A2FO

Fixed Displacement Bent Axis piston pump
Series 61
Size 10 to 180 cc
Nominal pressure: 400 bar
Maximum pressure: 450 bar

Index

Features

- Fixed displacement pump A2FO of axial piston, bent axis design is made suitable for hydrostatic drives in open circuits.
- Suitable for use in mobile or industrial applications.
- Output flow is proportional to drive speed and displacement.
- The drive shaft bearings are designed to give the service life expected in these areas of operation.
- Careful selection of the displacements offered, permit sizes to be matched to practically every application.
- Favorable power/ Weight ratio.
- Compact and economical design
- Optimum efficiency
- One piece pistons with piston rings

Specifications

Size				10	12	16	23	28	32	45	56
Displacement		V_g	cm^3	10.3	12.0	16.0	22.9	28.1	32	45.6	56.1
Max. speed		n_{max} **1)**	rpm	3150	3150	3150	2500	2500	2500	2240	2000
Max. perm. speed with increased input pressure P_{abs}		$n_{max.perm.}$ **2)**	rpm	6000	6000	6000	4750	4750	4750	4250	3750
Max. perm. output flow at n_{max}		q_{vmax}	l/min	32.4	37.8	50	57	70	80	102	112
Max. power at q_{vmax}	Δp=350 bar	P_{max}	kW	18.9	22	29.2	33	41	47	59.5	65
	Δp=400 bar	P_{max}	KW	21.6	25	34	38	47	53	68	75
Perm. torque	Δp=350 bar	T	Nm	57	67	88	126	156	178	254	312
	Δp=400 bar	T	Nm	65	76	101	145	178	203	290	356
Case volume			L	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45
Weight (approx.)		m	kg	6	6	6	9.5	9.5	9.5	13.5	18

Size				63	80	90	107	125	160	180
Displacement		V_g	cm^3	63	80.4	90	106.7	125	160.4	180
Max. speed		n_{max} **1)**	rpm	2000	1800	1800	1600	1600	1450	1450
Max. perm. speed with increased input pressure P_{abs}		$n_{max.perm.}$ **2)**	rpm	3750	3350	3350	3000	3000	2650	2650
Max. perm. output flow at n_{max}		q_{vmax}	l/min	126	144	162	170	200	232	261
Max. power at q_{vmax}	Δp=350 bar	P_{max}	kW	73.5	84	95	100	117	135	152
	Δp=400 bar	P_{max}	KW	84	96	108	114	133	155	174
Perm. torque	Δp=350 bar	T	Nm	350	445	501	594	696	893	1003
	Δp=400 bar	T	Nm	400	511	572	678	795	1020	1145
Case volume			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

1) the values shown are valid for an absolute pressure (P_{abs}) of 1 bar at the suction inlet S and when operated on mineral oil (with a specific mass of 0.88kg/L).

2) by increase of the input pressure (P_{abs} > 1 bar) the rotational speeds can be increased to the max. admissible speeds n_{max} limit (speed limits)

Determining the size:

Flow $q_v = \frac{V_g \times n \times n_v}{1000}$ [L/min]

Torque $T = \frac{V_g \times \Delta P}{20\pi \times n_{mh}}$ [Nm]

Power $P = \frac{2\pi \times T \times n}{60000} = \frac{q_v \times \Delta P}{600 \times n_t}$ [kW]

V_g = Displacement per revolution in mL/r
ΔP = Differential pressure in bar
n = Speed in rpm
n_v = Volumetric efficiency
n_{mh} = Mechanical-hydraulic efficiency
n_t = Overall efficiency

Ordering code

Axial piston unit
Bent axis design, fixed displacement
for use with mineral oil = A2F

Mode of operations
Pump, Open circuit = O

Size (Displacement V mL/rg³)
10, 12, 16, 23, 28, 32, 45, 56, 63, 80, 90, 107, 125, 160, 180

Series = 6

Index = 1

Direction of rotation(View on shaft end)
Clockwise = R
Anti-Clockwise = L

Seals
NBR (nitril- caoutchouc) = P
FKM (fluor- caoutchouc) = V

Shaft end	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	
Splined shaft DIN 5480	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	A
	●	●	-	●	●	-	●	●	-	●	-	●	-	●	-	Z
Parallel shaft with key, DIN 6885	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	B
	●	●	-	●	●	-	●	●	-	●	-	●	-	●	-	P

Flange mounting	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	
ISO 4-hole	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	B

Service line connections 1)	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	
A(B) SAE, at side S SAE, at rear	-	-	-	●	●	●	●	●	●	●	●	●	●	●	●	05
A (B) threads at side S threads, at rear	●	●	●	-	-	-	-	-	-	-	-	-	-	-	-	06

▭ = preferred type
● = available
- = not available

1) fastening threads resp.threaded ports are metric

Technical data

Hydraulic fluid
The A2FO fixed displacement pump is suitable for use with mineral oil.

Viscosity range
We recommend that a viscosity (at operating temperature)for optimum efficiency and service life purposes of

V_{opt} = optimum viscosity16...36mm /s

Be chosen, taken the tank temperature(open circuit) into account.

Limits of viscosity range
The following values apply in extreme cases:

V_{min} = 5 mm²/s

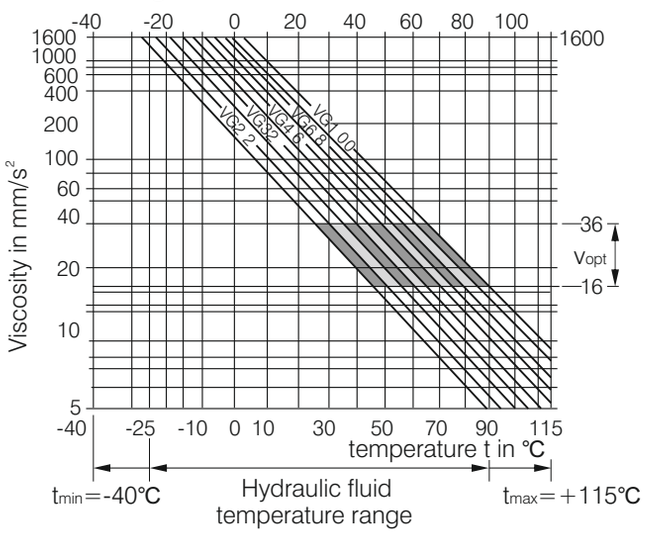
short term(t < 3 min)at max. permitted temperature t_{max}= 115°C

2 V_{max} = 1600 mm /s

short term(t < 3 min) with cold start(P < 30bar, n≤1000rpm t_{min}= -40°C)

Note that the maximum hydraulic fluid temperature must not be exceeded locally either (e.g. bearing area).The temperature in the bearing area is-depending on pressure and speed-up to 12 K higher than the average case drain temperature.

Selection diagram



Details regarding the choice of hydraulic fluid
The correct selection of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature, in an open circuit the tank temperature.
The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity lies within the optimum range (V_{opt}) (see shaded section of the selection diagram).We recommend that the highest possible viscosity range should be choosen in each case.
Example: At an ambient temperature of X°C an operating tempera ture of 60°C is set in the circuit. In the optimum operating viscosity range(Vopt; shaded area) this corresponds to the viscosity classes VG 46 or VG68; to be selected: VG 68.
Please note: The leakage fluid temperature, which is affected by pressure and rotational spaad, is always higher than the tank te mperature . At no point in the system may the temperature be hi gher than 115°C.

