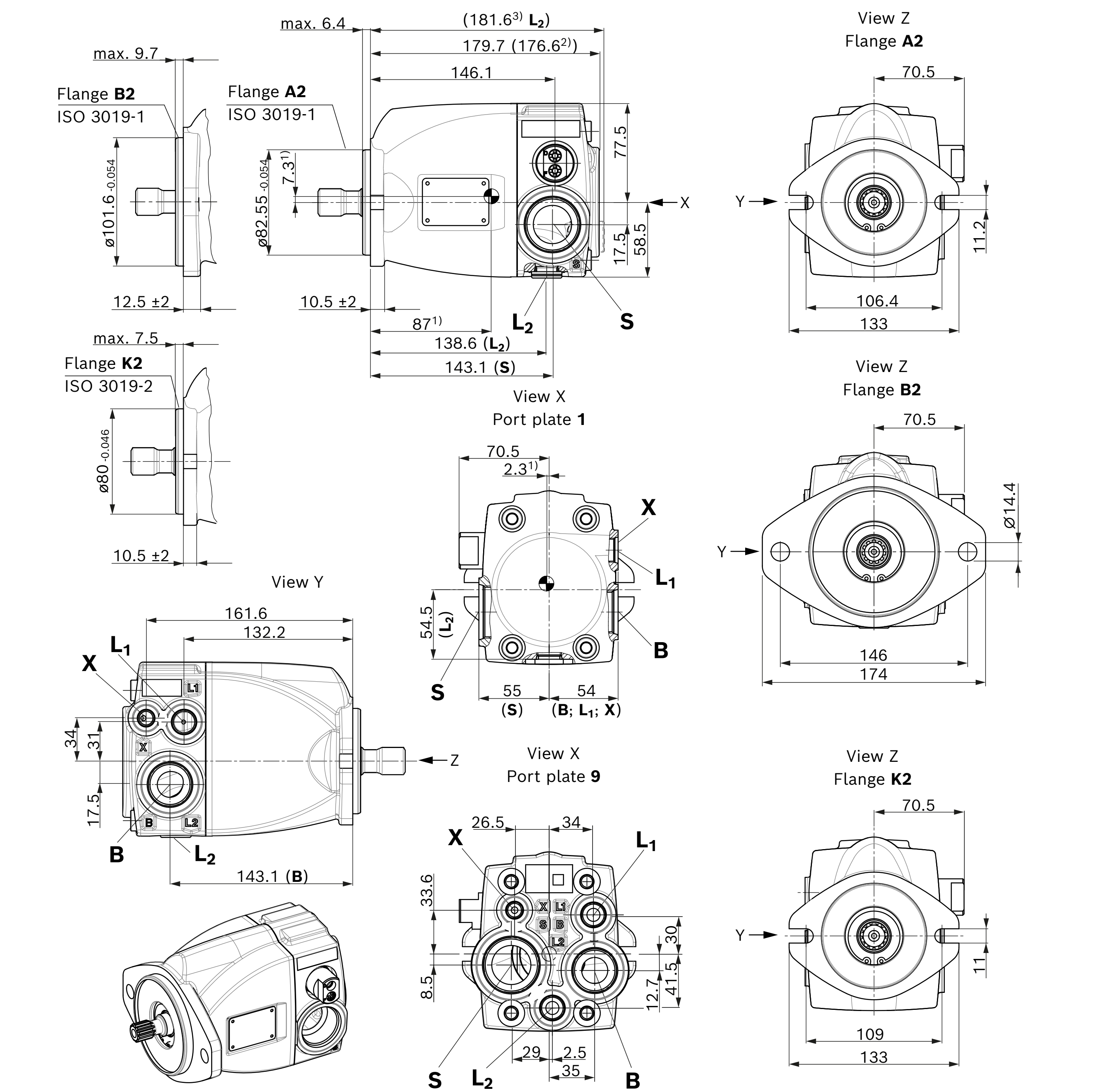


Characteristic curve measured with pump in zero stroke
Further information on request.

