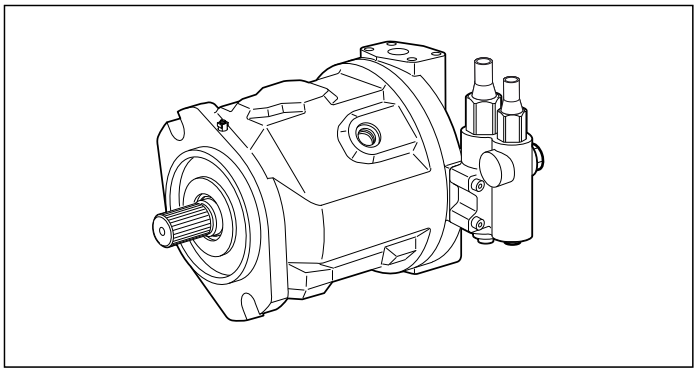
RE 92711-01-x-B2/2019.08.09
Replaces: 01.2017

rexroth
A Bosch Company

Axial piston variable pump A10VSO Series 31

for explosive areas II 2G Ex h IIC T4-T1 Gb X and II 3G Ex h IIC T4-T1 Gc X

Part II of instruction manual in accordance with ATEX Directive 2014/34/EU data sheet



- Sizes 18 to 100
- Nominal pressure 280 bar
- Maximum pressure 350 bar
- For industrial applications
- Open circuit

Explosion protection parameters

- Application per Directive 2014/34/EU (ATEX)
- Gas: II 2G Ex h IIC T4-T1 Gb X
  according to DIN EN ISO 80079-36 :2016,
  DIN EN ISO 80079-37:2016
- Gas: II 3G Ex h IIC T4-T1 Gc X
  according to DIN EN ISO 80079-36 :2016,
  DIN EN ISO 80079-37:2016

Features

- Variable displacement pump with axial piston rotary group of swashplate design for hydrostatic drives in open circuit
- Flow is proportional to the drive speed and displacement.
- Flow can be infinitely varied by controlling the swashplate angle.
- Hydrostatically unloaded cradle bearing
- Low noise level
- 2 leakage ports
- Excellent suction characteristics
- Long service life
- Good power to weight ratio
- Versatile controller range
- Short control time
- Through drive possibility to pump the same nominal size

Contents

Type code

01	02	03	04		05	06		07	08	09	10	11	12
A10VS	**O**			**/**	**31**		**–**						

Version

01	Standard version (without symbol)	

Axial piston unit

01	Swashplate design, variable, nominal pressure 280 bar, maximum pressure 350 bar	**A10VS**

Operating mode

02	Pump, open circuit	**O**

Sizes (NG)

03	Geometric displacement, see "Technical data" on page 7			**18**	**28**	**45**	**71**	**100**

Control devices

04	Two-point control, direct operated			●	●	●	●	●	**DG**
	Pressure controller	hydraulic		●	●	●	●	●	**DR**
	remote controlled	hydraulic		●	●	●	●	●	**DRG**
	with flow controller	hydraulic	X-T open	●	●	●	●	●	**DFR**
			X-T plugged	●	●	●	●	●	**DFR1**
	Pressure, flow and power controller			–	●	●	●	●	**DFLR**

Series

05	Series 3, index 1	**31**

Directions of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material and ATEX version

07	FKM (fluoroelastomer) and ATEX version II 2G Ex h IIC T4-T1 Gb X	**R**
	FKM (fluoroelastomer) and ATEX version II 3G Ex h IIC T4-T1 Gc X	**A**

Drive shafts

08	Parallel keyed shaft DIN 6885 limited suitability for through drive		●	●	●	●	●	**P**
	Splined shaft	Standard shaft	●	●	●	●	●	**S**
	ANSI B92.1a	same as shaft "S", but for higher torque	●	●	●	●	–	**R**

Mounting flange

09	ISO 3019-2	2-hole	●	●	●	●	●	**A**

Working port			**18**	**28**	**45**	**71**	**100**	
10	SAE flange ports, laterally opposite		●	●	●	–	●	**12**
	fastening thread, metric		–	–	–	●	–	**42**

Type code

01	02	03	04		05	06		07	08	09	10	11	12
A10VS	**O**			**/**	**31**		**–**						

Through drives[1] (for mounting options, see page 36)

11	Flange ISO 3019-2		Hub for splined shaft[2]							
	Diameter	Mounting[3]	Diameter		**18**	**28**	**45**	**71**	**100**	
	without through drive				●	●	●	●	●	**N00**
	ISO 80, 2-hole		3/4 in	11T 16/32DP	●	●	●	●	●	**KB2**
	ISO 100, 2-hole		7/8 in	13T 16/32DP	–	●	●	●	●	**KB3**
			1 in	15T 16/32DP	–	–	●	●	●	**KB4**
	ISO 125, 2-hole		1 1/4 in	14T 12/24DP	–	–	–	●	●	**KB5**
			1 1/2 in	17T 24/24DP	–	–	–	–	●	**KB6**
	ø 63, metric 4-hole		Shaft key ø25		–	●	●	●	●	**K57**
	Flange ISO 3019-1		Hub for splined shaft							
	Diameter		Diameter							
	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**
	127-2 (C)		1 1/2 in	17T12/24DP	–	–	–	–	●	**K24**

● = Available ○ = On request – = Not available

Notices
Note the project planning notes on page 38.
In addition to the type code, please specify the relevant technical data when placing your order.

Features of the ATEX version
The ATEX version is an advanced development of the A10VSO for compliance with Directive 2014/34/EU (ATEX). External features distinguishing it from the standard pump 92711 are the ground terminal, the Ex marking and the CE marking on the name plate.

Temperature classes per DIN EN ISO 80079-36
Depending on the temperature class T4, the maximum permissible temperature is to be observed (see "hydraulic fluid" and "Monitoring the operational data - X parameters").

Notices
ATEX classification: When ordering, please state which equipment group, category, explosion group, temperature class and ignition protection type are required for your planned ATEX application.
Technical data: Compared to the standard pump, restrictions apply in terms of temperature, case pressure and bearing flushing/installation position.
Painting/color selection: In order to avoid mechanically generated sparks from foreign particles made of aluminum with iron oxide and/or particles of rust of the surface[4], the pump is painted as standard with corrosion protecting. Please contact your Rexroth partner for available colors.
Bearing service life: The bearing service life must be calculated. The load cycle forms the basis for this. Please contact us.
Potential equalization: The pump must be grounded. For grounding points, please refer to the drawings starting on page 15.

1) All attachment pumps must match the ATEX classification for the application in question.
2) According to ANSI B92.1a (splined shafts according to SAE J744)
3) Arrangement of the mounting holes, viewed from through drive with control upwards
4) See DIN EN ISO 80079-36, 6.4.2.1

Hydraulic fluids

The Axial piston variable pump A10VSO 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

Information on the selection of hydraulic fluid
Selection of hydraulic fluid shall make sure that the operating viscosity in the operating temperature range is within the optimum range (v_{opt}; see selection diagram).

Please note
The leakage temperature which is influenced by pressure and rotational speed is always above the reservoir temperature.

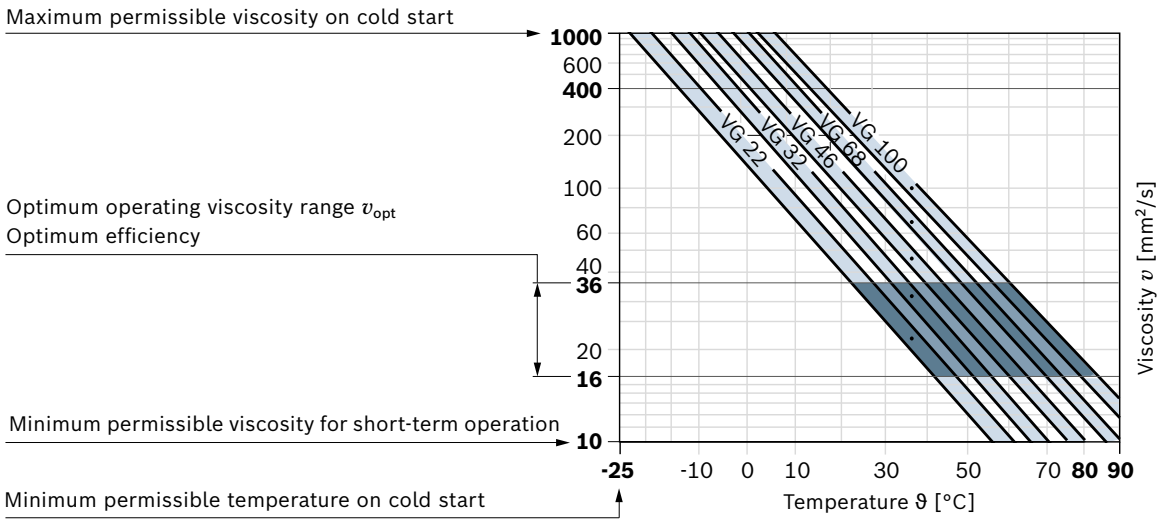
ATEX Temperature Class T4-T1:
Safety instructions, see page 5 "Operating data monitoring – X parameters"

Ignition temperature of hydraulic fluid
The pump is approved for temperature class T4 to T1 according to DIN EN ISO 80079-36.
Under DIN EN ISO 80079-37, only hydraulic fluids with an ignition temperature at least 50 K above the maximum surface temperature of the approved temperature class should be used. Example: if temperature class T4 is required during application, the ignition temperature of the hydraulic fluid should be ≥ 185 °C.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Maximum permissible temperature difference between axial piston unit	v_{max} ≤ 1600 mm²/s	ϑ_{St} ≥ -25 °C	t ≤ 3 minimum without load p ≤ 50 bar Maximum permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
and hydraulic fluid in the system maximum 25 K	v = 1600 to 400 mm²/s	ϑ ≥ -25 °C	For p_{nom}, 0.5 × n_{max} and t ≤ 15 min
Continuous operation	v = 400 to 10 mm²/s	ϑ = -25 °C to +90 °C	measured at drain port **L** Observe the permissible temperature range of the shaft seal
	v_{opt} = 36 to 16 mm²/s		optimal operating viscosity and efficiency range
Short-term operation	v_{min} ≤ 10 mm²/s	ϑ = -25 °C to +90 °C	t < 3 min, p < 0.3 × p_{nom}

▼ **Selection diagram**



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 under ISO 4406 should be maintained.

At a hydraulic fluid viscosity of less than 10 mm^2/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 mm^2/s at:

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

Operating data monitoring – X parameters

- Ambient temperature Ta: -20 °C to +40 °C

Safety instructions: Temperature class T4–T1
ATEX category II 3G Ex h IIC T4–T1 Gc X

To observe the **maximum leakage temperature of 90 °C**, at least one of the following measures must be taken and checked regularly:

- Check the leakage temperature at port **L** (maximum distance 30 cm)
- Check the maximum inlet temperature of 50 °C at the suction port
- Check a maximum inlet temperature that must be determined for the following operating points when commissioning:
  - maximum working pressure and maximum possible flow
  - maximum working pressure and minimum flow

Also monitor the reservoir level. Take appropriate action if the temperature exceeds limits.

ATEX category II 2G Ex h IIC T4–T1 Gb X

To observe the **maximum leakage temperature of 90 °C**, the following measures must be taken:

- Continuously monitor leakage temperature at each pump with a temperature sensor on ports **L** (maximum distance to port 30 cm).
- Connect the temperature sensor with a switching-off for the system at the limit temperature of 90 °C.
- This shut-off function should be tested during commissioning; see chapter 8.1.2 of the instruction manual.

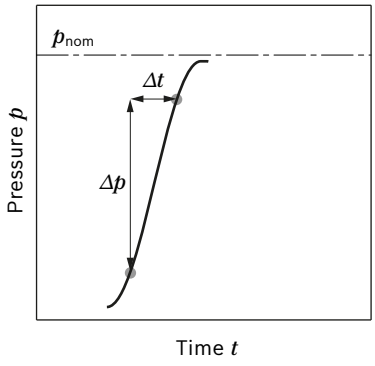
Reservoir level monitoring is also required.

Manufacturer-specific installation instructions can be found in the instruction manual 92701-01-x-B1 as of chapter "7.3 Installation position"

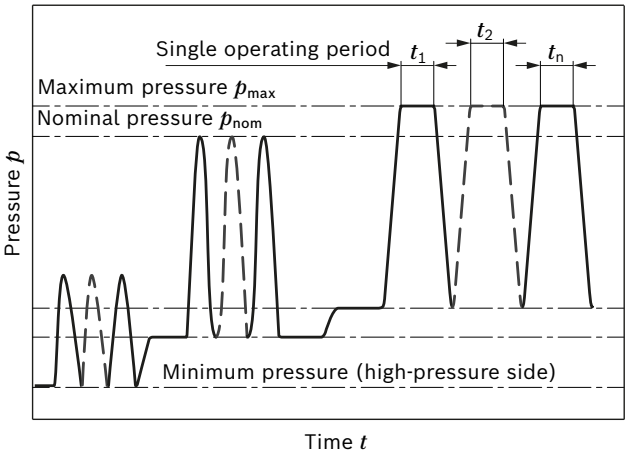
Working pressure range

Pressure at working port B		**Definition**
Nominal pressure p_{nom}	280 bar abs.	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	350 bar abs.	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 (high-pressure side)	10 bar[1] abs.	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$	16000 bar/s	Maximum permissible pressure build-up and reduction speed during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\,min}$ **Standard**	0.8 bar abs.	Minimum pressure at suction port **S** (inlet) which is required to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Maximum pressure $p_{S\,max}$	10 bar[2] absolute	
Leakage pressure at port L, L_1		
Maximum pressure $p_{L\,max}$	2 bar abs.	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{L\,max}$. A case drain line to the reservoir is required.

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



▼ **Pressure definition**



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

Notice
Working pressure range applies when using hydraulic fluids based on mineral oils.

