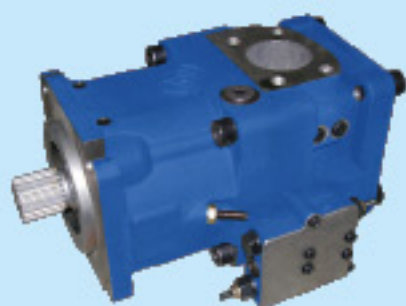


AWD+



华德液压

HD-A2F 6系列

斜轴式轴向柱塞 定量泵马达

北京华德液压工业集团有限责任公司
BEIJING HUADE HYDRAULIC INDUSTRIAL GROUP CO.,LTD.

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

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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 (T₁, T₂).
- 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 positions 1 and 2

Note

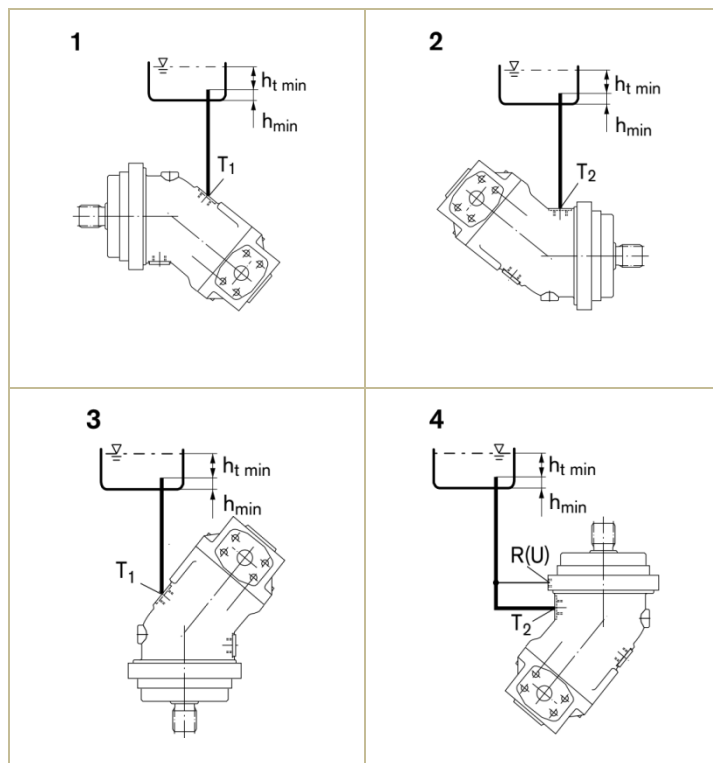
- With sizes 10 to 200 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering-special version). With sizes 250 to 1000, port U is provided as standard in the area near the bearings for air bleeding.

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)

- L₁ Case drain port
- R Air bleeding port
- U Bearing flushing / air bleed port
- T₁, T₂ Drain port
- h_{t min} Minimum necessary immersion depth (200 mm)
- h_{min} Minimum required spacing to reservoir bottom (100 mm)

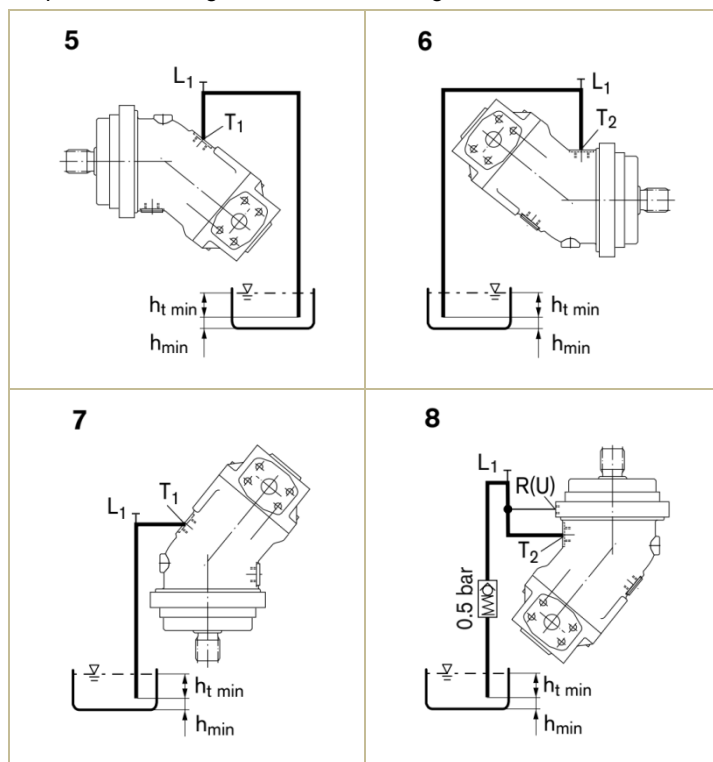
Below-reservoir installation (standard)

- 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 oilwithout 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
	$\cong V_{gmax} (cm^3/r)$			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			■	■	-	■	■	■	■	■	■	■	■	-	-	A
	shaft			■	-	■	■	-	■	-	■	-	■	-	■	■	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 A and B at rear	01	0	-	-	-	-	-	-	-	-	-	-	-	■	□	010
		7	-	-	-	-	-	-	-	-	-	-	-	-	□	017
SAE flange ports A and B at side, opposite	02	0	-	-	-	-	-	-	-	-	-	-	-	■	□	020
		7	-	-	■	□	□	□	■	■	■	■	■	-	-	027
		9	-	-	-	■	■	■	■	-	-	-	-	-	-	029
SAE flange ports A and B at bottom (same side)	10	0	■	■	■	■	■	■	■	■	■	■	-	■	100	
		7	-	-	-	-	-	-	-	-	-	-	-	■	107	
Port plate with ¹⁾ 1-level pressure relief valves for mounting a counterbalance valve	BVD 17	1	-	-	-	-	-	-	■	■	-	-	-	-	171	
		8	-	-	-	-	-	-	■	■	-	-	-	-	178	
	18	1	■	■	■	■	■	■	■	■	■	■	-	-	181	
	BVE 18	8	-	-	-	-	-	-	■	■	■	■	-	-	188	
Port plate with pressure relief valves	19	1	■	■	■	■	■	■	■	■	■	■	-	-	191	
		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

