Rexroth
Bosch Group

Axial piston fixed motor AA2FM

RA-A 91001/07.2014
Replaces: 06.12

Data sheet

Series 6

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

Open and closed circuits

Contents

Features

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

Ordering code for standard program

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

Hydraulic fluid

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

Axial piston unit

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

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

Operation mode

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

Size

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

Series

06		**6**

Index

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

Direction of rotation

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

Seals

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

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

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

● = Available ❍ = On request – = Not available

Ordering code for standard program

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

	Port plates for service lines			10 to 16	23	28, 32	45	56, 63	80, 90	107, 125	160, 180	250	
12	SAE flange ports A and B at rear1)	51	0	–	●	●	●	●	●	●	●	●	**510**
	SAE flange ports A and B at side, opposite1)	52	0	–	●	●	●	●	●	●	●	●	**520**
			7	–	●	●	●	●	●	●	●	●	**527**
	Threaded ports A and B at side, opposite1)	53	0	●	●	●	–	–	–	–	–	–	**530**
	Threaded ports A and B at side and rear1)2)	54	0	–	●	●	–	–	–	–	–	–	**540**
	SAE flange ports A and B at bottom1)	60	0	–	–	–	–	–	●	●	–	–	**600**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve3)5) BVD 20	17	1	–	–	–	–	–	–	●	–	–	**171** **178**
		18	8	–	–	●	●	●	●	●	●	–	**181**
	BVD/BVE 25	18		–	–	–	–	–	–	●	●	–4)	**188**
	Port plate with pressure-relief valves5)	19	1	–	–	●	●	●	●	●	●	–	**191**
			2	–	–	●	●	●	●	●	●	–	**192**

	Valves	
12	Without valve	**0**
	With pressure-relief valve (without pressure boost facility)	**1**
	With pressure-relief valve (with pressure boost facility)	**2**
	With flushing and boost pressure valve, mounted	**7**
	Counterbalance valve BVD/BVE mounted3)6)	**8**
	Flushing and boost pressure valve, integrated	**9**

	Speed sensors (see page 35)	10 to 16	23 to 32	45	56 to 90	107 to 180	250	
13	Without speed sensor (without code)	●	●	●	●	●	●	
	Prepared for HDD speed sensor	–	▲	▲	▲	▲	–	**F**
	HDD speed sensor mounted7)	–	▲	▲	▲	▲	–	**H**
	Prepared for DSM/DSA speed sensor	–	●	●	●	●	–	**U**
	DSM/DSA speed sensor mounted7)	–	●	●	●	●	–	**V**

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

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

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

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

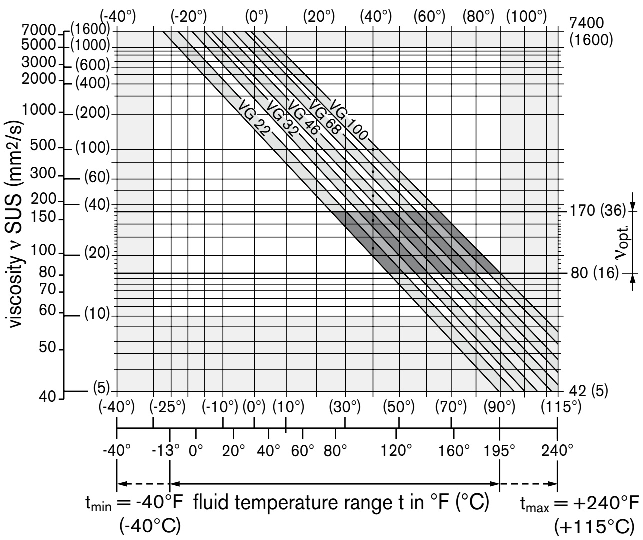
Technical data

Hydraulic fluid

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

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

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

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

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

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

Viscosity and temperature of hydraulic fluid

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

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

2) Sizes 250, please contact us.

Technical data

Filtration of the hydraulic fluid

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

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

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

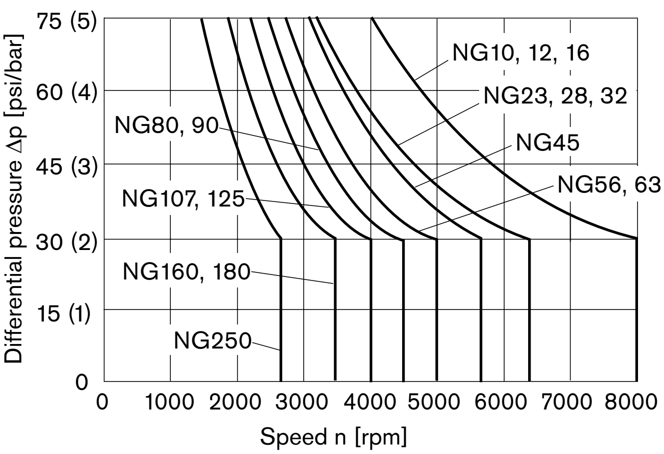
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

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

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



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

Temperature range

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

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

Direction of flow

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

Speed range

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

Long-life bearing

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

Flushing flow (recommended)

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

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Sizes 10 to 180

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

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

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

Sizes 250

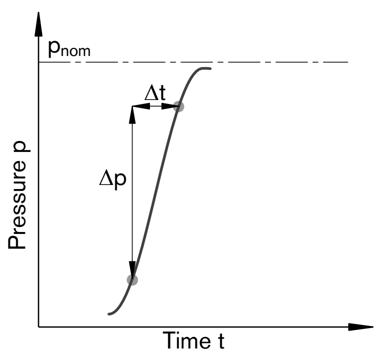
Nominal pressure p_{nom} ________ 5100 psi (350 bar) absolute

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

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

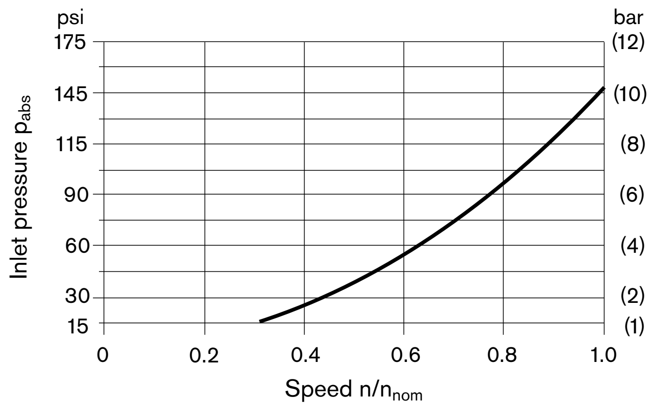
Minimum pressure (high-pressure side) _______________ 365 psi (25 bar) absolute

Rate of pressure change $R_{A\ max}$
with integrated pressure-relief valve__130000 psi/s (9000 bar/s)
without pressure-relief valve ______ 232000 psi/s (16000 bar/s)



Note
Values for other hydraulic fluids, please contact us.

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



This diagram is valid only for the optimum viscosity range from ν_{opt} = 170 to 74 SUS (36 to 16 mm²/s).
Please contact us if these conditions cannot be satisfied.

Definition

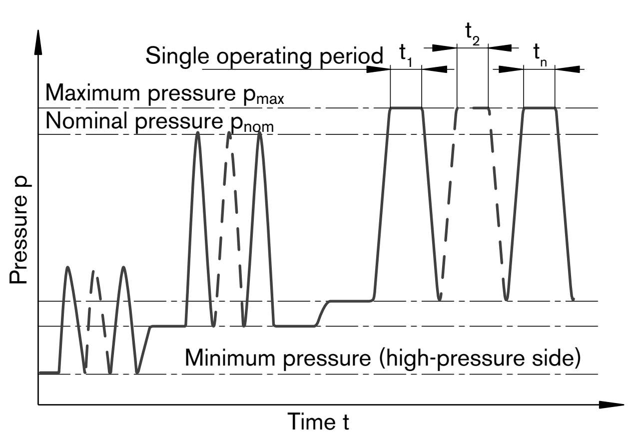
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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

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

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

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



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

Technical data

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

Size		NG		10	12	16	23	28	32	45	56
Displacement geometric, per revolution		V_g	in^3	0.63	0.73	0.98	1.40	1.71	1.95	2.78	3.42
			cm^3	10.3	12	16	22.9	28.1	32	45.6	56.1
Speed maximum[1]		n_{nom}	rpm	8000	8000	8000	6300	6300	6300	5600	5000
		n_{max}[2]	rpm	8800	8800	8800	6900	6900	6900	6200	5500
Input flow[3]			gpm	21.8	25.3	33.9	38.2	46.8	53.4	67.4	74.2
at n_{nom} and V_g		q_V	L/min	82	96	128	144	177	202	255	281
Torque[4] at V_g and	$\Delta p = 5100$ psi	T	lb-ft	42	49	66	94	116	132	188	231
	$\Delta p = 350$ bar	T	Nm	57	67	89	128	157	178	254	313
	$\Delta p = 5800$ psi	T	lb-ft	49	56	75	108	132	150	213	263
	$\Delta p = 400$ bar	T	Nm	66	76	102	146	179	204	290	357
Rotary stiffness		c	kNm/rad	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94
Moment of inertia for rotary group		J_{GR}	$lbs\text{-}ft^2$	0.0095	0.0095	0.0095	0.0285	0.0285	0.0285	0.0569	0.0997
			kgm^2	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042
Maximum angular acceleration		α	rad/s^2	5000	5000	5000	6500	6500	6500	14600	7500
Case volume		V	gal	0.045	0.045	0.045	0.053	0.053	0.053	0.087	0.119
			L	0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45
Mass (approx.)		m	lbs	12	12	12	21	21	21	30	40
			kg	5.4	5.4	5.4	9.5	9.5	9.5	13.5	18

Size		NG		63	80	90	107	125	160	180	250
Displacement geometric, per revolution		V_g	in^3	3.84	4.91	5.49	6.51	7.63	9.79	10.98	15.25
			cm^3	63	80.4	90	106.7	125	160.4	180	250
Speed maximum[1]		n_{nom}	rpm	5000	4500	4500	4000	4000	3600	3600	2700
		n_{max}[2]	rpm	5500	5000	5000	4400	4400	4000	4000	–
Input flow[3]			gpm	83.1	95.6	106.9	112.7	132.1	152.5	171.1	178
at n_{nom} and V_g		q_V	L/min	315	362	405	427	500	577	648	675
Torque[4] at V_g and	$\Delta p = 5100$ psi	T	lb-ft	259	330	371	438	513	659	740	1030
	$\Delta p = 350$ bar	T	Nm	351	448	501	594	696	893	1003	1393
	$\Delta p = 5800$ psi	T	lb-ft	296	378	423	501	587	753	845	–
	$\Delta p = 400$ bar	T	Nm	401	512	573	679	796	1021	1146	–
Rotary stiffness		c	kNm/rad	6.25	8.73	9.14	11.2	11.9	17.4	18.2	73.1
Moment of inertia for rotary group		J_{GR}	$lbs\text{-}ft^2$	0.0997	0.1708	0.1708	0.2753	0.2753	0.5221	0.5221	1.4475
			kgm^2	0.0042	0.0072	0.0072	0.0116	0.0116	0.0220	0.0220	0.061
Maximum angular acceleration		α	rad/s^2	7500	6000	6000	4500	4500	3500	3500	10000
Case volume		V	gal	0.119	0.145	0.145	0.211	0.211	0.291	0.291	0.660
			L	0.45	0.55	0.55	0.8	0.8	1.1	1.1	2.5
Mass (approx.)		m	lbs	40	51	51	71	71	99	99	161
			kg	18	23	23	32	32	45	45	73

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

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

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

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

Note

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

Technical data

Determining the operating characteristics

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

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

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

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

V_g = Displacement per revolution in in³ (cm³)

Δp = Differential pressure in psi (bar)

n = Speed in rpm

η_v = Volumetric efficiency

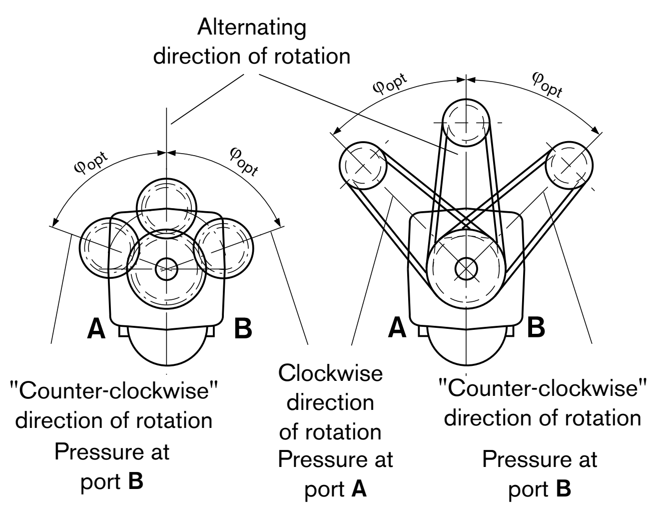
η_{mh} = Mechanical-hydraulic efficiency

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

Effect of radial force F_q on the service life of bearings

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

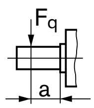
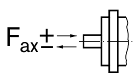
	Toothed gear drive	V-belt output
NG	φ_{opt}	φ_{opt}
10 to 180	± 70°	± 45°
250	± 45°	± 70°

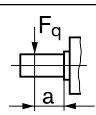
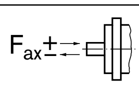


Technical data

Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

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

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

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

Note

Influence of the direction of the permissible axial force:

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

Technical data

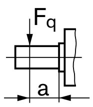
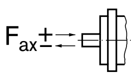
Size	**NG**		**45**	**45**	**56**[3]	**56**	**56**	**56**	**63**[3]	**63**	**63**
Drive shaft	ø	in	1 1/4	1.18	1 1/4	1 3/8	1.18	1.37	1 1/4	1 3/8	1.38
		mm	–	30	–	–	30	35	–	–	35
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\ max}$	lbf	1641	1709	1709	2068	2136	2045	1708	2315	2046
		kN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

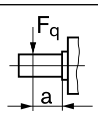
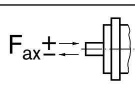
Size	**NG**		**80**[3]	**80**[3]	**80**	**80**	**90**[3]	**90**[3]	**90**	**107**[3]	**107**
Drive shaft	ø	in	1 1/4	1 3/8	1.37	1.57	1 1/4	1 3/8	1.57	1 1/2	1 3/4
		mm	–	–	35	40	–	–	40	–	–
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\ max}$	lbf	1709	2608	2608	2563	1709	2608	2563	2788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

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

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

Technical data

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

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

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

Note

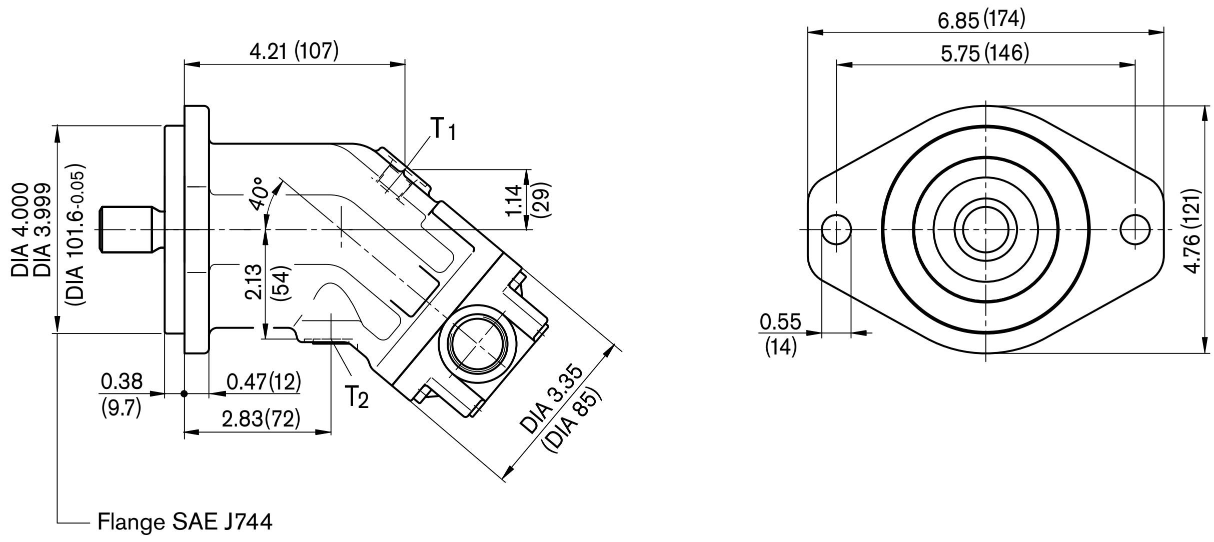
Influence of the direction of the permissible axial force:

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

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

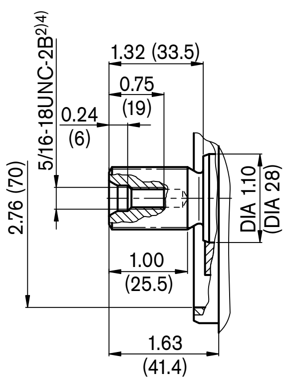
Dimensions sizes 10, 12, 16 – SAE design

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

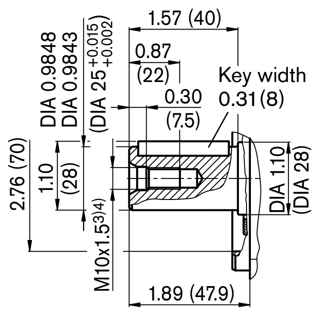


Shaft ends

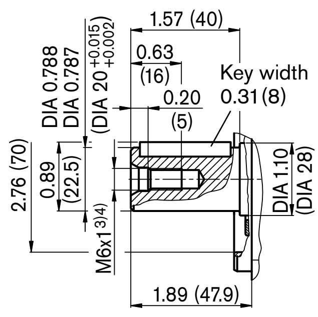
S Splined shaft SAE J744 7/8 in 13 T 16/32 DP[1)]



B Parallel keyed shaft, DIN 6885, AS8x7x32 mm)



P Parallel keyed shaft DIN 6885, AS8x7x50 (mm) (not for size16)



Ports

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

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

Dimensions size 10, 12, 16 – SAE design

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

Location of the service line ports on the port plates

53 – Threaded ports at side, opposite

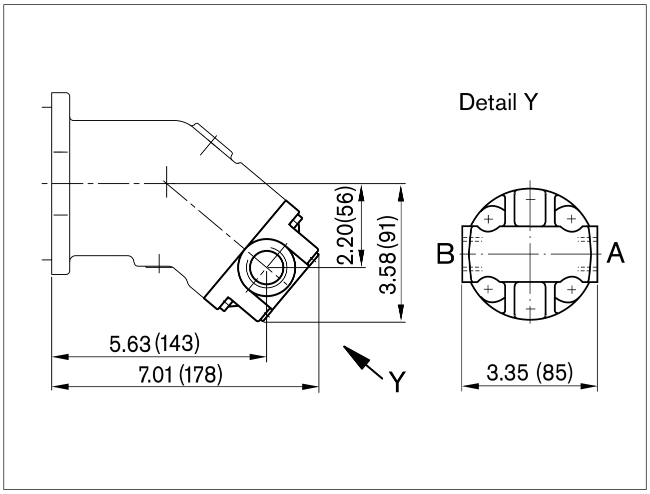
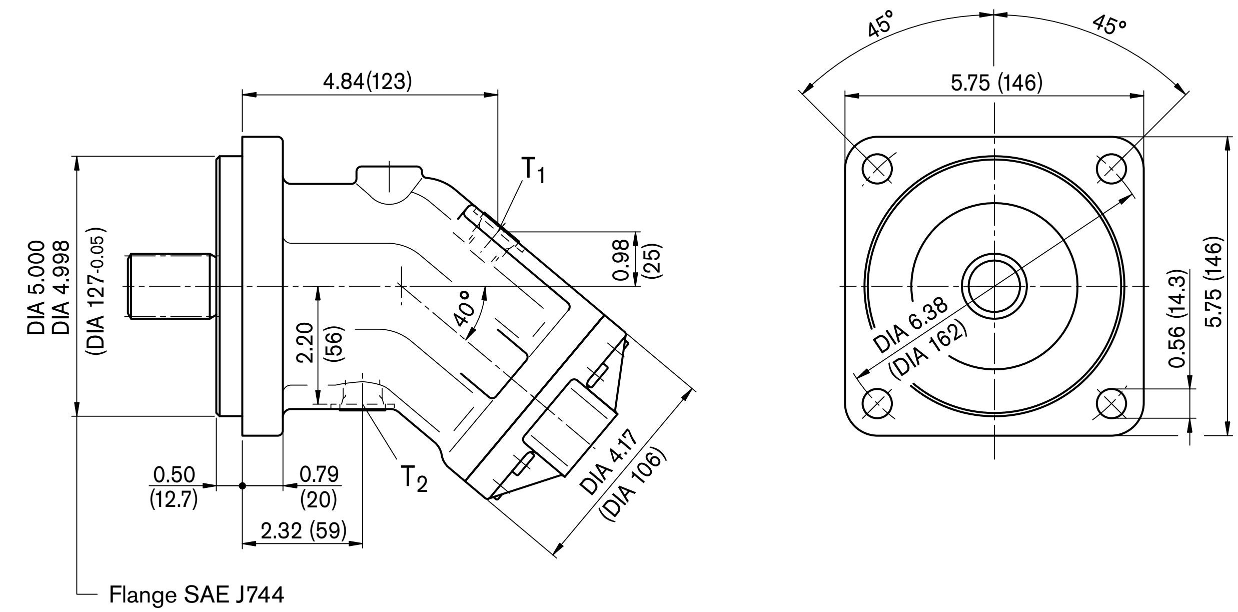


Plate	Designation	Port for	Standard[3)]	Size[1)]	p_{max} [psi (bar)][2)]	State[4)]
53	A, B	Service line	ISO11926	1 1/16-12UN-2B; 0.79 (20) deep	6500 (450)	O

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

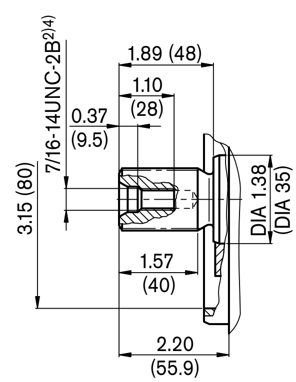
Dimensions sizes 23, 28, 32 – SAE design

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

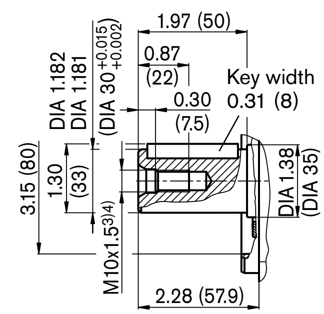


Shaft ends

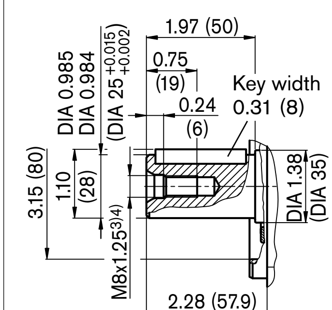
S Splined shaft SAE J744
1 1/4 in 14T 12/24 DP[1]



B Parallel keyed shaft
DIN 6885, AS8x7x40 (mm)



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



Ports

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

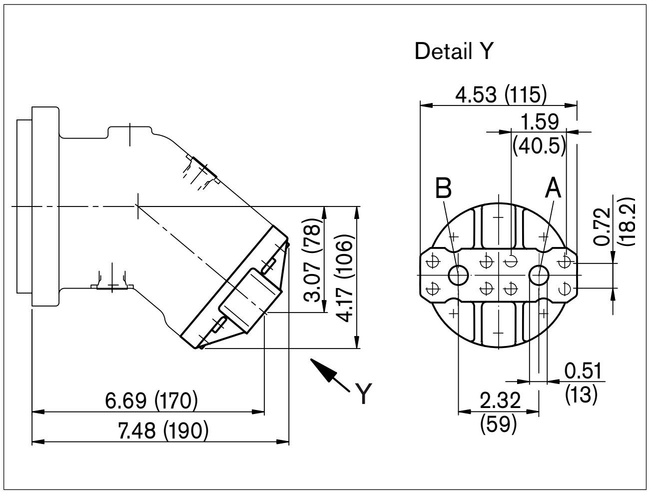
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending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

Dimensions sizes 23, 28, 32 – SAE design

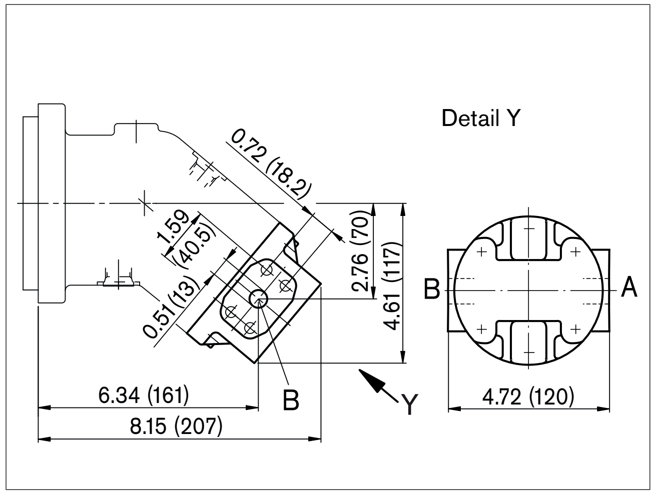
Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

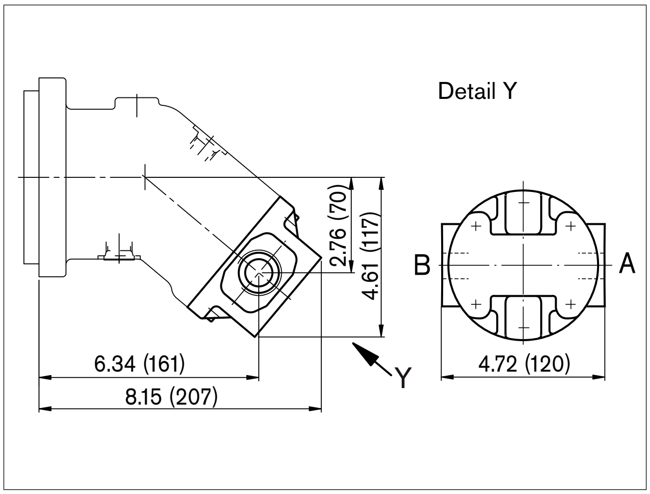
51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite



53 – Threaded ports at side, opposite



54 – Threaded ports at side and rear

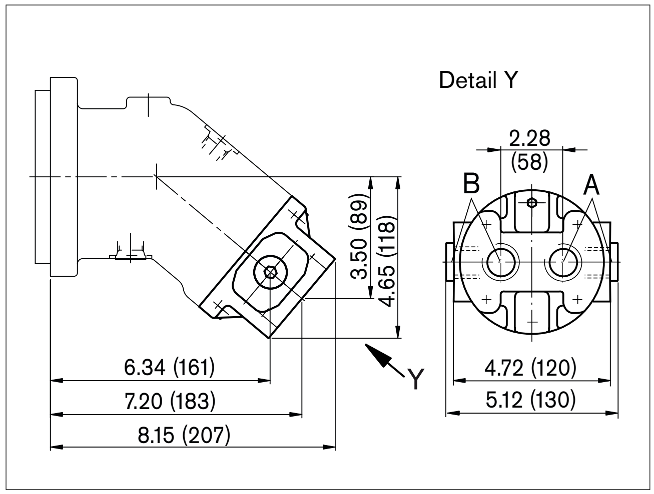


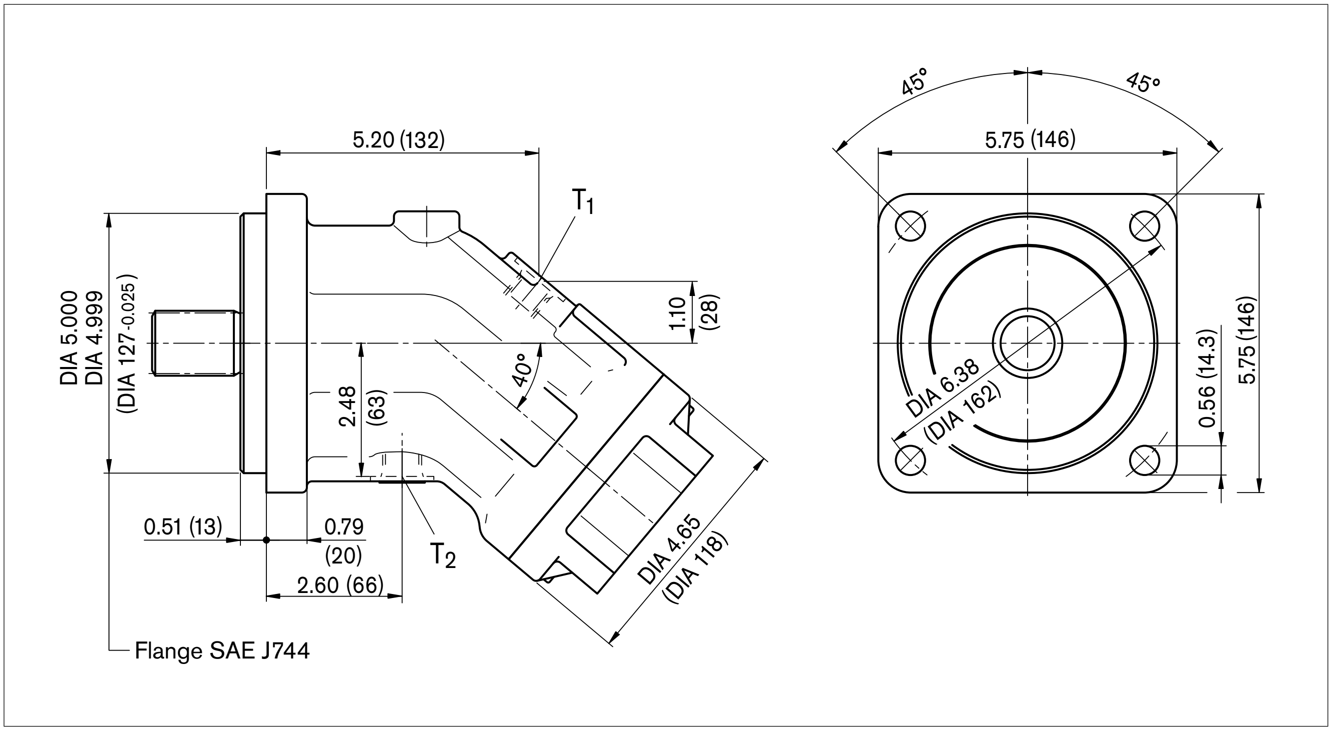
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[4]
51, 52	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1/2 in 5/16-18UNC-2B; 0.71 (18) deep	6500 (450)	O
53		Service line	ISO 11926[3]	1 5/16-12UN-2B; 0.79 (20) deep	6500 (450)	O
54						O 1x each

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

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

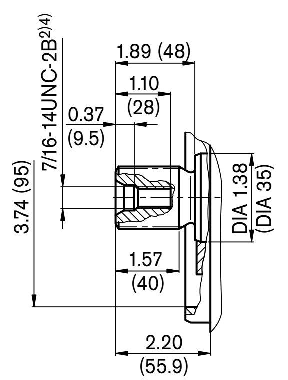
Dimensions size 45 – SAE design

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

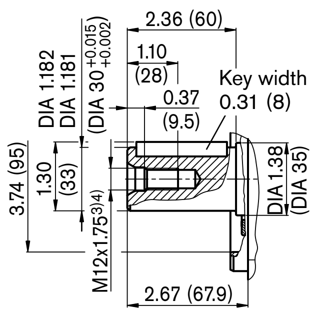


Shaft ends

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



P Parallel keyed shaft
DIN 6885, AS8x7x50(mm)



Ports

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

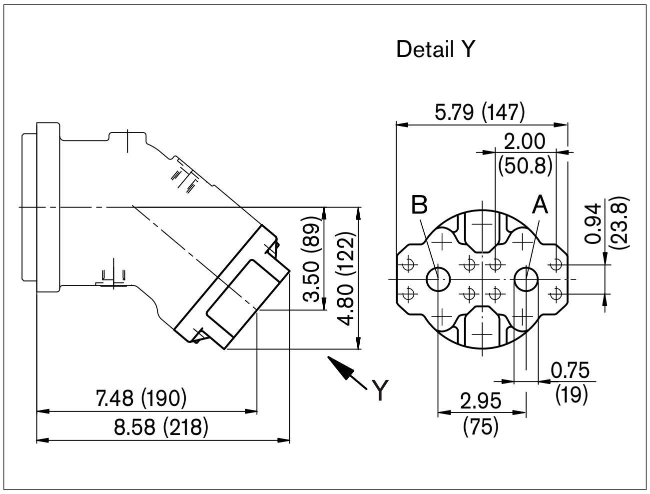
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending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

Dimensions size 45 – SAE design

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

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

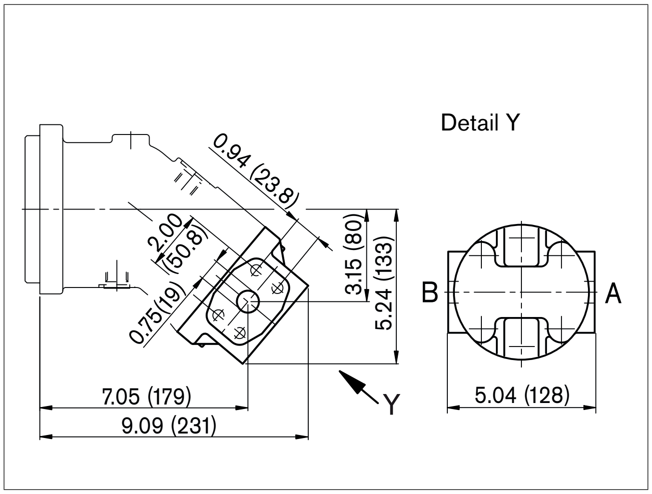


Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52	A, B	Service line Fastening thread A/B	SAE J518[3] ASME B1.1	3/4 in 3/8-16UNC-2B; 0.82 (21) deep	6500 (450)	O

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

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

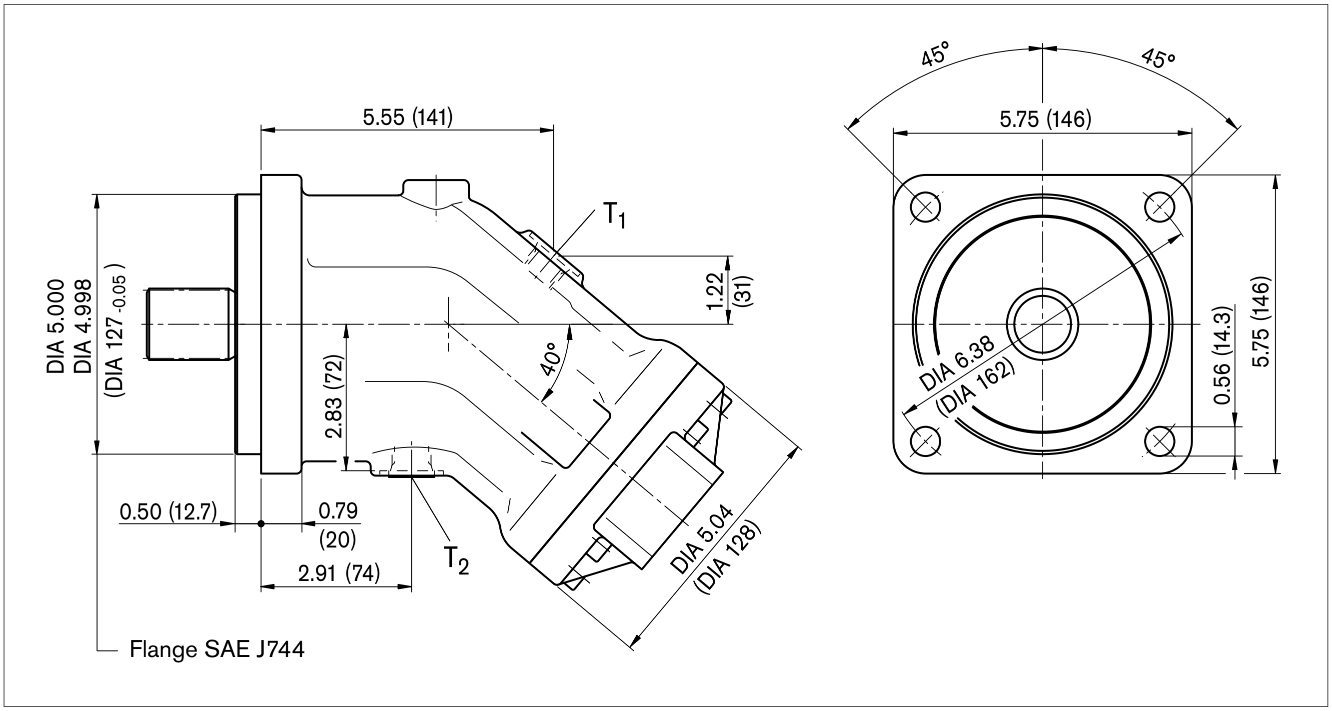
3) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 30 and 33

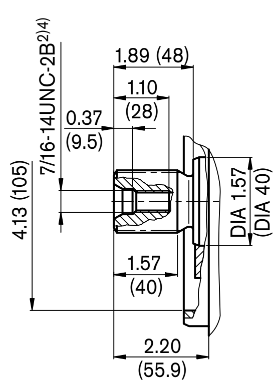
Dimensions sizes 56, 63 – SAE design

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

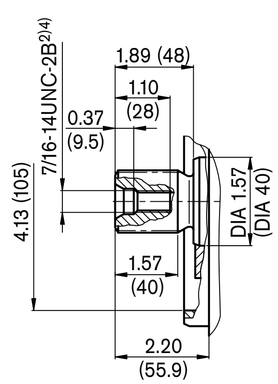


Shaft ends

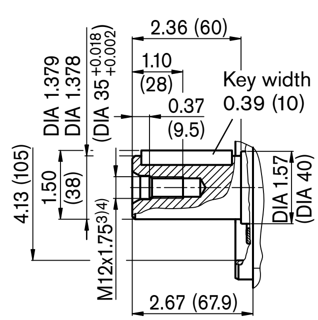
S Splined shaft SAE J744 1 1/4 in 14T 12/24 DP[1]



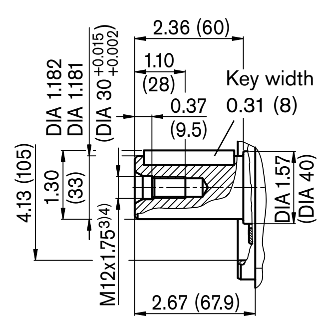
T Splined shaft SAE J744 1 3/8 in 21T 16/32 DP[1]



B Parallel keyed shaft DIN 6885, AS10x8x50 (mm)



P Parallel keyed shaft DIN 6885, AS8x7x50 (mm) (not for size 63)



Ports

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

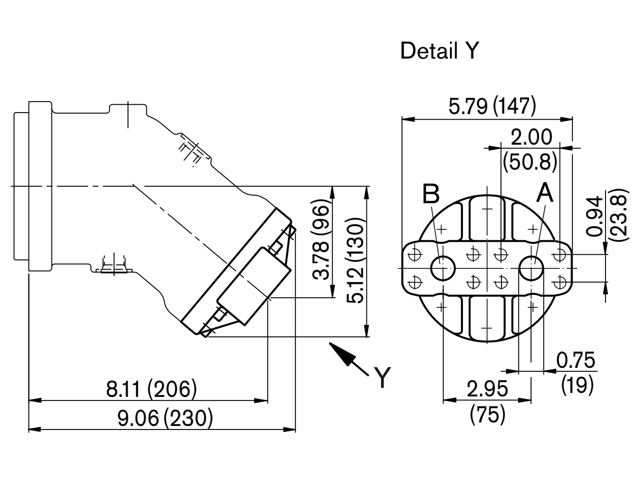
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending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

Dimensions sizes 56, 63 – SAE design

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

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

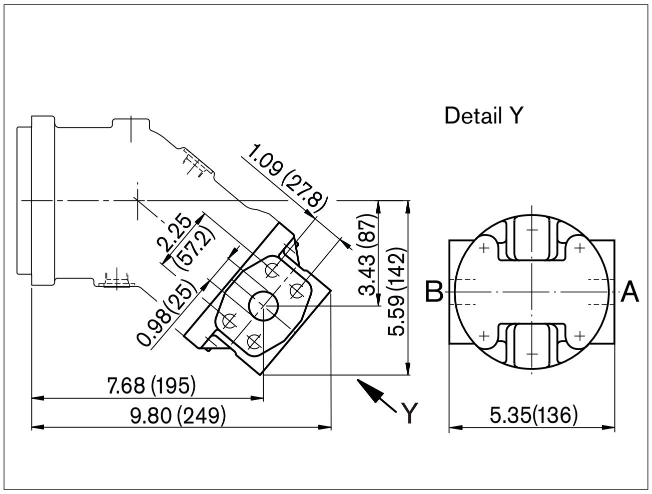


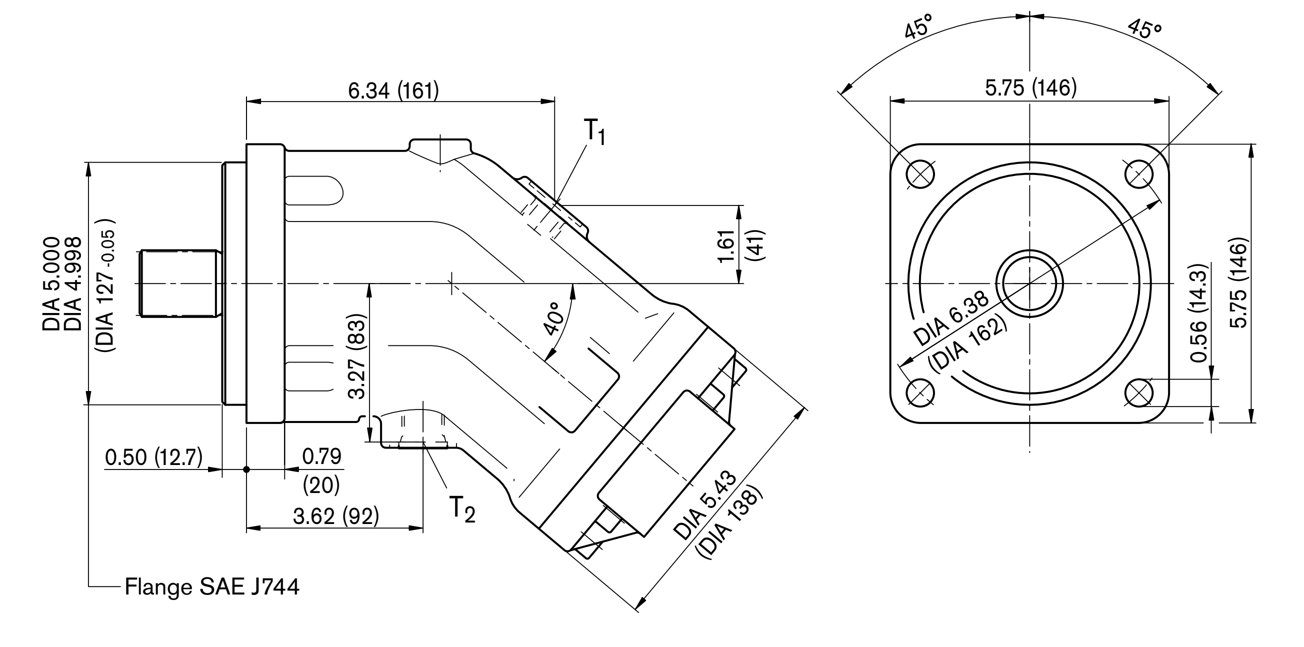
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.82 (21) deep	6500 (450)	O
52				1 in 7/16-14UNC-2B; 0.75 (19) deep	6500 (450)	O

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

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

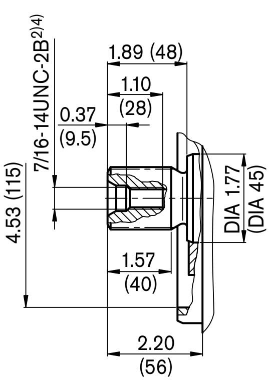
Dimensions sizes 80, 90 – SAE design

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

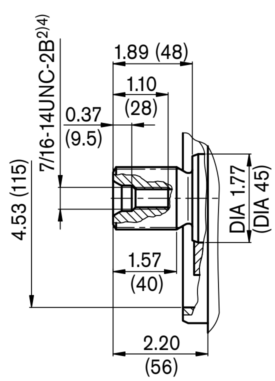


Shaft ends

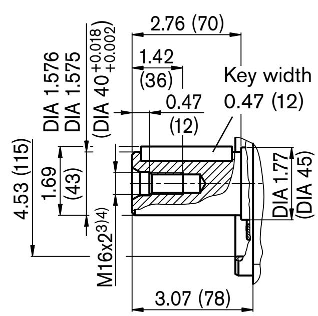
U Splined shaft SAE J744
1 3/8 in 21T 16/32 DP[1]



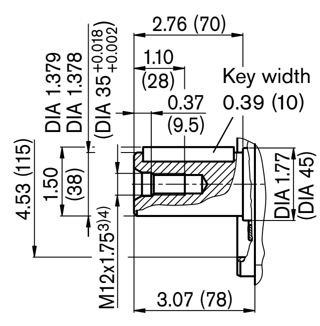
Q Splined shaft SAE J744
1 1/4 in 14T 12/24 DP[1]



B Parallel keyed shaft
DIN 6885, AS12x8x56 (mm)



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



Ports

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

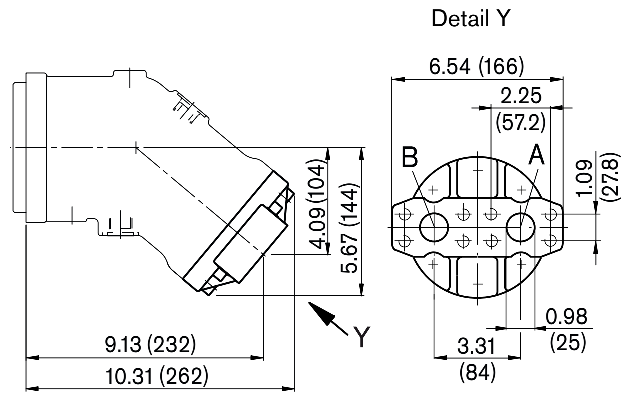
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending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

Dimensions sizes 80, 90 – SAE design

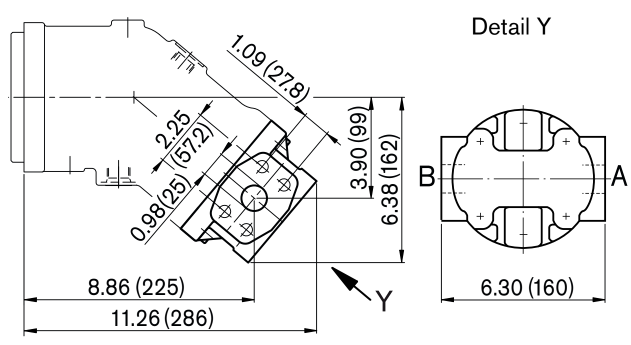
Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

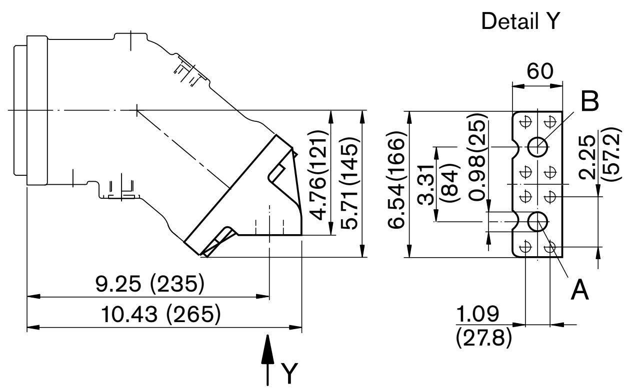
51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite



60 – SAE flange ports at bottom



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

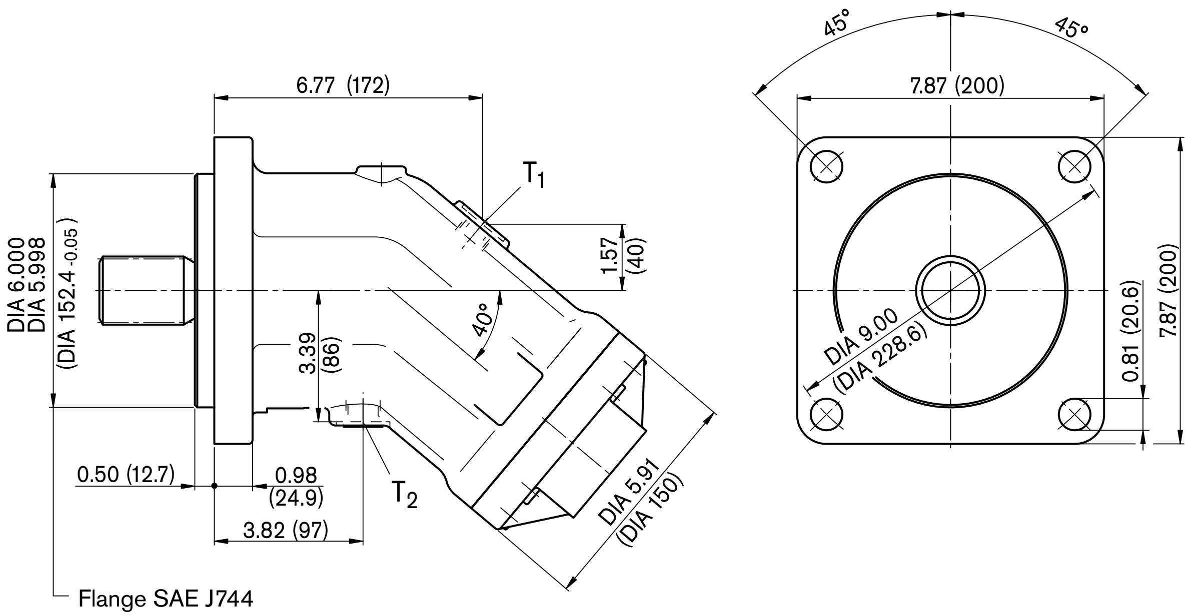
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52, 60	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1 in 7/16-14UNC-2B; 0.75 (19) deep	6500 (450)	O

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

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

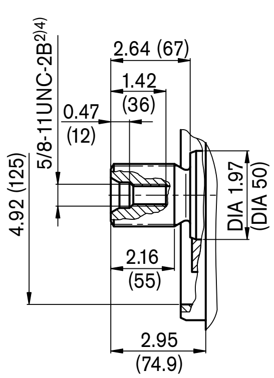
Dimensions sizes 107, 125 – SAE design

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

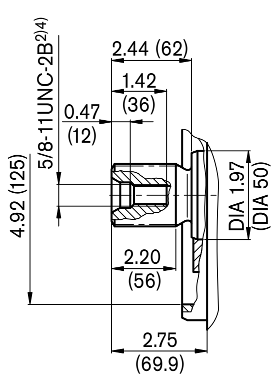


Shaft ends

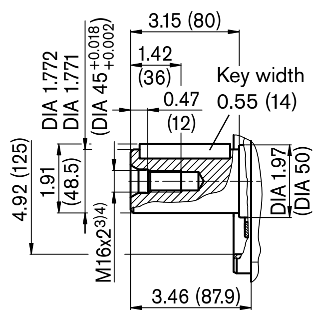
S Splined shaft SAE J744
1 3/4 in 13T 8/16 DP[1]



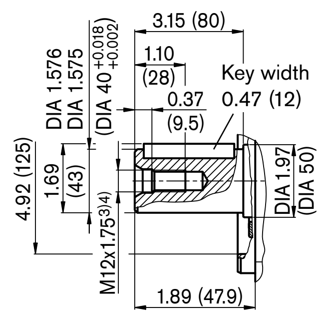
U Splined shaft
1 1/2 in 23T 16/32 DP[1]



B Parallel keyed shaft
DIN 6885, AS14x9x63 (mm)



P Parallel keyed shaft
DIN 6885, AS12x8x63 (mm)
(not for size 125)



Ports

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

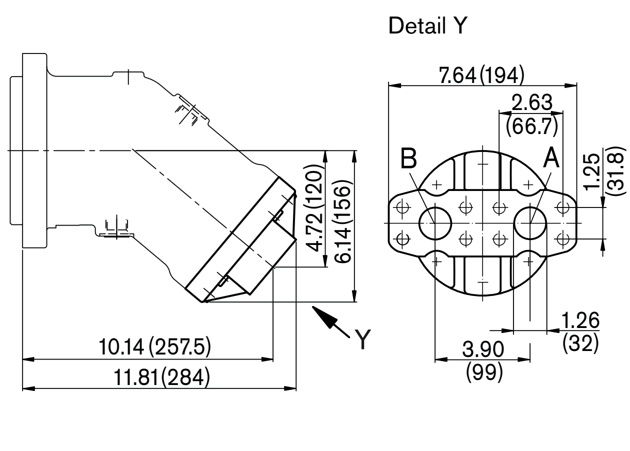
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending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

Dimensions sizes 107, 125 – SAE design

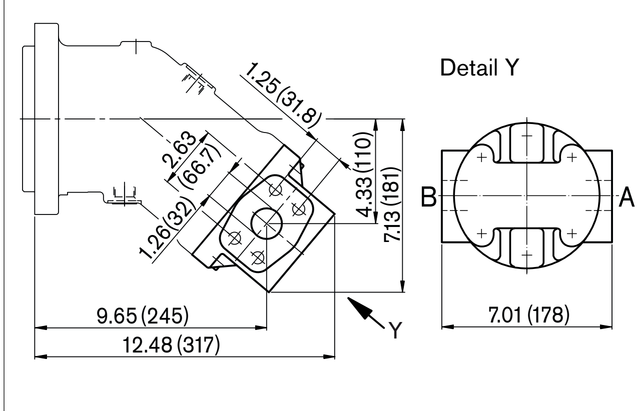
Before finalizing your design, request a binding installation drawing. Dimensions in inch and (millimeters).

Location of the service line ports on the port plates

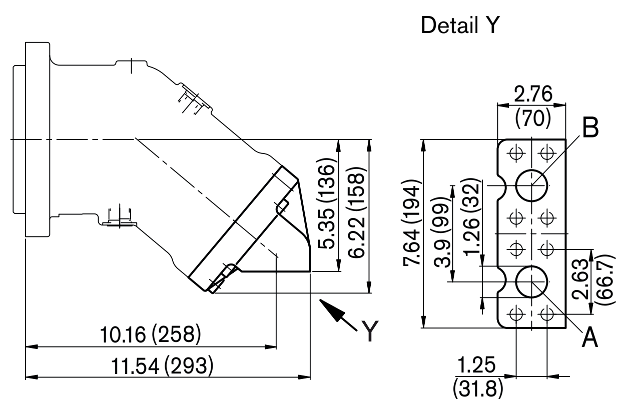
51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite



60 – SAE flange ports at bottom



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

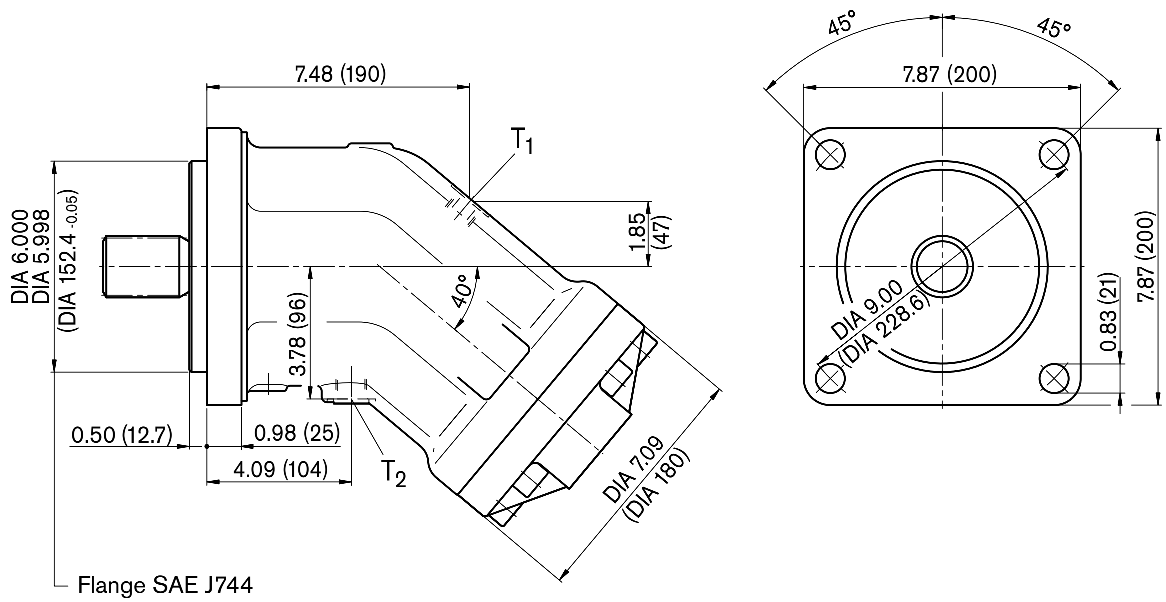
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52, 60	A, B	Service line	SAE J518	1 1/4 in	6500 (450)	O
		Fastening thread A/B	ASME B1.1	1/2-13UNC-2B; 0.75 (19) deep		

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

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

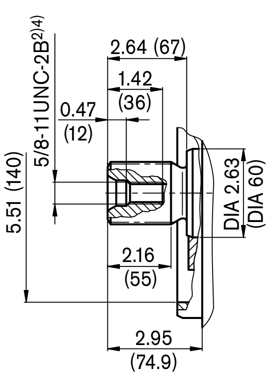
Dimensions sizes 160, 180 – SAE design

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

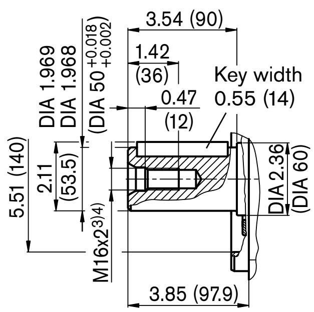


Shaft ends

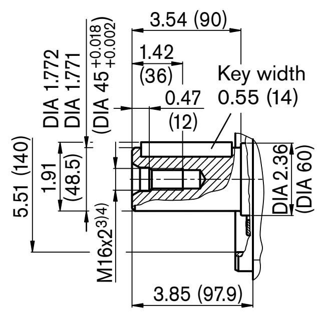
S Splined shaft SAE J744 1 3/4 in 13T 8/16 DP[1]



B Parallel keyed shaft DIN 6885, AS14x9x70 (mm)



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



Ports

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

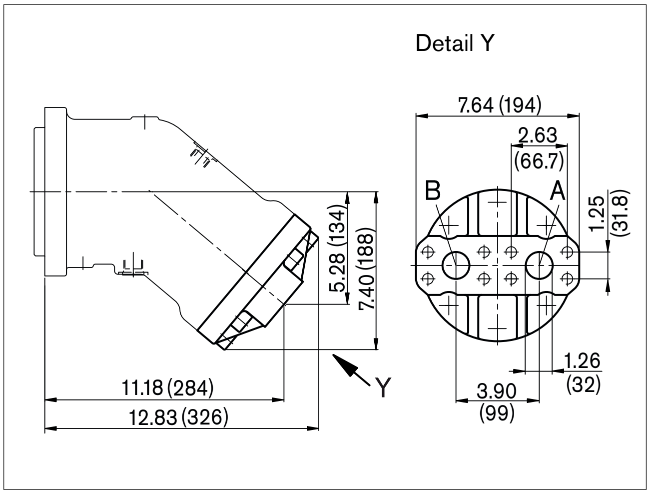
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 38 for the maximum tightening torques.
5) Momentary pressure spikes may occur depending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

Dimensions sizes 160, 180 – SAE design

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

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

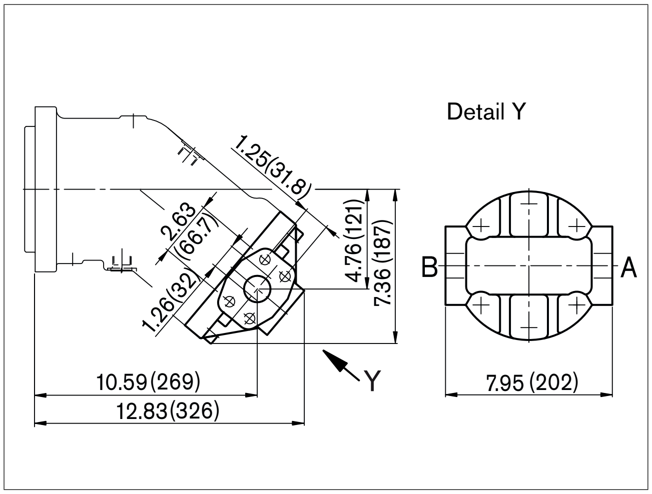


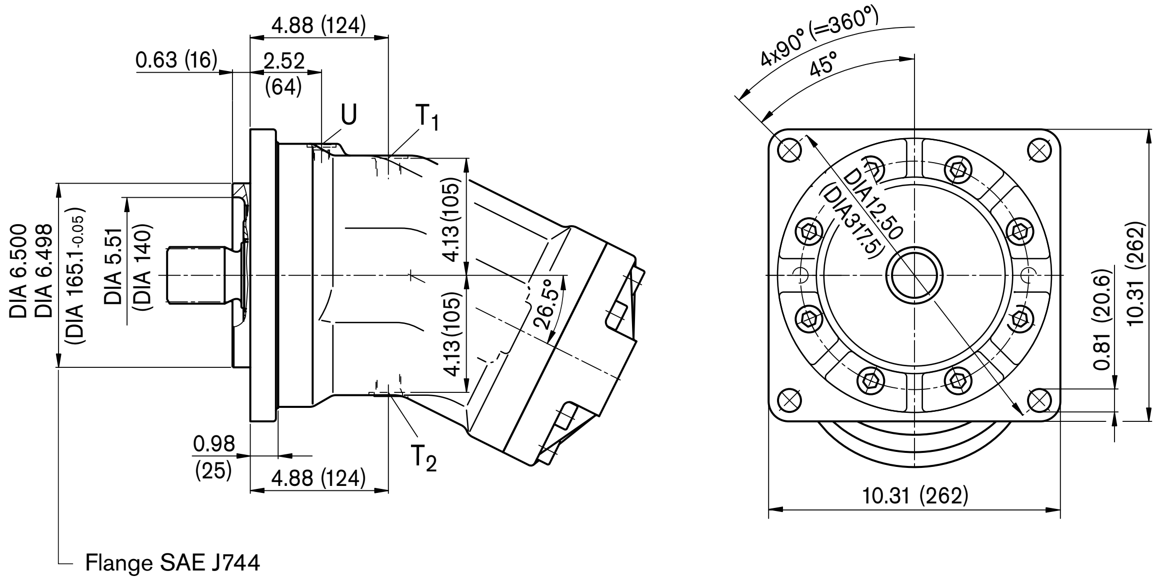
Plate	Designation	Port for	Standard	Size[1]	p_{max} [psi (bar)][2]	State[3]
51, 52	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1 1/4 in 1/2-13UNC-2B; 0.75 (19) deep	6500 (450)	O

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

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

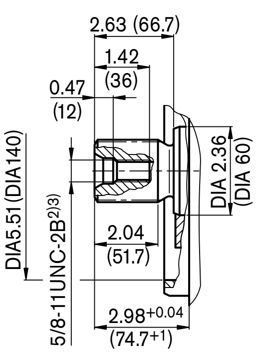
Dimensions size 250 – SAE design

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

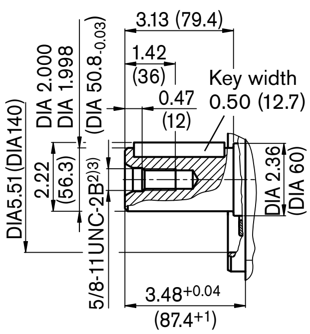


Drive shafts

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



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



Ports

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

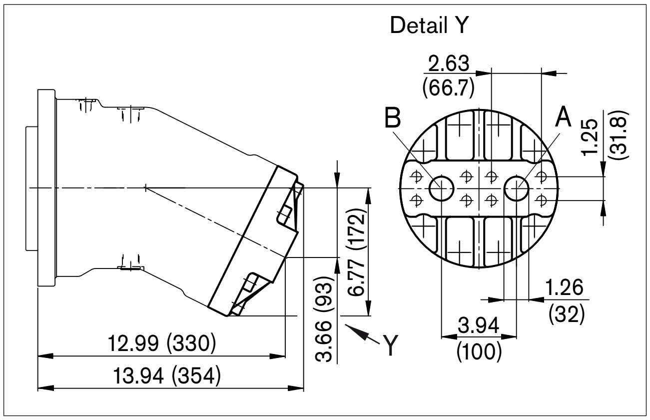
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 38 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring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

Dimensions size 250

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

Location of the service line ports on the port plates

51 – SAE flange ports at rear



52 – SAE flange ports at side, opposite

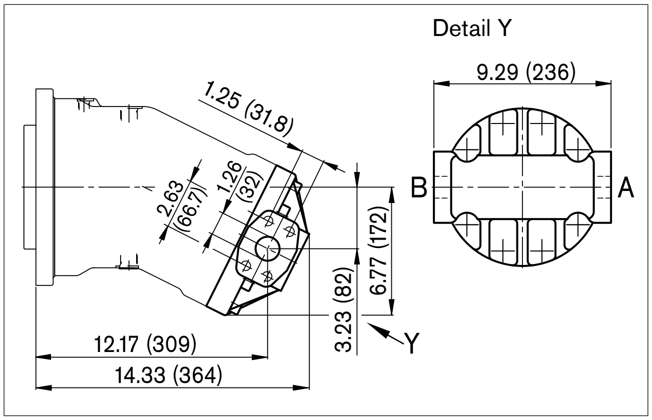


Plate	Designation	Port for	Standard	Size[1]	p_{max} [bar][2]	State[3]
51, 52	A, B	Service line Fastening thread A/B	SAE J518 ASME B1.1	1 1/4 in 1/2-13UNC-2B; 0.75 (19) deep	5800 (400)	O

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

Flushing and boost pressure valve

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

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

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

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

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

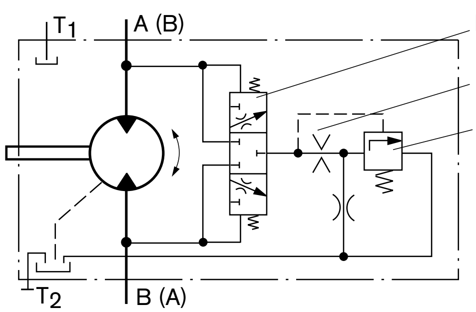
Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 23 to 250, fixed setting______________ 230 psi (16 bar)

Switching pressure of flushing piston Δp
Sizes 23 to 250____________________115±15 psi (8±1 bar)

Flushing flow q_v

Orifice (throttles with integrated valve) can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 365$ psi (25 bar) and
$\nu = 46$ SUS (10 mm^2/s)
(p_{ND} = low pressure, p_G = case pressure)

Schematic



Flushing and boost pressure valve, mounted (code 7)

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

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

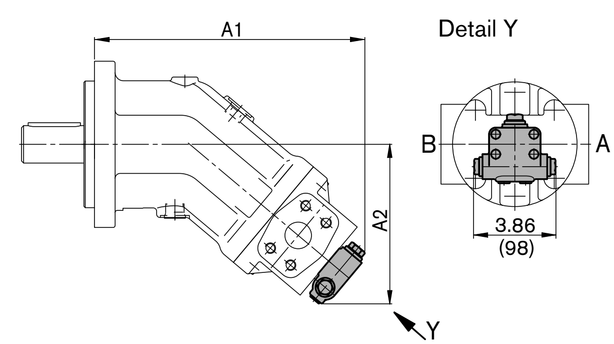
Size 250
Standard flushing flow 2.64 gpm (10 L/min).

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

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

Dimensions

Port plate 527 – SAE flange ports at side



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

Pressure-relief valves

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

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

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

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

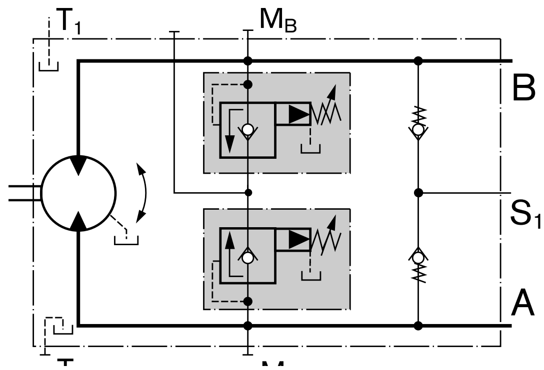
With the version "with pressure boost facility" (192), a higher pressure setting can be realized by applying an external pilot pressure of 365 to 435 psi (25 to 30 bar) to port P_{St}.

When ordering, please state in plain text:

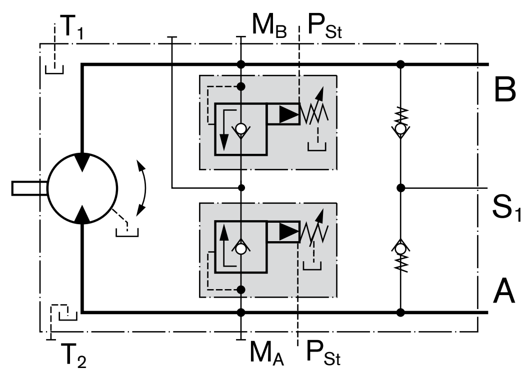
– Cracking pressure of pressure-relief valve

– Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Version without pressure boost facility "191"



Version with pressure boost facility "192"



Ports

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

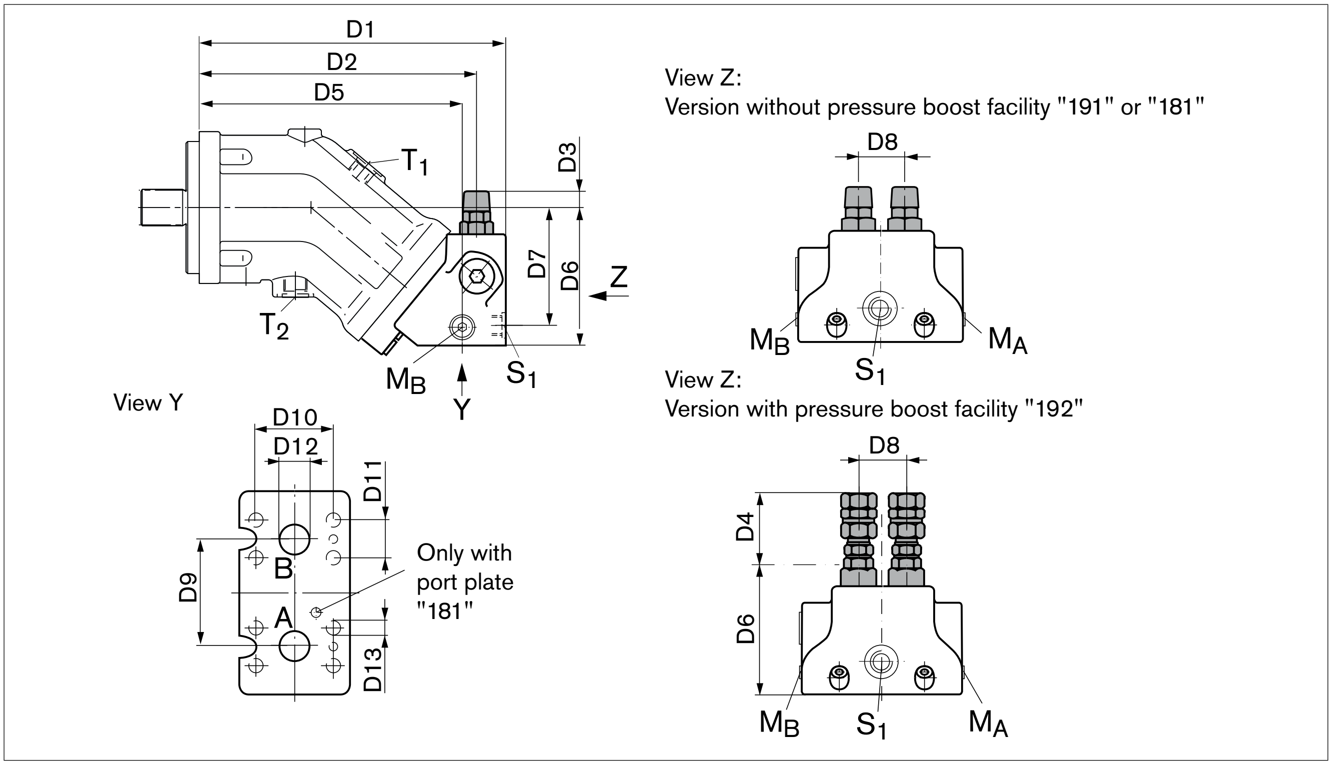
1) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

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

Pressure-relief valves

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

Dimensions



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

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

1) Thread according to DIN 13

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

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

Counterbalance valve BVD and BVE

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

Function

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

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

Note

– BVD available for sizes 28 to 180 and BVE available for sizes 107 to 180.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: AA2FM90/61W–VUDN**188** + BVD20F27S/41B–V03K16D0400S12

– For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!

– For the design of the brake release valve, we must know for the mechanical park brake:

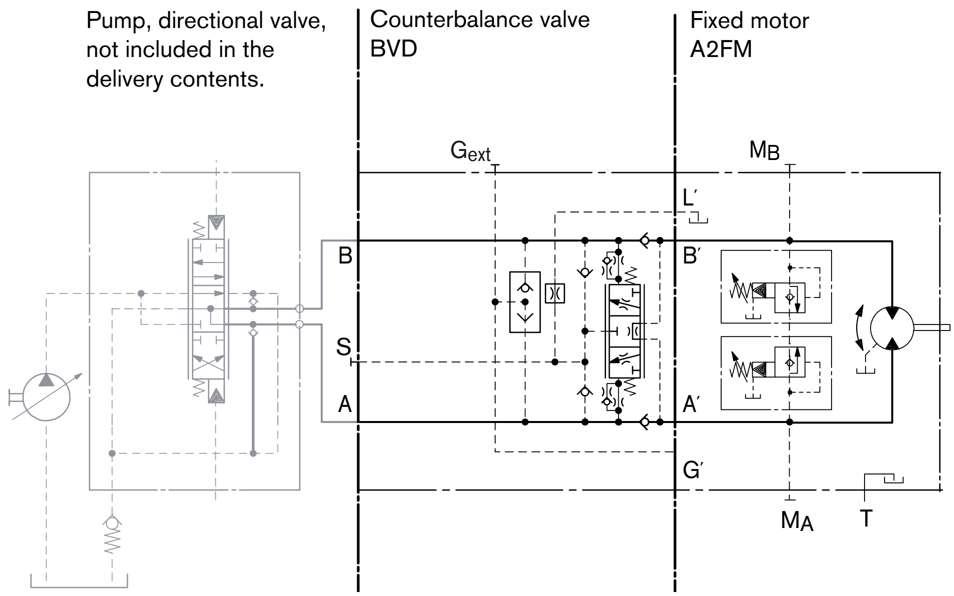
- the pressure at the start of opening
- the volume of the brake piston between minimum stroke (brake closed) and maximum stroke (brake released with 305 psi (21 bar)
- the required closing time for a warm device (oil viscosity approx. 69.6 SUS (15 mm^2/s))

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

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



Counterbalance valve BVD and BVE

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

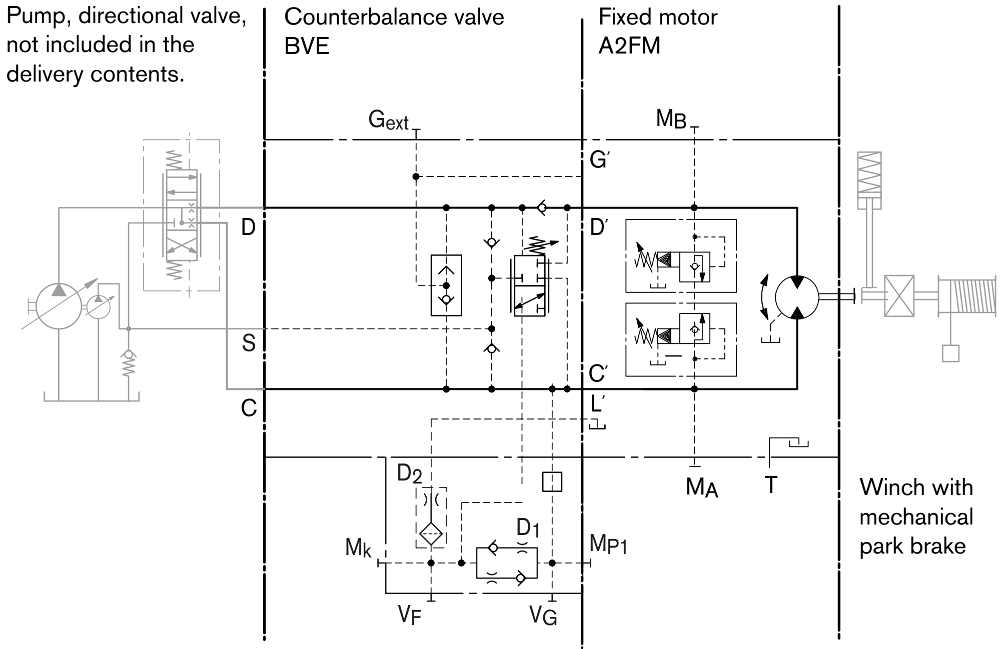
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

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



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

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

DBV ______________________________ pressure-relief valve

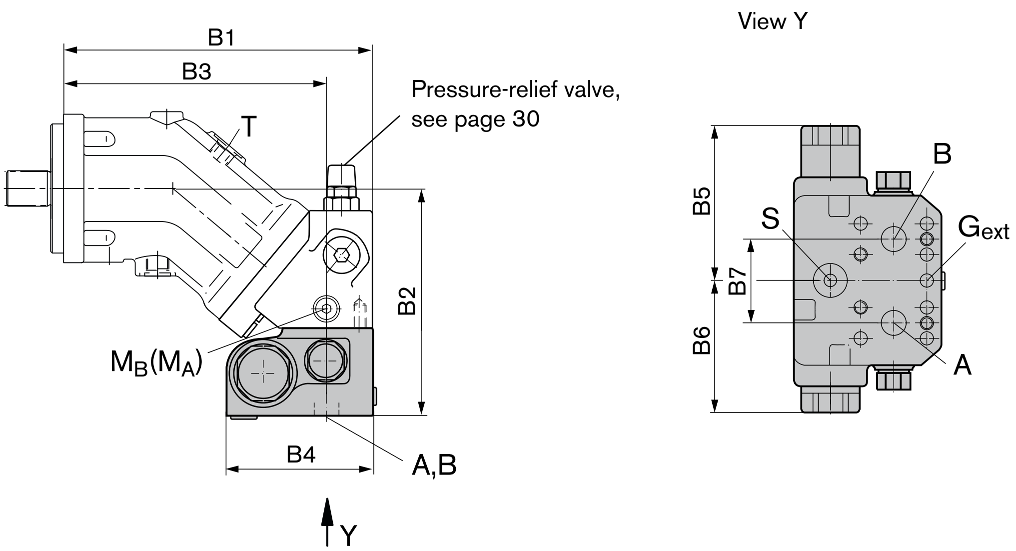
BVD _________________ counterbalance valve, double-acting

BVE ____________________ counterbalance valve, one-sided

Counterbalance valve BVD and BVE

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

Dimensions



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

Counterbalance valve BVD and BVE

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

Ports

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

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

Mounting the counterbalance valve

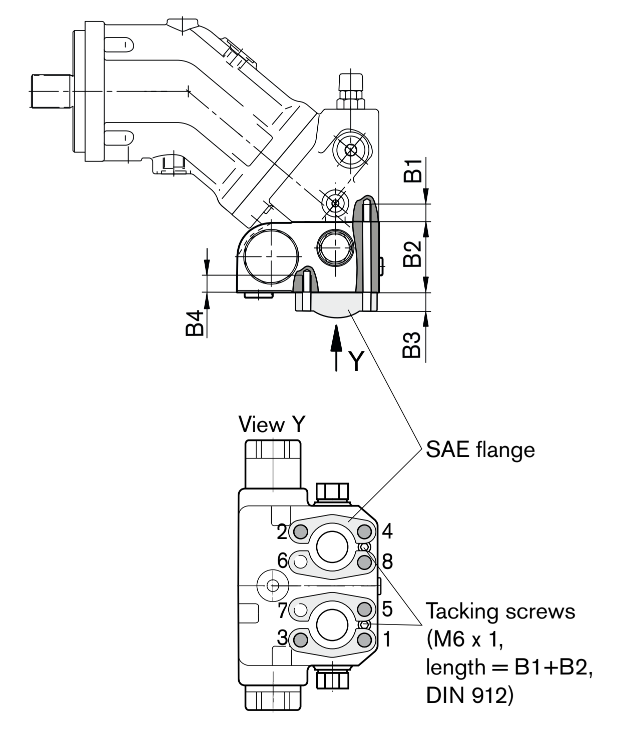
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the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

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

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

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

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



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

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

Speed sensors

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

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

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

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

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

DSM ______________________________ RE 95132

DSA ______________________________ RE 95133

HDD ______________________________ RE 35135

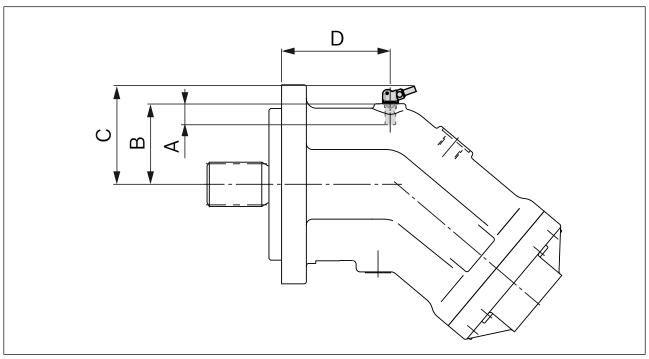
The sensor is mounted at the specially provided port D as follows:

DSM/DSA ____________________ with one mounting bolt

HDD ______________________ with two mounting bolts

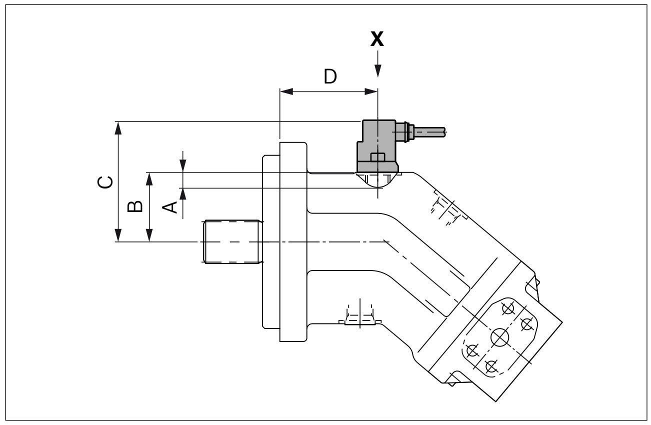
We recommend ordering the AA2FM fixed motor complete with sensor mounted.

Version "V"
Sizes 23 to 180 with DSM/DSA sensor

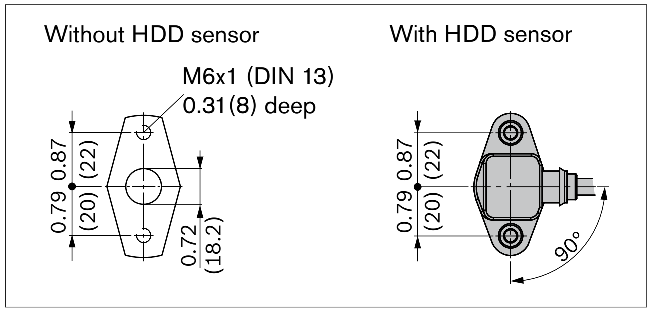


Version "F"

Sizes 23 to 180 with HDD sensor



View X



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

Installation instructions

General

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

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

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

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

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

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

Installation position

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

Recommended installation positions: 1 and 2.

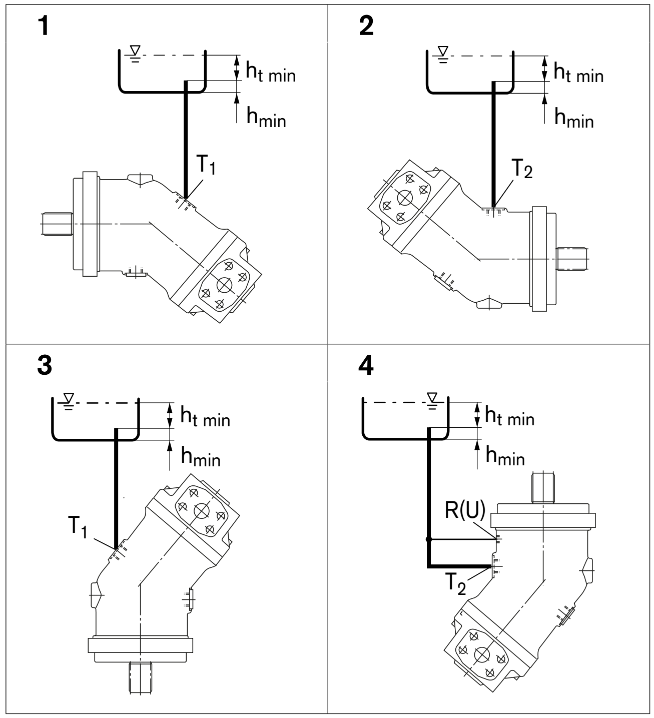
Note
With sizes 10 to 180 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering - special version). With size 250, port U is provided as standard in the area near the bearings for air bleeding.

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

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

Below-reservoir installation (standard)

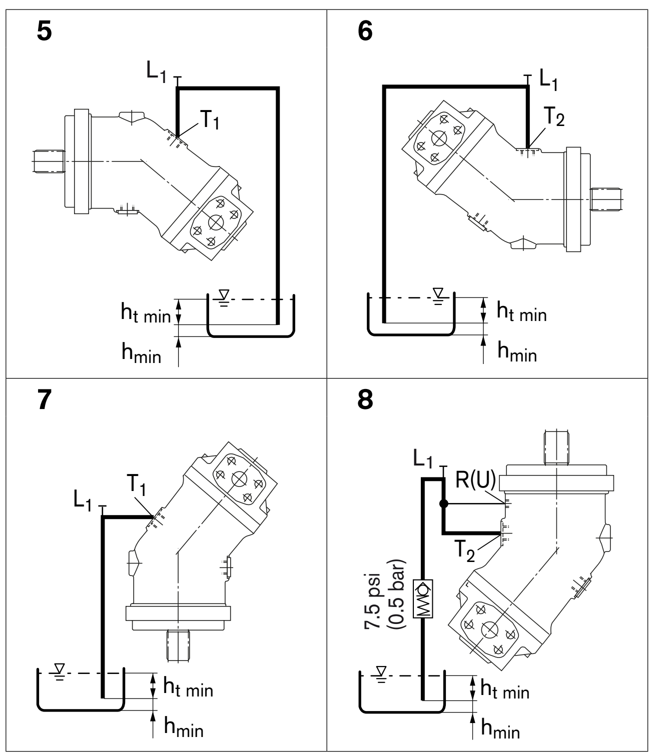
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

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

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



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

Additional information of general instructions (page 38)

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

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

General instructions

– The motor AA2FM is designed to be used in open and closed circuits.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e. g. by wearing protective clothing).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

- The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

- The service line ports and function ports can only be used to accommodate hydraulic lines.

– The data and notes contained herein must be adhered to.

– Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. If you require characteristic values relating to reliability (e. g. $MTTF_d$) for functional safety, please consult the responsible contact person at Bosch Rexroth.

– The following tightening torques apply:

- Fittings:
Observe the manufacturer's instructions regarding tightening torques of the fittings used.

- Mounting bolts:
For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.

- Female threads in the axial piston unit:
The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the female threads and must not be exceeded. For values, see the table on page 37

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

Bosch Rexroth Corporation
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Rexroth
Bosch Group

Fixed Plug-In Motor A2FE

RE 91008/06.2012
Replaces: 09.07

Data sheet

Series 6

Size	Nominal pressure/Maximum pressure
28 to 180	400/450 bar
250 to 355	350/400 bar

Open and closed circuits

Contents

Features

- 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)
- The output speed is dependent on the flow of the pump and the displacement of the motor
- The output torque increases with the pressure differential between the high-pressure and the low-pressure side.
- 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

Ordering code for standard program

	A2F		E		/	6		W	–	V						
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 and 355 only in combination with long-life bearings "L" (without code)		
	HFB, HFC hydraulic fluid	Sizes 28 to 180 (without code)	
		Sizes 250 to 355 (only in combination with long-life bearings "L")	E-

Axial piston unit

02	Bent-axis design, fixed	A2F

	Drive shaft bearing	28 to 180	250 to 355	
03	Standard bearing (without code)	●	●	
	Long-life bearing	–	●	L

Operating mode

04	Motor, plug-in version	E

Sizes (NG)

05	Geometric displacement, see table of values on page 7												
	28	32	45	56	63	80	90	107	125	160	180	250	355

Series

06		6

Index

07	NG28 to 180	1
	NG250 and 355	0

Direction of rotation

08	Viewed on drive shaft, bidirectional	W

Seals

09	FKM (fluor-caoutchouc)	V

	Drive shafts	28	32	45	56	63	80	90	107	125	160	180	250	355	
10	Splined shaft DIN 5480	●	●	–	●	●	●	●	●	●	●	●	–	–	A
		●	–	●	●	–	●	–	●	–	●	–	●	●	Z

	Mounting flanges		28 to 180	250 and 355	
11	ISO 3019-2	2-hole	●	–	L
		4-hole	–	●	M

● = Available ❍ = On request – = Not available ▒ = Preferred program

Ordering code for standard program

	A2F		E		/	6		W	–	V						
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

Port plates[1)]

				28	32	45	56	63	80	90	107	125	160	180	250	355	
12	SAE flange ports A and B at rear	01	0	–	–	–	–	–	–	–	–	–	–	–	●	❍	010
			7	–	–	–	–	–	–	–	–	–	–	–	–	❍	017
	SAE flange ports A and B at side, opposite	02	0	–	–	–	–	–	–	–	–	–	–	–	●	❍	020
			7	–	–	●	▲	▲	▲	▲	●	●	●	●	●	–	027
			9	–	–	–	●	●	●	●	–	–	–	–	–	–	029
	SAE flange ports A and B at bottom (same side)	10	0	●	●	●	●	●	●	●	●	●	●	●	–	●	100
			7	–	–	–	–	–	–	–	–	–	–	–	–	●	107
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[2)] BVD	17	1	–	–	–	–	–	–	–	●	●	–	–	–	–	171 178
		18	8	●	●	●	●	●	●	●	●	●	●	●	–	–	181
	BVE	18	8	–	–	–	–	–	–	–	●	●	●	●	–[4)]	–	188
	Port plate with pressure-relief valves	19	1	●	●	●	●	●	●	●	●	●	●	●	–	–	191
			2	●	●	●	●	●	●	●	●	●	●	●	–	–	192

Valves (see pages 14 to 21)

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

Speed sensor (see page 22)

		28 to 45	56 to 180	250	355[4)]	
13	Without speed sensor (without code)	●	●	●	●	
	Prepared for HDD speed sensor	–	▲	●	–	F
	HDD speed sensor mounted[5)]	–	▲	●	–	H
	Prepared for DSA speed sensor	❍	❍	❍	–	U
	DSA speed sensor mounted[5)]	❍	❍	❍	–	V

Special version (only sizes 28 to 180)

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

Standard / special version

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

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

1) Fastening thread or threaded ports, metric
2) Note the restrictions on page 19.
3) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE – RE 95525) separately.
4) Please contact us.
5) Specify ordering code of sensor according to data sheet (DSA – RE 95133, HDD – RE 95135) separately and observe the requirements on the electronics

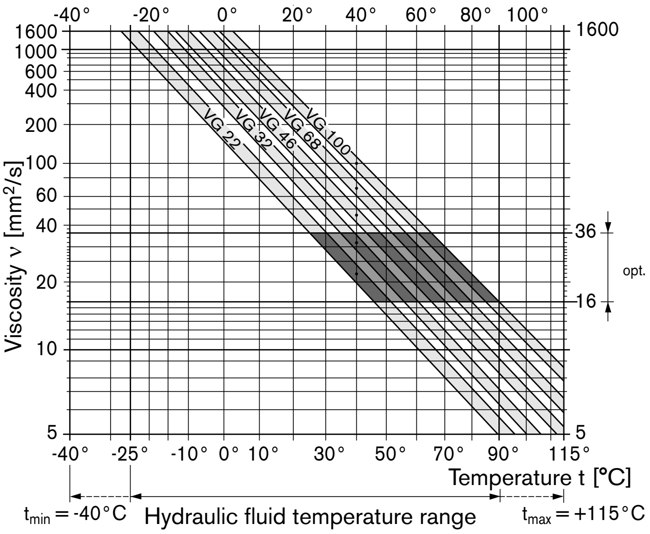
Technical data

Hydraulic fluid

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

The plug-in motor A2FE is not suitable for operation with HFA hydraulic fluid. If HFB, HFC or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed .

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

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

Note

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

If the above conditions cannot be maintained due to extreme operating parameters, we recommend the use of a flushing and boost pressure valve (see page 14).

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -50 °C T_{opt} = +5 °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	$\nu_{max} = 1600$	$T_{St} \geq$ -40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm (for sizes 28 to 180) n ≤ 0.25 • n_{nom} (for sizes 250 and 355)
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400	T = -40 °C to -25 °C	at p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq 7$	T_{max} = +103 °C	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T ≤ +115 °C	see page 5

1) At temperatures below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).
2) Sizes 250 and 355, please contact us.

Technical data

Filtration of the hydraulic fluid

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

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

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

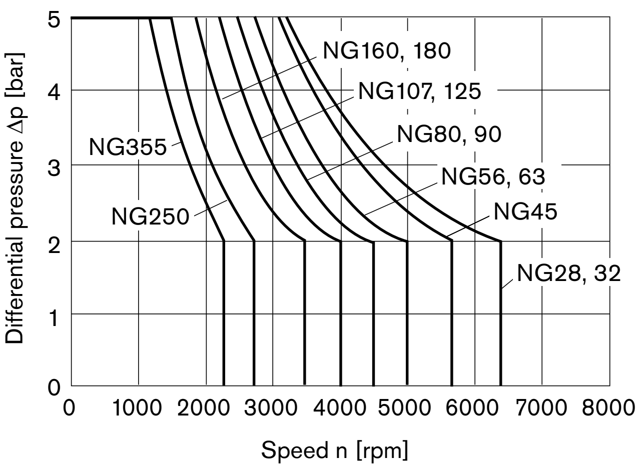
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 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.



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.

Note
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	
clockwise	**counter-clockwise**
A to **B**	**B** to **A**

Speed range

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

Long-life bearing

Sizes 250 and 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.

Technical data

Operating pressure range
(operating with mineral oil)

Pressure at service line port A or B

Sizes 28 to 180

Nominal pressure p_{nom} ________________ 400 bar absolute

Maximum pressure p_{max} _______________ 450 bar absolute
Single operating period____________________________ 10 s
Total operating period ____________________________ 300 h

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

Sizes 250 and 355

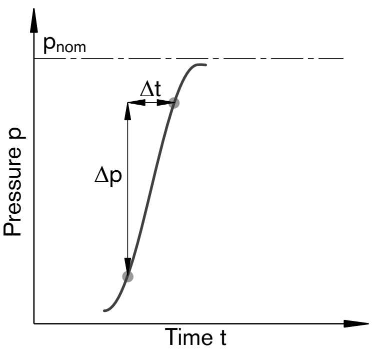
Nominal pressure p_{nom} ________________ 350 bar absolute

Maximum pressure p_{max} _______________ 400 bar absolute
Single operating period____________________________ 10 s
Total operating period ____________________________ 300 h

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

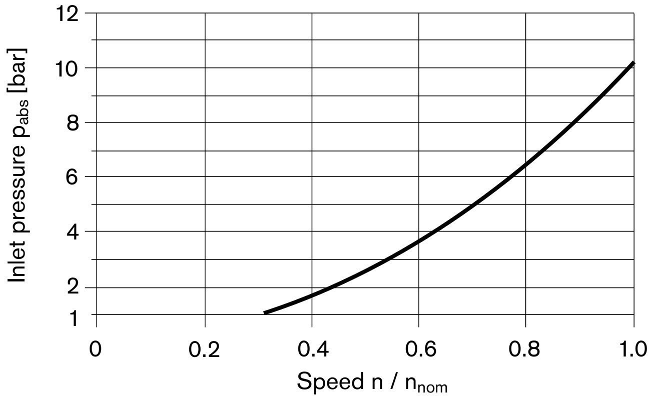
Minimum pressure (high-pressure side) ___25 bar absolute

Rate of pressure change $R_{A\ max}$
with integrated pressure-relief valve____________ 9000 bar/s
without pressure-relief valve _________________ 16000 bar/s



Note
Values for other hydraulic fluids, please contact us.

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



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if these conditions cannot be satisfied.

Definition

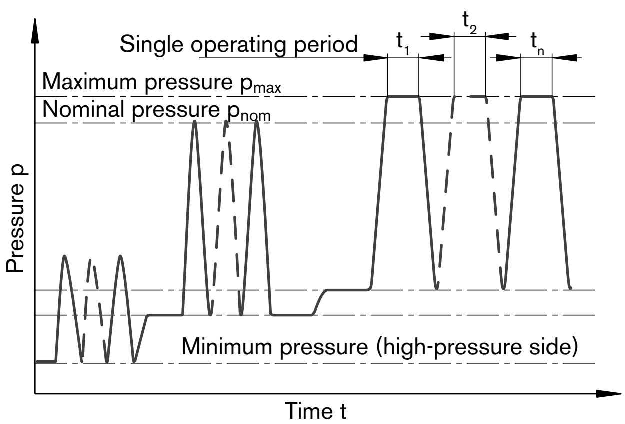
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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

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

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

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



Total operating period = $t_1 + t_2 + ... + t$

Technical data

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

Size		NG		28	32	45	56	63	80
Displacement geometric, per revolution		V_g	cm³	28.1	32	45.6	56.1	63	80.4
Speed maximum[1]		n_{nom}	rpm	6300	6300	5600	5000	5000	4500
		n_{max}[2]	rpm	6900	6900	6200	5500	5500	5000
Input flow[3] at n_{nom} and V_g		q_V	L/min	177	202	255	281	315	362
Torque[4] at V_g and	$\Delta p = 350$ bar	T	Nm	157	178	254	313	351	448
	$\Delta p = 400$ bar	T	Nm	179	204	290	357	401	512
Rotary stiffness		c	kNm/rad	2.93	3.12	4.18	5.94	6.25	8.73
Moment of inertia for rotary group		J_{GR}	kgm²	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072
Maximum angular acceleration		α	rad/s²	6500	6500	14600	7500	7500	6000
Case volume		V	L	0.20	0.20	0.33	0.45	0.45	0.55
Mass (approx.)		m	kg	10.5	10.5	15	18	19	23

Size		NG		90	107	125	160	180	250	355
Displacement geometric, per revolution		V_g	cm³	90	106.7	125	160.4	180	250	355
Speed maximum[1]		n_{nom}	rpm	4500	4000	4000	3600	3600	2700	2240
		n_{max}[2]	rpm	5000	4400	4400	4000	4000	–	–
Input flow3[)] at n_{nom} and V_g		q_V	L/min	405	427	500	577	648	675	795
Torque[4] at V_g and	$\Delta p = 350$ bar	T	Nm	501	594	696	893	1003	1393	1978
	$\Delta p = 400$ bar	T	Nm	573	679	796	1021	1146	–	–
Rotary stiffness		c	kNm/rad	9.14	11.2	11.9	17.4	18.2	73.1	96.1
Moment of inertia for rotary group		J_{GR}	kgm²	0.0072	0.0116	0.0116	0.0220	0.0220	0.061	0.102
Maximum angular acceleration		α	rad/s²	6000	4500	4500	3500	3500	10000	8300
Case volume		V	L	0.55	0.8	0.8	1.1	1.1	2.5	3.5
Mass (approx.)		m	kg	25	34	36	47	48	82	110

1) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm²/s
- with hydraulic fluid based on mineral oils

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

3) Restriction of input flow with counterbalance valve, see page 19

4) Torque without radial force, with radial force see page 8

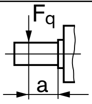
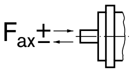
Note

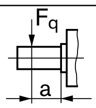
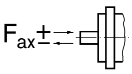
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the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

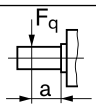
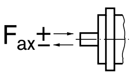
Technical data

Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	**NG**		**28**	**28**	**32**	**45**	**56**	**56[4)]**	**56**
Drive shaft	ø	mm	25	30	30	30	30	30	35
Maximum 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
	a	mm	16	16	16	18	18	18	18
with permissible torque	T_{max}	Nm	179	179	204	290	357	294	357
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	400	330	400
Maximum axial force[2)] 	$+F_{ax\ max}$	N	500	500	500	630	800	800	800
	$-F_{ax\ max}$	N	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7

Size	**NG**		**63**	**80**	**80[4)]**	**80**	**90**	**107**	**107**
Drive shaft	ø	mm	35	35	35	40	40	40	45
Maximum radial force[1)] at distance a (from shaft collar) 	$F_{q\ max}$	kN	9.1	11.6	11.1	11.4	11.4	13.6	14.1
	a	mm	18	20	20	20	20	20	20
with permissible torque	T_{max}	Nm	401	512	488	512	573	679	679
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	380	400	400	400	400
Maximum axial force[2)] 	$+F_{ax\ max}$	N	800	1000	1000	1000	1000	1250	1250
	$-F_{ax\ max}$	N	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	8.7	10.6	10.6	10.6	10.6	12.9	12.9

Size	**NG**		**125**	**160**	**160**	**180**	**250**	**355**
Drive shaft	ø	mm	45	45	50	50	50	60
Maximum radial force[1)] at distance a (from shaft collar) 	$F_{q\ max}$	kN	14.1	18.1	18.3	18.3	1.2[5)]	1.5[5)]
	a	mm	20	25	25	25	41	52.5
with permissible torque	T_{max}	Nm	796	1021	1021	1146	[3)]	[3)]
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	[3)]	[3)]
Maximum axial force[2)] 	$+F_{ax\ max}$	N	1250	1600	1600	1600	2000	2500
	$-F_{ax\ max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	12.9	16.7	16.7	16.7	[3)]	[3)]

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

Note

Influence of the direction of the permissible axial force:

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

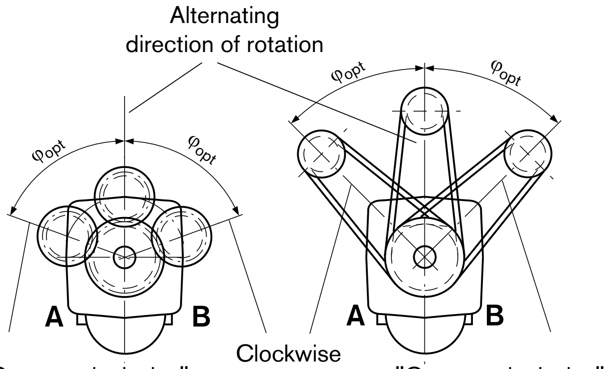
$-F_{ax\ max}$ = Reduction in service life of bearings (avoid)

Technical data

Effect of radial force F_q on the service life of bearings

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

	Toothed gear drive	V-belt output
NG	φ_{opt}	φ_{opt}
28 to 180	± 70°	± 45°
250 and 355	± 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

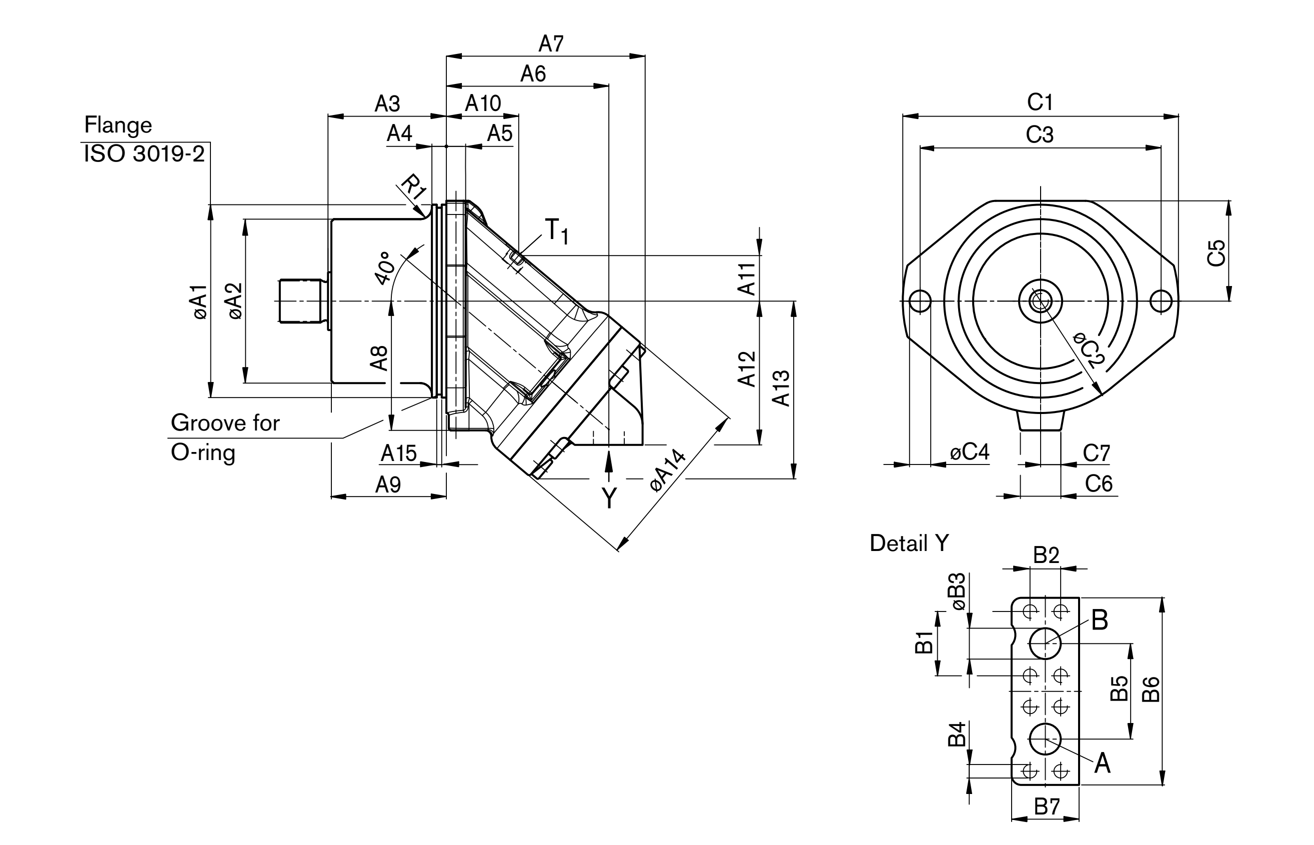
η_{mh} = Mechanical-hydraulic efficiency

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

Dimensions sizes 28 to 180

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 10 – SAE flange ports at bottom



Size	øA1	øA2	A3[1]	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	øA14	A15
28, 32	$135_{-0.025}$	$94_{-0.5}$	88.8	15	16	94	114	95	87.1	45	27	91	106	106	5.2
45	$160_{-0.025}$	$117^{+1.5}_{-2}$	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	øB3	B4, DIN 13[2]	B5	B6	B7	C1	øC2	C3	øC4	C5	C6	C7
28, 32	40.5	18.2	13	M8 x 1.25; 15 deep	59	115	40	188	154	160	14	71	42	13
45	50.8	23.8	19	M10 x 1.5; 17 deep	75	147	49	235	190	200	18	82	47.5	15
56, 63	50.8	23.8	19	M10 x 1.5; 17 deep	75	147	48	235	190	200	18	82	36	0
80, 90	57.2	27.8	25	M12 x 1.75; 17 deep	84	166	60	260	220	224	22	98	40	0
107, 125	66.7	31.8	32	M14 x 2; 19 deep	99	194	70	286	232	250	22	103	40	0
160, 180	66.7	31.8	32	M14 x 2; 19 deep	99	194	70	286	232	250	22	104	42	0

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

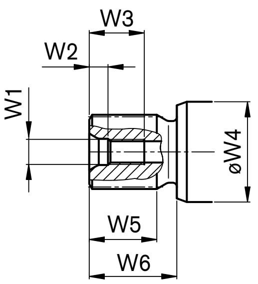
1) To shaft collar
2) Observe the general instructions on page 24 for the maximum tightening torques.
3) Not included in the delivery contents

Note
Port plates 17, 18 and 19; see pages 17 and 20.

Dimensions sizes 28 to 180

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft



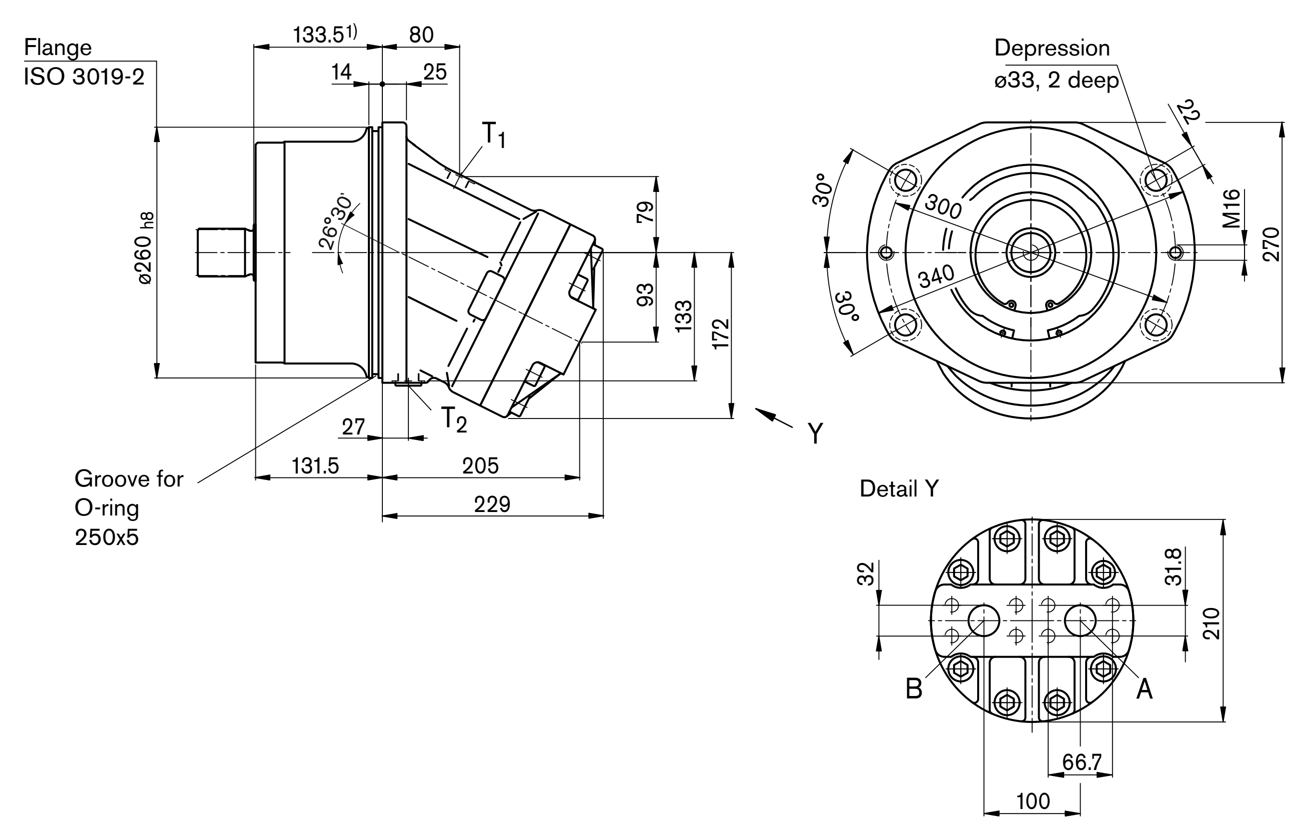
Size	Splined shaft (DIN 5480)	W1[1)]	W2	W3	øW4	W5	W6
28, 32	**A** W30 x 2 x 14 x 9g	M10 x 1.5	7.5	22	35	27	35
28	**Z** W25 x 1.25 x 18 x 9g	M8 x 1.25	6	19	35	28	43
45	**Z** W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	35	27	35
56, 63	**A** W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	40	32	40
56	**Z** W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	40	27	35
80, 90	**A** W40 x 2 x 18 x 9g	M16 x 2	12	36	45	37	45
80	**Z** W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	45	32	40
107, 125	**A** W45 x 2 x 21 x 9g	M16 x 2	12	36	50	42	50
107	**Z** W40 x 2 x 18 x 9g	M12 x 1.75	9.5	28	50	37	45
160, 180	**A** W50 x 2 x 24 x 9g	M16 x 2	12	36	60	44	55
160	**Z** W45 x 2 x 21 x 9g	M16 x 2	12	36	60	42	50

1) Center bore according to DIN 332 (thread according to DIN 13), observe the general instructions on page 24 for the maximum tightening torques.

Dimensions size 250

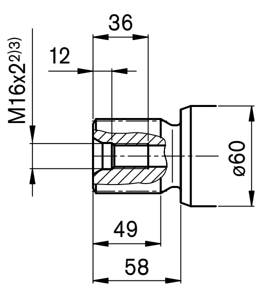
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

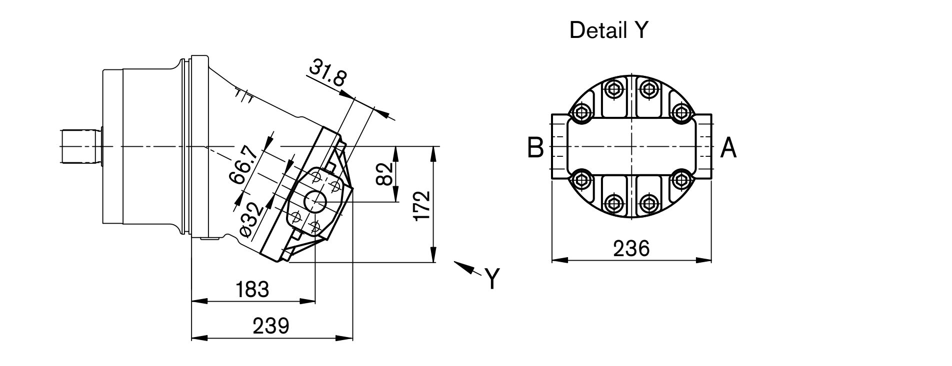


Drive shaft

Z Splined shaft DIN 5480
W50x2x24x9g



Port plate 02 – SAE flange ports at side



Ports

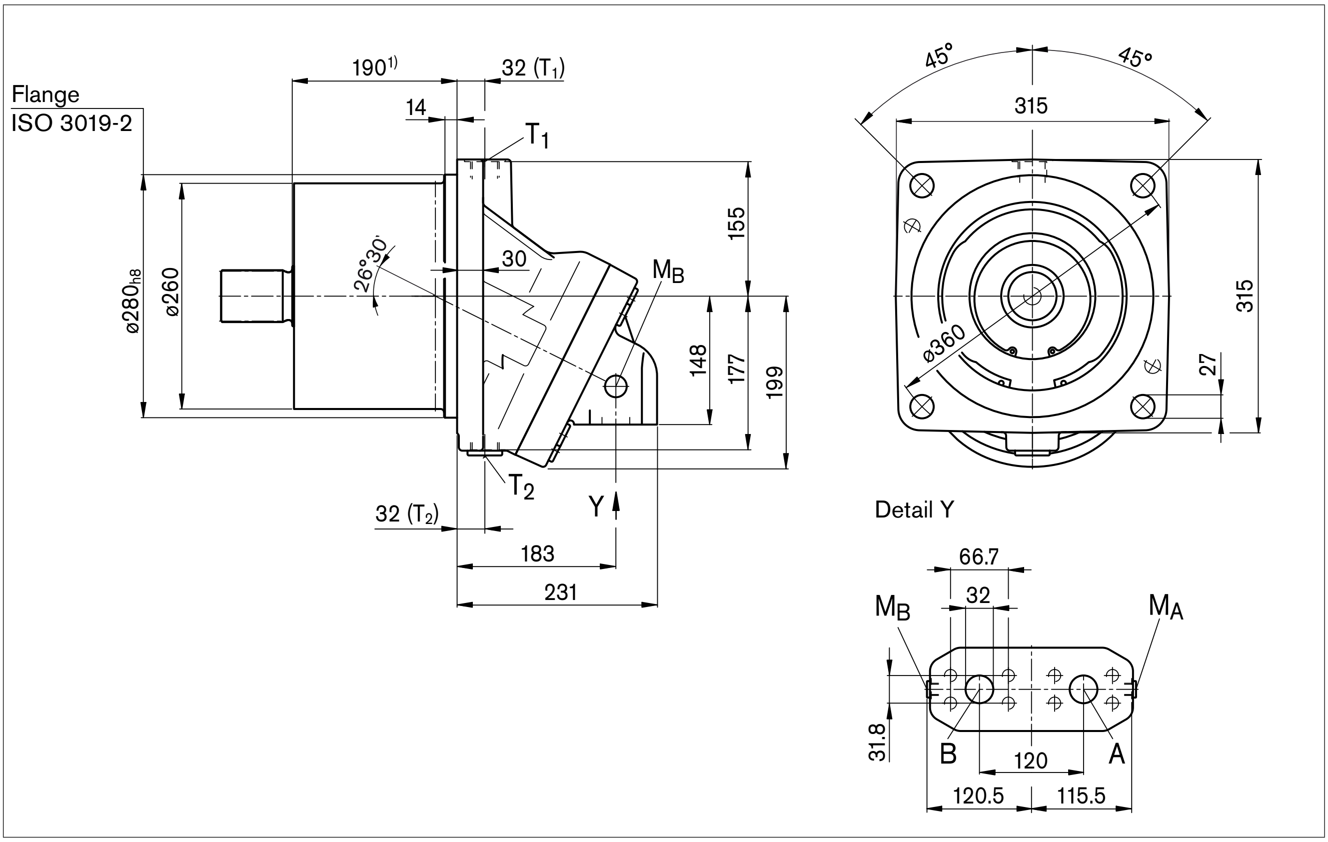
Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
A, B	Service line fastening thread A/B	SAE J518[6] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
T_1	Drain line	DIN 3852[7]	M22 x 1.5; 14 deep	3	O[5]
T_2	Drain line	DIN 3852[7]	M22 x 1.5; 14 deep	3	X[5]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 24 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 23).
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 355

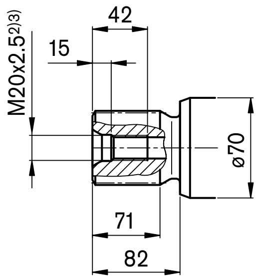
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 10 – SAE flange ports at bottom



Drive shaft

Z Splined shaft DIN 5480
W60x2x28x9g



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line fastening thread A/B	SAE J518[6)] DIN 13	1 1/4 in M14 x 2; 22 deep	400	O
T_1	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	O[5)]
T_2	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	X[5)]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 24 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devcies and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 23).
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Flushing and boost pressure valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

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.

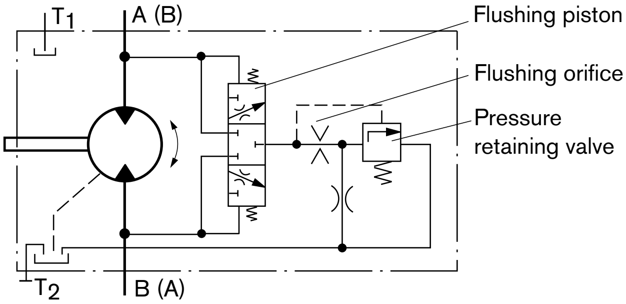
With port plate 027 (sizes 45 to 180 and 250) and with port plate 107 (size 355), the valve is mounted directly on the fixed motor.

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

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 $\nu = 10$ mm^2/s
(p_{ND} = low pressure, p_G = case pressure)

Schematic



Standard flushing flows

Flushing and boost pressure valve, mounted (code 7)

Size	Flushing flow q_v [L/min]	ø [mm]	Mat. No. of orifice
45	3.5	1.2	R909651766
107, 125	8	1.8	R909419696
160, 180	10	2.0	R909419697
250	10	2.0	R909419697
355	16	2.5	R910803019

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 (code 9)

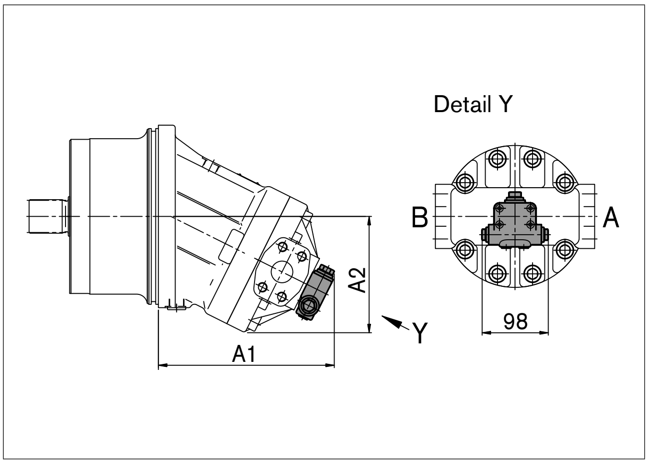
Size	Throttle ø [mm]	q_v [L/min]
56, 63, 80, 90	1.5	6
	1.8	7.3

Flushing and boost pressure valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

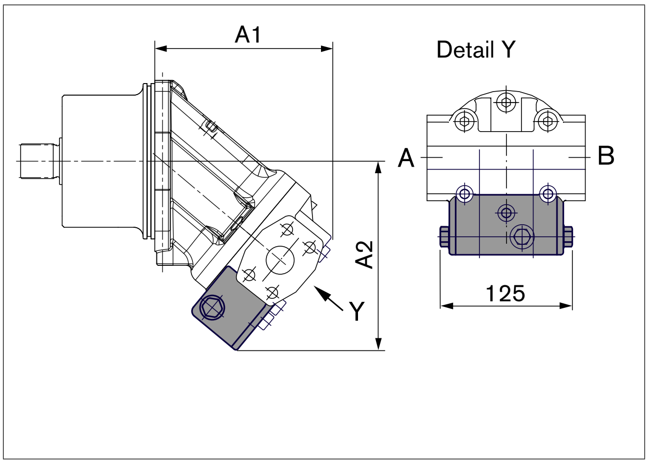
Dimensions

Sizes 107 to 250
Port plate 027 – SAE flange ports at side



Size	A1	A2
107, 125	211	192
160, 180	232	201
250	260.5	172

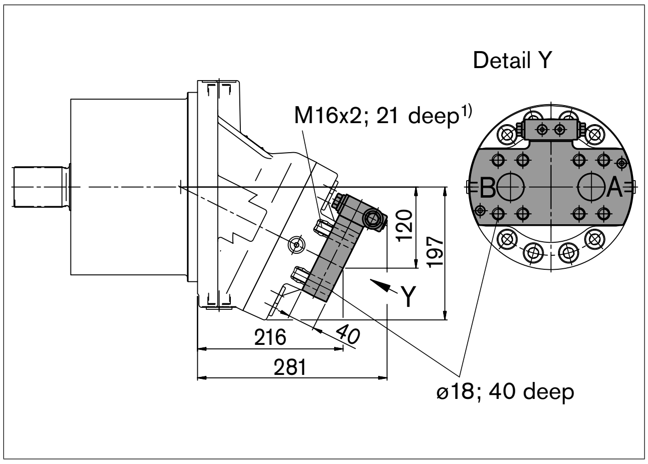
Sizes 56 to 90
Port plate 029 – SAE flange ports at side



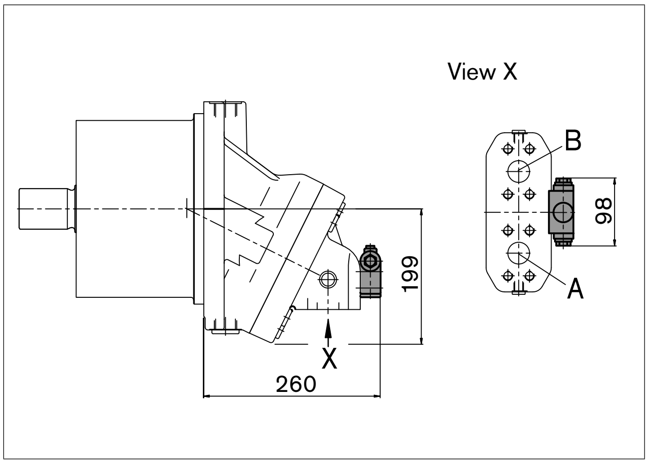
Size	A1	A2
56, 63	165	176
80, 90	178	186.7

1) DIN 13, observe the general instructions on page 24 for the maximum tightening torques.

Size 355
Port plate 017 – SAE flange ports at rear



Port plate 107 – SAE flange ports at bottom



Pressure-relief valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

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

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

Cracking pressure setting range ____________ 50 to 420 bar

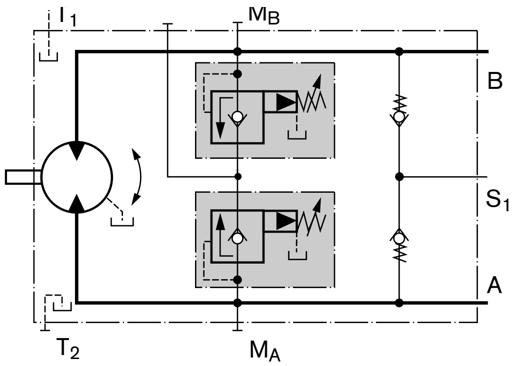
With the version "with pressure boost facility" (192), a higher pressure setting can be realized by applying an external pilot pressure of 25 to 30 bar to port P_{St}.

When ordering, please state in plain text:

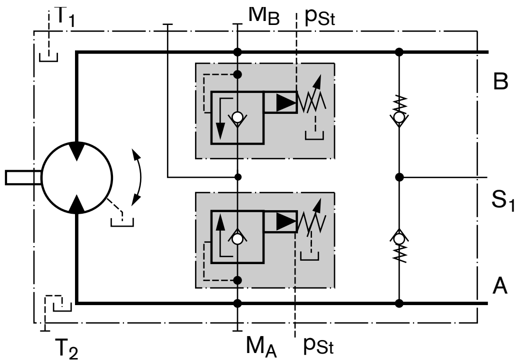
– Cracking pressure of pressure-relief valve

– Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Version without pressure boost facility "191"



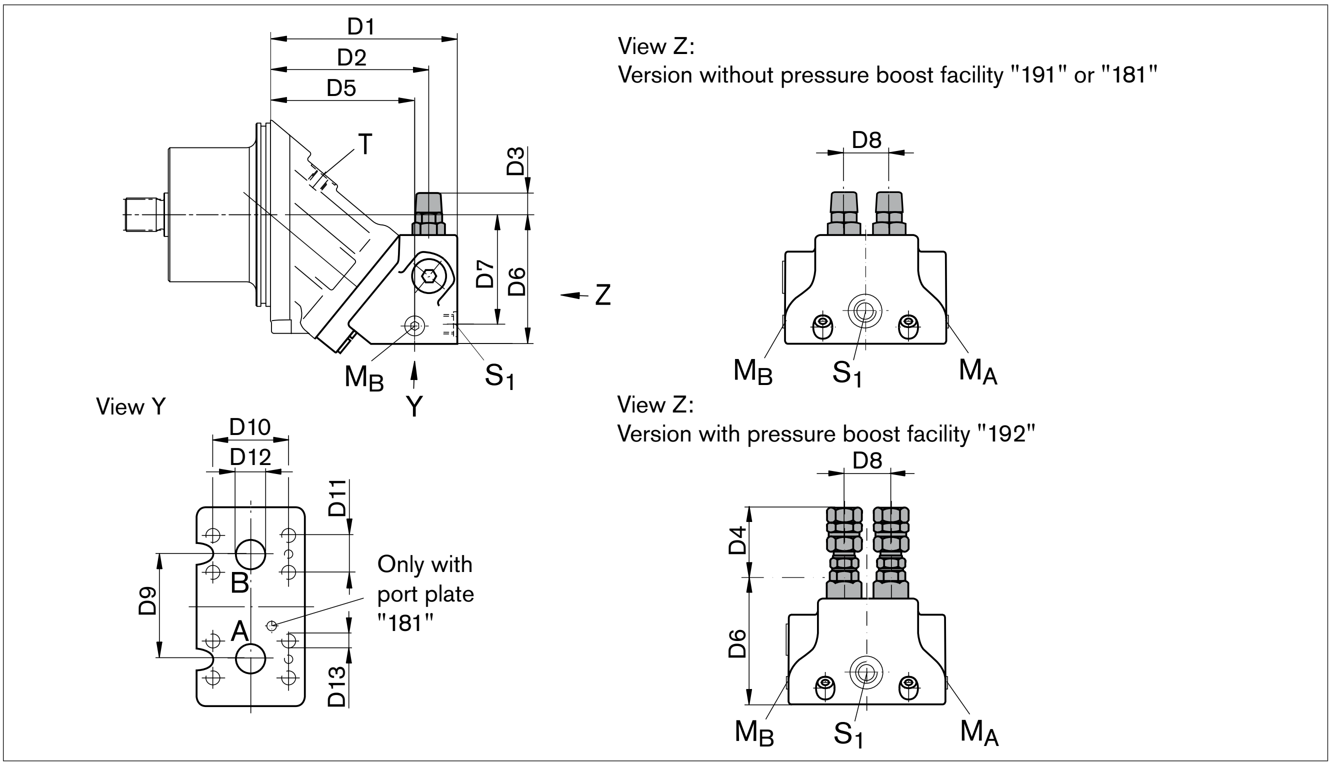
Version with pressure boost facility "192"



Pressure-relief valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions



Size		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[2]
28, 32	MHDB.**16**	145	122	25	68	110	102	87	36	66	50.8	23.8	ø19	M10; 17 deep
45	MHDB.**16**	161	137	22	65	126	113	98	36	66	50.8	23.8	ø19	M10; 17 deep
56, 63	MHDB.**22**	189	162	19	61	147	124	105	42	75	50.8	23.8	ø19	M10; 13 deep
80, 90	MHDB.**22**	193	165	17.5	59	151	134	114	42	75	57.2	27.8	ø25	M12; 18 deep
107, 125	MHDB.**32**	216	184	10	52	168	149.5	130	53	84	66.7	31.8	ø32	M14; 19 deep
160, 180	MHDB.**32**	249	218	5	47	202	170	149	53	84	66.7	31.8	ø32	M14; 19 deep

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

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

Ports

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

1) Observe the general instructions on page 24 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Function

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

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

Note

– BVD available for sizes 28 to 180 and BVE available for sizes 107 to 180.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A2FE90/61W–VAB**188** + BVD20F27S/41B–V03K16D0400S12

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!

– For the design of the brake release valve, we must know for the mechanical park brake:

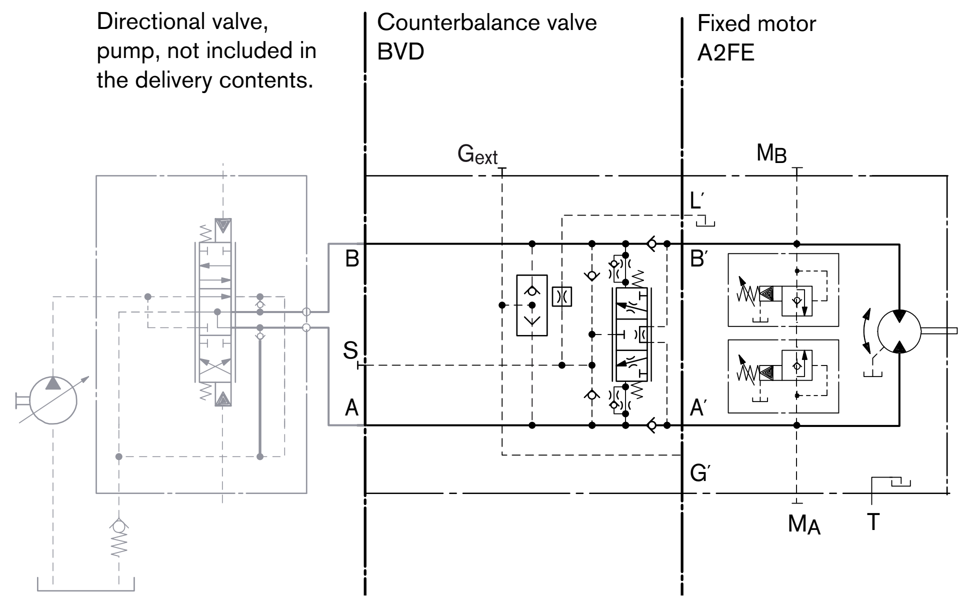
- the pressure at the start of opening
- the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
- the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

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



Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

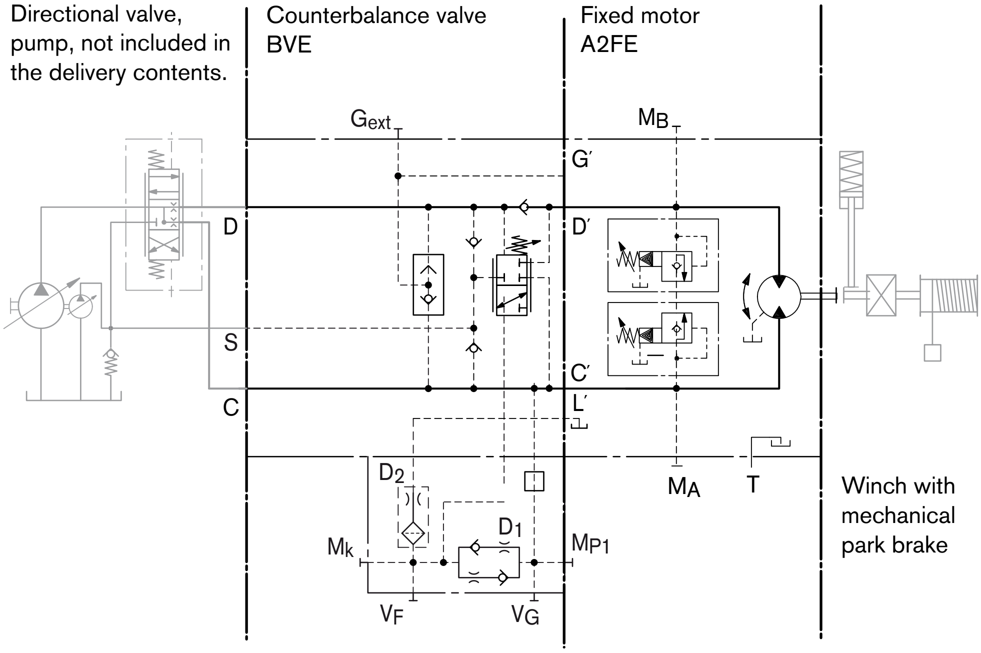
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A2FE090/61W-VAB188 + BVE25W385/51ND-V100K00D4599T30S00-0



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

	Without valve		Restricted values in operation with DBV and BVD/BVE							
Motor			DBV				BVD/BVE			
NG	p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	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				220	
63		315								
80		360								
90		405								
107		427				171 191, 192				178
125		500								
107		427	32		400	181 191, 192	25 (BVD/BVE)		320	188
125		500								
160		577								
180		648								

DBV ________________________________ pressure-relief valve

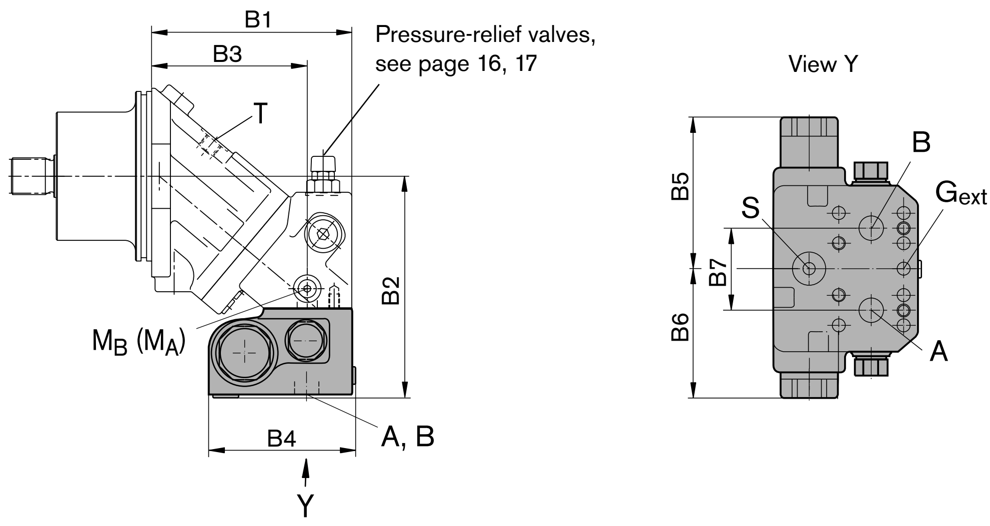
BVD __________________ counterbalance valve, double-acting

BVE _____________________ counterbalance valve, one-sided

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions



A2FE Size	Counterbalance valve Type	Ports A, B	Dimensions B1	B2	B3	B4 (S)	B4 (L)	B5	B6	B7
28, 32	BVD**20**..16	3/4 in	145	175	110	142	147	139	98	66
45	BVD**20**..16	3/4 in	161	196	126	142	147	139	98	66
56, 63	BVD**20**..17	3/4 in	189	197	147	142	147	139	98	75
80, 90	BVD**20**..27	1 in	193	207	151	142	147	139	98	75
107, 125	BVD**20**..28	1 in	216	238	168	142	147	139	98	84
107, 125	BVD**25**..38	1 1/4 in	216	239	168	158	163	175	120.5	84
160, 180	BVD**25**..38	1 1/4 in	249	260	202	158	163	175	120.5	84
107, 125	BVE**25**..38	1 1/4 in	216	240	168	167	172	214	137	84
160, 180	BVE**25**..38	1 1/4 in	249	260	202	167	172	214	137	84
250	On request									

Ports

Designation	Port for	Version	Standard	Size1)	Maximum pressure [bar]2)	State4)
A, B	Service line		SAE J518	see table above	420	O
S	Infeed	BVD20	DIN 3852 3)	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25	DIN 3852 3)	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852 3)	M12 x 1.5; 12.5 deep	30	O
G_{ext}	Brake release, high pressure	S	DIN 3852 3)	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B		ISO 6149 1)	M12 x 1.5; 12 deep	420	X

1) Observe the general instructions on page 24 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Mounting the counterbalance valve

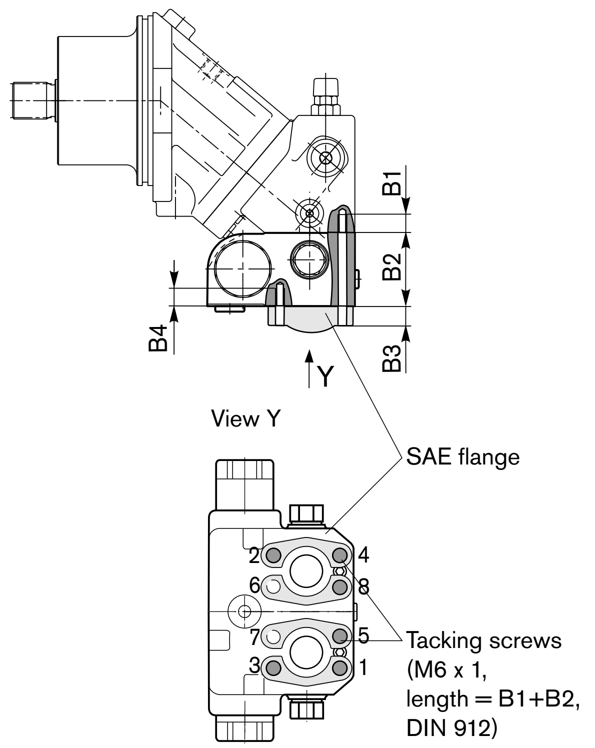
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the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

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

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

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

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	205



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

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

Speed sensors

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

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

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

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

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

DSA ______________________________ RE 95133

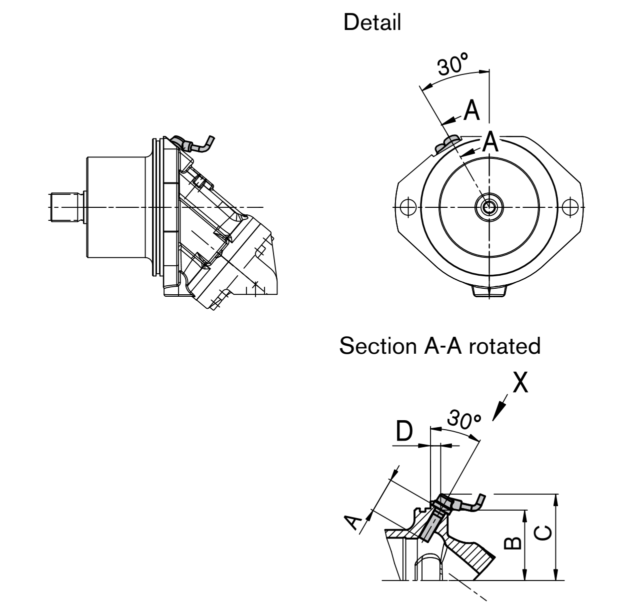
HDD ______________________________ RE 95135

The sensor is mounted on the port provided for this purpose with a mounting bolt.

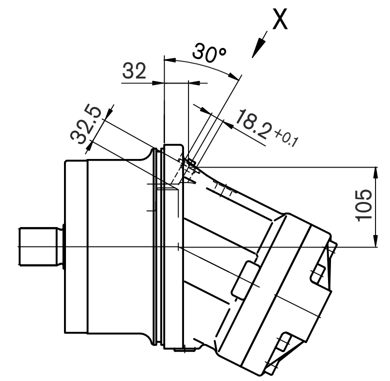
We recommend ordering the A2FE plug-in motor complete with sensor mounted.

Version "V"
Sizes 28 to 180 with DSA sensor

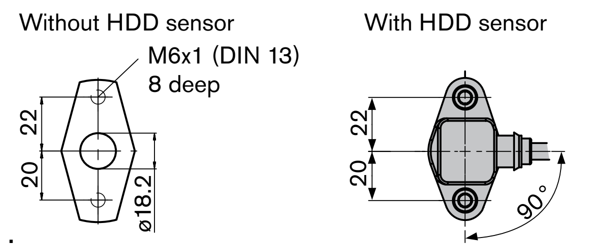
Size 250 with DSA sensor on request.



Version "H"
Size 250 with HDD sensor



View X



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

Installation instructions

General

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

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

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

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

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

Installation position

See the following examples 1 to 5.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_1 (sizes 28 to 180) T_2 (sizes 250 and 355)
3	–	T_1
4	(L_1)	T_1, (L_1)
5	(L_1)	T_2, (L_1)
6	(L_1)	T_1, (L_1)

L_1 Filling / air bleed

T_1, T_2 Drain port

$h_{t\,min}$ Minimum required immersion depth (200 mm)

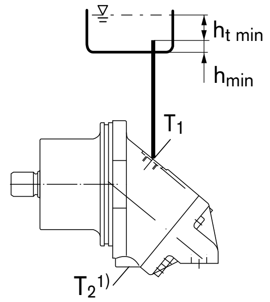
h_{min} Minimum required spacing to reservoir bottom (100 mm)

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).

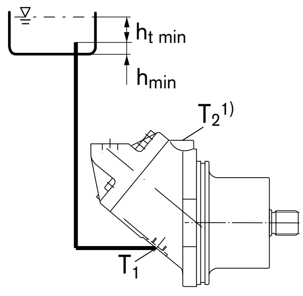
Below-reservoir installation (standard)

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

1



2a 2)



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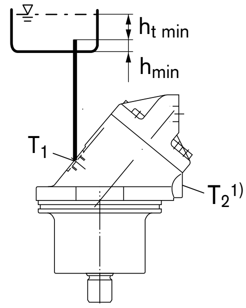

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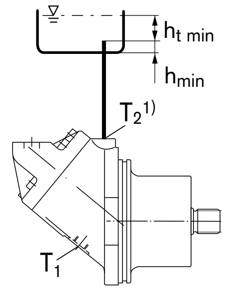
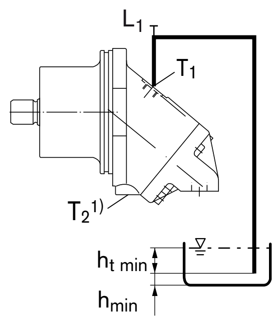


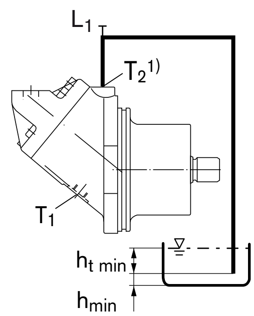
Above-reservoir installation

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

4



5 4)



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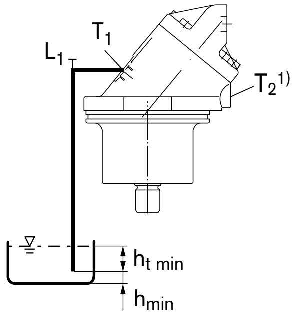

General instructions

– The motor 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. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e. g. by wearing protective clothing).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

- The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

- The service line ports and function ports can only be used to accommodate hydraulic lines.

– The data and notes contained herein must be adhered to.

– 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 Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\,max}$	Required tightening torque of the threaded plugs M_V [1]	WAF hexagon socket of the threaded plugs
DIN 3852	M12 x 1.5	50 Nm	25 Nm[2]	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M20 x 1.5	170 Nm	80 Nm	10 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
	M30 x 2	420 Nm	215 Nm	17 mm
	M33 x 2	540 Nm	225 Nm	17 mm
DIN ISO 228	G 1/4	40 Nm	–	–

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

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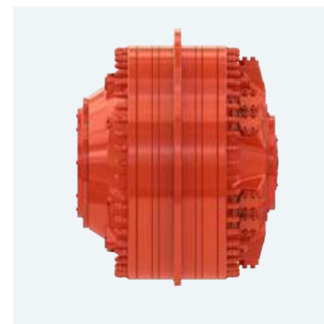
The Drive & Control Company

Rexroth
Bosch Group

Step into the future with Hägglunds CBM

Empowering possibilities



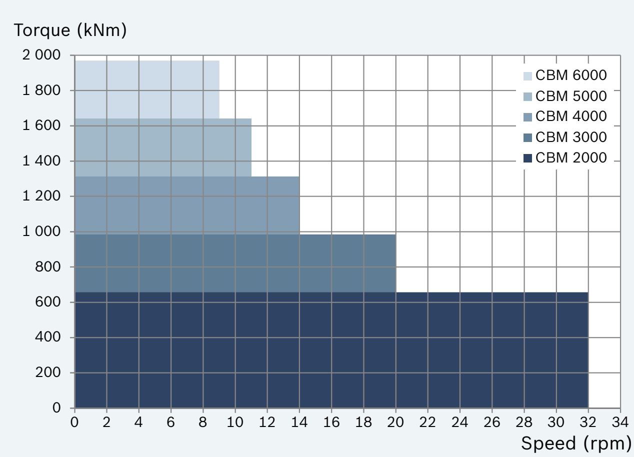
When it comes to production, everyone wants more. But these days there's less of everything else: from available time to the energy and resources for the job. With the Hägglunds CBM direct drive from Bosch Rexroth, the equation is easier to solve.

The Hägglunds CBM packs 50 % more torque into a motor that's smaller and 50 % lighter than its predecessor. That gives it the world's highest torque-to-weight ratio. Even so, it has all the advantages you'd expect from a direct drive. Full torque from zero, protection from shock loads and four-quadrant operation are part of the same small package.

Put simply, the Hägglunds CBM does more with less – and lets you do the same. From industry to offshore, you can handle more work with less space, less energy and less weight on the driven shaft.

That means greater productivity with a smaller footprint. And that's an ingenious solution.

Wide operating range



Motor data, Hägglunds CBM

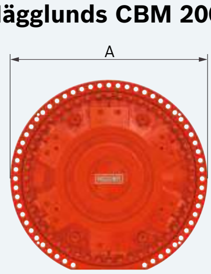
Motor type	Displacement (cm³/rev)	Specific torque (Nm/bar)	Max. speed (rpm)	Max. pressure *(bar)	Max. torque **(kNm)
CBM 2000-1200	75 832	1 200	58	350	394
CBM 2000-1400	88 301	1 400	48	350	460
CBM 2000-1600	100 770	1 600	41	350	525
CBM 2000-1800	113 748	1 800	36	350	591
CBM 2000	126 726	2 000	32	350	657
CBM 3000-2200	138 686	2 200	29	350	722
CBM 3000-2400	151 155	2 400	26	350	788
CBM 3000-2600	164 133	2 600	24	350	854
CBM 3000-2800	177 111	2 800	22	350	919
CBM 3000	190 089	3 000	20	350	985
CBM 4000-3200	201 540	3 200	18	350	1 051
CBM 4000-3400	214 518	3 400	17	350	1 116
CBM 4000-3600	227 496	3 600	16	350	1 182
CBM 4000-3800	240 474	3 800	15	350	1 248
CBM 4000	253 452	4 000	14	350	1 313
CBM 5000-4600	290 859	4 600	12	350	1 510
CBM 5000	316 815	5 000	11	350	1 642
CBM 6000-5600	354 222	5 600	9	350	1 838
CBM 6000	380 178	6 000	9	350	1 970

*) The motors are designed according to DNV-rules. Test pressure 420 bar/6 000 psi.
Peak/transient pressure 420 bar/6 000 psi maximum, allowed to occur 10 000 times.
**) Calculated as T = Ts x (350-15) x 0.98.

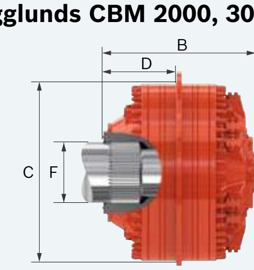
Dimensions, motors with splines

Motor type	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Weight (kg)	Main conn.	Drain conn.
CBM 2000	1 460	872	1 300	419	-	N360x8x30x44x9H	4 100	SAE 2”	BSP 1 1/4” and 2”
CBM 3000	1 460	990	1 300	419	-	N440x8x30x54x9H	5 000	SAE 2”	BSP 1 1/4” and 2”
CBM 4000	1 460	1 108	1 300	537	-	N440x8x30x54x9H	5 800	SAE 2”	BSP 1 1/4” and 2”
CBM 5000	1 460	1 224	1 300	535	270	N460x8x30x56x9H	6 700	SAE 2”	BSP 1 1/4” and 2”
CBM 6000	1 460	1 342	1 300	535	270	N460x8x30x56x9H	7 500	SAE 2”	BSP 1 1/4” and 2”

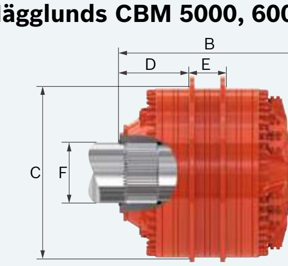
Hägglunds CBM 2000-6000



Hägglunds CBM 2000, 3000, 4000



Hägglunds CBM 5000, 6000



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Find your local contact person here:
www.boschrexroth.com/contact

R999000202 (2013-06)

Rexroth
Bosch Group

External Gear Motors
F & N Series

RA 14 025/04.07
Replaces: 07.04

AZMF ... , AZMN ...

Model F = 8.2 ... 22.9 cm^3 (0.51 ... 1.40 in^3)
N = 20.4 ... 36.4 cm^3 (1.24 ... 2.28 in^3)

Contents

General

Rexroth external gear motors are produced in two different models, with a wide range of displacements, and a variety of port, shaft and mounting options.

Features

- Nominal pressure 3000 psi (210 bar)
- Plain Bearings for heavy duty applications
- Drive Shafts to SAE or DIN
- Port connections: flange or screw thread
- Consistent high quality
- Considerably longer life due to reinforced shaft and housing

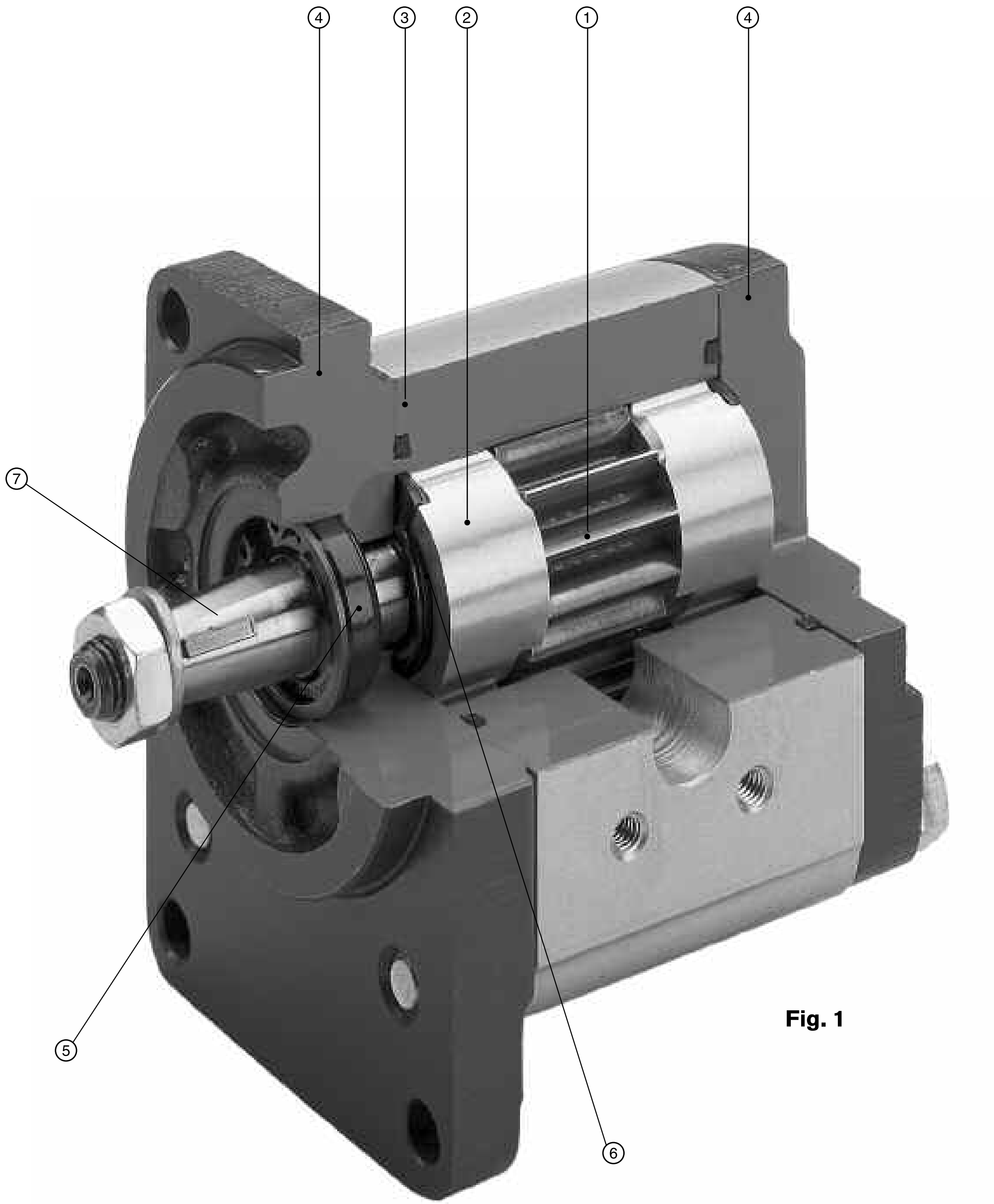


Fig. 1

General

Basic design
Referencing Fig. 1, the motor essentially consists of a pair of gears ① supported in bearing blocks ②, and a housing ③ with front and rear covers ④. The output shaft ⑦ extends from the front cover where it is sealed by a shaft seal ⑤.

The bearing forces are absorbed by special bearings with sufficient elasticity to produce surface contact instead of line contact ②. They also assure good operation under emergency conditions, especially at low speed. The internal sealing is pressure-sensitive, which ensures optimum efficiency.

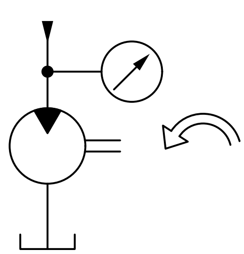
The bearing blocks ② provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearings is controlled by the communication of operating pressure to the rear of the bearings.

Special seals ⑥ form the boundary of the zone.

If pressurized oil is fed into the motor, a torque can be obtained from the shaft leading out of the housing. Here, a distinction is made between motors for one direction of rotation and reversible motors.

Motors for one direction of rotation
These are of asymmetrical design, i.e. the high and low pressure sides are defined and not interchangeable at will. In this case, reversible operation is not possible.

In order to ensure a high efficiency level, a special running in method is used for motors. Leakage oil is discharged internally to the outlet side. Pressure loading of the outlet is limited by the shaft seal.

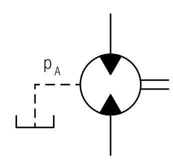


Reversible motors
These motors are of symmetrical design. Depending upon the effective direction of the high pressure, the gears and bearing blocks are pressed against one of the sides of the housing. Depending upon the direction of rotation, sealing zones are formed which provide radial clearance. There are therefore two sealing zones opposite one another. The pressure zones which provide axial clearance are defined by symmetrical shaped seal rings.

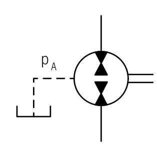
The leakage oil from the bearing bushings is discharged through a separate leakage-oil fitting in the housing cover. Here, the faces of the two gears are joined by means of a bore in the shaft which is not used for power take-off. Due to this external discharge of leakage oil, the return port in question can be loaded. (Series connection of a number of motors.)

Reversible motors are distinguished as follows:

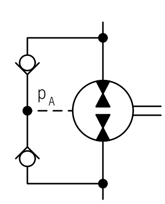
– Motors for 2-quadrant operation, i.e. output torque in both directions.



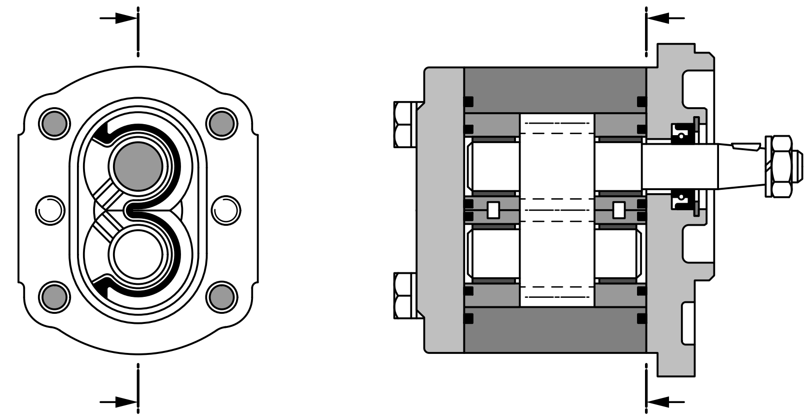
– Motors for 4-quadrant operation, i.e. both output and input torque in both directions. (Hydraulic motor becomes a pump if load reversal occurs.)



– To avoid the need for an additional leakage-oil connection, the internal leakage oil may be routed into the respective outlet via internal check valves. The pressure in the outlet p_A is limited correspondingly.



Motor for One Direction of Rotation



Bi-Rotational Motor

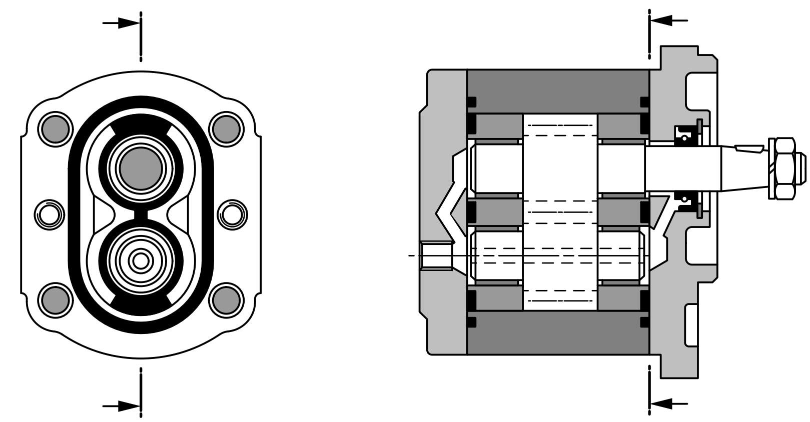


Fig. 2

Bosch Rexroth Gear Motors

Specification

General	
Construction	External gear-type motor
Mounting	Flange or through-bolting with pilot
Line connections	Flange
Direction of rotation (Fig. 3)	One direction of rotation or reversible
Mounting position	any
Ambient temperature range	– 15 °C ... + 60 °C (+5° F... 140° F)
Fluid	Mineral oil-based hydraulic fluids to DIN/ISO, other fluids to order
Viscosity	12 ... 800 mm^2/s permitted range 20 ... 100 mm^2/s recommended range ... 2000 mm^2/s permitted for starting
Fluid temperature range	– 15 °C ... + 80 °C (+5° F... 176°F)
Filtration	NAS 1638, class 10; ISO/DIS 4406, class 19/16; obtained with filter fineness $\beta_{25} \geq 75$[1])

[1]) Dirt particles retention > 25 µm is 1 : 75, i.e. 98.67 %

Safety requirements pertaining to the whole system must be observed.
In the case of applications with high numbers of load cycles, please consult us.

Direction of Rotation

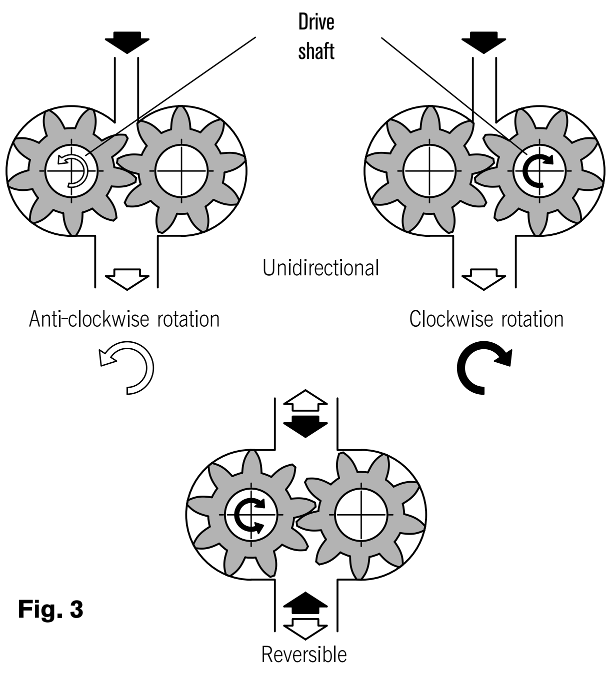
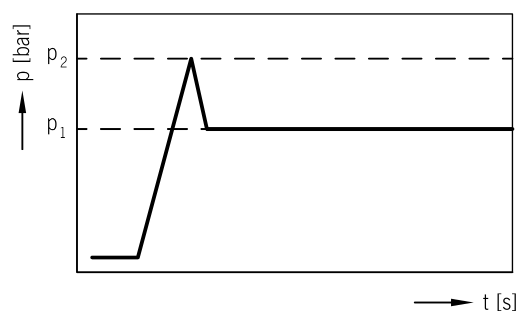


Fig. 3

* As viewed looking at end of drive shaft.

Definition of Pressure



p_1 max. continuous pressure
p_2 max. starting pressure (depending on the application, this must be taken into consideration when setting the pressure of the hydraulic system's pressure-relief valve).

Bosch Rexroth Gear Motors

Design Calculations of Gear Motors (Reference chart 1)

The design calculations for motors are based on the following parameters:

V	[cm^3/rev]	Displacement
Q	[l/min]	Flow consumption
Δp	[bar]	Pressure (p_1, p_A)
M	[Nm]	Output torque
n	[rev/min]	Speed
P	[kW]	Power output

It is also necessary to allow for different efficiencies such as:

η_v Volumetric efficiency
η_{hm} Hydraulic-mechanical efficiency
η_t Total efficiency

The following formulas describe the various relationships. They include correction factors for adapting the parameters to the usual units encountered in practice.

Note: For approximate selection data, please use the graphs on the following pages. These graphs contain the levels of efficiency in each case.

Installation and commissioning

- Fill the motor with fluid before installing.
- Check the direction of rotation.
- Before installing the motor, clean the pipes thoroughly of all dirt, scale, sand, swarf, etc. Welded pipes in particular must be pickled or flushed out.
- Before starting up the motor for the first time, the entire hydraulic system must be thoroughly purged of air.
- Cover the shaft seal when spraying or brush-painting the equipment.
- Pay close attention to the specification, especially speeds and pressures.

For further information, see "Service Instruction Manual", RA 14 025-S

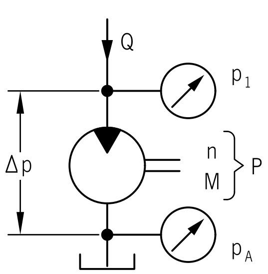
Filter recommendations

By far the largest number of premature failures of gear motors are due to contaminated fluid. Our guarantee does not apply to wear resulting from dirt in the system. We recommend filtering, which reduces the size and concentration of the contamination particles to a permitted minimum.

Operating pressure [bar]	>160	<160
Contamination class NAS 1638	9	10
Contamination class ISO 4406	18/15	19/16
Achieved with filter $ß_X = 75$	20	25

Full-flow filtering is always recommended. The initial contamination of the fluid with which the system is filled must not exceed Class 10 to NAS 1638. Past experience has shown that even brand new fluids often exceed this value. In such cases, filling appliance incorporating a special filter will have to be used.

Chart 1



$Q = \frac{V \cdot n}{\eta_{v\%}} \cdot 10^{-1}$	$V = \frac{Q \cdot \eta_{v\%}}{n} \cdot 10$	$n = \frac{Q \cdot \eta_{v\%}}{V} \cdot 10$
$\Delta p = \frac{M}{1{,}59 \cdot V \cdot \eta_{hm}} \cdot 10^4$	$V = 1{,}59 \cdot \frac{M}{\Delta p \cdot \eta_{hm\%}} \cdot 10^4$	$M = 1{,}59 \cdot V \cdot \Delta p\ \eta_{hm\%} \cdot 10^{-4}$
$P = \frac{Q \cdot \Delta p \cdot \eta_{t\%}}{6} \cdot 10^{-4}$		

[%]

Q —— η_v ——→ n
Δp —— η_{hm} ——→ M
$\Delta p \cdot Q$ —— η_t ——→ P

V cm^3/U	Q l/min	Δp bar	Achtung Note Attention	η %
n U/min	P kW	M Nm		

Drive Arrangements

1. Flexible couplings (Fig. 4)
The coupling must not transfer any radial or axial forces to the motor.

The maximum radial runout of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.

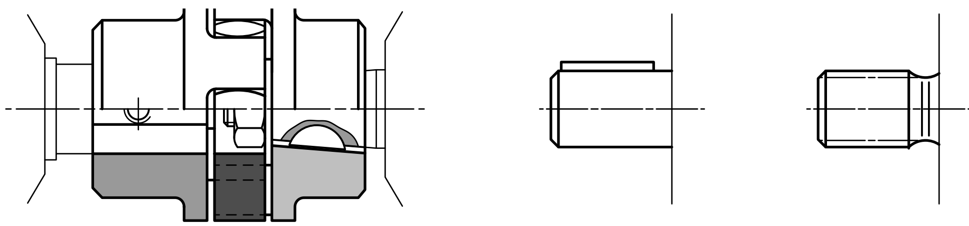


Fig. 4

2. Sleeve couplings (Fig. 5)
Used on shafts with DIN or SAE splining.
Note: There must be no radial or axial forces exerted on the motor shaft or sleeve coupling.
The sleeve must be free to move axially. The distance between the motor shaft and drive shaft must be 2^{+1}.
Oil-bath lubrication is necessary.

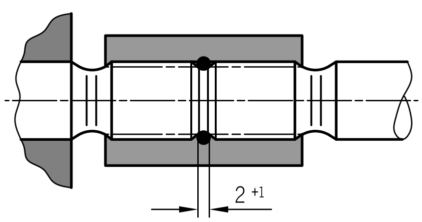


Fig. 5

Size **F**
B 17 x 14 DIN 5482
$M_{max.} = 190$ Nm

3. Drive shaft with dog (Fig. 6)

For the close-coupling of the motors to gearboxes, etc. the motors shaft has a special drive dog which combines with a center coupling ③ (included with the motors). There is no shaft seal.

The recommended arrangements and dimensions for the drive end and sealing are as follows:

① **Drive shaft**
Case-hardening steel DIN 17 210, e.g. 20 Mn CrS 5.
case-hardened 0.6 deep; HRc 60 ±3.
Surface for sealing ring ground without rifling $R_t \leqq 4$ µm.

② **Radial shaft seal**
Rubber-covered seal (see DIN 3760, Type AS or double-lipped ring). Cut 15° chamfer or fit shaft seal with protective sleeve.

Permitted pressure p_A/p_L to be regarded. Support ring if necessary.

Size **F**

$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
65	16	230
	19	190
	22.5	160

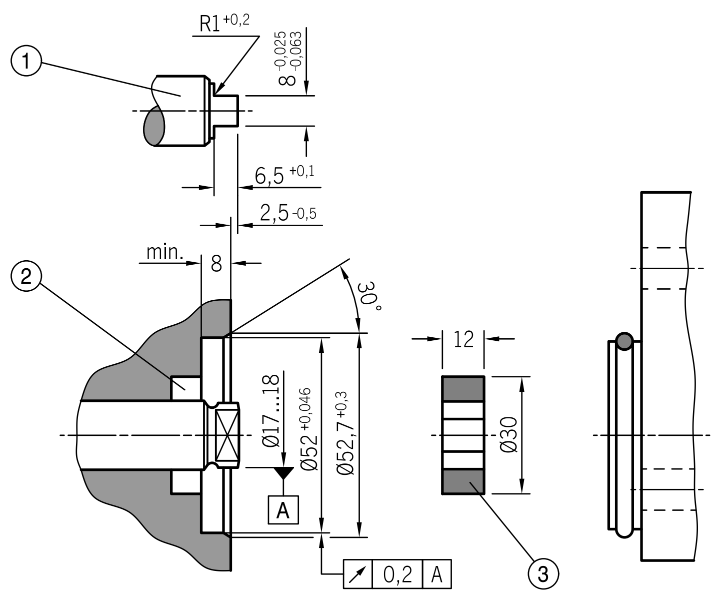


Fig. 6

5. Outrigger bearings

Outrigger bearings eliminate possible problems associated with side load when the motors are driven by V-belts or gear-wheels. The diagrams below show the maximum overhung and thrust loads that can be tolerated referred to a bearing life of $L_H = 1{,}000$ hours.

Size F Typ 1

$M_{max.}$ [Nm]	V [cm^3/rev]	$p_{max.}$ [bar]
65	16	230
	19	190
	22.5	160

* Fr is reduced by 0.7 Fa when axial loading Fa is applied.

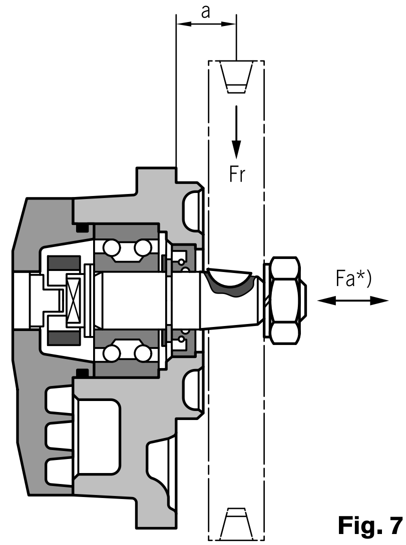
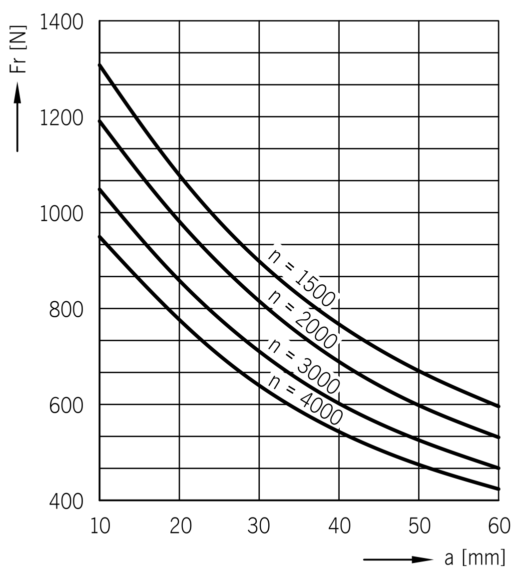


Fig. 7



Ordering Code (F Series Motor)

AZ M F -1□ or 2□ -016 U R R 12 M L -□□□ - S□□□□

Function

M = Motor

Size (F)

.51 in³ (8.2 cm³) = 008
.69in³ (11.3 cm³) = 011
.87in³ (14.3 cm³) = 014
1.01 in³ (16.5 cm³) = 016
1.19 in³ (19.5 cm³) = 019
1.40in³ (22.9 cm³) = 022

Direction of rotation

Right = R
Left = L
Universal = U (Bi-rotational)

PRV Setting (bar)

EXAMPLE:
180 bar = 180

Special Design

End cover

B - Standard
A - Rear ports
L - Case drain port
L S0018 - Internal case drain
D - PRV (bar)

Seals

NBR = M
FPM = P
NBR, shaft seal in FPM = K

Drive shafts

		Matching front flange
C	Conical 1:5 (Tapered key)	B, P
S	Conical 1:5 metric for flange A (Tapered key)	A
H	Conical 1:8 metric (Tapered key)	O
N	Dog (Tang)	M
A	Cylindrical (Straight key) ISO Ø 18mm	B
Q	Cylindrical (Straight key) SAE A 5/8˝	R
Q	SAE 5/8˝ Keyed, Long *Use **S0022** suffix	R
R	Spline shaft SAE A 9T	R, C
P	Spline shaft SAE 11T	R, C
F	Splne shaft DIN 5482 B17x14	B, P

Front flange

B	Square flange Centring Ø 80 mm
R	SAE A 2-bolt
P	Transmission flange Centring Ø 50 mm
O	Square flange Centring Ø 36.47 mm
C	SAE B 2-bolt
M	Transmission flange Centring Ø 52 mm with O-ring
A	Outrigger bearing Centring Ø 80 mm (outboard bearing)

Line connections

20	Rectangular flange
12	Thread (UN-2B) SAE O-ring BOSS
01	BSP Pipe thread ISO 228
30	Rectangular flange
07	Split flange SAE Code 61 Metric bolts
40	Split flange SAE Code 61 UNC bolts

* Common S0 Codes:
S0018 – Cross check valves in rear cover (internal case drain)
S0022 – 5/8˝ Long keyed shaft
S0030 – S0018 & S0022
S0028 – Pressure relief valve and anti-cavitation valve

Size **F**

4 ... 28 cm^3/ rev

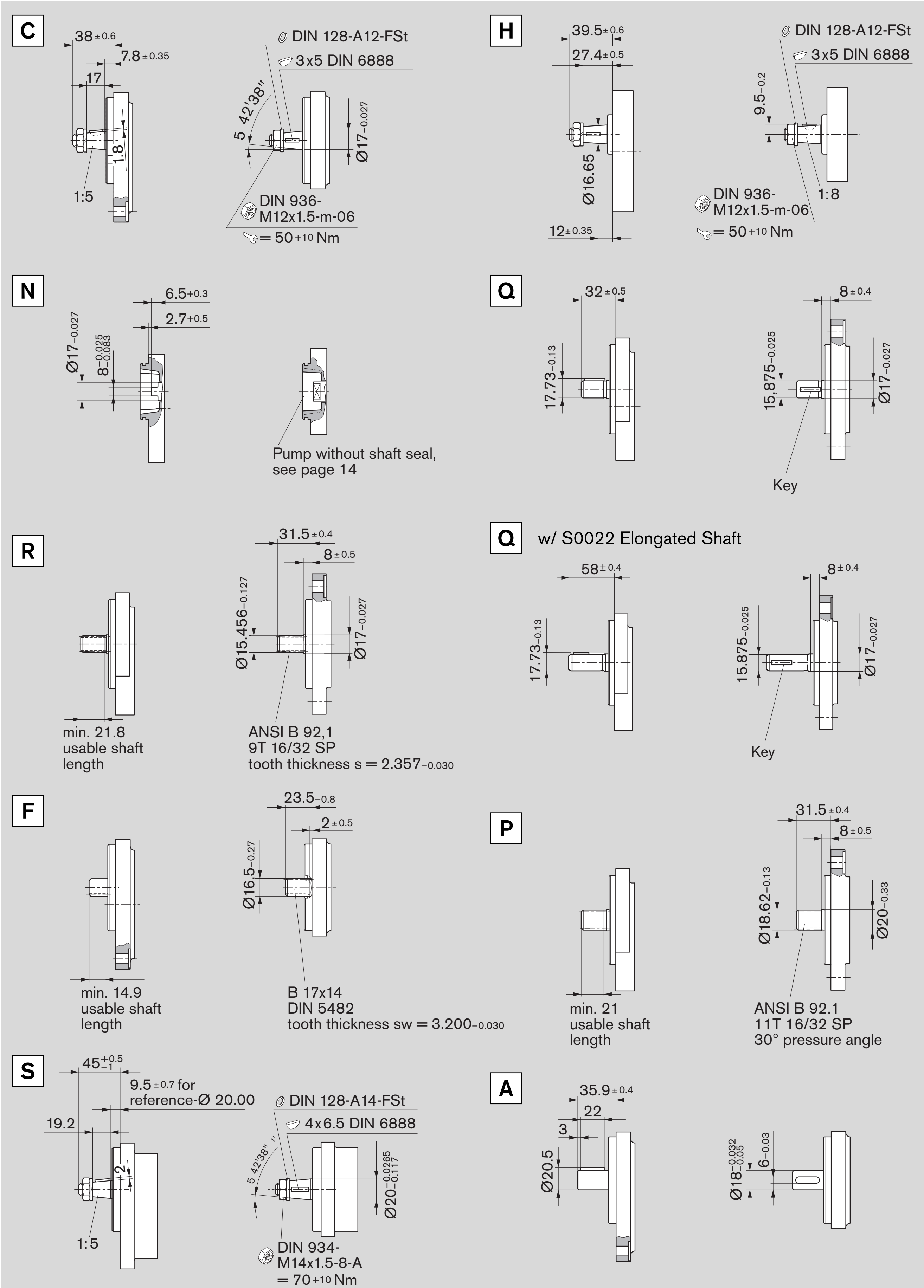
F Series Motor Product Index

(Reference page 10 for ordering code designators)

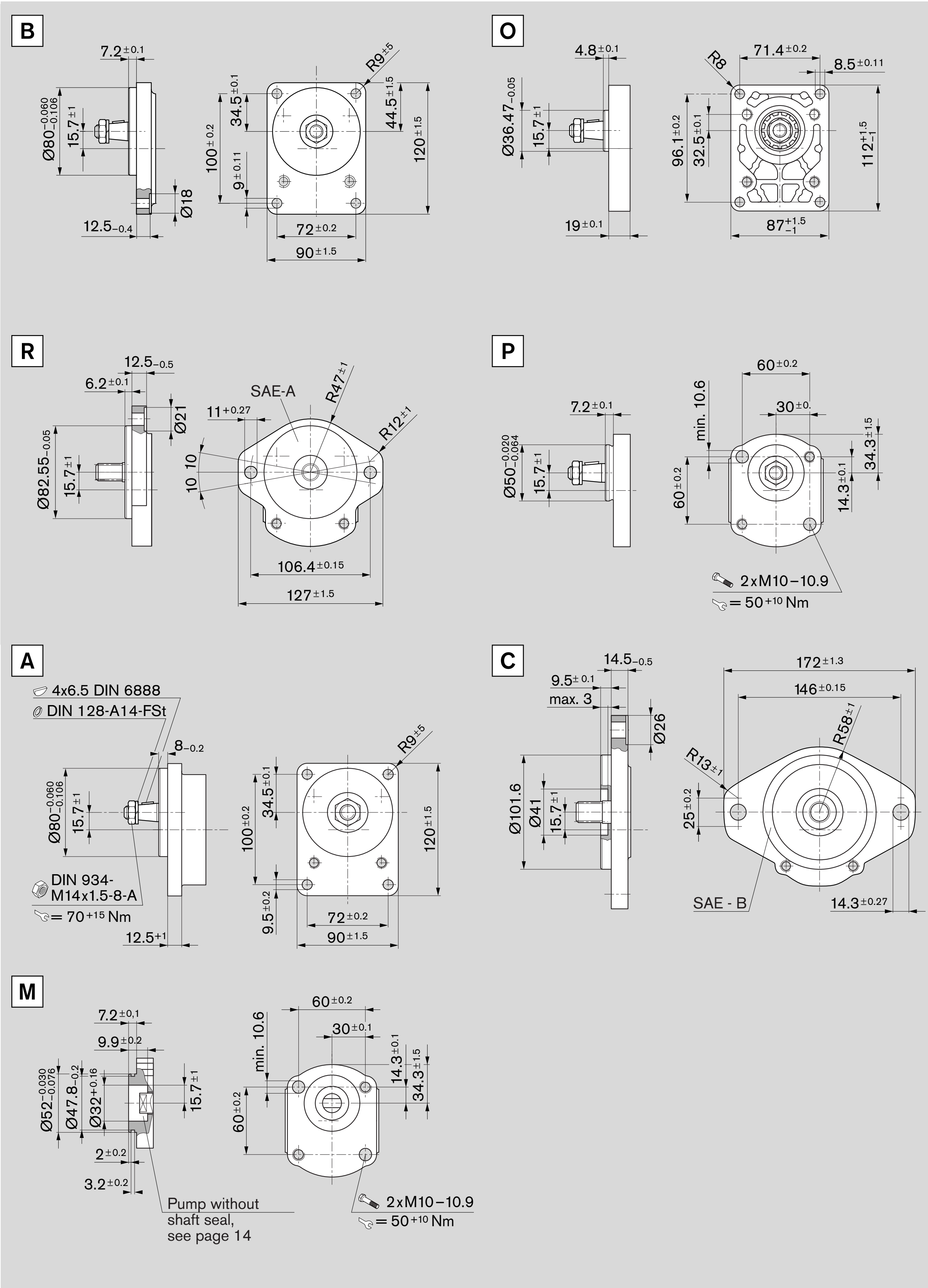
AZPF-XX-XXXX _ _ _ ML

Page Number	Ordering code	Shaft Type	Mounting Flange	Ports	Port Orientation	Case Drain
18	AZMF-12-XXXURR12ML	R	R	12	side	rear
19	AZMF-12-XXXURR12MA	R	R	12	rear	rear
20	AZMF-12-XXXURR12ML-S0018	R	R	12	side	internal
21	AZMF-12-XXXUQR12ML	Q	R	12	side	rear
22	AZMF-12-XXXUQR12MA	Q	R	12	rear	rear
23	AZMF-12-XXXUQR12ML-S0018	Q	R	12	side	internal
24	AZMF-12-XXXUQR12ML-S0022	Q-S0022	R	12	side	rear
25	AZMF-12-XXXUQR12MA-S0022	Q-S0022	R	12	side	rear
26	AZMF-12-XXXUQR12ML-S0030	Q-S0022	R	12	rear	internal
27	AZMF-1X-XXXXCB20MB	C	B	20	side	no case
28	AZMF-1X-XXXXFB20MB	F	B	20	side	no case
29	AZMF-1X-XXXXSA20MB	S	A	20	side	no case
30	AZMF-1X-XXXXNM20MB	N	M	20	side	no case
31	AZMF-1X-XXXUCB20ML	C	B	20	side	rear
32	AZMF-1X-XXXUFB20ML	F	B	20	side	rear
33	AZMF-1X-XXXUSA20ML	S	A	20	side	rear
34	AZMF-1X-XXXUNT20ML	N	T	20	side	rear
35	AZMF-1X-XXXUCN20ML	C	N	20	side	rear
36	AZMF-1X-XXXUCN20ML-S0018	C	N	20	side	internal
37	AZMF-1X-XXXUFN01ML	F	N	01	side	rear
38	AZMF-1X-XXXUFN20ML-S0018	F	N	20	side	internal
39	AZMF-1X-XXXUFN01ML-S0018	F	N	01	side	internal

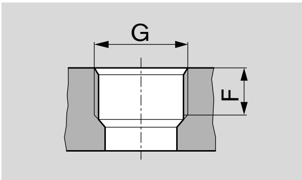
F Series Drive Shafts



F Series Front Cover



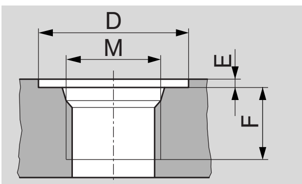
F Series Port Connections



01 **Pipe thread ISO 228/1**

when pressure $p_2 > 210$ bar limited fatigue strength

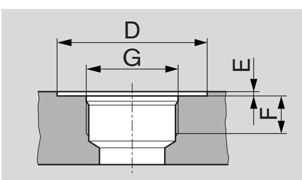
Synopsis of Types	Size	Pressure port		Suction port	
		G	F	G	F
01	4 ... 16 cm³	G ¹/₂	16	G ³/₄	16
	19 ... 28 cm³	G ³/₄		G1	19



03 **Thread metric ISO 6149 with O-ring**

when pressure $p_2 > 210$ bar limited fatigue strength

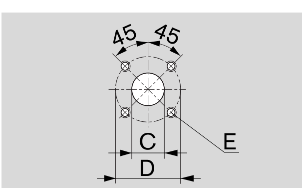
Synopsis of Types	Size	Pressure port				Suction port			
		M	D	E	F	M	D	E	F
03	4 ... 5.5 cm³	M 18 x 1.5	29	0.5	14.5	M 18 x 1.5	29	0.5	14.5
	8 ... 16 cm³	M 22 x 1.5	34		18	M 27 x 1.5	40		19
	19 ... 28 cm³					M 33 x 1.5	46		22



12 **Thread (UN-2B) SAE O-ring BOSS**

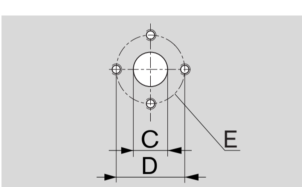
when pressure $p_2 > 210$ bar limited fatigue strength

Synopsis of Types	Size	Pressure port				Suction port			
		G	D	E	F	G	D	E	F
12	4 ... 5.5 cm³	SAE - 12	25	0.5	13	SAE - 12	25	0.5	13
	8 cm³	SAE - 12	35		16	SAE - 12	35		16
	11 ... 22 cm³					SAE - 12	45		19



20 **Rectangular flange DIN 3901/3902**

Synopsis of Type	Size	Pressure port			Suction port		
		C	D	E	C	D	E
20	4 ... 5.5 cm³	15	35	M 6 depth 13	15	40	M 6 depth 13
	8 ... 16 cm³				20		
	19 ... 28 cm³				26	55	M 8 depth 13

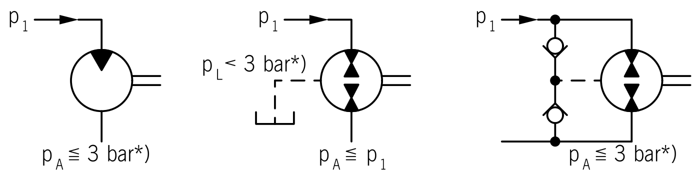


30 **Rectangular flange**

Synopsis of Type	Size	Pressure port			Suction port		
		C	D	E	C	D	E
30	4 ... 8 cm³	13.5	30.2	M 6 depth 13	13.5	30.2	M 6 depth 13
	11 ... 28 cm³				20.0	39.7	M 8 depth 13

F Series Performance Ratings

Size			008	011	014	016	019	022
Displacement		cm^3/rev	8.2	11.3	14.3	16.5	19.5	22.9
max. continuous pressure	p_1	bar	210	210	210	210	180	180
		psi	3045	3045	3045	3045	2610	2610
max. starting pressure	p_2	bar	280	280	280	280	210	210
		psi	4060	4060	4060	4060	3045	3045
min. rotational speed		min^{-1}	500	500	500	500	500	500
max. rotational speed	p_1		4000	3500	3000	3000	3000	3000
Motor outlet pressure	p_A	bar						
Leakage-oil line pressure	p_L							



*) Short-term when starting 10 bar

F Series Motor
SAE O-Ring BOSS - Standard Porting

	Side Ports		Rear Port	
Displacement (cc)	Inlet	Outlet	Inlet	Outlet
4	-12	-12	-12	-12
5	-12	-12	-12	-12
8	-12	-12	-12	-12
11	-12	-12	-12	-12
14	-12	-12	-12	-12
16	-12	-12	-12	-12
19	-12	-12	-12	-12
22	-12	-12	-12	-12

SAE Porting - Specifications and Dimensions
per SAE J1926/1

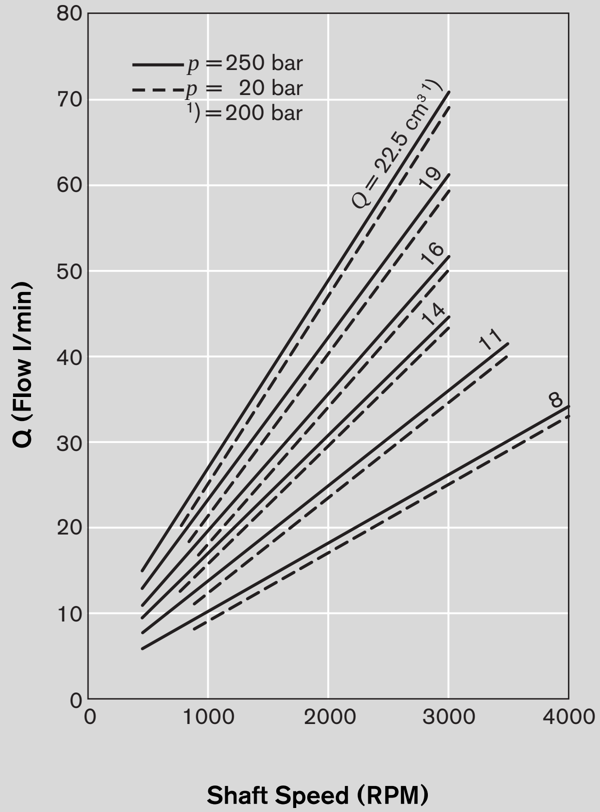
Dash Size	Thread Size (in)
-2	5/16-24 UNF-2B
-3	3/8-24 UNF-2B
-4	7/16-20 UNF-2B
-5	1/2-20 UNF-2B
-6	9/16-18 UNF-2B
-8	3/4-16 UNF-2B
-10	7/8-14 UNF-2B
-12	1-1/16-12 UN-2B
-14	1-3/16-12 UN-2B
-16	1-5/16-12 UN-2B
-20	1-5/8-12 UN-2B
-24	1-7/8-12 UN-2B
-32	2-1/2-12 UN-2B

Note: Ratings represent units incorporating SAE O-Ring BOSS threaded ports.
Pressure ratings may differ for other types of ports.