Dimensions size 18 and size 28

DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load-sensing

Clockwise rotation

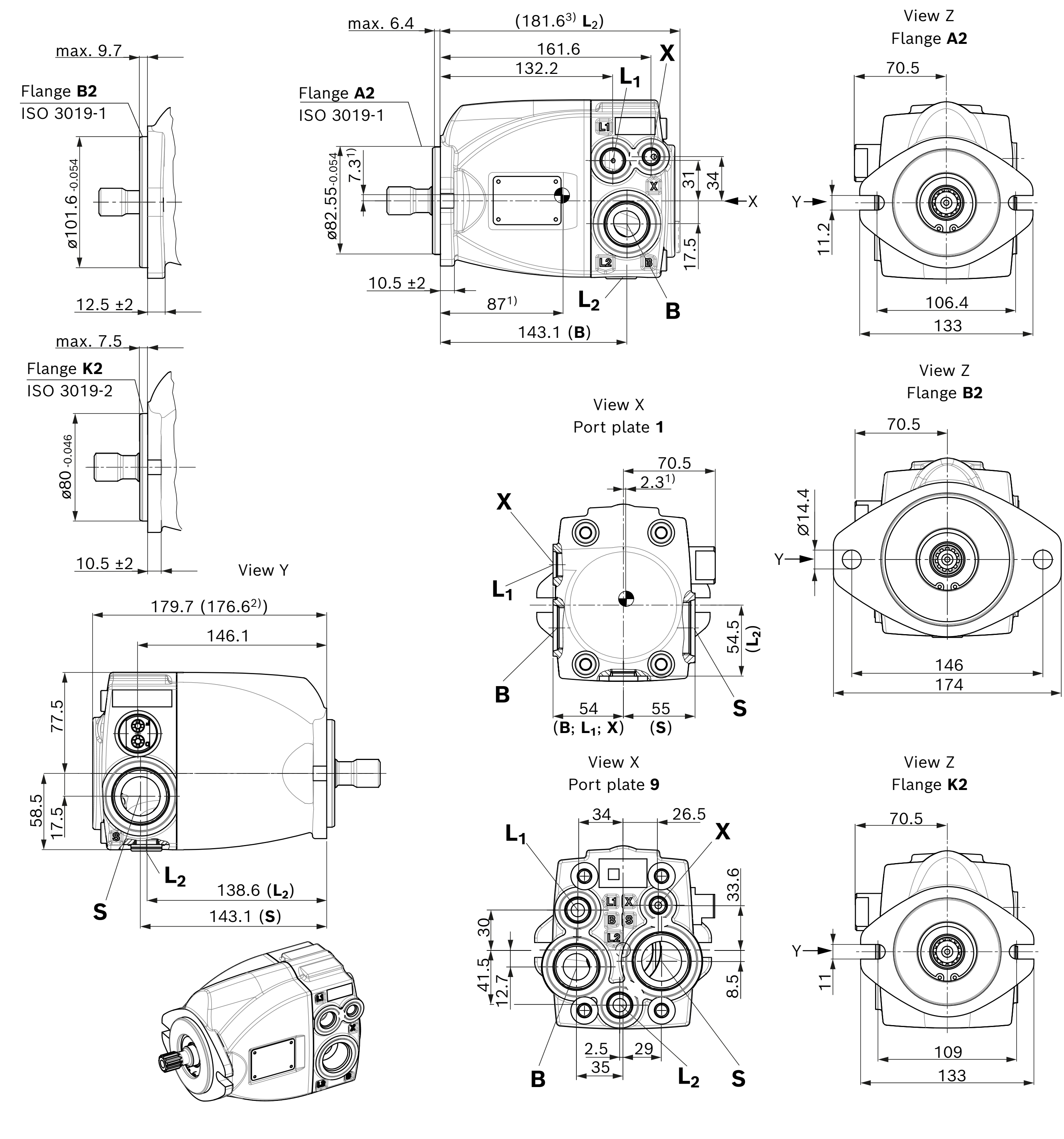


1) Center of gravity
2) Connection surfaces **S**, **B**, **X**, L_1 and L_2 with port plate 9
3) With port plates 9 and L_2 plugged only

Dimensions size 18 and size 28

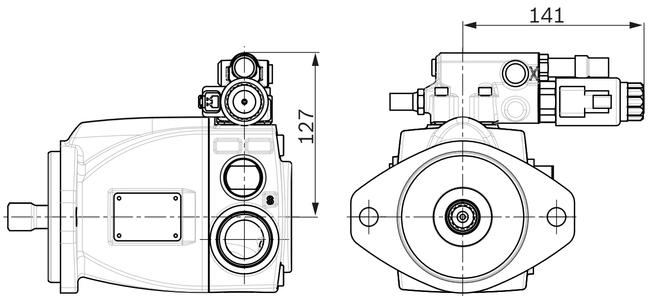
DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load-sensing