1) Lower pressure is time-dependent, please contact us
2) Other values on request

Technical data

Standard rotary group

Size		NG		18	28	45	71	100
Geometric displacement, per revolution		$V_{g\,max}$	cm^3	18	28	45	71	100
Maximum rotational speed[1]	at $V_{g\,max}$	n_{nom}	rpm	3300	3000	2600	2200	2000
Flow	at n_{nom} and $V_{g\,max}$	q_v	l/min	59	84	117	156	200
	at n_E = 1500 rpm	q_{vE}	l/min	27	42	68	107	150
Power	at n_{nom}, $V_{g\,max}$ and Δp = 280 bar	P	kW	28	39	55	73	93
	at n_E = 1500 rpm	P_E	kW	12.6	20	32	50	70
Torque	at $V_{g\,max}$ and Δp = 280 bar	T	Nm	80	125	200	316	445
	at $V_{g\,max}$ and Δp = 100 bar	T	Nm	30	45	72	113	159
Rotary stiffness Drive shaft	S	c	Nm/rad	11087	22317	37500	71884	121142
	R	c	Nm/rad	14850	26360	41025	76545	–
	P	c	Nm/rad	13158	25656	41232	80627	132335
Moment of inertia of the rotary group		J_{TW}	kgm^2	0.00093	0.0017	0.0033	0.0083	0.0167
Maximum angular acceleration[2]		α	rad/s^2	6800	5500	4000	2900	2400
Case volume		V	L	0.4	0.7	1.0	1.6	2.2
Weight (approx.)		m	kg	12	15	21	33	45

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

Key

V_g	=	Displacement per revolution [cm^3]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{mh}	=	Mechanical-hydraulic efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Notice

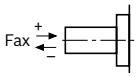
Theoretical values, without efficiency and tolerances; values rounded

Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit and a loss of the explosion protection. We recommend checking the loads by means of a test or calculation / simulation and comparison with the permissible values.

1) The values are applicable:
- for the optimum viscosity range from ν_{opt} = 36 to 16 mm^2/s
- with hydraulic fluid on the basis of mineral oils
- at an abs. pressure p_{abs} = 1.0 bar at the suction port **S**

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

Permissible radial and axial loading of the drive shaft

Size		NG		18	28	45	71	100
Maximum radial force at a/2		$F_{q\ max}$	N	350	1200	1500	1900	2300
Maximum axial force		$\pm F_{ax\ max}$	N	700	1000	1500	2400	4000

Notice

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

Permissible drive and through-drive torques

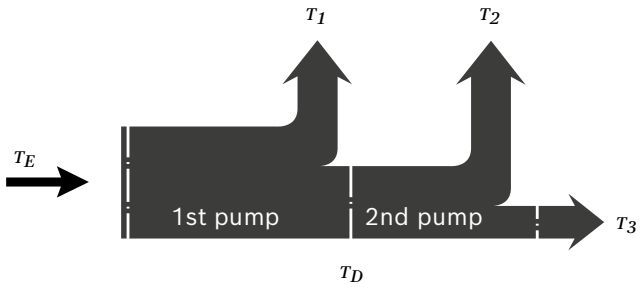
The axial piston unit can be delivered with a through drive, as shown in the type code on page 2.
The through drive version is identified by the code K01...KB06.

It is advisable to couple no more than three single pumps in series.
For pump combinations, the maximum input torque must not be exceeded.
All attachment pumps must match the ATEX classification for the application in question.

Permissible input and through-drive torques

Size				18	28	45	71	100
Torque at $V_{g\,max}$ and Δp = 280 bar[1]		T_{max}	Nm	80	125	200	316	445
Maximum input torque on drive shaft[2]								
	P	$T_{E\,max}$	Nm	88	137	200	439	857
		Ø	mm	18	22	25	32	40
	S	$T_{E\,max}$	Nm	124	198	319	626	1104
		Ø	in	3/4	7/8	1	1 1/4	1 1/2
	R	$T_{E\,max}$	Nm	160	250	400	644	–
		Ø	in	3/4	7/8	1	1 1/4	–
Maximum through-drive torque								
	P	$T_{D\,max}$	Nm	88	137	200	439	778
	S	$T_{D\,max}$	Nm	108	160	319	492	778
	R	$T_{D\,max}$	Nm	120	176	365	548	–

▼ **Distribution of torques**



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	<	$T_{D\,max}$

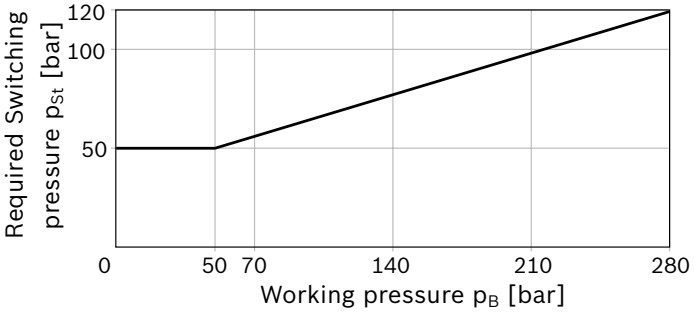
1) Efficiency not considered
2) For drive shafts with no radial force

DG – Two-point control, directly operated

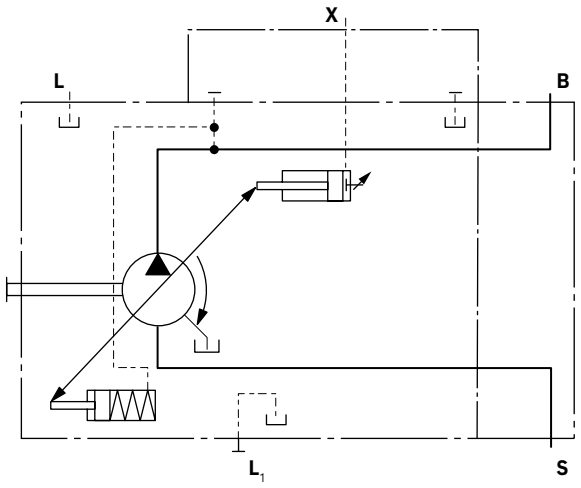
The variable pump can be set to a minimum swivel angle by connecting an external switching pressure to port **X.** This will supply control fluid directly to the stroking piston; a minimum pressure of $p_{st} \geq 50$ bar is required.
The variable pump can only be switched between $V_{g\,min}$ and $V_{g\,max}$
Please note, that the required switching pressure at port **X** is directly dependent on the actual working pressure p_B at port **B.** (See switching pressure characteristic curve).
The maximum permissible switching pressure is 280 bar.

- Switching pressure p_{ST} in X= 0 bar ≙ $V_{g\,max}$
- Switching pressure p_{ST} in X≥ 50 bar ≙ $V_{g\,min}$

▼ **Switching pressure characteristic curve**



▼ **Circuit diagram DG**

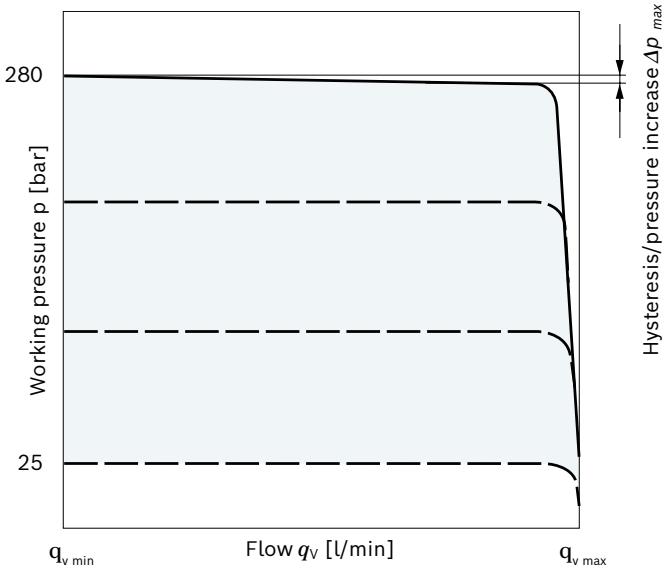


DR – Pressure controller

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.

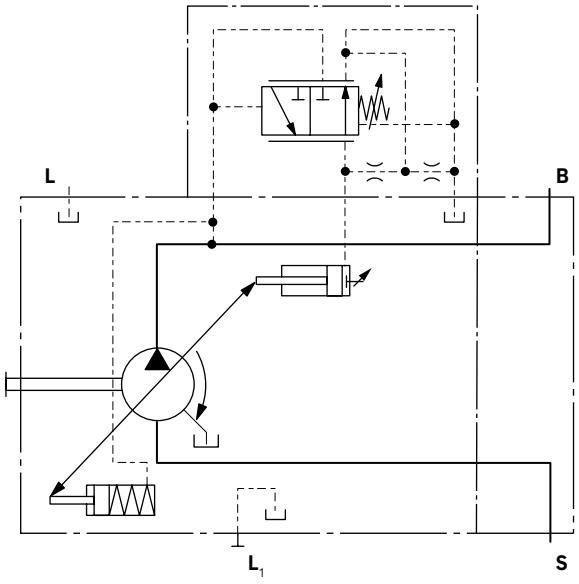
- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1)] for pressure control 25 to 280 bar. Standard is 280 bar.

▼ **Characteristic curve DR**



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

▼ **Circuit diagram DR nominal size 18 to 100**



Controller data

NG		18	28	45	71	100
Pressure increase maximum	Δp [bar]	4	4	6	8	10
Hysteresis and repeated accuracy	Δp [bar]	maximum 3				
Control 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 10.

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 another setting is required (range from 10-22 bar) please state in plain text.

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

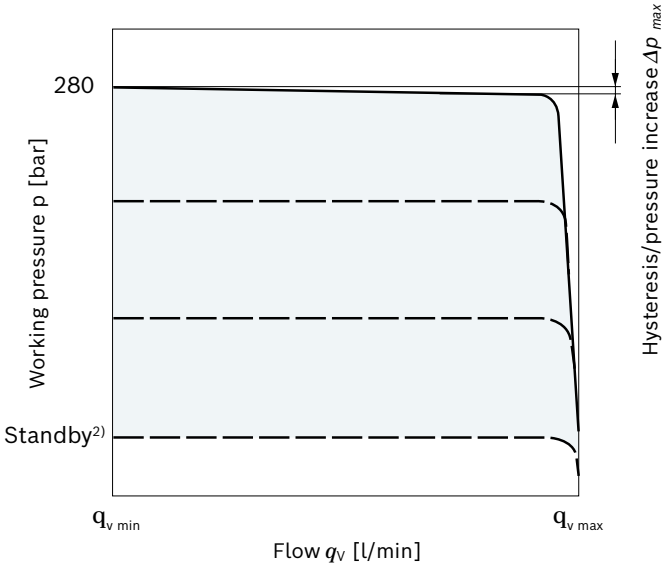
- a direct operated, hydraulic or electric proportional one, suitable for the control fluid mentioned above.

The maximum line length should not exceed 2 m.

- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1] for pressure control 20 to 280 bar (**3**). Standard is 280 bar.
- Setting range for differential pressure 10 - 22 bar (**2**) Standard is 20 bar.

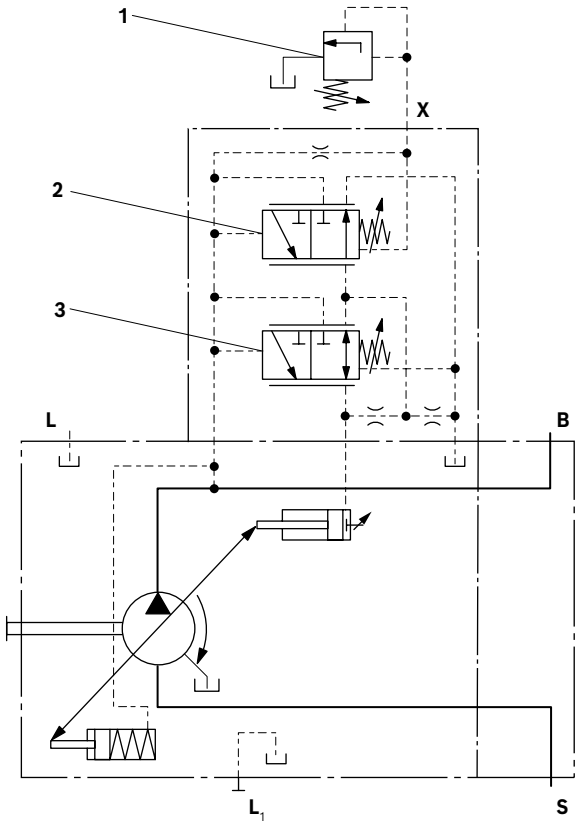
Relieving the load on port **X** to the reservoir results in a zero stroke pressure ("standby") pressure which lies about 1 to 2 bar higher than the differential pressure Δp, however, other system influences are not taken into account.

