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wechat

MOTOR

SA2FE / SA2FM / SA6VE / SA6VM



SKS HYDRAULICS

MOTOR



COMPANY PROFILE

Founded in 2014, Zhejiang SKS Hydraulic Co., Ltd. is a wholly-owned subsidiary of SKS Hydraulic Technology Co., Ltd. with a registered capital of RMB 0.5 billion yuan, which locates in No. 1058, Jiangxian Road, Yuxin Town, Nanhu District, Jiaxing, Zhejiang Province. Our company covers an area of about 160 mu, in which the standardized workshop and supporting facilities of about 105,000 square meters are built.

Zhejiang SKS is a national high-tech enterprise, mainly engaged in the design, R & D, production and sales of hydraulic components, reducers and parts. Its main products are hydraulic plunger pumps, hydraulic motors, reducers and other components and parts, which are widely used in hydraulic equipment systems such as engineering machinery, ship machinery, mining machinery, etc. Our company has introduced advanced casting production lines, heat treatment production lines, machining production lines and component test production lines from Germany, Japan, Denmark, Taiwan and other countries and regional companies, which realizes complete independent development and production of products, and forms world advanced hydraulic component and reducer production system. At the same time our company has also established provincial high-tech R & D center and high-end hydraulic research institute.

Zhejiang SKS is committed to becoming a leader in the hydraulic drive industry and fully building "SKS" to become a world hydraulic brand. Our company strives to enter the ranks of the best comprehensive manufacturers of components and parts in China and even the world, makes excellent hydraulic components to provide global customers with high-quality hydraulic products and hydraulic transmission solutions, and configures "China Core" for Chinese engineering machinery.

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MOTOR

Fixed Plug-In Motor
SA2FE Series



Size 28 to 180
Nominal pressure/Maximum pressure 400/450 bar
Open and closed circuits

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Ordering code for standard program

	SA2F		E	/	6		W	-	V					
01	02	03	04	05		06	07	08		09	10	11	12	13

Hydraulic fluid

01	Mineral oil and HFD.												
	HFB, HFC hydraulic fluid Sizes 28 to 180 (without code)												
													E-

Axial piston unit

02	Bent-axis design, fixed												SA2F
----	-------------------------	--	--	--	--	--	--	--	--	--	--	--	------

Drive shaft bearing 28 to 180

03	Standard bearing (without code)											●	
	Long-life bearing											-	L

Operating mode

04	Motor, plug-in version												E
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Sizes (NG)

05	Geometric displacement, see table of values on page 7												
		28	32	45	56	63	80	90	107	125	160	180	

Series

06													6
----	--	--	--	--	--	--	--	--	--	--	--	--	---

Index

07	NG28 to 180												1
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Direction of rotation

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

Seals

09	FKM (fluor-caoutchouc)												V
----	------------------------	--	--	--	--	--	--	--	--	--	--	--	---

Drive shafts

10		28	32	45	56	63	80	90	107	125	160	180	
	Splined shaft	●	●	●	●	●	●	●	●	●	●	●	A
	DIN 5480	●	●	●	●	●	●	●	●	●	●	●	Z

Mounting flanges 28 to 180

11	ISO 3019-2	2-hole		●		L
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● = Available - = Not available

Ordering code for standard program

	SA2F		E	/	6	W	-	V					
01	02	03	04	05	06	07	08	09	10	11	12	13	

Port plates		28 32 45 56 63 80 90 107 125 160 180											
01	SAE flange ports A and B at rear	0	-	-	-	-	-	-	-	-	-	-	010
		7	-	-	-	-	-	-	-	-	-	-	017
02	SAE flange ports A and B at side, opposite	0	-	-	-	-	-	-	-	-	-	-	020
		7	-	-	●	●	●	●	●	●	●	●	027
10	SAE flange ports A and B at bottom (same side)	0	●	●	●	●	●	●	●	●	●	●	100
		7	-	-	-	-	-	-	-	-	-	-	107
12	Port plate BVD	17	1	-	-	-	-	-	●	●	-	-	171
		18	8	●	●	●	●	●	●	●	●	●	178
	Port plate with pressure-relief valves	19	1	●	●	●	●	●	●	●	●	●	191
		2	●	●	●	●	●	●	●	●	●	●	192
Valves													
Without valve													0
Pressure-relief valve (without pressure boost facility)													1
Pressure-relief valve (with pressure boost facility)													2
Flushing and boost pressure valve, mounted													7
Counterbalance valve BVD/BVE mounted ²⁾³⁾													8
Flushing and boost pressure valve, integrated													9
Speed sensor													
13	Without speed sensor (without code)		●		●								
	Prepared for HDD speed sensor		●		●								F
	HDD speed sensor mounted ⁵⁾		●		●								H
	Prepared for DSA speed sensor		○		○								U
	DSA speed sensor mounted ⁵⁾		○		○								V

● = Available ○ = On request - = Not available

Technical data

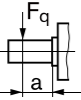
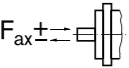
Table of values (theoretical values, without efficiency and tolerances; values rounded)


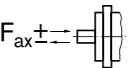
Size	NG		28	32	45	56	63	80	
Displacement geometric, per revolution	V _g	cm ³	28.1	32	45.6	56.1	63	80.4	
Speed maximum ¹⁾	n _{nom}	rpm	6300	6300	5600	5000	5000	4500	
	n _{max} ²⁾	rpm	6900	6900	6200	5500	5500	5000	
Input flow ³⁾ at n _{nom} and V _g	q _v	L/min	177	202	255	281	315	362	
Torque ⁴⁾ at V _g and									
	Δp = 350 bar	T	Nm	157	178	254	313	351	448
	Δp = 400 bar	T	Nm	179	204	290	357	401	512
Rotary stiffness	c	kNm/rad	2.93	3.12	4.18	5.94	6.25	8.73	
Moment of inertia for rotary group	J _{GR}	kgm ²	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072	
Maximum angular acceleration	α	rad/s ²	6500	6500	14600	7500	7500	6000	
Case volume	V	L	0.20	0.20	0.33	0.45	0.45	0.55	
Mass (approx.)	m	kg	10.5	10.5	15	18	19	23	
Size	NG		90	107	125	160	180		
Displacement geometric, per revolution	V _g	cm ³	90	106.7	125	160.4	180		
Speed maximum ¹⁾	n _{nom}	rpm	4500	4000	4000	3600	3600		
	n _{max} ²⁾	rpm	5000	4400	4400	4000	4000		
Input flow ³⁾ at n _{nom} and V _g	q _v	L/min	405	427	500	577	648		
Torque ⁴⁾ at V _g and									
	Δp = 350 bar	T	Nm	501	594	696	893	1003	
	Δp = 400 bar	T	Nm	573	679	796	1021	1146	
Rotary stiffness	c	kNm/rad	9.14	11.2	11.9	17.4	18.2		
Moment of inertia for rotary group	J _{GR}	kgm ²	0.0072	0.0116	0.0116	0.0220	0.0220		
Maximum angular acceleration	α	rad/s ²	6000	4500	4500	3500	3500		
Case volume	V	L	0.55	0.8	0.8	1.1	1.1		
Mass (approx.)	m	kg	25	34	36	47	48		

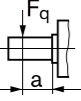
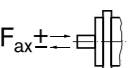
Technical data

Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	NG		28	28	32	45	56	56	56
Drive shaft	ø	mm	25	30	30	30	30	30	35
Maximum radial force at distance a (from shaft collar)		Fq max	5.7	5.4	5.4	7.6	9.5	7.8	9.1
		a	16	16	16	18	18	18	18
with permissible torque	Tmax	Nm	179	179	204	290	357	294	357
△ permissible pressure Δp	Δp perm	bar	400	400	400	400	400	330	400
Maximum axial force 		+Fax max	500	500	500	630	800	800	800
		-Fax max	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	±Fax perm/bar	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7

Size	NG		63	80	80	80	90	107	107
Drive shaft	ø	mm	35	35	35	40	40	40	45
Maximum radial force at distance a (from shaft collar)		Fq max	9.1	11.6	11.1	11.4	11.4	13.6	14.1
		a	18	20	20	20	20	20	20
with permissible torque	Tmax	Nm	401	512	488	512	573	679	679
△ permissible pressure Δp	Δp perm	bar	400	400	380	400	400	400	400
Maximum axial force 		+Fax max	800	1000	1000	1000	1000	1250	1250
		-Fax max	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	±Fax perm/bar	N/bar	8.7	10.6	10.6	10.6	10.6	12.9	12.9

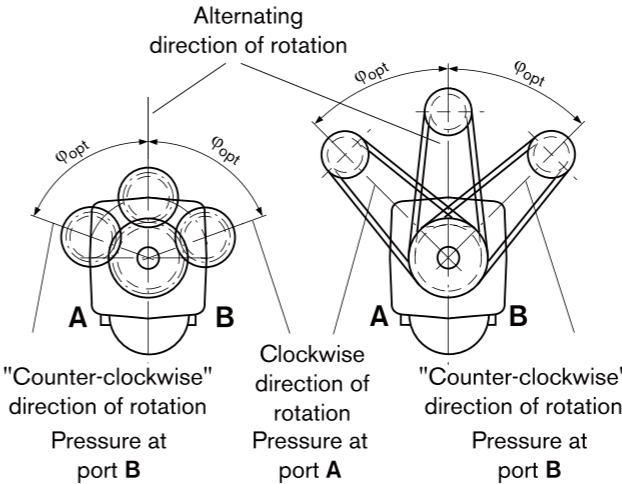
Size	NG		125	160	160	180
Drive shaft	ø	mm	45	45	50	50
Maximum radial force at distance a (from shaft collar)		Fq max	14.1	18.1	18.3	18.3
		a	20	25	25	25
with permissible torque	Tmax	Nm	796	1021	1021	1146
△ permissible pressure Δp	Δp perm	bar	400	400	400	400
Maximum axial force 		+Fax max	1250	1600	1600	1600
		-Fax max	0	0	0	0
Permissible axial force per bar operating pressure	±Fax perm/bar	N/bar	12.9	16.7	16.7	16.7

Technical data

Effect of radial force Fq on the service life of bearings

By selecting a suitable direction of radial force Fq, 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:

NG	Toothed gear drive	V-belt output
	φopt	φopt
28 to 180	± 70°	± 45°



Determining the operating characteristics

Input flow $q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g}$ [min⁻¹]

