Axial piston fixed motor A2FM for explosive areas II 2G ck IIB Tx

Part II of instruction manual according to ATEX directive 94/9/EC data sheet
RE 91001-01-X-B2
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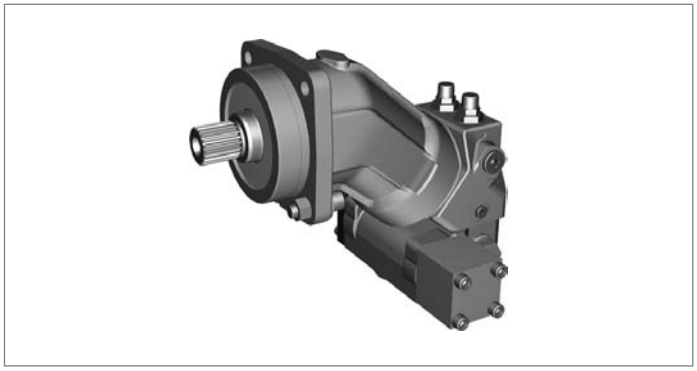

- Series 61
- Sizes 10 to 180
- Nominal pressure 400 bar
- Maximum pressure 450 bar
- Open and closed circuits

Details on explosion protection

- Field of application according to ATEX 94/9/EC
- Gas: II 2G ck IIB Tx in accordance with DIN EN 13463-1:2009, DIN EN 13463-5:2011

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 depends on the flow of the pump and the displacement of the motor
- The output torque increases with the pressure differential between the high-pressure side and the low-pressure side.
- Finely graduated sizes permit far-reaching adaptation to the drive concerned
- High power density
- Small dimensions
- High total efficiency
- Good starting efficiency
- Economical design
- One-piece tapered piston with piston rings for sealing

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Ordering code

01	02	03		04	05		06	07	08	09	10	11
A2F	**M**		**/**	**61**	**W**	**–**			**B**		**J**	

Axial piston unit

01	Bent-axis design, fixed, , nominal pressure 400 bar, maximum pressure 450 bar	**A2F**

Operating mode

02	Motor (plug-in motor A2FE, see data sheet 91008-01-X-B2)	**M**

Size (NG)

03	Geometric displacement, see Technical data on page 7															
		10	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**

Series

04	Series 6, index 1	**61**

Direction of rotation

05	Viewed from drive shaft, bidirectional	**W**

Sealing material ATEX version

06	ATEX device category 3G (normal level of safety), shaft seal ring made of FKM (fluor-caoutchouc)	**A**
	ATEX device category 2G (normal level of safety), shaft seal ring made of FKM (fluor-caoutchouc)	**R**

Drive shaft		**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	
07	Splined shaft DIN 5480	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	**A**
		●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	**Z**
	Parallel keyed shaft, DIN 6885	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	**B**
		●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	**P**

Mounting flange

08	ISO 3019-2; 4-hole	**B**

Port plate for working lines[1]		**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	
09	SAE flange ports A and B at rear	–	–	–	●	●	●	●	●	●	●	●	●	●	●	●	**010**
	SAE flange ports A and B at side, opposite	–	–	–	●	●	●	●	●	●	●	●	●	●	●	●	**020**
	Threaded ports A and B, at side, opposite	●	●	●	●	●	●	–	–	–	–	–	–	–	–	–	**030**
	Threaded connections A and B at side and rear[2]	●	●	●	●	●	●	●	●	●	–	–	–	–	–	–	**040**
	SAE flange ports A and B at bottom (same side)	–	–	–	–	●	●	●	●	●	●	●	●	●	●	●	**100**
	Port plate with 1-stage pressure-relief valves for mounting a counterbalance valve[3] BVD20	–	–	–	–	–	–	–	–	–	–	–	●	●	–	–	**178**
	Port plate with 1-stage pressure-relief valves for mounting a counterbalance valve[3] BVD20/25	–	–	–	–	●	●	●	●	●	●	●	●	●	●	●	**188**

Rotary group

10	Version J	**J**

Special version

11	Special version	**-S**

● = Available – = Not available

Note
Note the project planning notes on page 29.

1) Fastening thread or threaded ports, metric
2) Threaded connections at the sides sealed with threaded plugs
3) Indicate ordering code for counterholding valve BVD separately as per data sheet 95522.
Note the restrictions described on page 24.

Features of the ATEX version

With the ATEX version of the A2FM axial piston fixed motor, a restriction of the technical data must to be taken into account.

External distinguishing feature compared to the standard motor is the grounding connection, which is marked by a socket-head screw on the mounting flange. Observe the instruction manual.

Note

Potential equalization: The motor must be grounded via the grounding connection (to be provided by the customer).

For grounding points, see the instruction manual (Part I, 91001-01-X-B1) chapter 7.5 “Connecting potential equalization“.

Temperature classes according to EN 13463-1

Depending on the two temperature classes T3 and T4, the maximum permissible speed and temperature restrictions must be taken into account (see table “Viscosity and temperature of the hydraulic fluid” and “Technical data”).

Hydraulic fluids

The fixed motor A2FM is designed for operation with HLP mineral oil according to DIN 51524.

Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons

The fixed motor A2FM for explosive areas is only approved for mineral oils.

Notes on selection of hydraulic fluid

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

The ignition temperature of the hydraulic fluid must be greater than 250 °C.

Note

At no point of the component may the temperature be higher than 90 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.

If it is not possible to maintain the conditions above due to extreme operating parameters, we recommend flushing the case at port $\mathbf{T_1/T_2}$.

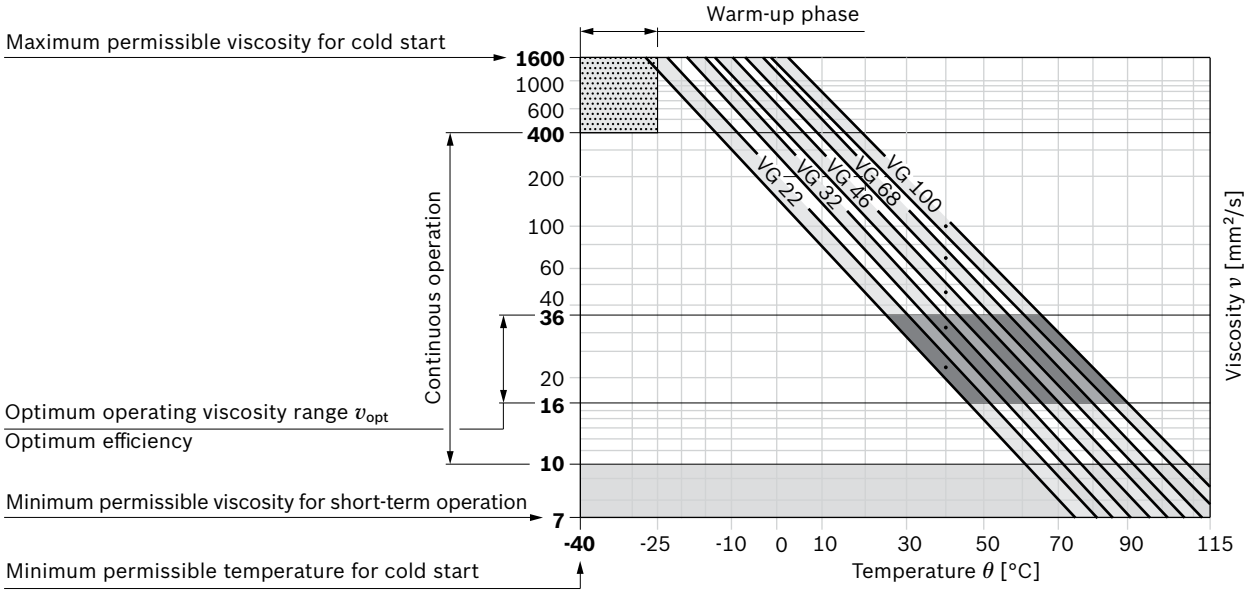
Project planning note

The maximum leakage temperature and case pressure must not be exceeded. For this purpose, constant monitoring by means of appropriate sensors in the system is necessary.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	v_{max} ≤ 1600 mm²/s	θ_{St} ≥ −40 °C	t ≤ 3 min, n ≤ 1000 rpm, without load p ≤ 50 bar
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	v < 1600 to 400 mm²/s	θ = −40 °C to −25 °C	at p ≤ 0.7 × p_{nom}, n ≤ 0.5 × n_{nom} and t ≤ 15 min
Continuous operation	v = 400 to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
Temperature class T3		θ = −25 °C to +90 °C	measured at port **T**
Temperature class T4		θ = −25 °C to +70 °C	observe permissible temperature range of the shaft seal ring (ΔT = approx. 12 K between bearing/shaft seal and port **T**)
	v_{opt} = 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	v_{min} ≥ 7 mm²/s		t < 3 min, p < 0.3 × p_{nom}

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit. A cleanliness level of at least 19/17/14 is to be maintained according to ISO 4406.

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.
The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. Momentary (t < 0.1 s) pressure peaks of up to 10 bar are allowed. The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
The case pressure must be equal to or higher than the ambient pressure.
These values are valid for ambient pressure p_{abs} = 1 bar.
The FKM shaft seal ring may be used for leakage temperatures from -25 °C to +90 °C.

Flow direction

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

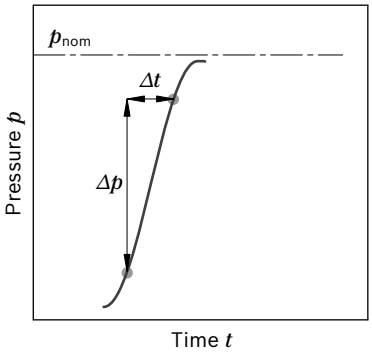
Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm.
For the maximum speed, see Technical data on page 7.

