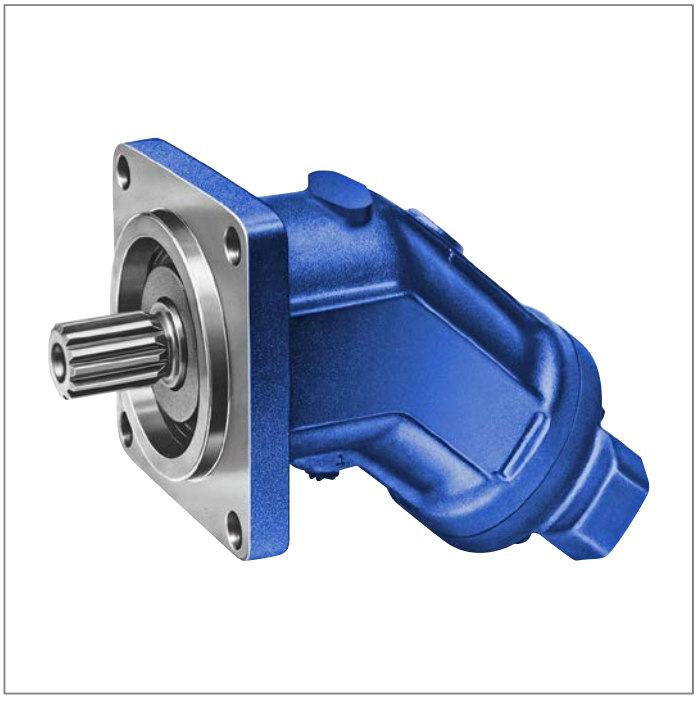
RE-A 91001/2020-03-26
Replaces: 07.2014

rexroth
A Bosch Company

Axial piston fixed motor AA2FM series 6x

Americas



- All-purpose high pressure motor
- Size 10 ... 250
- Nominal pressure up to 5800 psi (400 bar)
- Maximum pressure up to 6500 psi (450 bar)
- Open and closed circuits
- SAE version (for the US market)

Features

- Large variety of available nominal sizes allows exact adjustment to the application
- High power density
- Very high total efficiency
- High starting efficiency
- Working ports SAE flange or thread
- Optional with integrated pressure relief valve
- Optional with mounted additional valve: counterbalance valve (BVD/BVE), flushing and boost-pressure valve
- Bent-axis design

Contents

Type code

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15
	AA2F		**M**		**/**	**6**		**W**	**–**	**V**						

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearing “L“ (without code)		
	HFB-, HFC-hydraulic fluid	Sizes 10 to 180 (without code)	
		Size 250 (only in combination with long-life bearing “L”)	**E-**

Axial piston unit

02	Bent-axis design, fixed	**AA2F**

Drive shaft bearing

		10–180	**250**	
03	Standard bearing (without code)	●	●	
	Long-life bearing	–	●	**L**

Operating mode

04	Motor	**M**

Sizes (NG) [1)]

05	Geometric displacement (see table of values)											
		10	**12**	**16**	**23**	**28**	**32**	**107**	**125**	**160**	**180**	**250**

Series

06		**6**

Index

07		size 10 to 180	**1**
		size 250	**0**

Direction of rotation

08	Viewed on drive shaft, bidirectional	**W**

Seal material

09	FKM (fluoroelastomer)	**V**

Drive shaft

		10	**12**	**16**	**23**	**28**	**32**	**107**	**125**	**160**	**180**	**250**	
10	Splined shaft SAE J744 (ANSI B92.1a)	●	●	●	●	●	●	●	●	●	●	●	**S**
		–	–	–	–	–	–	●	●	–	–	–	**U**
	Parallel keyed shaft DIN 6885	●	●	●	●	●	●	●	●	●	●	–	**B**
		●	●	–	●	●	–	●	–	●	–	–	**P**
	Parallel keyed shaft SAE	–	–	–	–	–	–	–	–	–	–	●	**K**

Mounting flange

			10–16	**23–250**	
11	SAE J744	2-hole	●	–	**C**
		4-hole	–	●	**D**

● = Available ○ = On request – = Not available

[1)] Sizes 45, 56, 63, 80, 90 see data sheet 91071 (A2FM series 70)

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15
	AA2F		**M**		**/**	**6**		**W**	**–**	**V**						

Working ports

					10-16	23	28-32	107-125	160-180	250	
12	SAE working ports **A** and **B** at rear	51	0	–	●	●	●	●	●	**510**
	SAE working ports **A** and **B** at side, opposite	52	0	–	●	●	●	●	●	**520**
			7	–	●	●	●	●	●	**527**
	Threaded ports **A** and **B** at side, opposite	53	0	●	●	●	–	–	–	**530**
	Threaded ports **A** and **B** side and rear[1]	54	0	–	●	●	–	–	–	**540**
	SAE working ports **A** and **B** at bottom	60	0	–	–	–	●	–	–	**600**
	Port plate with pressure relief valves for mounting a counterbalance valve[3] BVD	17	1	–	–	–	●	–	–	**171 178**
		18	8	–	–	●	●	●	–	**181**
	BVE	18		–	–	–	○	○	–[2]	**188**
	Port plate with pressure relief valves[3]	19	1	–	–	●	●	●	–	**191**
			2	–	–	●	●	●	–	**192**

Valves

Without valve	**0**
Pressure-relief valves (without pressure boost facility)	**1**
Pressure-relief valves (with pressure boost facility)	**2**
Flushing and boost pressure valve mounted	**7**
Counterbalance valve BVD/BVE mounted[4]	**8**

Speed sensors

		10-16	23-32	107-125	160	180	250	
13	Without speed sensor (without code)	●	●	●	●	●	●	
	Prepared for HDD speed sensor	–	–	–	–	–	●	**F**
	HDD speed sensor mounted[5]	–	–	–	–	–	●	**H**
	Prepared for DSA speed sensor	–	●	●	●	●	–	**U**
	Speed sensor DSA mounted[5]	–	●	●	●	●	–	**V**

Special version (only sizes 28 to 180)

14	Standard version (without code)	
	Special version for slew drives (standard with port plate 19)	**J**

Standard / special version

15	Standard version (without code)	
	Standard version with installation variants, e. g. **T** ports against standard open or close	**–Y**
	Special version	**–S**

● = Available ○ = On request – = Not available

1) Threaded ports at the sides plugged with threaded plugs.
2) Please contact us.
3) Threaded ports and fastening threads are metric
4) Specify ordering code of counterbalance valve according to data sheet 95522 (BVD) respectively data sheet 95526 (BVE) separately.
5) Specify ordering code of sensor according to data sheet 95133 (DSA) respectively data sheet 95135 (HDD) separately.

Notice

- Please note the project planning notes in chapter Project planning notes
- Please note that not all type code combinations are available although the individual functions are marked as being available

Technical data

Table of values

Size			10	12	16	23	28	32	107	125	160	180	250
Displacement geometric, per revolution	V_g	in³	0.63	0.73	0.98	1.4	1.71	1.95	6.51	7.63	9.79	11	15.3
		cm³	10.3	12	16	22.9	28.1	32	106.7	125	160.4	180	250
Nominal pressure	p_{nom}	psi	5800	5800	5800	5800	5800	5800	5800	5800	5800	5800	5100
		bar	400	400	400	400	400	400	400	400	400	400	350
Maximum pressure	p_{max}	psi	6500	6500	6500	6500	6500	6500	6500	6500	6500	6500	5800
		bar	450	450	450	450	450	450	450	450	450	450	400
Maximum speed [1]	n_{nom}	rpm	8000	8000	8000	6300	6300	6300	4000	4000	3600	3600	2700
	n_{max} [2]	rpm	8800	8800	8800	6900	6900	6900	4400	4400	4000	4000	
Inlet flow [3] at n_{nom}	q_V	gpm	21.7	25.4	33.8	38	46.8	53.4	113	132	152	171	178
		l/min	82	96	128	144	177	202	427	500	577	648	675
Torque [4] at p_{nom}	M	lb-ft	49	56	75	108	132	150	501	587	753	845	1027
		Nm	66	76	102	146	179	204	679	796	1021	1146	1393
Rotary stiffness	c	lb-ft/rad	679	922	1173	1888	2161	2301	8261	8777	12834	13424	53916
		kNm/rad	0.92	1.25	1.59	2.56	2.93	3.12	11.2	11.9	17.4	18.2	73.1
Moment of inertia for rotary group	J_{TW}	lb-ft²	0.009	0.009	0.009	0.028	0.028	0.028	0.275	0.275	0.522	0.522	1.448
		kg·m²	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0116	0.0116	0.022	0.022	0.061
Maximum angular acceleration	α	rad/s²	5000	5000	5000	6500	6500	6500	4500	4500	3500	3500	10000
Case volume	V	gal	0.045	0.045	0.045	0.053	0.053	0.053	0.211	0.211	0.291	0.291	0.66
		l	0.17	0.17	0.17	0.2	0.2	0.2	0.8	0.8	1.1	1.1	2.5
Weight (approx.)	m	lbs	12	12	12	21	21	21	71	71	99	99	161
		kg	5.4	5.4	5.4	9.5	9.5	9.5	32	32	45	45	73

[1] These values are valid at:
- for the optimum viscosity range from v_{opt} = 36 to 16 cSt
- with hydraulic fluid based on mineral oils

[2] Intermittent maximum speed: overspeed for unload and overhauling processes, t < 5 s and Δp < 2200 psi (150 bar)

[3] Restriction of input flow with counterbalance valve

[4] Torque without radial force, with radial force see table "Permissible radial and axial forces of the drive shafts"

Note

- The values in the table are theoretical values, without consideration of efficiencies and tolerances. The values are 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. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm.

Determining the operating characteristics		
Inlet flow	$q_v = \frac{V_g \times n}{231 \times \eta_v}$	[gpm]
Rotational speed	$n = \frac{q_v \times 231 \times \eta_v}{V_g}$	[rpm]
Torque	$M = \frac{V_g \times \Delta p \times \eta_{hm}}{24 \times \pi}$	[lb-ft]
Power	$P = \frac{2 \pi \times M \times n}{33000} = \frac{q_v \times \Delta p \times \eta_t}{1714}$	[HP]

Key

V_g	Displacement per revolution [in³]
Δp	Differential pressure [psi]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \cdot \eta_{hm}$)

Hydraulic fluids

The axial piston unit is designed for operation with mineral oil HLP according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR, HFDU)
- 90223: Fire-resistan, water-containing hydraulic fluids (HFAE, HFAS, HFB, HFC)
- 90225: Restricted technical data for operation with fire-resistant hydraulic fluids

Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature[1]	Comment
Cold start	v_{max} ≤ 1600 cSt	NBR[2]	ϑ_{St} ≥ -40 °F (-40 °C)	t ≤ 3 min, without load (p ≤ 725 psi / 50 bar), n ≤ 1000 rpm (size 10 to 180), ≤ 0.25 • n_{nom} (size 250), permissible temperature difference between axial piston unit and hydraulic fluid max. 45 °F (25 K)
		FKM	ϑ_{St} ≥ -13 °F (-25 °C)	
Warm-up phase	v = 400 ... 1600 cSt			t ≤ 15 min, p ≤ 0.7 • p_{nom} and n ≤ 0.5 • n_{nom}
Continuous operation	v = 10 ... 400 cSt[3]	NBR[2]	ϑ ≤ +172 °F (+78 °C)	measured at port **T**
		FKM	ϑ ≤ +217 °F (+103 °C)	
	v_{opt} = 16 ... 36 cSt			range of optimum operating viscosity and efficiency
Short-term operation	v_{min} = 7 ... 10 cSt	NBR[2]	ϑ ≤ +172 °F (+78 °C)	t ≤ 3 min, p ≤ 0.3 • p_{nom} measured at port **T**
		FKM	ϑ ≤ +217 °F (+103 °C)	