Counter-clockwise rotation

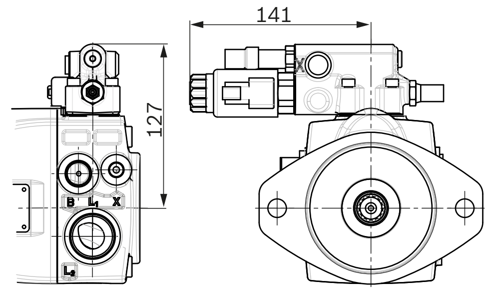


1) Center of gravity
2) Connection surfaces **S**, **B**, **X**, L_1 and L_2 with port plate 9
3) With port plates 9 and L_2 plugged only

▼ **D3/D4 Pressure controller with override, electric-proportional, clockwise rotation**

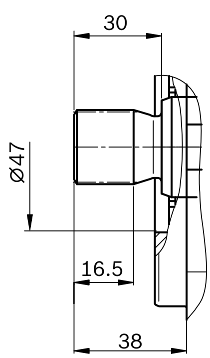


▼ **D3/D4 Pressure controller with override, electric-proportional, counter-clockwise rotation**



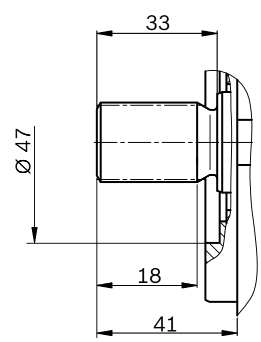
▼ **Splined shaft SAE J744**

S3 – 3/4 in 11T 16/32DP[1)]



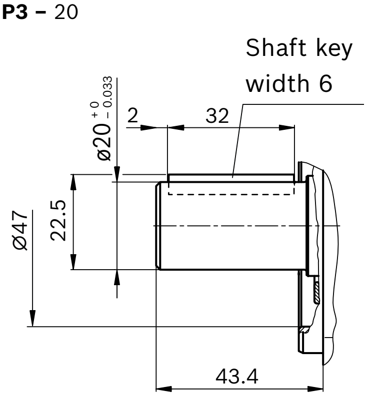
▼ **Splined shaft SAE J744**

S4 – 7/8 in 13T 16/32DP[1)]



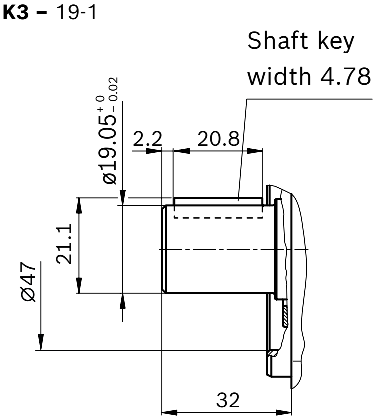
▼ **Keyed shaft ISO 3019-2**

P3 – 20



▼ **Keyed shaft ISO 3019-1**

K3 – 19-1



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

Ports and fastening threads version "B"

Ports		Standard[2]	Size	$p_{max\ abs}$ [bar][3]	State[6]
B	Working port	ISO 11926	1 5/16-12UN-2B; 20 deep	280	O
S	Suction port	ISO 11926	1 5/8-12UN-2B; 20 deep	5	O
L_1	Drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	O[4]
L_2	Drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	X[4]
X	Pilot signal	ISO 11926	7/16-20UNF-2B; 12 deep	280	O[5]

Ports and fastening threads version "M"

