

Axial Piston Fixed Pump AA2FO (A2FO)

RA 91401/03.08 1/28
Replaces: 07.05

Technical data sheet

Series 6

Sizes	Nominal pressure/Peak pressure
5	4550/5100 psi (315/350 bar)
10 to 200	5800/6500 psi (400/450 bar)
250 to 1000	5100/5800 psi (350/400 bar)
Open circuits	



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Features

- Fixed pump with axial tapered piston rotary group of bent axis design, for hydrostatic drives in open circuits
- For use in mobile and stationary applications areas
- 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
- High power density
- Compact design
- High overall efficiency
- Economical conception
- One piece pistons with piston rings

Ordering Code / Standard Program (ordering code size 5 see page 10)

			O		/	6			-	V			
01	02	03	04	05		06	07	08		09	10	11	12

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearing "L" (no code)											
	HFB-, HFC hydraulic fluid											
	Sizes 10 to 200 (no code) Sizes 250 to 1000 (only in combination with long-life bearing "L")											E-

Axial piston unit

			10 to 180	200	250	355 to 1000	
02	Bent axis design, fixed	Version SAE	●	-	●	-	AA2F
		Version ISO	-	●	-	●	A2F

Drive shaft bearing

		10 to 200	250 to 500	710 to 1000	
03	Standard bearing (no code)	●	●	-	
	Long-life bearing	-	●	●	L

Operation mode

04	Pump, open circuits	O
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Size

05	≈ Displacement V_g (cm ³)										
	Size	10	12	16	23	28	32	45	56	63	80
	in ³ /rev.	0.63	0.73	0.98	1.40	1.71	1.95	2.78	3.42	3.84	4.91
	Size	90	107	125	160	180	200	250	355	500	710
	in ³ /rev.	5.49	6.51	7.63	9.79	10.98	12.20	15.25	21.66	30.51	43.33

Series

06		6
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Index

07	sizes 10 to 180											1
	size 200											3
	sizes 250 to 1000											0

Direction of rotation

08	Viewed from shaft end	clockwise	R
		counter-clockwise	L

Seals

09	FKM (flour-caoutchouc)	V
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Ordering Code / Standard Program (ordering code size 5 see page 10)

			O		/	6			-	V			
01	02	03	04	05		06	07	08		09	10	11	12

Shaft end			10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	250	
10	SAE Version (AA2F)	SAE Splined shaft	●	●	●	●	●	●	●	●	●	-	-	●	●	●	●	●	S
			-	-	-	-	-	-	-	●	●	-	-	-	-	-	-	-	T
			-	-	-	-	-	-	-	-	-	●	●	●	●	-	-	-	U
			-	-	-	-	-	-	-	-	-	●	●	-	-	-	-	-	Q
	Parallel keyed shaft DIN 6885	●	●	●	●	●	●	-	●	●	-	-	●	●	●	●	-	B	
		-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-	P	
	SAE parallel keyed shaft		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	K
ISO Version (A2F)	Splined shaft DIN 5480								●	-	-	-	-	-	-	-	A		
									-	●	●	●	●	●	●	Z			
	Parallel keyed shaft DIN 6885								●	-	-	-	-	-	-	-	B		
									-	●	●	●	●	●	●	P			

Mounting flange			10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	250	
11	SAE Version (AA2F)	2-hole – SAE	●	●	●	–	–	–	–	–	–	–	–	–	–	–	–	–	C
		4-hole – SAE	–	–	–	●	●	●	●	●	●	–	–	●	●	●	●	●	D
			–	–	–	–	–	–	–	–	–	●	●	–	–	–	–	–	DN
	200 355 500 710 1000																		
	ISO Version (A2F)	4-hole – ISO								●	–	–	–	–	–	–	–	B	
		8-hole – ISO								–	●	●	●	●	●	●	●	H	

Service line ports			10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	250	
12	AA2F ¹⁾																		
	SAE flange ports A and B, at side and SAE flange port S, rear		-	-	-	●	●	●	●	●	●	●	●	●	●	●	●	●	55
	Threaded ports A and B, at side and SAE flange port S, rear		●	●	●	-	-	-	-	-	-	-	-	-	-	-	-	-	56
	A2F ²⁾																		
	SAE flange ports A and B, at side and SAE flange port S, rear									●	-	-	-	-	-	-	-	-	05
	SAE flange ports A and B, rear and SAE flange port S, rear									-	●	●	●	●	●	●	●	●	11

¹⁾ Fastening threads resp. threaded ports are SAE (UN/UNF)

²⁾ Fastening threads are metric

● = available - = not available

Technical Data

Hydraulic fluid

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

The fixed pump AA2FO is unsuitable for operation with HFA. If HFB, HFC and HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the used hydraulic fluid.

Operating viscosity range

For optimum efficiency and service life, select an operating viscosity (at operating temperature) within the optimum range of

$$v_{\text{opt}} = \text{optimum viscosity } 80 \dots 170 \text{ SUS } (16 \dots 36 \text{ mm}^2/\text{s})$$

depending on the tank temperature (closed circuit) and tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

Sizes 5 to 200:

$$v_{\text{min}} = 42 \text{ SUS } (5 \text{ mm}^2/\text{s})$$

short-term ($t < 3 \text{ min}$)
at max. perm. temperature of $t_{\text{max}} = +240^\circ\text{F}$ ($+115^\circ\text{C}$).

$$v_{\text{max}} = 7400 \text{ SUS } (1600 \text{ mm}^2/\text{s}),$$

short-term ($t < 3 \text{ min}$)
at cold start ($p \leq 435 \text{ psi} / 30 \text{ bar}$, $n \leq 1000 \text{ rpm}$,
 $t_{\text{min}} = -40^\circ\text{F} / -40^\circ\text{C}$).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Sizes 250 to 1000:

$$v_{\text{min}} = 60 \text{ SUS } (10 \text{ mm}^2/\text{s}),$$

short-term ($t < 3 \text{ min}$)
at max. perm. temperature of
 $t_{\text{max}} = +195^\circ\text{F}$ ($+90^\circ\text{C}$)

$$v_{\text{max}} = 4600 \text{ SUS } (1000 \text{ mm}^2/\text{s}),$$

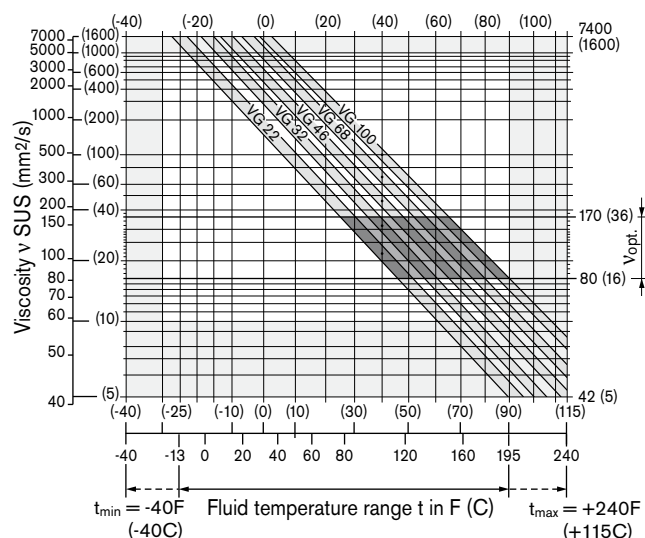
short-term ($t < 3 \text{ min}$)
at cold start ($p \leq 435 \text{ psi} / 30 \text{ bar}$, $n \leq 1000 \text{ rpm}$,
 $t_{\text{min}} = -13^\circ\text{F} / -25^\circ\text{C}$).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 240°F (115°C) (195°F (90°C) at size 250 to 1000) must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is - depending on pressure and speed - up to 22°F (12 K) higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40°F and -13°F (-40°C and -25°C) (cold start phase), please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

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 an open circuit the tank temperature.

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

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

Please note:

The case drain temperature, which is affected by pressure and speed, is always higher than the tank temperature. At no point in the system may the temperature be higher than 240°C (115°C) for sizes 5 to 200 or 195°F (90°C) for sizes 250 to 1000.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U (size 250 to 1000).

Filtration

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure functional reliability 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 (195°F (90°C) to max. 240°F (115°C), not permitted for sizes 250 to 1000) at least cleanliness level

19/17/14 according to ISO 4406 is required.

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

Technical Data

Operational pressure range

Inlet

Pressure at port S

The minimum inlet pressure depends on speed. The following limits must not be exceeded.

$p_{abs \min}$ _____ 12 psi (0.8 bar)

$p_{abs \max}$ _____ 435 psi (30 bar)

Outlet

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

AA2F Sizes	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	250	Nominal pressure	Peak pressure
Shaft end: S	●	●	●	●	●	●	●					●	●	●	●		5800 psi (400 bar)	6500 psi (450 bar)
S								●	●							●	5100 psi (350 bar)	5800 psi (400 bar)
Q										●							4350 psi (300 bar)	5100 psi (350 bar)
Q											●						4000 psi (280 bar)	4550 psi (315 bar)
T								●	●								5800 psi (400 bar)	6500 psi (450 bar)
U										●	●	●	●				5800 psi (400 bar)	6500 psi (450 bar)
B	●	●	●	●	●	●		●	●			●	●	●	●		5100 psi (350 bar)	5800 psi (400 bar)
P							●										5100 psi (350 bar)	5800 psi (400 bar)
K																●	5100 psi (350 bar)	5800 psi (400 bar)

A2F Sizes	5			200	355	500	710	1000	Nominal pressure	Peak pressure
Shaft end: Z					●	●	●	●	5100 psi (350 bar)	5800 psi (400 bar)
A				●					5800 psi (400 bar)	6500 psi (450 bar)
P					●	●	●	●	5100 psi (350 bar)	5800 psi (400 bar)
B				●					5100 psi (350 bar)	5800 psi (400 bar)
B	●								3050 psi (210 bar)	3600 psi (250 bar)
C	●								4550 psi (315 bar)	5100 psi (350 bar)

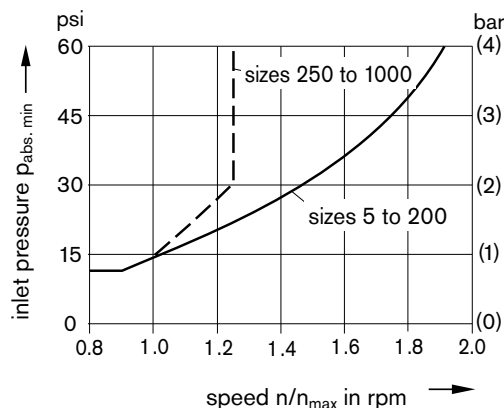
With pulsating loads over $p_N = 4550$ psi / 315 bar ($p_{\max} = 5100$ psi / 350 bar);

we recommend the use of a splined shaft (AA2FO 10 to 250: S, T or U / A2FO 200: A / A2FO 355 to 1000: Z)

Attention: sizes 10 to 200: shaft end with drives of radial force loads at the drive shaft (pinion, V-belt drives) necessitate reduction of the nominal pressure to $p_N = 4550$ psi (315 bar)! Sizes 250 to 1000 please contact us.