▼ **Characteristic curve DRG**



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

▼ **Circuit diagram DRG nominal size 18 to 100**



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

NG		18	28	45	71	100
Pressure increase maximum	Δp [bar]	4	4	6	8	10
Hysteresis and repeated accuracy	Δp [bar]	maximum 3				
Control fluid consumption	l/min	maximum approx. 3				

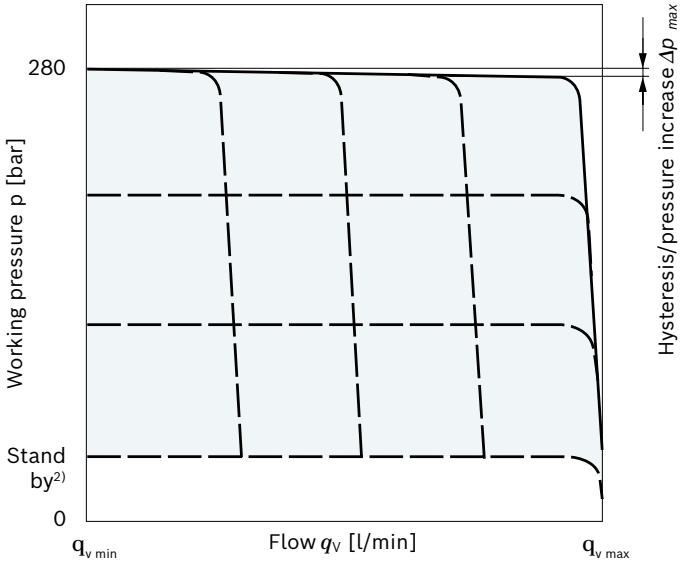
1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.
2) Zero stroke pressure from differential pressure setting Δp on controller (**2**)

DFR/DFR1 – Pressure flow controller

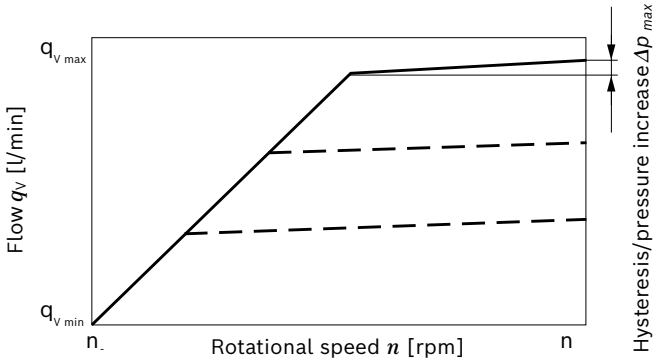
In addition to the pressure controller function (see page 10), an adjustable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual hydraulic fluid quantity required 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 280 bar.
  Standard is 280 bar.
- Pressure controller DR data see page 10.

▼ **Characteristic curve DRF/DRS**

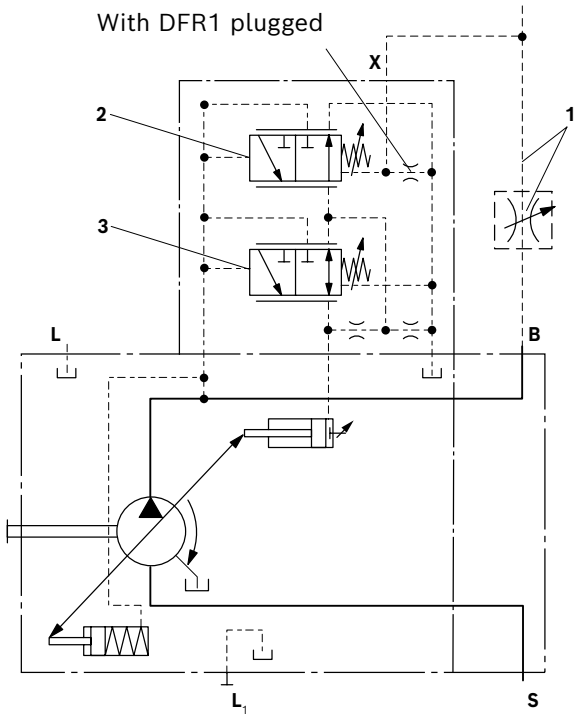


▼ **Characteristic curve at variable rotational speed**



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

▼ **Circuit diagram DFR size 18 to 100**



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

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 on port **X** to the reservoir results in a zero stroke pressure ("standby") pressure which lies about 1 to 2 bar higher than the differential pressure Δp, however, other system influences are not taken into account.

Controller data

DR pressure controller data see page 10

Maximum flow deviation measured at drive speed n = 1500 rpm.

NG		18	28	45	71	100
Pressure increase, maximum	Δp [bar]	4	4	6	8	10
Hysteresis and repeat accuracy	Δp [bar]	maximum 3				
Pilot fluid consumption	l/min	DFR maximum approx. 3 to 4.5 DFR1 maximum approx. 3				
Flow deviation	$\Delta q_{V\,max}$ [l/min]	0.9	1.0	1.8	2.8	4.0

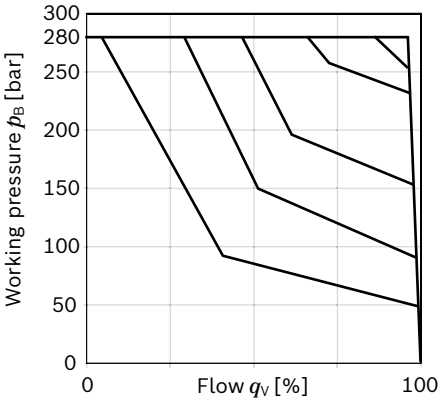
DFLR – Pressure, flow and power controller

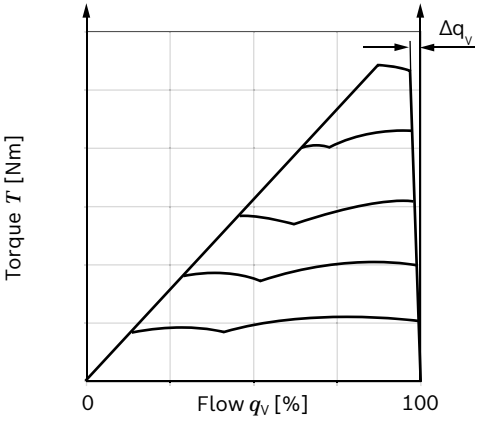
Pressure controller equipped as DR(G),
see page 10 (11).
Equipment of the flow controller like DFR1,
see page 12.
In order to achieve a constant drive torque with varying working pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant. Flow control is possible below the power control curve. When ordering please state the power characteristics to be set at the factory in plain text, e.g. 20 kW at 1500 rpm.

Controller data

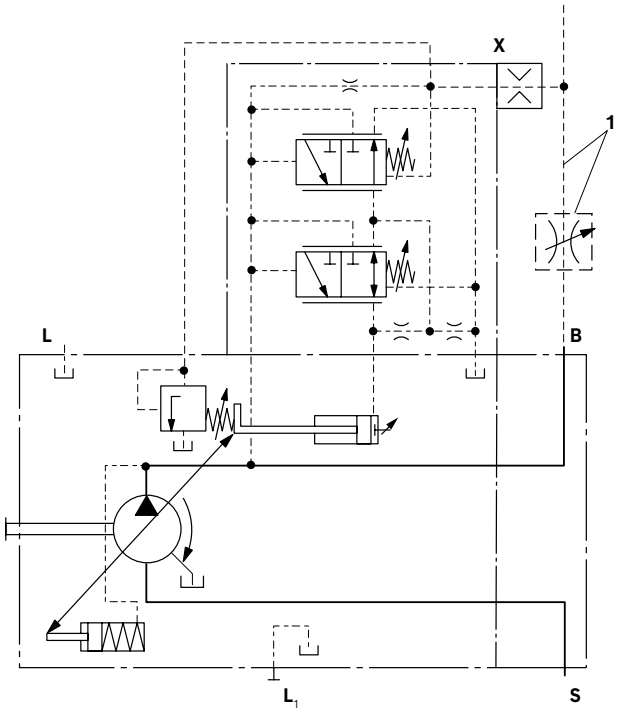
For technical data of pressure controller DR see page 10.
For technical data of flow controller FR see page 12.
Pilot fluid consumption maximum approx. 5.5 l/min.
Beginning of control 50 bar

▼ **Characteristic curve DFLR**





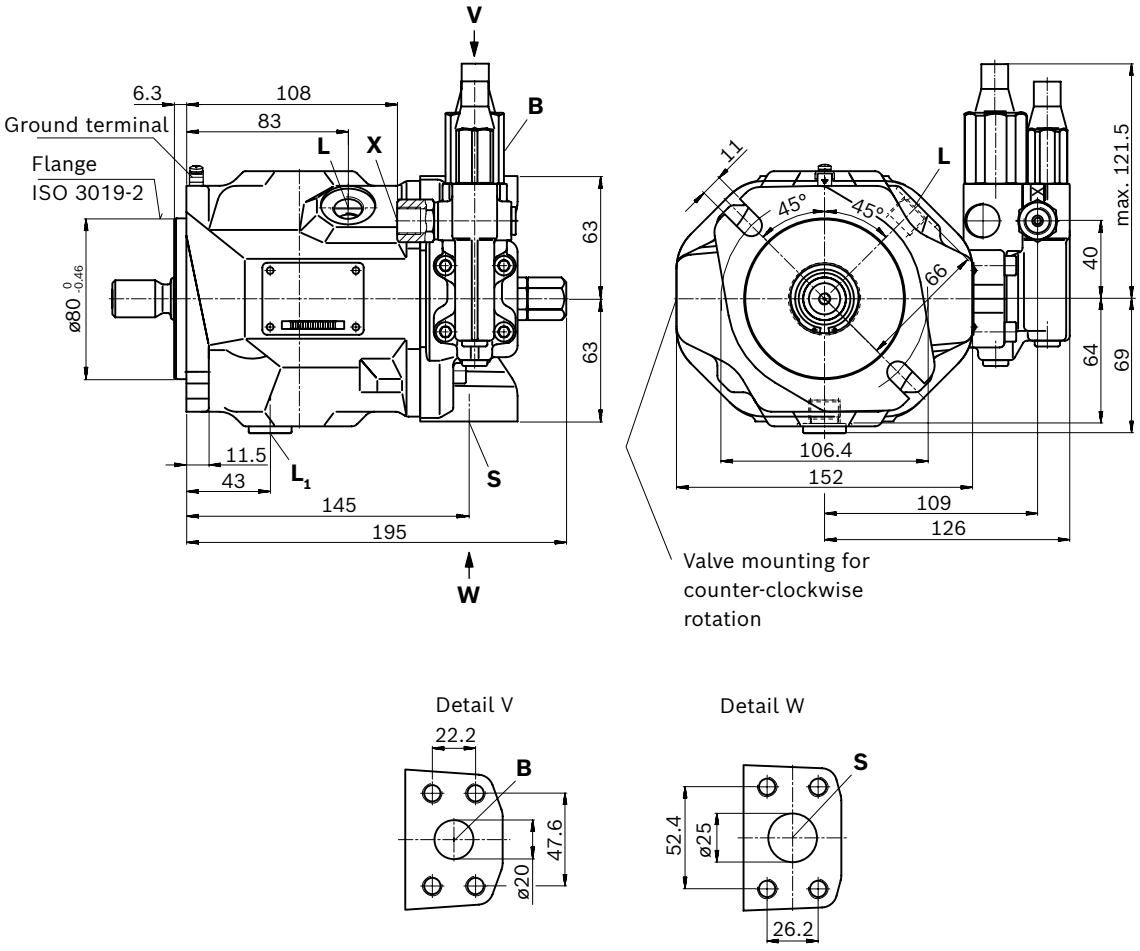
▼ **Circuit diagram DFLR nominal size 28 to 100**



1 Metering orifice
is not included in the scope of delivery.

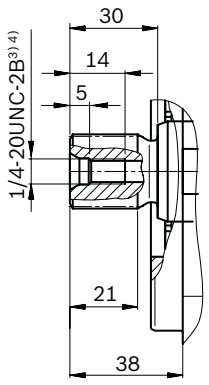
Dimensions, size 18

DFR/DFR1 – Pressure flow controller



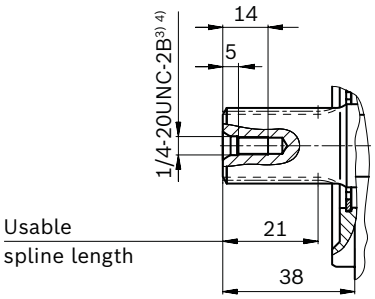
▼ **Splined shaft 3/4 in (SAE J744)**

S – 11T 16/32DP[1)]



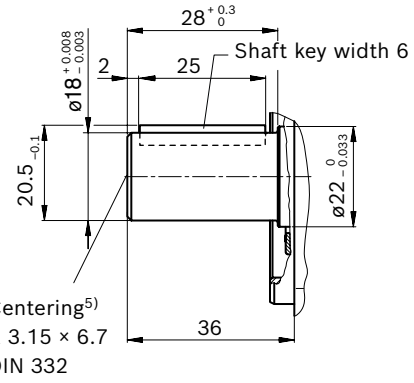
▼ **Splined shaft 3/4 in (SAE J744)**

R – 11T 16/32DP[1)2)]



▼ **Parallel keyed shaft DIN 6885**

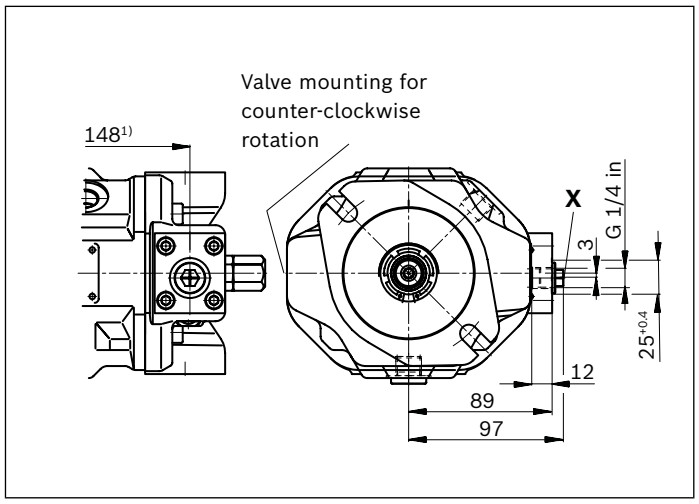
P – A6 × 6 × 25



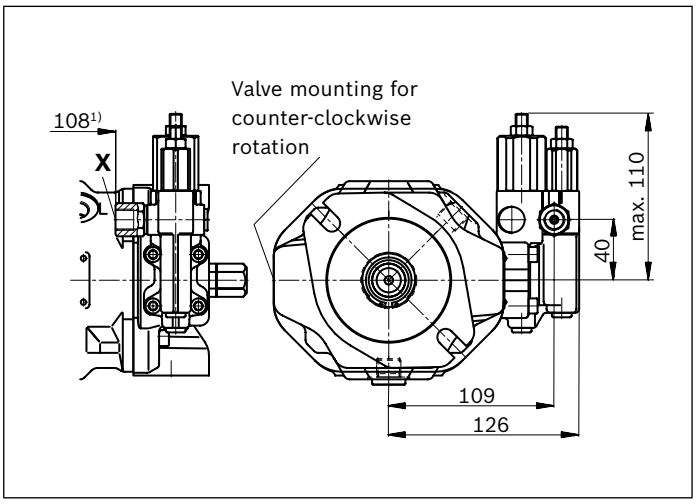
Ports		Standard	Size[4)]	$p_{max\ abs}$ [bar][6)]	State[10)]
B	Working port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	3/4 in M10×*1*.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	1 in M10×*1*.5; 17 deep	10	O
L	Drain port	DIN 3852[8)]	M16 × 1.5; 12 deep	2	O[9)]
L_1	Drain port	DIN 3852[8)]	M16 × 1.5; 12 deep	2	X[9)]
X	Pilot pressure port	DIN 3852[8)]	M14 × 1.5; 12 deep	350	O
X	Pilot pressure port with DG-control	DIN ISO 228[8)]	G1/4 in; 12 deep	350	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.
3) Thread according to ASME B1.1
4) Observe the general notices on page 38 concerning the maximum tightening torques.
5) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
7) Metric fastening thread is a deviation from standard.
8) The countersink may be deeper than specified in the standard.
9) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting in part I).
10) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