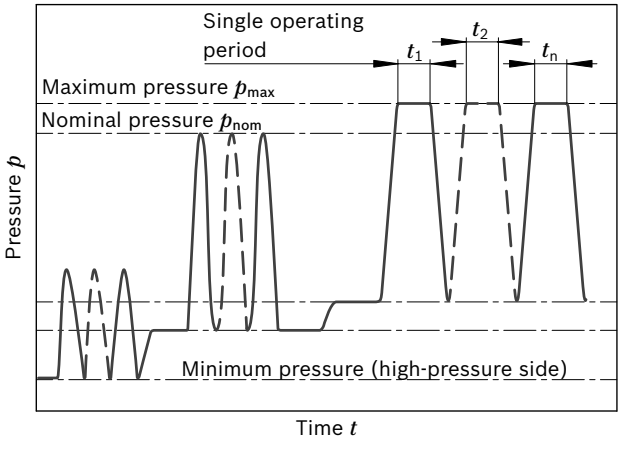
Working pressure range

Pressure at the working line ports A or B		Definition
Nominal pressure p_{nom}	400 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	450 bar absolute	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar absolute	Minimum pressure at the high-pressure side (**A** or **B**) required to prevent damage to the axial piston unit.
Minimum pressure – pump operating mode (inlet)	See characteristic	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} (pressure **A** + pressure **B**)	700 bar	The summation pressure is the sum of the pressures at both work ports (**A** and **B**).
Rate of pressure change $R_{A\,max}$		Maximum permissible rate of pressure build-up and reduction during a pressure change across the entire pressure range.
with built-in pressure relief valve	9000 bar/s	
without pressure relief valve	16000 bar/s	

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

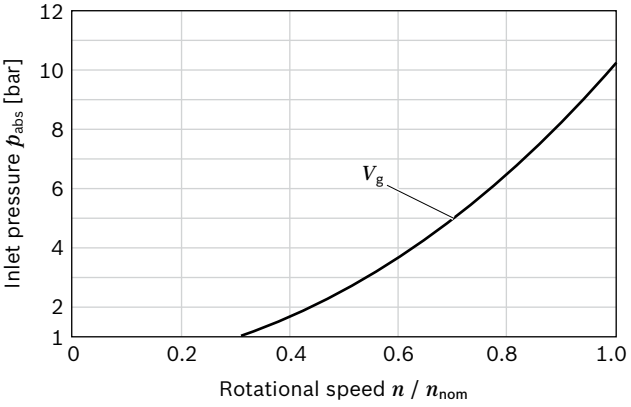


▼ **Pressure definition**



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

▼ **Minimum pressure – pump operating mode (inlet)**



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

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

Technical data

Size		NG		10	12	16	23	28	32	45	56
Displacement geometric, per revolution		V_g	cm^3	10.3	12	16	22.9	28.1	32	45.6	56.1
Speed maximum[1]	Temperature class T3	n_{max}	rpm	8000	8000	8000	6300	6300	6300	5600	5000
	Temperature class T4	n_{max}	rpm	4000	4000	4000	3150	3150	3150	2800	2500
Inlet flow[2]		$q_{v\,max}$	l/min	82	96	128	144	177	202	255	281
Torque[3]	at Δp = 350 bar	T	Nm	57	67	89	128	157	178	254	313
	at Δp = 400 bar	T	Nm	66	76	102	146	179	204	290	357
Rotary stiffness		c_{min}	kNm/rad	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94
Moment of inertia for rotary group		J_{TW}	kgm^2	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042
Maximum angular acceleration		α	rad/s^2	5000	5000	5000	6500	6500	6500	14600	7500
Case volume		V	l	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45
Weight approx.		m	kg	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18

Size		NG		63	80	90	107	125	160	180
Displacement geometric, per revolution		V_g	cm^3	63	80.4	90	106.7	125	160.4	180
Speed maximum[1]	Temperature class T3	n_{max}	rpm	5000	4500	4500	4000	4000	3600	3600
	Temperature class T4	n_{max}	rpm	2500	2250	2250	2000	2000	1800	1800
Inlet flow[2]		$q_{v\,max}$	l/min	315	362	405	427	500	577	648
Torque[3]	at Δp = 350 bar	T	Nm	351	448	501	594	696	893	1003
	at Δp = 400 bar	T	Nm	401	512	573	679	796	1021	1146
Rotary stiffness		c_{min}	kNm/rad	6.25	8.73	9.14	11.2	11.9	17.4	18.2
Moment of inertia for rotary group		J_{TW}	kgm^2	0.0042	0.0072	0.0072	0.0116	0.0116	0.0220	0.0220
Maximum angular acceleration		α	rad/s^2	7500	6000	6000	4500	4500	3500	3500
Case volume		V	l	0.45	0.55	0.55	0.8	0.8	1.1	1.1
Weight approx.		m	kg	18	23	23	32	32	45	45

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	T	$= \frac{V_g \times \Delta p \times \eta_{hm}}{20 \times \pi}$	[Nm]
Power	P	$= \frac{2\pi \times T \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600}$	[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 ($\eta_t = \eta_v \times \eta_{hm}$)

Note

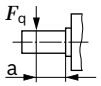
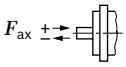
- Theoretical values, without efficiency and tolerances; values rounded.
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced 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.

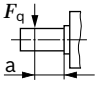
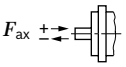
1) The valid values (observing the maximum permissible flow):
   – for the optimum viscosity range from v_{opt} = 36 to 16 mm^2/s
   – with hydraulic fluid on the basis of mineral oil

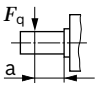
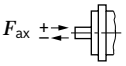
2) Observe limitation of inlet flow due to counterbalance valve (see page 24).

3) Torque without radial force, with radial force see page 8.

Permissible radial and axial forces of the drive shafts

Size	NG		10	10	12	12	16	23	23	28	28
Drive shaft	Ø	mm	20	25	20	25	25	25	30	25	30
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	kN	3.0	3.2	3.0	3.2	3.2	5.7	5.4	5.7	5.4
	a	mm	16	16	16	16	16	16	16	16	16
Maximum torque at $F_{q\,max}$	T_{max}	Nm	66	66	76	76	102	146	146	179	179
Maximum differential pressure at $V_{g\,max}$ and $F_{q\,max}$	Δp_{max}	bar	400	400	400	400	400	400	400	400	400
Maximum axial force at standstill or pressure-free operation 	+ $F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
	− $F_{ax\,max}$	N	320	320	320	320	320	500	500	500	500
Permissible axial force per bar working pressure	+ $F_{ax\,perm}$/bar	N/bar	3.0	3.0	3.0	3.0	3.0	5.2	5.2	5.2	5.2

Size	NG		32	45	56	56 [2]	56	63	80	80 [2]	80
Drive shaft	Ø	mm	30	30	30	30	35	35	35	35	40
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	N	5.4	7.6	9.5	7.8	9.1	9.1	11.6	11.1	11.4
	a	mm	16	18	18	18	18	18	20	20	20
Maximum torque at $F_{q\,max}$	T_{max}	Nm	204	290	357	294	357	401	512	488	512
Maximum differential pressure at $V_{g\,max}$ and $F_{q\,max}$	Δp_{max}	bar	400	400	400	330	400	400	400	380	400
Maximum axial force at standstill or pressure-free operation 	+ $F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
	− $F_{ax\,max}$	N	500	630	800	800	800	800	1000	1000	1000
Permissible axial force per bar working pressure	+ $F_{ax\,perm}$/bar	N/bar	5.2	7.0	8.7	8.7	8.7	8.7	10.6	10.6	10.6

Size	NG		90	107	107	125	160	160	180
Drive shaft	Ø	mm	40	40	45	45	45	50	50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	kN	11.4	13.6	14.1	14.1	18.1	18.3	18.3
	a	mm	20	20	20	20	25	25	25
Maximum torque at $F_{q\,max}$	T_{max}	Nm	573	679	679	796	1021	1021	1146
Maximum differential pressureat $V_{g\,max}$ and $F_{q\,max}$	$p_{nom\,perm.}$	bar	400	400	400	400	400	400	400
Maximum axial force at standstill or pressure-free operation 	+ $F_{ax\,max}$	N	0	0	0	0	0	0	0
	− $F_{ax\,max}$	N	1000	1250	1250	1250	1600	1600	1600
Permissible axial force per bar working pressure	+ $F_{ax\,perm}$/bar	N/bar	10.6	12.9	12.9	12.9	16.7	16.7	16.7

1) With intermittent operation
2) Restricted technical data only for splined shaft

Effect of radial force F_q on the service life of bearings

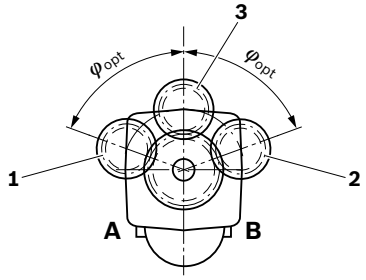
By selecting a suitable direction of radial force F_q, the load on the bearings, caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

	Gear output drive	V-belt output
NG	φ_{opt}	φ_{opt}
10 to 180	±70 °	±45 °

Note

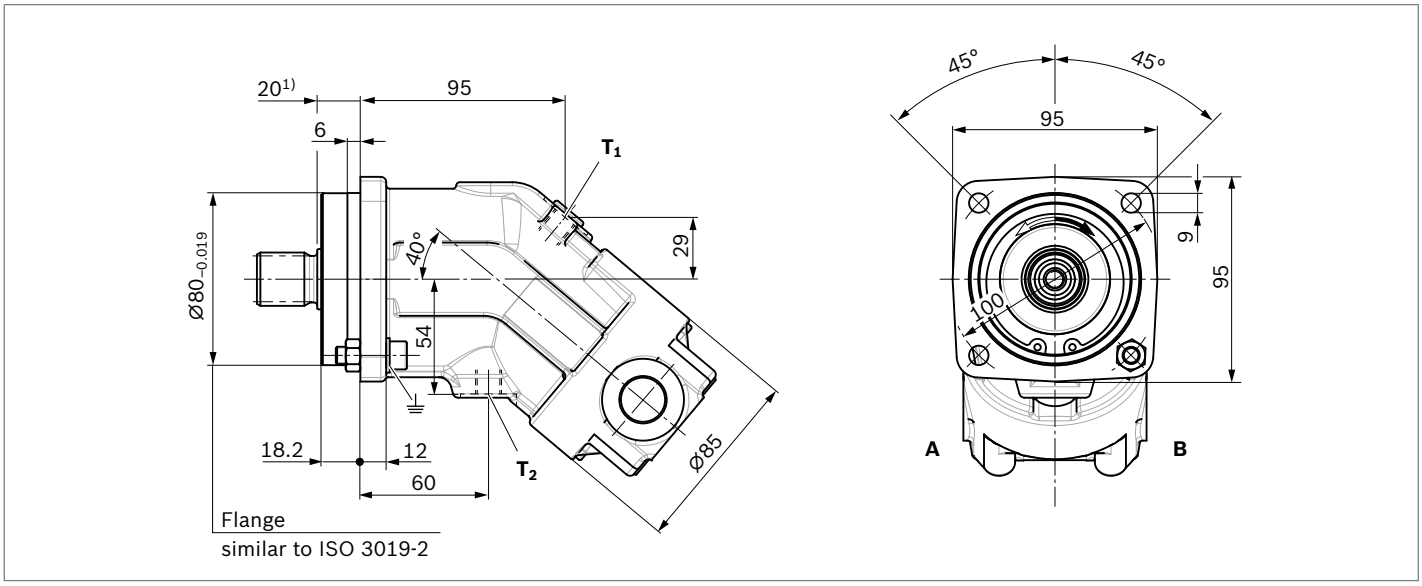
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- Special requirements apply in the case of belt drives. Please contact us.

