Rexroth
Bosch Group

Axial piston fixed motor AA2FM

RA-A 91001/07.2014 1/40
Replaces: 06.12

Data sheet

Series 6

Sizes	Nominal pressure/Maximum pressure
10 to 180	5800/6500 psi (400/450 bar)
250	5100/5800 psi (350/400 bar)

Open and closed circuits

Contents

Features

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

Ordering code for standard program

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

Hydraulic fluid

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

Axial piston unit

02	Bent axis design, fixed, SAE Version	**AA2F**

Drive shaft bearing

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

Operation mode

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

Size

05	Geometric displacement, see table of values on page 7								
	size	**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**
	in^3/rev.	0.63	0.73	0.98	1.40	1.71	1.95	2.78	3.42
	size	**63**	**80**	**90**	**107**	**125**	**160**	**180**	**250**
	in^3/rev.	3.84	4.91	5.49	6.51	7.63	9.79	10.98	15.25

Series

06		**6**

Index

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

Direction of rotation

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

Seals

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

	Drive shafts	**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	**250**	
10	Splined shaft SAE J744 (ANSI B92.1a)	●	●	●	●	●	●	●	●	●	–	–	●	●	●	●	●	**S**
		–	–	–	–	–	–	–	●	●	–	–	–	–	–	–	–	**T**
		–	–	–	–	–	–	–	–	–	●	●	●	●	–	–	–	**U**
		–	–	–	–	–	–	–	–	–	●	●	–	–	–	–	–	**Q**
	Parallel keyed shaft DIN 6885	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	–	**B**
		●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	–	**P**
	SAE parallel keyed shaft	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	●	**K**

	Mounting flange		**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	**250**	
11	SAE J744	2-hole	●	●	●	–	–	–	–	–	–	–	–	–	–	–	–	–	**C**
		4-hole	–	–	–	●	●	●	●	●	●	–	–	●	●	●	●	●	**D**
			–	–	–	–	–	–	–	–	–	●	●	–	–	–	–	–	**DN**

● = Available ❍ = On request – = Not available

Ordering code for standard program

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

	Port plates for service lines				10 to 16	23	28, 32	45	56, 63	80, 90	107, 125	160, 180	250	
12	SAE flange ports A and B at rear[1]		51	0	–	●	●	●	●	●	●	●	●	510
	SAE flange ports A and B at side, opposite[1]		52	0	–	●	●	●	●	●	●	●	●	520
				7	–	●	●	●	●	●	●	●	●	527
	Threaded ports A and B at side, opposite[1]		53	0	●	●	●	–	–	–	–	–	–	530
	Threaded ports A and B at side and rear[1][2]		54	0	–	●	●	–	–	–	–	–	–	540
	SAE flange ports A and B at bottom[1]		60	0	–	–	–	–	–	●	●	–	–	600
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[3][5]	BVD 20	17	1	–	–	–	–	–	–	●	–	–	171 178
			18	8	–	–	●	●	●	●	●	●	–	181
		BVD/BVE 25	18		–	–	–	–	–	–	●	●	–[4]	188
	Port plate with pressure-relief valves[5]		19	1	–	–	●	●	●	●	●	●	–	191
				2	–	–	●	●	●	●	●	●	–	192

	Valves	
	Without valve	0
	With pressure-relief valve (without pressure boost facility)	1
	With pressure-relief valve (with pressure boost facility)	2
	With flushing and boost pressure valve, mounted	7
	Counterbalance valve BVD/BVE mounted[3][6]	8
	Flushing and boost pressure valve, integrated	9

	Speed sensors (see page 35)	10 to 16	23 to 32	45	56 to 90	107 to 180	250	
13	Without speed sensor (without code)	●	●	●	●	●	●	
	Prepared for HDD speed sensor	–	▲	▲	▲	▲	–	F
	HDD speed sensor mounted[7]	–	▲	▲	▲	▲	–	H
	Prepared for DSM/DSA speed sensor	–	●	●	●	●	–	U
	DSM/DSA speed sensor mounted[7]	–	●	●	●	●	–	V

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

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

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

1) Fastening threads or threaded ports are SAE (UN/UNF)
2) Threaded ports at the sides (sizes 10 to 63) plugged with threaded plugs
3) Note the restrictions on page 32
4) Please contact us.
5) Fastening threads and threaded ports are metric
6) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE – RE 95525) separately.
7) Specify ordering code of sensor according to data sheet (DSM – RE 95132, DSA – RE 95133, HDD – RE 95135) separately and observe the requirements on the electronics

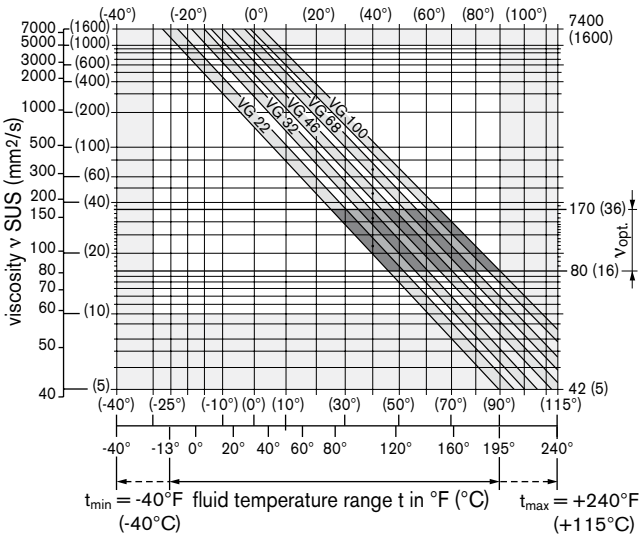
Technical data

Hydraulic fluid

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

The fixed motor AA2FM is not suitable for operation with HFA hydraulic fluid. If HFB, HFC or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

Example: At an ambient temperature of X °F (X °C), an operating temperature of 140 °F (60 °C) is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note
The case drain temperature, which is affected by pressure and speed, can be higher than the circuit temperature or reservoir temperature. At no point of the component may the temperature be higher than 240 °F (115 °C). The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U (size 250) or using a flushing and boost pressure valve (see pages 28).

Viscosity and temperature of hydraulic fluid

	Viscosity [SUS (mm²/s)]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -58 °F (-50 °C) $T_{opt} =$ +41 °F to +68 °F (+5 °C to +20 °C)	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	$\nu_{max} =$ 7400 (1600)	$T_{St} \geq$ -40 °F (-40 °C)	t ≤ 3 min, without load (p ≤ 725 psi (50 bar)), n ≤ 1000 rpm (for sizes 10 to 180), n ≤ 0.25 • n_{nom} (for sizes 250)
Permissible temperature difference		ΔT ≤ 45 °F (25 °C)	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 7400 to 1850 (1600 to 400)	T = -40 °F to -13 °F (-40 °C to -25 °C)	at p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 22 °F (12 °C)	between hydraulic fluid in the bearing and at port T.
Maximum temperature		+240 °F (115 °C)	in the bearing
		+217 °F (103 °C)	measured at port T
Continuous operation	ν = 1850 to 47 (400 to 10) ν_{opt} = 170 to 74 (36 to 16)	T = -13 °F to +195 °F (-25 °C to +90 °C)	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq$ 32 (7)	$T_{max} =$ +217 °F (+103 °C)	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T ≤ +240 °F (+115 °C)	see page 5

1) At temperatures below -13 °F (-25 °C), an NBR shaft seal is required (permissible temperature range: -40 °F to +195 °F (-40 °C to +90 °C)).
2) Sizes 250, please contact us.

Technical data

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

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

At very high hydraulic fluid temperatures (+195 °F to +240 °F (90 °C to maximum 115 °C)), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

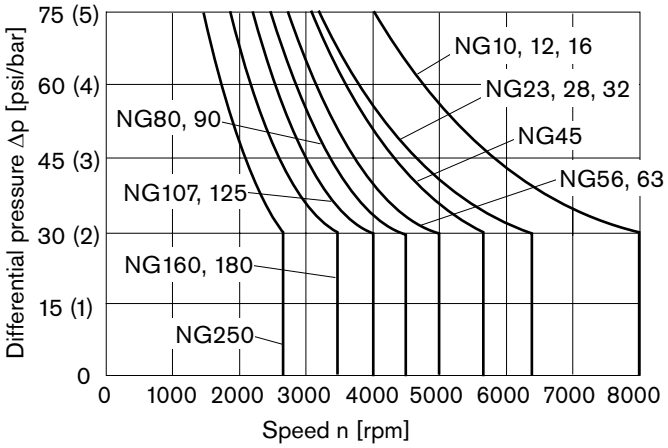
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 30 psi (2 bar) between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes ($t < 0.1$ s) of up to 145 psi (10 bar) are permitted. The service life of the shaft seal decreases with an increase in the frequency of pressure spikes.

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



The values are valid for an ambient pressure p_{abs} = 15 psi (1 bar).

Temperature range

The FKM shaft seal may be used for case drain temperatures from -13 °F to +240 °F (-25 °C to +115 °C).

Note
For application cases below -13 °F (-25 °C), an NBR shaft seal is required (permissible temperature range: -40 °F to 195 °F (-40 °C to +90 °C). State NBR shaft seal in plain text when ordering.
Please contact us.

Direction of flow

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

Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm. See table of values on page 7 for maximum speed.

Long-life bearing

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

Flushing flow (recommended)

Size		250
$q_{v\ flush}$	gpm	2.6
	L/min	10

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Sizes 10 to 180

Nominal pressure p_{nom} _____ 5800 psi (400 bar) absolute

Maximum pressure p_{max} _____ 6500 psi (450 bar) absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{Su} _____
10150 psi (700 bar)

Sizes 250

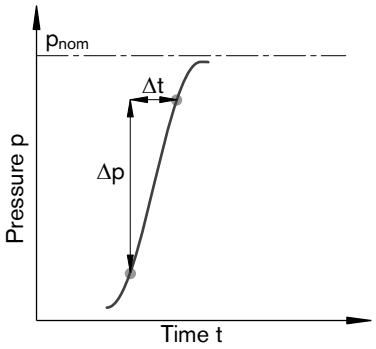
Nominal pressure p_{nom} _____ 5100 psi (350 bar) absolute

Maximum pressure p_{max} _____ 5800 psi (400 bar) absolute
Single operating period _____ 10 s
Total operating period _____ 300 h

Summation pressure (pressure A + pressure B) p_{Su} _____
10150 psi (700 bar)

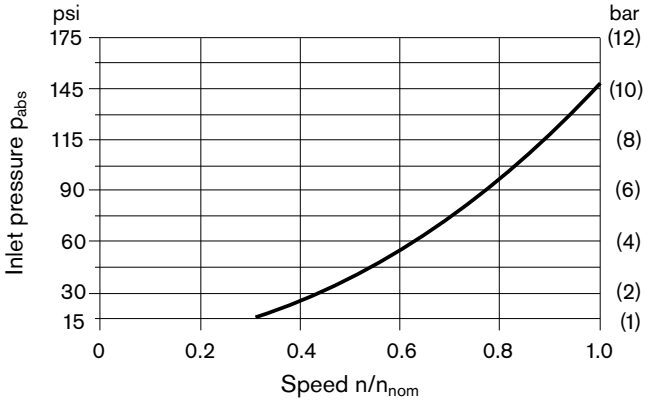
Minimum pressure (high-pressure side) _____
365 psi (25 bar) absolute

Rate of pressure change $R_{A\ max}$
with integrated pressure-relief valve __ 130000 psi/s (9000 bar/s)
without pressure-relief valve _____ 232000 psi/s (16000 bar/s)



Note
Values for other hydraulic fluids, please contact us.

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



This diagram is valid only for the optimum viscosity range from ν_{opt} = 170 to 74 SUS (36 to 16 mm^2/s).
Please contact us if these conditions cannot be satisfied.

Definition

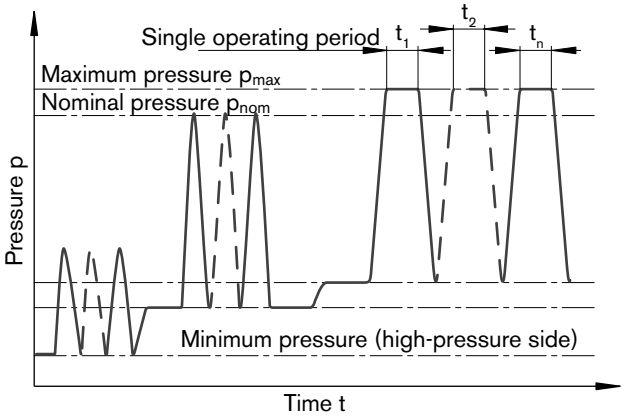
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

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

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

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



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

Technical data

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

Size		NG		10	12	16	23	28	32	45	56
Displacement geometric, per revolution		V_g	in^3	0.63	0.73	0.98	1.40	1.71	1.95	2.78	3.42
			cm^3	10.3	12	16	22.9	28.1	32	45.6	56.1
Speed maximum[1]		n_{nom}	rpm	8000	8000	8000	6300	6300	6300	5600	5000
		n_{max}[2]	rpm	8800	8800	8800	6900	6900	6900	6200	5500
Input flow[3]			gpm	21.8	25.3	33.9	38.2	46.8	53.4	67.4	74.2
at n_{nom} and V_g		q_V	L/min	82	96	128	144	177	202	255	281
Torque[4]	$\Delta p = 5100$ psi	T	lb-ft	42	49	66	94	116	132	188	231
at V_g and	$\Delta p = 350$ bar	T	Nm	57	67	89	128	157	178	254	313
	$\Delta p = 5800$ psi	T	lb-ft	49	56	75	108	132	150	213	263
	$\Delta p = 400$ bar	T	Nm	66	76	102	146	179	204	290	357
Rotary stiffness		c	kNm/rad	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94
Moment of inertia for rotary group		J_{GR}	$lbs\text{-}ft^2$	0.0095	0.0095	0.0095	0.0285	0.0285	0.0285	0.0569	0.0997
			kgm^2	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042
Maximum angular acceleration		α	rad/s^2	5000	5000	5000	6500	6500	6500	14600	7500
Case volume		V	gal	0.045	0.045	0.045	0.053	0.053	0.053	0.087	0.119
			L	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45
Mass (approx.)		m	lbs	12	12	12	21	21	21	30	40
			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	250
Displacement geometric, per revolution		V_g	in^3	3.84	4.91	5.49	6.51	7.63	9.79	10.98	15.25
			cm^3	63	80.4	90	106.7	125	160.4	180	250
Speed maximum[1]		n_{nom}	rpm	5000	4500	4500	4000	4000	3600	3600	2700
		n_{max}[2]	rpm	5500	5000	5000	4400	4400	4000	4000	–
Input flow[3]			gpm	83.1	95.6	106.9	112.7	132.1	152.5	171.1	178
at n_{nom} and V_g		q_V	L/min	315	362	405	427	500	577	648	675
Torque[4]	$\Delta p = 5100$ psi	T	lb-ft	259	330	371	438	513	659	740	1030
at V_g and	$\Delta p = 350$ bar	T	Nm	351	448	501	594	696	893	1003	1393
	$\Delta p = 5800$ psi	T	lb-ft	296	378	423	501	587	753	845	–
	$\Delta p = 400$ bar	T	Nm	401	512	573	679	796	1021	1146	–
Rotary stiffness		c	kNm/rad	6.25	8.73	9.14	11.2	11.9	17.4	18.2	73.1
Moment of inertia for rotary group		J_{GR}	$lbs\text{-}ft^2$	0.0997	0.1708	0.1708	0.2753	0.2753	0.5221	0.5221	1.4475
			kgm^2	0.0042	0.0072	0.0072	0.0116	0.0116	0.0220	0.0220	0.061
Maximum angular acceleration		α	rad/s^2	7500	6000	6000	4500	4500	3500	3500	10000
Case volume		V	gal	0.119	0.145	0.145	0.211	0.211	0.291	0.291	0.660
			L	0.45	0.55	0.55	0.8	0.8	1.1	1.1	2.5
Mass (approx.)		m	lbs	40	51	51	71	71	99	99	161
			kg	18	23	23	32	32	45	45	73

1) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 170$ to 74 SUS (36 to 16 mm^2/s)
- with hydraulic fluid based on mineral oils

2) Intermittent maximum speed: overspeed for unload and overhauling processes, $t < 5$ s and $\Delta p < 2200$ psi (150 bar)

3) Restriction of input flow with counterbalance valve, see page 32

4) Torque without radial force, with radial force see page 9

Note

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

Technical data

Determining the operating characteristics

Input flow $q_v = \frac{V_g \cdot n}{231 \cdot \eta_v}$ gpm $\left(q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v} \right.$ L/min $\left. \right)$

Speed $n = \frac{q_v \cdot 231 \cdot \eta_v}{V_g}$ rpm $\left(n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g} \right.$ rpm $\left. \right)$

Torque $T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{24 \cdot \pi}$ lb-ft $\left(T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi} \right.$ Nm $\left. \right)$

Power $P = \frac{2\pi \cdot T \cdot n}{33\,000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{1714}$ HP $\left(P = \frac{2\pi \cdot T \cdot n}{60\,000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600} \right.$ kW $\left. \right)$

V_g = Displacement per revolution in in^3 (cm^3)

Δp = Differential pressure in psi (bar)

n = Speed in rpm

η_v = Volumetric efficiency

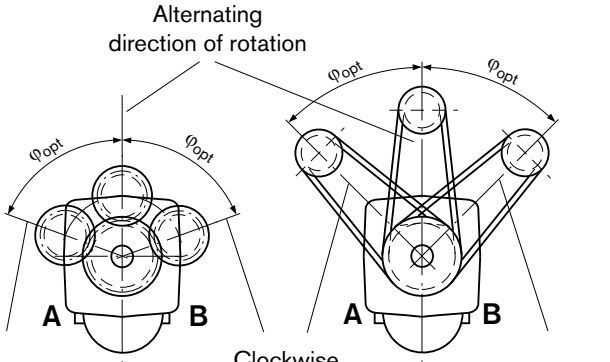
η_{mh} = Mechanical-hydraulic efficiency

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

Effect of radial force F_q on the service life of bearings

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

	Toothed gear drive	V-belt output
NG	φ_{opt}	φ_{opt}
10 to 180	± 70°	± 45°
250	± 45°	± 70°



"Counter-clockwise" direction of rotation
Pressure at port **B**

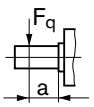
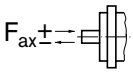
Clockwise direction of rotation
Pressure at port **A**

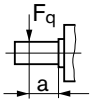
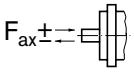
"Counter-clockwise" direction of rotation
Pressure at port **B**

Technical data

Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	NG		10	10	10	12	12	12	16[3]	16
Drive shaft	ø	in	7/8	0.79	0.98	7/8	0.79	0.98	7/8	0.98
		mm	–	20	25	–	20	25	–	25
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lbf	629.5	674.4	719.4	741.9	674.4	719.4	966.7	719.4
		kN	2.8	3.0	3.2	3.3	3.0	3.2	4.3	3.2
	a	in	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
		mm	16.8	16	16	16.8	16	16	16.8	16
with permissible torque	T_{max}	lb-ft	47.9	49	47.9	56.1	56.1	56.9	72.3	73.8
		Nm	65	66	65	76	76	76	98	100
≙ permissible pressure Δp	Δp_{perm}	psi	5800	5800	5800	5800	5800	5800	5550	5800
		bar	400	400	400	400	400	400	385	400
Maximum axial force[2] 	$-F_{ax\,max}$	lbf	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9
		N	320	320	320	320	320	320	320	320
	$+F_{ax\,max}$	N	0	0	0	0	0	0	0	0
Permissible axial force per psi (bar) operating pressure	$\pm F_{ax\,perm/bar}$	lbf/psi	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
		N/bar	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

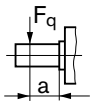
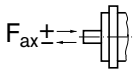
Size	NG		23	23	23	28	28	28	32	32
Drive shaft	ø	in	1 1/4	0.98	1.18	1 1/4	0.98	1.18	1 1/4	1.18
		mm	–	25	30	–	25	30	–	30
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lbf	809.3	1281.4	1213.9	989.1	1281.4	1213.9	1146.5	1213.9
		kN	3.6	5.7	5.4	4.4	5.7	5.4	5.1	5.4
	a	in	0.94	0.63	0.63	0.94	0.63	0.63	0.94	0.63
		mm	24	16	16	24	16	16	24	16
with permissible torque	T_{max}	lb-ft	106.2	108	106.2	131.3	132	131.3	150.5	150.5
		Nm	144	146	144	178	179	178	204	204
≙ permissible pressure Δp	Δp_{perm}	psi	5800	5800	5800	5800	5800	5800	5800	5800
		bar	400	400	400	400	400	400	400	400
Maximum axial force[2] 	$-F_{ax\,max}$	lbf	112.2	112.2	112.2	112.2	112.2	112.2	112.2	112.2
		N	500	500	500	500	500	500	500	500
	$+F_{ax\,max}$	N	0	0	0	0	0	0	0	0
Permissible axial force per psi (bar) operating pressure	$\pm F_{ax\,perm/bar}$	lbf/psi	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
		N/bar	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2

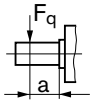
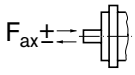
1) With intermittent operation
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) Restricted technical data

Note

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

Technical data

Size	NG		45	45	56[3]	56	56	56	63[3]	63	63
Drive shaft	ø	in	1 1/4	1.18	1 1/4	1 3/8	1.18	1.37	1 1/4	1 3/8	1.38
		mm	–	30	–	–	30	35	–	–	35
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lbf	1641	1709	1709	2068	2136	2045	1708	2315	2046
		kN	7.3	7.6	7.6	9.2	9.5	9.1	7.6	10.3	9.1
	a	in	0.94	0.71	0.94	0.94	0.71	0.71	0.94	0.94	0.71
		mm	24	18	24	24	18	18	24	24	18
with permissible torque	T_{max}	lb-ft	214	214	223	263	263	263	223	295	295
		Nm	290	290	302	356	357	356	302	400	400
≙ permissible pressure Δp	Δp_{perm}	psi	5800	5800	4950	5800	5800	5800	4350	5800	5800
		bar	400	400	339	400	400	400	301	400	400
Maximum axial force[2] 	$-F_{ax\,max}$	lbf	142	142	180	180	180	180	180	180	180
		N	630	630	800	800	800	800	800	800	800
	$+F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per psi (bar) operating pressure	$+F_{ax\,perm/bar}$	lbf/psi	0.11	0.11	0.13	0.13	0.13	0.13	0.13	0.13	0.13
		N/bar	7.0	7.0	8.7	8.7	8.7	8.7	8.7	8.7	8.7

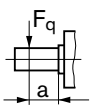
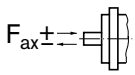
Size	NG		80[3]	80[3]	80	80	90[3]	90[3]	90	107[3]	107
Drive shaft	ø	in	1 1/4	1 3/8	1.37	1.57	1 1/4	1 3/8	1.57	1 1/2	1 3/4
		mm	–	–	35	40	–	–	40	–	–
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lbf	1709	2608	2608	2563	1709	2608	2563	2788	2743
		kN	7.6	11.6	11.6	11.4	7.6	11.6	11.4	12.4	12.2
	a	in	0.94	0.94	0.79	0,79	0.94	0.94	0.79	1.06	1.32
		mm	24	24	20	20	24	24	20	27	33.5
with permissible torque	T_{max}	lb-ft	223	332	378	378	223	332	423	438	502
		Nm	302	450	512	512	302	450	573	594	680
≙ permissible pressure Δp	Δp_{perm}	psi	3450	5100	5800	5800	3050	4550	5800	5100	5800
		bar	237	352	400	400	211	314	400	349	400
Maximum axial force[2] 	$-F_{ax\,max}$	lbf	225	225	225	225	225	225	225	281	281
		N	1000	1000	1000	1000	1000	1000	1000	1250	1250
	$+F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per psi (bar) operating pressure	$+F_{ax\,perm/bar}$	lbf/psi	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.20	0.20
		N/bar	10.6	10.6	10.6	10.6	10.6	10.6	10.6	12.9	12.9

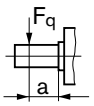
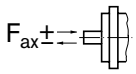
1) With intermittent operation
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) Restricted technical data

Note

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

Technical data

Size	NG		107	107	125[3]	125	125	160[3]	160	160	180[3]	180
Drive shaft	ø	in	1.57	1.77	1 1/2	1 3/4	1.77	1 3/4	1.77	1.97	1 3/4	1.97
		mm	40	45	–	–	45	–	45	50	–	50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lbf	3057	3169	2788	3215	3170	3350	4069	4114	3350	4114
		kN	13.6	14.1	12.4	14.3	14.1	14.9	18.1	18.3	14.9	18.3
	a	in	0.79	0.79	1.06	1.32	0.79	1.32	0.98	0.98	1.32	0.98
		mm	20	20	27	33.5	20	33.5	25	25	33.5	25
with permissible torque	T_{max}	lb-ft	501	502	438	587	587	611	753	749	611	844
		Nm	679	680	594	796	796	828	1021	1016	828	1144
≙ permissible pressure Δp	Δp_{perm}	psi	5800	5800	4350	5800	5800	4700	5800	5800	4200	5800
		bar	400	400	298	400	400	325	400	400	289	400
Maximum axial force[2] 	$-F_{ax\,max}$	lbf	281	281	281	281	281	360	360	360	360	360
		N	1250	1250	1250	1250	1250	1600	1600	1600	1600	1600
	$+F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0
Permissible axial force per psi (bar) operating pressure	$\pm F_{ax\,perm/bar}$	lbf/psi	0.20	0.20	0.20	0.20	0.20	0.26	0.26	0.26	0.26	0.26
		N/bar	12.9	12.9	12.9	12.9	12.9	16.7	16.7	16.7	16.7	16.7

Size	NG		250
Drive shaft	ø	in	1.97
		mm	50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lbf	270[5]
		kN	1.2[5]
	a	in	1.61
		mm	41
with permissible torque	T_{max}	lb-ft	1027
		Nm	1393
≙ permissible pressure Δp	Δp_{perm}	psi	5100
		bar	350
Maximum axial force[2] 	$-F_{ax\,max}$	lbf	450
		N	2000
	$+F_{ax\,max}$	N	0
Permissible axial force per psi (bar) operating pressure	$\pm F_{ax\,perm/bar}$	lbf/psi	[4]
		N/bar	

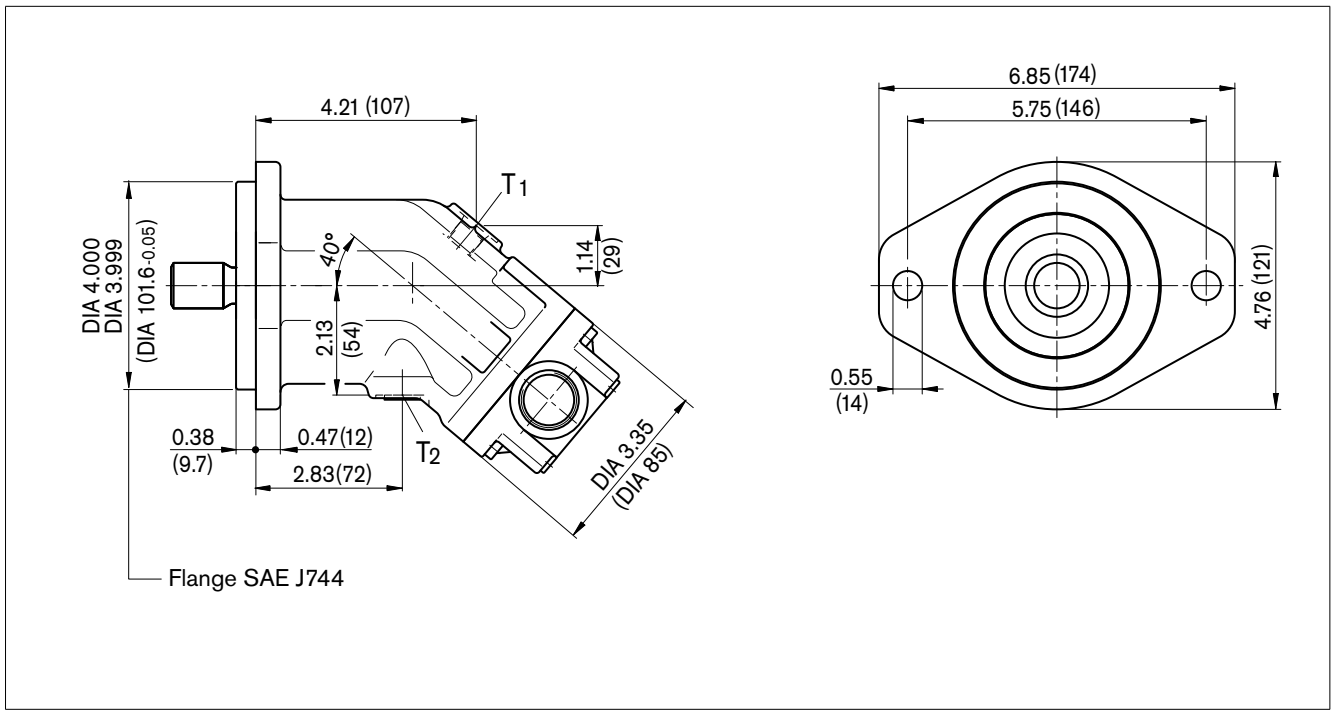
1) With intermittent operation
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) Restricted technical data
4) Please contact us.
5) When at a standstill or when axial piston unit operating in non-pressurized conditions. Higher forces are permissible when under pressure, please contact us.

Note

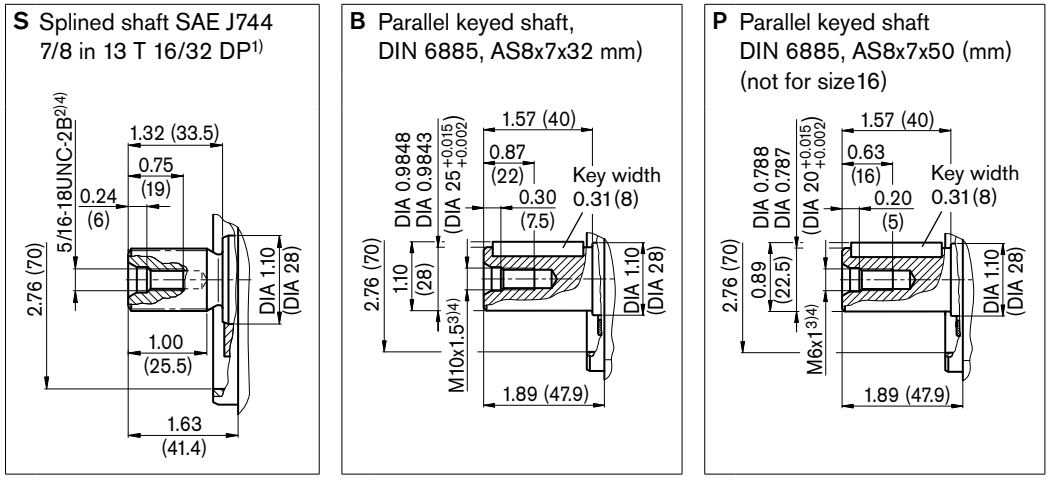
Influence of the direction of the permissible axial force:
$+F_{ax\,max}$ = Increase in service life of bearings
$-F_{ax\,max}$ = Reduction in service life of bearings (avoid)

Dimensions sizes 10, 12, 16 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).