Diagrams

Size **F**

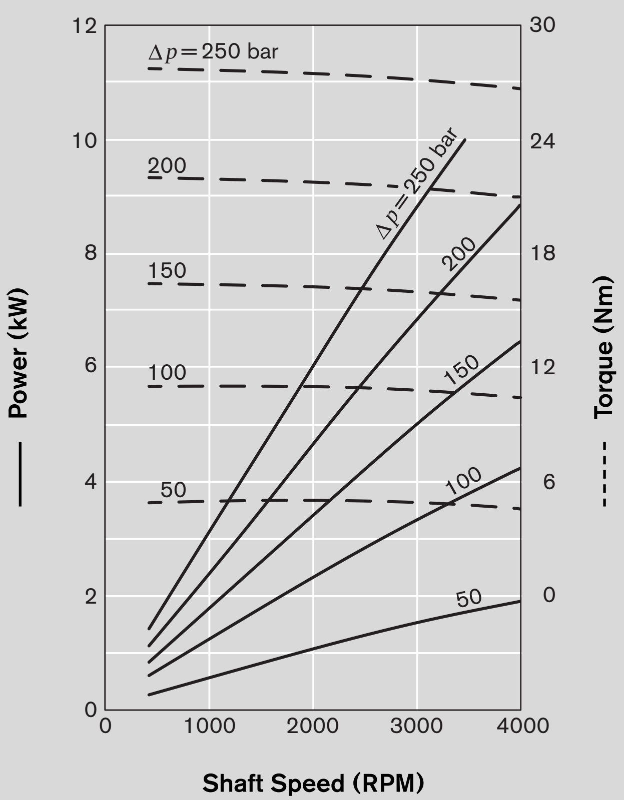
ν = 35 mm²/s, T = 50 °C



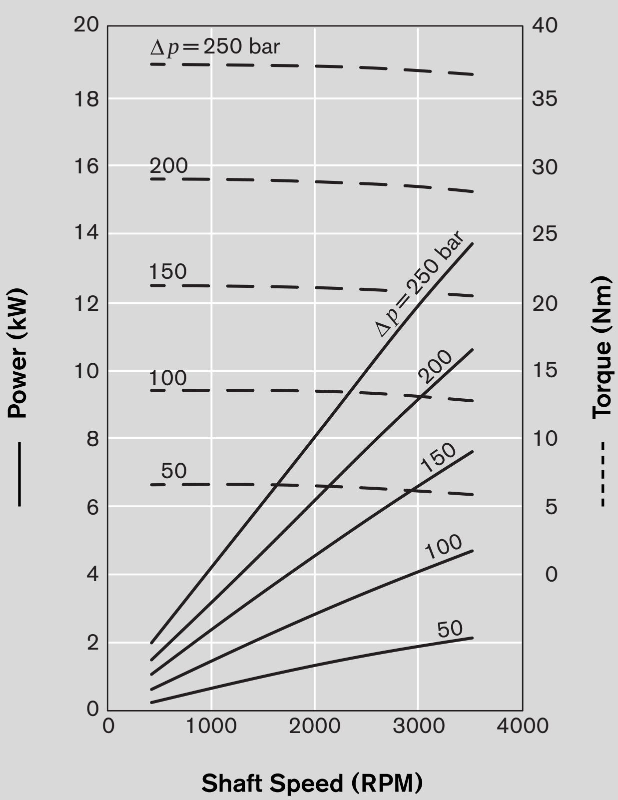
Unit Conversions

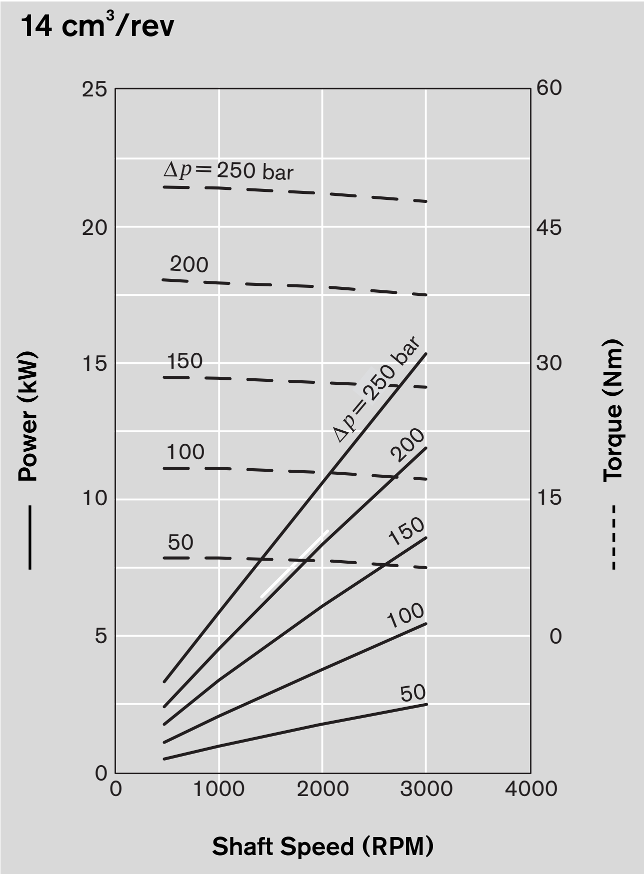
Pressure: psi = bar x 14.7
Torque: ft-lbs = (Nm) x .738
Power: hp = (kW) x 1.341
Volume: in³ = (cc) x 0.061
gpm = (LPM) x 0.2642

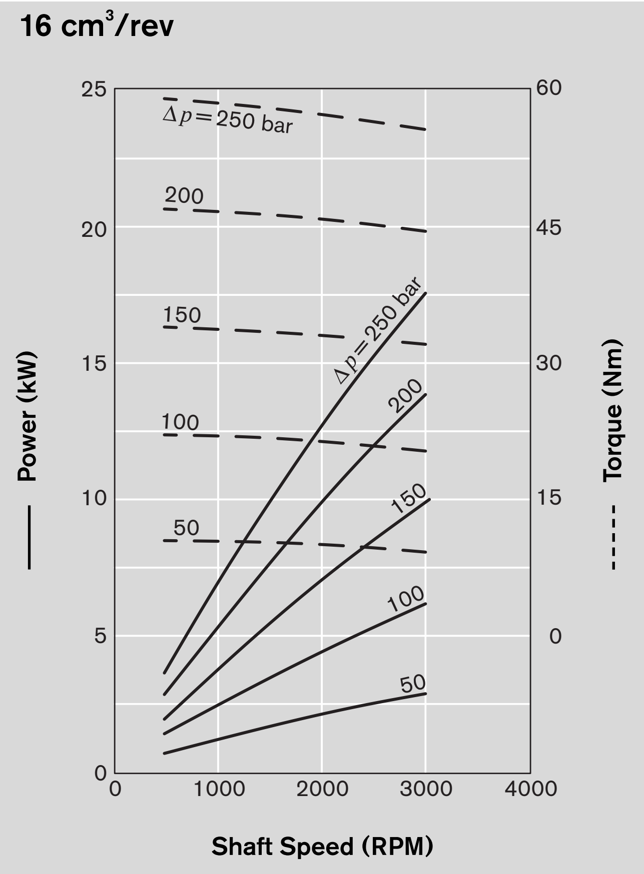
8 cm³/rev

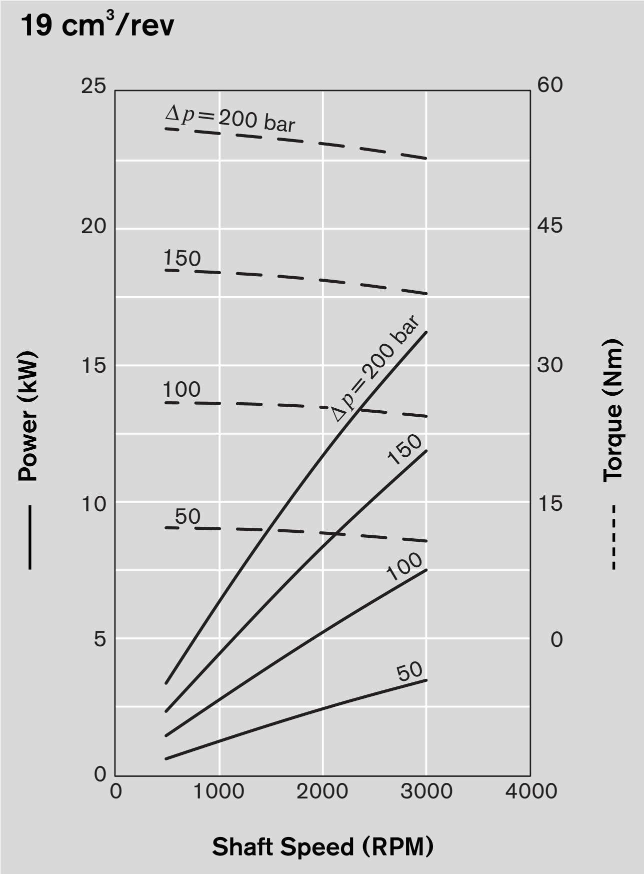


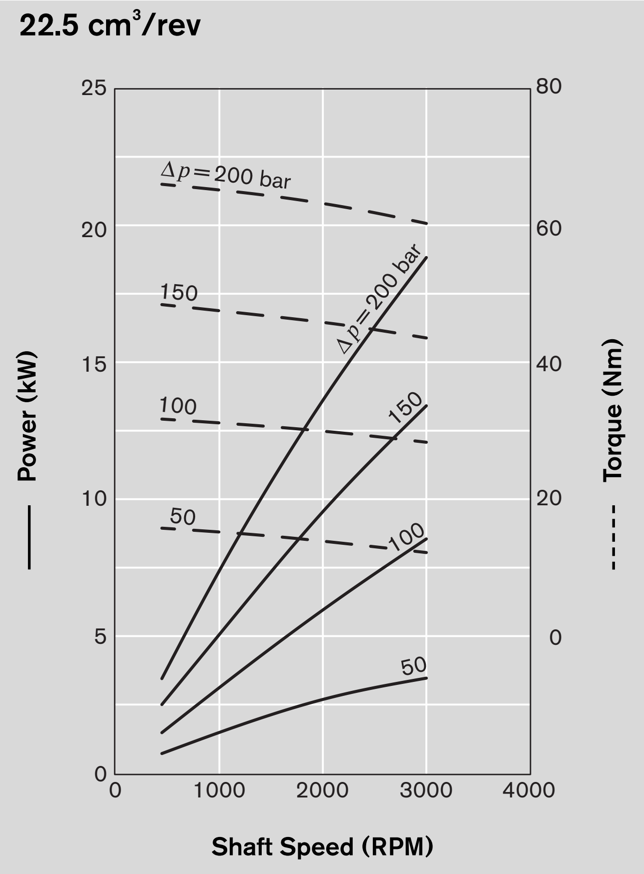
11 cm³/rev

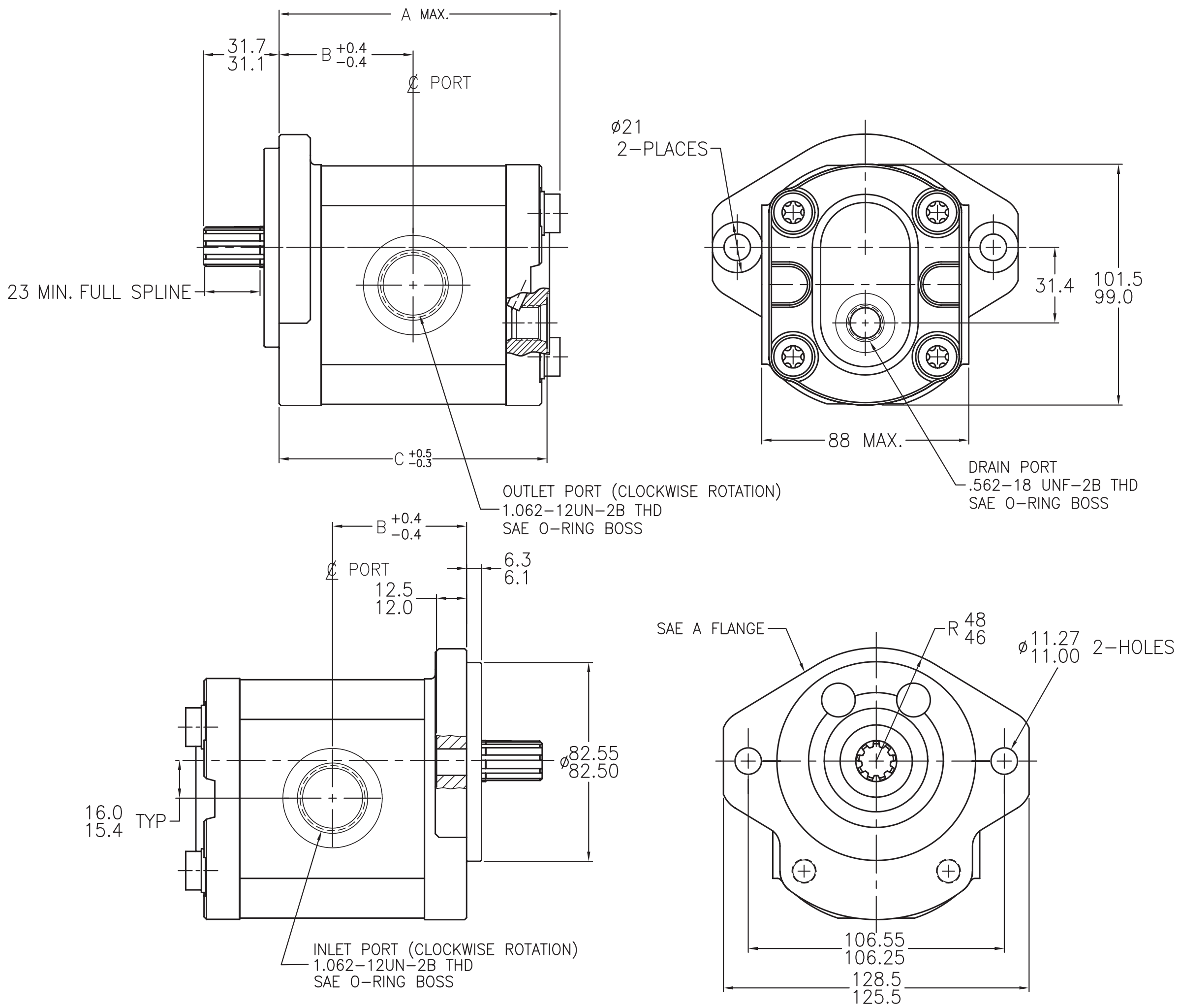



14 cm³/rev
Power (kW)
Torque (Nm)
Shaft Speed (RPM)
Δp = 250 bar
200
150
100
50
Δp = 250 bar
200
150
100
50

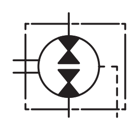

16 cm³/rev
Power (kW)
Torque (Nm)
Shaft Speed (RPM)
Δp = 250 bar
200
150
100
50
Δp = 250 bar
200
150
100
50


19 cm³/rev
Power (kW)
Torque (Nm)
Shaft Speed (RPM)
Δp = 200 bar
150
100
50
Δp = 200 bar
150
100
50


22.5 cm³/rev
Power (kW)
Torque (Nm)
Shaft Speed (RPM)
Δp = 200 bar
150
100
50
Δp = 200 bar
150
100
50



Features	Details
Shaft	9t spline
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

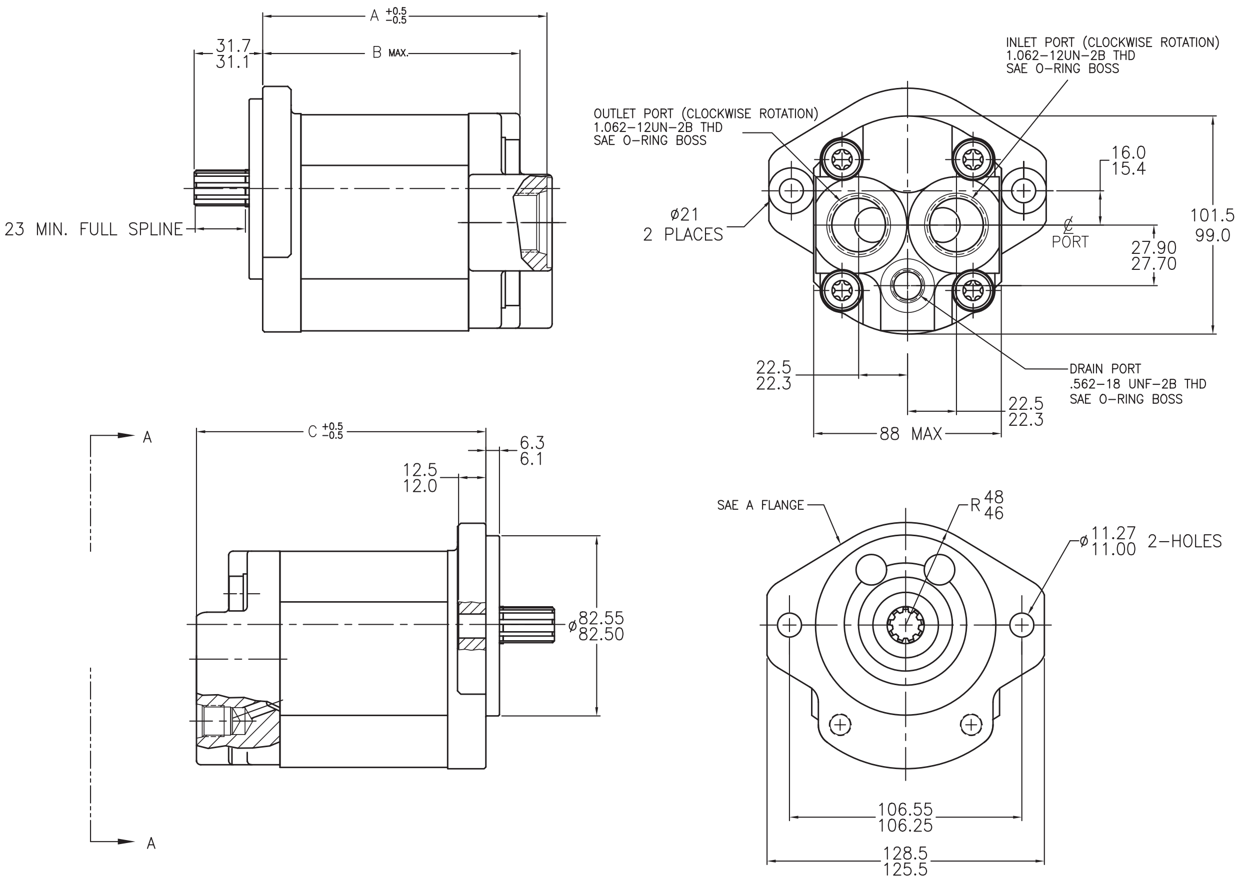


Ordering code
AZMF – 12 – □ □ □ U R R 12 ML

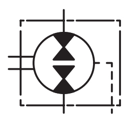
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 001**	210	4000	91.6	43.2	85.8	-12	-12
11.0		**9 511 290 002**	210	3500	96.6	45.7	90.8	-12	-12
14.0		**9 511 290 003**	210	3000	101.6	48.2	95.8	-12	-12
16.0		**9 511 290 004**	210	3000	105.0	49.9	99.2	-12	-12
19.0		**9 511 290 005**	180	3000	110.0	52.4	104.2	-12	-12
22.0		**9 511 290 006**	180	3000	115.4	55.1	109.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	9t spline
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Rear ports/case drain

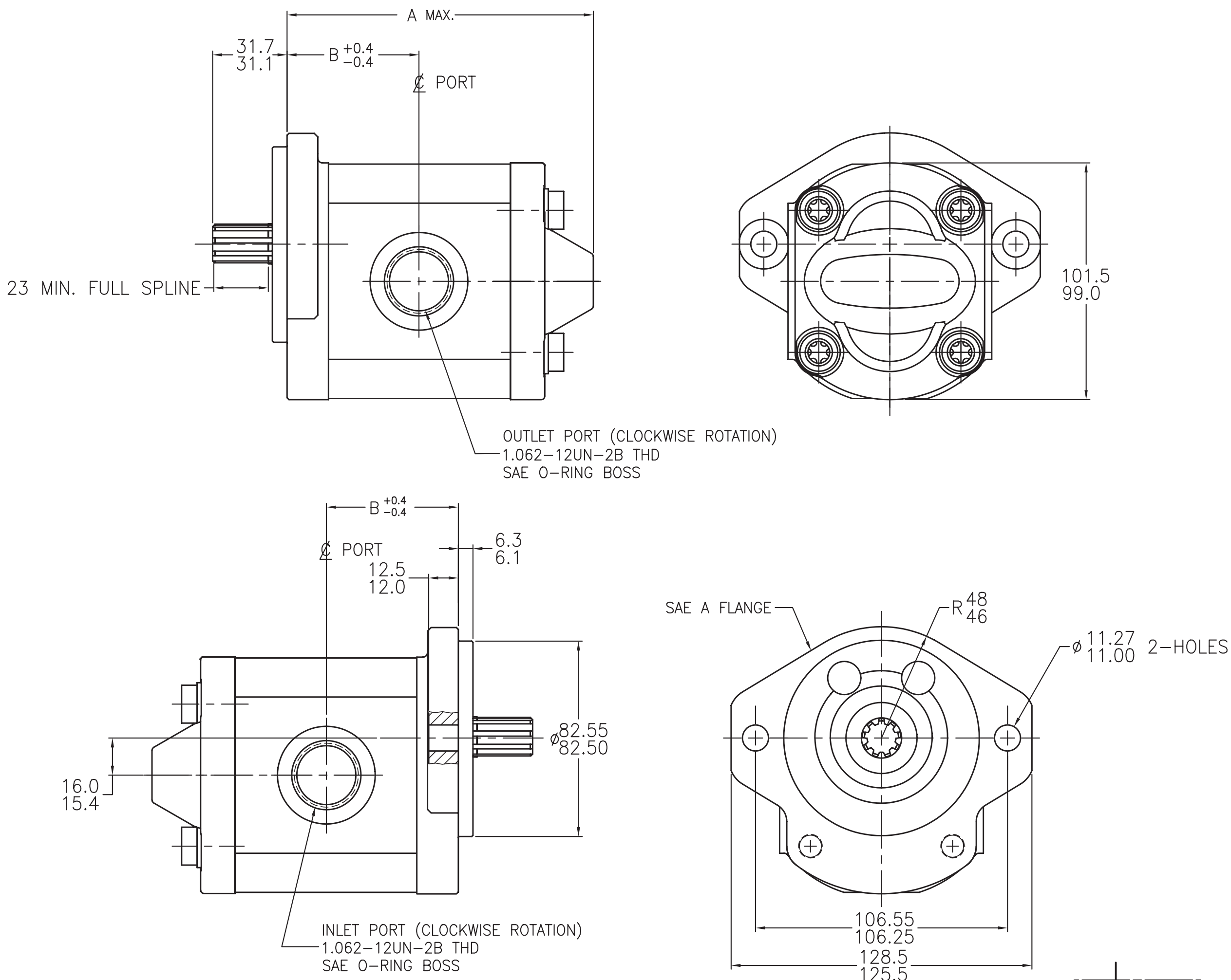


Ordering code
AZMF – 12 – □ □ □ U R R 12 MA

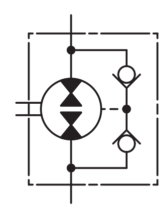
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 052**	210	4000	107.1	93.7	107.1	-12	-12
11.0		**9 511 290 053**	210	3500	112.1	98.7	112.1	-12	-12
14.0		**9 511 290 054**	210	3000	117.1	103.7	117.1	-12	-12
16.0		**9 511 290 055**	210	3000	120.5	107.1	120.5	-12	-12
19.0		**9 511 290 056**	180	3000	125.5	112.1	125.5	-12	-12
22.0		**9 511 290 057**	180	3000	130.9	117.5	130.9	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	9t spline
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Internal case drain

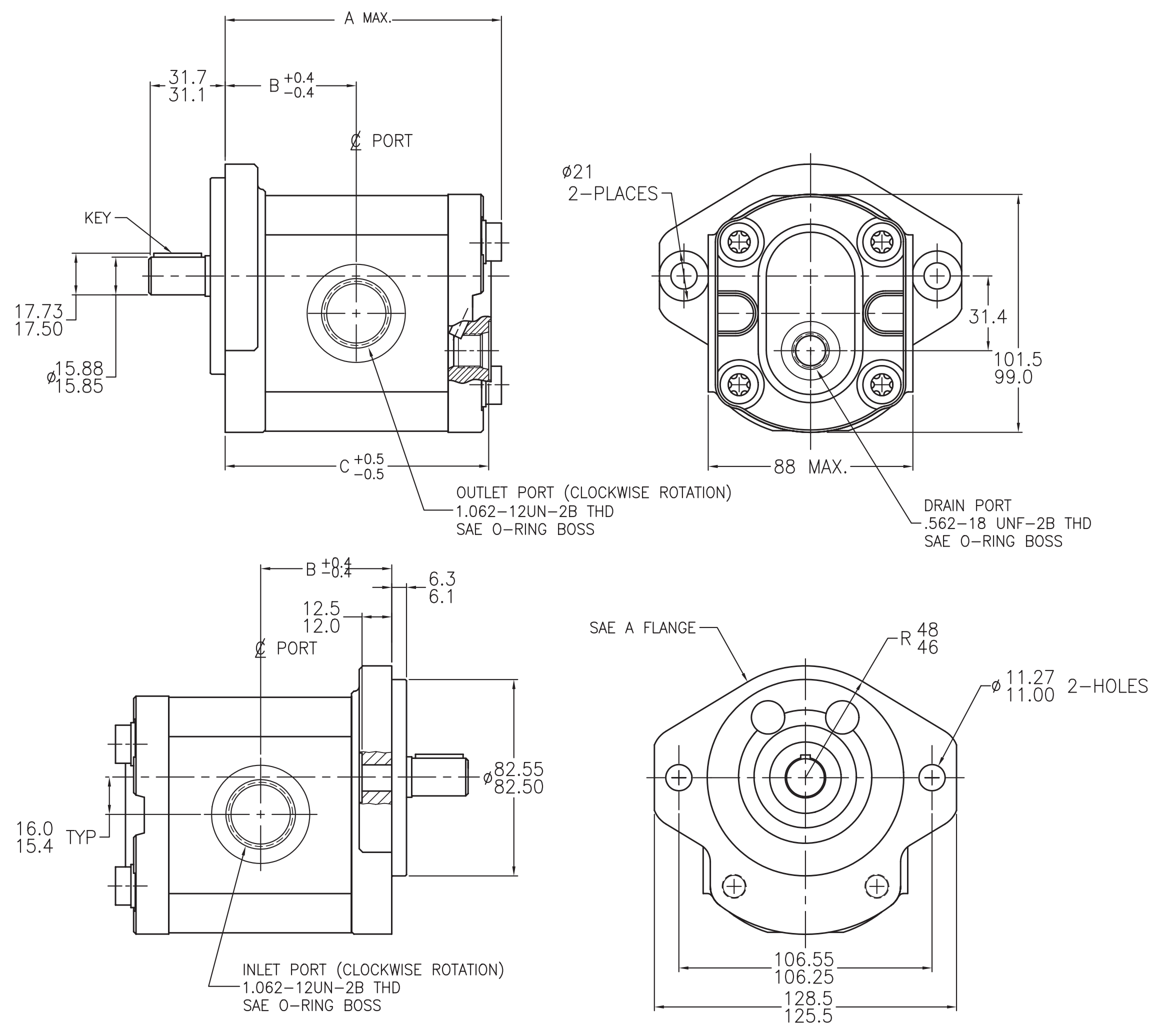


Ordering code
AZMF – 12 – □ □ □ U R R 12 ML – S0018

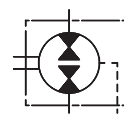
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B		Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 019**	210	4000	105.7	43.2		-12	-12
11.0		**9 511 290 020**	210	3500	110.7	45.7		-12	-12
14.0		**9 511 290 021**	210	3000	115.7	48.2		-12	-12
16.0		**9 511 290 022**	210	3000	119.1	49.9		-12	-12
19.0		**9 511 290 023**	180	3000	124.1	52.4		-12	-12
22.0		**9 511 290 024**	180	3000	129.5	55.1		-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** This unit contains internal leakage valves



Features	Details
Shaft	5/8” keyed
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

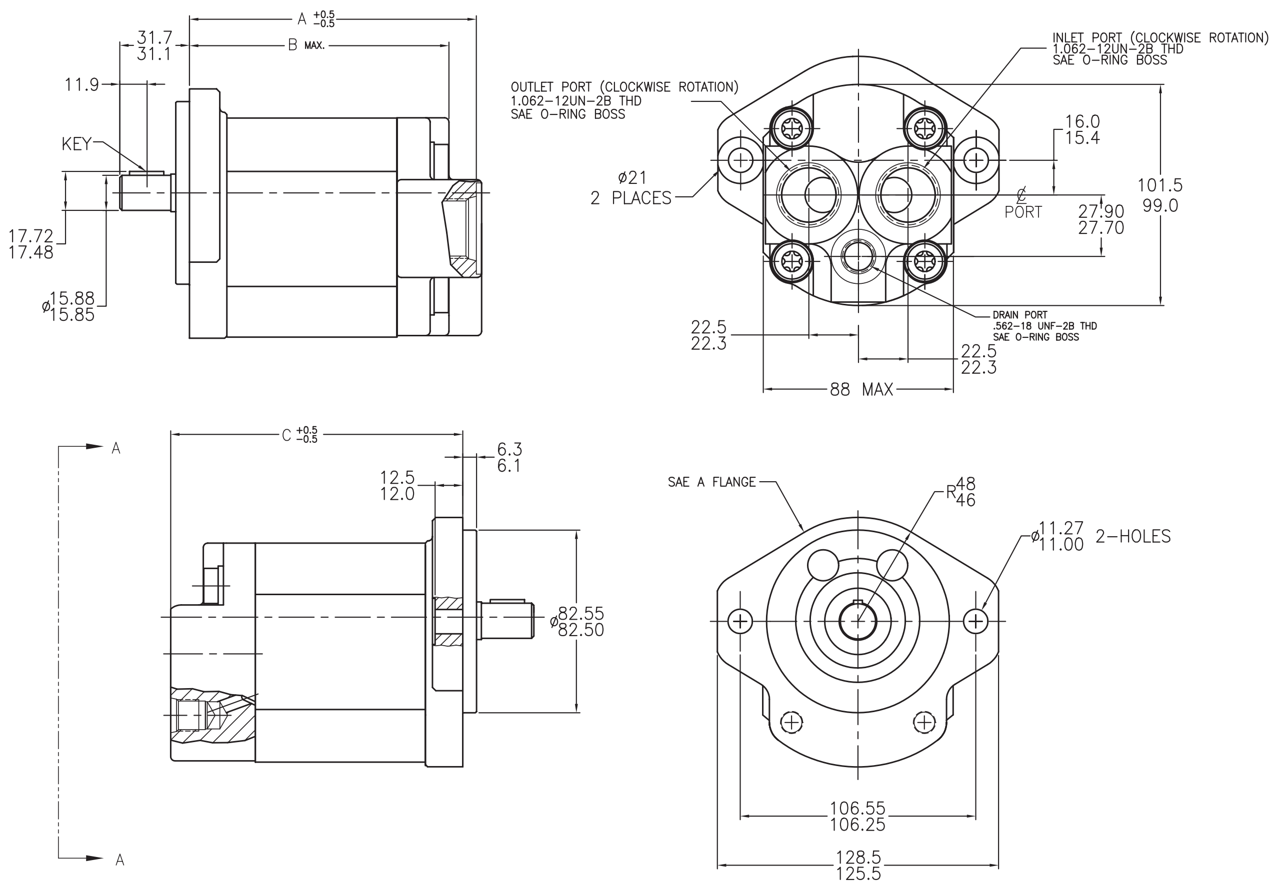


Ordering code
AZMF – 12 – □ □ □ U Q R 12 ML

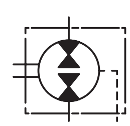
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 007**	210	4000	91.6	43.2	85.8	-12	-12
11.0		**9 511 290 008**	210	3500	96.6	45.7	90.8	-12	-12
14.0		**9 511 290 009**	210	3000	101.6	48.2	95.8	-12	-12
16.0		**9 511 290 010**	210	3000	105.0	49.9	99.2	-12	-12
19.0		**9 511 290 011**	180	3000	110.0	52.4	104.2	-12	-12
22.0		**9 511 290 012**	180	3000	115.4	55.1	109.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	5/8” keyed
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Rear ports/case drain

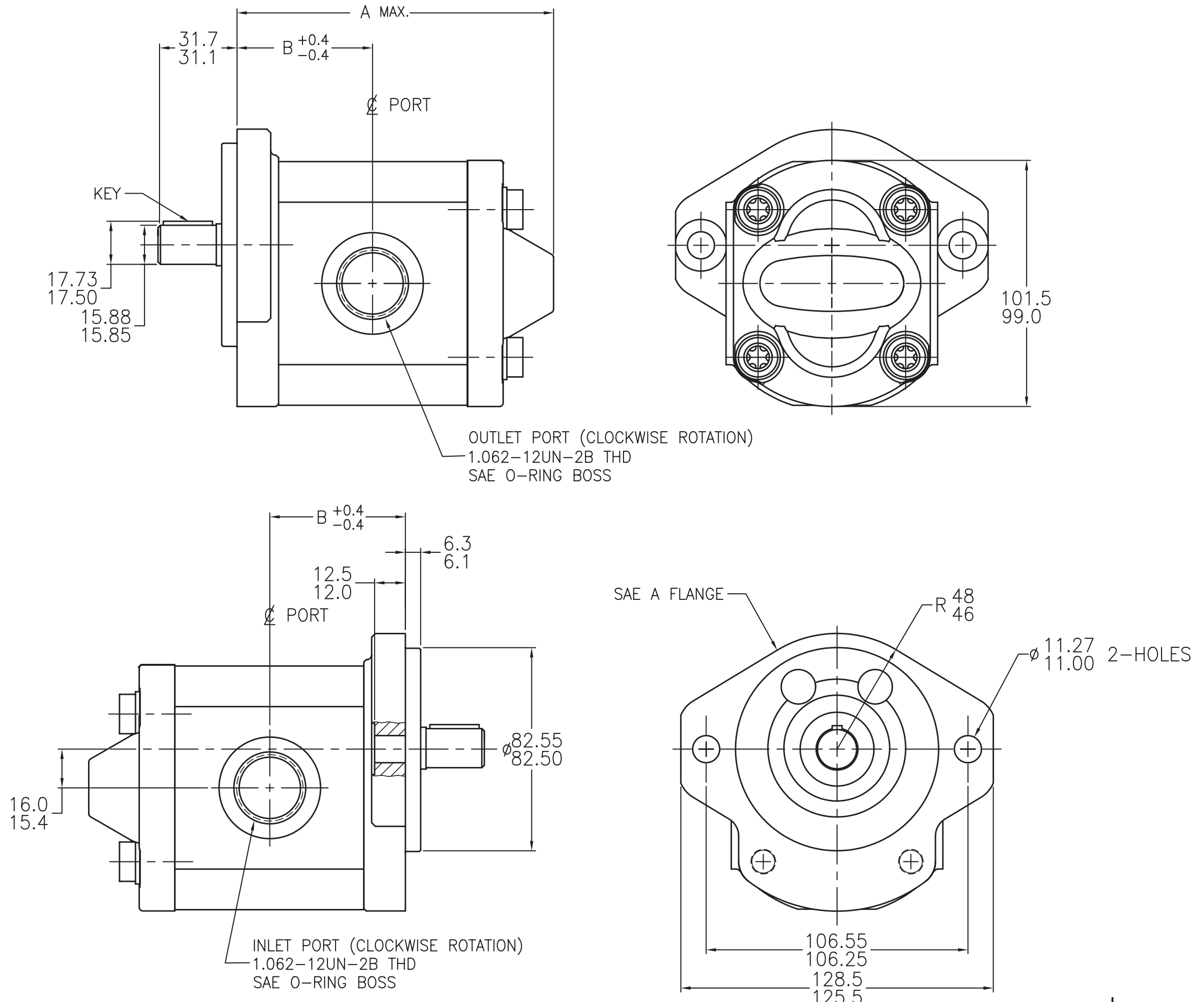


Ordering code
AZMF – 12 – □ □ □ U Q R 12 MA

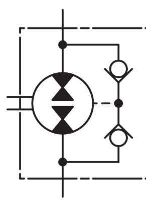
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 058**	210	4000	107.1	93.7	107.1	-12	-12
11.0		**9 511 290 059**	210	3500	112.1	98.7	112.1	-12	-12
14.0		**9 511 290 060**	210	3000	117.1	103.7	117.1	-12	-12
16.0		**9 511 290 061**	210	3000	120.5	107.1	120.5	-12	-12
19.0		**9 511 290 062**	180	3000	125.5	112.1	125.5	-12	-12
22.0		**9 511 290 063**	180	3000	130.9	117.5	130.9	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	5/8” keyed
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Internal case drain

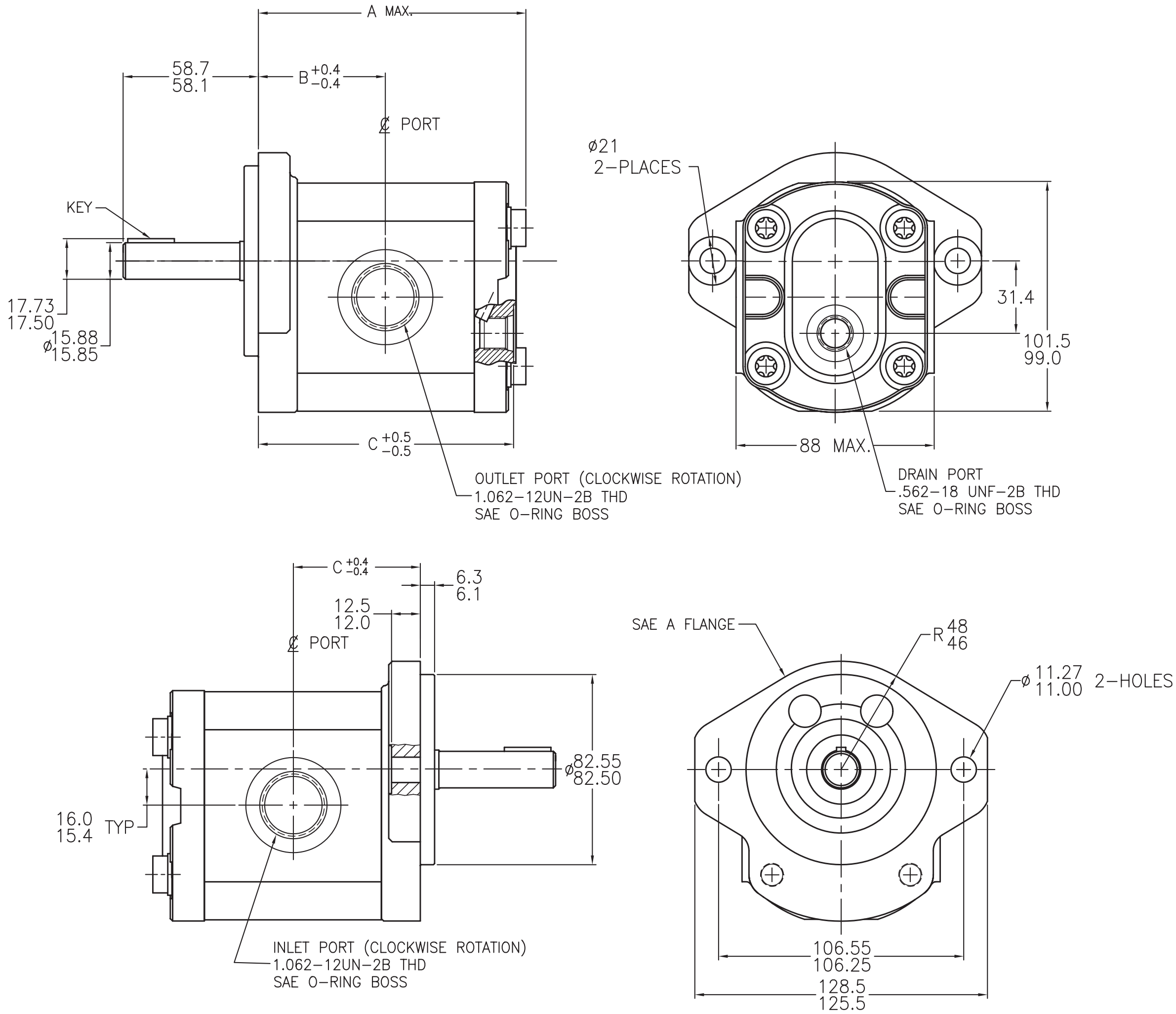


Ordering code
AZMF – 12 – □ □ □ U Q R 12 ML – S0018

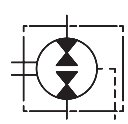
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B		Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 025**	210	4000	105.7	43.2		-12	-12
11.0		**9 511 290 026**	210	3500	110.7	45.7		-12	-12
14.0		**9 511 290 027**	210	3000	115.7	48.2		-12	-12
16.0		**9 511 290 028**	210	3000	119.1	49.9		-12	-12
19.0		**9 511 290 029**	180	3000	124.1	52.4		-12	-12
22.0		**9 511 290 030**	180	3000	129.5	55.1		-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** This unit contains internal leakage valves



Features	Details
Shaft	5/8" keyed – long
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

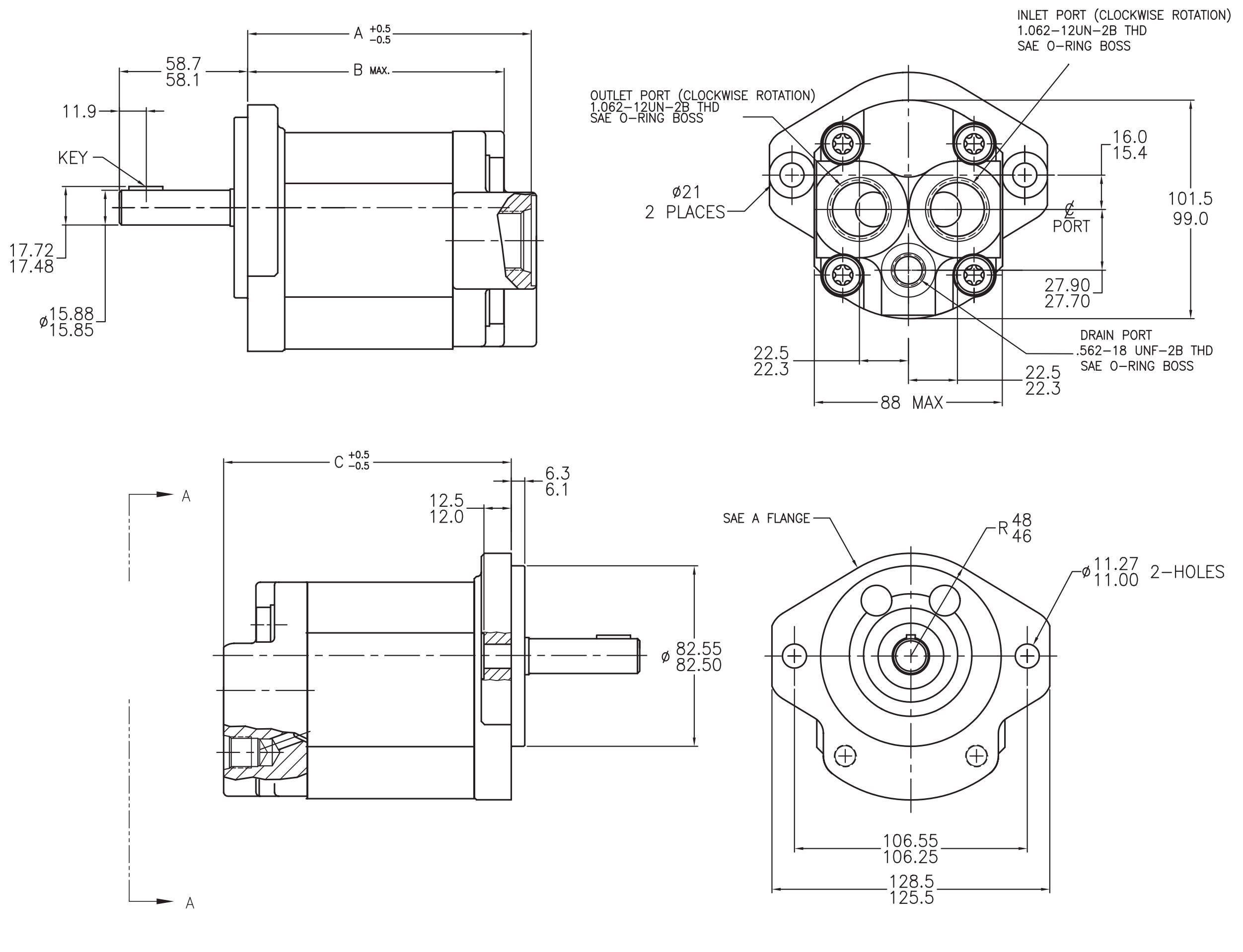


Ordering code
AZMF – 12 – □ □ □ U Q R 12 ML – S0022

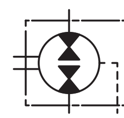
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 013**	210	4000	91.6	43.2	85.8	-12	-12
11.0		**9 511 290 014**	210	3500	96.6	45.7	90.8	-12	-12
14.0		**9 511 290 015**	210	3000	101.6	48.2	95.8	-12	-12
16.0		**9 511 290 016**	210	3000	105.0	49.9	99.2	-12	-12
19.0		**9 511 290 017**	180	3000	110.0	52.4	104.2	-12	-12
22.0		**9 511 290 018**	180	3000	115.4	55.1	109.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	5/8” keyed – long
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Rear ports/case drain

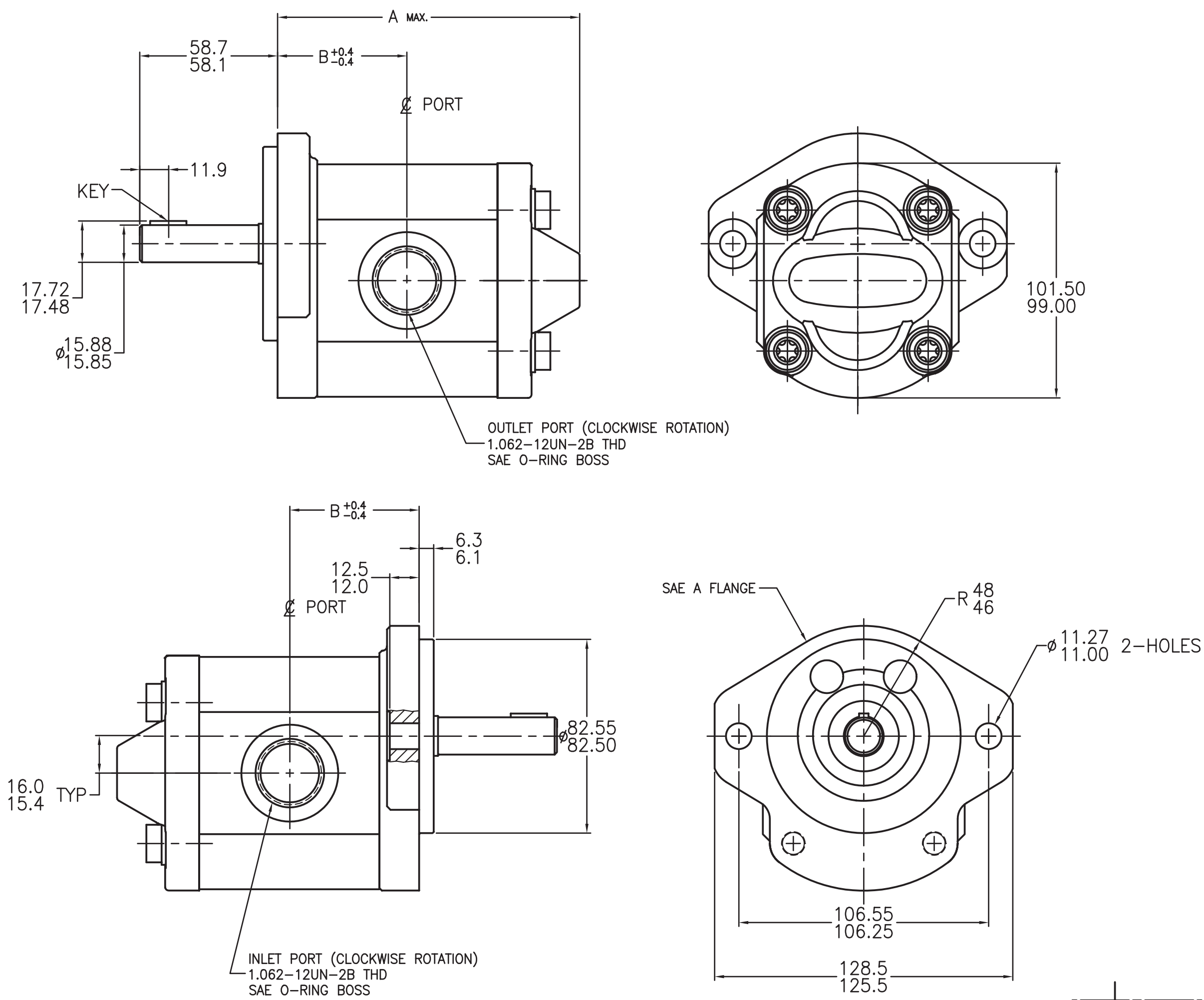


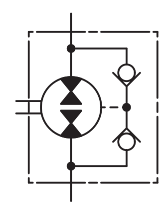
Ordering code
AZMF – 12 – □ □ □ U Q R 12 MA – S0022

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 064**	210	4000	107.1	93.7	107.1	-12	-12
11.0		**9 511 290 065**	210	3500	112.1	98.7	112.1	-12	-12
14.0		**9 511 290 066**	210	3000	117.1	103.7	117.1	-12	-12
16.0		**9 511 290 067**	210	3000	120.5	107.1	120.5	-12	-12
19.0		**9 511 290 068**	180	3000	125.5	112.1	125.5	-12	-12
22.0		**9 511 290 069**	180	3000	130.9	117.5	130.9	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)





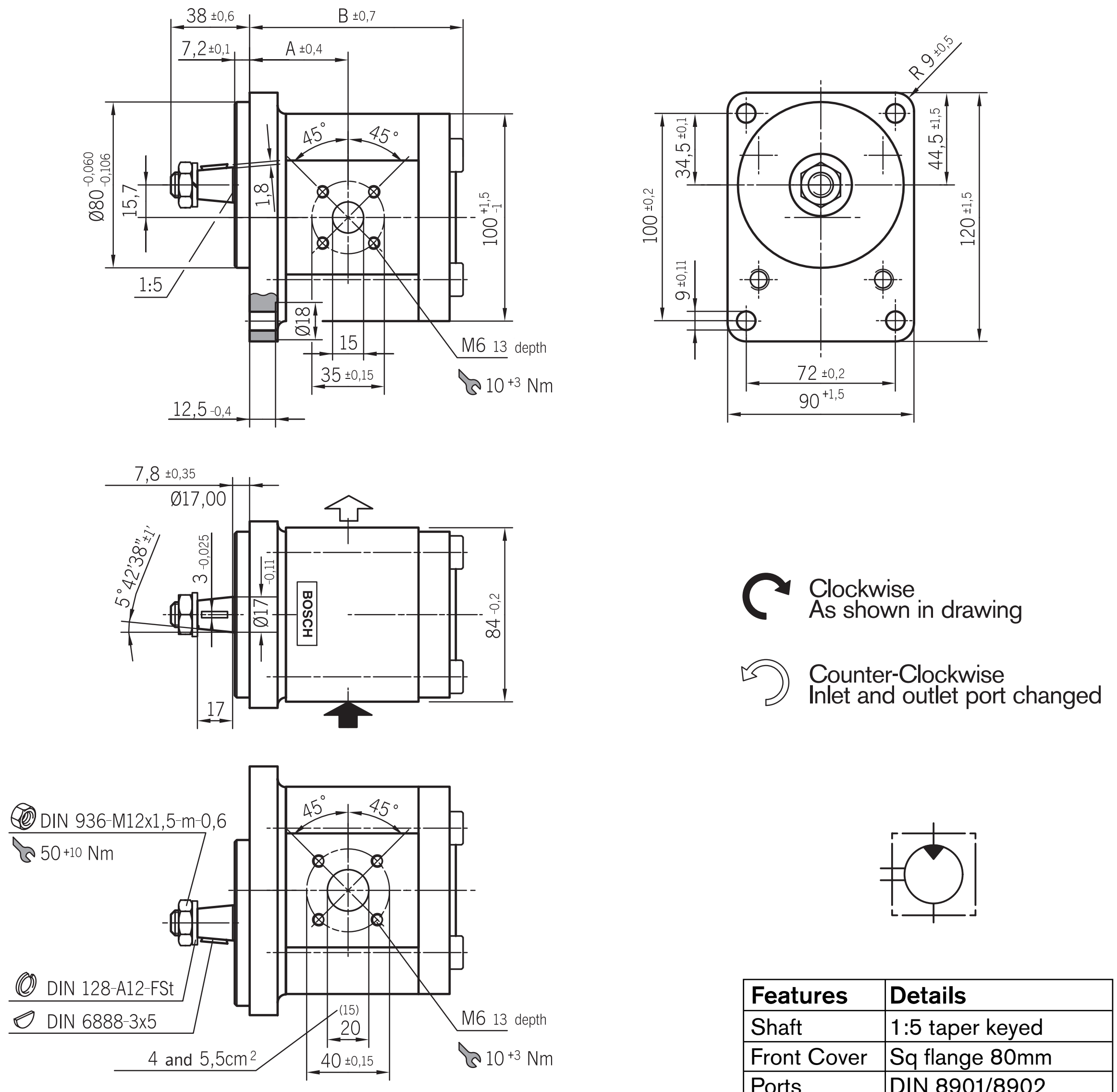
Features	Details
Shaft	5/8" keyed – long
Front Cover	SAE A 2-bolt
Ports	SAE ORB
Rear Cover	Internal case drain

Ordering code
AZMF – 12 – □ □ □ U Q R 12 ML – S0030

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
8.0		**9 511 290 031**	210	4000	105.7	43.2	105.7	-12	-12
11.0		**9 511 290 032**	210	3500	110.7	45.7	110.7	-12	-12
14.0		**9 511 290 033**	210	3000	115.7	48.2	115.7	-12	-12
16.0		**9 511 290 034**	210	3000	119.1	49.9	119.1	-12	-12
19.0		**9 511 290 035**	180	3000	124.1	52.4	124.1	-12	-12
22.0		**9 511 290 036**	180	3000	129.5	55.1	129.5	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** This unit contains internal leakage valves.

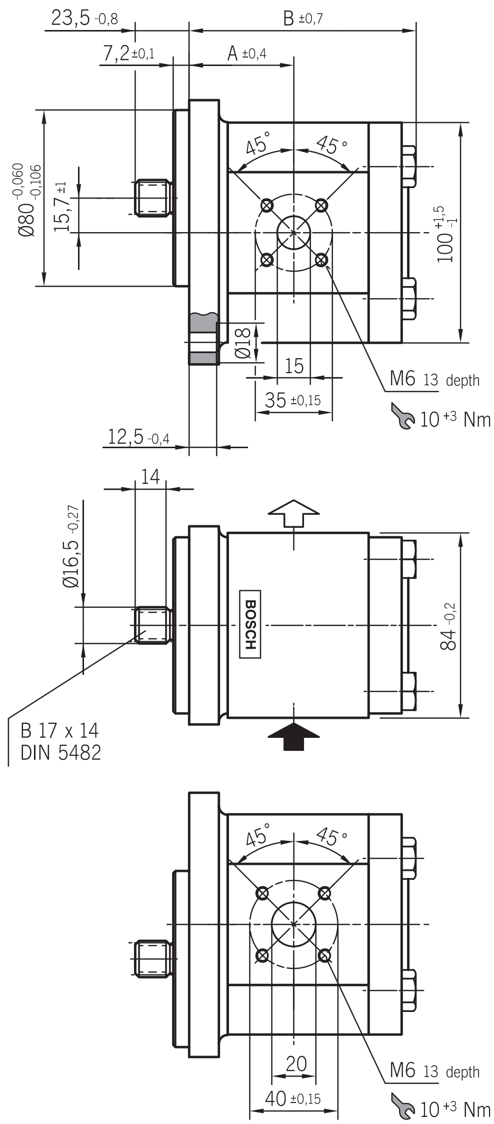


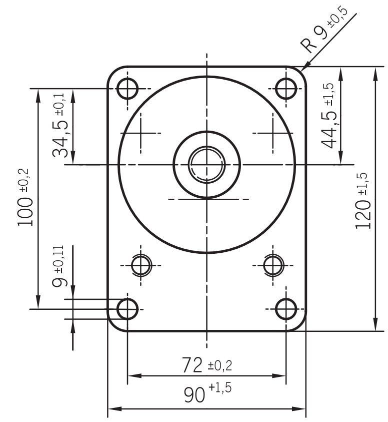
Features	Details
Shaft	1:5 taper keyed
Front Cover	Sq flange 80mm
Ports	DIN 8901/8902
Rear Cover	Standard

Ordering code
AZ M F – 1 X – □□□ □C B 20 MB

Displacement [cm³/rev]	Ordering-Number * L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0	**0 511 425 300**	**0 511 425 001**	210	4000	43.2	91.6			
11.0	**0 511 525 300**	**0 511 525 001**	210	3500	47.0	96.6			
14.0	**0 511 525 304**		210	3000	47.5	101.6			
16.0		**0 511 625 005**	210	3000	47.5	105.0			
19.0		**0 511 625 003**	180	3000	47.5	110.0			
19.0		**0 511 625 009**	180	3000	47.5	110.0			
19.0	**0 511 625 308**		180	3000	47.5	110.0			
22.0	**0 511 725 304**	**0 511 725 005**	180	3000	61.1	127.4			

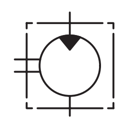
* Contact factory for availabilty of units with no ordering number listed.





Clockwise
As shown in drawing

Counter-Clockwise
Inlet and outlet port changed

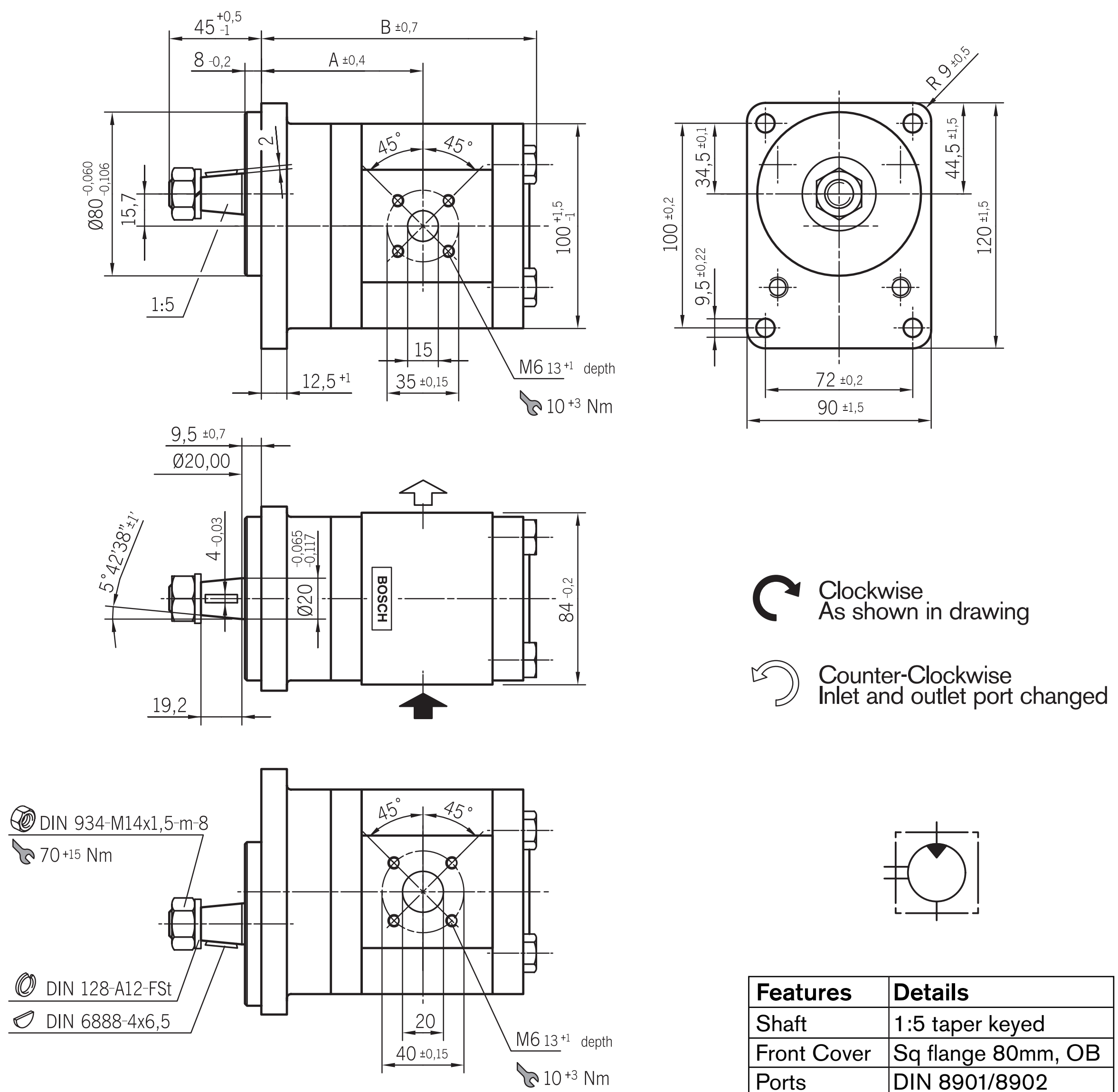


Features	Details
Shaft	DIN 5482 spline
Front Cover	Sq flange 80mm
Ports	DIN 8901/8902
Rear Cover	Standard

Ordering code
AZ M F – 1 X – □□□ □ F B 20 MB

Displacement [cm³/rev]	Ordering-Number * L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B			
8.0	**0 511 425 301**	**0 511 425 002**	210	4000	43.2	91.6			
11.0	**0 511 525 301**	**0 511 525 002**	210	3500	47.0	96.6			
14.0	**0 511 525 303**		210	3000	47.5	101.6			
16.0	**0 511 625 301**	**0 511 625 001**	210	3000	47.5	105.0			
19.0	**0 511 625 300**	**0 511 625 002**	180	3000	47.5	110.0			
22.0	**0 511 725 303**	**0 511 725 004**	180	3000	61.1	127.4			

* Contact factory for availabilty of units with no ordering number listed.

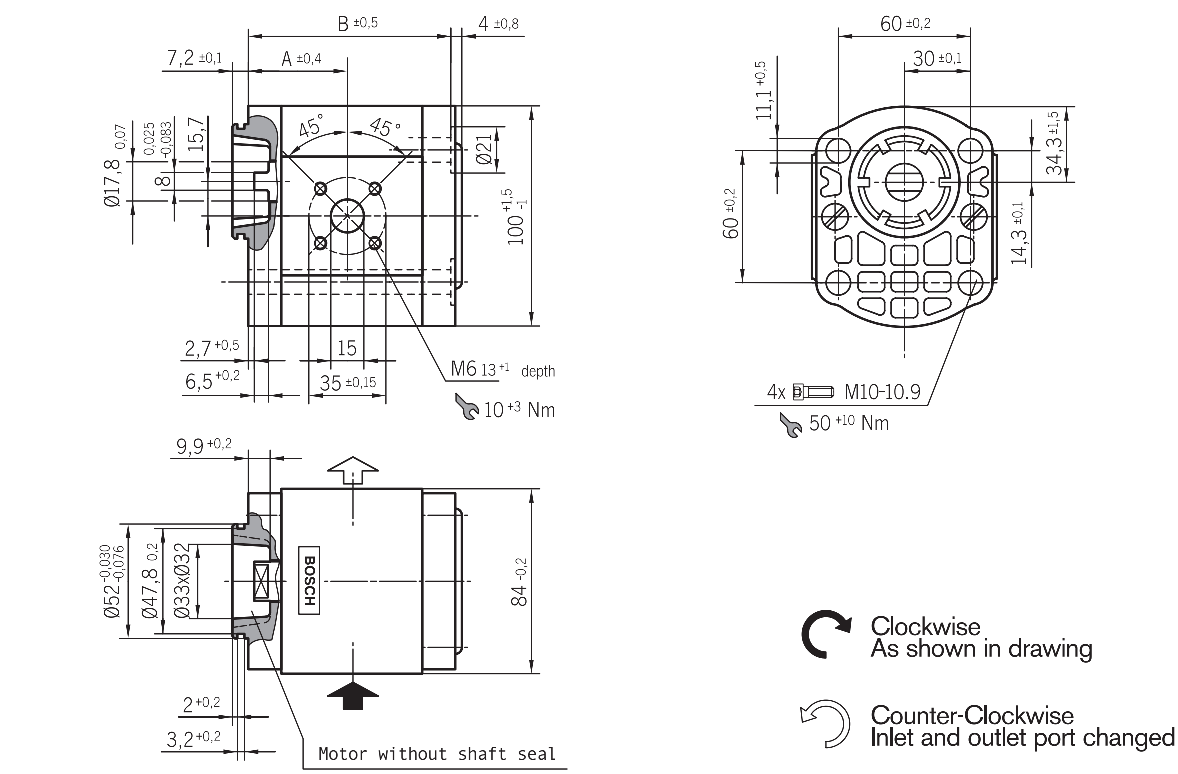


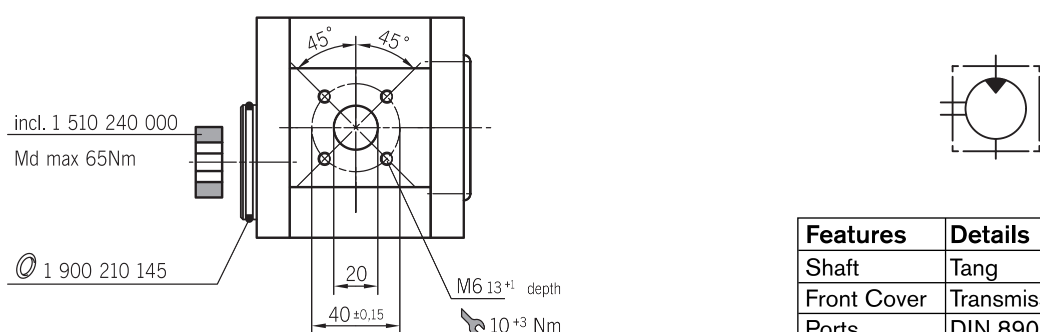
Features	Details
Shaft	1:5 taper keyed
Front Cover	Sq flange 80mm, OB
Ports	DIN 8901/8902
Rear Cover	Standard

Ordering code
AZ M F – 1 X – □□□ □S A 20 MB

Displacement [cm³/rev]	Ordering-Number * L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B			
8.0	**0 511 445 300**	**0 511 445 001**	210	4000	74.7	121.3			
11.0	**0 511 545 300**	**0 511 545 001**	210	3500	78.5	126.3			
14.0	**0 511 545 301**		210	3000	79.0	131.3			
16.0	**0 511 645 300**	**0 511 645 001**	210	3000	79.0	134.7			
19.0	**0 511 645 302**		180	3000	79.0	139.7			
22.0	**0 511 745 300**	**0 511 745 001**	180	3000	92.6	157.1			

* Contact factory for availabilty of units with no ordering number listed.



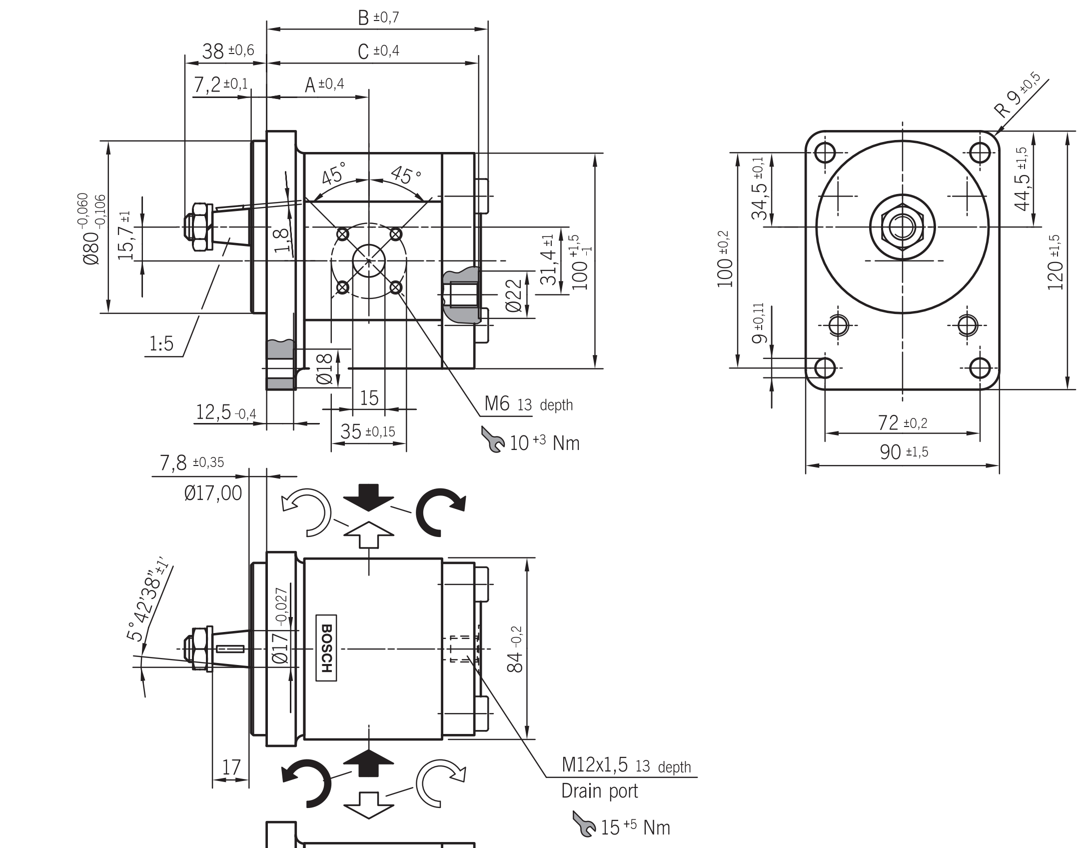


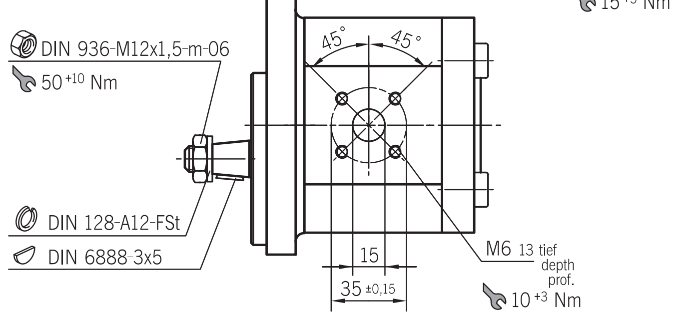
Features	Details
Shaft	Tang
Front Cover	Transmission
Ports	DIN 8901/8902
Rear Cover	Standard

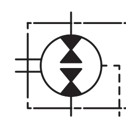
Ordering code
AZ M F – 1 X – □□□ □ N M 20 MB

Displacement [cm³/rev]	Ordering-Number * L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B			
8.0	**0 511 415 300**	**0 511 415 001**	210	4000	40.7	80.3			
11.0	**0 511 515 300**	**0 511 515 001**	210	3500	44.5	85.3			
16.0	**0 511 615 301**	**0 511 615 002**	210	3000	45.0	93.7			
19.0	**0 511 615 300**	**0 511 615 001**	180	3000	45.0	98.7			
22.0	**0 511 715 300**	**0 511 715 001**	180	3000	52.6	104.1			

* Contact factory for availabilty of units with no ordering number listed.





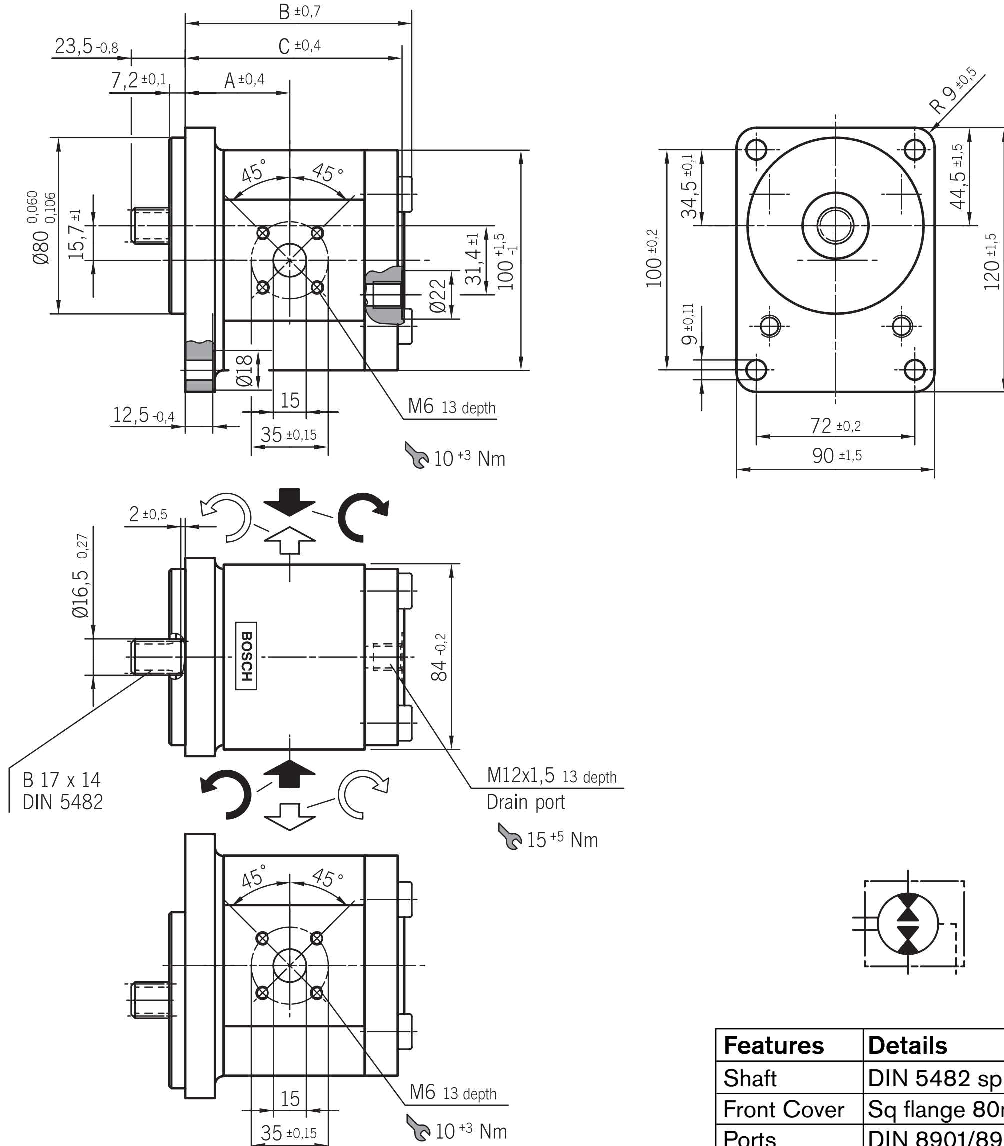


Features	Details
Shaft	1:5 taper keyed
Front Cover	Sq flange 80mm
Ports	DIN 8901/8902
Rear Cover	Case drain

Ordering code
AZ M F – 1 X – □□□ U C B 20 ML

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 425 601**	210	4000	43.2	91.6	85.8		
11.0		**0 511 525 604**	210	3500	47.0	96.6	90.8		
16.0		**0 511 625 602**	210	3000	47.5	105.0	99.2		
22.0		**0 511 725 601**	180	3000	55.1	115.4	109.6		

* Contact factory for availabilty of units with no ordering number listed.

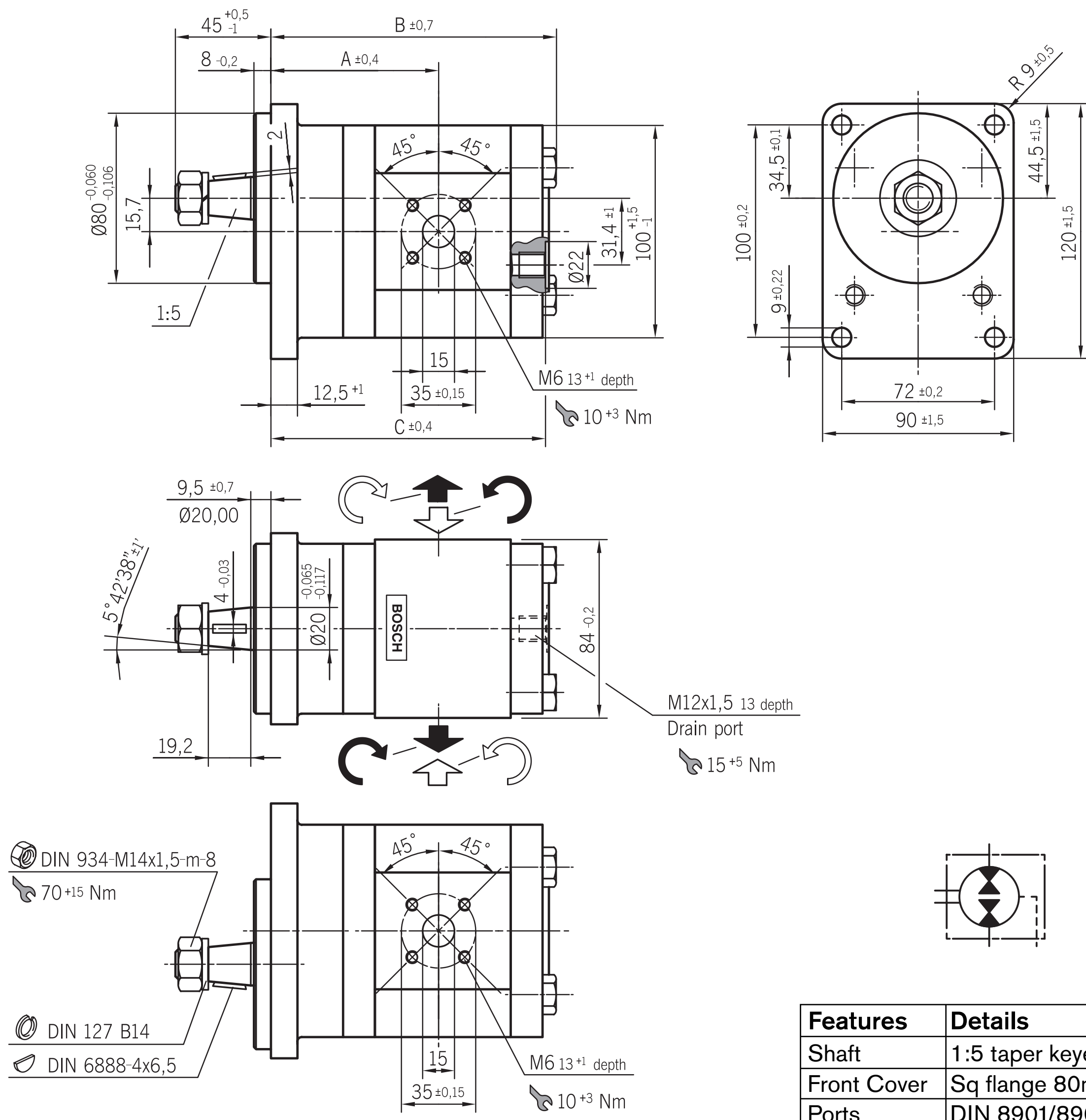


Features	Details
Shaft	DIN 5482 spline
Front Cover	Sq flange 80mm
Ports	DIN 8901/8902
Rear Cover	Case drain

Ordering code
AZ M F – 1 X – □□□ U F B 20 ML

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 425 603**	210	4000	43.2	91.6	85.8		
11.0		**0 511 525 601**	210	3500	47.0	96.6	90.8		
16.0		**0 511 625 603**	210	3000	47.5	105.0	99.2		
19.0		**0 511 625 605**	180	3000	47.5	110.0	104.2		
22.0		**0 511 725 602**	180	3000	55.1	115.4	109.6		

* Contact factory for availabilty of units with no ordering number listed.

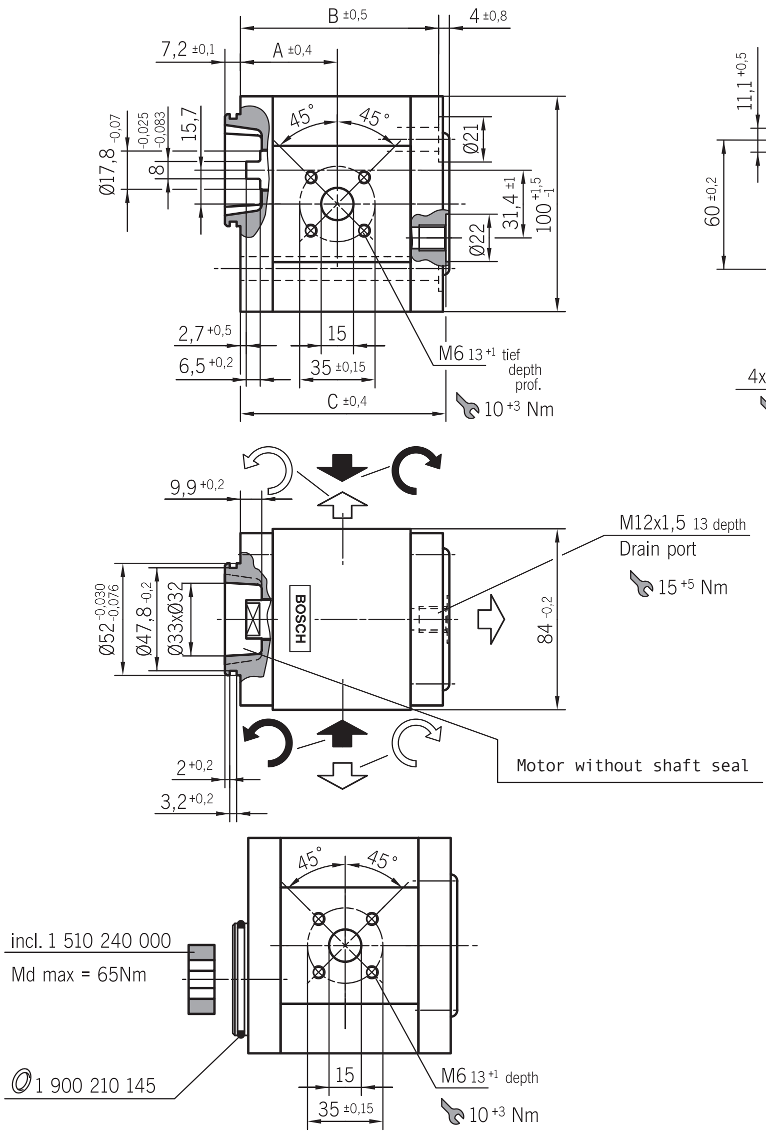


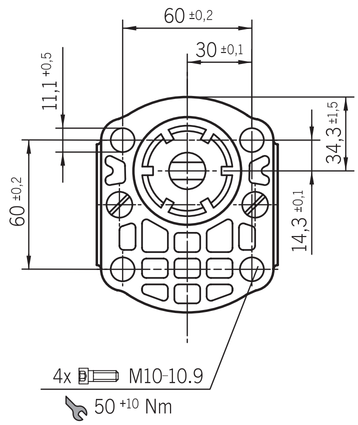
Features	Details
Shaft	1:5 taper keyed
Front Cover	Sq flange 80mm, OB
Ports	DIN 8901/8902
Rear Cover	Case drain

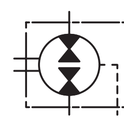
Ordering code
AZ M F – 1 X – □□□ U S A 20 ML

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 445 601**	210	4000	74.7	121.3	117.3		
11.0		**0 511 545 601**	210	3500	78.5	126.3	122.3		
16.0		**0 511 645 601**	210	3000	79.0	134.7	130.7		
19.0		**0 511 645 603**	180	3000	79.0	139.7	135.7		

* Contact factory for availabilty of units with no ordering number listed.





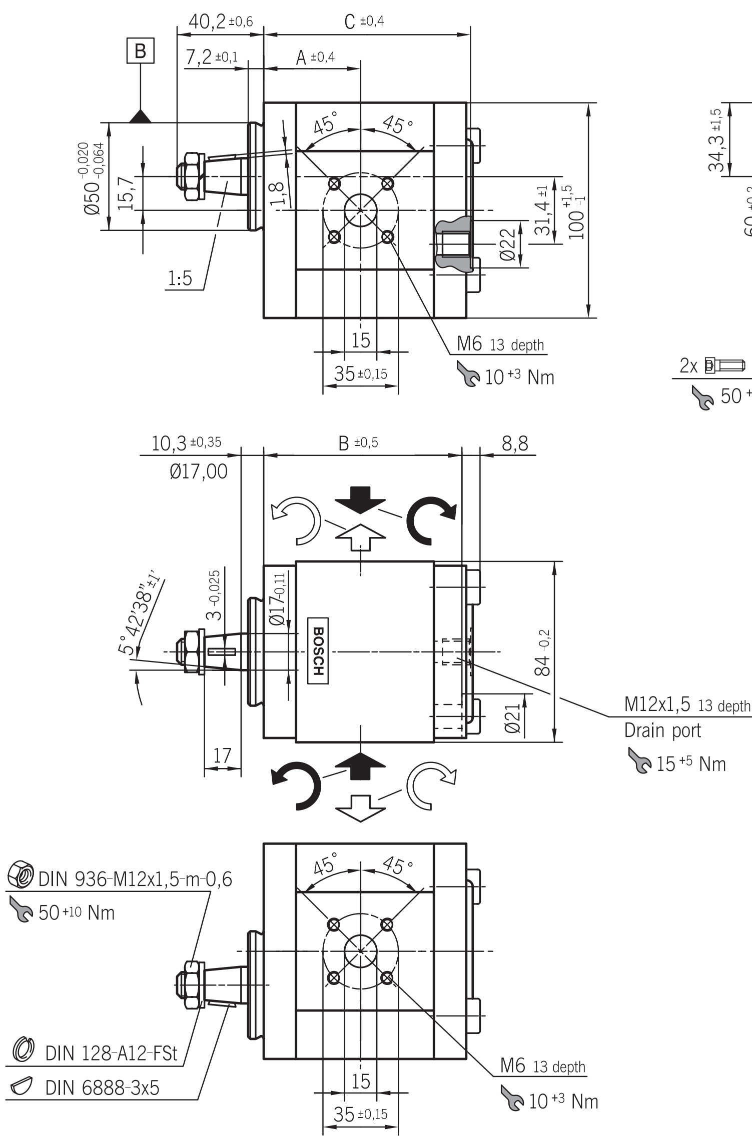


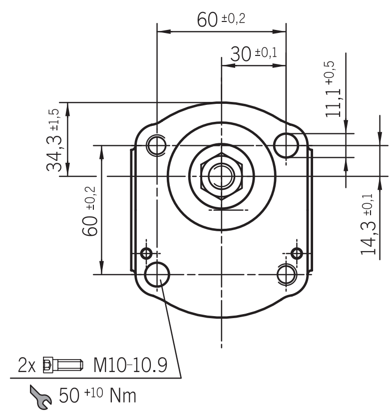
Features	Details
Shaft	Tang
Front Cover	Transmission
Ports	DIN 8901/8902
Rear Cover	Case drain

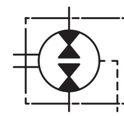
Ordering code
AZ M F – 1 X – □□□ U N T 20 ML

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 415 605**	210	4000	40.7	80.3	83.1		
11.0		**0 511 515 602**	210	3500	44.5	85.3	88.1		
16.0		**0 511 615 607**	210	3000	45.0	93.7	96.5		
19.0		**0 511 615 608**	180	3000	45.0	98.7	101.5		
22.0		**0 511 715 601**	180	3000	52.6	104.1	106.9		

* Contact factory for availabilty of units with no ordering number listed.





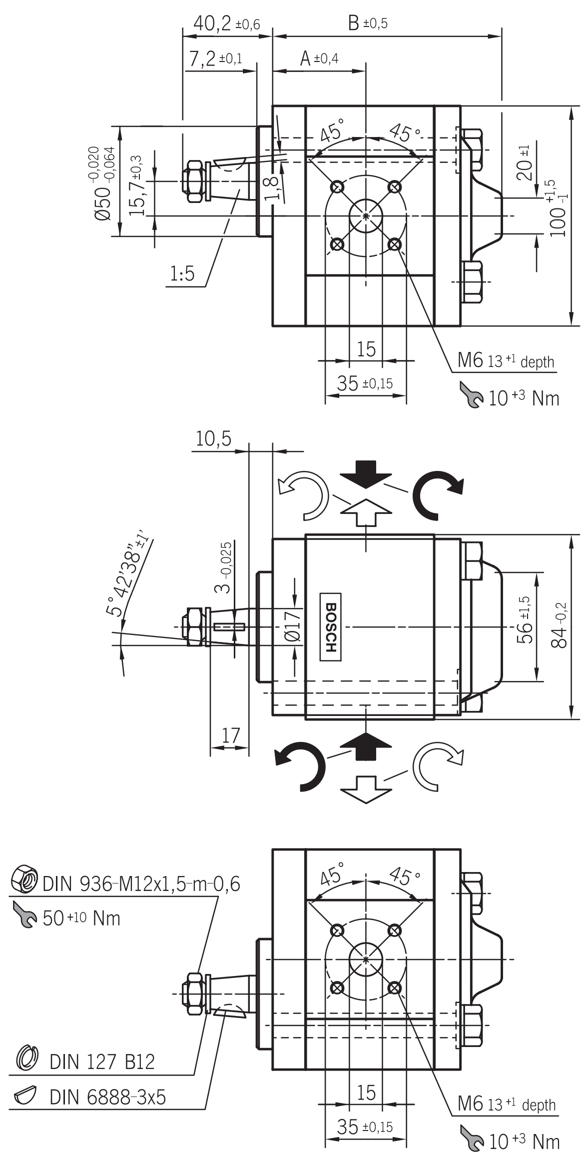


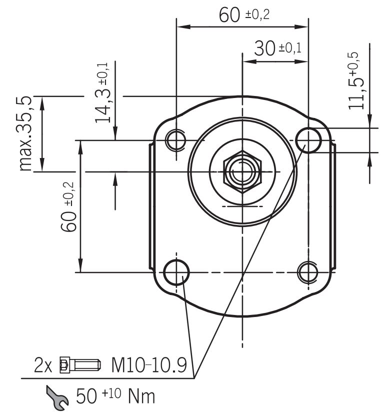
Features	Details
Shaft	1:5 taper keyed
Front Cover	Transmission
Ports	DIN 8901/8902
Rear Cover	Case drain

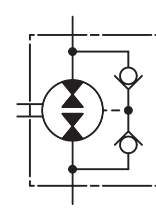
Ordering code
AZ M F – 1 X – □□□ U C N 20 ML

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 415 606**	210	4000	40.7	80.3	83.3		
11.0		**0 511 515 601**	210	3500	44.5	85.3	88.3		
14.0		**0 511 515 605**	210	3000	45.0	90.3	93.3		

* Contact factory for availabilty of units with no ordering number listed.





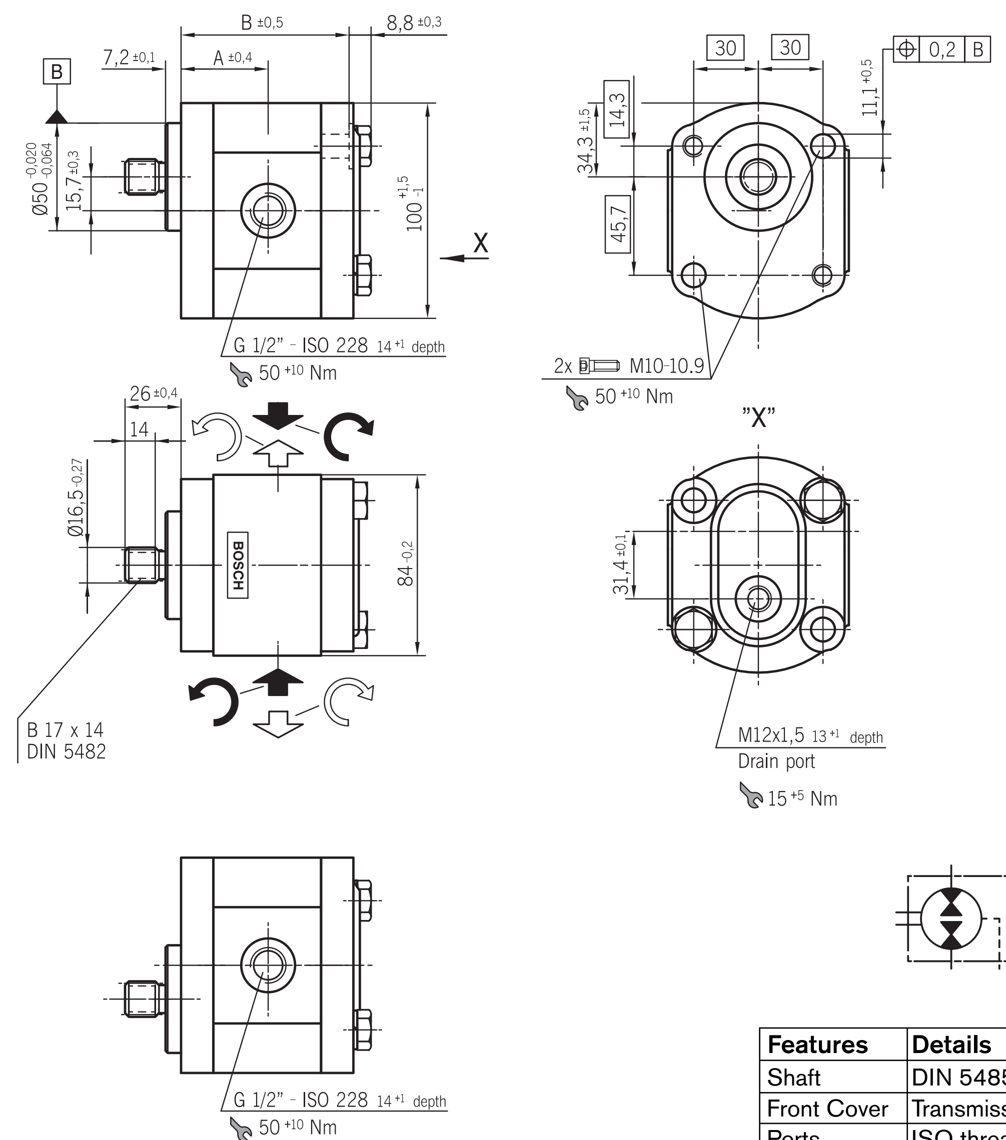


Features	Details
Shaft	1:5 taper keyed
Front Cover	Transmissiom
Ports	DIN 8901/8902
Rear Cover	Internal case drain

Ordering code
AZ M F – 1 X – □ □ □ – U C N 20 M □ – S0018

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 415 603**	210	4000	40.7	80.3	104.0		

* Contact factory for availabilty of units with no ordering number listed.



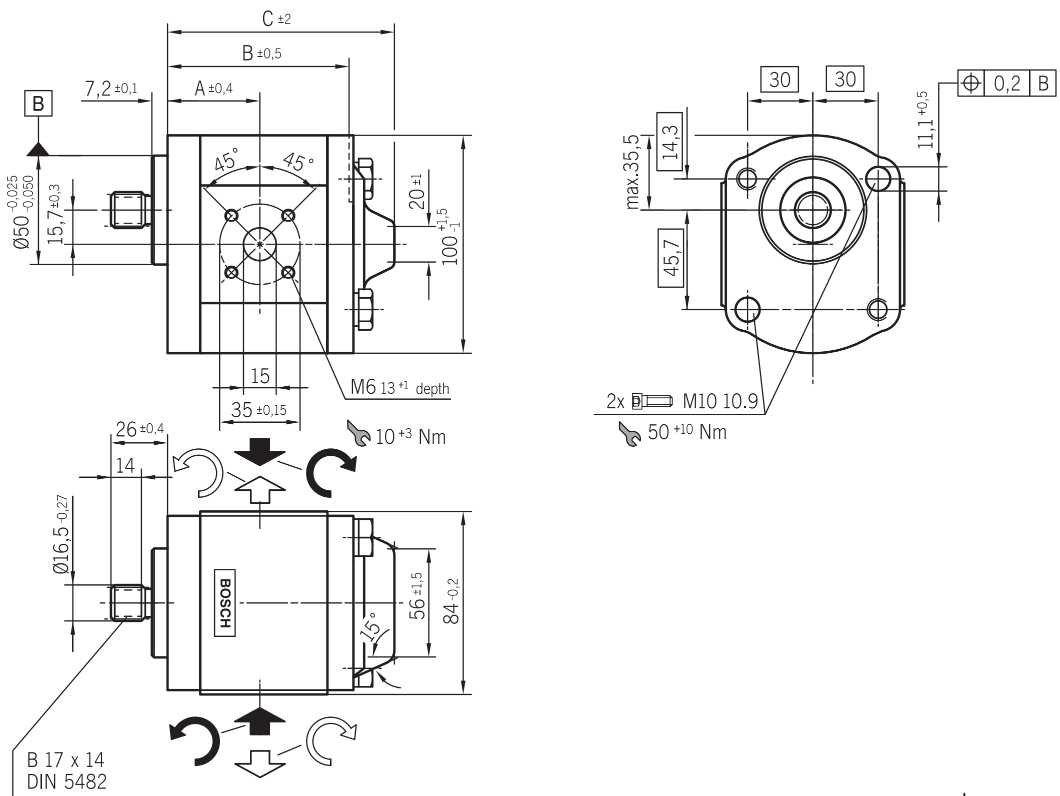
Features	Details
Shaft	DIN 5485 spline
Front Cover	Transmission
Ports	ISO threaded
Rear Cover	Case drain

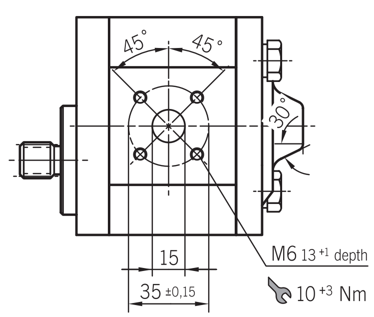
Ordering code

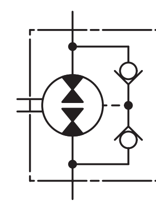
AZ M F – 1 X – □□□ U F N 01 ML

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B			
8.0		**0 511 415 608**	210	4000	40.7	80.3			

* Contact factory for availabilty of units with no ordering number listed.





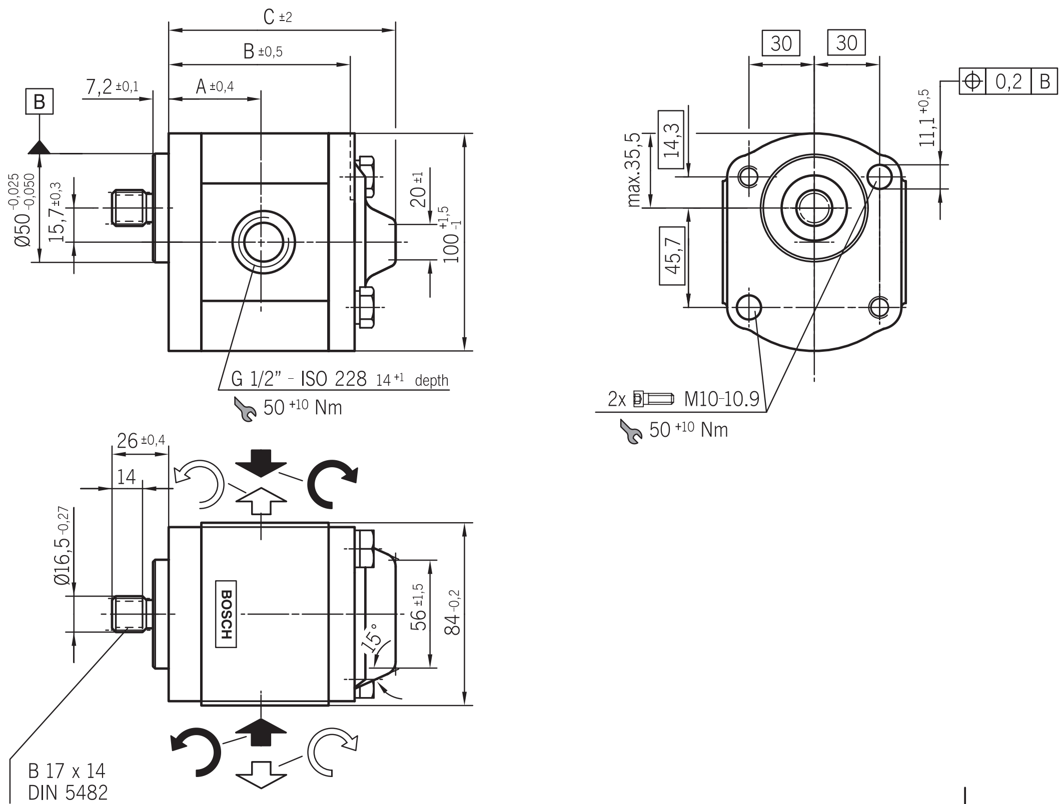


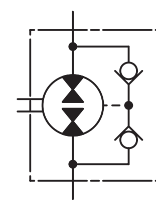
Features	Details
Shaft	DIN 5485 spline
Front Cover	Transmission
Ports	DIN 8901/8902
Rear Cover	Internal case drain

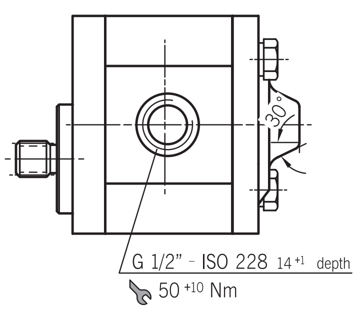
Ordering code
AZ M F – 1 X – □□□ U F N 20 M L – S0018

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
16.0		**0 511 615 606**	210	3000	45.0	93.7	114.5		

* Contact factory for availabilty of units with no ordering number listed.







Features	Details
Shaft	DIN 5485 spline
Front Cover	Transmission
Ports	ISO threaded
Rear Cover	Internal case drain

Ordering code
AZ M F – 1 X – □□□ U F N 01 M L – S0018

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
8.0		**0 511 415 604**	210	4000	40.7	80.3	101.1		

* Contact factory for availabilty of units with no ordering number listed.

Ordering Code (N Series Motor)

AZ M N -1□ or 2□ -028 U D C 12 M L -□□□ - S□□□□

Function

M = Motor

Size (N)

1.24 in³ (20.4 cm³) = 020
1.41 in³ (23.1 cm³) = 022
1.57 in³ (25.8 cm³) = 025
1.74 in³ (28.4 cm³) = 028
1.98 in³ (32.4 cm³) = 032
2.22 in³ (36.4 cm³) = 036

Direction of rotation

Right = R
Left = L
Universal = U (Bi-rotational)

PRV (bar)

EXAMPLE:
180 bar = 180

Special Design

End cover

B - Standard
A - Rear ports
L - Case drain port
L S0018 - Internal case drain
D - PRV (bar)

Seals

NBR = M
FPM = P
NBR, shaft seal in FPM = K

Drive shafts

		Matching front flange
C	Conical 1:5 (Tapered key)	B
N	Dog (Tang)	M
D	Spline shaft SAE B 13T	C
P	Spline shaft SAE 11T	R, C
Q	SAE 3/4″ Keyed - Short	R, C
Q	SAE 3/4″ Keyed - Long *S0022 Suffix	R, C
X	Special (S0 Code Defines Special Shaft)	R, C

Front flange

Code	Front flange
B	Square flange Pilot Ø 100 mm
C	SAE B 2-bolt
M	Transmission flange Pilot Ø 52 mm with O-ring
R	SAE A 2-bolt

Line connections

Code	Line connections
20	Rectangular flange
12	Thread (UN-2B) SAE O-ring BOSS
07	Split flange SAE Code 61 Metric bolts
40	Split flange SAE Code 61 UNC bolts

* Common Special Design Codes:
S0018 – Internal case drain
S0022 – 3/4″ Long keyed shaft
S0030 – S0018 & S0022
S0275 – Tapered key shaft with thread per SAE J744 Size 22-3

Size **N**

20 ... 36 cm^3/ rev

N Series Motor Product Index

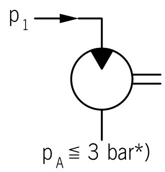
(Reference page 40 for ordering code designators)

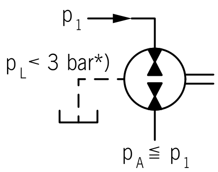
AZMN-12-XXXX _ _ _ KL

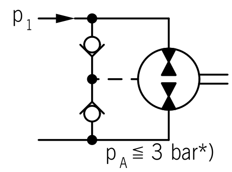
Page Number	Ordering code	Shaft Type	Mounting Flange	Ports	Port Orientation	Case Drain
45	AZMN-12-XXXUDC12KL	D	C	12	side	rear
46	AZMN-12-XXXUXC12KL-S0275	SAE Taper	C	12	side	rear
47	AZMN-12-XXXUPC12KL	P	C	12	side	rear
48	AZMN-12-XXXUQC12KL	Q	C	12	side	rear
49	AZMN-12-XXXUQC12KL-S0022	Q-S0022	C	12	side	rear
50	AZMN-11-XXXXCB20KB	C	B	20	side	rear

N Series Performance Ratings

Size			**020**	**022**	**025**	**028**	**032**	**036**
Displacement		cm^3/rev	20.4	23.1	25.8	28.4	32.4	36.4
max. continuous pressure	p_1	bar	210	210	210	210	180	160
		psi	3045	3045	3045	3045	2610	2320
max. starting pressure	p_2	bar	240	240	240	240	210	190
		psi	3480	3480	3480	3480	3045	2755
min. rotational speed		min^{-1}	500	500	500	500	500	500
max. rotational speed	p_1		3000	3000	3000	2800	2800	2500
Motor outlet pressure	p_A	bar						
Leakage-oil line pressure	p_L							







*) Short-term when starting 10 bar

N Series Motor
SAE O-Ring BOSS - Standard Porting

	Side Ports		Rear Port	
Displacement (cc)	Inlet	Outlet	Inlet	Outlet
20	-10	-10		
22	-10	-10		
25	-12	-12		
28	-12	-12		
32	-12	-12		
36	-12	-12		

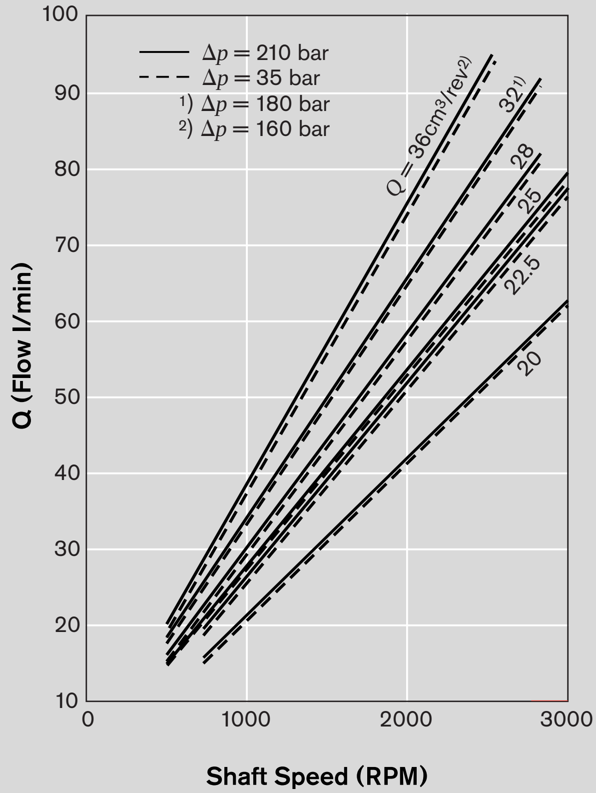
SAE Porting - Specifications and Dimensions
per SAE J1926/1

Dash Size	Thread Size (in)
-2	5/16-24 UNF-2B
-3	3/8-24 UNF-2B
-4	7/16-20 UNF-2B
-5	1/2-20 UNF-2B
-6	9/16-18 UNF-2B
-8	3/4-16 UNF-2B
-10	7/8-14 UNF-2B
-12	1-1/16-12 UN-2B
-14	1-3/16-12 UN-2B
-16	1-5/16-12 UN-2B
-20	1-5/8-12 UN-2B
-24	1-7/8-12 UN-2B
-32	2-1/2-12 UN-2B

Diagrams

Size **N**

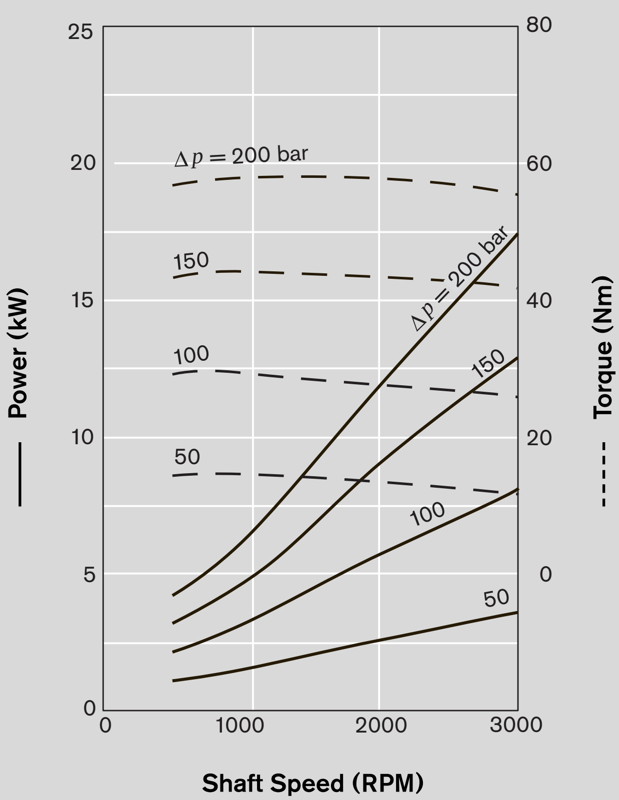
ν = 35 mm²/s, T = 50 °C



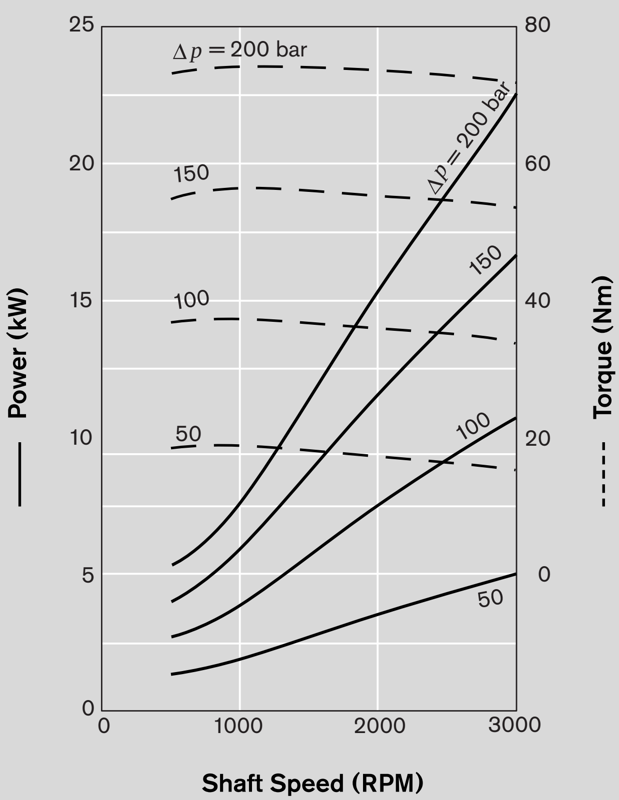
Unit Conversions

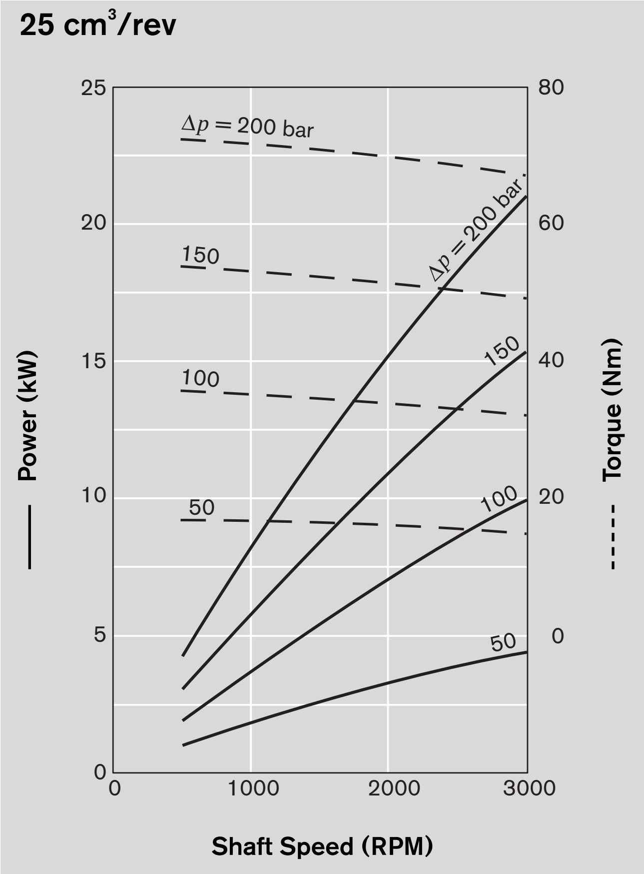
Pressure: psi = bar x 14.7
Torque: ft-lbs = (Nm) x .738
Power: hp = (kW) x 1.341
Volume: in³ = (cc) x 0.061
gpm = (LPM) x 0.2642

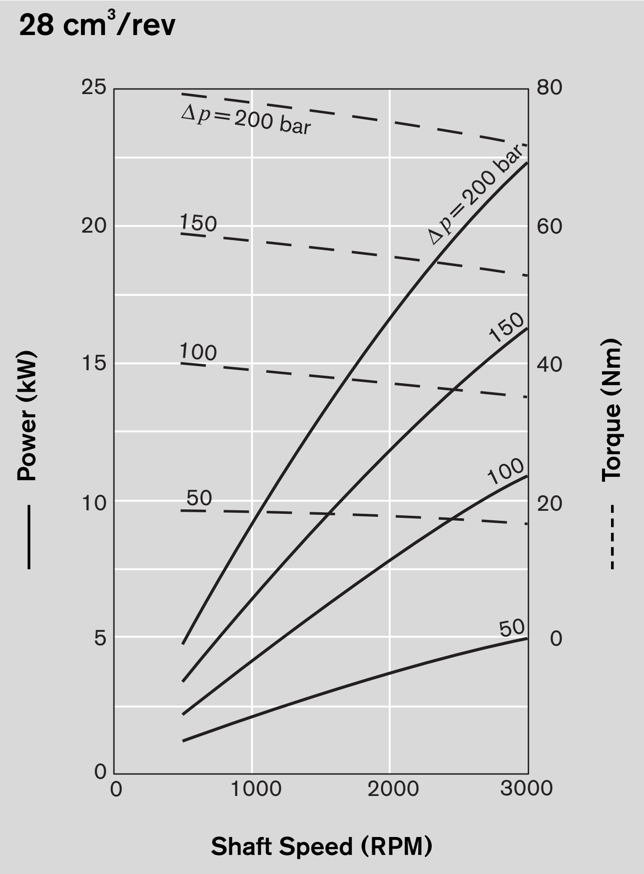
20 cm³/rev

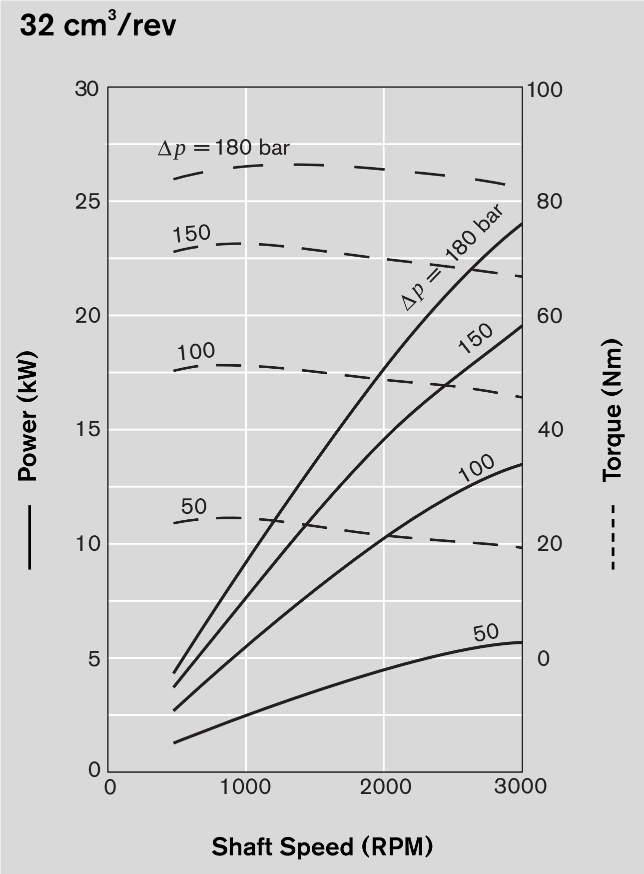


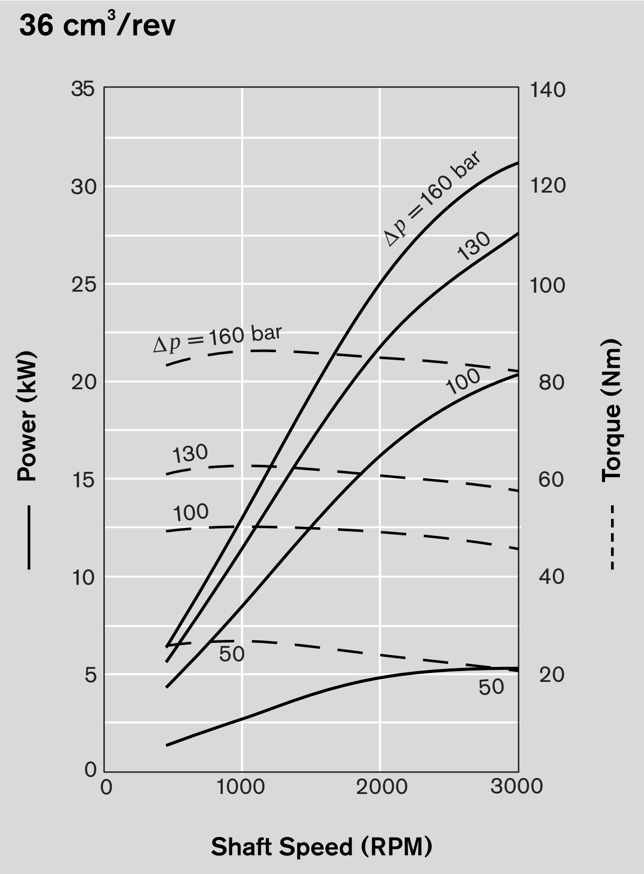
22.5 cm³/rev

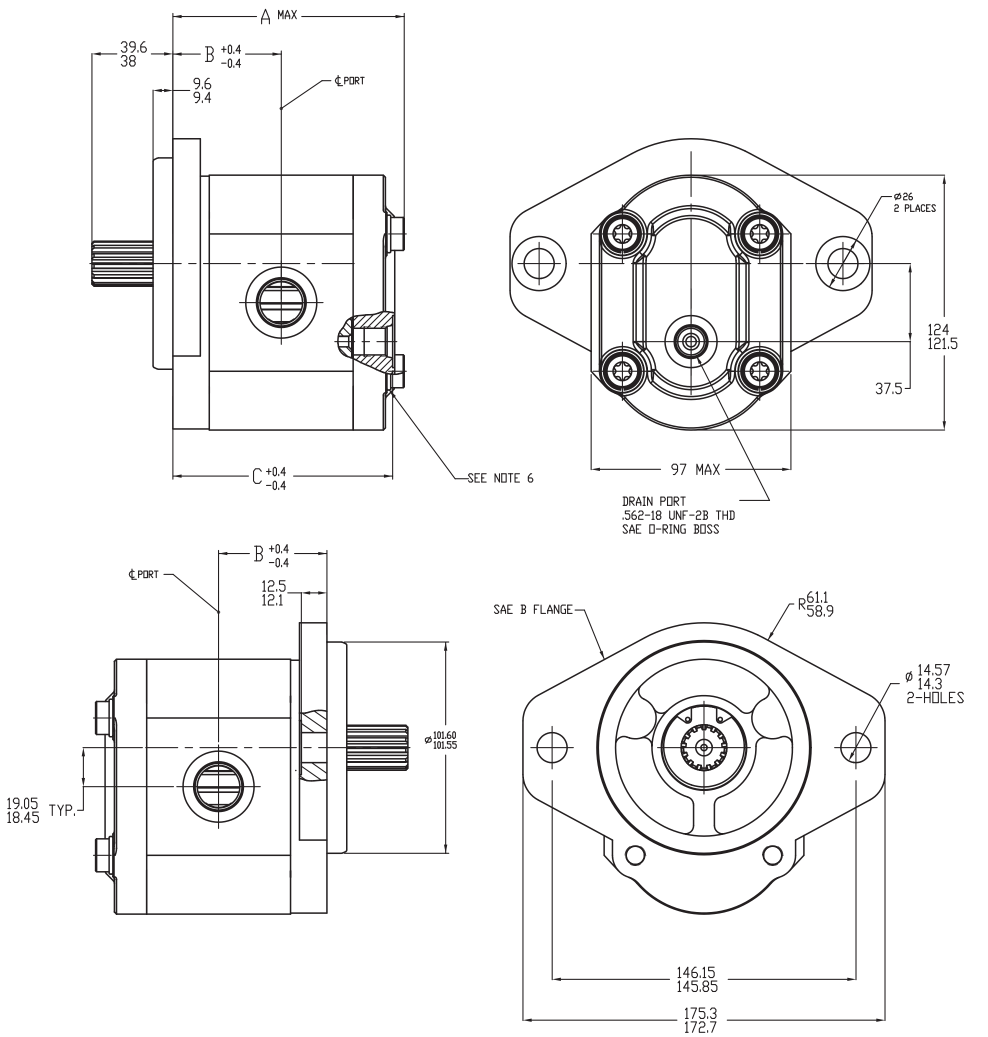



25 cm³/rev
Δp = 200 bar
150
100
50
Δp = 200 bar
150
100
50
Power (kW)
Torque (Nm)
Shaft Speed (RPM)

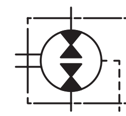

28 cm³/rev
Δp = 200 bar
150
100
50
Δp = 200 bar
150
100
50
Power (kW)
Torque (Nm)
Shaft Speed (RPM)


32 cm³/rev
Δp = 180 bar
150
100
50
Δp = 180 bar
150
100
50
Power (kW)
Torque (Nm)
Shaft Speed (RPM)


36 cm³/rev
Δp = 160 bar
130
100
50
Δp = 160 bar
130
100
50
Power (kW)
Torque (Nm)
Shaft Speed (RPM)



Features	Details
Shaft	13t spline
Front Cover	SAE B 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

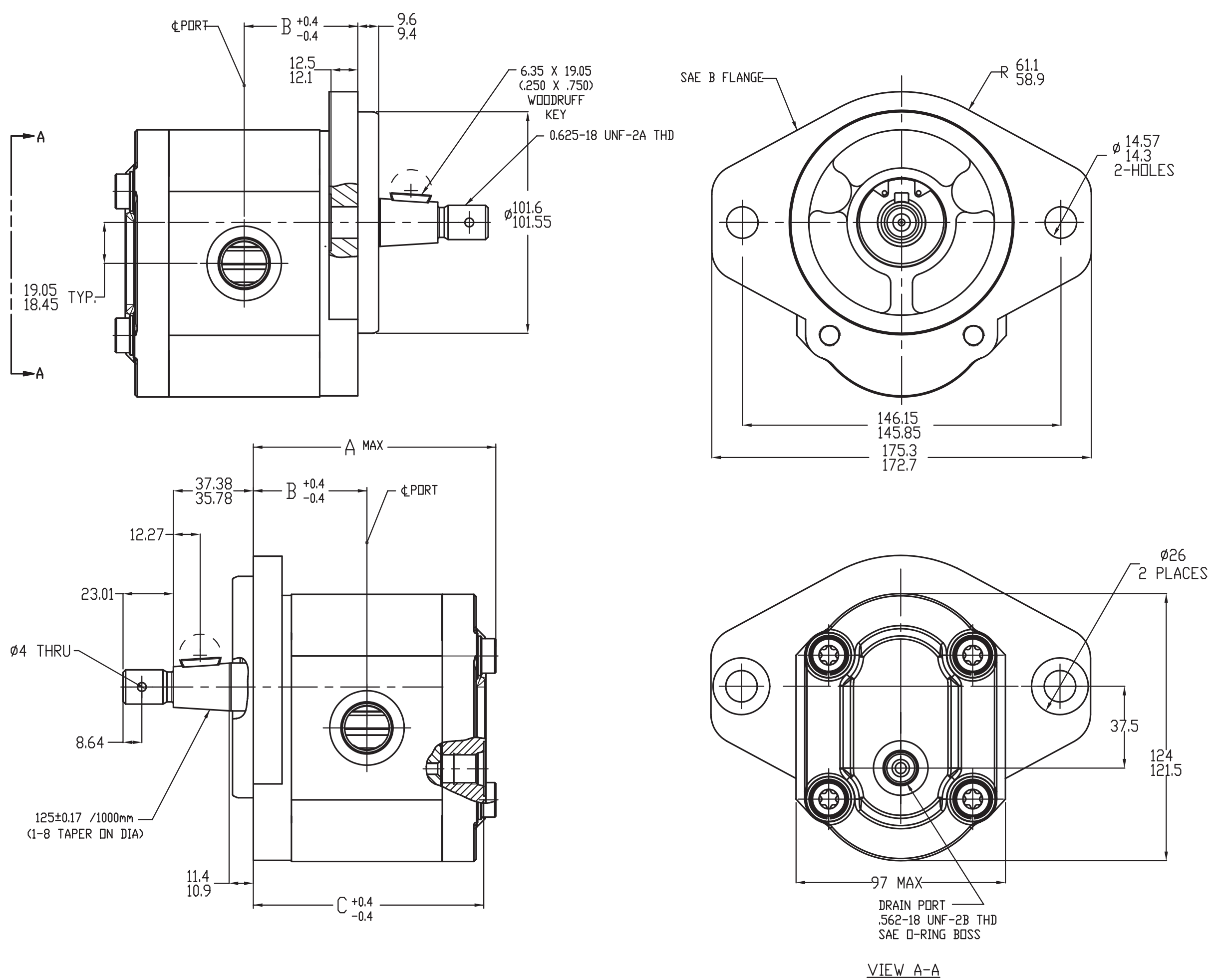


Ordering code
AZMN – 12 – □ □ □ U D C 12 KL

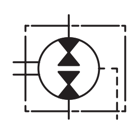
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
20.0		**9 511 390 001**	210	3000	109.8	52.1	105.6	-10	-10
22.5		**9 511 390 002**	210	3000	114.7	53.6	108.6	-10	-10
25.0		**9 511 390 003**	210	3000	115.8	55.1	111.6	-12	-12
28.0		**9 511 390 004**	210	2800	118.8	56.6	114.6	-12	-12
32.0		**9 511 390 005**	180	2800	123.3	58.6	119.1	-12	-12
36.0		**9 511 390 006**	160	2500	129.7	61.1	123.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



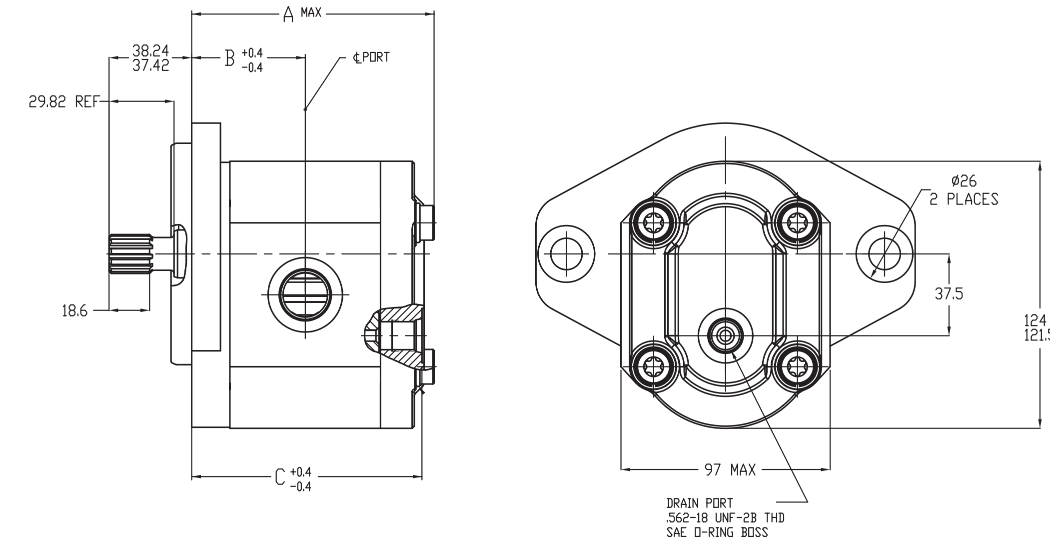
Features	Details
Shaft	SAE tapered key
Front Cover	SAE B 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

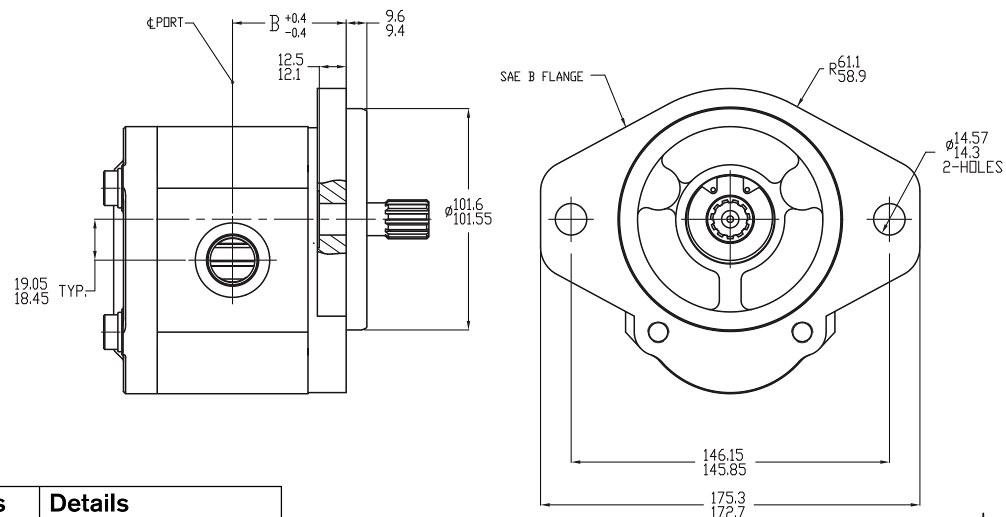


Ordering code
AZMN – 12 – □ □ □ U X C 12 KL – S0275

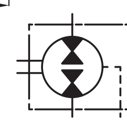
Displacement [cm³/rev]	Ordering-Number *		Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
		Bi-Rotational							
20.0		**9 511 390 031**	210	3000	109.8	52.1	105.6	-10	-10
22.5		**9 511 390 032**	210	3000	114.7	53.6	108.6	-10	-10
25.0		**9 511 390 033**	210	3000	115.8	55.1	111.6	-12	-12
28.0		**9 511 390 034**	210	2800	118.8	56.6	114.6	-12	-12
32.0		**9 511 390 035**	180	2800	123.3	58.8	119.1	-12	-12
36.0		**9 511 390 036**	160	2500	129.7	61.1	123.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.
** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)





Features	Details
Shaft	11t spline
Front Cover	SAE B 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

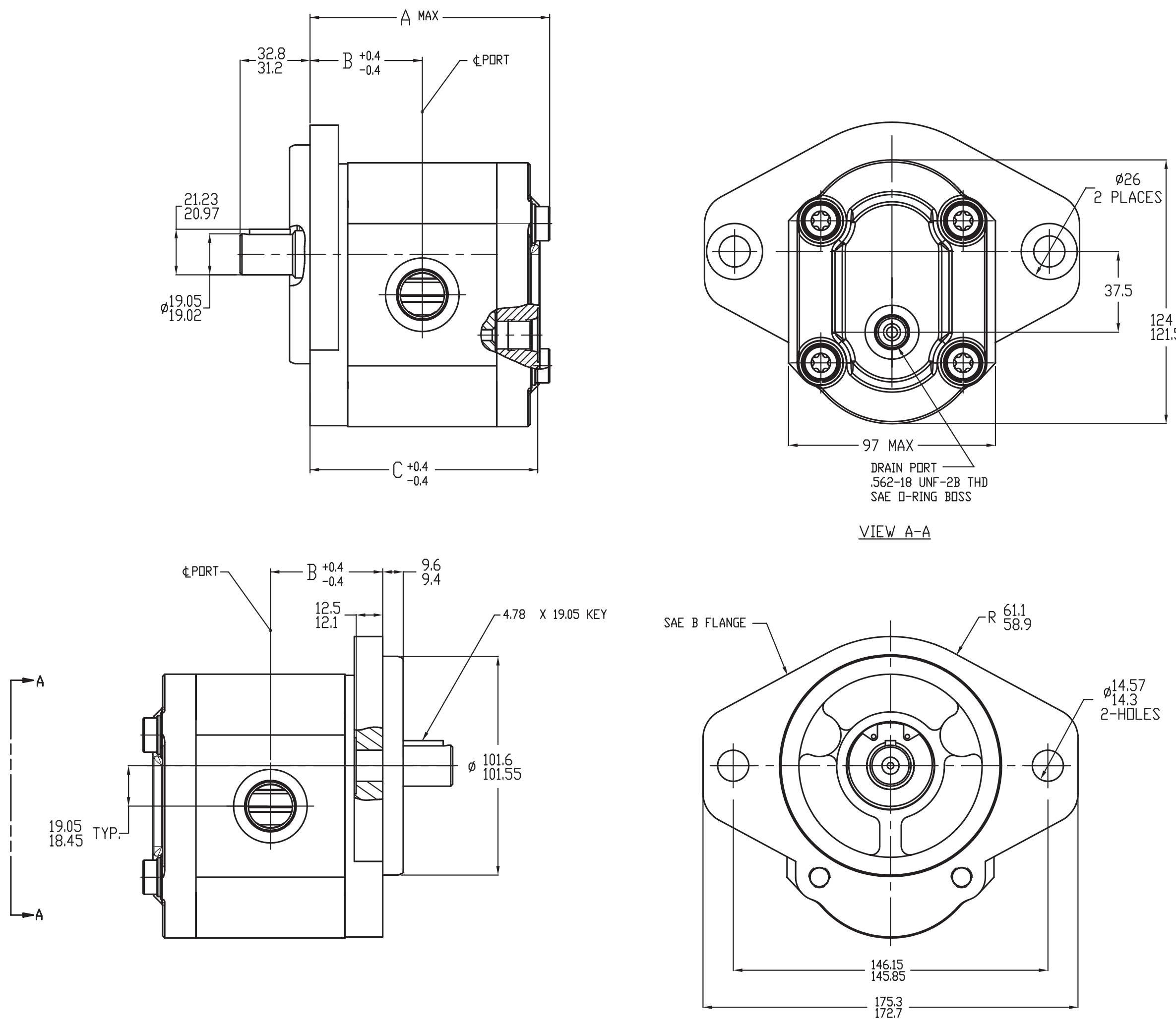


Ordering code
AZMN – 12 – □ □ □ U P C 12 KL

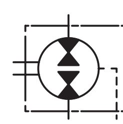
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
20.0		**9 511 390 025**	210	3000	109.8	52.1	105.6	-10	-10
22.5		**9 511 390 026**	210	3000	114.7	53.6	108.6	-10	-10
25.0		**9 511 390 027**	210	3000	115.8	55.1	111.6	-12	-12
28.0		**9 511 390 028**	210	2800	118.8	56.6	114.6	-12	-12
32.0		**9 511 390 029**	180	2800	123.3	58.8	119.1	-12	-12
36.0		**9 511 390 030**	160	2500	129.7	61.1	123.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	3/4" keyed
Front Cover	SAE B 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

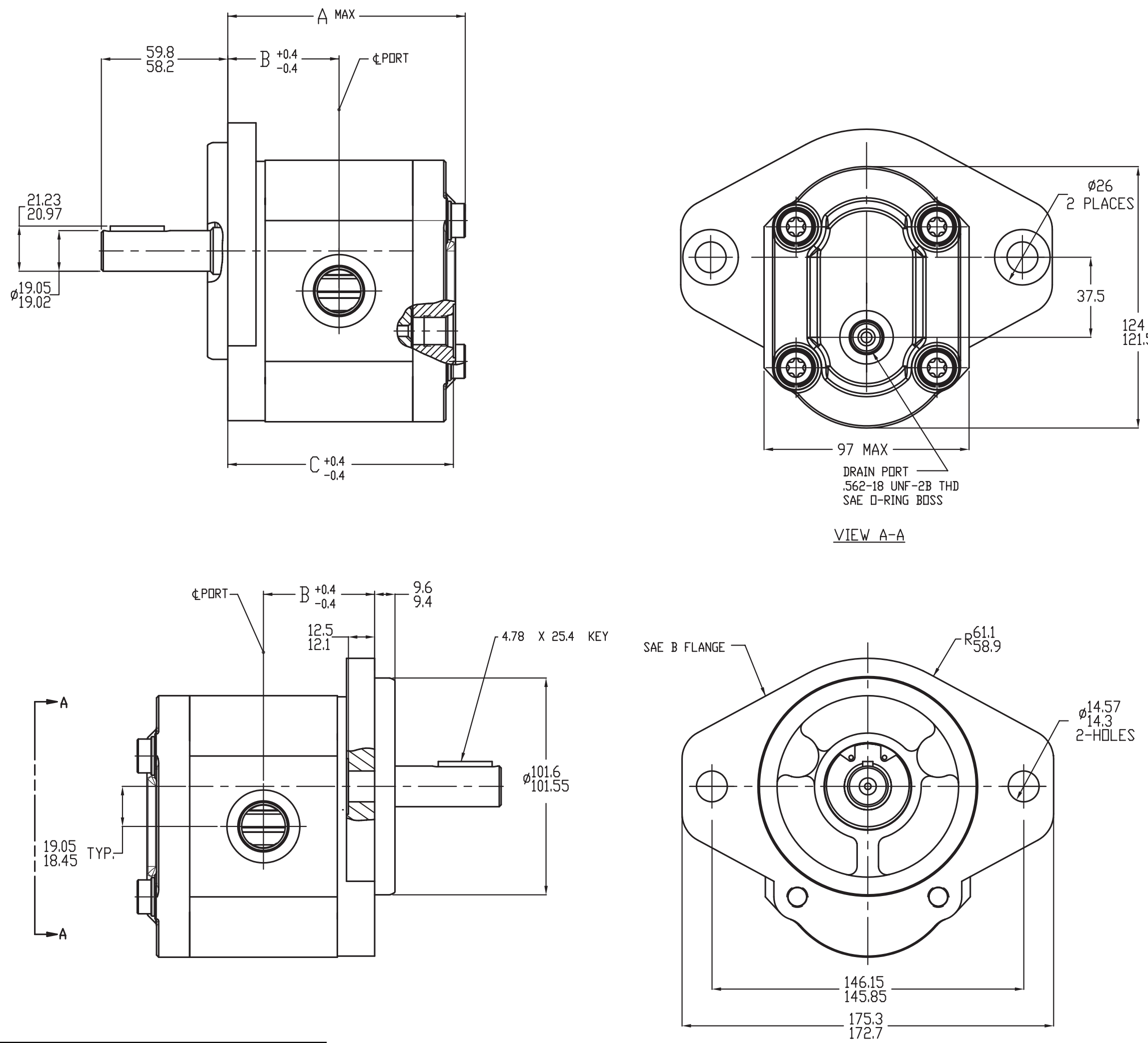


Ordering code
AZMN – 12 – □ □ □ U Q C 12 KL

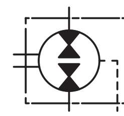
Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
20.0		**9 511 390 013**	210	3000	109.8	52.1	105.6	-10	-10
22.5		**9 511 390 014**	210	3000	114.7	53.6	108.6	-10	-10
25.0		**9 511 390 015**	210	3000	115.8	55.1	111.6	-12	-12
28.0		**9 511 390 016**	210	2800	118.8	56.6	114.6	-12	-12
32.0		**9 511 390 017**	180	2800	123.3	58.8	119.1	-12	-12
36.0		**9 511 390 018**	160	2500	129.7	61.1	123.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	3/4” keyed – long
Front Cover	SAE B 2-bolt
Ports	SAE ORB
Rear Cover	Case drain

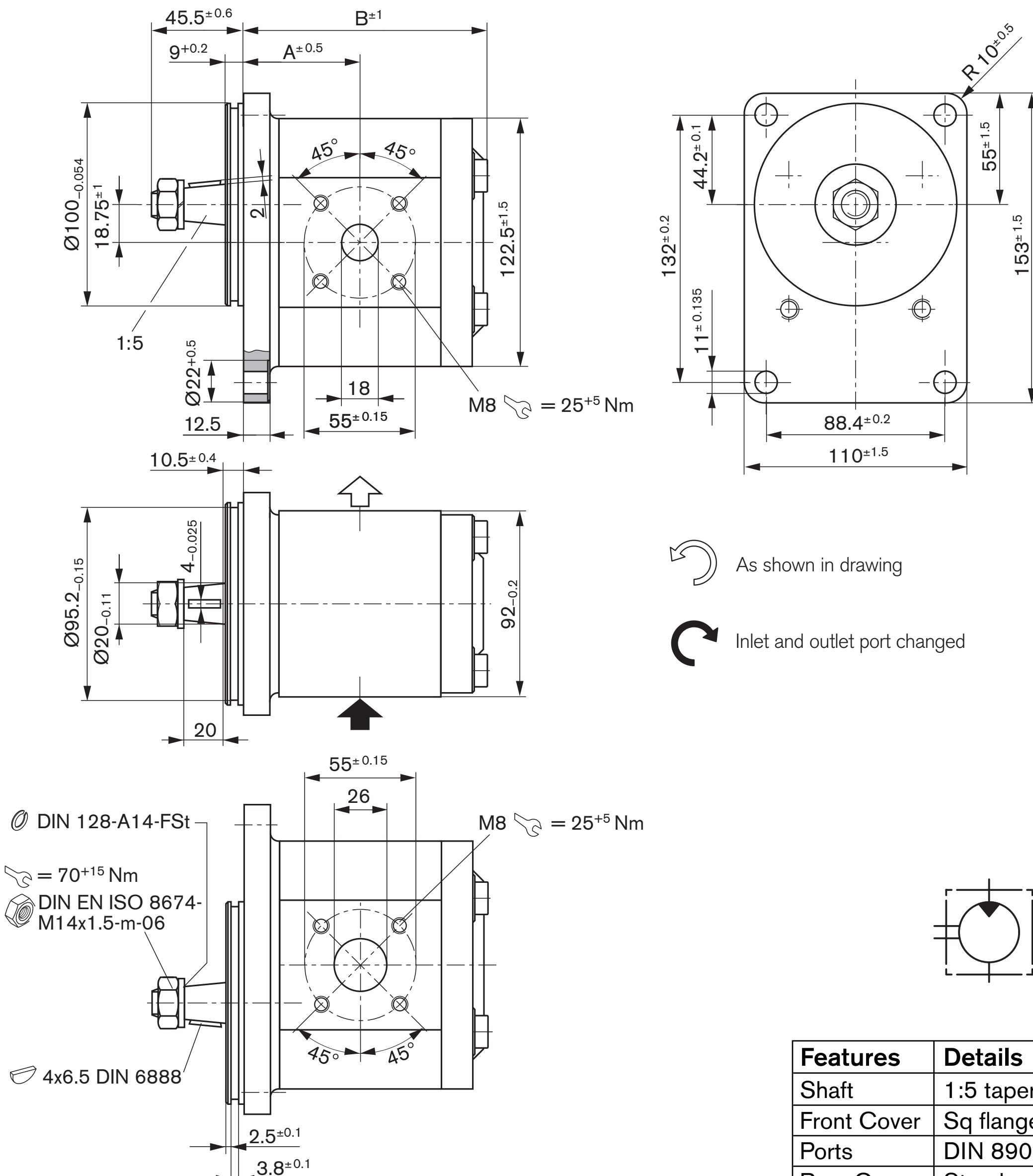


Ordering code
AZMN – 12 – □ □ □ U Q C 12 KL – S0022

Displacement [cm³/rev]	Ordering-Number *	Bi-Rotational	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C	Inlet Port ** (SAE O-Ring BOSS)	Outlet Port (SAE O-Ring BOSS)
20.0		**9 511 390 043**	210	3000	109.8	52.1	105.6	-10	-10
22.5		**9 511 390 044**	210	3000	114.7	53.6	108.6	-10	-10
25.0		**9 511 390 045**	210	3000	115.8	55.1	111.6	-12	-12
28.0		**9 511 390 046**	210	2800	118.8	56.6	114.6	-12	-12
32.0		**9 511 390 047**	180	2800	123.3	58.6	119.1	-12	-12
36.0		**9 511 390 048**	160	2500	129.7	61.1	123.6	-12	-12

* Contact factory for availabilty of units with no ordering number listed.

** Case drain port size: SAE -6 O-Ring BOSS (.562-18 UNF-2B THD)



Features	Details
Shaft	1:5 taper keyed
Front Cover	Sq flange 100mm
Ports	DIN 8901/8902
Rear Cover	Standard

Ordering code
AZMN – 12 – □ □ □ □ C B 20 KB

Displacement [cm³/rev]	Ordering-Number * L	Ordering-Number * R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	C		
20.0									
22.5									
25.0	**0511 725 307**		210	3000	55.0	116.1			
28.0	**0511 725 309**	**0511 725 019**	200	3000	56.6	119.1			
32.0									
36.0									

* Contact factory for availabilty of units with no ordering number listed.

Spare Parts (reference Fig. 8)

Example Model Code: AZMF – 12 008 – U**R**R 12**M**L

Model Code Designator for Shaft — Model Code Designator for Seal

	Model Code For Shaft	Shaft Description	Model Code For Seal	Seal Material	Bi-Directional Motor Item 1, 2, & 3	Uni-Directional Motor Item 1, 2, & 3	Shaft Seal Item 4
F Series Motor	R	SAE 9T Spline	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	1510283065
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	Q	5/8" Straight Key	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	1510283065
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	P	SAE 11T Spline	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	Consult Factory
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	C	1:5 Tapered Key	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	1510283065
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	S	1:5 Tapered for Flange A	M	NBR	1517010195	1517010152	
			P	FPM	1517010193	1517010193	1510283015
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	H	1:8 Tapered Key	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	1510283065
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	N	Dog (Tang)	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	1510283065
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
	F	Din 5482 B17x14 Spline	M	NBR	1517010195	1517010152	
			P	FPM	1517010196	1517010193	1510283065
			K	NBR W/FPM SHAFT SEAL	1517010195	1517010152	
N Series Motor	D	SAE 13T Spline	M	NBR	R98640146P	—	
			P	FPM	—	—	1510283028
			K	NBR W/FPM SHAFT SEAL	—	—	
	P	SAE 11T Spline	M	NBR	R98640146P	—	
			P	FPM	—	—	1510283028
			K	NBR W/FPM SHAFT SEAL	—	—	
	Q	3/4" Straight Key	M	NBR	R98640146P	—	
			P	FPM	—	—	1510283028
			K	NBR W/FPM SHAFT SEAL	—	—	
	X	S0075 Tapered	M	NBR	R98640146P	—	
			P	FPM	—	—	1510283028
			K	NBR W/FPM SHAFT SEAL	—	—	
	C	1:5 Tapered Key	M	NBR	R98640146P	—	
			P	FPM	—	—	1510283028
			K	NBR W/FPM SHAFT SEAL	—	—	
	N	Dog (Tang)	M	NBR	R98640146P	—	
			P	FPM	—	—	1510283028
			K	NBR W/FPM SHAFT SEAL	—	—	

* Shaft seals are Viton material regardless of material used for other seals

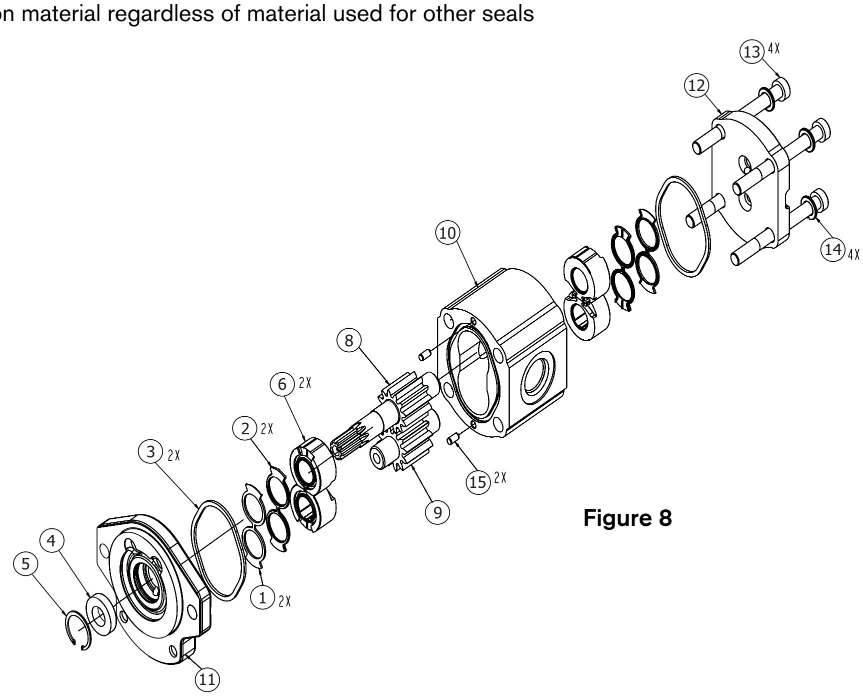


Figure 8

Part Number Index

External Gear Pumps – Multiple Pumps

Bosch Rexroth Corporation
Hydraulics
Product Segment External Gear Units
8 Southchase Court
Fountain Inn, SC 29644-9018
Telephone (864) 967-2777
Facsimile (864) 962-5338
www.boschrexroth-us.com

Rexroth
Bosch Group

Fixed Displacement Motor A10FM A10FE

RA 91 172/12.06 **1**/32
Replaces: 10.03

Technical Data Sheet

Size 10...63
Series 52
Nominal pressure
4060 psi (280 bar)
Peak pressure
5100 psi (350 bar)
Open and closed circuit

A10FM 23...63

A10FE 10...45
(2-hole-flange)

A10FE 11...18
(8-hole-flange)

Contents

Features

- Fixed displacement motor, axial piston in swashplate design for hydrostatic transmissions in open and closed circuit applications
- Output speed proportional to inlet flow
- Output torque increases with the pressure gradient between high and low-pressure sides
- For mobile and industrial applications
- Long service life
- High permissible output speeds
- Well proven A10-rotary group
- High power to weight ratio - compact size
- Plug-in version for space saving installation
- Low noise level
- Mechanical and hydraulic connections acc. to SAE standards
- Speed pickup optional
- Integrated anti cavitation valve optional, i.e. fan drives

Ordering Code - Standard Program A10FM

A10F	M		/	5	2		–	V		C			
01	02	03		04	05	06		07	08	09	10	11	12

Axial piston unit

01	Swashplate design, fixed	**A10F**

Mode of operation

02	Motor	**M**

Size

			18	23	28	37	45	58	63
03	Displacement $V_{g\ max}$	[in^3]	1.10	1.43	1.73	2.23	2.71	3.53	3.84
		[cm^3]	18	23	28	37	45	58	63

Series

04		**5**

Index

05		**2**

Direction of rotation

06	viewing on shaftend	alternating	**W**
		clockwiese	**R**[1)]
		counter clockwiese	**L**[1)]

Seal

07	FKM fluor-rubber	**V**

Shaft end

		18	23	28	37	45	58	63	
08	Splined shaft to SAE J744	○	●	●	●	●	●	●	**R**
	Splined shaft to SAE J744	–	○	○	●	●	●	●	**W**
	Tapered with woodruff key	○	●	●	●	●	●	●	**C**

Mounting flange

09	SAE 2-hole	○	●	●	●	●	●	●	**C**

Ports for service lines

10	Port A/B on side - same side; SAE flange; UNC threaded bolt holes	–	●	●	●	●	●	●	**60N00**
	Threaded ports A/B on side - same side; UNF thread	○	●	●	●	●	●	●	**66N00**
	Port A/B at rear - SAE flange; UNC threaded bolt holes	○	○	○	●	●	○	○	**61N00**
	SAE threaded ports at rear - UNF thread	○	●	●	●	●	○	○	**64N00**

Valves

11	Without valve	○	●	●	●	●	●	●	**0**
	Integrated flushing valve	–	●	●	●	●	●	●	**7**[2)]
	Integrated anti cavitation valve	○	●	●	●	●	●	●	**2**[1)2)]

Speed pickup

12	Without speed pickup	○	●	●	●	●	●	●	
	Prepared for speed pickup (for inductive sensor ID)	○	●	●	●	●	●	●	**D**

● available ○ in preparation – not available

1) With valve option “2“ (integrated anti cavitation valve) only.
2) With port for service lines option „60N00“ and „66N00“

Ordering Code - Standard Program A10FE

A10F	E		/	5	2		–	V					
01	02	03		04	05	06		07	08	09	10	11	12

Axial piston unit

01	Swashplate design, fixed	**A10F**

Mode of operation

02	Plug-in motor	**E**

Size

			10	11	14	16	18	23	28	37	45	58	63
03	Displacement $V_{g\,max}$	[in³]	0.65	0.70	0.86	0.98	1.10	1.43	1.73	2.24	2.71	3.53	3.84
		[cm³]	10	11	14	16	18	23	28	37	45	58	63

Series

04		**5**

Index

05		**2**

Direction of rotation

06	viewing on shaft end	alternating	**W**
		clockwiese	**R**[1]
		counter clockwiese	**L**[1]

Seal

07	FKM fluor-rubber	**V**

Drive shaft

		10	11	14	16	18	23	28	37	45	58	63	
08	Splined shaft to SAE J744	○	○	○	○	●	●	●	●	●	○	○	**R**
	Splined shaft to SAE J744	–	–	–	–	–	○	○	○	○	○	○	**W**
	Tapered with woodruff key	●	●	●	●	●	●	●	●	●	○	○	**C**

Mounting flange

		10	11	14	16	18	23	28	37	45	58	63	
09	SAE 2-hole	●	●	●	●	●	–	–	–	–	–	–	**C**
	Special 2-hole flange	–	–	–	–	–	●	●	●	●	○	○	**F**
	Special 8-hole flange	–	●	●	●	●	–	–	–	–	–	–	**H**

Ports for service lines

		10	11	14	16	18	23	28	37	45	58	63	
10	Port A/B on side - same side; SAE flange; UNC threaded bolt holes	–	–	–	–	–	●	●	●	●	○	○	**60N00**
	Port A/B on side - same side; thread metric	●	●	●	●	●	●	●	●	●	○	○	**66N00**
	Port A/B at rear - SAE flange; UNC threaded bolt holes	–	–	–	–	○	○	○	○	○	○	○	**61N00**
	SAE threaded ports at rear - UNF thread	–	–	–	–	○	○	○	○	○	○	○	**64N00**

Valves

		10	11	14	16	18	23	28	37	45	58	63	
11	Without valve	○	●	○	●	●	●	●	●	●	○	○	**0**
	Integrated flushing valve	–	–	–	–	–	○	○	●	●	○	○	**7**[2]
	Integrated anti cavitation valve	●	●	●	●	●	●	●	●	●	○	○	**2**[1][2]

Speed pickup

		10	11	14	16	18	23	28	37	45	58	63	
12	Without speed pickup	●	●	●	●	●	●	●	●	●	○	○	
	Prepared for speed pickup (for inductive sensor ID)	–	–	–	–	○	○	●	○	○	○	○	**D**

● available ○ in preparation – not available

[1] With valve option “2“ (integrated anti cavitation valve) only.

[2] With port for service lines option „60N00“ and „66N00“

Technical Data

Fluid

Prior to project design, please see our technical data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable fluis) and RE 90223 (HF- fluids) for detailed information on fluids and operating conditions.

When using HF- or environmentally acceptable fluids attention must be paid to possible limitations of the technical data, if necessary contact us.

When ordering , please state in clear text the fluid to be used.

Operating viscosity range

For optimum efficiency and service life we recommend that the operating viscosity (at operating temperature) be selected in the range

ν_{opt} = opt. operating viscosity 80...170 SUS (16...36 mm²/s)

referred to the circuit temperature (closed circuit) or to tank temperature (open circuit).

Limit of viscosity range

For critical operating conditions the following values apply:

ν_{min} = 42 SUS (5 mm²/s) (closed circuit)
ν_{min} = 60 SUS (10 mm²/s) (open circuit)
for short periods ($t \leq 1$ min)
at max. perm. fluid temperature of 239°F (115 °C).

Please note that the max. leakage fluid temperature of 239°F (115 °C) is also not exceeded in certain areas (for instance bearing area).The fluid temperature in the bearing area is approx. 7°F (5 K) higher than the average leakage fluid temperature

ν_{max} = 7500 SUS (1600 mm²/s)
for short periods ($t \leq 1$ min)
on cold start ($t_{min} = p \leq 435$ psi (30 bar), $n \leq 1000$ min^{-1}, -13°F (–25 °C)).

At temperatures between -40°F (-40 °C) and -13°F (-25 °C) special measures are required, please consult us for further information.

For detailed information on operation with low temperatures see data sheet RE 90300-03-B.

Notes on the selection of the hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open circuit) in relation to the ambient temperature.

The fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (ν_{opt}), 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 in the tank is 140°F (60 °C) . In the optimum viscosity range (ν_{opt}; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

Important: The leakage oil (case drain oil) temperature is influenced by pressure and input speed and is always higher than the tank temperature. However, at no point in the circuit may the temperature exceed 239°F (115 °C).

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperatures please consult us.

Filtration of fluid

The finer the filtration the better the achieved cleanliness of the pressure fluid and the longer the life of the axial piston unit.

To ensure a reliable functioning of the axial piston unit, a minimum cleanliness of

20/18/15 to ISO 4406 is necessary.

At very high operating temperatures (195°F (90 °C) to max. 239°F (115 °C)) a cleanliness of

19/17/14 to ISO 4406 is necessary.

If above mentioned grades cannot be maintained please consult us.

Operating pressure range

Pressure at port A or B

(Pressure data to DIN 24312)

Nominal pressure p_N ________________ 4060 psi (280 bar)

Peak pressure p_{max} __________________5100 psi (350 bar)

Case drain pressure

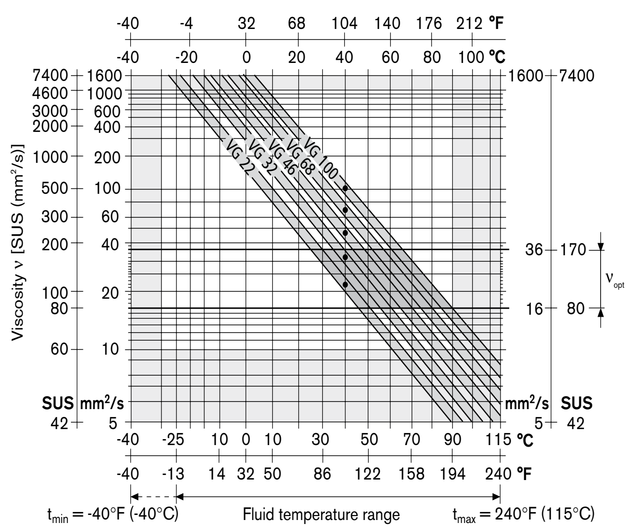
Maximum permissible leakage fluid at port L

$p_{abs\ max}$ Motor operation open circuit_____ 58 psi (4 bar) abs
$p_{abs\ max}$ Motor operation closed circuit____ 58 psi (4 bar) abs
$p_{abs\ max}$ Motor/Pump operation open circuit 29 psi (2 bar) abs

Direction of flow

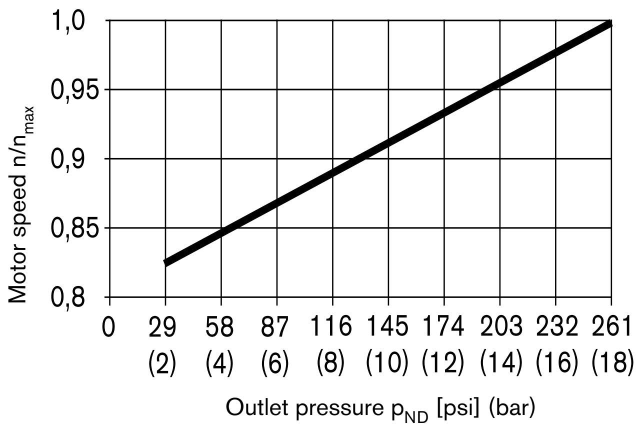
Flow A to B = right hand rotation
Flow B to A = left hand rotation

Selection chart



Technical Data

Permissible speed depending on outlet pressure



Calculation of size

Flow $q_V = \dfrac{V_g \cdot n}{231 \cdot \eta_V}$ [gpm]

$q_V = \dfrac{V_g \cdot n}{1000 \cdot \eta_V}$ [L/min]

Torque $T = \dfrac{V_g \cdot \Delta p \cdot \eta_{mh}}{24 \cdot \pi}$ [lb-ft]

$T = \dfrac{1{,}59 \cdot V_g \cdot \Delta p \cdot \eta_{mh}}{100}$ [Nm]

or $T = T_K \cdot \Delta p \cdot \eta_{mh}$

Power $P = \dfrac{T \cdot n}{5252} = \dfrac{q_V \cdot \Delta p \cdot \eta_t}{1714}$ [HP]

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

Output speed $n = \dfrac{q_v \cdot 231 \cdot \eta_v}{V_g}$ [rpm]

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

V_g = geometr. displacement per revolution in in^3 (cm^3)
Δp = pressure differential in psi (bar)
n = drive speed in rpm (min^{-1})
η_V = volumetric efficiency
η_{mh} = mechanical-hydraulic efficiency
η_t = overall efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)
T_K = torque constant

Technical Data

Table of values[1]

Size				10	11	14	16	18	23
Displacement		$V_{g\ max}$	in^3	0.65	0.70	0.86	0.98	1.10	1.43
			(cm^3)	(10.6)	(11.5)	(14.1)	(16.1)	(18)	(23.5)
Speed[2]									
max. at $V_{g\ max}$		$n_{0\ max}$	min^{-1}	5000	4200	4200	4200	4200	4900
Inlet flow									
at $n_{0\ max}$		$q_{V0\ max}$	gpm	14	12.7	15.6	17.9	20.1	30.4
			(L/min)	(53)	(48)	(59)	(68)	(76)	(115)
Power									
at $n_{0\ max}$	$\Delta p = 4060$ psi	$P_{o\ max}$	HP	33	30	37	42	47	71
	(280 bar)		(kW)	(24.7)	(22.5)	(27.6)	(31.6)	(35.3)	(53.6)
Torque									
at $V_{g\ max}$	$\Delta p = 4060$ psi	T_{max}	lb-ft	34.6	37.5	46.5	53.1	59	77.4
	(280 bar)		(Nm)	(47)	(51)	(63)	(72)	(80)	(105)
Moment of inertia (about drive axis)		J	$lb\text{-}ft^2$	0.014	0.022	0.022	0.022	0.022	0.04
			(kgm^2)	(0.0006)	(0.00093)	(0.00093)	(0.00093)	(0.00093)	(0.00017)
Actual starting torque									
at	$\Delta p = 4060$ psi		lb-ft	27.6	22.1	33.2	39.1	49.8	55.3
$n = 0\ min^{-1}$	(280 bar)		(Nm)	(37.5)	(30)	(45)	(53)	(67.5)	(75)
Angular acceleration, max.			rad/s^2	8000	6800	6800	6800	6800	5500
Torsional	Shaft R		lb-ft/rad	–	–	–	–	10942	21005
stiffness			(Nm/rad)					(14835)	(28478)
	Shaft W		lb-ft/rad	–	–	–	–	–	–
			(Nm/rad)						
	Shaft C		lb-ft/rad	11126	13765	13765	13765	13765	22140
			(Nm/rad)	(15084)	(18662)	(18662)	(18662)	(18662)	(30017)
Case volume			gal	0.03	0.04	0.04	0.04	0.04	0.16
			(L)	(0.1)	(0.15)	(0.15)	(0.15)	(0.15)	(0.6)
Weight		m	lbs	11.0	14.3	14.3	14.3	14.3	26.5
			(kg)	(5)	(6.5)	(6.5)	(6.5)	(6.5)	(12)

[1] theoretical rounded values without correction for η_{mh} and η_v
[2] At max. speed the low pressure side must see at least 18 bar.

Technical Data

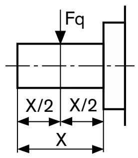
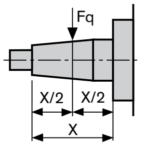
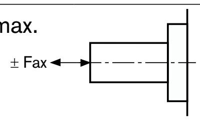
Table of values[1)]

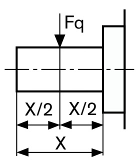
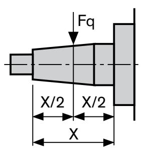
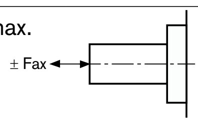
Size				28	37	45	58	63
Displacement		$V_{g\,max}$	in^3	1.73	2.24	2.71	3.53	3.84
			(cm^3)	(28.5)	(36.7)	(44.5)	(58)	(63.1)
Speed[2)]								
max. at $V_{g\,max}$		$n_{0\,max}$	min^{-1}	4700	4200	4000	3600	3400
Inlet flow								
at $n_{0\,max}$		$q_{V0\,max}$	gpm	35.4	40.7	47	55.2	56.8
			(L/min)	(134)	(154)	(178)	(209)	(215)
Power								
at $n_{0\,max}$	$\Delta p = 4060$ psi	$P_{o\,max}$	HP	83	95	111	130	133
	(280 bar)		(kW)	(62.5)	(71.8)	(83.1)	(97.4)	(100.1)
Torque								
at $V_{g\,max}$	$\Delta p = 4060$ psi	T_{max}	lb-ft	93.7	120	146	190	207
	(280 bar)		(Nm)	(127)	(163)	(198)	(258)	(281)
Moment of inertia (about drive axis)		J	lb-ft^2	0.04	0.078	0.078	0.133	0.133
			(kgm^2)	(0.00017)	(0.00033)	(0.00033)	(0.0056)	(0.0056)
Actual starting torque								
at $n = 0$ min^{-1}	$\Delta p = 4060$ psi		lb-ft	77.4	92.2	125	151	169
	(280 bar)		(Nm)	(105)	(125)	(170)	(205)	(230)
Angular acceleration, max.			rad/s^2	5500	4000	4000	3300	3300
Torsional stiffness	Shaft R		lb-ft/rad	21005	34563	34563	59443	59443
			(Nm/rad)	(28478)	(46859)	(46859)	(80590)	(80590)
	Shaft W		lb-ft/rad	–	28389	28389	44925	44925
			(Nm/rad)		(38489)	(38489)	(60907)	(60907)
	Shaft C		lb-ft/rad	22140	34332	34332	64663	64663
			(Nm/rad)	(30017)	(46546)	(46546)	(87667)	(87667)
Case volume			gal	0.16	0.18	0.18	0.21	0.21
			(L)	(0,6)	(0,7)	(0,7)	(0,8)	(0,8)
Weight		m	lbs	26.5	37.5	37.5	48.5	48.5
			(kg)	(12)	(17)	(17)	(22)	(22)

1) theoretical rounded values without correction for η_{mh} and η_v
2) At max. speed the low pressure side must see at least 18 bar.

Technical Data

Permissible radial and axial forces on drive shaft

Size						10	11	14	16	18	23
Radial force, max.	Shaft R, W 	Shaft C 	at X/2	$F_{q\ max}$	lb (N)	560 (250)	790 (350)	790 (350)	790 (350)	790 (350)	2700 (1200)
Axial force, max.				$F_{ax\ max}$	lb (N)	900 (400)	1570 (700)	1570 (700)	1570 (700)	1570 (700)	2250 (1000)

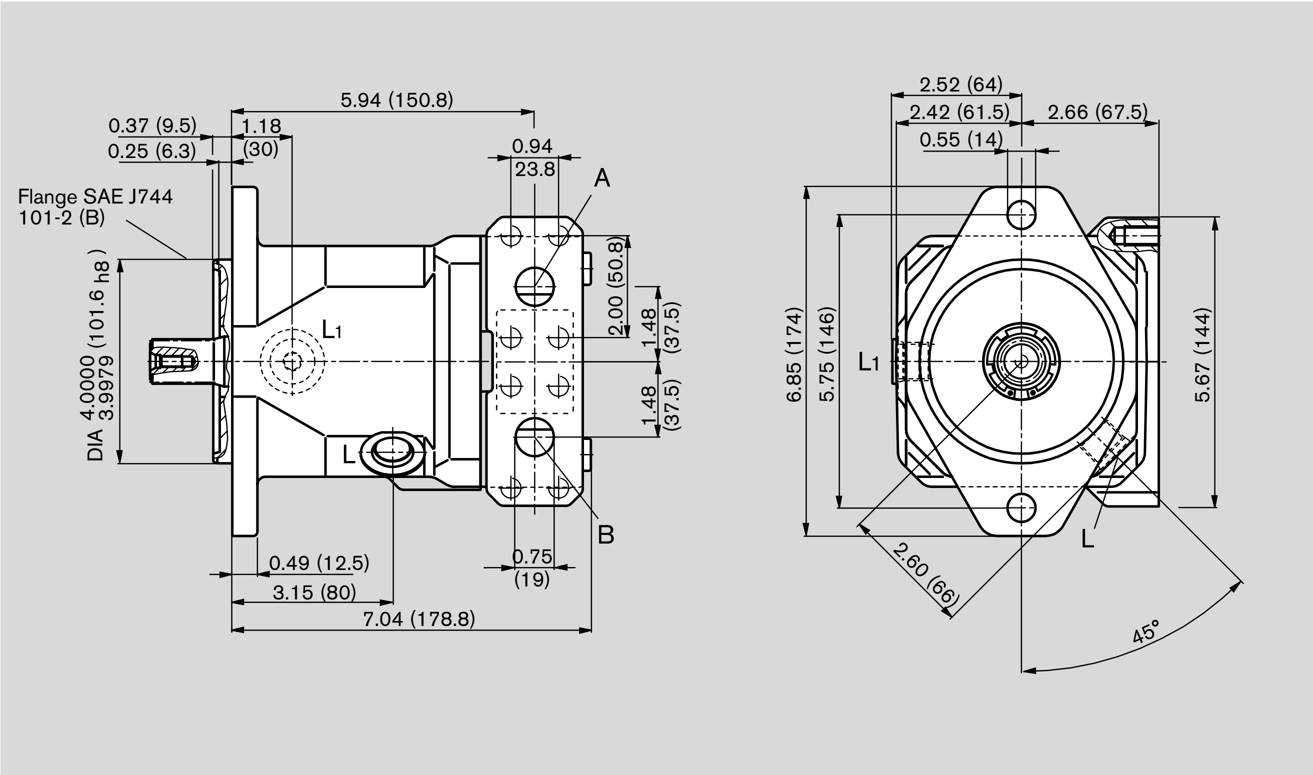
Size						28	37	45	58	63
Radial force, max.	Shaft R, W 	Shaft C 	at X/2	$F_{q\ max}$	lb (N)	2700 (1200	3370 (1500)	3370 (1500)	3820 (1700)	3820 (1700)
Axial force, max.				$F_{ax\ max}$	lb (N)	2250 (1000)	3370 (1500)	3370 (1500)	4500 (2000)	4500 (2000)

Notes

Unit Dimensions A10FM 23-28

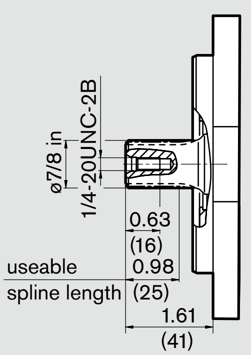
Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 23-28/52W-VXC60N000

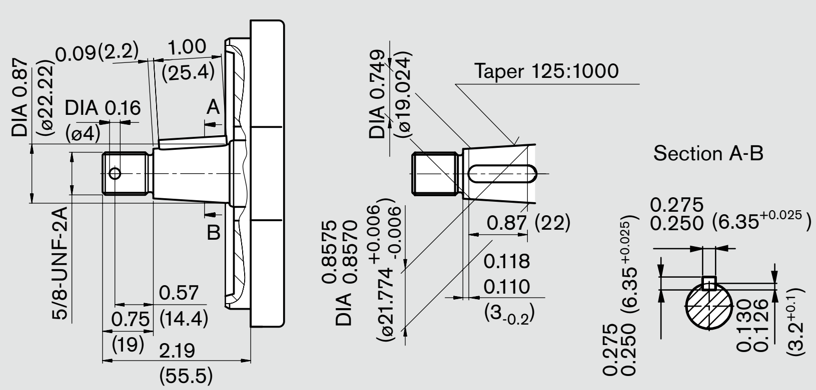


Shaft ends

R splined 7/8 in 13T 16/32DP[1]
(SAE J744 - 22-4 (B))



C tapered
(SAE J744 - 22-3 (B))



Ports

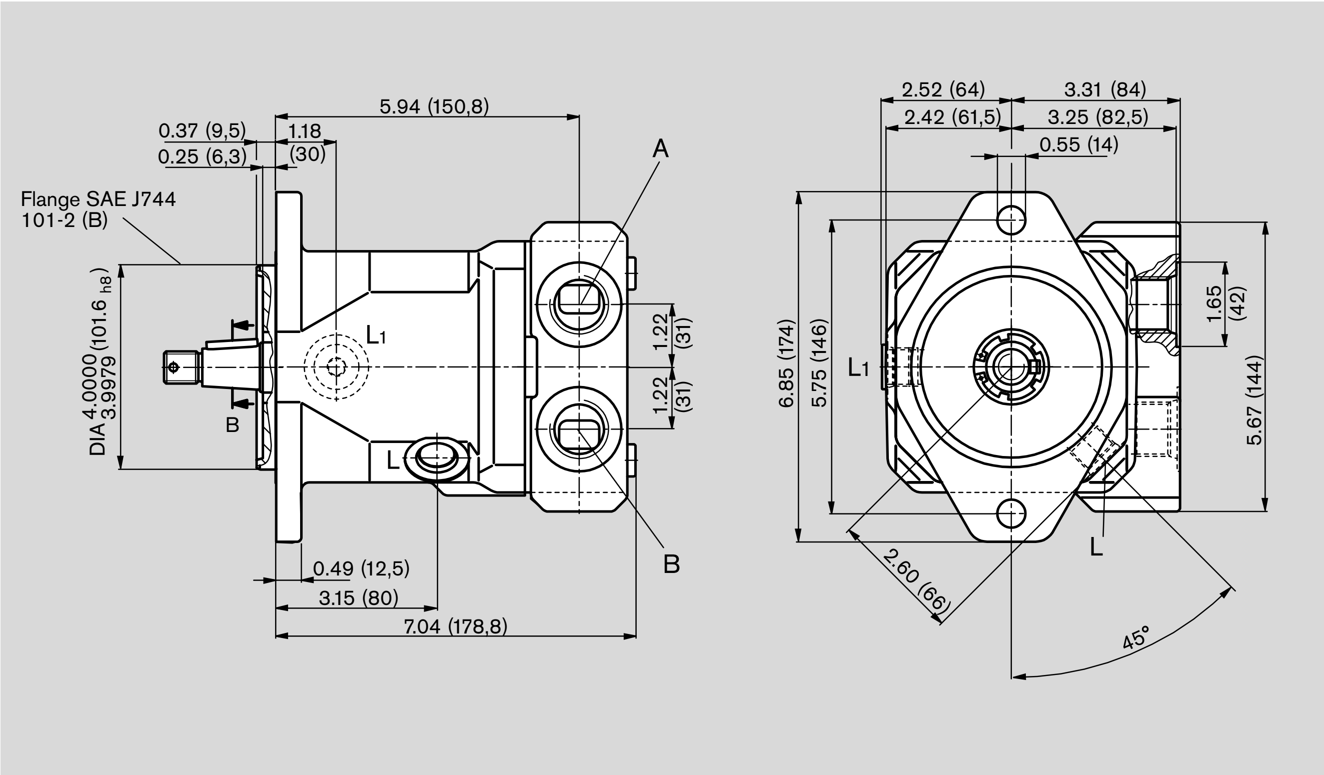
				Tightening torque, max.[2]
A	Pressure port (high pressure series)	SAE J518	SAE 3/4 in	
	Fixing thread	ISO 68	3/8-16 UNC-2B; 0.83 (17) deep	31 lb-ft (60 Nm)
B	Pressure port (high pressure series)	SAE J518	SAE 3/4 in	
	Fixing thread	ISO 68	3/8-16 UNC-2B; 0.83 (17) deep	31 lb-ft (60 Nm)
L,L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	117 lb-ft (160 Nm)

1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
2) see General Notes

Unit Dimensions A10FM 23-28

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 23-28/52W-VXC66N000



Shaft ends see page: 10

Ports

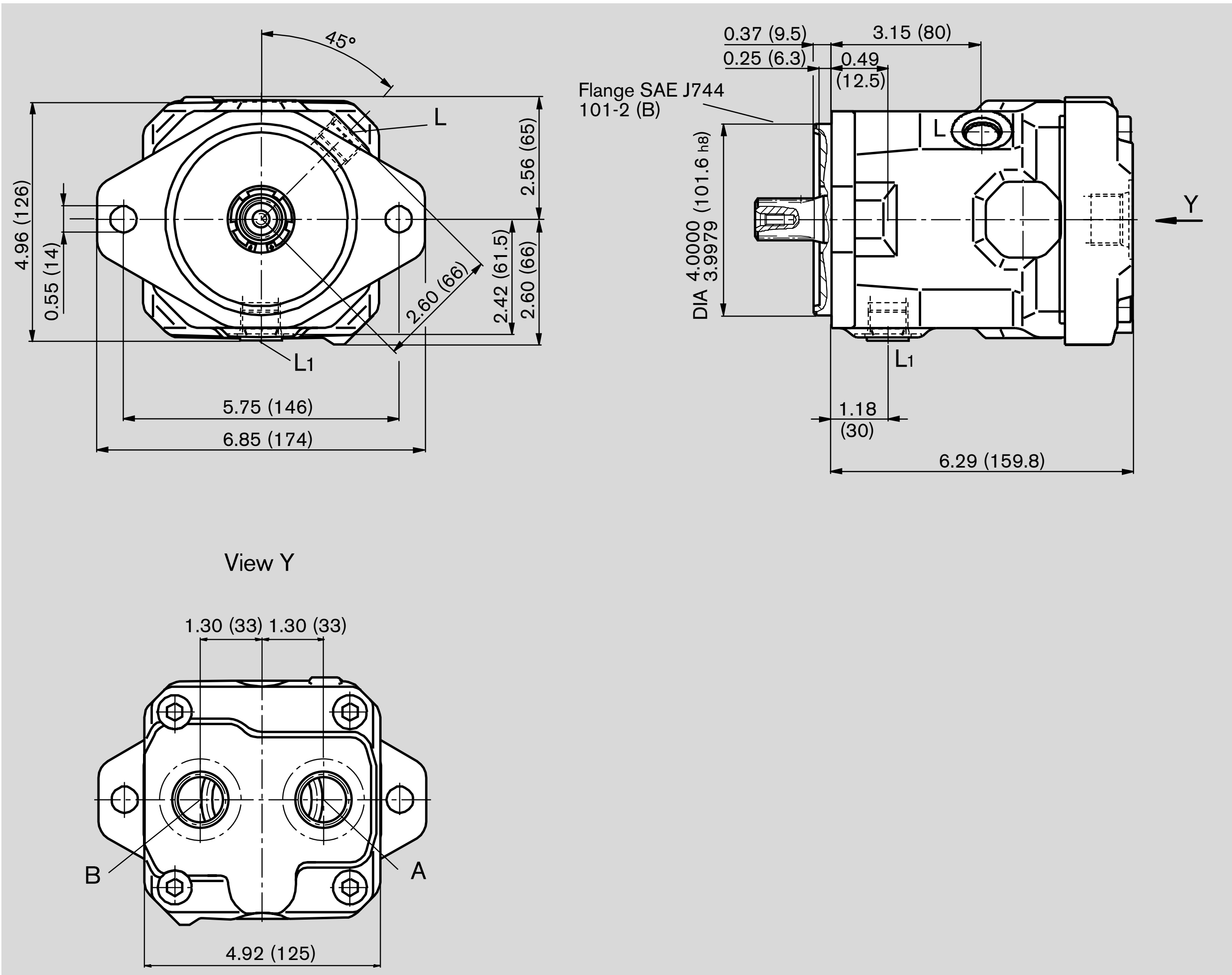
				Tightening torque, max.[1]
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	117 lb-ft (160 Nm)

[1] see General Notes

Unit Dimensions A10FM 23-28

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 23-28/52W-VXC64N000



Shaft ends see page: 10

Ports

				Tightening torque, max.[1]
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	117 lb-ft (160 Nm)

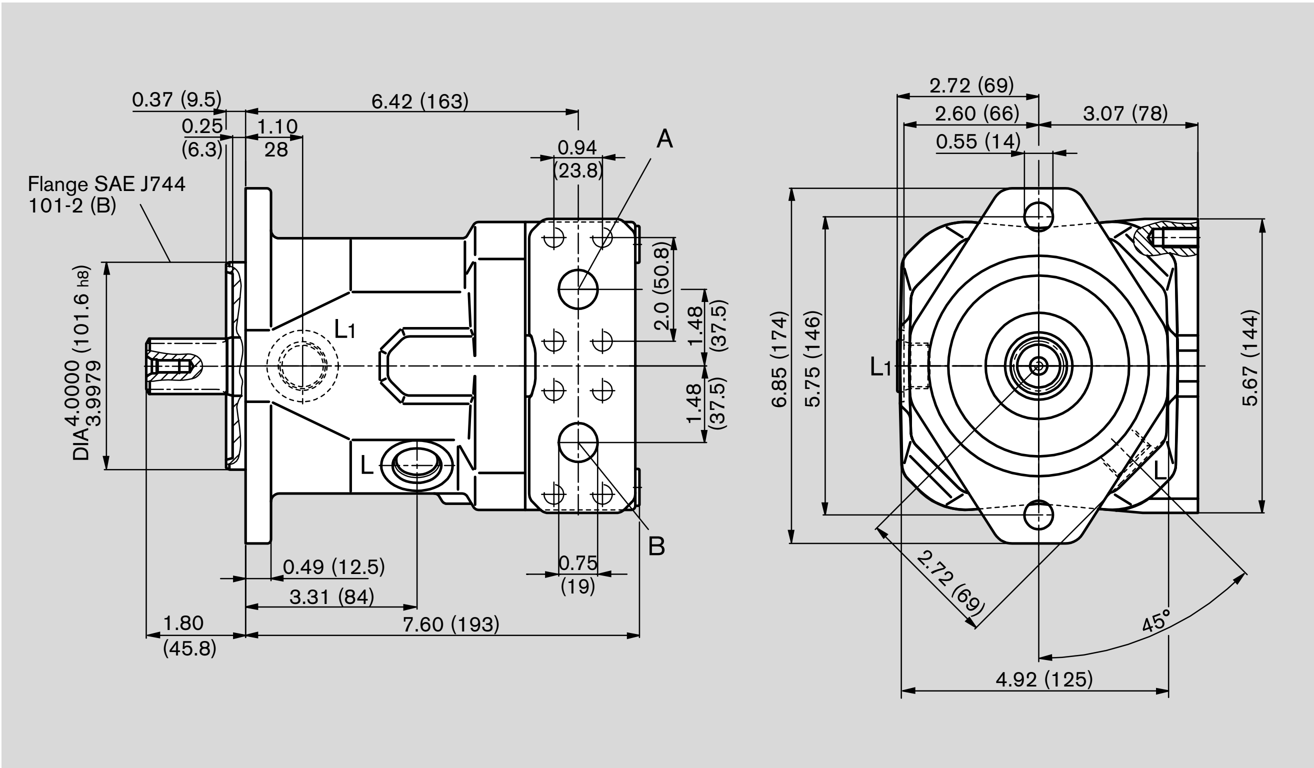
[1] see General Notes

Notes

Unit Dimensions A10FM 37-45

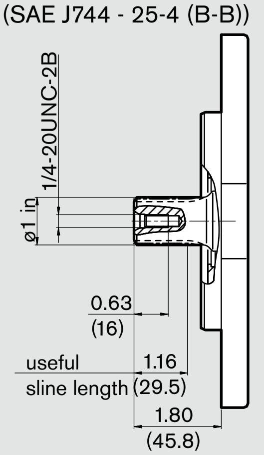
Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 37-45/52W-VXC60N000

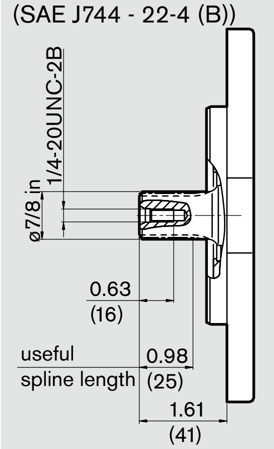


Shaft ends

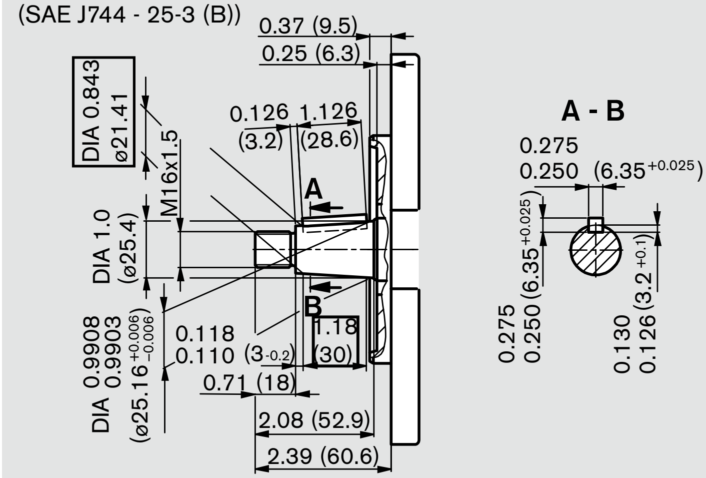
R splined 7/8 in 15T 16/32DP[1)]
(SAE J744 - 25-4 (B-B))



W splined 7/8 in 13T 16/32DP[1)]
(SAE J744 - 22-4 (B))



C tapered
(SAE J744 - 25-3 (B))



Ports

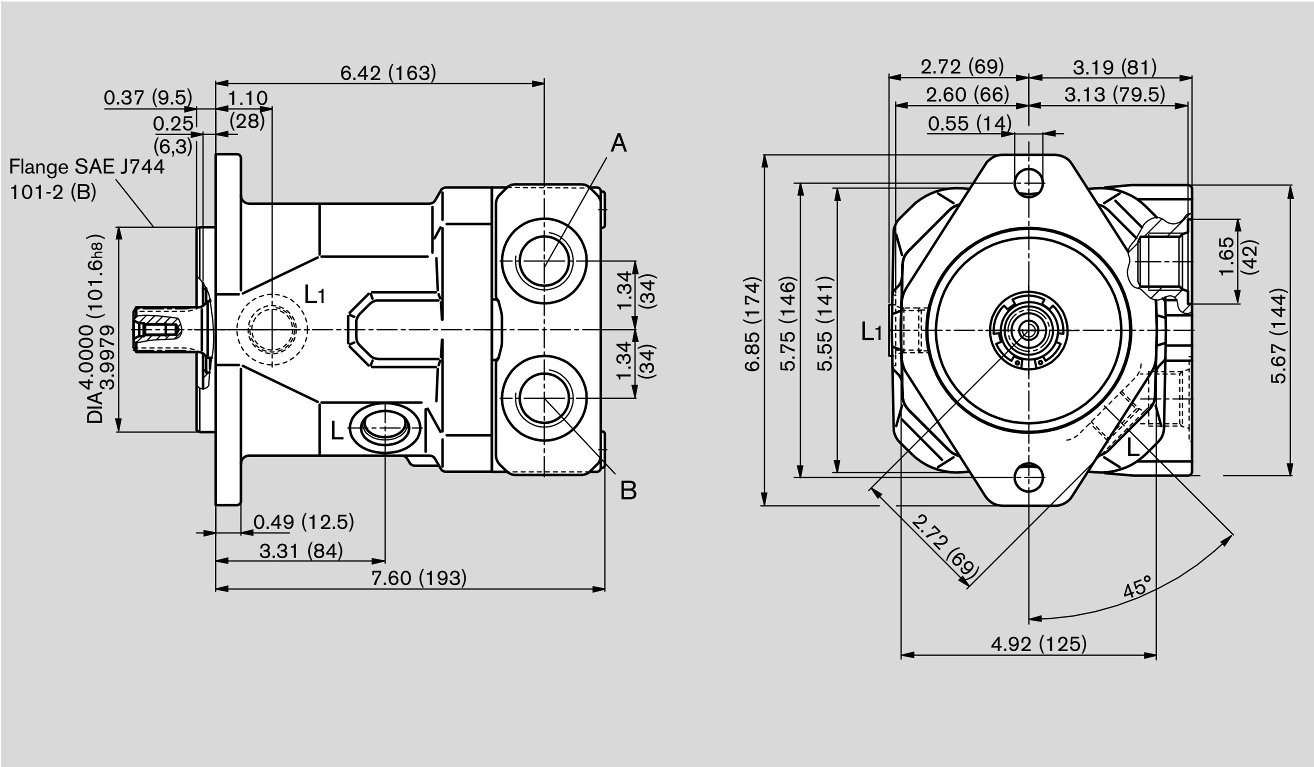
				Tightening torque, max.[1)]
A	Pressure port	SAE J518C ISO 68	3/4 in 3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
B	Pressure port	SAE J518C ISO 68	3/4 in 3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

[1)] see General Notes

Unit Dimensions A10FM 37-45

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 37-45/52W-VXC66N000



Shaft ends see page: 14

Ports

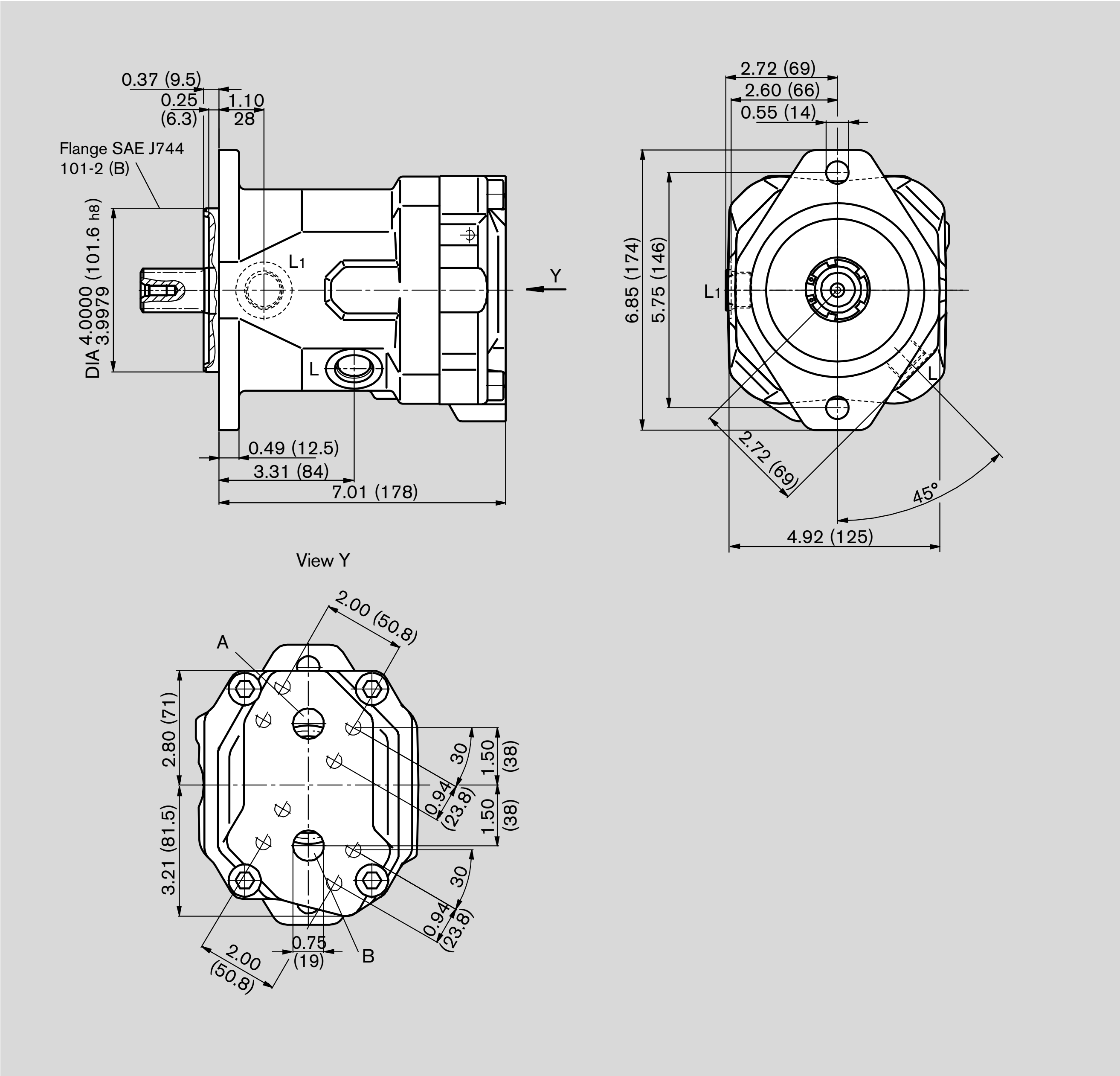
				Tightening torque, max.[1)
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

[1) see General Notes

Unit Dimensions A10FM 37-45

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 37-45/52W-VXC61N000



Shaft ends see page: 14

Ports

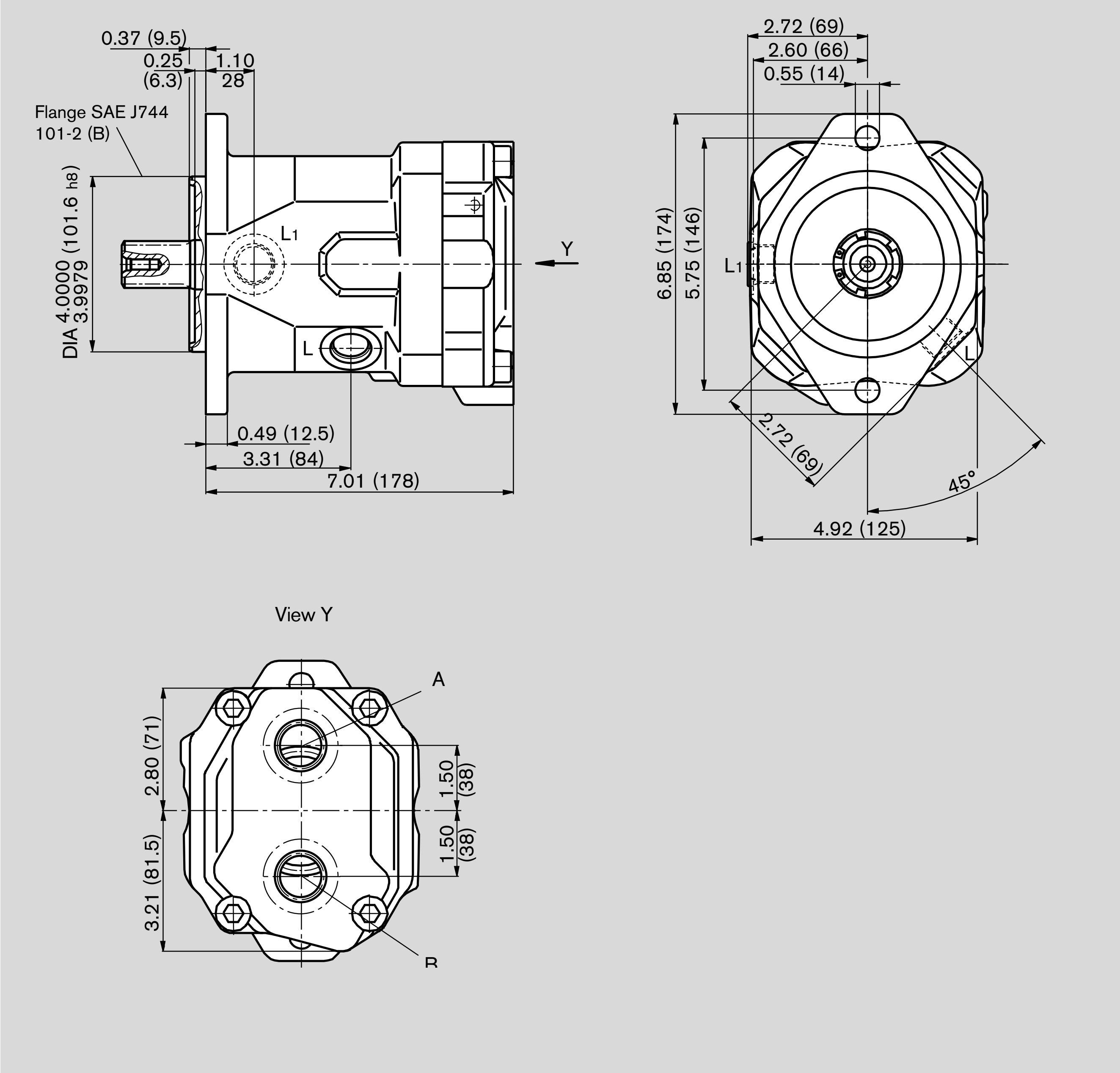
				Tightening torque, max.[1]
A	Pressure port	SAE J518C	3/4 in	
		ISO 68	3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
B	Pressure port	SAE J518C	3/4 in	
		ISO 68	3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

[1] see General Notes

Unit Dimensions A10FM 37-45

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 37-45/52W-VXC64N000



Shaft ends see page: 14

Ports

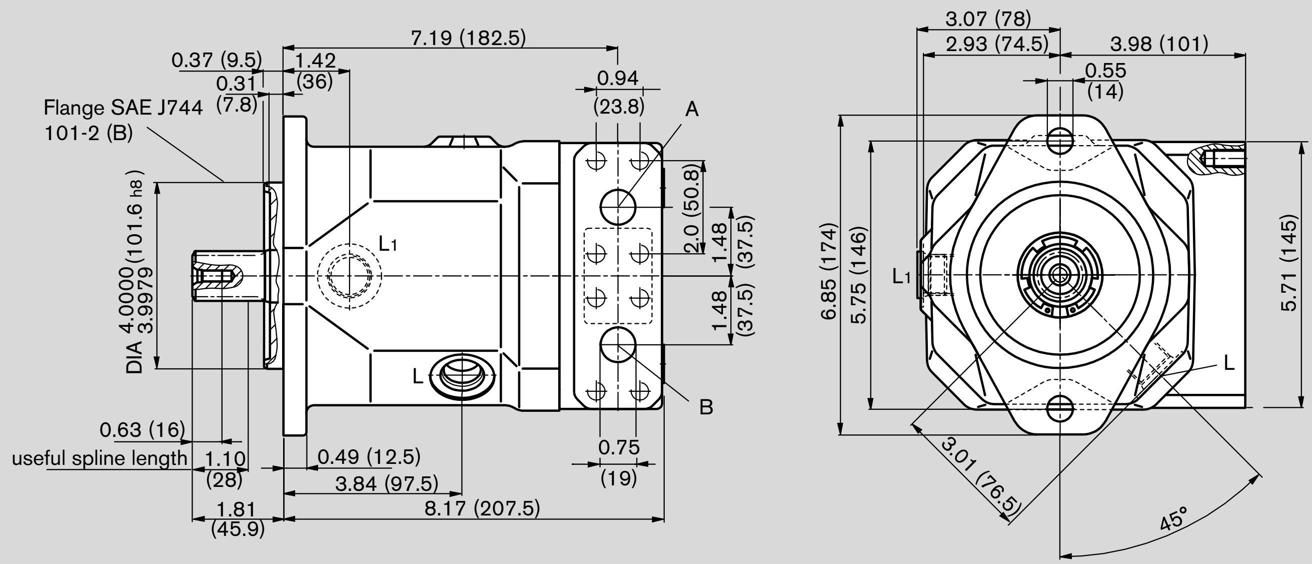
				Tightening torque, max.[1]
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

[1] see General Notes

Unit Dimensions A10FM 58-63

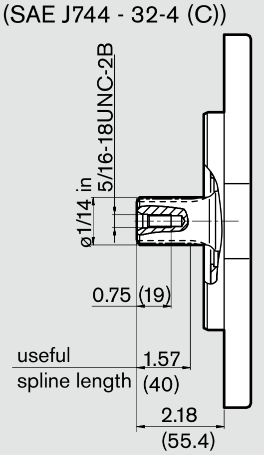
Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 58-63/52W-VXC60N000

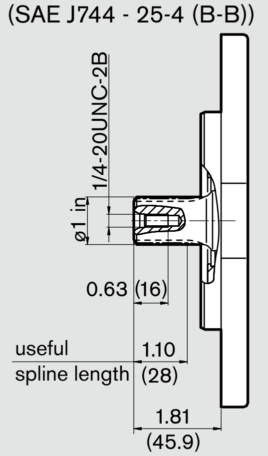


Shaft ends

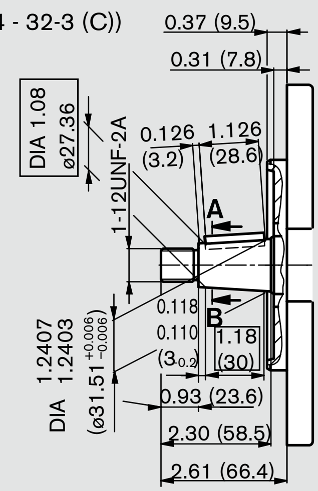
R splined 1 1/4 in 14T 12/24DP[1)]
(SAE J744 - 32-4 (C))

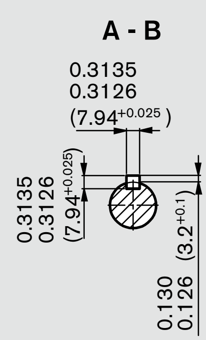


W splined 1 in 15T 16/32DP[1)]
(SAE J744 - 25-4 (B-B))



C tapered
(SAE J744 - 32-3 (C))





Ports

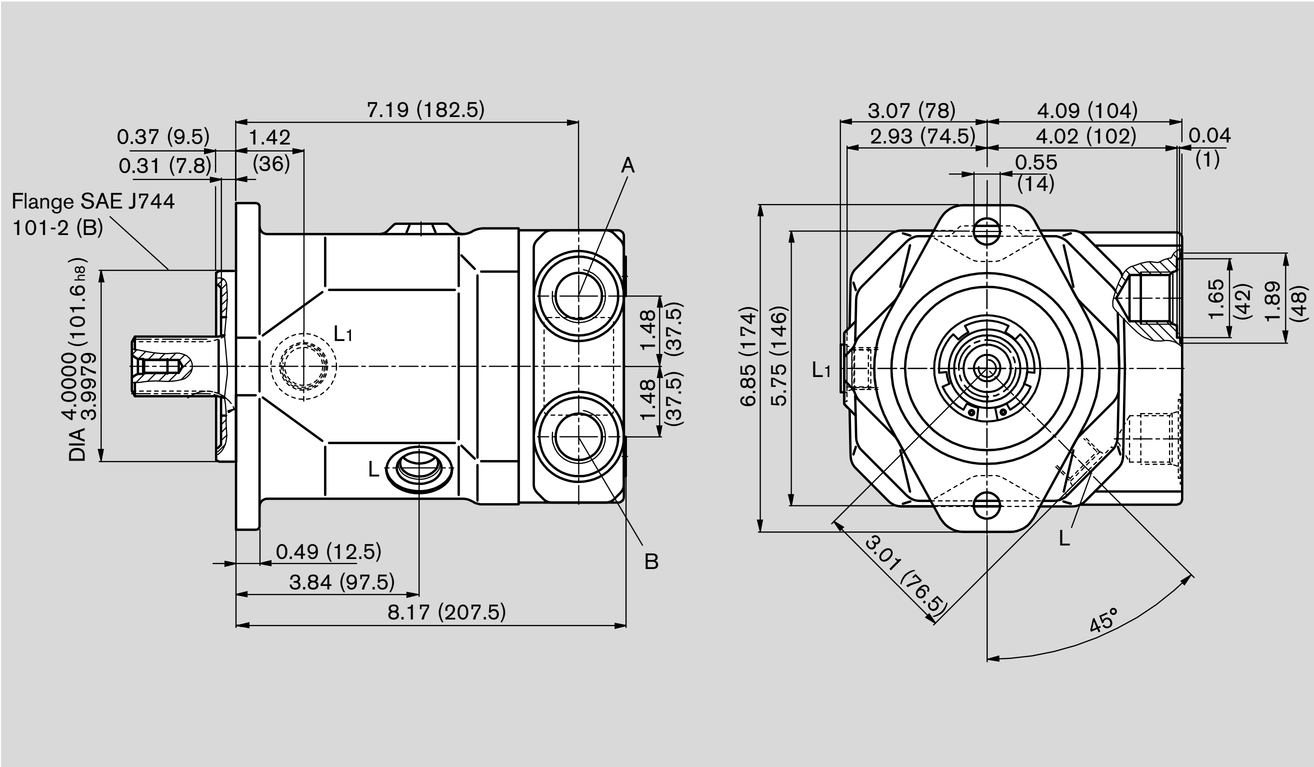
				Tightening torque, max.[1)]
A	Pressure port	SAE J518C ISO 68	3/4 in 3/8-16 UNC-2B 0.83 (21) deep	 31 lb-ft (42 Nm)
B	Pressure port	SAE J518C ISO 68	3/4 in 3/8-16 UNC-2B 0.83 (21) deep	 31 lb-ft (42 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

1) see General Notes

Unit Dimensions A10FM 58-63

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FM 58-63/52W-VXC66N000



Shaft ends see page: 18

Ports

				Tightening torque, max.[1]
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (20) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

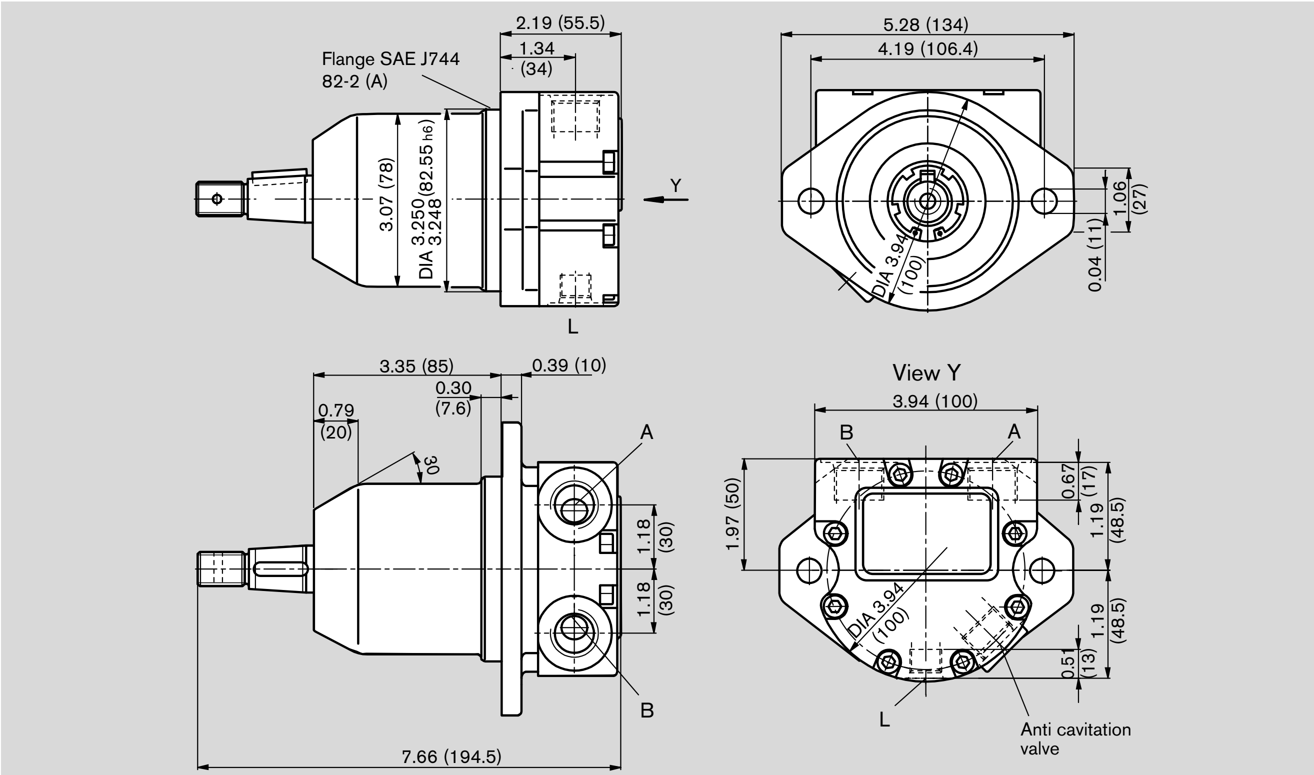
[1] see General Notes

Notes

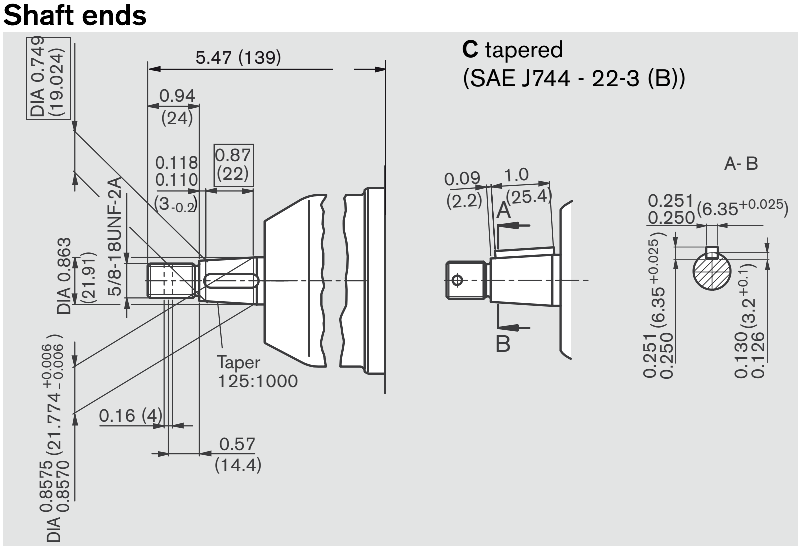
Unit Dimensions A10FE 10

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 10/52W-VXC66N000



Shaft ends



Ports

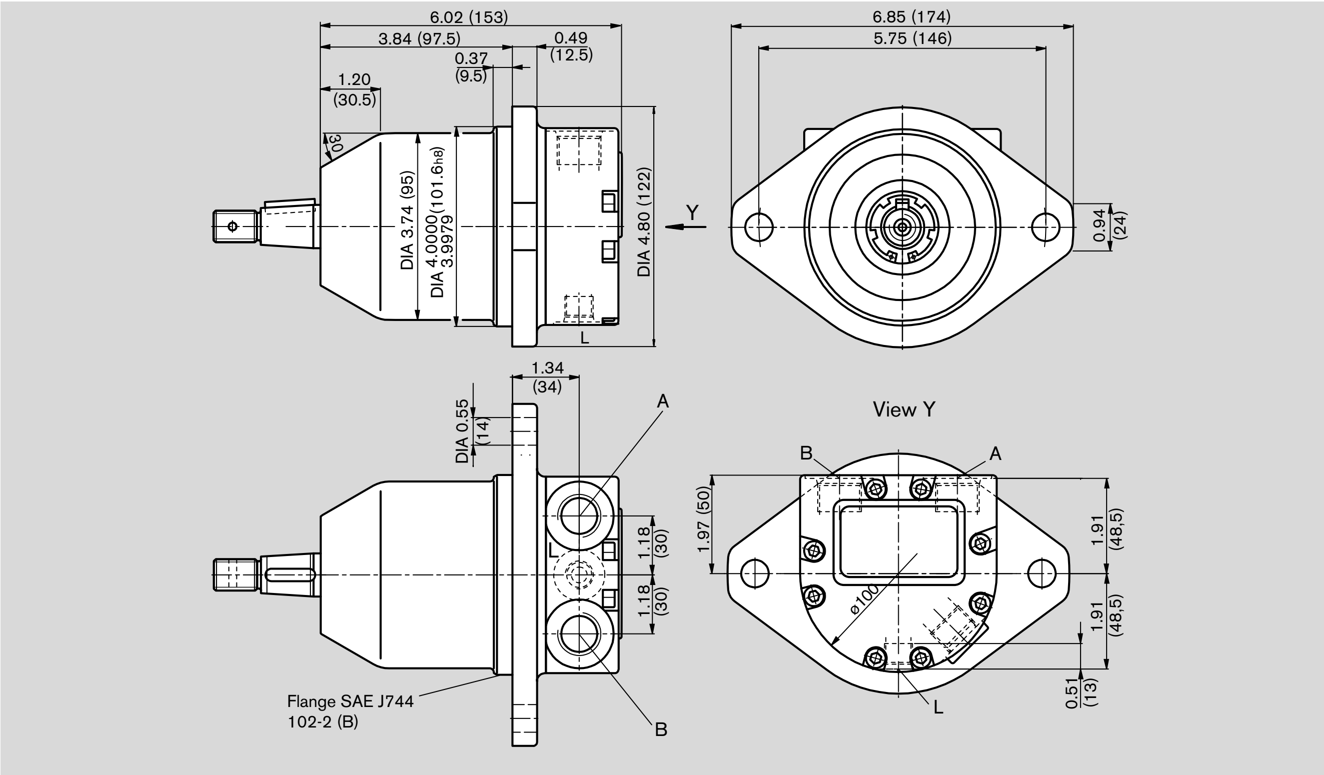
				Tightening torque, max.[1)]
A	Pressure port	ISO 11926	7/8-14 UNF-2B; 0.67 (17) deep	176 lb-ft (240 Nm)
B	Pressure port	ISO 11926	7/8-14 UNF-2B; 0.67 (17) deep	176 lb-ft (240 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	9/16-18 UNF-2B; 0.51 (13) deep	58 lb-ft (80 Nm)

[1)] see General Notes

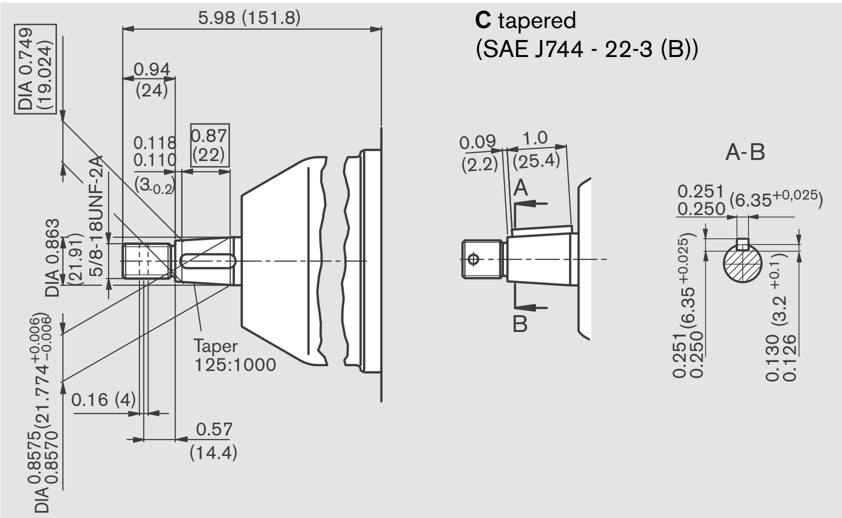
Unit Dimensions A10FE 11-18

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 11-18/52W-VCC66N000



Shaft ends



Ports

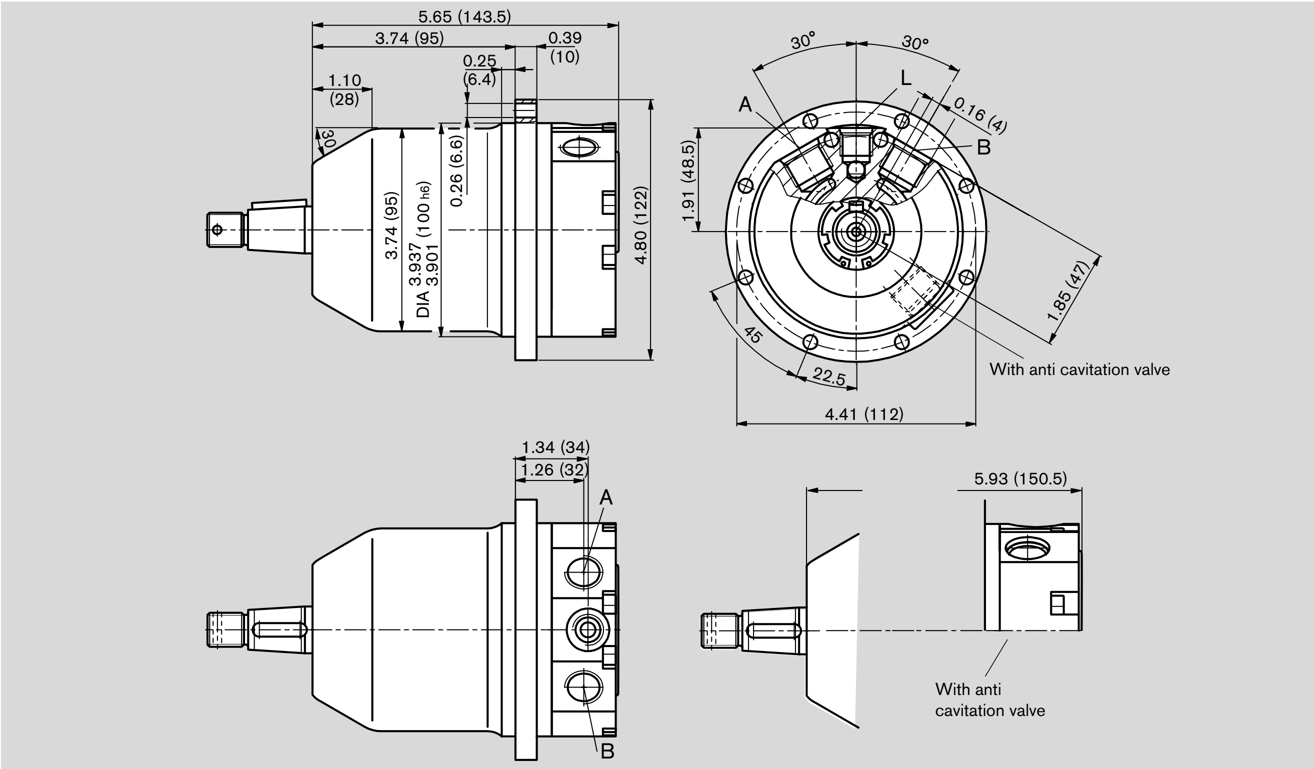
				Tightening torque, max.[1]
A	Pressure port	ISO 11926	7/8-14 UNC-2B 0.67 (17) deep	176 lb-ft (240 Nm)
B	Pressure port	ISO 11926	7/8-14 UNC-2B 0.67 (17) deep	176 lb-ft (240 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	9/16-18 UNF-2B; 0.51 (13) deep	58 lb-ft (80 Nm)

[1] see General Notes

Unit Dimensions A10FE 11-18

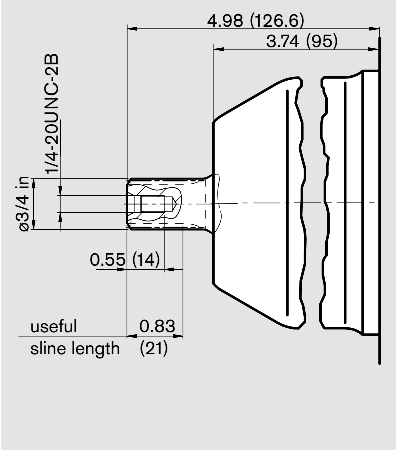
Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 11-18/52W-VXH66N000
A10FE 11-18/52W-VXH66N002

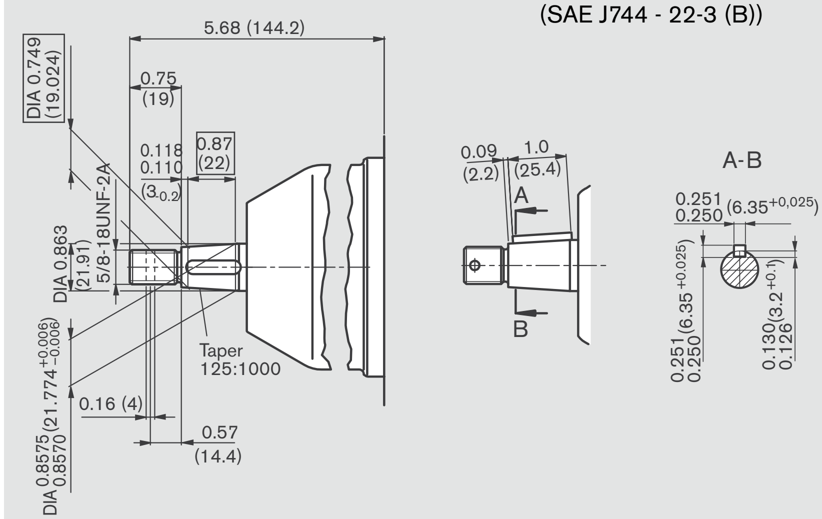


Shaft ends

R splined 3/4 in 11T 16/32DP[1)]
(SAE J744 - 19-4 (A-B))



C tapered
(SAE J744 - 22-3 (B))



Ports

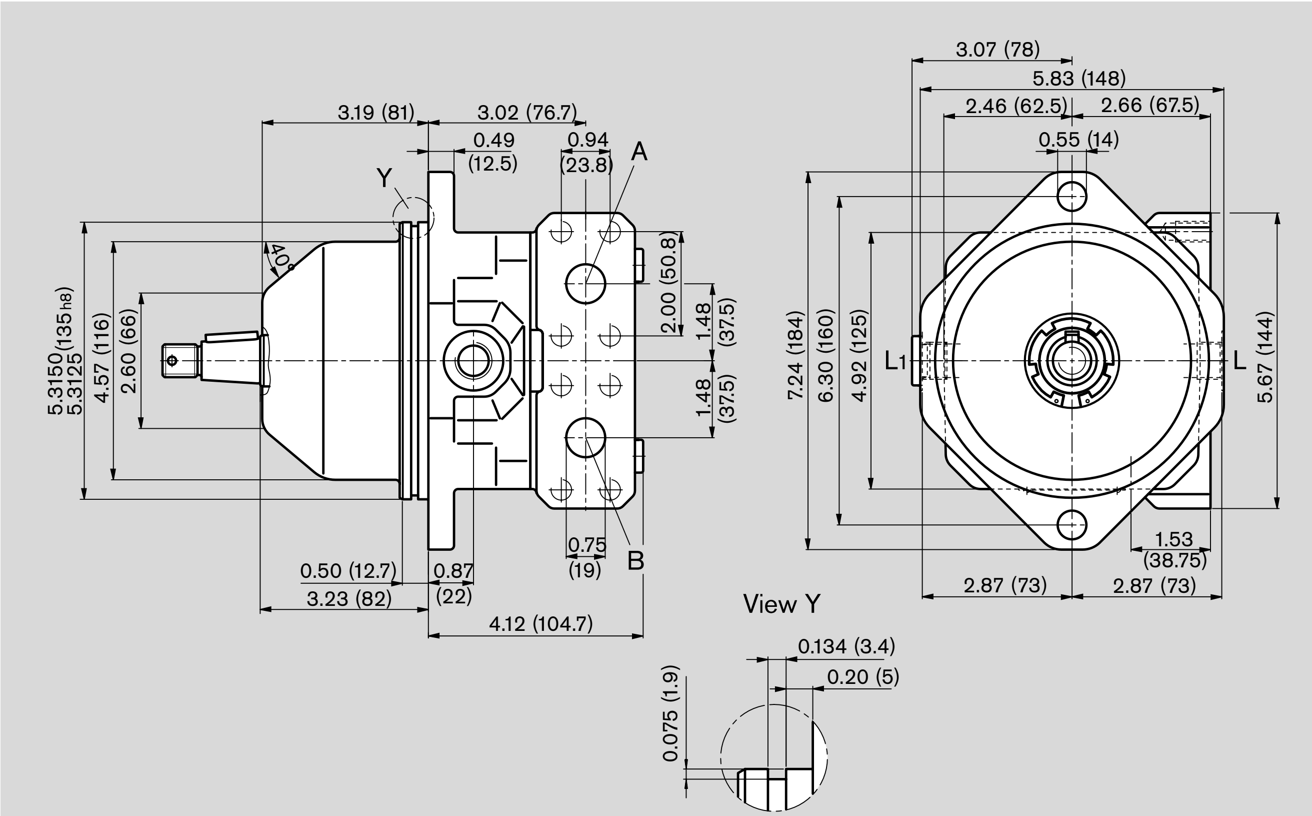
				Tightening torque, max.[1)]
A	Pressure port	ISO 11926	3/4-16 UNF-2B; 0.59 (15) deep	117 lb-ft (160 Nm)
B	Pressure port	ISO 11926	3/4-16 UNF-2B; 0.59 (15) deep	117 lb-ft (160 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	9/16-18 UNF-2B; 0.51 (13) deep	58 lb-ft (80 Nm)

[1)] see General Notes

Unit Dimensions A10FE 23-28

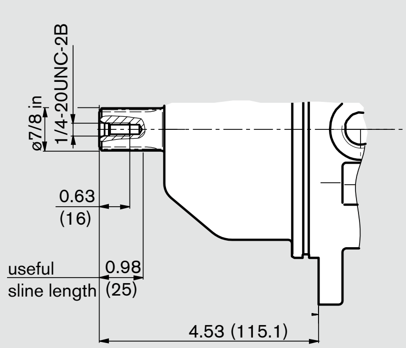
Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 23-28/52W-VXF60N000

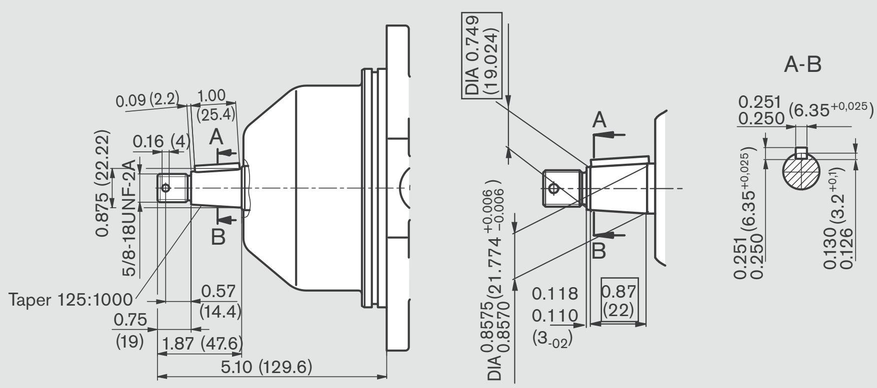


Shaft ends

R splined 7/8 in 13T 16/32DP[1] (SAE J744 - 22-4 (A-B))



C tapered (SAE J744 - 22-3 (B))



Ports

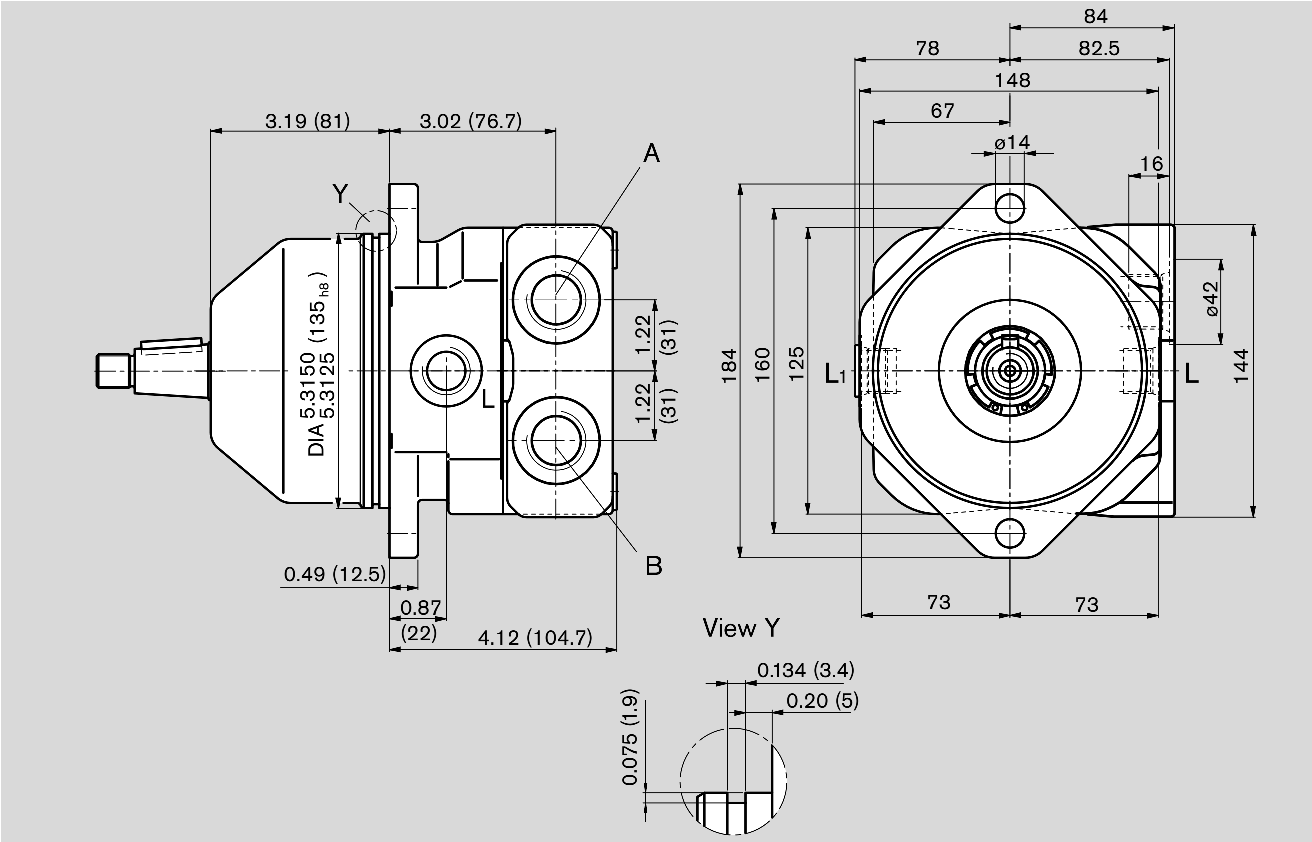
				Tightening torque, max.[1]
A	Pressure port	SAE J518C	3/4 in	
		ISO 68	3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
B	Pressure port	SAE J518C	3/4 in	
		ISO 68	3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	176 lb-ft (240 Nm)

[1] see General Notes

Unit Dimensions A10FE 23-28

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 23-28/52W-VXF66N000



Shaft ends see page: 24

Ports

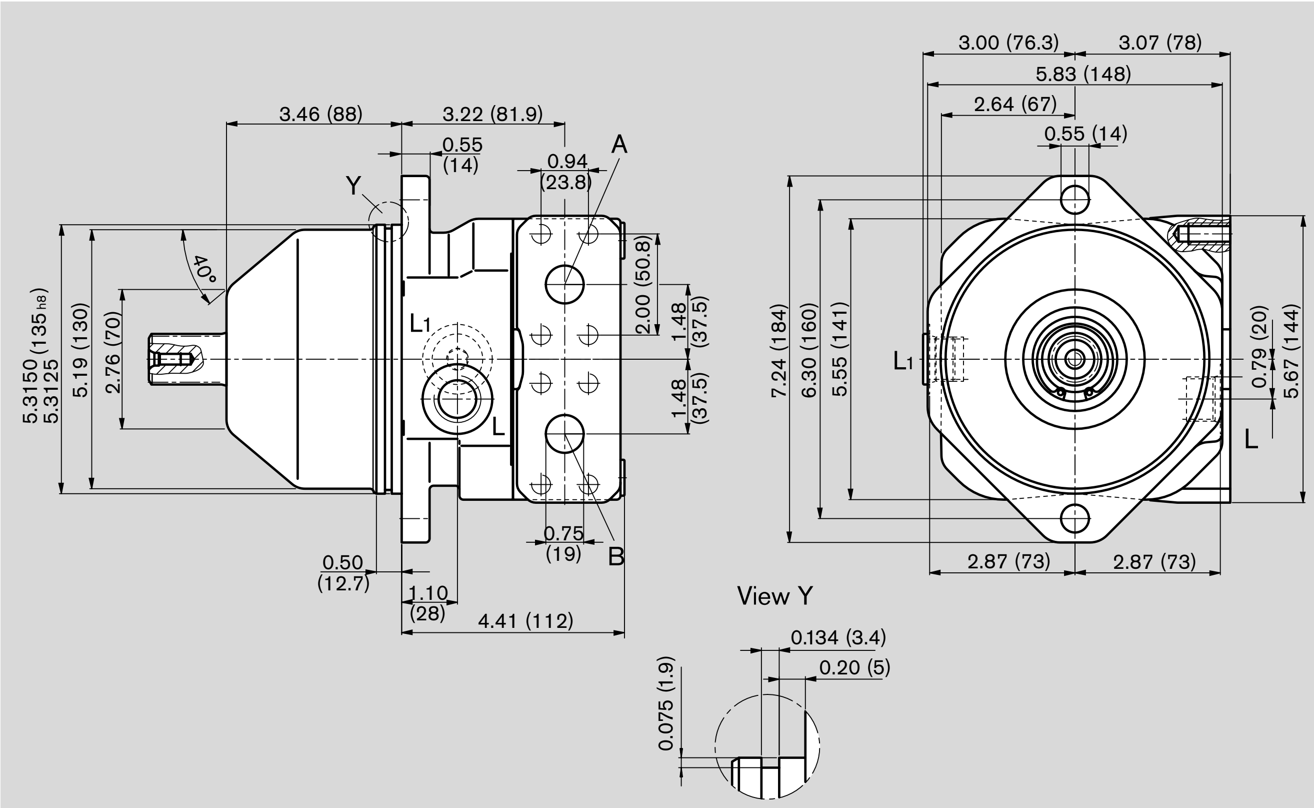
				Tightening torque, max.[1]
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	176 lb-ft (240 Nm)

[1] see General Notes

Unit Dimensions A10FE 37-45

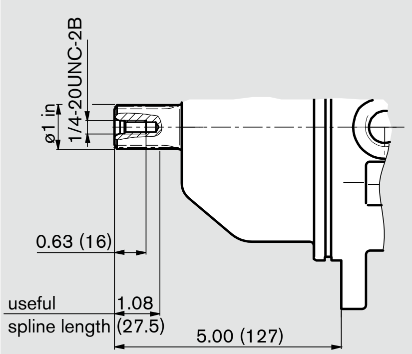
Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 37-45/52W-VXF60N000

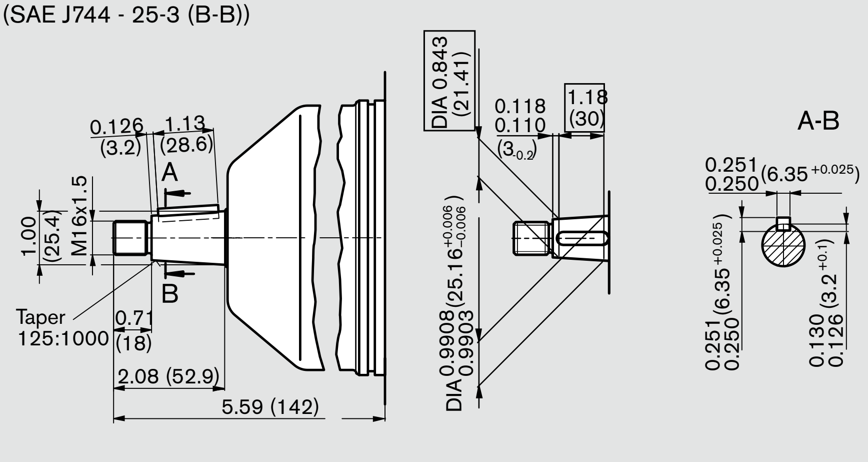


Shaft ends

R splined 1 in 15T 16/32DP[1] (SAE J744 - 25-4 (B-B))



C tapered (SAE J744 - 25-3 (B-B))



Ports

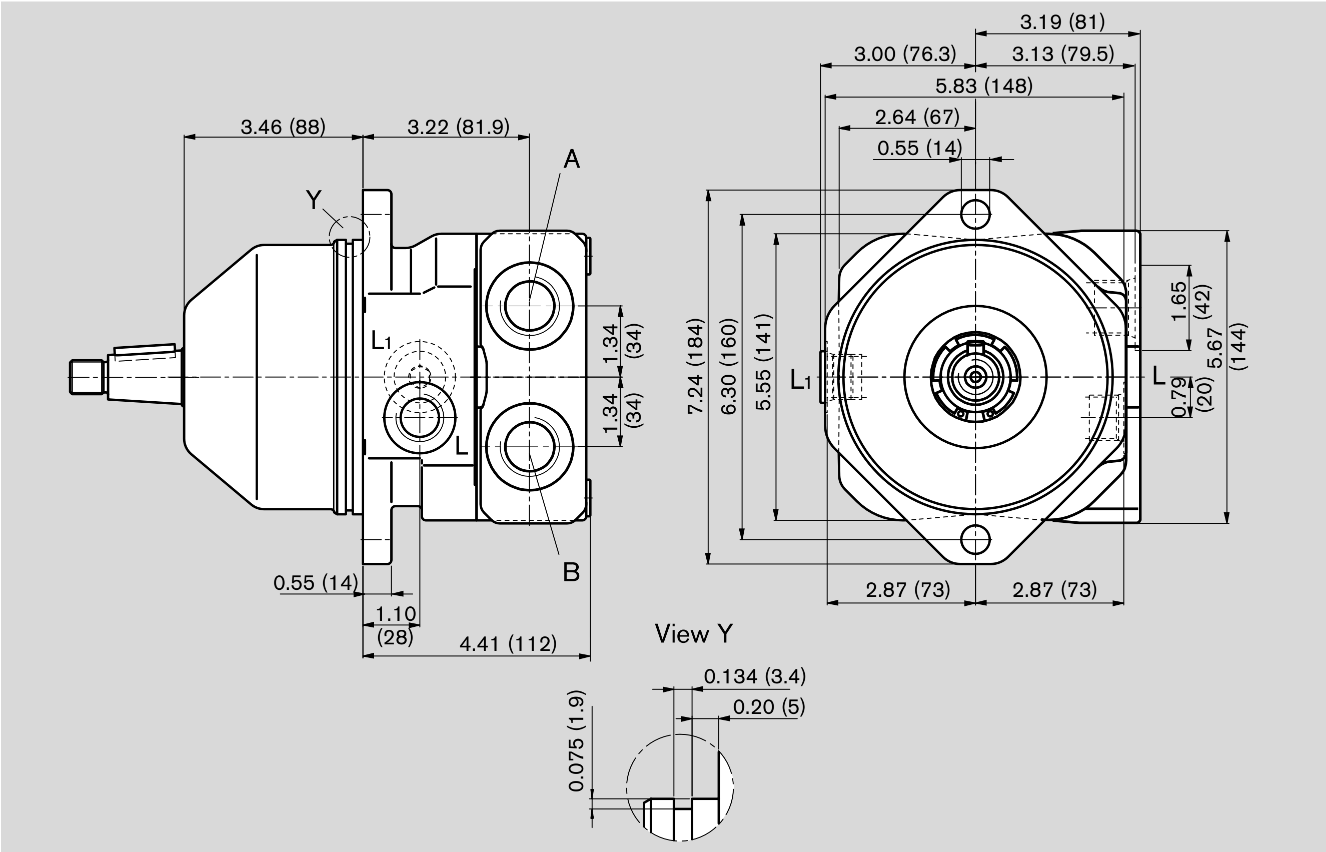
				Tightening torque, max.[1]
A	Pressure port	SAE J518C	3/4 in	
		ISO 68	3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
B	Pressure port	SAE J518C	3/4 in	
		ISO 68	3/8-16 UNC-2B 0.83 (21) deep	31 lb-ft (42 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

[1] see General Notes

Unit Dimensions A10FE 37-45

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

A10FE 37-45/52W-VXF66N000



Shaft ends see page: 24

Ports

				Tightening torque, max.[1]
A	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
B	Pressure port	ISO 11926	1 1/16-12 UN-2B; 0.79 (16) deep	265 lb-ft (360 Nm)
L, L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	176 lb-ft (240 Nm)

[1] see General Notes

Notes

Flushing and Boost Pressure Valve

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

Ordering Option N007

This valve assembly is used to flush an unacceptable heat load out of the closed loop circuit, and to maintain the necessary minimum boost pressure (232 psi (16 bar), fixed setting). The valve is integrated into the port plate.

