HYDSTAR

ISO9001认证企业

液压泵专业生产厂家-江苏海斯特

Hydraulic Pump Manufacture-Hydstar Hydraulic

Technical Manual

2023

江苏海斯特液压科技有限公司

Jiangsu Hydstar Hydraulic Technology Co., Ltd.

CONTENTS

Axial Piston Fixed Motor
A2FM

Data sheet

Series 6

Size	Nominal pressure/Maximum pressure
5	315/350 bar
10 to 200	400/450 bar
250 to 1000	350/400 bar

Open and closed circuits

Contents

Features

- Fixed motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- For use in mobile and stationary applications
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and the low-pressure side.
- Finely graduated sizes permit far-reaching adaptation to the drive case
- High power density
- Small dimensions
- High total efficiency
- Good starting characteristics
- Economical design
- One-piece tapered piston with piston rings for sealing

Ordering code for standard program

	A2F		M		/	6		W	–	V						
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearings "L" (without code)		
	HFB, HFC hydraulic fluid	Sizes 5 to 200 (without code)	
		Sizes 250 to 1000 (only in combination with long-life bearings "L")	**E-**

Axial piston unit

02	Bent-axis design, fixed	**A2F**

Drive shaft bearing		**5 to 200**	**250 to 500**	**710 to 1000**	
03	Standard bearing (without code)	●	●	–	
	Long-life bearing	–	●	●	**L**

Operating mode

04	Motor (plug-in motor A2FE, see RE 91008)	**M**

Size (NG)

05	Geometric displacement, see table of values on page 7																				
	5	**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	**200**	**250**	**355**	**500**	**710**	**1000**

Series

06		**6**

Index

07		NG10 to 180	**1**
		NG200	**3**
		NG5 and 250 to 1000	**0**

Direction of rotation

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

Seals

09	FKM (fluor-caoutchouc)	**V**

Drive shafts		**5**	**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	**200**	**250 to 1000**	
10	Splined shaft DIN 5480	–	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	●	–	**A**
		–	●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	–	●	**Z**
	Parallel keyed shaft DIN 6885	●	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	●	–	**B**
		–	●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	–	●	**P**
	Conical shaft[1)]	●	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	**C**

Mounting flanges			**5 to 250**	**355 to 1000**	
11	ISO 3019-2	4-hole	●	–	**B**
		8-hole	–	●	**H**

● = Available ❍ = On request – = Not available ▭ = Preferred program

1) Conical shaft with threaded pin and woodruff key (DIN 6888). The torque must be transmitted via the tapered press fit.

Ordering code for standard program

	A2F		M		/	6		W	–	V						
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

	Port plates for service lines[2]			5	10-16	23	28, 32	45	56,63	80,90	107-125	160-180	200	250	355-500	1000	
12	SAE flange ports A and B at rear	01	0	–	–	●	●	●	●	●	●	●	●	●	●	●	010
			7	–	–	–	–	–	–	–	–	–	–	–	●	–	017
	SAE flange ports A and B at side, opposite	02	0	–	–	●	●	●	●	●	●	●	–	●	–	–	020
			7	–	–	–	–	●	▲	▲	●	●	–	●	–	–	027
			9	–	–	–	–	–	●	●	–	–	–	–	–	–	029
	Threaded ports A and B at side, opposite	03	0	●	●	●	●	–	–	–	–	–	–	–	–	–	030
	Threaded ports A and B at side and rear[3]	04	0	–	●	●	●	●	●	–	–	–	–	❍	–	–	040
	SAE flange ports A and B at bottom (same side)	10	0	–	–	–	●	●	●	●	●	●	–	–	❍	–	100
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5]	BVD 17	1	–	–	–	–	–	–	–	●	–					171 178
		18	8	–	–	–	●	●	●	●	●	●	–	–	–	–	181
		BVE 18		–	–	–	–	–	–	–	●	●	–	–[4]	–	–	188
	Port plate with pressure-relief valves	19	1	–	–	–	●	●	●	●	●	●	–	–	–	–	191
			2	–	–	–	●	●	●	●	●	●	–	–	–	–	192

	Valves (see pages 34 to 41)	
	Without valve	0
	Pressure-relief valve (without pressure boost facility)	1
	Pressure-relief valve (with pressure boost facility)	2
	Flushing and boost pressure valve, mounted	7
	Counterbalance valve BVD/BVE mounted[5][6]	8
	Flushing and boost pressure valve, integrated	9

	Speed sensors (see pages 42 and 43)	5 to 16	23 to 180	200	250 to 500	710 to 1000[4]	
13	Without speed sensor (without code)	●	●	●	●	●	
	Prepared for HDD speed sensor	–	▲	▲	●	–	F
	HDD speed sensor mounted[7]	–	▲	▲	●	–	H
	Prepared for DSA speed sensor	–	❍	❍	❍	–	U
	DSA speed sensor mounted[7]	–	❍	❍	❍	–	V

	Special version	
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 closed	–Y
	Special version	-S

● = Available ❍ = On request – = Not available ▲ = Not for new projects ▭ = Preferred program

2) Fastening thread or threaded ports, metric
3) Threaded ports at the sides (sizes 10 to 63) plugged with threaded plugs
4) Please contact us.
5) Note the restrictions on page 39.
6) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE – RE 95525) separately.
7) Specify ordering code of sensor according to data sheet (DSA – RE 95133, HDD – RE 95135) separately and observe the requirements on the electronics

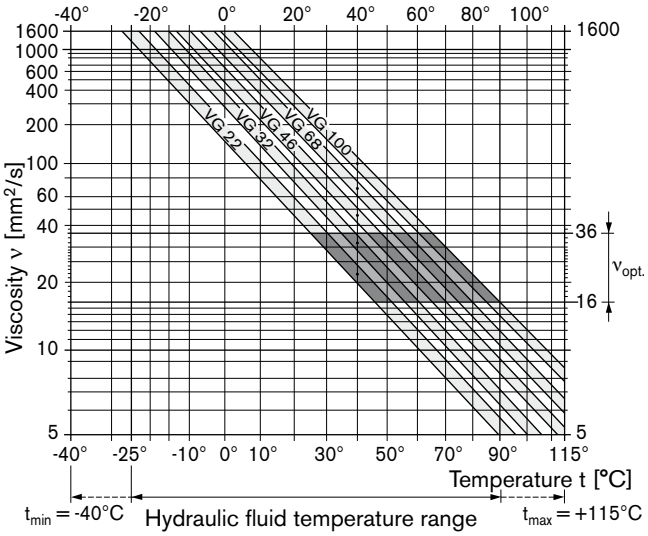
Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids), RE 90222 (HFD hydraulic fluids) and RE 90223 (HFA, HFB, HFC hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The fixed motor A2FM is not suitable for operation with HFA hydraulic fluid. If HFB, HFC or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit, the circuit temperature, in an open circuit, the reservoir temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the circuit temperature or reservoir temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U (sizes 250 to 1000) or using a flushing and boost pressure valve (see pages 34).

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Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -50 °C T_{opt} = +5 °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm (for sizes 5 to 200), n ≤ 0.25 • n_{nom} (for sizes 250 to 1000)
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400	T = -40 °C to -25 °C	at p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq$ 7	T_{max} = +103 °C	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T ≤ +115 °C	see page 5

1) At temperatures below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).
2) Sizes 250 to 1000, please contact us.

Technical data

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.

To ensure the functional reliability of the axial piston unit, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

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

If the above classes cannot be achieved, please contact us.

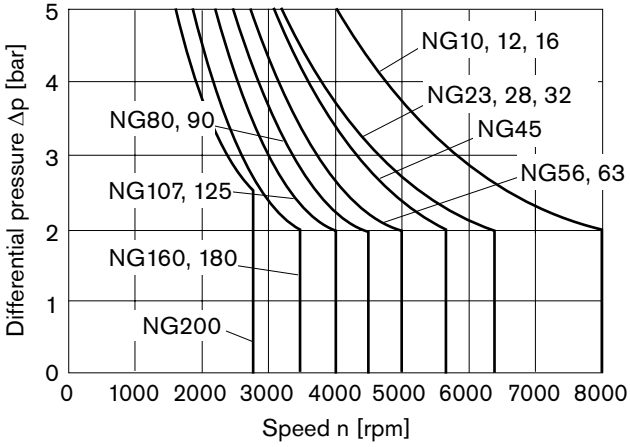
Shaft seal

Permissible pressure loading

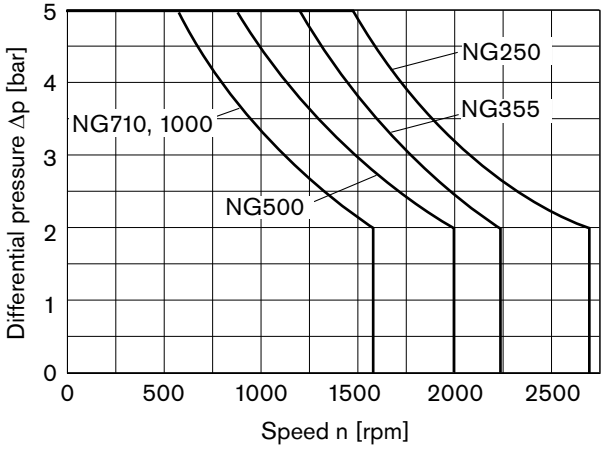
The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes ($t < 0.1$ s) of up to 10 bar are permitted. The service life of the shaft seal decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or higher than the ambient pressure.

Sizes 10 to 200



Sizes 250 to 1000



The values are valid for an ambient pressure $p_{abs} = 1$ bar.

Temperature range

The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C.

Note
For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C). State NBR shaft seal in plain text when ordering.
Please contact us.

Direction of flow

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

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. See table of values on page 7 for maximum speed.

Long-life bearing

Sizes 250 to 1000
For long service life and use with HF hydraulic fluids. Identical external dimensions as motor with standard bearings. Subsequent conversion to long-life bearings is possible. Bearing and case flushing via port U is recommended.

Flushing flow (recommended)

NG	250	355	500	710	1000
$q_{v\,flush}$ (L/min)	10	16	16	16	16

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Size 5

Nominal pressure p_{nom} _____ 315 bar absolute

Maximum pressure p_{max} _____ 350 bar absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{Su} 630 bar

Sizes 10 to 200

Nominal pressure p_{nom} _____ 400 bar absolute

Maximum pressure p_{max} _____ 450 bar absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Sizes 250 to 1000

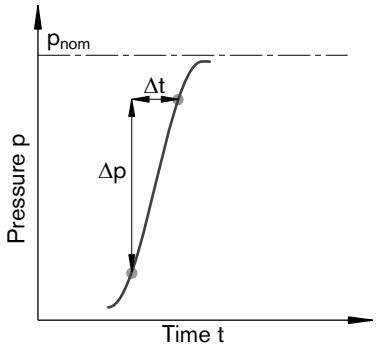
Nominal pressure p_{nom} _____ 350 bar absolute

Maximum pressure p_{max} _____ 400 bar absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

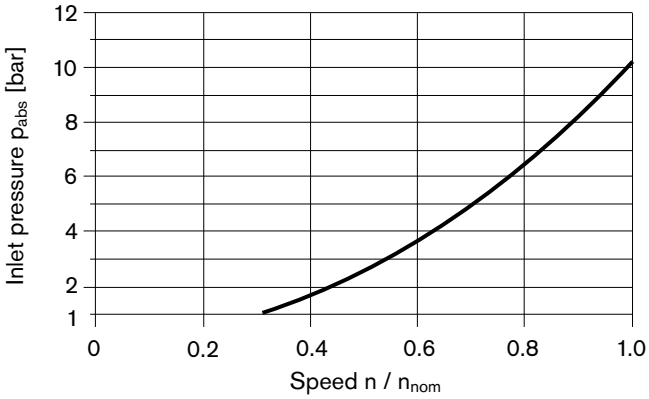
Minimum pressure (high-pressure side) ___25 bar absolute

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve _____ 9000 bar/s
without pressure-relief valve _____ 16000 bar/s



Note
Values for other hydraulic fluids, please contact us.

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). The minimum pressure depends on the speed of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm²/s.
Please contact us if these conditions cannot be satisfied.

Definition

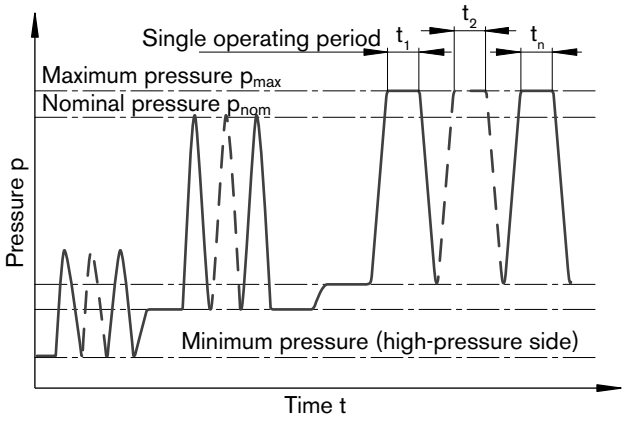
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
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.

Minimum pressure (high-pressure side)
Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

Rate of pressure change R_A
Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.



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

Technical data

Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size	NG		5	10	12	16	23	28	32	45	56	63	80
Displacement geometric, per revolution	V_g	cm^3	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4
Speed maximum[1]	n_{nom}	rpm	10000	8000	8000	8000	6300	6300	6300	5600	5000	5000	4500
	n_{max}[2]	rpm	11000	8800	8800	8800	6900	6900	6900	6200	5500	5500	5000
Input flow[3]													
at n_{nom} and V_g	q_V	L/min	49	82	96	128	144	177	202	255	281	315	362
Torque[4]													
at V_g and $\Delta p = 350$ bar	T	Nm	24.7[5]	57	67	89	128	157	178	254	313	351	448
$\Delta p = 400$ bar	T	Nm	–	66	76	102	146	179	204	290	357	401	512
Rotary stiffness	c	kNm/rad	0.63	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94	6.25	8.73
Moment of inertia for rotary group	J_{GR}	kgm^2	0.00006	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072
Maximum angular acceleration	α	rad/s^2	5000	5000	5000	5000	6500	6500	6500	14600	7500	7500	6000
Case volume	V	L		0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55
Mass (approx.)	m	kg	2.5	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18	18	23

Size	NG		90	107	125	160	180	200	250	355	500	710	1000
Displacement geometric, per revolution	V_g	cm^3	90	106.7	125	160.4	180	200	250	355	500	710	1000
Speed maximum[1]	n_{nom}	rpm	4500	4000	4000	3600	3600	2750	2700	2240	2000	1600	1600
	n_{max}[2]	rpm	5000	4400	4400	4000	4000	3000	–	–	–	–	–
Input flow[3]													
at n_{nom} and V_g	q_V	L/min	405	427	500	577	648	550	675	795	1000	1136	1600
Torque[4]													
at V_g and $\Delta p = 350$ bar	T	Nm	501	594	696	893	1003	1114	1393	1978	2785	3955	5570
$\Delta p = 400$ bar	T	Nm	573	679	796	1021	1146	1273	–	–	–	–	–
Rotary stiffness	c	kNm/rad	9.14	11.2	11.9	17.4	18.2	57.3	73.1	96.1	144	270	324
Moment of inertia for rotary group	J_{GR}	kgm^2	0.0072	0.0116	0.0116	0.0220	0.0220	0.0353	0.061	0.102	0.178	0.55	0.55
Maximum angular acceleration	α	rad/s^2	6000	4500	4500	3500	3500	11000	10000	8300	5500	4300	4500
Case volume	V	L	0.55	0.8	0.8	1.1	1.1	2.7	2.5	3.5	4.2	8	8
Mass (approx.)	m	kg	23	32	32	45	45	66	73	110	155	325	336

1) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm^2/s
- with hydraulic fluid based on mineral oils

2) Intermittent maximum speed: overspeed for unload and overhauling processes, $t < 5$ s and $\Delta p < 150$ bar

3) Restriction of input flow with counterbalance valve, see page 39

4) Torque without radial force, with radial force see page 8

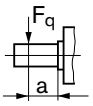
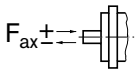
5) Torque at $\Delta p = 315$ bar

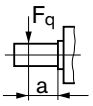
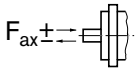
Note
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible start up angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

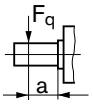
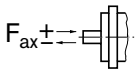
Technical data

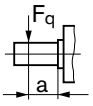
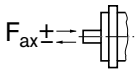
Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	NG		5	5[3]	10	10	12	12	16	23	23
Drive shaft	ø	mm	12	12	20	25	20	25	25	25	30
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	kN	1.6	1.6	3.0	3.2	3.0	3.2	3.2	5.7	5.4
	a	mm	12	12	16	16	16	16	16	16	16
with permissible torque	T_{max}	Nm	24.7	24.7	66	66	76	76	102	146	146
≙ permissible pressure Δp	Δp_{perm}	bar	315	315	400	400	400	400	400	400	400
Maximum axial force[2] 	$+F_{ax\,max}$	N	180	180	320	320	320	320	320	500	500
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	1.5	1.5	3.0	3.0	3.0	3.0	3.0	5.2	5.2

Size	NG		28	28	32	45	56	56[4]	56	63	80
Drive shaft	ø	mm	25	30	30	30	30	30	35	35	35
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	kN	5.7	5.4	5.4	7.6	9.5	7.8	9.1	9.1	11.6
	a	mm	16	16	16	18	18	18	18	18	20
with permissible torque	T_{max}	Nm	179	179	204	290	357	294	357	401	512
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	400	330	400	400	400
Maximum axial force[2] 	$+F_{ax\,max}$	N	500	500	500	630	800	800	800	800	1000
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7	8.7	10.6

Size	NG		80[4]	80	90	107	107	125	160	160	180
Drive shaft	ø	mm	35	40	40	40	45	45	45	50	50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	kN	11.1	11.4	11.4	13.6	14.1	14.1	18.1	18.3	18.3
	a	mm	20	20	20	20	20	20	25	25	25
with permissible torque	T_{max}	Nm	488	512	573	679	679	796	1021	1021	1146
≙ permissible pressure Δp	Δp_{perm}	bar	380	400	400	400	400	400	400	400	400
Maximum axial force[2] 	$+F_{ax\,max}$	N	1000	1000	1000	1250	1250	1250	1600	1600	1600
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	10.6	10.6	10.6	12.9	12.9	12.9	16.7	16.7	16.7

Size	NG		200	250	355	500	710	1000
Drive shaft	ø	mm	50	50	60	70	90	90
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	kN	20.3	1.2[6]	1.5[6]	1.9[6]	3.0[6]	2.6[6]
	a	mm	25	41	52.5	52.5	67.5	67.5
with permissible torque	T_{max}	Nm	1273	[5]	[5]	[5]	[5]	[5]
≙ permissible pressure Δp	Δp_{perm}	bar	400	[5]	[5]	[5]	[5]	[5]
Maximum axial force[2] 	$+F_{ax\,max}$	N	1600	2000	2500	3000	4400	4400
	$-F_{ax\,max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	16.7	[5]	[5]	[5]	[5]	[5]

1) With intermittent operation
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) Conical shaft with threaded pin and woodruff key (DIN 6888)
4) Restricted technical data only for splined shaft
5) Please contact us.
6) When at a standstill or when axial piston unit operating in non-pressurized conditions. Higher forces are permissible when under pressure, please contact us.

Note

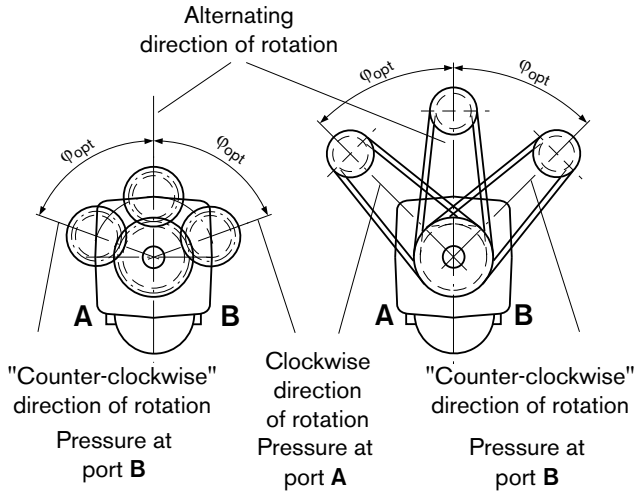
Influence of the direction of the permissible axial force:
$+F_{ax\,max}$ = Increase in service life of bearings
$-F_{ax\,max}$ = Reduction in service life of bearings (avoid)

Technical data

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	V-belt output
NG	φ_{opt}	φ_{opt}
5 to 180	± 70°	± 45°
200 to 1000	± 45°	± 70°



Determining the operating characteristics

Input flow $q_v = \dfrac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \dfrac{q_V \cdot 1000 \cdot \eta_v}{V_g}$ [min^{-1}]

Torque $T = \dfrac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$ [Nm]

Power $P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [kW]

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

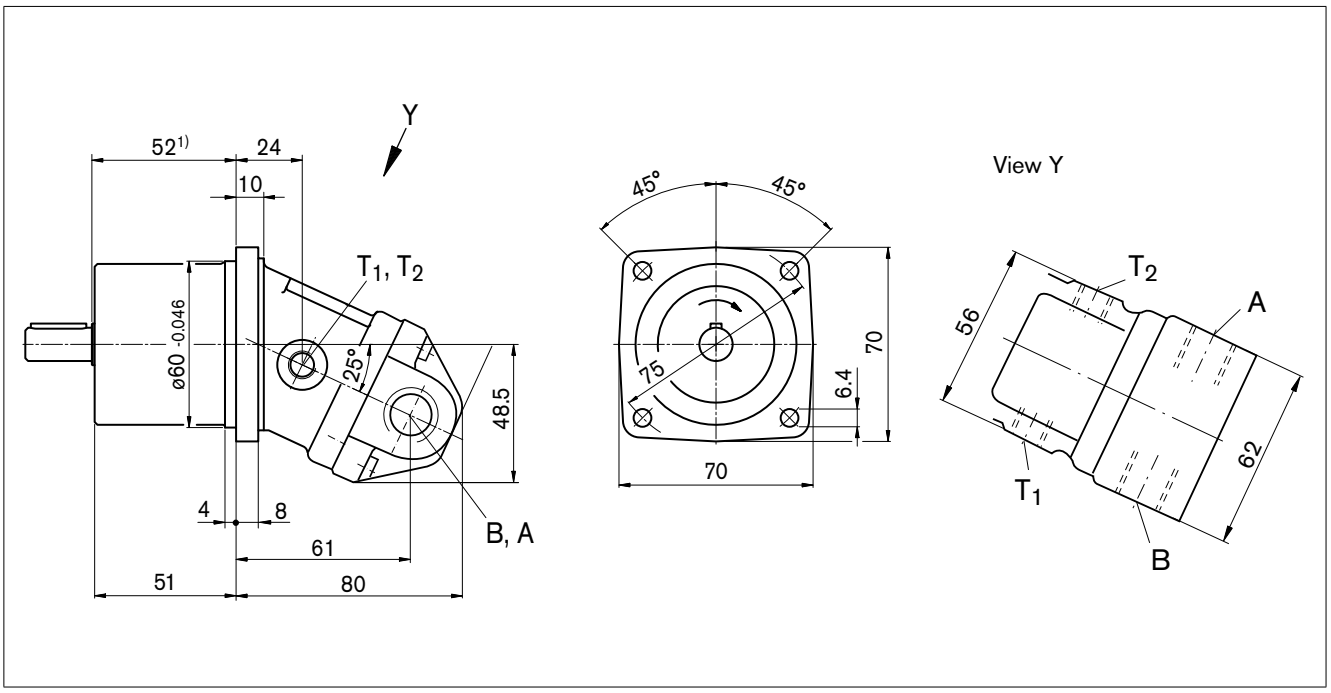
η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

