The Drive & Control Company

Rexroth
Bosch Group

Axial piston variable pump A4VBO Series 1x and 3x

RE 92122
Edition: 08.2018
Replaces: 04.2012

- Optimized high-pressure pump for maximum power requirement up to 500 bar
- Sizes 71, 125, 250, 450
- Nominal pressure 450 bar
- Maximum pressure 500 bar
- Open circuit

Features

- Variable pump with axial piston rotary group in swash-plate design for hydrostatic drives in open circuit as well as operation with boosted inlet
- The flow can be infinitely varied by the control.
- Robust pump with very long service life
- Reduced noise
- Through drive option
- Axial and radial load capacity of drive shaft
- Modular design
- High power density
- Visual swivel angle indicator
- Favorable power/weight ratio
- Short response times
- Internal and external bearing flushing
- Inside-reservoir installation possible

Contents

Type code

01	02	03	04	05		06	07	08	09		10	11	12
	A4VB	**O**			**/**			**V**		**–**		**25**	

Rotary group version

		71	125	250	450	
01	High-speed version	–	–	●	–	**H**

Axial piston unit

02	Variable, swashplate design, nominal pressure 450 bar, maximum pressure 500 bar	**A4VB**

Operating mode

03	Pump, open circuit	**O**

Size (NG)

04	Geometric displacement, see table of values on page 7	**71**	**125**	**250**	**450**

Control device

			Data sheet	71	125	250	450	
05	Hydraulic control with	servo/proportional valve	92076	●	●	●	●	**HS5**
		internal control pressure supply		●	●	●	–	**HS5V**
		On-board electronics		●	●	○	●	**HS5E**
	Power controller	mechanically adjustable	92064	●	●	○	○	**LR2**
	Electrohydraulic control system	internal control pressure supply	92088	●	●	○	–	**DFE1**
		external control pressure supply		●	●	●	–	**DFE1Z**

Series

		71	125	250	450	
06	Series 1, index 0 (index 1)	●	–	–	–	**10**
	Series 3, index 0	–	●	–	●	**30**
	Series 3, index 3, efficiency-optimized version. Only with high-speed rotary group “HA4VBO...” and “Sealing material FKM” design	–	–	●	–	**33**

Direction of rotation

			71...450	
07	Viewed on drive shaft	clockwise		**R**
		counter-clockwise		**L**

Sealing material

		71...450	
08	FKM (fluoroelastomer)		**V**

Drive shaft

		71	125	250	450	
09	Splined shaft DIN 5480, without undercut	–	–	–	●	**R**
	DIN 5480 splined shaft	●	●	●	–	**Z**

Mounting flange

			71	125	250	450	
10	In accordance with ISO 3019-2 metric	4-hole	●	●	●	–	**B**
		8-hole	–	–	–	●	**H**

Working port

		71...450	
11	SAE flange ports **B** and **S**, shifted laterally 90°, metric fastening thread 2. Pressure ports $\mathbf{B_1}$ opposite **B** - plugged with flange plate on delivery		**25**

● = Available ○ = On request – = Not available

01	02	03	04	05		06	07	08	09		10	11	12
	A4VB	**O**			**/**			**V**		**–**		**25**	

Through drive (for mounting options, see page 27)

12	Flange **ISO 3019-2** (metric)		Hub for splined shaft						
	Diameter	Mounting[1)]	Diameter		**71**	**125**	**250**	**450**	
	With through drive	Without conversion option			●	–	–	●	**K...**
		For universal through drive, see data sheet 95581			–	●	●	–	**U...**
	125, 4-hole		32x2x14x9g[2)]		○	○	○	○	**31**
	140, 4-hole		40 x 2 x 18 x 9 g[2)]		●	●	●	○	**33**
	160, -4-hole		50 x 2 x 24 x 9 g[2)]		–	●	●	○	**34**
	224, 4-hole		60x2x28x9g[2)]		–	–	●	○	**35**
			70x3x22x9g[2)]		–	–	–	○	**77**
	315, 8-hole		80x3x25x9g[2)]		–	–	–	●	**97**
	80, 2-hole		3/4 in	11T 16/32DP[3)]	○	○	○	○	**B2**
	100, 2-hole		7/8 in	13T 16/32DP[3)]	●	○	○	○	**B3**
			1 in	15T 16/32DP[3)]	●	○	○	○	**B4**
	125, 4-hole		1 in	15T 16/3 2DP[3)]	●	○	○	○	**E1**
	125, 2-hole		1 1/4 in	14T 12/24DP[3)]	○	○	○	○	**B5**
			1 1/2 in	17T 12/24DP[3)]	–	○	○	○	**B6**
	160, 4-hole		1 1/4 in	14T 12/24DP[3)]	○	○	○	○	**B8**
	180, 4-hole		1 1/2 in	17T 12/24DP[3)]	–	○	○	○	**B9**
			1 3/4 in	13T 8/16DP[3)]	–	–	○	○	**B7**
	Flange ISO **3019-1** (SAE)		Hub for splined shaft						
	Diameter	Attachment	Diameter		**71**	**125**	**250**	**450**	
	82-2 (A)		5/8 in	9T 16/32DP[3)]	●	○	○	○	**01**
			3/4 in	11T 16/32DP[3)]	○	○	○	○	**52**
	101-2 (B)		7/8 in	13T 16/32DP[3)]	●	●	●	○	**68**
			1 in	15T 16/32DP[4)]	○	●	●	○	**04**
			1 1/4 in	14T 12/24DP[3)]	○	○	○	○	**06**
	127-4 (C)		1 in	15T 16/32DP[3)]	○	○	○	○	**E2**
			1 1/4 in	14T 12/24DP[3)]	○	○	○	○	**15**
	127-2 (C)		1 1/4 in	14T 12/24DP[3)]	○	○	○	○	**07**
			1 1/2 in	17T 12/24DP[3)]	–	●	●	○	**24**
	152-4 (D)		1 1/2 in	17T 12/24DP[3)]	–	○	○	○	**96**
			1 3/4 in	13T 8/16DP[3)]	–	○	○	○	**17**
	Prepared for through drive, with pressure-resistant plugged cover				●	●	●	●	**99**

● = Available ○ = On request – = Not available

Notice

- Observe the project planning notes (page 31).
- In addition to the type code, please specify the relevant technical data when placing your order.
- For notes on combination pumps, see page27)

1) Mounting hole arrangement as viewed on the through drive with the control at top.
2) Splined hub according to DIN 5480
3) Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

Hydraulic fluids

The A4VBO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
See the following data sheets for application instructions and requirements for hydraulic fluids before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

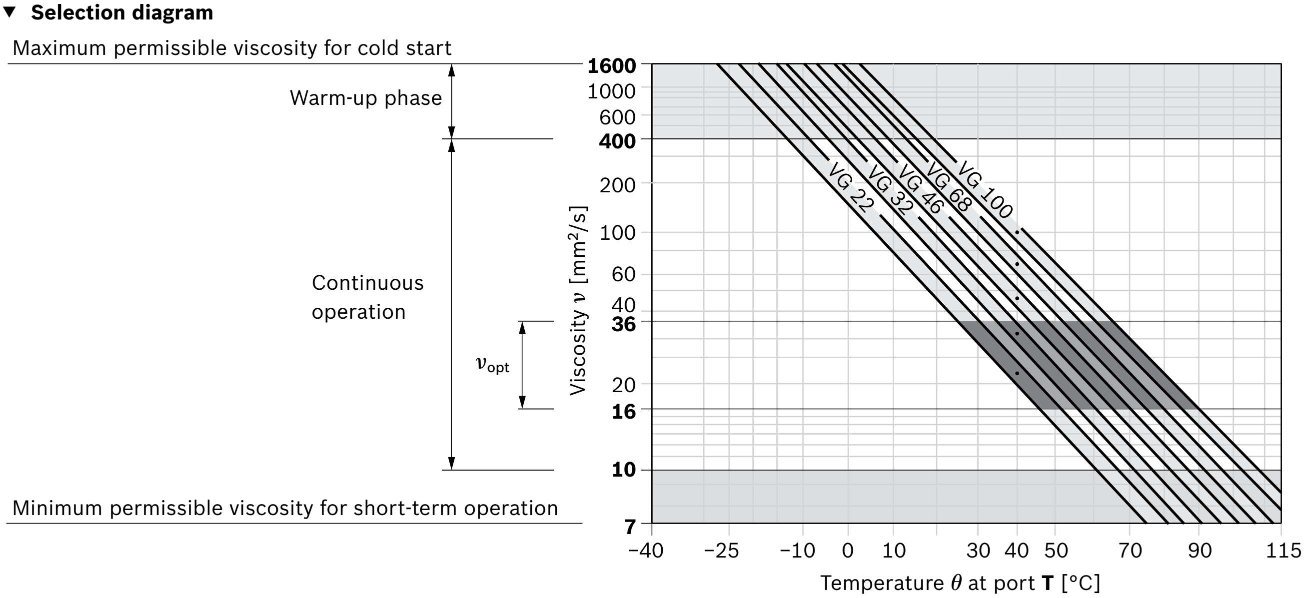
Explanation regarding the selection of hydraulic fluid
The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}; see selection diagram).

Hydraulic fluid filtration
Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At a hydraulic fluid viscosity of less than 10 mm²/s (e.g., due to high temperatures during short-term operation) at the drain port, a cleanliness level of at least 19/17/14 under ISO 4406 is required.
For example, the viscosity is 10 mm²/s at:
- HLP 32 a temperature of 73 °C
- HLP 46 a temperature of 85 °C

Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature[3]	Comment
Cold start	ν_{max} ≤ 1600 mm²/s	NBR[2]	θ_{St} ≥ -40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 min^{-1} Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
		FKM	θ_{St} ≥ -25 °C	
Warm-up phase	ν = 1600 ... 400 mm²/s			t ≤ 15 min, p ≤ 0.7 × p_{nom}
Continuous operation	ν = 400 ... 10 mm²/s[1]	NBR[2]	θ ≤ +85 °C	measured at port **T**
		FKM	θ ≤ +110 °C	
	ν_{opt} = 36 ... 16 mm²/s			Optimal operating viscosity and efficiency range
Short-term operation	ν_{min} = 10 ... 7 mm²/s	NBR[2]	θ ≤ +85 °C	t ≤ 3 min, p ≤ 0.3 × p_{nom}, measured at port **T**
		FKM	θ ≤ +110 °C	

▼ **Selection diagram**



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

2) Special version, please contact us

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

Bearing flushing

Bearing flushing is required for a safe, continuous operation under the following operating conditions:

- Operation at critical conditions for temperature and viscosity
- With vertical installation (drive shaft facing upwards) for lubricating the front bearing and the shaft seal.

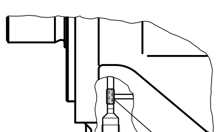
Bearing flushing is realized at port **U** in the area of the front flange of the variable pump. The flushing fluid flows through the front bearing and discharges with the pump drain at the drain port.

Depending on the individual sizes, the following flushing flows are
recommended:

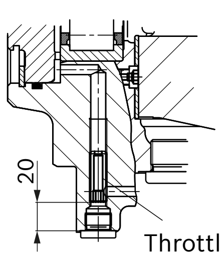
NG		71	125	250	450
q_{Sp}	l/min	4	5	10	20

For the flushing flows stated, there is a pressure differential of about 2 or 3 bar between port **U** (including fitting) and the housing area (series 1x and series 3x, respectively).

Note for NG 125 and 250 Series 3x
When using external bearing flushing, the throttle screw in port **U** must be turned to the stop.



Note on size 450
One of the bearing flushings extracted from the feed pressure to be applied from outside is present. If an external bearing flushing is used, the throttle screw in port **U** is to be screwed out to 20 mm.



