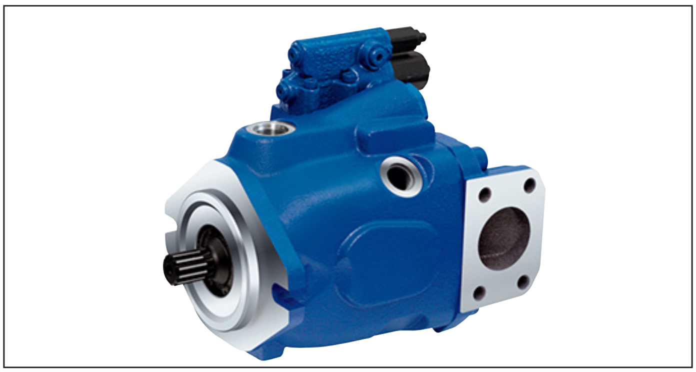
Axial piston variable pump A10VNO series 52 and 53



- For low-pressure applications such as tractors or fan drives
- Sizes 28 to 85
- Nominal pressure 210 bar
- Maximum pressure 250 bar
- Open circuit

Features

- Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- Flow is proportional to drive speed and displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- Stable bearing for long service life
- High permissible drive speed
- Favorable power-to-weight ratio – compact dimensions
- Low noise
- Excellent suction characteristics
- Electro-hydraulic pressure control
- Short control response times

Contents

Type code

01	02	03	04		05	06		07	08	09	10	11	12
A10VN	**O**			**/**	**5x**		**–**	**V**					

Axial piston unit

		28	45	63	85	
01	Swashplate design, variable, nominal pressure 210 bar, maximum pressure 250 bar	●	●	●	●	**A10VN**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

		28	45	63	85
03	Geometric displacement, see table of values on page 7	○	●	○	○

Control device

					28	45	63	85	
04	Pressure controller	Hydraulic			●	●	●	●	**DR**
	With flow controller	Hydraulic	X-T open		●	●	●	●	**DRF**
			X-T plugged	With flushing function	●	●	●	●	**DRS**
				Without flushing function	●	●	●	●	**DRSC**
	With pressure cut-off	Hydraulic	Remote controlled		●	●	●	●	**DRG**
		Electric	Negative control	*U* = 12 V	●	●	●	●	**ED71**
				U = 24 V	●	●	●	●	**ED72**
	Electro-proportional control		Positive control						
	With pressure control			*U* = 12 V	●	●	●	●	**EP1D**
				U = 24 V	●	●	●	●	**EP2D**
	With pressure and flow control (load-sensing)		X-T open	*U* = 12 V	●	●	●	●	**EP1DF**
				U = 24 V	●	●	●	●	**EP2DF**
	With pressure and flow control (load-sensing)		X-T plugged	*U* = 12 V	●	●	●	●	**EP1DS**
				U = 24 V	●	●	●	●	**EP2DS**
	With electro-hydraulic pressure control			*U* = 12 V	●	●	●	●	**EP1ED**
				U = 24 V	●	●	●	●	**EP2ED**
	Electro-proportional control		Positive control						
	With pressure control			*U* = 12 V	●	●	●	●	**EK1D**
				U = 24 V	●	●	●	●	**EK2D**
	Pressure and flow control with controller cut-off (load sensing)		X-T open	*U* = 12 V	●	●	●	●	**EK1DF**
				U = 24 V	●	●	●	●	**EK2DF**
	Pressure and flow control with controller cut-off (load sensing)		X-T plugged	*U* = 12 V	●	●	●	●	**EK1DS**
				U = 24 V	●	●	●	●	**EK2DS**
	Electro-hydraulic pressure control with controller cut-off			*U* = 12 V	●	●	●	●	**EK1ED**
				U = 24 V	●	●	●	●	**EK2ED**

Series

		28	45	63	85	
05	Series 5, index 2	–	●	●	–	**52**
	Series 5, index 3	●	●[1]	●[1]	●	**53**

Direction of rotation

			28	45	63	85	
06	Viewed on drive shaft	Clockwise					**R**
		Counter-clockwise					**L**

● = Available ○ = On request – = Not available

1) The following controls are only available in series 53: **EP**1(2).. and **EK**1(2)..

01	02	03	04		05	06		07	08	09	10	11	12
A10V(S)	**O**			**/**	**52**		**–**	**V**					

Sealing material

07	FKM (fluorocarbon rubber)	**V**

Drive shaft

			28	45	63	85	
08	Splined shaft	Standard shaft	●	●	●	●	**S**
	ISO 3019-1	Similar to shaft "S" however for higher torque	●	●	●	●	**R**

Mounting flange

			28	45	63	85	
09	ISO 3019-1 (SAE)	2-hole	●	●	●	●	**C**
		4-hole	–	–	–	●	**D**

Working port

				28	45	63	85	
10	SAE flange ports Metric fastening thread	Rear	Not for through drive	●	●	●	●	**11**
		Laterally opposite	For through drive	●	●	●	●	**12**

Through drive (for mounting options, see page 37)

11	Flange ISO 3019-1 Diameter	Hub for splined shaft[1)] Diameter		28	45	63	85	
	Without through drive			●	●	●	●	**N00**
	82-2 (A)	5/8 in	9T 16/32DP	●	●	●	●	**K01**
		3/4 in	11T 16/32DP	●	●	●	●	**K52**
	101-2 (B)	7/8 in	13T 16/32DP	–	●	●	●	**K68**
		1 in	15T 16/32DP	–	–	●	●	**K04**
	127-4 (C)	1 1/4 in	14T 12/24DP	–	–	–	●	**K15**

Connector for solenoids

		28	45	63	85	
12	Without connector (without solenoid, only for hydraulic controls, without signs)	●	●	●	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode (for electric controls)	●	●	●	●	**P**

● = Available ○ = On request – = Not available

Notice

- Observe the general project planning notes on page 44 and the project planning notes regarding each control device.
- In addition to the type code, please specify the relevant technical data.

1) In accordance with ANSI B92.1a

Hydraulic fluids

The A10VNO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
See the following data sheets for application instructions and requirements for hydraulic fluids before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids

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:

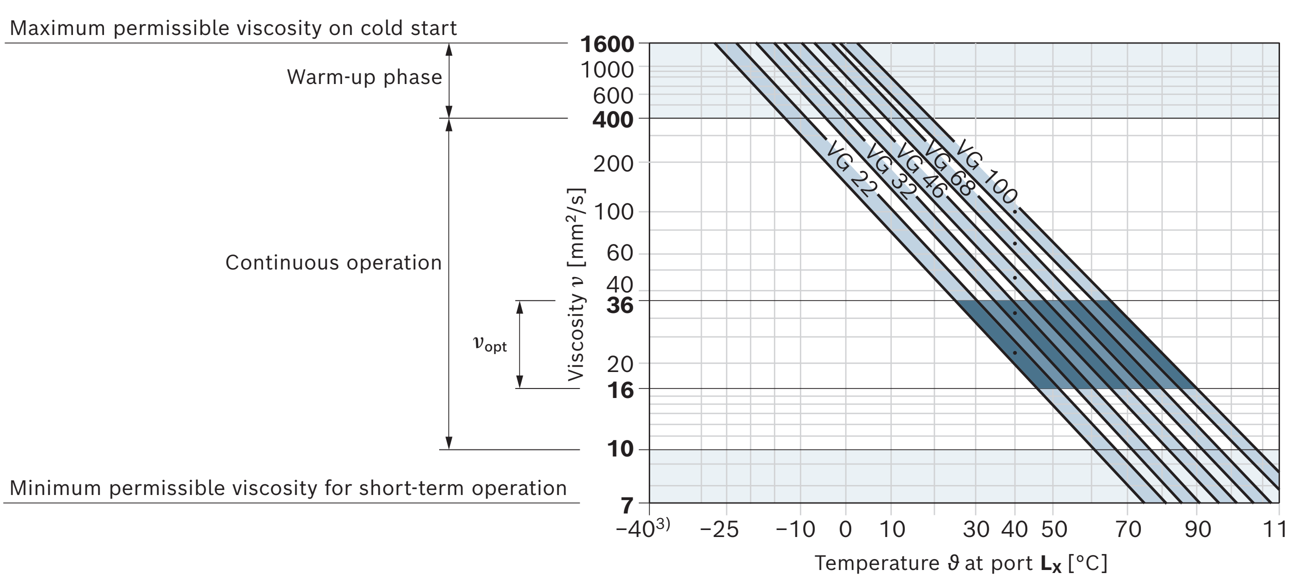
- 90245: Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)

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)]	Remarks
Cold start	$\nu_{max} \le 1600$ mm²/s	FKM	$\vartheta_{St} \ge -25$ °C	$t \le 3$ min, without load ($p \le 50$ bar), $n \le 1000$ 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			$t \le 15$ min, $p \le 0.7 \times p_{nom}$ and $n \le 0.5 \times n_{nom}$
Continuous operation	ν = 400 ... 10 mm²/s[1)]	FKM	$\vartheta \le +110$ °C	Measured at port $\mathbf{L_x}$
	ν_{opt} = 36 ... 16 mm²/s			Optimal operating viscosity and efficiency range
Short-term operation	ν_{min} = 10 ... 7 mm²/s	FKM		$t \le 3$ min, $p \le 0.3 \times p_{nom}$, measured at port $\mathbf{L_x}$

▼ **Selection diagram**



1) This corresponds, for example on the VG 46, to a temperature range of +4 °C to +85 °C (see selection diagram)

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

3) For applications in the low-temperature range, please contact us.

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406

At a hydraulic fluid viscosity of less than 10 mm²/s (e.g. due to high temperatures during short-term operation) at the drain port, a cleanliness level of at least 19/17/14 under ISO 4406 is required.

For example, viscosity is 10 mm²/s at:

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

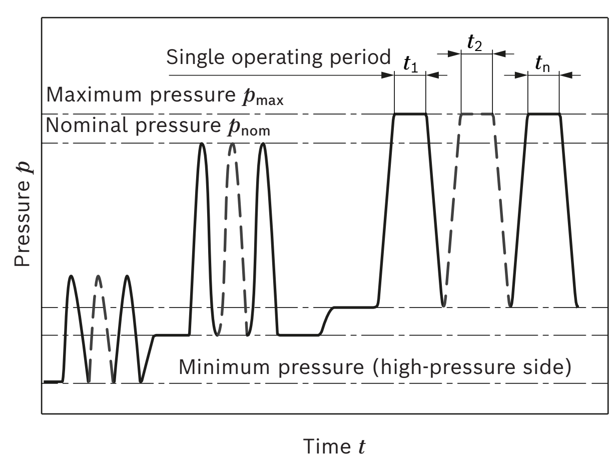
Working pressure range

Pressure at working port B		Definition
Nominal pressure p_{nom}	210 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	250 bar	The maximum pressure corresponds to the maximum working pressure within a single operating period. The sum of single operating periods must not exceed the total operating period.
Single operating period	2.5 ms	
Total operating period	300 h	
Minimum pressure $p_{B\,abs}$ (high-pressure side)	10 bar	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$	16000 bar/s	Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\,min}$ Standard	0.8 bar absolute	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 absolute	
Leakage pressure at port L, L_1, L_2		
Maximum pressure $p_{L\,max}$	2 bar	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{L\,max}$. The leakage pressure must always exceed the ambient pressure. A case drain line to the reservoir is required.
Pilot pressure port X with external high pressure		
Maximum pressure p_{max}	250 bar	When designing all control lines with external high pressure, the values for the rate of pressure change, maximum single operating period and total operating period applicable to port **B** must not be exceeded.

Notice

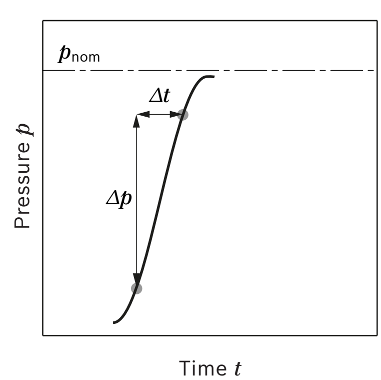
Working pressure range applies when using hydraulic fluids based on mineral oils.
Please contact us for values for other hydraulic fluids.

▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \dots + t_n$

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



Technical data

Size		NG		28	45	63	85
Geometric displacement, per revolution		$V_{g\,max}$	cm³	28	45	63	85
Maximum rotational speed[1)]	at $V_{g\,max}$	n_{nom}	rpm	3200	2900	2700	2700
Flow	at n_{nom} and $V_{g\,max}$	q_v	l/min	90	131	170	230
Power	at n_{nom}, $V_{g\,max}$ and Δp = 210 bar	P	kW	31	46	59	80
Torque	at $V_{g\,max}$ and Δp = 210 bar	M	Nm	94	150	210	284
Rotary stiffness of drive shaft	S	c	Nm/rad	11000	22300	37500	65500
	R	c	Nm/rad	14800	26500	40500	69400
Moment of inertia of the rotary group		J_{TW}	kgm²	0.00093	0.0017	0.0033	0.056
Maximum angular acceleration[2)]		α	rad/s²	6800	4900	3500	2500
Case volume		V	l	0.25	0.3	0.5	0.8
Weight **without** through drive (approx.)		m	kg	11.5	15	18	22
Weight **with** through drive (approx.)				13	18	24	28

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

Key

V_g Displacement per revolution [cm³]

Δp Differential pressure [bar]

n Rotational speed [rpm]

η_v Volumetric efficiency

η_{hm} Hydraulic-mechanical efficiency

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

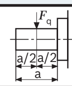
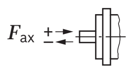
Notice

- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends checking the load by means of test or calculation / simulation and comparison with the permissible values.

1) The values are applicable:
– at an absolute pressure p_{abs} = 1 bar at the suction port **S**
– for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
– with hydraulic fluid based on mineral oils

2) The data are valid for values between the minimum required and maximum permissible rotational speed. It applies for external stimuli (e.g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connection parts must be considered.

Permissible radial and axial loading of the drive shaft

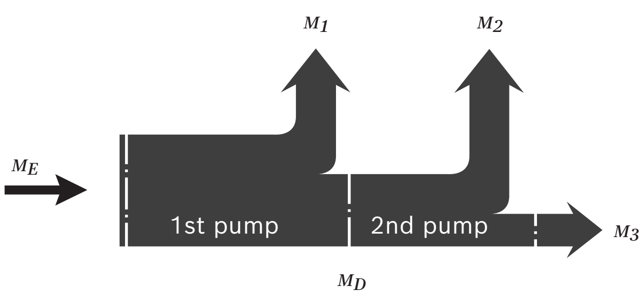
Size		NG		28	45	63	85
Maximum radial force at a/2		$F_{q\ max}$	N	150	650	1000	1350
Maximum axial force		$\pm F_{ax\ max}$	N	400	650	1000	1350

Notice
- The values given are maximum values and do not apply to continuous operation. All loads of the drive shaft reduce the bearing service life.

Permissible inlet and through-drive torques

Size				28	45	63	85
Torque at $V_{g\,max}$ and Δp = 210 bar[1]		M_{max}	Nm	94	150	210	284
Maximum input torque on drive shaft[2]							
	S	$M_{E\ max}$	Nm	124	198	319	630
		Ø	in	3/4	7/8	1	1 1/4
	R	$M_{E\ max}$	Nm	160	250	400	650
		Ø	in	3/4	7/8	1	1 1/4
Maximum through-drive torque							
	S	$M_{D\ max}$	Nm	108	160	319	484
	R	$M_{D\ max}$	Nm	120	176	365	484

▼ **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	<	$M_{D\ max}$

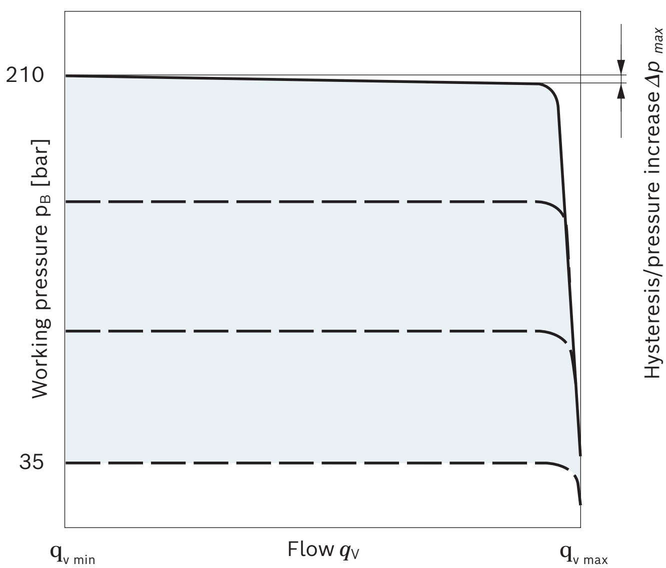
1) Efficiency not considered
2) For drive shafts with no radial force

DR – 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.

