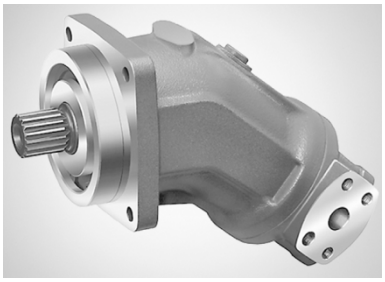
Pump HD-A2FO Sizes 5～500 Series 6 Nominal pressure 400 bar Maximum pressure 450 bar



- Fixed pump with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in an open circuit.
- For use in mobile and stationary applications,the flow is proportional to the drive speed and displacement.
- The drive shaft bearings are designed for the bearing service life requirements usually encountered in these areas.
- High power density,Small dimensions,High total efficiency,Economical design, One-piece tapered piston with piston rings for sealing.

Motor HD-A2FM Sizes 5～500 Series 6 Nominal pressure 400 bar Maximum pressure 450 bar

- Fixed motor with axial tapered piston rotary group of bentaxis 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.
- 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.

Motor HD-A2FE Sizes 28～355 Series 6 Nominal pressure 400 bar Maximum pressure 450 bar

- Fixed plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits.
- Far-reaching integration in mechanical gearbox due to recessed mounting flange located in the center of the case (extremely space-saving construction)
- Small dimensions,High total efficiency,Complete unit,ready-assembled and tested,Easy to install,simply plug into the mechanical gearbox,No configuration specifications to be observed when installing.

■ Contents

■ Ordering Code For Standard Program

HD	-		A2F		O	56	/	6	1	R	-	V	A	B	05	-	
0		1	2	3	4	5		6	7	8		9	10	11	12		13

0	Manufacturer		Code
	HUADE HYDRAULIC 华德液压		HD

1	Oil types / Specifications		5～200	250	355	500	Code
	Mineral oil	……without code	■	■	■	■	-
	HFD	for sizes 250～500 only in combination with long-life bearings L	■	■	■	■	-
	HFB,HFC	Size 5～200……without code	■	-	-	-	-
		Size 250～500 only in combination with long-life bearings L	-	■	■	■	E

2	Axial piston unit	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200～500	Code
	Bent-axis design, fixed	□	■	■	■	■	■	■	■	□	A2F

3	Drive shaft bearing	5～200	250	355	500	Code
	Standard bearing……without code	■	-	-	-	-
	Long-life bearing	-	■	■	■	L

4	Operation mode	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200～500	Code
	Pump, open circuit	□	■	■	■	■	■	■	■	□	O

5	Displacement	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200	250	355	500	Code
	≦ V_{gmax}（cm^3/r）	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200	250	355	500	-

6	Series	5～500	Code
	Series 6	■	6

7	Index	5	10～180	200	250	355	500	Code
	Size 10～180	-	■	-	-	-	-	1
	Size 200	-	-	■	-	-	-	3
	Size 5 and 250～500	■	-	-	■	■	■	0

8	Direction of rotation		Code
	Viewed on drive shaft	Clockwise (forward dextral)	R
		Counter-clockwise (reverse left-handed)	L

9	Sealing material	5～500	Code
	FKM (Fluoro-rubber)	■	V
	NBR(Nitrile-rubber),Shaft seal FKM (Fluoro-rubber)	■	P

■ Ordering Code For Standard Program

HD	-		A2F		O	56	/	6	1	R	-	V	A	B	05	-	
0		1	2	3	4	5		6	7	8		9	10	11	12		13

10	Drive shaft		5	10/12	16	23/28	32	45	56	63	80	90	107	125	160	180/200	250/355/500	Code
	Splined	I	-	■	■	■	■	-	■	■	■	■	■	■	■	■	-	A
	shaft	II	-	■	-	■	-	■	■	-	■	-	■	-	■	-	■	Z
	Parallel	I	■	■	■	■	■	-	■	■	■	■	■	■	■	■	-	B
	shaft	II	-	■	-	■	-	■	■	-	■	-	■	-	■	-	■	P
	Conical shaft [1)]		■	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C

11	Mounting flange		5～250	355～500	Code
	ISO 3019-2	4 hole	■	-	B
		8 hole	-	■	H

12	Working port	5	10～16	23～250	355～500	Code
	SAE flange port...B(A) at side,S at rear,Fastening thread,metric.	-	-	■	-	05
	Threaded port....B(A) at side,S at rear,metric thread.	-	■	-	-	06
	SAE flange port...B(A) and S at rear,Fastening thread,metric.	-	-	-	■	11
	Threaded port....B(A) and S at rear,metric thread.	■	-	-	-	07

13	Standard / special version	Code
	Standard version……without code	-
	Standard version with installation variants	Y
	Special version	S

□ Note:1）Conical shaft with threaded pin and woodruff key (DIN 6888). The torque must be transmitted via the tapered press fit.

■ = Optimization scheme (shorter delivery time)

■ = Available

□ = On request

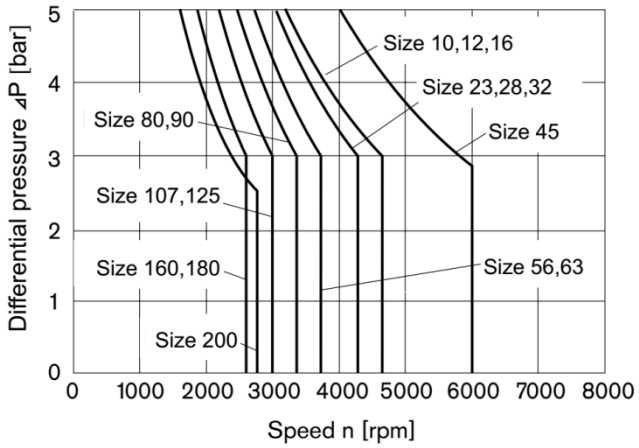
\- = Not available

Shaft seal...Permissible pressure loading

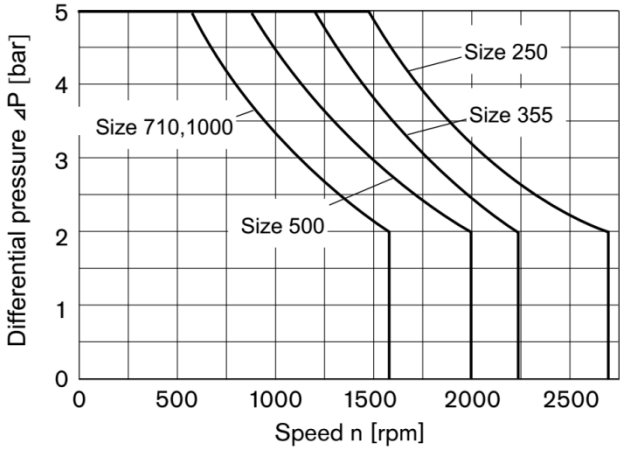
- The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure).
- The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature.
- For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes (t < 0.1 s) of up to 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.

Static characteristic

- Sizes 10 to 200



- Sizes 250 to 500



The values are valid for an ambient pressure P_{abs} = 1 bar

Temperature range

- The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C
- For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -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	Direction of flow
clockwise (R)	S → B
counter-clockwise (L)	S → A

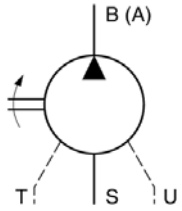
Long-life bearing

- Sizes 250～500
- 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

Sizes	250	355	500
$q_{v\ flush}$（l/min）	10	16	16

Ports

Ports	Port for	Diagram
A, B	Working port	
S	Suction port	
T	Drain port	
U（Sizes 250～500）	Flushing port	

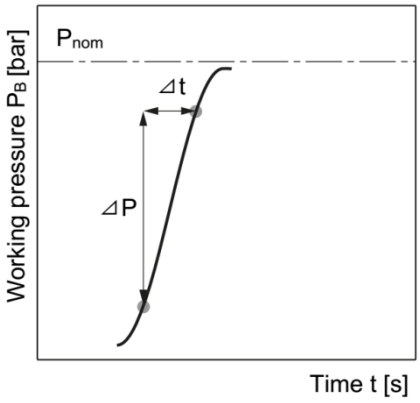
■ Working pressure range

□ Working pressure range valid when using hydraulic fluids based on mineral oils

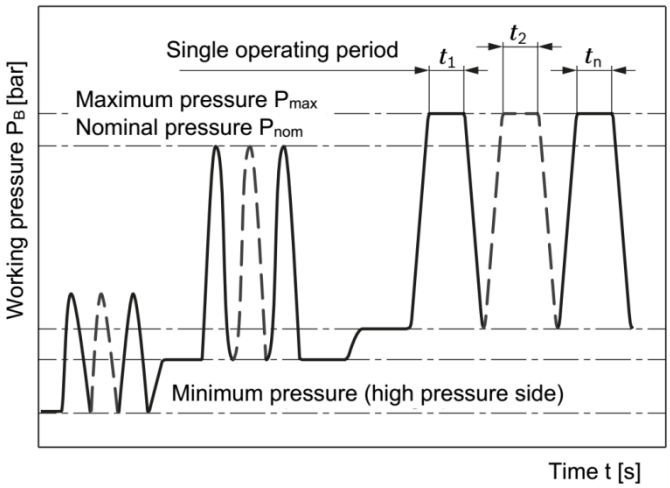
Pressure at service line port A or B			Definition
Nominal pressure P_{nom}	Size 5	315 bar (absolute)	The nominal pressure corresponds to the maximum design pressure
	Size 10～200	400 bar (absolute)	
	Size 250～500	350 bar (absolute)	
Maximum pressure P_{max}	Size 5	350 bar (absolute)	The maximum pressure 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.
	Size 10～200	450 bar (absolute)	
	Size 250～500	400 bar (absolute)	
	Single operating period	10 s	
	Total operating period	300 h	
Minimum pressure P_{min} high-pressure side		25 bar (absolute)	Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$ Without pressure-relief valve		16000 bar/s	Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)			
Minimum pressure $P_{S\,min}$		0.8 bar (absolute)	Minimum pressure at suction port S (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Maximum pressure $P_{S\,max}$		30 bar (absolute)	For higher inlet pressure, please consult us.

Note:Values for other hydraulic fluids, please contact us

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



■ Pressure defnition



□ Total operating period = $t_1 + t_2 + t_3$ ……$+ t_n$

■ Table of values

□ Theoretical values, without considering efficiencies and tolerances, values rounded off

Technical Data	A2FO			5	10	12	16	23	28	32	45	56	63	80
Displacement		V_g	cm^3	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4
Rotational	maximum	n_{nom}	rpm	5600	3150	3150	3150	2500	2500	2500	2240	2000	2000	1800
speed 1)		n_{max} 2)	rpm	8000	6000	6000	6000	4750	4750	4750	4250	3750	3750	3350
Flow	at n_{nom}	q_v	l/min	27.6	32	38	50	57	70	80	102	112	126	145
Power	⊿P=350 bar	P	KW	14.5 4)	19	22	29	33	41	47	60	65	74	84
	⊿P=400 bar	P	KW	-	22	25	34	38	47	53	68	75	84	96
Torque 3)	⊿P=350 bar	T	Nm	24.7 4)	57	67	89	128	157	178	254	313	351	448
at V_g and	⊿P=400 bar	T	Nm	-	66	76	102	146	179	204	290	357	401	512
Case volume		V	l	0.12	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55
Weight	approx	m	Kg	2.5	6	6	6	9.5	9.5	9.5	13.5	18	18	23

Technical Data	A2FO			90	107	125	160	180	200	250	355	500		
Displacement		V_g	cm^3	90	106.7	125	160.4	180	200	250	355	500		
Rotational	maximum	n_{nom}	rpm	1800	1600	1600	1450	1450	1550	1500	1320	1200		
speed 1)		n_{max} 2)	rpm	3350	3000	3000	2650	2650	2750	1800	1600	1500		
Flow	at n_{nom}	q_v	l/min	162	171	200	233	261	310	375	469	600		
Power	⊿P=350 bar	P	KW	95	100	117	136	152	181	219	273	350		
	⊿P=400 bar	P	KW	108	114	133	155	174	207	-	-	-		
Torque 3)	⊿P=350 bar	T	Nm	501	594	696	893	1003	1114	1393	1978	2785		
at V_g and	⊿P=400 bar	T	Nm	573	679	796	1021	1146	1273	-	-	-		
Case volume		V	l	0.55	0.8	0.8	1.1	1.1	2.7	2.5	3.5	4.2		
Weight	approx	m	Kg	23	32	32	45	45	66	73	110	155		

□ Note

1）The values are applicable

- for an absolute pressure P_{abs}=1 bar at suction port S
- within the optimum viscosity range from V_{opt} = 16 to 36 mm^2/s

2）Maximum speed (limiting speed) with increased inlet pressure pabs at suction port S

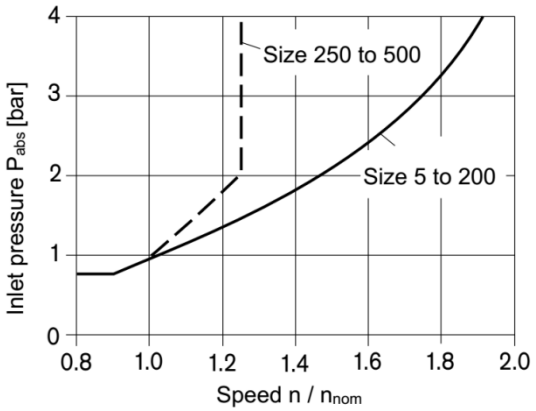
3）Torque without radial force, with radial force

4）Torque at ⊿P = 315 bar

■ 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.

■ Maximum speed...limiting speed



■ Technical Data

□ Permissible radial and axial loading on the drive shaft

Technical Data A2FO			5	5 3)	10	10	12	12	16	23	23	28	28
Drive shaft	Φ	mm	12	12	20	25	20	25	25	25	30	25	30
Max.radial force 1)	$F_{q\,max}$	KN	1.6	1.6	3.0	3.2	3.0	3.2	3.2	5.7	5.4	5.7	5.4
at distance a	a	mm	12	12	16	16	16	16	16	16	16	16	16
(from shaft collar)													
permissible torque	T_{max}	Nm	24.7	24.7	66	66	76	76	102	146	146	179	179
permissible pressure	ΔP_{perm}	bar	315	315	400	400	400	400	400	400	400	400	400
Maximum axial force 2)	$+F_{ax\,max}$	N	180	180	320	320	320	320	320	500	500	500	500
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	1.5	1.5	3.0	3.0	3.0	3.0	3.0	5.2	5.2	5.2	5.2

Technical Data A2FO			32	45	56	56 4)	56	63	80	80 4)	80	90	
Drive shaft	Φ	mm	30	30	30	30	35	35	35	35	40	40	
Max.radial force 1)	$F_{q\,max}$	KN	5.4	7.6	9.5	7.8	9.1	9.1	11.6	11.1	11.4	11.4	
at distance a	a	mm	16	18	18	18	18	18	20	20	20	20	
(from shaft collar)													
permissible torque	T_{max}	Nm	204	290	357	294	357	401	512	488	512	573	
permissible pressure	ΔP_{perm}	bar	400	400	400	330	400	400	400	380	400	400	
Maximum axial force 2)	$+F_{ax\,max}$	N	500	630	800	800	800	800	1000	1000	1000	1000	
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	5.2	7.0	8.7	8.7	8.7	8.7	10.6	10.6	10.6	10.6	

Technical Data A2FO			107	107	125	160	160	180	200	250	355	500	
Drive shaft	Φ	mm	40	45	45	45	50	50	50	50	60	70	
Max.radial force 1)	$F_{q\,max}$	KN	13.6	14.1	14.1	18.1	18.3	18.3	20.3	1.2 5)	1.5 5)	1.9 5)	
at distance a	a	mm	20	20	20	25	25	25	25	41	52.5	52.5	
(from shaft collar)													
permissible torque	T_{max}	Nm	679	679	796	1021	1021	1146	1273	-	-	-	
permissible pressure	ΔP_{perm}	bar	400	400	400	400	400	400	400	-	-	-	
Maximum axial force 2)	$+F_{ax\,max}$	N	1250	1250	1250	1600	1600	1600	1600	2000	2500	-	
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	12.9	12.9	12.9	16.7	16.7	16.7	16.7	-	-	-	

□ Note

1）With intermittent operation

2）Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.

3）Conical shaft with threaded pin and woodruff key (DIN 6888)

4）Restricted technical data only for splined shaft

5）When at a standstill or when axial piston unit operating in nonpressurized conditions. Higher forces are permissible when under pressure, please contact us

□ Note:Influence of the direction of the permissible axial force

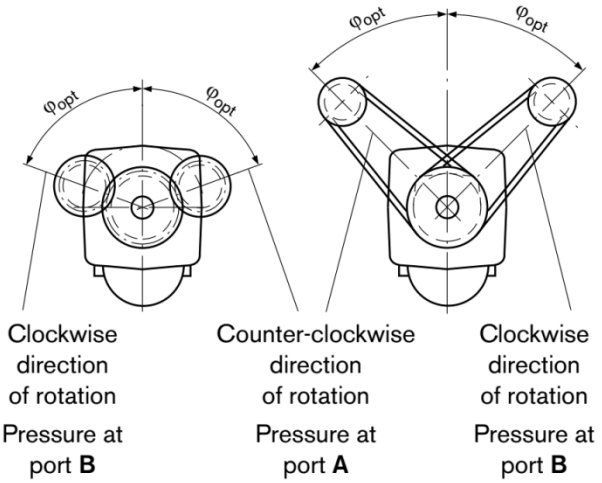
$+F_{ax\ max}$ = Increase in service life of bearings

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

■ Effect of radial force

- 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

	Toothed gear drive	V-belt output
Size	Ψ_{opt}	Ψ_{opt}
5～180	± 70°	± 45°
200～500	± 45°	± 70°



■ Determining the operating characteristics

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

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

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

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

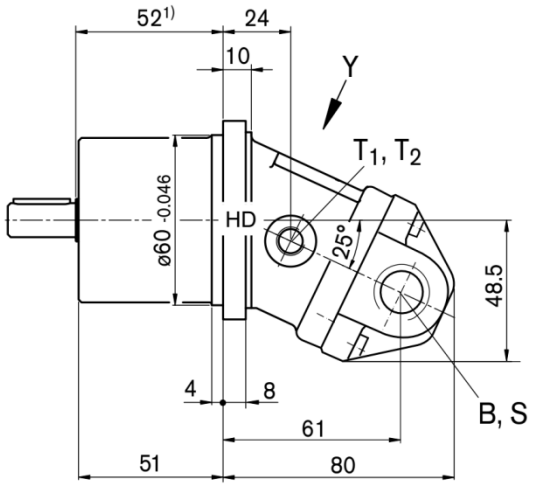
η_v = Volumetric efficiency

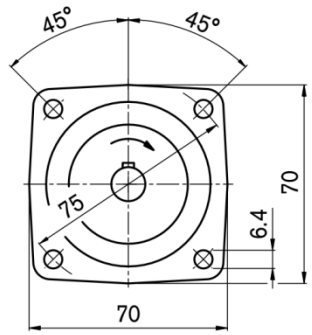
η_{mh} = Mechanical-hydraulic efficiency

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

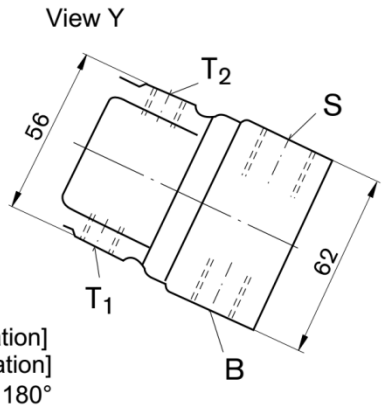
■ Size 5...Dimensions in mm

□ Port plate 07...Threaded ports A/B and S at side





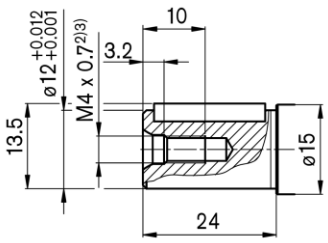
illustration：[cw direction of rotation]
on version, [ccw direction of rotation]
the port plate is rotated through 180°



□ Drive shaft

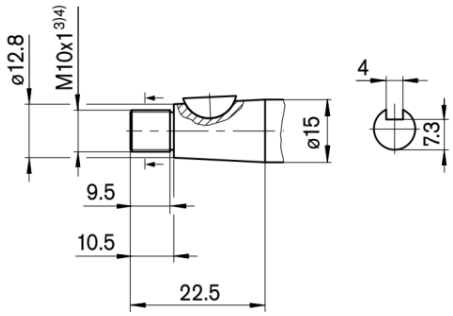
■ Size 5

B Parallel keyed shaft DIN 6885
A 4 x 4 x 20



■ Size 5

C Conical shaft DIN 6888
with threaded pin and woodruff key 3 x 5 tapering 1:10



□ Ports

Ports	Port for	Standard [6]	Size [3]	P_{Max} [bar] [5]	State [8]
B(A)	Working port	DIN 3852	M18 x 1.5 deep 12	350	O
S	Suction port	DIN 3852	M22 x 1.5 deep 14	30	O
T_1, T_2	Drain port	DIN 3852	M10 x 1 deep 8	3	X/O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

4) Thread according to DIN 3852, maximum tightening torque 30 Nm

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

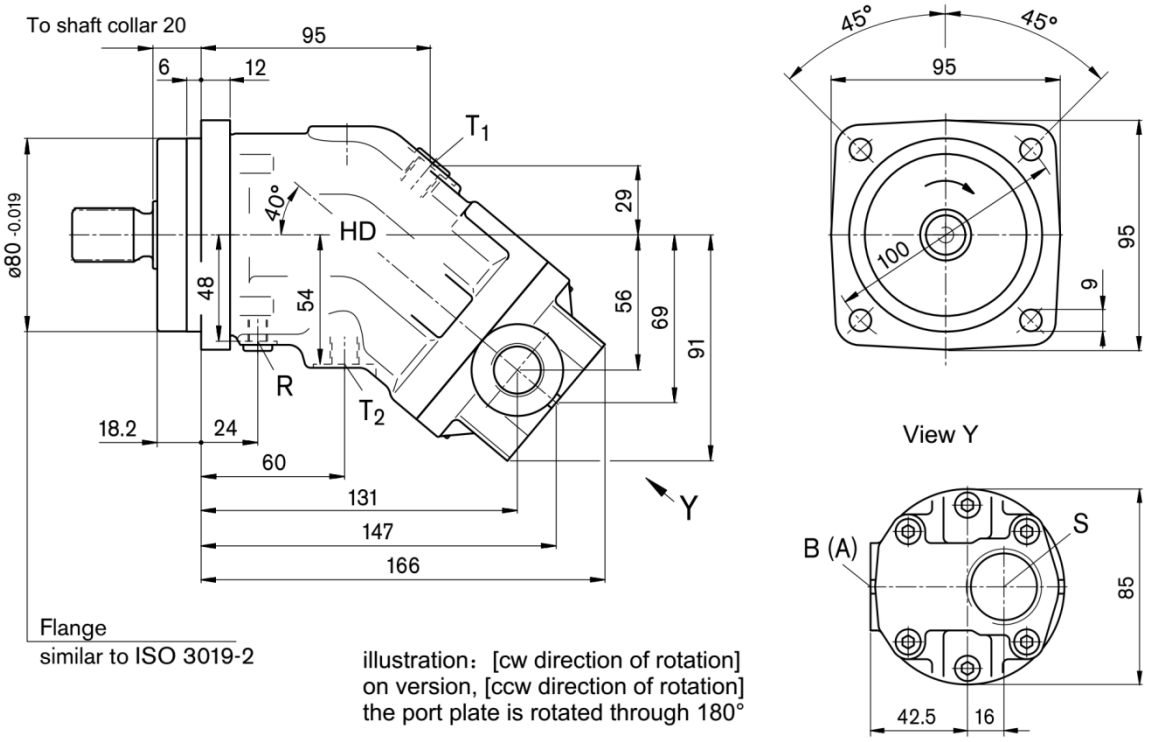
6) The spot face can be deeper than specified in the appropriate standard

7) Depending on the installation position, T_1 or T_2 must be connected

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

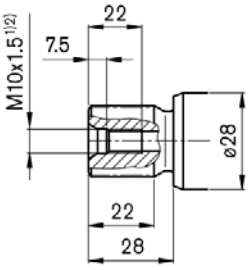
■ Size 10, 12, 16...Dimensions in mm

□ Port plate 06...Threaded ports A/B at side and threaded port S at rear

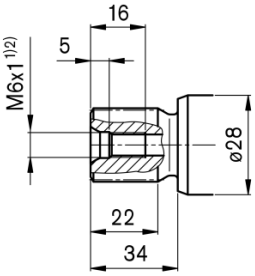


□ Drive shaft

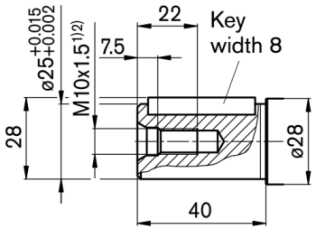
■ Size 10, 12, 16
A Splined shaft DIN 5480
W 25 x 1.25 x 18 x 9g



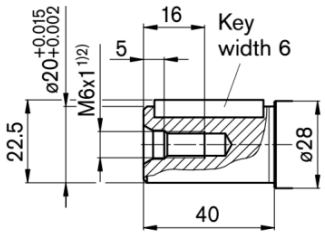
■ Size 10, 12
Z Splined shaft DIN 5480
W 20 x 1.25 x 14 x 9g



■ Size 10, 12, 16
B Parallel keyed shaft DIN 6885
AS 8 x 7 x 32



■ Size 10, 12
P Parallel keyed shaft DIN 6885
AS 6 x 6 x 32



□ Ports

Ports	Port for	Standard [4]	Size [2]	P_{Max} [bar] [3]	State [7]
B(A)	Working port	DIN 3852	M22 x 1.5 deep 14	350	O
S	Suction port	DIN 3852	M33 x 2 deep 18	30	O
T_1, T_2	Drain port	DIN 3852	M12 x 1.5 deep 12	3	X/O [6]
R	Air bieed	DIN 3852	M8 x 1 deep 8	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

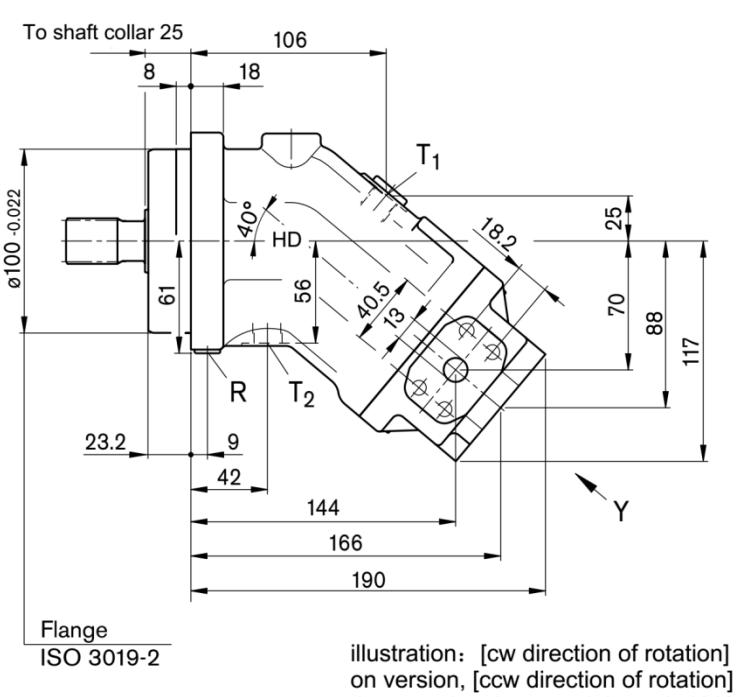
4) The spot face can be deeper than specified in the appropriate standard

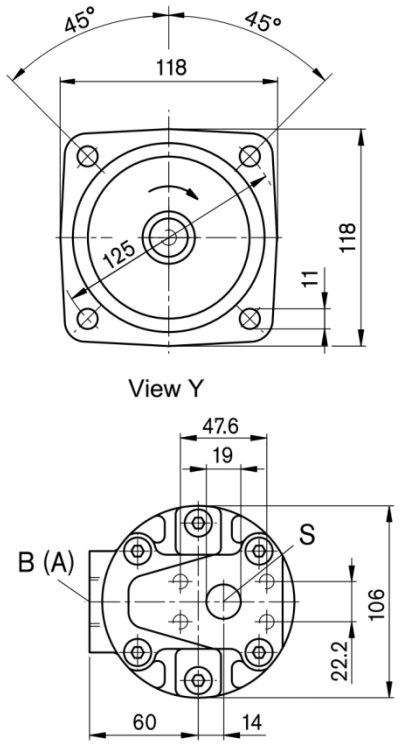
6) Depending on the installation position, T_1 or T_2 must be connected

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

■ Size 23, 28, 32...Dimensions in mm

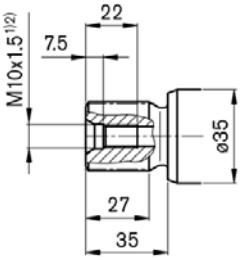
□ Port plate 05... SAE flange port A/B at side and SAE flange port S at rear



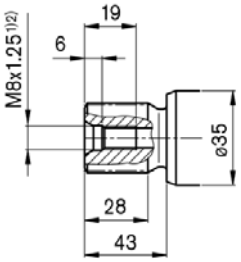


□ Drive shaft

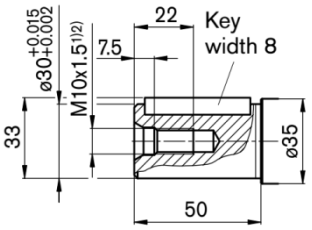
■ Size 23, 28, 32
A Splined shaft DIN 5480
W 30 x 2 x14 x 9g



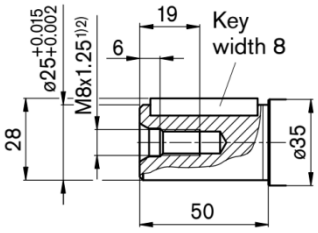
■ Size 23, 28
Z Splined shaft DIN 5480
W 25 x 1.25 x 18 x 9g



