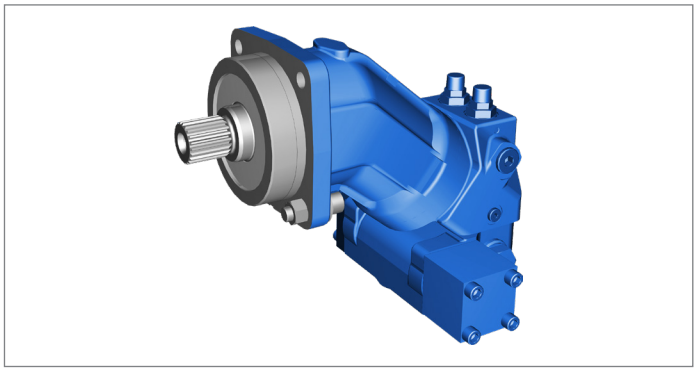
RE 91001-01-X-B2/2023-03-27
Replaces: 04.2016

rexroth
A Bosch Company

Axial piston fixed motor A2FM Series 61

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

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



- All-purpose high pressure motor
- Sizes 10 to 180
- Nominal pressure 400 bar
- Maximum pressure 450 bar
- Open and closed circuits

Information on explosion protection

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

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
- One-piece tapered piston with piston rings for sealing

Contents

Type 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	**A2F**

Operating mode

02	Motor	**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 on drive shaft, bidirectional	**W**

Sealing material ATEX version

06	ATEX device category 3G (normal level of safety), shaft seal ring made of FKM (fluorocarbon rubber)	**A**
	ATEX device category 2G (normal level of safety), shaft seal ring made of FKM (fluorocarbon rubber)	**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 ports 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

Notice
Note the project planning notes on page 29.

1) Fastening thread or threaded ports, metric
2) Threaded ports at the sides sealed with threaded plugs
3) Indicate type code for counterbalance 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 from the standard motor:
- The unpainted part of the mounting flange, which is marked by a socket-head screw,
- The ex-mark and the CE-mark on the name plate.

Observe the instruction manual.

Temperature classes per DIN EN ISO 80079-36
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").

Notice
ATEX classification: When ordering, please state which equipment group, category, explosion group, temperature class and ignition protection type are required for your planned ATEX application.
Technical data: Compared to the standard motor, there are restrictions regarding temperature, case pressure and bearing flushing / installation position.
Painting/color selection: In order to avoid mechanically generated sparks from foreign particles made of aluminum with iron oxide and/or particles of rust of the surface[1)], the axial piston unit is painted as standard with corrosion protecting. For the available colors, please contact your Rexroth contact person.
Maintenance interval: The bearing service life of the axial piston unit is limited. Therefore, the maintenance intervals in accordance with instruction manual (Part I) must be observed; if necessary, the individual service life must be calculated. Please contact us.
Potential equalization: The axial piston unit must be grounded. For grounding points, please refer to the drawings starting on page 10.

Hydraulic fluids

The fixed motor A2FM is designed for operation with HLP mineral oil according to DIN 51524.
See the following data sheets for application instructions and requirements for hydraulic fluids before the start of project planning:
- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons

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

Information on the selection of hydraulic fluid
The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}; see selection diagram).
The ignition temperature of the hydraulic fluid must be greater than 250 °C.

Please note
The temperature must not exceed 90 °C at any point in the component. The temperature difference shown in the table must be taken into account for 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 $\mathbf{T_1}$/$\mathbf{T_2}$.

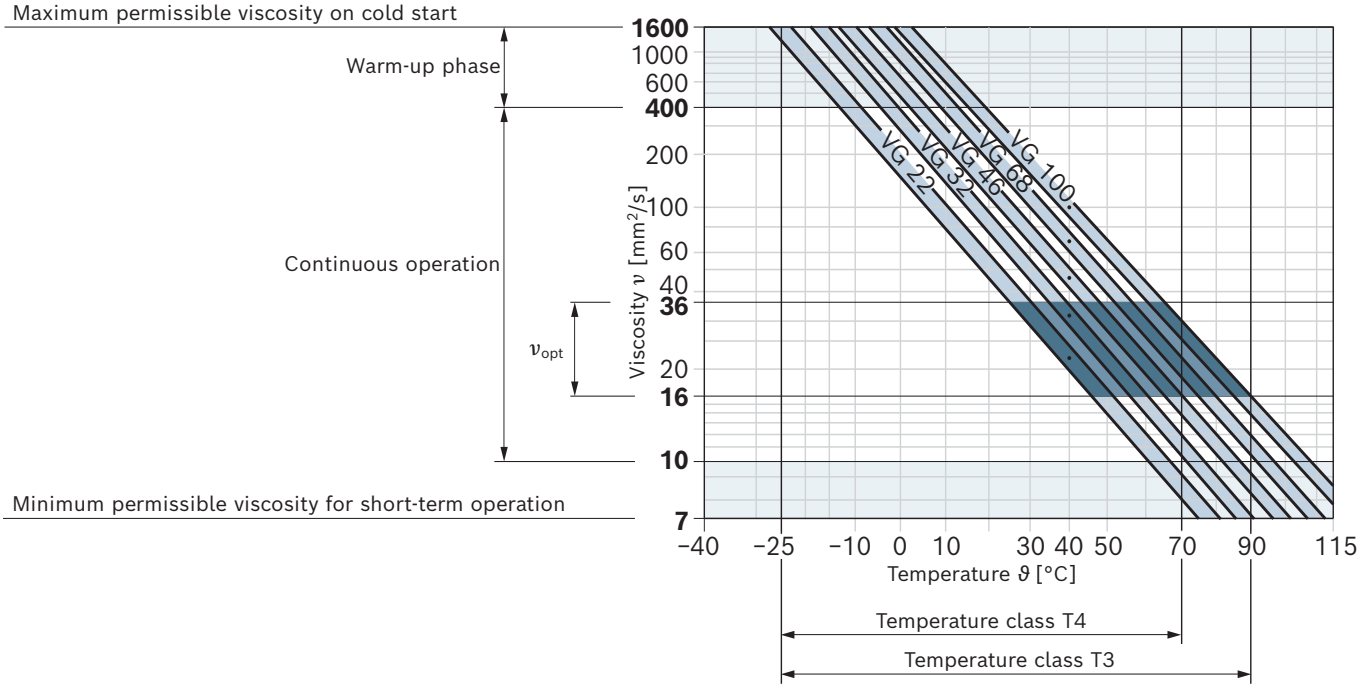
Project planning note
The maximum leakage temperature and case pressure must not be exceeded. Observe the safety instructions on page 5 "Operating data monitoring – X parameters".

1) See DIN EN ISO 80079-36, 6.4.2.1

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Remarks
Cold start	v_{max} ≤ 1600 mm²/s	ϑ_{St} ≥ −25 °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		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		Optimal operating viscosity and efficiency range
Short-term operation	v_{min} = 10 ... 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 20/18/15 is to be maintained according to ISO 4406.

At a hydraulic fluid viscosity of less than 10 mm²/s (e.g. due to high temperatures during short-term operation), a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

For example, the viscosity 10 mm²/s at:

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

Operating data monitoring – X parameters

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

Safety instructions: Temperature class T4–T1
ATEX category II 3G Ex h IIB T4-T1 Gc X
To observe the **maximum leakage temperature of 90 °C**, at least one of the following measures must be taken and checked regularly:

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

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

ATEX category II 2G Ex h IIB T4-T1 Gb X
To observe the **maximum leakage temperature of 70 °C**, the following measures must be taken:

- Continuously monitor leakage temperature at each axial piston unit with a temperature sensor on port **T** (maximum distance to port 30 cm).
- Connect the temperature sensor with a switching-off for the system at the limit temperature of 70 °C.
- This shut-off function should be tested during commissioning; see chapter 8.1.2 of the instruction manual.

Reservoir level monitoring is also required.

Installation instructions can be found in the instruction manual 91001-01-X-B1 as of chapter "7.3 Installation position"

Flow direction

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

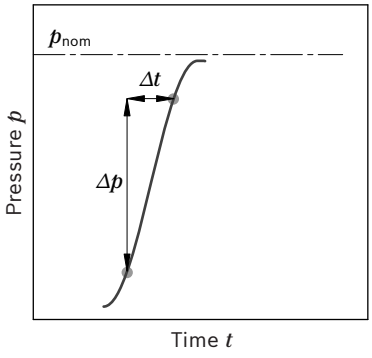
Speed range

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

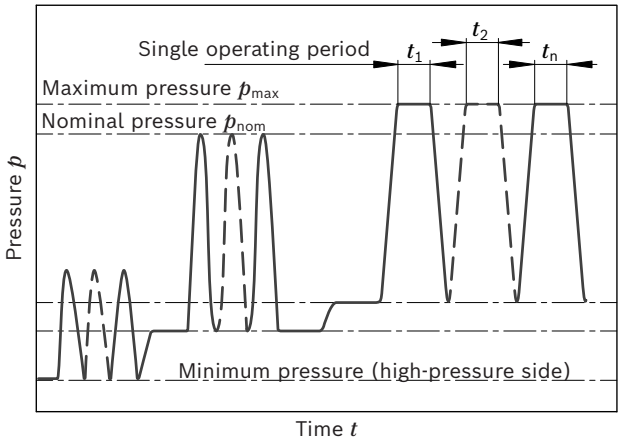
Working pressure range

Pressure at working port A or B		Definition
Nominal pressure p_{nom}	400 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	450 bar	The maximum pressure corresponds to the maximum working pressure within a single operating period. The sum of single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** or **B**) which is required to prevent damage to the axial piston unit.
Minimum pressure – operation as a pump (inlet)	See characteristic curve	To prevent damage to the axial piston motor during operation as a pump (change of the high-pressure side with constant direction of rotation, e.g. during brake applications) a minimum pressure has to be ensured at the working port (inlet). The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Summation pressure p_{Su} (pressure **A** + pressure **B**)	700 bar	The summation pressure is the sum of the pressures at the ports for the working lines (**A** and **B**).
Rate of pressure change $R_{A\,max}$		Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
with integrated pressure relief valve	9000 bar/s	
without pressure relief valve	16000 bar/s	
Case pressure at port T		
Continuous differential pressure $\Delta p_{T\,cont}$	2 bar	Maximum, averaged differential pressure at the shaft seal (housing pressure to ambient pressure)
Pressure peaks $p_{T\,peak}$	10 bar	t < 0.1 s

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

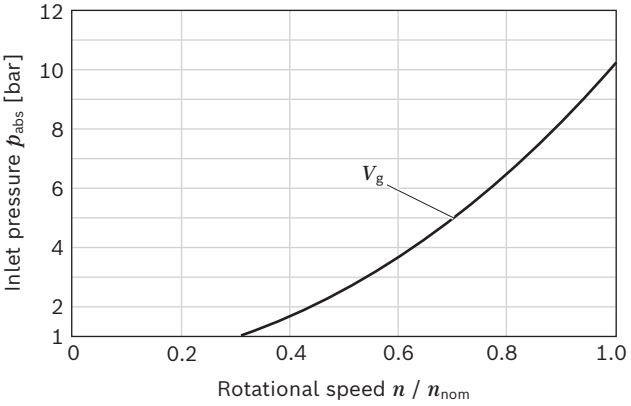


▼ **Pressure definition**



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

▼ **Minimum pressure – operation as a pump (inlet)**



This diagram is only valid for the optimum viscosity range of ν_{opt} = 36 bis 16 mm²/s.
If the above-mentioned conditions cannot be ensured, please contact us.