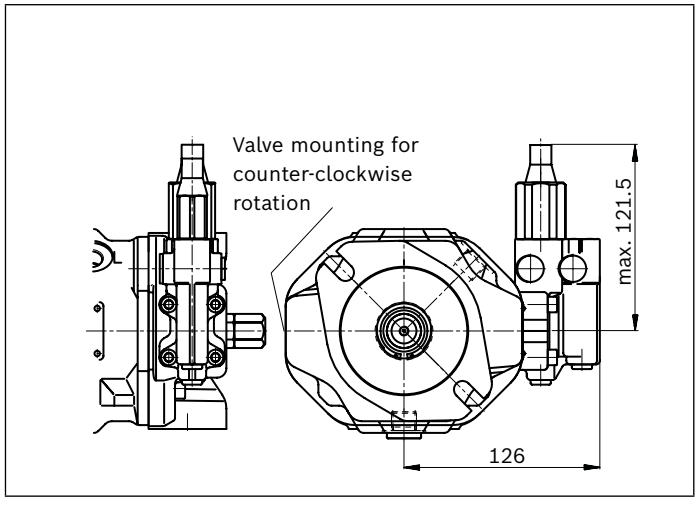
▼ **DG – Two-point control, direct operated**



▼ **DRG – pressure controller, remotely controlled**



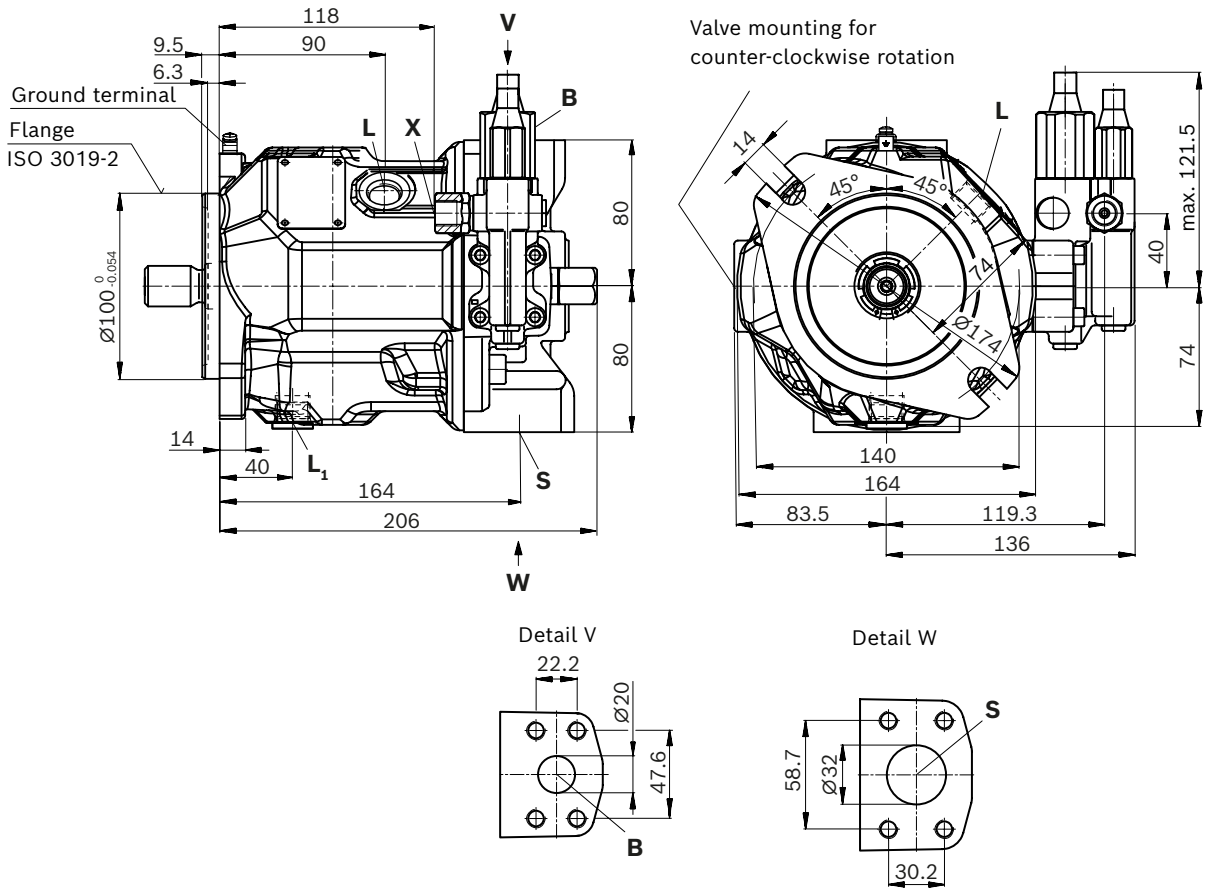
▼ **DR – Pressure controller**



1) To flange surface

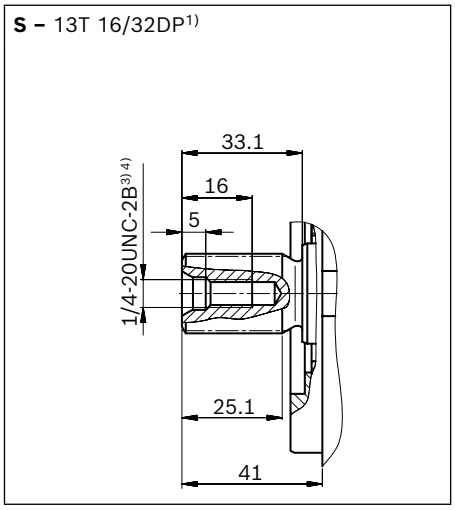
Dimensions, size 28

DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation



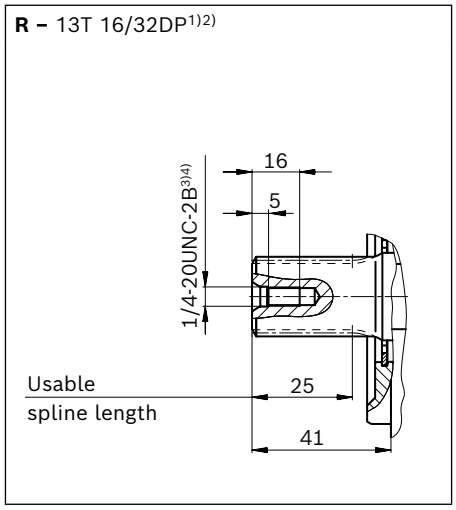
▼ **Splined shaft 7/8 in (SAE J744)**

S – 13T 16/32DP[1)]



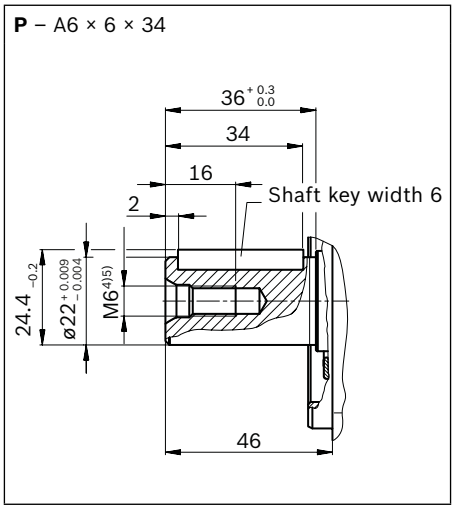
▼ **Splined shaft 7/8 in (SAE J744)**

R – 13T 16/32DP[1)2)]



▼ **Cylindrical shaft with shaft key (DIN 6885)**

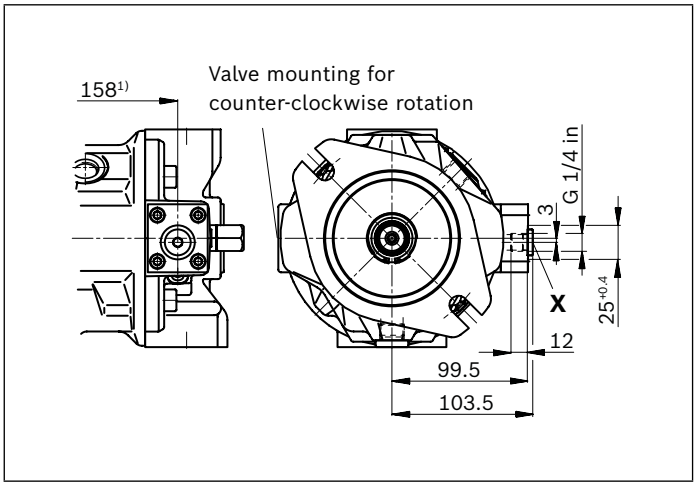
P – A6 × 6 × 34



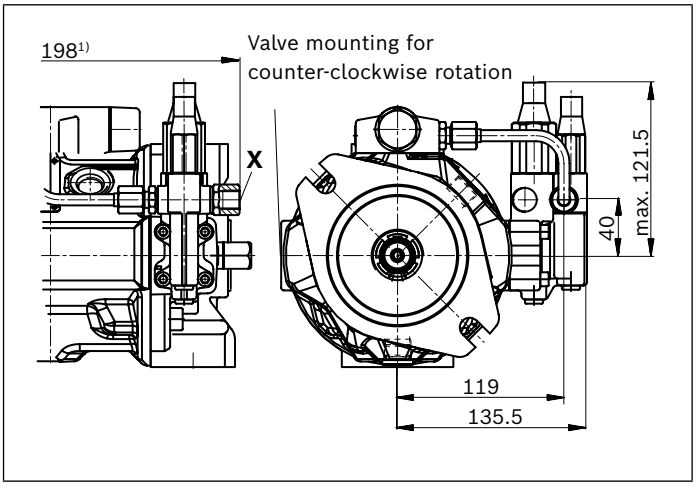
Ports		Standard	Size[4)]	$p_{max\ abs}$ [bar][6)]	State[10)]
B	Working port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	3/4 in M10×*1*.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	1 1/4 in M10×*1*.5; 17 deep	10	O
L	Drain port	DIN 3852[8)]	M18 × 1.5; 12 deep	2	O[9)]
L_1	Drain port	DIN 3852[8)]	M18 × 1.5; 12 deep	2	X[9)]
X	Pilot pressure port	DIN 3852[8)]	M14 × 1.5; 12 deep	350	O
X	Pilot pressure port with DG-control	DIN ISO 228[8)]	G1/4 in; 12 deep	350	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.
3) Thread according to ASME B1.1
4) For notices on tightening torques, see the instruction manual.
5) Thread according to DIN 13
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
7) Metric fastening thread is a deviation from standard.
8) The countersink may be deeper than specified in the standard.
9) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 44).
10) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

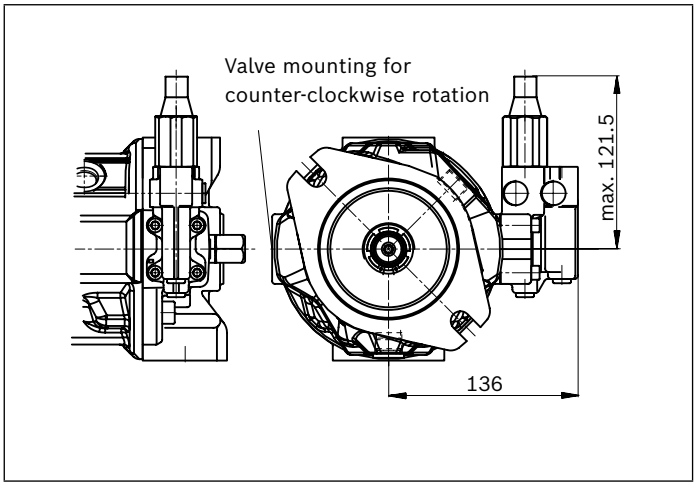
▼ **DG – Two-point control, direct operated**



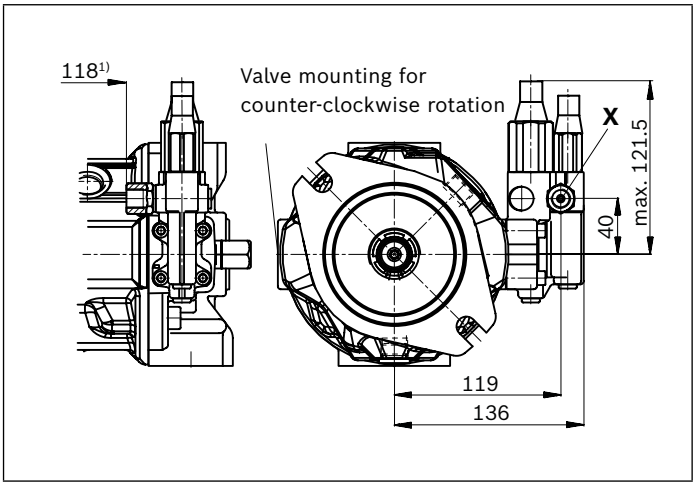
▼ **DFLR – Pressure, flow and power controller**