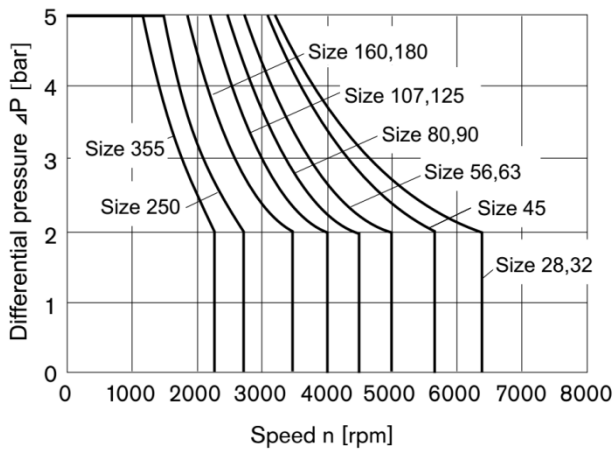
- 1) Specify ordering code of counterbalance valve according to data sheet eparately
- 2) Specify ordering code of sensor according to data sheet separately and observe the requirements on the electronics

- = 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 T	Working port Drain port	

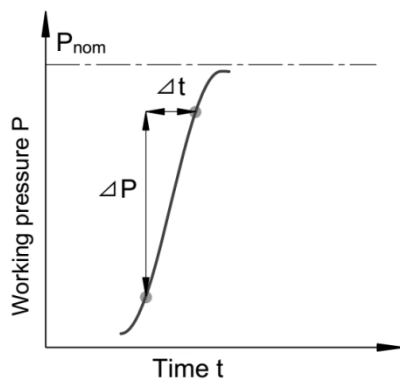
■ Working pressure range

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

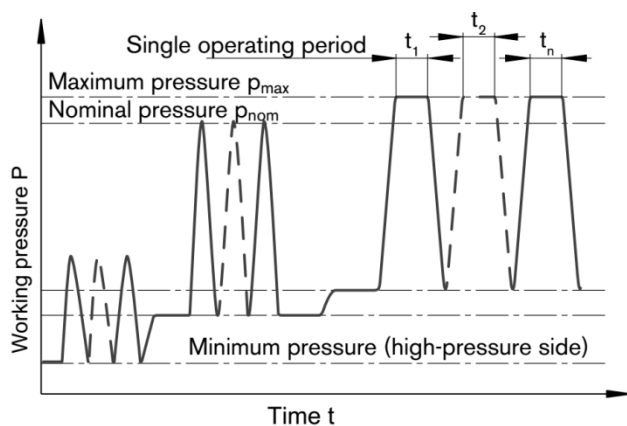
Pressure at service line port A or B		Definition
Nominal pressure P_{nom}	Size 28~180	400 bar (absolute)
	Size 250~355	350 bar (absolute)
Maximum pressure $P_{B max}$	Size 28~180	450 bar (absolute)
	Size 250~355	400 bar (absolute)
Single operating period		10 s
Total operating period		300 h
Summation pressure $(P_A + P_B) P_{Su}$		700 bar
Minimum pressure P_{min} high-pressure side		25 bar (absolute)
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		
Without pressure-relief valve		16000 bar/s

➤ Note: Values for other hydraulic fluids, please contact us

■ Rate of pressure change $R_{A max}$



■ Pressure definition

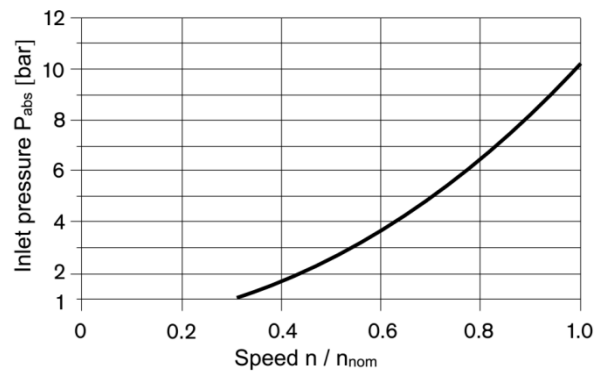


□ Total operating period = $t_1 + t_2 + t_3 \dots + t_n$

■ 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 $16 \text{ mm}^2/\text{s}$.

□ 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⁾	$\Delta P=350$ bar	T	Nm	157	178	254	313	351	448
	at V_g and $\Delta P=400$ 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


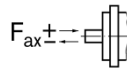
Technical Data	HD-A2FE			90	107	125	160	180	250	355
Displacement		V_g	cm ³	90	106.7	125	160.4	180	250	355
Speed ¹⁾	maximum	n_{nom}	rpm	4500	4000	4000	3600	3600	2700	2240
		n_{max} ²⁾	rpm	5000	4400	4400	4000	4000	-	-
Input flow ³⁾	at n_{nom} and V_g	q_v	l/min	405	427	500	577	648	675	795
Torque ⁴⁾	$\Delta P=350$ bar	T	Nm	501	594	696	893	1003	1393	1978
	at V_g and $\Delta P=400$ 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


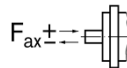
- Note
- 1) The values are applicable
 - ⚡ within the optimum viscosity range from $V_{opt} = 16$ to $36 \text{ mm}^2/\text{s}$
 - ⚡ with hydraulic fluid based on mineral oils
 - 2) Intermittent maximum speed: overspeed for unload and overhauling processes, $t < 5 \text{ s}$ and $\Delta P < 150 \text{ bar}$
 - 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⁾ at distance a (from shaft collar)		$F_{q \max}$	KN	5.7	5.4	5.4	7.6	9.5	7.8	9.1	9.1	11.6	11.1	11.4
		a	mm	16	16	16	18	18	18	18	18	20	20	20
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⁾		$+F_{\text{ax max}}$	N	500	500	500	630	800	800	800	800	1000	1000	1000
		$-F_{\text{ax max}}$	N	0	0	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{\text{ax max/bar}}$	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⁾ at distance a (from shaft collar)		$F_{q \max}$	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⁾
		a	mm	20	20	20	20	25	25	25	25	41	52.5	52.5
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⁾		$+F_{\text{ax max}}$	N	1000	1250	1250	1250	1600	1600	1600	1600	2000	2500	
		$-F_{\text{ax max}}$	N	0	0	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{\text{ax max/bar}}$	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

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

■ Effect of radial force

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

	Toothed gear drive	V-belt output
Size	Ψ_{opt}	Ψ_{opt}
5~180	$\pm 70^\circ$	$\pm 45^\circ$
200~500	$\pm 45^\circ$	$\pm 70^\circ$