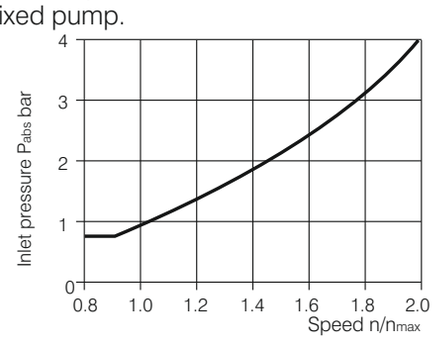
Filteration
The finer the filtration, the cleaner the fluid and the longer the service life of the axial piston unit.
To ensure proper function of the axial piston unit,the hydraulic fluid must have a cleanliness level of at least 20/18/15 according to ISO 4406.
At very high hydraulic fluid temperatures (90°C to max.115°C),a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

Operational pressure range

Inlet
Pressure at port S
The minimum inlet pressure depends on speed. The following limits must not be exceeded.

P_{abs} min ----------0.8 bar
P_{abs} max ----------30 bar

Minimum inlet pressure at suction port S with increased speed
In order to avoid damage of the pump a minimum inlet pressure at the suction port must be assured.The minimum inlet pressure is related to the rotational speed of the fixed pump.



Note: max. permissible speed $n_{max\ perm.}$(speed limit)
min. permissible inlet pressure at port S
admissible values for the drive shaft seal

Outlet
Maximum pressure on port A or B
(pressure data according to DIN 24312)

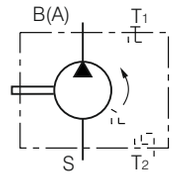
	Shaft end A, Z	Shaft end B, P
Nominal pressure P_N	400bar	350bar
Peak pressure P_{max}	450bar	400bar

Direction of flow
Direction of rotation,viewed on shaft end

clockwise	counter-clockwise
S to B	S to A

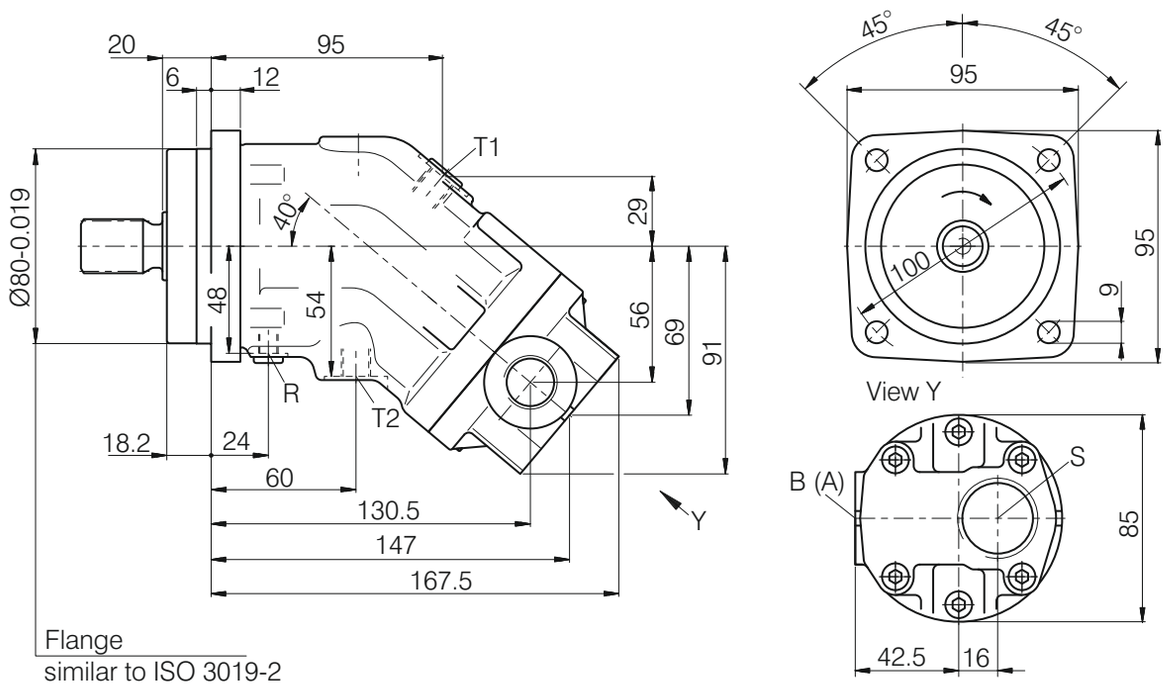
Symbol
Connections

A, B	Service line port
S	Suction port
T_1,T_2	Drain ports



Unit Dimension Size 10, 12, 16 (Dimension in mm)

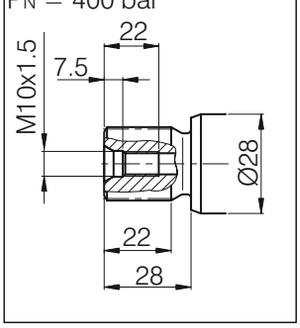
illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)



