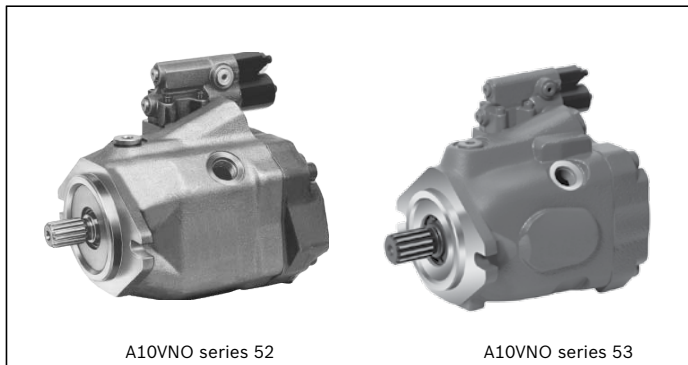


Axial piston variable pump A10VNO series 52 and 53

Americas



- ▶ Size 28 to 85
- ▶ Nominal pressure 3050 psi (210 bar)
- ▶ Maximum pressure 3600 psi (250 bar)
- ▶ open circuit

Features

- ▶ Variable pump with axial piston rotary group of swash-plate design for hydrostatic drives in open circuits.
- ▶ The flow is proportional to the drive speed and the displacement.
- ▶ The flow can be infinitely varied by adjusting the swash-plate angle.
- ▶ Stable storage 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 response times

Contents

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Ordering code

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

Axial piston unit

01	Variable swashplate design, nominal pressure 3050 psi (210 bar), maximum pressure 3600 psi (250 bar)	28	45	63	85	A10VN
----	--	----	----	----	----	-------

Operating mode

02	Pump, open circuit	O
----	--------------------	---

Size (NG)

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

Control device

04	Pressure control	hydraulic					DR	
	with flow control	hydraulic	X-T open				DRF	
			X-T plugged				DRS	
				with flushing function				DRSC
				without flushing function				DRG
	pressure cut-off	hydraulic	remotely operated					ED71
electrical			negative control	U = 12 V				ED72

Series

05	Series 5, index 2	-	•	•	-	52
	Series 5, index 3	•	-	-	•	53

Direction of rotation

06	Viewed on drive shaft	clockwise	R
		counter-clockwise	L

Sealing material

07	FKM (fluor-caoutchouc)	V
----	------------------------	---

Drive shaft

08	Splined shaft ANSI B92.1a	Standard shaft	•	•	•	•	S
		similar to shaft "S" however for higher input torque	•	•	•	•	R

Mounting flanges

09	ISO 3019-1 (SAE)	2-hole	•	•	•	•	C
		4-hole	-	-	-	•	D

Working port

10	SAE flange port fastening thread, UNC	rear	not for through drive	•	•	•	•	61
		at side, opposite	for through drive	•	•	•	•	62

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

Through drive (for fitting options, see page 29)

11	Flange ISO 3019-1	Hub for splined shaft ¹⁾				28	45	63	85	
	diameter	diameter								
	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	

Connector for solenoids

12	DEUTSCH – molded connector, 2-pin – without suppressor diode (for electric controls)	•	•	•	•	P
----	--	---	---	---	---	---

• = Available ◦ = On request - = Not available

Information

- ▶ Note the project planning notes on page 36.
- ▶ Preservation:
 - Up to 12 months as standard
 - Up to 24 months long-term (state in plain text when ordering)

1) According to ANSI B92.1a

Hydraulic fluids

The A10VO 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
- ▶ 90221: Environmentally acceptable hydraulic fluids

Notes on 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 (ν_{opt} : see selection diagram).

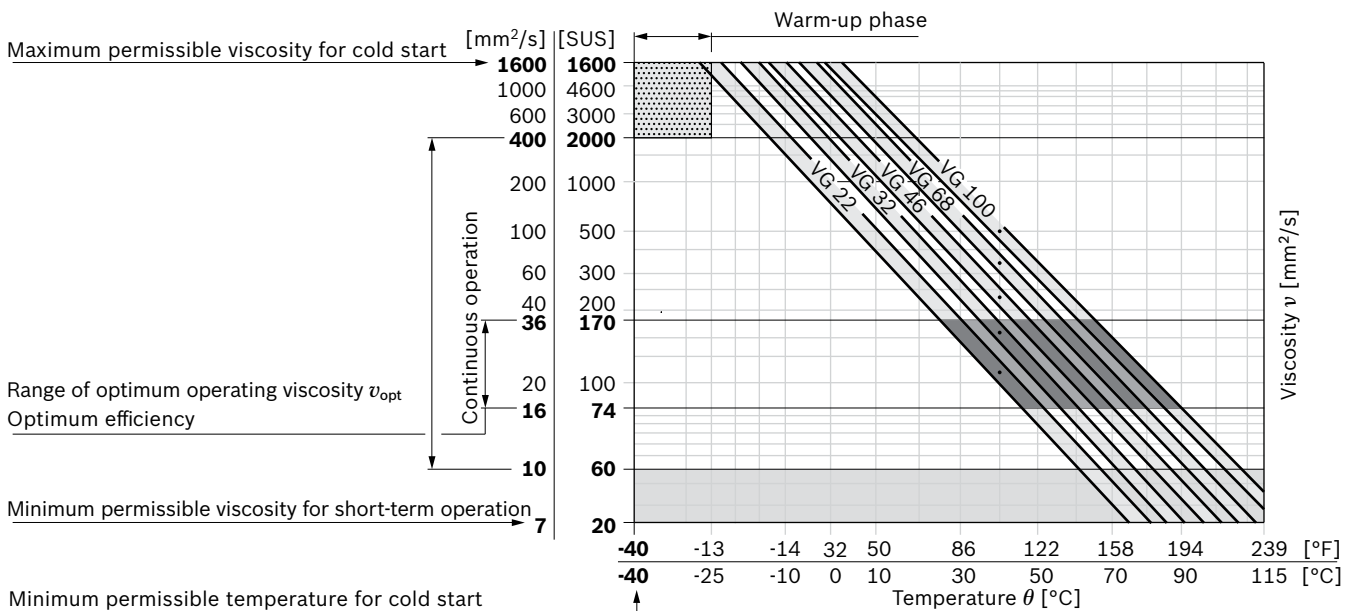
Note

At no point of the component may the temperature be higher than 239 °F (115 °C). The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 7500$ SUS (1600 mm ² /s)	$\theta_{st} \geq -40$ °F (-40 °C)	$t \leq 1$ min, without load ($p \leq 435$ psi (30 bar)), $n \leq 1000$ rpm
	Permissible temperature difference	$\Delta T \leq 45$ °F (25 K)	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 7500$ to 1850 SUS (1600 to 400 mm ² /s)	$\theta = -40$ °F to -13 °F (-40 °C to -25 °C)	Note the detailed information on operation with low temperatures, see data sheet 90300-03-B.
Continuous operation	$\nu = 1850$ to 60 SUS (400 to 10 mm ² /s)		This corresponds, for example on the VG 46, to a temperature range of 41 °F (+5 °C) to 185 °F (+85 °C) (see selection diagram page 4)
		$\theta = -13$ °F to +230 °F (-25 °C to +110 °C)	measured at port L Note the permissible temperature range of the shaft seal ($\Delta T =$ approx. 9 °F (5 K) between the bearing/shaft seal and port L)
	$\nu_{opt} = 170$ to 80 SUS (36 to 16 mm ² /s)		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 49$ SUS (7 mm ² /s)		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ Selection diagram



Filtration of the fluid

The finer the filtration, the better the hydraulic fluid cleanliness level, and the longer 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.

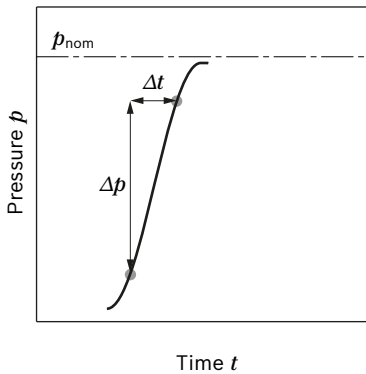
At very high hydraulic fluid temperatures (194 °F (90 °C) to maximum 239 °F (115 °C)), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

Operating pressure range

Pressure at working port B		Definition
Nominal pressure p_{nom}	3050 psi (210 bar) absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	3600 psi (250 bar) absolute	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.
Single operating period	2.5 ms	
Total operating period	300 h	
Minimum pressure $p_{B abs}$ (high pressure side)	145 psi (10 bar) absolute	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 $R_{A max}$	235000 psi/s (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)		Definition
Minimum pressure $p_{S min}$	Standard 10psi (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 $p_{S max}$	75 psi (5 bar) absolute	
Leakage pressure at port L ₁ , L ₂		Definition
Maximum pressure $p_{L max}$	30 psi (2 bar) absolute	Maximum 7.5 psi (0.5 bar) higher than inlet pressure at port S , but not higher than $p_{L max}$. A case drain line to the reservoir is required.

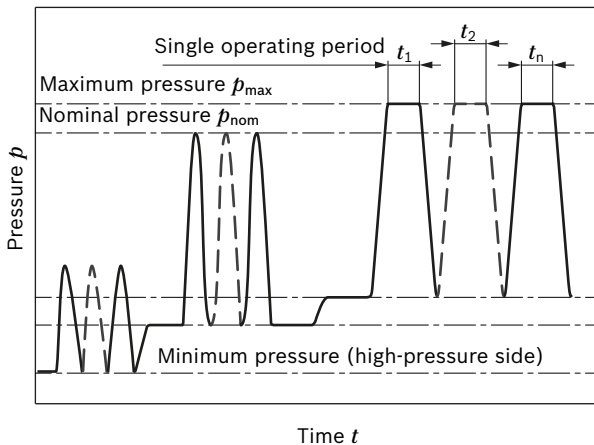
▼ Rate of pressure change $R_{A max}$



Note

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

▼ Pressure definition



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

Technical data

Size		NG	28	45	63	85	
Displacement, geometric, per revolution		$V_{g \max}$	in ³ (cm ³)	1.71 (28)	2.75 (45)	3.84 (63)	5.19 (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	gpm (l/min)	23.8 (90)	34.6 (131)	45 (170)	60.8 (230)
Power	at n_{nom} , $V_{g \max}$ and $\Delta p = 3050$ psi (210 bar)	P	HP (kW)	42 (31)	62 (46)	79 (59)	107 (80)
Torque	at $V_{g \max}$ and $\Delta p = 3050$ psi (210 bar)	T	lb-ft (Nm)	69 (94)	110 (150)	155 (210)	209 (284)
Rotary stiffness drive shaft	S	c	lb-ft/rad (Nm/rad)	8082 (11000)	16400 (22300)	27560 (37500)	48100 (65500)
	R	c	lb-ft/rad (Nm/rad)	10870 (14800)	19400 (26500)	30240 (40500)	51200 (69400)
Moment of inertia for rotary group		J_{GR}	lbs-ft ² (kgm ²)	0.2207 (0.00093)	0.0403 (0.0017)	0.0783 (0.0033)	0.1329 (0.0056)
Maximum angular acceleration ²⁾		α	rad/s ²	6800	4900	3500	2500
Case volume		V	gal (l)	0.06 (0.25)	0.08 (0.3)	0.13 (0.5)	0.21 (0.8)
Weight without through drive (approx.)		m	lbs (kg)	25 (11.5)	33 (15)	40 (18)	48.5 (22)
Weight with through drive (approx.)				28.6 (13)	40 (18)	53 (24)	62 (28)

Determining the operating characteristics

$$\text{Flow } q_v = \frac{V_g \times n \times \eta_v}{231 (1000)} \quad \left[\begin{array}{l} \text{gpm} \\ \text{(l/min)} \end{array} \right]$$

$$\text{Torque } T = \frac{V_g \times \Delta p}{24 (20) \times \pi \times \eta_{mh}} \quad \left[\begin{array}{l} \text{lb-ft} \\ \text{(Nm)} \end{array} \right]$$

$$\text{Power } P = \frac{2 \pi \times T \times n}{33000 (60000)} = \frac{q_v \times \Delta p}{1714 (600) \times \eta_t} \quad \left[\begin{array}{l} \text{HP} \\ \text{(kW)} \end{array} \right]$$

Key

$$V_g = \text{Displacement per revolution [in}^3 \text{ (cm}^3\text{)]}$$

$$\Delta p = \text{Differential pressure [psi (bar)]}$$

$$n = \text{Rotational speed [rpm]}$$

$$\eta_v = \text{Volumetric efficiency}$$

$$\eta_{mh} = \text{Mechanical-hydraulic efficiency}$$

$$\eta_t = \text{Total efficiency } (\eta_t = \eta_v \times \eta_{mh})$$

Note

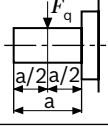
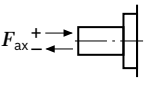
- ▶ Theoretical values, without efficiency and tolerances; values rounded.
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or the destruction of the axial piston unit. We recommend testing the loads by means of experiment or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

1) The values are valid:

- At absolute pressure $p_{\text{abs}} = 15$ psi (1 bar) at suction port **S**
- For the optimal viscosity range of $\nu_{\text{opt}} = 170$ to 80 SUS (36 to 16 mm²/s)
- For hydraulic fluid based on mineral oils

2) The scope of application lies between the minimum necessary and the maximum permissible drive speeds. It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, Cardan shaft twice the rotary frequency). The limiting value is only valid for a single pump. The load capacity of the connection parts must be considered.