▼ **Toothed gear output drive**



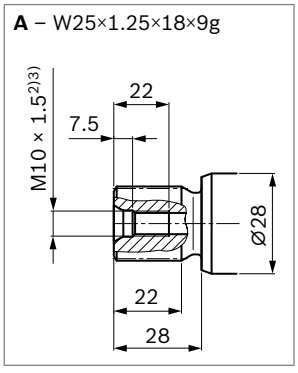
1 “Counter-clockwise” rotation. Pressure at port **B**
2 “Clockwise” rotation, Pressure at port **A**
3 Bidirectional direction of rotation

Dimensions, sizes 10, 12, 16



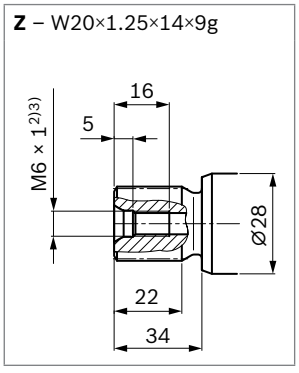
▼ **Splined shaft DIN 5480, NG10, 12, 16**

A – W25×1.25×18×9g



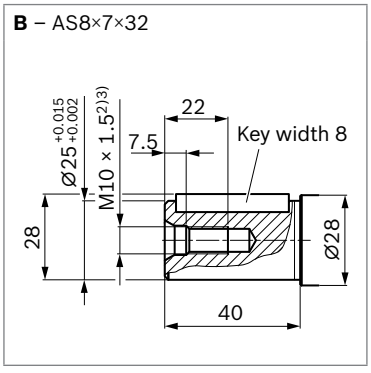
▼ **Splined shaft DIN 5480, NG10, 12**

Z – W20×1.25×14×9g



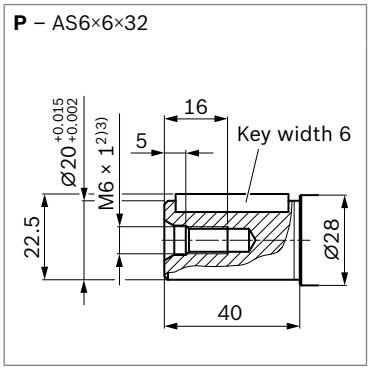
▼ **Parallel keyed shaft, DIN 6885 NG10, 12, 16**

B – AS8×7×32



▼ **Parallel keyed shaft, DIN 6885, NG10, 12**

P – AS6×6×32

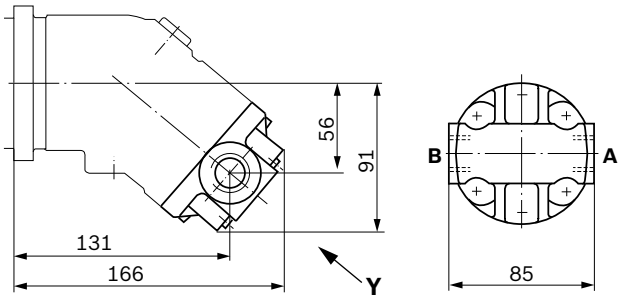


Ports		Standard	Size[3)]	$p_{max\ abs}$ [bar][4)]	State[7)]
A, B	Working port (see subplates, page 11)			450	
T_1	Drain port	DIN 3852[6)]	M12 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M12 × 1.5; 12 deep	3	O[5)]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. 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 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working line ports on port plates**

030 – threaded connections **A** and **B** on side, opposite



040 – threaded connections **A** and **B** on side and at rear

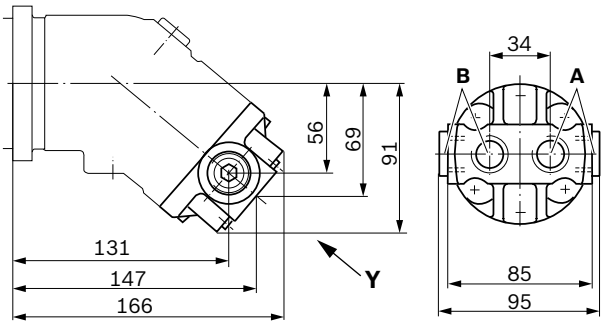
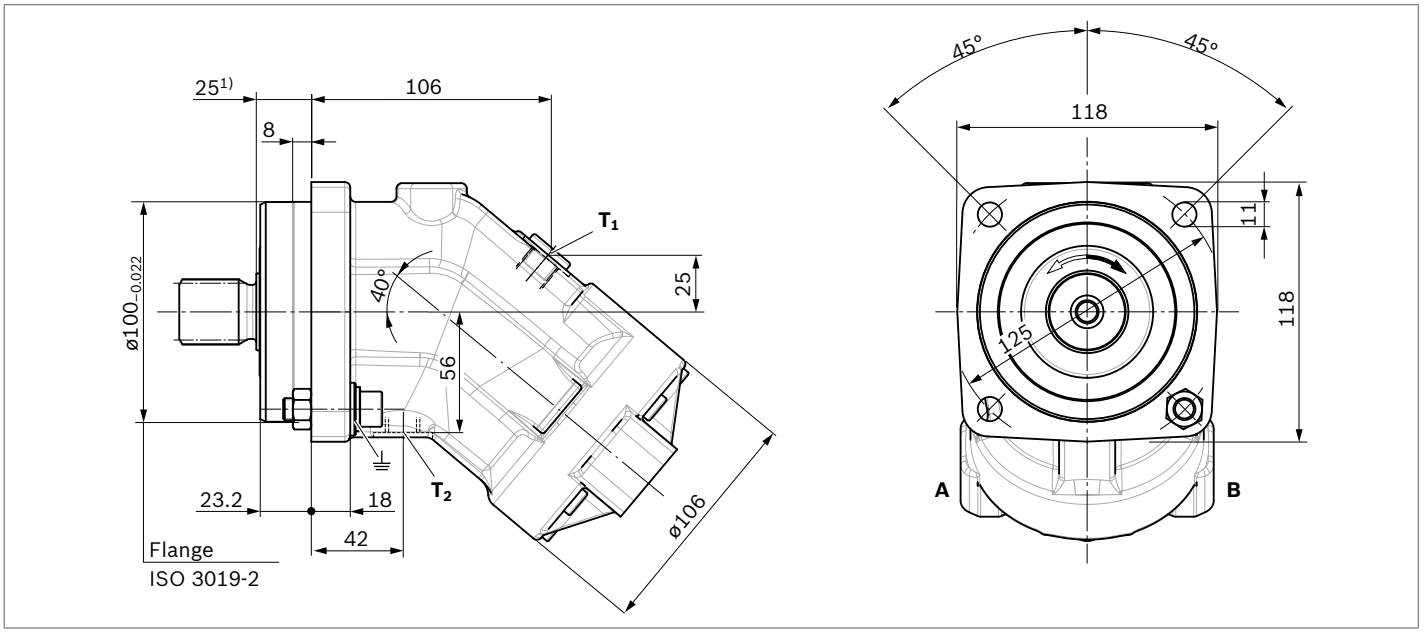


Plate	Ports		Standard[3)]	Size[1)]	$p_{max\ abs}$ [bar][2)]	State[4)]
030	**A, B**	Working port	DIN 3852	M22 × 1.5; 14 deep	450	O
040	**A, B**	Working port	DIN 3852	M22 × 1.5; 14 deep	450	each 1 × O

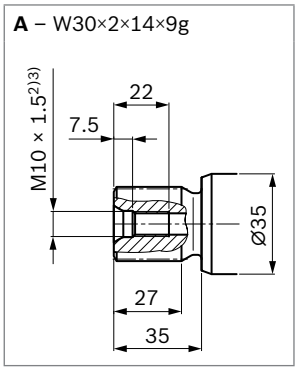
1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than as specified in the standard
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, sizes 23, 28, 32



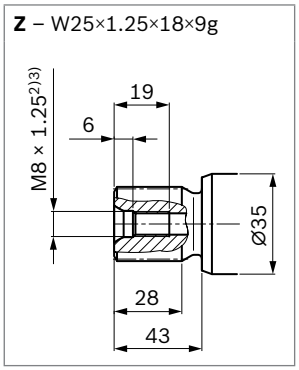
▼ **Splined shaft DIN 5480, NG23, 28, 32**

A – W30×2×14×9g



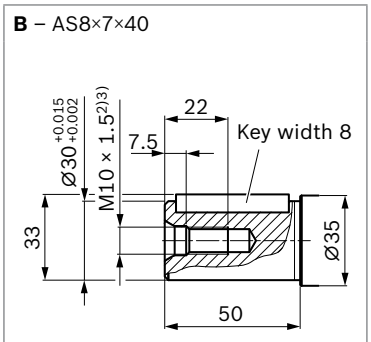
▼ **Splined shaft DIN 5480, NG23, 28**

Z – W25×1.25×18×9g



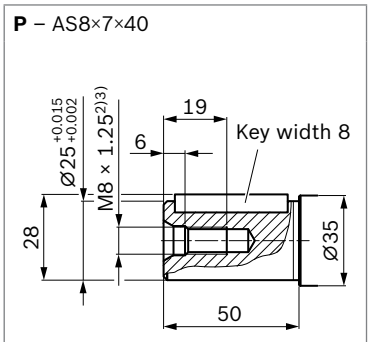
▼ **Parallel keyed shaft, DIN 6885, NG23, 28, 32**

B – AS8×7×40



▼ **Parallel keyed shaft, DIN 6885, NG23, 28**

P – AS8×7×40

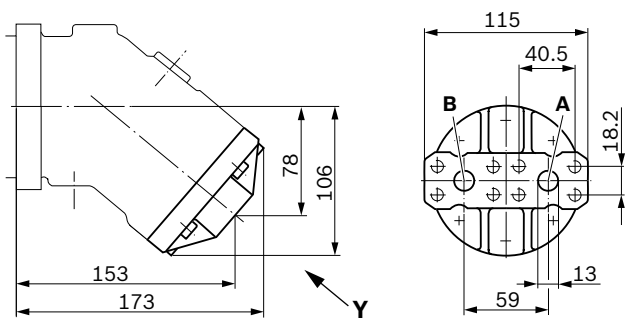


Ports		Standard	Size[3)]	$p_{max\ abs}$ [bar][4)]	State[7)]
A, B	Working port (see subplates page 13)			450	
T_1	Drain port	DIN 3852[6)]	M16 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M16 × 1.5; 12 deep	3	O[5)]

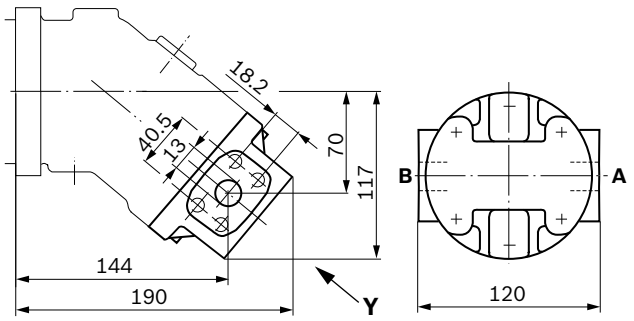
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working ports on port plates**