Notice

- In addition to the hydraulic fluid and the temperature, the service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the case pressure.
- The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
- The case pressure must be greater than the external pressure (ambient pressure) at the shaft seal.

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
Maximum rotational speed[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]	at n_{nom}	$q_{v\,max}$	l/min	82	96	128	144	177	202	255	281
Torque[3]	at Δp = 350 bar	M	Nm	57	67	89	128	157	178	254	313
	at Δp = 400 bar	M	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 of the rotary group		J_{TW}	kgm^2	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042
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
Maximum rotational speed[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]	at n_{nom}	$q_{v\,max}$	l/min	315	362	405	427	500	577	648
Torque[3]	at Δp = 350 bar	M	Nm	351	448	501	594	696	893	1003
	at Δp = 400 bar	M	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 of the rotary group		J_{TW}	kgm^2	0.0042	0.0072	0.0072	0.0116	0.0116	0.0220	0.0220
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

Determination of 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 ($\eta_t = \eta_v \times \eta_{hm}$)

Notice

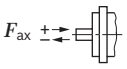
- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced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

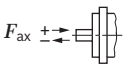
1) The valid values (observing the maximum permissible inlet flow):
– for the optimum viscosity range from v_{opt} = 36 to 16 mm^2/s
– with hydraulic fluid based on mineral oils

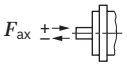
2) Observe limitation of inlet flow due to counterbalance valve (see page 24).

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

Permissible radial and axial loading on 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 $F_{q\ max}$	M_{max}	Nm	66	66	76	76	102	146	146	179	179
Maximum differential pressure at $F_{q\ max}$	Δp_{max}	bar	400	400	400	400	400	400	400	400	400
Maximum axial force at standstill or depressurized 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 $F_{q\ max}$	M_{max}	Nm	204	290	357	294	357	401	512	488	512
Maximum differential pressure at $F_{q\ max}$	Δp_{max}	bar	400	400	400	330	400	400	400	380	400
Maximum axial force at standstill or depressurized 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

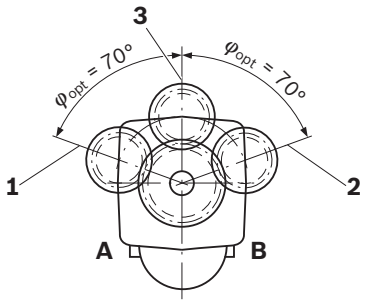
Size	NG		90	107	107	125	160	160	180
Drive shaft	Ø	mm	40	40	45	45	45	50	50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	11.4	13.6	14.1	14.1	18.1	18.3	18.3
	a	mm	20	20	20	20	25	25	25
Maximum torque at $F_{q\ max}$	M_{max}	Nm	573	679	679	796	1021	1021	1146
Maximum differential pressure at $F_{q\ max}$	$p_{nom\ perm.}$	bar	400	400	400	400	400	400	400
Maximum axial force at standstill or depressurized 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 bearing service life

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 bearing service life. Recommended position of mating gear is dependent on the direction of rotation. Examples:

▼ **Gear output drive**

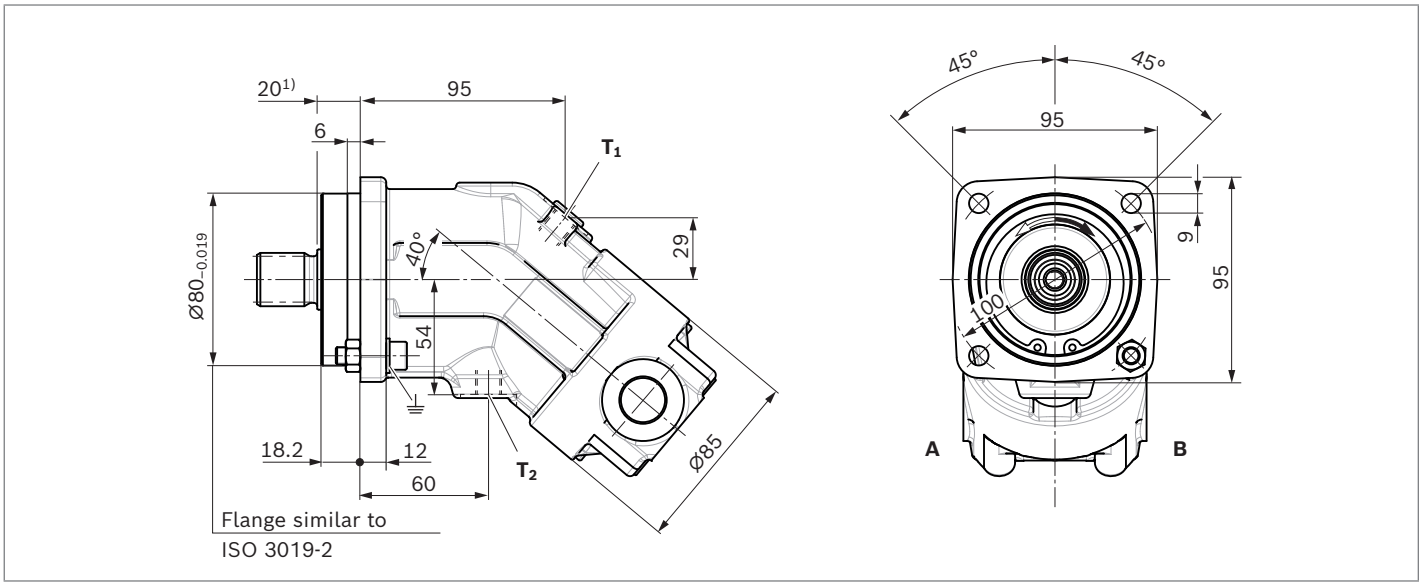


1 “Counter-clockwise” rotation, pressure at port **B**
2 “Clockwise” rotation, pressure at port **A**
3 “Bidirectional” direction of rotation

Notice

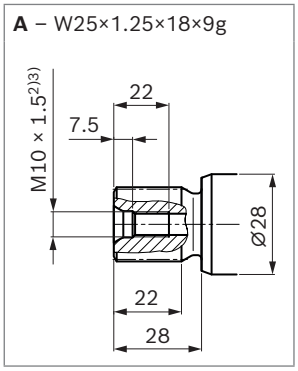
- The values given are maximum values and do not apply to continuous operation.
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the service life of the bearing is reduced.
- Special requirements apply in the case of belt drives. Please contact us.

Dimensions, sizes 10, 12, 16



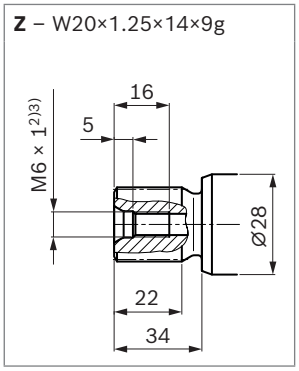
▼ **Splined shaft DIN 5480, NG10, 12, 16**

A – W25×1.25×18×9g



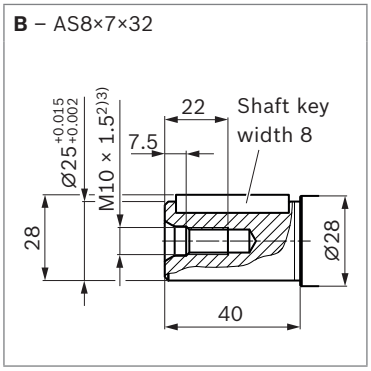
▼ **Splined shaft DIN 5480, NG10, 12**

Z – W20×1.25×14×9g



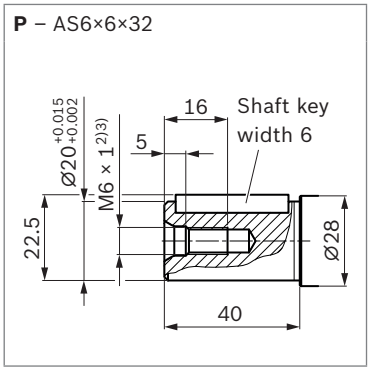
▼ **Parallel keyed shaft, DIN 6885 NG10, 12, 16**

B – AS8×7×32



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

P – AS6×6×32

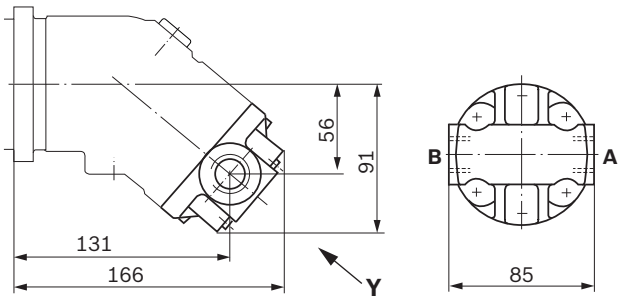


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 11)			450	
T_1	Drain port	DIN 3852[6)]	M12 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M12 × 1.5; 12 deep	3	O[5)]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can 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 countersink may be deeper than 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 ports **A** and **B** on side, opposite