1) If the specified temperatures cannot be maintained due to extreme operating parameters, please contact us.
2) Special version, please contact us.
3) Equates e.g. with the VG 46 a temperature range of +41 °F to +185 °F (+5 °C to +85 °C) (see selection diagram)

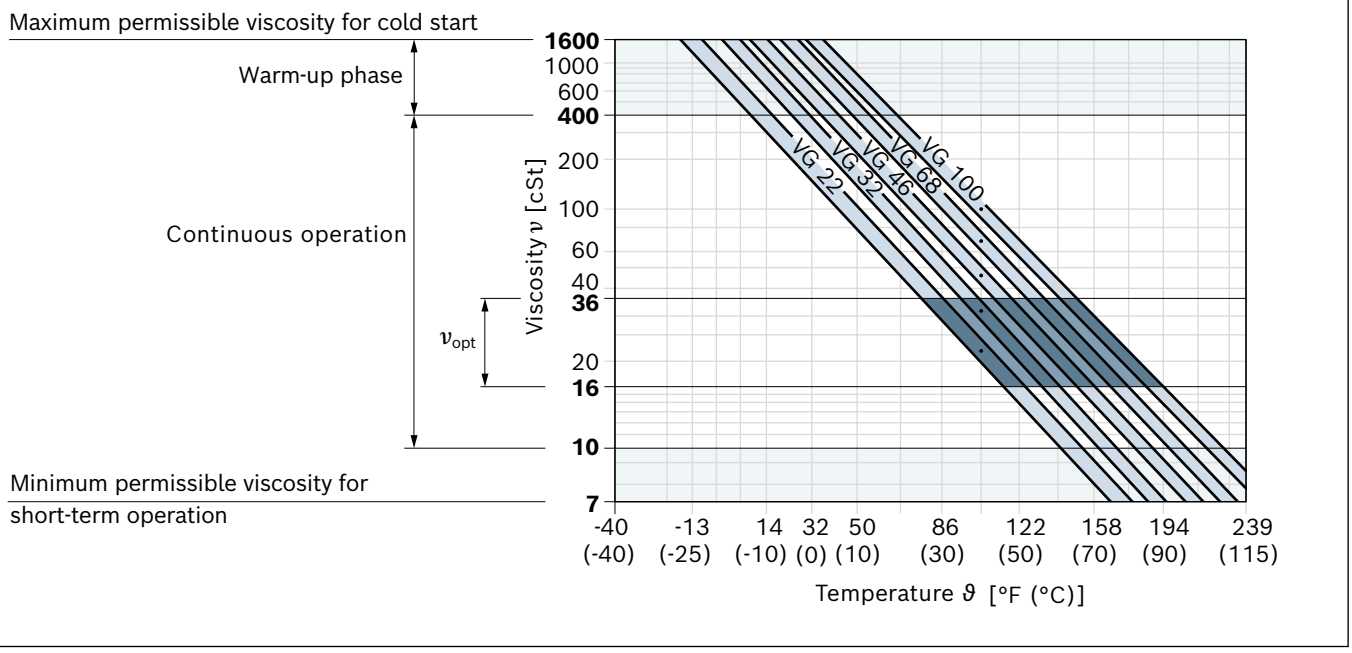
Note
To reduce high temperature of the hydraulic fluid in the axial piston unit we recommend the use of a flushing and boost pressure valve (see chapter Extended functions and versions).

Selection of hydraulic fluid
Bosch Rexroth evaluates hydraulic fluids on the basis of the Fluid Rating according to the technical data sheet 90235.
Hydraulic fluids with positive evaluation in the Fluid Rating are provided in the following technical data sheet:

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

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

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 is to be maintained according to ISO 4406.

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

For example, the viscosity is 10 cSt at:

- HLP 32 a temperature of 163°F
- HLP 46 a temperature of 185°F

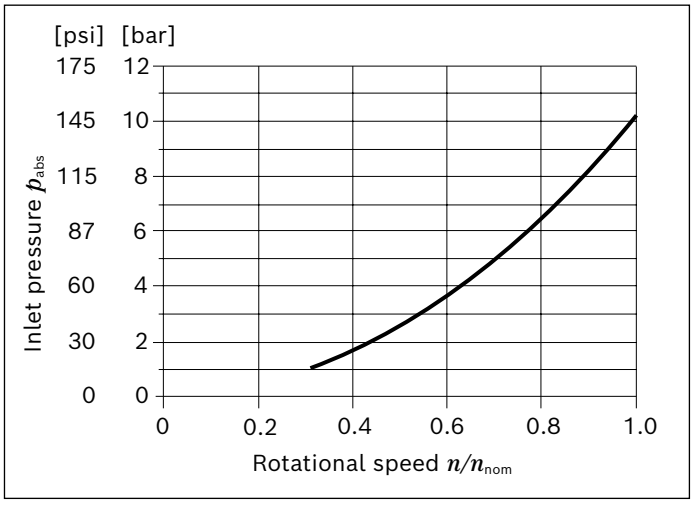
Operating pressure range

Pressure at working port A or B (high-pressure side)			**Definition**
Nominal pressure	p_{nom}	see table of values	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure	p_{max}	see table of values	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period		10 s	
Total operating period		300 h	
Minimum pressure	$p_{HP\ min}$	365 psi (25 bar)	Minimum pressure on high-pressure side (port **A** or **B**) required to prevent damage to the axial piston unit.
Minimum pressure at inlet (pump operating mode)	$p_{E\ min}$	see diagram	To prevent damage to the axial piston motor in pump mode (change of high-pressure side with unchanged direction of rotation, e.g. when braking),a minimum pressure must be guaranteed at the working port (inlet). The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Total pressure	p_{Su}	10150 psi (700 bar)	The summation pressure is the sum of the pressures at both work ports (**A** and **B**).
Rate of pressure change			**Definition**
with integrated pressure relief valve	$R_{A\ max}$	130000 psi/s (9000 bar/s)	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
without pressure relief valve	$R_{A\ max}$	230000 psi/s (16000 bar/s)	
Case pressure at port T			**Definition**
Continuous differential pressure	$\Delta p_{T\ cont}$	30 psi (2 bar)	Maximum averaged differential pressure at the shaft seal (case to ambient)
Pressure peaks	$p_{T\ peak}$	145 psi (10 bar)	t < 0.1 s

Note

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

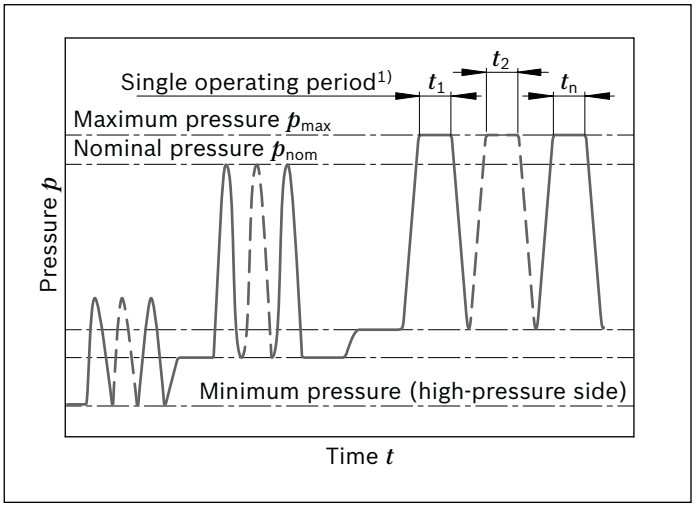
Minimum pressure at inlet (pump operating mode)



This diagram is only valid for the optimum viscosity range of v_{opt} = 16 to 36 cSt.

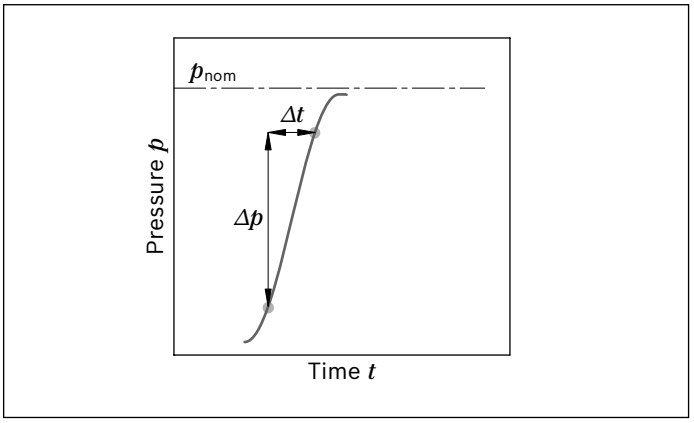
If the above mentioned conditions cannot be ensured, please contact us.

Pressure definition

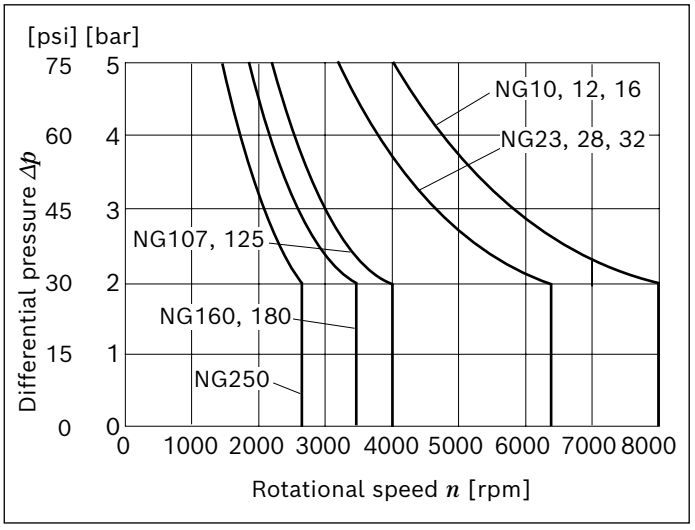


1) Total operating period = $t_1 + t_2 + ... + t_n$

Rate of pressure change



Maximum differential pressure at the shaft seal



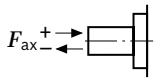
Note

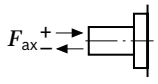
- The service life of the shaft seal is influenced by the speed of the axial piston unit and the case pressure.
- The service life decreases with an increase of the mean differential pressure between the case and the ambient pressure and with a higher frequency of pressure spikes.
- The case pressure must be equal to or higher than the ambient pressure.