■ Size 23, 28, 32
B Parallel keyed shaft DIN 6885
AS 8 x 7 x 40



■ Size 23, 28
P Parallel keyed shaft DIN 6885
AS 8 x 7 x 40



□ Ports

Ports	Port for	Standard	Size [2]	P_{Max} [bar] [3]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1/2” M8 x 1.25 deep 15	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	3/4” M10 x 1.5 deep 17	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M16 x 1.5 deep 12	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M10 x 1 deep 12	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

4) The spot face can be deeper than specified in the appropriate standard

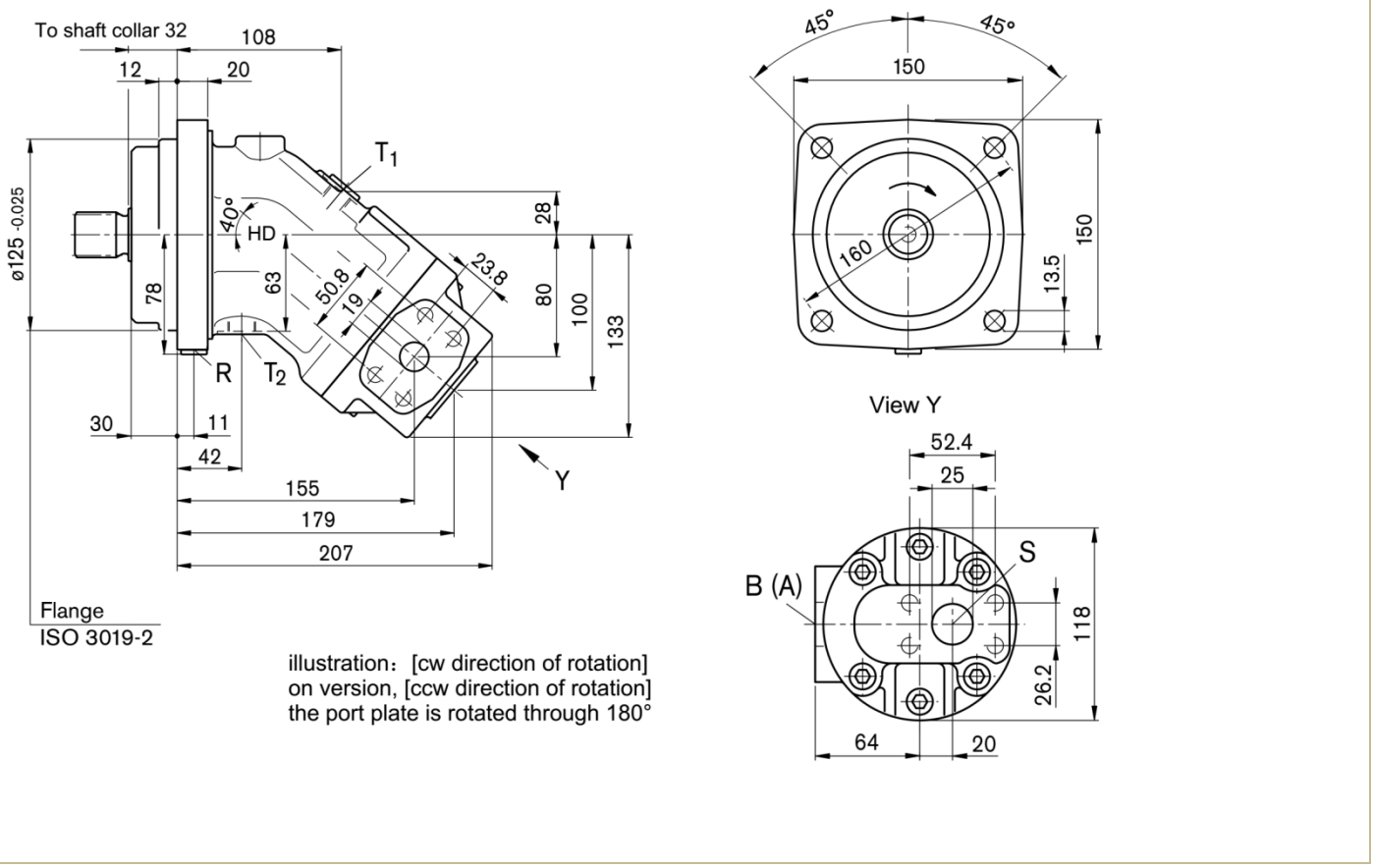
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

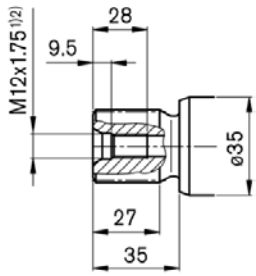
■ Size 45...Dimensions in mm

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

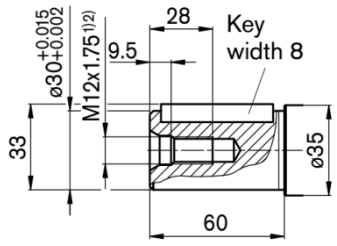


☐ Drive shaft

■ Size 45
Z Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



■ Size 45
P Parallel keyed shaft DIN 6885
AS 8 x 7 x 50



☐ Ports

Ports	Port for	Standard	Size [2]	P_{Max} [bar] [3]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	3/4” M10 x 1.5 deep 17	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	1” M10 x 1.5 deep 17	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M18 x 1.5 deep 12	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M12 x 1.5 deep 12	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

4) The spot face can be deeper than specified in the appropriate standard

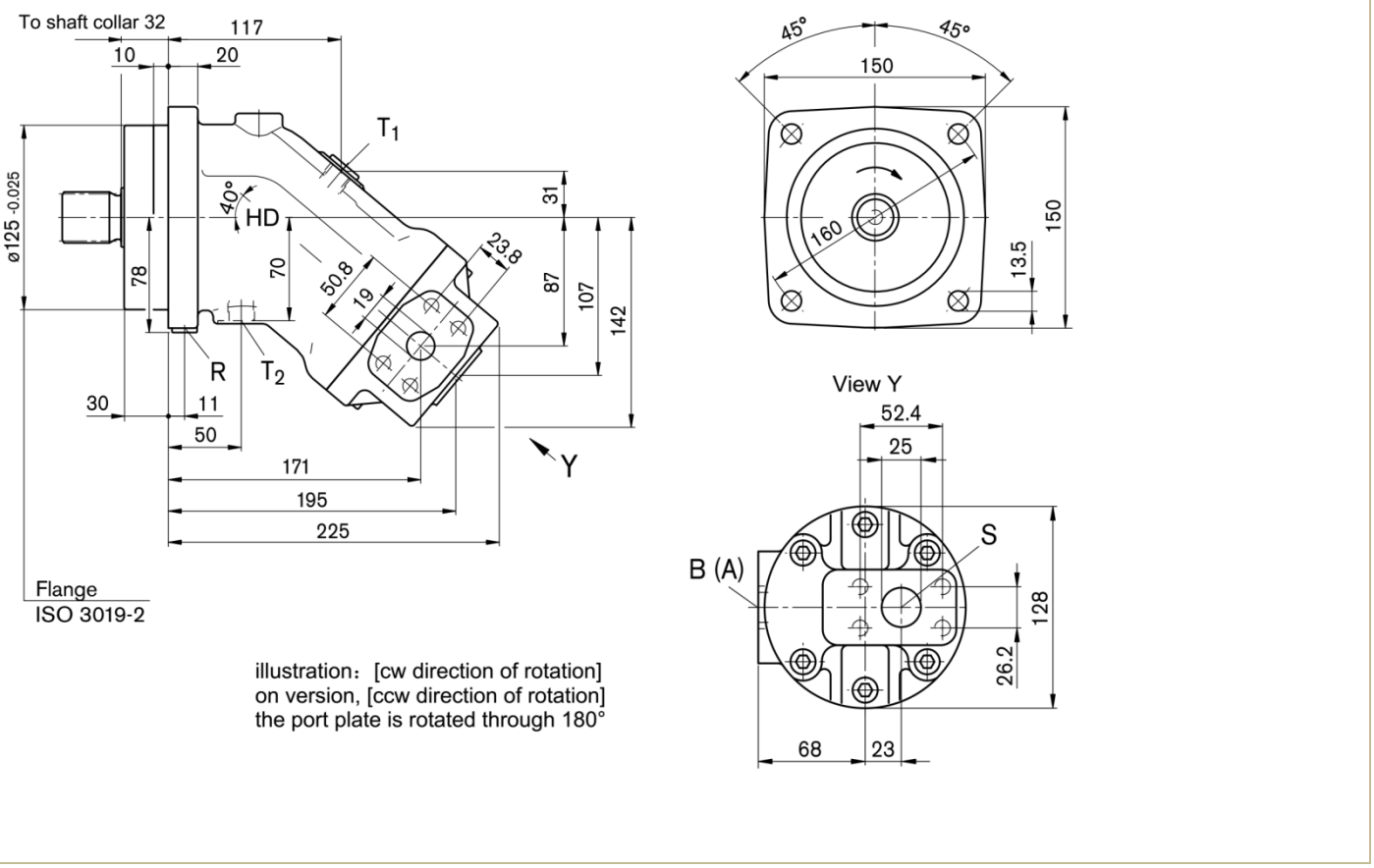
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

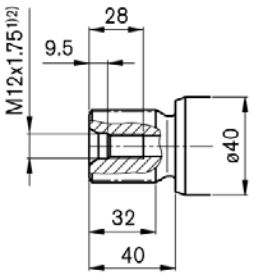
■ Size 56, 63...Dimensions in mm

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

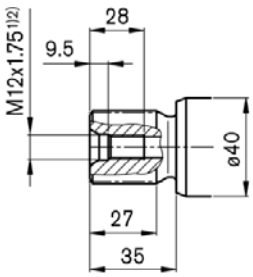


☐ Drive shaft

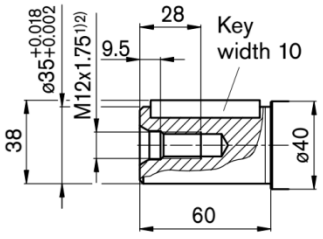
■ Size 56, 63
A Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



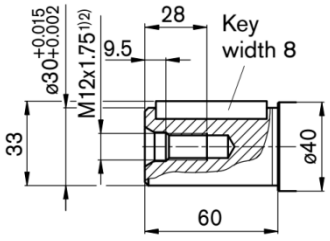
■ Size 56
Z Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



■ Size 56, 63
B Parallel keyed shaft DIN 6885
AS 10 x 8 x 50



■ Size 56
P Parallel keyed shaft DIN 6885
AS 8 x 7 x 50



☐ Ports

Ports	Port for	Standard	Size [2]	P_{Max} [bar] [3]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	3/4” M10 x 1.5 deep 17	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	1” M10 x 1.5 deep 17	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M18 x 1.5 deep 12	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M12 x 1.5 deep 12	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

4) The spot face can be deeper than specified in the appropriate standard

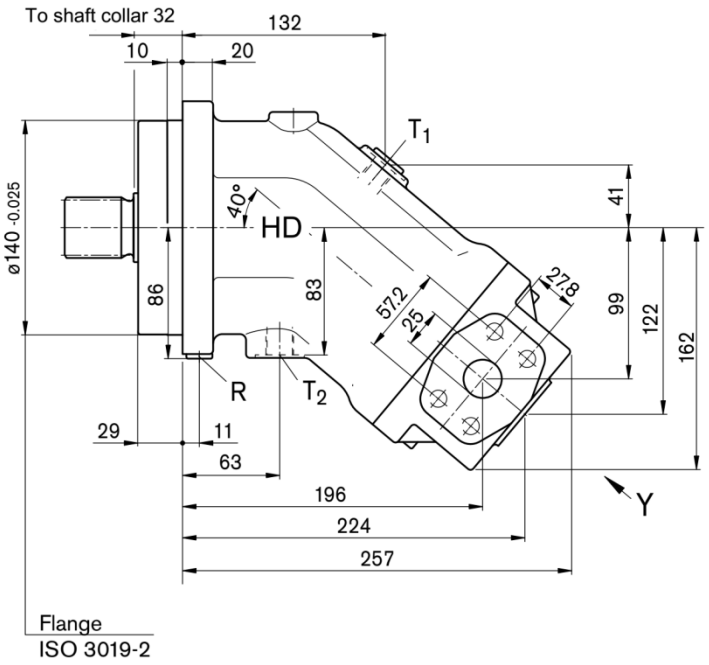
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

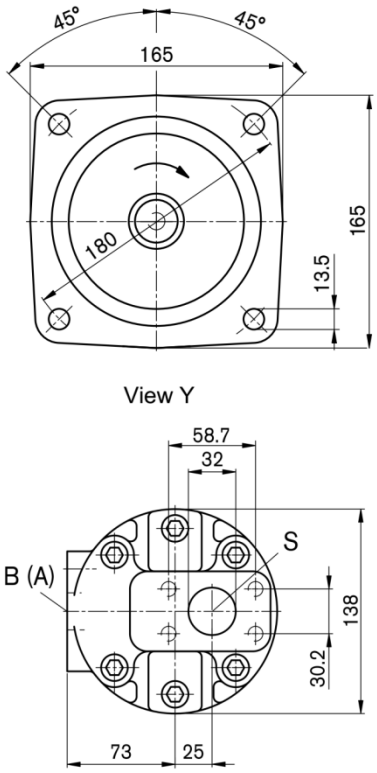
6) Depending on the installation position, T_1 or T_2 must be connected

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

■ Size 80, 90...Dimensions in mm

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

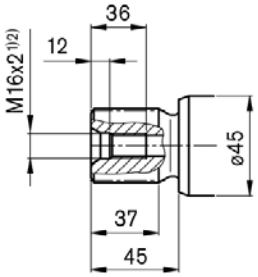




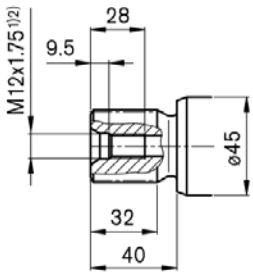
illustration：[cw direction of rotation]
on version, [ccw direction of rotation]
the port plate is rotated through 180°

☐ Drive shaft

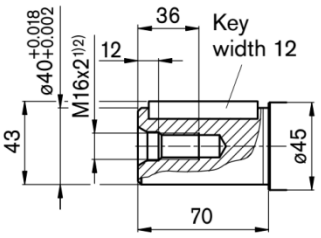
■ Size 80, 90
A Splined shaft DIN 5480
W 40 x 2 x 18 x 9g



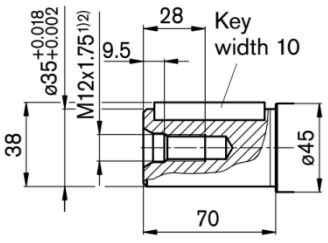
■ Size 80
Z Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



■ Size 80, 90
B Parallel keyed shaft DIN 6885
AS 12 x 8 x 56



■ Size 80
P Parallel keyed shaft DIN 6885
AS 10 x 8 x 56



☐ Ports

Ports	Port for	Standard	Size [2]	P_{Max} [bar] [3]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1” M12 x 1.5 deep 17	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	1-1/4” M10 x 1.5 deep 17	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M18 x 1.5 deep 12	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M12 x 1.5 deep 12	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

4) The spot face can be deeper than specified in the appropriate standard

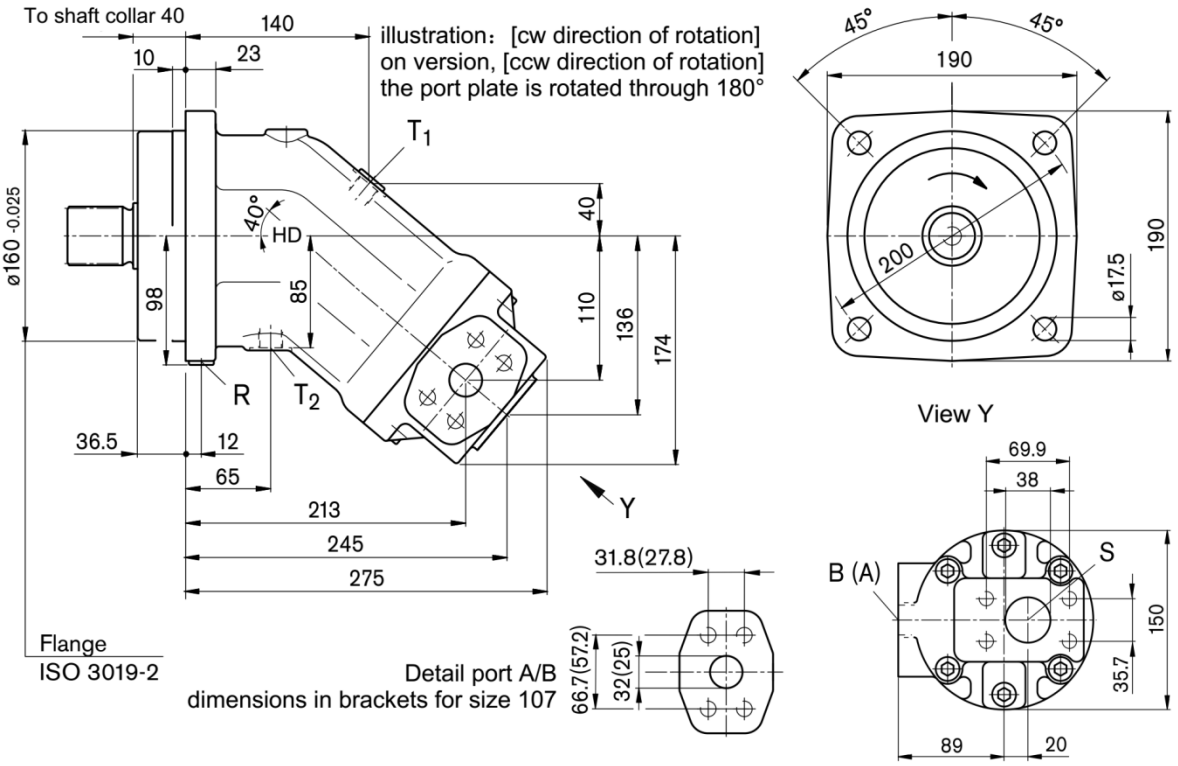
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

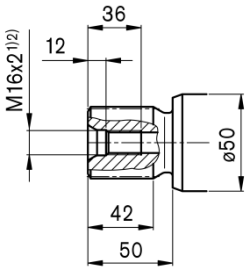
■ Size 107, 125...Dimensions in mm

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

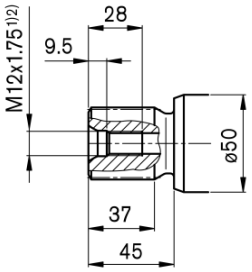


□ Drive shaft

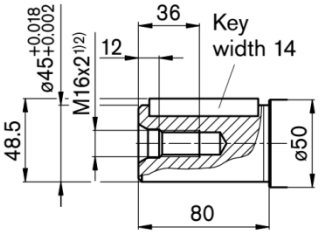
■ Size 107, 125
A Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



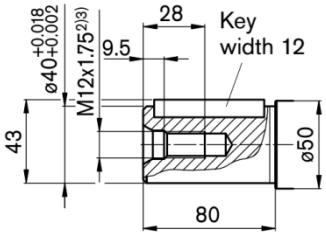
■ Size 107
Z Splined shaft DIN 5480
W 40 x 2 x18 x 9g



■ Size 107, 125
B Parallel keyed shaft DIN 6885
AS 14 x 9 x 63



■ Size 107
P Parallel keyed shaft DIN 6885
AS 12 x 8 x 63



□ Ports

Ports	Port for	Standard	Size [2]	P_{Max} [bar] [3]	State [7]
B(A) Size 107	Working port Fastening thread	SAE J518 [5] DIN13	1” M12 x 1.75 deep 17	450	O
B(A) Size 125	Working port Fastening thread	SAE J518 [5] DIN13	1-1/4” M14 x 2 deep 19	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	1-1/2” M12 x 1.75 deep 20	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M18 x 1.5 deep 12	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M14 x 1.5 deep 12	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

4) The spot face can be deeper than specified in the appropriate standard

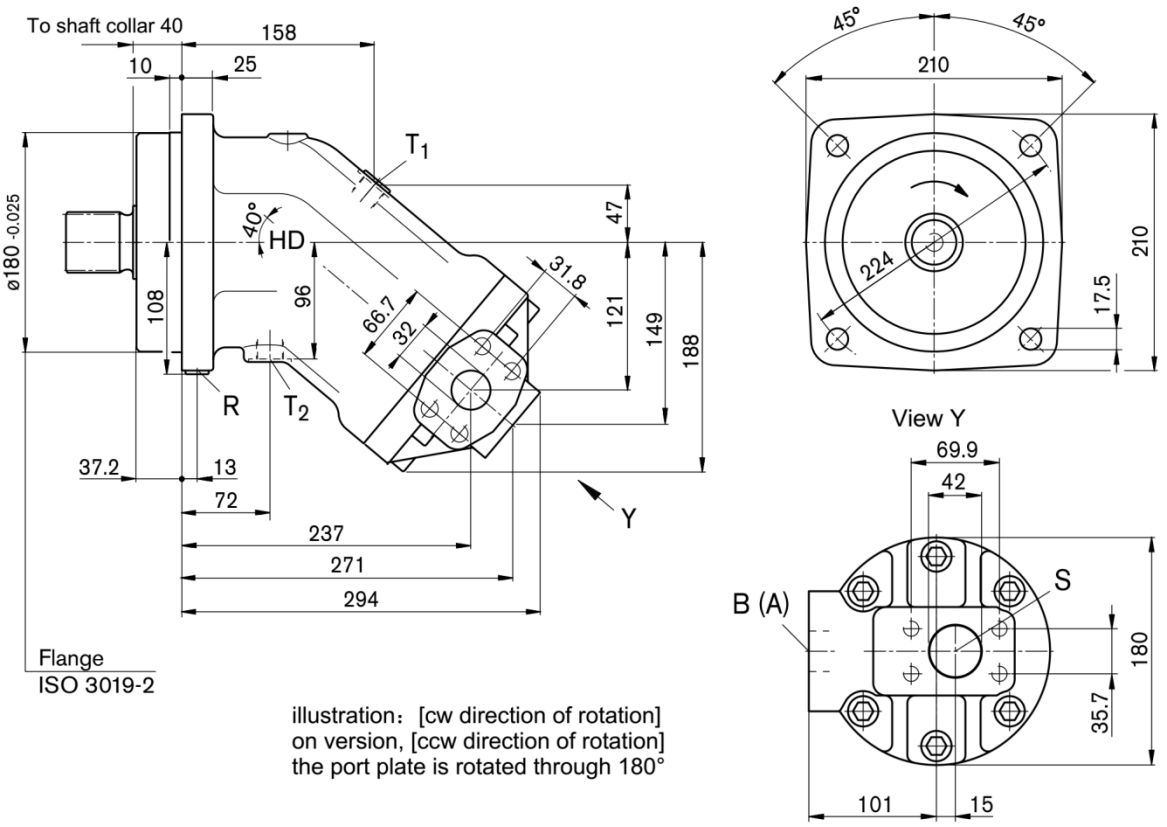
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

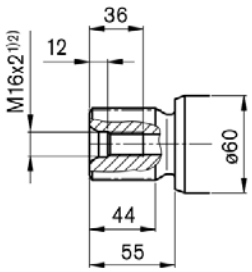
■ Size 160, 180...Dimensions in mm

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

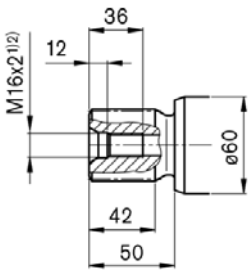


□ Drive shaft

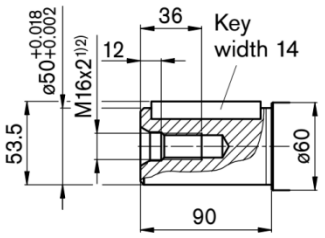
■ Size 160, 180
A Splined shaft DIN 5480
W 50 x 2 x 24 x 9g



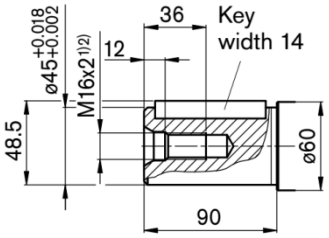
■ Size 160
Z Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



■ Size 160, 180
B Parallel keyed shaft DIN 6885
AS 14 x 9 x 70



■ Size 160
P Parallel keyed shaft DIN 6885
AS 14 x 9 x 70



□ Ports

Ports	Port for	Standard	Size [2]	P_{Max} [bar] [3]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1-1/4” M14 x 2 deep 19	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	1-1/2” M12 x 1.75 deep 20	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M22 x 1.5 deep 14	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M14 x 1.5 deep 12	3	X

Note

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

2) For the maximum tightening torques the general instructions must be observed.

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

4) The spot face can be deeper than specified in the appropriate standard

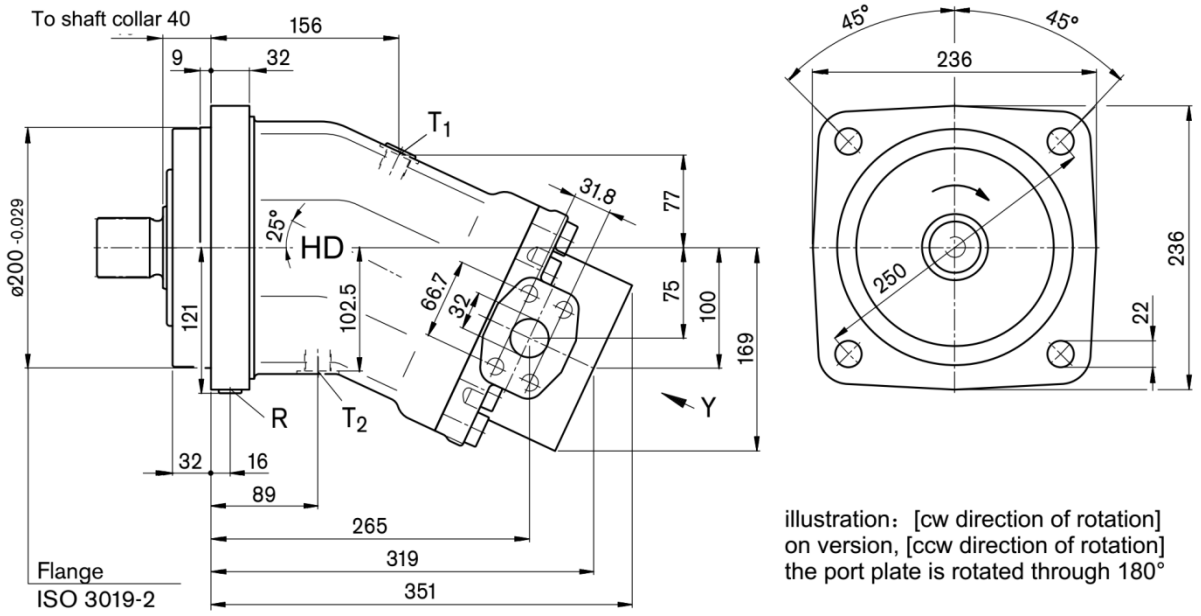
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

■ Size 200...Dimensions in mm

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

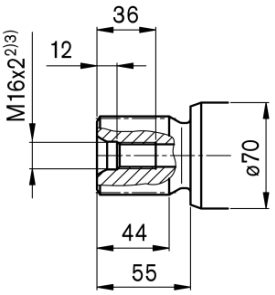


illustration：[cw direction of rotation]
on version, [ccw direction of rotation]
the port plate is rotated through 180°

□ Drive shaft

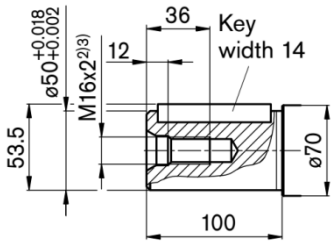
■ Size 200

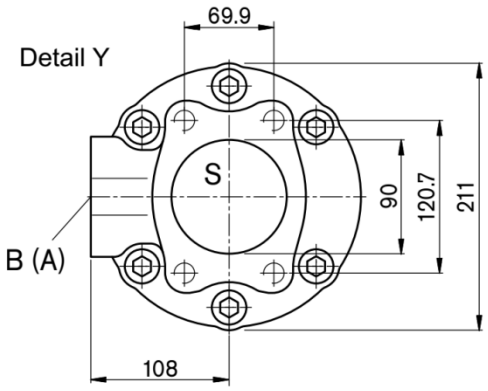
A Splined shaft DIN 5480
W 50 x 2 x 24 x 9g



■ Size 200

B Parallel keyed shaft DIN 6885
AS 14 x 9 x 80





□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [1]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1-1/4” M14 x 2 deep 19	450	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	3-1/2” M16 x 2 deep 24	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M22 x 1.5 deep 14	3	O/X [6]
R	Air bieed	DIN 3852 [4]	M14 x 1.5 deep 12	3	X

Note

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

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

3) For the maximum tightening torques the general instructions must be observed.