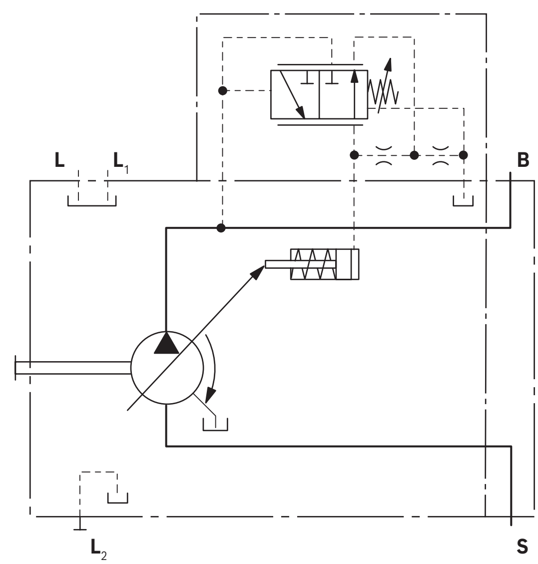
- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1)] for pressure control 35 to 210 bar. Standard is 210 bar.

▼ **Characteristic curve DR**



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

▼ **Circuit diagram DR**



Controller data

Size		28	45	63	85
Pressure increase	Δp [bar]	6	6	6	8
Hysteresis and repeatability	Δp [bar]	Maximum 4			
Pilot fluid consumption	l/min	Maximum approx. 3			

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

DRG – Pressure controller, remotely controlled

For the remote controlled pressure controller, the LS pressure limitation is performed using a separately arranged pressure relief valve. Therefore, any pressure control value under the pressure set on the pressure controller can be regulated. Pressure controller DR see page 9.

A pressure relief valve is externally piped up to port **X** for remote control. This relief valve is not included in the scope of delivery of the DRG control.

When there is differential pressure Δp at the control valve and with the standard setting on the remote controlled pressure cut-off of 20 bar, the amount of control fluid at the port is **X** approx. 1.5 l/min. If a different setting (range 10 to 22 bar) is required, please state in plain text.

As a separate pressure relief valve (**1**) we recommend:

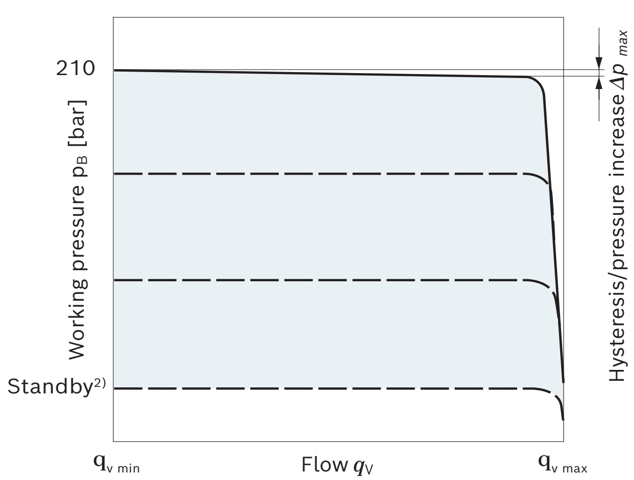
- A direct operated, hydraulic or electric proportional one, suitable for the control fluid mentioned above.

The maximum line length should not exceed 2 m.

- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1)] for pressure control 35 to 210 bar (**3**). Standard is 210 bar.
- Setting range for differential pressure 10 up to 22 bar (**2**) Standard is 20 bar.

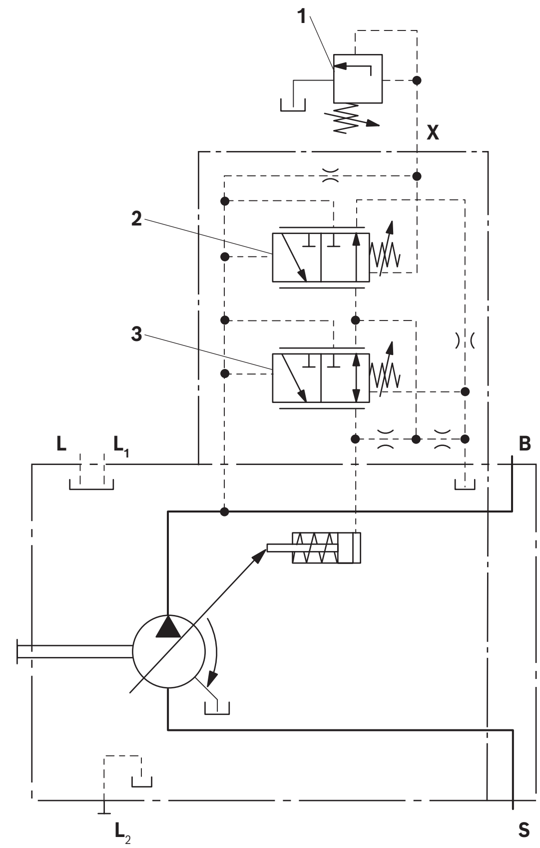
Unloading port **X** to the reservoir results in a zero stroke pressure (standby) which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

▼ **Characteristic curve DRG**



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

▼ **Circuit diagram DRG**



1 The separate pressure relief valve and the line are not included in the scope of delivery.
2 Remote controlled pressure cut-off (**G**)
3 Pressure controller (**DR**)

Controller data

Size		**28**	**45**	**63**	**85**
Pressure increase	Δp [bar]	6	6	6	8
Hysteresis and repeatability	Δp [bar]	Maximum 4			
Pilot fluid consumption	l/min	Maximum approx. 4.5			

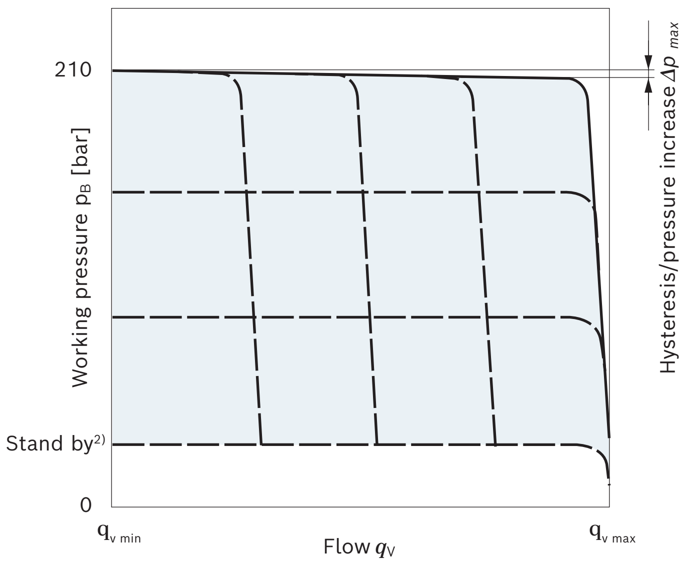
1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.
2) Zero stroke pressure from pressure setting Δp on controller (**2**)

DRF/DRS/DRSC – Pressure flow controller

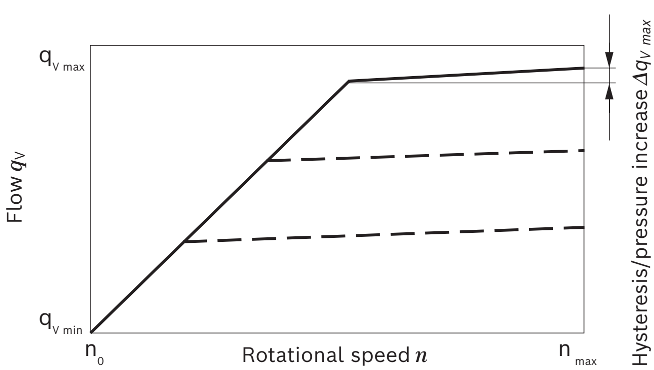
In addition to the pressure controller function (see page 9), an adjustable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual hydraulic fluid quantity required by the consumer. With all controller combinations, the V_g reduction has priority.

- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1)] to 210 bar.
- DR pressure controller data see page 9

▼ **Characteristic curve DRF/DRS/DRSC**



▼ **Characteristic curve at variable rotational speed**

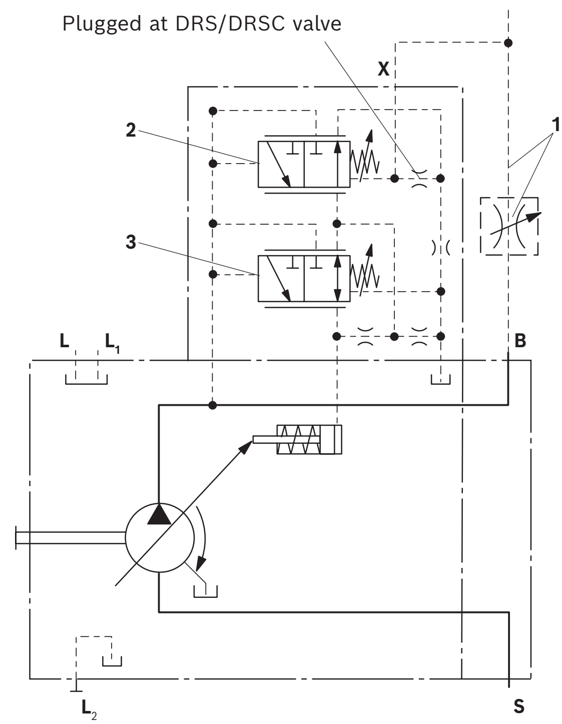


Characteristic curves valid at n_1 = 1500 rpm and ϑ_{fluid} = 50 °C.

Possible connections at port **B**
(not included in the scope of delivery)

LS mobile control blocks	Data sheets
M4-12	64276
M4-15	64283
LUDV mobile control blocks	
M7-22	64295

▼ **Circuit diagram DRF**



1 The metering orifice (control block) and the line is not included in the scope of delivery.
2 Flow controller (**FR**).
3 Pressure controller (**DR**)

Notice
The DRS and DRSC versions have no unloading from **X** to the reservoir.
The LS must thus be unloaded in the system.
Because of the flushing function of the flow controller in the DRS control valve, sufficient unloading of the **X** line must also be ensured.
If this unloading of the **X** line cannot be ensured, the DRF control valve must be used.

For further information see page 12

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

Differential pressure Δp:

- Standard setting: 14 bar
  If another setting is required, please state in clear text.
- Setting range: 14 bar to 22 bar

Unloading port **X** to the reservoir results in a zero stroke pressure (standby) which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

Controller data

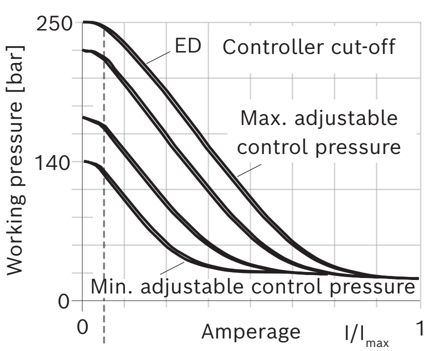
- DR pressure controller data, see page 9
- Maximum flow deviation measured at drive speed n = 1500 rpm.

Size		28	45	63	85
Flow deviation	Δq_{vmax} [l/min]	0.9	1.0	1.8	2.5
Hysteresis; repeatability	Δp [bar]	Maximum 4			
Pilot fluid consumption	l/min	Maximum approx. 3 to 4.5 (DRF) Maximum approx. 3 (DRS / DRSC)			

ED – Electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.
When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of power failure, e.g. for fan speed control).
The swivel time characteristic of the ED control was optimized for the use as a fan drive system.
When ordering, specify the type of application in plain text.

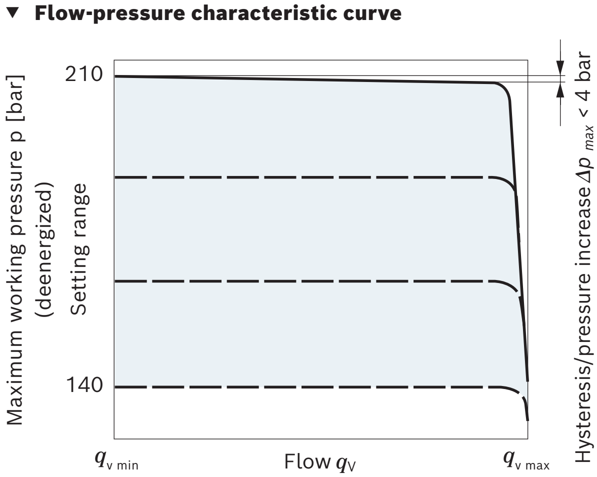
▼ **Current-pressure characteristic ED**
(negative characteristic curve)



Setting point (control current for start of control at p_{max})

- Hysteresis static < 3 bar.

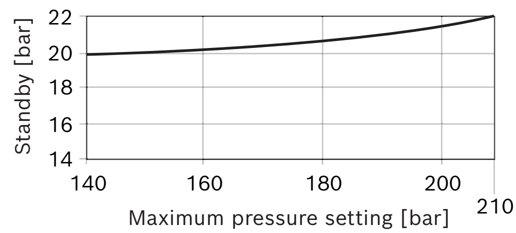
▼ **Flow-pressure characteristic curve**



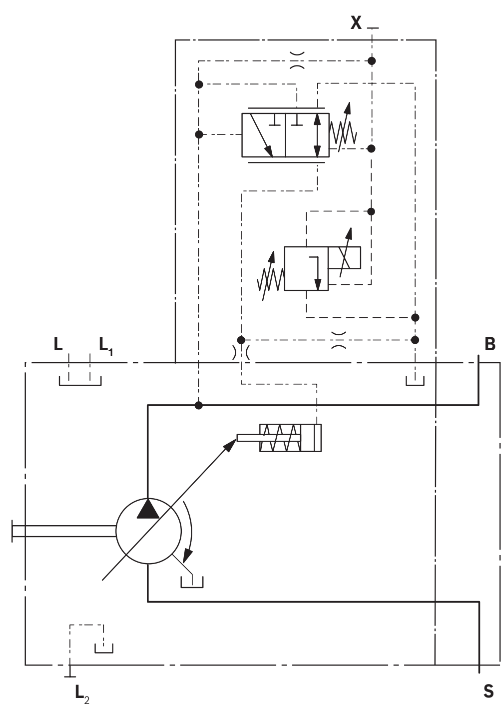
- Characteristic curves valid at n_1 = 1500 rpm and ϑ_{fluid} = 50 °C.

- Pilot fluid consumption: 3 to 4.5 l/min.
- For standby standard setting, see the following diagram; other values on request.

▼ **Influence of the pressure setting on standby (maximally energized)**



▼ **Circuit diagram ED71/ED72**



The following electronic control units and amplifiers are available for controlling the electro-hydraulic pressure control:

BODAS controllers RC Series	Data sheet
30	95205
31	95206
And application software	
Analog amplifier RA	95230

Technical data, solenoids	**ED71**	**ED72**
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{max}	100 mA	50 mA
End of control at p_{min}	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Recommended amplitude	120 mA	60 mA
Duty cycle	100%	100%
Type of protection: see connector version page 39		
Operating temperature range at valve -20 °C to +115 °C		

Notice

With **ED71**, de-energized operating condition (jump from 100 to 0 mA) results in a pressure increase of the maximum pressure of 4 to 5 bar.

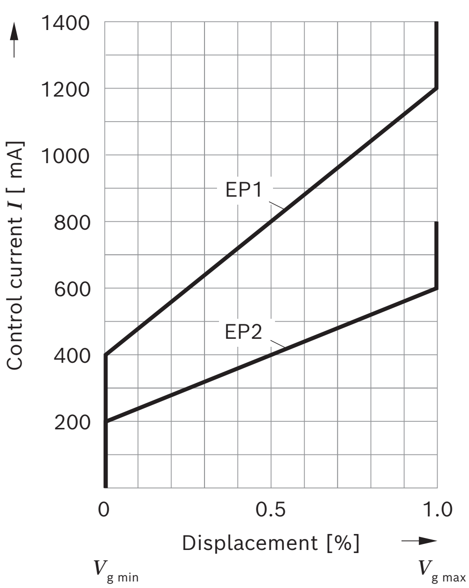
With **ED72**, de-energized operating condition (jump from 50 to 0 mA) results in a pressure increase of the maximum pressure of 4 to 5 bar.