Shaft seal

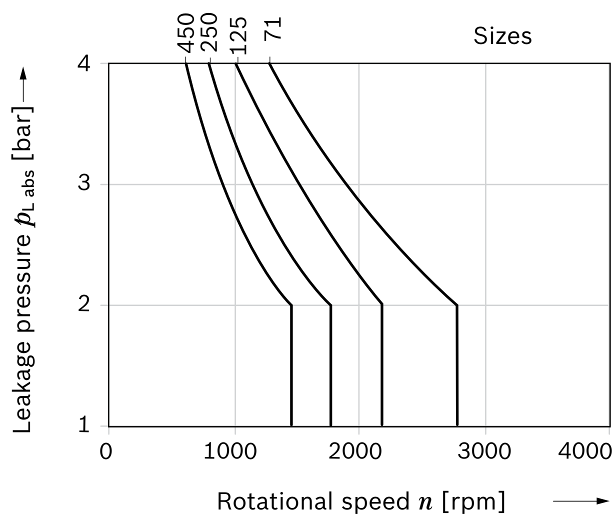
Permissible pressure load

The service life of the shaft seal ring is affected by the rotational speed of the pump and the leakage pressure. It is recommended that the average, continuous leakage pressure of 2 bar absolute at operating temperature not be exceeded (max. permissible leakage pressure of 4 bar absolute at reduced rotational speed; see diagram). Momentary (t < 0.1 s) pressure peaks of up to 10 bar absolute are acceptable. The service life of the shaft seal ring decreases with an increase in the frequency of pressure peaks.

The housing pressure must be equal to or greater than the external pressure on the shaft seal ring.

At size 450, a slide ring seal for a case pressure of up to 10 bar is available.

▼ **Characteristic curve leakage pressure**



Notice
For details on the viscosity and temperatures of the hydraulic fluids, please see page 4.

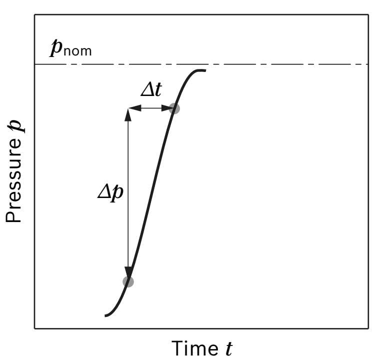
Flow direction

S to **B**

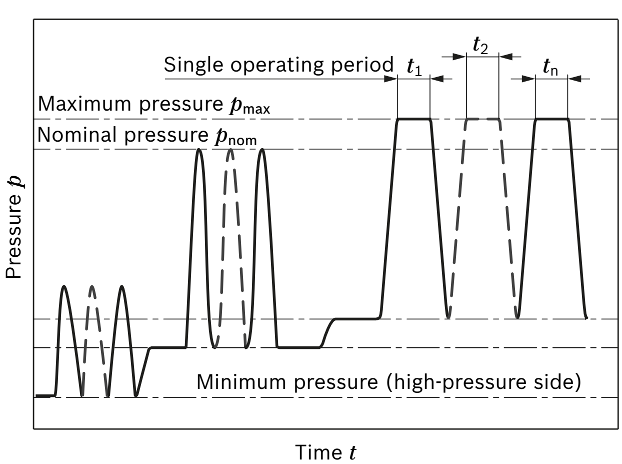
Working pressure range

Pressure at working port B		Definition
Nominal pressure p_{nom}	450 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	500 bar	The maximum pressure is the maximum working pressure during a single operating period. The sum of the single operating periods must not exceed the total operating period (maximum number of cycles: approx. 1 million).
Single operating period	1 s	
Total operating period	300 h	
Minimum pressure $p_{B\ abs}$ (High-pressure side)	15 bar[1]	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and the swivel angle.
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)		
Version without charge pump		Minimum pressure at suction port **S** (inlet) which is required to prevent damage to the axial piston unit. The minimum required pressure is dependent on the rotational speed and displacement of the axial piston unit (see diagram “Maximum permissible speed” on page). At size 450, a pre-charge pressure is urgently required (see diagram, “pre-charge pressure at size 450”).
Minimum pressure $p_{S\ min}$ NG 71 ... 250	≥ 0.8 bar absolute	
Minimum pressure $p_{S\ min}$ NG 450	≥ 5 bar absolute	
Maximum pressure $p_{S\ max}$	≤ 30 bar	
Case pressure at port T, K_1, K_2, R(L)		
Max. static pressure $p_{L\ max}$	4 bar	Maximum 1.2 bar higher than inlet pressure at port **S**, but not higher than $p_{L\ max}$. A drain line to the reservoir is required.
Pressure peaks $p_{L\ peak}$	6 bar	t < 0.1 s

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



▼ **Pressure definition**

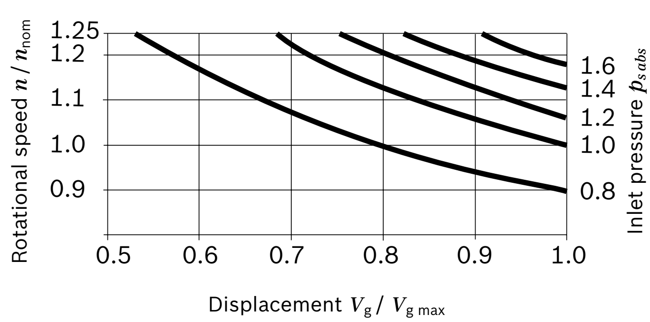


Total operating period = $t_1 + t_2 + ... + t_n$

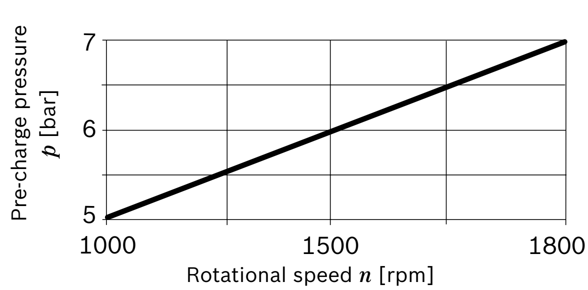
1) Lower values on request

Notice
Working pressure range applies when using mineral oil-based hydraulic fluids. Please contact us for values for other hydraulic fluids.

Maximum permissible rotational speed NG 71 ... 250 (speed limit)
($p_{S\ abs}$ = Inlet pressure [bar])



Pre-charge pressure at NG 450



Technical data

Size		NG		71	125	250	450
Geometric displacement per revolution		$V_{g\ max}$	cm^3	71	125	250	500
Max. rotational speed[1]	at $V_{g\ max}$[2]	n_{nom}	rpm	2200	1800	1800	1800
	at $V_g \leq V_{g\ max}$[3]	n_{max}	rpm	2700	2200	1800	1800
Flow	at n_{nom} and $V_{g\ max}$	q_v	l/min	156	225	450	810
	at 1500 rpm	q_v	l/min	107	188	375	675
Power	at n_{nom}, $V_{g\ max}$ and Δp = 450 bar	P	kW	117	169	337	608
	at 1500 rpm	P	kW	80	141	281	506
Torque	at $V_{g\ max}$ and Δp = 450 bar[2]	M_{max}	Nm	508	894	1791	3220
	and Δp = 100 bar[2]	M	Nm	113	199	398	716
Rotary stiffness drive shaft	Shaft end R	c	kNm/rad	–	–	–	1234
	Shaft end Z	c	kNm/rad	146	263	543	–
Moment of inertia		J_{TW}	kgm^2	0.0121	0.03	0.0959	0.3325
Max. angular acceleration[4]		α	rad/s^2	11000	8000	4800	2800
Case volume		V	l	2.5	5	10	14
Weight (without through drive) approx.		m	kg	65	100	195	390

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

Key

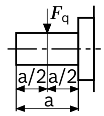
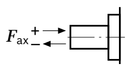
V_g	=	Displacement per revolution [cm^3]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{hm}	=	Hydraulic-mechanical efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Notices

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

1) The values apply:
   – to the optimum viscosity range from ν_{opt} = 36 to 16 mm^2/s
   – with hydraulic fluid based on mineral oils
2) The values apply at absolute pressure p_{abs} = 1 bar at suction port **S**. For NG 450, please note the required pre-charge pressure according to the diagram on page 6.
3) At NG 71 ... 250 maximum rotational speed (speed limit) when increasing the inlet pressure p_{abs} at suction port **S** and $V_g < V_{g\ max}$, see diagram on page 6.
4) 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. Factor in the load capacity of the connecting parts.

Permissible radial and axial loading on the drive shafts

Size		NG		71	125	250	450
Max. radial force at distance a/2		$F_{q\ max}$	N	1200	1600	2000	3000
Maximum axial force		$+F_{ax\ max}$	N	800	1000	1800	2200
		$-F_{ax\ max}$	N				

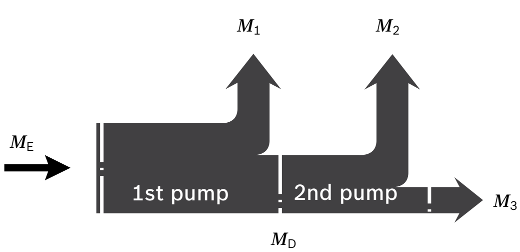
Notices

- Special requirements apply in the case of belt drives. Please contact us.
- Effective direction of permissible axial force
  $+F_{ax\ max}$ = increase in service life
  $-F_{ax\ max}$ = reduction in bearing service life

Permissible input and through-drive torques

Size			NG		71	125	250	450
Torque at $V_{g\ max}$ and Δp = 450 bar[1]			M_{max}	Nm	508	894	1791	3220
Max. input torque on drive shaft[2]								
	Splined shaft	R	$M_{E\ max}$	Nm	–	–	–	6440
	Splined shaft	Z	$M_{E\ max}$	Nm	1055	1786	3412	–
Max. through-drive torque			$M_{D\ max}$	Nm	480	780	1400	3220

▼ **Distribution of torques**



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

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

Characteristic curves

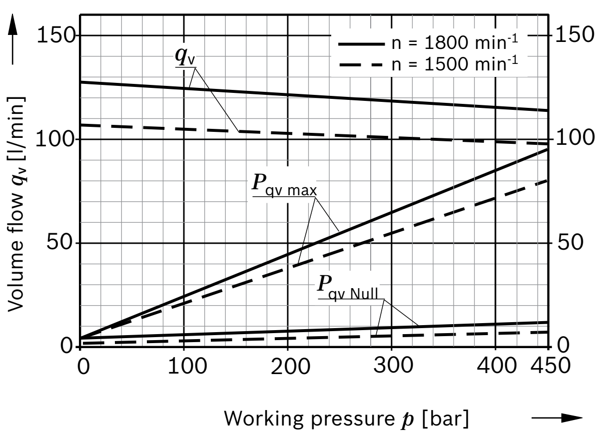
Drive power and flow

(Operating fluid: Hydraulic fluid ISO VG 46 DIN 51519, t = 50 °C)

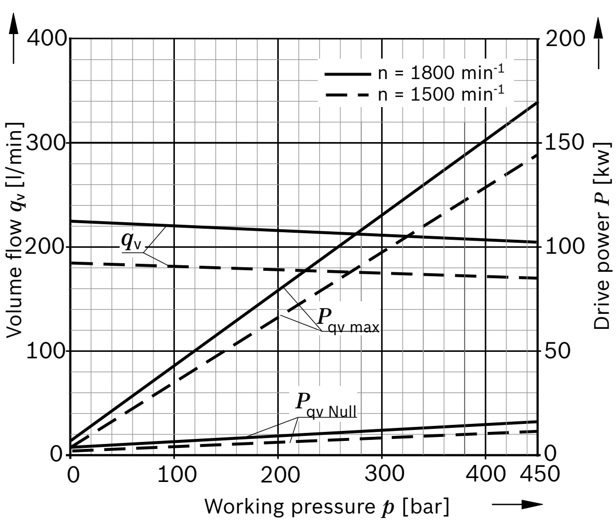
Total efficiency $$n_t = \frac{q_v \times p}{P_{qv\,max} \times 600}$$