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

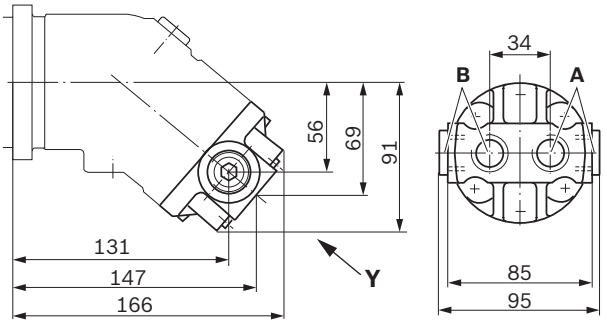
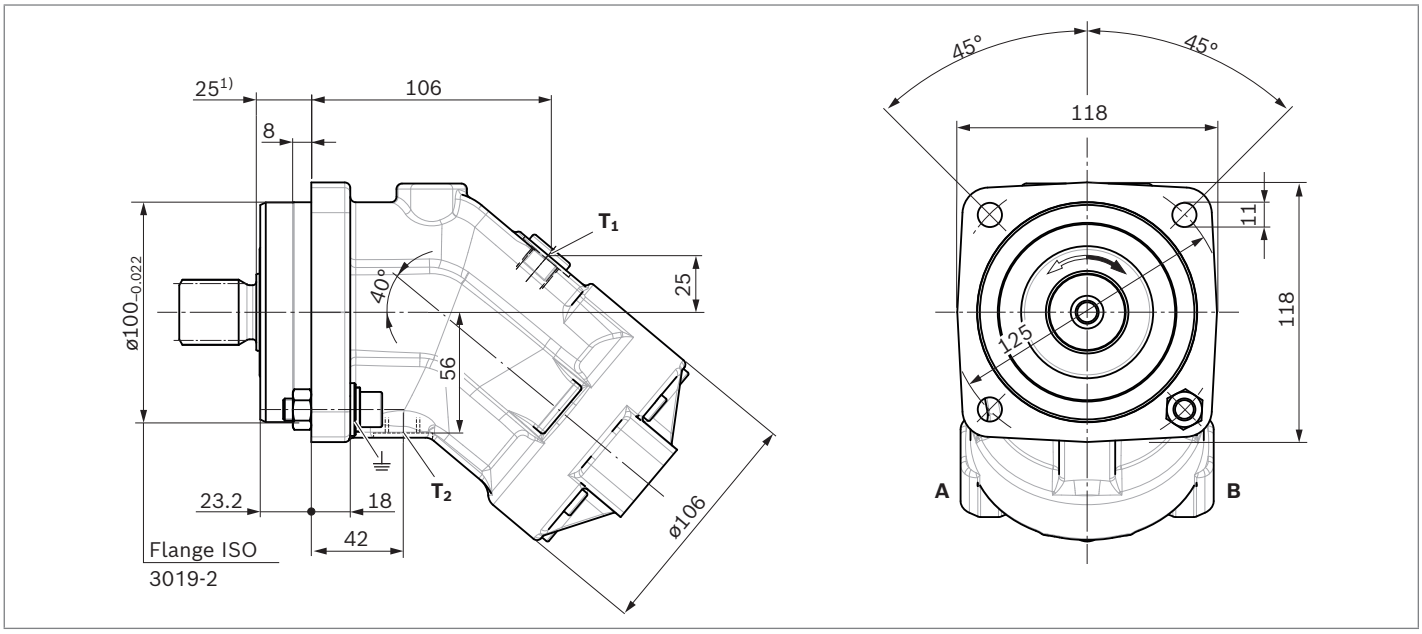


Plate	Ports		Standard[3]	Size[1]	p_{max} [bar][2]	State[4]
030	**A, B**	Working port	DIN 3852	M22 × 1.5; 14 deep	450	O
040	**A, B**	Working port	DIN 3852	M22 × 1.5; 14 deep	450	Each 1 × O

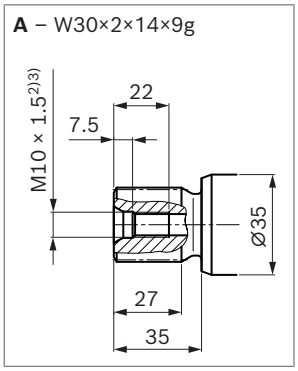
1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) The countersink may be deeper than specified in the standard.
4) O = Must be connected (plugged on delivery)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

Dimensions, sizes 23, 28, 32



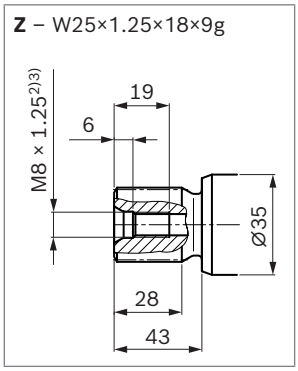
▼ **Splined shaft DIN 5480, NG23, 28, 32**

A – W30×2×14×9g



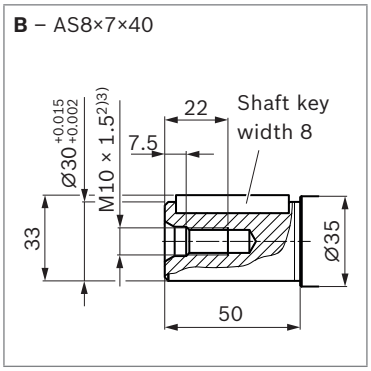
▼ **Splined shaft DIN 5480, NG23, 28**

Z – W25×1.25×18×9g



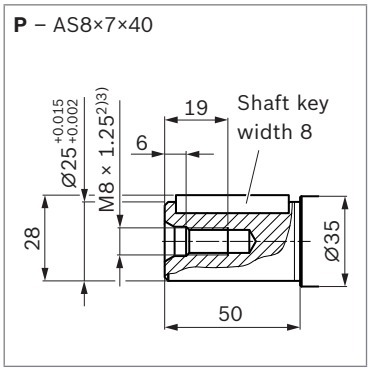
▼ **Parallel keyed shaft, DIN 6885, NG23, 28, 32**

B – AS8×7×40



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

P – AS8×7×40

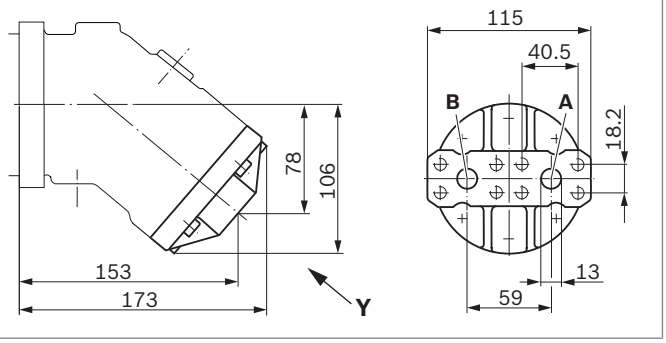


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 13)			450	
T_1	Drain port	DIN 3852[6)]	M16 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M16 × 1.5; 12 deep	3	O[5)]

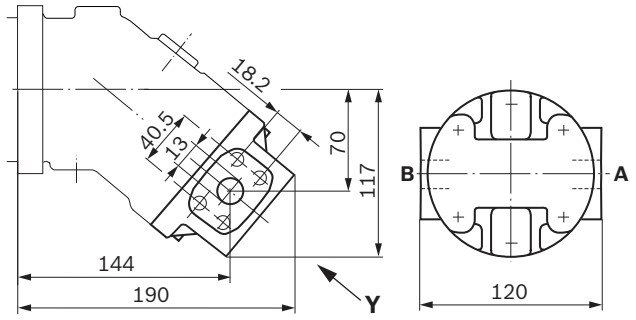
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The countersink may be deeper than 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**

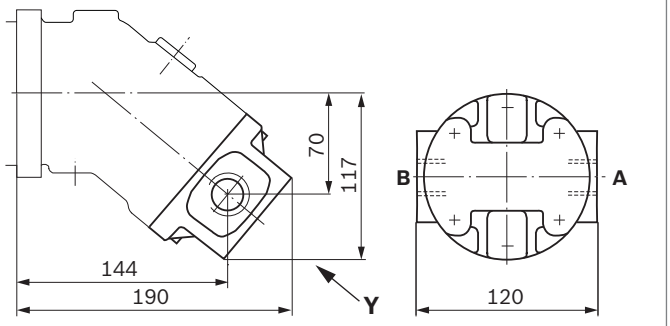
010 – SAE flange connections **A** and **B** at rear



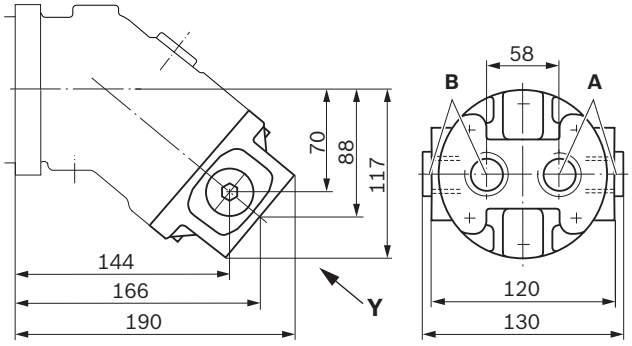
020 – SAE flange connections **A** and **B** on side, opposite