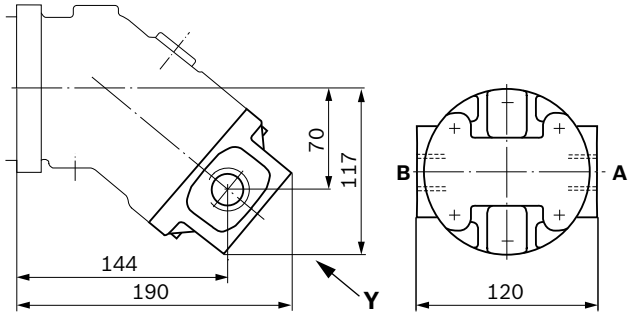
010 – SAE flange connections **A** and **B** at rear



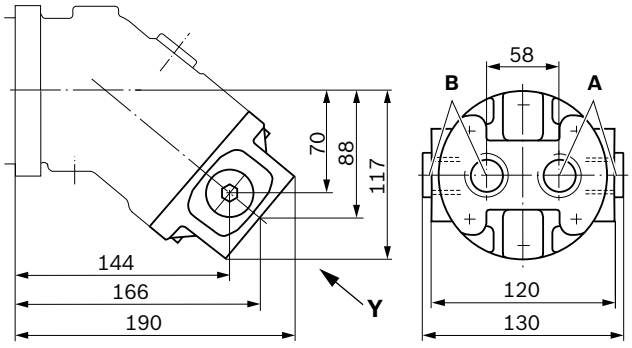
020 – SAE flange connections **A** and **B** on side, opposite



030 – threaded connections **A** and **B** on side, opposite



040 – threaded connections **A** and **B** on side and at rear



100 – SAE flange connections **A** and **B** below (same side)[4]

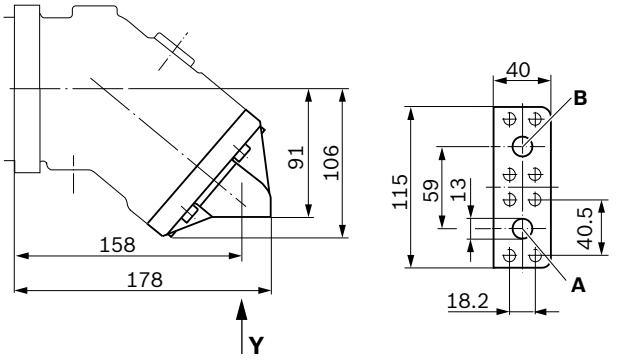
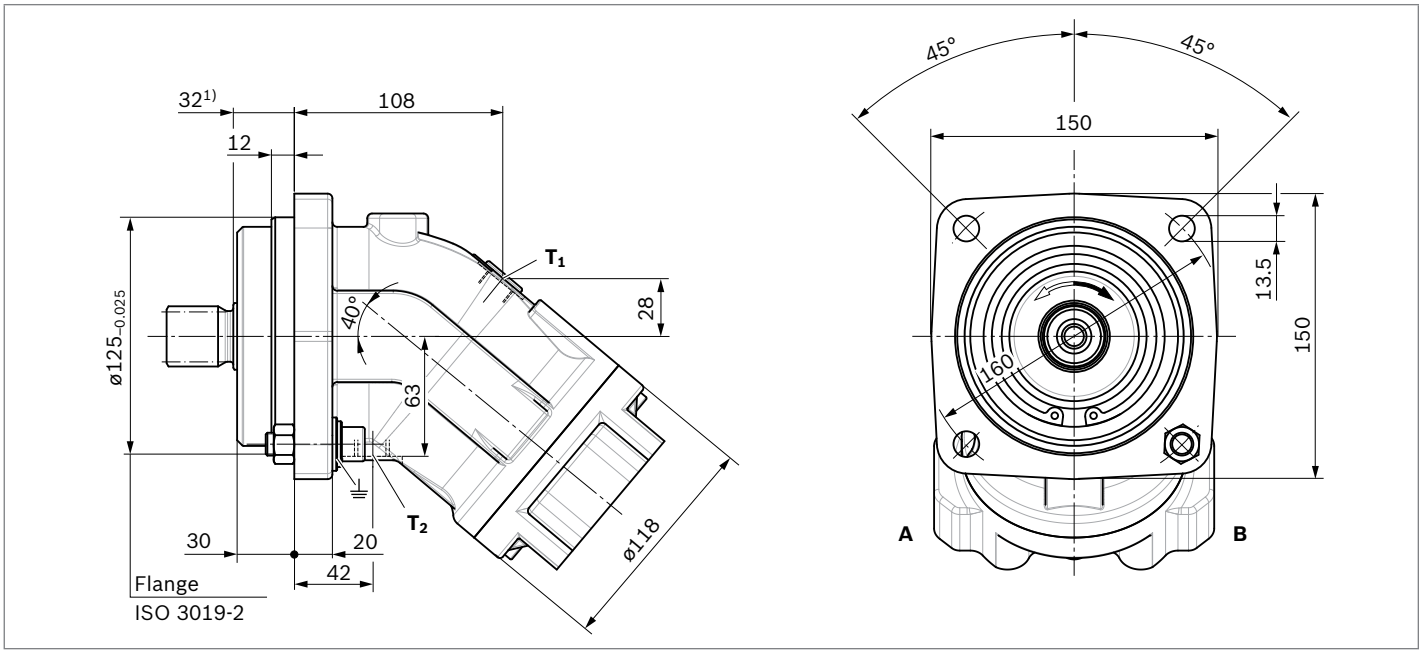


Plate	Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	State[6]
010, 020, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3] DIN 13	1/2 in M8 × 1.25; 15 deep	450	O
030	**A, B**	Working port	DIN 3852[5]	M27 × 2; 16 deep	450	O
040	**A, B**	Working port	DIN 3852[5]	M27 × 2; 16 deep	450	each 1 × O

Subplate **188** see Page 26.

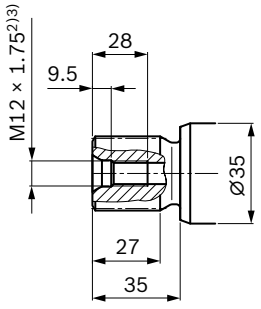
1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) Only sizes 28 and 32
5) The spot face can be deeper than as specified in the standard
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 45



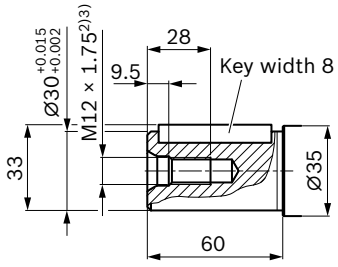
▼ **Splined shaft DIN 5480**

Z - W30×2×14×9g



▼ **Parallel keyed shaft, DIN 6885**

P – AS8×7×50

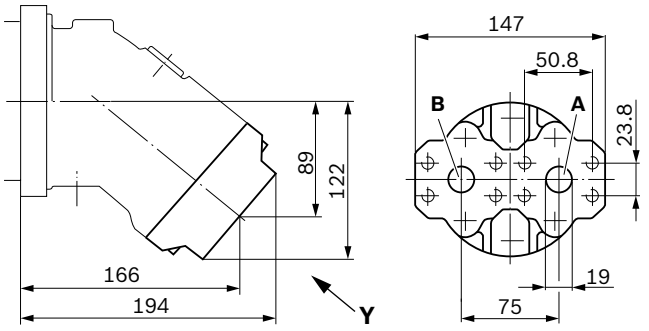


Ports		Standard	Size[3]	$p_{max\ abs}$ [bar][4]	State[7]
A, B	Working port (see subplates, page 15)			450	
T_1	Drain port	DIN 3852[6]	M18 × 1.5; 12 deep	3	X[5]
T_2	Drain port	DIN 3852[6]	M18 × 1.5; 12 deep	3	O[5]

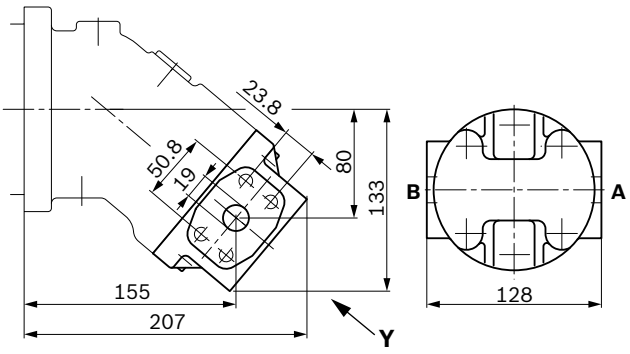
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working ports on port plates**

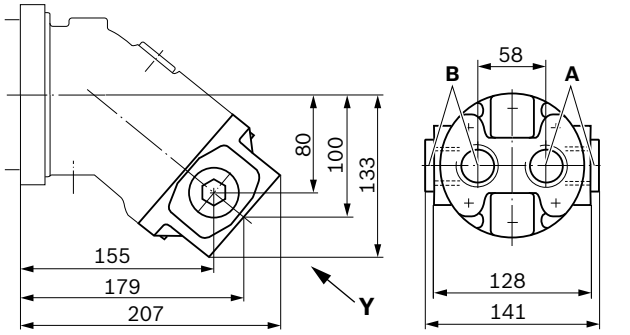
010 – SAE flange connections **A** and **B** at rear



020 – SAE flange connections **A** and **B** on side, opposite



040 – threaded connections **A** and **B** on side and at rear



100 – SAE flange connections **A** and **B** below (same side)

