

Axial piston variable pump

A1VO Series 10

RE 92650

Edition: 06.2016

Replaces: 08.2015



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

Characteristics

- ▶ Variable pump with axial piston rotary group of swash-plate 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 of 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 due to interchangeable through drive adapter

Contents

Ordering code	2
Hydraulic fluids	4
Shaft seal	5
Working pressure range	6
Technical data	7
DR/DN pressure controller	9
D3/D4 – Pressure controller with override	10
DRS0/DNSO – Pressure controller with load sensing	11
Dimensions size 18 and size 28	12
Dimensions, size 35	15
Through drives dimensions	18
Overview of attachment options	19
Combination pumps A1VO + A1VO	20
Connector for solenoids	21
Installation instructions	22
Project planning notes	24
Safety instructions	24

Ordering 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	Variable swashplate design, 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

		018	028	035	
04	Pressure controller	•	•	•	DR
	with load sensing	•	•	•	DRS0
	Setting range 20 to 100 bar	•	•	•	DN
	with load sensing	•	•	•	DNS0
	with override, electric-proportional, negative control	•	•	•	D3
		•	•	•	D4

Controller design and mounting

05	Built-on (only possible at control valve D3 and D4)	•	•	•	A
	Cartridge (only possible at control valve DR, DRS0, DN and DNS0)	•	•	•	C

Setting

06	Adjustable	2
----	------------	---

Connector for solenoids¹⁾ (see page 21)

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
----	-------------------	----

Design 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
	ISO, port threads with O-ring seal according to ISO 6149, metric fastening thread on through drive version	•	•	•	M

Direction of rotation

11	Viewed on drive shaft	clockwise	•	•	•	R
		counter-clockwise	•	•	•	L

Sealing material

12	FKM (fluoroelastomer)	V
----	-----------------------	---

Mounting flanges

13	SAE J744	82-2	•	•	-	A2
		101-2	•	•	•	B2

¹⁾ Connectors for other electric components may differ

Drive shaft (permissible input torque, see page 8)

Service line port

Through drives (for attachment options, see page 19)

Reduction of geometric displacement

Standard / special version

● = Available ○ = On request - = Not available

Note the project planning notes on page 24.

4) Mounting drillings pattern viewed on through drive, with service line port B on right.

Hydraulic fluids

The A1VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.

Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

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

Details regarding the selection of hydraulic fluid

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

Note

At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.

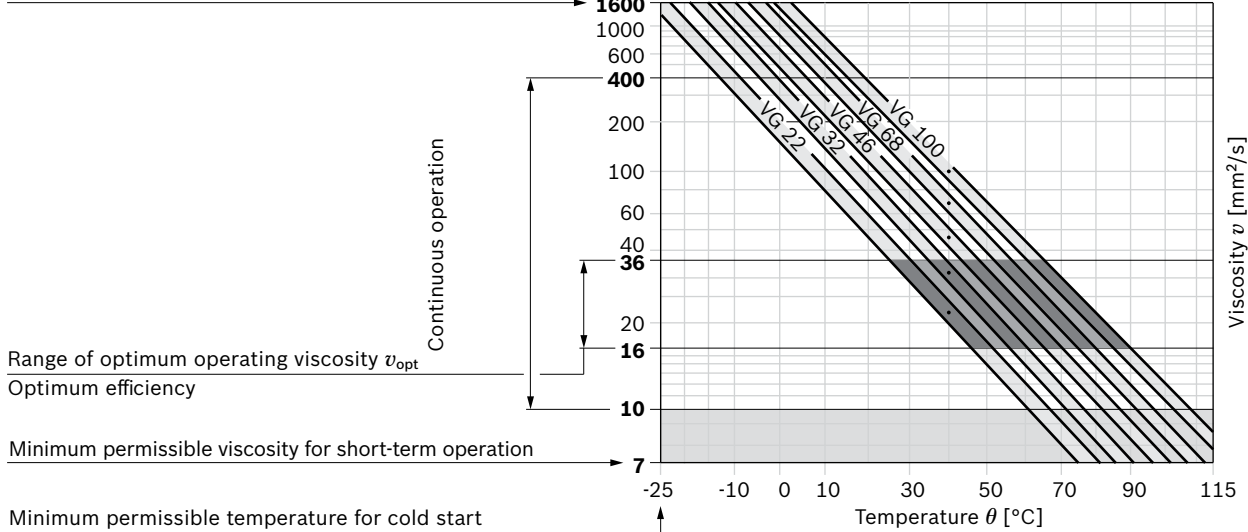
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$v_{max} \leq 1600 \text{ mm}^2/\text{s}$	$\theta_{st} \geq -25 \text{ }^\circ\text{C}$	$t \leq 3 \text{ min}$, without load ($20 \text{ bar} \leq p \leq 50 \text{ bar}$), $n \leq 1000 \text{ RPM}$
	Permissible temperature difference	$\Delta T \leq 25 \text{ K}$	between axial piston unit and hydraulic fluid
Warm-up phase	$v < 1600 \text{ to } 400 \text{ mm}^2/\text{s}$	$\theta = -25 \text{ }^\circ\text{C}$	at $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15 \text{ min}$
Continuous operation	$v = 400 \text{ to } 10 \text{ mm}^2/\text{s}$		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25 \text{ }^\circ\text{C to } +90 \text{ }^\circ\text{C}$	Note the permissible temperature range of the shaft seal measured at port L (ΔT = approx. 5 K between the bearing/shaft seal and port L)
	$v_{opt} = 36 \text{ to } 16 \text{ mm}^2/\text{s}$		Range of optimum operating viscosity and efficiency
Short-term operation	$v_{min} \geq 7 \text{ mm}^2/\text{s}$		$t < 1 \text{ min}$, $p < 0.3 \cdot p_{nom}$

▼ Selection diagram

Maximum permissible viscosity for cold start



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. In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained. At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), at least cleanliness level 19/17/14 according to ISO 4406 is necessary. Please contact us if the above classes cannot be observed.

Shaft seal

The FKM shaft seal ring may be used for leakage temperatures from -25 °C to +115 °C.

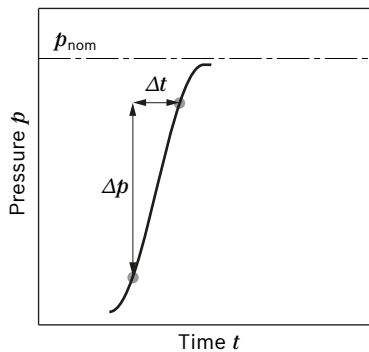
Note

For the temperature range below -25 °C, the values in the table on page 4 are to be observed.

Working pressure range

Pressure at service line 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 the maximum working 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 $p_{B abs}$ (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 rate of pressure build-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 avoid 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	
Leakage 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 $p_{L max}$.