4) The spot face can be deeper than specified in the appropriate standard

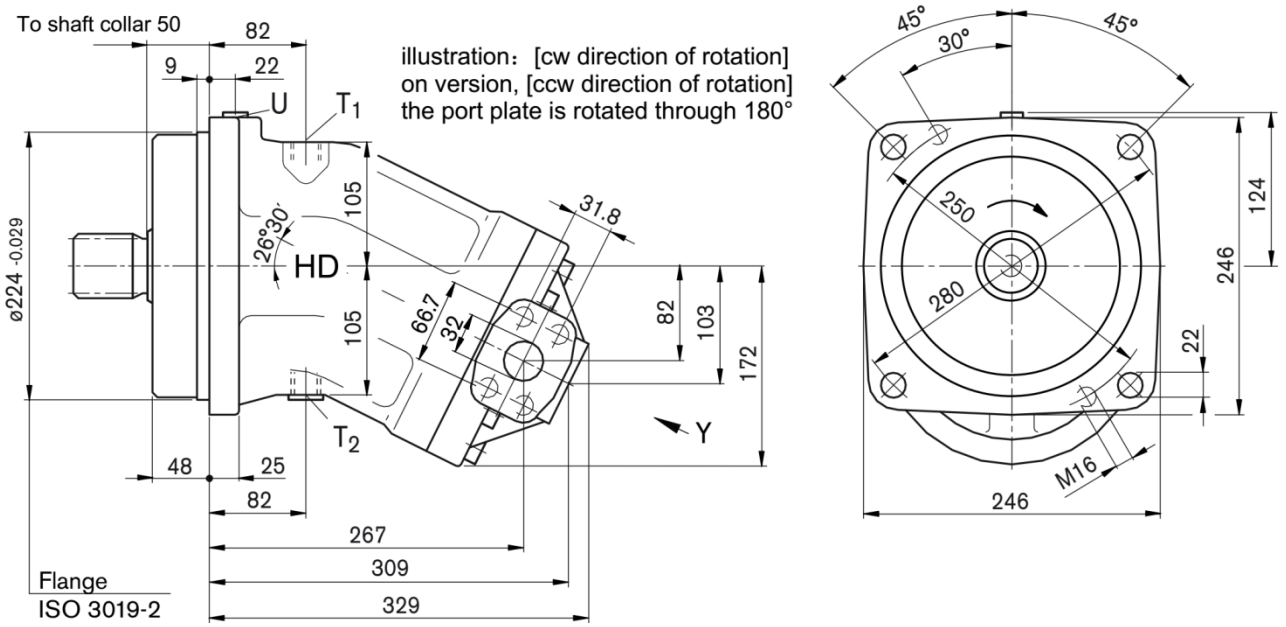
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

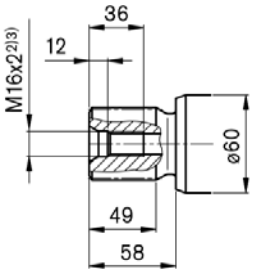
■ Size 250...Dimensions in mm

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

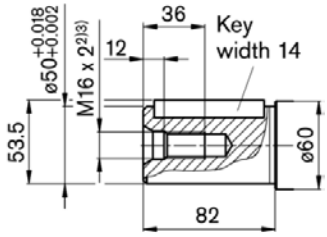


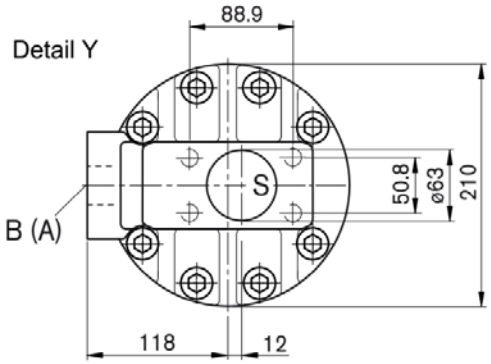
☐ Drive shaft

Z Splined shaft DIN 5480
W 50 x 2 x 24 x 9g



P Parallel keyed shaft DIN 6885
AS 14 x 9 x 80





☐ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [1]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1-1/4” M14 x 2 deep 19	400	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	2-1/2” M12 x 1.75 deep 17	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M22 x 1.5 deep 14	3	X/O [6]
U	Air bieed	DIN 3852 [4]	M14 x 1.5 deep 12	3	X

Note

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

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

3) For the maximum tightening torques the general instructions must be observed.

4) The spot face can be deeper than specified in the appropriate standard

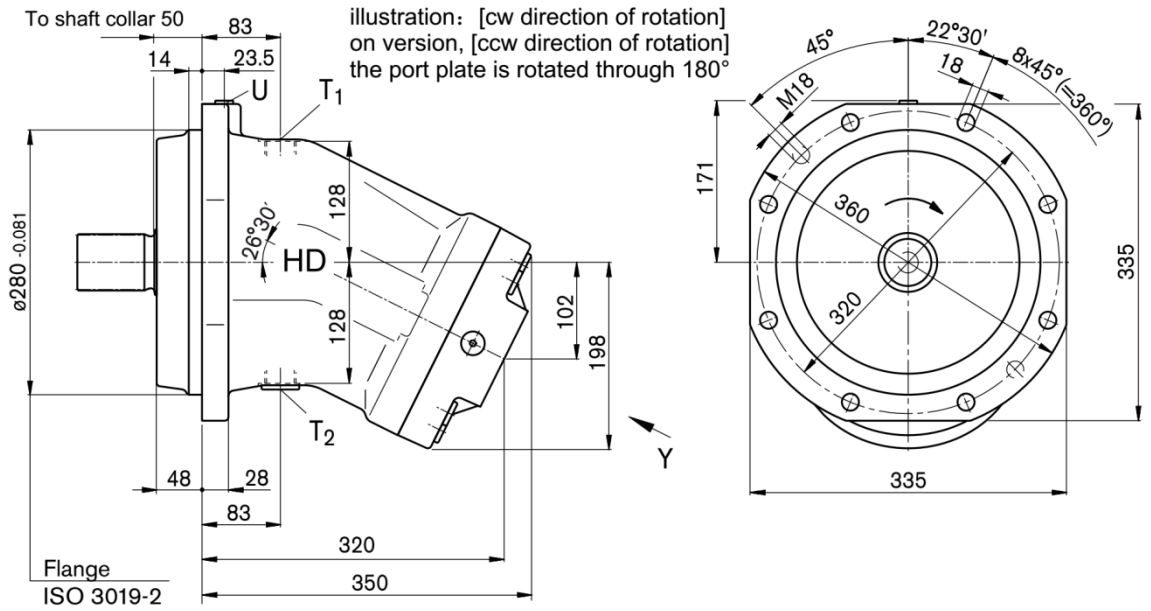
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

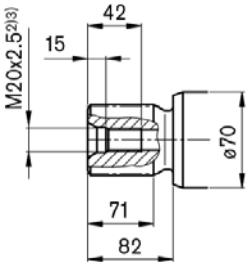
■ Size 355...Dimensions in mm

☐ Port plate 11... SAE flange ports A/B and S at rear

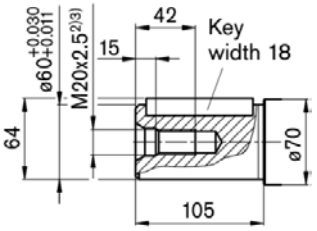


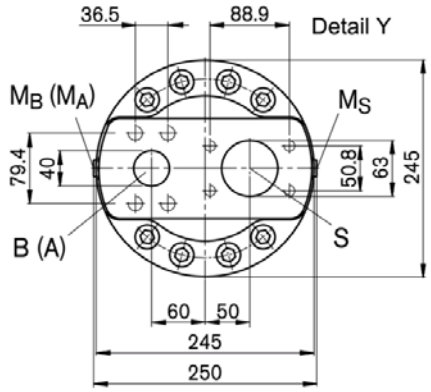
☐ Drive shaft

A Splined shaft DIN 5480
W 60 x 2 x 28 x 9g



B Parallel keyed shaft DIN 6885
AS 18 x 11 x 100





☐ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [1]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1-1/2" M16 x 2 deep 21	400	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	2-1/2" M12 x 1.75 deep 17	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M33 x 2 deep 18	3	O/X [6]
U	Bearing flushing port	DIN 3852 [4]	M14 x 1.5 deep 12	3	X
M_A, M_B	Measuring workting pressure	DIN 3852 [4]	M14 x 1.5 deep 12	400	X
M_S	Measuring suction pressure	DIN 3852 [4]	M14 x 1.5 deep 12	30	X

Note

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

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

3) For the maximum tightening torques the general instructions must be observed.

4) The spot face can be deeper than specified in the appropriate standard

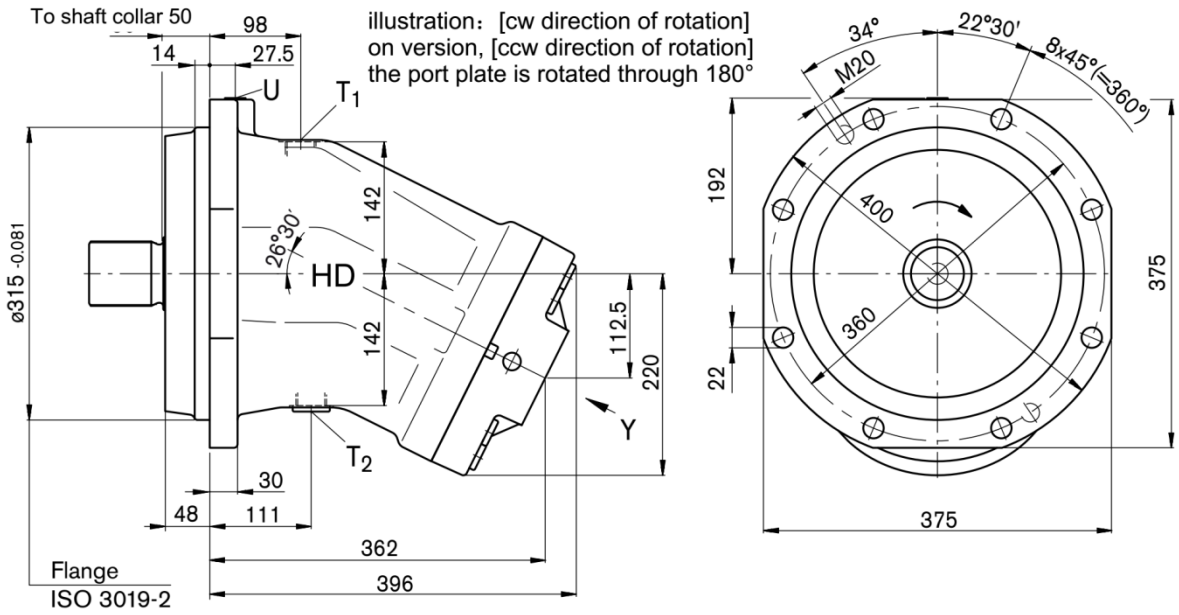
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

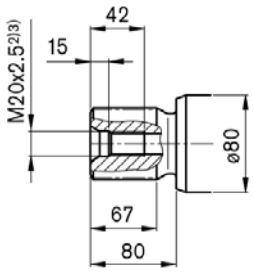
■ Size 500...Dimensions in mm

☐ Port plate 11... SAE flange ports A/B and S at rear

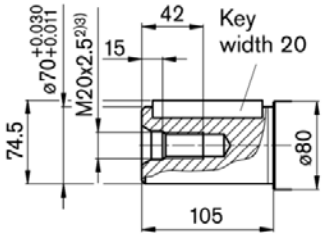


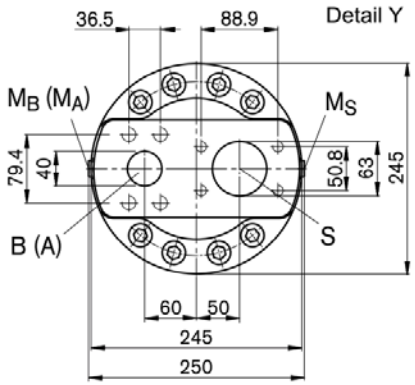
☐ Drive shaft

Z Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



P Parallel keyed shaft DIN 6885
AS 20 x 12 x 100





☐ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [1]	State [7]
B(A)	Working port Fastening thread	SAE J518 [5] DIN13	1-1/2" M16 x 2 deep 21	400	O
S	Suction port Fastening thread	SAE J518 [5] DIN13	3" M16 x 2 deep 24	30	O
T_1, T_2	Drain port	DIN 3852 [4]	M33 x 2 deep 18	3	O/X [6]
U	Bearing flushing port	DIN 3852 [4]	M18 x 1.5 deep 12	3	X
M_A, M_B	Measuring workting pressure	DIN 3852 [4]	M14 x 1.5 deep 12	400	X
M_S	Measuring suction pressure	DIN 3852 [4]	M14 x 1.5 deep 12	30	X

Note

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

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

3) For the maximum tightening torques the general instructions must be observed.

4) The spot face can be deeper than specified in the appropriate standard

5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) Depending on the installation position, T_1 or T_2 must be connected

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

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

Installation position

- See the following examples 1 to 8
- Additional installation positions are available upon request.
- Recommended installation positions 1 and 2

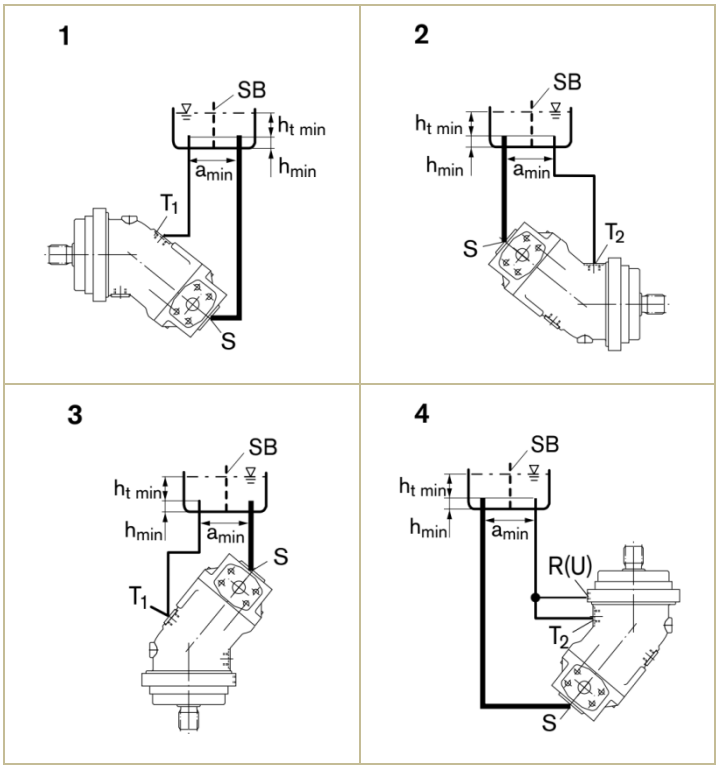
- Note

Ins.Position	1	2	3	4	5	6	7	8
Air bleed	-	-	-	R(U)	L_1	L_1	L_1	R(U)
Filling	T_1	T_2	T_1	T_2	$T_1(L_1)$	$T_2(L_1)$	$T_1(L_1)$	$T_2(L_1)$

L_1	Case drain port
R	Air bleeding port
U	Bearing flushing / air bleed port
S	Suction port
T_1,T_2	Drain port
SB	Baffle (baffle plate)
$h_{t\,min}$	Minimum necessary immersion depth (200 mm)
$h_{S\,max}$	Maximum permissible suction height(800 mm)
a_{min}	When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

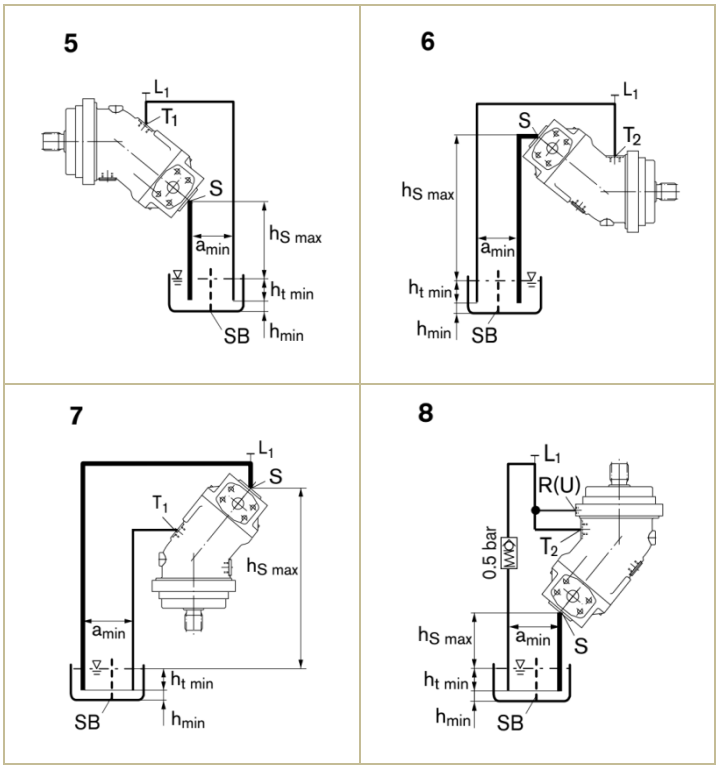
Below-reservoir installation (standard)

- 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 0.5 bar) can prevent draining of the pump housing.



■ Ordering Code For Standard Program

HD	-		A2F		M	90	/	6	1	W	-	V	A	B	010			-	
0		1	2	3	4	5		6	7	8		9	10	11	12	13	14		15

0	Manufacturer		Code
	HUADE HYDRAULIC 华德液压		HD

1	Oil types / Specifications		5～200	250	355	500	Code
	Mineral oil	……without code	■	■	■	■	-
	HFD	for sizes 250～500 only in combination with long-life bearings L	■	■	■	■	-
	HFB,HFC	Size 5～200……without code	■	-	-	-	-
		Size 250～500 only in combination with long-life bearings L	-	■	■	■	E

2	Axial piston unit	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200～500	Code
	Bent-axis design, fixed	□	■	■	■	■	■	■	■	□	A2F

3	Drive shaft bearing	5～200	250	355	500	Code
	Standard bearing……without code	■	-	-	-	-
	Long-life bearing	-	■	■	■	L

4	Operation mode	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200～500	Code
	Motor	□	■	■	■	■	■	■	■	□	M

5	Displacement	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200	250	355	500	Code
	≦ V_{gmax}（cm^3/r）	5	10/12/16	23/28/32	45	56/63	80/90	107/125	160/180	200	250	355	500	-

6	Series	5～500	Code
	Series 6	■	6

7	Index	5	10～180	200	250	355	500	Code
	Size 10～180	-	■	-	-	-	-	1
	Size 200	-	-	■	-	-	-	3
	Size 5 and 250～500	■	-	-	■	■	■	0

8	Direction of rotation	Code
	Viewed on drive shaft bidirectional	W

9	Sealing material	5～500	Code
	FKM (Fluoro-rubber)	■	V
	NBR(Nitrile-rubber),Shaft seal FKM (Fluoro-rubber)	■	P

■ Ordering Code For Standard Program

HD	-		A2F		M	90	/	6	1	W	-	V	A	B	010			-	
0		1	2	3	4	5		6	7	8		9	10	11	12	13	14		15

10	Drive shaft		5	10/12	16	23/28	32	45	56	63	80	90	107	125	160	180/200	250/355/500	Code
	Splined	I	-	■	■	■	■	-	■	■	■	■	■	■	■	■	-	A
	shaft	II	-	■	-	■	-	■	■	-	■	-	■	-	■	-	■	Z
	Parallel	I	■	■	■	■	■	-	■	■	■	■	■	■	■	■	-	B
	shaft	II	-	■	-	■	-	■	■	-	■	-	■	-	■	-	■	P
	Conical shaft [1]		■	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C

11	Mounting flange		5～250	355～500	Code
	ISO 3019-2	4 hole	■	-	B
		8 hole	-	■	H

12	Working port			5	10,12 16	23	28 32	45	56 63	80 90	107 125	160 180	200	250	355 500	Code
	SAE flange ports	01	0	-	-	■	■	■	■	■	■	■	■	■	■	010
	A and B at rear		7	-	-	-	-	-	-	-	-	-	-	-	■	017
	SAE flange ports	02	0	-	-	■	■	■	■	■	■	■	-	■	-	020
	A and B at side, opposite		7	-	-	-	-	■	□	□	■	■	-	■	-	027
			9			-	-	-	■	■	-	-	-	-	-	029
	Threaded ports A and B	03	0	■	■	■	■	-	-	-	-	-	-	-	-	030
	at side, opposite															
	Threaded ports A and B [2]	04	0	-	■	■	■	■	■	-	-	-	-	□	-	040
	at side and rear															
	SAE flange ports	10	0	-	-	-	■	■	■	■	■	■	-	-	□	100
	A and B at bottom (same side)															
	Port plate with BVD	17	1	-	-	-	-	-	-	-	■	-	-	-	-	171
	1-level pressure relief		8	-	-	-	-	-	-	-	■	-	-	-	-	178
	valves for mounting a	18	1	-	-	-	■	■	■	■	■	■	-	-	-	181
	counterbalance valve [3] BVE	18	8	-	-	-	-	-	-	-	■	■	-	-	-	188
	Port plate with	19	1	-	-	-	■	■	■	■	■	■	-	-	-	191
	pressure relief valves		2	-	-	-	■	■	■	■	■	■	-	-	-	192

Valves

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

■ Ordering Code For Standard Program

HD	-		A2F		M	90	/	6	1	W	-	V	A	B	010			-	
0		1	2	3	4	5		6	7	8		9	10	11	12	13	14		15

13	Speed sensors	5～16	23～180	200	250～500	Code
	Without speed sensor.....without code	■	■	■	■	-
	Prepared for HDD speed sensor	-	-	-	■	F
	HDD speed sensor mounted [4)]	-	-	-	■	H
	Prepared for DSA speed sensor	-	■	■	-	U
	DSA speed sensor mounted [4)]	-	■	■	-	V

14	Special version	Code
	Standard version……without code	-
	Special version for slew drives	J

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

□ Note

1）Conical shaft with threaded pin and woodruff key (DIN 6888). The torque must be transmitted via the tapered press fit

2）Threaded ports at the sides (sizes 10 to 63) plugged with threaded plugs

3）Specify ordering code of counterbalance valve according to data sheet eparately

4）Specify ordering code of sensor according to data sheet separately and observe the requirements on the electronics

■ = Optimization scheme (shorter delivery time)

■ = Available

□ = On request

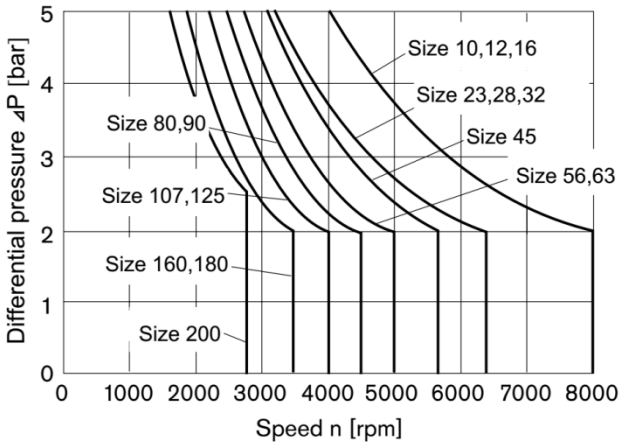
\- = Not available

Shaft seal...Permissible pressure loading

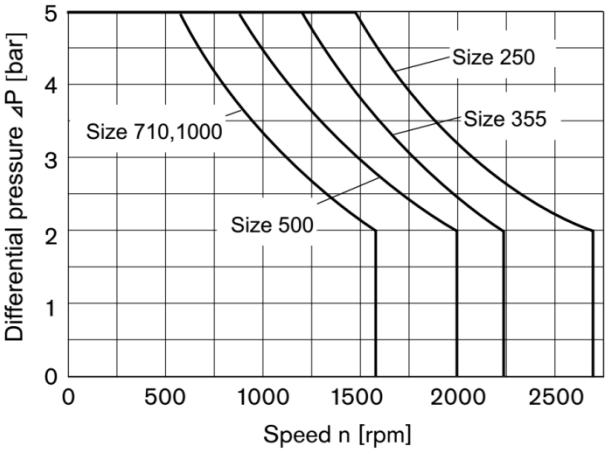
- The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure).
- The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature.
- For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes (t < 0.1 s) of up to 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.

Static characteristic

- Sizes 10 to 200



- Sizes 250 to 500



The values are valid for an ambient pressure P_{abs} = 1 bar

Temperature range

- The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C
- For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range -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	Direction of flow
clockwise (R)	A → B
counter-clockwise (L)	B → 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 for maximum speed.

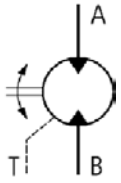
Long-life bearing

- Sizes 250～500
- 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

Sizes	250	355	500
$q_{v\ flush}$ (l/min)	10	16	16

Ports

Ports	Port for	Diagram
A, B	Working port	
T	Drain port	

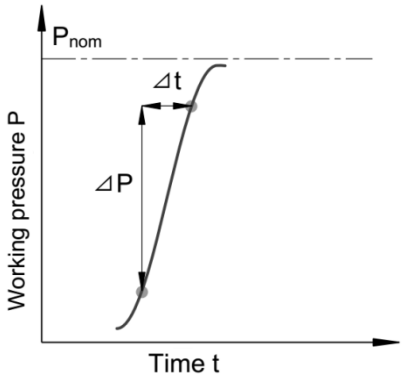
■ Working pressure range

□ Working pressure range valid when using hydraulic fluids based on mineral oils

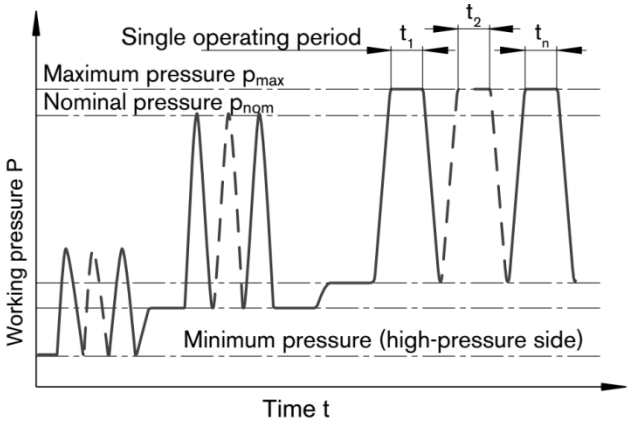
Pressure at service line port A or B			Definition
Nominal pressure P_{nom}	Size 5	315 bar (absolute)	The nominal pressure corresponds to the maximum design pressure
	Size 10～200	400 bar (absolute)	
	Size 250～500	350 bar (absolute)	
Maximum pressure $P_{B\,max}$	Size 5	350 bar (absolute)	The maximum pressure 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.
	Size 10～200	450 bar (absolute)	
	Size 250～500	400 bar (absolute)	
	Single operating period	10 s	
	Total operating period	300 h	
	Summation pressure (P_A+ P_B) P_{Su}	700 bar	The summation pressure is the sum of the pressures at both service line ports (A and B).
Minimum pressure P_{min} high-pressure side		25 bar (absolute)	Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$			Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range
	With integrated pressure-relief valve	9000 bar/s	
	Without pressure-relief valve	16000 bar/s	

Note:Values for other hydraulic fluids, please contact us

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



■ Pressure defnition

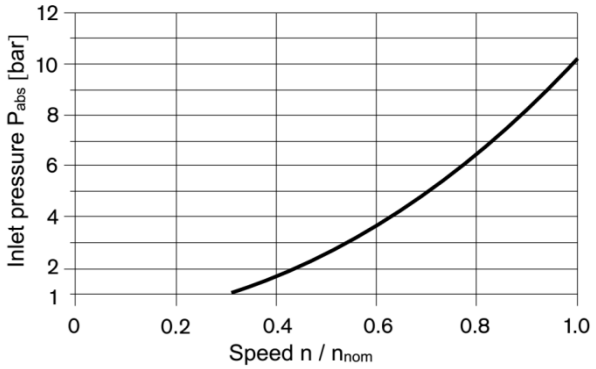


□ Total operating period = $t_1 + t_2 + t_3$ ……+ t_n

■ 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 V_{opt} = 36 to 16 mm^2/s.

□ Please contact us if these conditions cannot be satisfied.

■ Table of values

□ Theoretical values, without considering efficiencies and tolerances, values rounded off

Technical Data	A2FM			5	10	12	16	23	28	32	45	56	63	80
Displacement		V_g	cm^3	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4
Speed [1]	maximum	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]	⊿P=350 bar	T	Nm	24.7[5]	57	67	89	128	157	178	254	313	351	448
at V_g and	⊿P=400 bar	T	Nm	-	66	76	102	146	179	204	290	357	401	512
Case volume		V	l	0.12	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55
Weight	approx	m	Kg	2.5	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18	18	23

Technical Data	A2FM			90	107	125	160	180	200	250	355	500		
Displacement		V_g	cm^3	90	106.7	125	160.4	180	200	250	355	500		
Speed [1]	maximum	n_{nom}	rpm	4500	4000	4000	3600	3600	2750	2700	2240	2000		
		n_{max} [2]	rpm	5000	4400	4400	4000	4000	3000	-	-	-		
Input flow [3]	at n_{nom} and V_g	q_v	l/min	405	427	500	577	648	550	675	795	1000		
Torque [4]	⊿P=350 bar	T	Nm	501	594	696	893	1003	1114	1393	1978	2785		
at V_g and	⊿P=400 bar	T	Nm	573	679	796	1021	1146	1273	-	-	-		
Case volume		V	l	0.55	0.8	0.8	1.1	1.1	2.7	2.5	3.5	4.2		
Weight	approx	m	Kg	23	32	32	45	45	66	73	110	155		

□ Note

1）The values are applicable

- for an absolute pressure P_{abs}=1 bar at suction port S
- within the optimum viscosity range from V_{opt} = 16 to 36 mm^2/s

2）Intermittent maximum speed: overspeed for unload and overhauling processes, t < 5 s and ⊿P < 150 bar

3）Restriction of input flow with counterbalance valve

4）Torque without radial force, with radial force.

5）Torque at ⊿P = 315 bar

■ 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.