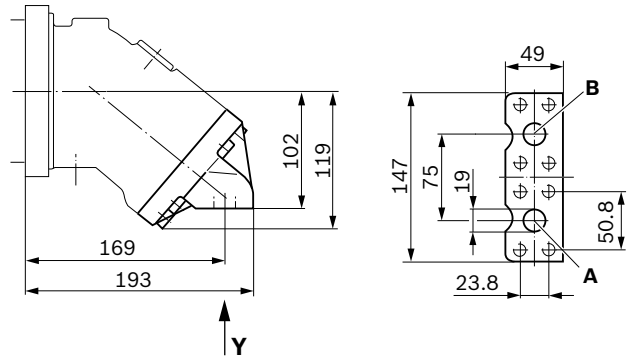
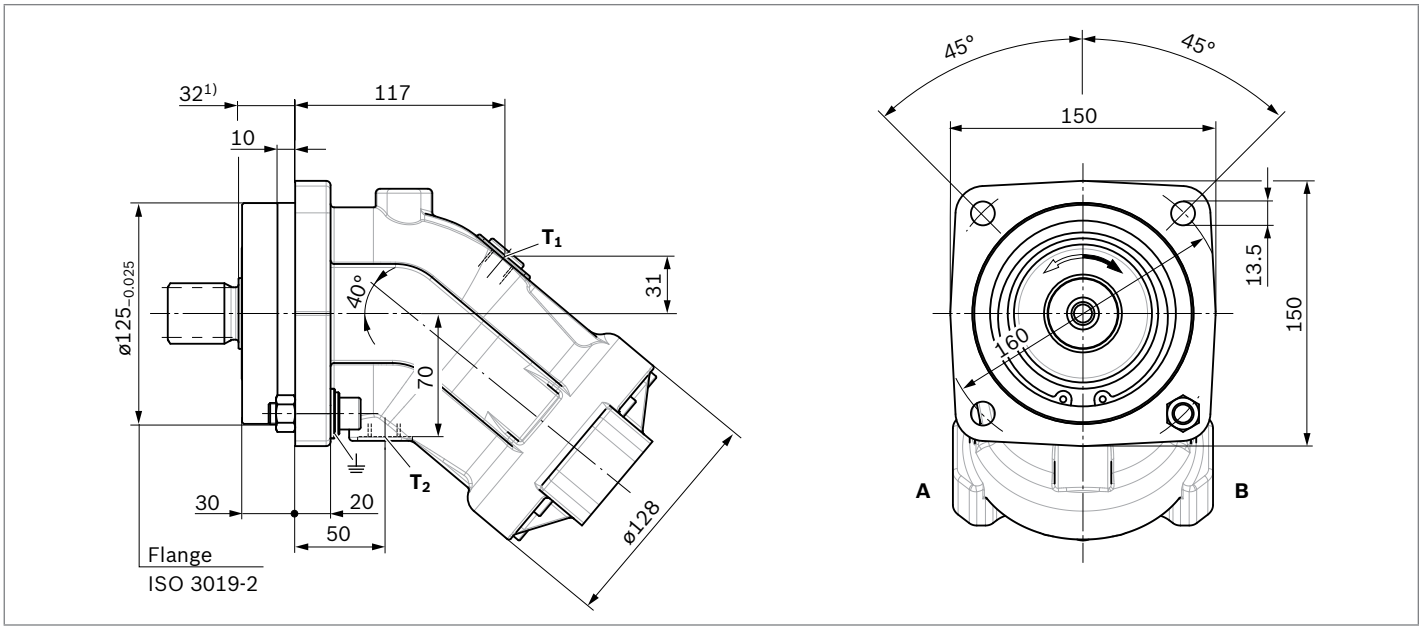


Plate	Ports		Standard	Size[1)]	$p_{max\ abs}$ [bar][2)]	State[6)]
010, 020, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3)] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
040	**A, B**	Working port	DIN 3852[4)]	M33 × 2; 18 deep	450	each 1 × O

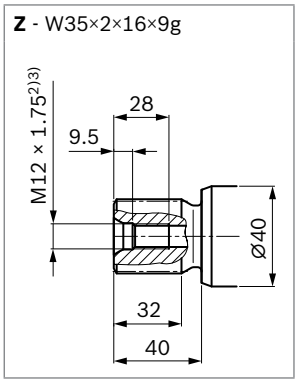
Subplate **188** see Page 26.

1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) The spot face can be deeper than as specified in the standard
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

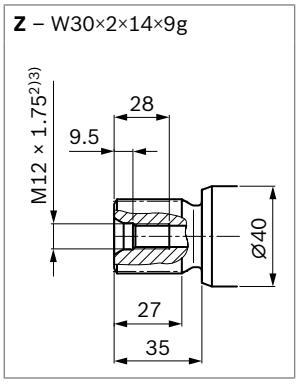
Dimensions sizes 56, 63



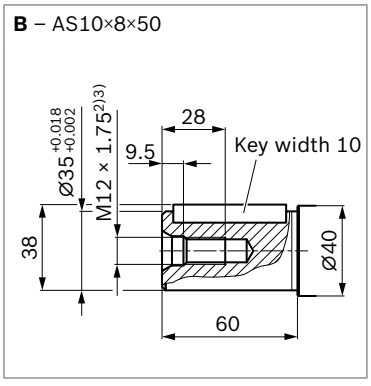
▼ **Splined shaft DIN 5480, NG56, 63**



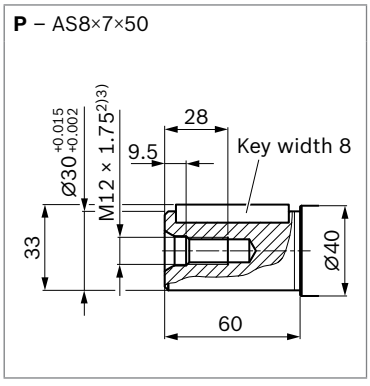
▼ **Splined shaft DIN 5480, NG56**



▼ **Parallel keyed shaft, DIN 6885, NG56, 63**



▼ **Parallel keyed shaft, DIN 6885, NG56**

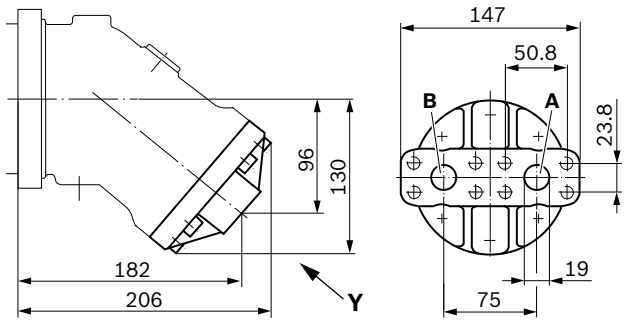


Ports		Standard	Size[3)]	$p_{max\ abs}$ [bar][4)]	State[7)]
A, B	Working port (see subplates, page 17)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

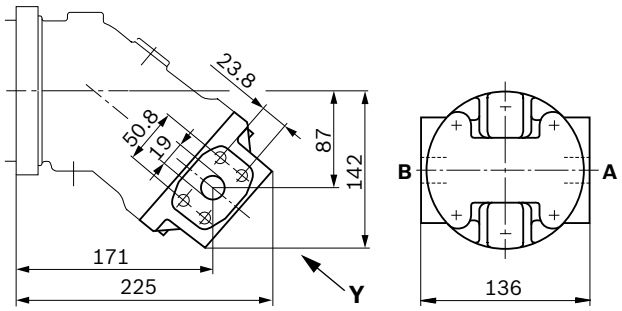
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working ports on port plates**

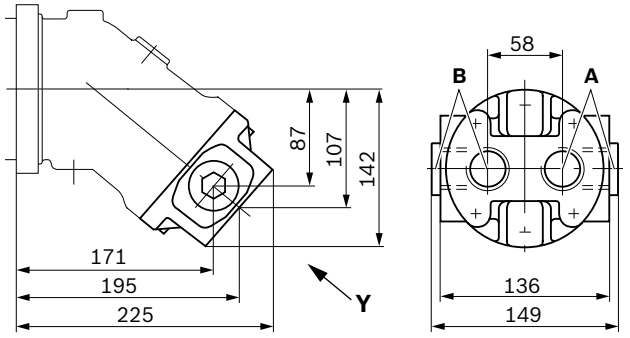
010 – SAE flange connections **A** and **B** at rear



020 – SAE flange connections **A** and **B** on side, opposite



040 – threaded connections **A** and **B** on side and at rear



100 – SAE flange connections **A** and **B** below (same side)

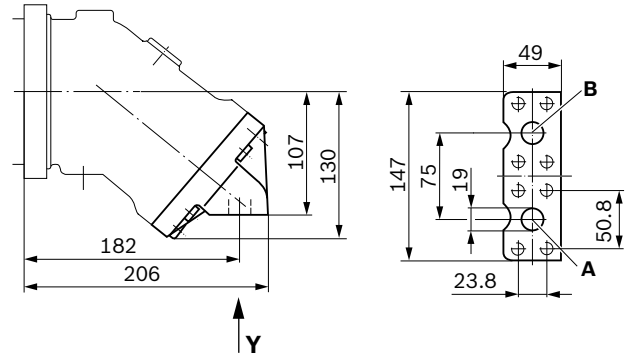
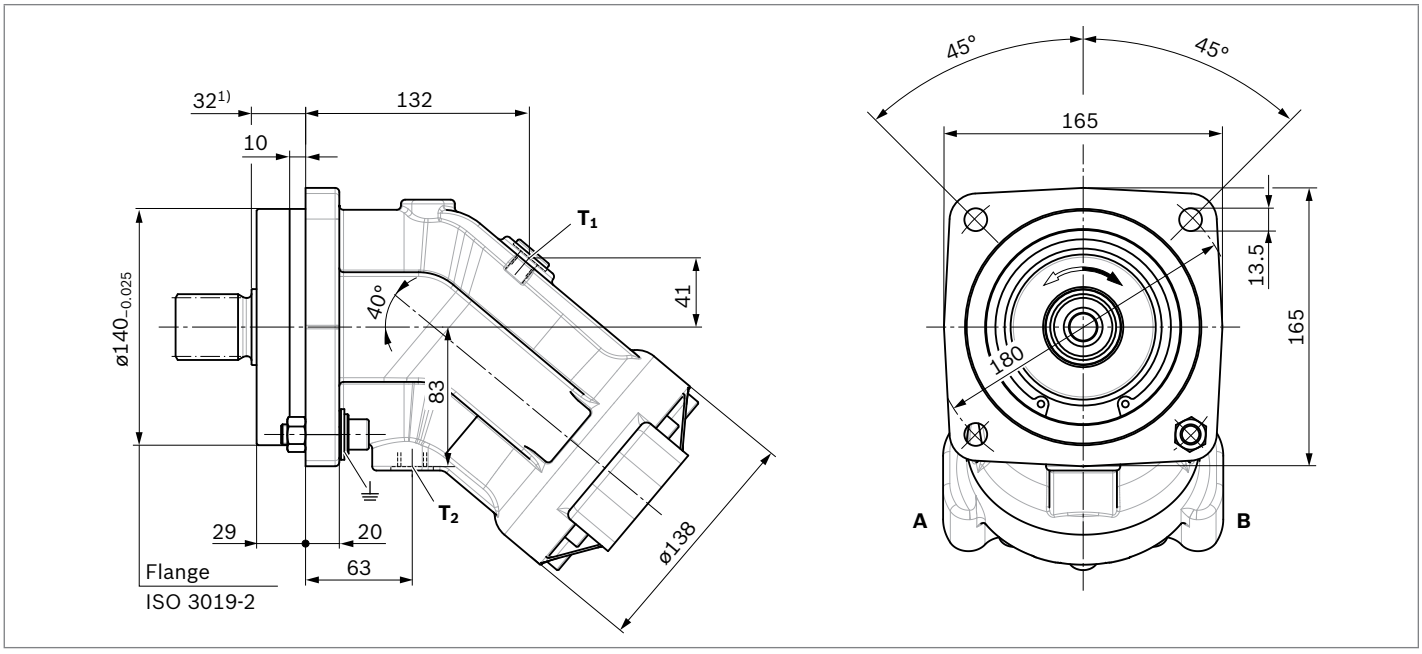


Plate	Ports		Standard	Size[1)]	$p_{max\ abs}$ [bar][2)]	State[6)]
010, 020, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3)] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
040	**A, B**	Working port	DIN 3852[4)]	M33 × 2; 18 deep	450	each 1 × O

Subplate **188** see Page 26.