EP – Electro-proportional control

Electro proportional control makes a continuous and reproducible setting of the pump displacement possible directly via the cradle. The control force of the control piston is applied by a proportional solenoid.
The control is proportional to the current
(for start of control, see table right).
In a depressurized state, the pump is swiveled to its initial position ($V_{g\,max}$) by an adjusting spring. If the working pressure exceeds a limit value of approx. 4 bar, the pump starts to swivel from $V_{g\,max}$ to $V_{g\,min}$ without control by the solenoid (control current < start of control). With a minimum swivel angle $V_{g\,min}$ and de-energized EP solenoids, a minimum pressure of 10 bar must be maintained.
A PWM signal is used to control the solenoid.

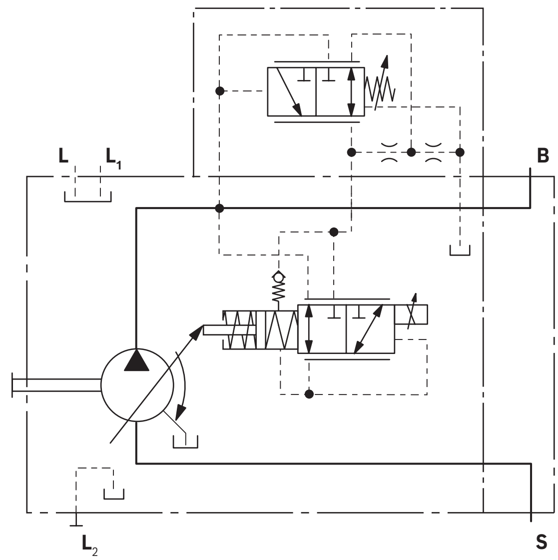
EP.D: The pressure control regulates the pump displacement back to $V_{g\,min}$ after the pressure command value has been reached.
A minimum working pressure of 14 bar is needed for safe and reproducible control. The required control fluid is taken from the high pressure.

▼ **Characteristic curve EP1/2**



▶ Hysteresis static current-displacement characteristic curve < 5 %.

▼ **Circuit diagram EP.D**



Technical data, solenoids	EP1	EP2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Dither frequency	100 Hz	100 Hz
Recommended amplitude	120 mA	60 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Duty cycle	100%	100%
Type of protection: see connector version page 39		
Operating temperature range at valve -20 °C to +115 °C		

The following electronic control units and amplifiers are available for controlling the proportional solenoids:

BODAS controllers RC Series	Data sheet
30	95205
31	95206
40	95207 and 95208
And application software	
Analog amplifier RA	95230

Notice
We recommend the valve with flushing function for the EP.D control variant. Please contact us.

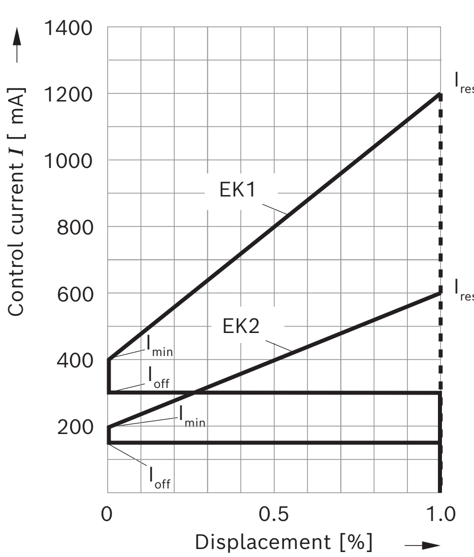
EK – Electro-proportional control with controller cut-off

Variant EK... is based completely on the variant EP... (see page 15).
In addition to the electro-proportional control function, a controller cut-off is integrated in the electric characteristic curve. The pump then swivels to $V_{g\ max}$ if the pilot signal is lost (e.g. cable break) and then works with the DRF settings if necessary (see page 11).
The controller cut-off is only intended for short-term use and not for permanent use if the pilot signal is lost.
If the pilot signal is lost, the pump swivel times will be increased by the EK valve.
A PWM signal is used to control the solenoid.

Notice
A minimum working pressure of 50 bar is needed for safe and reproducible electro-proportional control with controller cut-off. For lower pressures, a pilot signal of > 500 mA (EK2) or > 1000 mA (EK1) is required in order to avoid undesired controller cut-off. The required control fluid is taken from the high pressure.

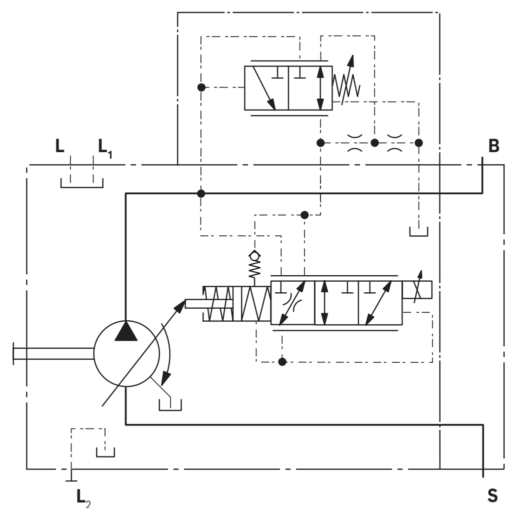
In $V_{g\ max}$ position, the spring force of the return spring is maximum. To overcome the force of this spring, the solenoid must be subjected to excessive current (I_{res}).

▼ **Characteristic curve EK1/2**



- Hysteresis static current-displacement characteristic curve < 5 %.
- For changes in current, ramp times of > 200 ms must be observed.

▼ **Circuit diagram EK.D**



Technical data, solenoids	EK1	EK2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_{g\ min}$	400 mA	200 mA
End of control at $V_{g\ max}$	1200 mA	600 mA
Dither frequency	100 Hz	100 Hz
Recommended amplitude	120 mA	60 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Duty cycle	100%	100%
Type of protection: see connector version page 39		
Operating temperature range at valve -20 °C to +115 °C		

	EK1	EK2
I_{min} [mA]	400	200
I_{max} [mA]	1200	600
I_{off} [mA]	< 300	< 150
I_{res} [mA]	> 1200	> 600

The following electronic control units and amplifiers are available for controlling the proportional solenoids:

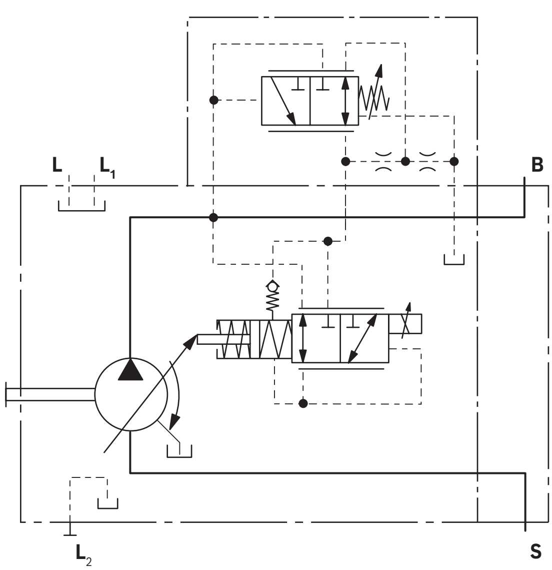
BODAS controllers RC Series	Data sheet
30	95205
31	95206
40	95207 and 95208
And application software	
Analog amplifier RA	95230

Notice
We recommend the valve with flushing function for the EK.D control variant. Please contact us.

EP(K).DF / EP(K).DS / EP(K) – with pressure flow controller

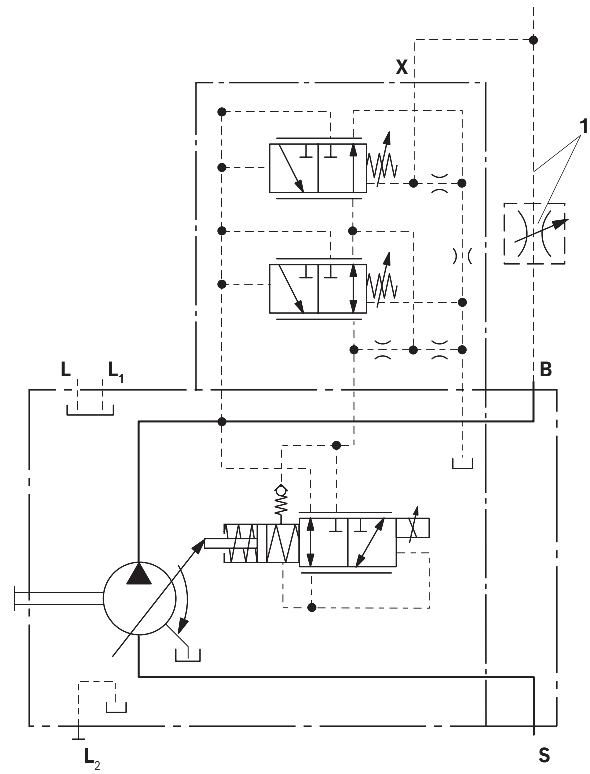
A hydraulic pressure flow control is superimposed on the electro-proportional control.
The pressure control regulates the pump displacement infinitely varied back to $V_{g\,min}$ after the set pressure command value has been reached.
This function is super-imposed on the EP or EK control, i.e. the control-current dependent EP or EK function is executed below the pressure command value.
For setting range for pressure flow controller, see page 11.
With all controller combinations, the V_g reduction has priority.
With flow control, the pump flow can be influenced in addition to pressure control. The pump flow is thus equal to the actual amount of hydraulic fluid required by the consumer. This is achieved using the differential pressure at the consumer (e.g. orifice).
The EP.DS or EK.DS version has no connection between **X** and the reservoir (load-sensing). Please refer to the notes on page 11.

▼ **Circuit diagram EP.D**

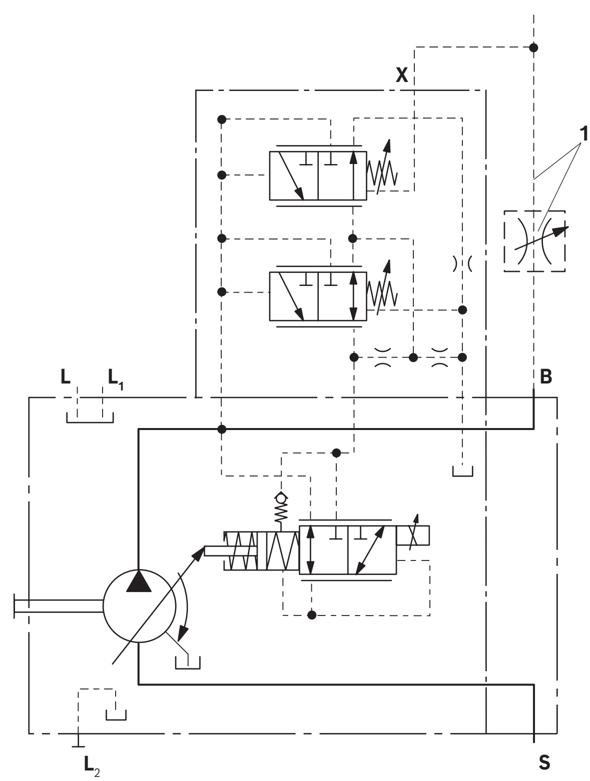


1 The metering orifice (control block) and the line is not included in the scope of delivery.

▼ **Circuit diagram EP.DF**



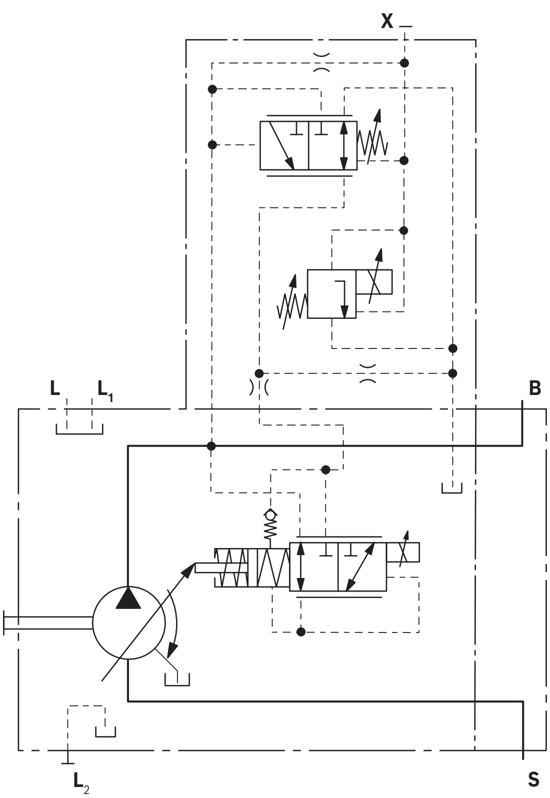
▼ **Circuit diagram EP.DS**



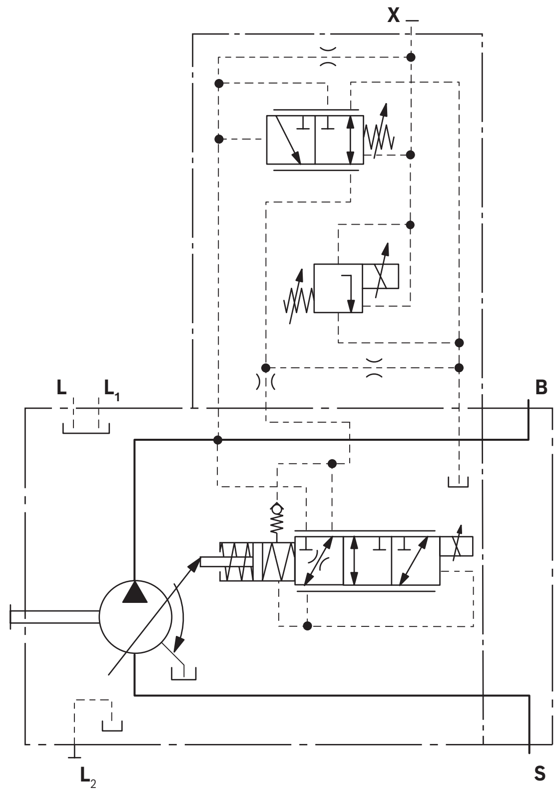
EP.ED / EK.ED – with electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.
When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The pressure can be set steplessly by the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (negative characteristic curve, e.g. for fan speed control). A PWM signal is used to control the solenoid.
For further information and technical data of the solenoids for ED control please refer to page 13.