Shaft ends

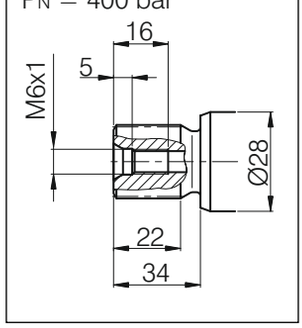
Sizes10, 12, 16

“A” Splined shaft DIN 5480
W25x1.25x18x9g
P_N = 400 bar



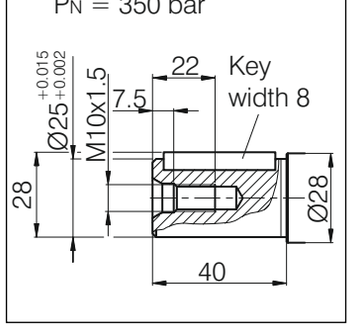
Sizes10, 12,

“Z” Splined shaft DIN 5480
W20x1.25x14x9g
P_N = 400 bar



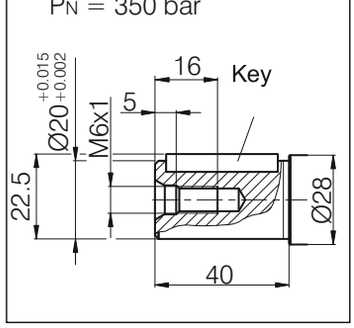
Sizes10, 12, 16

“B” Parallel keyed shaft
DIN 6885, AS8x7x32
P_N = 350 bar



Sizes10, 12,

“P” Parallel keyed shaft
DIN 6885, AS6x6x32
P_N = 350 bar



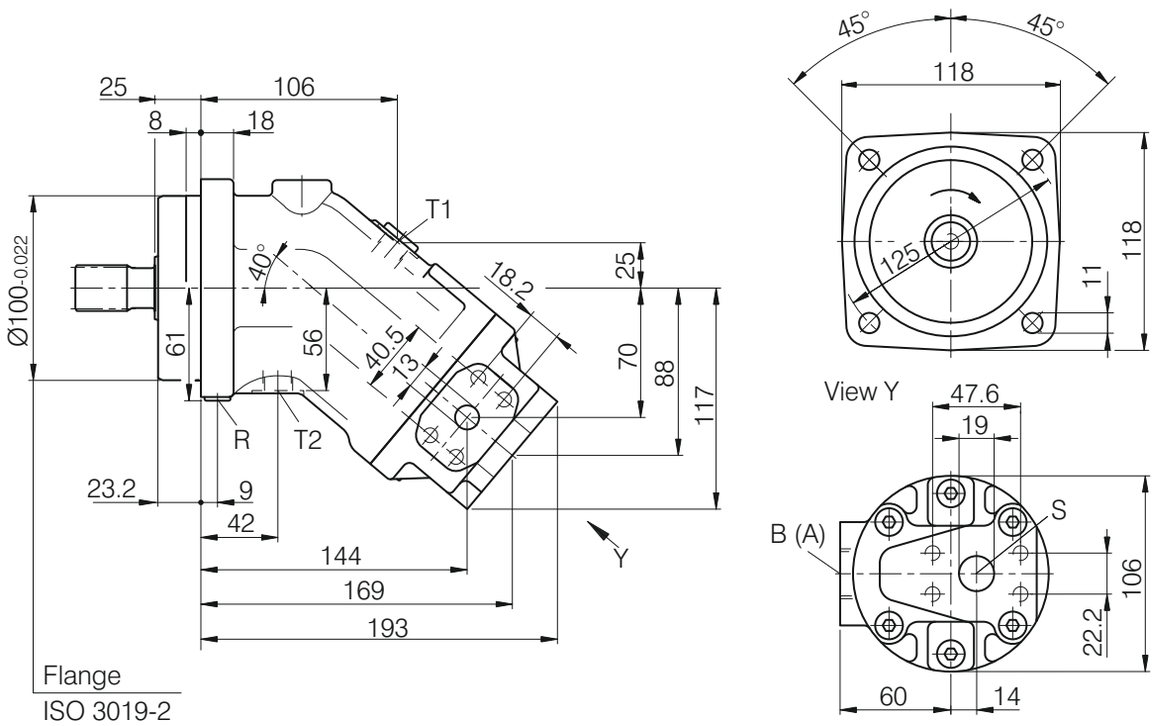
Port details

Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	M22x1.5;14 deep	400
S	Suction line, fastening thread	M33x2; 18 deep	30
T1	Case drain line	M12x1.5;12 deep	3
T2	Case drain line	M12x1.5;12 deep	3
R	Air bleed	M8x1; 8 deep	3

Unit Dimension Size 23, 28, 32 (Dimension in mm)

Port plate 05-SAE flange port A/B at side and SAE flange port S at rear

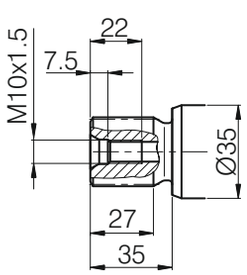
illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)



Drive shaft

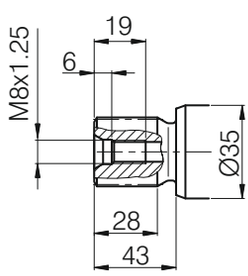
Sizes 23, 28, 32

“A” Splined shaft DIN 5480 W30x2x14x9g



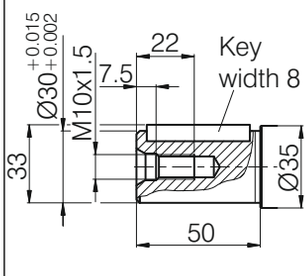
Sizes 23, 28

“Z” Splined shaft DIN 5480 W25x1.25x18x9g



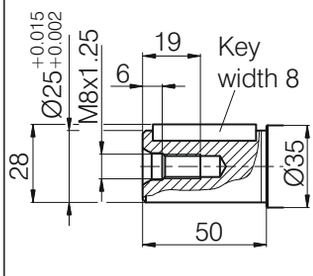
Sizes 23, 28, 32

“B” Parallel keyed shaft DIN 6885, AS8x7x40



Sizes 23, 28

“P” Parallel keyed shaft DIN 6885, AS8x7x40



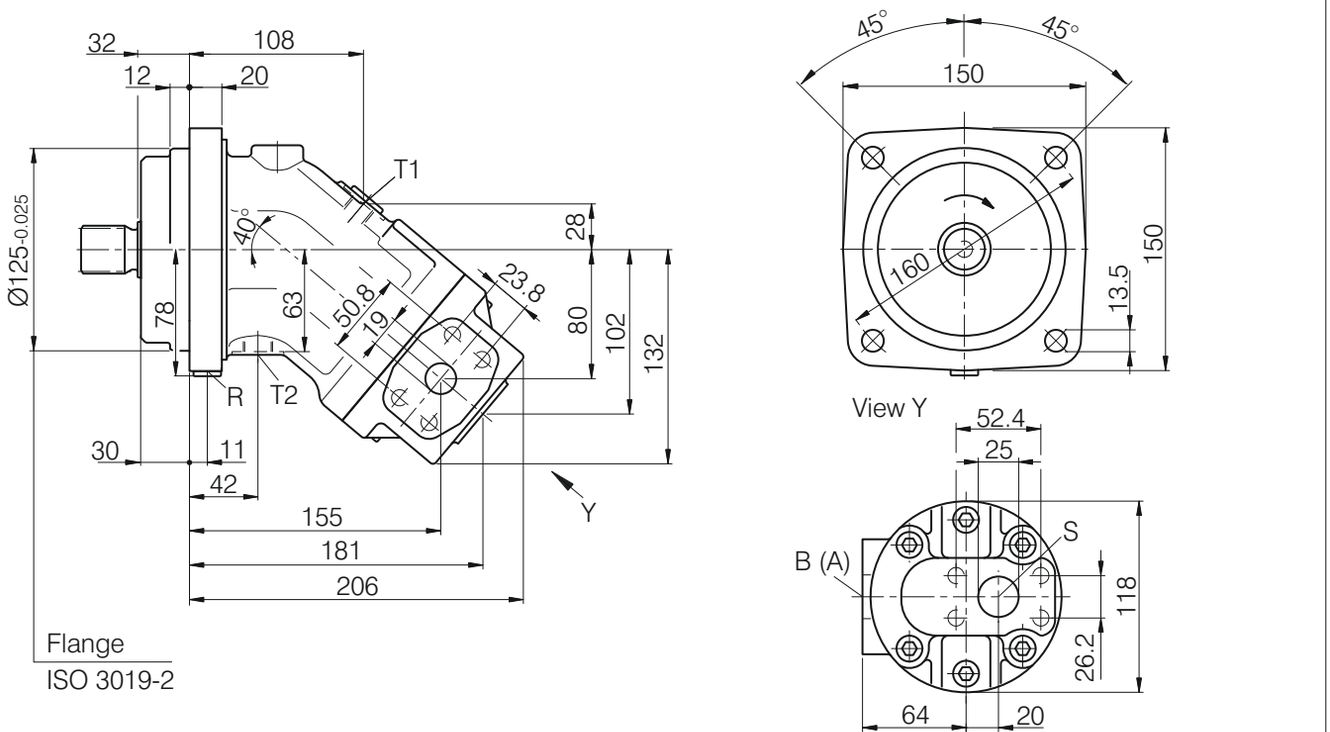
Port details

Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	SAE 1/2 in M8x1.25;15 deep	400
S	Suction line, fastening thread	SAE 3/4 in M10x1.5; 17 deep	30
T1	Case drain line	M16x1.5;12 deep	3
T2	Case drain line	M16x1.5;12 deep	3
R	Air bleed	M10x1; 12 deep	3

Unit Dimension Size 45 (Dimension in mm)

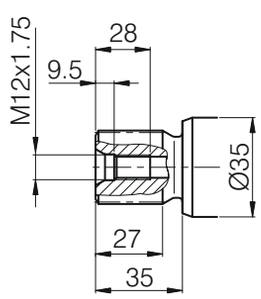
Port plate 05-SAE flange port A/B at side and SAE flange port S at rear

illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)