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 $n_{\max \text{ limit}}$ (speed limit)
- min. permissible pressure at port S
- admissible values for the drive shaft seal (see next page).

Technical Data

Direction of flow

Direction of rotation, viewed on shaft end
clockwise counter-clockwise

S to B

S to A

Long-life bearing (sizes 250 to 1000)

For long service life and use with HF hydraulic fluids. Same external dimensions as pump with standard bearing. A long-life bearing can be specified. Flushing of bearing and case via port U recommended.

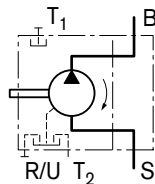
Flushing volumes (recommended)

Size	250	355	500	710	1000
$q_{v \text{ flush}}$ gpm	2.6	4.2	4.2	4.2	4.2
L/min	10	16	16	16	16

Symbol

Connections

A, B Service line port
S Suction port
T₁, T₂ Drain ports
R/U Port for bearing flushing



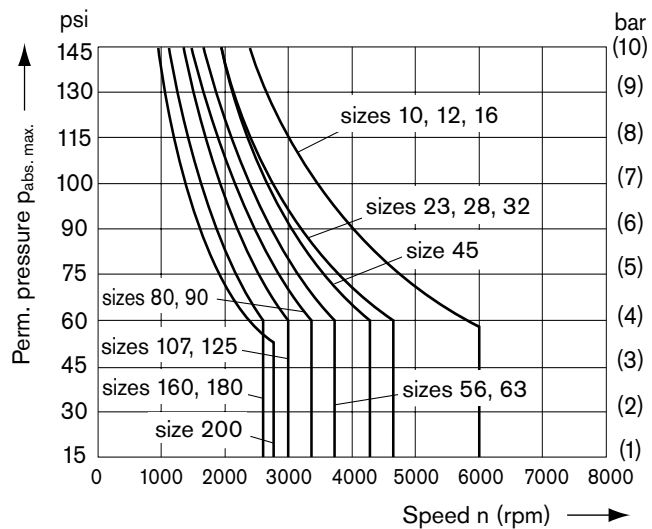
Shaft seal ring

Permissible pressure loading

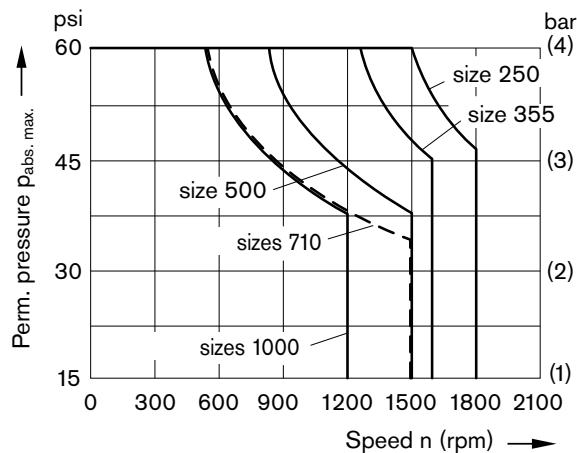
The service life of the shaft seal ring is affected by the speed of the pump and the case drain pressure. It is recommended that the average, continuous case drain pressure at operating temperature 45 psi (3 bar) absolute not be exceeded (max. permissible case drain pressure to 90 psi (6 bar) absolute at reduced speed, see diagram). Short-term ($t < 0.1$ s) pressure spikes of up to 145 psi (10 bar) absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.

Sizes 10 to 200



Sizes 250 to 1000



Temperature range

The FKM shaft seal ring is permissible for a case temperatures of

-13°F to +240°F (-25°C to +115°C) at sizes 5 to 200 and
-13°F to +195°F (-25°C to +90°C) at sizes 250 to 1000

Note:

For application cases below -13°F (-25 °C) a Buna-N (NBR) shaft seal ring is necessary (permissible temperature range -40 °F to +195 °F / -40 °C to +90 °C). Please contact us.

Technical Data

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

Size			5	10	12	16	23	28	32	45	56	63	80
Displacement	V_g	in ³	0.30	0.63	0.73	0.98	1.40	1.71	1.95	2.78	3.42	3.84	4.91
		cm ³	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4
Max. speed	$n_{\max}^{1)}$	rpm	5600	3150	3150	3150	2500	2500	2500	2240	2000	2000	1800
		$n_{\max \text{ limit}}^{2)}$	rpm	8000	6000	6000	6000	4750	4750	4750	4250	3750	3350
Max. flow at $n_{\max}$	$qV_{\max}$	gpm	7.3	8.6	10.0	13.2	15.1	18.5	21.1	27.0	29.6	33.3	38.0
		L/min	27.6	32.4	37.8	50	57	70	80	102	112	126	144
Power at	$\Delta p = 5100 \text{ psi}$	$P_{\max}$	HP	19.5 ³⁾	25	30	39	44	55	63	80	88	113
	$\Delta p = 350 \text{ bar}$	$P_{\max}$	kW	14.5 ³⁾	18.9	22	29.2		41	47	59.5	65	73.5
	$\Delta p = 5800 \text{ psi}$	$P_{\max}$	HP	–	30	34	45	51	63	71	91	100	113
	$\Delta p = 400 \text{ bar}$	$P_{\max}$	kW	–	22	25	34	38	47	53	68	75	84
Torque at	$\Delta p = 5100 \text{ psi}$	T	lb-ft	18 ³⁾	42	50	65	94	116	132	189	232	260
	$\Delta p = 350 \text{ bar}$	T	Nm	24.7 ³⁾	57	67	88	126	156	178	254	312	350
	$\Delta p = 5800 \text{ psi}$	T	lb-ft	–	48	56	75	107	131	150	214	263	295
	$\Delta p = 400 \text{ bar}$	T	Nm	–	65	76	101	145	178	203	290	356	400
Rotary stiffness	c	Nm/rad	625	922	1250	1590	2560	2930	3120	4180	5940	6250	8730
Moment of inertia for rotary group	J_{TW}	lbs-ft ²	0.0014	0.0095	0.0095	0.0095	0.0285	0.0285	0.0285	0.0569	0.0997	0.0997	0.1708
		kgm ²	0.00006	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072
Angular acceleration max.	α	rad/s ²	5000	5000	5000	5000	6500	6500	6500	14600	7500	7500	6000
Filling capacity	V	gal		0.045	0.045	0.045	0.053	0.053	0.053	0.087	0.119	0.119	0.145
		L		0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55
Mass (approx.)	m	lbs	5.5	12	12	12	21	21	21	30	40	40	51
		kg	2.5	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18	18	23

Size			90	107	125	160	180	200	250	355	500	710	1000
Displacement	V_g	in ³	5.49	6.51	7.63	9.79	10.98	12.20	15.25	21.66	30.51	43.33	61.02
		cm ³	90	106.7	125	160.4	180	200	250	355	500	710	1000
Max. speed	$n_{\max}^{1)}$	rpm	1800	1600	1600	1450	1450	1550	1500	1320	1200	1200	950
		$n_{\max \text{ limit}}^{2)}$	rpm	3350	3000	3000	2650	2650	2750	1800	1500	1500	1200
Max. flow	$qV_{\max}$	gpm	42.8	44.9	52.8	61.2	69.0	81.9	99.1	123.9	158.5	218.2	251.0
		L/min	162	170	200	232	261	310	375	469	600	826	950
Power at	$\Delta p = 5100 \text{ psi}$	$P_{\max}$	HP	127	134	157	183	205	244	295	368	472	747
	$\Delta p = 350 \text{ bar}$	$P_{\max}$	kW	95	100	117	135	152	181	219	273	350	554
	$\Delta p = 5800 \text{ psi}$	$P_{\max}$	HP	145	153	179	208	233	277	–	–	–	–
	$\Delta p = 400 \text{ bar}$	$P_{\max}$	kW	108	114	133	155	174	207	–	–	–	–
Torque at	$\Delta p = 5100 \text{ psi}$	T	lb-ft	372	442	517	664	746	828	1036	1470	2070	4141
	$\Delta p = 350 \text{ bar}$	T	Nm	501	594	696	893	1003	1114	1393	1978	2785	3955
	$\Delta p = 5800 \text{ psi}$	T	lb-ft	422	500	586	752	845	938	–	–	–	–
	$\Delta p = 400 \text{ bar}$	T	Nm	572	678	795	1020	1145	1272	–	–	–	–
Rotary stiffness	c	Nm/rad	9140	11200	11900	17400	18200	57300	73100	96100	144000	270000	324000
Moment of inertia for rotary group	J_{TW}	lbs-ft ²	0.1708	0.2753	0.2753	0.5221	0.5221	0.8377	1.4475	2.4205	4.2240	13.052	13.052
		kgm ²	0.0072	0.0116	0.0116	0.0220	0.0220	0.0353	0.061	0.102	0.178	0.55	0.55
Angular acceleration max.	α	rad/s ²	6000	4500	4500	3500	3500	11000	10000	8300	5500	4300	4000
Filling capacity	V	gal	0.145	0.211	0.211	0.291	0.291	0.713	0.660	0.925	1.110	2.113	2.113
		L	0.55	0.8	0.8	1.1	1.1	2.7	2.5	3.5	4.2	8	8
Mass (approx.)	m	lbs	51	71	71	99	99	145	161	242	342	715	741
		kg	23	32	32	45	45	66	73	110	155	325	336

¹⁾ The values shown are valid for an absolute pressure (p_{abs}) of 15 psi (1 bar) at the suction inlet S and when operated on mineral oil (with a specific mass of 7.36 lbs/gal (0.88 kg/L)).

²⁾ By increase of the input pressure ($p_{\text{abs}} > 14.5 \text{ psi} / 1 \text{ bar}$) the rotational speeds can be increased to the max. admissible speeds $n_{\max \text{ limit}}$ (speed limits) (see diagram page 8).