▼ **Circuit diagram EP.ED**



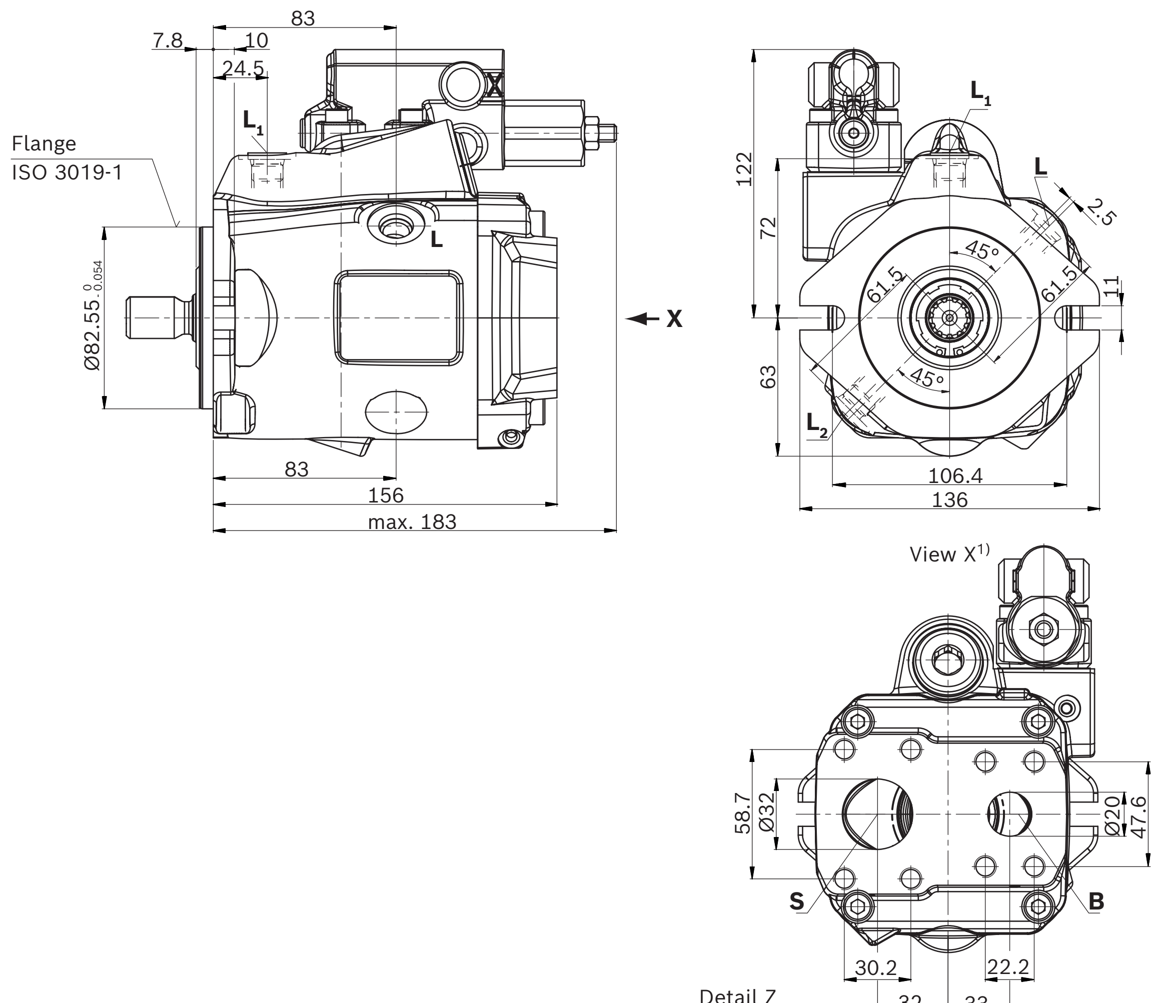
▼ **Circuit diagram EK.ED**



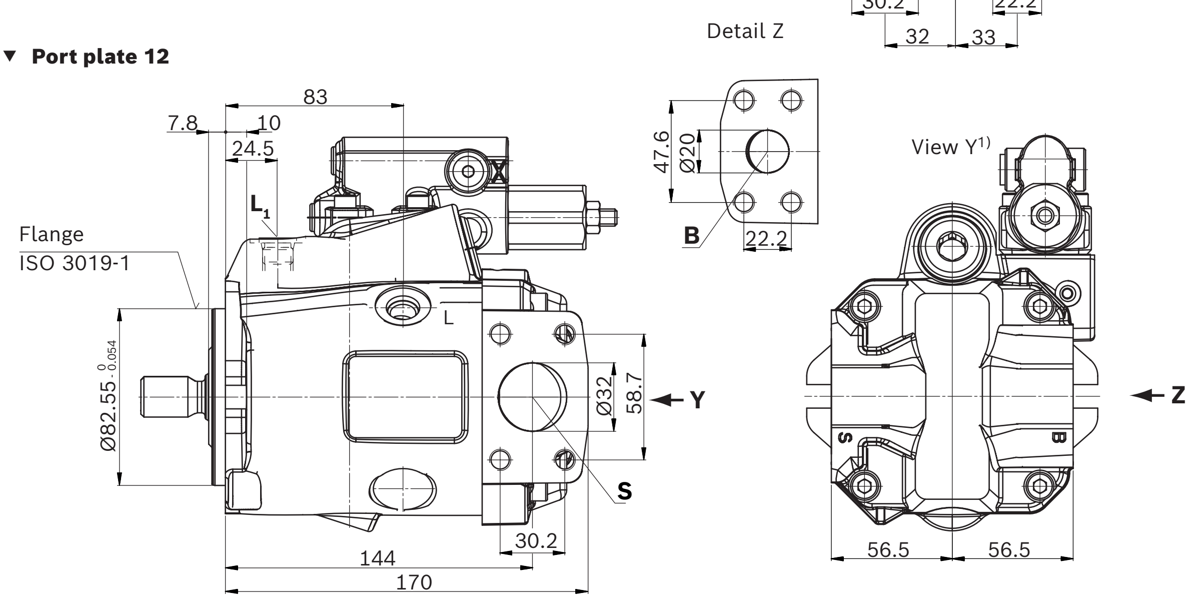
Dimensions, size 28

DR – Hydraulic pressure controller; clockwise rotation, series 53

▼ **Port plate 11**



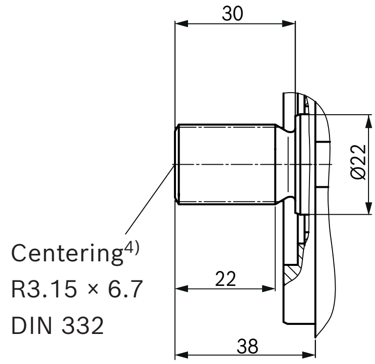
▼ **Port plate 12**



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

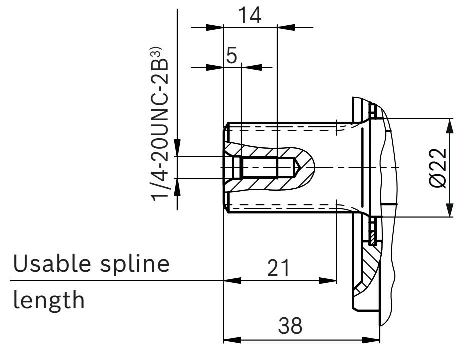
▼ **Splined shaft 3/4 in (19-4, ISO 3019-1)**

S – 11T 16/32DP[1)]



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

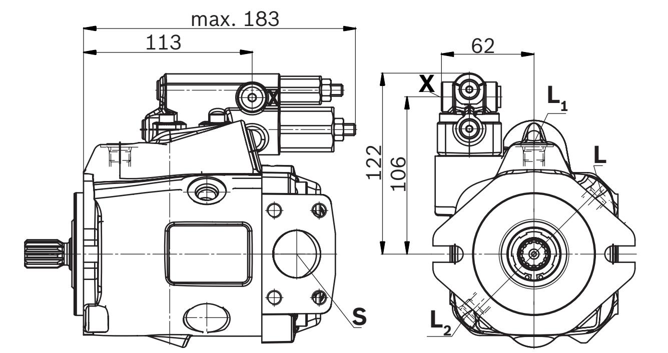
R – 11T 16/32DP[1)2)]



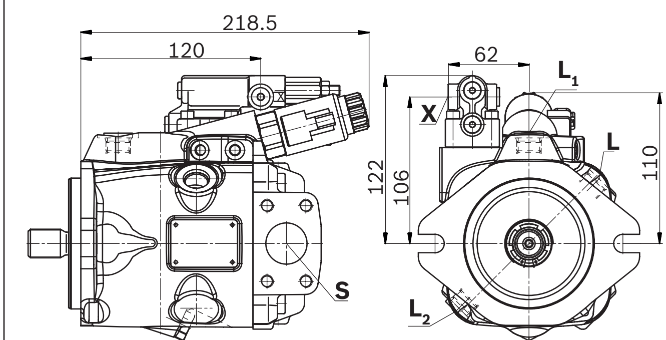
Ports		**Standard**	**Size**	p_{max} **[bar]**[5)]	**State**[8)]
B	Working port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	3/4 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 1/4 in M10 × 1.5; 17 deep	5	O
L	Drain port	ISO 11926[6)]	3/4-16UNF-2B; 13 deep	2	O[7)]
$\mathbf{L_1}$, $\mathbf{L_2}$	Drain port	ISO 11926[6)]	3/4-16UNF-2B; 13 deep	2	X[7)]
X	Pilot pressure	ISO 11926	7/16-20UNF-2B; 11.5 deep	250	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.
3) Thread according to ASME B1.1
4) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw
5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
6) The countersink may be deeper than specified in the standard.
7) Depending on the installation position, **L**, $\mathbf{L_1}$ or $\mathbf{L_2}$ must be connected (also see installation instructions starting on page 40).
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

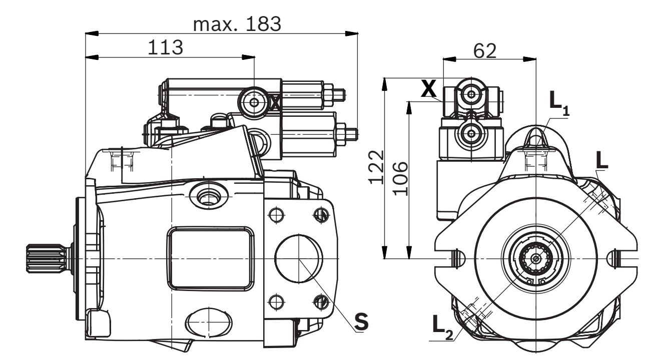
▼ DRG – Pressure controller, remotely controlled, series 53



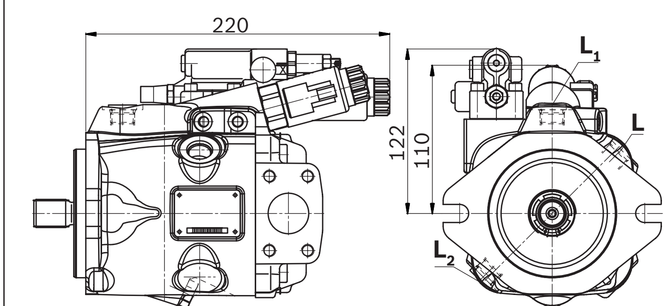
▼ EP.D. / EK.D. – Electro-proportional control, series 53



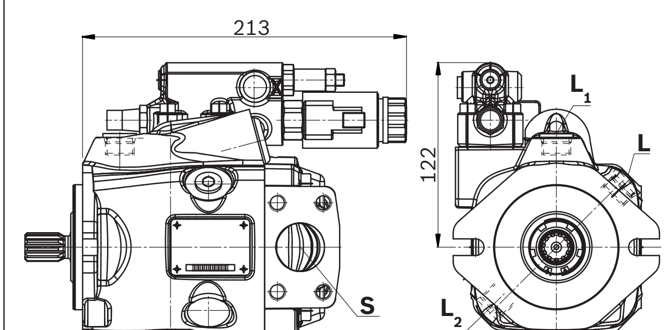
▼ DRF/DRS/DRSC – Pressure and flow controller, series 53



▼ EP.ED. / EK.ED. – Electro-proportional control, series 53



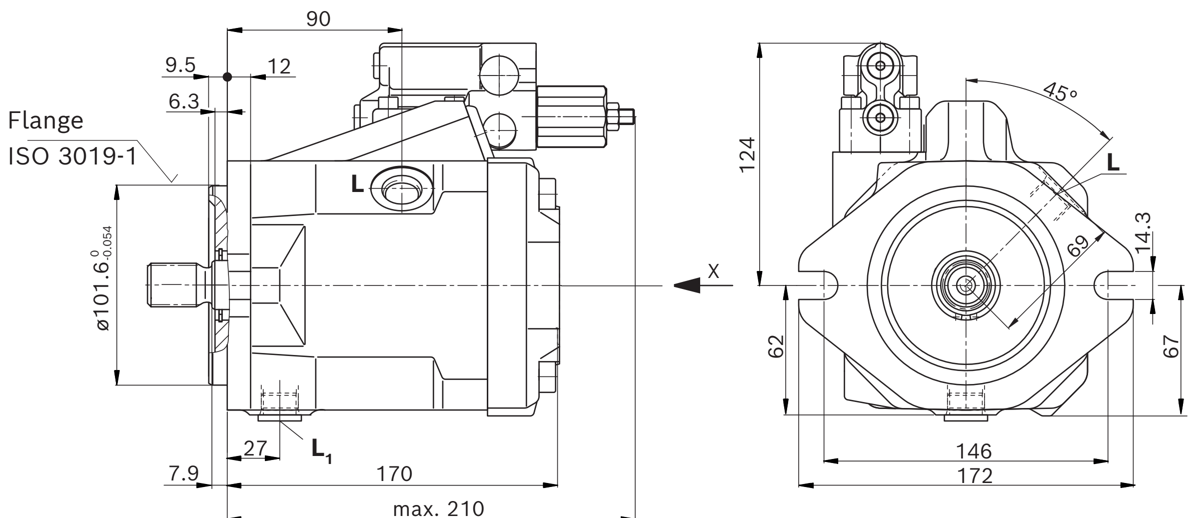
▼ ED7. / ER7. – Electro-proportional pressure control, series 53



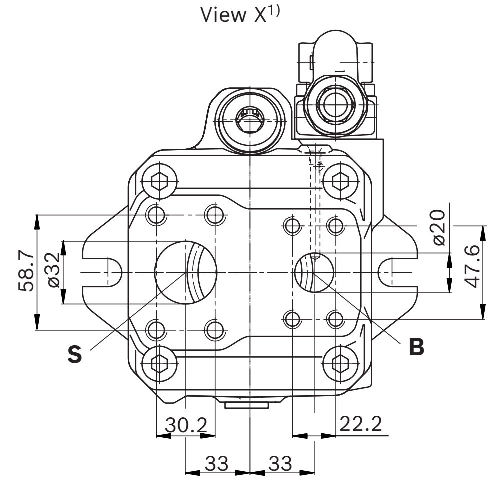
Dimensions, size 45

DR – Hydraulic pressure controller; clockwise rotation, series 52

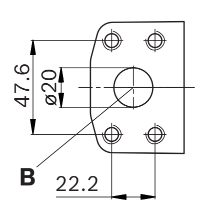
▼ **Port plate 11**



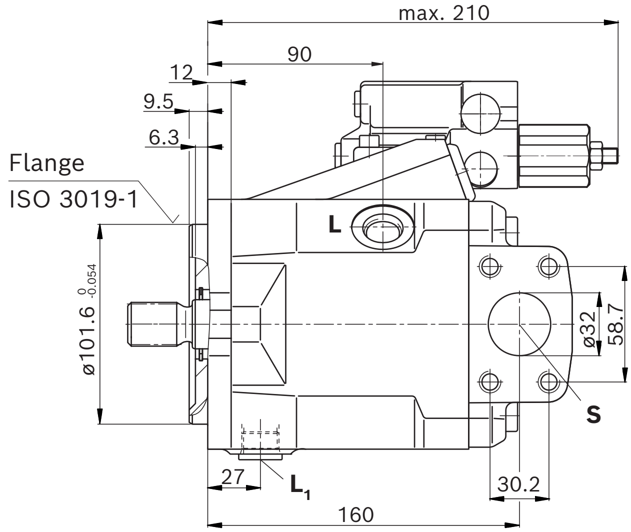
View X[1)]



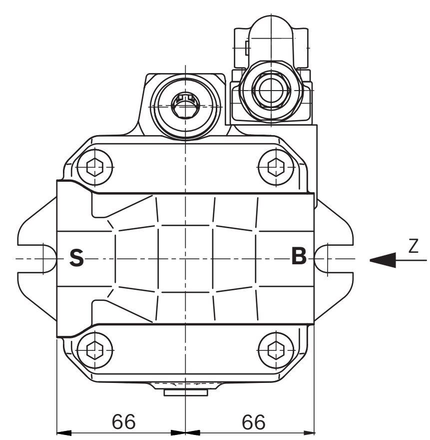
Detail Z



▼ **Port plate 12**



View Y[1)]