Volumetric efficiency $$n_v = \frac{q_v}{q_{v\,theor}}$$

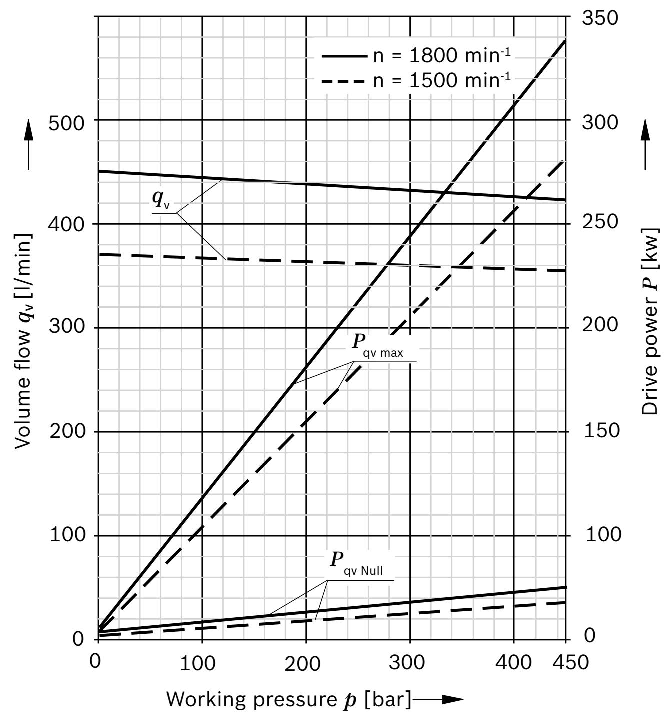
▼ **Size 71**



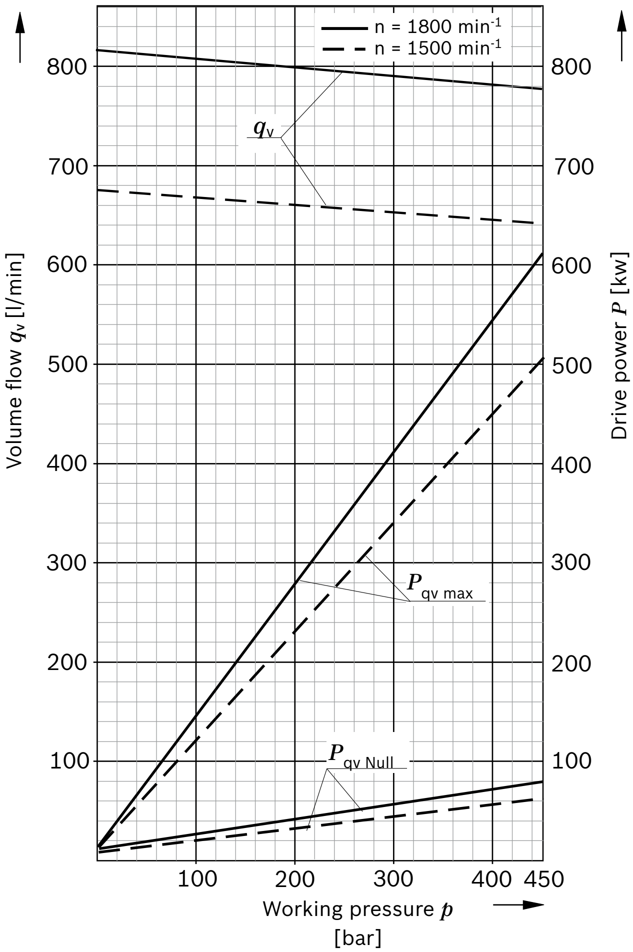
▼ **Size 125**



▼ **Size 250**



▼ **Size 450**


n = 1800 min⁻¹
n = 1500 min⁻¹
qv
Pqv max
Pqv Null
800
700
600
500
400
300
200
100
100
200
300
400
450
Volume flow qv [l/min]
Drive power P [kw]
Working pressure p
[bar]

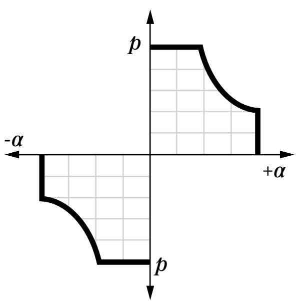
Overview of control device

Control system HS5., with servo or proportional valve

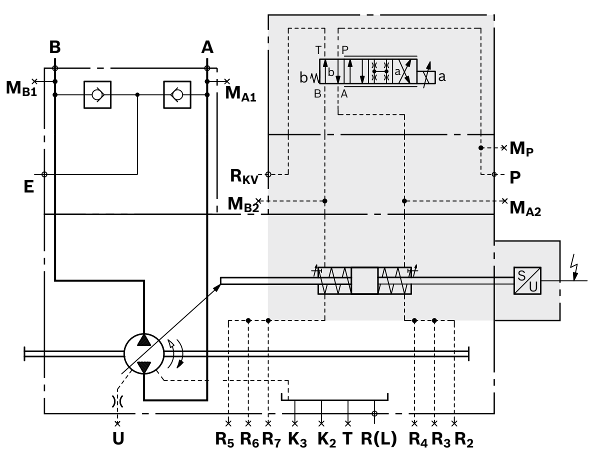
(see data sheet 92076)

The stepless displacement control is accomplished by means of a servo or proportional valve and electrical feedback of the swivel angle.

▼ **Characteristic curve HS5**



▼ **Example: Circuit diagram HS5 NG500**

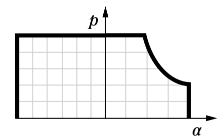


Electro-hydraulic control system DFE1

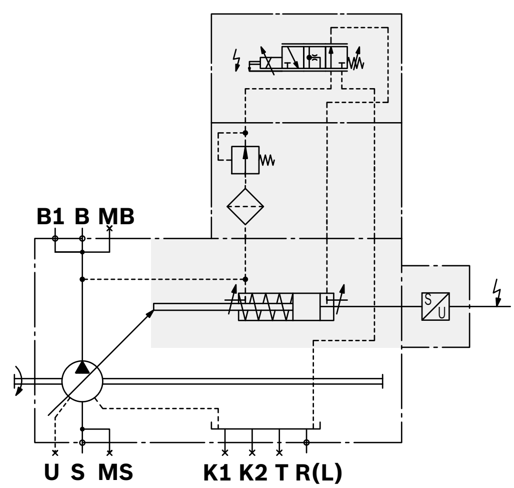
(see data sheet 92088)

An electrically actuated proportional valve controls the power, pressure and swivel angle of the A4VBO...DFE1 variable pump. The current at the proportional valve determines the position of the swashplate angle and thus the flow of the pump via the stroking piston and the position transducer. (DFE1Z with internal control pressure supply)

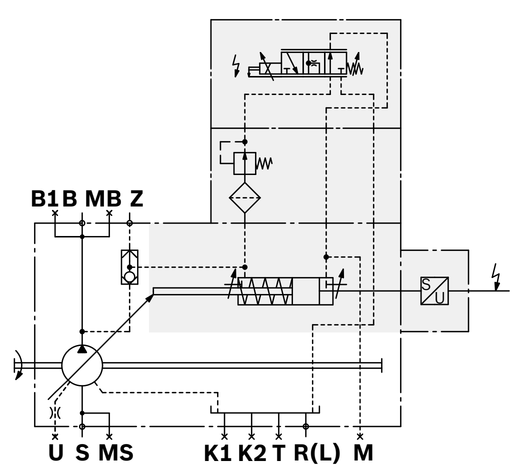
▼ **Characteristic curve DFE1**



▼ **Circuit diagram DFE1**

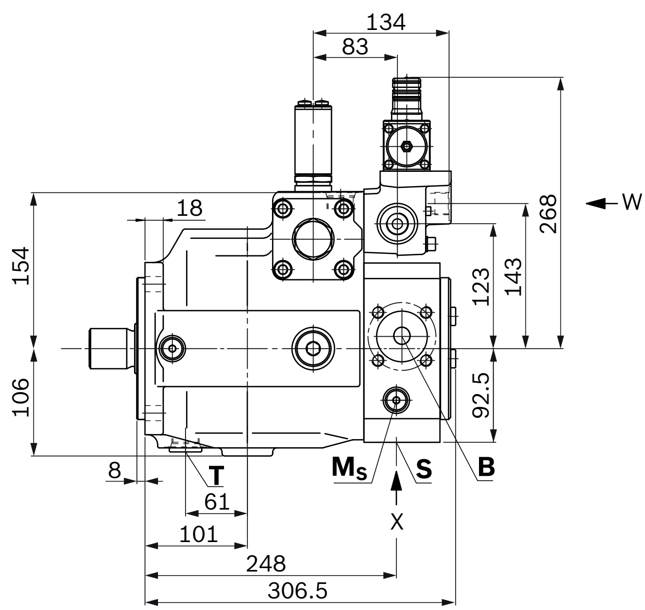


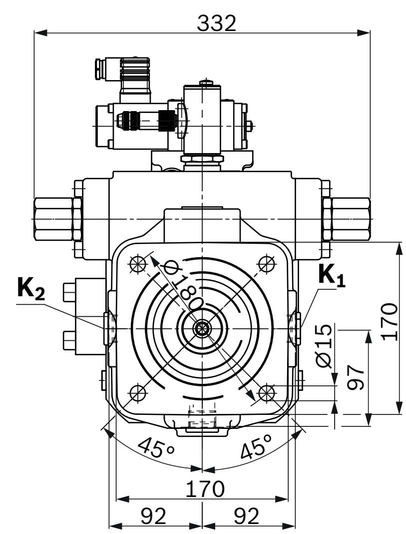
▼ **Circuit diagram DFE1Z**



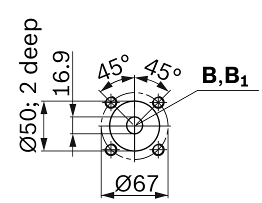
Dimensions, size 71

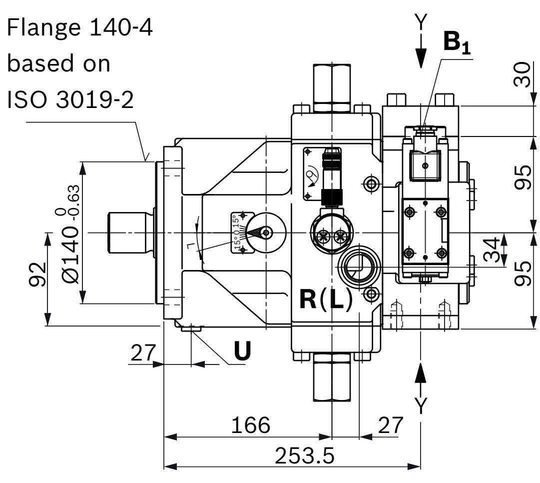
HS5 – electrohydraulic control with proportional valve