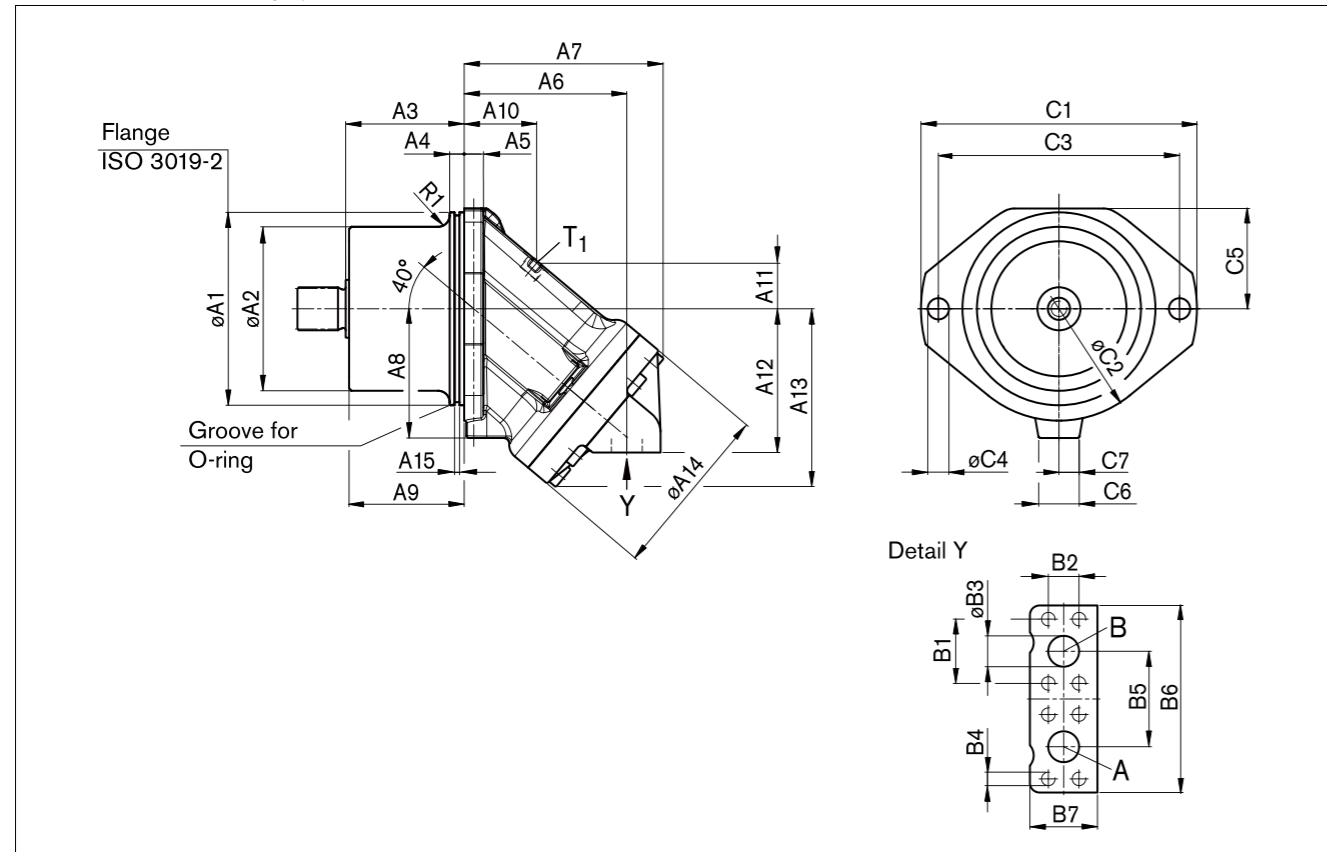
Torque $T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$ [Nm]

Power $P = \frac{2 \pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [kW]

V_g = Displacement per revolution in cm³
 Δp = Differential pressure in bar
 n = Speed in rpm
 η_v = Volumetric efficiency
 η_{mh} = Mechanical-hydraulic efficiency
 η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Dimensions sizes 28 to 180

Port plate 10 – SAE flange ports at bottom



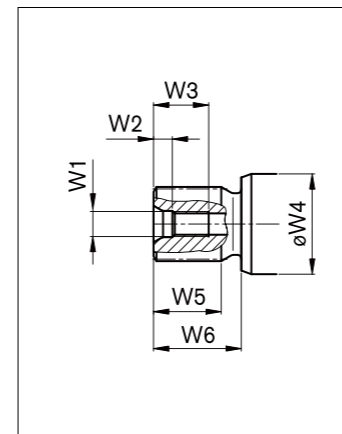
Size	øA1	øA2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	øA14	A15
28, 32	135 _{-0.025}	94 _{-0.5}	88.8	15	16	94	114	95	87.1	45	27	91	106	106	5.2
45	160 _{-0.025}	117 ₋₂ ^{+1.5}	92.3	15	18	109	133	106	90	50	31.3	102	119	118	5.2
56, 63	160 _{-0.025}	121 _{-0.5}	92.3	15	18	122	146	109	90	59	34	107	130	128	5.2
80, 90	190 _{-0.029}	140.3 _{-0.5}	110	15	20	127	157	123	106	54	41	121	145	138	5.2
107, 125	200 _{-0.029}	152.3 _{-0.5}	122.8	15	20	143	178	135	119	58	41	136	157	150	5.2
160, 180	200 _{-0.029}	171.6 _{-0.5}	122.8	15	20	169	206	134	119.3	75	47	149	185	180	5.2

Size	B1	B2	øB3	B4, DIN 13	B5	B6	B7	C1	øC2	C3	øC4	C5	C6	C7
28, 32	40.5	18.2	13	M8 x 1.25; 15 deep	59	115	40	188	154	160	14	71	42	13
45	50.8	23.8	19	M10 x 1.5; 17 deep	75	147	49	235	190	200	18	82	47.5	15
56, 63	50.8	23.8	19	M10 x 1.5; 17 deep	75	147	48	235	190	200	18	82	36	0
80, 90	57.2	27.8	25	M12 x 1.75; 17 deep	84	166	60	260	220	224	22	98	40	0
107, 125	66.7	31.8	32	M14 x 2; 19 deep	99	194	70	286	232	250	22	103	40	0
160, 180	66.7	31.8	32	M14 x 2; 19 deep	99	194	70	286	232	250	22	104	42	0

Size	R1	O-ring	Service line port A, B SAE J518	Drain port T ₁ DIN 3852
28, 32	10	126 x 4	1/2 in	M16 x 1.5; 12 deep
45	10	150 x 4	3/4 in	M18 x 1.5; 12 deep
56, 63	10	150 x 4	3/4 in	M18 x 1.5; 12 deep
80, 90	10	180 x 4	1 in	M18 x 1.5; 12 deep
107, 125	16	192 x 4	1 1/4 in	M18 x 1.5; 12 deep
160, 180	12	192 x 4	1 1/4 in	M22 x 1.5; 14 deep

Dimensions sizes 28 to 180

Drive shaft



Size	Splined shaft (DIN 5480)	W1	W2	W3	øW4	W5	W6
28, 32	A W30 x 2 x 14 x 9g	M10 x 1.5	7.5	22	35	27	35
28	Z W25 x 1.25 x 18 x 9g	M8 x 1.25	6	19	35	28	43
45	Z W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	35	27	35
56, 63	A W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	40	32	40
56	Z W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	40	27	35
80, 90	A W40 x 2 x 18 x 9g	M16 x 2	12	36	45	37	45
80	Z W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	45	32	40
107, 125	A W45 x 2 x 21 x 9g	M16 x 2	12	36	50	42	50
107	Z W40 x 2 x 18 x 9g	M12 x 1.75	9.5	28	50	37	45
160, 180	A W50 x 2 x 24 x 9g	M16 x 2	12	36	60	44	55
160	Z W45 x 2 x 21 x 9g	M16 x 2	12	36	60	42	50

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 027 (sizes 45 to 180) the valve is mounted directly on the fixed motor.

Cracking pressure of pressure retaining valve

(observe when setting the primary valve)

Sizes 45 to 180, fixed setting _____ 16 bar

Switching pressure of flushing piston Δp

Sizes 45 to 180 _____ 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:

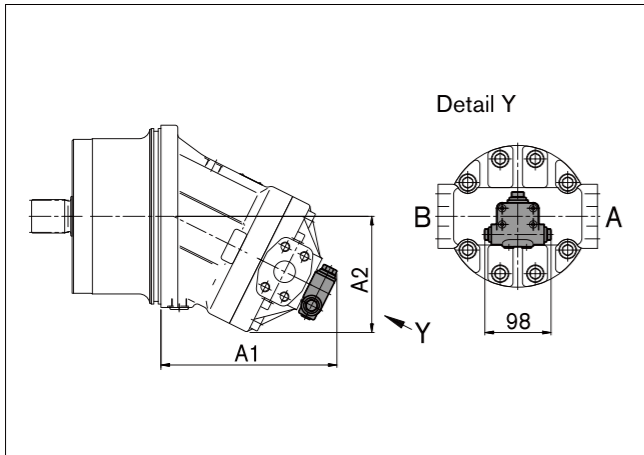
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $v = 10$ mm²/s

(p_{ND} = low pressure, p_G = case pressure)

Dimensions

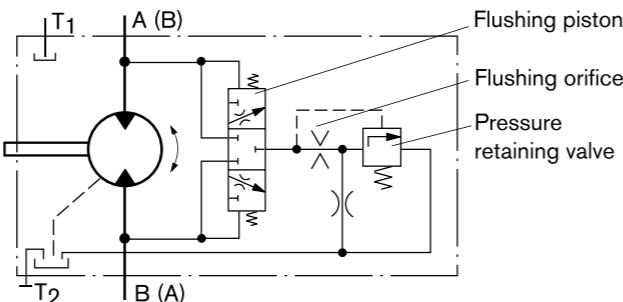
Sizes 107 to 180

Port plate 027 – SAE flange ports at side



Size	A1	A2
107, 125	211	192
160, 180	232	201

Schematic



Standard flushing flows

Flushing and boost pressure valve

Size	Flushing flow q_v [L/min]	ϕ [mm]	Mat. No. of orifice
45	3.5	1.2	R909651766
107, 125	8	1.8	R909419696
160, 180	10	2.0	R909419697

With sizes 45 to 180, orifices can be supplied for flushing flows from 3.5 to 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure $\Delta p_{ND} = 25$ bar.

Flushing and boost pressure valve

Size	Throttle ϕ [mm]	q_v [L/min]
56, 63,	1.5	6
80, 90	1.8	7.3

Pressure-relief valve

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).

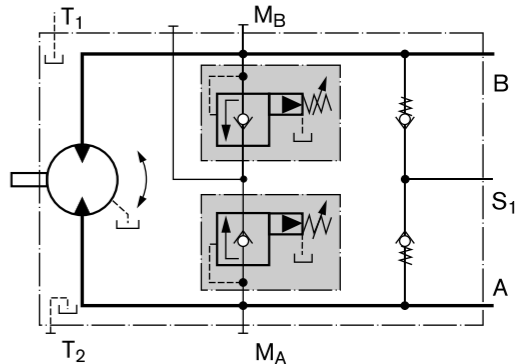
Cracking pressure setting range _____ 50 to 420 bar

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

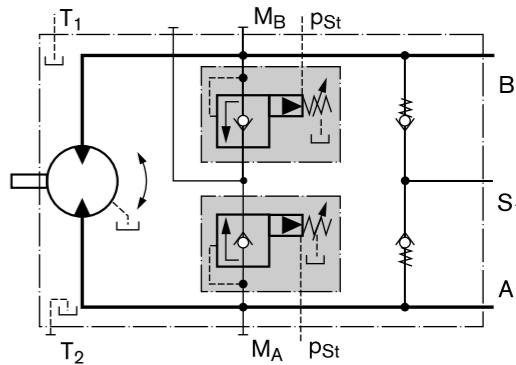
When ordering, please state in plain text:

- 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"