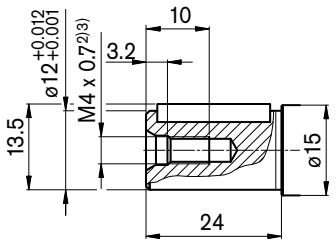
Dimensions size 5

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

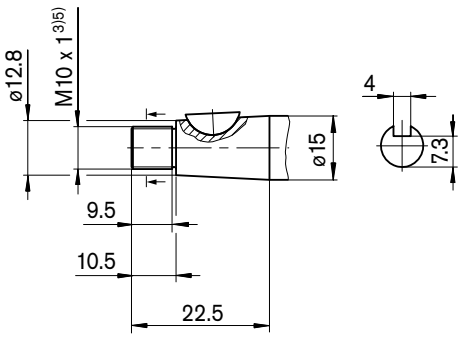


Drive shafts

B Parallel keyed shaft
DIN 6885, A4x4x20



C Conical shaft with threaded pin and woodruff key, 3x5
(DIN 6888), (tapering 1:10)



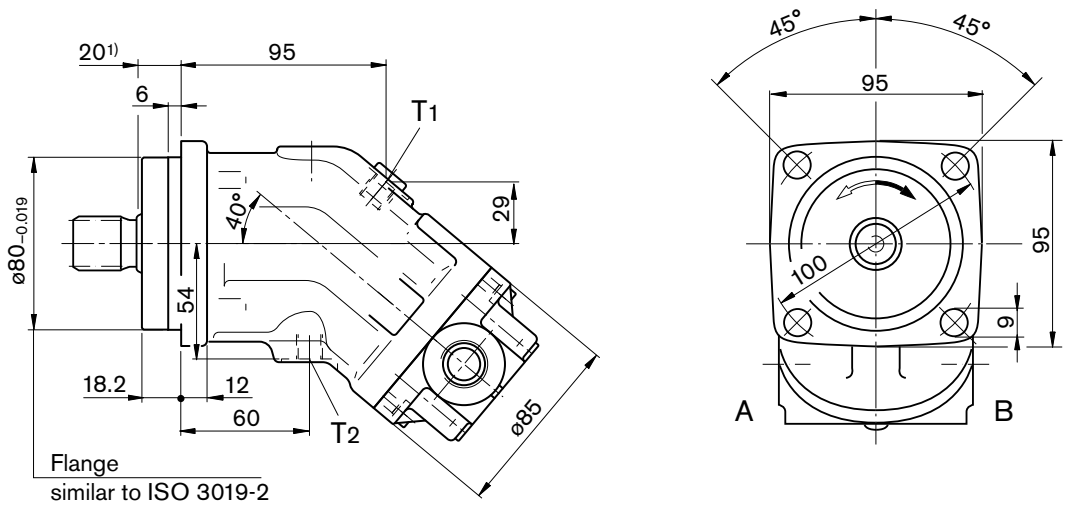
Ports

Designation	Port for	Standard[6)]	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line	DIN 3852	M18 x 1.5; 12 deep	350	O
T_1	Drain line	DIN 3852	M10 x 1; 8 deep	3	O
T_2	Drain line	DIN 3852	M10 x 1; 8 deep	3	O

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Thread according to DIN 3852, maximum tightening torque: 30 Nm
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)

Dimensions sizes 10, 12, 16

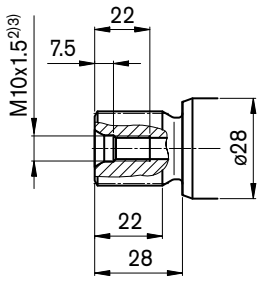
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

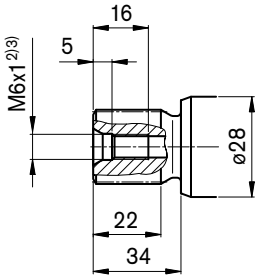
Sizes 10, 12, 16

A Splined shaft DIN 5480 W25x1.25x18x9g



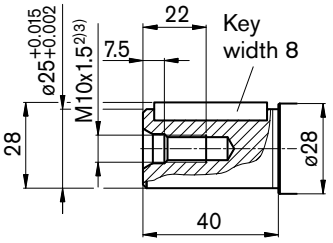
Sizes 10, 12

Z Splined shaft DIN 5480 W20x1.25x14x9g



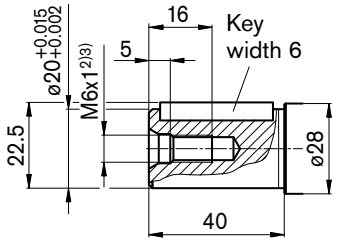
Sizes 10, 12, 16

B Parallel keyed shaft DIN 6885, AS8x7x32



Sizes 10, 12

P Parallel keyed shaft DIN 6885, AS6x6x32



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M12 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M12 x 1.5; 12 deep	3	O[5)]

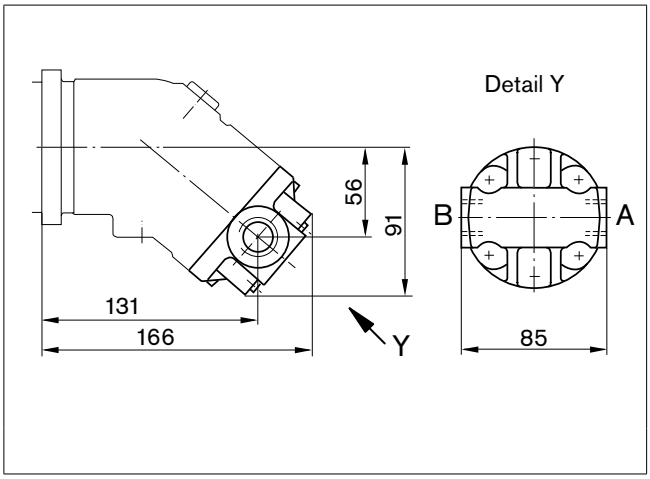
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 10, 12, 16

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

03 – Threaded ports at side, opposite



04 – Threaded ports at side and rear

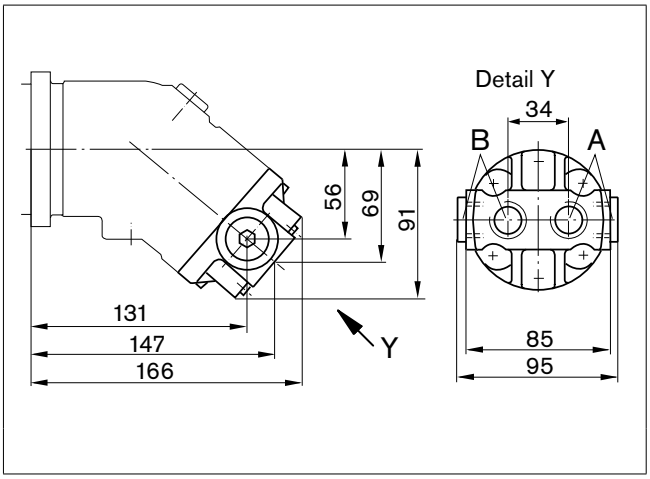
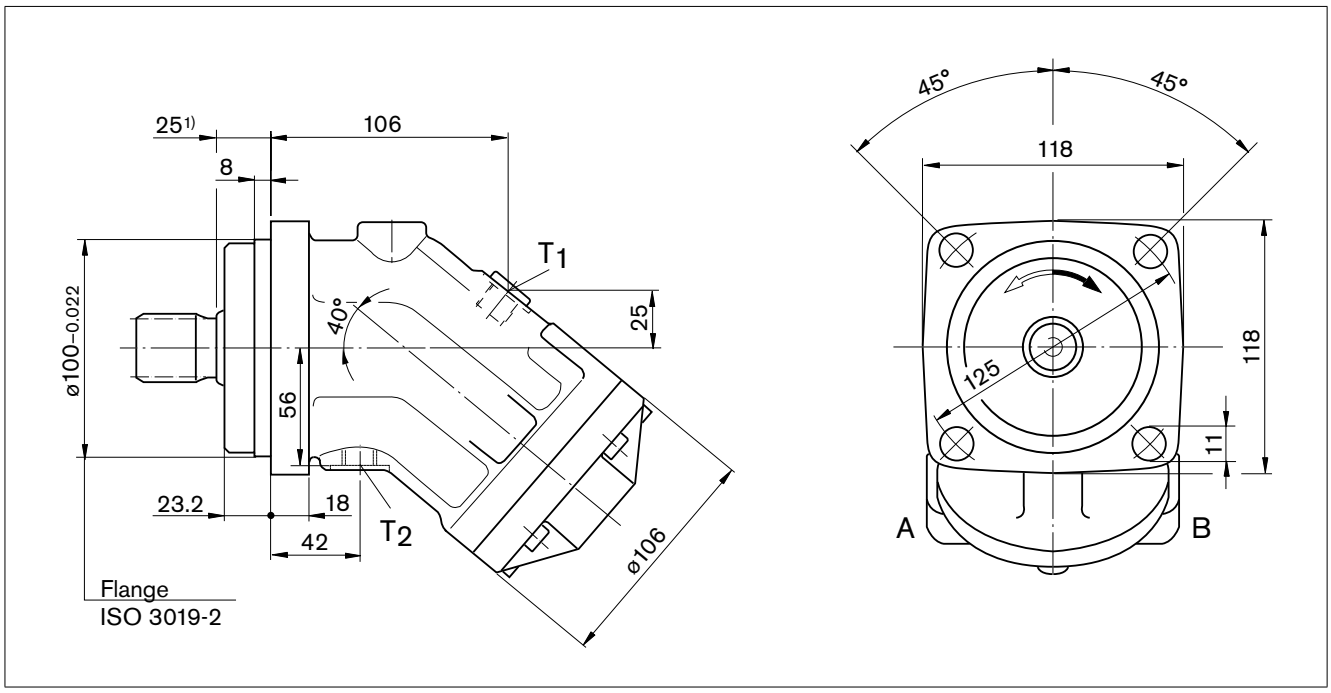


Plate	Designation	Port for	Standard[3]	Size[1]	Maximum pressure [bar][2]	State[4]
03	A, B	Service line	DIN 3852	M22 x 1.5; 14 deep	450	O
04		Service line	DIN 3852	M22 x 1.5; 14 deep	450	1x O each

1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)

Dimensions sizes 23, 28, 32

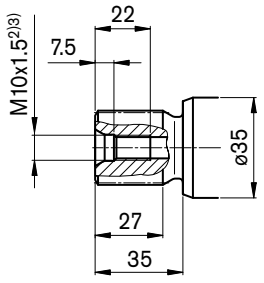
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

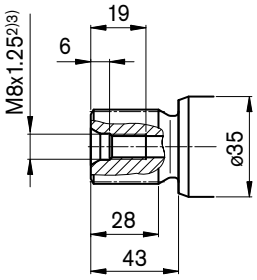
Sizes 23, 28, 32

A Splined shaft DIN 5480
W30x2x14x9g



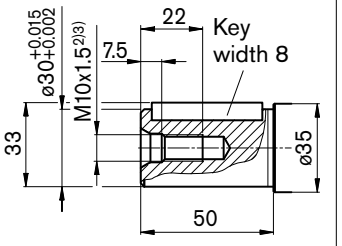
Sizes 23, 28

Z Splined shaft DIN 5480
W25x1.25x18x9g



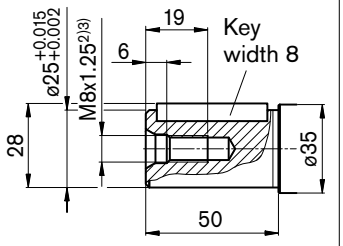
Sizes 23, 28, 32

B Parallel keyed shaft
DIN 6885, AS8x7x40



Sizes 23, 28

P Parallel keyed shaft
DIN 6885, AS8x7x40



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[7]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6]	M16 x 1.5; 12 deep	3	X[5]
T_2	Drain line	DIN 3852[6]	M16 x 1.5; 12 deep	3	O[5]

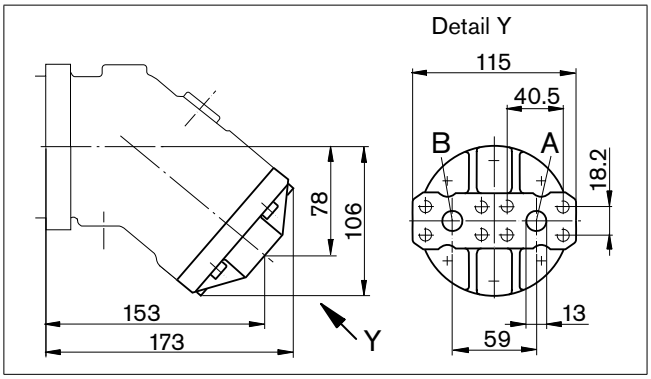
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 23, 28, 32

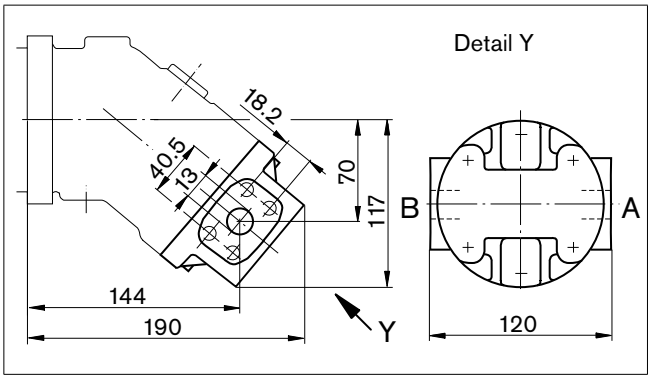
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

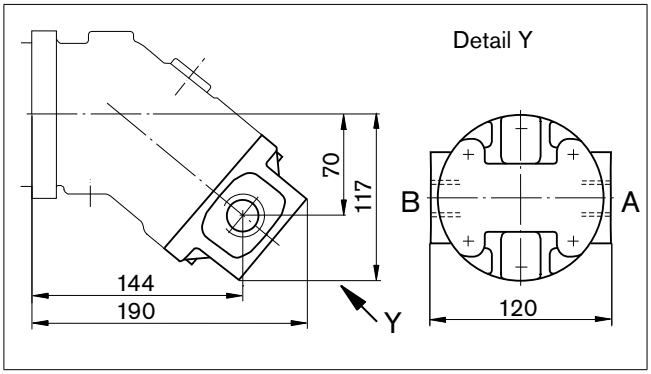
01 – SAE flange ports at rear



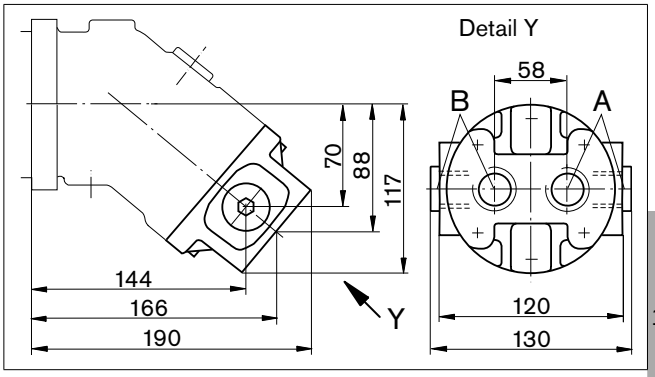
02 – SAE flange ports at side, opposite



03 – Threaded ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)[4]

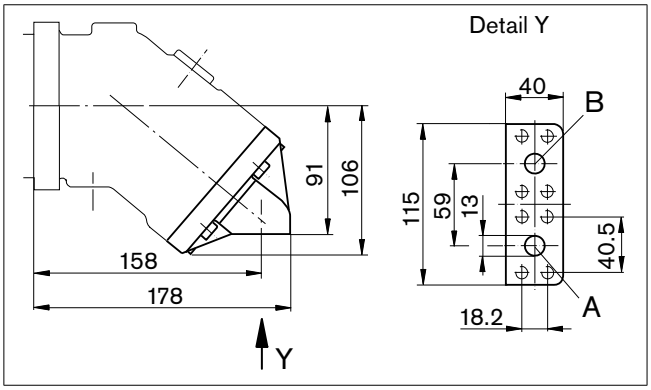


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1/2 in M8 x 1.25; 15 deep	450	O
03		Service line	DIN 3852[5]	M27 x 2; 16 deep	450	O
04		Service line	DIN 3852[5]	M27 x 2; 16 deep	450	1x O each

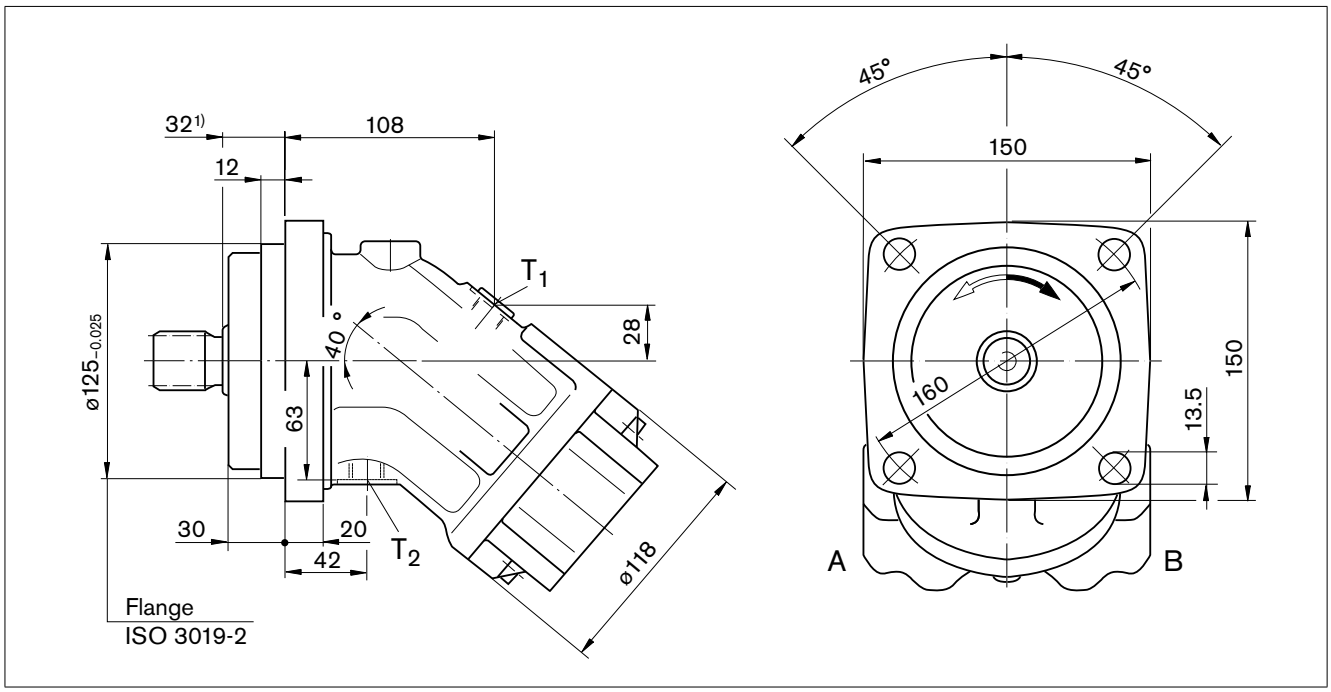
1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard
4) Only sizes 28 and 32
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 37 and 40

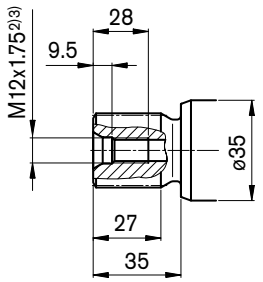
Dimensions size 45

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

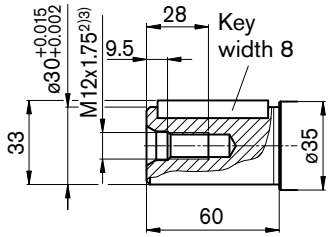


Drive shafts

Z Splined shaft DIN 5480
W30x2x14x9g



P Parallel keyed shaft
DIN 6885, AS8x7x50



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	O[5)]

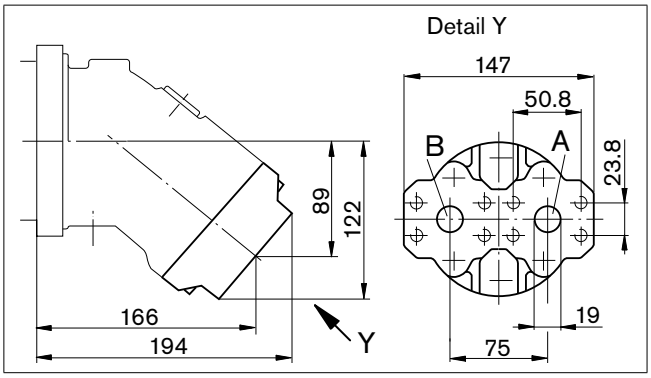
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 45

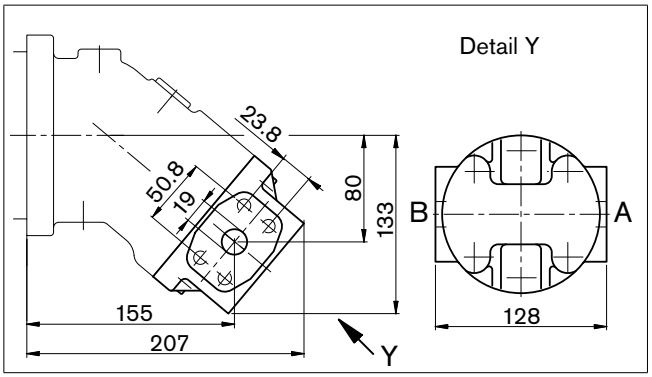
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

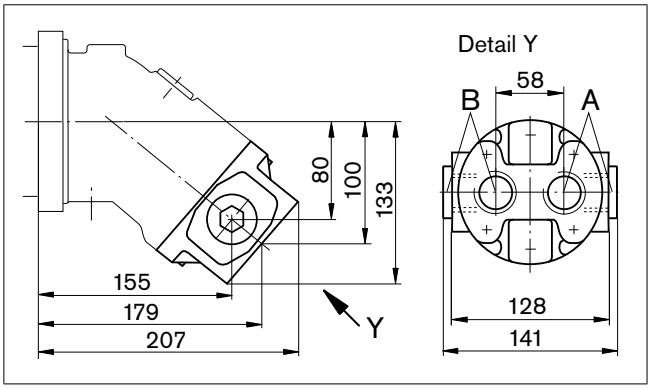
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

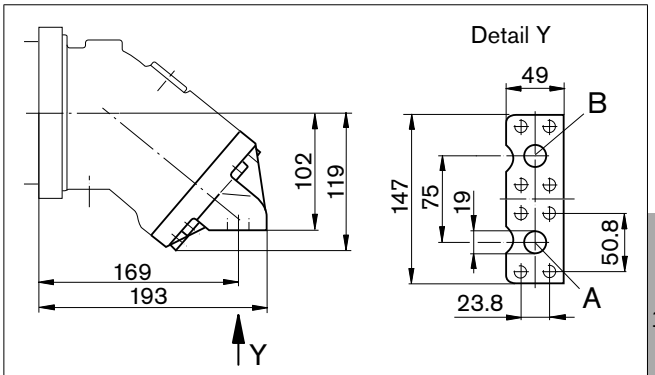


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[5]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
04		Service line	DIN 3852[4]	M33 x 2; 18 deep	450	1x O each