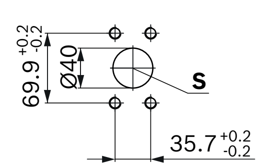


Detail Y

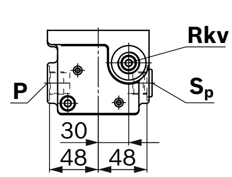




Detail X



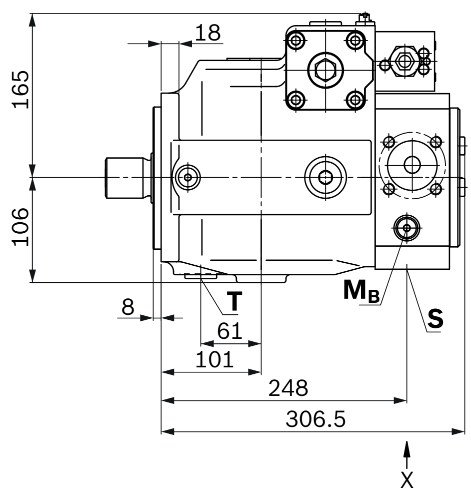
Detail W

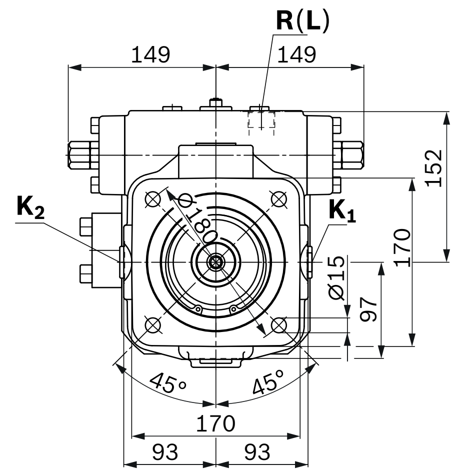


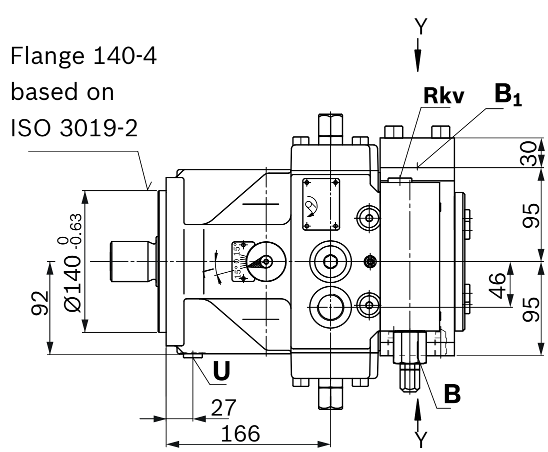
▶ For connection table, see page 14

Dimensions, size 71

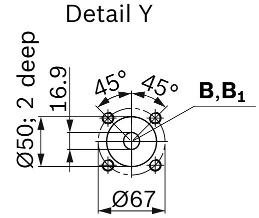
LR2 - power controller with hyperbolic characteristic curve, basic setting $V_{g\ max}$, mechanically adjustable



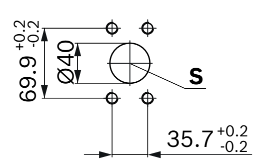




Detail Y



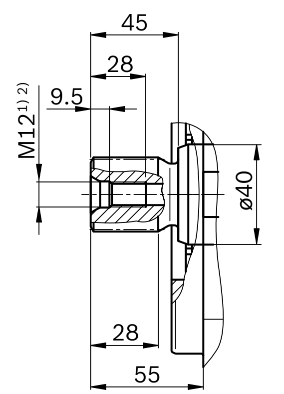
Detail X



▶ For connection table, see page 14

▼ **DIN 5480 splined shaft**

Z – W40x2x18x9g

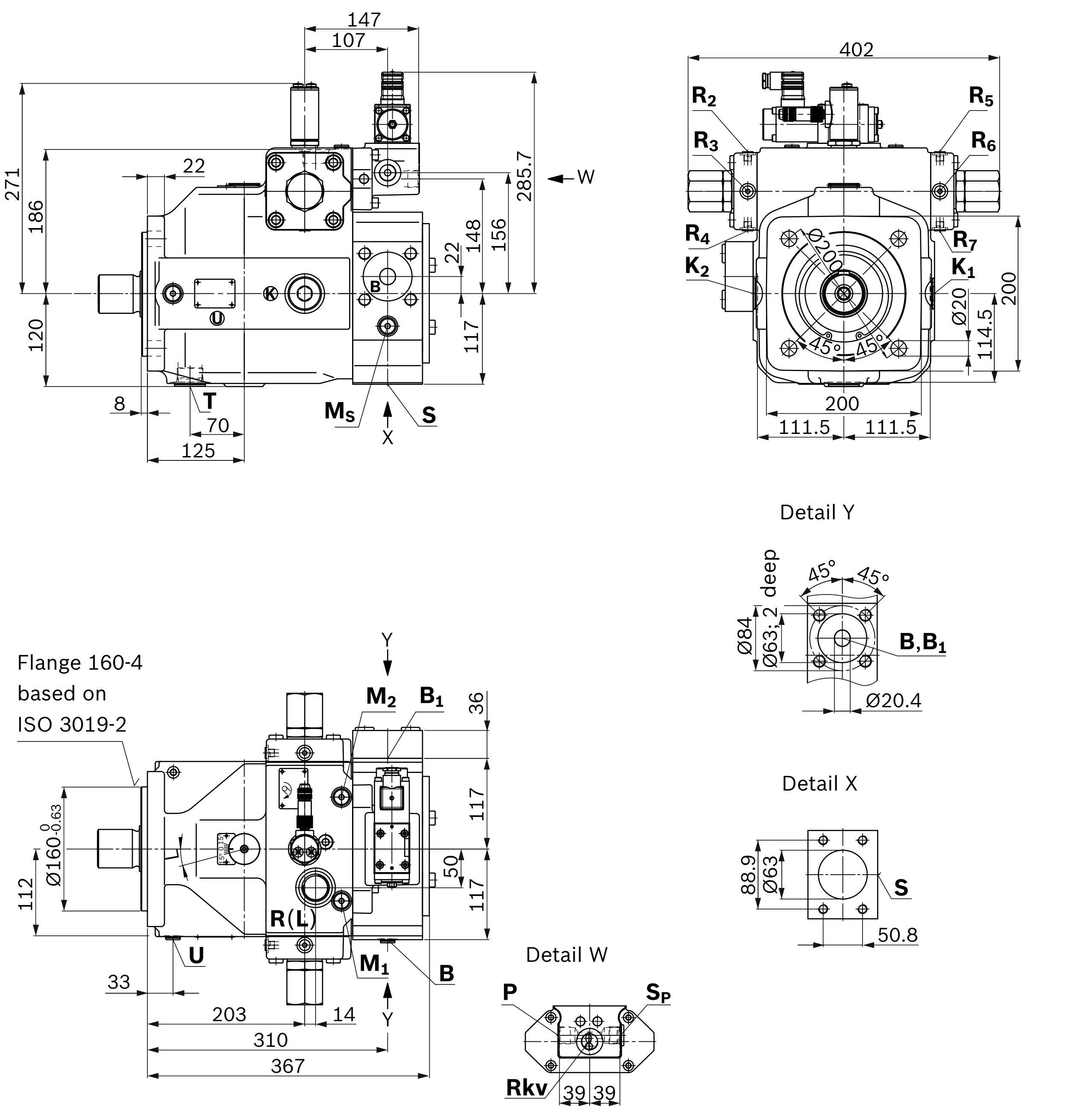


Ports		Standard	Size[2)]	$p_{\text{max abs}}$ **[bar]**[3)]	State[7)]
B	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-16 M12 × 1.75; 18 deep	500	O
B_1	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-16 M12 × 1.75; 18 deep	500	X
S	Suction port (standard pressure series) Fastening thread	SAE J518 DIN 13	SAE 1 1/2in M12 × 1.75; 20 deep	30	O
M_B	Measuring working pressure	ISO 6149	M14 × 1.5; 11.5 deep	500	X
M_S	Measuring suction pressure	ISO 6149	M14 × 1.5; 11.5 deep	30	X
T	Fluid drain	ISO 6149[5)]	M27 × 2; 16 deep	4	X[6)]
K_1, K_2	Filling – air bleeding, return flow (drain port)	ISO 6149[5)]	M27 × 2; 19 deep	4	X[6)]
R(L)	Filling – air bleeding, return flow (drain port)	ISO 6149	M27 × 2; 16 deep	4	O[6)]
Rkv	Control fluid return flow (with HS5)	DIN 3852	M22 × 1.5; 15.5 deep	210	O
Rkv	Control fluid return flow (with LR2)	DIN 3852	M18 × 1.5; 12 deep	210	X
P, S_p	Control pressure (for LR2)	DIN 3852	M22 × 1.5; 15.5 deep	315	O
Z	Control pressure (for DFE1Z)	ISO 6149	M14 × 1.5; 15.5 deep	50	O
U	Bearing flushing	ISO 6149	M14 × 1.5; 11.5 deep	4	X

1) DIN 332 center bore (DIN 13 thread)
2) Observe the instructions in the instruction manual concerning the maximum tightening torques.
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Metric fastening thread is a deviation from standard.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, T_1, K_2, K_3 or R(L) must be connected (see also installation instructions on pages 29 and 30).
7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Dimensions, size 125

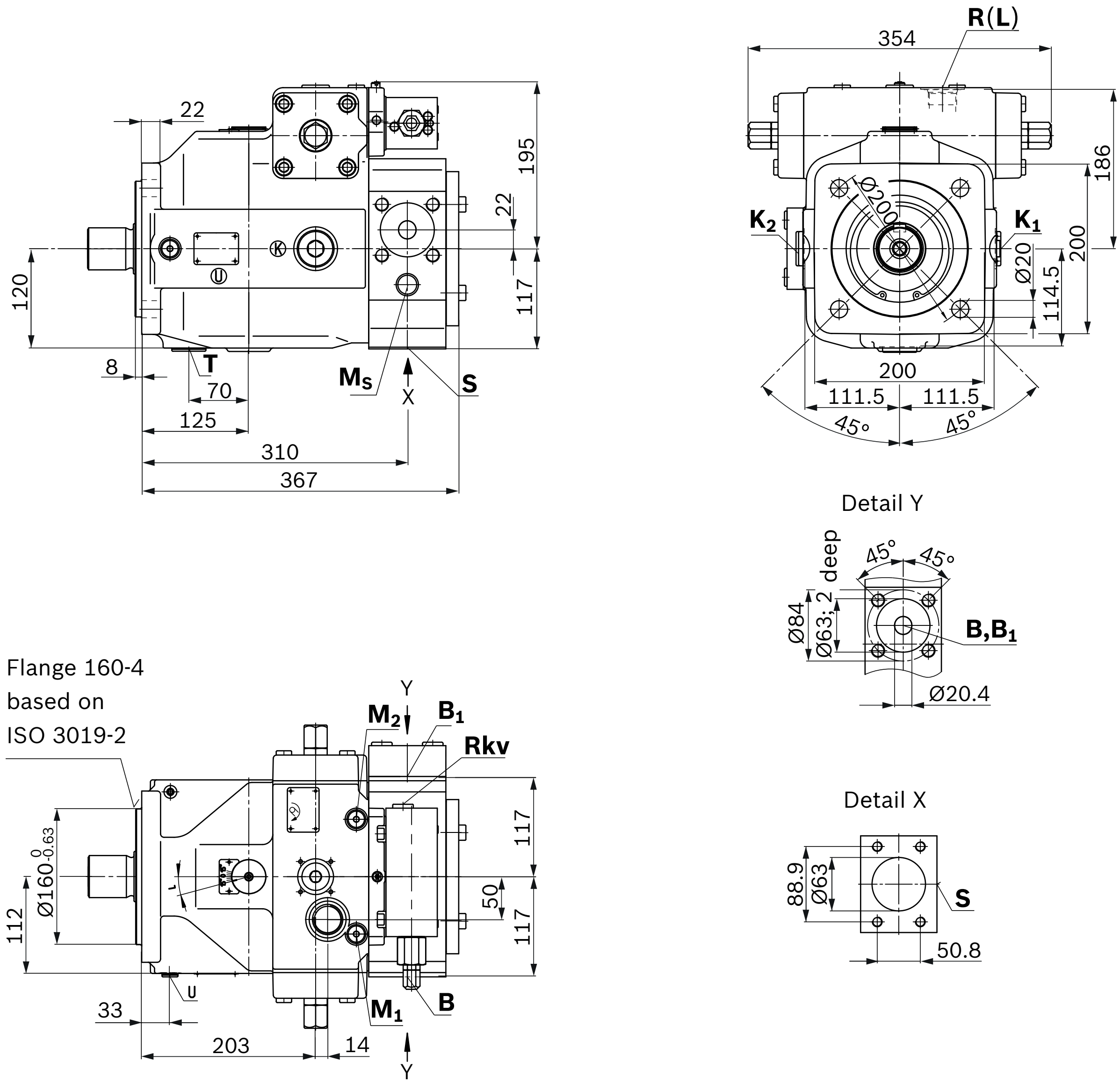
HS5 – electrohydraulic control with proportional valve