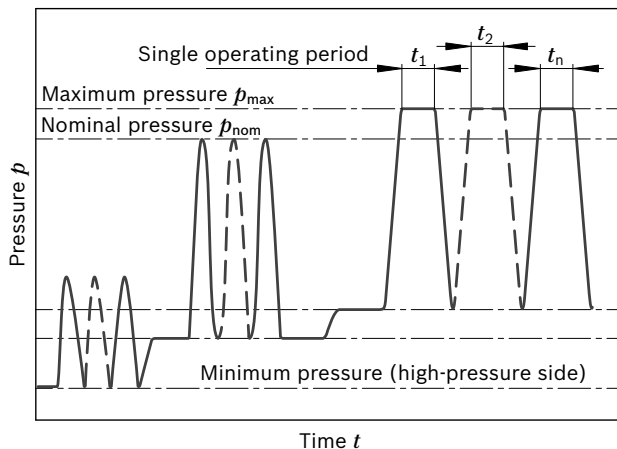
▼ Rate of pressure change $R_{A max}$



Note

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

▼ Pressure definition



$$\text{Total operating period} = t_1 + t_2 + \dots + t_n$$

¹⁾ Please contact us about lower pressures

Technical data

Size		NG		018	028	035
Displacement, geometric, per revolution		$V_{g \max}$	cm ³	18	28	35
		$V_{g \min}$	cm ³	0	0	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 $\Delta p = 250$ bar	P	kW	25	37	44
Torque	at $V_{g \max}$ and $\Delta p = 250$ bar	T	Nm	72	111	139
Rotary stiffness of 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
Moment of inertia for rotary group		J_{TW}	kgm ²	0.000686	0.00737	0.00159
Maximum angular acceleration ⁵⁾		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 operating characteristics			
Flow	q_v	$= \frac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	$= \frac{V_g \times \Delta p}{20 \times \pi \times \eta_{\text{hm}}}$	[Nm]
Power	P	$= \frac{2 \pi \times T \times n}{60000} = \frac{q_v \times \Delta p}{600 \times \eta_t}$	[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 ($\eta_t = \eta_v \cdot \eta_{\text{hm}}$)

Note

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

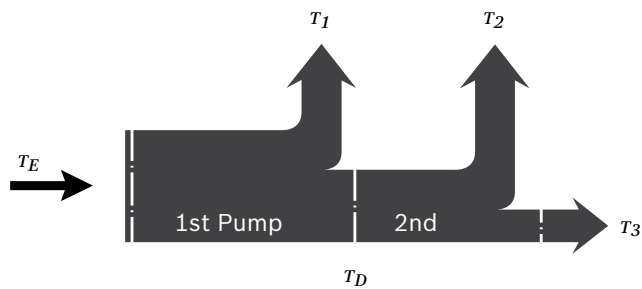
- The values are valid:
 - For the optimum viscosity range from $\nu_{\text{opt}} = 36$ to 16 mm²/s
 - For hydraulic fluid based on mineral oils
 - For a pressure $p_{\text{suction}} \geq 1$ bar absolute at suction port **S**.
- For a pressure $p_{\text{suction}} < 1$ bar at suction port **S**, please contact us.

- The data are valid at values between the minimum required and maximum permissible 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 input and through-drive torques

Size				018	028	035	
Torque at $V_{g\ max}$ and $\Delta p = 250\ \text{bar}^{1)}$			T_{\max}	Nm	72	111	139
Input torque at drive shaft, maximum ²⁾							
	S3	3/4 in	$T_{E\ max}$	Nm	143	143	–
	S4	7/8 in	$T_{E\ max}$	Nm	198	198	198
	S5	1 in	$T_{E\ max}$	Nm	–	–	319
Through-drive torque, maximum ¹⁾			$T_{D\ max}$	Nm			
	S3	3/4 in	$T_{D\ max}$	Nm	87	87	–
	S4	7/8 in	$T_{D\ max}$	Nm	87	87	139
	S5	1 in	$T_{D\ max}$	Nm	–	–	139

▼ 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	$T_D = T_2 + T_3$
	$T_D < T_{D\ max}$

Note
For axial and/or radial loading (pinion, v-belt), please contact us!

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 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: $V_{g \max}$.