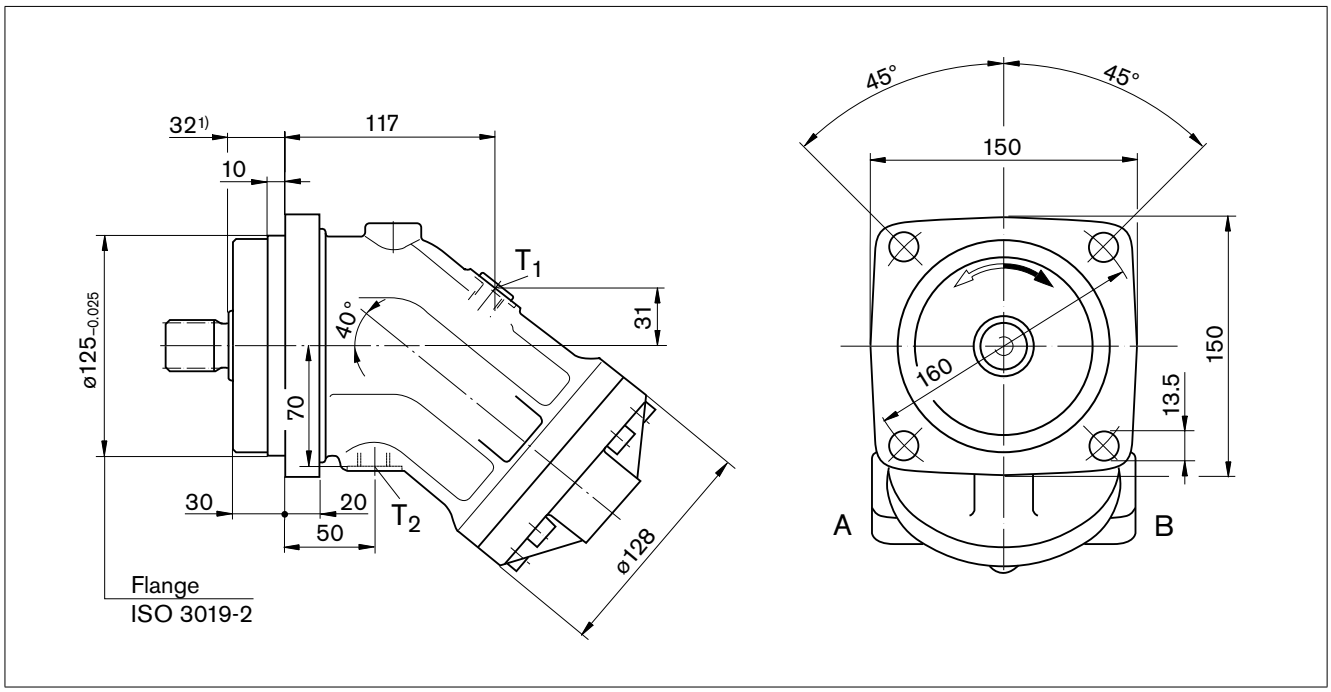
1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 37 and 40

Dimensions sizes 56, 63

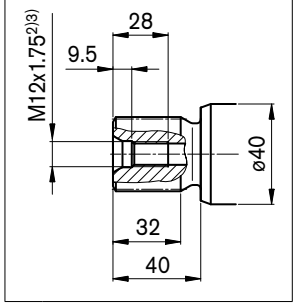
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

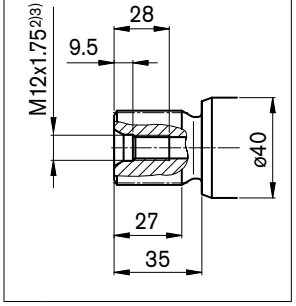
NG56, 63

A Splined shaft DIN 5480
W35x2x16x9g



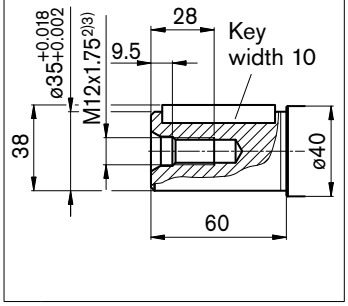
NG56

Z Splined shaft DIN 5480
W30x2x14x9g



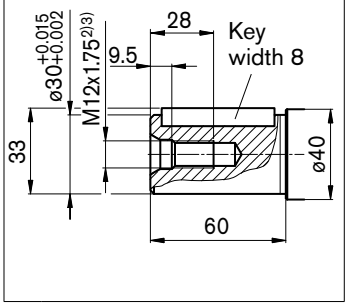
NG56, 63

B Parallel keyed shaft
DIN 6885, AS10x8x50



NG56

P Parallel keyed shaft
DIN 6885, AS8x7x50



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[7]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	X[5]
T_2	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	O[5]

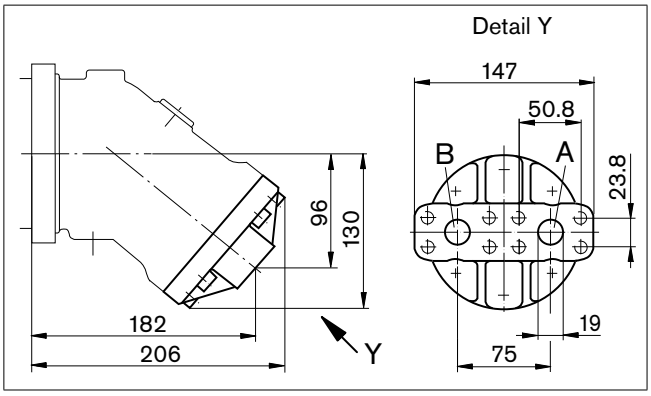
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 56, 63

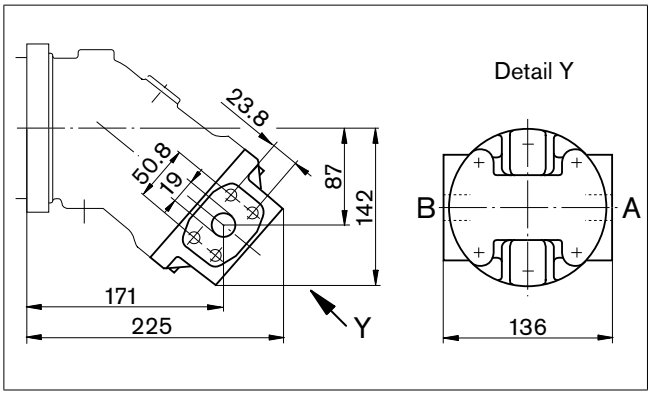
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

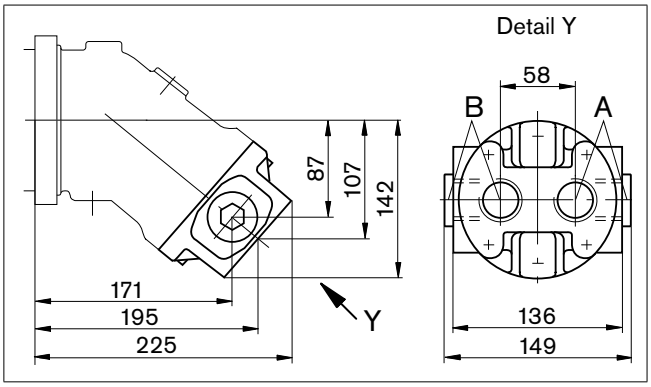
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

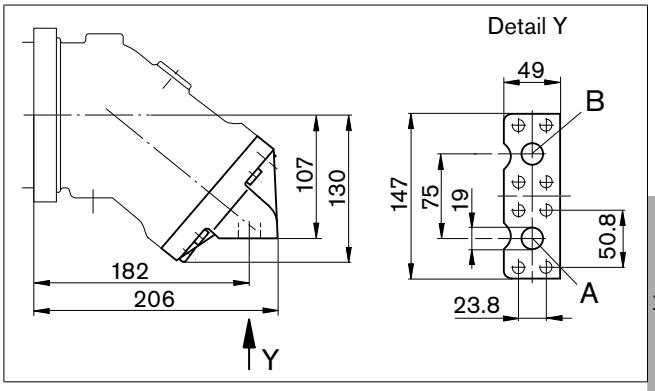


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[5]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
04		Service line	DIN 3852[4]	M33 x 2; 18 deep	450	1x O each

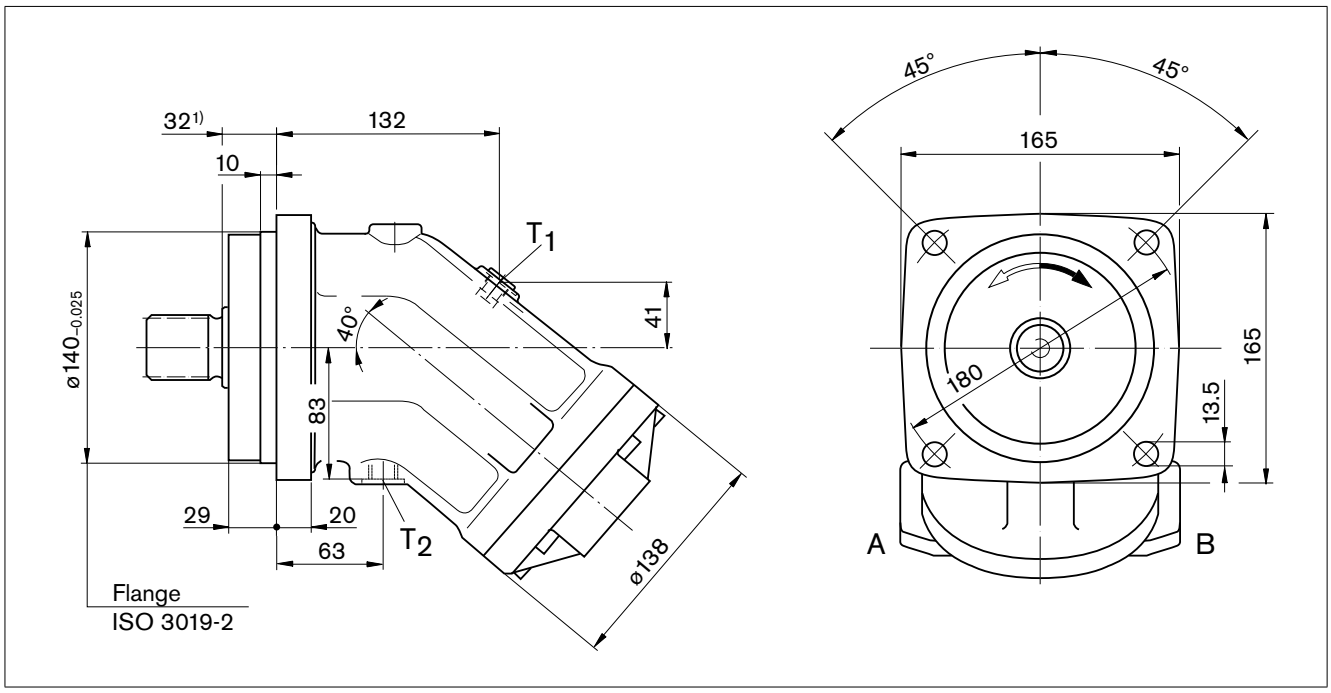
1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 37 and 40

Dimensions sizes 80, 90

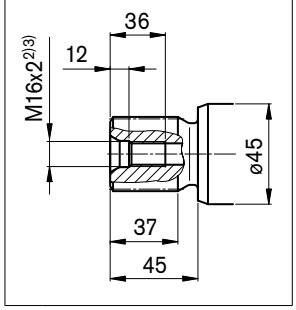
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

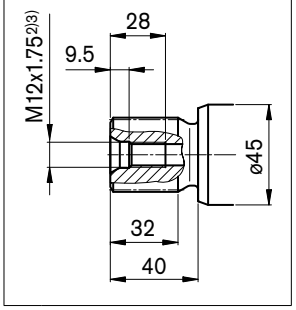
NG80, 90

A Splined shaft DIN 5480
W40x2x18x9g



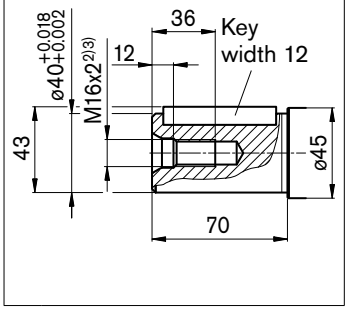
NG80

Z Splined shaft DIN 5480
W35x2x16x9g



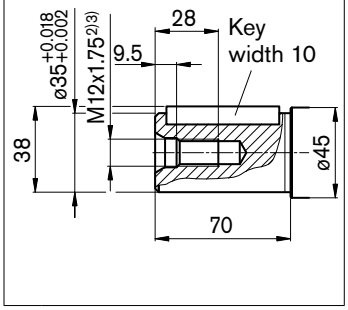
NG80, 90

B Parallel keyed shaft
DIN 6885, AS12x8x56



NG80

P Parallel keyed shaft
DIN 6885, AS10x8x56



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	O[5)]

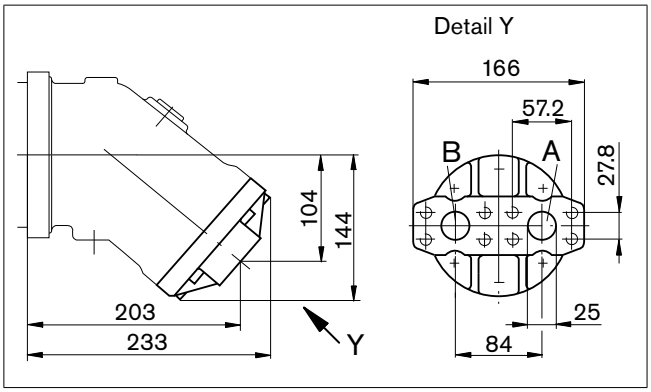
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 80, 90

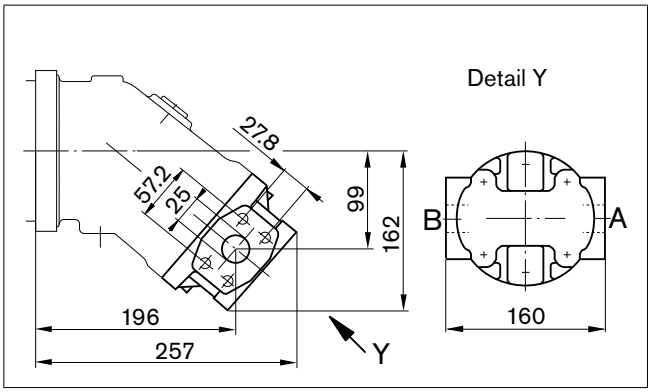
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



10 – SAE flange ports at bottom (same side)

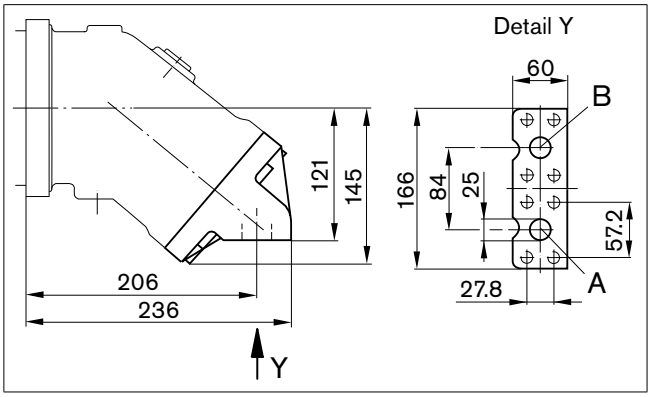


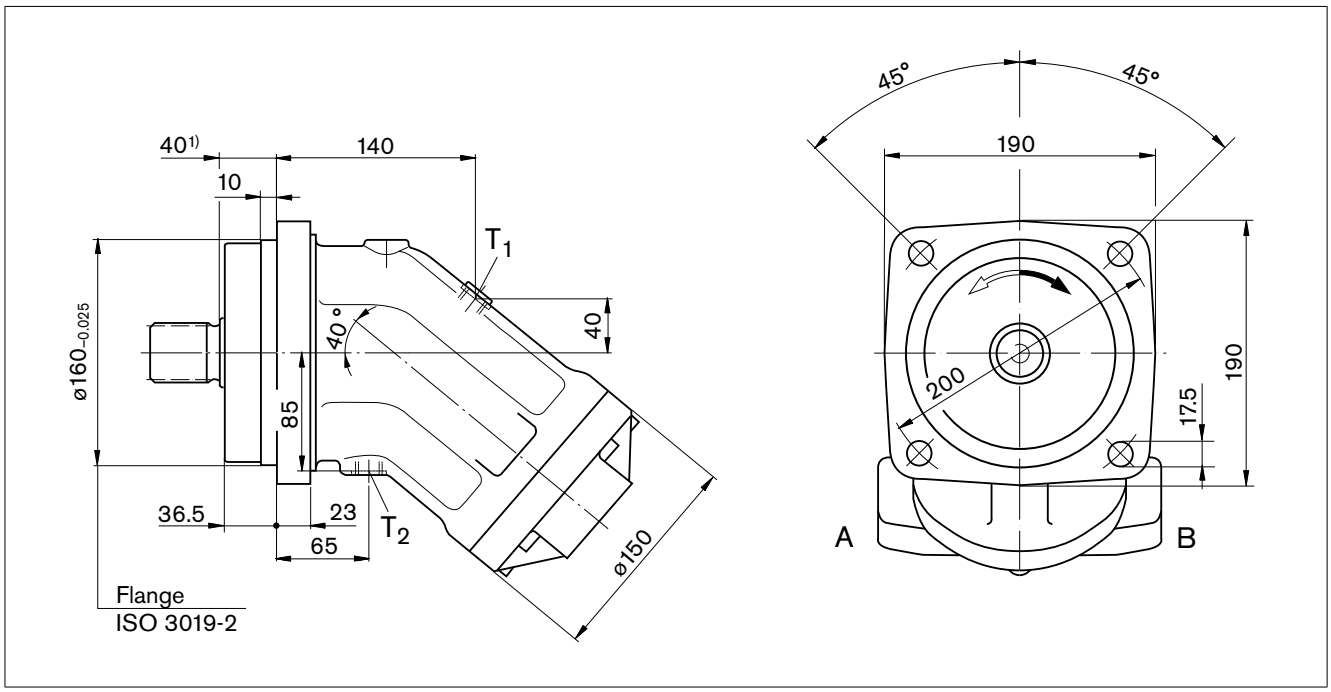
Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	450	O

1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

Note
Port plates 18 and 19: see pages 37 and 40

Dimensions sizes 107, 125

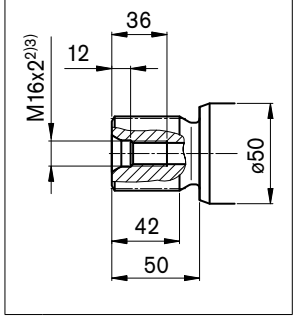
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

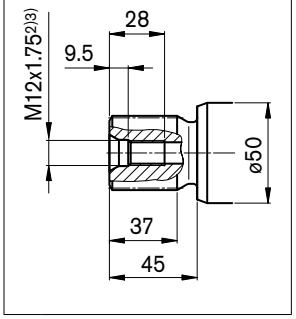
NG107, 125

A Splined shaft DIN 5480 W45x2x21x9g



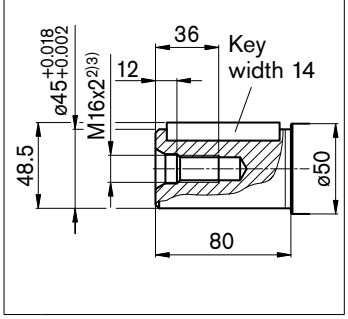
NG107

Z Splined shaft DIN 5480 W40x2x18x9g



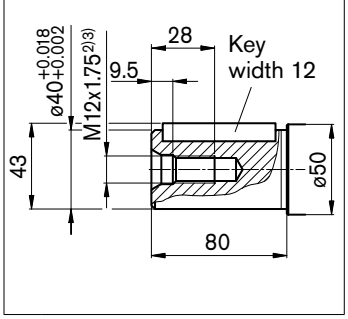
NG107, 125

B Parallel keyed shaft DIN 6885, AS14x9x63



NG107

P Parallel keyed shaft DIN 6885, AS12x8x63



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	O[5)]

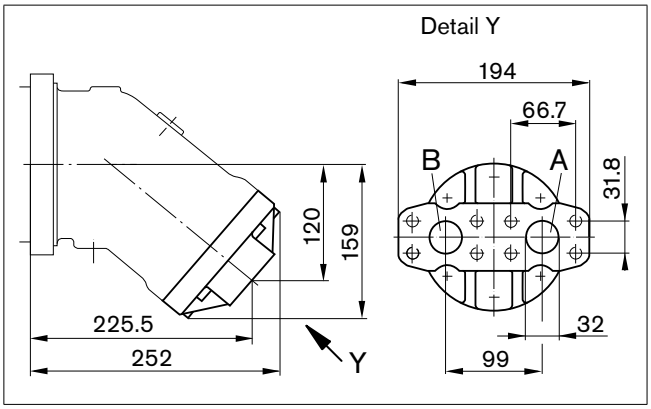
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 107, 125

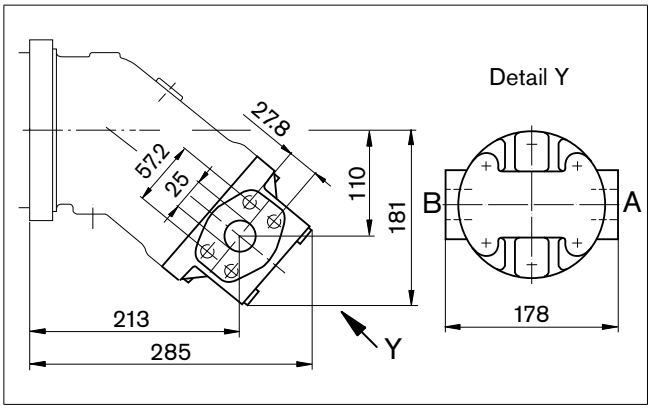
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

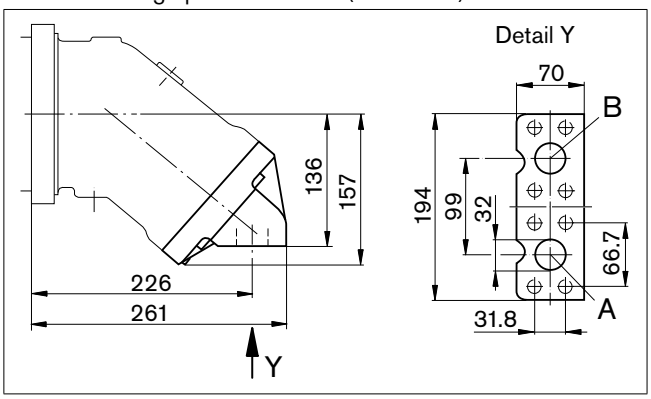
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite (size 107)



10 – SAE flange ports at bottom (same side)



02 – SAE flange ports at side, opposite (size 125)