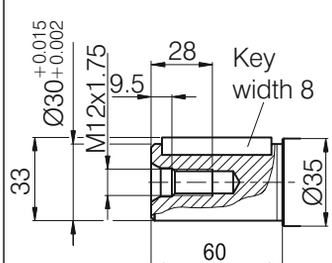


Drive shaft

“Z” Splined shaft DIN5480 W30x2x14x9g



“P” Parallel keyed shaft DIN5480, AS8x7x50



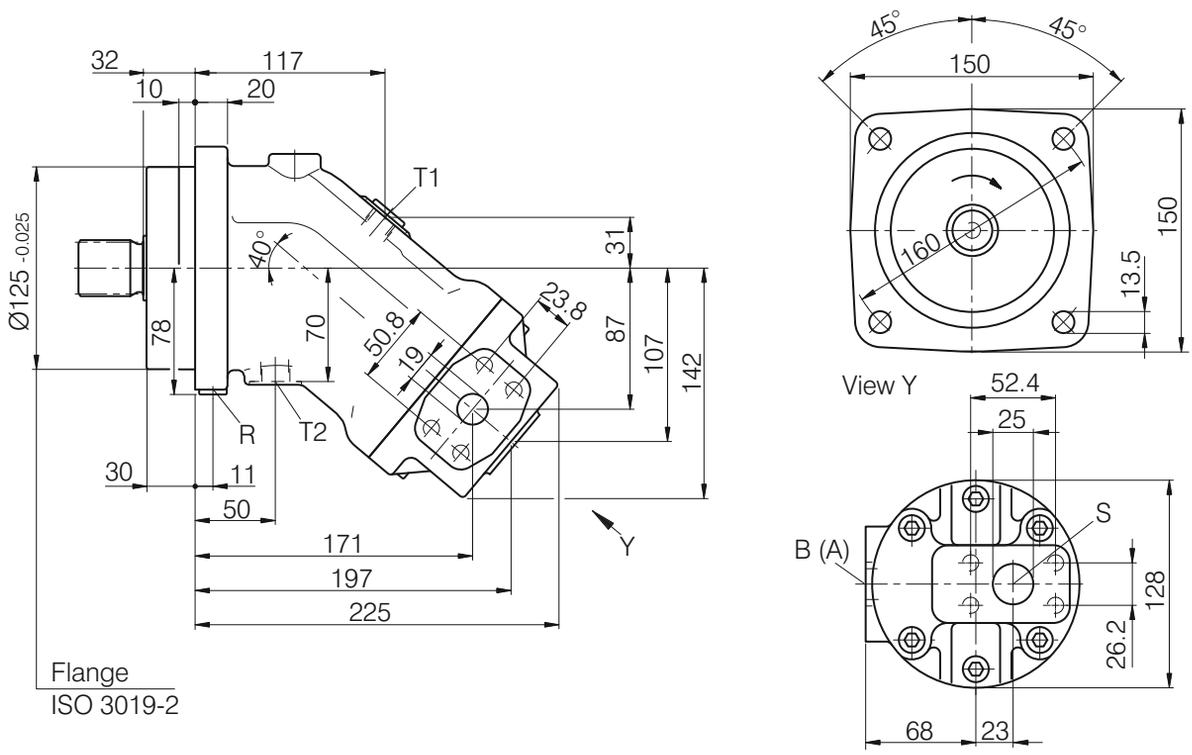
Port details

Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	SAE 3/4 in M10x1.5;17 deep	400
S	Suction line, fastening thread	SAE 1 in M10x1.5; 17 deep	30
T1	Case drain line	M18x1.5;12 deep	3
T2	Case drain line	M18x1.5;12 deep	3
R	Air bleed	M12x1.5; 12 deep	3

Unit Dimension Size 56, 63 (Dimension in mm)

Port plate 05-SAE flange port A/B at side and SAE flange port S at rear

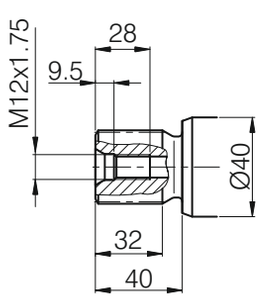
illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)