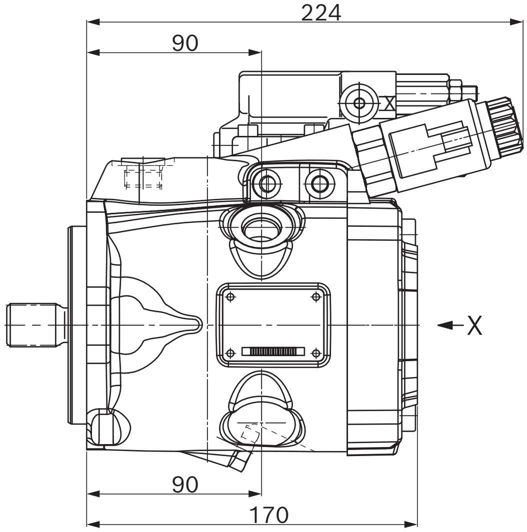


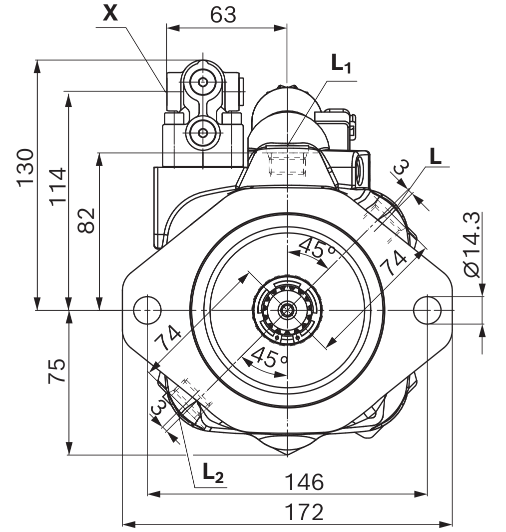
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions, size 45

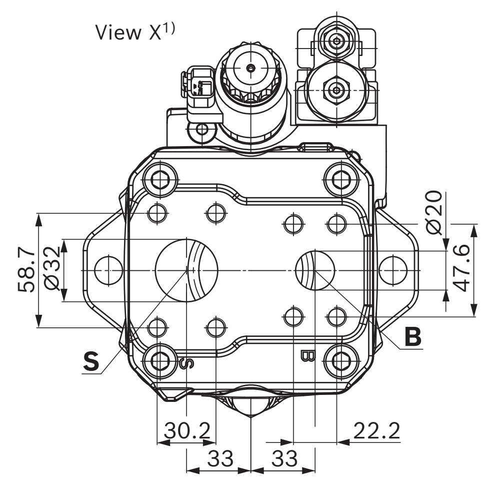
EP.D../EK.D.. – Electro-proportional control, clockwise rotation, series 53

▼ **Port plate 11**

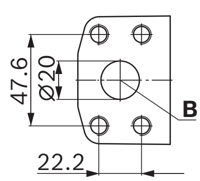




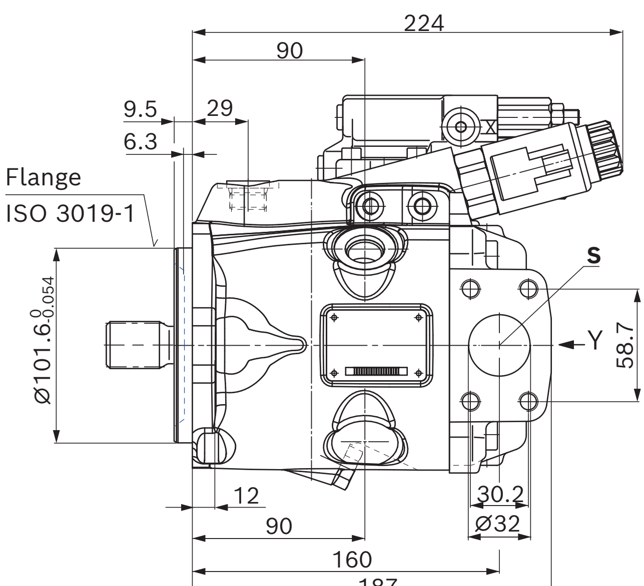
View X1)



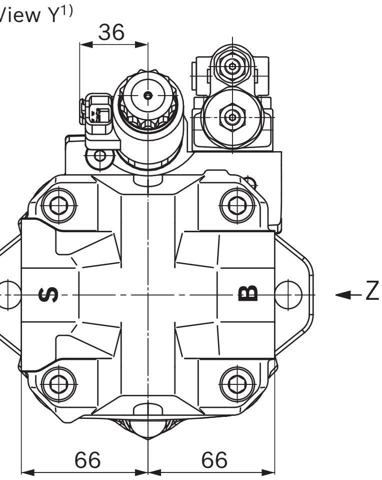
Detail Z



▼ **Port plate 12**



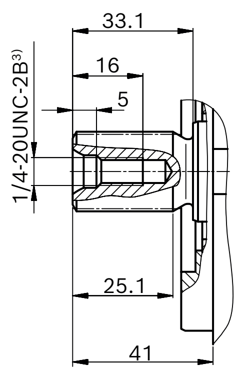
View Y1)



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

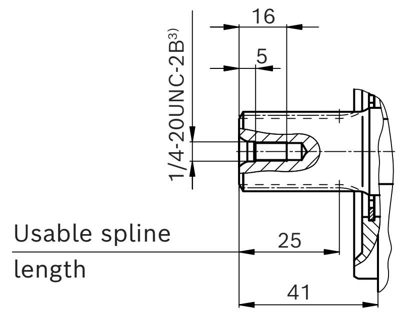
▼ **Splined shaft 7/8 in (22-4, ISO 3019-1)**

S – 13T 16/32DP[1]



▼ **Splined shaft 7/8 in (similar to ISO 3019-1)**

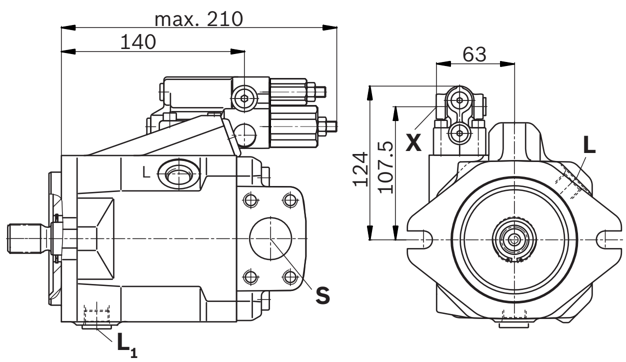
R – 13T 16/32DP[1)2)]



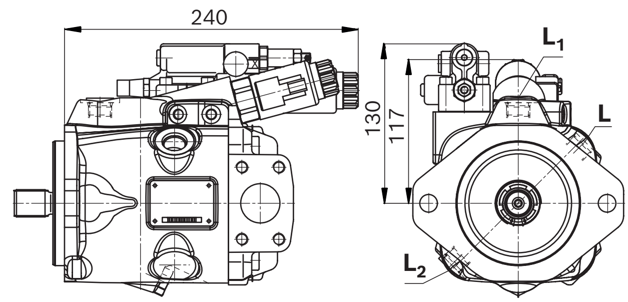
Ports		**Standard**	**Size**	$p_{\max}$ **[bar]**[4]	**State**[7]
B	Working port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	3/4 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 1/4 in M10 × 1.5; 17 deep	5	O
L	Drain port	ISO 11926[5]	3/4-16UNF-2B; 12 deep	2	O[6]
$\mathbf{L_1}$, $\mathbf{L_2}$[8]	Drain port	ISO 11926[5]	3/4-16UNF-2B; 12 deep	2	X[6]
X	Pilot pressure	ISO 11926	7/16-20UNF-2B; 11.5 deep	250	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.
3) Thread according to ASME B1.1
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, **L**, $\mathbf{L_1}$ or $\mathbf{L_2}$ must be connected (also see installation instructions starting on page 40).
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)
8) Only for series 53.

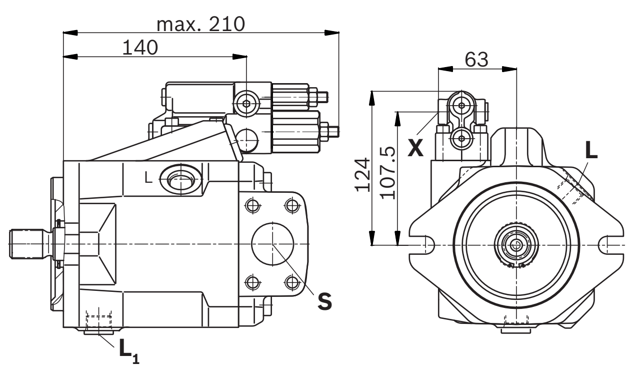
▼ **DRG – Pressure controller, remotely controlled, series 52**



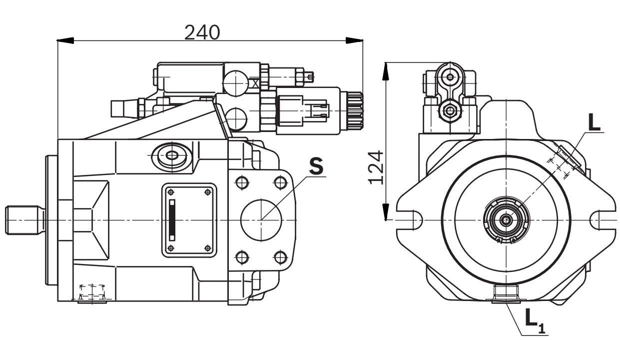
▼ **EP.ED. / EK.ED. – Electro-proportional control, series 53**



▼ **DFR/DFR1 – Pressure and flow controller, series 52**



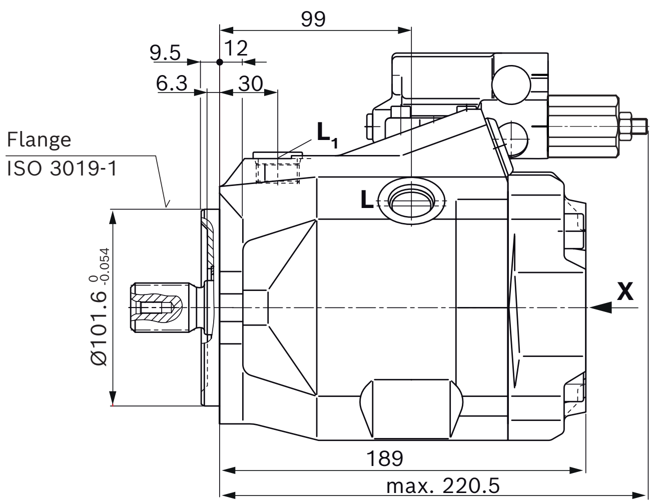
▼ **ED7. / ER7. – Electro-proportional pressure control, series 52**

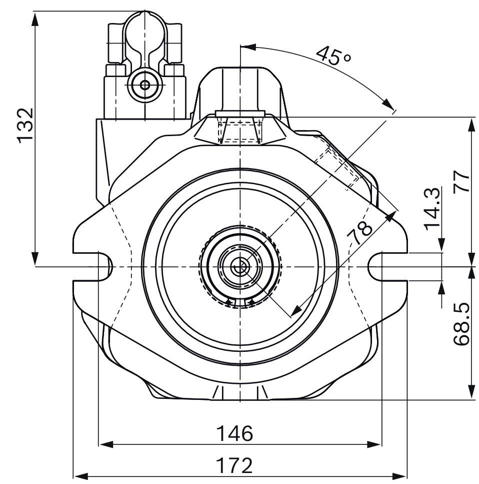


Dimensions, size 63

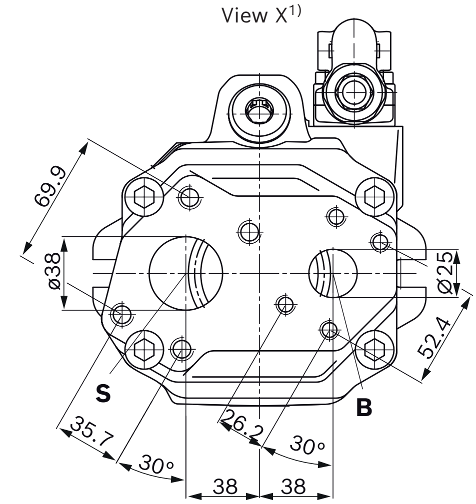
DR – Hydraulic pressure controller; clockwise rotation, series 52

▼ **Port plate 11**

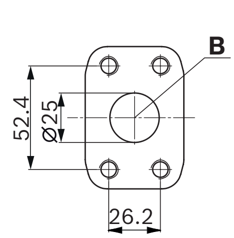




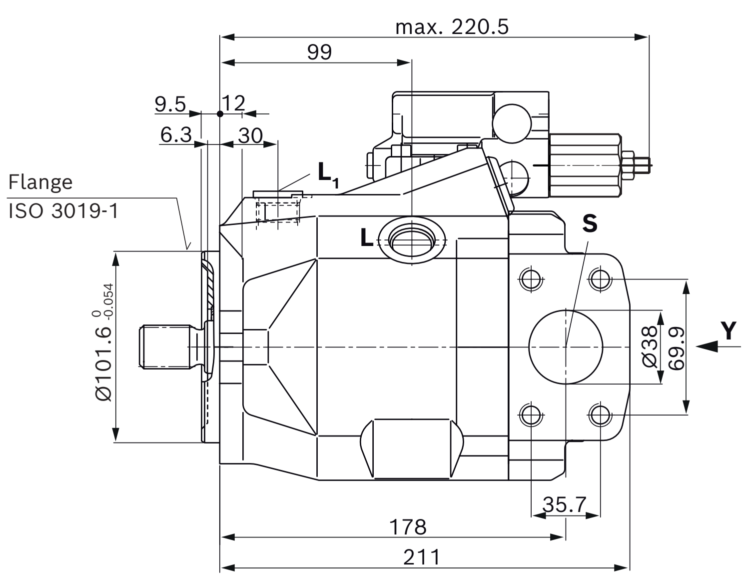
View X1)



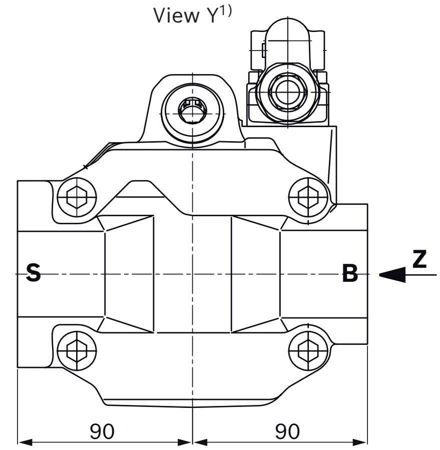
Detail Z



▼ **Port plate 12**



View Y1)

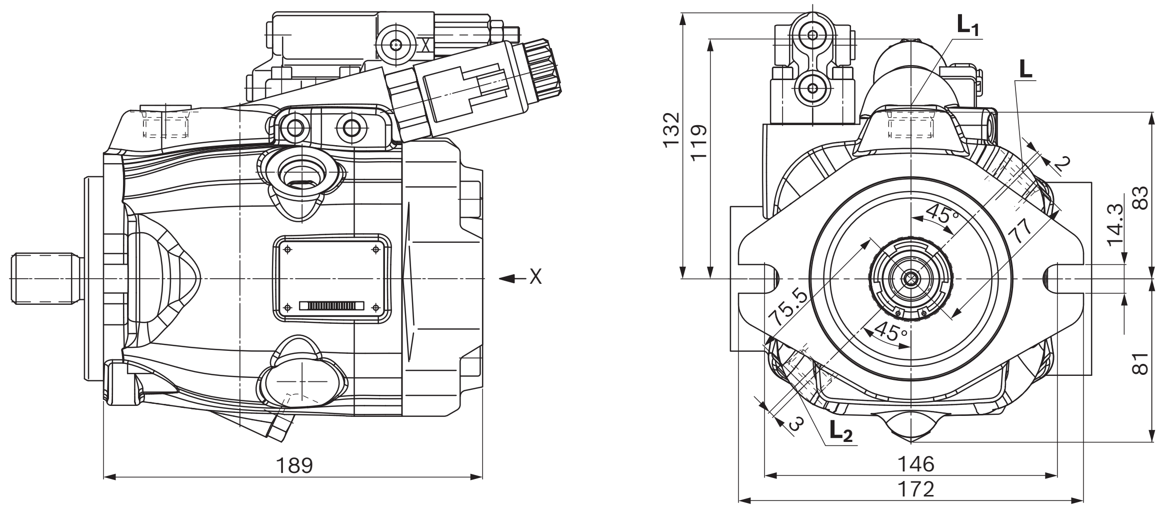


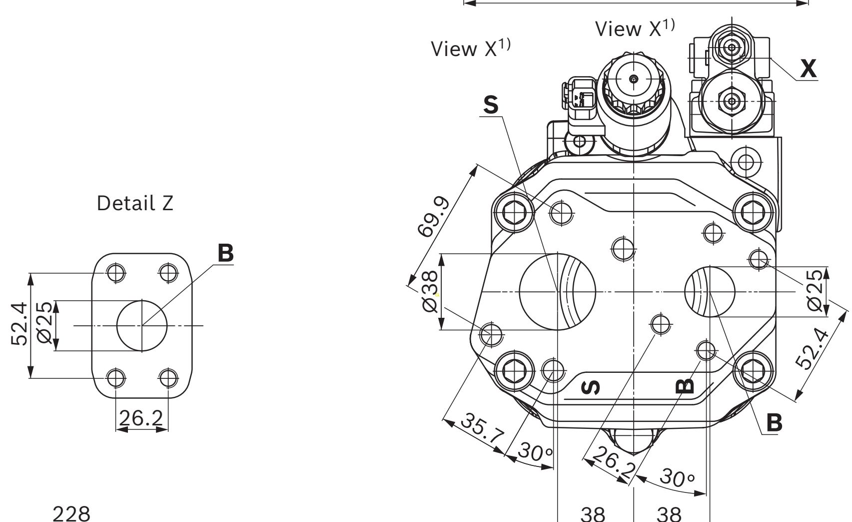
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions, size 63