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



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



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

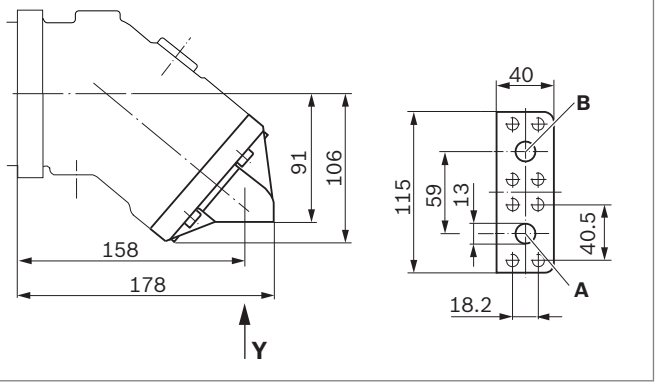
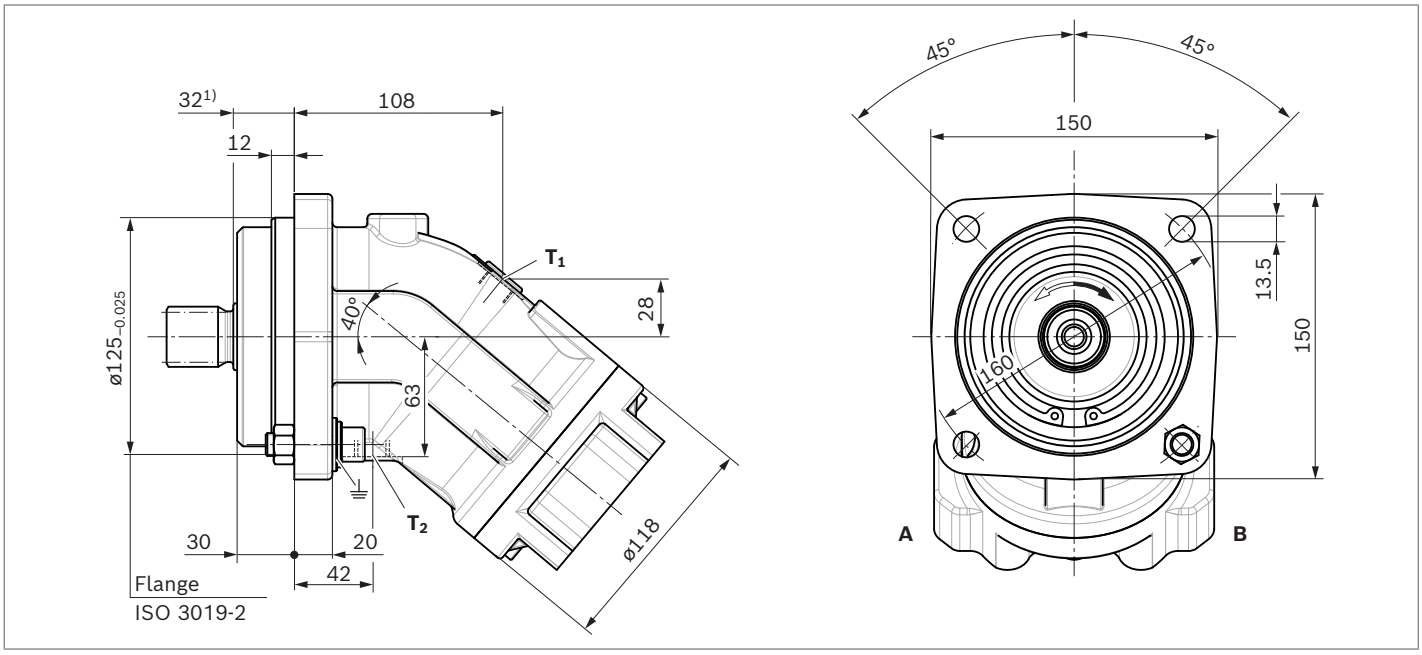


Plate	Ports		Standard	Size[1]	p_{max} [bar][2]	State[6]
010, 020, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3] DIN 13	1/2 in M8 × 1.25; 15 deep	450	O
030	**A, B**	Working port	DIN 3852[5]	M27 × 2; 16 deep	450	O
040	**A, B**	Working port	DIN 3852[5]	M27 × 2; 16 deep	450	Each 1 × O

Port plate **188** see page 26.

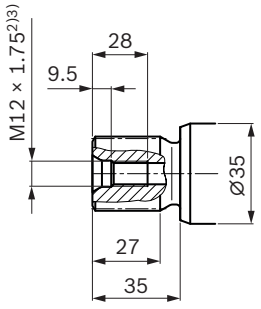
1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) Only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

Dimensions, size 45



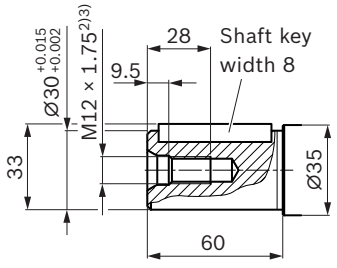
▼ **Splined shaft DIN 5480**

Z – W30×2×14×9g



▼ **Parallel keyed shaft, DIN 6885**

P – AS8×7×50

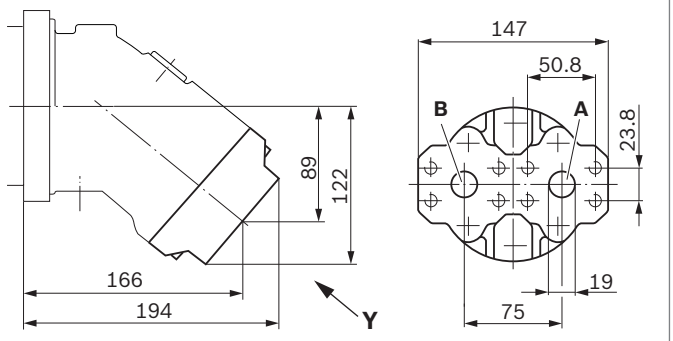


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 15)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

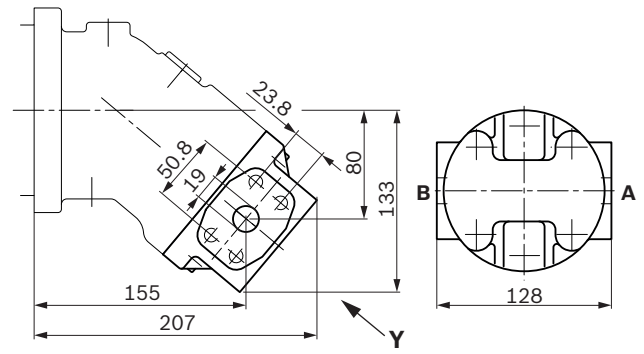
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The countersink may be deeper than 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**

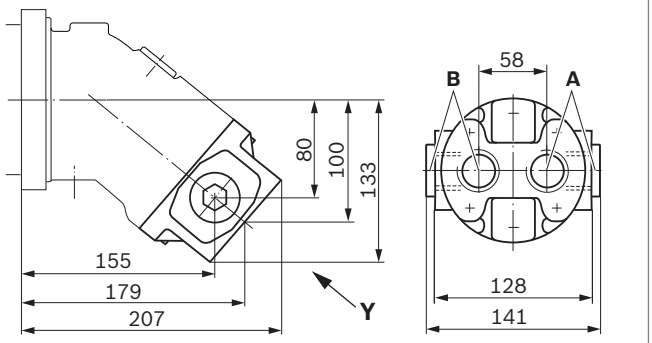
010 – SAE flange connections **A** and **B** at rear



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



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



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

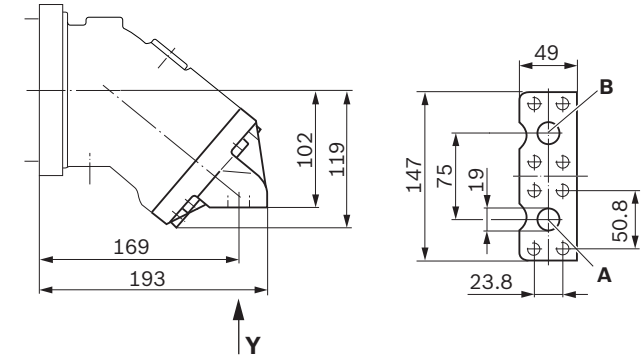
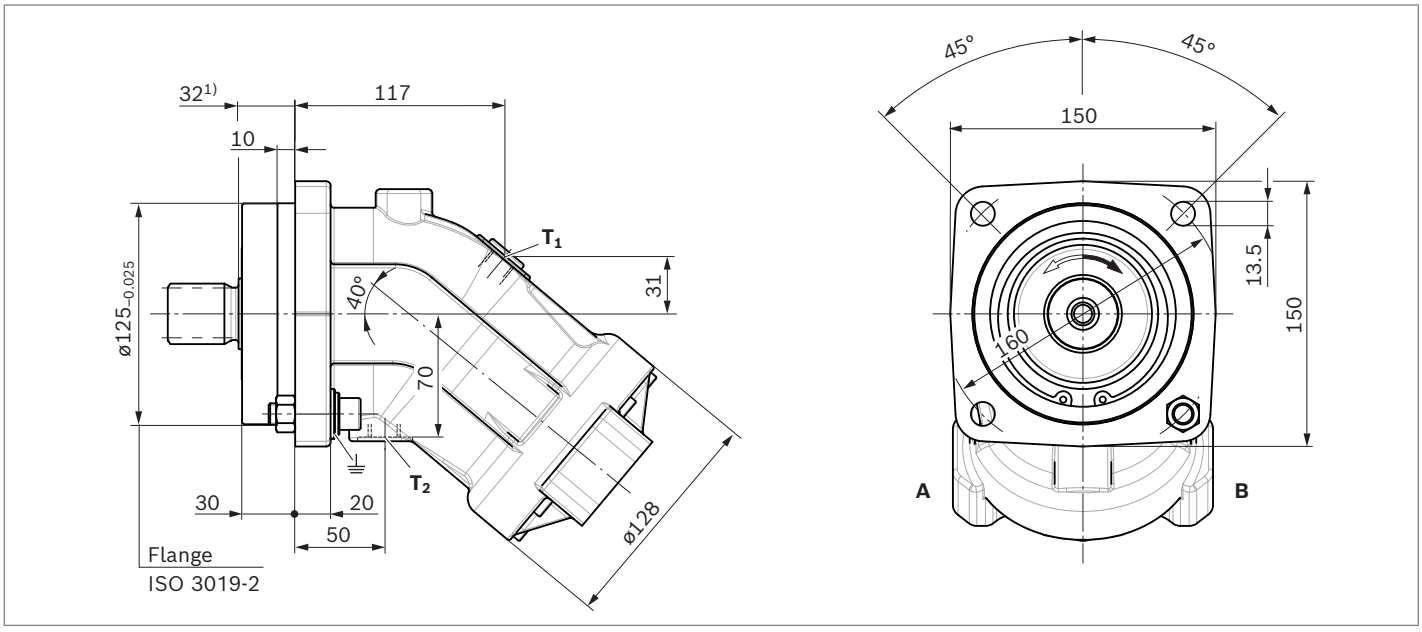


Plate	Ports		Standard	Size[1]	p_{max} [bar][2]	State[6]
010, 020, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
040	**A, B**	Working port	DIN 3852[4]	M33 × 2; 18 deep	450	Each 1 × O

Port plate **188** see page 26.