Drive shaft

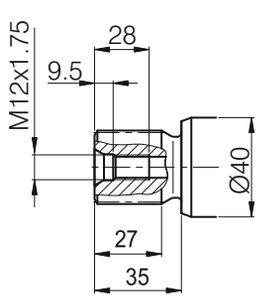
Size 56, 63

“A” Splined shaft DIN 5480 W35x2x16x9g



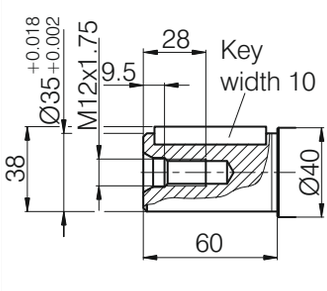
Size 56

“Z” Splined shaft DIN 5480 W30x2x14x9g



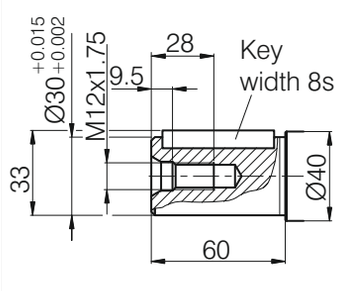
Size 56, 63

“B” Parallel keyed shaft DIN 6885 AS10x8x50



Size 56

“P” Parallel keyed shaft DIN 6885 AS8x7x50



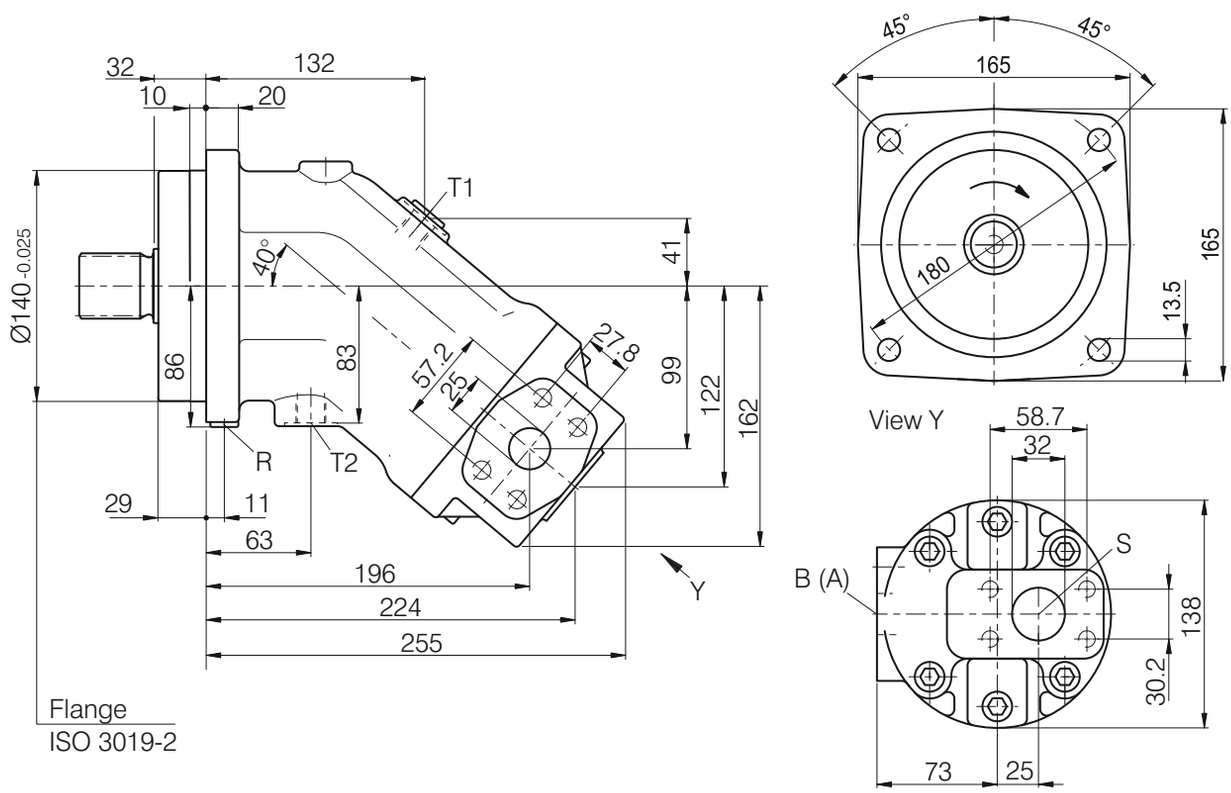
Port details

Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	SAE 3/4 in M10x1.5;17 deep	400
S	Suction line, fastening thread	SAE 1 in M10x1.5; 17 deep	30
T1	Case drain line	M18x1.5;12 deep	3
T2	Case drain line	M18x1.5;12 deep	3
R	Air bleed	M12x1.5; 12 deep	3

Unit Dimension Size 80, 90 (Dimension in mm)

Port plate 05-SAE flange port A/B at side and SAE flange port S at rear

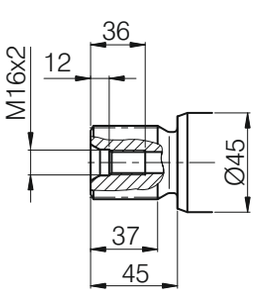
illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)



Drive shaft

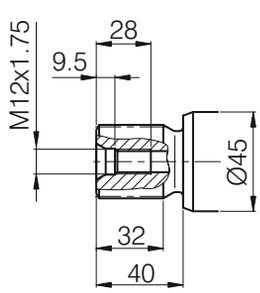
Size 80, 90

“A” Splined shaft DIN 5480 W40x2x18x9g



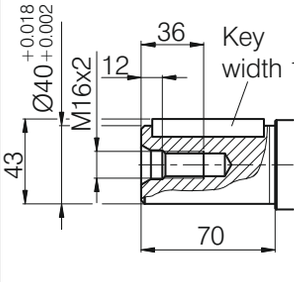
Size 80

“Z” Splined shaft DIN 5480 W35x2x16x9g



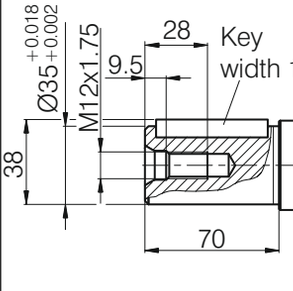
Size 80, 90

“B” Parallel keyed shaft DIN 6885, AS12x8x56



Size 80

“P” Parallel keyed shaft DIN 6885, AS10x8x56



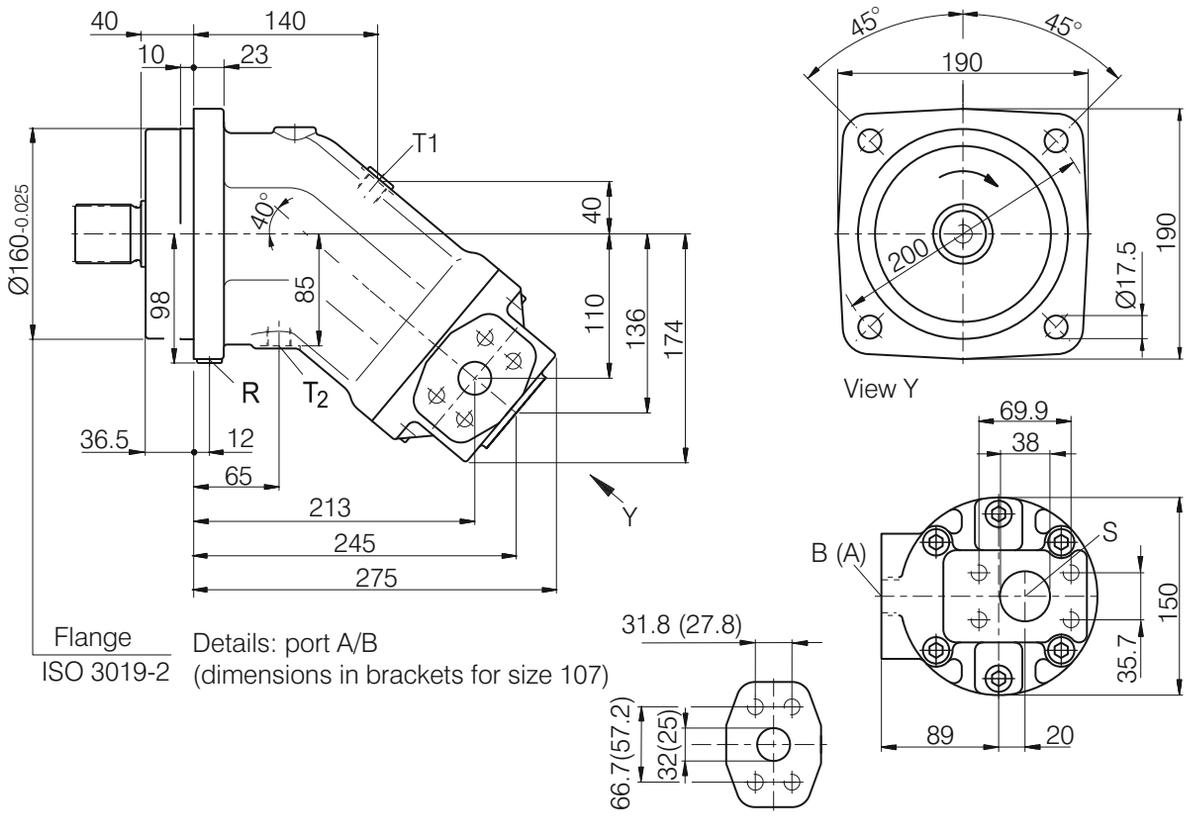
Port details

Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	SAE 1 in M12x1.5;17 deep	400
S	Suction line, fastening thread	SAE 1 1/4 in M10x1.5; 17 deep	30
T1	Case drain line	M18x1.5;12 deep	3
T2	Case drain line	M18x1.5;12 deep	3
R	Air bleed	M12x1.5; 12 deep	3

Unit Dimension Size 107, 125 (Dimension in mm)

Port plate 05-SAE flange port A/B at side and SAE flange port S at rear

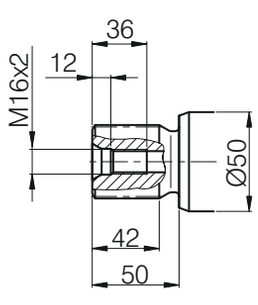
illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)