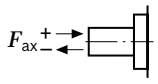
Direction of flow

Direction of rotation, viewed on drive shaft	
clockwise	counter-clockwise
A to **B**	**B** to **A**

Permissible radial and axial forces of the drive shaft

Size			**10**			**12**			**16**		**23**			**28**
Drive shaft	Code Size (Ø in mm)		**S** 7/8	**P** Ø20	**B** Ø25	**S** 7/8	**P** Ø20	**B** Ø25	**S** 7/8	**B** Ø25	**S** 1 1/4	**P** Ø25	**B** Ø30	**S** 1 1/4
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	lbf	629	674	719	742	674	719	967	719	809	1281	1214	989
		kN	2.8	3	3.2	3.3	3	3.2	4.3	3.2	3.6	5.7	5.4	4.4
	a	in	0.66	0.63	0.63	0.66	0.63	0.63	0.66	0.63	0.94	0.63	0.63	0.94
		mm	16.8	16	16	16.8	16	16	16.8	16	24	16	16	24
Permitted torque at $F_{q\,max}$	$T_{q\,max}$	lb-ft	49	49	49	56	56	56	72	75	108	108	108	132
		Nm	66	66	66	76	76	76	98	102	146	146	146	179
Permitted differential pressure at $F_{q\,max}$	$\Delta p_{q\,max}$	psi	5800	5800	5800	5800	5800	5800	5584	5800	5800	5800	5800	5800
		bar	400	400	400	400	400	400	385	400	400	400	400	400
Maximum axial force, when standstill or in non-pressurized conditions 	+ $F_{ax\,max}$	lbf	0	0	0	0	0	0	0	0	0	0	0	0
	- $F_{ax\,max}$	lbf	72	72	72	72	72	72	72	72	112	112	112	112
		N	320	320	320	320	320	320	320	320	500	500	500	500
Maximum axial force, per psi operating pressure	+ $F_{ax\,max}$	lbf/psi	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.08	0.08	0.08	0.08
		N/bar	3	3	3	3	3	3	3	3	5.2	5.2	5.2	5.2

Size			**28**		**32**		**107**				**125**		
Drive shaft	Code Size (Ø in mm)		**P** Ø25	**B** Ø30	**S** 1 1/4	**B** Ø30	**U** 1 1/2	**S** 1 3/4	**P** Ø40	**B** Ø45	**U** 1 1/2	**S** 1 3/4	**B** Ø45
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	lbf	1281	1214	1147	1214	2788	2743	3057	3170	2788	3215	3170
		kN	5.7	5.4	5.1	5.4	12.4	12.2	13.6	14.1	12.4	14.3	14.1
	a	in	0.63	0.63	0.94	0.63	1.06	1.32	0.79	0.79	1.06	1.32	0.79
		mm	16	16	24	16	27	33.5	20	20	27	33.5	20
Permitted torque at $F_{q\,max}$	$T_{q\,max}$	lb-ft	132	132	150	150	438	501	501	501	438	587	587
		Nm	179	179	204	204	594	679	679	679	594	796	796
Permitted differential pressure at $F_{q\,max}$	$\Delta p_{q\,max}$	psi	5800	5800	5800	5800	5062	5800	5800	5800	4322	5800	5800
		bar	400	400	400	400	349	400	400	400	298	400	400
Maximum axial force, when standstill or in non-pressurized conditions 	+ $F_{ax\,max}$	lbf	0	0	0	0	0	0	0	0	0	0	0
	- $F_{ax\,max}$	lbf	112	112	112	112	281	281	281	281	281	281	281
		N	500	500	500	500	1250	1250	1250	1250	1250	1250	1250
Maximum axial force, per psi operating pressure	+ $F_{ax\,max}$	lbf/psi	0.08	0.08	0.08	0.08	0.2	0.2	0.2	0.2	0.2	0.2	0.2
		N/bar	5.2	5.2	5.2	5.2	12.9	12.9	12.9	12.9	12.9	12.9	12.9

Size			**160**			**180**		**250**	
Drive shaft	Code Size (Ø in mm)		**S** 1 3/4	**P** Ø45	**B** Ø50	**S** 1 3/4	**B** Ø50	**S** 2	**K** Ø50.8
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	lbf	3350	4069	4114	3350	4114	270 [1]	
		kN	14.9	18.1	18.3	14.9	18.3	1.2 [1]	
	a	in	1.32	0.98	0.98	1.32	0.98	1.61	
		mm	33.5	25	25	33.5	25	41	
Permitted torque at $F_{q\,max}$	$T_{q\,max}$	lb-ft	611	753	753	611	845		
		Nm	828	1021	1021	828	1146		
Permitted differential pressure at $F_{q\,max}$	$\Delta p_{q\,max}$	psi	4710	5800	5800	4192	5800		
		bar	325	400	400	289	400		
Maximum axial force, when standstill or in non-pressurized conditions 	+ $F_{ax\,max}$	lbf	0	0	0	0	0	0	
	- $F_{ax\,max}$	lbf	360	360	360	360	360	450	
		N	1600	1600	1600	1600	1600	2000	
Maximum axial force, per psi operating pressure	+ $F_{ax\,max}$	lbf/psi	0.26	0.26	0.26	0.26	0.26		
		N/bar	16.7	16.7	16.7	16.7	16.7		

[1] When at a standstill or when axial piston unit operating in non-pressurized conditions.
Higher forces are permissible when under pressure, please contact us.

General instructions

- The values given are maximum values and do not apply to continuous operation.
- The axial force in direction $-F_{ax}$ is to be avoided as the service life of the bearing is reduced.
- Special requirements apply in the case of belt drives. Please contact us.

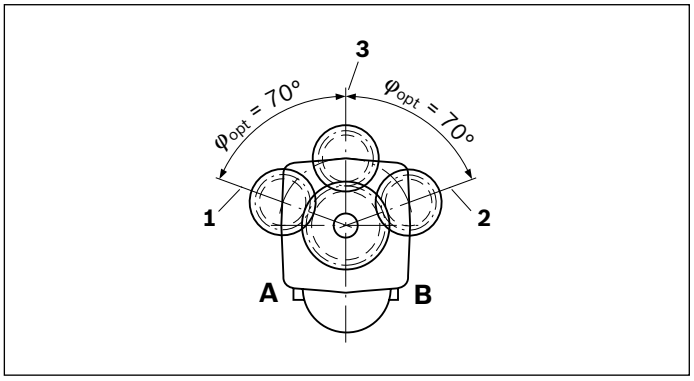
Notes for size 250:

- In case of radial forces limited performance data is valid. Please contact us.
- In case of axial forces during operation of the unit please contact us.

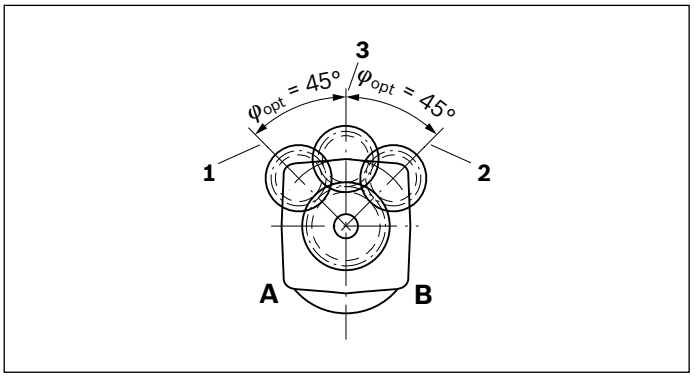
Effect of radial force F_q on the service life of bearings

By selecting a suitable direction of radial force F_q the load on the bearings caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

Toothed gear drive, size 10 ... 180



Toothed gear drive, size 250



1 Direction of rotation "counter-clockwise", pressure at port **B**

2 Direction of rotation "clockwise", pressure at port **A**

3 Direction of rotation "bidirectional"

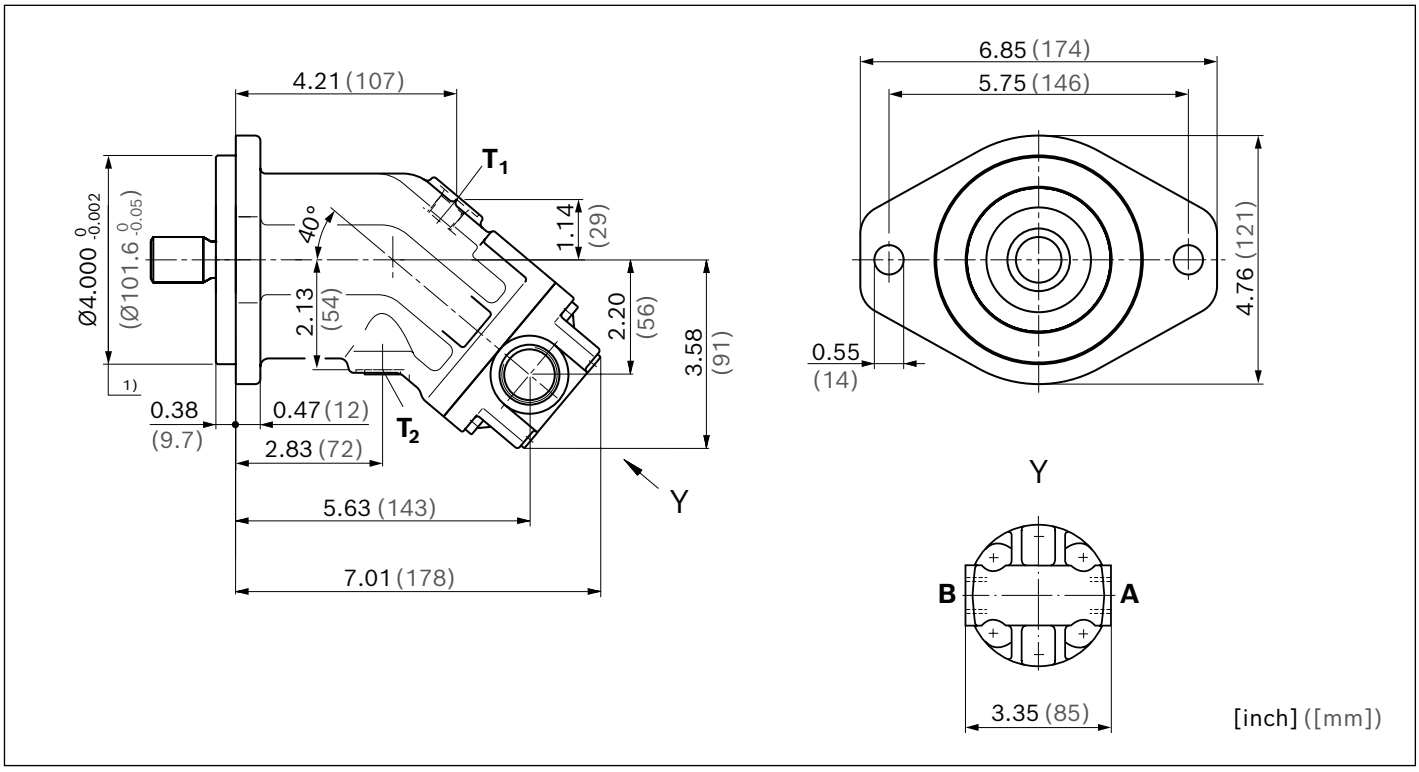
Long-Life bearing

Size 250

For long service life and use with HF hydraulic fluids. Identical external dimensions as version with standard bearings. Subsequent conversion to long-life bearings is possible.