Shaft ends



Ports

Designation	Port for	Standard[6]	Size[4]	p_{max} [psi (bar)][5]	State[8]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	O[7]
T_2	Drain line	ISO 11926	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X[7]

1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
   X = Plugged (in normal operation)

Dimensions size 10, 12, 16 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

53 – Threaded ports at side, opposite

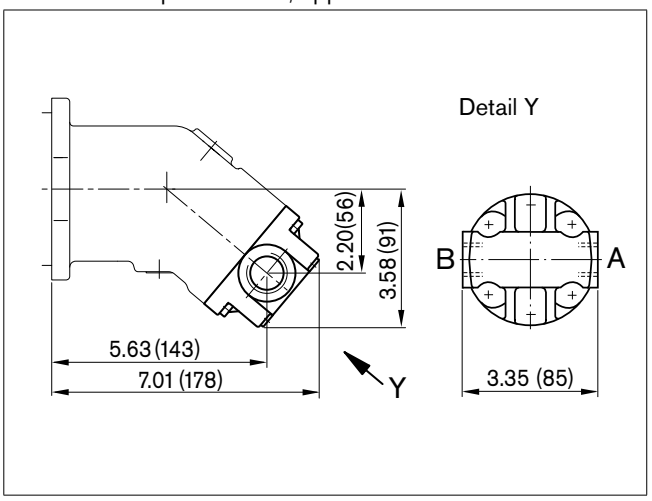
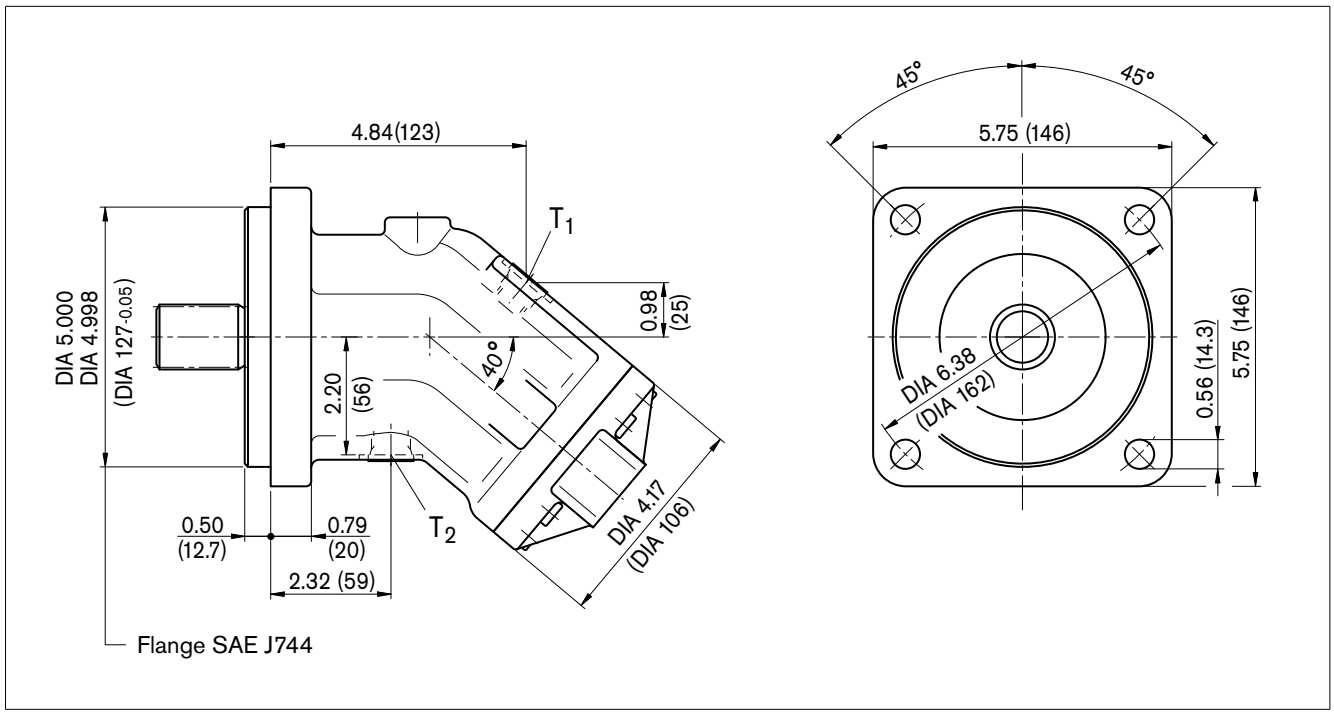


Plate	Designation	Port for	Standard[3]	Size[1]	p_{max} [psi (bar)][2]	State[4]
53	A, B	Service line	ISO11926	1 1/16-12UN-2B; 0.79 (20) deep	6500 (450)	O

1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)

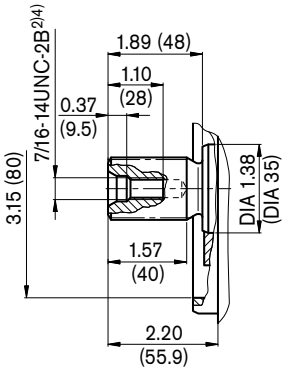
Dimensions sizes 23, 28, 32 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

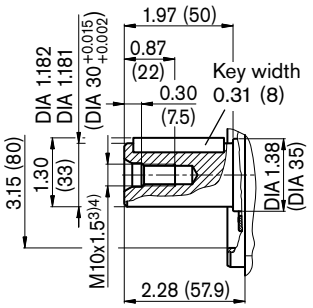


Shaft ends

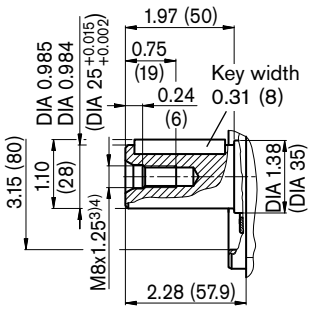
S Splined shaft SAE J744
1 1/4 in 14T 12/24 DP[1)]



B Parallel keyed shaft
DIN 6885, AS8x7x40 (mm)



P Parallel keyed shaft
DIN 6885, AS8x7x50 (mm)
(not for size 32)



Ports

Designation	Port for	Standard	Size[4)]	p_{max} [psi (bar)][5)]	State[8)]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[6)]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	O[7)]
T_2	Drain line	ISO 11926[6)]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	X[7)]

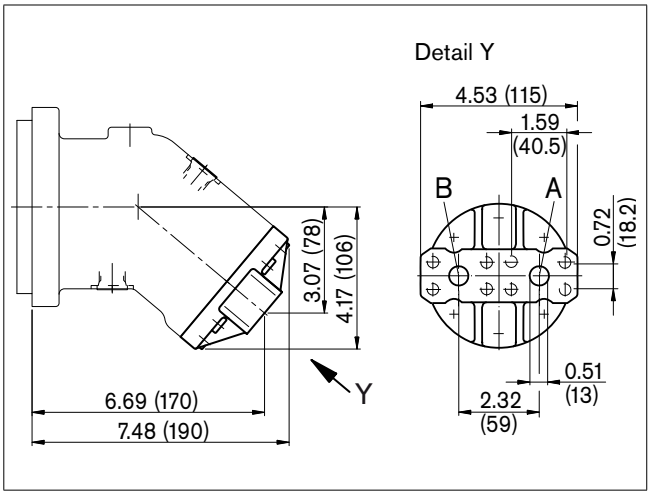
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 23, 28, 32 – SAE design

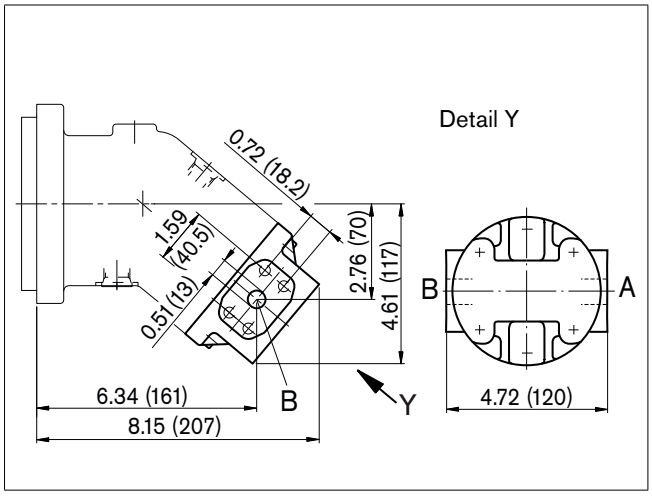
Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

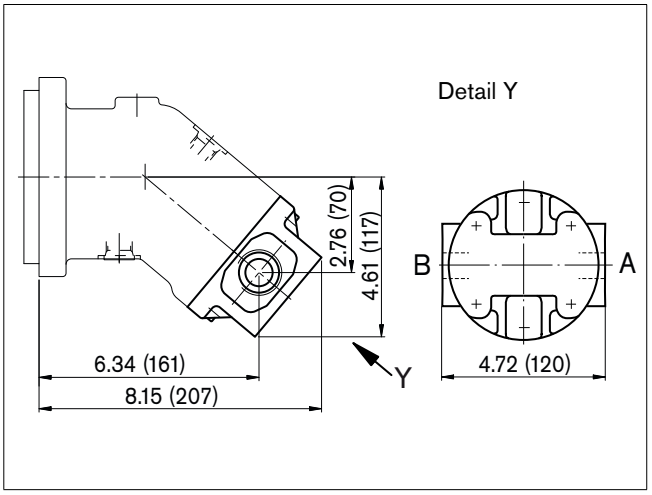
51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite



53 – Threaded ports at side, opposite



54 – Threaded ports at side and rear

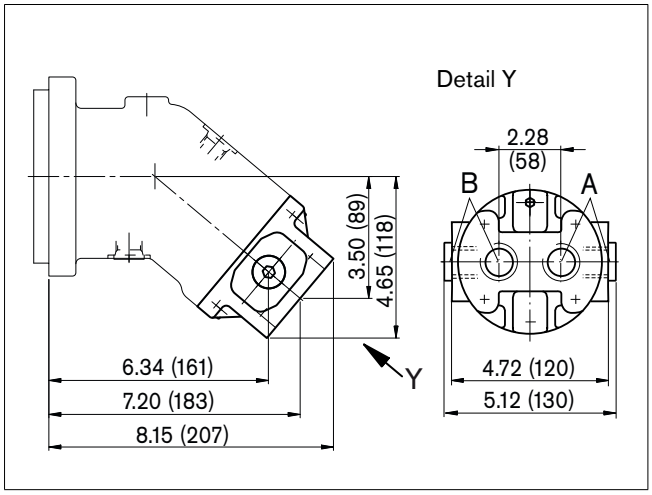


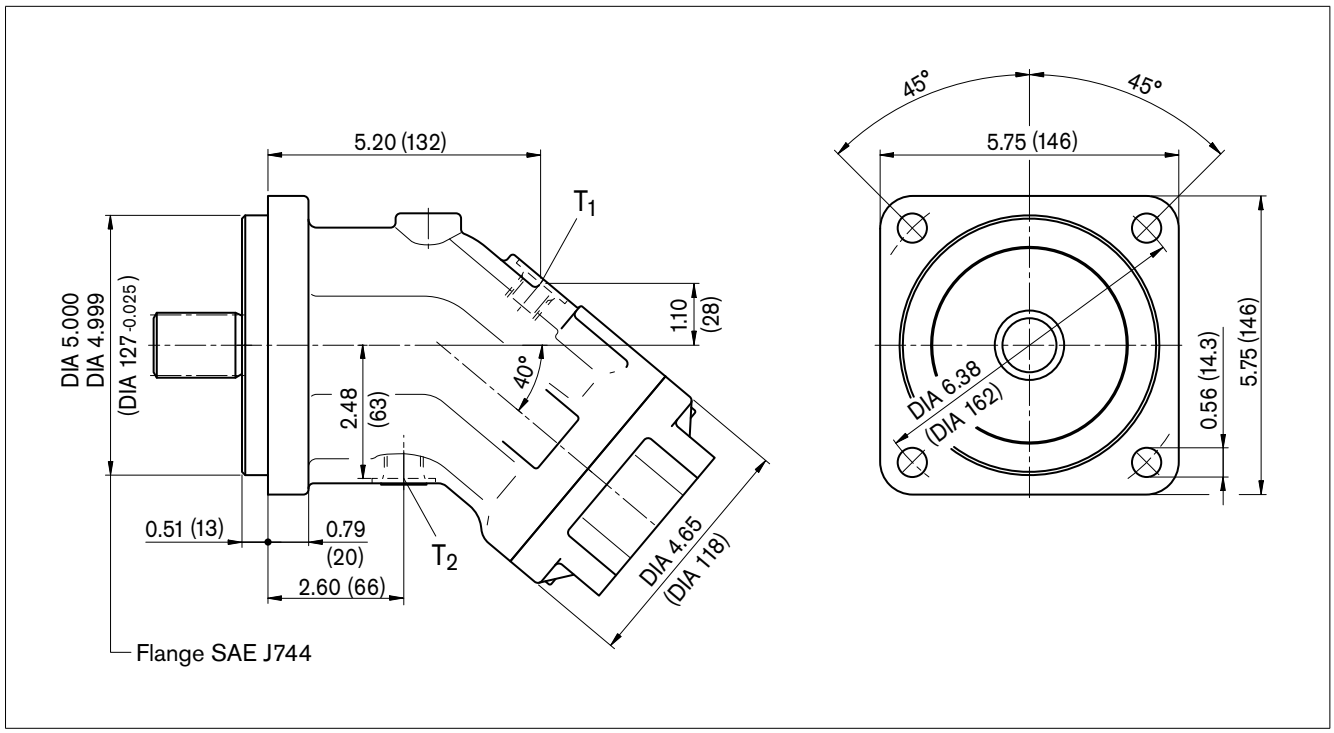
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[4]
51, 52	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1/2 in 5/16-18UNC-2B; 0.71 (18) deep	6500 (450)	O
53		Service line	ISO 11926[3]	1 5/16-12UN-2B; 0.79 (20) deep	6500 (450)	O
54						O 1x each

1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)

Note
Port plates 18 and 19: see pages 30 and 33

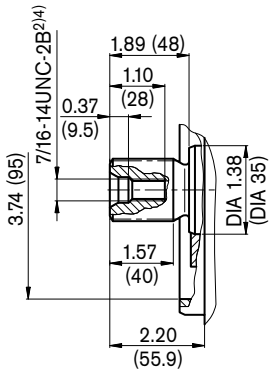
Dimensions size 45 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