Drive shaft

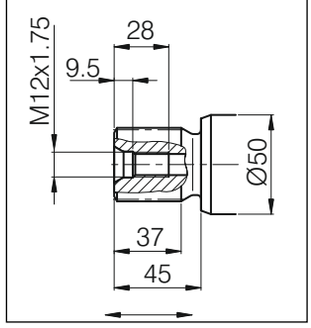
Size 107, 125

“A” Splined shaft DIN 5480
W45x2x21x9g



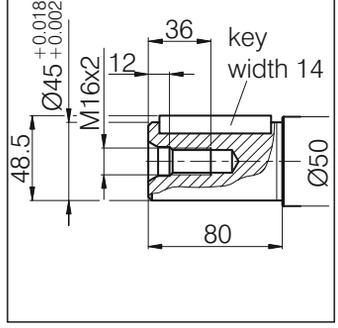
Size 107

“Z” Splined shaft DIN 5480
W40x2x18x9g



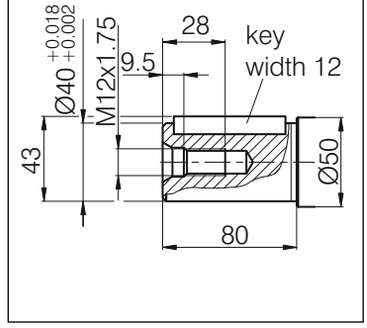
Size 107, 125

“B” Parallel keyed shaft
DIN 6885, AS14x9x63



Size 107

“P” Parallel keyed shaft
DIN 6885, AS12x9x63



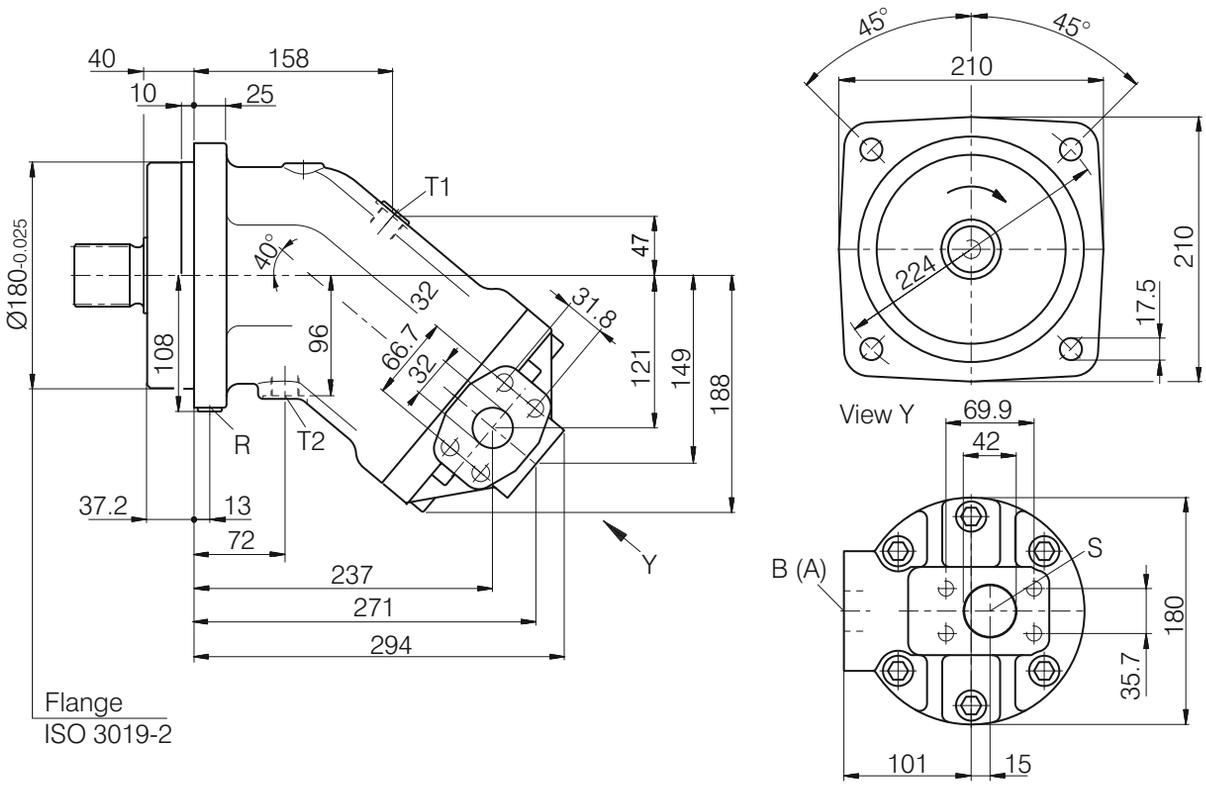
Port details

Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	SAE 1 in (size107) M12x1.75;17 deep 11/4 in (size125) M14x2;19 deep	400
S	Suction line, fastening thread	SAE 1 1/2 in M12x1.75; 17 deep	30
T1	Case drain line	M18x1.5;12 deep	3
T2	Case drain line	M18x1.5;12 deep	3
R	Air bleed	M14x1.5; 12 deep	3

Unit Dimension Size 160, 180 (Dimension in mm)

Port plate 05-SAE flange port A/B at side and SAE flange port S at rear

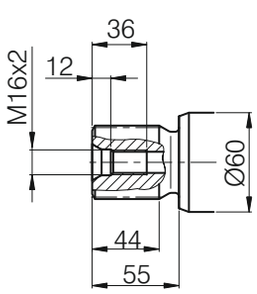
illustration: cw direction of rotation (on version “ccw direction of rotation” the port plate is rotated through 180°)



Drive shaft

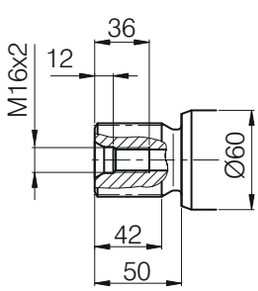
Size 160, 180

“A” Splined shaft DIN 5480
W50x2x24x9g



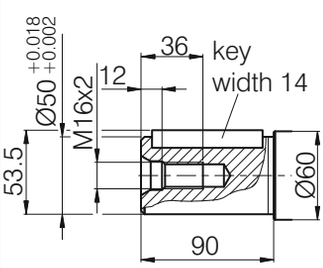
Size 160

“Z” Splined shaft DIN 5480
W45x2x21x9g



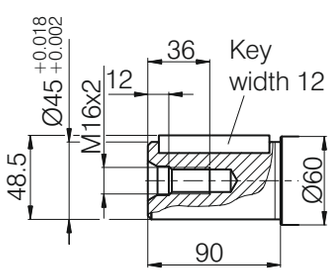
Size 160, 180

“B” Parallel keyed shaft
DIN 6885, AS14x9x70



Size 160

“P” Parallel keyed shaft
DIN 6885, AS14x9x70



Port details

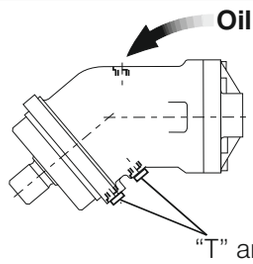
Designation	Port for	Standard	Maximum pressure (bar)
B/A	Service line, fastening thread B/A	SAE 1 1/4 in M14x2;19 deep	400
S	Suction line, fastening thread	SAE 1 1/2 in M12x1.75; 20 deep	30
T1	Case drain line	M22x1.5;14 deep	3
T2	Case drain line	M22x1.5;14deep	3
R	Air bleed	M14x1.5; 12 deep	3

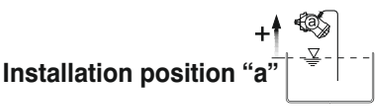
Installation notes for A2FO Axial piston units

Fixed pump A2FO, Series 6.1

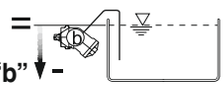
Optimum filling orientation:

Air bleed port “R” standard in **A2FO**

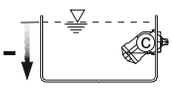




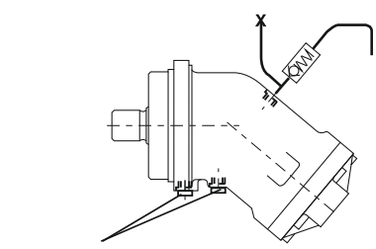
Installation position “a”

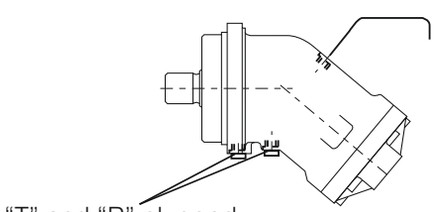


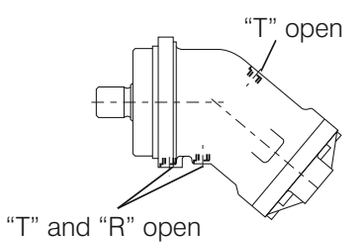
Installation position “b”

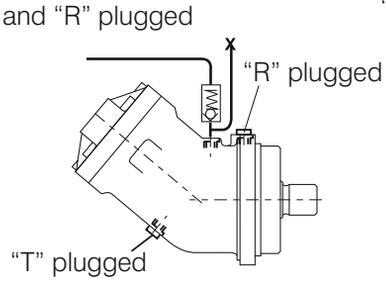


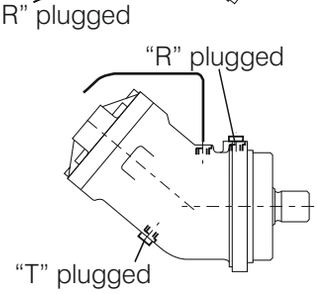
Installation position “c”

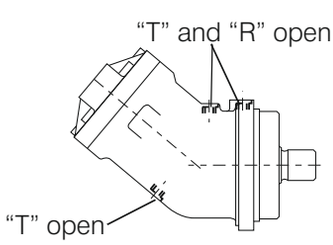












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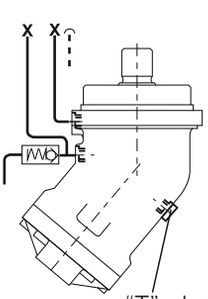

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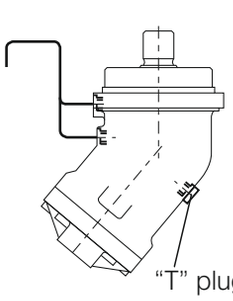

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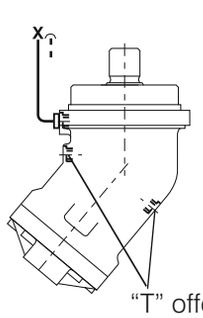
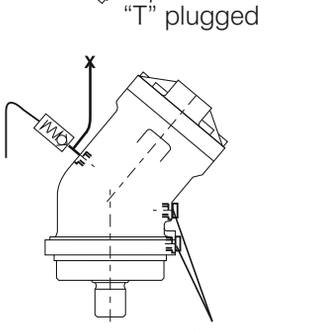
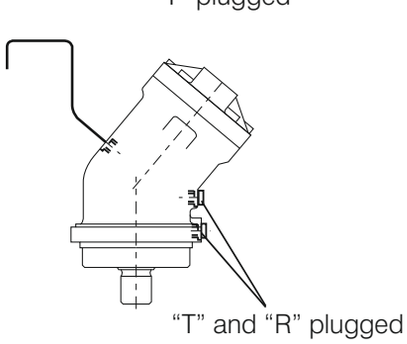
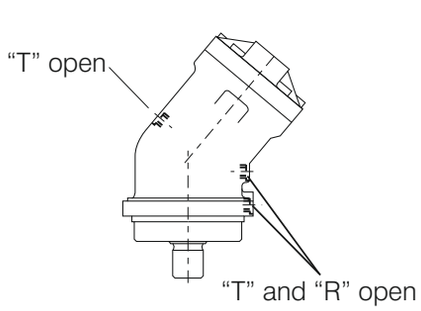
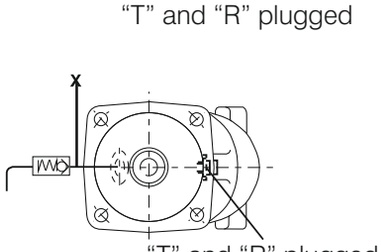
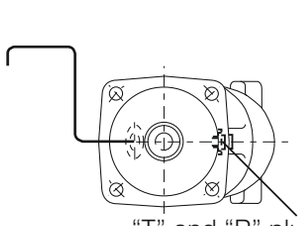


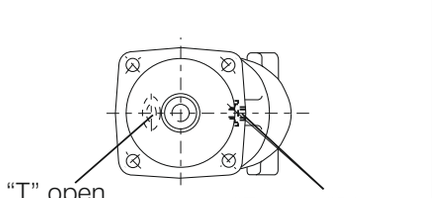












Installation notes for A2FO Axial piston units

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines. Particularly in the installation position “drive shaft upward” filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the pump housing must be directed to the reservoir via the highest available drain port1 (TT2).

For combinations of multiple units, make sure that the respective case pressure in each units is not exceed. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation If this is not possible, separate drain lines must be laid if necessary. To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction and drain lines must flow into the reservoir below the minimum fluif level. The permissible suction height hs results from the overall loss of pressure; it must not, however, be higher than hs_{max} =800mm. The minimum suction pressure at port S must also not fall below 0.8bar absolute during operation and during cold start.