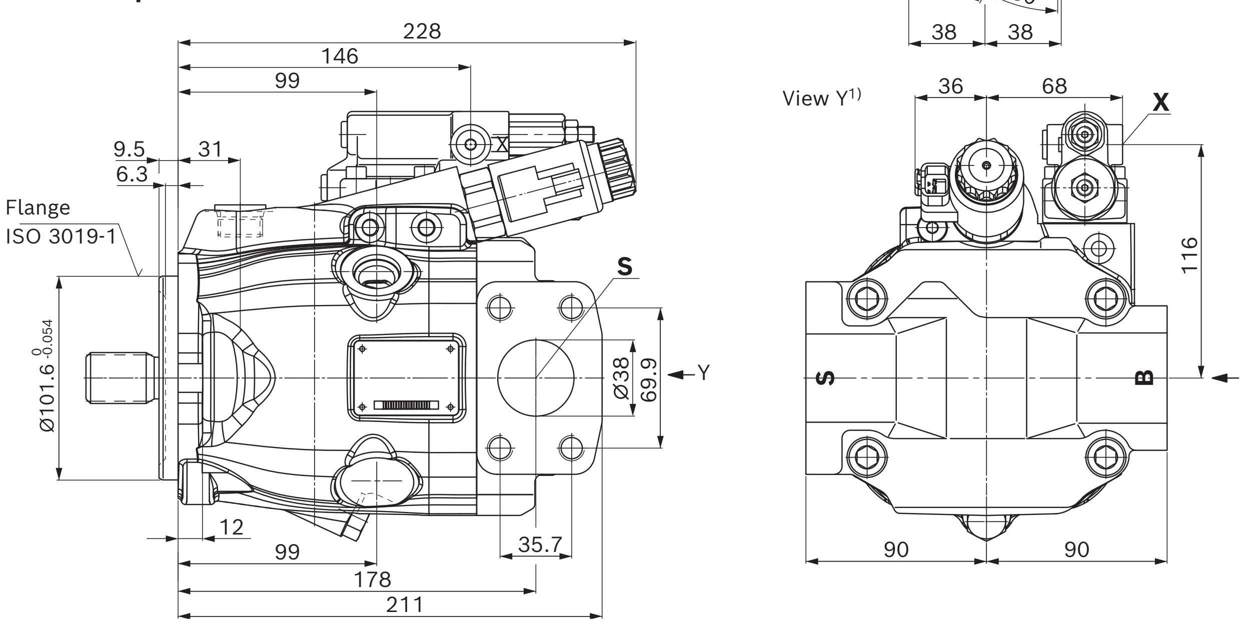
EP.D../EK.D.. – Electro-proportional control, clockwise rotation, series 53

▼ **Port plate 11**





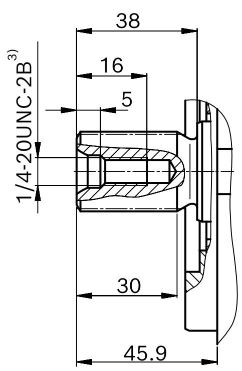
▼ **Port plate 12**



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

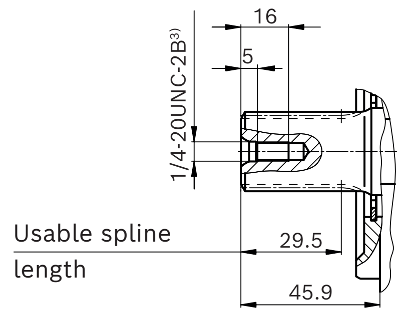
▼ **Splined shaft 1 in (25-4, ISO 3019-1)**

S – 15T 16/32DP[1)]



▼ **Splined shaft 1 in (similar to ISO 3019-1)**

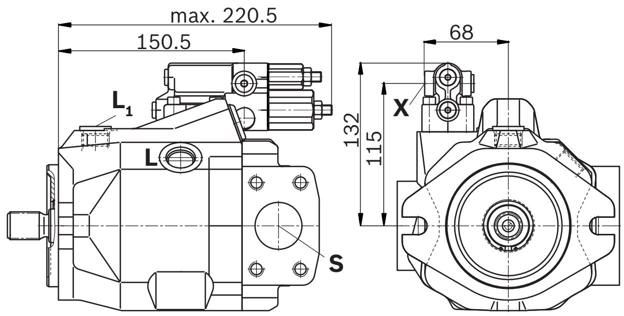
R – 15T 16/32DP[1)2)]



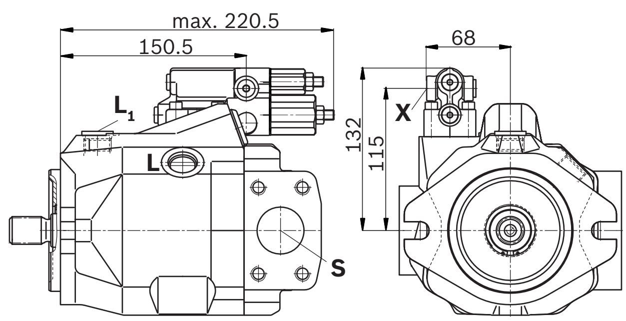
Ports		**Standard**	**Size**	p_{max} **[bar]**[4)]	**State**[7)]
B	Working port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O
L	Drain port	ISO 11926[5)]	7/8-14UNF-2B; 13 deep	2	O[6)]
$\mathbf{L_1}$, $\mathbf{L_2}$[8)]	Drain port	ISO 11926[5)]	7/8-14UNF-2B; 13 deep	2	X[6)]
X	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	250	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.
3) Thread according to ASME B1.1
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, **L**, $\mathbf{L_1}$ or $\mathbf{L_2}$ must be connected (also see installation instructions starting on page 40).
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)
8) Only for series 53.

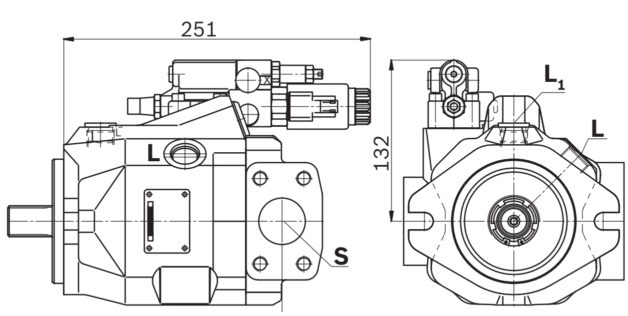
▼ **DRG – Pressure controller, remotely controlled, series 52**



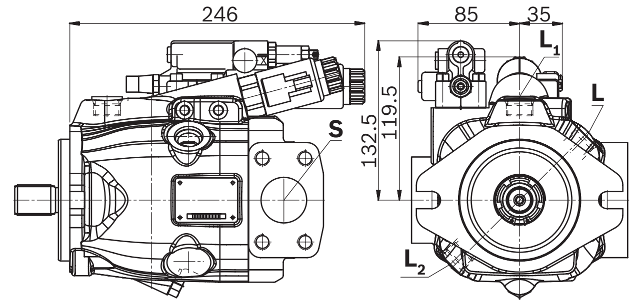
▼ **DFR/DFR1/DRSC – Pressure and flow controller, series 52**



▼ **ED7. / ER7. – Electro-proportional pressure control, series 52**



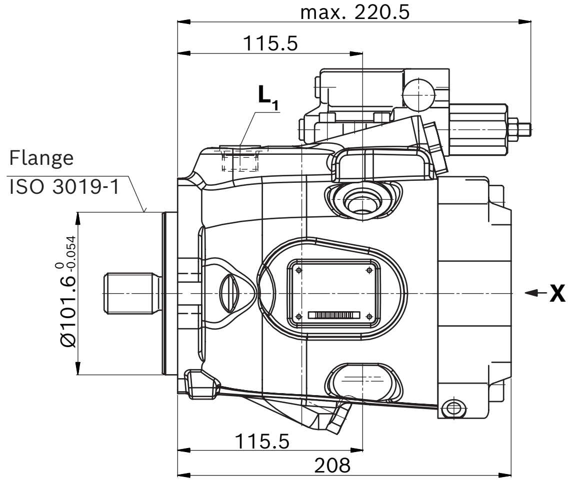
▼ **EP.ED. / EK.ED. – Electro-proportional control, series 53**

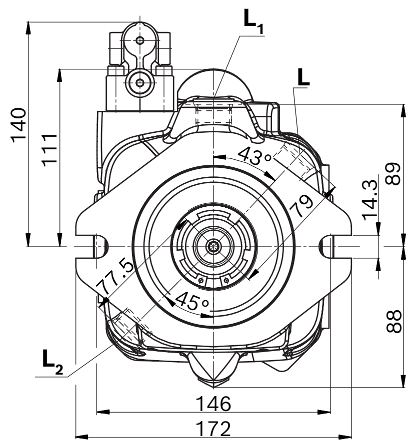


Dimensions, size 85

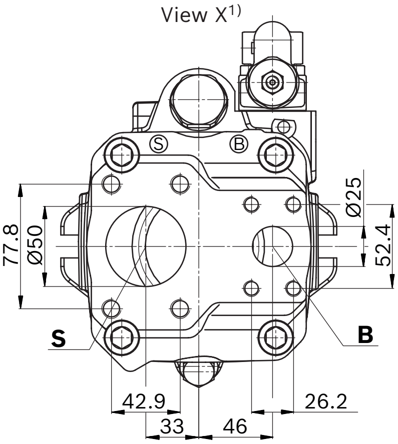
DR – Hydraulic pressure controller; clockwise rotation, mounting flange C series 53

▼ **Port plate 11**

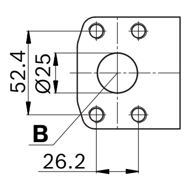




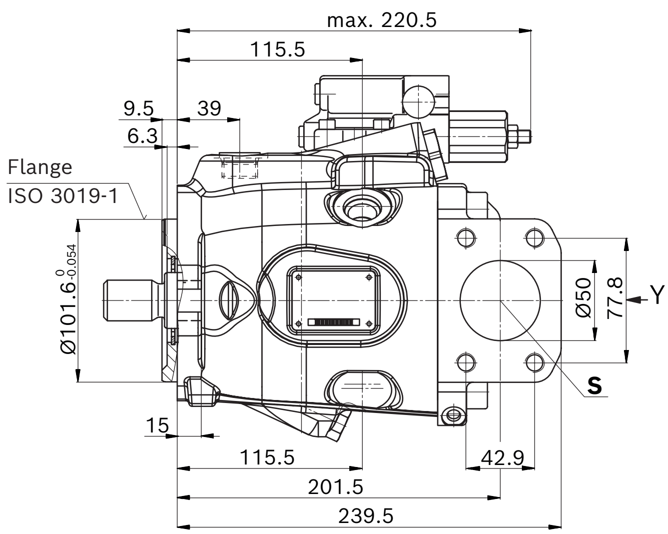
View X[1]



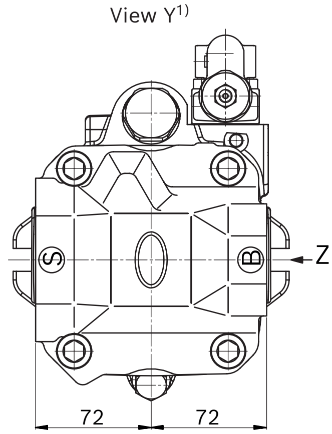
Detail Z



▼ **Port plate 12**



View Y[1]

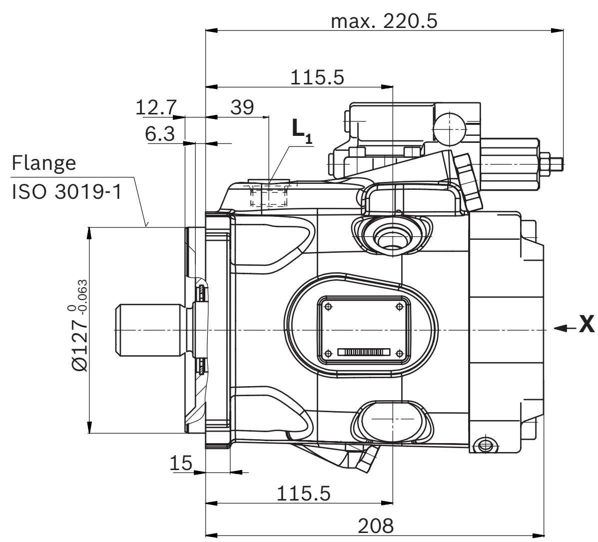


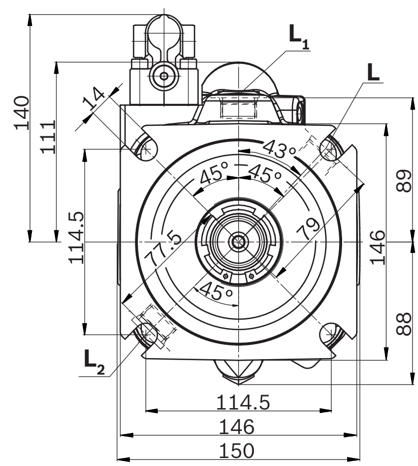
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions, size 85

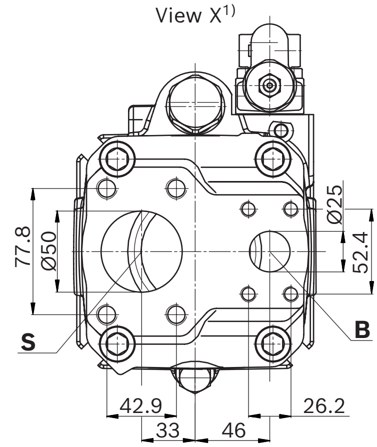
DR – Hydraulic pressure controller; clockwise rotation, mounting flange D series 53

▼ **Port plate 11**



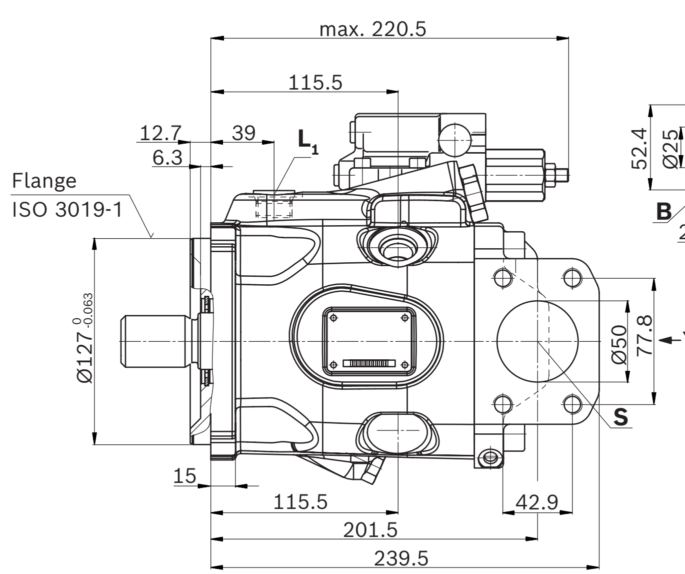


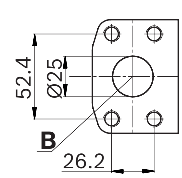
View X[1)]