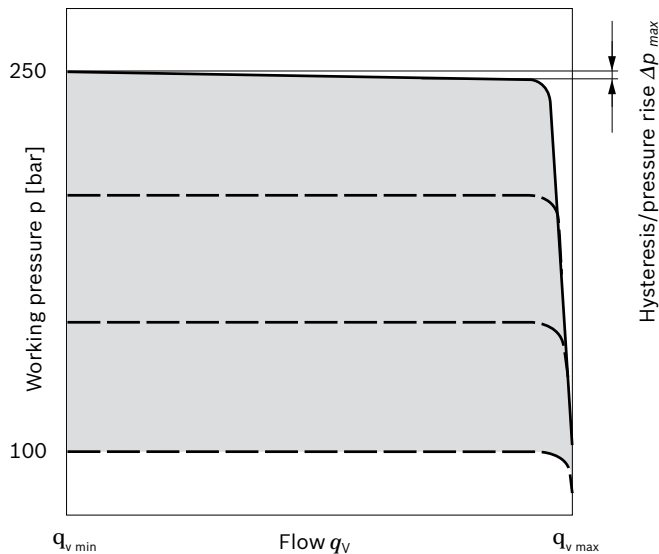
► DR

Setting range ¹⁾ for pressure control 100 to 250 bar.
Standard 250 bar

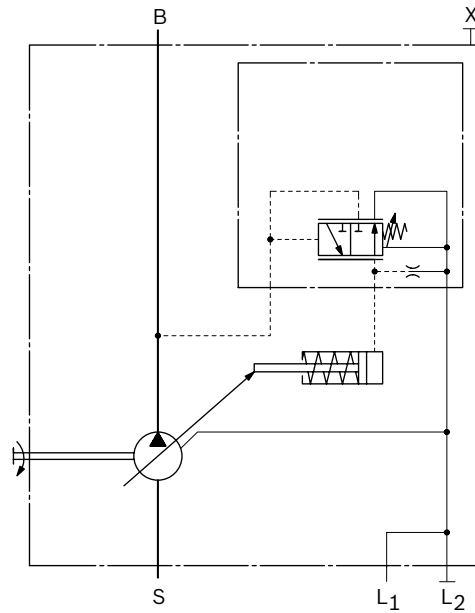
DN

Setting range ¹⁾ for pressure control 20 to 100 bar.
Standard is 100 bar

▼ Characteristic curve DR



▼ Schematic DR



Controller data

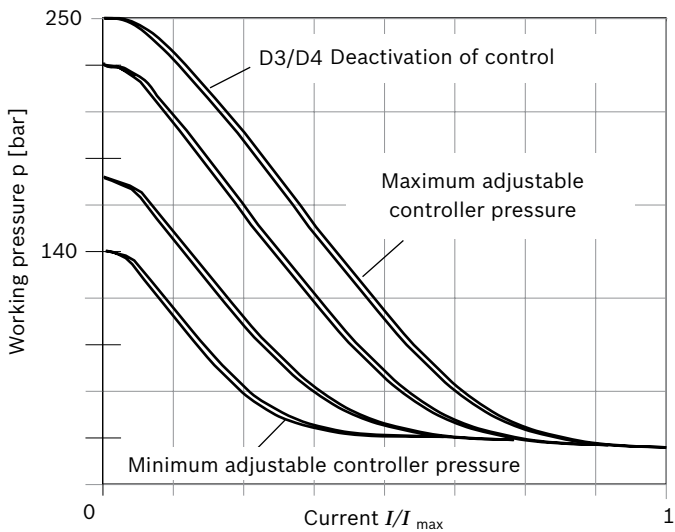
NG	18	28	35
Hysteresis and repeat precision Δp	Maximum 5 bar		
Pilot fluid consumption	Approx. 3 l/min max.		

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 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 beginning of control, the unit will go to the set maximum pressure. The same thing applies 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.

DRS0/DNSO – Pressure controller with load sensing

In addition to the pressure controller 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 metering 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.

► DRS0

Setting range ¹⁾ for pressure control 100 to 250 bar.

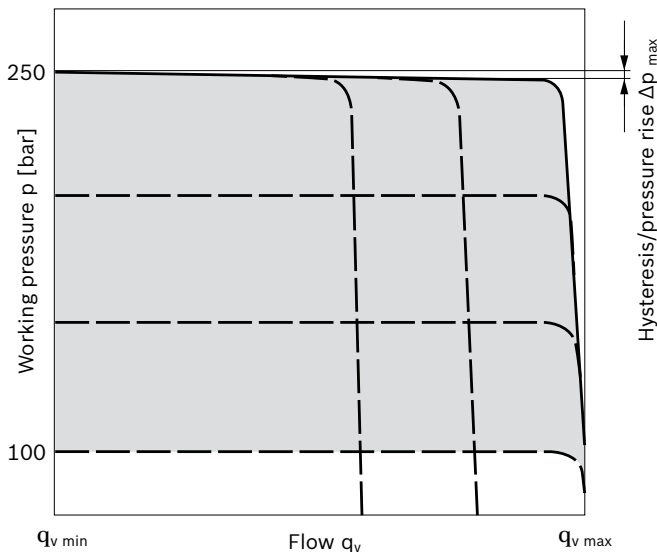
► DNS0

Setting range ¹⁾ for pressure control 20 to 100 bar.

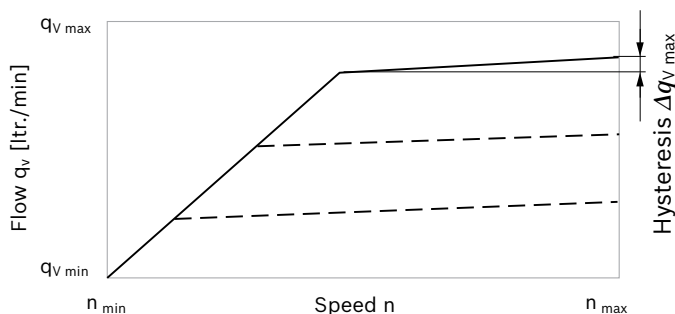
Note

The DRS0/DNSO version has no connection from **X** to the reservoir, which means that the LS relief has to be incorporated into the system.

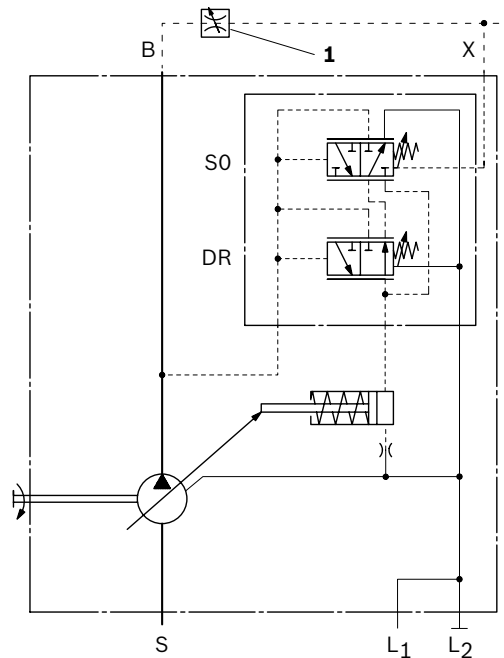
▼ Characteristic curve DRS0



▼ Characteristic curve at variable speed



▼ Schematic 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 clear text.