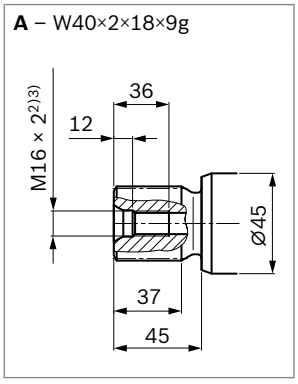
1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) The spot face can be deeper than as specified in the standard
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 80, 90



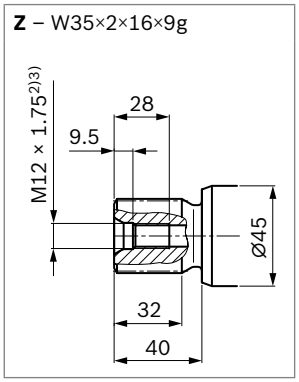
▼ **Splined shaft DIN 5480, NG80, 90**

A – W40×2×18×9g



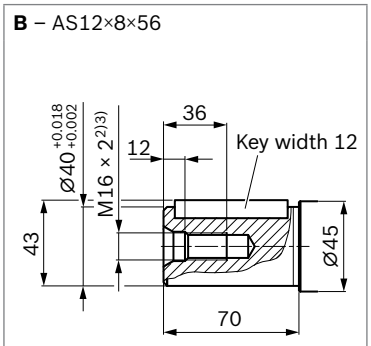
▼ **Splined shaft DIN 5480, NG80**

Z – W35×2×16×9g



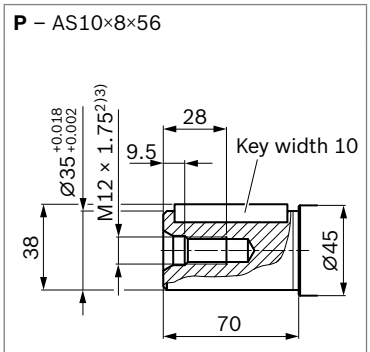
▼ **Parallel keyed shaft, DIN 6885, NG80, 90**

B – AS12×8×56



▼ **Parallel keyed shaft, DIN 6885, NG80**

P – AS10×8×56

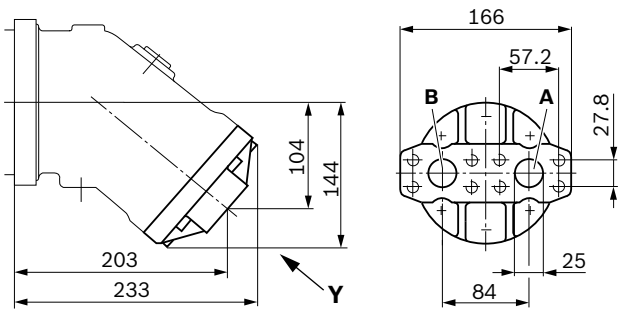


Ports		Standard	Size[3)]	$p_{max\ abs}$ [bar][4)]	State[7)]
A, B	Working port (see subplates, page 19)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

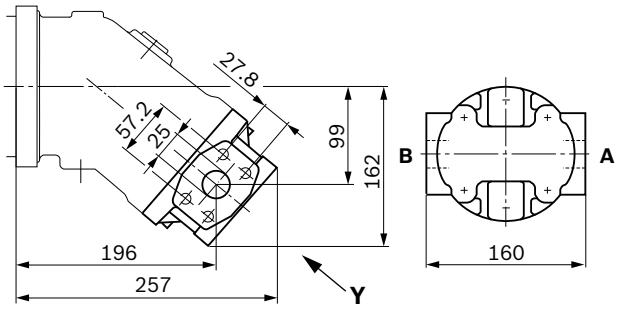
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working ports on port plates**

010 – SAE flange connections **A** and **B** at rear



020 – SAE flange connections **A** and **B** on side, opposite



100 – SAE flange connections **A** and **B** below (same side)

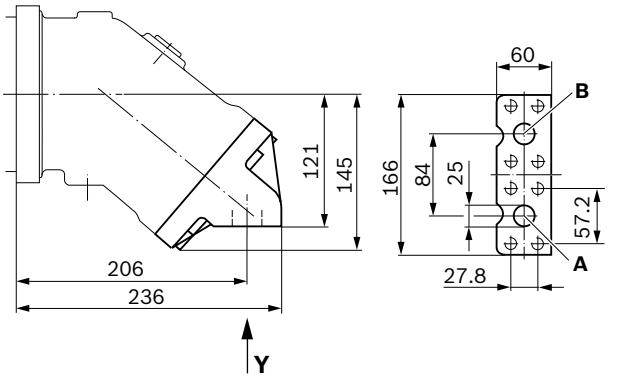
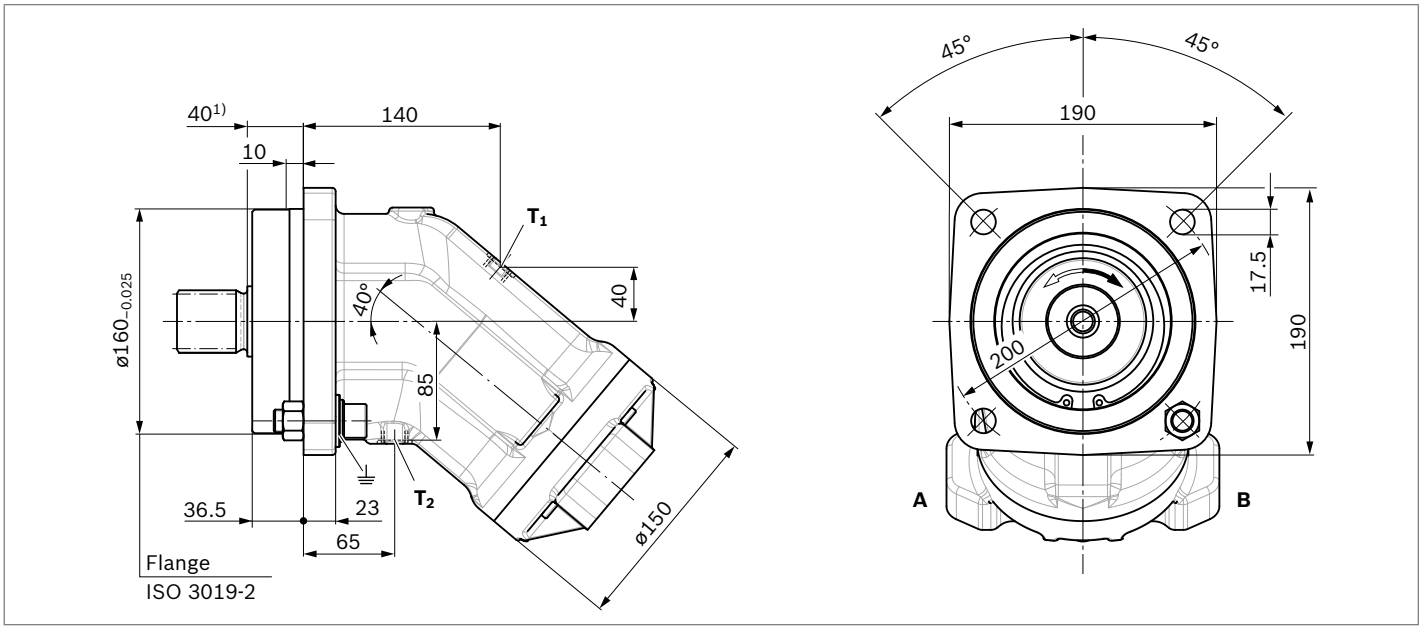


Plate	Ports		Standard	Size[1)]	$p_{max\ abs}$ [bar][2)]	State[6)]
010, 020, 100	**A, B**	Working port	SAE J518[3)]	1 in	450	O
		Fastening thread A/B	DIN 13	M12 × 1.75; 17 deep		

Subplate **188** see Page 26.

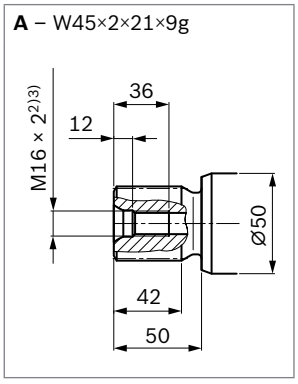
1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 107, 125



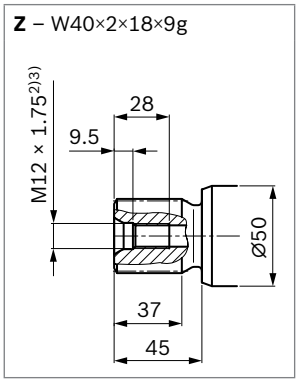
▼ **Splined shaft DIN 5480, NG107, 125**

A – W45×2×21×9g



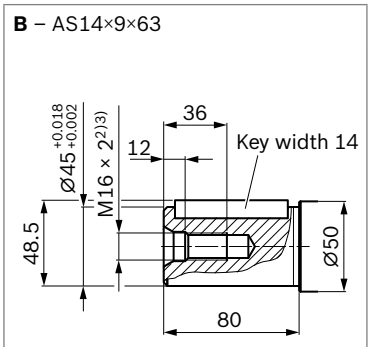
▼ **Splined shaft, DIN 5480 NG107**

Z – W40×2×18×9g



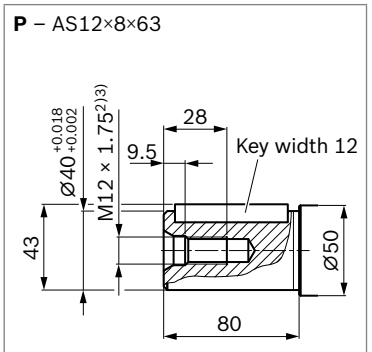
▼ **Parallel keyed shaft, DIN 6885, NG107, 125**

B – AS14×9×63



▼ **Parallel keyed shaft, DIN 6885, NG107**

P – AS12×8×63

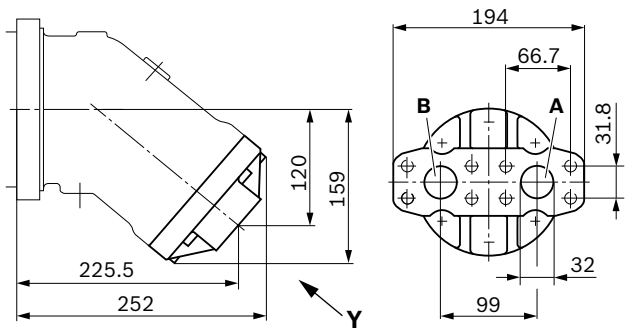


Ports		Standard	Size[3)]	$p_{max\ abs}$ [bar][4)]	State[7)]
A, B	Working port (see subplates, page 21)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