■ Determining the operating characteristics

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

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

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

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

V_g = Displacement per revolution in cm³

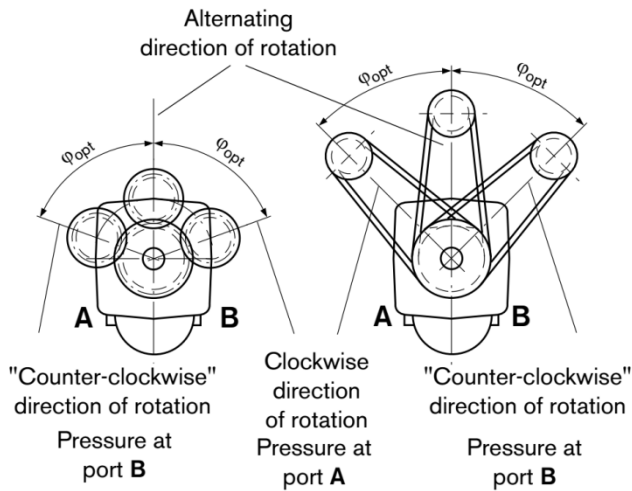
Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

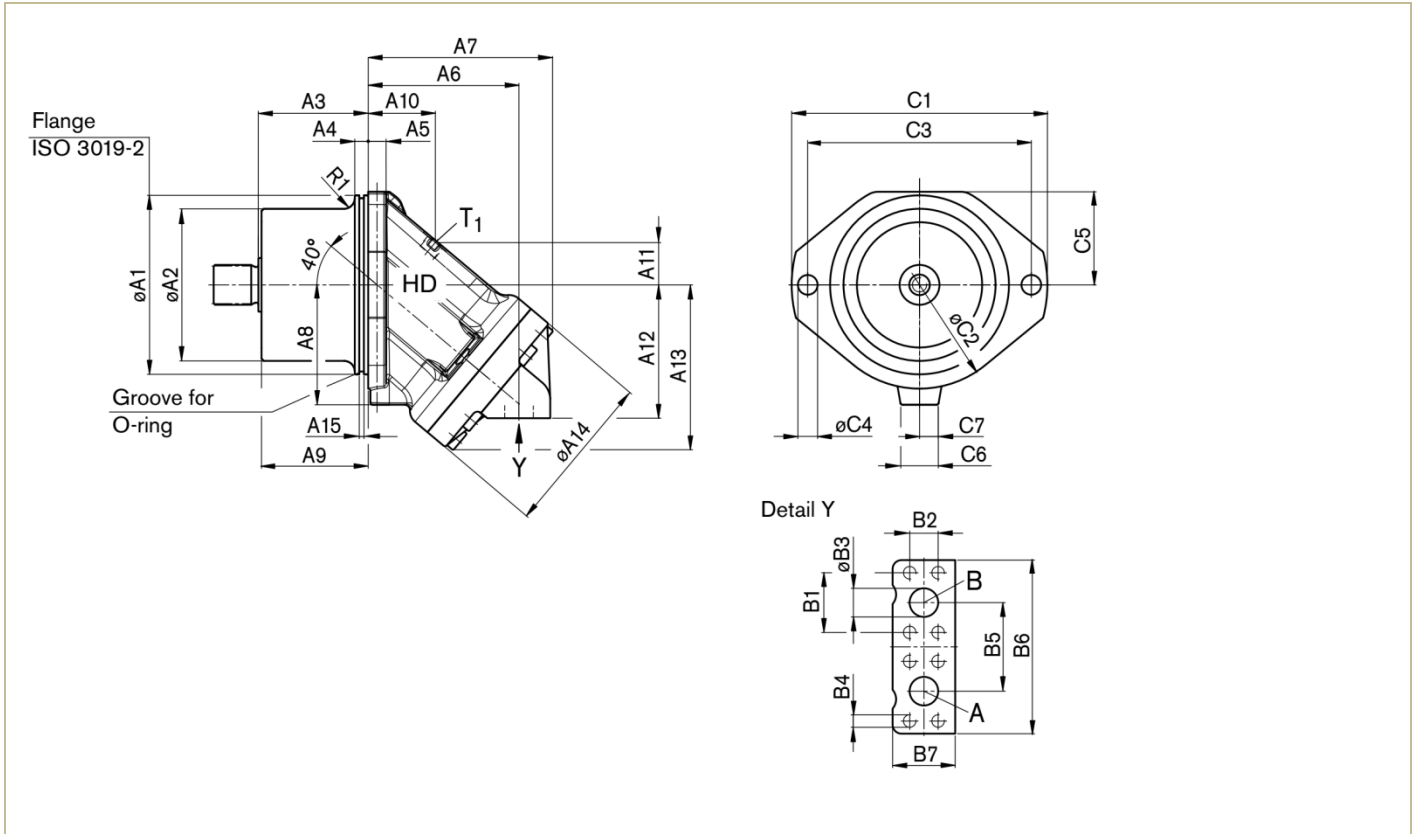
η_{mh} = Mechanical-hydraulic efficiency

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



■ 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

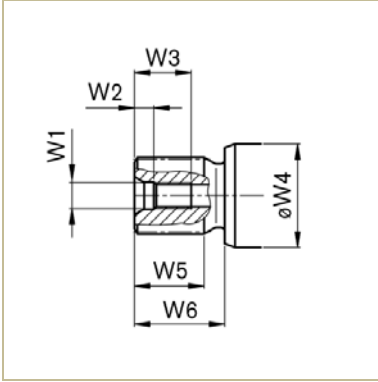
Size	B1	B2	ΦB3	B4...DIN 13 ²⁾	B5	B6	B7	C1	ΦC2	C3	ΦC4	C5	C6	C7
28, 32	40.5	18.2	13	M8 x 1.25 deep 15	59	115	40	188	154	160	14	71	42	13
45	50.8	23.8	19	M10 x 1.5 deep 17	75	147	49	235	190	200	18	82	47.5	15
56, 63	50.8	23.8	19	M10 x 1.5 deep 17	75	147	48	235	190	200	18	82	36	0
80, 90	57.2	27.8	25	M12 x 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 collar 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