▶ For connection table, see page 17

Dimensions, size 125

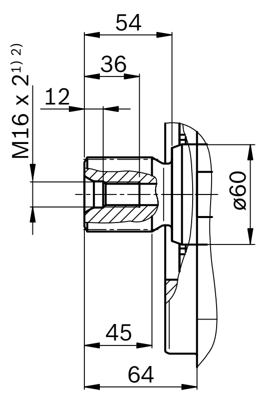
LR2 - power controller with hyperbolic characteristic curve, basic setting $V_{g\,max}$, mechanically adjustable



▶ For connection table, see page 17

▼ **DIN 5480 splined shaft**

Z – W50x2x24x9g

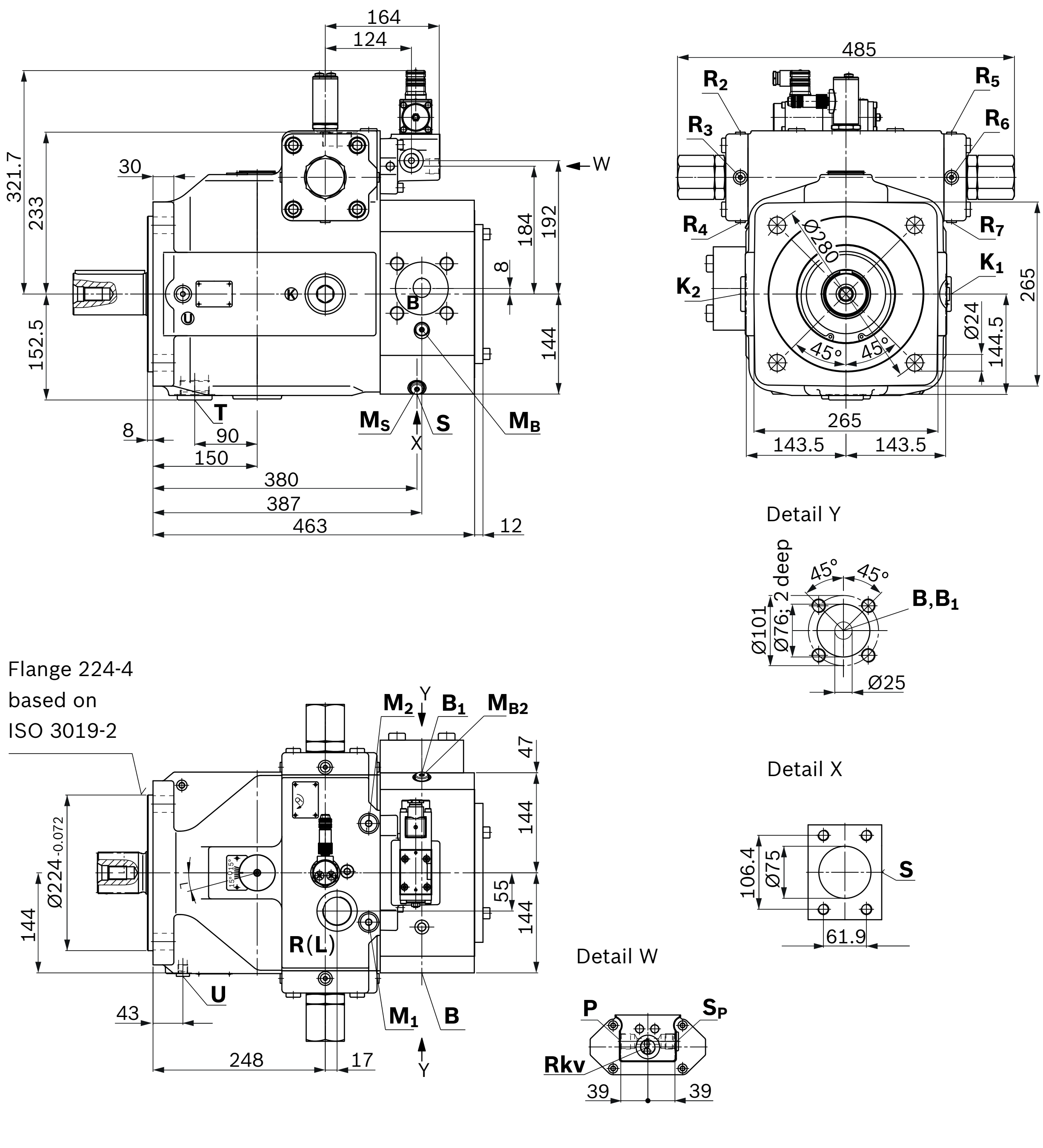


Ports		Standard	Size[2]	$p_{max\ abs}$ [bar][3]	State[7]
B	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-20 M16 × 2; 24 deep	500	O
B_1	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-20 M16 × 2; 24 deep	500	X
S	Suction port (standard pressure series) Fastening thread	SAE J518[4] DIN 13	SAE 2 1/2in M12 × 1.75; 18 deep	30	O
M_B	Measuring working pressure	ISO 6149	M14 × 1.5; 11.5 deep	500	X
M_S	Measuring suction pressure	ISO 6149	M14 × 1.5; 11.5 deep	30	X
M_1, M_2	Measuring control pressure	ISO 6149	M14 × 1.5; 11.5 deep	315	X
T	Fluid drain	ISO 6149[5]	M33 × 2; 18 deep	4	X[6]
Rkv	Control fluid return flow (with HS5)	DIN 3852[5]	M22 × 1.5; 15.5 deep	210	O
Rkv	Control fluid return flow (with LR2)	DIN 3852[5]	M18 × 1.5; 12 deep	210	O
P, S_p	Control pressure	DIN 3852[5]	M22 × 1.5; 15.5 deep	315	O
R_2-R_7	Air bleeding the control	DIN 3852[5]	M10 × 1; 10 deep	315	O
K_1, K_2	Filling – air bleeding, return flow (drain port)	ISO 6149[5]	M33 × 2; 18 deep	4	X[6]
R(L)	Filling – air bleeding, return flow (drain port)	ISO 6149[5]	M33 × 2; 18 deep	4	O[6]
Z	Control pressure	ISO 6149	M14 × 1.5; 15.5 deep	50	O
U	Bearing flushing	ISO 6149	M14 × 1.5; 11.5 deep	4	X

1) DIN 332 center bore (DIN 13 thread)
2) Observe the instructions in the instruction manual concerning the maximum tightening torques.
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Metric fastening thread is a deviation from standard.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, T_1, K_2, K_3 or R(L) must be connected (see also installation instructions on pages 29 and 30).
7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