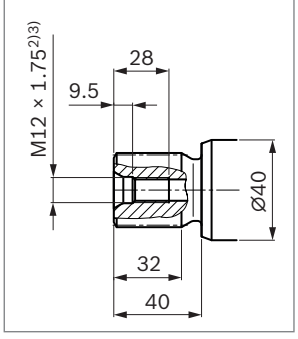
1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) The countersink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

Dimensions, sizes 56, 63



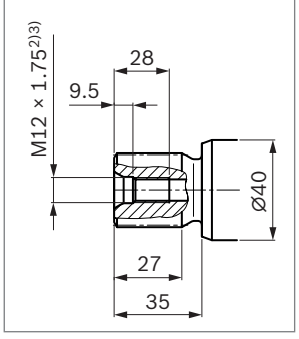
▼ **Splined shaft DIN 5480, NG56, 63**

A – W35×2×16×9g



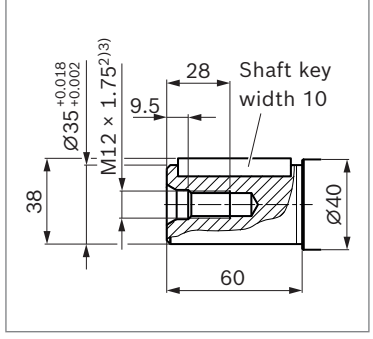
▼ **Splined shaft DIN 5480, NG56**

Z – W30×2×14×9g



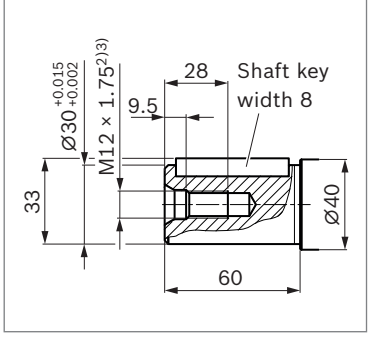
▼ **Parallel keyed shaft, DIN 6885, NG56, 63**

B – AS10×8×50



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

P – AS8×7×50

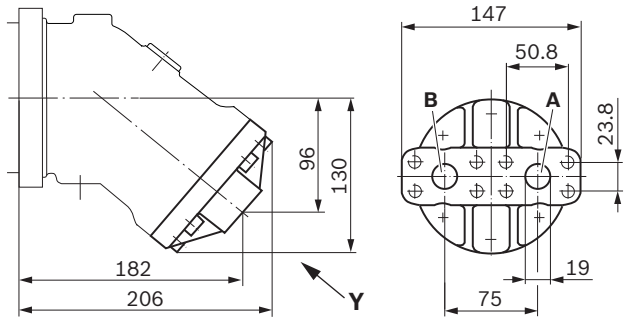


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 17)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

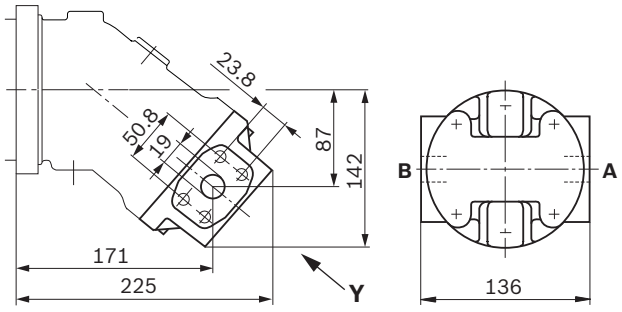
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The countersink may be deeper than 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**

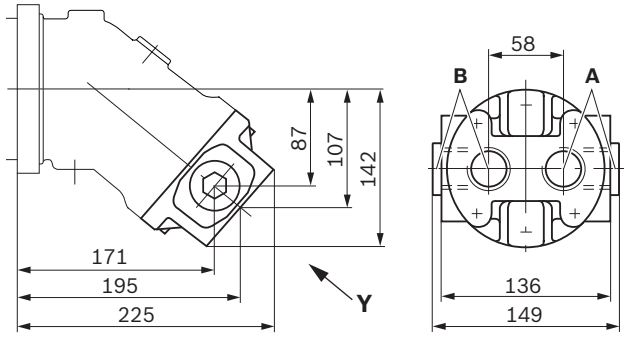
010 – SAE flange connections **A** and **B** at rear



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



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



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

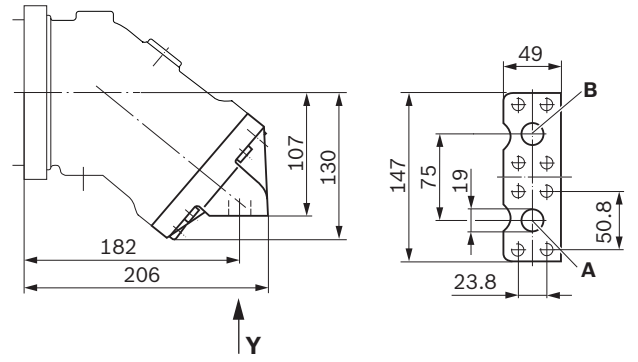
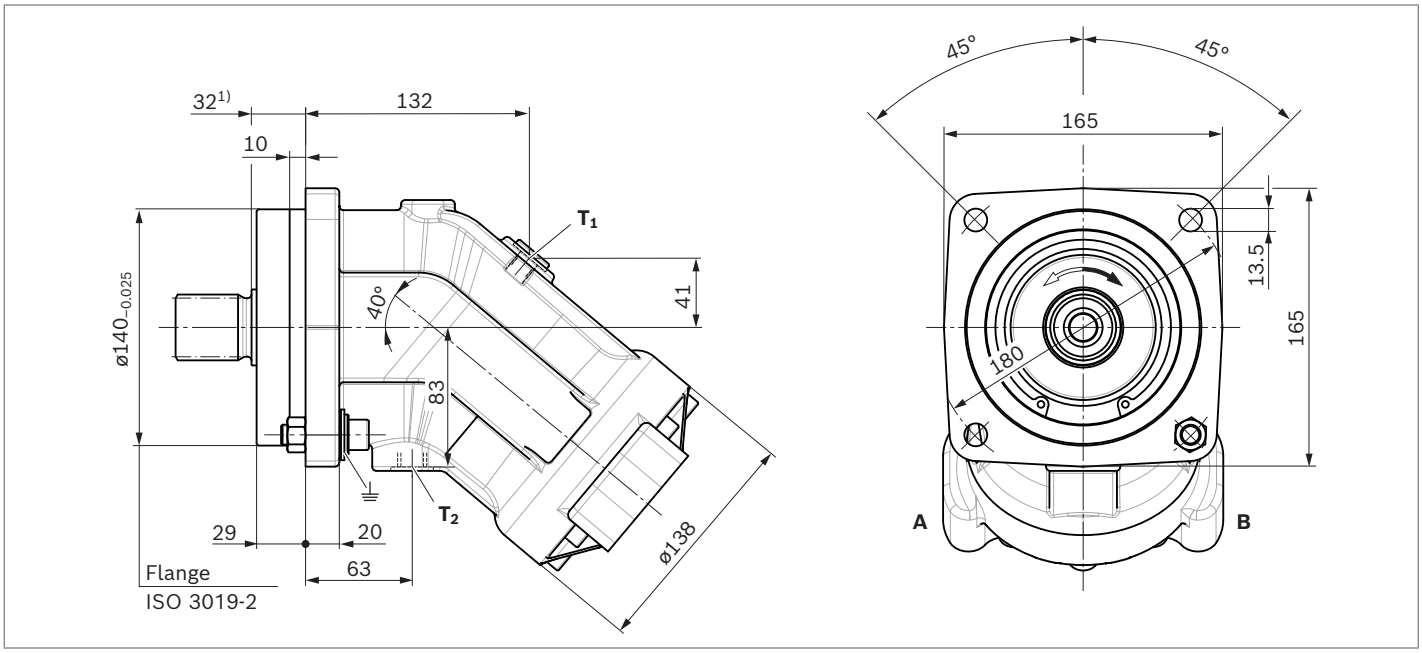


Plate	Ports		Standard	Size[1]	p_{max} [bar][2]	State[6]
010, 020, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
040	**A, B**	Working port	DIN 3852[4]	M33 × 2; 18 deep	450	Each 1 × O

Port plate **188** see page 26.

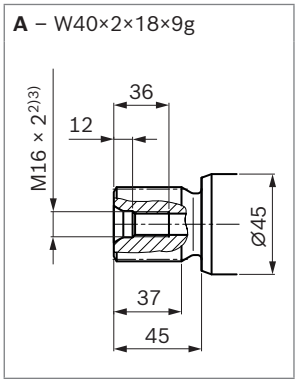
1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) The countersink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

Dimensions, sizes 80, 90



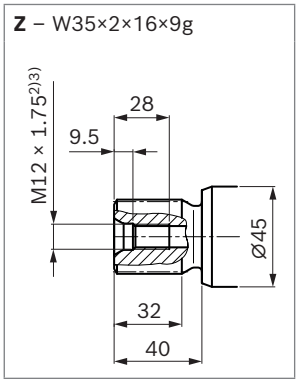
▼ **Splined shaft DIN 5480, NG80, 90**

A – W40×2×18×9g



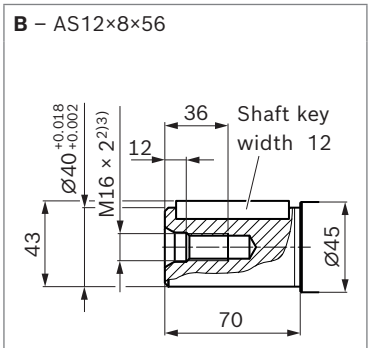
▼ **Splined shaft DIN 5480, NG80**

Z – W35×2×16×9g



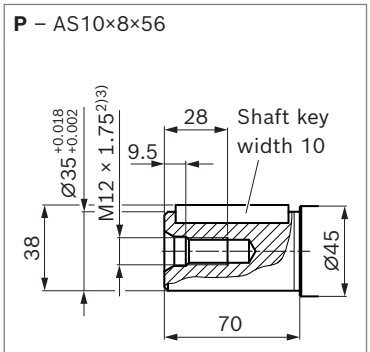
▼ **Parallel keyed shaft, DIN 6885, NG80, 90**