Control data

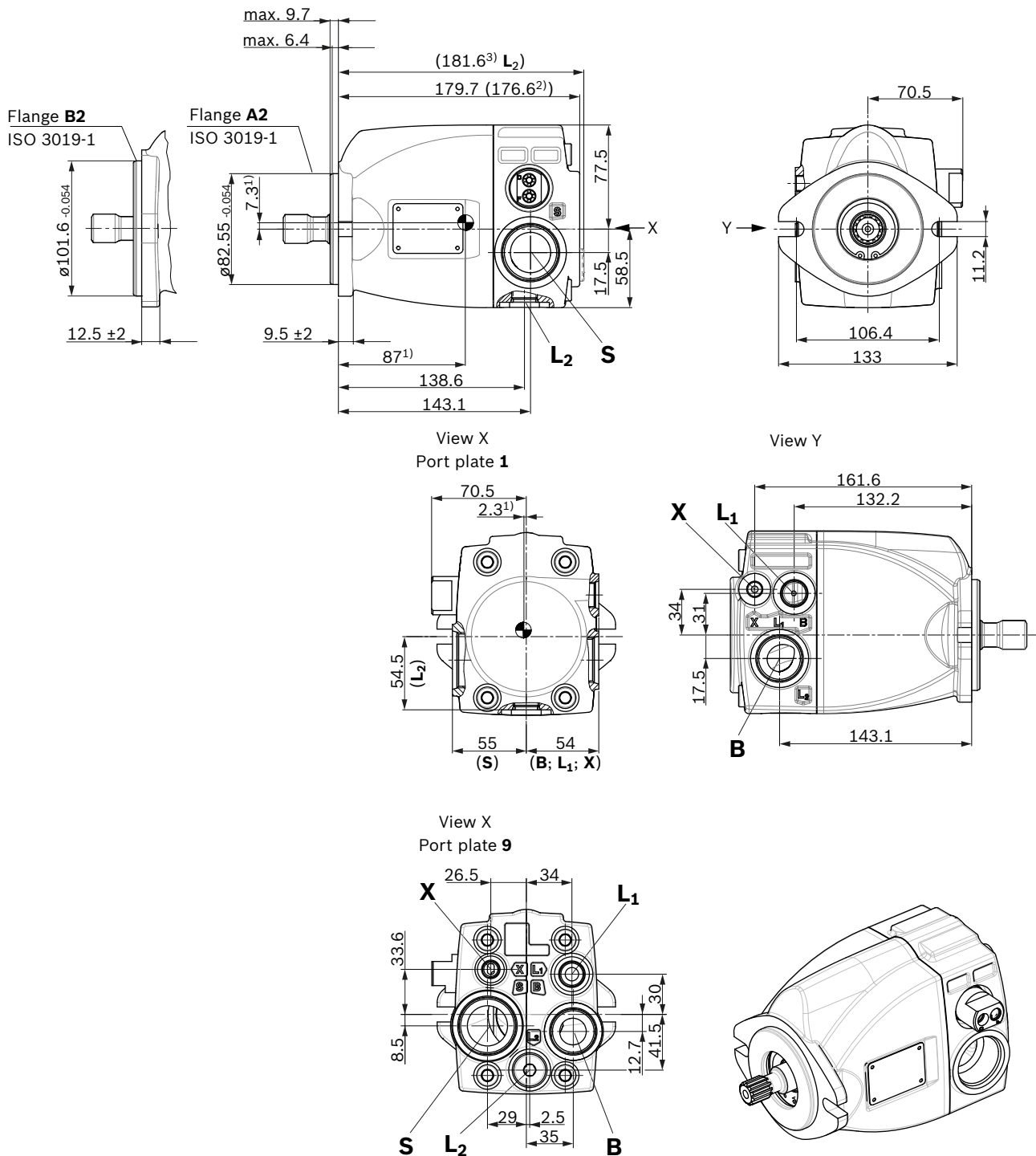
For data for the pressure controller DR, please refer to page 9. Maximum flow differential (hysteresis and increase) measured at drive speed $n = 1500 \text{ rpm}$ and $t_{\text{fluid}} = 50 \text{ °C}$

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

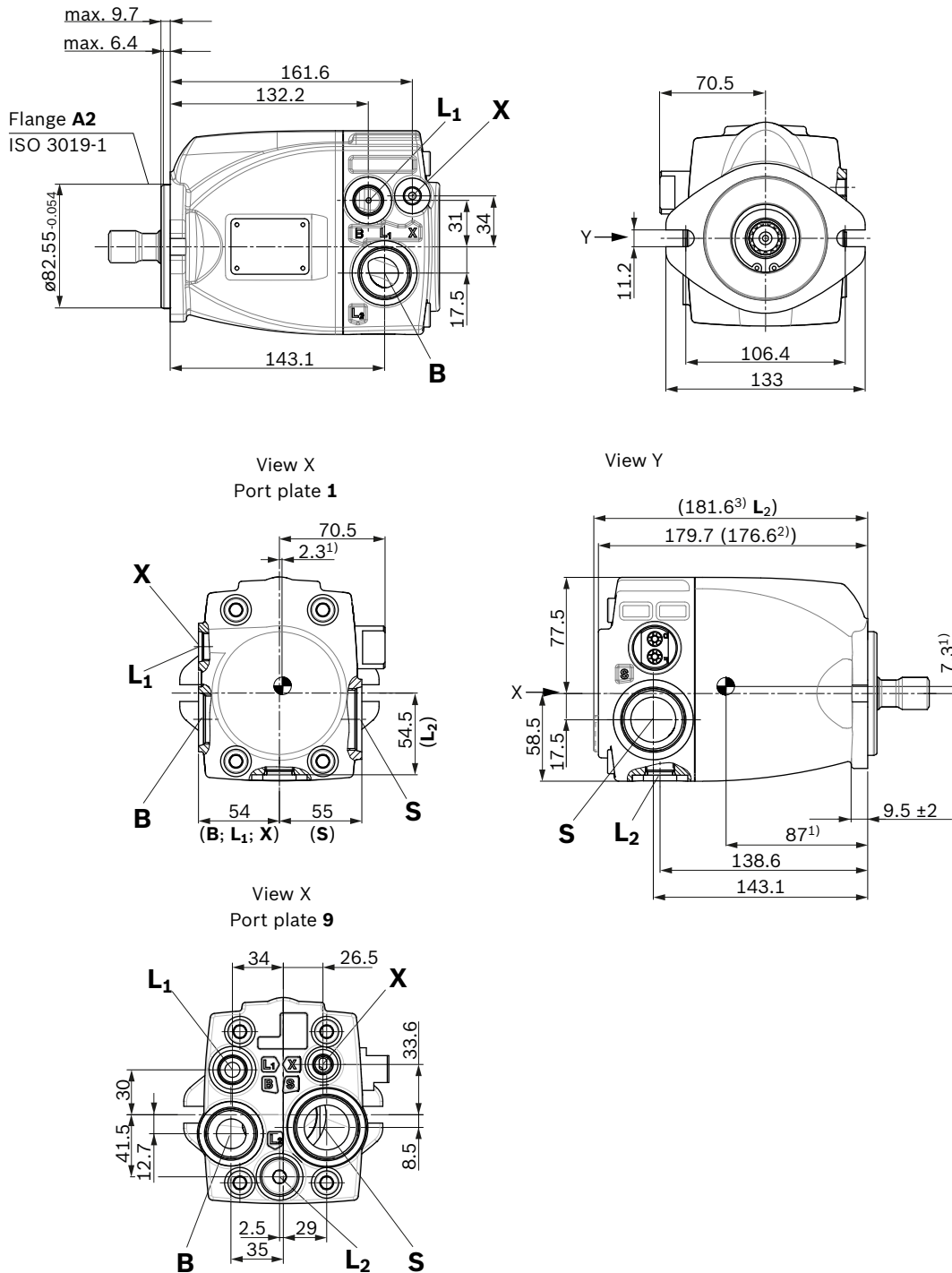
¹⁾ In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. Lower values on request

Dimensions size 18 and size 28

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

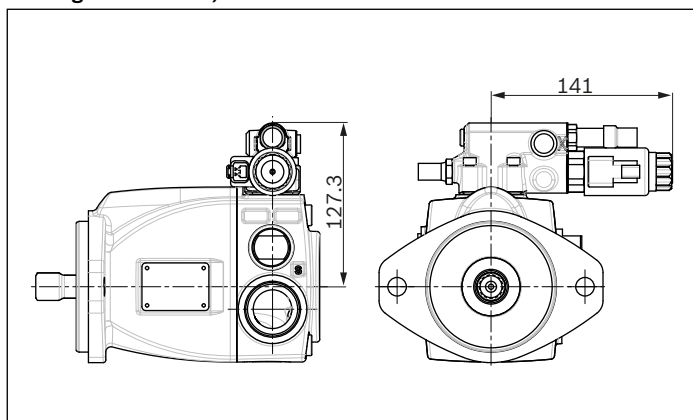


- 1) Center of gravity
- 2) Connection surfaces **S**, **B**, **X**, **L₁** and **L₂** with port plate 9
- 3) Only at port plate 9 and L₂ closed