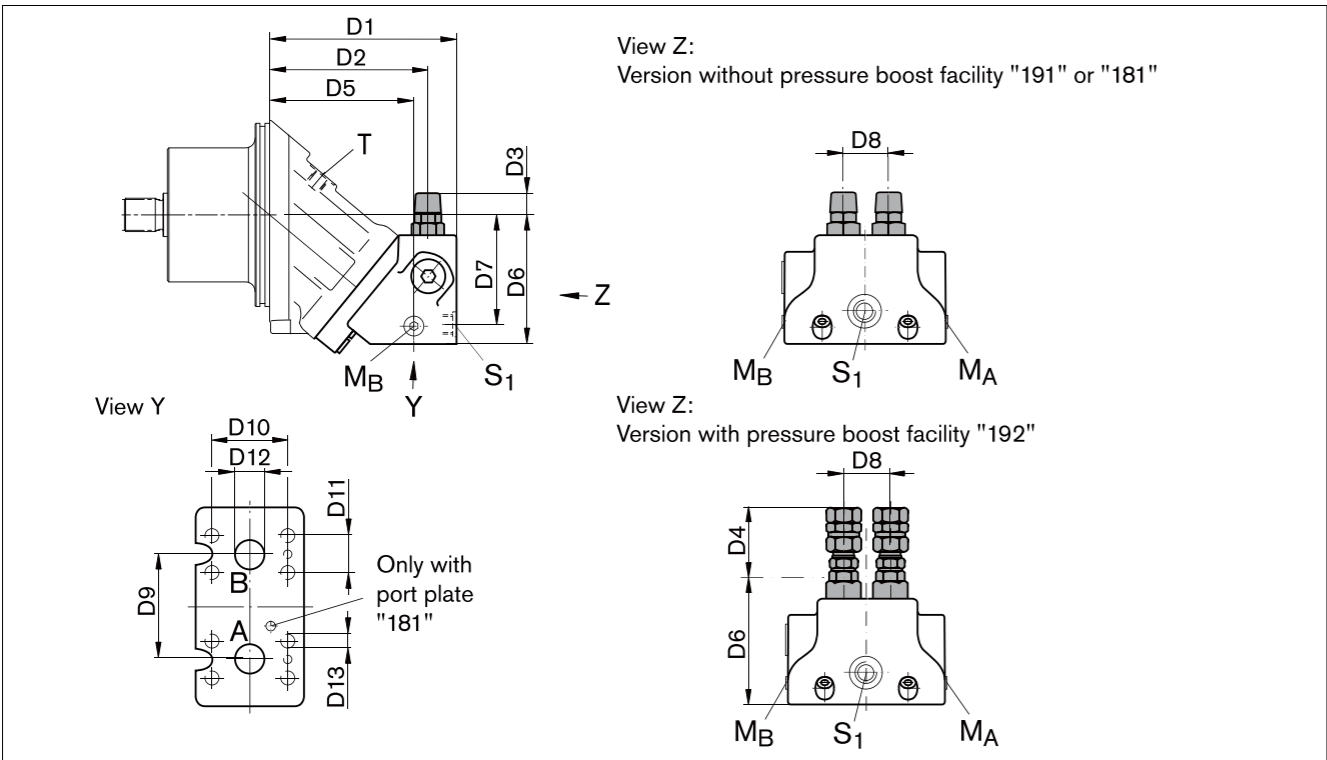


Version with pressure boost facility "192"



Pressure-relief valve

Dimensions



Size		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
28, 32	MHDB.16	145	122	25	68	110	102	87	36	66	50.8	23.8	ø19	M10; 17 deep
45	MHDB.16	161	137	22	65	126	113	98	36	66	50.8	23.8	ø19	M10; 17 deep
56, 63	MHDB.22	189	162	19	61	147	124	105	42	75	50.8	23.8	ø19	M10; 13 deep
80, 90	MHDB.22	193	165	17.5	59	151	134	114	42	75	57.2	27.8	ø25	M12; 18 deep
107, 125	MHDB.32	216	184	10	52	168	149.5	130	53	84	66.7	31.8	ø32	M14; 19 deep
160, 180	MHDB.32	249	218	5	47	202	170	149	53	84	66.7	31.8	ø32	M14; 19 deep

Size	A, B	S ₁	M _A , M _B	P _{St}
28, 32	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
45	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
56, 63	3/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
80, 90	1 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
107, 125	1 1/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
160, 180	1 1/4 in	M26 x 1.5; 16 deep	M30 x 1.5; 16 deep	G 1/4

Assembly instruction for port plate with pressure boost facility "192":

The lock nut must be counterheld when installing the hydraulic line at the p_{st} port!

Ports

Designation	Port for	Standard	Size	Maximum pressure [bar]	State
A, B	Service line	SAE J518	See above	450	O
S ₁	Supply (only with port plate 191/192)	DIN 3852	See above	5	O
M _A , M _B	Measuring operating pressure	DIN 3852	See above	450	X
P _{St}	Pilot pressure (only with port plate 192)	DIN ISO 228	See above	30	O

Counterbalance valve BVD

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. 20 bar.

Note

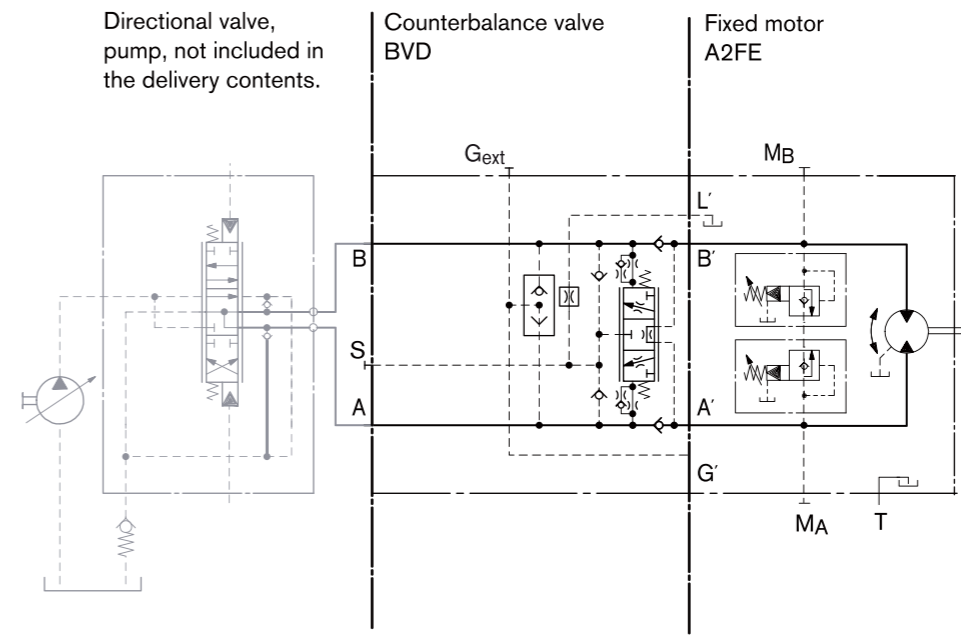
- BVD available for sizes 28 to 180 and BVE available for sizes 107 to 180.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A2FE90/61W-VAB188 + BVD20F27S/41B-V03K16D0400S12
- The counterbalance valve does 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 counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
 - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A2FE090/61W-VAB188 + BVD20F27S/41B-V03K16D0400S12



Counterbalance valve BVD

Winch counterbalance valve BVD...W

Application options

- Winch drive in cranes (BVD)
- Track drive in excavator crawlers (BVD)

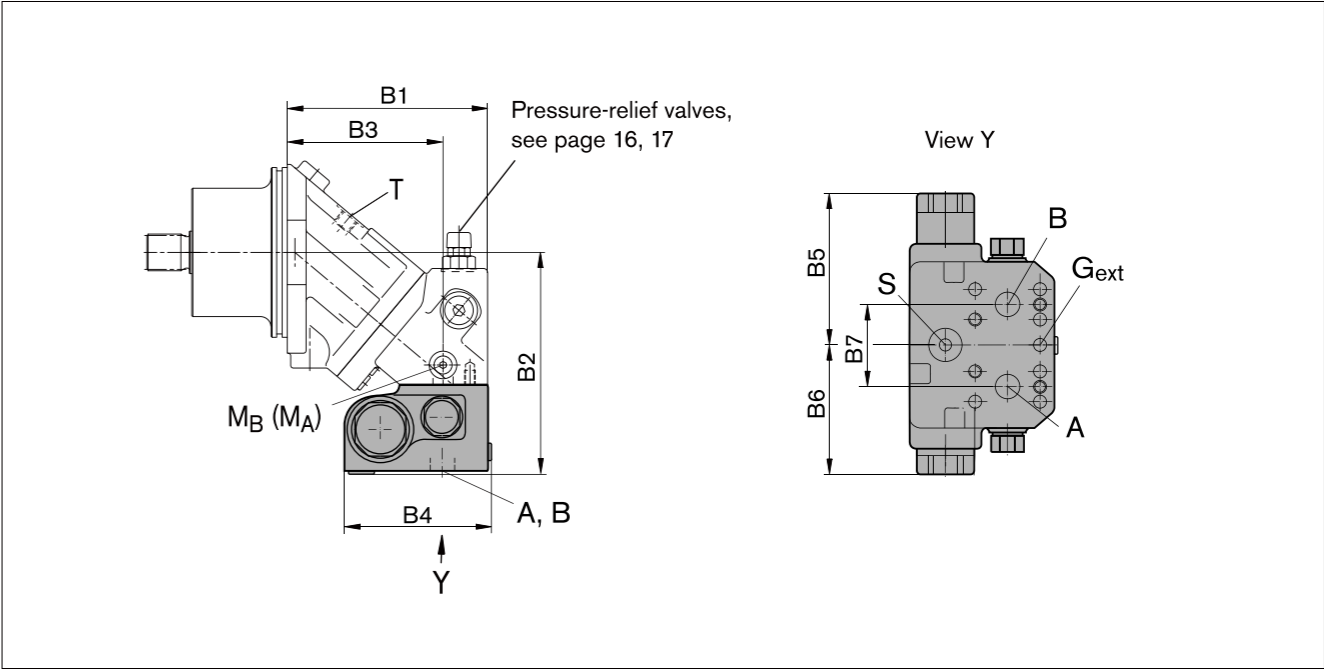
Permissible input flow or pressure in operation with BVD

Motor NG	Without valve		Restricted values in operation with BVD			
	p _{nom} /p _{max} [bar]	q _V max [L/min]	BVD NG	p _{nom} /p _{max} [bar]	q _V [L/min]	Code
28	400/450	176	20 (BVD)	350/420	100	188
32		201				
45		255				
56		280				
63		315				
80		360				
90		405				
107		427				
125		500				
107		427	25 (BVD)			320
125	500					
160	577					
180	648					

BVD _____ counterbalance valve, double-acting

Counterbalance valve BVD and BVE

Dimensions



A2FE Size	Counterbalance valve		Dimensions							
	Type	Ports A, B	B1	B2	B3	B4 (S)	B4 (L)	B5	B6	B7
28, 32	BVD20..16	3/4 in	145	175	110	142	147	139	98	66
45	BVD20..16	3/4 in	161	196	126	142	147	139	98	66
56, 63	BVD20..17	3/4 in	189	197	147	142	147	139	98	75
80, 90	BVD20..27	1 in	193	207	151	142	147	139	98	75
107, 125	BVD20..28	1 in	216	238	168	142	147	139	98	84
107, 125	BVD25..38	1 1/4 in	216	239	168	158	163	175	120.5	84
160, 180	BVD25..38	1 1/4 in	249	260	202	158	163	175	120.5	84
107, 125	BVE25..38	1 1/4 in	216	240	168	167	172	214	137	84
160, 180	BVE25..38	1 1/4 in	249	260	202	167	172	214	137	84