Permissible radial and axial forces of the drive shaft

Size	NG	28	45	63	85	
Maximum radial force at a/2	 $F_{q \max}$	lbf (N)	33 (150)	146 (650)	225 (1000)	303 (1350)
Maximum axial force	 $\pm F_{ax \max}$	lbf (N)	90 (400)	146 (650)	225 (1000)	303 (1350)

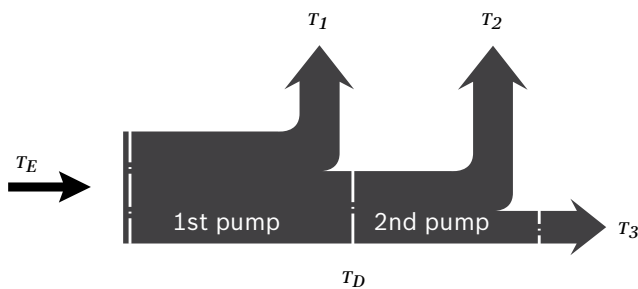
Note

- ▶ The values given are maximum values and do not apply to continuous operation. For drives with radial loading (pinion, V-belt drives), please contact us!

Permissible input and through-drive torques

Size		28	45	63	85	
Torque at $V_{g \max}$ and $\Delta p = 3050 \text{ psi (210 bar)}^{1)}$	T_{max}	lb-ft (Nm)	69 (94)	110 (150)	155 (210)	209 (284)
Input torque at drive shaft, maximum ²⁾						
S	$T_{E \max}$	lb-ft (Nm)	91 (124)	146 (198)	235 (319)	464 (630)
	\varnothing	in	3/4	7/8	1	1 1/4
R	$T_{E \max}$	lb-ft (Nm)	118 (160)	184 (250)	295 (400)	479 (650)
	\varnothing	in	3/4	7/8	1	1 1/4
Maximum through-drive torque						
S	$T_{D \max}$	lb-ft (Nm)	80 (108)	118 (160)	235 (319)	357 (484)
R	$T_{D \max}$	Nm	89 (120)	130 (176)	270 (365)	357 (484)

▼ **Torque distribution**



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

1) Efficiency not considered

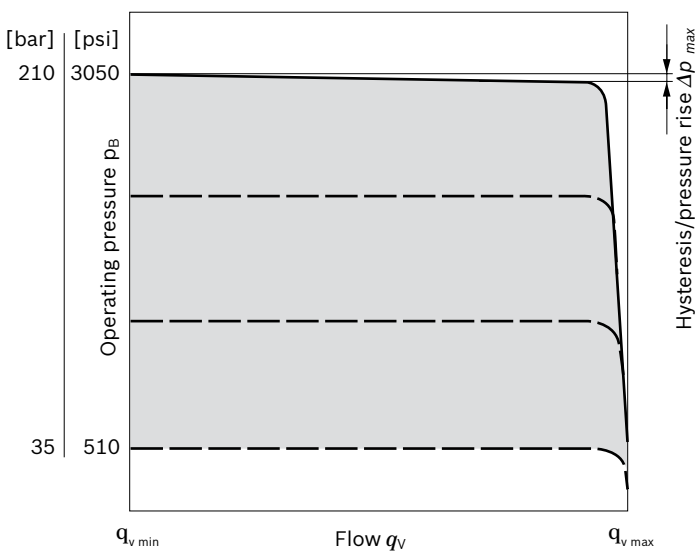
2) For drive shafts with no radial force

DR – Pressure control

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

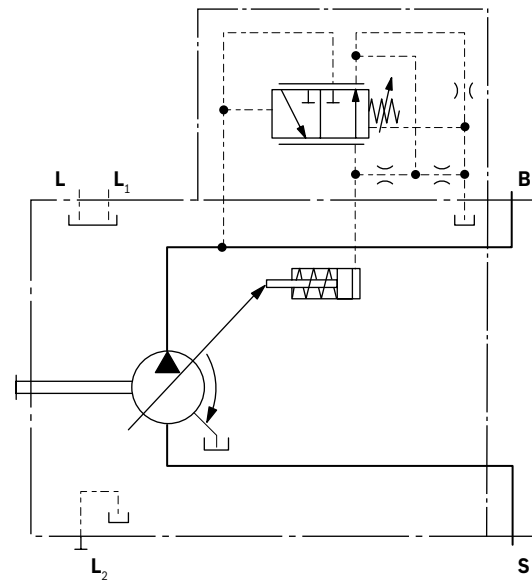
- ▶ Basic position in depressurized state: $V_{g \max}$.
- ▶ Setting range¹⁾ for pressure control 510 to 3050 psi (35 to 210 bar).
Standard is 3050 psi (210 bar).

▼ Characteristic curve DR



Characteristic curve valid at $n_1 = 1500$ rpm and $\theta_{\text{fluid}} = 120$ °F (50 °C).

▼ Schematic DR



Controller data

NG		28	45	63	85
Pressure increase	Δp [psi (bar)]	90 (6)	90 (6)	90 (6)	115 (8)
Hysteresis and repeat precision	Δp [psi (bar)]	maximum 60 (4)			
Pilot fluid consumption	[gpm (l/min)]	maximum approx. 0.8 (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 control remotely operated

For the remote-controlled pressure control, the target pressure can be set using a separately arranged pressure relief valve. Pressure control DR see page 9.

A pressure relief valve can be externally piped to port **X** for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the scope of supply of the pump.

The differential pressure at the DRG control valve is set as standard to 290 psi (20 bar). At port **X** the amount of control fluid is about 0.4 gpm (1.5 l/min). If a different setting (range 145 to 320 psi (10 to 22 bar)) is required, please state in plain text.

As a separate pressure relief valve, we recommend:

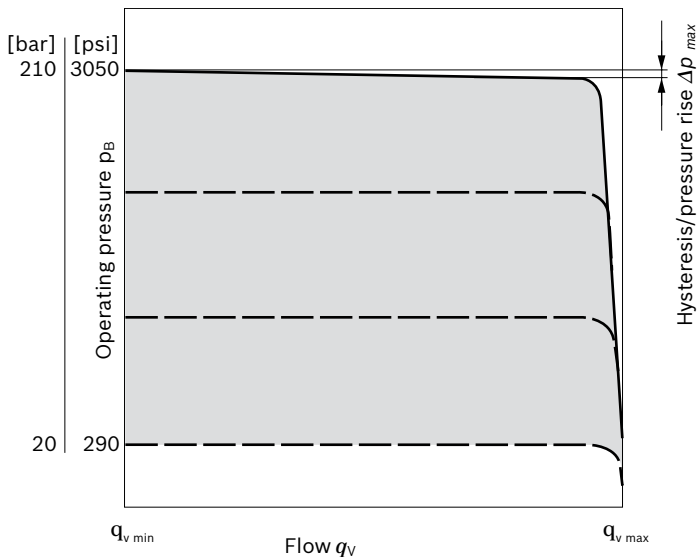
DBDH 6 (hydraulic) to RE 25402 or

DBETR-SO 381 with orifice dia 0.03 inch (Ø 0.8 mm) in P (electric) to RE 29166.

The max. length of piping should not exceed 6.6 ft (2 m).

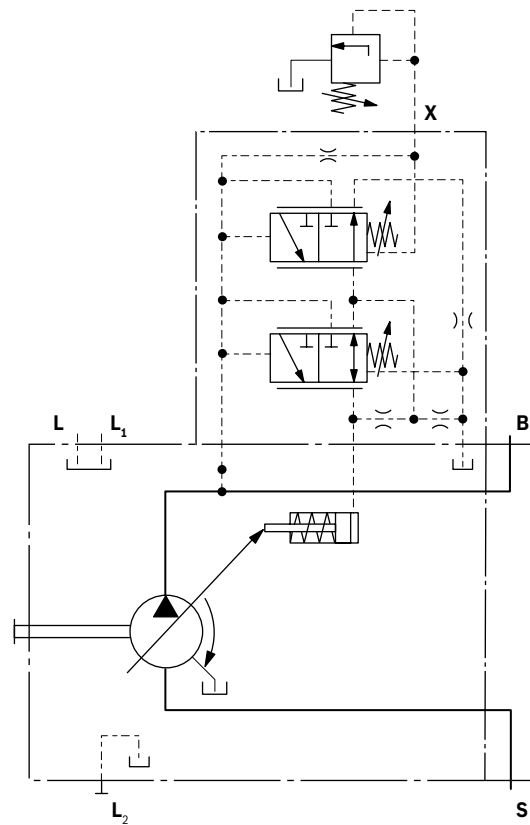
- ▶ Basic position in depressurized state: $V_{g \max}$.
- ▶ Setting range¹⁾ for pressure control 290 to 3050 psi (20 to 210 bar).
Standard is 3050 psi (210 bar).

▼ Characteristic curve DRG



Characteristic curve valid at $n_1 = 1500$ rpm and $\theta_{\text{fluid}} = 120$ °F (50 °C).

▼ Schematic DRG



Controller data

NG		28	45	63	85
Pressure increase	Δp [psi (bar)]	90 (6)	90 (6)	90 (6)	115 (8)
Hysteresis and repeat precision	Δp [psi (bar)]	maximum 60 (4)			
Pilot fluid consumption	gpm (l/min)	maximum approx. 1.2 (4.5)			

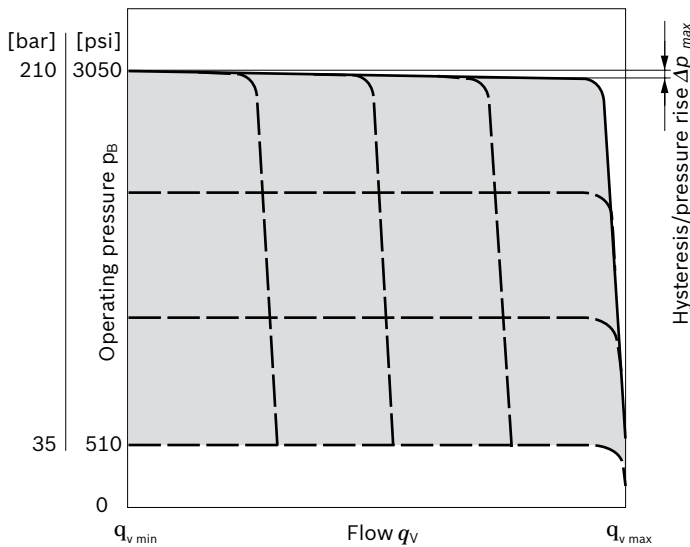
1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

DRF/DRS/DRSC – Pressure and flow control

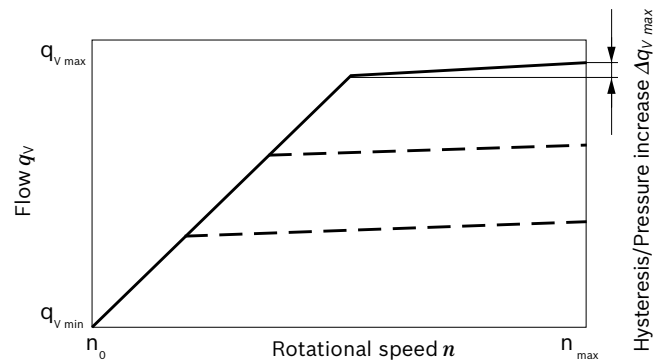
In addition to the pressure control function (see page 9), a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual required flow by the consumer, regardless of changing pressure levels. The pressure control overrides the flow control function.