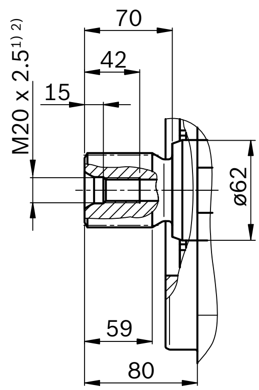
Dimensions, size 250

HS5 – electrohydraulic control with proportional valve



▼ **DIN 5480 splined shaft**

Z – W60x2x28x9g

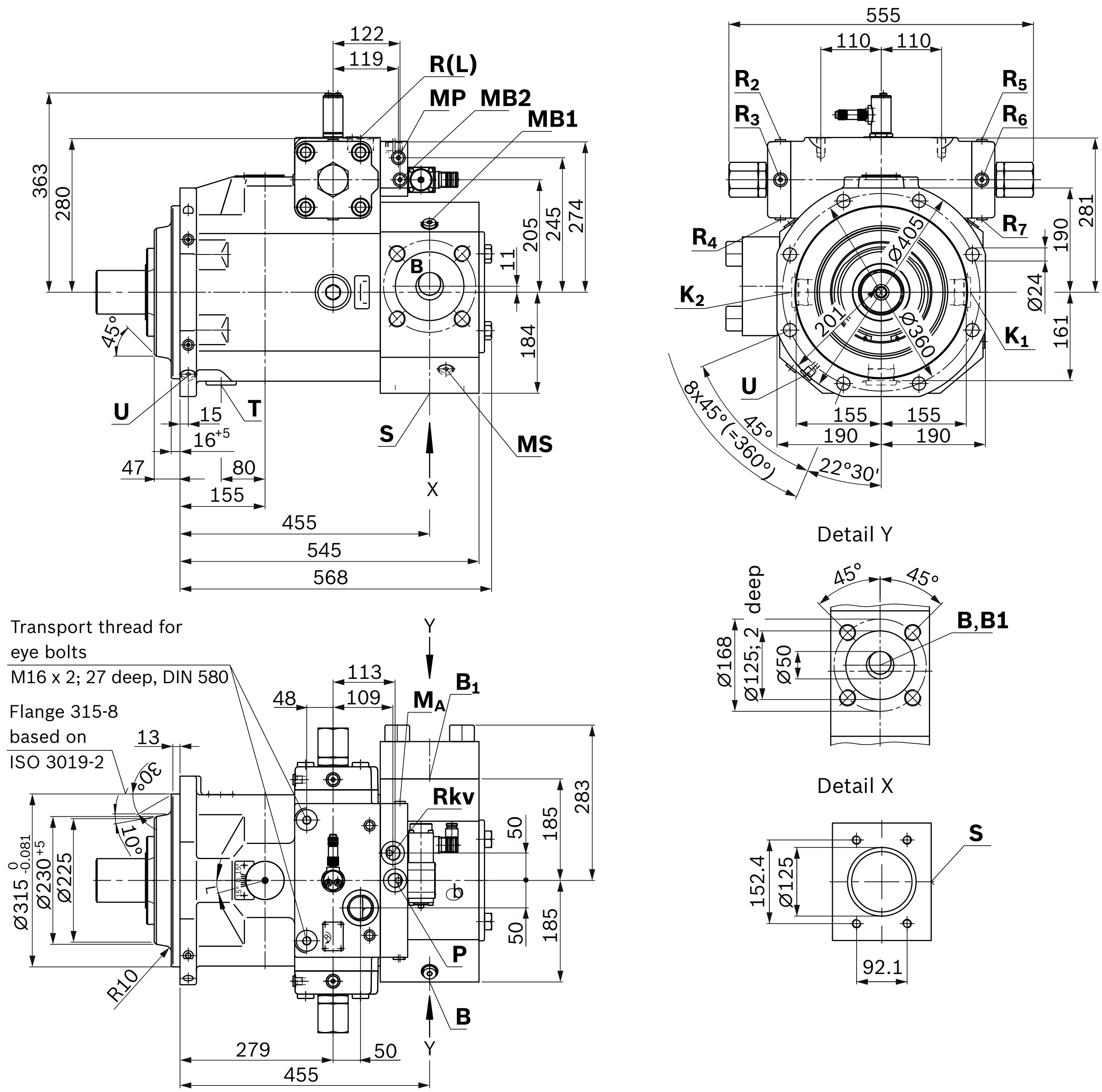


Ports		Standard	Size[2)]	$p_{\text{max abs}}$ [bar][3)]	State[7)]
B	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-25 M20 × 2.5; 24 deep	500	O
B_1	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-25 M20 × 2.5; 24 deep	500	X
S	Suction port Fastening thread	SAE J518[4)] DIN 13	SAE 3 in M16 × 2; 24 deep	30	O
M_B	Measuring working pressure	ISO 6149	M14 × 1.5; 12 deep	500	X
M_S	Measuring suction pressure	ISO 6149	M14 × 1.5; 12 deep	30	X
M_1, M_2	Measuring control pressure	ISO 6149	M18 × 1.5; 12 deep	315	X
T	Fluid drain	ISO 6149[5)]	M42 × 2; 20 deep	4	X[6)]
Rkv	Control fluid return flow	DIN 3852[5)]	M22 × 1.5; 12 deep	210	O
P, S_p	Control pressure	DIN 3852[5)]	M22 × 1.5; 15.5 deep	315	O
R_2-R_7	Air bleeding the control	DIN 3852[5)]	M10 × 1; 10 deep	315	O
K_1, K_2	Filling – air bleeding, return flow (drain port)	ISO 6149[5)]	M42 × 2; 20 deep	4	X[6)]
R(L)	Filling – air bleeding, return flow (drain port)	ISO 6149[5)]	M42 × 2; 20 deep	4	O[6)]
Z	Control pressure	ISO 6149	M14 × 1.5; 15.5 deep	50	O
U	Bearing flushing	ISO 6149	M14 × 1.5; 12 deep	4	X

1) DIN 332 center bore (DIN 13 thread)
2) Observe the instructions in the instruction manual concerning the maximum tightening torques.
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Metric fastening thread is a deviation from standard.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, T_1, K_2, K_3 or R(L) must be connected (see also installation instructions on pages 29 and 30).
7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

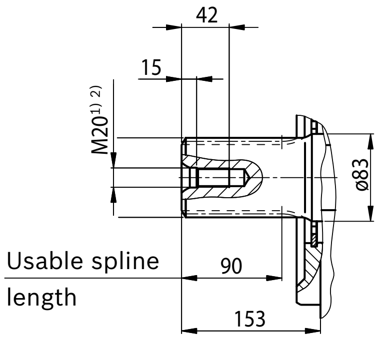
Dimensions, size 450

HS5 – electrohydraulic control with proportional valve



▼ **DIN 5480 splined shaft**

R – W80x3x25x9g



Ports		Standard	Size[2)]	$p_{\text{max abs}}$ **[bar]**[3)]	State[7)]
B	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-50 M30 × 3.5; 45 deep	500	O
B_1	Working port (high-pressure series) Fastening thread	ISO/DIS 6164-3 DIN 13	DN-50 M30 × 3.5; 45 deep	500	X
S	Suction port Fastening thread	SAE J518[4)] DIN 13	SAE 5 in M16 × 2; 24 deep	30	O
M_B	Measuring working pressure	ISO 6149	M18 × 1.5; 14.5 deep	500	X
M_S	Measuring suction pressure	ISO 6149	M18 × 1.5; 14.5 deep	30	X
T	Fluid drain	ISO 6149[5)]	M48 × 2; 22 deep	10	X[6)]
Rkv	Control fluid return flow	DIN 3852[5)]	M27 × 2; 19 deep	210	O
R_2-R_7	Air bleeding the control	DIN 3852[5)]	M14 × 1; 11.5 deep	315	O
K_1, K_2	Filling – air bleeding, return flow (drain port)	ISO 6149[5)]	M48 × 2; 22 deep	10	X[6)]
R(L)	Filling – air bleeding, return flow (drain port)	ISO 6149[5)]	M48 × 2; 22 deep	10	O[6)]
U	Bearing flushing	ISO 6149	M18 × 1.5; 14.5 deep	4	X

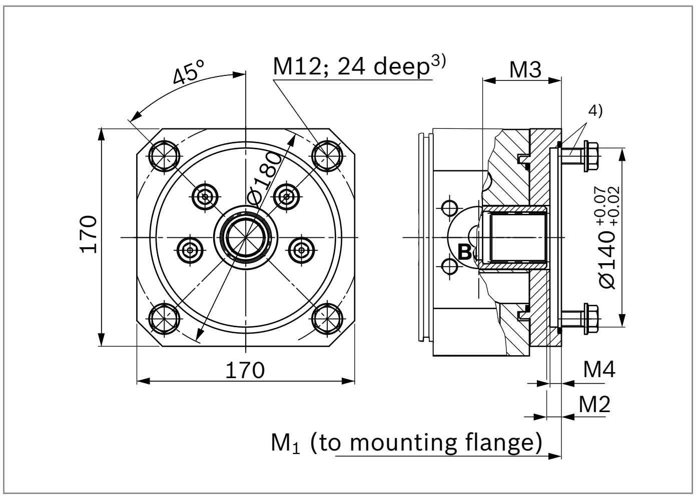
1) DIN 332 center bore (DIN 13 thread)
2) Observe the instructions in the instruction manual concerning the maximum tightening torques.
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Metric fastening thread is a deviation from standard.
5) The countersink may be deeper than specified in the standard.
6) Depending on the installation position, T_1, K_2, K_3 or R(L) must be connected (see also installation instructions on pages 29 and 30).
7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Dimensions for through drives

ISO 3019-2 flange (metric)		Hub for splined shaft[1]	Availability across sizes				Code
Diameter	**Mounting[2]**	**Diameter**	**71**	**125**	**250**	**450**	
140-4		N40 × 2 × 18 × 8H	●	–	–	o	K33
			–	●	●	–	U33
160-4		N50 × 2 × 24 × 8H	–	●	●	–	U34

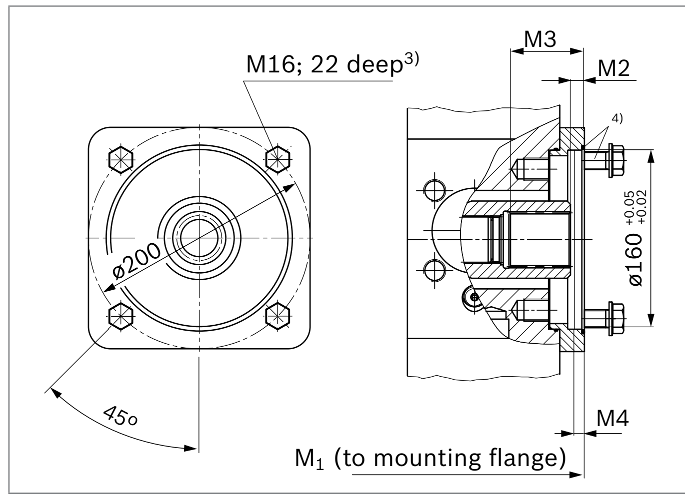
● = Available o = On request – = Not available

▼ **140-4**

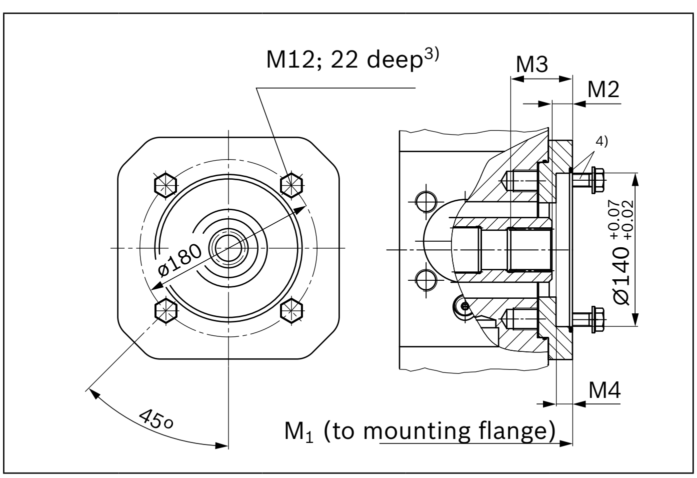


K33				
NG	**M1**	**M2**	**M3**	**M4**
71	316	11.5	61.5	9

▼ **160-4**



U34				
NG	**M1**	**M2**	**M3**	**M4**
125	377	12.5	64.1	9
250	485	12.5	66.5	9



U33				
NG	**M1**	**M2**	**M3**	**M4**
125	377	12.5	56.3	9
250	485	12.5	61.4	9

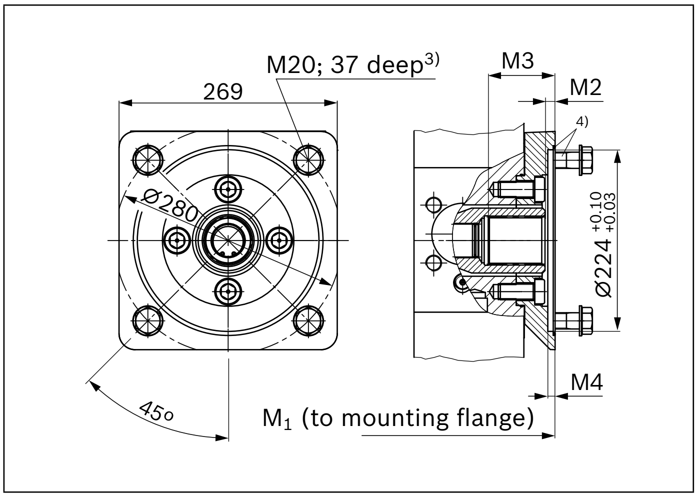
1) According to DIN 5480
2) Mounting holes pattern viewed on through drive with control at top.
3) DIN 13 thread; observe the max. tightening torques in the instruction manual.
4) O-ring and mounting bolts included in delivery.

Dimensions for through drives

ISO 3019-2 flange (metric)		Hub for splined shaft[1]	Availability across sizes				Code
Diameter	Mounting[2]	Diameter	71	125	250	450	
224-4		N60 × 2 × 28 × 8H	–	–	●	–	U35
315-8		N80 × 3 × 25 × 8H	–	–	–	●	K97

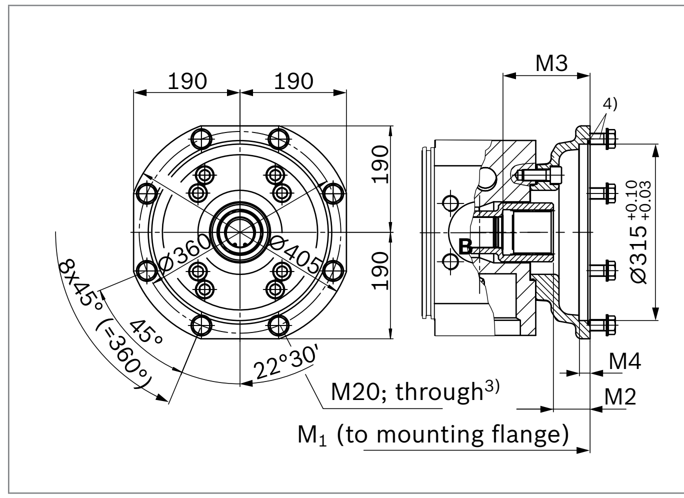
● = Available ○ = On request – = Not available

▼ 224-4



U35				
NG	M1	M2	M3	M4
250	501	12.5	87.5	9

▼ 160-4



K97				
NG	M1	M2	M3	M4
450	642	65.5	155.5	19

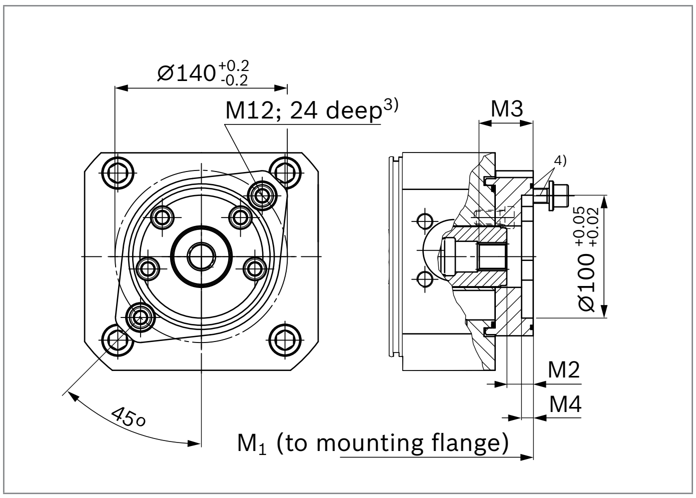
1) According to DIN 5480
2) Mounting holes pattern viewed on through drive with control at top.
3) DIN 13 thread; observe the max. tightening torques in the instruction manual.
4) O-ring and mounting bolts included in delivery.