Ports

Designation	Port for	Version	Standard	Size	Maximum pressure [bar]	State
A, B	Service line		SAE J518	see table above	420	O
S	Infeed	BVD20	DIN 3852	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25	DIN 3852	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852	M12 x 1.5; 12.5 deep	30	O
G _{ext}	Brake release, high pressure	S	DIN 3852	M12 x 1.5; 12.5 deep	420	X
M _A , M _B	Measuring pressure A and B		ISO 61493	M12 x 1.5; 12 deep	420	X

Counterbalance valve BVD and BVE

Mounting the counterbalance valve

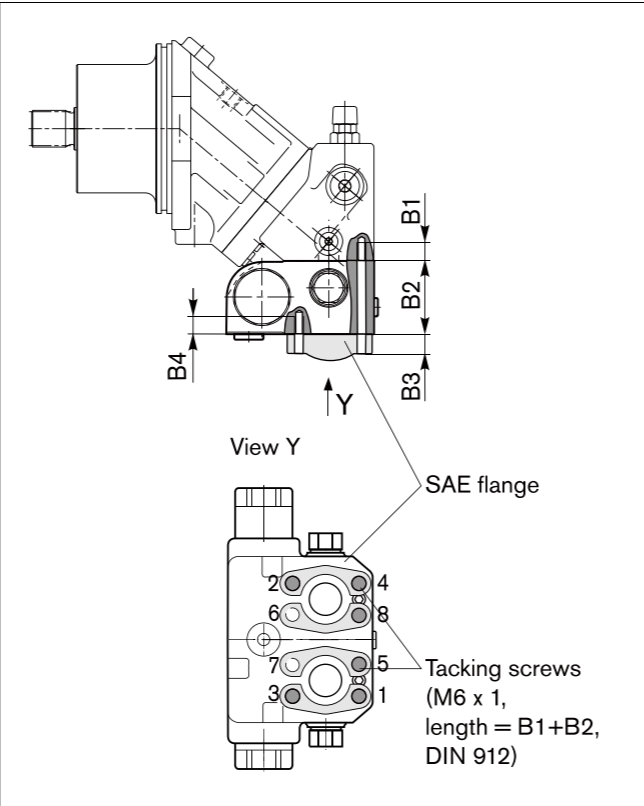
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the 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 [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	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; 17 deep	M10 x 1.5; 17 deep	M12 x 1.75; 18 deep	M14 x 2; 19 deep	M12 x 1.75; 17 deep
B2	78 ²⁾	68	68	85	68
B3	customer-specific				
B4	M10 x 1.5; 15 deep	M10 x 1.5; 15 deep	M12 x 1.75; 16 deep	M14 x 2; 19 deep	M12 x 1.75; 16 deep

1) Minimum required thread reach 1 x Ø-thread

2) Including sandwich plate

Speed sensors

The versions A2FE...U and A2FE...F ("prepared for speed sensor", i.e. without sensor) is equipped with a toothed ring.

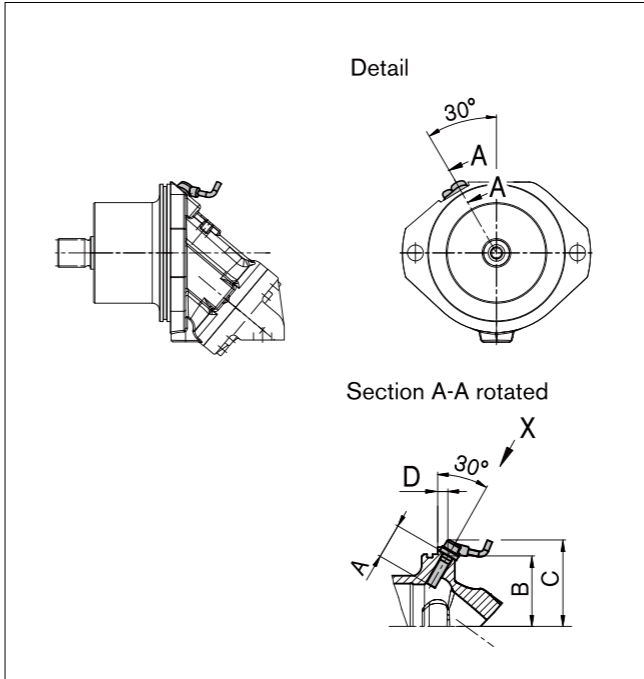
On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

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

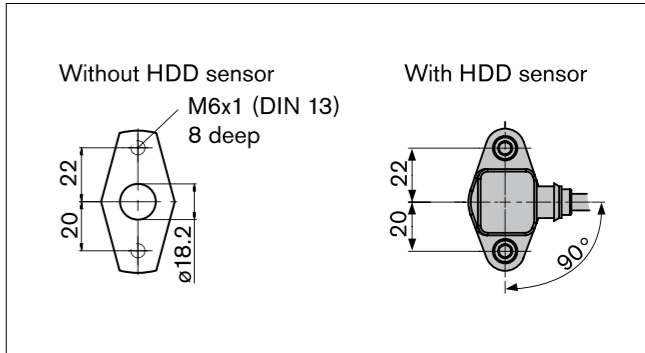
Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

Version "V"

Sizes 28 to 180 with DSA sensor



View X



Size	28, 32	45	56, 63	80, 90	107, 125	160, 180	250
Number of teeth	38	45	47	53	59	67	78
DSA A Insertion depth (tolerance ± 0.1)	32	32	32	32	32	32	32
B Contact surface	66	On request					
C	On request						
D	12.3	On request					

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.

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 5.
Further installation positions are possible upon request.

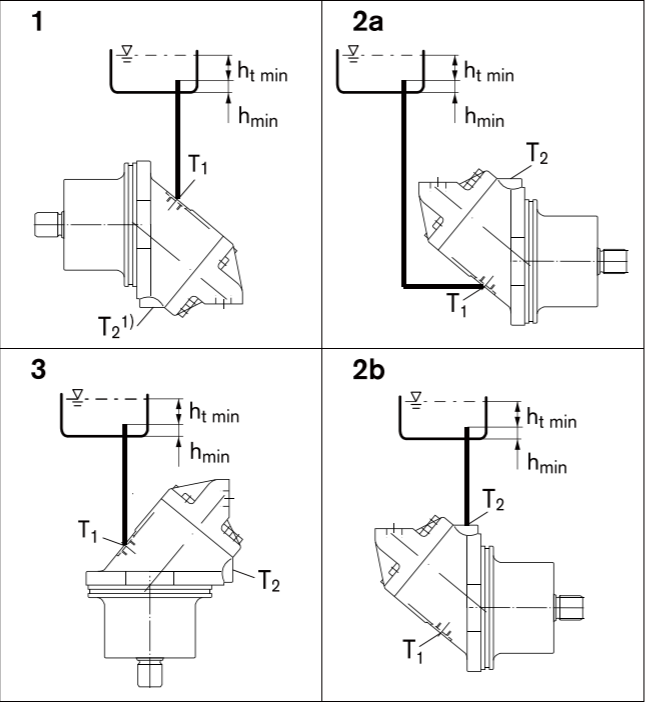
Recommended installation positions: 1 and 2.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_1 (sizes 28 to 180)
3	–	T_1
4	(L_1)	T_1 , (L_1)
5	(L_1)	T_2 , (L_1)
6	(L_1)	T_1 , (L_1)

- L_1 Filling / air bleed
- T_1 , T_2 Drain port
- $h_{t\ min}$ Minimum required immersion depth (200 mm)
- h_{min} Minimum required spacing to reservoir bottom (100 mm)

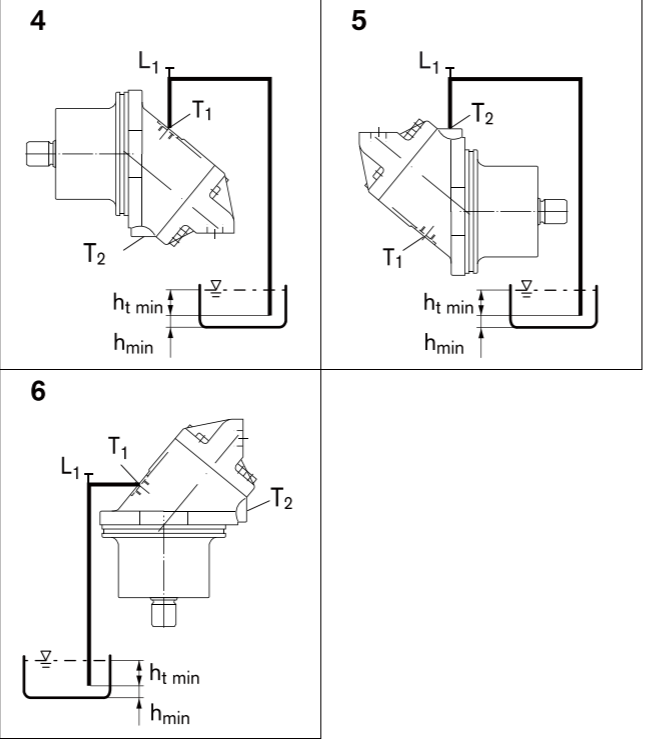
Below-reservoir installation (standard)

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.



Axial Piston Fixed Motor
SA2FM Series



- Size 5
Nominal pressure/Maximum pressure 315/350 bar
- Size 10 to 180
Nominal pressure/Maximum pressure 400/450 bar
- Open and closed circuits

Contents

Ordering code for standard program	21
Technical data	23
Dimensions sizes 5 to 180	26
Flushing and boost pressure valve	41
Pressure-relief valve	42
Counterbalance valve BVD	44
Speed sensors	48
Installation instructions	49

Ordering code for standard program

	SA2F		M		/	6		W	-	V			
01	02	03	04	05		06	07	08		09	10	11	12

Hydraulic fluid

01	Mineral oil and HFD.	
	HFB, HFC hydraulic fluid	

Axial piston unit

02	Bent-axis design, fixed	SA2F
----	-------------------------	------

Drive shaft bearing

5 to 180

03	Standard bearing (without code)	●	
	Long-life bearing	-	L

Operating mode

04	Motor (plug-in motor A2FE)	M
----	-----------------------------	---

Size (NG)

05	Geometric displacement	
		5 10 12 16 23 28 32 45 56 63 80 90 107 125 160 180

Series

06		6
----	--	---

Index

07	NG10 to 180	1
----	-------------	---

Direction of rotation

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

Seals

09	FKM (fluor-caoutchouc)	V
----	------------------------	---

Drive shafts

5 10 12 16 23 28 32 45 56 63 80 90 107 125 160 180

10	Splined shaft DIN 5480	-	●	●	●	●	●	-	●	●	●	●	●	●	●	A
		-	●	●	●	●	●	●	●	●	●	●	●	●	●	Z
	Parallel keyed shaft DIN 6885	●	●	●	●	●	●	-	●	●	●	●	●	●	●	B
		-	●	●	●	●	●	●	●	-	●	-	●	-	-	P
Conical shaft	●	-	-	-	-	-	-	-	-	-	-	-	-	-	C	