B – AS12×8×56



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

P – AS10×8×56

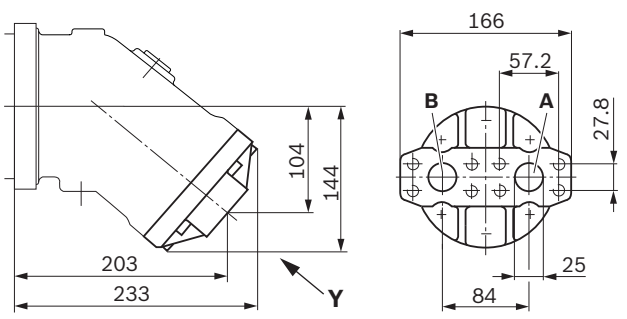


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 19)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

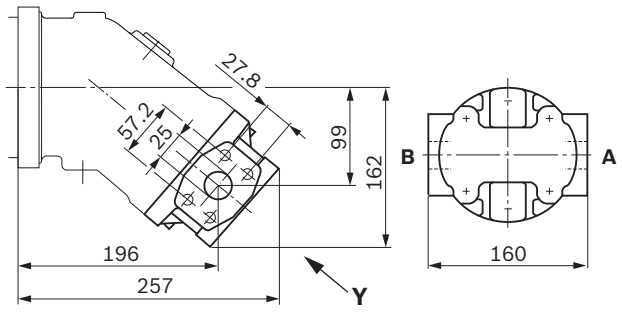
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The countersink may be deeper than 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)

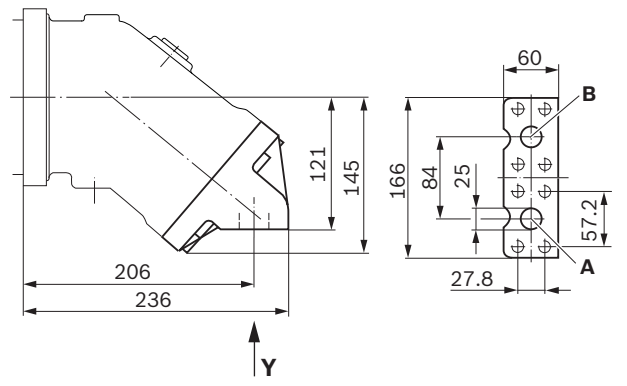
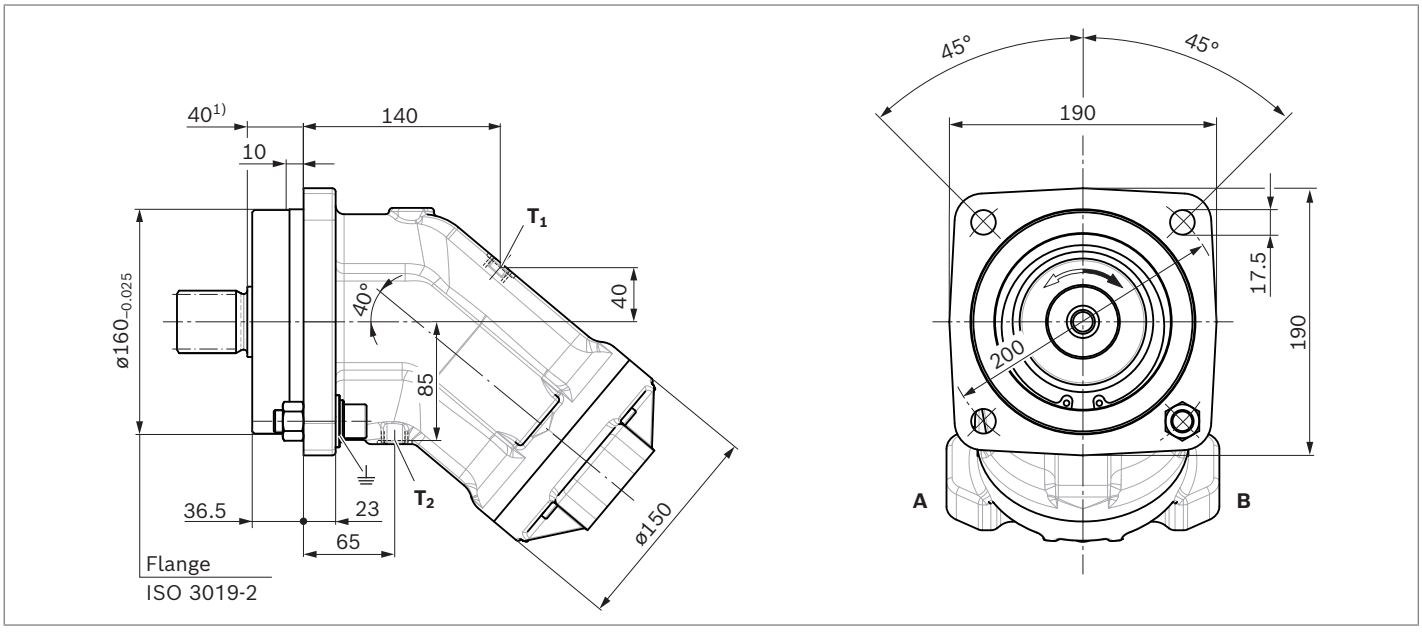


Plate	Ports		Standard	Size[1]	p_{max} [bar][2]	State[6]
010, 020, 100	**A, B**	Working port	SAE J518[3]	1 in	450	O
		Fastening thread A/B	DIN 13	M12 × 1.75; 17 deep		

Port plate **188** see page 26.

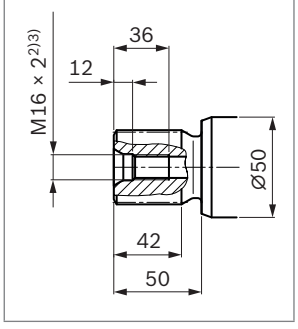
1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) O = Must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

Dimensions, sizes 107, 125



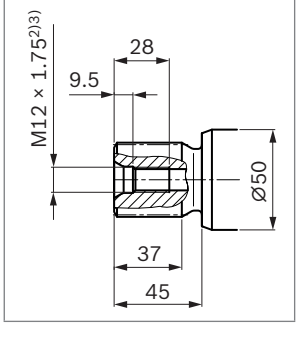
▼ **Splined shaft DIN 5480, NG107, 125**

A – W45×2×21×9g



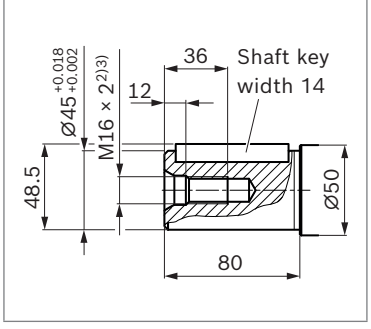
▼ **Splined shaft DIN 5480, NG107**

Z – W40×2×18×9g



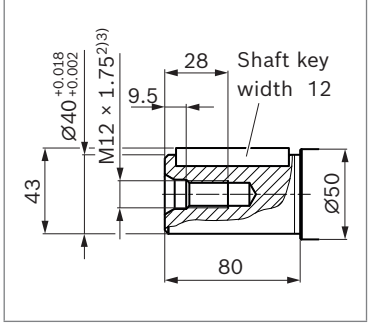
▼ **Parallel keyed shaft, DIN 6885, NG107, 125**

B – AS14×9×63



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

P – AS12×8×63

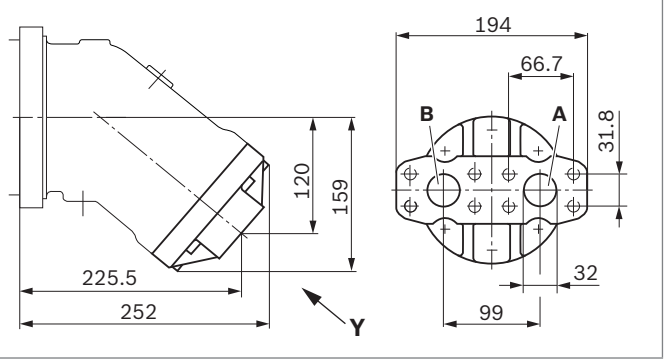


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 21)			450	
T_1	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M18 × 1.5; 12 deep	3	O[5)]

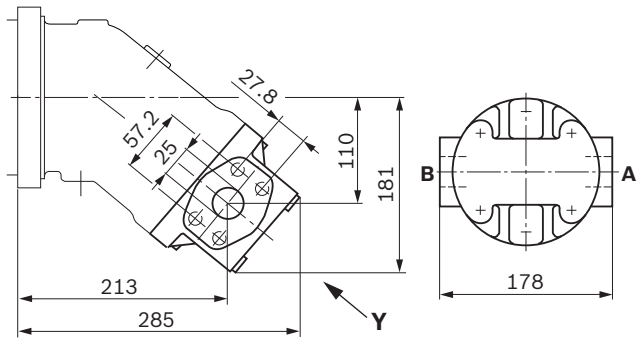
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The countersink may be deeper than 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**

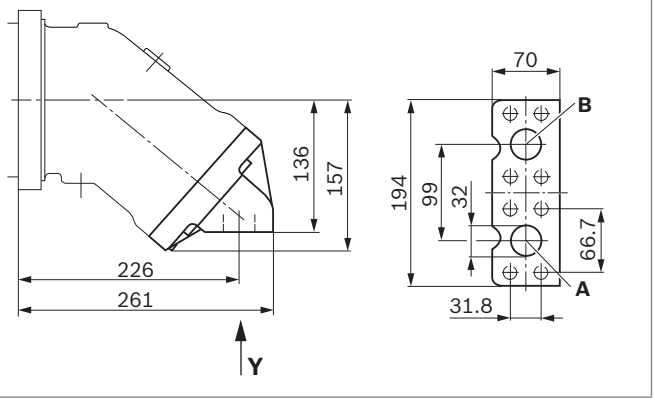
010 – SAE flange connections **A** and **B** at rear