- ▶ Basic position in depressurized state: $V_{g \max}$.
 - ▶ Setting range¹⁾ for pressure control 510 to 3050 psi (35 to 210 bar).
- Standard is 3050 psi (210 bar).

▼ Characteristic curve DRF/DRS/DRSC



▼ Characteristic curve at variable speed



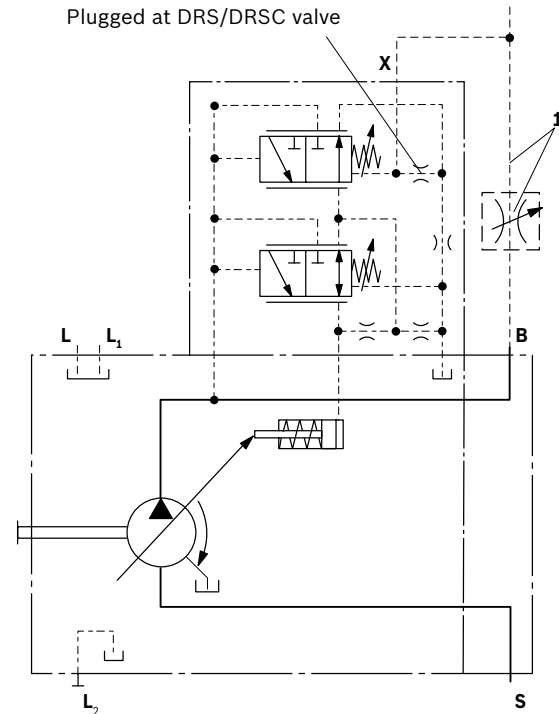
Characteristic curve valid at $n_1 = 1500$ rpm and $\theta_{fluid} = 120$ °F (50 °C).

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.

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

LS mobile control blocks	Data sheets
M4-12	64276
M4-15	64283
LUDV mobile control blocks	
M6-15	64284
M7-22	64295

▼ Schematic DRF



1 The sensing orifice (control block) and the line is not included in the delivery contents.

Note

The DRS and DRSC valve versions have no pilot line between **X** and the reservoir. Unloading the LS-pilot line must be possible in the valve system. Because of the flushing function sufficient unloading of the flow control in DRS control valve **X**-line must also be provided. If this pilot line of the **X** line does not have to be guaranteed, the DRSC control valve must be used.

For further information see page 12

Differential pressure Δp :

- ▶ Standard setting: 200 to 320 psi (14 to 22 bar).
- If another setting is required, please state in clear text.
- Relieving the load on port **X** to the reservoir results in a zero stroke ("standby") pressure which lies about 15 to 30 psi (1 to 2 bar) higher than the differential pressure Δp .
- No account is taken of system influences.

Controller data

- ▶ DR Pressure control data see page 9.
- ▶ Maximum flow deviation measured at drive speed
n = 1500 rpm.

NG		28	45	63	85
Flow deviation	Δq_{vmax} [gpm (l/min)]	0.24 (0.9)	0.26 (1.0)	0.48 (1.8)	0.66 (2.5)
Hysteresis; repeat precision	Δp [bar]	maximum 60 (4)			
Pilot fluid consumption	[gpm (l/min)]	maximum approx. 0.8 to 1.2 (3) (DRF) maximum approx. 0.8 (3) (DRS / DRSC)			

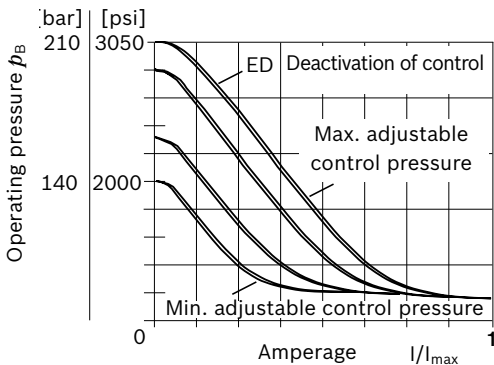
ED – Electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current. When a change is made at the consumer (load pressure), the position of the control piston will shift. 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 a loss of power, e.g. for fan drives). The response time characteristic curve of the ED-control was optimized for the use as a fan drive system. When ordering, specify the type of application in clear text.

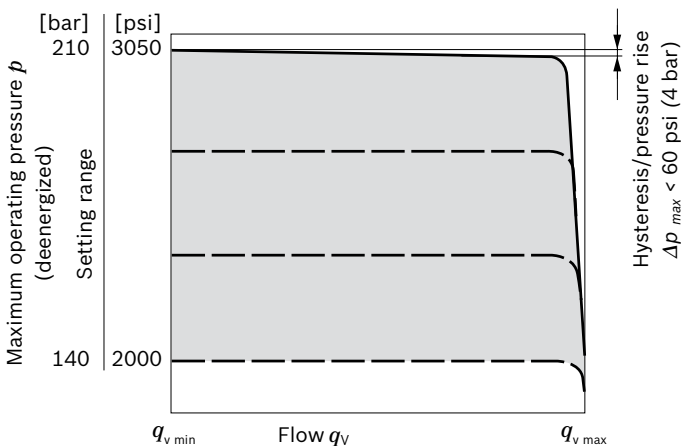
▼ Static current-pressure characteristic curve ED

(negative characteristic curve measured with pump in zero stroke)



► Hysteresis static < 45 psi (3 bar).

▼ Flow-pressure characteristic curve

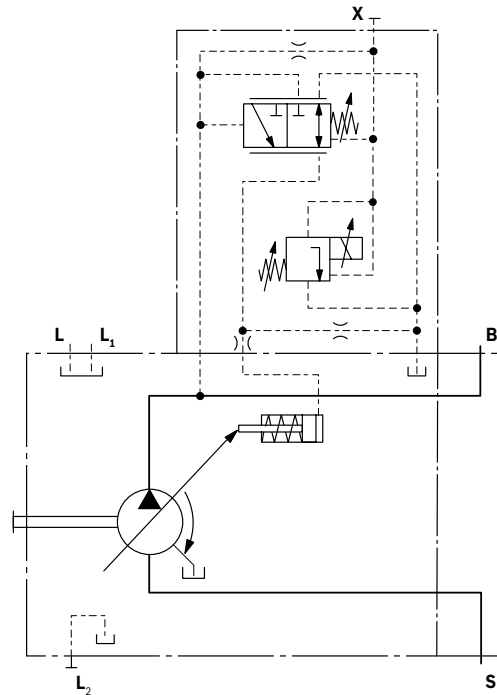


► Characteristic curve valid at $n_1 = 1500$ rpm and $\theta_{fluid} = 120$ °F (50 °C).

► Pilot fluid consumption: 0.8 to 1.2 gpm (3 to 4.5 l/min).

► Standby standard setting 360 psi (23 bar). Other values on request.

▼ Schematic ED71/ED72



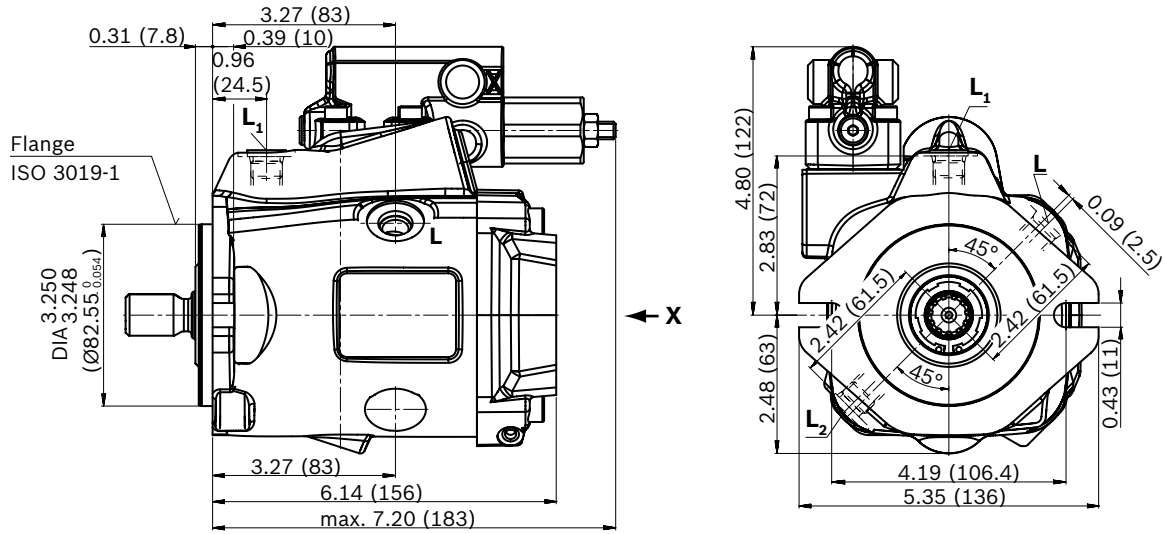
Technical data, solenoid	ED71	ED72
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{min}	100 mA	50 mA
End of control at p_{max}	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 31		
Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)		

3050 psi (210 bar) is the standard nominal pressure, higher pressures for fan drive application on request. You will also find more information about fan systems in application brochure 98065.

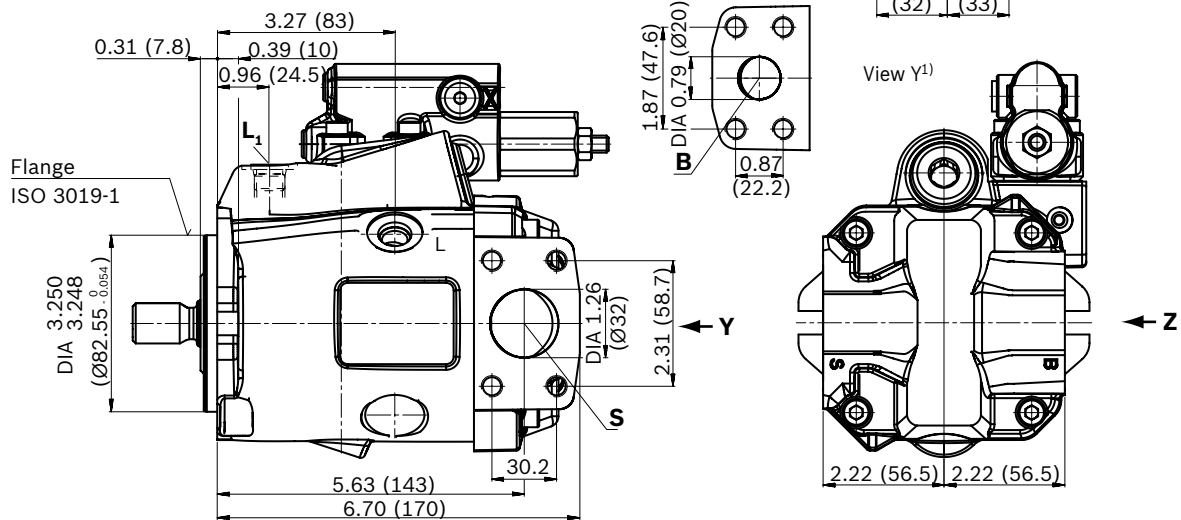
Dimensions, Size 28, series 53

DR – Hydraulic pressure controller; clockwise rotation

▼ **Port plate 61**

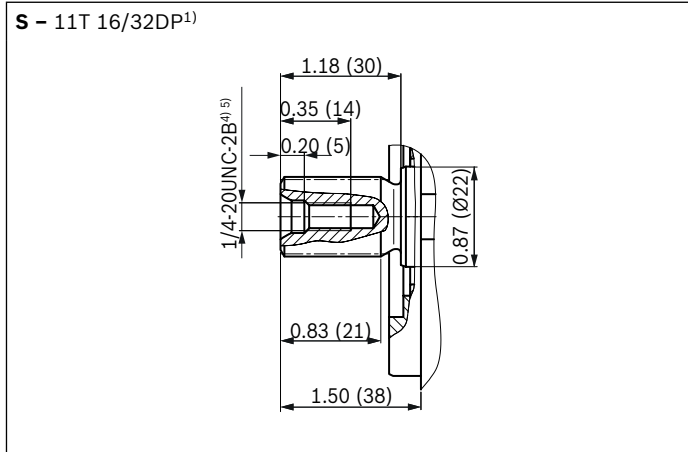


▼ **Port plate 62**

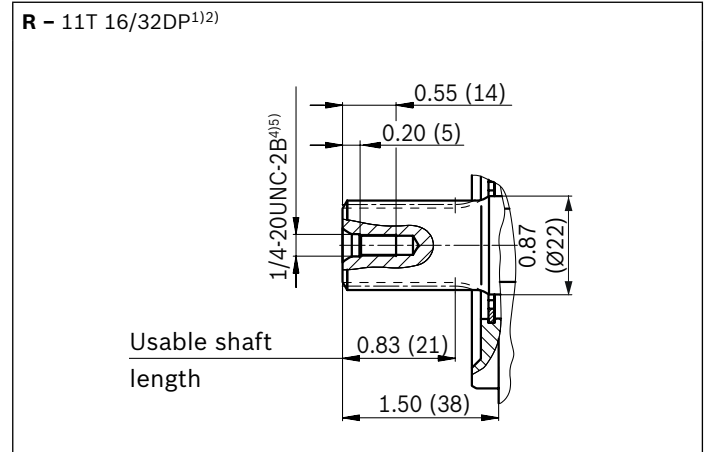


1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

▼ Splined shaft 3/4 in (SAE J744)