Mounting flanges

5 to 180

11	ISO 3019-2 4-hole	●	B
----	-------------------	---	---

● = Available ○ = On request - = Not available

Ordering code for standard program

	SA2F		M		/	6		W	-	V			
01	02	03	04	05		06	07	08		09	10	11	12

Port plates for service lines

5 10-16 23 28,32 45 56,63 80,90 107-125 160-180

12	SAE flange ports A and B at rear	01	0	-	-	●	●	-	-	-	-	-	010
		7	-	-	-	-	-	-	-	-	-	-	017
	SAE flange ports A and B at side, opposite	02	0	-	-	-	-	-	●	●	-	-	020
		7	-	-	-	-	-	●	●	-	-	-	027
		9	-	-	-	-	-	-	-	-	-	-	029
	Threaded ports A and B at side, opposite	03	0	-	●	-	-	-	-	-	-	-	030
	Threaded ports A and B at side and rear	04	0	-	●	-	-	-	-	-	-	-	040
	SAE flange ports A and B at bottom (same side)	10	0	-	-	-	-	-	●	●	-	-	100
	Port plate with 1-level pressure- relief valves	BVD	17	1	-	-	-	-	-	-	●	-	-
18			8	-	-	-	-	-	-	●	-	-	181
Port plate with pressure-relief valves		19	1	-	-	-	-	-	●	●	-	-	191
		2	-	-	-	-	-	-	●	●	-	-	192

Valves

Without valve	0
Pressure-relief valve (without pressure boost facility)	1
Pressure-relief valve (with pressure boost facility)	2
Flushing and boost pressure valve, mounted	7
Counterbalance valve BVD mounted	8
Flushing and boost pressure valve, integrated	9

Speed sensors

5 to 16 23 to 180

13	Without speed sensor (without code)	●	●	
	Prepared for HDD speed sensor	-	●	F
	HDD speed sensor mounted	-	●	H
	Prepared for DSA speed sensor	-	○	U
	DSA speed sensor mounted	-	○	V

● = Available ○ = On request - = Not available

Technical data

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

Size	NG		5	10	12	16	23	28	32	45	56	63	80	
Displacement geometric, per revolution	V _g	cm ³	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4	
Speed maximum ¹⁾	n _{nom}	rpm	10000	8000	8000	8000	6300	6300	6300	5600	5000	5000	4500	
	n _{max} ²⁾	rpm	11000	8800	8800	8800	6900	6900	6900	6200	5500	5500	5000	
Input flow ³⁾														
at n _{nom} and V _g	q _V	L/min	49	82	96	128	144	177	202	255	281	315	362	
Torque ⁴⁾														
at V _g and	Δp = 350 bar	T	Nm	24.7 ⁵⁾	57	67	89	128	157	178	254	313	351	448
	Δp = 400 bar	T	Nm	—	66	76	102	146	179	204	290	357	401	512
Rotary stiffness	c	kNm/rad	0.63	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94	6.25	8.73	
Moment of inertia for rotary group	J _{GR}	kgm ²	0.00006	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072	
Maximum angular acceleration	α	rad/s ²	5000	5000	5000	5000	6500	6500	6500	14600	7500	7500	6000	
Case volume	V	L		0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55	
Mass (approx.)	m	kg	2.5	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18	18	23	
Size	NG		90	107	125	160	180							
Displacement geometric, per revolution	V _g	cm ³	90	106.7	125	160.4	180							
Speed maximum ¹⁾	n _{nom}	rpm	4500	4000	4000	3600	3600							
	n _{max} ²⁾	rpm	5000	4400	4400	4000	4000							
Input flow ³⁾														
at n _{nom} and V _g	q _V	L/min	405	427	500	577	648							
Torque ⁴⁾														
at V _g and	Δp = 350 bar	T	Nm	501	594	696	893	1003						
	Δp = 400 bar	T	Nm	573	679	796	1021	1146						
Rotary stiffness	c	kNm/rad	9.14	11.2	11.9	17.4	18.2							
Moment of inertia for rotary group	J _{GR}	kgm ²	0.0072	0.0116	0.0116	0.0220	0.0220							
Maximum angular acceleration	α	rad/s ²	6000	4500	4500	3500	3500							
Case volume	V	L	0.55	0.8	0.8	1.1	1.1							
Mass (approx.)	m	kg	23	32	32	45	45							

Technical data

Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

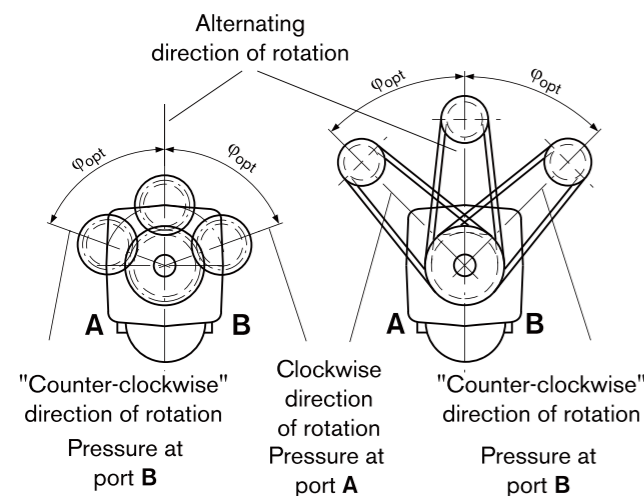
Size	NG		5	5	10	10	12	12	16	23	23
Drive shaft	ø	mm	12	12	20	25	20	25	25	25	30
Maximum radial force at distance a (from shaft collar)	F _{q max}	kN	1.6	1.6	3.0	3.2	3.0	3.2	3.2	5.7	5.4
	a	mm	12	12	16	16	16	16	16	16	16
with permissible torque	T _{max}	Nm	24.7	24.7	66	66	76	76	102	146	146
Δ permissible pressure Δp	Δp _{perm}	bar	315	315	400	400	400	400	400	400	400
Maximum axial force	+F _{ax max}	N	180	180	320	320	320	320	320	500	500
	-F _{ax max}	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	±F _{ax perm/bar}	N/bar	1.5	1.5	3.0	3.0	3.0	3.0	3.0	5.2	5.2
Size	NG		28	28	32	45	56	56	56	63	80
Drive shaft	ø	mm	25	30	30	30	30	30	35	35	35
Maximum radial force at distance a (from shaft collar)	F _{q max}	kN	5.7	5.4	5.4	7.6	9.5	7.8	9.1	9.1	11.6
	a	mm	16	16	16	18	18	18	18	18	20
with permissible torque	T _{max}	Nm	179	179	204	290	357	294	357	401	512
Δ permissible pressure Δp	Δp _{perm}	bar	400	400	400	400	400	330	400	400	400
Maximum axial force	+F _{ax max}	N	500	500	500	630	800	800	800	800	1000
	-F _{ax max}	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	±F _{ax perm/bar}	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7	8.7	10.6
Size	NG		80	80	90	107	107	125	160	160	180
Drive shaft	ø	mm	35	40	40	40	45	45	45	50	50
Maximum radial force at distance a (from shaft collar)	F _{q max}	kN	11.1	11.4	11.4	13.6	14.1	14.1	18.1	18.3	18.3
	a	mm	20	20	20	20	20	20	25	25	25
with permissible torque	T _{max}	Nm	488	512	573	679	679	796	1021	1021	1146
Δ permissible pressure Δp	Δp _{perm}	bar	380	400	400	400	400	400	400	400	400
Maximum axial force	+F _{ax max}	N	1000	1000	1000	1250	1250	1250	1600	1600	1600
	-F _{ax max}	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	±F _{ax perm/bar}	N/bar	10.6	10.6	10.6	12.9	12.9	12.9	16.7	16.7	16.7

Technical data

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}
5 to 180	$\pm 70^\circ$	$\pm 45^\circ$



Determining the operating characteristics

$$\text{Input flow } q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v} \quad [\text{L/min}]$$

$$\text{Speed } n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g} \quad [\text{min}^{-1}]$$

$$\text{Torque } T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi} \quad [\text{Nm}]$$

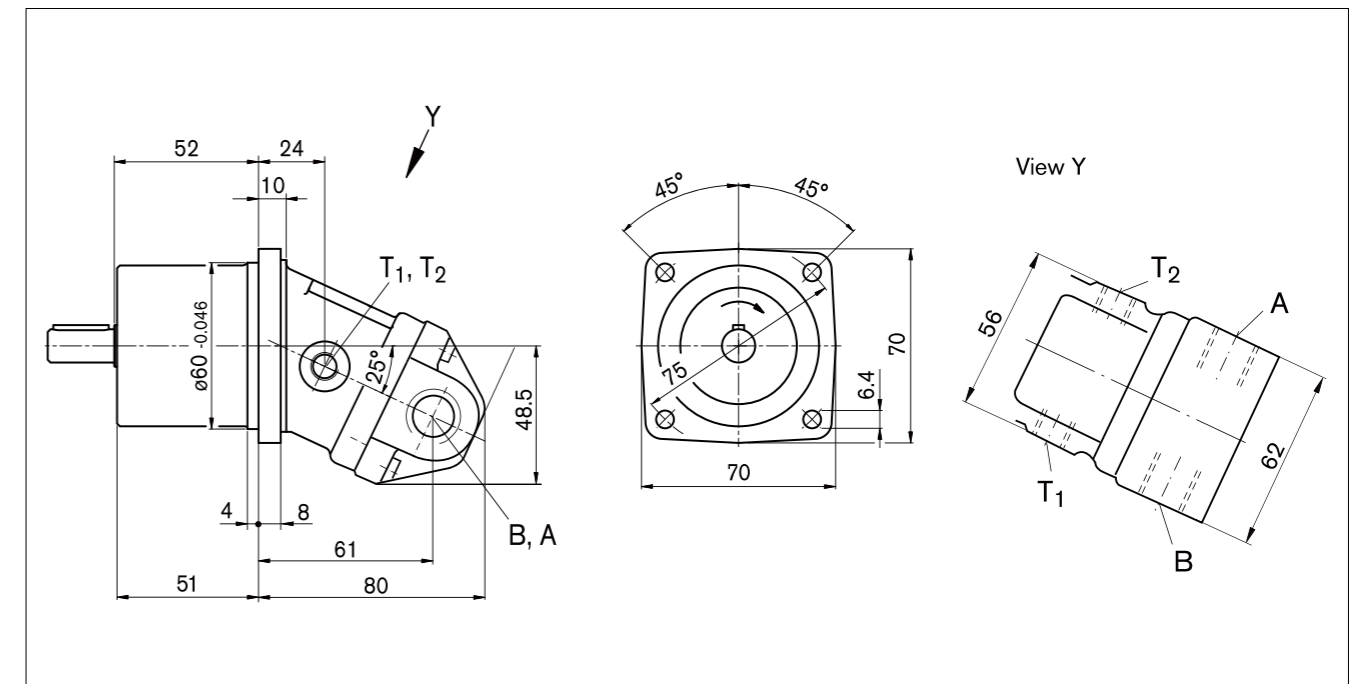
$$\text{Power } P = \frac{2 \pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600} \text{ [kW]}$$

$$V_g = \text{Displacement per revolution in cm}^3$$
$$\Delta p = \text{Differential pressure in bar}$$

n = Speed in rpm

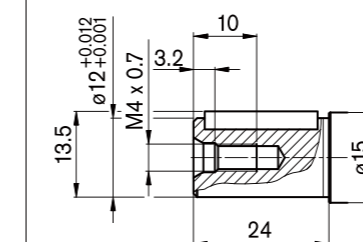
$$\eta_v = \text{Volumetric efficiency}$$
 η_{mh} = Mechanical-hydraulic efficiency
$$\eta_t = \text{Total efficiency } (\eta_t = \eta_v \cdot \eta_{mh})$$