Dimensions for through drives

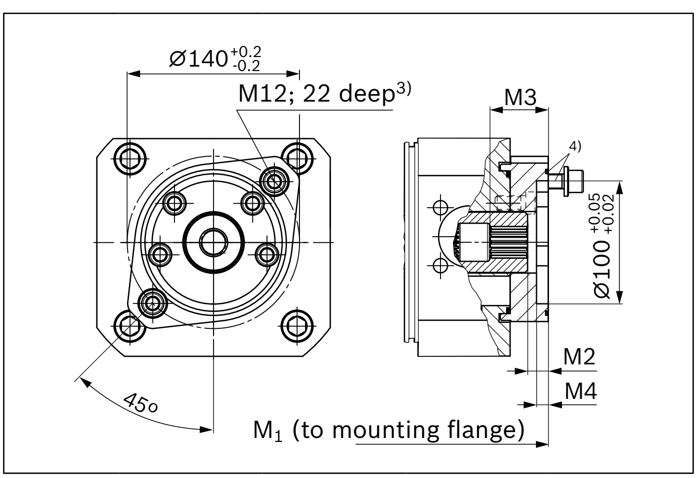
ISO 3019-2 flange (metric)		Hub for splined shaft[1]		Availability across sizes				Code
Diameter	Mounting[2]	Diameter		71	125	250	450	
100-2		7/8 in	13T 16/32DP	●	–	–	o	KB3
		1 in	15T 16/32DP	●	–	–	o	KB4
125-4		1 in	15T 16/32DP	●	–	–	o	KE1

● = Available o = On request – = Not available

▼ **100-2**

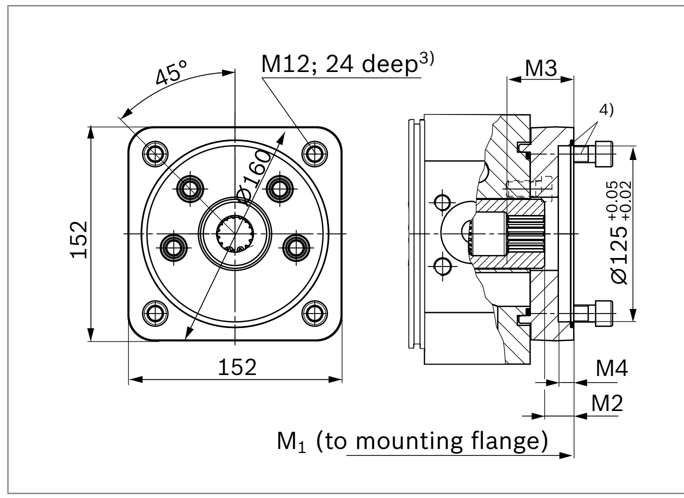


KB3				
NG	**M1**	**M2**	**M3**	**M4**
71	322	20.4	43.5	8



KB4				
NG	**M1**	**M2**	**M3**	**M4**
71	322	20	49.4	8

▼ **160-4**



KE1				
NG	**M1**	**M2**	**M3**	**M4**
71	322	19.9	49	10

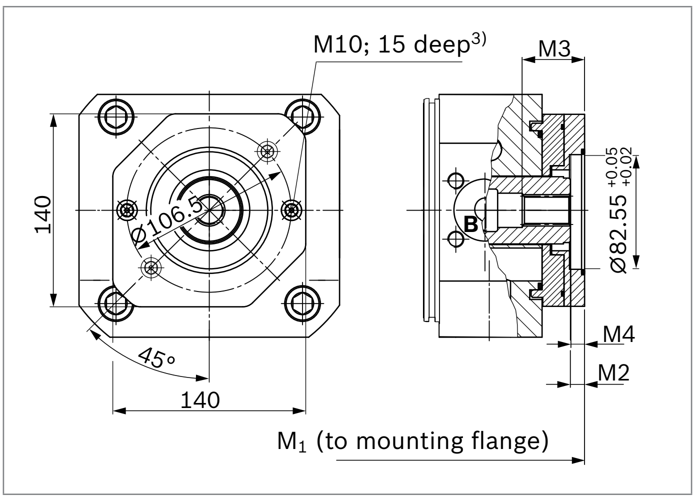
1) According to DIN 5480
2) Mounting holes pattern viewed on through drive with control at top.
3) DIN 13 thread; observe the max. tightening torques in the instruction manual.
4) O-ring and mounting bolts included in delivery.

Dimensions for through drives

ISO 3019-1 flange (SAEJ744)		Hub for splined shaft[1]		Availability across sizes				Code
Diameter	Mounting[2]	Diameter		71	125	250	450	
82-2 (A)		5/8 in	9T 16/32DP	●	–	–	○	K01
				–	○	○	–	U01
101-2 (B)		7/8 in	13T 16/32DP	●	–	–	○	K68
				–	●	●	–	U68

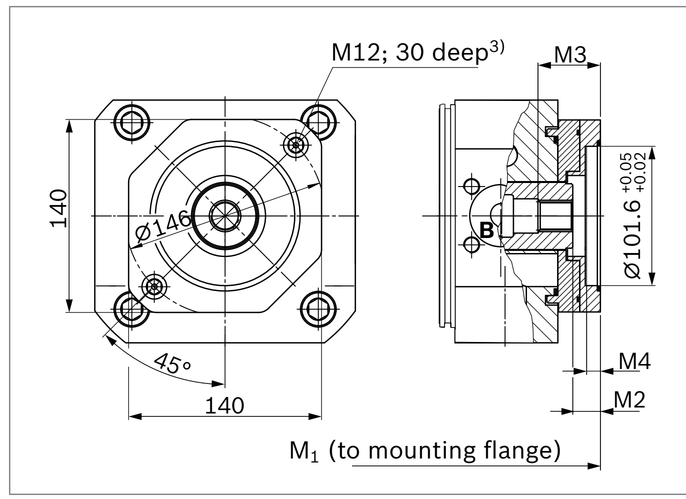
● = Available ○ = On request – = Not available

▼ **82-2**

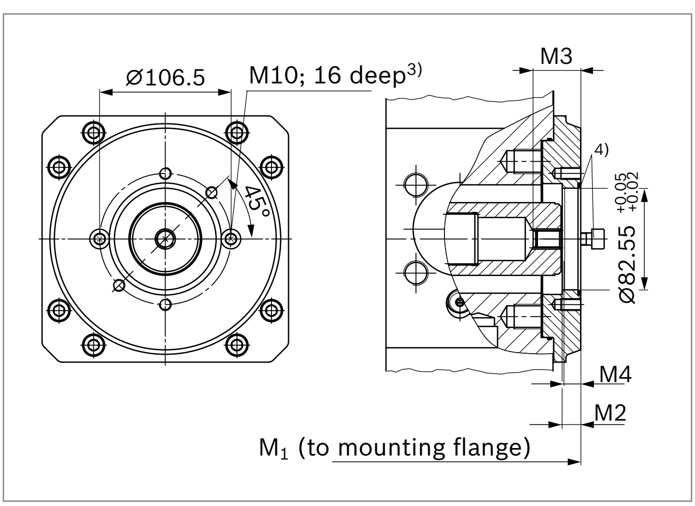


K01				
NG	M1	M2	M3	M4
71	330	10.5	36	10

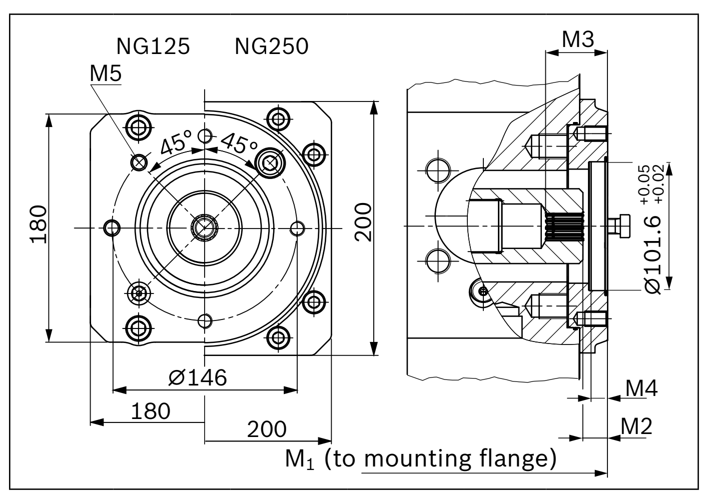
▼ **101-2**



K68				
NG	M1	M2	M3	M4
71	322	20.5	43.6	10



U01				
NG	M1	M2	M3	M4
125	377	10.3	36	13
250	485	16	35.4	13



U68					
NG	M1	M2	M3	M4	M5[3]
125	377	28	53	13	M12; 22 deep
250	485	19.5	42.6	13	M12; 18 deep

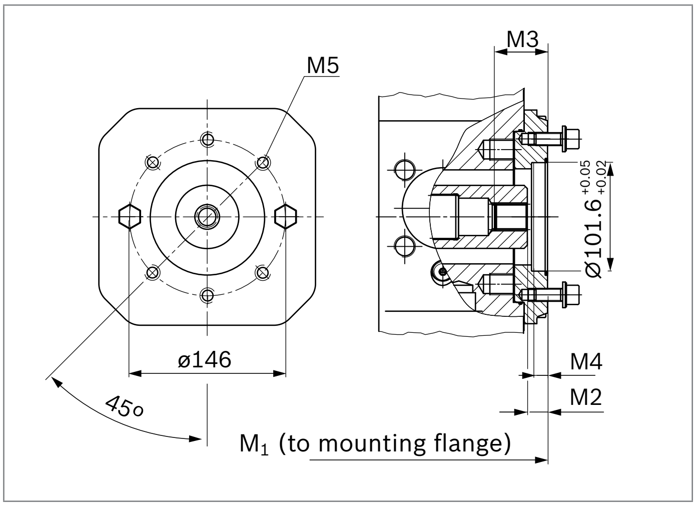
1) In accordance with ANSI B92.1a, 30° pressure angle, flat root, side fit, Tolerance Class 5
2) Mounting holes pattern viewed on through drive with control at top.
3) DIN 13 thread; observe the max. tightening torques in the instruction manual.
4) O-ring and mounting bolts included in delivery.