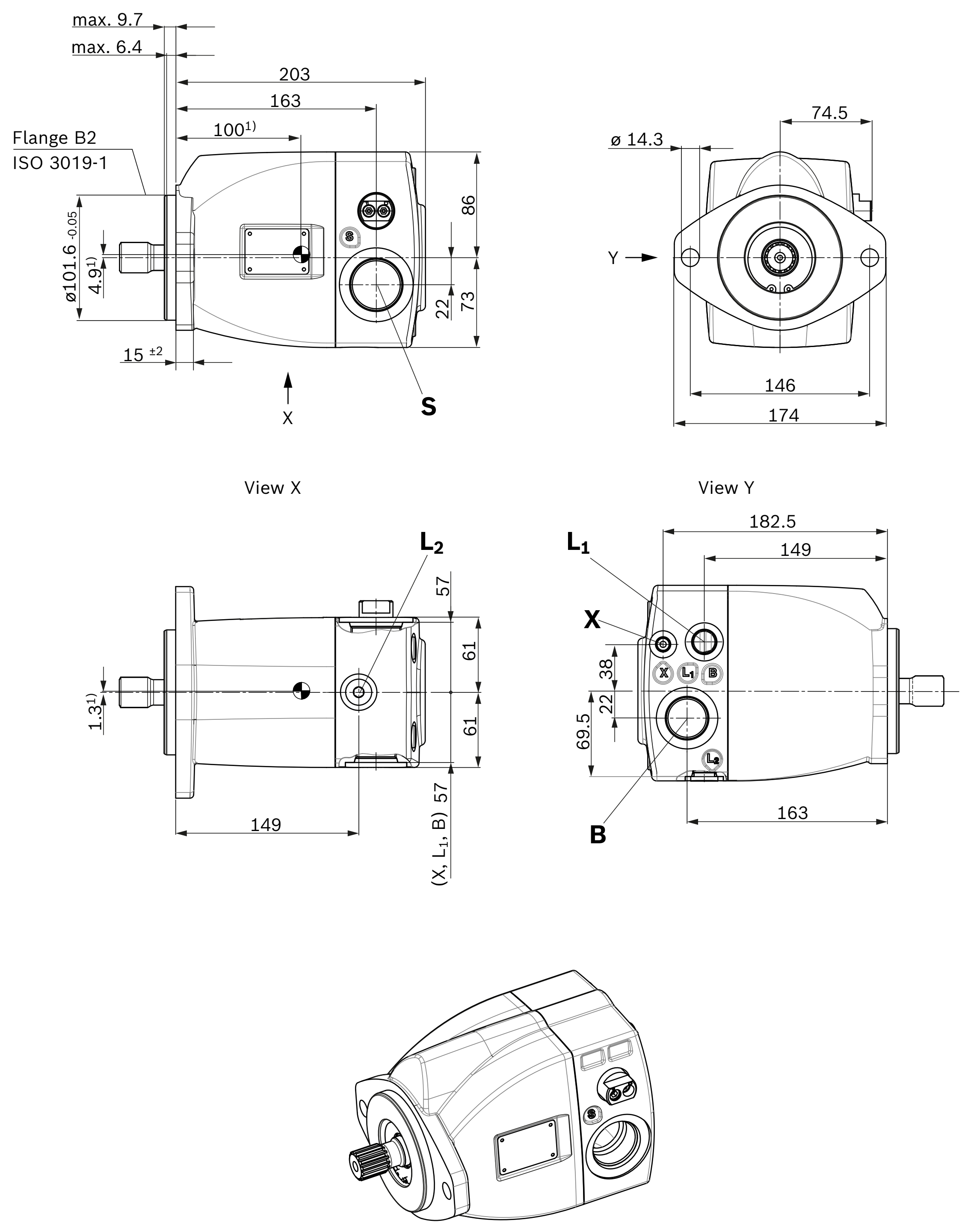
Ports		Standard[2]	Size	$p_{max\ abs}$ [bar][3]	State[6]
B	Working port	ISO 6149	M33 × 2; 19 deep	280	O
S	Suction port	ISO 6149	M42 × 2; 19.5 deep	5	O
L_1	Drain port	ISO 6149	M18 × 1.5; 14.5 deep	10	O[4]
L_2	Drain port	ISO 6149	M18 × 1.5; 14.5 deep	10	X[4]
X	Pilot signal	ISO 6149	M12 × 1.5; 11.5 deep	280	O[5]

2) The countersink may be deeper than specified in the standard.
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Depending on the installation position, L_1 or L_2 must be connected (see also the installation instructions on page 23).
5) Only if an S0 controller is present.
6) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