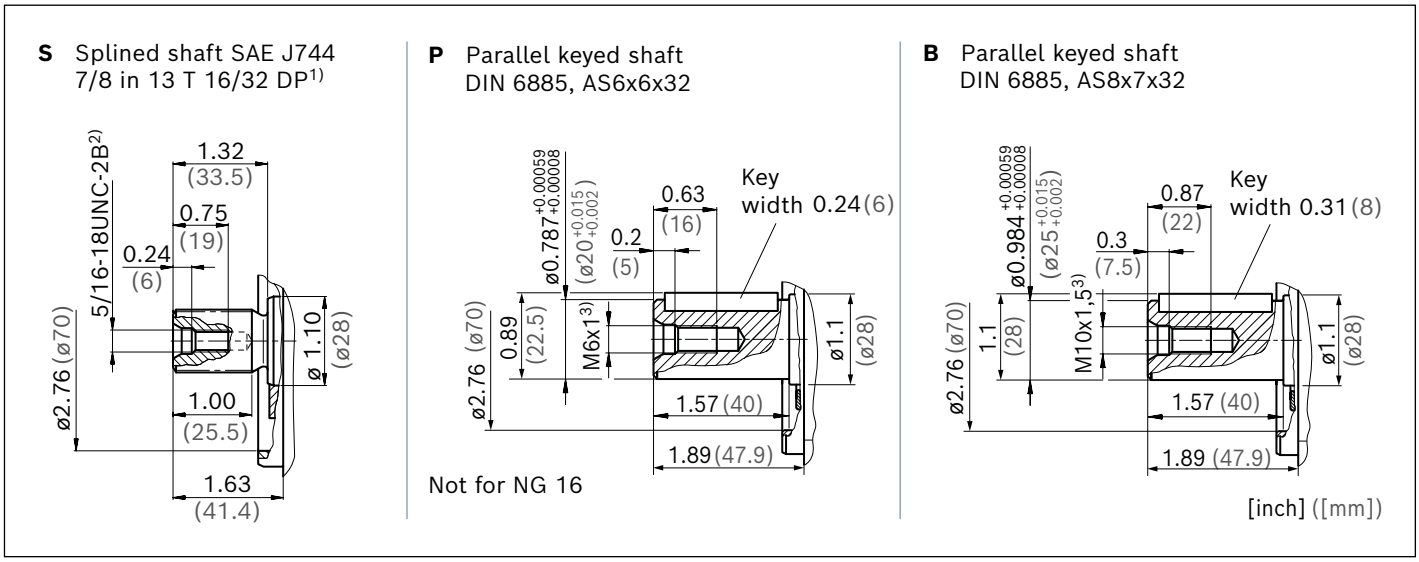
Dimensions

Size 10 ... 16



1) Flange SAE J744

Drive shafts S, P and B



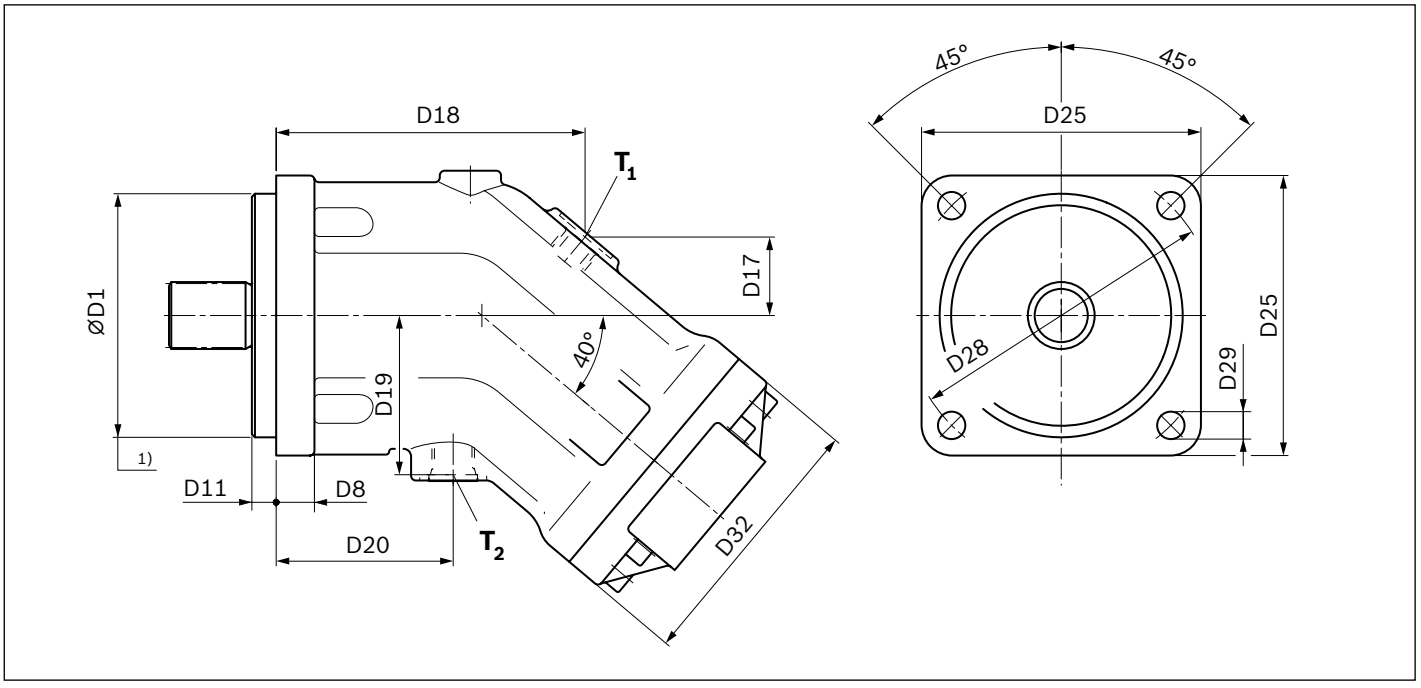
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)

Ports

Size			10	12	16
A, B	Working port	Size	1 1/16 in 12UN-2B; 0.79 in deep		
		Standard [1]	ISO 11926		
		State on delivery	With protective cover (must be connected)		
T_1	Drain port	Size	9/16 in 18UNF-2B; 0.51 in (13 mm) deep		
		Standard [1]	ISO 11926		
		State on delivery [2]	Plugged (observe installation instructions)		
T_2	Drain port	Size	9/16 in 18UNF-2B; 0.51 in (13 mm) deep		
		Standard [1]	ISO 11926		
		State on delivery [2]	With protective cover (observe installation instructions)		

[1] The spot face can be deeper than specified in the appropriate standard.
[2] Unless otherwise specified. Other layouts on request.

Size 23 ... 180

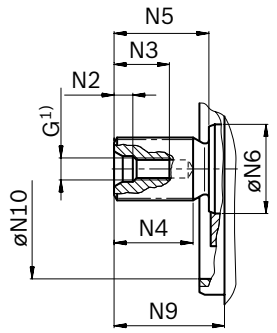


[1] Flange SAE J744

Size	D1		D8		D11		D17		D18		D19		D20		D25		D28		D29		D32	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
23	5 $^{0}_{-0.002}$	127 $^{0}_{-0.05}$	0.79	20	0.5	12.7	0.98	25	4.84	123	2.2	56	2.32	59	5.75	146	6.38	162	0.56	14.3	4.17	14.3
28	5 $^{0}_{-0.002}$	127 $^{0}_{-0.05}$	0.79	20	0.5	12.7	0.98	25	4.84	123	2.2	56	2.32	59	5.75	146	6.38	162	0.56	14.3	4.17	14.3
32	5 $^{0}_{-0.002}$	127 $^{0}_{-0.05}$	0.79	20	0.5	12.7	0.98	25	4.84	123	2.2	56	2.32	59	5.75	146	6.38	162	0.56	14.3	4.17	14.3
107	6 $^{0}_{-0.002}$	152.4 $^{0}_{-0.05}$	0.98	25	0.5	12.7	1.57	40	6.77	172	3.39	86	3.82	97	7.87	200	9	228.6	0.81	20.6	5.91	20.6
125	6 $^{0}_{-0.002}$	152.4 $^{0}_{-0.05}$	0.98	25	0.5	12.7	1.57	40	6.77	172	3.39	86	3.82	97	7.87	200	9	228.6	0.81	20.6	5.91	20.6
160	6 $^{0}_{-0.002}$	152.4 $^{0}_{-0.05}$	0.98	25	0.5	12.7	1.85	47	7.48	190	3.78	96	4.09	104	7.87	200	9	228.6	0.81	20.6	7.09	20.6
180	6 $^{0}_{-0.002}$	152.4 $^{0}_{-0.05}$	0.98	25	0.5	12.7	1.85	47	7.48	190	3.78	96	4.09	104	7.87	200	9	228.6	0.81	20.6	7.09	20.6

Drive shafts S and U

Splined shaft SAE J744



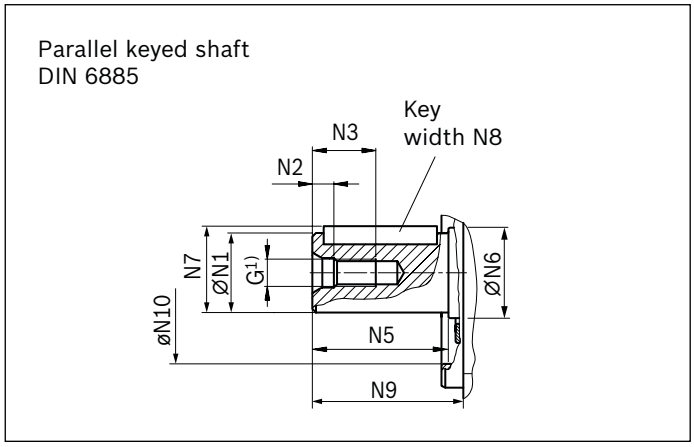
1) Thread according to ASME B1.1

Splined shaft SAE J744

NG	Code	Designation 1)	Thread G	N2		N3		N4		N5		ØN6		N9		ØN10	
				in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
23	S	1 1/4 in 14T 12/24 DP	7/16-14UNC-2B	0.37	9.5	1.1	28	1.57	40	1.89	48	1.38	35	2.2	55.9	3.15	80
28	S	1 1/4 in 14T 12/24 DP	7/16-14UNC-2B	0.37	9.5	1.1	28	1.57	40	1.89	48	1.38	35	2.2	55.9	3.15	80
32	S	1 1/4 in 14T 12/24 DP	7/16-14UNC-2B	0.37	9.5	1.1	28	1.57	40	1.89	48	1.38	35	2.2	55.9	3.15	80
107	U	1 1/2 in 23T 16/32 DP	5/8-11UNC-2B	0.47	12	1.42	36	2.2	56	2.44	62	1.97	50	2.75	69.9	4.92	125
	S	1 3/4 in 13T 8/16 DP	5/8-11UNC-2B	0.47	12	1.42	36	2.17	55	2.64	67	1.97	50	2.95	74.9	4.92	125
125	U	1 1/2 in 23T 16/32 DP	5/8-11UNC-2B	0.47	12	1.42	36	2.2	56	2.44	62	1.97	50	2.75	69.9	4.92	125
	S	1 3/4 in 13T 8/16 DP	5/8-11UNC-2B	0.47	12	1.42	36	2.17	55	2.64	67	1.97	50	2.95	74.9	4.92	125
160	S	1 3/4 in 13T 8/16 DP	5/8-11UNC-2B	0.47	12	1.42	36	2.17	55	2.64	67	2.36	60	2.95	74.9	5.51	140
180	S	1 3/4 in 13T 8/16 DP	5/8-11UNC-2B	0.47	12	1.42	36	2.17	55	2.64	67	2.36	60	2.95	74.9	5.51	140

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

Drive shafts P and B



1) Center bore according to DIN 332 (thread according to DIN 13)