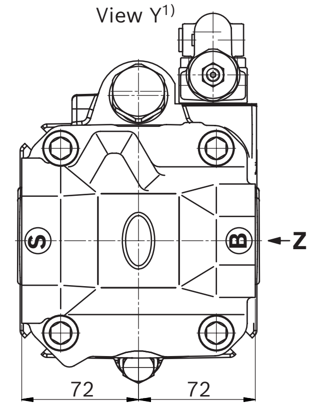
Detail Z

▼ **Port plate 12**





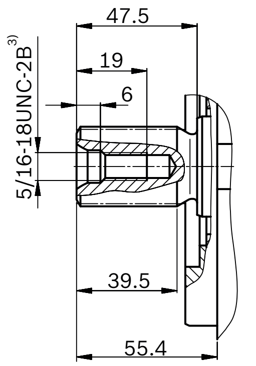
View Y[1)]



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

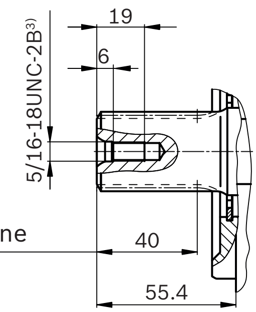
▼ **Splined shaft 1 1/4 in (32-4, ISO 3019-1)**

S – 14T 12/24DP[1)]



▼ **Splined shaft 1 1/4 in (similar to ISO 3019-1)**

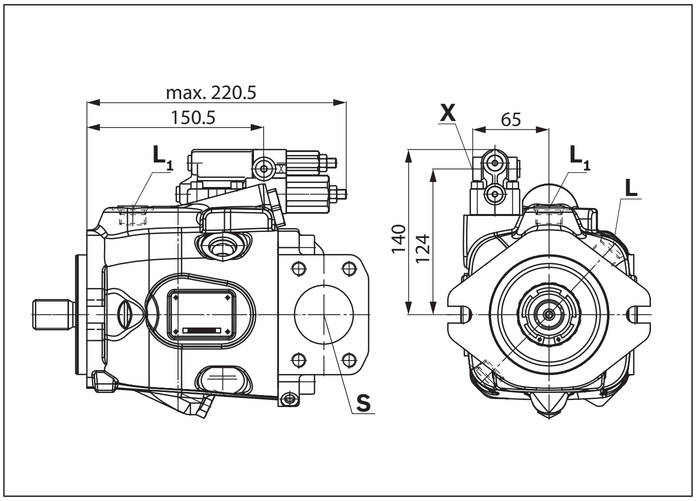
R – 14T 12/24DP[1)2)]



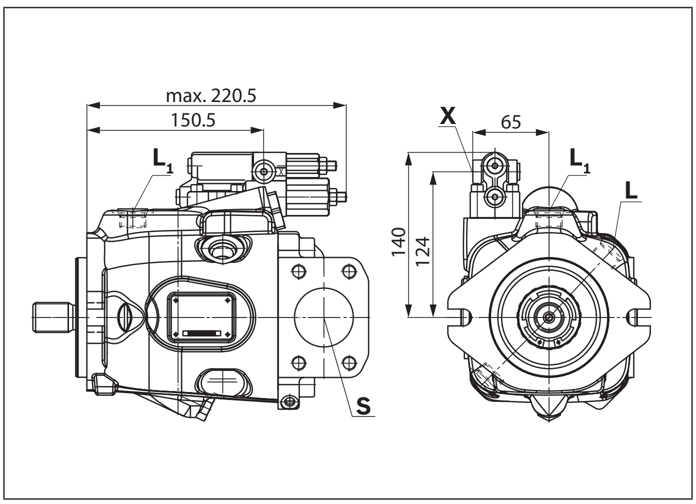
Ports		**Standard**	**Size**	p_{max} **[bar]**[4)]	**State**[7)]
B	Working port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	2 in M12 × 1.75; 20 deep	5	O
L	Drain port	ISO 11926[5)]	7/8-14UNF-2B; 13 deep	2	O[6)]
L$_1$, L$_2$	Drain port	ISO 11926[5)]	7/8-14UNF-2B; 13 deep	2	X[6)]
X	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	250	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.
3) Thread according to ASME B1.1
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, **L**, **L$_1$** or **L$_2$** must be connected (also see installation instructions starting on page 40).
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

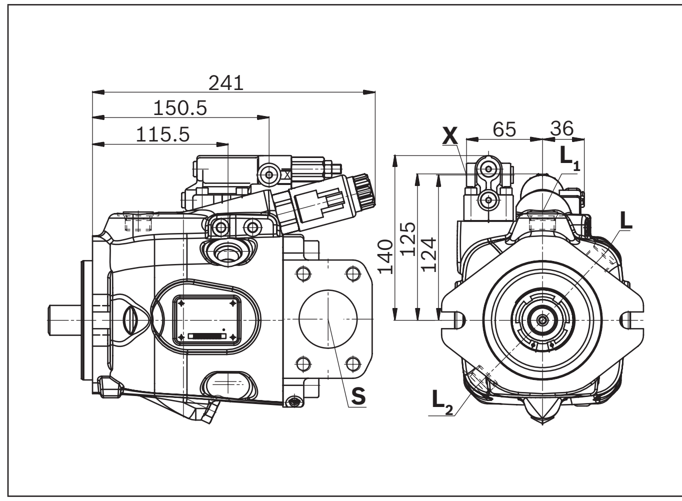
▼ **DRG – Pressure controller, remotely controlled, series 53**



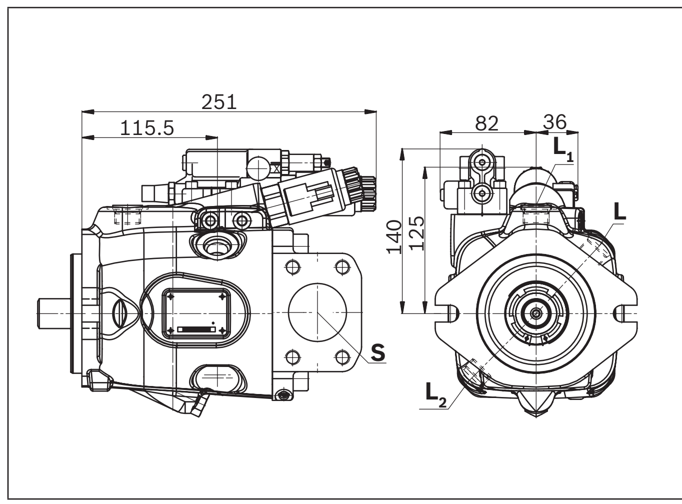
▼ **DRF/DRS/DRSC – Pressure and flow controller, series 53**



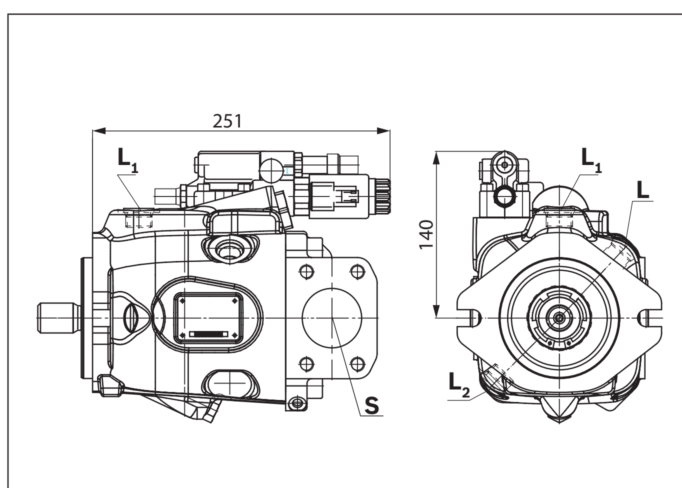
▼ **EP.D. / EK.D. – Electro-proportional control, series 53**



▼ **EP.ED. / EK.ED. – Electro-proportional control, series 53**



▼ **ED7. / ER7. – Electro-proportional pressure control, series 53**

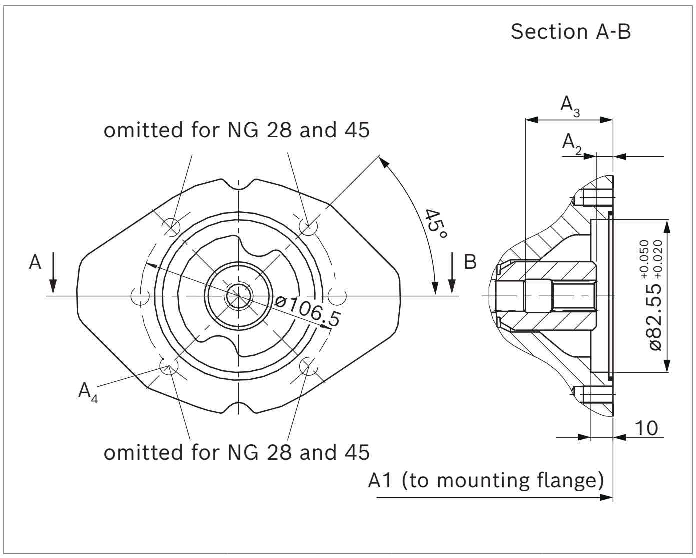


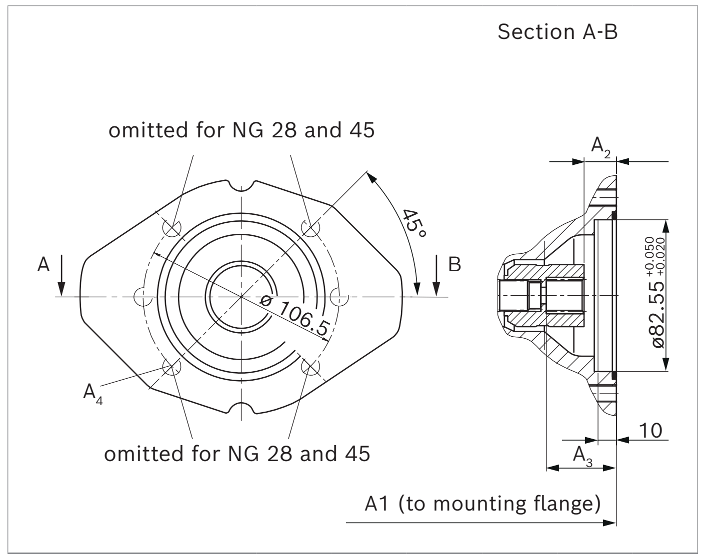
Dimensions, through-drive

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability across sizes				Code
Diameter	**Mounting[2]**	**Diameter**		**28**	**45**	**63**	**85**	
82-2 (A)	ᵒ°, ∘∘	5/8 in	9T 16/32DP	●	●	●	●	K01
		3/4 in	11T 16/32DP	●	●	●	●	K52

● = Available ○ = On request

▼ **82-2**





K01 (SAE J744 16-4 (A))	NG	A1	A2[4]	A3[4]	A4[3]
	28	182	9.3	42.5	M10×1.5; 14.5 deep
	45	204	9.2	36.2	M10×1.5; 16 deep
	63	229	10	52.7	M10×1.5; 16 deep
	85	255	8.7	58.2	M10×1.5; 16 deep

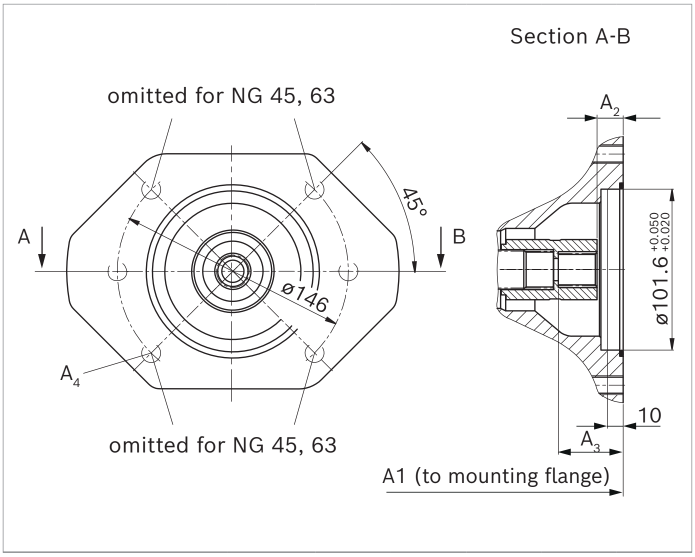
K52 (SAE J744 19-4 (A-B))	NG	A1	A2[4]	A3[4]	A4[3]
	28	182	18.3	39.3	M10×1.5; 14.5 deep
	45	204	18.4	39.4	M10×1.5; 16 deep
	63	229	18.4	38.8	M10×1.5; 16 deep
	85	255	18.4	38.8	M10×1.5; 16 deep

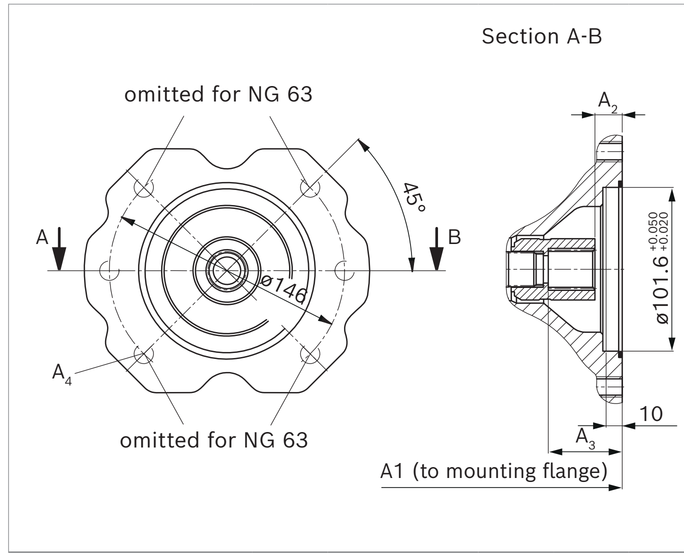
1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Mounting holes pattern viewed on through drive with control at top
3) Thread according to DIN 13.
4) Minimum dimensions

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability across sizes				Code
Diameter	**Mounting**[2]	**Diameter**		**28**	**45**	**63**	**85**	
101-2 (B)	°°, ∘∘	7/8 in	13T 16/32DP	–	●	●	●	K68
		1 in	15T 16/32DP	–	–	●	●	K04

● = Available ○ = On request

▼ 101-2





K68 (SAE J744 22-4 (B))	NG	A1	A2[4]	A3[4]	A4[3]
	45	204	17.4	42.4	M12 × 1.75; 18 deep
	63	229	17.4	41.8	M12 × 1.75; 18 deep
	85	255	17.4	41.8	M12 × 1.75; 18 deep

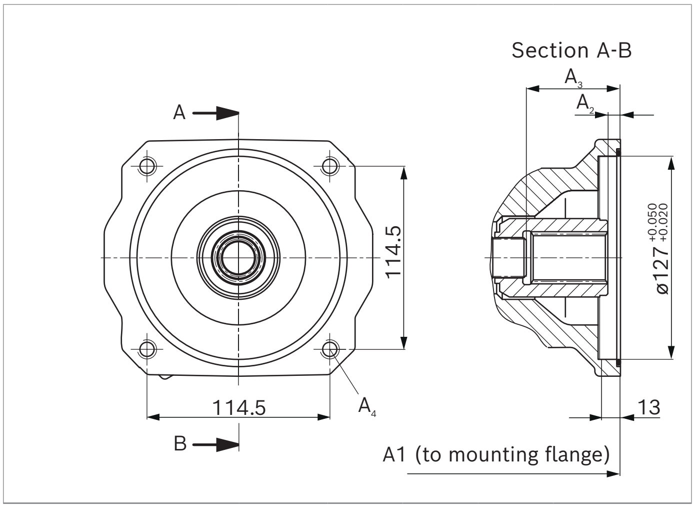
K04 (SAE J744 25-4 (B-B))	NG	A1	A2[4]	A3[4]	A4[3]
	63	229	17.9	47.4	M12 × 1.75; 18 deep
	85	255	17.9	46.8	M12 × 1.75; 18 deep

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Mounting holes pattern viewed on through drive with control at top
3) Thread according to DIN 13.
4) Minimum dimensions