▼ Splined shaft 3/4 in (SAE J744)

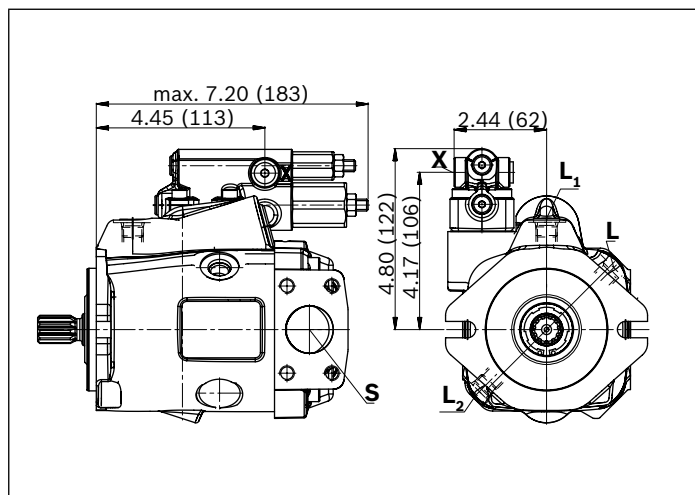


Ports	Standard	Size ⁴⁾	$p_{\max \text{ abs}}$ [psi (bar)] ⁵⁾	Condition ⁸⁾
B	Working line port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.75 (19) deep	3600 (250) O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 1/4 in 7/16-14UNC-2B; 0.79 (20) deep	75 (5) O
L	Case drain port	DIN 11926 ⁶⁾	3/4-16UNF-2B; 0.47 (12) deep	30 (2) O ⁷⁾
L₁, L₂	Case drain port	DIN 11926 ⁶⁾	3/4-16UNF-2B; 0.47 (12) deep	30 (2) X ⁷⁾
X	Control pressure	DIN 11926	7/16-20UNF-2A; 0.45 (11.5) deep	3600 (250) O

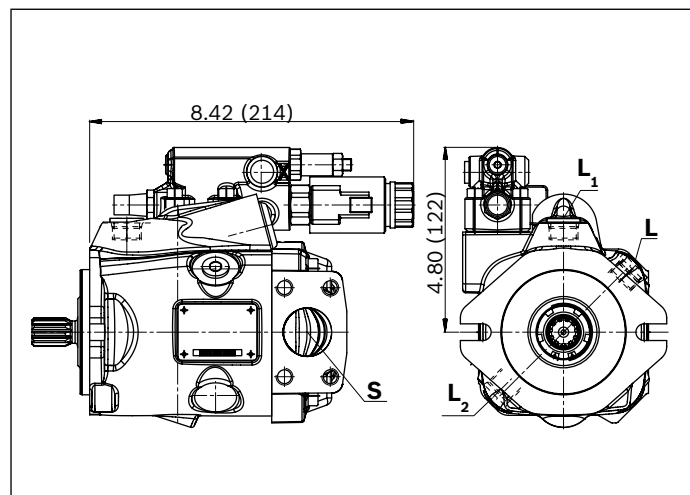
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) Observe the general instructions on page 36 concerning the maximum tightening torques.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than as specified in the standard.
7) Depending on the installation position, L, L₁ or L₂ must be connected (also see installation instructions starting on page 32).
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

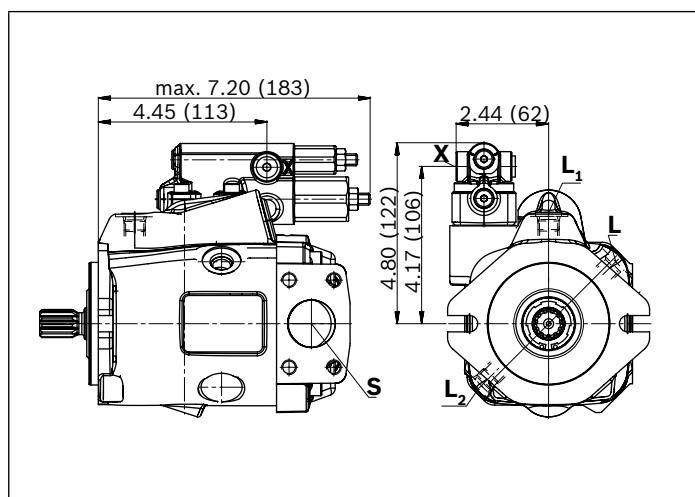
▼ DRG – Pressure controller, remote controlled, series 53



▼ ED7. – Electro-prop. Pressure control, series 53



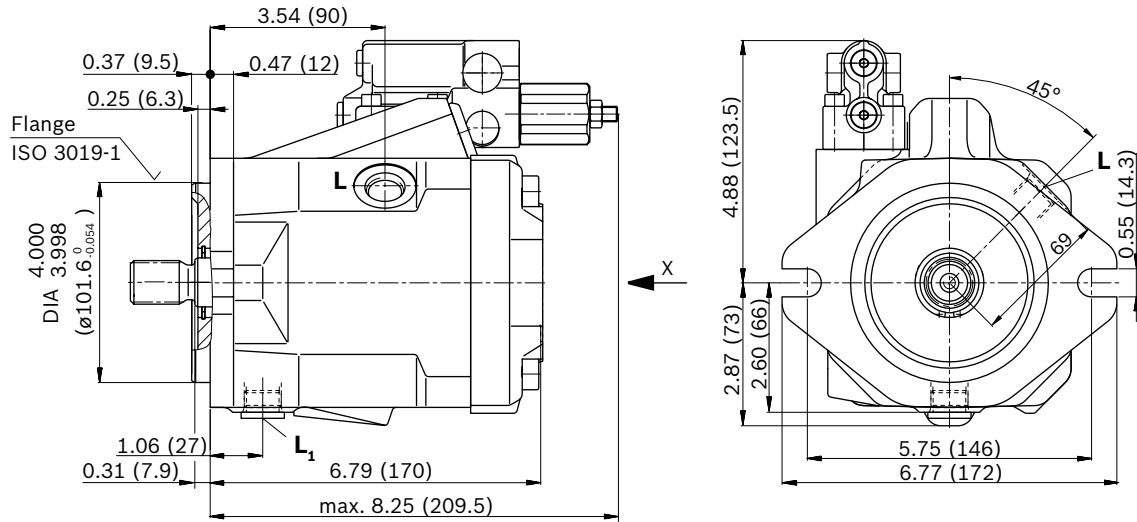
▼ DRF/DRS/DRSC – Pressure and flow control, series 53



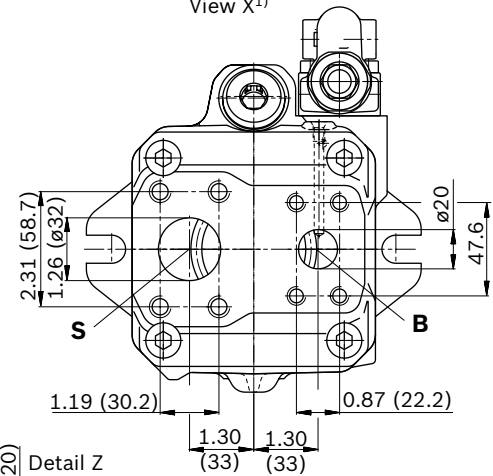
Dimensions, Size 45, series 52

DR – Hydraulic pressure controller; clockwise rotation

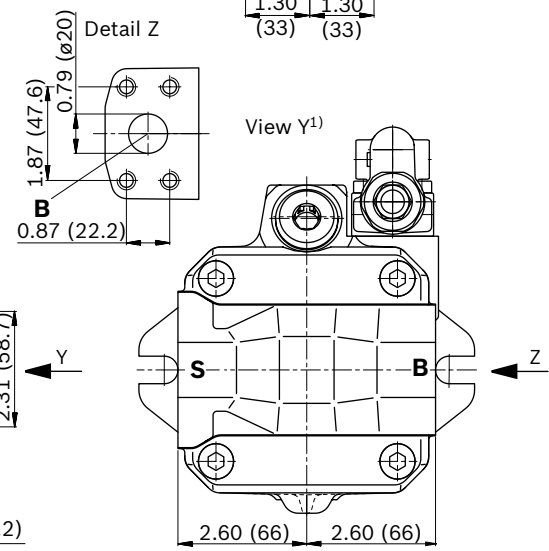
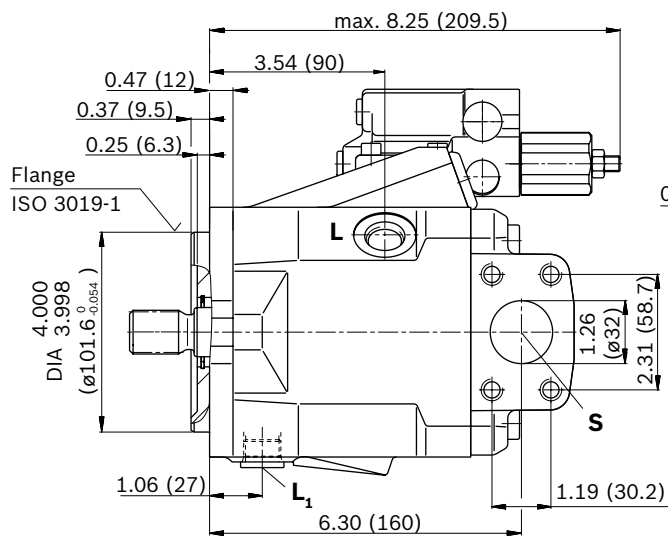
▼ Port plate 61



View X¹⁾

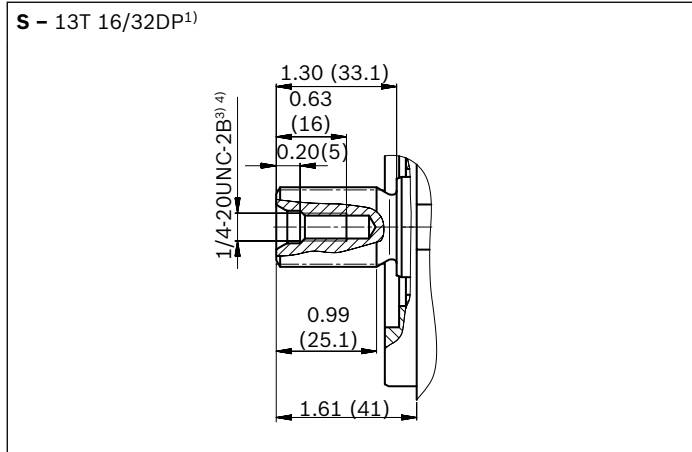


▼ Port plate 62

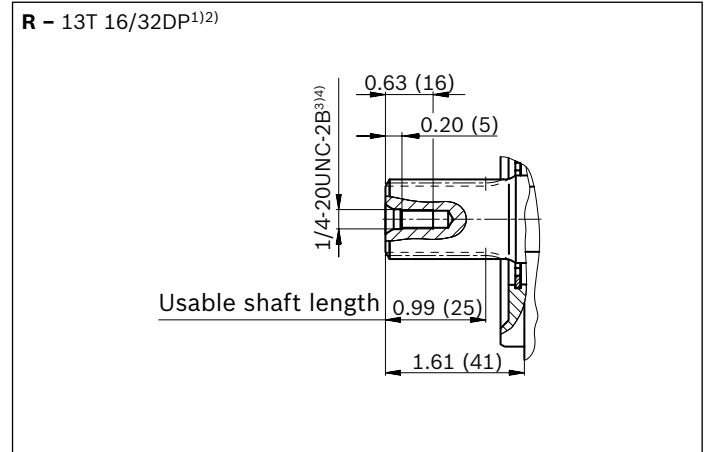


1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

▼ Splined shaft 7/8 in (SAE J744)