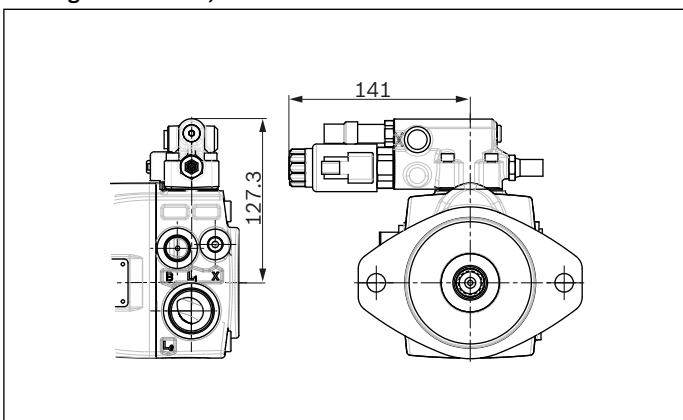
Dimensions size 18 and size 28**DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load sensing, counter clockwise rotation**

- 1) Center of gravity
- 2) Connection surfaces **S**, **B**, **X**, **L₁** and **L₂** with port plate 9
- 3) Only at port plate 9 and **L₂** closed

▼ **D3/D4 Pressure controller with override, electric-proportional, negative control; cw**

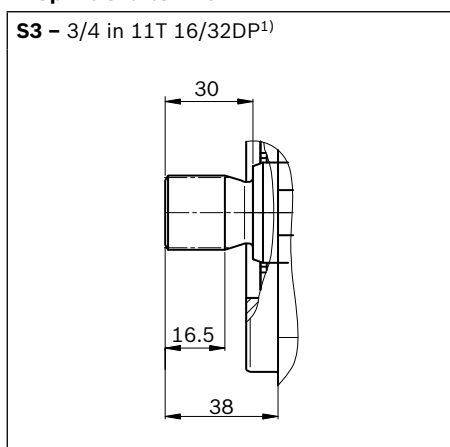


▼ **D3/D4 Pressure controller with override, electric-proportional, negative control; ccw**



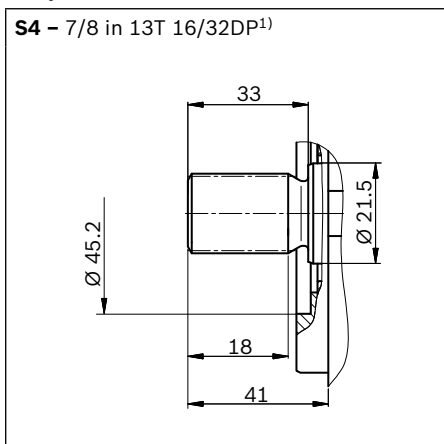
▼ **Spline shaft SAE J744**

S3 – 3/4 in 11T 16/32DP¹⁾



▼ **Spline shaft SAE J744**

S4 – 7/8 in 13T 16/32DP¹⁾



Ports and fastening threads version “B”

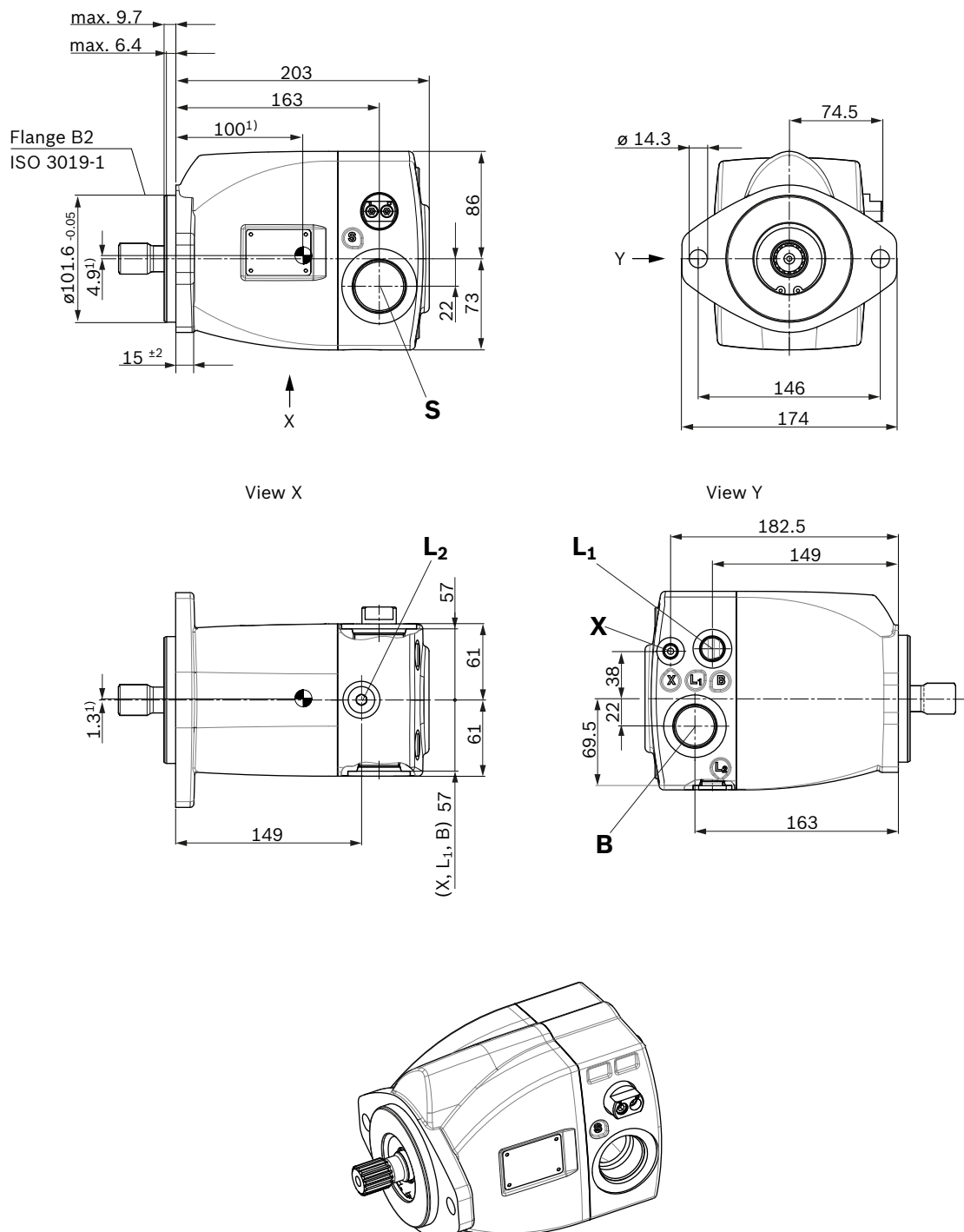
Ports		Standard ⁴⁾	Size ³⁾	$p_{max abs}$ [bar] ⁵⁾	State ⁸⁾
B	Service line port	ISO 11926	1 5/16-12UN-2B; 20 tief	280	O
S	Suction port	ISO 11926	1 5/8-12UN-2B; 20 tief	5	O
L₁	Case drain port	ISO 11926	3/4-16UNF-2B; 15 tief	10	O ⁶⁾
L₂	Case drain port	ISO 11926	3/4-16UNF-2B; 15 tief	10	X ⁶⁾
X	Pilot signal	ISO 11926	7/16-20UNF-2B; 12 tief	280	O ⁷⁾