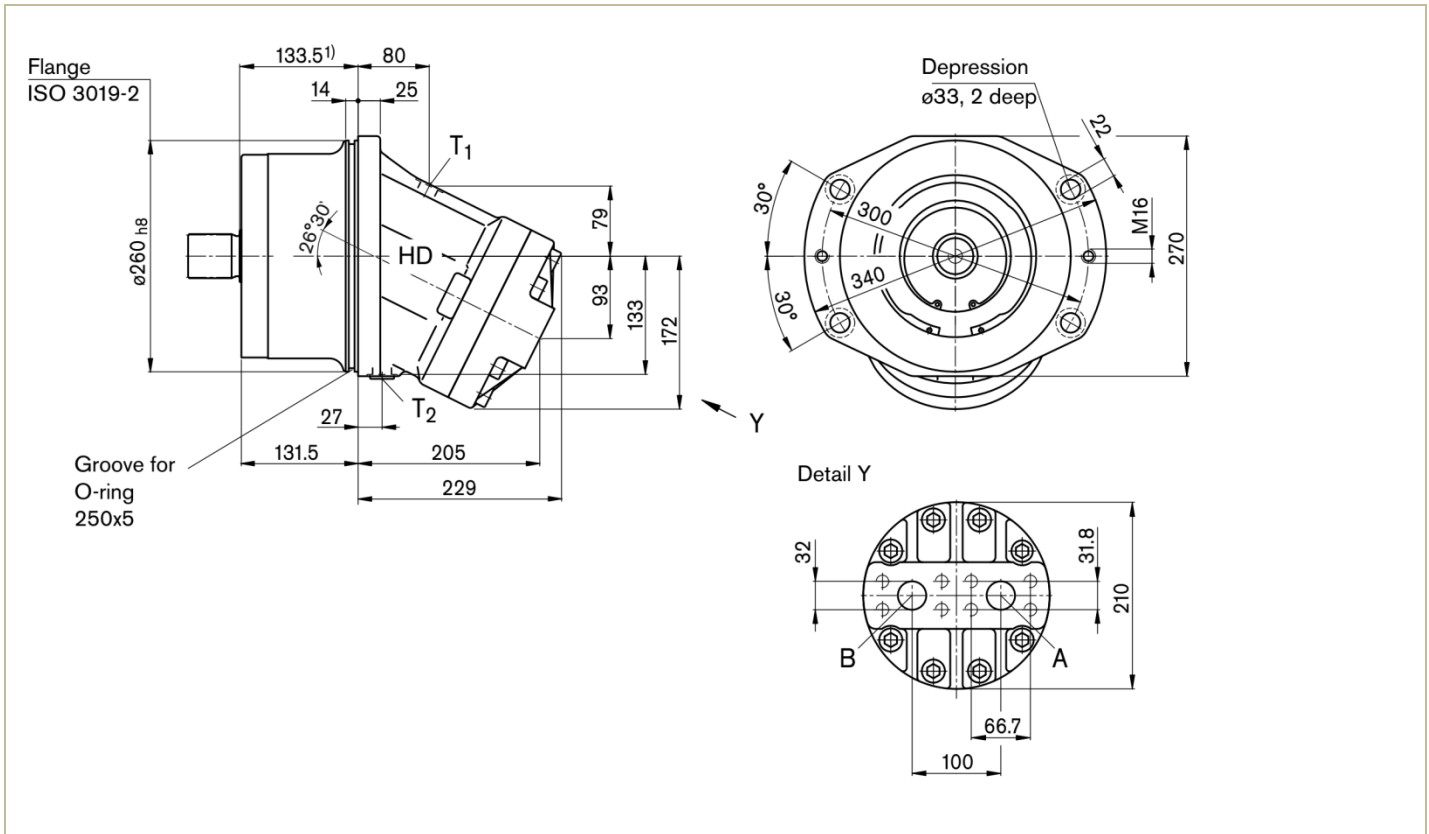


Size	Splined shaft...DIN 5480	W1 ¹⁾	W2	W3	$\phi W4$	W5	W6
28, 32	A W30 x 2 x 14 x 9g	M10 x 1.5	7.5	22	35	27	35
28	Z W25 x 1.25 x 18 x 9g	M8 x 1.25	6	19	35	28	43
45	Z W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	35	27	35
56, 63	A W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	40	32	40
56	Z W30 x 2 x 14 x 9g	M12 x 1.75	9.5	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

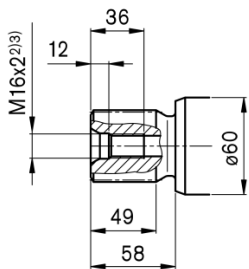


□ Drive shaft

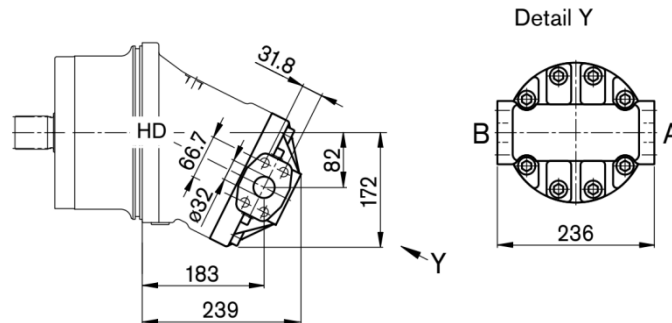
■ Size 250

Z Splined shaft DIN 5480

W 50 x 2 x 24 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 2 deep 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⁾