Dimensions size 35

DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load-sensing

Clockwise rotation

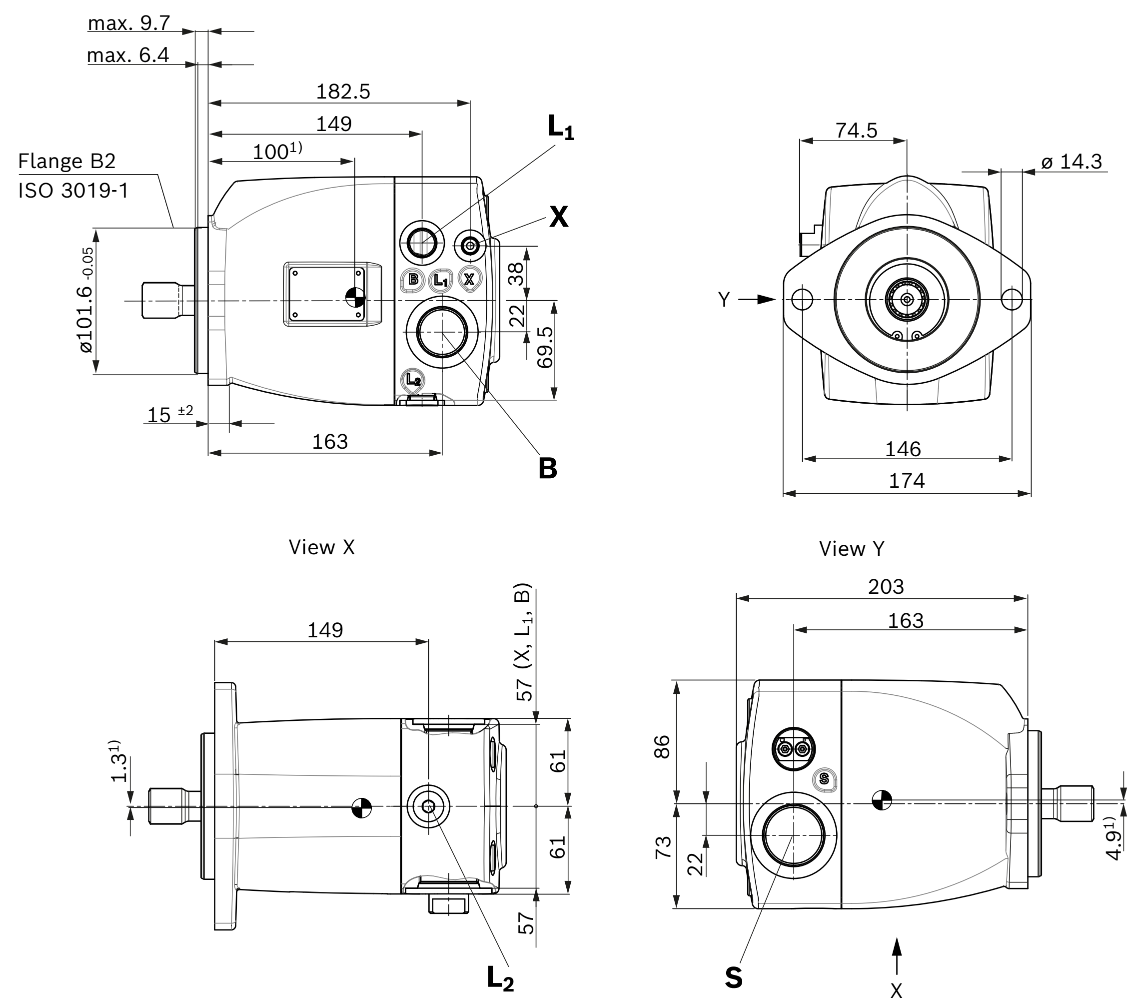


1) Center of gravity

Dimensions size 35

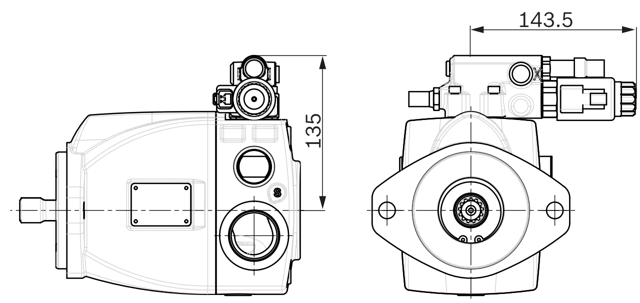
DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load-sensing

Counter-clockwise rotation

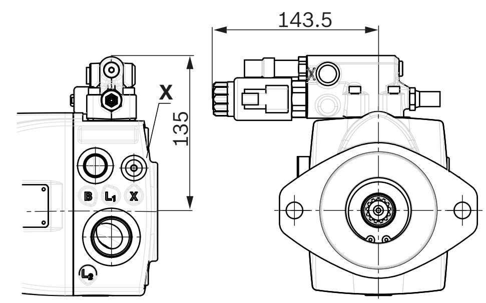


1) Center of gravity

▼ **D3/D4 Pressure controller with override, electric-proportional, clockwise rotation**

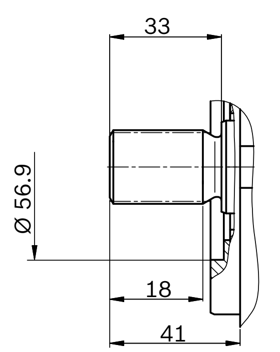


▼ **D3/D4 Pressure controller with override, electric-proportional, counter-clockwise rotation**



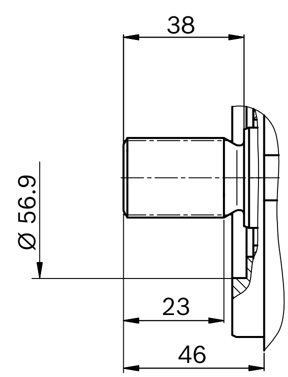
▼ **Splined shaft SAE J744**

S4 – 7/8 in 13T 16/32DP[1)]