▼ **DR – Pressure controller**



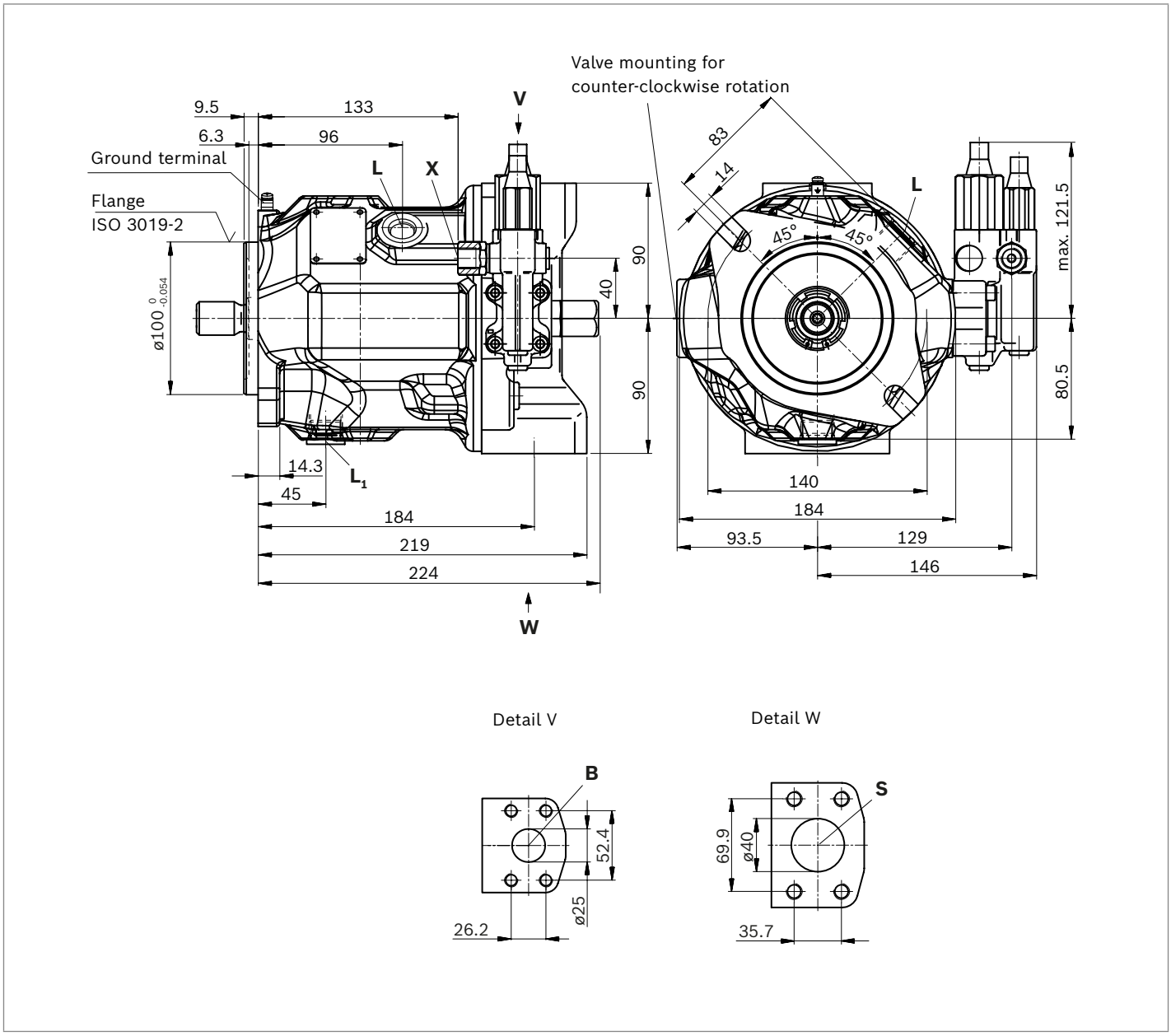
▼ **DRG – Pressure controller, remotely controlled**



1) To flange surface

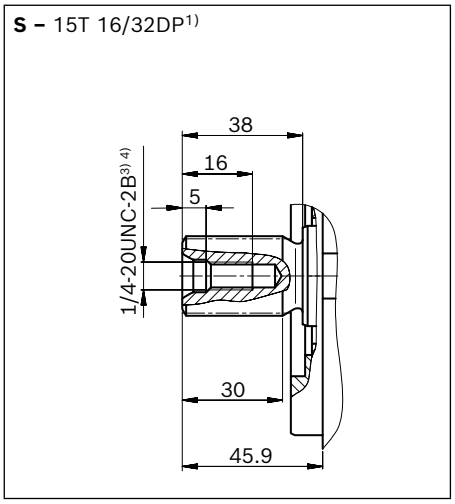
Dimensions, size 45

DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation



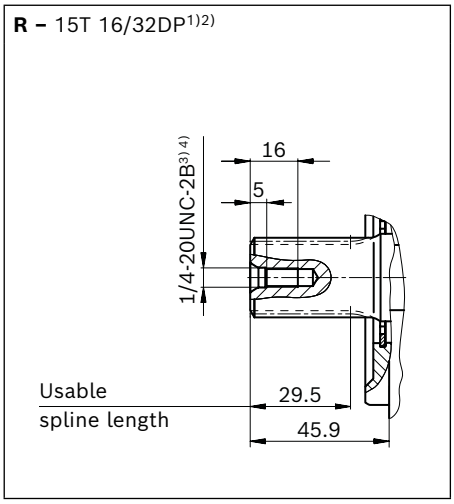
▼ **Splined shaft 1 in (SAE J744)**

S – 15T 16/32DP[1)]



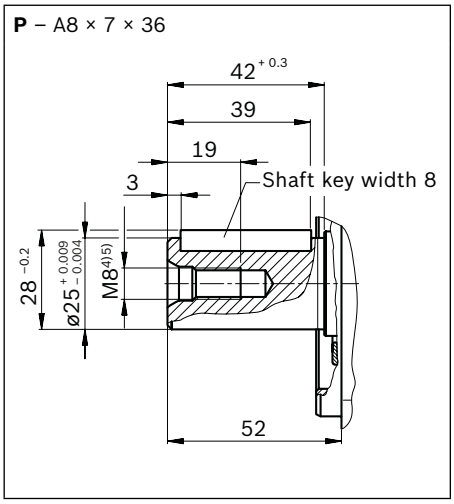
▼ **Splined shaft 1 in (SAE J744)**

R – 15T 16/32DP[1)2)]



▼ **Cylindrical shaft with shaft key (DIN 6885)**

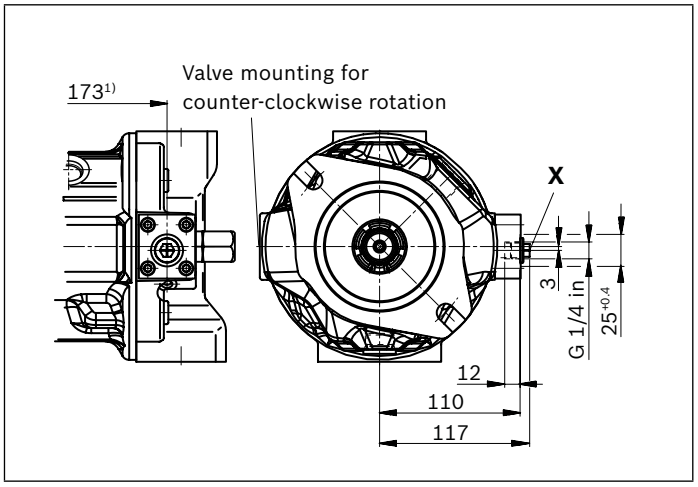
P – A8 × 7 × 36



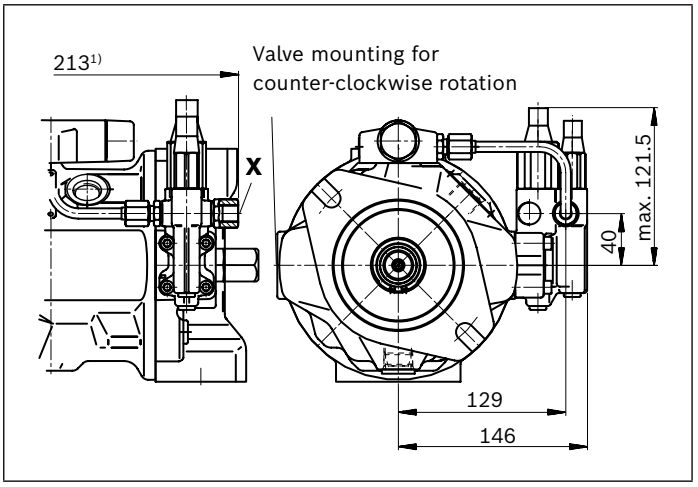
Ports		Standard	Size[4)]	$p_{max\ abs}$ [bar][6)]	State[10)]
B	Working port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	1 in M10×*1.5*; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	1 1/2 in M12 × 1.75; 20 deep	10	O
L	Drain port	DIN 3852[8)]	M22 × 1.5; 14 deep	2	O[9)]
L_1	Drain port	DIN 3852[8)]	M14 × 1.5; 14 deep	2	X[9)]
X	Pilot pressure port	DIN 3852[8)]	M14 × 1.5; 12 deep	350	O
X	Pilot pressure port with DG-control	DIN ISO 228[8)]	G1/4 in; 12 deep	350	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.
3) Thread according to ASME B1.1
4) For notices on tightening torques, see the instruction manual.
5) Thread according to DIN 13
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
7) Metric fastening thread is a deviation from standard.
8) The countersink may be deeper than specified in the standard.
9) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 44).
10) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

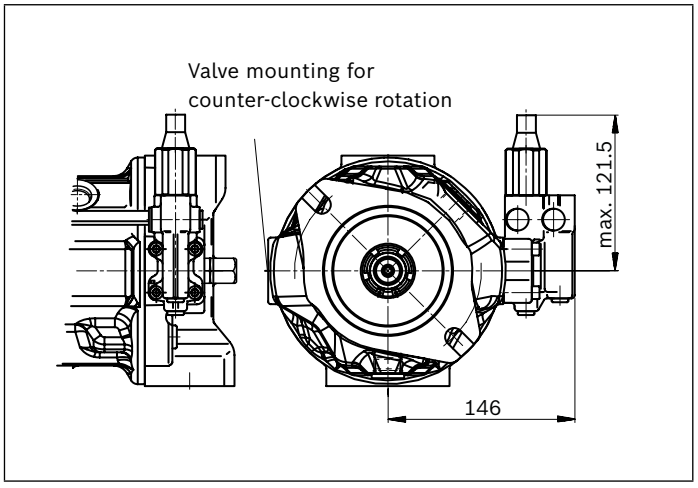
▼ **DG – Two-point control, direct operated**



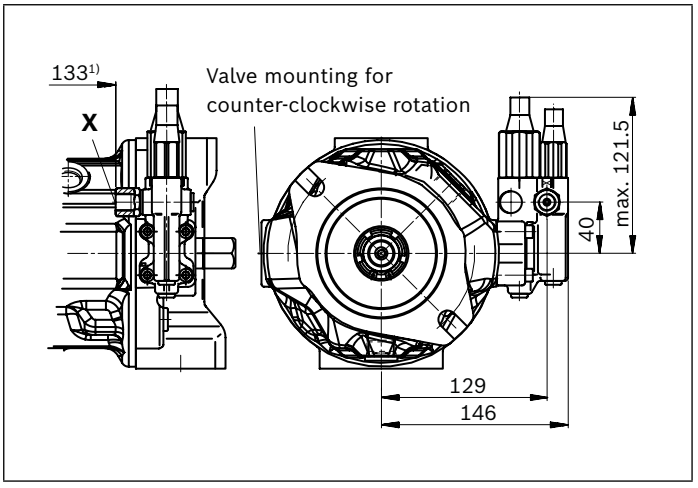
▼ **DFLR – Pressure, flow and power controller**



▼ **DR – Pressure controller**



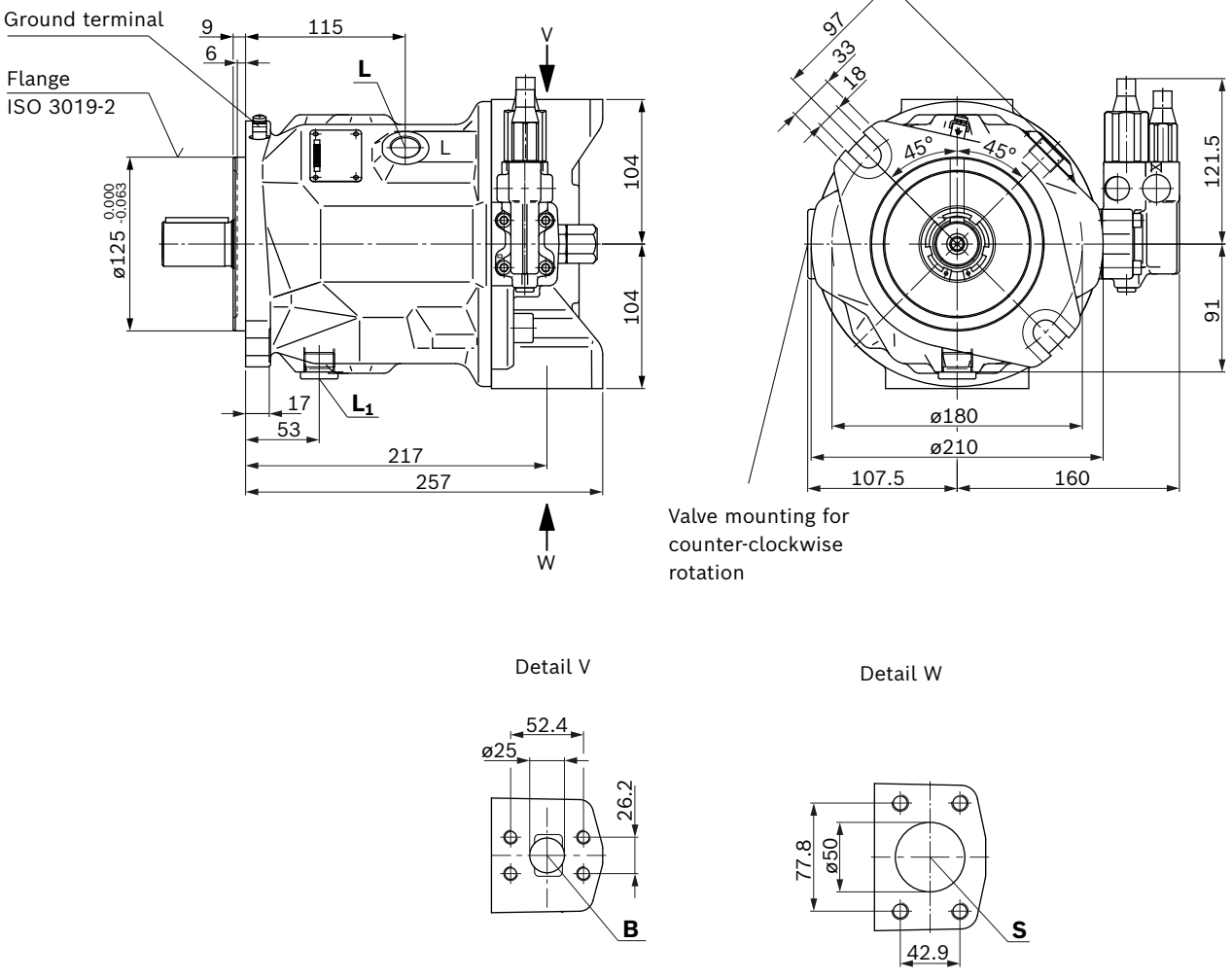
▼ **DRG – Pressure controller, remotely controlled**