Dimensions size 5

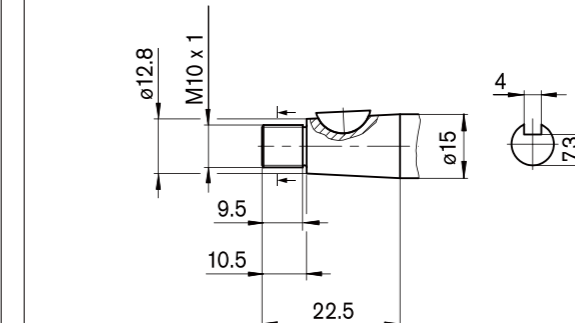


Drive shafts

B Parallel keyed shaft
DIN 6885, A4x4x20



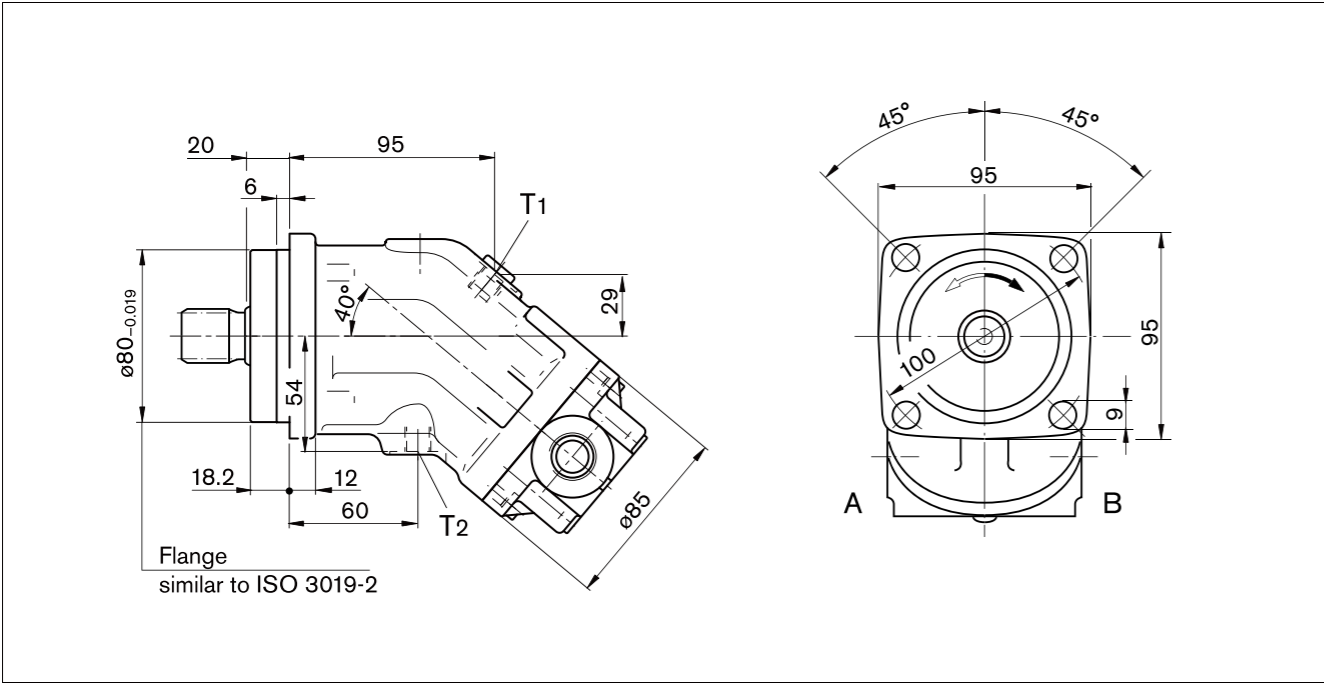
C Conical shaft with threaded pin and woodruff key, 3x5 (DIN 6888), (tapering 1:10)



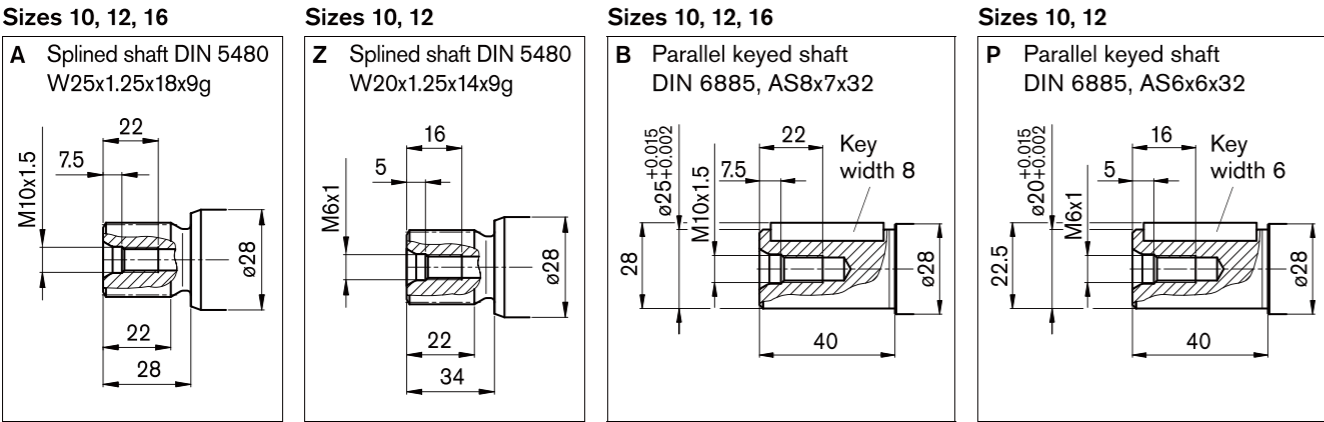
Ports

Designation	Port for	Standard ⁶⁾	Size ³⁾	Maximum pressure [bar]	State
A, B	Service line	DIN 3852	M18 x 1.5; 12 deep	350	O
T ₁	Drain line	DIN 3852	M10 x 1; 8 deep	3	O
T ₂	Drain line	DIN 3852	M10 x 1; 8 deep	3	O

Dimensions sizes 10, 12, 16



Drive shafts



Ports

Designation	Port for	Standard	Size	Maximum pressure [bar]	State
A, B	Service line (see port plates)			450	
T ₁	Drain line	DIN 3852	M12 x 1.5; 12 deep	3	X
T ₂	Drain line	DIN 3852	M12 x 1.5; 12 deep	3	O

Dimensions sizes 10, 12, 16

Location of the service line ports on the port plates

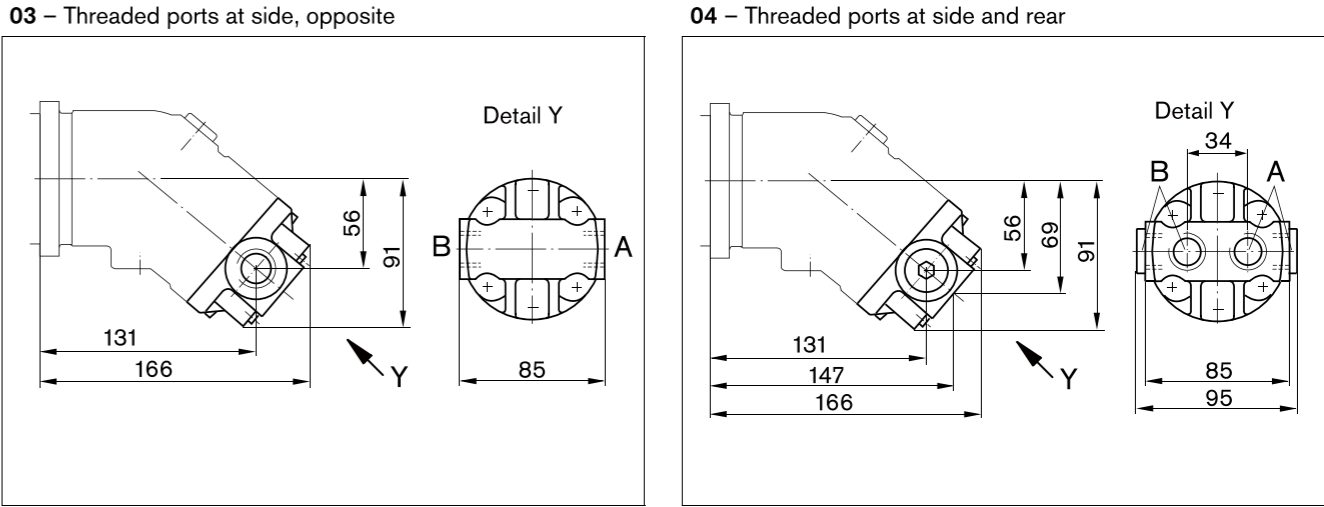
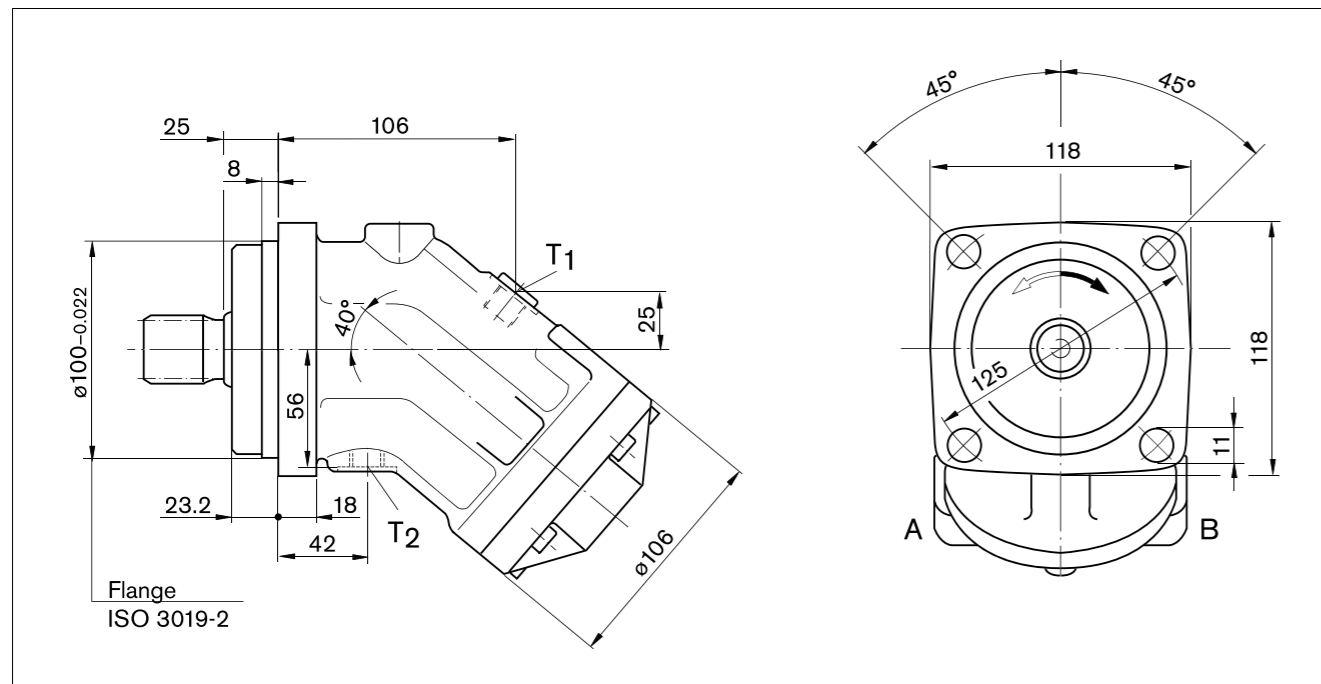