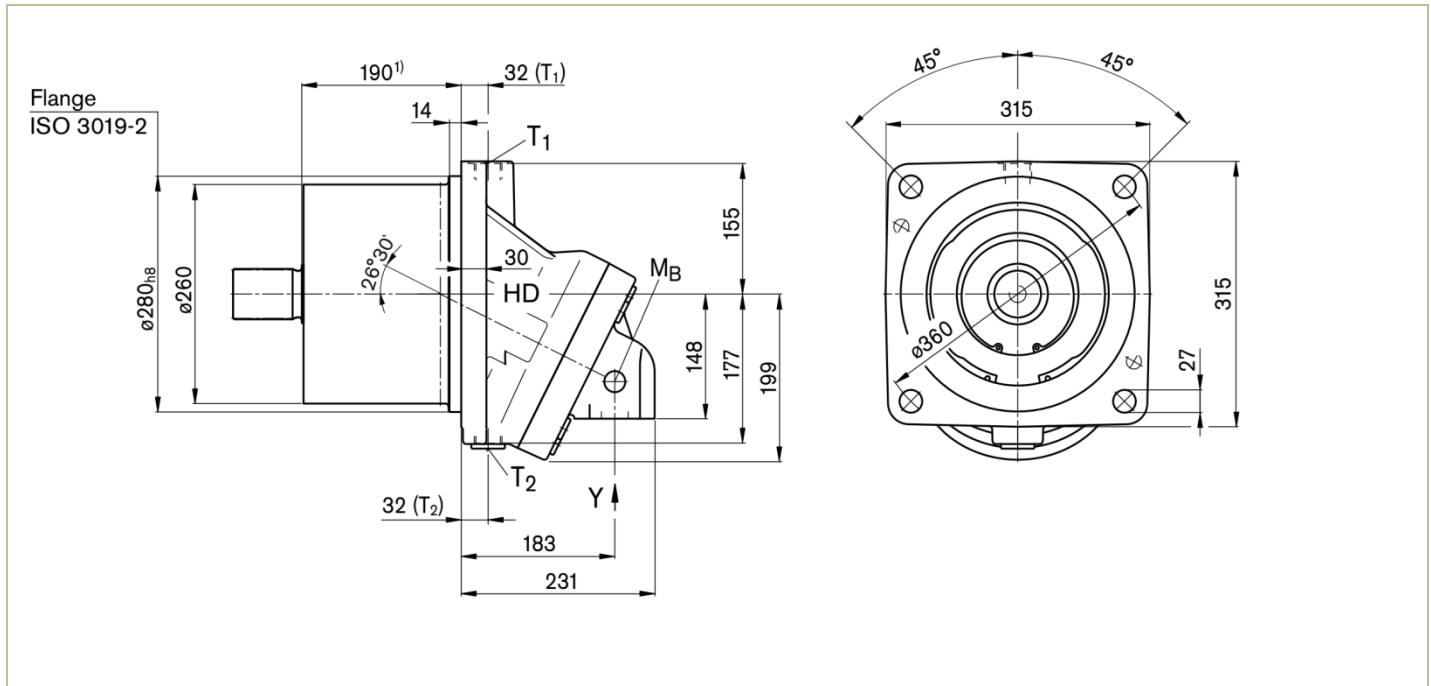
Note

- 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, T₁ or T₂ must be connected
- 8) O = Must be connected (plugged on delivery) X = plugged (in normal operation)

■ Size 355...Dimensions in mm

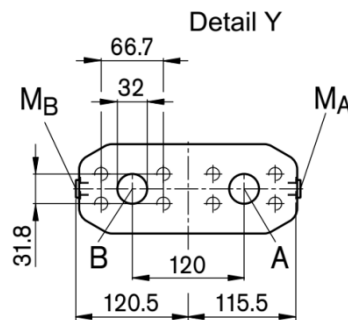
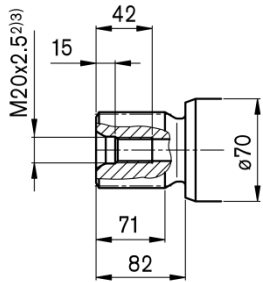
□ Port plate 10...SAE flange ports at bottom



□ Drive shaft

■ Size 355

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



□ Ports

Ports	Port for	Standard	Size ³⁾	P _{Max} [bar] ⁴⁾	State ⁸⁾
A, B	Working port Fastening thread	SAE J518 ⁵⁾ 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 working pressure	DIN 3852 ⁵⁾	M14 x 1.5 deep 12	400	X

Note

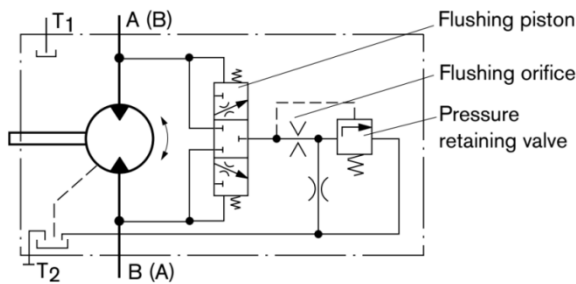
- 1) To shaft colla
- 2) Center bore according to DIN 332 (thread according to DIN 13)
- 3) For the maximum tightening torques the general instructions must be observed.
- 4) Momentary pressure spikes may occur depending on the application.
Keep this in mind when selecting measuring devices and fittings.

- 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, T₁ or T₂ 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 ΔP
 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 $V = 10$ mm²/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 $\Delta P_{ND} = 25$ 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

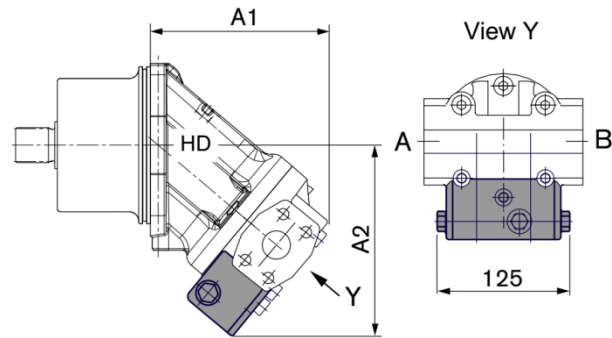
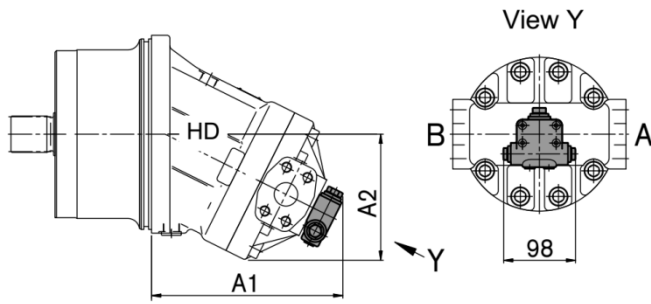
□ Dimensions in mm

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

Size 107~250

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

Size 56~90



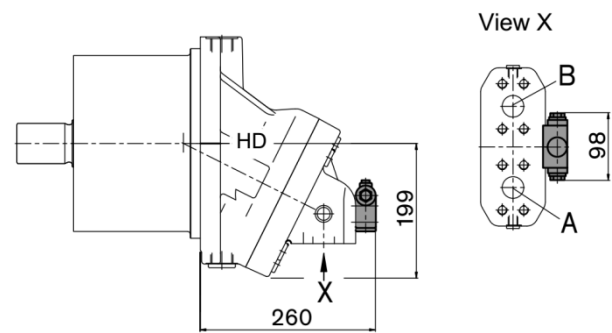
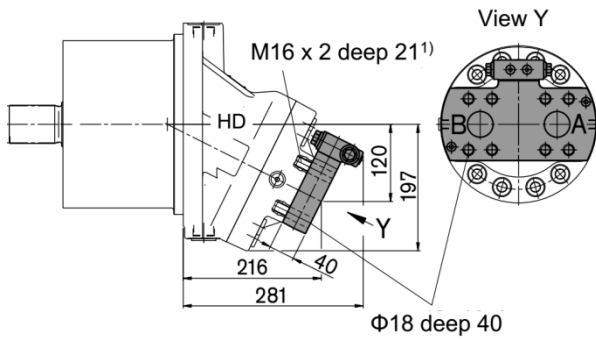
Size	A1	A2			Size	A1	A2		
107, 125	211	192			56, 63	165	176		
160, 180	232	201			80, 90	178	186.7		
250	260.5	172							