A built-in fixed orifice determines the flushing flow, which is taken out of the low pressure side of the loop and directed into the motor housing. It leaves the housing together with the case drain flow. This combined flow is replenished with fresh oil by means of the boost pump.

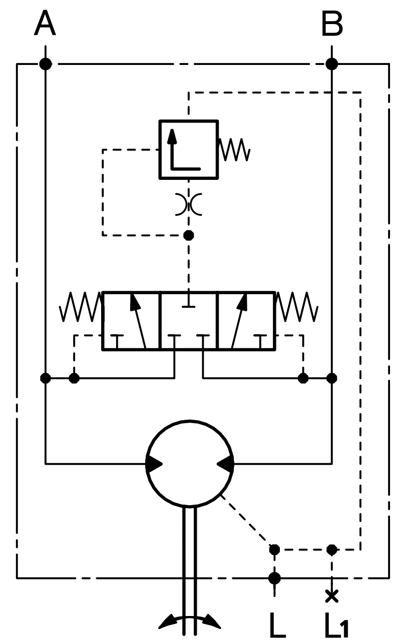
Standard flushing flow

With low press. side p_{ND} = 290 psi (20 bar) and an orifice dia. 0.06 in (1.6 mm): 1.45 gpm (5,5 L/min) (sizes 23 - 63). Other orifice diameters are available, please state in clear text.

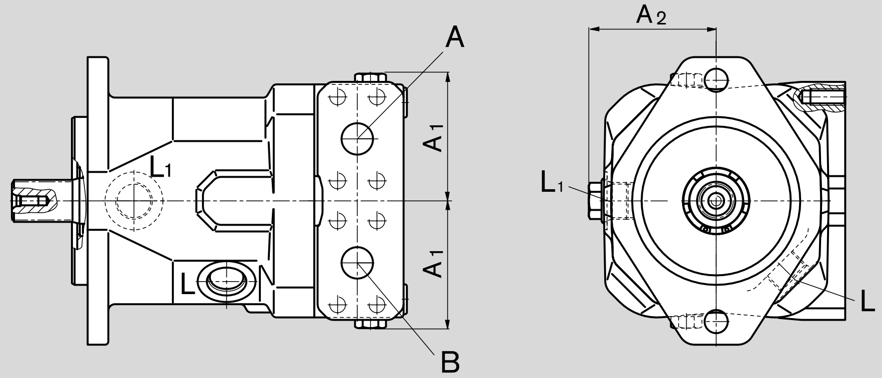
Forther flushing flows for sizes 23 - 63 see table:

Flushing flow gpm (L/min)	Orifice dia. in (mm)
0.92 (3.5)	0.05 (1.2)
1.45 (5.5)	0.06 (1.6)
2.48 (9)	0.08 (2)

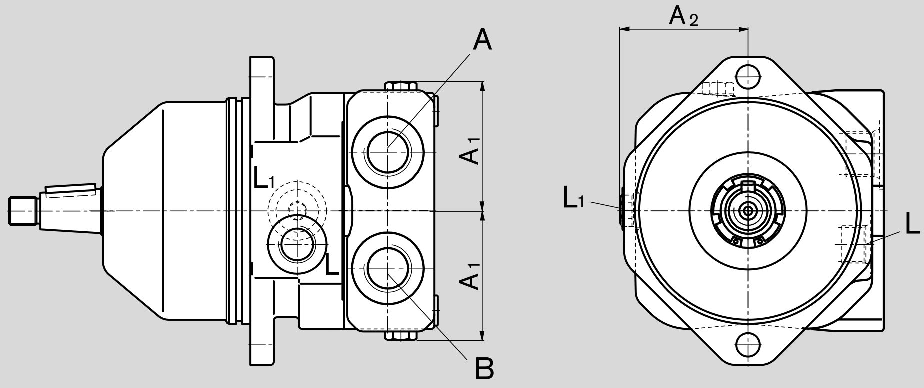
Circuit drawing



Unit Dimensions A10FM



Unit Dimensions A10FE



NG	A_1	A_2
23/28	2.83 (72)	2.83 (72)
37/45	3.03 (77)	3.03 (77)
58/63	3.03 (77)	3.23 (82)

Anti-cavitation Valve

Before finalizing your design please request certified installation drawing. Dimensions in inches and (mm).

Ordering option N002

When stopping a system with a relatively large mass (i.e. fan drive) the anti-cavitation valve provides fluid to the motor inlet during the coasting time.

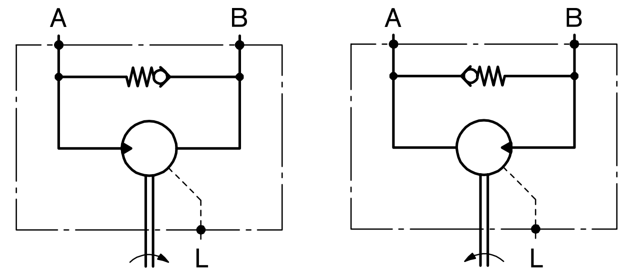
The valve assembly is integrated inside the port plate.

In this case it is necessary **to specify a direction of rotation (c**lock**w**iese **or c**ounter **c**lock**w**iese**)** looking at the shaft end of the motor.

The outside dimensions are identical to the standard units except the A10FE 11 - 18 with the 8-hole mounting flange, for the difference in length see unit dimensions.

Schematic

Direction of rotation **cw** Direction of rotation **ccw**



Speed Pickup

Ordering Option D

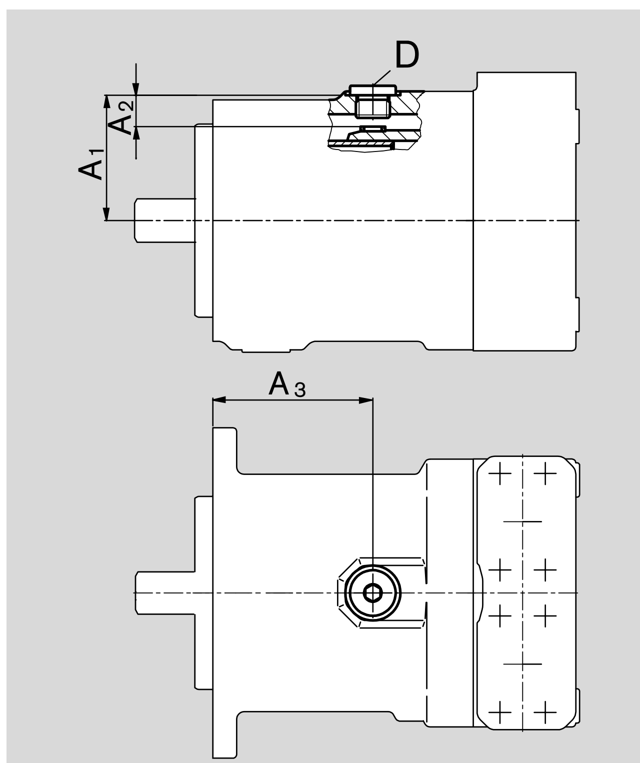
The version A10FM...D includes a toothed speed pickup ring on rotary group (Prepared for speed pickup).

In this case, the rotating cylinder barrel can provide a speed dependent signal, which can be picked up by a suitable sensor and processed for further evaluation. Sensor port (D) will be closed for delivery.

For completion of the actual speed pickup function the necessary working parts must be ordered separately.

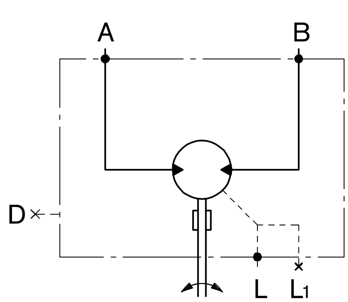
Inductive speed sensor ID R 18/20-L250 (see RE 95130) and mounting parts (spacer and 2 seals per kit) can be ordered separately with the following part numbers:

Size	Material part list No.	Nr. of teeth
23/28	R902428802	48
37/45	R902433368	48
58/63	R902437556	56



Size	A_1	A_2	A_3	Port D (closed)
23/28	2.40	0.61	4.00	M 18x1,5
	(61)	(15.5)	(101.8)	
37/45	2.60	0.67	3.31	M 18x1,5
	(66)	(17)	(84.2)	
58/63	2.73	0.52	5.60	M 18x1,5
	(69)	(13,1)	(128.5)	

Schematic



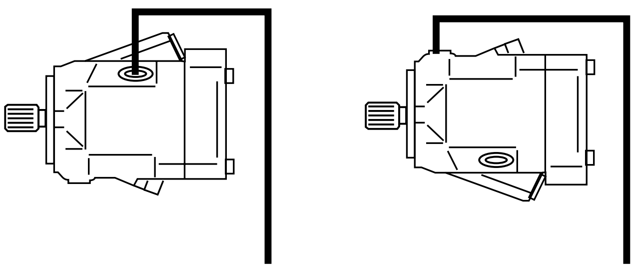
Installation Notes

The motor housing must be filled with hydraulic fluid when starting up and during operation. The drain line must be arranged so that the housing cannot empty itself when the motor is stationary. The end of the line must enter the tank below the minimum fluid level.

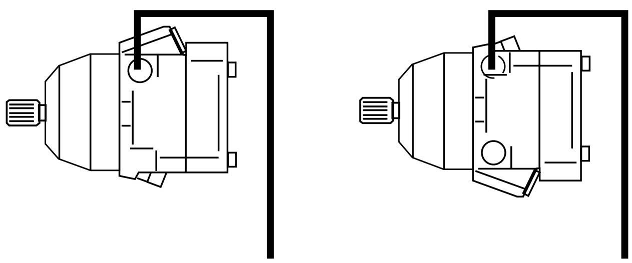
The port, located at the highest point must be used in all installation positions to fill the housing and to connect the drain line.

In case of vertical installation please consult us.

A10FM



A10FE



General Notes

– The A10FM/A10FE motor is designed to be used in open and closed loop circuits.

– Project planning, assembly, and startup of the motor require the involvement of trained personnel.

– The working and functional ports are only designed to accommodate hydraulic piping.

– Tightening torques: The tightening torques specified in this data sheet are maximum values and may not be exceeded (maximum value for screw thread). Manufacturer specifications for the max. permissible tightening torques of the used fittings must be observed!
For DIN 13 fastening screws we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.

– The housing temperature rises during and shortly after operation. Take suitable safety precautions (e.g. wear protective clothing).

– The data and information contained herein must be adhered to.

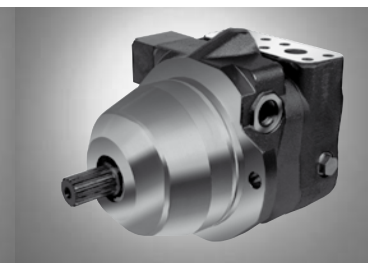
Bosch Rexroth Corporation
Axial & Radial Piston Units
8 Southchase Court
Fountain Inn, SC 29644-9018
USA
Telephone (864) 967-2777
Facsimile (864) 967-8900
www.boschrexroth-us.com

Bosch Rexroth Corporation
2315 City Line Road
Bethlehem, PA 18017-2131
USA
Telephone (610) 694-8300
Facsimile (610) 694-8467
www.boschrexroth-us.com

Axial piston-variable motor A10VM
Plug-in version A10VE

RA 91703/06.09 **1**/28
Replaces:11.07

Technical Data Sheet



Series 52
Size 28...85
Nom. pressure 4000 psi (280 bar)
Peak pressure 5100 psi (350 bar)
open and closed circuit

Contents

Features

– Dual displacement motor, axial piston swashplate design,for hydrostatic transmissions in open and closed circuits
– Output speed is directly proportional to inlet flow and inversely proportional to motor displacement
– Output torque increases proportional to the pressure difference between high and low pressure sides and increasing displacement
– Heavy duty bearings for long service life
– High permissible output speed
– Well proven A10-rotary unit technology
– High power/weight ratio – compact dimensions
– Cost effective
– Low noise
– Control range 1 : 3,75
– External control pressure supply possible
– Minimum displacement can be set externally
– SAE-2-bolt mounting flange on A10VM
– Special 2-bolt mounting flange on A10VE

Ordering code - Standardprogram

A10V	M			/	52	W		–	V		C			
01	02	03	04		05	06	07		08	09	10	11	12	13

Axial piston unit

01	Swash plate design, variable	**A10V**

Operating mode

02	Motor	**M**

Size

		28	45	63	85
03	Displacement $V_{g\,max}$ [in^3 /rev.] (cm^3 /rev.)	1.71 (28)	2.75 (45)	3.78 (62)	5.19 (85)

Control devices

				28	45	63	85	
04	Two point control							
	Directly operated, external control supply, without pilot valve			●	●	●	●	**DG**
	Hydraulically operated	Stroking time orifice	without	●	●	●	o	**HZ**
			with	●	●	●	o	**HZ6**
	Electrically with solenoid valve Control voltage 12V[1]	Stroking time orifice	without	●	●	●	●	**EZ1**
			with	●	●	●	●	**EZ6**
	Electrically with solenoid valve Control voltage 24V[1]	Stroking time orifice	without	●	●	●	o	**EZ2**
			with	●	●	●	o	**EZ7**

Series

05		**52**

Direction of rotation

06	Viewed on shaftend	Bi-directional	**W**

Minimum displacement

			28	45	63	85	
07	$V_{g\,min}$ in^3 (cm^3) steplessly adjustable	from/to	0.49/1.71 (8/28)	0.73/1.52 (12/25)	0.98/2.32 (16/38)	1.34/3.05 (22/50)	**1**
	Adjustment please state in clear text	from/to	–	1.59/2.75 (26/45)	2.44/3.78 (40/62)	2.93/5.19 (48/85)	**2**

Seals

08	FKM (fluor rubber)	**V**

Shaft end

		28	45	63	85	
09	Splined acc. to SAE J744	●	●	●	●	**R**
	(for details see unit dimensions)	–	●	●	o	**W**

Mounting flange

		28	45	63	85	
10	SAE 2-bolt	●	●	●	●	**C**

Ports for service lines

		28	45	63	85	
11	SAE flanges , at side-same side, UNC fixing screws	●	●	●	●	**60N00**
	SAE flanges at rear, UNC fixing screws	o	●	o	o	**61N00**
	Threaded ports on side-same side, UNC thread	●	●	●	o	**66N00**

Valves

		28	45	63	85	
12	Without valves	●	●	●	●	**0**
	Integrated flushing valve, only with side ports (10N00 and 16N00)	●	●	●	●	**7**

Speed pickup

		28	45	63	85	
13	Without speed pickup	●	●	●	●	**–**
	Prepared for inductve type of speed pickup ID R	●	●	●	o	**D**

[1] Shown in the unit dimensions: DIN connector from HIRSCHMANN;
Preferred for mobile applications (other dimensions): DEUTSCH connector molded, 2-pin – without suppressor diode;
Please specify the required connector design in plain text.

● available o in preparation – not available

Ordering code - Standardprogram

A10V	E			/	52	W		–	V		F			
01	02	03	04		05	06	07		08	09	10	11	12	13

Axial piston unit

01	Swash plate design, variable	**A10V**

Operating mode

02	Motor, plug-in type	**E**

Size

		28	45	63
03	Displacement $V_{g\ max}$ [in^3 /rev. (cm^3 /rev.)]	1.71 (28)	2.75 (45)	3.78 (62)

Control devices

				28	45	63	
04	Two point control						
	Directly operated, external control supply, without pilot valve			●	●	o	**DG**
	Hydraulically	Stroking time orifice	without	●	●	●	**HZ**
			with	●	●	●	**HZ6**
	Electrically with solenoid valve Control voltage 12V[1]	Stroking time orifice	without	●	●	●	**EZ1**
			with	●	●	●	**EZ6**
	Electrically with solenoid valve Control voltage 24V[1]	Stroking time orifice	without	●	●	●	**EZ2**
			with	●	●	●	**EZ7**

Series

05		**52**

Direction of rotation

06	Viewed on shaftend	Bi-directional	**W**

Minimum displacement

			28	45	63	
07	$V_{g\ min}$ in^3 (cm^3) steplessly adjustable	from/to	0.61/1.71 (10/28)	0.73/1.52 (12/25)	0.98/2.32 (16/38)	**1**
	Adjustment please state in clear text	from/to	–	1.59/2.75 (26/45)	2.44/3.78 (40/62)	**2**

Seals

08	FKM (fluoro rubber)	**V**

Shaft end

		28	45	63	
09	Splined acc. to SAE J744	●	●	●	**R**
	(for details see unit dimensions)	–	●	●	**W**

Mounting flange

		28	45	63	
10	Special 2-bolt	●	●	●	**F**

Ports for service lines

		28	45	63	
11	SAE flanges at side-same side, UNC fixing screws	●	●	●	**60N00**
	SAE flanges at rear, UNC fixing screws	o	●	o	**61N00**
	Threaded ports on side-same side, UNF thread	●	●	●	**66N00**

Valves

		28	45	63	
12	Without valves	●	●	●	**0**
	Integrated flushing valve, only with side ports (10N00 and 16N00)	●	●	●	**7**

Speed pickup

		28	45	63	
13	Without speed pickup	●	●	●	**–**
	Prepared for inductive type of speed pickup ID R	o	●	o	**D**

[1] Shown in the unit dimensions: DIN connector from HIRSCHMANN;
Preferred for mobile applications (other dimensions): DEUTSCH connector molded, 2-pin – without suppressor diode;
Please specify the required connector design in plain text.

● available   o in preparation   – not available

Technical data

Fluid

Prior to project design please see our data sheets RE 90220 (mineral oil), RE 90221 (ecologically acceptable fluids) and RE90223 (HF-fluids) for detailed information on fluids and application conditions.

When operating on ecologically acceptable fluids, limitations to the techical data may be necessary.

Please contact us and state the fluid used in clear text when ordering.

Operating viscosity range

For optimum efficiency and service life we recommend an operating viscosity (at operating temperature) in the range

ν_{opt} = opt. operating viscosity 80...170 SUS (16...36 mm^2/s)

referred to circuit temperature in closed circuits or tank temperature in open circuits.

Limits of viscosity range

The following limits are valid for extreme operating conditions:

ν_{min} = 42 SUS (5 mm^2/s) (closed circuit)
ν_{min} = 60 SUS (10 mm^2/s) (open circuit)

briefly ($t \leq 1$ min) at max. permissible temperature of 240 °F (115 °C).

Please note, that the max. fluid temperature of 240 °F (115 °C) may also not be exceeded in certain areas (for instance bearing area) The temperature in the bearing area is approx. 9°F (5 K) higher than the average fluid temperature.

ν_{max} = 7400 SUS (1600 mm^2/s)
briefly ($t \leq 1$ min)
on cold start (t_{min} = -13 °F (-25°C), $p \leq 435$ psi (30 bar), $n \leq$ 1000 rpm).

At temperatures between -13 °F (–25 °C) and -40 °F (–40 °C) special measures may be required for certain installation positions. Please consult us for further information

For detailed information on operation at very low temperatures see RE 90300-03-B.

Notes on the selection of the hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open circuit), circuit temperature (closed circuits), in relation to the ambient temperature.

The fluid should be selected, so that within the operating temperatue range, the viscosity lies within the optimum range (ν_{opt}), 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 °F (X °C) the operating temperature in the tank is 140 °F (60 °C). In the optimum viscosity range (ν_{opt}; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; select VG 68.

Important: The leakage oil (case drain oil) temperature is influenced by pressure and motor speed and is always higher than the tank temperature. However, at no point in the circuit may the temperature exceed 240 °F (115 °C).

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperatures please consult us

Filtration of fluid

The finer the filtration the better the achieved cleanliness of the fluid and the longer the life of the axial piston unit.

To ensure a reliable functioning of the axial piston unit, a minimum cleanliness of

20/18/15 to ISO 4406 is necessary.

At very high fluid temperatures (194 °F to max. 240 °F)(90 °C to max. 115 °C)) the minimum cleanliness has to be at least

19/17/14 to ISO 4406 .

If above cleanliness classes cannot be met please consult us.

Operating pressure range

Pressure at port A or B

(Pressure data to DIN 24312)

Nominal pressure p_N ______________ 4000 psi (280 bar)[1]
Peak pressure p_{max} ________________5100 psi (350 bar)
With motors connected in series please consult us.

Case drain pressure

Max. permissible pressure at leakage port L

$p_{abs\ max}$ operation as motor in open circuit __58 psi(4 bar $_{abs}$)
$p_{abs\ max}$ operation as motor in closed circuit _58 psi(4 bar $_{abs}$)
$p_{abs\ max}$ motor/pump operation in open circuit 29 psi(2 bar $_{abs}$)

Direction of rotation

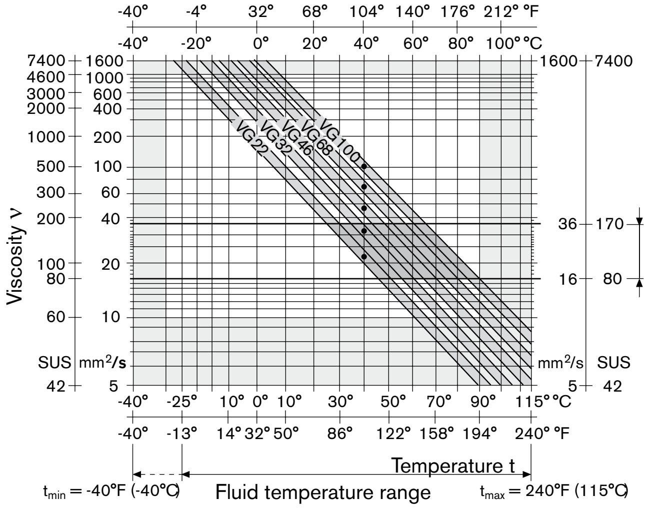
Direction of rotation, viewed on shaft end	
clockwise	counter-clockwise
B to **A**	**A** to **B**

Adjustment of displacement

The minimum displacement is steplessly adjustable within the range of the screw lenghts 1 or 2 (see ordering code).

Please state minimum displacement in clear text when ordering.

Selection diagram



1) Higher pressures on request

Technical data

Table of values

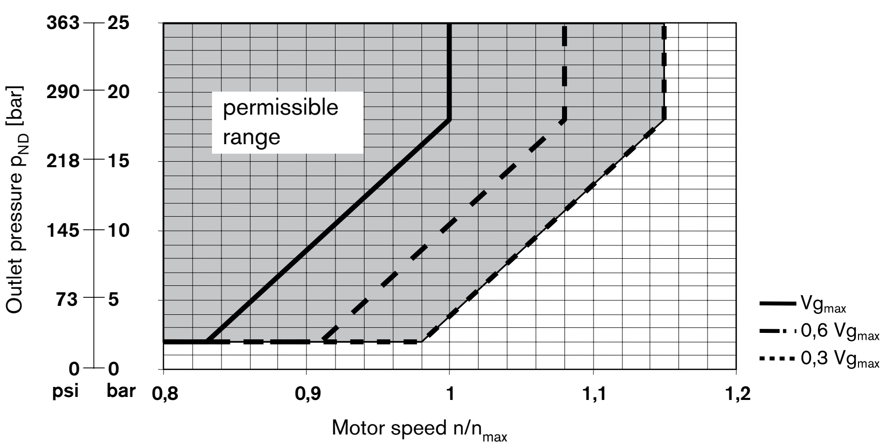
theoretical, rounded values, without considering η_{mh} and η_v

Size				28	45	63	85
Displacement		$V_{g\ max}$	in³ (cm³)	1.71 (28)	2.75 (45)	3.78 (62)	5.31 (87)
		$V_{g\ min}$	in³ (cm³)	0.49 (8 (VM) 0.61 (10)(VE)	0.73 (12)	0.98 (16)	1.34 (22)
Speed[1)]							
max. at $V_{g\ max}$		$n_{0\ max}$	rpm	4700	4000	3300	3100
max. at $V_{g\ min}$		$n_{0\ cont.}$	rpm	5400	4600	3900	3560
Min. speed in cont. operation		$n_{0\ min}$	rpm	250	250	250	250
Inlet flow							
at $n_{0\ max}$ and $V_{g\ max}$		$q_{V0\ max}$	gpm (L/min)	34.8 (131,6)	47.5 (180)	54 (205)	71.3 (270)
Torque constant[2)] at $V_{g\ max}$		T_C	lb-ft/psi (Nm/bar)	0.022 (0,445)	0.036 (0,716)	0.049 (1,002)	0.071 (1,35)
Torque							
at $V_{g\ max}$	p_N= 4000 psi	T_{max}	lb-ft	91	146	200	283
	(280 bar)		(Nm)	(125)	(200)	(276)	(387)
Actual starting torque							
at n = 0 rpm	p_N = 4000 psi	T	lb-ft	67	108	149	184
	(280 bar)		Nm	(92)	(149)	(205)	(253)
Rotary stiffness	Shaft R	c	lb-ft/rad	18900	29800	50500	111600
			(Nm/rad)	(26000)	(41000)	(69400)	(152900)
	Shaft W	c	lb-ft/rad	14400	25000	39300	85800
			(Nm/rad)	(19800)	(34400)	(54000)	(117900)
Mass moment of inertia (about output shaft)		J_{TW}	lb-ft²	0.0403	0.0783	0.1329	0.2847
			(kgm²)	(0,0017)	(0,0033)	(0,0056)	(0,012)
Angular acceleration, max.		α	rad/s²	5500	4000	3300	2700
Filling volume		V	gal (L)	0.16 (0,6)	0.185 (0,7)	0.21 (0,8)	0,26 (1,0)
Weight approx.		m	lbs (kg)	30.9 (14)	39.7 (18)	57.3 (26)	75.0 (34)

1) At max. speed in closed circuit operation make sure that motor outlet pressure is at least ≥ 18 bar.

2) in open circuit Δp 280bar at $p_{boostpress.}$ 2bar
in closed circuit Δp 260bar at $p_{boostpress.}$ 20bar

Minimum required outlet pressure at port A (B) depending on motor speed



Technical data

Calculating size

Flow $q_V = \dfrac{V_g \cdot n}{231 \cdot \eta_V}$ [gpm]

Torque $T = \dfrac{V_g \cdot \Delta p \cdot \eta_{mh}}{24 \cdot \pi}$ [lb-ft]

Output power $P = \dfrac{T \cdot n}{5252} = \dfrac{q_V \cdot \Delta p \cdot \eta_t}{1714}$ [HP]

Output speed $n = \dfrac{q_v \cdot 231 \cdot \eta_v}{V_g}$ [rpm]

V_g = geometric displacement per rev. in^3
Δp = Differential pressure in psi
n = speed in rpm
η_V = volumetric efficiency
η_{mh} = mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)
T_K = Torque constant

Flow $q_V = \dfrac{V_g \cdot n}{1000 \cdot \eta_V}$ [L/min]

Torque $T = \dfrac{1{,}59 \cdot V_g \cdot \Delta p \cdot \eta_{mh}}{100}$ [Nm]

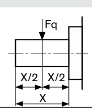
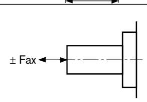
or $T = T_K \cdot \Delta p \cdot \eta_{mh}$

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

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

V_g = geometric displacement per rev. 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 ($\eta_t = \eta_V \cdot \eta_{mh}$)
T_K = Torque constant

Permissible radial and axial forces on drive shaft

Size					28	45	63	85
Max. radial force		bei X/2	$F_{q\,max}$	lb (N)	270 (1200)	337 (1500)	382 (1700)	450 (2000)
Max. axial force			F_{ax}	lb (N)	225 (1000)	337 (1500)	450 (2000)	674 (3000)

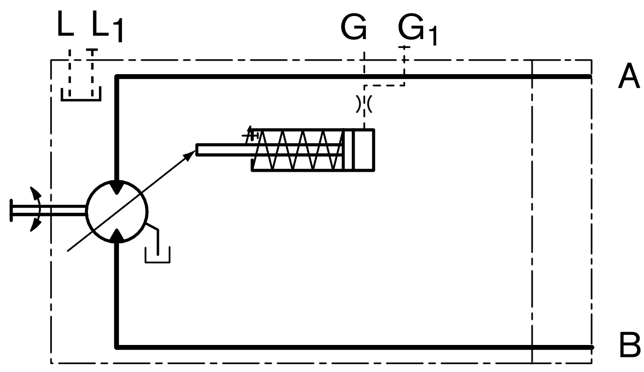
Two-point direct control DG

Normally the motor is at max. displacement. By applying an external pressure to port G, the control piston is directly pressurized.and the motor swivels back to min. displacement

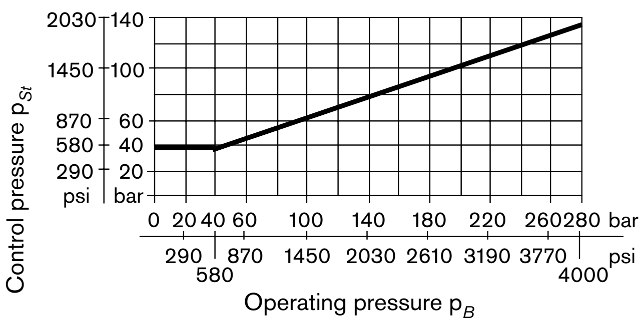
The minimum required control pressure is $p_{St} \geq 580$ psi (40 bar)

Please note, that this minimum required control pressure at port G depends directly on the operating pressure p_B in port A or B. (Pressure in A or B),see control pressure diagram below. With a control pressure above this minimum required pressure level the motor will destroke properly.

Schematic



Control pressure diagram



Ports

A, B	Pressure port
L, L_1	Case drain ports
G, G_1	Ports for external control pressure

Control pressure = 0 psi (0 bar) ≙ $V_{g\ max}$

Control pressure ≥ 580 psi (40 bar) = $V_{g\ min}$ (see diagram)

The max. perm. control pressure is p_{St} ≙ 4000 psi (280 bar).

$V_{gmin.}$. adjustment please state in clear text with order

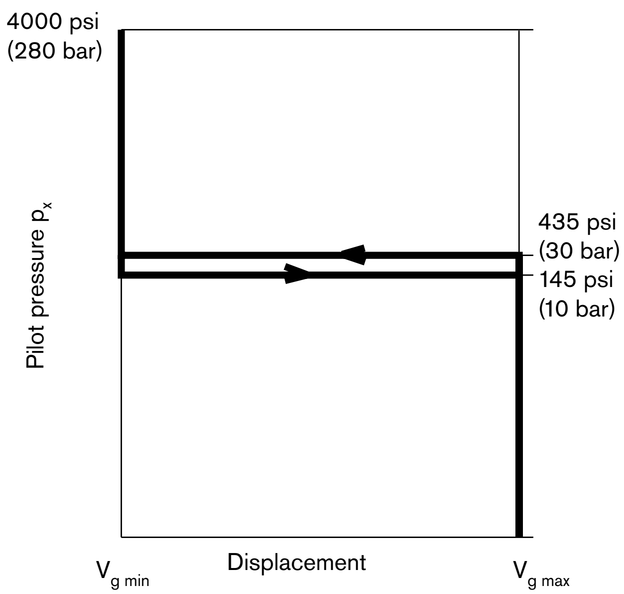
Two-point control, hydraulically operated HZ/HZ6

Normally the motor is at max. displacement. By applying a pilot pressure p_X to port X the pilot valve shifts and the control piston is pressurized causing the motor to swivel to min. displacement.($p_X \geq$ 435 psi (30bar)).

The necessary control pressure is via a shuttle valve taken out of the motor pressure side A or B. A minimum pressure difference of $\Delta p_{A,B} \geq$ 290 psi (20 bar) between the motor pressure sides is required.

Only $V_{g\,max}$ or $V_{g\,min}$ are possible.

$V_{g\,min}$ - adjustment please state in clear ext when ordering.



Pilot pressure p_X = 0 psi (0 bar) $\triangleq V_{g\,max}$

Pilot pressure $p_X \geq$ 435 psi (30 bar) $\triangleq V_{g\,min}$

Techn. data HZ/HZ6	
Minimum pilot pressure	435 psi (30 bar)
Maximum pilot pressure	4000 psi (280 bar)

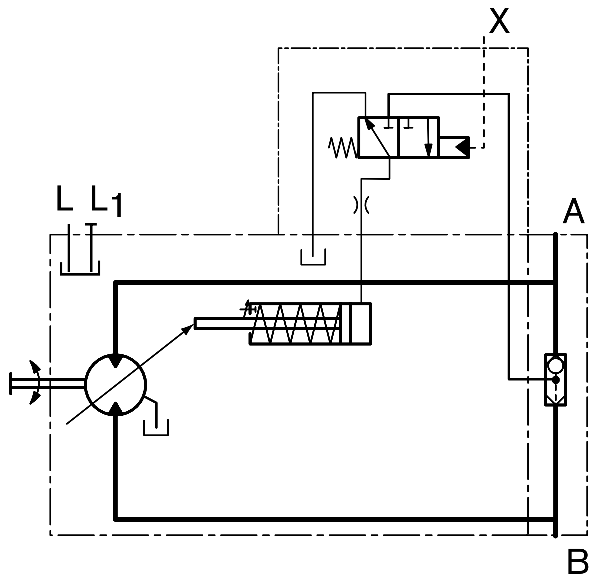
Version HZ6 with stroking time shuttle orifice

Slow down of swivel action by means of shuttle orifice.

This enables a smooth swivel action.

Standard orifice size = dia 0.0083 in (ø 0,21 mm); other sizes on request.

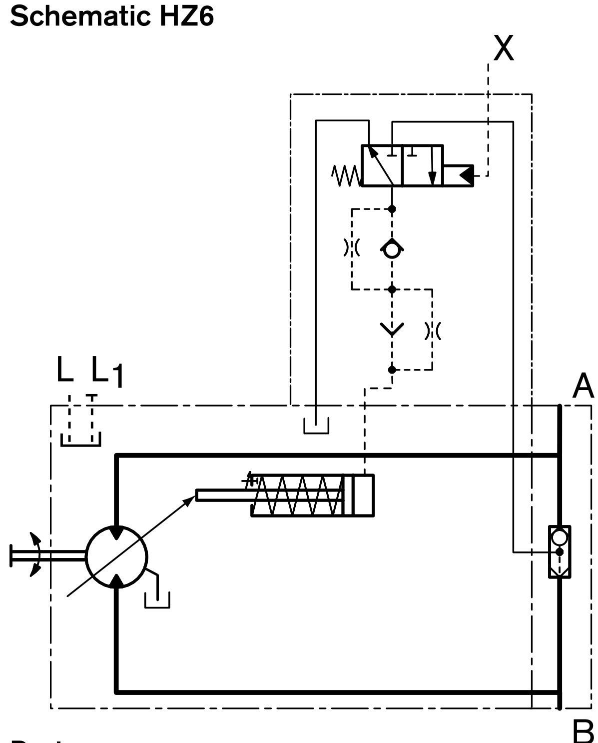
Schematic HZ



Ports

A,B	Pressure ports
L, L1	Case drain ports
X	Pilot pressure port

Schematic HZ6



Ports

A,B	Pressure ports
L, L1	Case drain ports
X	Pilot pressure port

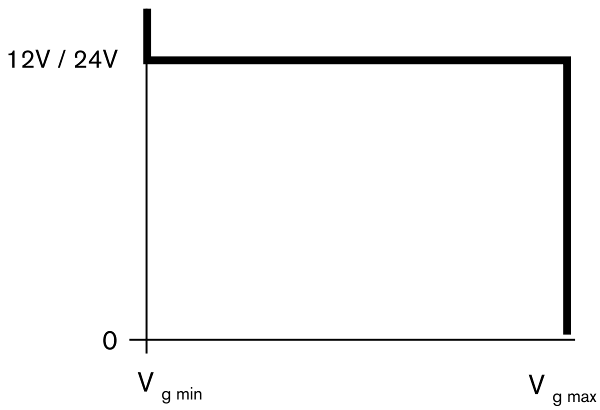
Two-point control, electrically operated EZ[1)]

Normally the motor is at maximum displacement. By energizing the solenoid of the control valve, the control piston is pressurized and the motor swivels to minimum displacement.

The control pressure is via a shuttle valve taken out of the motor pressure side A or B. A minimum pressure difference of $\Delta p_{A,B} \geq$ 290 psi (20 bar) between the pressure sides is required.

The motor can only swivel between $V_{g\ max}$ or $V_{g\ min}$.

$V_{g\ min}$-adjustment please state in clear ext when ordering.



De-energized	≙ $V_{g\ max}$
Energized	≙ $V_{g\ min}$

Techn. data EZ		
Version	EZ 1/6	EZ 2/7
Supply voltage	12V DC	24V DC
Nom. current at 68 °F (20°C)	1,5 A	0,8 A
Duty cycler	100%	100%
Plug protection class to DIN 43650	IP 65	IP 65

Ambient temperature range -4°F (-20°C) to 140°F(+60°C).
If the above temperature range cannot be met please consult us.

Features

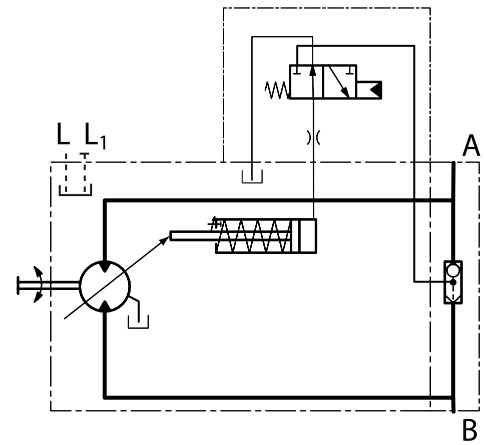
– with spring return at solenoid

– Solenoid plug can be turned 4 x 90°

Version EZ6/7 with stroking time shuttle orifice

Slow down of swivel action by means of shuttle orifice.
This enables a smooth swivel action.
Standard orifice size = 0.0083 in (0,21mm); other sizes on request.

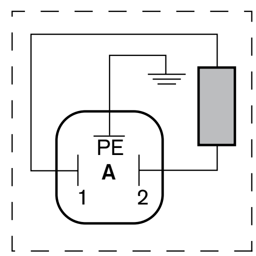
Schematic EZ1/2



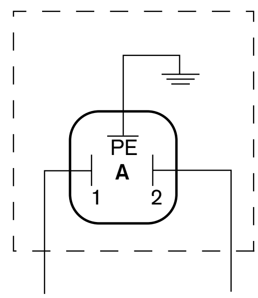
Ports

A,B	Pressure ports
L, L1	Case drain ports

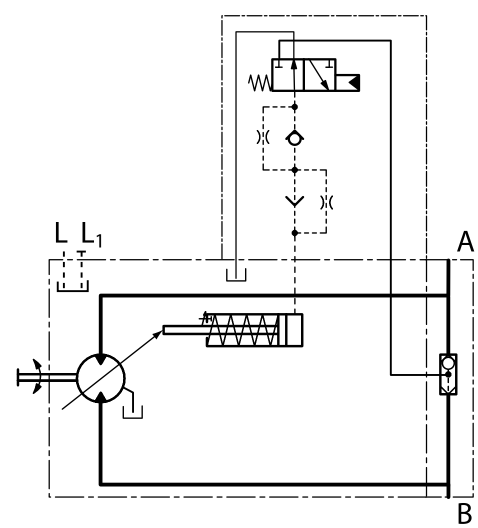
Connection to solenoid acc. to DIN 43650



Plug connection to DIN EN 175301-803-A Cable screw joint M16x1.5



Schematic EZ6/7



Ports

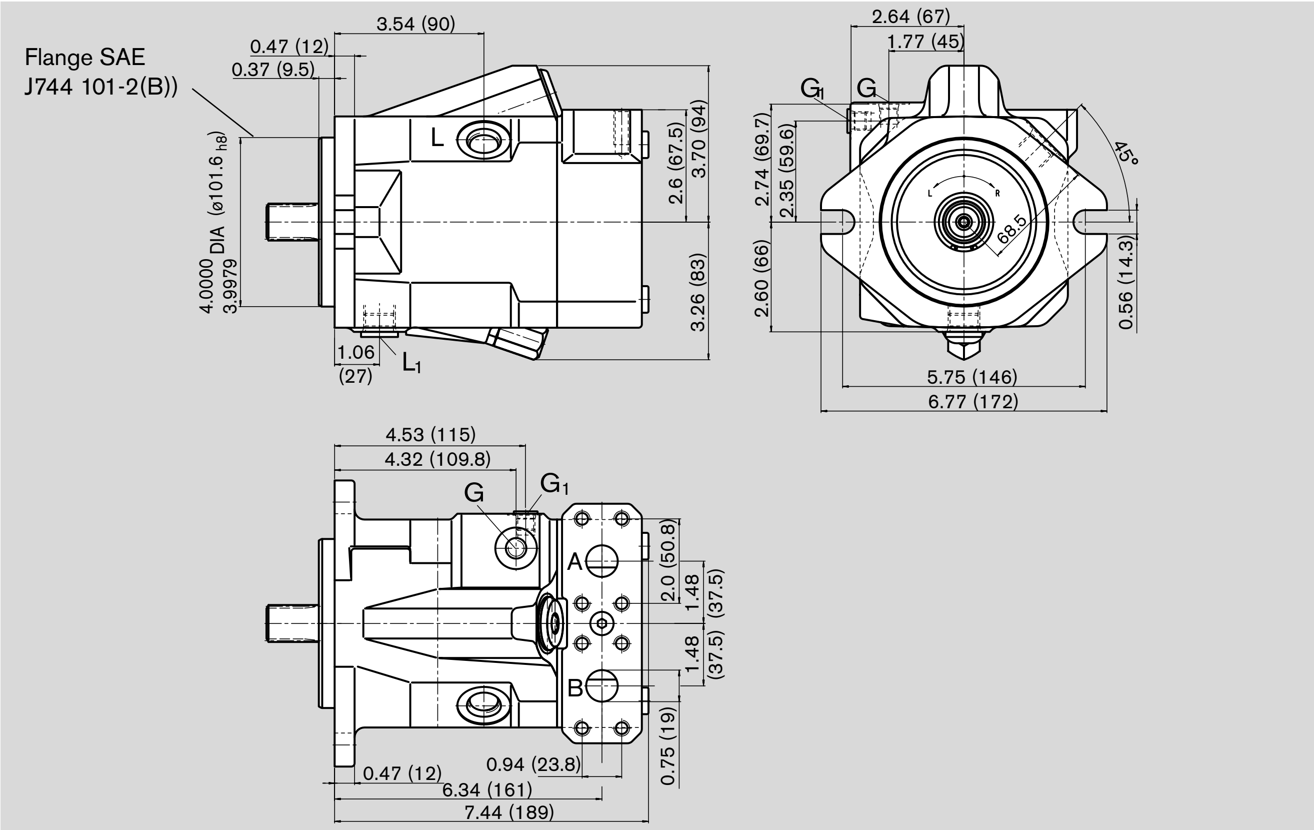
A,B	Pressure ports
L, L1	Case drain ports

[1)] Shown in the unit dimensions: DIN connector from HIRSCHMANN;
Preferred for mobile applications (other dimensions): DEUTSCH connector molded, 2-pin – without suppressor diode;
Please specify the required connector design in plain text.

Unit dimensions A10VM, Size 28

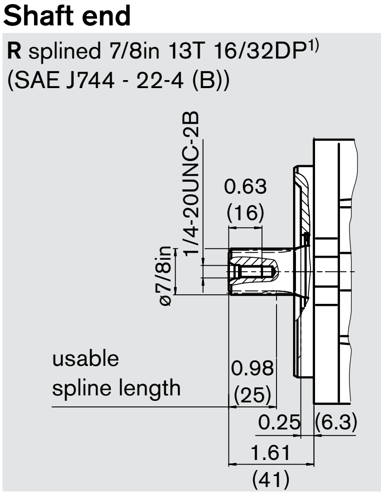
Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VM 28DG/52WX-VXC60N000



Shaft end

R splined 7/8in 13T 16/32DP[1]
(SAE J744 - 22-4 (B))



Ports

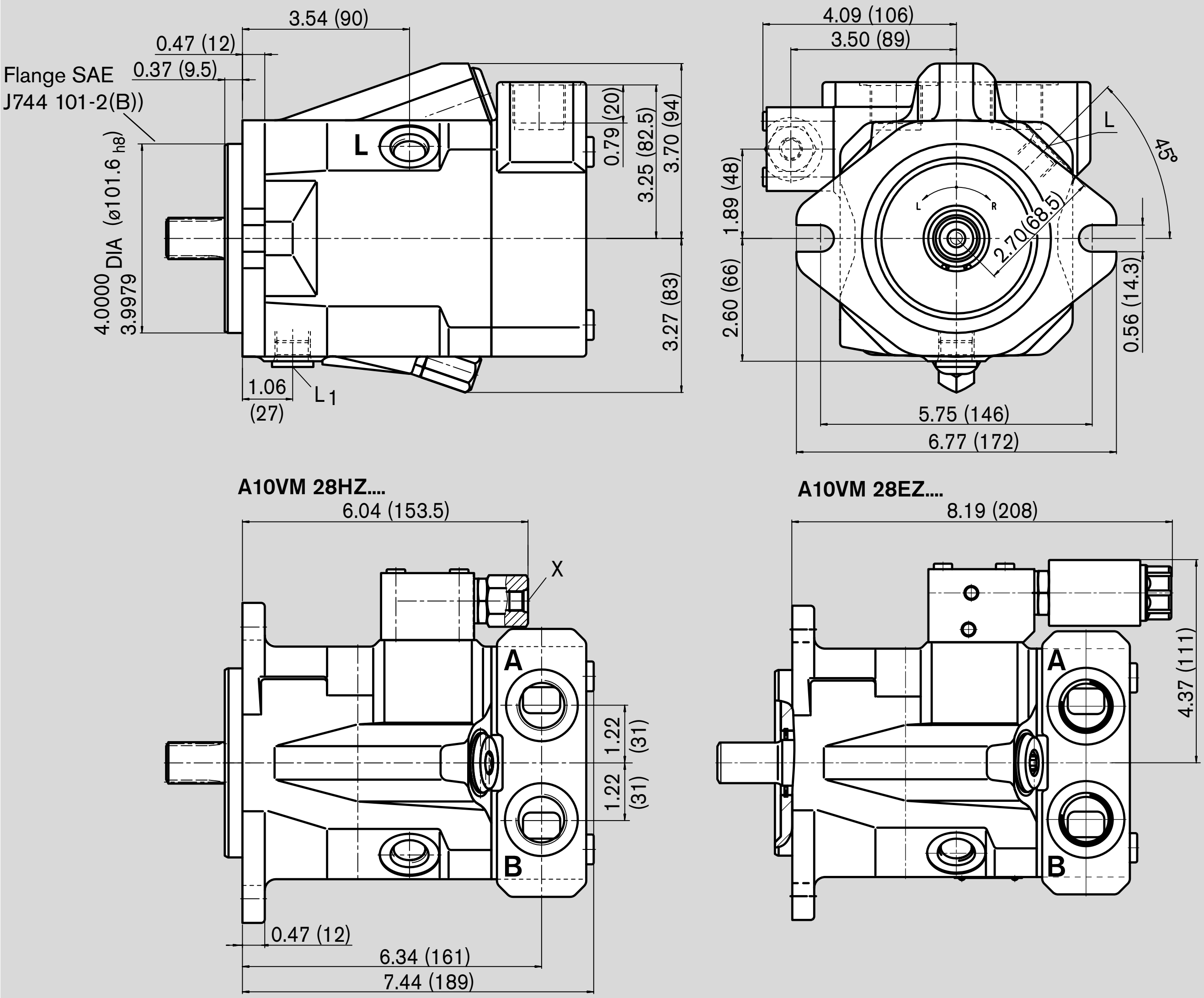
				Tightening torque, max.[2]
A, B	Pressure port (high press. series, code 62)	SAE J518C	3/4 in	
	Fixing thread	ISO 68	3/8-16UNC-2B; 0.83 (21) deep	30 lb-ft (42 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	116 lb-ft (160 Nm)
G,G_1	Port for ext. contr. press. (G_1 plugged)	ISO 11926	7/16-20 UNF-2B; 0.47 (12) tief	29 lb-ft (40 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Unit dimensions A10VM, Size 28

Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VM 28HZX/52WX-VXC66N000
A10VM 28EZX/52WX-VXC66N000



Ports

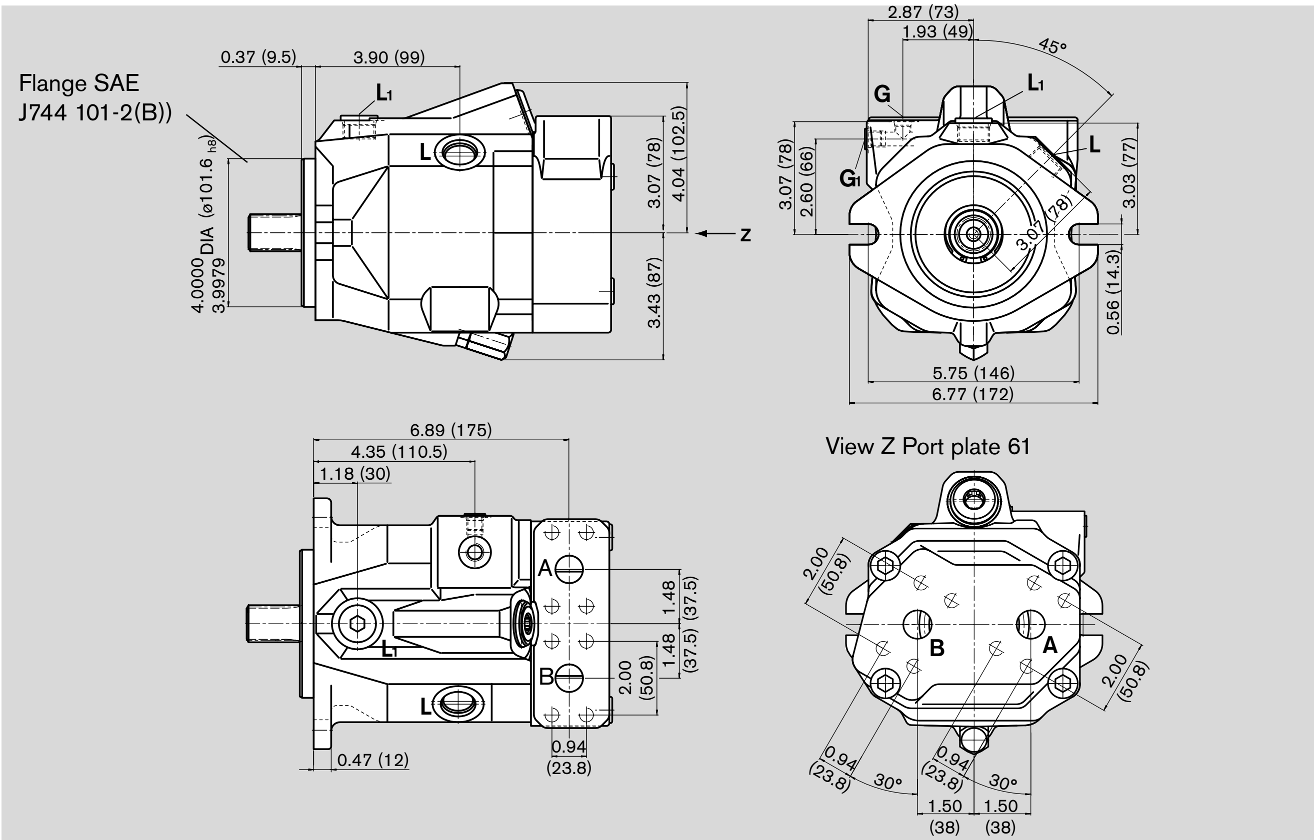
				Tightening torque, max.[1]
A, B	Pressure port	ISO 11926	1 1/16-12UN-2B; 0.79 (20) deep	261 lb-ft (360 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	116 lb-ft (160 Nm)
X	Pilot pressure port	ISO 11926	7/16-20UNF-2B; 0.39 (10) deep	29 lb-ft (40 Nm)

[1] see safety information

Unit dimensions A10VM, Size 45

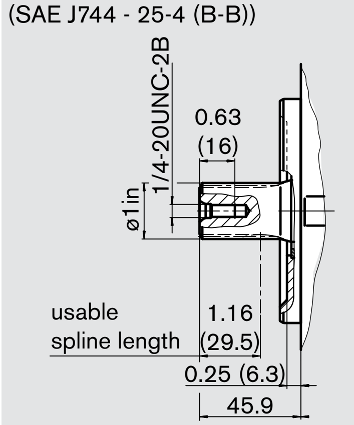
Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VM 45DG/52WX-VXC60N000
A10VM 45DG/52WX-VXC61N000

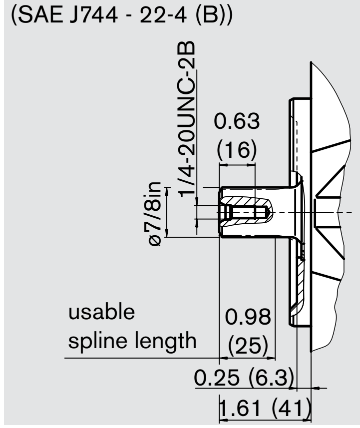


Shaft ends

R splined 1in 15T 16/32DP[1]
(SAE J744 - 25-4 (B-B))



W splined 7/8in 13T 16/32DP[1]
(SAE J744 - 22-4 (B))



Ports

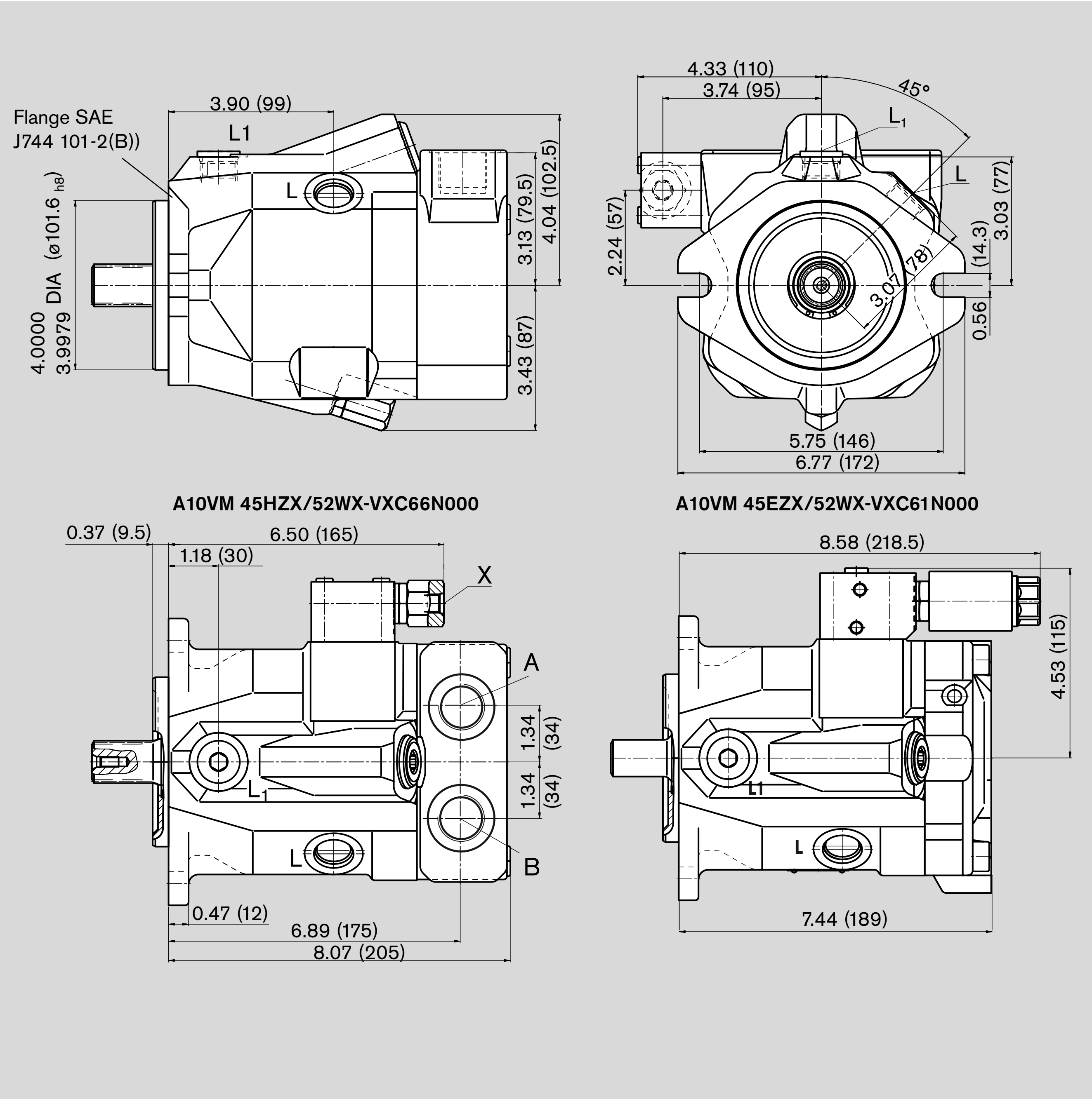
				Tightening torque, max.[2]
A, B	Pressure port (high press. series, code 62)	SAE J518C	3/4 in	
	Fixing thread	ISO 68	3/8-16UNC-2B; 0.83 (21) deep	31 lb-ft (42 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
G, G_1	Port for ext. control press. (G_1 plugged)	ISO 11926	7/16-20 UNF-2B; 12 deep	29 lb-ft (40 Nm)

1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
2) see safety information

Unit dimensions A10VM, Size 45

Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VM 45HZX/52WX-VXC66N000
A10VM 45EZX/52WX-VXC61N000



Ports

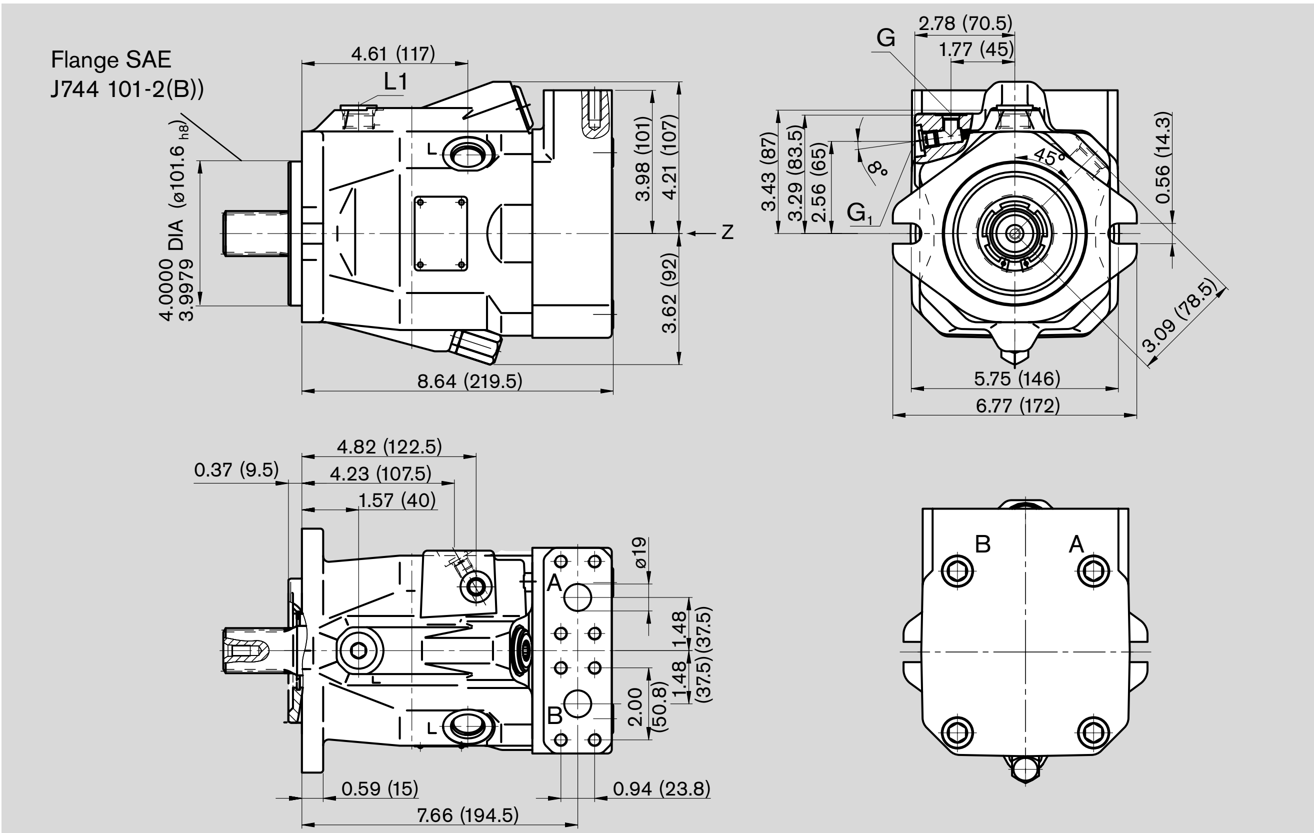
				Tightening torque, max.[1]
A, B	Pressure port	ISO 11926	1 1/16-12UN-2B; 0.79 (20) deep	261 lb-ft (360 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
X	Pilot pressure port	ISO 11926	7/16-20UNF-2B; 0.39 (10) deep	29 lb-ft (40 Nm)

[1] see safety information

Unit dimensions A10VM, Size 63

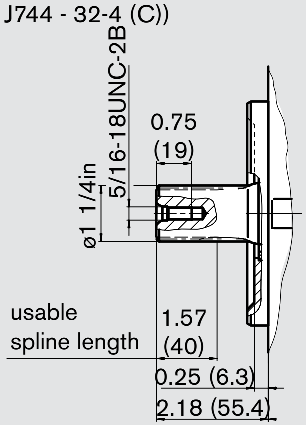
Before finalizing your design please request a certified installation drawing.
Dimensions in inches (mm)

A10VM 63DG/52WX-VXC60N000

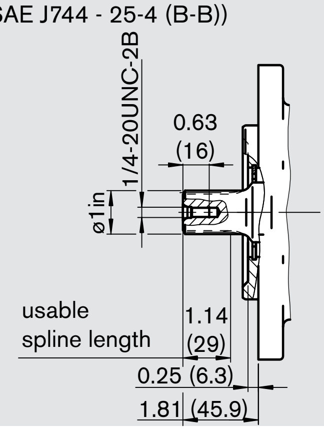


Shaft ends

R splined 1 1/4in 14T 12/24DP[1]
(SAE J744 - 32-4 (C))



W splined 1in 15T 16/32DP[1]
(SAE J744 - 25-4 (B-B))



Ports

				Tightening torque, max.[2]
A/B	Pressure port (high press. series, code 62)	SAE J518C	3/4 in	
	Fixing thread	ISO 68	3/8-16UNC-2B; 0.83 (21) deep	31 lb-ft (42 Nm)
L/L_1	Case drain port (L_1plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
G,G_1	Port for ext. control press. (G_1 plugged)	ISO 11926	7/16-20 UNF-2B; 12 deep	29 lb-ft (40 Nm)

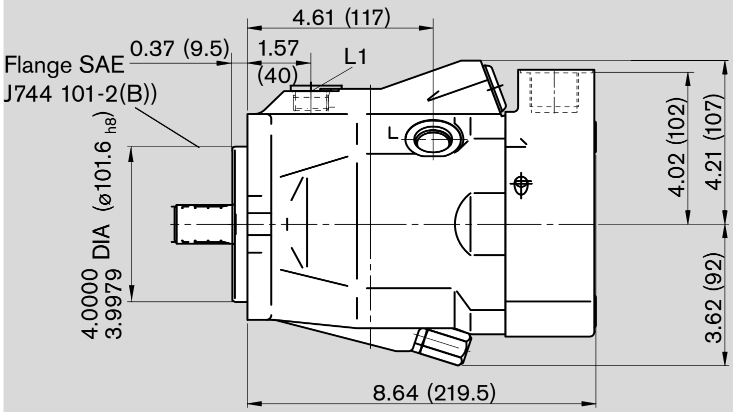
[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

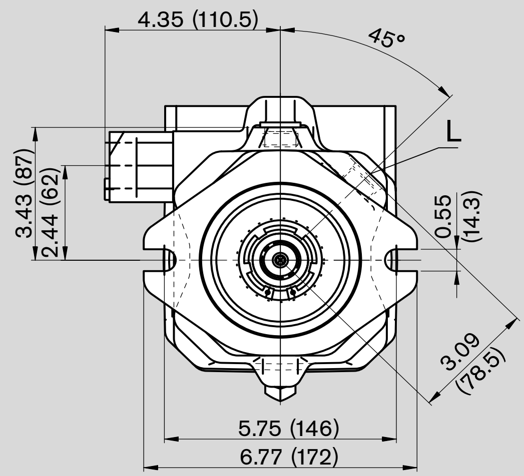
Unit dimensions A10VM, Size 63

Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

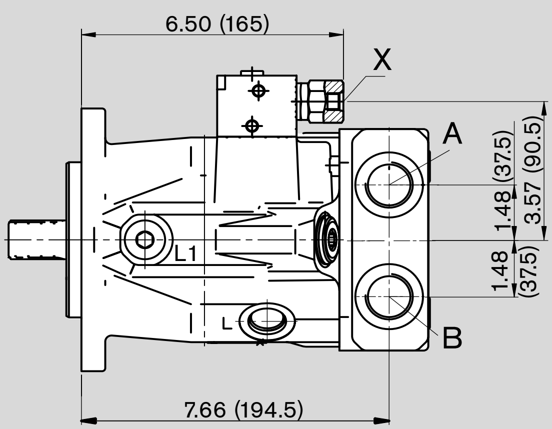
A10VM 63HZX/52WX-VXC66N000

A10VM 63EZX/52WX-VXC60N000

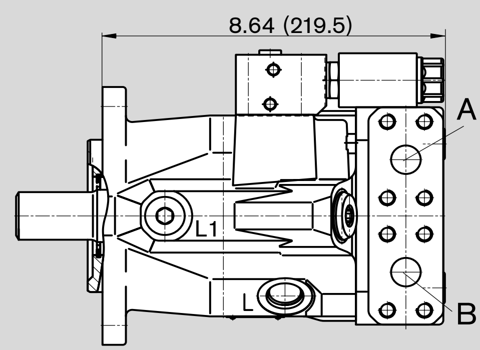




A10VM 63HZX/52WX-VXC66N000



A10VM 63EZX/52WX-VXC60N000
(Dimensions for ports see page 14)



Ports

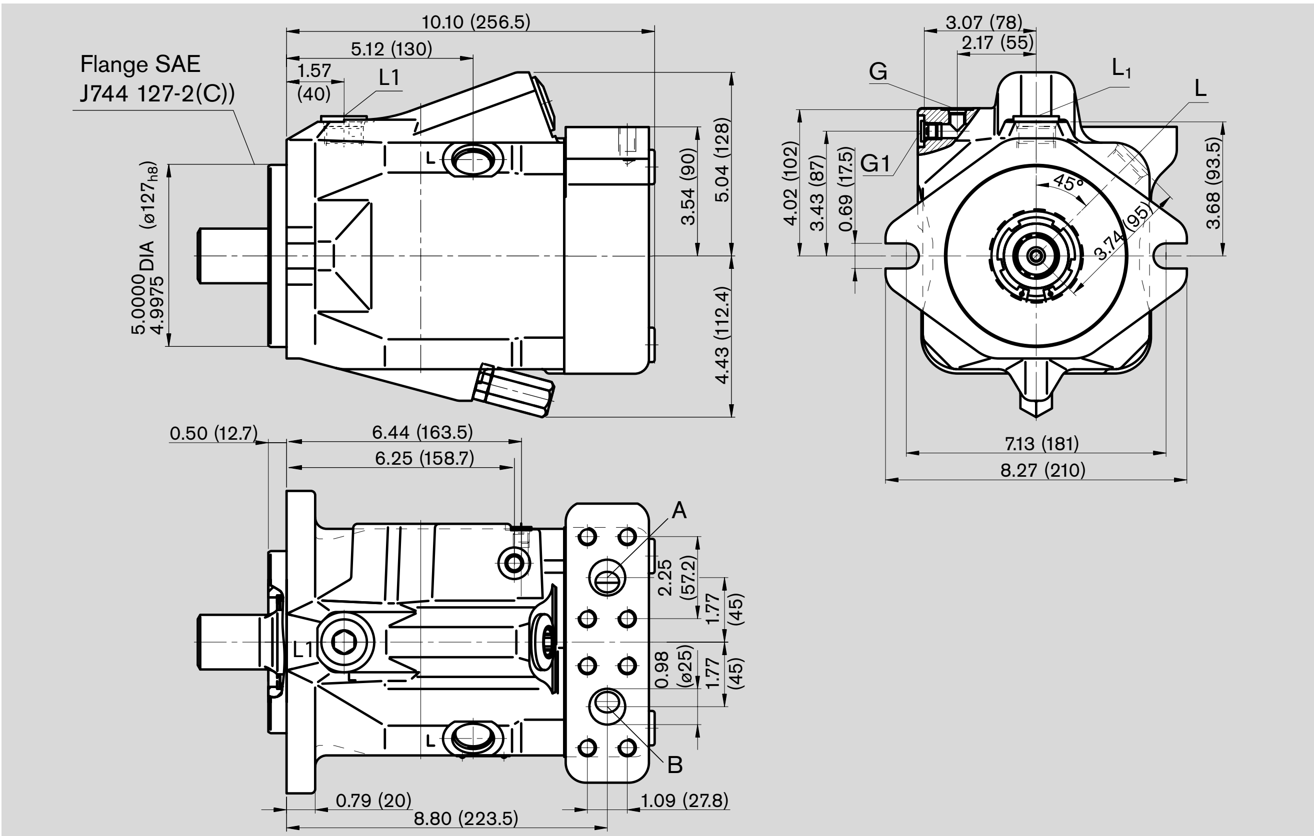
				Tightening torque, max.[2]
A/B	Pressure port	ISO 11926	1 1/16-12UN-2B; 0.79 (20) deep	262 lb-ft (360 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
X	Pilot pressure port	ISO 11926	7/16-20UNF-2B; 0.39 (10) deep	29 lb-ft (40 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Unit dimensions A10VM, Size 85

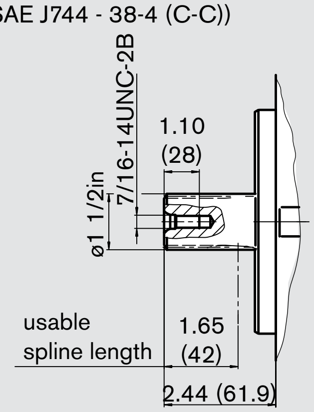
Before finalizing your design please request a certified installation drawing.
Dimensions in inches (mm)

A10VM 85DG/52WX-VXC60N000

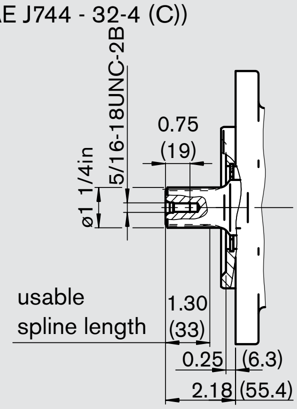


Shaft ends

R splined 1 1/2in 17T 12/24DP[1)]
(SAE J744 - 38-4 (C-C))



W splined 1 1/4in 14T 12/24DP[1)]
(SAE J744 - 32-4 (C))



Ports

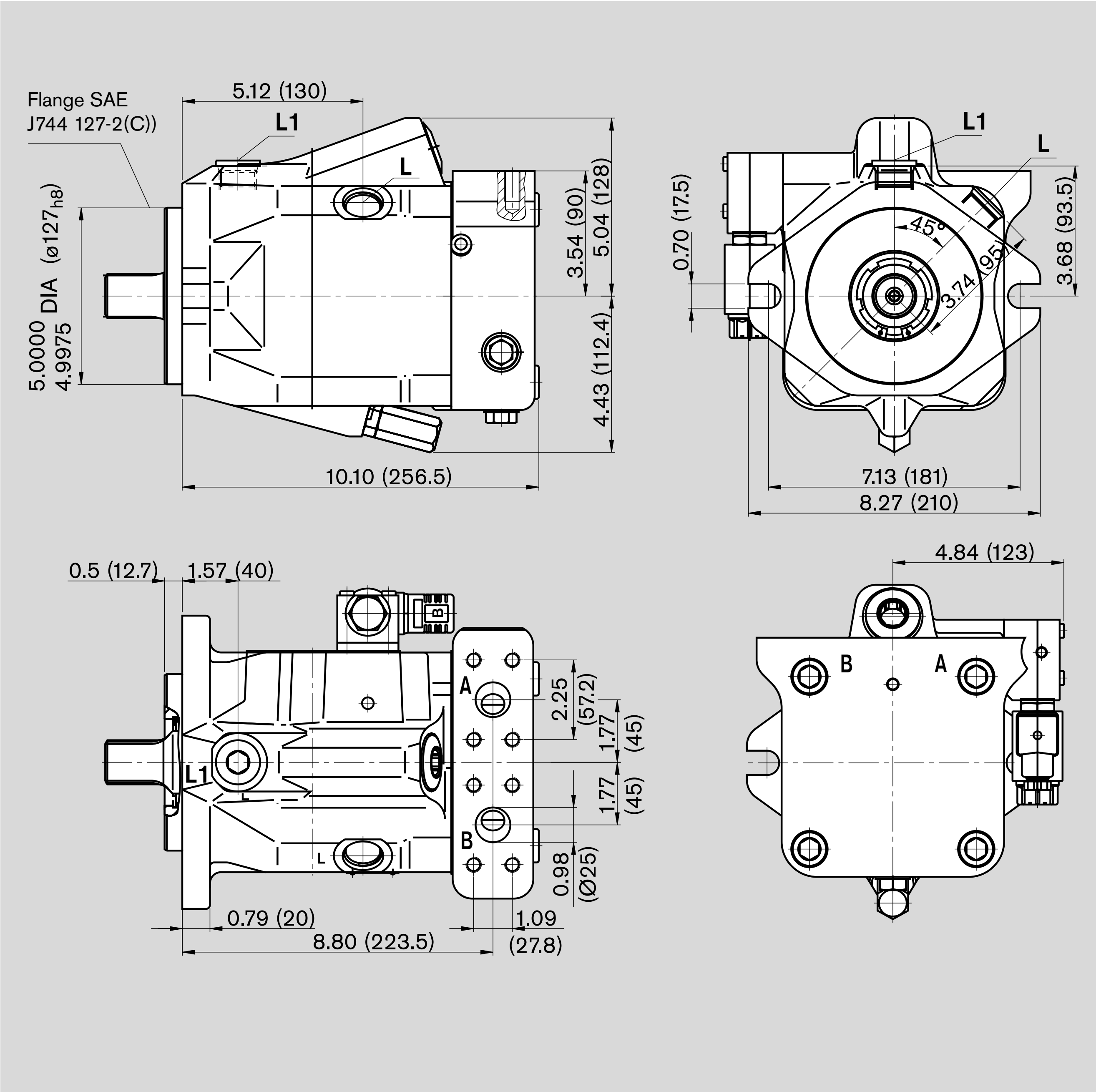
				Tightening torque, max.[2)]
A/B	Pressure port (high press. series, code 62)	SAE J518C	1 in	
	Fixing thread	ISO 68	7/16-14UNC-2B; 0.87 (22) deep	48 lb-ft (66) Nm
L/L_1	Case drain port (L_1 plugged)	ISO 11926	1 1/16-12 UN-2B	262 lb-ft (360 Nm)
G,G_1	Port for ext. control press. (G_1 plugged)	ISO 11926	7/16-20 UNF-2B	29 lb-ft (40 Nm)

1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
2) see safety information

Unit dimensions A10VM, Size 85

Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VM 85EZX/52WX-VXC60N000



Ports

				Tightening torque, max.[2]
A/B	Pressure port (high press. series, code 62)	SAE J518C	1 in	
	Fixing thread	ISO 11926	7/16-14UNC-2B; 0.87 (22) deep	48 lb-ft (66) Nm
L/L_1	Case drain port (L_1 plugged)	ISO 11926	1 1/16-12 UN-2B	262 lb-ft (360 Nm)

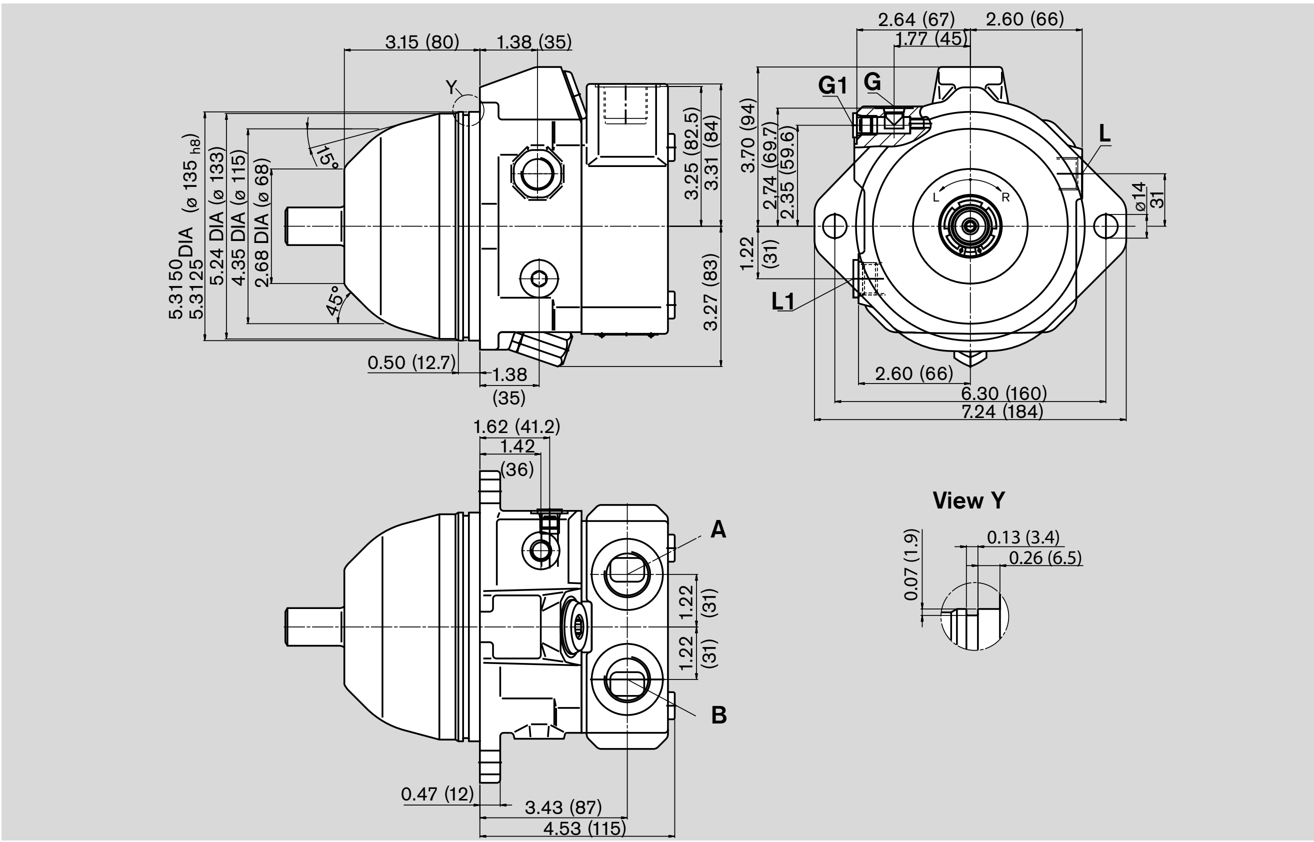
[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5

[2] see safety information

Unit dimensions A10VE, Size 28

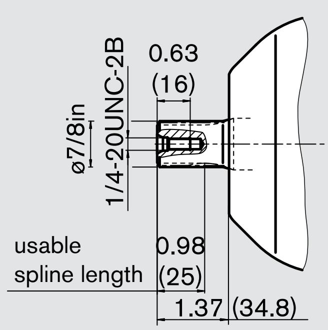
Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VE 28DG/52WX-VXF66N000



Shaft end

R splined 7/8in 13T 16/32DP[1]
(SAE J744 - 22-4 (B))



Ports

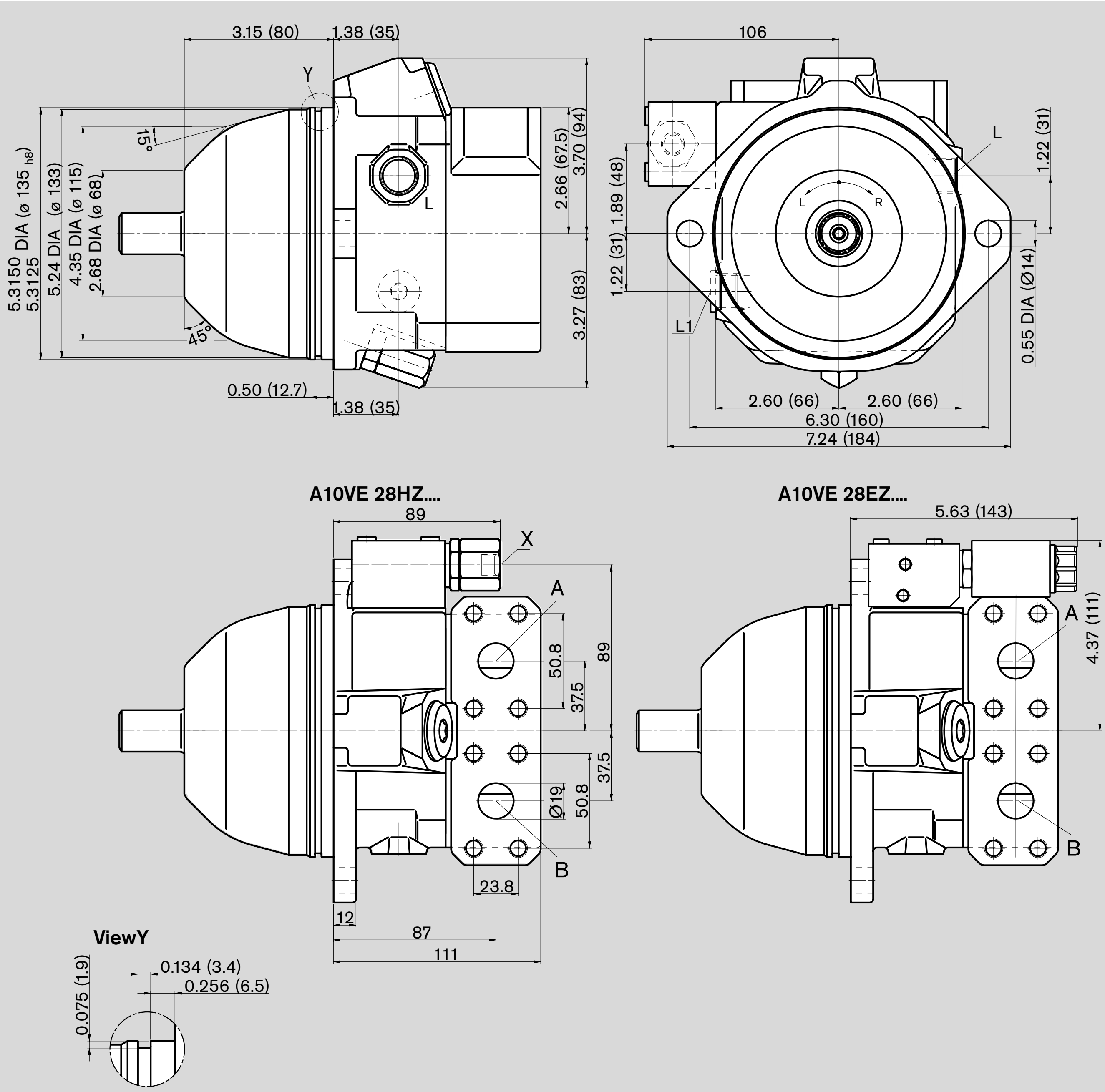
				Tightening torque, max.[2]
A/B	Pressure port	ISO 11926	1 1/16-12UN-2B; 0.79 (20) deep	261 lb-ft (360 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	116 lb-ft (160 Nm)
G,G_1	Port for ext. control press. (G_1 plugged)	ISO 11926	7/16-20 UNF-2B	29 lb-ft (40 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Unit dimensions A10VE, size 28

Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VE 28HZX/52WX-VXF60N000
A10VE 28EZX/52WX-VXF60N000



Ports

				Tightening torque, max.[2]
A, B	Pressure port (high press. series, code 62)	SAE J518C	3/4 in	
	Fixing thread	ISO 68	3/8-16 UNC-2B; 0.83 (21) deep	31 lb-ft (42) Nm
L/L_1	Case drain port (L_1 plugged)	ISO 11926	3/4-16 UNF-2B	116 lb-ft (160 Nm)
X	Pilot pressure port	ISO 11926	7/16-20 UNF-2B	29 lb-ft (40 Nm)

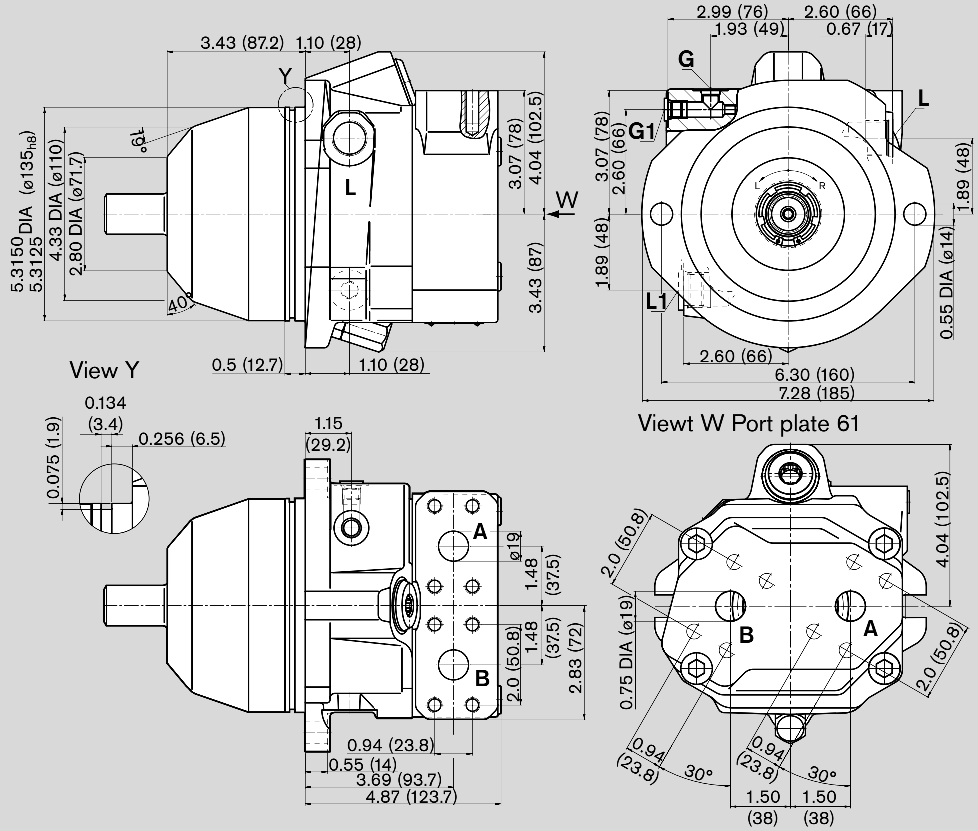
[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5

[2] see safety information

Unit dimensions A10VE, Size 45

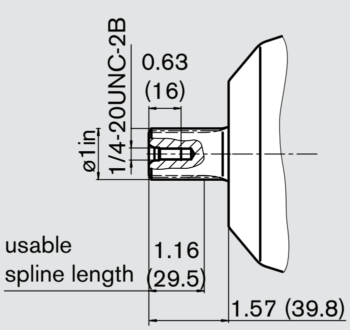
Before finalizing your design please request a certified installation drawing.
Dimensions in inches (mm)

A10VE 45DG/52WX-VXF60N000
A10VE 45DG/52WX-VXF61N000

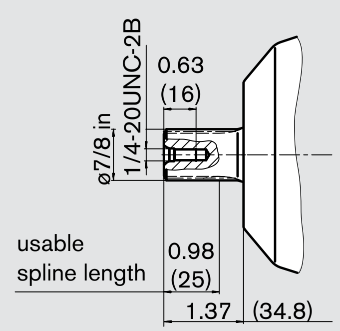


Shaft ends

R splined 1in 15T 16/32DP[1]
(SAE J744 - 25-4 (B-B))



W splined 7/8in 13T 16/32DP[1]
(SAE J744 - 22-4 (B))



Ports

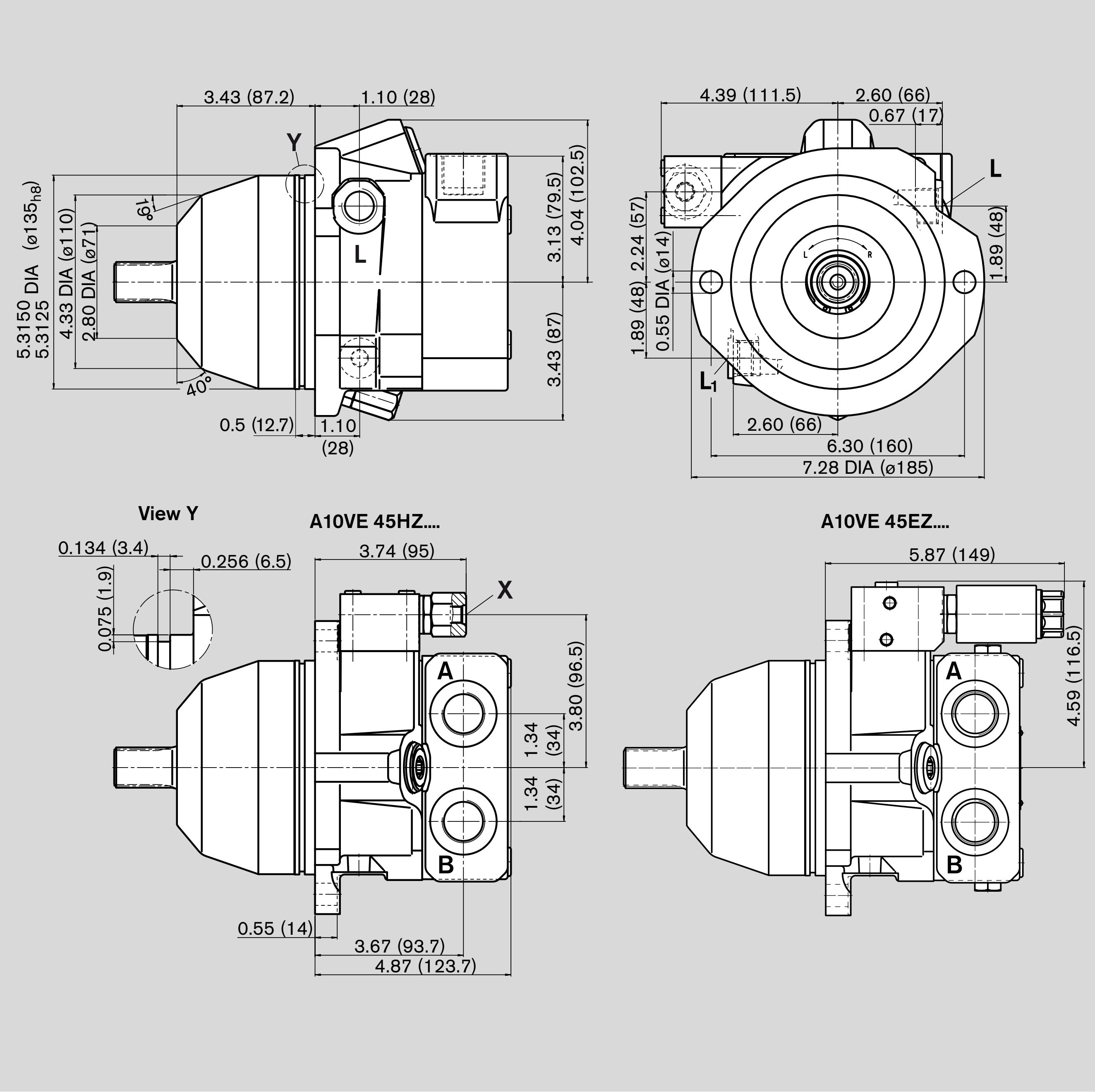
				Tightening torque, max.[2]
A/B	Pressure port (high press. series, code 62)	SAE J518C	3/4 in	
	Fixing thread	ISO 68	3/8-16UNC-2B; 0.83 (21) deep	31 lb-ft (42 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
G,G_1	Port for ext. control press. (G_1 plugged)	ISO 11926	7/16-20 UNF-2B	29 lb-ft (40 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Unit dimensions A10VE, Size 45

Before finalizing your design please request a certified installation drawing.
Dimensions in inches (mm)

A10VE 45HZX/52WX-VXF66N000
A10VE 45EZX/52WX-VXFXXN000



Ports

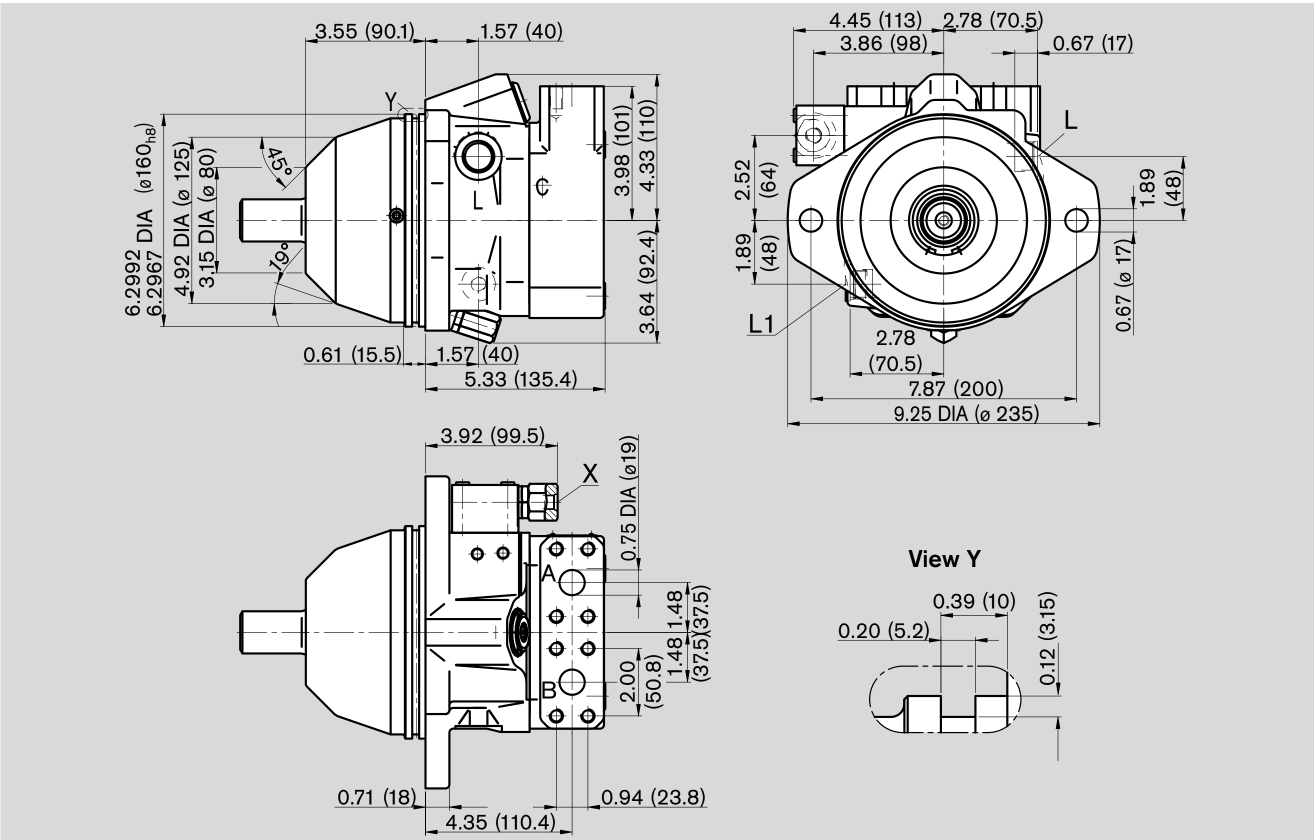
				Tightening torque, max.[2]
A/B	Pressure port	ISO 11926	1 1/16-12UN-2B; 0.79 (20) deep	262 lb-ft (360 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
X	Pilot pressure port	ISO 11926	7/16-20 UNF-2B	29 lb-ft (40 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Unit dimensions A10VE, Size 63

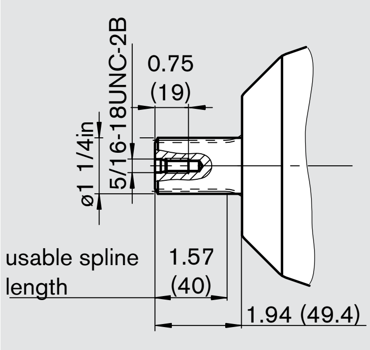
Before finalizing your design please request a certified installation drawing.
Dimensions in inches (mm)

A10VE 63HZ/52WX-VXF60N000

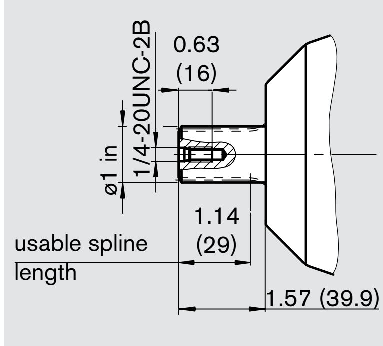


Shaft ends

R splined 1 1/4in 14T 12/24DP[1]
(SAE J744 - 32-4 (C))



W splined 1in 15T 16/32DP[1]
(SAE J744 - 25-4 (B-B))



Ports

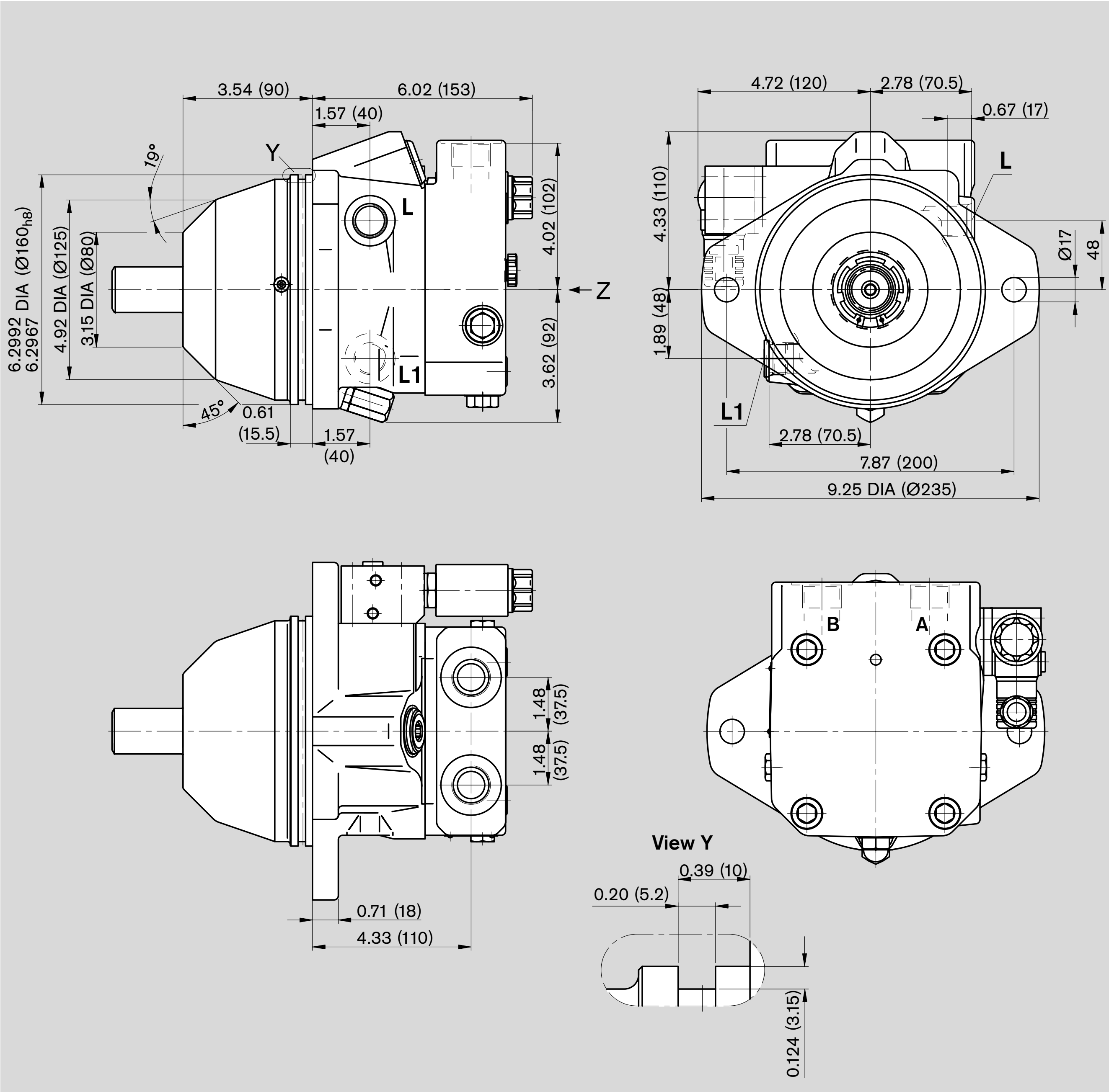
				Tightening torque, max.[2]
A/B	Pressure port (high press. series, code 62)	SAE J518	3/4 in	
	Fixing thread	ISO 68	3/8-16UNC-2B; 0.83 (21) deep	31 lb-ft (42 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)
X	Pilot pressure port	ISO 11926	7/16-20 UNF-2B	29 lb-ft (40 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Unit dimensions A10VE, Size 63

Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

A10VE 63EZX/52WX-VXF66N000



Ports

				Tightenig torque max.[2]
A/B	Pressure port	ISO 11926	1 1/16-12UN-2B; 0.79 (20) deep	262 lb-ft (360 Nm)
L/L_1	Case drain port (L_1 plugged)	ISO 11926	7/8-14 UNF-2B	175 lb-ft (240 Nm)

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, fit class 5
[2] see safety information

Integrated flushing and boost press. relief valve, N007

The flushing and boost pressure relief valve is used in closed circuits to flush an unacceptable heat load out of the circuit and to maintain a minimum boost pressure level (fixed setting). The valve is integrated into the port plate.

A built-in fixed orifice determines the flushing flow, which is taken out of the low pressure side of the loop and directed into the motor housing. It leaves the housing together with the case drain flow. This combined flow must be replenished with fresh, cool fluid by means of the boost pump.

Standard flushing flow

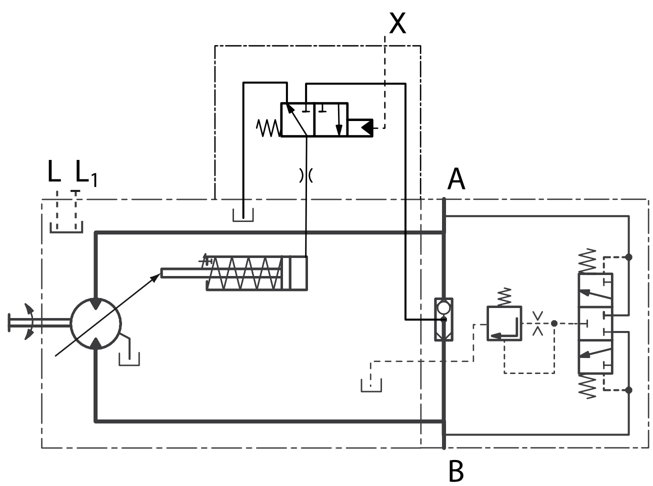
With a pressure of p_{ND} = 290 psi (20 bar) in the low pressure side of the circuit and an orifice dia. of 0.063 in (ø1,6 mm) the flushing flow amounts to 1.45 gpm (5,5 L/min) (Size 28 - 85). Other orifice diameters can be ordered in clear text.

Further flushing flows for sizes 28 - 85 see table:

Flushing flow gpm (L/min)	Orifice dia. in inches (mm)
0.92 (3,5)	0.047 (1,2)
1.45 (5,5)	0.063 (1,6)
2.38 (7,2)	0.071 (1,8)

Schematic

eg. A10VM..HZ/...N007



Speed pickup

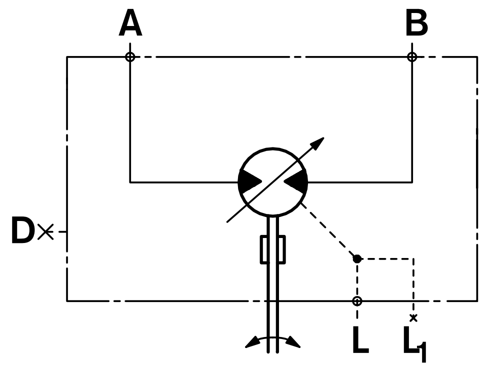
Before finalizing your design please request a certified installation drawing. Dimensions in inches (mm)

The version A10VM/E...D („prepared for speed pickup“) comprises gearing around the rotary unit.

In this case, the rotating cylinder barrel can provide a speed dependent signal, which can be picked up by a suitable sensor and processed for further evaluation. The sensor port will be plugged for delivery.
This preparation for speed pickup does not include the necessary working parts They must be ordered separately as a kit with a corresponding part number .
Inductive speed sensor ID R 18/20-L250 (see RE 95130) and mounting parts (spacer and 2 seals per kit) can be ordered separately under the following part numbers:

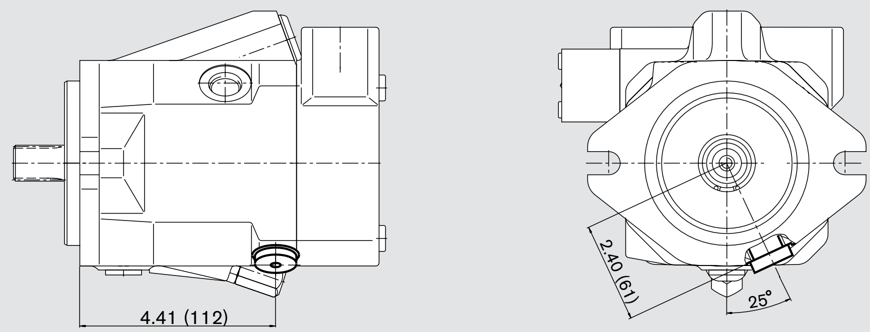
Size	Part Nr.	Number of teeth
28	R902428802	48
45	R902437557	48
63	R902428802	56
85	In preparation.	

Schematic



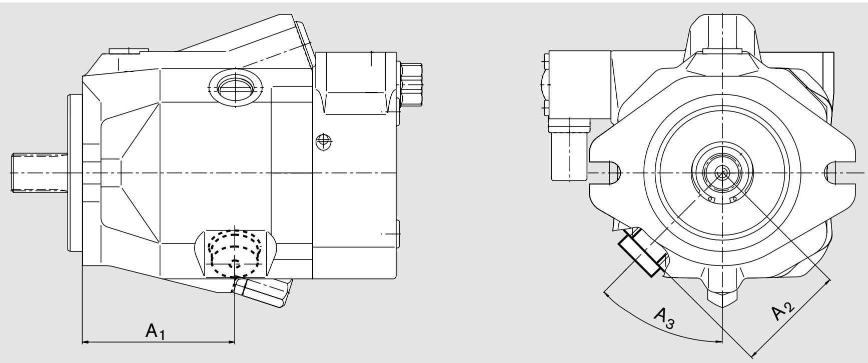
Dimensions port D

A10VM 28

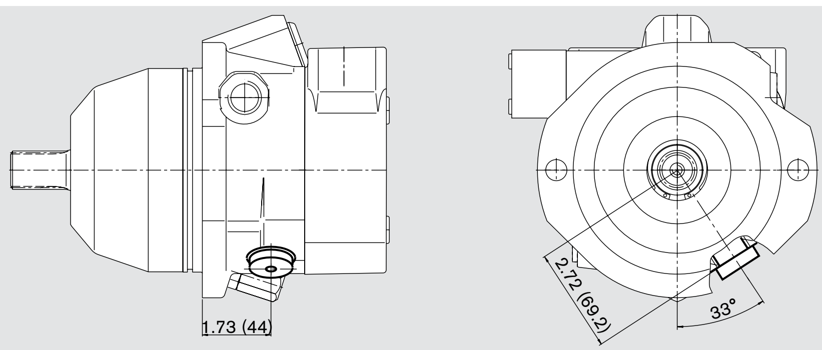


A10VM 45, 63 and 85

Size	A1	A2	A3
45	3.78 (96)	2.72 (69,2)	45°
63	5.53 (140,5)	2.80 (71)	57,5°
85	5.12 (130)	3.59 (91,3)	45°



A10VE 45



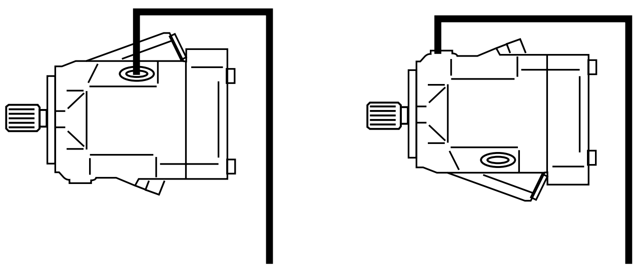
Mounting position

The motor housing must be filled during start up and operation. The drain line must be arranged, so that the housing cannot empty itself when the motor is at standstill. The end of the drain line must enter the tank below the minimum fluid level.

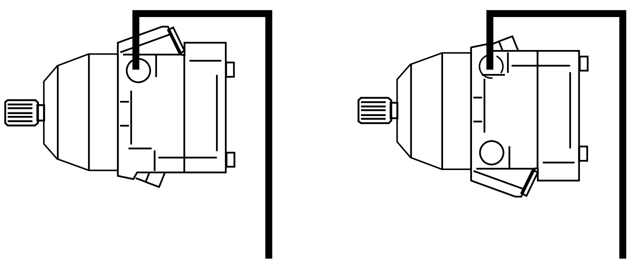
In all installation positions the highest case drain port must be used to fill the housing and to connect the drail line.

In case of a vertical installation please consult us.

A10VM



A10VE



Notes

General Notes

– The variable motor A10VM/VE was designed for operation in open and closed circuits.

– System design, installation and commissioning require trained technicians and tradesmen.

– All hydraulic ports can only be used for the fastening of hydraulic service lines.

– Tightening torques: The tightening torques, given in this data sheet represent maximum values and may not be exceeded (max. values for the female threads in the motor castings). Please comply with the manufacturer's information regarding the maximum permissible tightening torques for the used fittings!
For fastening screws to ISO 11926 we recommend to check the permissible tightening torques in each case acc. to VDI 2230 issue 2003.

– During and shortly after operation of a motor the housing and especially a solenoid can be extremely hot, avoid being burned. Take suitable safety measures (eg. wear protective clothing).

– All given data, information or instructions must be adhered to!

– To prevent fretting corrosion we recomend permanent oil lubrication of the drive shaft spline.

Bosch Rexroth Corporation
Axial & Radial Piston Units
8 Southchase Court
Fountain Inn, SC 29644-9018
USA
Telephone (864) 967-2777
Facsimile (864) 967-8900
www.boschrexroth-us.com

Bosch Rexroth Corporation
2315 City Line Road
Bethlehem, PA 18017-2131
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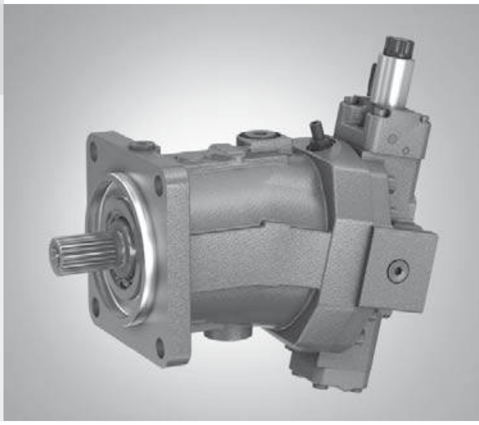
Facsimile (610) 694-8467
www.boschrexroth-us.com

Rexroth
Bosch Group

RA-A 91610/04.13 1/74
Replaces: 06.12

Axial Piston Variable Motor A6VM (US-Version)

Data sheet



Series 71
Sizes 60 to 215
Nominal pressure 6500 psi (450 bar)
Maximum pressure 7250 psi (500 bar)
Open and closed circuits

Contents

Features

- Variable motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- For use in mobile and stationary applications
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement can be infinitely changed from $V_{g\ max}$ to $V_{g\ min} = 0$.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.
- Wide control range with hydrostatic transmissions
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust motor with long service life
- High power density
- Good starting characteristics
- Version with 9-piston rotary group
- Good low speed characteristics
- High uniformity

Ordering code for standard program

A6V	M					0	0			/	71	A	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Axial piston unit

01	Bent-axis design, variable, nominal pressure 6500 psi (450 bar), maximum pressure 7250 psi (500 bar)	**A6V**

Operating mode

02	Motor	**M**

Sizes (NG)

03	Geometric displacement, see table of values on page 8	in cm^3/rev	**060**	**085**	**115**	**150**	**170**	**215**
		in in^3/rev	**3.66**	**5.19**	**7.02**	**9.15**	**10.37**	**13.12**

Control devices

				060	085	115	150	170	215	
04	Proportional control hydraulic	positive control	Δp_{St} = 145 psi (10 bar)	●	●	●	●	●	●	**HP1**
			Δp_{St} = 365 psi (25 bar)	●	●	●	●	●	●	**HP2**
		negative control	Δp_{St} = 145 psi (10 bar)	●	●	●	●	●	●	**HP5**
			Δp_{St} = 365 psi (25 bar)	●	●	●	●	●	●	**HP6**
	Proportional control electric	positive control	U = 12 V DC	●	●	●	●	●	●	**EP1**
			U = 24 V DC	●	●	●	●	●	●	**EP2**
		negative control	U = 12 V DC	●	●	●	●	●	●	**EP5**
			U = 24 V DC	●	●	●	●	●	●	**EP6**
	Two-point control hydraulic	negative control		–	–	–	●	●	●	**HZ5**
				●	●	●	–	–	–	**HZ7**
	Two-point control electric	negative control	U = 12 V DC	–	–	–	●	●	●	**EZ5**
			U = 24 V DC	–	–	–	●	●	●	**EZ6**
			U = 12 V DC	●	●	●	–	–	–	**EZ7**
			U = 24 V DC	●	●	●	–	–	–	**EZ8**
	Automatic control high-pressure related, positive control	with minimum pressure increase	Δp ≤ approx 145 psi (10 bar)	●	●	●	●	●	●	**HA1**
		with pressure increase	Δp =1450 psi (100 bar)	●	●	●	●	●	●	**HA2**
	Automatic control speed-related, negative control p_{St}/p_{HD} = 5/100	hydr. travel direction valve		●	●	●	●	●	●	**DA0**
		elect. travel direction valve + electric $V_{g\ max}$ circuit	U = 12 V DC	●	●	●	●	●	●	**DA1**
			U = 24 V DC	●	●	●	●	●	●	**DA2**

Pressure control/overrides

				060	085	115	150	170	215	
05	Without pressure control/override			●	●	●	●	●	●	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6			●	●	●	●	●	●	**D1**
	Override of the HA1 and HA2 controls	hydraulic remote control, proportional		●	●	●	●	●	●	**T3**
		electric, two-point	U = 12 V DC	●	●	●	●	●	●	**U1**
			U = 24 V DC	●	●	●	●	●	●	**U2**
		electric and travel direction valve, electric	U = 12 V DC	●	●	●	●	●	●	**R1**
			U = 24 V DC	●	●	●	●	●	●	**R2**

Connector for solenoids[1] (see page 62)

		060	085	115	150	170	215	
06	Without connector (without solenoid, only with hydraulic controls)	●	●	●	●	●	●	**0**
	DEUTSCH - molded connector, 2-pin – without suppressor diode	●	●	●	●	●	●	**P**

● = Available ❍ = On request – = Not available

1) Connectors for other electric components can deviate.

Ordering code for standard program

A6V	M					0	0			/	71	A	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Additional function 1

07	Without additional function	0

Additional function 2

08	Without additional function	0

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		0
	With damping	HP, EP, HP5,6D. and EP5,6D., HZ, EZ, HA with counterbalance valve BVD/BVE	1
		One-sided in inlet to large stroking chamber (HA)	4
		One-sided in outlet from large stroking chamber (DA)	7

Setting ranges for displacement[2)]

	$V_{g\,max}$-adjusting screw	$V_{g\,min}$-adjusting screw	060	085	115	150	170	215	
10	Without adjusting screw	short (0-adjustable)	●	●	●	●	●	●	A
		medium	●	●	●	●	●	●	B
		long	●	●	●	●	●	●	C
		extra long	–	–	●	●	●	●	D
	Short	short (0-adjustable)	●	●	●	●	●	●	E
		medium	●	●	●	●	●	●	F
		long	●	●	●	●	●	●	G
		extra long	–	–	●	●	●	●	H
	Medium	short (0-adjustable)	●	●	●	●	●	●	J
		medium	●	●	●	●	●	●	K
		long	●	●	●	●	●	●	L
		extra long	–	–	●	●	●	●	M

Series

11	Series 7, index 1	71

Configuration of ports and fastening threads

12	ANSI, port threads with O-ring seal according to ISO 11926	A

Direction of rotation

13	Viewed on drive shaft, bidirectional	W

Seals

14	FKM (fluor-caoutchouc)	V

Drive shaft bearing

15	Standard bearing	0

Mounting flanges

			060	085	115	150	170	215	
16	SAE J744	127-4	●	–	–	–	–	–	C4
		127-2	–	●	–	–	–	–	C2
		152-4	–	–	●	●	●	–	D4
		165-4	–	–	–	–	–	●	E4

● = Available ❍ = On request – = Not available

2) The settings for the adjusting screws can be found in the table (pages 70 and 71).

Ordering code for standard program

A6V	M					0	0			/	71	A	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Drive shafts

			060	085	115	150	170	215	
17	Splined shaft ANSI B92.1a	1 1/4 in 14T 12/24DP	●	–	–	–	–	–	**S7**
		1 1/2 in 17T 12/24DP	–	●	–	–	–	–	**S9**
		1 3/4 in 13T 8/16DP	–	–	●	●	–	–	**T1**
		2 in 15T 8/16DP	–	–	–	❍	●	●	**T2**

Port plates for service lines

			060	085	115	150	170	215	
18	SAE flange ports A and B at rear		●	●	●	●	●	●	**1**
	SAE flange ports A and B at side, opposite		●	●	●	●	●	●	**2**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[3)]	BVD20	●	●	●	–	–	–	**7**
		BVD25, BVE25	–	–	●	●	●	●	**8**

Valves (see pages 66 to 71)

				060	085	115	150	170	215	
19	Without valve			●	●	●	●	●	●	**0**
	Counterbalance valve BVD/BVE mounted[4)]			●	●	●	●	●	●	**W**
	Flushing and boost pressure valve mounted, flushing on both sides Flushing flow with: $\Delta p = p_{ND} - p_G = 365$ psi (25 bar) and $\nu = 60$ SUS (10 mm^2/s) (p_{ND} = low pressure, p_G = case pressure) Only possible with port plates 1 and 2	**Flushing flow q_v [gpm (L/min)]**								
		0.9	(3.5)	●	●	●	–	–	–	**A**
		1.3	(5)	●	●	●	–	–	–	**B**
		2.1	(8)	●	●	●	●	●	●	**C**
		2.6	(10)	●	●	●	●	●	●	**D**
		3.7	(14)	●	●	●	–	–	–	**F**
		4.5	(17)	–	–	–	●	●	●	**G**
		5.3	(20)	–	–	●[5)]	●	●	●	**H**
		6.6	(25)	–	–	●[5)]	●	●	●	**J**
		7.9	(30)	–	–	●[5)]	●	●	●	**K**
		9.2	(35)	–	–	–	●	●	●	**L**
		10.6	(40)	–	–	–	●	●	●	**M**

Speed sensors (see page 72)

		060	085	115	150	170	215	
20	Without speed sensor	●	●	●	●	●	●	**0**
	Prepared for DSM speed sensor	●	●	●	●	●	●	**U**
	DSM speed sensor mounted[6)]	●	●	●	●	●	●	**V**

Standard / special version

21	Standard version	**0**
	Standard version with installation variants, e. g. T ports against standard open or closed	**Y**
	Special version	**S**

● = Available ❍ = On request – = Not available

3) Only possible in combination with HP, EP and HA control. Note the restrictions on page 66.
4) Specify ordering code of counterbalance valve acc. to data sheet (BVD – RE 95522, BVE – RE 95525) separately. Note the restrictions on page 66.
5) Not for EZ7, EZ8 and HZ7
6) DSA on request. Specify ordering code of DSM acc. to data sheet RE 95132 separately and observe the requirements on the electronics.

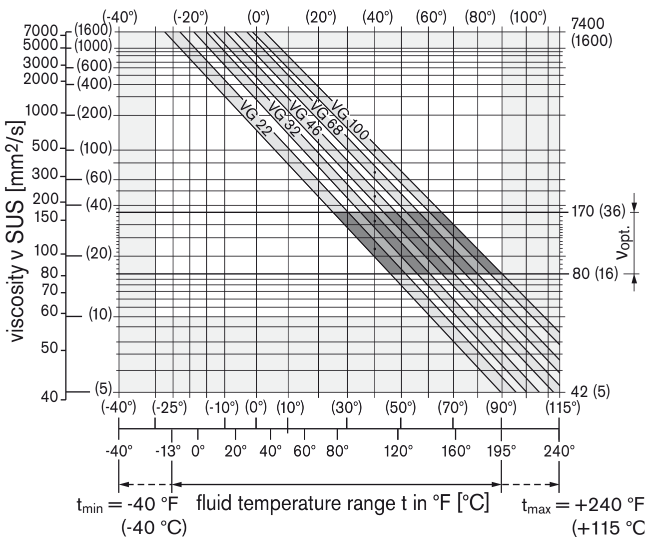
Technical data

Hydraulic fluid

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

The variable motor A6VM is not suitable for operation with HFA hydraulic fluid. If HFB, HFC or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.
Please contact us.

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

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

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

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U or using a flushing and boost pressure valve (see pages 63 and 64).

Viscosity and temperature of hydraulic fluid

	Viscosity [SUS (mm²/s)]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -58 °F (-50 °C) T_{opt} = +41 °F to +68 °F (+5 °C to +20 °C)	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	ν_{max} = 7400 (1600)	$T_{St} \geq$ -40 °F (-40 °C)	t ≤ 3 min, without load (p ≤ 725 psi (50 bar)), n ≤ 1000 rpm
Permissible temperature difference		ΔT ≤ 45 °F (25 °C)	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 7400 to 1850 (1600 to 400)	T = -40 °F to -13 °F (-40 °C to -25 °C)	at p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 22 °F (12 °C)	between hydraulic fluid in the bearing and at port T. The bearing temperature can be reduced by flushing via port U.
Maximum temperature		240 °F (115 °C)	in the bearing
		217 °F (103 °C)	measured at port T
Continuous operation	ν = 1850 to 47 (400 to 10) ν_{opt} = 170 to 74 (36 to 16)	T = -13 °F to +195 °F (-25 °C to +90 °C)	measured at port T, no restriction within the permissible data
Short-term operation	$\nu_{min} \geq$ 32 (7)	T_{max} = +217 °F (+103 °C)	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T ≤ +240 °F (+115 °C)	see page 6

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

Technical data

Filtration of the hydraulic fluid

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

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

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

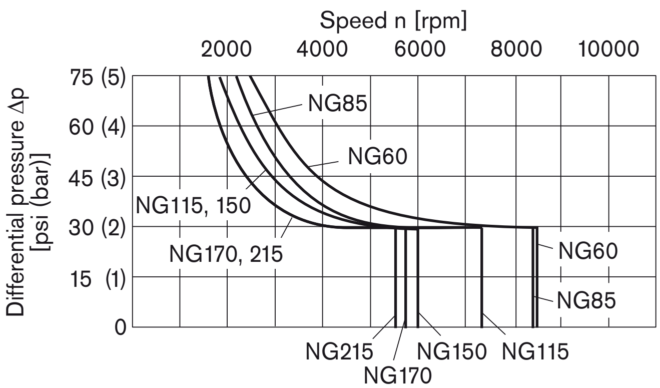
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

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

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



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

Temperature range

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

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

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HP, HA.T3 ______ increase
DA ______ decrease

With the following controls, an increase in the case pressure has no influence on the beginning of control:
HA.R and HA.U, EP, HA

The factory setting of the beginning of control is made at p_{abs} = 30 psi (2 bar) case pressure.

Direction of flow

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

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

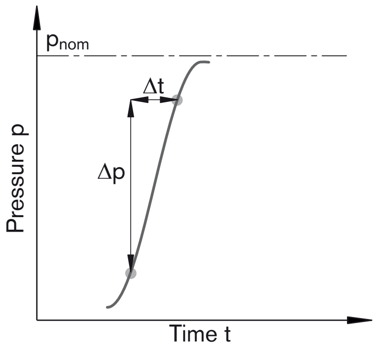
Nominal pressure p_{nom} ________ 6500 psi (450 bar) absolute

Maximum pressure p_{max} _______ 7250 psi (500 bar) absolute
Single operating period ____________________________ 10 s
Total operating period ____________________________ 300 h

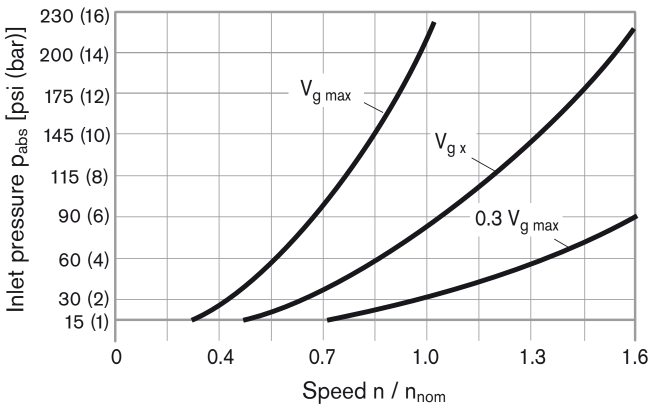
Minimum pressure
(high-pressure side) ____________ 365 psi (25 bar) absolute

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

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



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). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from ν_{opt} = 170 to 74 SUS (36 to 16 mm²/s).
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

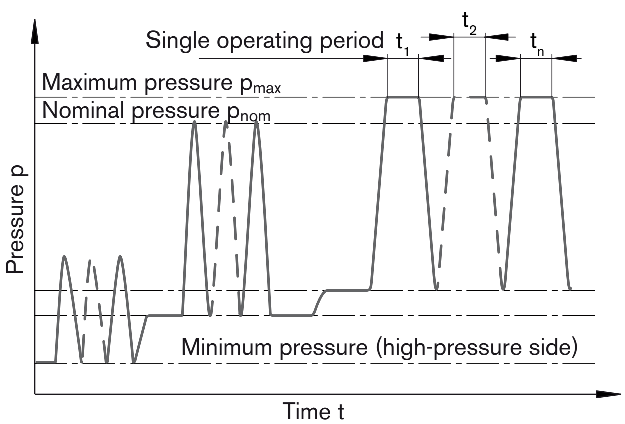
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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

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

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

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



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

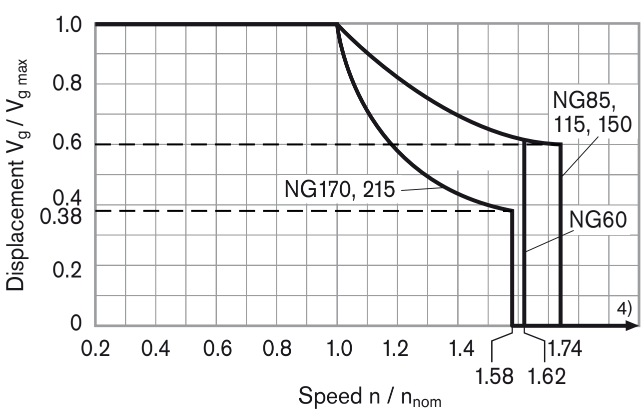
Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size	NG		60	85	115	150	170	215
Displacement geometric, per revolution	$V_{g\,max}$	in³	3.78	5.20	7.05	9.28	10.48	13.21
		cm³	62.0	85.2	115.6	152.1	171.8	216.5
	$V_{g\,min}$	in³	0	0	0	0	0	0
		cm³	0	0	0	0	0	0
	$V_{g\,x}$	in³	2.26	3.11	4.21	5.55	3.97	5.00
		cm³	37	51	69	91	65	82
Speed maximum[1] (while adhering to the maximum permissible input flow)								
at $V_{g\,max}$	n_{nom}	rpm	4450	3900	3550	3250	3100	2900
at $V_g < V_{g\,x}$ (see diagram below)	n_{max}	rpm	7200	6800	6150	5600	4900	4600
at $V_{g\,0}$	n_{max}	rpm	8400	8350	7350	6000	5750	5500
Input flow[2]	$q_{V\,max}$	gpm	73	88	108	131	141	166
at n_{nom} and $V_{g\,max}$		L/min	276	332	410	494	533	628
Torque[3]	T	lb-ft	326	448	608	800	903	1139
at $V_{g\,max}$ and $\Delta p = 6500$ psi (450 bar)		Nm	444	610	828	1089	1230	1550
Rotary stiffness								
$V_{g\,max}$ to $V_g/2$	c_{min}	lb-ft/rad	10695	16521	27511	32084	38279	51334
		Nm/rad	14500	22400	37300	43500	51900	69600
$V_g/2$ to 0 (interpolated)	c_{max}	lb-ft/rad	33412	49785	76559	91458	115355	144267
		Nm/rad	45300	67500	103800	124000	156400	195600
Moment of inertia for rotary group	J_{GR}	lb-ft²	0.1020	0.1709	0.2610	0.4295	0.5055	0.7190
		kgm²	0.0043	0.0072	0.0110	0.0181	0.0213	0.0303
Maximum angular acceleration	α	rad/s²	21000	17500	15500	11000	11000	10000
Case volume	V	Gal	0.21	0.26	0.40	0.45	0.61	0.74
		L	0.8	1.0	1.5	1.7	2.3	2.8
Weight (approx.)	m	lbs	62	79	101	134	137	172
		kg	28	36	46	61	62	78

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, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Permissible displacement in relation to speed

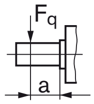
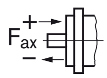


The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 170$ to 74 SUS (36 to 16 mm²/s)
- with hydraulic fluid on the basis of mineral oil

1) Restriction of input flow with counterbalance valve, see page 66
2) Torque without radial force, with radial force see page 9
3) Values in this range on request

Technical data

Permissible radial and axial forces of the drive shafts

Size	NG		60	85	115	150	150	170	215
Drive shaft		in	1 1/4	1 1/2	1 3/4	1 3/4	2	2	2
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	lb	1713	2802	3350	3585	3917	4355	5081
		N	7620	12463	14902	15948	17424	19370	22602
	a	in	0.94	1.06	1.32	1.32	1.32	1.32	1.32
		mm	24.0	27.0	33.5	33.5	33.5	33.5	33.5
with permissible torque	T_{max}	lb-ft	229	439	611	656	803	907	1066
		Nm	310	595	828	890	1089	1230	1445
≙ permissible pressure Δp at $V_{g\,max}$	$p_{nom\ perm.}$	psi	4550	6400	6500	5350	6500	6500	6100
		bar	315	440	450	370	450	450	420
Maximum axial force[2] 	$+ F_{ax\,max}$	lb	0	0	0	0	0	0	0
		N	0	0	0	0	0	0	0
	$- F_{ax\,max}$	lb	112	160	202	232	232	252	281
		N	500	710	900	1030	1030	1120	1250
Permissible axial force per bar operating pressure	$+ F_{ax\ perm./psi}$	lb/psi	0.12	0.15	0.18	0.21	0.21	0.23	0.26
	$+ F_{ax\ perm./bar}$	N/bar	7.5	9.6	11.3	13.3	13.3	15.1	17.0

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

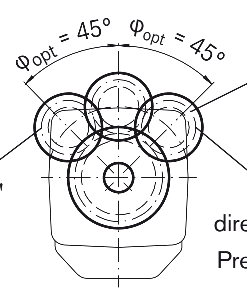
Note
Influence of the direction of the permissible axial force:

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

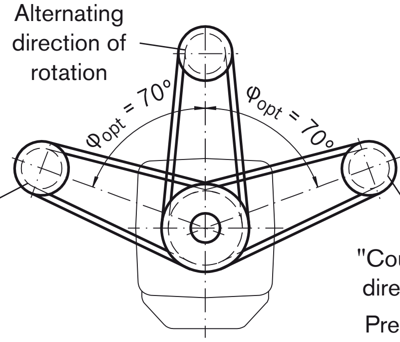
Effect of radial force F_q on the service life of bearings

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

Toothed gear drive



V-belt drive



Determining the operating characteristics

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

Speed $$n = \frac{q_V \cdot 231 \cdot \eta_v}{V_g} = \text{[rpm]} \qquad \left(\frac{q_V \cdot 1000 \cdot \eta_v}{V_g}\ \text{[rpm]}\right)$$

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

Power $$P = \frac{2\,\pi \cdot T \cdot n}{33000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{1714}\ \text{[HP]} \left(\frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600}\ \text{[kW]}\right)$$

V_g = Displacement per revolution in in^3 (cm^3)
Δp = Differential pressure in psi (bar)
n = Speed in rpm
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

HP – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

HP1, HP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum pilot pressure)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum pilot pressure)

HP5, HP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: p_{St} = 1450 psi (100 bar)
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 7250 psi (500 bar) can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 145 psi (10 bar).
- The beginning of control and the HP characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HP1, HP5 pilot pressure increase Δp_{St} = 145 psi (10 bar)

HP1 positive control

A pilot pressure increase of 145 psi (10 bar) at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control

A pilot pressure increase of 145 psi (10 bar) at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control,
setting range ________________ 30 to 290 psi (2 to 20 bar)

Standard setting:
Beginning of control at 45 psi (3 bar) (end of control at 190 psi (13 bar))

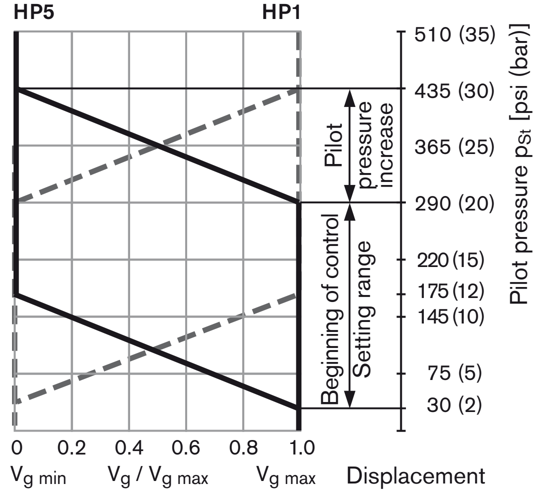
Note

The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

Characteristic



HP2, HP6 pilot pressure increase Δp_{St} = 365 psi (25 bar)

HP2 positive control

A pilot pressure increase of 365 psi (25 bar) at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

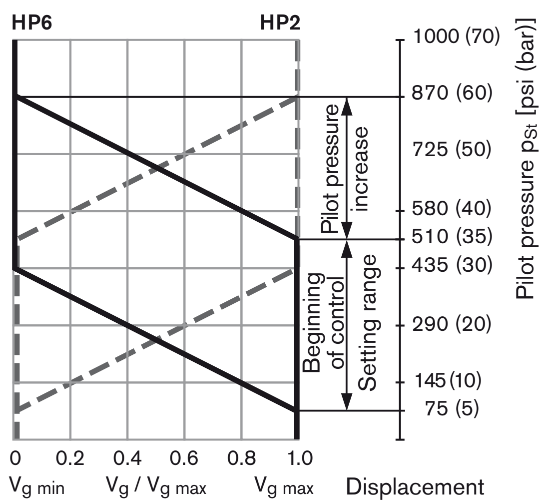
HP6 negative control

A pilot pressure increase of 365 psi (25 bar) at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control,
setting range ________________ 75 to 725 psi (5 to 50 bar)

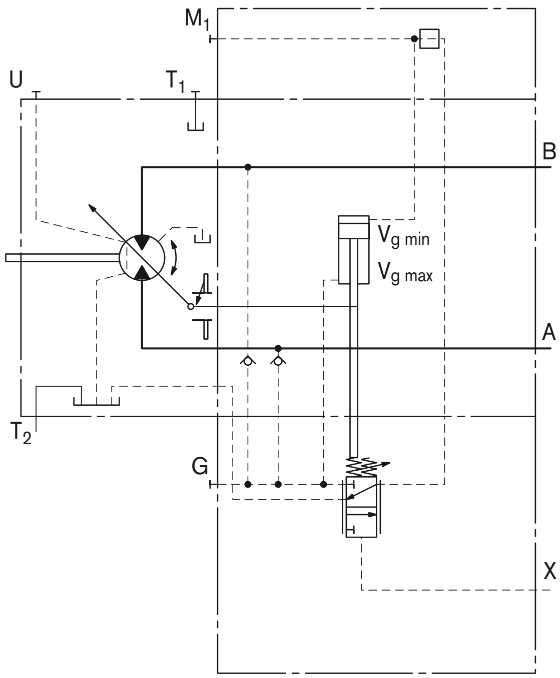
Standard setting:
Beginning of control at 145 psi (10 bar) (end of control at 510 psi (35 bar))

Characteristic

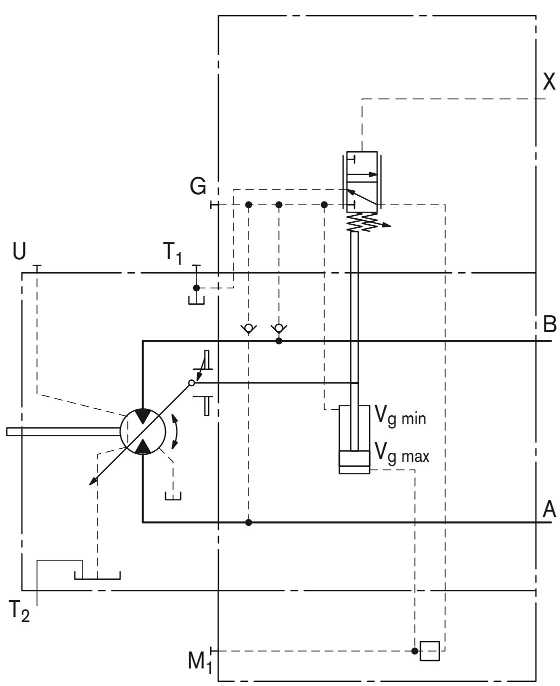


HP – Proportional control hydraulic

Schematic HP1, HP2: positive control



Schematic HP5, HP6: negative control



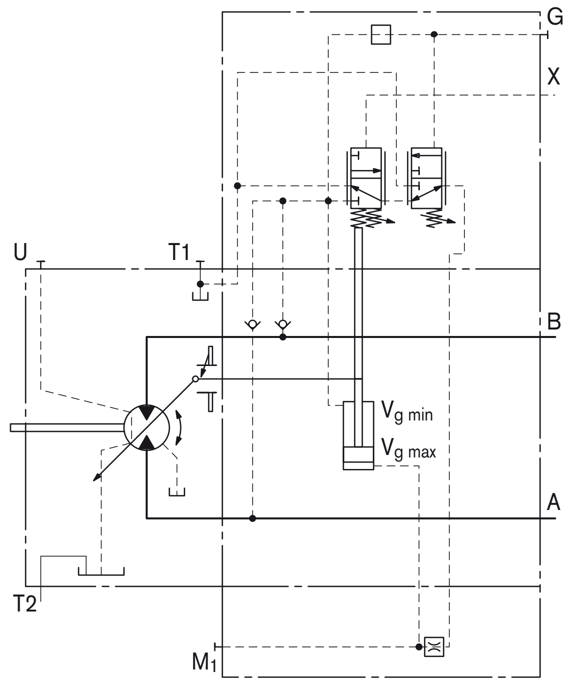
HP5D1, HP6D1
Pressure control, fixed setting

The pressure control overrides the HP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve__ 1150 to 6500 psi (80 to 450 bar)

Schematic HP5D1, HP6D1: negative control



EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid.

EP1, EP2 positive control

– Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum control current)

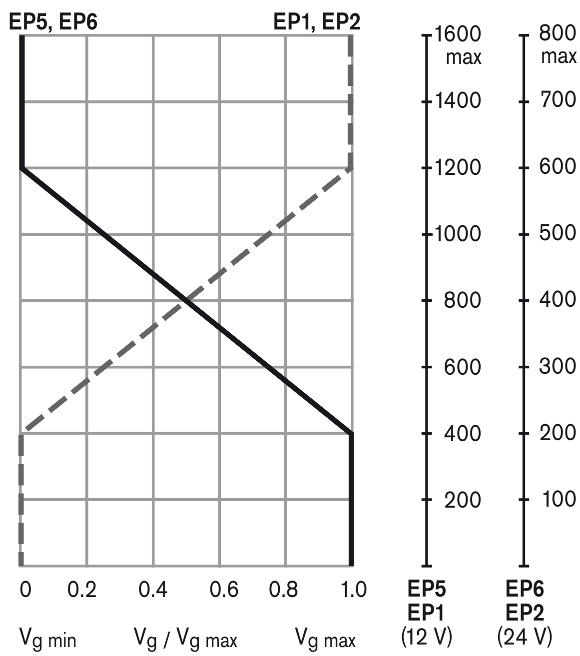
– End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum control current)

EP5, EP6 negative control

– Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum control current)

– End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. For lower pressures, please contact us.

Please note that pressures up to 7250 psi (500 bar) can occur at port G.

Technical data, solenoid

	EP1, EP5	EP2, EP6
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection see connector design page 62		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

– BODAS controller RC
  Series 20 ______ RE 95200
  Series 21 ______ RE 95201
  Series 22 ______ RE 95202
  Series 30 ______ RE 95203, RE 95204
  and application software

– Analog amplifier RA ______ RE 95230

– Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics

Note

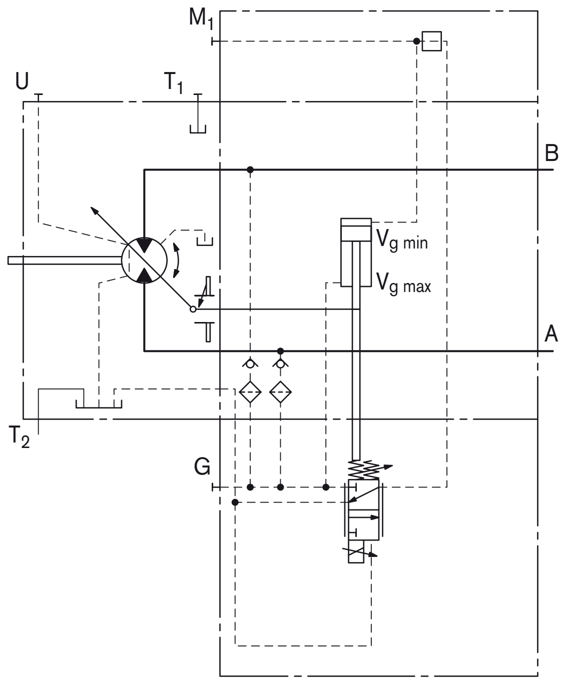
The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

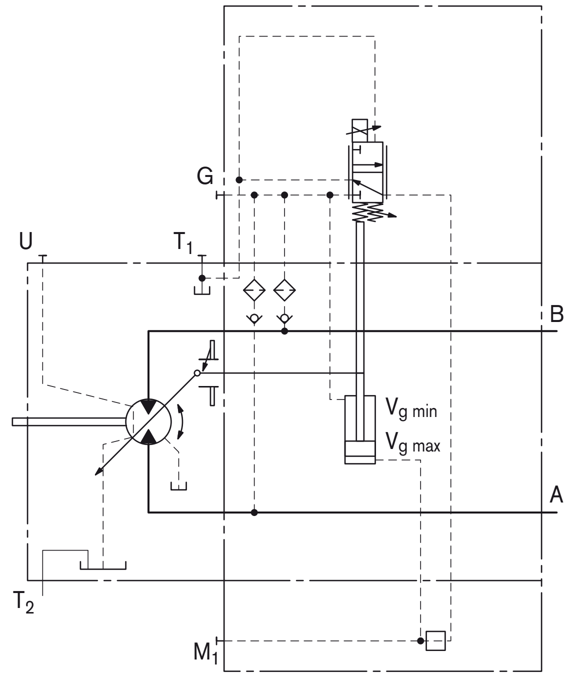
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2: positive control



Schematic EP5, EP6: negative control



EP – Proportional control electric

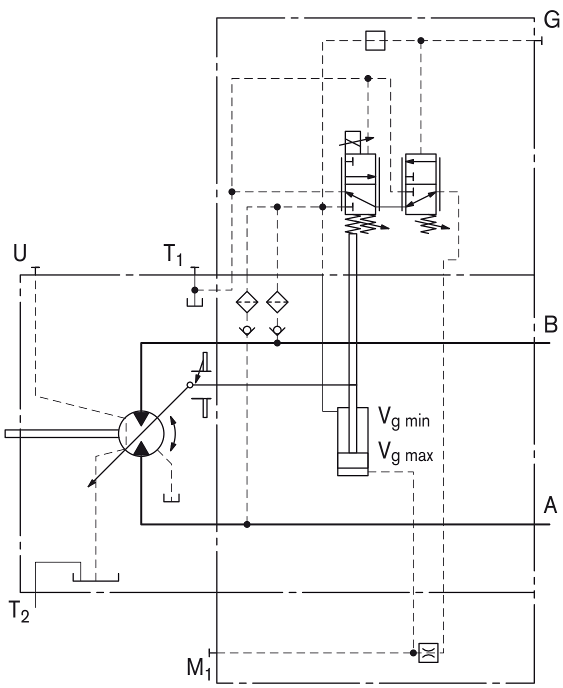
EP5**D1**, EP6**D1**
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve__ 1150 to 6500 psi
(80 to 450 bar)

Schematic EP5D1, EP6D1: negative control



HZ – Two-point control hydraulic

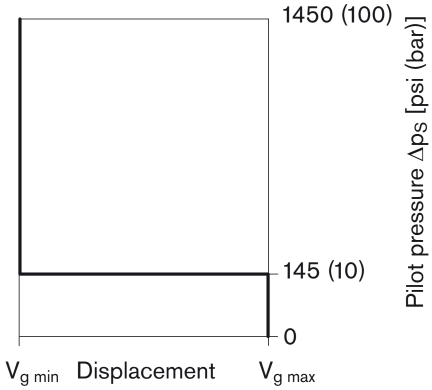
The two-point hydraulic control allows the displacement to be set to either $V_{g\ min}$ or $V_{g\ max}$ by switching the pilot pressure at port X on or off.

HZ5, HZ7 negative control

– Position at $V_{g\ max}$ (without pilot pressure, maximum torque, minimum speed)

– Position at $V_{g\ min}$ (with pilot pressure > 145 psi (10 bar) activated, minimum torque, maximum permissible speed)

Characteristic HZ5, HZ7

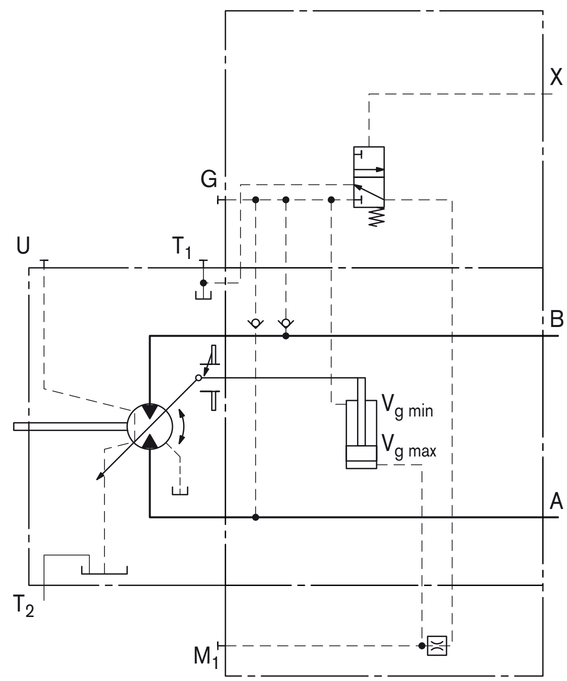


Note

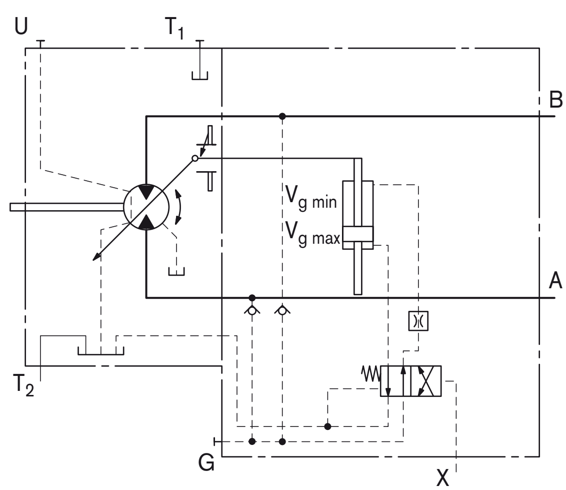
– Maximum permissible pilot pressure: 1450 psi (100 bar)

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 7250 psi (500 bar) can occur at port G.

Schematic HZ5: negative control
Sizes 150 to 215



Schematic HZ7: negative control
Sizes 60 to 115



EZ – Two-point control electric

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

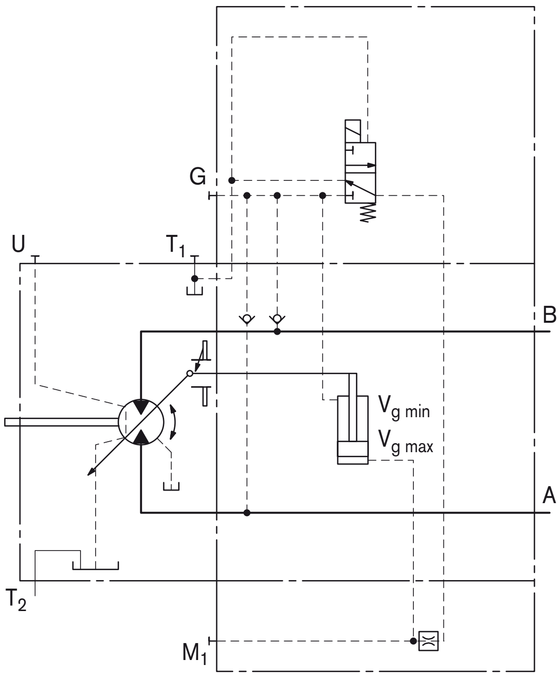
Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 7250 psi (500 bar) can occur at port G.

Technical data, solenoid with DIA37
Sizes 150 to 280

	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection see connector design page 62		

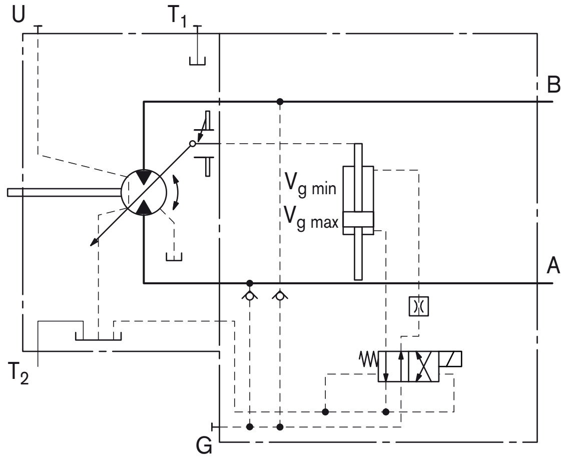
Schematic EZ5, EZ6: negative control
Sizes 150 to 215



Technical data, solenoid with DIA45
Sizes 60 to 115

	EZ7	EZ8
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	4.8 Ω	19.2 Ω
Nominal power	30 W	30W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 62		

Schematic EZ7, EZ8: negative control
Sizes 60 to 115



HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VM motor with HA control is $V_{g\ min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control , the controller swivels the motor from $V_{g\ min}$ to $V_{g\ max}$ with increase of pressure. The displacement is modulated between $V_{g\ min}$ and $V_{g\ max}$, thereby depending on load conditions.

HA1, HA2 positive control

- Beginning of control at $V_{g\ min}$ (minimum torque, maximum speed)
- End of control at $V_{g\ max}$ (maximum torque, minimum speed)

Note

- For safety reasons, winch drives are not permissible with beginning of control at $V_{g\ min}$ (standard for HA).
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 7250 psi (500 bar) can occur at port G.
- The beginning of control and the HA.T3 characteristic are influenced by case pressure. An increase in case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HA – Automatic control high-pressure related

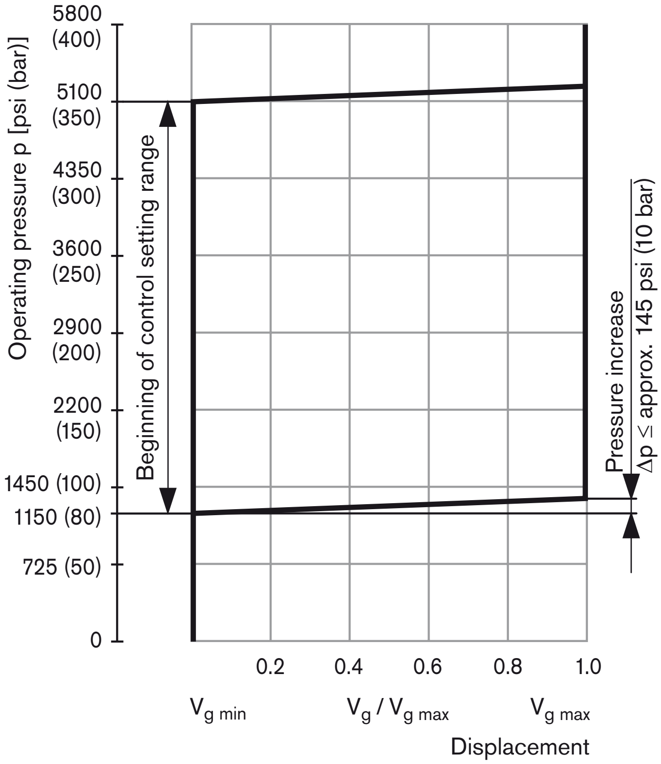
HA1
With minimum pressure increase, positive control

An operating pressure increase of $\Delta p \leq$ 145 psi (10 bar) results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

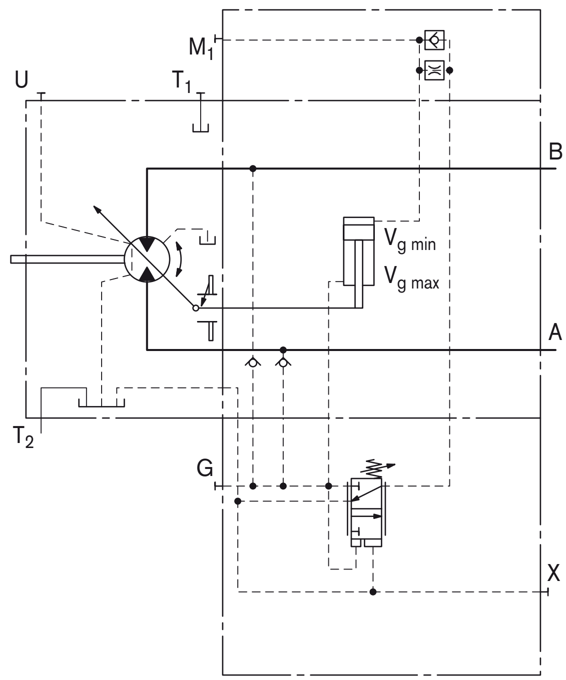
Beginning of control,
setting range ____________ 1150 to 5100 psi (80 to 350 bar)

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 4350 psi (300 bar).

Characteristic HA1



Schematic HA1



HA – Automatic control high-pressure related

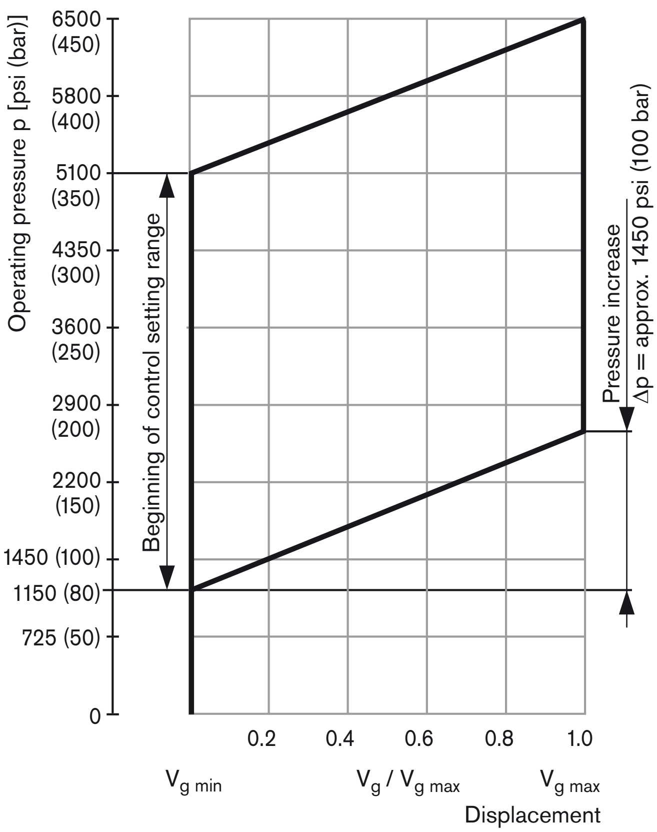
HA2
With pressure increase, positive control

An operating pressure increase of Δp = approx. 1450 psi (100 bar) results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

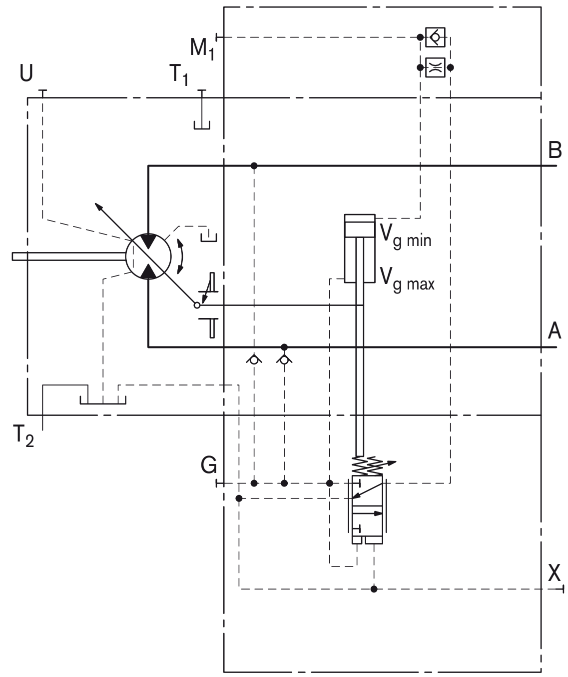
Beginning of control, setting range ________ 1150 to 5100 psi (80 to 350 bar)

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 2900 psi (200 bar)

Characteristic HA2



Schematic HA2



HA – Automatic control high-pressure related

HA.T3
Override hydraulic remote control, proportional

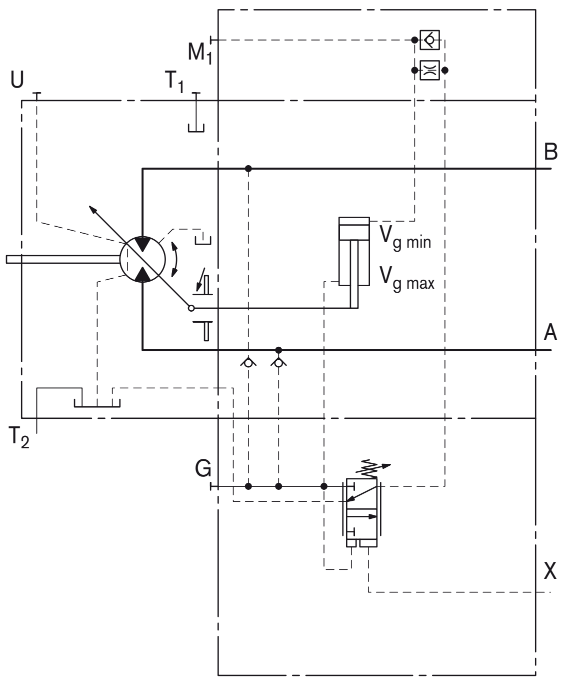
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port X.

For each 15 psi (1 bar) of pilot pressure increase, the beginning of control is reduced by 250 psi (17 bar).

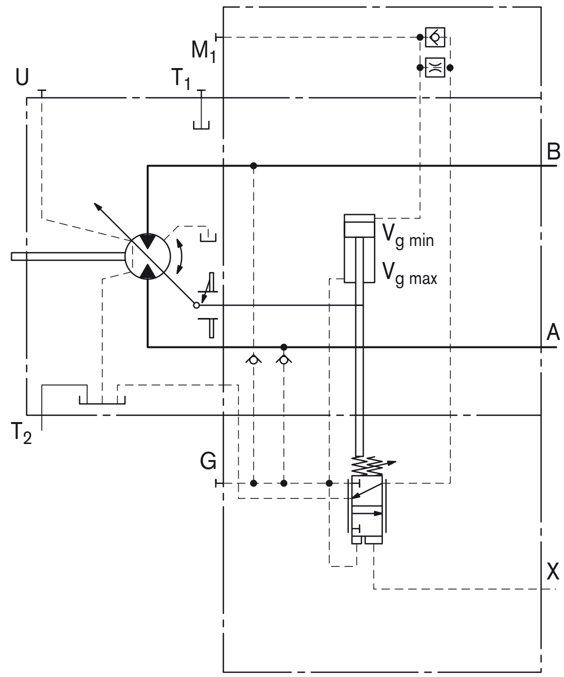
Beginning of control setting	4350 psi (300 bar)	4350 psi (300 bar)
Pilot pressure at port X	0 bar	145 psi (10 bar)
Beginning of control at	4350 psi (300 bar)	1900 psi (130 bar)

Note
Maximum permissible pilot pressure 1450 psi (100 bar).

Schematic HA1.T3



Schematic HA2.T3



HA – Automatic control high-pressure related

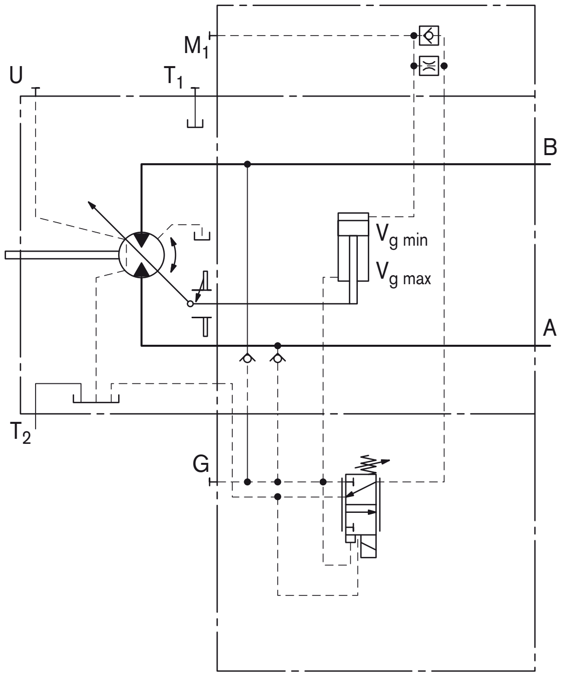
HA.**U1**, HA.**U2**
Override electric, two-point

With the HA.U1 or HA.U2 control, the beginning of control can be overridden by an electric signal to a switching solenoid. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position. The beginning of control is adjustable between 1150 and 4350 psi (80 and 300 bar) (specify required setting in plain text when ordering).

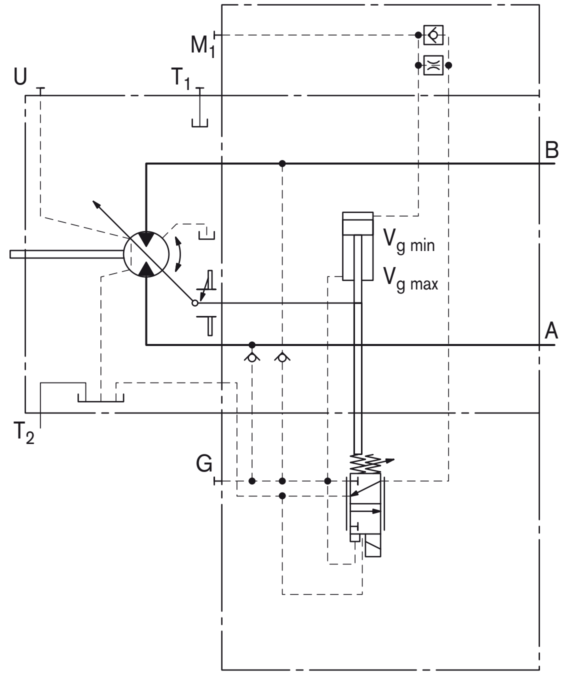
Technical data, solenoid with DIA45

	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\ max}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 62		

Schematic HA1U1, HA1U2



Schematic HA2U1, HA2U2



HA – Automatic control high-pressure related

HA.**R1**, HA.**R2**
Override electric, travel direction valve electric (see page 25)

With the HA.R1 or HA.R2 control, the beginning of control can be overridden by an electric signal to switching solenoid b. When the override solenoid b is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor (A or B) is always connected to the HA control, and thus determines the swivel angle, even if the high-pressure side changes (e. g. -travel drive during a downhill operation). This thereby prevents undesired jerky deceleration and/or braking characteristics.

Depending on the direction of rotation (direction of travel), the travel direction valve is actuated through the pressure spring or the switching solenoid a (see page 24 for further details).

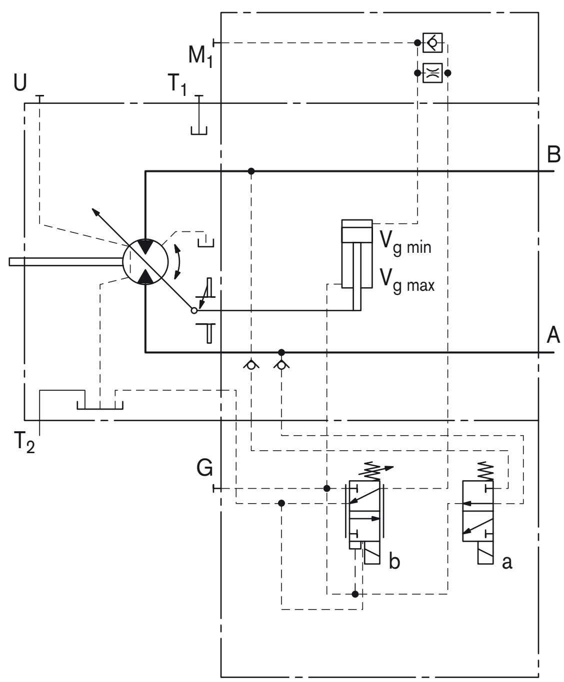
Technical data, solenoid a with DIA37
(travel direction valve)

		R1	R2
Voltage		12 V (±20 %)	24 V (±20 %)
No override		de-energized	de-energized
Direction of rotation	Operating pressure in		
ccw	B	energized	energized
cw	A	de-energized	de-energized
Nominal resistance (at 68 °F (20 °C))		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection see connector design page 62			

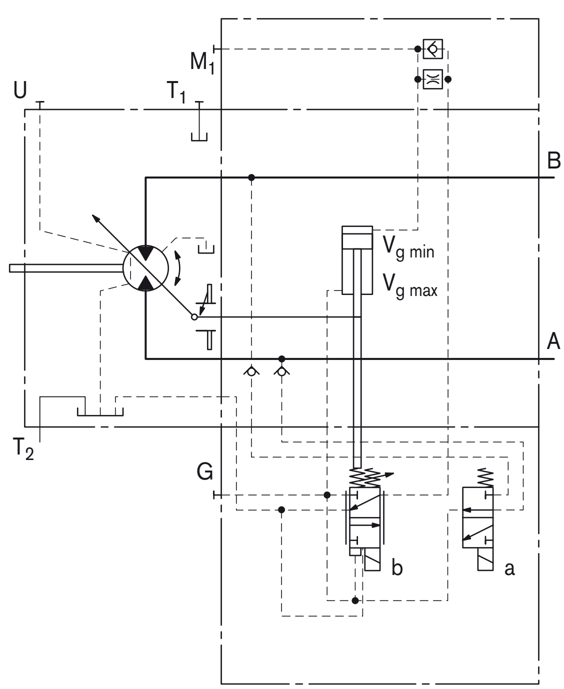
Technical data, solenoid b with DIA45
(electric override)

	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\,max}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 62		

Schematic HA1R1, HA1R2



Schematic HA2R1, HA2R2



DA – Automatic control speed-related

The variable motor A6VM with automatic speed-related control is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.

A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.

Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

Pressure ratio p_{St}/p_{HD} ____________________ 5/100

DA closed loop control is only suitable for certain types of drive systems and requires review of the engine and vehicle parameters to ensure that the motor is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

Detailed information is available from our sales department and on the Internet at www.boschrexroth.com/da-control.

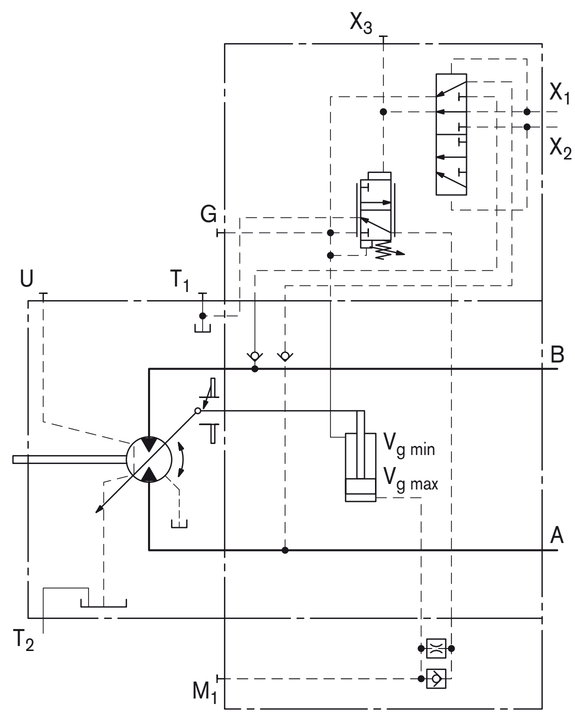
Note
The beginning of control and the DA characteristic are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

DA0
Hydraulic travel direction valve, negative control

Dependent on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	A	X_1
ccw	B	X_2

Schematic DA0



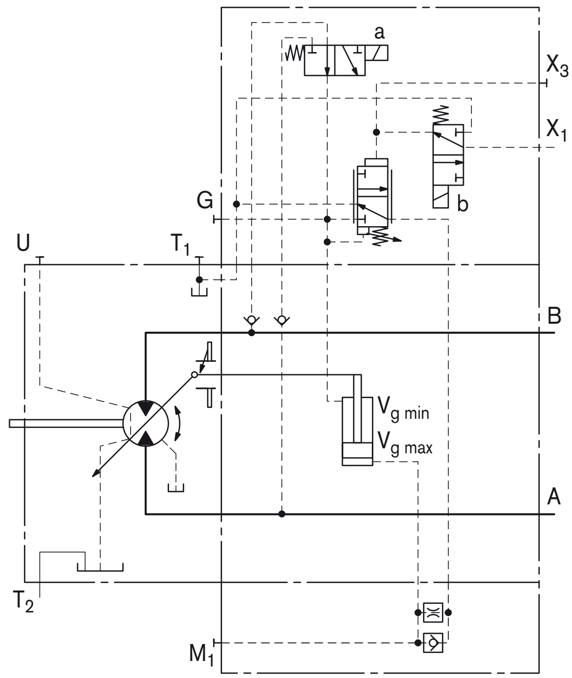
DA – Automatic control speed-related

DA1, DA2
Electric travel direction valve + electric $V_{g\ max}$-circuit, negative control

The travel direction valve is either spring offset or switched by energizing switching solenoid a, depending on the direction of rotation (travel direction).

When the switching solenoid b is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\ max}$-circuit).

Schematic DA1, DA2



Technical data, solenoid a with DIA37
(travel direction valve)

		DA1	DA2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	B	de-energized	de-energized
cw	A	energized	energized
Nominal resistance (at 68 °F (20 °C))		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection see connector design page 62			

Technical data, solenoid b with DIA37
(electric override)

	DA1	DA2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\ max}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection see connector design page 62		

Electric travel direction valve (for DA, HA.R)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).

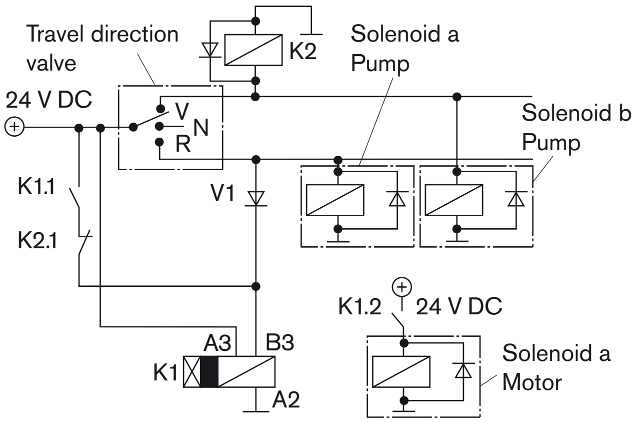
If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.

When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

- the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.
- reversing,
  the electric circuitry causes the travel direction valve on the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

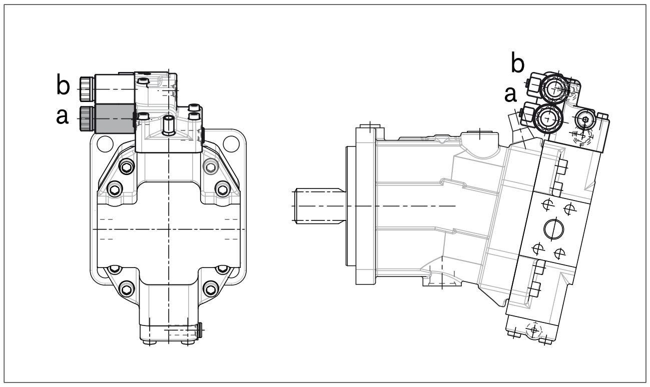
As a result, jerky deceleration or braking is prevented in both cases.

Schematic - electric travel direction valve

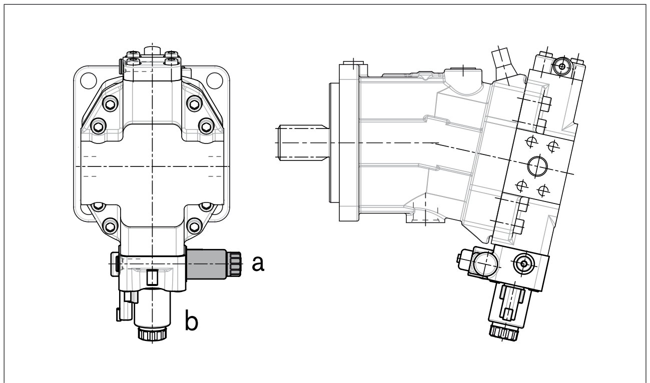


Note
The shown diodes and relays are not included in the delivery of the motor.

DA1, DA2 control (see page 24)



HA1R., HA2R. control (see page 22)



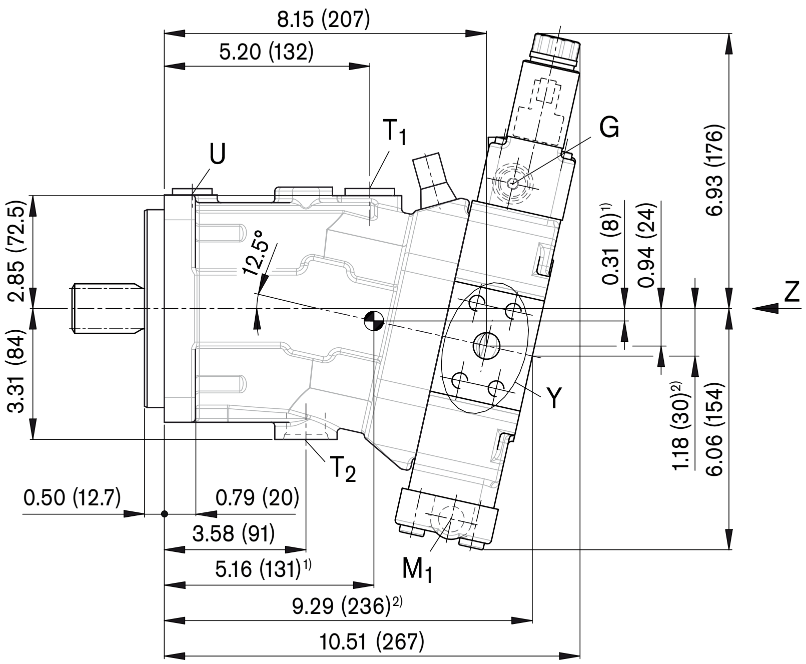
Switching solenoid a on the travel direction valve

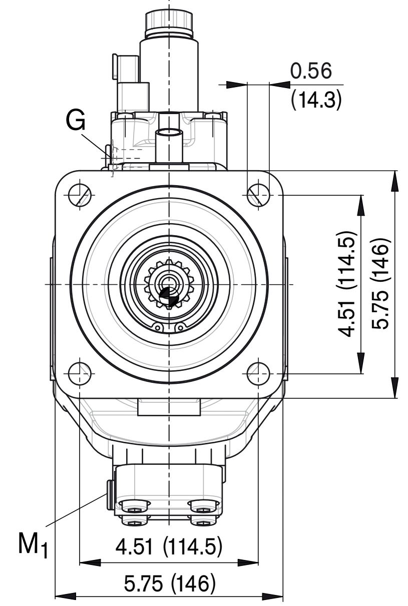
Dimensions size 60

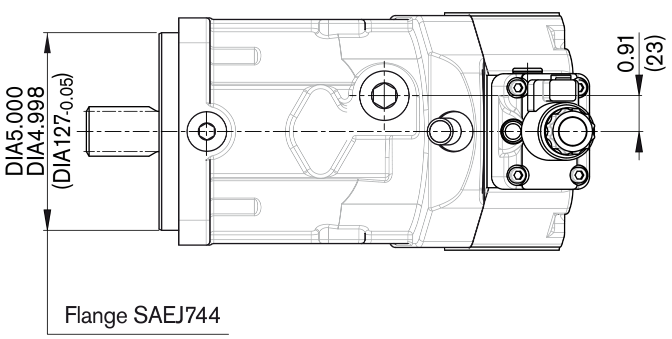
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

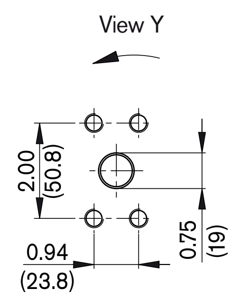
EP5, EP6 – Proportional control electric, negative control

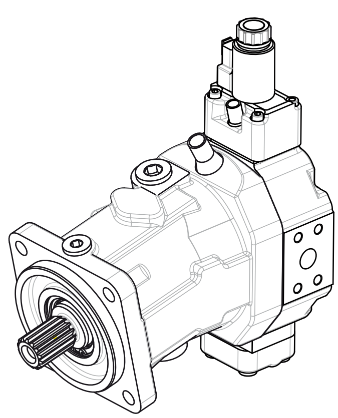
Port plate 2 – SAE flange ports A and B at side, opposite











1) Center of gravity

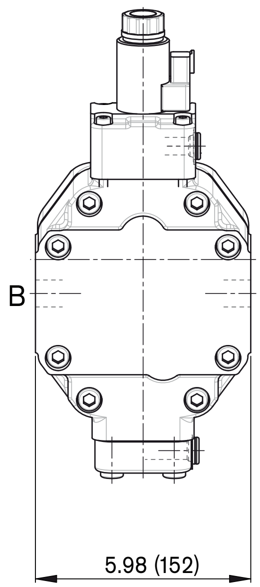
2) Port plate 1 – SAE flange ports A and B at rear

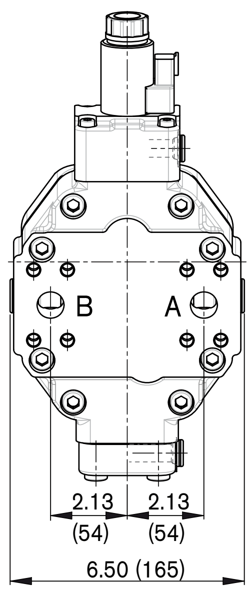
Dimensions size 60

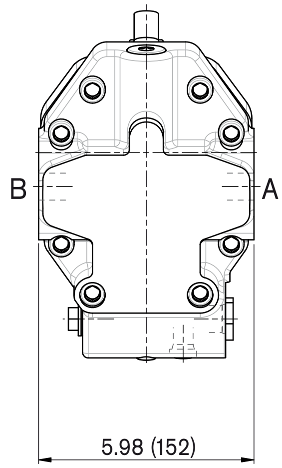
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

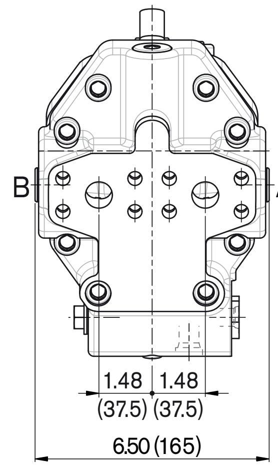
Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear	**2** SAE flange ports A and B at side, opposite only HZ7, EZ7/8	**1** SAE flange ports A and B at rear only HZ7, EZ7/8



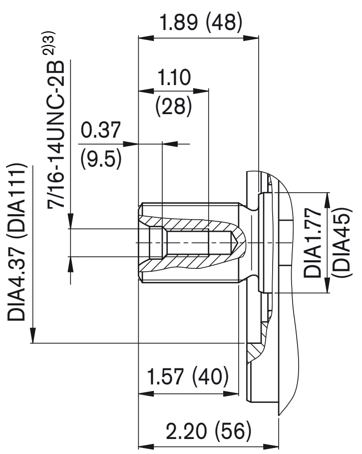






Drive shaft

S7 Splined shaft 1 1/4 in 14 T 12/24DP[1]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 74 for the maximum tightening torques.

Dimensions size 60

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State[7]
A, B[5]	Service line Fastening thread A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	3/4 in 3/8 in - 16 UNC-2B; 0.83 (21) deep	7250 (500)	O
T_1	Drain line	ISO 11926[6]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
T_2	Drain line	ISO 11926[6]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X
U	Bearing flushing	ISO 11926[6]	7/8 in - 14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1 and HA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	45 (3)	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	580 (40)	O
X_1	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	O
X_3	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	X
M_1	Measuring stroking chamber	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X

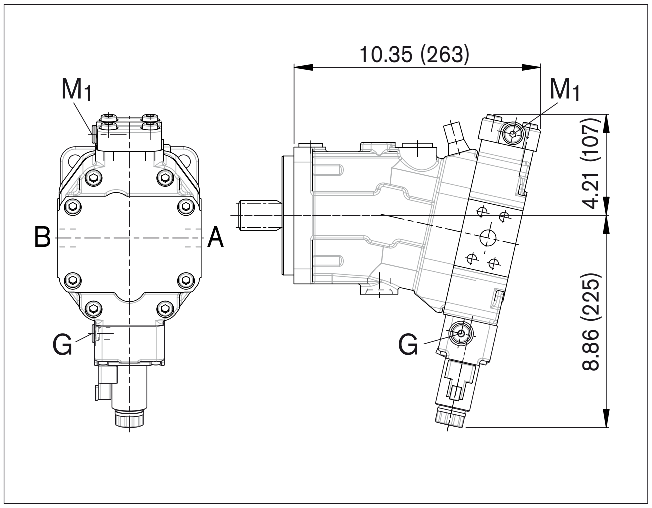
1) Observe the general instructions on page 74 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 72).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 60

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

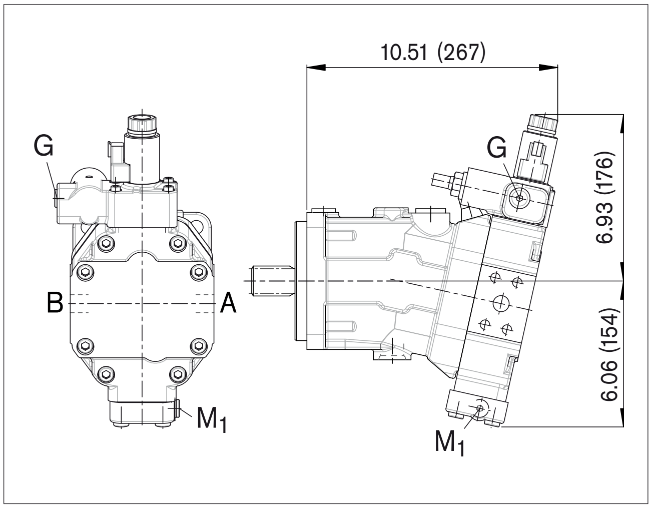
EP1, EP2

Proportional control electric, positive control



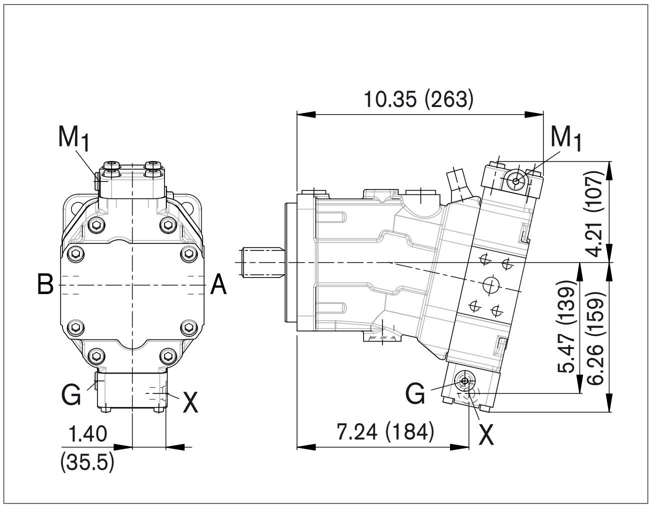
EP5D1, EP6D1

Proportional control electric, negative control, with pressure control fixed setting



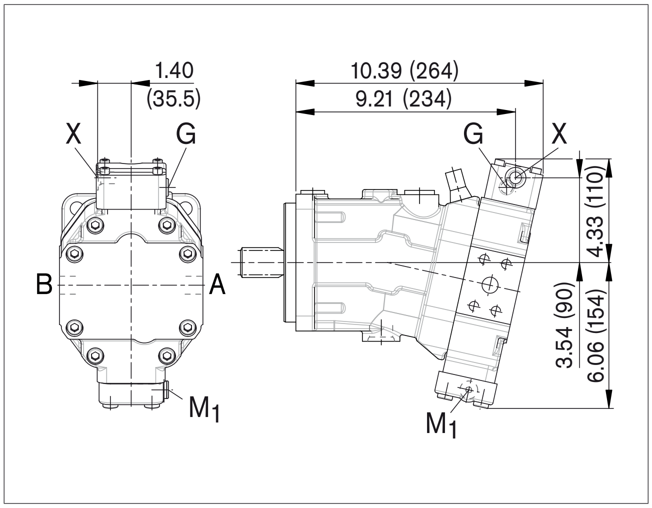
HP1, HP2

Proportional control hydraulic, positive control



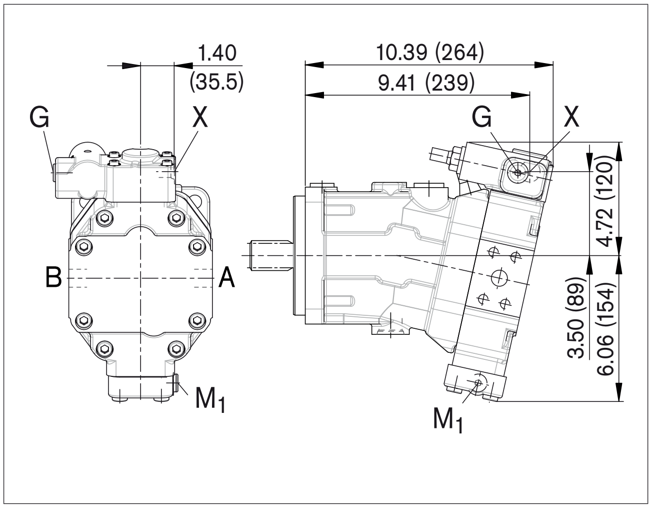
HP5, HP6

Proportional control hydraulic, negative control



HP5D1, HP6D1

Proportional control hydraulic, negative control, with pressure control fixed setting

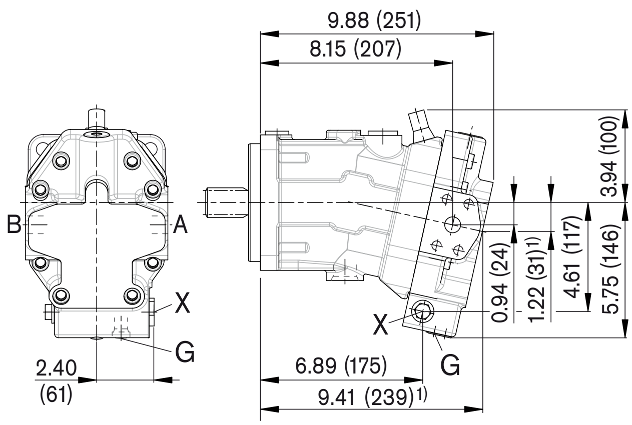


Dimensions size 60

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

HZ7

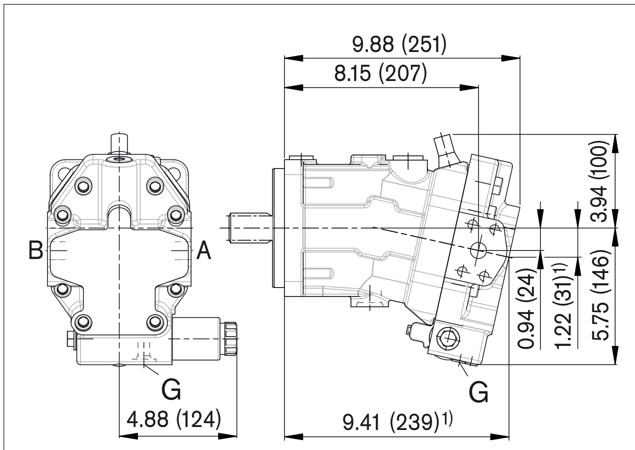
Two-point control hydraulic, negative control



1) Port plate 1 – SAE flange ports A and B at rear

EZ7, EZ8

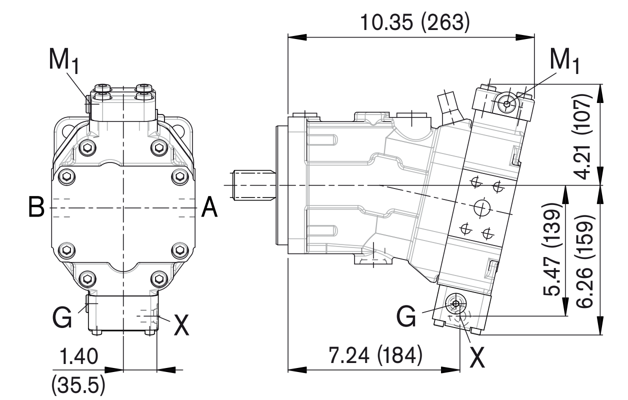
Two-point control electric, negative control



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T3, HA2T3

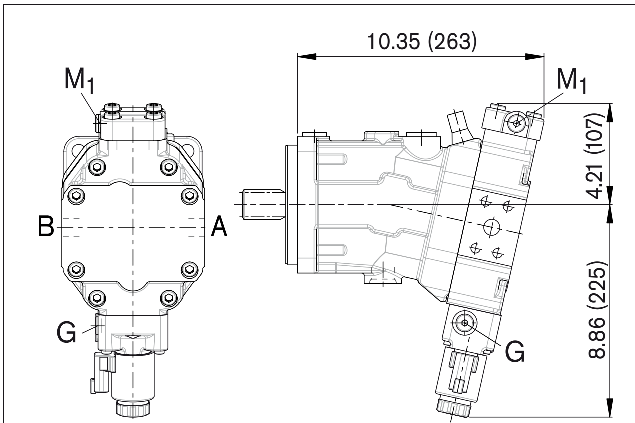
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

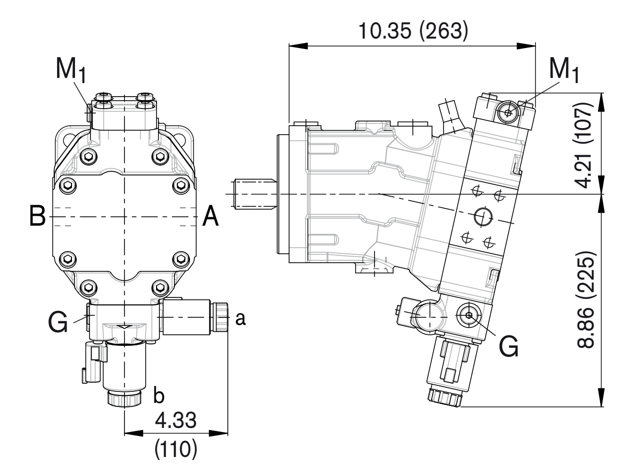
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

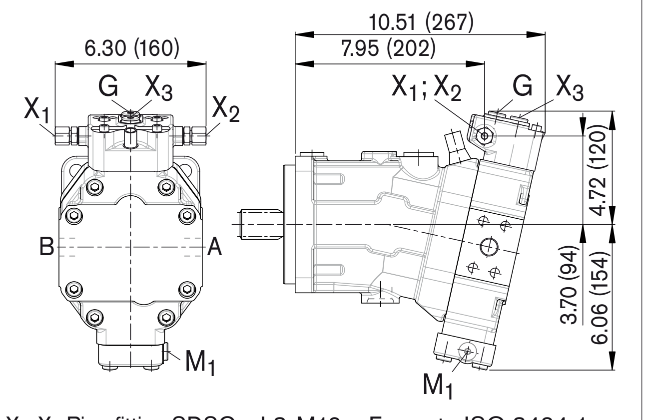


Dimensions size 60

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

DA0

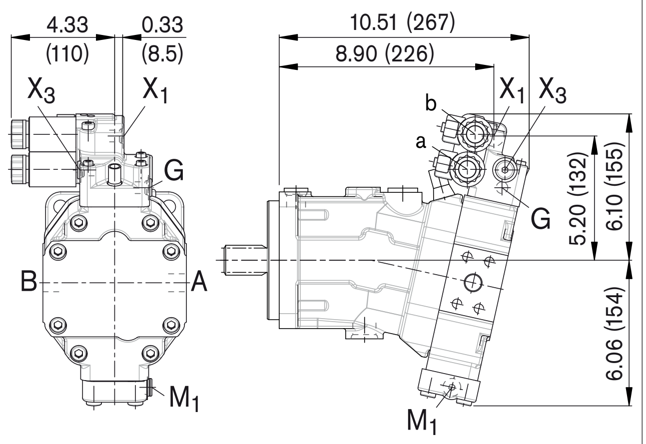
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

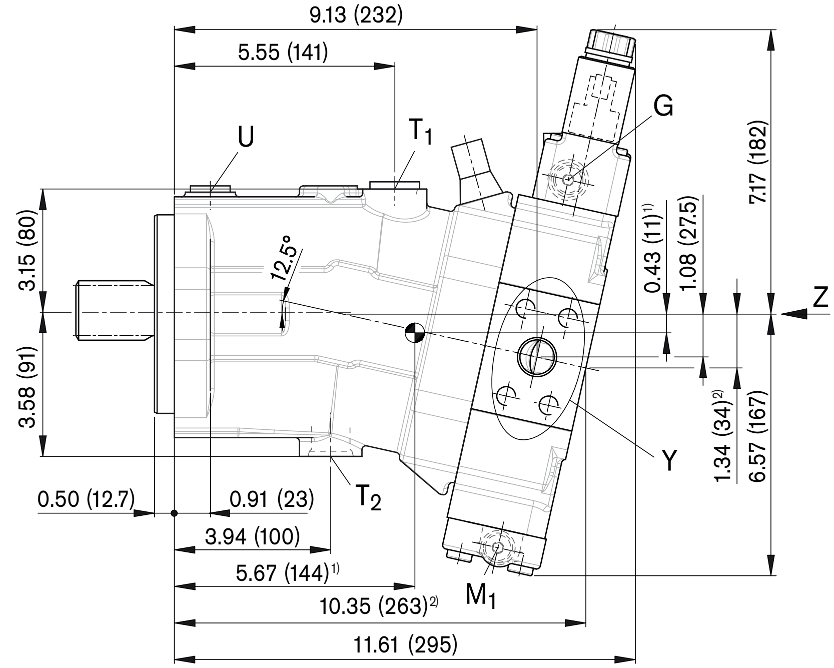


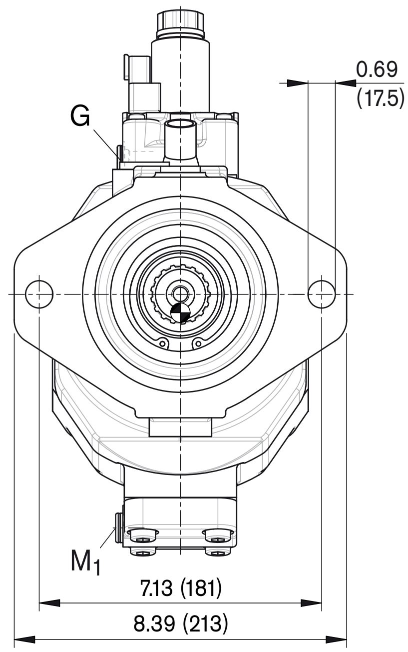
Dimensions size 85

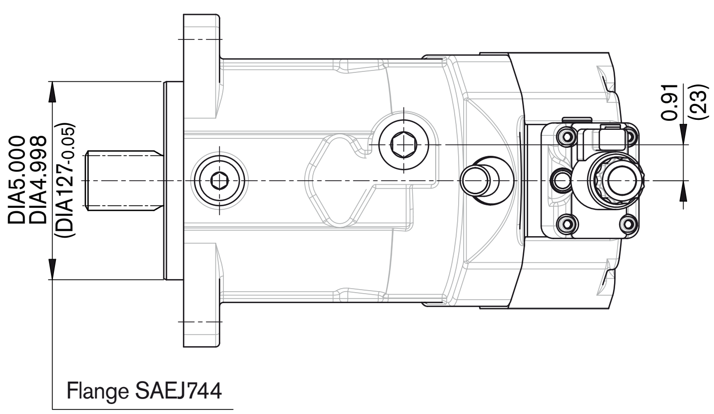
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

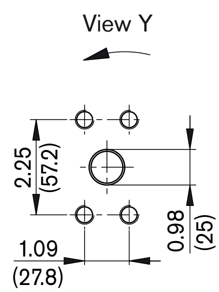
EP5, EP6 – Proportional control electric, negative control

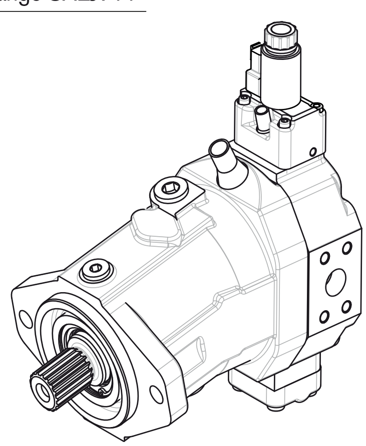
Port plate 2 – SAE flange ports A and B at side, opposite











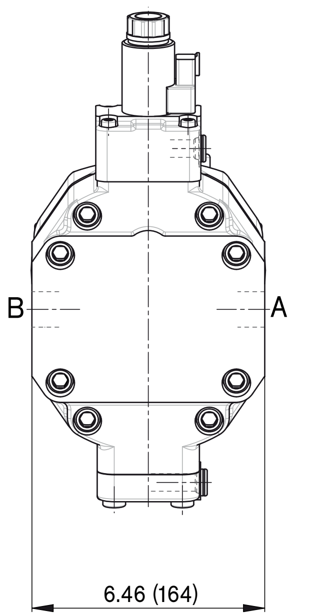
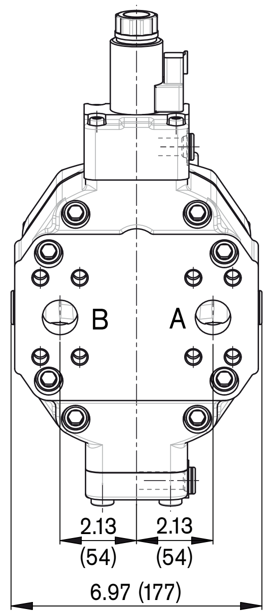
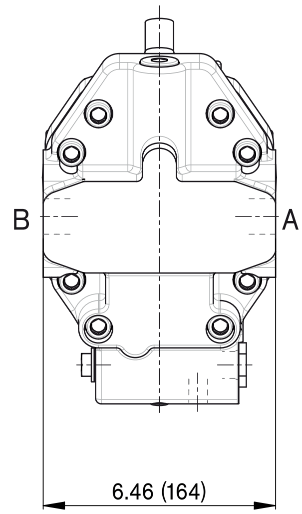
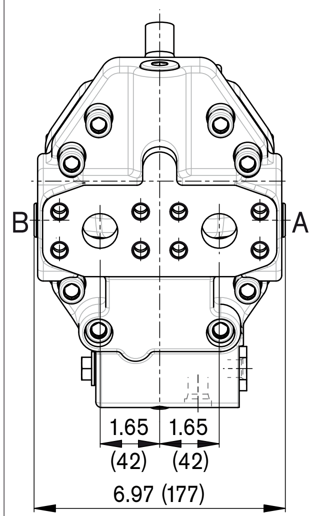
1) Center of gravity

2) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 85

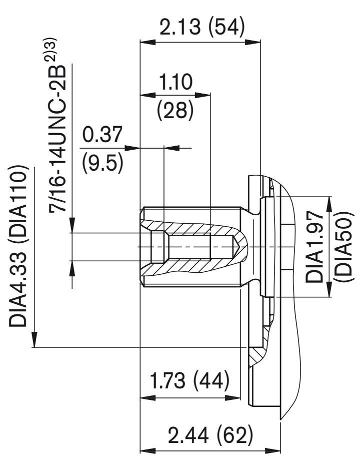
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear	**2** SAE flange ports A and B at side, opposite only HZ7, EZ7/8	**1** SAE flange ports A and B at rear only HZ7, EZ7/8
			

Drive shaft

S9 Splined shaft 1 1/2 in
17 T 12/24DP[1)]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 74 for the maximum tightening torques.