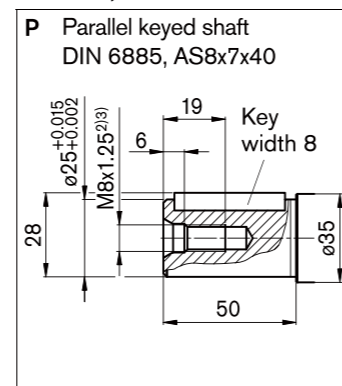
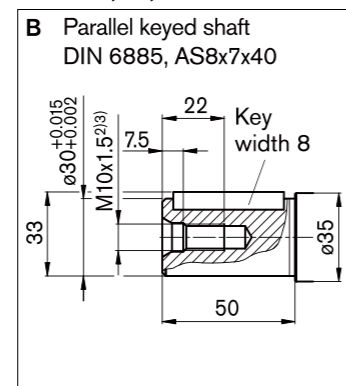
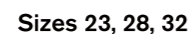
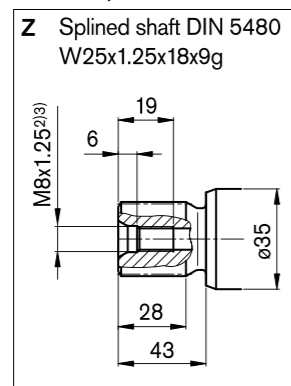
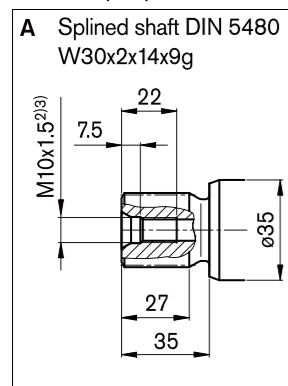
Plate	Designation	Port for	Standard	Size	Maximum pressure [bar]	State
03	A, B	Service line	DIN 3852	M22 x 1.5; 14 deep	450	O
04		Service line	DIN 3852	M22 x 1.5; 14 deep	450	1x O each

Dimensions sizes 23, 28, 32



Drive shafts

Sizes 23, 28, 32



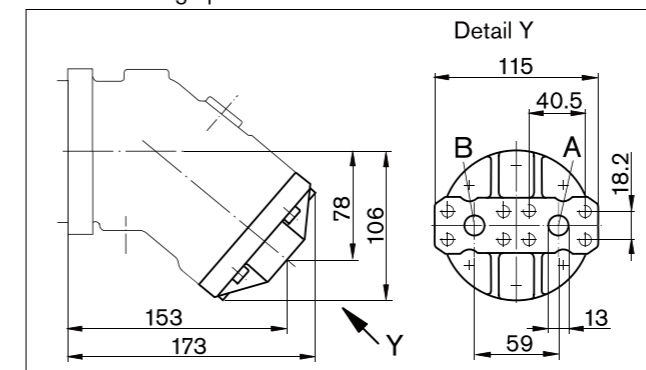
Ports

Designation	Port for	Standard	Size	Maximum pressure [bar]	State
A, B	Service line (see port plates)			450	
T ₁	Drain line	DIN 3852	M16 x 1.5; 12 deep	3	X
T ₂	Drain line	DIN 3852	M16 x 1.5; 12 deep	3	O

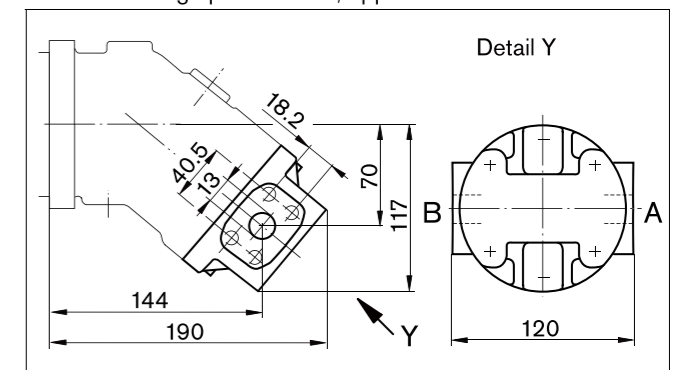
Dimensions sizes 23, 28, 32

Location of the service line ports on the port plates

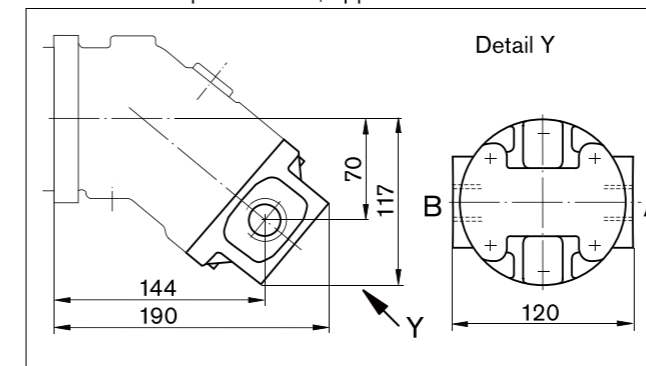
01 – SAE flange ports at rear



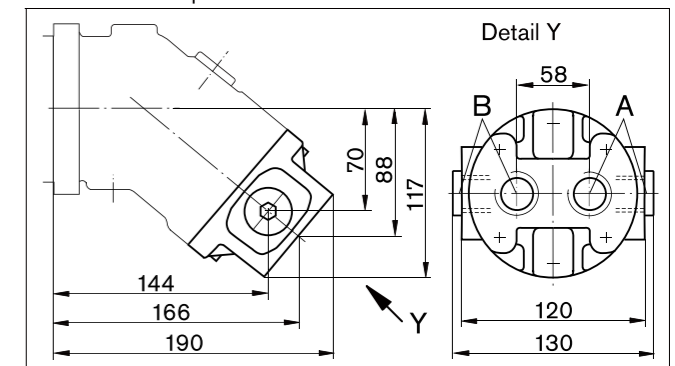
02 – SAE flange ports at side, opposite



03 – Threaded ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

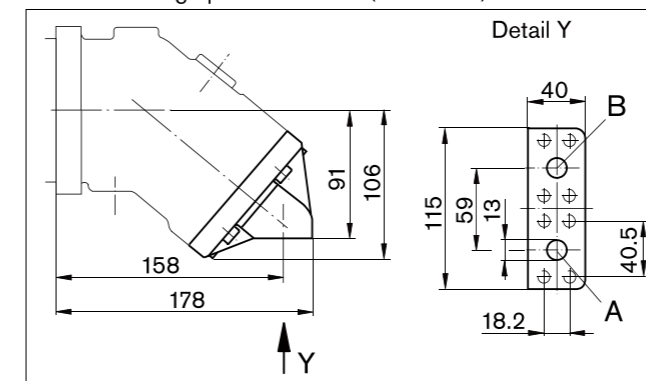
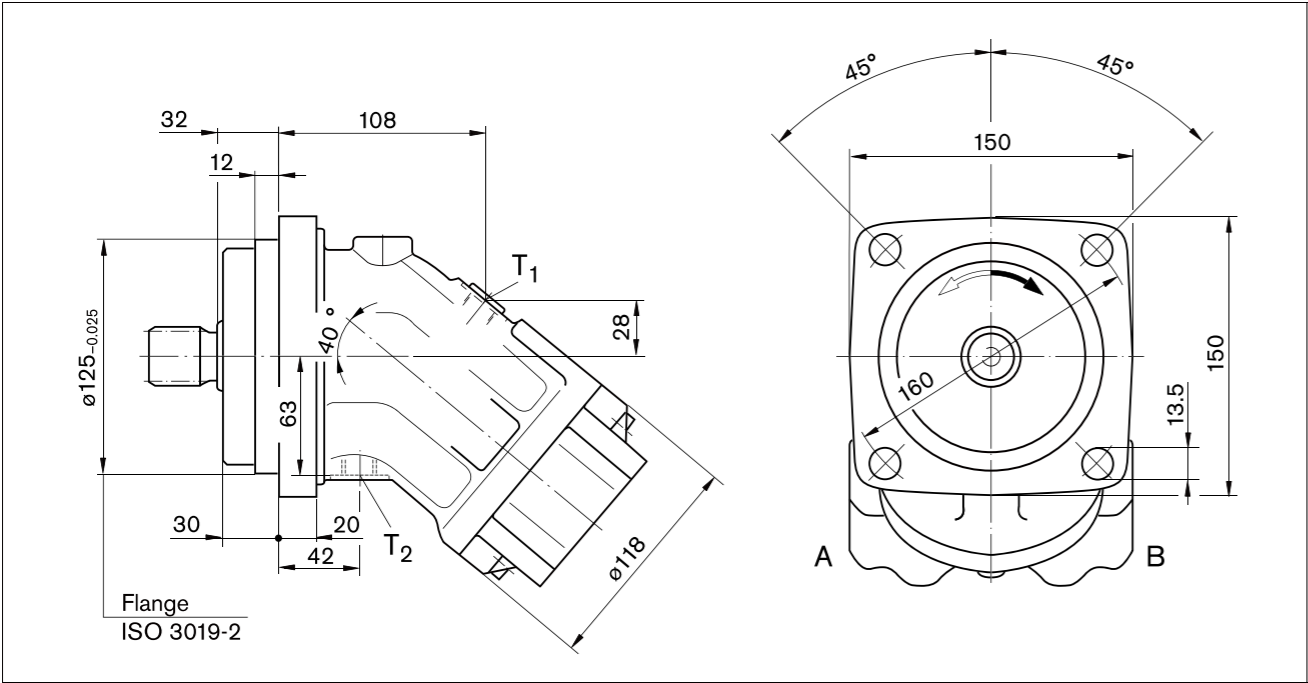


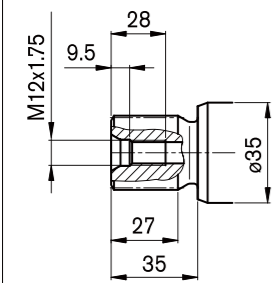
Plate	Designation	Port for	Standard	Size	Maximum pressure [bar]	State
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518 DIN 13	1/2 in M8 x 1.25; 15 deep	450	O
03		Service line	DIN 3852	M27 x 2; 16 deep	450	O
04		Service line	DIN 3852	M27 x 2; 16 deep	450	1x O each

Dimensions size 45

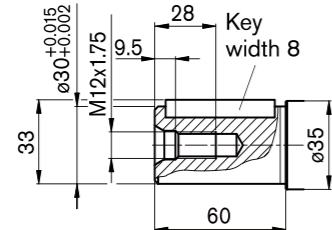


Drive shafts

Z Splined shaft DIN 5480
W30x2x14x9g



P Parallel keyed shaft
DIN 6885, AS8x7x50



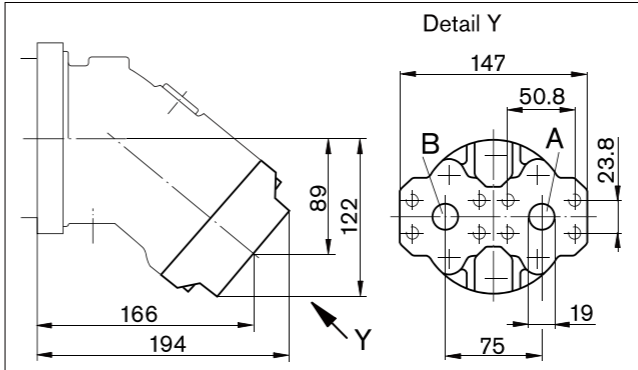
Ports

Designation	Port for	Standard	Size	Maximum pressure [bar]	State
A, B	Service line (see port plates)			450	
T ₁	Drain line	DIN 3852	M18 x 1.5; 12 deep	3	X
T ₂	Drain line	DIN 3852	M18 x 1.5; 12 deep	3	O