▼ Splined shaft 7/8 in (SAE J744)

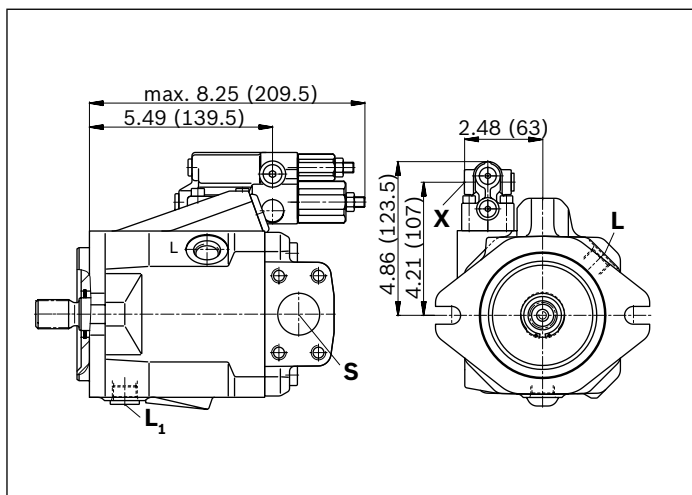


Ports		Standard	Size ⁴⁾	$p_{\max \text{ abs}}$ [psi (bar)] ⁵⁾	Condition ⁸⁾
B	Service line port (standard pressure series) Fixing thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.75 (19) deep	3600 (250)	O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 1/4 in 7/16-14UNC-2B; 0.79 (20) deep	75 (5)	O
L	Case drain port	ISO 11926 ⁶⁾	3/4-16UNF-2B; 0.47 (12) deep	30 (2)	O ⁷⁾
L₁	Case drain port	ISO 11926 ⁶⁾	3/4-16UNF-2B; 0.47 (12) deep	30 (2)	X ⁷⁾
X	Control pressure	ISO 11926	7/16-20UNF-2B; 0.45 (11.5) deep	3600 (250)	O

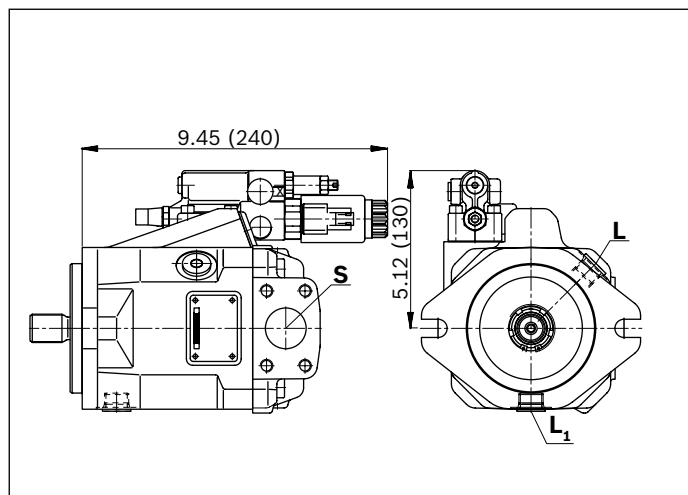
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
 2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
 3) Thread according to ASME B1.1
 4) Observe the general instructions on page 36 concerning the maximum tightening torques.
 5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) The spot face can be deeper than as specified in the standard.
 7) Depending on the installation position, L or L₁ must be connected (also see installation instructions starting on page 32).
 8) O = Must be connected (plugged on delivery)
 X = Plugged (in normal operation)

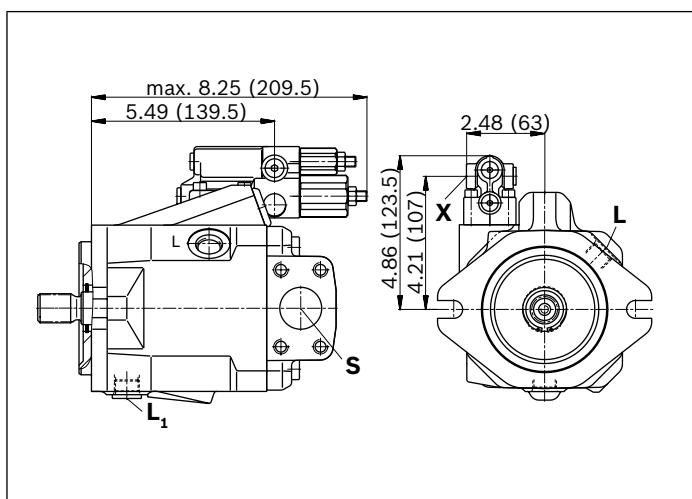
▼ DRG - Pressure controller, remote controlled, series 52



▼ ED7. - Electro-prop. Pressure control, series 52



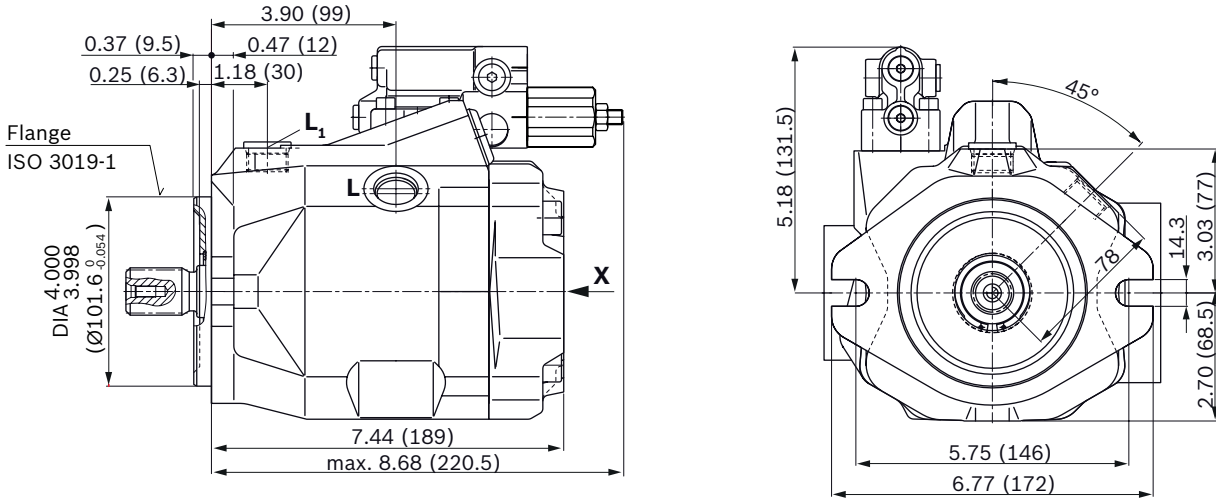
▼ DRF/DRS/DRSC - Pressure and flow control, series 52



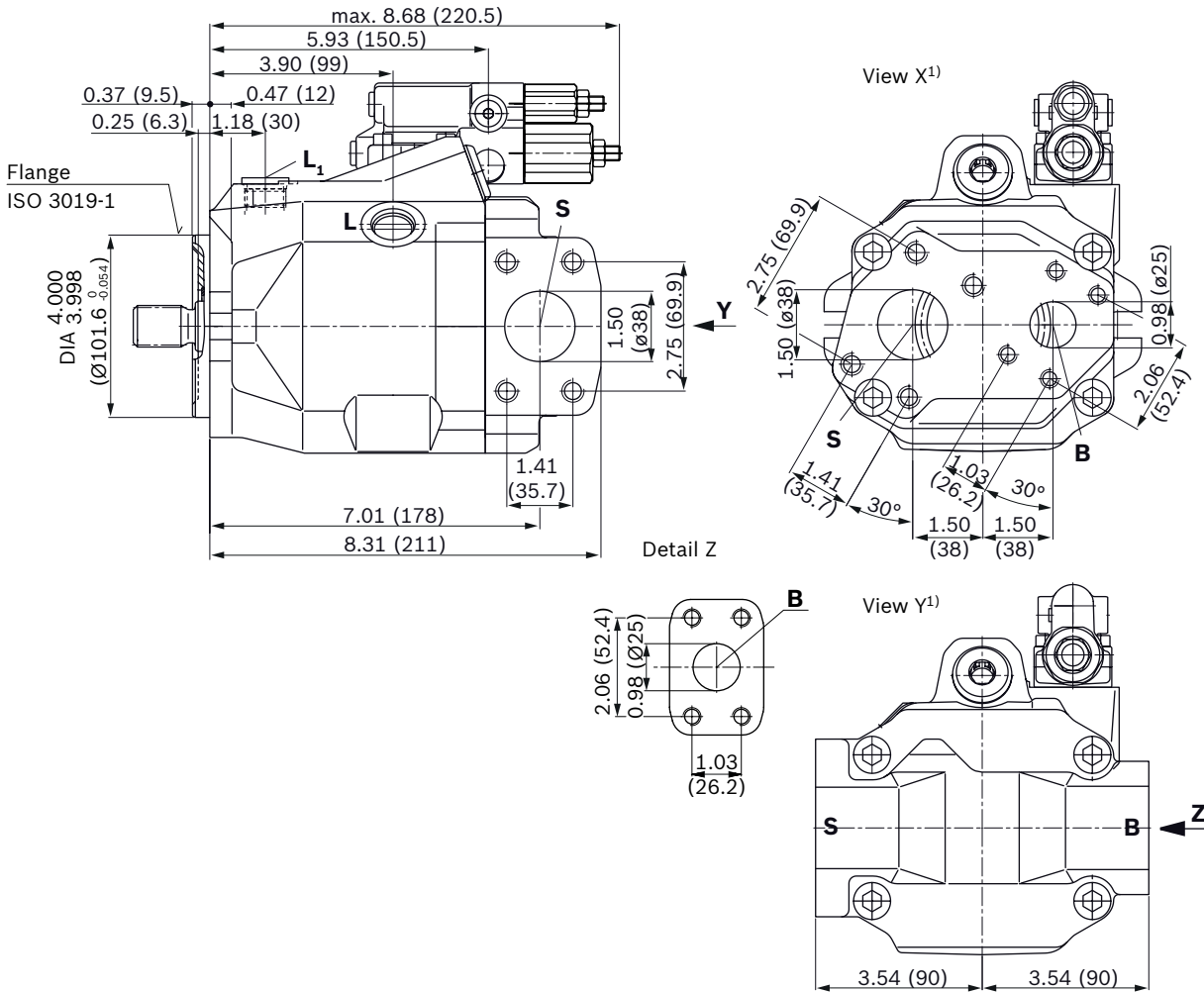
Dimensions, Size 63, series 52

DR – Hydraulic pressure controller; clockwise rotation

▼ **Port plate 61**



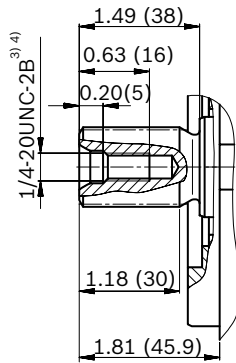
▼ **Port plate 62**



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

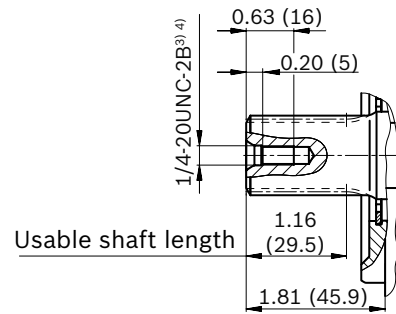
▼ Splined shaft 1 in SAE J744

S – 15T 16/32DP¹⁾



▼ Splined shaft 1 in SAE J744

R – 15T 16/32DP¹⁾²⁾



Ports		Standard	Size ⁴⁾	$p_{\max \text{ abs}}$ [psi (bar)] ⁵⁾	Condition ⁸⁾
B	Working line port (standard pressure series)	SAE J518	1 in	3600 (250)	O
	Fastening thread	ASME B1.1	3/8-16UNC-2B; 0.71 (18) deep		
S	Suction port (standard pressure series)	SAE J518	1 1/2 in	75 (5)	O
	Fastening thread	ASME B1.1	1/2-13UNC-2B; 0.87 (22) deep		
L	Case drain port	ISO 11926 ⁶⁾	7/8-14UNF-2B; 0.51 (13) deep	30 (2)	O ⁷⁾
L₁	Case drain port	ISO 11926 ⁶⁾	7/8-14UNF-2B; 0.51 (13) deep	30 (2)	X ⁷⁾
X	Control pressure	ISO 11926	7/16-20UNF-2A; 0.45 (11.5) deep	3600 (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, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the general instructions on page 36 concerning the maximum tightening torques.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

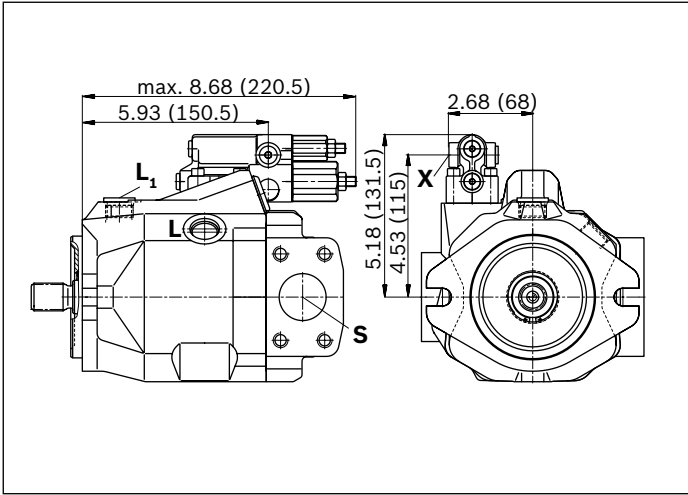
6) The spot face can be deeper than as specified in the standard.