Dimensions size 85

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

Ports

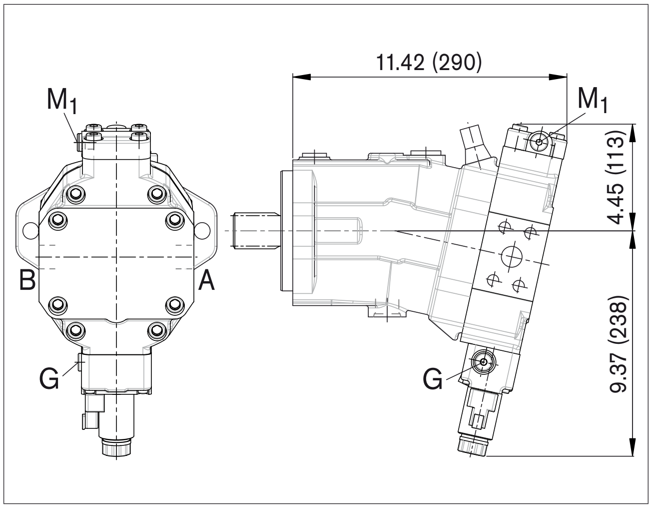
Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)][2)]	State[7)]
A, B[5)]	Service line Fastening thread A/B, screw grade 8 with hardened washer	SAE J518[3)] ASME B1.1	1 in 7/16 in - 14 UNC-2B; 0.87 (22) deep	7250 (500)	O
T_1	Drain line	ISO 11926[6)]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	X[4)]
T_2	Drain line	ISO 11926[6)]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	O[4)]
G	Synchronous control	ISO 11926[6)]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X
U	Bearing flushing	ISO 11926[6)]	7/8 in - 14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6)]	9/16 in - 18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1 and HA2)	ISO 11926[6)]	9/16 in - 18 UNF-2B; 0.51 (13) deep	45 (3)	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	580 (40)	O
X_1	Pilot signal (DA1, DA2)	ISO 11926[6)]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	O
X_3	Pilot signal (DA1, DA2)	ISO 11926[6)]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	X
M_1	Measuring stroking chamber	ISO 11926[6)]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X

1) Observe the general instructions on page 74 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 72).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

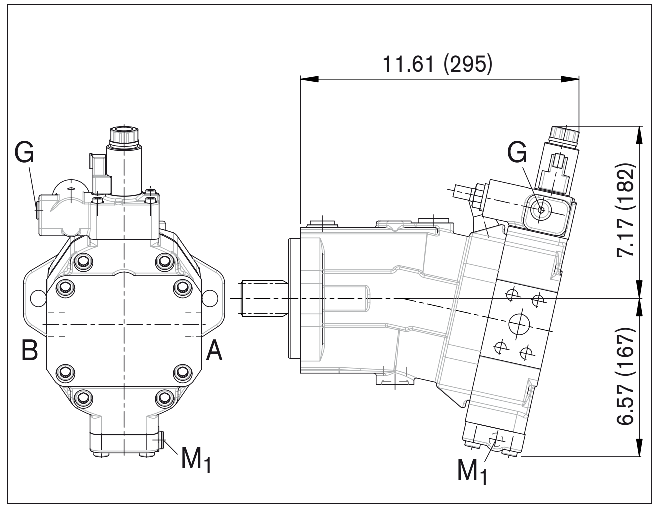
Dimensions size 85

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

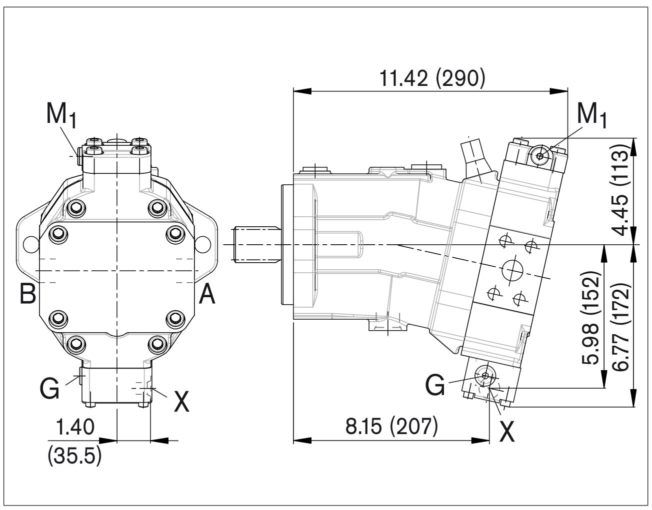
EP1, EP2
Proportional control electric, positive control



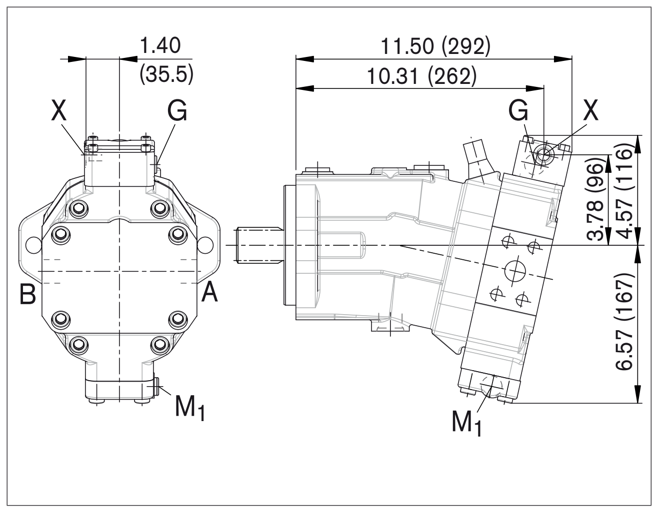
EP5D1, EP6D1
Proportional control electric, negative control, with pressure control fixed setting



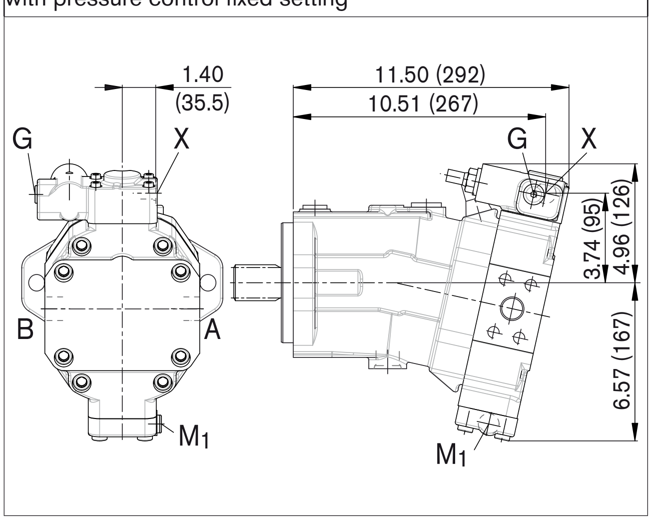
HP1, HP2
Proportional control hydraulic, positive control



HP5, HP6
Proportional control hydraulic, negative control



HP5D1, HP6D1
Proportional control hydraulic, negative control, with pressure control fixed setting

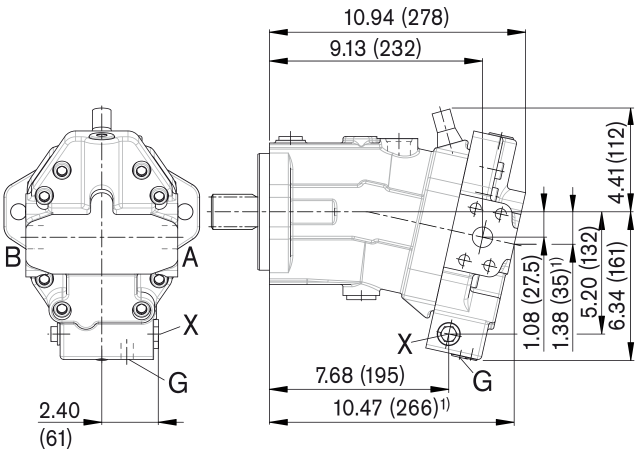


Dimensions size 85

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

HZ7

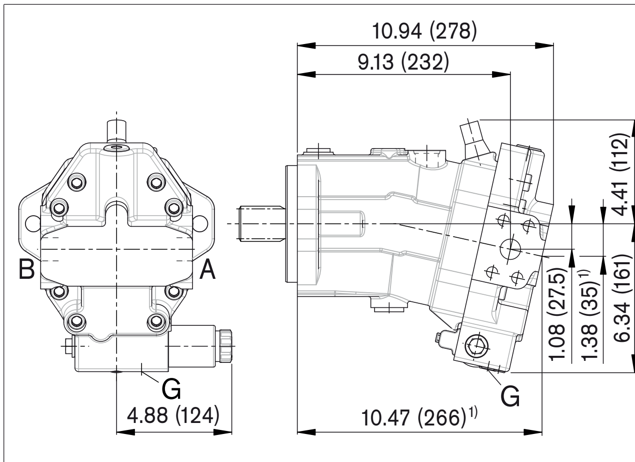
Two-point control hydraulic, negative control



1) Port plate 1 – SAE flange ports A and B at rear

EZ7, EZ8

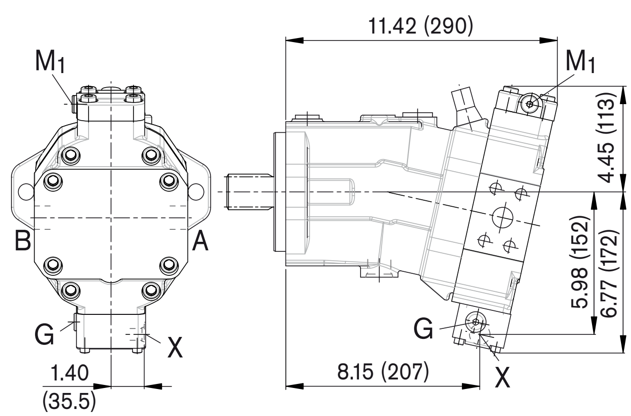
Two-point control electric, negative control



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T3, HA2T3

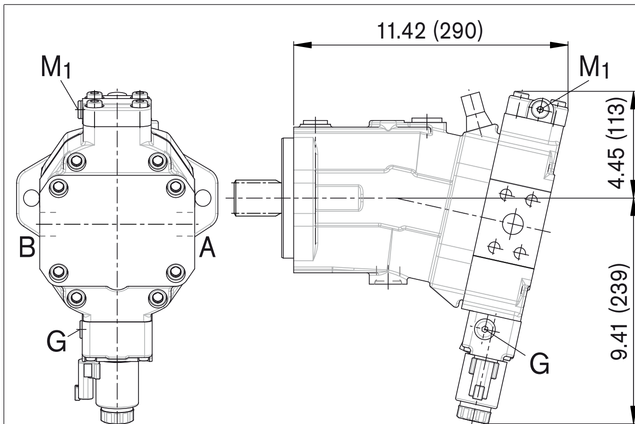
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

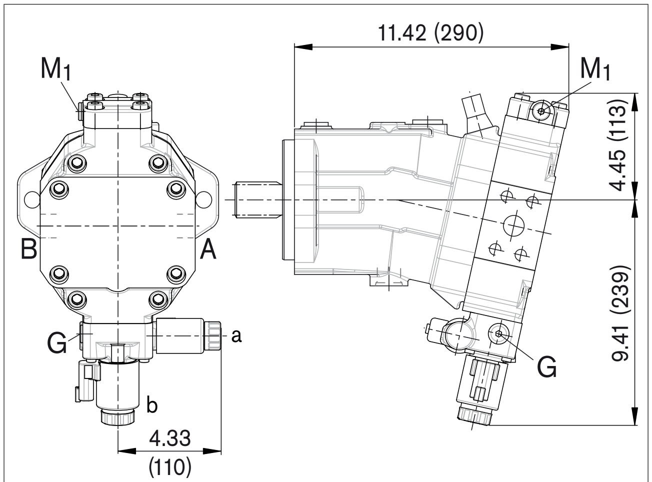
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

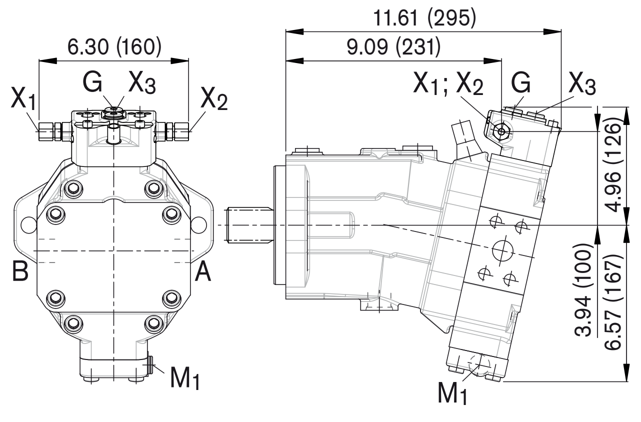


Dimensions size 85

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

DA0

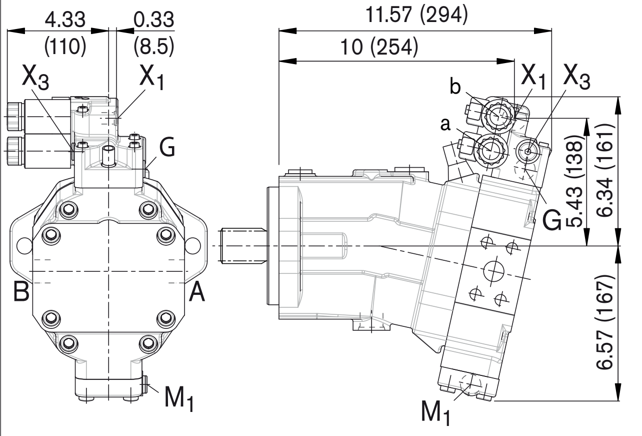
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

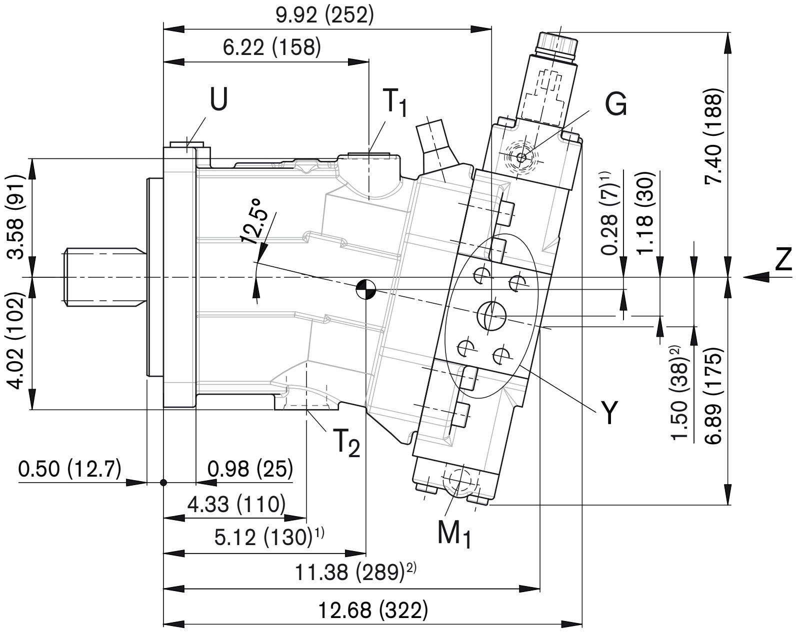


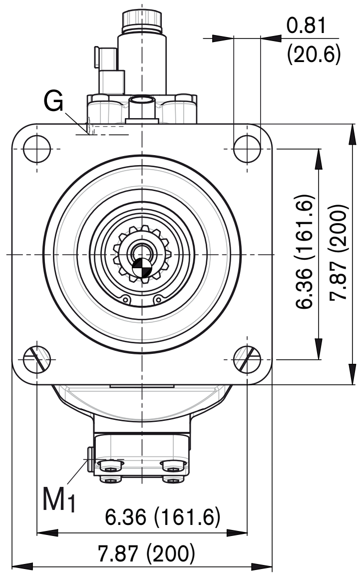
Dimensions size 115

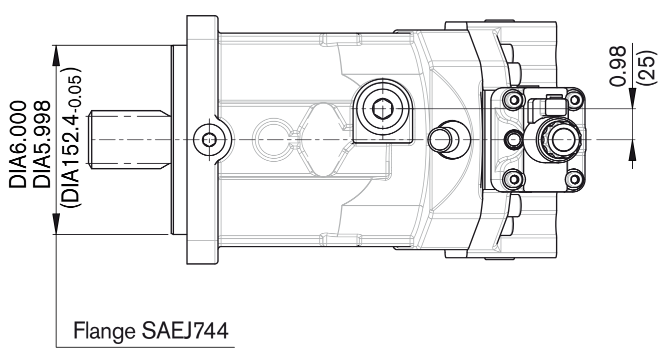
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

EP5, EP6 – Proportional control electric, negative control

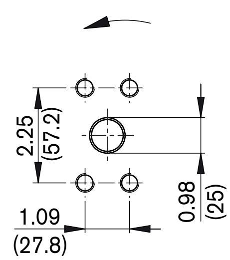
Port plate 2 – SAE flange ports A and B at side, opposite

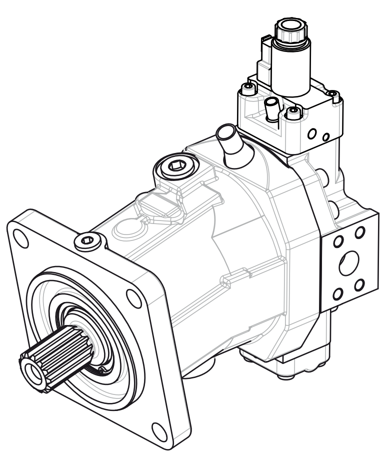






View Y



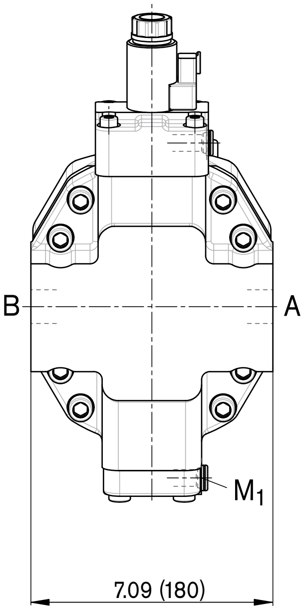
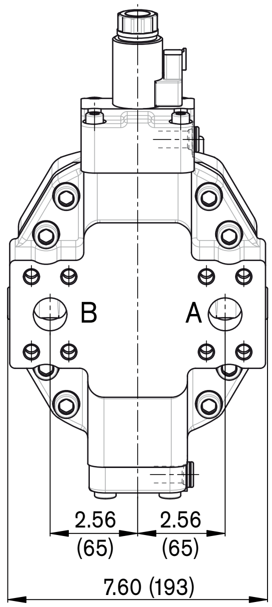
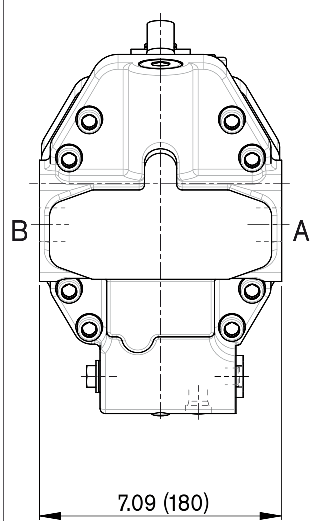
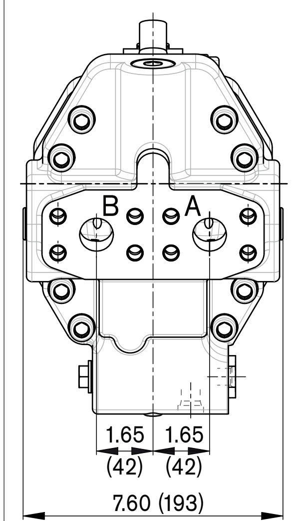


1) Center of gravity
2) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 115

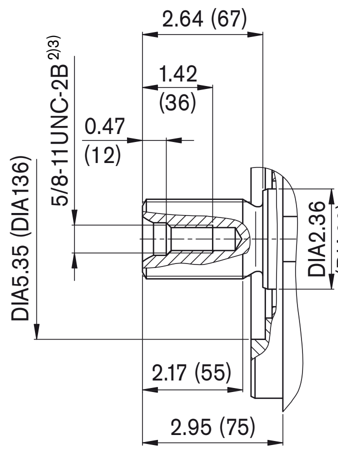
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear	**2** SAE flange ports A and B at side, opposite only HZ7, EZ7/8	**1** SAE flange ports A and B at rear only HZ7, EZ7/8
			

Drive shaft

T1 Splined shaft 1 3/4 in 13 T 8/16DP[1]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 74 for the maximum tightening torques.

Dimensions size 115

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

Ports

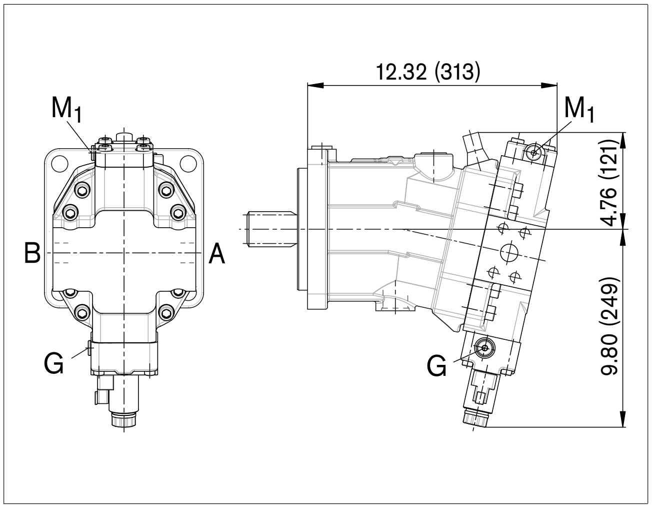
Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State[7]
A, B[5]	Service line Fastening thread A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 in 7/16 in - 14 UNC-2B; 0.87 (22) deep	7250 (500)	O
T_1	Drain line	ISO 11926[6]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
T_2	Drain line	ISO 11926[6]	1 5/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X
U	Bearing flushing	ISO 11926[6]	7/8 in - 14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1 and HA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	45 (3)	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	580 (40)	O
X_1	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	O
X_3	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	X
M_1	Measuring stroking chamber	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X

1) Observe the general instructions on page 74 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 72).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

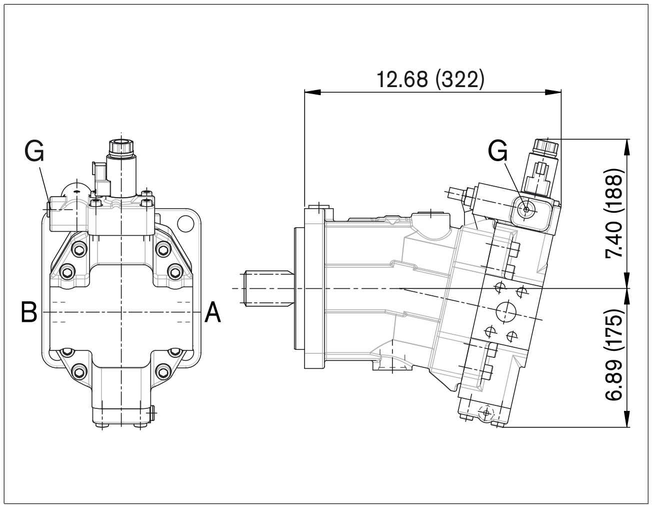
Dimensions size 115

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

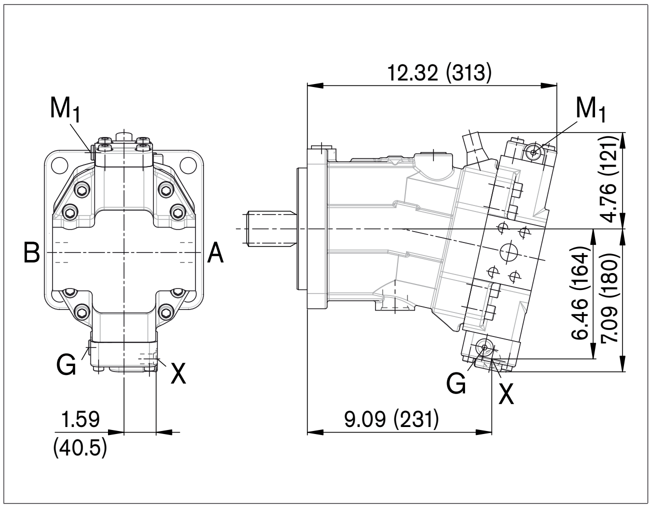
EP1, EP2
Proportional control electric, positive control



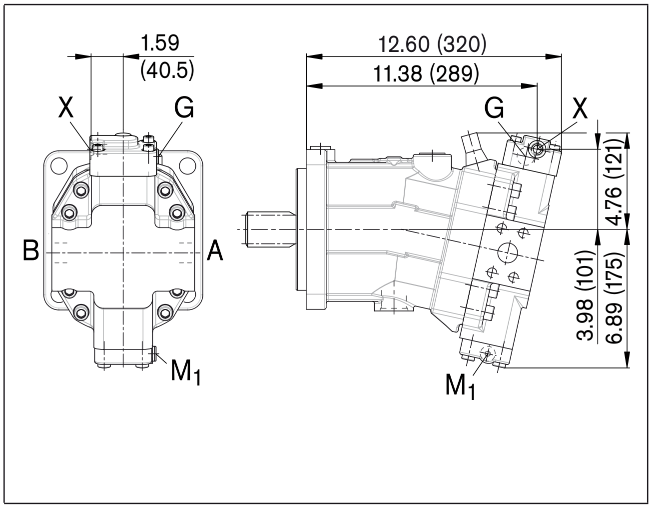
EP5D1, EP6D1
Proportional control electric, negative control, with pressure control fixed setting



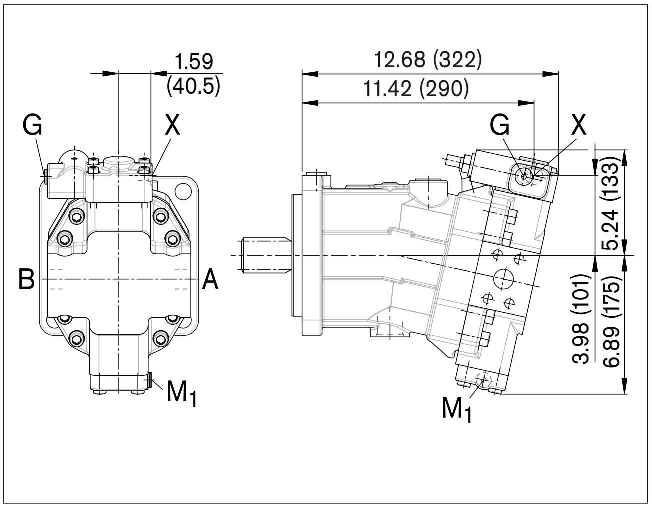
HP1, HP2
Proportional control hydraulic, positive control



HP5, HP6
Proportional control hydraulic, negative control



HP5D1, HP6D1
Proportional control hydraulic, negative control, with pressure control fixed setting

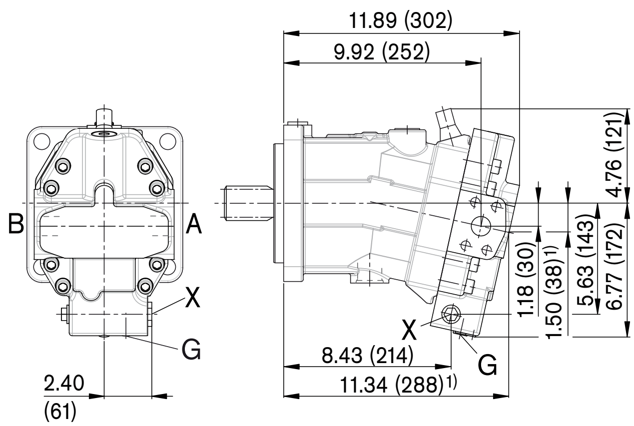


Dimensions size 115

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

HZ7

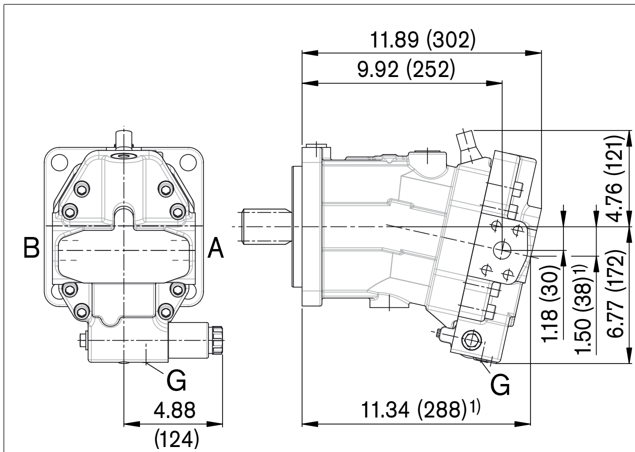
Two-point control hydraulic, negative control



1) Port plate 1 – SAE flange ports A and B at rear

EZ7, EZ8

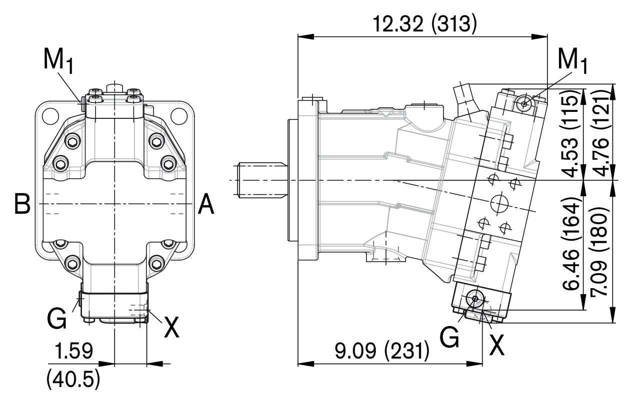
Two-point control electric, negative control



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T3, HA2T3

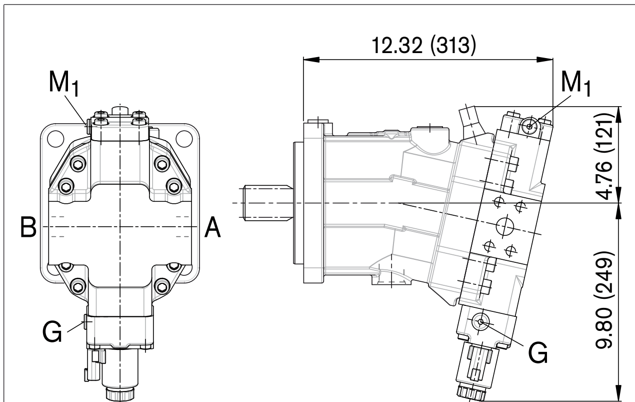
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

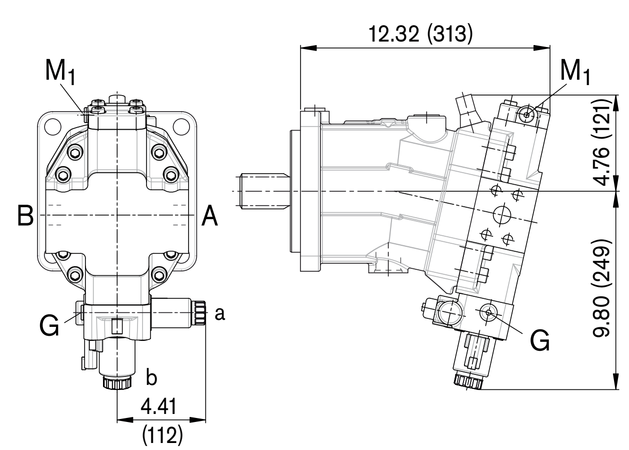
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

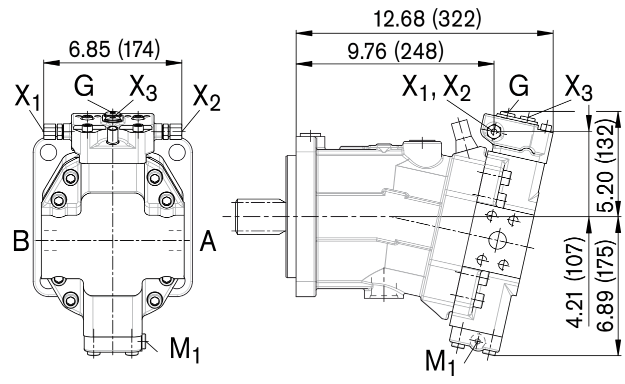


Dimensions size 115

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

DA0

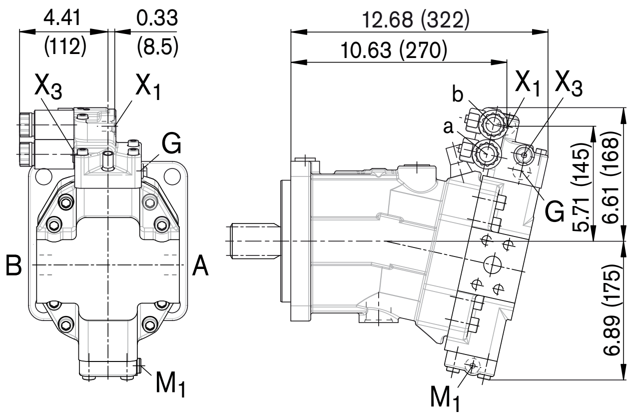
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

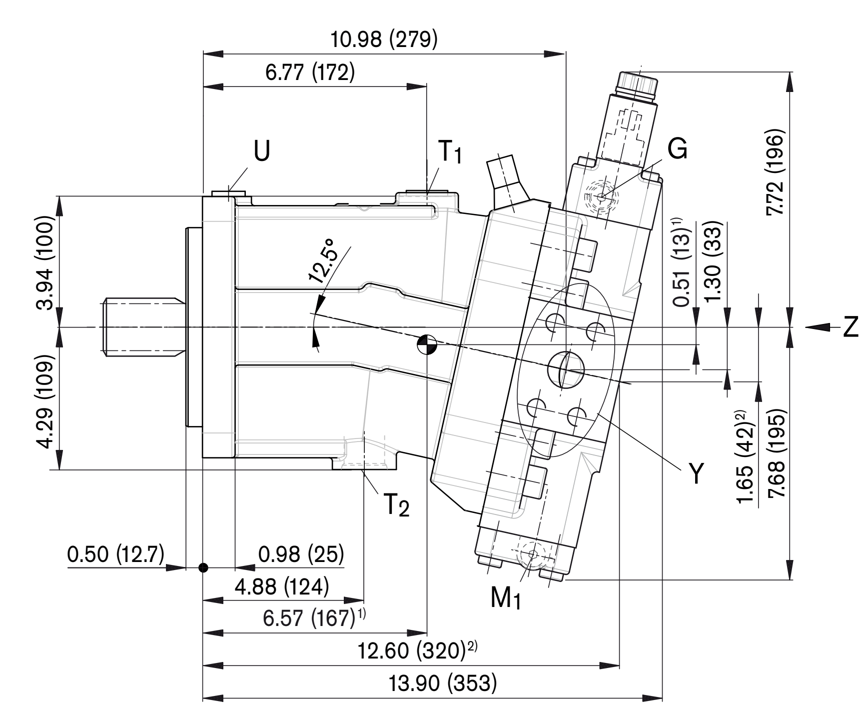


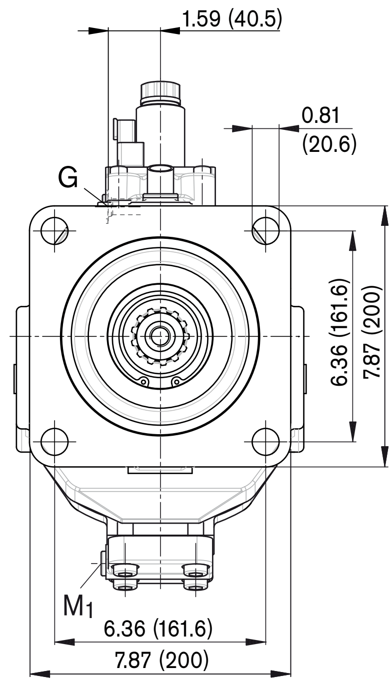
Dimensions size 150

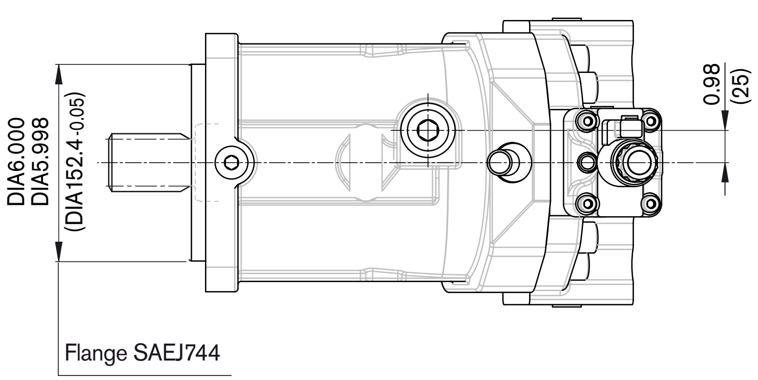
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

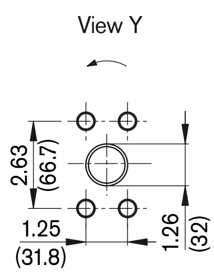
EP5, EP6 – Proportional control electric, negative control

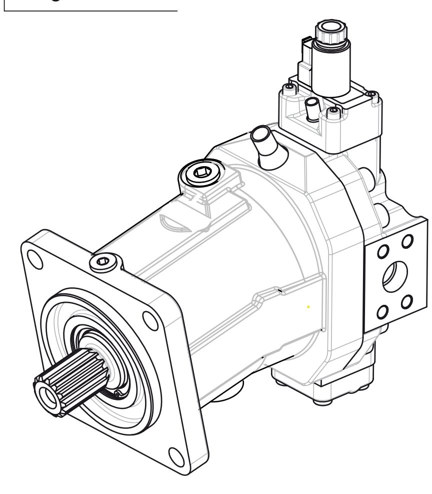
Port plate 2 – SAE flange ports A and B at side, opposite











1) Center of gravity

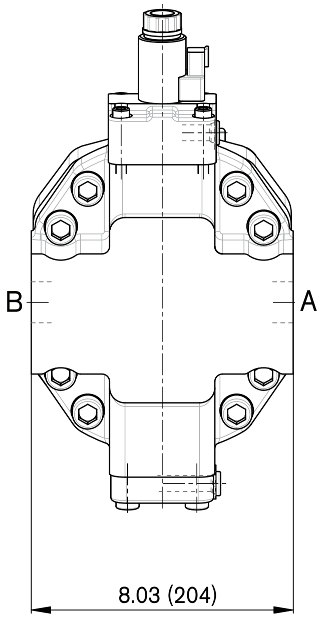
2) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 150

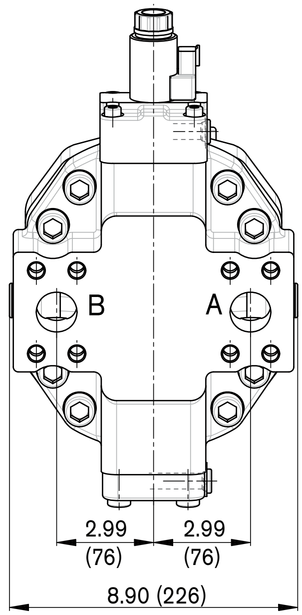
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

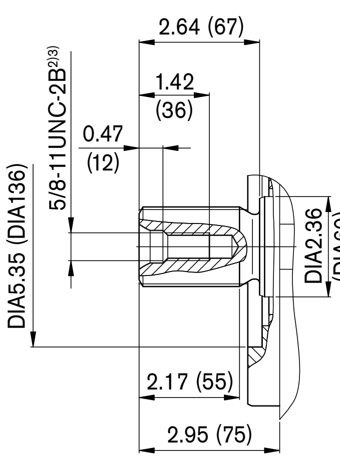


1 SAE flange ports A and B at rear

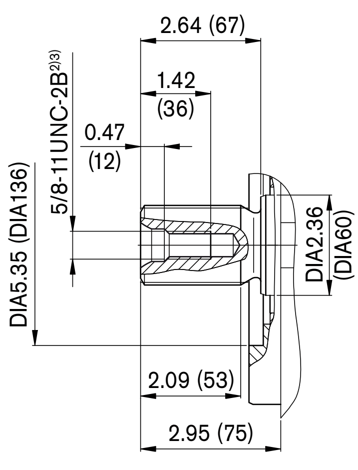


Drive shafts

T1 Splined shaft 1 3/4 in 13 T 8/16DP[1)]



T2 Splined shaft 2 in 15 T 8/16DP[1)]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 74 for the maximum tightening torques.

Dimensions size 150

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

Ports

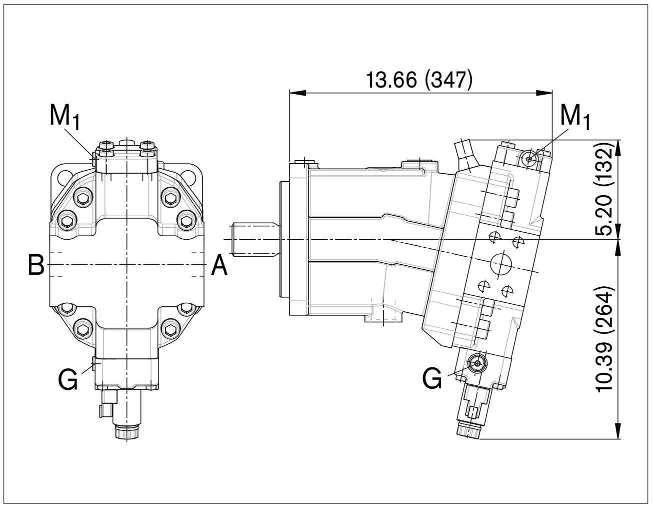
Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State[7]
A, B[5]	Service line Fastening thread A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 1/4 in 1/2 in - 13 UNC-2B; 0.75 (19) deep	7250 (500)	O
T_1	Drain line	ISO 11926[6]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
T_2	Drain line	ISO 11926[6]	1 5/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X
U	Bearing flushing	ISO 11926[6]	7/8 in - 14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1 and HA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	45 (3)	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	580 (40)	O
X_1	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	O
X_3	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	X
M_1	Measuring stroking chamber	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X

1) Observe the general instructions on page 74 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 72).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

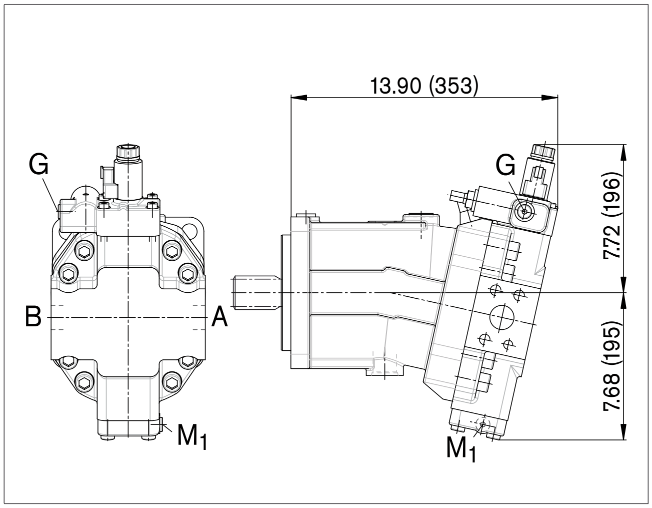
Dimensions size 150

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

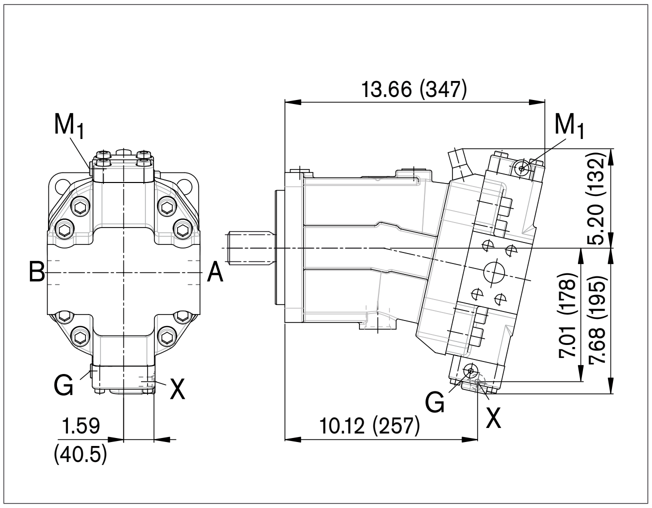
EP1, EP2
Proportional control electric, positive control



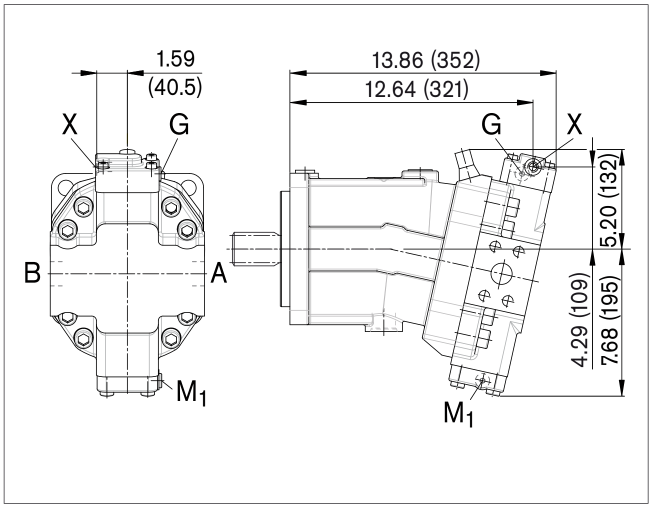
EP5D1, EP6D1
Proportional control electric, negative control, with pressure control fixed setting



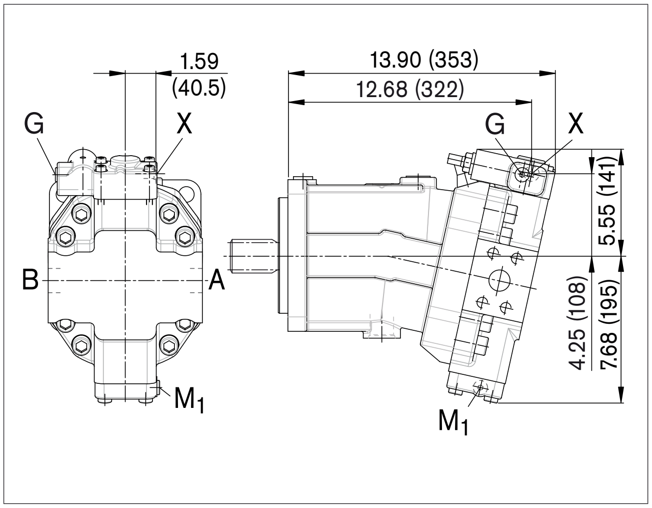
HP1, HP2
Proportional control hydraulic, positive control



HP5, HP6
Proportional control hydraulic, negative control



HP5D1, HP6D1
Proportional control hydraulic, negative control, with pressure control fixed setting

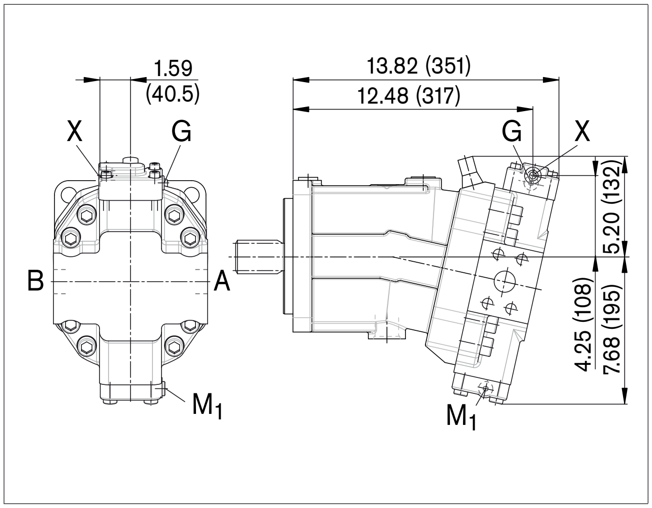


Dimensions size 150

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

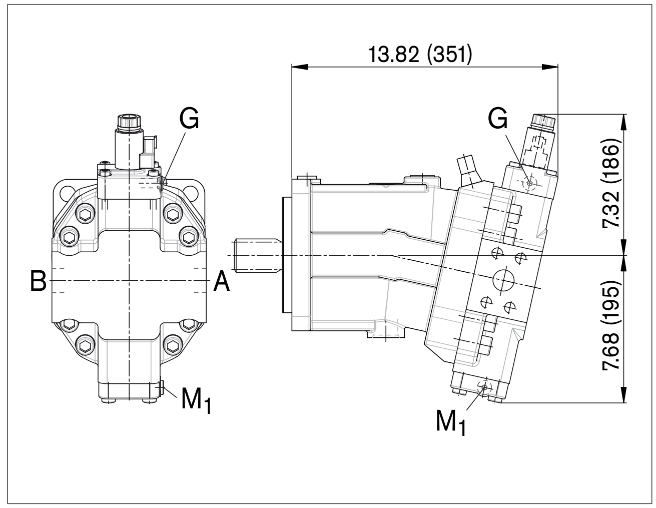
HZ5

Two-point control hydraulic, negative control



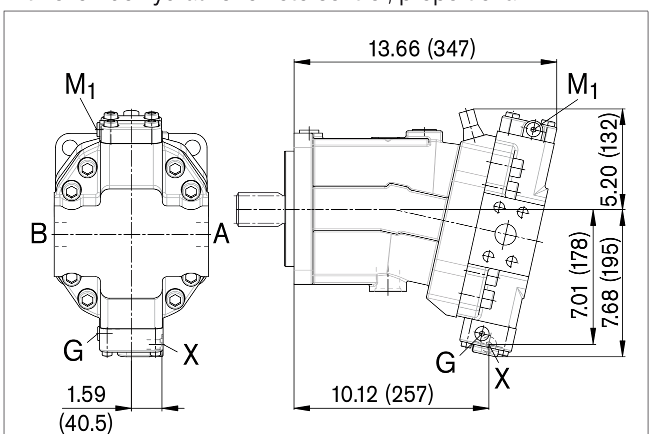
EZ5, EZ6

Two-point control electric, negative control



HA1, HA2 / HA1T3, HA2T3

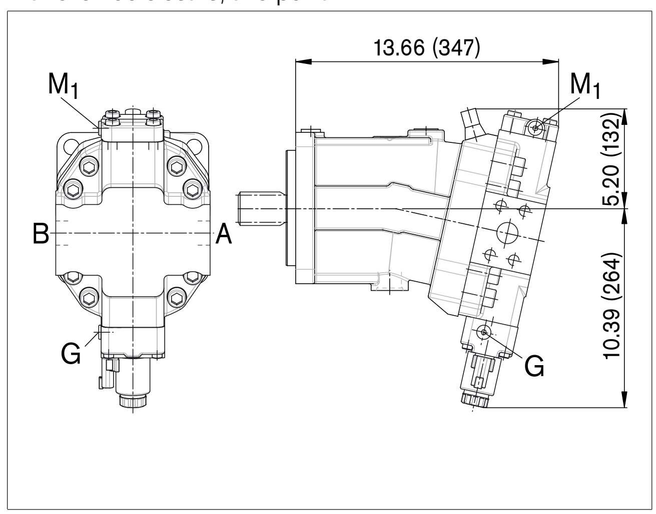
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

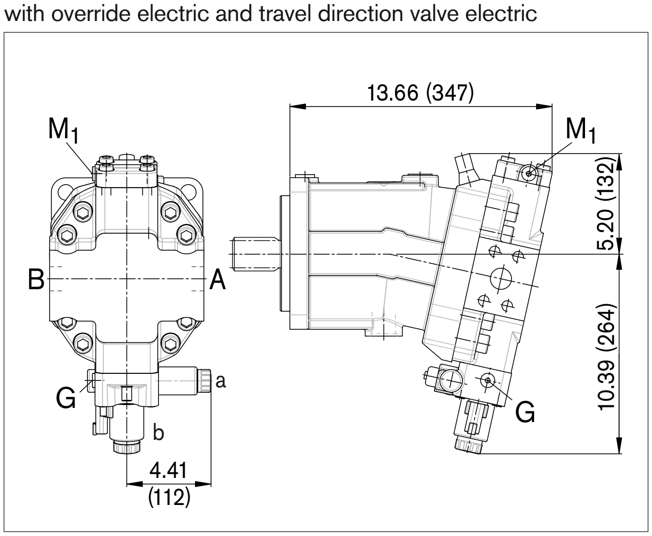
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

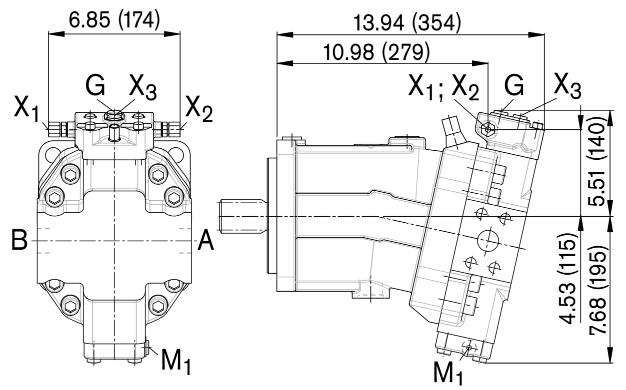


Dimensions size 150

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

DA0

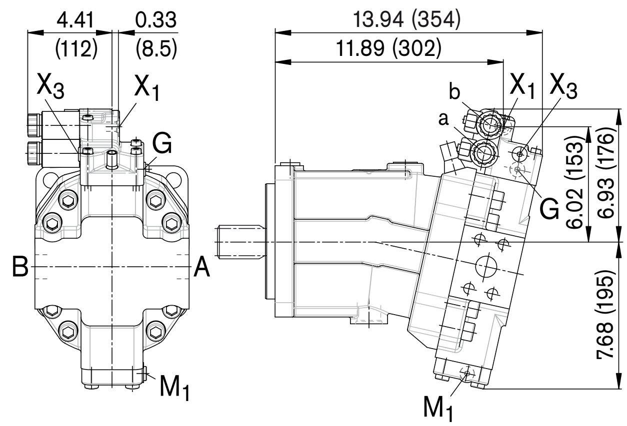
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

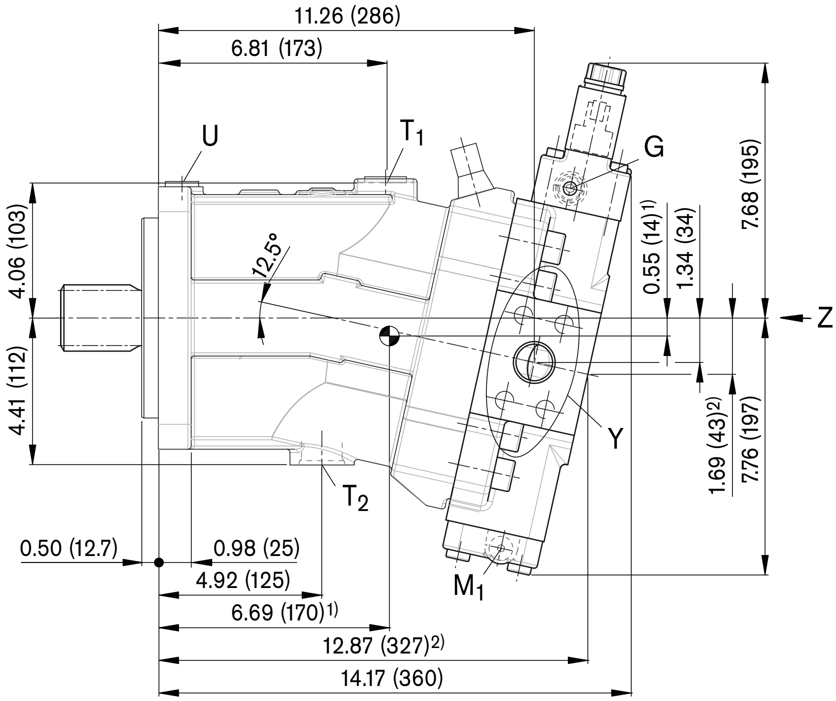


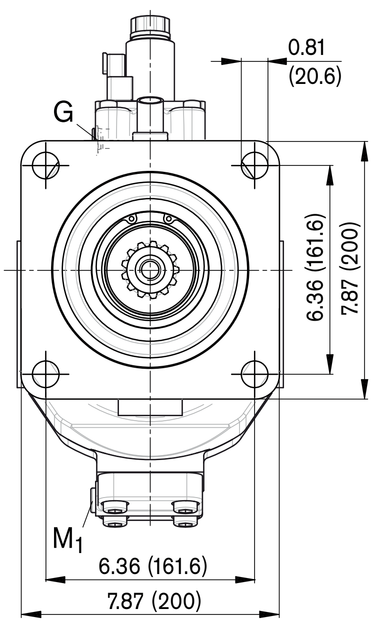
Dimensions size 170

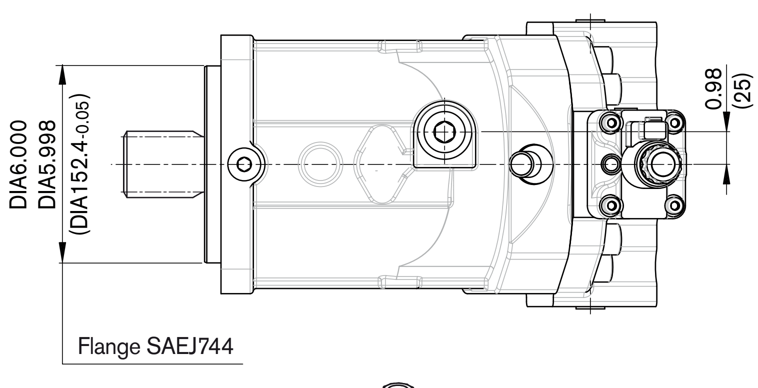
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

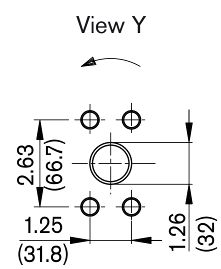
EP5, EP6 – Proportional control electric, negative control

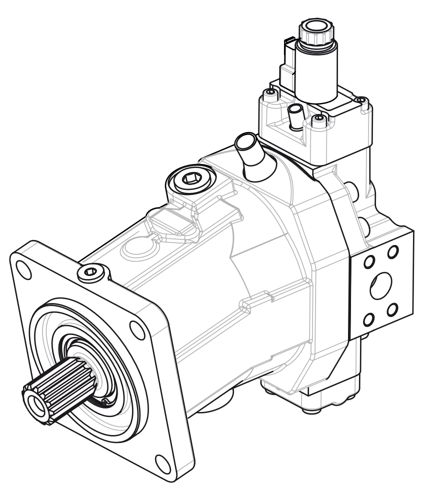
Port plate 2 – SAE flange ports A and B at side, opposite











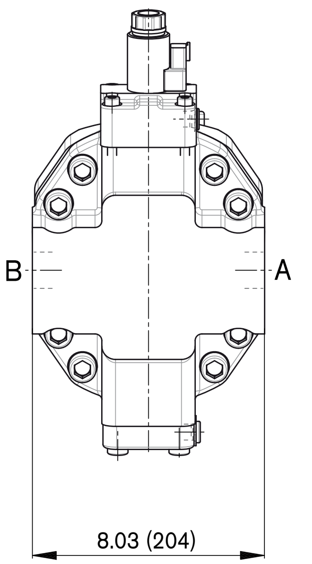
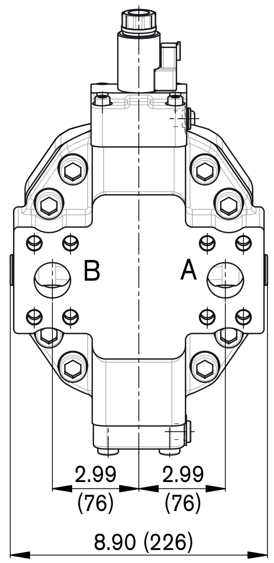
1) Center of gravity

2) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 170

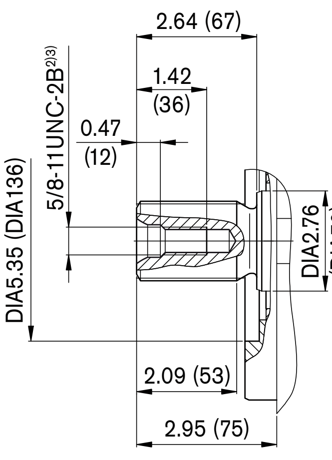
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear
	

Drive shaft

T2 Splined shaft 2 in 15 T 8/16DP[1)]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 74 for the maximum tightening torques.

Dimensions size 170

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State[7]
A, B[5]	Service line Fastening thread A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 1/4 in 1/2 in - 13 UNC-2B; 0.75 (19) deep	7250 (500)	O
T_1	Drain line	ISO 11926[6]	1 1/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
T_2	Drain line	ISO 11926[6]	1 5/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X
U	Bearing flushing	ISO 11926[6]	7/8 in - 14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1 and HA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	45 (3)	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	580 (40)	O
X_1	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	O
X_3	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	X
M_1	Measuring stroking chamber	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X

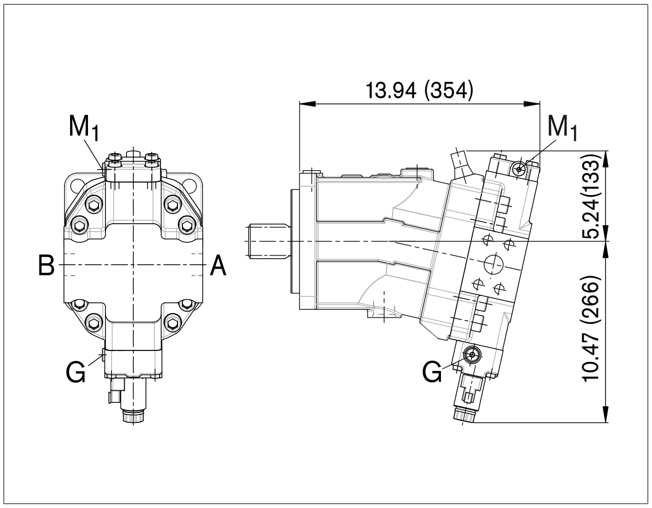
1) Observe the general instructions on page 74 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 72).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 170

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

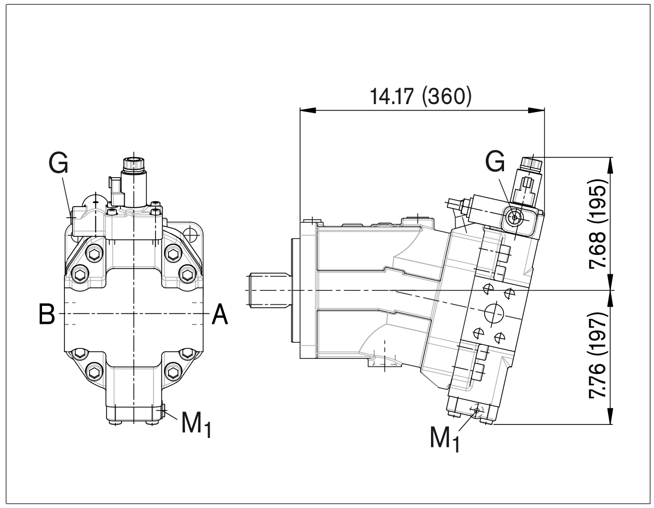
EP1, EP2

Proportional control electric, positive control



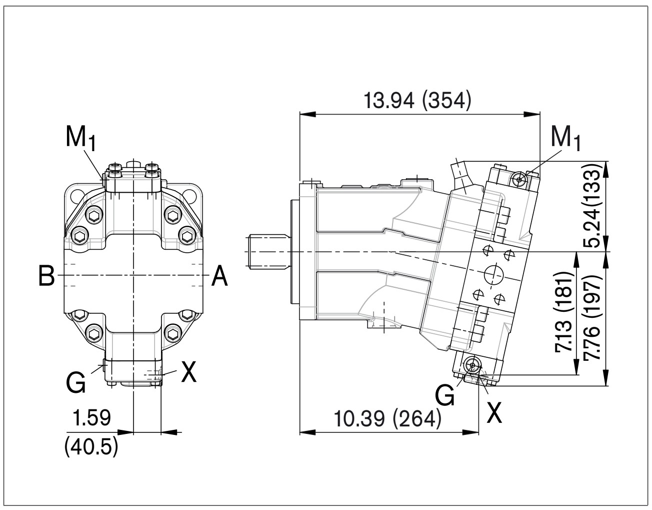
EP5D1, EP6D1

Proportional control electric, negative control, with pressure control fixed setting



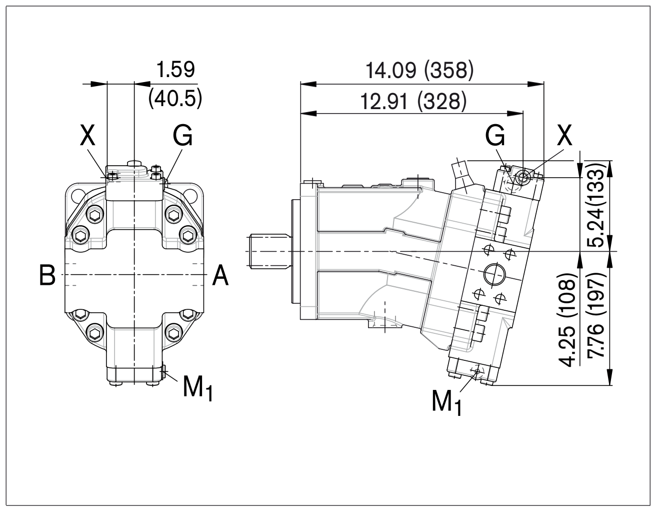
HP1, HP2

Proportional control hydraulic, positive control



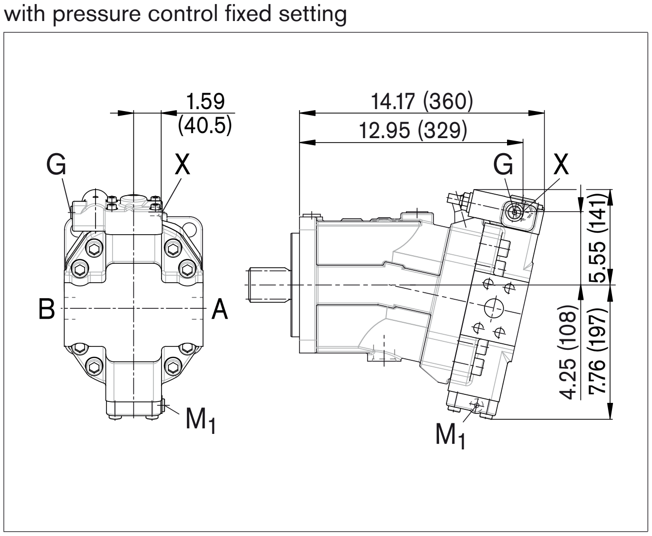
HP5, HP6

Proportional control hydraulic, negative control



HP5D1, HP6D1

Proportional control hydraulic, negative control, with pressure control fixed setting

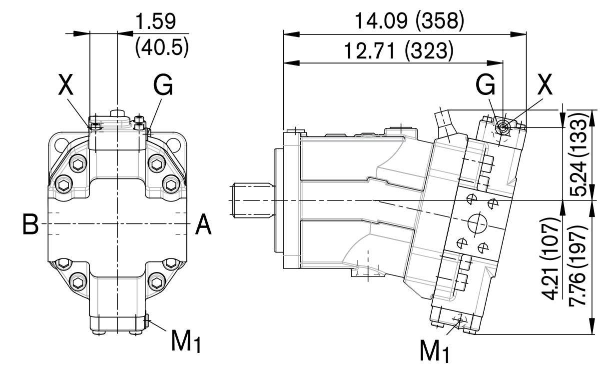


Dimensions size 170

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

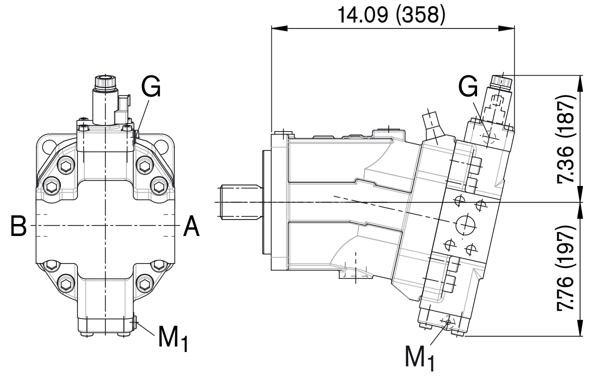
HZ5

Two-point control hydraulic, negative control



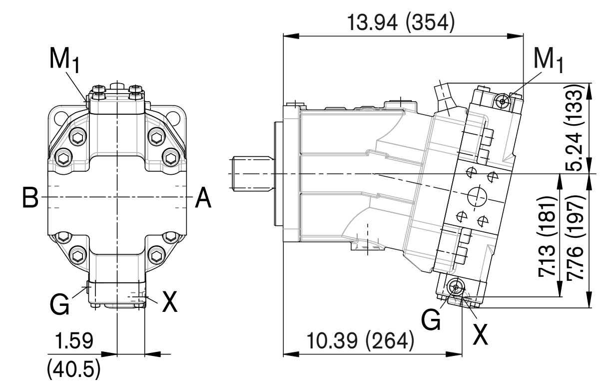
EZ5, EZ6

Two-point control electric, negative control



HA1, HA2 / HA1T3, HA2T3

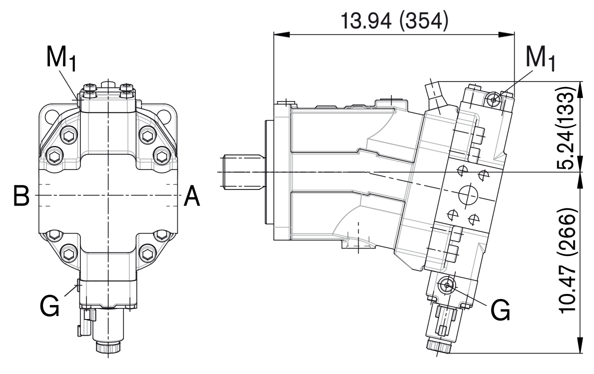
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

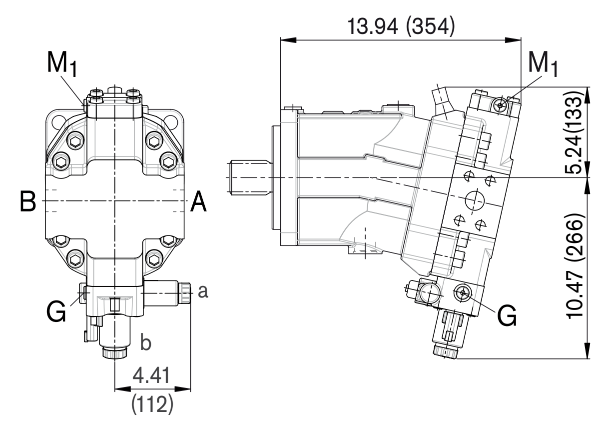
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

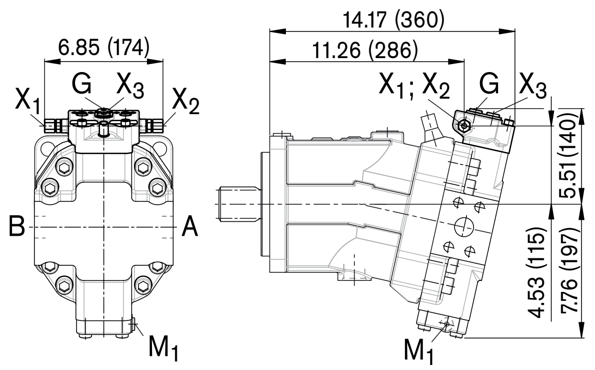


Dimensions size 170

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

DA0

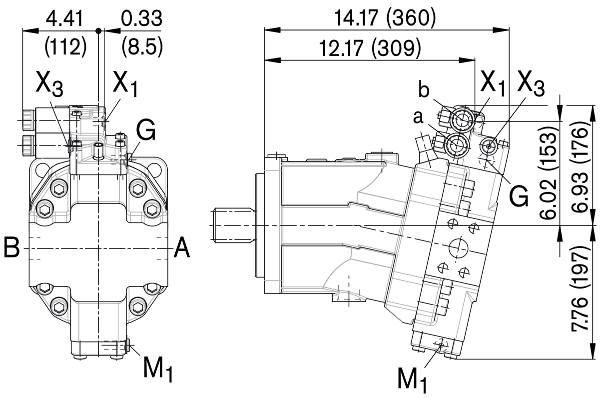
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

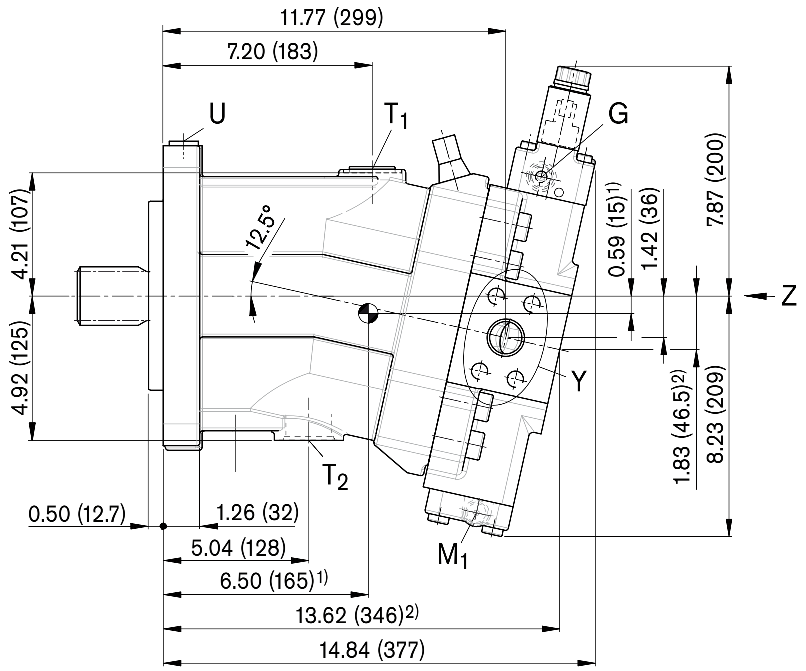


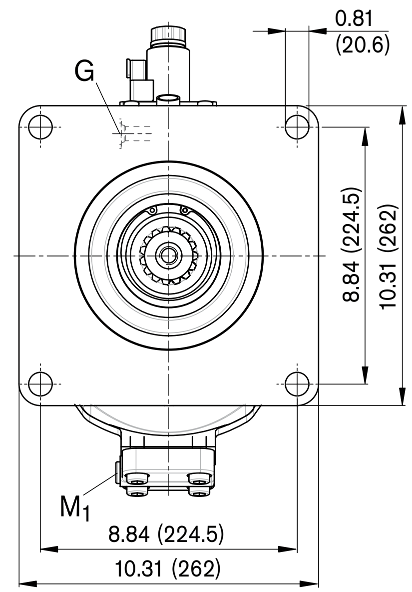
Dimensions size 215

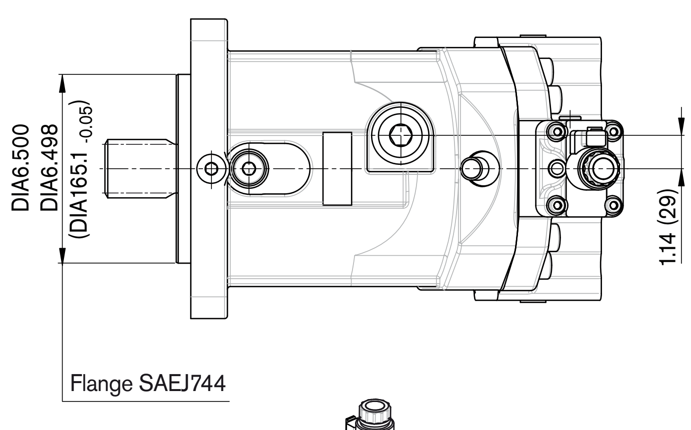
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

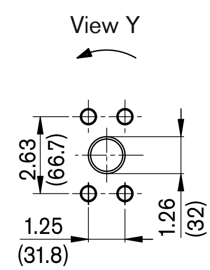
EP5, EP6 – Proportional control electric, negative control

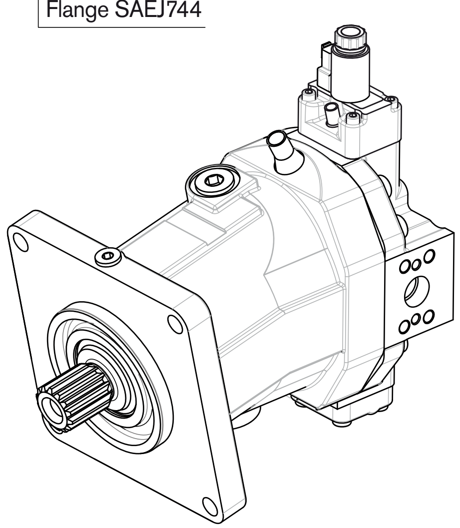
Port plate 2 – SAE flange ports A and B at side, opposite











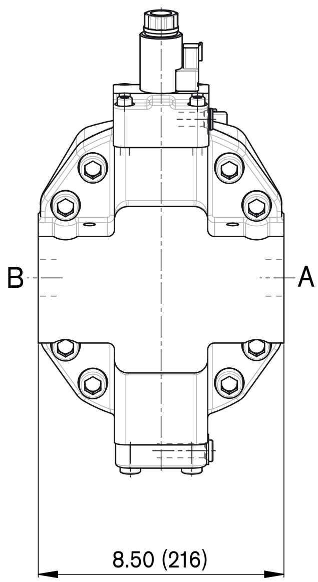
1) Center of gravity
2) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 215

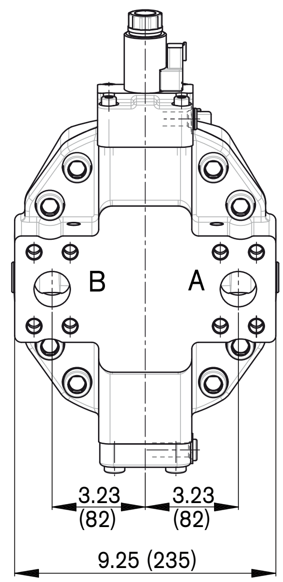
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

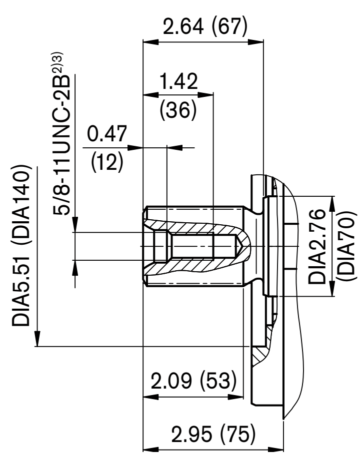


1 SAE flange ports A and B at rear



Drive shaft

T2 Splined shaft 2 in 15 T 8/16DP[1)]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 74 for the maximum tightening torques.

Dimensions size 215

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State[7]
A, B[5]	Service line Fastening thread A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 1/4 in 1/2 in - 13 UNC-2B; 0.75 (19) deep	7250 (500)	O
T_1	Drain line	ISO 11926[6]	1 5/16 in - 12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
T_2	Drain line	ISO 11926[6]	1 5/8 in - 12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X
U	Bearing flushing	ISO 11926[6]	7/8 in - 14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1 and HA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	45 (3)	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	580 (40)	O
X_1	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	O
X_3	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	580 (40)	X
M_1	Measuring stroking chamber	ISO 11926[6]	9/16 in - 18 UNF-2B; 0.51 (13) deep	7250 (500)	X

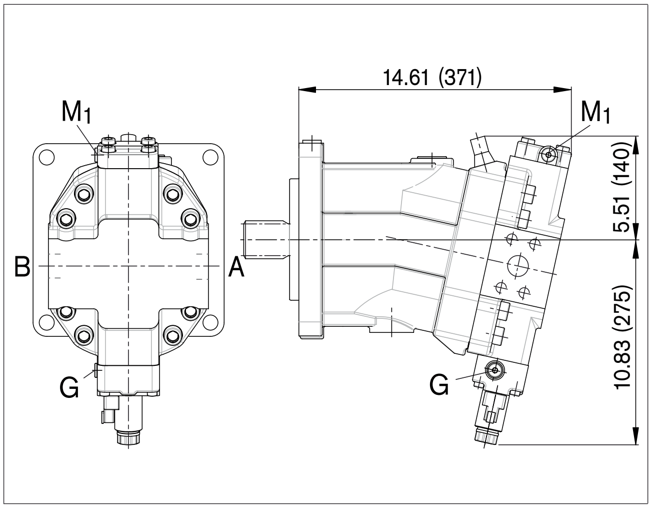
1) Observe the general instructions on page 74 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 72).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 215

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

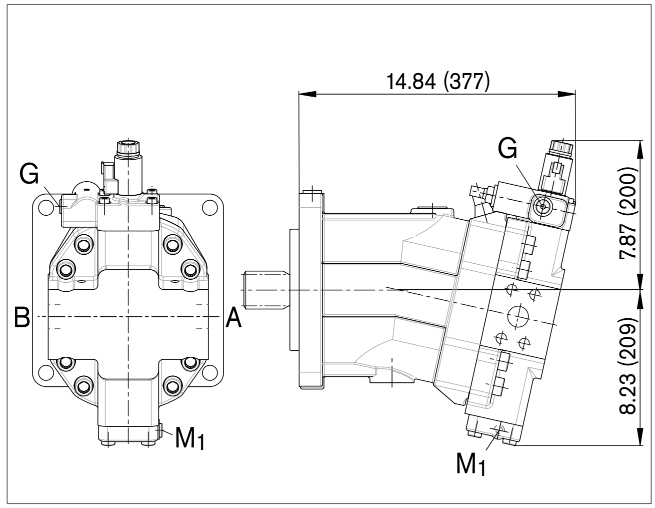
EP1, EP2

Proportional control electric, positive control



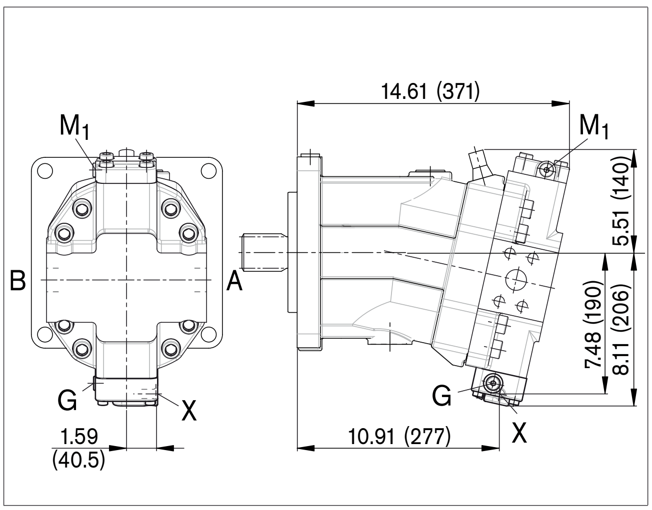
EP5D1, EP6D1

Proportional control electric, negative control, with pressure control fixed setting



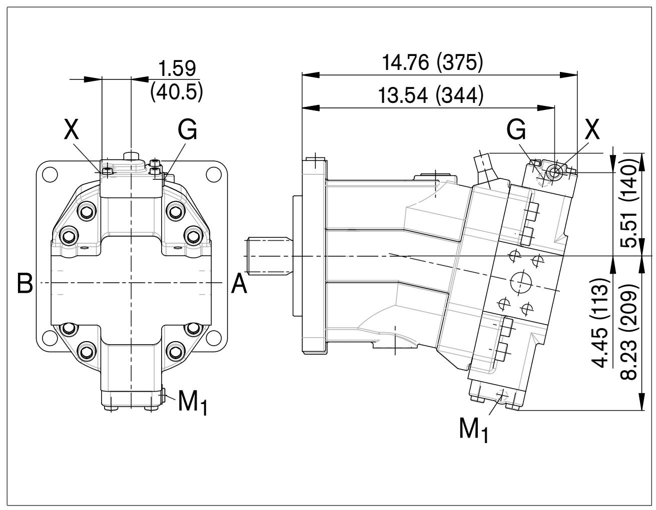
HP1, HP2

Proportional control hydraulic, positive control



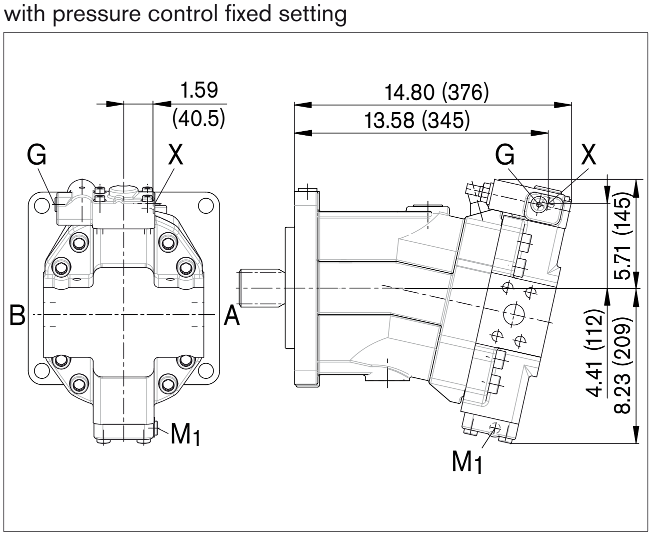
HP5, HP6

Proportional control hydraulic, negative control



HP5D1, HP6D1

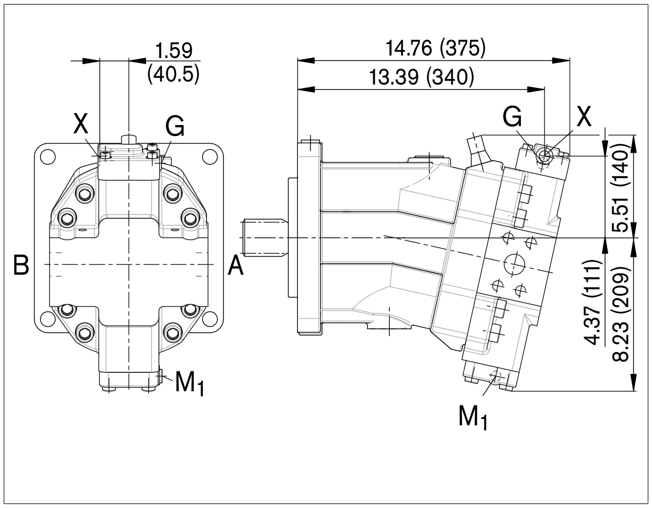
Proportional control hydraulic, negative control, with pressure control fixed setting



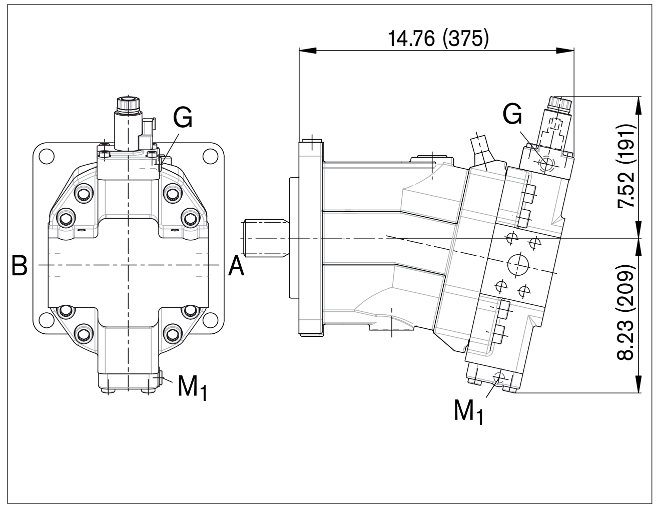
Dimensions size 215

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

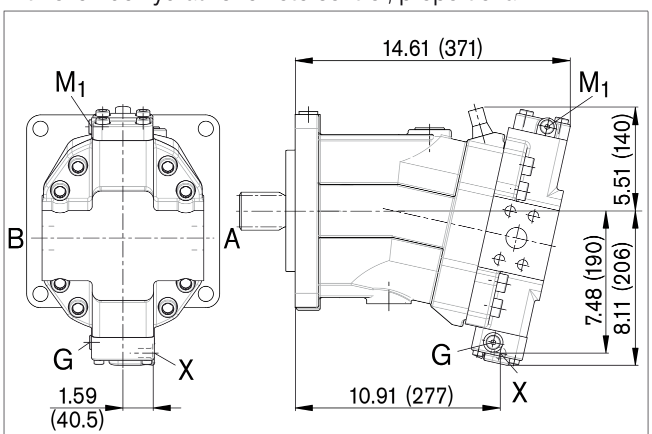
HZ5
Two-point control hydraulic, negative control



EZ5, EZ6
Two-point control electric, negative control

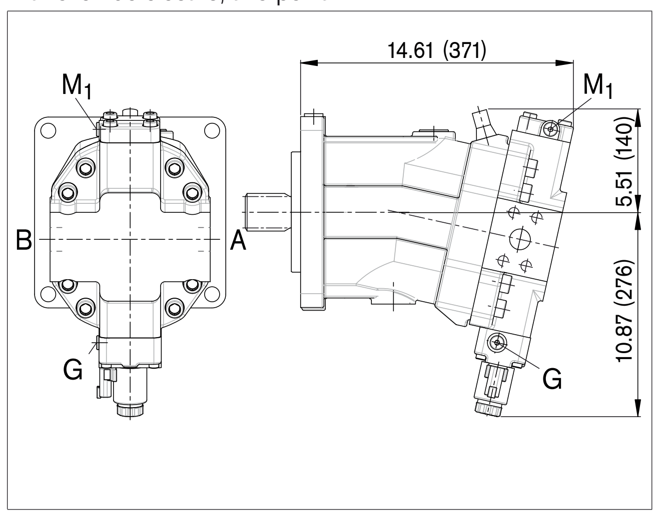


HA1, HA2 / HA1T3, HA2T3
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional

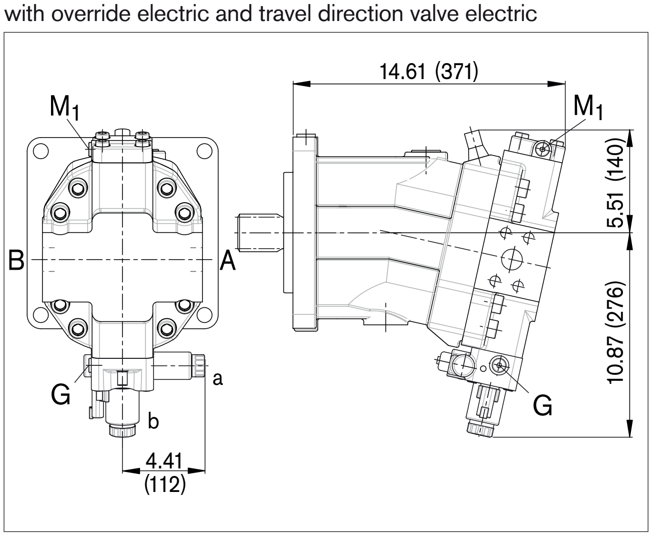


HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2
Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2
Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

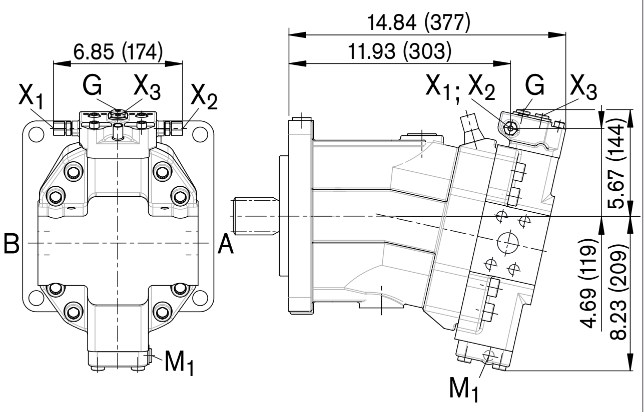


Dimensions size 215

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

DA0

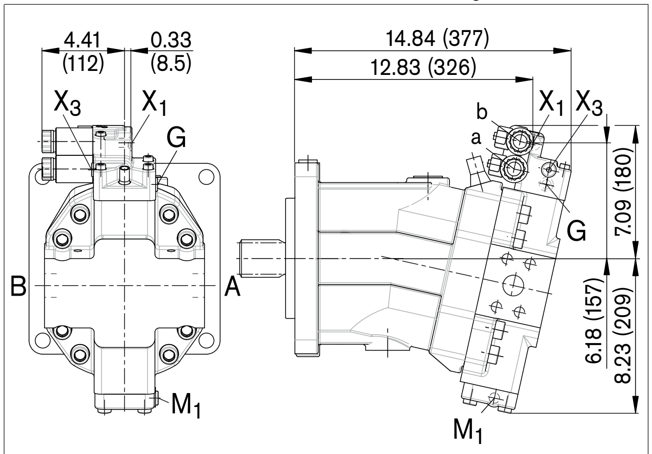
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit



Connector for solenoids

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

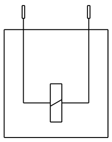
DEUTSCH DT04-2P-EP04

Molded, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:
IP67 ______________________________ DIN/EN 60529

and IP69K ___________________________ DIN 40050-9

Circuit symbol



Mating connector

DEUTSCH DT06-2S-EP04
Bosch Rexroth Mat. No. R902601804

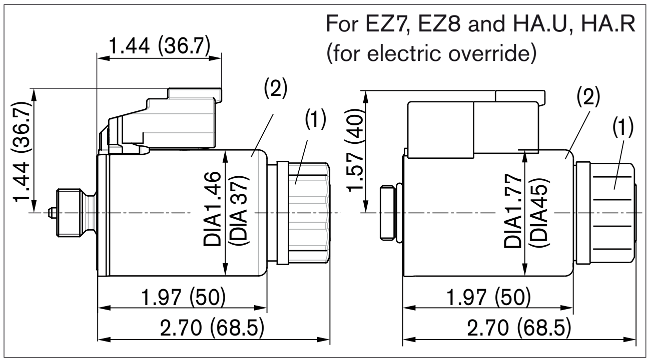
Consisting of: DT designation

– 1 housing _________________________ DT06-2S-EP04

– 1 wedge __________________________________ W2S

– 2 sockets ________________________ 0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.



Changing connector orientation

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

1. Loosen the mounting nut (1) of the solenoid. To do this, turn the mounting nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired orientation.
3. Retighten the mounting nut. Tightening torque: 3.7+0.7 lb-ft (5+1 Nm). (WAF26, 12-sided DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

Flushing and boost pressure valve

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

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.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 60 to 215, fixed setting ______________ 230 psi (16 bar)

Switching pressure of flushing piston Δp
Sizes 60 to 115 (small flushing valve) ___115±15 psi (8±1 bar)
Sizes 115 to 215 (medium and large flushing valve) 255±22.5 psi (17.5±1.5 bar)

Flushing flow q_v
Orifices can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 365 psi (25 bar) and ν = 60 SUS (10 mm²/s)
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 60 to 115

Material number of orifice	DIA [mm]	q_v [gpm(L/min)]	Code
R909651766	1.2	0.9 (3.5)	A
R909419695	1.4	1.3 (5)	B
R909419696	1.8	2.1 (8)	C
R909419697	2.0	2.6 (10)	D
R909444361	2.4	3.7 (14)	F

Medium flushing valve for size 115

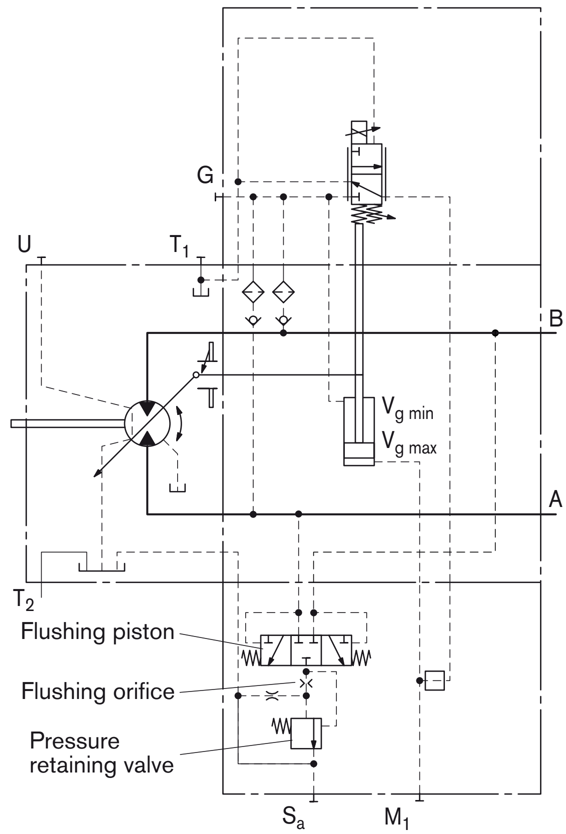
Material number of orifice	DIA [mm]	q_v [gpm(L/min)]	Code
R909431310	2.8	5.3 (20)	H
R909435172	3.5	6.6 (25)	J
R909449967	5.0	7.9 (30)	K

Large flushing valve for sizes 150 to 215

Material number of orifice	DIA [mm]	q_v [gpm(L/min)]	Code
R909449998	1.8	2.1 (8)	C
R909431308	2.0	2.6 (10)	D
R909431309	2.5	4.5 (17)	G
R909431310	2.8	5.3 (20)	H
R902138235	3.1	6.6 (25)	J
R909435172	3.5	7.9 (30)	K
R909436622	4.0	9.2 (35)	L
R909449967	5.0	10.6 (40)	M

For a flushing flow greater than 9.2 gpm (35 L/min), it is recommended that port S_a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

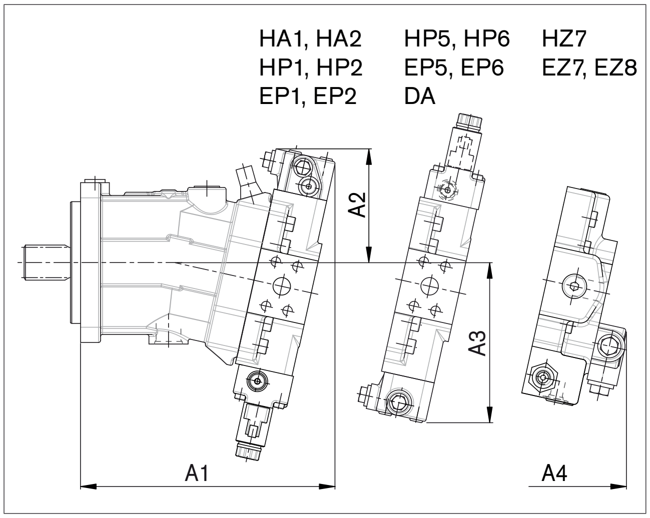
Schematic EP
Port S_a only for sizes 150 to 215



Flushing and boost pressure valve

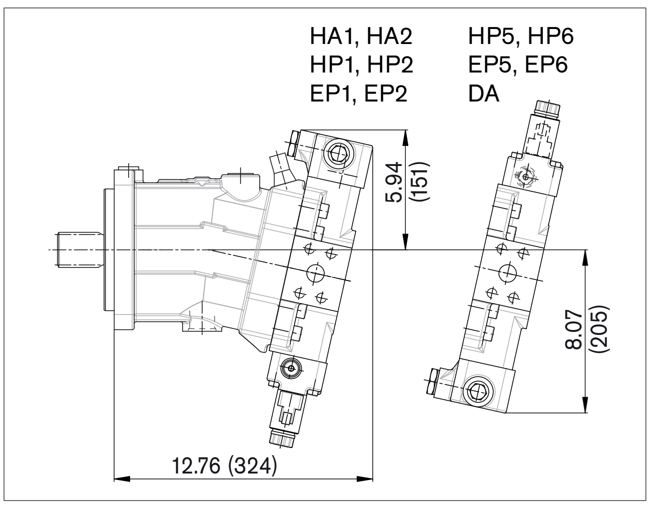
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Dimensions of sizes 60 to 115 (small flushing valve)



NG	A1	A2	A3	A4
060	10.51	5.24	6.93	10.24
	(267)	(133)	(176)	(260)
085	11.69	5.59	7.64	10.94
	(297)	(142)	(194)	(278)
115	12.56	5.63	7.95	11.85
	(319)	(143)	(202)	(301)

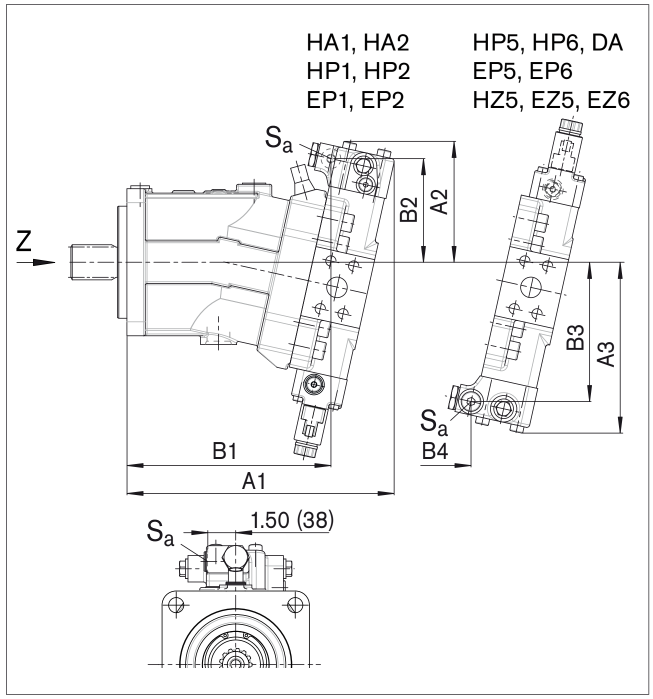
Dimensions of size 115 (medium flushing valve)



NG	S_a[1]
150	7/8-14UNF-2B; 0.67 (17) deep
170	7/8-14UNF-2B; 0.67 (17) deep
215	7/8-14UNF-2B; 0.67 (17) deep

1) ISO 11926, ports plugged (in normal operation)
Observe the general instructions on page 74 for the maximum tightening torques.
The spot face can be deeper than specified in the appropriate standard.

Dimensions for sizes 150 to 215 (large flushing valve)



NG	A1	B1	A2	B2	A3	B3	B4
150	14.06	10.67	6.50	5.59	9.06	7.36	7.80
	(357)	(271)	(165)	(142)	(230)	(187)	(198)
170	14.33	10.94	6.50	5.59	9.17	7.48	8.03
	(364)	(278)	(165)	(142)	(233)	(190)	(204)
215	15.00	11.61	6.77	5.83	9.61	7.91	8.54
	(381)	(295)	(172)	(148)	(244)	(201)	(217)

Counterbalance valve BVD and BVE

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

Function

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

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

Note

– BVD available for sizes 60 to 215 and BVE available for sizes 115 to 215.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VM085HA1T30004A/71AWV0C2S97W0-0 + BVD20F27S/41B–V03K16D0400S12

– For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!

– For the design of the brake release valve, we must know for the mechanical park brake:

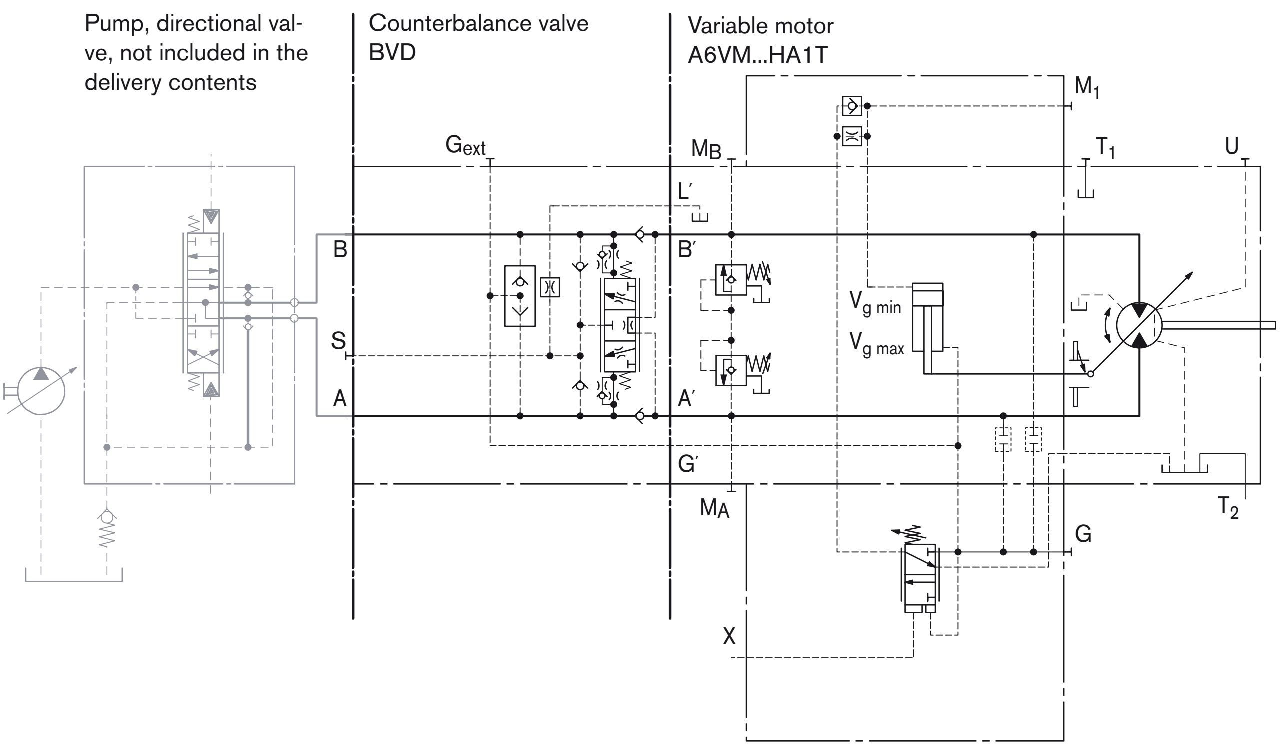
- the pressure at the start of opening
- the volume of the brake piston between minimum stroke (brake closed) and maximum stroke (brake released with 305 psi (21 bar))
- the required closing time for a warm device (oil viscosity approx. 69.6 SUS (15 mm²/s))

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A6VM085HA1T30004A/71AWV0C2S97W0-0 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

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

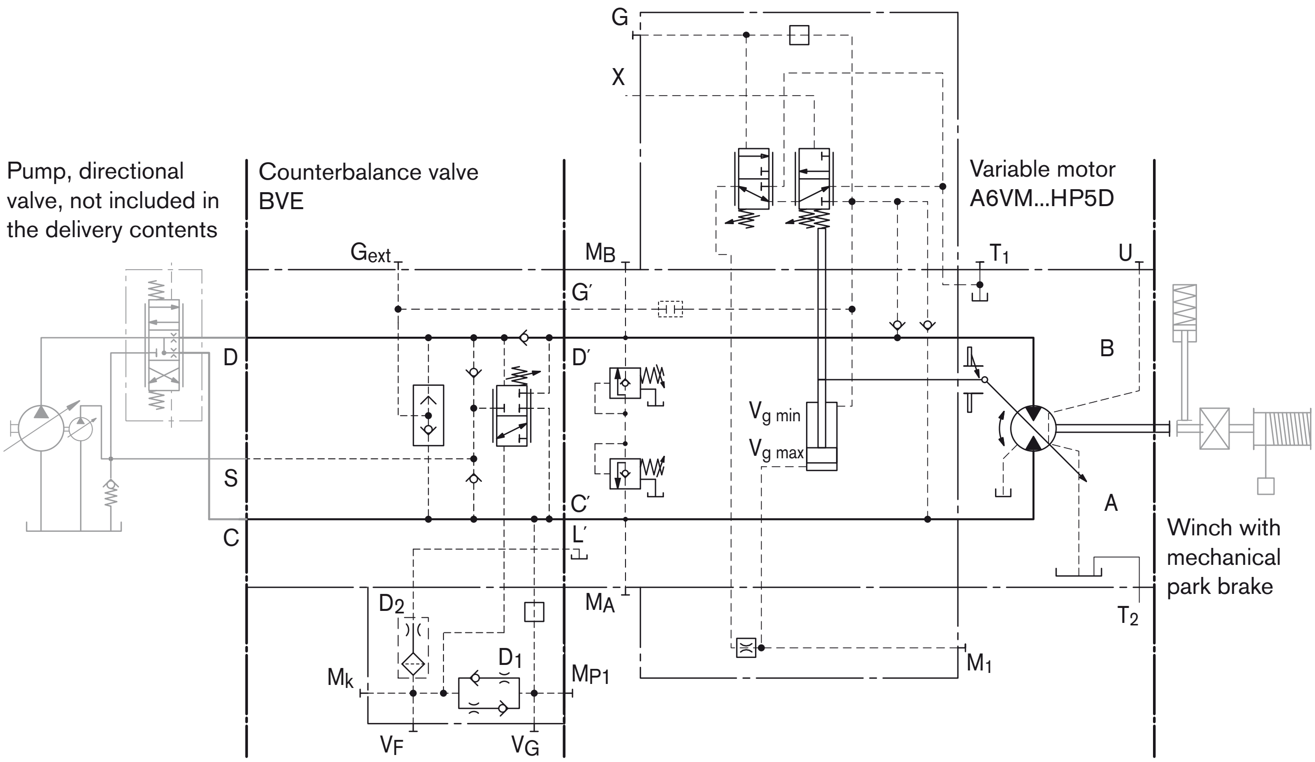
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A6VM085HP5D10001A/71AWV0C2S97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0



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

Motor NG	Without valve p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values in operation with DBV and BVD/BVE: DBV NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	BVD/BVE NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
60	6500/7250 (450/500)	73 (276)	22	5100/6100 (350/420)	63 (240)	7	20 (BVD)	5100/6100 (350/420)	58 (220)	7W
85		88 (332)								
115		108 (410)	32		106 (400)					
115		108 (410)				8	25 (BVD/BVE)		85 (320)	8W
150		131 (494)								
170		141 (533)								
215		166 (628)	On request							

DBV ______________________________ pressure-relief valve

BVD _________________counterbalance valve, double-acting

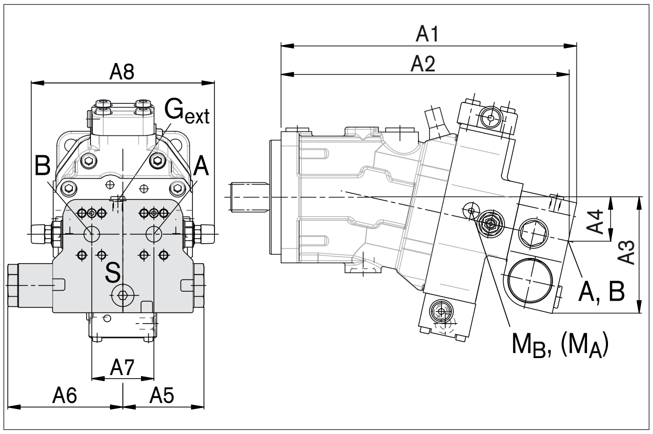
BVE ____________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

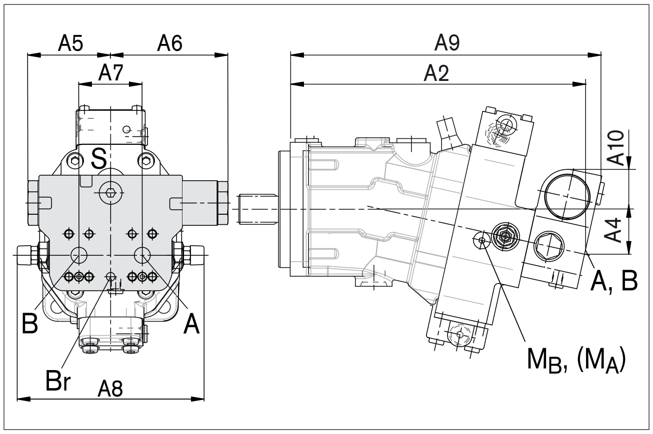
Before finalizing your design, request a binding installation drawing. Dimensions in inch (mm).

Dimensions

A6VM...HA, HP1, HP2 and EP1, EP2



A6VM...HP5, HP6 and EP5, EP6[1)]



A6VM	Counterbalance valve											
NG...plate	Type	Ports	Dimensions in inch (mm)									
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
60...7	BVD20...17	3/4 in	13.2(335)	12.8(326)	5.6(143)	2.0(50)	3.9(98)	5.5(139)	3.0(75)	8.7(222)	13.8(350)	2.0(50)
85...7	BVD20...27	1 in	14.3(364)	14.0(355)	5.8(148)	2.2(55)	3.9(98)	5.5(139)	3.0(75)	8.7(222)	14.9(379)	1.8(46)
115...7	BVD20...28	1 in	15.5(394)	15.2(385)	6.0(152)	2.3(59)	3.9(98)	5.5(139)	3.3(84)	9.2(234)	16.1(409)	1.6(41)
115...8	BVD25...38	1 1/4 in	16.2(412)	15.8(402)	6.5(165)	2.5(63)	4.7(120.5)	6.9(175)	3.3(84)	9.4(238)	16.8(427)	2.2(56)
150...8	BVD25...38	1 1/4 in	17.4(443)	17.0(433)	6.6(168)	2.6(67)	4.7(120.5)	6.9(175)	3.3(84)	9.4(238)	18.0(458)	2.1(53)
170...8	BVD25...38	1 1/4 in	17.7(449)	17.3(439)	6.7(170)	2.7(68)	4.7(120.5)	6.9(175)	3.3(84)	9.4(238)	18.3(464)	2.0(51)
215...8	BVD25...38	1 1/4 in	18.9(480)	18.5(470)	6.9(176)	2.9(74)	4.7(120.5)	6.9(175)	3.3(84)	11.7(299)	19.5(495)	1.8(46)
115...8	BVE25...38	1 1/4 in	16.2(412)	15.8(402)	6.7(171)	2.5(63)	5.4(137)	8.4(214)	3.3(84)	9.4(238)	16.9(429)	2.5(63)
150...8	BVE25...38	1 1/4 in	17.4(443)	17.0(433)	6.9(175)	2.6(67)	5.4(137)	8.4(214)	3.3(84)	9.4(238)	17.9(455)	2.3(59)
170...8	BVE25...38	1 1/4 in	17.7(449)	17.3(439)	6.9(176)	2.7(68)	5.4(137)	8.4(214)	3.3(84)	9.4(238)	18.3(464)	2.3(59)
215...8	BVE25...38	1 1/4 in	18.9(480)	18.5(470)	7.1(182)	3.0(74)	5.4(137)	8.4(214)	3.3(84)	11.7(299)	19.5(495)	2.0(52)

Ports

Designation	Port for	Version	A6VM plate	Standard	Size[2)]	Maximum pressure [psi (bar)][3)]	State[5)]
A, B	Service line			SAE J518	see table above	6100 (420)	O
S	Infeed	BVD20		DIN 3852[4)]	M22 x 1.5; 0.55 (14) deep	435 (30)	X
		BVD25, BVE25		DIN 3852[4)]	M27 x 2; 0.63 (16) deep	435 (30)	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4)]	M12 x 1.5; 0.49 (12.5) deep	435 (30)	O
			8	DIN 3852[4)]	M12 x 1.5; 0.47 (12) deep	435 (30)	O
G_{ext}	Brake release, high-pressure	S		DIN 3852[4)]	M12 x 1.5; 0.49 (12.5) deep	6100 (420)	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4)]	M18 x 1.5; 0.57 (14.5) deep	6100 (420)	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VM motor.
The designation of the ports on the installation drawing of the motor is binding!

2) Observe the general instructions on page 74 for the maximum tightening torques.

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

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

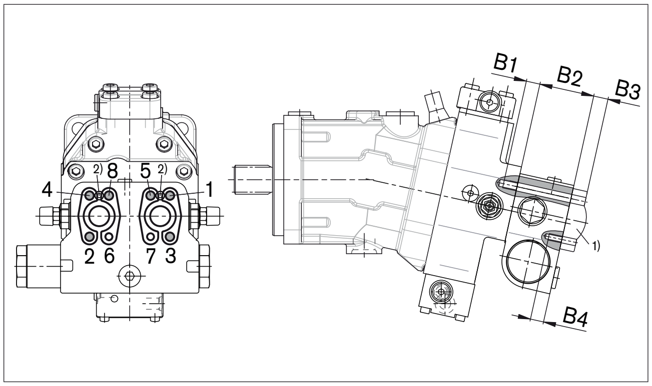
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the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

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

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

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

Thread	Strength class	Tightening torque [lb-ft (Nm)]
M6 x 1 (tacking screw)	10.9	11.4 (15.5)
M10	10.9	55.3 (75)
M12	10.9	95.9 (130)
M14	10.9	151.2 (205)



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG...plate	60...7	85...7 115...7	115...8, 150...8, 170...8
B1[3)]	M10 x 1.5 0.67 (17) deep	M12 x 1.75 0.59 (15) deep	M14 x 2 0.75 (19) deep
B2	2.68 (68)	2.68 (68)	3.35 (85)
B3	customer-specific		
B4	M10 x 1.5 0.59 (15) deep	M12 x 1.75 0.63 (16) deep	M14 x 2 0.75 (19) deep

3) Minimum required thread reach 1 x DIA-thread

Additional information of general instructions (page 74)

Ports Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\,max}$	Required tightening torque of the threaded plugs M_V	WAF hexagon socket of the threaded plugs
ISO 11926	9/16-18 UNF-2B	59 lb-ft	26 lb-ft	1/4 in
		80 Nm	35 Nm	
	7/8-14 UNF-2B	177 lb-ft	81 lb-ft	3/8 in
		240 Nm	110 Nm	
	1 1/16-12 UN-2B	266 lb-ft	125 lb-ft	9/16 in
		360 Nm	170 Nm	
	1 5/16-12 UN-2B	398 lb-ft	199 lb-ft	5/8 in
		540 Nm	270 Nm	
	1 5/8-12 UN-2B	708 lb-ft	236 lb-ft	3/4 in
		960 Nm	320 Nm	
DIN 3852	M12 x 1.5	37 lb-ft	18 lb-ft[1)2)]	0.24 in
		50 Nm	25 Nm[1)2)]	6 mm
	M22 x 1.5	155 lb-ft	59 lb-ft[1)]	0.39 in
		210 Nm	80 Nm[1)]	10 mm
	M27 x 2	243 lb-ft	100 lb-ft[1)]	0.47 in
		330 Nm	135 Nm[1)]	12 mm

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

Speed sensor

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

Version A6VM...U ("prepared for speed sensing", i.e. without sensor) is equipped with a toothed ring on the rotary group.

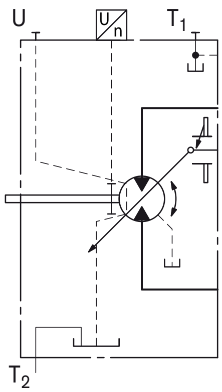
With the speed sensor DSM mounted, a signal proportional to motor speed can be generated.The DSM sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet (DSM – RE 95132).

The sensor is mounted on the port provided for this purpose with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.

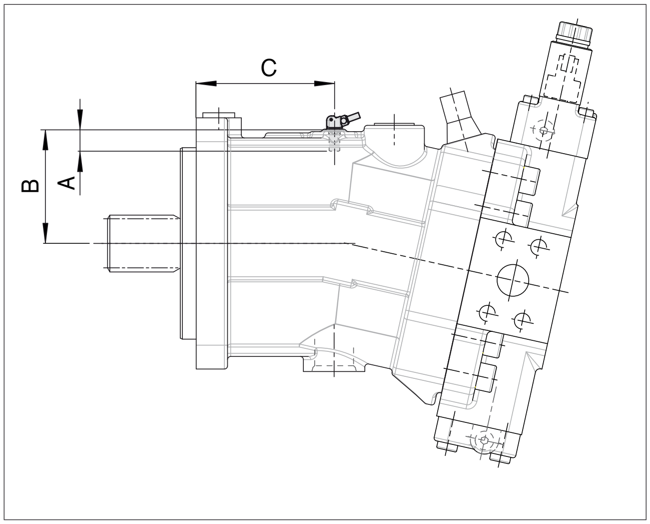
We recommend ordering the A6VM variable motor complete with sensor mounted.

Schematic



Dimensions

Version "V" with mounted speed sensor



Size		60	85	115	150	170	215
Number of teeth		54	58	67	72	75	80
A	Insertion depth tolerance -0.0098	0.72	0.72	0.72	0.72	0.72	0.72
	(-0.25)	(18.4)	(18.4)	(18.4)	(18.4)	(18.4)	(18.4)
B	Contact surface	2.95	3.11	3.46	3.66	3.78	3.98
		(75)	(79)	(88)	(93)	(96)	(101)
C		3.55	3.91	4.30	4.85	4.87	5.01
		(90.2)	(99.2)	(109.2)	(123.2)	(123.7)	(127.2)

Setting range for displacement

	60				85				115				150			
	$V_{g\,max}$ [in³/rev (cm³/rev)]		$V_{g\,min}$ [in³/rev (cm³/rev)]		$V_{g\,max}$ [in³/rev (cm³/rev)]		$V_{g\,min}$ [in³/rev (cm³/rev)]		$V_{g\,max}$ [in³/rev (cm³/rev)]		$V_{g\,min}$ [in³/rev (cm³/rev)]		$V_{g\,max}$ [in³/rev (cm³/rev)]		$V_{g\,min}$ [in³/rev (cm³/rev)]	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
A	3.78 (62.0)	3.78 (62.0)	0.0	0.92 (15.0)	5.20 (85.2)	5.20 (85.2)	0.0	1.92 (31.5)	7.05 (115.6)	7.05 (115.6)	0.0	1.46 (24.0)	9.28 (152.1)	9.28 (152.1)	0.0	2.68 (44.0)
	without screw		M10 x 60 R909154690		without screw		M12 x 70 R909085976		without screw		M12 x 70 R909085976		without screw		M12 x 80 R909153075	
B	3.78 (62.0)	3.78 (62.0)	> 0.92 (15.0)	1.86 (30.5)	5.20 (85.2)	5.20 (85.2)	> 1.92 (31.5)	3.17 (52.0)	7.05 (115.6)	7.05 (115.6)	> 1.46 (24.0)	2.90 (47.5)	9.28 (152.1)	9.28 (152.1)	> 2.68 (44.0)	4.21 (69.0)
	without screw		M10 x 70 R909153779		without screw		M12 x 80 R909153075		without screw		M12 x 80 R909153075		without screw		M12 x 90 R909154041	
C	3.78 (62.0)	3.78 (62.0)	> 1.86 (30.5)	2.62 43.0	5.20 (85.2)	5.20 (85.2)	> 3.17 (52.0)	3.60 (59.0)	7.05 (115.6)	7.05 (115.6)	> 2.90 (47.5)	4.33 (71.0)	9.28 (152.1)	9.28 (152.1)	> 4.21 (69.0)	6.04 (99.0)
	without screw		M10 x 80 R909154058		without screw		M12 x 90 R909154041		without screw		M12 x 90 R909154041		without screw		M12 x 100 R909153975	
D	x		x		x		x		7.05 (115.6)	7.05 (115.6)	> 4.33 (71.0)	4.88 (80.0)	9.28 (152.1)	9.28 (152.1)	> 6.04 (99.0)	6.47 (106.0)
									without screw		M12 x 100 R909153975		without screw		M12 x 110 R909154212	
E	< 3.78 (62.0)	2.90 (47.5)	0.0	0.92 (15.0)	< 5.20 (85.2)	3.39 (55.5)	0.0	1.92 (31.5)	< 7.05 (115.6)	5.71 (93.5)	0.0	1.46 (24.0)	< 9.28 (152.1)	6.77 (111.0)	0.0	2.68 (44.0)
	M10 x 60 R909154690		M10 x 60 R909154690		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 80 R909153075	
F	< 3.78 (62.0)	2.90 (47.5)	> 0.92 (15.0)	1.86 (30.5)	< 5.20 (85.2)	3.39 (55.5)	> 1.92 (31.5)	3.17 (52.0)	< 7.05 (115.6)	5.71 (93.5)	> 1.46 (24.0)	2.90 (47.5)	< 9.28 (152.1)	6.77 (111.0)	> 2.68 (44.0)	4.21 (69.0)
	M10 x 60 R909154690		M10 x 70 R909153779		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041	
G	< 3.78 (62.0)	2.90 (47.5)	> 1.86 (30.5)	2.62 43.0	< 5.20 (85.2)	3.39 (55.5)	> 3.17 (52.0)	3.60 (59.0)	< 7.05 (115.6)	5.71 (93.5)	> 2.90 (47.5)	4.33 (71.0)	< 9.28 (152.1)	6.77 (111.0)	> 4.21 (69.0)	6.04 (99.0)
	M10 x 60 R909154690		M10 x 80 R909154058		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 100 R909153975	
H	x		x		x		x		< 7.05 (115.6)	5.71 (93.5)	> 4.33 (71.0)	4.88 (80.0)	< 9.28 (152.1)	6.77 (111.0)	> 6.04 (99.0)	6.47 (106.0)
									M12 x 70 R909085976		M12 x 100 R909153975		M12 x 80 R909153075		M12 x 110 R909154212	
J	< 2.90 (47.5)	2.01 (33.0)	0.0	0.92 (15.0)	< 3.39 (55.5)	2.14 (35.0)	0.0	1.92 (31.5)	< 5.71 (93.5)	4.33 (71.0)	0.0	1.46 (24.0)	< 6.77 (111.0)	5.31 (87.0)	0.0	2.68 (44.0)
	M10 x 70 R909153779		M10 x 60 R909154690		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 2.90 (47.5)	2.01 (33.0)	> 0.92 (15.0)	1.86 (30.5)	< 3.39 (55.5)	2.14 (35.0)	> 1.92 (31.5)	3.17 (52.0)	< 5.71 (93.5)	4.33 (71.0)	> 1.46 (24.0)	2.90 (47.5)	< 6.77 (111.0)	5.31 (87.0)	> 2.68 (44.0)	4.21 (69.0)
	M10 x 70 R909153779		M10 x 70 R909153779		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909154041	
L	< 2.90 (47.5)	2.01 (33.0)	> 1.86 (30.5)	2.62 43.0	< 3.39 (55.5)	2.14 (35.0)	> 3.17 (52.0)	3.60 (59.0)	< 5.71 (93.5)	4.33 (71.0)	> 2.90 (47.5)	4.33 (71.0)	< 6.77 (111.0)	5.31 (87.0)	> 4.21 (69.0)	6.04 (99.0)
	M10 x 70 R909153779		M10 x 80 R909154058		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909154041		M12 x 100 R909153975	
M	x		x		x		x		< 5.71 (93.5)	4.33 (71.0)	> 4.33 (71.0)	4.88 (80.0)	< 6.77 (111.0)	5.31 (87.0)	> 6.04 (99.0)	6.47 (106.0)
									M12 x 80 R909153075		M12 x 100 R909153975		M12 x 90 R909154041		M12 x 110 R909154212	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... in³ (cm³), $V_{g\,max}$ = ... in³ (cm³)

Theoretical, maximum setting: for $V_{g\,min} = 0.7 \cdot V_{g\,max}$
for $V_{g\,max} = 0.3 \cdot V_{g\,max}$

Settings that are not listed in the table may lead to damage. Please contact us.

Setting range for displacement

	170				215			
	$V_{g\ max}$ [in³/rev (cm³/rev)]		$V_{g\ min}$ [in³/rev (cm³/rev)]		$V_{g\ max}$ [in³/rev (cm³/rev)]		$V_{g\ min}$ [in³/rev (cm³/rev)]	
	from	to	from	to	from	to	from	to
A	10.48 (171.8)	10.48 (171.8)	0.0	2.14 (35.0)	13.21 (216.5)	13.21 (216.5)	0.0	2.72 (44.5)
	without screw		M12 x 80 R909153075		without screw		M12 x 80 R909153075	
B	10.48 (171.8)	10.48 (171.8)	> 2.14 (35.0)	3.87 (63.5)	13.21 (216.5)	13.21 (216.5)	> 2.72 (44.5)	4.88 (80.0)
	without screw		M12 x 90 R909154041		without screw		M12 x 90 R909154041	
C	10.48 (171.8)	10.48 (171.8)	> 3.87 (63.5)	5.98 (98.0)	13.21 (216.5)	13.21 (216.5)	> 4.88 (80.0)	7.02 (115.0)
	without screw		M12 x 100 R909153975		without screw		M12 x 100 R909153975	
D	10.48 (171.8)	10.48 (171.8)	> 5.98 (98.0)	9.15 (150.0)	13.21 (216.5)	13.21 (216.5)	> 7.02 (115.0)	9.15 (150.0)
	without screw		M12 x 110 R909154212		without screw		M12 x 110 R909154212	
E	< 10.48 (171.8)	8.48 (139.0)	0.0	2.14 (35.0)	< 13.21 (216.5)	10.68 (175.0)	0.0	2.72 (44.5)
	M12 x 80 R909153075		M10 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075	
F	< 10.48 (171.8)	8.48 (139.0)	> 2.14 (35.0)	3.87 (63.5)	< 13.21 (216.5)	10.68 (175.0)	> 2.72 (44.5)	4.88 (80.0)
	M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041	
G	< 10.48 (171.8)	8.48 (139.0)	> 3.87 (63.5)	5.98 (98.0)	< 13.21 (216.5)	10.68 (175.0)	> 4.88 (80.0)	7.02 (115.0)
	M12 x 80 R909153075		M12 x 100 R909153975		M12 x 80 R909153075		M12 x 100 R909153975	
H	< 10.48 (171.8)	8.48 (139.0)	> 5.98 (98.0)	7.32 (120.0)	< 13.21 (216.5)	10.68 (175.0)	> 7.02 (115.0)	9.15 (150.0)
	M12 x 80 R909153075		M12 x 110 R909154212		M12 x 80 R909153075		M12 x 110 R909154212	
J	< 8.48 (139.0)	6.83 (112.0)	0.0	2.14 (35.0)	< 10.68 (175.0)	8.60 (141.0)	0.0	2.72 (44.5)
	M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 8.48 (139.0)	6.83 (112.0)	> 2.14 (35.0)	3.87 (63.5)	< 10.68 (175.0)	8.60 (141.0)	> 2.72 (44.5)	4.88 (80.0)
	M12 x 90 R909154041		M12 x 90 R909154041		M12 x 90 R909154041		M12 x 90 R909154041	
L	< 8.48 (139.0)	6.83 (112.0)	> 3.87 (63.5)	5.98 (98.0)	< 10.68 (175.0)	8.60 (141.0)	> 4.88 (80.0)	7.02 (115.0)
	M12 x 90 R909154041		M12 x 100 R909153975		M12 x 90 R909154041		M12 x 100 R909153975	
M	< 8.48 (139.0)	6.83 (112.0)	> 5.98 (98.0)	7.32 (120.0)	< 10.68 (175.0)	8.60 (141.0)	> 7.03 (115.0)	9.15 (150.0)
	M12 x 90 R909154041		M12 x 110 R909154212		M12 x 90 R909154041		M12 x 110 R909154212	

Specify exact settings for $V_{g\ min}$ and $V_{g\ max}$ in plain text when ordering: $V_{g\ min}$ = ... in³ (cm³), $V_{g\ max}$ = ... in³ (cm³)

Theoretical, maximum setting: for $V_{g\ min} = 0.7 \cdot V_{g\ max}$
for $V_{g\ max} = 0.3 \cdot V_{g\ max}$

Settings that are not listed in the table may lead to damage. Please contact us.

Installation instructions

General

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

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

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

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

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

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

Installation position

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

Recommended installation position: 1 and 2.

Note
In certain installation positions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

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

L_1 Filling / air bleed

U Bearing flushing / air bleed port

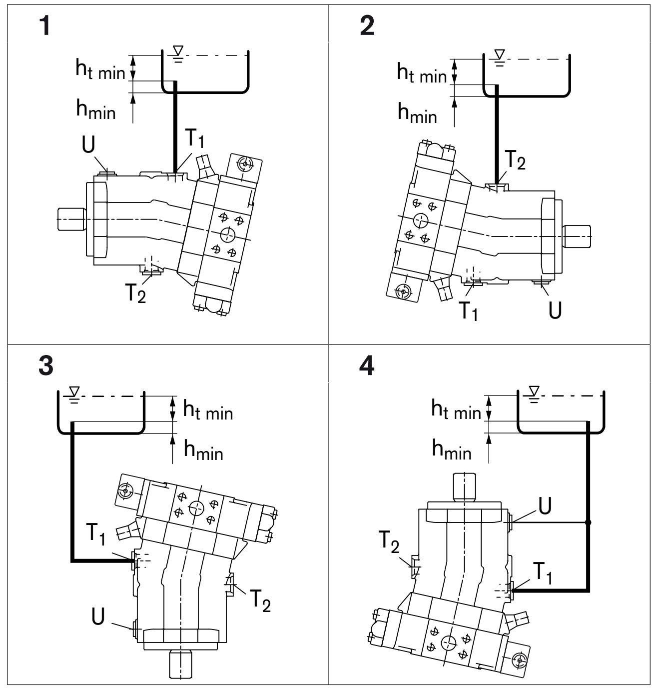
T_1, T_2 Drain port

$h_{t\,min}$ Minimum required immersion depth (7.87 inch (200 mm))

h_{min} Minimum required spacing to reservoir bottom (3.94 inch (100 mm))

Below-reservoir installation (standard)

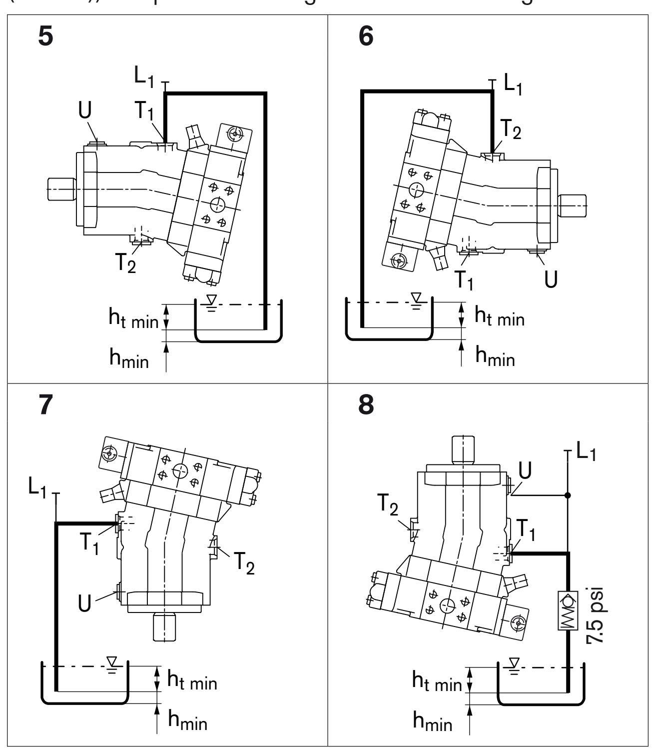
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

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

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



General instructions

Ports Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\ max}$	Required tightening torque of the threaded plugs M_V	WAF hexagon socket of the threaded plugs
ISO 11926	9/16-18 UNF-2B	59 lb-ft	26 lb-ft	1/4 in
		80 Nm	35 Nm	
	7/8-14 UNF-2B	177 lb-ft	81 lb-ft	3/8 in
		240 Nm	110 Nm	
	1 1/16-12 UN-2B	266 lb-ft	125 lb-ft	9/16 in
		360 Nm	170 Nm	
	1 5/16-12 UN-2B	398 lb-ft	199 lb-ft	5/8 in
		540 Nm	270 Nm	
	1 5/8-12 UN-2B	708 lb-ft	236 lb-ft	3/4 in
		960 Nm	320 Nm	
DIN 3852	M12 x 1.5	37 lb-ft	18 lb-ft[1)2)]	0.24 in
		50 Nm	25 Nm[1)2)]	6 mm
	M22 x 1.5	155 lb-ft	59 lb-ft[1)]	0.39 in
		210 Nm	80 Nm[1)]	10 mm
	M27 x 2	243 lb-ft	100 lb-ft[1)]	0.47 in
		330 Nm	135 Nm[1)]	12 mm

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

General instructions

– The motor A6VM is designed to be used in open and closed circuits.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

  - The service line ports and function ports can only be used to accommodate hydraulic lines.

– The data and notes contained herein must be adhered to.

– Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. If you require characteristic values relating to reliability (e. g. $MTTF_d$) for functional safety, please consult the responsible contact person at Bosch Rexroth.

– The following tightening torques apply:

  - Fittings:
    Observe the manufacturer's instructions regarding the tightening torques of the fittings used.

  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13 or 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 of the female threads and must not be exceeded. For values, see table on page 73.

  - 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 table on page 73.

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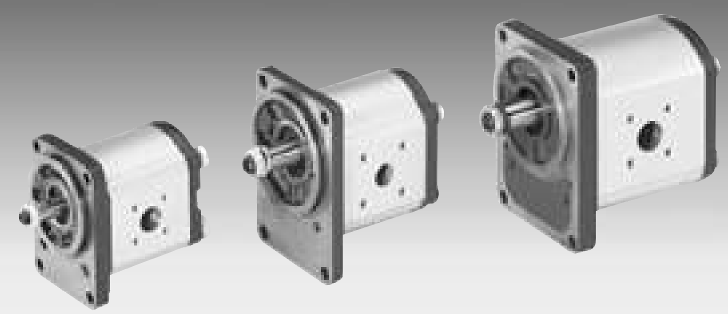
Rexroth
Bosch Group

External Gear Motors

RE 14 026/05.09
Replaces:
RE 14 026/01.05

AZMF ..., AZMN ..., AZMG ...

Model F = 8 ... 22.5 cm^3/rev
N = 25 und 28 cm^3/rev
G = 22.5 ... 45 cm^3/rev



Contents

Page

General

Rexroth external gear motors are produced in 3 different models, with different displacements being produced by means of gears of differing widths.
Different versions of motors are achieved by the use of different flanges, shafts, valves and integrated speed sensors.

Features

- High pressures combined with small size and low weight
- Large speed ranges
- Broad viscosity and temperature ranges
- Reversible motors for 2- and 4-quadrant operation

Fields of application

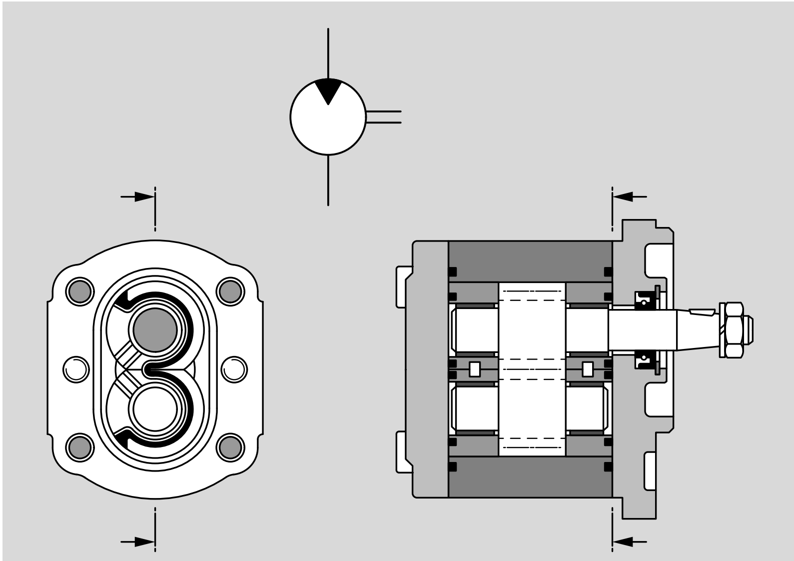
- Road construction machines as road rollers and pavers
- Agricultural machines and forestry technology as harvesters and forestry machines
- Street vehicles such as busses, trucks and special vehicles and above all in hydrostatic fan drives.

Function

If pressurized oil is fed into the motor, a torque can be obtained from the shaft leading out of the housing. Here, a distinction is made between motors that rotate on one direction and reversible motors.

External gear motors that rotate in one direction

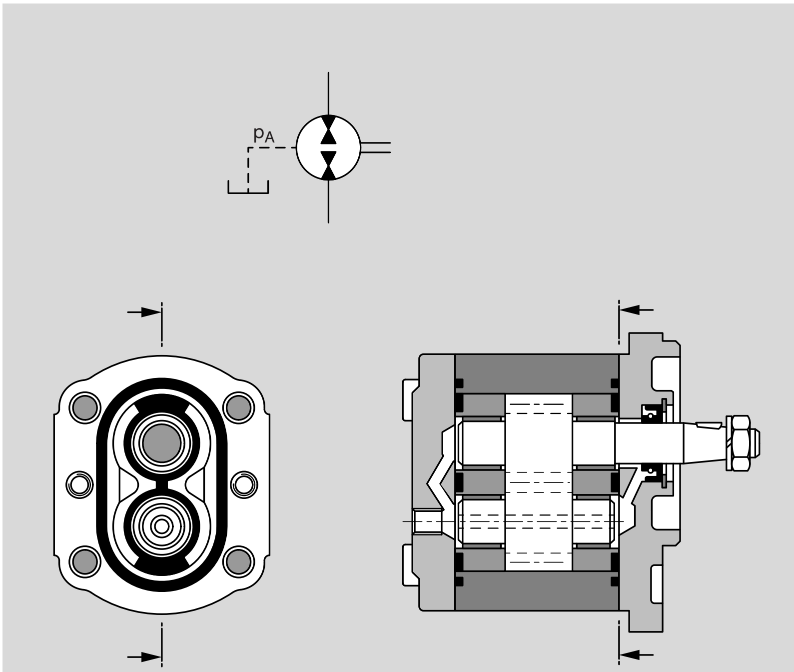
These are of asymmetrical design, i.e. the high and low pressure sides are defined and not interchangeable at will. In this case, reversible operation is not possible. In order to ensure a high efficiency level, a special running-in method is used for motors. Leakage oil is discharged internally to the outlet side. Pressure loading of the outlet is limited by the shaft seal.



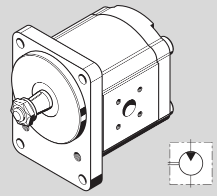
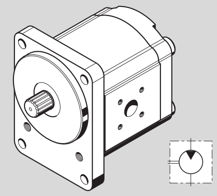
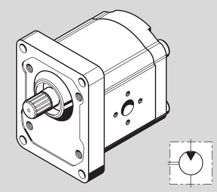
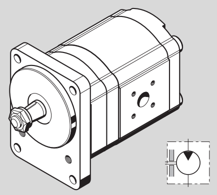
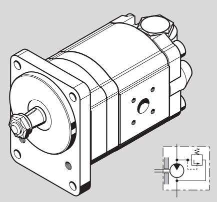
Reversible external gear motors

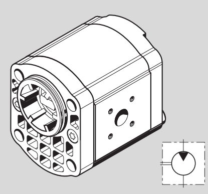
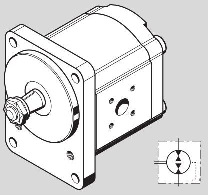
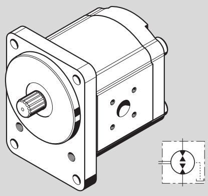
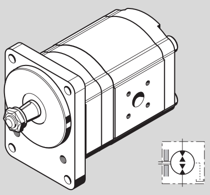
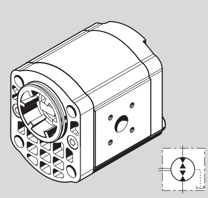
The displacement method in external gear motors is the reverse of the pump process. Reversible motors have a special feature, however. Their symmetrical construction means that the high or low pressure chambers are separate from the bearing and shaft seal chamber. The resulting leakage oil is routed through a separate oil drain gland in the housing cover. This oil drainage enables the motor to be subjected to load via the return line, which in turn allows the use of series connections. Due to the connection between the shaft seal and the low-pressure end, however, standard motors and pumps can only withstand a pressure of up to approx. 3 bar.

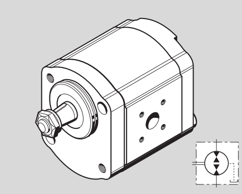
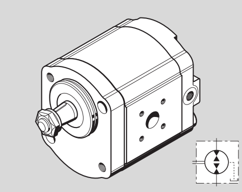
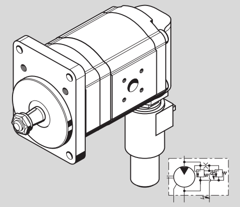
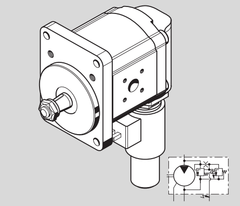
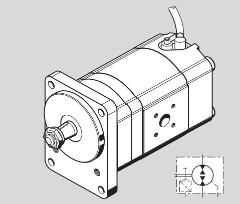
The figure shows a reversible gear motor for 4-quadrant operation, i.e. both output and input torque in both directions. (Hydraulic motor becomes a pump if load reversal occurs.)



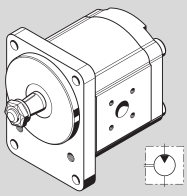
Product overview “Model F” preferential range

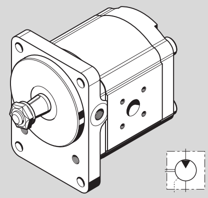
Version	Page
	19
	20
	21
	22
	23

Version	Page
	24
	25
	26
	27
	28

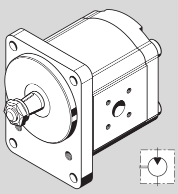
Version	Page
	29
	30
	31
	32
	34

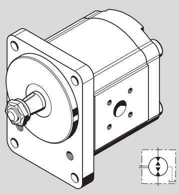
Product overview “Model N” preferential range

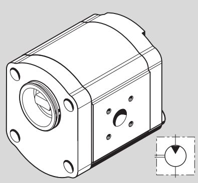
Version	Page
	35

Version	Page
	36

Product overview “Model G” preferential range

Version	Page
	37

Version	Page
	38

Version	Page
	39

Ordering code

External Gear Motors Model “F”

AZ	M	F	–	1x	–	022	R	C	B	20	M	B	200xx	–	S0001

Function

M = Motor

Series

1x = Standard bearing

Size (F)

8.0 cm³/rev	= **008**
11.0 cm³/rev	= **011**
14.0 cm³/rev	= **014**
16.0 cm³/rev	= **016**
19.0 cm³/rev	= **019**
22.5 cm³/rev	= **022**

Direction of rotation

Right	= **R**
Left	= **L**
Universal	= **U**

*) The special equipments partly contained on the pages 20–35, are not considered in the representation of the ordering code.

Special design*)

Valve adjustment

PRV 200 bar	= **200 xx**
PRV	= **180 xx**

Rear cover

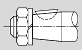
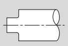
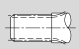
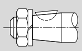
Standard	= **B**
PRV	= **G**
drain oil line connection (axial)	= **L**
PRV excess flow internal	= **D**

Seals

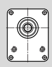
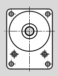
NBR	= **M**
FPM	= **P**
NBR, WDR in FPM	= **K**

Drive shafts

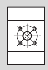
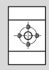
suitable front cover

C	Tapered keyed shaft 1 : 5		**B** **P**
N	Tang drive		**T**
F	Spline shaft DIN 5482 B 17 x 14		**B** **P**
S	Tapered keyed shaft 1 : 5 for flange A		**A**

Front cover

B	Square flange Centring Ø 80 mm	
P	2-bolt mounting Centring Ø 50 mm	
O	Square flange Centring Ø 36.47 mm	
A	Outboard bearing Ø 80 mm, Type 1	
N	2-bolt mounting Centring Ø 50 mm	
T	4-bolt mounting Ø 52 mm, with O-ring	

Port connections

20	Rectangular flange	
30	Rectangular flange	

Ordering code

External Gear Motors Model "N"

AZ	M	N	–	1x	–	020	R	C	B	20	M	B		–	S0001

Function
M = Motor

Series
1x = Standard bearing

Size (N)

25.0 cm³/rev	= **025**
28.0 cm³/rev	= **028**

Direction of rotation

Right	= **R**
Left	= **L**

Special design

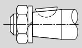
Rear cover

Standard	= **B**
Special design	= **X**

Seals

NBR	= **M**
FPM	= **P**

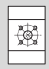
Drive shafts

			suitable front cover
C	Tapered keyed shaft 1 : 5		**B**

Front cover

B	Square flange Centring Ø 100 mm	

Port connections

20	Rectangular flange	

External Gear Motors Model "G"

AZ	M	G	–	1x	–	022	R	C	B	20	M	B		–	S0001

Function
M = Motor

Model
G = 22.5...56 cm³/rev

Size (G)

22.5 cm³/rev	= **022**
28.0 cm³/rev	= **028**
32.0 cm³/rev	= **032**
45.0 cm³/rev	= **045**

Direction of rotation

Right	= **R**
Left	= **L**
Universal	= **U**

Special design

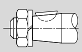
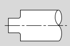
Rear cover

Standard	= **B**
Special design	= **X**

Seals

NBR	= **M**
NBR, WDR in FPM	= **K**

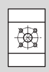
Drive shafts

			suitable front cover
C	Tapered keyed shaft 1 : 5		**B**
N	Tang drive		**M**

Front cover

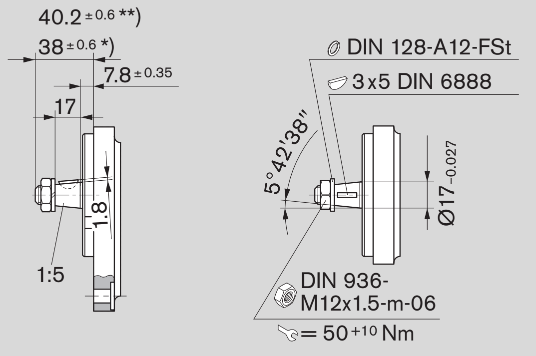
B	Square flange Centring Ø 105 mm	
M	2-bolt mounting Ø 52 mm, with O-ring	

Port connections

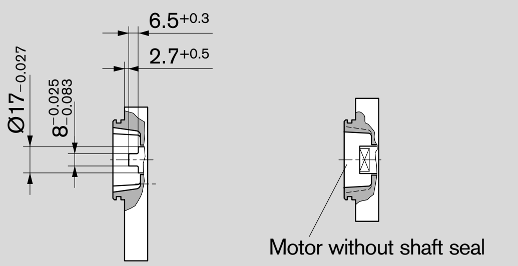
20	Rectangular flange	

Drive shaft model "F"

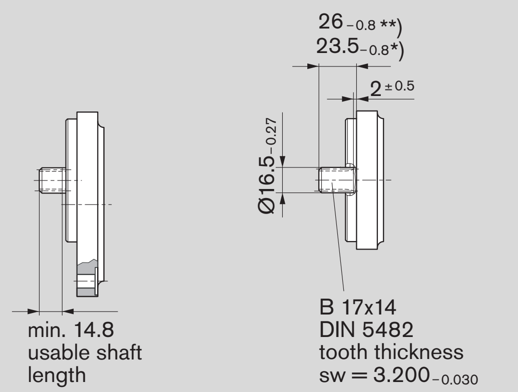
C



N



F



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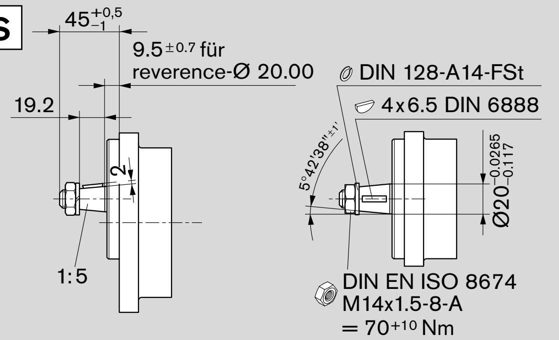
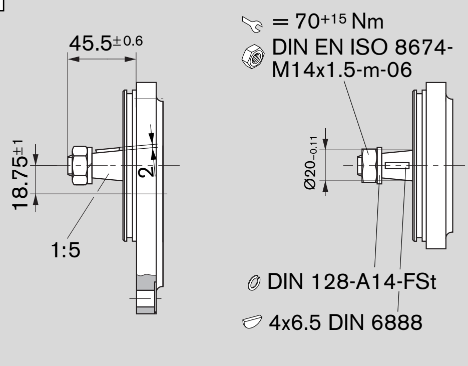


Drive shaft model "N"

C

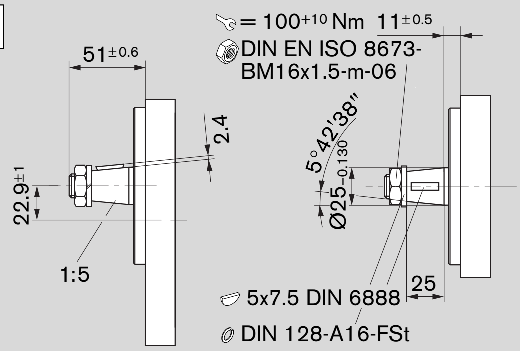


*) in combination with front cover B

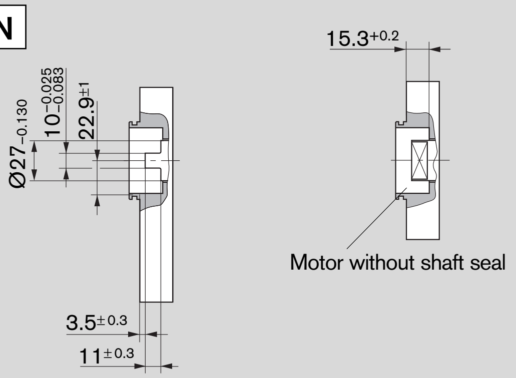
**) in combination with front cover P

Drive shaft model "G"

C

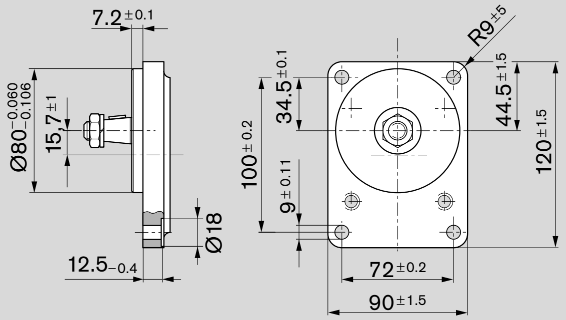


N

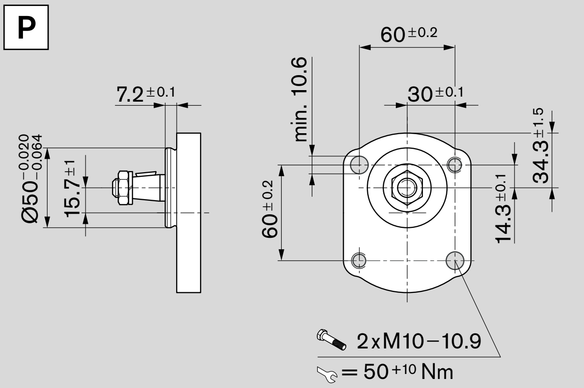


Front cover model “F”

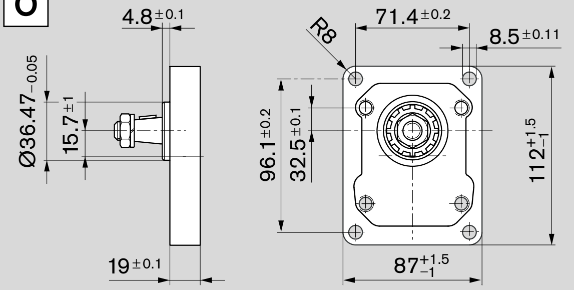
B



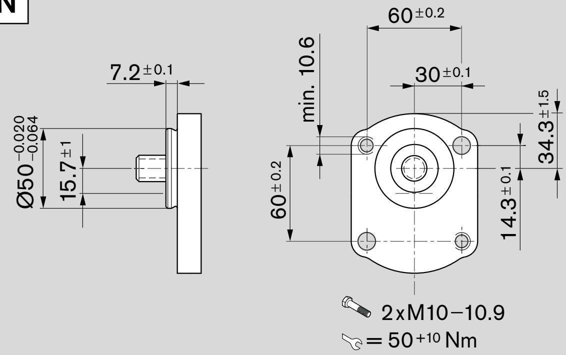
P



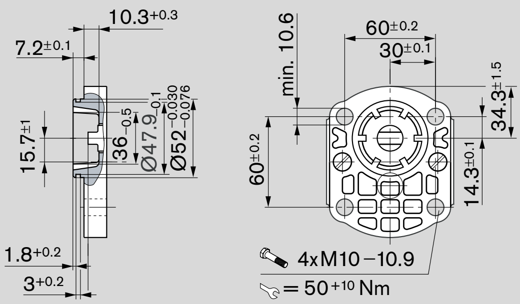
O



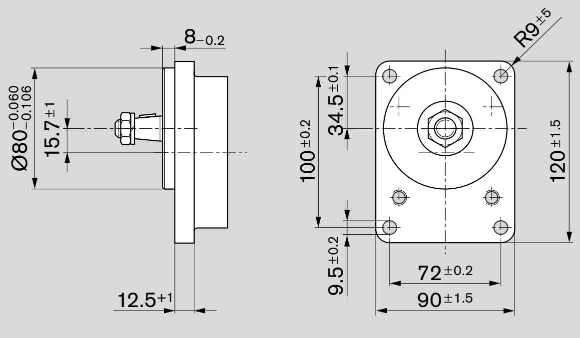
N



T

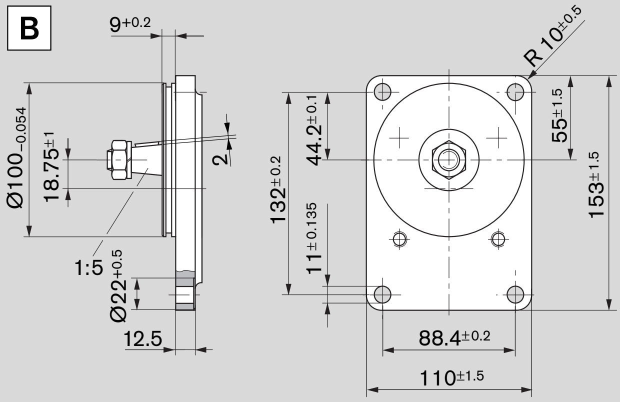


A

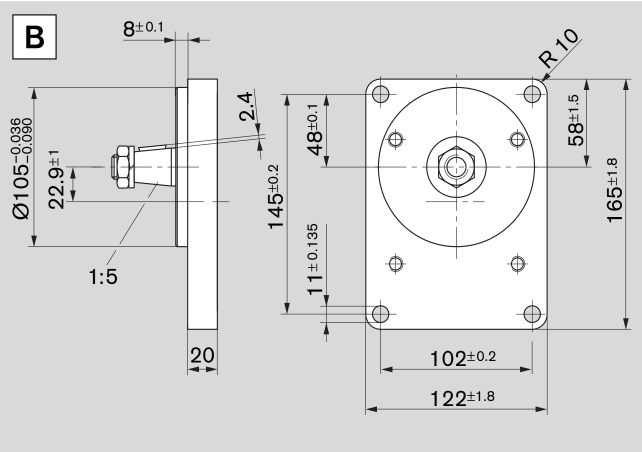


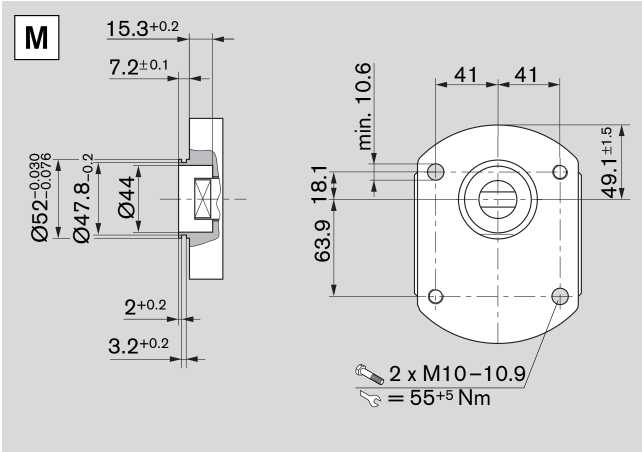
Front cover model “N”

B

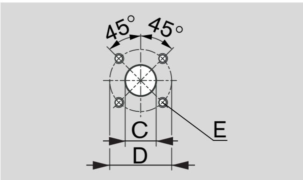


Front cover model “G”





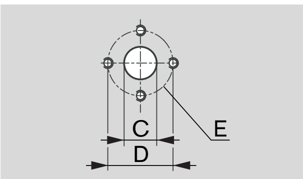
Port connections



20 **Rectangular flange**

Synopsis of Type	**Size**	**Inlet side** C	D	E	**Outlet side** C	D	E
20	8.0 ... 22.5 cm³	15	35	M6 utilizable depth 13	20	40	M6 utilizable depth 13
	22.5 ... 45.0 cm³	18	55	M8 utilizable depth 13	26	55	M8 utilizable depth 13

Synopsis of Type	**Size**	**Port connections** (direction of rotation universal) C	D	E
20	8.0 ... 22.5 cm³	15	35	M6 utilizable depth 13
	22.5 ... 45.0 cm³	18	55	M8 utilizable depth 13

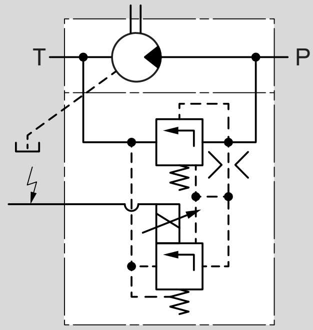


30 **Rectangular flange**

Synopsis of Type	**Size**	**Inlet side** C	D	E C	**Outlet side** D	E	
30	4 ... 8 cm³	13.5	30.2	M6 utilizable depth 13	13.5	30.2	M6 utilizable depth 13
	11 ... 28 cm³				20.0	39.7	M8 utilizable depth 13

External gear motors with integrated valves, sensors





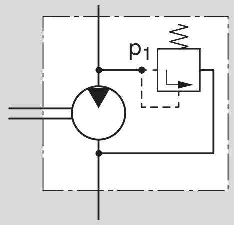
Pages 31, 32

Gear motor with integrated, pilot-operated proportional pressure relief valve and rotary shaft seal relieved of load thanks to the three-chamber design.
The use of gear motors without this relief of the rotary shaft seal is not recommended due to the loads from the oil return line, particularly when the oil is cold. The basis of this drive unit is a motor model “F”. The pilot proportional pressure relief valve is integrated in the rear end cover. This unit has the following advantages:

– No pipework necessary for the functioning of the prop. pressure relief valve
– Integrated pressure relief
– Fail-safe function in the event of power loss
– Drag speed virtually zero
– Motor speed prop. controllable
– Unaffected by pressure loads from the outlet

Additional information see:
Hydrostatic fan drives 1 987 761 700
http://www.boschrexroth.com/brm

External gear motors with pressure relief valve

return port pressure < 3 bar (10 bar at starting)

Page 23

External gear motors with integrated speed sensor

Page 34

The DSM1-10 Hall-effect speed sensor was specially developed for tough use in mobile work machines. The sensor detects the speed signal of ferromagnetic gear wheels. In this process, as an active sensor, it supplies a signal with constant amplitude independent of the rotational speed.
Due to its compact, sturdy design, the gear motor with integrated sensor is suitable for the applications such as

– In fan drives for buses, trucks and construction machinery from 7 to 20 kW
– As a vibration drive for road rollers and road construction machinery

For additional information see: **Speed Sensor DSM RE 95 132**
http://www.boschrexroth.com/brm

Design calculations for motors

The design calculations for motors are based on the following parameters:

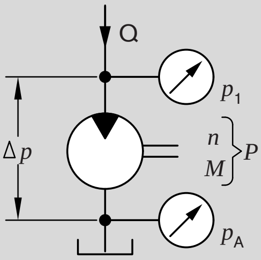
V	[cm³/rev]	Displacement
Q	[l/min]	Inlet flow rate
p	[bar]	Pressure (p_1, p_A)
M	[Nm]	Output torque
n	[rev/min]	Output speed
P	[kW]	Output power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Mechanical-hydraulic efficiency
η_t	Total efficiency

The following formulas describe the various relationships. They include correction factors for adapting the parameters to the usual units encountered in practice.

Note: Diagrams providing approximate selection data can be found on subsequent pages. These graphs contain the levels of efficiency in each case.



$$Q = \frac{V \cdot n}{\eta_v} \cdot 10^{-1} \qquad V = \frac{Q \cdot \eta_v}{n} \cdot 10 \qquad n = \frac{Q \cdot \eta_v}{V} \cdot 10$$

$$\Delta p = \frac{M}{1.59 \cdot V \cdot \eta_{hm}} \cdot 10^4 \qquad V = 1.59 \cdot \frac{M}{\Delta p \cdot \eta_{hm}} \cdot 10^4 \qquad M = 1.59 \cdot V \cdot \Delta p \cdot \eta_{hm} \cdot 10^{-4}$$

$$P = \frac{Q \cdot \Delta p \cdot \eta_t}{6} \cdot 10^{-4}$$

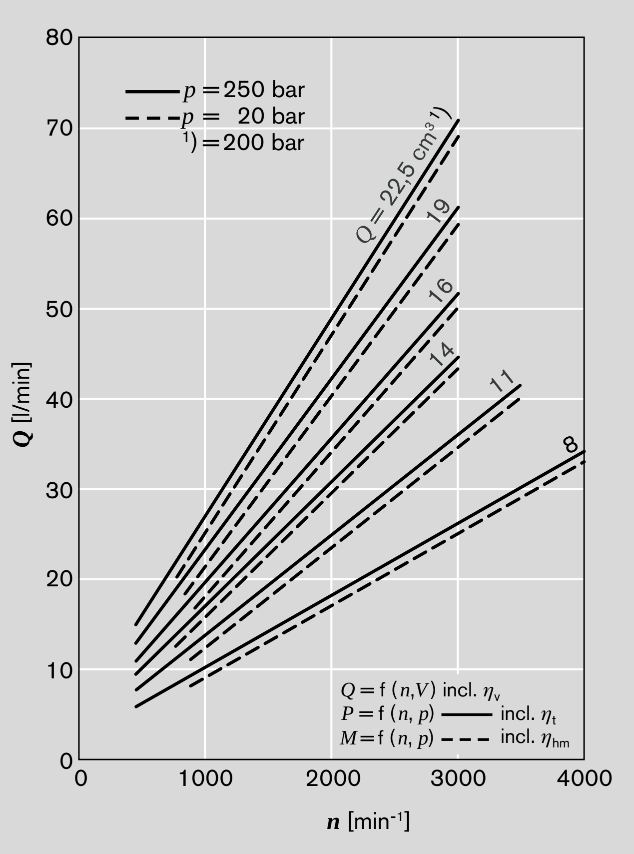
	[%]	
Q	η_v	$\rightarrow n$
Δp	η_{hm}	$\rightarrow M$
$\Delta p \cdot Q$	η_t	$\rightarrow P$

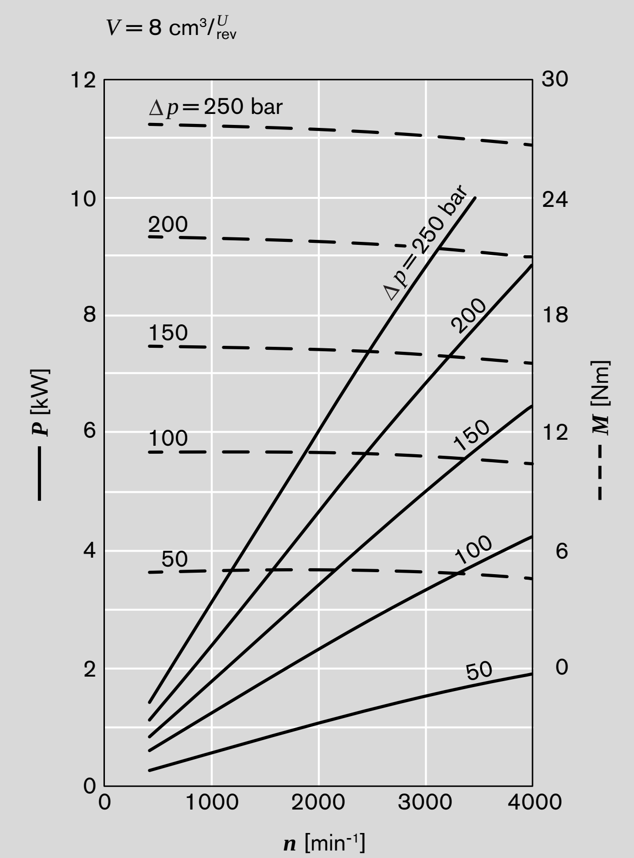
V [cm³/rev] Q [l/min] Δp [bar] **Note:** η [%]

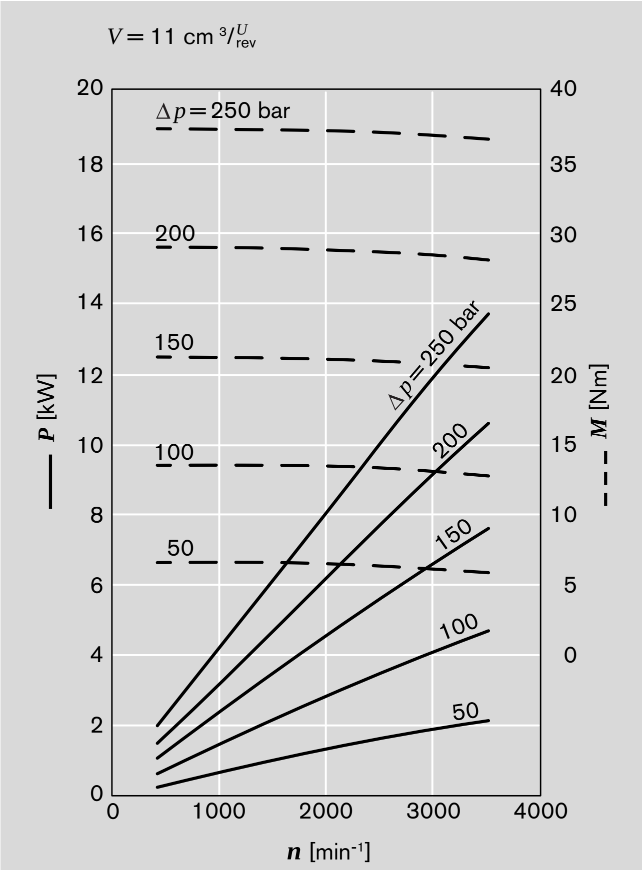
n [rev/min] P [kW] M [Nm]

Diagrams Model "F"

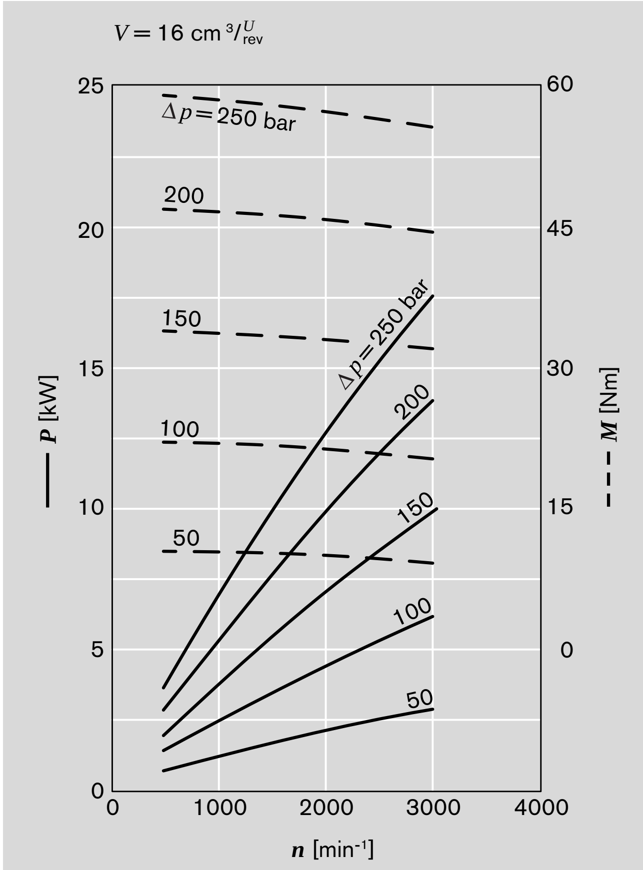
$\upsilon = 35$ mm²/s, $T = 50$ °C



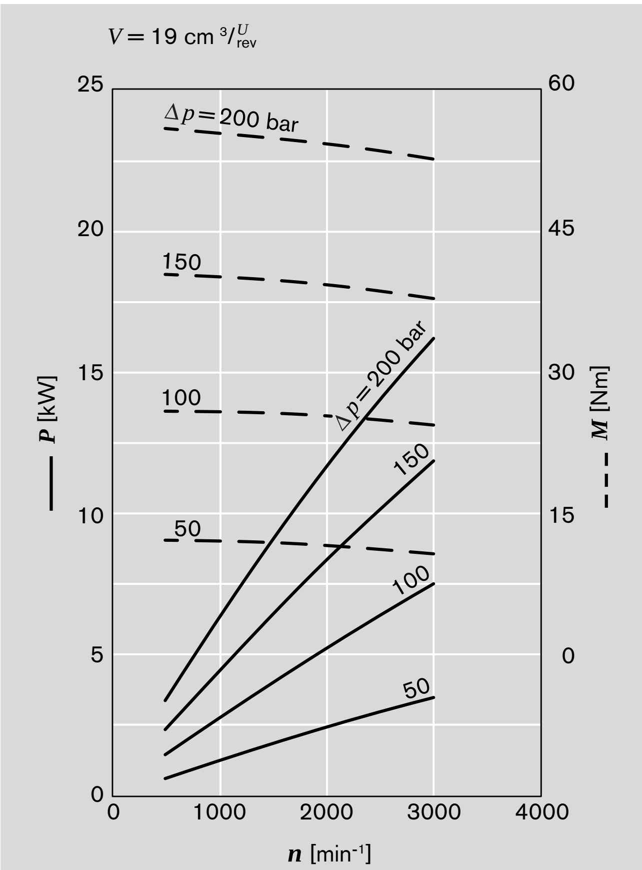




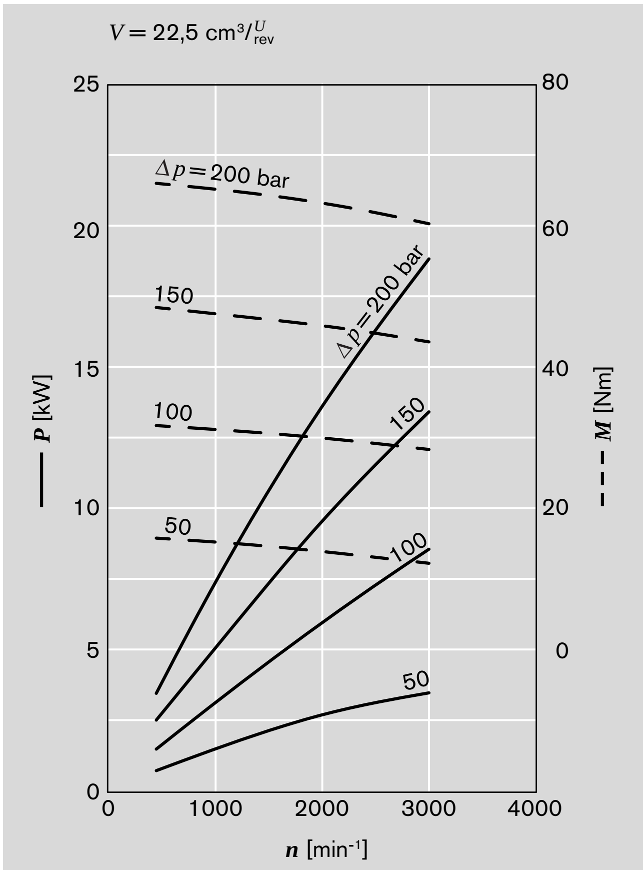
$V = 11$ cm $^3/_{rev}^U$
$\Delta p = 250$ bar
200
150
100
50
$\Delta p = 250$ bar
200
150
100
50
P [kW]
M [Nm]
n [min⁻¹]



$V = 16$ cm $^3/_{rev}^U$
$\Delta p = 250$ bar
200
150
100
50
$\Delta p = 250$ bar
200
150
100
50
P [kW]
M [Nm]
n [min⁻¹]



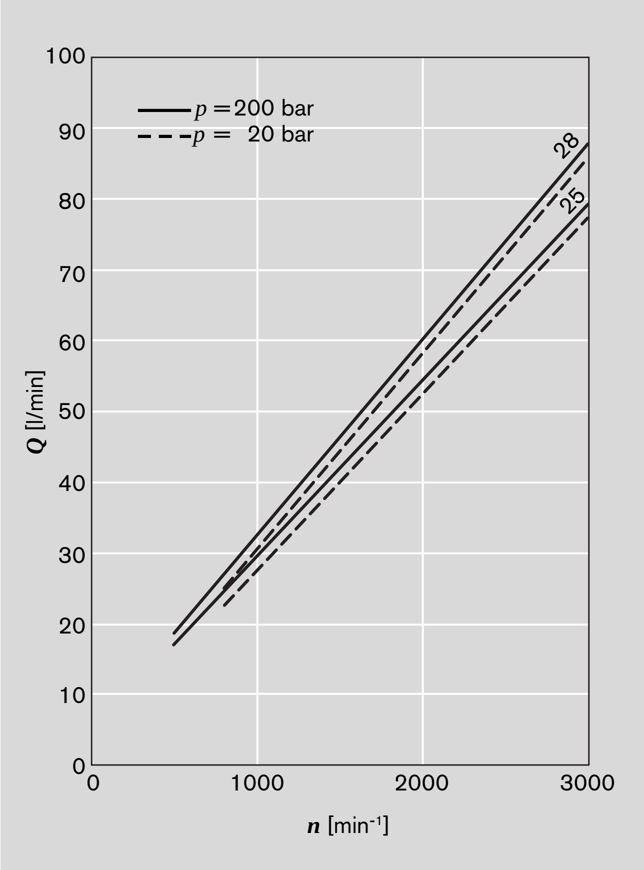
$V = 19$ cm $^3/_{rev}^U$
$\Delta p = 200$ bar
150
100
50
$\Delta p = 200$ bar
150
100
50
P [kW]
M [Nm]
n [min⁻¹]



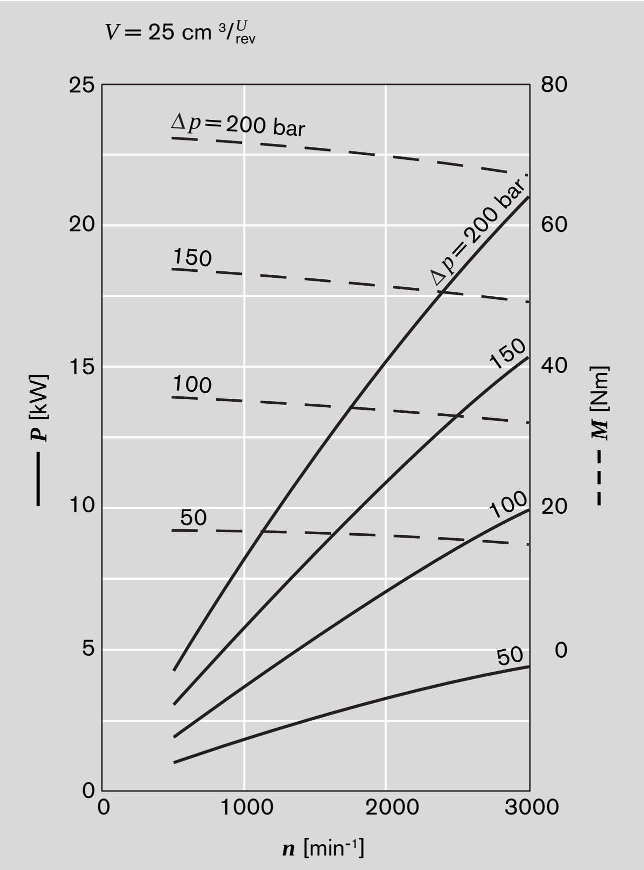
$V = 22{,}5$ cm $^3/_{rev}^U$
$\Delta p = 200$ bar
150
100
50
$\Delta p = 200$ bar
150
100
50
P [kW]
M [Nm]
n [min⁻¹]

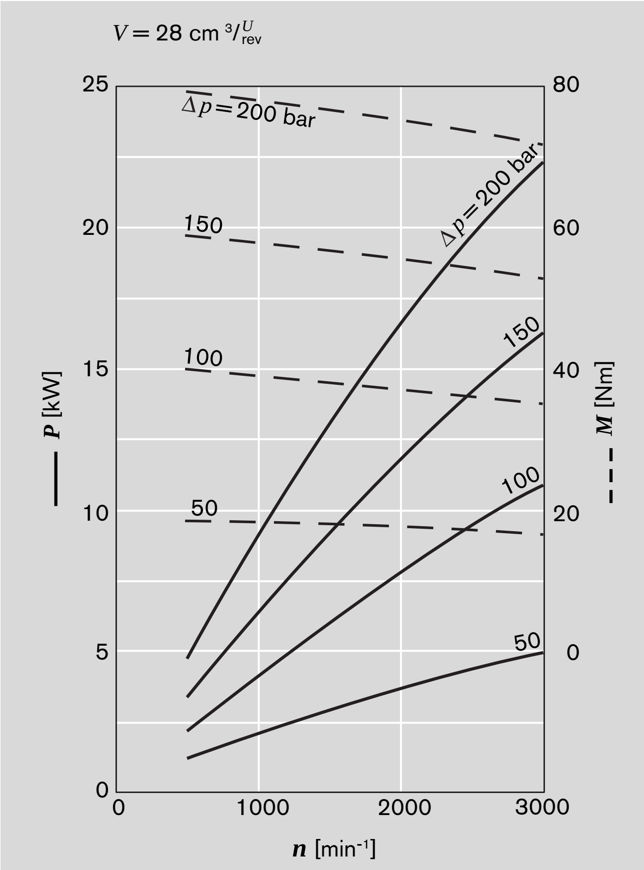
Diagrams Model “N”

$\upsilon = 35\ mm^2/s$, $T = 50\ °C$



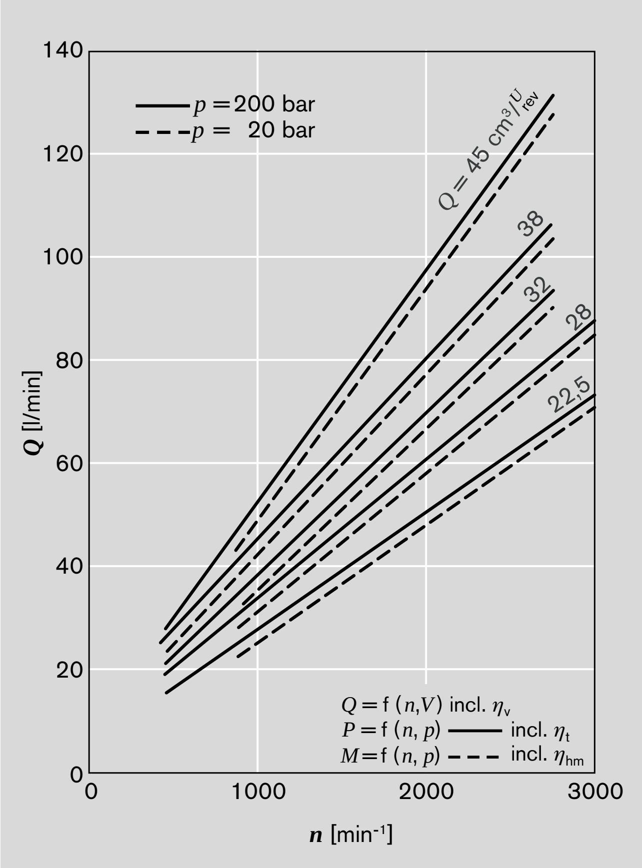
$Q = f\ (n, V)$ incl. η_v
$P = f\ (n, p)$ ——— incl. η_t
$M = f\ (n, p)$ – – – incl. η_{hm}

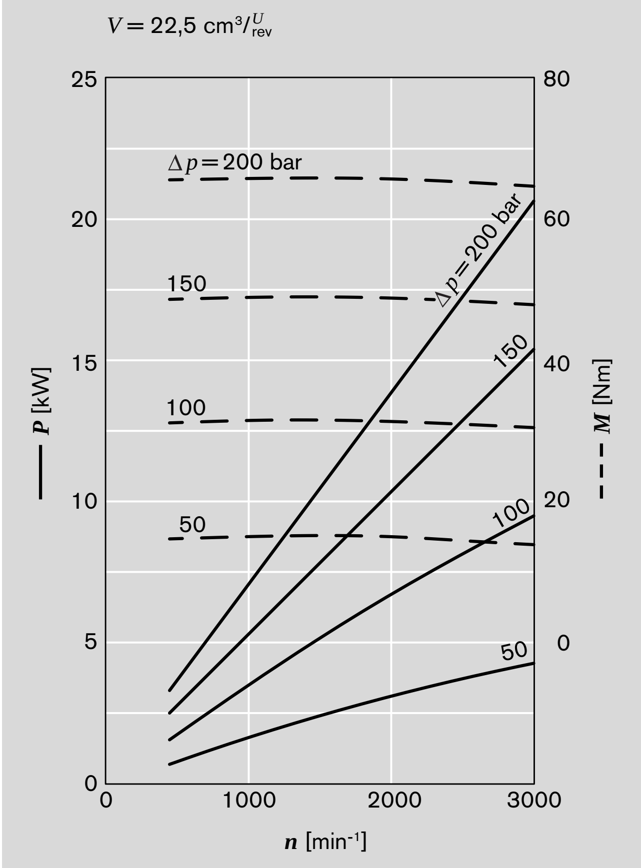


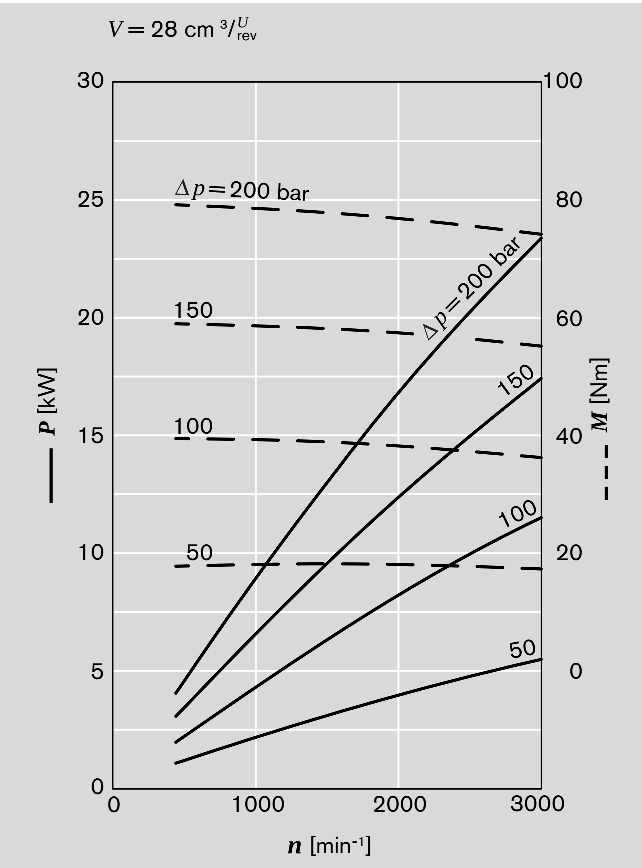


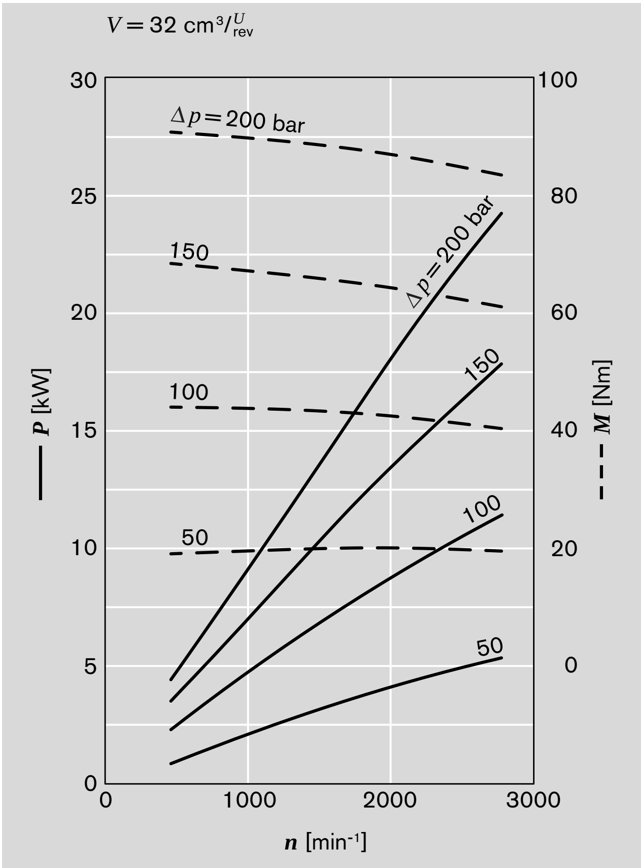
Diagrams Model “G”

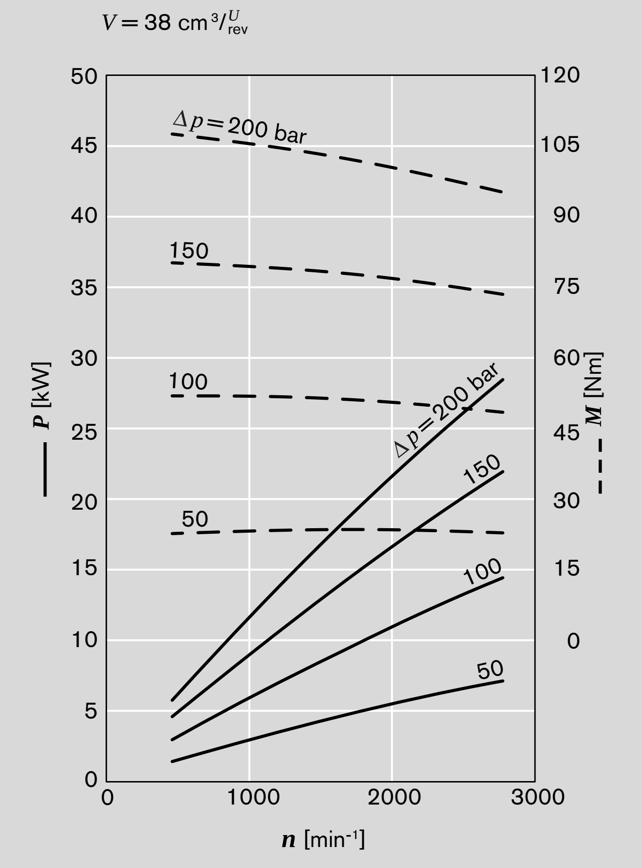
$\upsilon = 35\ mm^2/s$, $T = 50\ °C$

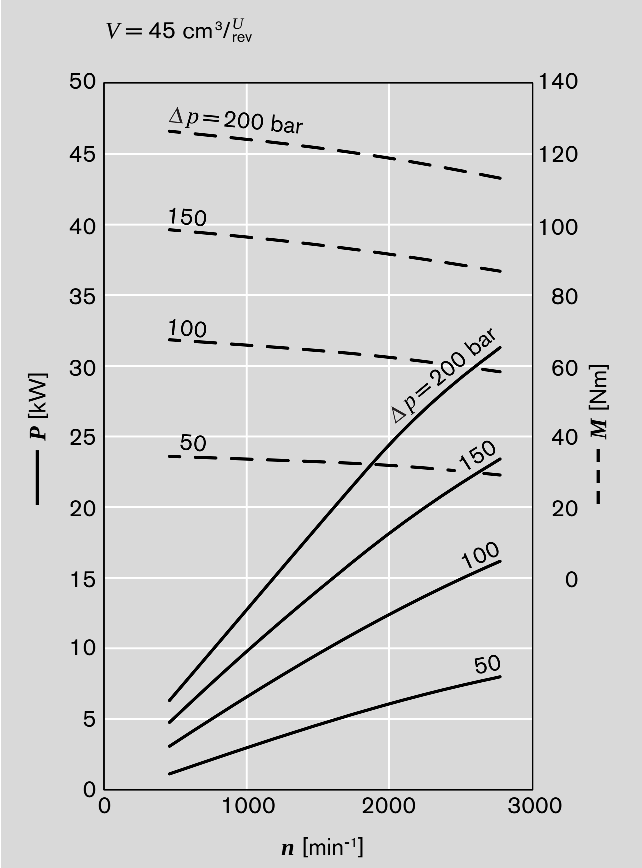












Specifications

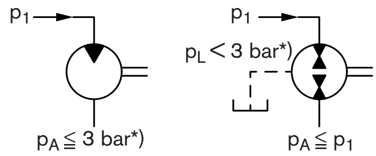
General	
Construction	external gear motor
Mounting	Flange or through-bolting with spigot
Port connections	screw, flange
Direction of rotation (looking on shaft)	One direction of rotation or reversible
Mounting position	any
Load on shaft	radial and axial forces after consulting
Ambient temperature range	–30 °C...+80 °C with NBR seals*) –20 °C...+110 °C with FPM seals**)
Fluids	mineral oil-based hydraulic fluids to DIN/ISO, other fluids upon request
Viscosity	12…800 mm²/s permitted range 20…100 mm²/s recommended range …2,000 mm²/s permitted for starting
Fluid temperature range	max. +80 °C with NBR seals*) max. 110 °C with FPM seals**)
Filter ***)	contamination at least class 19/16 according to ISO 4406 to be obtained with filter b20 = 75. For higher lifespan demands we recommend a corre spondingly higher filter class.

*) NBR = Perbunan®
**) FPM = Viton®
***) During the application of control systems or devices with critical counter-reaction, such as steering and brake valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.

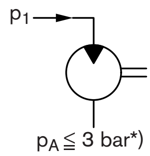
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with frequent load cycles please consult us.

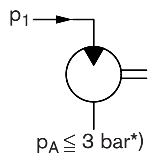
Model F

Displacement	cm³/rev	**5.5** 1)	**8**	**11**	**14**	**16**	**19**	**22.5**
max. continuous pressure p_1	bar	250					180	
max. starting pressure p_2		280					210	
min. rotational speed	min⁻¹	500						
max. rotational speed p_1		4,000		3,500	3,000			
Motor outlet pressure p_A Leakage-oil line pressure p_L	bar							

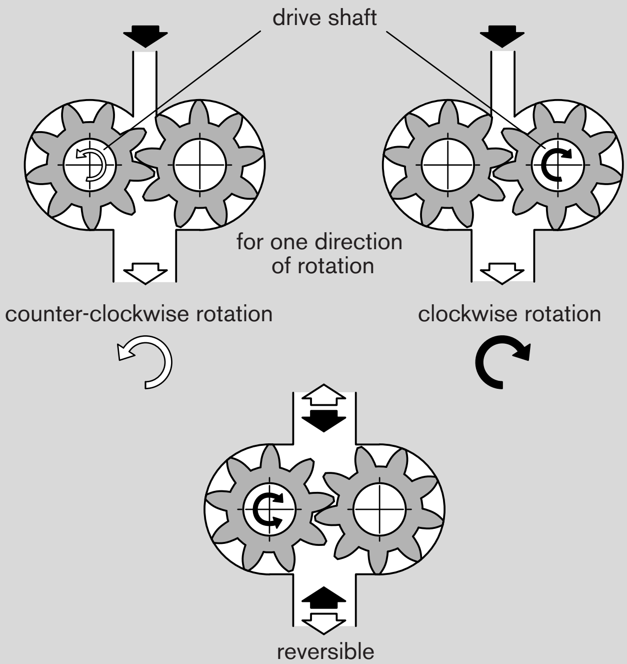
Model N

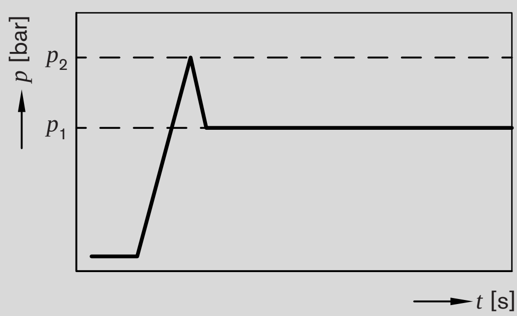
Displacement	cm³/rev	**25**	**28**
max. continuous pressure p_1	bar	210	200
max. starting pressure p_2		240	230
min. rotational speed	min⁻¹	500	
max. rotational speed p_1		3,000	
Motor outlet pressure p_A Leakage-oil line pressure p_L	bar		

Model G

Displacement	cm³/rev	**22.5**	**28**	**32**	**38**	**45**
max. continuous pressure p_1	bar	180				
max. starting pressure p_2		210				
min. rotational speed	min⁻¹	500				
max. rotational speed p_1		3,000		2,800	2,600	
Motor outlet pressure p_A Leakage-oil line pressure p_L	bar					

1) On request *) Short-term when starting 10 bar





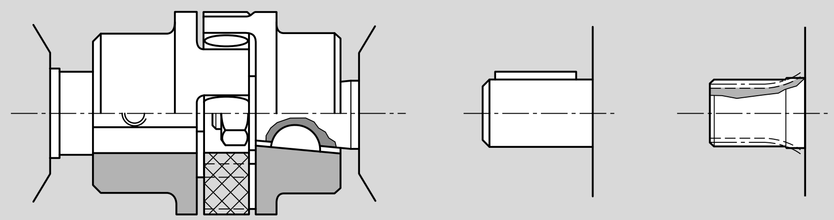
p_1 max. continuous pressure
p_2 starting pressure (depending on the application, this must be taken into consideration when setting the pressure of the hydraulic system's pressure-relief valve).

Power take-off

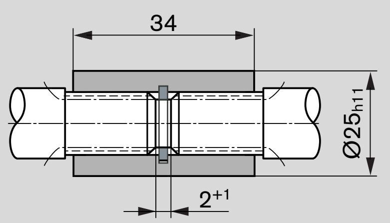
1. Flexible couplings
The coupling must not transfer any radial or axial forces to the motor.

The maximum radial run out of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.



2. Sleeve couplings
Used on shafts with DIN or SAE splining.
Note: There must be no radial or axial forces exerted on the motor or sleeve coupling. The sleeve must be free to move axially. The distance between the motor shaft and drive shaft must be 2^{+1}. Oil-bath or oil-mist lubrication is necessary.



Spline shaft	$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
DIN	190	8...22.5	$p_{max.}$
SAE	130		

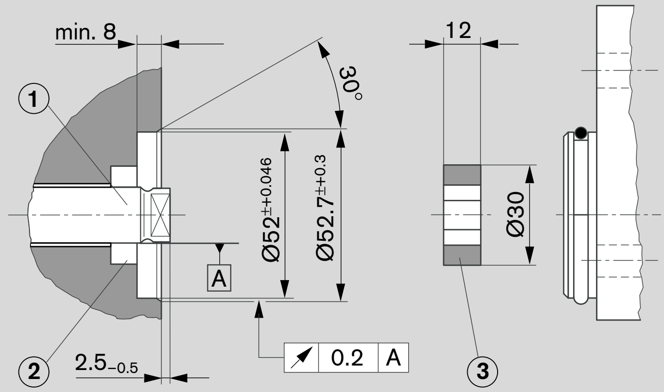
3. Drive shaft with tang
For the close-coupling of the motors to gearboxes, etc. the motors shaft has a special drive shaft with tang which combines with a center coupling ③. There is no shaft seal.

The recommended arrangements and dimensions for the drive end and sealing are as follows.

① **Drive shaft**
Case-hardened steel DIN 17 210, e.g. 20 MnCrS 5
case-hardened 0.6 deep; HRc 60 ±3.
Surface for sealing ring ground without rifling $R_{max.} \leq 4\mu m$

② **Radial shaft seal**
Rubber-covered seal (see DIN 3760, Type AS or double-lipped ring).
Cut 15° chamfer or fit shaft seal with protective sleeve.

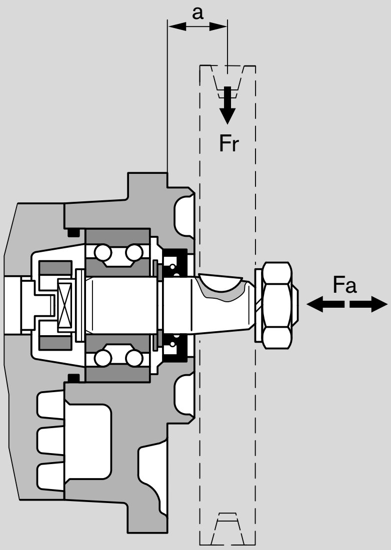
Model "F"



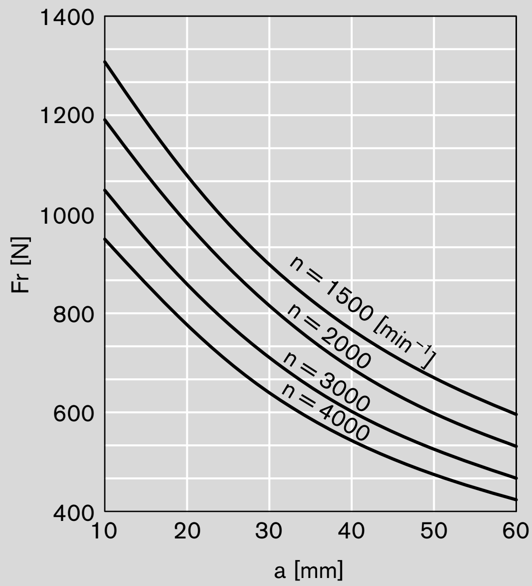
$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
65	8...14	280
	16	230
	19	190
	22.5	160

4. Outboard bearing Model "F"
Outboard bearings eliminate possible problems when the motors are driven by V-belts or gearwheels. The diagrams below show the maximum overhung and thrust loads that can be tolerated, referring to a bearing life of $L_H = 1{,}000$ hours.

$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
65	16	230
	19	190
	22.5	160

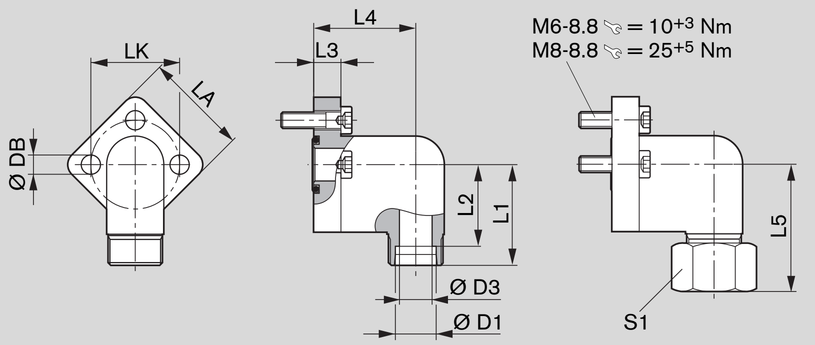


Fr is reduced by 0.7 Fa when axial loading Fa is applied.