■ Technical Data

□ Permissible radial and axial loading on the drive shaft

Technical Data A2FM				5	5 [3]	10	10	12	12	16	23	23	28	28
Drive shaft	Φ	mm		12	12	20	25	20	25	25	25	30	25	30
Max.radial force [1]	$F_{q\,max}$	KN		1.6	1.6	3.0	3.2	3.0	3.2	3.2	5.7	5.4	5.7	5.4
at distance a	a	mm		12	12	16	16	16	16	16	16	16	16	16
(from shaft collar)														
permissible torque	T_{max}	Nm		24.7	24.7	66	66	76	76	102	146	146	179	179
permissible pressure	ΔP_{perm}	bar		315	315	400	400	400	400	400	400	400	400	400
Maximum axial force [2]	$+F_{ax\,max}$	N		180	180	320	320	320	320	320	500	500	500	500
	$-F_{ax\,max}$	N		0	0	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar		1.5	1.5	3.0	3.0	3.0	3.0	3.0	5.2	5.2	5.2	5.2

Technical Data A2FM			32	45	56	56 [4]	56	63	80	80[4]	80	90	
Drive shaft	Φ	mm	30	30	30	30	35	35	35	35	40	40	
Max.radial force [1]	$F_{q\,max}$	KN	5.4	7.6	9.5	7.8	9.1	9.1	11.6	11.1	11.4	11.4	
at distance a	a	mm	16	18	18	18	18	18	20	20	20	20	
(from shaft collar)													
permissible torque	T_{max}	Nm	204	290	357	294	357	401	512	488	512	573	
permissible pressure	ΔP_{perm}	bar	400	400	400	330	400	400	400	380	400	400	
Maximum axial force [2]	$+F_{ax\,max}$	N	500	630	800	800	800	800	1000	1000	1000	1000	
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	5.2	7.0	8.7	8.7	8.7	8.7	10.6	10.6	10.6	10.6	

Technical Data A2FM			107	107	125	160	160	180	200	250	355	500	
Drive shaft	Φ	mm	40	45	45	45	50	50	50	50	60	70	
Max.radial force [1]	$F_{q\,max}$	KN	13.6	14.1	14.1	18.1	18.3	18.3	20.3	1.2 [5]	1.5 [5]	1.9 [5]	
at distance a	a	mm	20	20	20	25	25	25	25	41	52.5	52.5	
(from shaft collar)													
permissible torque	T_{max}	Nm	679	679	796	1021	1021	1146	1273	-	-	-	
permissible pressure	ΔP_{perm}	bar	400	400	400	400	400	400	400	-	-	-	
Maximum axial force [2]	$+F_{ax\,max}$	N	1250	1250	1250	1600	1600	1600	1600	2000	2500	-	
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	12.9	12.9	12.9	16.7	16.7	16.7	16.7	-	-	-	

□ Note

1）With intermittent operation

2）Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.

3）Conical shaft with threaded pin and woodruff key (DIN 6888)

4）Restricted technical data only for splined shaft

5）When at a standstill or when axial piston unit operating in nonpressurized conditions. Higher forces are permissible when under pressure, please contact us

Note:Influence of the direction of the permissible axial force

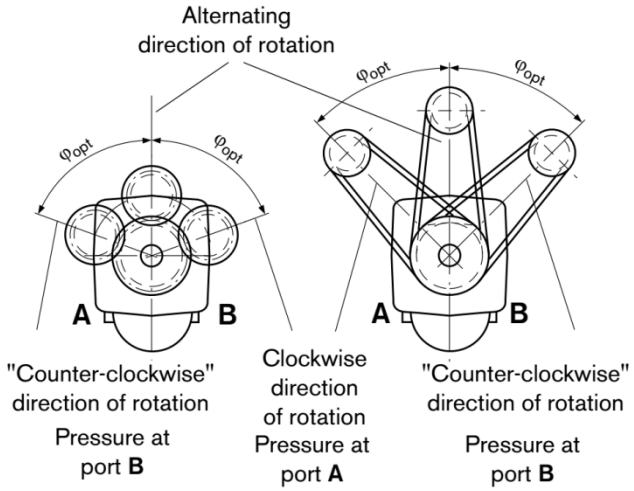
$+F_{ax\ max}$ = Increase in service life of bearings

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

■ Effect of radial force

- 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

	Toothed gear drive	V-belt output
Size	Ψ_{opt}	Ψ_{opt}
5～180	± 70°	± 45°
200～500	± 45°	± 70°



■ Determining the operating characteristics

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

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

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

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

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

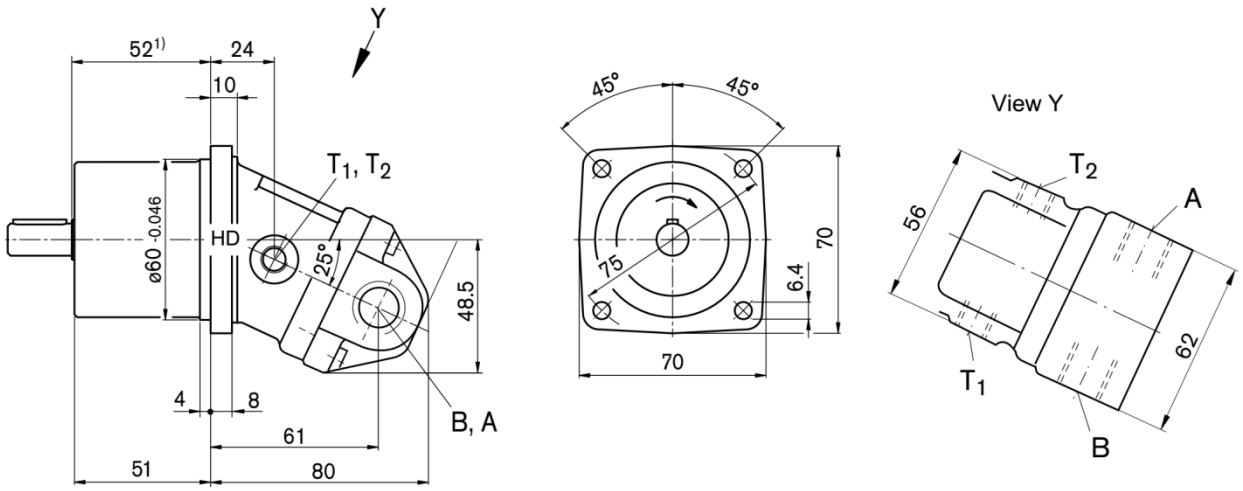
η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

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

■ Size 5...Dimensions in mm

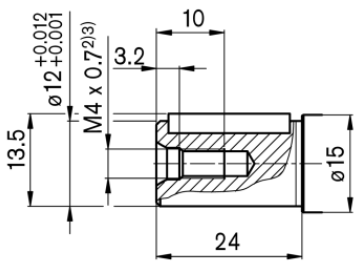
□ Port plate 030...Threaded ports A and B at side, opposite.



□ Drive shaft

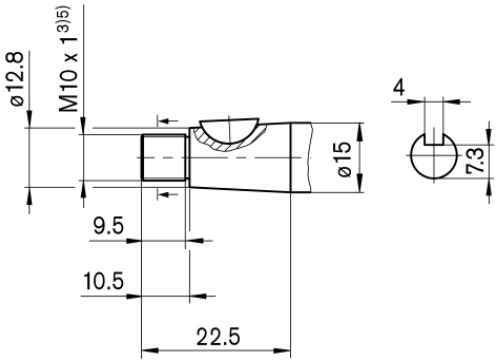
■ Size 5

B Parallel keyed shaft DIN 6885
A 4 x 4 x 20



■ Size 5

C Conical shaft DIN 6888
with threaded pin and woodruff key 3 x 5 tapering 1:10



□ Ports

Ports	Port for	Standard 6)	Size 3)	P_{Max} [bar] 4)	State 7)
A, B	Working port	DIN 3852	M18 x 1.5 deep 12	350	O
T_1	Drain port	DIN 3852	M10 x 1 deep 8	3	O
T_2	Drain port	DIN 3852	M10 x 1 deep 8	3	O

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

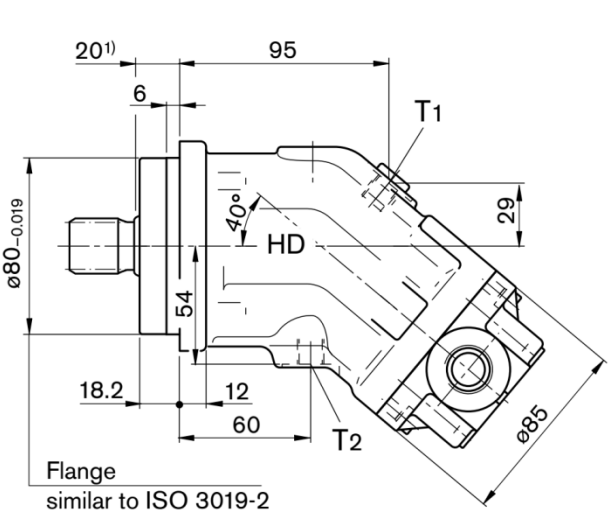
5) Thread according to DIN 3852, maximum tightening torque 30 Nm

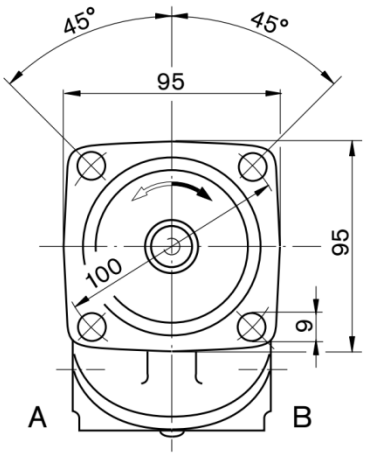
6) The spot face can be deeper than specified in the appropriate standard

7) O = Must be connected (plugged on delivery)

■ Size 10, 12, 16...Dimensions in mm

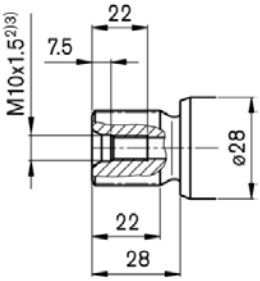
□ Port plate 030...Threaded ports A and B at side, opposite.



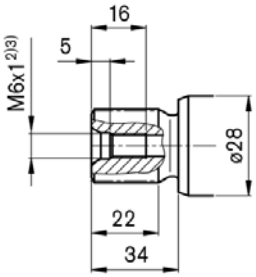


□ Drive shaft

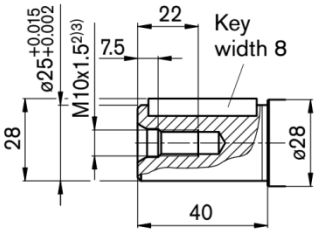
■ Size 10, 12, 16
A Splined shaft DIN 5480
W 25 x 1.25 x 18 x 9g



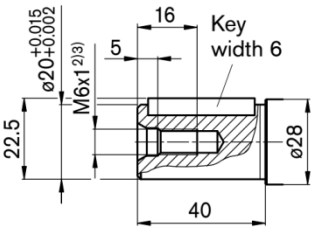
■ Size 10, 12
Z Splined shaft DIN 5480
W 20 x 1.25 x 14 x 9g



■ Size 10, 12, 16
B Parallel keyed shaft DIN 6885
AS 8 x 7 x 32



■ Size 10, 12
P Parallel keyed shaft DIN 6885
AS 6 x 6 x 32



□ Ports

Ports	Port for	Standard	Size [3)]	P_{Max} [bar] [4)]	State [8)]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5)]	M12 x 1.5 deep 12	3	X [7)]
T_2	Drain port	DIN 3852 [5)]	M12 x 1.5 deep 12	3	O [7)]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

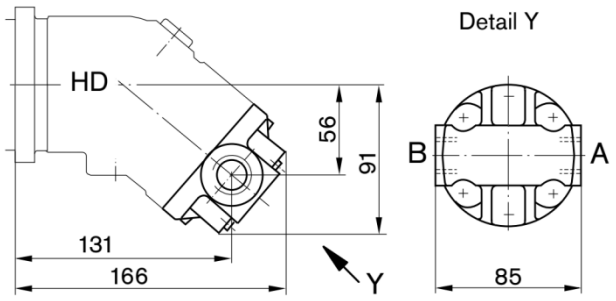
7) Depending on the installation position, T_1 or T_2 must be connected

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

■ Size 10, 12, 16...Dimensions in mm

□ Location of the service line ports on the port plates

■ Plate 03...Threaded ports at side, opposite



■ Plate 04...Threaded ports at side and rear

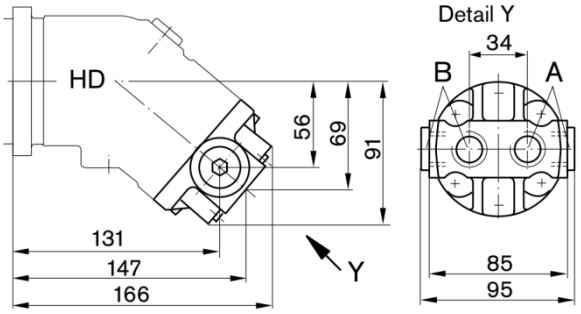


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
03	A, B	Working port	DIN 3852 [3]	M22 x 1.5 deep 14	450	X
04	A, B	Working port	DIN 3852 [3]	M22 x 1.5 deep 14	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

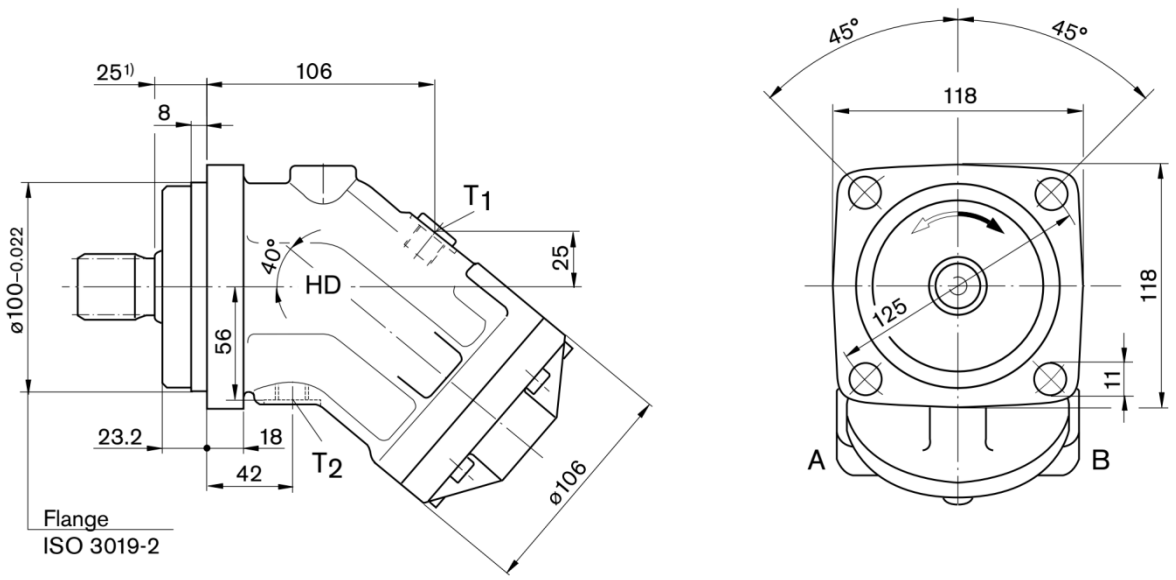
2) Momentary pressure spikes may occur depending on the application.
Keep this in mind when selecting measuring devices and fittings.

3) The spot face can be deeper than specified in the appropriate standard

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

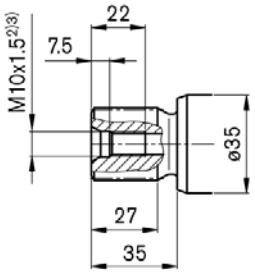
■ Size 23, 28, 32...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

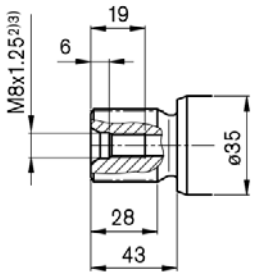


□ Drive shaft

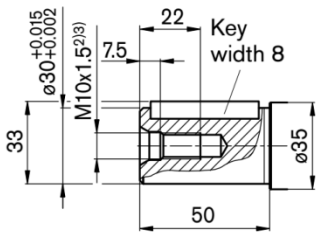
■ Size 23, 28, 32
A Splined shaft DIN 5480
W 30 x 2 x 14 x 9g



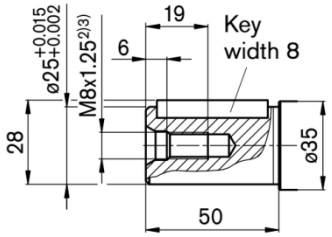
■ Size 23, 28
Z Splined shaft DIN 5480
W 25 x 1.25 x 18 x 9g



■ Size 23, 28, 32
B Parallel keyed shaft DIN 6885
AS 8 x 7 x 40



■ Size 23, 28
P Parallel keyed shaft DIN 6885
AS 8 x 7 x 40



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5]	M16 x 1.5 deep 12	3	X [7]
T_2	Drain port	DIN 3852 [5]	M16 x 1.5 deep 12	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

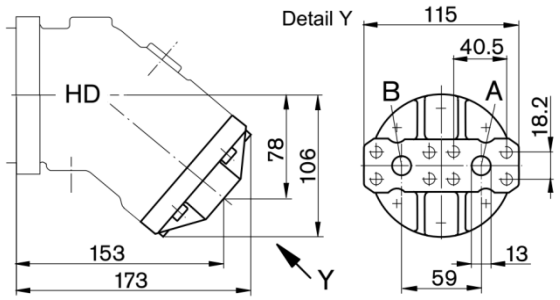
7) Depending on the installation position, T_1 or T_2 must be connected

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

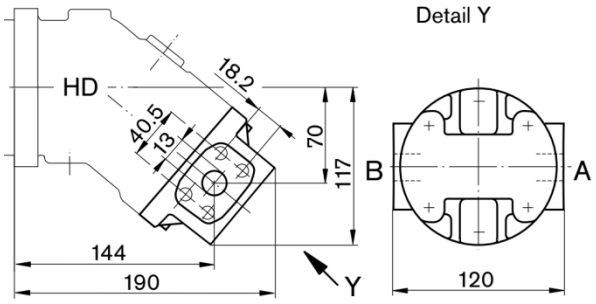
■ Size 23, 28, 32...Dimensions in mm

□ Location of the service line ports on the port plates

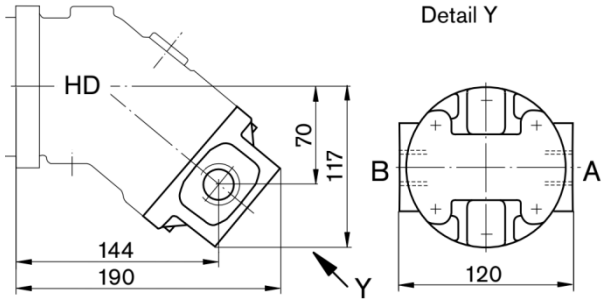
■ Plate 01...SAE flange ports at rear



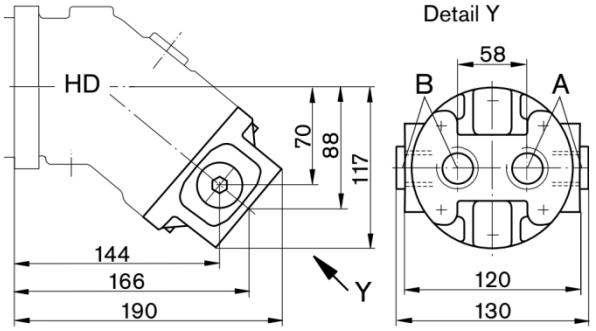
■ Plate 02...SAE flange ports at side, opposite



■ Plate 03...Threaded ports at side, opposite



■ Plate 04...Threaded ports at side and rear



■ Plate 10...SAE flange ports at bottom (same side)

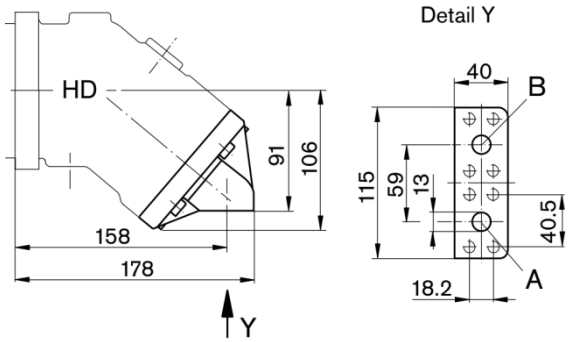


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 02, 10	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	1/2” M8 x 1.25 deep 15	450	O
03	A, B	Working port	DIN 3852 [3]	M27 x 2 deep 16	450	X
04	A, B	Working port	DIN 3852 [3]	M27 x 2 deep 16	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

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

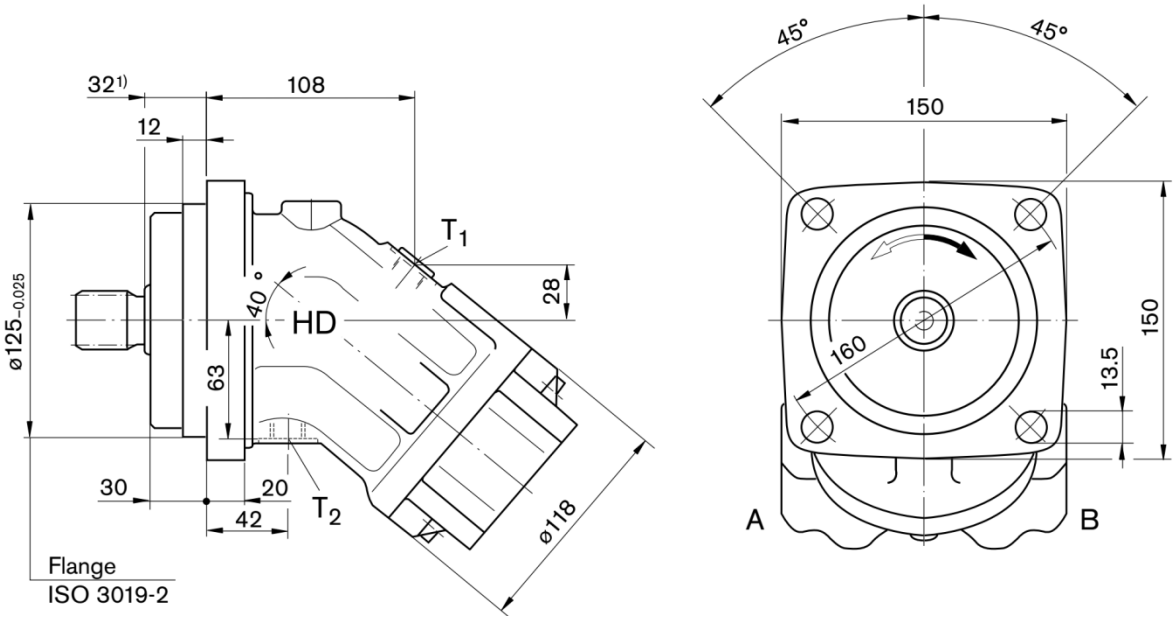
3) The spot face can be deeper than specified in the appropriate standard

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

■ Size 45...Dimensions in mm

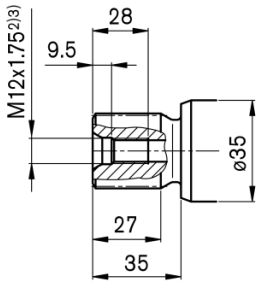
☐ Port plate 010... SAE flange ports at rear.



☐ Drive shaft

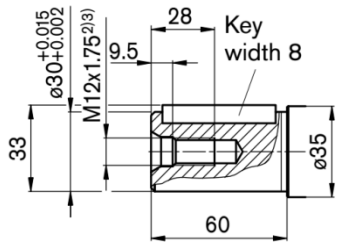
■ Size 45

Z Splined shaft DIN 5480
W 30 x 2 x14 x 9g



■ Size 45

P Parallel keyed shaft DIN 6885
AS 8 x 7 x 50



☐ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5]	M18 x 1.5 deep 12	3	X [7]
T_2	Drain port	DIN 3852 [5]	M18 x 1.5 deep 12	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

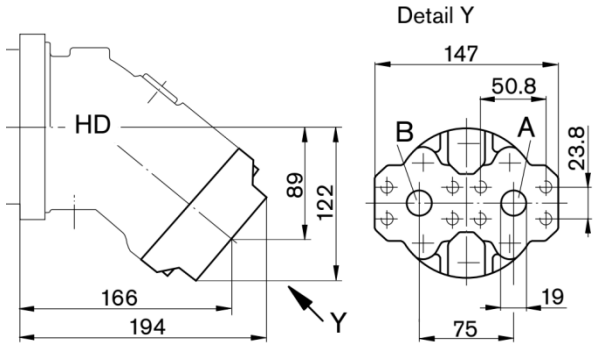
7) Depending on the installation position, T_1 or T_2 must be connected

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

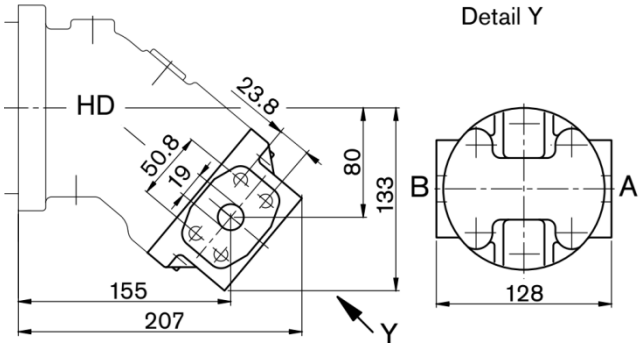
■ Size 45...Dimensions in mm

□ Location of the service line ports on the port plates

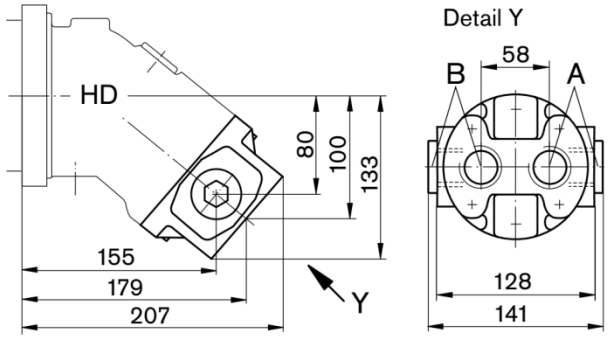
■ Plate 01...SAE flange ports at rear



■ Plate 02...SAE flange ports at side, opposite



■ Plate 04...Threaded ports at side and rear



■ Plate 10...SAE flange ports at bottom (same side)

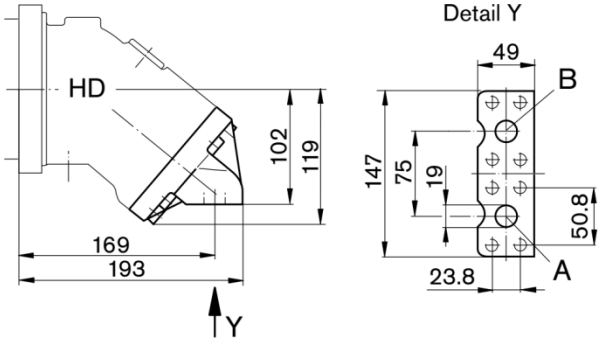


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 02, 10	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	3/4” M10 x 1.5 deep 17	450	O
04	A, B	Working port	DIN 3852 [3]	M33 x 2 deep 18	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

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

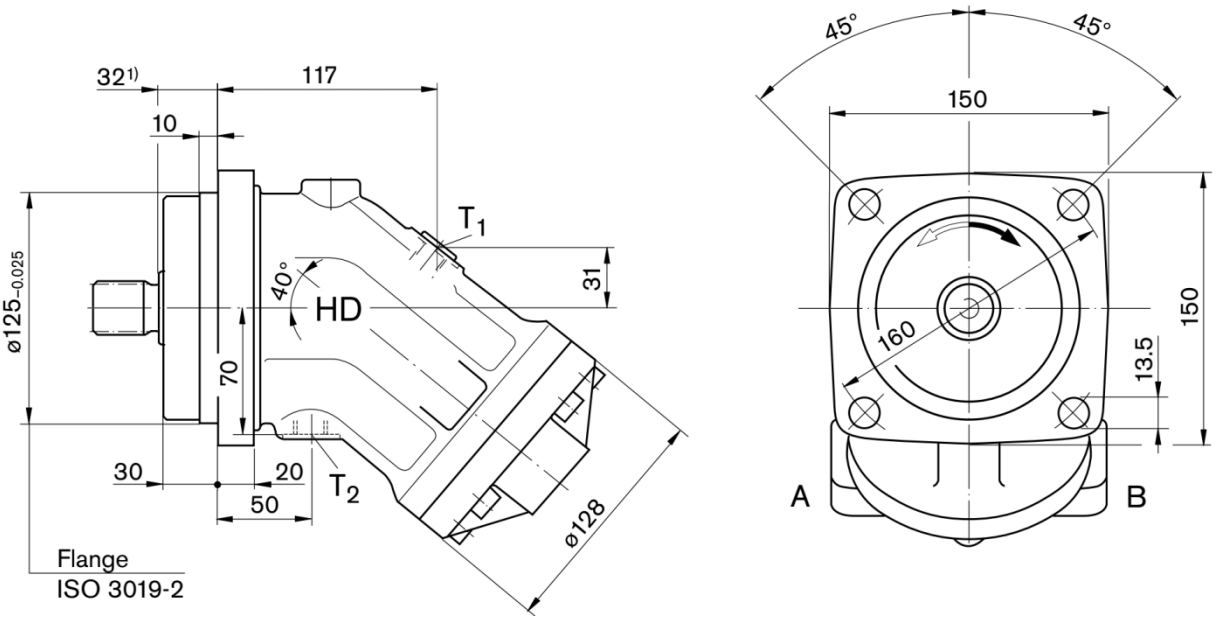
3) The spot face can be deeper than specified in the appropriate standard

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

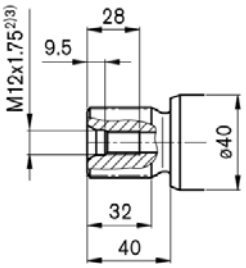
■ Size 56, 63...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

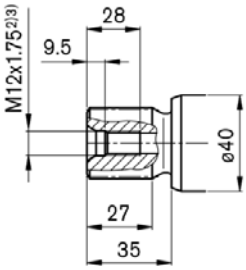


□ Drive shaft

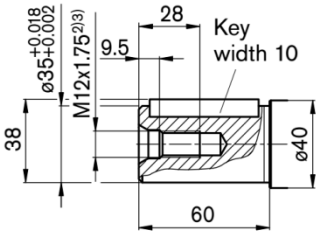
■ Size 56, 63
A Splined shaft DIN 5480
W 35 x 2 x16 x 9g