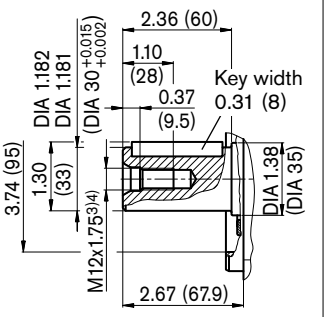


Shaft ends

S Splined shaft SAE J744
1 1/4 in 14T 2/24 DP[1)]



P Parallel keyed shaft
DIN 6885, AS8x7x50(mm)



Ports

Designation	Port for	Standard	Size[4)]	p_{max} [psi (bar)][5)]	State[8)]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[6)]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	O[7)]
T_2	Drain line	ISO 11926[6)]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	X[7)]

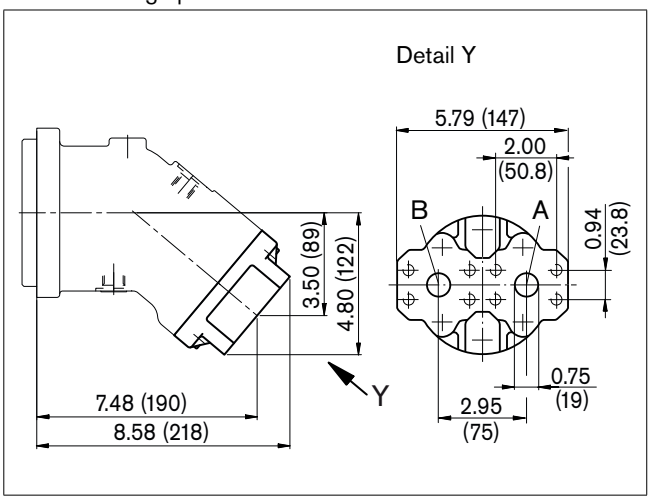
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 45 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

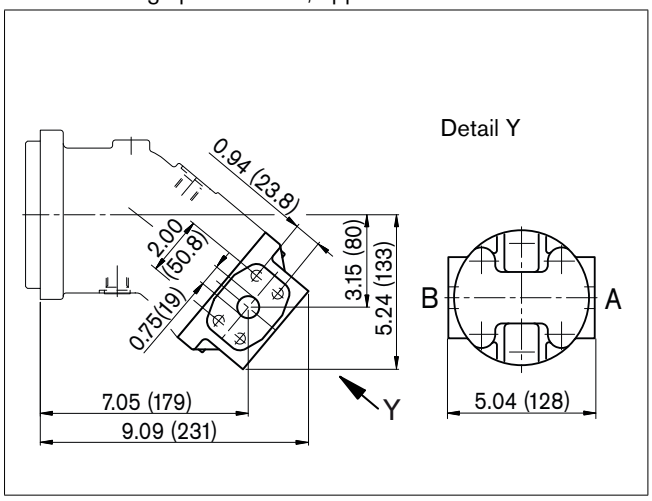


Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52	A, B	Service line	SAE J518[3]	3/4 in	6500 (450)	O
		Fastening thread A/B	ASME B1.1	3/8-16UNC-2B; 0.82 (21) deep		

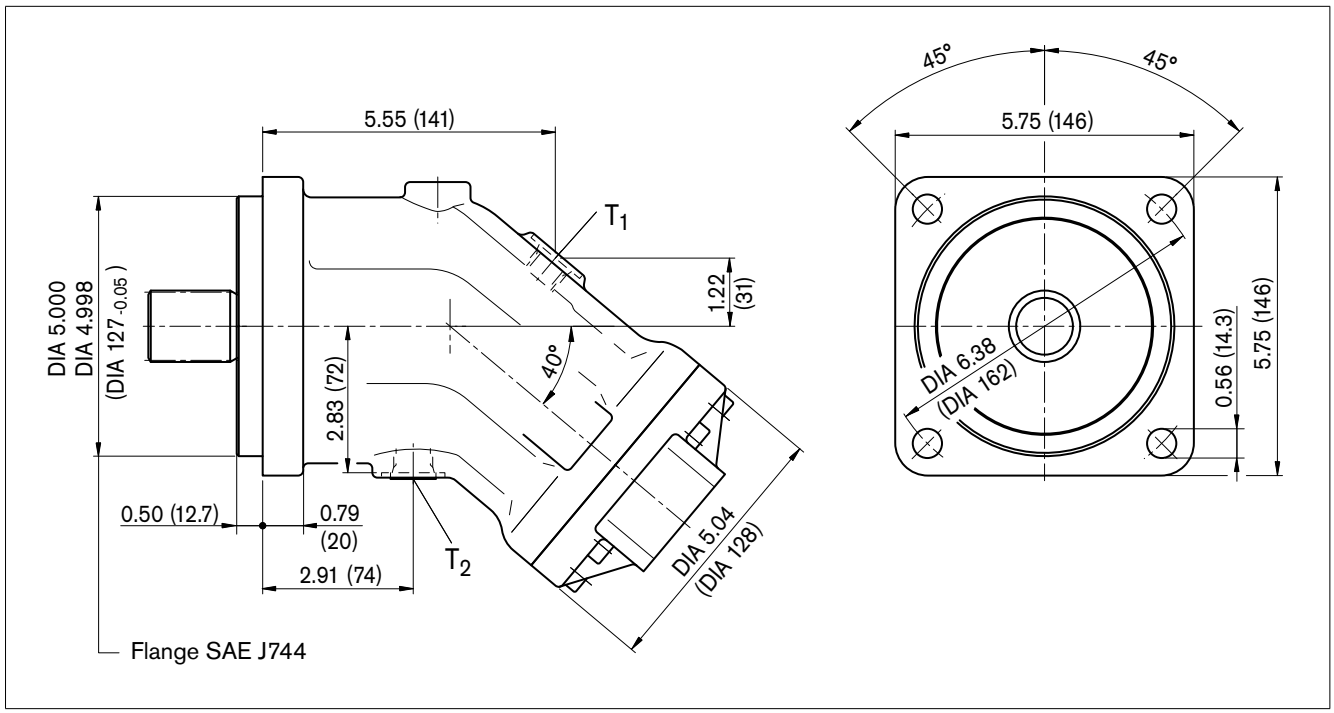
1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

Note

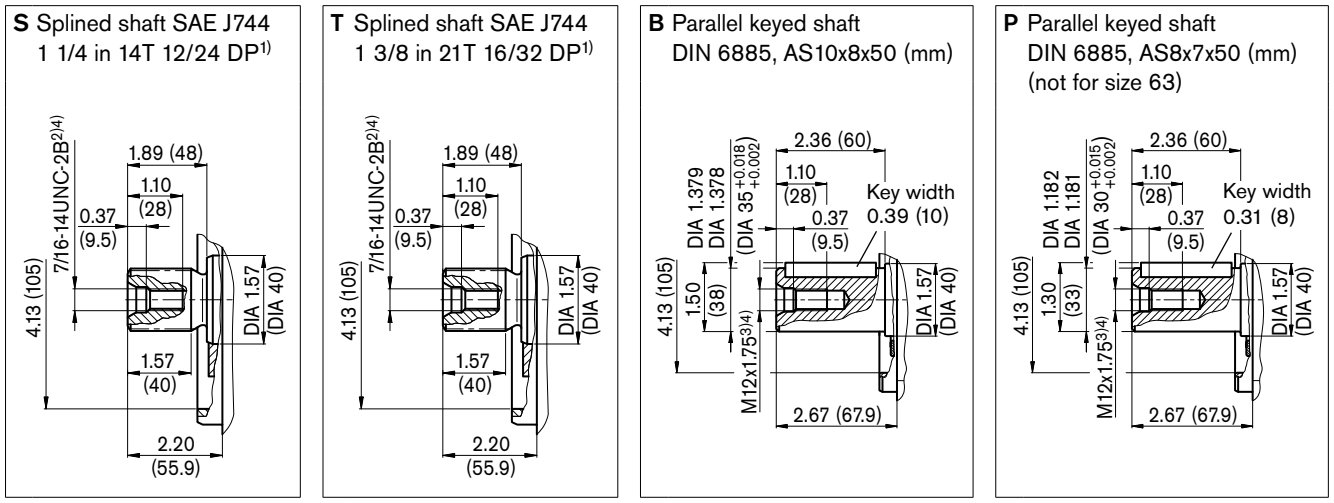
Port plates 18 and 19: see pages 30 and 33

Dimensions sizes 56, 63 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).



Shaft ends



Ports

Designation	Port for	Standard	Size[4]	p_{max} [psi (bar)][5]	State[8]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[6]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	O[7]
T_2	Drain line	ISO 11926[6]	3/4-16UNF-2B; 0.59 (15) deep	45 (3)	X[7]

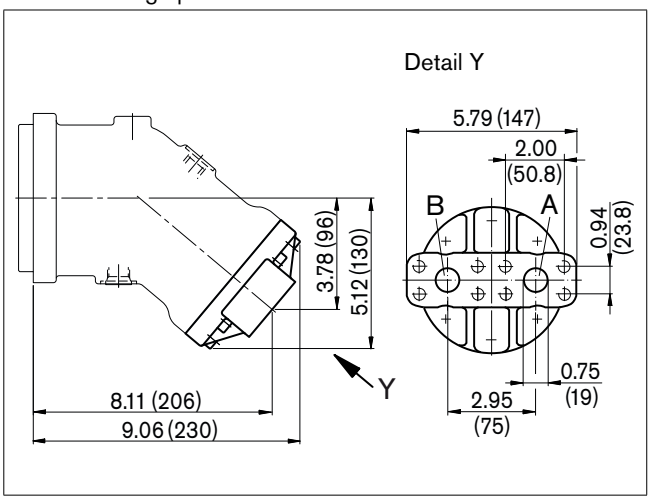
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
   X = Plugged (in normal operation)

Dimensions sizes 56, 63 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

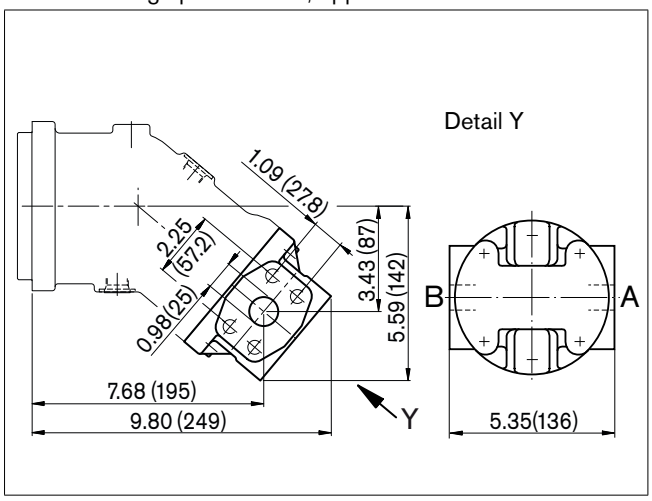


Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.82 (21) deep	6500 (450)	O
52				1 in 7/16-14UNC-2B; 0.75 (19) deep	6500 (450)	O

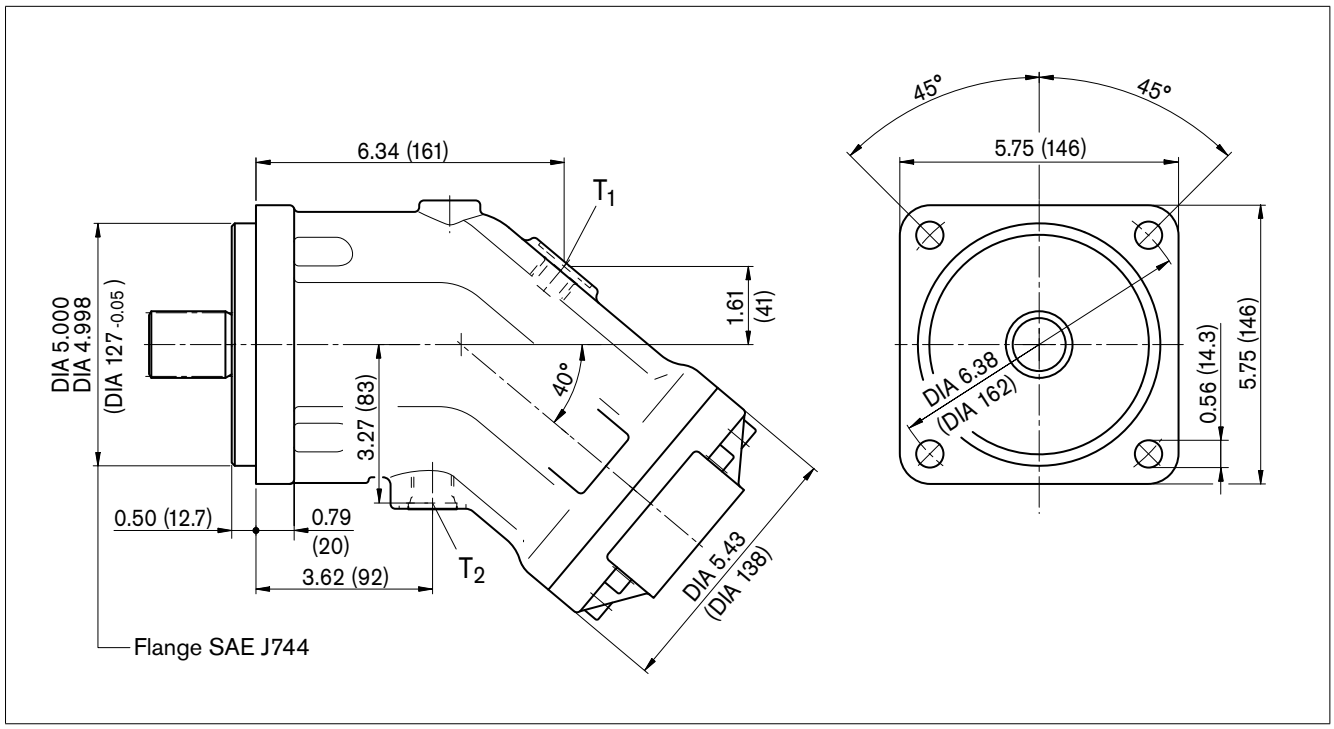
1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 30 and 33

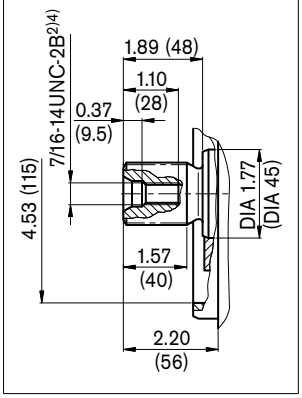
Dimensions sizes 80, 90 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

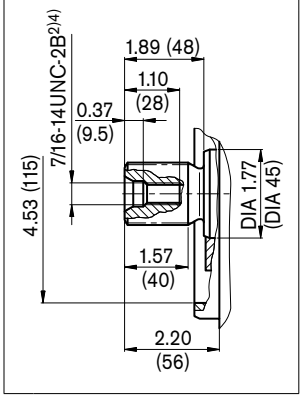


Shaft ends

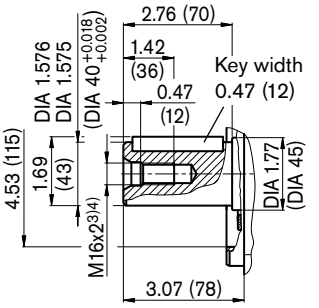
U Splined shaft SAE J744
1 3/8 in 21T 16/32 DP[1)]