Connectors

Gear motor flange, 3-bolt, 90° angle, for square flange 30 see page 8

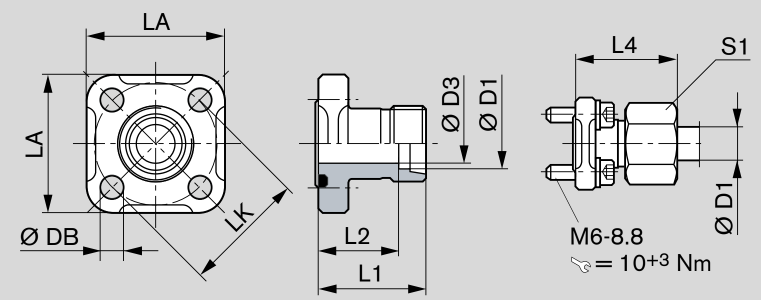


LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 3 pieces	O-ring NBR *)	Weight [kg]	Ordering-No.	p [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M6x22	16x2.5	0.13	**1 515 702 146**	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M6x22	16x2.5	0.14	**1 515 702 147**	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M6x22	16x2.5	0.17	**1 515 702 148**	160
40	22L	19	43	35.5	14	41.0	53	48	36	8.4	M8x30	24x2.5	0.29	**1 515 702 149**	160
40	28L	24	43	35.5	14	41.0	53	48	41	8.4	M8x30	24x2.5	0.40	**1 515 702 150**	160

Complete screw connection with O-ring, metric screw set, nut/mother and sleeve fitting *) NBR = Perbunan®

Connectors (continuation)

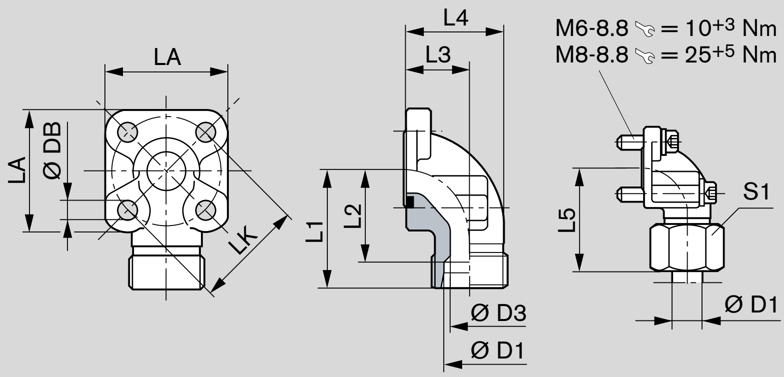
Gear motor flange, straight, for square flange 20 see page 8



LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws 4 pieces	O-ring NBR *)	Weight [kg]	Ordering-No.	*p* [bar]
35	10L	8	30	23.0	39.0	40	19	6.4	M6x22	20x2.5	0.09	**1 515 702 064**	315
35	12L	10	30	23.0	39.0	40	22	6.4	M6x22	20x2.5	0.10	**1 515 702 065**	315
35	15L	12	30	23.0	38.0	40	27	6.4	M6x22	20x2.5	0.10	**1 515 702 066**	250
40	15L	12	35	28.0	43.0	42	27	6.4	M6x22	24x2.5	0.12	**1 515 702 067**	100
40	18L	15	35	27.5	44.0	42	32	6.4	M6x22	24x2.5	0.13	**1 515 702 068**	100
40	22L	19	35	27.5	44.5	42	36	6.4	M6x22	24x2.5	0.12	**1 515 702 069**	100
40	28L	24	42	27.5	34.5	42	41	6.4	M6x22	24x2.5	0.15	**1 515 702 008**	100

Complete screw connection with O-ring, metric screw set, nut/mother and sleeve fitting *) NBR = Perbunan®

Gear motor flange, 90° angle, for square flange 20 see page 8

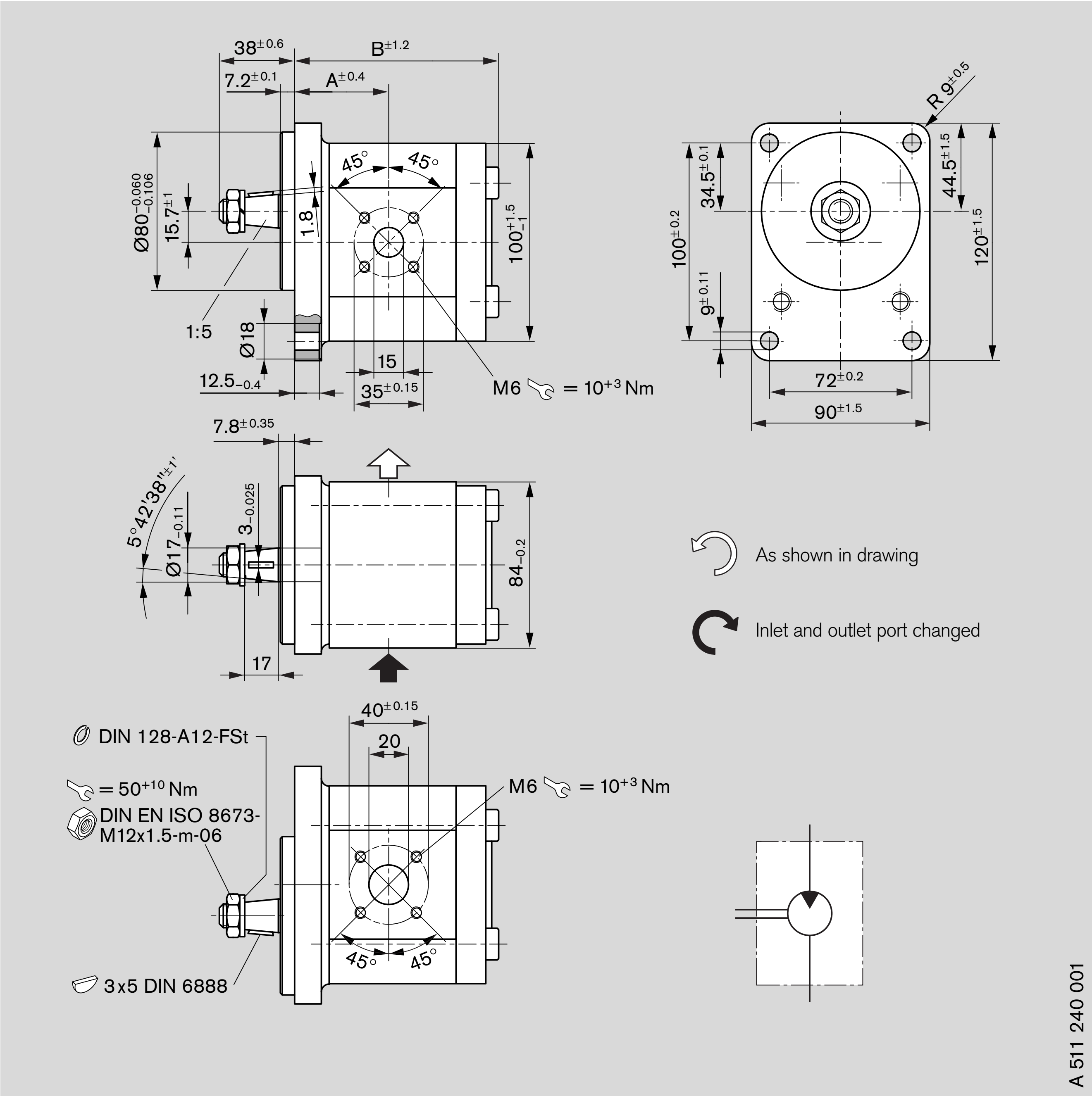


LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 2 pcs.	Screws 2 pcs.	O-ring NBR *)	Weight [kg]	Ordering-No.	*p* [bar]
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M6 x 22	M6 x 35	20 x 2.5	0.16	**1 515 702 070**	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M6 x 22	M6 x 35	20 x 2.5	0.16	**1 515 702 071**	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M6 x 22	M6 x 35	20 x 2.5	0.15	**1 515 702 072**	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M6 x 22	M6 x 40	20 x 2.5	0.18	**1 515 702 002**	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M6 x 22	M6 x 40	20 x 2.5	0.18	**1 545 702 006**	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M6 x 22	M6 x 45	20 x 2.5	0.24	**1 515 702 017**	315
40	15L	12	38	31.0	22.5	36.5	46.0	42	27	6.4	M6 x 22	M6 x 22	24 x 2.5	0.15	**1 515 702 076**	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M6 x 22	M6 x 22	24 x 2.5	0.17	**1 515 702 074**	100
40	20S	16	40	29.5	22.5	35.5	50.0	42	36	6.4	M6 x 22	M6 x 45	24 x 2.5	0.20	**1 515 702 011**	250
40	22L	19	38	30.5	22.5	36.5	47.5	42	36	6.4	M6 x 22	M6 x 22	24 x 2.5	0.17	**1 515 702 075**	100
40	28L	22	40	32.5	28.0	43.0	49.0	42	41	6.4	M6 x 20	M6 x 50	24 x 2.5	0.24	**1 515 702 010**	100
40	35L	31	41	30.5	34.0	55.0	52.0	42	50	6.4	M6 x 22	M6 x 60	24 x 2.5	0.33	**1 515 702 018**	100
55	20S	17	45	34.5	24.0	40.0	56.0	58	36	8.4	M8 x 25	M8 x 50	33 x 2.5	0.44	**1 515 702 004**	250
55	30S	26	49	35.5	32.0	50.0	62.0	58	50	8.4	M8 x 25	M8 x 50	33 x 2.5	0.50	**1 515 702 006**	250
55	35L	31	49	38.5	32.0	51.5	62.0	58	50	8.4	M8 x 25	M8 x 60	33 x 2.5	0.47	**1 515 702 005**	100
55	42L	38	49	38.0	40.0	64.5	61.0	58	60	8.4	M8 x 25	M8 x 70	33 x 2.5	0.60	**1 515 702 019**	100

Complete screw connection with O-ring. metric screw set. nut/mother and sleeve fitting *) NBR = Perbunan®

Dimensions in mm

F-Motor



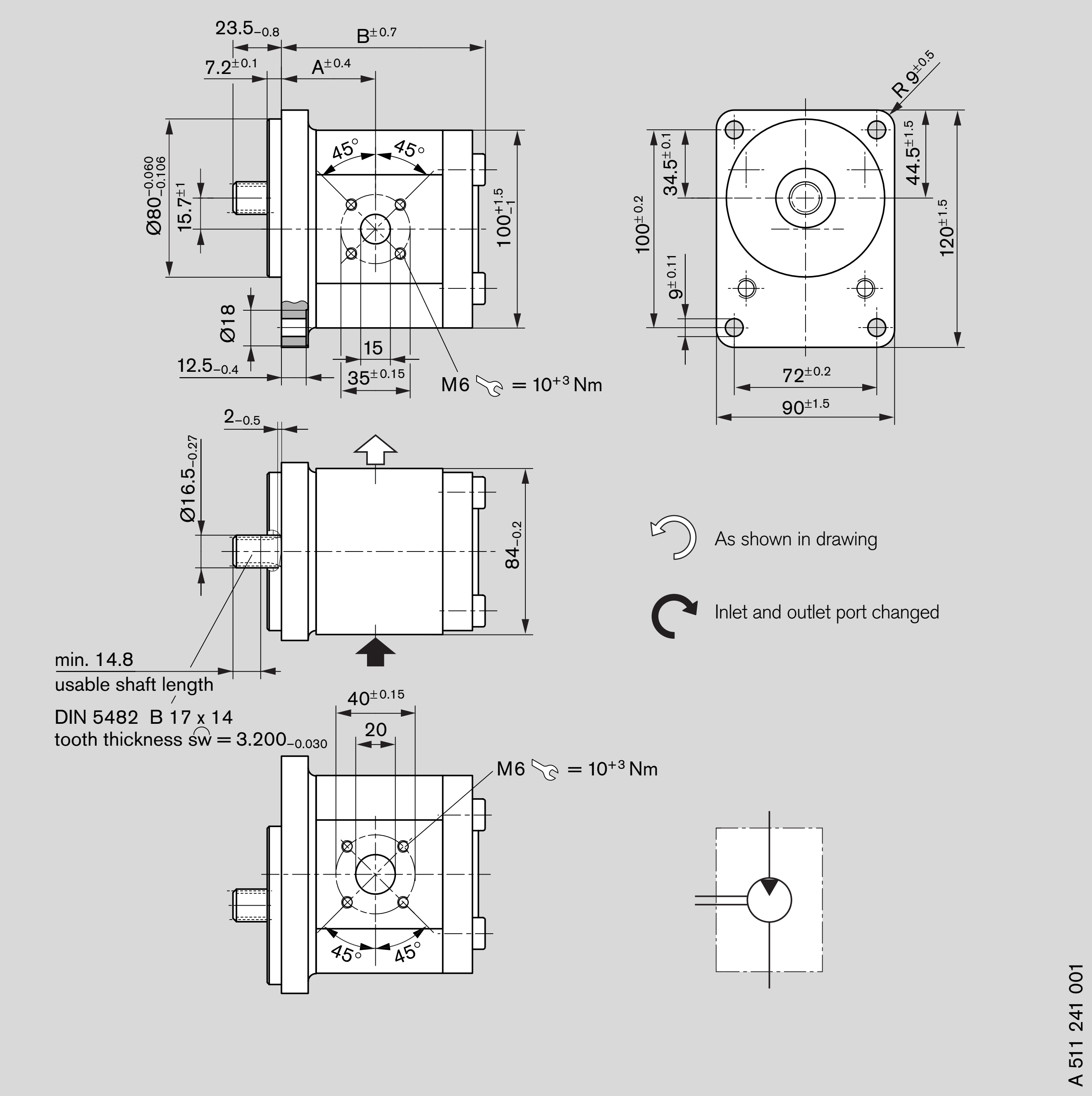
Ordering code

AZMF – 1x – □ □ □ □ C B 20 M B
AZMF – 10 – □ □ □ □ C B 20 K B*
AZMF – 10 – □ □ □ □ C B 20 M B – S0012 **

Displace-ment [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B
8	**0 511 425 300**	**0 511 425 001**	210	500	4,000	2.9	43.2	91.1
11	**0 511 525 300**	**0 511 525 001**	210	500	3,500	3.0	47.0	96.3
14	**0 511 525 304**	**–**	210	500	3,000	3.2	47.5	101.3
16	**–**	**0 511 625 005**	210	500	3,000	3.4	47.5	104.7
19	**0 511 625 308**	**0 511 625 003**	180	500	3,000	3.6	47.5	109.7
19	**–**	**0 511 625 009** *	180	500	3,000	3.6	47.5	109.7
22.5	**0 511 725 304** **	**0 511 725 005** **	210	500	3,000	3.9	61.1	125.3

Dimensions in mm

F-Motor



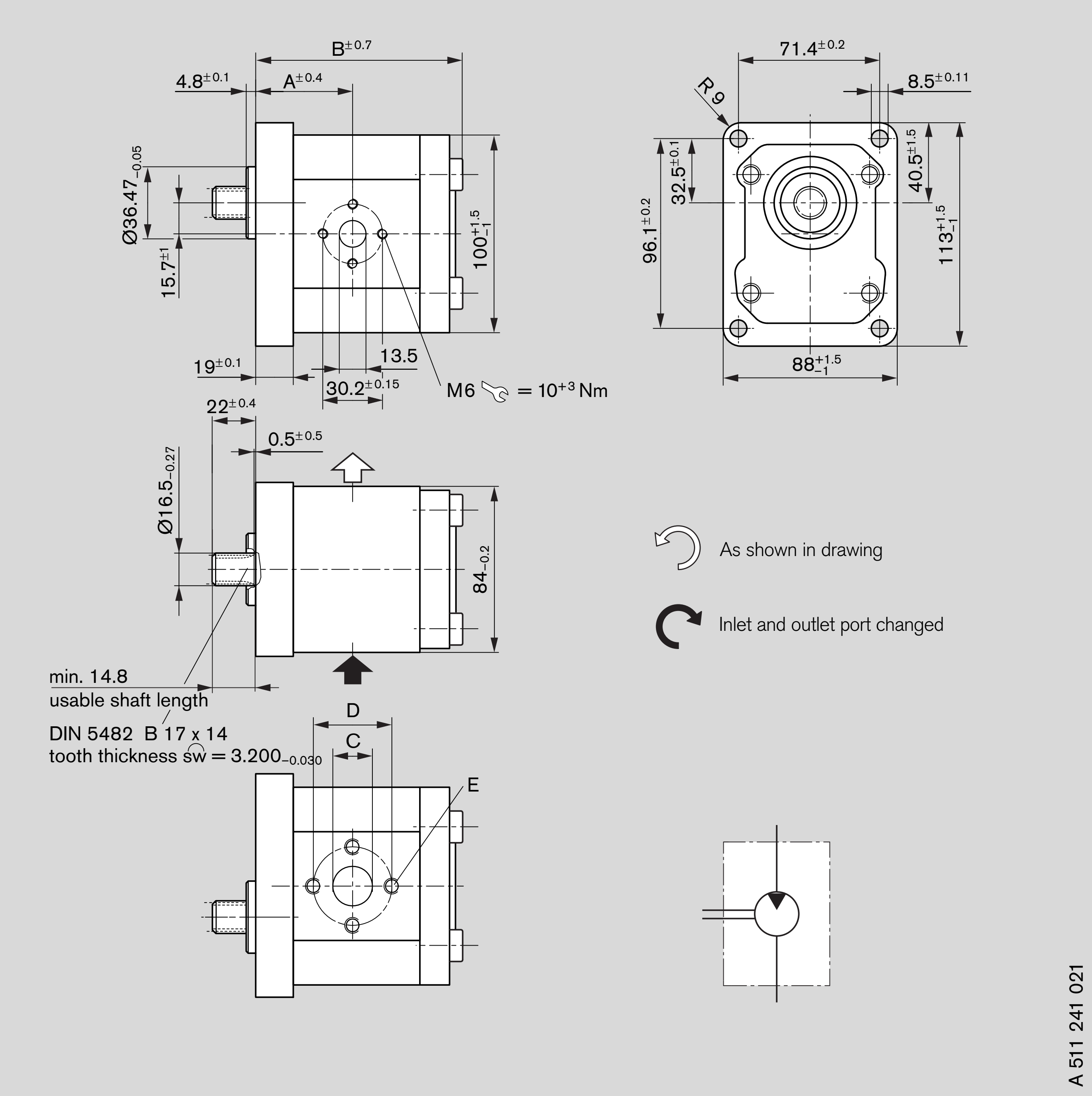
Ordering code

AZMF – 10 – □ □ □ □ F B 20 M B

Displace-ment [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 425 301**	**0 511 425 002**	210	500	4,000	2.9	43.2	91.0
11	**0 511 525 301**	**0 511 525 002**	210	500	3,500	3.0	47.0	96.0
14	**0 511 525 303**	–	210	500	3,000	3.2	47.5	101.0
16	**0 511 625 301**	**0 511 625 001**	210	500	3,000	3.4	47.5	104.4
19	**0 511 625 300**	**0 511 625 002**	180	500	3,000	3.6	47.5	109.4
22.5	**0 511 725 303**	**0 511 725 004**	180	500	3,000	3.8	61.1	126.8

Dimensions in mm

F-Motor



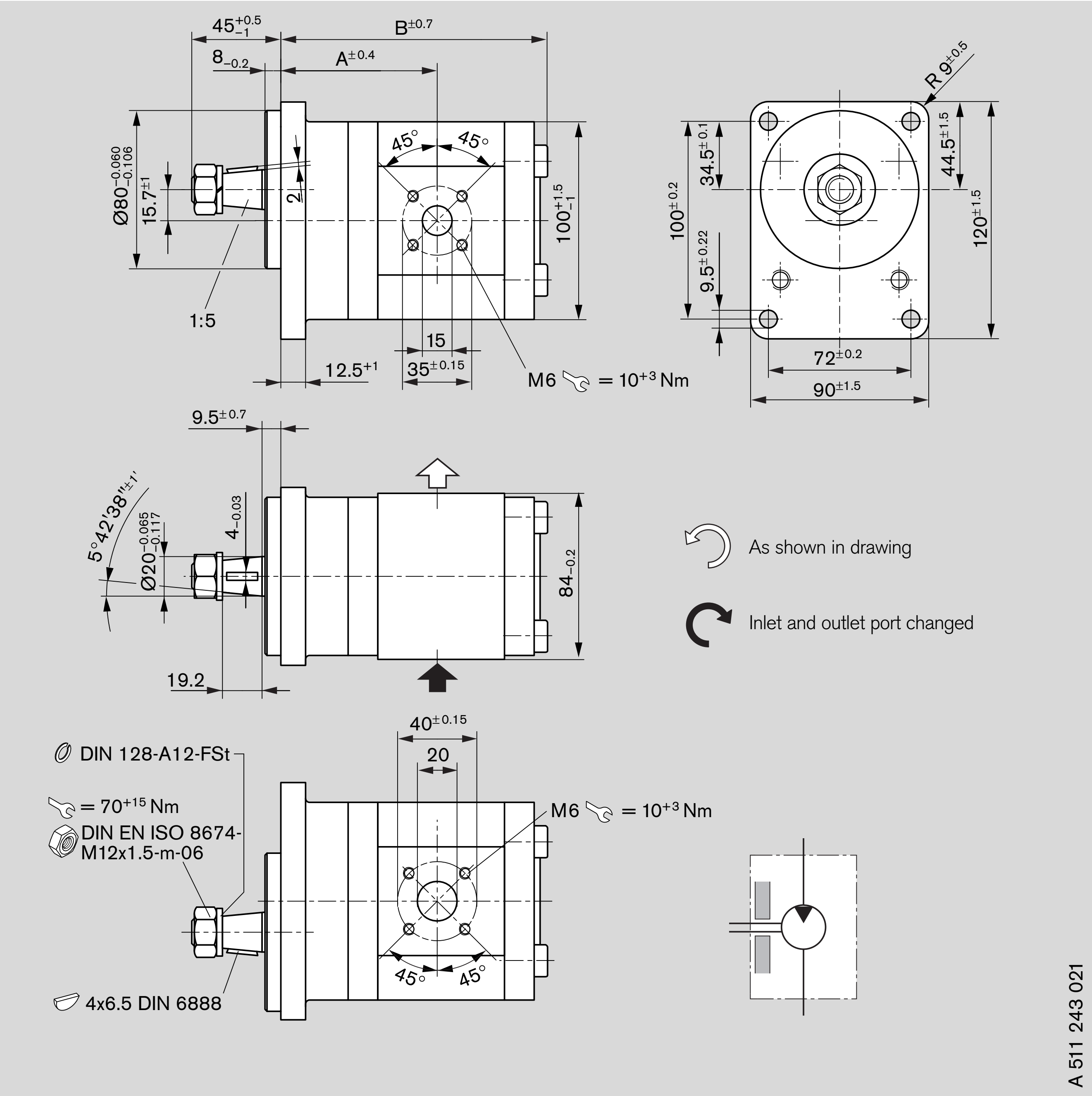
Ordering code

AZMF – 10 – □ □ □ □ F O 30 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	C	D	E
8	–	**0 511 425 003**	210	500	4,000	2.9	44.9	90.7	13.5	30.2	M6 = 10^{+3}
19	**0 511 625 303**	–	180	500	3,000	3.7	49.0	109.1	20.0	39.7	M8 = 25^{+5}
22.5	–	**0 511 725 305**	180	500	3,000	3.9	56.6	114.5	20.0	39.7	M8 = 25^{+5}

Dimensions in mm

F-Motor

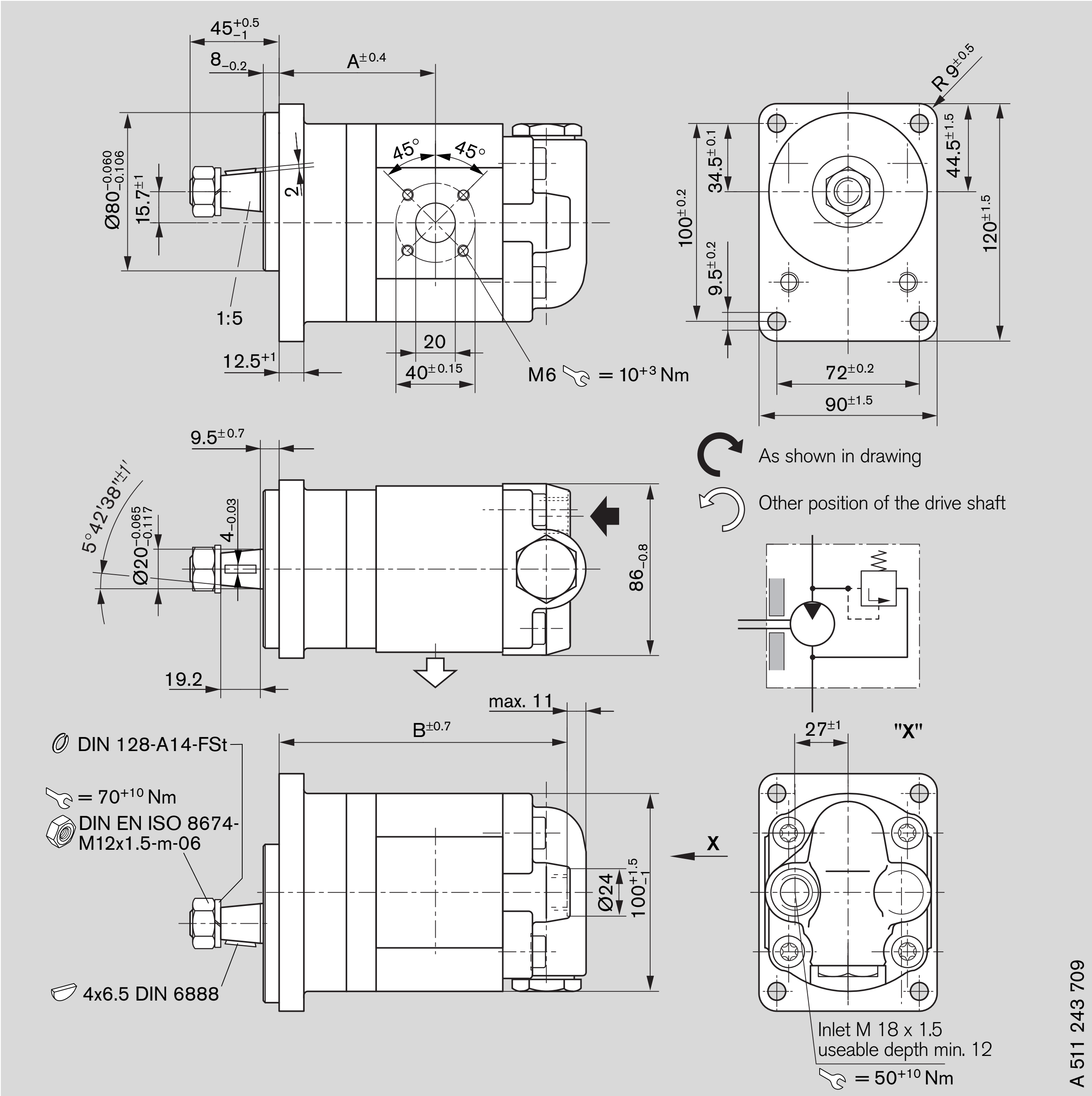


Ordering code
AZMF – 10 – □ □ □ □ S A 20 M B
AZMF – 10 – □ □ □ □ S A 20 M B – S0012

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 445 300**	**0 511 445 001**	250	500	4,000	3.5	74.7	120.6
11	**0 511 545 300**	**0 511 545 001**	250	500	3,500	3.6	78.5	125.6
14	**0 511 545 301**	–	250	500	3,000	3.7	79.0	130.6
16	**0 511 645 300**	**0 511 645 001**	250	500	3,000	3.8	79.0	134.0
16	–	**0 511 645 003**	230	500	3,000	3.8	93.0	134.0
19	**0 511 645 302**	–	190	500	3,000	4.2	79.0	139.0
22.5	**0 511 745 300***	**0 511 745 001***	160	500	2,500	4.8	92.6	156.4

Dimensions in mm

F-Motor



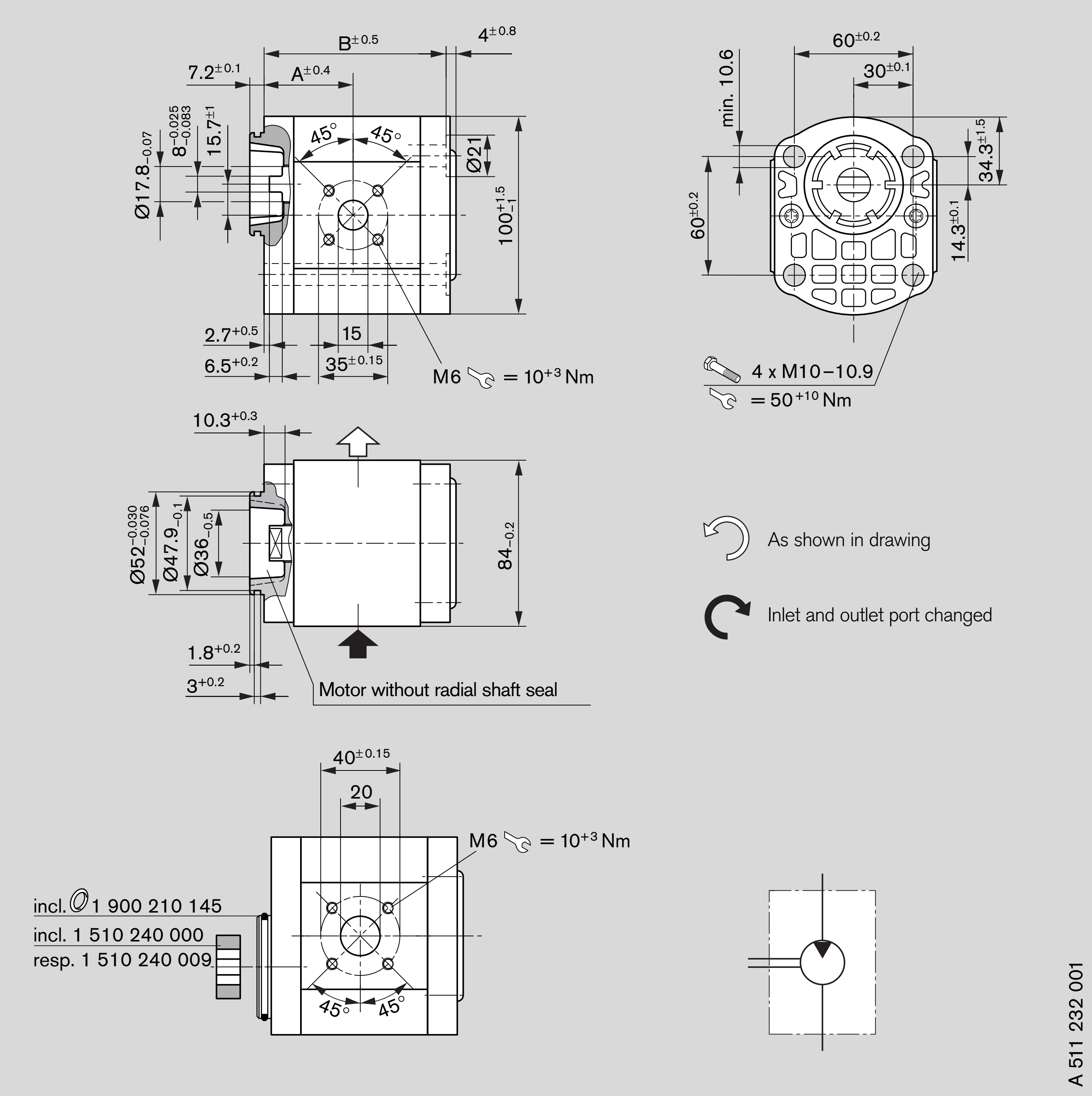
Ordering code

AZMF – 10 – □ □ □ □ S A 20 M D XXXXX – S0076

Displace-ment [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B
8	**0 511 445 301**	**0 511 445 003**	200	500	4,000	3.6	74.7	133.1
11	**0 511 545 302**	0 511 545 003	150	500	3,500	3.8	79.1	138.1

Dimensions in mm

F-Motor



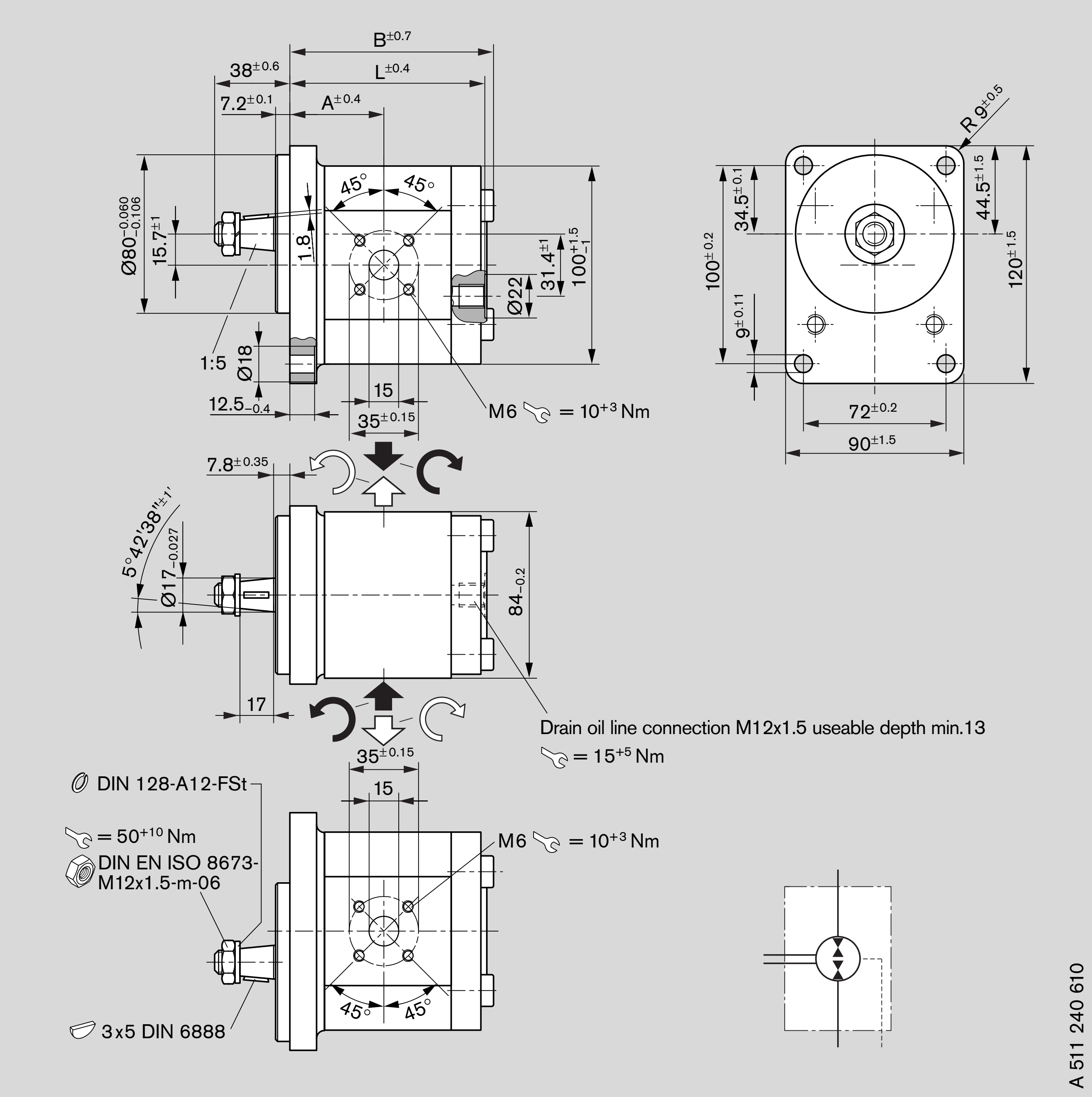
Ordering code

AZMF – 10 – ☐ ☐ ☐ ☐ N T 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 415 300**	**0 511 415 001**	250	500	4,000	2.5	40.7	80.3
11	**0 511 515 300**	**0 511 515 001**	250	500	3,500	2.6	44.5	85.3
16	**0 511 615 301**	**0 511 615 002**	230	500	3,000	3.0	45.0	93.7
19	**0 511 615 300**	**0 511 615 001**	190	500	3,000	3.2	45.0	98.7
22.5	**0 511 715 300**	**0 511 715 001**	160	500	3,000	3.4	52.6	104.1

Dimensions in mm

F-Motor

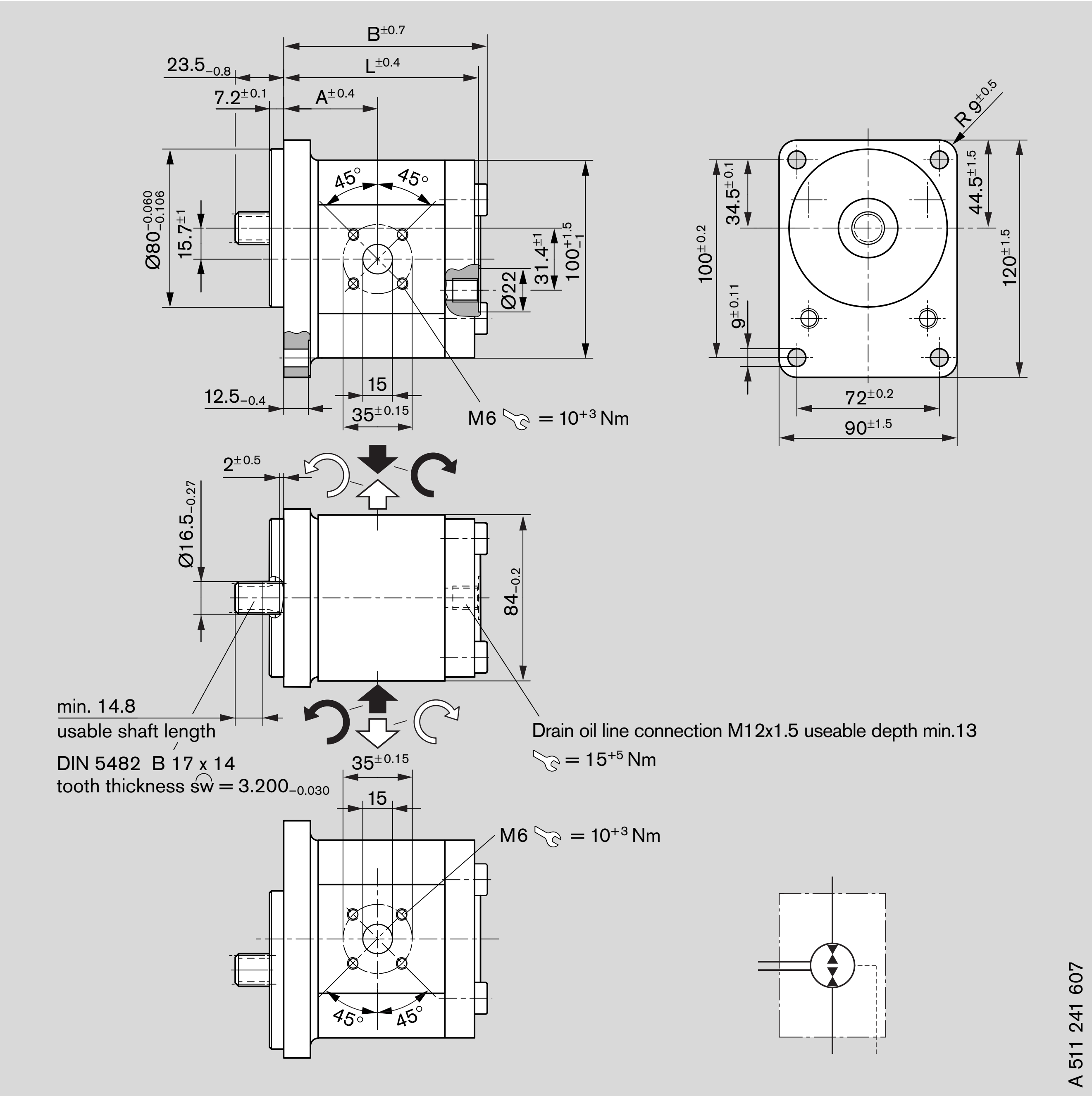


Ordering code
AZMF – 10 – □ □ □ U C B 20 M L
AZMF – 10 – □ □ □ U C B 20 K L*

Displacement [cm³/rev]	Ordering-No. Universal	Max. operating-pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 425 601**	210	500	4,000	3.4	43.2	90.7	85.8
11	**0 511 525 604**	210	500	3,500	4.2	47.0	95.9	90.8
16	**0 511 625 602**	210	500	3,000	3.9	47.5	104.3	99.2
22.5	**0 511 725 601** *	180	500	3,000	3.9	55.1	114.6	109.6

Dimensions in mm

F-Motor

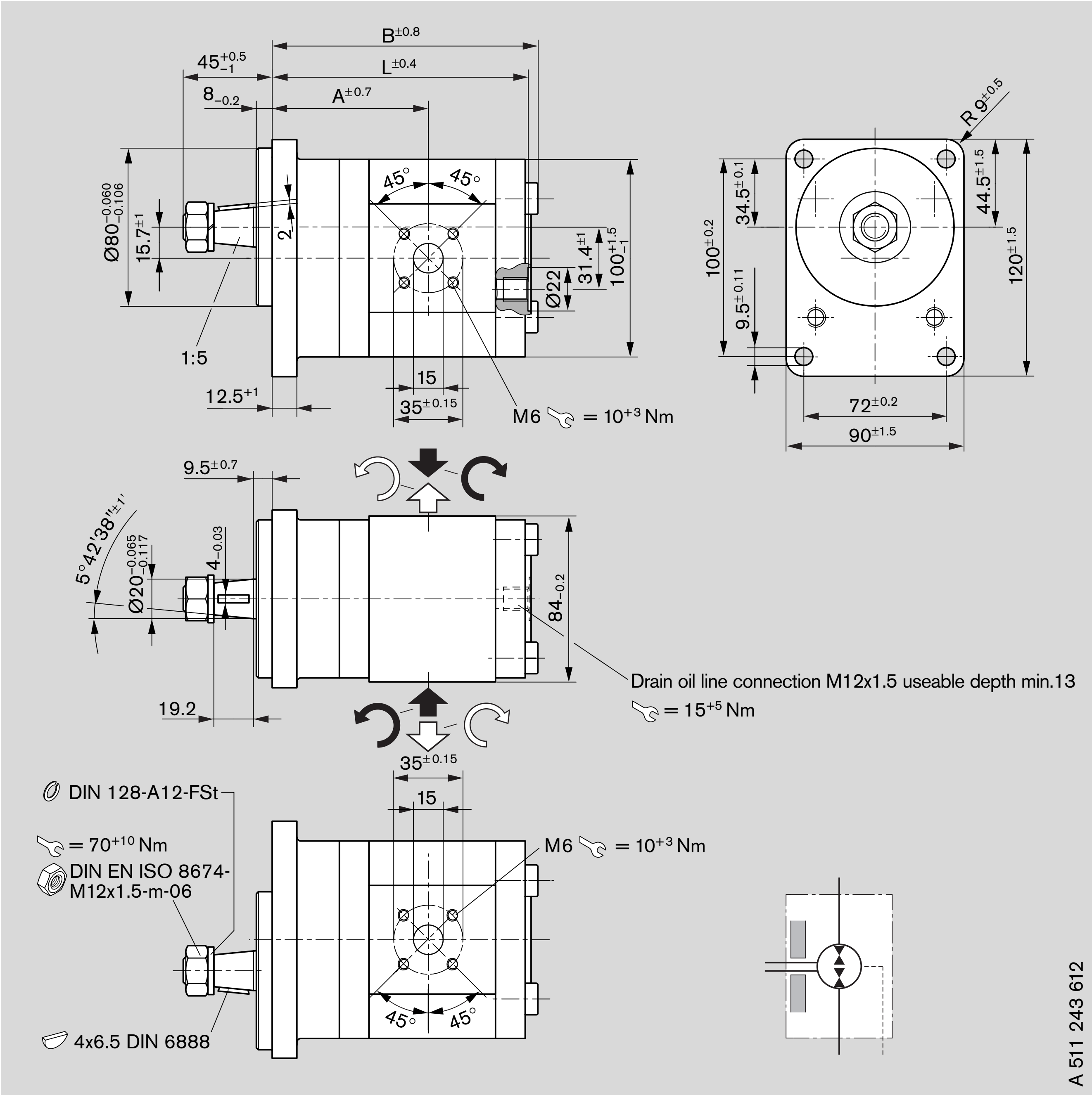


Ordering code
AZMF – 10 – ☐ ☐ ☐ U F B 20 M L

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotating speed [min⁻¹]	Max. rotating speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 425 603**	210	500	4,000	2.9	43.2	91.0	85.8
11	**0 511 525 601**	210	500	3,500	3.0	47.0	96.0	90.8
16	**0 511 625 603**	210	500	3,000	3.4	47.5	104.4	99.2
19	**0 511 625 605**	180	500	3,000	3.6	47.5	109.4	104.2
22.5	**0 511 725 602**	180	500	3,000	3.8	55.1	114.8	109.6

Dimensions in mm

F-Motor

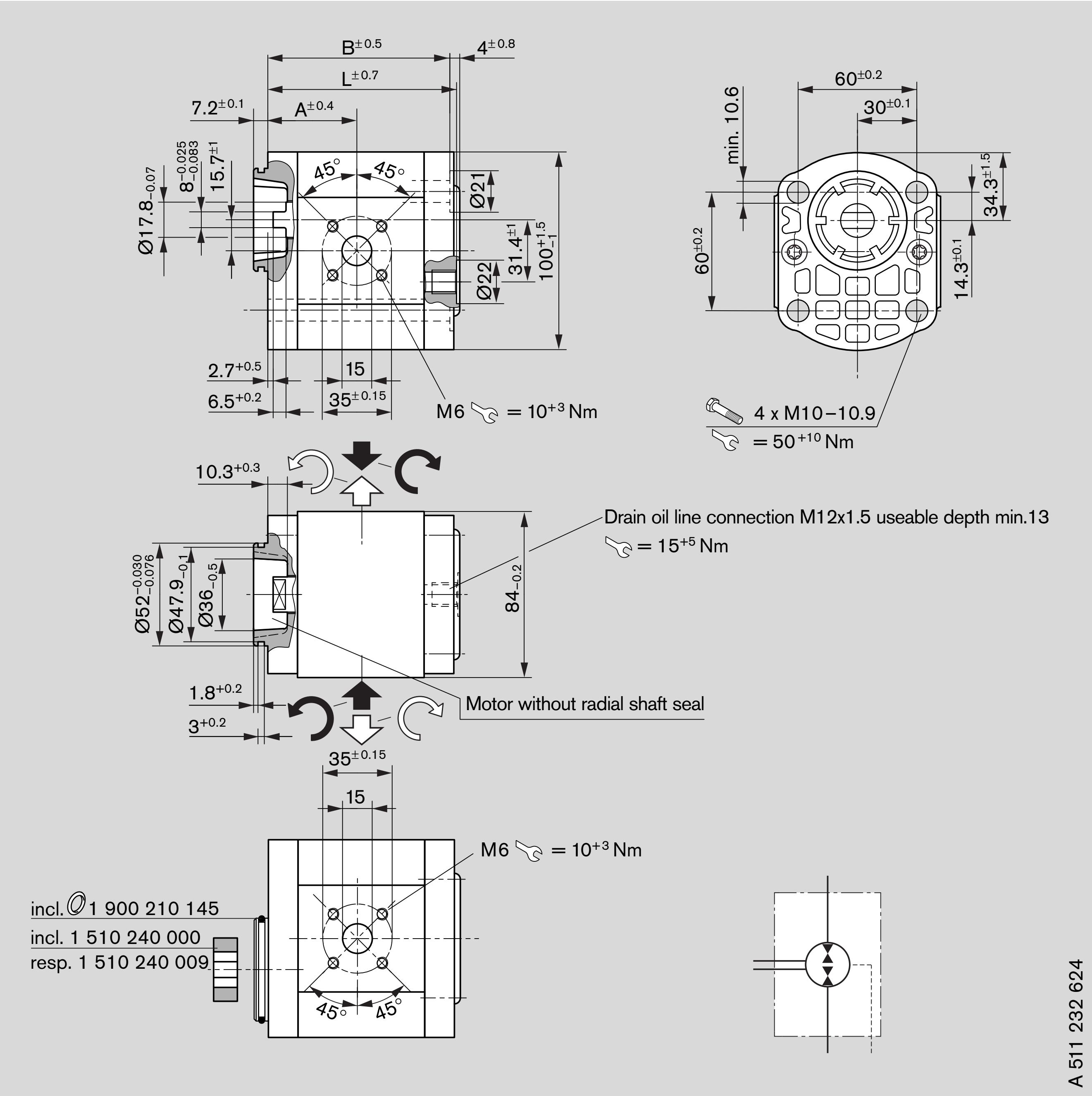


Ordering code
AZMF – 10 – ☐ ☐ ☐ U S A 20 M L

Displacement [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 445 601**	250	500	4,000	3.5	74.8	120.8	116.9
11	**0 511 545 601**	250	500	3,500	3.6	78.6	125.8	121.9
16	**0 511 645 601**	230	500	3,000	4.0	79.1	134.2	130.3
19	**0 511 645 603**	190	500	3,000	4.2	79.1	139.2	135.3

Dimensions in mm

F-Motor

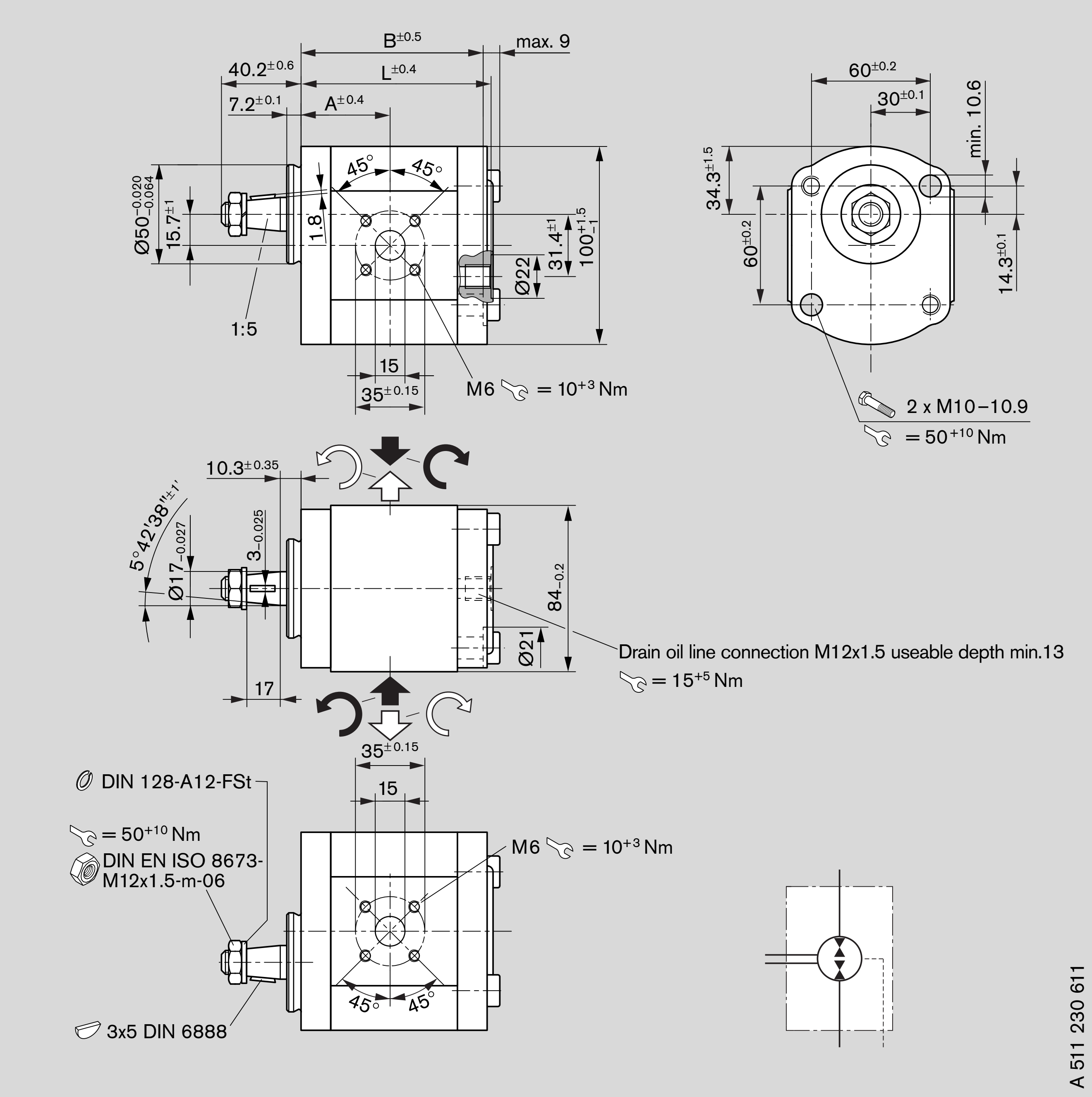


Ordering code
AZMF – 10 – □ □ □ U N T 20 M L – S0164

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 415 605**	250	500	4,000	2.5	40.7	80.3	82.8
11	**0 511 515 602**	250	500	3,500	2.6	44.5	85.3	87.8
16	**0 511 615 607**	230	500	3,000	3.0	45.0	93.7	96.2
19	**0 511 615 608**	190	500	3,000	3.2	45.0	98.7	101.2
22.5	**0 511 715 601**	160	500	3,000	3.4	52.6	104.1	106.6

Dimensions in mm

F-Motor

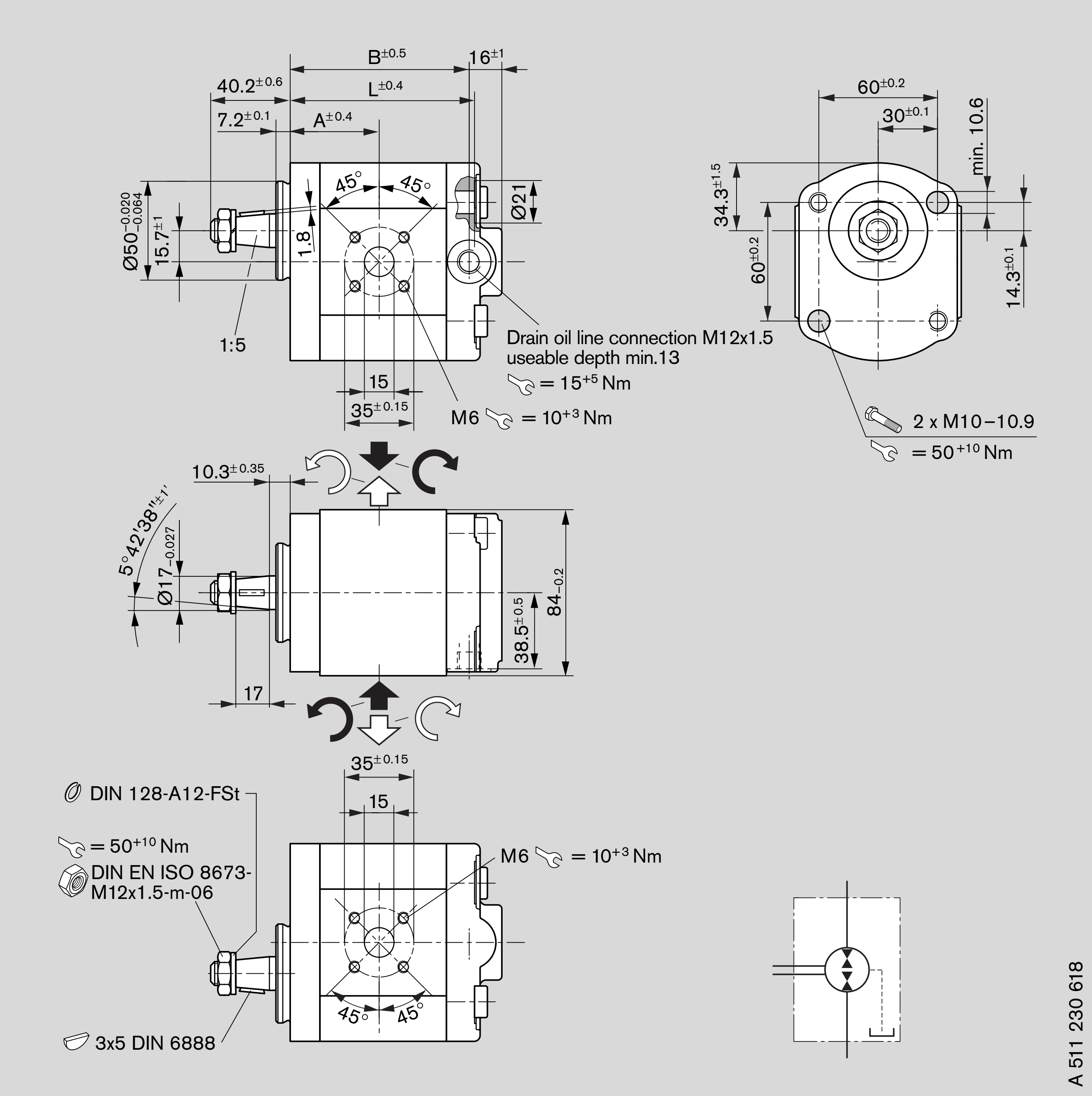


Ordering code
AZMF – 1X – □ □ □ U C P 20 M L

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 415 606**	210	500	4,000	2.8	40.7	80.3	83.3
11	**0 511 515 601**	210	500	3,500	2.8	44.5	85.3	88.3
14	**0 511 515 605**	210	500	3,000	3.1	45.0	90.3	93.3
16	**0 511 615 609**	210	500	3,000	3.1	45.0	93.7	96.7

Dimensions in mm

F-Motor



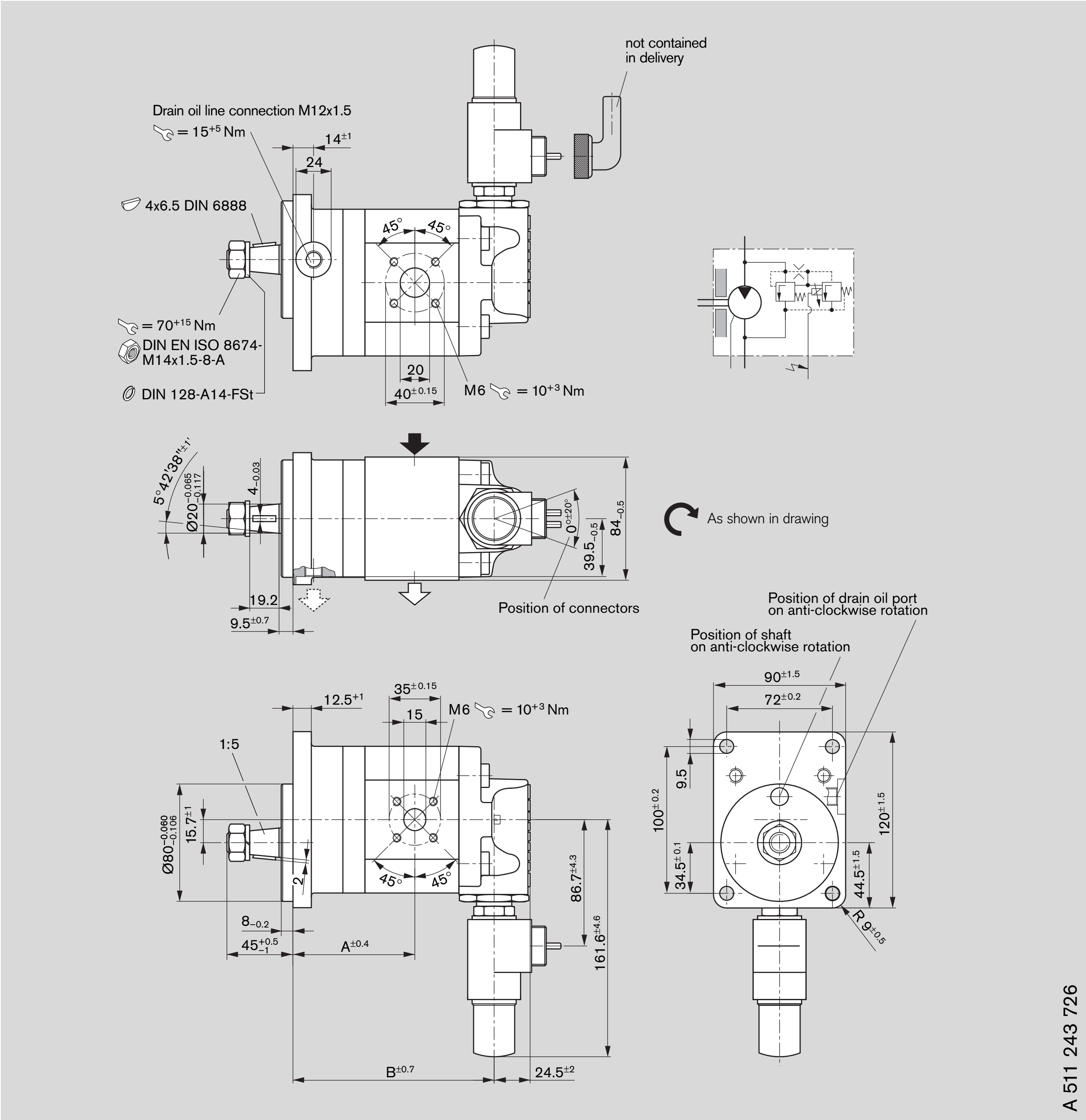
Ordering code

AZMF – 11 – ☐ ☐ ☐ U C N 20 M B – S0077

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 415 607**	210	500	4,000	2.9	40.7	80.3	80.3

Dimensions in mm

F-Motor

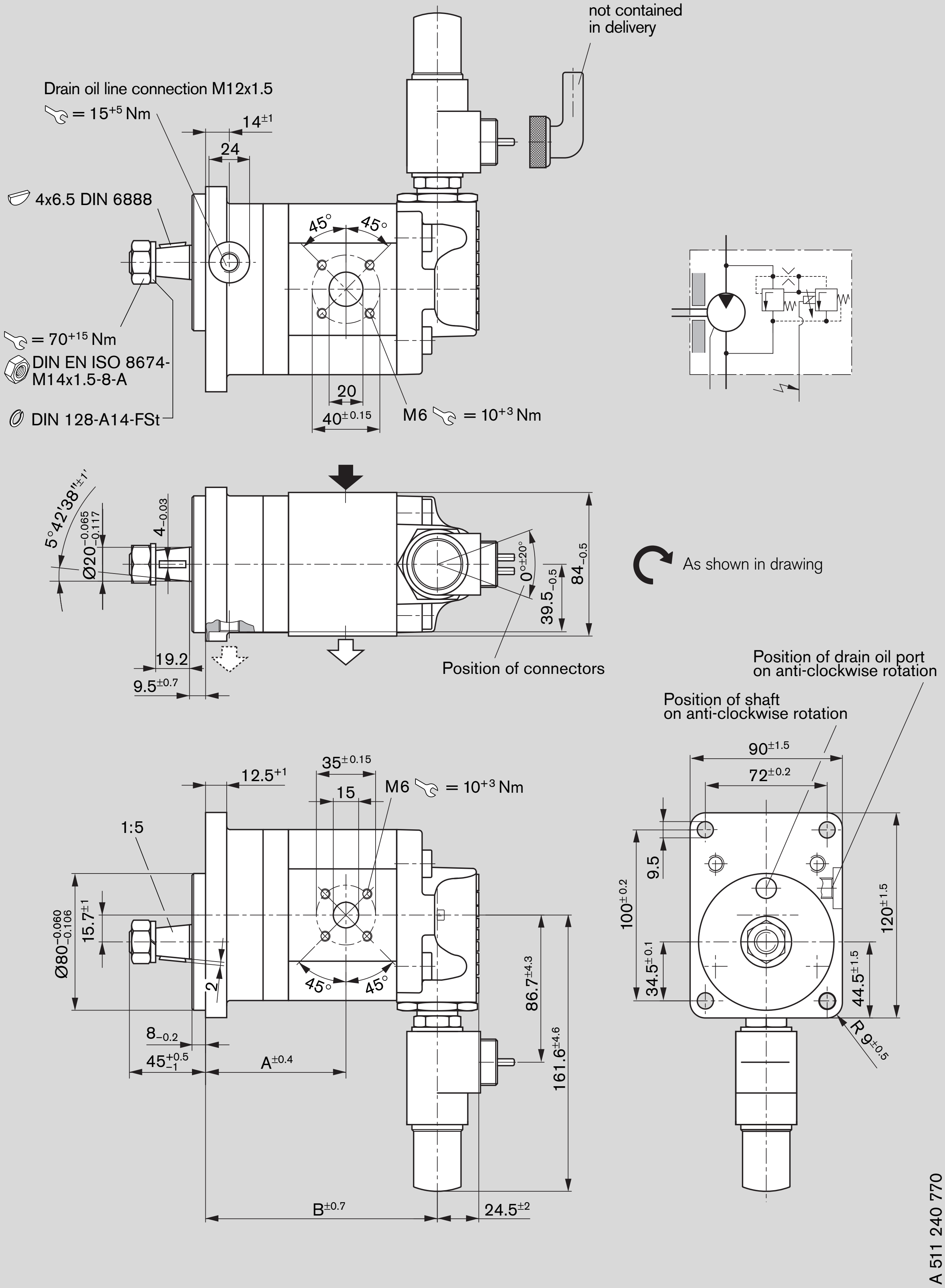


Ordering code
AZMF – 11 – ☐ ☐ ☐ ☐ S A 20 P GXXXX
AZMF – 12 – ☐ ☐ ☐ ☐ S A 20 P GXXXX*

Displace-ment [cm³/rev]	Ordering-No. L	R	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	PVR [bar]	Coil nominal current [I]	kg	Dimension [mm] A	B
16	–	**0 511 645 007**	500	3,000	130	1.5	5.0	79.0	137.7
16	–	**0 511 645 005** *	500	3,000	170	1.5	5.0	79.0	137.7
16	**0 511 645 306**	–	500	3,000	170	1.5	5.1	79.0	137.7
16	**0 511 645 307**	–	500	3,000	210	1.5	5.1	79.0	137.7
16	–	**0 511 645 011** *	500	3,000	210	1.5	5.1	79.0	137.7

Dimensions in mm

F-Motor



Dimensions in mm

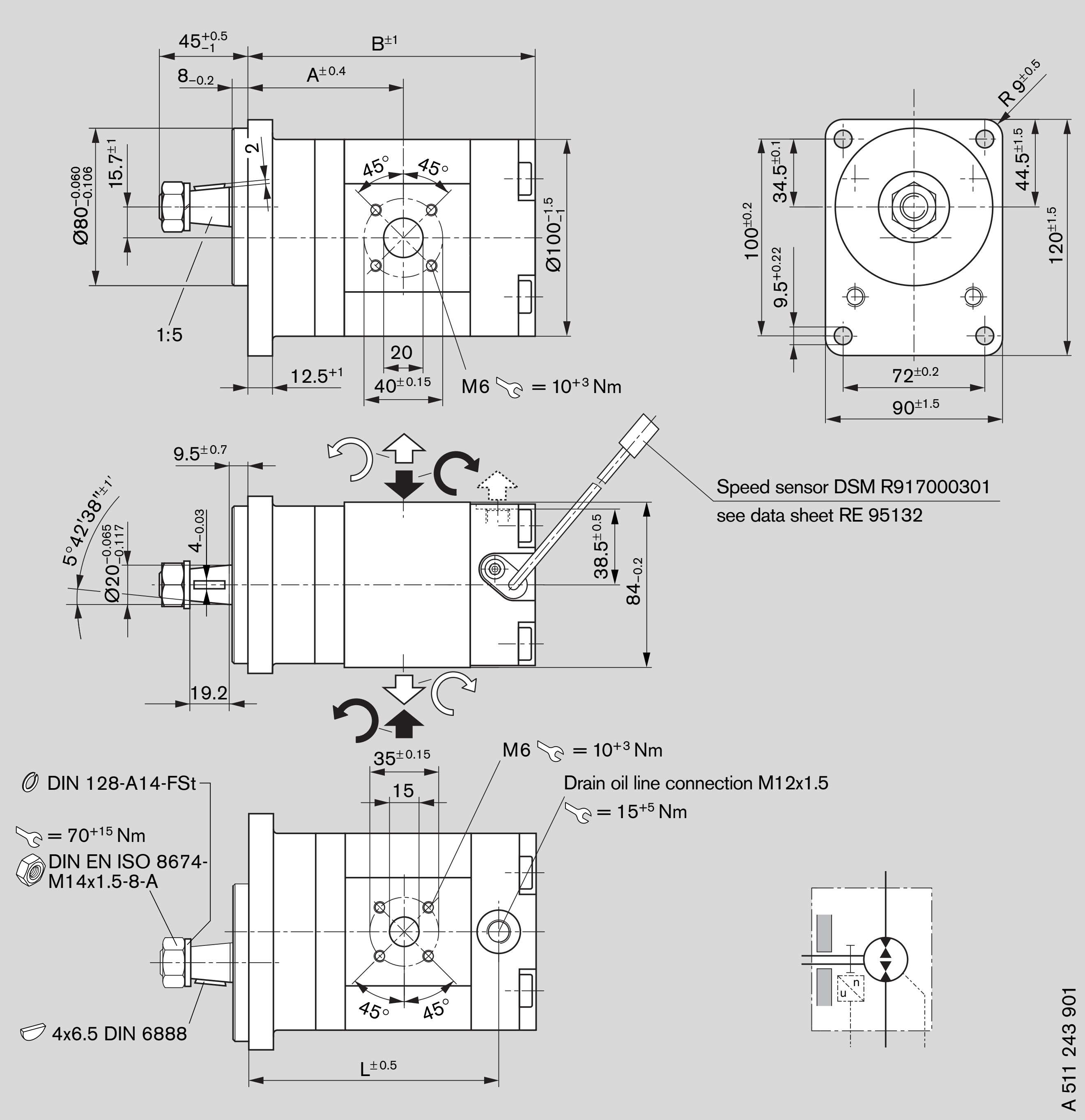
F-Motor

Ordering code
AZMF – 11 – ☐ ☐ ☐ ☐ C B 20 P GXXXX

Displace-ment [cm³/rev]	Ordering-No. L	R	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	PRV [bar]	Coil nominal current [I]	kg	Dimension [mm] A	B
8	**0 511 425 302**	–	500	4,000	210	0.75	4.7	48.7	98.3
8	–	**0 511 425 015**	500	4,000	90	1.5	4.6	48.7	98.3
8	–	**0 511 425 013**	500	4,000	130	1.5	4.7	48.7	98.3
8	–	**0 511 425 012**	500	4,000	170	1.5	4.7	48.7	98.3
8	–	**0 511 425 014**	500	4,000	150	1.5	4.7	48.7	98.3
11	–	**0 511 525 013**	500	3,500	170	1.5	4.7	47.5	103.5
11	–	**0 511 525 011**	500	3,500	180	0.75	4.8	47.5	103.5
11	**0 511 525 309**	–	500	3,500	90	1.5	4.8	47.5	103.5
11	**0 511 525 308**	–	500	3,500	180	0.75	4.8	47.5	103.5
14	–	**0 511 525 014**	500	3,000	210	1.5	4.9	43.2	108.5
16	–	**0 511 625 019**	500	3,000	210	1.5	5.0	47.5	111.7
16	**0 511 625 309**	–	500	3,000	210	1.5	5.0	47.5	111.7
16	–	**0 511 625 020**	500	3,000	210	0.75	5.0	47.5	111.7
19	–	**0 511 625 018**	500	3,000	210	1.5	5.1	47.5	116.7
19	–	**0 511 625 022**	500	3,000	210	0.75	4.0	47.5	116.7
19	–	**0 511 625 021**	500	3,000	180	0.75	5.1	47.5	116.7
22.5	**0 511 725 311**	–	500	3,000	210	1.5	5.3	55.1	122.1
22.5	–	**0 511 725 021**	500	3,000	210	1.5	5.3	55.1	122.1
22.5	–	**0 510 725 023**	500	3,000	210	0.75	5.3	55.1	122.1
22.5	–	**0 511 725 027**	500	3,000	170	1.5	5.2	55.1	122.1

Dimensions in mm

F-Motor

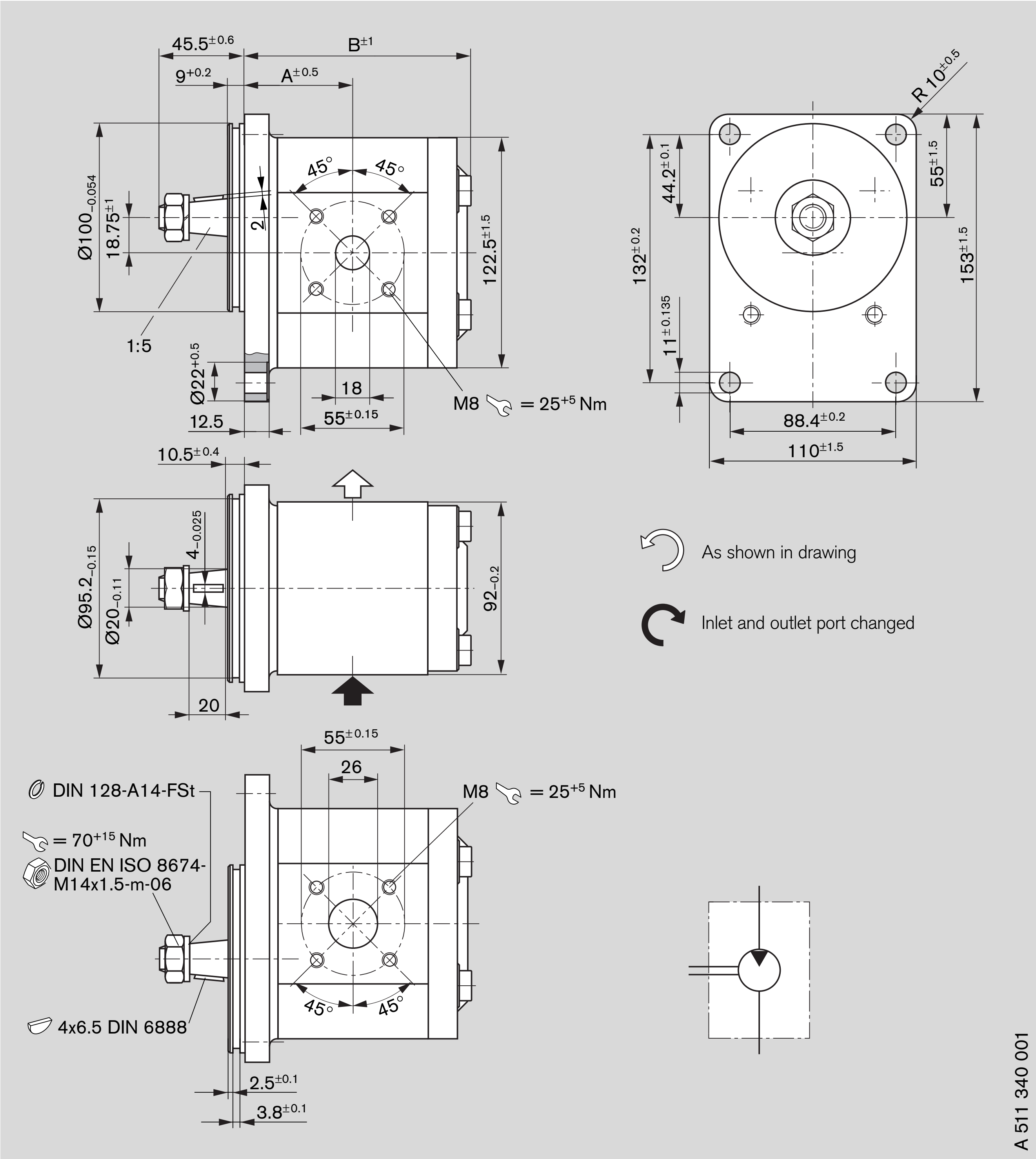


Ordering code
AZMF – 12 – □ □ □ U S A 20 P L – S0079

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
16	**0 511 645 607**	230	500	3,000	3.6	79	146.7	127.7

Dimensions in mm

N-Motor

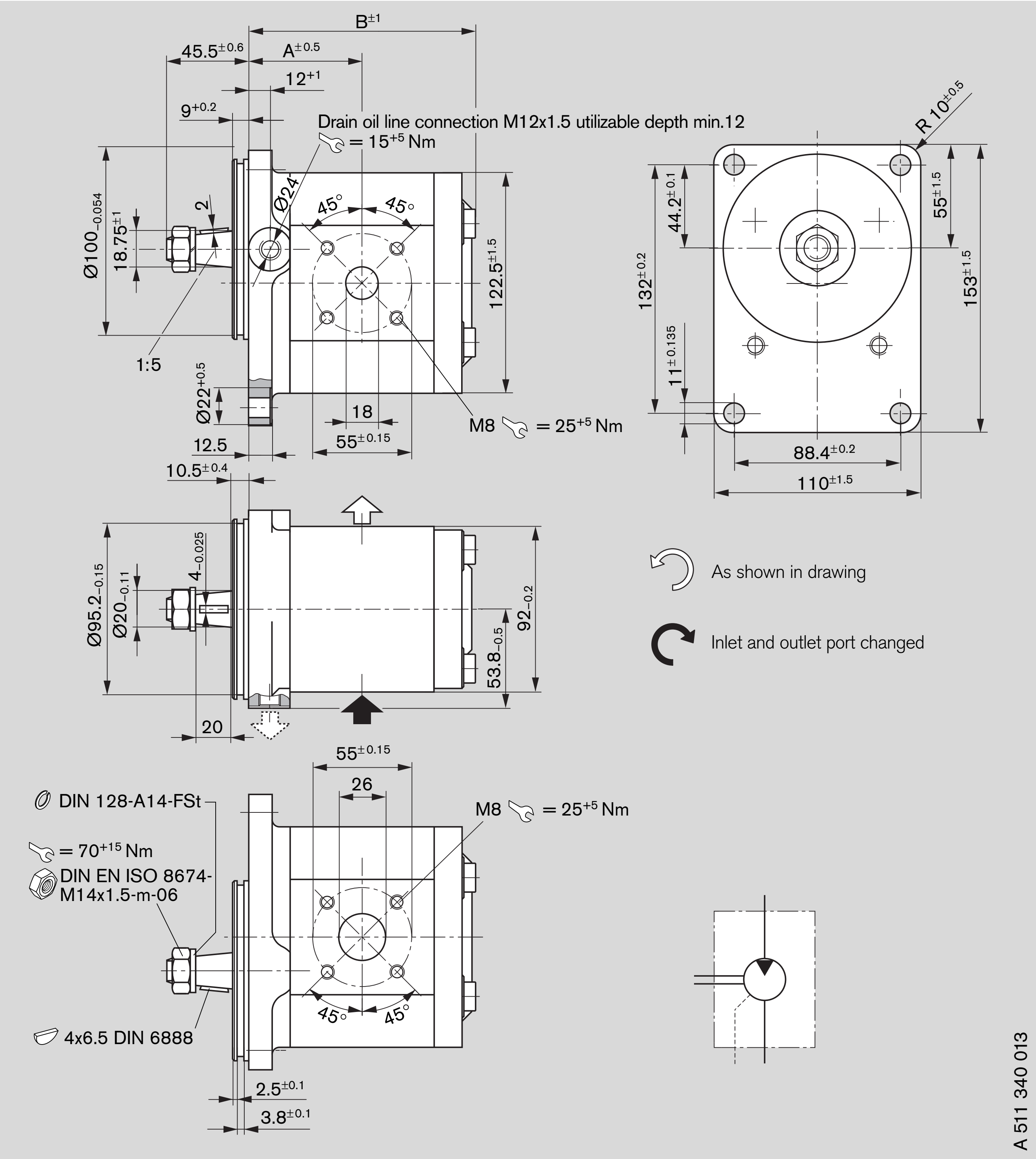


Ordering code
AZMN – 11 – □ □ □ □ C B 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
25	**0 511 725 307**	–	210	500	3,000	6.3	55.0	116.1
28	**0 511 725 309**	**0 511 725 019**	200	500	3,000	6.3	56.6	119.1

Dimensions in mm

N-Motor



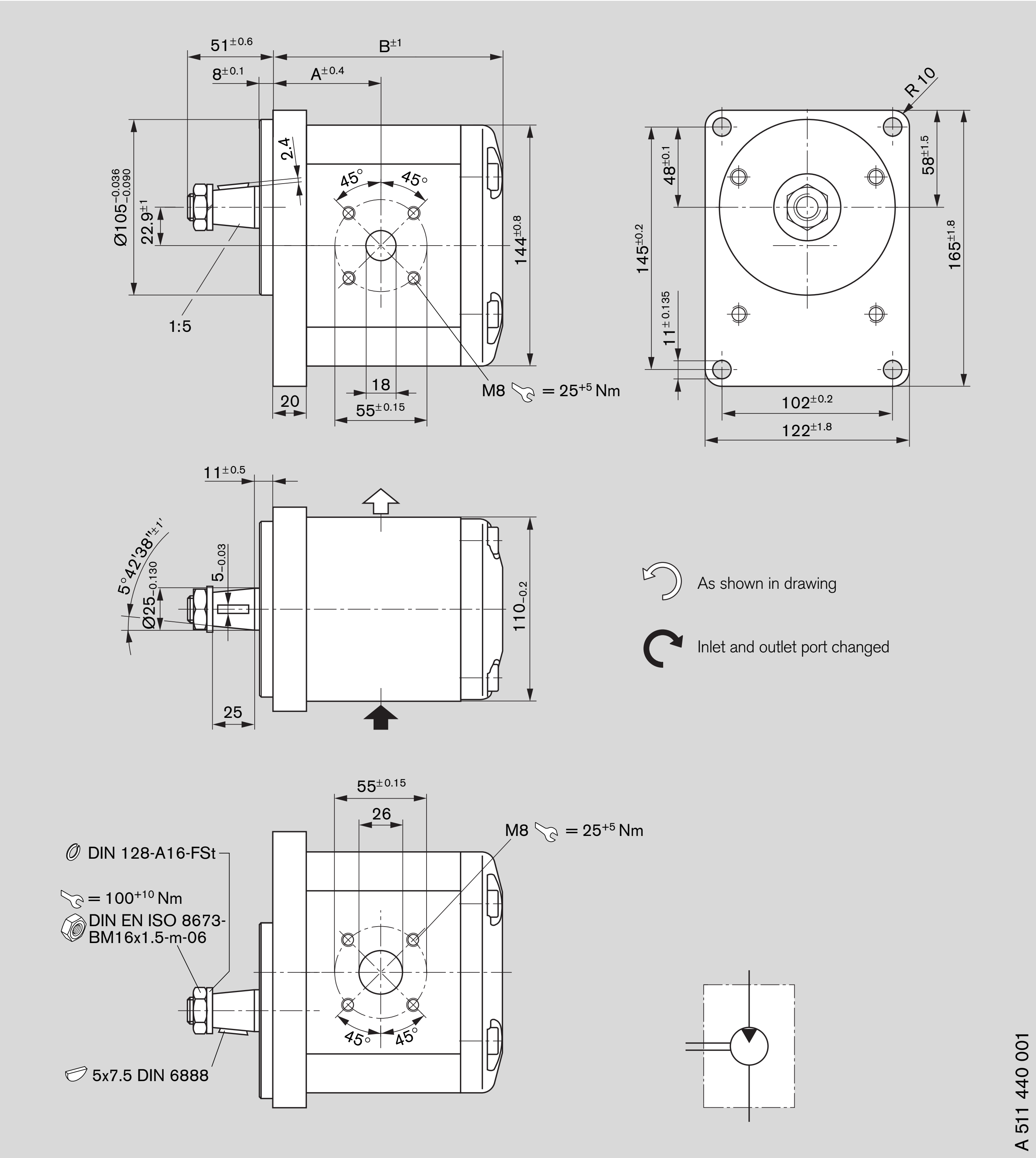
Ordering code

AZMN – 11 – ☐ ☐ ☐ ☐ C B 20 P B – S0097

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
25	–	**0 511 725 024**	210		3,000	10.3	60.5	120.8
28	**0 511 725 312**	–	210		2,800	6.1	62.0	123.8

Dimensions in mm

G-Motor



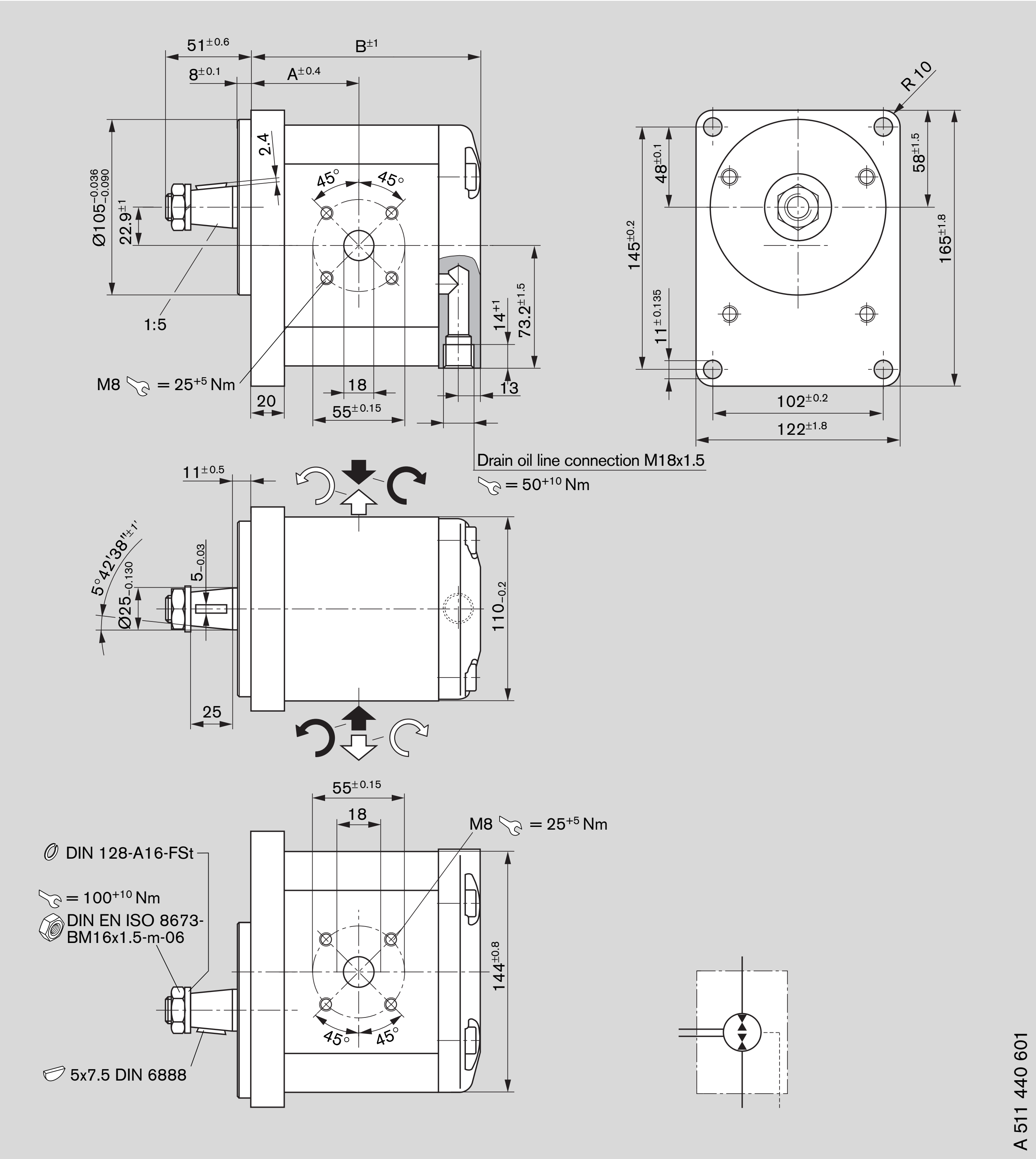
Ordering code

AZMG – 11 – □ □ □ □ C B 20 M B

Displace-ment [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
22.5	**0 511 725 300**	**0 511 725 001**	180	500	3,000	9.1	61.0	128.7
32	**0 511 725 301**	**0 511 725 002**	180	500	2,800	9.6	64.5	137.2
45	**0 511 725 302**	**0 511 725 003**	180	500	2,600	10.1	69.5	149.2

Dimensions in mm

G-Motor



Ordering code

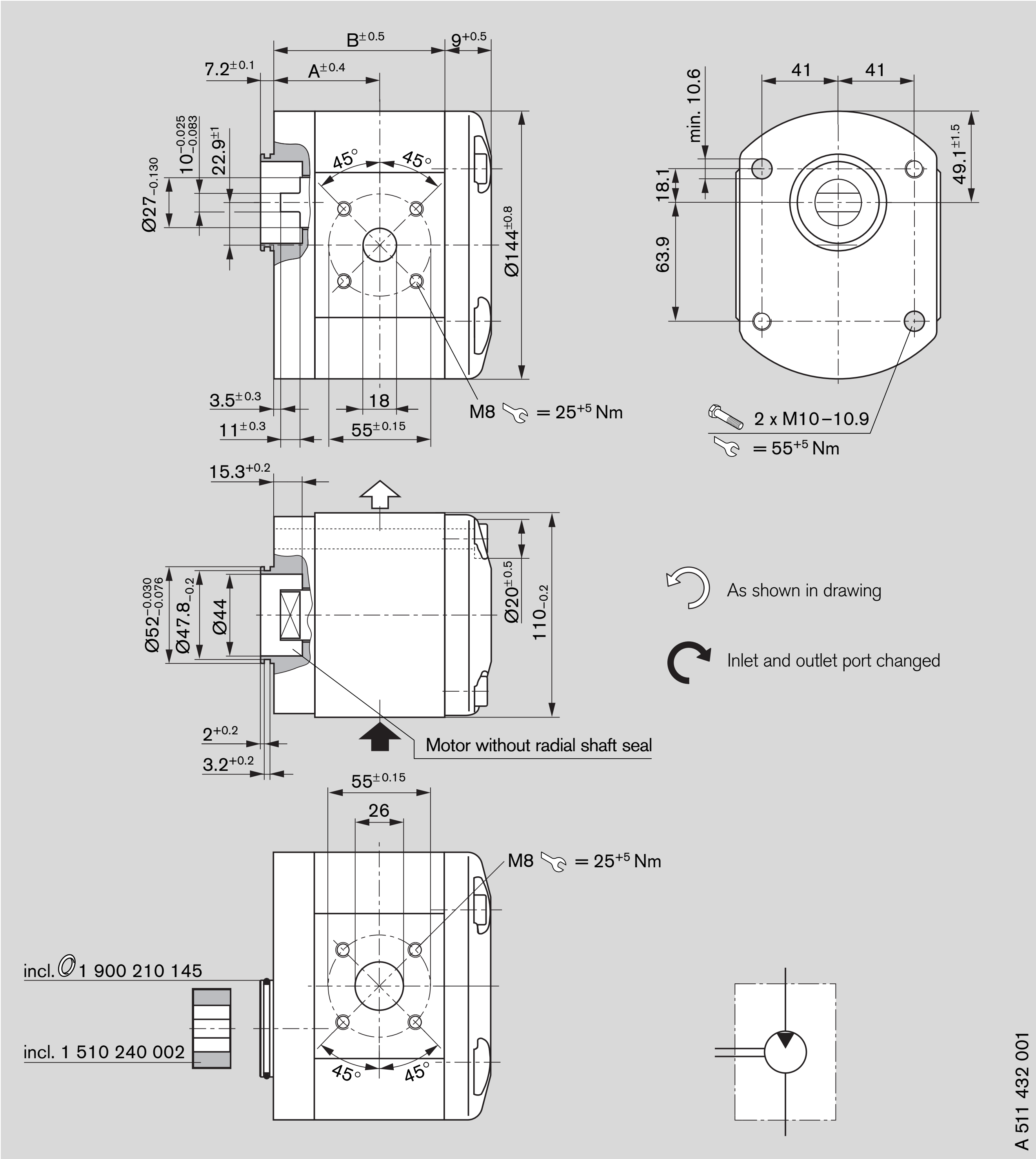
AZMG – 11 – ☐ ☐ ☐ U C B 20 K X* – S0077

AZMG – 11 – ☐ ☐ ☐ U C B 20 M X – S0077

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B
22.5	**0 511 725 600**	210	500	3,000	9.0	61.0	128.7
28	**0 511 726 603**	210	500	3,000	9.2	63.0	133.7
32	**0 511 726 604***	210	500	2,800	9.4	64.5	137.2

Dimensions in mm

G-Motor



Ordering code
AZMG – 11 – □ □ □ □ N M 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
45		**0 511 715 002**	210	500	2,600	8.4	70.5	151.2

Notes

Filter recommendation
The major share of premature failures in external gear motors is caused by contaminated pressure fluid.
As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class NAS 1638	9	10
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.
Basic contamination of the pressure fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General
– The motors supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
– Motor may only be operated in compliance with permitted data (see pages 14 – 18).

Project planning notes
Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear motors are used we recommend that the following note be adhered to.

Technical data
All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.
Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change.**

Characteristics
When designing the external gear motor, note the maximum possible service data based on the characteristics displayed on pages 10 to 14.

Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document:
“General product information for hydraulic products”
RE 07 008.

Leakage oil line
A leakage oil line must be connected directly to the tank in reversible motors or motors stressed by run-back. Observe sufficient dimensions.

Contained in delivery
The components with characteristics as described under device measurements and ordering code, pages 19 – 39, are contained in delivery.

You can find further information in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

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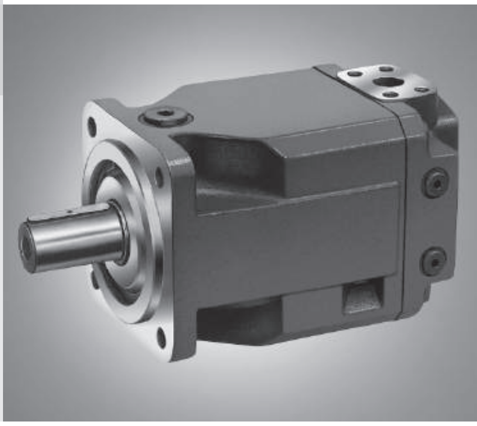
Rexroth
Bosch Group

Fixed Displacement Motor A4FM

RE 91 120/04.00
replaces: 03.95
and RE 91 100

for open and closed circuits



Sizes 22...500
Series 1, Series 3
Nominal pressure up to 400 bar
Peak pressure up to 450 bar

Index

Features

– Axial Piston Fixed Displacement Motor A4FM of swashplate design is used in open and closed loop circuits for hydrostatic drives.
– Output speed is proportional to input flow and inversely proportional to motor displacement.
– Output torque increases with the pressure drop across the motor between the high and low pressure sides.
– Long service life, optimum efficiencies
– Compact design for special applications where A2FM cannot be applied
– Proven rotary group in swashplate-technology

Ordering Code

	A4F	M		/			W	–				

Hydraulic fluid

Mineral oil, HFD (no code)	
HFA, HFB, HFC-Hydraulic fluid (only sizes 71...500)	**E-**

Axial piston unit

Swashplate design, fixed displacement	**A4F**

Mode of operation

Motor	**M**

Size

	22	28	40	56	71	125	250	500
≙ Displacement V_g (cm^3)	●	●	●	●	●	●	●	○

Series

Sizes 22...56, 125...500	**3**
Size 71	**1**

Index

Sizes 22...56	**2**
Sizes 71...500	**0**

Direction of rotation

Viewed on shaft end	alternating	**W**

Seals

NBR (Nitril-caoutchouc), shaft sealing in FKM (Fluor-caoutchouc)	Sizes 22...56	**N**
	Sizes 71...500	**P**
FKM (Fluor-caoutchouc)	Sizes 71...500	**V**

Shaft end	22	28	40	56	71	125	250	500	
Splined shaft SAE	○	○	–	–	–	–	–	–	**S**
Splined shaft SAE	●	●	–	–	–	–	–	–	**T**
Splined shaft DIN 5480	–	–	●	●	●	●	●	○	**Z**
Parallel with key DIN 6885	–	–	–	–	●	●	●	○	**P**

Mounting flange	22	28	40	56	71	125	250	500	
SAE 2-hole	●	●	●	●	–	–	–	–	**C**
ISO 4-hole	–	–	–	–	●	●	●	–	**B**
ISO 8-hole	–	–	–	–	–	–	–	○	**H**

Service line connections	22...40	56	71...500	
Ports A, B: SAE at rear (with metric fixing screws)	–	●	●	**01**
Ports A, B: SAE at side (on opposite sides) (with metric fixing screws)	●	–	●	**02**

● = available

○ = available on enquiry

– = not available

Technical Data

Fluid

We request that before starting a project detailed information about the choice of pressure fluids and application conditions are taken from our catalogue sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (fire resistance fluids, HF).

When using HF- or environmentally acceptable hydraulic fluids possible limitations for the technical data have to be taken into consideration. If necessary please consult our technical department (please indicate type of the hydraulic fluid used for your application on the order sheet).

The sizes 22..56 are not suitable for operation with HFA, HFB and HFC.

Operation viscosity range

In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected from within the range:

ν_{opt} = operating viscosity 16...36 mm²/s

referred to the loop temperature (closed circuit) or tank temperature (open circuit).

Viscosity limits

The limiting values for viscosity are as follows:

Size 22...56

ν_{min} = 5 mm²/s, short term at a max. permissible temp. of t_{max}= 115°C
ν_{max} = 1600 mm²/s, short term on cold start (t_{min} = -40°C)

Size 71...500

ν_{min} = 10 mm²/s, short term at a max. permissible drain temp. t_{max} = 90°C
ν_{max} = 1000 mm²/s, short term on cold start (t_{min} = -25°C)

Please note that the max. fluid temperature is also not exceeded in certain areas (for instance bearing area).

At temperature of -25°C up to -40°C special measures may be required for certain installation positions, please contact us.

Notes on the selection of the hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the loop (closed circuit) or the tank temperature (open circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity lies within the optimum range (ν_{opt}) (see shaded section of the selection diagram). We recommend that the highest possible viscosity range should be chosen in each case.

Example: At an ambient temperature of X°C the operating temperature is 60°C. Within the operating viscosity range (ν_{opt}; shaded area), this corresponds to viscosity ranges VG 46 or VG 68. VG 68 should be selected.

Important: The leakage oil (case drain oil) temperature is influenced by pressure and motor speed and is always higher than the circuit temperature. However, at no point in the circuit may the temperature exceed 115°C for sizes 22...56 or 90°C for sizes 71...500.

If it is not possible to comply with the above condition because of extreme operating parameters or high ambient temperatures we recommend housing flushing. Please consult us.

Filtration

The finer the filtration the better the achieved purity grade of the pressure fluid and the longer the life of the axial piston unit. To ensure the functioning of the axial piston unit a minimum purity grade of:

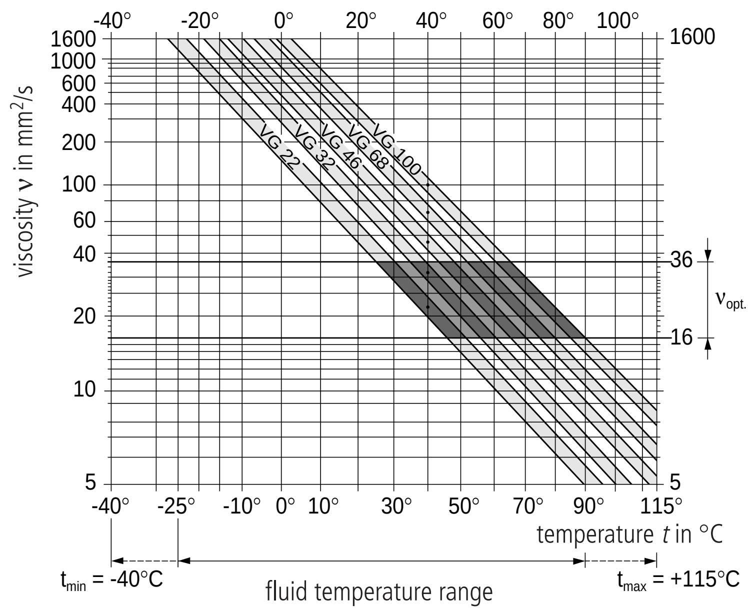
9 to NAS 1638
18/15 to ISO/DIS 4406 is necessary.

At very high temperatures of the hydraulic fluid (90°C to max. 115°C, not permissible for sizes 71...500) at least cleanless class

8 to NAS 1638
17/14 to ISO/DIS 4406 is necessary.

If above mentioned grades cannot be maintained please consult supplier.

Selection diagram



Technical Data

valid for operation with mineral oils

Flushing of the bearings (Sizes 125...500)

operating conditions, flushing quantities and notes on bearing flushing see RE 92 050 (A4VSO).

Operating pressure range

Maximum pressure at port A or B (Pressure data to DIN 24312)

Size		22...56	71...500
Nominal pressure p_N	*bar*	400 [1])	350
Peak pressure p_{max}	*bar*	450 [1])	400

[1]) Size 28 with S-shaft: 315/350 bar

The summ of the pressures at ports A and B may not exceed 700 bar.

Direction of flow

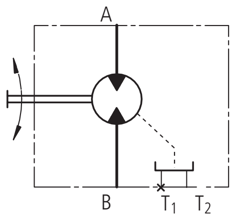
clockwise rotation	anti-clockwise rotation
A to **B**	**B** to **A**

Symbol

Size 22...56

A, B Service line ports

T_1, T_2 Case drain (1 port plugged)



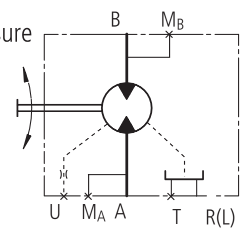
Size 71...500

A, B Service line ports

M_A,M_B Pressure gauge, working pressure

T, R(L) Case drain, Air bleed (1port plugged)

U Flushing port (Sizes71...500)



Case drain pressure

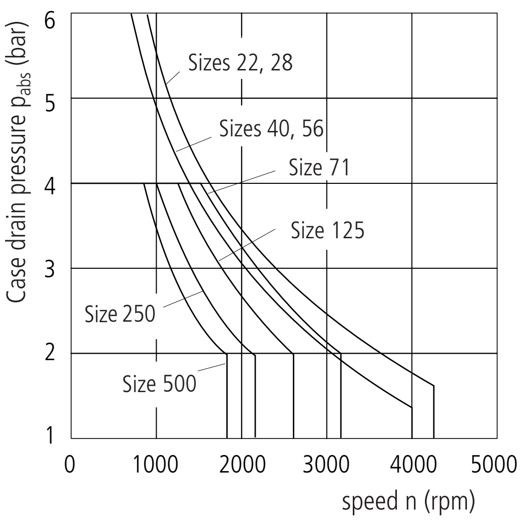
The max. permissible leakage pressure (housing pressure) is dependent on speed (see diagram). The pressure in the housing must be equal to or greater than the external pressure on the shaft sealing ring.

Max. leakage pressure (housing pressure)

$p_{abs.\ max.}$ ______ 6 bar (sizes 22...56)

______ 4 bar(sizes71...500)

A leakage line to the tank is necessary.



Installation and Commissioning Guidelines

General

At start-up and during operation the motor housing has imperatively to be filled up with hydraulic fluid (filling of the case chamber). Start-up has to be carried out at low speed and without load till the system is completely bleeded.

At a longer standstill the case may discharge via operating line. At new start-up a sufficient filling of the housing has to be granted.

The leakage oil in the housing has to be discharged to the tank via highest positioned case drain port.

Installation position

- Sizes 22...56: Shaft horizontal or shaft down
- Sizes 71 (series1): Shaft horizontal, vertical installation position as to agreement
- Sizes 125...500: Optional, at vertical installation position bearing flushing is recommended at port U (as to RD 9205)

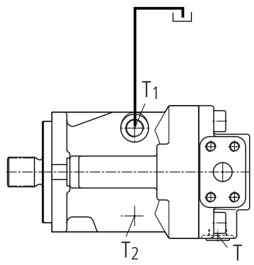
Installation below tank level

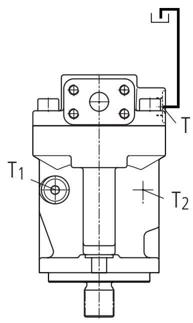
Motor below min. oil level in the tank (standard)

➔ Fill up axial piston motor before start-up via highest positioned case drain port

➔ Operate motor at low speed till motor system is completely filled up

➔ Minimum immerson depth of the drain line in the tank: 200mm (relative to the min. oil level in the tank).



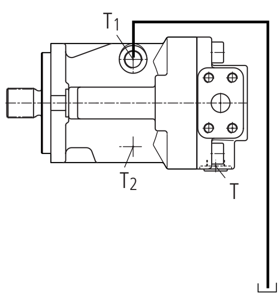


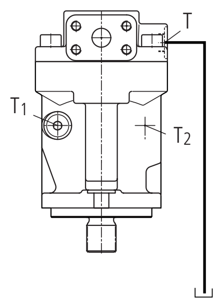
Installation on top of tank level

Motor on top of min. oil level in the tank

➔ Actions as installation below tank level

➔ Note: installation position "drive shaft up" for sizes 22...56 not permissible





Technical Data

valid for operation with mineral oil

Table of values (theoretical values, without considering η_{mh} and η_v; values rounded)

Size			22	28	40	56	71	125	250	500
Displacement	V_g	cm^3	22	28	40	56	71	125	250	500
Max. speed	$n_{max\ continuous}$	rpm	4250	4250	4000	3600	3200	2600	2200	1800
	$n_{max\ interm.}$ [1])	rpm	5000	5000	5000	4500	–	–	–	–
Max. flow (at n_{max})	$q_{V\ max}$	L/min	93	119	160	202	227	325	550	900
Torque constants	T_K	Nm/bar	0,35	0,445	0,64	0,89	1,13	1,99	3,97	7,95
Torque (at Δp = 400 bar)	T_{max}	Nm	140	178	255	356	395[2])	696[2])	1391[2])	2783[2])
Filling volume		L	0,3	0,3	0,4	0,5	2,0	3,0	7,0	11,0
Moment of inertia about drive axis	J	kgm^2	0,0015	0,0015	0,0043	0,0085	0,0121	0,0300	0,0959	0,3325
Actual starting torque at n = 0 rpm (Δp = 350 bar)		Nm (approx.)					320	564	1127	
Weight (approx.)	m	kg	11	11	15	21	34	61	120	

[1]) Intermittent max. speed at overspeed: Δp = 70…150 bar [2]) Δp = 350 bar

Calculation of size

Flow $$q_v = \frac{V_g \bullet n}{1000 \bullet \eta_v}$$ in L/min

Output speed $$n = \frac{q_V \bullet 1000 \bullet \eta_V}{V_g}$$

Output torque $$T = \frac{V_g \bullet \Delta p \bullet \eta_{mh}}{20 \bullet \pi}$$ in Nm

$$= T_K \bullet \Delta p \bullet \eta_{mh}$$

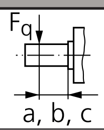
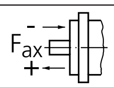
Output power $$P = \frac{T \bullet n}{9549} = \frac{2\,\pi \bullet T \bullet n}{60\,000}$$ in kW

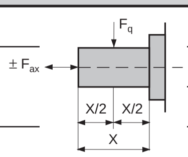
$$= \frac{q_v \bullet \Delta p \bullet \eta_t}{600}$$

V_g = geometric displacement per rev. in cm^3
Δp = pressure differential in bar
n = speed in rpm
η_v = volumetric efficiency
η_{mh} = mech.-hyd. efficiency
η_t = overall efficiency

Output drive

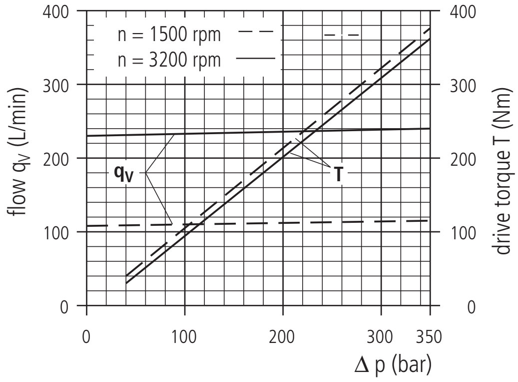
permissible axial and radial loading on drive shaft

Size				22	28	40	56
Distance of F_q (from shaft shoulder)		a	mm	17,5	17,5	17,5	17,5
		b	mm	30	30	30	30
		c	mm	42,5	42,5	42,5	42,5
Max. permissible radial force at distance	a	$F_{q\ max}$	N	2500	2050	3600	5000
	b	$F_{q\ max}$	N	1400	1150	2890	4046
	c	$F_{q\ max}$	N	1000	830	2416	3398
Max. permissible axial load		$-F_{ax\ max}$	N	1557	1557	2120	2910
		$+F_{ax\ max}$	N	417	417	880	1490

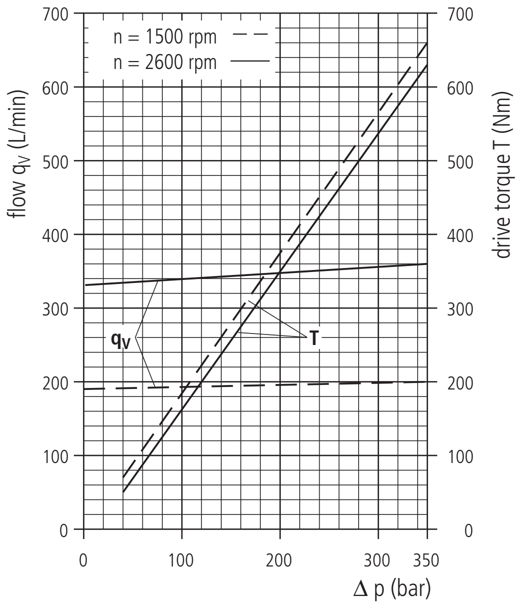
Size				71	125	250	500
Max. axial force at housing pressure p_{max} 1 bar abs.		$\pm F_{ax\ max}$	N	1400	1900	3000	4000
Max. axial force at housing pressure p_{max} 4 bar abs.		$+F_{ax\ max}$	N	810	1050	1850	2500
		$-F_{ax\ max}$	N	1990	2750	4150	5500
Max. radial force		$F_{q\ max}$	N	1700	2500	4000	5000

Flow and Drive Torque

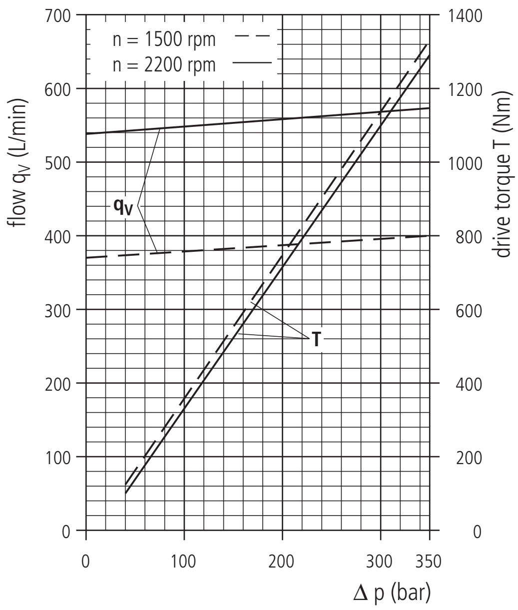
Size 71



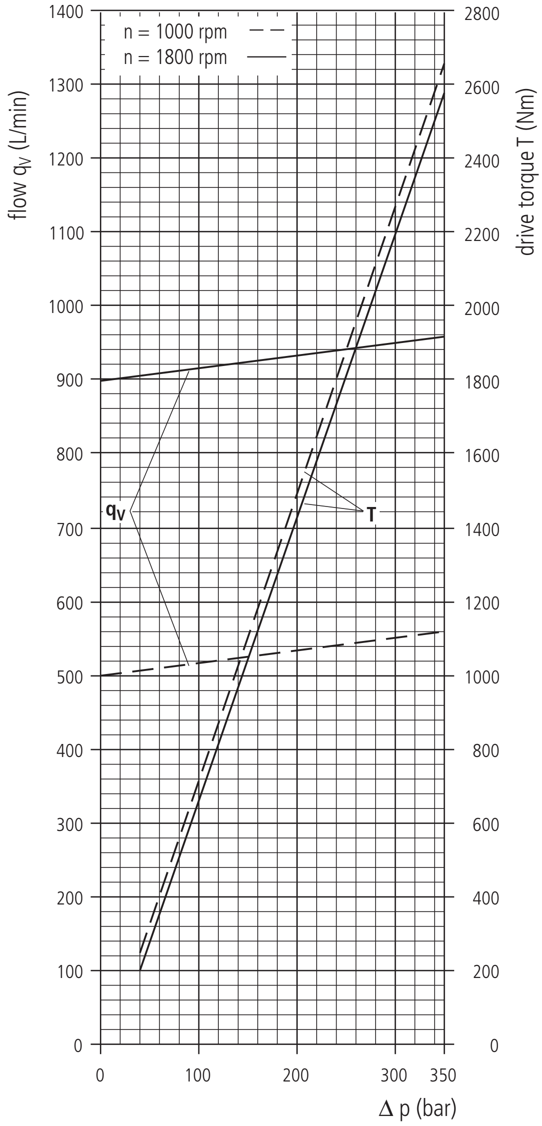
Size 125



Size 250



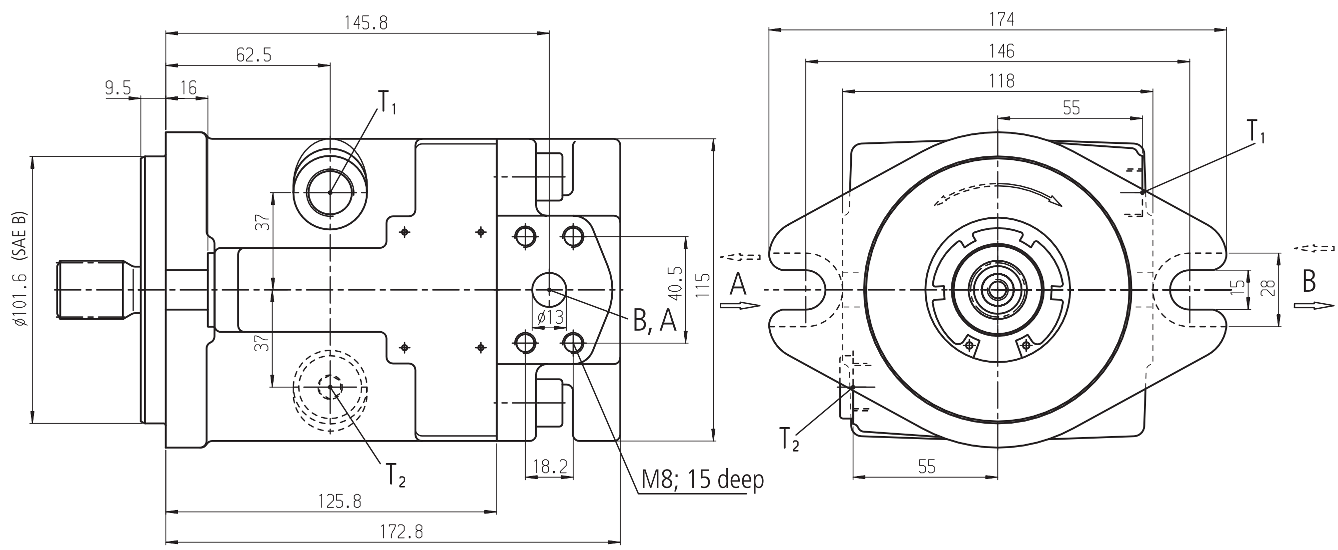
Size 500



(Fluid: Hydraulic oil ISO VG 46 DIN 51519, t = 50°C)

Unit Dimensions, Size 22, 28

Before finalising your design, please request a certified drawing.



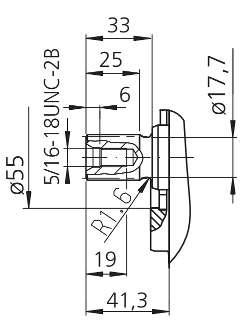
Connections

A, B	Service line ports	SAE $^1/_2$" 420 bar (6000 psi) high pressure series
T_1, T_2	Leakage port / oil filling port	M18x1,5; 12 deep

Shaft ends

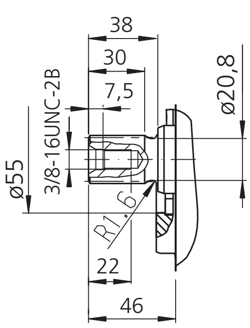
S

Splined shaft SAE $^7/_8$",
30° pressure angle,
13 teeth, 16/32 pitch,
flat root, side fit,
tolerance class 5
ANSI B92.1a-1976



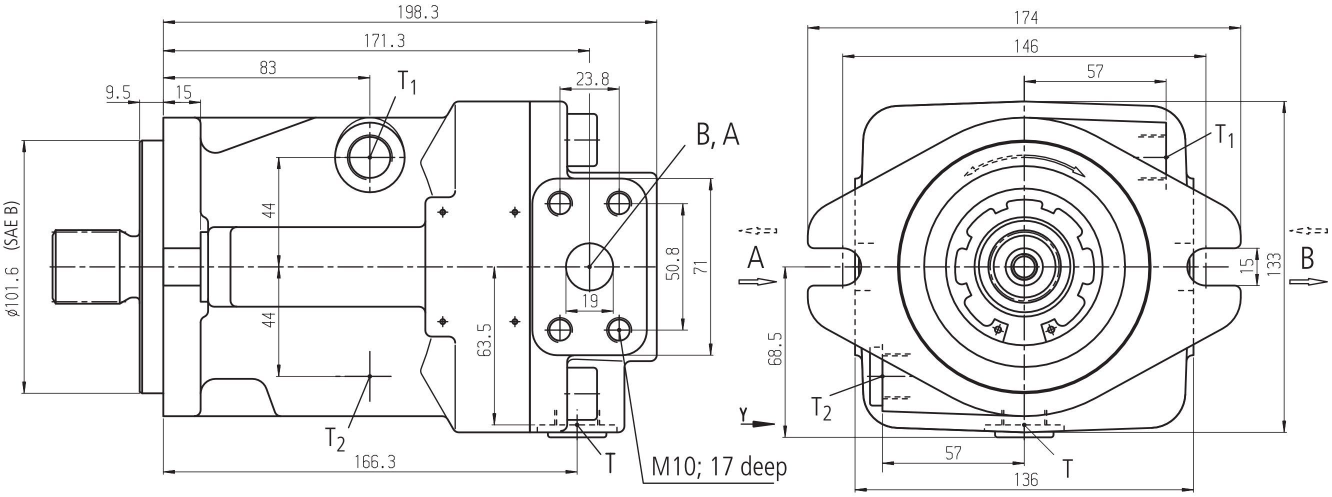
T

Splined shaft SAE 1"
30° pressure angle,
15 teeth, 16/32 pitch,
flat root, side fit,
tolerance class 5
ANSI B92.1a-1976



Unit Dimensions, Size 40

Before finalising your design, please request a certified drawing.



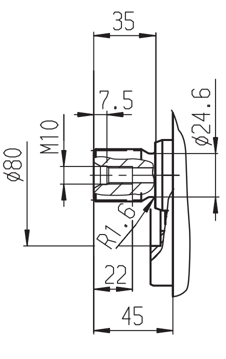
Connections

A, B	Service line ports	SAE $^3/_4$" 420 bar (6000 psi) high pressure serie
T, T_1, T_2	Leakage port / oil filling port	M18x1,5; 15 deep

Shaft ends

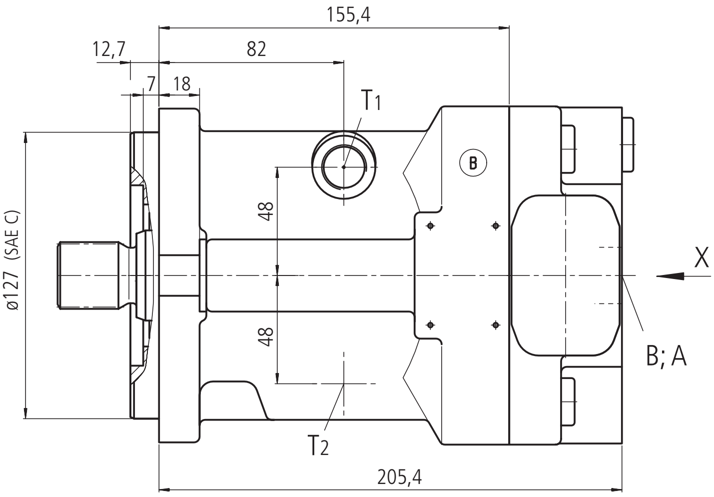
Z

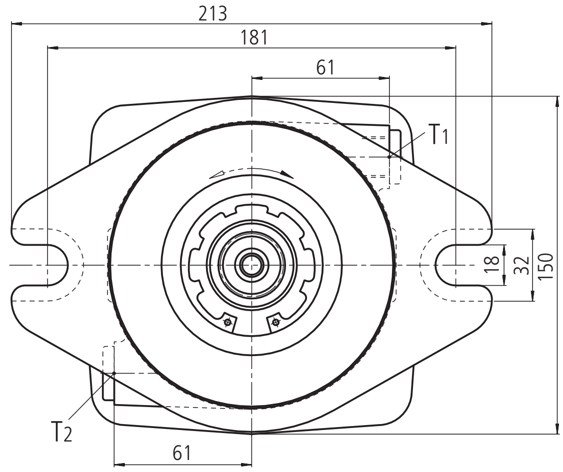
Splined shaft
W 30x2x30x14x9g
DIN 5480



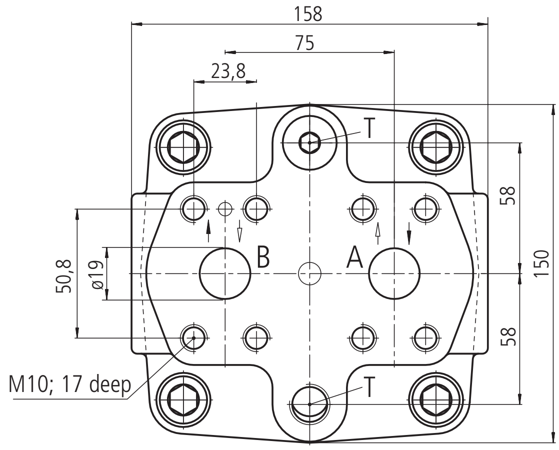
Unit Dimensions, Size 56

Before finalising your design, please request a certified drawing.





View X



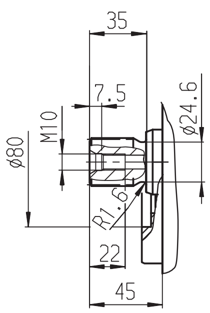
Connections

A, B	Service line ports	SAE $^3/_4$" 420 bar (6000 psi) high pressure serie
T, T_1, T_2	Leakage port / oil filling port	M 18x1,5 ; 12 deep

Shaft ends

Z

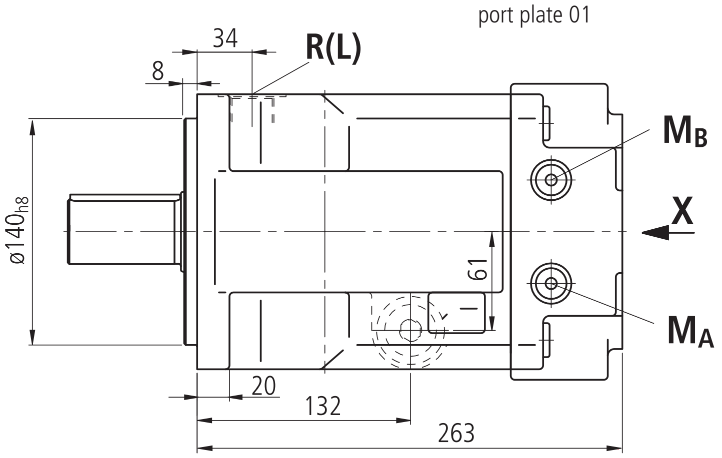
Splined shaft
W 30x2x30x14x9g
DIN 5480

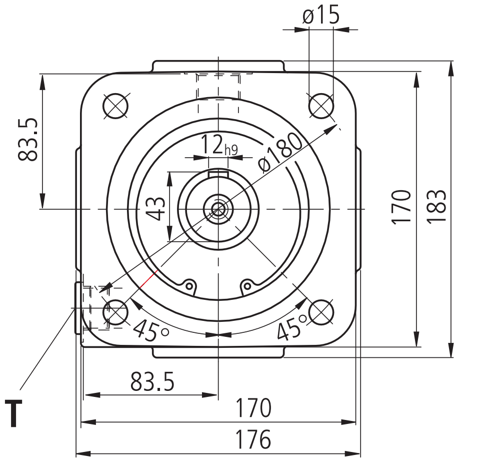


Unit Dimensions, Size 71

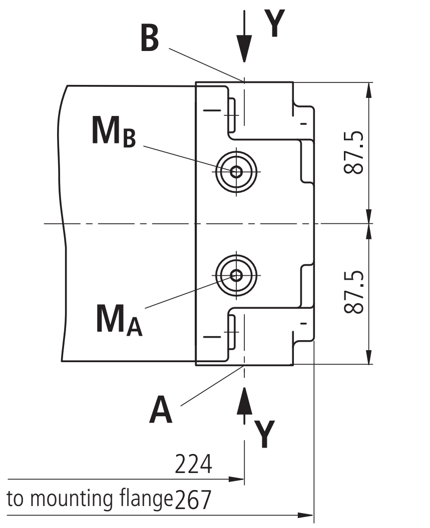
Before finalising your design, please request a certified drawing.

port plate 01

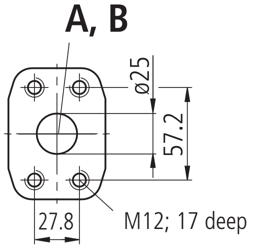




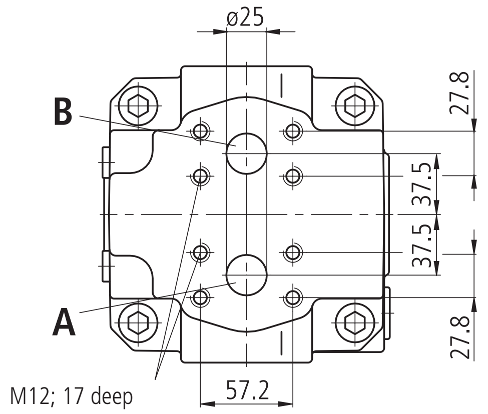
port plate 02



View Y



port plate 01
View X



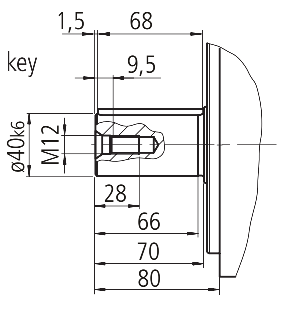
Connections

A, B	service line ports	SAE 1" (high pressure series)
R (L)	oil filling and bleed	M27x2
T	oil drain (plugged)	M27x2
M_A, M_B	measuring port for pressure (plugged)	M14x1,5

Shaft end

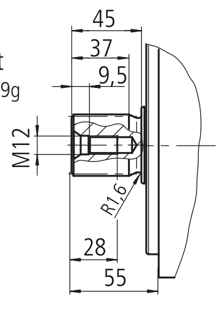
P

Parallel shaft with key
AS 12x8x68
DIN 6885



Z

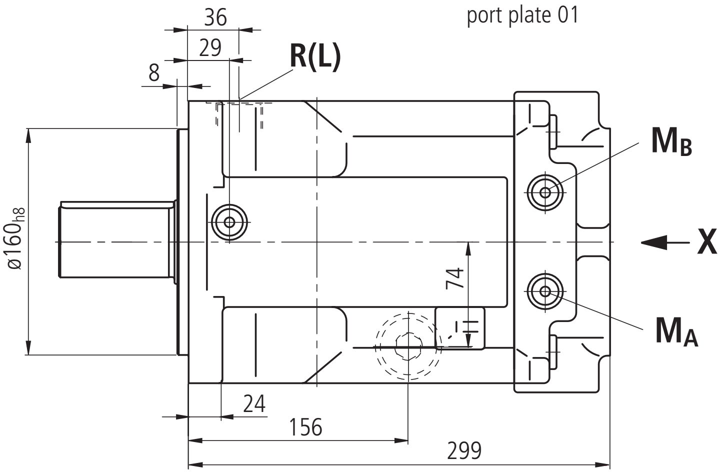
Splined shaft
W40x2x30x18x9g
DIN 5480

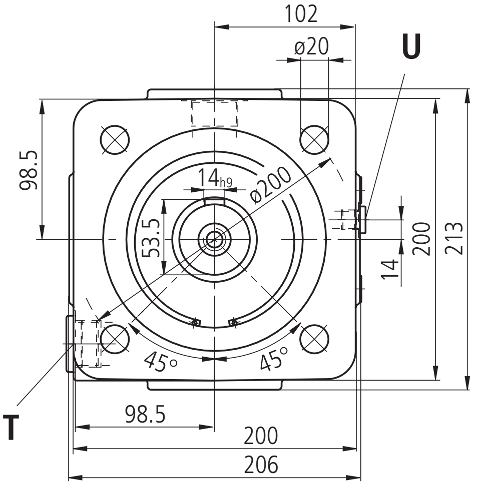


Unit Dimensions, Size 125

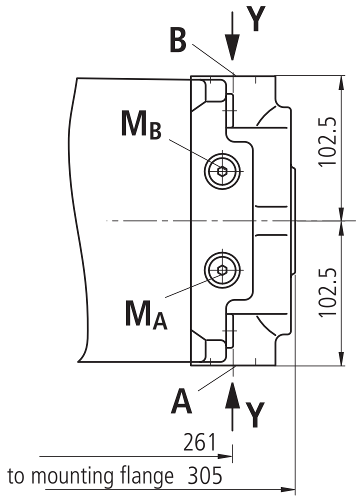
Before finalising your design, please request a certified drawing.

port plate 01

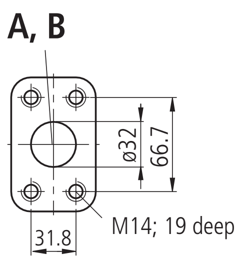




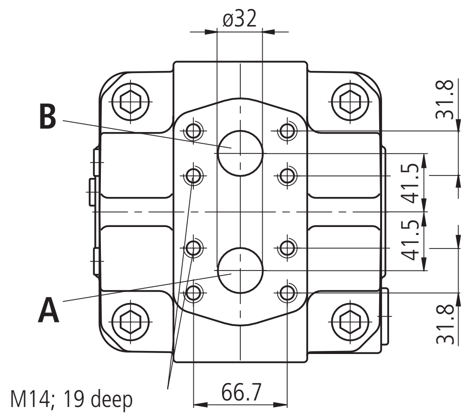
port plate 02



View Y



port plate 01
View X



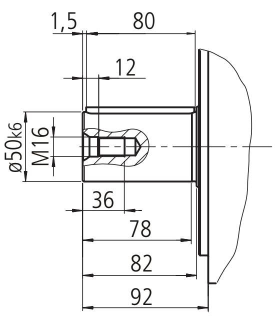
Connections

A, B	service line ports	SAE 1 1/4" (high pressure series)
R (L)	oil filling and bleed	M33x2
T	oil drain (plugged)	M33x2
M_A, M_B	measuring port for pressure (plugged)	M14x1,5
U	Flushing port, flushing of the bearings (plugged)	M14x1,5

Shaft end

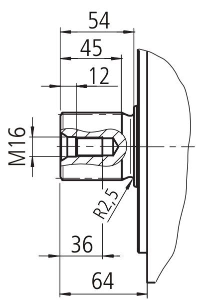
P

Parallel shaft with key
14x9x80
DIN 6885



Z

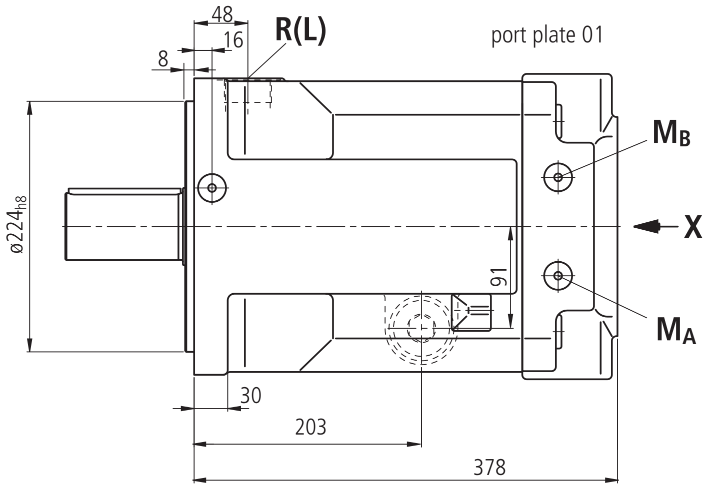
Splined shaft
W50x2x30x24x9g
DIN 5480

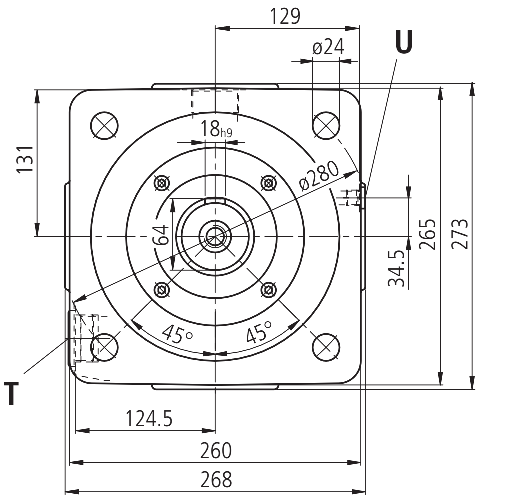


Unit Dimensions, Size 250

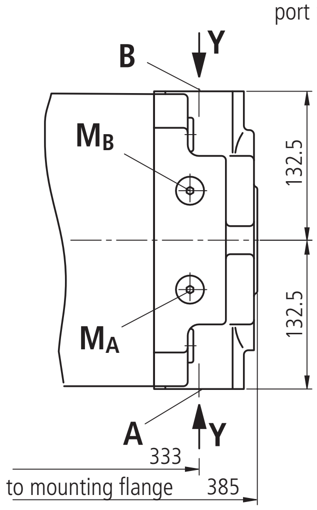
Before finalising your design, please request a certified drawing.

port plate 01

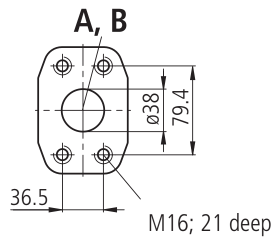




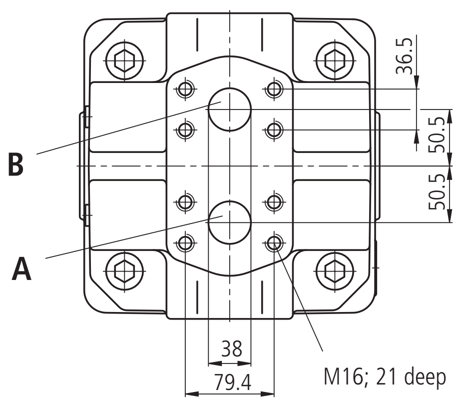
port plate 02



View Y



port plate 01
View X



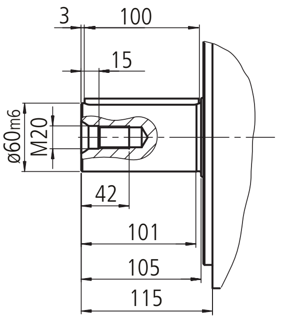
Connections

A, B	service line ports	SAE 1 1/2" (high pressure series)
R (L)	oil filling and bleed	M42x2
T	oil drain (plugged)	M42x2
M_A, M_B	measuring port for pressure (plugged)	M14x1,5
U	Flushing port, flushing of the bearings (plugged)	M14x1,5

Shaft end

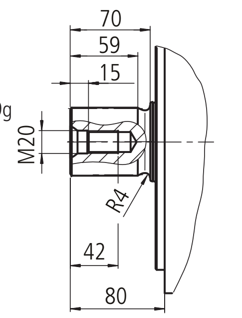
P

Parallel shaft with key
AS 18x11x100
DIN 6885



Z

Splined shaft
W60x2x30x28x9g
DIN 5480



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Rexroth
Bosch Group

Variable Plug-in Motor A6VE

Data sheet

Series 63

Size	Nominal pressure/Maximum pressure
28 to 160	400 bar/450 bar
250	350 bar/400 bar

Open and closed circuits

Contents

Features

- Variable 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 a recessed mounting flange located on the center of the case (extremely space-saving construction)
- Easy to install, simply plug into the mechanical gearbox (no configuration specifications to be observed)
- Tested unit ready to install
- For use especially in mobile applications
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.

Ordering code for standard program

A6V	E					/	63	W		–	V								
01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16	17	18

Axial piston unit

01	Bent-axis design, variable	**A6V**

Operating mode

02	Motor, plug-in version	**E**

Sizes (NG)

03	Geometric displacement, see table of values on page 7	**28**	**55**	**80**	**107**	**160**	**250**

Control devices

			28	55	80	107	160	250	
04	Proportional control hydraulic	$\Delta p = 10$ bar	●	●	●	●	●	●	**HD1**
		$\Delta p = 25$ bar	●	●	●	●	●	●	**HD2**
	Two-point control hydraulic		–	–	–	–	–	●	**HZ**
			●	–	–	–	●	–	**HZ1**
			–	●	●	●	●1)	–	**HZ3**
	Proportional control electric	12 V	●	●	●	●	●	●	**EP1**
		24 V	●	●	●	●	●	●	**EP2**
	Two-point control electric	12 V	●	–	–	–	●	●	**EZ1**
		24 V	●	–	–	–	●	●	**EZ2**
		12 V	–	●	●	●	–	–	**EZ3**
		24 V	–	●	●	●	–	–	**EZ4**
	Automatic control high-pressure related	with minimum pressure increase $\Delta p \leq 10$ bar	●	●	●	●	●	●	**HA1**
		with pressure increase $\Delta p = 100$ bar	●	●	●	●	●	●	**HA2**
		with minimum pressure increase $\Delta p \leq 10$ bar	–	●	●	●	●	–	**HA3**1)
	Automatic control speed related $p_{St}/p_{HD} = 3/100$, hydraulic travel direction valve		–	–	–	–	–	●	**DA**
	$p_{St}/p_{HD} = 5/100$, electric travel direction valve + electric $V_{g\ max}$-circuit	24 V	●	●	●	●	●	–	**DA3**

Pressure control (only for HD, EP)

05	Without pressure control (without code)	
	Pressure control, fixed setting	**D**

Override of controls HA

06	Without override (without code)	
	Hydraulic override, remote control, proportional	**T**

Series

07	Series 6, index 3	**63**

Direction of rotation

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

Setting ranges for displacement2)

			28	55	80	107	160	250	
09	$V_{g\ min} = 0$ to $0.7\ V_{g\ max}$ (without code)		●	●	●	●	●	–	
	$V_{g\ min} = 0$ to $0.4\ V_{g\ max}$	$V_{g\ max} = V_{g\ max}$ to $0.8\ V_{g\ max}$	–	–	–	–	–	●	**1**
	$V_{g\ min} > 0.4\ V_{g\ max}$ to $0.8\ V_{g\ max}$	$V_{g\ max} = V_{g\ max}$ to $0.8\ V_{g\ max}$	–	–	–	–	–	●	**2**

Seals

		28	55	80	107	160	250	
10	FKM (fluor-caoutchouc)	●	●	●	●	●	●	**V**

● = Available ❍ = On request – = Not available ▭ = Preferred program

1) Only possible in combination with port plate 22 (integrated counterbalance valve).

2) Specify exact settings for $V_{g\ min}$ and $V_{g\ max}$ in plain text when ordering: $V_{g\ min} = ...\ cm^3$, $V_{g\ max} = ...\ cm^3$

Ordering code for standard program

A6V	E					/	63	W		–	V							
01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16	17	18

Drive shafts

		28	55	80	107	160	250	
11	Splined shaft DIN 5480	●	–	●	–	●	–	**A**
		–	●	–	●	–	●	**Z**

Mounting flanges

			28	55	80	107	160	250	
12	Similar to ISO 3019-2	2-hole	●	●	●	●	●	–	**L**
		4-hole	–	–	–	–	–	●	**M**
	Modified adapter flange	2-hole	–	–	–	●	–	–	**U**

Port plates for service lines[3]

					28	55	80	107	160	250	
13	SAE flange ports A and B at side, opposite		02	0	●	●	●	●	●	●	**020**
				7	●	●	●	●	●	●	**027**
	SAE flange ports A and B at bottom only with integrated counterbalance valve BVI[4]		22	1	–	●	●	●	●	–	**221**
				2	–	●	●	●	●	–	**222**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5)7)]	BVD	37	0 8	–	–	–	●	–	–	**370** **378**
			38	0 8	–	●	●	●	●	●[9)]	**380**
		BVE	38	0 8	–	–	–	●	●	–[9)]	**388**

Valves (see pages 29 to 37)

14	Without valve		**0**
	Brake release valve integrated (pilot pressure for brake release)	internal ducting	**1**
		external piping	**2**
	Flushing and boost pressure valve mounted		**7**
	Counterbalance valve mounted[6)7)]		**8**

Speed sensor (see page 38)

		28	55	80	107	160	250	
15	Without speed sensor	●	●	●	●	●	●	**0**
	Prepared for DSA speed sensor	❍	❍	❍	❍	❍	❍	**U**
	DSA speed sensor mounted[8)]	❍	❍	❍	❍	❍	❍	**V**

Connector for solenoids (see page 28)

		28 to 160	250	
16	Without connector (without solenoid, only with hydraulic controls)	●	–	**0**
	(size 250 without code)	–	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode	●	–	**P**
	HIRSCHMANN connector – without suppressor diode (without code)	–	●	

Beginning of control

			28	55	80	107	160	250	
17	Port plate 02, 37, 38	at $V_{g\,min}$ (standard for HA)	●	●	●	●	●	●	**A**
		at $V_{g\,max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	●	●	●	●	**B**
	Port plate 22	at $V_{g\,min}$ (standard for HA3)	–	●	●	●	●	–	**B**
		at $V_{g\,max}$ (standard for HZ3)	–	●	●	●	●	–	**B**

Standard / special version

18	Standard version (without code)	
	Standard version with installation variants (e. g. T ports against standard open or closed)	**-Y**
	Special version	**-S**

● = Available ❍ = On request – = Not available ▭ = Preferred program

3) Metric fastening thread
4) Only for HZ3 and HA3. Add specification of integrated counterbalance valve BVI, see separate ordering code on page 35. Note the restrictions on page 36.
5) Only possible in conjunction with HD, EP and HA1 and HA2 control
6) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE - RE 95525) separately.
7) Note the restrictions on page 32.
8) Specify ordering code of sensor according to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.
9) Counterbalance valve MHB32, please contact us.

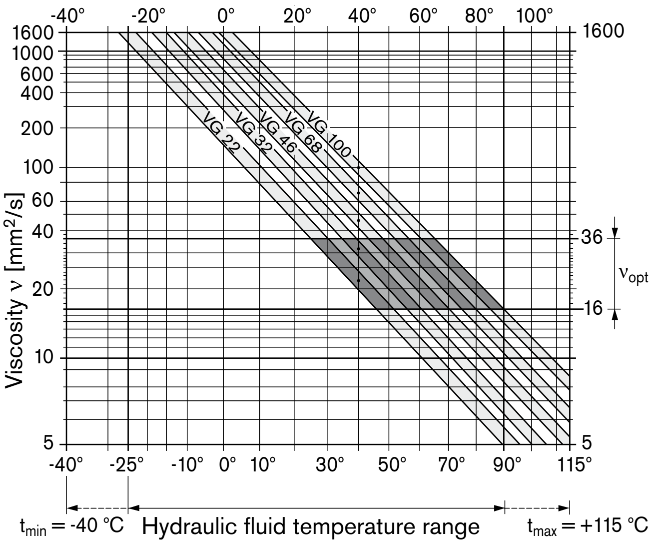
Technical data

Hydraulic fluid

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

The variable motor A6VE is not suitable for operation with HFA hydraulic fluid. If HFB, HFC, or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

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

Note

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

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case with a flushing and boost pressure valve (see page 29).

Viscosity and temperature of hydraulic fluid

	Viscosity [mm^2/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -50 °C T_{opt} = +5 °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	$t \leq$ 3 min, without load ($p \leq$ 50 bar), $n \leq$ 1000 rpm (sizes 28 to 160), $n \leq 0.25 \cdot n_{nom}$ (size 250)
Permissible temperature difference		$\Delta T \leq$ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400	T = -40 °C to -25 °C	At $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq$ 15 min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq$ 7	T_{max} = +103 °C	measured at port T, t < 3 min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq$ +115 °C	see page 5

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

Technical data

Filtration of the hydraulic fluid

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

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

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

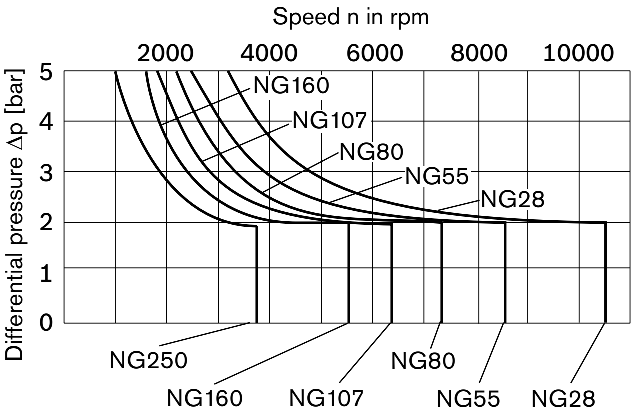
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 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.



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.

Note
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.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HD, HA.T (sizes 28 to 160) ____ increase
HD, EP, HA, HA.T (size 250) ____ increase
DA ____ decrease

With the following controls, an increase in the case pressure has no influence on the beginning of control:
EP, HA (sizes 28 to 160)

The factory settings for the beginning of control are made at $p_{abs} = 2$ bar (sizes 28 to 160) or $p_{abs} = 1$ bar (size 250) case pressure.

Direction of flow

Direction of rotation, viewed on drive shaft	
cw	**ccw**
A to **B**	**B** to **A**

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Sizes 28 to 160

Nominal pressure p_{nom} ________________ 400 bar absolute

Maximum pressure p_{max} ________________ 450 bar absolute
Single operating period ________________ 10 s
Total operating period ________________ 300 h

Size 250

Nominal pressure p_{nom} ________________ 350 bar absolute

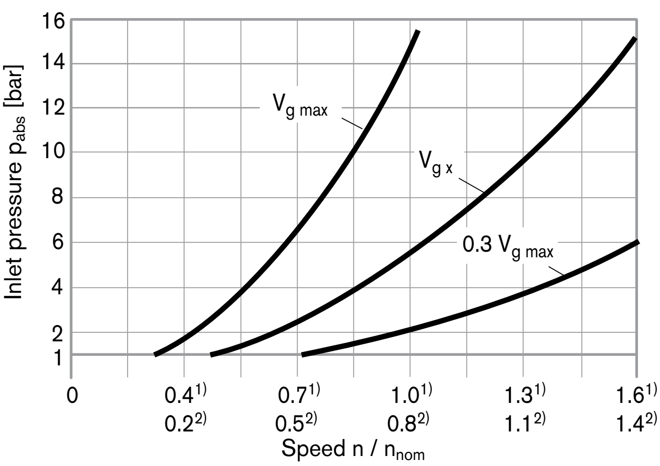
Maximum pressure p_{max} ________________ 400 bar absolute
Single operating period ________________ 10 s
Total operating period ________________ 300 h

Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve ____________ 9000 bar/s
without pressure-relief valve ________________ 16000 bar/s

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operation 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). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



1) For sizes 28 to 160
2) For size 250

This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

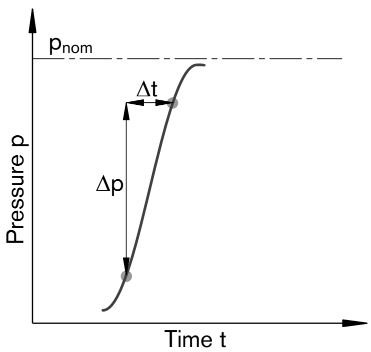
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

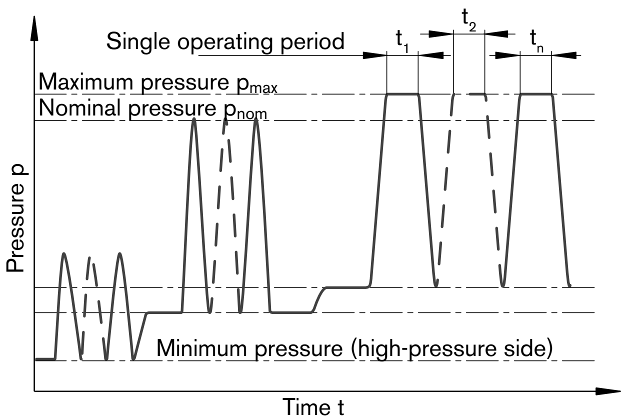
Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

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

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

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





Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

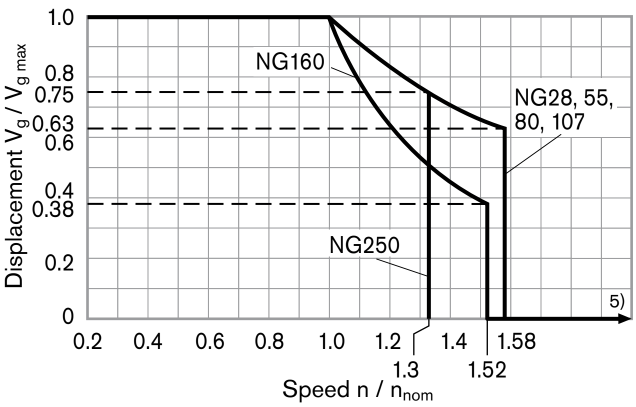
Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size		NG	28	55	80	107	160	250
Displacement geometric[1], per revolution	$V_{g\,max}$	cm^3	28.1	54.8	80	107	160	250
	$V_{g\,min}$	cm^3	0	0	0	0	0	0
	$V_{g\,x}$	cm^3	18	35	51	68	61	188
Speed maximum[2] (while adhering to the maximum permissible input flow)								
at $V_{g\,max}$	n_{nom}	rpm	5550	4450	3900	3550	3100	2700
At $V_g < V_{g\,x}$ (see diagram below)	n_{max}	rpm	8750	7000	6150	5600	4900	3600
at $V_{g\,0}$	n_{max}	rpm	10450	8350	7350	6300	5500	3600
Input flow[3]								
at n_{nom} and $V_{g\,max}$	$q_{V\,max}$	L/min	156	244	312	380	496	675
Torque[4]								
At $V_{g\,max}$ and $\Delta p = 400$ bar	T	Nm	179	349	509	681	1019	–
At $V_{g\,max}$ and $\Delta p = 350$ bar	T	Nm	157	305	446	596	891	1391
Rotary stiffness								
$V_{g\,max}$ to $V_{g/2}$	c_{min}	KNm/rad	6	10	16	21	35	60
$V_{g/2}$ to 0 (interpolated)	c_{max}	KNm/rad	18	32	48	65	105	181
Moment of inertia for rotary group	J_{GR}	kgm^2	0.0014	0.0042	0.008	0.0127	0.0253	0.061
Maximum angular acceleration	α	rad/s^2	47000	31500	24000	19000	11000	10000
Case volume	V	L	0.5	0.75	1.2	1.5	2.4	3.0
Mass (approx.)								
Port plate 02, 37, 38	m	kg	16	26	34	47	64	90
Port plate 22	m	kg	–	35	43	53	72	–

1) The minimum and maximum displacement are infinitely adjustable, see ordering code, page 2. (standard setting for size 250 if not specified in the order: $V_{g\,min} = 0.2 \bullet V_{g\,max}$, $V_{g\,max} = V_{g\,max}$).
2) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm^2/s
- with hydraulic fluid based on mineral oils
3) Restriction of input flow with counterbalance valve, see page 32
4) Torque without radial force, with radial force see page 8

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 startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Permissible displacement in relation to speed



5) Values in this range on request

Technical data

Permissible radial and axial forces of the drive shafts

Size	NG		28	55	80	107	160	250
Drive shaft	ø	mm	30	30	40	40	50	50
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\,max}$	N	4838	7581	10283	13758	16435	1200[3]
	a	mm	17.5	17.5	22.5	22.5	27.5	41
with permissible torque	T_{max}	Nm	179	281	509	681	1019	[4]
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	400	322	400	400	400	[4]
Maximum axial force[2]	$+F_{ax\,max}$	N	315	500	710	900	1120	1200
	$-F_{ax\,max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	4.6	7.5	9.6	11.3	15.1	[4]

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

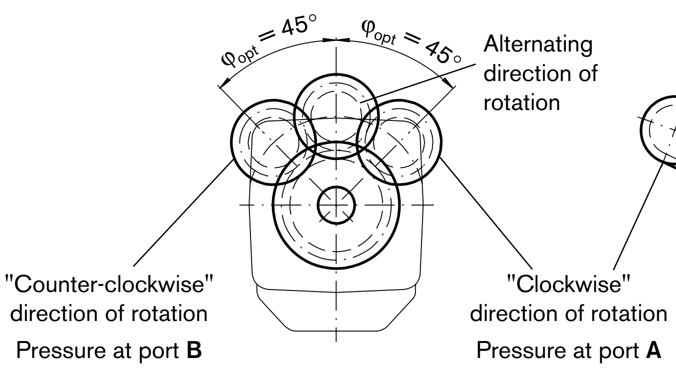
Note
Influence of the direction of the permissible axial force:

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

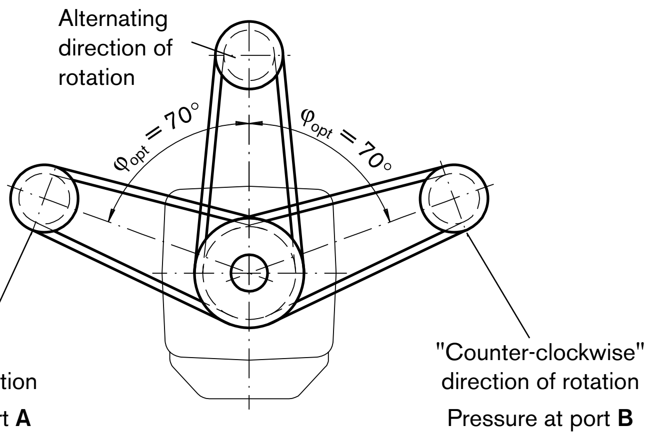
Effect of radial force F_q on the service life of bearings

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

Toothed gear drive



V-belt drive



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

HD – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

- Beginning of control at $V_{g\ max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: $p_{St} = 100$ bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 450 bar can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.
- The beginning of control and the HD characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic.
- A leakage flow of maximum 0.3 L/min can escape at port X due to internal leakage (operating pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

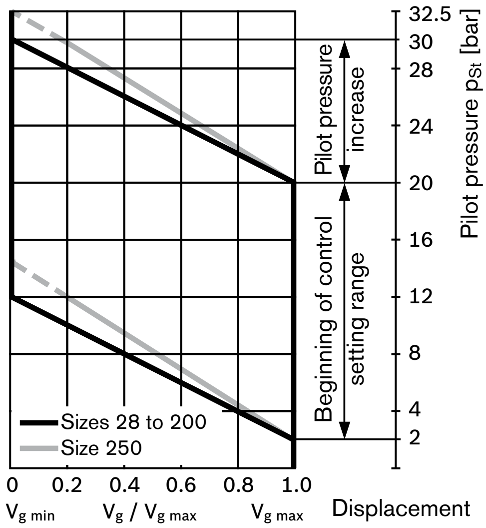
HD1
Pilot pressure increase $\Delta p_{St} = 10$ bar

A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\ max}$ to 0 cm³ (sizes 28 to 160) or from $V_{g\ max}$ to 0.2 $V_{g\ max}$ (size 250).

Beginning of control, setting range ____________2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

HD1 characteristic



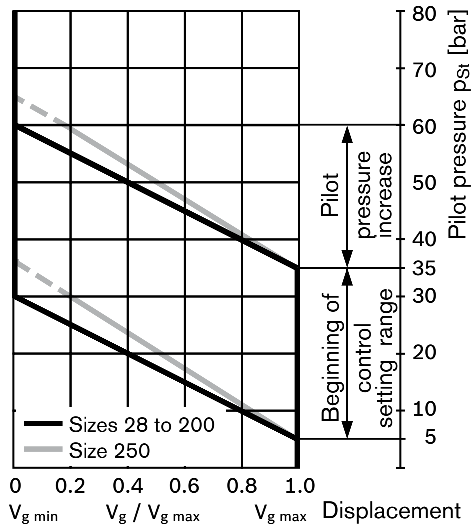
HD2
Pilot pressure increase $\Delta p_{St} = 25$ bar

A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\ max}$ to 0 cm³ (sizes 28 to 160) or from $V_{g\ max}$ to 0.2 $V_{g\ max}$ (size 250).

Beginning of control, setting range ____________5 to 35 bar

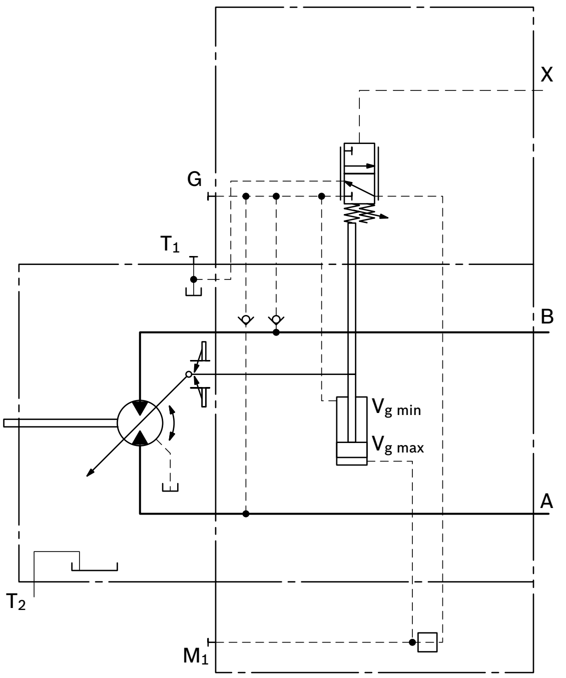
Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

HD2 characteristic

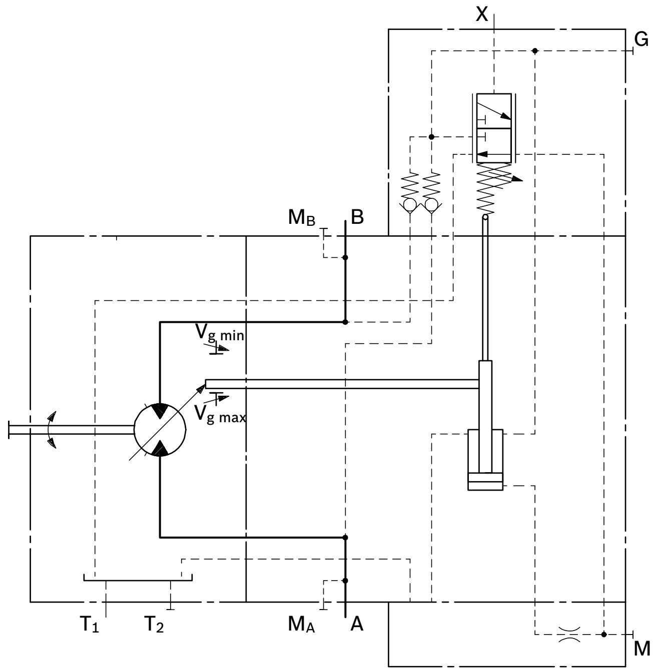


HD – Proportional control hydraulic

Schematic HD1, HD2
Sizes 28 to 160



Schematic HD1, HD2
Size 250



Note

The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

HD – Proportional control hydraulic

HD.D
Pressure control, fixed setting

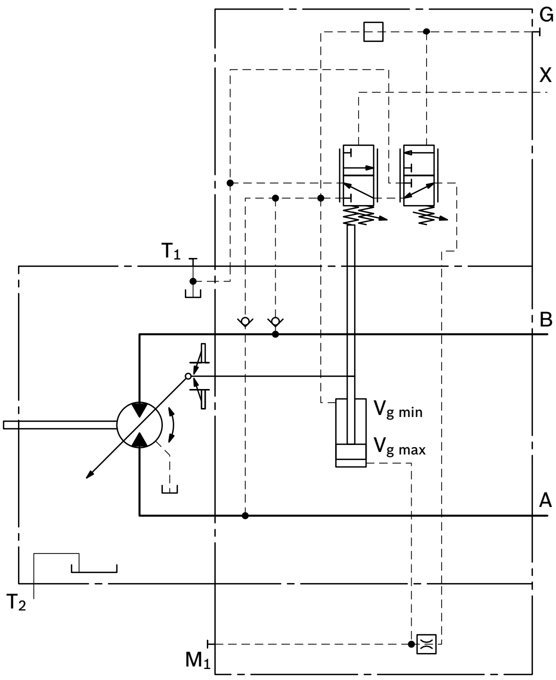
The pressure control overrides the HD control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

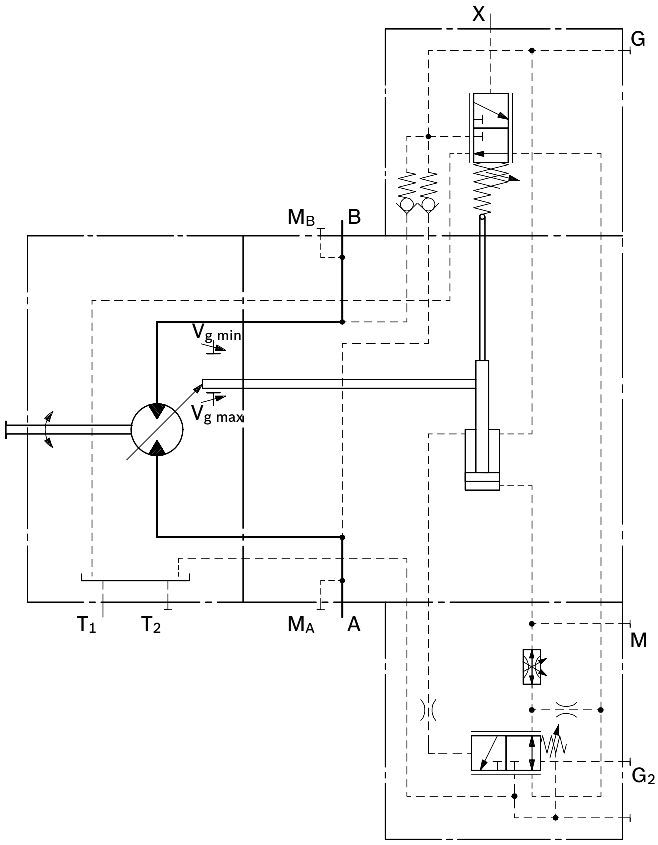
Setting range of the pressure control valve

Sizes 28 to 160	80 to 400 bar
Size 250	80 to 350 to bar

Schematic HD.D
Sizes 28 to 160



Schematic HD.D
Size 250



EP – Proportional control electric

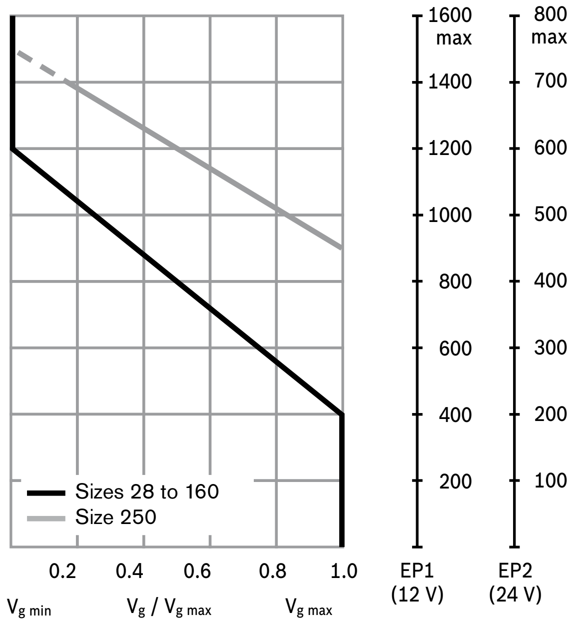
The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid (sizes 28 to 200) or proportional valve (sizes 250).

For size 250, the pilot oil supply at port P requires an external pressure of $p_{min} = 30$ bar ($p_{max} = 100$ bar).

– Beginning of control at $V_{g\ max}$ (maximum torque, minimum speed at minimum control current)

– End of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

The following only needs to be noted for size 250:

– The beginning of control and the EP characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic.

Technical data, solenoid

Sizes 28 to 160

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

– BODAS controller RC
  Series 20 ______ RE 95200
  Series 21 ______ RE 95201
  Series 22 ______ RE 95202
  Series 30 ______ RE 95203, RE 95204
  and application software

– Analog amplifier RA ______ RE 95230

– Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics

Technical data, proportional valve

Size 250

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Beginning of control at $V_{g\ max}$	900 mA	450 mA
End of control at $V_{g\ min}$	1400 mA	700 mA
Limiting current	2.2 A	1.0 A
Nominal resistance (at 20 °C)	2.4 Ω	12 Ω
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

See also proportional pressure-reducing valve DRE 4K (RE 29181).

Note

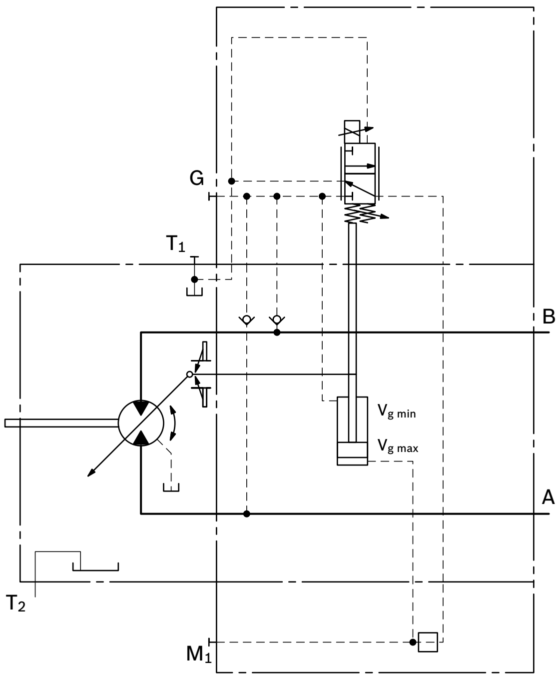
The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

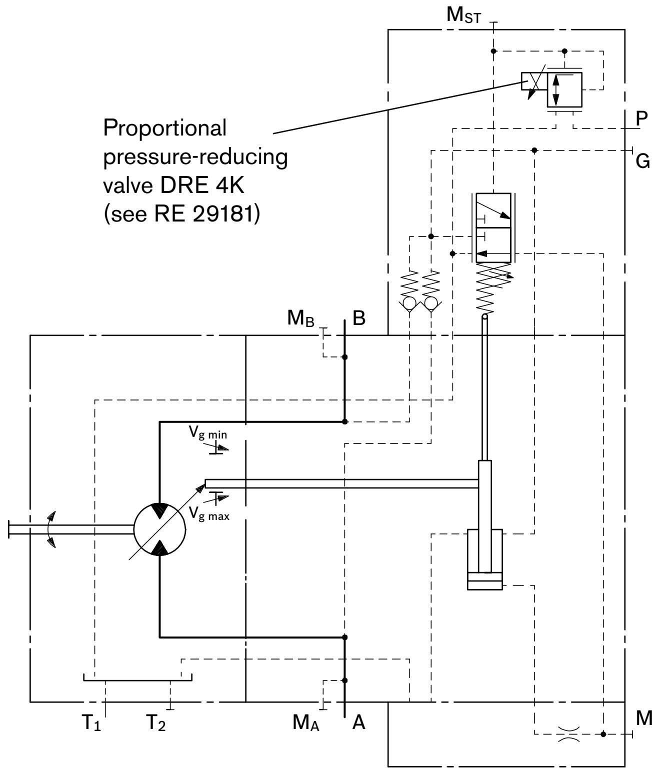
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2
Sizes 28 to 160



Schematic EP1, EP2
Size 250



EP – Proportional control electric

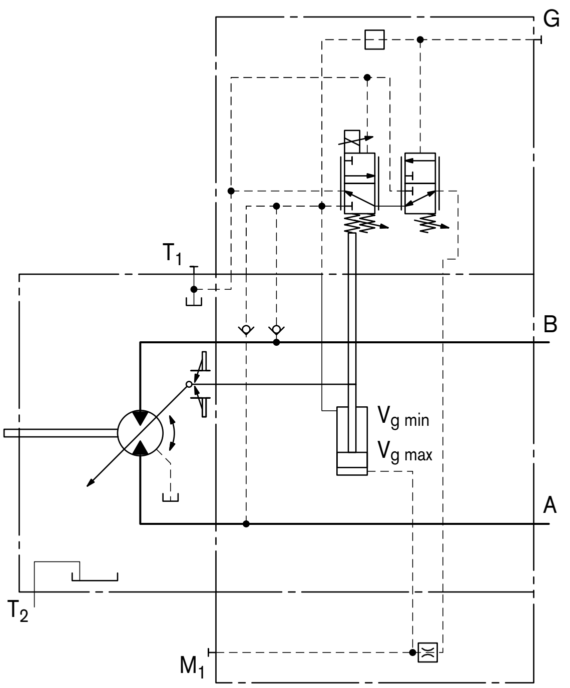
EP.D
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

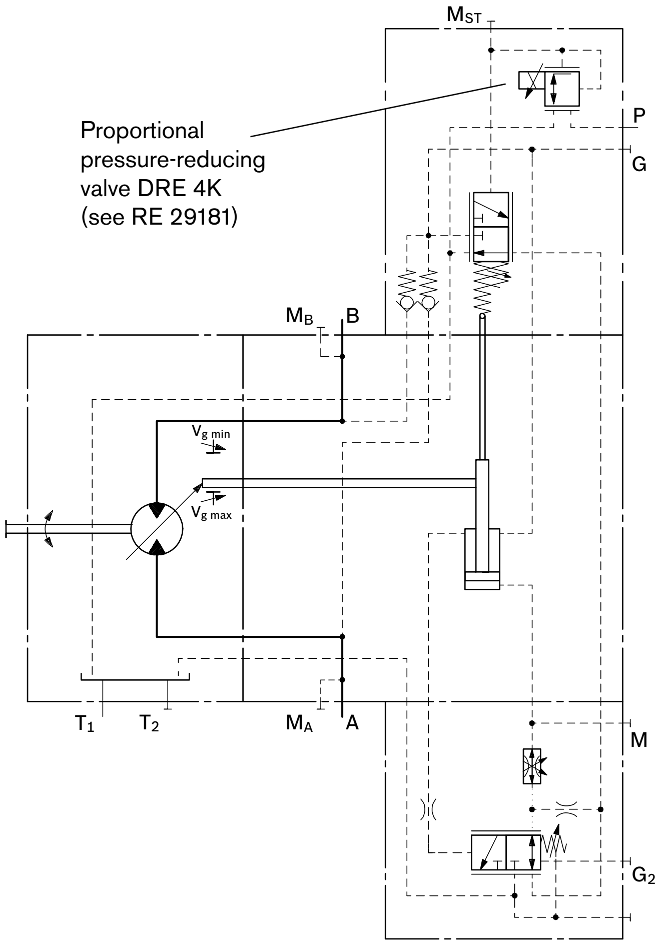
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve
Sizes 28 to 160 ________________ 80 to 400 bar
Size 250 ________________ 80 to 350 bar

Schematic EP.D
Sizes 28 to 160



Schematic EP.D
Size 250

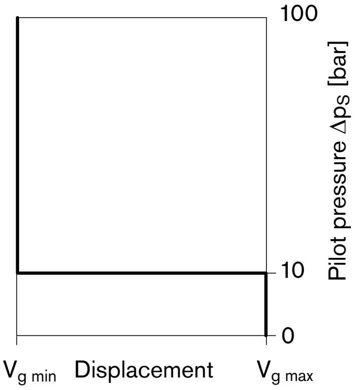


HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

Characteristic HZ

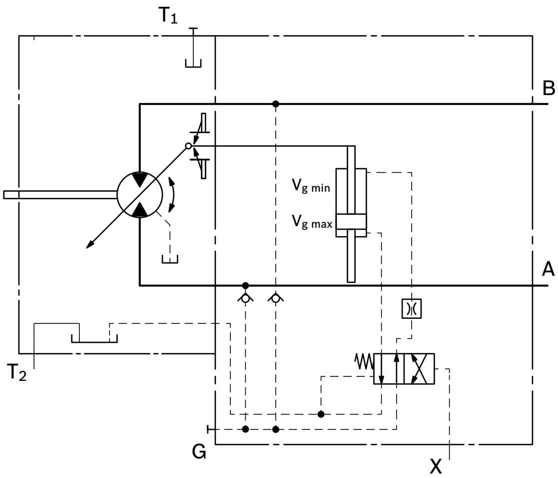


Note

- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 450 bar can occur at port G.
- A leakage flow of maximum 0.3 L/min is present at port X (operating pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir.

Schematic HZ3

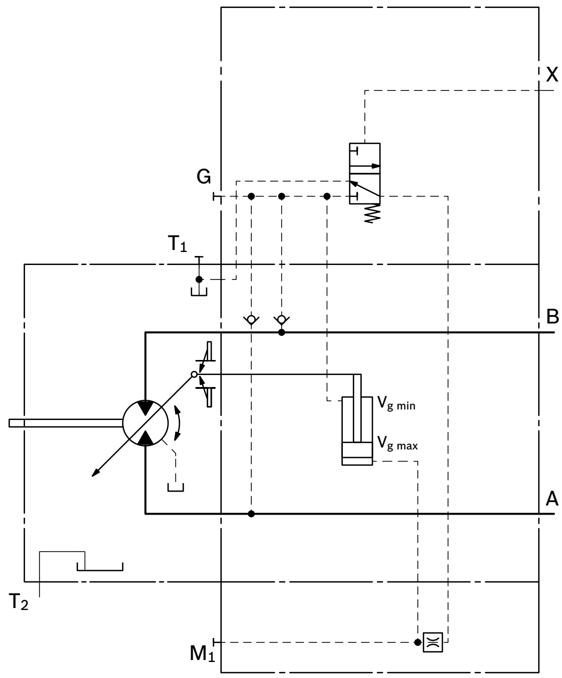
Sizes 55 to 107



Size 160
With integrated counterbalance valve BVI, see page 37

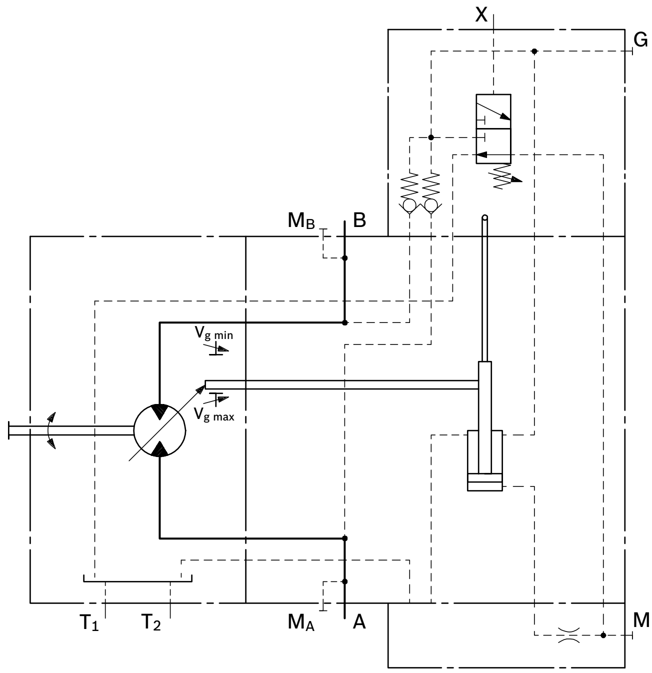
Schematic HZ1

Sizes 28, 160



Schematic HZ

Size 250



EZ – Two-point control electric

The two-point electric control with switching solenoid (sizes 28 to 160) or control valve (size 250) allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current at the switching solenoid or control valve on or off.

Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

Technical data, solenoid with Ø37
Sizes 28, 160

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

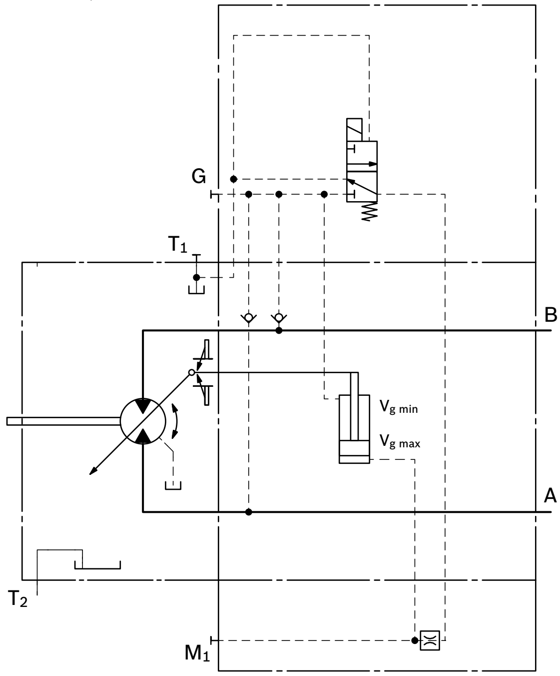
Technical data, solenoid with Ø45
Sizes 55 to 107

	EZ3	EZ4
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

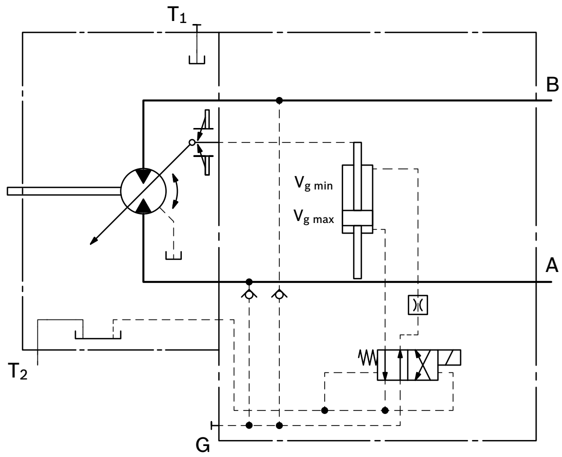
Technical data, control valve
Size 250

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	6 Ω	23 Ω
Nominal power	26 W	26W
Minimum required current	2 A	1.04 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

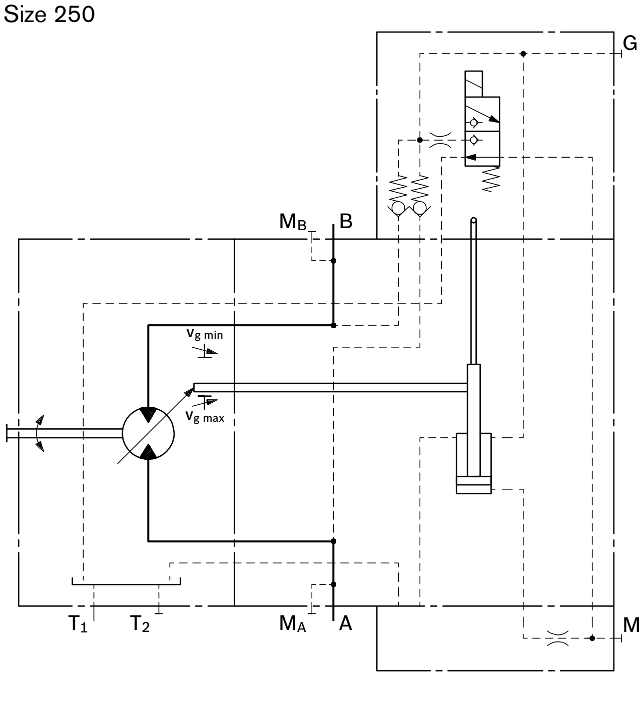
Schematic EZ1, EZ2
Sizes 28, 160



Schematic EZ3, EZ4
Sizes 55 to 107



Schematic EZ1, EZ2
Size 250



HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VE motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

– Beginning of control at $V_{g\,min}$ (minimum torque, maximum speed)

– End of control at $V_{g\,max}$ (maximum torque, minimum speed)

Note

– For safety reasons, winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure $<$ 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

– The beginning of control and the HA characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic. Only for HA1T (sizes 28 to 160) and HA1, HA2, HA3, HA.T, (size 250).

– A leakage flow of maximum 0.3 L/min is present at port X (operating pressure $>$ pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir. **Only for control HA.T**.

HA – Automatic control high-pressure related

HA1, HA3
With minimum pressure increase

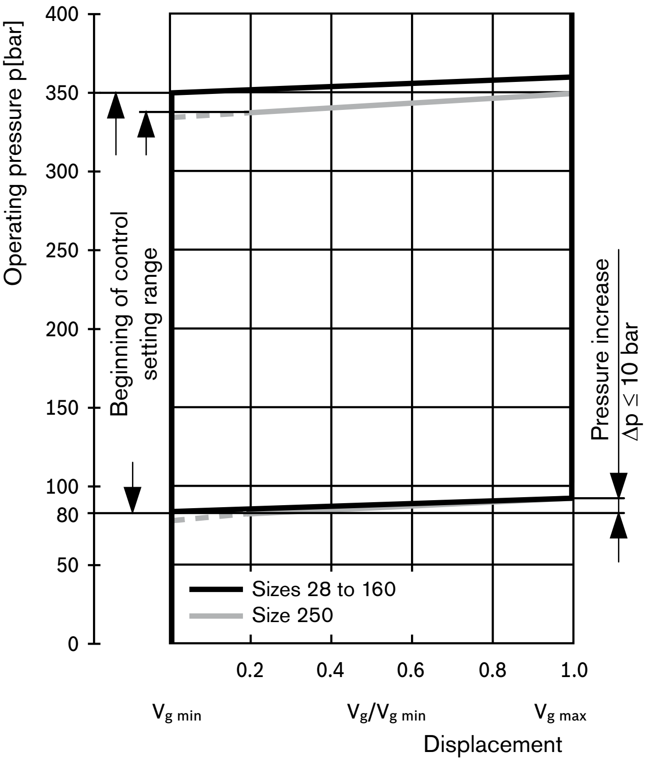
An operating pressure increase of Δp ≤ approx. 10 bar results in an increase in displacement from 0 cm³ to $V_{g\,max}$ (sizes 28 to 160) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).

Beginning of control, setting range

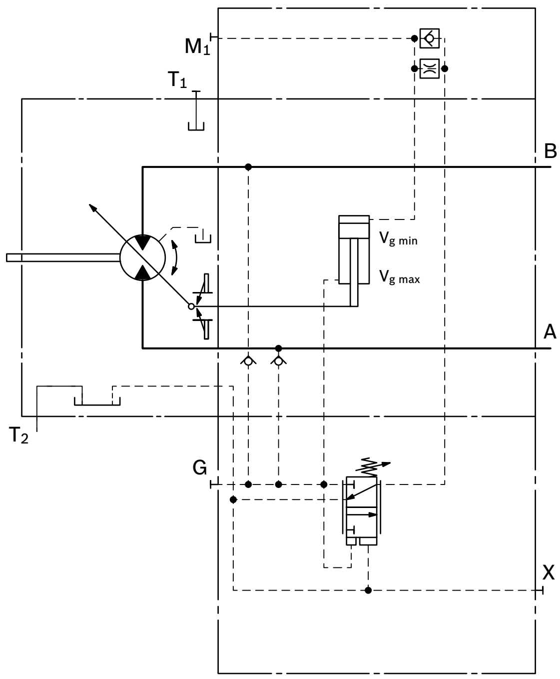
Sizes 28 to 160	80 to 350 bar
Size 250	80 to 340 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

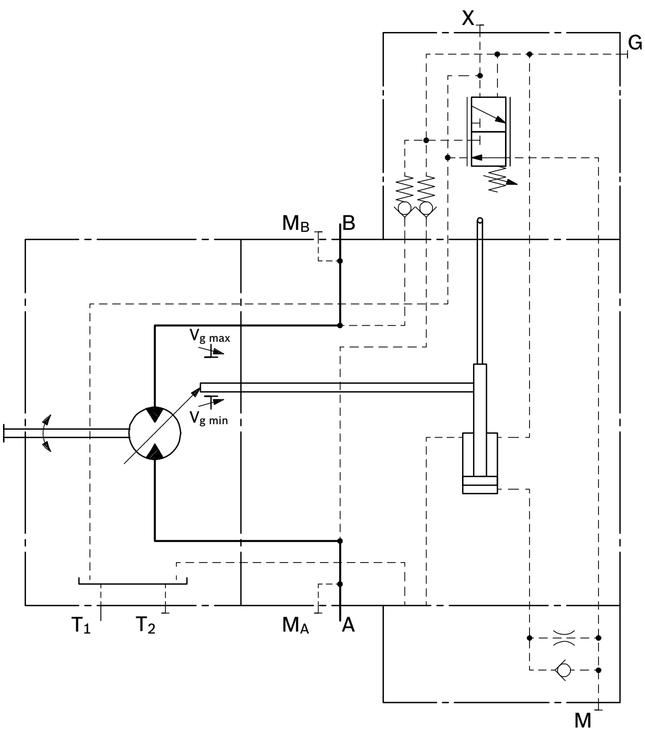
Characteristic HA1, HA3



Schematic HA1
Sizes 28 to 160



Size 250



Schematic HA3
Sizes 55 to 160
With integrated counterbalance valve BVI, see page 37

HA – Automatic control high-pressure related

HA2
With pressure increase

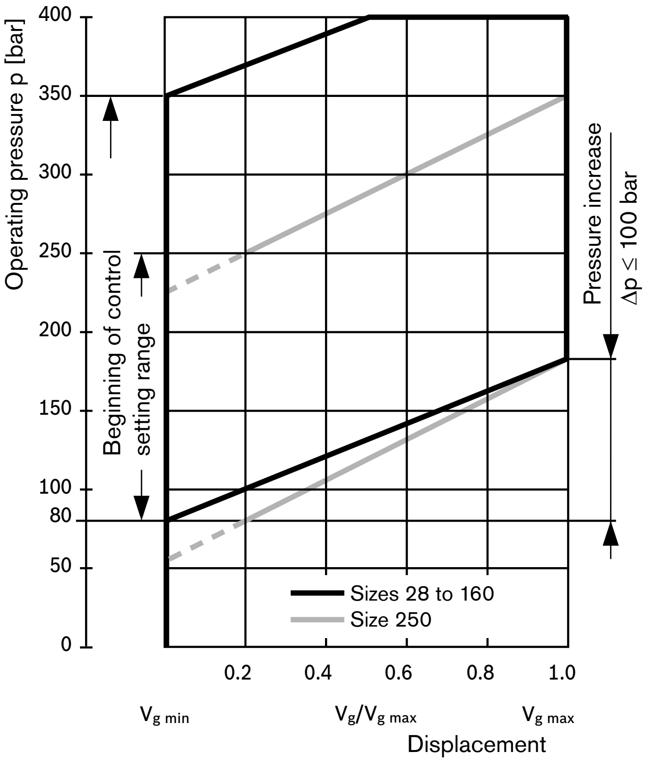
An operating pressure increase of Δp = approx. 100 bar results in an increase in displacement from 0 cm^3 to $V_{g\ max}$ (sizes 28 to 160) or from 0.2 $V_{g\ max}$ to $V_{g\ max}$ (size 250).

Beginning of control, setting range

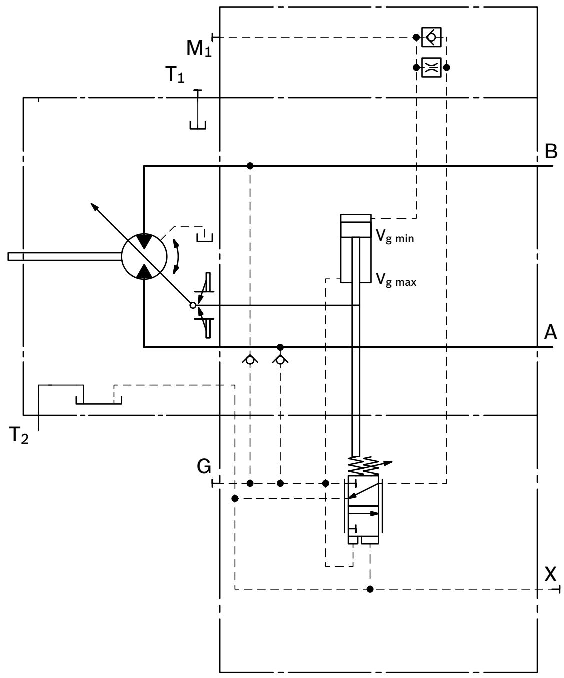
Sizes 28 to 160	80 to 350 bar
Size 250	80 to 250 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar.

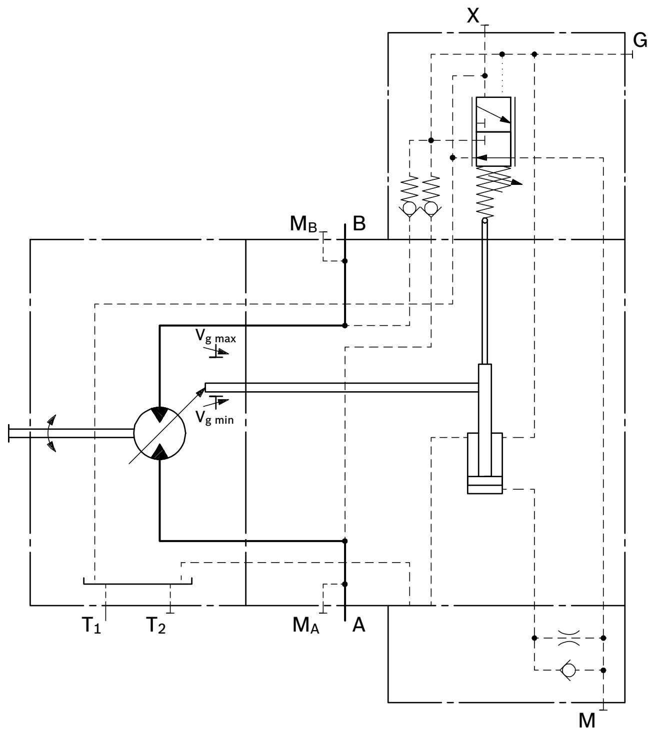
Characteristic HA2



Schematic HA2
Sizes 28 to 160



Size 250



HA – Automatic control high-pressure related

HA.T
Override hydraulic remove control, proportional

With the HA.T control, the beginning of control can be influenced by applying a pilot pressure to port X.

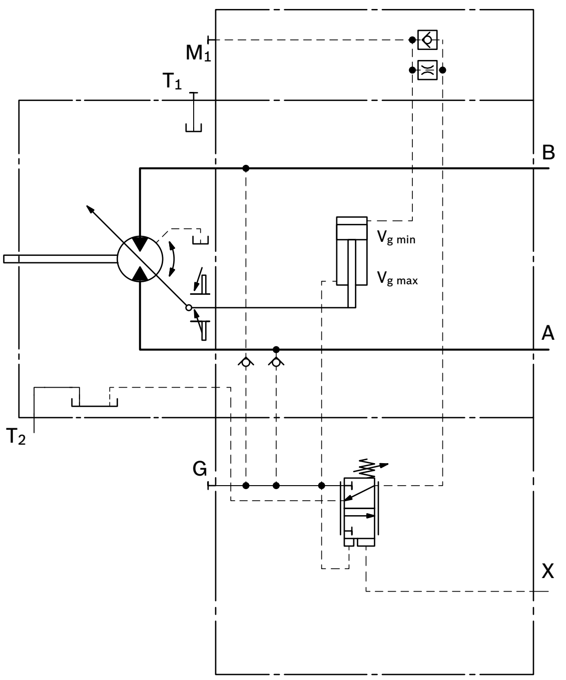
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar (sizes 28 to 160) or 8 bar (size 250).

Example (sizes 28 to 160):

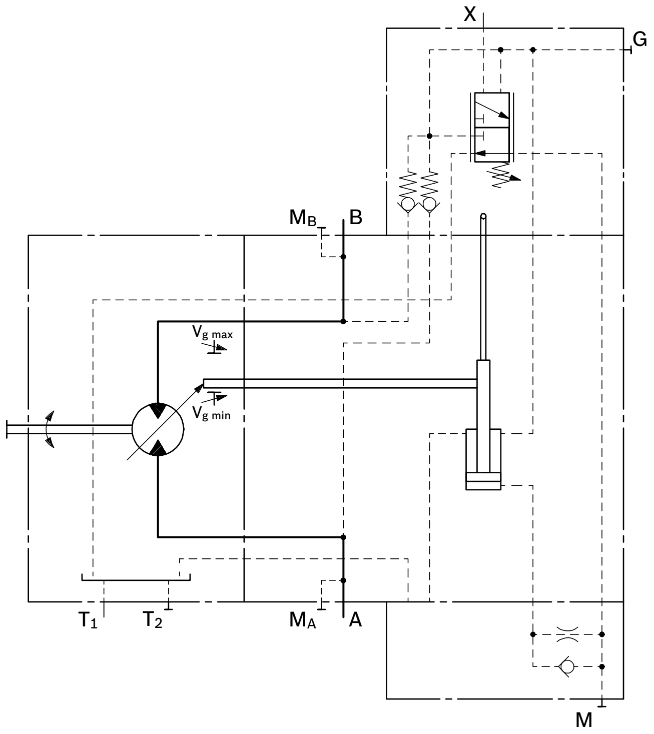
Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
Maximum permissible pilot pressure 100 bar.

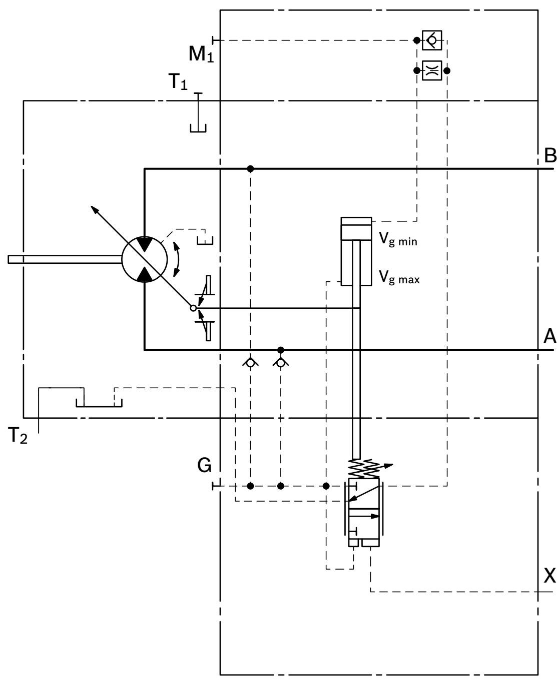
Schematic HA1.T
Sizes 28 to 160



Schematic HA1.T
Size 250



Schematic HA2.T
Sizes 28 to 160



DA – Automatic control speed-related

The variable motor A6VE with automatic speed-related control, is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.

A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.

Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

Pressure ratio p_{St}/p_{HD}: 3/100, 5/100

DA closed loop control is only suitable for certain types of drive systems and requires review of the engine and vehicle parameters to ensure that the motor is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

Detailed information is available from our sales department and on the Internet at www.boschrexroth.com/da-control.

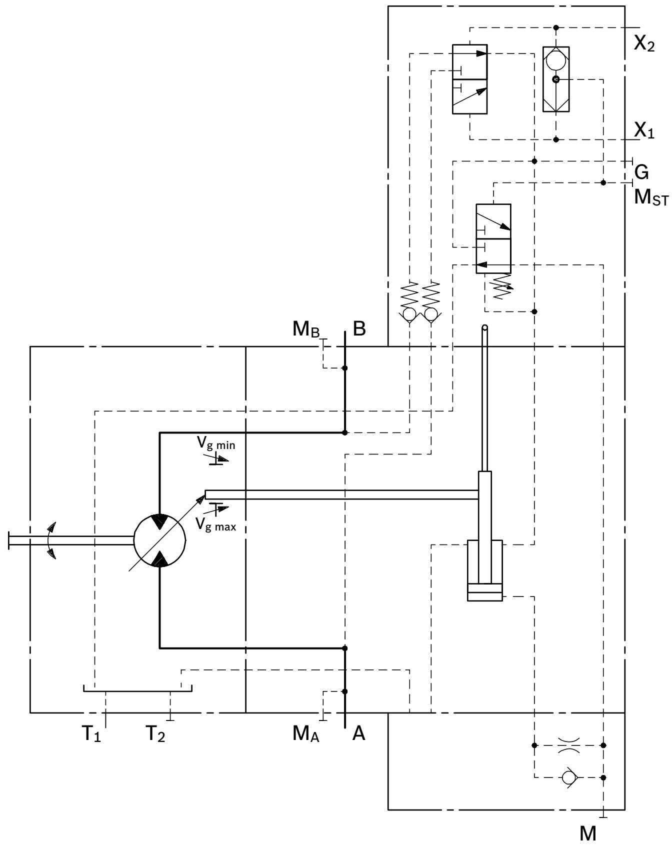
Note
The beginning of control and the DA characteristic are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 5) and thus a parallel shift of the characteristic.

DA
Hydraulic travel direction valve

Dependent on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	A	X_1
ccw	B	X_2

Schematic DA
Size 250



DA – Automatic control speed-related

DA3
Electric travel direction valve + electric $V_{g\ max}$-circuit

The travel direction valve is either spring offset or switched by energizing switching solenoid a, depending on the direction of rotation (travel direction).

When the switching solenoid b is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\ max}$-circuit).

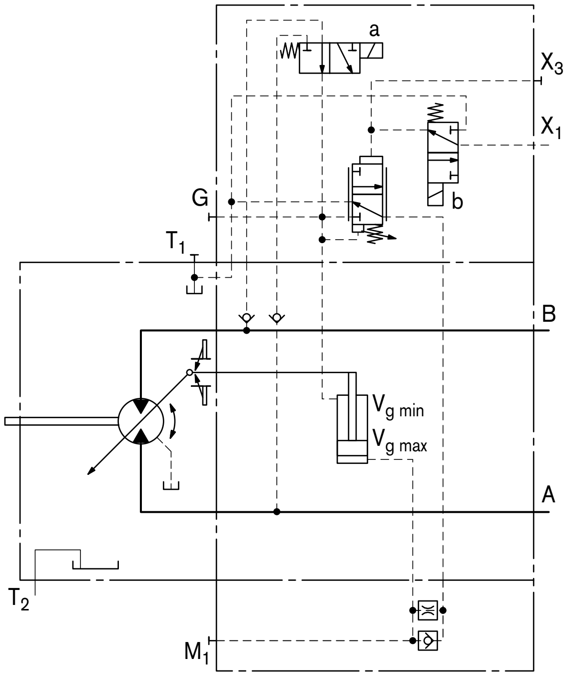
Technical data, solenoid a with Ø37
(travel direction valve)

		DA3
Voltage		24 V (±20 %)
Direction of rotation	Operating pressure in	
ccw	B	de-energized
cw	A	energized
Nominal resistance (at 20 °C)		21.7 Ω
Nominal power		26.5 W
Minimum required current		0.67 A
Duty cycle		100 %
Type of protection see connector design page 28		

Technical data, solenoid b with Ø37
(electric override)

	DA3,
Voltage	24 V (±20 %)
No override	de-energized
Displacement $V_{g\ max}$	energized
Nominal resistance (at 20 °C)	21.7 Ω
Nominal power	26.5 W
Minimum required current	0.67 A
Duty cycle	100 %
Type of protection see connector design page 28	

Schematic DA3
Sizes 28 to 160



Electric travel direction valve (for DA)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).

If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.

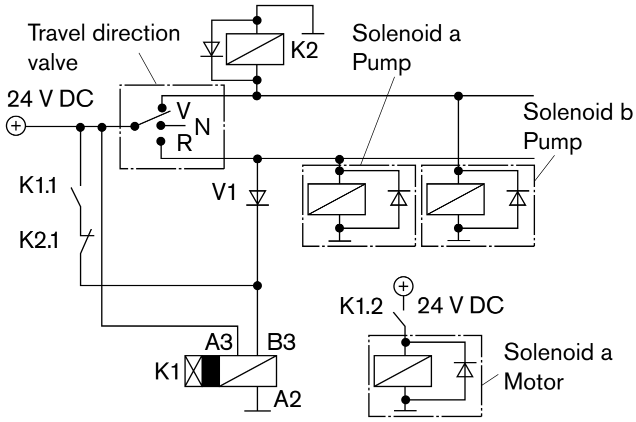
When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

– the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.

– reversing,
  the electric circuitry causes the travel direction valve on the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

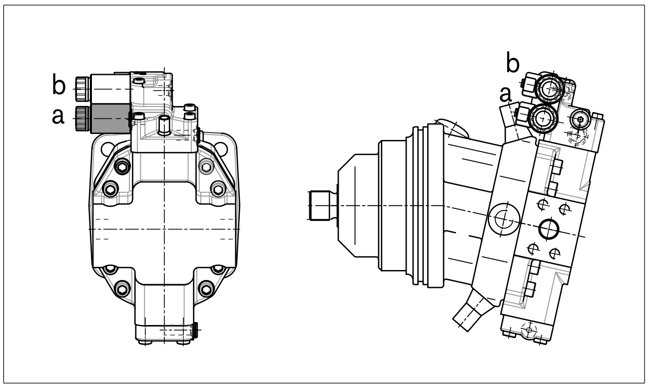
As a result, jerky deceleration or braking is prevented in both cases.

Schematic - electric travel direction valve



Note
The shown diodes and relays are not included in the delivery of the motor.

DA3 control (see page 22)

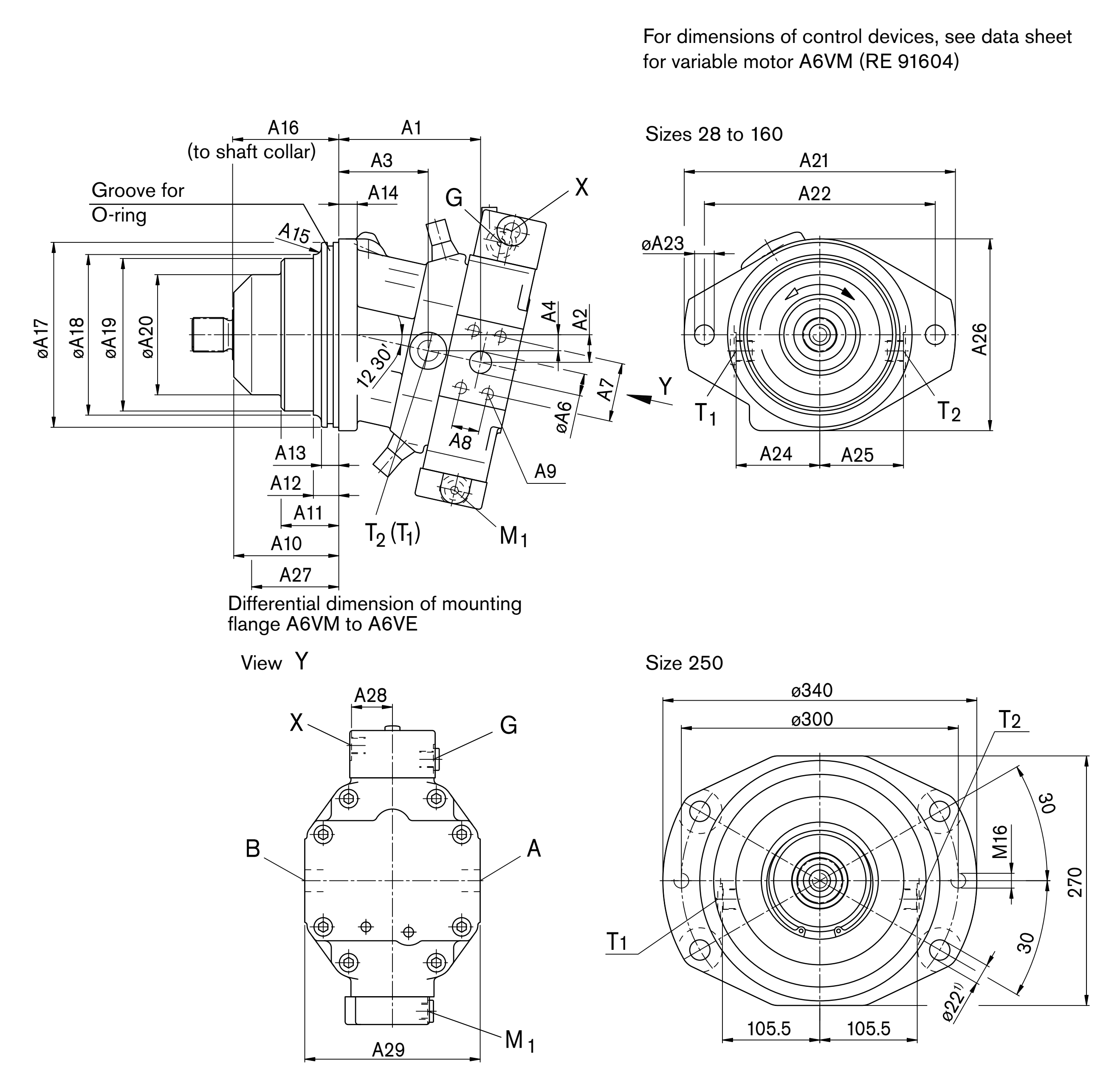


Dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HD1, HD2 – Proportional control hydraulic

Port plate 02 – SAE flange port A and B at side, opposite



Ports

Size	Service line port A, B SAE J518	Drain port T_1; T_2[2)] DIN 3852[3)]
28	3/4 in	M18 x 1.5; 12 deep
55	3/4 in	M18 x 1.5; 12 deep
80	1 in	M18 x 1.5; 12 deep
107	1 in	M18 x 1.5; 12 deep
160	1 1/4 in	M26 x 1.5; 16 deep
250	1 1/4 in	M22 x 1.5; 14 deep

1) Hole ø22 with spot face ø48; 2 deep
2) 1x plugged
3) Observe the general instructions on page 40 for the maximum tightening torques.
For further ports, see variable motor A6VM (RE 91604)!

Dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Standard flange L (sizes 28 to 160), **M** (size 250)

NG	A1	A2	A3	A4	øA6	A7	A8	A9 (DIN 13)[2]	A10	A11	A12	A13	A14	A15
28	91	20	47	10	ø19	50.8	23.8	M10 x 1.5; 17 deep	88	54	–	15	14	R10
55	123	24	77	14	ø19	50.8	23.8	M10 x 1.5; 17 deep	91	50	22	15	16	R6
80	129	28	78	16	ø25	57.2	27.8	M12 x 1.75; 17 deep	109.5	65	30	15	18	R10
107	137	30	84	18	ø25	57.2	27.8	M12 x 1.75; 17 deep	121.8	72	35	15	18	R12
160	171	34	109	20	ø32	66.7	31.8	M14 x 2; 19 deep	122	67	29	15	20	R5
250	204	44	103	20	ø32	66.7	31.8	M14 x 2; 19 deep	131.5	–	–	14	25[1]	–

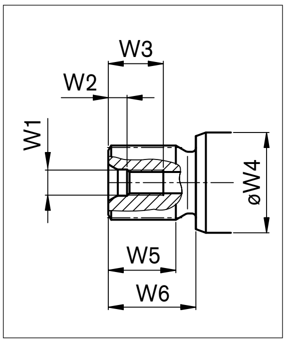
NG	A16[3]	A17	A18	A19	A20	A21	A22	øA23	A24	A25	A26	A27	A28	A29	O-ring[4]
28	89	$135_{-0.025}$	110	–	86	188	160	ø13.5	62.5	62.5	142	64	35.5	132	126x4
55	92	$160_{-0.025}$	139	132	104	235	200	ø17	72.5	72.5	166	59	35.5	152	150x4
80	110.5	$190_{-0.029}$	151	143	116	260	224	ø21	78.5	78.5	198	79	35.5	164	182x4
107	122.8	$200_{-0.029}$	168	160	132	286	250	ø21	86.5	86.5	210	82	40.5	180	192x4
160	123	$200_{-0.029}$	188	180	146	286	250	ø21	98.5	98.5	210	83	40.5	204	192x4
250	133.5	$260_{-0.081}$	230	–	–	–	–	–	–	–	–	83.5	48.5	224	250x5

Adapter flange U (size 107)

NG	A1	A2	A3	A4	A5	A6	A7	A8	A9 (DIN 13)[2]	A10	A11	A12	A13	A14
107	150	30	96	18	15.5	25	57.2	27.8	M12 x 1.75; 17 deep	109.5	59.7	22.7	18	15

NG	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	O-ring[4]
107	R8	110.5	$190_{-0.025}$	168	160	132	260	224	22	86.5	86.5	198	91.5	13.8	70	182x4

Drive shafts



NG	Splined shaft DIN 5480	W1[2)5)]	W2	W3	øW4	W5	W6
28	**A** (W30x2x14x9g)	M10 x 1.5	7.5	22	ø35	27	35
55	**Z** (W30x2x14x9g)	M12 x 1.75	9.5	28	ø45	27	35
80	**A** (W40x2x18x9g)	M16 x 2	12	36	ø50	37	45
107	**Z** (W40x2x18x9g)	M12 x 1.75	9.5	28	ø60	37	45
160	**A** (W50x2x24x9g)	M16 x 2	12	36	ø70	44	55
250	**Z** (W50x2x24x9g)	M16 x 2	12	36	ø60	49	58

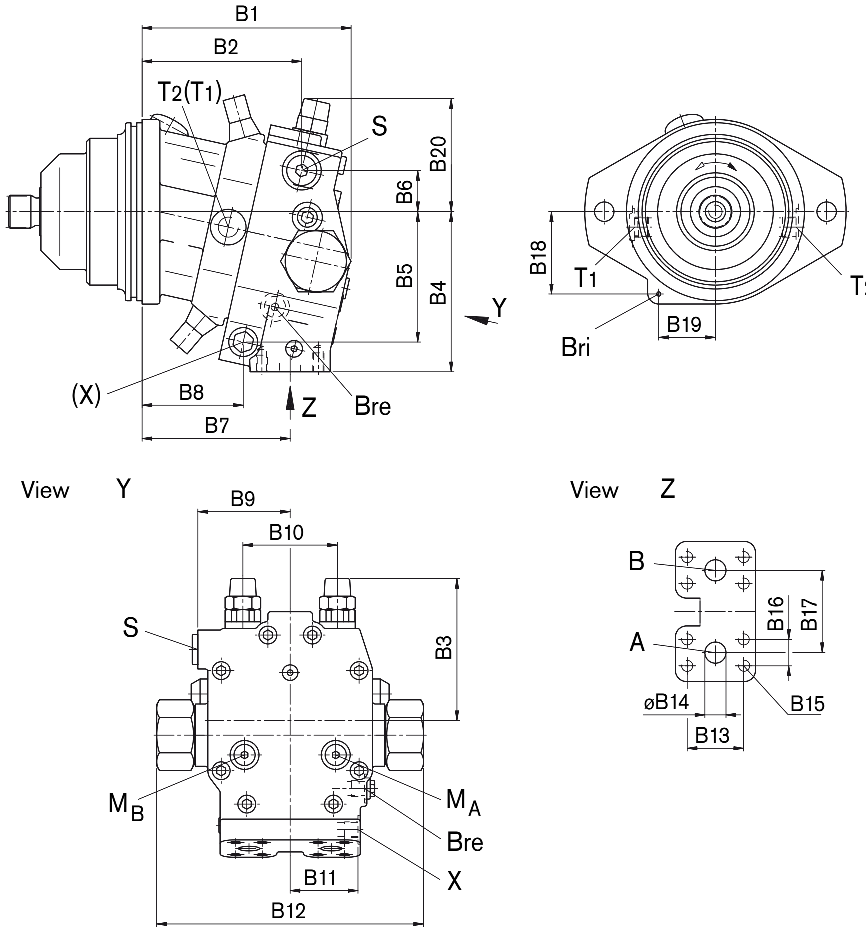
1) Hole ø22 with spot face ø48; 2 deep
2) Observe the general instructions on page 40 for the maximum tightening torques.
3) To shaft collar
4) The O-ring is not included in the delivery contents
5) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HA3 – Automatic control high-pressure related

Port plate 22 – SAE flange port A and B at bottom, with integrated counterbalance valve



Ports

NG	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15 (DIN 13)[2)]	B16	B17
55	192	144	127	144	117	37	133	91	83	85	64	259	50.8	19	M10 x 1.5; 17 deep	23.8	80
80	198	150	136	162	132	40	138	93	83	90	69	259	57.2	25	M12 x 1.75; 17 deep	27.8	86
107	202	161	139	171.5	143	40	144	99	85	96	72	259	57.2	25	M12 x 1.75; 17 deep	27.8	86
160	240	195	152	197	162	47	177	128	102	108	78	259	66.7	32	M14 x 2; 19 deep	31.8	94

NG	B18	B19	B20	Service line port A, B SAE J518	Drain port T_1; T_2[1)] DIN 3852[2)]	Infeed S DIN 3852[2)]
55	74	51	102	3/4 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
80	90	53	114	1 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
107	96	58	122	1 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
160	94	65	136	1 1/4 in	M26 x 1.5; 16 deep	M27 x 2; 16 deep

1) 1x plugged

2) Observe the general instructions on page 40 for the maximum tightening torques.