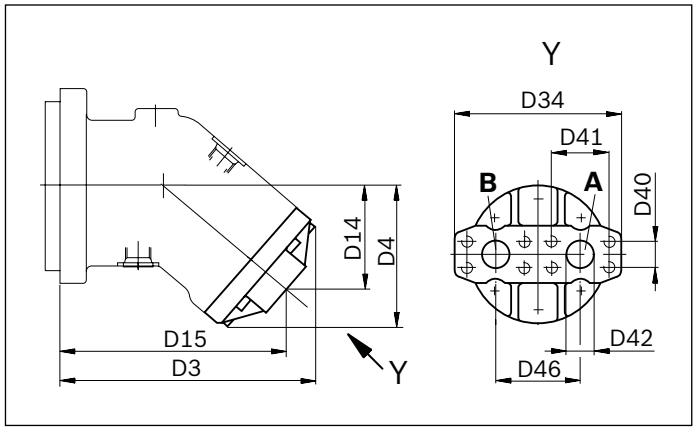
Parallel keyed shaft DIN 6885

NG	Code	Designation	Thread G	ØN1		N2		N3		N5		ØN6		N7	
				in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
23	P	Ø25, AS8x7x40	M8 × 1.25	0.98 $^{+0.001}_{+0}$	25 $^{+0.015}_{+0.002}$	0.24	6	0.75	19	1.97	50	1.38	35	1.1	28
	B	Ø30, AS8x7x40	M10 × 1.5	1.18 $^{+0.001}_{+0}$	30 $^{+0.015}_{+0.002}$	0.3	7.5	0.87	22	1.97	50	1.38	35	1.3	33
28	P	Ø25, AS8x7x40	M8 × 1.25	0.98 $^{+0.001}_{+0}$	25 $^{+0.015}_{+0.002}$	0.24	6	0.75	19	1.97	50	1.38	35	1.1	28
	B	Ø30, AS8x7x40	M10 × 1.5	1.18 $^{+0.001}_{+0}$	30 $^{+0.015}_{+0.002}$	0.3	7.5	0.87	22	1.97	50	1.38	35	1.3	33
32	B	Ø30, AS8x7x40	M10 × 1.5	1.18 $^{+0.001}_{+0}$	30 $^{+0.015}_{+0.002}$	0.3	7.5	0.87	22	1.97	50	1.38	35	1.3	33
107	P	Ø40, AS12x8x63	M12 × 1.75	1.57 $^{+0.001}_{+0}$	40 $^{+0.018}_{+0.002}$	0.37	9.5	1.1	28	3.15	80	1.97	50	1.69	43
	B	Ø45, AS14x9x63	M16 × 2	1.77 $^{+0.001}_{+0}$	45 $^{+0.018}_{+0.002}$	0.47	12	1.42	36	3.15	80	1.97	50	1.91	48.5
125	B	Ø45, AS14x9x63	M16 × 2	1.77 $^{+0.001}_{+0}$	45 $^{+0.018}_{+0.002}$	0.47	12	1.42	36	3.15	80	1.97	50	1.91	48.5
160	P	Ø45, AS14x9x70	M16 × 2	1.77 $^{+0.001}_{+0}$	45 $^{+0.018}_{+0.002}$	0.47	12	1.42	36	3.54	90	2.36	60	1.91	48.5
	B	Ø50, AS14x9x70	M16 × 2	1.97 $^{+0.001}_{+0}$	50 $^{+0.018}_{+0.002}$	0.47	12	1.42	36	3.54	90	2.36	60	2.11	53.5
180	B	Ø50, AS14x9x70	M16 × 2	1.97 $^{+0.001}_{+0}$	50 $^{+0.018}_{+0.002}$	0.47	12	1.42	36	3.54	90	2.36	60	2.11	53.5

NG	Code	Designation	Thread G	N8		N9		ØN10	
				in	mm	in	mm	in	mm
23	P	Ø25, AS8x7x40	M8 × 1.25	0.31	8	2.28	57.9	3.15	80
	B	Ø30, AS8x7x40	M10 × 1.5	0.31	8	2.28	57.9	3.15	80
28	P	Ø25, AS8x7x40	M8 × 1.25	0.31	8	2.28	57.9	3.15	80
	B	Ø30, AS8x7x40	M10 × 1.5	0.31	8	2.28	57.9	3.15	80
32	B	Ø30, AS8x7x40	M10 × 1.5	0.31	8	2.28	57.9	3.15	80
107	P	Ø40, AS12x8x63	M12 × 1.75	0.47	12	3.46	87.9	4.92	125
	B	Ø45, AS14x9x63	M16 × 2	0.55	14	3.46	87.9	4.92	125
125	B	Ø45, AS14x9x63	M16 × 2	0.55	14	3.46	87.9	4.92	125
160	P	Ø45, AS14x9x70	M16 × 2	0.55	14	3.85	97.9	5.51	140
	B	Ø50, AS14x9x70	M16 × 2	0.55	14	3.85	97.9	5.51	140
180	B	Ø50, AS14x9x70	M16 × 2	0.55	14	3.85	97.9	5.51	140

Port plate 510

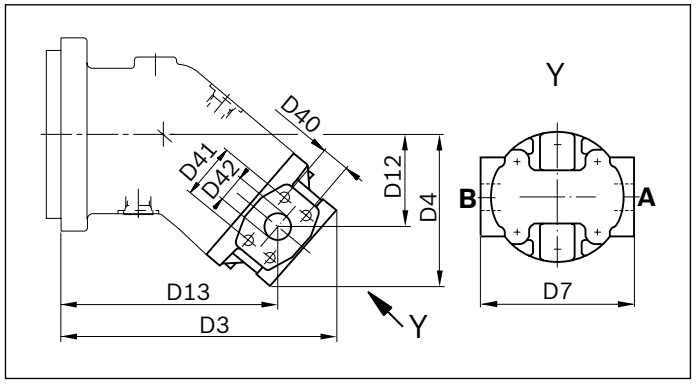
SAE working ports at rear



Size	D3		D4		D14		D15		D34		D40		D41		D42		D46	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
23 ... 32	7.48	190	4.17	106	3.07	78	6.69	170	4.53	115	0.72	18.2	1.59	40.5	0.51	13	2.32	59
107 ... 125	11.2	284	6.14	156	4.72	120	10.2	258	7.64	194	1.25	31.8	2.63	66.7	1.26	32	3.9	99
160 ... 180	12.8	326	7.4	188	5.28	134	11.2	284	7.64	194	1.25	31.8	2.63	66.7	1.26	32	3.9	99

Port plate 520

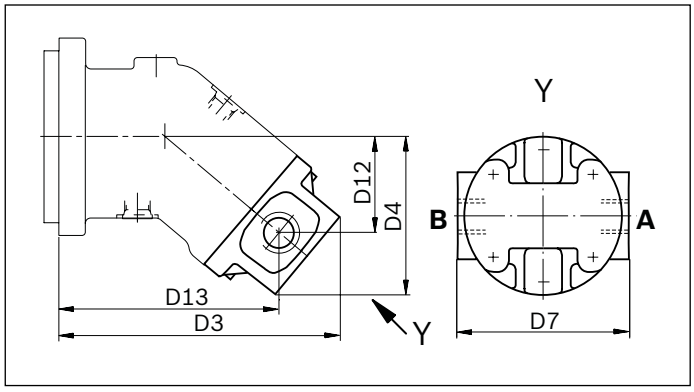
SAE working ports at side, opposite



Size	D3		D4		D7		D12		D13		D40		D41		D42	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
23 ... 32	8.15	207	4.61	117	4.72	120	2.76	70	6.34	161	0.72	18.2	1.59	40.5	0.51	13
107 ... 125	12.5	317	7.13	181	7.01	178	4.33	110	9.65	245	1.25	31.8	2.63	66.7	1.26	32
160 ... 180	12.8	326	7.36	187	7.95	202	4.76	121	10.6	269	1.25	31.8	2.63	66.7	1.26	32

Port plate 530

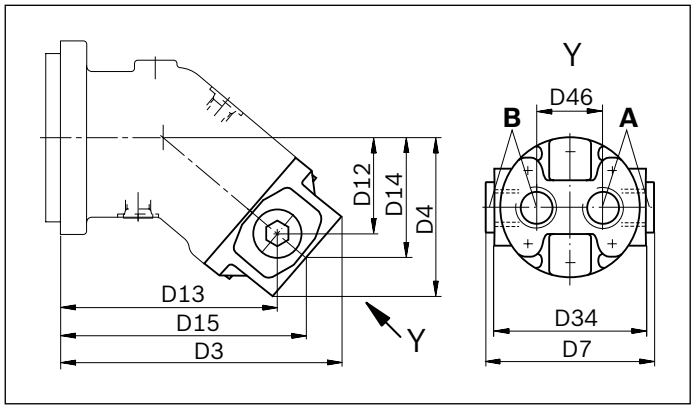
Threaded ports at side, opposite



Size	D3		D4		D7		D12		D13	
	in	mm	in	mm	in	mm	in	mm	in	mm
23 ... 32	8.15	207	4.61	117	4.72	120	2.76	70	6.34	161

Port plate 540

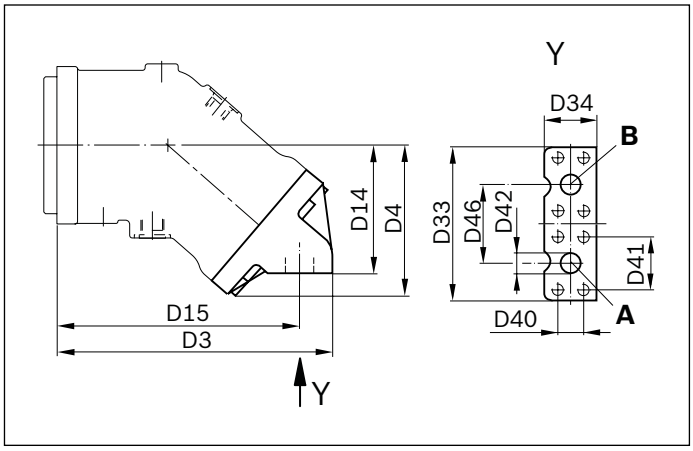
Threaded ports at side and rear



Size	D3		D4		D7		D12		D13		D14		D15		D34		D46	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
23 ... 32	8.15	207	4.65	118	5.12	130	2.76	70	6.34	161	3.5	89	7.2	183	4.72	120	2.28	58

Port plate 600

SAE working ports at bottom



Size	D3		D4		D14		D15		D33		D34		D40		D41		D42		D46	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
107 ... 125	11.5	293	6.22	158	5.35	136	10.2	258	7.64	194	2.76	70	1.25	31.8	2.63	66.7	1.26	32	3.9	99

Note

- The dimensional drawings of the port plates with valves can be found in the chapter "Extended functions and versions".

Ports

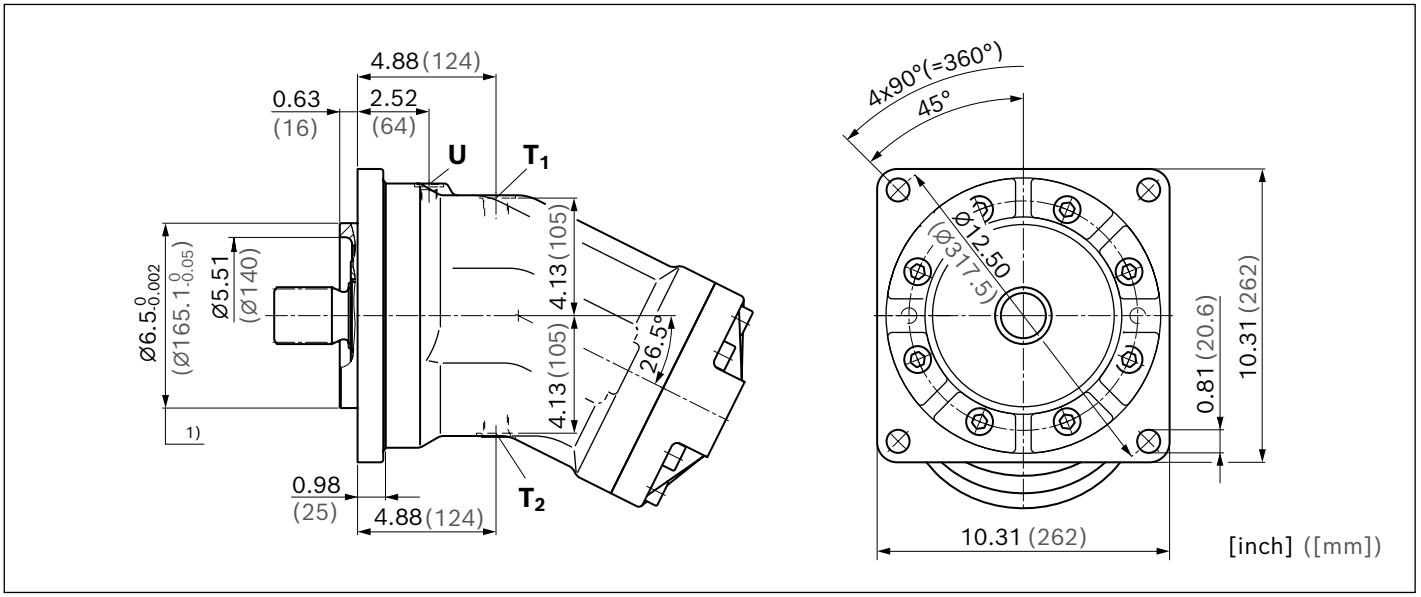
Size			23	28	32	107	125	160	180
A, B (port plate 510, 520, 600)	Working	Size	1/2 in			1 1/4 in			
		Standard	Dimensions according to SAE J518						
		Fastening thread	5/16 18UNC-2B; 0.71 in (18 mm) deep			1/2 13UNC-2B; 0.75 in (19 mm) deep			
		State on delivery	With protective cover (must be connected)						
A, B (port plate 530, 540)	Working port	Size	1 5/16 12UN-2B; 0.79 in (20 mm) deep			–			
		Standard [1]	ISO 11926			–			
		State on delivery [2]	With protective cover (must be connected)						
T_1	Drain port	Size	3/4 16UNF-2B; 0.59 in (15 mm) deep			7/8 14UNF-2B; 0.67 in (17 mm) deep			
		Standard [1]	ISO 11926						
		State on delivery [3]	With protective cover (observe installation instructions)						
T_2	Drain port	Size	3/4 16UNF-2B; 0.59 in (15 mm) deep			7/8 14UNF-2B; 0.67 in (17 mm) deep			
		Standard [1]	ISO 11926						
		State on delivery [3]	Plugged (observe installation instructions)						

[1] The spot face can be deeper than specified in the appropriate standard.