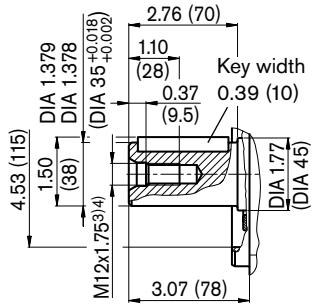
Q Splined shaft SAE J744
1 1/4 in 14T 12/24 DP[1)]



B Parallel keyed shaft
DIN 6885, AS12x8x56 (mm)



P Parallel keyed shaft
DIN 6885, AS10x8x56 (mm)
(not for size 90)



Ports

Designation	Port for	Standard	Size[4)]	p_{max} [psi (bar)][5)]	State[8)]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[6)]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	O[7)]
T_2	Drain line	ISO 11926[6)]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	X[7)]

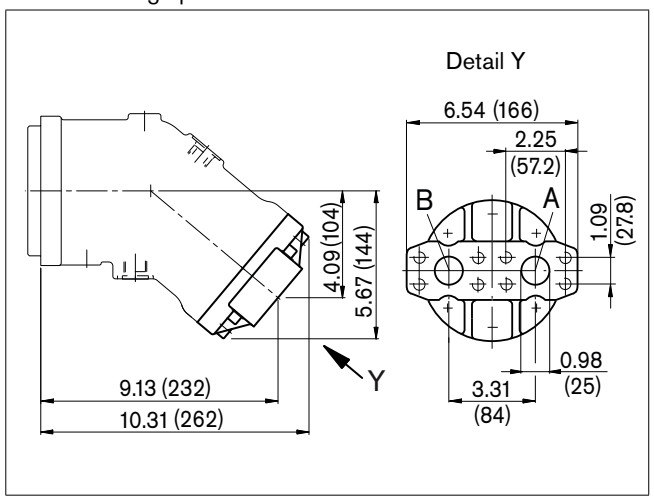
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
   X = Plugged (in normal operation)

Dimensions sizes 80, 90 – SAE design

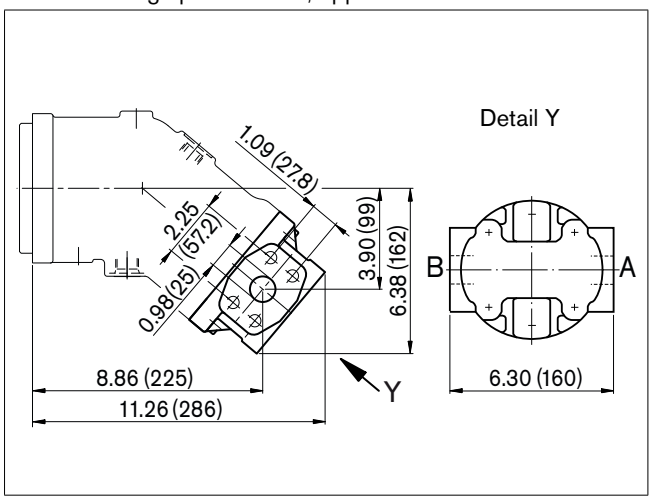
Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

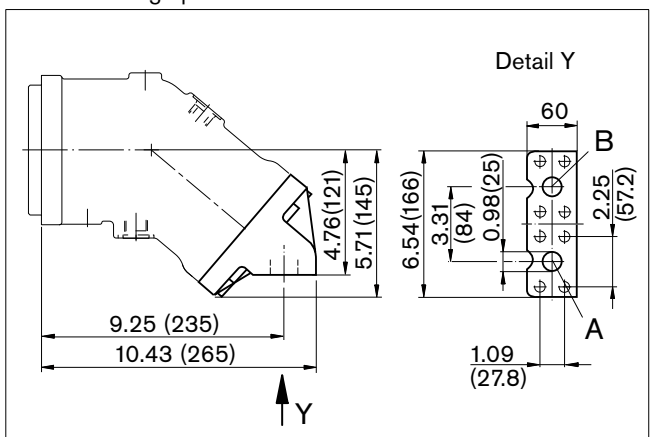
51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite



60 – SAE flange ports at bottom



Installation version 1 is shown.
Installation version 2 is turned arround 180°.

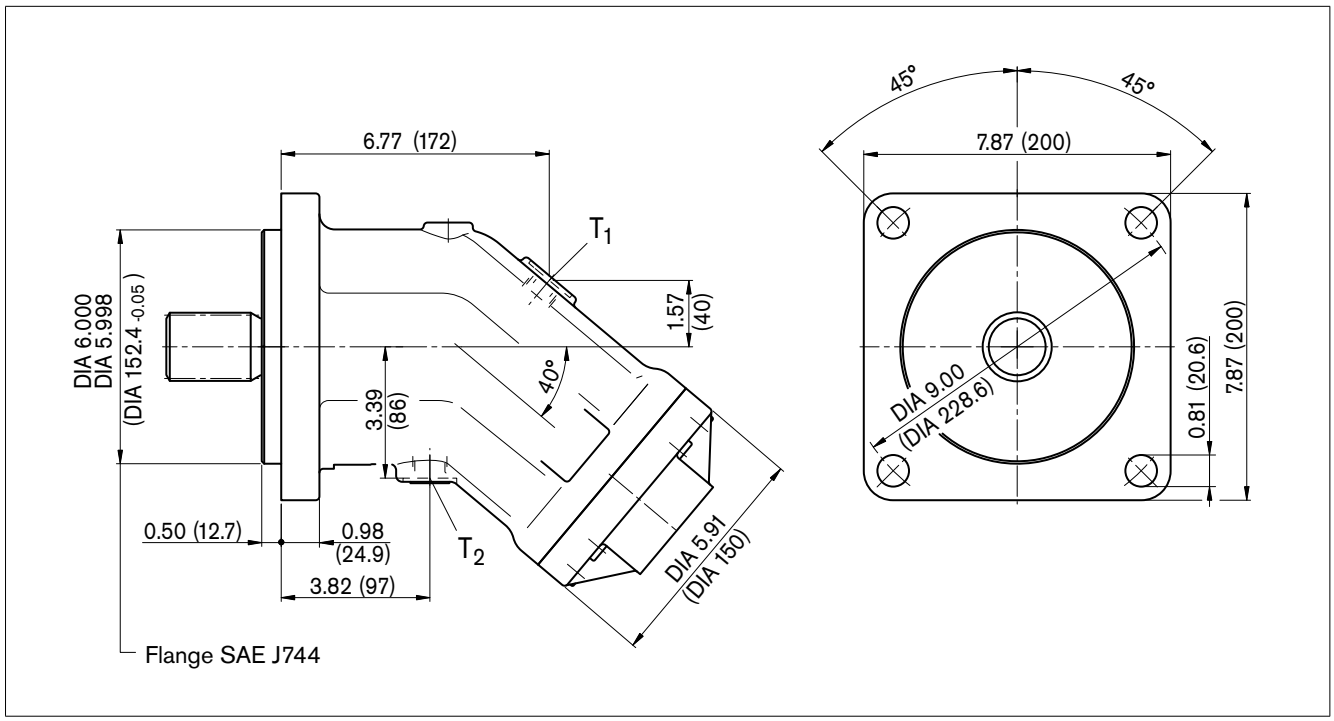
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52, 60	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1 in 7/16-14UNC-2B; 0.75 (19) deep	6500 (450)	O

1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

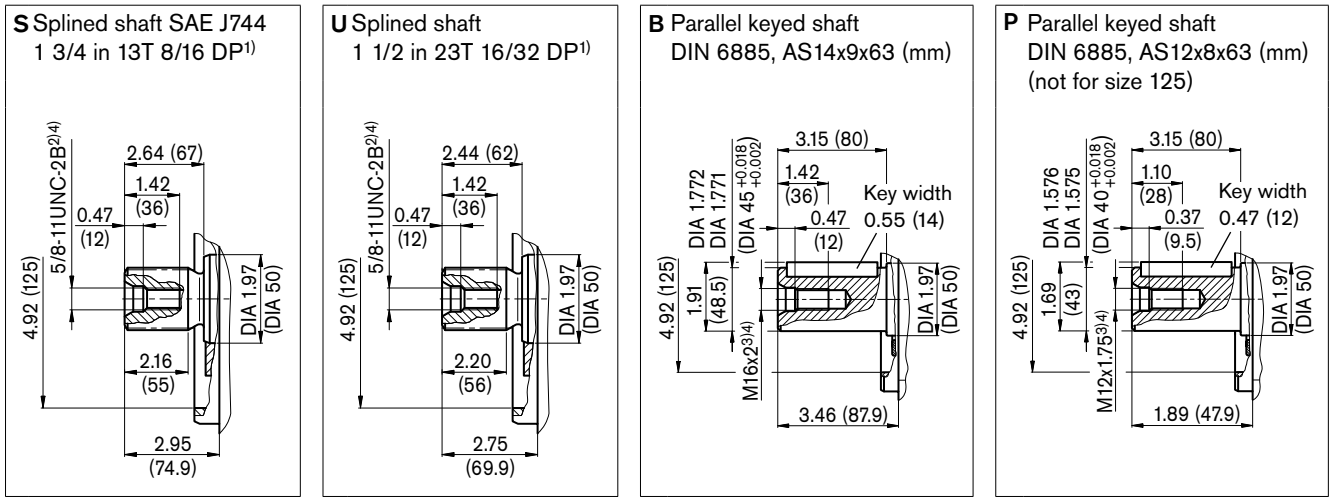
Note
Port plates 18 and 19: see pages 30 and 33

Dimensions sizes 107, 125 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).



Shaft ends



Ports

Designation	Port for	Standard	Size[4]	p_{max} [psi (bar)][5]	State[8]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[6]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	O[7]
T_2	Drain line	ISO 11926[6]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	X[7]

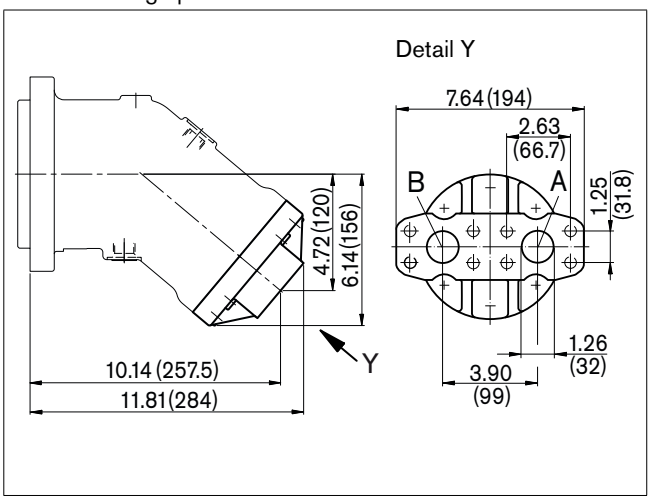
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
   X = Plugged (in normal operation)

Dimensions sizes 107, 125 – SAE design

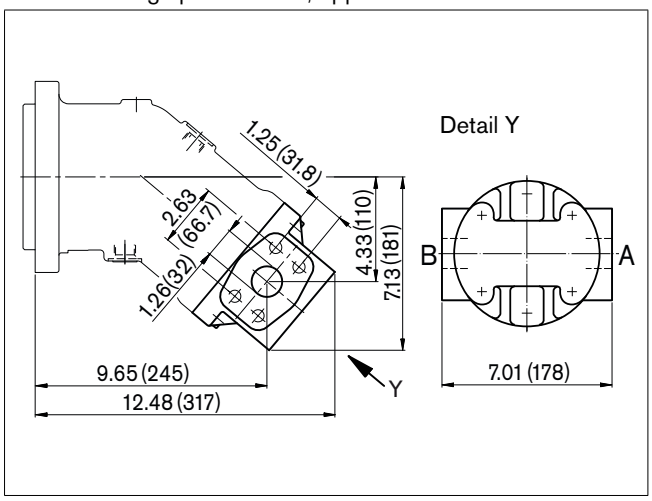
Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

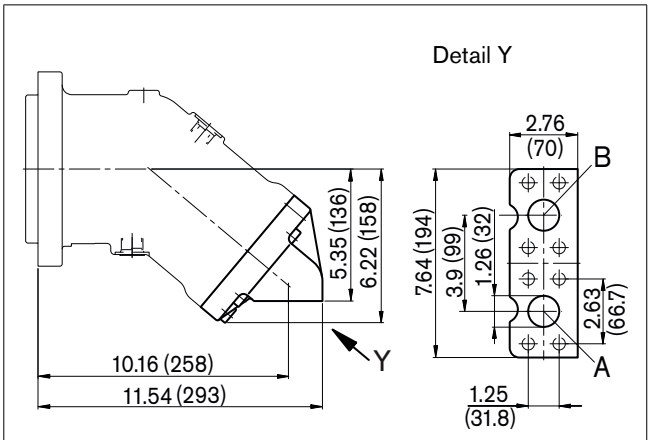
51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite



60 – SAE flange ports at bottom



Installation version 1 is shown.
Installation version 2 is turned arround 180°.

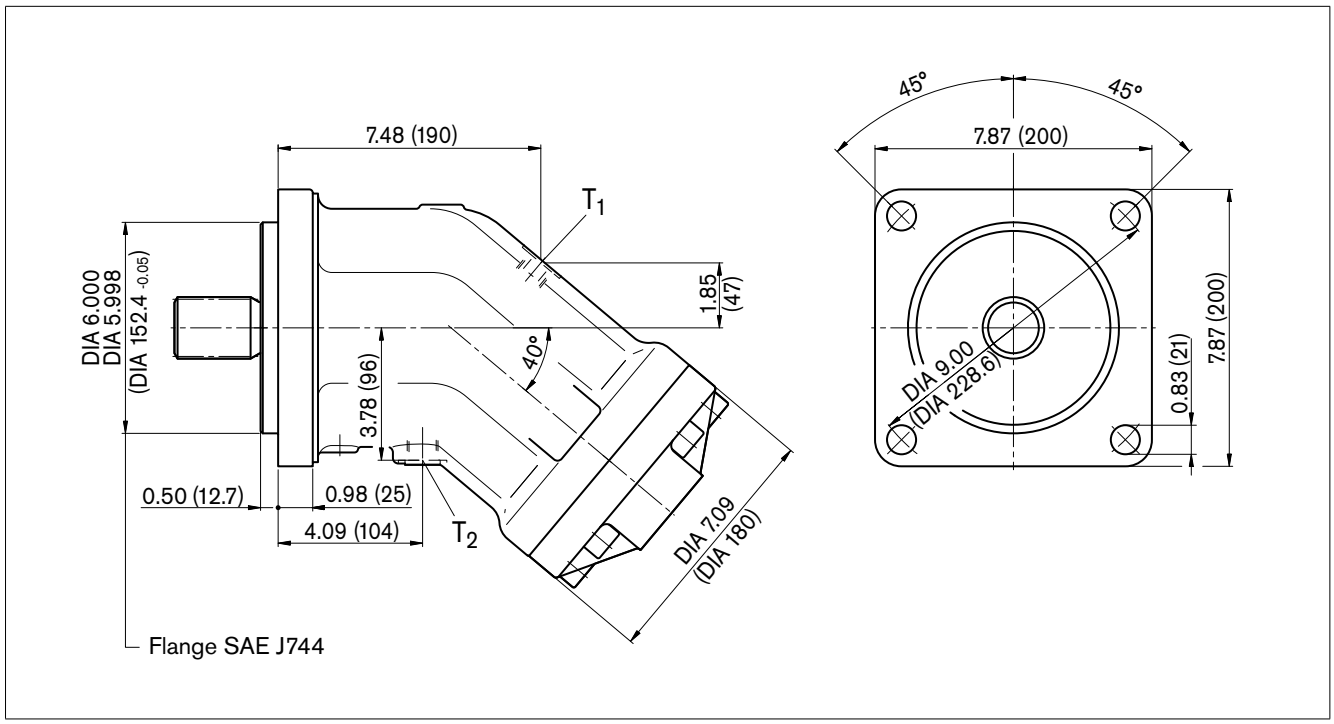
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52, 60	A, B	Service line	SAE J518	1 1/4 in	6500 (450)	O
		Fastening thread A/B	ASME B1.1	1/2-13UNC-2B; 0.75 (19) deep		