Note:
Port plate HZ3 and HA3 are not identical!

Dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports

Designa-tion	Port for	Standard[5]	Size[1]	Maximum pressure [bar][2]	State[8]
X	Pilot signal (open with HZ and HA3T, plugged with HA3)	ISO 6149	M14 x 1.5; 11.5 deep	100	O
M_A, M_B	Measuring stroking chamber	DIN 3852	M14 x 1.5; 11.5 deep	420	X
Bre	Brake release, external	DIN 3852	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal (not provided on versions with flange U)	–	ø4	30	X/O[7]

1) Observe the general instructions on page 40 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 39).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

DEUTSCH DT04-2P-EP04

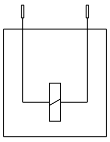
Sizes 28 to 160

Molded, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:
IP67 ______________________________ DIN/EN 60529

and IP69K ___________________________ DIN 40050-9

Circuit symbol

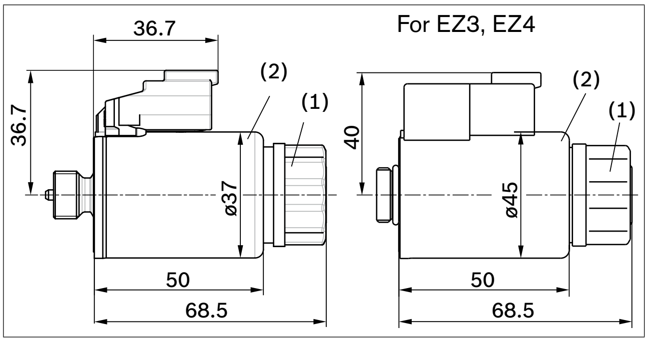


Mating connector

DEUTSCH DT06-2S-EP04
Bosch Rexroth Mat. No. R902601804

Consisting of:	DT designation
– 1 housing	DT06-2S-EP04
– 1 wedge	W2S
– 2 sockets	0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.



HIRSCHMANN DIN EN 175 301-803-A/ISO 4400

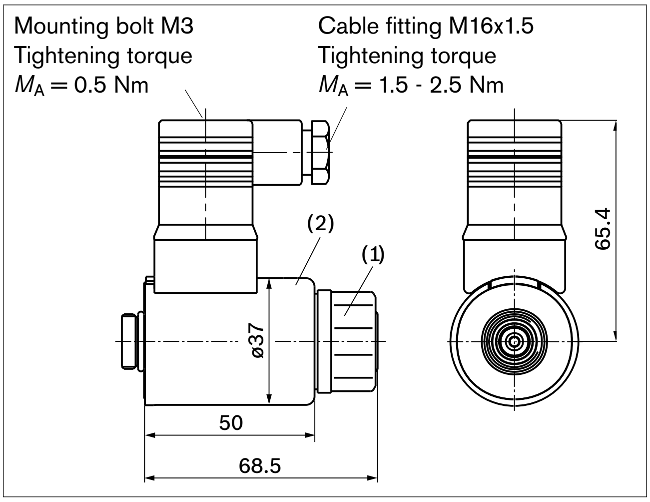
Size 250

Without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:
IP65 ______________________________DIN/EN 60529

The seal ring in the cable fitting is suitable for line diameters of 4.5 mm to 10 mm.

The HIRSCHMANN connector is included in the delivery contents of the motor.



Changing connector orientation

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

1. Loosen the mounting nut (1) of the solenoid. To do this, turn the mounting nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired orientation.
3. Retighten the mounting nut. Tightening torque: 5+1 Nm. (WAF26, 12-sided DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

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.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
fixed setting ________________ 16 bar

Switching pressure of flushing piston Δp ________ 8±1 bar

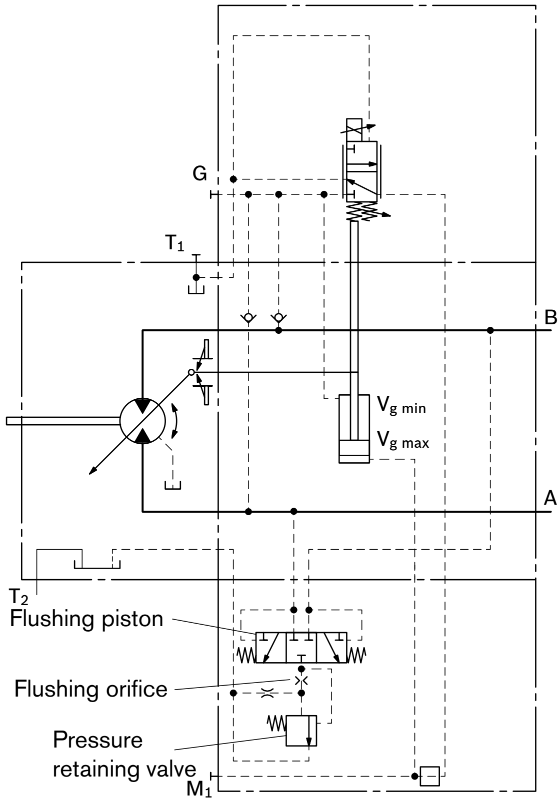
Flushing flow q_v

Orifices 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 $\nu = 10$ mm^2/s
(p_{ND} = low pressure, p_G = case pressure)

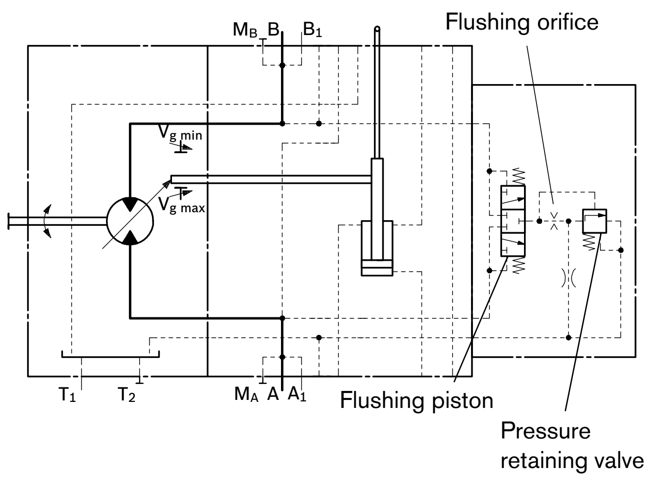
Size	Flushing flow q_V [L/min]	Mat. No. of orifice
28, 55	3.5	R909651766
80	5	R909419695
107	8	R909419696
160	10	R909419697
250	10	R909419697

With sizes 28 to 160, 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.

Schematic EP
Sizes 28 to 160



Schematic
Size 250

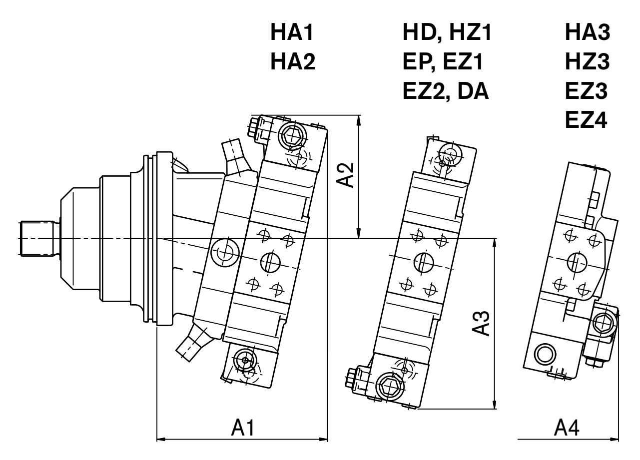


Flushing and boost pressure valve

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

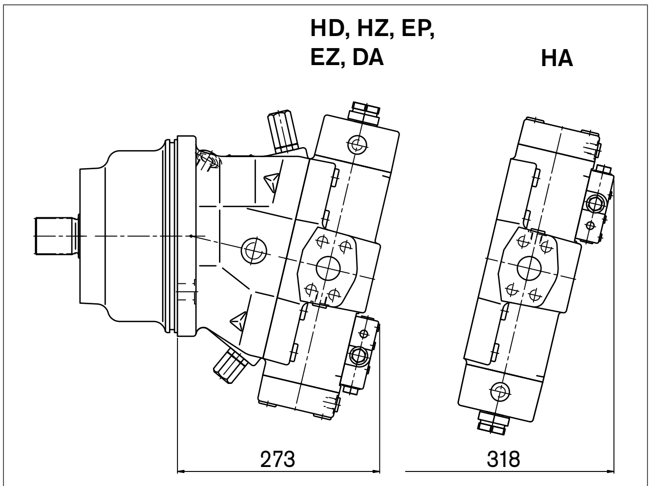
Dimensions

Sizes 28 to 160



NG	A1	A2	A3	A4
28	152	125	161	–
55	182	133	176	176
80	194	141	192	176
107 (L flange)	204	143	202	186
107 (U flange)	217	143	202	199
160	245	154	220	–

Size 250



Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Function

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

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

Note

– BVD available for sizes 55 to 160 and BVE available for sizes 107 and 160.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VE80HA1T/63W–VAL38800A + BVD20F27S/41B–V03K16D0400S12

– For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525

– For the design of the brake release valve, we must know for the mechanical park brake:

  - the pressure at the start of opening

  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)

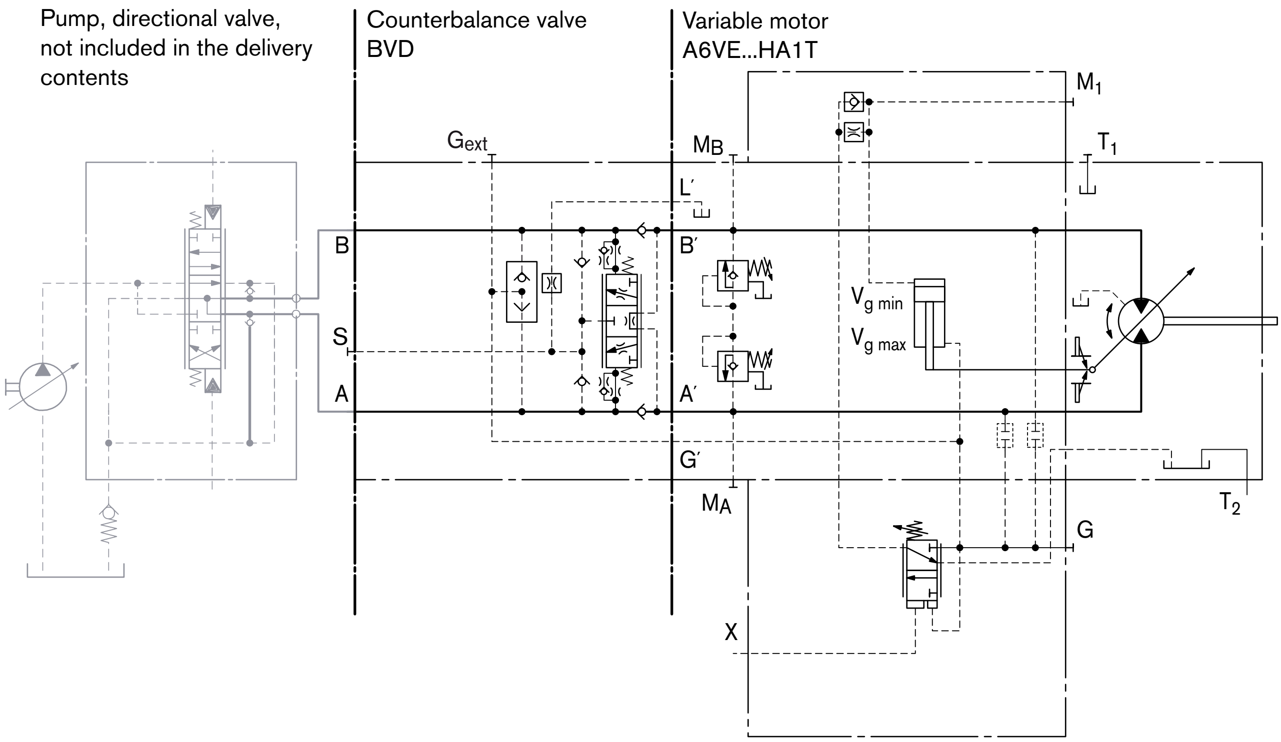
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

Example schematic for travel drive for wheeled excavators
A6VE80HA1T/63W–VAL38800A + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

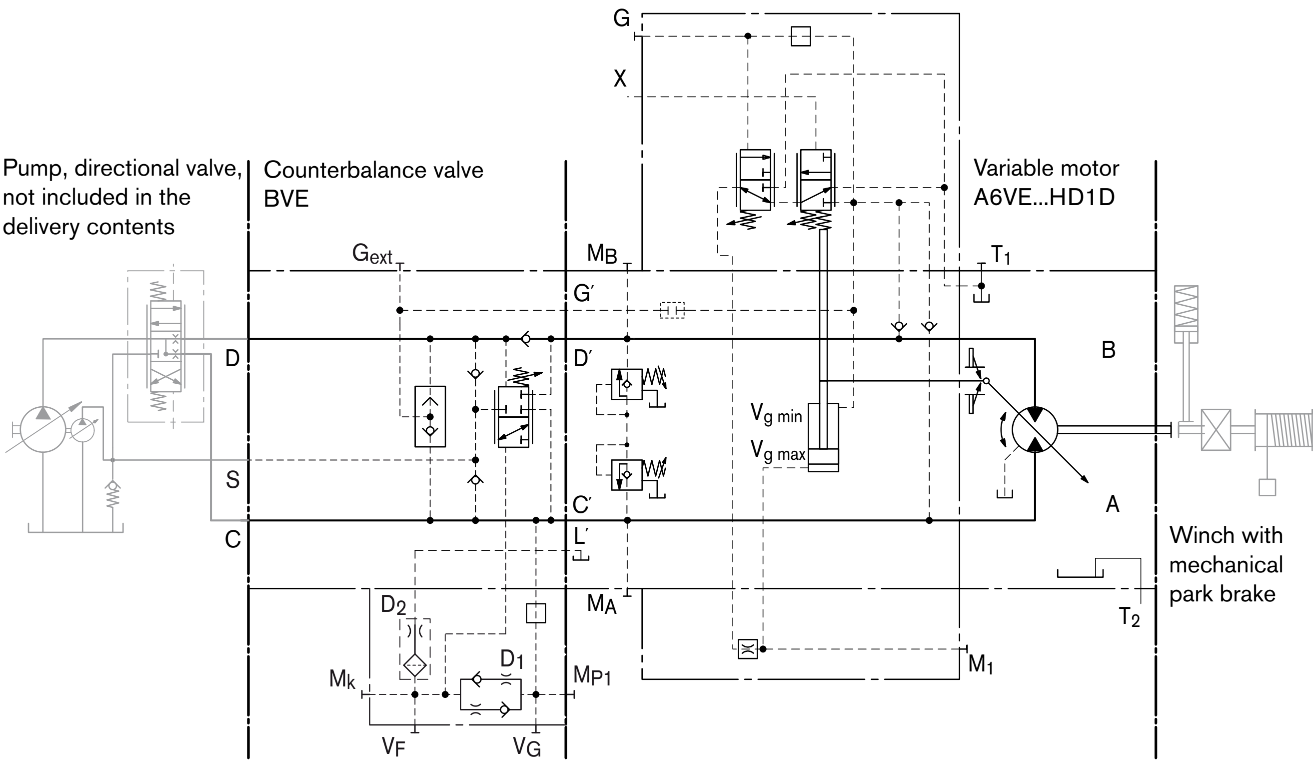
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Winch counterbalance valve BVD...W and BVE

Application options

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

Example schematic for winch drive in cranes
A6VE80HD1D/63W–VAL38800B + BVE25W38S/51ND-V100K00D4599T30S00-0



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

Motor NG	Without valve p_{nom}/p_{max} [bar]	$q_{V\,max}$ [L/min]	Restricted values in operation with DBV and BVD/BVE: DBV NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	BVD/BVE NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
55	400/450	244	22	350/420	240	380	20 (BVD)	350/420	220	388
80		312								
107		380	32		400	370				378
107		380				380	25 (BVD/BVE)		320	388
160		496								
250	350/400	675	On request							

DBV ______________________________ pressure-relief valve

BVD _________________counterbalance valve, double-acting

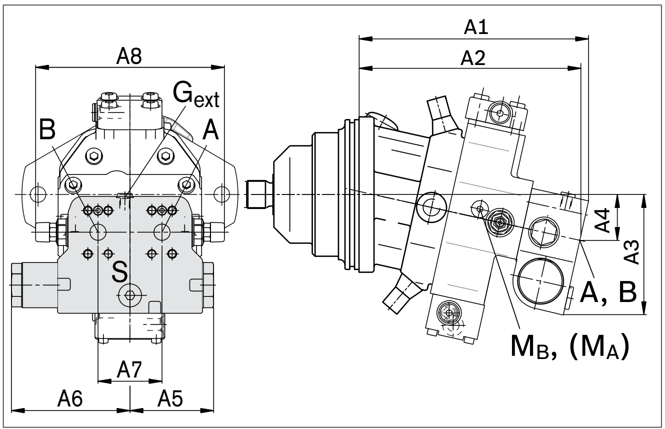
BVE ____________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

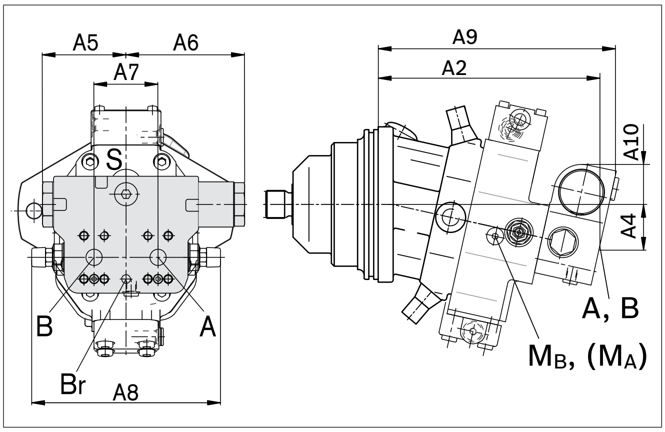
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions

A6VE...HA1/2



A6VE...HD or EP[1)]



A6VE	Counterbalance valve												
NG...plate	Type	Ports	Dimensions										
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...38	BVD20...17	3/4 in	252	243	143	50	98	139	75	222	267	50
80...38	BVD20...27	1 in	261	252	148	55	98	139	75	222	276	46
107...37	BVD20...28	1 in	280	271	152	59	98	139	84	234	295	41
107...38	BVD25...38	1 1/4 in	298	288	165	63	120.5	175	84	238	311	56
160...38	BVD25...38	1 1/4 in	334	324	170	68	120.5	175	84	238	349	51
107...38	BVE25...38	1 1/4 in	298	288	171	63	137	214	84	238	315	63
160...38	BVE25...38	1 1/4 in	334	324	176	68	137	214	84	238	349	59

Ports

Designation	Port for	Version	A6VE Plate	Standard	Size[2)]	Maximum pressure [bar][3)]	State[5)]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4)]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4)]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4)]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4)]	M12 x 1.5; 12 deep	30	O
G_{ext}	Brake release, high-pressure	S		DIN 3852[4)]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4)]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HD and EP, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VE motor.
The designation of the ports on the installation drawing of the motor is binding!
2) Observe the general instructions on page 40 for the maximum tightening torques.
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) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Mounting the counterbalance valve

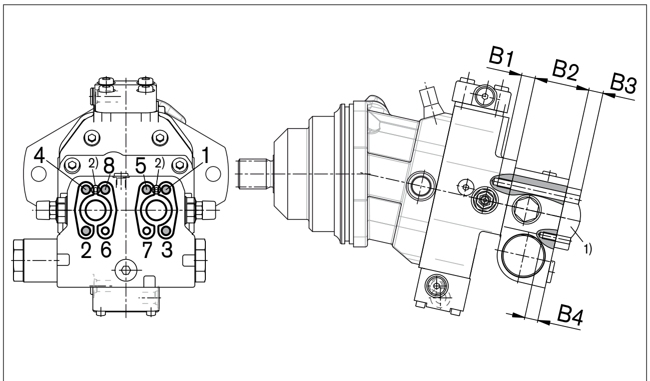
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the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

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

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

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

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10 x 1.5	10.9	75
M12 x 1.75	10.9	130
M14 x 2	10.9	205



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG...plate	55...38	80...38, 107...37	107...38, 160...38
B1 3)	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

Counterbalance valve integrated BVI

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Function

The integrated counterbalance valve is 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 or traveling downhill.

Note

– The integrated counterbalance valve must be ordered additionally, see ordering code below.

– The counterbalance valve does not replace the mechanical service brake and park brake.

– 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)

Application options

– Track drive in excavator crawlers

Ordering code

BVI			00		–	
01	02	03	04	05		06

Counterbalance valve

01	Counterbalance valve integrated	**BVI**

	Brake piston version	qv [L/min]	Material number	
02	Volume preselected	≤ 150	R902038832	**51**
		= 150 – 210	R902038936	**52**
		= 210 – 270	R902038833	**53**
		= 270 – 330	R902038834	**54**
		= 330 – 400	R902038835	**55**
		≥ 400	R902038836	**56**

	Throttle mounting	Material number	
03	Constant throttle	R909432302	**0008**
	Throttle pin	R909651165	**0603**

Check valve

04	Without residual opening	**00**

Brake release valve

05	With brake release valve (standard with HZ)	Without disable function	**1**
	With brake release valve (standard with HA)	With disable function	**2**

Standard / special version

06	Standard version	**0**
	Special version	**S**

Counterbalance valve integrated BVI

Table of values

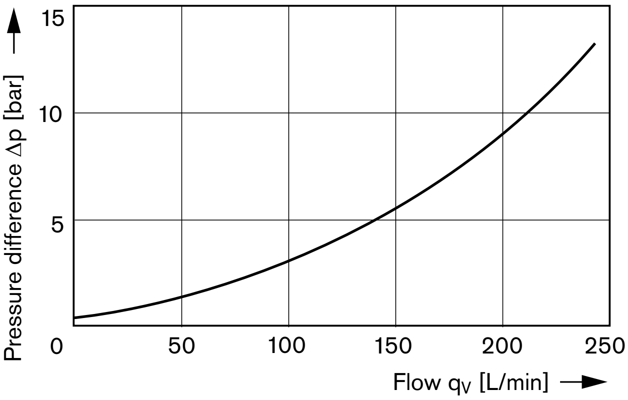
Operating pressure	nominal pressure	p	bar	350
	peak pressure	p	bar	420
Flow, maximum		$q_{v\ max}$	L/min	400
Counterbalance spool	start of opening	p	bar	12
	fully open	p	bar	26
Pressure-reducing valve for brake release (fixed setting)	control pressure	p	bar	21^{+4}
	beginning of control	p	bar	10^{+4}

Comparison between port plates 02 and 22

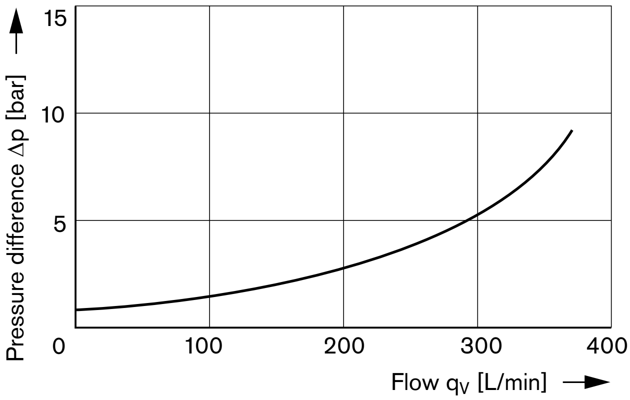
Maximum permissible input flow with restricted nominal pressure 350 bar, maximum pressure 420 bar

Motor NG	Without restrictions standard plate (02) p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values plate with integrated counterbalance valve (22) Code	p_{nom}/p_{max} [bar]	with BVI + DBV q_V [L/min]
55	400/450	276	22	350/420	240
80		332			
107		410			
160		533			400

Infeed characteristic M22 x 1.5

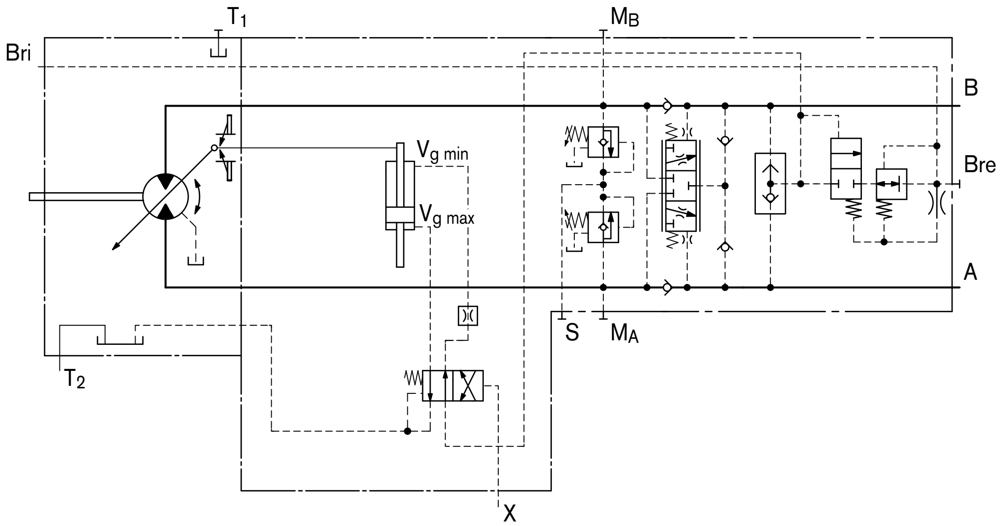


Infeed characteristic M27 x 2

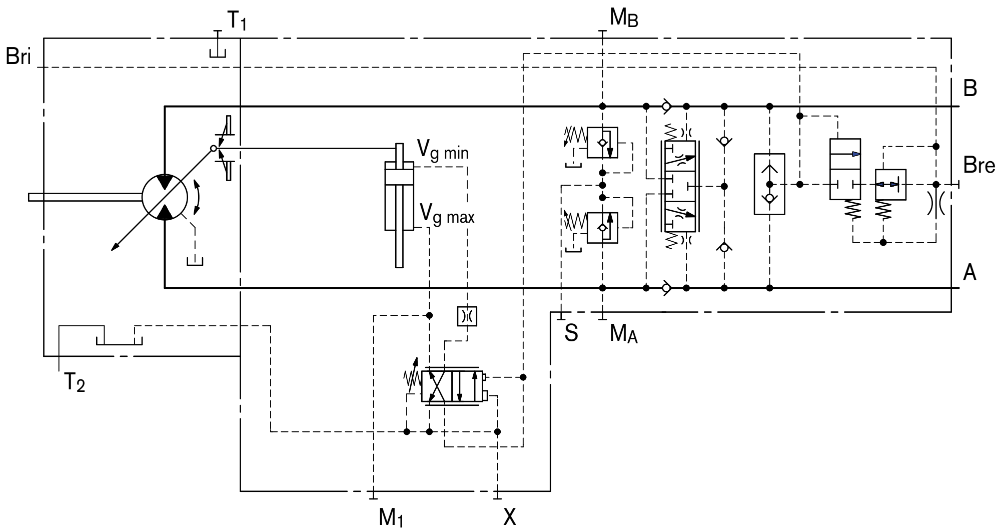


Counterbalance valve integrated BVI

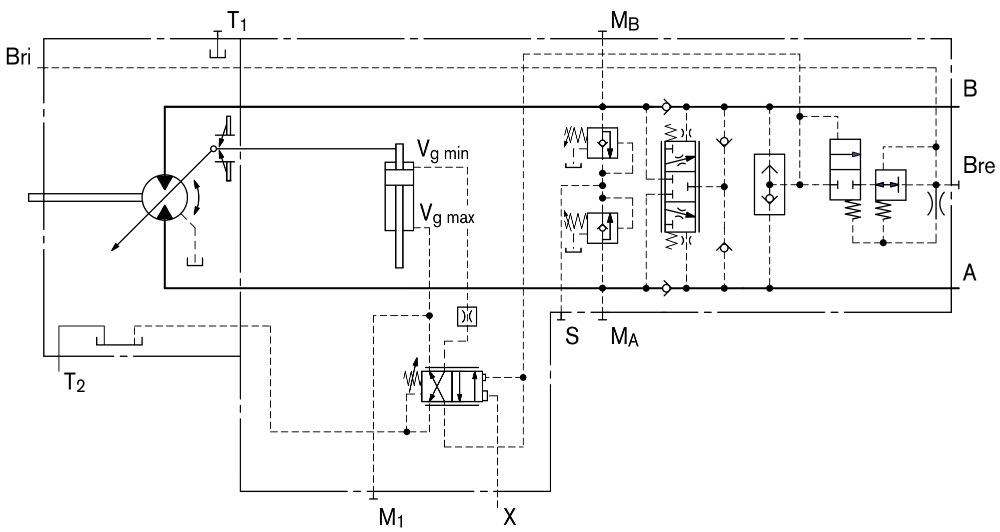
Schematic HZ3



Schematic HA3



Schematic HA3.T



Speed sensor

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Version A6VE...U ("prepared for speed spensor", 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.

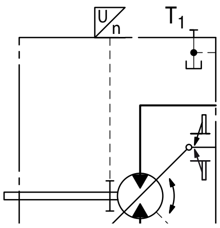
With the speed sensor DSA mounted, a signal proportional to motor speed can be generated. The sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (DSA – RE 95133).

The sensor is mounted on the port provided for this purpose with a mounting bolt.

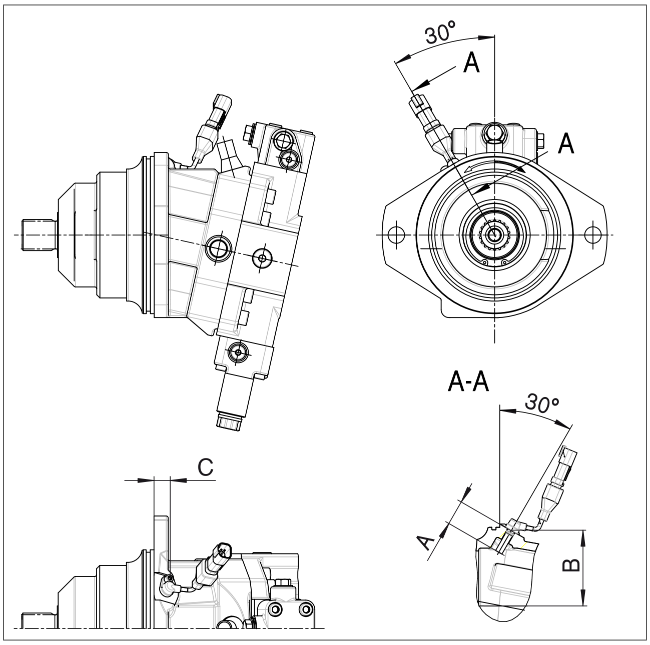
We recommend ordering the A6VE variable motor complete with installed sensor.

Schematic



Dimensions

Version "V" with mounted speed sensor



NG	55	80	107	160	250
Number of teeth	54	58	67	75	86
A	32	32	32	32	on request
B	83.3	87.3	96.3	104.3	on request
C	26	16.5	14.2	28.5	on request

Installation instructions

General

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

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

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

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

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

Installation position

See the following examples 1 to 6.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

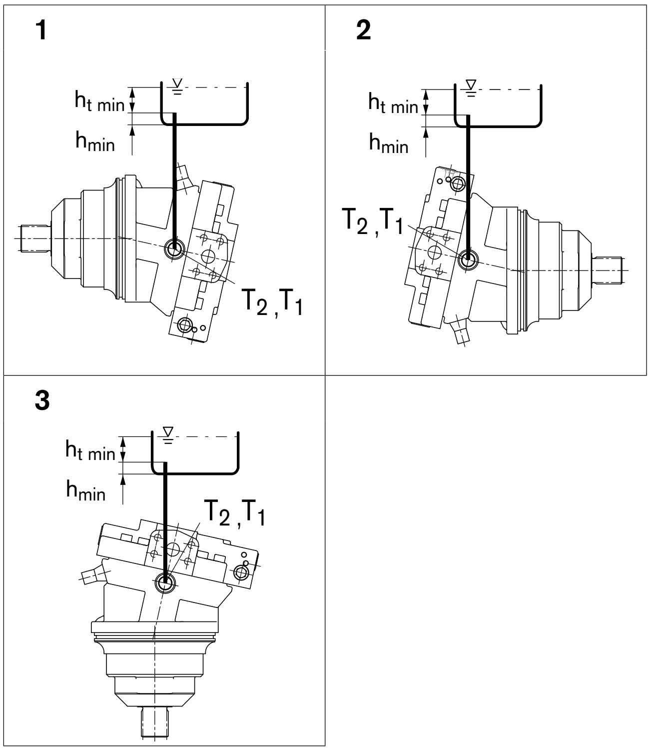
Note
In certain installation conditions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

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

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

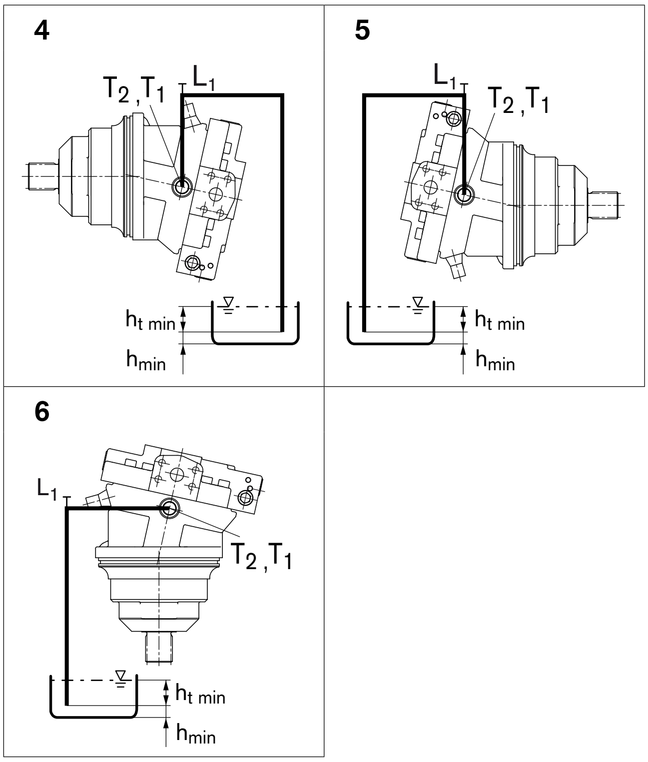
Below-reservoir installation (standard)

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



Above-reservoir installation

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



General instructions

– The motor A6VE is designed to be used in open and closed circuits.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. 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 instruction regarding tightening torques for the fittings used.

- Mounting bolts:
For mounting bolts with metric ISO threads according to DIN 13, 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 Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\ max}$	Required tightening torque of the threaded plugs M_V 1)	WAF hexagon socket of the threaded plugs
DIN 3852	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

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 17 Nm for M12 x 1.5.

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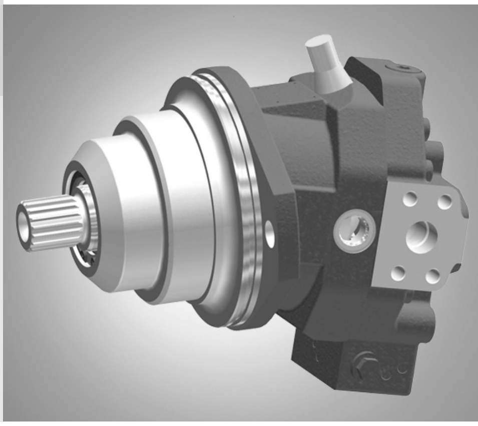
Rexroth
Bosch Group

Variable Plug-in Motor A6VE

RE 91616/06.12
Replaces: 01.12

Data sheet



Series 71
Sizes 60 to 170
Nominal pressure 450 bar
Maximum pressure 500 bar
Open and closed circuits

Contents

Features

- Variable 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 a recessed mounting flange located in the center of the case (extremely space-saving construction)
- Easy to install, simply plug into the mechanical gearbox (no configuration specifications to be observed)
- Tested unit ready to install
- For use especially in mobile applications
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.

Ordering code for standard program

A6V	E					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Axial piston unit

01	Bent-axis design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A6V**

Operating mode

02	Plug-in motor	**E**

Sizes (NG)

03	Geometric displacement, see table of values on page 8	**060**	**085**	**115**	**170**

Control devices

				060	085	115	170	
04	Proportional control hydraulic	positive control	Δp_{St} = 10 bar	●	●	●	●	**HP1**
			Δp_{St} = 25 bar	●	●	●	●	**HP2**
		negative control	Δp_{St} = 10 bar	●	●	●	●	**HP5**
			Δp_{St} = 25 bar	●	●	●	●	**HP6**
	Proportional control electric	positive control	U = 12 V DC	●	●	●	●	**EP1**
			U = 24 V DC	●	●	●	●	**EP2**
		negative control	U = 12 V DC	●	●	●	●	**EP5**
			U = 24 V DC	●	●	●	●	**EP6**
	Two-point control hydraulic	negative control		–	–	–	●	**HZ5**
				●	●	●	❍[1]	**HZ7**
	Two-point control electric	negative control	U = 12 V DC	–	–	–	●	**EZ5**
			U = 24 V DC	–	–	–	●	**EZ6**
			U = 12 V DC	●	●	●	–	**EZ7**
			U = 24 V DC	●	●	●	–	**EZ8**
	Automatic control, high-pressure related, positive control	with minimum pressure increase	Δp ≤ approx. 10 bar	●	●	●	●	**HA1**
		with pressure increase	Δp = 100 bar	●	●	●	●	**HA2**
		with minimum pressure increase	Δp ≤ approx. 10 bar	❍	❍	❍	❍	**HA3**[1]

Pressure control/override

05	Without pressure control/override	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6	**D1**
	Override of the HA1 and HA2 controls, hydraulic remote control, proportional	**T3**

Connector for solenoids[2] (see page 36)

06	Without connector (without solenoid, only with hydraulic controls)	**0**
	DEUTSCH - molded connector, 2-pin – without suppressor diode	**P**

Additional function 1

07	Without additional function	**0**

Additional function 2

08	Without additional function	**0**

● = Available ❍ = On request – = Not available

1) Only possible in combination with port plate 6 (integrated counterbalance valve)
2) Connectors for other electric components can deviate.

Ordering code for standard program

A6V	E					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		0
	Damping	HP, EP, HP5, 6D. and EP5,6D.; HZ, EZ, HA3, HA1 and HA2 with counterbalance valve BVD/BVE	1
		One-sided in inlet to large stroking chamber (HA)	4

Setting range for displacement[3)]

			060	085	115	170	
10	$V_{g\ max}$-adjusting screw	$V_{g\ min}$-adjusting screw					
	Without adjusting screw	short (0-adjustable)	●	●	●	●	A
		medium	●	●	●	●	B
		long	●	●	●	●	C
		extra long	–	–	●	●	D
	Short	short (0-adjustable)	●	●	●	●	E
		medium	●	●	●	●	F
		long	●	●	●	●	G
		extra long	–	–	●	●	H
	Medium	short (0-adjustable)	●	●	●	●	J
		medium	●	●	●	●	K
		long	●	●	●	●	L
		extra long	–	–	●	●	M

Series

11	Series 7, index 1	71

Configuration of ports and fastening threads

12	Metric, port threads with O-ring seal according to ISO 6149	M

Direction of rotation

13	Viewed on drive shaft, bidirectional	W

Seals

14	FKM (fluor-caoutchouc)	V

Drive shaft bearing

15	Standard bearing	0

Mounting flanges

			060	085	115	170	
16	ISO 3019-2	160-2	●	–	–	–	P2
		190-2	–	●	–	–	Y2
		200-2	–	–	●	●	S2

Drive shafts

			060	085	115	170	
17	Splined shaft DIN 5480	W35x2x16x9g	●	–	–	–	Z8
		W40x2x18x9g	–	●	●	–	Z9
		W45x2x21x9g	–	–	–	●	A1

● = Available ❍ = On request – = Not available

3) The settings for the adjusting screws can be found in the table (page 46).

Ordering code for standard program

A6V	E					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Port plates for service lines

			060	085	115	170	
18	SAE flange ports A and B at rear		●	●	●	●	**1**
	SAE flange ports A and B at side, opposite		●	●	●	●	**2**
	SAE flange port A and B at bottom only with integrated counterbalance valve BVI[4]		●	●	●	❍	**6**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5]	BVD20	●	●	●	–	**7**
		BVD25, BVE25	–	–	●	●	**8**

Valves (see pages 37 to 46)

			060	085	115	170	
19	Without valve		●	●	●	●	**0**
	Counterbalance valve BVD/BVE mounted[6]		●	●	●	●	**W**
	Brake release valve integrated (only with port plate 6)	for external piping	●	●	●	❍	**Y**
		with internal ducting	●	●	●	❍	**Z**
	Flushing and boost pressure valve mounted, flushing on both sides Flushing flow with: $\Delta p = p_{ND} - p_G = 25$ bar and $\nu = 10\ mm^2/s$ (p_{ND} = low pressure, p_G = case pressure) Only possible with port plates 1 and 2	**Flushing flow q_v [L/min]**					
		3.5	●	●	●	–	**A**
		5	●	●	●	–	**B**
		8	●	●	●	●	**C**
		10	●	●	●	●	**D**
		14	●	●	●	–	**F**
		17	–	–	–	●[7]	**G**
		20	–	–	●[7]	●[7]	**H**
		25	–	–	●[7]	●[7]	**J**
		30	–	–	●[7]	●[7]	**K**
		35	–	–	–	●[7]	**L**
		40	–	–	–	●[7]	**M**

Speed sensor (see page 36)

20	Without speed sensor	**0**
	Prepared for DSA speed sensor	**U**
	DSA speed sensor mounted[8]	**V**

Standard / special version

21	Standard version	**0**
	Standard version with installation variants, e. g. T ports against standard open or closed	**Y**
	Special version	**S**

● = Available ❍ = On request – = Not available

4) Only for HZ7 and HA3. Supplement specification for integrated counterbalance valve BVI, see separate ordering code on page 43. Note the restrictions on page 44.
5) Only possible in combination with HP, EP and HA control. Note the restrictions on page 40.
6) Specify ordering code of counterbalance valve acc. to data sheet (BVD – RE 95522, BVE – RE 95525) separately. Note the restrictions on page 40.
7) Not for EZ7, EZ8, HZ7 and HA3
8) Specify ordering code of sensor acc. to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.

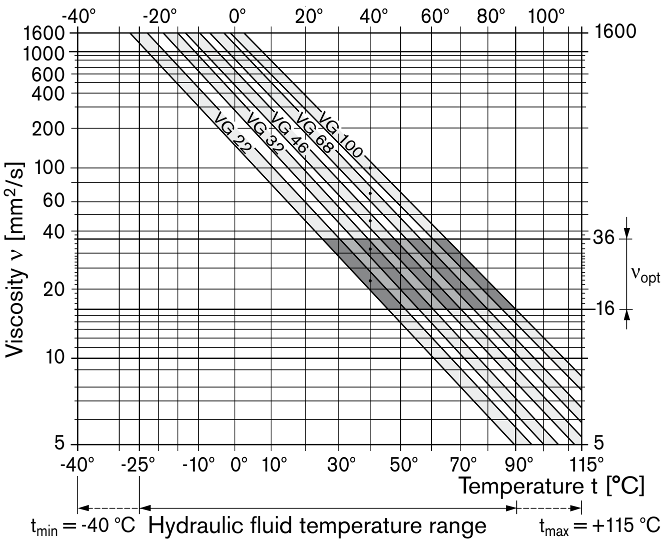
Technical data

Hydraulic fluid

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

The variable motor A6VE is not suitable for operation with HFA hydraulic fluid. If HFB, HFC or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.
Please contact us.

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

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

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

If the above conditions cannot be maintained due to extreme operating parameters, we recommend using a flushing and boost pressure valve (see pages 37 and 38).

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -50 °C T_{opt} = +5 °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu <$ 1600 to 400	T = -40 °C to -25 °C	at $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15$ min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation	$\nu_{min} \geq 7$	T_{max} = +103 °C	measured at port T, $t < 3$ min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq$ +115 °C	see page 6

1) At temperatures below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).

Technical data

Filtration of the hydraulic fluid

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

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

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

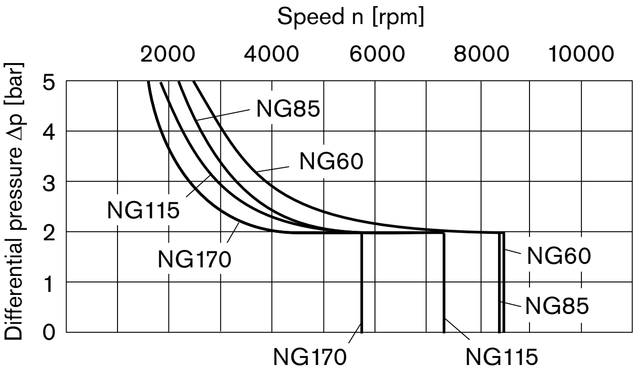
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 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.



These 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.

Note
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.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HP, HA.T3 ______________________ increase

With the following controls, an increase in the case pressure has no influence on the beginning of control: EP, HA

The factory setting of the beginning of control is made at $p_{abs} = 2$ bar case pressure.

Direction of flow

Direction of rotation, viewed on drive shaft	
cw	**ccw**
A to **B**	**B** to **A**

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

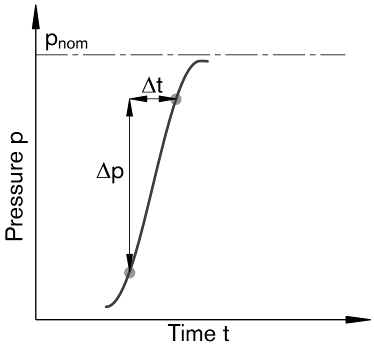
Nominal pressure p_{nom} ________ 450 bar absolute

Maximum pressure p_{max} ________ 500 bar absolute
Single operating period ________ 10 s
Total operating period ________ 300 h

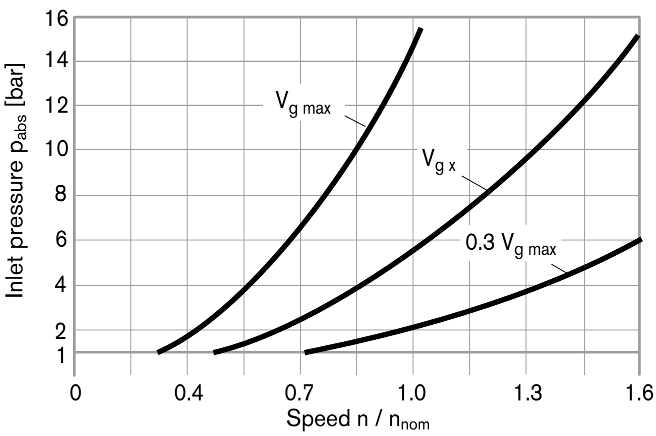
Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Rate of pressure change $R_{A\ max}$
with integrated pressure-relief valve________ 9000 bar/s
without pressure-relief valve ________ 16000 bar/s



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). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

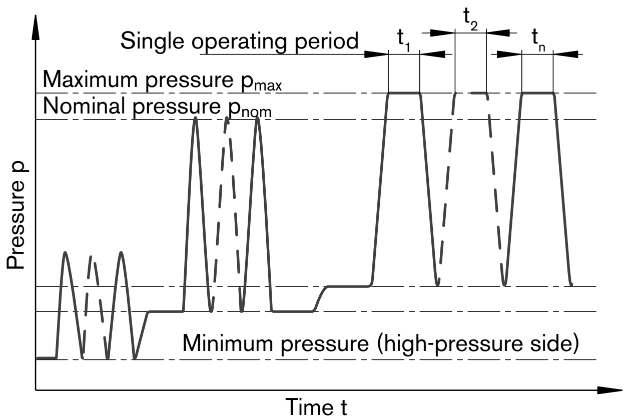
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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

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

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

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



Total operating period = $t_1 + t_2 + ... + t_n$

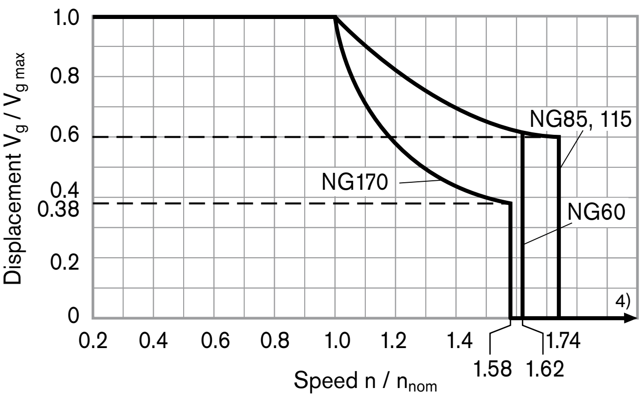
Technical data

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

Size		NG		60	85	115	170
Displacement geometric, per revolution		$V_{g\,max}$	cm^3	62.0	85.2	115.6	171.8
		$V_{g\,min}$	cm^3	0	0	0	0
		$V_{g\,x}$	cm^3	37	51	69	65
Speed maximum[1] (while adhering to the maximum permissible input flow)							
at $V_{g\,max}$		n_{nom}	rpm	4450	3900	3550	3100
at $V_g < V_{g\,x}$ (see diagram below)		n_{max}	rpm	7200	6800	6150	4900
at $V_{g\,0}$		n_{max}	rpm	8400	8350	7350	5750
Input flow[2] at n_{nom} and $V_{g\,max}$		$q_{V\,max}$	L/min	276	332	410	533
Torque[3] at $V_{g\,max}$ and $\Delta p = 450$ bar		T	Nm	444	610	828	1230
Rotary stiffness $V_{g\,max}$ to $V_g/2$		c_{min}	kNm/rad	15	22	37	52
$V_g/2$ to 0 (interpolated)		c_{max}	kNm/rad	45	68	104	156
Moment of inertia for rotary group		J_{GR}	kgm^2	0.0043	0.0072	0.0110	0.0213
Maximum angular acceleration		α	rad/s^2	21000	17500	15500	11000
Case volume		V	L	0.8	1.0	1.5	2.3
Mass (approx.)	without BVI	m	kg	28	36	46	62
	with BVI	m	kg	37	45	52	70

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 startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Permissible displacement in relation to speed



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

2) Restriction of input flow with counterbalance valve, see pages 40 and 44
3) Torque without radial force, with radial force see page 9
4) Values in this range on request

Technical data

Permissible radial and axial forces of the drive shaft

Size	NG		60	85	115	170
Drive shaft		in	W35	W40	W40	W45
Maximum radial force[1)] at distance a (from shaft collar)	$F_{q\,max}$	N	10266	12323	16727	21220
	a	mm	20	22.5	22.5	25
with permissible torque	T_{max}	Nm	444	610	828	1189
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	450	450	450	435
Maximum axial force[2)]	$+F_{ax\,max}$	N	500	710	900	1120
	$-F_{ax\,max}$	N	0	0	0	0
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	7.5	9.6	11.3	15.1

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

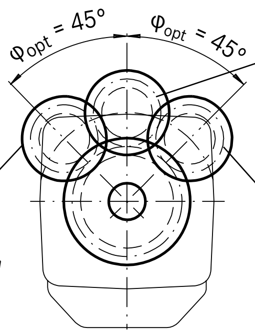
Note
Influence of the direction of the permissible axial force:

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

Effect of radial force F_q on the service life of bearings

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

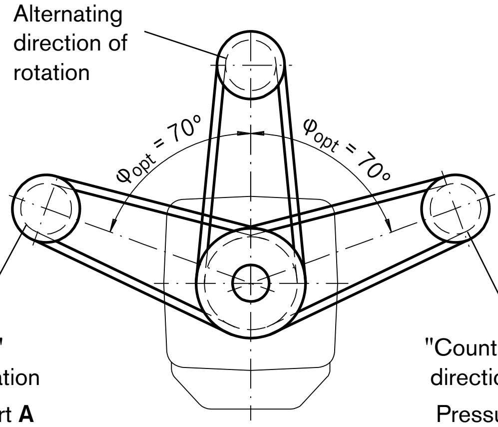
Toothed gear drive



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

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

V-belt drive



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

Determining the operating characteristics

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

Speed $n = \dfrac{q_V \cdot 1000 \cdot \eta_v}{V_g}$ [rpm]

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

HP – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

HP1, HP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum pilot pressure)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum pilot pressure)

HP5, HP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: p_{St} = 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.
- The beginning of control and the HP characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HP1, HP5 pilot pressure increase Δp_{St} = 10 bar

HP1 positive control

A pilot pressure increase of 10 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control

A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range ____________ 2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

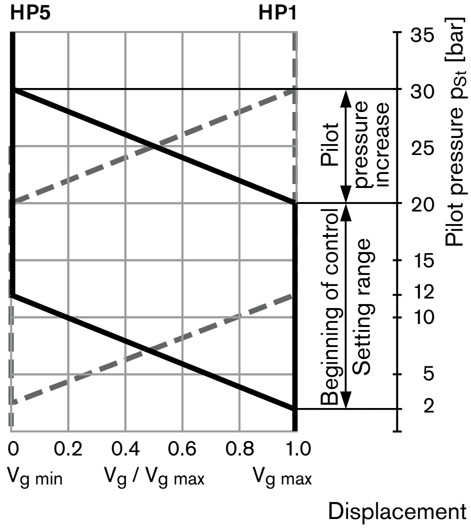
Note

The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

Characteristic



HP2, HP6 pilot pressure increase Δp_{St} = 25 bar

HP2 positive control

A pilot pressure increase of 25 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

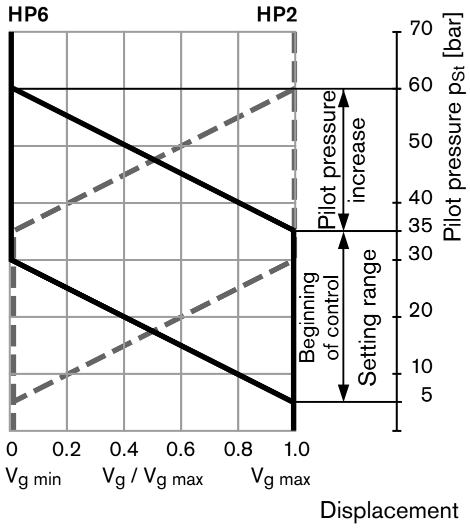
HP6 negative control

A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range ____________5 to 35 bar

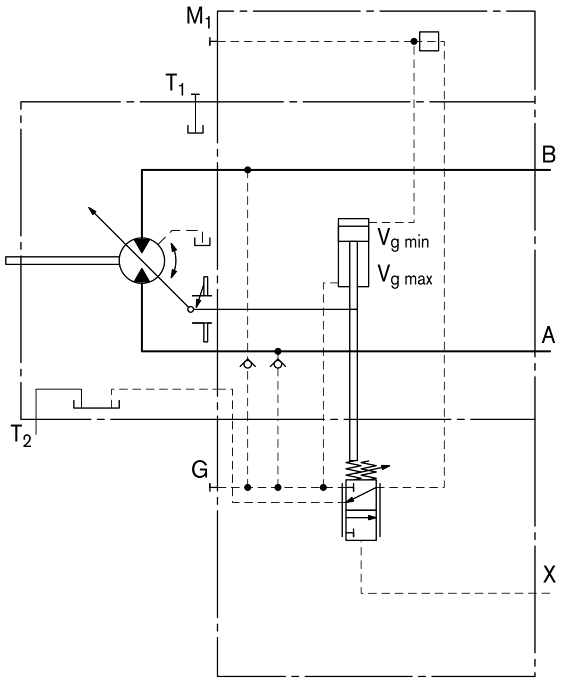
Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

Characteristic

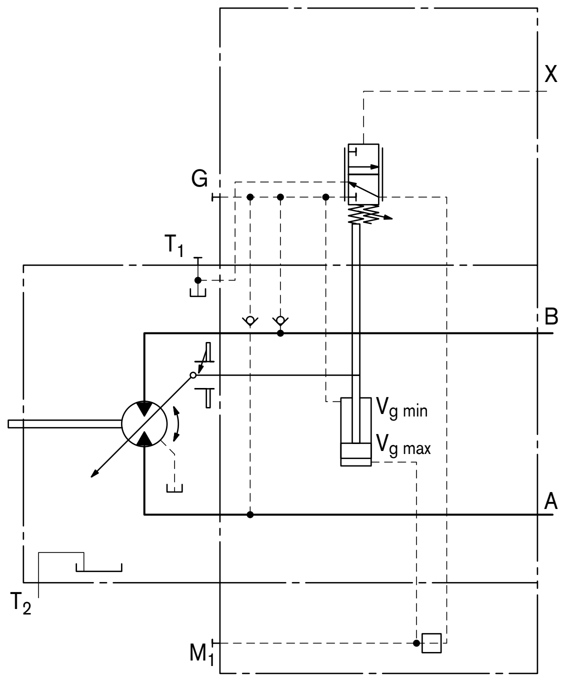


HP – Proportional control hydraulic

Schematic HP1, HP2: positive control



Schematic HP5, HP6: negative control



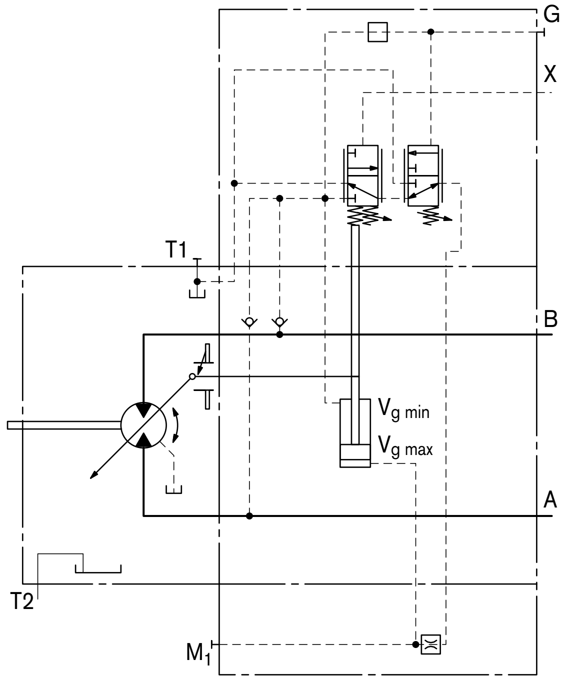
HP5D1, HP6D1
Pressure control, fixed setting

The pressure control overrides the HP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve_____ 80 to 450 bar

Schematic HP5D1, HP6D1: negative control



EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid.

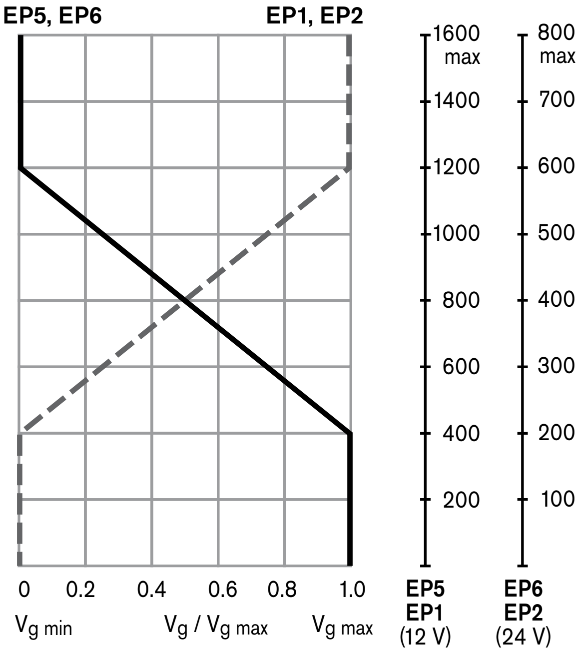
EP1, EP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum control current)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum control current)

EP5, EP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum control current)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 500 bar can occur at port G.

Technical data, solenoid

	EP1, EP5	EP2, EP6
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection see connector design page 36		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

- BODAS controller RC
  Series 20 ____ RE 95200
  Series 21 ____ RE 95201
  Series 22 ____ RE 95202
  Series 30 ____ RE 95203, RE 95204
  and application software
- Analog amplifier RA ____ RE 95230
- Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the internet at: www.boschrexroth.com/mobile-electronics

Note

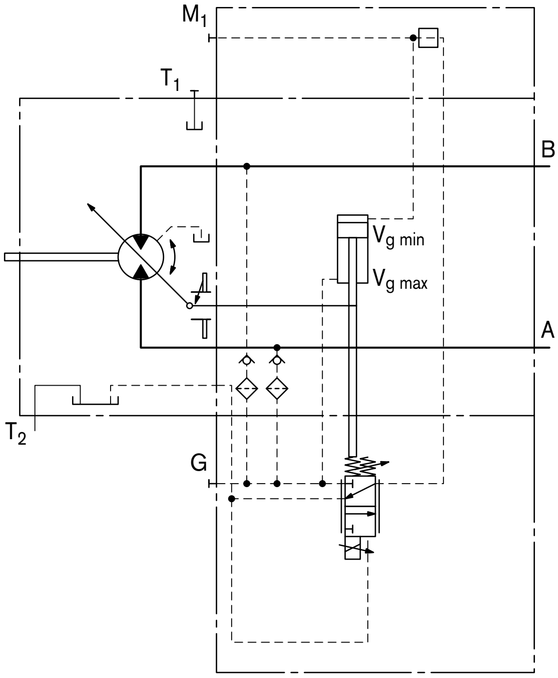
The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

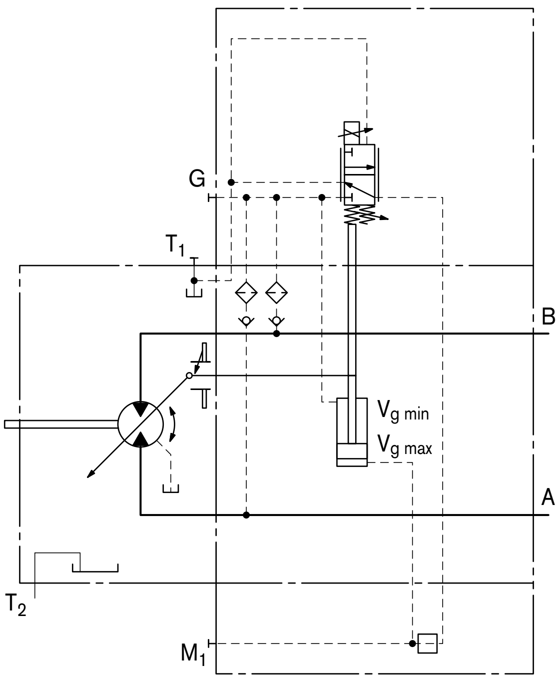
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2: positive control



Schematic EP5, EP6: negative control



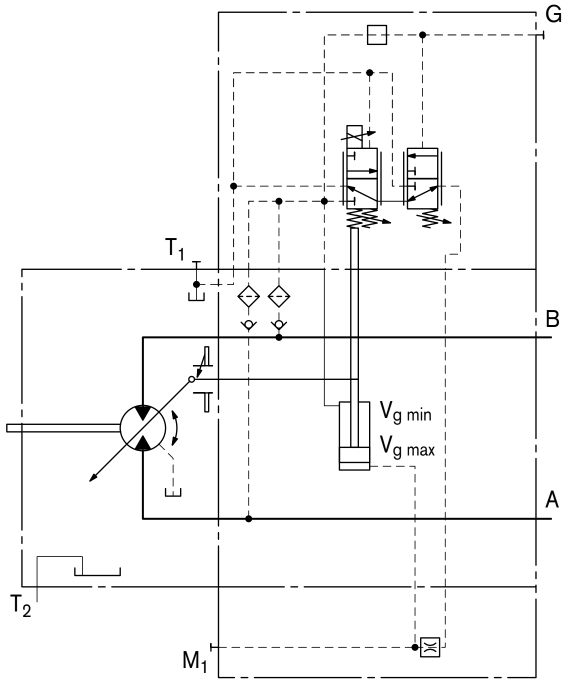
EP5**D1**, EP6**D1**
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve_____ 80 to 450 bar

Schematic EP5D1, EP6D1: negative control



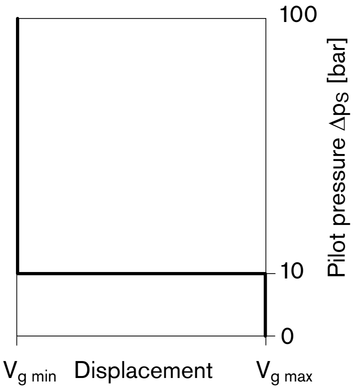
HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\ min}$ or $V_{g\ max}$ by switching the pilot pressure at port X on or off.

HZ5, HZ7 negative control

- Position at $V_{g\ max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\ min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

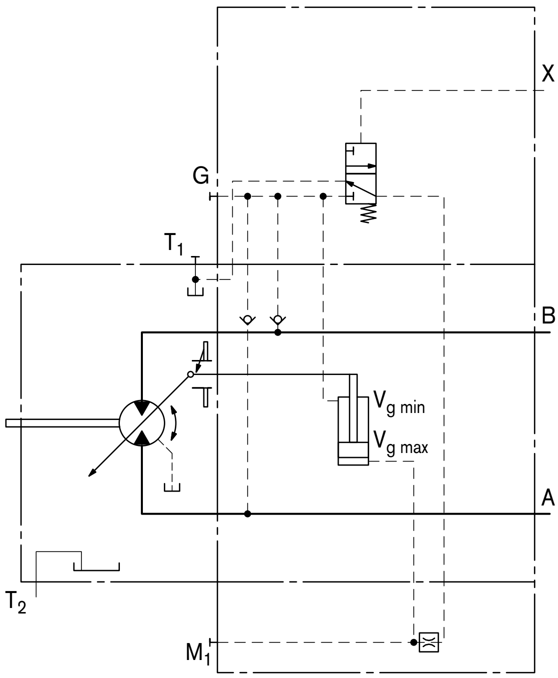
Characteristic HZ5, HZ7



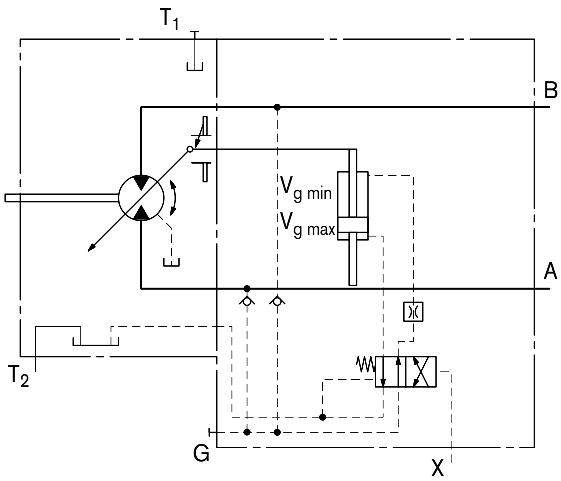
Note

- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.

Schematic HZ5: negative control
Size 170



Schematic HZ7: negative control
Sizes 60 to 115



Schematic HZ7: negative control
Size 170 with integrated counterbalance valve BVI, see page 45

EZ – Two-point control electric

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

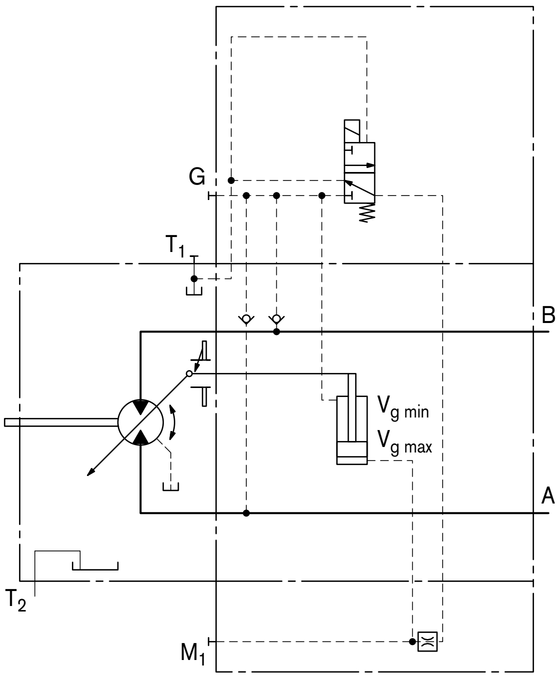
Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 500 bar can occur at port G.

Technical data, solenoid with Ø37
Size 170

	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection see connector design page 36		

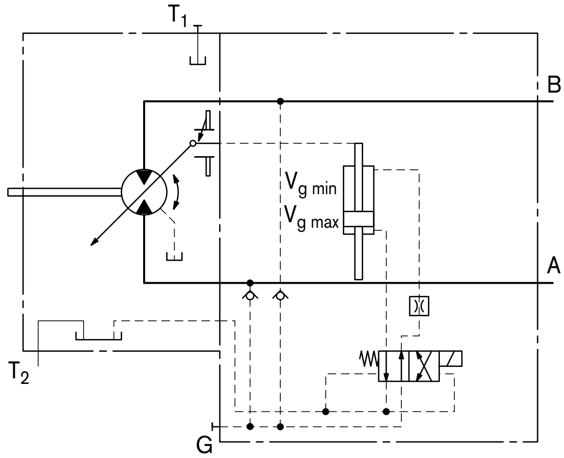
Schematic EZ5, EZ6: negative control
Size 170



Technical data, solenoid with Ø45
Sizes 60 to 115

	EZ7	EZ8
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty Cycle	100%	100%
Type of protection see connector design page 36		

Schematic EZ7, EZ8: negative control
Sizes 60 to 115



HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VE motor with HA control is $V_{g\ min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\ min}$ to $V_{g\ max}$ with increase of pressure. The displacement is modulated between $V_{g\ min}$ and $V_{g\ max}$, thereby depending on load conditions.

HA1, HA2, HA3 positive control

- Beginning of control at $V_{g\ min}$ (minimum torque, maximum speed)
- End of control at $V_{g\ max}$ (maximum torque, minimum speed)

Note

- For safety reasons, winch drives are not permissible with beginning of control at $V_{g\ min}$ (standard for HA).
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.
- The beginning of control and the HA.T3 characteristic are influenced by case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HA – Automatic control high-pressure related

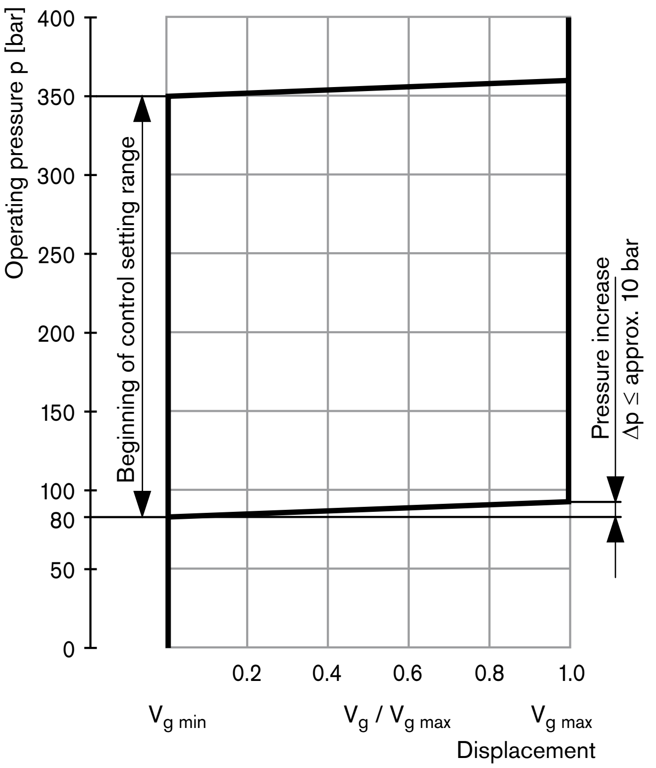
HA1, HA3
With minimum pressure increase, positive control

An operating pressure increase of Δp ≤ approx. 10 bar results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

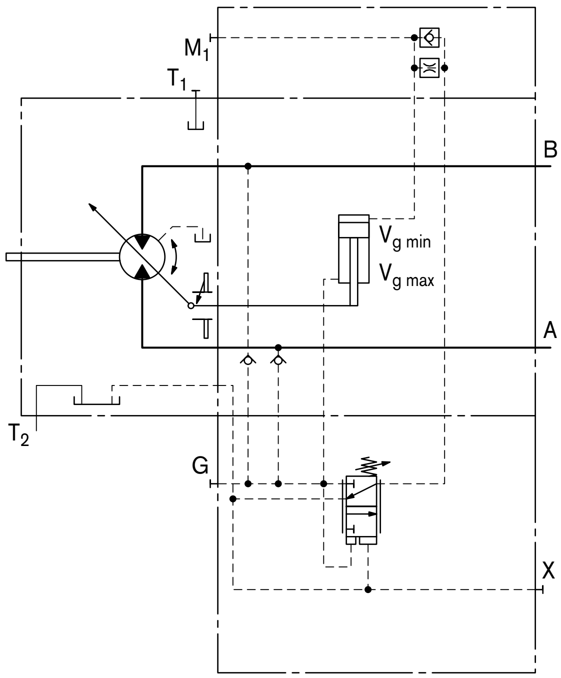
Beginning of control, setting range ___________ 80 to 350 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

Characteristic HA1, HA3



Schematic HA1



Schematic HA3

With integrated counterbalance valve BVI, see page 45

HA – Automatic control high-pressure related

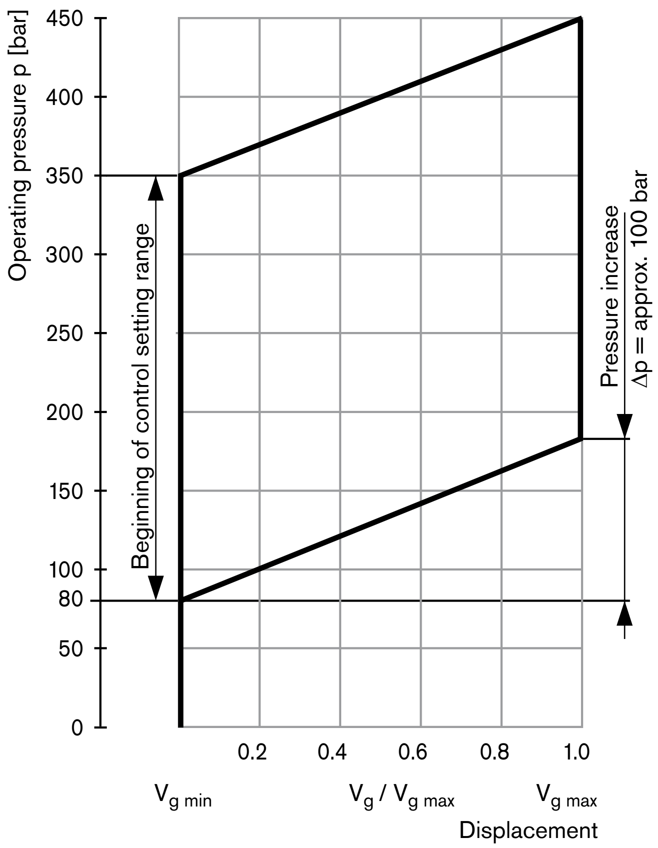
HA2
With pressure increase, positive control

An operating pressure increase of Δp = approx. 100 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

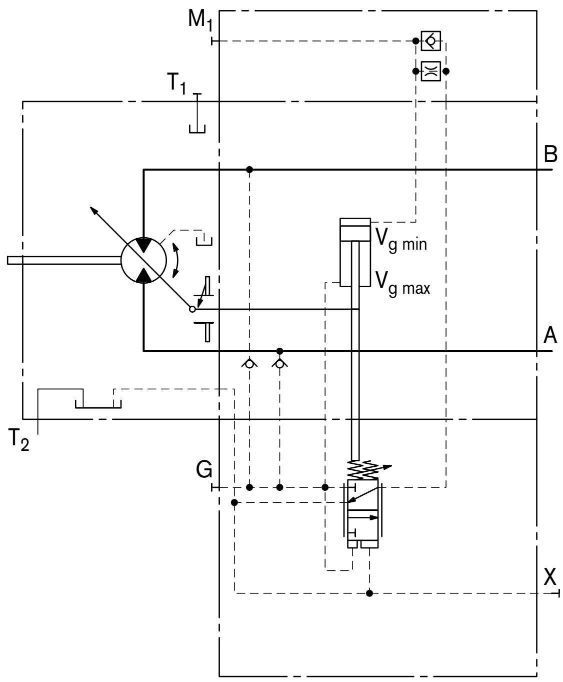
Beginning of control, setting range ___________ 80 to 350 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar.

Characteristic HA2



Schematic HA2



HA – Automatic control high-pressure related

HA.T3
Override hydraulic remote control, proportional

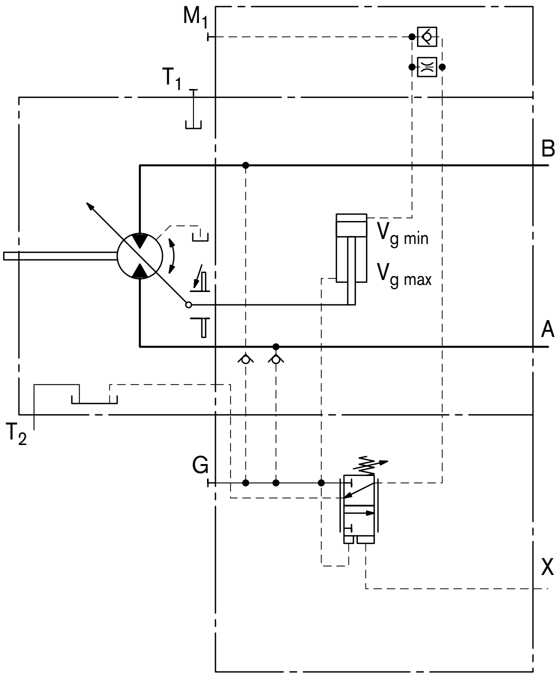
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port X.

For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar.

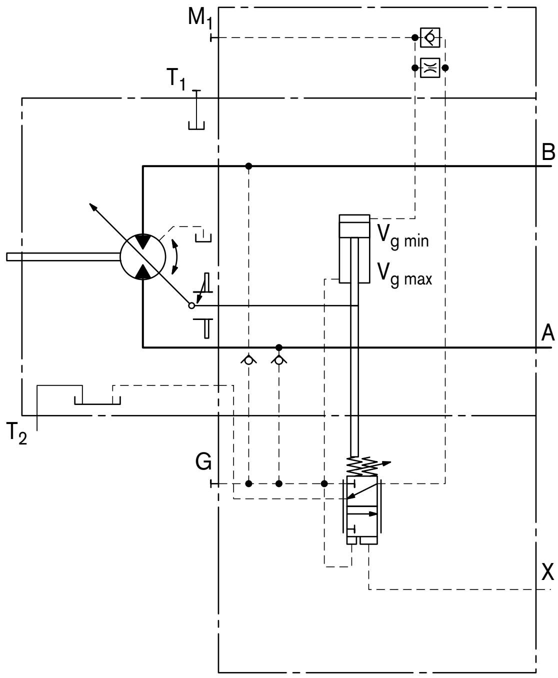
Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
Maximum permissible pilot pressure 100 bar.

Schematic HA1.T3



Schematic HA2.T3



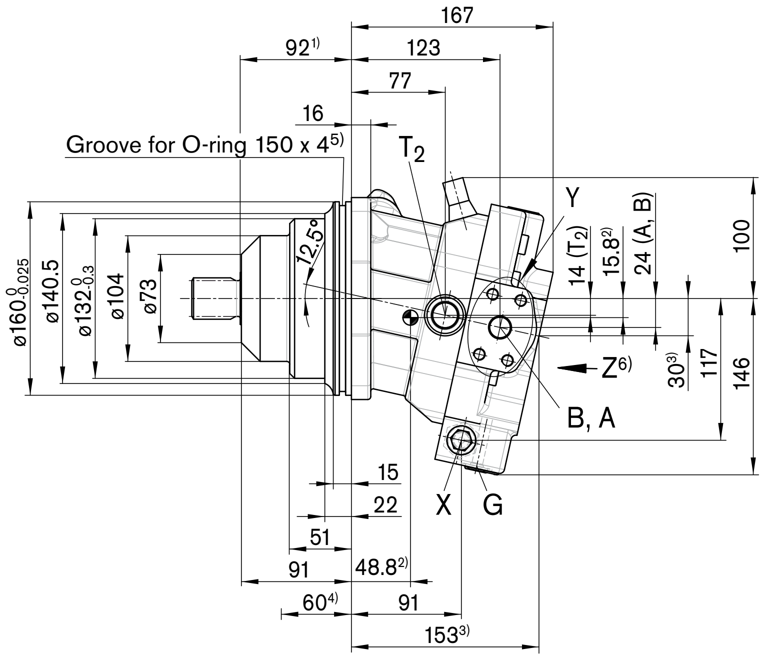
Schematic HA3.T3
With integrated counterbalance valve BVI, see page 45

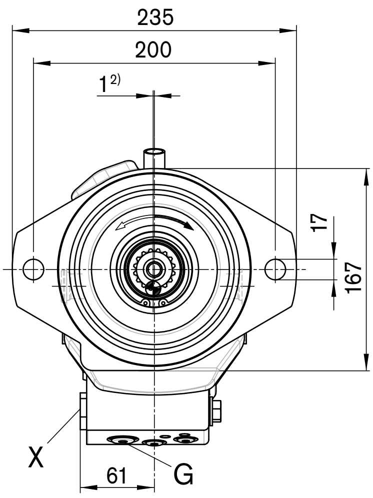
Dimensions size 60

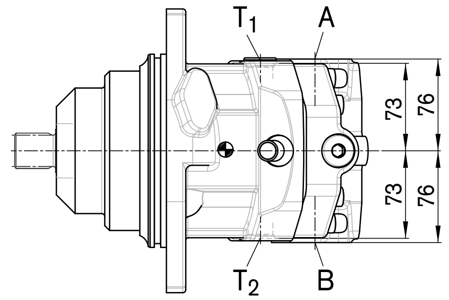
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

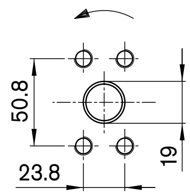
Port plate 2 – SAE flange ports A and B at side, opposite

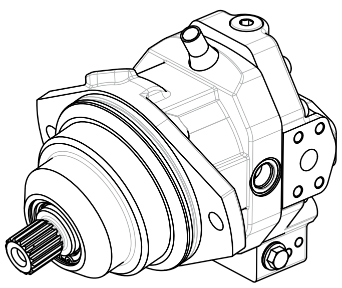






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Differential dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 22

Note

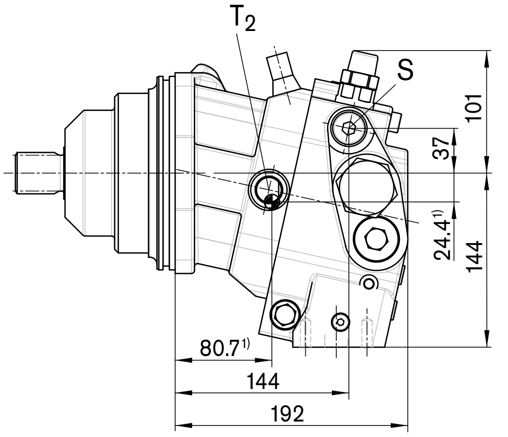
Dimensions of control devices, see RE 91610.

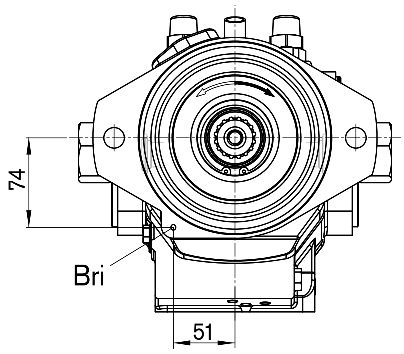
Dimensions size 60

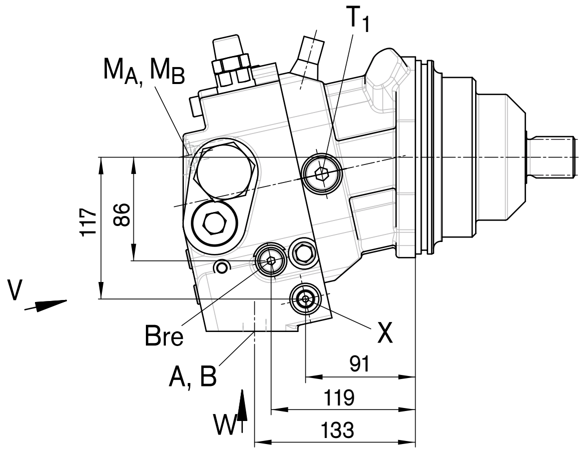
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

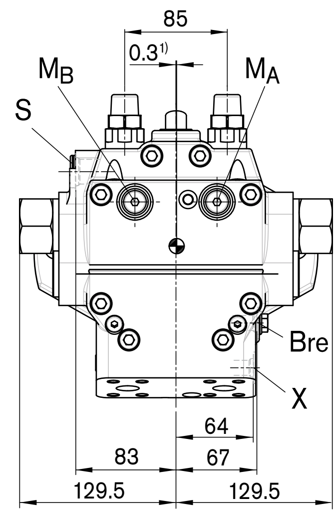
Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom

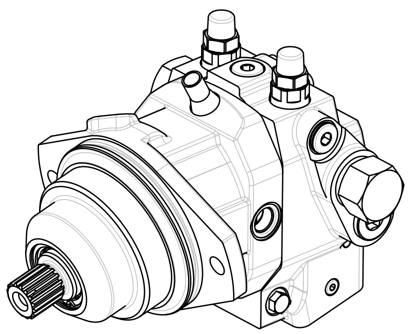




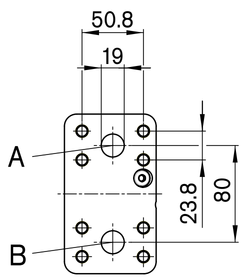


View V





View W

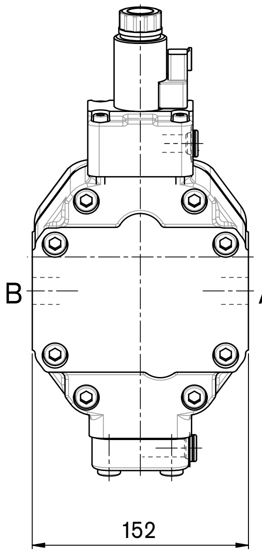
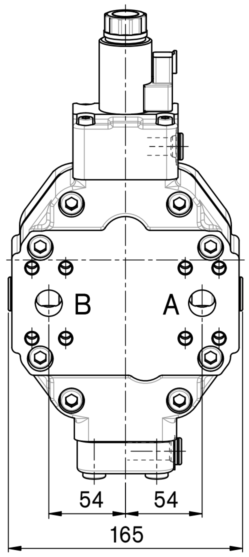
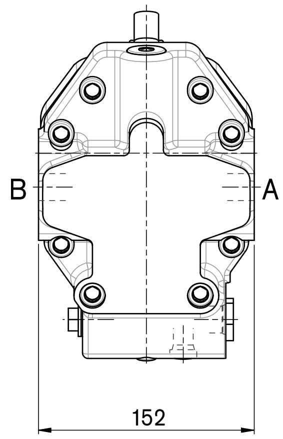
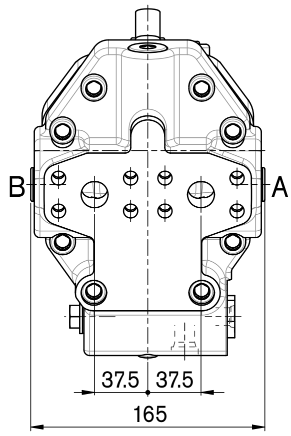


1) Center of gravity

Dimensions size 60

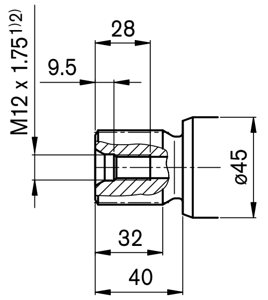
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear	**2** SAE flange ports A and B at side, opposite only HZ7, EZ7/8	**1** SAE flange ports A and B at rear only HZ7, EZ7/8
			

Drive shaft

Z8 Splined shaft DIN 5480 W35x2x16x9g



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

2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 60

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	420	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M22 x 1.5; 15.5 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

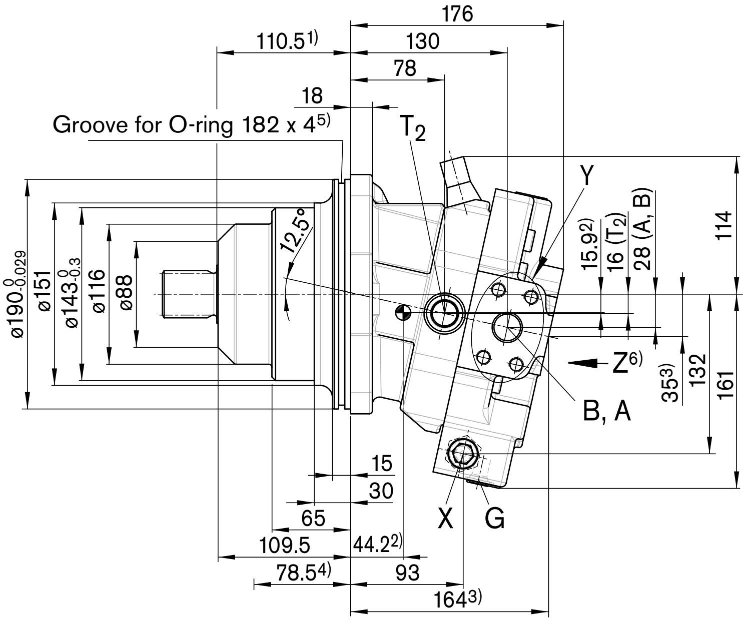
1) Observe the general instructions on page 48 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

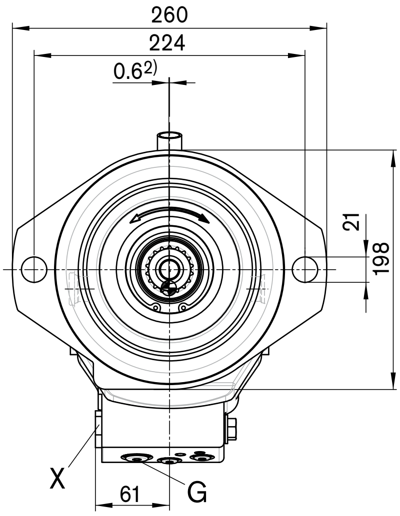
Dimensions size 85

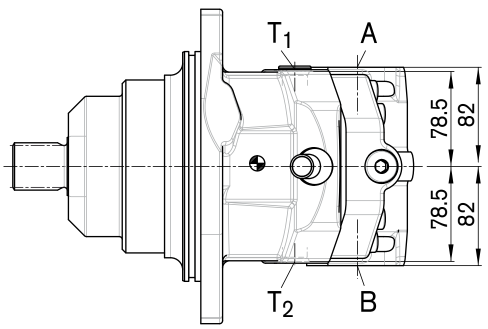
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

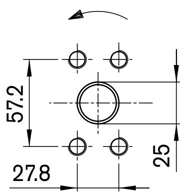
Port plate 2 – SAE flange ports A and B at side, opposite

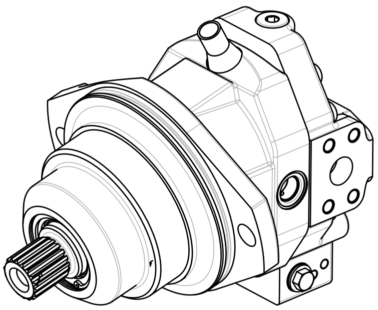






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Difference in dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 26

Note

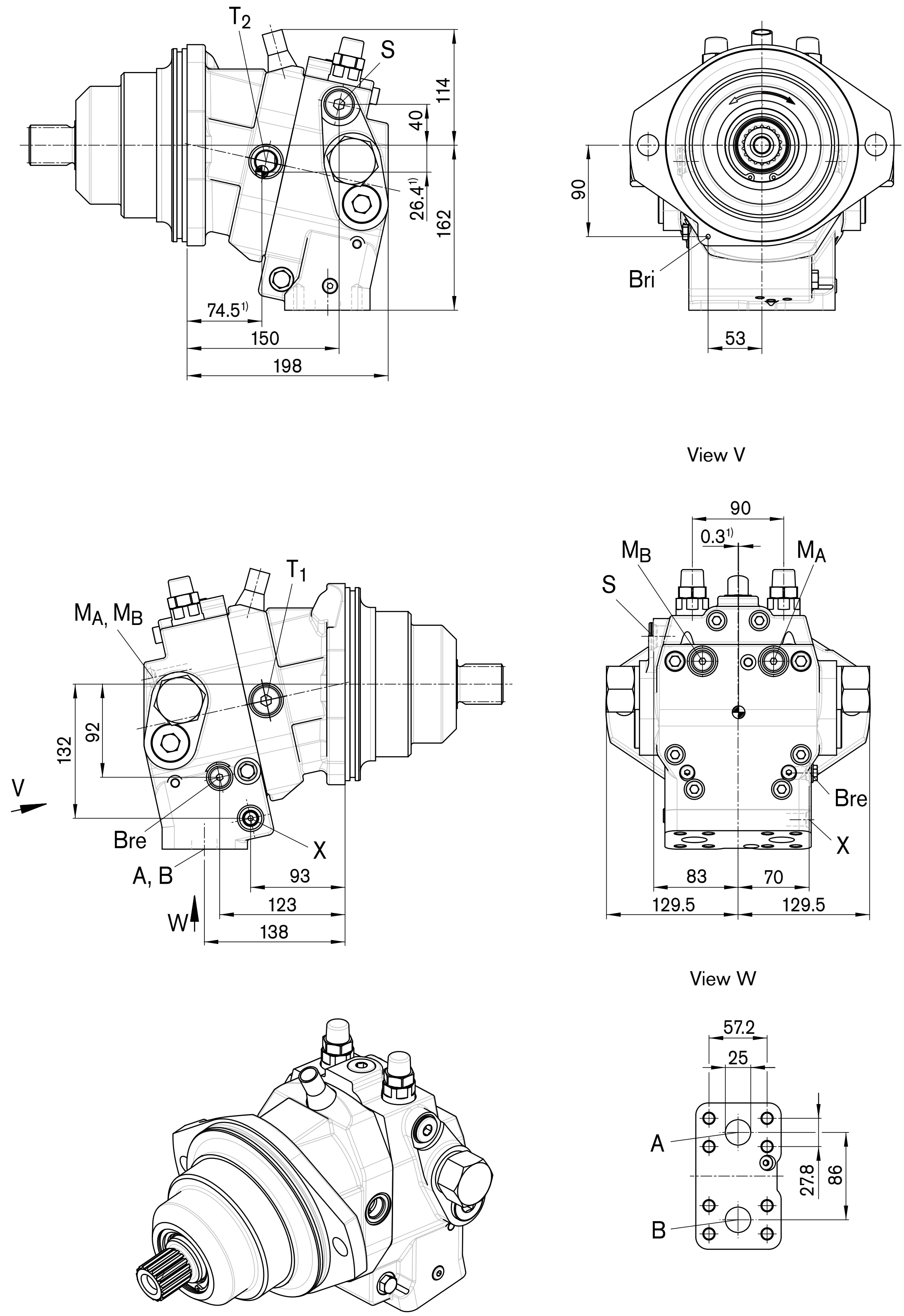
Dimensions of control device, see RE 91610.

Dimensions size 85

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



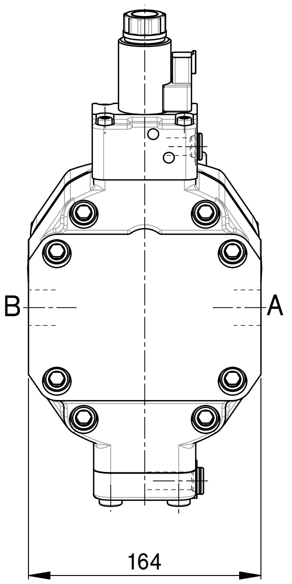
1) Center of gravity

Dimensions size 85

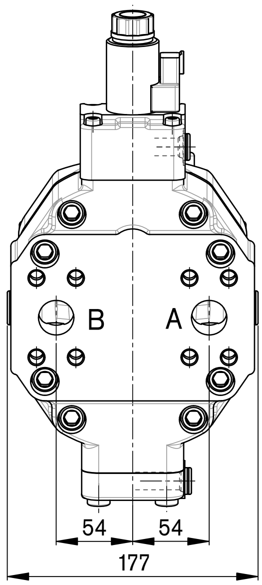
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

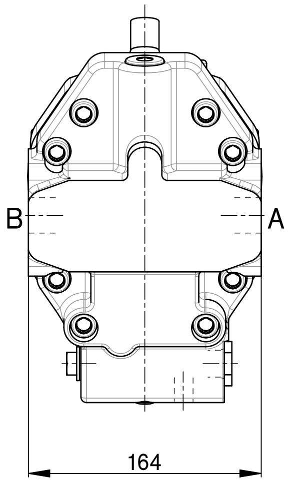
2 SAE flange ports A and B at side, opposite



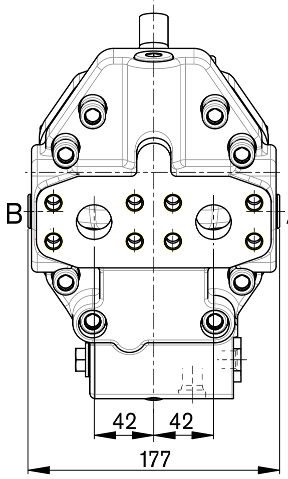
1 SAE flange ports A and B at rear



2 SAE flange ports A and B at side, opposite only HZ7, EZ7/8

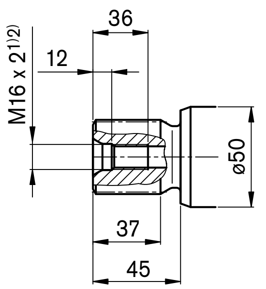


1 SAE flange ports A and B at rear only HZ7, EZ7/8



Drive shaft

Z9 Splined shaft DIN 5480 W40x2x18x9g



1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 85

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	420	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M22 x 1.5; 15.5 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

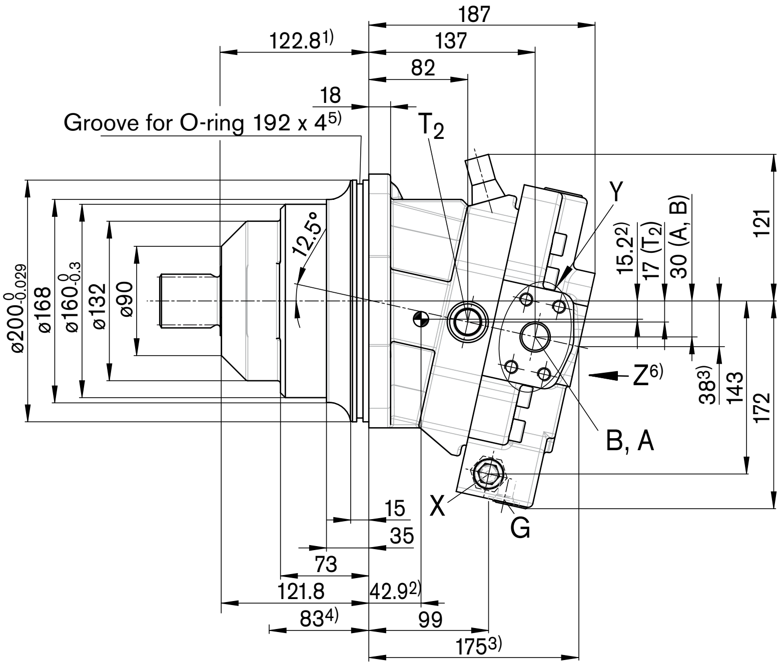
1) Observe the general instructions on page 48 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

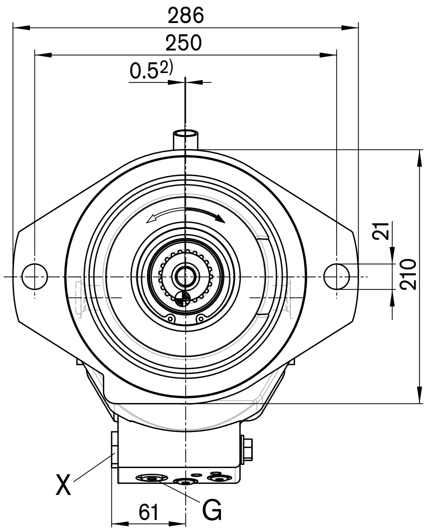
Dimensions size 115

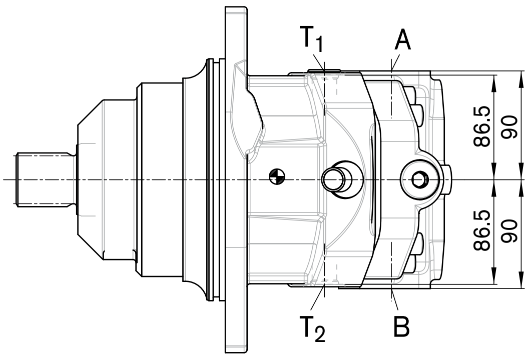
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

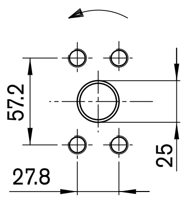
Port plate 2 – SAE flange ports A and B at side, opposite

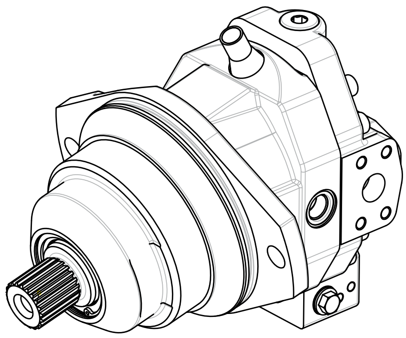






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Difference in dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 30

Note

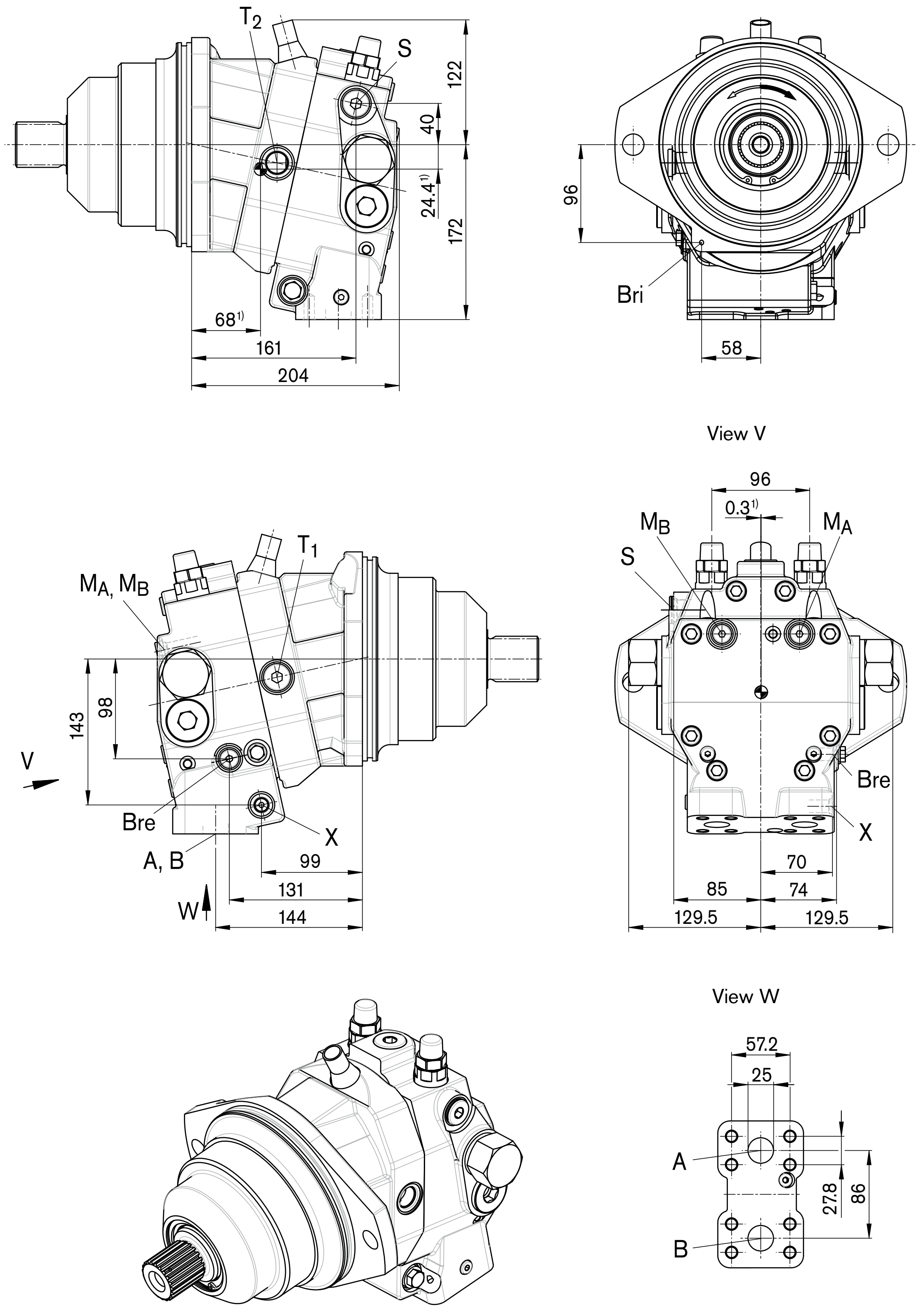
Dimensions of control device, see RE 91610.

Dimensions size 115

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



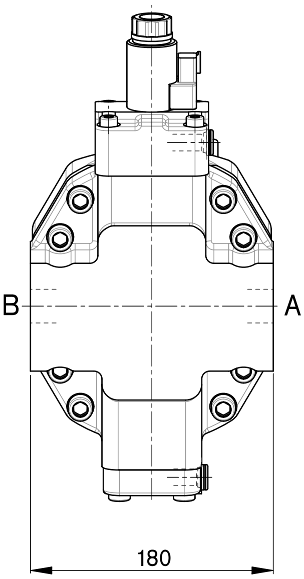
1) Center of gravity

Dimensions size 115

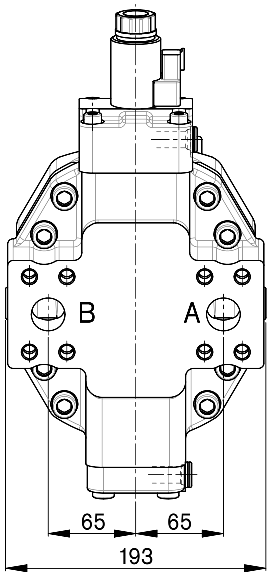
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

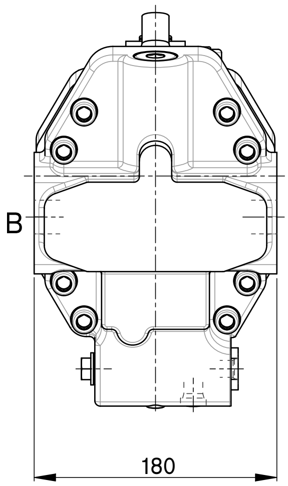
2 SAE flange ports A and B at side, opposite



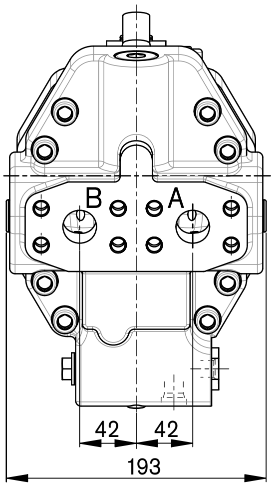
1 SAE flange ports A and B at rear



2 SAE flange ports A and B at side, opposite only HZ7, EZ7/8

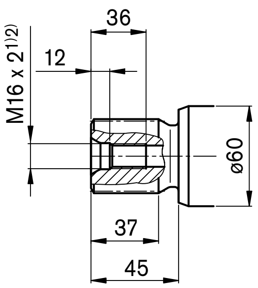


1 SAE flange ports A and B at rear only HZ7, EZ7/8



Drive shaft

Z9 Splined shaft DIN 5480 W40x2x18x9g



1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 115

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	420	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M22 x 1.5; 15.5 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

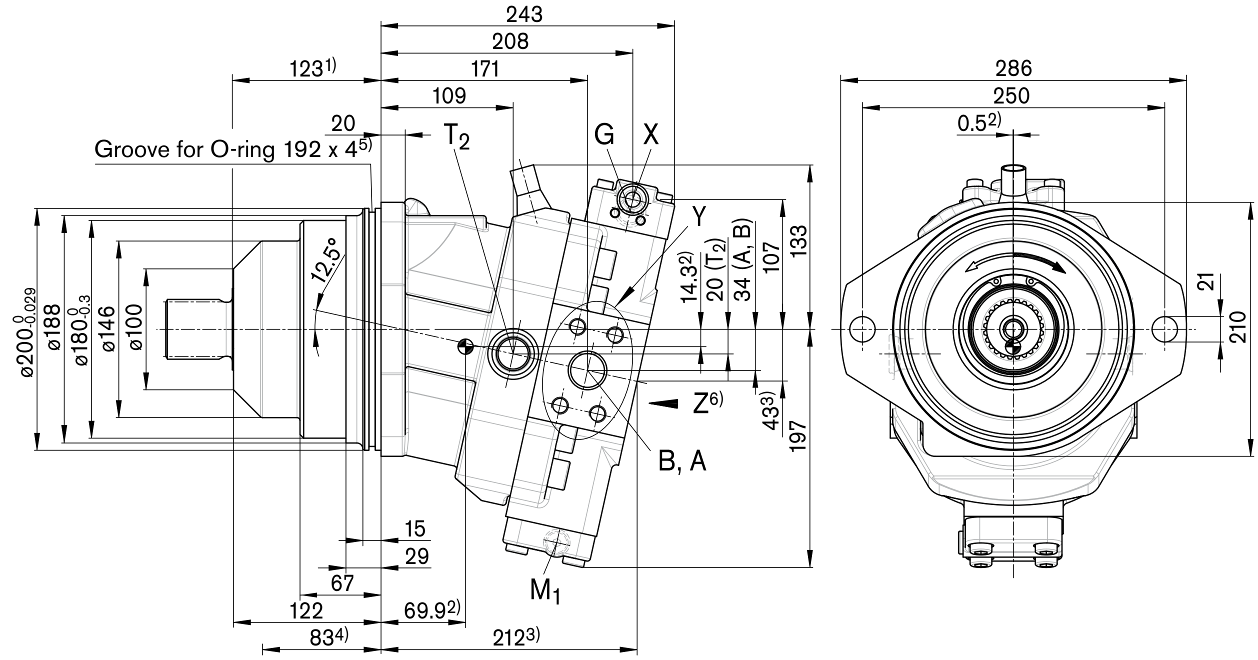
1) Observe the general instructions on page 48 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

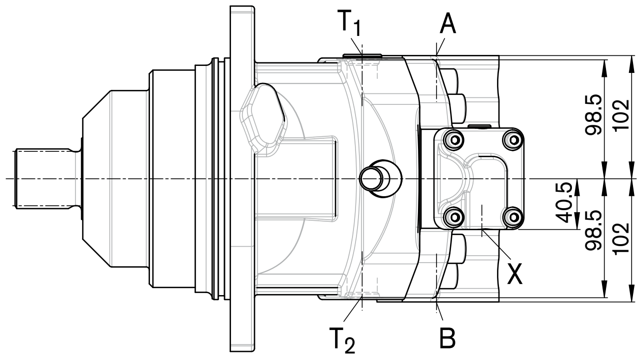
Dimensions size 170

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

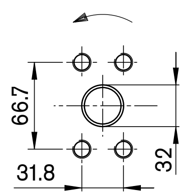
HZ5 – Two-point control hydraulic

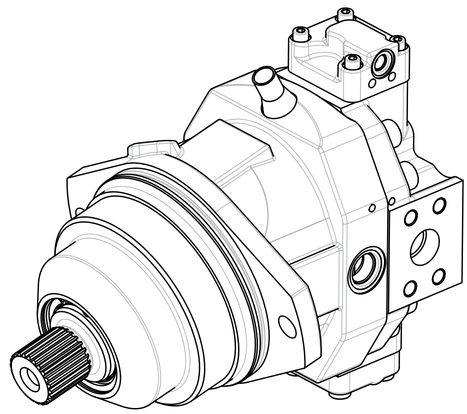
Port plate 2 – SAE flange ports A and B at side, opposite





View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Difference in dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 34

Note

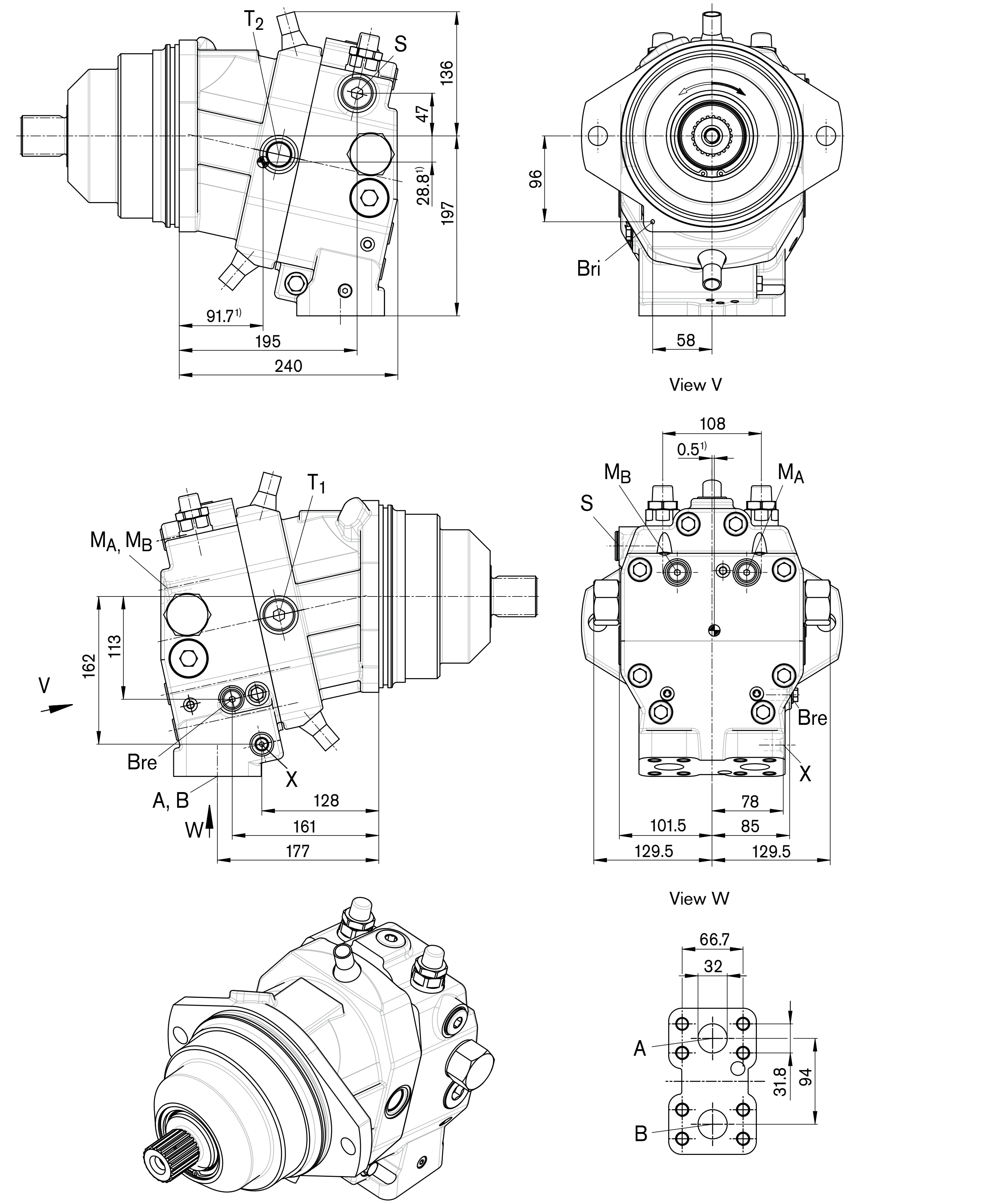
Dimensions of control device, see RE 91610.

Dimensions size 170

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



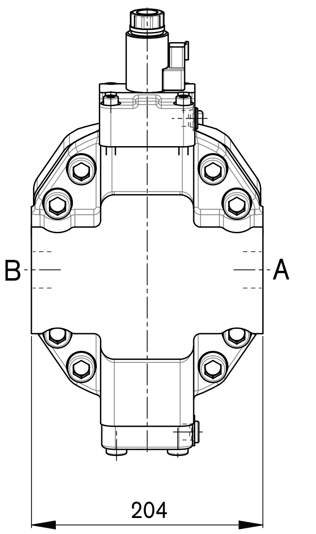
1) Center of gravity

Dimensions size 170

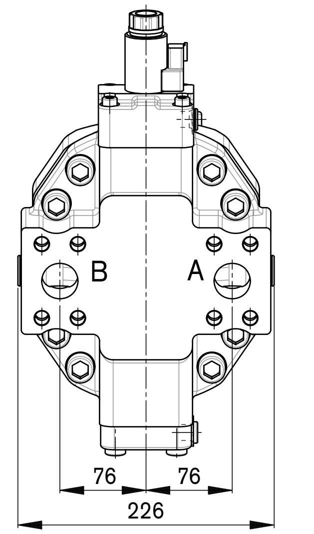
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

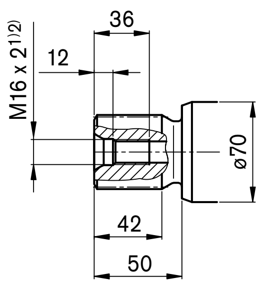


1 SAE flange ports A and B at rear



Drive shaft

A1 Splined shaft DIN 5480 W45x2x21x9g



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

2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 170

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	500	O
T_1	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 16 deep	500	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	420	O
T_1	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M27 x 2; 19 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

1) Observe the general instructions on page 48 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

Connector for solenoids

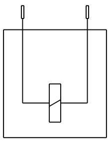
DEUTSCH DT04-2P-EP04

Molded, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:
IP67 ________________ DIN/EN 60529

and IP69K ________________ DIN 40050-9

Circuit symbol



Mating connector

DEUTSCH DT06-2S-EP04
Bosch Rexroth Mat. No. R902601804

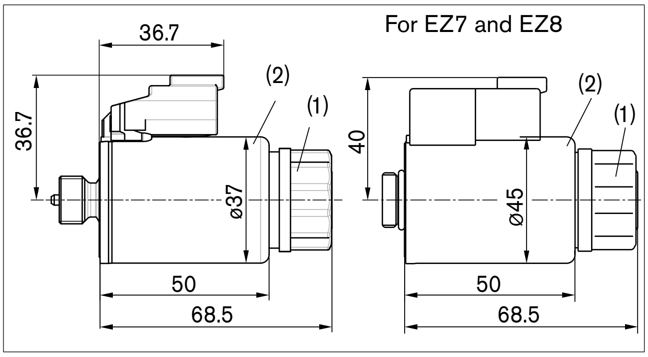
Consisting of: DT designation

– 1 housing ________________ DT06-2S-EP04

– 1 wedge ________________ W2S

– 2 sockets ________________ 0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.



Changing connector orientation

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

1. Loosen the mounting nut (1) of the solenoid. To do this, turn the mounting nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired orientation.
3. Retighten the mounting nut. Tightening torque: 5+1 Nm. (WAF26, 12kt DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Speed sensor

Version A6VE...U ("prepared for speed sensing", i.e. without sensor) is equipped with a toothed ring on the rotary group.

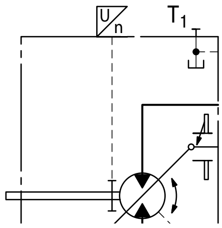
With the speed sensor DSA mounted, a signal proportional to motor speed can be generated.The DSA sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet (DSA – RE 95133)

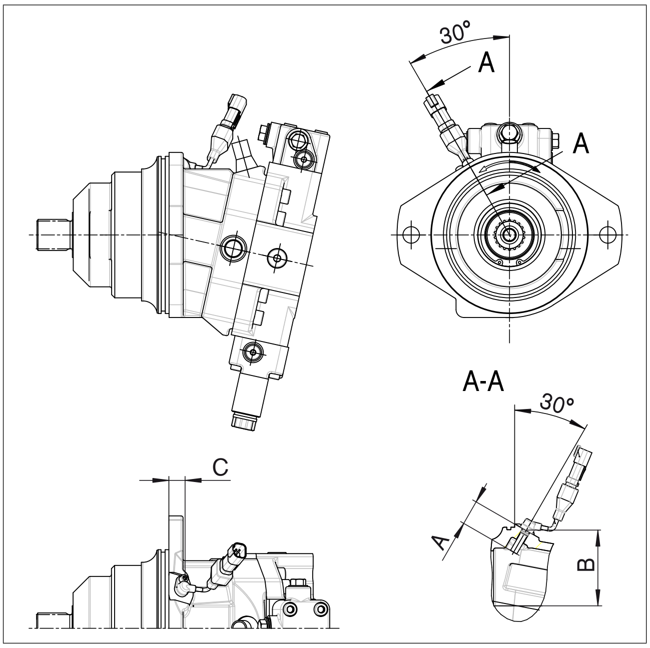
The sensor is mounted on the port provided for this purpose with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.

We recommend ordering the A6VE variable motor complete with sensor mounted.

Schematic



Dimensions
Version "V" with mounted speed sensor



NG	60	85	115	170
Number of teeth	54	58	67	75
A	32	32	32	32
B	83.3	87.3	96.3	104.3
C	26	16.5	14.2	28.5

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.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
fixed setting ______ 16 bar

Switching pressure of flushing piston Δp
Size 60 to 115 (small flushing valve) ______ 8 ±1 bar
Size 115 to 170 (medium and large flushing valve 17.5 ±1.5 bar

Flushing flow q_v
Orifices 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 $\nu = 10$ mm^2/s
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 60 to 115

Mat. No. of orifice	ø [mm]	q_v [L/min]	Code
R909651766	1.2	3.5	A
R909419695	1.4	5	B
R909419696	1.8	8	C
R909419697	2.0	10	D
R909444361	2.4	14	F

Medium flushing valve for size 115

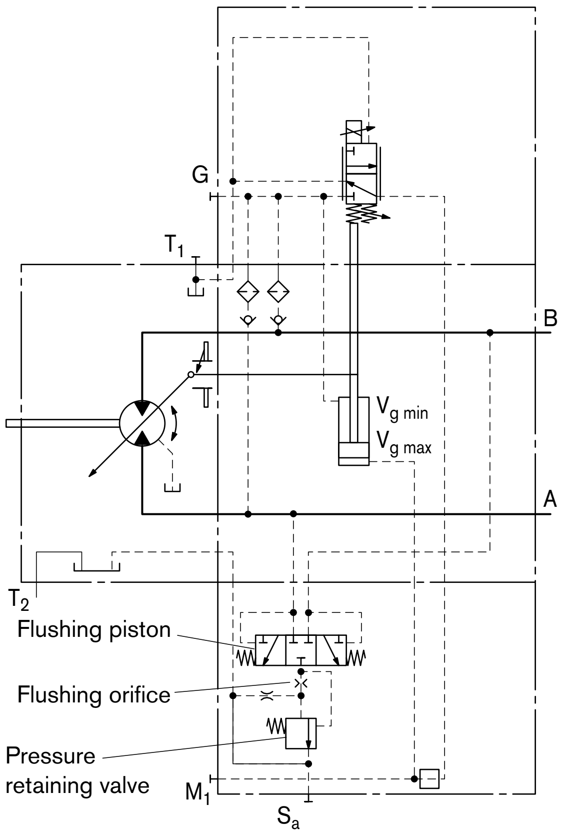
Mat. No. of orifice	ø [mm]	q_v [L/min]	Code
R909431310	2.8	20	H
R909435172	3.5	25	J
R909449967	5.0	30	K

Large flushing valve for size 170

Mat. No. of orifice	ø [mm]	q_v [L/min]	Code
R909449998	1.8	8	C
R909431308	2.0	10	D
R909431309	2.5	17	G
R909431310	2.8	20	H
R902138235	3.1	25	J
R909435172	3.5	30	K
R909436622	4.0	35	L
R909449967	5.0	40	M

For a flushing flow greater than 35 L/min, it is recommended that port S_a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

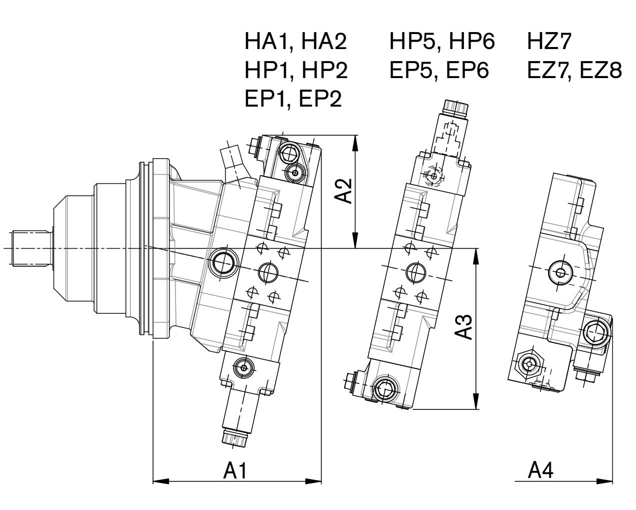
Schematic EP
Port S_a only for size 170



Flushing and boost pressure valve

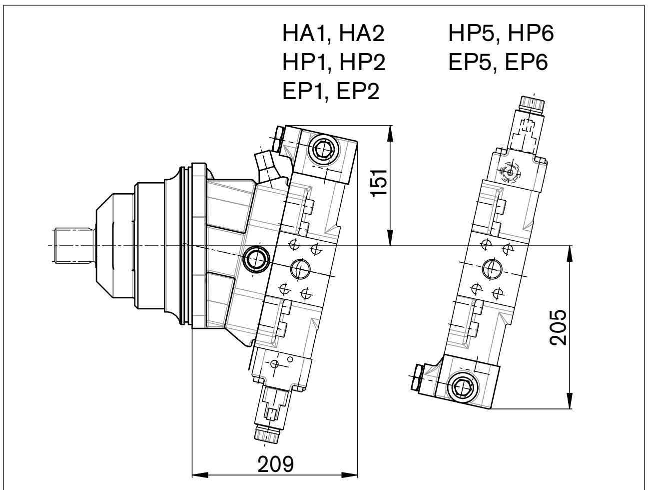
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions of sizes 60 to 115 (small flushing valve)

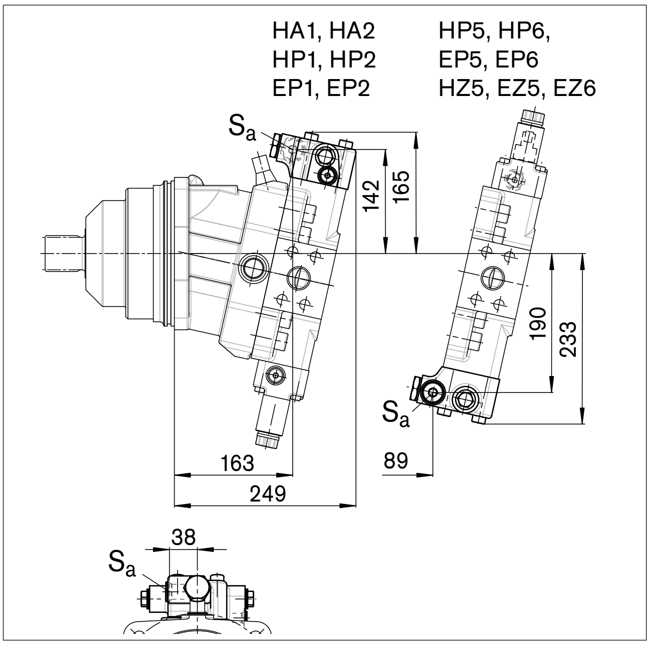


NG	A1	A2	A3	A4
060	183	133	176	176
085	195	142	194	176
115	204	143	202	186

Dimensions of size 115 (medium flushing valve)



Dimensions, size 170 (large flushing valve)



Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
S_a	Flushing (only size 170)	ISO 6149[3]	M22 x 1.5; 15.5 deep	3	X

1) Observe the general instructions on page 48 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.
4) X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Function

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

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

Note

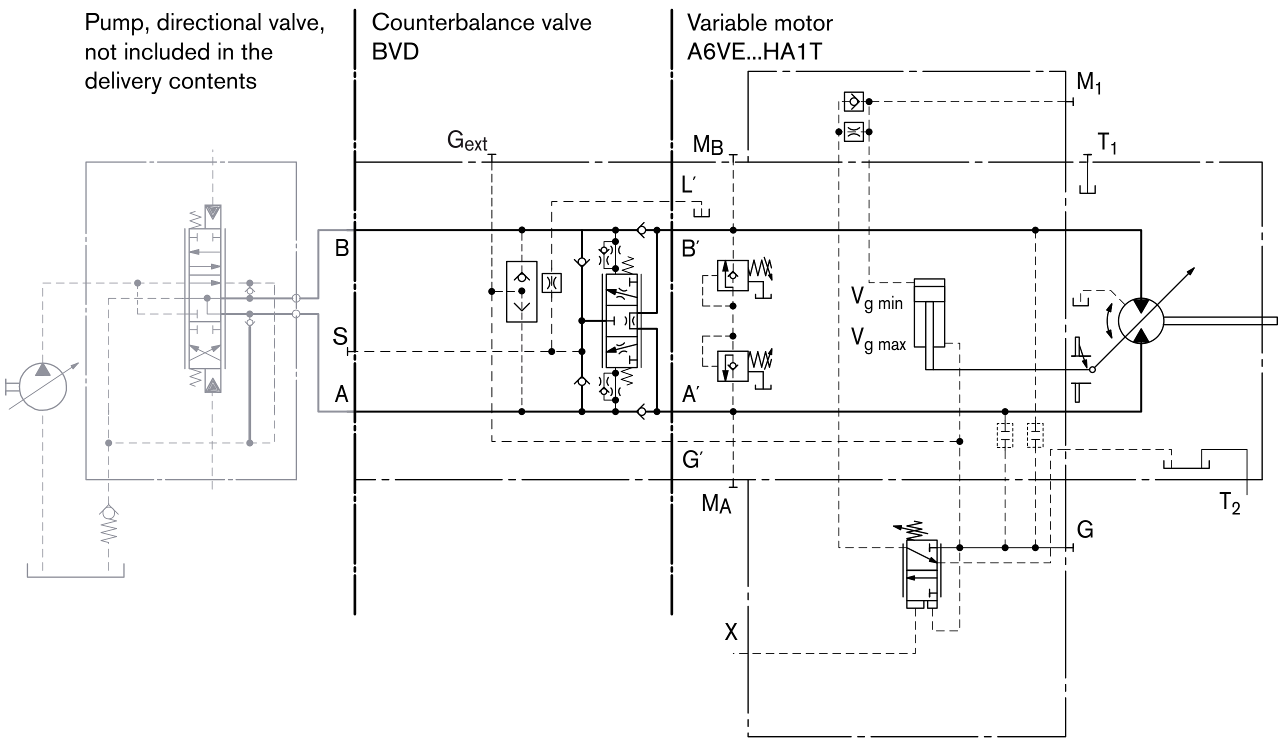
- BVD available for sizes 60 to 170 and BVE available for sizes 115 to 170.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VE085HA1T30004A/71MWV0Y2Z97W0-0 + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!
- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of opening
  - the volume of the 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)

Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A6VE085HA1T30004A/71MWV0Y2Z97W0-0 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

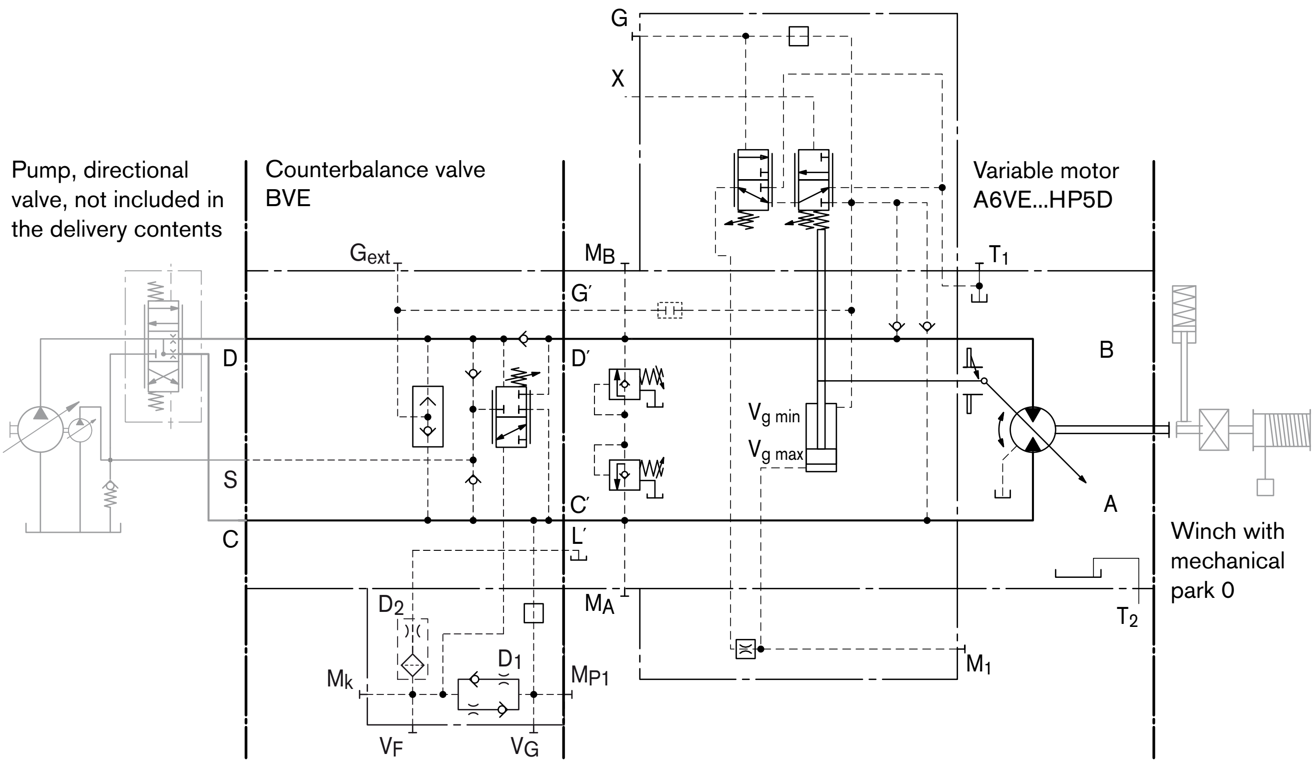
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Winch counterbalance valve BVD...W and BVE

Application options

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

Example schematic for winch drive in cranes
A6VE085HP5D10001A/71MWV0Y2Z97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0



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

Motor	Without valve		Restricted values in operation with DBV and BVD/BVE							
			DBV				BVD/BVE			
NG	p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
60	450/500	276	22	350/420	240	7	20 (BVD)	350/420	220	7W
85		332								
115		410	32		400					
115		410				8	25 (BVD/BVE)		320	8W
170		533								

DBV ____________________ pressure relief valve

BVD ________________counterbalance valve, double-acting

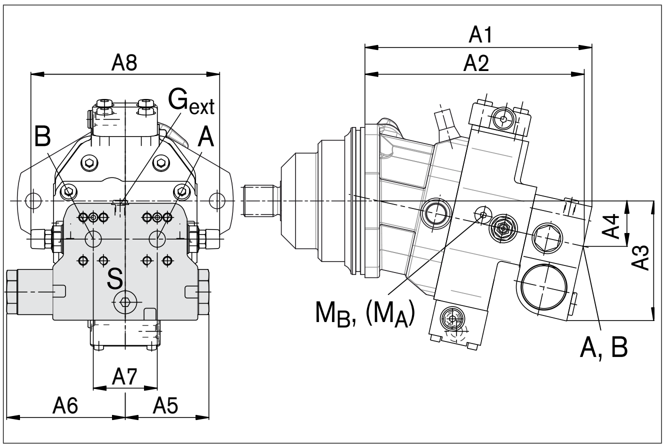
BVE __________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

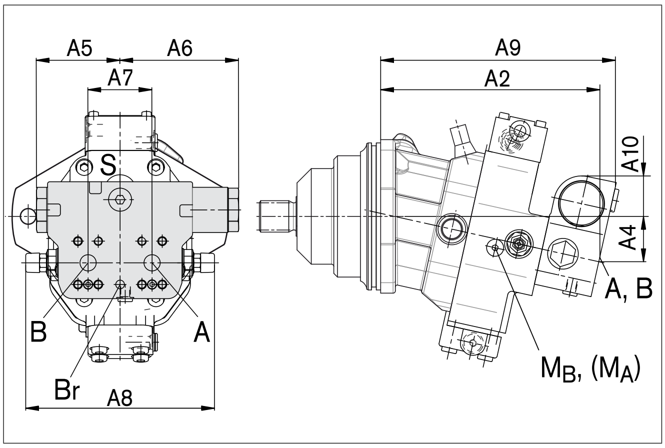
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions

A6VE...HA, HP1, HP2 and EP1, EP2



A6VE...HP5, HP6 and EP5, EP6[1)]



A6VE	Counterbalance valve												
NG...plate	Type	Ports	Dimensions										
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
60...7	BVD20...17	3/4 in	252	243	143	50	98	139	75	222	267	50
85...7	BVD20...27	1 in	261	252	148	55	98	139	75	222	276	46
115...7	BVD20...28	1 in	280	271	152	59	98	139	84	234	295	41
115...8	BVD25...38	1 1/4 in	298	288	165	63	120.5	175	84	238	311	56
170...8	BVD25...38	1 1/4 in	334	324	170	68	120.5	175	84	238	349	51
115...8	BVE25...38	1 1/4 in	298	288	171	63	137	214	84	238	315	63
170...8	BVE25...38	1 1/4 in	334	325	176	68	137	214	84	238	349	59

Ports

Designation	Port for	Version	A6VE plate	Standard	Size[2)]	Maximum pressure [bar][3)]	State[5)]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4)]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4)]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4)]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4)]	M12 x 1.5; 12 deep	30	O
G_{ext}	Brake release, high-pressure	S		DIN 3852[4)]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4)]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VE motor.
The designation of the ports on the installation drawing of the motor is binding!
2) Observe the general instructions on page 48 for the maximum tightening torques.
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) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Mounting the counterbalance valve

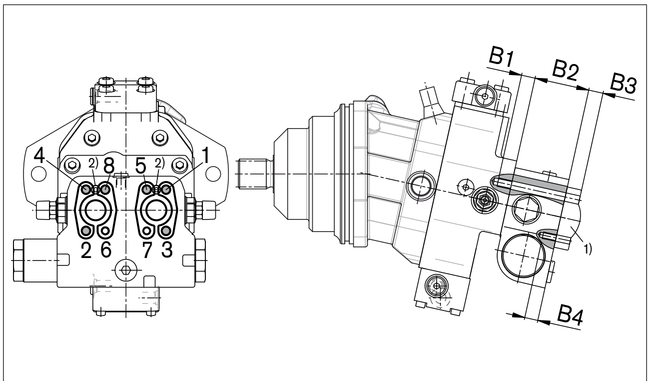
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the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

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

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

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

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10 x 1.5	10.9	75
M12 x 1.75	10.9	130
M14 x 2	10.9	205



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG... plate	60...7	85...7, 115...7	115...8, 170...8
B1[3]	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

Counterbalance valve integrated BVI

Function

The integrated counterbalance valve is 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 or travelling downhill.

Note

– The integrated counterbalance valve must be ordered additionally, see ordering code below.

– The counterbalance valve does not replace the mechanical service brake and park brake.

– For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of beginning
  - 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)

Application options

– Track drive in excavator crawlers

Ordering code

BVI			00		–	
01	02	03	04	05		06

Counterbalance valve

01	Counterbalance valve integrated	**BVI**

	Counterbalance spool version	qv [L/min]	Material number	
02	Volume preselection	≤ 150	R902038832	**51**
		= 150 – 210	R902038936	**52**
		= 210 – 270	R902038833	**53**
		= 270 – 330	R902038834	**54**
		= 330 – 400	R902038835	**55**
		≥ 400	R902038836	**56**

	Throttle mounting	Material number	
03	Constant throttle	R909432302	**0008**
	Throttle pin	R909651165	**0603**

Check valve

04	Without residual opening	**00**

Brake release valve

05	With brake release valve (standard HZ) without disable function	**1**
	With brake release valve (standard HA) with disable function	**2**

Standard / special version

06	Standard version	**0**
	Special version	**S**

Counterbalance valve integrated BVI

Table of values

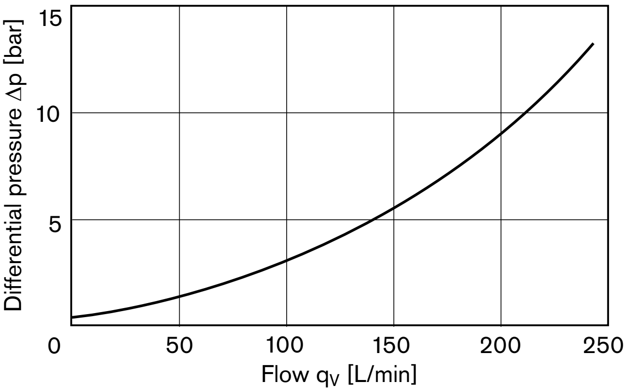
Operating pressure	nominal pressure	p	bar	350
	maximum pressure	p	bar	420
Flow, maximum		$q_{v\ max}$	L/min	400
Counterbalance spool	start of opening	p	bar	12
	fully open	p	bar	26
Pressure-reducing valve for brake release (fixed setting)	control pressure	p	bar	21^{+4}
	beginning of control	p	bar	10^{+4}

Comparison of port plates 1 + 2 and 6

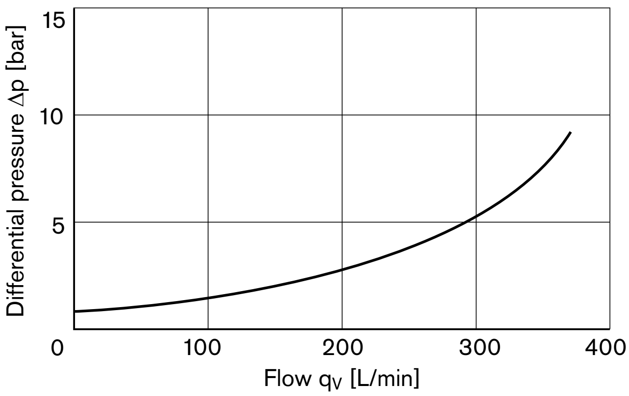
Maximum permissible input flow with restricted nominal pressure 350 bar, maximum pressure 420 bar

Motor NG	Without restrictions standard plate (1 + 2) p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values plate with integrated counterbalance valve (6) Code	p_{nom}/p_{max} [bar]	with BVE + DBV q_V [L/min]
60	450/500	276	6	350/420	240
85		332			
115		410			
170		533			400

Infeed characteristic M22 x 1.5

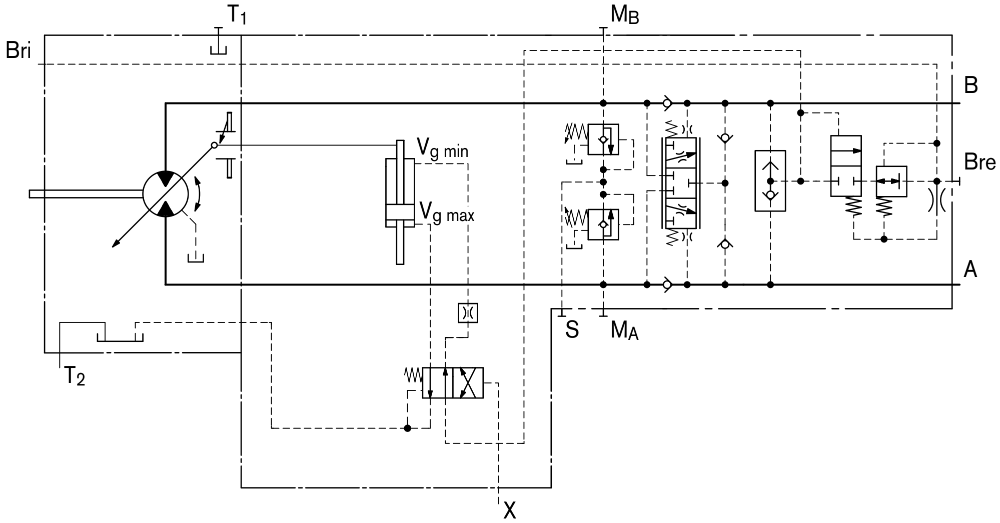


Infeed characteristic M27 x 2

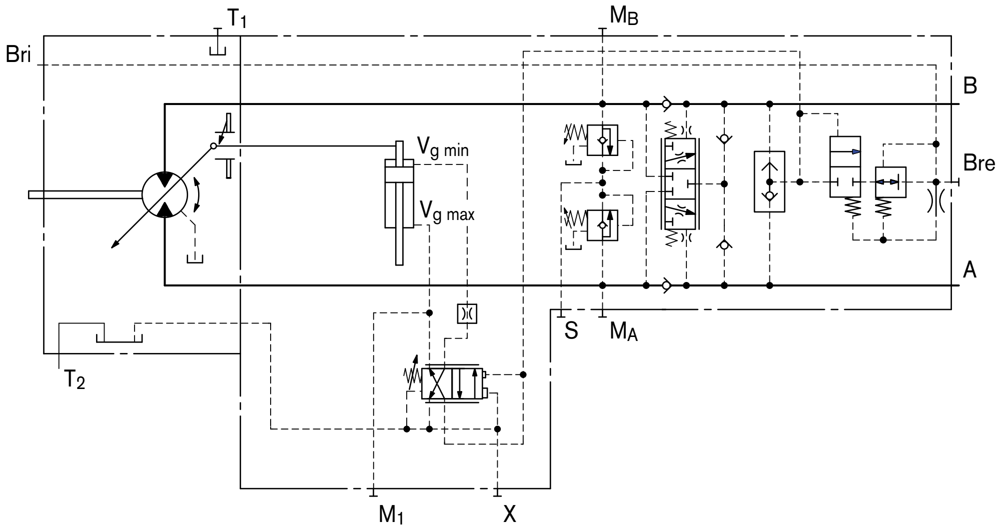


Counterbalance valve integrated BVI

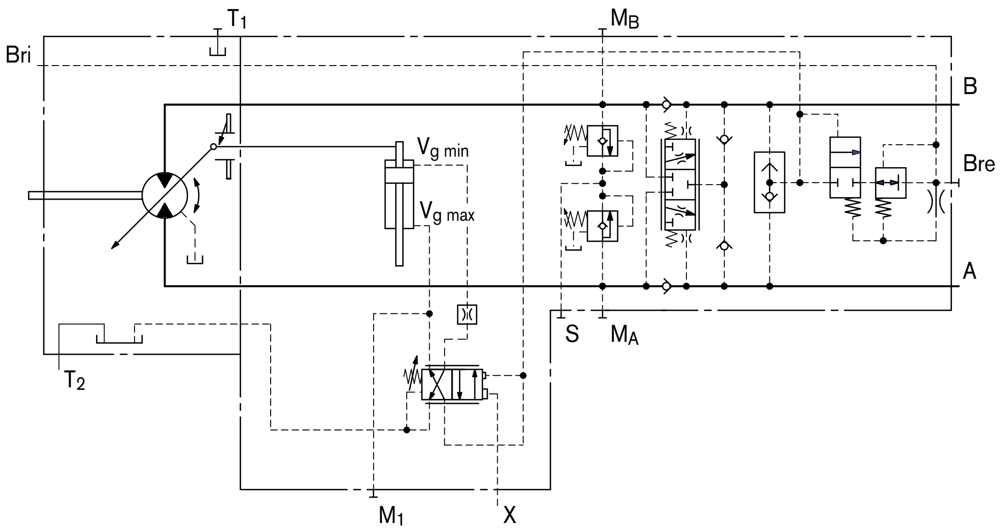
Schematic HZ7



Schematic HA3



Schematic HA3.T3



Setting range for displacement

	60				85				115				170			
	$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
A	62.0	62.0	0.0	15.0	85.2	85.2	0.0	28.0	115.6	115.6	0.0	24.0	171.8	171.8	0.0	28.0
	without screw		M10 x 60 R909154690		without screw		M12 x 70 R909085976		without screw		M12 x 70 R909085976		without screw		M12 x 80 R909153075	
B	62.0	62.0	> 15.0	30.5	85.2	85.2	> 28.0	48.0	115.6	115.6	> 24.0	47.5	171.8	171.8	> 28.0	56.0
	without screw		M10 x 70 R909153779		without screw		M12 x 80 R909153075		without screw		M12 x 80 R909153075		without screw		M12 x 90 R909154041	
C	62.0	62.0	> 30.5	43.0	85.2	85.2	> 48.0	59.0	115.6	115.6	> 47.5	71.0	171.8	171.8	> 56.0	91.0
	without screw		M10 x 80 R909154058		without screw		M12 x 90 R909154041		without screw		M12 x 90 R909154041		without screw		M12 x 100 R909153975	
D	x		x		x		x		115.6	115.6	> 71.0	80.0	171.8	171.8	> 91.0	118.0
									without screw		M12x100 R909153975		without screw		M12x110 R909154212	
E	< 62.0	47.5	0.0	15.0	< 85.2	59.0	0.0	28.0	< 115.6	93.5	0.0	24.0	< 171.8	145.0	0.0	28.0
	M10 x 60 R909154690		M10 x 60 R909154690		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 80 R909153075		M10 x 80 R909153075	
F	< 62.0	47.5	> 15.0	30.5	< 85.2	59.0	> 28.0	48.0	< 115.6	93.5	> 24.0	47.5	< 171.8	145.0	> 28.0	56.0
	M10 x 60 R909154690		M10 x 70 R909153779		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041	
G	< 62.0	47.5	> 30.5	43.0	< 85.2	59.0	> 48.0	59.0	< 115.6	93.5	> 47.5	71	< 171.8	145.0	> 56.0	91.0
	M10 x 60 R909154690		M10 x 80 R909154058		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 100 R909153975	
H	x		x		x		x		< 115.6	93.5	> 71.0	80.0	< 171.8	145.0	> 91.0	118.0
									M12 x 70 R909085976		M12 x 100 R909153975		M12 x 80 R909153075		M12 x 110 R909154212	
J	< 47.5	33.0	0.0	15.0	< 59.0	38.5	0.0	28.0	< 93.5	71.0	0.0	24.0	< 145.0	118.0	0.0	28.0
	M10 x 70 R909153779		M10 x 60 R909154690		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 47.5	33.0	> 15.0	30.5	< 59.0	38.5	> 28.0	48.0	< 93.5	71.0	> 24.0	47.5	< 145.0	118.0	> 28.0	56.0
	M10 x 70 R909153779		M10 x 70 R909153779		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909151041	
L	< 47.5	33.0	> 30.5	43.0	< 59.0	38.5	> 48.0	59.0	< 93.5	71.0	> 47.5	71.0	< 145.0	118.0	> 56.0	91.0
	M10 x 70 R909153779		M10 x 80 R909154058		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909154041		M12 x 100 R909153975	
M	x		x		x		x		< 93.5	71.0	> 71.0	80.0	< 145.0	118.0	> 91.0	118.0
									M12 x 80 R909153075		M12 x 100 R909153975		M12 x 90 R909154041		M12 x 110 R909154212	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering:
$V_{g\,min}$ = ... cm^3, $V_{g\,max}$ = ... cm^3

Theoretical, maximum setting:
for $V_{g\,min} = 0.7 \cdot V_{g\,max}$
for $V_{g\,max} = 0.3 \cdot V_{g\,max}$

Settings that are not listed in the table may lead to damage. Please contact us.

Installation instructions

General

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

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

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

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

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

Installation position

See the following examples 1 to 6.
Further installation positions are possible upon request.

Recommended installation position: 1 and 2.

Note
In certain installation positions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

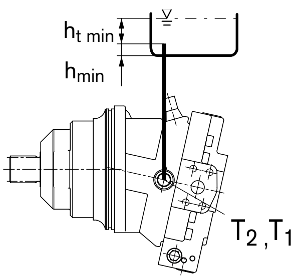
Installation position	Air bleed	Filling
1	–	T_2, T_1
2	–	T_2, T_1
3	–	T_2, T_1
4	L_1	T_2, T_1 (L_1)
5	L_1	T_2, T_1 (L_1)
6	L_1	T_2, T_1 (L_1)

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

Below-reservoir installation (standard)

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

1



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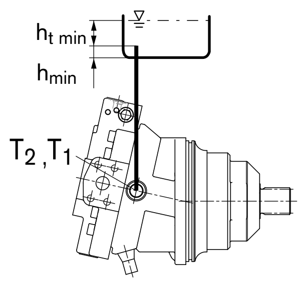

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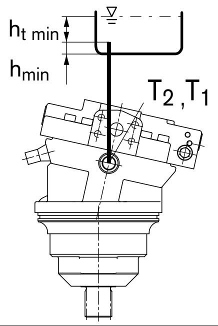
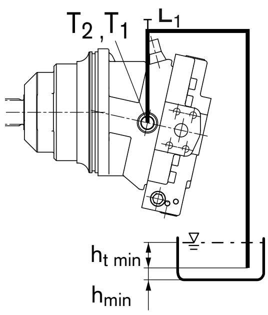


Above-reservoir installation

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

4



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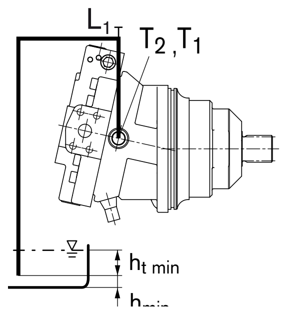

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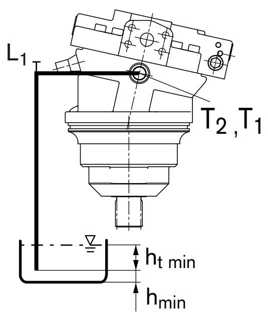

General instructions

– The motor A6VE is designed to be used in open and closed circuits.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. 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 the tightening torques of the fittings used.
- Mounting bolts:
  For mounting bolts with metric ISO thread according to DIN 13, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
- Female threads of the axial piston unit:
  The maximum permissible tightening torques $M_{G\ max}$ are maximum values of 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 the threaded plugs M_V apply. For values, see the following table.

Ports Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\ max}$	Required tightening torque of the threaded plugs M_V	WAF hexagon socket of the threaded plugs
ISO 6149	M10 x 1	30 Nm	15 Nm	5 mm
	M12 x 1.5	50 Nm	25 Nm	6 mm
	M14 x 1.5	80 Nm	45 Nm	6 mm
	M18 x 1.5	140 Nm	70 Nm	8 mm
	M22 x 1.5	210 Nm	100 Nm	10 mm
	M27 x 2	330 Nm	170 Nm	12 mm
DIN 3852	M12 x 1.5	50 Nm	25 Nm[1)2)]	6 mm
	M22 x 1.5	210 Nm	80 Nm[1)]	10 mm
	M27 x 2	330 Nm	135 Nm[1)]	12 mm

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

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Rexroth
Bosch Group

Secondary control with A4VSO/G axial piston units

RE 92056/10.04
Replaces: 01 .04

Type A4VSO...DS1

Nominal size 40...1000
Series 1X, 3X
Nominal pressure 315 bar
Peak pressure 400 bar

Secondary unit
Type A4VSO250DS1

Digital closed loop control
assembly HNC100-SEK

Overview of contents

Features

– Highly dynamic rotary drive
– Motor and generator operation in both directions of rotation
– Energy recovery and energy storage
– With speed, position or closed loop torque control with high accuracy and dynamics
– Throttle-free coupling and energy transmission of as many independently working (motor or generator driven) machines as required, to a common supply with quasi-constant operating pressure
– Compact digital closed loop control electronics

Function

Secondary controlled hydrostatic drives are connected to a power supply with a quasi-constant operating pressure to form the basis for an energy saving drive concept with high dynamics for creating closed loop speed, position or torque controls with energy recovery.

The power consumption or return into the supply network is not throttled and is matched to the demand by matching the stroke volume of the unit to the relevant load.

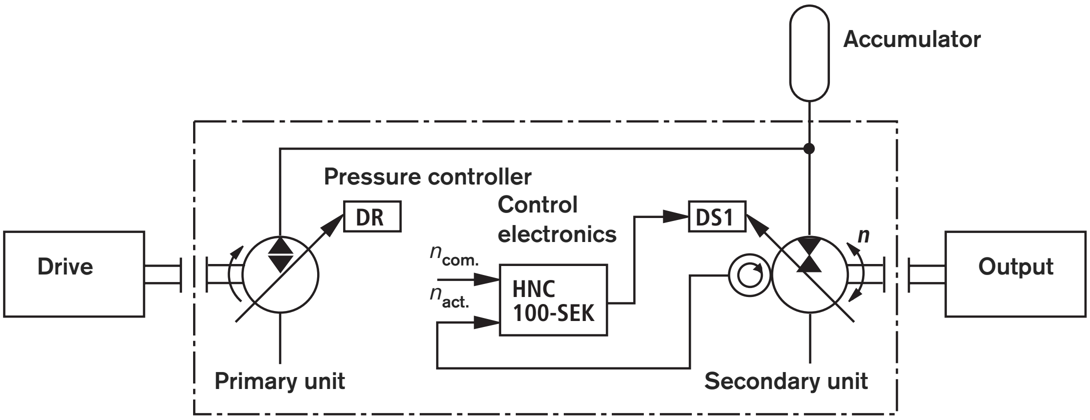
This means that any number of units, operating as motors or pumps, may be connected in parallel. Four quadrant operation is possible, however the units for speed or torque reversal have to be swiveled over "centre". Thereby the direction of flow is also reversed.

If required an accumulator may be fitted between the primary and secondary units.

The accumulator is used to cover rapid flow peaks. Furthermore it is used to store the energy that comes from the secondary unit during pump operation into the hydraulic net, when this energy is not required by any other actuator. Together with the pressure controlled primary unit and the operating status of the secondary unit the load condition of the accumulator and its pre-charge determine the quasi-constant high pressure in the system.

The specific characteristics of secondary control such as reducing the amount of equipment required at the primary side, combined with the possibility of energy recovery, the storage of braking energy and the virtually load-independent speed and positioning accuracy, open up a wide range of applications.

For further information see "Hydraulic Trainer Volume 6" (RE 00293).



Secondary unit components

1 Axial piston unit A4VSO...DS1

1.1 4-way servo valve (see RE 29583)

NS	Type
40, 71	4WS2EM10-5X/20B11ET315K31EV
125, 180	4WS2EM10-5X/30B11ET315K31EV
250, 355	4WS2EM10-5X/45B11ET315K31EV
500, 750, 1000	4WS2EM10-5X/75B11ET315K31EV

Alternative: Proportional valve

1.2 Swivel angle transducer IW9-03-DT (see page 26)
Alternative: Integrated spool position transducer

2 Sandwich plate filter – Ordering detail: **Z**
(not required when a proportional valve is used)

NS	Type
40, 71	DFZBH/HC060QC10Y1X/V
125 to 1000	DFZBH/HC110QC10Y1X/V
With optical and electrical clogging indicator:	VD2.0X/-V-C24

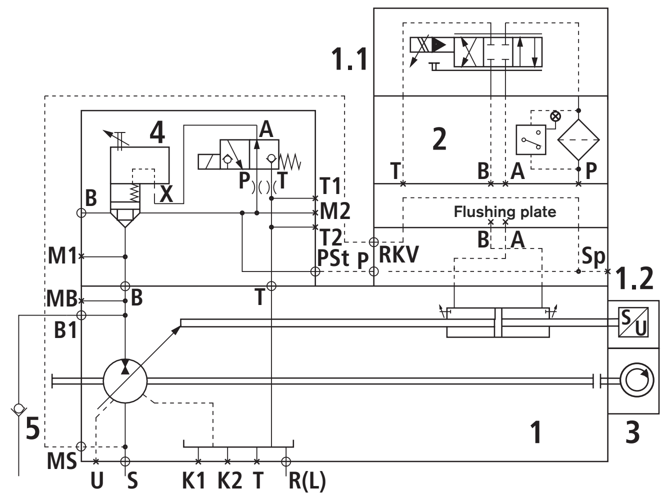
3 Incremental encoder GEL 293
(Ordering details: **T03 or T04**) (see page 25)

4 Electrically operated check valve (isolating valve)
(Ordering detail: **1**) (see page 26)

5 Anti-cavitation valve, **separate order** (see page 26)

Associated electronics:
Digital closed loop controller assembly SYHNC100SEK (RE 30141) valve amplifier

Circuit A4VSO
A4VSOXXXDS1/XXW–XXX13T031Z



Technical data: axial piston unit A4VSO (valid for mineral oil)

Operating pressure (pressure range details to DIN 24312)

Pressure at port B

Nom. pressure p_N 1) 315 bar

Peak pressure p_{max} 400 bar

Absolute pressure at port S (suction opening)

$p_{abs\ min}$ 0.8 bar

A boost pump can be connected to port S.

Boost pressure range

Max. boost pressure $p_{E\ max}$ 30 bar

Recommended boost pressure p_E 16 bar

Boost pump inlet pressure

Suction pressure $p_{S\ abs\ min}$ (ν = 10 to 300 mm²/s) ≥ 0.7 bar

Control pressure range

Max. permissible control pressure [1] p_{max} = 315 bar

Min. recommended control pressure p_{min} = Operating pressure or 150 bar (see diagram)

Leakage oil pressure

Max. leakage oil pressure (housing pressure)

$p_{L\ abs\ max}$ 4 bar

Installation orientation

Optional. The pump housing must be filled on commissioning and remain full during operation.

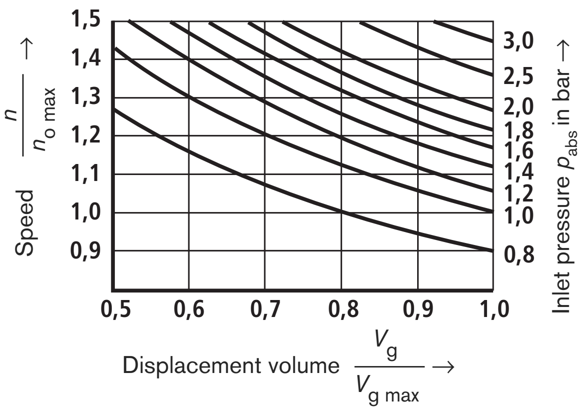
Note: The values in the table are guidance values and under certain operating conditions may have to be reduced.

[1] Determined from the permissible servo valve data and other system components

☞ **A4VSG applications after technical clarification.**

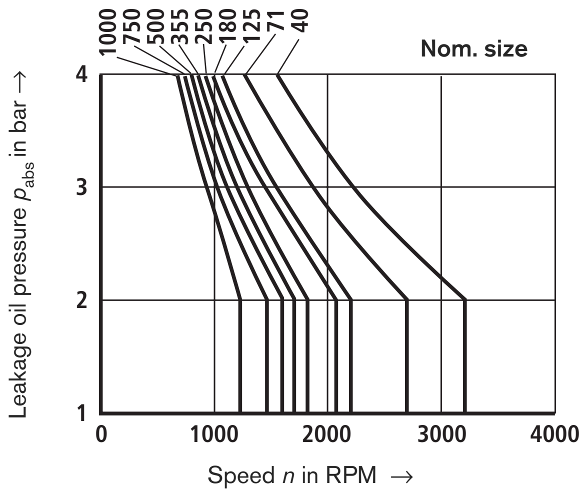
Determination of the inlet pressure p_{abs} at the suction port S with an increase of speed

Definition $n_{o\ max}$ see table on page 4.

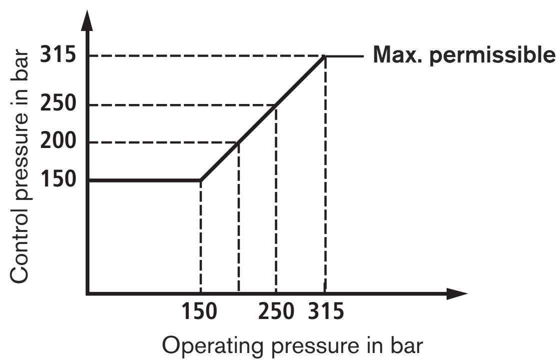


Leakage oil pressure

The permissible leakage oil pressure (housing pressure) is dependent on the speed.



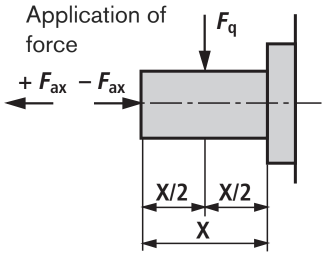
Recommended control pressure in relation to the operating pressure

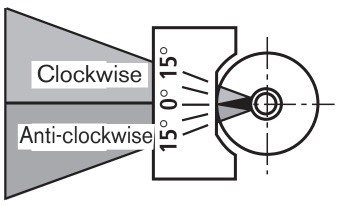


Technical data: secondary unit A4VSO

Value table (theoretical values, without taking η_{mh} and η_v into consideration; the values have been rounded)

Nom. size		NS	**40**	**71**	**125**	**180**	**250**	**355**	**500**	**750**	**1000**
Displacement volume	$V_{g\,max}$	cm^3	40	71	125	180	250	355	500	750	1000
Max. speed											
$V_g \leq 1.0\ V_{g\,max}$, $p_E \geq 15$ bar	n_{max}	RPM	3700	3200	2600	2400	2000	2000	1800	1600	1600
$V_g \leq 0.8\ V_{g\,max}$, $p_E \geq 15$ bar	n_{max}	RPM	4900	4100	3400	2900	2600	2200	2000	1800	1600
$V_g \leq 0.8\ V_{g\,max}$, $p_E \geq 1$ bar	$n_{o\,max\,zul}$	RPM	3200	2700	2200	2100	1800[1]	1700[1]	1600[1]	1450	1000
$V_g \leq 1.0\ V_{g\,max}$, $p_E \geq 1$ bar	$n_{o\,max}$	RPM	2600	2200	1800	1800	1500[1]	1500[1]	1320[1]	1200	1000
Torque at $V_{g\,max}$ and $\Delta p = 300$ bar	T	Nm	191	339	597	859	1194	1695	2387	3581	4775
Power at $V_{g\,max}$, n_{max} and $\Delta p = 300$ bar	P	kW	74	114	163	216	250	355	450	600	800
Adjustment volume (from 0 to $V_{g\,max}$)	$V_{S\,max}$	cm^3	5.9	10.5	26.0	26.0	50.9	50.9	63.8	105	129
Adjustment time (from 0 to $V_{g\,max}$)	t_S	s	0.030	0.040	0.050	0.050	0.060	0.060	0.080	0.090	0.1
Moment of inertia		kgm^2	0.0049	0.0121	0.0300	0.055	0.0959	0.19	0.3325	0.66	1.20
Minimum total moment of inertia required [2]		kgm^2	0.025	0.06	0.15	0.27	0.48	0.95	1.66	3.33	6
Approx. weight (with RVE and incremental encoder) A4VSO-DS1		kg	65	79	122	136	218	241	373	513	642
Perm. axial force at housing pressure p_{max} 1 bar abs.	$\pm F_{ax\,max}$	N	1000	1400	1900	2250	3000	3600	4000	5450	8000
Perm. axial force at housing pressure p_{max} 4 bar abs.	$+ F_{ax\,max}$	N	620	810	1050	1400	1850	2100	2500	3150	4700
	$- F_{ax\,max}$	N	1380	1950	2750	3050	4150	5050	5500	7800	11000
Perm. radial force	$F_{q\,max}$	N	1200	1700	2500	3100	4000	4400	5000	6000	10000





1) High speed version (15 % higher speed) available on request

2) A higher moment of inertia improves the control characteristics.

Flow direction

Swivel range [3]	Rotation direction [4] Clockwise	Anti-clock-wise	Pressure in	Operating mode
Clockwise	B ⇒ S	–	B	Motor
Clockwise		S ⇒ B	B	Pump
Anti-clock	–	B ⇒ S	B	Motor
Anti-clock	S ⇒ B	–	B	Pump

3) Compared to the swivel angle indicator

4) Viewed on the shaft

Technical parameters

Flow $q_V = \dfrac{V_g \cdot n \cdot \eta_v}{1000}$ in L/min

Drive torque $T = \dfrac{1,59 \cdot V_g \cdot \Delta p}{100 \cdot \eta_{mh}}$ in Nm

Drive power $P = \dfrac{2\pi \cdot T \cdot n}{60000} = \dfrac{T \cdot n}{9549} = \dfrac{q_V \cdot \Delta p}{600 \cdot \eta_t}$ in kW

V_g = Geometric displacement volume in cm^3 per revolution
Δp = Pressure differential in bar
n = Speed in RPM
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Ordering details

	A4VSO		/	W–			13			

Pressure fluid

Mineral oil = **No code**

Axial piston unit

Swashplate design, variable = **A4VSO**

p_N = 315 bar, p_{max} = 400 bar

Nominal size

≙ displacement $V_{g\,max}$ (cm³)

40	71	125	180	250	355	500	750	1000

Control and adjustment device

Speed control, secondary controlled, with built-on servo valve = **DS1**

Speed control, secondary controlled, without servo valve = **DS1E**

Series

NS 40, 71 = **1X**

NS 125 to 1000 = **3X**

Direction of rotation

Bi-directional = **W**

Seals

NBR (nitril rubber to ISO 1629) with an FKM shaft seal ring = **P**

FKM (fluor rubber to ISO 1629) = **V**

Shaft end

Cylinderical with keyway DIN 6886 = **P**

Spined shaft DIN 5480 = **Z**

Mounting flange	40	71	125	180	250	355	500	750	1000	
ISO 4-hole	●	●	●	●	●	●	–	–	–	= **B**
ISO 8-hole	–	–	–	–	–	–	●	●	●	= **H**

Actuator connections

Pressure port	B	SAE at side, 90° offset	
Suction port	S	Metric fixing screws	= **13**

Through drive			40	71	125	180	250	355	500	750	1000	
Without auxiliary pump, without through pump			●	●	●	●	●	●	●	●	●	= **N00**
With through drive to accept an axial piston pump												
Flange	Spigot/shaft	To mount an										
ISO 125, 4-hole	Splined shaft 32x2x14x9g	A4VSO40	●	●	●	●	●	●	●	●	●	= **K31**
ISO 140, 4-hole	Splined shaft 40x2x18x9g	A4VSO71	–	●	●	●	●	●	●	●	●	= **K33**
ISO 160, 4-hole	Splined shaft 50x2x24x9g	A4VSO125	–	–	●	●	●	●	●	●	●	= **K34**
ISO 160, 4-hole	Splined shaft 50x2x24x9g	A4VSO180	–	–	–	●	●	●	●	●	●	= **K34**
ISO 224, 4-hole	Splined shaft 60x2x28x9g	A4VSO250	–	–	–	–	●	●	●	●	●	= **K35**
ISO 224, 4-hole	Splined shaft 70x3x22x9g	A4VSO355	–	–	–	–	–	●	●	●	●	= **K77**
ISO 315, 8-hole	Splined shaft 80x2x38x9g	A4VSO500	–	–	–	–	–	–	●	●	●	= **K43**
ISO 400, 8-hole	Splined shaft 90x3x28x9g	A4VSO750	–	–	–	–	–	–	–	●	–	= **K76**
ISO 250, 8-hole	Splined shaft 90x3x28x9g	A4VSO1000	–	–	–	–	–	–	–	–	●	= **K88**
With built-on incremental encoder 1000 Imp/Rev.			●	●	●	●	●	●	●	●	●	= **T03**
With built-on incremental encoder 2500 Imp/Rev.			●	●	●	●	●	●	●	●	●	= **T04**
Optional incremental encoder, through drive fitted with cover			●	●	●	●	●	●	●	●	●	= **T10**
Special tacho mount			●	●	●	●	●	●	●	●	●	= **T99**
Euro flange, through drive closed			●	●	●	●	●	●	●	●	●	= **T00**

Valves

Without valve block = **0**

Built-on electrically operated check valve (isolating valve) = **1**

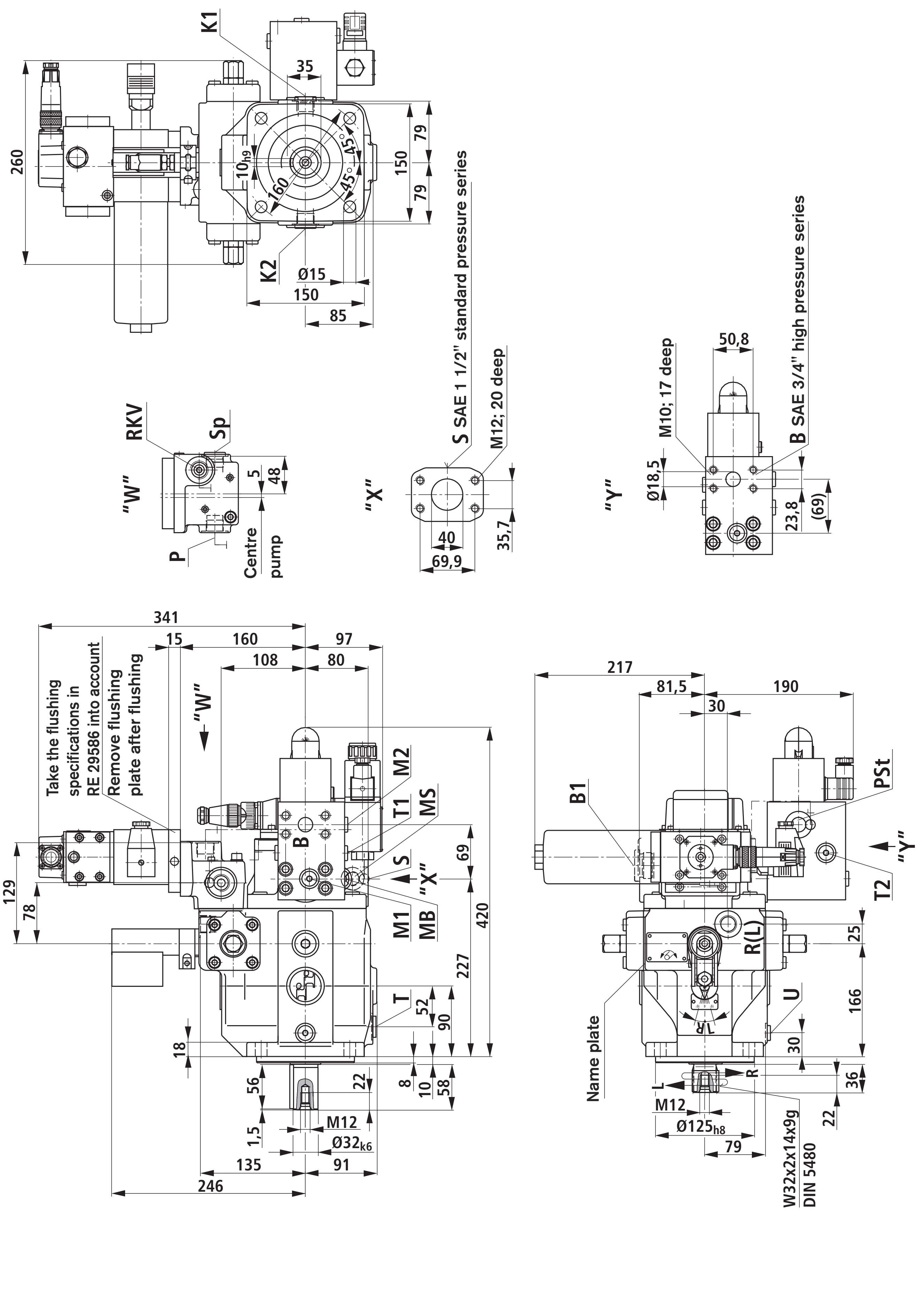
Filtration

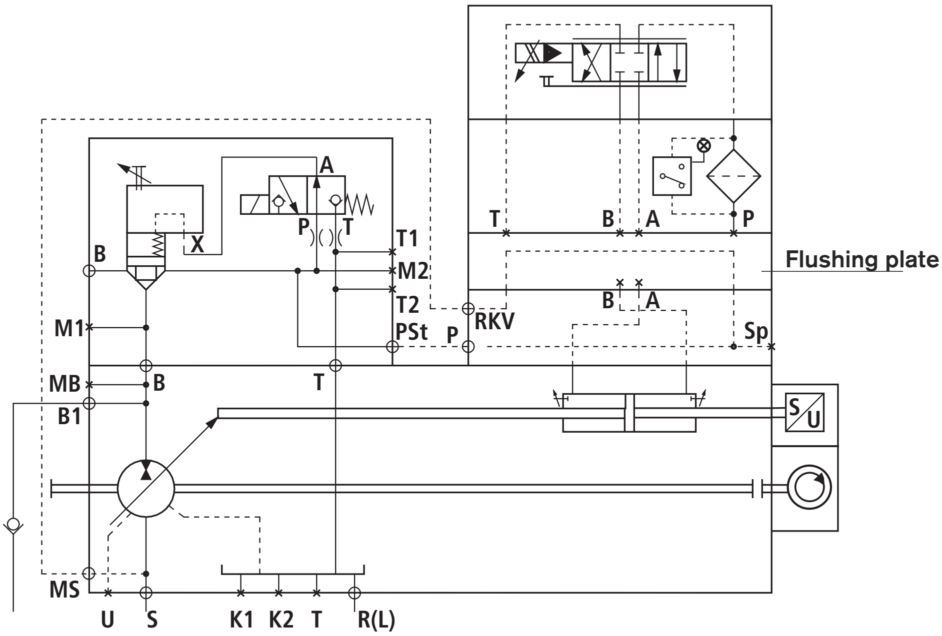
Without filter = **N**

With built-on sandwich plate filter = **Z**

● = Available; – = Not available; A4VSG available on request

Unit dimensions / circuit: A4VSO40DS1/1XW–..B13T031Z (in mm)

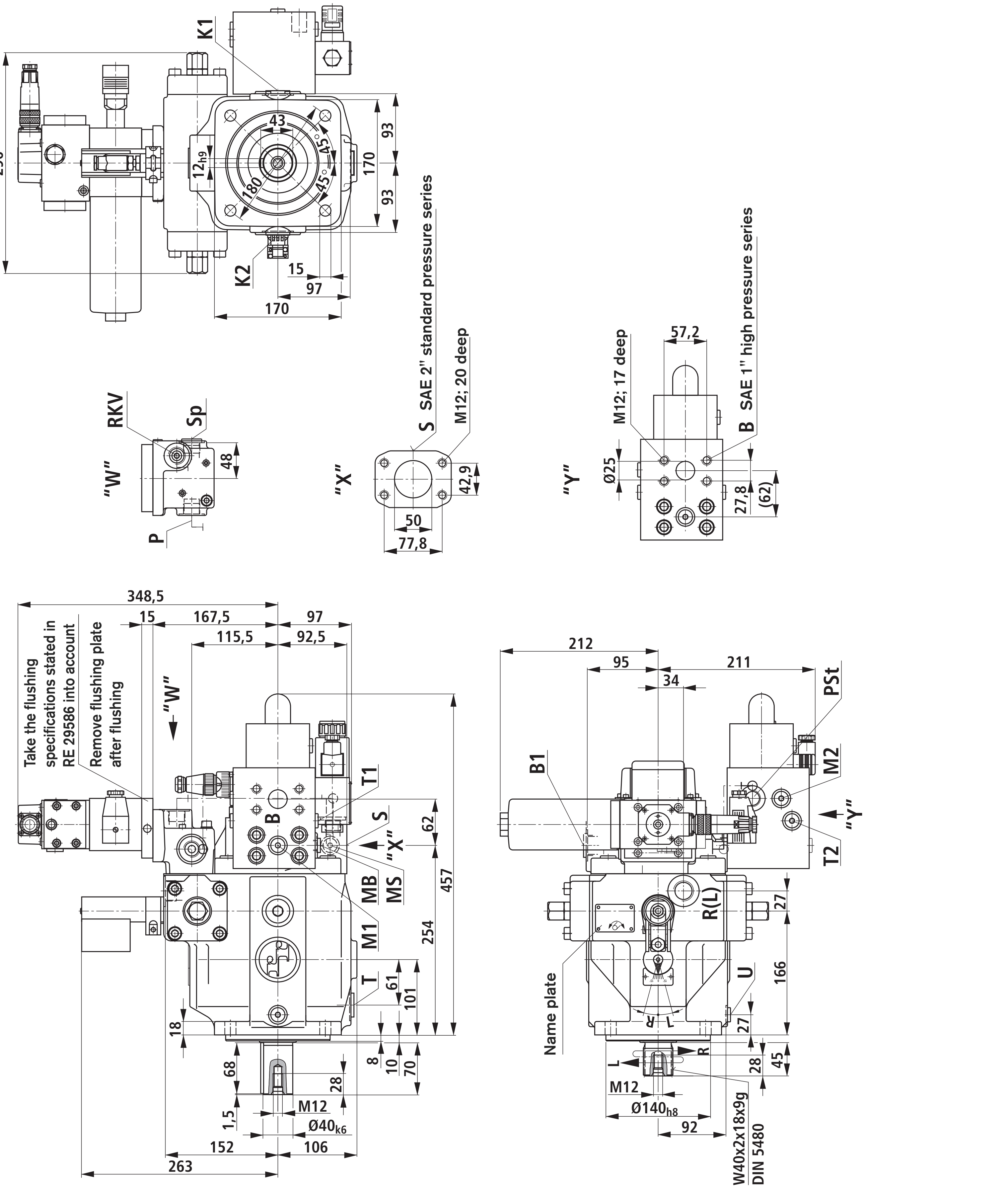


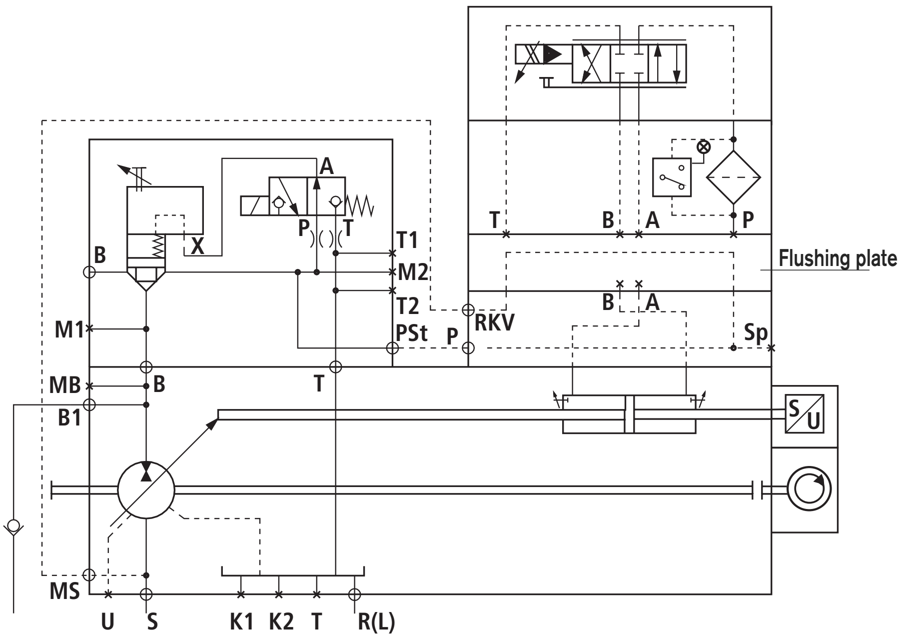


Connectionn identification:

B	= Pressure port	SAE 3/4"
B1	= Auxiliary port	M22x1,5
S	= Suction port	SAE 1 1/2"
K1, K2	= Flushing port	M22x1,5
MB	= Operating pressure test point	M14x1,5
M1, M2	= Operating pressure test point	G 1/4
Sp	= External control pressure connection	M22x1,5
R(L)	= Return	M22x1,5
T	= Oil drain	M22x1,5
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M14x1,5
RKV	= Control oil return (piped)	M22x1,5
MS	= Control oil return (piped)	M18x1,5
P	= Control pressure connection (piped)	M22x1,5
PSt	= Control pressure connection (piped)	G 1/2

Unit dimensions / circuit: A4VSO71DS1/1XW–..B13T031Z (in mm)

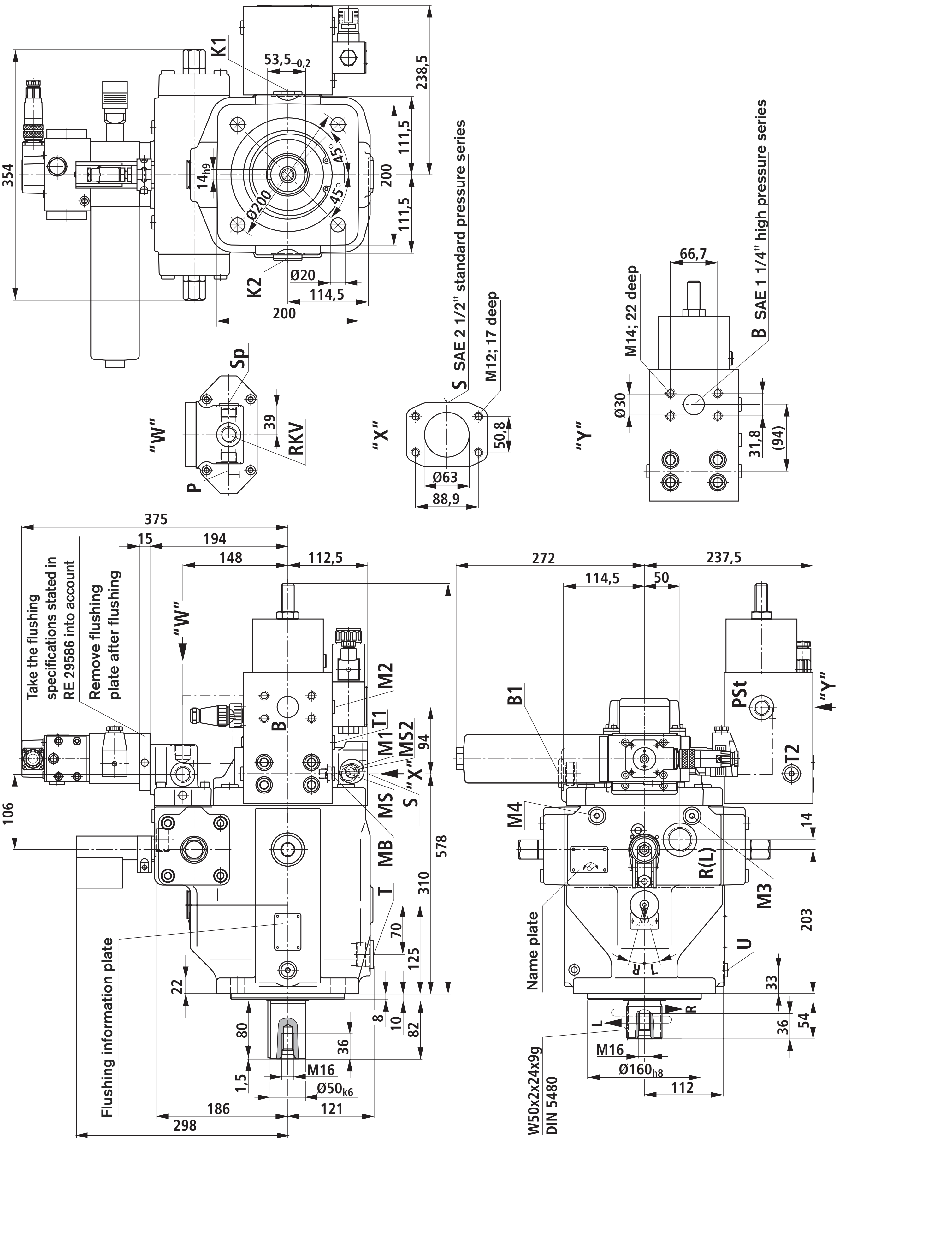


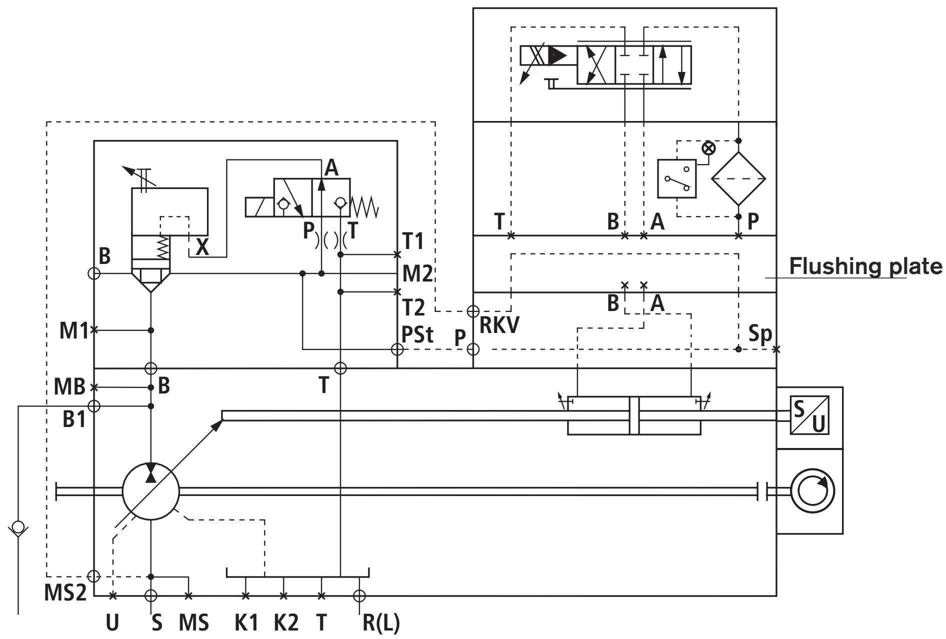


Connection identification:

B	= Pressure port	SAE 1"
B1	= Auxiliary port	M27x2
S	= Suction port	SAE 2"
K1, K2	= Flushing port	M27x2
MB	= Operating pressure test point	M14x1,5
M1, M2	= Operating pressure test point	G 1/4
Sp	= External control pressure connection	M22x1.5
R(L)	= Return	M27x2
T	= Oil drain	M27x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M14x1.5
RKV	= Control oil return (piped)	M22x1.5
MS	= Control oil return (piped)	M18x1.5
P	= Control pressure connection (piped)	M22x1.5
PSt	= Control pressure connection (piped)	G 1/2

Unit dimensions / circuit: A4VSO125DS1/3XW–..B13T031Z (in mm)

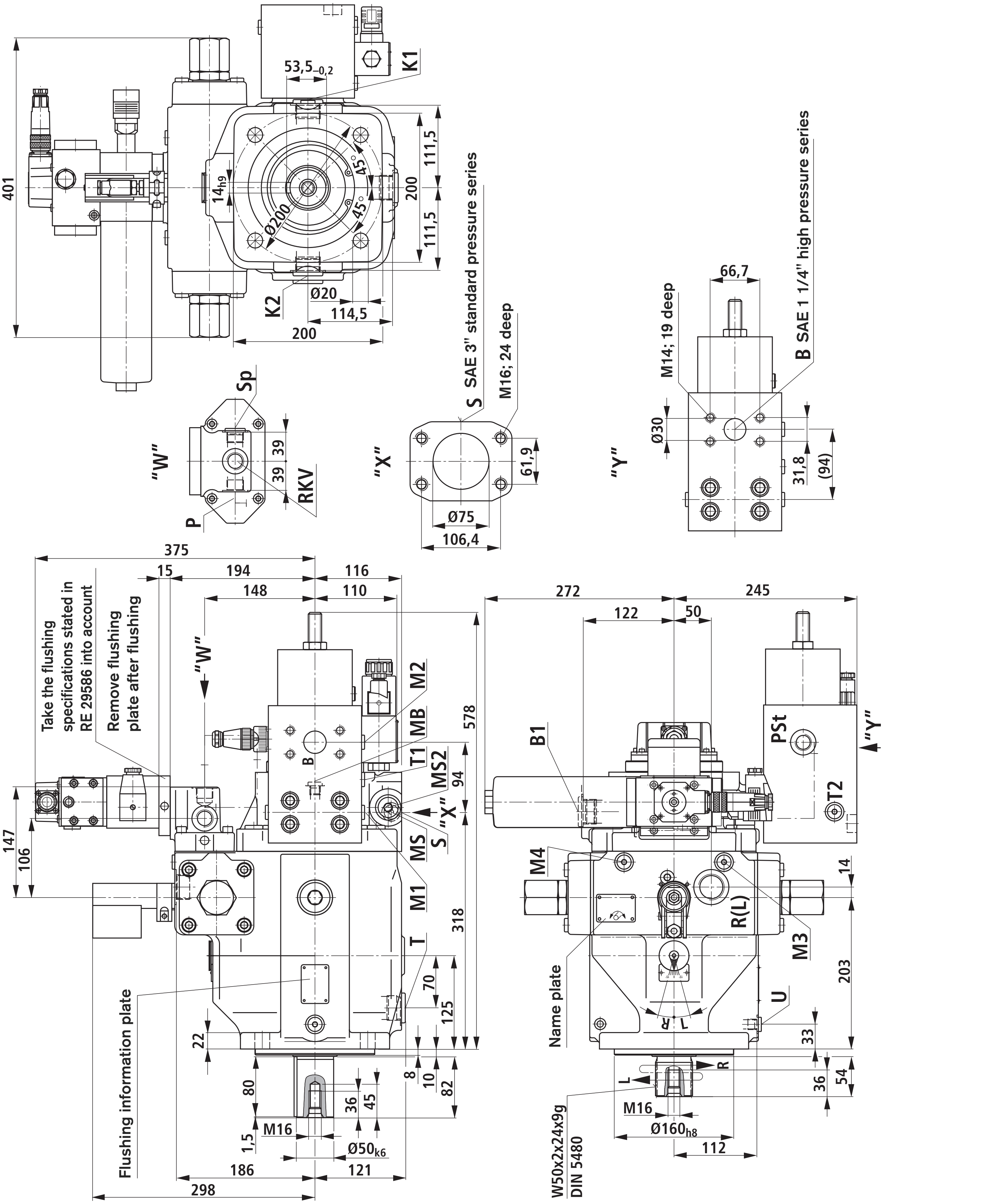


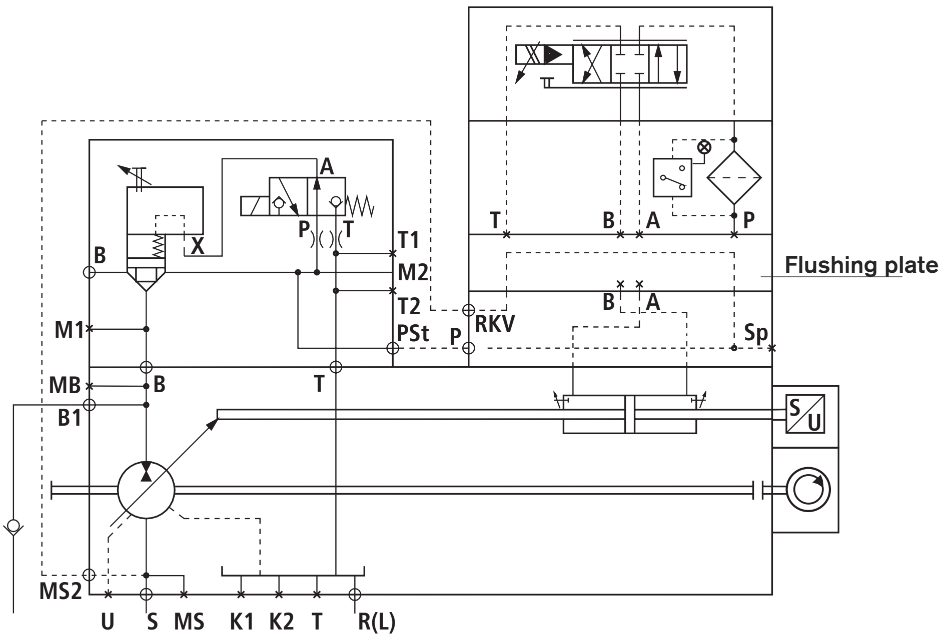


Connection identification:

B	= Pressure port	SAE 1 1/4"
B1	= Auxiliary port	M33x2
S	= Suction port	SAE 2 1/2"
K1, K2	= Flushing port	M33x2
MB	= Operating pressure test point	M14x1.5
MS	= Suction pressure test point	M14x1.5
M1, M2	= Operating pressure test point	G 1/4
M3, M4	= Control pressure test point	M14x1.5
Sp	= External control pressure connection	M22x1.5
R(L)	= Oil filing and air bleeding	M33x2
T	= Oil drain	M33x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M14x1.5
RKV	= Control oil return (piped)	M22x1.5
MS2	= Control oil return (piped)	G 1/2
P	= Control pressure connection (piped)	M22x1.5
PSt	= Control pressure connection (piped)	G 1/2

Unit dimensions / circuit: A4VSO180DS1/3XW–..B13T031Z (in mm)

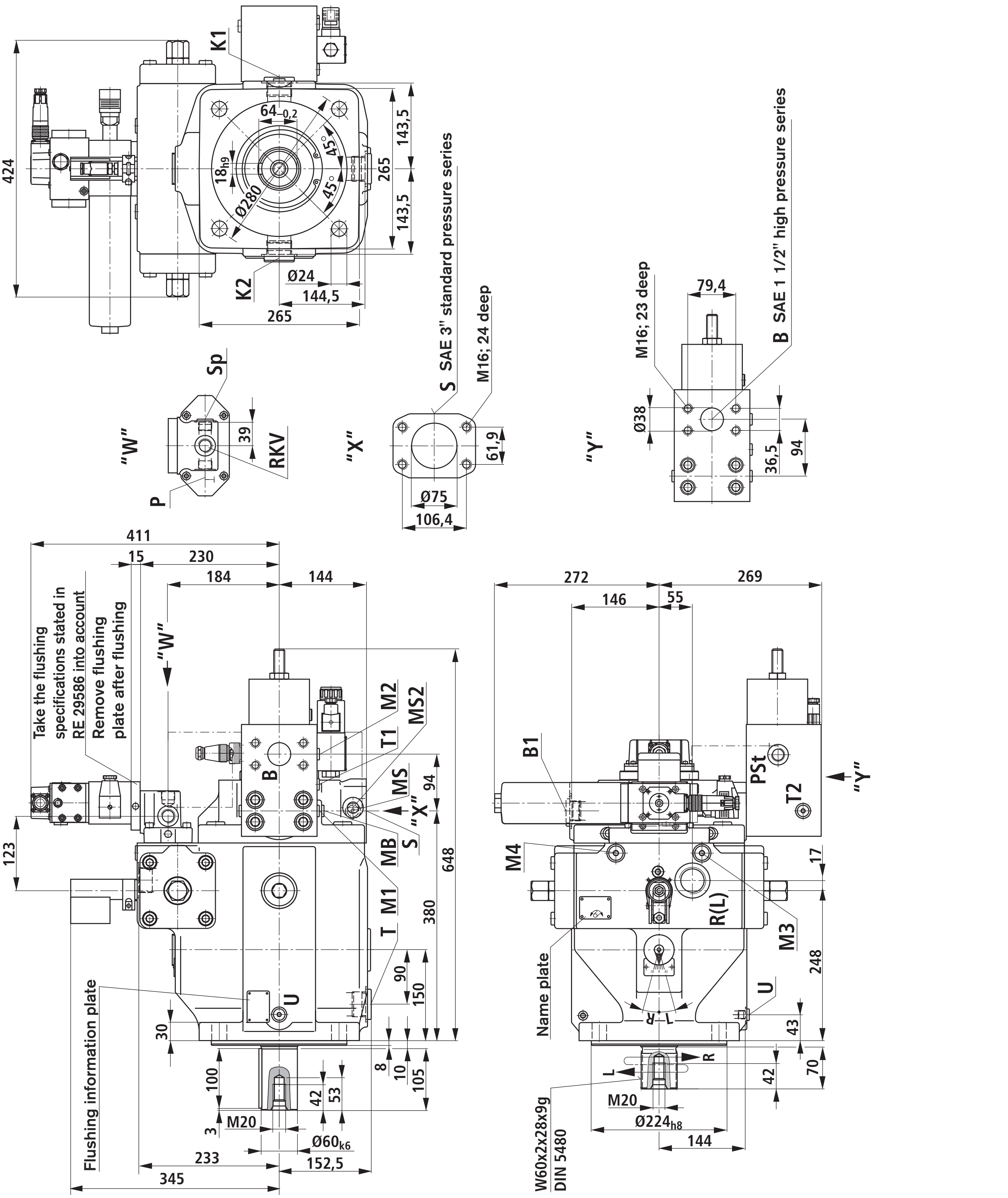


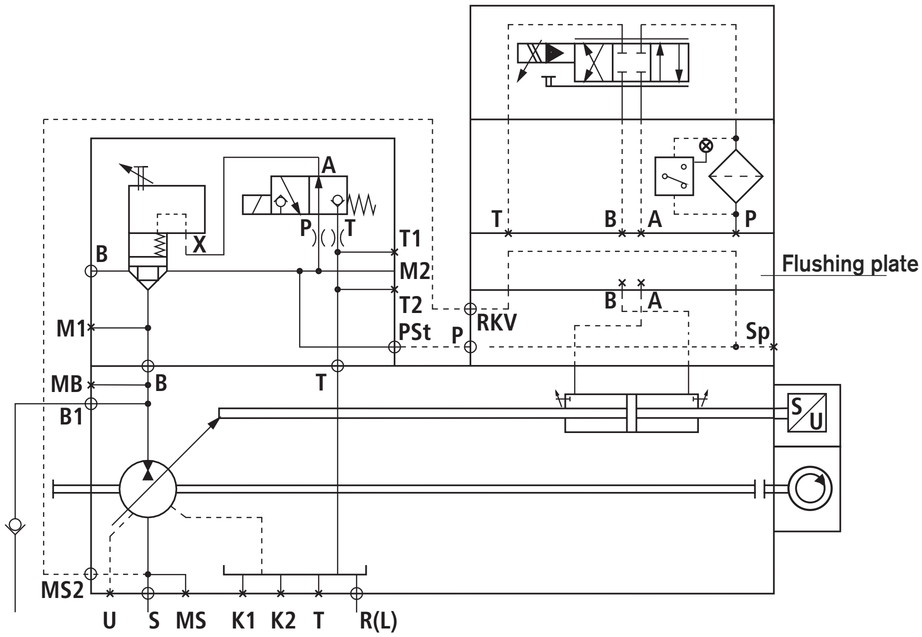


Connection identification:

B	= Pressure port	SAE 1 1/4"
B1	= Auxiliary port	M33x2
S	= Suction port	SAE 3"
K1, K2	= Flushing port	M33x2
MB	= Operating pressure test point	M14x1.5
MS	= Suction pressure test point	M14x1,5
M1, M2	= Operating pressure test point	G 1/4
M3, M4	= Control pressure test point	M14x1.5
Sp	= External control pressure connection	M22x1.5
R(L)	= Oil filling and air bleeding	M33x2
T	= Oil drain	M33x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M14x1.5
RKV	= Control oil return (piped)	M22x1.5
MS2	= Control oil return (piped)	G 1/2
P	= Control pressure connection (piped)	M22x1.5
PSt	= Control pressure connection (piped)	G 1/2

Unit dimensions / circuit: A4VSO250DS1/3XW–..B13T031Z (in mm)

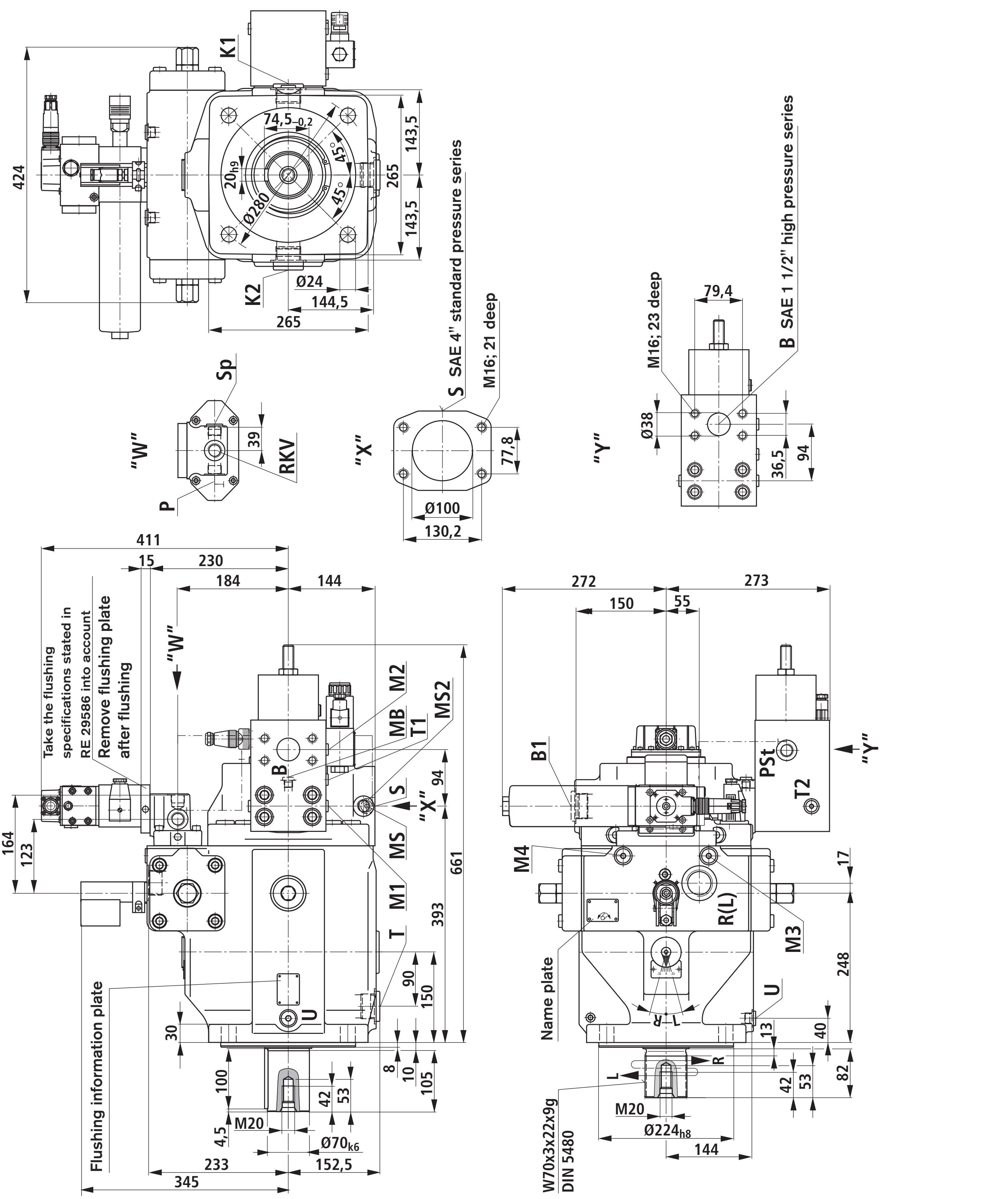


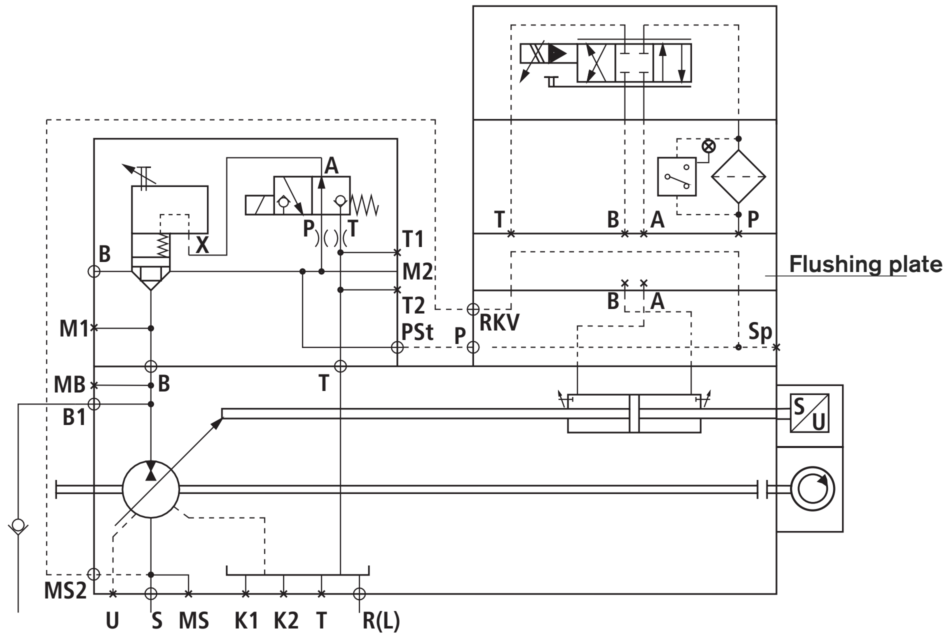


Connection identification:

B	= Pressure port	SAE 1 1/2"
B1	= Auxiliary port	M42x2
S	= Suction port	SAE 3"
K1, K2	= Flushing port	M42x2
MB	= Operating pressure test point	M14x1.5
MS	= Suction pressure test point	M14x1.5
M1, M2	= Operating pressure test point	G 1/4
M3, M4	= Control pressure test point	M18x1.5
Sp	= External control pressure connection	M22x1.5
R(L)	= Oil filling and air bleeding	M42x2
T	= Oil drain	M42x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M14x1,5
RKV	= Control oil return (piped)	M22x1,5
MS2	= Control oil return (piped)	G 1/2
P	= Control pressue connection (piped)	M22x1,5
PSt	= Control pressue connection (piped)	G 1/2

Unit dimensions / circuit: A4VSO355DS1/3XW–..B13T031Z (in mm)

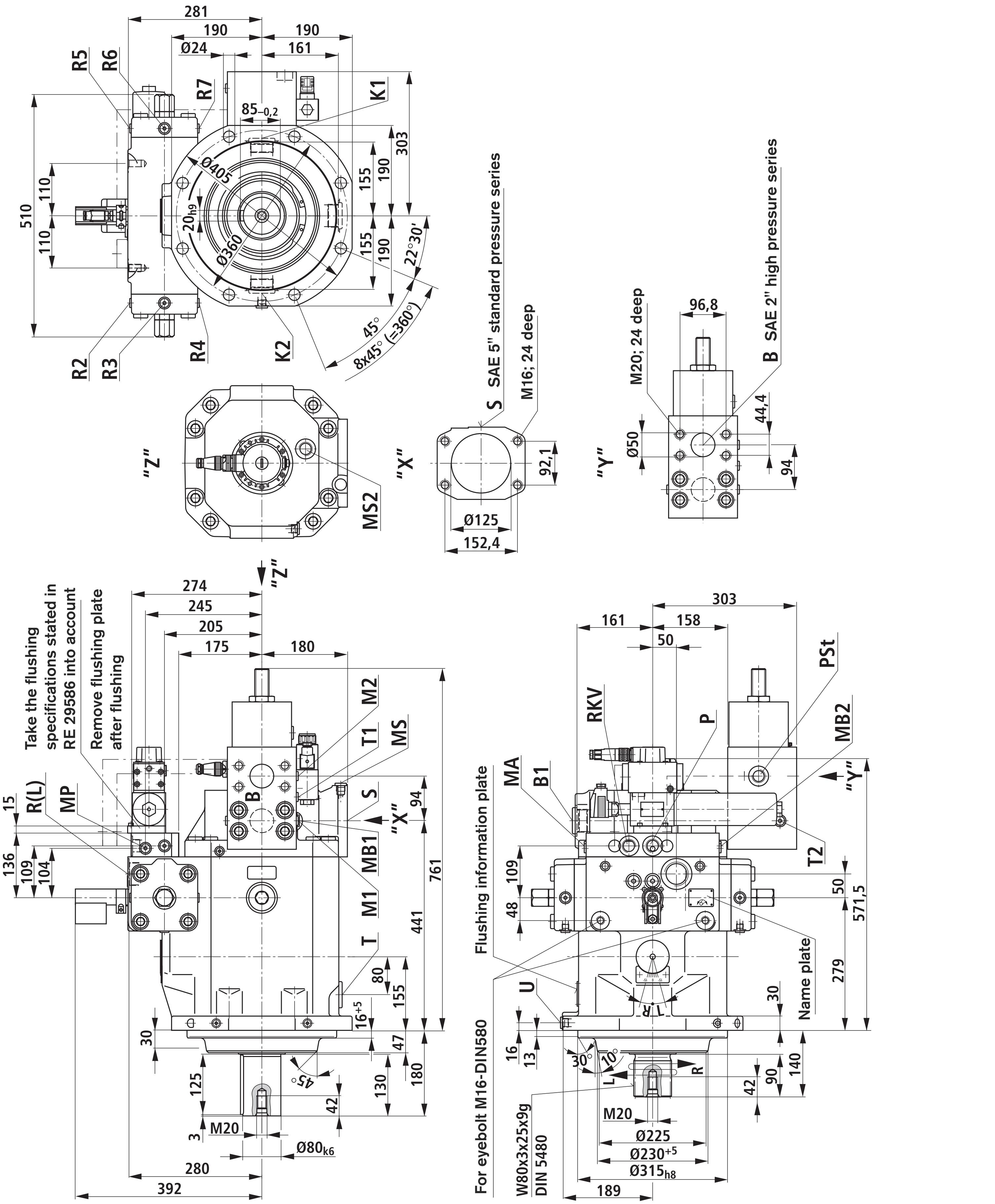


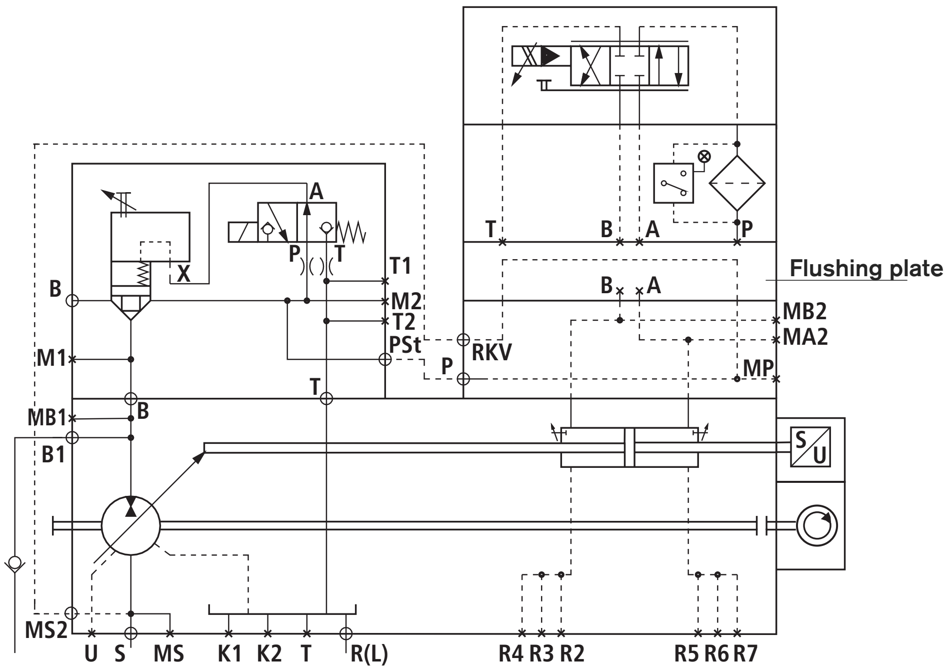


Connection identification:

B	= Pressure port	SAE 1 1/2"
B1	= Auxiliary port	M42x2
S	= Suction port	SAE 4"
K1, K2	= Flushing port	M42x2
MB	= Operating pressure test point	M14x1.5
MS	= Suction pressure test point	M14x1.5
M1, M2	= Operating pressure test point	G 1/4
M3, M4	= Control pressure test point	M18x1.5
Sp	= External control pressure connection	M22x1.5
R(L)	= Oil filling and air bleeding	M42x2
T	= Oil drain	M42x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M18x1.5
RKV	= Control oil return (piped)	M22x1.5
MS2	= Control oil return (piped)	G 1/2
P	= Control pressure connection (piped)	M22x1,5
PSt	= Control pressure connection (piped)	G 1/2

Unit dimensions / circuit: A4VSO500DS1/3XW–..H13T031Z (in mm)

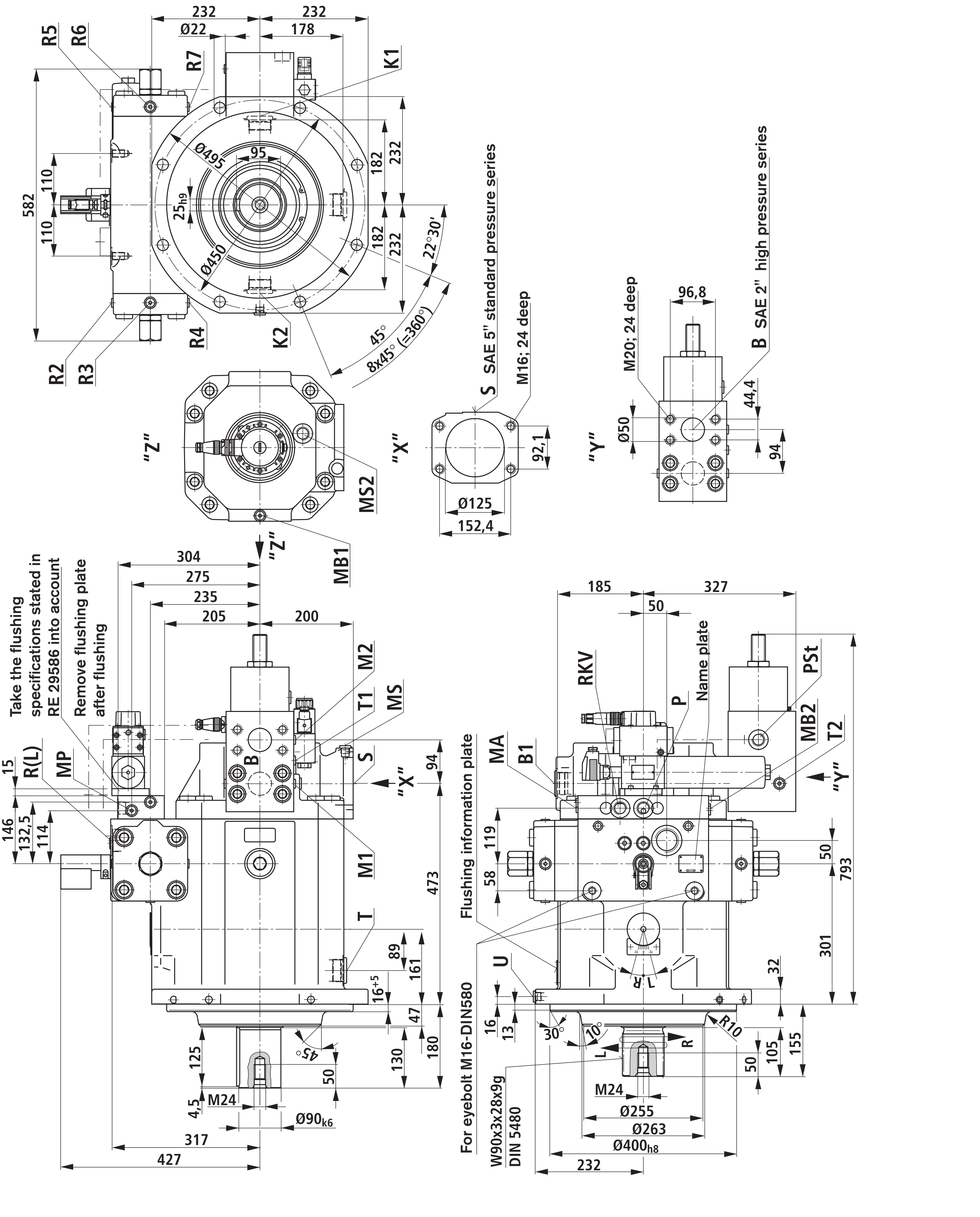


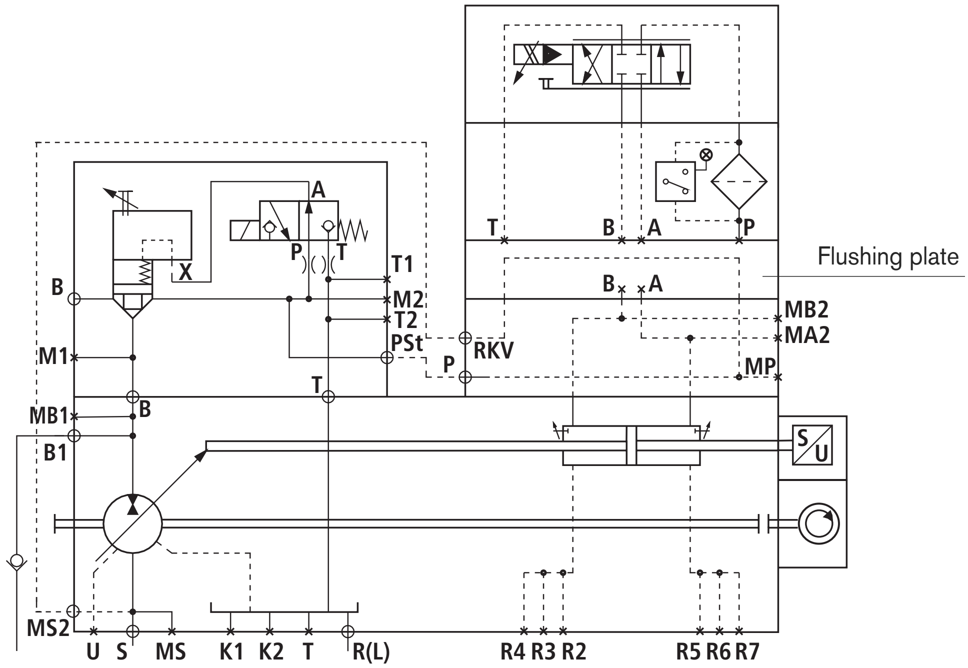


Connection identification:

B	= Pressure port	SAE 2"
B1	= Auxiliary port	M48x2
S	= Suction port	SAE 5"
K1, K2	= Flushing port	M48x2
MB1	= Operating pressure test point	M18x1.5
MA, MB2	= Control pressure test point	M14x1.5
MS	= Suction pressure test point	M18x1.5
M1, M2	= Operating pressure test point	G 1/4
MP	= External control pressure connection	M14x1.5
R(L)	= Oil filling and air bleeding	M48x2
R2-R7	= Adjustment air bleeding	M4x1.5
T	= Oil drain	M48x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M18x1.5
RKV	= Control oil return (piped)	M27x2
MS2	= Control oil return (piped)	M27x2
P	= Control pressure connection (piped)	M27x2
PSt	= Control pressure connection (piped)	G 3/4

Unit dimensions / circuit: A4VSO750DS1/3XW–..H13T031Z (in mm)

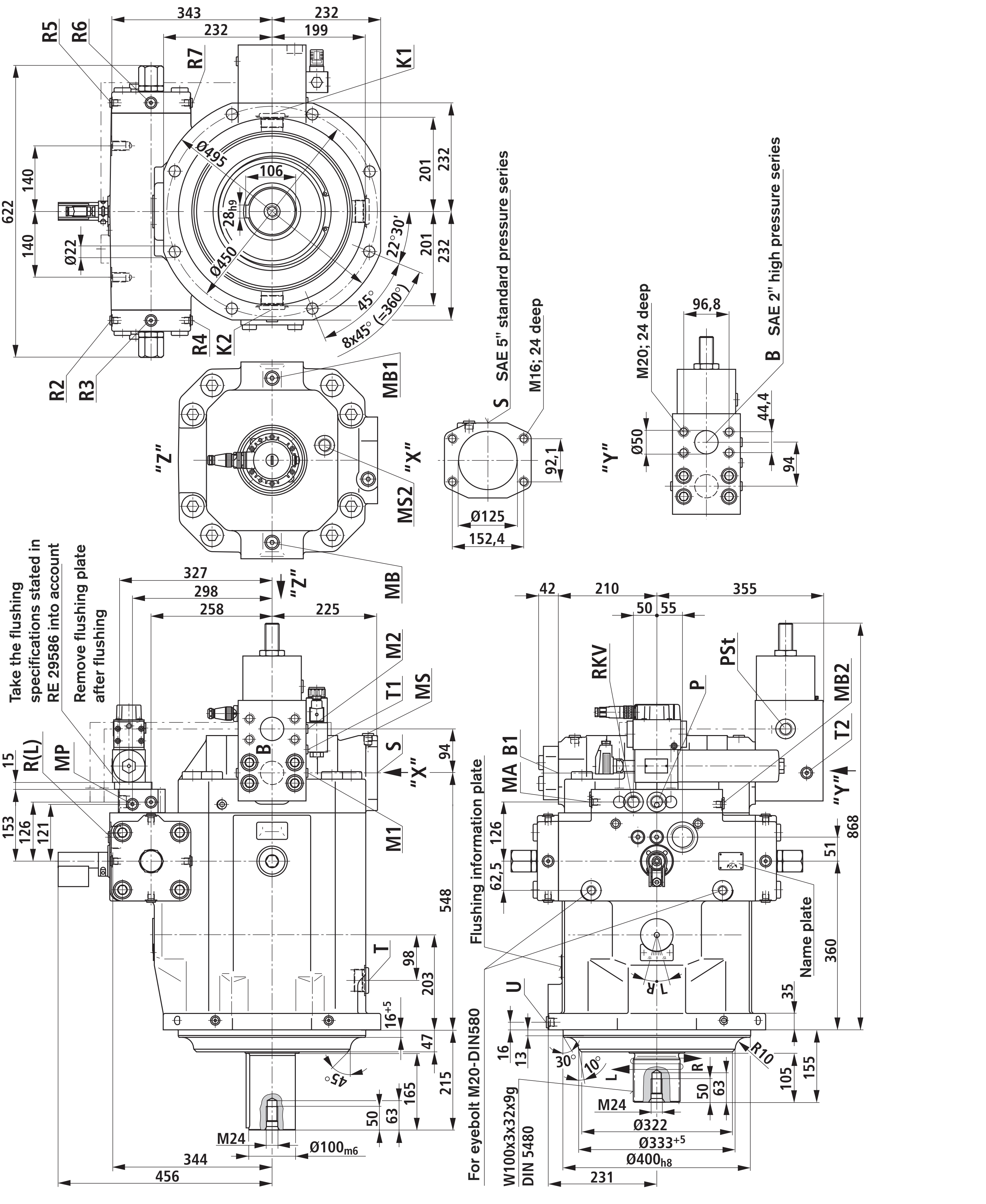


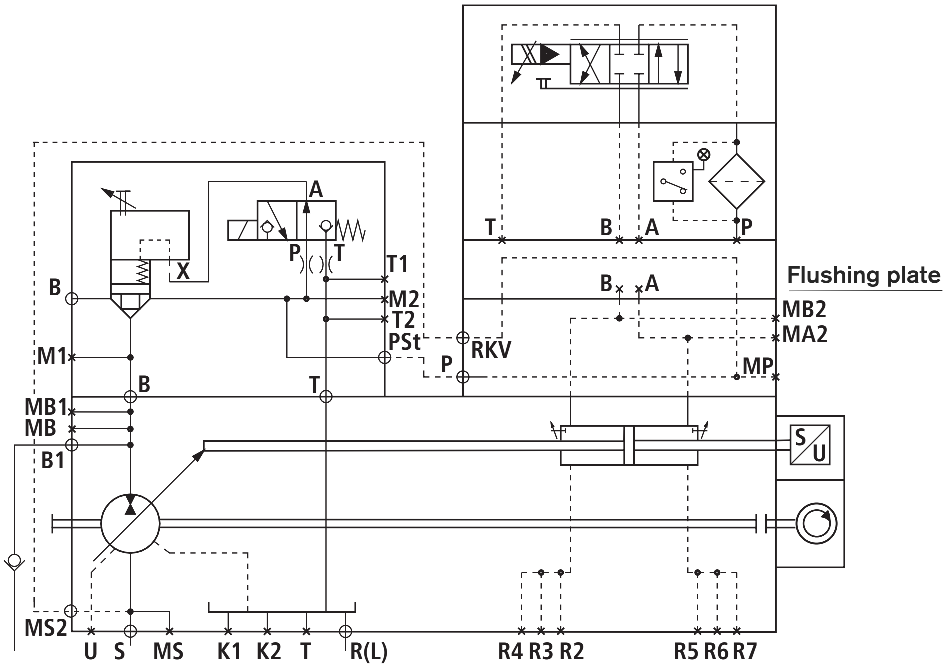


Connection identification:

B	= Pressure port	SAE 2"
B1	= Auxiliary port	M48x2
S	= Suction port	SAE 5"
K1, K2	= Flushing port	M48x2
MB1	= Operating pressure test point	M18x1,5
MA, MB2	= Control pressure test point	M14x1,5
MS	= Suction pressure test point	M18x1,5
M1, M2	= Operating pressure test point	G 1/4
MP	= External control pressure connection	M14x1.5
R(L)	= Oil filling and air bleeding	M48x2
R2-R7	= Adjustment air bleeding	M4x1.5
T	= Oil drain	M48x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M18x1.5
RKV	= Control oil return (piped)	M27x2
MS2	= Control oil return (piped)	M27x2
P	= Control pressure connection (piped)	M27x2
PSt	= Control pressure connection (piped)	G 3/4

Unit dimensions / circuit: A4VSO1000DS1/3XW–..H13T031Z (in mm)





Connection identification:

B	= Pressure port	SAE 2"
B1	= Auxiliary port	M48x2
S	= Suction port	SAE 5"
K1, K2	= Flushing port	M48x2
MB, MB1	= Operating pressure test point	M18x1.5
MA, MB2	= Control pressure test point	M14x1.5
MS	= Suction pressure test point	M18x1.5
M1, M2	= Operating pressure test point	G 1/4
MP	= External control pressure connection	M14x1.5
R(L)	= Oil filling and air bleeding	M48x2
R2-R7	= Adjustment air bleeding	M4x1.5
T	= Oil drain	M48x2
T1, T2	= Leakage oil/bleeding	G 1/4
U	= Flushing connection (bearing flushing)	M18x1.5
RKV	= Control oil return (piped)	M27x2
MS2	= Control oil return (piped)	M27x2
P	= Control pressure connection (piped)	M27x2
PSt	= Control pressure connection (piped)	G 3/4

Closed loop speed control DS1

With closed loop speed control the swivel angle and thereby the stroke volume is controlled via the DS1 controller of the hydraulic unit. At a quasi-constant pressure the stroke volume is continuously adjusted to achieve the required torque to maintain the designated speed.