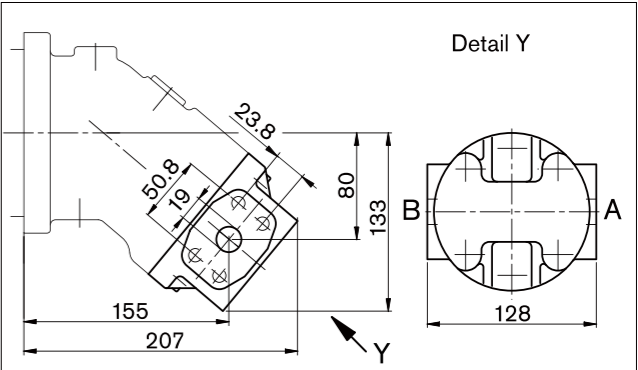
Dimensions size 45

Location of the service line ports on the port plates

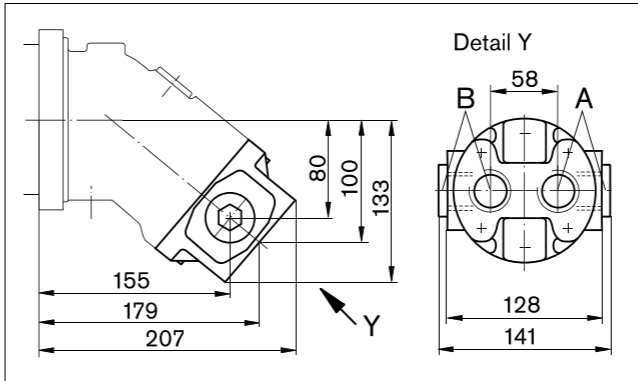
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

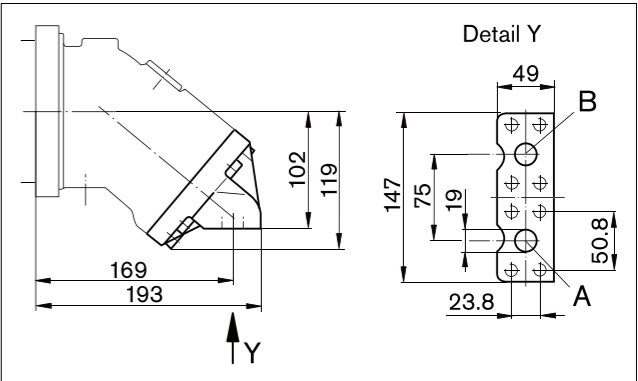
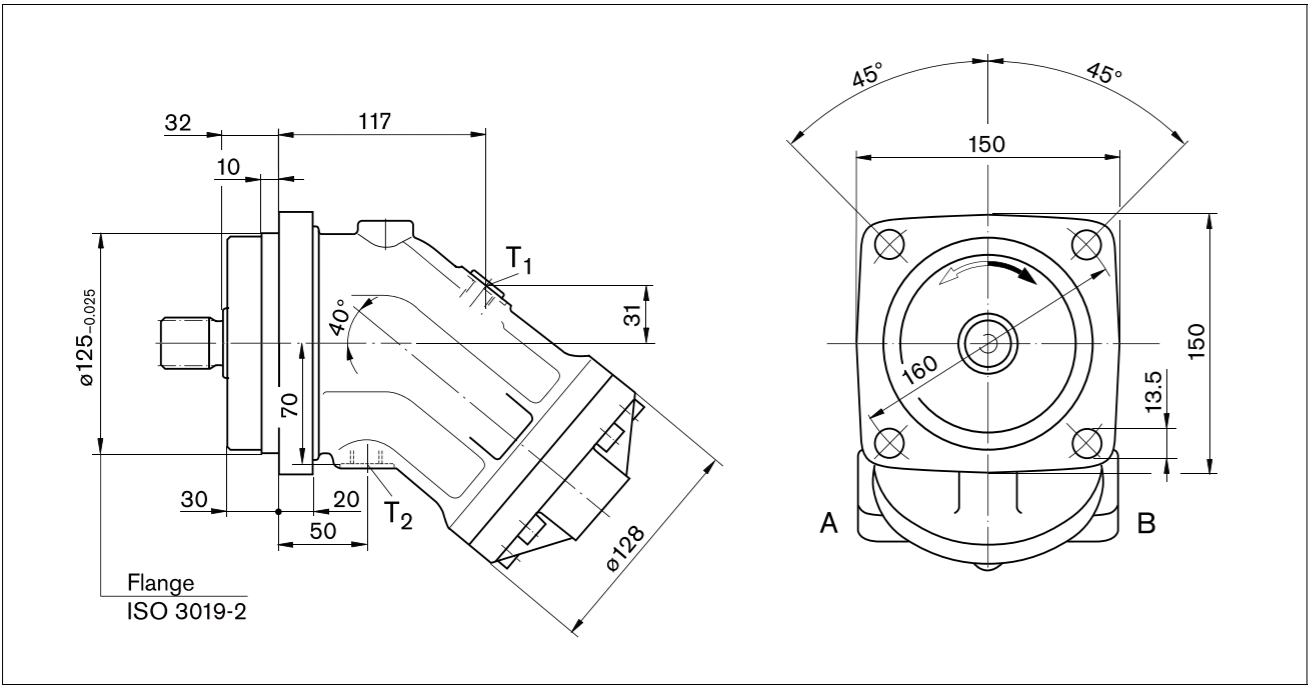


Plate	Designation	Port for	Standard	Size	Maximum pressure [bar]	State
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518 DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
04		Service line	DIN 3852	M33 x 2; 18 deep	450	1x O each

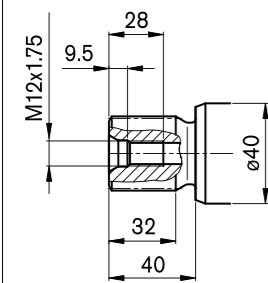
Dimensions sizes 56, 63



Drive shafts

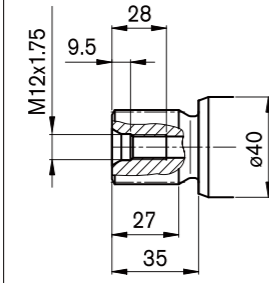
NG56, 63

A Splined shaft DIN 5480
W35x2x16x9g



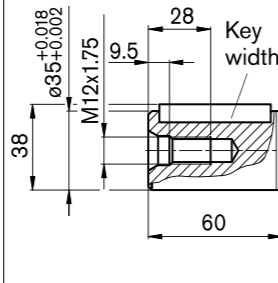
NG56

Z Splined shaft DIN 5480
W30x2x14x9g



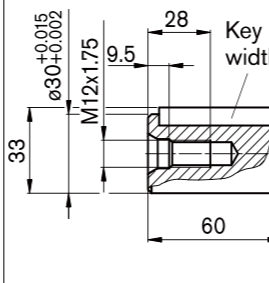
NG56, 63

B Parallel keyed shaft
DIN 6885, AS10x8x50



NG56

P Parallel keyed shaft
DIN 6885, AS8x7x50



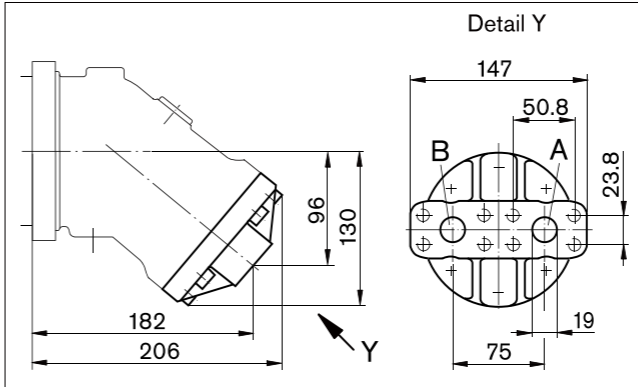
Ports

Designation	Port for	Standard	Size	Maximum pressure [bar]	State
A, B	Service line (see port plates)			450	
T ₁	Drain line	DIN 3852	M18 x 1.5; 12 deep	3	X
T ₂	Drain line	DIN 3852	M18 x 1.5; 12 deep	3	O

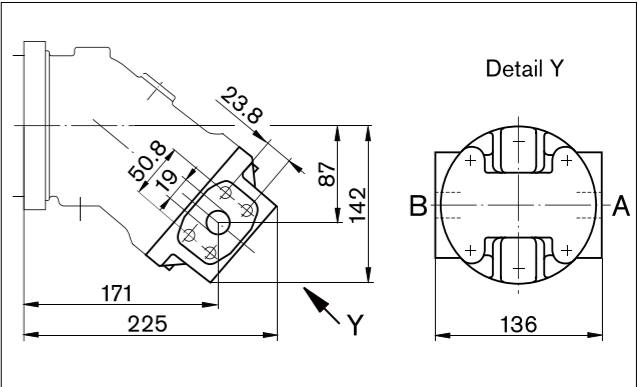
Dimensions sizes 56, 63

Location of the service line ports on the port plates

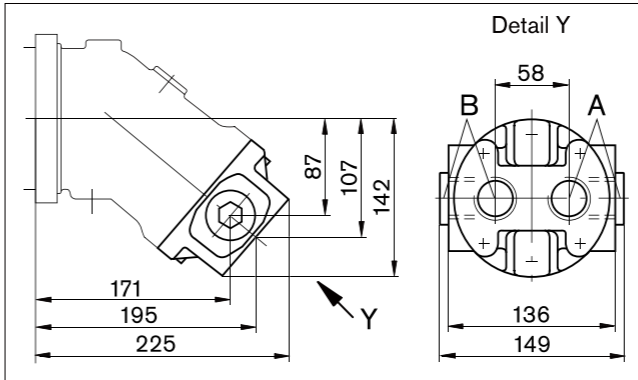
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

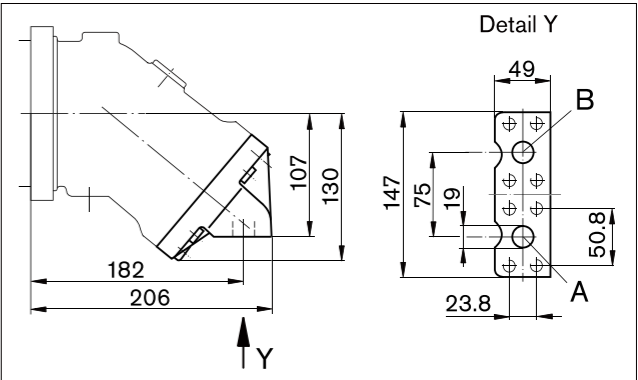


Plate	Designation	Port for	Standard	Size	Maximum pressure [bar]	State
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518 DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
04		Service line	DIN 3852	M33 x 2; 18 deep	450	1x O each