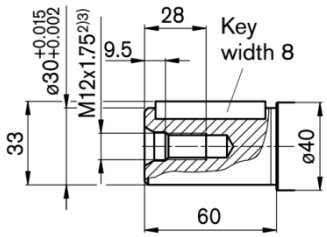
■ Size 56
Z Splined shaft DIN 5480
W 30 x 2 x14 x 9g



■ Size 56, 63
B Parallel keyed shaft DIN 6885
AS 10 x 8 x 50



■ Size 56
P Parallel keyed shaft DIN 6885
AS 8 x 7 x 50



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5]	M18 x 1.5 deep 12	3	X [7]
T_2	Drain port	DIN 3852 [5]	M18 x 1.5 deep 12	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

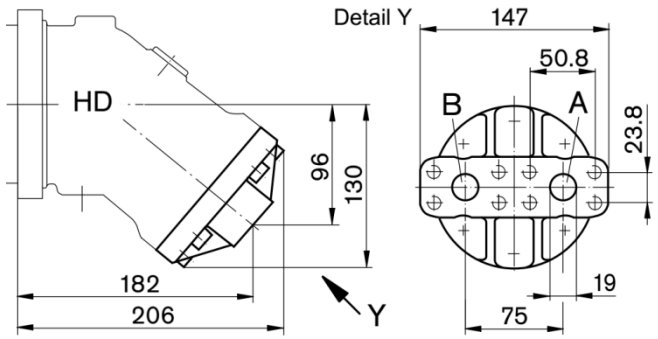
7) Depending on the installation position, T_1 or T_2 must be connected

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

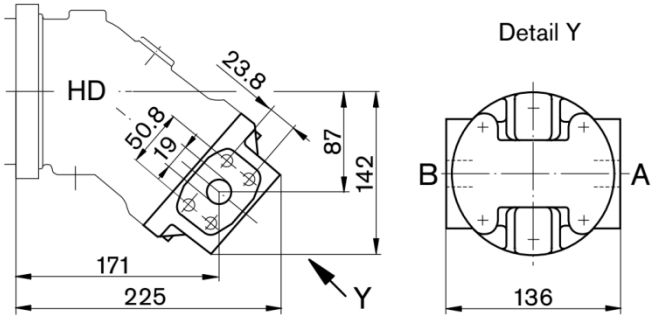
■ Size 56, 63...Dimensions in mm

□ Location of the service line ports on the port plates

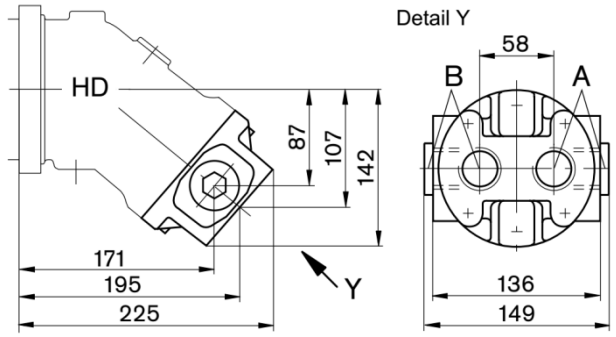
■ Plate 01...SAE flange ports at rear



■ Plate 02...SAE flange ports at side, opposite



■ Plate 04...Threaded ports at side and rear



■ Plate 10...SAE flange ports at bottom (same side)

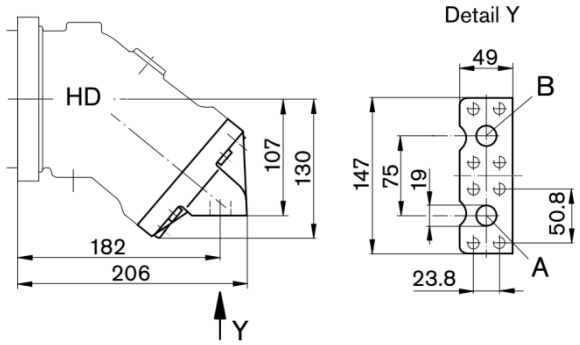


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 02, 10	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	3/4” M10 x 1.5 deep 17	450	O
04	A, B	Working port	DIN 3852 [3]	M33 x 2 deep 18	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

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

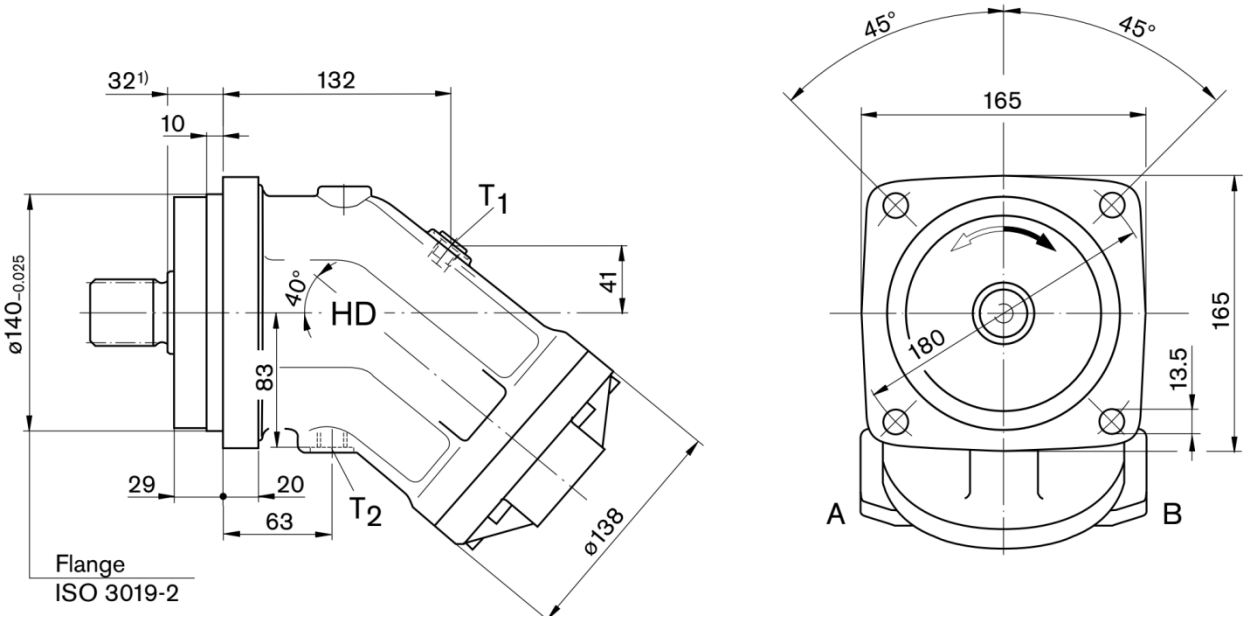
3) The spot face can be deeper than specified in the appropriate standard

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

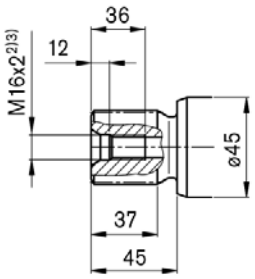
■ Size 80, 90...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

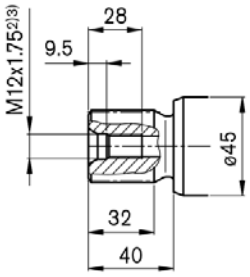


□ Drive shaft

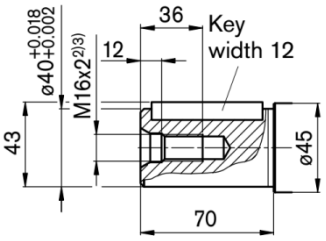
■ Size 80, 90
A Splined shaft DIN 5480
W 40 x 2 x18 x 9g



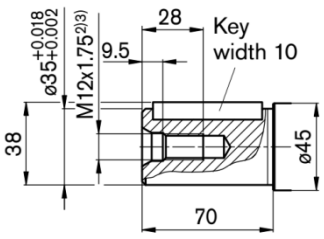
■ Size 80
Z Splined shaft DIN 5480
W 35 x 2 x 16 x 9g



■ Size 80, 90
B Parallel keyed shaft DIN 6885
AS 12 x 8 x 56



■ Size 80
P Parallel keyed shaft DIN 6885
AS 10 x 8 x 56



□ Ports

Ports	Port for	Standard	Size [3)]	P_{Max} [bar] [4)]	State [8)]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5)]	M18 x 1.5 deep 12	3	X [7)]
T_2	Drain port	DIN 3852 [5)]	M18 x 1.5 deep 12	3	O [7)]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

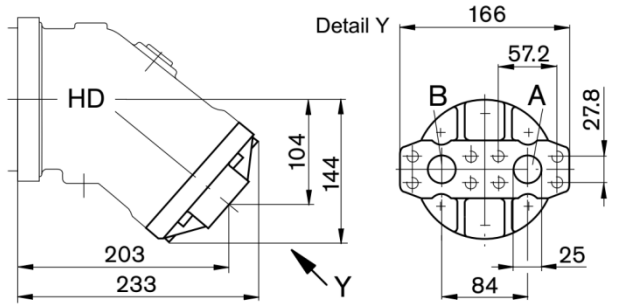
7) Depending on the installation position, T_1 or T_2 must be connected

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

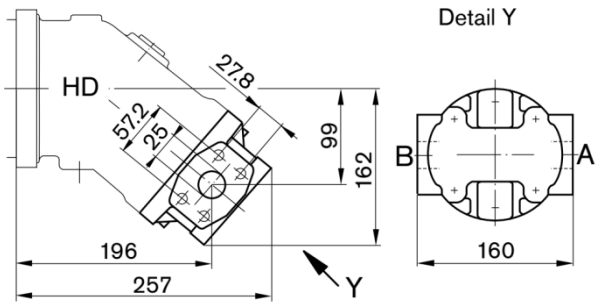
■ Size 80, 90...Dimensions in mm

□ Location of the service line ports on the port plates

■ Plate 01...SAE flange ports at rear



■ Plate 02...SAE flange ports at side, opposite



■ Plate 10...SAE flange ports at bottom (same side)

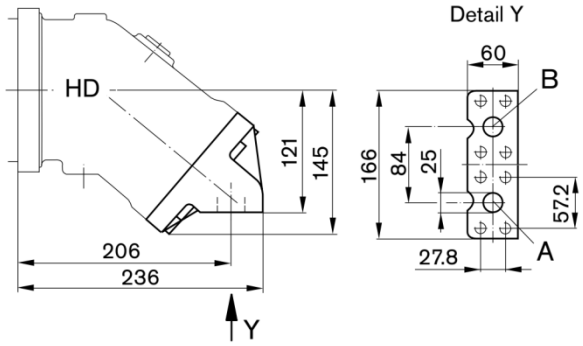


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 02, 10	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	3/4” M10 x 1.5 deep 17	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

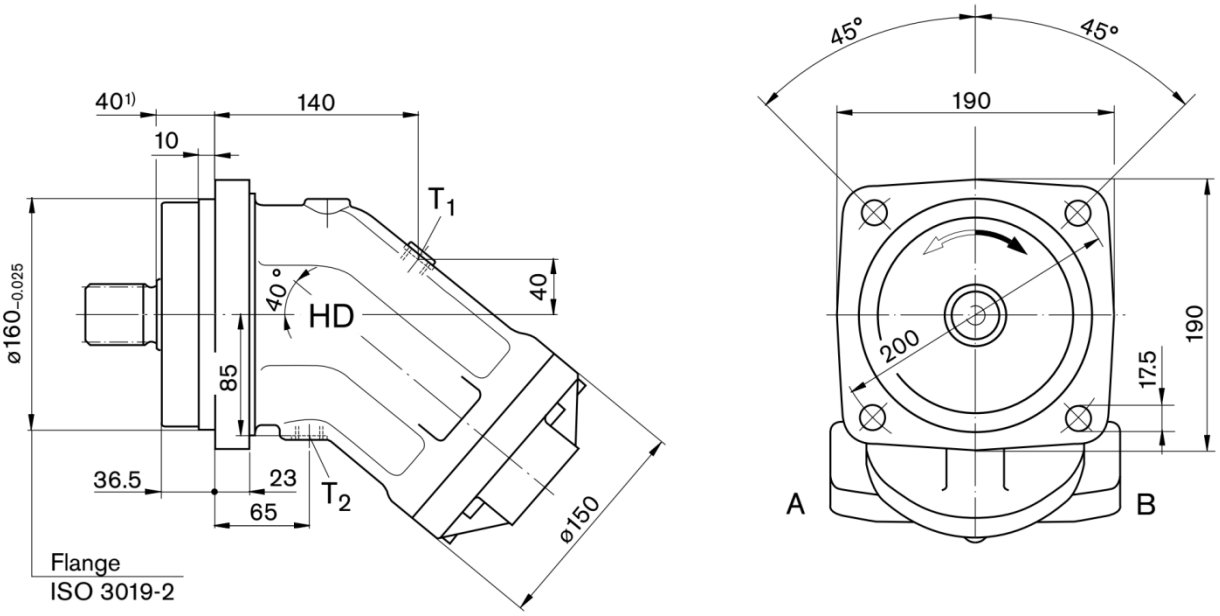
2) Momentary pressure spikes may occur depending on the application.
Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

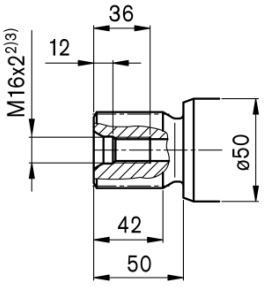
■ Size 107, 125...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

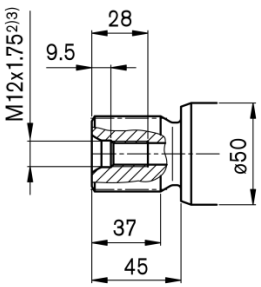


□ Drive shaft

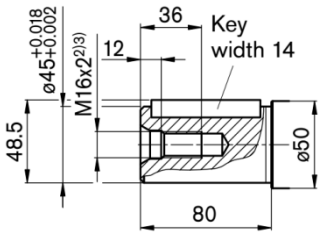
■ Size 107, 125
A Splined shaft DIN 5480
W 45 x 2 x 21 x 9g



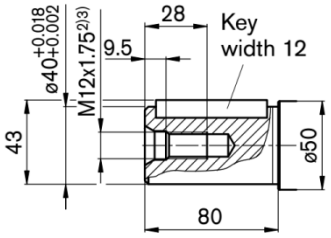
■ Size 107
Z Splined shaft DIN 5480
W 40 x 2 x 18 x 9g



■ Size 107, 125
B Parallel keyed shaft DIN 6885
AS 14 x 9 x 63



■ Size 107
P Parallel keyed shaft DIN 6885
AS 12 x 8 x 63



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5]	M18 x 1.5 deep 12	3	X [7]
T_2	Drain port	DIN 3852 [5]	M18 x 1.5 deep 12	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

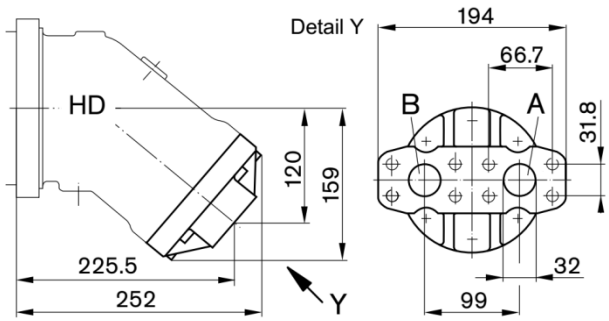
7) Depending on the installation position, T_1 or T_2 must be connected

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

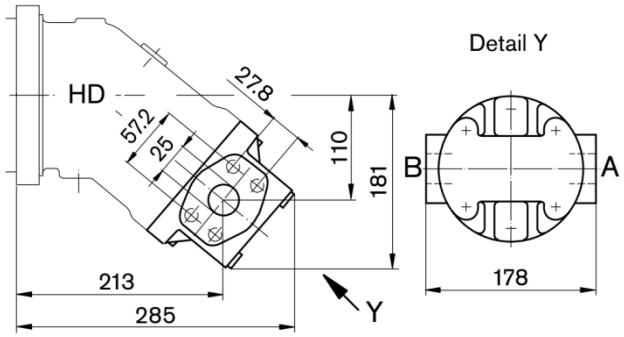
■ Size 107, 125...Dimensions in mm

□ Location of the service line ports on the port plates

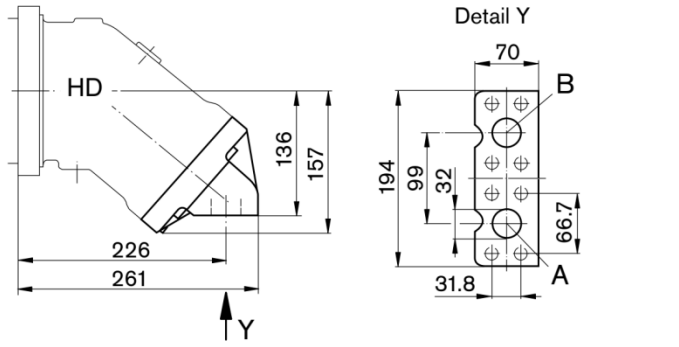
■ Plate 01...SAE flange ports at rear



■ Plate 02...SAE flange ports at side, opposite



■ Plate 10...SAE flange ports at bottom (same side)



■ Plate 02...SAE flange ports at side, opposite (Size125)

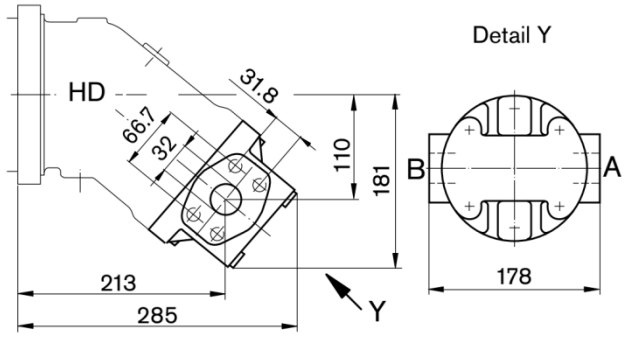


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 10	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	1-1/4” M14 x 2 deep 19	450	O
02 Size107	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	1” M12 x 1.75 deep 17	450	O
02 Size125	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	1-1/4” M14 x 2 deep 19	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

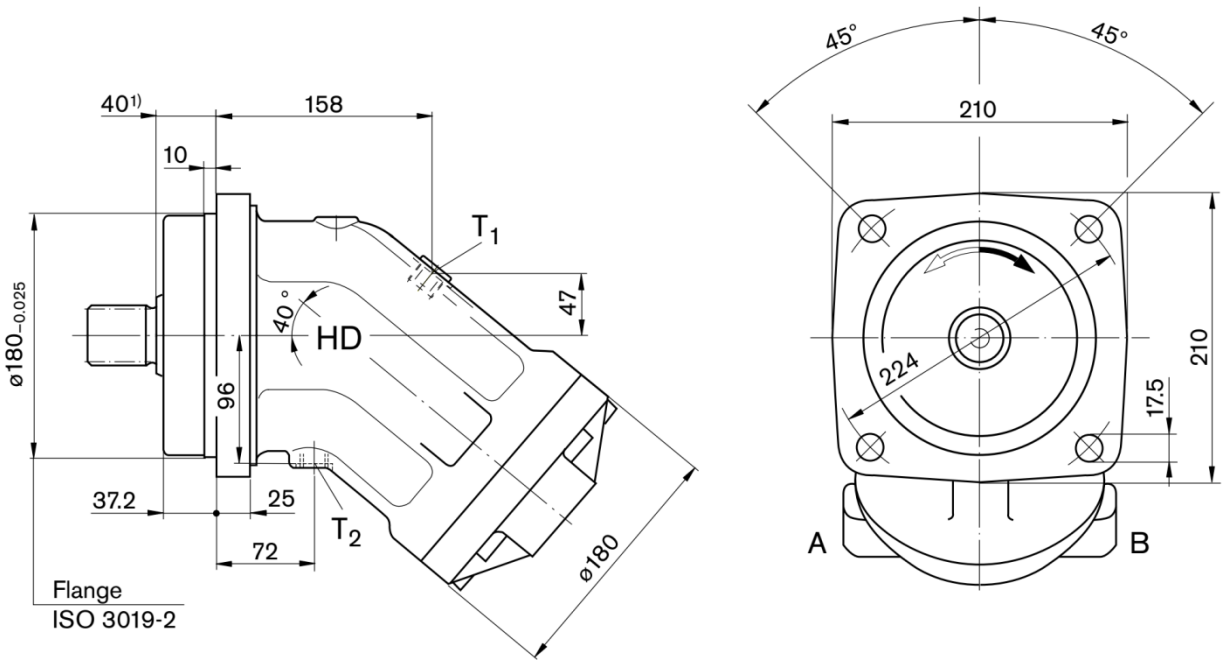
2) Momentary pressure spikes may occur depending on the application.
Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

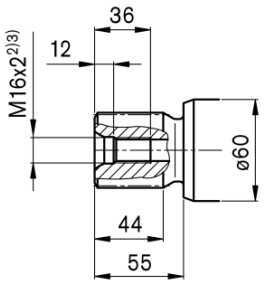
■ Size 160, 180...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

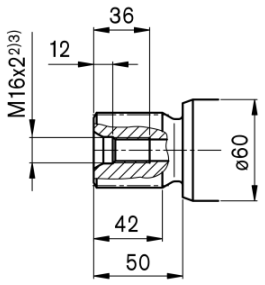


□ Drive shaft

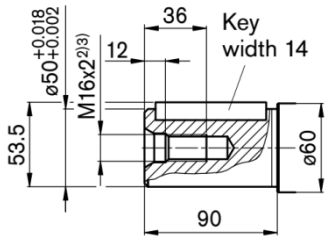
■ Size 160, 180
A Splined shaft DIN 5480
W 50 x 2 x 24 x 9g



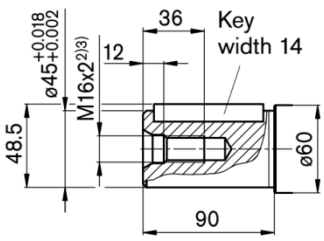
■ Size 160
Z Splined shaft DIN 5480
W 45 x 2 x 21 x 9g



■ Size 160, 180
B Parallel keyed shaft DIN 6885
AS 14 x 9 x 70



■ Size 160
P Parallel keyed shaft DIN 6885
AS 14 x 9 x 70



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	X [7]
T_2	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

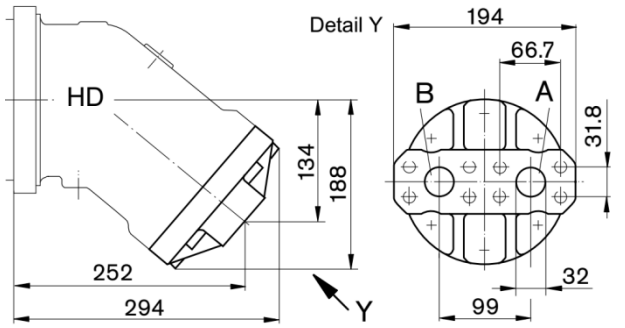
7) Depending on the installation position, T_1 or T_2 must be connected

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

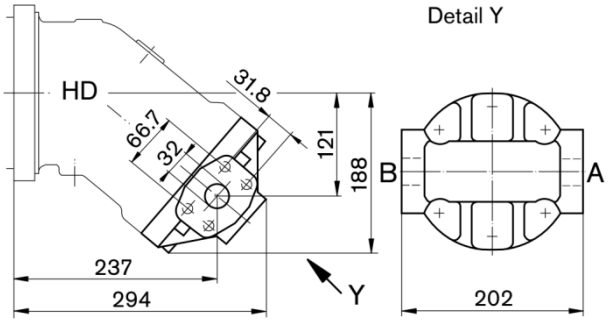
■ Size 160, 180...Dimensions in mm

□ Location of the service line ports on the port plates

■ Plate 01...SAE flange ports at rear



■ Plate 02...SAE flange ports at side, opposite



■ Plate 10...SAE flange ports at bottom (same side)

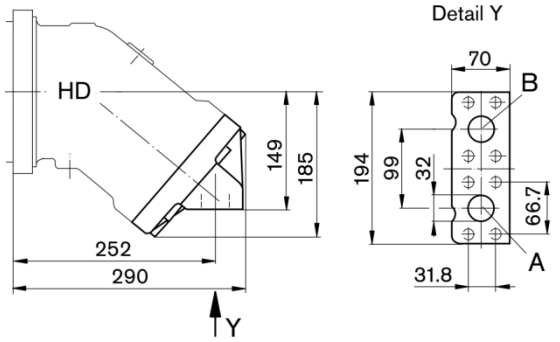


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 02, 10	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	1-1/4” M14 x 2 deep 19	450	O

Note

1) For the maximum tightening torques the general instructions must be observed.

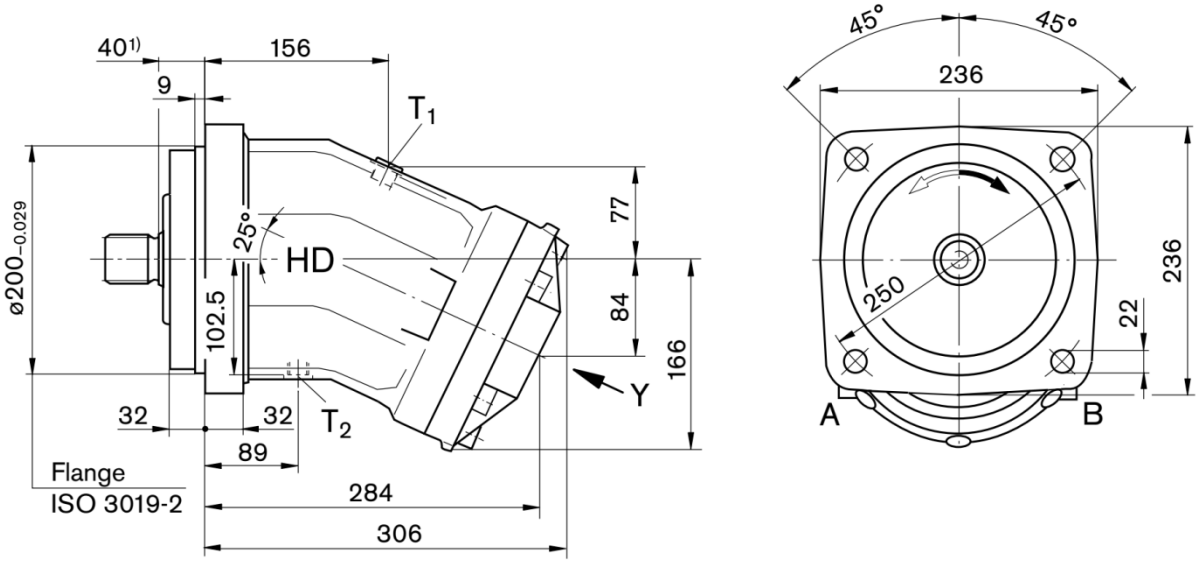
2) Momentary pressure spikes may occur depending on the application.
Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

■ Size 200...Dimensions in mm

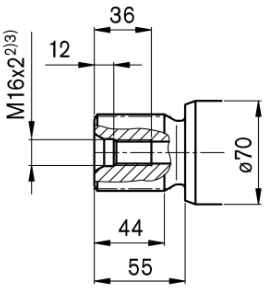
□ Port plate 010... SAE flange ports at rear.