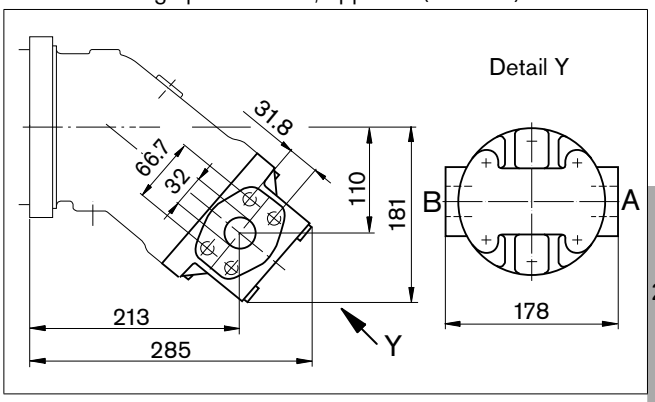


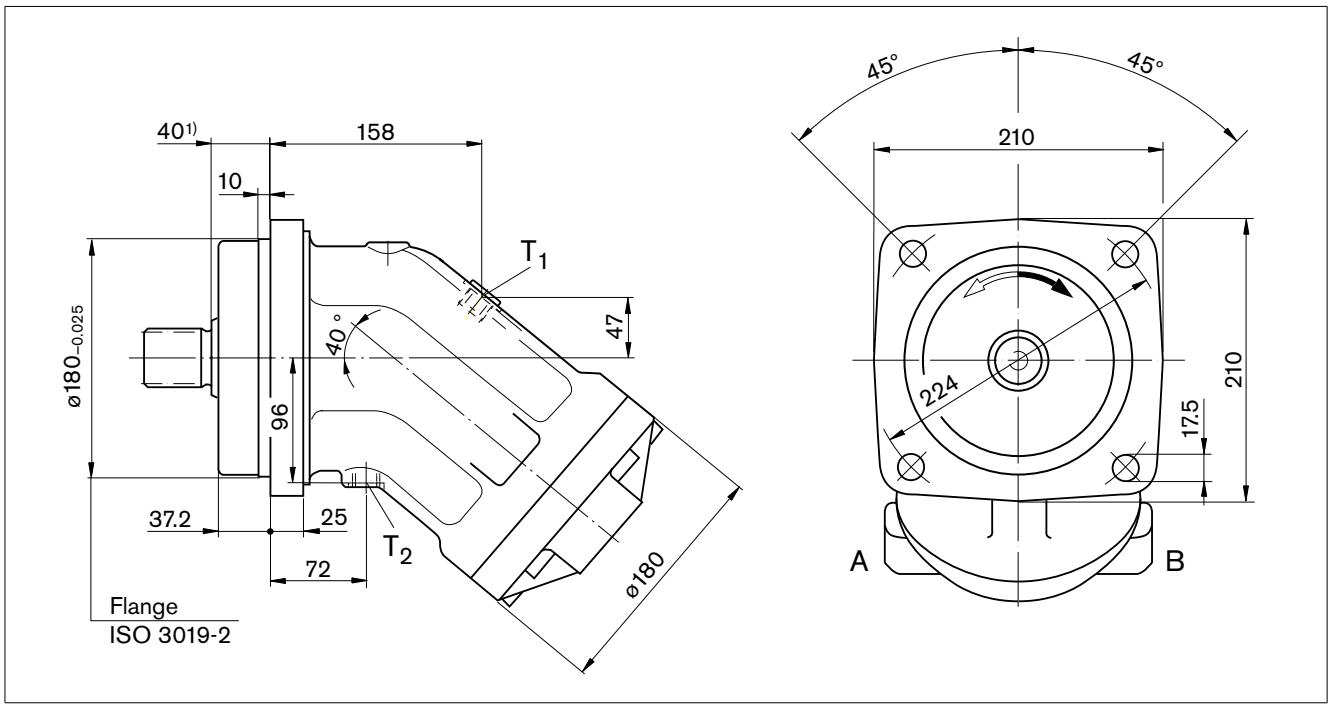
Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
02 (size 107)		Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	450	O
02 (size 125)		Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O

1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

Note
Port plates 17, 18 and 19: see pages 37 and 40

Dimensions sizes 160, 180

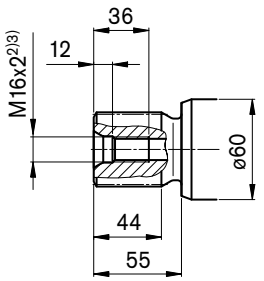
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

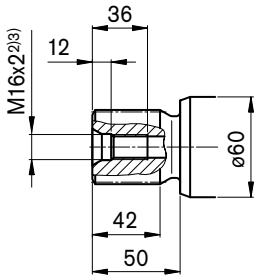
NG160, 180

A Splined shaft DIN 5480
W50x2x24x9g



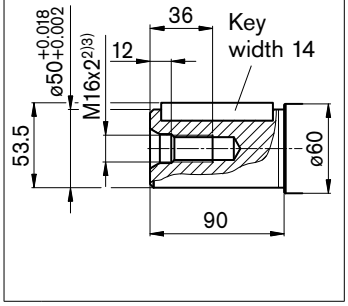
NG160

Z Splined shaft DIN 5480
W45x2x21x9g



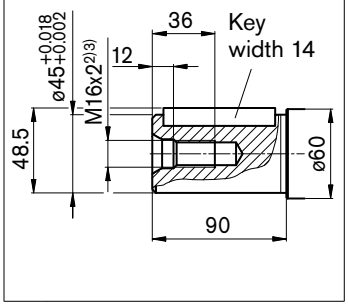
NG160, 180

B Parallel keyed shaft
DIN 6885, AS14x9x70



NG160

P Parallel keyed shaft
DIN 6885, AS14x9x70



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[7]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6]	M22 x 1.5; 14 deep	3	X[5]
T_2	Drain line	DIN 3852[6]	M22 x 1.5; 14 deep	3	O[5]

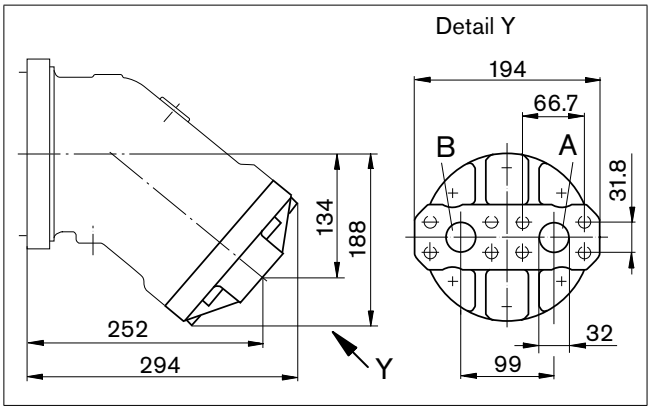
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 160, 180

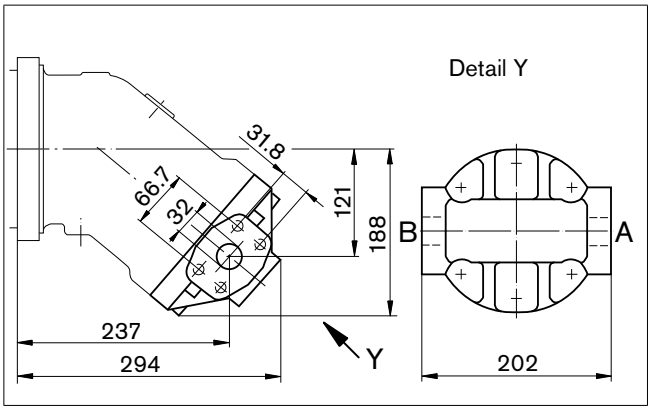
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



10 – SAE flange ports at bottom (same side)

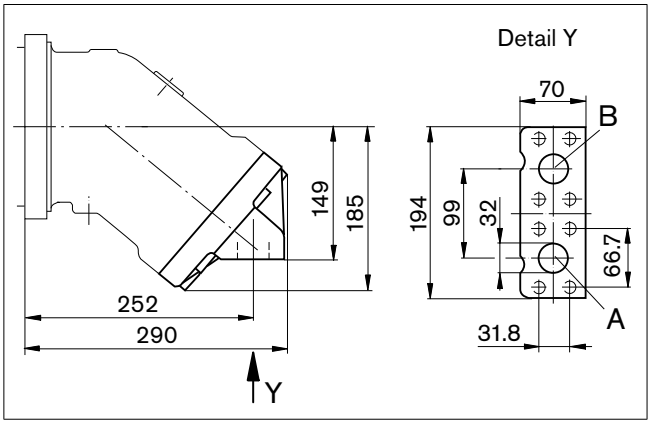


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O

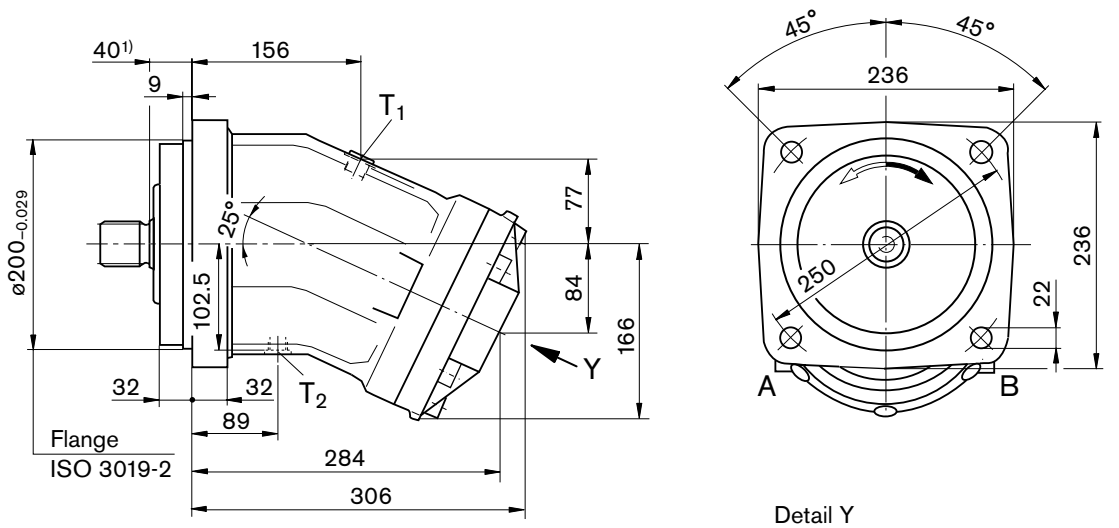
1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

Note
Port plates 18 and 19: see pages 37 and 40

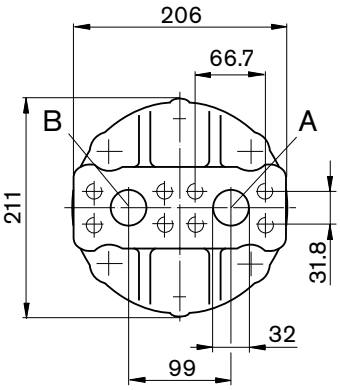
Dimensions size 200

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

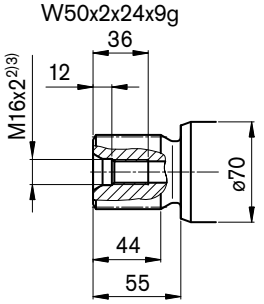


Detail Y

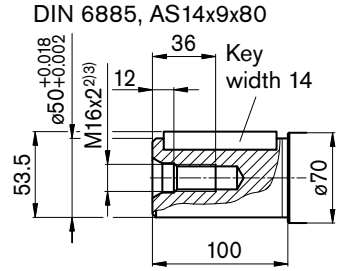


Drive shafts

A Splined shaft DIN 5480
W50x2x24x9g



B Parallel keyed shaft
DIN 6885, AS14x9x80



Ports

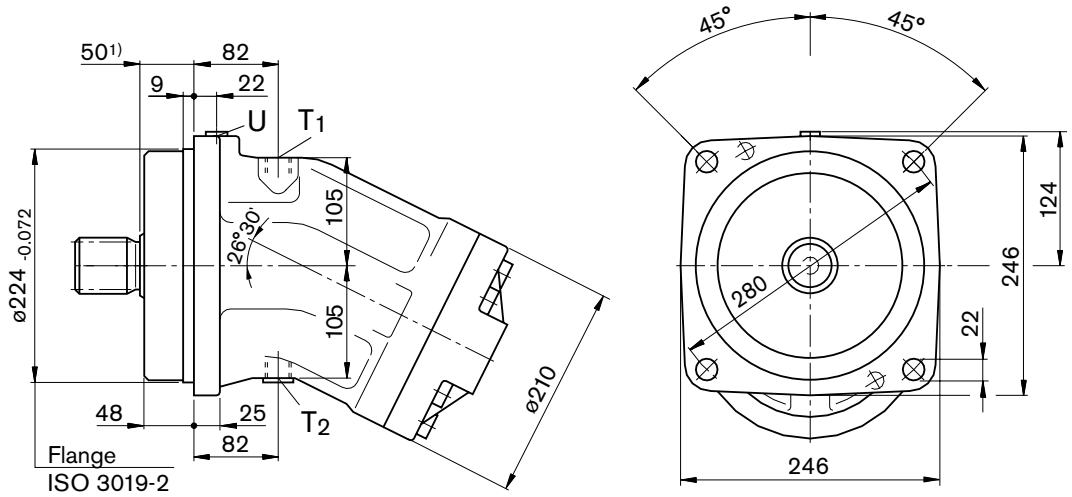
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J5185[5)] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
T_1	Drain line	DIN 3852[7)]	M22 x 1.5; 14 deep	3	X[6)]
T_2	Drain line	DIN 3852[7)]	M22 x 1.5; 14 deep	3	O[6)]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Notes

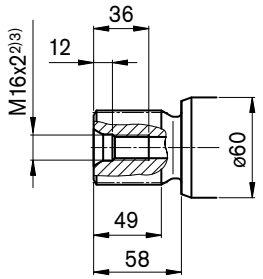
Dimensions size 250

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

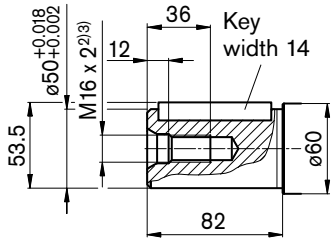


Drive shafts

Z Splined shaft DIN 5480
W50x2x24x9g



P Parallel keyed shaft
DIN 6885, AS14x9x80



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[7]
A, B	Service line (see port plates)			400	
T_1	Drain line	DIN 3852[6]	M22 x 1.5; 14 deep	3	O[5]
T_2	Drain line	DIN 3852[6]	M22 x 1.5; 14 deep	3	X[5]
U	Bearing flushing	DIN 3852[6]	M14 x 1.5; 12 deep	3	X

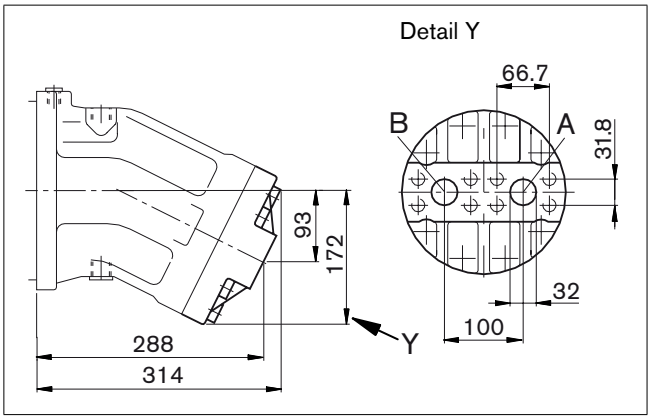
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 250

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite

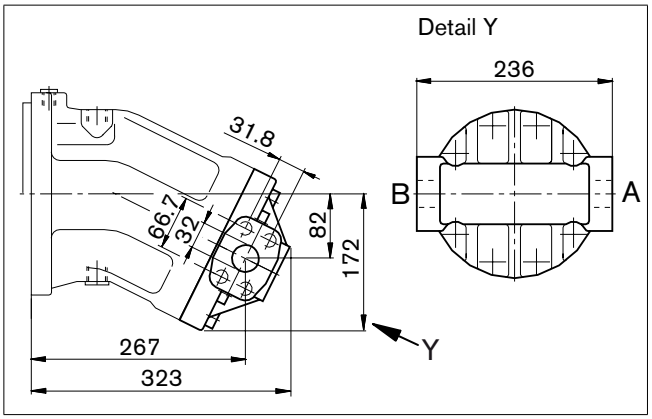


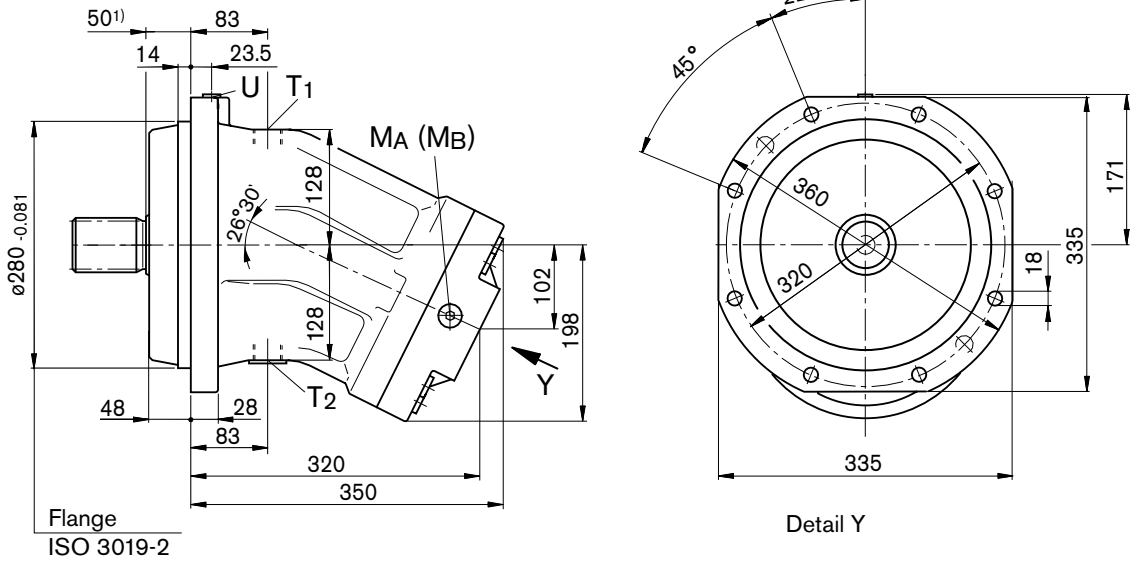
Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 02	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O

1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

Dimensions size 355

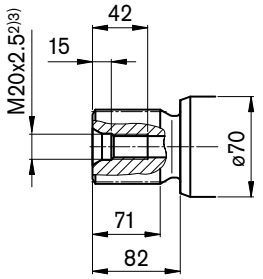
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

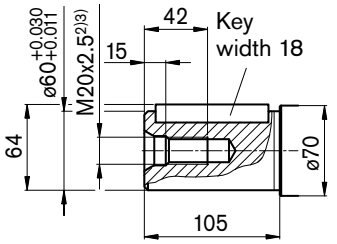


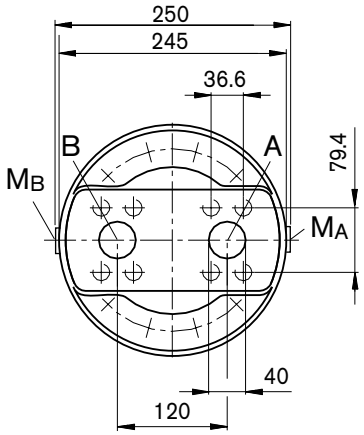
Drive shafts

Z Splined shaft DIN 5480
W60x2x28x9g



P Parallel keyed shaft
DIN 6885, AS18x11x100





Ports

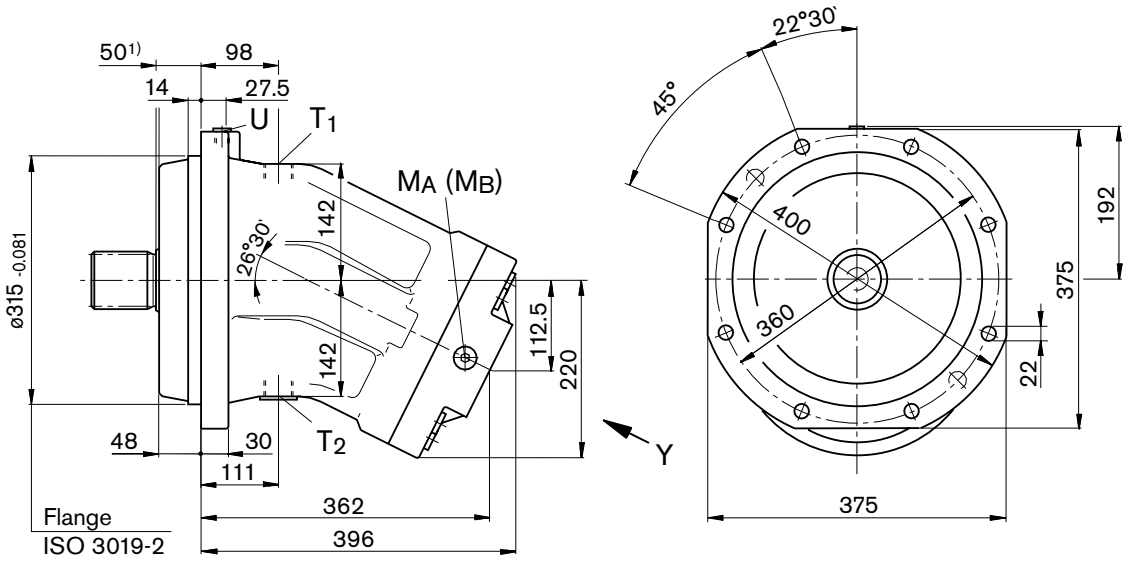
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J5185[5)] DIN 13	1 1/2 in M16 x 2; 21 deep	400	O
T_1	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	O[6)]
T_2	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	X[6)]
U	Bearing flushing	DIN 3852[7)]	M14 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7)]	M14 x 1.5; 12 deep	400	X

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

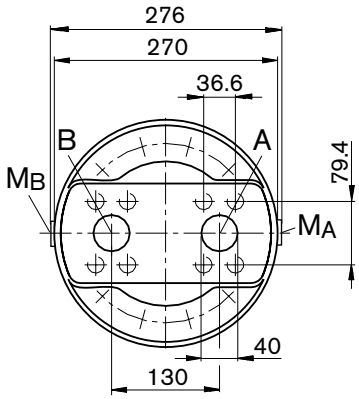
Dimensions size 500

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

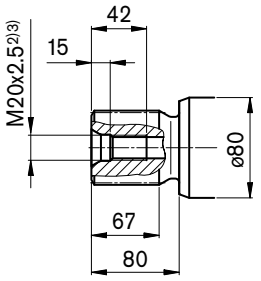


Detail Y

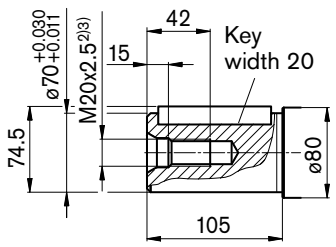


Drive shafts

Z Splined shaft DIN 5480
W70x3x22x9g



P Parallel keyed shaft
DIN 6885, AS20x12x100



Ports

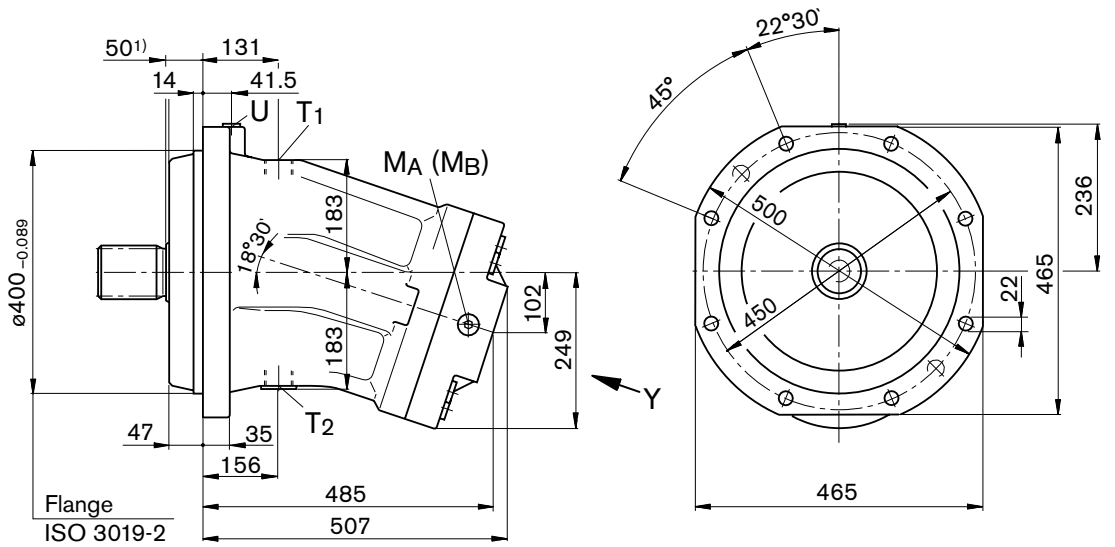
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J5185[5)] DIN 13	1 1/2 in M16 x 2; 21 deep	400	O
T_1	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	O[6)]
T_2	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	X[6)]
U	Bearing flushing	DIN 3852[7)]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7)]	M14 x 1.5; 12 deep	400	X