□ 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

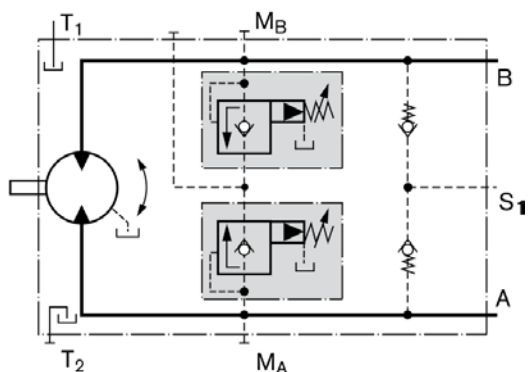
Pressure-relief valve

- 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 high-pressure side to the low-pressure side.
- The pressure-relief valves are only available in combination with port plates 181, 191 or 192 (counterbalance valve for mounting to port plate 181)
- 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}

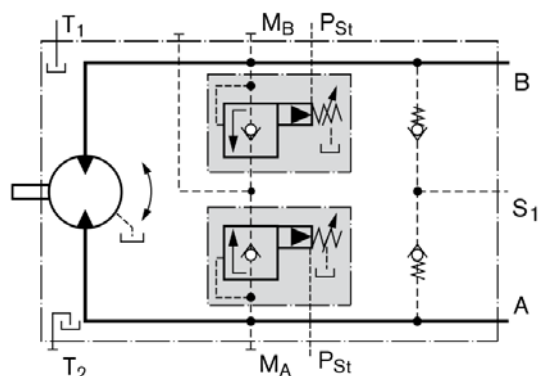
- When ordering, please state in plain text
- ✚ Cracking pressure of pressure-relief valve
- ✚ Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Schematic

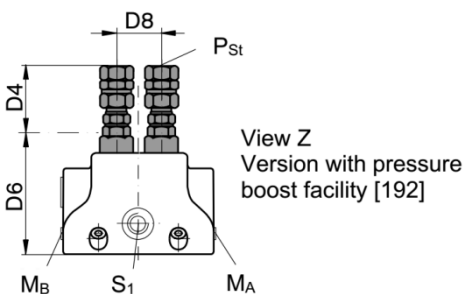
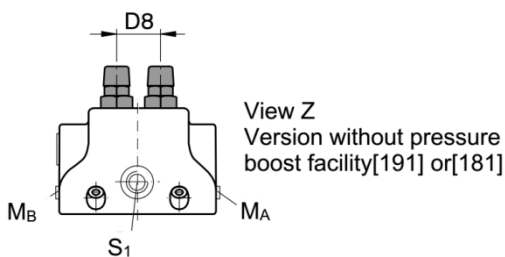
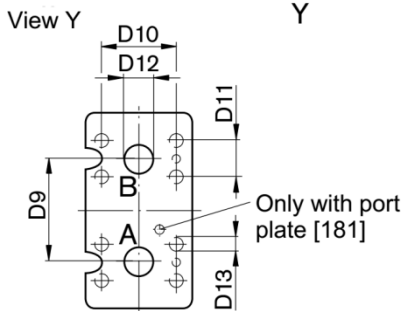
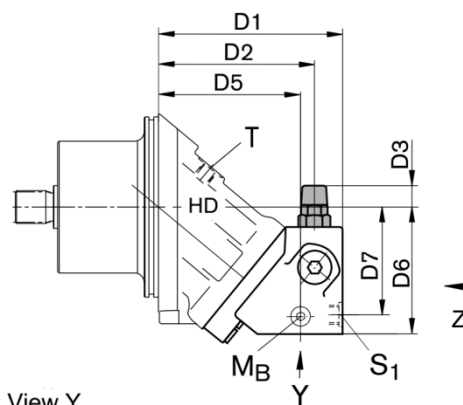
- Version without pressure boost facility [191]



- 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"	

➤ 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.
 3) O = Must be connected (plugged on delivery) X = plugged (in normal operation)

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

■ 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 mm²/s)