▼ **Splined shaft SAE J744**

S5 – 1 in 15T 16/32DP[1)]



Ports and fastening threads version "B"

Ports		Standard[2)]	Size	$p_{max\ abs}$ [bar][3)]	State[6)]
B	Working port	ISO 11926	1 5/16-12UN-2B; 20 deep	280	O
S	Suction port	ISO 11926	1 5/8-12UN-2B; 20 deep	5	O
L_1	Drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	O[4)]
L_2	Drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	X[4)]
X	Pilot signal	ISO 11926	7/16-20UNF-2B; 12 deep	280	O[5)]

Ports and fastening threads version "M"

Ports		Standard[2)]	Size	$p_{max\ abs}$ [bar][3)]	State[6)]
B	Working port	ISO 6149	M33 × 2; 20 deep	280	O
S	Suction port	ISO 6149	M42 × 2; 20 deep	5	O
L_1	Drain port	ISO 6149	M18 × 1.5; 13 deep	10	O[4)]
L_2	Drain port	ISO 6149	M18 × 1.5; 13 deep	10	X[4)]
X	Pilot signal	ISO 6149	M12 × 1.5; 12 deep	280	O[5)]

Notice
At all ports - in particular when connecting port **S** - use the stud ends provided for the standard with the corresponding width across flats. Please contact us about larger widths across flats.

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

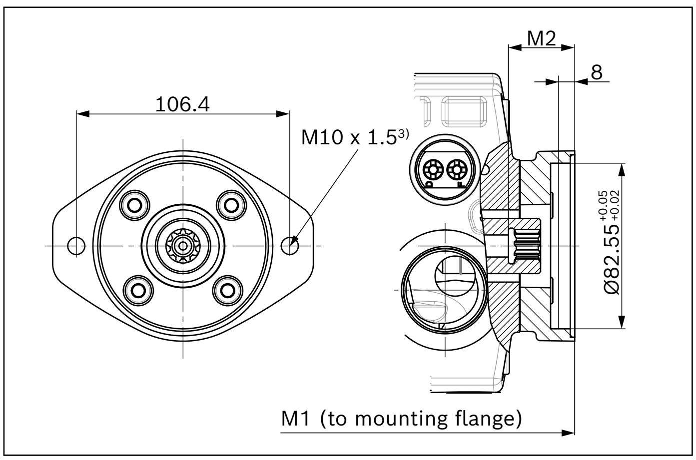
2) The countersink may be deeper than specified in the standard.
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Depending on the installation position, **L_1** or **L_2** must be connected (see also the installation instructions on page 23).
5) Only if an S0 controller is present.
6) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

Dimensions for through drives

Flange SAE J744			Hub for splined shaft[1)]			Availability NG			Code
Diameter	**Mounting[2)]**	**Designation**	**Diameter**		**Designation**	**18**	**28**	**35**	
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

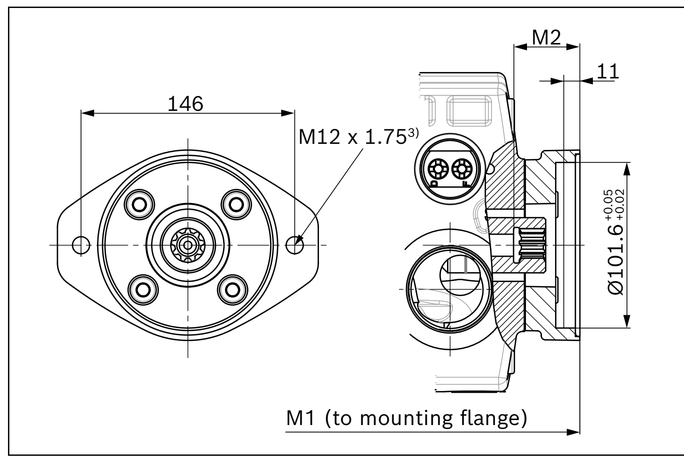
● = Available ○ = On request – = Not available

▼ **82-2 (A)**



Code	NG	M1	M2 minimum[4)]
A2S2	18	203.2	31
	28	203.2	31
	35	227.6	31
A2S3	18	203.2	37
	28	203.2	37
	35	227.6	37
A2S4	18	203.2	40
	28	203.2	40
	35	227.6	40

▼ **101-2 (B)**



Code	NG	M1	M2 minimum[4)]
B2S4	18	203.2	40
	28	203.2	40
	35	227.6	40
B2S5	35	227.6	45