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 710

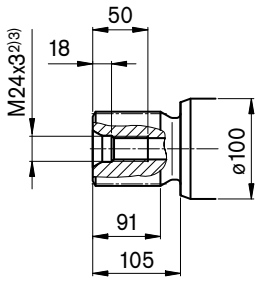
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

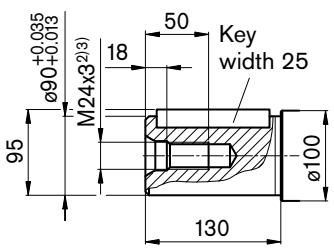


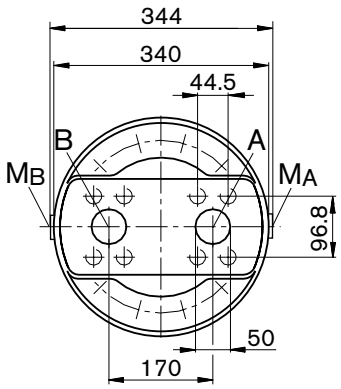
Drive shafts

Z Splined shaft DIN 5480
W90x3x28x9g



P Parallel keyed shaft
DIN 6885, AS25x14x125





Ports

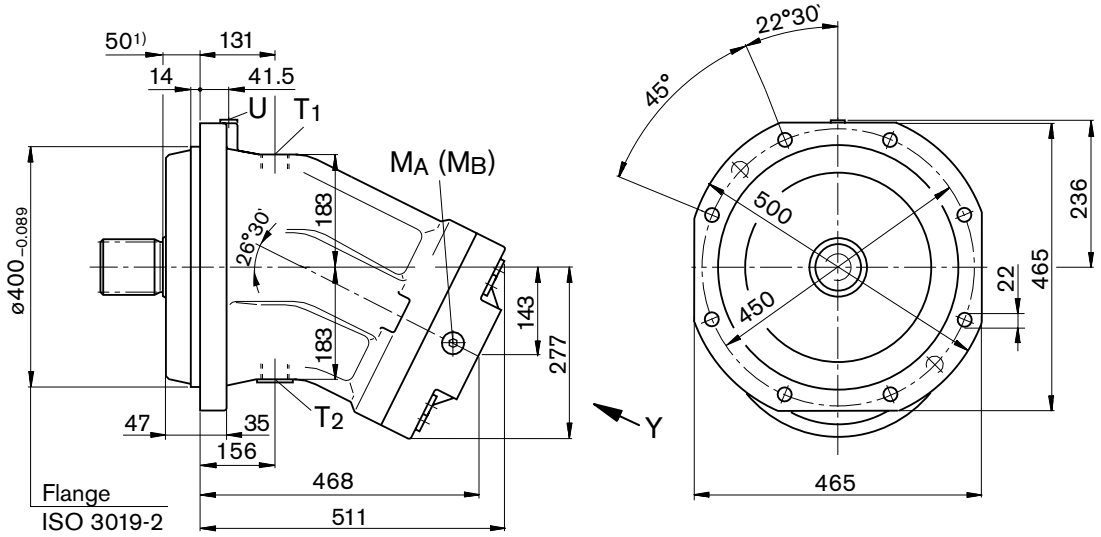
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[5)] DIN 13	2 in M20 x 2.5; 30 deep	400	O
T_1	Drain line	DIN 3852[7)]	M42 x 2; 20 deep	3	O[6)]
T_2	Drain line	DIN 3852[7)]	M42 x 2; 20 deep	3	X[6)]
U	Bearing flushing	DIN 3852[7)]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7)]	M14 x 1.5; 12 deep	400	X

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

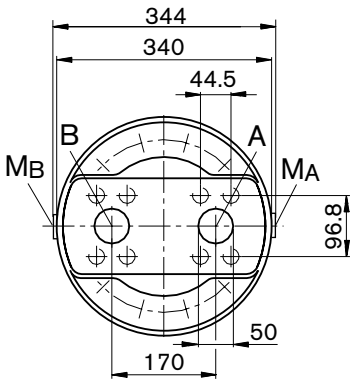
Dimensions size 1000

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

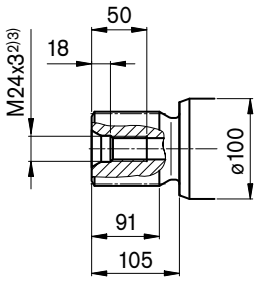


Detail Y

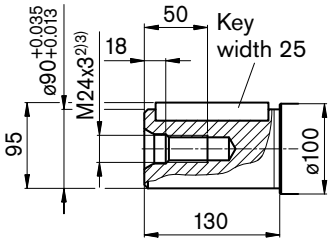


Drive shafts

Z Splined shaft DIN 5480
W90x3x28x9g



P Parallel keyed shaft
DIN 6885, AS25x14x125



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[5)] DIN 13	2 in M20 x 2.5; 30 deep	400	O
T_1	Drain line	DIN 3852[7)]	M42 x 2; 20 deep	3	O[6)]
T_2	Drain line	DIN 3852[7)]	M42 x 2; 20 deep	3	X[6)]
U	Bearing flushing	DIN 3852[7)]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7)]	M14 x 1.5; 12 deep	400	X

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Flushing and boost pressure valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

With port plate 027, the valve is mounted directly on the fixed motor (sizes 45 to 180, 250); with port plate 017 (sizes 355 and 500) on a plate.

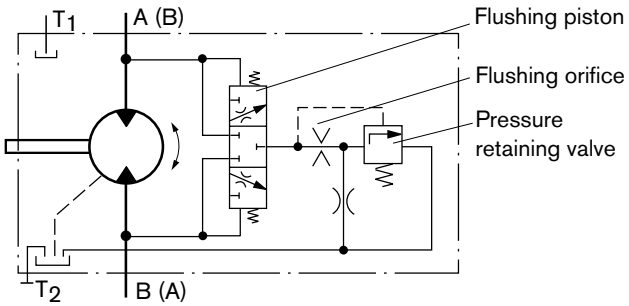
Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 45 to 500, fixed setting 16 bar

Switching pressure of flushing piston Δp
Sizes 45 to 500 8±1 bar

Flushing flow q_v

Orifice (throttles with integrated valve) can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Schematic



Standard flushing flows

Flushing and boost pressure valve, mounted (code 7)

Size	Flushing flow q_v [L/min]	ø [mm]	Mat. No. of orifice
45	3.5	1.2	R909651766
107, 125	8	1.8	R909419696
160, 180	10	2.0	R909419697
250	10	2.0	R909419697
355, 500	16	2.5	R910803019

With sizes 45 to 180, orifices can be supplied for flushing flows from 3.5 to 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure $\Delta p_{ND} = 25$ bar.

Flushing and boost pressure valve, integrated (code 9)

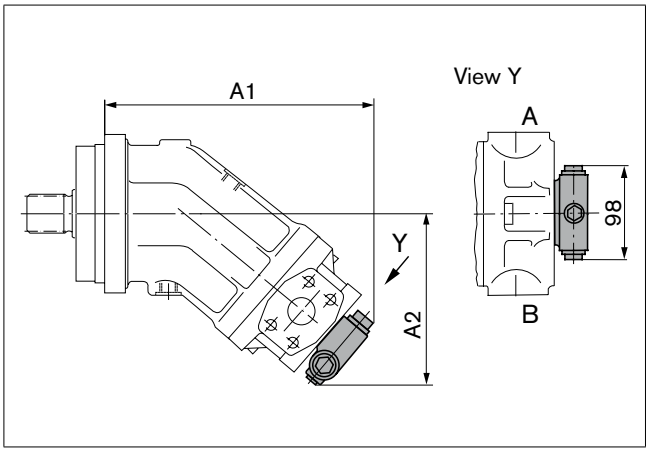
Size	Throttle ø [mm]	q_v [L/min]
56, 63, 80, 90	1.5	6
	1.8	7.3

Flushing and boost pressure valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

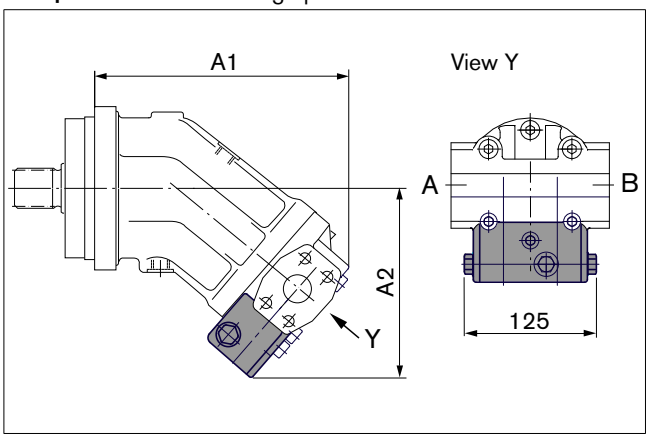
Dimensions

Port plate 027 – SAE flange ports at side



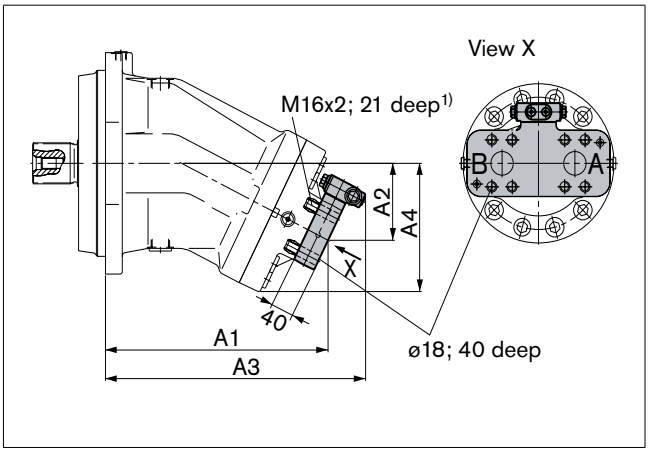
Size	A1	A2
45	223	151
107, 125	294	192
160, 180	315	201
250	344	172

Port plate 029 – SAE flange ports at side



Size	A1	A2
56, 63	225	176
80, 90	257	186.7

Port plate 017 – SAE flange ports at rear



Size	A1	A2	A3	A4
355	356	120	421	198
500	397	130	464	220

1) DIN 13, observe the general instructions on page 46 for the maximum tightening torques

Pressure-relief valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

The MHDB pressure-relief valves (see RE 64642) 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 combination with port plates 181, 191 or 192 (counterbalance valve for mounting to port plate 181: see next page).

Cracking pressure setting range _____ 50 to 420 bar

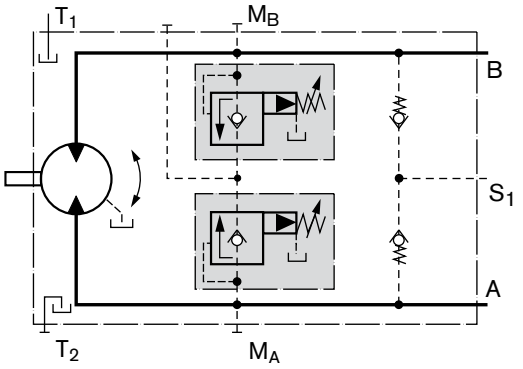
With the version "with pressure boost facility" (192), a higher pressure setting can be realized by applying an external pilot pressure of 25 to 30 bar to port P_{St}.

When ordering, please state in plain text:

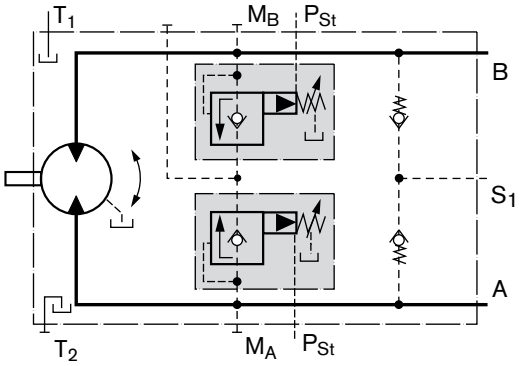
– Cracking pressure of pressure-relief valve

– Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Version without pressure boost facility "191"



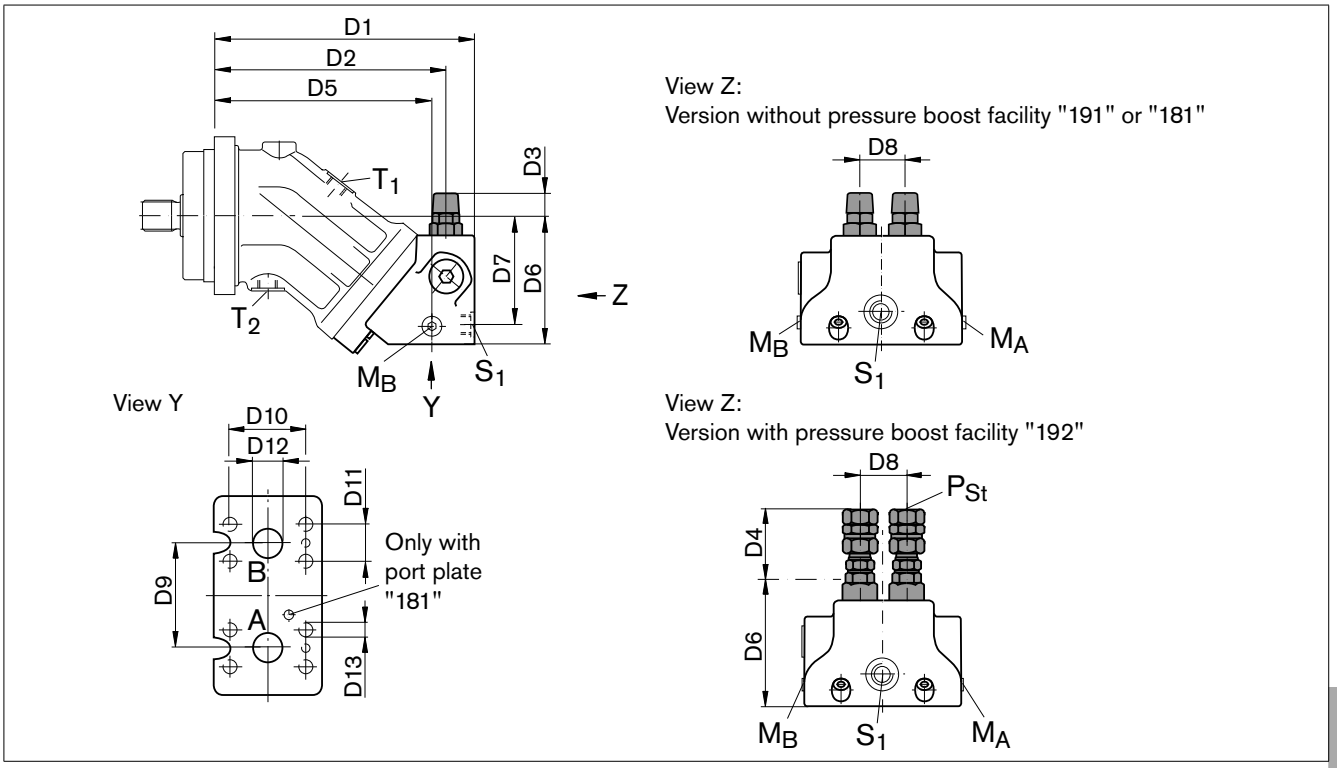
Version with pressure boost facility "192"



Pressure-relief valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions



Size		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[2]
28, 32	MHDB.**16**	209	186	25	68	174	102	87	36	66	50.8	23.8	ø19	M10; 17 deep
45	MHDB.**16**	222	198	22	65	187	113	98	36	66	50.8	23.8	ø19	M10; 17 deep
56, 63	MHDB.**22**	250	222	19	61	208	124	105	42	75	50.8	23.8	ø19	M10; 13 deep
80, 90	MHDB.**22**	271	243	17.5	59	229	134	114	42	75	57.2	27.8	ø25	M12; 18 deep
107, 125	MHDB.**32**	298	266	10	52	250	149.5	130	53	84	66.7	31.8	ø32	M14; 19 deep
160, 180	MHDB.**32**	332	301	5	47	285	170	149	53	84	66.7	31.8	ø32	M14; 19 deep

Size	A, B	S_1[1]	M_A, M_B[1]	P_{St}[1]
28, 32	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
45	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
56, 63	3/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
80, 90	1 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
107, 125	1 1/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
160, 180	1 1/4 in	M26 x 1.5; 16 deep	M30 x 1.5; 16 deep	G 1/4

Assembly instructions for port plate with pressure boost facility "192":
The lock nut must be counterheld when installing the hydraulic line at the p_{st} port!

Ports

Designation	Port for	Standard	Size	Maximum pressure [bar][2]	State[3]
A, B	Service line	SAE J518	See above	450	O
S_1	Supply (only with port plate 191/192)	DIN 3852	See above	5	O
M_A, M_B	Measuring operating pressure	DIN 3852	See above	450	X
P_{St}	Pilot pressure (only with port plate 192)	DIN ISO 228	See above	30	O

1) Observe the general instructions on page 46 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

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. 20 bar.

Note

- BVD available for sizes 28 to 180 and BVE available 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: A2FM90/61W–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 RE 95522 and BVE counterbalance valve in RE 95525!
- 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 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

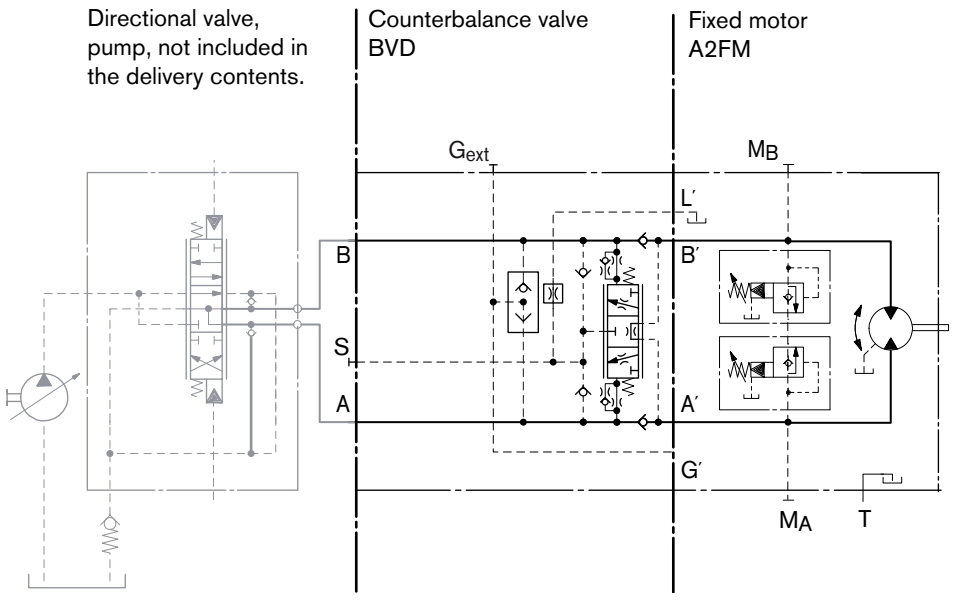
Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

38/46

Example schematic for travel drive on wheeled excavators
A2FM090/61W-VAB188 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

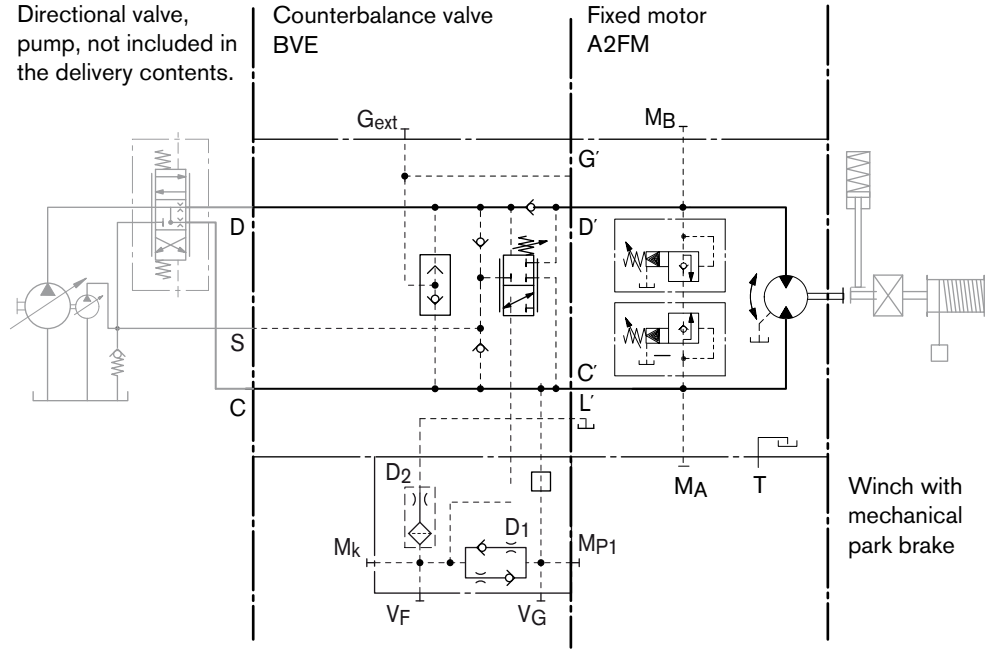
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A2FM090/61W-VAB188 + BVE25W385/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor	Without valve		Restricted values in operation with DBV and BVD/BVE							
			DBV				BVD/BVE			
NG	p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
28	400/450	176	16	350/420	100	181 191, 192	20 (BVD)	350/420	100	188
32		201								
45		255								
56		280	22		240				220	
63		315								
80		360								
90		405								
107		427				171 191, 192				178
125		500								
107		427	32		400	181 191, 192	25 (BVD/BVE)		320	188
125		500								
160		577								
180		648								

DBV _____ pressure-relief valve

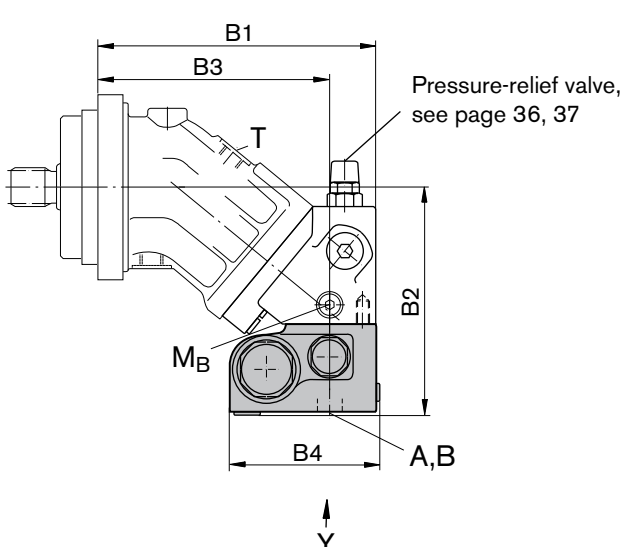
BVD _____ counterbalance valve, double-acting

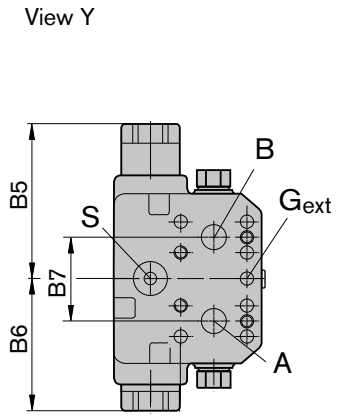
BVE _____ counterbalance valve, one-sided