□ Drive shaft

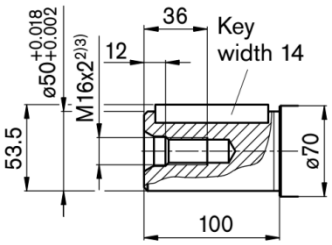
■ Size 200

A Splined shaft DIN 5480
W 50 x 2 x 24 x 9g

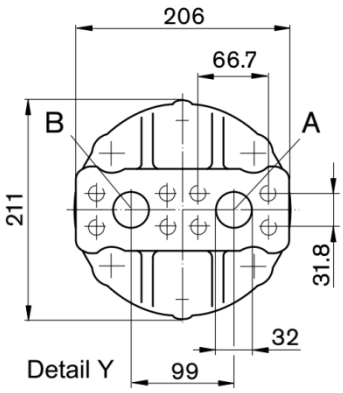


■ Size 200

B Parallel keyed shaft DIN 6885
AS 14 x 9 x 80



■ Plate 01...SAE flange ports at rear



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port Fastening thread	SAE J518 [6] DIN 13	1-1/4” M14 x 2deep 19	450	
T_1	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	X [7]
T_2	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

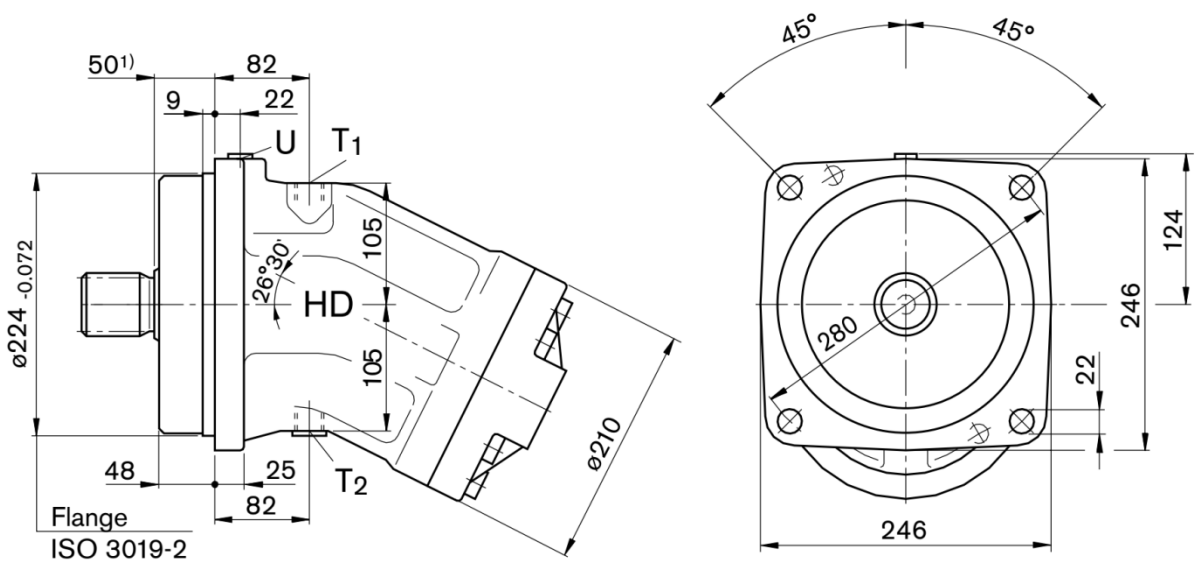
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

7) Depending on the installation position, T_1 or T_2 must be connected

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

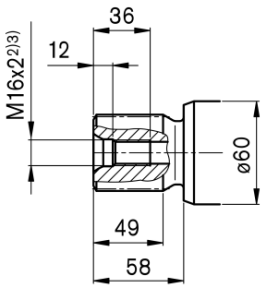
■ Size 250...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

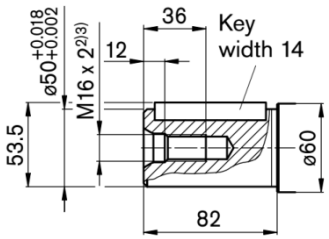


□ Drive shaft

■ Size 250
Z Splined shaft DIN 5480
W 50 x 2 x 24 x 9g



■ Size 250
P Parallel keyed shaft DIN 6885
AS 14 x 9 x 80



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port		see port plates	450	
T_1	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	X [7]
T_2	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	O [7]
U	Bearing flushing port	DIN 3852 [5]	M14 x 1.5 deep 12	3	X

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

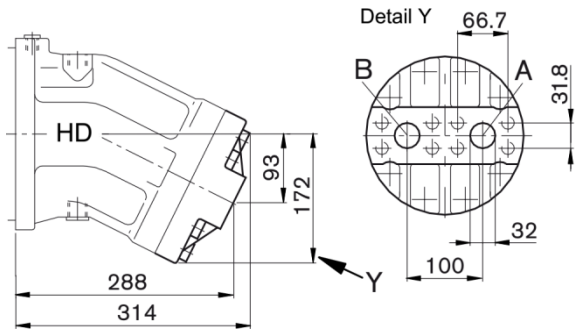
7) Depending on the installation position, T_1 or T_2 must be connected

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

■ Size 250...Dimensions in mm

□ Location of the service line ports on the port plates

■ Plate 01...SAE flange ports at rear



■ Plate 02...SAE flange ports at side, opposite

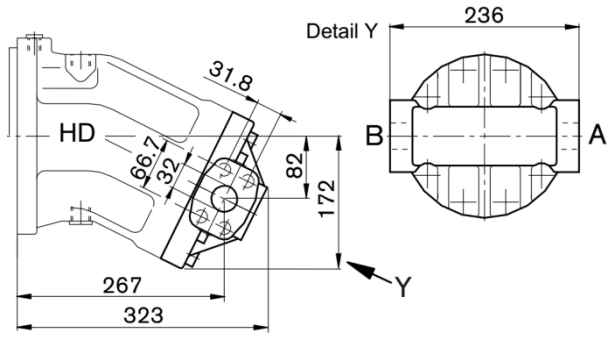


Plate	Ports	Port for	Standard	Size [1]	P_{Max} [bar] [2]	State [5]
01, 02	A, B	Working port Fastening thread	SAE J518 [4] DIN 13	1-1/4” M14 x 2 deep 19	400	O

Note

1) For the maximum tightening torques the general instructions must be observed.

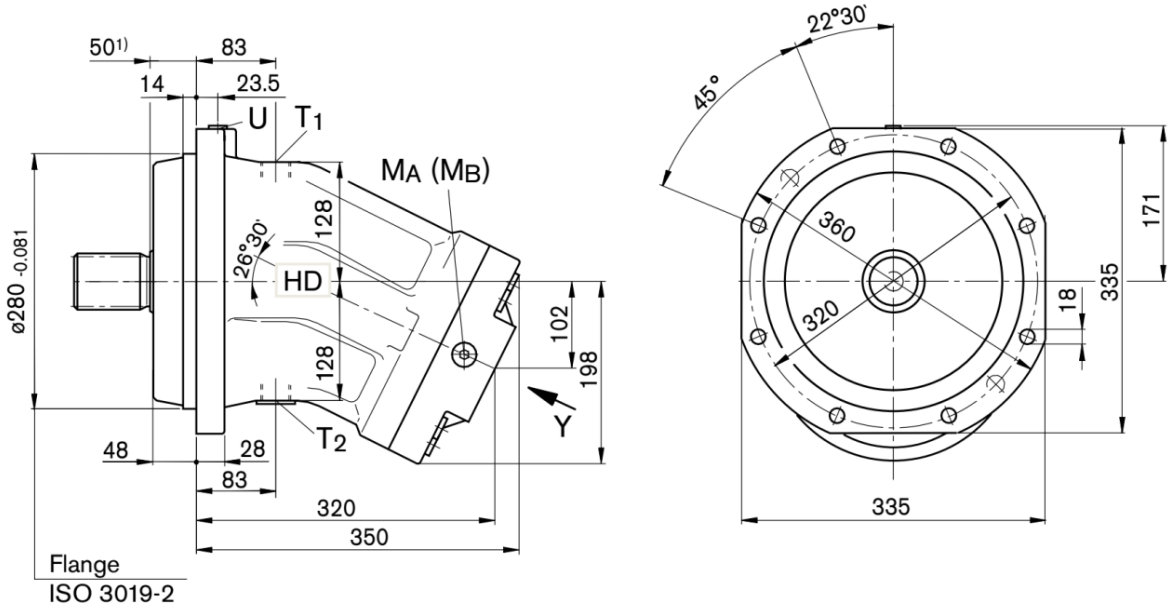
2) Momentary pressure spikes may occur depending on the application.
Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

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

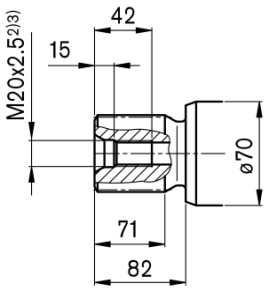
■ Size 355...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

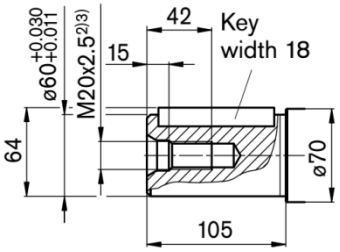


□ Drive shaft

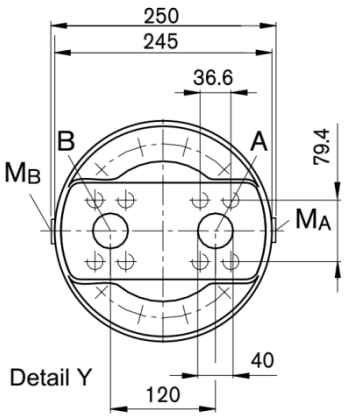
■ Size 355
Z Splined shaft DIN 5480
W 60 x 2 x 28 x 9g



■ Size 355
P Parallel keyed shaft DIN 6885
AS 18 x 11 x 100



■ Plate 01...SAE flange ports at rear



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port Fastening thread	SAE J518 [6] DIN 13	1-1/2” M16 x 2 deep 21	450	
T_1	Drain port	DIN 3852 [5]	M33 x 2 deep 18	3	X [7]
T_2	Drain port	DIN 3852 [5]	M33 x 2 deep 18	3	O [7]
U	Bearing flushing port	DIN 3852 [5]	M14 x 1.5 deep 12	3	X
M_A, M_B	Measuring workting pressure	DIN 3852 [5]	M14 x 1.5 deep 12	400	X

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

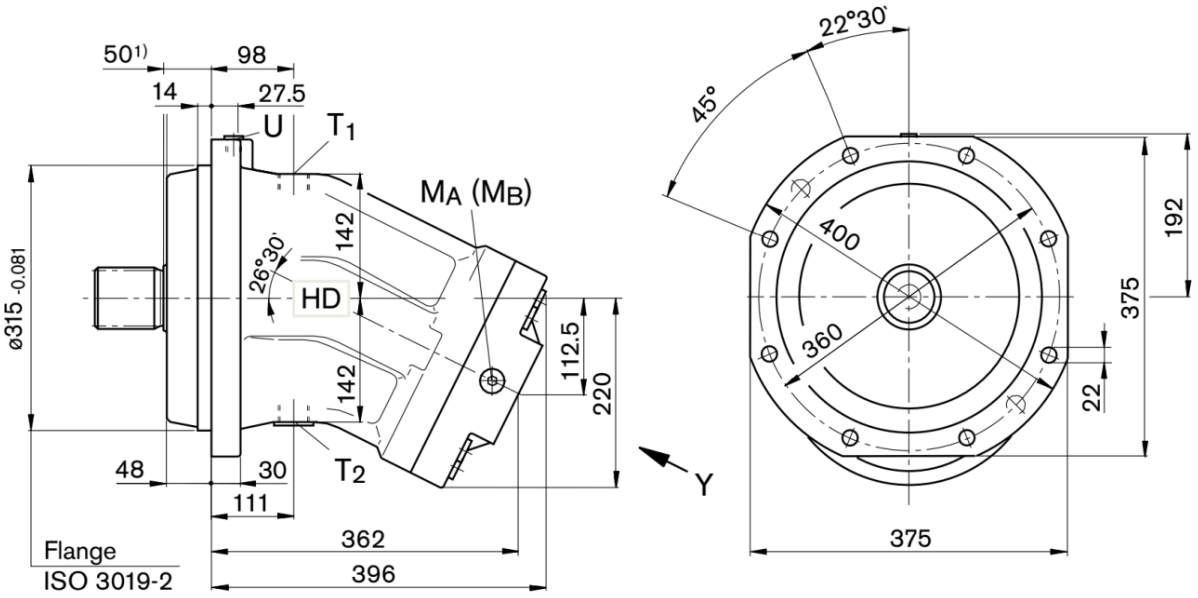
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

7) Depending on the installation position, T_1 or T_2 must be connected

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

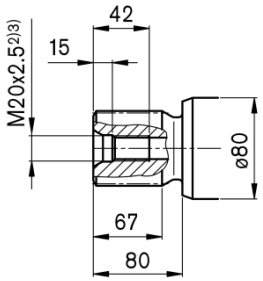
■ Size 500...Dimensions in mm

□ Port plate 010... SAE flange ports at rear.

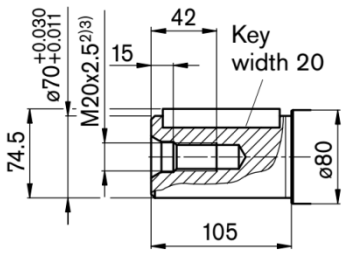


□ Drive shaft

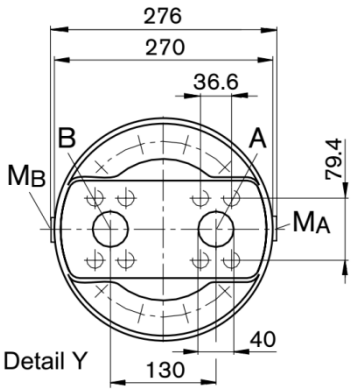
■ Size 500
Z Splined shaft DIN 5480
W 70 x 3 x 22 x 9g



■ Size 500
P Parallel keyed shaft DIN 6885
AS 20 x 12 x 100



■ Plate 01...SAE flange ports at rear



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port Fastening thread	SAE J518 [6] DIN 13	1-1/2” M16 x 2 deep 21	450	
T_1	Drain port	DIN 3852 [5]	M33 x 2 deep 18	3	X [7]
T_2	Drain port	DIN 3852 [5]	M33 x 2 deep 18	3	O [7]
U	Bearing flushing port	DIN 3852 [5]	M18 x 1.5 deep 12	3	X
M_A, M_B	Measuring workting pressure	DIN 3852 [5]	M14 x 1.5 deep 12	400	X

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

7) Depending on the installation position, T_1 or T_2 must be connected

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

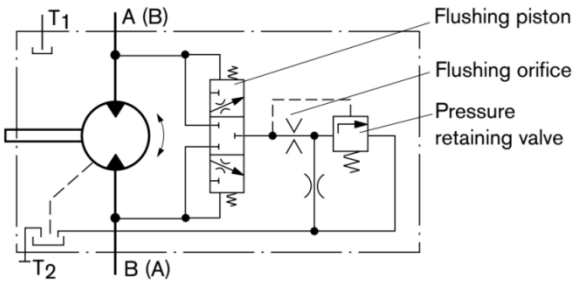
Flushing and boost pressure valve

- 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, the valve is mounted directly on the fixed motor (sizes 45 to 180, 250); with port plate 017 (sizes 355 and 500) on a plate.

Fixed setting

- Cracking pressure of pressure retaining valve(observe when setting the primary valve)
  Sizes 45 to 500, fixed setting…….....16 bar
- Switching pressure of flushing piston ⊿P
  Sizes 45 to 500.....8±1 bar

Schematic



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 mm^2/s
- P_{ND} = low pressure P_G = case pressure

Standard flushing flows

- Flushing and boost pressure valve, mounted

Size	flushing flows q_v l/min	Throttle Φ mm
45	3.5	1.2
107, 125	5	1.8
160, 180	8	2.0
250	10	2.0
355, 500	10	2.5

- 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 ΔP_{ND} = 25 bar.

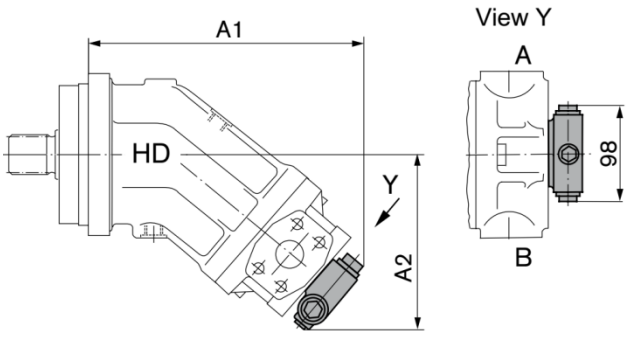
- Flushing and boost pressure valve, integrated

Size	flushing flows q_v l/min	Throttle Φ mm
56, 63	6	1.5
80, 90	7.3	1.8

■ Flushing and boost pressure valve

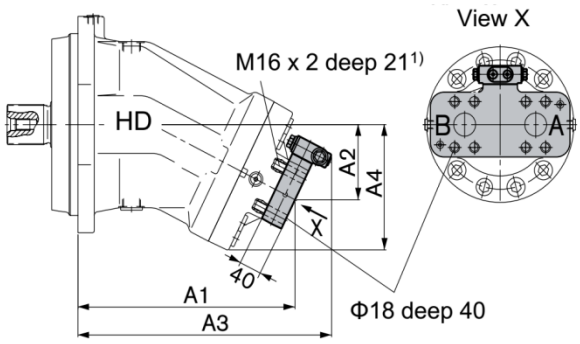
◘ Dimensions in mm

◘ Port plate 027...SAE flange ports at side



Size	A1	A2		
45	223	151		
107, 125	294	192		
160, 180	315	201		
250	344	172		

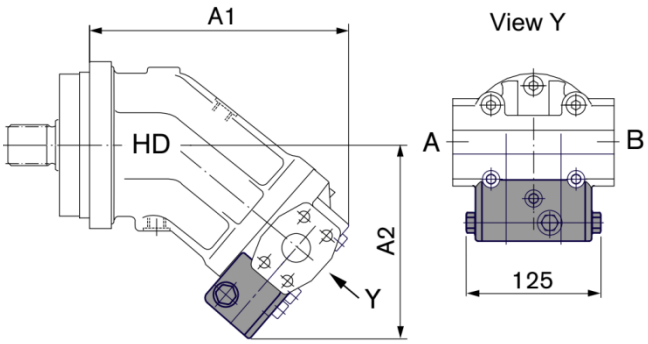
◘ Port plate 017...SAE flange ports at rear



Size	A1	A2	A3	A4
355	356	120	421	198
500	397	130	464	220	

1) DIN 13, observe the general instructions for the maximum tightening torques

◘ Port plate 029...SAE flange ports at side



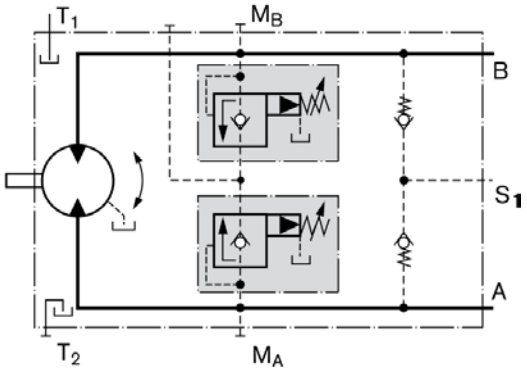
Size	A1	A2		
56, 63	225	176		
80, 90	257	186.7		

Pressure-relief valve

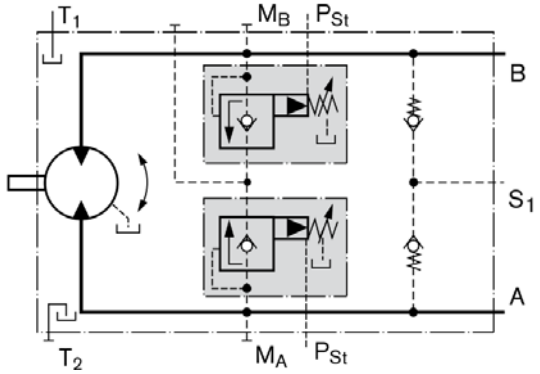
- The pressure-relief valves protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the highpressure side to the low-pressure side.
- The pressure-relief valves are only available in combination with port plates 181,191 or 192 (counterbalance valve for mounting to port plate 181)
- 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)

Schematic

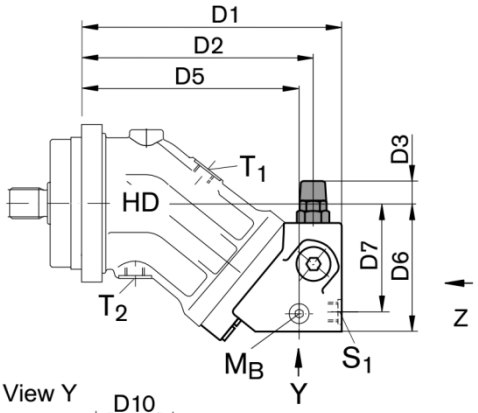
- Version without pressure boost facility [191]

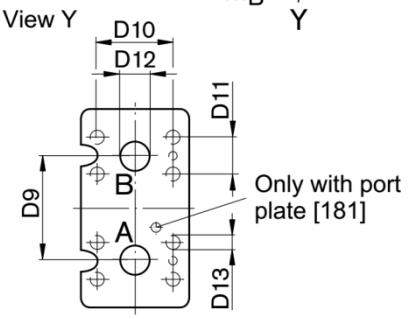


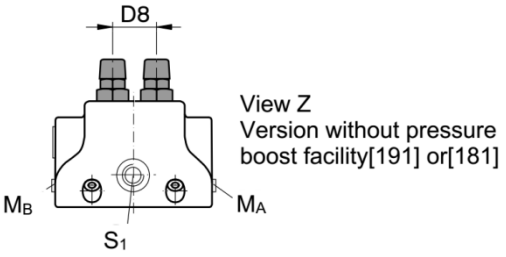
- Version with pressure boost facility [192]

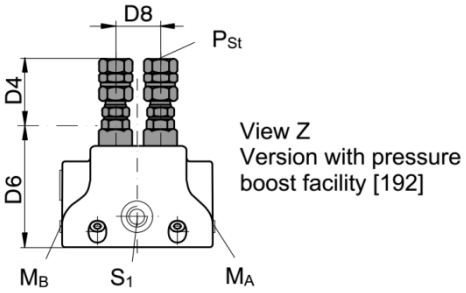


- Dimensions in mm









■ Pressure-relief valve

□ Dimensions in mm

Size	Code	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[2)]
28, 32	MHDB16	209	186	25	68	174	102	87	36	66	50.8	23.8	Φ19	M10 deep 17
45	MHDB16	222	198	22	65	187	113	98	36	66	50.8	23.8	Φ19	M10 deep 17
56, 63	MHDB22	250	222	19	61	208	124	105	42	75	50.8	23.8	Φ19	M10 deep 13
80, 90	MHDB22	271	243	17.5	59	229	134	114	42	75	57.2	27.8	Φ25	M12 deep 18
107, 125	MHDB32	298	266	10	52	250	149.5	130	53	84	66.7	31.8	Φ32	M14 deep 19
160, 180	MHDB32	332	301	5	47	285	170	149	53	84	66.7	31.8	Φ32	M14 deep 19

Size	Port A,B	S_1[1)]	M_A, M_B[1)]	P_{St}[1)]	
28, 32	3/4”	M22 x 1.5 deep 14	M20 x 1.5 deep 14	G1/4”	Assembly instructions for port plate with pressure boost facility "192" The lock nut must be counterheld when installing the hydraulic line at the pst port
45	3/4”	M22 x 1.5 deep 14	M20 x 1.5 deep 14	G1/4”	
56, 63	3/4”	M26 x 1.5 deep 16	M26 x 1.5 deep 16	G1/4”	
80, 90	1”	M26 x 1.5 deep 16	M26 x 1.5 deep 16	G1/4”	
107, 125	1-1/4”	M26 x 1.5 deep 16	M26 x 1.5 deep 16	G1/4”	
160, 180	1-1/4”	M26 x 1.5 deep 16	M30 x 1.5 deep 16	G1/4”	

□ Ports

Ports	Port for	Standard	Size [1)]	P_{Max} [bar] [2)]	State [3)]
A, B	Working port	SAE J518	See above	450	O
S_1	Supply port (only with port plate 191/192)	DIN 3852	See above	5	O
M_A, M_B	Measuring operating pressure port	DIN 3852	See above	450	X
P_{St}	Pilot pressure port (only with port plate 192)	DIN 3852	See above	30	O

Note

1) For the maximum tightening torques the general instructions must be observed.

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) X = plugged (in normal operation)

■ Counterbalance valve BVD and BVE

- 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
- 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.

■ Note

- Ordering example
  A2FM90/61W–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 and BVE counterbalance valve
- 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 mm^2/s)

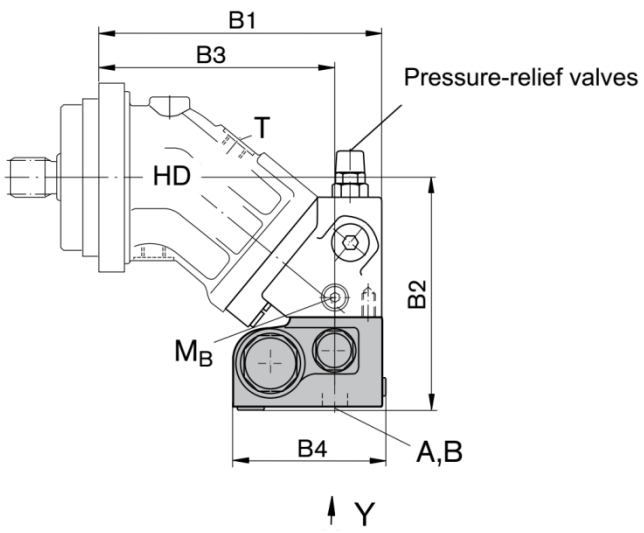
■ Technical Data

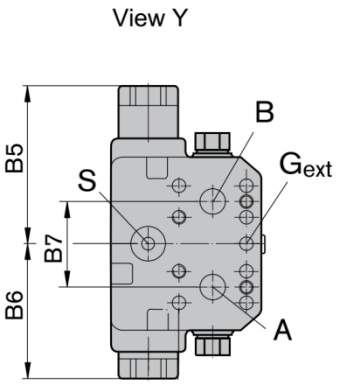
- Permissible input flow or pressure in operation with DBV and BVD/BE

Motor	Without valve		Restricted values in operation with DBV				Restricted values in operation with BVD/BVE			
HD-A2FM Size	P_{nom}/P_{max} bar	$q_{v\ max}$ l/min	DBV size	P_{nom}/P_{max} bar	q_v l/min	Plate Code	BVD/BVE size	P_{nom}/P_{max} bar	q_v l/min	Plate Code
28	400/450	176	16	350/420	100	181	20	350/420	100	188
32		201				191, 192	BVD			
45		255								
56		280	22		240				220	
63		315								
80		360								
90		405								
107		427				171				178
125		500				191, 192				
107		427	32		400	181	25		320	188
125		500				191, 192	BVD/BVE			
160		577								
180		648								

■ Counterbalance valve BVD and BVE

□ Dimensions in mm





□ 尺寸数据（mm）

HD-A2FM	Counterbalance valve		Dimensions in mm							
Size	Type	Port A, B	B1	B2	B3	B4(S)	B4(L)	B5	B6	B7
28, 32	BVD20…16	3/4”	209	175	174	142	147	139	98	66
45	BVD20…16	3/4”	222	196	187	142	147	139	98	66
56, 63	BVD20…17	3/4”	250	197	208	142	147	139	98	75
80, 90	BVD20…27	1”	271	207	229	142	147	139	98	75
107, 125	BVD20…28	1”	298	238	251	142	147	139	98	84
107, 125	BVD25…38	1-1/4”	298	239	251	158	163	175	120.5	84
160, 180	BVD25…38	1-1/4”	332	260	285	158	163	175	120.5	84
107, 125	BVE25…38	1-1/4”	298	240	251	167	172	214	137	84
160, 180	BVE25…38	1-1/4”	332	260	285	167	172	214	137	84
250	On request									

□ Ports

Ports	Port for	Version	Standard	Size [1]	P_{Max} [bar] [2]	State [4]
A, B	Working port		SAE J518	See above	420	O
S	Infeed	BVD20	DIN 3852 [3]	M22 x 1.5 deep 14	30	X
		BVD25, BVE25	DIN 3852 [3]	M27 x 2 deep 16	30	X
Br	Brake release,reduce high pressure	L	DIN 3852 [3]	M12 x 1.5 deep 12.5	30	O
G_{ext}	Brake release,high pressure	S	DIN 3852 [3]	M12 x 1.5 deep 12.5	420	X
M_A, M_B	Measuring pressure A, B		ISO 6149 [3]	M12 x 1.5 deep 12	420	X

Note

1) For the maximum tightening torques the general instructions must be observed.

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)

■ Counterbalance valve BVD and BVE

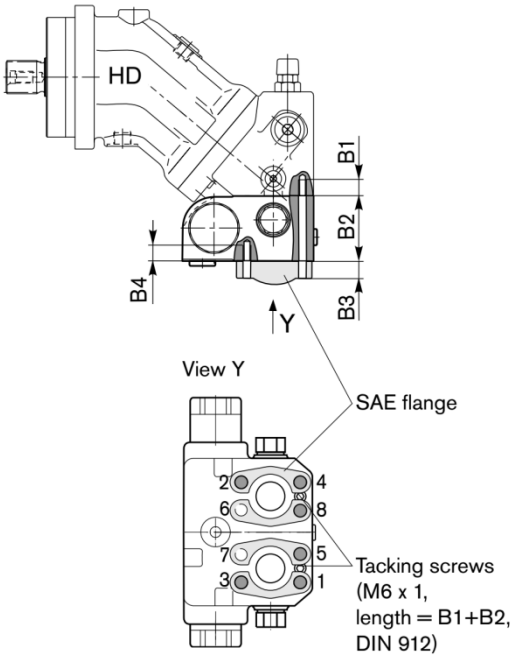
- When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to 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
M6 x 1 tacking screw	10.9	15.5 Nm
M10 x 1.5	10.9	75 Nm
M12 x 1.75	10.9	130 Nm
M14 x 2	10.9	205 Nm

HD-A2FM Size	28,32 45	56,63	80,90	107,125 160,180	107,125
Port plate	18				17
B1 [1]	M10x1.5 deep 17	M10x1.5 deep 17	M12x1.75 deep 18	M14x2 deep 19	M12x1.75 deep 17
B2	78 [2]	68	68	85	68
B3	-	-	-	-	-
B4	M10x1.5 deep 15	M10x1.5 deep 15	M12x1.75 deep 16	M14x2 deep 19	M12x1.75 deep 17

1) Minimum required thread reach 1 x Φ thread
2) Including sandwich plate

■ Installation drawing



Speed sensors

- The versions A2FM...U and A2FM...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 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.

Installation

- The sensor is mounted at the specially provided port D as follows
  DAS..... . . with one mounting bolt
  HDD..... with two mounting bolts
- We recommend ordering the A2FM fixed motor complete with sensor mounted

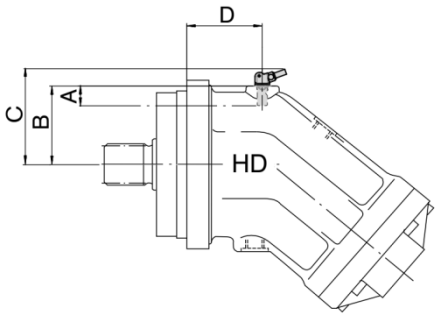
Technical Data

Size		23,28,32	45	56,63	80,90	107,125
Number of teeth		38	45	47	53	59
DSA	A depth$_{\pm 0.1}$	18.4	18.4	18.4	18.4	18.4
	B surface	57.9	64.9	69.9	74.9	79.9
	C	74.5	81.5	86.5	91.5	96.5
	D	54.7	54.3	61.5	72.5	76.8

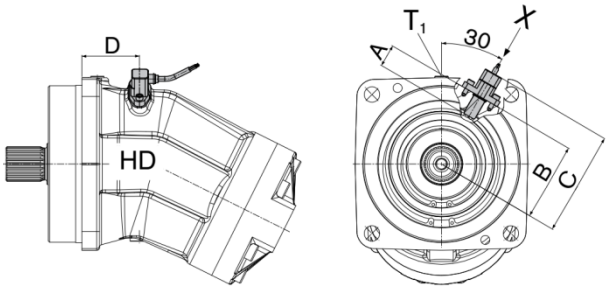
Size		160,180	200	250	355	500
Number of teeth		67	80	78	90	99
HDD	A depth$_{\pm 0.1}$	-	-	32	32	32
	B surface	-	-	110.5	122.5	132.5
	C	-	-	149	161	171
	D	-	-	82	93	113
DSA	A depth$_{\pm 0.1}$	18.4	18.4	32	32	32
	B surface	87.4	100.9	-	-	-
	C	104	117.5	-	-	-
	D	86.8	97.5	-	-	-

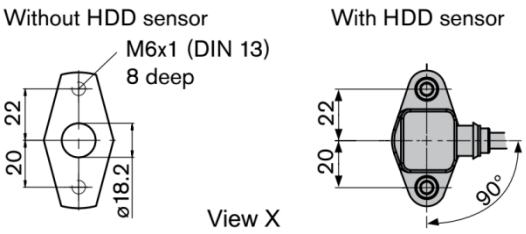
Installation drawing

- Version "V" …Sizes 23 to 200 with DSA sensor



- Version "H"…Sizes 250 to 500 with HDD sensor





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 suction and drain lines must flow into the reservoir below the minimum fluid level.