³⁾ Torque at $\Delta p = 4550 \text{ psi}$ (315 bar)

Technical Data

Caution: Exceeding the permissible limit values may result in a loss of function, a reduction in 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 startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Determining the size

$$\text{Flow} \quad q_v = \frac{V_g \cdot n \cdot \eta_v}{231} \quad \text{gpm} \quad \left(q_v = \frac{V_g \cdot n \cdot \eta_v}{1000} \quad \text{L/min} \right)$$

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

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

V_g = Displacement per revolution in in³ (cm³)

Δp = Differential pressure in psi (bar)

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency

Technical Data

Permissible radial and axial loading on the drive shaft

The specified values given are maximum values and do not apply to continuous operation.

Size			5	10	12	16	23	28	32	45	56	63	80	
Radial force, max. ¹⁾ at distance a (from shaft collar)		F _q max	lbf	160	472	562	730	865	1079	1214	1630	1832	2057	2304 ²⁾
			N	710	2100	2500	3250	3850	4800	5400	7250	8150	9150	10250
		a	in	0.47	0.63	0.63	0.63	0.63	0.63	0.63	0.71	0.71	0.71	0.79
			mm	12	16	16	16	16	16	16	18	18	18	20
Axial force, max. ³⁾		+F _{ax} max	lbf	40	72	72	72	112	112	112	142	180	180	225
			N	180	320	320	320	500	500	500	630	800	800	1000
		-F _{ax} max	lbf	40	72	72	72	112	112	112	142	180	180	225
			N	180	320	320	320	500	500	500	630	800	800	1000
Permissible axial force/psi (bar) operating pressure	±F _{ax per.} /psi (bar)	lbf/psi	0.023	0.05	0.05	0.05	0.08	0.08	0.08	0.11	0.13	0.13	0.16	
		N/bar	1.5	3.0	3.0	3.0	5.2	5.2	5.2	7.0	8.7	8.7	10.6	

Size			90	107	125	160	180	200	250	355	500	710	1000	
Radial force, max. ¹⁾ at distance a (from shaft collar)		F _{q max}	lbf	2574 ²⁾	2720	3170	3664	4114	5148	270	337	427	674	584
			N	11450	12100	14100	16300	18300	22900	1200 ⁴⁾	1500 ⁴⁾	1900 ⁴⁾	3000 ⁴⁾	2600 ⁴⁾
		a	in	0.79	0.79	0.79	0.98	0.98	0.98	1.61	2.07	2.07	2.66	2.66
			mm	20	20	20	25	25	25	41	52.5	52.5	67.5	67.5
Axial force, max. ³⁾		+F _{ax max}	lbf	225	281	281	360	360	360	450	562	674	989	989
			N	1000	1250	1250	1600	1600	1600	2000	2500	3000	4400	4400
		-F _{ax max}	lbf	225	281	281	360	360	360	450	562	674	989	989
			N	1000	1250	1250	1600	1600	1600	2000	2500	3000	4400	4400
Permissible axial force/psi (bar) operating pressure	±F _{ax per.} /psi (bar)	lbf/psi	0.16	0.20	0.20	0.26	0.26	0.26	⁵⁾	⁵⁾	⁵⁾	⁵⁾	⁵⁾	
		N/bar	10.6	12.9	12.9	16.7	16.7	16.7						

¹⁾ During intermittent operation (sizes 5 to 200)

²⁾ Value for Q-shaft: $F_{q \max} = 2023 \text{ lbf}$ (9000 N)

³⁾ Max. permissible axial force when at standstill or when axial piston unit working in pressureless conditions.

⁴⁾ When at standstill or when axial piston unit operating in depressurized condition. Higher forces are permissible when under pressure. Please contact us.

⁵⁾ Please contact us

When considering the permissible axial force, the force-transfer direction must be taken into account:

– $F_{ax \max}$ = increase in service life of bearings

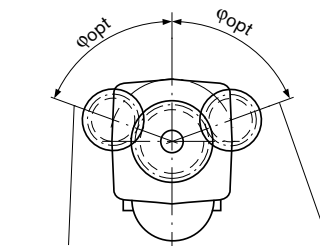
+ $F_{ax \max}$ = reduction in service life of bearings (avoid)

Effect of radial force F_q on the service life of the bearings

By selecting a suitable force-transfer direction of F_q , the stress on the bearing caused by the internal transmission forces can be reduced, thus achieving the optimum service life for the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

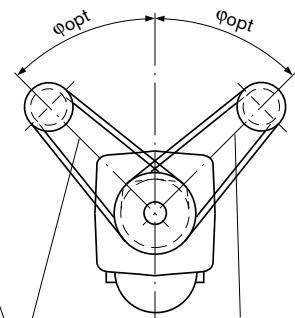
	Toothed gear drive	V-belt drive
Size	$\varphi_{\text{opt.}}$	$\varphi_{\text{opt.}}$
10 to 180	$\pm 70^\circ$	$\pm 45^\circ$
200 to 1000	$\pm 45^\circ$	$\pm 70^\circ$

Toothed gear drive



Clockwise
direction of rotation
Pressure on port B

V-belt drive



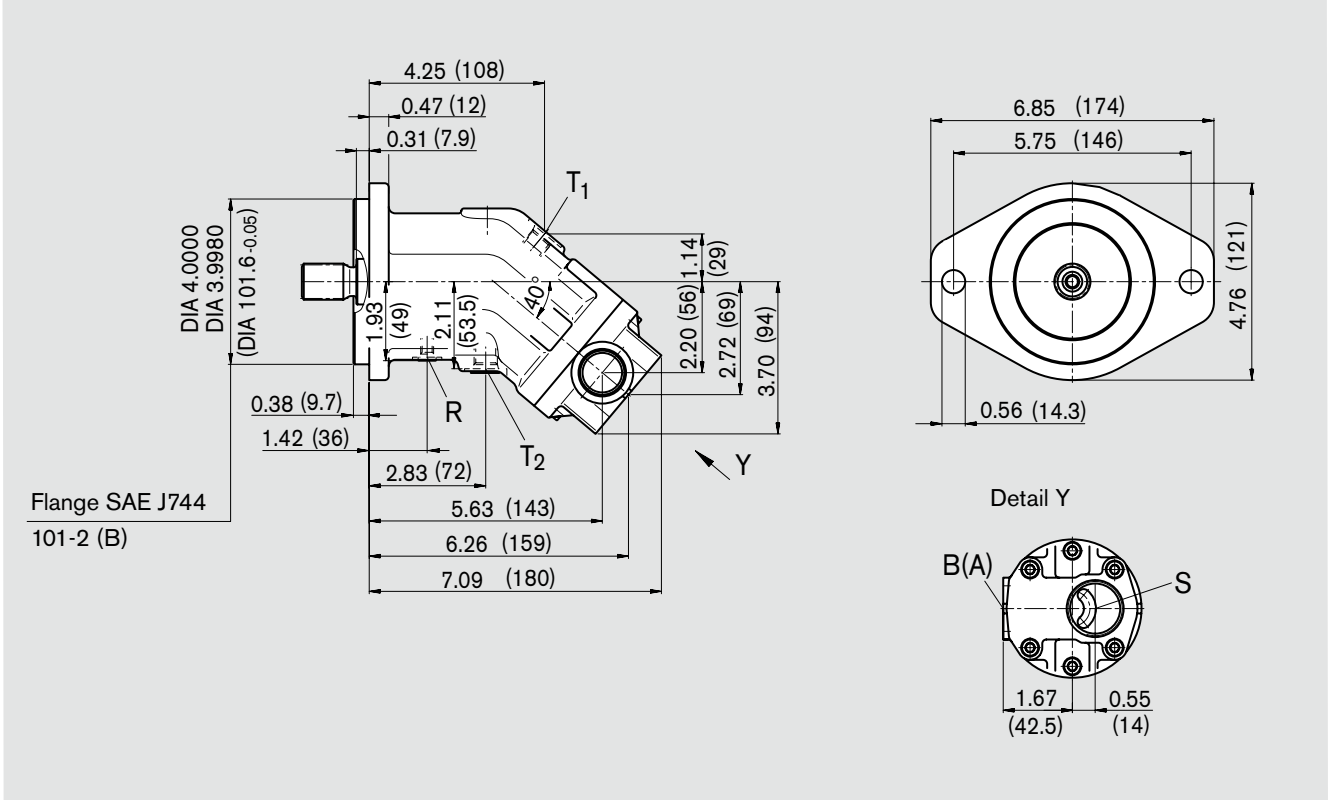
Counter-clockwise
direction of rotation
Pressure on port A

Clockwise
direction of rotation
Pressure on port B

Unit Dimensions, Sizes 10, 12, 16 – SAE Design

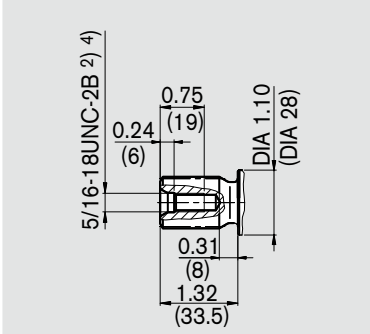
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

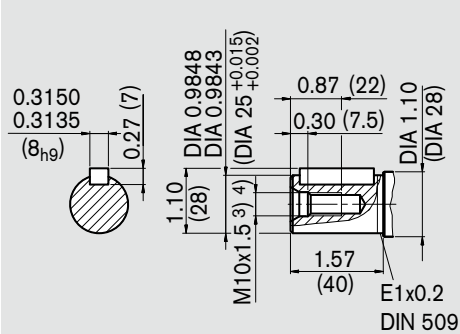


Shaft ends

S Splined shaft 7/8 in 13T 16/32 DP ¹⁾
(SAE J744 – 22-4 (B))
p_N = 5800 psi (400 bar)



B Parallel keyed shaft
DIN 6885 – AS8x7x32 (mm)
p_N = 5100 psi (350 bar)



Ports

B (A)	Service line port	ISO 11926	1 1/16 in -12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm) ⁴⁾
S	Suction port	ISO 11926	1 5/16 in -12 UN-2B; 0.79 (20) deep	400 lb-ft (540 Nm) ⁴⁾
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	9/16 in -18 UNF-2B; 0.51 (13) deep	60 lb-ft (80 Nm) ⁴⁾
R	Air bleed (plugged)	ISO 11926	5/16 in -24 UNF-2B; 0.93 (10) deep	7 lb-ft (10 Nm) ⁴⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