1) To flange surface

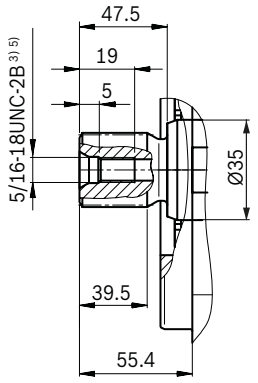
Dimensions, size 71

DFR/DFR1 – Pressure flow controller



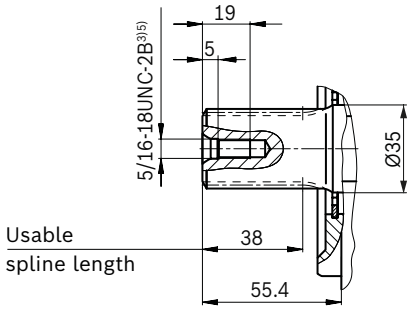
▼ **Splined shaft 1 1/4 in (SAE J744)**

S – 14T 12/24DP[1)]



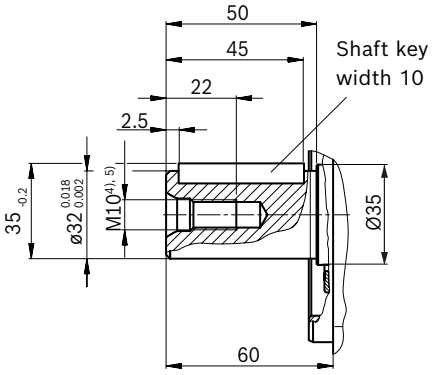
▼ **Splined shaft 1 1/4 in (SAE J744)**

R – 14T 12/24DP[1)2)]



▼ **Parallel keyed shaft DIN 6885**

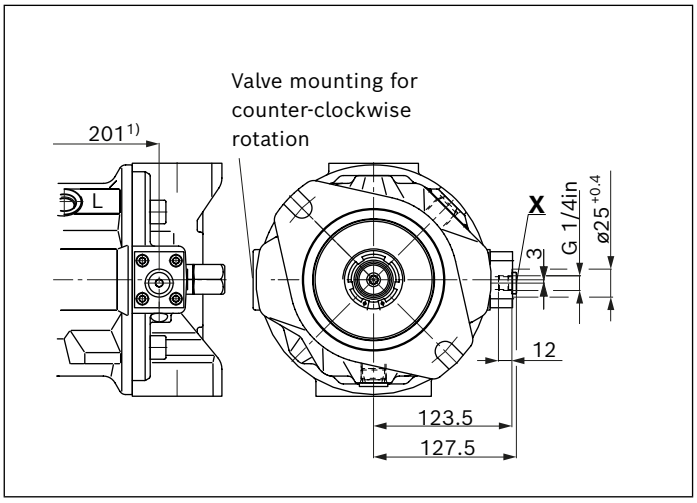
P – A10x8x45



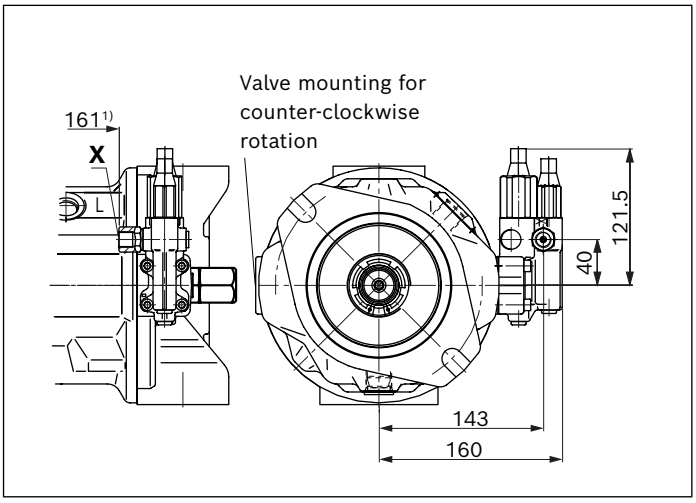
Ports		Standard	Size[5)]	p_{max} [bar][6)]	State[10)]
B	Working port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	1 in M10 x 1.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[7)] DIN 13	2 in M12 x 1.75; 20 deep	10	O
L	Drain port	DIN 3852[8)]	M22 x 1.5; 14 deep	2	O[9)]
L_1	Drain port	DIN 3852[8)]	M22 x 1.5; 14 deep	2	X[9)]
X	Pilot pressure	DIN 3852	M14 x 1.5; 12 deep	350	O
X	Pilot pressure (with DG-control)	DIN ISO 228	G 1/4 in; 12 deep	280	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.
3) Thread according to ASME B1.1
4) Center bore according to DIN 332 (thread according to DIN 13)
5) Observe the general notices on page 38 concerning the maximum tightening torques.
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
7) Metric fastening thread is a deviation from standard.
8) The countersink may be deeper than specified in the standard.
9) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting in part I).
10) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

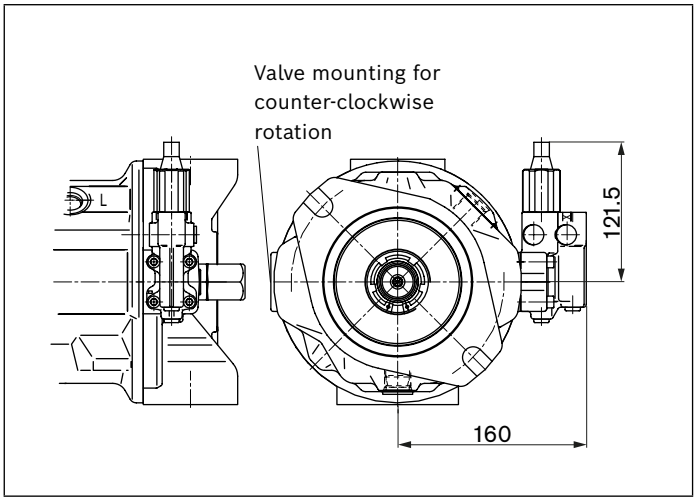
▼ **DG – Two-point control, direct operated**



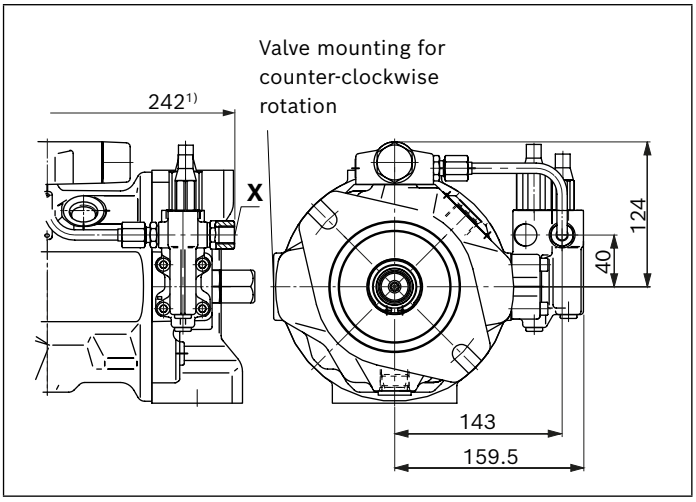
▼ **DRG – pressure controller, remotely controlled**



▼ **DR – Pressure controller**



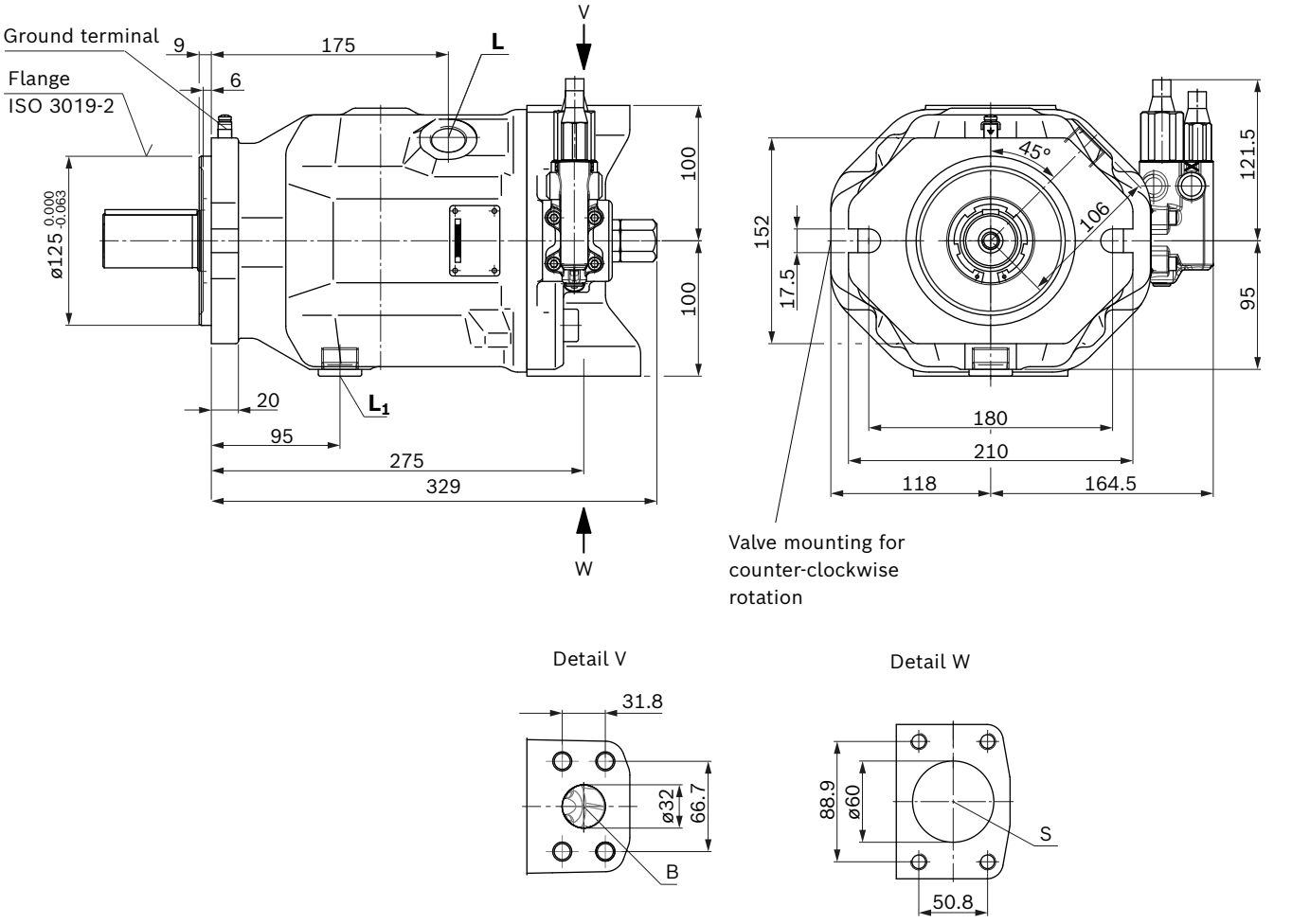
▼ **DFLR – Pressure, flow and power controller**



1) To flange surface

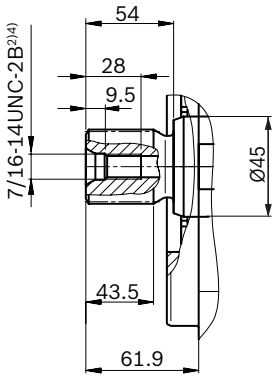
Dimensions, size 100

DFR/DFR1 – Pressure flow controller



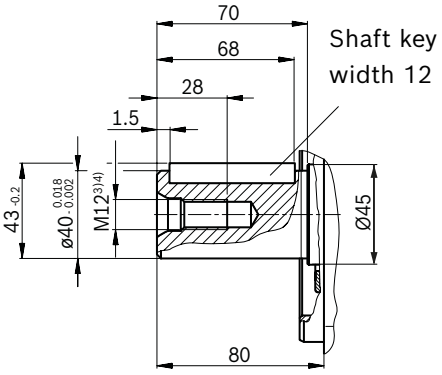
▼ **Splined shaft 1 1/2 in (SAE J744)**

S – 17T 12/24DP[1)]