Installation position

- See the following examples 1 to 8
- Additional installation positions are available upon request.
- Recommended installation positions1 and 2

Note

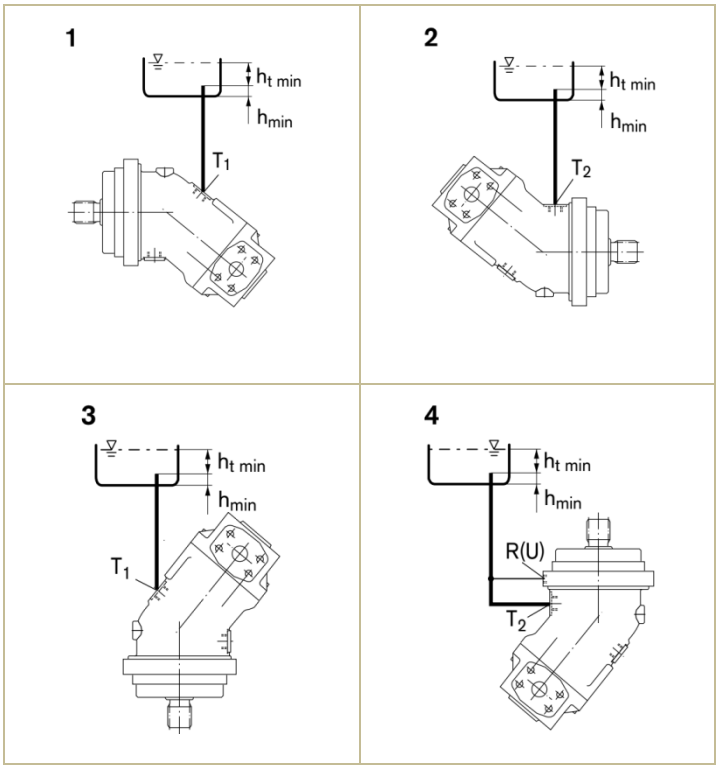
- With sizes 10 to 200 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering-special version). With sizes 250 to 1000, port U is provided as standard in the area near the bearings for air bleeding.

Ins.Position	1	2	3	4	5	6	7	8
Air bleed	-	-	-	R(U)	L_1	L_1	L_1	R(U)
Filling	T_1	T_2	T_1	T_2	$T_1(L_1)$	$T_2(L_1)$	$T_1(L_1)$	$T_2(L_1)$

L_1	Case drain port
R	Air bleeding port
U	Bearing flushing / air bleed port
T_1,T_2	Drain port
$h_{t\,min}$	Minimum necessary immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

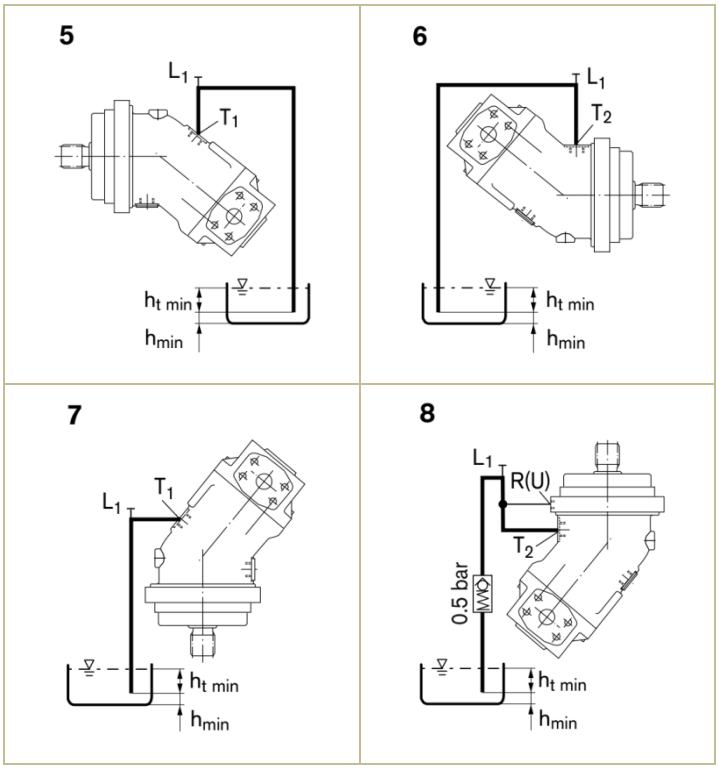
Below-reservoir installation (standard)

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



■ Ordering Code For Standard Program

HD	-		A2F		E	90	/	6	1	W	-	V	A	B	010			-	
0		1	2	3	4	5		6	7	8		9	10	11	12	13	14		15

0	Manufacturer	Code
	HUADE HYDRAULIC 华德液压	HD

1	Oil types / Specifications		28～180	250	355	Code
	Mineral oil	……without code	■	■	■	-
	HFD	for sizes 250～355 only in combination with long-life bearings L	■	■	■	-
	HFB,HFC	Size 28～180……without code	■	-	-	-
		Size 250～355 only in combination with long-life bearings L	-	■	■	E

2	Axial piston unit	28/32	45	56/63	80/90	107/125	160/180	250/355	Code
	Bent-axis design, fixed	■	■	■	■	■	■	□	A2F

3	Drive shaft bearing	28～180	250	355	Code
	Standard bearing……without code	■	■	■	-
	Long-life bearing	-	■	■	L

2	Operation mode	28/32	45	56/63	80/90	107/125	160/180	250/355	Code
	Motor,plug-in version	■	■	■	■	■	■	□	E

5	Displacement	28	32	45	56	63	80	90	107	125	160	180	250	355	Code
	≙ V_{gmax}（cm^3/r）	28	32	45	56	63	80	90	107	125	160	180	250	355	-

6	Series	28～355	Code
	Series 6	■	6

7	Index	28～180	250	355	Code
	Size 28～180	■	-	-	1
	Size 250～355	-	■	■	0

8	Direction of rotation	Code
	Viewed on drive shaft bidirectional	W

9	Sealing material	28～355	Code
	FKM (Fluoro-rubber)	■	V
	NBR(Nitrile-rubber),Shaft seal FKM (Fluoro-rubber)	■	P

10	Drive shaft		28	32	45	56	63	80	90	107	125	160	180	250	355	Code
	Splined	I	■	■	-	■	■	■	■	■	■	■	■	-	-	A
	shaft	II	■	-	■	■	-	■	-	■	-	■	-	■	■	Z

■ Ordering Code For Standard Program

HD	-		A2F		E	90	/	6	1	W	-	V	A	B	010			-	
0		1	2	3	4	5		6	7	8		9	10	11	12	13	14		15

11	Mounting flange		28～180	250～355	Code
	ISO 3019-2	2 hole	■	-	L
		4 hole	-	■	M

12	Working port			28	32	45	56	63	80	90	107	125	160	180	250	355	Code
	SAE flange ports	01	0	-	-	-	-	-	-	-	-	-	-	-	■	□	010
	A and B at rear		7	-	-	-	-	-	-	-	-	-	-	-	-	□	017
	SAE flange ports	02	0	-	-	-	-	-	-	-	-	-	-	-	■	□	020
	A and B at side, opposite		7	-	-	■	□	□	□	□	■	■	■	■	■	-	027
			9	-	-	-	■	■	■	■	-	-	-	-	-	-	029
	SAE flange ports	10	0	■	■	■	■	■	■	■	■	■	■	■	-	■	100
	A and B at bottom (same side)		7	-	-	-	-	-	-	-	-	-	-	-	-	■	107
	Port plate with[1)] BVD	17	1	-	-	-	-	-	-	-	■	■	-	-	-	-	171
	1-level pressure relief		8	-	-	-	-	-	-	-	■	■	-	-	-	-	178
	valves for mounting a	18	1	■	■	■	■	■	■	■	■	■	■	■	-	-	181
	counterbalance valve BVE	18	8	-	-	-	-	-	-	-	■	■	■	■	-	-	188
	Port plate with	19	1	■	■	■	■	■	■	■	■	■	■	■	-	-	191
	pressure relief valves		2	■	■	■	■	■	■	■	■	■	■	■	-	-	192

Valves

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

■ Ordering Code For Standard Program

HD	-		A2F		E	90	/	6	1	W	-	V	A	B	010			-	
0		1	2	3	4	5		6	7	8		9	10	11	12	13	14		15

13	Speed sensors	28	32	45	56	63	80	90	107	125	160	180	250	355	Code
	Without speed sensor ..without code	■	■	■	■	■	■	■	■	■	■	■	■	□	-
	Prepared for HDD speed sensor	-	-	-	-	-	-	-	-	-	-	-	■	-	F
	HDD speed sensor mounted [2)]	-	-	-	-	-	-	-	-	-	-	-	■	-	H
	Prepared for DSA speed sensor	■	■	■	■	■	■	■	■	■	■	■	-	-	U
	DSA speed sensor mounted [2)]	■	■	■	■	■	■	■	■	■	■	■	-	-	V

14	Special version	Code
	Standard version……without code	-
	Special version for slew drives	J

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

□ Note

1）Specify ordering code of counterbalance valve according to data sheet eparately

2）Specify ordering code of sensor according to data sheet separately and observe the requirements on the electronics

■ = Optimization scheme (shorter delivery time)

■ = Available

□ = On request

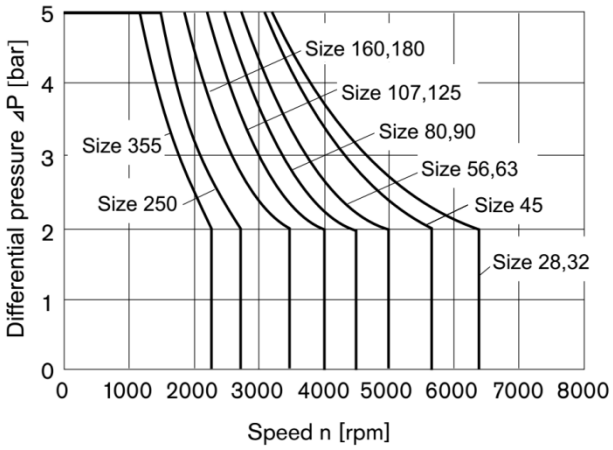
- = Not available

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 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 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.

Static characteristic

- Sizes 28 to 355



The values are valid for an ambient pressure P_{abs} = 1 bar

Temperature range

- The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C
- For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -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	Direction of flow
clockwise (R)	A → B
counter-clockwise (L)	B → A

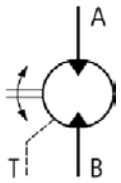
Speed range

- 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 for maximum speed.

Long-life bearing

- Sizes 250,355
- 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.

Ports

Ports	Port for	Diagram
A, B	Working port	
T	Drain port	

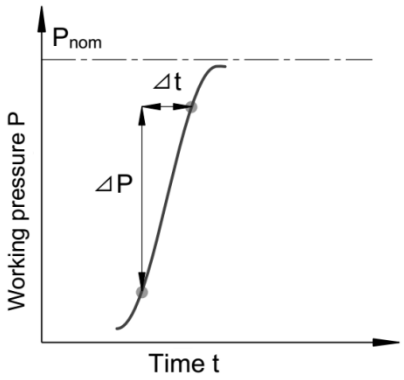
■ Working pressure range

□ Working pressure range valid when using hydraulic fluids based on mineral oils

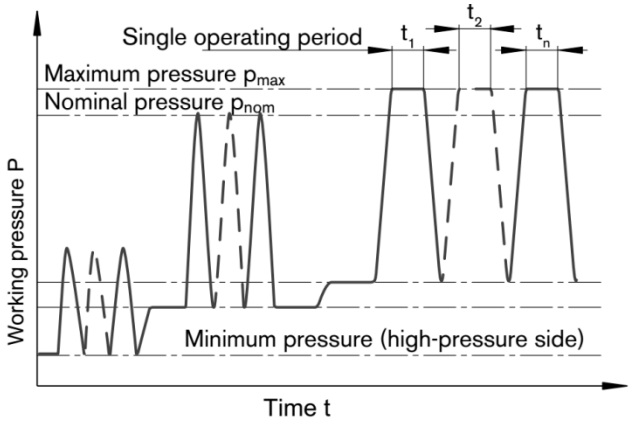
Pressure at service line port A or B			Definition
Nominal pressure P_{nom}	Size 28～180	400 bar (absolute)	The nominal pressure corresponds to the maximum design pressure
	Size 250～355	350 bar (absolute)	
Maximum pressure $P_{B\,max}$	Size 28～180	450 bar (absolute)	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
	Size 250～355	400 bar (absolute)	
	Single operating period	10 s	
	Total operating period	300 h	
	Summation pressure (P_A+ P_B) P_{Su}	700 bar	The summation pressure is the sum of the pressures at both service line ports (A and B).
Minimum pressure P_{min} high-pressure side		25 bar (absolute)	Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$			Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range
	With integrated pressure-relief valve	9000 bar/s	
	Without pressure-relief valve	16000 bar/s	

Note:Values for other hydraulic fluids, please contact us

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



■ Pressure defnition

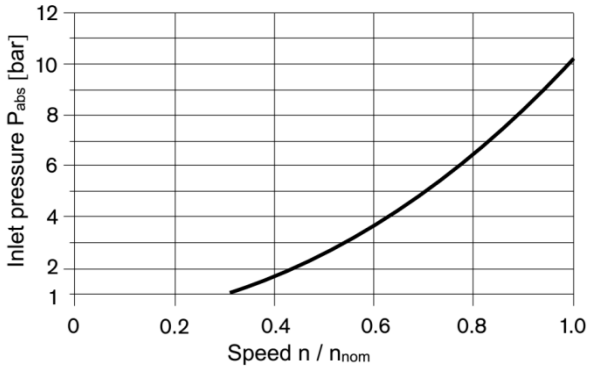


□ Total operating period = t_1 + t_2 + t_3 ……+ t_n

■ 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 V_{opt} = 36 to 16 mm^2/s.

□ Please contact us if these conditions cannot be satisfied.

■ Table of values

□ Theoretical values, without considering efficiencies and tolerances, values rounded off)

Technical Data	HD-A2FE			28	32	45	56	63	80	
Displacement		V_g	cm^3	28.1	32	45.6	56.1	63	80.4	
Speed [1]	maximum	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]	⊿P=350 bar	T	Nm	157	178	254	313	351	448	
at V_g and	⊿P=400 bar	T	Nm	179	204	290	357	401	512	
Case volume		V	l	0.20	0.20	0.33	0.45	0.45	0.55	
Weight	approx	m	Kg	10.5	10.5	15	18	19	23	

Technical Data	HD-A2FE			90	107	125	160	180	250	355
Displacement		V_g	cm^3	90	106.7	125	160.4	180	250	355
Speed [1]	maximum	n_{nom}	rpm	4500	4000	4000	3600	3600	2700	2240
		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	675	795
Torque [4]	⊿P=350 bar	T	Nm	501	594	696	893	1003	1393	1978
at V_g and	⊿P=400 bar	T	Nm	573	679	796	1021	1146	-	-
Case volume		V	l	0.55	0.8	0.8	1.1	1.1	2.5	3.5
Weight	approx	m	Kg	25	34	36	47	48	82	110

□ Note

1）The values are applicable

- within the optimum viscosity range from V_{opt} = 16 to 36 mm^2/s
- with hydraulic fluid based on mineral oils

2）Intermittent maximum speed:overspeed for unload and overhauling processes, t < 5 s and ⊿P < 150 bar

3）Restriction of input flow with counterbalance valve

4）Torque without radial force.

■ 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.

■ Technical Data

□ Permissible radial and axial loading on the drive shaft

Technical Data HD-A2FE			28	28	32	45	56	56 3)	56	63	80	80 3)	80
Drive shaft	Φ	mm	25	30	30	30	30	30	35	35	35	35	40
Max.radial force 1)	$F_{q\,max}$	KN	5.7	5.4	5.4	7.6	9.5	7.8	9.1	9.1	11.6	11.1	11.4
at distance a	a	mm	16	16	16	18	18	18	18	18	20	20	20
(from shaft collar)													
permissible torque	T_{max}	Nm	179	179	204	290	357	294	357	401	512	488	512
permissible pressure	ΔP_{perm}	bar	400	400	400	400	400	330	400	400	400	380	400
Maximum axial force 2)	$+F_{ax\,max}$	N	500	500	500	630	800	800	800	800	1000	1000	1000
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7	8.7	10.6	10.6	10.6

Technical Data HD-A2FE			90	107	107	125	160	160	180	200	250	355	500
Drive shaft	Φ	mm	40	40	45	45	45	50	50	50	50	60	70
Max.radial force 1)	$F_{q\,max}$	KN	11.4	13.6	14.1	14.1	18.1	18.3	18.3	20.3	1.2 4)	1.5 4)	1.9 4)
at distance a	a	mm	20	20	20	20	25	25	25	25	41	52.5	52.5
(from shaft collar)													
permissible torque	T_{max}	Nm	573	679	679	796	1021	1021	1146	1273	-	-	-
permissible pressure	ΔP_{perm}	bar	400	400	400	400	400	400	400	400	-	-	-
Maximum axial force 2)	$+F_{ax\,max}$	N	1000	1250	1250	1250	1600	1600	1600	1600	2000	2500	
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,max/bar}$	N/bar	10.6	12.9	12.9	12.9	16.7	16.7	16.7	16.7	-	-	-

□ Note

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 only for splined shaft

4）When at a standstill or when axial piston unit operating in nonpressurized conditions. Higher forces are permissible when under pressure, please contact us

Note:Influence of the direction of the permissible axial force

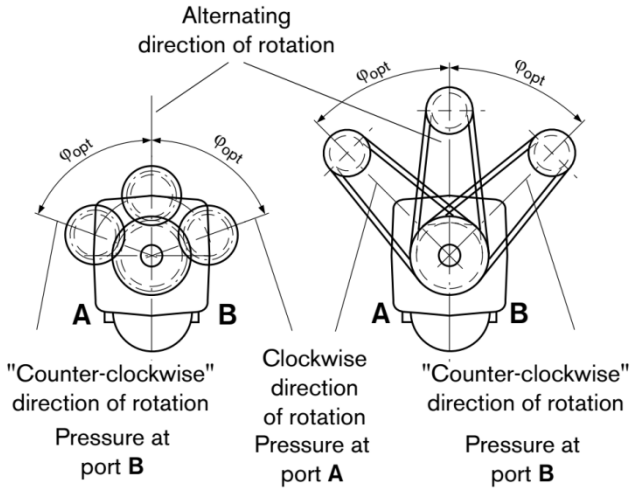
$+F_{ax\ max}$ = Increase in service life of bearings

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

■ Effect of radial force

- 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

	Toothed gear drive	V-belt output
Size	Ψ_{opt}	Ψ_{opt}
5～180	± 70°	± 45°
200～500	± 45°	± 70°



■ Determining the operating characteristics

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

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

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

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

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

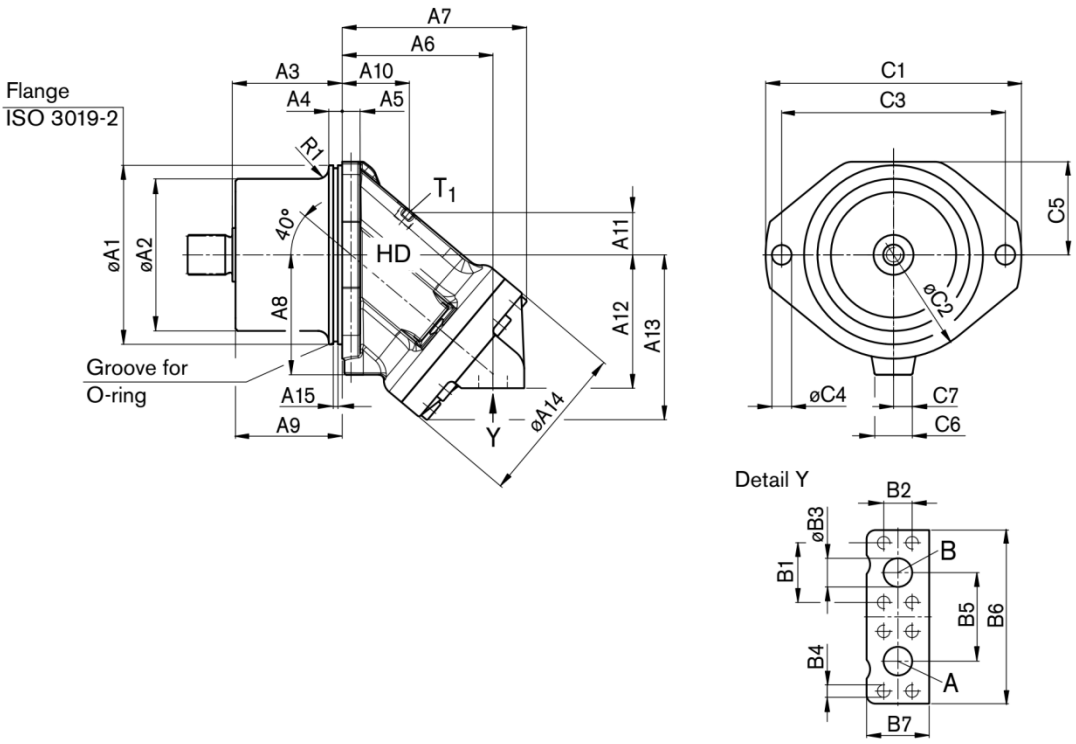
η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

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

■ Size 28～180...Dimensions in mm

□ Port plate 01...SAE flange ports at bottom



□ Ports

Size	ΦA1	ΦA2	A3 [1]	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	Φ14	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	$160_{-0.025}$	$117^{+1.5}_{-2}$	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

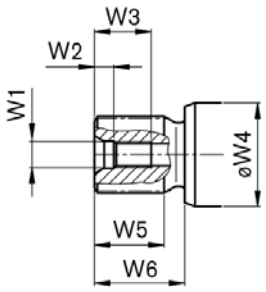
Size	B1	B2	ΦB3	B4...DIN 13 [2]	B5	B6	B7	C1	ΦC2	C3	ΦC4	C5	C6	C7
28, 32	40.5	18.2	13	M8 x 1.25 deep 15	59	115	40	188	154	160	14	71	42	13
45	50.8	23.8	19	M10 x 1.5 deep 17	75	147	49	235	190	200	18	82	47.5	15
56, 63	50.8	23.8	19	M10 x 1.5 deep 17	75	147	48	235	190	200	18	82	36	0
80, 90	57.2	27.8	25	M12 x 1.75 deep 17	84	166	60	260	220	224	22	98	40	0
107, 125	66.7	31.8	32	M14 x 2 deep 19	99	194	70	286	232	250	22	103	40	0
160, 180	66.7	31.8	32	M14 x 2 deep 19	99	194	70	286	232	250	22	104	42	0

Size	R1	O ring[3]	Working port A, B…SAE J518	Drain port T_1...DIN 3852 [2]
28, 32	10	126 x 4	1/2”	M16 x 1.5 deep 12
45	10	150 x 4	3/4”	M18 x 1.5 deep 12
56, 63	10	150 x 4	3/4”	M18 x 1.5 deep 12
80, 90	10	180 x 4	1”	M18 x 1.5 deep 12
107, 125	16	192 x 4	1-1/4”	M18 x 1.5 deep 12
160, 180	12	192 x 4	1-1/4”	M22 x 1.5 deep 14

□ Note:1) To shaft colla 2) For the maximum tightening torques the general instructions must be observed. 3) Not included in the delivery contents

■ Size 28～180...Dimensions in mm

□ Drive shaft

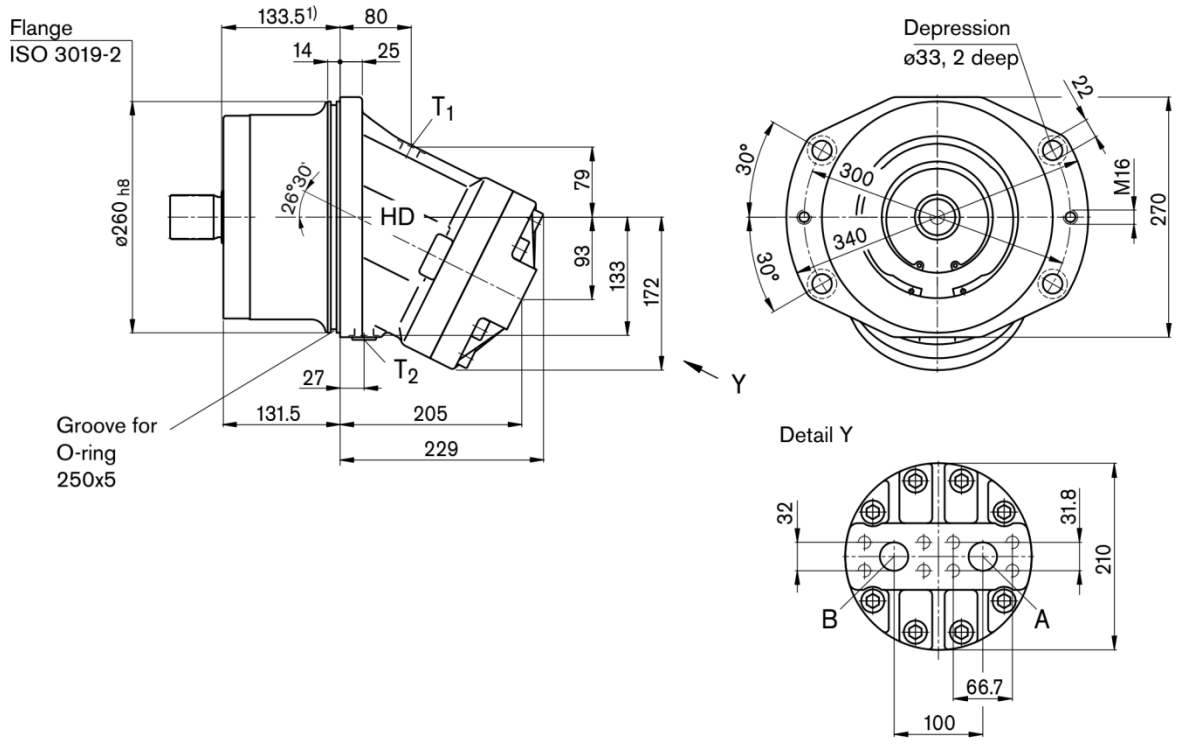


Size	Splined shaft…DIN 5480	W1 [1)]	W2	W3	ΦW4	W5	W6
28, 32	A W30 x 2 x 14 x 9g	M10 x 1.5	7.5	22	35	27	35
28	Z W25 x 1.25 x 18 x 9g	M8 x 1.25	6	19	35	28	43
45	Z W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	35	27	35
56, 63	A W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	40	32	40
56	Z W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	40	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

□ Note:1) Center bore according to DIN 332 (thread according to DIN 13),For the maximum tightening torques the general instructions must be observed.