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions





A2FM Size	Counterbalance valve Type	Ports A, B	Dimensions B1	B2	B3	B4 (S)	B4 (L)	B5	B6	B7
28, 32	BVD**20**..16	3/4 in	209	175	174	142	147	139	98	66
45	BVD**20**..16	3/4 in	222	196	187	142	147	139	98	66
56, 63	BVD**20**..17	3/4 in	250	197	208	142	147	139	98	75
80, 90	BVD**20**..27	1 in	271	207	229	142	147	139	98	75
107, 125	BVD**20**..28	1 in	298	238	251	142	147	139	98	84
107, 125	BVD**25**..38	$1^1/_4$ in	298	239	251	158	163	175	120.5	84
160, 180	BVD**25**..38	$1^1/_4$ in	332	260	285	158	163	175	120.5	84
107, 125	BVE**25**..38	$1^1/_4$ in	298	240	251	167	172	214	137	84
160, 180	BVE**25**..38	$1^1/_4$ in	332	260	285	167	172	214	137	84
250	On request									

Ports

Designation	Port for	Version	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
A, B	Service line		SAE J518	see table above	420	O
S	Infeed	BVD20	DIN 3852[3]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25	DIN 3852[3]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852[3]	M12 x 1.5; 12.5 deep	30	O
G_{ext}	Brake release, high pressure	S	DIN 3852[3]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B		ISO 6149[3]	M12 x 1.5; 12 deep	420	X

1) Observe the general instructions on page 46 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Mounting the counterbalance valve

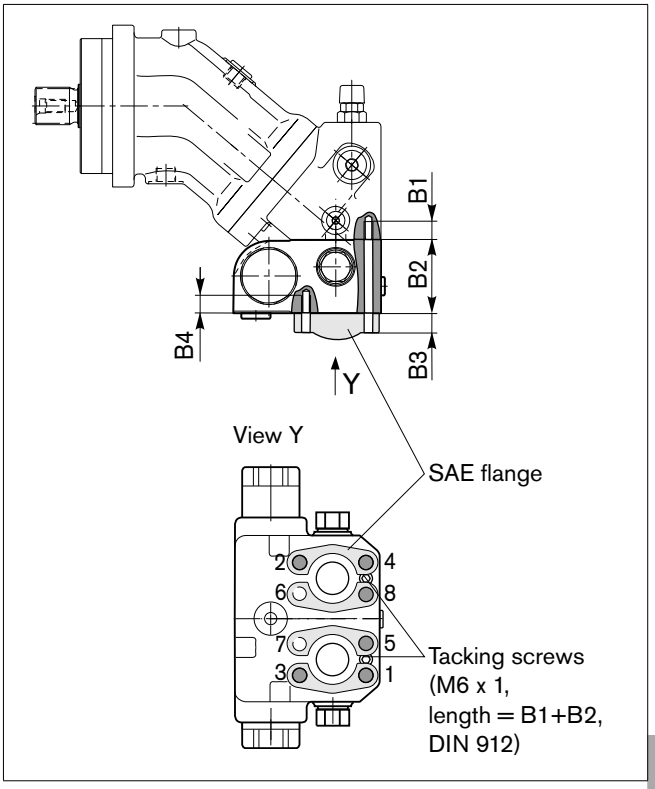
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) _____ length B1+B2+B3
2 screws (**6, 7**) _____ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	205



Size	28, 32, 45	56, 63	80, 90	107, 125, 160, 180	107, 125
Port plate	18				17
B1[1)]	M10 x 1.5; 17 deep	M10 x 1.5; 17 deep	M12 x 1.75; 18 deep	M14 x 2; 19 deep	M12 x 1.75; 17 deep
B2	78[2)]	68	68	85	68
B3	customer-specific				
B4	M10 x 1.5; 15 deep	M10 x 1.5; 15 deep	M12 x 1.75; 16 deep	M14 x 2; 19 deep	M12 x 1.75; 17 deep

1) Minimum required thread reach 1 x ø-thread
2) Including sandwich plate

Speed sensors

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

The versions A2FM...U and A2FM...F ("prepared for speed sensor", i.e. without sensor) is 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 _____ RE 95133

HDD _____ RE 35135

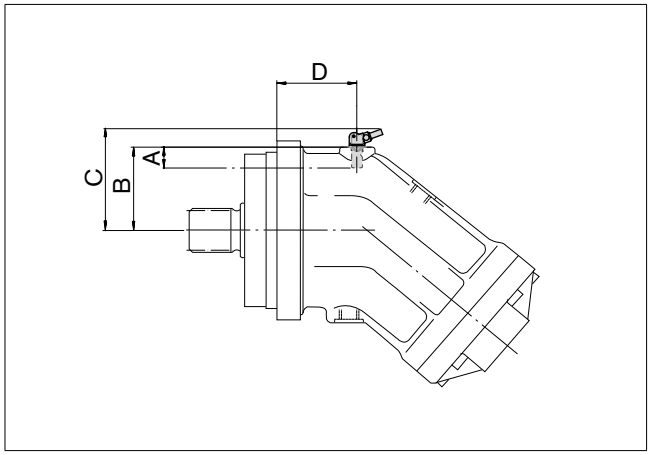
The sensor is mounted at the specially provided port D as follows:

DSA _____ with one mounting bolt

HDD _____ with two mounting bolts

We recommend ordering the A2FM fixed motor complete with sensor mounted.

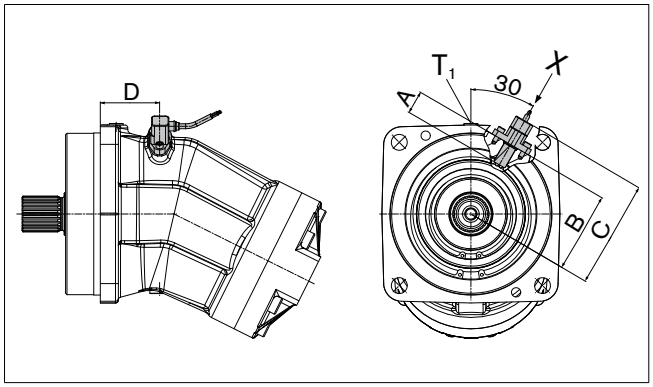
Version "V"
Sizes 23 to 200 with DSA sensor



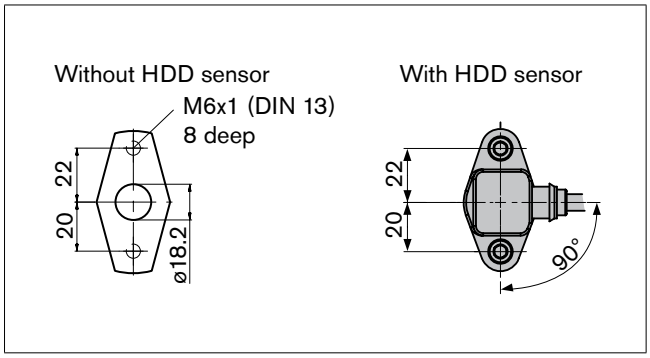
Version "V"
Sizes 250 to 500 with DSA sensor

On request

Version "H"
Sizes 250 to 500 with HDD sensor



View X



Speed sensors

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Size			23, 28, 32	45	56, 63	80, 90	107, 125
Number of teeth			38	45	47	53	59
DSA	A	Insertion depth (tolerance ± 0.1)	18.4	18.4	18.4	18.4	18.4
	B	Contact surface	57.9	64.9	69.9	74.9	79.9
	C		74.5	81.5	86.5	91.5	96.5
	D		54.7	54.3	61.5	72.5	76.8

Size			160, 180	200	250	355	500
Number of teeth			67	80	78	90	99
HDD	A	Insertion depth (tolerance ± 0.1)	–	–	32	32	32
	B	Contact surface	–	–	110.5	122.5	132.5
	C		–	–	149	161	171
	D		–	–	82	93	113
DSA	A	Insertion depth (tolerance ± 0.1)	18.4	18.4	32	32	32
	B	Contact surface	87.4	100.9	–	–	–
	C		104	117.5	–	–	–
	D		86.8	97.5			

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

Particularly in the installation position "drive shaft upwards" filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the motor housing must be directed to the reservoir via the highest available drain port (T_1, T_2).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

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

In all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 8.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

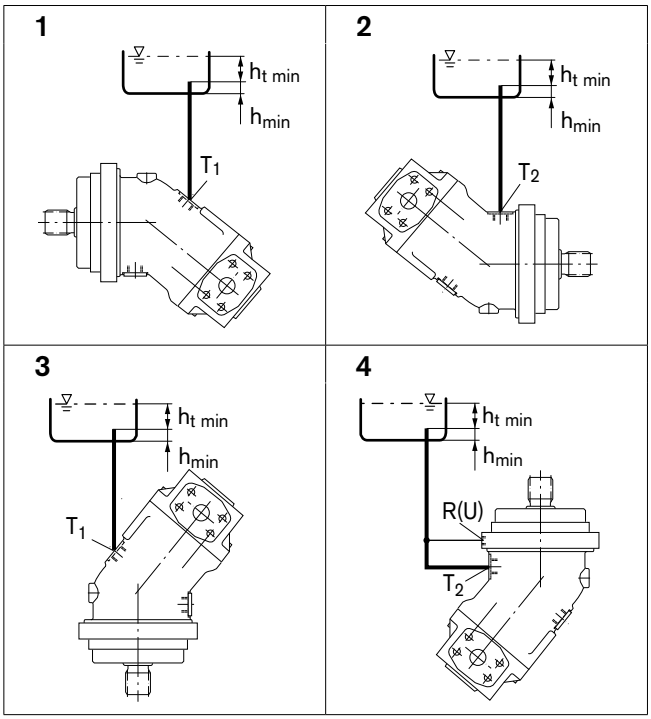
Note
With sizes 10 to 200 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering - special version). With sizes 250 to 1000, port U is provided as standard in the area near the bearings for air bleeding.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_2
3	–	T_1
4	R (U)	T_2
5	L_1	T_1 (L_1)
6	L_1	T_2 (L_1)
7	L_1	T_1 (L_1)
8	R (U)	T_2 (L_1)

L_1	Filling / air bleed
R	Air bleed port (special version)
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

Below-reservoir installation (standard)

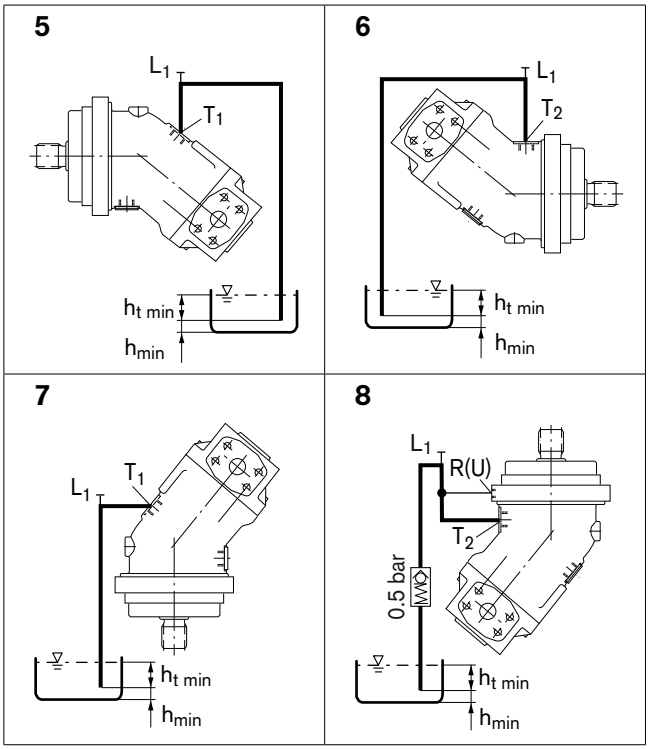
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



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 0.5 bar) can prevent draining of the motor housing.



General instructions

– The motor A2FM is designed to be used in open and closed circuits.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly.

– 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).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

- The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

- The service line ports and function ports can only be used to accommodate hydraulic lines.

– The data and notes contained herein must be adhered to.

– The product is not approved as a component for the safety concept of a general machine according to ISO 13849.

– The following tightening torques apply:

- Fittings:
  Observe the manufacturer's instructions regarding tightening torques of the fittings used.

- Mounting bolts:
  For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.

- Female threads in the axial piston unit:
  The maximum permissible tightening torques $M_{G\,max}$ are maximum values for the female threads and must not be exceeded. For values, see the following table.

- Threaded plugs:
  For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports		Maximum permissible tightening torque of the female threads $M_{G\,max}$	Required tightening torque of the threaded plugs M_V[1)]	WAF hexagon socket of the threaded plugs
Standard	Size of thread			
DIN 3852[1)]	M10 x 1	30 Nm	15 Nm[2)]	5 mm
	M12 x 1.5	50 Nm	25 Nm[2)]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M20 x 1.5	170 Nm	80 Nm	10 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M30 x 2	420 Nm	215 Nm	17 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm
DIN ISO 228	G 1/4	40 Nm	–	–

1) The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.
2) In the "lightly oiled" state, the M_V is reduced to 10 Nm for M10 x 1 and 17 Nm for M12 x 1.5.

Axial piston fixed motor
A2FE series 6x

Data sheet

- High pressure motor for integration in mechanical gearboxes
- Size 28 ... 355
- Nominal pressure up to 400 bar
- Maximum pressure up 450 bar
- Open and closed circuits
- High pressure motor for integration in mechanical gearboxes
- Open and closed circuits

Features

- Space-saving construction due to recessed mounting flange
- Easy to install, simply slide into the mechanical gearbox
- High power density
- Very high total efficiency
- High starting efficiency
- Optional with integrated pressure relief valve
- Optional with mounted addifitonal valve: counterbalance valve (BVD/BVE), flushing and boost-pressure valve
- Bent-axis design

Inhalt

Type code

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15
	A2F		**E**		**/**	**6**		**W**	**–**	**V**						

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 to 355 only in combination with long-life bearing “L“ (without code)		
	HFB-, HFC-hydraulic fluid	Sizes 28 to 180 (without code)	
		NG250 bis 355(nur in Verbindung mit Long-Life Lagerung “L“)	**E-**

Axial piston unit

02	Bent-axis design, fixed	**A2F**

Drive shaft bearing

		28-180	**250-355**	
03	Standard bearing (without code)	●	●	
	Long-life bearing	–	●	**L**

Operating mode

04	Motor, plug-in version	**E**

Sizes (NG)[1)]

05	Geometric displacement in cm^3/U								
	28	**32**	**107**	**125**	**160**	**180**	**250**	**355**	

Series

06		**6**

Index

07		size 28 to 180	**1**
		size 250 to 355	**0**

Direction of rotation

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

Seal material

09	FKM (fluoroelastomer)	**V**

Drive shaft

		28	**32**	**107**	**125**	**160**	**180**	**250**	**355**	
10	Splined shaft DIN 5480	●	●	●	●	●	●	–	–	**A**
		●	–	●	–	●	–	●	●	**Z**

Mounting flange

			28-180	**250-355**	
11	ISO 3019-2	2-whole	●	–	**L**
		4-whole	–	●	**M**

● = Available ○ = On request – = Not available

[1)] Sizes 45, 56, 63, 80, 90 see data sheet 91071 (A2FE series 70)

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15
	A2F		**E**		**/**	**6**		**W**	**–**	**V**						

Working ports

					28	32	107	125	160	180	250	355	
12	SAE working ports **A** and **B** at side, opposite		**02**	0	–	–	–	–	–	–	●	–	**020**
				7	–	–	●	●	●	●	●	–	**027**
	SAE working port **A** and **B** bottom (same side)		**10**	0	●	●	●	●	●	●	–	●	**100**
				7	–	–	–	–	–	–	–	●	**107**
	Port plate with pressure relief valves for mounting a counterbalance valve	BVD	**17**	1	–	–	●	●	–	–	–	–	**171** **178**
			18	8	●	●	●	●	●	●	–	–	**181**
		BVE	**18**		–	–	●	●	●	●	–[1]	–	**188**
	Port plate with pressure-relief valves		**19**	1	●	●	●	●	●	●	–	–	**191**
				2	●	●	●	●	●	●	–	–	**192**

Valves

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

Speed sensor

		28-32	107-180	250	355[1]	
13	Without speed sensor	●	●	●	●	
	Prepared for DSA speed sensor	●	●	○	–	**U**
	DSA speed sensor mounted[3]	●	●	○	–	**V**

Special version (only sizes 28 to 180)

14	Standard version (without code)	
	Special version for slew drives (standard 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 closed	**–Y**
	Special version	**–S**

● = Available ○ = On request – = Not available

1) Please contact us.
2) Specify ordering code of counterbalance valve according to data sheet 95522 (BVD) respectively data sheet 95526 (BVE) separately.
3) Specify ordering code of sensor according to data sheet 95133 (DSA) 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				28	32	107	125	160	180	250	355
Displacement geometric, per revolution		V_g	cm^3	28.1	32	106.7	125	160.4	180	250	355
Nominal pressure		p_{nom}	bar	400	400	400	400	400	400	350	350
Maximum pressure		p_{max}	bar	450	450	450	450	450	450	400	400
Maximum speed [1]		n_{nom}	rpm	6300	6300	4000	4000	3600	3600	2700	2240
		n_{max} [2]	rpm	6900	6900	4400	4400	4000	4000		
Inlet flow [3]	at n_{nom}	q_V	l/min	177	202	427	500	577	648	675	795
Torque [4]	at p_{nom}	M	Nm	179	204	679	796	1021	1146	1393	1978
Rotary stiffness		c	kNm/rad	2.93	3.12	11.2	11.9	17.4	18.2	73.1	96.1
Moment of inertia for rotary group		J_{TW}	$kg \cdot m^2$	0.0012	0.0012	0.0116	0.0116	0.022	0.022	0.061	0.102
Maximum angular acceleration		α	rad/s^2	6500	6500	4500	4500	3500	3500	10000	8300
Case volume		V	l	0.2	0.2	0.8	0.8	1.1	1.1	2.5	3.5
Weight (approx.)		m	kg	10.5	10.5	34	36	47	48	82	110

[1] These values are valid at:
- for the optimum viscosity range from v_{opt} = 36 to 16 mm^2/s
- with hydraulic fluid based on mineral oils

[2] Intermittent maximum speed: overspeed for unload and overhauling processest, t < 5 s and Δp < 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	$q_v = \frac{V_g \times n}{1000 \times \eta_v}$	[l/min]
Rotational speed	$n = \frac{q_v \times 1000 \times \eta_v}{V_g}$	[rpm]
Torque	$M = \frac{V_g \times \Delta p \times \eta_{hm}}{20 \times \pi}$	[Nm]
Power	$P = \frac{2\pi \times M \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600}$	[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 ($\eta_t = \eta_v \bullet \eta_{hm}$)

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

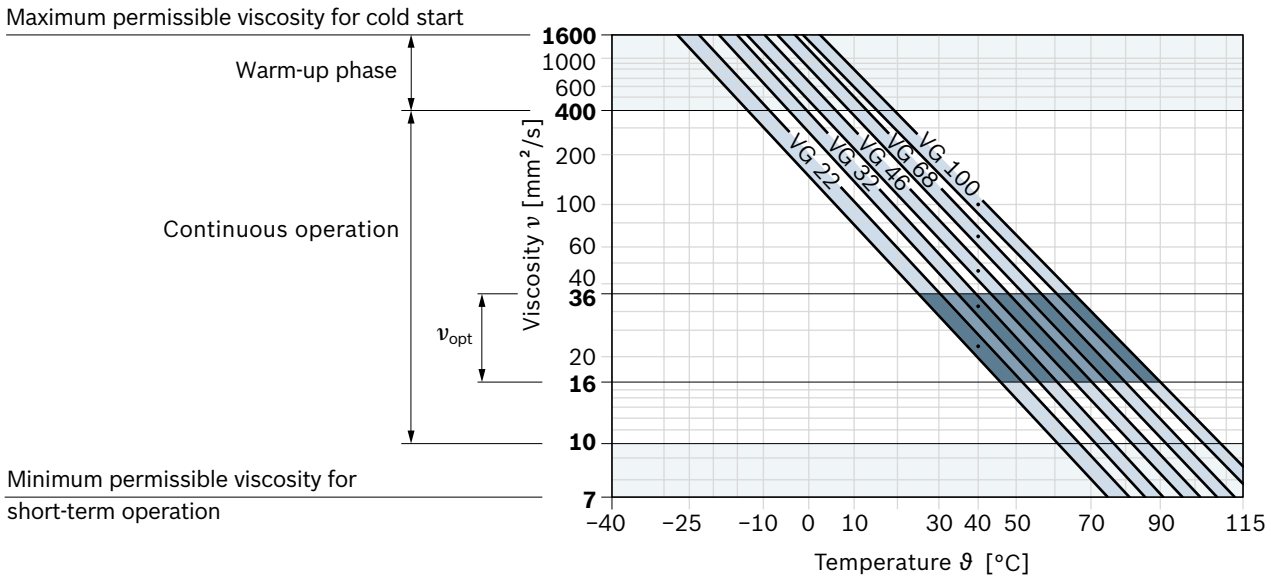
	Viscosity	Shaft seal	Temperature[1]	Comment
Cold start	$v_{max} \leq 1600$ mm²/s	NBR[2]	$\vartheta_{St} \geq -40$ °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm (size 28 to 180), n ≤ 0.25 • n_{nom} (size 250 to 355), permissible temperature difference between axial piston unit and hydraulic fluid max. 25 K
		FKM	$\vartheta_{St} \geq -25$ °C	
Warm-up phase	v = 400 ... 1600 mm²/s			t ≤ 15 min, p ≤ 0.7 • p_{nom} and n ≤ 0.5 • n_{nom}
Continuous operation	v = 10 ... 400 mm²/s[3]	NBR[2]	$\vartheta \leq +78$ °C	measured at port **T**
		FKM	$\vartheta \leq +103$ °C	
	v_{opt} = 16 ... 36 mm²/s			range of optimum operating viscosity and efficiency
Short-term operation	v_{min} = 7 ... 10 mm²/s	NBR[2]	$\vartheta \leq +78$ °C	t ≤ 3 min, p ≤ 0.3 • p_{nom} measured at port **T**
		FKM	$\vartheta \leq +103$ °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 +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).

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 mm²/s (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 mm²/s at:

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

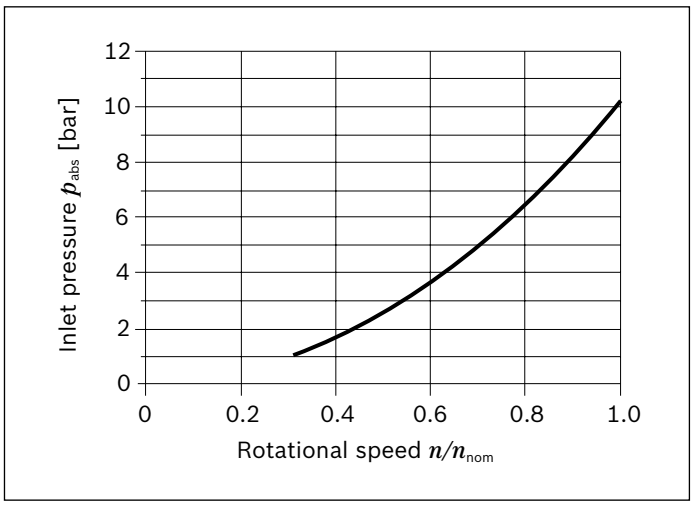
Operating pressure range

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	$p_{HP\ min}$	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}	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	$R_{A\ max}$	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	$R_{A\ max}$	16000 bar/s	
Case pressure at port T			**Definition**
Continuous differential pressure	$\Delta p_{T\ cont}$	2 bar	Maximum averaged differential pressure at the shaft seal (case to ambient)
Pressure peaks	$p_{T\ peak}$	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.