7) Depending on the installation position, L, L₁ or L₂ must be connected (also see installation instructions starting on page 32).

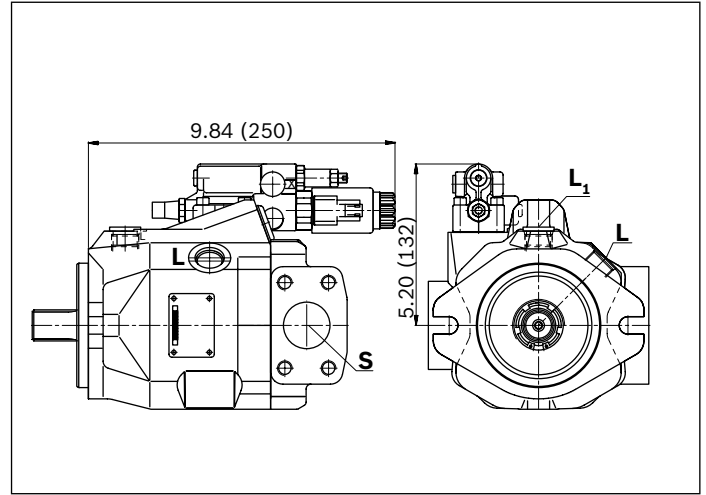
8) O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

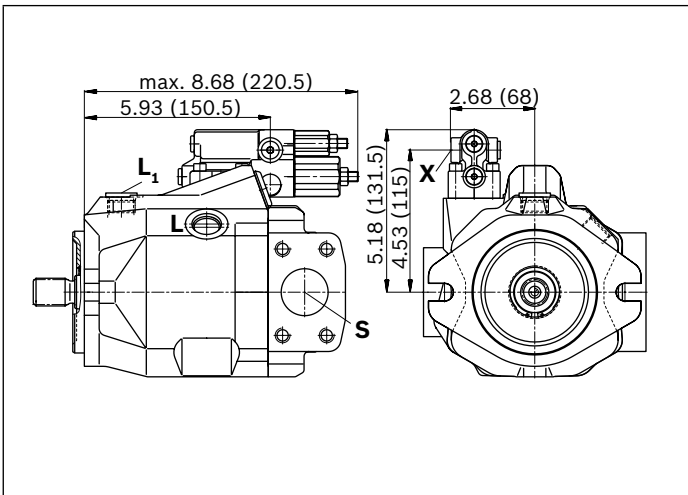
▼ DRG – Pressure controller, remote controlled, series 52



▼ ED7. / ER7. – Electro-prop. Pressure control, series 52



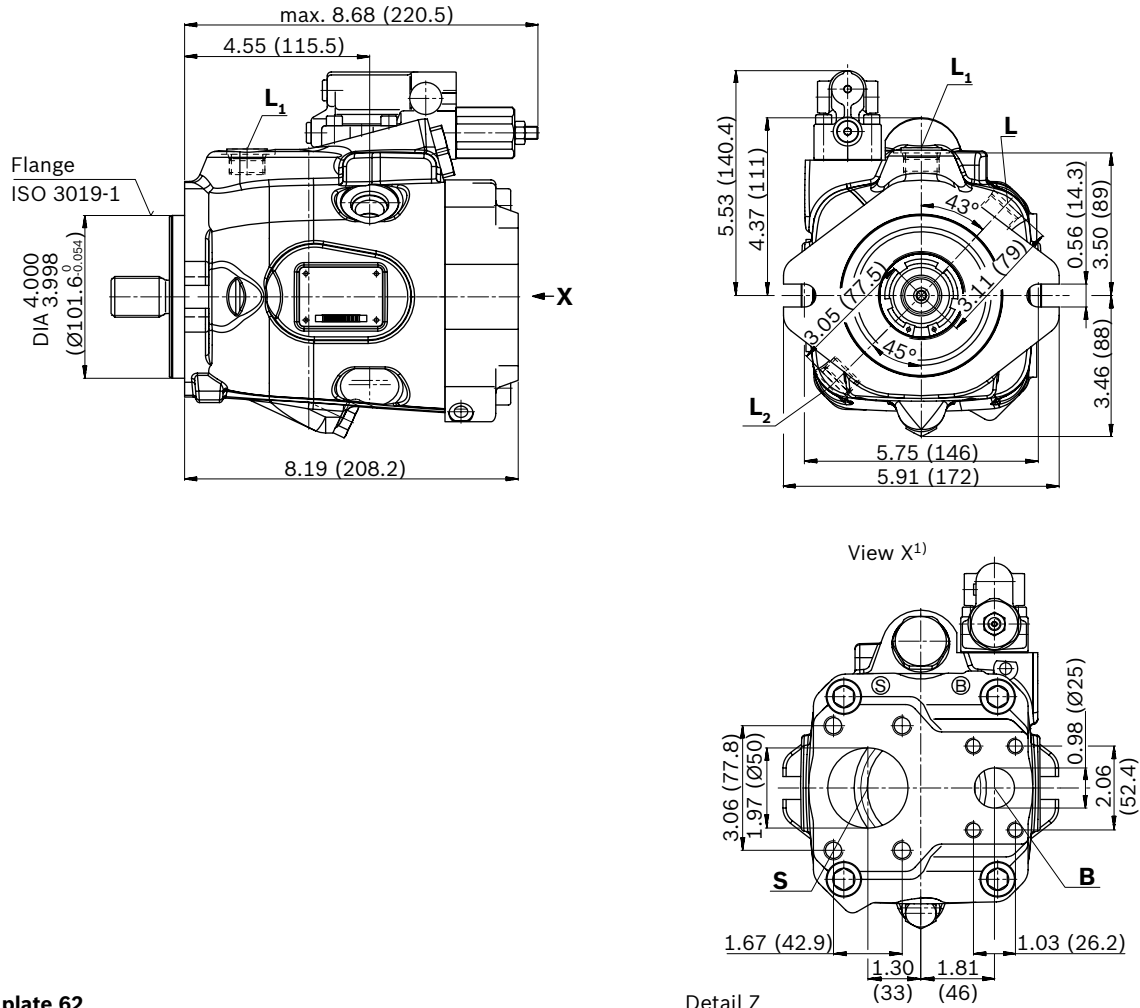
▼ DRF/DRS/DRSC – Pressure and flow control, series 52