In a quasi-constant pressure system the torque is proportional to the swivel angle or the displacement of the axial piston unit. The swivel angle of the unit is sensed by an inductive position transducer and the actual speed value by means of an incremental rotary encoder.

Included within the scope of supply are the servo valve and the flushing plate. The guidelines stated within RE 07700 and RE 29583 are to be taken into account during commissioning. For less demanding applications, with regard to the dynamics, the drive system can be fitted with a proportional valve in place of the servo valve.

Not included within the scope of supply is the SYHNC100-SEK, to RE 30141, digital control assembly. The system is electronically monitored.

The electrically operated check valve (isolating valve), which is built onto the high pressure connection, is switched into the closed position in case of emergency. The energy supply to the secondary unit is thereby interrupted; braking in the generator mode with energy recovery to the hydraulic supply is possible.

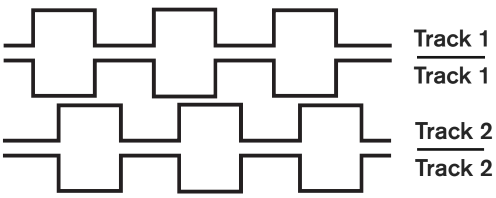
In order to prevent cavitation due to the unit running on or slowing down due to an emergency off signal anti-cavitation valves are to be provided. These must be separately ordered and mounted in the port B1 pipe work. These check valves are without a spring and have therefore to be mounted vertically.

Technical data: Incremental encoder GEL 293 (item 3); ordering details T03 or T04

Resolution:	– Ordering detail T03		1000 increments/revolution
	– Ordering detail T04		2500 increments/revolution
Protection			IP 65
Power comsumption: $R_L = \infty$; $U_B = 5$ V		W	≤ 1.0
Operating temperature range to DIN 32 876		°C	– 20 up to + 80

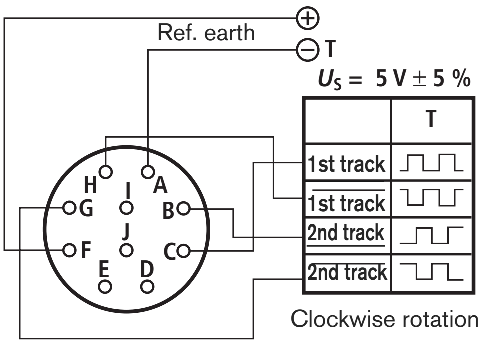
Signal pattern T

Feed voltage $U_S = 5$ V ± 5%; signal voltage $U_{Si} = 5$ V



Signal diagram, clockwise rotation viewed on the shaft!

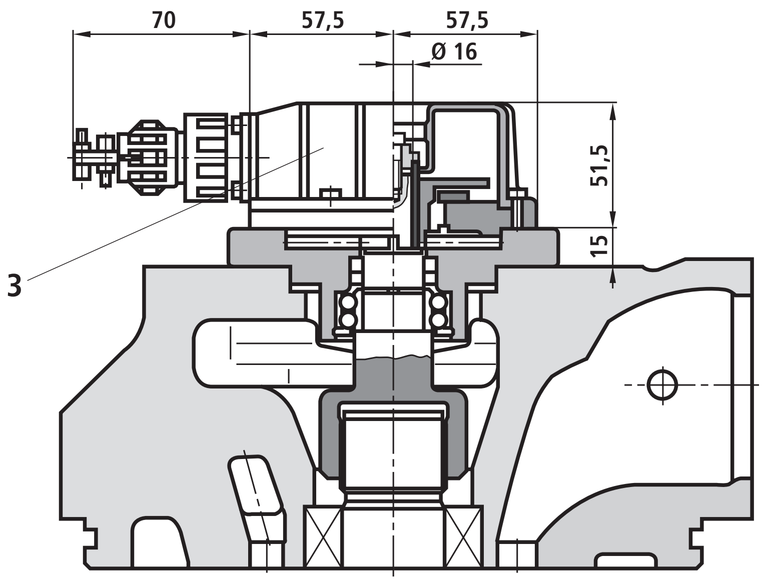
Plug allocation (10-pin plug)



The incremental encoder is independent of the build size.

Maximum cable lengths
between encoder and interface electronics.
Earth cable shield connected on one side to the receiver. The given data are guidance values and refer to the cable type LiYCY 6 (10) x 0.25 mm².

$U_S = 5$ V (T)							
f	kHz	5	10	20	50	100	200
L_{max} ($I_a \leq 100$ mA)	m	> 200	> 200	> 200	> 200	145	72



The use of the speed sensing systems is possible, in this case please consult ourselves.

Technical data: swivel angle transducer IW9-03-DT (item 1.3)

Technical data – swivel angle transducer

Measuring system				Differential throttle
Control stroke				± 4 mm
Linearity tolerance			%	≤ 1.5
Frequency carrier		*f*	kHz	5
Coil resistance	– Between ports 1 and 2		Ω	32
(at 20 °C)	– Between port 2 and ⏚		Ω	46
	– Between port 1 and ⏚		Ω	32
Electrical connection				Plug connections to DIN 43 650 - BFZ-Pg9
Plug connection protection to DIN 40 050				IP 65

Technical data: electrically operated check valve (isolating valve RVE A4VS, item 4); ordering detail 1

Electrical data (also see directional poppet valve M–3SED6, RE 22049)

DC voltage	V	24
Power consumption	W	30
Duty		Continuous
Protection to DIN 40 050		IP 65

Hydraulic data (see cartridge valve type LC.., RE 21010)

Nom. size	Logic element	Built into housing	Max. flow q_{Vmax} in L/min at a pressure drop of 5 bar
40	LC16B40D-7X/	AGEV4-05701-AB/46	200
71	LC25B40D-7X/	AGEV4-05702-AB/46	400
125	LC32B40D-7X/	AGEV4-05703-AB/46	700
180	LC32B40D-7X/	AGEV4-05703-AB/46	700
250	LC32B40D-7X/	AGEV4-05704-AB/46	700
355	LC32B40D-7X/	AGEV4-05704-AB/46	700
500	LC40B40D-7X/	AGEV4-05705-AB/46	1200
750	LC40B40D-7X/	AGEV4-05705-AB/46	1200
1000	LC40B40D-7X/	AGEV4-05705-AB/46	1200

Technical data: Anti-cavitation valve (item 5), separate order

Anti-cavitation valve (RE 20375)

Nom. size	Without boost	With boost
40	S10A0.0	S10A1.0
71	S15A0.0	S15A1.0
125	S20A0.0	S20A1.0
180	S20A0.0	S20A1.0
250	S25A0.0	S25A1.0
355	S25A0.0	S25A1.0
500	S30A0.0	S30A1.0
750	S30A0.0	S30A1.0
1000	S30A0.0	S30A1.0

Note: These anti-cavitation valves are piped to port B1.

Technical data: digital HNC100-SEK control system, separate order

The digital HNC100-SEK control system is suitable for the closed loop control of speed and torque as well as the open loop torque control of secondary controlled axial piston units type A4VS..DS1(E). The HNC100-SEK is designed for the sensing and evaluation of the swivel angle position of individual or tandem units as well as the speed sensing of incremental encoders.
The software contains closed, open loop and monitoring functions specifically laid out for secondary controls.

The following selections available as standard software:

- Version A037: closed loop speed control
  Power limitation, PID speed controller with speed dependent parameter switching, secondary PD swivel angle controller, power limitation with variable limiting value set points.
- Version A038: Master/Slave closed loop speed control
  For use when two or more secondary units are rigidly mechanically connected. Swivel angle master/slave command value set points, with adjustable torque distribution. Speed limitation of the slave drive within an adjustable tolerance band for protection if the mechanical connection fails in addition to all of the other functions of the A037 version.
- Version A039: open loop torque control.
  Converting the torque command value into a swivel angle command value taking into account the pressure and adjustable friction characteristic curves. Speed limitation via adjustable maximum values. Calculating the actual torque value as well as all of the functions of the A038 version.
- Version A040: closed loop torque control.
  PI torque controller, speed limitation via adjustable maximum values as well as all of the functions of the A039 version.

Features

- Highly dynamic rotary drive
- Compact unit for panel mounting or optionally available as a 19“ rack plug-in unit
- Parameterisation and process visualisation via a commercially available PC
- Evaluation and the monitoring of two inductive swivel angle transducers
- 4 analogue differential amplifier inputs
- 4 Impedance converter inputs
- 24 digital inputs
- 24 digital outputs
- Profibus DP and CAN-BUS, Interbus S on request
- Monitoring functions with the output of fault codes for external diagnostics
- Conformity with the relevant EC regulations, CE sign

Monitoring functions

- Minimum swivel angle value
- Minimum speed value
- Swivel angle differential
- Torque differential
- Speed differential
- Overspeed
- Maximum acceleration
- Incremental encoder cable break
- Inductive position transducer cable break

Ordering details: HNC100-SEK digital control unit

SYHNC100 – SEK – 2X / – 24 – – – E24 – *

Digital NC control HNC100

Version for secondary control **= SEK**

Series 20 to 29 **= 2X**
(20 to 29: unchanged technical data and connection allocation)

Installation type:
Housing for panel mounting **= W**
Housing for rack mounting **= M**

24 digital inputs/outputs **= 24**

Without bus connection **= 0**
Profibus DP **= P**
CAN-BUS **= C**
INTERBUS-S on request!

Further details in clear text

Standard software version:
A037 = Closed loop RPM control
A038 = Closed loop master/slave RPM control
A039 = Open loop torque control
A040 = Closed loop torque control

E24 = Hydrostatic drives

Evaluation electronics for the inductive position transducer:
0 = Without evaluation electronics
C = Evaluation electronics for position transducer type IW9, stroke 9 mm **(standard)**
On request:
Evaluation electronics for the position transducer DPH…

Ordering details for accessories:

KABELSATZ VT 15300 – 1X / 03,0 / *

Connection cable for connecting a PC to the digital NC control HNC100-SEK

Series 10 to 19 **= 1X**
(10 to 19: unchanged technical data and connection allocation)

03,0 = Cable length in m

Further details in clear text

Software engineering

The PC programme **„WIN-PED"** is available for the user for setting and documenting the control parameters and the display of condition values on a PC.

Scope of functions:
- Dialogue window for on-line or off-line setting of the parameter values
- Comprehensive options for displaying process variables, the digital inputs, outputs and flags
- Recording and graphical representation of up to four process variables; trigger possiblities via digital switching signals as well as process variables

System requirements:
- IBM-PC or compatible system
- Windows 3.1 or Windows 95
- Processor Intel 80286 or higher (recommendation 80486 or better)
- Min. 8 MB RAM (recommendation 16 MB)
- 10 MB free hard disc space

Note:

The project data, e.g. A037 closed loop speed control, for the HNC100SEK is included within the scope of supply. It is delivered with the hardware on a CD.

The PC programme „WIN-PED" (SYS-HNC-WINPED5-C01) is **not** included within the scope of supply. It has to be separately ordered or it can be downloaded, free of charge from the Internet!

To order a CD-ROM: Material No. **R900725471**

To download from the Internet: www.boschrexroth.de/hnc100

Enquiries: support.nc-systems@boschrexroth.de

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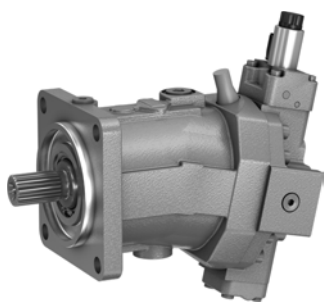
The Drive & Control Company

Axial piston variable motor A6VM series 65

Americas

RE-A 91607
Edition: 01.2015



- Sizes 55 to 200
- Nominal pressure 5800 psi (400 bar)
- Maximum pressure 6500 psi (450 bar)
- Open and closed circuits

Features

- Variable motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuit
- For use in mobile and stationary applications
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement can be infinitely varied from $V_{g\,max}$ to $V_{g\,min}$ = 0.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high and low-pressure side and with increasing displacement.
- Wide control range with hydrostatic transmissions
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust motor with long service life
- High power density
- Good starting efficiency

Contens

Ordering code

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**65**	**A**	**W**	**V**	**0**						**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 5800 psi (400 bar), maximum pressure 6500 psi (450 bar)	**A6V**

Operating mode

02	Motor	**M**

Size (NG)

03	Geometric displacement, see technical data on page 8	in cm^3/rev	**055**	**080**	**107**	**140**	**160**	**200**
		in in^3/rev	**3.36**	**4.88**	**6.53**	**8.54**	**9.76**	**12.20**

Control device

				055	080	107	140	160	200	
04	Proportional control hydraulic	positive control	Δp_{St} = 145 psi (10 bar)	●	●	●	●	●	●	**HP1**
			Δp_{St} = 365 psi (25 bar)	●	●	●	●	●	●	**HP2**
		negative control	Δp_{St} = 145 psi (10 bar)	●	●	●	●	●	●	**HP5**
			Δp_{St} = 365 psi (25 bar)	●	●	●	●	●	●	**HP6**
	Proportional control electrical	positive control	U = 12 V DC	●	●	●	●	●	●	**EP1**
			U = 24 V DC	●	●	●	●	●	●	**EP2**
		negative control	U = 12 V DC	●	●	●	●	●	●	**EP5**
			U = 24 V DC	●	●	●	●	●	●	**EP6**
	Two-point control hydraulic	negative control		–	–	–	●	●	●	**HZ5**
				●	●	●	–	–	–	**HZ7**
	Two-point control electrical	negative control	U = 12 V DC	–	–	–	●	●	●	**EZ5**
			U = 24 V DC	–	–	–	●	●	●	**EZ6**
			U = 12 V DC	●	●	●	–	–	–	**EZ7**
			U = 24 V DC	●	●	●	–	–	–	**EZ8**
	Automatic control high-pressure related, Positive control	with minimum pressure increase	$\Delta p \leq$ approx. 145 psi (10 bar)	●	●	●	●	●	●	**HA1**
		with pressure increase	Δp = 1450 psi (100 bar)	●	●	●	●	●	●	**HA2**
	Automatic control speed related, negative control p_{St} / p_{HD} = 5/100	hydr. travel direction valve		●	●	●	●	●	●	**DA0**
		electric travel direction valve + electric $V_{g\,max}$ circuit	U = 12 V DC	●	●	●	●	●	●	**DA1**
			U = 24 V DC	●	●	●	●	●	●	**DA2**

Pressure control/override

				055	080	107	140	160	200	
05	Without pressure control/override			●	●	●	●	●	●	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6			●	●	●	●	●	●	**D1**
	Override of controls HA1 and HA2	hydraulic remote control, proportional		●	●	●	●	●	●	**T3**
		electric, two-point	U = 12 V DC	●	●	●	●	●	●	**U1**
			U = 24 V DC	●	●	●	●	●	●	**U2**
		electric and travel direction valve, electric	U = 12 V DC	●	●	●	●	●	●	**R1**
			U = 24 V DC	●	●	●	●	●	●	**R2**

Connector for solenoids[1] (see page 61)

06	Without connector (without solenoid, only for hydraulic control)	**0**
	DEUTSCH - molded connector, 2-pin, without suppressor diode	**P**

● = Available ○ = On request – = Not available

1) Connectors for other electric components can deviate.

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**65**	**A**	**W**	**V**	**0**						**–**	

Additional function 1

07	Without additional function	**0**

Additional function 2

08	Without additional function	**0**

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		**0**
	Damping	HP, EP, HP5,6D. and EP5,6D., HZ, EZ, HA with counterbalance valve BVD/BVE	**1**
		One-sided in inlet to large stroking chamber (HA)	**4**
		One-sided in outlet from large stroking chamber (DA)	**7**

Setting range for displacement[2)]

10	$V_{g\,max}$-setting screw	$V_{g\,min}$-setting screw	**055**	**080**	**107**	**140**	**160**	**200**	
	Without setting screw	short (0-adjustable)	●	●	●	●	●	●	**A**
		medium	●	●	●	●	●	●	**B**
		long	●	●	●	●	●	●	**C**
		extra long	–	–	●	●	●	●	**D**
	Short	short (0-adjustable)	●	●	●	●	●	●	**E**
		medium	●	●	●	●	●	●	**F**
		long	●	●	●	●	●	●	**G**
		extra long	–	–	●	●	●	●	**H**
	Medium	short (0-adjustable)	●	●	●	●	●	●	**J**
		medium	●	●	●	●	●	●	**K**
		long	●	●	●	●	●	●	**L**
		extra long	–	–	●	●	●	●	**M**

Series

11	Series 6, index 5	**65**

Configuration of ports and fastening threads

12	ANSI, port threads with O-ring sealing according to ISO 11926	**A**

Direction of rotation

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

Sealing material

14	FKM (fluoroelastomer)	**V**

Drive shaft bearing

15	Standard bearing	**0**

Mounting flange

			055	**080**	**107**	**140**	**160**	**200**	
16	SAE J744	127-4	●	–	–	–	–	–	**C4**
		127-2	–	●	–	–	–	–	**C2**
		152-4	–	–	●	●	●	–	**D4**
		165-4	–	–	–	–	–	●	**E4**

● = Available ○ = On request – = Not available

2) The settings for the setting screws can be found in the table (see pages 69 and 70).

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**65**	**M**	**W**	**V**	**0**						**–**	

Drive shaft

			055	080	107	140	160	200	
17	Splined shaft ANSI B92.1a	1 1/4 in 14T 12/24 DP	●	●	–	–	–	–	**S7**
		1 3/4 in 13T 8/16 DP	–	–	●	●	●	–	**T1**
		2 in 15T 8/16 DP	–	–	–	–	–	●	**T2**

Port plate for service lines

			055	080	107	140	160	200	
18	SAE flange ports A and B at rear		●	●	●	●	●	●	**1**
	SAE flange ports A and B at side, opposite		●	●	●	●	●	●	**2**
	Port plate with 1-stage pressure limitation valves for mounting a counterbalance valve[3]	BVD20	●	●	●	–	–	–	**7**
		BVD25, BVE25	–	–	●	●	●	●	**8**

Valve (see pages 62 to 67)

				055	080	107	140	160	200	
19	Without valve			●	●	●	●	●	●	**0**
	With counterbalance valve BVD/BVE mounted[4]			●	●	●	●	●	●	**W**
	With flushing and boost pressure valve, mounted	**Flushing flow q_v [gpm (l/min)]**								
	Flushing on both sides	0.9	(3.5)	●	●	●	–	–	–	**A**
	Flushing flow at:	1.3	(5)	●	●	●	–	–	–	**B**
	$\Delta p = p_{ND} - p_G$ = 365 psi (25 bar) and	2.1	(8)	●	●	●	●	●	●	**C**
	ν = 60 SUS (10 mm²/s)	2.6	(10)	●	●	●	●	●	●	**D**
	(p_{ND} = low pressure, p_G = case pressure)	3.7	(14)	●	●	●	–	–	–	**F**
	Only possible with port plates 1 and 2	4.5	(17)	–	–	–	●	●	●	**G**
		5.3	(20)	–	–	●[5]	●	●	●	**H**
		6.6	(25)	–	–	●[5]	●	●	●	**J**
		7.9	(30)	–	–	●[5]	●	●	●	**K**
		9.2	(35)	–	–	–	●	●	●	**L**
		10.6	(40)	–	–	–	●	●	●	**M**

Speed sensor (see page 68)

		055	080	107	140	160	200	
20	Without speed sensor	●	●	●	●	●	●	**0**
	Prepared for speed sensor DSM/DSA	●	●	●	●	●	●	**U**
	With speed sensor DSM/DSA mounted[6]	●	●	●	●	●	●	**V**

Standard / special version

21	Standard version	**0**
	Standard version with installation variants, e. g. T ports against standard open and closed	**Y**
	Special version	**S**

● = Available ○ = On request – = Not available

Notes
- Note the project planning notes on page 73.
- Preservation:
  - up to 12 months as standard
  - up to 24 months long-term (state in plain text when ordering)

3) Only possible in conjunction with HP, EP and HA control. Note the restrictions described on page 64.
4) State ordering code for counterbalance valve separately in accordance with data sheet 95522 for BVD or 95525 for BVE. Note the restrictions described on page 64.
5) Not for EZ7, EZ8 and HZ7.
6) State ordering code for sensor separately in accordance with data sheet 95132 for DSM or 95133 for DSA and note the requirements relating to the electronics.

Hydraulic fluids

The variable motor A6VM is designed for operation with mineral oil HLP according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90223: Fire-resistan, water-containing hydraulic fluids (HFAE, HFAS, HFB, HFC)

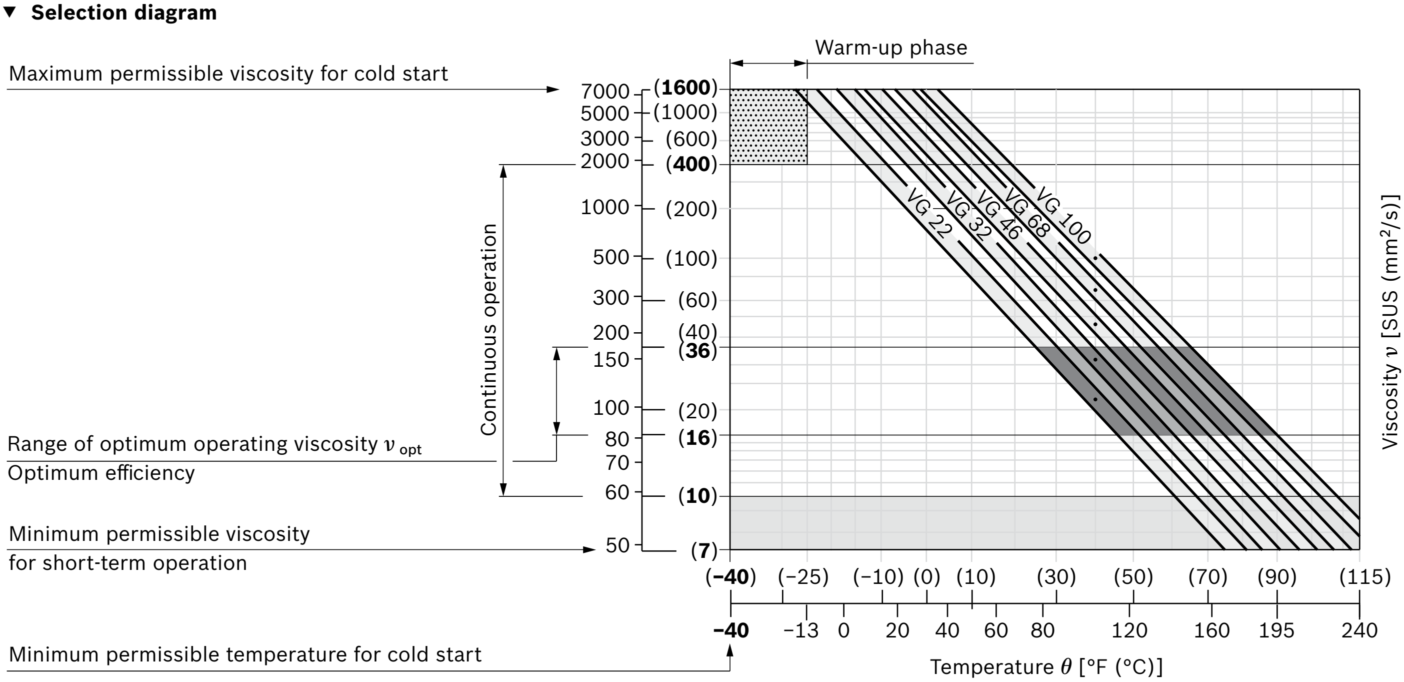
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 240 °F (115 °C). The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port **U** or using a flushing and boost pressure valve (see page 62).

Viscosity and temperature of hydraulic fluids

	Viscosity		Temperature		Comment
Cold start	$\nu_{max} \leq$	7400 SUS (1600 mm²/s)	$\theta_{St} \geq$	−40 °F (−40 °C)	$t \leq$ 3 min, $n \leq$ 1000 rpm, without load $p \leq$ 725 psi ($p \leq$ 50 bar)
Permissible temperature difference			$\Delta T \leq$	45 °F (25 K)	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu <$	7400 to 1850 SUS (1600 to 400 mm²/s)	$\theta =$	−40 °F to −13 °F (−40 °C to −25 °C)	at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq$ 15 min
Continuous operation	$\nu =$	1850 to 47 SUS (400 to 10 mm²/s)			This corresponds, for example on the VG 46, to a temperature range of +41 °F to + 185 °F (+5 °C to +85 °C)(see selection diagram)
			$\theta =$	−13 °F to +217 °F (−25 °C to +103 °C)	measured at port **T** Note the permissible temperature range of the shaft seal (ΔT = approx. 22 °F (12 K) between the bearing/shaft seal and port **T**)
	$\nu_{opt} =$	167 to 81 SUS (36 to 16 mm²/s)			Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq$	49 SUS (7 mm²/s)			$t <$ 3 min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

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

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

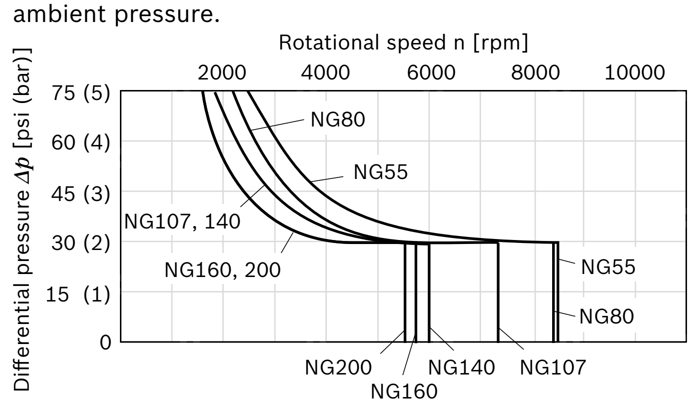
At very high hydraulic fluid temperatures (195 °F (90 °C) to maximum 217 °F (103 °C), measured at port **T**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

Permissible pressure loading

The service life of the shaft seal will be influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary pressure spikes ($t < 0.1$ s) of up to 145 psi (10 bar) are permitted. The service life of the shaft seal decreases with increasing frequency of pressure spikes and increasing mean differential pressure.

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



The FKM shaft seal may be used for leakage temperatures from -13 °F to +240 °F (-25 °C to +115 °C). For application cases below -13 °F (-25 °C), an NBR shaft seal is required (permissible temperature range:
-40 °F to +195 °F (-40 °C to +90 °C)).

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control when using the following control options:

- HP, HA.T3: Increase
- DA: Decrease

With the following settings, an increase in case pressure will have no effect on the beginning of control:
HA.R and HA.U, EP, HA

The factory setting of the beginning of control is made at p_{abs} = 30 psi (2 bar) case pressure.

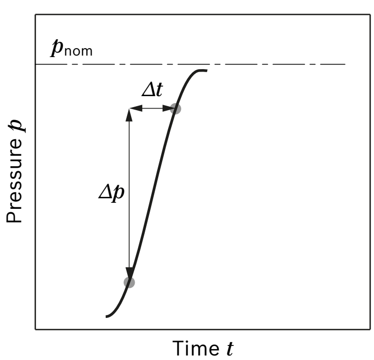
Flow direction

Direction of rotation, viewed on drive shaft	
clockwise (cw)	counter-clockwise (ccw)
A to **B**	**B** to **A**

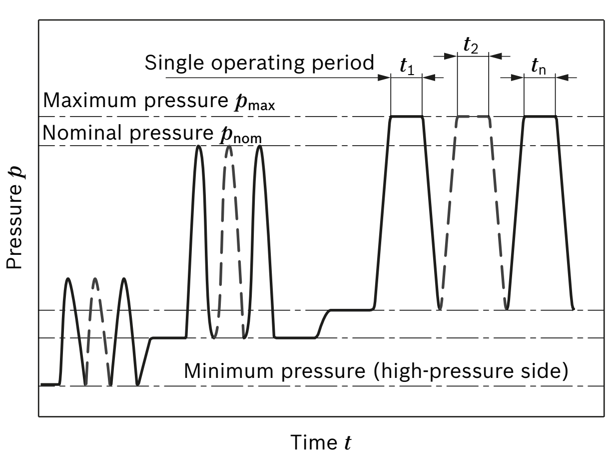
Operating pressure range

Pressure at service line port A or B		**Definition**
Nominal pressure p_{nom}	5800 psi (400 bar) absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	6500 psi (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.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	365 psi (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.
Minimum pressure – pump operating mode (inlet)	See the diagram below	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). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve)
Summation pressure p_{Su} (pressure **A** + pressure **B**)	10150 psi (700 bar)	The summation pressure is the sum of the pressures at both service line ports (**A** and **B**)
Rate of pressure change $R_{A\ max}$		Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
With integrated pressure-relief valve	130530 psi/s (9000 bar/s)	
Without pressure-relief valve	232060 psi/s (16000 bar/s)	

▼ **Rate of pressure change $R_{A\ max}$**

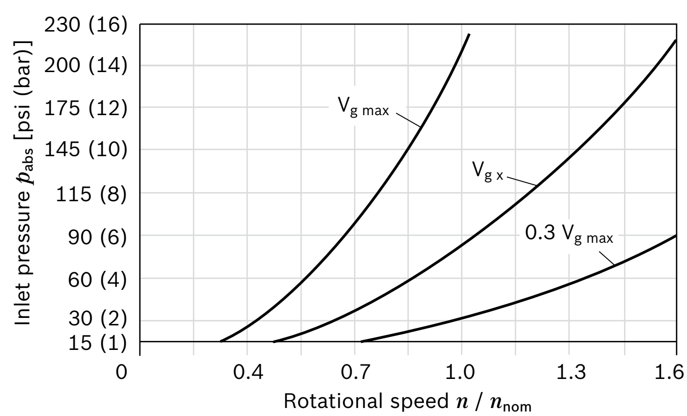


▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

▼ **Minimum pressure – pump operating mode (inlet)**



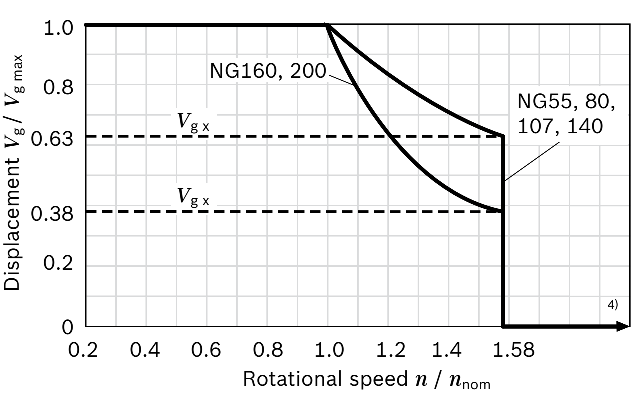
This diagram is valid only for the optimum viscosity range from ν_{opt} = 170 to 73 SUS (36 to 16 mm²/s).
Please contact us if these conditions cannot be satisfied.

Note
Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		55	80	107	140	160	200
Displacement geometric, per revolution		$V_{g\,max}$	in³	3.34	4.88	6.53	8.54	9.76	12.20
			cm³	54.8	80	107	140	160	200
		$V_{g\,min}$	in³	0	0	0	0	0	0
			cm³	0	0	0	0	0	0
		$V_{g\,x}$	in³	2.14	3.11	4.15	5.37	3.73	4.64
			cm³	35	51	68	88	61	76
Maximum speed[1] (complying with the maximum permissible inlet flow)	at $V_{g\,max}$	n_{nom}	rpm	4450	3900	3550	3250	3100	2900
	at $V_g < V_{g\,x}$ (see diagram)	n_{max}	rpm	7000	6150	5600	5150	4900	4600
	at $V_{g\,0}$	n_{max}	rpm	8350	7350	6300	5750	5500	5100
Inlet flow[2]	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	gpm	64	82	100	120	131	153
			l/min	244	312	380	455	496	580
Torque[3]	at $V_{g\,max}$ and Δp = 5800 psi (400 bar)	T	lb-ft	257	375	502	657	752	939
			Nm	349	509	681	891	1019	1273
Rotary stiffness	$V_{g\,max}$ to $V_g/2$	c_{min}	lb-ft/rad	7400	12000	15000	25000	26000	32000
			kNm/rad	10	16	21	34	35	44
	$V_g/2$ to 0 (interpolated)	c_{min}	lb-ft/rad	24000	35000	48000	69000	77000	96000
			kNm/rad	32	48	65	93	105	130
Moment of inertia for rotary group		J_{TW}	lb-ft²	0.100	0.190	0.301	0.491	0.600	0.838
			kgm²	0.0042	0.008	0.0127	0.0207	0.0253	0.0353
Maximum angular acceleration		α	rad/s²	31500	24000	19000	11000	11000	11000
Case volume		V	gal	0.20	0.32	0.40	0.48	0.63	0.71
			l	0.75	1.2	1.5	1.8	2.4	2.7
Weight, approx.		m	lbs	62	79	101	134	137	172
			kg	28	36	46	61	62	78

▼ **Permissible displacement in relation to speed**



Determining the operating characteristics

Inlet flow	$q_v = \frac{V_g \times n}{231 \times \eta_v}$	[gpm]	$\left(\frac{V_g \times n}{1000 \times \eta_v}\right)$	[l/min]
Rotational speed	$n = \frac{q_v \times 231 \times \eta_v}{V_g}$	[rpm]	$\left(\frac{q_v \times 1000 \times \eta_v}{V_g}\right)$	[rpm]
Torque	$T = \frac{V_g \times \Delta p \times \eta_{mh}}{24 \times \pi}$	[lb-ft]	$\left(\frac{V_g \times \Delta p \times \eta_{mh}}{20 \times \pi}\right)$	[Nm]
Power	$P = \frac{2\,\pi \times T \times n}{33000} = \frac{q_v \times \Delta p \times \eta_t}{1714}$	[HP]	$\left(\frac{2\,\pi \times T \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600}\right)$	[kW]

Key

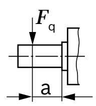
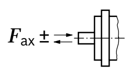
V_g	=	Displacement per revolution [in³ (cm³)]
Δp	=	Differential pressure [bar (bar)]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{mh}	=	Mechanical-hydraulic efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \bullet \eta_{mh}$)

Notes

- Theoretical values, without efficiency levels and tolerances; values rounded
- 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, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

1) The values are valid:
   - For the optimum viscosity range from ν_{opt} = 170 to 75 SUS (36 to 16 mm²/s)
   - with hydraulic fluid on the basis of mineral oil
2) Note inlet flow limitation due to counterbalance valve (see page 64).
3) Torque without radial force, With radial force see page 9.
4) Values in this range on request

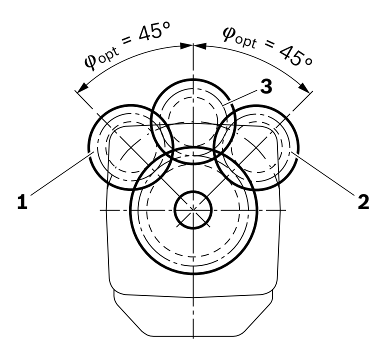
Permissible radial and axial forces of the drive shafts

Size	NG		55	80	107	140	160	200
Drive shaft		in	1 1/4	1 1/4	1 3/4	1 3/4	1 3/4	2
Maximum radial force[1)] at distance a (from shaft collar) 	$F_{q\,max}$	lb	1756	1 699	2 755	3 605	3 257	4 507
		N	7811	7559	12256	16036	14488	20047
	a	in	0.94	0.94	1.32	1.32	1.32	1.32
		mm	24.0	24.0	33.5	33.5	33.5	33.5
Torque maximum at $F_{q\,max}$	T_{max}	lb-ft	229	221	502	657	679	939
		Nm	310	300	681	891	920	1273
Differential pressure maximum at $V_{g\,max}$ and $F_{q\,max}$	Δp_{max}	psi	4569	3423	5802	5802	5236	5802
		bar	315	236	400	400	361	400
Maximum axial force at standstill or depres-surized rotation 	$+ F_{ax\,max}$	lb	0	0	0	0	0	0
		N	0	0	0	0	0	0
	$- F_{ax\,max}$	lb	112	160	202	232	252	281
		N	500	710	900	1030	1120	1250
Permissible axial force per bar operating pressure	$+ F_{ax\,perm/bar}$	lb/psi	0.12	0.15	0.18	0.21	0.23	0.26
		N/bar	7.5	9.6	11.3	13.3	15.1	17.0

Effect of radial force F_q on the service life of bearings

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

▼ **Toothed gear output drive**



1 "Clockwise" rotation, pressure at port **B**
2 "Counter-clockwise" rotation, pressure at port **A**
3 Alternating direction of rotation

Notes

- ▶ The permissible axial force in $-F_{ax}$ direction is to be avoided, because thereby the bearing life is reduced.
- ▶ Special requirements apply in the case of belt drives. Please contact us.

1) For intermittent operation

HP – Proportional hydraulic control

The proportional hydraulic control provides infinite adjustment of the displacement. The control is proportional to the pilot pressure applied to port **X**.

HP1, HP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum pilot pressure)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum pilot pressure)

HP5, HP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: p_{St} = 1450 psi (100 bar)
- The control oil is internally taken from the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port **G** via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 6500 psi (450 bar) can occur at port **G**.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 145 psi (10 bar).
- The beginning of control and the HP characteristic curve are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 6) and thus a parallel displacement of the characteristic.

HP1, HP5 pilot pressure increase Δp_{St} = 145 psi (10 bar)

HP1 positive control

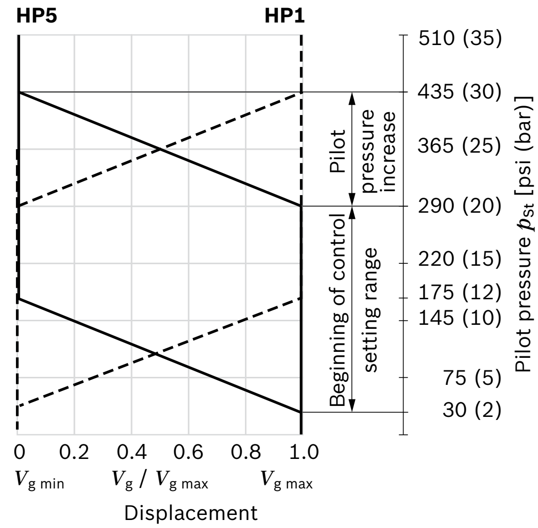
A pilot pressure increase of 145 psi (10 bar) at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control

A pilot pressure increase of 145 psi (10 bar) at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

- Beginning of control, setting range 30 to 290 psi (2 to 20 bar)
- Standard setting:
  Beginning of control at 45 psi (3 bar) (end of control at 190 psi (13 bar))

▼ **Characteristic curve**



HP2, HP6 pilot pressure increase Δp_{St} = 365 psi (25 bar)

HP2 positive control

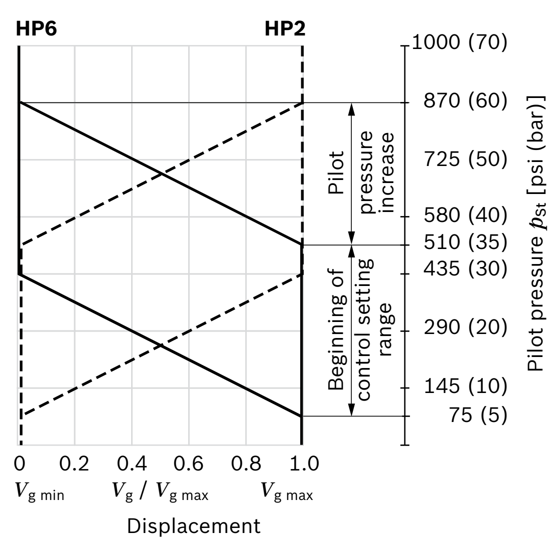
A pilot pressure increase of 365 psi (25 bar) at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP6 negative control

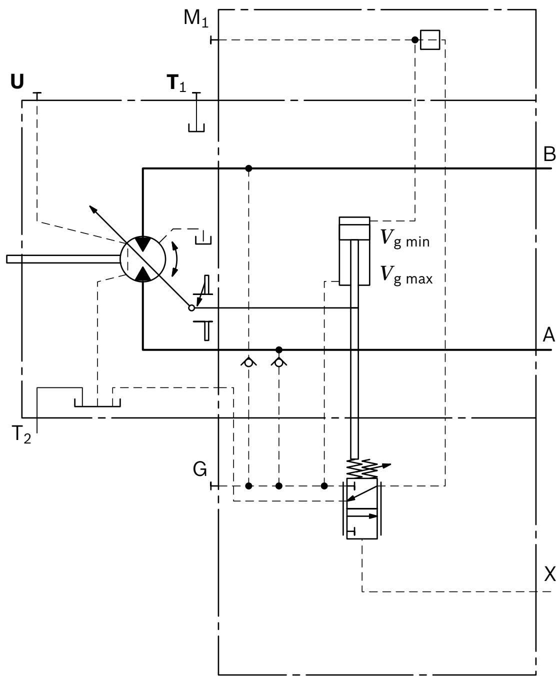
A pilot pressure increase of 365 psi (25 bar) at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

- Beginning of control, setting range 75 to 510 psi (5 to 35 bar)
- Standard setting:
  Beginning of control at 145 psi (10 bar) (end of control at 510 psi (35 bar))

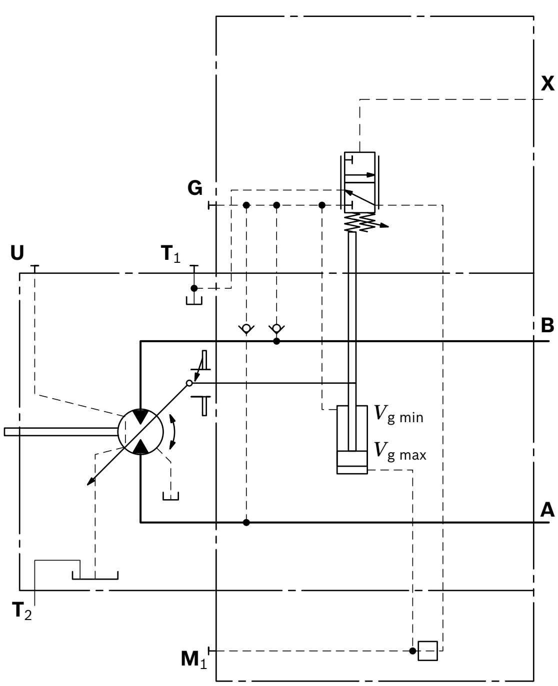
▼ **Characteristic curve**



▼ **Schematic HP1, HP2: Positive control**



▼ **Schematic HP5, HP6: negative control**

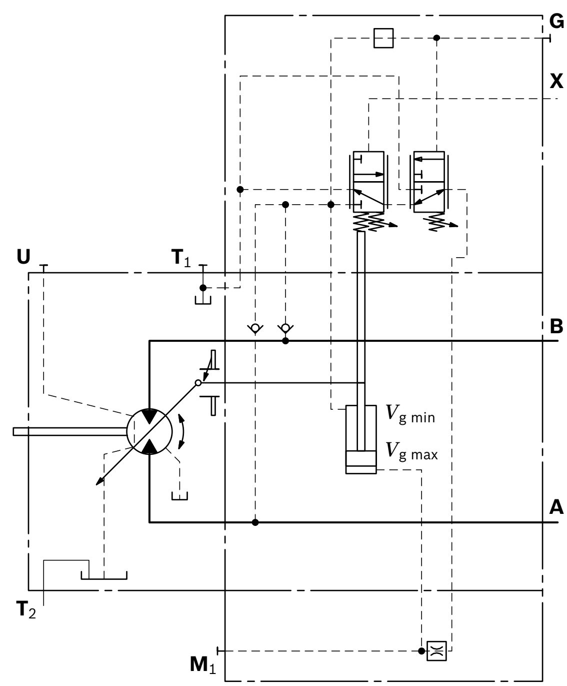


HP5D1, HP6D1

Pressure control, fixed setting

The pressure control overrides the HP control function.
If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control, the motor will swivel towards a larger displacement.
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease.
With the increase in displacement the motor develops more torque, while the pressure remains constant.
Setting range of the pressure control valve 1150 to 5800 psi (80 to 400 bar)

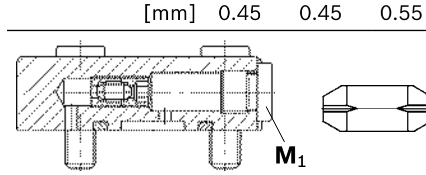
▼ **Schematic HP5D1, HP6D1: negative control**



Response time damping

Standard for HP without damping
HP, HP5D1, HP6D1 – with throttle pin on both sides, symmetrical

Size		55	80	107	140	160	200
Groove size	[inch]	0.018	0.018	0.022	0.022	0.022	0.026
	[mm]	0.45	0.45	0.55	0.55	0.55	0.65



EP – Proportional electric control

The proportional electric control provides infinite setting of the displacement. Control is proportional to the electric control current applied to the solenoid.

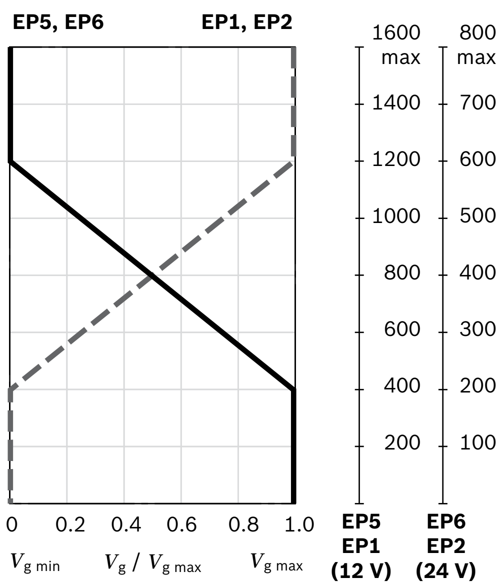
EP1, EP2 positive control

- Beginning of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at minimum control current)
- End of control at $V_{g\ max}$ (maximum torque, minimum speed at maximum control current)

EP5, EP6 negative control

- Beginning of control at $V_{g\ max}$ (maximum torque, minimum speed at minimum control current)
- End of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at maximum control current)

▼ **Characteristic curve**



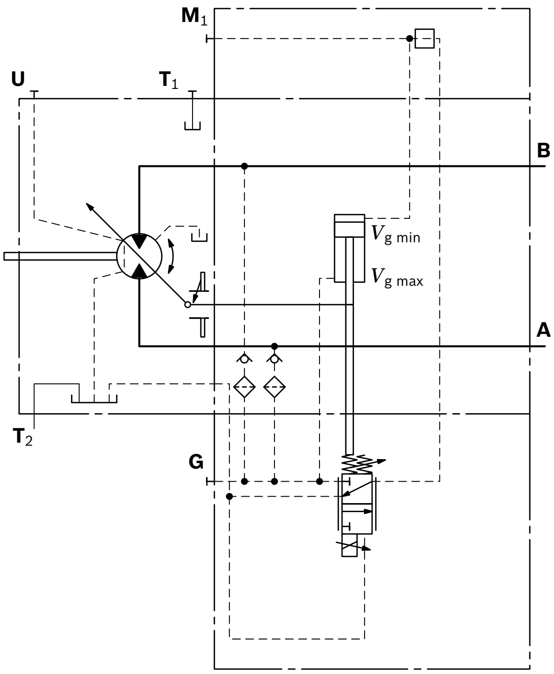
Note

The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port **G** using an external check valve. For lower pressures, please contact us.
Please note that pressures up to 6500 psi (450 bar) can occur at port **G**.

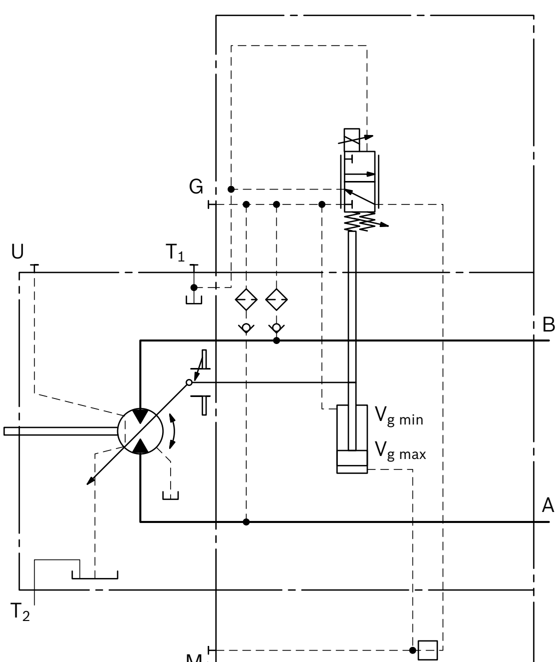
Technical data, solenoid	EP1, EP5	EP2, EP6
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection: see connector version on page 61		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.
Further information can also be found on the internet at www.boschrexroth.com/mobile-electronics.

▼ **Schematic EP1, EP2: positive control**



▼ **Schematic EP5, EP6: negative control**

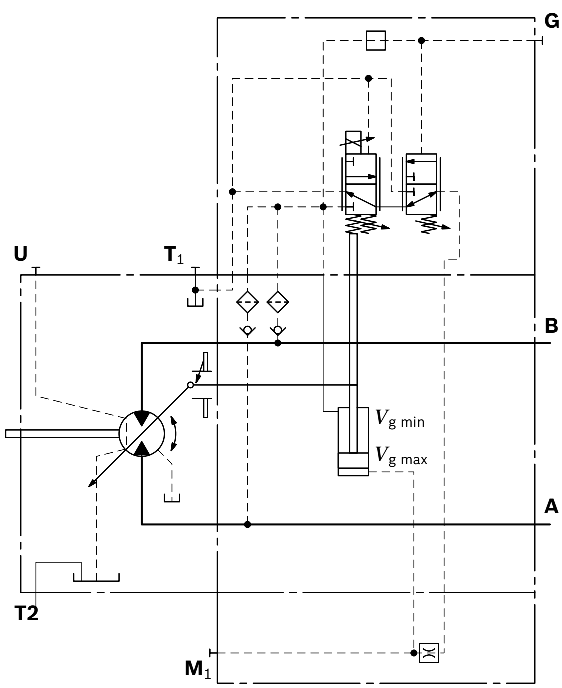


EP5D1, EP6D1

Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control, the motor will swivel towards a larger displacement.
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.
Setting range of the pressure control valve 1150 to 5800 psi (80 to 400 bar)

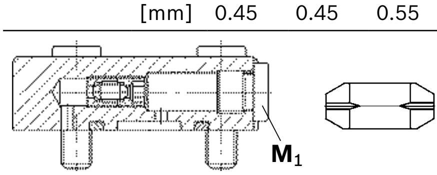
▼ **Schematic EP5D1, EP6D1: negative control**



Response time damping

Standard for EP without damping
EP, EP5D1, EP6D1 – with throttle pin on both sides, symmetrical

Size		55	80	107	140	160	200
Groove size	[inch]	0.018	0.018	0.022	0.022	0.022	0.026
	[mm]	0.45	0.45	0.55	0.55	0.55	0.65



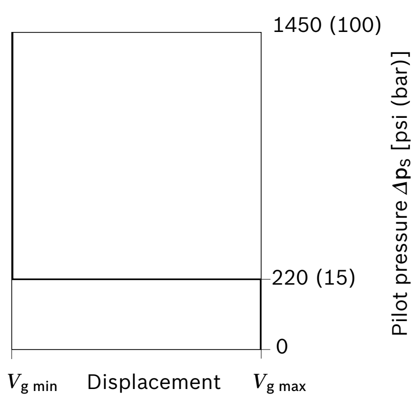
HZ – Two-point hydraulic control

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port **X** on or off.

HZ5, HZ7 negative control

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\,min}$ (with pilot pressure > 220 psi (15 bar) activated, minimum torque, maximum permissible speed)

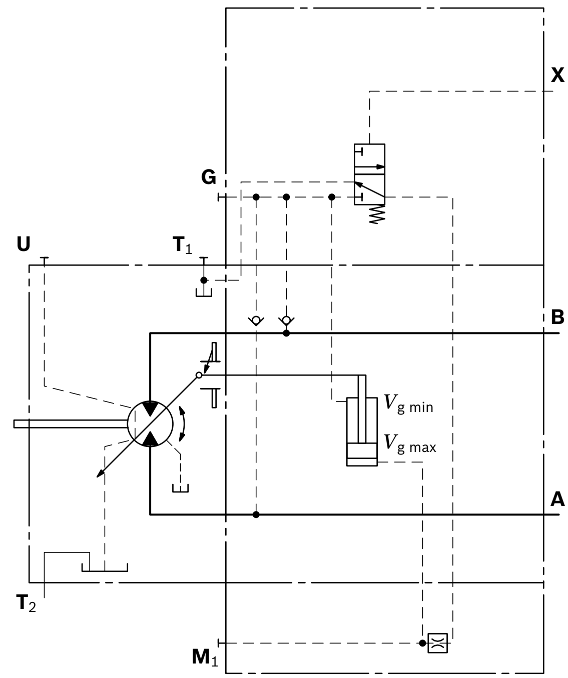
▼ **Characteristic curve HZ5, HZ7**



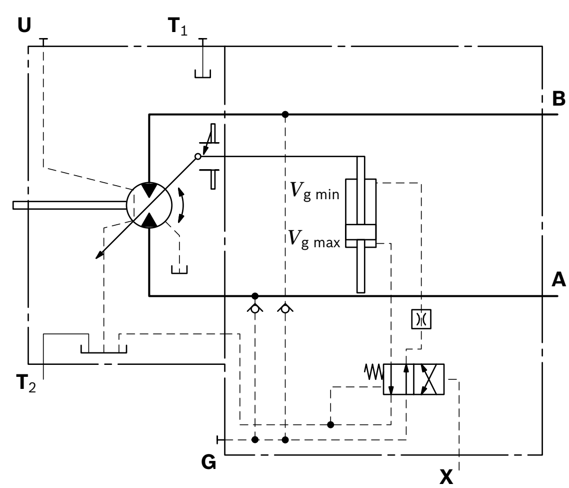
Note

- Maximum permissible pilot pressure: 1450 psi (100 bar)
- The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port **G** via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 6500 psi (450 bar) can occur at port **G**.

▼ **Schematic HZ5: Negative control, size 140 to 200**



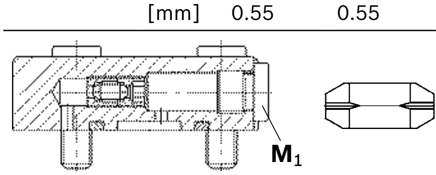
▼ **Schematic HZ7: Negative control, size 55 to 107**



Response time damping

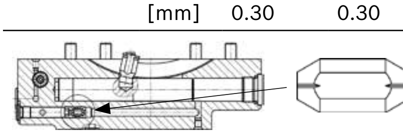
HZ5 – with throttle pin on both sides, symmetrical

Size		140	160	200
Groove size	[inch]	0.022	0.022	0.026
	[mm]	0.55	0.55	0.65



HZ7 – with throttle pin on both sides, symmetrical

Size		55	80	107
Groove size	[inch]	0.012	0.012	0.012
	[mm]	0.30	0.30	0.30



EZ – Two-point electric control

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

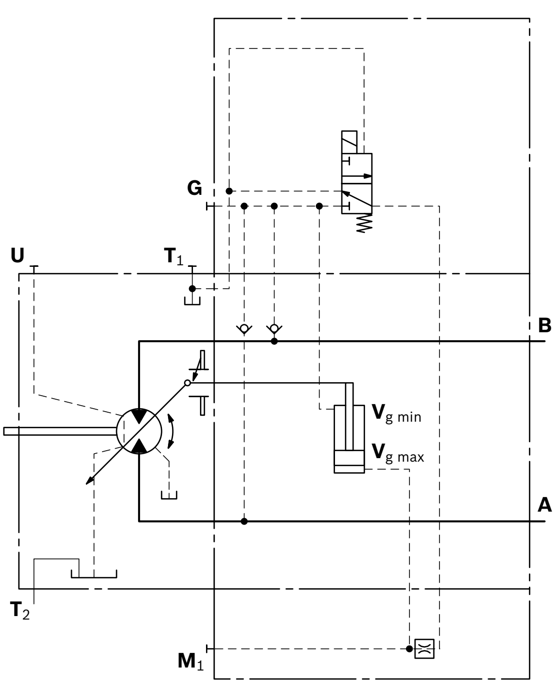
Note

The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port **G** via an external check valve. For lower pressures, please contact us. Please note that pressures up to 6500 psi (450 bar) can occur at port **G**.

Sizes 140 to 200

Technical data, solenoid with DIA37	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 61		

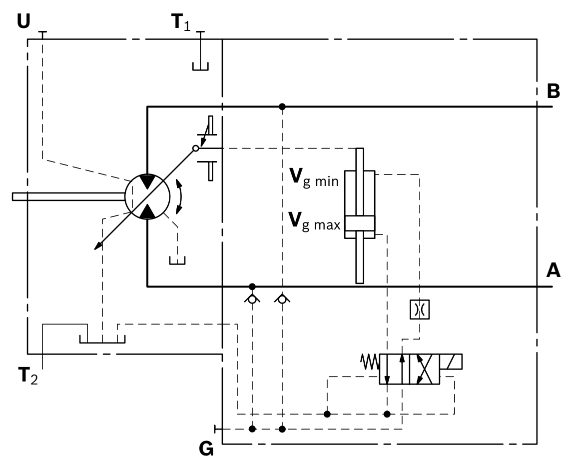
▼ **Schematic EZ5, EZ6: Negative control**



Sizes 55 to 107

Technical data, solenoid with DIA45	EZ7	EZ8
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 61		

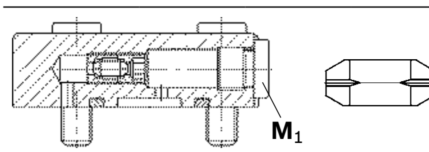
▼ **Schematic EZ7, EZ8: Negative control**



Response time damping

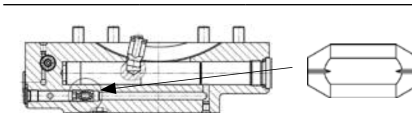
EZ5, EZ6 – with throttle pin on both sides, symmetrical

Size		140	160	200
Groove size	[inch]	0.022	0.022	0.026
	[mm]	0.55	0.55	0.65



EZ7, EZ8 – with throttle pin on both sides, symmetrical

Size		55	80	107
Groove size	[inch]	0.012	0.012	0.012
	[mm]	0.30	0.30	0.30



HA – Automatic high-pressure related control

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.
The displacement of the A6VM motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control unit internally measures the operating pressure at **A** or **B** (no control line required) and upon reaching the set beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of operating pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

HA1, HA2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum speed)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed)

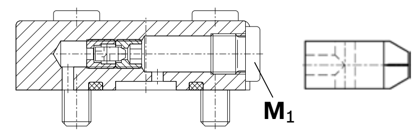
Note

- For safety reasons, winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).
- The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 435 psi (30 bar) is required in **A** (**B**). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port **G** via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 6500 psi (450 bar) can occur at port **G**.
- The beginning of control and the HA.T3 characteristic curve are influenced by case pressure. An increase in case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

Response time damping

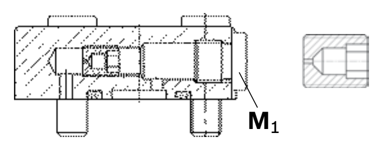
HA – with one-sided throttle pin – inlet to large stroking chamber

Size		55	80	107	140	160	200
Groove size	[inch]	0.018	0.018	0.022	0.022	0.022	0.022
	[mm]	0.45	0.45	0.55	0.55	0.55	0.65



HA – with counterbalance valve BVD or BVE – with throttle screw

Size		55	80	107	140	160	200
Groove size	[inch]	0.031	0.031	0.031	0.031	0.031	0.031
	[mm]	0.80	0.80	0.80	0.80	0.80	0.80



HA1

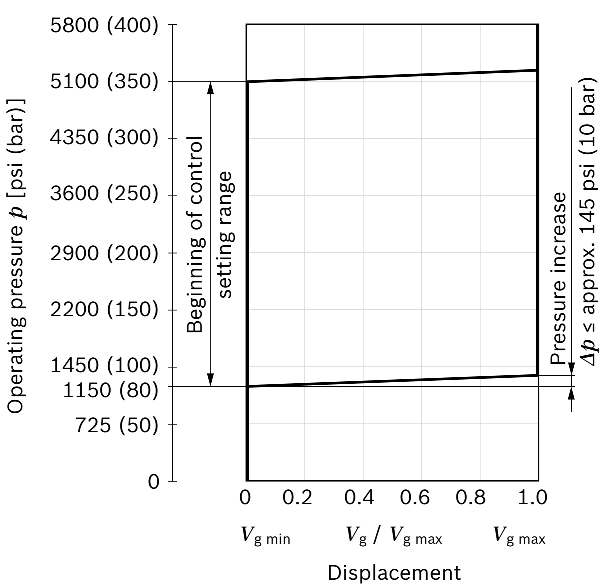
With minimum pressure increase, positive control

An operating pressure increase of $\Delta p \le$ approx. 145 psi (10 bar) results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

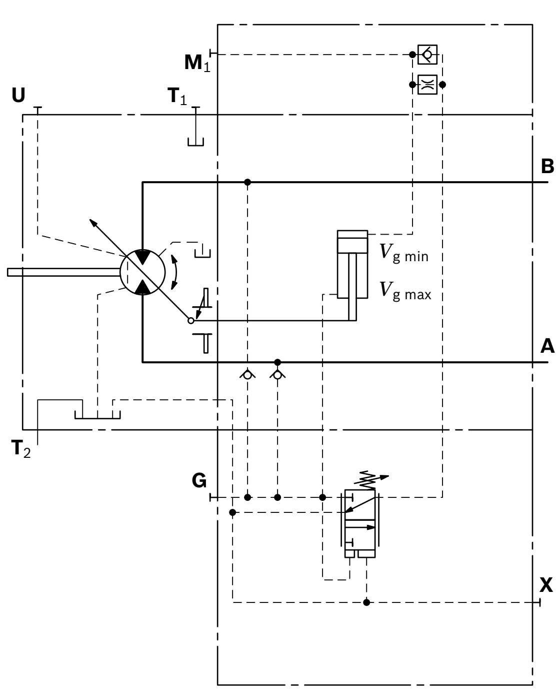
Beginning of control, setting range 1150 to 5100 psi (80 to 350 bar)

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 4350 psi (300 bar).

▼ **Characteristic curve HA1**



▼ **Schematic HA1**



HA2

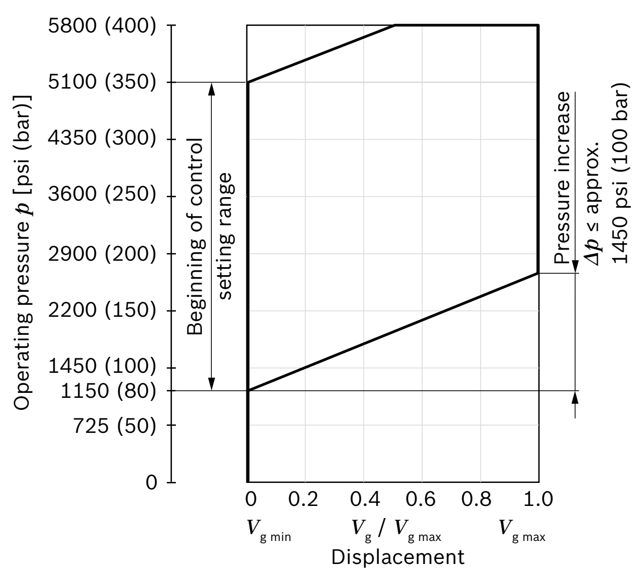
With pressure increase, positive control

An operating pressure increase of $\Delta p \le$ approx. 1450 psi (100 bar) results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

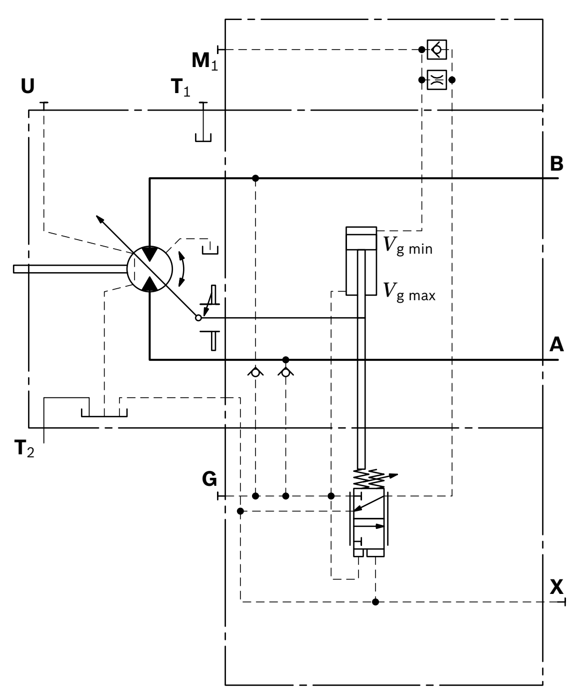
Beginning of control, setting range 1150 to 5100 psi (80 to 350 bar)

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 2900 psi (200 bar)

▼ **Characteristic curve HA2**



▼ **Schematic HA2**



HA.T3

Hydraulic override, remote control, proportional

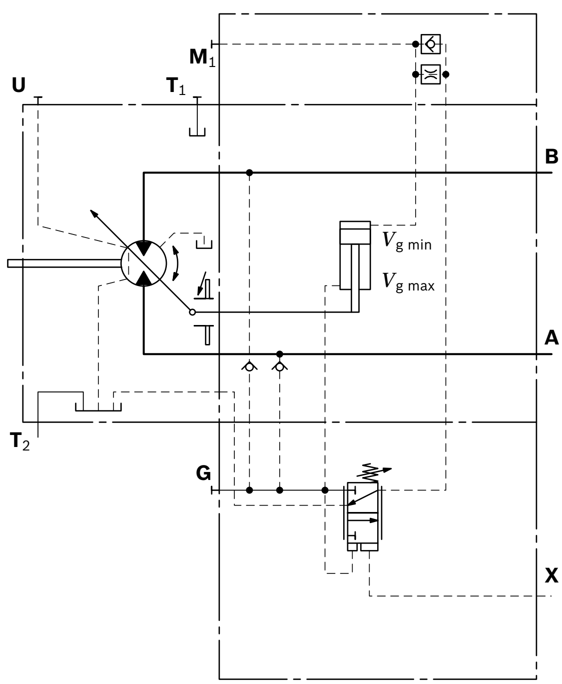
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port **X**.
For each 15 psi (1 bar) of pilot pressure increase, the beginning of control is reduced by 250 psi (17 bar).

Beginning of control setting	4350 psi (300 bar)	4350 psi (300 bar)
Pilot pressure at port **X**	0 psi	145 psi
	0 bar	(10 bar)
Beginning of control at	4350 psi	1900 psi
	(300 bar)	(130 bar)

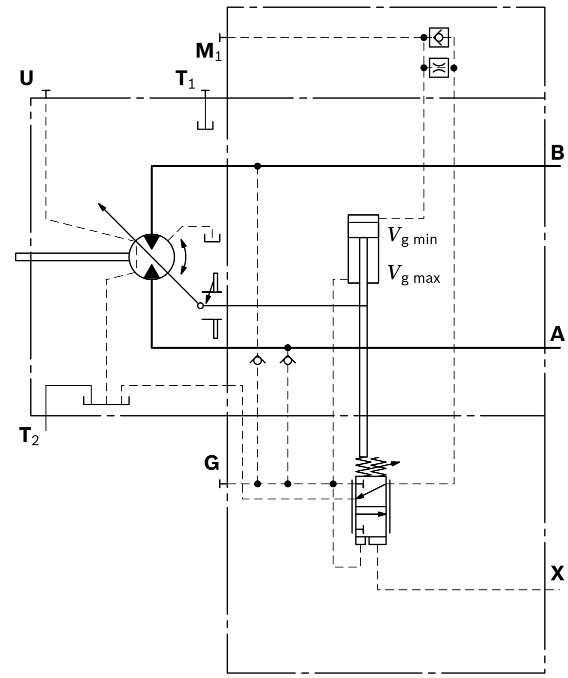
Note

Maximum permissible pilot pressure 1450 psi (100 bar).

▼ **Schematic HA1.T3**



▼ **Schematic HA2.T3**



HA.U1, HA.U2

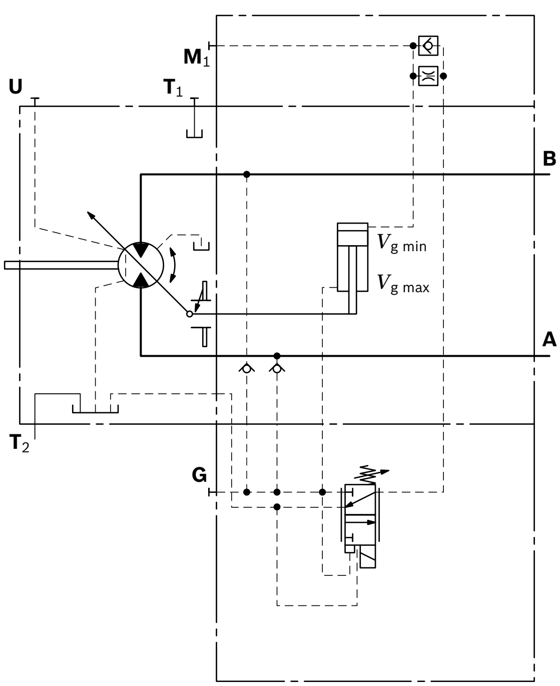
Electric override, two-point

With the HA.U1 or HA.U2 control, the beginning of control can be overridden by an electric signal to a switching solenoid. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

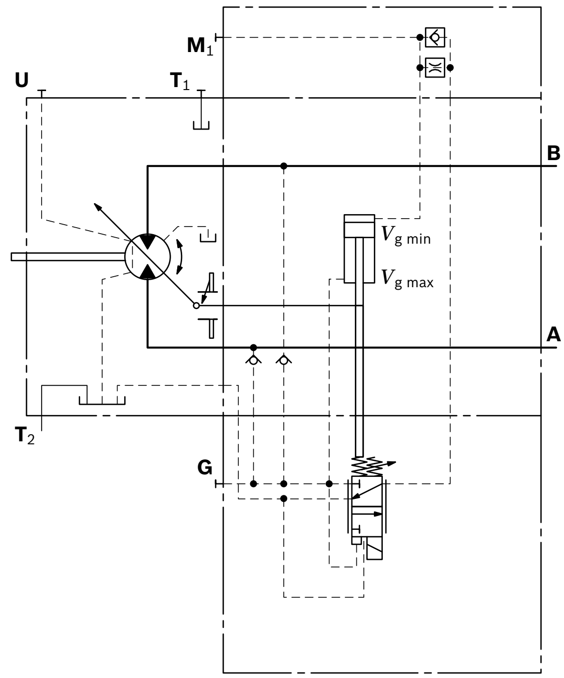
The beginning of control can be set between 1150 and 4350 psi (80 and 300 bar) (specify required setting in plain text when ordering).

Technical data, solenoid with DIA45	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\ max}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 61		

▼ **Schematic HA1U1, HA1U2**



▼ **Schematic HA2U1, HA2U2**



HA.R1, HA.R2
Electric override, electric travel direction valve

With the HA.R1 or HA.R2 control, the beginning of control can be overridden by an electric signal to switching solenoid **b**. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor (**A** or **B**) is always connected to the HA control, and thus determines the swivel angle, even if the high-pressure side changes (e. g. -travel drive during a downhill operation). This thereby prevents undesired jerky deceleration and/or braking characteristics.

The travel direction valve (see page 24) is either pressure spring or switched by energizing switching solenoid **a**, depending on the direction of rotation (travel direction).

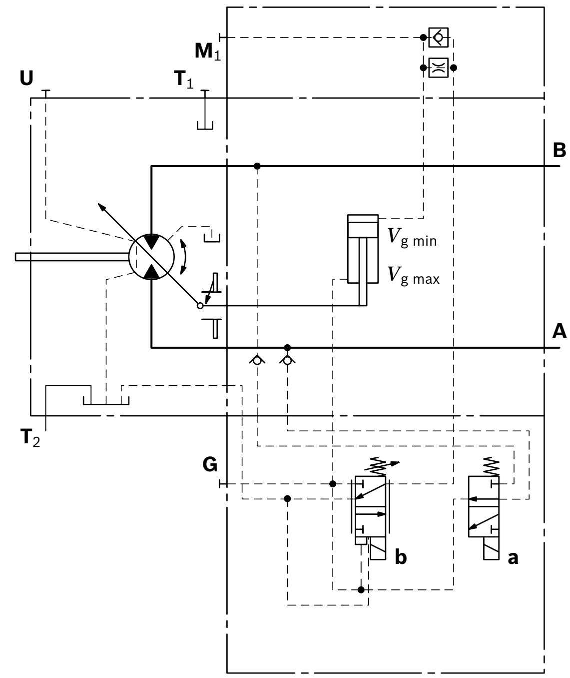
Electric override

Technical data, solenoid b with DIA45	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 61		

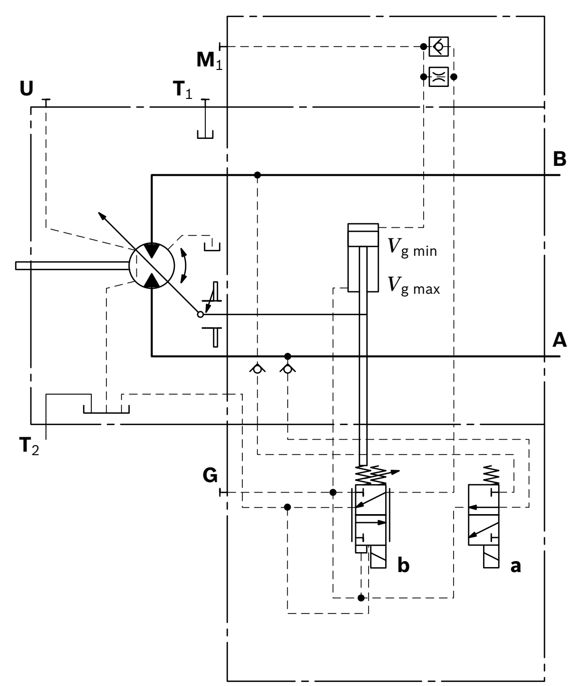
Travel direction valve, electric

Technical data, solenoid a with DIA37		R1	R2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	**B**	energized	energized
cw	**A**	de-energized	de-energized
Nominal resistance (at 68 °F (20 °C))		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required active current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection: see connector version on page 61			

▼ **Schematic HA1R1, HA1R2**



▼ **Schematic HA2R1, HA2R2**



DA – Automatic speed-related control

The variable motor A6VM with automatic speed-related control, type DA, is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.
A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.
Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.
If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

- Pressure ratio p_{St}/p_{HD} = 5/100

DA closed loop control is only suitable for certain types of drive systems and requires review of the engine and vehicle parameters to ensure that the motor is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.
Detailed information is available from our sales organization.

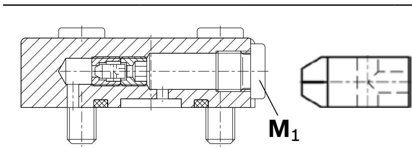
Note

The beginning of control and the DA characteristic curve are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

Response time damping

DA – with one-sided throttle pin – outlet to large stroking chamber

Size		55	80	107	140	160	200
Groove size	[inch]	0.018	0.018	0.022	0.022	0.022	0.026
	[mm]	0.45	0.45	0.55	0.55	0.55	0.65



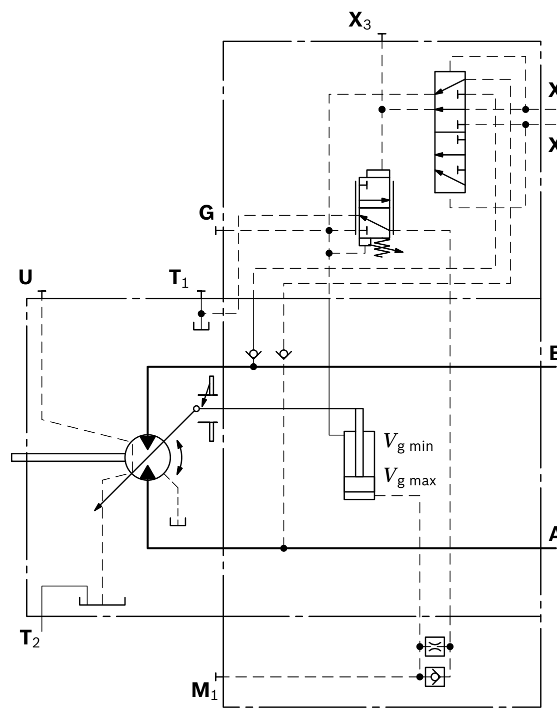
DA0

Hydraulic travel direction valve negative control

Depending on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	**A**	X_1
ccw	**B**	X_2

▼ **Schematic DA0**



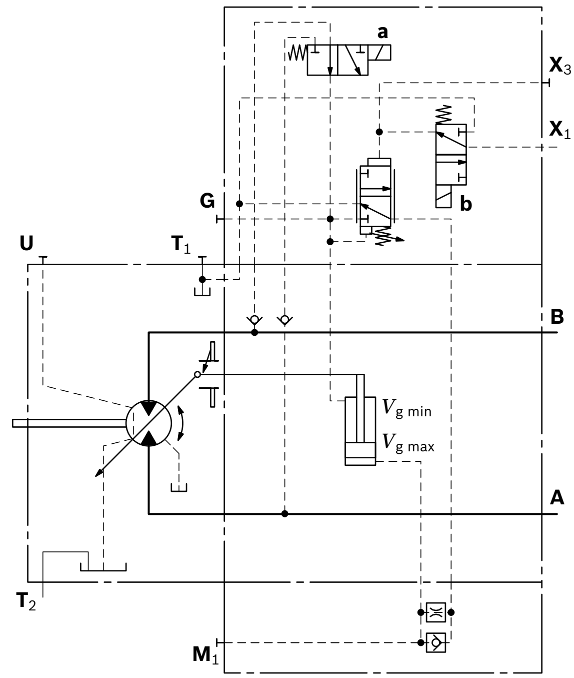
DA1, DA2

Electric travel direction valve + electric $V_{g\ max}$ circuit, negative control

The travel direction valve is pressure spring offset or switched by energizing switching solenoid **a**, depending on the direction of rotation (travel direction).

When the switching solenoid **b** is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\ max}$-circuit).

▼ **Schematic DA1, DA2**



Travel direction valve, electric

Technical data, solenoid a with DIA37		DA1	DA2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	**B**	de-energized	de-energized
cw	**A**	energized	energized
Nominal resistance (at 68 °F (20 °C))		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required active current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection: see connector version on page 61			

Electric override

Technical data, solenoid b with DIA37	DA1	DA2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\ max}$	energized	energized
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 61		

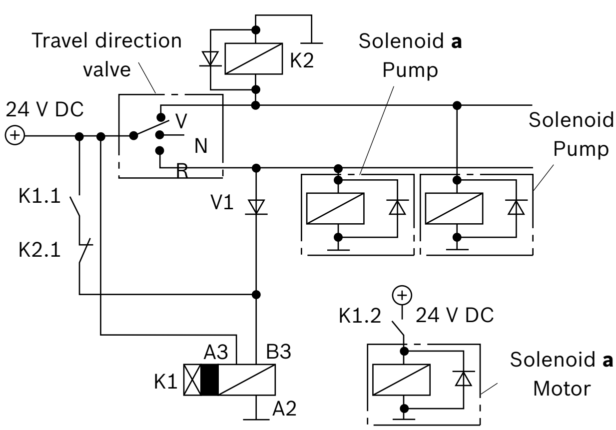
Electric travel direction valve (for DA, HA.R)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).
If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.
When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

- the neutral position, the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.
- Reversing,
  the travel direction valve causes the travel direction valve of the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

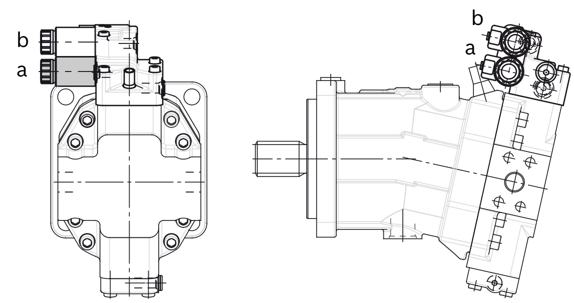
As a result, jerky deceleration or braking is prevented in both cases.

▼ **Schematic - electric travel direction valve**

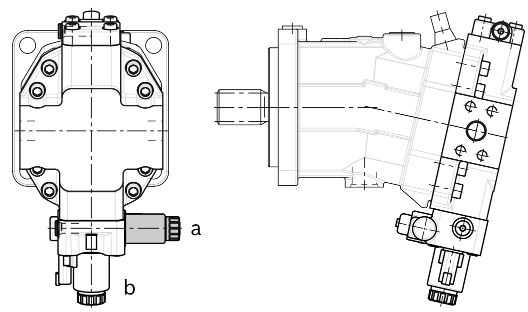


The diodes and relays shown are not included in the scope of delivery of the motor.

▼ **Control DA1, DA**



▼ **HA1R., HA2R. control**

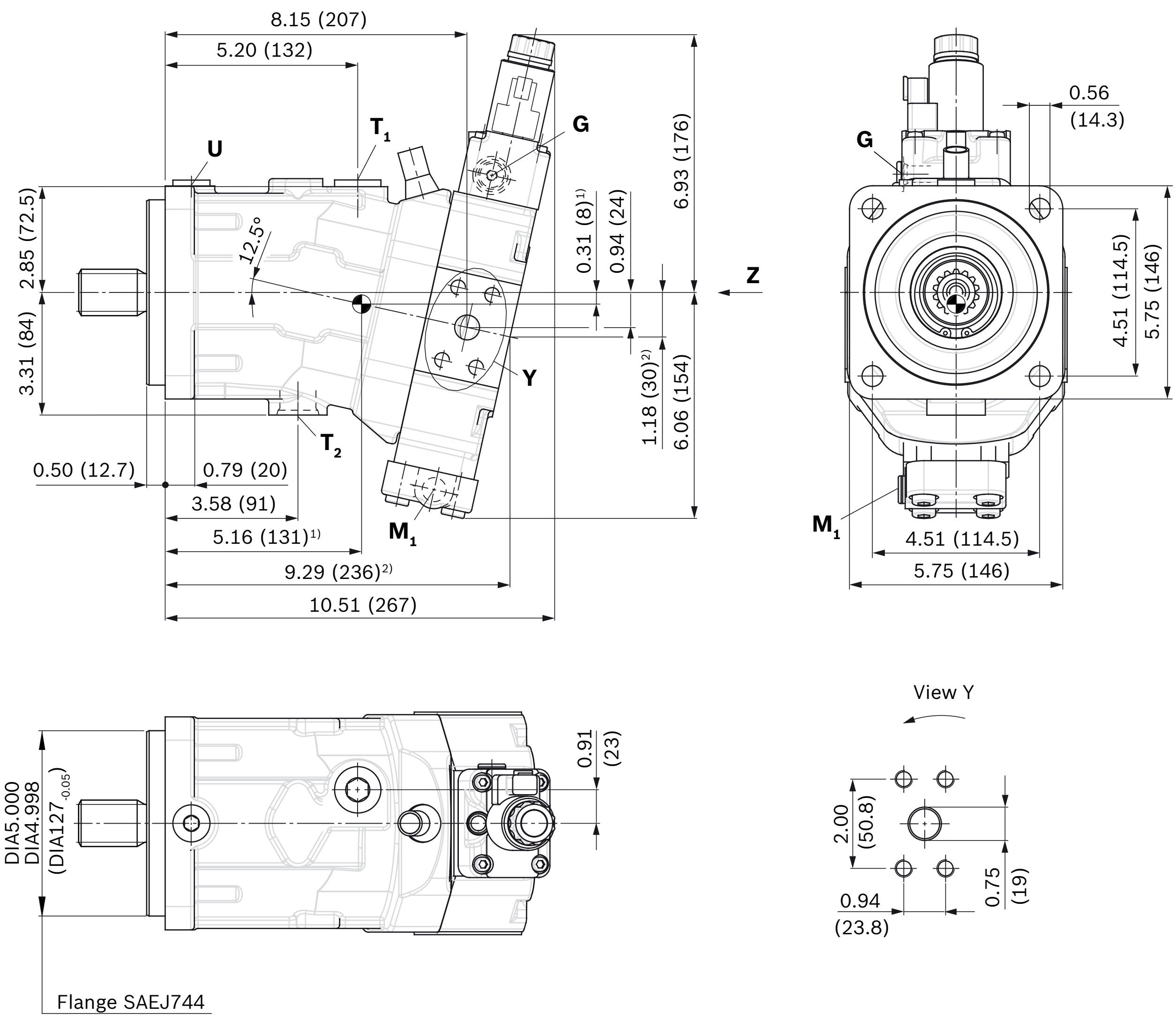


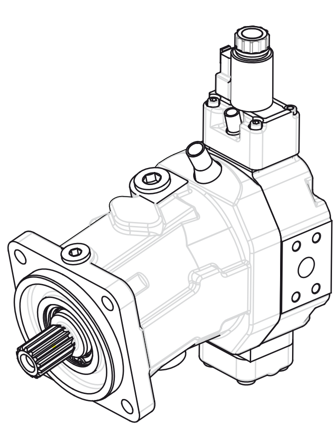
Switching solenoid **a** on the travel direction valve

Dimensions size 55

EP5, EP6 – Proportional electric control, negative control

Port plate 2 — SAE flange ports A and B at side, opposite



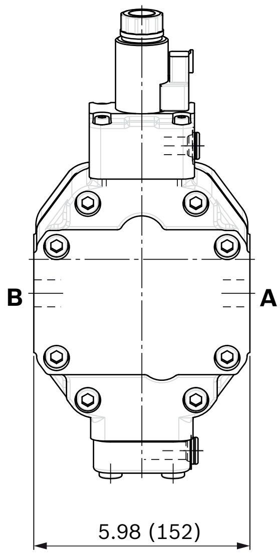


1) Center of gravity

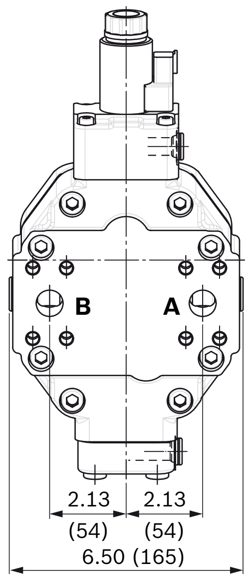
2) Port plate 1 — SAE flange ports **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

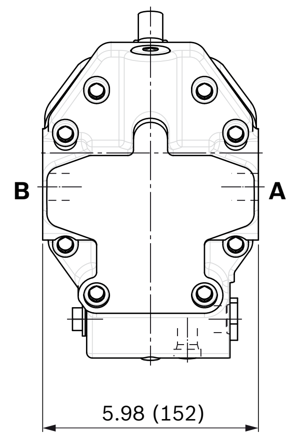
2 SAE flange port
A and **B** at side,
opposite



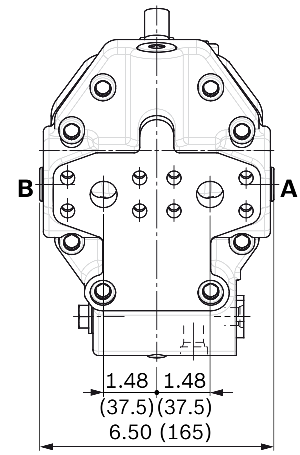
1 SAE flange port
A and **B** at rear



2 SAE flange port
A and **B** at side, opposite
only HZ7, EZ7/8

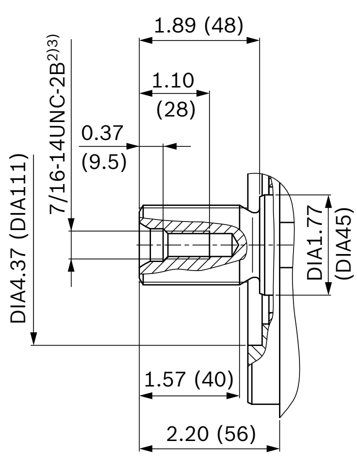


1 SAE flange port
A and **B** at rear
only HZ7, EZ7/8



▼ **Splined shaft SAE J744**

S7 – 1 1/4 in 14T 12/24DP[1)]

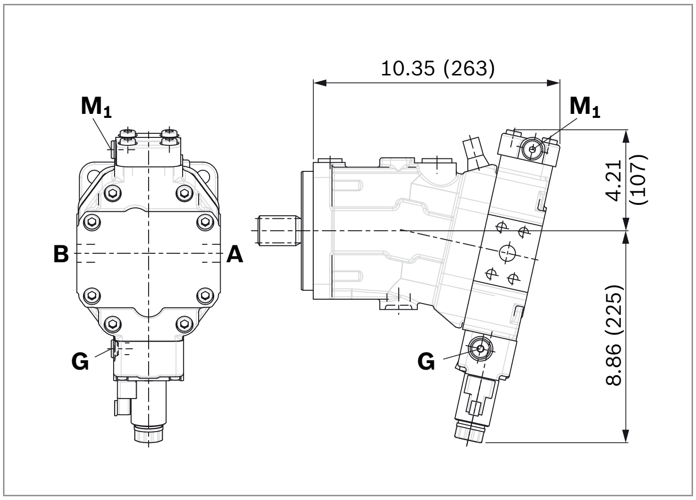


1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual

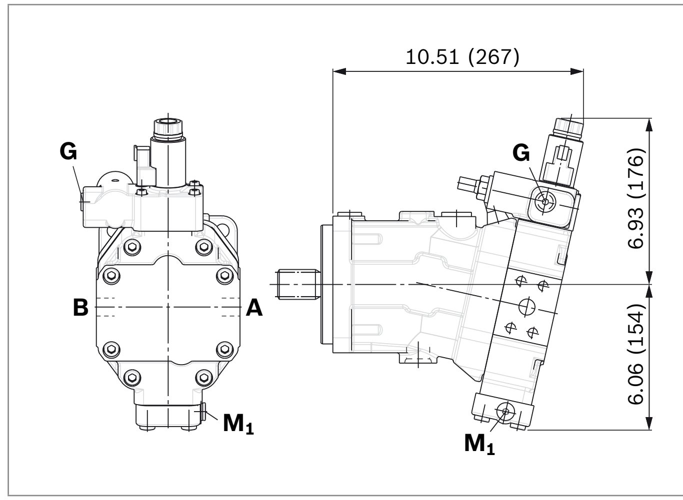
Ports		Standard	Size[1]	$p_{\text{max abs}}$ [psi (bar)][2]	Status[7]
A, B[5]	Working port Mounting bolt A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	3/4 in 3/8 in - 16 UNC-2B; 0.83 (21) deep	6500 psi (450 bar)	O
$\mathbf{T_1}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
$\mathbf{T_2}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X
U	Bearing flushing	ISO11926[6]	7/8 in -14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1, HA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	45 (3)	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	580 (40)	O
$\mathbf{X_1}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	O
$\mathbf{X_3}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	X
$\mathbf{M_1}$	Measuring stroking chamber	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X

1) For notes on tightening torques, see instruction manual
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 71).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

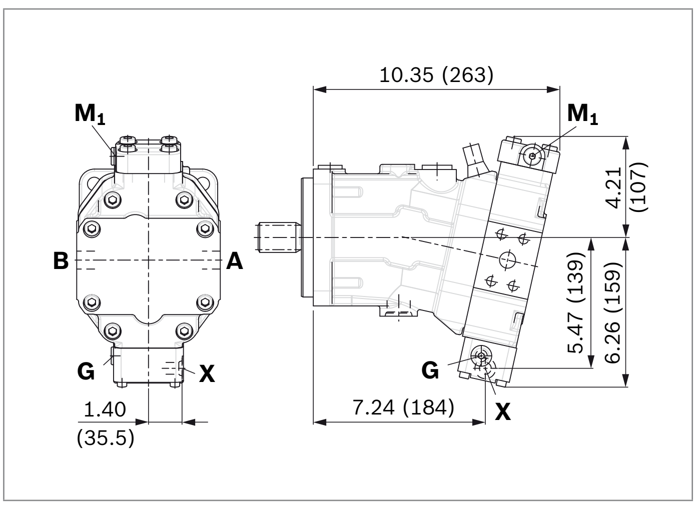
▼ **EP1, EP2** – Electric proportional control, positive control



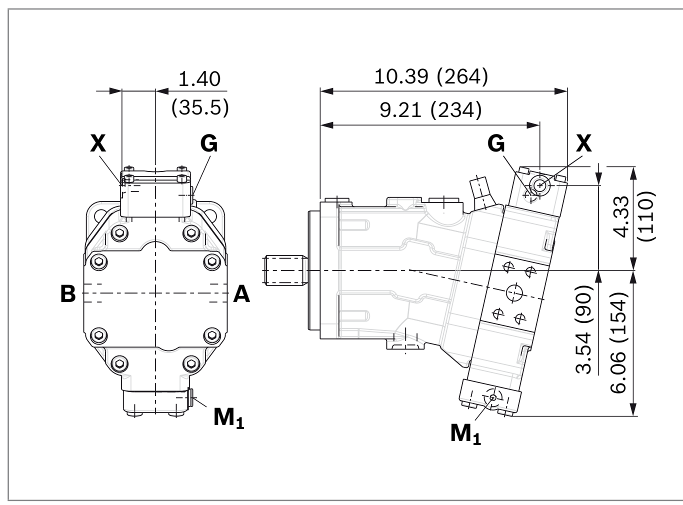
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



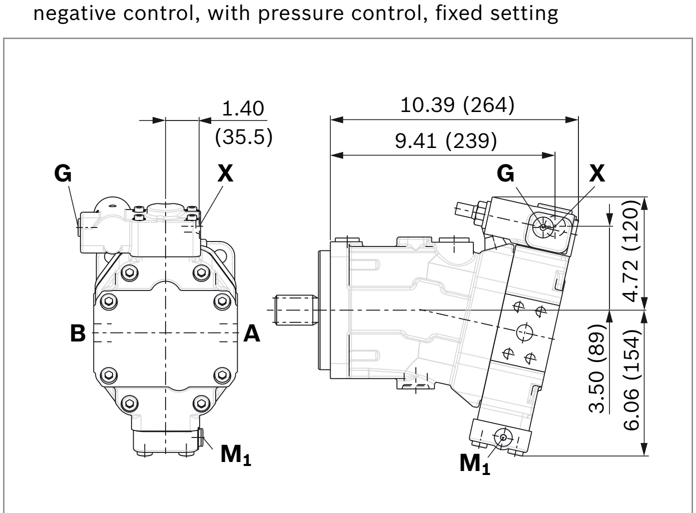
▼ **HP1, HP2** – Hydraulic proportional control, positive control



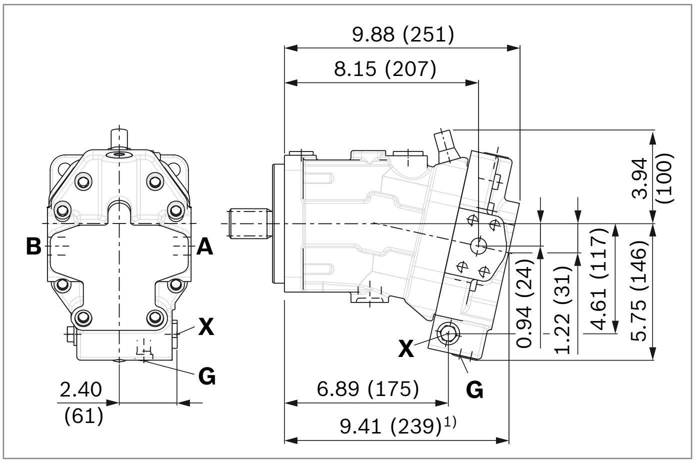
▼ **HP5, HP6** – Hydraulic proportional control, negative control



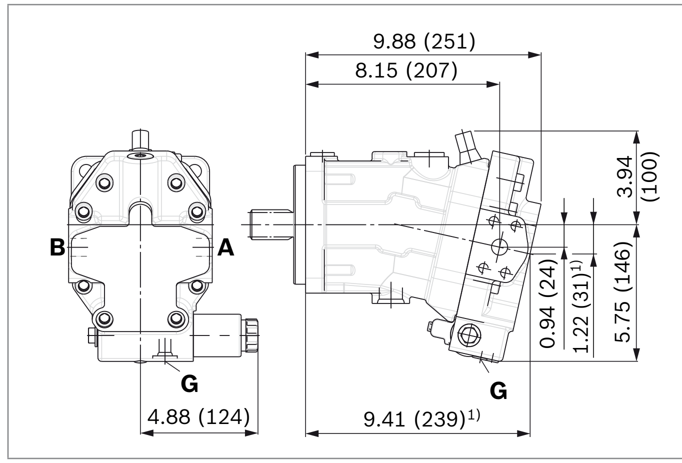
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



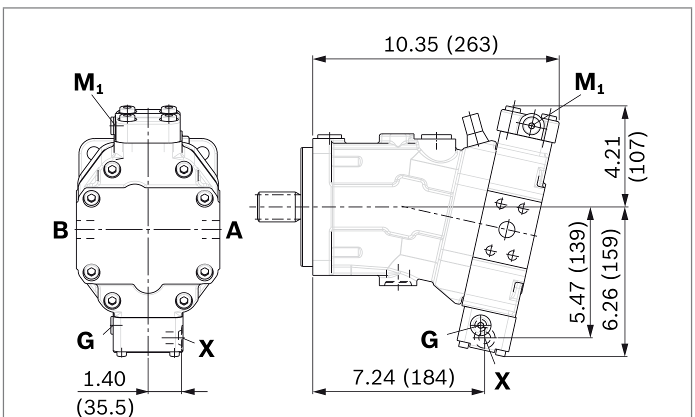
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control



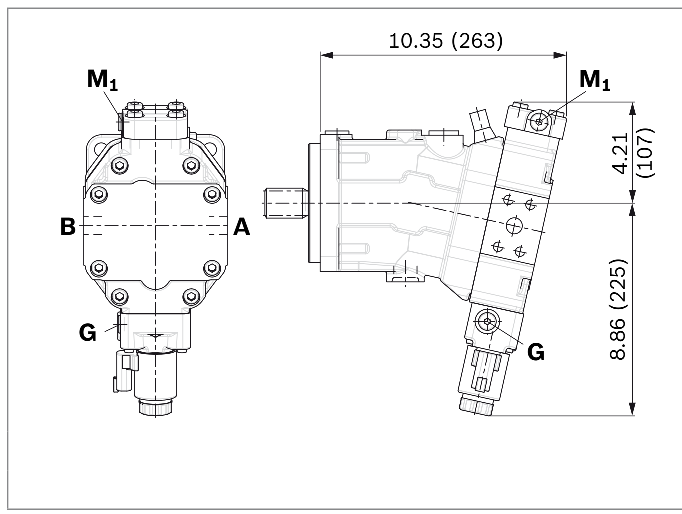
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



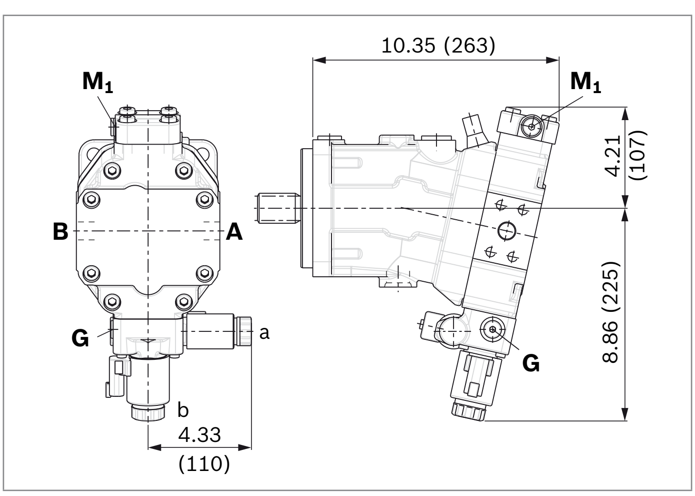
HA1 and HA2, X plugged

HA1T and HA2T, X open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

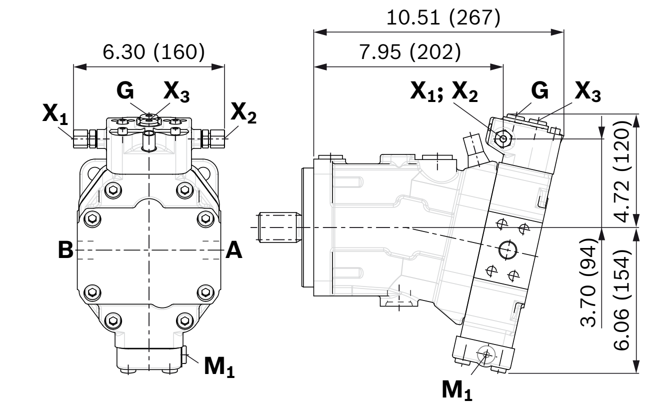


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE flange ports A and B at rear

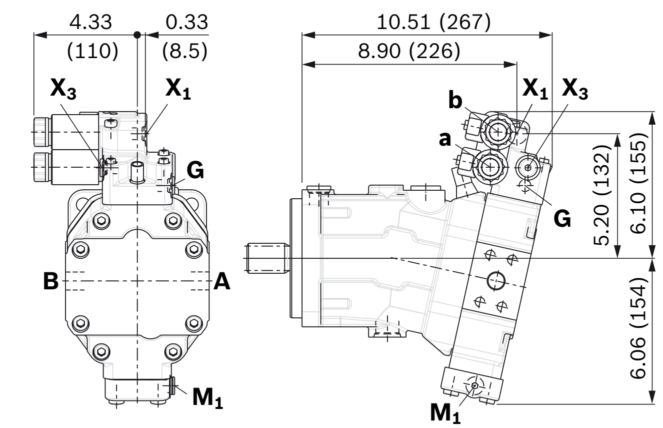
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X_1, X_2 pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

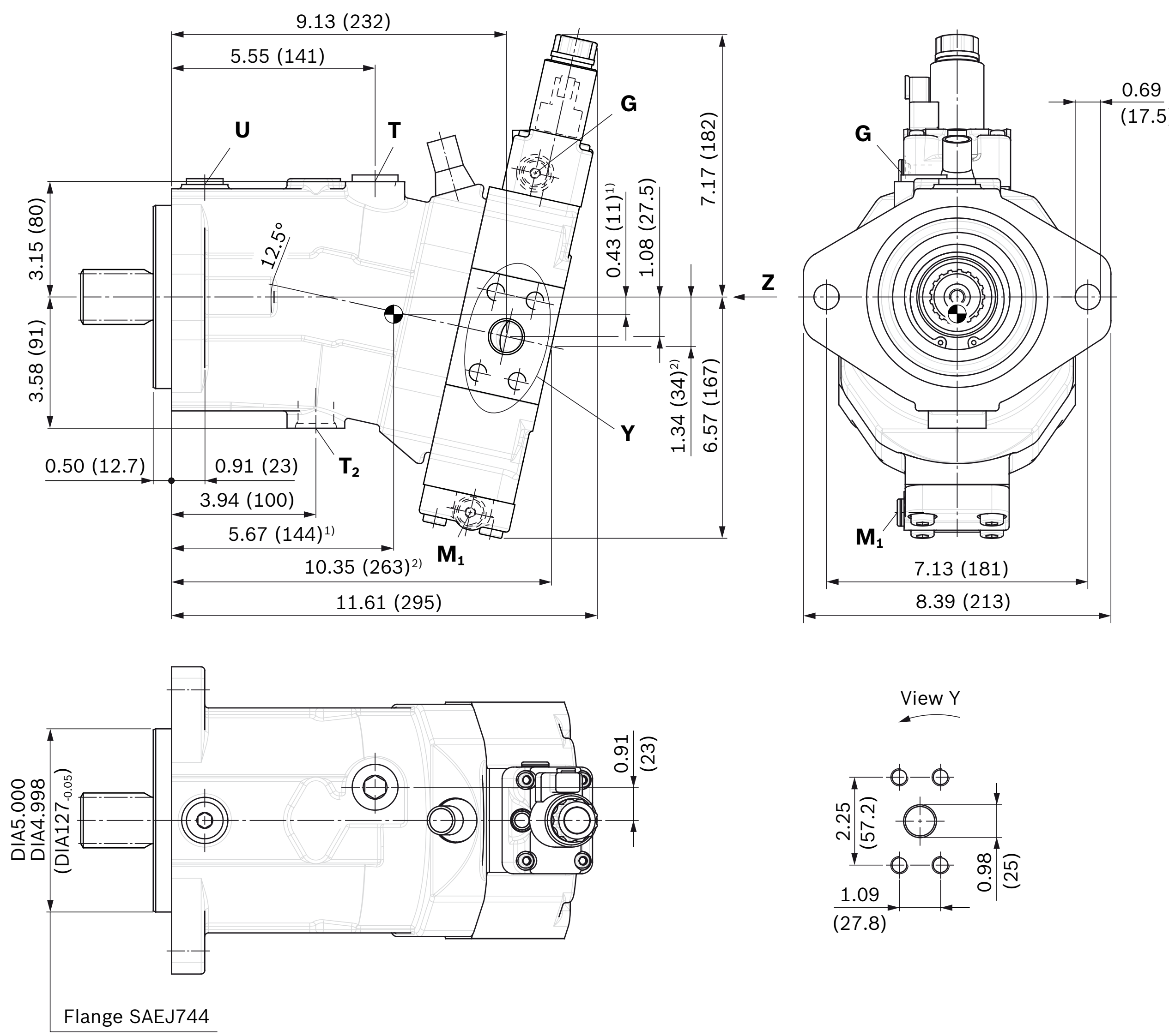
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ switch

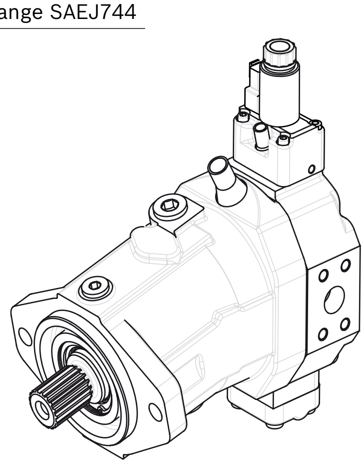


Dimensions size 80

EP5, EP6 – Proportional electric control, negative control

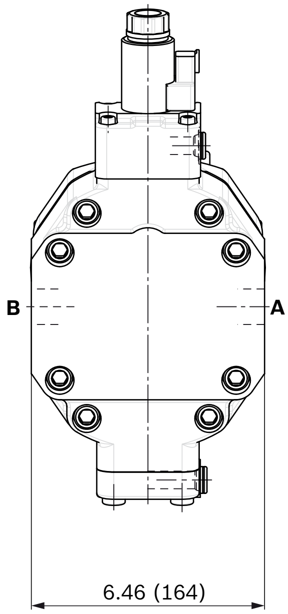
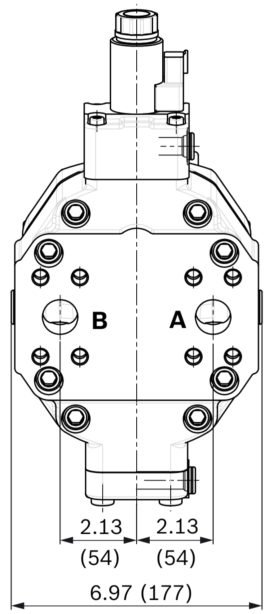
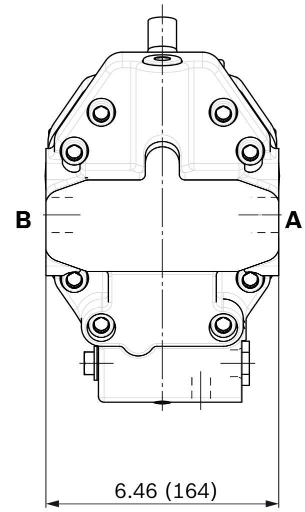
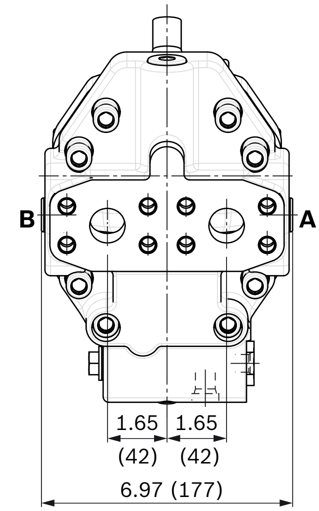
Port plate 2 — SAE flange ports A and B at side, opposite





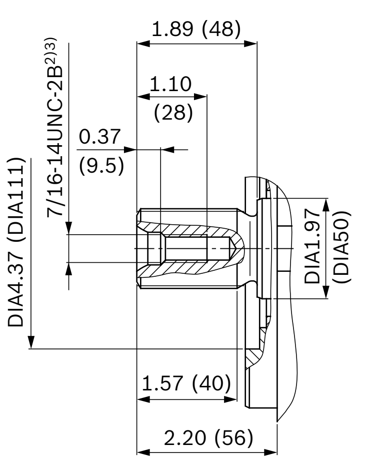
1) Center of gravity
2) Port plate 1 — SAE flange ports **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

2 SAE flange port **A** and **B** at side, opposite	**1** SAE flange port **A** and **B** at rear	**2** SAE flange port **A** and **B** at side, opposite only HZ7, EZ7/8	**1** SAE flange port **A** and **B** at rear only HZ7, EZ7/8
			

▼ **Splined shaft SAE J744**

S7 – 1 1/4 in 14T 12/24DP[1)]

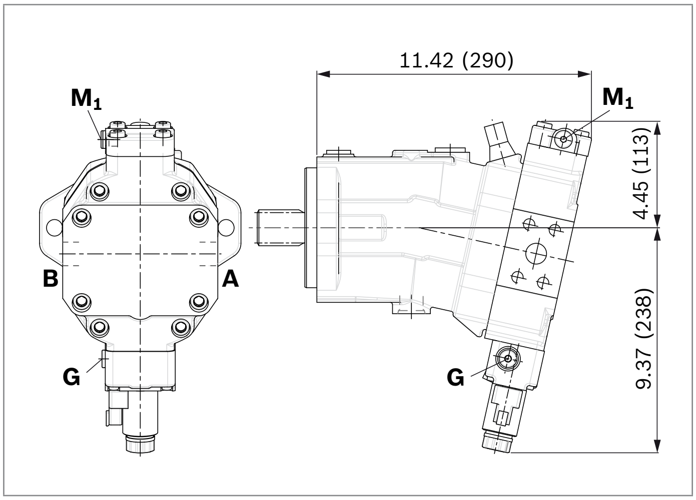


1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual

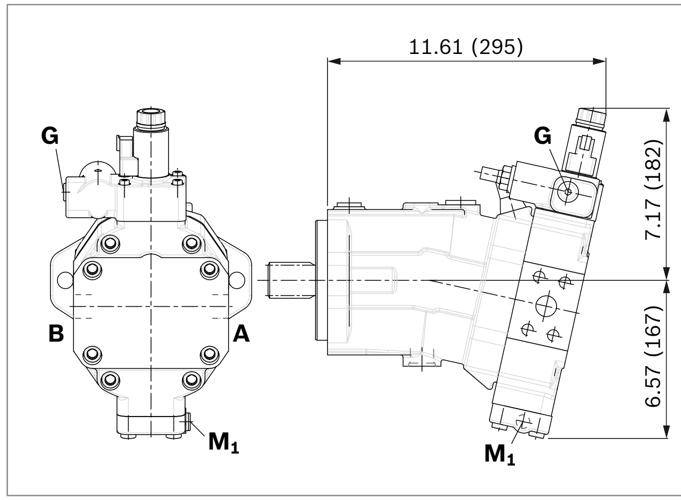
Ports		Standard	Size[1]	$p_{\text{max abs}}$ [psi (bar)][2]	Status[7]
A, B[5]	Service line port Mounting bolt A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 in 7/16 in -14 UNC-2B; 0.87 (22) deep	6500 psi (450 bar)	O
$\mathbf{T_1}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
$\mathbf{T_2}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X
U	Bearing flushing	ISO11926[6]	7/8 in -14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1, HA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	45 (3)	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	580 (40)	O
$\mathbf{X_1}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	O
$\mathbf{X_3}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	X
$\mathbf{M_1}$	Measuring stroking chamber	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X

1) For notes on tightening torques, see instruction manual
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 71).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

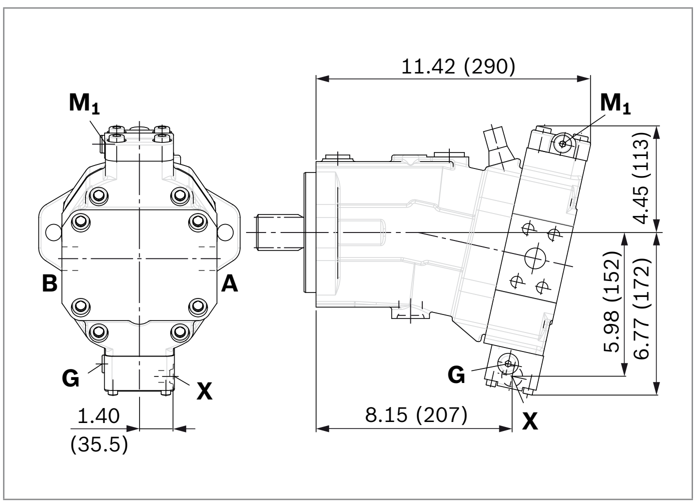
▼ **EP1, EP2** – Electric proportional control, positive control



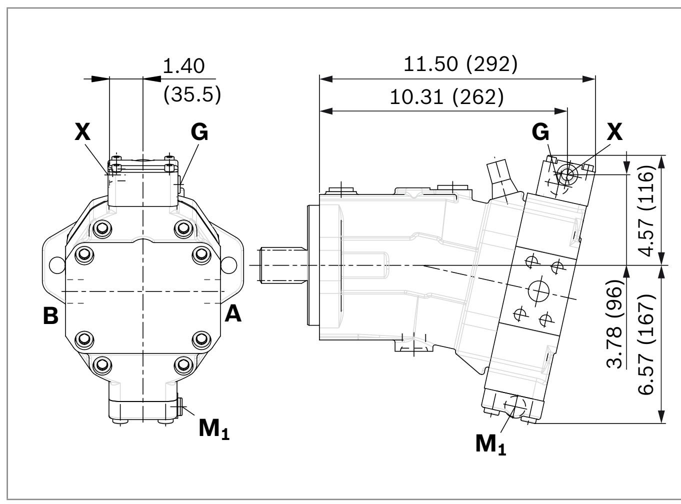
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



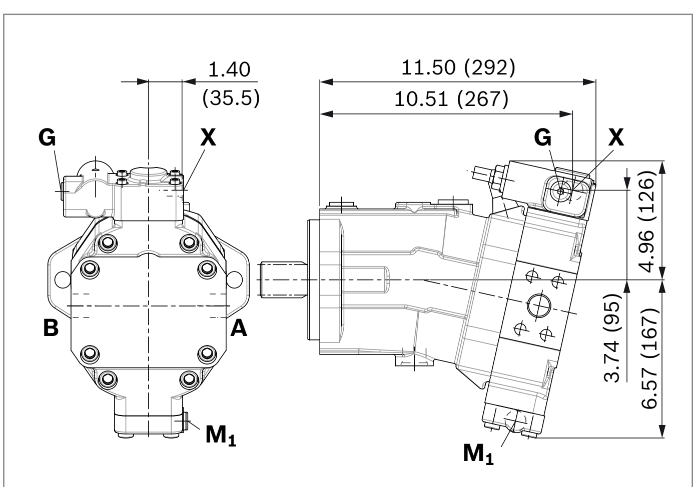
▼ **HP1, HP2** – Hydraulic proportional control, positive control



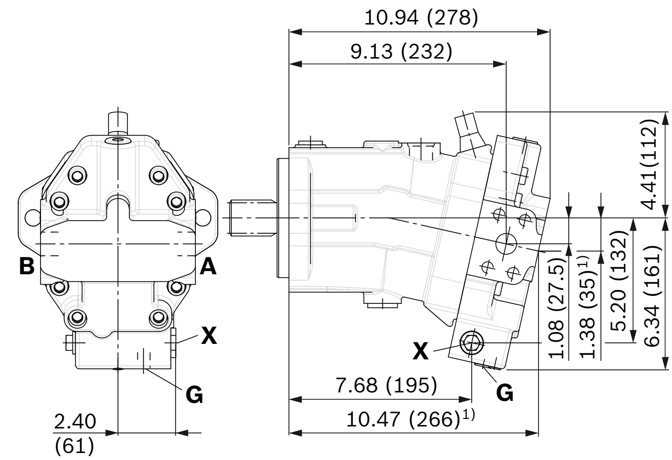
▼ **HP5, HP6** – Hydraulic proportional control, negative control



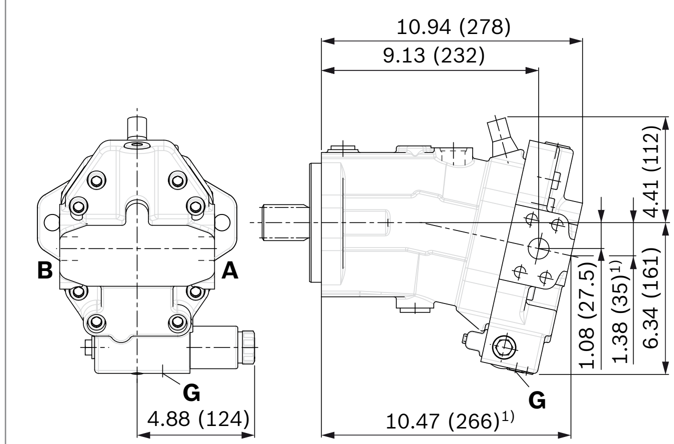
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



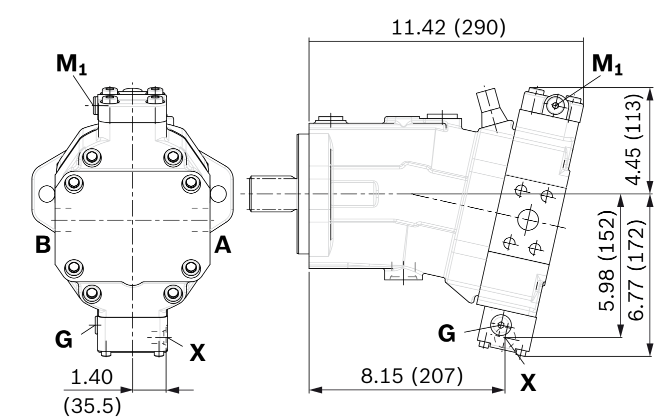
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control



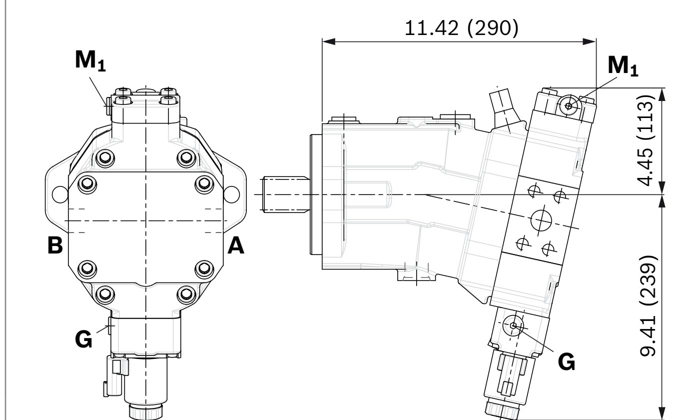
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



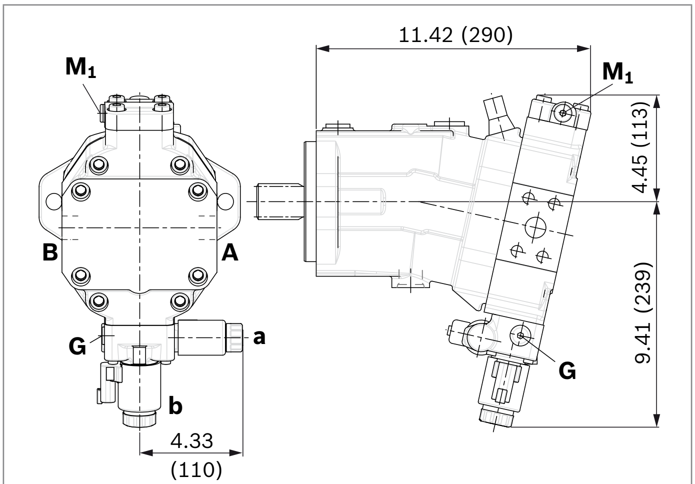
HA1 and HA2, X plugged

HA1T and HA2T, X open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

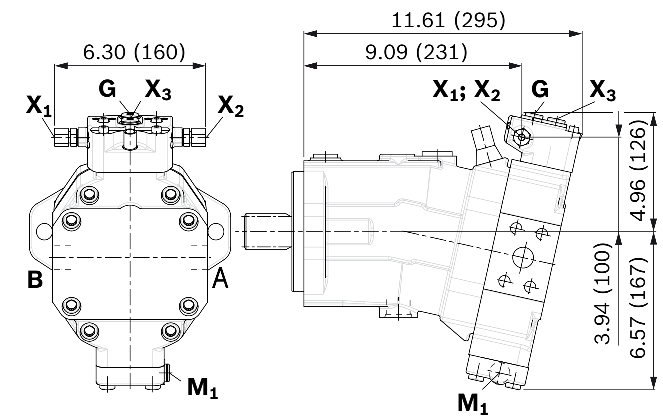


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE flange ports A and B at rear

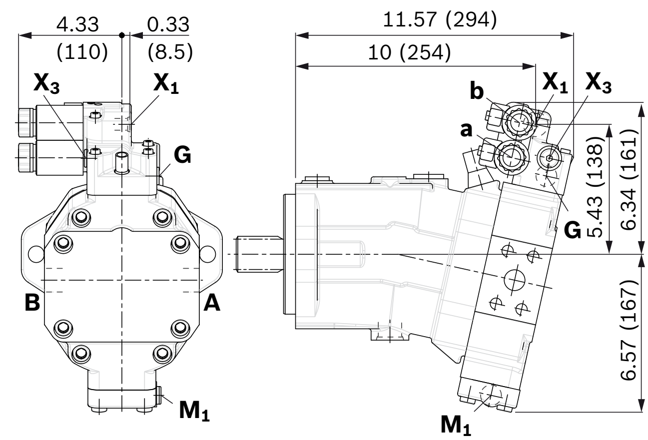
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X_1, X_2 pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

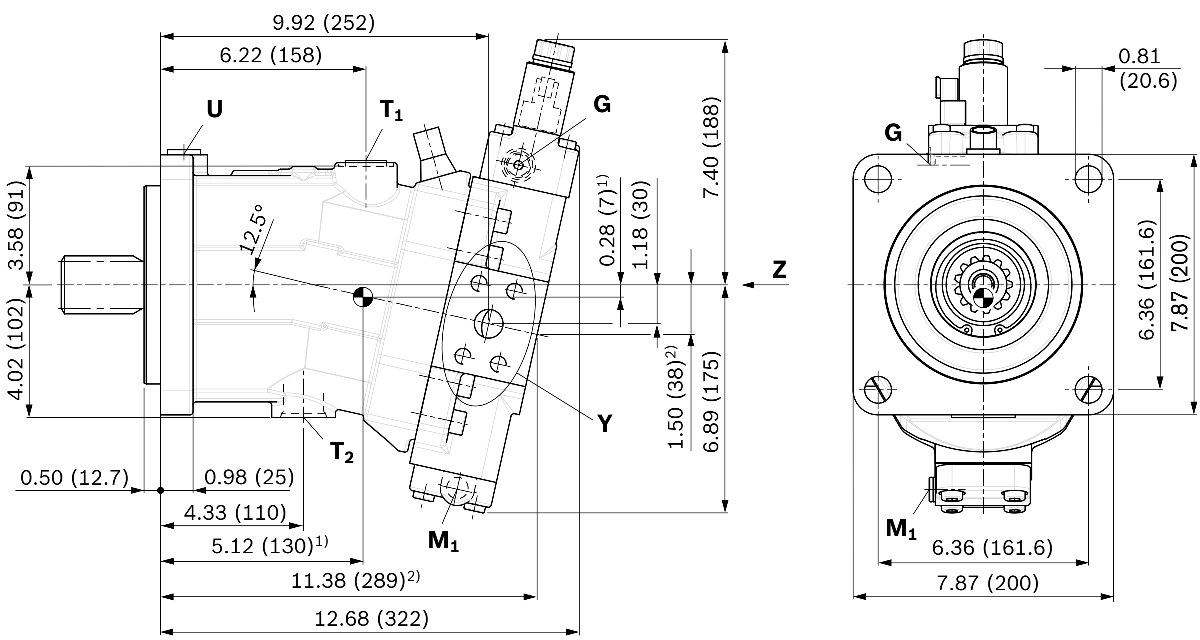
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ switch

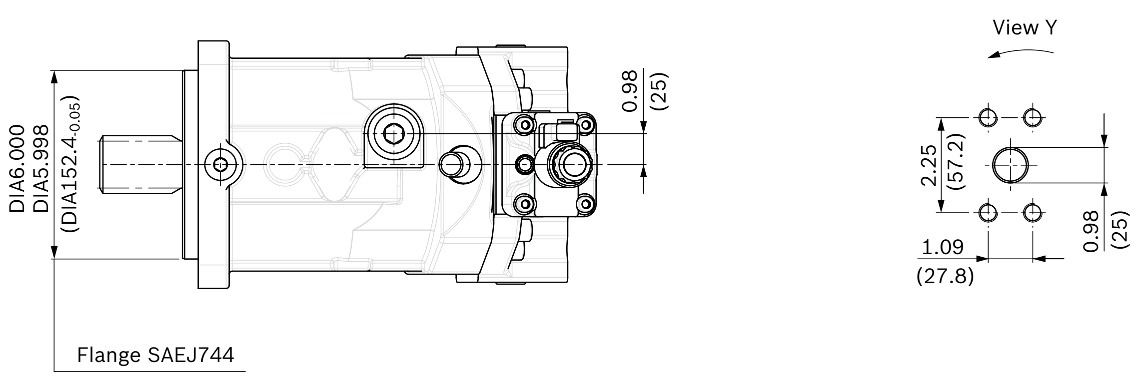


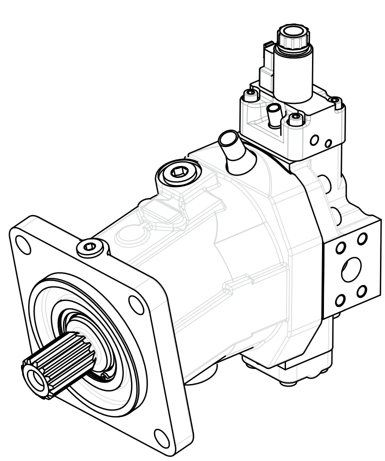
Dimensions size 107

EP5, EP6 – Proportional electric control, negative control

Port plate 2 — SAE flange ports A and B at side, opposite



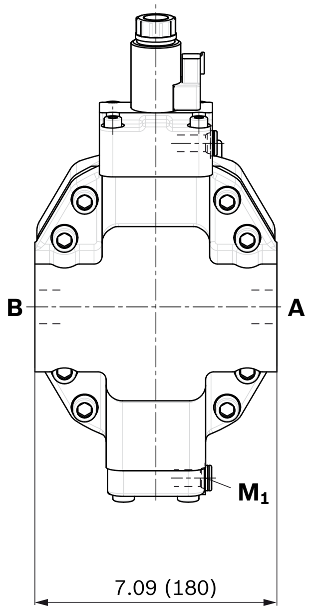




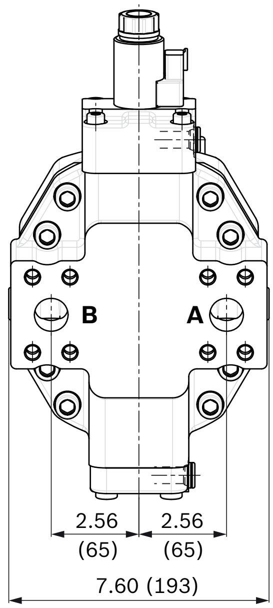
1) Center of gravity
2) Port plate 1 — SAE flange ports **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

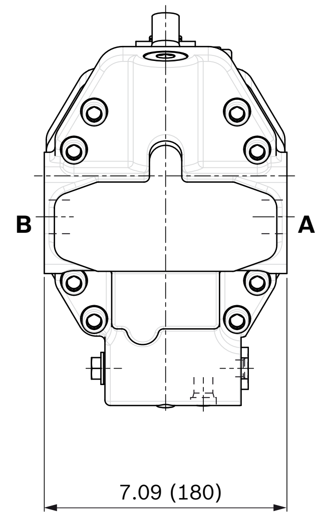
2 SAE flange port
A and **B** at side,
opposite



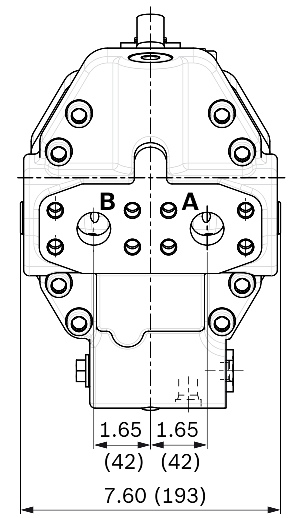
1 SAE flange port
A and **B** at rear



2 SAE flange port
A and **B** at side, opposite
only HZ7, EZ7/8

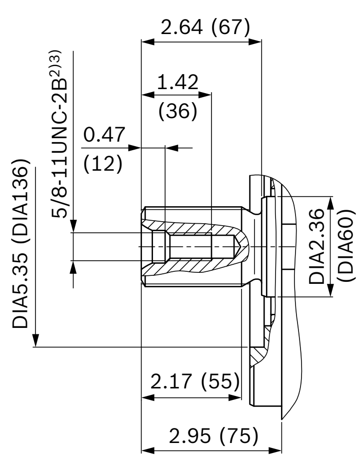


1 SAE flange port
A and **B** at rear
only HZ7, EZ7/8



▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/16 DP[1)]

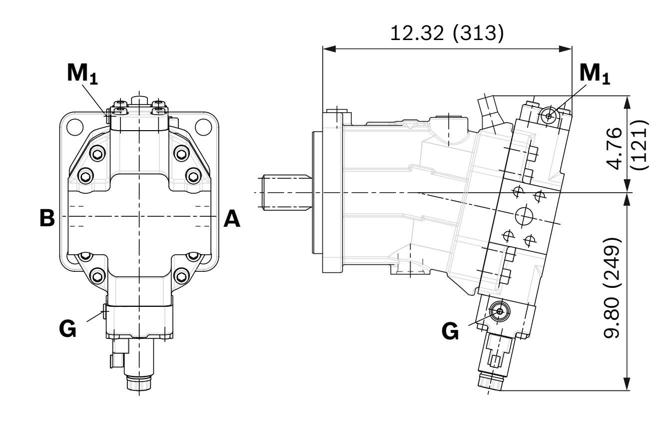


1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual

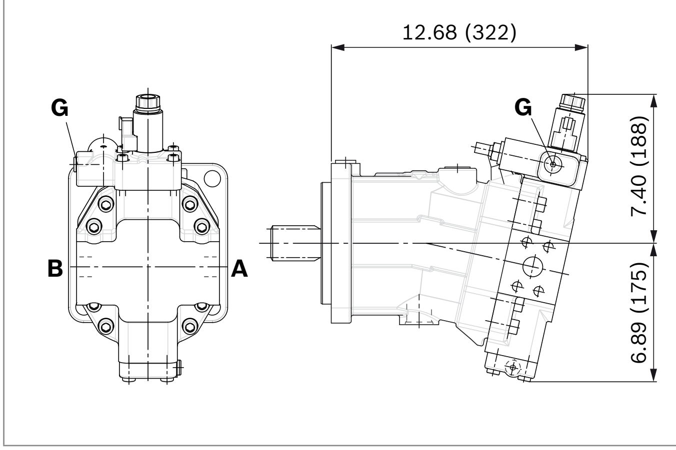
Ports		Standard	Size[1]	$p_{\text{max abs}}$ [psi (bar)][2]	Status[7]
A, B[5]	Working port Mounting bolt A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 in 7/16 in -14 UNC-2B; 0.87 (22) deep	6500 psi (450 bar)	O
$\mathbf{T_1}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
$\mathbf{T_2}$	Drain port	ISO 11926[6]	1 5/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X
U	Bearing flushing	ISO11926[6]	7/8 in -14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1, HA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	45 (3)	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	580 (40)	O
$\mathbf{X_1}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	O
$\mathbf{X_3}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	X
$\mathbf{M_1}$	Measuring stroking chamber	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X

1) For notes on tightening torques, see instruction manual
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 71).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

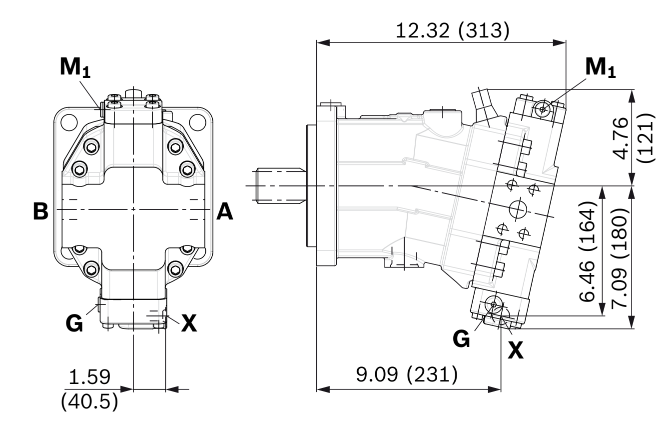
▼ **EP1, EP2** – Electric proportional control, positive control



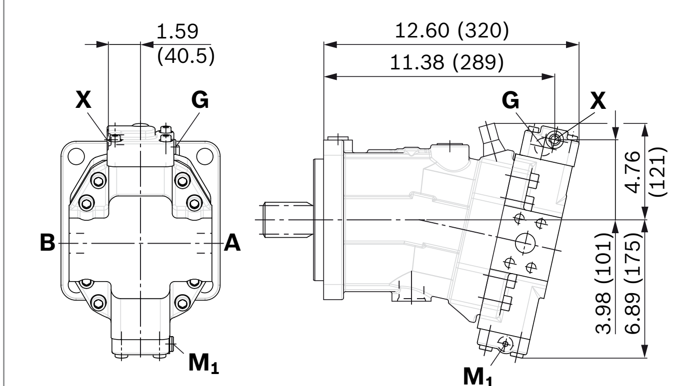
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



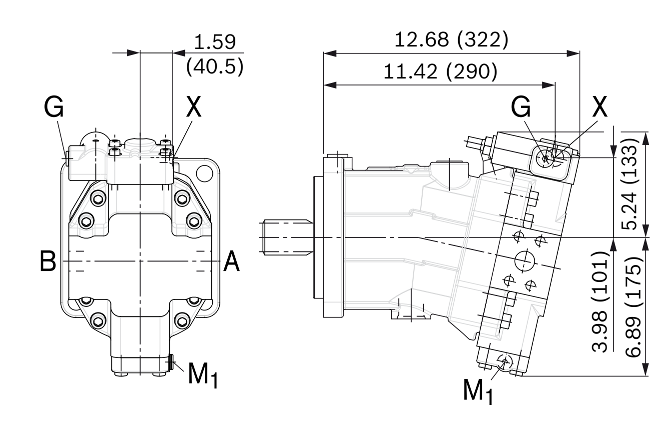
▼ **HP1, HP2** – Hydraulic proportional control, positive control



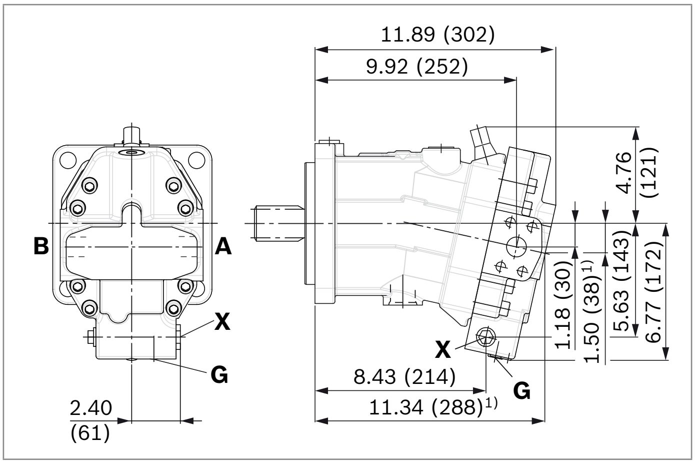
▼ **HP5, HP6** – Hydraulic proportional control, negative control



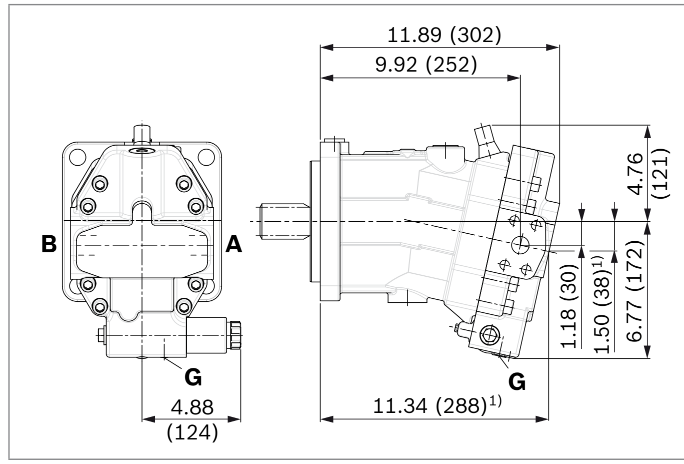
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



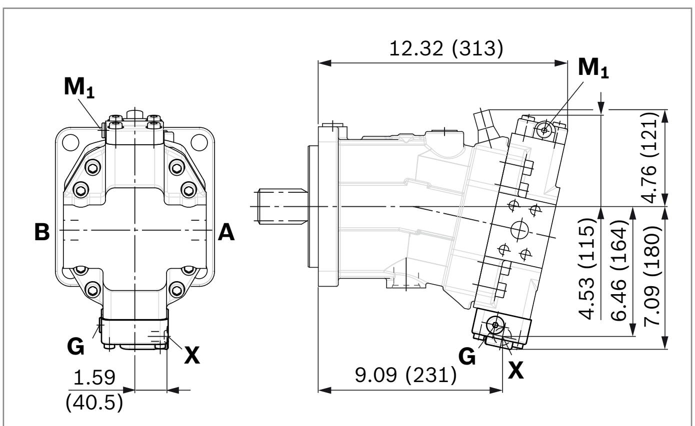
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control



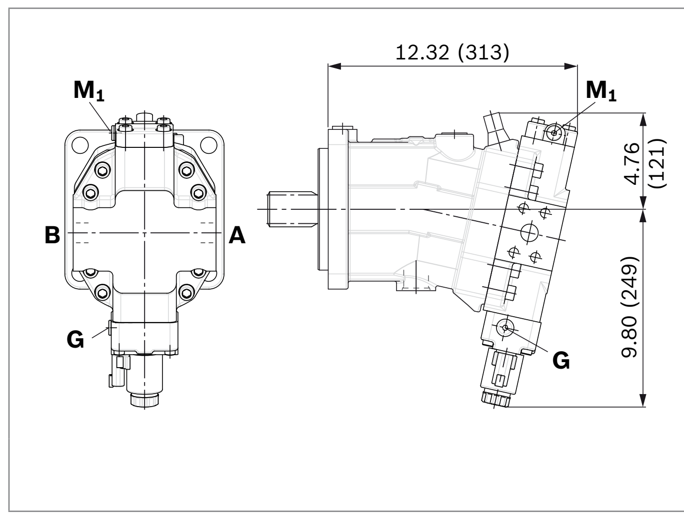
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



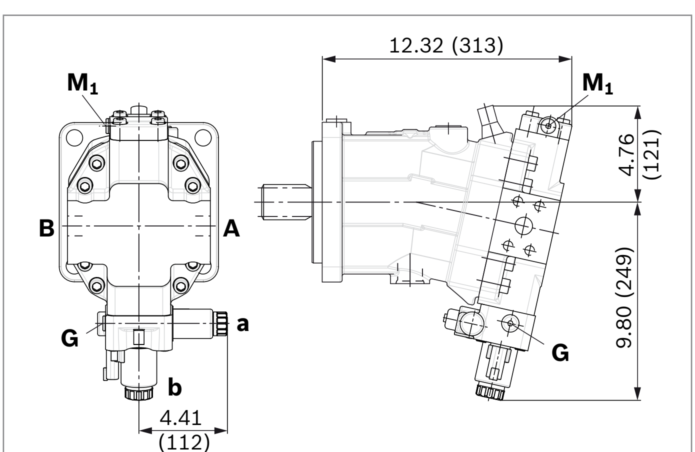
HA1 and HA2, X plugged

HA1T and HA2T, X open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

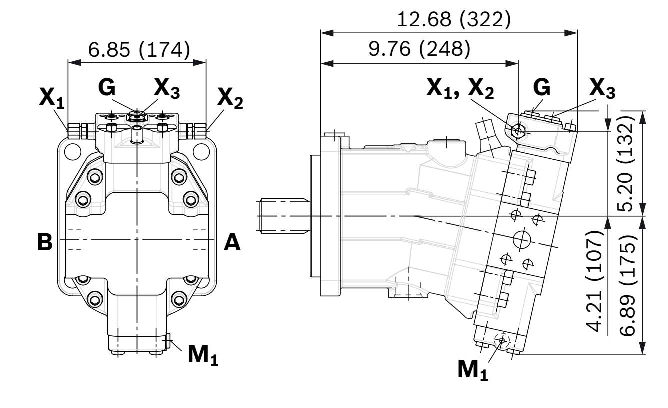


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE flange ports A and B at rear

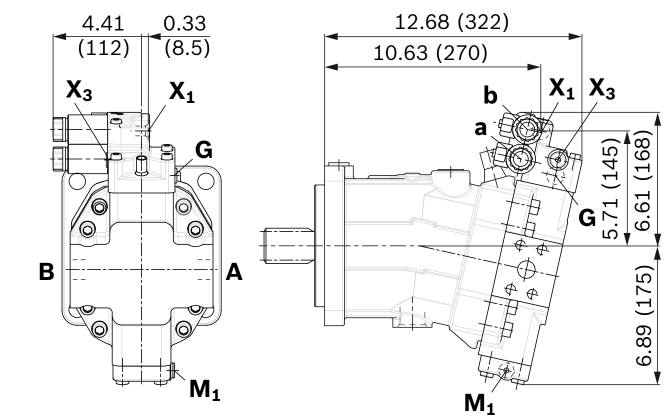
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X_1, X_2 pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

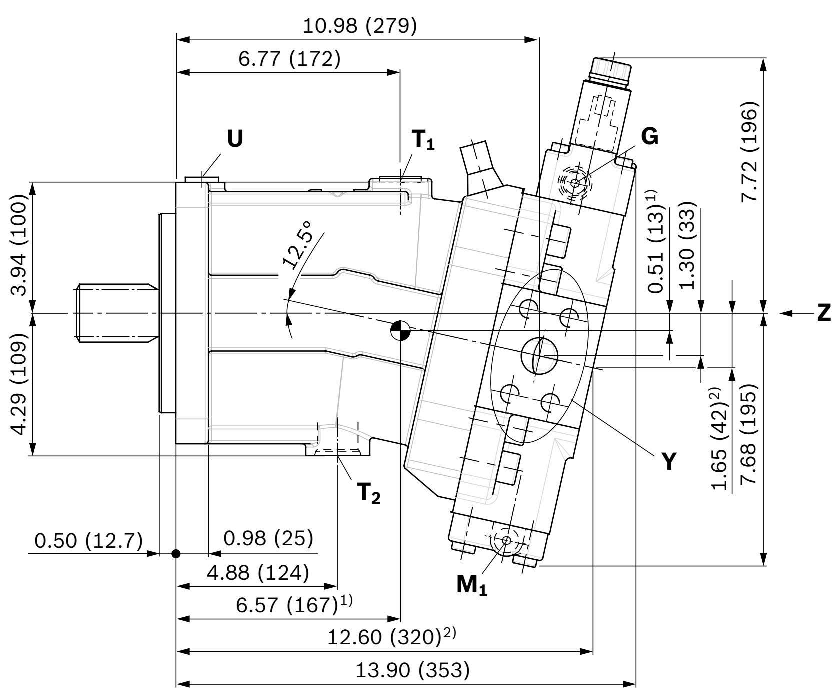
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ switch

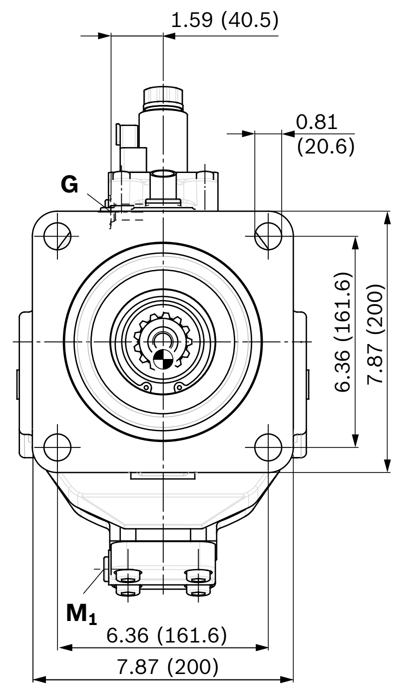


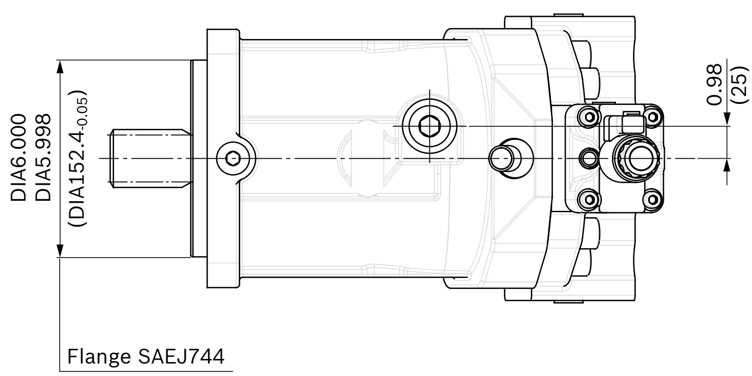
Dimensions size 140

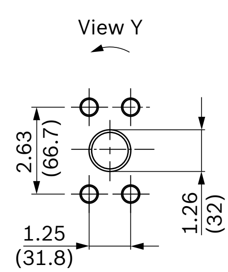
EP5, EP6 – Proportional electric control, negative control

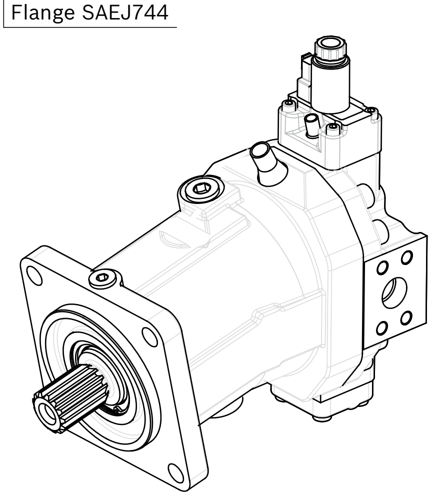
Port plate 2 — SAE flange ports A and B at side, opposite







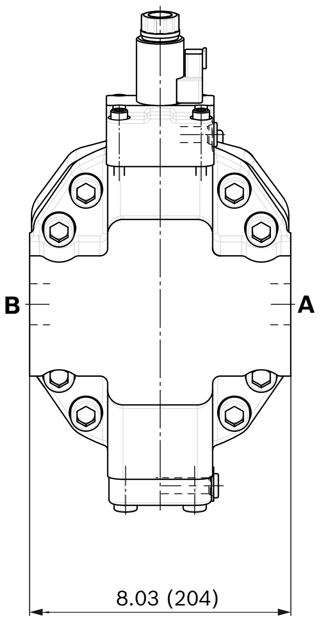




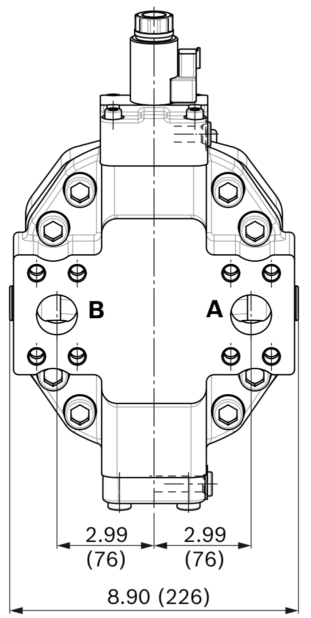
1) Center of gravity
2) Port plate 1 — SAE flange ports **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

2 SAE flange port **A** and **B** at side, opposite

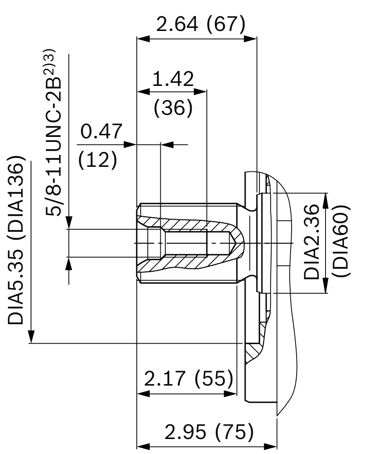


1 SAE flange port **A** and **B** at rear



▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/16DP[1]

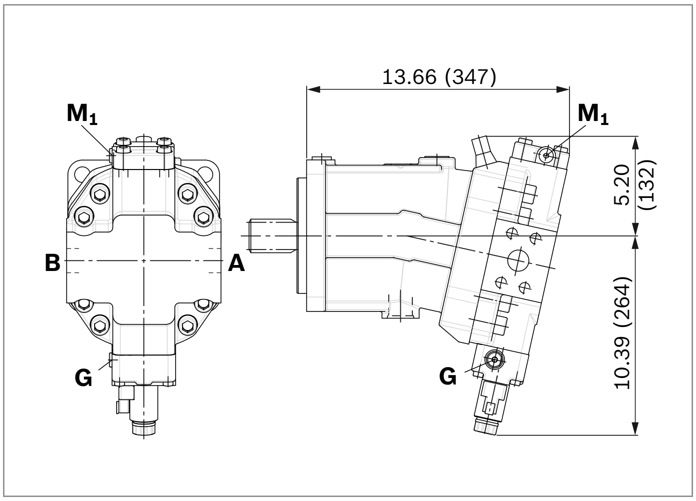


1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual

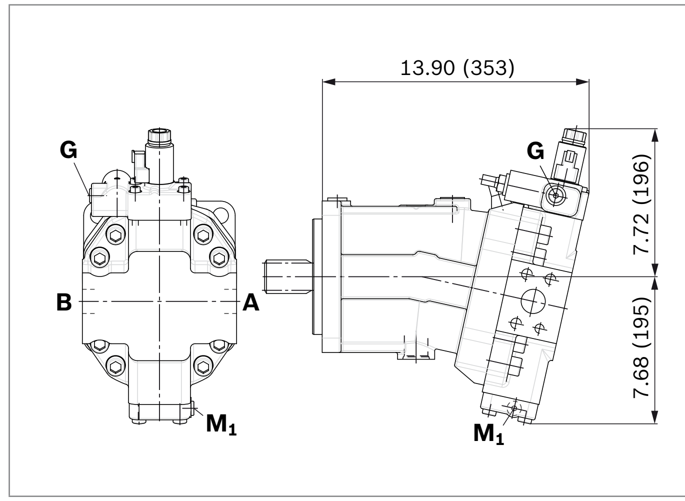
Ports		**Standard**	**Size**[1]	$p_{\text{max abs}}$ **[psi (bar)]**[2]	**Status**[7]
A, B[5]	Working port Mounting bolt A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 1/4 in 1/2 in -13 UNC-2B; 0.75 (19) deep	6500 psi (450 bar)	O
$\mathbf{T_1}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
$\mathbf{T_2}$	Drain port	ISO 11926[6]	1 5/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X
U	Bearing flushing	ISO11926[6]	7/8 in -14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1, HA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	45 (3)	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	580 (40)	O
$\mathbf{X_1}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	O
$\mathbf{X_3}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	X
$\mathbf{M_1}$	Measuring stroking chamber	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X

1) For notes on tightening torques, see instruction manual
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 71).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

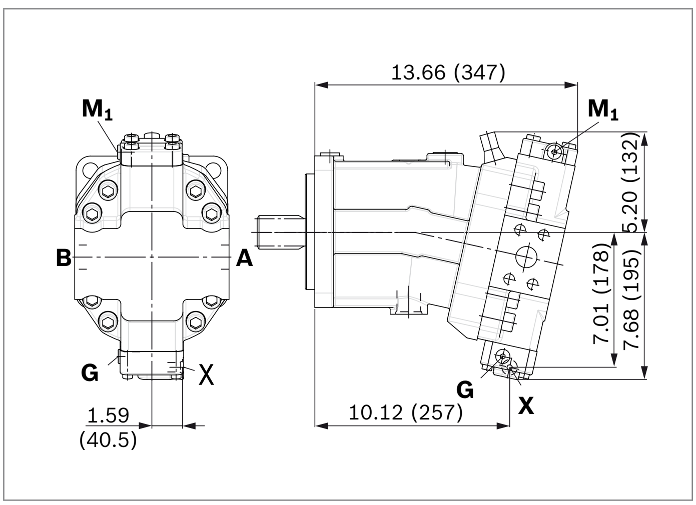
▼ **EP1, EP2** – Electric proportional control, positive control



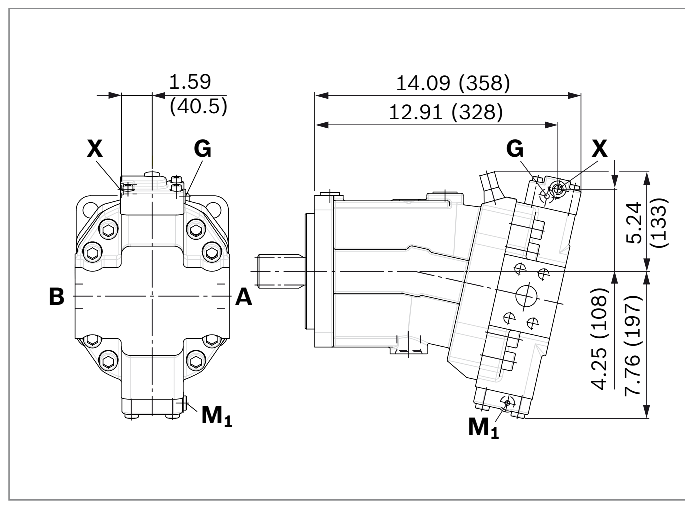
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



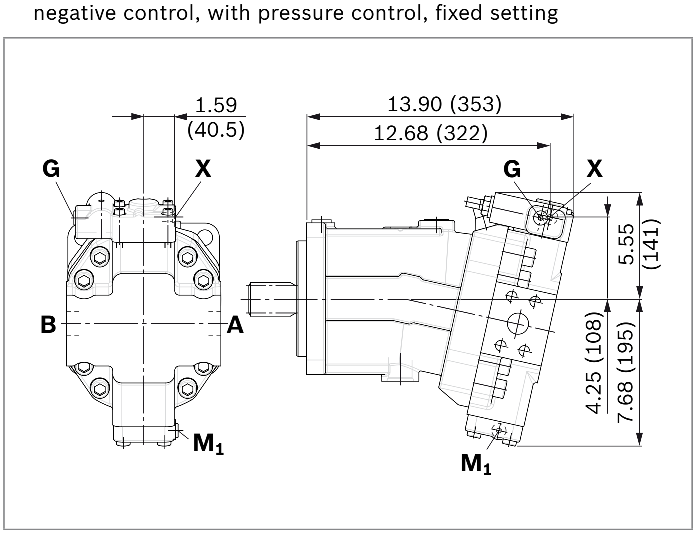
▼ **HP1, HP2** – Hydraulic proportional control, positive control



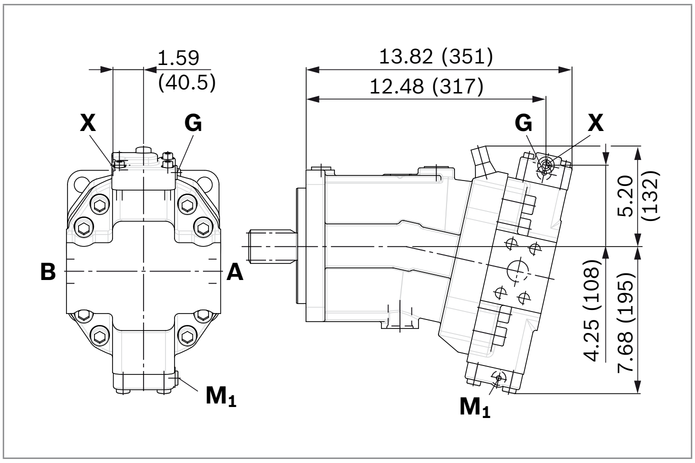
▼ **HP5, HP6** – Hydraulic proportional control, negative control



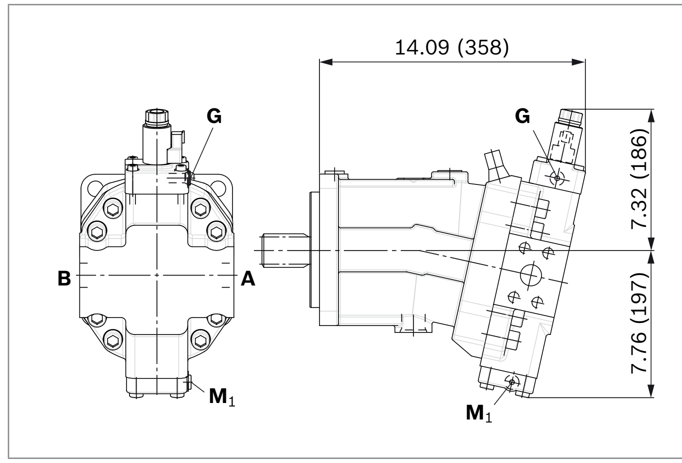
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



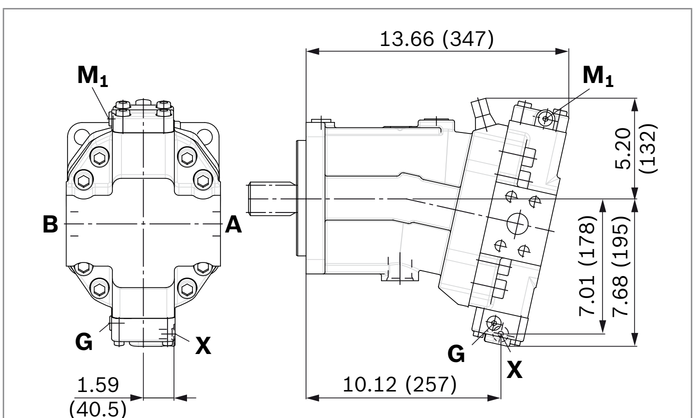
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control

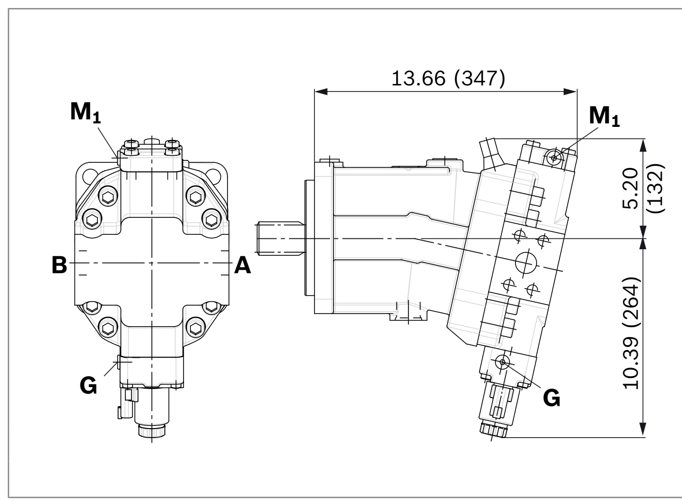


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

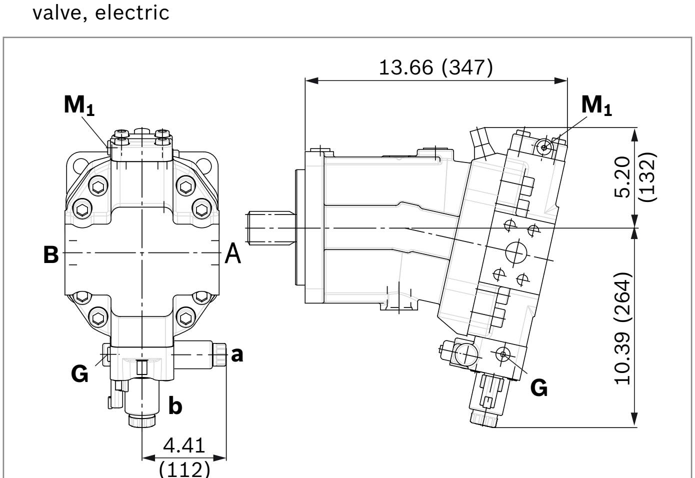


HA1 and HA2, X plugged
HA1T and HA2T, X open

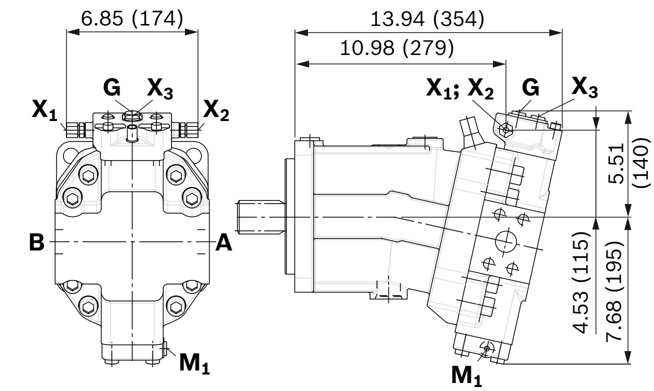
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric

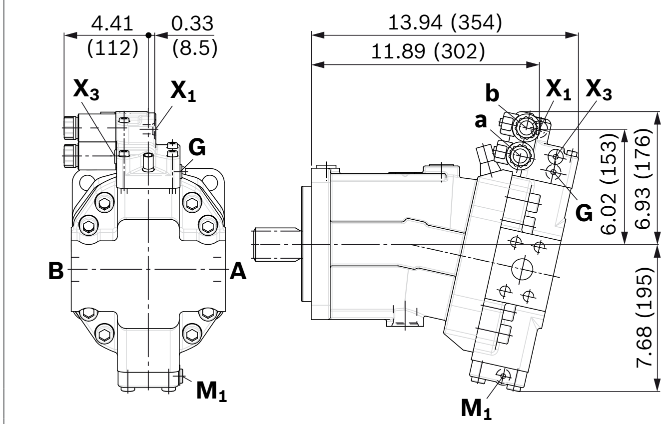


▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



$\mathbf{X}_1$, $\mathbf{X}_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1
Use assembled fitting!

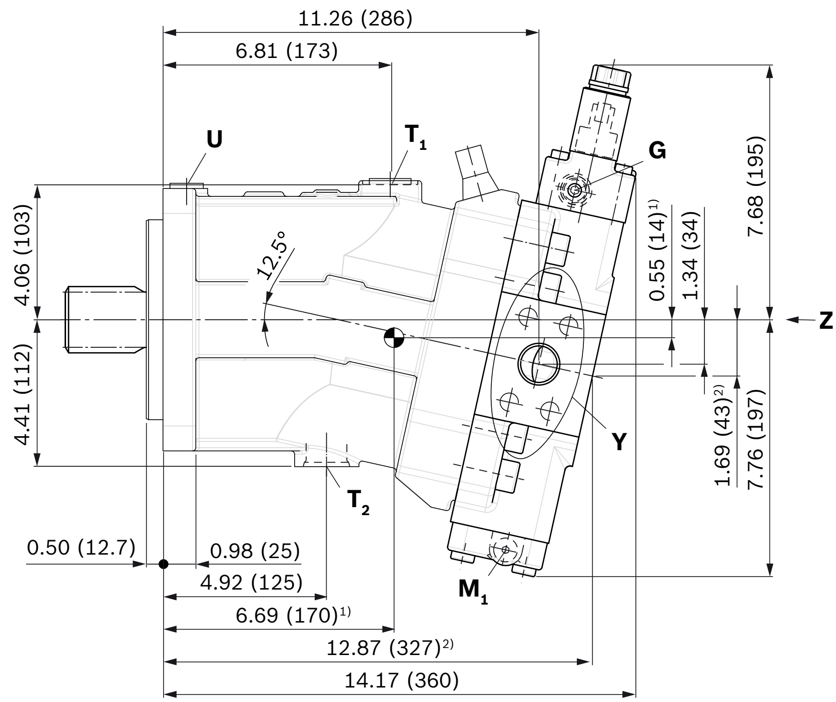
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ switch

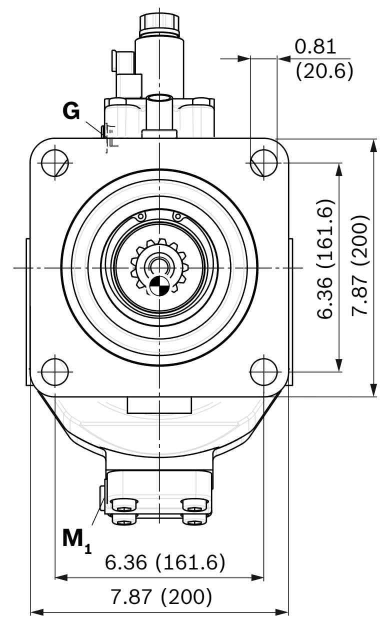


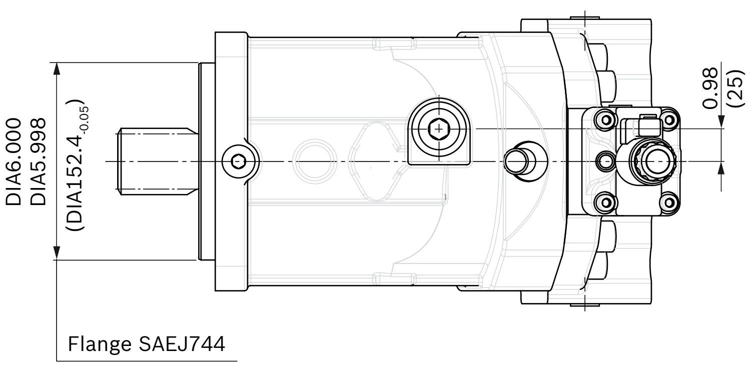
Dimensions size 160

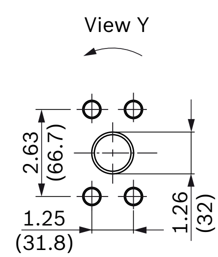
EP5, EP6 – Proportional electric control, negative control

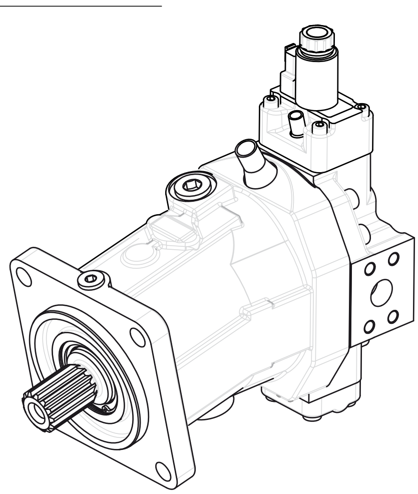
Port plate 2 – SAE flange ports A and B at side, opposite







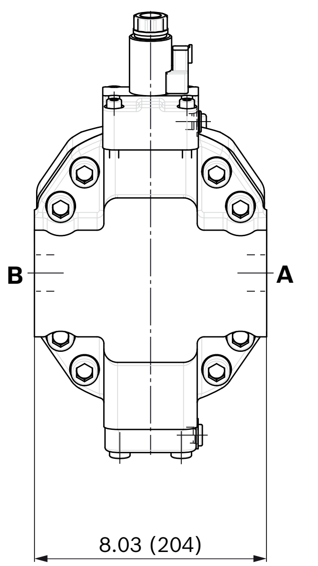
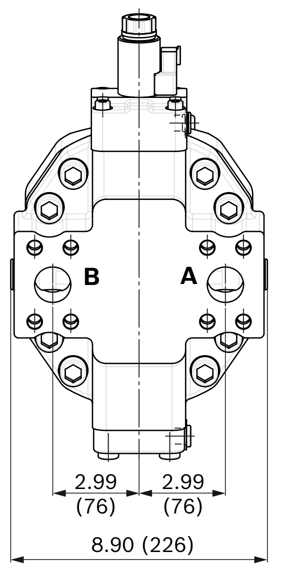




1) Center of gravity

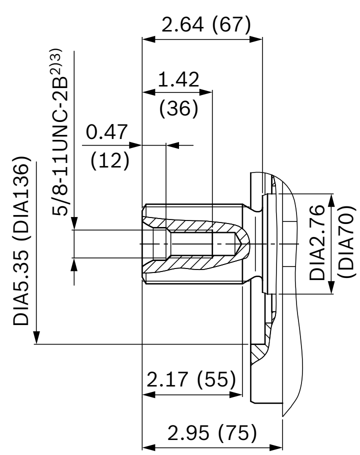
2) Port plate 1 – SAE flange ports **A** and **B** at rear

▼ Location of the service line ports on the port plates (view Z)

2 SAE flange port **A** and **B** at side, opposite	**1** SAE flange port **A** and **B** at rear
	

▼ Splined shaft SAE J744

T1 – 1 3/4 in 13T 8/16 DP[1]

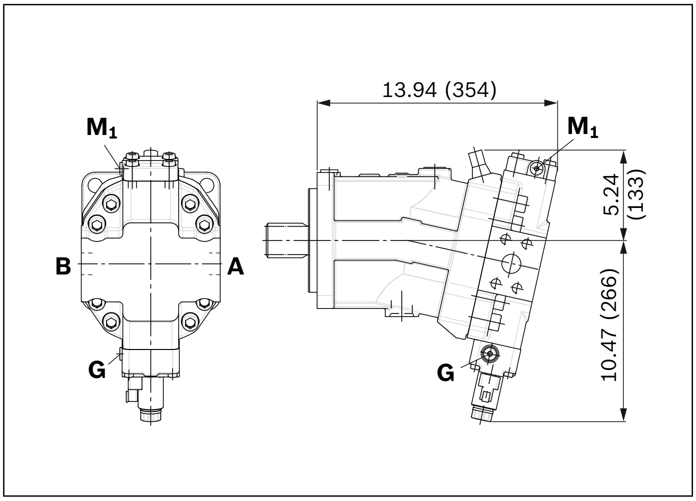


1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual

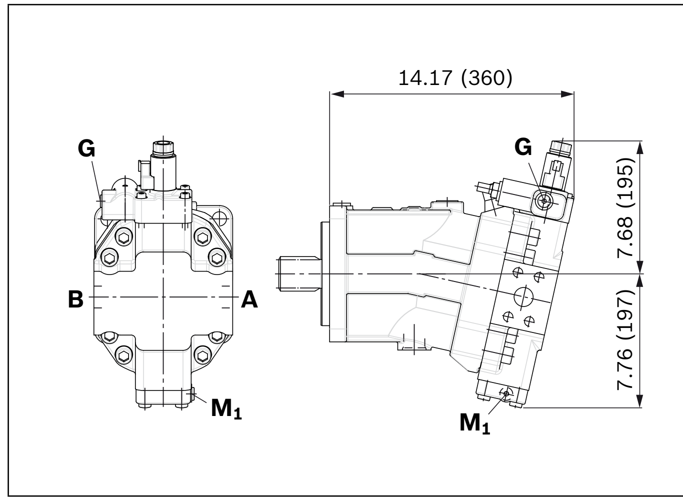
Ports		Standard	Size[1]	$p_{\text{max abs}}$ [psi (bar)][2]	Status[7]
A, B[5]	Working port Mounting bolt A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 1/4 in 1/2 in -13 UNC-2B; 0.75 (19) deep	6500 psi (450 bar)	O
$\mathbf{T_1}$	Drain port	ISO 11926[6]	1 1/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
$\mathbf{T_2}$	Drain port	ISO 11926[6]	1 5/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X
U	Bearing flushing	ISO11926[6]	7/8 in -14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1, HA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	45 (3)	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	580 (40)	O
$\mathbf{X_1}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	O
$\mathbf{X_3}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	X
$\mathbf{M_1}$	Measuring stroking chamber	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X

1) For notes on tightening torques, see instruction manual
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 71).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

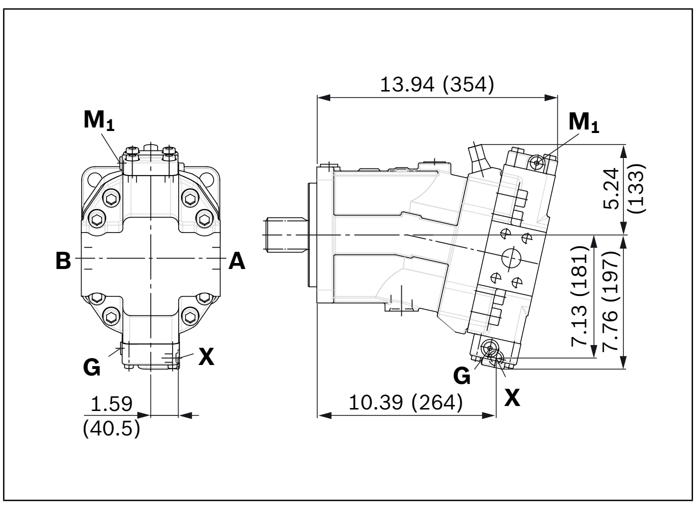
▼ **EP1, EP2** – Electric proportional control, positive control



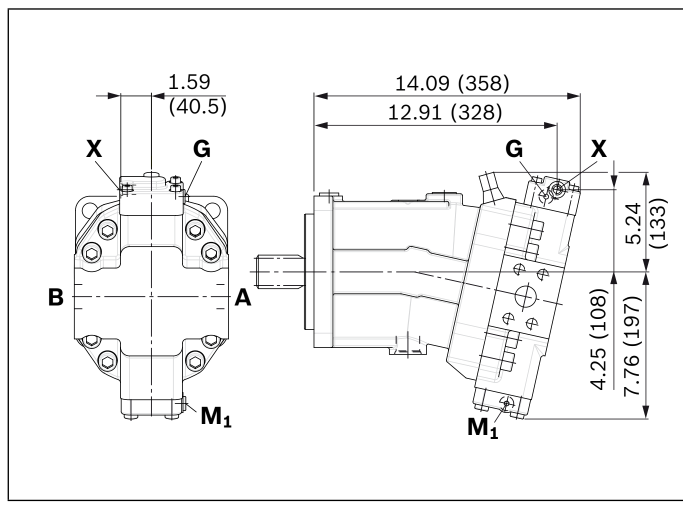
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



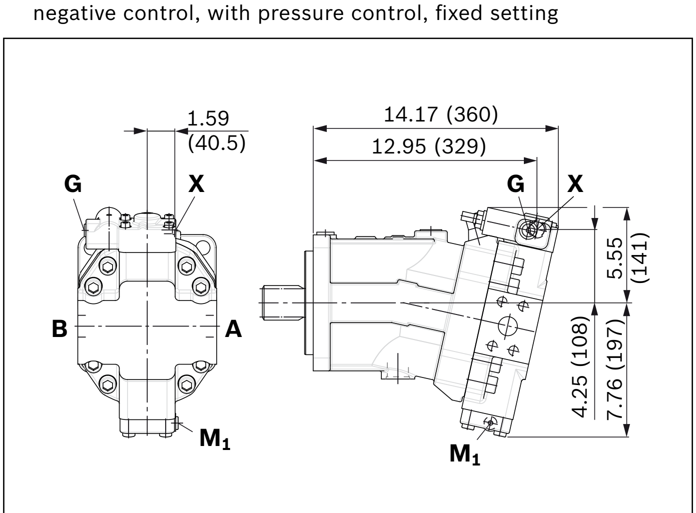
▼ **HP1, HP2** – Hydraulic proportional control, positive control



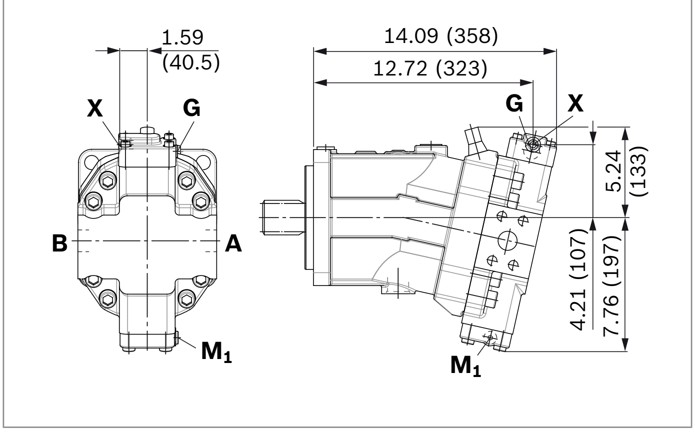
▼ **HP5, HP6** – Hydraulic proportional control, negative control



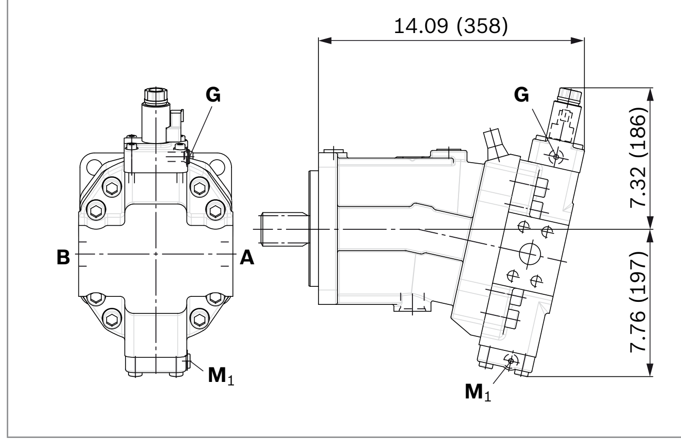
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



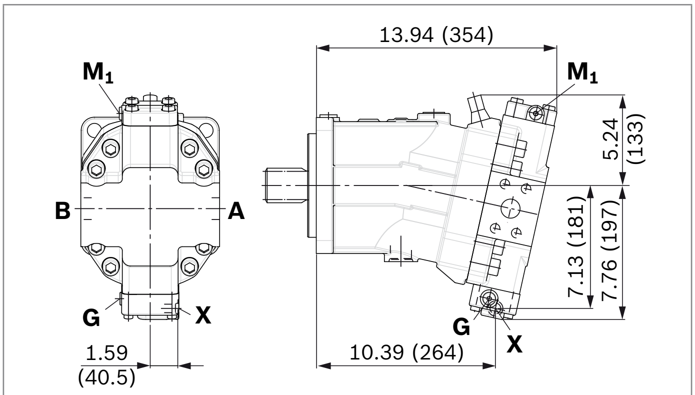
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control



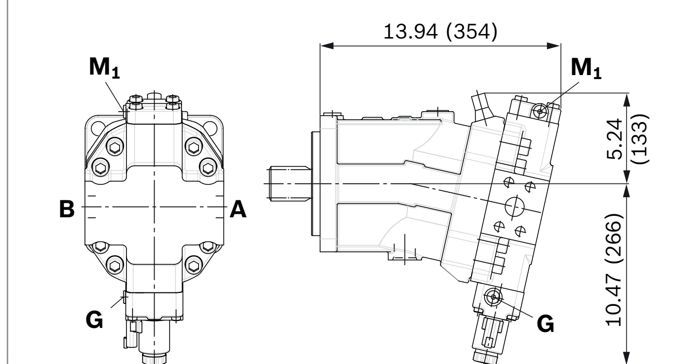
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



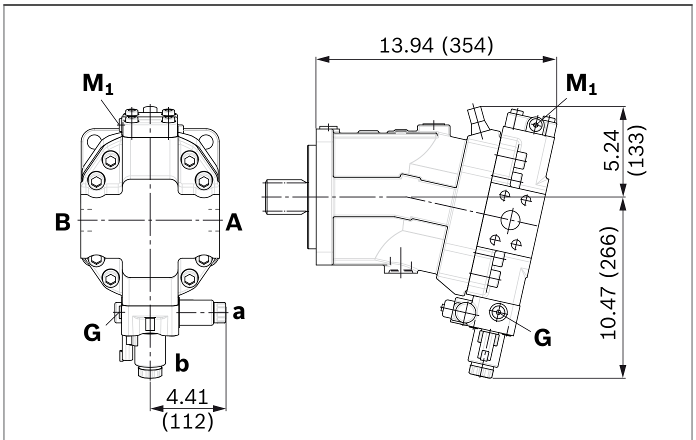
HA1 and HA2, X plugged

HA1T and HA2T, X open

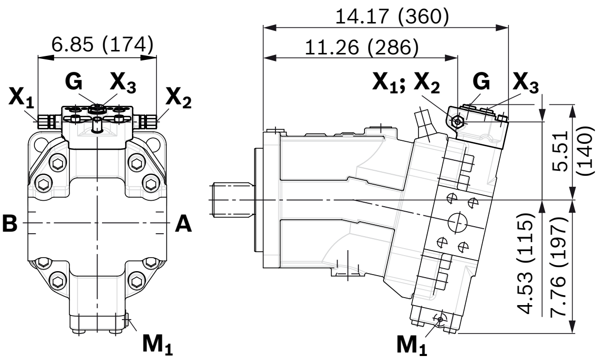
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



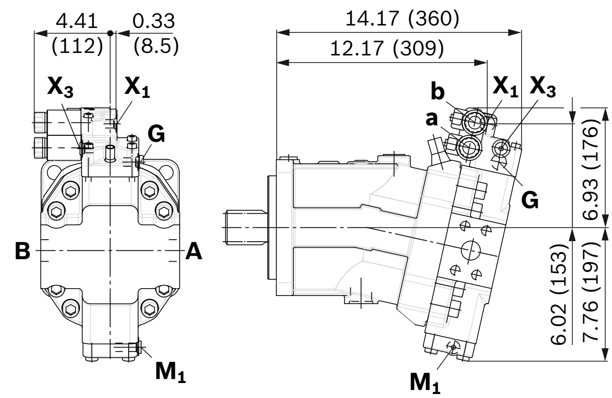
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X_1, X_2 pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

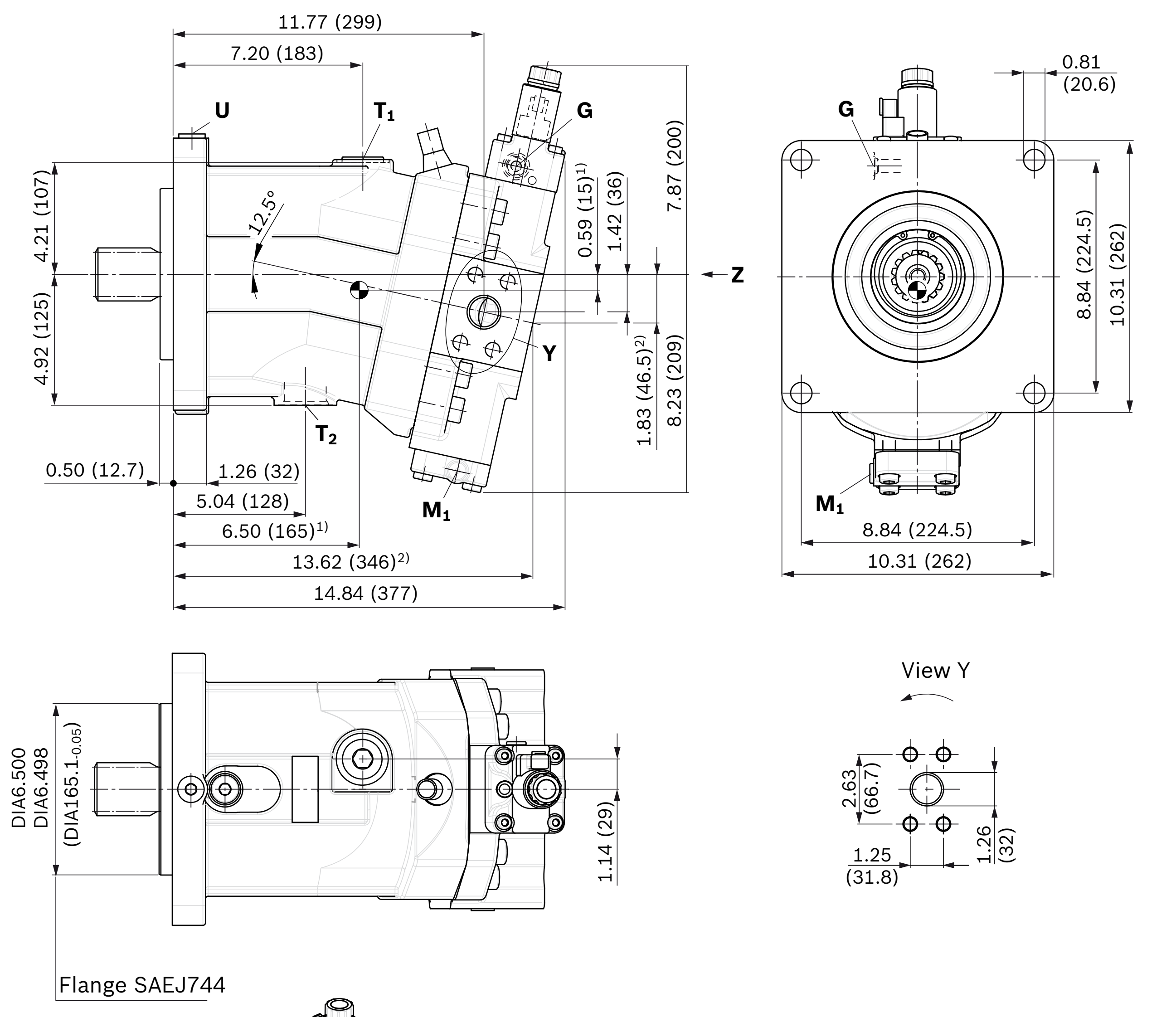
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ switch

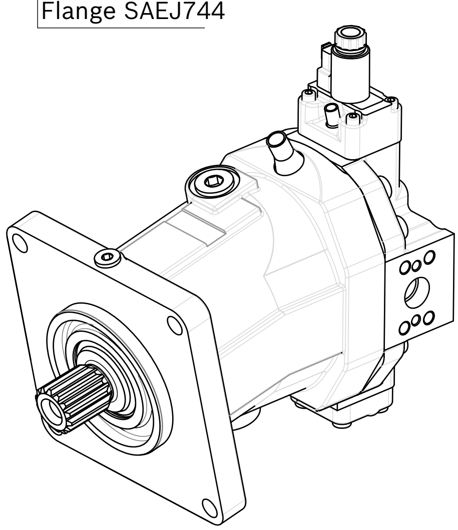


Dimensions size 200

EP5, EP6 – Proportional electric control, negative control

Port plate 2 — SAE flange ports A and B at side, opposite

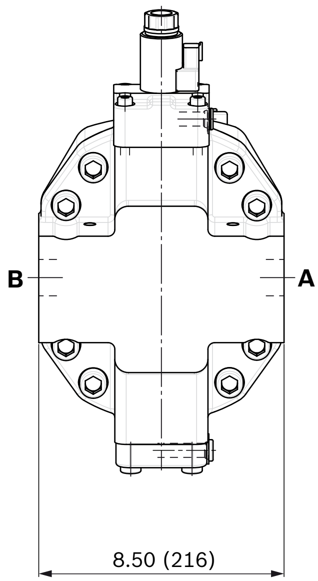
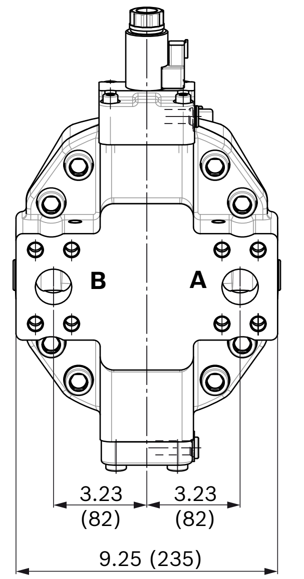




1) Center of gravity

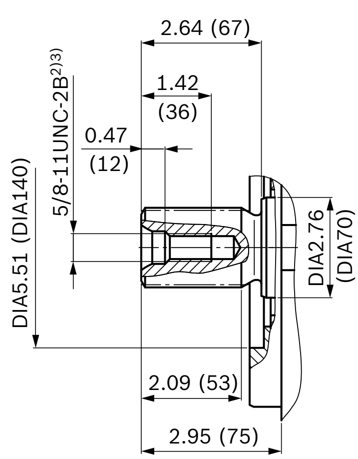
2) Port plate 1 — SAE flange ports **A** and **B** at rear

▼ **Location of the service line ports on the port plates** (view **Z**)

2 SAE flange port **A** and **B** at side, opposite	**1** SAE flange port **A** and **B** at rear
	

▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]

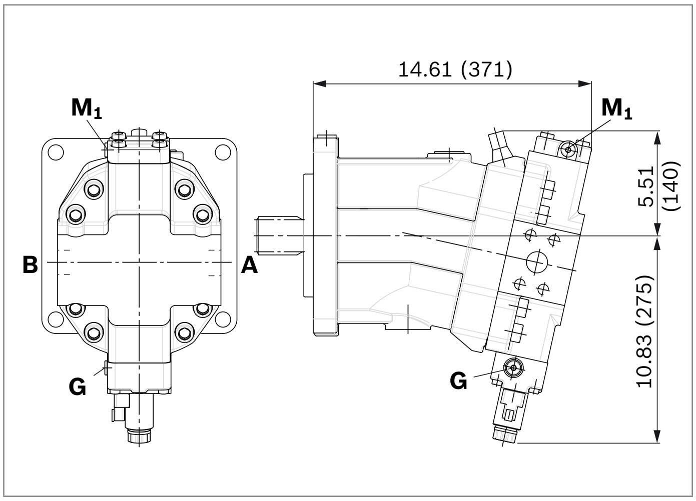


1) Involute toothing acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual

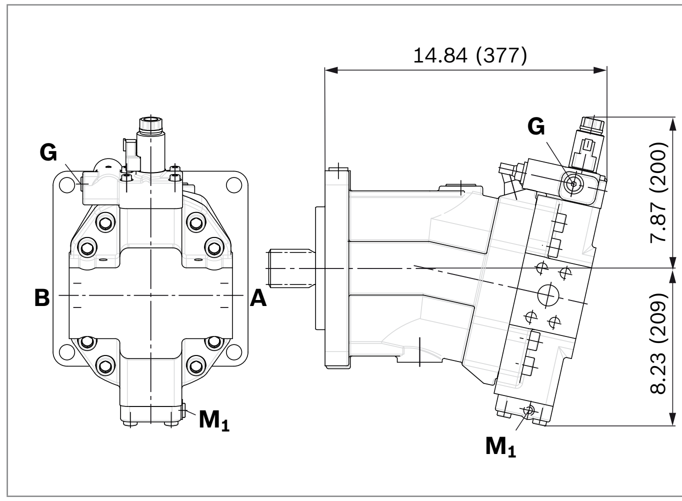
Ports		**Standard**	**Size**[1]	$p_{\text{max abs}}$ **[psi (bar)]**[2]	**Status**[7]
A, B[5]	Working port Mounting bolt A/B, screw grade 8 with hardened washer	SAE J518[3] ASME B1.1	1 1/4 in 1/2 in -13 UNC-2B; 0.75 (19) deep	6500 psi (450 bar)	O
$\mathbf{T_1}$	Drain port	ISO 11926[6]	1 5/16 in -12 UN-2B; 0.79 (20) deep	45 (3)	X[4]
$\mathbf{T_2}$	Drain port	ISO 11926[6]	1 5/8 in -12 UN-2B; 0.79 (20) deep	45 (3)	O[4]
G	Synchronous control	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X
U	Bearing flushing	ISO11926[6]	7/8 in -14 UNF-2B; 0.67 (17) deep	45 (3)	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	1450 (100)	O
X	Pilot signal (HA1, HA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	45 (3)	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	580 (40)	O
$\mathbf{X_1}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	O
$\mathbf{X_3}$	Pilot signal (DA1, DA2)	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	580 (40)	X
$\mathbf{M_1}$	Measuring stroking chamber	ISO 11926[6]	9/16 in -18 UNF-2B; 0.51 (13) deep	6500 psi (450 bar)	X

1) For notes on tightening torques, see instruction manual
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 71).
5) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

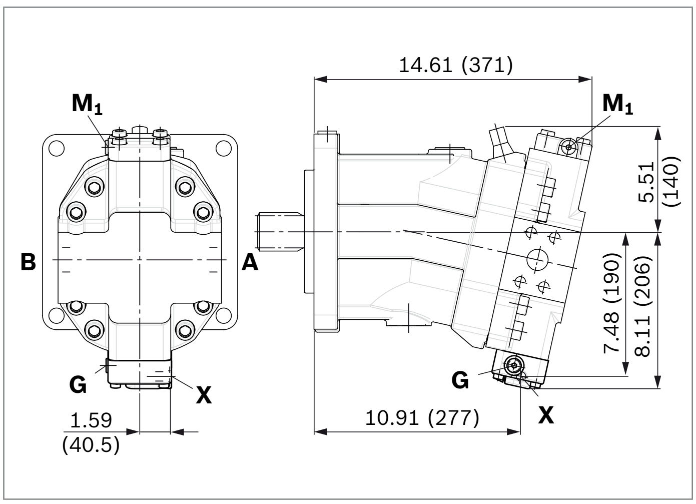
▼ **EP1, EP2** – Electric proportional control, positive control



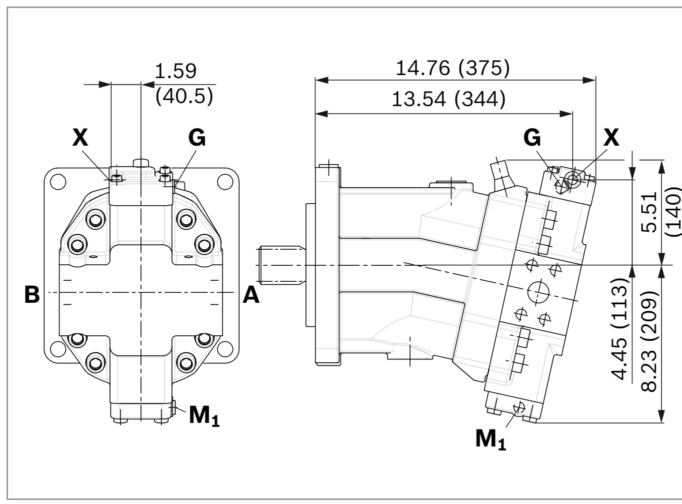
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed setting



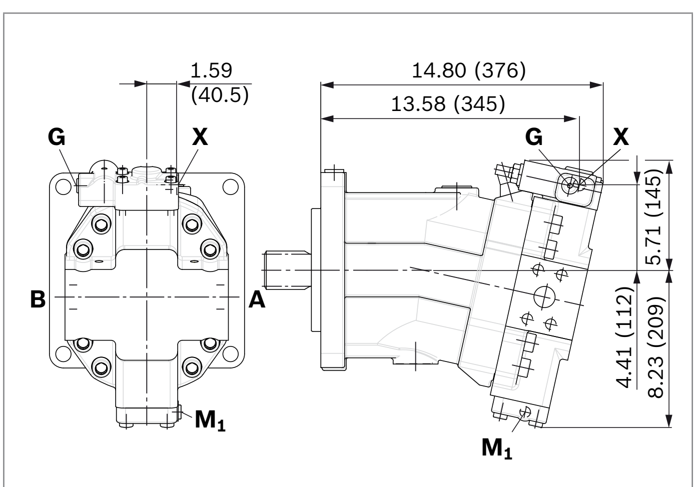
▼ **HP1, HP2** – Hydraulic proportional control, positive control



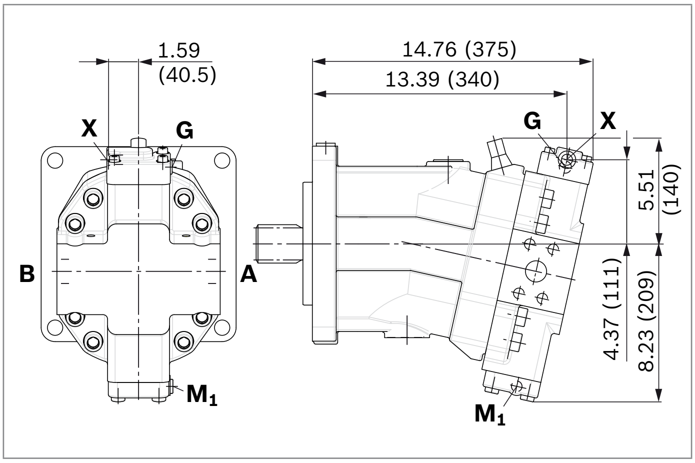
▼ **HP5, HP6** – Hydraulic proportional control, negative control



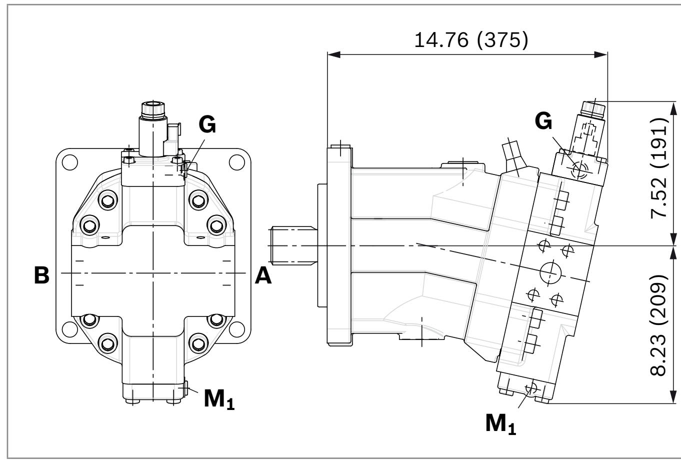
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed setting



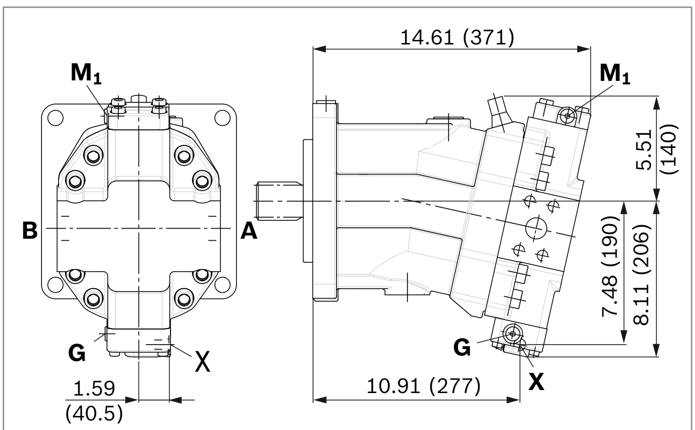
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control



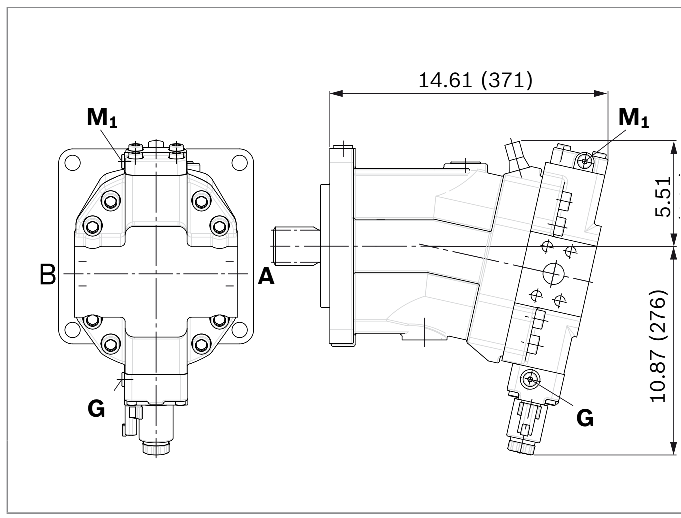
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



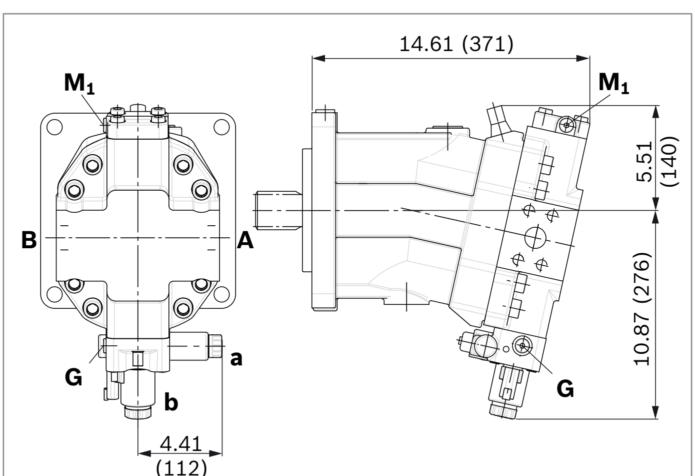
HA1 and HA2, X plugged

HA1T and HA2T, X open

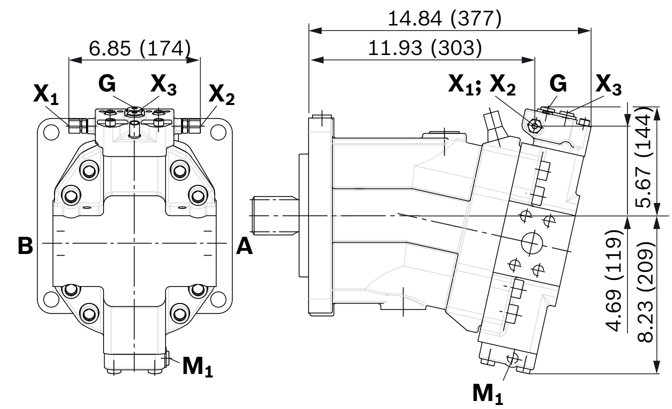
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



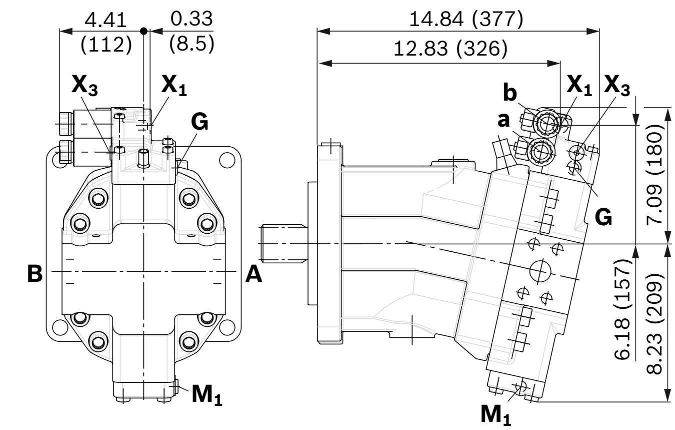
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X_1, X_2 pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ switch



Connector for solenoids

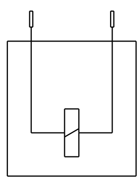
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Circuit symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery.