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



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



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

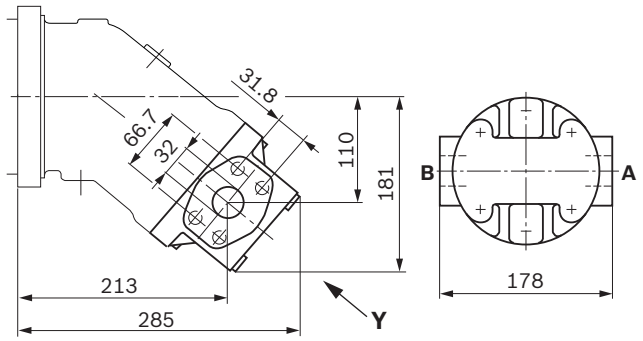
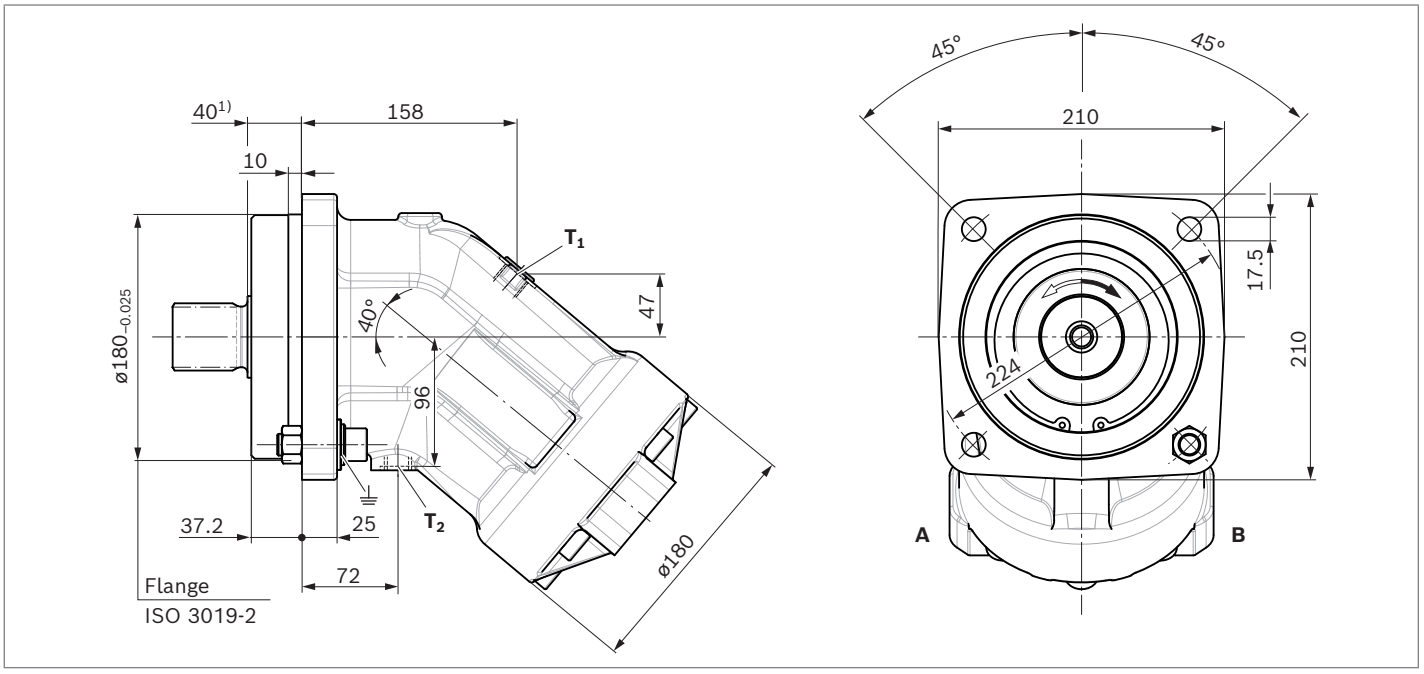


Plate	Ports		Standard	Size[1]	p_{max} [bar][2]	State[4]
010, 100	**A, B**	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	450	O
020 (NG107)	**A, B**	Working port Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 × 1.75; 17 deep	450	O
020 (NG125)	**A, B**	Working port Fastening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

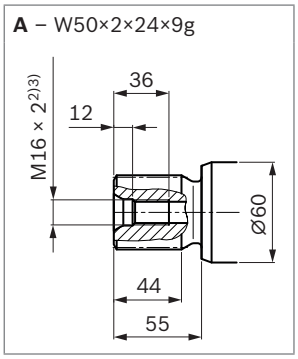
1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
4) O = Must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

Dimensions, sizes 160, 180



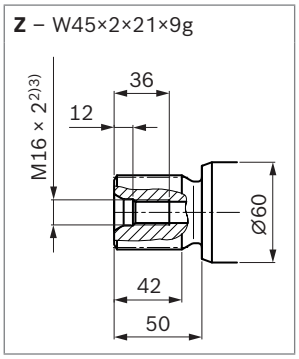
▼ **Splined shaft DIN 5480, NG160, 180**

A – W50×2×24×9g



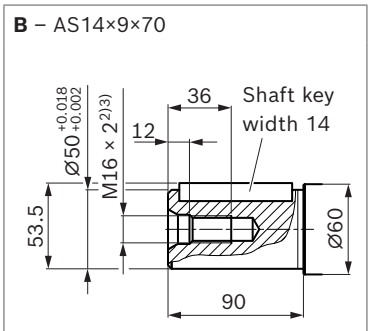
▼ **Splined shaft DIN 5480, NG160**

Z – W45×2×21×9g



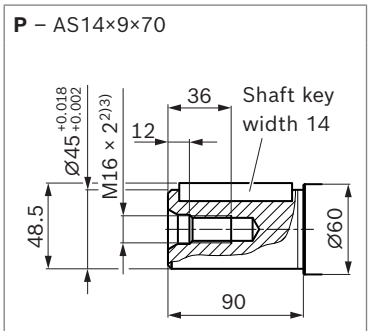
▼ **Parallel keyed shaft, DIN 6885, NG160, 180**

B – AS14×9×70



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

P – AS14×9×70

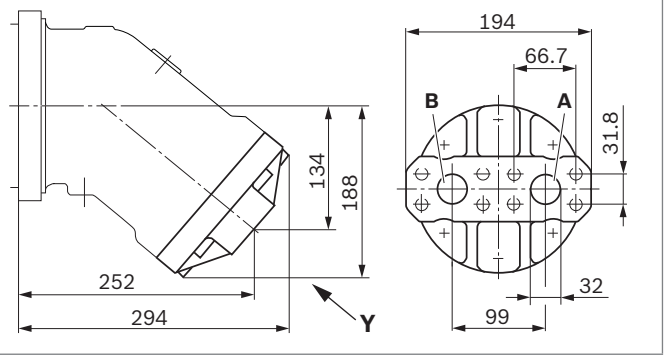


Ports		Standard	Size[3)]	p_{max} [bar][4)]	State[7)]
A, B	Working port (see port plates, page 23)			450	
T_1	Drain port	DIN 3852[6)]	M22 × 1.5; 14 deep	3	X[5)]
T_2	Drain port	DIN 3852[6)]	M22 × 1.5; 14 deep	3	O[5)]

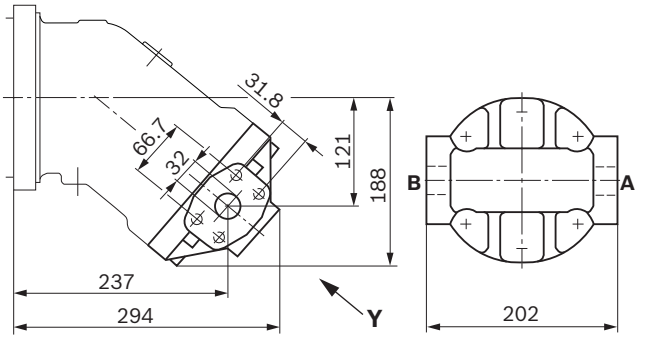
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) For maximum tightening torques, see instruction manual.
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 27).
6) The countersink may be deeper than 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)

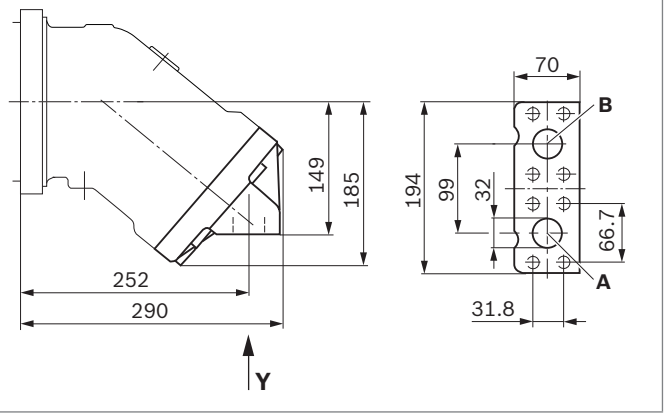


Plate	Ports		Standard	Size[1]	p_{max} [bar][2]	State[6]
010, 020, 100	**A, B**	Working port	SAE J518[3]	1 1/4 in	450	O
		Fastening thread A/B	DIN 13	M14 × 2; 19 deep		

Port plate **188** see page 26.

1) For maximum tightening torques, see instruction manual.
2) Depending on the application, momentary pressure peaks can 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 travel drives and winches should reduce the danger of overspeed and cavitation of axial piston motors in open circuits. 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 supply pressure falls sharply.
If the supply pressure falls below the value specified for the relevant counterbalance valve, the counterbalance spool moves into the closed position. The cross section of the counterbalance valve return passage 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.