▼ **Parallel keyed shaft DIN 6885**

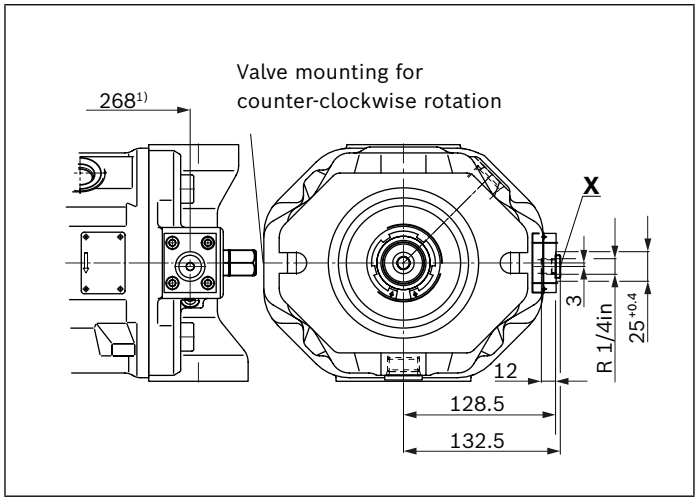
P – A12x8x68



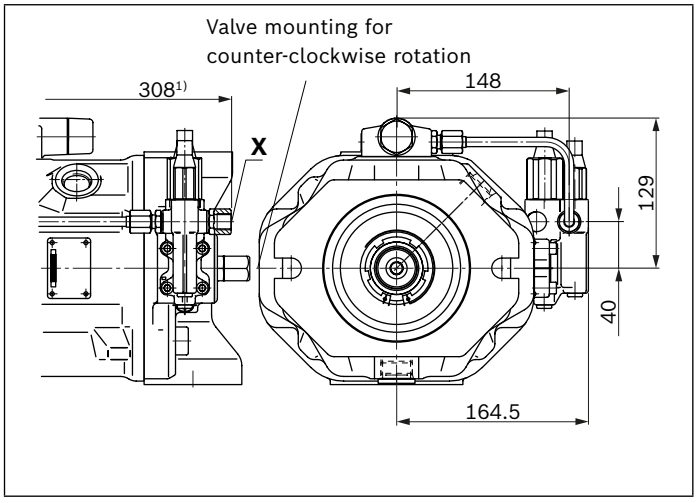
Ports		Standard	Size[4)]	$p_{max\ abs}$ [bar][5)]	State[9)]
B	Working port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	1 1/4 in M14 x 2; 19 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	2 1/2 in M12 x 1.75; 17 deep	10	O
L	Drain port	DIN 3852[7)]	M27 x 2; 16 deep	2	O[8)]
L_1	Drain port	DIN 3852[7)]	M27 x 2; 16 deep	2	X[8)]
X	Pilot pressure	DIN 3852	M14 x 1.5; 12 deep	350	O
X	Pilot pressure (with DG-control)	DIN ISO 228	G 1/4 in; 12 deep	280	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general notices on page 38 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) Metric fastening thread is a deviation from standard.
7) The countersink may be deeper than specified in the standard.
8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting in part I).
9) O = Must be connected (comes plugged)
X = Plugged (in normal operation)

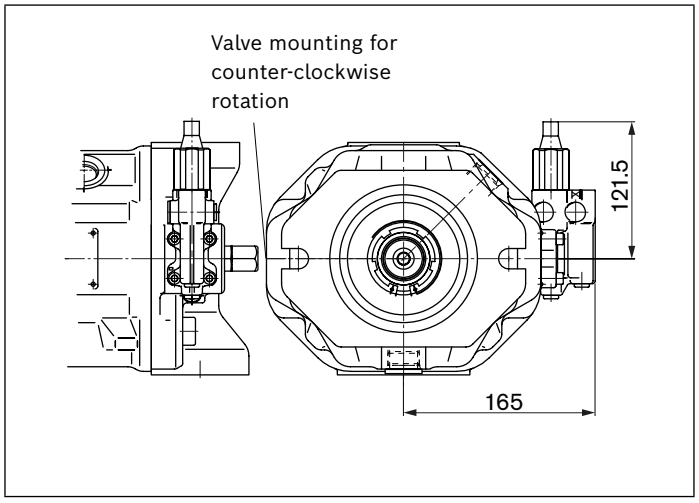
▼ **DG – Two-point control, direct operated**



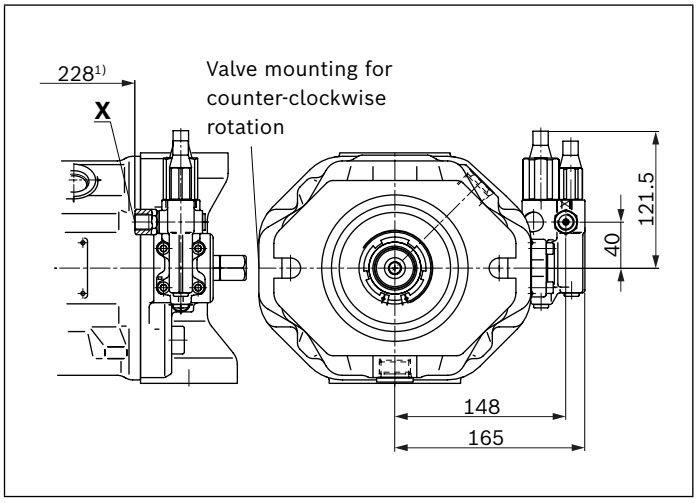
▼ **DFLR – Pressure, flow and power controller**



▼ **DR – Pressure controller**



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



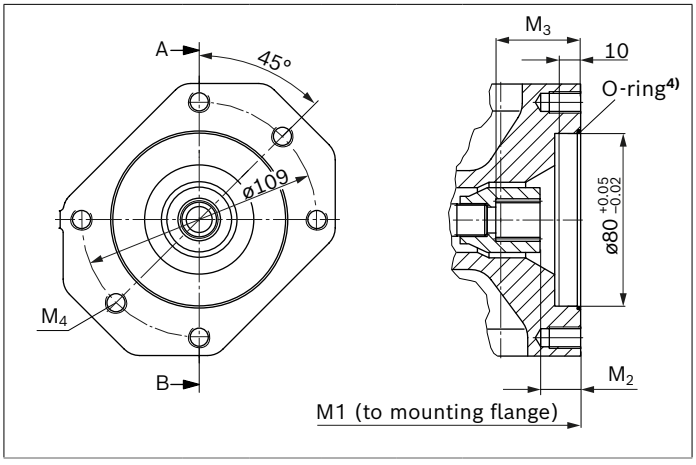
1) To flange surface

Dimensions, through drive

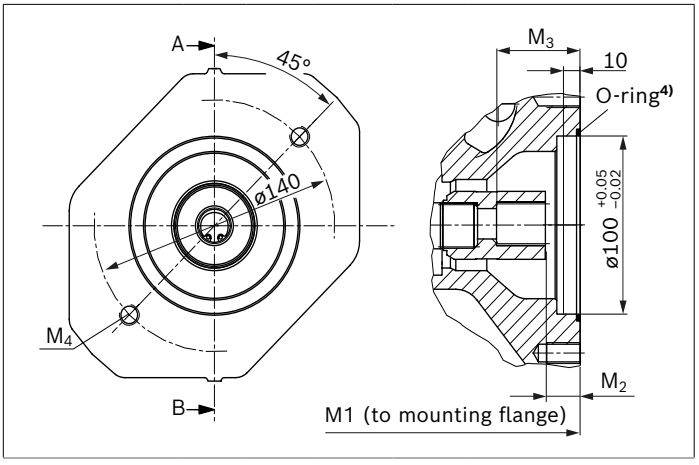
Flange ISO 3019-2 (metric)		Hub for splined shaft[1]		Availability across sizes						Code
Diameter	Mounting[2]	Diameter		18	28	45	71	100		
80-2	⚷, ⚷, ⚷	3/4 in	11T 16/32 DP	●	●	●	●	●		**KB2**
100-2	⚷	7/8 in	13T 16/32 DP	–	●	●	●	●		**KB3**
		1 in	15T 16/32 DP	–	–	●	●	●		**KB4**

● = Available ○ = On request

▼ **80-2**



▼ **100-2**



KB2 (SAE J744 19-4 (A-B))	NG	M1	M2	M3	M4[3]
	18	182	18.8	38.7	M10 × 1.5; 14.5 deep
	28	204	18.8	38.7	M10×1.5; 16 deep
	45	229	18.9	38.7	M10×1.5; 16 deep
	71	267	21.3	41.4	M10 × 1.5; 20 deep
	100	338	19	38.9	M10 × 1.5; 20 deep

KB3 (SAE J744 22-4 (B))	NG	M1	M2	M3	M4[3]
	28	204	17.8	41.7	M12×1.5
	45	229	17.9	41.7	M12×1.5
	71	267	20.3	44.1	M12×1.75; 20 deep
	100	338	18.0	41.9	M12×1.75; 20 deep

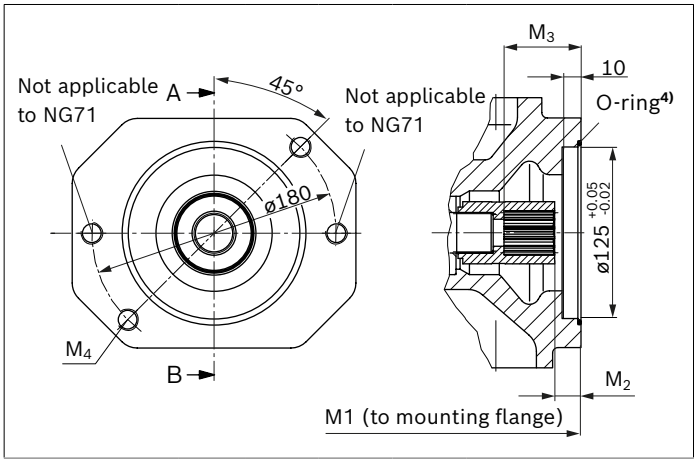
KB4 (SAE J744 25-4 (B-B))	NG	M1	M2	M3	M4[3]
	45	229	18.4	46.7	M12 × 1.75
	71	267	20.8	49.1	M12 × 1.75; 20 deep
	100	338	18.2	46.6	M12 × 1.75; 20 deep

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; observe the notices regarding the maximum tightening torques instruction manual.
4) O-ring included in the scope of delivery

Flange ISO 3019-2 (metric)		Hub for splined shaft[1]		Availability across sizes						Code
Diameter	**Mounting[2]**	**Diameter**		**18**	**28**	**45**	**71**	**100**		
125-2	⚬, ⚬	1 1/4 in	14T 12/24 DP	–	–	–	●	●		**KB5**
		1 1/2 in	17T 12/24 DP	–	–	–	–	●		**KB6**

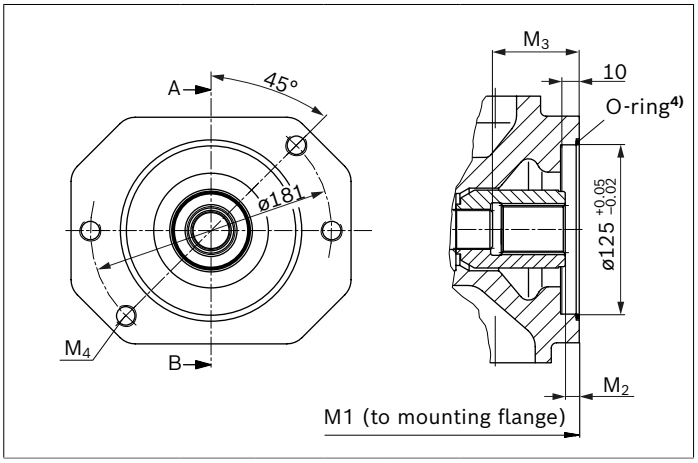
● = Available ○ = On request

▼ **125-2**



KB5 (SAE J744 32-4 (C))	NG	M1	M2	M3	M4[3]
	71	267	21.8	58.6	M16×2; continuous
	100	338	19.5	56.4	M16×2; continuous

▼ **125-2**

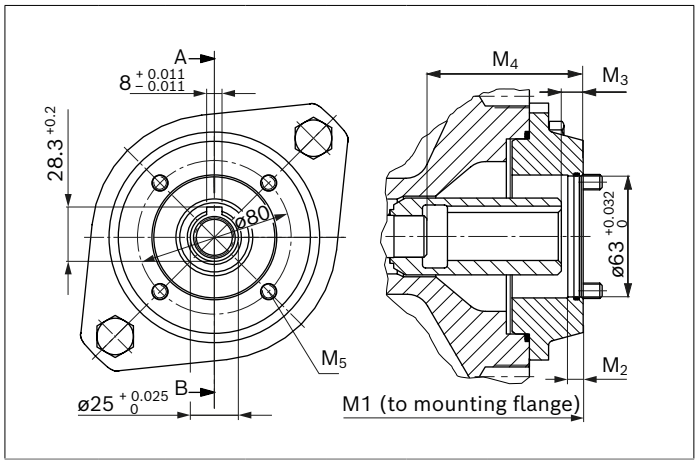


KB6 (SAE J744 38-4 (C-C))	NG	M1	M2	M3	M4[3]
	100	338	10.5	65	M16×2; continuous

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; observe the notices regarding the maximum tightening torques instruction manual.
4) O-ring included in the scope of delivery

Metric 4-hole flange for mounting a radial piston pump R4		Hub for metric keyed shaft	Availability across sizes						Code
Diameter	**Attachment**[1]	**Diameter**	**18**	**28**	**45**	**71**	**100**		
63-4	⌘	25	–	●	●	●	●		**K57**

● = Available ○ = On request



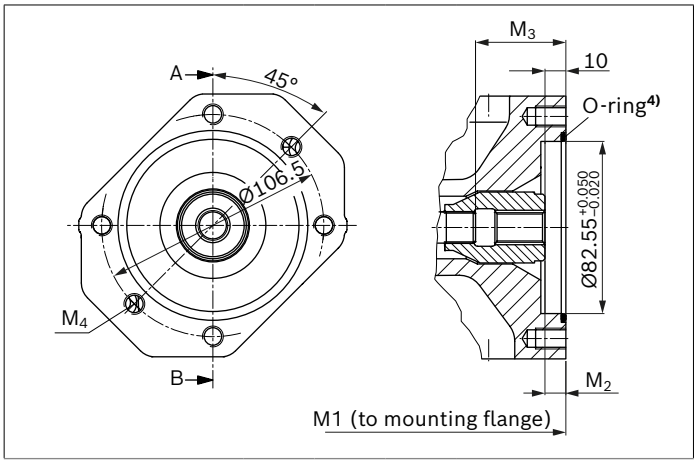
K57	NG	M1	M2	M3	M4	M5[2)3)]
	28	232	8	10.6	58.4	M8×1.5
	45	257	8	11	81	M8×1.5
	71	283	8	12.5	77	M10×1.5
	100	354	8	10.5	81	M10×1.5

1) Mounting holes pattern viewed on through drive with control at top.
2) Thread according to DIN 13; observe the notices regarding the maximum tightening torques instruction manual.
3) Screws are included.