[2] Unless otherwise specified: In case of port plate 540 ports at the sides plugged. Other layouts on request.

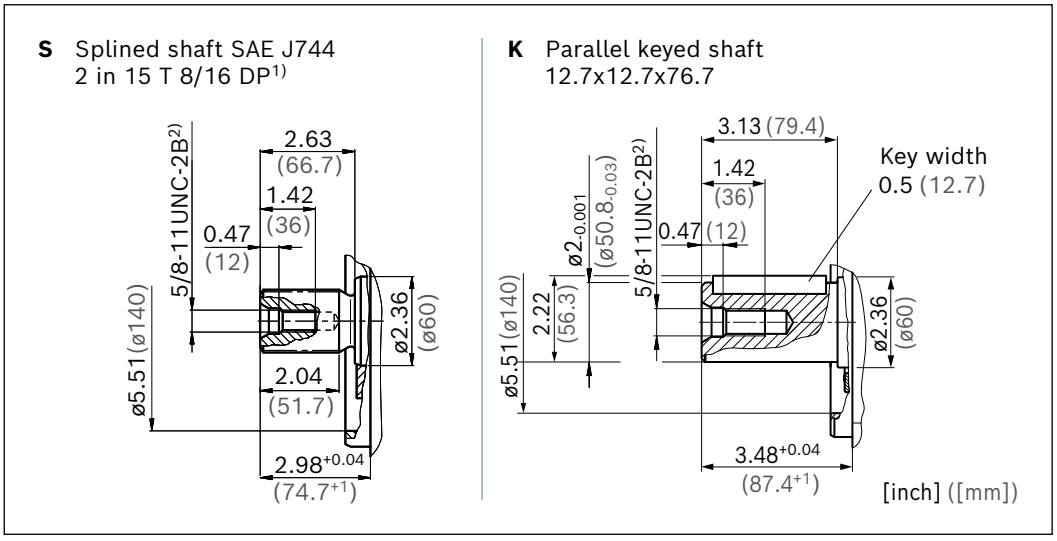
[3] Unless otherwise specified. Other layouts on request.

Size 250



1) Flange SAE J744

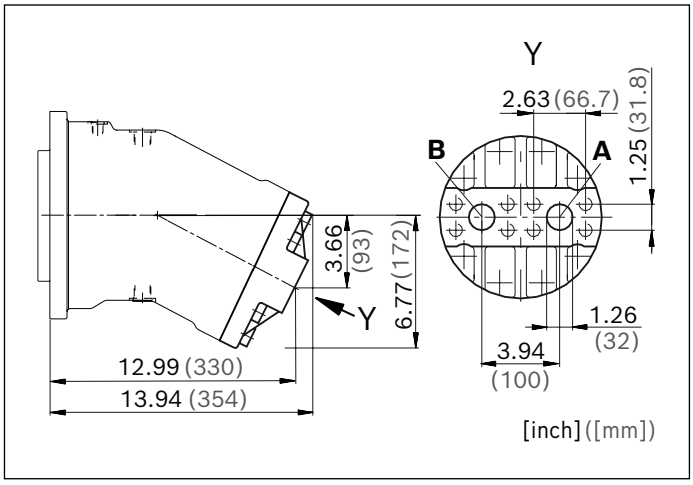
Drive shafts S and K



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

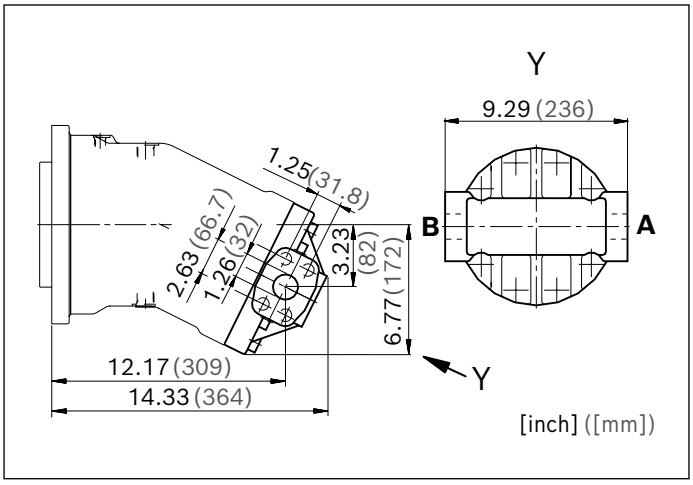
Port plate 510

SAE working ports at rear



Port plate 520

SAE working ports at side, opposite



Ports

Size			250
A, B	Working port	Size	1 1/4 in
		Standard	Dimensions according to SAE J518
		Fastening thread	1/2 13UNC-2B; 0.75 in (19 mm) deep
		State on delivery	With protective cover (must be connected)
T_1	Drain port	Size	7/8 14UNF-2B; 0.67 in (17 mm) deep
		Standard [1]	ISO 11926
		State on delivery [2]	With protective cover (observe installation instructions)
T_2	Drain port	Size	7/8 14UNF-2B; 0.67 in (17 mm) deep
		Standard [1]	ISO 11926
		State on delivery [2]	Plugged (observe installation instructions)
U	Bearing flushing	Size	9/16 18UNF-2B; 0.51 in (13 mm) deep
		Standard [1]	ISO 11926
		State on delivery	Plugged

[1] The spot face can be deeper than specified in the appropriate standard.

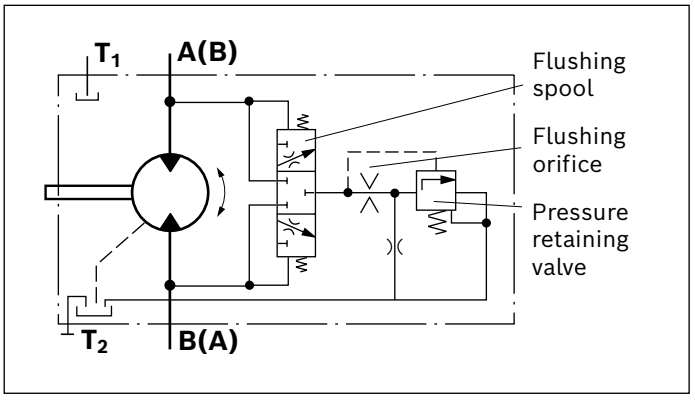
[2] Unless otherwise specified. Other layouts on request.

Extended functions and versions

Flushing and boost pressure valve

The flushing and boost pressure valve is used in closed circuits for the removal of heat and to ensure a minimum boost pressure level.
Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the leakage. The removed hydraulic fluid must be replaced by cooled hydraulic fluid from the boost pump.
With port plate 527, the valve is mounted directly on the fixed motor (sizes 23 to 250).

Circuit diagram



Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 23 to 250, fixed setting: 230 psi (16 bar)

Switching pressure of flushing piston Δp
Sizes 23 to 250: 115±15 psi (8±1 bar)

Flushing flow q_v
Orifices can be used to adjust the flushing flows as required. The following information is based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 365 psi (25 bar) and v = 10 cSt
(p_{ND} = low pressure, p_G = case pressure)

Size 23 ... 180

Material number of orifice	Flushing flow q_v		Orifice-Ø	
	gpm	l/min	in	mm
R909651766	0,92	3.5	0.047	1.2
R909419695	1.32	5	0.055	1.4
R902030345	1.72	6.5	0.063	1.6
R909419696	2.1	8	0.071	1.8
R909419697	2.6	10	0.079	2
R902107424	3.4	13	0.091	2.3
R909444361	3.7	14	0.094	2.4

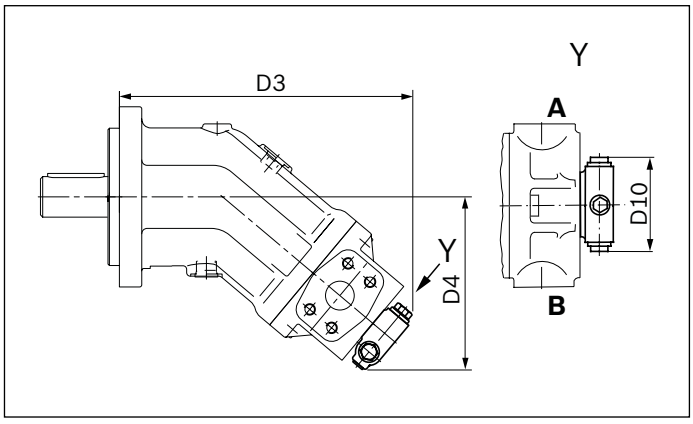
For flushing flows deviating from the values in the table, please state the required flushing flow when ordering.
The flushing flow without orifice is approx. 3.2 to 3.7 gpm (12 to 14 l/min) at low pressure Δp_{ND} = 115 psi (25 bar).

Size 250
Standard flushing flow: 2.6 gpm (10 l/min)
For other flushing flows please contact us.

Dimensions

Port plate 527

SAE working ports at side, opposite



Size	D3		D4		D10	
	in	mm	in	mm	in	mm
23 ... 32	8.9	226	5.47	139	4.02	102
107, 125	12.8	326	7.56	192	4.02	102
160, 180	13.7	347	7.91	201	4.02	102
250	15.2	386	6.77	172	4.02	102

Pressure relief valve

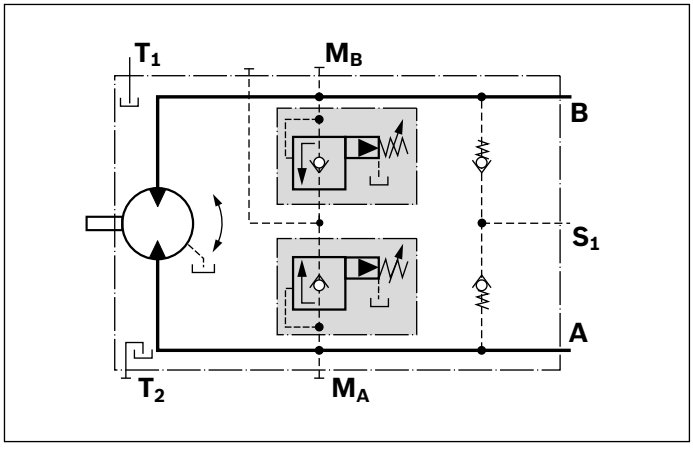
The MHDB pressure relief valves protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the high-pressure side to the low-pressure side.
The pressure relief valves are only available in conjunction with port plates 181, 191 or 192. (port plate 181: see section “BVD and BVE counterbalance valve”

Setting range of cracking pressure: 725 up to 6200 psi (50 up to 420 bar)