1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

Note
Port plates 17, 18 and 19: see pages 30 and 33

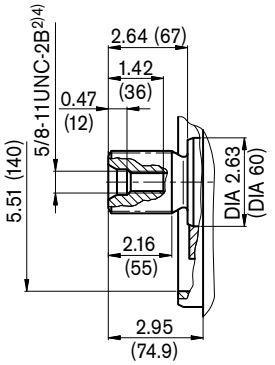
Dimensions sizes 160, 180 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

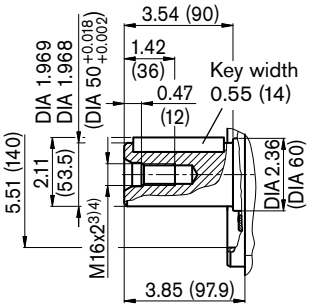


Shaft ends

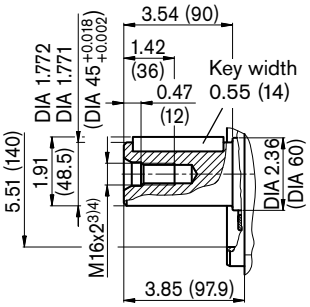
S Splined shaft SAE J744
1 3/4 in 13T 8/16 DP[1)]



B Parallel keyed shaft
DIN 6885, AS14x9x70 (mm)



P Parallel keyed shaft
DIN 6885, AS14x9x70 (mm)
(not for size 180)



Ports

Designation	Port for	Standard	Size[4)]	p_{max} [psi (bar)][5)]	State[8)]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[6)]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	O[7)]
T_2	Drain line	ISO 11926[6)]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	X[7)]

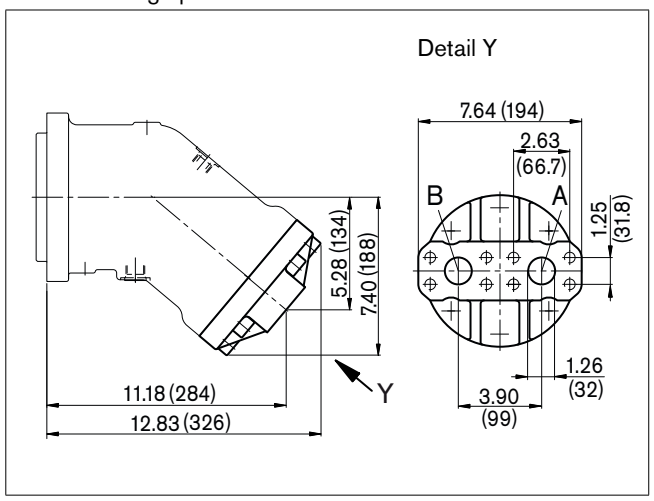
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions sizes 160, 180 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

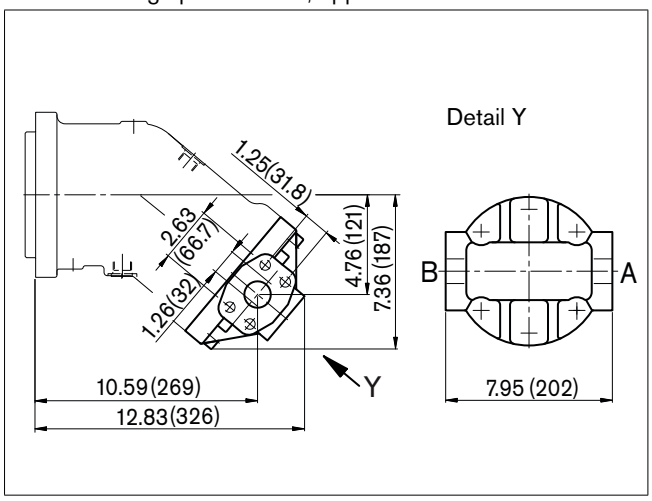


Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1 1/4 in 1/2-13UNC-2B; 0.75 (19) deep	6500 (450)	O

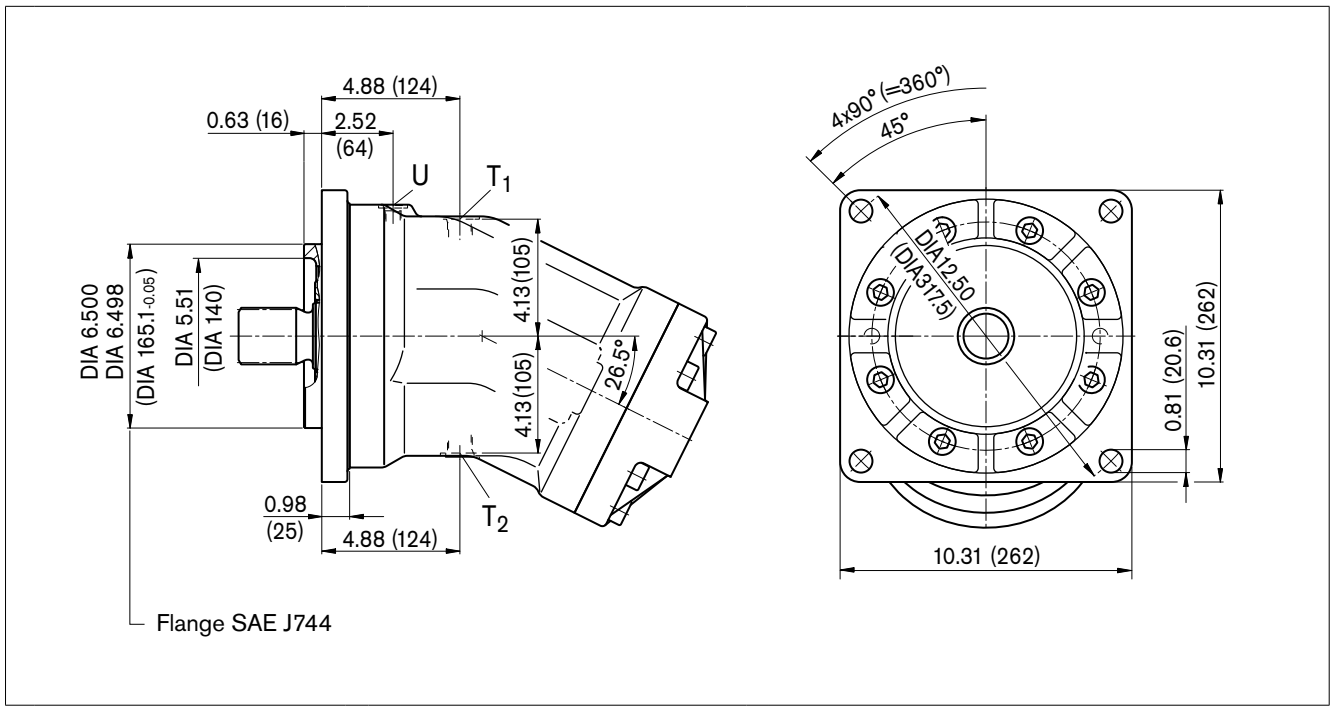
1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 30 and 33

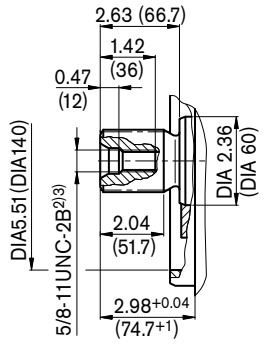
Dimensions size 250 – SAE design

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

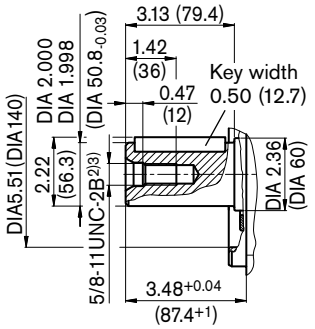


Drive shafts

S Splined shaft SAE J744
2 in 15T 8/16 DP[1)]



K Parallel keyed shaft
12.7x12.7x76.7 (mm)



Ports

Designation	Port for	Standard	Size[3)]	p_{max} [psi (bar)][4)]	State[7)]
A, B	Service line (see port plates)				
T_1	Drain line	ISO 11926[5)]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	O[6)]
T_2	Drain line	ISO 11926[5)]	7/8-14UNF-2B; 0.67 (17) deep	45 (3)	X[6)]
U	Port for bearing flushing	ISO 11926[5)]	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X

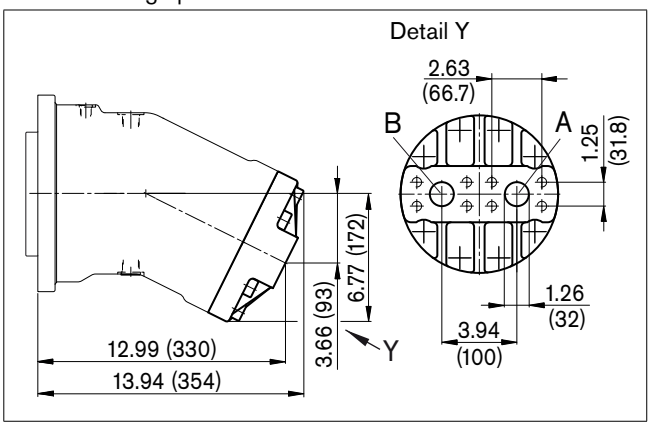
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 38 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) The spot face can be deeper than specified in the appropriate standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 36)
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 250

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

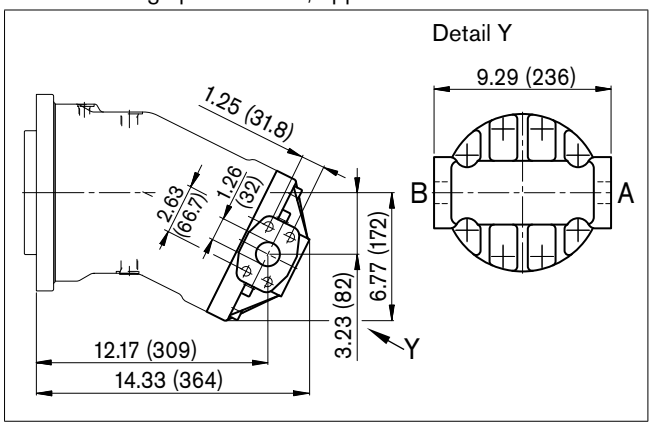


Plate	Designation	Port for	Standard	Size[1]	p_{max} [bar][2]	State[3]
51, 52	A, B	Service line	SAE J518	1 1/4 in	5800 (400)	O
		Fastening thread A/B	ASME B1.1	1/2-13UNC-2B; 0.75 (19) deep		

1) Observe the general instructions on page 38 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

Flushing and boost pressure valve

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

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

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

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

With port plate 527, the valve is mounted directly on the fixed motor (sizes 23 to 250).

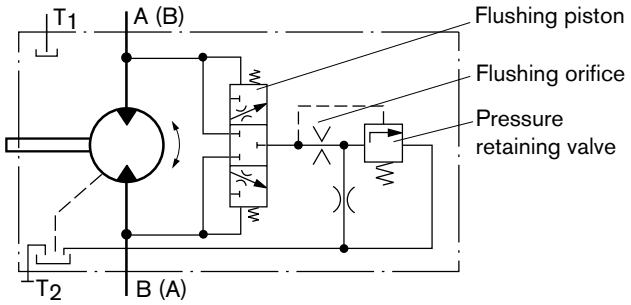
Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 23 to 250, fixed setting 230 psi (16 bar)

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

Flushing flow q_v

Orifice (throttles with integrated valve) can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 365$ psi (25 bar) and
$\nu = 46$ SUS (10 mm²/s)
(p_{ND} = low pressure, p_G = case pressure)

Schematic



Flushing and boost pressure valve, mounted (code 7)

Sizes 23 to 180
Orifices can be supplied for the following flushing flows:

Material number of orifice	q_v [gpm (L/min)]
R909651766	0.93 (3.5)
R909419695	1.32 (5)
R902030345	1.72 (6.5)
R909419696	2.11 (8)
R909419697	2.64 (10)
R902107424	3.43 (13)
R909444361	3.7 (14)

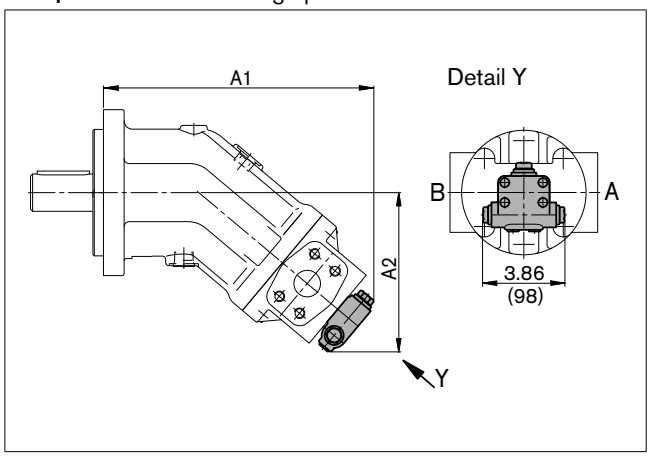
Size 250
Standard flushing flow 2.64 gpm (10 L/min).

For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 3.2 to 3.7 gpm (12 to 14 L) at low pressure $\Delta p_{ND} = 365$ psi (25 bar). For size 250, please contact us.

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Dimensions

Port plate 527 – SAE flange ports at side



Size		A1	A2
23 to 32	in	8.90	5.47
	mm	(226)	(139)
45	in	9.72	5.94
	mm	(247)	(151)
56, 63	in	10.67	6.26
	mm	(271)	(159)
80, 90	in	11.69	6.83
	mm	(297)	(173.5)
107, 125	in	12.83	7.56
	mm	(326)	(192)
160, 180	in	13.66	7.91
	mm	(347)	(201)
250	in	15.20	6.77
	mm	(386)	(172)

Pressure-relief valves

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

The MHDB pressure-relief valves (see RE 64642) protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the high-pressure side to the low-pressure side.

The pressure-relief valves are only available in combination with port plates 181, 191 or 192 (counterbalance valve for mounting to port plate 181: see next page).

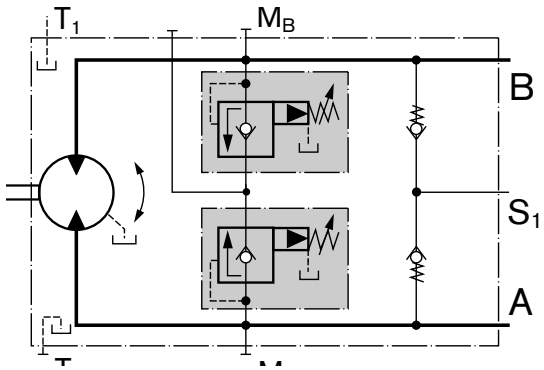
Cracking pressure setting range
725 to 6100 psi (50 to 420 bar)

With the version "with pressure boost facility" (192), a higher pressure setting can be realized by applying an external pilot pressure of 365 to 435 psi (25 to 30 bar) to port P_{St}.