²⁾ Thread according to ISO 68

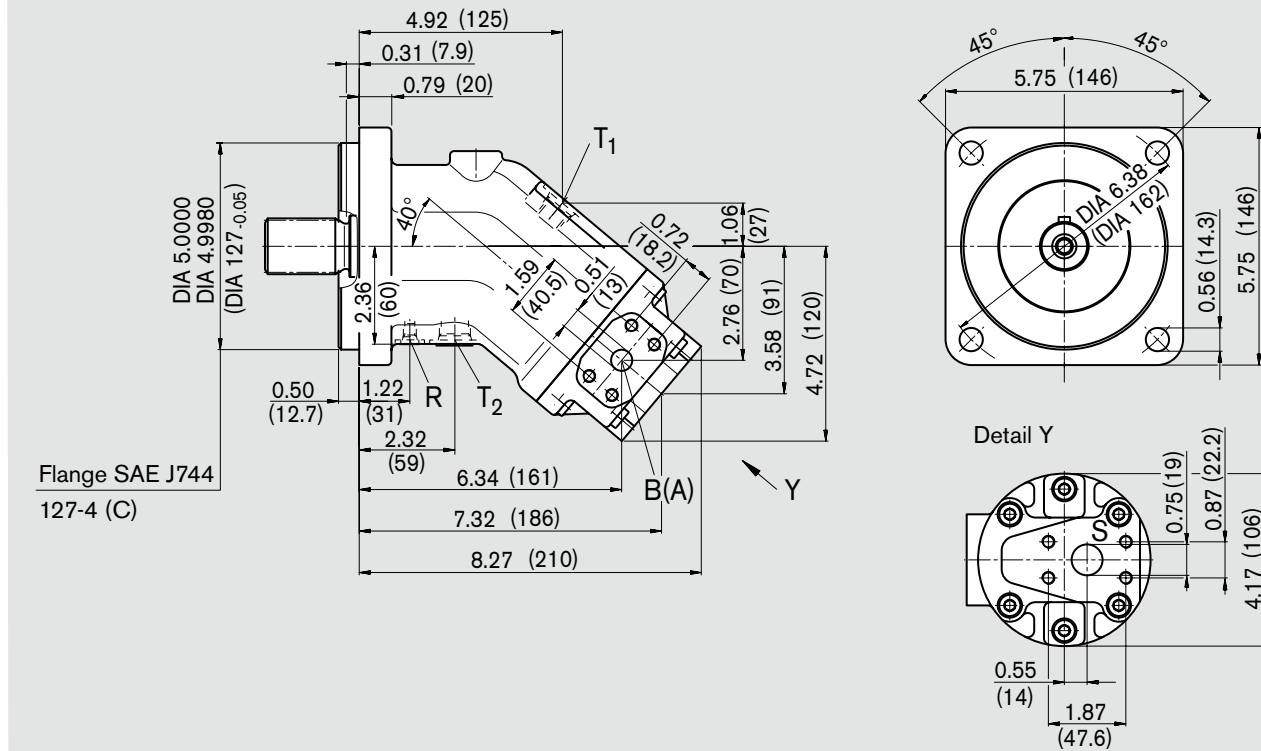
³⁾ Center bore according to DIN 332 (thread according to DIN 13)

⁴⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Sizes 23, 28, 32 – SAE Design

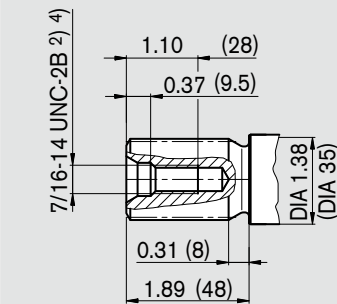
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

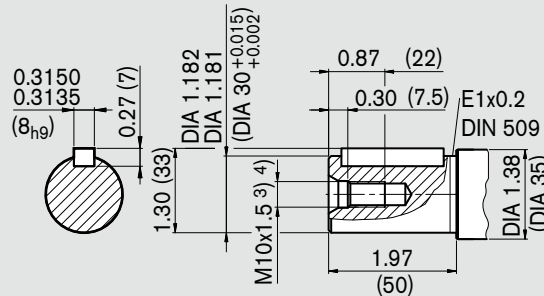


Shaft ends

S Splined shaft 1 1/4 in 14T 12/24 DP ¹⁾
(SAE J744 – 32-4 (C))
p_N = 5800 psi (400 bar)



B Parallel keyed shaft
DIN 6885 – AS8x7x40 (mm)
p_N = 5100 psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 ISO 68	1/2 in 5/16 in-18 UNC-2B; 0.71 (18) deep ⁴⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 ISO 68	3/4 in 3/8 in-16 UNC-2B; 0.79 (20) deep ⁴⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	3/4 in-16 UNF-2B; 0.59 (15) deep	120 lb-ft (160 Nm) ⁴⁾
R	Air bleed (plugged)	ISO 11926	5/16 in-24 UNF-2B; 0.39 (10) deep	7 lb-ft (10 Nm) ⁴⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

²⁾ Thread according to ISO 68

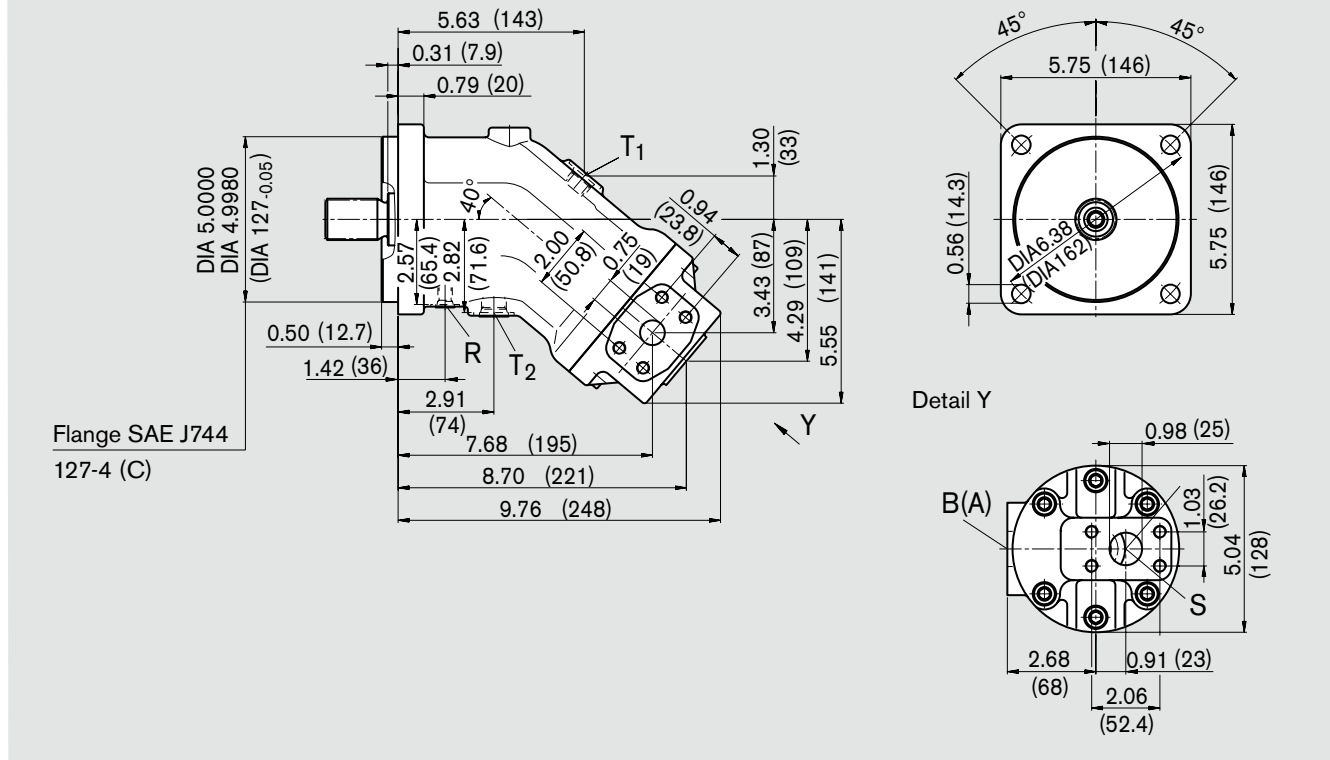
³⁾ Center bore according to DIN 332 (thread according to DIN 13)

⁴⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Sizes 56, 63 – SAE Design

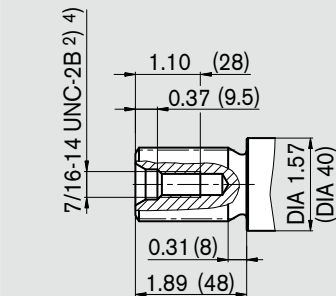
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

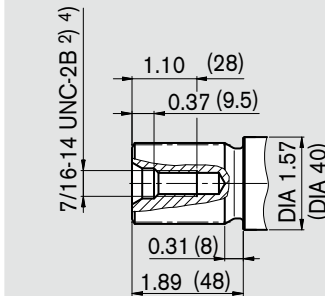


Shaft ends

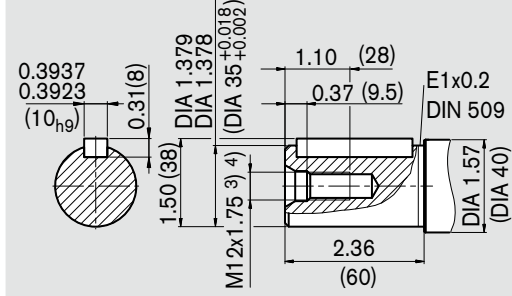
S Splined shaft 1 1/4 in 14T 12/24 DP ¹⁾
(SAE J744 – 32-4 (C))
 $p_N = 5100$ psi (350 bar)



T Splined shaft 1 3/8 in 21T 16/32 DP ¹⁾
 $p_N = 5800$ psi (400 bar)



B Parallel keyed shaft
DIN 6885 – AS10x8x50 (mm)
 $p_N = 5100$ psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 ISO 68	3/4 in 3/8 in-16 UNC-2B; 0.82 (21) deep ⁴⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 ISO 68	1 in 3/8 in-16 UNC-2B; 0.79 (20) deep ⁴⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	3/4 in-16 UNF-2B; 0.59 (15) deep	120 lb-ft (160 Nm) ⁴⁾
R	Air bleed (plugged)	ISO 11926	7/16 in-20 UNF-2B; 0.47 (12) deep	30 lb-ft (40 Nm) ⁴⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