1) In accordance with ANSI B92.1a, 30° pressure angle, flat root, side fit, Tolerance Class 5
2) Mounting holes pattern viewed on through drive with working port B on right.
3) Continuous thread according to DIN 13, see instruction manual for details on tightening torques.
4) Wave length for pumps with mounting flanges according to ISO 3019-1

Overview of mounting options

Through drive[1]			Mounting option – 2nd pump						
Flange	**Hub for splined shaft**	**Code**	**A1VO/10 NG (shaft)**	**A4VG/32 NG (shaft)**	**A10VG/10 NG (shaft)**	**A10VO/52/53 NG (shaft)**	**A10VNO/52/53 NG (shaft)**	**A10V(S)O/31 NG (shaft)**	**External gear pump**
82-2 (A)	5/8 in	A2S2	18, 28 (S2)	–	–	10 (U), 18(U)	–	18(U)	AZPF
	3/4 in	A2S3	18, 28 (S3)	–	–	10 (S), 18 (S, R)	28 (R)	18 (S, R)	–
	7/8 in	A2S4	18, 28 (S4)	–	–	–	–	–	–
101-2 (B)	7/8 in	B2S4	18, 28 (S4) 35 (S4)	–	18 (S)	28 (S, R)	–	28 (S, R)	AZPN AZPG
	1 in	B2S5	35 (S5)	28 (S)	28 (S)	–	–	–	–

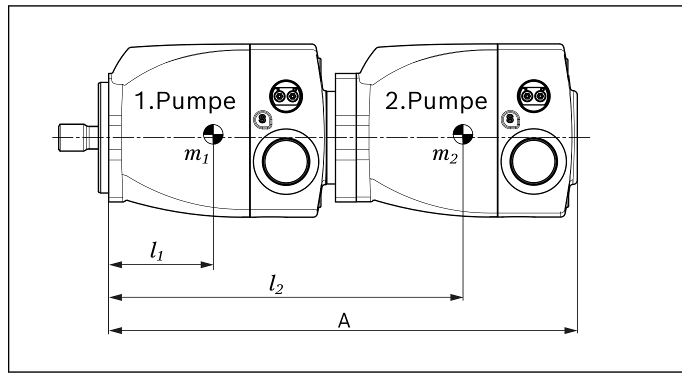
1) Additional through drives are available on request

Combination pumps A1VO + A1VO

Total length A

A1VO (1. pump)	A1VO (2. pump)		
	NG18	**NG28**	**NG35**
NG18	383	–	–
NG28	383	383	–
NG35	410	410	431

By using combination pumps, it is possible to have 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 "+".
Order example:
A1VO035DRS0C200/10BRVB2S51B2S500-0+
A1VO035DRS0C200/10BRVB2S51000000-0
A tandem pump, with two pumps of equal size, is permissible without additional supports, assuming that the dynamic mass acceleration does not exceed maximum 10 g (= 98.1 m/s²).
For combination pumps consisting of more than two pumps, the mounting flange must be calculated for the permissible mass torque.



m_1, m_2	Weight of pump	[kg]
l_1, l_2,	Distance from center of gravity	[mm]

$$M_m = (m_1 \times l_1 + m_2 \times l_2) \times \frac{1}{102} \quad [\text{Nm}]$$

Permissible moments of inertia

Size			18	28	35
static	M_m	Nm	500	500	890
dynamic at 10 g (98.1 m/s²)	M_m	Nm	50	50	89
Weight **without** through drive	m	Kg	12.3	12.3	18.4
Weight **with** through drive			13.5	13.5	19.8
Distance, center of gravity **without** through drive	l_1	mm	87	87	100
Distance, center of gravity **with** through drive	l_1	mm	97	97	108

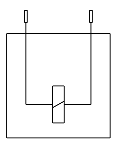
Connector for solenoids

DEUTSCH DT04-2P

Molded, 2-pin, without bidirectional suppressor diode
The installed mating connector has the following
Type of protection:

- 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).

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

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 pump housing must be discharged to the reservoir via the highest available tank port (**L_1**, **L_2**).
For combinations of multiple units, the leakage fluid must be drained off at each 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 conditions, 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 permissible suction height h_S results from the total pressure loss. 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 abs. during operation and during a cold start.
When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated return flow from being drawn directly back into the suction line.

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.