Notice

- 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 holding 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 cracking pressure
  - 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 pressure relief valves and BVD

Motor	Without valve		Limited values when using pressure relief valves and BVD						
			PRV[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							

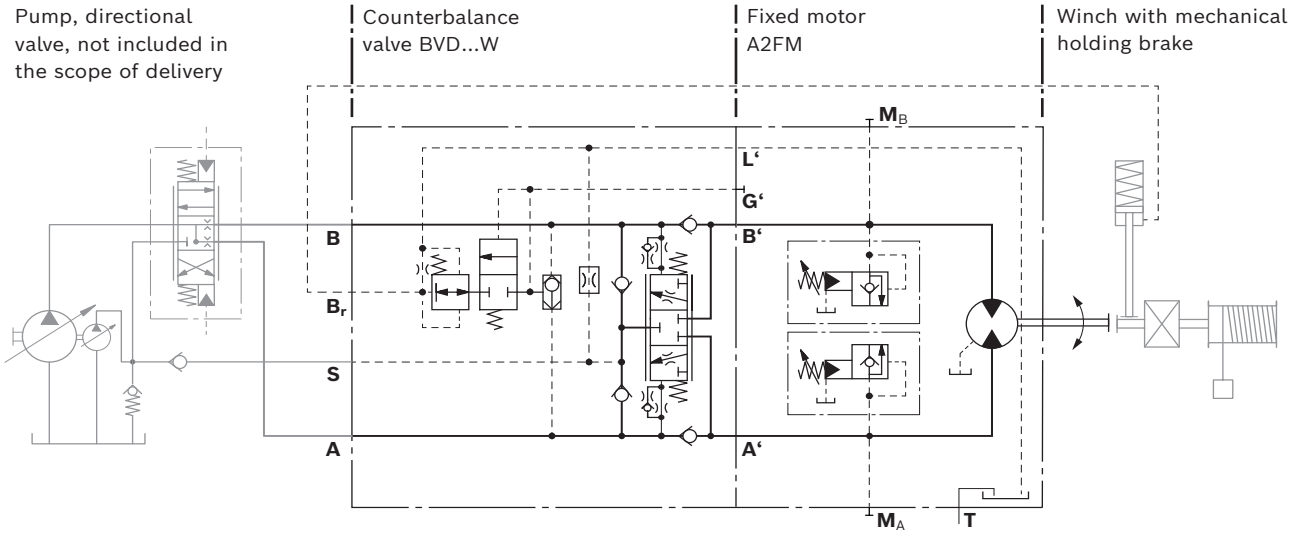
1) Pressure relief valve
2) Counterbalance valve, double-acting

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

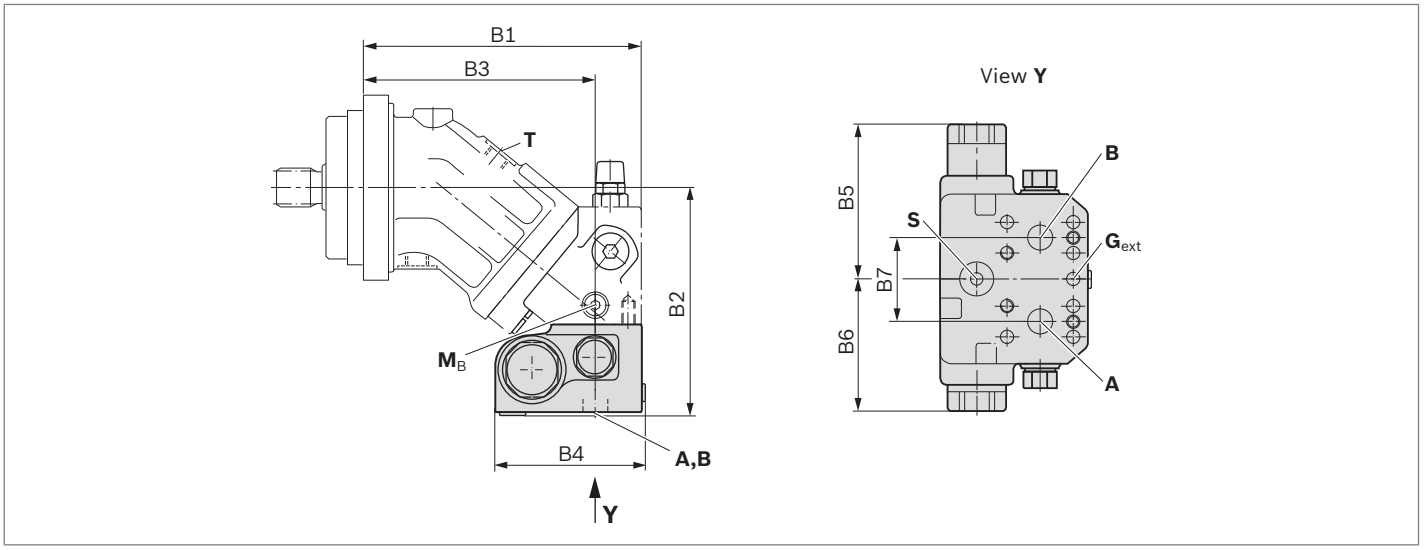
Application option

- 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} [bar][2]	State[4]
A, B	Working line		SAE J518	See table above	420	O
S	Boost pressure supply	BVD20	DIN 3852[3]	M22 × 1.5; 14 deep	30	X
		BVD25	DIN 3852[3]	M27 × 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852[3]	M12 × 1.5; 12.5 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 the counterbalance valve

When delivered, the counterbalance valve is fastened to the motor with two tacking screws (transport lock).
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 fastened to the motor port plate using the provided tacking screws.

The counterbalance valve is finally mounted to the motor by fitting the SAE flange.
The screws to be used and the instructions for mounting can be found in the instruction manual.

1) For notices on tightening torques, see the instruction manual.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) The countersink may be deeper than 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 in each unit is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating condition, particularly at cold start. If this is not possible, separate drain lines must be laid if necessary.
To prevent the transmission of structure-borne noise, use elastic elements to decouple all connecting lines from all vibration-capable components (e.g. reservoir, frame parts).
Under all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

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

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

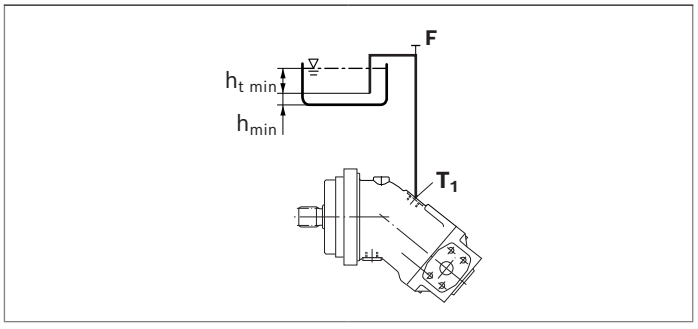
See the following examples **1** to **6**.
Further installation positions are available upon request.
Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

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

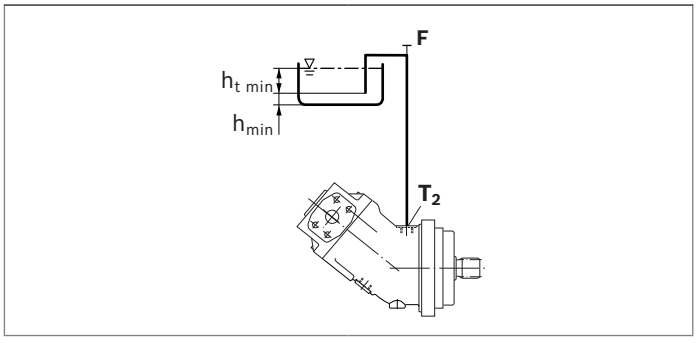
▼ **Installation position 1**

Air bleed	Filling
–	**T_1** (**F**)



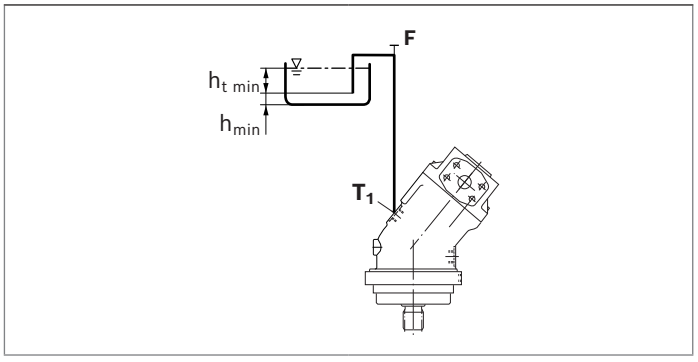
▼ **Installation position2**

Air bleed	Filling
–	**T_2** (**F**)



▼ **Installation position3**

Air bleed	Filling
–	**T_1** (**F**)

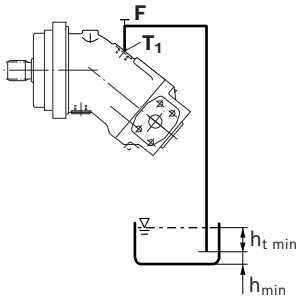


Above-reservoir installation

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

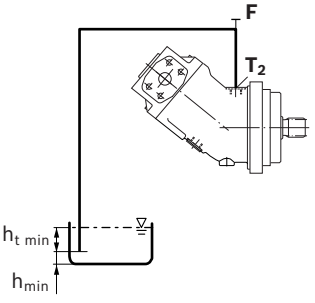
▼ **Installation position 4**

Air bleed	Filling
F	**T_1 (F)**



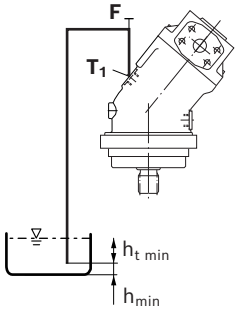
▼ **Installation position5**

Air bleed	Filling
F	**T_2** (F)



▼ **Installation position 6**

Air bleed	Filling
F	**T_1 (F)**



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 skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Preservation: Our axial piston units are supplied as standard with preservation protection for a maximum of 12 months. If longer preservation protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply for optimal storage conditions, which can be found in data sheet 90312 or in the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_D$) for functional safety.
- Be sure to add a pressure relief valve to the hydraulic system.
- Please note that a hydraulic system is an oscillating system. This can lead, for example, to the excitation of the natural frequency within the hydraulic system during operation at constant rotational speed over a long period of time. The frequency of the motor to be observed is 7 times the rotational speed frequency. This can be prevented, for example, with suitably designed hydraulic lines.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- The ports and fastening threads are designed for the p_{max} permissible pressures of the respective ports, see the connection tables. 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 ports and function ports are only intended to accommodate hydraulic lines.
- Please note that the series control of motors and the operation under summation pressure affect the efficiency of the units.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit. Take the appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in 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.
- Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. impure hydraulic fluid). This can result in restriction or loss of load-holding functions in lifting winches. The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.

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