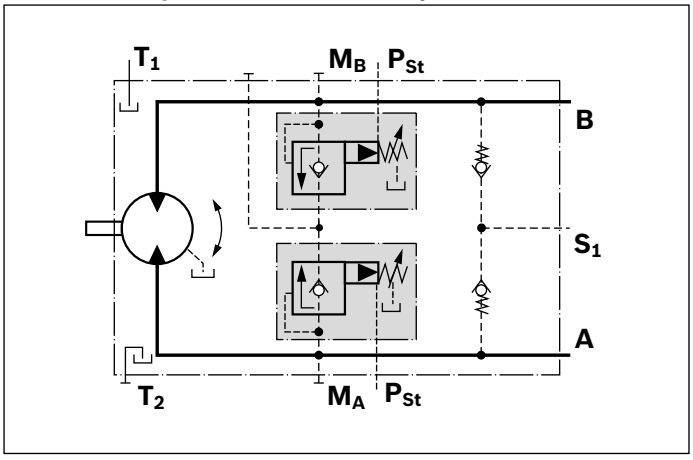
For versions “with pressure sequencing stage” (code 192), a higher pressure setting can be implemented by connecting an external pilot pressure of 364 up to 435 psi (25 up to 30 bar) at port P_{St}.
When ordering, state in plain text:

- Cracking pressure of pressure relief valve
- Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Version without pressure boost facility (code 191)



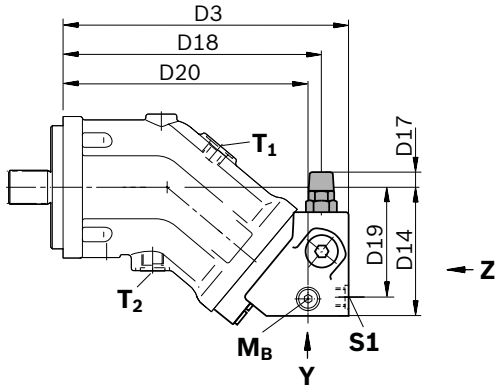
Version with pressure boost facility (code 192)



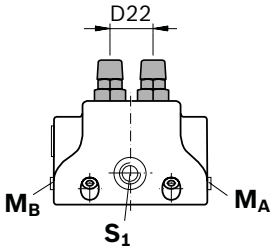
Permissible input flow or pressure in case of port plate with pressure-relief valves

Size		Code	p_{nom}		p_{max}		q_V	
Motor	**MHDB**		**psi**	**bar**	**psi**	**bar**	**gpm**	**l/min**
28 ... 32	16	191, 192	5100	350	6100	420	26.4	100
107 ... 180	32						106	400

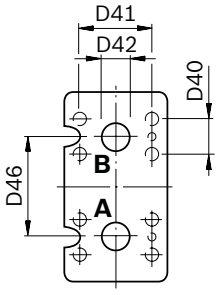
Dimensions



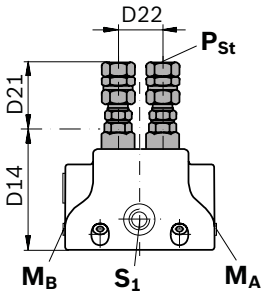
Detailed view **Z**:
Version without pressure boost facility (code 191)



Detailed view **Y**



Detailed view **Z**:
Version with pressure boost facility (code 192)



Size		D3		D14		D17		D18		D19		D20		D21		D22	
Motor	**MHDB**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**
28, 32	16	8.9	226	4.02	102	0.98	25	7.99	203	3.43	87	7.52	191	2.68	68	1.42	36
107, 125	32	13	330	5.89	149.5	0.39	10	11.7	298	5.12	130	11.1	282	2.05	52	2.09	53
160, 180		14.3	364	6.69	170	0.2	5	13.1	333	5.87	149	12.5	317	1.85	47	2.09	53

Size		D40		D41		D42		D46	
Motor	**MHDB**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**
28, 32	16	0.94	23.8	2	50.8	0.75	19	2.6	66
107, 125	32	1.25	31.8	2.63	66.7	1.26	32	3.31	84
160, 180		1.25	31.8	2.63	66.7	1.26	32	3.31	84

Ports

Size			28, 32	107, 125	160, 180
A, B	Working port	Size	3/4 in	1 1/4 in	
		Standard	Dimensions according to SAE J518		
		Fastening thread [1]	M10 × 1.5; 0.67 in (17 mm) deep	M14 × 2; 0.75 in (19 mm) deep	
		State on delivery	With protective cover (must be connected)		
S_1	Boost port	Size	M22 × 1.5; 0.55 in (14 mm) deep	M26 × 1.5; 0.63 in (16 mm) deep	
		Standard	DIN 3852		
		State on delivery	With protective cover (must be connected)		
P_{St}	Pilot pressure port	Size	G 1/4 [2]		
		Standard	DIN ISO 228		
M_A, M_B	Measuring port pressure A, B	Size	M20 × 1.5; 0.55 in (14 mm) deep	M26 × 1.5; 0.63 in (16 mm) deep	M30 × 1.5; 0.63 in (16 mm) deep
		Standard [3]	DIN 3852		
		State on delivery	Plugged		

[1] Thread according to DIN 13
[2] Only with port plate 192
[3] The spot face can be deeper than specified in the appropriate standard.

Counterbalance valve BVD and BVE

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 290 psi.

Note

- BVD available for sizes 28 to 180.
- BVE on request for sizes 107 to 180.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example:
  A2FM(E)107/61W–VAB**188** + BVD20F27S/41B–V03K16D0400S12
- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve in data sheet 95522 and BVE counterbalance valve in data sheet 95526!
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 305 psi / 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 16 cSt)

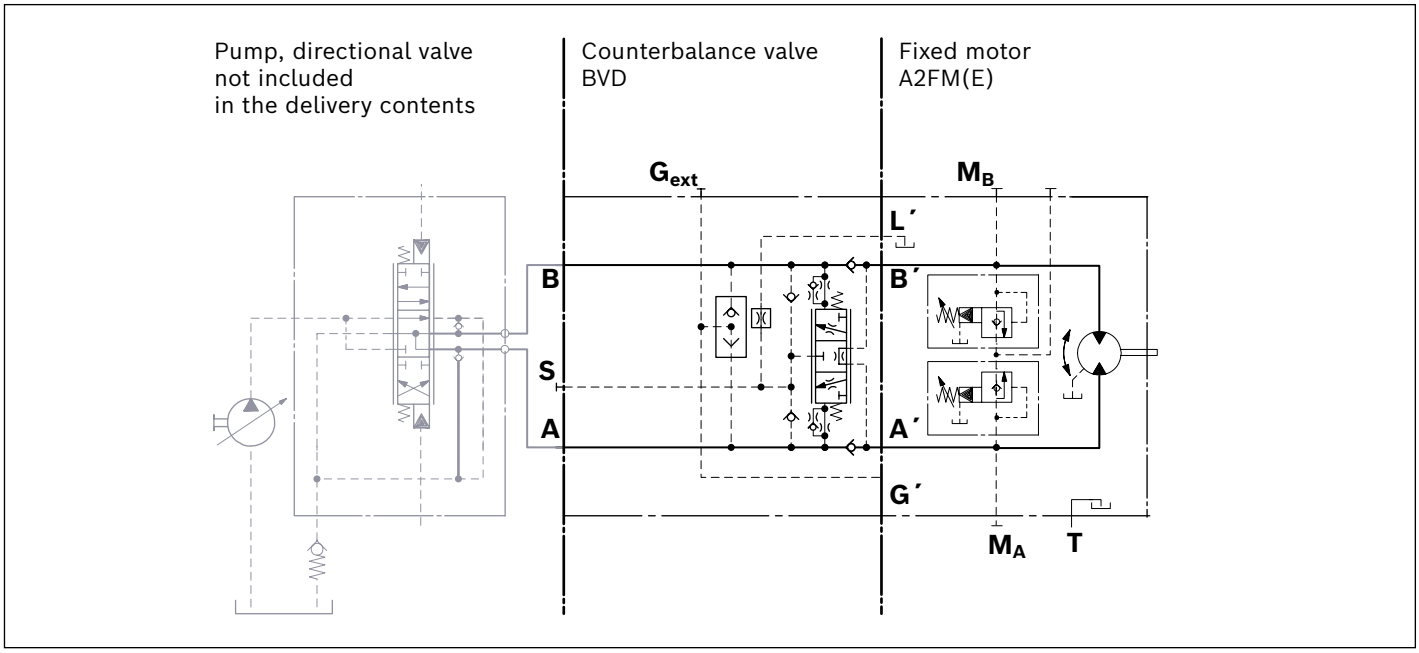
Travel drive counterbalance valve BVD...F

Application option:

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators

A2FM(E)107/61W-VAB188 + BVD20F27S/41B–V03K16D0400S12



Winch counterbalance valve BVD...W

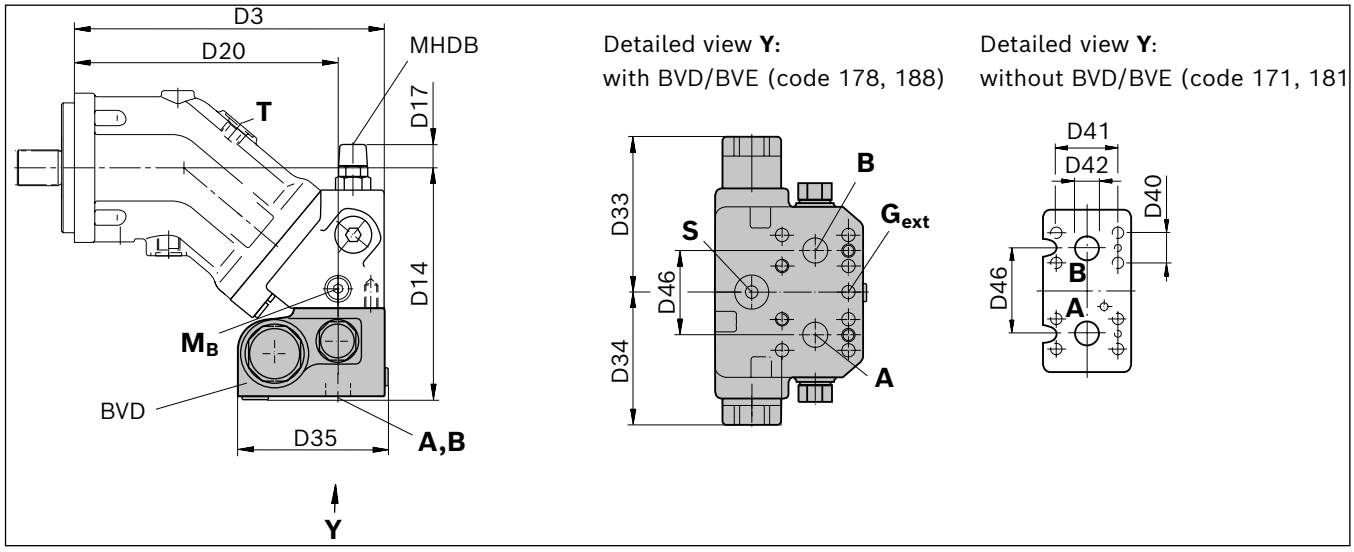
Application options:

- Winch drive in cranes
- Track drive in excavator crawlers

Permissible input flow or pressure in case of port plate with counterbalance valves

Size			Code	p_{nom}		p_{max}		q_V	
Motor	BVD	MHDB		psi	bar	psi	bar	gpm	l/min
28 ... 32	20	16	181, 188	5100	350	6100	420	26.4	100
107 ... 125		32	171, 178					58.1	220
107 ... 180	25	32	181, 188					84.5	320