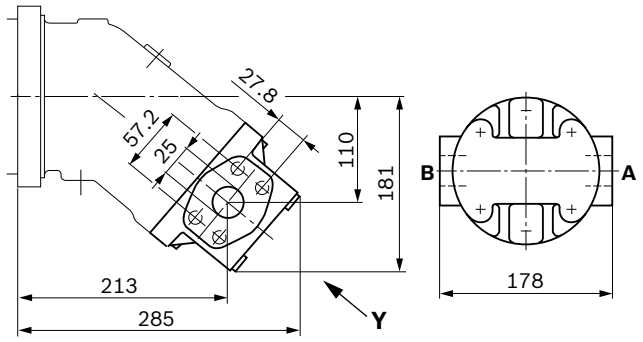
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working ports on port plates**

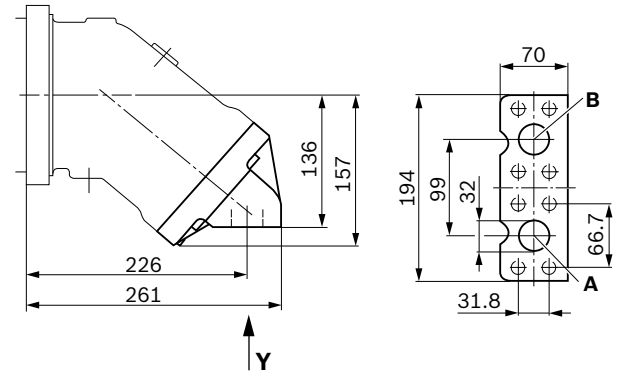
010 – SAE flange connections **A** and **B** at rear



020 – SAE flange connections **A** and **B** on side, opposite (NG107)



100 – SAE flange connections **A** and **B** below (same side)



020 – SAE flange connections **A** and **B** on side, opposite (NG125)

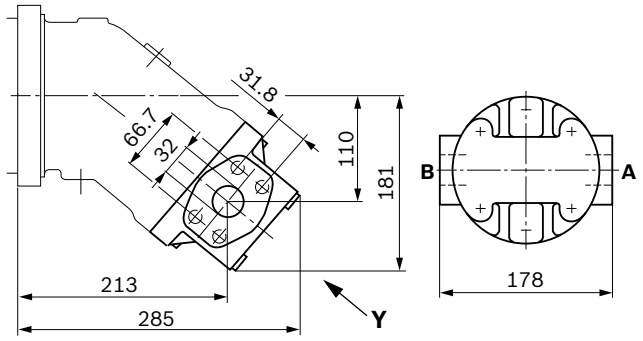
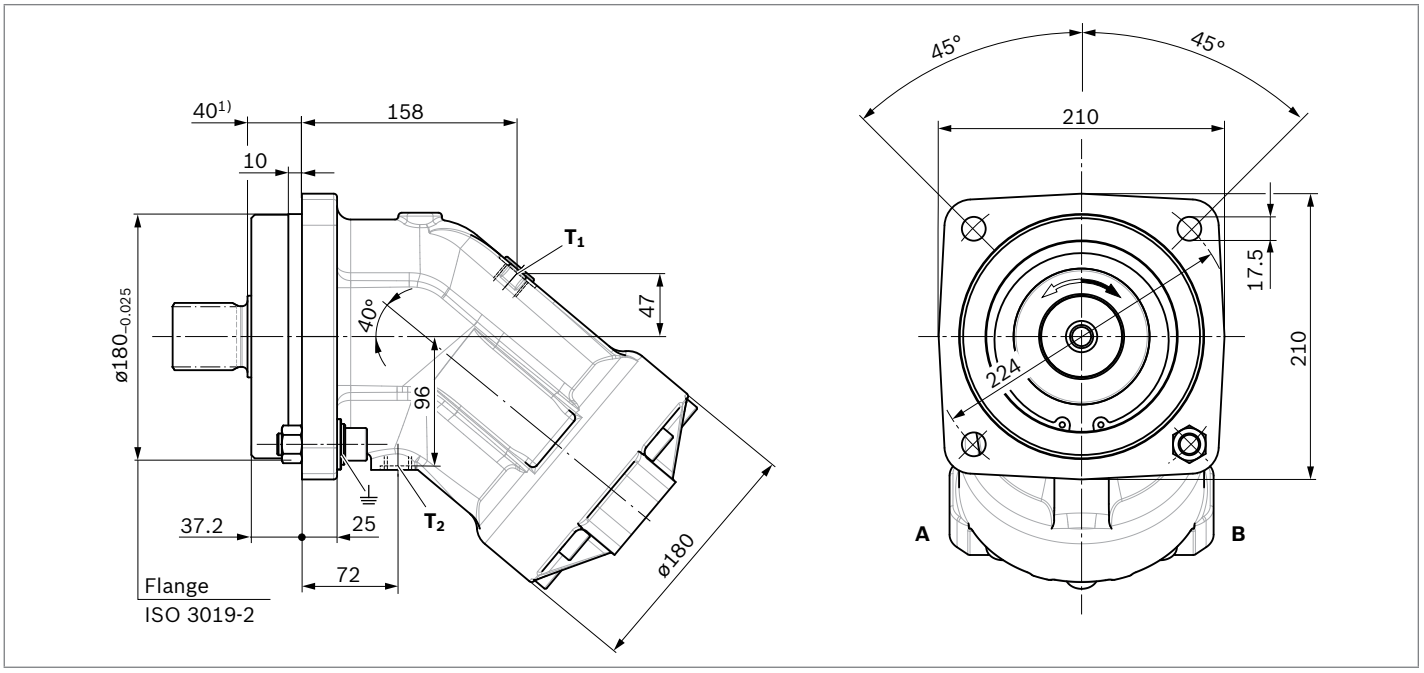


Plate	Ports		Standard	Size[1)]	$p_{max\ abs}$ [bar][2)]	State[4)]
010, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3)] DIN 13	1 1/4 in M14 × 2; 19 deep	450	O
020 (NG107)	**A, B**	Working port Fastening thread A/B	SAE J518[3)] DIN 13	1 in M12 × 1.75; 17 deep	450	O
020 (NG125)	**A, B**	Working port Fastening thread A/B	SAE J518[3)] DIN 13	1 1/4 in M14 × 2; 19 deep	450	O

Port plate **178** and **188** see page 26.

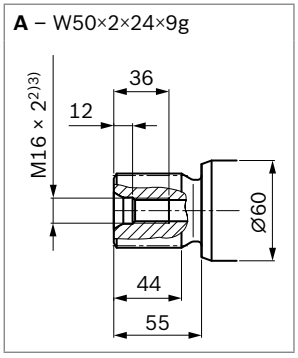
1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 160, 180



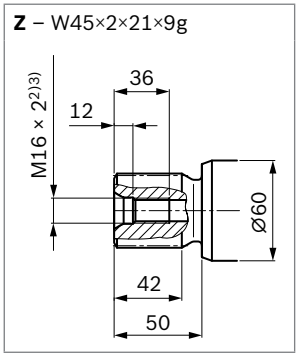
▼ **Splined shaft DIN 5480, NG160, 180**

A – W50×2×24×9g



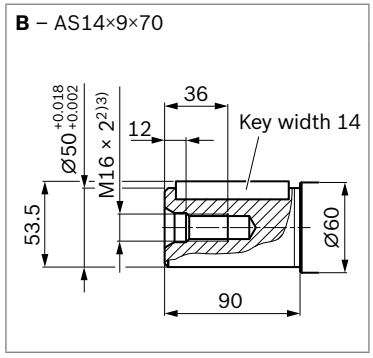
▼ **Splined shaft, DIN 5480, NG160**

Z – W45×2×21×9g



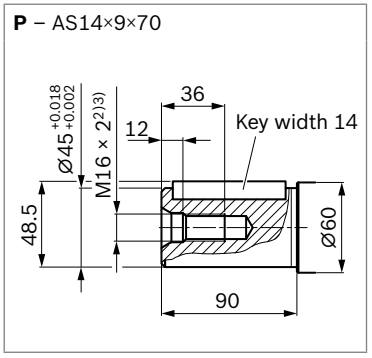
▼ **Parallel keyed shaft, DIN 6885, NG160, 180**

B – AS14×9×70



▼ **Parallel keyed shaft, DIN 6885, NG160**

P – AS14×9×70

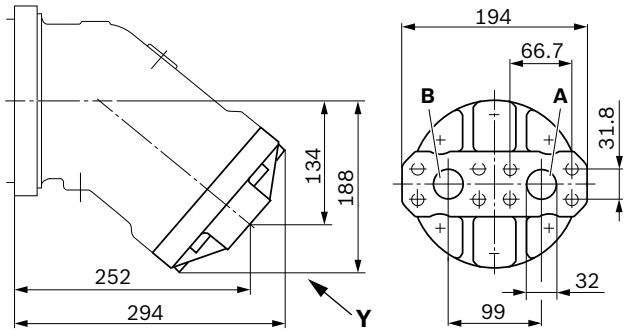


Ports		Standard	Size[3)]	$p_{max\ abs}$ [bar][4)]	State[7)]
A, B	Working port (see subplates, page 23)			450	
T_1	Drain port	DIN 3852[6)]	M22 x 1.5; 14 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M22 x 1.5; 14 deep	3	O[5)]

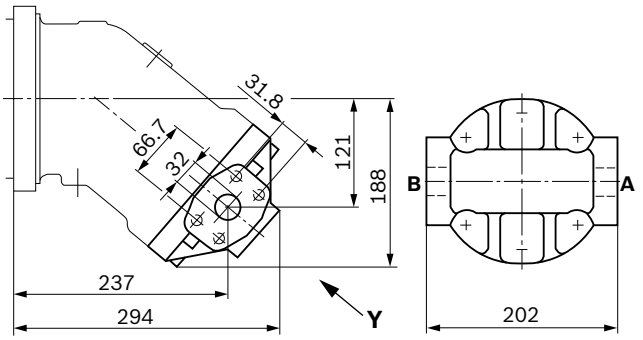
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For notes on tightening torques, see the instruction manual.
4) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The spot face can be deeper than as specified in the standard
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **Location of working line ports on port plates**

010 – SAE flange connections **A** and **B** at rear



020 – SAE flange connections **A** and **B** on side, opposite



100 – SAE flange connections **A** and **B** below (same side)

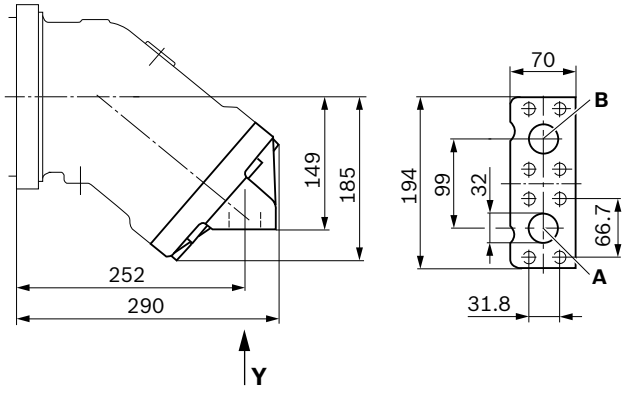


Plate	Ports		Standard	Size[1)]	$p_{max\ abs}$ [bar][2)]	State[6)]
010, 020, 100	**A, B**	Working port	SAE J518[3)]	1 1/4 in	450	O
		Fastening thread A/B	DIN 13	M14 × 2; 19 deep		

Subplate **188** see Page 26.