Installation position

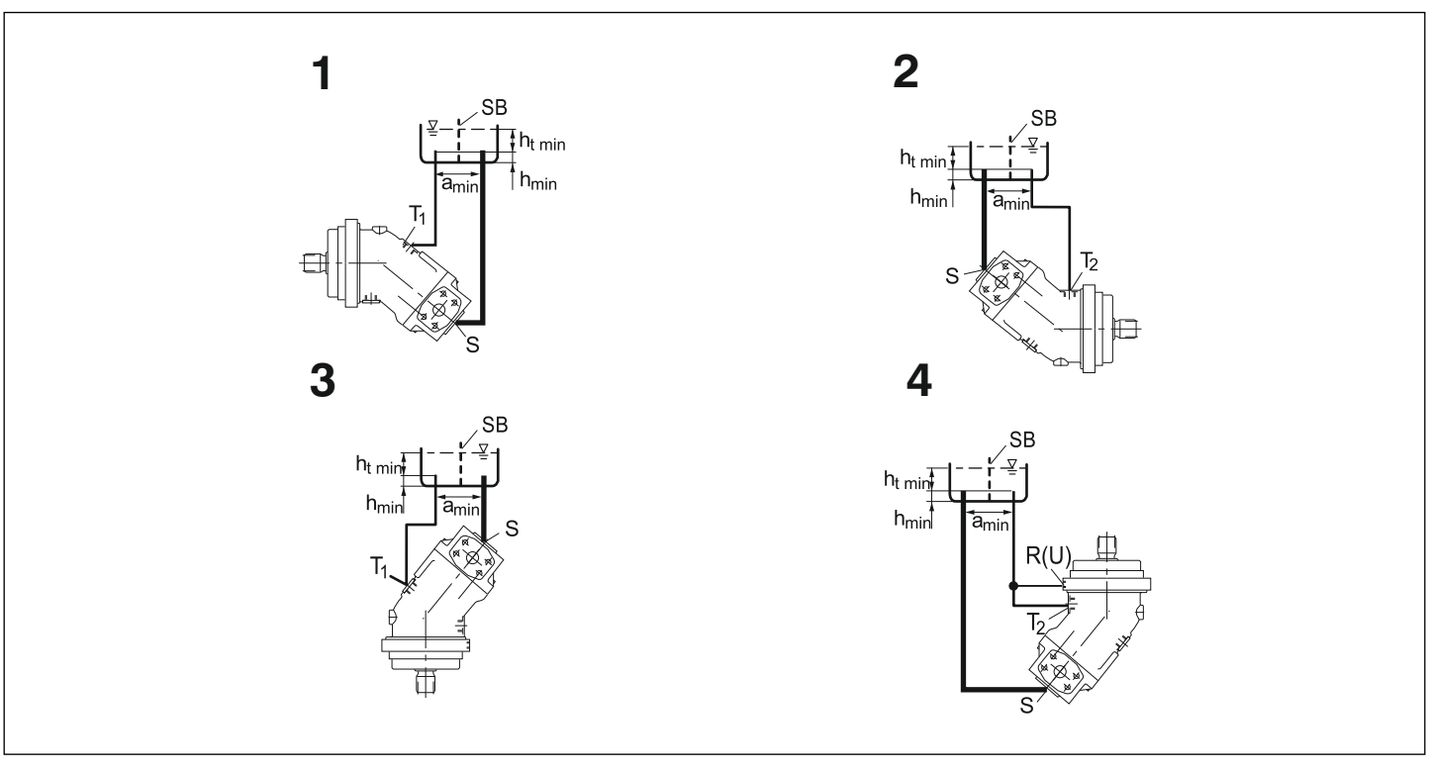
See the following examples 1 to 8

Further instllation positions are possible upon request.

Recommended installation positions: 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.

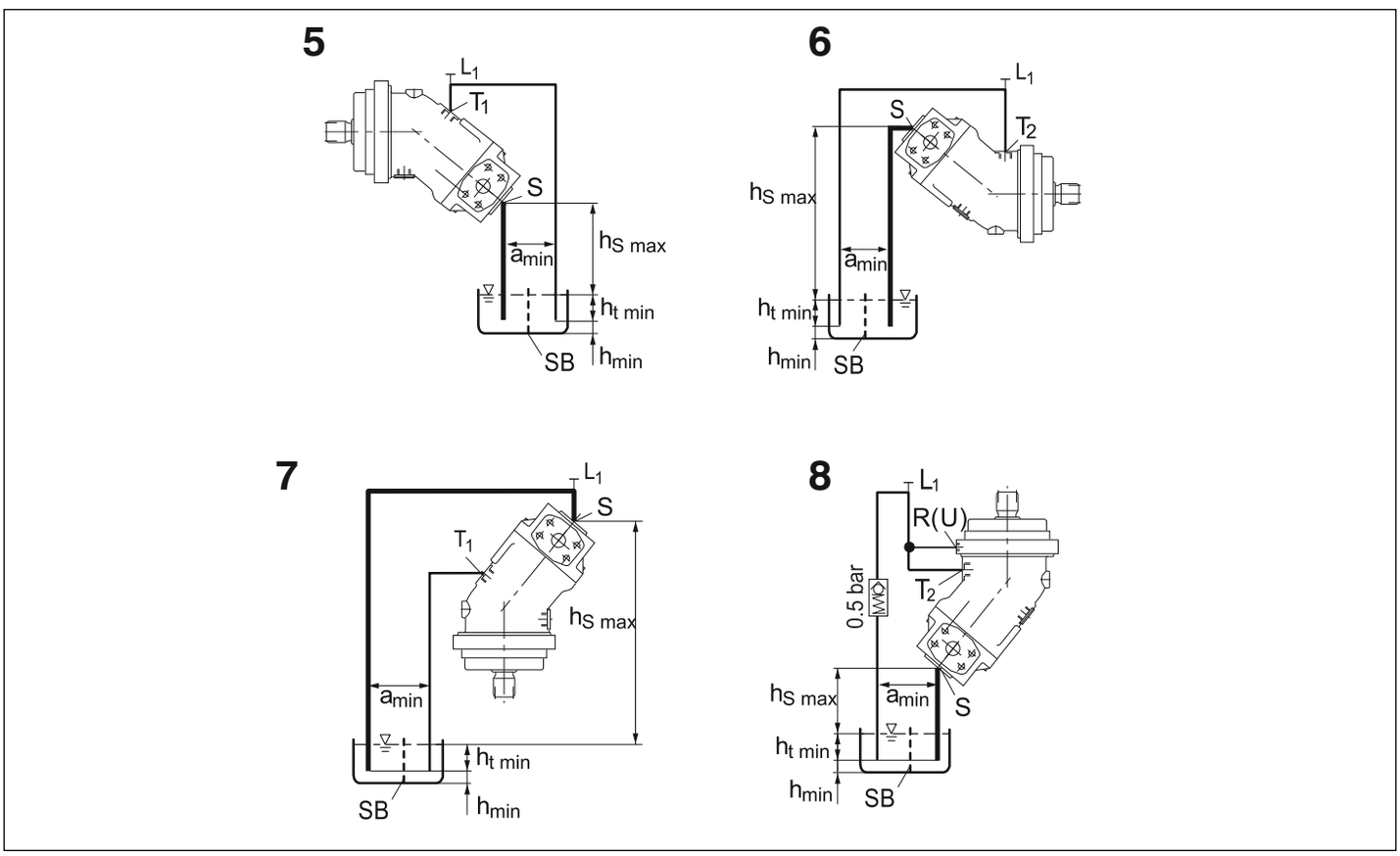


Installation position	Air bleed	Filling
1	-	T_1
2	-	T_2
3	-	T_1
4	R (U) 2	T

Installation notes for A2FO Axial piston units

Above-reservoir installation

Above -reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Recommendation for installation position 8 (drive shaft upward): A check valve in the drain line (cracking pressure 0.5 bar) A ceck valve in the drain line (cracking pressure 0.5bar) can prevent draining of the pump housing.



Installation position	Air bleed	Filling
5	L1	T_1 (L_1)
6	L1	T_2 (L_1)
7	L1	T_1(L_1)
8	R (U)$_2$	T(L_1)

L1	Filling / air bleed
R	Air bleed port
U	Bearing flushing/ air bleed port
S	Suction port
T1, T2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200mm)
h_{min}	Minimum required spacing to reservoir bottom (100mm)
SB	Baffle (Baffle plate)
$h_{s\ max}$	Maximum permissible suction height (800mm)
a_{min}	When designing the reservoir, ensure adequate space between the suction line and the drain line This prevents the heated, return flow from being

General Instructions

- The pump A2FO is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly.
- During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.
- A pressure-relief valve is to be fitted in the hydraulic system.
- The following tightening torques apply:

- **Fittings:**
  Observe the manufacturer's instructions regarding tightening torques of the fittings used.
- **Mounting bolts:**
  For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
- **Female threads in the axial piston unit:**
  The maximum permissible tightening torques MG max are maximum values for the female threads and must not be exceeded. For values, see the following table.
- **Threaded plugs:**
  For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs MV apply. For values, see the following table.

Ports standard	Size of standard	Maximum permissible tightening torque of the female threads $M_{G\,max}$	Required tightening torque of the threaded plugs MV **1)**	WAF hexagon socket in the threaded plugs
DIN3852	M8 x 1	10 Nm	7 Nm	3 mm
	M10 x 1	30 Nm	15 Nm **2)**	5 mm
	M12 x 1.5	50 Nm	25 Nm **2)**	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm

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

The specified data is for product description purposes only and may not be deemed to be guaranteed unless expressly confirmed in the contract.

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