■ Size 250...Dimensions in mm

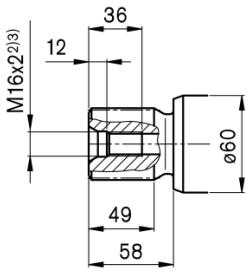
□ Port plate 01...SAE flange ports at rear



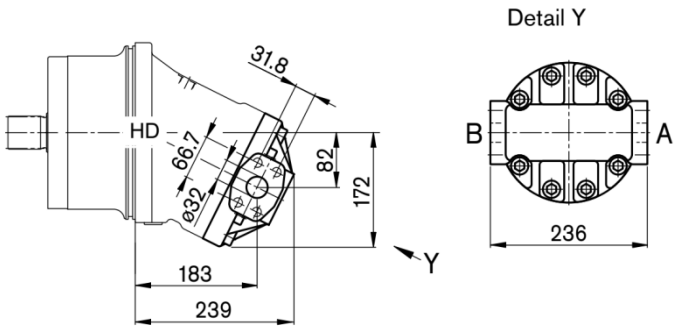
□ Drive shaft

■ Size 250

Z Splined shaft DIN 5480
W 50 x 2 x24 x 9g



□ Port plate 02...SAE flange ports at side



□ Ports

Ports	Port for	Standard	Size [3]	P_{Max} [bar] [4]	State [8]
A, B	Working port Fastening thread	SAE J518 [6] DIN 13	1-1/4” M14 x 2deep 19	450	
T_1	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	X [7]
T_2	Drain port	DIN 3852 [5]	M22 x 1.5 deep 14	3	O [7]

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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

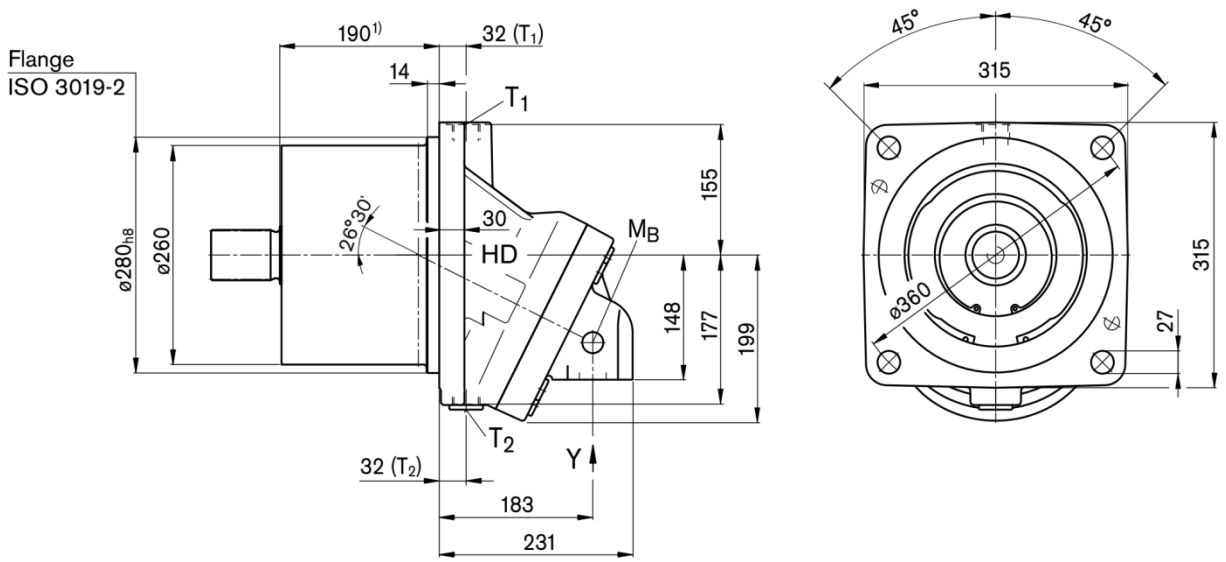
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

7) Depending on the installation position, T_1 or T_2 must be connected

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

■ Size 355...Dimensions in mm

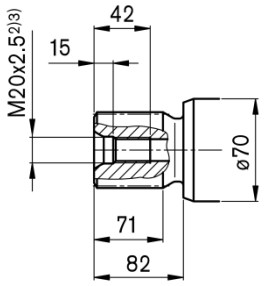
□ Port plate 10...SAE flange ports at bottom

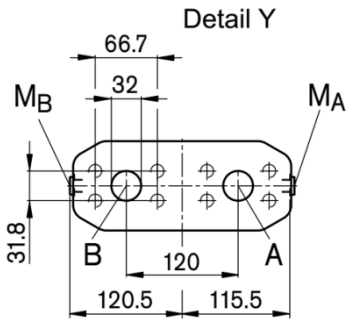


□ Drive shaft

■ Size 355

Z Splined shaft DIN 5480
W 60 x 2 x28 x 9g





□ Ports

Ports	Port for	Standard	Size [3)]	P_{Max} [bar] [4)]	State [8)]
A, B	Working port Fastening thread	SAE J518 [6)] DIN 13	1-1/4” M14 x 2 deep 22	400	
T_1	Drain port	DIN 3852 [5)]	M33 x 2 deep 18	3	X [7)]
T_2	Drain port	DIN 3852 [5)]	M33 x 2 deep 18	3	O [7)]
M_A, M_B	Measuring workting pressure	DIN 3852 [5)]	M14 x 1.5 deep 12	400	X

Note

1) To shaft colla

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

3) For the maximum tightening torques the general instructions must be observed.

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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

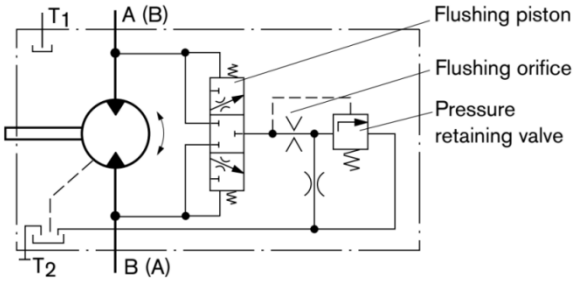
7) Depending on the installation position, T_1 or T_2 must be connected

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

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 and 250) and with port plate 107 (size 355), the valve is mounted directly on the fixed motor.
- Cracking pressure of pressure retaining valve(observe when setting the primary valve)
  Sizes 45 to 355, fixed setting…….....16 bar
- Switching pressure of flushing piston ⊿P
  Sizes 45 to 355….....8±1 bar

Schematic



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 mm^2/s
- P_{ND} = low pressure P_G = case pressure

Standard flushing flows

- Flushing and boost pressure valve, mounted

Size	flushing flows q_v l/min	Throttle Φ mm
45	3.5	1.2
107, 125	5	1.8
160, 180	8	2.0
250	10	2.0
355	10	2.5

- 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 ΔP_{ND} = 25 bar.

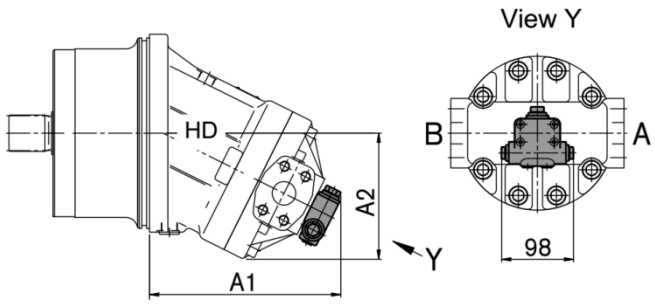
- Flushing and boost pressure valve, integrated

Size	flushing flows q_v l/min	Throttle Φ mm
56, 63	6	1.5
80, 90	7.3	1.8

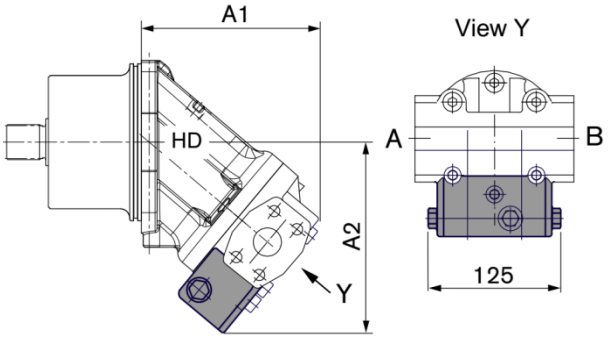
■ Flushing and boost pressure valve

□ Dimensions in mm

□ Port plate 027...SAE flange ports at side Size 107～250

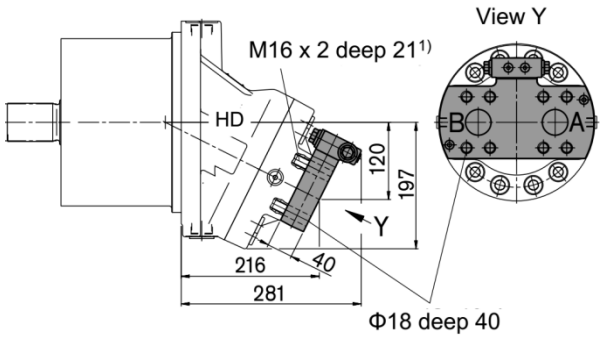


□ Port plate 029...SAE flange ports at side Size 56～90

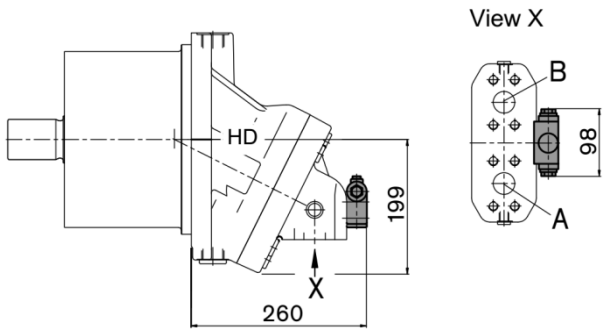


Size	A1	A2			Size	A1	A2		
107, 125	211	192			56, 63	165	176		
160, 180	232	201			80, 90	178	186.7		
250	260.5	172							

□ Port plate 017...SAE flange ports at rear Size 355



□ Port plate 107...SAE flange ports at bottom Size 355



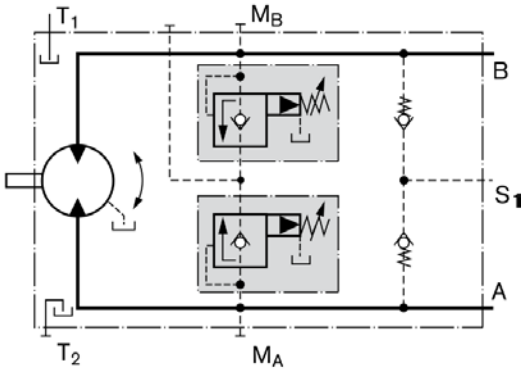
1) DIN 13, observe the general instructions for the maximum tightening torques

Pressure-relief valve

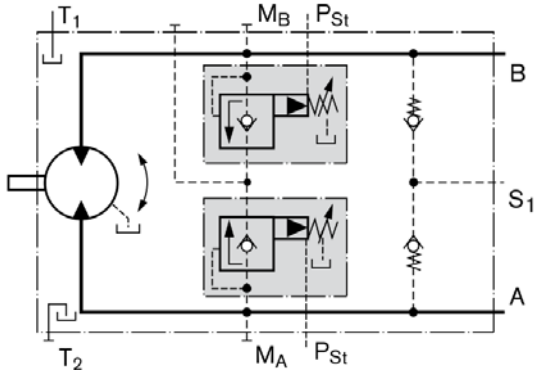
- The pressure-relief valves protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the highpressure side to the low-pressure side.
- The pressure-relief valves are only available in combination with port plates 181,191 or 192 (counterbalance valve for mounting to port plate 181)
- 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)

Schematic

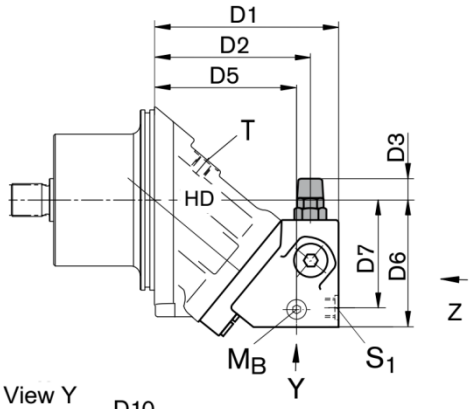
- Version without pressure boost facility [191]



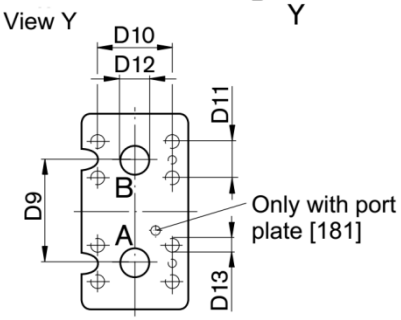
- Version with pressure boost facility [192]

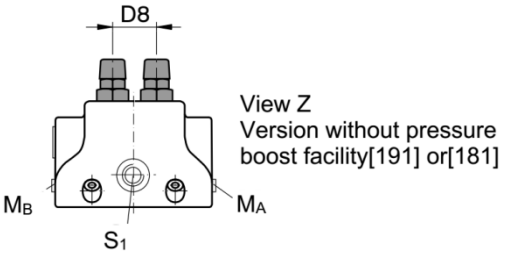


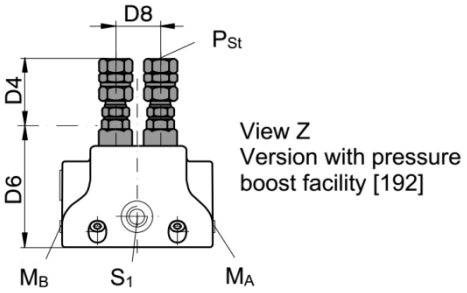
- Dimensions in mm



View Y







■ Pressure-relief valve

◘ Dimensions in mm

Size	Code	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[2)]
28, 32	MHDB16	209	186	25	68	174	102	87	36	66	50.8	23.8	Φ19	M10 deep 17
45	MHDB16	222	198	22	65	187	113	98	36	66	50.8	23.8	Φ19	M10 deep 17
56, 63	MHDB22	250	222	19	61	208	124	105	42	75	50.8	23.8	Φ19	M10 deep 13
80, 90	MHDB22	271	243	17.5	59	229	134	114	42	75	57.2	27.8	Φ25	M12 deep 18
107, 125	MHDB32	298	266	10	52	250	149.5	130	53	84	66.7	31.8	Φ32	M14 deep 19
160, 180	MHDB32	332	301	5	47	285	170	149	53	84	66.7	31.8	Φ32	M14 deep 19

Size	Port A,B	S_1[1)]	M_A, M_B[1)]	P_{St}[1)]	
28, 32	3/4”	M22 x 1.5 deep 14	M20 x 1.5 deep 14	G1/4”	Assembly instructions for port plate with pressure boost facility "192" The lock nut must be counterheld when installing the hydraulic line at the pst port
45	3/4”	M22 x 1.5 deep 14	M20 x 1.5 deep 14	G1/4”	
56, 63	3/4”	M26 x 1.5 deep 16	M26 x 1.5 deep 16	G1/4”	
80, 90	1”	M26 x 1.5 deep 16	M26 x 1.5 deep 16	G1/4”	
107, 125	1-1/4”	M26 x 1.5 deep 16	M26 x 1.5 deep 16	G1/4”	
160, 180	1-1/4”	M26 x 1.5 deep 16	M30 x 1.5 deep 16	G1/4”	

- Assembly instruction for port plate with pressure boost facility "192":The lock nut must be counterheld when installing the hydraulic line at the pst port!

◘ Ports

Ports	Port for	Standard	Size [1)]	P_{Max} [bar] [2)]	State [3)]
A, B	Working port	SAE J518	See above	450	O
S_1	Supply port (only with port plate 191/192)	DIN 3852	See above	5	O
M_A, M_B	Measuring operating pressure port	DIN 3852	See above	450	X
P_{St}	Pilot pressure port (only with port plate 192)	DIN/ISO 228	See above	30	O

Note

1) For the maximum tightening torques the general instructions must be observed.

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) X = plugged (in normal operation)

Counterbalance valve BVD and BVE

- 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
- 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

  HD-A2FE90/61W - VAB188 + BVD20F27S/41B - V03K16D0400S12

Note

- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve and BVE counterbalance valve.
- 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 mm^2/s)

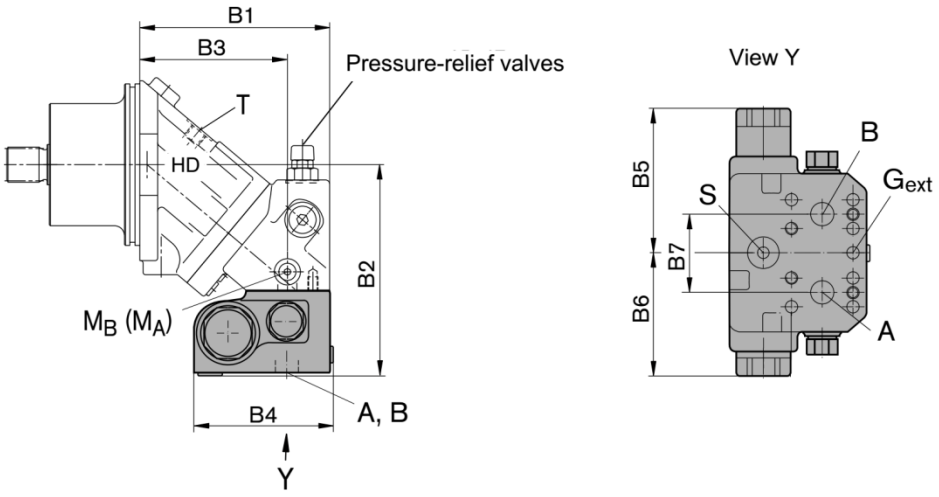
Technical Data

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

Motor	Without valve		Restricted values in operation with DBV				Restricted values in operation with BVD/BVE			
HD-A2FE Size	P_{nom}/P_{max} bar	$q_{v\ max}$ l/min	DBV size	P_{nom}/P_{max} bar	q_v l/min	Plate Code	BVD/BVE size	P_{nom}/P_{max} bar	q_v l/min	Plate Code
28	400/450	176	16	350/420	100	181	20	350/420	100	188
32		201				191, 192	BVD			
45		255								
56		280	22		240				220	
63		315								
80		360								
90		405								
107		427				171				178
125		500				191, 192				
107		427	32		400	181	25		320	188
125		500				191, 192	BVD/BVE			
160		577								
180		648								

■ Counterbalance valve BVD and BVE

□ Dimensions in mm



□ 尺寸数据（mm）

A2FM	Counterbalance valve		Dimensions in mm							
Size	Type	Port A, B	B1	B2	B3	B4(S)	B4(L)	B5	B6	B7
28, 32	BVD20…16	3/4”	209	175	174	142	147	139	98	66
45	BVD20…16	3/4”	222	196	187	142	147	139	98	66
56, 63	BVD20…17	3/4”	250	197	208	142	147	139	98	75
80, 90	BVD20…27	1”	271	207	229	142	147	139	98	75
107, 125	BVD20…28	1”	298	238	251	142	147	139	98	84
107, 125	BVD25…38	1-1/4”	298	239	251	158	163	175	120.5	84
160, 180	BVD25…38	1-1/4”	332	260	285	158	163	175	120.5	84
107, 125	BVE25…38	1-1/4”	298	240	251	167	172	214	137	84
160, 180	BVE25…38	1-1/4”	332	260	285	167	172	214	137	84
250	On request									

□ Ports

Ports	Port for	Version	Standard	Size [1]	P_{Max} [bar] [2]	State [4]
A, B	Working port		SAE J518	See above	420	O
S	Infeed	BVD20	DIN 3852 [3]	M22 x 1.5 deep 14	30	X
		BVD25, BVE25	DIN 3852 [3]	M27 x 2 deep 16	30	X
Br	Brake release,reduce high pressure	L	DIN 3852 [3]	M12 x 1.5 deep 12.5	30	O
G_{ext}	Brake release,high pressure	S	DIN 3852 [3]	M12 x 1.5 deep 12.5	420	X
M_A, M_B	Measuring pressure A, B		ISO 6149 [3]	M12 x 1.5 deep 12	420	X

Note

1) For the maximum tightening torques the general instructions must be observed.

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)

■ Counterbalance valve BVD and BVE

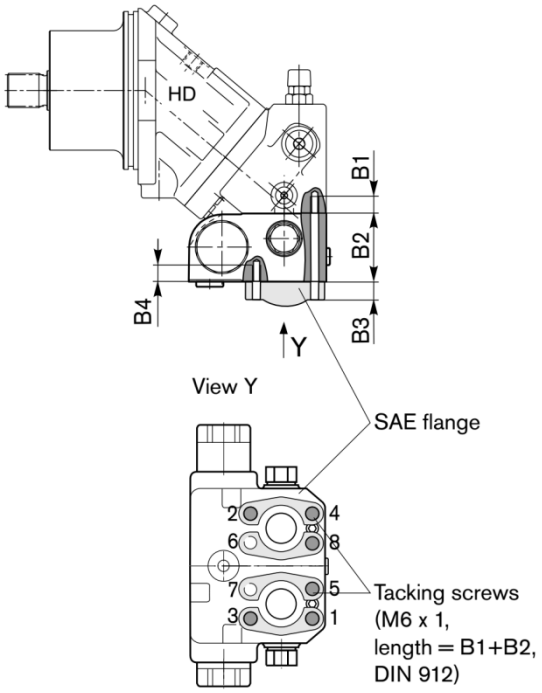
- When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to 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
M6 x 1 tacking screw	10.9	15.5 Nm
M10 x 1.5	10.9	75 Nm
M12 x 1.75	10.9	130 Nm
M14 x 2	10.9	205 Nm

A2FM Size	28,32 45	56,63	80,90	107,125 160,180	107,125
Port plate	18				17
B1 [1]	M10x1.5 deep 17	M10x1.5 deep 17	M12x1.75 deep 18	M14x2 deep 19	M12x1.75 deep 17
B2	78 [2]	68	68	85	68
B3	-	-	-	-	-
B4	M10x1.5 deep 15	M10x1.5 deep 15	M12x1.75 deep 16	M14x2 deep 19	M12x1.75 deep 17

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

■ Installation drawing



Speed sensors

- The versions A2FE...U and A2FE...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 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.

Installation

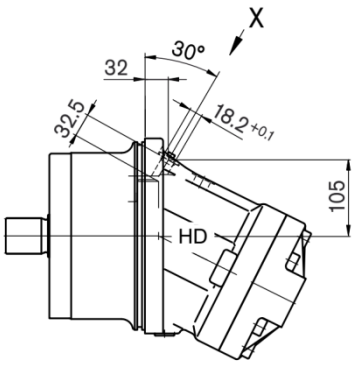
- The sensor is mounted on the port provided for this purpose with a mounting bolt.
- We recommend ordering the A2FE plug-in motor complete with sensor mounted.

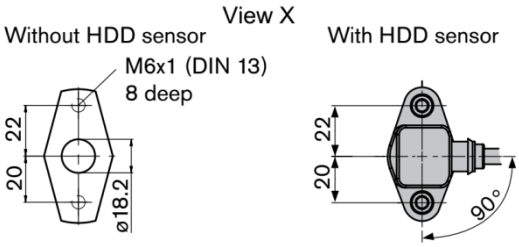
Technical Data

Size		28,32	45	56,63	80,90	107,125	160,180
Number of teeth		38	45	47	53	59	67
DSA	A depth$_{\pm 0.1}$	32	32	32	32	32	32
	B surface	66	-				
	C	-					
	D	12.3	-				

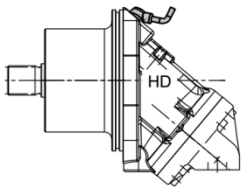
Installation drawing

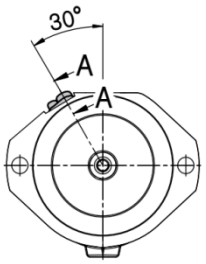
- Version "H"…Sizes 250 with HDD sensor



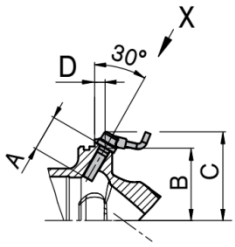


- Version "V" …Sizes 28 to 180 with DSA sensor





Section A-A rotated



■ 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 suction and drain lines must flow into the reservoir below the minimum fluid level.

■ Installation position

- See the following examples 1 to 5
- Additional installation positions are available upon request.
- Recommended installation positions1 and 2

- Note

Ins.Position	1	2	3	4	5	6
Air bleed	-	-	-	L_1	L_1	L_1
Filling	T_1	T_1,T_2	T_1	T_1(L_1)	T_1(L_1)	T_2(L_1)

L_1	Case drain port
T_1,T_2	Drain port
$h_{t\,min}$	Minimum necessary immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

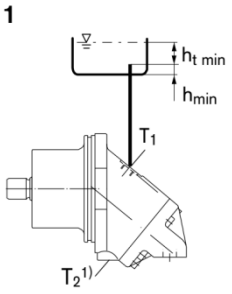
- Mark

1) Standard for sizes 250 and 355, special version for sizes 28 to 180
2) Piping suggestion without port T2 (standard for sizes 28 to 180).
3) Piping suggestion with port T2 (standard for sizes 250 to 355, special version for sizes 28 to 180).
4) Installation position only permissible if port T2 is fitted (standard for sizes 250 and 355, special version for sizes 28 to 180)

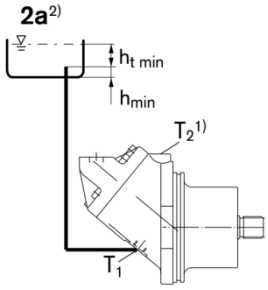
■ Below-reservoir installation (standard)

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

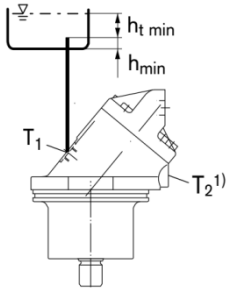
1



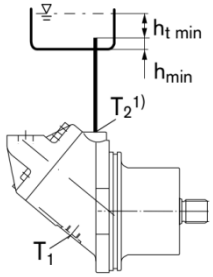
2a 2)



3



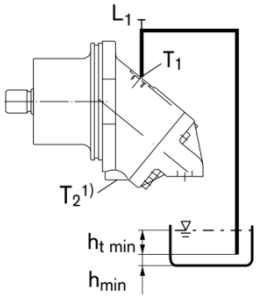
2b 3)



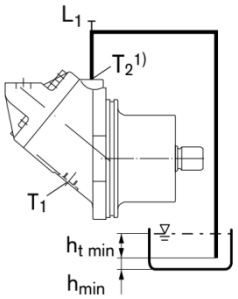
■ Above-reservoir installation

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

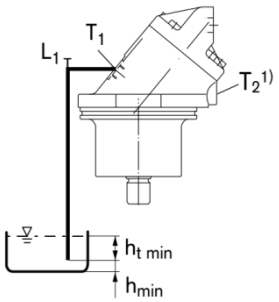
4



5 4)



6



■ Hydraulic fluid

- Before starting project planning, please refer to our data sheets mineral oil and environmentally acceptable hydraulic fluids for detailed information regarding the choice of hydraulic fluid and application conditions.
- When using environmentally acceptable hydraulic fluids, the limitations regarding technical data and seals must be observed. Please contact us. When ordering, indicate the hydraulic fluid that is to be used.

■ Notes on the choice of hydraulic fluid

- In order to select the correct hydraulic fluid, it is necessary to know the operating temperature in the reservoir (open circuit) in relation to the ambient temperature.
- The hydraulic fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (nopt), see shaded section of the selection diagram. We recommend to select the higher viscosity grade in each case.
- Example: at an ambient temperature of X ˚C the operating temperature is 60˚C. In the optimum operating viscosity range (V_{opt}; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

■ Important

- The case drain temperature is influenced by pressure and input speed and is always higher than the reservoir temperature. However, at no point in the component may the temperature exceed 90˚C. The temperature difference specified on the left is to be taken into account when determining the viscosity in the bearing.
- If the above conditions cannot be met, due to extreme operating parameters please contact us.

■ Filtration of the hydraulic fluid

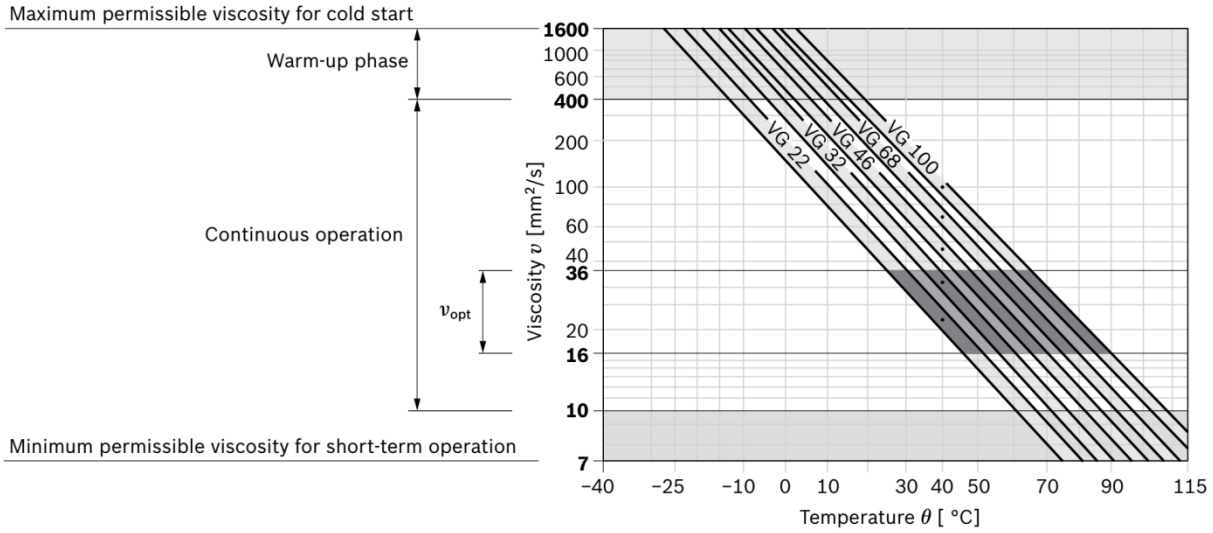
- The finer the filtration the better the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.
- In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained.
- At very high hydraulic fluid temperatures (90˚C to maximum 115˚C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.
- If the above cleanliness levels cannot be maintained, contact us.

■ Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature [3]	Comment
Cold start	V_{max} ≤1600 mm²/s	NBR [2] FKM	θ_{St} ≥ -40˚C θ_{St} ≥ -25˚C	t ≤3 min, without load (P ≤ 50 bar) n≤1000 rpm Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
Warm-up phase	V = 1600～400 mm²/s			t ≤15 min,P ≤0.7＊P_{nom} and n ≤ 0.5＊n_{nom}
Continuous operation	V = 400～10 mm²/s[1]	NBR [2] FKM	θ= +85˚C T = +110˚C	measured at port L, L_1
	V = 36～16 mm²/s			Range of optimum operating viscosity and efciency
Short-term operation	V = 10～7 mm²/s	NBR [2] FKM	θ = +85˚C θ = +110˚C	t ≤3 min,P ≤0.3＊P_{nom} measured at port L, L_1

1）Corresponds e.g. for VG 46 to a temperature range of +4 °C to +85 °C (see selection diagram) 2）Version EA10VSO...-P (if operating with HFA, HFB and HFC hydraulic fluids)
3）If the temperature at extreme operating parameters cannot be adhered to, please contact us

■ Selection diagram



General instructions

- The pump HD-A2FO is designed to be used in open circuits. The motor HD-A2FM/E 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.
- During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e.g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

Service line ports

- The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.

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 following table.
- 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 following table.

Ports tightening torques

Ports		Maximum permissible tightening torque of the female threads M_{Gmax}	Required tightening torque of the threaded plugs M_V [1)]	hexagon socket in the threaded plugs WAF
Standard	Size of thread			
DIN 3852	M8 x 1	10 Nm	7 Nm	3 mm
	M10 x 1	30 Nm	12 Nm	5 mm
	M12 x 1.5	50 Nm	25 Nm [2)]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm
DIN ISO 228	G1/4"	40 Nm	-	-

Note

1) The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.

2) In the "lightly oiled" state, the MV is reduced to 10 Nm for M10 x 1 and 17 Nm for M12 x 1.5.