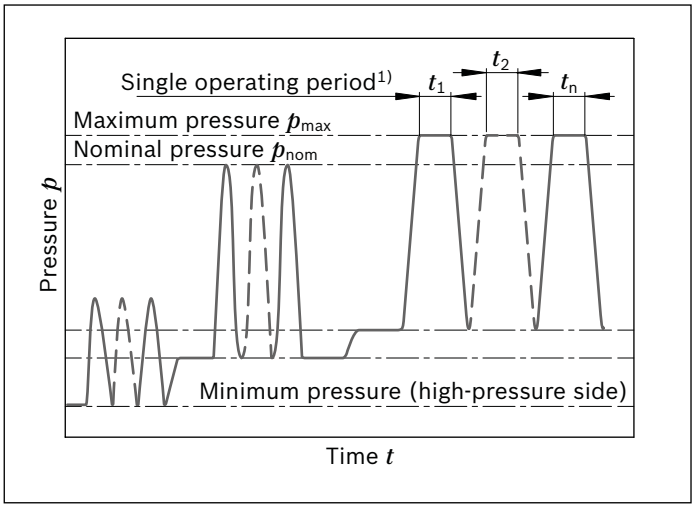
Minimum pressure at inlet (pump operating mode)



This diagram is only valid for the optimum viscosity range of v_{opt} = 16 to 36 mm^2/s.

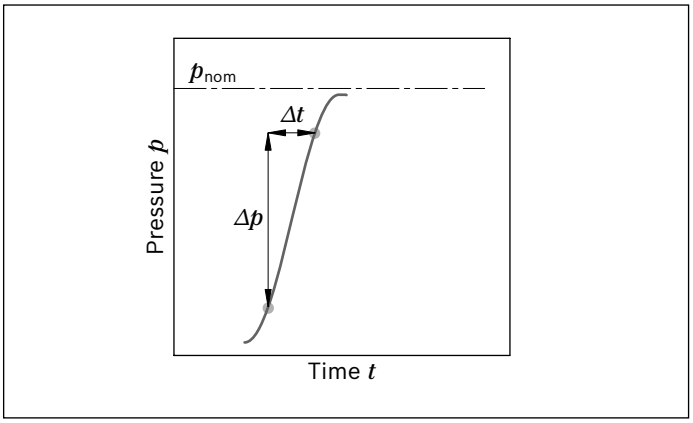
If the above mentioned conditions cannot be ensured, please contact us.

Pressure definition

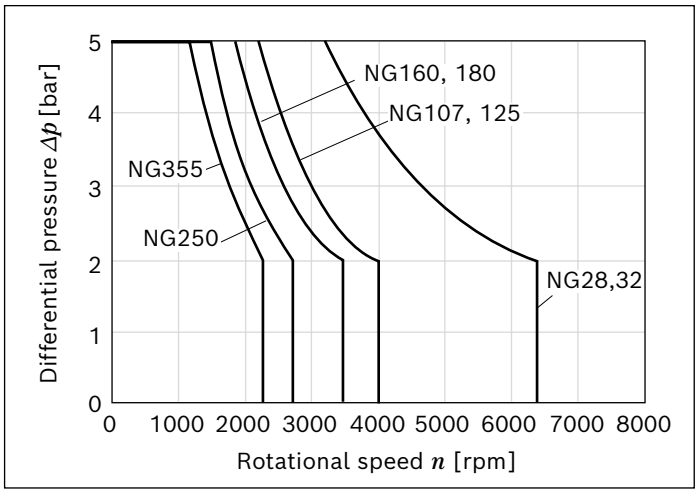


1) Total operating period = $t_1 + t_2 + ... + t_n$

Rate of pressure change



Maximum differential pressure at the shaft seal



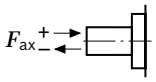
Note

- 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				28		32	107		125	160		180	250	355
Drive shaft	Code			Z	A	A	Z	A	A	Z	A	A	Z	Z
	⌀		mm	25	30	30	40	45	45	45	50	50	50	60
Maximum radial force at distance a (from shaft collar) 	$F_{q\ max}$		kN	5.7	5.4	5.4	13.6	14.1	14.1	18.1	18.3	18.3	1.2 [1]	1.5 [1]
	a		mm	16	16	16	20	20	20	25	25	25	41	52.5
Permitted torque at $F_{q\ max}$	$T_{q\ max}$		Nm	179	179	204	679	679	796	1021	1021	1146		
Permitted differential pressure at $F_{q\ max}$	$\Delta p_{q\ max}$		bar	400	400	400	400	400	400	400	400	400		
Maximum axial force, when standstill or in non-pressurized conditions 	+ $F_{ax\ max}$		N	0	0	0	0	0	0	0	0	0	0	0
	- $F_{ax\ max}$		N	500	500	500	1250	1250	1250	1600	1600	1600	2000	2500
Maximum axial force, per bar operating pressure	+ $F_{ax\ max}$		N/bar	5.2	5.2	5.2	12.9	12.9	12.9	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.

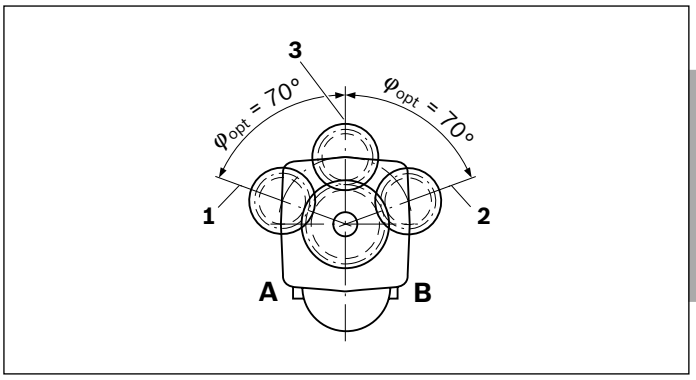
Notes for sizes 250 ... 355:

- 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.

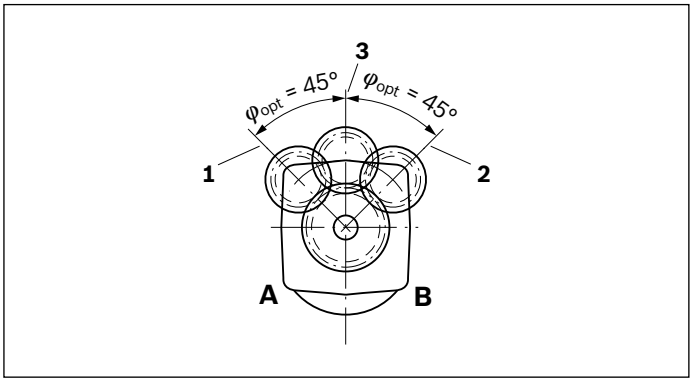
Effect of radial force F_q on the service life of bearings

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 28 ... 180



Toothed gear drive, size 250 ... 355



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

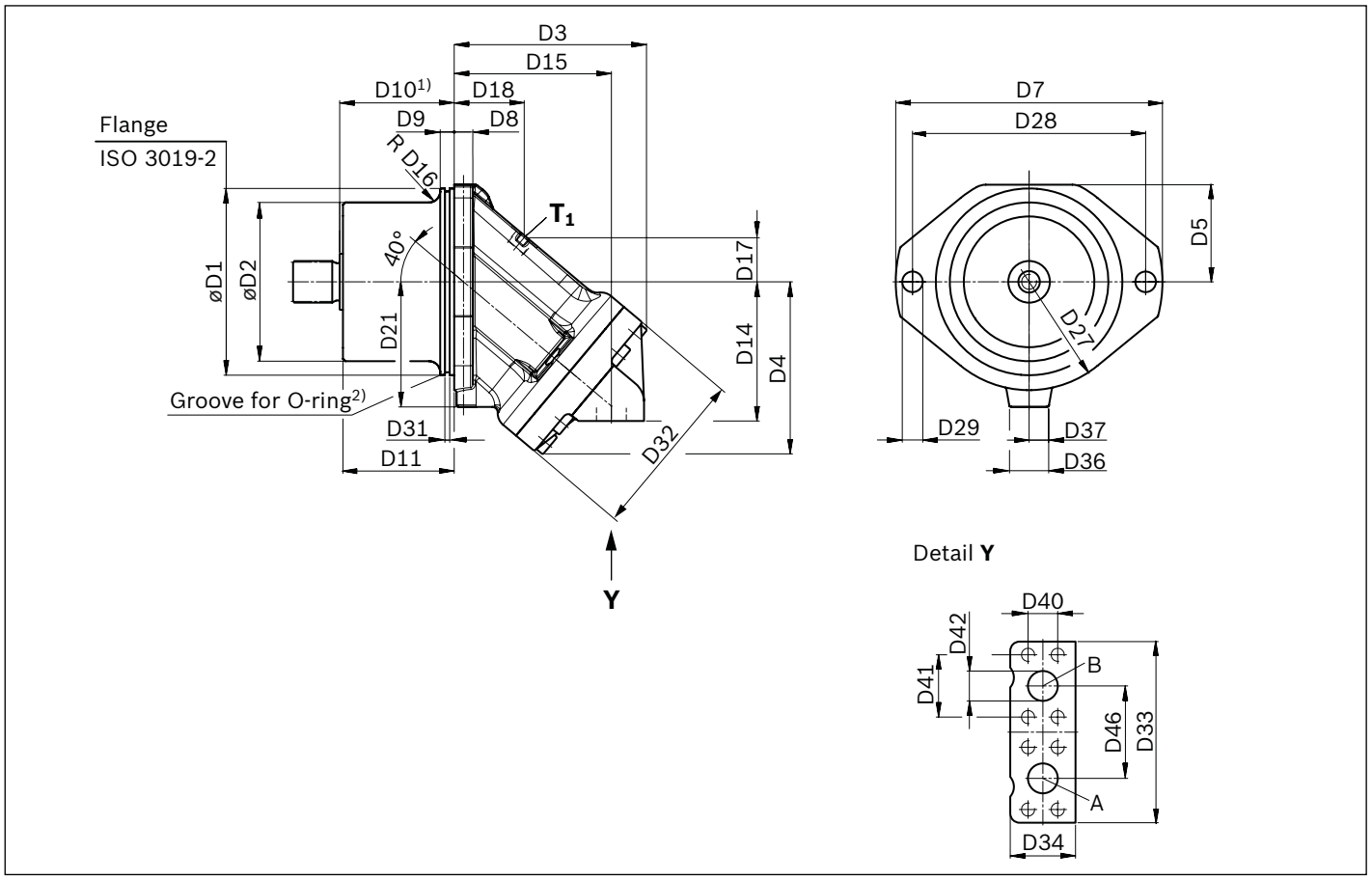
Sizes 250 and 355

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 28 ... 180

Port plate 10



[1)] To shaft collar

[2)] The O-ring is not included in the delivery contents.

Size	D1	D2	D3	D4	D5	D7	D8	D9	D10	D11	D14	D15	D16	D17	D18	D21	D27	D28	D29
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
28, 32	135 $^{0}_{-0.025}$	94	114	106	71	188	16	15	88.8	87.1	91	94	10	27	45	95	154	160	14
107, 125	200 $^{0}_{-0.029}$	152.3	178	157	103	286	20	15	122.8	119	136	143	16	41	58	135	232	250	22
160, 180	200 $^{0}_{-0.029}$	171.6	206	185	104	286	20	15	122.8	119.3	149	169	12	47	75	134	232	250	22

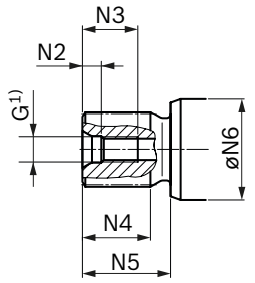
Size	D31	D32	D33	D34	D36	D37	D40	D41	D42	D46	O-Ring
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
28, 32	5.2	106	115	40	42	13	18.2	40.5	13	59	Ø126 × 4
125, 107	5.2	150	194	70	40	0	31.8	66.7	32	99	Ø192 × 4
160, 180	5.2	180	194	70	42	0	31.8	66.7	32	99	Ø192 × 4

Note

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

Drive shafts Z and A

Splined shaft DIN 5480



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

Splined shaft DIN 5480

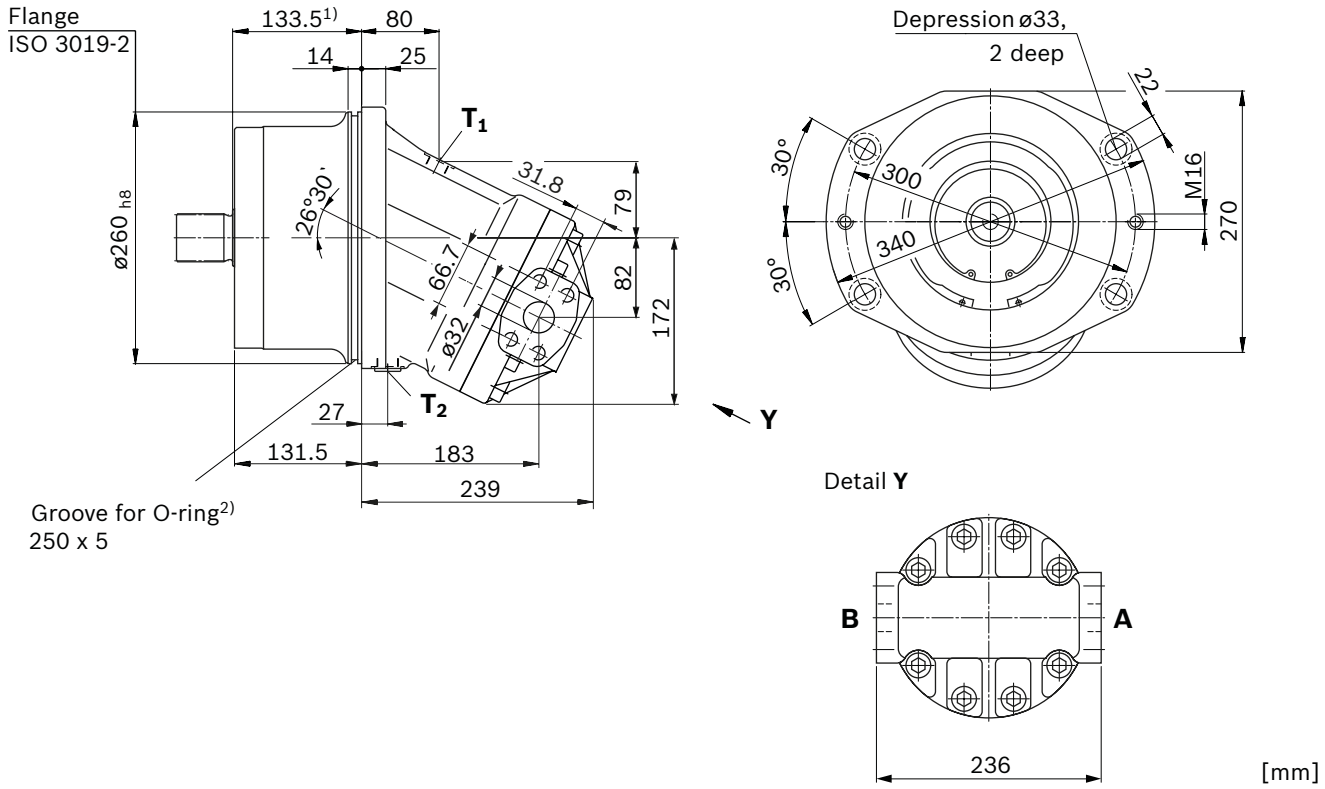
NG	Code	Designation	Thread G	N2	N3	N4	N5	ØN6
				mm	mm	mm	mm	mm
28	Z	W25×1.25×18×9g	M8 × 1.25	6	19	28	43	35
	A	W30×2×14×9g	M10 × 1.5	7.5	22	27	35	35
32	A	W30×2×14×9g	M10 × 1.5	7.5	22	27	35	35
107	Z	W40×2×18×9g	M12 × 1.75	9.5	28	37	45	50
	A	W45×2×21×9g	M16 × 2	12	36	42	50	50
125	A	W45×2×21×9g	M16 × 2	12	36	42	50	50
160	Z	W45×2×21×9g	M16 × 2	12	36	42	50	60
	A	W50×2×24×9g	M16 × 2	12	36	44	55	60
180	A	W50×2×24×9g	M16 × 2	12	36	44	55	60

Ports

Size			28	32	107	125	160	180
A, B	Working port	Size	1/2 in		1 1/4 in			
		Standard	Dimensions according to SAE J518					
		Fastening thread 1)	M8 × 125; 15 mm deep		M14 × 2; 19 mm deep			
		State on delivery	With protective cover (must be connected)					
T_1	Drain port	Size	M16 × 15; 12 mm deep		M18 × 15; 12 mm deep		M22 × 15; 14 mm deep	
		Standard 2)	DIN 3852					
		State on delivery 3)	Plugged (observe installation instructions)					

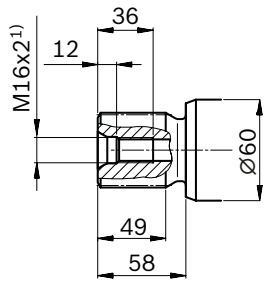
1) Thread according to DIN 13
2) The spot face can be deeper than specified in the appropriate standard.
3) Unless otherwise specified. Other layouts on request.

Size 250



1) To shaft collar
2) The O-ring is not included in the delivery contents.

Z Splined shaft DIN 5480
W50x2x24x9g



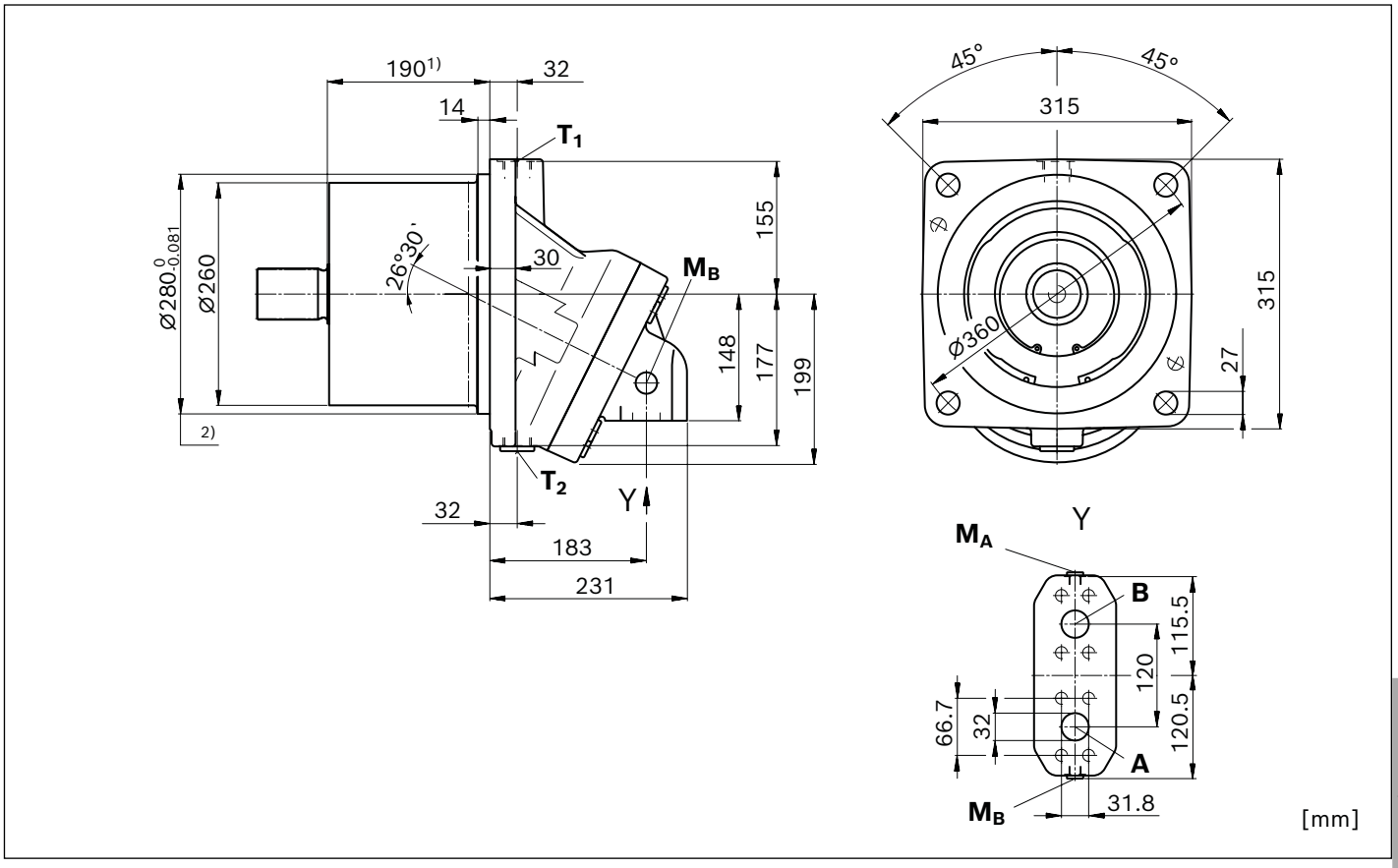
1) Center bore according to DIN 332 (thread according to DIN 13)

Ports

Size			250
A, B	Working port	Size	1 1/4 in
		Standard	Dimensions according to SAE J518
		Fastening thread [1)]	M14 × 2; 19 mm deep
		State on delivery	With protective cover (must be connected)
T_1	Drain port	Size	M22 × 15; 14 mm deep
		Standard [2)]	DIN 3852
		State on delivery [3)]	With protective cover (observe installation instructions)
T_2	Drain port	Size	M22 × 15; 14 mm deep
		Standard [2)]	DIN 3852
		State on delivery [3)]	Plugged (observe installation instructions)

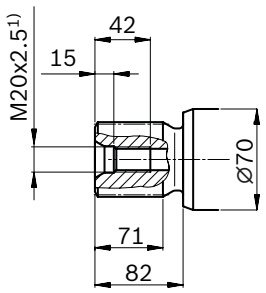
1) Thread according to DIN 13
2) The spot face can be deeper than specified in the appropriate standard.
3) Unless otherwise specified. Other layouts on request.

Size 355



1) To shaft collar
2) Flange ISO 3019-2

Z Splined shaft DIN 5480
W60x2x28x9g



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

Ports

Size			355
A, B	Working port	Size	1 1/4 in
		Standard	Dimensions according to SAE J518
		Fastening thread [1)]	M14 × 2; 22 mm deep
		State on delivery	With protective cover (must be connected)
T_1	Drain port	Size	M33 × 2; 18 mm deep
		Standard [2)]	DIN 3852
		State on delivery [3)]	With protective cover (observe installation instructions)
T_2	Drain port	Size	M33 × 2; 18 mm deep
		Standard [2)]	DIN 3852
		State on delivery [3)]	Plugged (observe installation instructions)
M_A, M_B	Measuring port pressure A, B	Size	M14 × 15; 12 mm deep
		Standard [2)]	DIN 3852
		State on delivery	Plugged

1) Thread according to DIN 13
2) The spot face can be deeper than specified in the appropriate standard.
3) 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.