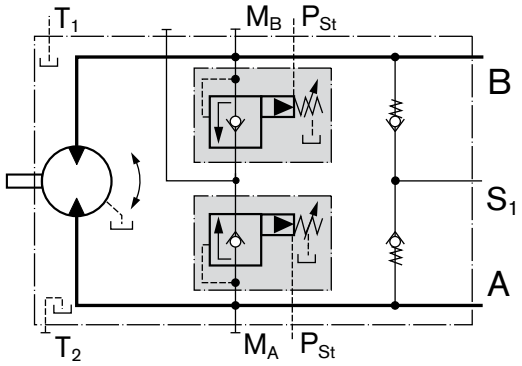
When ordering, please state in plain text:

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

Version without pressure boost facility "191"



Version with pressure boost facility "192"



Ports

Designation	Port for	Standard	Size	p_{max} [psi (bar)][1]	State[2]
A, B	Service line	SAE J518	See page 30	6500 (450)	O
S_1	Supply (only with port plate 191/192)	DIN 3852		75 (5)	O
M_A, M_B	Measuring operating pressure	DIN 3852		6500 (450)	X
P_{St}	Pilot pressure (only with port plate 192)	DIN ISO 228		435 (30)	O

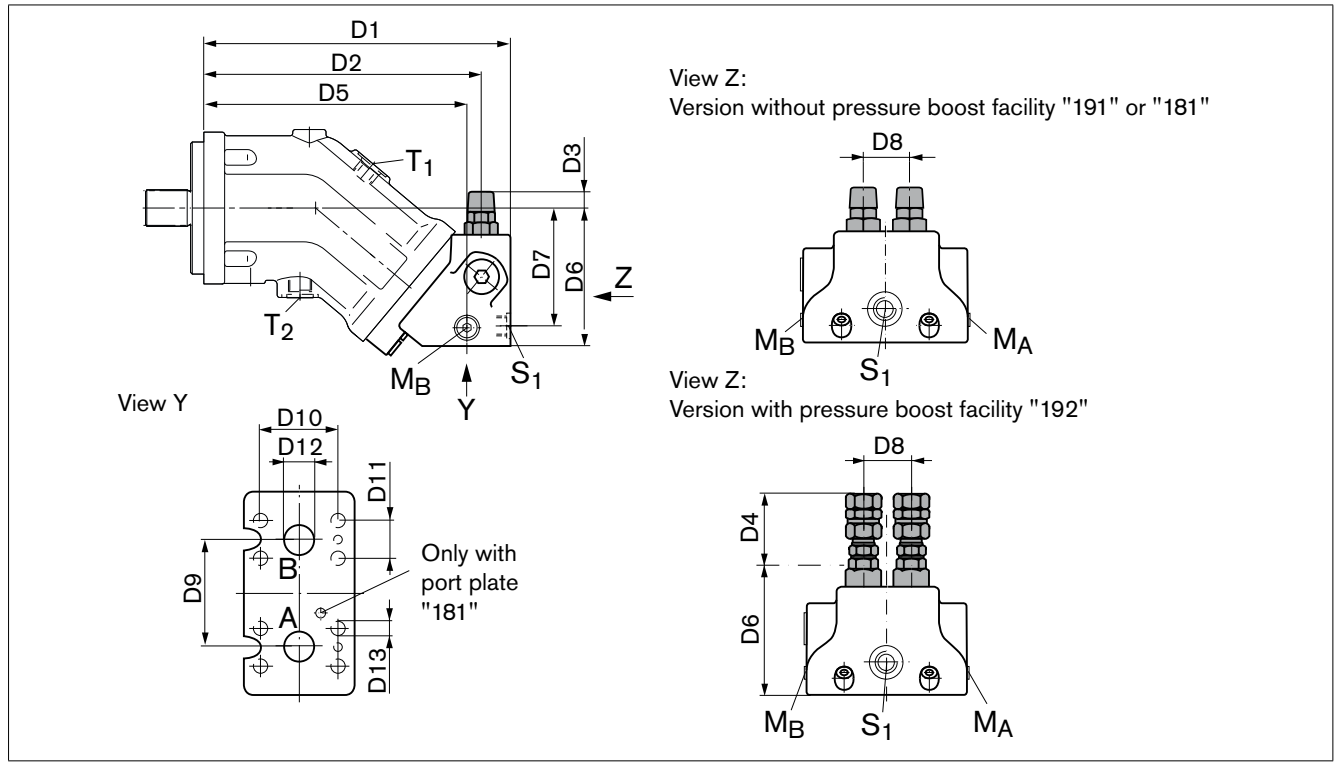
1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Pressure-relief valves

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Dimensions



Size			D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[1)2)]
28, 32	MHDB.**16**	in	8.90	7.99	0.98	2.68	7.52	4.02	3.43	1.42	2.60	2.00	0.94	0.75	M10; 0.67 (17) deep
		mm	226	203	25	68	191	102	87	36	66	50.8	23.8	19	
45	MHDB.**16**	in	9.69	8.74	0.87	2.56	8.31	4.45	3.86	1.42	2.60	2.00	0.94	0.75	M10; 0.67 (17) deep
		mm	246	222	22	65	211	113	98	36	66	50.8	23.8	19	
56, 63	MHDB.**22**	in	10.79	9.69	0.75	2.40	9.13	4.88	4.13	1.65	2.95	2.00	0.94	0.75	M10; 0.51 (13) deep
		mm	274	246	19	61	232	124	105	42	75	50.8	23.8	19	
80, 90	MHDB.**22**	in	11.81	10.71	0.69	2.32	10.16	5.28	4.49	1.65	2.95	2.25	1.09	0.98	M12; 0.71 (18) deep
		mm	300	272	17.5	59	258	134	114	42	75	57.2	27.8	25	
107, 125	MHDB.**32**	in	12.99	11.73	0.39	2.05	11.10	5.89	5.12	2.09	3.31	2.63	1.25	1.26	M14; 0.75 (19) deep
		mm	330	298	10	52	282	149.5	130	53	84	66.7	31.8	32	
160, 180	MHDB.**32**	in	14.33	13.11	0.20	1.85	12.48	6.69	5.87	2.09	3.31	2.63	1.25	1.26	M14; 0.75 (19) deep
		mm	364	333	5	47	317	170	149	53	84	66.7	31.8	32	

Size	A, B	S_1[2)]	M_A, M_B[2)]	P_{St}[2)]
28, 32	3/4 in	M22 x 1.5; 0.55 (14) deep	M20 x 1.5; 0.55 (14) deep[2)]	G 1/4
45	3/4 in	M22 x 1.5; 0.55 (14) deep	M20 x 1.5; 0.55 (14) deep[2)]	G 1/4
56, 63	3/4 in	M26 x 1.5; 0.63 (16) deep	M26 x 1.5; 0.63 (16) deep[2)]	G 1/4
80, 90	1 in	M26 x 1.5; 0.63 (16) deep	M26 x 1.5; 0.63 (16) deep[2)]	G 1/4
107, 125	1 1/4 in	M26 x 1.5; 0.63 (16) deep	M26 x 1.5; 0.63 (16) deep[2)]	G 1/4
160, 180	1 1/4 in	M26 x 1.5; 0.63 (16) deep	M30 x 1.5; 0.63 (16) deep	G 1/4

1) Thread according to DIN 13

2) Observe the general instructions on page 38 for the maximum tightening torques.

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

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Function

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

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 290 psi (20 bar).

Note

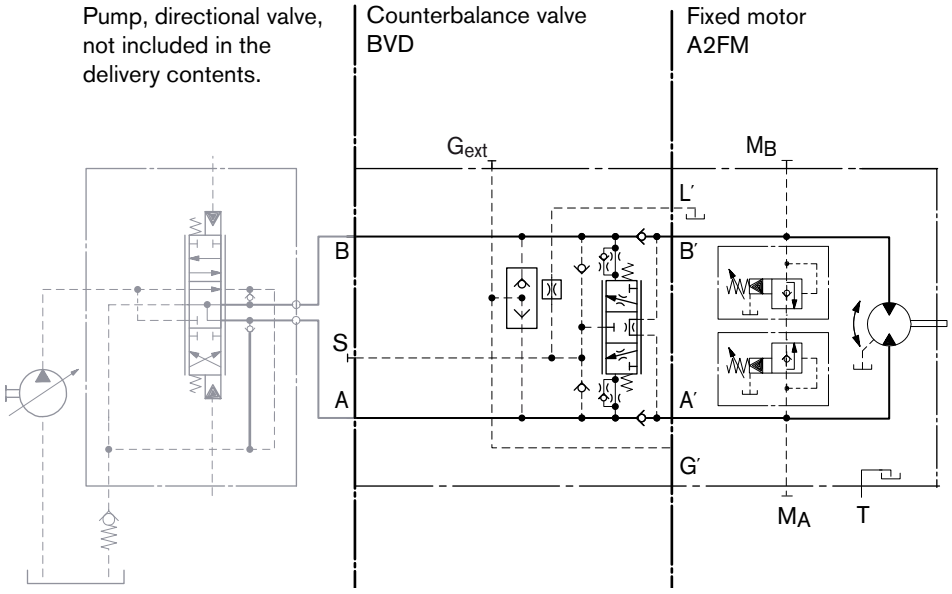
- BVD available for sizes 28 to 180 and BVE available for sizes 107 to 180.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: AA2FM90/61W–VUDN**188** + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!
- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of opening
  - the volume of the brake piston between minimum stroke (brake closed) and maximum stroke (brake released with 305 psi (21 bar)
  - the required closing time for a warm device (oil viscosity approx. 69.6 SUS (15 mm^2/s))

Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
AA2FM090/61W-VAB188 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

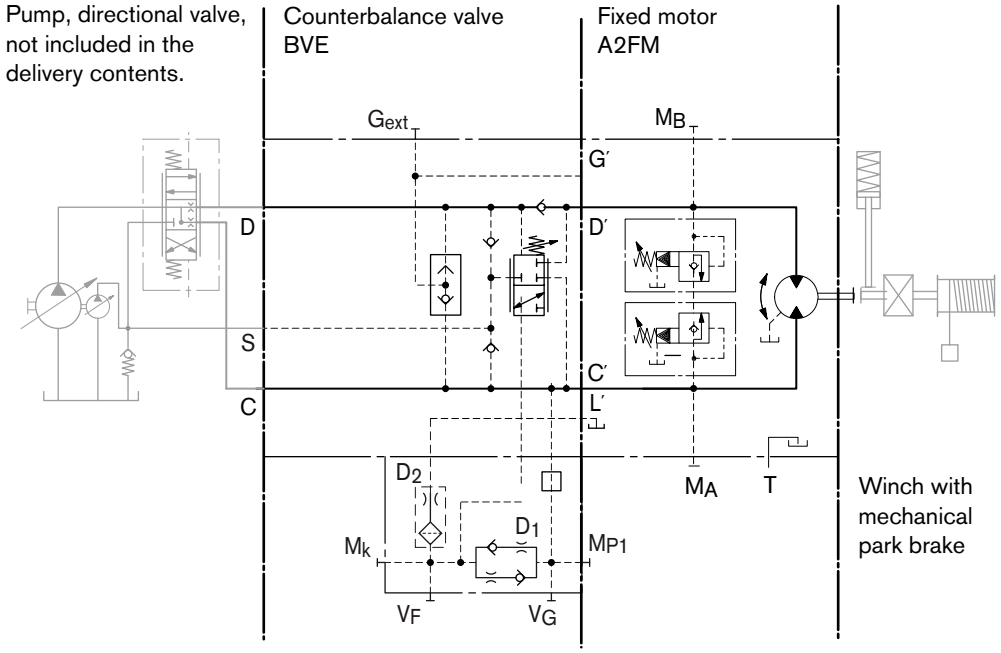
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
AA2FM090/61W-VAB188 + BVE25W385/51ND-V100K00D4599T30S00-0



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

Motor Size	Without valve		Restricted values in operation with DBV and BVD/BVE							
			DBV				BVD/BVE			
	p_{nom}/p_{max} [psi (bar)]	$q_{V\ max}$ [GPM(L/min)]	Size	p_{nom}/p_{max} [psi (bar)]	q_V [GPM(L/min)]	Code	Size	p_{nom}/p_{max} [psi (bar)]	q_V [GPM(L/min)]	Code
28	5800/6500 (400/450)	46.49 (176)	16	5100/6100 (350/420)	26.41 (100)	181 191, 192	20 (BVD)	5100/6100 (350/420)	26.41 (100)	188
32		53.09 (201)								
45		67.36 (255)								
56		73.96 (280)	22		63.40 (240)				58.12 (220)	
63		83.21 (315)								
80		95.10 (360)								
90		106.98 (405)								
107		112.80 (427)				171 191, 192				178
125		132.08 (500)								
107		112.80 (427)	32		105.66 (400)	181 191, 192	25 (BVD/ BVE)		84.54 (320)	188
125		132.08 (500)								
160		152.42 (577)								
180		171.18 (648)								

DBV _____ pressure-relief valve

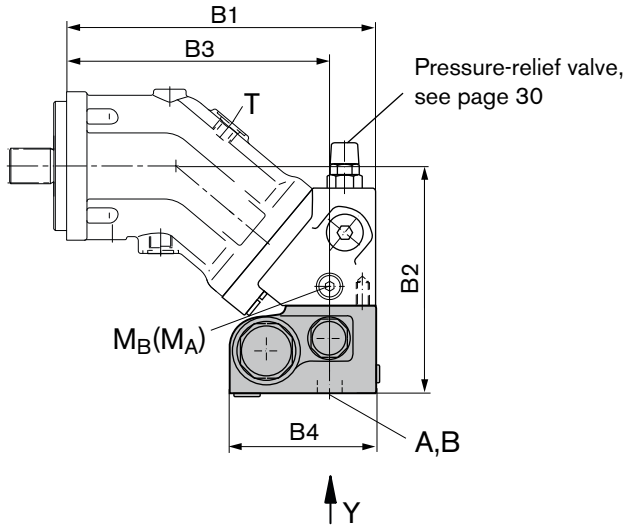
BVD _____ counterbalance valve, double-acting

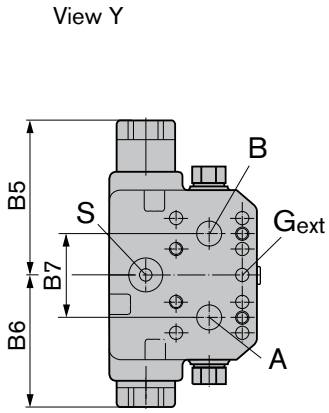
BVE _____ counterbalance valve, one-sided