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability across sizes						Code
Diameter	Mounting[2]	Diameter		18	28	45	71	100		
82-2 (A)	⚷, ⚷, ⚷	5/8 in	9T 16/32DP	●	●	●	●	●		K01
		3/4 in	11T 16/32DP	●	●	●	●	●		K52

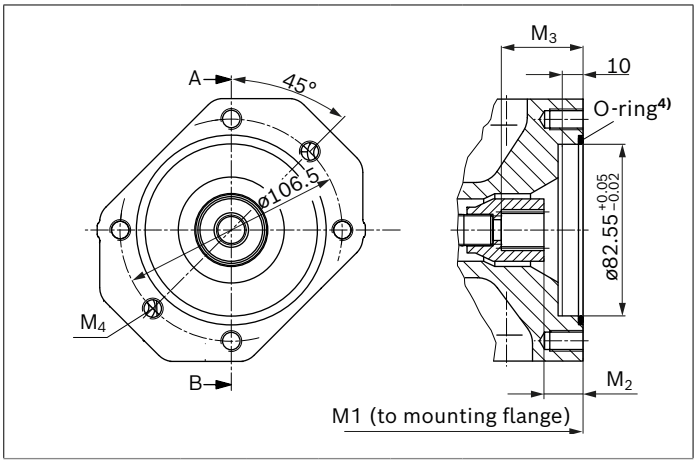
● = Available ○ = On request

▼ **82-2**



K01 (SAE J744 82-2 (A))	NG	M1	M2	M3	M4
	18	182	10	43.3	M10×1.5; 14.5 deep
	28	204	10	33.7	M10×1.5; 16 deep
	45	229	11.7	53.4	M10×1.5; 16 deep
	71	267	11.8	61.3	M10×1.5; 20 deep
	100	338	10.5	65	M10×1.5; 16 deep

▼ **82-2**



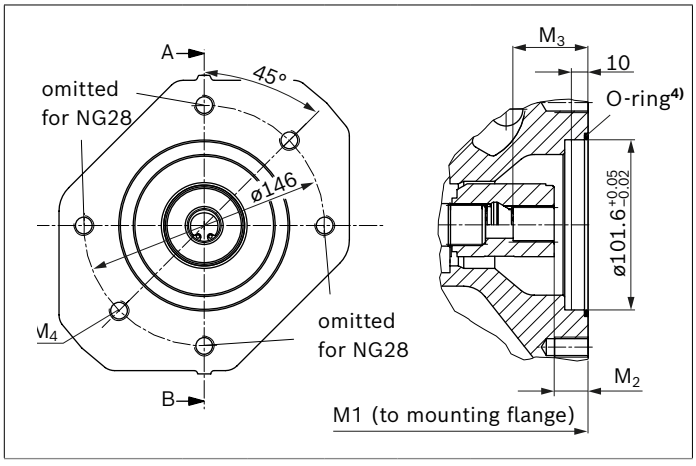
K52 (SAE J744 82-2 (A))	NG	M1	M2	M3	M3
	18	182	18.8	38.7	M10×1.5; 14.5 deep
	28	204	18.8	38.7	M10×1.5; 16 deep
	45	229	18.9	38.7	M10×1.5; 16 deep
	71	267	21.3	41.4	M10×1.5; 20 deep
	100	338	19	38.9	M10×1.5; 16 deep

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; observe the notices regarding the maximum tightening torques instruction manual.
4) O-ring included in the scope of delivery

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability across sizes						Code
Diameter	**Mounting[2]**	**Diameter**		**18**	**28**	**45**	**71**	**100**		
101-2	⚷, ⚷, ⚷	7/8 in	13T 16/32 DP	–	●	●	●	●		K68
		1 in	15T 16/32 DP	–	–	●	●	●		K04

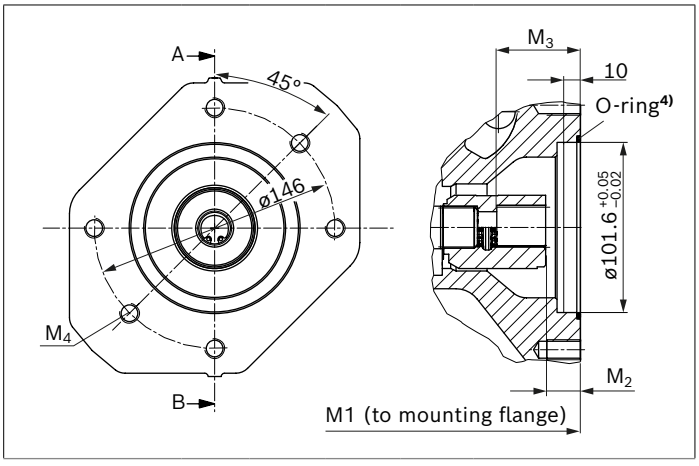
● = Available ○ = On request

▼ **101-2**



K68 (SAE J744 22-4 (B))	NG	M1	M2	M3	M4[3]
	28	204	17.8	41.7	M12×1.75
	45	229	17.9	41.7	M12x1.75; 18 deep
	71	267	20.3	44.1	M12×1.75; 20 deep
	100	338	18	41.9	M12×1.75; 20 deep

▼ **101-2**



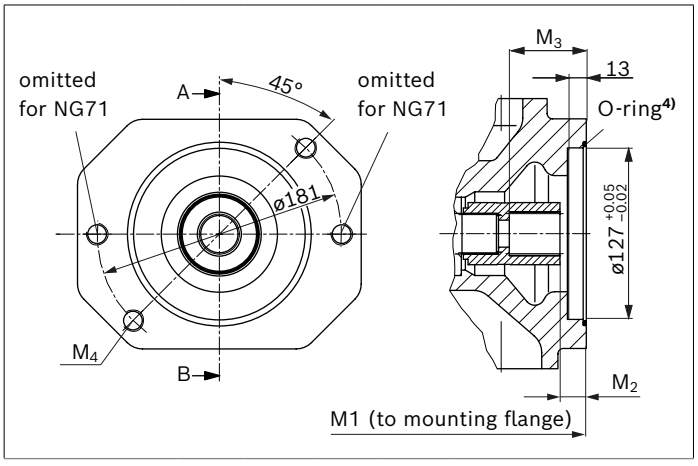
K04 (SAE J744 25-4 (B-B))	NG	M1	M2	M3	M4[3]
	45	229	18.4	46.7	M12×1.75; 18 deep
	71	267	20.8	49.1	M12×1.75; 20 deep
	100	338	18.2	46.6	M12×1.75; 20 deep

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; observe the notices regarding the maximum tightening torques instruction manual.
4) O-ring included in the scope of delivery

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability across sizes						Code
Diameter	**Mounting[2]**	**Diameter**		**18**	**28**	**45**	**71**	**100**		
127-2	⚷, ⚷, ⚷	1 1/4 in	14T 12/24 DP	–	–	–	●	●		K07
		1 1/2 in	17T 12/24 DP	–	–	–	–	●		K24

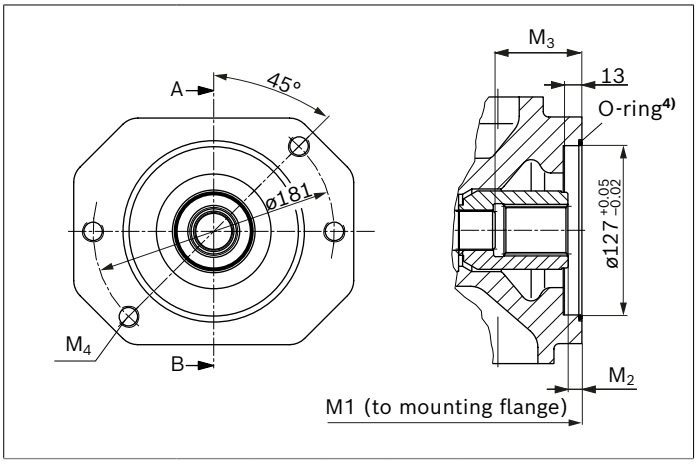
● = Available ○ = On request

▼ **127-2**



K07 (SAE J744 32-4 (C))	NG	M1	M2	M3	M4[3]
	71	267	21.8	58.6	M16×*2*; continuous
	100	338	19.5	56.4	M16×*2*; continuous

▼ **127-2**



K24 (SAE J744 38-4 (C-C))	NG	M1	M2	M3	M4[3]
	100	338	10.5	65	M16×*2*; continuous

1) Hub for splined shaft 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; observe the notices regarding the maximum tightening torques instruction manual.
4) O-ring included in the scope of delivery

Overview of mounting options

Through drive			**Mounting options – 2nd Pump**
Flange (ISO) ISO 3019-2	**Hub for Splined shaft**	**Code.**	**A10VSO/31 ATEX NG (shaft)**
80-2	3/4 in	KB2	18 (S, R)
100-2	7/8 in	KB3	28 (S, R)
	1 in	KB4	45 (S, R)
125-2	1 1/4 in	KB5	71 (S, R)
	1 1/2 in	KB6	100 (S)
Flange (ISO)	**Hub for Keyed shaft**	**Code**	**A10VSO/31 ATEX NG (shaft)**
63-4	ø25 mm	K57	–
Flange (SAE) ISO 3019-1	**Hub for Splined shaft**	**Code**	**A10VO/31 NG (shaft)**
82-2 (A)	5/8 in	K01	18 (U)
	3/4 in	K52	18 (S, R)
101-2 (B)	7/8 in	K68	28 (S, R) 45 (U, W)[1)]
	1 in	K04	45 (S, R) –
127-2 (C)	1 1/4 in	K07	71 (S, R) 100 (U)[3)]
	1 1/2 in	U24	100 (S)

Notices

- All attachment pumps must match the ATEX classification for the application in question.

1) Not for main pump NG28 with K68
2) Not for main pump NG45 with K04
3) Not for main pump NG71 with K07

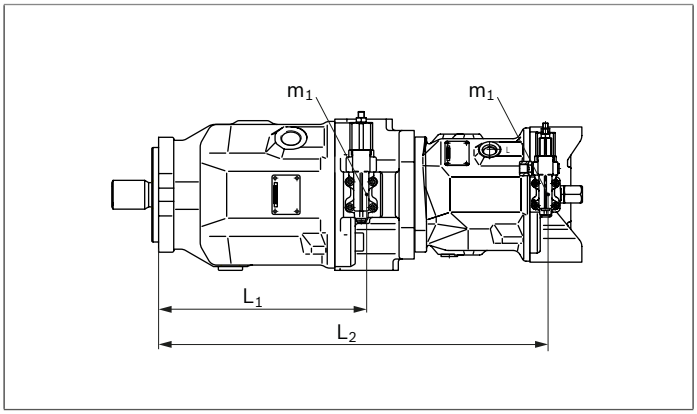
Combination pumps A10VSO + A10VSO

Due to the application of combination pumps, the user is also provided with independent circuits without the need for splitter gearboxes.
When ordering combination pumps, the type designations of the 1st and 2nd The pump must be connected with a "**+**" and they are combined into one part number. Each single pump should be ordered according to type code.

Notice

- The combination pump type code is shown in shortened form in the order confirmation.
  Example:
  A10VSO 100 DR/31R+A10VSO 100 DR/31R
- Each through drive is plugged with a **non–pressure-resistant** cover. This means the units must be sealed with a pressure-resistant cover before commissioning. Through drives can also be ordered with a pressure-resistant cover. Please specify in plain text.

Order example:
A10VSO100DR/31R-ASB12KB5+
A10VSO71DR/31R-ASB12N00
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/s^2).
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).



m_1, m_2	Weight of pump	[kg]
l_1, l_2	Distance from center of gravity	[mm]
$T_m = (m_1 \bullet l_1 + m_2 \bullet l_2 + ... \bullet ....) \bullet \frac{1}{102}$		[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 (as of Page 30) + l_1 of the 2nd Pump
l_3	=	Dimension "M1" from through drive drawings (as of Page 30) of the 1st pump + "M1" of the 2nd pump + l_1 of the 3rd pump

Permissible moments of inertia

NG				**18**	**28**	**45**	**71**	**100**
static	T_m	Nm		500	880	1370	2160	3000
dynamic at 10 g (98.1 m/s^2)	T_m	Nm		50	88	137	216	300
Weight with through drive	m	kg		14	19	25	39	54
Weight without through drive				12	15	21	33	45
Distance from center of gravity	l_1	mm		90	110	130	150	160

Please also pay attention to the installation information in part I.

Project planning notes

- The A10VSO ATEX pump is intended for the application in open circuits.
- The project planning, assembly and commissioning of the axial piston unit require the involvement of qualified skilled persons.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notices contained herein must be observed.
- Pressure controllers are not safeguards against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Not all versions of the product are approved for the application in a safety function according to ISO 13849. Please consult the proper contact at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- For drives that are operated for a long period with constant rotational speed, the natural frequency of the hydraulic system can be stimulated by the excitation frequency of the pump (rotational speed frequency ×9). This can be prevented with suitably designed hydraulic lines.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burning on the axial piston unit. 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 an undefined position due to contamination (e.g. impure hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are appropriately implemented.

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