²⁾ Thread according to ISO 68

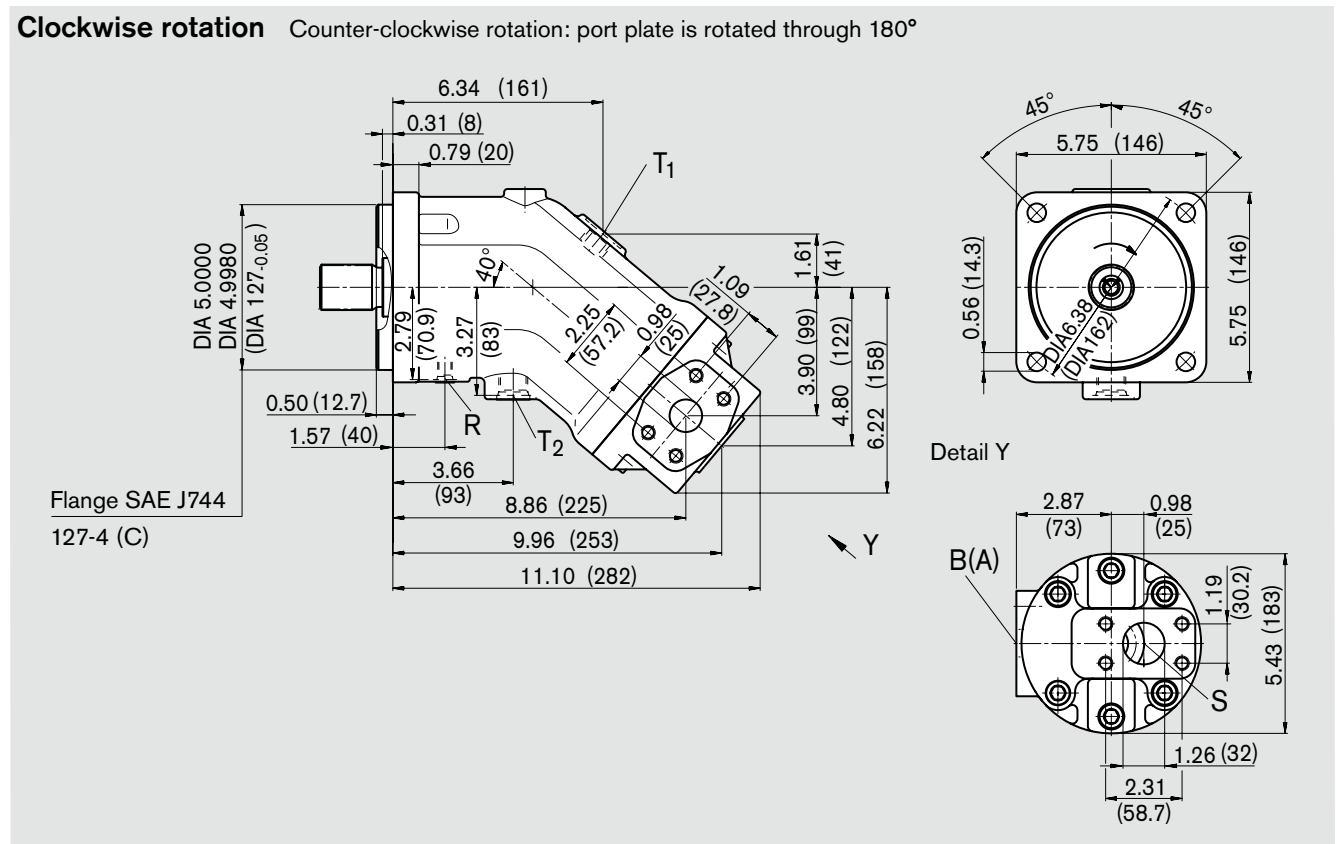
³⁾ Center bore according to DIN 332 (thread according to DIN 13)

⁴⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Sizes 80, 90 – SAE Design

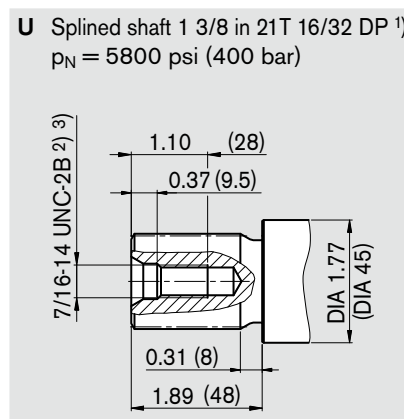
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

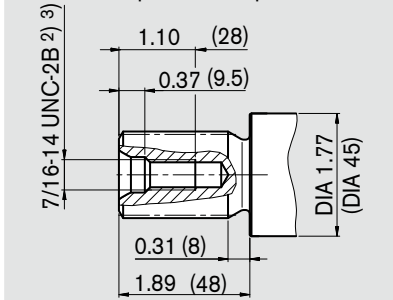


Shaft ends

U Splined shaft 1 3/8 in 21T 16/32 DP 1)
 $p_N = 5800 \text{ psi (400 bar)}$



Q Splined shaft 1 1/4 in 14T 12/24 DP 1)
(SAE J744 – 32-4 (C))
Size 80: $p_N = 4350$ psi (300 bar)
Size 90: $p_N = 4000$ psi (280 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 ISO 68	1 in 7/16 in-14 UNC-2B; 0.87 (22) deep ³⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 ISO 68	1 1/4 in 7/16 in-14 UNC-2B; 1.02 (26) deep ³⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	7/8 in-14 UNF-2B; 0.67 (17) deep	180 lb-ft (240 Nm) ³⁾
R	Air bleed (plugged)	ISO 11926	7/16 in-20 UNF-2B; 0.47 (12) deep	30 lb-ft (40 Nm) ³⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

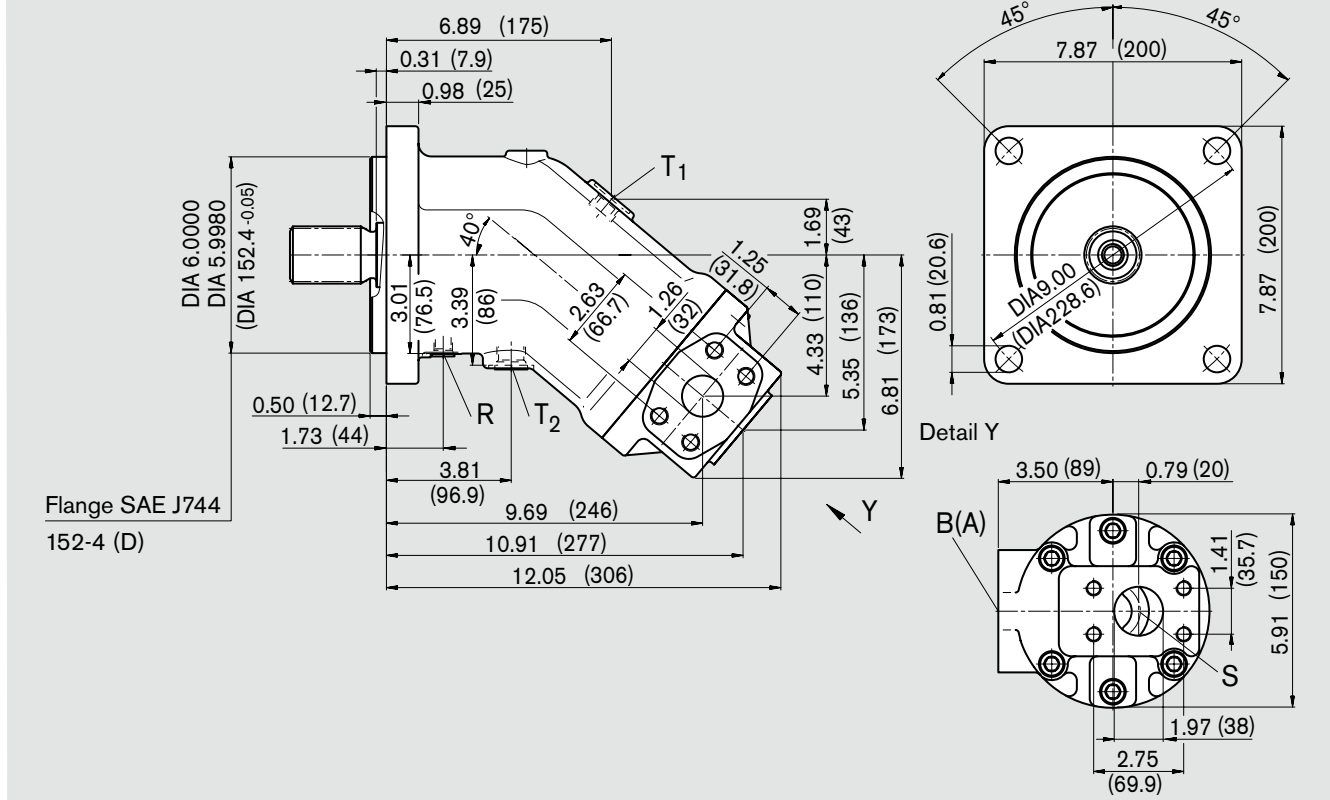
2) Thread according to ISO 68

³⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Sizes 107, 125 – SAE Design

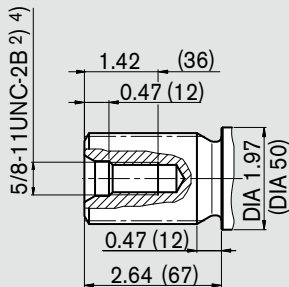
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

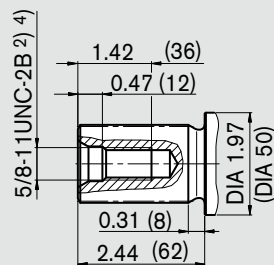


Shaft ends

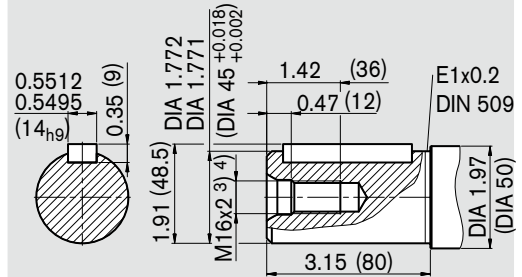
S Splined shaft 1 3/4 in 13T 8/16 DP ¹⁾
(SAE J744 – 44-4 (D))
p_N = 5800 psi (400 bar)