Dimensions



Size		Code	D3		D14		D17		D20		D33		D34		D35 [1]	
Motor	Counterbalance valve		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
28, 32	BVD20..16	188	8.9	226	6.89	175	0.98	25	7.52	191	5.47	139	3.86	98	5.59	142
107, 125	BVD20..28	178	13	330	9.37	238	0.39	10	11.1	283	5.47	139	3.86	98	5.59	142
	BVD25..38	188	13	330	9.41	239	0.39	10	11.1	283	6.89	175	4.74	120.5	6.22	158
160, 180	BVD25..38	188	14.3	364	10.2	260	0.2	5	12.5	317	6.89	175	4.74	120.5	6.22	158

Size		Code	D40		D41		D42		D46	
Motor	Counterbalance valve		in	mm	in	mm	in	mm	in	mm
28, 32	BVD20..16	188	0.94	23.8	2	50.8	0.75	19	2.6	66
107, 125	BVD20..28	178	1.09	27.8	2.25	57.2	0,98	25	3.31	84
	BVD25..38	188	1.25	31.8	2.63	66.7	1.26	32	3.31	84
160, 180	BVD25..38	188	1.25	31.8	2.63	66.7	1.26	32	3.31	84

[1] For version with brake release valve (BV...L): Dimension D35 +0.2 in (5 mm)

Ports

Size			**28, 32**	**107, 125**		**160, 180**
A, B	Working port	Size	3/4 in	1 in [1]	1 1/4 in [2]	1 1/4 in
		Standard	Dimensions according to SAE J518			
		Fastening thread [3]	M10 × 1.5; 0.67 in (17 mm) deep	M12 × 1,75; 0.63 in (16 mm) deep	M14 × 2; 0.75 in (19 mm) deep	
		State on delivery	With protective cover (must be connected)			
S	Boost port	Size	M22 × 1.5; 0.55 in (14 mm) deep		M27 × 2; 0.63 in (16 mm) deep	
		Standard [4]	DIN 3852			
		State on delivery	Plugged			
B_r	Brake release port (only BV...L)	Size	M12 × 1.5			
		Standard [4]	DIN 3852			
		State on delivery	With protective cover (must be connected)			
G_{ext}	Brake release port (only BV...S)	Size	M12 × 1.5			
		Standard [4]	DIN 3852			
		State on delivery	Plugged			
M_A, M_B	Measuring port pressure A, B	Size	M12 × 1.5; 0.47 in deep			
		Standard [4]	ISO 6149			
		State on delivery	Plugged			

[1] With BVD20
[2] With BVD25
[3] Thread according to DIN 13
[4] The spot face can be deeper than specified in the appropriate standard.

Speed sensors

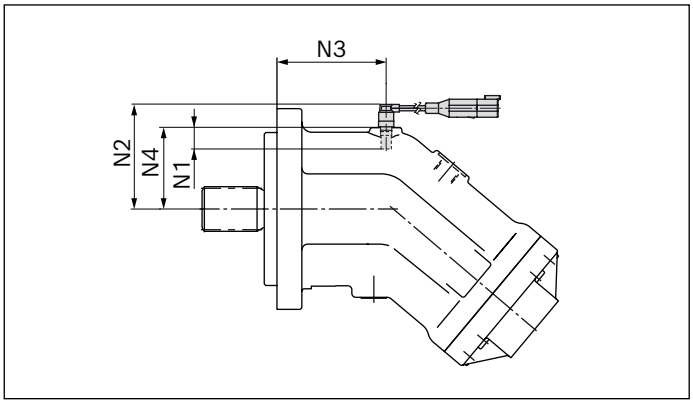
The versions AA2FM...U and AA2FM...F ("prepared for speed sensor", i.e. without sensor) are equipped with a toothed ring on the rotary group.
On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.
With the DSA or HDD speed sensor mounted a signal proportional to motor speed can be generated. The sensors measures the speed and direction of rotation.
Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

DSA: data sheet 95133
HDD: data sheet 95135

The sensor is mounted at the specially provided port as follows:
DSA: with one mounting bolt
HDD: with two mounting bolts

We recommend ordering the AA2FM fixed motor complete with sensor mounted.

DSA speed sensor mounted (code V)



Motor	Number of teeth	N1		N2		N3		N4	
Size		in	mm	in	mm	in	mm	in	mm
23 ... 32	38	0.72 $^{+0.004}_{-0.004}$	18.4 $^{+0.1}_{-0.1}$	3.08	78.3	2.86	72.6	2.28	57.9
107, 125	59	0.72 $^{+0.004}_{-0.004}$	18.4 $^{+0.1}_{-0.1}$	3.95	100.3	4.3	109.3	3.15	79.9
160, 180	67	0.72 $^{+0.004}_{-0.004}$	18.4 $^{+0.1}_{-0.1}$	4.24	107.8	4.68	118.8	3.44	87.4

Project planning information

Installation information

General information

- During commissioning and during operation, the axial piston unit must be filled with hydraulic fluid and bled. This must also be observed during longer standstill as the axial piston unit might drain itself via the hydraulic lines.
- Complete filling and bleeding must especially be ensured with the “Drive shaft upwards” installation position as there is, for example, the risk of running dry.
- The leakage in the housing area must be discharged to the tank via the highest-located drain port (**T1**, **T2**).
- If one joint drain line is used for several units, it is to be ensured that the relevant housing pressure is not exceeded. The joint drain line must be dimensioned so that the maximum admissible housing pressure of all connected units is not exceeded in any operating state, particularly during cold start. If this is not possible, separate drain lines have to be laid, if necessary.
- In order to achieve favorable noise values, all connection lines are to be decoupled using elastic elements and over-tank installation is to be avoided.
- The tank line must lead into the tank below the minimum liquid level in every operating state.

Installation position

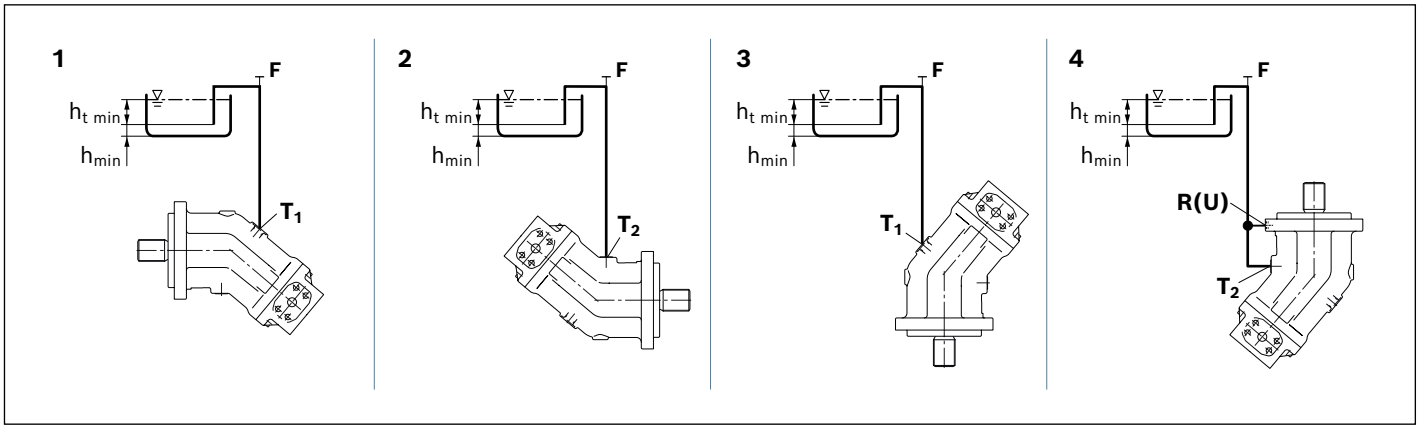
See the following examples **1** to **8**.
Further installation positions are possible upon request.
Recommended installation position: **1** and **2**.

Note

For installation position **4** and **8** "shaft upwards" an air bleed port **R** is required (specify in plain text when ordering, special version).
With size 250, port **U** is provided as standard in the area near the bearings for air bleeding.

Below-tank installation (standard)

Below-tank installation is at hand if the axial piston unit is installed below the minimum liquid level outside the tank.

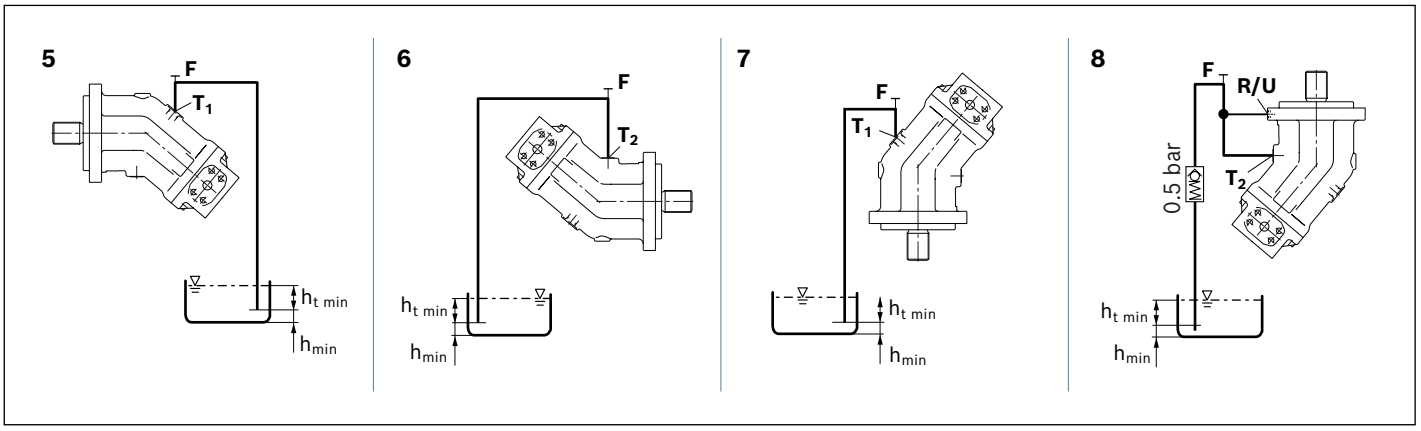


Installation position	Air bleeding	Filling
1	**F**	**T_1**
2	**F**	**T_2**
3	**F**	**T_1**
4	**R (U)**	**T_2**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

Recommendation for installation position **8** (drive shaft upward): A check valve in the drain line (cracking pressure 7,5 psi / 0,5 bar) can prevent draining of the pump housing.



Installation position	Air bleeding	Filling
5	**F**	**T_1 (F)**
6	**F**	**T_2 (F)**
7	**F**	**T_1 (F)**
8	**R (U)**	**T_2 (F)**

Key

F	Filling / Air bleeding
R	Air bleed port
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (8 in / 200 mm)
h_{min}	Minimum required spacing to reservoir bottom (4 in / 100 mm)

Note: Connection **F** is part of the external piping and must be provided on the customer side to simplify the filling and bleeding.

General project planning notes

- The axial piston motor is designed to be used in open and closed circuits.
- The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified datas and notes must be observed.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation times are valid under optimal storage conditions. Details of these conditions can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_D$) for functional safety.
- A pressure relief valve is to be provided in the hydraulic system.
- Observe the instructions in the instruction manual regarding tightening torques of connection threads and other threaded joints used.
- The notes in the instruction manual on tightening torques of the port threads and other screw joints must be observed.
- The ports and fastening threads are designed for the permissible maximum pressure p_{max} (see instruction manual). The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The working ports and function ports are designated only to accommodate hydraulic lines.

Safety Instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. contaminated hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator‘s specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk.
  The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.
- In certain conditions, moving parts in high pressure relief valves might get stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid). This can result in restriction or loss of load holding functions in lifting winches. Therefore it is the machine and/or system manufacturers responsibility to make sure that the load can always be put in a safe mode if needed. Also, he needs to ensure that these measures are properly implemented.

Accessories

Product	Refer to document
Counterbalance valve BVD 20-25	RE 95522
Counterbalance valve BVE 25	RE 95526
Speed sensor DSA	RE 95133
Speed sensor HDD	RE 95135

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