1) For notes on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD

Function

Counterbalance valves for drives and winches should reduce the danger of overspeed and cavitation in open circuits of axial piston motors. Cavitation occurs if, during braking, when going downhill or during the load-lowering process, the motor speed is greater than it should be for the given inlet flow and thus the inlet pressure collapses.
If the difference between inlet pressure and outlet pressure falls below the value “opening end of piston in counterholding valve” (see data sheet 95522), the brake piston moves into the closed position.
The cross-sectional area of the counterbalance valve return duct is then reduced, creating a bottleneck in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the rotational speed of the motor is again as it should be for the given inlet flow.

Note

- BVD available in sizes 28 to 180,
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set.
  Order example: A2FM90/61W–AAB188J-S + BVD20W27L/41B-V01K00D0800S00
- The counterbalance valve does not replace the mechanical service brake and parking brake.
- Counterbalance valves must be optimized during prototype commissioning to prevent unacceptable operating conditions and compliance with the specification must be verified.
- Observe the detailed notes on the BVD counterbalance valve contained in data sheet 95522
- For the design of the brake release valve, we must know the following data for the mechanical holding brake:
  - the pressure at the start of opening
  - the volume of the brake 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)

Permissible inlet flow or pressure when using DBV and BVD

Motor	Without valve		Limited values when using DBV and BVD						
			DBV[1]			BVD[2]			
NG	p_{nom}/p_{max} [bar]	q_V [l/min]	NG	p_{nom}/p_{max} [bar]	q_V [l/min]	NG	p_{nom}/p_{max} [bar]	q_V [l/min]	Code
28	400/450	176	16	350/420	100	20	350/420	100	188
32		201							
45		255							
56		280	22		240			220	
63		315							
80		360							
90		405							
107		427							178
125		500							
107		427	32		400	25		320	188
125		500							
160		577							
180		648							

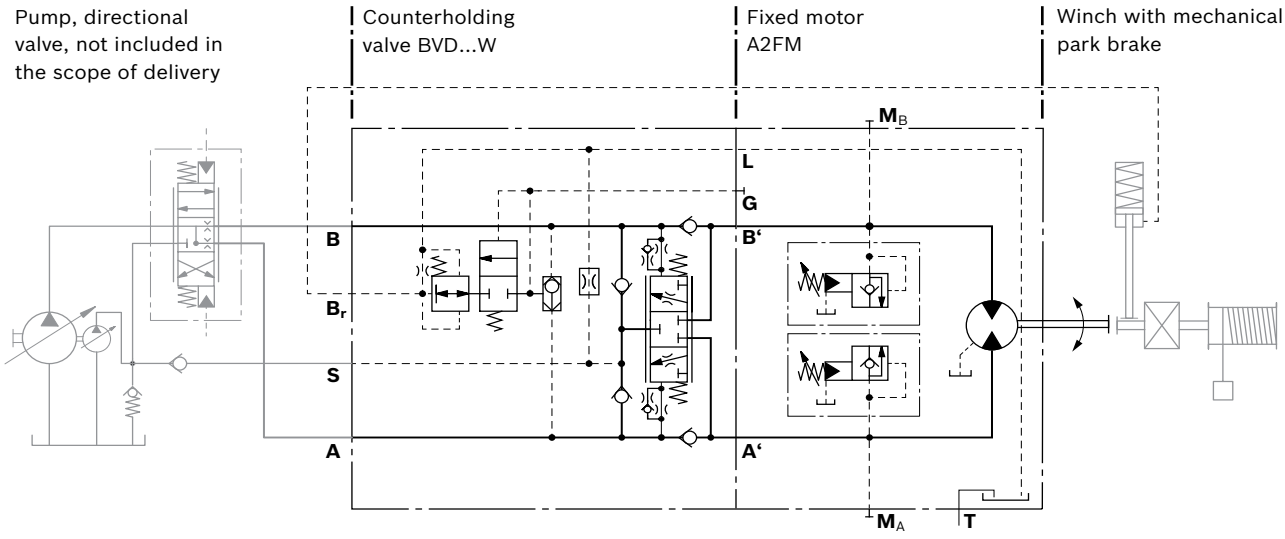
1) Pressure relief valve
2) Counterbalance valve, dual action

Counterbalance valve for winches and track drive BVD...W

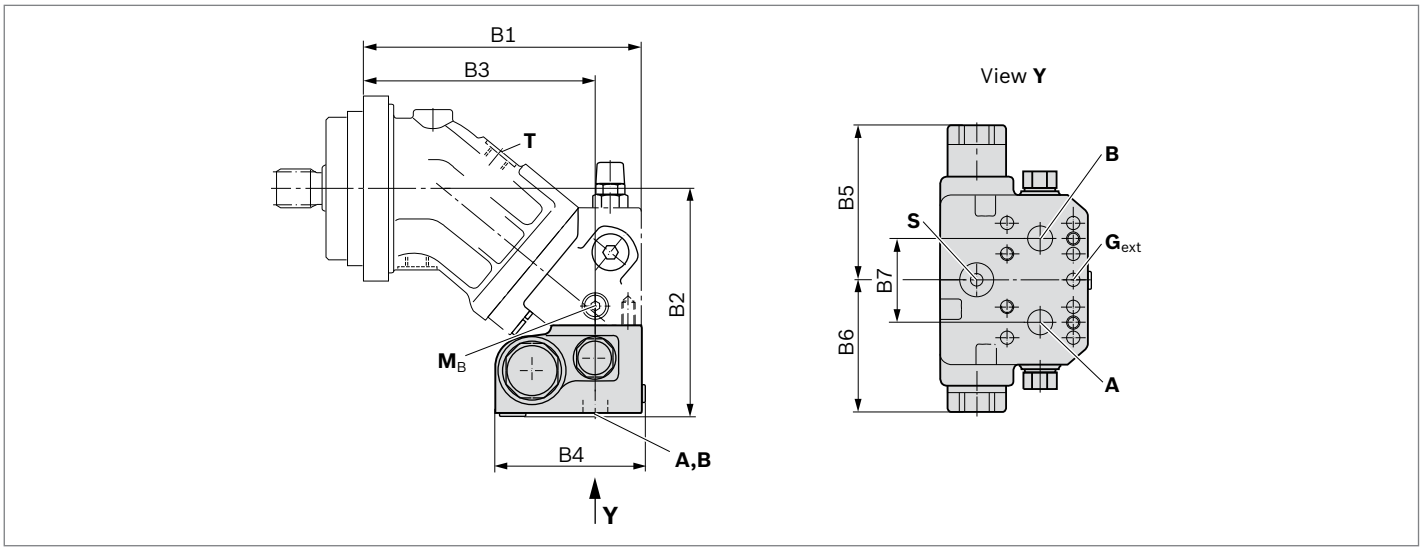
Application option

- Winch drives in cranes
- Track drive in excavators

▼ **Application example for winch counterbalance valve BVD...W in cranes**



Dimensions



A2FM	Counterbalance valve									
NG	Type	Ports	Dimensions							
		A, B	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

Ports		Version	Standard	Size[1]	$p_{max\ zul}$ [bar][2]	State[4]
A, B	Working line		SAE J518	see table above	420	O
S	Infeed	BVD20	DIN 3852[3]	M22 × 1.5; 14 deep	30	X
		BVD25	DIN 3852[3]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852[3]	M12 × 1.5; 12.5 deep	30	O
			DIN 3852[3]	M12 × 1.5; 12 deep	30	O
G_{ext}	Brake release, high pressure	S	DIN 3852[3]	M12 × 1.5; 12.5 deep	420	X
M_A, M_B	Pressure measurement A and B		ISO 6149[3]	M12 × 1.5; 12 deep	420	X

Mounting of 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 working 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
The screws to be used and the instructions for fitting can be found in the instruction manual.

1) For notes on tightening torques, see the instruction manual
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 as specified in the standard
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

The leakage in the housing area must be directed to the reservoir via the highest 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, 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.

Key	
F	Filling / air bleeding
R	Air bleed (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 distance to reservoir bottom (100 mm)

Installation position

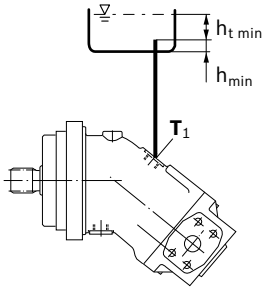
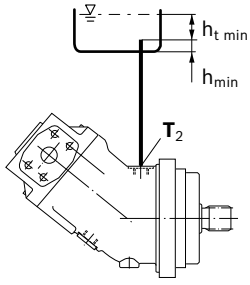
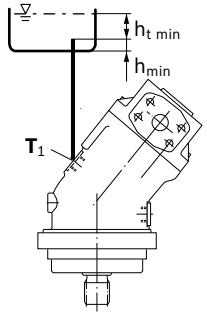
See the following examples **1** to **6**.

Further installation positions are available upon request.

Recommended installation position: **1** and **2**

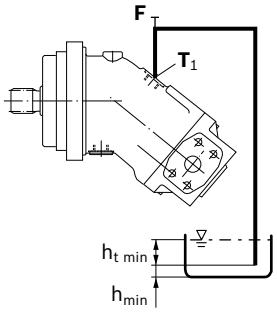
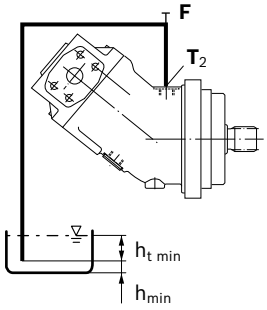
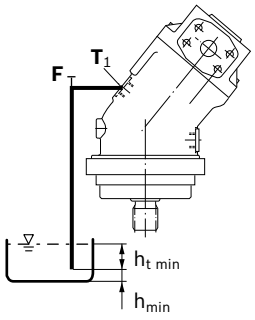
Below-reservoir installation (standard)

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

Installation position	Air bleed	Filling
1 	–	**T_1**
2 	–	**T_2**
3 	–	**T_1**

Above-reservoir installation

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

Installation position	Air bleed	Filling
4 	**F**	**T1** (**F**)
5 	**F**	**T2** (**F**)
6 	**F**	**T1** (**F**)

Note

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

Project planning notes

- The 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. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTFd) for functional safety.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working line ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve pistons) can, under certain circumstances get blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of various filter elements (external or internal flow filter) 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 set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

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