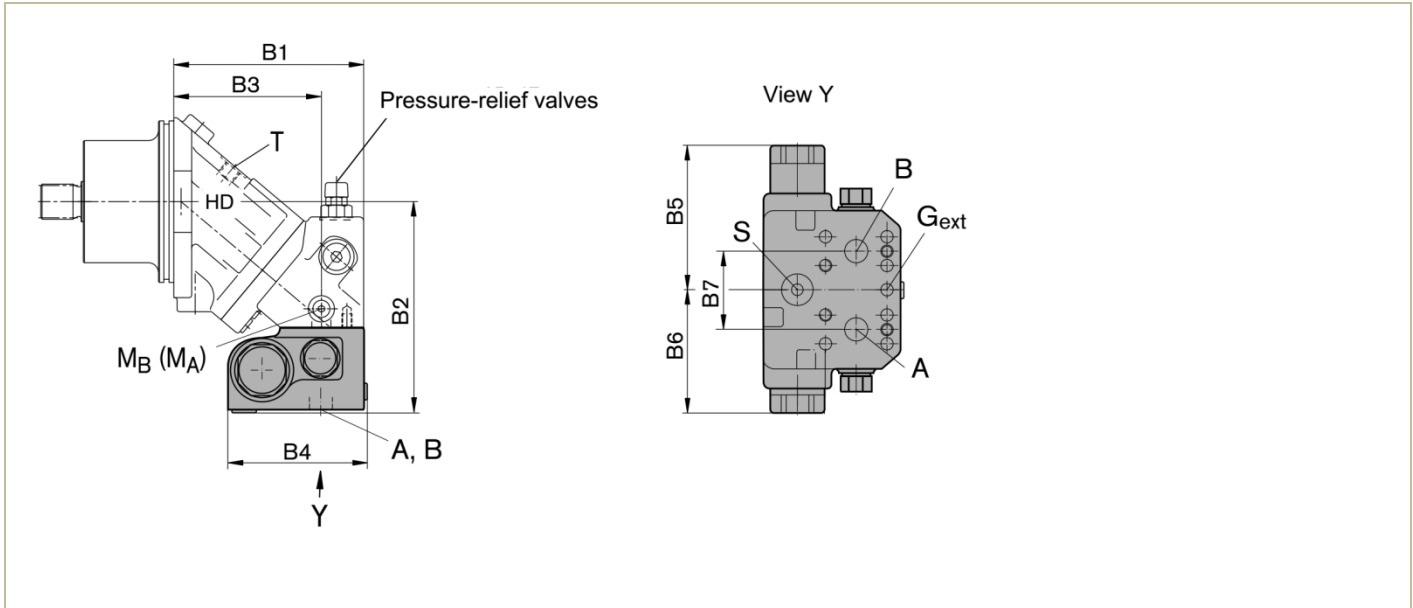
■ Technical Data

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

Motor HD-A2FE Size	Without valve		Restricted values in operation with DBV				Restricted values in operation with BVD/BVE					
	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	181 191, 192	20 BVD	350/420	100	188		
32		201										
45		255										
56		280	22		240	171 191, 192					25 BVD/BVE	320
63		315										
80		360										
90		405										
107		427	32		400	181 191, 192	25 BVD/BVE		188			
125		500										
107		427										
125	500											
160	577	648										
180	648											

Counterbalance valve BVD and BVE

Dimensions in mm



尺寸数据 (mm)

A2FM Size	Counterbalance valve Type	Port A, B	Dimensions in mm							
			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.

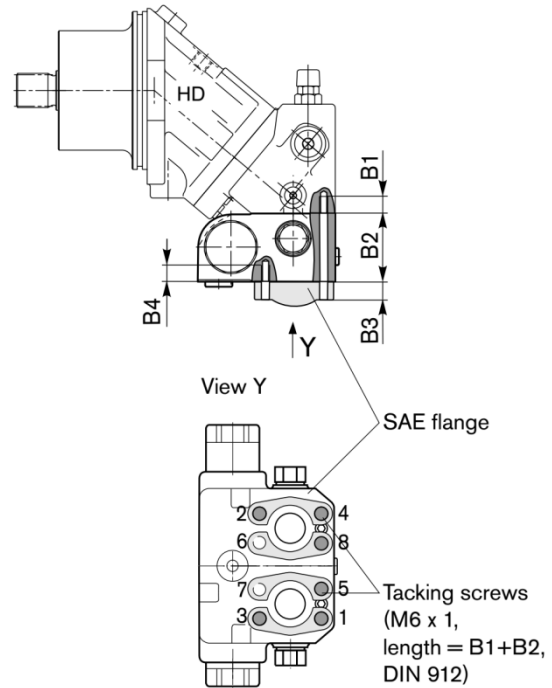
3) The spot face can be deeper than specified in the appropriate standard

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)

■ Installation drawing



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	56,63	80,90	107,125	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

■ 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 measure 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

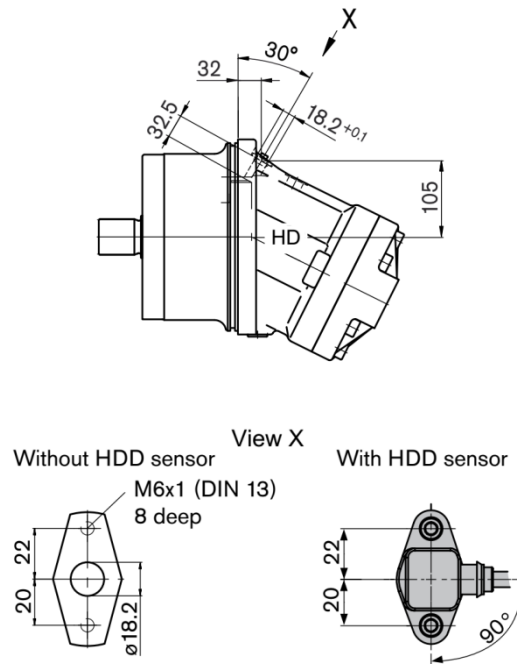
- ❑ The sensor is mounted on the port provided for this purpose with a mounting bolt.
- ❑ We recommend ordering the A2FE plug-in motor complete with sensor mounted.

■ Technical Data

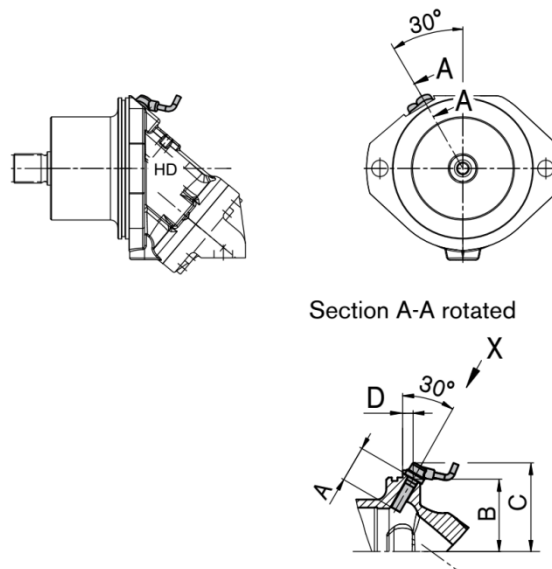
Size	28,32	45	56,63	80,90	107,125	160,180
Number of teeth	38	45	47	53	59	67
DSA	A depth $\pm 0,1$	32	32	32	32	32
	B surface	66				
	C					
	D	12.3				

■ Installation drawing

- ❑ Version "H"...Sizes 250 with HDD sensor



- ❑ Version "V" ...Sizes 28 to 180 with DSA sensor



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 positions 1 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	$T_1(L_1)$	$T_1(L_1)$	$T_2(L_1)$