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1)]		Availability across sizes				Code
Diameter	**Mounting[2)]**	**Diameter**		**28**	**45**	**63**	**85**	
127-4 (C)	⸬	1 1/4 in	14T 12/24DP	–	–	–	●	K15

● = Available ○ = On request

▼ **127-4**



K15 (SAE J744 32-4 (C))	**NG**	**A1**	**A2[4)]**	**A3[4)]**	**A4[3)]**
	85	255	17.9	55.9	M12 × 1.75; 16 deep

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Mounting holes pattern viewed on through drive with
3) Thread according to DIN 13.
4) Minimum dimensions

Overview of mounting options

Through drive			**Mounting options – 2nd pump**			
Flange ISO 3019-1	**Hub for splined shaft**	**Code**	**A10VNO/5x NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**A1VO/10 NG (shaft)**	**External gear pump**
82-2 (A)	5/8 in	K01	–	10 (U), 18 (U)	18 (S2)	AZPF
	3/4 in	K52	28 (S, R)	10 (S), 18 (S, R)	18 (S3)	
101-2 (B)	7/8 in	K68	45 (S, R)	28 (S, R) 45 (U, W)[1]	35 (S4)	AZPN/AZPG
	1 in	K04	63 (S, R)	45 (S, R) 60, 63 (U, W)[2] 72 (U, W)[2]	35 (S5)	–
127-4 (C)	1 1/4 in	K15	85 (S, R)	60, 63 (S, R) 72 (S, R)	–	–

1) Not for NG45 with K68
2) Not for NG63 with K04

Combination pumps A10VNO + A10VNO

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

Order example:

A10VNO63DRS/52R-VSC12K04+
A10VNO45DRF/52R-VSC11N00

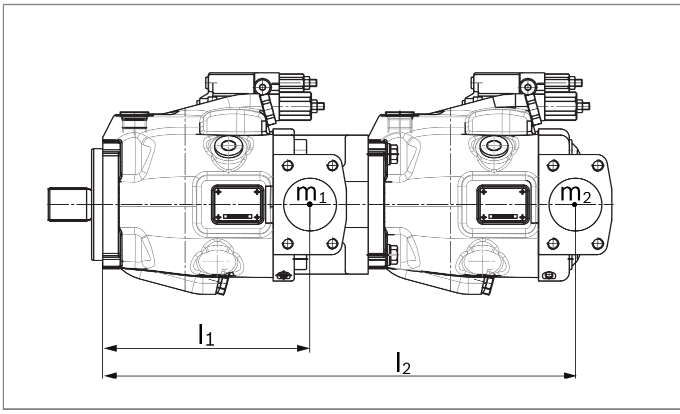
A tandem pump, with two pumps of equal size, is permissible without additional supports, assuming that the dynamic mass acceleration does not exceed maximum 10 *g* (= 98.1 m/s²).

For combination pumps consisting of more than two pumps, a calculation of the mounting flange regarding the permissible mass torque is required (please contact us).

Through drives are plugged with a **non-pressure-resistant** cover. Therefore, single pumps must be equipped with a pressure-resistant cover before commissioning. Through drives can also be ordered with a pressure-resistant cover, please specify in plain text.

Notice

With a mounted hub, through drives are delivered with a spacer as transport protection.
The spacer must be removed before installation of the 2nd pump and before commissioning. For further information, see instruction manual 92703-01-B



m_1, m_2, m_3	Weight of pump	[kg]
l_1, l_2, l_3	Distance from center of gravity	[mm]
$M_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times \dfrac{1}{102}$		[Nm]

Calculation for multiple pumps		
l_1	=	Front pump distance from center of gravity (values from "Permissible moments of inertia" table)
l_2	=	Dimension "M1" from through drive drawings (from page 34) + l_1 of the 2nd pump
l_3	=	Dimension "M1" from through drive drawings from page 34) of the 1st pump + "M1" of the 2nd pump + l_1 of the 3rd pump

Permissible moments of inertia

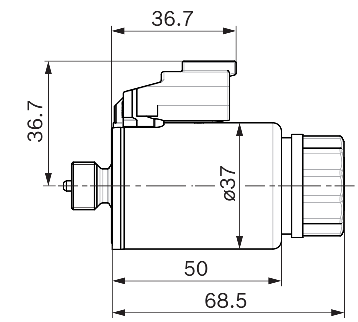
NG			28	45	63	85
Static	M_m	Nm	500	890	900	1370
Dynamic at 10 *g* (98.1 m/s²)	M_m	Nm	50	89	90	137
Weight with through-drive plate	m	kg	13	18	24	28
Weight without through-drive plate (e.g. 2nd pump)			11.5	15	18	22
Distance, center of gravity **without** through drive	l_1	mm	78	85	96	105
Distance, center of gravity **with** through drive	l_1	mm	87	99	115	127

Connector for solenoids

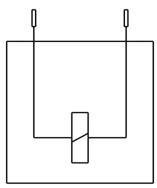
DEUTSCH DT04-2P

Molded, 2-pin, without bidirectional suppressor diode
The following type of protection ensues with the installed mating connector:

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



▼ **Switching symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery.
This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

- If necessary, you can change the position of the connector by turning the solenoid body.
- The procedure is defined in instruction manual 92703-01-B.
- Only the dead weight (<1 N) of the connection cable with a length of 150 mm may act on the plug-in connection and the solenoid coil with coil nut. Other forces and vibrations are not permissible. For example, this can be realized by suspension of the cable at the same vibration system.

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 drain port (**L**, **L_1**, **L_2**).
If a shared drain line is used for several units, make sure that the respective case pressure in each unit is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating condition, particularly at cold start. If this is not possible, separate drain line must be laid, if necessary.
To prevent the transmission of structure-borne noise, use elastic elements to decouple all connecting lines from all vibration-capable components (e.g. reservoir, frame parts).
Under 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 not fall below 0.8 bar absolute during operation and during cold start.
When designing the reservoir, ensure that there is adequate distance between the suction line and the drain line. We recommend using a baffle (baffle plate) between suction line and drain line. A baffle improves the air separation ability as it gives the hydraulic fluid more time for desorption. Apart from that, this prevents the heated return flow from being drawn directly back into the suction line. The suction port must be supplied with air-free, calmed and cooled hydraulic fluid.

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 40.

Installation position

See the following examples **1** to **12**.
Further installation positions are available upon request.
Recommended installation position: **1** and **4**

Key	
F	Filling / Air bleeding
S	Suction port
L; L_1; L_2	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{ES\ min}$	Minimum height required to prevent axial piston unit from draining (25 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

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

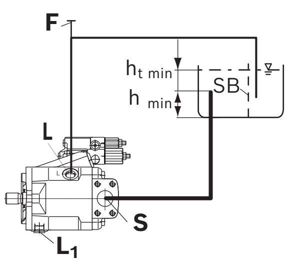
Below-reservoir installation (standard)

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

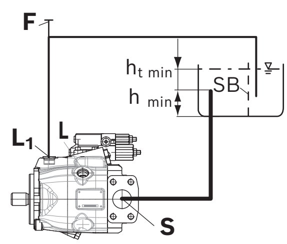
▼ Installation position 1

Air bleed	Filling	Air bleed	Filling
F	**L** (**F**)	**F**	$\mathbf{L_1}$ (**F**)

Series **52**



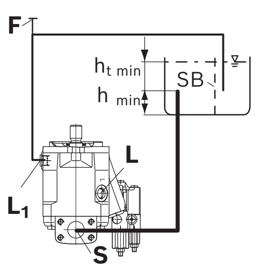
Series **53**



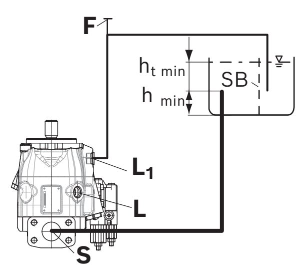
▼ Installation position 2[1)]

Air bleed	Filling	Air bleed	Filling
F	$\mathbf{L_1}$ (**F**)	**F**	$\mathbf{L_1}$ (**F**)

Series **52**



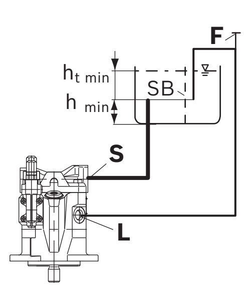
Series **53**



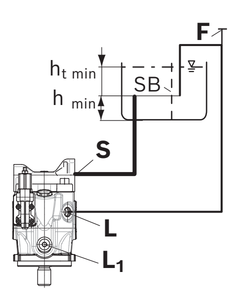
▼ Installation position 3[1)]

Air bleed	Filling	Air bleed	Filling
F	**L** (**F**)	**F**	**L** (**F**)

Series **52**



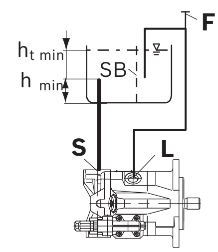
Series **53**



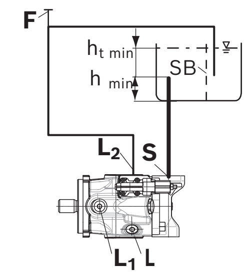
▼ Installation position 4

Air bleed	Filling	Air bleed	Filling
F	**L** (**F**)	**F**	$\mathbf{L_2}$ (**F**)

Series **52**



Series **53**



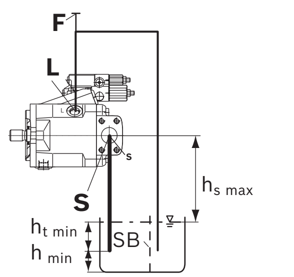
1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

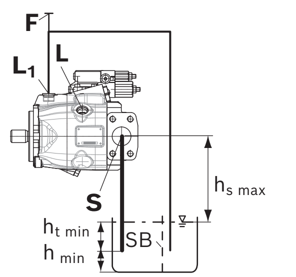
Above-reservoir installation

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, a height difference $h_{ES\ min}$ of at least 25 mm is required in position 6 Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

▼ **Installation position 5**

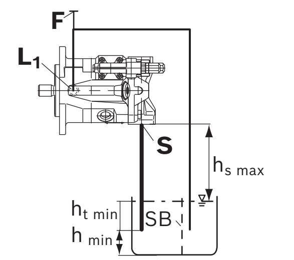
Air bleed	Filling	Air bleed	Filling
F	**L** (**F**)	**F**	**L$_1$** (**F**)
Series **52**		Series **53**	

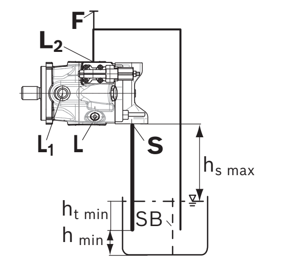




▼ **Installation position 8**

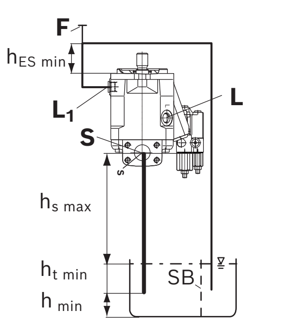
Air bleed	Filling	Air bleed	Filling
F	**L** (**F**)	**F**	**L$_2$** (**F**)
Series **52**		Series **53**	

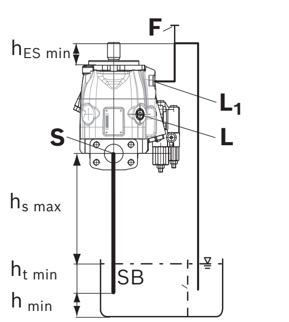




▼ **Installation position 6**[1)]

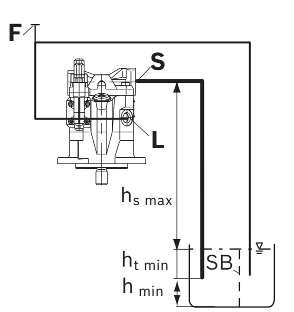
Air bleed	Filling	Air bleed	Filling
F	**L$_1$** (**F**)	**F**	**L$_1$** (**F**)
Series **52**		Series **53**	

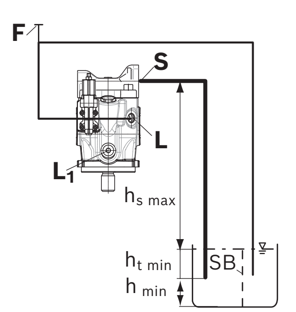




▼ **Installation position 7**[1)]

Air bleed	Filling	Air bleed	Filling
F	**L** (**F**)	**F**	**L** (**F**)
Series **52**		Series **53**	





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.

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.

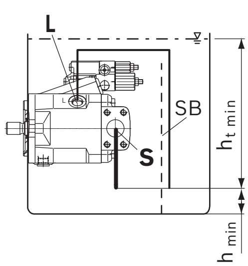
Notice

- ▶ Our advice is to fit a suction pipe to the suction port **S** and to fit a pipe to case drain port **L**, **L_1** or **L_2**. In this case, the other drain port must be plugged. The housing of the axial piston unit is to be filled via **L, L_1** or **L_2** (see installation position 9 to 12) before the pipework is fitted and the reservoir is filled with hydraulic fluid.

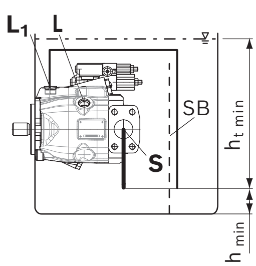
▼ **Installation position 9**

Air bleed	Filling	Air bleed	Filling
L	**L**	**L_1**	**L_1**

Series **52**



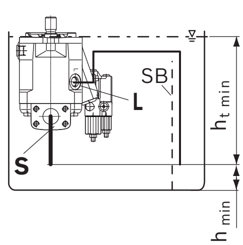
Series **53**



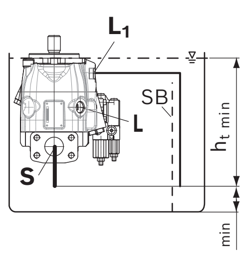
▼ **Installation position 10**[1)]

Air bleed	Filling	Air bleed	Filling
L_1	**L_1**	**L_1**	**L_1**

Series **52**



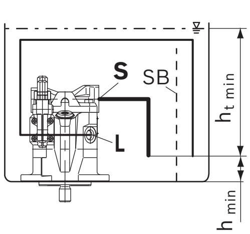
Series **53**



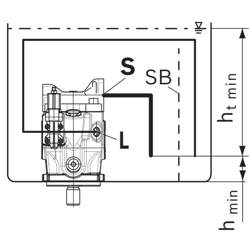
▼ **Installation position 11**[1)]

Air bleed	Filling	Air bleed	Filling
L	**L**	**L**	**L**

Series **52**



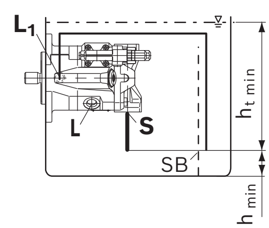
Series **53**



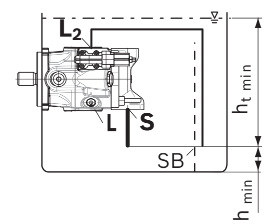
▼ **Installation position 12**

Air bleed	Filling	Air bleed	Filling
L_1	**L_1**	**L_2**	**L_2**

Series **52**



Series **53**



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 A10VNO axial piston variable pump is designed to be used in open circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of skilled personnel.
- 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 preservation protection for a maximum of 12 months. If longer preservation protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all configuration variants of the product are approved for use in safety functions according to ISO 13849. Please consult the proper contact at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. Applying a direct voltage signal (DC) to solenoids does not create electromagnetic interference (EMI) nor is the solenoid affected by EMI. Electromagnetic interference (EMI) potential exists when operating and controlling a solenoid with a modulated direct voltage signal (e.g. PWM signal) Appropriate testing and measures should be taken by the machine manufacturer to ensure other components or operators (e.g. with pacemaker) are not affected by this potential.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- For controllers requiring external pilot pressure, sufficient control fluid must be provided to the associated ports to ensure the required pilot pressures for the respective controller function. These controllers are subject to leakage due to their design. An increase in control fluid demand has to be anticipated over the total operating time. The design of the control fluid supply must thus be sufficiently large. If the control fluid is too low, the respective controller function may be impaired and undesired system behavior may result.
- For drives that are operated for a long period of time with constant rotational speed, the natural frequency of the hydraulic system can be stimulated by the excitation frequency of the pump (rotational speed frequency x 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 service 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 properly implemented.