Ports and fastening threads version “M”

Ports		Standard ⁴⁾	Size ³⁾	$p_{max abs}$ [bar] ⁵⁾	State ⁸⁾
B	Service line port	ISO 6149	M33 × 2; 20 deep	280	O
S	Suction port	ISO 6149	M42 × 2; 20 deep	5	O
L₁	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	O ⁶⁾
L₂	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	X ⁶⁾
X	Pilot signal	ISO 6149	M12 × 1.5; 12 deep	280	O ⁷⁾

- 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) Observe the instructions in the operating instructions concerning the maximum tightening torques.
- 4) The spot face can be deeper than specified in the standard.

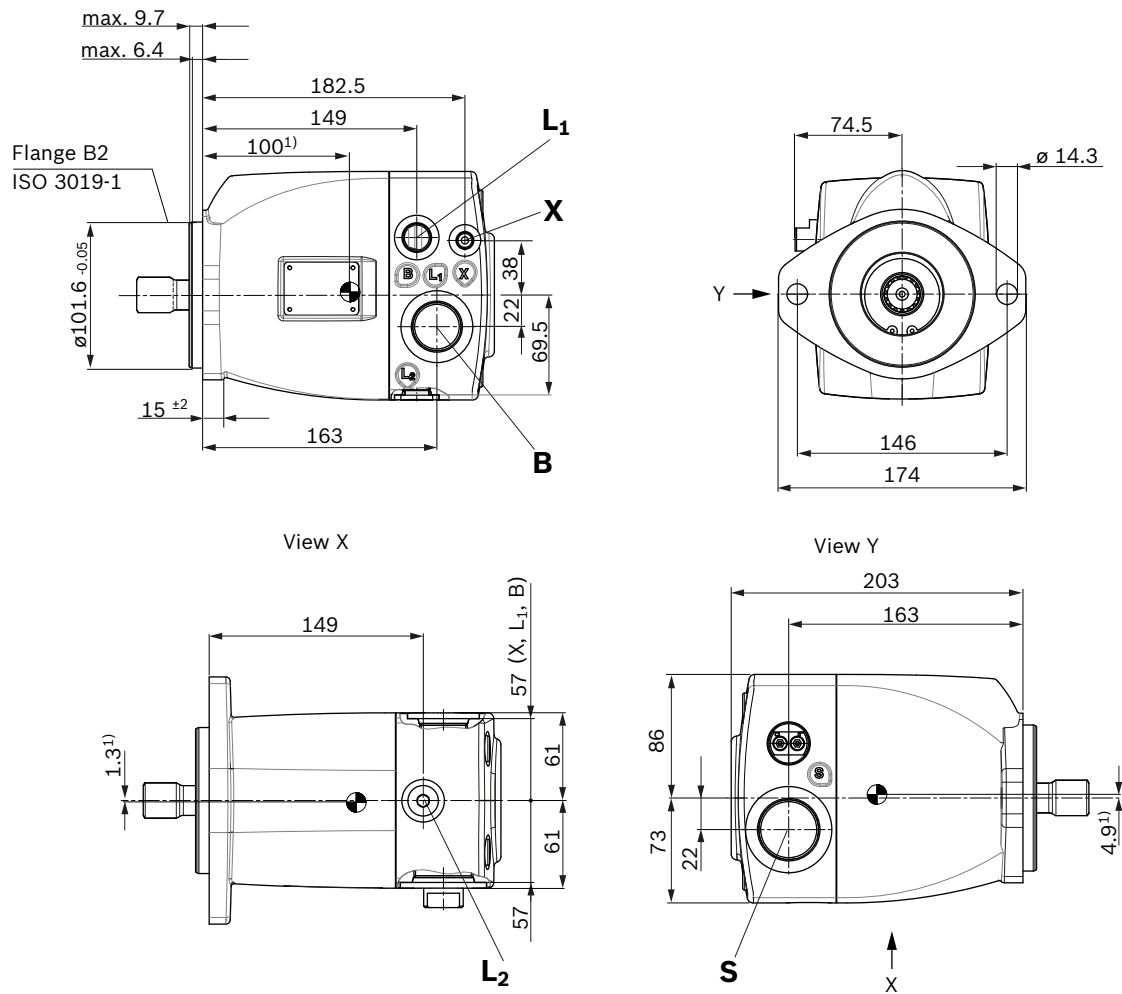
- 5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
- 6) Depending on the installation position, **L₁** or **L₂** must be connected (see also the installation instructions on page 22).
- 7) Only if an S0 controller is present.
- 8) O = Must be connected (plugged on delivery)
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

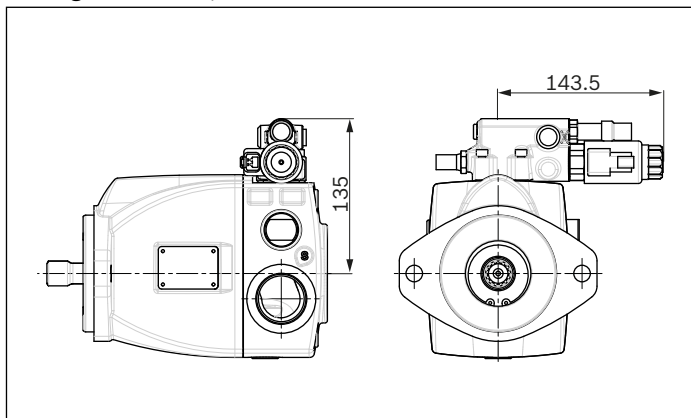
Dimensions, size 35

DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load sensing, counter clockwise rotation