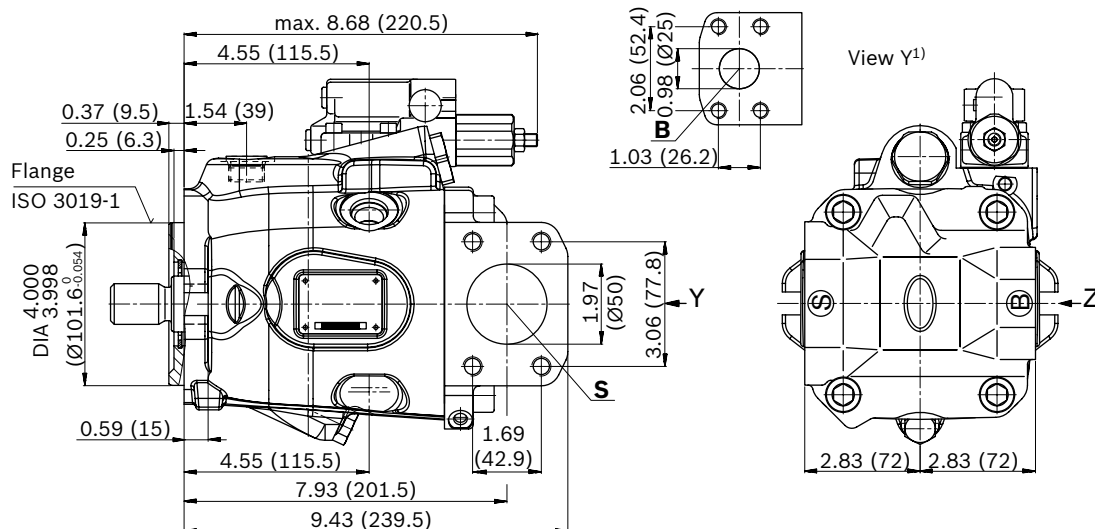
Dimensions, Size 85, series 53

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

▼ **Port plate 61**



▼ **Port plate 62**

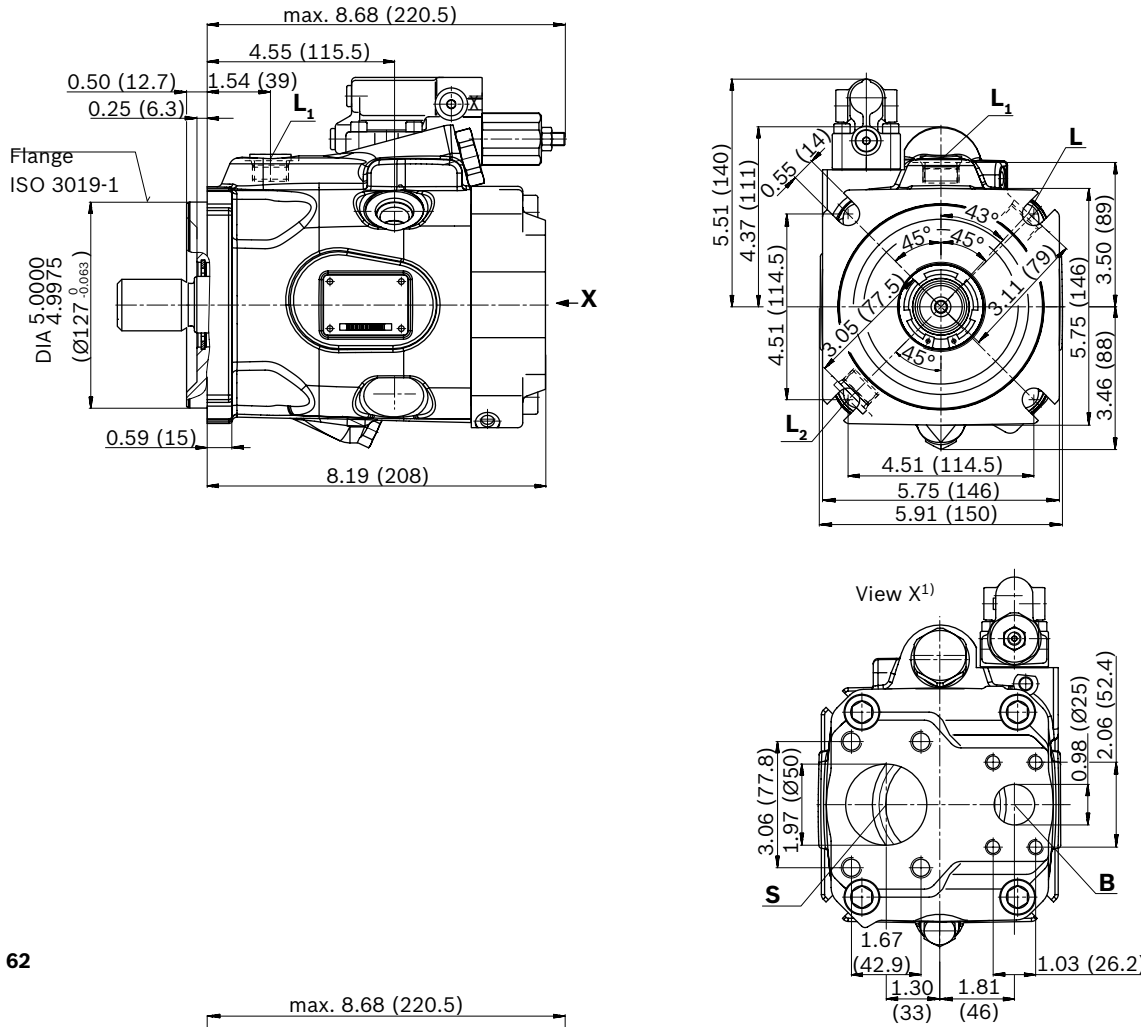


1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

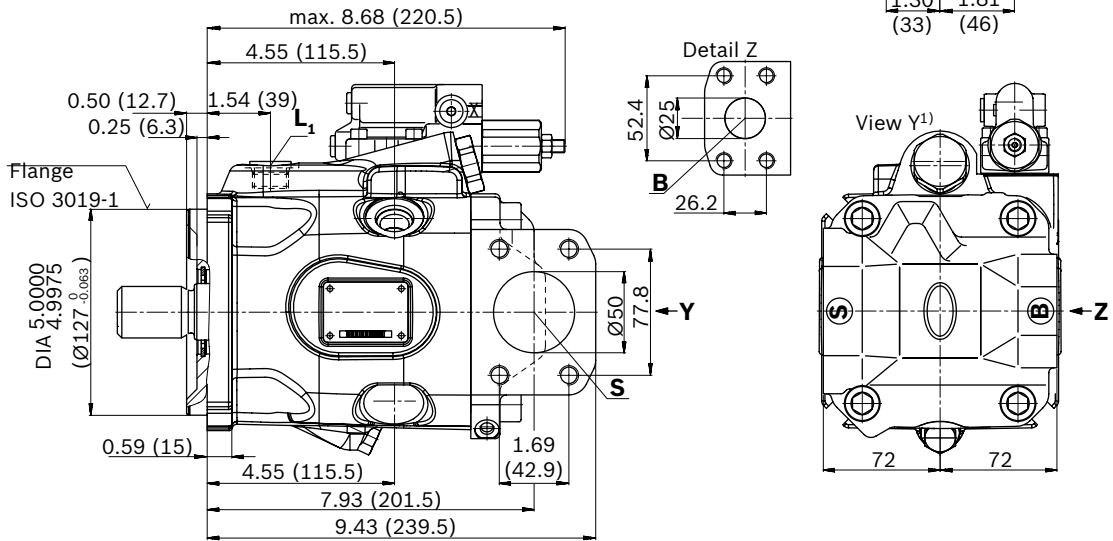
Dimensions, Size 85, series 53

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

▼ **Port plate 61**



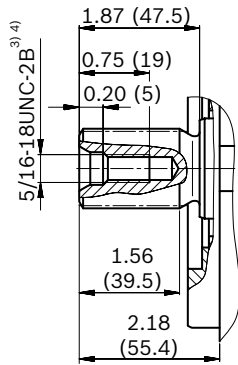
▼ **Port plate 62**



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

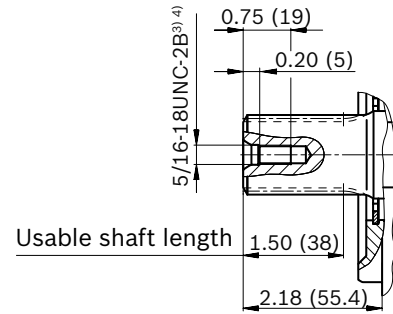
▼ Splined shaft 1 1/4 in SAE J744

S – 14T 12/24DP¹⁾



▼ Splined shaft 1 1/4 in SAE J744

R – 14T 12/24DP¹⁾²⁾



Ports		Standard	Size ⁴⁾	$p_{\max \text{ abs}}$ [psi (bar)] ⁵⁾	Condition ⁸⁾
B	Working line port (standard pressure series)	SAE J518	1 in	3600 (250)	O
	Fastening thread	ASME B1.1	3/8-16UNC-2B; 0.71 (18) deep		
S	Suction port (standard pressure series)	SAE J518	2 in	75 (5)	O
	Fastening thread	ASME B1.1	1/2-13UNC-2B; 0.87 (22) deep		
L	Case drain port	ISO 11926 ⁶⁾	7/8-14UNF-2B; 13 deep	30 (2)	O ⁷⁾
L₁, L₂	Case drain port	ISO 11926 ⁶⁾	7/8-14UNF-2B; 13 deep	30 (2)	X ⁷⁾
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	3600 (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, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the general instructions on page 36 concerning the maximum tightening torques.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

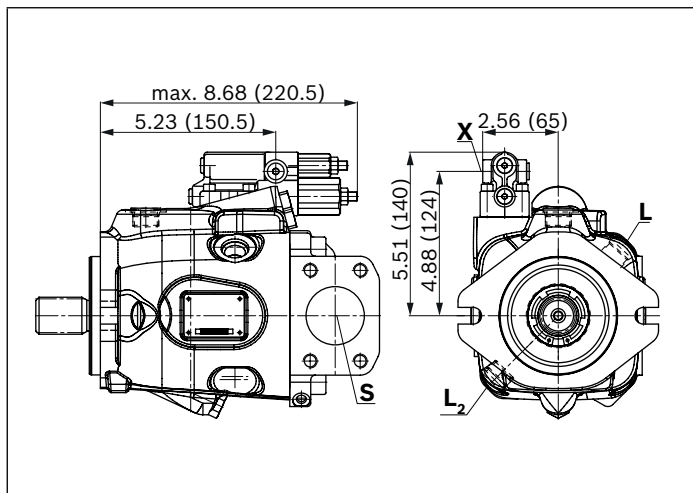
6) The spot face can be deeper than as specified in the standard.

7) Depending on the installation position, L, L₁ or L₂ must be connected (also see installation instructions starting on page 32).

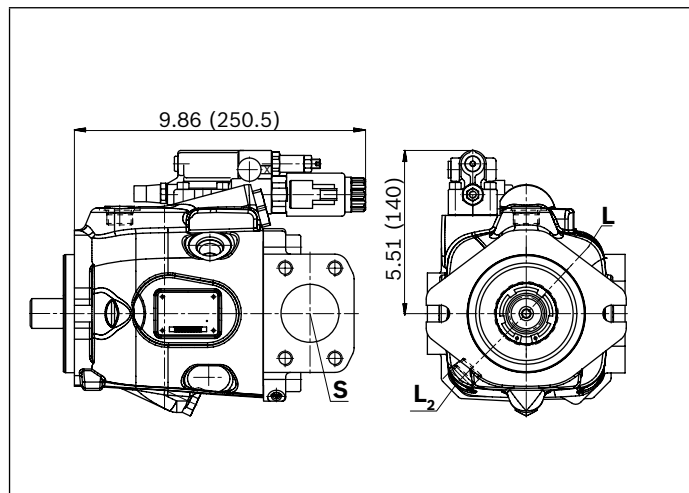
8) O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

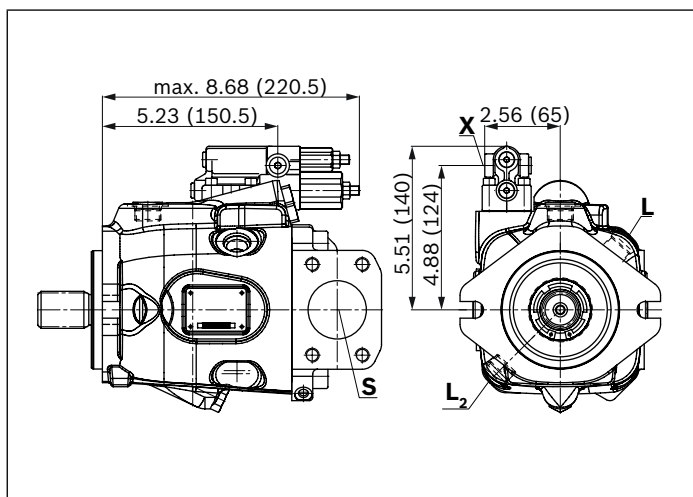
▼ DRG - Pressure controller, remote controlled, series 53



▼ ED7. - Electro-prop. Pressure control, series 53



▼ DRF/DRS/DRSC - Pressure and flow control, series 53

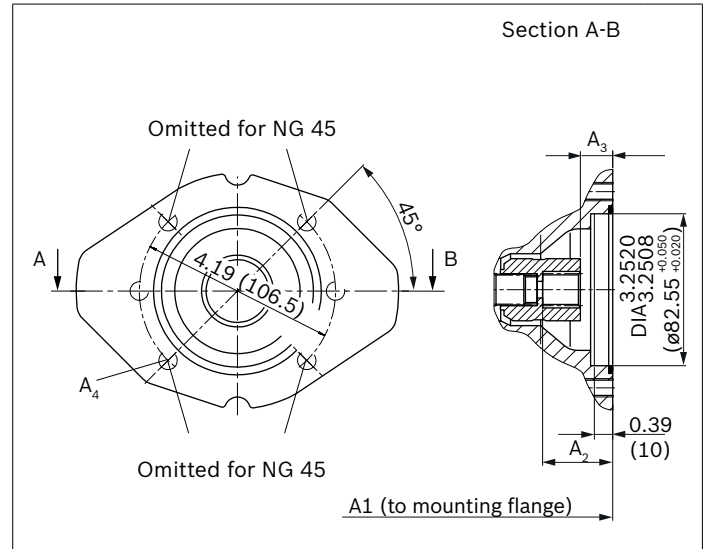
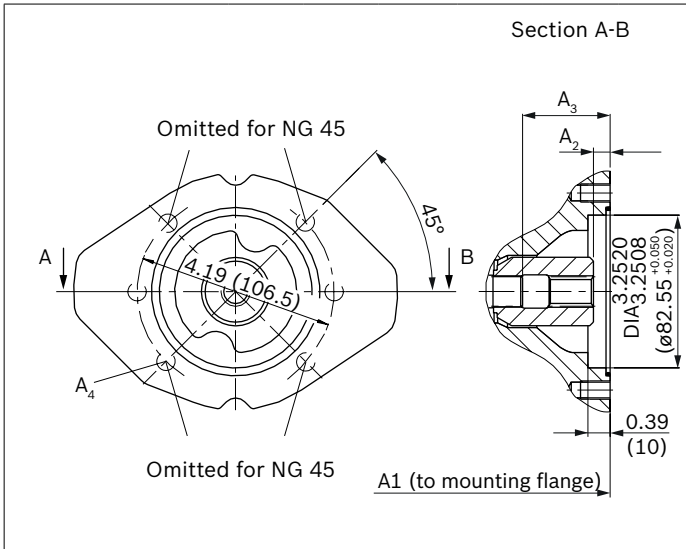


Dimensions through drive

Flange ISO 3019-1 (SAE)		Hub for splined shaft ¹⁾		Availability over sizes				Code
diameter	Symbol ²⁾	diameter		28	45	63	85	
82-2 (A)	♂, ∞	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	A3	A4 ³⁾
28	7.17 (182)	0.37 (9.3)	1.70 (43.3)	M10×1.5; 0.57 (14.5) deep	
45	8.03 (204)	0.39 (9.9)	1.85 (47)	M10×1.5; 0.63 (16) deep	
63	9.02 (229)	0.42 (10.7)	2.09 (53)	M10×1.5; 0.63 (16) deep	
85	10.03 (255)	0.37 (9.5)	2.32 (59)	M10×1.5; 0.63 (16) deep	

K52 (SAE J744 19-4 (A-B))	NG	A1	A2	A3	A4 ³⁾
28	7.17 (182)	1.53 (39)	0.74 (18.8)	M10×1.5; 0.57 (14.5) deep	
45	8.03 (204)	1.54 (39.3)	0.74 (18.8)	M10×1.5; 0.63 (16) deep	
63	9.02 (229)	1.55 (39.4)	0.75 (18.9)	M10×1.5; 0.63 (16) deep	
85	10.03 (255)	1.55 (39.4)	0.75 (18.9)	M10×1.5; 0.63 (16) deep	