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 107 to 355, fixed setting: 16 bar

Switching pressure of flushing piston Δp
Sizes 107 to 355: 8±1 bar

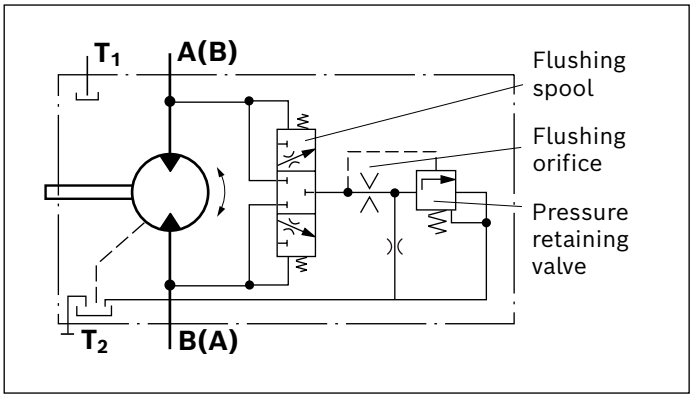
Flushing flow q_v
Orifices (throttles with integrated valve) can be used to set the flushing flows as required.
The specifications below are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $v = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Flushing and boost-pressure valve attached (port plates 027 and 017)

Size	Flushing flow q_v	Orifice-Ø	Material number of orifice
	l/min	mm	
107, 125	8	1.8	R909419696
160, 180	10	2	R909419697
250			
355	16	2.5	R910803019

With sizes 107 to 180, orifices can be supplied for flushing flows from 8 to 10 l/min. For flushing flows deviating from the values in the table, please state the required flushing flow when ordering. For nominal sizes 250 to 355, please always specify the flushing flow. For sizes 107 to 180 the flushing flow without orifice is approx. 12 to 14 l/min at low pressure $\Delta p_{ND} = 25$ bar, for sizes 250 to 355 please contact us.

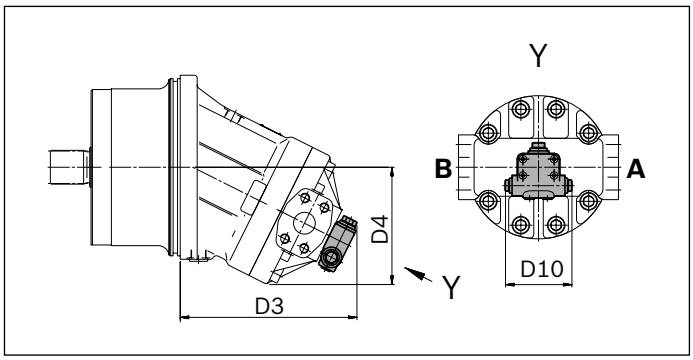
Circuit diagram



Dimensions

Port plate 027

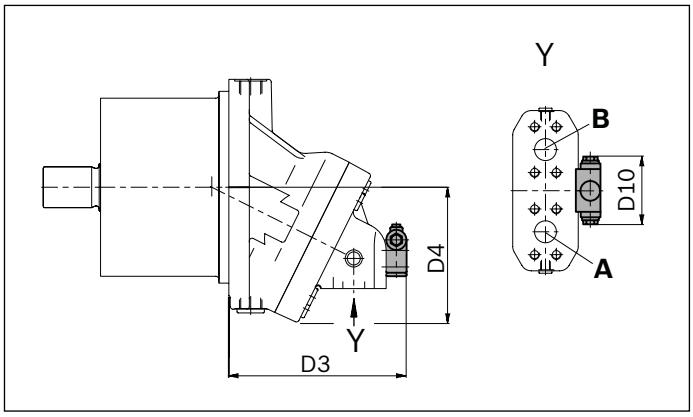
SAE working ports at side, opposite



Size	D3	D4	D10
	mm	mm	mm
107, 125	211	192	102
160, 180	232	201	102
250	260.5	172	102

Port plate 107

SAE working ports at bottom



Size	D3	D4	D10
	mm	mm	mm
355	260	199	102

Pressure relief valve

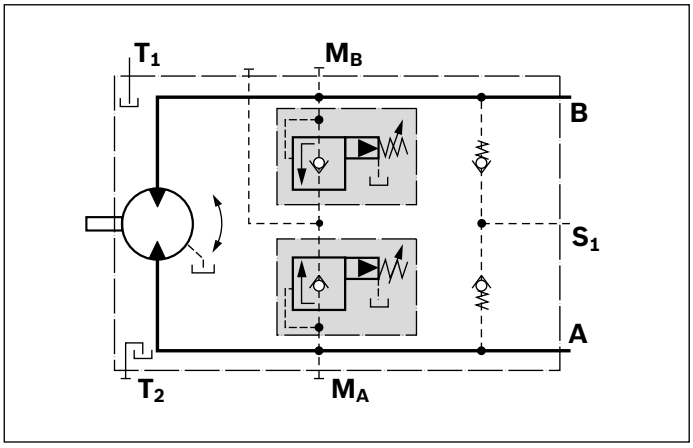
The MHDB pressure relief valves protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the high-pressure side to the low-pressure side.
The pressure relief valves are only available in conjunction with connection plates 181, 191 or 192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

Setting range of cracking pressure: 50 up to 420 bar

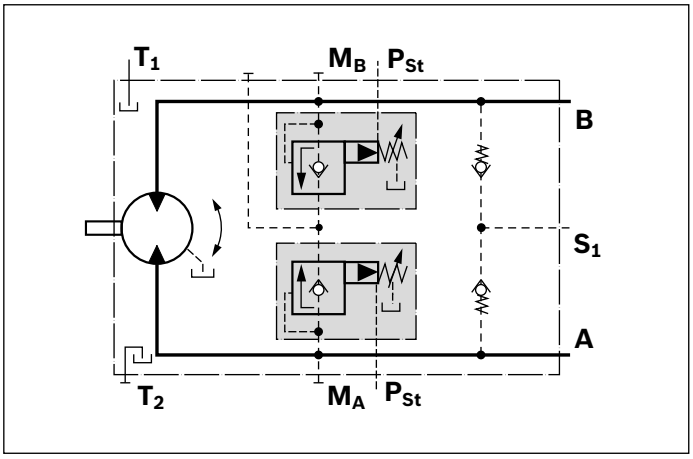
For versions “with pressure sequencing stage” (code 192), a higher pressure setting can be implemented by connecting an external pilot pressure of 25 up to 30 bar at port **P**$_{St}$.
When ordering, state in plain text:

- 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)



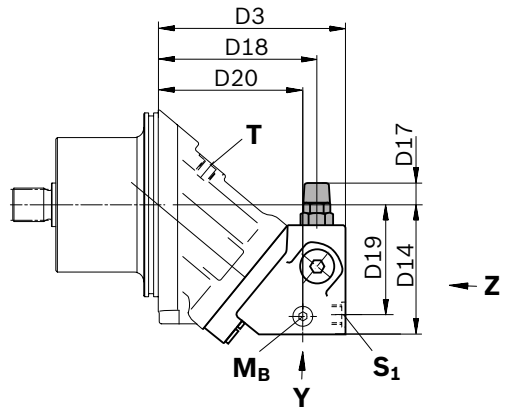
Version with pressure boost facility (code 192)



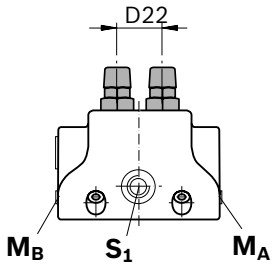
Permissible input flow or pressure in case of port plate with pressure-relief valves

Size		Code	p_{nom}	p_{max}	q_V
Motor	MHDB		bar	bar	l/min
28 ... 32	16	191, 192	350	420	100
107 ... 180	32				400

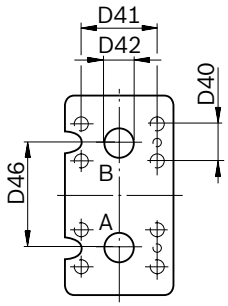
Dimensions



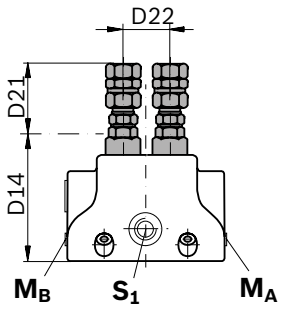
Detailed view **Z**:
Version without pressure boost facility (code 191)



Detailed view **Y**



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



Size		D3	D14	D17	D18	D19	D20	D21	D22	D40	D41	D42	D46
Motor	**MHDB**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**
28, 32	16	145	102	25	122	87	110	68	36	23.8	50.8	19	66
107, 125	32	216	149.5	10	184	130	168	52	53	31.8	66.7	32	84
160, 180		249	170	5	218	149	202	47	53	31.8	66.7	32	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 × 15; 17 mm deep	M14 × 2; 19 mm deep	
		State on delivery	With protective cover (must be connected)		
S_1	Boost port	Size	M22 × 15; 14 mm deep	M26 × 15; 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 × 15; 14 mm deep	M26 × 15; 16 mm deep	M30 × 15; 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. 20 bar.

Note

- BVD available for sizes 28 to 180 and BVE available 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 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 16 mm^2/s)

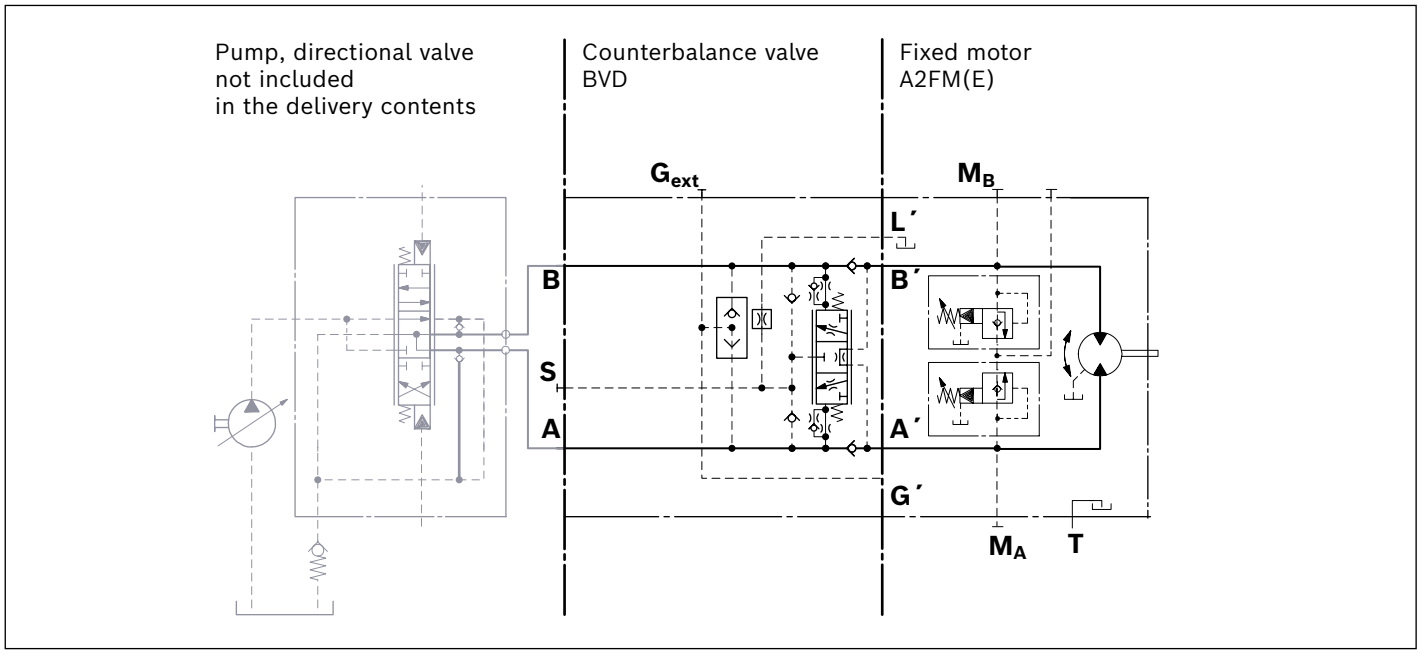
Travel drive counterbalance valve BVD...F

Application option:

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators

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



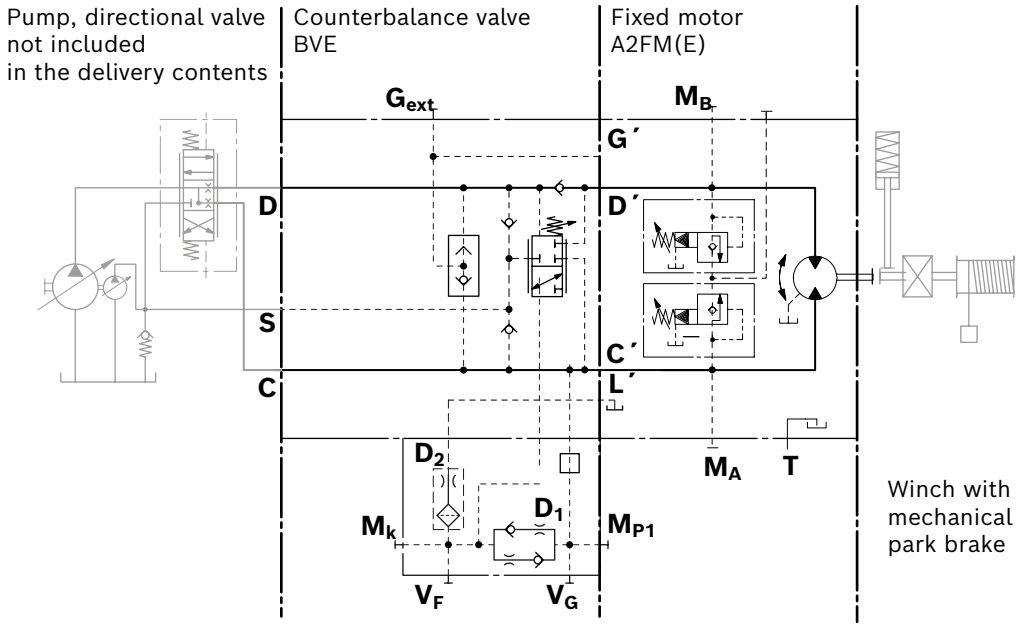
Winch counterbalance valve BVD...W and BVE

Application options:

- Winch drive in cranes (BVD and BVE)
- Track drive in excavator crawlers (BVD)

Example circuit diagram for winch drive in cranes

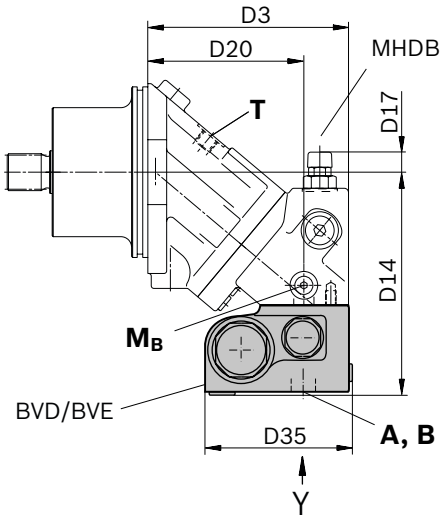
A2FM(E)107/61W-VAB188 + BVE25W385/51ND-V100K00D4599T30S00-0



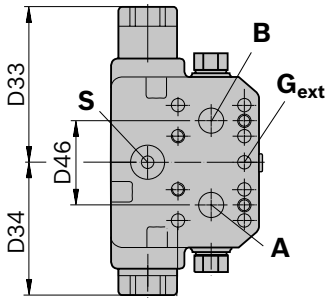
Permissible input flow or pressure in case of port plate with counterbalance valves

Size			Code	p_{nom}	p_{max}	q_v
Motor	**BVD/ BVE**	**MHDB**		**bar**	**bar**	**l/min**
28 ... 32	20	16	181, 188	350	420	100
107 ... 125		22	171, 178			220
107 ... 180	25	32	181, 188			320

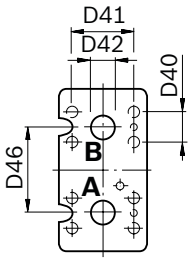
Dimensions



Detailed view **Y**:
with BVD/BVE (code 178, 188)



Detailed view **Y**:
without BVD/BVE (code 171, 181)



Size		Code	D3	D14	D17	D20	D33	D34	D35 [1]	D40	D41	D42	D46
Motor	**Counterbalance valve**		**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**
28, 32	BVD20..16	188	145	175	25	110	139	98	142	23.8	50.8	19	66
107, 125	BVD20..28	178	216	238	10	168	139	98	142	27.8	57.2	25	84
	BVD25..38	188	216	239	10	168	175	120.5	158	31.8	66.7	32	84
	BVE25..38	188	216	240	10	168	214	137	167	31.8	66.7	32	84
160, 180	BVD25..38	188	249	260	5	202	175	120.5	158	31.8	66.7	32	84
	BVE25..38	188	249	260	5	202	214	137	167	31.8	66.7	32	84

[1] For version with brake release valve (BV...L): Dimension D35 +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 × 15; 17 mm deep	M12 × 175; 16 mm deep	M14 × 2; 19 mm deep	
		State on delivery	With protective cover (must be connected)			
S	Boost port	Size	M22 × 15; 14 mm deep		M27 × 2; 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 × 15; 12 mm deep			
		Standard [4]	ISO 6149			
		State on delivery	Plugged			

[1] With BVD20
[2] With BVD25 / BVE25
[3] Thread according to DIN 13
[4] The spot face can be deeper than specified in the appropriate standard.

Speed sensors

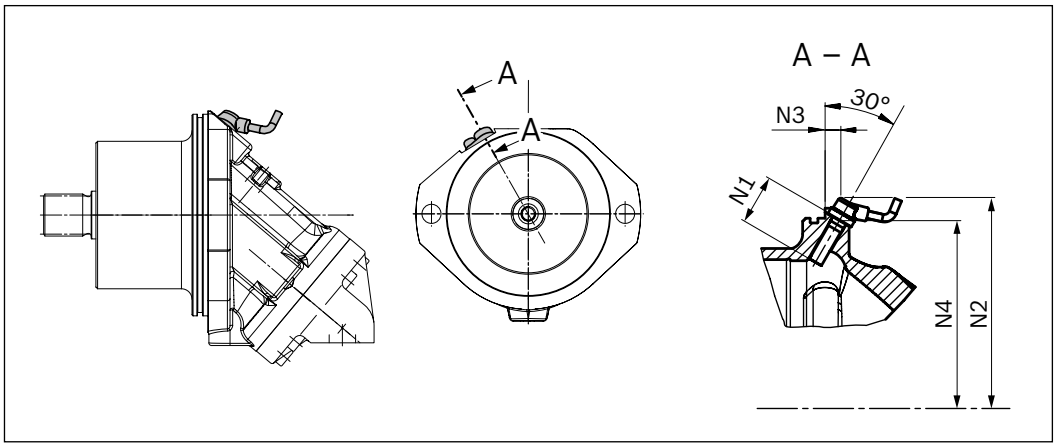
The versions A2FE...U ("prepared for speed sensor", i.e. without sensor) are equipped with a toothed ring on the rotary group.
On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.
With the DSA speed sensor mounted a signal proportional to motor speed can be 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

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

We recommend ordering the A2FE plug-in motor complete with sensor mounted.

DSA speed sensor mounted (code V)
Size 28 ... 250



Motor Size	Number of teeth	N1 mm	N2 mm	N3 mm	N4 mm
28 ... 32	38	32	86	15	66
107 ... 125	59	32	104	28	85
160 ... 180	67	32	114	33	95
250	78_{-1}	32			

Project planning information

Installation instructions

General

- During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.
- The case drain fluid in the housing must be directed to the reservoir via the highest available drain port (**T_1,T_2**).
- If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate reservoir lines must be laid as required.
- To achieve favorable noise values, all connecting lines should be decoupled by using elastic elements and above-reservoir installation is to be avoided.
- In all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples **1** to **6**.
Further installation positions are possible upon request.
Recommended installation position: **1** and **2**.

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.

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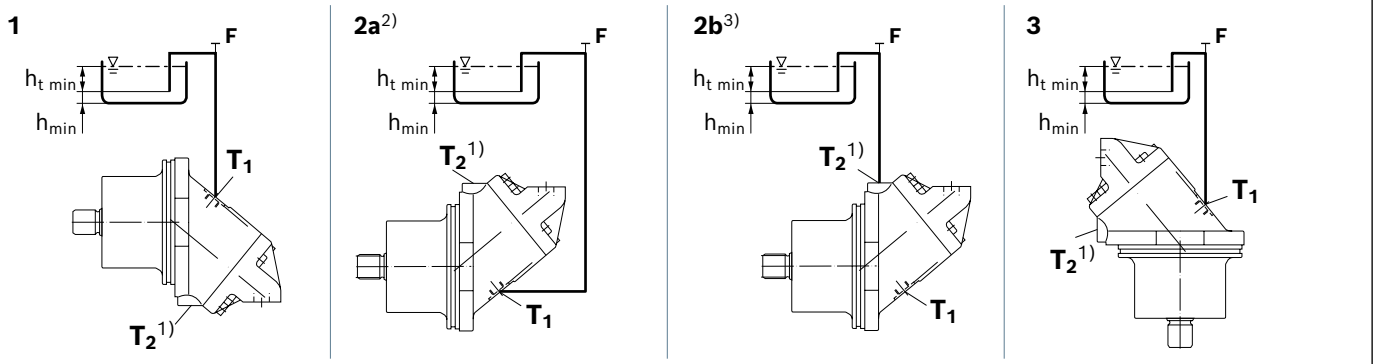
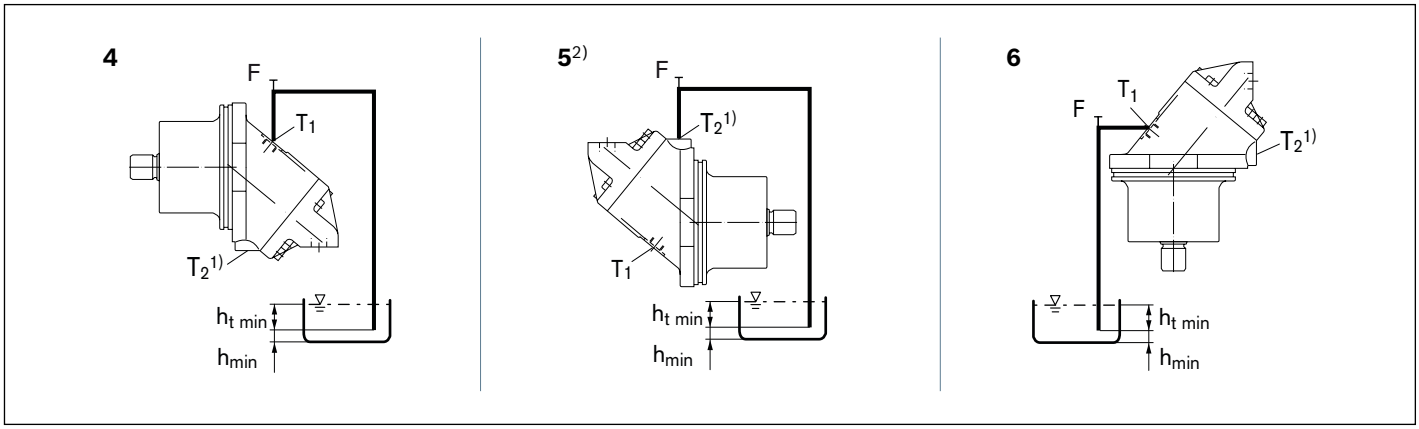


1) Standard for sizes 250 and 355, special version for sizes 28 to 180.
2) Piping suggestion without port T_2 (sizes 28 to 180)
3) Piping suggestion with Port T_2 (sizes 250 to 355).

Installation position	Air bleeding	Filling
1	**F**	**T_1**
2a	**F**	**T_1**
2b	**F**	**T_2**
3	**F**	**T_1**

Above-reservoir installation

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



1) Standard for sizes 250 and 355, special version for sizes 28 to 180.
2) Installation position only permissible if port T_2 is fitted (sizes 250 and 355).

Installation position	Air bleeding	Filling
4	**F**	**T_1 (F)**
5	**F**	**T_2 (F)**
6	**F**	**T_1 (F)**

Key

F	Filling / Air bleeding
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (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.
- 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 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 getting burnt on the axial piston unit and especially on the solenoids. Take the appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. contaminated hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator‘s specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.
- 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