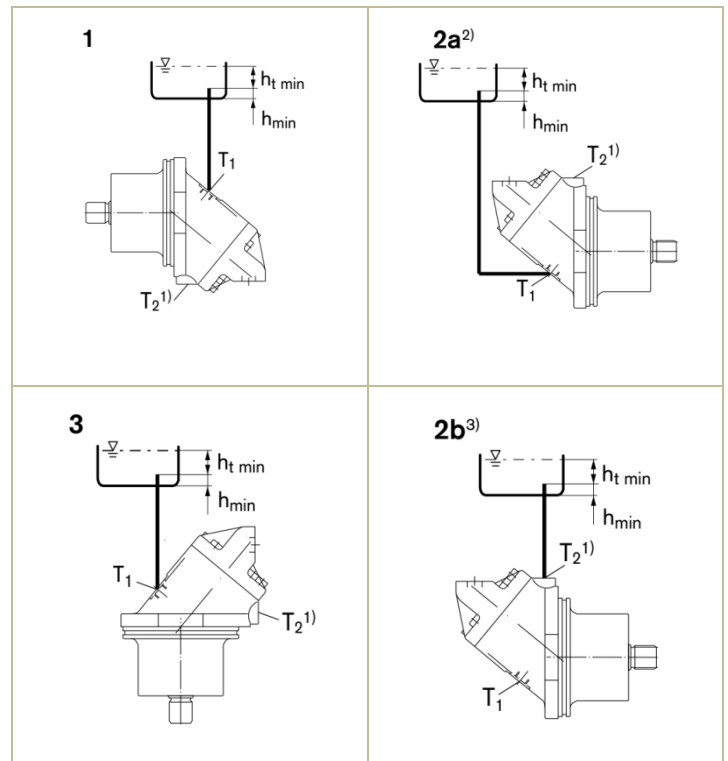
- L_1 Case drain port
- T_1, T_2 Drain port
- $h_{t\ min}$ Minimum necessary immersion depth (200 mm)
- h_{min} Minimum required spacing to reservoir bottom (100 mm)

Mark

- 1) Standard for sizes 250 and 355, special version for sizes 28 to 180
- 2) Piping suggestion without port T_2 (standard for sizes 28 to 180).
- 3) Piping suggestion with port T_2 (standard for sizes 250 to 355, special version for sizes 28 to 180).
- 4) Installation position only permissible if port T_2 is fitted (standard for sizes 250 and 355, special version for sizes 28 to 180)

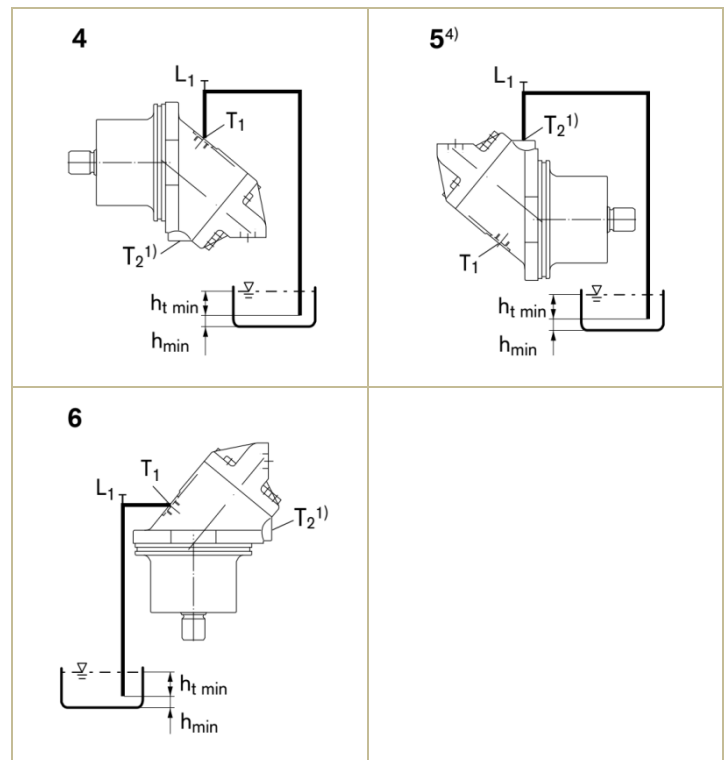
Below-reservoir installation (standard)

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



Above-reservoir installation

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



■ 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

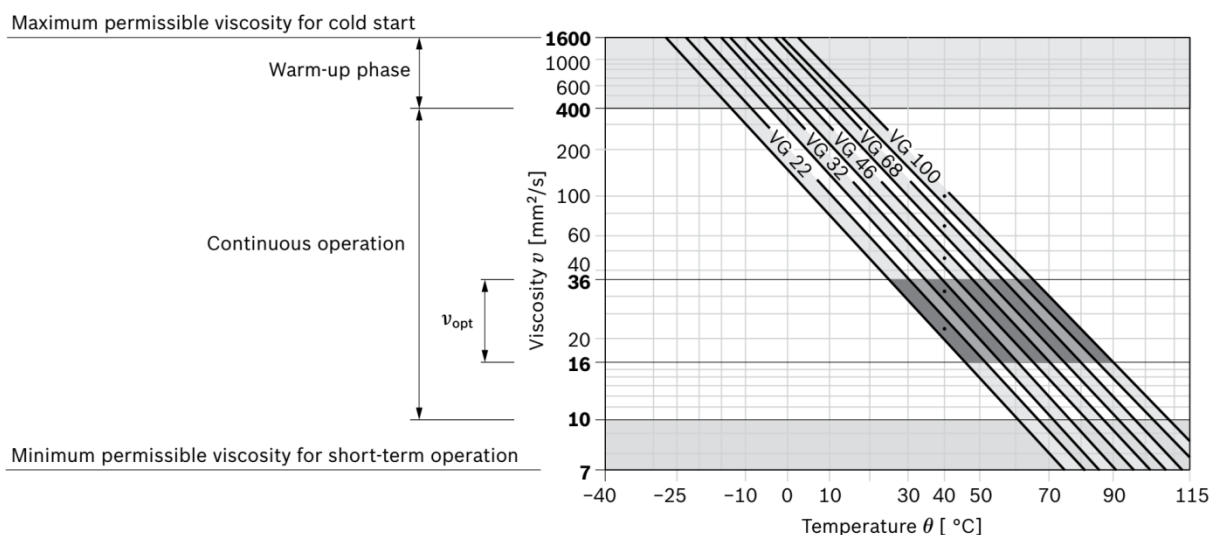
- ❑ The finer the filtration the better the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.
- ❑ In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to 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 mm ² /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 mm ² /s			t ≤ 15 min, P ≤ 0.7 * P _{nom} and n ≤ 0.5 * n _{nom}
Continuous operation	V = 400~10 mm ² /s ¹⁾	NBR ²⁾ FKM	θ = +85°C T = +110°C	measured at port L, L ₁
	V = 36~16 mm ² /s			Range of optimum operating viscosity and efficiency
Short-term operation	V = 10~7 mm ² /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 motor HD-A2FE 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 $M_{G\ max}$	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
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 M_V is reduced to 10 Nm for M10 x 1 and 17 Nm for M12 x 1.5.