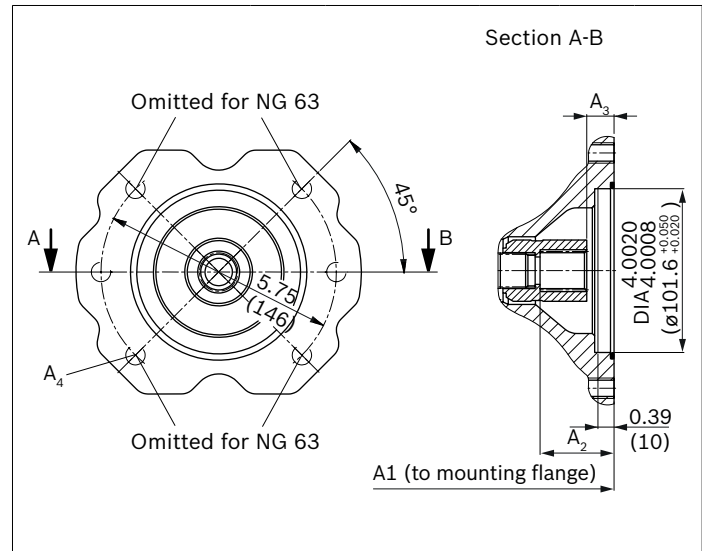
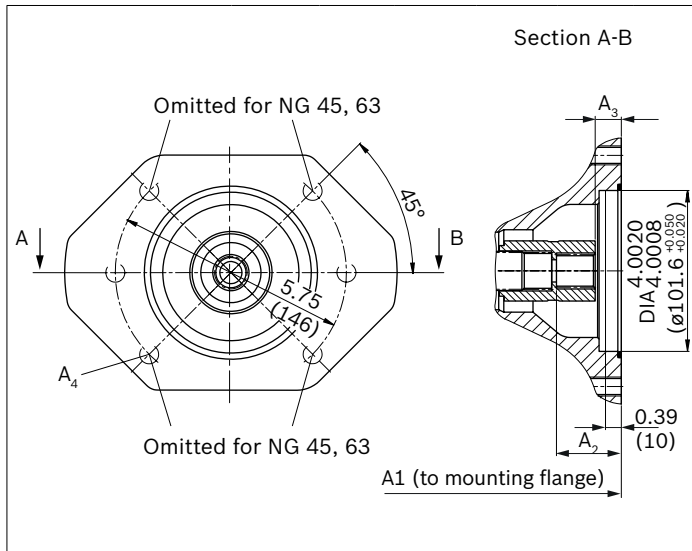
1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Mounting bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the general instructions on page 54 for the maximum tightening torques.

Flange ISO 3019-1 (SAE)		Hub for splined shaft ¹⁾		Availability over sizes				Code
diameter	Symbol 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	A3	A4 ³⁾
	45	8.03 (204)	1.66 (42.3)	0.70 (17.8)	M12×1.75; 0.71 (18) deep
	63	9.02 (229)	1.67 (42.4)	0.71 (17.9)	M12×1.75; 0.71 (18) deep
	85	10.03 (255)	1.67 (42.4)	0.71 (17.9)	M12×1.75; 0.71 (18) deep

K04 (SAE J744 25-4 (B-B))	NG	A1	A2	A3	A4 ³⁾
	63	9.02 (229)	1.88 (47.9)	0.74 (18.9)	M12×1.75; 0.71 (18) deep
	85	10.03 (255)	1.87 (47.4)	0.72 (18.4)	M12×1.75; 0.71 (18) deep

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

2) Mounting bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the general instructions on page 54 for the maximum tightening torques.

Overview of attachment options

Through drive		Attachment of 2nd pump				
Flange ISO 3019-1	Hub for splined shaft	Short code	A10VNO/5x NG (shaft)	A10V(S)O/5x NG (shaft)	A1VO/10 NG (shaft)	External gear
82-2 (A)	5/8 in	K01	–	10 (U), 18 (U)	18 (S2)	Series F
	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)	Series N/G
	1 in	K04	63 (S, R)	45 (S, R) 60, 63 (U, W) ²⁾ 72 (U, W) ²⁾	35 (S5)	

1) Not for NG28 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 of the 1st and 2nd pump must be linked by a "+".

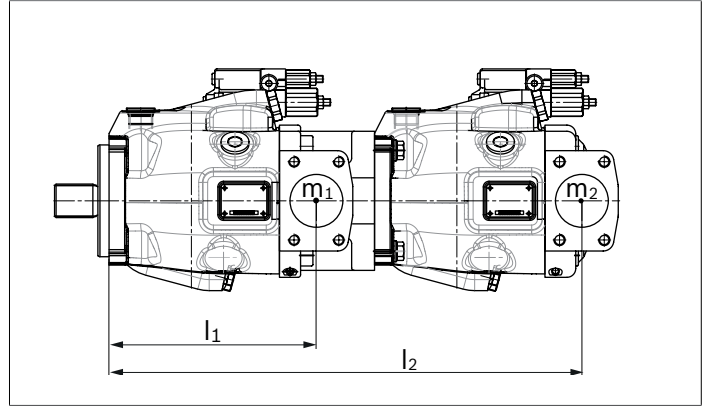
Order example:

A10VNO63DRS/53R-VSC12K04+

A10VNO45DRF/53R-VSC11N00

It is permissible to use a combination of two single pumps of the same nominal 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 (please consult us).



m_1, m_2, m_3	Weight of pump	[lbs (kg)]
l_1, l_2, l_3	Distance, center of gravity	[in (mm)]
$T_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times \frac{1}{12 (102)}$		[lb-ft (Nm)]

Permissible mass moment of inertia

Size			28	45	63	85
static	T_m	lb-ft	-	656	664	1010
		(Nm)	(-)	(890)	(900)	(1370)
dynamic at 10 g (98.1 m/s ²)	T_m	lb-ft	-	65	66	101
		(Nm)	(-)	(89)	(90)	(137)
Weight with through-drive plate	m	lbs (kg)	29 (13)	40 (18)	53 (24)	62 (28)
Weight without through-drive plate (e.g. 2nd pump)		lbs (kg)	25 (11.5)	33 (15)	40 (18)	49 (22)
Distance, center of gravity without through drive	l_1	in	3.07	3.35	3.78	4.13
		(mm)	(78)	(85)	(96)	(105)
Distance, center of gravity with through drive	l_1	in	3.42	3.90	4.53	5.00
		(mm)	(87)	(99)	(115)	(127)

Connector for solenoids

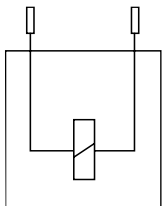
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

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

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

▼ Circuit symbol



▼ Mating connector DEUTSCH DT06-2S-EP04

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.

Note

- ▶ If necessary, you can change the connector orientation by turning the solenoid housing.
- ▶ The procedure can be taken from the instruction manual.

Electronic controls

Control	Electronics function	electronics		Further information
Electric pressure control	Controlled power outlet	RA	analog	95230
		RC4-5/30 ¹⁾	Digital	95205

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 case drain in the case interior must be directed to the reservoir via the highest available drain port (**L**, **L₁²⁾**, **L₂³⁾**). If a shared drain line is used for several units, make sure that the relevant 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 reservoir lines must be laid as required.

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

In all operating conditions, the suction 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 $h_{s \max} = 31.50 \text{ in (800 mm)}$. The minimum suction pressure at port **S** must also not fall below 12 psi (0.8 bar) absolute during operation and during cold start.

When designing the reservoir, ensure that there is sufficient distance between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Note

In certain installation conditions, 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 34.

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.

2) For NG45 and NG63 series 52, **L₁** is opposite, L must then be connected if necessary.

3) Only series 53

Installation position

See the following examples **1** to **12**.

Additional installation positions are available upon request.

Recommended installation position: **1** and **3**

Below-reservoir installation (standard)

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

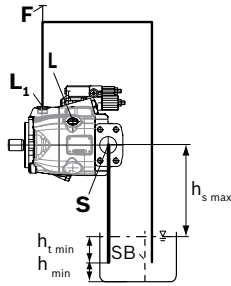
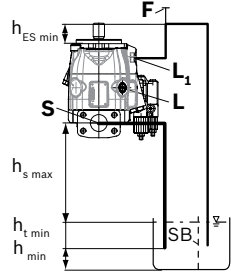
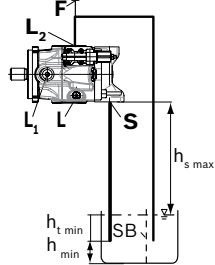
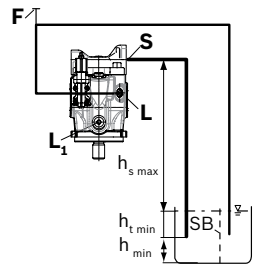
Installation position	Air bleeding	Filling
1 ²⁾	F	S + L or L ₁
2 ¹⁾	F	S + L ₁
3 ³⁾	F	S + L or L ₁
4	F	S + L or L ₁

Above-reservoir installation

Above-reservoir installation means the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining in position 6, the height difference $h_{ES\ min}$ must be at least 0.98 in (25 mm). Observe the maximum permissible suction height $h_{S\ max} = 31.50$ in (800 mm).

A check valve in the drain line is only permissible in individual cases. Consult us for approval.

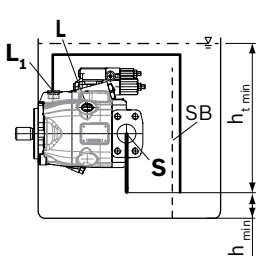
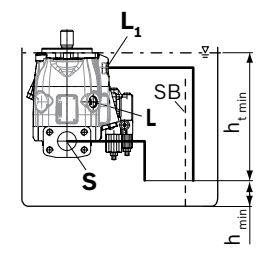
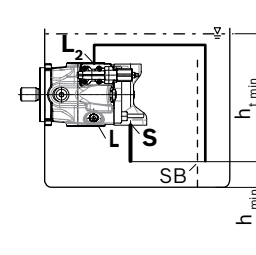
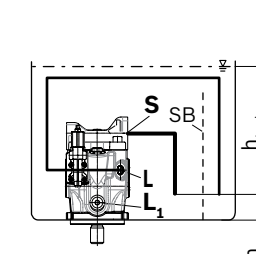
For key, see page 34.

Installation position	Air bleeding	Filling
<p>5²⁾</p> 	F	L ₁ or L
<p>6¹⁾²⁾</p> 	F	L ₁
<p>7³⁾</p> 	F	L ₂
<p>8¹⁾</p> 	F	S or L

- 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.
- 2) For NG45 and NG63 series 52, L₁ is opposite, L must then be connected if necessary.
- 3) Only series 53

Tank 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
<p>g²⁾</p> 	Via the highest available port L	Automatically via the open port L or L₁ due to the position under the hydraulic fluid level
<p>10</p> 	Via the highest available port L₁	Automatically via the open port L , L₁ or S due to the position under the hydraulic fluid level
<p>11³⁾</p> 		
<p>12</p> 	Via the highest available port L	Automatically via the open port L , L₁ or S due to the position under the hydraulic fluid level

Key and assembly note

Key	
F	Filling / air bleeding
S	Suction port
L; L₁, L₂	Tank port
SB	Baffle (baffle plate)
h_{t, min}	Minimum required immersion depth (7.87 in (200 mm))
h_{min}	Minimum required distance to tank base (3.94 in (100 mm))
h_{ES, min}	Minimum necessary height needed to protect the axial piston unit from draining (0.98 in (25 mm)).
h_{s, max}	Maximum permissible suction height (21.50 in (800 mm))

Note

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

- 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.
- 2) For NG45 and NG63 series 52, **L₁** is opposite, **L** must then be connected if necessary.
- 3) Only series 53

- ▶ The A10VNO pump is designed to be used in open circuits.
- ▶ Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- ▶ Before using the axial piston unit, please read the corresponding instruction manual thoroughly and completely.
- ▶ Before finalizing your design, request a binding installation drawing.
- ▶ The specified data and notes must be observed.
- ▶ Pressure controllers are not backups against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- ▶ Depending on the operating condition of the axial piston unit (operating pressure, fluid temperature), the characteristic curve may shift.
- ▶ Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact us.
- ▶ 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.
- ▶ 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 minimize 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.