U Splined shaft 1 1/2 in 23T 16/32 DP ¹⁾
p_N = 5800 psi (400 bar)



B Parallel keyed shaft
DIN 6885 – AS14x9x63 (mm)
p_N = 5100 psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 ISO 68	1 1/4 in 1/2 in -13 UNC-2B; 0.75 (19) deep ⁴⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 ISO 68	1 1/2 in 1/2 in -13 UNC-2B; 0.95 (24) deep ⁴⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	7/8 in -14 UNF-2B; 0.67 (17) deep	180 lb-ft (240 Nm) ⁴⁾
R	Air bleed (plugged)	ISO 11926	7/16 in -20 UNF-2B; 0.47 (12) deep	30 lb-ft (40 Nm) ⁴⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

²⁾ Thread according to ISO 68

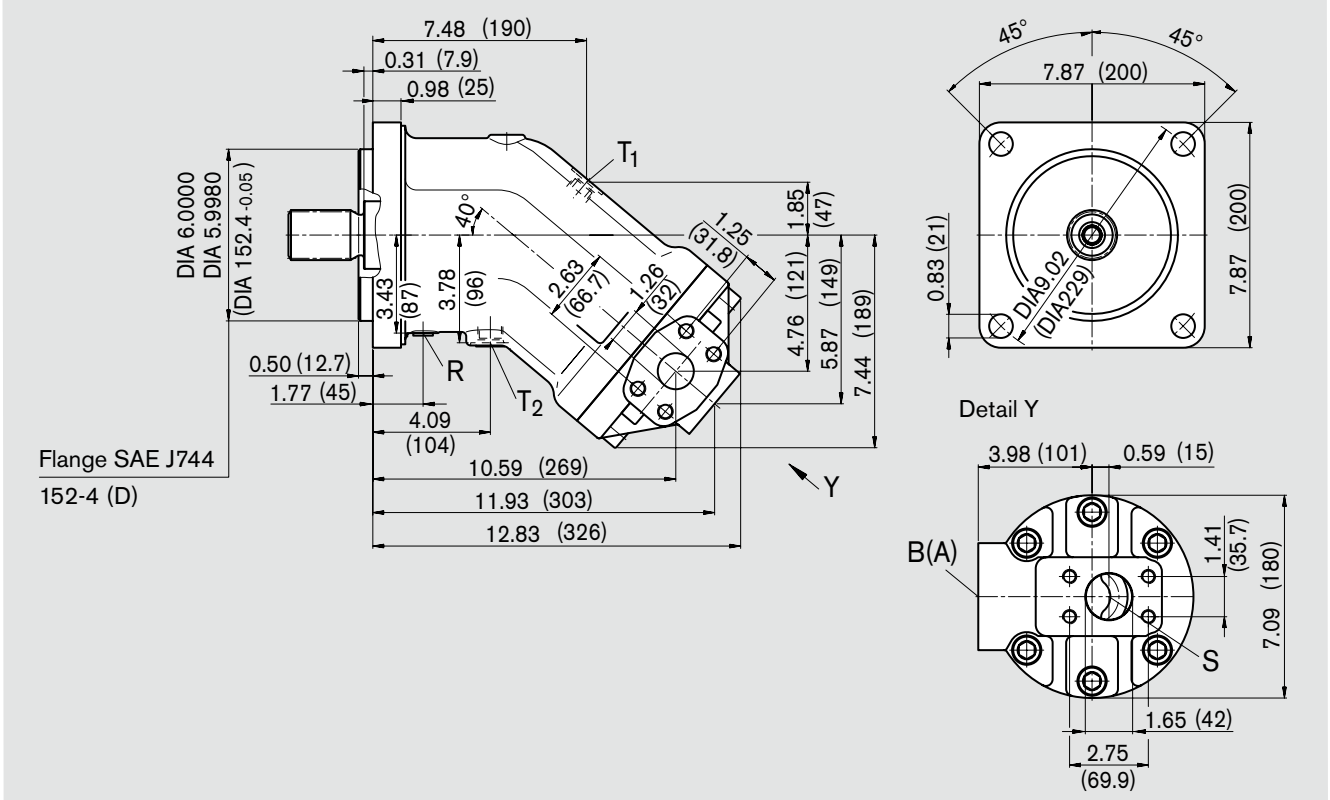
³⁾ Center bore according to DIN 332 (thread according to DIN 13)

⁴⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Sizes 160, 180 – SAE Design

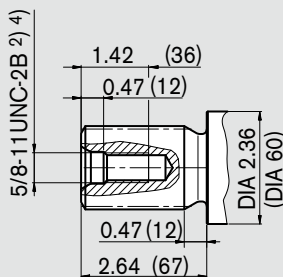
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

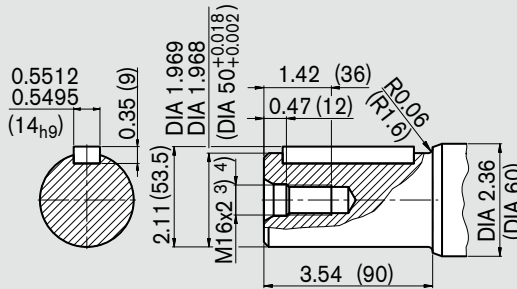


Shaft ends

S Splined shaft 1 3/4 in 13T 8/16 DP ¹⁾
(SAE J744 – 44-4 (D))
 $p_N = 5800$ psi (400 bar)



B Parallel keyed shaft
DIN 6885 – AS14x9x70 (mm)
 $p_N = 5100$ psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 ISO 68	1 1/4 in 1/2 in-13 UNC-2B; 0.75 (19) deep ⁴⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 ISO 68	1 1/2 in 1/2 in-13 UNC-2B; 0.95 (24) deep ⁴⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	7/8 in-14 UNF-2B; 0.67 (17) deep	180 lb-ft (240 Nm) ⁴⁾
R	Air bleed (plugged)	ISO 11926	9/16 in-20 UNF-2B; 0.51 (13) deep	60 lb-ft (80 Nm) ⁴⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

²⁾ Thread according to ISO 68

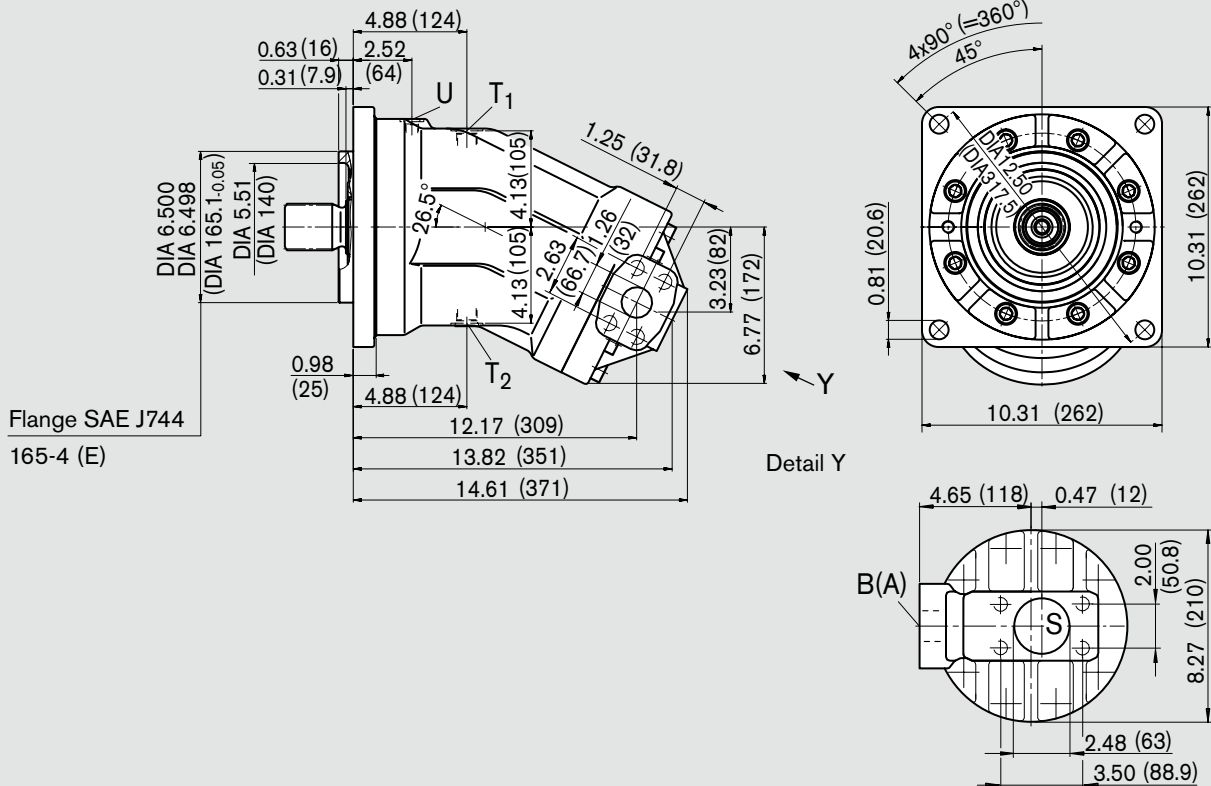
³⁾ Center bore according to DIN 332 (thread according to DIN 13)

⁴⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Size 250 – SAE Design

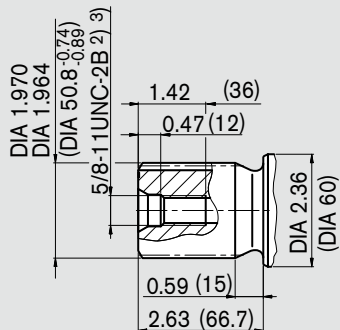
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

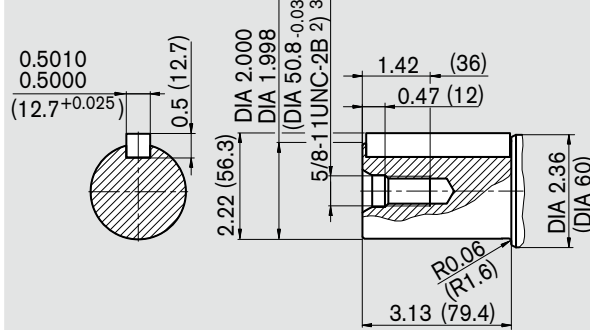


Shaft ends

S Splined shaft 2 in 15T 8/16 DP ¹⁾
(SAE J744 – 50-4 (F))
 $p_N = 5100 \text{ psi (350 bar)}$