Dimensions for through drives

ISO 3019-1 flange (SAEJ744)		Hub for splined shaft[1]		Availability across sizes				Code
Diameter	**Mounting[2]**	**Diameter**		**71**	**125**	**250**	**450**	
101-2 (B)		1 in	15T 16/32DP	–	●	●	–	U04
127-2 (C)		1 1/2	17T 12/24DP	–	●	●	–	U24

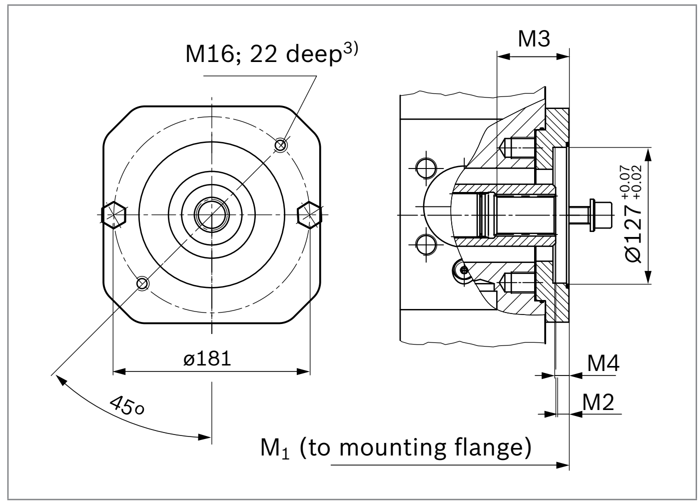
● = Available ○ = On request – = Not available

▼ **101-2**



U04					
NG	**M1**	**M2**	**M3**	**M4**	**M5[3]**
125	377	18.9	48.3	13	M12; 22 deep
250	485	18.9	48.3	13	M12; 18 deep

▼ **127-2**



U24				
NG	**M1**	**M2**	**M3**	**M4**
125	377	10.4	60.4	13
250	485	12.4	67.4	13

1) In accordance with ANSI B92.1a, 30° pressure angle, flat root, side fit, Tolerance Class 5
2) Mounting holes pattern viewed on through drive with control at top.
3) DIN 13 thread; observe the max. tightening torques in the instruction manual.
4) O-ring and mounting bolts included in delivery.

Overview of mounting options

Through drive			Mounting options – 2nd pump				
ISO 3019-2 flange (metric)	**Hub for splined shaft**	**Code**	**A4VBO NG (shaft)**	**A4VSO A4VSG NG (shaft)**	**A10V(S)O/3x[1] NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**External gear pump**
140-4	W40x2x18x9g[2]	K33 U33	71 (Z)	71 (Z)	–	–	–
160-4	W50x2x24x9g[2]	U34	125 (Z)	125 (Z) 180 (Z)	–	–	–
224-4	W60x2x28x9g	U35	250 (Z)	250 (Z)			
315-8	W80x3x25x9g[2]	K97	450 (R)	–	–	–	–
ISO 3019-1 flange (SAE J744)	**Hub for splined shaft**	**Code**	**A4VBO NG (shaft)**	**A4VSO A4VSG NG (shaft)**	**A10V(S)O/3x NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**External gear pump**
82-2 (A)	5/8in[3]	K01 U01	–	–	–	–	AZPF[4] NG 4 ... 22
101-2 (B)	7/8in[3]	K68 U68	–	–	28 (S)	28 (S)	AZPN[4] NG 20 ... 32
	1in[3]	K04 U04	–	–	45 (S)	45 (S)	PGH4
127-2 (C)	1 1/2in[3]	K24 U24	–	–	100 (S)	85/100 (S)	PGH5

1) If a through drive for an A10V(S)O with R-shaft is desired, please contact us.
2) According to DIN 5480
3) In accordance with ANSI B92.1a
4) Rexroth recommends special versions of the gear pumps, please contact us.

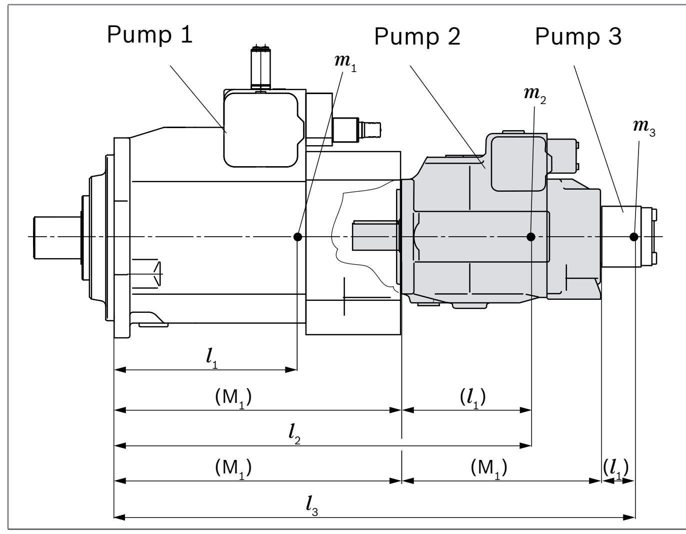
By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of pumps 1 and 2 must be connected with a "**+**" and are combined into one part number. Each single pump should be ordered according to type code.

Notice

- The combination pump type code is shown in shortened form in the order confirmation.
  Example:
  A4VBO 125 HS5/30R+A4VBO 71 HS5/10R
- 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:
A4VBO125HS5/30R-VZB25K33+
A4VSO71HS5/10R-VZB25N000

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/s^2) 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 contact us).



m_1, m_2, m_3	Weight of pump	[kg]
l_1, l_2, l_3	Distance from center of gravity	[mm]

$$T_m = (m_1 \bullet l_1 + m_2 \bullet l_2 + m_3 \bullet l_3) \bullet \frac{1}{102} \text{ [Nm]}$$

Calculation for multiple pumps		
l_1	=	Front pump distance from center of gravity (from "Permissible moments of inertia" table)
l_2	=	Dimension "M1" from through drive drawings (page 24 to 25) + l_1 of the 2nd pump
l_3	=	Dimension "M1" from through drive drawings (page 24 to 25) of the 1st pump + "M1" of the 2nd pump + l_1 of the 3rd pump

Permissible moments of inertia

Size			71	125	250	450
static	T_m	Nm	2000	4200	9300	15600
Dynamic at 10 g (98.1 m/s^2)	T_m	Nm	200	420	930	1560
Weight	m	kg	65	100	200	390
Distance from center of gravity	l_1	mm	140	170	210	230

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air-bled during commissioning and operation. This must also be done following a prolonged standstill period, as the axial piston unit may drain via the hydraulic lines.
When installed with the drive shaft up in particular, the unit should be completely filled and air-bled, otherwise there is a risk, e.g., of dry running.
The leakage in the housing area must be directed to the reservoir via the highest drain port (**T**, $\mathbf{K_1}$, $\mathbf{K_2}$, **R**(**T**)).
For combination pumps, the leakage must be drained off at each single pump.
If a shared drain line is used for several units, make sure that the respective case pressure in each unit is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, particularly at cold start. If this is not possible, lay separate drain lines, if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
Make sure the suction and drain lines flow into the reservoir below the minimum fluid level under all operating conditions. The permissible suction height h_S results from the total pressure loss. However, it must not be higher than $h_{S\,max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute (with size of 71 to 250) or 5 bar absolute (with size 450) during operation and during a cold start.
When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, and possible foaming return flow from being drawn directly back into the suction line.

Notice

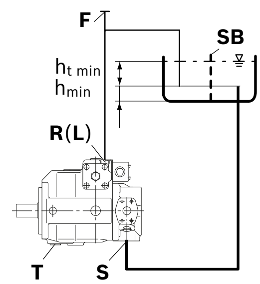
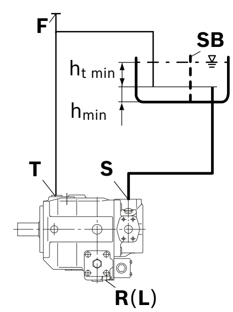
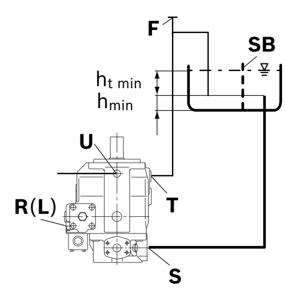
Effects on the control system are to be expected in certain installation positions. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in response time.

Installation position

See the following examples **1** up to **7**.
Further installation positions are possible upon request.
Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

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

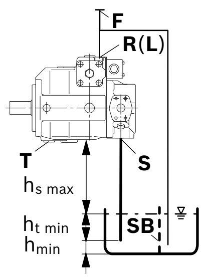
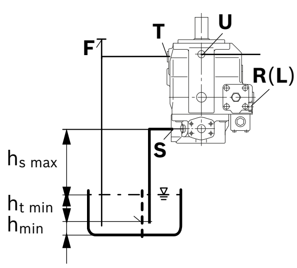
Installation position	Air bleed	Filling
1 	**R**(**L**) + **F**	**S** + **R**(**L**)
2 	**T** + **F**	**S** + **T**
3 	**T** + **F**	**S** + **T** + **U**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\,max}$ = 800 mm.

Notice

A boost pump is required with size 450

Installation position	Air bleed	Filling
4 	**F** + **R**(**L**)	**R**(**L**) + **F**
5[1] 	**F** + **T**	**T** + **F** + **U**

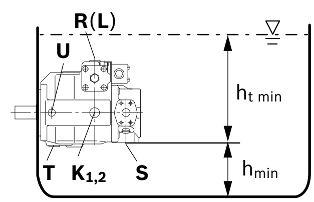
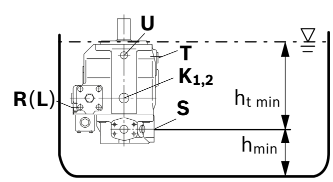
Key	
R(**L**)	Filling/air bleeding
S	Suction port
T	Drain port
U	Flushing port
K_1, **K_2**	Flushing port
SB	Baffle (baffle plate)
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\,max}$	Permissible suction height (800 mm)

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely under 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.

The exception is control HS5M, DFE1x and LR2

The proportional valve can be positioned separately in the system and connected via the designated ports **X_1** and **X_2** of the pump.
The unit can be installed in the reservoir together with the directly mounted position transducer.
Approved for HLP fluids DIN 51524.

Installation position	Air bleed	Filling
6 	Via the highest port **R(L)**	Automatically via the open port **T**, **$K_{1,2}$** due to the position under the hydraulic fluid level
7 	Via the highest open port **T**, **U**	Automatically via the open port **R(L)**, **T**, **$K_{1,2}$** due to the position under the hydraulic fluid level

Notice

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

Project planning notes

- The A4VBO axial piston variable pump is designed to be used in open circuit.
- The project planning, assembly and commissioning of the axial piston unit require the involvement of qualified skilled persons.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- The characteristic curve may also shift due to the dither frequency or control electronics.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in Data Sheet 90312 or in the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the proper contact at Bosch Rexroth if you require reliability parameters (e.g., $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. Use of the recommended direct current (DC) on the electromagnet does not produce any electromagnetic interference (EMI), nor is the electromagnet influenced by EMI.
  Potential electromagnetic interference (EMI) exists if the solenoid is energized with a modulated direct current (e.g. PWM signal). The machine manufacturer should conduct appropriate tests and take appropriate measures to ensure that other components or operators (e.g. with a pacemaker) are not affected by the potentiality.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- For drives that are operated for a long period with constant rotational speed, the natural frequency of the hydraulic system can be stimulated by the excitation frequency of the pump (rotational speed frequency ×9). This can be prevented with suitably designed hydraulic lines.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must make sure the connecting elements and lines meet the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended for hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burned on the axial piston unit, especially on the solenoids. Take the appropriate safety measures (e.g., by wearing protective clothing).
- Under certain circumstances, moving parts in control equipment (e.g., valve spools) can 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 should test whether additional measures are required on the machine for the relevant application in order to bring the driven consumer into a safe position (e.g., safe stop) and make sure any measures are properly implemented.

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