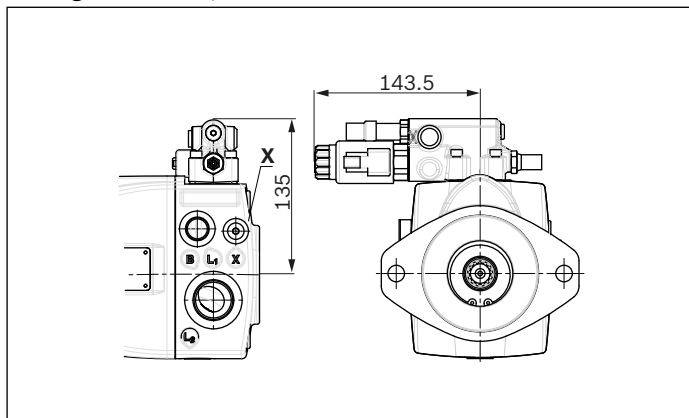


¹⁾ Center of gravity

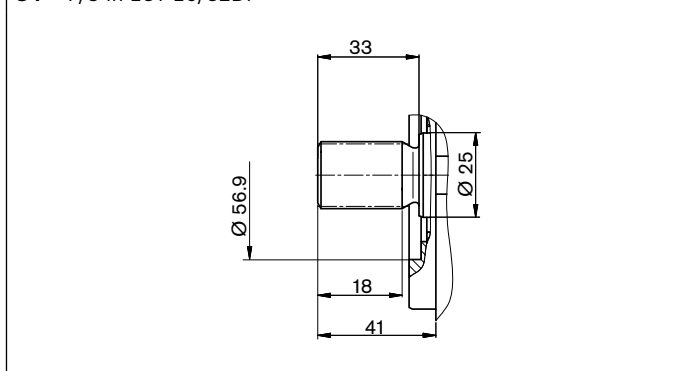
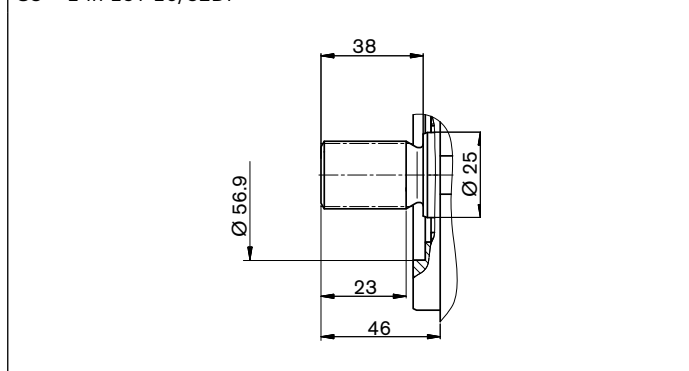
▼ D3/D4 Pressure controller with override, electric-proportional, negative control; cw



▼ D3/D4 Pressure controller with override, electric-proportional, negative control; ccw



▼ Splined shaft SAE J744

S4 – 7/8 in 13T 16/32DP¹⁾S5 – 1 in 15T 16/32DP¹⁾

Ports and fastening threads version “B”

Ports		Standard ⁴⁾	Size ³⁾	$p_{\max \text{ abs}}$ [bar] ⁵⁾	State ⁸⁾
B	Service line 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
L₁	Case drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	O ⁶⁾
L₂	Case drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	X ⁶⁾
X	Pilot signal	ISO 11926	7/16-20UNF-2B; 12 deep	280	O ⁷⁾

Ports and fastening threads version “M”

Ports		Standard ⁴⁾	Size ³⁾	$p_{\max \text{ abs}}$ [bar] ⁵⁾	State ⁸⁾
B	Service line port	ISO 6149	M33 × 2; 20 deep	280	O
S	Suction port	ISO 6149	M42 × 2; 20 deep	5	O
L₁	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	O ⁶⁾
L₂	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	X ⁶⁾
X	Pilot signal	ISO 6149	M12 × 1.5; 12 deep	280	O ⁷⁾

Note

With all the 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) Thread according to ASME B1.1

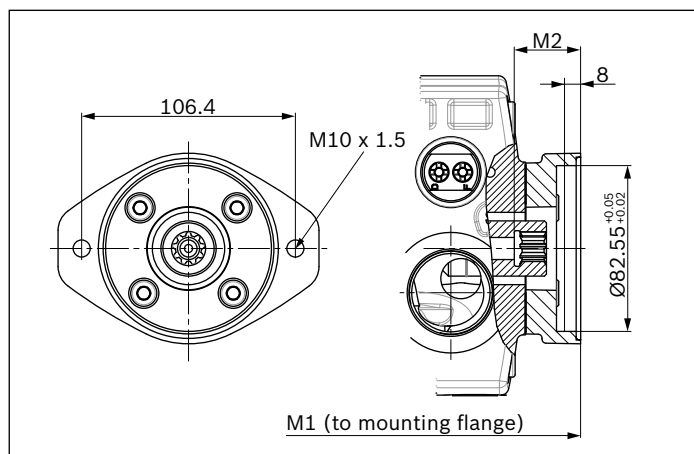
3) Observe the instructions in the operating instructions concerning the maximum tightening torques.
4) The spot face can be deeper than specified in the standard.
5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
6) Depending on the installation position, **L₁** or **L₂** must be connected (see also the installation instructions on page 22).
7) Only if an S0 controller is present.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Through drives dimensions

Flange SAE J744			Hub for splined shaft ¹⁾			Availability NG			Code
Diameter	Attachment ²⁾	Designation	Diameter	Designation		018	028	035	
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

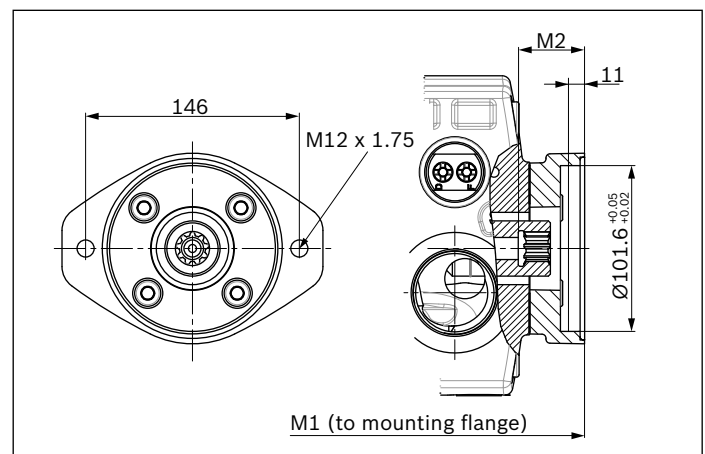
● = Available ○ = On request – = Not available

▼ 82-2 (A)



Short code	NG	M1	M2
A2S2	018	203.2	32
	028	203.2	32
	035	227.6	32
A2S3	018	203.2	38
	028	203.2	38
	035	227.6	38
A2S4	018	203.2	41
	028	203.2	41
	035	227.6	41

▼ 101-2 (B)



Short code	NG	M1	M2
B2S4	018	203.2	41
	028	203.2	41
	035	227.6	41
B2S5	035	227.6	46

- 1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Mounting drillings pattern viewed on through drive, with service line port B on right.
- 3) Continuous thread according to DIN 13; observe the instructions in the operating instructions concerning the maximum tightening torques.