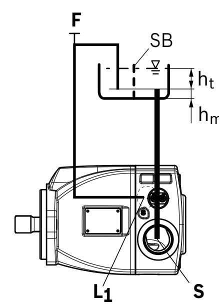
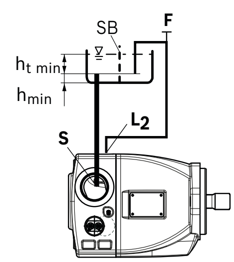
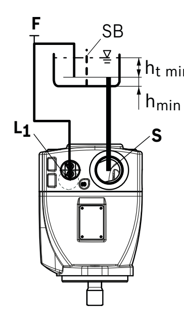
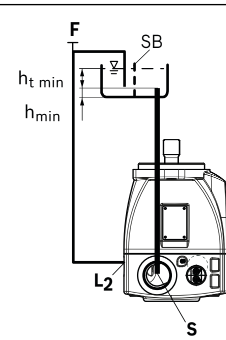
For key, see page 24.

Installation position

See the following examples **1** to **11**.
Further installation positions are available upon request.
Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

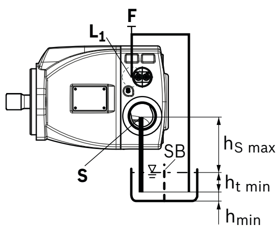
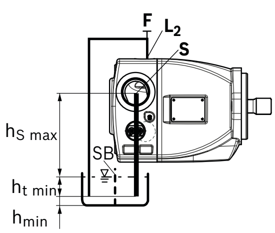
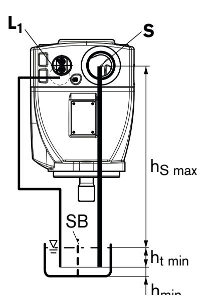
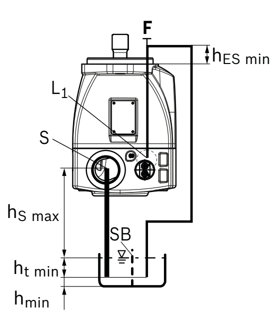
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position		Air bleed	Filling
1		**F, L_1**	**L_1**
2		**F, L_2**	**L_2**
3		**F, L_1** or **L_2**	**L_1** or **L_2**
4[1)]		**F, L_1** or **L_2**	**L_1** or **L_2**

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. To prevent the axial piston unit from draining in position 8, the height difference $h_{ES\ min}$ must be at least 25 mm. 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	L_1
8[1)] 	L_1	L_1

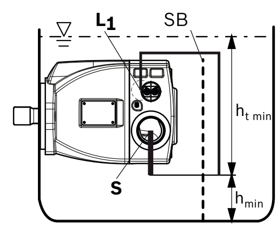
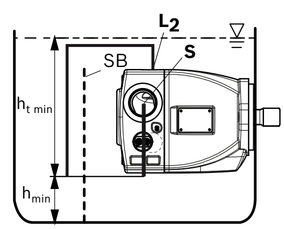
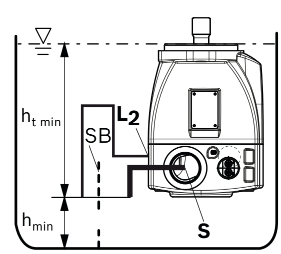
Notice

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

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"**.

Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleed	Filling
9 	Via the highest available port $\mathbf{L_1}$	Automatically via the open port $\mathbf{L_1}$ due to the position under the hydraulic fluid level
10 	Via the highest available port $\mathbf{L_2}$	Automatically via the open port $\mathbf{L_2}$ due to the position under the hydraulic fluid level
11[1)] 		

Key	
$\mathbf{L_1}$, $\mathbf{L_2}$	Filling / Air bleeding
S	Suction 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)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

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.

Project planning notes

- The A1VO axial piston variable pump is designed to be used in open circuit.
- The project planning, assembly and commissioning of the axial piston unit require the involvement of qualified skilled persons.
- 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.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- The characteristic curve may also shift due to the dither frequency or control electronics.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservation is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, which can be found in data sheet 90312 or in the instruction manual.
- Not all versions of the product are approved for use in a safety function 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. Use of the recommended direct current (DC) on the electromagnet does not produce any electromagnetic interference (EMI) nor is the electromagnet influenced by EMI. Potential electromagnetic interference (EMI) exists if the solenoid is energized with a modulated direct current (e.g. PWM signal). The machine manufacturer should conduct appropriate tests and take appropriate measures to ensure that other components or operators (e.g. with a pacemaker) are not affected by this potentiality.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- For drives that are operated for a long period with constant rotational speed, the natural frequency of the hydraulic system can be stimulated by the excitation frequency of the pump (rotational speed frequency ×9). This can be prevented with suitably designed hydraulic lines.
- 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 that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended 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 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 appropriately implemented.

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