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Dimensions





A2FM Size	Counterbalance valve Type	Ports A, B		Dimensions B1	B2	B3	B4 (S)	B4 (L)	B5	B6	B7
28, 32	BVD**20**..16	3/4 in	in	8.90	6.89	6.73	5.59	5.79	5.47	3.86	2.60
			mm	226	175	191	142	147	139	98	66
45	BVD**20**..16	3/4 in	in	9.69	7.72	8.31	5.59	5.79	5.47	3.86	2.60
			mm	246	196	211	142	147	139	98	66
56, 63	BVD**20**..17	3/4 in	in	10.79	7.76	9.13	5.59	5.79	5.47	3.86	2.95
			mm	274	197	232	142	147	139	98	75
80, 90	BVD**20**..27	1 in	in	11.81	8.15	10.16	5.59	5.79	5.47	3.86	2.95
			mm	300	207	258	142	147	139	98	75
107, 125	BVD**20**..28	1 in	in	12.99	9.37	11.14	5.59	5.79	5.47	3.86	3.31
			mm	330	238	283	142	147	139	98	84
107, 125	BVD**25**..38	$1^1/_4$ in	in	12.99	9.41	11.14	6.22	6.41	6.89	4.74	3.31
			mm	330	239	283	158	163	175	120.5	84
160, 180	BVD**25**..38	$1^1/_4$ in	in	14.33	10.24	12.48	6.22	6.41	6.89	4.74	3.31
			mm	364	260	317	158	163	175	120.5	84
107, 125	BVE**25**..38	$1^1/_4$ in	in	12.99	9.45	11.14	6.57	6.77	8.43	5.39	3.31
			mm	330	240	283	167	172	214	137	84
160, 180	BVE**25**..38	$1^1/_4$ in	in	14.33	10.24	12.48	6.57	6.77	8.43	5.39	3.31
			mm	364	260	317	167	172	214	137	84
250	On request										

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Ports

Designation	Port for	Version	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State[4]
A, B	Service line		SAE J518	see table on page 33	6100 (420)	O
S	Infeed	BVD20	DIN 3852[3]	M22 x 1.5; 0.55 (14) deep	435 (30)	X
		BVD25, BVE25	DIN 3852[3]	M27 x 2; 0.63 (16) deep	435 (30)	X
Br	Brake release, reduced high pressure	L	DIN 3852[3]	M12 x 1.5; 0.29 (12.5) deep	435 (30)	O
G_{ext}	Brake release, high pressure	S	DIN 3852[3]	M12 x 1.5; 0.29 (12.5) deep	6100 (420)	X
M_A, M_B	Measuring pressure A and B		ISO 6149[3]	M12 x 1.5; 0.47 (12) deep	6100 (420)	X

1) Observe the general instructions on page 38 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Mounting the counterbalance valve

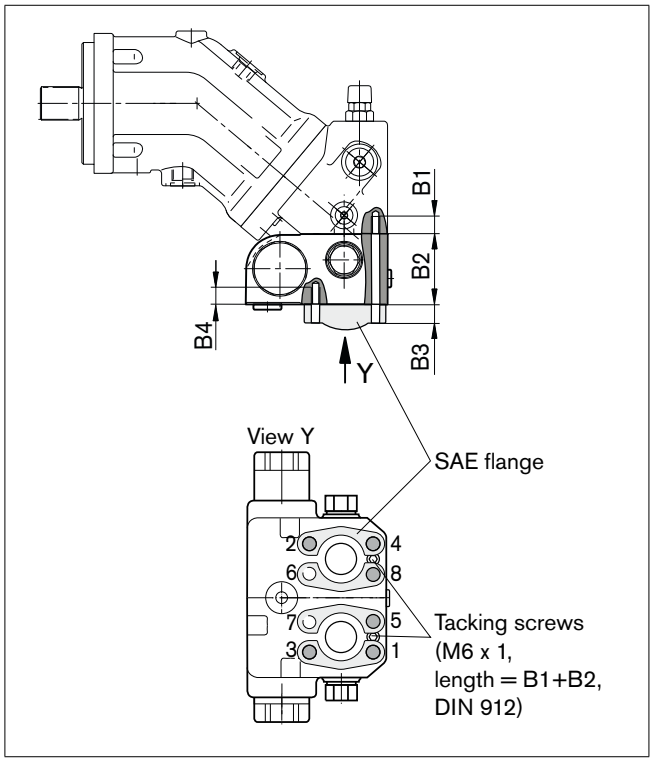
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the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

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

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

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

Thread	Strength class	Tightening torque [lb-ft (Nm)]
M6 x 1 (tacking screw)	10.9	11.4 (15.5)
M10	10.9	55 (75)
M12	10.9	95 (130)
M14	10.9	150 (205)



Size	28, 32, 45	56, 63	80, 90	107, 125, 160, 180	107, 125
Port plate	18				17
B1[1]	M10 x 1.5; 0.67 (17) deep	M10 x 1.5; 0.67 (17) deep	M12 x 1.75; 0.71 (18) deep	M14 x 2; 0.75 (19) deep	M12 x 1.75; 0.67 (17) deep
B2	3.07 (78)[2]	2.67 (68)	2.67 (68)	3.35 (85)	2.67 (68)
B3	customer-specific				
B4	M10 x 1.5; 0.59 (15) deep	M10 x 1.5; 0.59 (15) deep	M12 x 1.75; 0.63 (16) deep	M14 x 2; 0.75 (19) deep	M12 x 1.75; 0.67 (17) deep

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

Speed sensors

Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

The versions AA2FM...U and AA2FM...F ("prepared for speed sensor", i.e. without sensor) is equipped with a toothed ring on the rotary group.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

With the DSM/DSA or HDD speed sensor mounted a signal proportional to motor speed can be generated.
The sensors measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

DSM _____ RE 95132

DSA _____ RE 95133

HDD _____ RE 35135

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

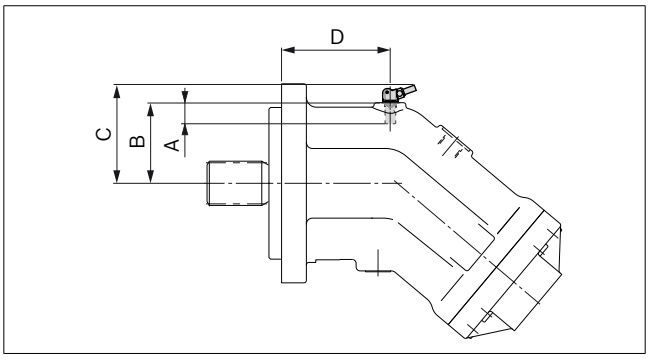
DSM/DSA _____ with one mounting bolt

HDD _____ with two mounting bolts

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

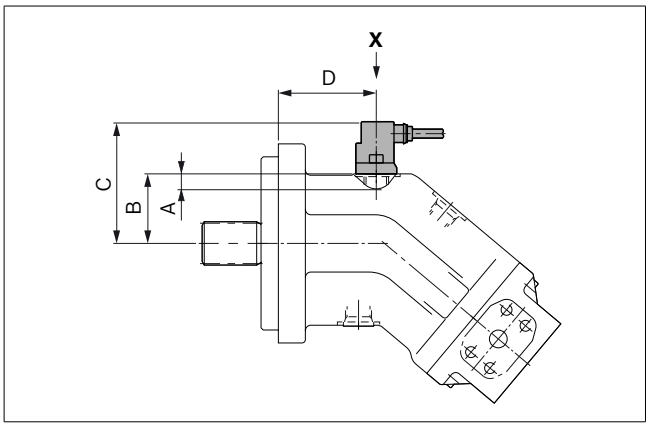
Version "V"

Sizes 23 to 180 with DSM/DSA sensor

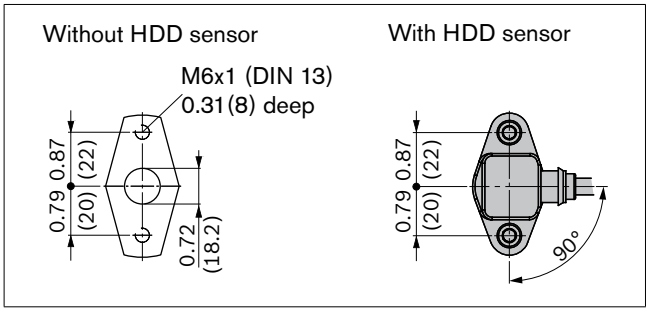


Version "F"

Sizes 23 to 180 with HDD sensor



View X



Size					23, 28, 32	45	56, 63	80, 90	107, 125	160, 180
Number of teeth					38	45	47	53	59	67
HDD	A	Insertion depth	(tolerance ± 0.004)	in	0.63	0.63	0.63	0.63	0.63	0.63
			(tolerance ± 0.1)	mm	16	16	16	16	16	16
	B	Contact surface		in	2.19	2.46	2.66	2.85	3.05	3.35
				mm	55.5	62.5	67.5	72.5	77.5	85
	C			in	3.69	3.97	4.17	4.36	4.56	4.85
				mm	93.8	100.8	105.8	110.8	115.8	123.3
	D			in	2.15	2.14	2.42	2.85	3.02	3.42
				mm	73.7	79.3	87.5	101.5	111.8	118.8
DSM/ DSA	A	Insertion depth	(tolerance ± 0.004)	in	0.72	0.72	0.72	0.72	0.72	0.72
			(tolerance ± 0.1)	mm	18.4	18.4	18.4	18.4	18.4	18.4
	B	Contact surface		in	2.28	2.56	2.75	2.95	3.15	3.44
				mm	57.9	64.9	69.9	74.9	79.9	87.4
	C			in	2.93	3.21	3.41	3.60	3.80	4.09
				mm	74.5	81.5	86.5	91.5	96.5	104
	D			in	2.82	3.08	3.37	3.40	4.28	4.68
				mm	71.7	78.3	85.5	101.5	108.8	118.8

Installation instructions

General

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

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

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

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

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

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

Installation position

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

Recommended installation positions: 1 and 2.

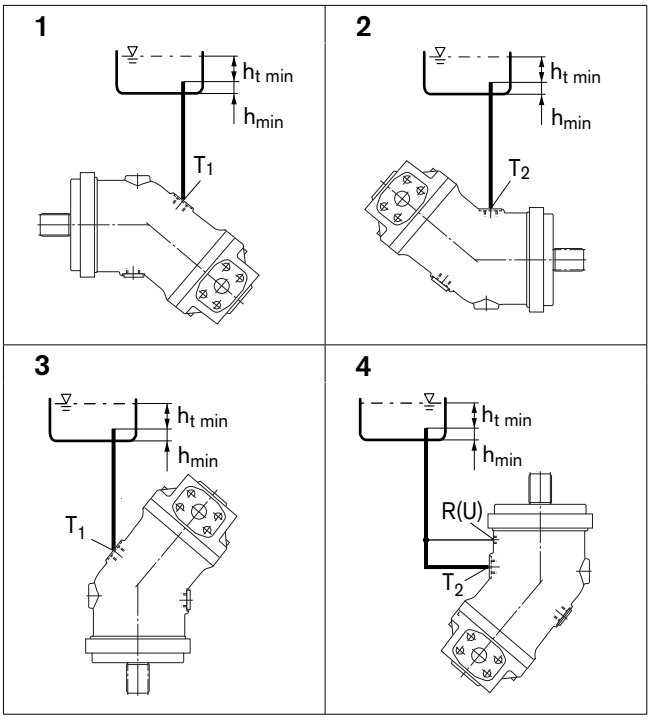
Note
With sizes 10 to 180 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering - special version). With size 250, port U is provided as standard in the area near the bearings for air bleeding.

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

L_1	Filling / air bleed
R	Air bleed port (special version)
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (7.87 in (200 mm))
h_{min}	Minimum required spacing to reservoir bottom (3.94 in (100 mm))

Below-reservoir installation (standard)

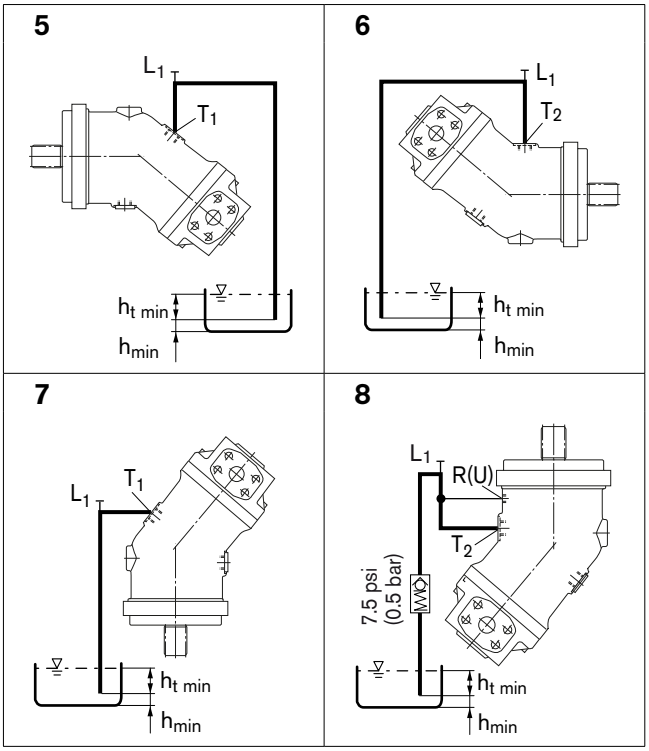
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

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

Recommendation for installation position 8 (drive shaft upward): A check valve in the drain line (cracking pressure 7.5 psi (0.5 bar)) can prevent draining of the motor housing.



Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Additional information of general instructions (page 38)

Ports Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\ max}$	Required tightening torque of the threaded plugs M_V	WAF hexagon socket of the threaded plugs
ISO 11926	9/16-18 UNF-2B	59 lb-ft	26 lb-ft	1/4 in
		80 Nm	35 Nm	
	3/4-16 UNF-2B	118 lb-ft	52 lb-ft	5/16 in
		160 Nm	70 Nm	
	7/8-14 UNF-2B	177 lb-ft	81 lb-ft	3/8 in
		240 Nm	110 Nm	
	1 1/16-12 UN-2B	266 lb-ft	125 lb-ft	9/16 in
		360 Nm	170 Nm	
	1 5/16-12 UN-2B	398 lb-ft	199 lb-ft	5/8 in
		540 Nm	270 Nm	
ISO 6149	M12 x 1.5	36 lb-ft	18 lb-ft	0.24 in
		50 Nm	25 Nm	6 mm
DIN 3852	M12 x 1.5	37 lb-ft	18 lb-ft[1)2)]	0.24 in
		50 Nm	25 Nm[1)2)]	6 mm
	M20 x 1.5	125 lb-ft	59 lb-ft[1)]	0.39 in
		170 Nm	80 Nm[1)]	10 mm
	M22 x 1.5	155 lb-ft	59 lb-ft[1)]	0.39 in
		210 Nm	80 Nm[1)]	10 mm
	M26 x 1.5	170 lb-ft	88 lb-ft[1)]	0.47 in
		230 Nm	120 Nm[1)]	12 mm
	M27 x 2	243 lb-ft	100 lb-ft[1)]	0.47 in
		330 Nm	135 Nm[1)]	12 mm
	M30 x 2	310 lb-ft	158 lb-ft[1)]	0.67 in
		420 Nm	215 Nm[1)]	17 mm
DIN ISO 228	G 1/4	29 lb-ft	–	–
		40 Nm	–	–

1) The tightening torques apply for screws in the „dry“ state as received on delivery and in the „lightly oiled“ state for installation.
2) In the „lightly oiled“ state, the M_V is reduced to 12.5 lb-ft (17 Nm) for M12 x 1.5.

General instructions

- The motor AA2FM is designed to be used in open and closed circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- 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.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. If you require characteristic values relating to reliability (e. g. $MTTF_d$) for functional safety, please consult the responsible contact person at Bosch Rexroth.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instructions regarding tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
  - Female threads in the axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the female threads and must not be exceeded. For values, see the table on page 37

Threaded plugs:
For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the table on page 37.

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