Overview of attachment options

Through drive ¹⁾		Fitting options – 2nd pump							
Flange	Hub for splined shaft	Short 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)	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)	Series N Series G
	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 (1st pump)	A1VO (2nd 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 pump must be linked by a “+”.

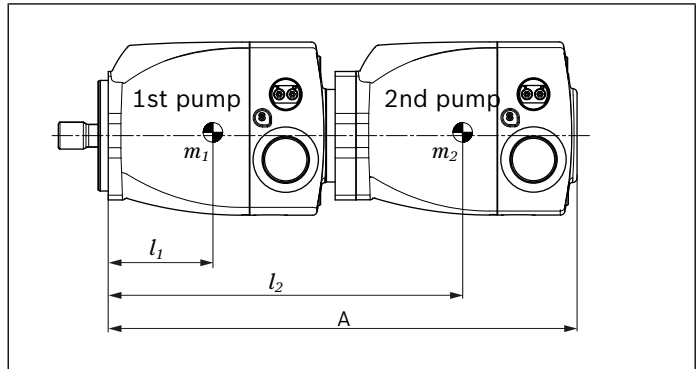
Order example:

A1VO035DRS0C200/10BRVB2S51B2S500-0+

A1VO035DRS0C200/10BRVB2S51000000-0

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/s²) without additional support brackets.

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



m_1, m_2	Weight of pump	[kg]
l_1, l_2	Distance, center of gravity	[mm]
$T_m = (m_1 \times l_1 + m_2 \times l_2) \times \frac{1}{102} \text{ [Nm]}$		

Permissible mass moment of inertia

Size			18	28	35
static	T_m	Nm	500	500	890
dynamic at 10 g (98.1 m/s ²)	T_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

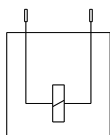
DEUTSCH DT04-2P

Molded 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

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.

The procedure is defined in the instruction manual.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. 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 leakage in the pump housing must be discharged to the reservoir via the highest available drain port (**L₁**, **L₂**).

For combinations of multiple units, the case drain 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 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 operational circumstances, particularly at cold start. If this is not possible, separate drain lines 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 overall loss of pressure. However, it must not be higher than $h_{s\ max} = 800\text{ mm}$. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during 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.

Note

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

For key, see page Page 23

Installation position

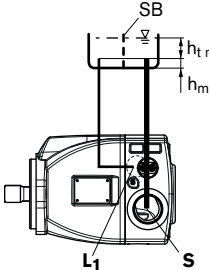
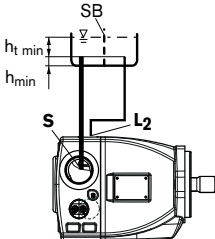
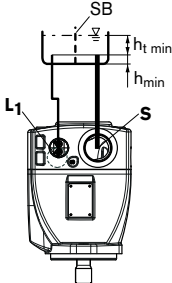
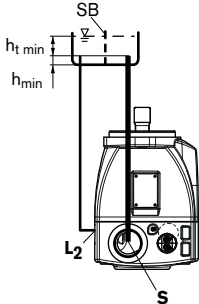
See examples **1** to **11** below.

Additional 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 bleeding	Filling
1 	L₁	L₁
2 	L₂	L₂
3 	L₁ or L₂	L₁ or L₂
4¹⁾ 	L₁ or L₂	L₁ or L₂

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.

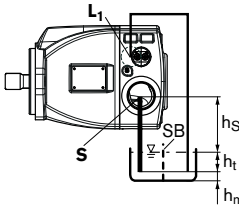
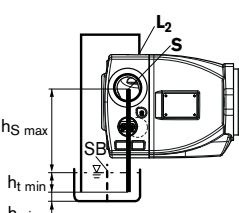
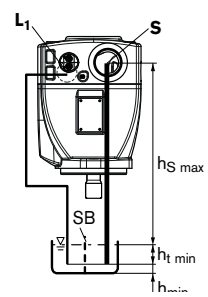
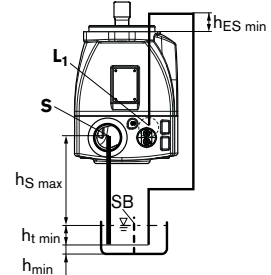
Above-reservoir installation

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

$h_{S \max} = 800 \text{ mm}$.

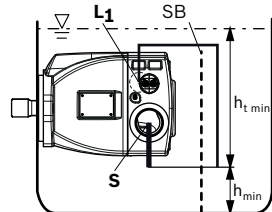
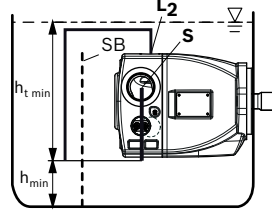
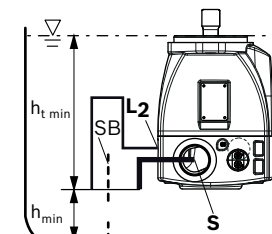
Installation position	Air bleeding	Filling
5 	L₁	L₁
6 	L₂	L₂
7 	L₁	L₁
8¹⁾ 	L₁	L₁

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 bleeding	Filling
9 	Via the highest available port L₁	Automatically via the open port L₁ due to the position under the hydraulic fluid level
10 	Via the highest available port L₂	Automatically via the open port L₂ due to the position below the hydraulic fluid level
11¹⁾ 		

Key	
L₁, L₂	Filling / air bleeding
S	Suction port
SB	Baffle (baffle plate)
h_{t min}	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)
h_{ES min}	Minimum necessary height needed to protect the 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 variable pump is designed to be used in an open circuit.
- ▶ The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled personnel.
- ▶ Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- ▶ Before finalizing your design, request a binding installation drawing.
- ▶ The specified data and notes must be observed.
- ▶ Depending on the operating condition 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 times apply under optimal storage conditions, details of these conditions can be found in the data sheet 90312 or the instruction manual.
- ▶ Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- ▶ Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference. Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- ▶ Pressure controllers is no safeguard from pressure overload. A pressure relief valve must be provided in the hydraulic system.
- ▶ Working ports:
 - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
 - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- ▶ 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).
- ▶ Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Bosch Rexroth AG
Mobile Applications
An den Kelterwiesen 14
72160 Horb a.N., Germany
Tel. +49 7451 92-0
info.ma@boschrexroth.de
www.boschrexroth.com

© This document, as well as the data, specifications and other information set forth in it, are the exclusive property of Bosch Rexroth AG. It may not be reproduced or given to third parties without consent. The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.