K Parallel keyed shaft
0.5x0.5x3.0 (in) 12.7x12.7x76.7 (mm)
 $p_N = 5100 \text{ psi (350 bar)}$



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 ISO 68	1 1/4 in 1/2 in -13 UNC-2B; 0.79 (20) deep ³⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 ISO 68	2 1/2 in 1/2 in -13 UNC-2B; 0.79 (20) deep ³⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	ISO 11926	7/8 in -14 UNF-2B; 0.67 (17) deep	180 lb-ft (240 Nm) ³⁾
U	Port for bearing flushing (plugged)	ISO 11926	9/16 in -18 UNF-2B; 0.51 (13) deep	60 lb-ft (80 Nm) ³⁾

¹⁾ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

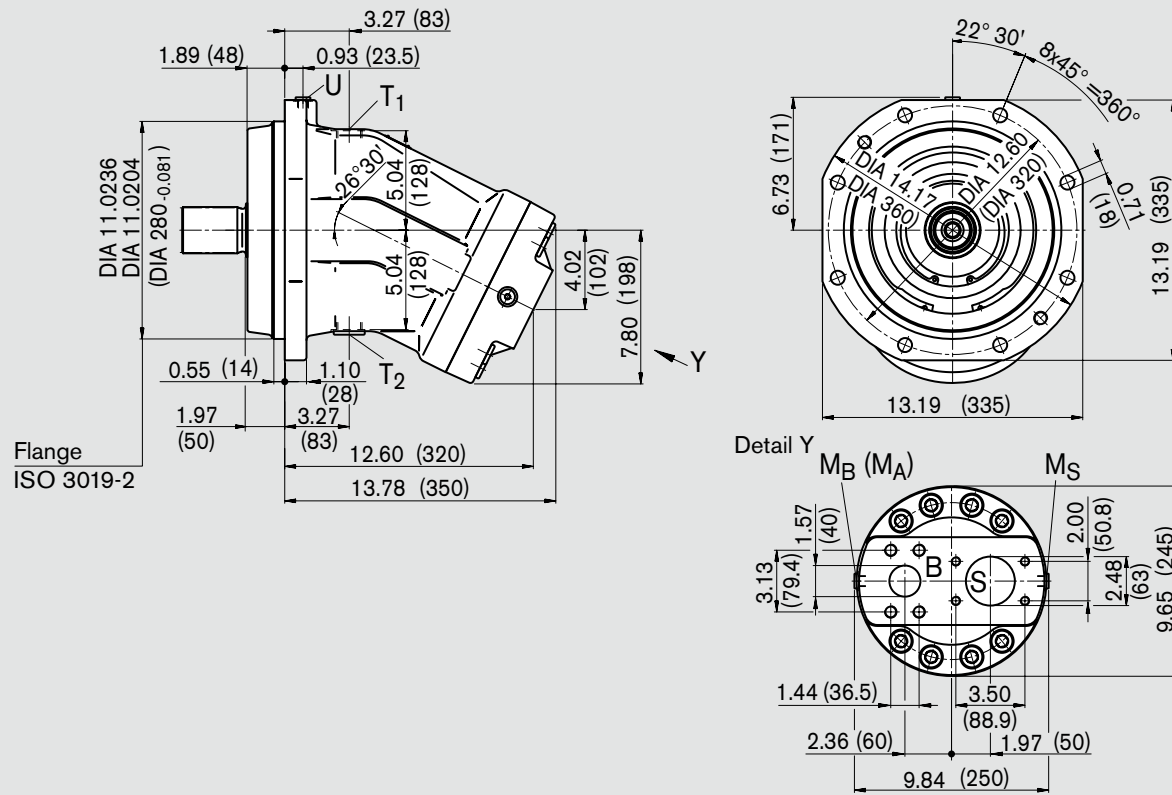
²⁾ Thread according to ISO 68

³⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Size 355 – ISO Design

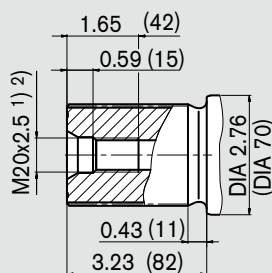
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

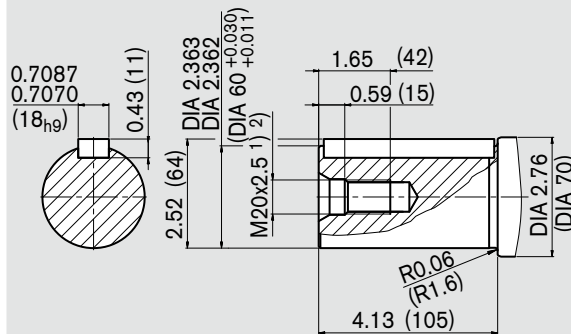


Shaft ends

Z Splined shaft DIN 5480
W60x2x30x28x9g
p_N = 5100 psi (350 bar)



P Parallel keyed shaft
DIN 6885 – AS18x11x100 (mm)
p_N = 5100 psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 DIN13	1 1/2 in M16x2; 0.83 (21) deep ²⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 DIN13	2 1/2 in M12x1.75; 0.67 (17) deep ²⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	DIN 3852	M33x2; 0.71 (18) deep	400 lb-ft (540 Nm) ²⁾
U	Port for bearing flushing (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾
M _A , M _B	Gauge ports operating pressure A, B (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾
M _S	Gauge port suction pressure (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾

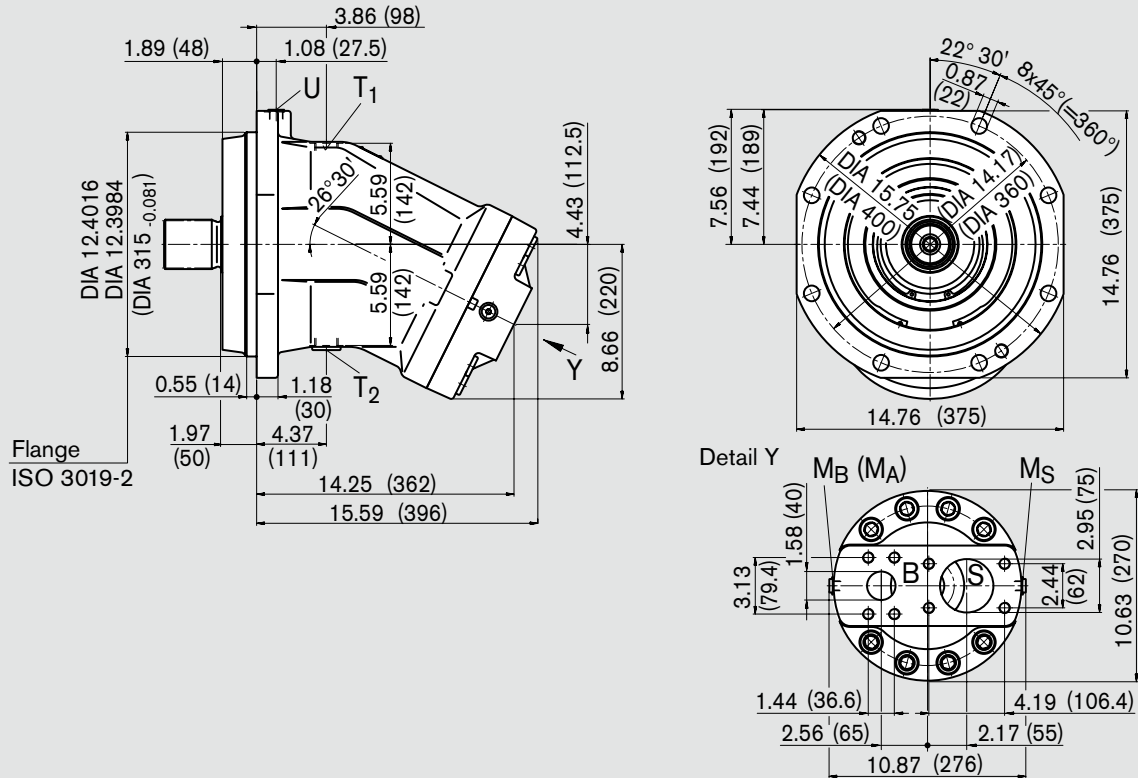
¹⁾ Centering bore according to DIN 332 (thread according to DIN 13)

²⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Size 500 – ISO Design

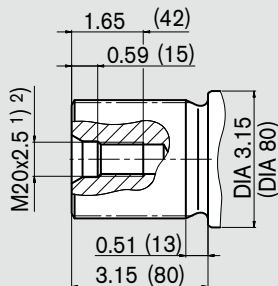
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

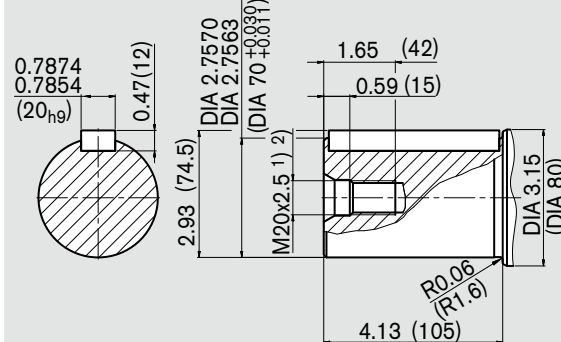


Shaft ends

Z Splined shaft DIN 5480
W70x3x30x22x9g
p_N = 5100 psi (350 bar)



P Parallel keyed shaft
DIN 6885 – AS20x12x100 (mm)
p_N = 5100 psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 DIN13	1 1/2 in M16x2; 0.95 (24) deep ²⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 DIN13	3 in M16x2; 0.95 (24) deep ²⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	DIN 3852	M33x2; 0.71 (18) deep	400 lb-ft (540 Nm) ²⁾
U	Port for bearing flushing (plugged)	DIN 3852	M18x1.5; 0.47 (12) deep	100 lb-ft (140 Nm) ²⁾
M _A , M _B	Gauge ports operating pressure A, B (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾
M _S	Gauge port suction pressure (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾

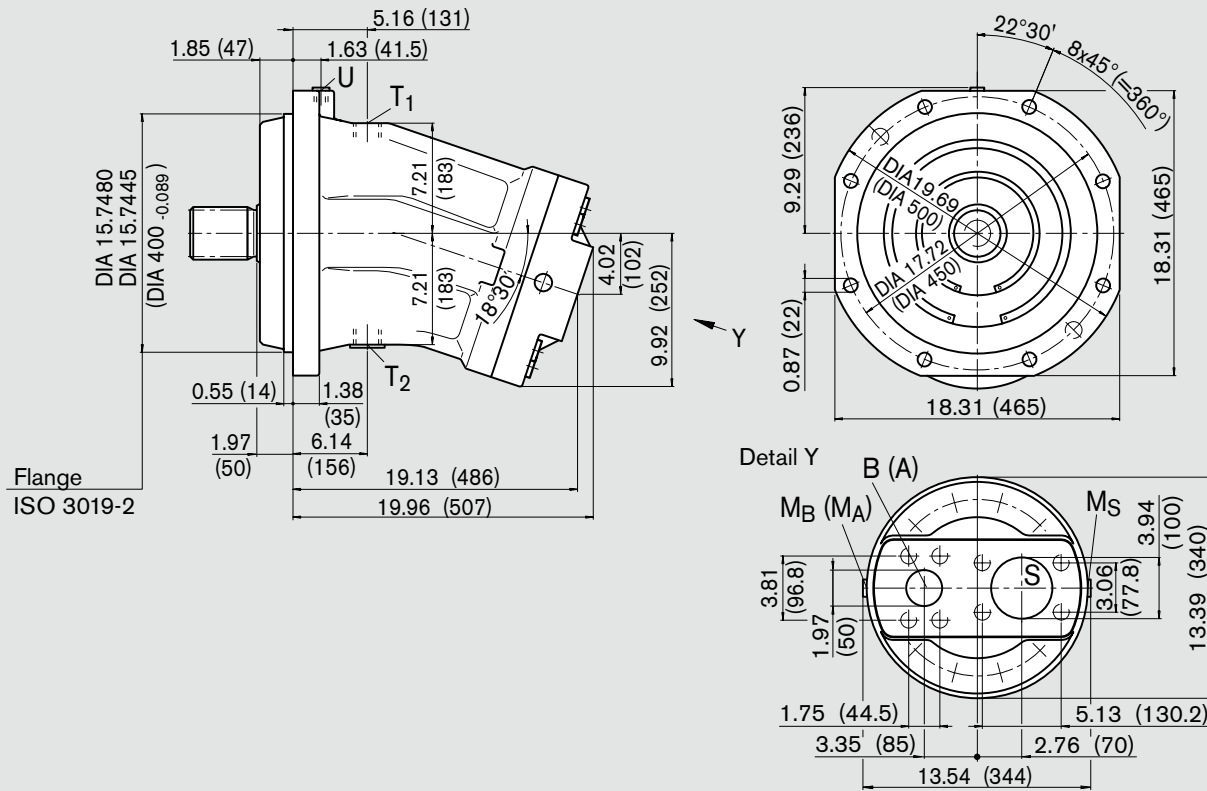
¹⁾ Centering bore according to DIN 332 (thread according to DIN 13)

²⁾ Please observe the general notes for the max. tightening torques on page 28

Unit Dimensions, Size 710 – ISO Design

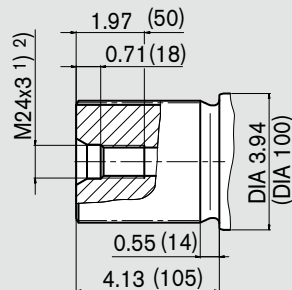
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Clockwise rotation Counter-clockwise rotation: port plate is rotated through 180°

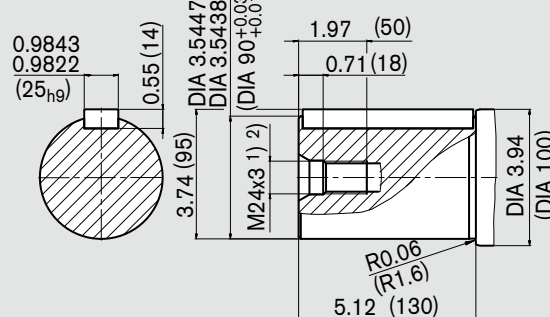


Shaft ends

Z Splined shaft DIN 5480
W90x3x30x28x9g
p_N = 5100 psi (350 bar)



P Parallel keyed shaft
DIN 6885 – AS25x14x125 (mm)
p_N = 5100 psi (350 bar)



Ports

B (A)	Service line port (high pressure series) Fastening threads B/A	SAE J518 DIN13	2 in M20x2.5; 1.18 (30) deep ²⁾	
S	Suction port (standard pressure series) Fastening threads S	SAE J518 DIN13	4 in M16x2; 0.95 (24) deep ²⁾	
T ₁ , T ₂	Case drain ports (T ₂ plugged)	DIN 3852	M42x2; 0.79 (20) deep	530 lb-ft (720 Nm) ²⁾
U	Port for bearing flushing (plugged)	DIN 3852	M18x1.5; 0.47 (12) deep	100 lb-ft (140 Nm) ²⁾
M _A , M _B	Gauge operating pressure A, B (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾
M _S	Gauge port suction pressure (plugged)	DIN 3852	M14x1.5; 0.47 (12) deep	60 lb-ft (80 Nm) ²⁾

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

²⁾ Please observe the general notes for the max. tightening torques on page 28

Installation Notes

General

The pump case must be completely filled up with hydraulic fluid during startup and during operation (filling the case chamber). The pump must be started up at low speed and no load until the system has been bled completely.

If stopped for an extended period, fluid may drain out of the case through the service lines. When restarting, make sure that the case contains sufficient fluid.

The leakage fluid inside the case chamber must be drained off to the tank through the highest case drain port. The min. suction pressure at port S must not fall below 12 psi (0.8 bar) absolute (see page 5).

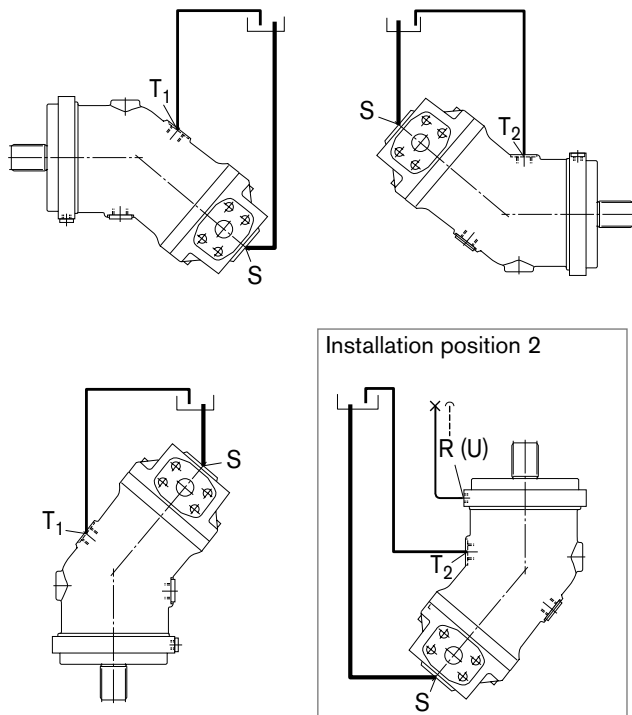
Installation position

Optional.

Installation below the tank

Pumps below min. fluid level in the tank (standard)

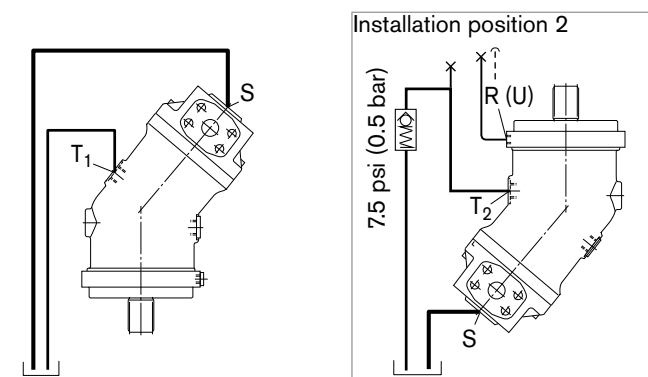
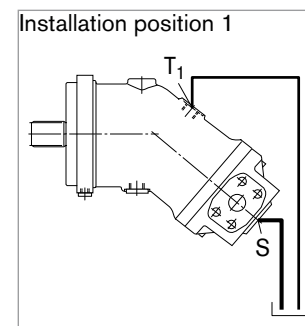
- Fill axial piston pump before startup via the highest case drain port
- Run the pump at low speed until the system is bled completely.
- Minimum immersion depth of leakage line in tank:
7.9 in (200 mm) (relative to the min. fluid level in the tank).
- Additional measures required for installation position 2 (shaft facing up): with installation position 2, make sure that the pump case is completely full before starting up. Bleed at port R (sizes 10 to 200) resp. U (sizes 250 to 1000). An air pocket in the bearing area is leading to damage of the axial piston pump.
- Recommendation: Fill up suction lines



Installation above the tank

Pump above minimum fluid level in tank

- Proceed in same way as below the tank installation
- Additional measures for installation positions 1 and 2:
If stopped for an extended period, fluid may drain out of the case chamber through the service lines (air enters through the shaft seal). The bearings will therefore not be properly lubricated when the pump is started up again. Fill the axial piston pump before restarting via the highest case drain port. Installation position 2: bleed at port R (sizes 10 to 200) resp. U (sizes 250 to 1000).
- Additional measures required for installation position 2 (shaft facing up):
In this installation position the bearings will not be properly lubricated, even if there is still some fluid in the case chamber. Putting a non-return valve (opening pressure 7.5 psi (0.5 bar)) in the leakage line can prevent the system emptying through the line.
- Note: min. admissible pressure at port S (min. suction pressure see page 5 and 8)



Notice

Notice

Notice

General Notes

- The AA2FO pump is designed to be used in open circuits.
- Project planning, assembly, and commissioning of the pump require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- During and shortly after operation, there is a risk of burns on the pump. Take suitable safety precautions, e.g. wear protective clothing
- There may be shifts in the characteristic depending on the operating state of the pump (operating pressure, fluid temperature).
- Tightening torques:
 - The tightening torques specified in this data sheet are maximum values and must not be exceeded (maximum values for screw thread).
Manufacturer's instruction for the max. permissible tightening torques of the used fittings must be observed!
 - For ISO 68 / DIN 13 fixing screws, we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.
- The data and information contained herein must be adhered to.