This can be supplied by Bosch Rexroth on request (material number R902601804).

Note

If necessary, you can change the connector orientation by turning the solenoid housing.

The procedure can be taken from the instruction manual.

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 leakage. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.
The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when adjusting the primary valve)

- Sizes 55 to 200, fixed setting 230 psi (16 bar)

Switching pressure of flushing spool Δp

- Sizes 55 to 107 (small flushing valve) 115±15 psi (8±1 bar)
- Sizes 107 to 200 (medium and large flushing valve) 254±22.5 psi (17.5±1.5 bar)

Flushing flow q_v
Orifices can be used to adjust the flushing flows as required. The following information is based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 365 psi (25 bar) and ν = 60 SUS (10 mm^2/s)
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 55 to 107

Material number of orifice	DIA [inch] (ø [mm])	q_v [gpm (l/min)]	Code
R909651766	0.047 (1.2)	0.9 (3.5)	A
R909419695	0.055 (1.4)	1.3 (5)	B
R909419696	0.071 (1.8)	2.1 (8)	C
R909419697	0.079 (2.0)	2.6 (10)	D
R909444361	0.094 (2.4)	3.7 (14)	F

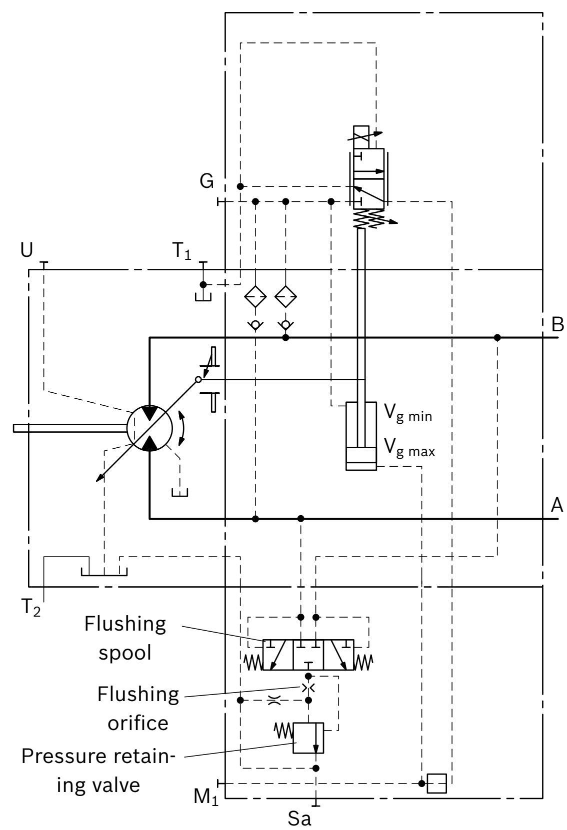
Medium flushing valve for size 107

Material number of orifice	DIA [inch] (ø [mm])	q_v [gpm (l/min)]	Code
R909431310	0.11 (2.8)	5.3 (20)	H
R909435172	0.14 (3.5)	6.6 (25)	J
R909449967	0.20 (5.0)	7.9 (30)	K

Large flushing valve for sizes 140 to 200

Material number of orifice	DIA [inch] (ø [mm])	q_v [gpm (l/min)]	Code
R909449998	0.071 (1.8)	2.1 (8)	C
R909431308	0.079 (2.0)	2.6 (10)	D
R909431309	0.10 (2.5)	4.5 (17)	G
R909431310	0.11 (2.8)	5.3 (20)	H
R902138235	0.12 (3.1)	6.6 (25)	J
R909435172	0.14 (3.5)	7.9 (30)	K
R909436622	0.16 (4.0)	9.2 (35)	L
R909449967	0.20 (5.0)	10.6 (40)	M

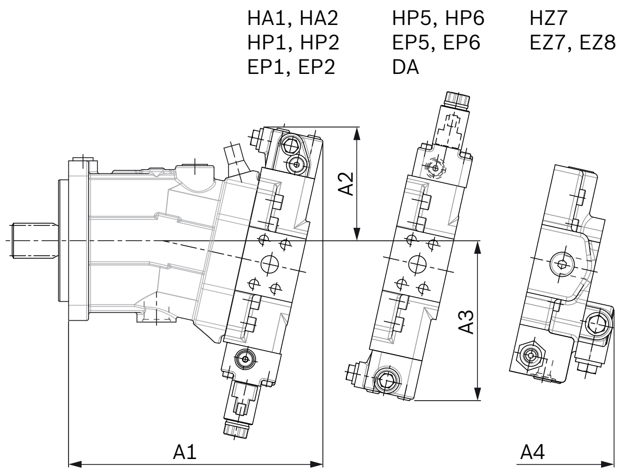
▼ **Schematic EP**



Notes

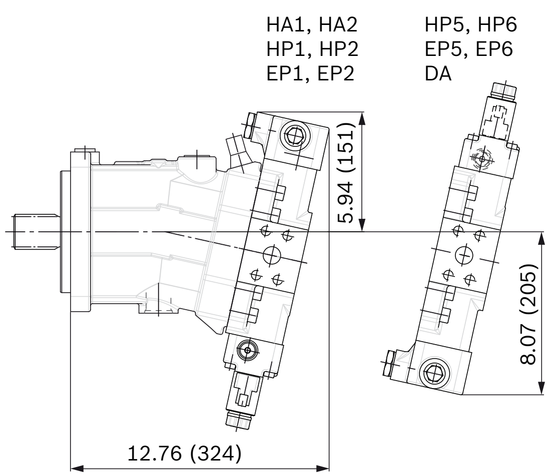
- Port **S**a only for sizes 140 to 200
- For a flushing flow greater than 9.2 gpm (35 l /min), it is recommended that port **S**a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

▼ **Dimensions of sizes 55 to 107 (small flushing valve)**

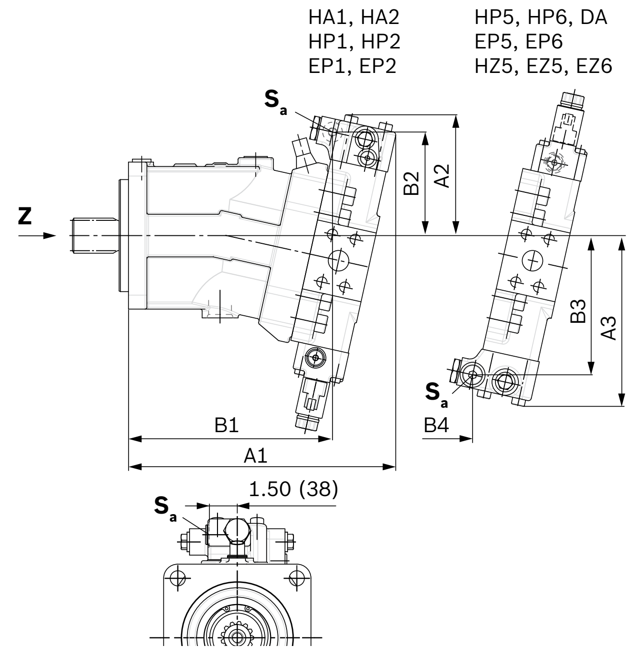


NG	A1	A2	A3	A4
55	10.51	5.24	6.93	10.24
	(267)	(133)	(176)	(260)
80	11.69	5.59	7.64	10.94
	(297)	(142)	(194)	(278)
107	12.56	5.63	7.95	11.85
	(319)	(143)	(202)	(301)

▼ **Dimensions of size 107 (medium flushing valve)**



▼ **Dimensions for sizes 140 to 200 (large flushing valve)**



NG	A1	B1	A2	B2	A3	B3	B4
140	14.06	10.67	6.50	5.59	9.06	7.36	7.80
	(357)	(271)	(165)	(142)	(230)	(187)	(198)
160	14.33	10.94	6.50	5.59	9.17	7.48	8.03
	(364)	(278)	(165)	(142)	(233)	(190)	(204)
200	15.00	11.61	6.77	5.83	9.61	7.91	8.54
	(381)	(295)	(172)	(148)	(244)	(201)	(217)

NG	S_a [1]
140	
160	7/8-14UNF-2B; 0.67 (17) deep
200	

1) ISO 11926, ports plugged (in normal operation)
For notes on tightening torques, see instruction manual.
The spot face may be deeper than that specified in the standard.

Counterbalance valve BVD and BVE

Function

Counterbalance valves for drives and winches should reduce the danger of overspeed and cavitation in open circuits of axial piston motors. Cavitation occurs if, during braking, when going downhill or during the load-lowering process, the motor speed is greater than it should be for the given inlet flow and thus the inlet pressure collapses. If the inlet pressure falls below the level specified for the relevant counterbalance valve, the counterbalance valve piston moves into the closed position.
The cross-sectional area of the counterbalance valve return duct is then reduced, creating a restriction in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the speed of the motor reaches the specified value for the given inlet flow.

Notes

- BVD available for sizes 55 to 200 and BVE available for sizes 107 to 200.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set.
  Ordering example: A6VM080HA1T30004A/65MWV0N4S 97W0-0 + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, control systems with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!
- The counterbalance valve does not replace the mechanical service brake and parking brake.
- Observe the detailed notes on the BVD counterbalance valve in data sheet 95522 and on the BVE counterbalance valve in data sheet 95525!
- For the design of the brake release valve, we must know for the mechanical parking brake:
  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum travel (brake closed) and maximum travel (brake released with 305 psi (21 bar))
  - the required closing time for a warm device (oil viscosity approx. 69.6 SUS (15 mm²/s))

Permissible inlet flow or pressure when using DBV[1] and BVD/BVE

Motor	Without valve		Limited values when using DBV[1] and BVD/BVE							
			DBV[1]				BVD[2]/BVE[3]			
NG	p_{nom}/p_{max} [psi (bar)]	$q_{V\ max}$ [gpm (l/min)]	NG	p_{nom}/p_{max} [psi (bar)]	q_V [gpm (l/min)]	Code	NG	p_{nom}/p_{max} [psi (bar)]	q_V [gpm (l/min)]	Code
55	5800 /6500 (400/450)	64 (244)	22	5100/6100 (350/420)	63 (240)	7	20 (BVD)	5100/6100 (350/420)	58 (220)	7W
80		82 (312)								
107		100 (380)	32		106 (400)					
107		100 (380)				8	25 (BVD/BVE)		85 (320)	8W
140		120 (455)								
160		131 (496)								
200		153 (580)	On request							

1) Pressure-relief valve
2) Counterbalance valve, double-acting
3) Counterbalance valve, single-acting

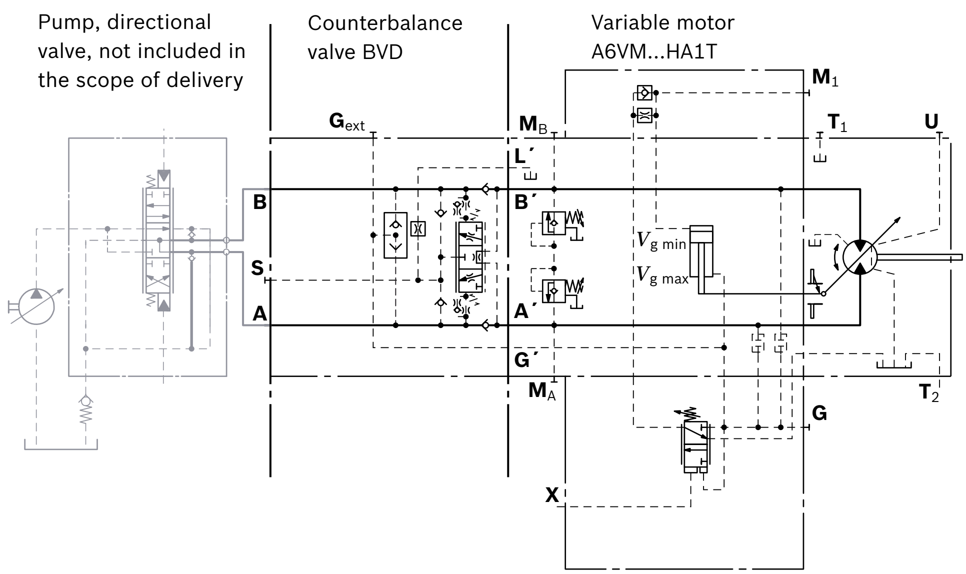
Counterbalance valve for travel drive BVD...F

Application option

- Travel drive for wheeled excavators (BVD and BVE)

▼ **Example schematic for travel drive on wheeled excavators**

A6VM080HA1T30004A/65MWV0N4S97W0-0 + BVD20F27S/41B–V03K16D0400S12



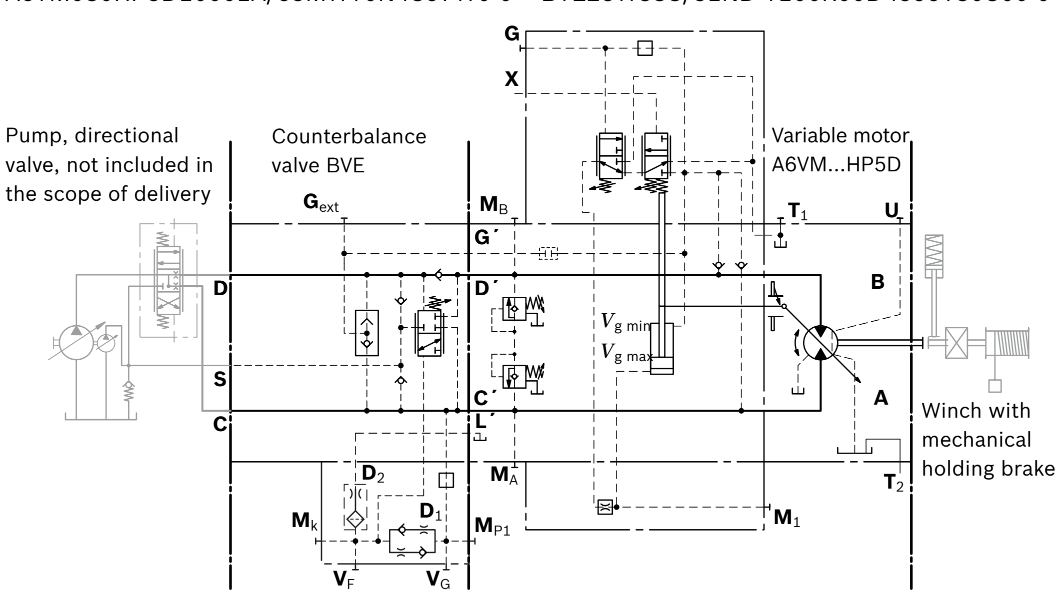
Counterbalance valve for winches and track drives BVD...W and BVE

Application option

- Winch drives in cranes (BVD and BVE)
- Track drive in crawler excavators (BVD)

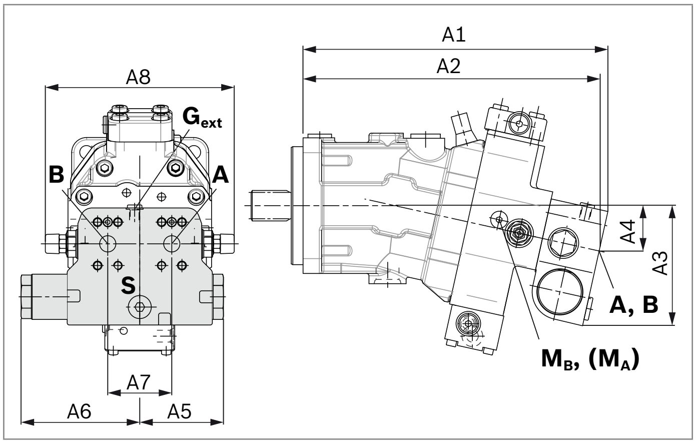
▼ **Example schematic for winch drive in cranes**

A6VM080HP5D10001A/65MWV0N4S97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0

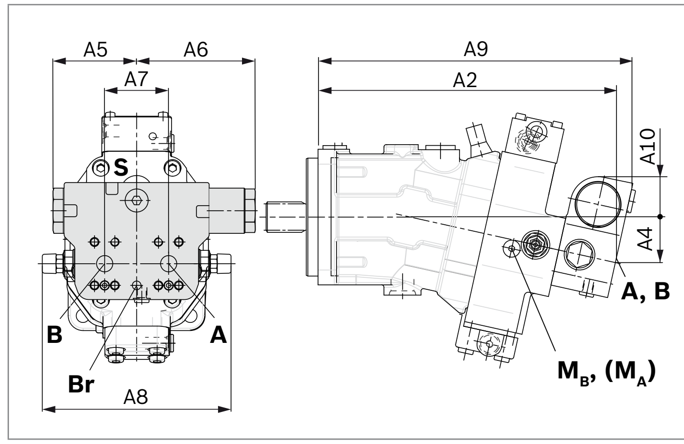


Dimensions

▼ **A6VM...HA, HP1, HP2 and EP1, EP2**



▼ **A6VM...HP5, HP6 and EP5, EP6**[1]



A6VM	Counterbalance valve											
NG...plate	Type	Ports	Dimensions									
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...7	BVD20...17	3/4 in	13.19 (335)	12.83 (326)	5.63 (143)	1.97 (50)	3.86 (98)	5.47 (139)	2.95 (75)	8.74 (222)	13.78 (350)	1.97 (50)
80...7	BVD20...27	1 in	14.33 (364)	13.98 (355)	5.83 (148)	2.17 (55)	3.86 (98)	5.47 (139)	2.95 (75)	8.74 (222)	14.92 (379)	1.81 (46)
107...7	BVD20...28	1 in	15.51 (394)	15.16 (385)	5.98 (152)	2.32 (59)	3.86 (98)	5.47 (139)	3.31 (84)	9.21 (234)	16.10 (409)	1.61 (41)
107...8	BVD25...38	1 1/4 in	16.22 (412)	15.83 (402)	6.50 (165)	2.48 (63)	4.74 (120.5)	6.89 (175)	3.31 (84)	9.37 (238)	16.81 (427)	2.20 (56)
140...8	BVD25...38	1 1/4 in	17.44 (443)	17.01 (433)	6.61 (168)	2.64 (67)	4.74 (120.5)	6.89 (175)	3.31 (84)	9.37 (238)	18.03 (458)	2.09 (53)
160...8	BVD25...38	1 1/4 in	17.68 (449)	17.28 (439)	6.69 (170)	2.68 (68)	4.74 (120.5)	6.89 (175)	3.31 (84)	9.37 (238)	18.27 (464)	2.01 (51)
200...8	BVD25...38	1 1/4 in	18.90 (480)	18.50 (470)	6.93 (176)	2.91 (74)	4.74 (120.5)	6.89 (175)	3.31 (84)	11.77 (299)	19.49 (495)	1.81 (46)
107...8	BVE25...38	1 1/4 in	16.22 (412)	15.83 (402)	6.73 (171)	2.48 (63)	5.39 (137)	8.43 (214)	3.31 (84)	9.37 (238)	16.89 (429)	2.48 (63)
140...8	BVE25...38	1 1/4 in	17.44 (443)	17.01 (433)	6.89 (175)	2.64 (67)	5.39 (137)	8.43 (214)	3.31 (84)	9.37 (238)	17.91 (455)	2.32 (59)
160...8	BVE25...38	1 1/4 in	17.68 (449)	17.28 (439)	6.93 (176)	2.68 (68)	5.39 (137)	8.43 (214)	3.31 (84)	9.37 (238)	18.27 (464)	2.32 (59)
200...8	BVE25...38	1 1/4 in	18.90 (480)	18.50 (470)	7.17 (182)	2.91 (74)	5.39 (137)	8.43 (214)	3.31 (84)	11.77 (299)	19.49 (495)	2.05 (52)

Ports		Version	A6VM plate	Standard	Size[2]	$p_{\text{max perm}}$ [psi (bar)][3]	Status[5]
A, B	Working line			SAE J518	see table above	6100 (420)	O
S	Infeed	BVD20		DIN 3852[4]	M22 × 1.5; 14 deep	435 (30)	X
		BVD25, BVE25		DIN 3852[4]	M27 × 2; 16 deep	435 (30)	X
B_r	Brake release, reduced high pressure	L	7	DIN 3852[4]	M12 × 1.5; 12.5 deep	435 (30)	O
			8	DIN 3852[4]	M12 × 1.5; 12 deep	435 (30)	O
G_{ext}	Brake release, high pressure	S		DIN 3852[4]	M12 × 1.5; 12.5 deep	6100 (420)	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4]	M18 × 1.5; 14.5 deep	6100 (420)	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations **A** and **B** on the counterbalance valve BVD do not correspond with the connection drawing of the A6VM motor.
The designation of the ports on the installation drawing of the motor is binding!
2) For notes on tightening torques, see instruction manual
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) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

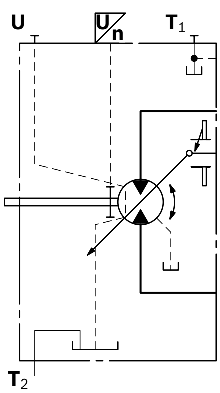
Mounting the counterbalance valve

When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport lock). 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 final mounting of the counterbalance valve on the motor is done with screw fitting of the SAE flange.
The screws to be used and the procedure mounting can be found in the instruction manual.

Speed sensor

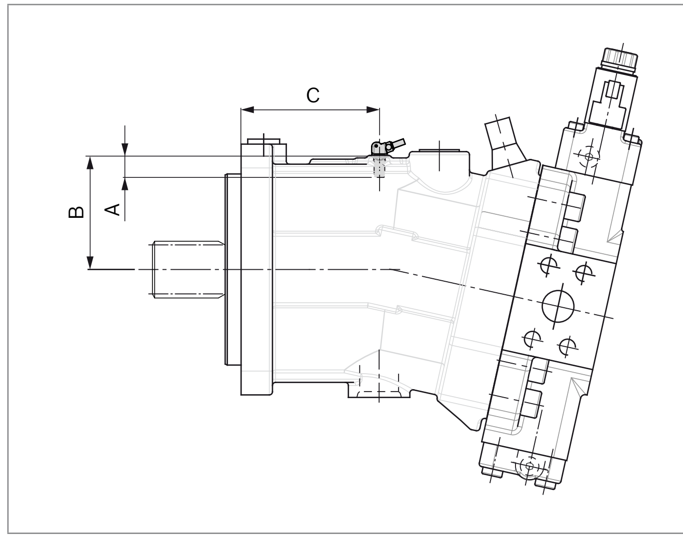
Version A6VM...U ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.
A signal proportional to motor speed can be generated with the fitted DSA/DSM speed sensor. The DSA/DSM sensor registers the speed and direction of rotation.
Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (95132 for DSM, 95133 for DSA).
The sensor is mounted on the port provided for this purpose with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.
We recommend ordering the A6VM variable motor complete with mounted sensor.

▼ **Schematic**



▼ **Dimensions**

"V" design with mounted speed sensor



Size		**55**	**80**	**107**	**140**	**160**	**200**
Number of teeth		54	58	67	72	75	80
A	Insertion depth (tolerance -0.0098 (-0.25))	0.72	0.72	0.72	0.72	0.72	0.72
		(18.4)	(18.4)	(18.4)	(18.4)	(18.4)	(18.4)
B	Contact surface	2.95	3.11	3.46	3.66	3.78	3.98
		(75)	(79)	(88)	(93)	(96)	(101)
C		3.55	3.91	4.30	4.85	4.87	5.01
		(90.2)	(99.2)	(109.2)	(123.7)	(123.7)	(127.2)

Setting range for displacement

	55				80				107			
	$V_{g\,max}$ [in^3/rev (cm^3/rev)]		$V_{g\,min}$ [in^3/rev (cm^3/rev)]		$V_{g\,max}$ [in^3/rev (cm^3/rev)]		$V_{g\,min}$ [in^3/rev (cm^3/rev)]		$V_{g\,max}$ [in^3/rev (cm^3/rev)]		$V_{g\,min}$ [in^3/rev (cm^3/rev)]	
	from	to	from	to	from	to	from	to	from	to	from	to
A	3.34 (54.8)	3.34 (54.8)	0.0	0.81 (13.3)	4.88 (80.0)	4.88 (80.0)	0.0	1.81 (29.7)	6.53 (107.0)	6.53 (107.0)	0.0	1.35 (22.2)
	without screw		M10 × 60 R909154690		without screw		M12 × 70 R909085976		without screw		M12 × 70 R909085976	
B	3.34 (54.8)	3.34 (54.8)	> 0.81 (> 13.3)	1.65 (27.0)	4.88 (80.0)	4.88 (80.0)	> 1.81 (> 29.7)	2.87 (47.0)	6.53 (107.0)	6.53 (107.0)	> 1.35 (> 22.2)	2.67 (43.8)
	without screw		M10 × 70 R909153779		without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
C	3.34 (54.8)	3.34 (54.8)	> 1.65 (> 27.0)	2.32 (38.0)	4.88 (80.0)	4.88 (80.0)	> 2.87 (> 47.0)	3.42 (56.0)	6.53 (107.0)	6.53 (107.0)	> 2.67 (> 43.8)	4.00 (65.5)
	without screw		M10 × 80 R909154058		without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
D	x		x		x		x		6.53 (107.0)	6.53 (107.0)	> 4.00 (> 65.5)	4.58 (75.0)
									without screw		M12 × 100 R909153975	
E	< 3.34 (< 54.8)	2.56 (42.0)	0.0	0.81 (13.3)	< 4.88 (< 80.0)	3.17 (52.0)	0.0	1.81 (29.7)	< 6.53 (< 107.0)	5.25 (86.0)	0.0	1.35 (22.2)
	M10 × 60 R909154690		M10 × 60 R909154690		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 70 R909085976	
F	< 3.34 (< 54.8)	2.56 (42.0)	> 0.81 (> 13.3)	1.65 (27.0)	< 4.88 (< 80.0)	3.17 (52.0)	> 1.81 (> 29.7)	2.87 (47.0)	< 6.53 (< 107.0)	5.25 (86.0)	> 1.35 (> 22.2)	2.67 (43.8)
	M10 × 60 R909154690		M10 × 70 R909153779		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 80 R909153075	
G	< 3.34 (< 54.8)	2.56 (42.0)	> 1.65 (> 27.0)	2.32 (38.0)	< 4.88 (< 80.0)	3.17 (52.0)	> 2.87 (> 47.0)	3.42 (56.0)	< 6.53 (< 107.0)	5.25 (86.0)	> 2.67 (> 43.8)	4.00 (65.5)
	M10 × 60 R909154690		M10 × 80 R909154058		M12 × 70 R909085976		M12 × 90 R909154041		M12 × 70 R909085976		M12 × 90 R909154041	
H	x		x		x		x		< 6.53 (< 107.0)	5.25 (86.0)	> 4.00 (> 65.5)	4.58 (75.0)
									M12 × 70 R909085976		M12 × 100 R909153975	
J	< 2.56 (< 42.0)	1.77 (29.0)	0.0	0.81 (13.3)	< 3.17 (< 52.0)	2.07 (34.0)	0.0	1.81 (29.7)	< 5.25 (< 86.0)	3.91 (64.0)	0.0	1.35 (22.2)
	M10 × 70 R909153779		M10 × 60 R909154690		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 70 R909085976	
K	< 2.56 (< 42.0)	1.77 (29.0)	> 0.81 (> 13.3)	1.65 (27.0)	< 3.17 (< 52.0)	2.07 (34.0)	> 1.81 (> 29.7)	2.87 (47.0)	< 5.25 (< 86.0)	3.91 (64.0)	> 1.35 (> 22.2)	2.67 (43.8)
	M10 × 70 R909153779		M10 × 70 R909153779		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
L	< 2.56 (< 42.0)	1.77 (29.0)	> 1.65 (> 27.0)	2.32 (38.0)	< 3.17 (< 52.0)	2.07 (34.0)	> 2.87 (> 47.0)	> 3.42 (> 56.0)	< 5.25 (< 86.0)	3.91 (64.0)	> 2.67 (> 43.8)	4.00 (65.5)
	M10 × 70 R909153779		M10 × 80 R909154058		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
M	x		x		x		x		< 5.25 (< 86.0)	3.91 (64.0)	> 4.00 (> 65.5)	4.58 (75.0)
									M12 × 80 R909153075		M12 × 100 R909153975	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... in^3 (cm^3), $V_{g\,max}$ = ... in^3 (cm^3)

Theoretical, maximum setting:
- for $V_{g\,min} = 0.7 \times V_{g\,max}$
- for $V_{g\,max} = 0.3 \times V_{g\,max}$

Settings that are not listed in the table may lead to damage. Please contact us.

	140				160				200			
	$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to
A	8.54 (140.0)	8.54 (140.0)	0.0 (0.0)	2.32 (38.0)	9.76 (160.0)	9.76 (160.0)	0.0 (0.0)	1.99 (32.6)	12.20 (200.0)	12.20 (200.0)	0.0 (0.0)	2.38 (39.0)
	without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
B	8.54 (140.0)	8.54 (140.0)	> 2.32 (> 38.0)	3.88 (63.5)	9.76 (160.0)	9.76 (160.0)	> 1.99 > (32.6)	3.61 (59.2)	12.20 (200.0)	12.20 (200.0)	> 2.38 (> 39.0)	4.39 (72.0)
	without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
C	8.54 (140.0)	8.54 (140.0)	> 3.88 (> 63.5)	5.43 (89.0)	9.76 (160.0)	9.76 (160.0)	> 3.61 > (59.2)	5.43 (89.0)	12.20 (200.0)	12.20 (200.0)	> 4.39 (> 72.0)	6.41 (105.0)
	without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975	
D	8.54 (140.0)	8.54 (140.0)	> 5.43 (> 89.0)	5.98 (98.0)	9.76 (160.0)	9.76 (160.0)	> 5.43 (> 89.0)	6.83 (112.0)	12.20 (200.0)	12.20 (200.0)	> 6.41 (> 105.0)	8.54 (140.0)
	without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212	
E	< 8.54 (<140.0)	6.41 (105.0)	0.0 (0.0)	2.32 (38.0)	< 9.76 (< 160.0)	7.87 (129.0)	0.0 (0.0)	1.99 (32.6)	< 12.20 (< 200.0)	10.01 (164.0)	0.0 (0.0)	2.38 (39.0)
	M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
F	< 8.54 (< 140.0)	6.41 (105.0)	> 2.32 (> 38.0)	3.88 (63.5)	< 9.76 (< 160.0)	7.87 (129.0)	> 1.99 > (32.6)	3.61 (59.2)	< 12.20 (< 200.0)	10.01 (164.0)	> 2.38 (> 39.0)	4.39 (72.0)
	M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
G	< 8.54 (< 140.0)	6.41 (105.0)	> 3.88 (> 63.5)	5.43 (89.0)	< 9.76 (< 160.0)	7.87 (129.0)	> 3.61 > (59.2)	5.43 (89.0)	< 12.20 (< 200.0)	10.01 (164.0)	> 4.39 (> 72.0)	6.41 (105.0)
	M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975	
H	< 8.54 (< 140.0)	6.41 (105.0)	> 5.43 (> 89.0)	5.98 (98.0)	< 9.76 (< 160.0)	7.87 (129.0)	> 5.43 (> 89.0)	6.83 (112.0)	< 12.20 (< 200.0)	10.01 (164.0)	> 6.41 (> 105.0)	8.54 (140.0)
	M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212	
J	< 6.41 (< 105.0)	4.88 (80.0)	0.0 (0.0)	2.32 (38.0)	< 7.87 (< 129.0)	6.10 (100.0)	0.0 (0.0)	1.99 (32.6)	< 10.01 (< 164.0)	7.96 (130.5)	0.0 (0.0)	2.38 (39.0)
	M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075	
K	< 6.41 (< 105.0)	4.88 (80.0)	> 2.32 (> 38.0)	3.88 (63.5)	< 7.87 (< 129.0)	6.10 (100.0)	> 1.99 > (32.6)	3.61 (59.2)	< 10.01 (< 164.0)	7.96 (130.5)	> 2.38 (> 39.0)	4.39 (72.0)
	M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041	
L	< 6.41 (< 105.0)	4.88 (80.0)	> 3.88 (> 63.5)	5.43 (89.0)	< 7.87 (< 129.0)	6.10 (100.0)	> 3.61 > (59.2)	5.43 (89.0)	< 10.01 (< 164.0)	7.96 (130.5)	> 4.39 (> 72.0)	6.41 (105.0)
	M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975	
M	< 6.41 (< 105.0)	4.88 (80.0)	> 5.43 (> 89.0)	5.98 (98.0)	< 7.87 (< 129.0)	6.10 (100.0)	> 5.43 (> 89.0)	6.83 (112.0)	< 10.01 (< 164.0)	7.96 (130.5)	> 6.41 (> 105.0)	8.54 (140.0)
	M12 × 90 R909154041		M12 × 110 R909154212		M12 × 90 R909154041		M12 × 110 R909154212		M12 × 90 R909154041		M12 × 110 R909154212	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... in^3 (cm^3), $V_{g\,max}$ = ... in^3 (cm^3)
Theoretical, maximum setting: ▶ for $V_{g\,min} = 0.7 \times V_{g\,max}$ / ▶ for $V_{g\,max} = 0.3 \times V_{g\,max}$
Settings that are not listed in the table may lead to damage. Please contact us.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the fluid from 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 leakage in the motor housing must be directed to the reservoir via the highest available drain port (**T_1**, **T_2**).

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

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

Note

In certain installation positions, an influence on the control characteristic curves can be expected. Gravity, dead weight and case pressure can cause minor shifts in characteristics and changes in response time.

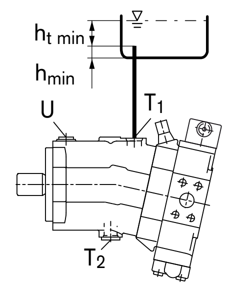
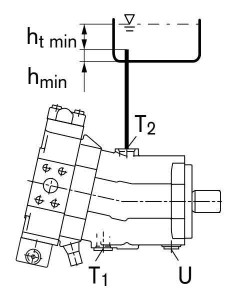
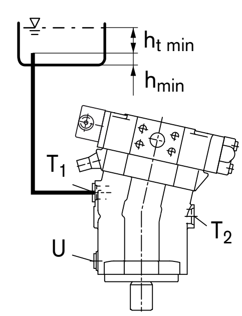
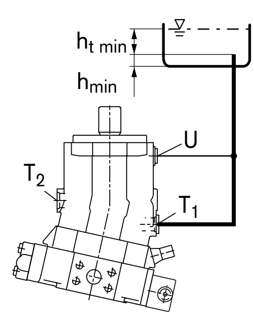
Key	
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\,min}$	Minimum required immersion depth (7.87 inch (200 mm))
h_{min}	Minimum required spacing to reservoir bottom (3.94 inch (100 mm))

Installation position

See examples **1** to **8** below.
Additional installation positions are available upon request.
Recommended installation position: **1** and **2**

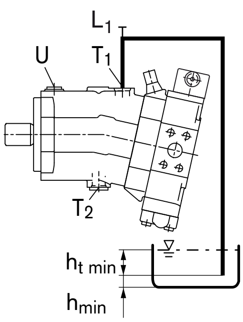
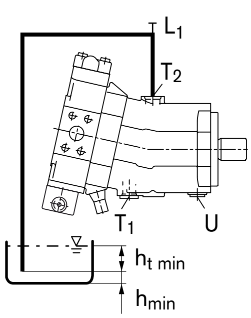
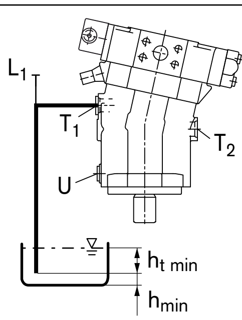
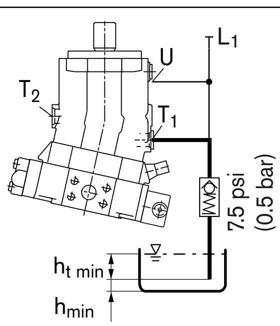
Below-reservoir installation (standard)

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

Installation position	**Air bleed**	**Filling**
1 		**T_1**
2 		**T_2**
3 		**T_1**
4 	**U**	**T_1**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.
Recommendation for installation position 8 (drive shaft upward):
A check valve in the drain line (cracking pressure 7.5 psi (0.5 bar)) can prevent draining of the motor housing.

<table>
<tr><th>Installation position</th><th></th><th>Air bleed</th><th>Filling</th></tr>
<tr><td>5</td><td>
</td><td>U (L_1)</td><td>T_1 (L_1)</td></tr>
<tr><td>6</td><td>
</td><td>L_1</td><td>T_2 (L_1)</td></tr>
<tr><td>7</td><td>
</td><td>L_1</td><td>T_1 (L_1)</td></tr>
<tr><td>8</td><td>
</td><td>U</td><td>T_1 (L_1)</td></tr>
</table>

Note

Port **L_1** is not part of the motor and can be made available by the customer for straightforward filling and air bleeding.

Project planning notes

- The motor A6VM 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 skilled person.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The data and notes contained herein must be adhered to.
- For safety reasons, control systems with beginning of control at $V_{g\,min}$ (e.g. HA) are not permissible for winch drives, e.g. anchor winches!
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic curve may shift.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Working 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 working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely minimize the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.
- If the axial piston motor is used in winch drives, make sure that the technical limit values are not exceeded under all operating conditions. If the axial piston motor is subjected to external overload (e.g. by exceeding the maximum permissible rotational speeds when lifting anchor while the ship is in motion), this could cause damage to the rotary group and in unfavorable cases to the axial piston motor bursting. If necessary, additional measures up to an including encapsulation are to be implemented by the machine/system manufacturer

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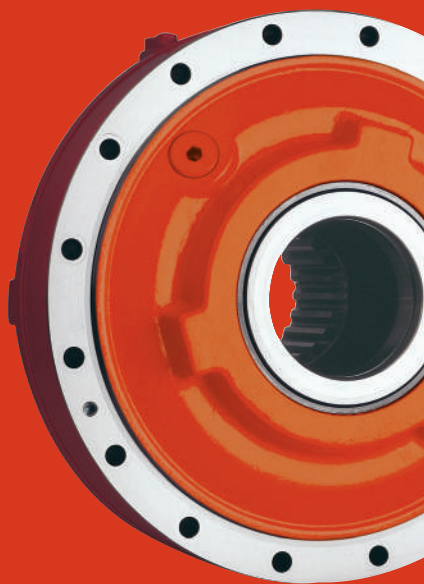
Compact CA

PRODUCT MANUAL



HÄGGLUNDS

Product Manual

COMPACT

EN396-10h 2011

One partner all over the world

Hägglunds Drives

is the worlds leading manufacturer of heavy duty hydraulic drive systems. If what you need is low speed and high torque, then Hägglunds Drives should be your partner. If what you need is a durable drive system that will work under the toughest conditions with a minimum of maintenance, then Hägglunds Drives should be your partner. We develop, manufacture & market complete drive systems and components of the highest quality, based upon our unique radial piston motors. Our industrial and marine customers are to be found all over the world. They know that when they need solutions, support or service, they have in us a partner they can trust. Hägglunds Drives main office and manufacturing plant is situated in Mellansel, Sweden. In Addition Hägglunds is represented in 40 countries worldwide.

Original EN396-9h, 2009

The content in this manual is subject to change without notice or obligation, unless certified referring to a certain purchase order. Information contained herein should be confirmed before placing orders.

Features

High power capacity
The new Compact has a wider speed range than any motor we have built before. It can work at high speed and high pressure, check out the efficiency curves on page 15.

High power/weight ratio
The new Compact with it´s small outer diameter and low weight will give you a high power to weight ratio that is extraordinary. This means great performance but also lower energy consumption.

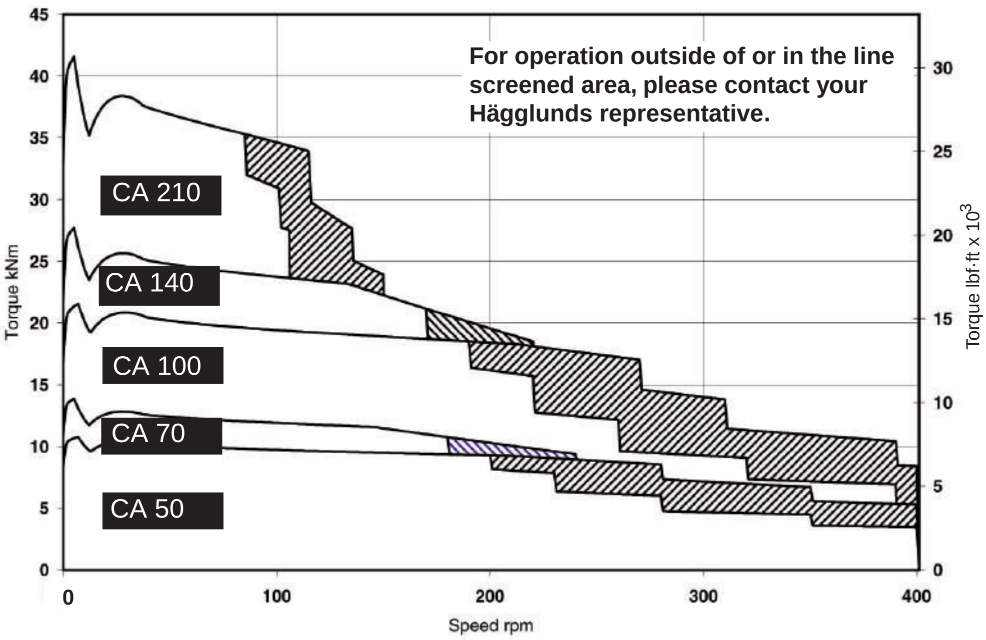
Insensitive to shock loads
The new Compact is small and light but at the same time tough and insensitive to shock loads. The new Compact has everything you have come to expect from a Hägglunds motor - high torque, wide speed range, shock resistant, easy to install, easy to maintain, and as tough as they come. - Only smaller!

Hole through motor centre
The hole through the motor centre is extremely useful in some applications. For example with through shaft for driving from both ends - or to gain access to the machine to feed water or other medium through the shaft.

Adaptable mounting
Even through we believe in standard solutions. We also believe in adapting our products to our customers needs. The new Compact can be mounted in just about any way you want it.

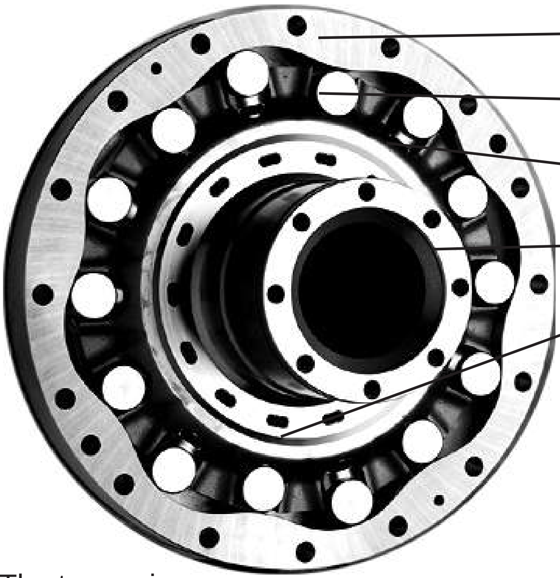
Quick selection diagram for Compact motors

The diagram below represents the torque and speed, corresponding to a basic rating life L_{10aah}= 20 000 h. Oil viscosity in the motor case 40 cSt (187 SSU). When operating below 5 rpm, coated pistons or oil with higher viscosity shall be used. Contact your Hägglunds representative.



Functional description

Hägglunds hydraulic industrial and marine motor COMPACT is of the radial-piston type with a rotating cylinder block/hollow shaft and a stationary housing. The cylinder block is mounted in fixed roller bearings in the housing. An even number of pistons are radially located in bores inside the cylinder block, and the valve plate directs the incoming and outgoing oil to and from the working pistons. Each piston is working against a cam roller.

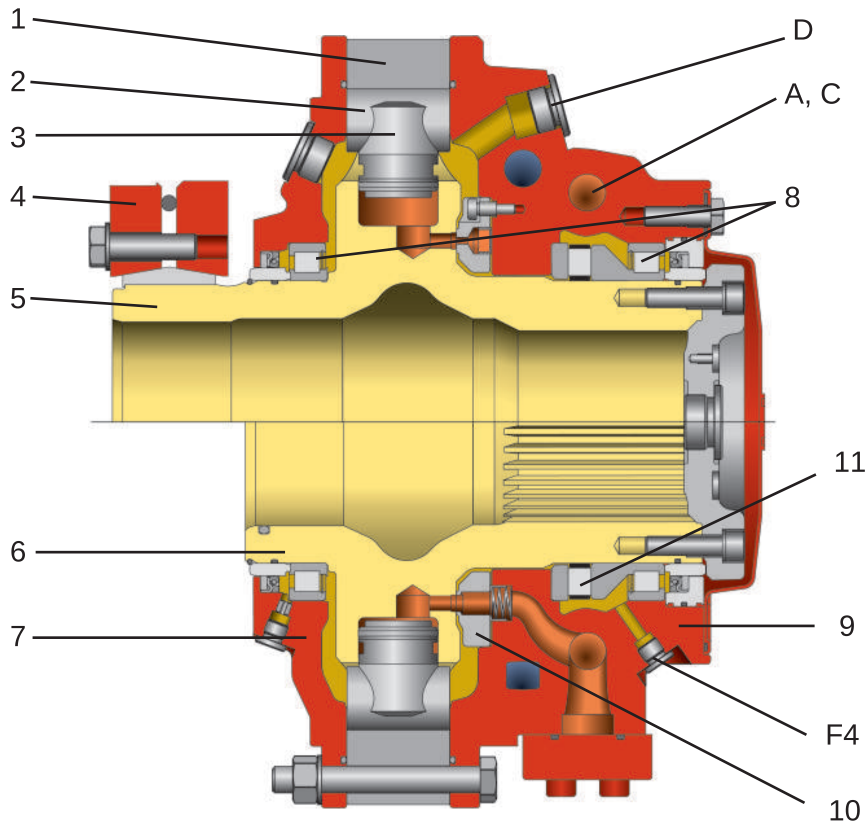


When the hydraulic pressure is acting on the pistons, the cam rollers are pushed against the slope on the cam ring that is rigidly connected to the housing, thereby producing a torque. The cam rollers transfer the reaction force to the pistons which are guided in the cylinder block. Rotation therefore occurs, and the torque available is proportional to the pressure in the system.

Oil main lines are connected to ports A and C in the connection block and drain lines to ports D1, D2 or D3 in the motor housing.

The motor is connected to the shaft of the driven machine through the hollow shaft of the cylinder block. The torque is transmitted by using a mechanical shrink disc, or alternatively by splines.
The symmetrical design of the motor has made it possible to design it as a two displacement motor. This means that two different displacements and speeds can be obtained for a given flow. To get the 2-speed function, a motor prepared for two speeds has to be ordered together with a 2-speed valve.

Fig. 1 **Compact motor**



Valid patents

US 4522110, US 005979295A, SE 456517, EP 0102915, JP 83162704, GB 1385693, EP 0524437.

Quality

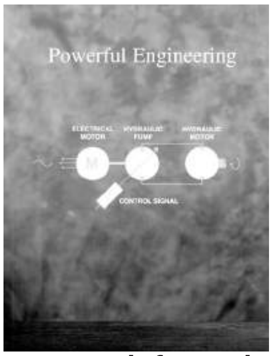
To assure our quality we maintain a Quality Assurance System, certified to standard ISO 9001, EN 29001 and BS 5750; Part 1.

1. Cam ring
2. Cam roller
3. Piston
4. Shaft coupling
5. Cylinder block / hollow shaft
6. Cylinder block / spline
7. Shaft end housing
8. Cylinder roller bearings
9. Connection block
10. Valve plate
11. Cylinder roller thrust bearing

A = Inlet or outlet port »A« (2 each)
C = Inlet or outlet port »C«
D = Drain port (3 each)
F4 = Flushing

Calculation fundamentals

	Metric		US	
Output power	$P=\frac{T\cdot n}{9549}$	(kW) on driven shaft	$P=\frac{T\cdot n}{5252}$	(hp) on driven shaft
Output torque* ($\eta_m=98\%$)	$T=T_s\cdot(p-\Delta p_l-p_c)\cdot\eta_m$	(Nm)	$T=\frac{T_s\cdot(p-\Delta p_l-p_c)\cdot\eta_m}{1000}$	(lbf·ft)
Pressure required ($\eta_m=98\%$)	$p=\frac{T}{T_s\cdot\eta_m}+\Delta p_l+p_c$	(bar)	$p=\frac{T\cdot 1000}{T_s\cdot\eta_m}+\Delta p_l+p_c$	(psi)
Flow rate required	$q=\frac{n\cdot V_i}{1000}+q_l$	(l/min)	$q=\frac{n\cdot V_i}{231}+q_l$	(gpm)
Output speed	$n=\frac{q-q_l}{V_i}\cdot 1000$	(rpm)	$n=\frac{q-q_l}{V_i}\cdot 231$	(rpm)
Inlet power	$P_{in}=\frac{q\cdot(p-p_c)}{600}$	(kW)	$P_{in}=\frac{q\cdot(p-p_c)}{1714}$	(hp)



For more information
See Powerful Engineering (EN347-4).

Quantity	Symbol		Metric	US
Power	P	=	kW	hp
Output torque	T	=	Nm	lbf·ft
Specific torque	T_s	=	Nm/bar	lbf·ft/1000 psi
Rotational speed	n	=	rpm	rpm
Required pressure	p	=	bar	psi

Quantity	Symbol		Metric	US
Pressure loss	Δp_l	=	bar	psi
Charge pressure	p_c	=	bar	psi
Flow rate required	q	=	l/min	gpm
Total volumetric loss	q_l	=	l/min	gpm
Displacement	V_i	=	cm^3/rev	in^3/rev
Mechanical efficiency	η_m	=	0.97 (Not valid for starting efficiency)	

Definitions

Rated speed[1)]

Rated speed is the highest allowed speed for a charge pressure of 12 bar (175 psi) above case pressure. When a closed loop system is used, a minimum of 15% of oil is to be exchanged in the main loop.

Max speed

Maximum speed is the maximum allowed speed. Special considerations are necessary regarding charge pressure, cooling and choice of hydraulic system for speeds rated above.

Accepted conditions for standard type of motor:

1. Oil viscosity 20 - **40** - 10000 cSt
   (98 - **187** - 4650 SSU). See page 24.
2. Temperature -35°C to +70°C
   (-31°F to +158°F).
3. Running case pressure 0-3 bar (0-45 psi)
   Max case pressure 8 bar (116 psi)
4. Charge pressure (see diagram).
5. Volumetric losses (see diagram).

[1)]Operating above rated conditions requires Hägglunds approval.

Data

Motor type **Metric**	FULL DISPLACEMENT Displace-ment V_i $\frac{cm^3}{rev}$	Specific torque T_s $\frac{Nm}{bar}$	Rated* speed n $\frac{rev}{min}$	Max.*** speed n $\frac{rev}{min}$	Max. ** pressure p bar	DISPLACEMENT SHIFT Displace-ment V_i $\frac{cm^3}{rev}$	Specific torque T_s $\frac{Nm}{bar}$	Rated speed n $\frac{rev}{min}$	Max. speed n $\frac{rev}{min}$	Ratio
CA 50 20	1256	20	400	400	350	**Not recommended to be used in reduced displacement**				
CA 50 25	1570	25	350	400	350					
CA 50 32	2010	32	280	400	350					
CA 50 40	2512	40	230	350	350					
CA 50	**3140**	**50**	**200**	**280**	**350**	**1570**	**25**	**200**	**280**	**1:2**
CA 70 40	2512	40	270	400	350					
CA 70 50	3140	50	225	320	350	1570	25	225	320	1:2
CA 70 60	3771	60	195	275	350	1886	30	195	275	1:2
CA 70	**4400**	**70**	**180**	**240**	**350**	**2200**	**35**	**180**	**240**	**1:2**
CA 100 40	2512	40	390	400	350					
CA 100 50	3140	50	320	400	350					
CA 100 64	4020	64	260	390	350					
CA 100 80	5024	80	220	310	350	2512	40	220	310	1:2
CA 100	**6280**	**100**	**190**	**270**	**350**	**3140**	**50**	**190**	**270**	**1:2**
CA 140 80	5024	80	245	340	350					
CA 140 100	6280	100	205	275	350	3140	50	205	275	1:2
CA 140 120	7543	120	180	245	350	3771	60	180	245	1:2
CA 140	**8800**	**140**	**170**	**220**	**350**	**4400**	**70**	**170**	**220**	**1:2**
CA 210 160	10051	160	105	150	350	5026	80	105	150	1:2
CA 210 180	11314	180	100	135	350	5657	90	100	135	1:2
CA 210	13200	210	85	115	350	6600	105	85	115	1:2

Motor type **US**	FULL DISPLACEMENT Displace-ment V_i $\frac{in^3}{rev}$	Specific torque T_s $\frac{lbf\cdot ft}{1000\ psi}$	Rated* speed n $\frac{rev}{min}$	Max. *** speed n $\frac{rev}{min}$	Max. ** pressure p psi	DISPLACEMENT SHIFT Displace-ment V_i $\frac{in^3}{rev}$	Specific torque T_s $\frac{lbf\cdot ft}{1000\ psi}$	Rated speed n $\frac{rev}{min}$	Max. speed n $\frac{rev}{min}$	Ratio
CA 50 20	76.6	1017	400	400	5000	**Not recommended to be used in reduced displacement**				
CA 50 25	95.8	1271	350	400	5000					
CA 50 32	122.6	1627	280	400	5000					
CA 50 40	153.3	2034	230	350	5000					
CA 50	**191.6**	**2543**	**200**	**280**	**5000**	**95.8**	**1271**	**200**	**280**	**1:2**
CA 70 40	153.3	2034	270	400	5000					
CA 70 50	191.6	2543	225	320	5000	95.8	1271	225	320	1:2
CA 70 60	230.1	3051	195	275	5000	115.1	1526	195	275	1:2
CA 70	**268.5**	**3560**	**180**	**240**	**5000**	**134.3**	**1780**	**180**	**240**	**1:2**
CA 100 40	153.3	2034	390	400	5000					
CA 100 50	191.6	2543	320	400	5000					
CA 100 64	245.3	3254	260	390	5000					
CA 100 80	306.6	4068	220	310	5000	153.3	2034	220	310	1:2
CA 100	**383.2**	**5085**	**190**	**270**	**5000**	**191.6**	**2543**	**190**	**270**	**1:2**
CA 140 80	306.6	4068	245	340	5000					
CA 140 100	383.2	5085	205	275	5000	191.6	2543	205	275	1:2
CA 140 120	460.3	6102	180	245	5000	230.1	3050	180	245	1:2
CA 140	**537**	**7119**	**170**	**220**	**5000**	**268.5**	**3560**	**170**	**220**	**1:2**
CA 210 160	613.2	8136	105	150	5000	306.7	4068	105	150	1:2
CA 210 180	690.4	9154	100	135	5000	345.2	4577	100	135	1:2
CA210	**805.5**	**10678**	**85**	**115**	**5000**	**402.8**	**5339**	**85**	**115**	**1:2**

*Related to a required charge pressure of 12 bar/175 psi for motors in braking mode. (Special considerations regarding charge pressure, cooling and choice of hydraulic system for speeds above rated, 4 ports must be used for higher speed).
**The motors are designed according to DNV-rules. Test pressure 420 bar/6000 psi. Peak/transient pressure 420 bar/6000 psi maximum, allowed to occur 10000 times.
***Speed above 280 rpm requires viton seals. Max permitted continues case pressure is 2 bar.

Ordering codes

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Compact motors

Example: C A 5 0 S A 0 V 0 C 0 0 0 0

C □ □□□ □□□ □□□□□□ □□ □□

Motor series

Generation

Motor size
CA 50
CA 70
CA 100
CA 140
CA 210

Specific torque (Nm/bar)

Mounting alternatives, shaft
Shrink disc coupling C
Splines S
Other 0

Multi disc brake or Tandem kit
Motor without brake or TA kit A
Motor prepared for brake or TA 1) B

Displacement shift
Single speed motor 0

Two speed motor, rotation clockwise R
(As viewed from shaft end and inlet to A port)

Two speed motor, rotation counter clockwise L
(As viewed from shaft end and inlet to A port)

Type of seal
Nitrile N
Viton V

Through hole kit
No 0
Yes H

Coated pistons and coated cam rollers
No 0
Yes C

Modification 00-99

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

1) Brake and TA kit must be ordered separately

Painting
Orange Standard
Other Option

Multi Disc Brake (MDA)

Example: M D A 0 5 N 1 0 0

M D □ □□ □ □ □□

Multidisc brake

Generation

Brake size
MDA 5
MDA 7
MDA 10
MDA 14*
MDA 21*

Type of seal
Nitrile N
Viton V

Modification 1-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

Brake must be ordered separately

Painting
Orange Standard
Other Option

***MDA 14 and MDA 21, designed for separate mounting on the driven shaft. MDA 14 can be mounted directly to the motor via Tandem kit 21, this is not possible with MDA 21.**

Torque arm

Example: T C A 5 - 0 - 0 - 0 0

T C □ □□ - □ - □ - □□

Torque arm

Generation

Torque arm size
TCA 5 (for CA 50)
TCA 7 (for CA 70)
TCA 10 (for CA 100)
TCA 14* (for CA 140/210)

Attachment
Pivoted 2
Other 9

Modification 0-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

***Also for CA 210**
Note: Torque arm incl. Pivot attachment.
TCA 5/7 - bolts supplied with motor.
TCA 10/14 - bolts & washers supplied with torque arm.

Ordering codes

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

2-Speed valve

Example: **VT C A 600 0 H 1 0 00**

VT C □ 600 □ □ □ □ □□

2-speed valve VT

For motors
CA 50 - CA 210

Generation

Max flow [l / min] 600

Brake function
Without brake function 0
With brake function *) B

Operated
Electric operated **) E
Hydraulic operated H

Exchange of oil in motor casing
Not prepared 0
Prepared 1

Modification 0-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

***) Only in combination with electric operated valve**
****) Other than 24 VDC, must be ordered separately**

Speed encoder

Example: **S P D B 1 - 1000**

S P D B □ - □□□□

Speed encoder

Digital

Generation

Type of encoder
Standard 1
Explosion proof 2

Pulse rate (pulse/rev)
1000
3600

Mounting set for speed encoder

Example: **S M C B 1 - 0 0 0**

S M C □ □ - □ □ □

Mounting set for speed encoder

For motors
Compact C

Generation B

Type of encoder
Standard 1
Explosion proof 3

Modification 0-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

Dimensions
With splines for flange mounting.

Fig. 2

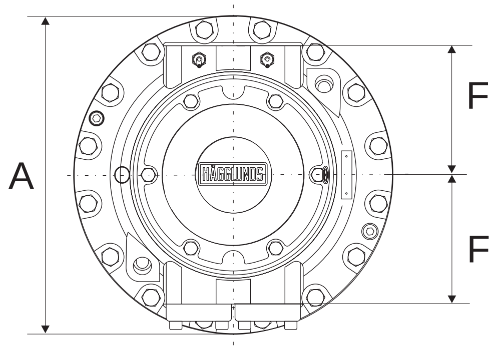


Fig. 3

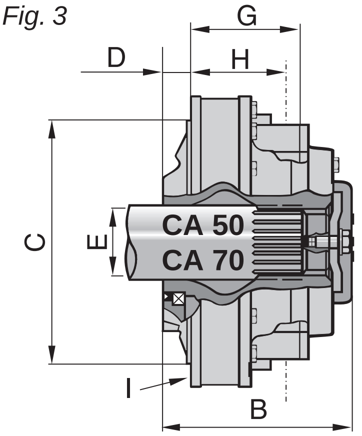


Fig. 3a

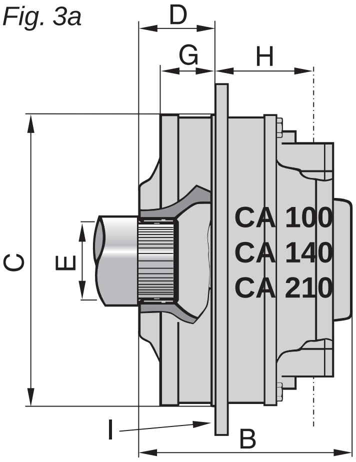


Table 1 **Dimensions for the motor**

Motor	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E	F mm (in)	G mm (in)	H mm (in)	I Hole Ø	Weight kg (lb)	Main. conn.	Drain conn.
CA 50	464 (18.26)	318.5 (12.54)	390 (15.35)	46.5 (1.83)	N120x5x30x22x9H	188 (7.40)	217.5 (8.56)	160 (6.30)	16xM16 PCD 430 (15.93)	175 (437)	SAE 1 1/4"	BSP 3/4"
CA 70	500 (19.68)		435 (17.12)						20xM16 PCD 470 (18.50)	205 (450)		
CA 100	560 (22.05)	406 (15.98)	470 (18.50)	135.5 (5.33)	N140x5x30x26x9H		95 (3.74)	158 (6.22)	17xØ22 PCD 520 (20.47)	265 (584)		
CA 140	600 (22.62)		510 (20.07)						21xØ22 PCD 560 (22.00)	305 (672)		
CA 210		507.5 (19.98)		156 (6.16)	N150x5x30x28x9H			238 (9.37)		395 (870)		

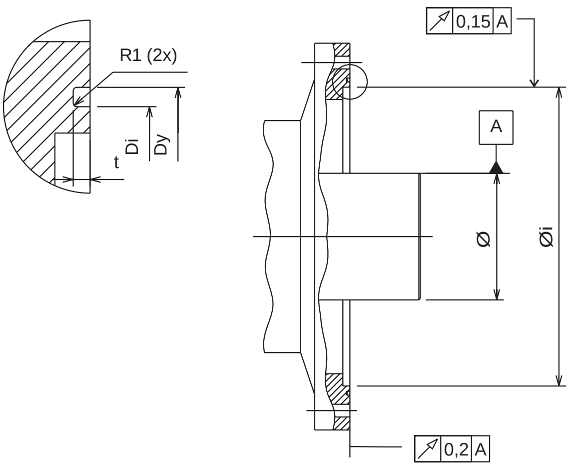
When the motor is used flange mounted it is normal to use spline. To avoid wear in the splines, the installation must be within the specified tolerances in fig. 4. If it´s possible, let the spline connection be filled with oil. If the spline is not lubricated, there is a risk for wear and corrosion. If there is radial and axial force on the shaft, the spline area in the motor shall be filled with oil. The splines shall be lubricated with hydraulic oil, or filled with transmission oil from the connected gearbox. To avoid wear in the splines, the installation must be within the specified tolerances in table 2. If there is no radial or axial force on the shaft, the shaft can be oiled only.

For production of the shaft, see 278 2230, 278 2231, 278 2232, 278 2233, 278 2234, 278 2235, 278 2236, 278 2238 or 278 2239. For control of spline see table 2.

Table 2 **Dimensions for splines**

Motor	**CA50/70**	**CA100/140**	**CA210**
Toth profile and bottom form	DIN 5480	DIN 5480	DIN 5480
Tolerance	8f	8f	8f
Guide	Back	Back	Back
Pressure angle	30°	30°	30°
Module	5	5	5
Number of teeth	22	26	28
Pitch diameter	Ø 110	Ø 130	Ø 140
Minor diameter	Ø 109 $^{0}_{-1.62}$	Ø 129 $^{0}_{-1.62}$	Ø 139 $^{0}_{-1.62}$
Major diameter	Ø 119 $^{0}_{-0.220}$	Ø139 $^{0}_{-0.250}$	Ø 149 $^{0}_{-0.250}$
Measure over measuring pins	129.781 $^{-0.083}_{-0.147}$	149.908 $^{-0.085}_{-0.150}$	159.961 $^{-0.085}_{-0.150}$
Diameter of measuring pins	Ø 10	Ø 10	Ø 10
Addendum modification X M	+2.25	+2.25	+2.25

Fig. 4



Dimensions

With hollow shaft, shrink disc coupling.

Fig. 5

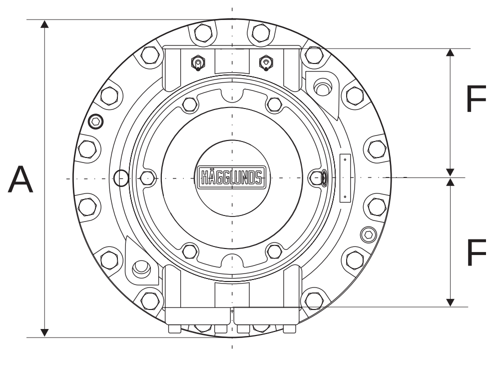


Fig. 6

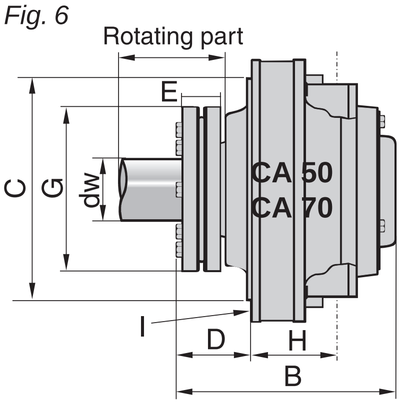


Fig. 6a

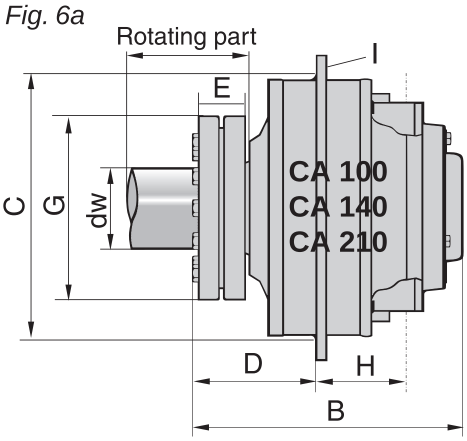


Table 3 **Dimensions for the motor**

<table>
<tr><th>Motor</th><th>A mm (in)</th><th>B mm (in)</th><th>C mm (in)</th><th>D mm (in)</th><th>E mm (in)</th><th>F mm (in)</th><th>G mm (in)</th><th>H mm (in)</th><th>I Hole Ø</th><th>dw mm (in)</th><th>Weight kg (lb)</th><th>Main. conn.</th><th>Drain conn.</th></tr>
<tr><td>CA 50</td><td>464 (18.26)</td><td rowspan="2">408 (16.08)</td><td>390 (15.35)</td><td rowspan="2">136 (5.35)</td><td rowspan="2">71.5 (2.81)</td><td rowspan="5">188 (7.40)</td><td rowspan="2">290 (11.42)</td><td rowspan="2">160 (6.30)</td><td>16xM16 PCD 430 (15.93)</td><td rowspan="2">120 (4.72)</td><td>205 (447)</td><td rowspan="5">SAE 1 1/4"</td><td rowspan="5">BSP 3/4"</td></tr>
<tr><td>CA 70</td><td>500 (19.68)</td><td>435 (17.12)</td><td>20xM16 PCD 470 (18.50)</td><td>232 (512)</td></tr>
<tr><td>CA 100</td><td>560 (22.05)</td><td rowspan="2">509 (20.04)</td><td>470 (18.50)</td><td rowspan="2">239 (9.41)</td><td rowspan="2">84.5 (3.33)</td><td rowspan="2">330 (12.99)</td><td rowspan="2">158 (6.22)</td><td>17xØ22 PCD 520 (20.47)</td><td rowspan="2">140 (5.51)</td><td>310 (683)</td></tr>
<tr><td>CA 140</td><td rowspan="2">600 (22.62)</td><td rowspan="2">510 (20.07)</td><td rowspan="2">21xØ22 PCD 560 (22.00)</td><td>347 (765)</td></tr>
<tr><td>CA 210</td><td>649 (25.55)</td><td>298 (11.72)</td><td>105 (4.13)</td><td>350 (13.78)</td><td>238 (9.37)</td><td>160 (6.29)</td><td>456 (1005)</td></tr>
</table>

Design of driven shaft end on heavily loaded shaft.

Where the driven shaft is heavily loaded and is subject to high stresses, for example for changes in the direction of rotation and/or load, it is recommended that the driven shaft should have a stress relieving groove; see fig. 7 and tables 4 and 6.

Table 4 **Alternative thread (fig. 2 & 3)**

CA 50-210		
D	M20	UNC 5/8"
E	>17 (0.67)	>13.5 (0.53)
F	25 (0.98)	22 (0.87)
G	50 (1.97)	30 (1.18)

Normally loaded shaft

In drives with only one direction of rotation and/or load where the stresses in the shaft are moderate, the shaft can be plain, see Fig. 8 and tables 4 and 6.

Table 6 **Dimensions for the driven shaft**

Dim	CA50/70	CA100/140	CA210
A mm in	120 $^{0}_{-0.025}$ 4.7244 $^{0}_{-0.00098}$	140 $^{0}_{-0.025}$ 5.5118 $^{0}_{-0.00098}$	160 $^{0}_{-0.025}$ 6.2992 $^{0}_{-0.00098}$
B mm in	71.5 2.81	84.5 3.33	105 4.13
C mm in	116 4.57	133 5.24	153 6.02

Note! The dimensions are valid for +20°C (86°F)

Fig. 7

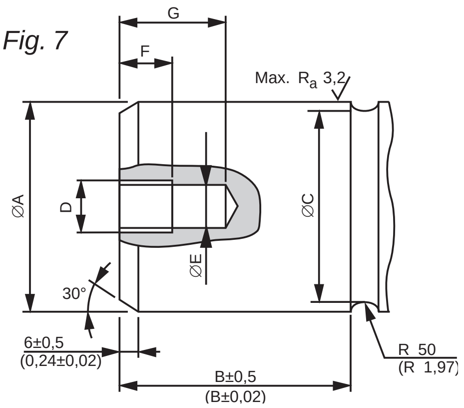
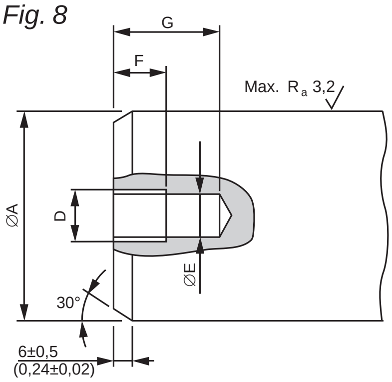


Table 5
Recommended material in the shaft

Unidirectional drives
Steel with yield strength Rel_{min} = 300 N/mm^2
Bidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm^2

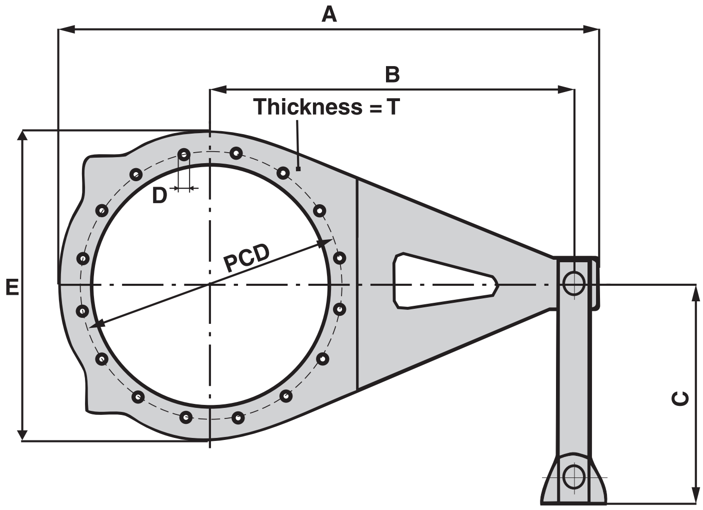
Fig. 8



Dimensions

Torque arm

Fig. 9 **Torque arm**

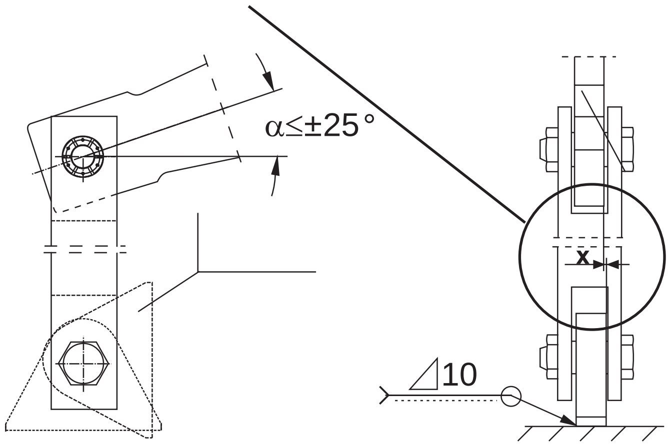


<table>
<tr><th>Torque arm</th><th>A mm (in)</th><th>B mm (in)</th><th>C mm (in)</th><th>D Ø</th><th>E mm (in)</th><th>T mm (in)</th><th>Weight kg (lb)</th></tr>
<tr><td>TCA 5 for CA50</td><td>890 (35.03)</td><td rowspan="2">600 (23.62)</td><td rowspan="2">340 (13.38)</td><td rowspan="2">M16</td><td>500 (19.68)</td><td rowspan="2">25 (0.98)</td><td>28 (61.5)</td></tr>
<tr><td>TCA 7 for CA70</td><td>915 (36.02)</td><td>550 (21.65)</td><td>31 (68.4)</td></tr>
<tr><td>TCA 10 for CA100</td><td rowspan="2">1175 (46.26)</td><td rowspan="2">800 (31.50)</td><td rowspan="2">435 (17.12)</td><td rowspan="2">M20</td><td rowspan="2">665 (26.18)</td><td rowspan="2">39 (1.54)</td><td>91 (200)</td></tr>
<tr><td>TCA 14 for CA140 and CA210</td><td>81 (178)</td></tr>
</table>

Torque arm	Max torque (Nm) For alternating or pulsating torque	Max torque (Nm) At static torque
TCA 5 for CA50	17500	21000
TCA 7 for CA70	24500	29400
TCA 10 for CA100	35000	42000
TCA 14 for CA140 and CA210	70000	84000
Torque arm	**Max torque (Nm) For alternating or pulsating torque**	**Max torque (Nm) At static torque**
TCA 5 for CA50	12900	15500
TCA 7 for CA70	18100	21700
TCA 10 for CA100	25800	31000
TCA 14 for CA140 and CA210	51600	62000

Fig. 9a **Mounting of pivoted attachment**

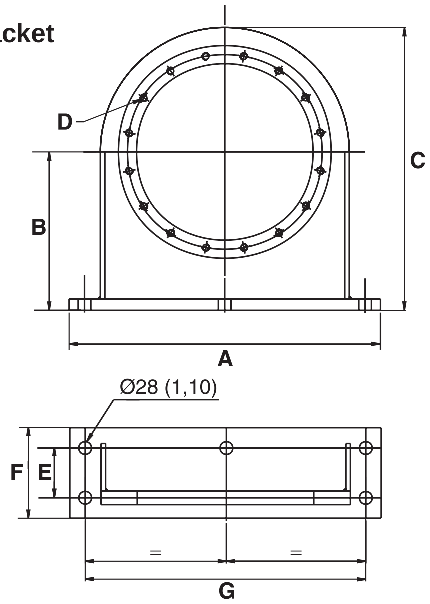
x = ±2 mm (0.079) misalignment in installation.
x ≤ ±15 mm (0.59) movement when in use.



Note: Ideal angle = 0°

Bracket

Fig. 10 **Bracket**



Bracket	A mm (in)	B mm (in)	C mm (in)	D Ø	E mm (in)	F mm (in)	G mm (in)	Weight kg (lb)
CAB 5 CAB 7	690 (27.16)	350 (13.78)	625 (24.60)	16xM16	110 (4.33)	200 (7.87)	620 (24.41)	85 (187)
CAB 10 CAB 14	750 (29.53)	480 (18.90)	805 (31.69)	20xM20	110 (4.33)	200 (7.87)	700 (27.55)	108 (238)

Accessories

Data Compact brake MDA

The brake is fatigue safe for pulsating torque			Oil volume
MDA 5	14250 Nm	(10500 lbf·ft)	1.7 l (0.45 US.gal.)
MDA 7	20000 Nm	(14750 lbf·ft)	1.7 l (0.45 US.gal.)
MDA 10	28500 Nm	(21000 lbf·ft)	1.7 l (0.45 US.gal.)
MDA 14	39800 Nm	(29350 lbf·ft)	2.0 l (0.53 US.gal.)
MDA 21	59800 Nm	(44100 lbf·ft)	2.0 l (0.53 US.gal.)

Pilot presssure: min 20 bar (280 psi) max 50 bar (725 psi)
Recommended opening pressure: 20-25 bar (290-360 psi)
Fatigue resistant for 25 bar (360 psi)
Displacement: MDA 5-10 0.2 lit. (0.06 US.gal.)
MDA 14 & 21 Min. 0.2 lit (0.06 US.gal)
MDA 14 & 21 Max. 0.3 lit (0.08 US.gal.)
Max speed 100 rpm, peaks up to 220 rpm.

Braking torque, dynamic with friction coefficient 0.12		
MDA 5	22600 ± 700 Nm	(16650 ± 515 lbf·ft)
MDA 7	30400 ± 900 Nm	(22400 ± 660 lbf·ft)
MDA 10	41500 ± 2000 Nm	(30600 ± 1475 lbf·ft)
MDA 14	57000 ± 3000 Nm	(42000 ± 2210 lbf·ft)
MDA 21	81800 ± 4300 Nm	(60300 ± 3170 lbf·ft)
Braking torque, static with friction coefficient 0.14		
MDA 5	26400 ± 800 Nm	(19450 ± 590 lbf·ft)
MDA 7	35500 ± 1100 Nm	(26200 ± 810 lbf·ft)
MDA 10	48400 ± 2300 Nm	(35700 ± 1695 lbf·ft)
MDA 14	66800 ± 3500 Nm	(49200 ± 2580 lbf·ft
MDA 21	95000 ± 5000 Nm	(70000 ± 3685 lbf·ft)

Inertia		
MDA 5	0.110 kgm^2	(2.3 lbf·ft^2)
MDA 7	0.128 kgm^2	(3.0 lbf·ft^2)
MDA 10	0.156 kgm^2	(3.7 lbf·ft^2)
MDA 14	0.360 kgm^2	(8.5 lbf·ft^2)
MDA 21	0.417 kgm^2	(9.9 lbf·ft^2)

There dynamic conditions may occur please contact your Hägglunds representative.

For emergency braking the brake can take these energies:		
MDA 5	540 kJ	(511 Btu)
MDA 7	755 kJ	(715 Btu)
MDA 10	1080 kJ	(1023 Btu)
MDA 14	950 kJ	(900 Btu)
MDA 21	1350 kJ	(1278 Btu)

Fig. 11 **MDA 5 - MDA 10 mounted on motor**

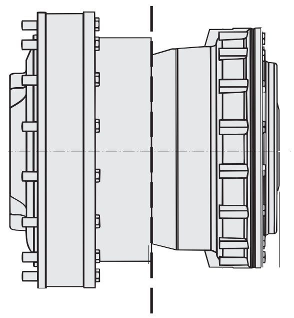
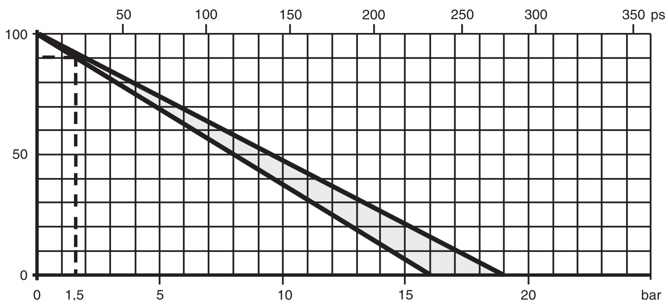
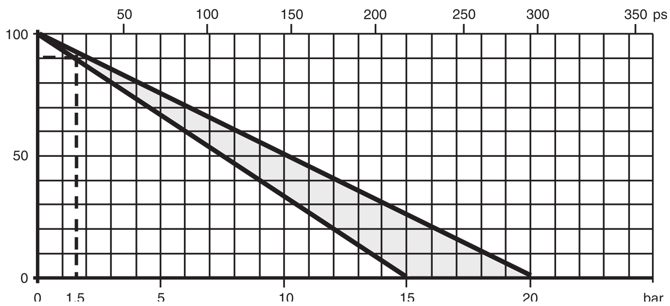


Diagram 1 **MDA 5 - MDA 10**



Back pressure in brake cylinder drainage line.

Diagram 1a **MDA 14 - MDA 21**



Back pressure in brake cylinder drainage line.

Fig 12a **MDA 14 and MDA 21 for separate mounting**

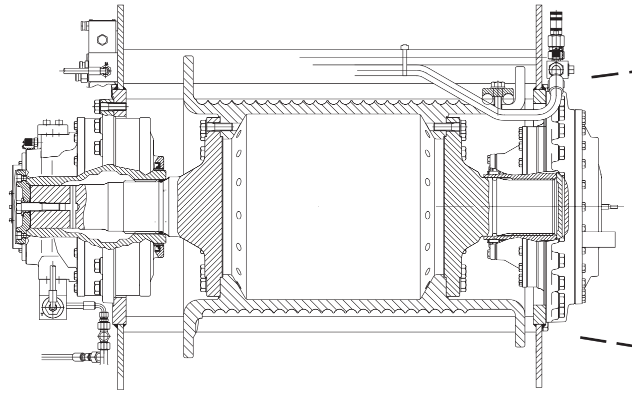
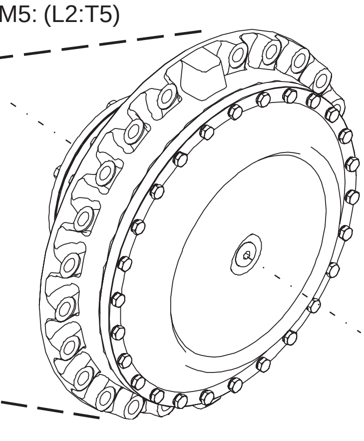


Fig 12 **MDA 14 and MDA 21**
Max external radial load: 200 kN (44800 lbf)
External load: 110 kN (24600 lbf) according to FEM M5: (L2:T5)



Accessories

Speed encoder with mounting set SMCB

Speed encoder with mounting set SMCB. The Speed encoder could be ordered in 18 different models, full scale output from 2 to 300 rpm.

Fig. 13 **Speed encoder**

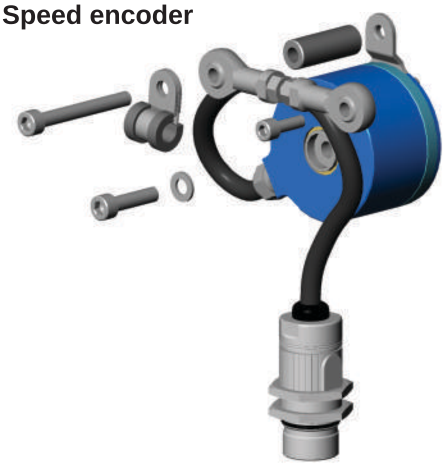
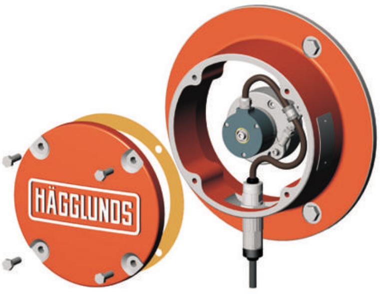


Fig. 14 **Speed encoder mounting set**



2-Speed valve for Compact, type VTCA 600

The 2-speed valve is designed for use with Compact motors CA 50-CA 210. The valve has displacement shifting function and is mounted directly on the motor. When ordering motor prepared for 2-speed function the main rotation, clockwise (R) or counter clockwise (L), has to be specified.
Displacement shift when motor is running is allowed for speed up to 30 rpm and max high pressure 150 bar (2175 psi).

The valve is available in three main designs:
VTCA 600 0 H: Hydraulic operated displacement shift.
VTCA 600 0 E: Electric operated displacement shift, 24 VDC.
VTCA 600 B E: Electric operated displacement shift with brake control function, 24 VDC.

Direction of rotation of motor shaft

With the inlet pressure supply connected to A port, the motor shaft rotates in the direction shown by the arrow, anti-clockwise viewed from the motor shaft side.
With the inlet pressure supply connected to C port, the motor shaft rotates clockwise viewed from the motor shaft side.

Fig. 15 **Standard motor**

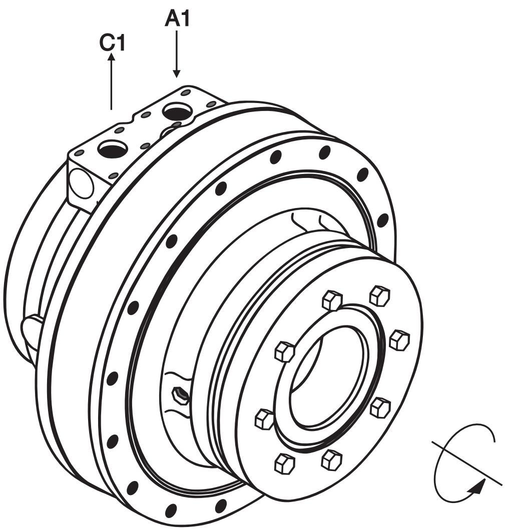
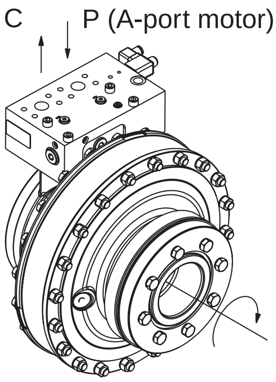
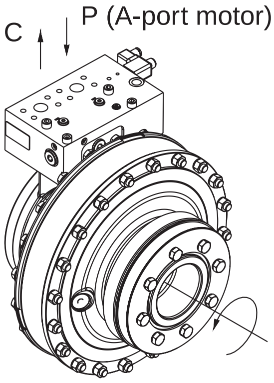


Fig. 16 **Right hand motor**



If the motor sign is marked "R" the motor rotation direction is clockwise, see fig. 16.

Fig. 17 **Left hand motor**



With a two-speed valve mounted on the motor and the oil supply connected to P give a counter clockwise rotation direction on a motor sign marked "L", see fig. 17.

Accessories

Cross-over valve, COCB 1000

The valve is designed for use with Compact motors CA 50 - CA 210. The valve is bolted directly on the motor, and the valve protects the motor and system from too high pressure, if the motor is suddenly stopped. The relief valves have a standard pressure settings of 350 bar (5075 psi), but are fully adjustable between 50 bar (500 psi) to 350 bar (5075 psi). Screws and O-rings are included in delivery.

Fig. 19 **COCB**

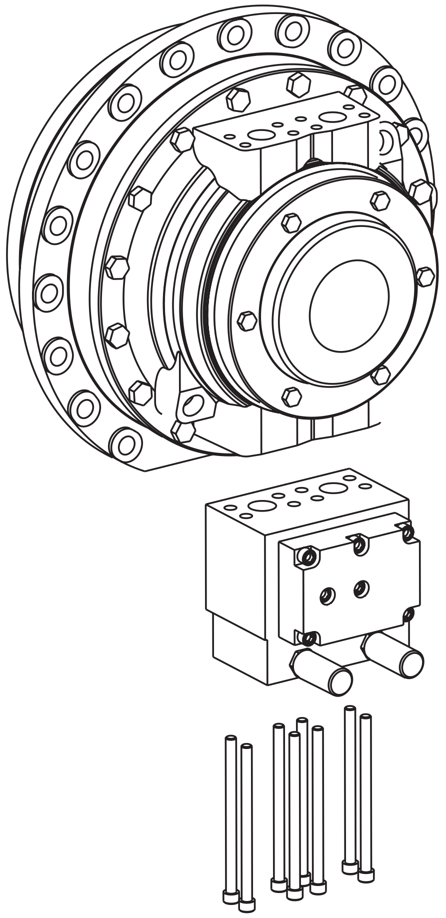
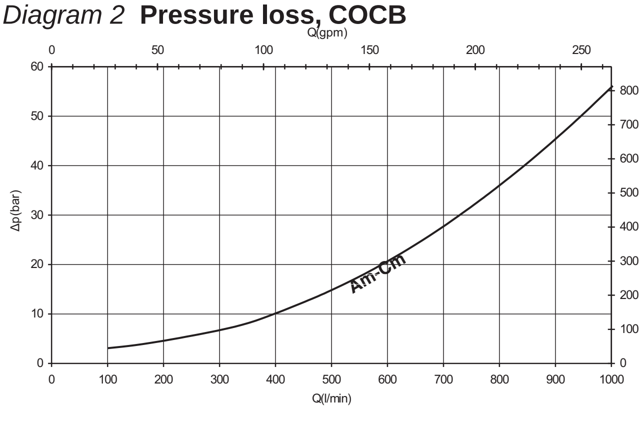


Diagram 2 **Pressure loss, COCB**



Emergency stop manifold, VECA

The VECA manifold can be mounted directly on the Compact motor. The VECA manifold can be converted for either clockwise or counter clockwise motor shaft rotation. The VECA manifold gives a very quick stop and can be integrated in most common control systems. Screws and O-rings are included in delivery.

Fig. 20 **VECA**

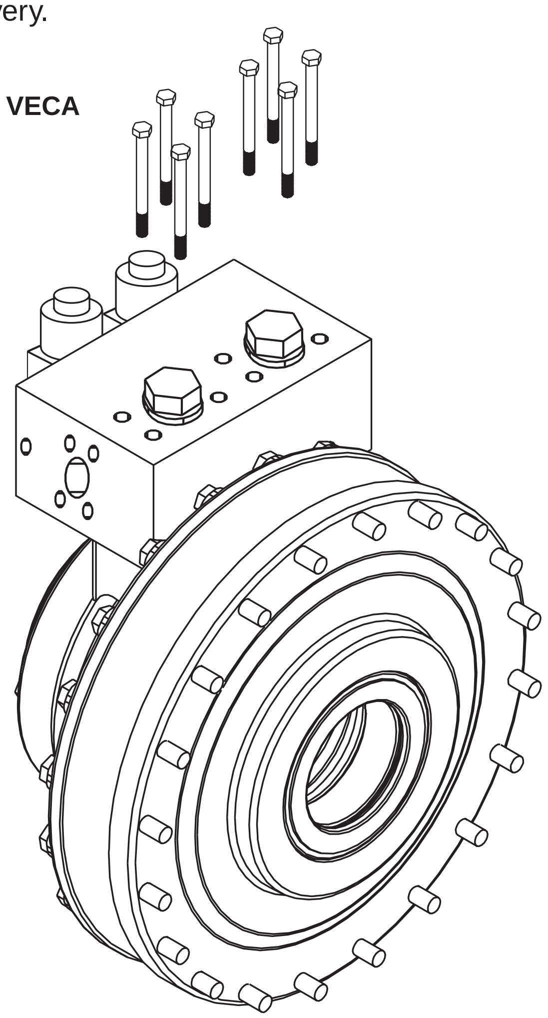
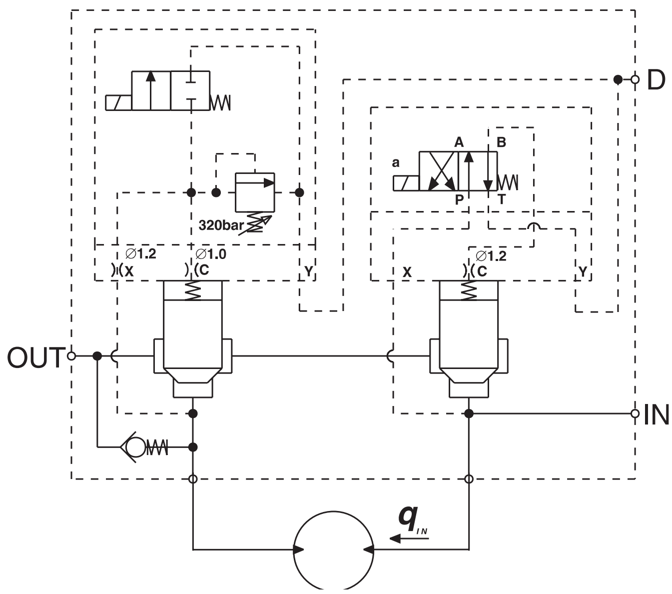


Diagram 3 **Schematic diagram, VECA**



Diagrams for Compact

Compact motors

Diagram 4 **Charge pressure - Compact motors 2 port connection**

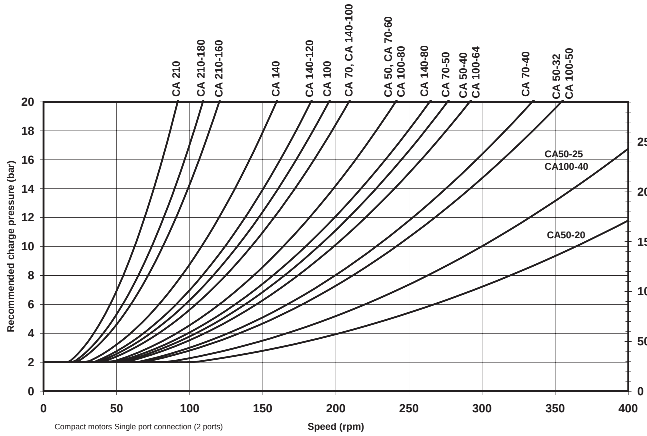
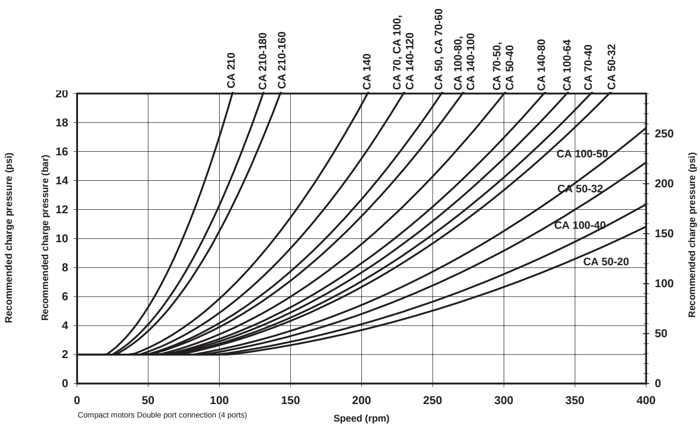


Diagram 5 **Charge pressure - Compact motors 4 port connection**



Case 1: The motor works in braking mode. Required charge pressure at the inlet port is according to diagram above.

Case 2: The motor works in driving mode only. Required back pressure at the outlet port corresponds to 30% of value given in diagram above, but may not be lower than 2 bar (29 psi).

Case 3: The motor is used with 2-speed valve. Required charge pressure at inlet port for valve is according to diagram below.

2-speed valve

Diagram 6 **Charge pressure - Compact motors half displacement (motor & valve)**

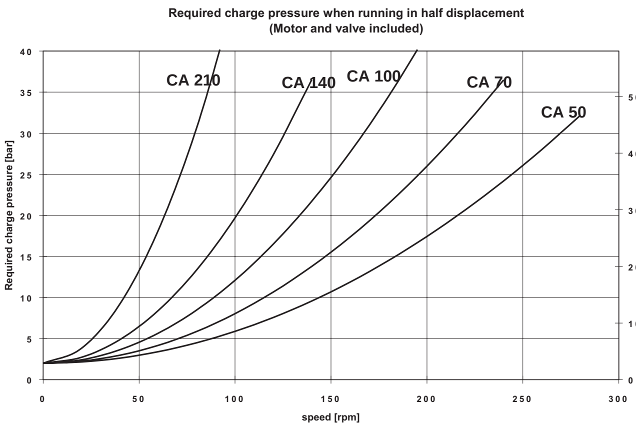


Diagram 7 **Exchange of oil in motor case vs pressure in C-line with restriction (D = 2 mm, 40 cSt/187 SSU)**

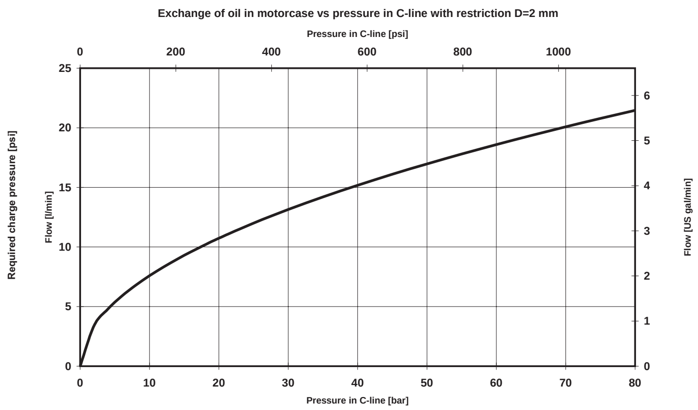


Diagram 8 **Pressure loss main circuit P-C full displacement (motor & valve, 40 cSt/187 SSU)**

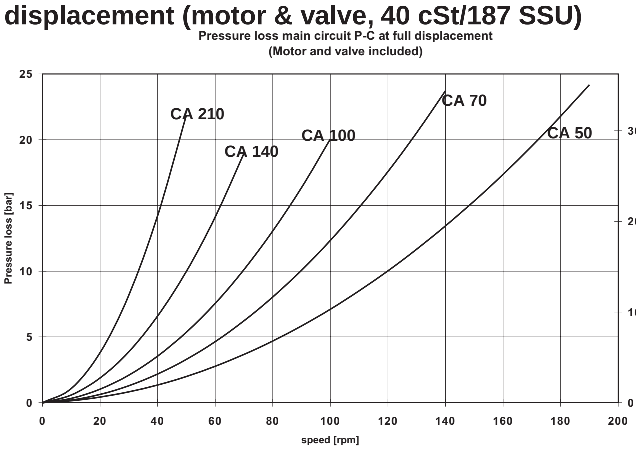
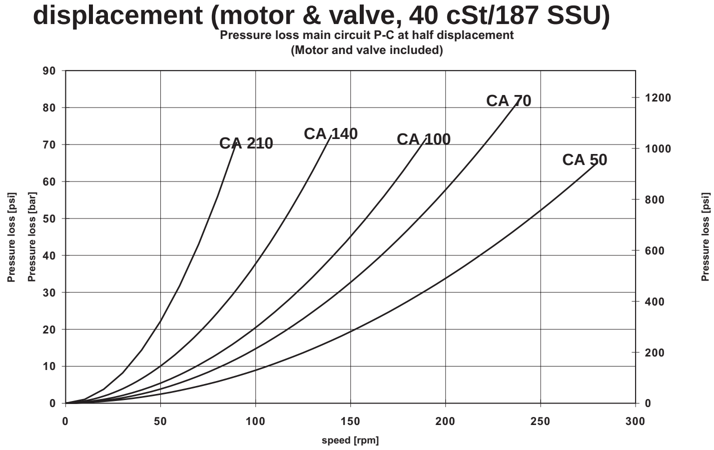


Diagram 9 **Pressure loss main circuit P-C half displacement (motor & valve, 40 cSt/187 SSU)**



Diagrams for Compact

Overall efficiency, oil viscosity 40 cSt/187 SSU, Pc = 15 bar (217 psi)

Diagram 10 CA 50, 2 ports

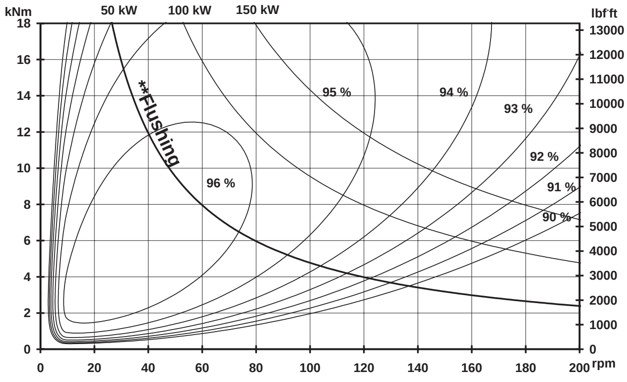


Diagram 11 CA 50, 4 ports

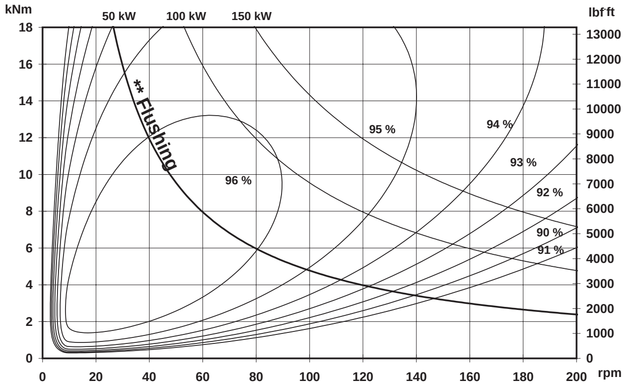


Diagram 12 CA 70, 2 ports

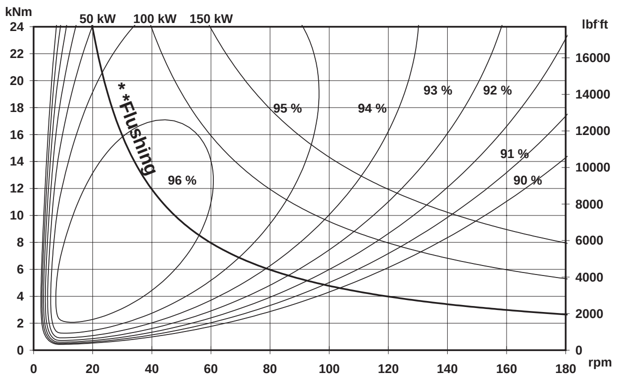


Diagram 13 CA 70, 4 ports

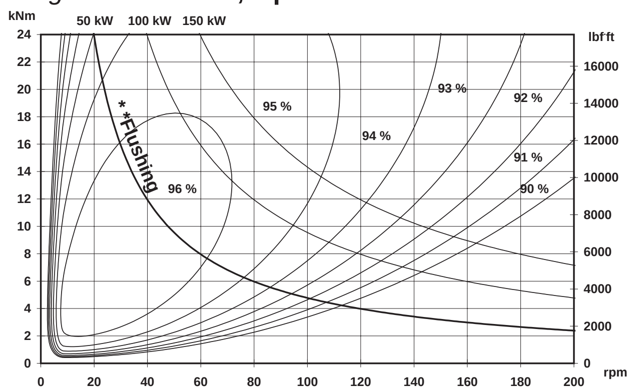


Diagram 14 CA 100, 2 ports

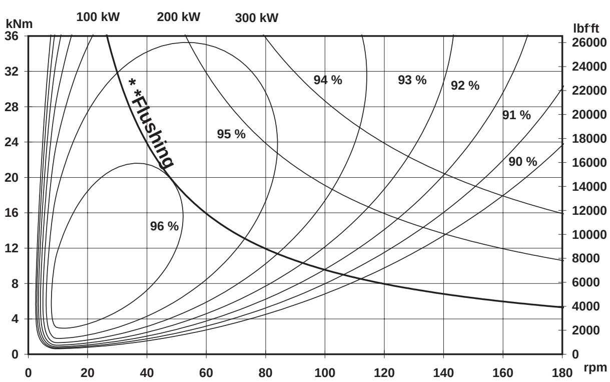


Diagram 15 CA 100, 4 ports

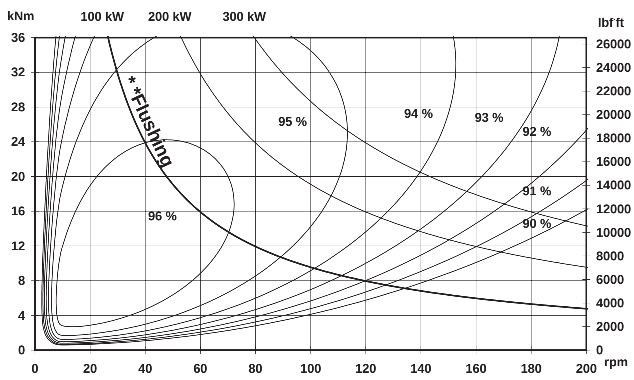


Diagram 16 CA 140, 2 ports

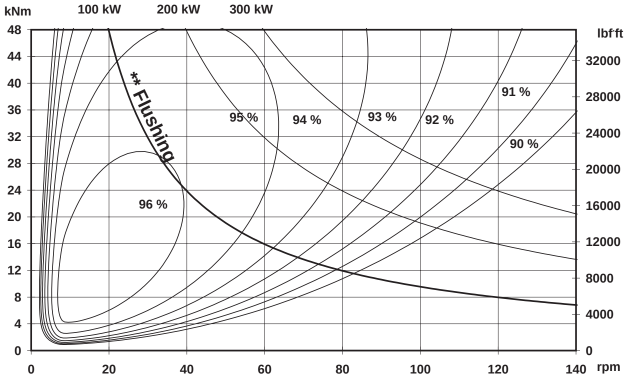
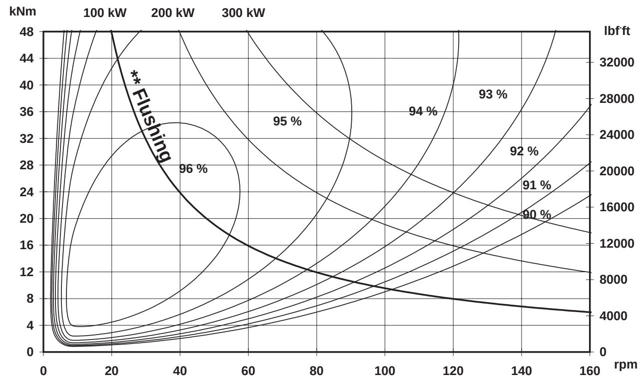


Diagram 17 CA 140, 4 ports



** See AC-4.5 Flushing of motor case.

Diagrams for Compact

Overall efficiency, oil viscosity 40 cSt/187 SSU, Pc = 15 bar (217 psi)

Diagram 18 **CA 210, 2 ports**

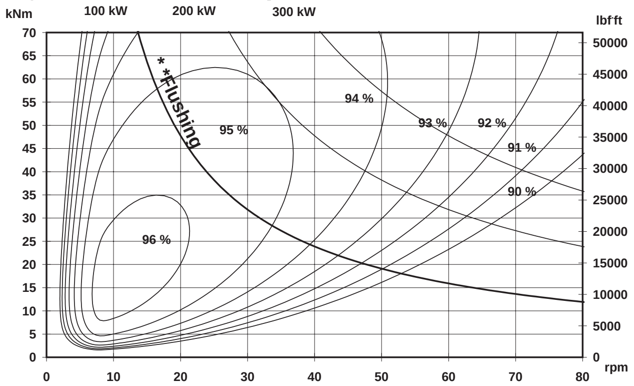
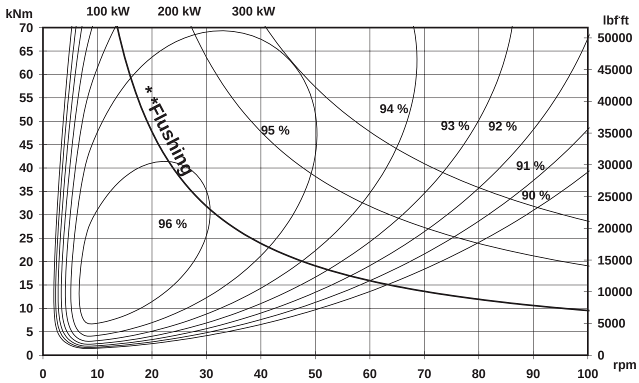


Diagram 19 **CA 210, 4 ports**



** See AC-4.5 Flushing of motor case.

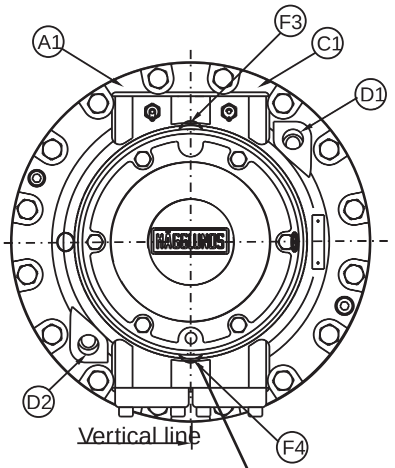
Flushing of motor case

The Compact motors have very high total efficiency, and they are now frequently used in applications with high power. To avoid high temperature in the motor case the heat must be cooled away, because high temperature gives lower viscosity and that gives reduction in basic rating life. Low viscosity also gives reduced permitted output power from the motor.

- For continuous duty in applications with an ambient temperature of +20°C (68°F), the motor case must be flushed when the output power exceeds the values shown below.

Max power without flushing		
CA 50/70	60 kW	(80 hp)
CA 100/140/210	120 kW	(160 hp)

Fig. 21 **Flushing connection F**



Flushing inlet. Connection G1/4". Max allowed flushing 20 litres/ min (5.5 gal./min).

Diagrams for Compact

Pressure loss, oil viscosity 40 cSt/187 SSU

Diagram 20 **CA 50 pressure loss 2 ports**

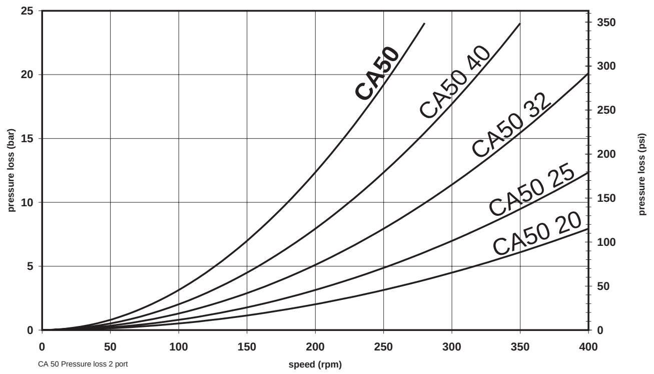


Diagram 21 **CA 50 pressure loss 4 ports**

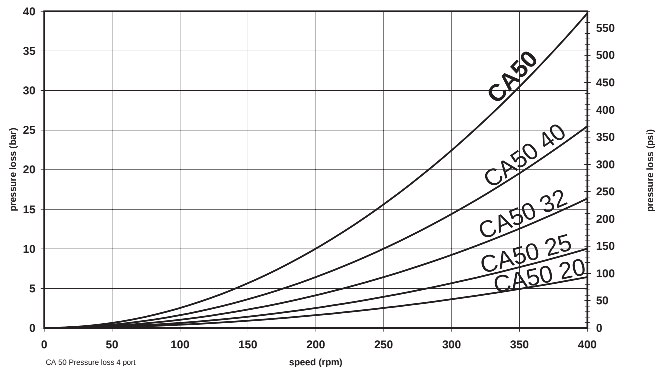


Diagram 22 **CA 70 pressure loss 2 ports**

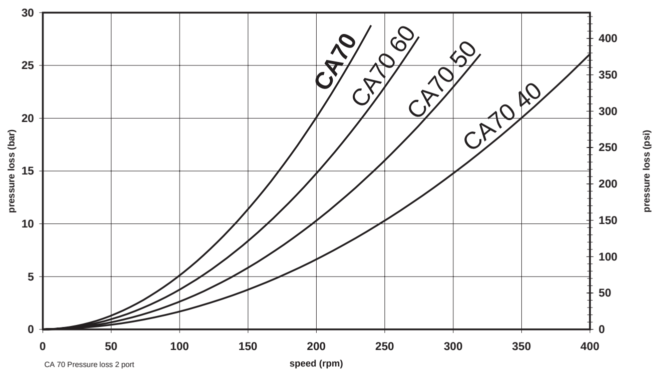


Diagram 23 **CA 70 pressure loss 4 ports**

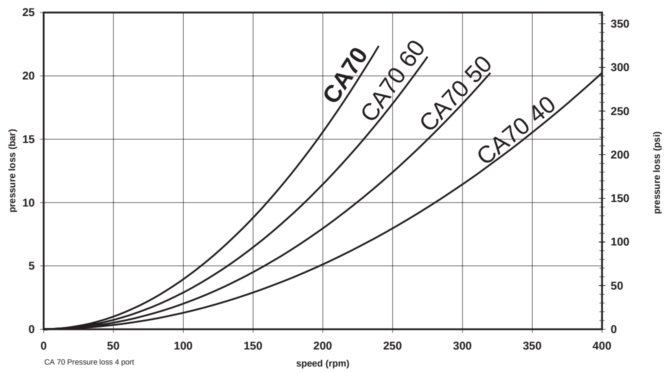


Diagram 24 **CA 100 pressure loss 2 ports**

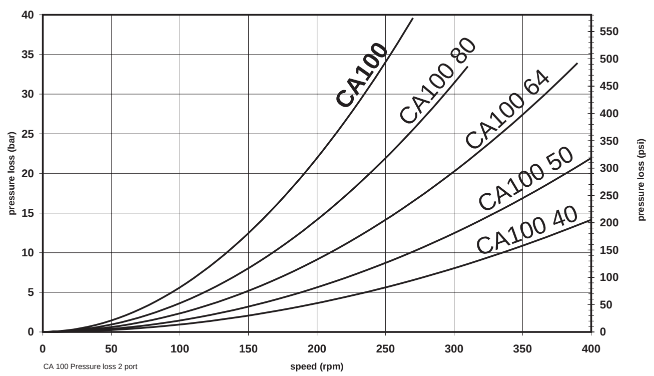


Diagram 25 **CA 100 pressure loss 4 ports**

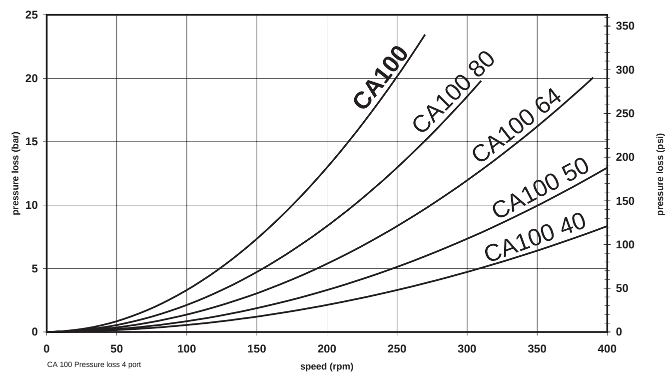


Diagram 26 **CA 140 pressure loss 2 ports**

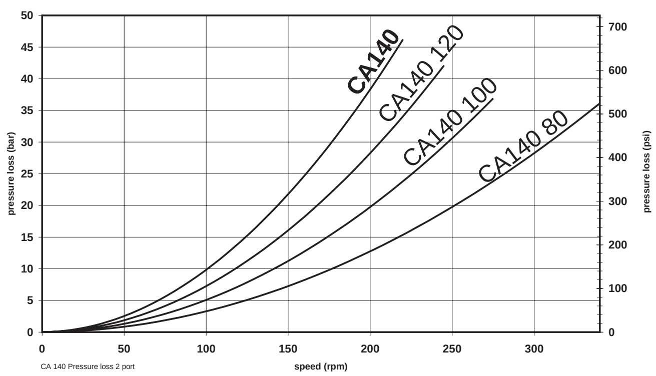
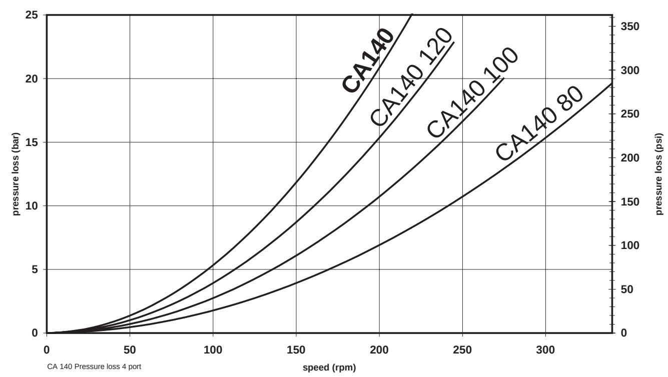


Diagram 27 **CA 140 pressusre loss 4 ports**



Diagrams for Compact

Pressure loss, oil viscosity 40 cSt/187 SSU

Diagram 28 **CA 210 pressure loss 2 ports**

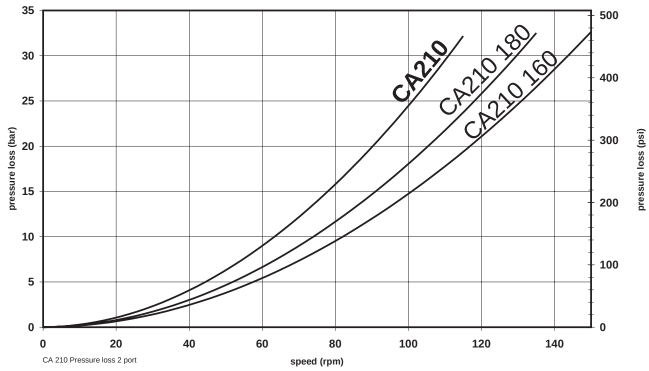
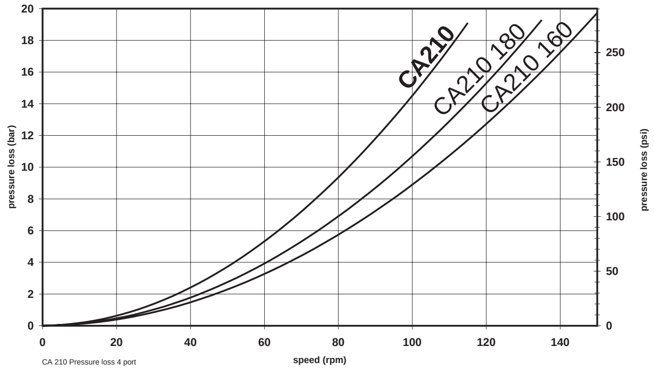


Diagram 29 **CA 210 pressure loss 4 ports**



Volumetric losses

Valid for an oil viscosity of 40 cSt/187 SSU, the diagram 30 shows the average values. When calculating volumetric losses using other viscosities, multiply the value given in the diagram by the factor K in diagram 31.

Diagram 30

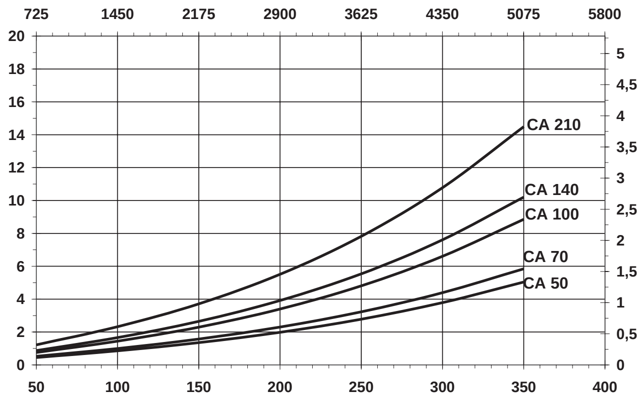
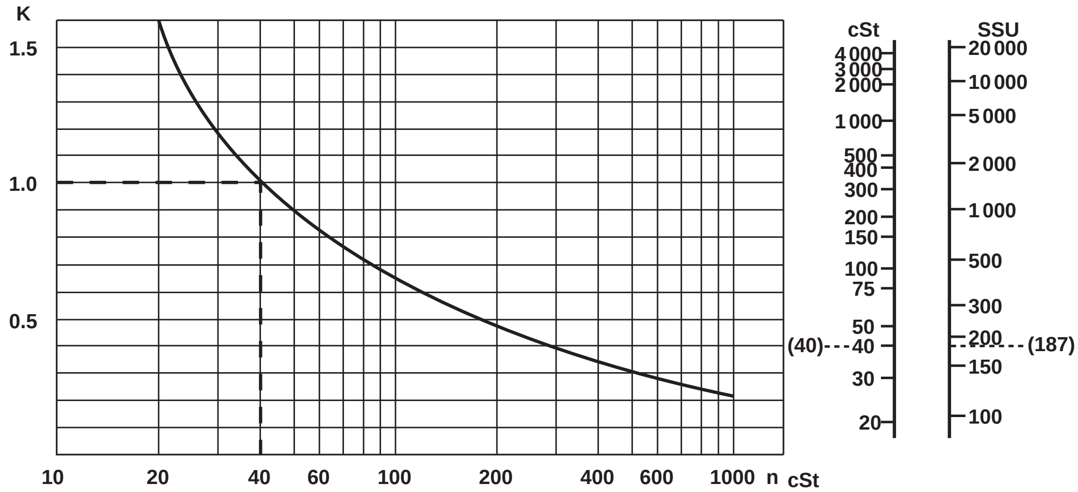


Diagram 31 **Factor K - Variation in volumetric losses**



Examples of installations

Fig. 23 **Flange mounted motor with splines**

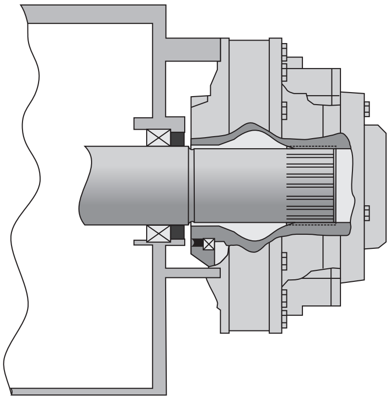


Fig. 22 **Torque arm mounted motor with splines.**

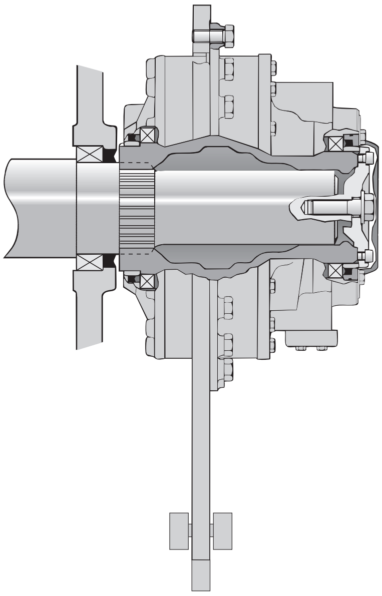


Fig. 24 **Motor with through hole for cooling of driven machine.**

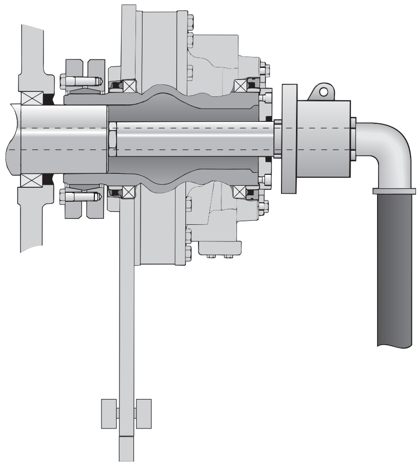


Fig. 25 **Flange mounted motor with through shaft for high radial load.**

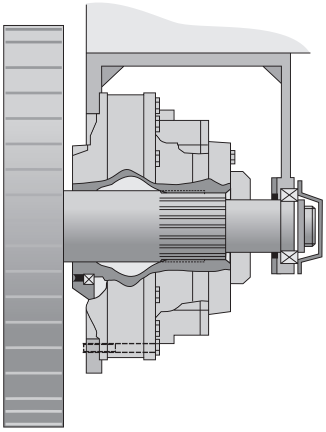


Fig. 27 **Bracket mounted motor with stub shaft.**

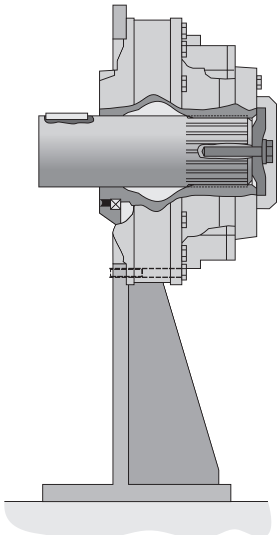


Fig. 26 **Bracket mounted capstan drive.**

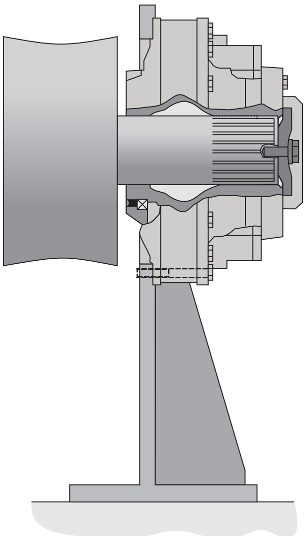


Fig. 28 **Direct mounted winch drum drive with brake.**

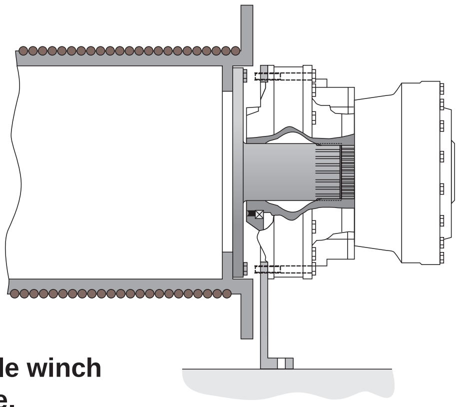
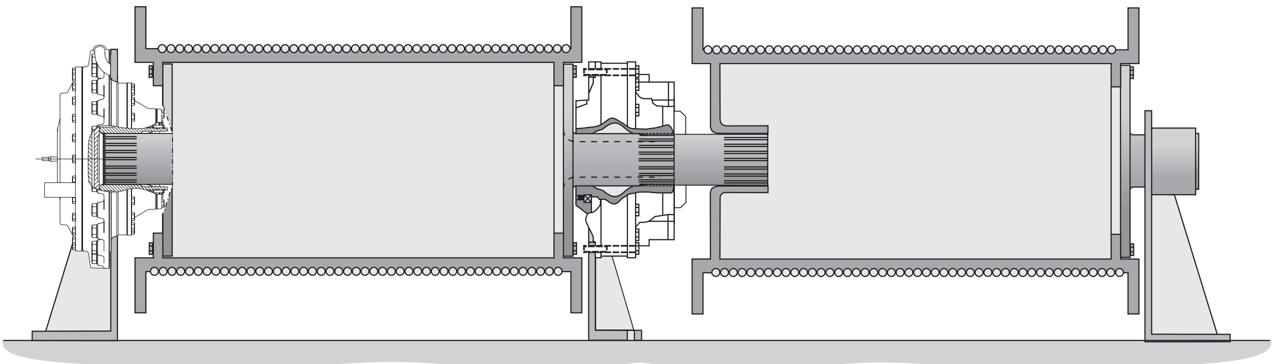


Fig. 28a **Direct mounted double winch drum drive with brake.**

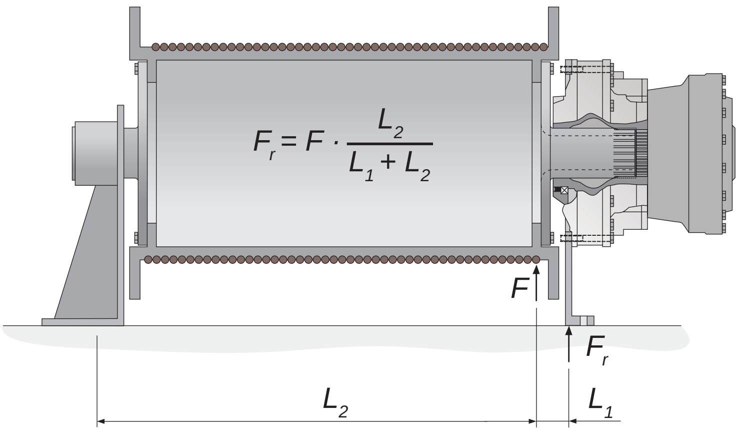


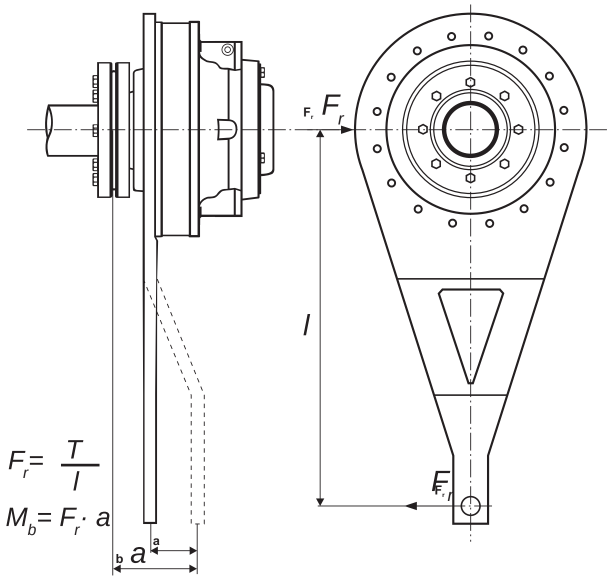
Recommended external loads for Compact

Motor mounted in winch - reaction forces.

- The bracket must be designed so it does not give extra external forces to the motor.

If not standard torque arms TCA are used, forces must be checked for main bearings and coupling.





F_r = Total radial force on fixed motor mounting
F_a = Axial force acting on motor centerline
T = Output torque for motor
M_b = Bending moment acting on hollow shaft

Permissible external loads

Fixed shaft - torque arm mounted motor, viscosity 40/250 cSt, speed 100 rpm.
Torque arm is mounted at a = 0 mm on the motor.
Note: When Bracket mounted motor or higher external load, please contact Hägglunds representative.

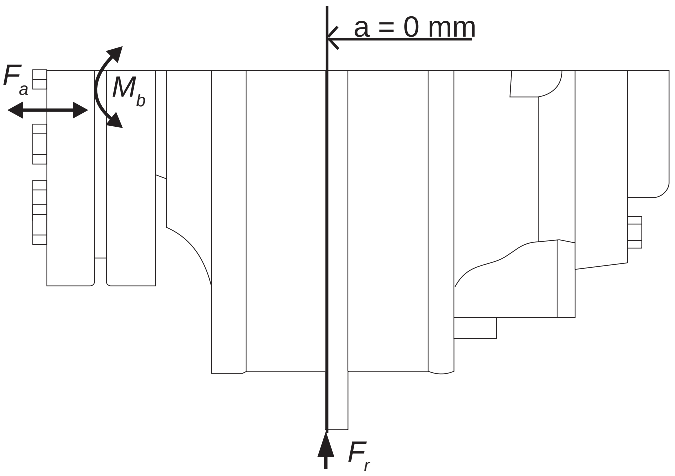


Diagram 32 **Motor type CA 50 and CA 70**

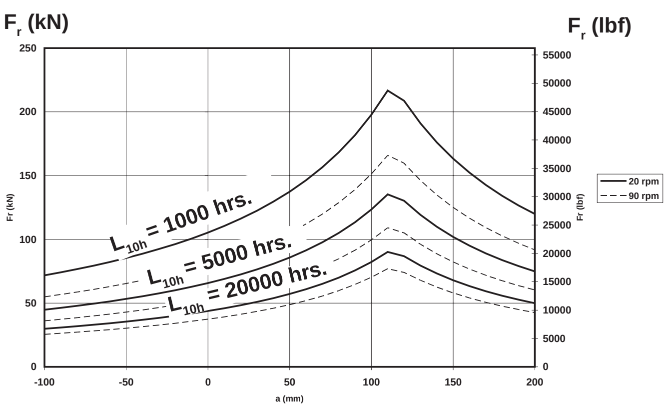


Diagram 33 **Motor type CA 100 and CA 140**

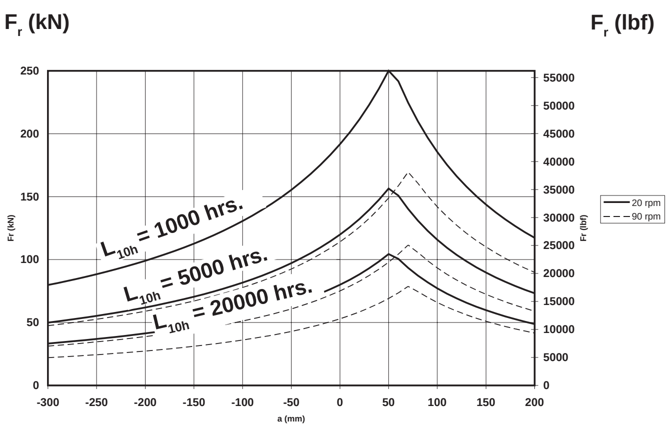
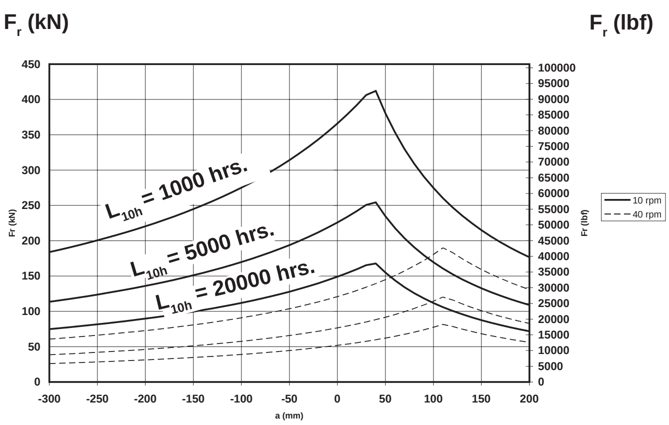


Diagram 34 **Motor type CA 210**



Max permitted external static load for Compact

Torque arm is mounted at a = 0 mm on the motor.

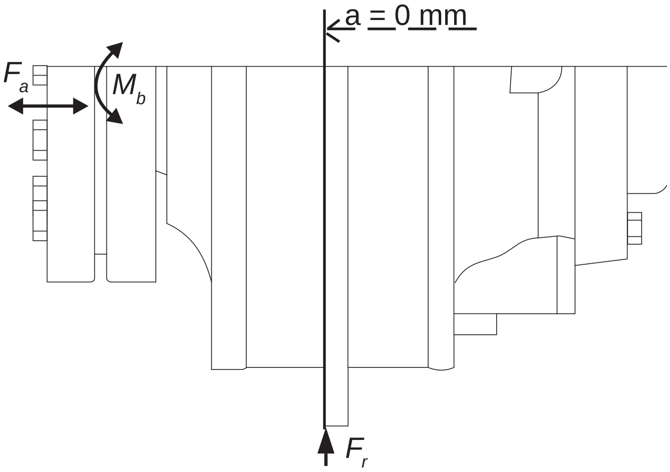


Diagram 35 **Motor type CA 50**

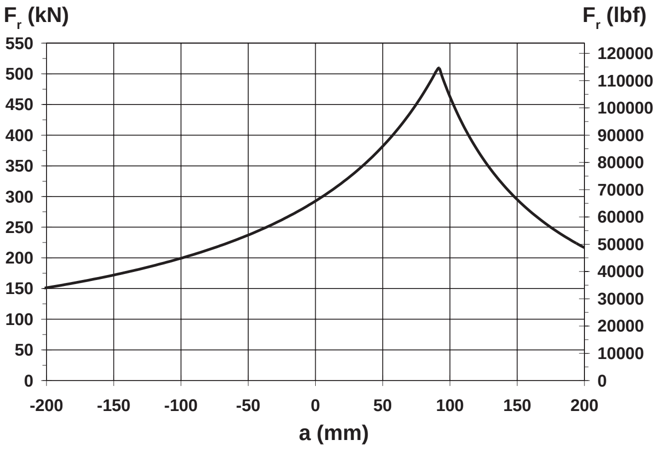


Diagram 36 **Motor type CA 70**

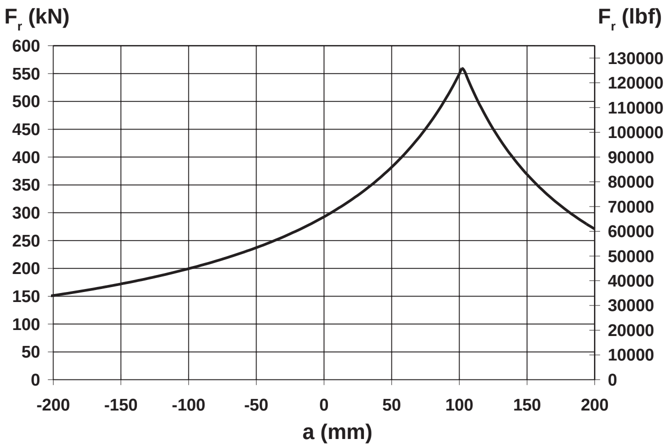


Diagram 37 **Motor type CA 100**

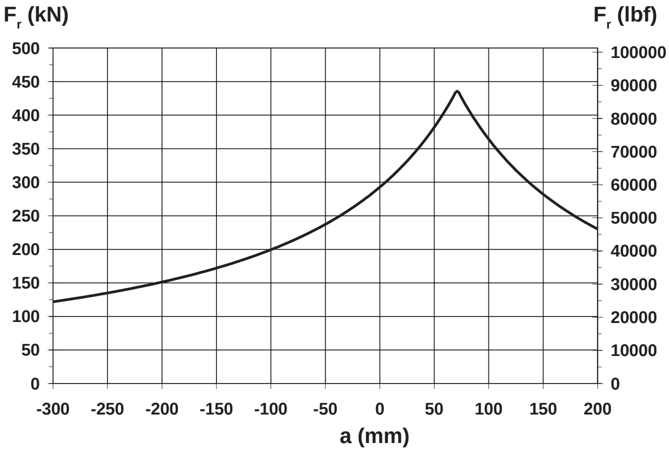


Diagram 38 **Motor type CA 140**

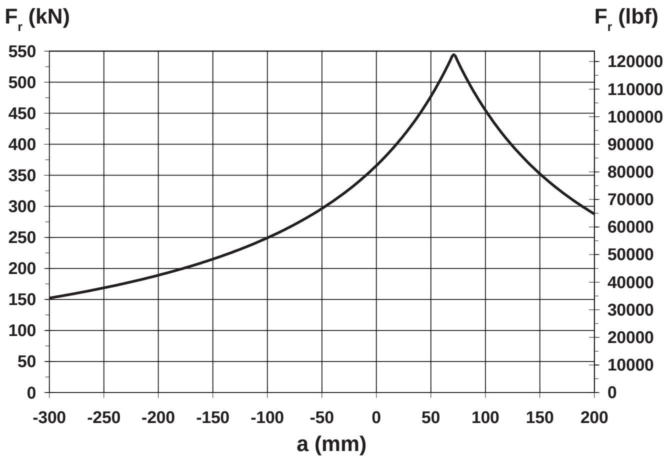
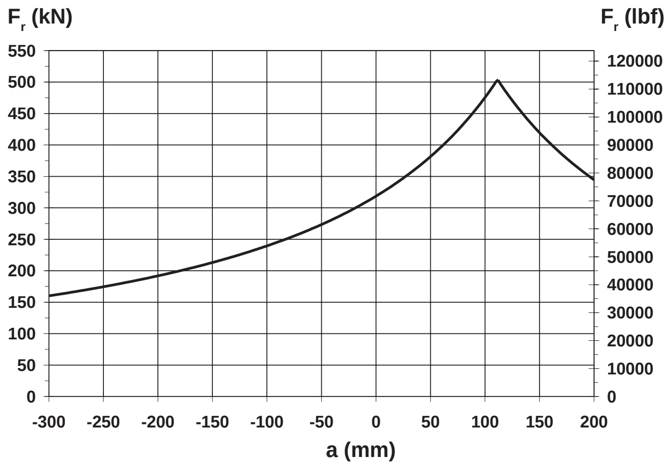


Diagram 39 **Motor type CA 210**



Choice of hydraulic fluid

The Hägglunds hydraulic motors are primarily designed to operate on conventional petroleum based hydraulic oils. The hydraulic oil can be chosen in consultation with the oil supplier or your local sales office, bearing the following requirements in mind:

General

The oil shall have FZG (90) fail stage minimum 11 described in IP 334 (DIN 51354). The oil must also contain inhibitors to prevent oxidation, corrosion and foaming. The viscosity of mineral oil is highly dependent of the temperature. The final choice of oil must depend on the operating temperature that can be expected or that has been established in the system and not in the hydraulic tank. High temperatures in the system greatly reduce the service life of oil and rubber seals, as well as resulting in low viscosity, which in turn provides poor lubrication. Content of water shall be less than 0.1%. In Industrial applications with high demands for service life, the content of water shall be less than 0.05%.

Recommended viscosity in motor case at operating temperature 40-150 cSt/187-720 SSU.
For speed below 5 rpm, coated pistons shall be used, please contact your Hägglunds representative.

Temperature limits	
Normal operating temperature should be less than +50°C (122°F)	
Nitrile seals (std motor) Viton seals	-35°C to +70°C -20°C to +100°C
Nitrile seals (std motor) Vition seals	-31°F to +158°F -4°F to +212°F

Minimum viscosity limits at operating temperature in motor case	
Standard motors with uncoated pistons and uncoated cam rollers	20 cSt/98 SSU*
Motors type C (coated pistons and coated cam rollers) for speed below 5 rpm or when charge pressure exceeds 50 bar (725 psi) at speed above 100 rpm	10 cSt/59 SSU*

* Low viscosity gives reduced service life for the motors.
Max permitted viscosity is 10000 cSt/48000 SSU

Fire resistant fluid

The following fluids are tested for Hägglunds motors (ISO/DP 6071).

Fluid	Approved	Seals	Internal paint
HFA: Oil (3-5%) in water emulsion	No	-	-
HFB: Inverted emulsion 40-45% water in oil	Yes	Nitrile (std motor)	Not painted*
HFC: Water-glycol	Yes	Nitrile (std motor)**	Not painted*
HFD synthetic fluids			
HFD:R - Phosphate esters	Yes	Viton	Not painted*
HFD:S - Chlorinated hydrocarbons	Yes	Viton	Not painted*
HFD:T - Mixture of the above	Yes	Viton	Not painted*
HFD:U - Other compositions	Yes	Viton	Not painted*

* Must be specified in the order.
**The motor must have synthetic oil for the axial bearing.

Environmentally acceptable fluids

Fluid	Approved	Seals	Internal paint
Vegetable */** Fluid HTG	Yes	Nitrile (std motor)	-
Synthetic ** Esters HE	Yes	Nitrile (std motor)	-

*Vegetable fluids give good lubrication and small change of viscosity with different temperature. Vegetable fluids must be controlled every 3 months and temperature shall be less than +45°C (113°F) to give good service life for the fluid.
**Environmental acceptable fluid give the same service life for the drive, as mineral oil.

Choice of hydraulic fluid

Down rating of pressure data and basic rating life

Down rating of pressure, for motors used in systems with fire resistant fluids, the maximum pressure for motor given on data sheet must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.7 x maximum pressure for motor
HFC-fluid	0.7 x maximum pressure for motor
HFD-fluid	0.9 x maximum pressure for motor

Down rating of basic rating life, for motors used in systems with fire resistant fluids, the "expected basic rated life" must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.26 x expected life with mineral oil
HFC-fluid	0.24 x expected life with mineral oil
HFD-fluid	0.80 x expected life with mineral oil

Filtration

The oil in a hydraulic system must always be filtered and also new oil from your supplier has to be filtered when adding it to the system. The grade of filtration in a hydraulic system is a question of service life v.s. money spent on filtration.
In order to obtain stated service life it is important to follow our recommendations concerning contamination level.
When choosing the filter it is important to consider the amount of dirt particles that the filter can absorb and still operate satisfactory. For that reason we recommend a filter with an indicator that gives a signal when it is time to change the filter cartridge.

Filtering recommendations

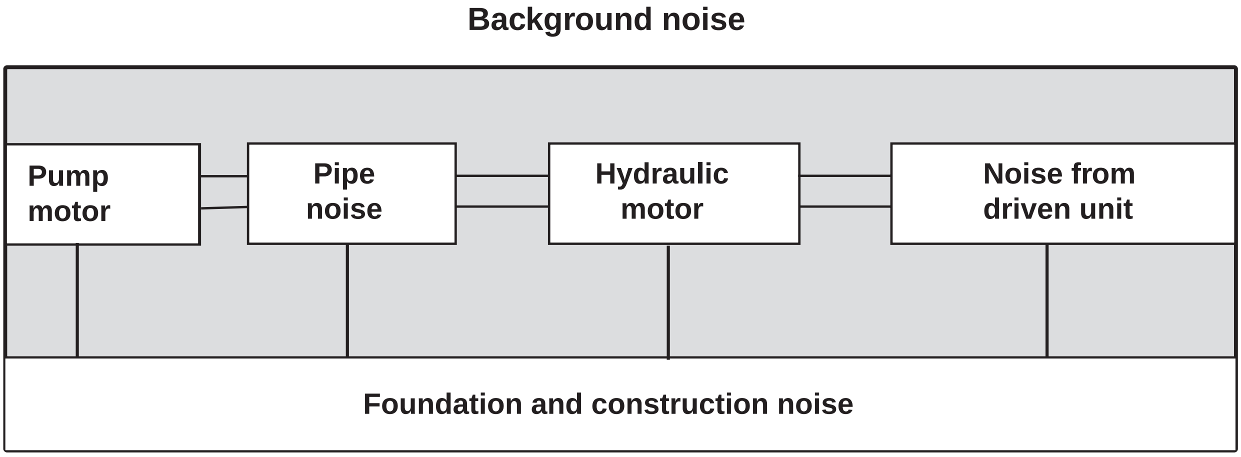
Before start-up, check that the system is thoroughly cleaned.
1. In general the contamination level should not exceed ISO 4406:1999 18/16/13 (NAS 1638, class 7).
2. When filling the tank and motor case, we recommend the use of a filter with the grade of filtration ß10=75.

Explanation of "Grade of Filtration"

Grade of filtration β**10=75** indicates the following:
β**10** means the size of particle ≥10μm that will be removed by filtration.
=75 means the grade of filtration of above mentioned size of particle. The grade of filtration is defined as number of particles in the oil before filtration in relation to number of particles in the oil after filtration.

Ex. Grade of filtration is β**10=75**.
Before the filtration the oil contains *N* number of particles ≥10μm and after passing the filter once the oil contains $\frac{N}{\mathbf{75}}$ number of particles ≥10μm.
This means that $N - \frac{N}{75} = \frac{74 \cdot N}{75}$ number of particles have been filtered (=98.6%).

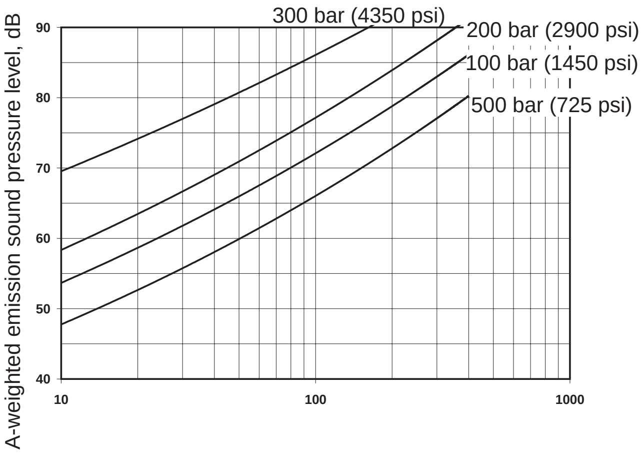
Noise from a complete installation



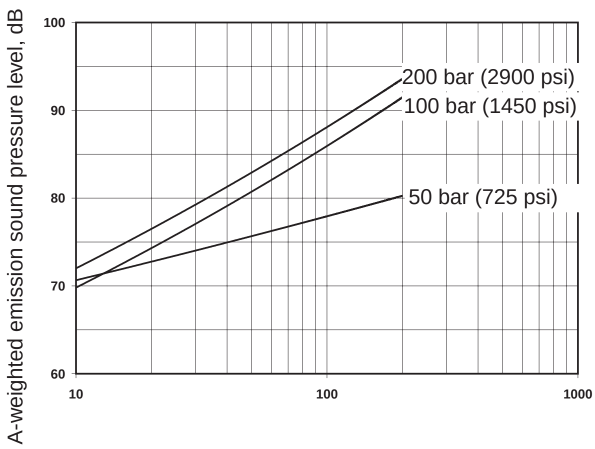
A-weighted emission sound pressure level of Compact CA

The emission sound pressure level have been calculated according to ISO/DIS 11203 for unattended machines. All values refer to a position of the test object > 1 m (3.28 ft).

CA 50 - 70



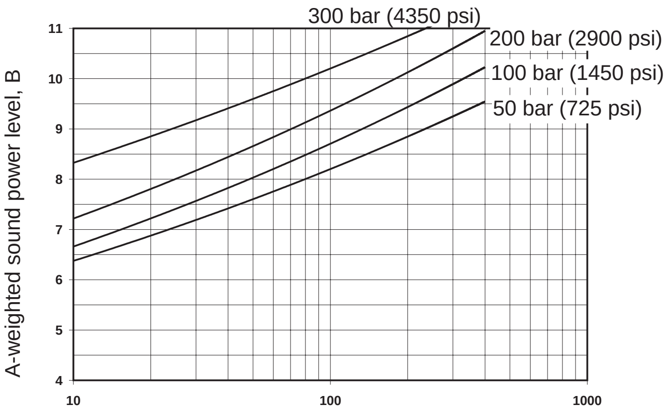
CA 100 - 210



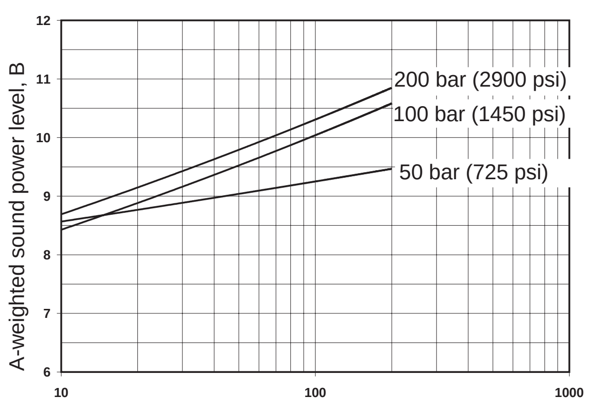
A-weighted sound power level of Compact CA

The sound power level have been calculated according to ISO/DIS 11203 for unattended machines. All values refer to a position of the test object > 1 m (3.28 ft).

CA 50 - 70



CA 100 - 210



Declaration of Incorporation

Example of the Incorporation of Conformity given by Hägglunds Drives AB

HÄGGLUNDS

Declaration of Incorporation of partly completed machinery
As defined by the EC Machinery Directive 2006/42/EC, Appendix II B

The manufacturer

Hägglunds Drives AB

hereby declares that the partly completed machinery

Name: Compact CA
Function: Hydraulic motor
Model: Compact
Type: CA
Trade name: Compact CA

satisfies the following essential requirements of Machinery Directive 2006/42/EC in accordance with the chapter numbers in Appendix I:

General principle no. 1.									
1.1.3	1.1.5	1.3.1	1.3.2	1.3.3	1.3.4	1.3.6	1.3.7	1.5.3	1.5.4
1.5.5	1.5.6	1.5.8	1.5.13	1.6.1	1.6.3	1.7.3	1.7.4		

The requirements are fulfilled provided that the data in the product documentation (fitting instructions, operating instructions, project management and configuration documents) are implemented by the product user. The requirements of Appendix I to Machinery Directive 2006/42/EC not mentioned here are not applied and have no relevance for the product.

It is also declared that the special technical documents for this partly completed machinery have been compiled in accordance with Appendix VII, Part B. These are transferred on request to the market surveillance body in paper-based/electronic format.

Conformity with the provisions of further EU Directives, Standards or Specifications:

SS-EN 982
SS-EN ISO 12100-1
SS-EN ISO 12100-2

The partly completed machinery may only be put into operation when it has been established that the machine into which the partly completed machinery is to be incorporated conforms to the provisions of EC Machinery Directive 2006/42/EC, where relevant according to this directive.

The individual below is authorized to compile the relevant technical files:

Name: Björn Leidelöf
Address: Hägglunds Drives AB, S-890 42 Mellansel

Björn Leidelöf Mellansel, 2009-12-29

We reserve the right to make changes to the content of the Declaration of Incorporation. Current issue on request.

The Declaration of Incorporation above, is available on request for deliveries from Hägglunds Drives AB. Translations into other languages are also available.

www.hagglunds.com

Hägglunds Drives AB
SE-890 42 Mellansel, Sweden
Tel: + 46 (0)660 870 00.
E-mail: info@se.hagglunds.com
www.hagglunds.com

Our drive is your performance.

EN 396-10H. Repro: Öviks Repro. Printer: Ågrens Tryckeri 2011.

Compact CB

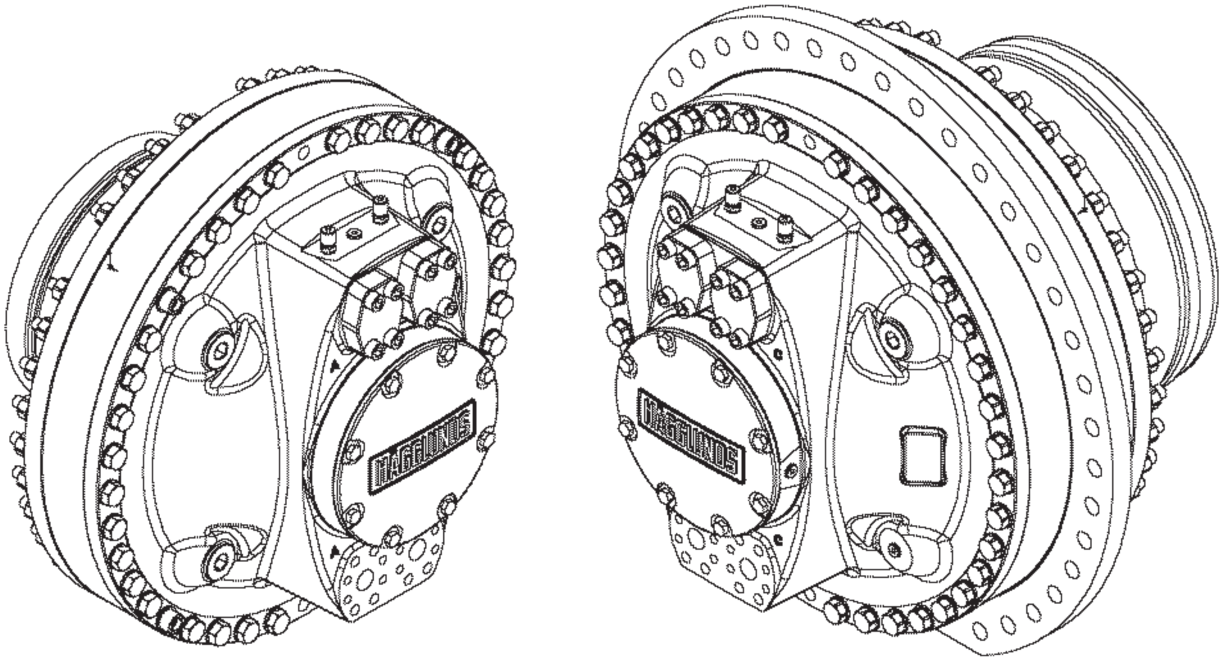
PRODUCT MANUAL

HÄGGLUNDS

Product Manual

COMPACT CB

EN734-7h 2011



One partner all over the world

Hägglunds Drives is a global leader in the hydraulic motors and drive systems niche.
The Group develops, manufactures and markets drive system solutions for applications requiring high torque, low speeds and variable speeds. The drive systems are used in a wide range of industries, such as Mining and materials handling, Marine and offshore, Recycling, Sugar, Pulp and paper, Rubber and plastics, and Building and construction.

We have approximately 900 employees. Production is located in Mellansel, Sweden, Columbus, Ohio, USA and San Antonio, Texas, USA. The Group has 16 subsidiaries, personnel in over 20 countries, and around 50 sales and service offices. In addition, there are distributors in around 20 countries. The largest geographical markets are Europe, China, India, Australia and North America.

We are owned by Bosch Rexroth, one of the largest hydraulic companies in the world.

Original EN734-5h, 2009

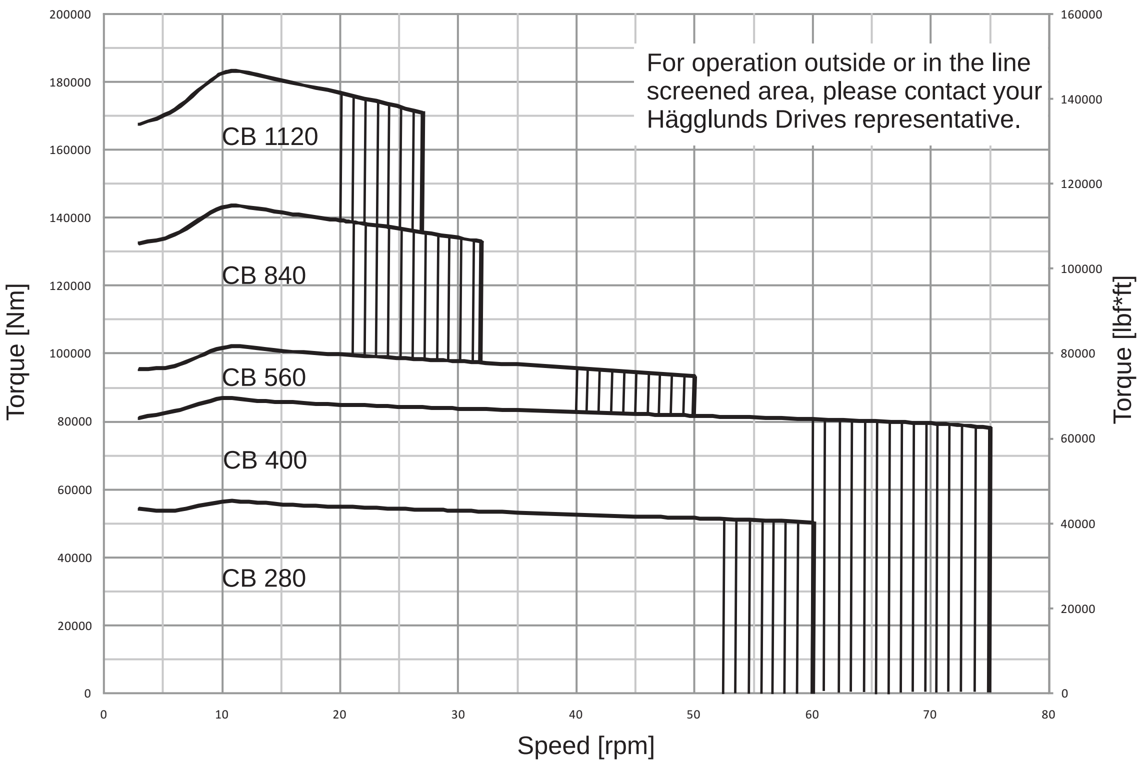
The content in this manual is subject to change without notice or obligation, unless certified referring to a certain purchase order. Information contained herein should be confirmed before placing orders.

Features of Hägglunds Drives new Compact CB motor

- High output torque and power to weight ratio
- Full torque from zero to maximum speed
- Small outer diameter
- Many sizes to choose from to optimise the drive
- Flexible mounting by using shaft coupling or splines, suitable for torque arm or flange mounting
- High efficiency and low maintenance cost
- Resistant against shock loads
- Through hole

Quick selection diagram for Compact CB motors

The diagram below represents the torque and speed, corresponding to a modified rating life L_{10aah} = 40 000 h. P_c = 15 bar (218 psi), oil viscosity in motor case 40 cSt (187 SSU). When operating below 3 rpm, coated pistons or oil with higher viscosity shall be used. Contact your Hägglunds representative.



Functional description

Hägglunds hydraulic industrial motor COMPACT CB is of the radial-piston type with a rotating cylinder block/hollow shaft and a stationary housing. The cylinder block is mounted in fixed roller bearings in the housing. An even number of pistons are radially located in bores inside the cylinder block, and the valve plate directs the incoming and outgoing oil to and from the working pistons. Each piston is working against a cam roller.

When the hydraulic pressure is acting on the pistons, the cam rollers are pushed against the slope on the cam ring that is rigidly connected to the housing, thereby producing a torque. The cam rollers transfer the reaction force to the pistons which are guided in the cylinder block. Rotation therefore occurs, and the torque available is proportional to the pressure in the system.

Oil main lines are connected to ports A and C in the connection block and drain lines to ports D1, D2, D3 or D4 in the motor housing.

The motor is connected to the shaft of the driven machine through the hollow shaft of the cylinder block. The torque is transmitted by using a mechanical shaft coupling, or alternatively by splines.

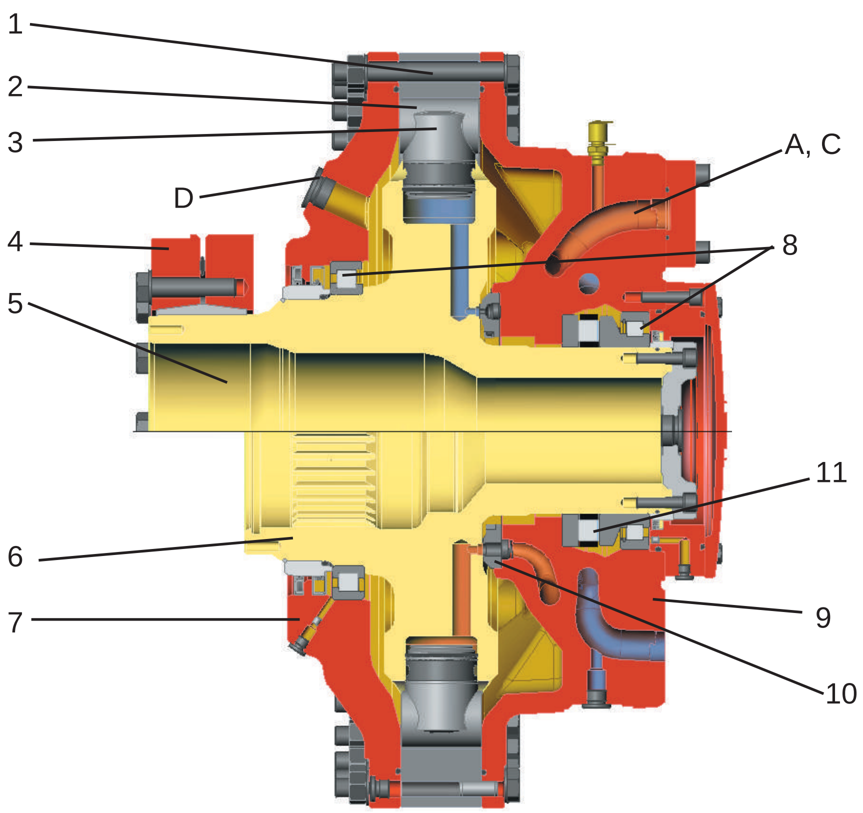
Valid patents

US 4522110, US 005979295A, SE 456517, EP 0102915, JP 83162704, GB 1385693, EP 0524437.

Quality

To assure our quality we maintain a Quality Assurance System, certified to standard ISO 9001, EN 29001 and BS 5750; Part 1.

Fig. 1 **Compact CB motor**

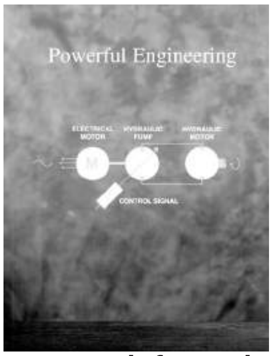


1. Cam ring
2. Cam roller
3. Piston
4. Shaft coupling
5. Cylinder block / hollow shaft
6. Cylinder block / spline
7. Shaft end housing
8. Cylinder roller bearings
9. Connection block
10. Valve plate
11. Axial bearing

A = Inlet or outlet port »A«
C = Inlet or outlet port »C«
D = Drain port

Calculation fundamentals

Output power	$P = \frac{T \cdot n}{9549}$ (kW) on driven shaft	$P = \frac{T \cdot n}{5252}$ (hp) on driven shaft
Output torque ($\eta_m = 98\%$)	$T = T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m$ (Nm)	$T = \frac{T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m}{1000}$ (lbf·ft)
Pressure required ($\eta_m = 98\%$)	$p = \frac{T}{T_s \cdot \eta_m} + \Delta p_l + p_c$ (bar)	$p = \frac{T \cdot 1000}{T_s \cdot \eta_m} + \Delta p_l + p_c$ (psi)
Flow rate required	$q = \frac{n \cdot V_i}{1000} + q_l$ (l/min)	$q = \frac{n \cdot V_i}{231} + q_l$ (gpm)
Output speed	$n = \frac{q - q_l}{V_i} \cdot 1000$ (rpm)	$n = \frac{q - q_l}{V_i} \cdot 231$ (rpm)
Inlet power	$P_{in} = \frac{q \cdot (p - p_c)}{600}$ (kW)	$P_{in} = \frac{q \cdot (p - p_c)}{1714}$ (hp)



For more information
See Powerful Engineering (EN347-4).

Quantity	Symbol		Metric	US
Power	P	=	kW	hp
Output torque	T	=	Nm	lbf·ft
Specific torque	T_s	=	Nm/bar	lbf·ft/1000 psi
Rotational speed	n	=	rpm	rpm
Required pressure	p	=	bar	psi

Quantity	Symbol		Metric	US
Pressure loss	Δp	=	bar	psi
Charge pressure	p_c	=	bar	psi
Flow rate required	q	=	l/min	gpm
Total volumetric loss	q_l	=	l/min	gpm
Displacement	V_i	=	cm^3/rev	in^3/rev
Mechanical efficiency	η_m	=	0.98*	

***Not valid for starting efficiency**

Definitions

Rated speed[1)]

Rated speed is the highest allowed speed for a charge pressure of 12 bar (175 psi) above case pressure. When a closed loop system is used, a minimum of 15% of oil is to be exchanged in the main loop.

Max speed

Maximum speed is the maximum allowed speed. Special considerations are necessary regarding charge pressure, cooling and choice of hydraulic system for speeds rated above.

[1)]Operating above rated conditions requires Hägglunds approval.

Accepted conditions for standard type of motor:

1. Oil viscosity 20 - **40** - 10000 cSt (98 - **187** - 4650 SSU). See page 21.
2. Temperature -35 °C to +70 °C (-31 °F to +158 °F).
3. Running case pressure 0-3 bar (0-45 psi) Max case pressure 8 bar (116 psi)
4. Charge pressure (see diagram).
5. Volumetric losses (see diagram).

Motor data

Metric **Motor type**	Displacement	Specific torque	Rated * speed 1)	Max. speed	Max. ** pres-sure	Max. torque 2)	Max. power 3) intermittently
	V_i cm^3/rev	T_s Nm/bar	*n* rpm	*n* rpm	*p* bar	kNm	kW
CB 280-240	15 100	240	53	68	350	79	530
CB 280	17 600	280	44	58	350	92	530
CB 400-240	15 100	240	94	125	350	79	970
CB 400-280	17 600	280	73	105	350	92	950
CB 400-320	20 100	320	71	94	350	110	970
CB 400-360	22 600	360	59	82	350	120	960
CB 400-440	27 600	440	49	65	320	131	820
CB 400-480	30 200	480	48	62	290	129	660
CB 400-520	32 700	520	41	57	270	130	670
CB 400-560	35 200	560	40	53	250	129	630
CB 400	25 100	400	58	75	350	130	970
CB 560-440	27 600	440	49	65	350	140	930
CB 560-480	30 200	480	48	62	350	160	970
CB 560-520	32 700	520	41	57	350	170	960
CB 560	35 200	560	40	53	350	180	970
CB 840-600	37 700	600	30	45	350	200	880
CB 840-640	40 200	640	28	41	350	210	850
CB 840-680	42 700	680	27	40	350	220	890
CB 840-720	45 200	720	25	37	350	240	870
CB 840-760	47 800	760	23	34	350	250	840
CB 840-800	50 300	800	23	34	350	260	890
CB 840	52 800	840	21	32	350	280	870
CB 1120-880	55 300	880	25	34	350	290	970
CB 1120-920	57 800	920	24	33	350	300	980
CB 1120-960	60 300	960	24	32	350	315	990
CB 1120-1000	62 800	1000	22	31	350	330	1000
CB 1120-1040	65 300	1040	21	29	350	340	980
CB 1120-1080	67 900	1080	20	28	350	355	980
CB 1120	70 400	1120	20	27	350	370	980

*) Related to a required pressure of 12 bar for motors in braking mode. (Special considerations regarding charge pressure, cooling and choice of hydraulic system for speeds above rated, 4 ports must be used for higher speed).
**) The motors are designed according to DNV-rules. Test pressure 420 bar. Peak/transient pressure 420 bar maximum, allowed to occur 10 000 times.
[1]) Special considerations regarding charge pressure, cooling and choice of hydraulic system for speed above rated.
[2]) Calculated as: Metric= Ts·(350-15)·0.98
[3]) Valid for minimum permissible oil viscosity 20 cSt in the motor case.

US **Motor type**	Displacement V_i in^3/rev	Specific torque T_S lbf·ft/1000 psi	Rated * speed 1) *n* rpm	Max. speed *n* rpm	Max. ** pressure *p* psi	Max. torque 2) lbf·ft	Max. power 3) intermittently hp
CB 280-240	920	12 200	53	68	5000	57 000	710
CB 280	1070	14 200	44	58	5000	67 000	710
CB 400-240	920	12 200	94	125	5000	57 000	1300
CB 400-280	1070	14 200	73	105	5000	67 000	1300
CB 400-320	1230	16 300	71	94	5000	76 000	1300
CB 400-360	1380	18 300	59	82	5000	86 000	1300
CB 400-440	1690	22 400	49	65	4600	97000	1100
CB 400-480	1840	24 400	48	62	4200	95000	890
CB 400-520	1990	26 400	41	57	3900	96000	900
CB 400-560	2150	28 500	40	53	3600	95000	840
CB 400	1530	20 300	58	75	5000	95 000	1300
CB 560-440	1690	22 400	49	65	5000	100 000	1300
CB 560-480	1840	24 400	48	62	5000	110 000	1300
CB 560-520	1990	26 400	41	57	5000	120 000	1300
CB 560	2150	28 500	40	53	5000	130 000	1300
CB 840-600	2300	30 500	30	45	5000	140 000	1200
CB 840-640	2450	32 500	28	41	5000	150 000	1100
CB 840-680	2610	34 600	27	40	5000	160 000	1200
CB 840-720	2760	36 600	25	37	5000	170 000	1200
CB 840-760	2910	38 700	23	34	5000	180 000	1100
CB 840-800	3070	40 700	23	34	5000	190 000	1200
CB 840	3220	42 700	21	32	5000	200 000	1200
CB 1120-880	3370	44 700	25	34	5000	210 000	1300
CB 1120-920	3520	46 700	24	33	5000	220 000	1300
CB 1120-960	3680	48 800	24	32	5000	230 000	1300
CB 1120-1000	3830	50 800	22	31	5000	240 000	1300
CB 1120-1040	3980	52 800	21	29	5000	250 000	1300
CB 1120-1080	4140	54 900	20	28	5000	260 000	1300
CB 1120	4290	56 900	20	27	5000	270 000	1300

*) Related to a required pressure of 175 psi for motors in braking mode. (Special considerations regarding charge pressure, cooling and choice of hydraulic system for speeds above rated, 4 ports must be used for higher speed).
**) The motors are designed according to DNV-rules. Test pressure 6000 psi. Peak/transient pressure 6000 psi maximum, allowed to occur 10 000 times.
1) Special considerations regarding charge pressure, cooling and choice of hydraulic system for speed above rated.
2) Calculated as: US= Ts·(5000-218)·0.98.
3) Valid for minimum permissible oil viscosity 20 cSt in the motor case.

Ordering codes

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Compact CB 280-840

Example: C B 2 8 0 SA0V0C 0 0 0 0

C □ □□□ □□□ □□□□□□ □□ □□

Motor series

Generation

Motor size
CB 280
CB 400
CB 560
CB 840

Specific torque (Nm/bar)

Mounting alternatives, shaft
Shrink disc coupling C
Splines S
Other 0

Multi disc brake or Tandem kit
Motor without brake or TA kit A

Displacement shift valve
Motor not prepared for displacement shift 0

Type of seal
Nitrile N
Viton V

Through hole kit
No 0
Yes H

Coated pistons and cam rollers
No 0
Yes C

Modification 00-99

Design
Standard 00
Special index 01-99

Painting
Orange Standard
Other Option

To be filled in by Hägglunds

Compact CB 1120

Example:

Example code	CB 1120 SA0V0C 00 00
Format	C☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐☐☐ ☐☐ ☐☐

Motor series

Generation

Motor size

CB 1120

Specific torque (Nm/bar)

Mounting alternatives, shaft

Splines S

Multi disc brake or Tandem kit
Motor without brake or TA kit A

Displacement shift valve
Motor not prepared for displacement shift 0

Type of seal
Nitrile N
Viton V

Through hole kit
No 0
Yes H

Coated pistons and cam rollers
No 0
Yes C

Modification 00-99

Design
Standard 00
Special index 01-99

Painting
Orange Standard
Other Option

To be filled in by Hägglunds

Torque arm

Example:

Example code	TCA 40 - 0 - 0 - 00
Format	TC☐ ☐☐☐-☐-☐-☐☐

Torque arm

Generation

Torque arm size
TCA 40 for CB 280, CB 400
TCA 84 for CB 560, CB 840
TCA 112 for CB 1120

Attachment
Pivoted 2
Other 9

Modification 0-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

Dimensions

With splines for flange mounting.

Fig. 2

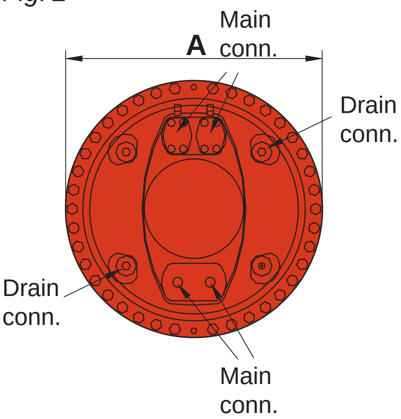


Fig. 3

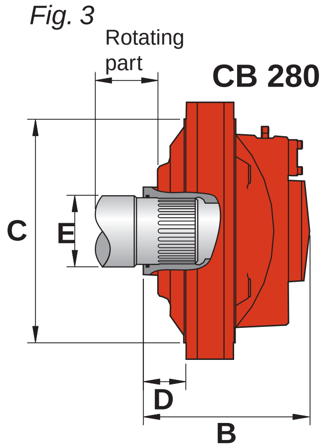


Fig. 4

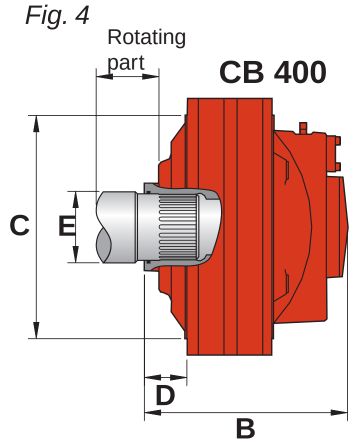


Fig. 5

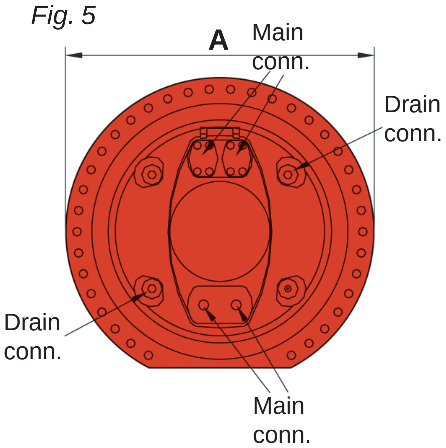


Fig. 6

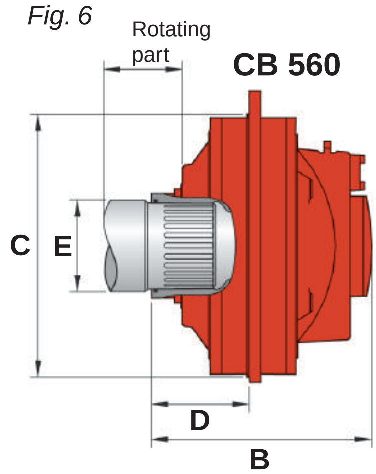


Fig. 7

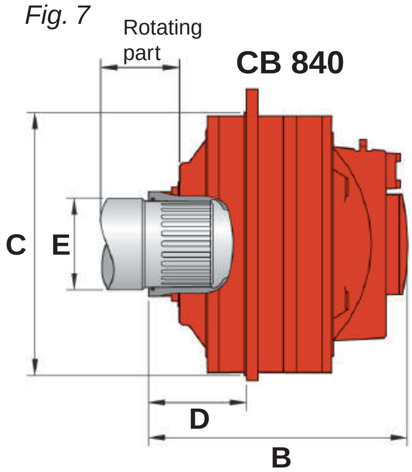


Fig. 8

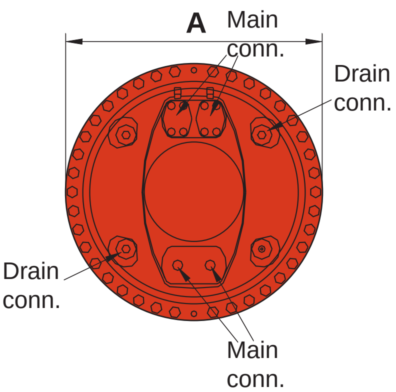


Fig. 9

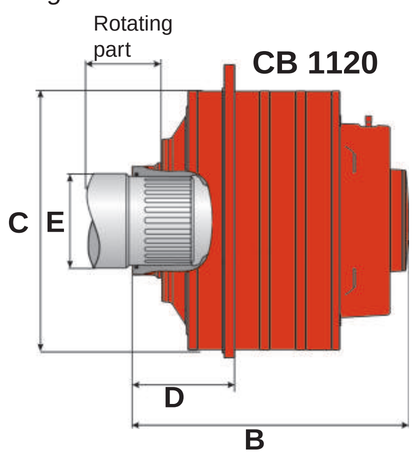


Table 1

Motor type	A (mm)	B (mm)	C (mm)	D (mm)	E Splines diameter (mm)	Weight (kg)	Main conn.	Drain conn.
CB 280	782	501	680	130	N 200x5x30x38x9H	705		
CB 400	782	619	680	130	N 200x5x30x38x9H	1060	SAE 1 1/4" *)	BSP 1 1/4"
CB 560	940	669	800	298	N 260x5x30x50x9H	1115		
CB 840	940	787	800	298	N 260x5x30x50x9H	1445	SAE 1 1/2" *)	
CB 1120	940	904	800	298	N 260x5x30x50x9H	1770		

*) Both SAE 1 1/4" and SAE 1 1/2" can be used.

Dimensions

With splines for flange or torque arm mounting.

The splines shall be lubricated, either oiled with hydraulic oil at assembly, or filled with transmission oil from the connected gearbox. To avoid wear in the splines, the installation must be within the specified tolerances in fig. 10a. For control of spline, see table 3. When splines are used for torque arm mounting, the splines shall be lubricated with oil at assembly, see fig. 10b. For control of spline, see table 3.

Table 2

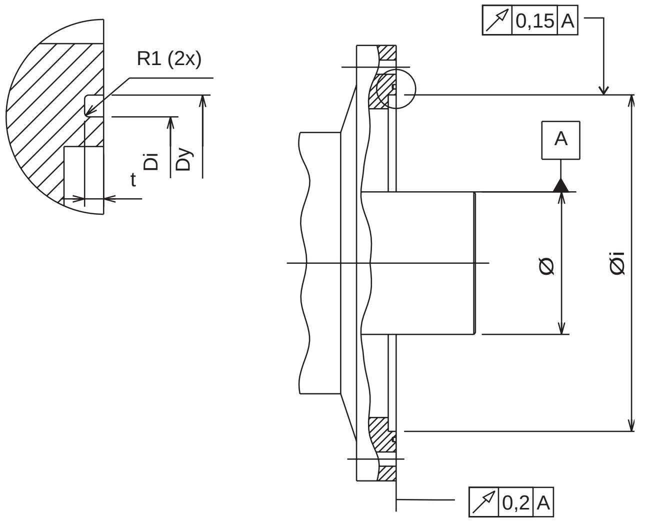
Unidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm^2
Bidirectional drives
Steel with yield strength Rel_{min} = 700 N/mm^2

Table 3

Motor	CB 280/400	CB 560/840/1120
Tooth profile and bottom form	DIN 5480	DIN 5480
Tolerance	8f	8f
Guide	Flank centring (Back)	Flank centring (Back)
Pressure angle	30°	30°
Module	5	5
Number of teeth	38	50
Pitch diameter	ø 190	ø 250
Minor diameter	ø 188	ø 248
Major diameter	ø $199^{0}_{-1.201}$	ø $259^{0}_{-1.201}$
Measure over measuring pins	$210.158^{0}_{-0.290}$	$270.307^{0}_{-0.320}$
Diameter of measuring pins	ø $10^{-0.088}_{-0.157}$	ø $10^{-0.103}_{-0.181}$
Addendum modification X M	+2.25	+2.25

Flange mounting

Fig. 10a



For production of shaft see 278 5024 and 278 5026.

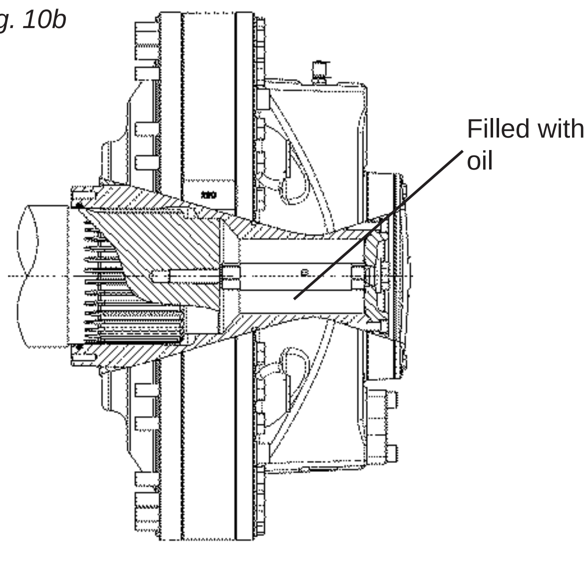
Table 4

	øi	Dy	Di	t	O-ring*
CB 280/400	$680^{+0.20}_{+0.05}$	ø 714	ø 700	4.4±0.1	2152 2115-743
CB 560/840/1120	$800^{+0.20}_{+0.05}$	ø 820	ø 806	4.4±0.1	2152 2115-793

* O-ring to be used in submerged applications, or for external lubrication of the splines.

Torque arm mounting

Fig. 10b



For production of shaft see 278 5023 and 278 5025.

Dimensions

With hollow shaft, shaft coupling.

Fig. 11

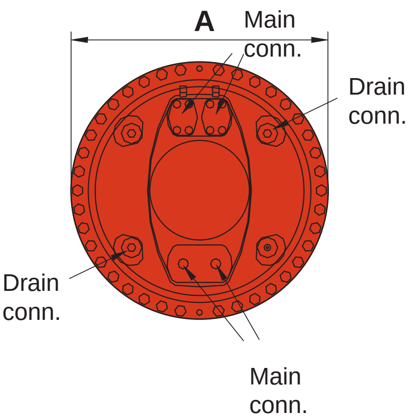


Fig. 12

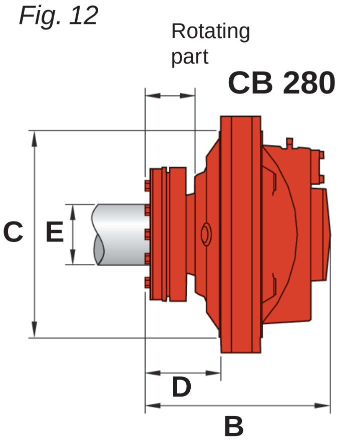


Fig. 13

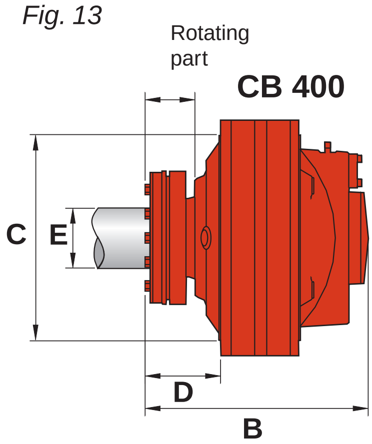


Fig. 14

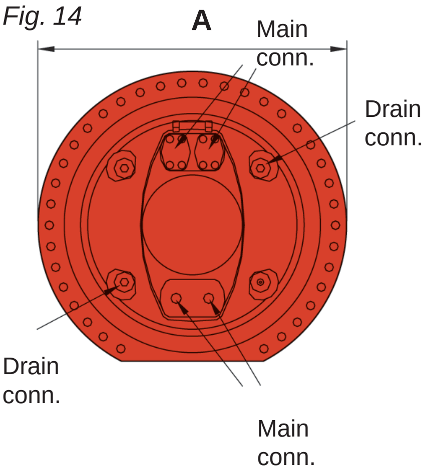


Fig. 15

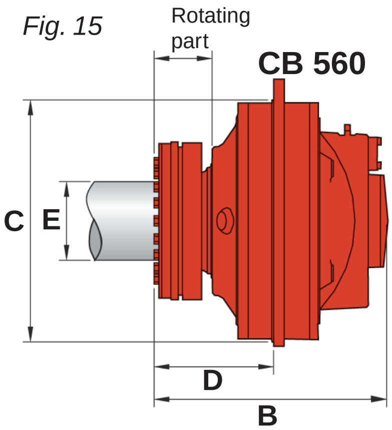


Fig. 16

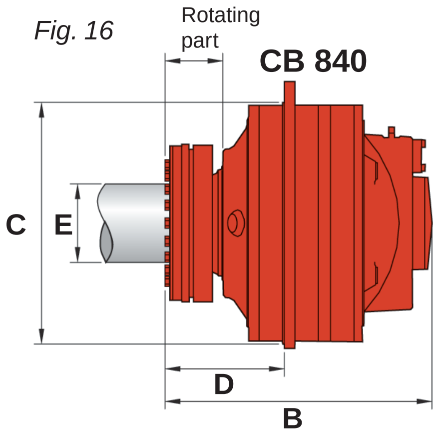


Fig. 17

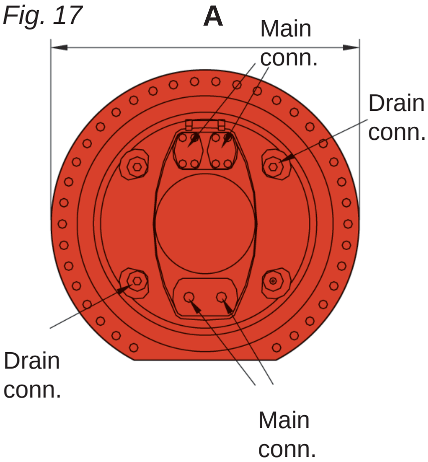
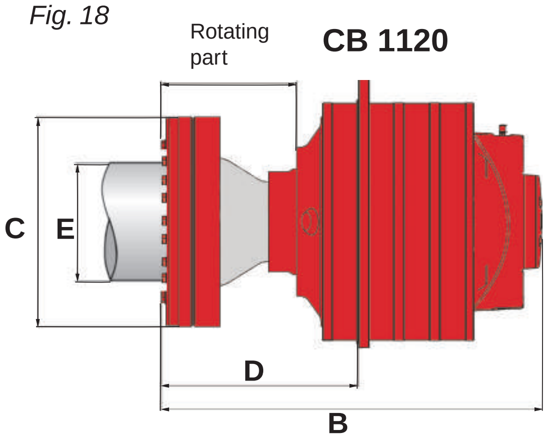


Fig. 18



Note. Shaft adapter is only available as accessory

Table 5

Motor-type	A (mm)	B (mm)	C (mm)	D (mm)	E dw (mm)	Weight (kg)	Main. conn.	Drain conn.
CB 280	782	612	680	241	180	800	SAE 1 1/4" *)	BSP 1 1/4"
CB 400	782	740	680	251	200	1160		
CB 560	940	767	800	396	260	1290		
CB 840	940	885	800	396	260	1620	SAE 1 1/2" *)	
CB 1120	940	1257	800	650	340	2340		

*) Both SAE 1 1/4" and SAE 1 1/2" can be used.

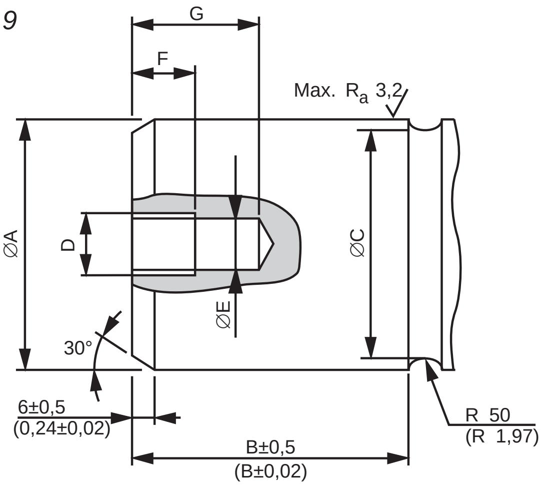
Dimensions

With hollow shaft, shaft coupling.

Design of driven shaft end on heavily loaded shaft.

Where the driven shaft is heavily loaded and is subject to high stresses, for example for changes in the direction of rotation and/or load, it is recommended that the driven shaft should have a stress relieving groove; see figure below and tables 6, 7 and 8.

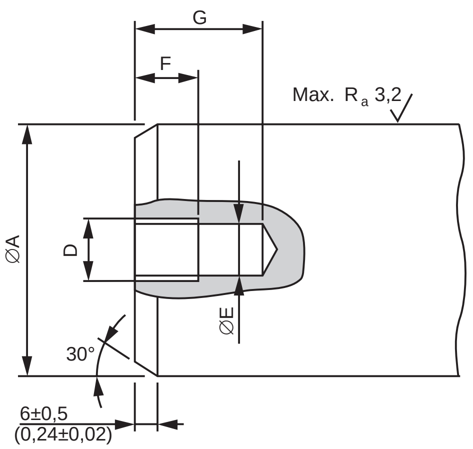
Fig. 19



Normally loaded shaft

In drives with only one direction of rotation and/or load where the stresses in the shaft are moderate, the shaft can be plain, see fig. 16 and tables 1, 2 and 3.

Fig. 20



Mounting tool for CB 280-840

Mounting the motor (fig. 21) onto the shaft with mounting tool MTMB art. nr. 378 0846-801 (same as for MA 141 - MB 800)

Table 6

Dim	CB 280	CB 400	CB 560/840
A mm in	$180^{-0.014}_{-0.054}$ $7.0866^{-0.00055}_{-0.00215}$	$200^{-0.015}_{-0.061}$ $7.8740^{-0.00059}_{-0.00240}$	$260^{-0.017}_{-0.069}$ $10.2362^{-0.00067}_{-0.00272}$
B mm in	106 4.17	117 4.61	153 6.02
C mm in	174 6.85	194 7.64	254 10

Note! The dimensions are valid for +20 °C (68 °F)

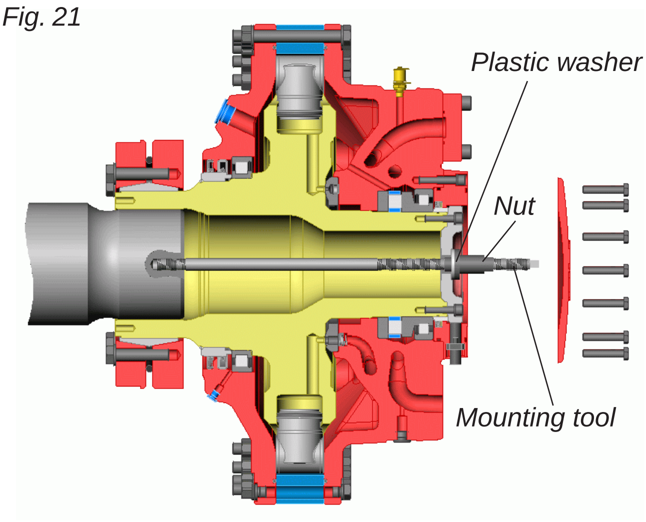
Table 7 Recommended material in the shaft

Unidirectional drives
Steel with yield strength Rel_{min} = 300 N/mm²
Bidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm²

Table 8 Alternative thread (fig. 19 & 20)

	CB 280 - CB 840	
D E F G	M20 >17 (0.67) 25 (0.98) 50 (1.97)	UNC 5/8" >13.5 (0.53) 22 (0.87) 30 (1.18)

Fig. 21



Dimensions CB1120

Design of driven shaft end on heavily loaded shaft.

Where the driven shaft is heavily loaded and is subject to high stresses, for example for changes in the direction of rotation and/or load, it is recommended that the driven shaft should have a stress relieving groove; see figure below and tables.

Fig. 22

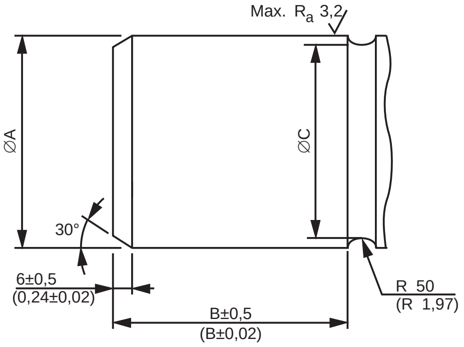


Table 9

Dim	CB 1120
A mm in	340 $^{-0.018}_{-0.075}$ 13.3858 $^{-0.00068}_{-0.00292}$
B mm in	215 8.46
C mm in	334 13.15

Note! The dimensions are valid for +20 °C (68 °F)

Table 10 Recommended material in the shaft

Unidirectional drives
Steel with yield strength Rel_{min} = 300 N/mm^2
Bidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm^2

Normally loaded shaft

In drives with only one direction of rotation and/or load where the stresses in the shaft are moderate, the shaft can be plain, see figure below.

Fig. 23

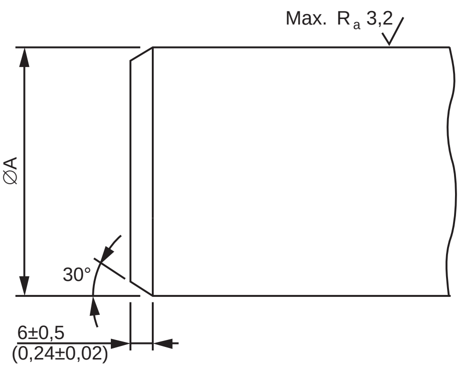
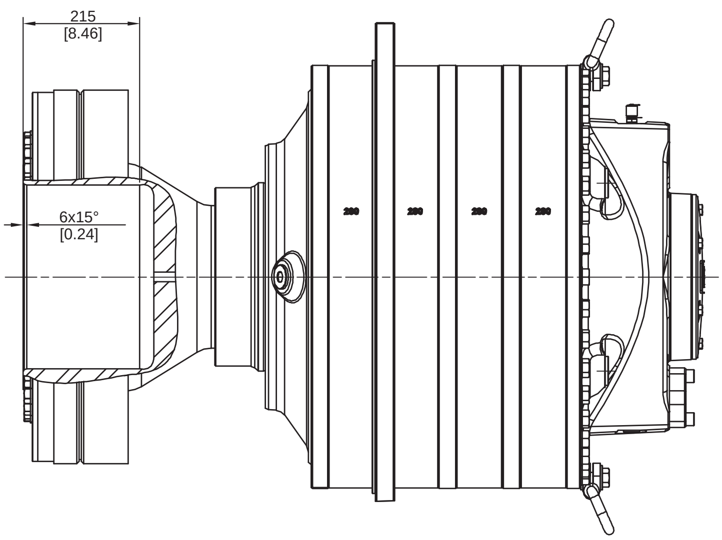


Fig. 24



Accessories

Torque arm, type TCA 40 - 112

Easy to apply - Hägglunds torque arms.

A shaft mounted gearless drive is achieved by utilizing the standard Hägglunds torque arm.
Spline shaft for external load, or shaft for shaft coupling can be used.
As a result, alignment problems, expensive flexible couplings and bed plates are eliminated.

Fig. 25 **Torque arm**

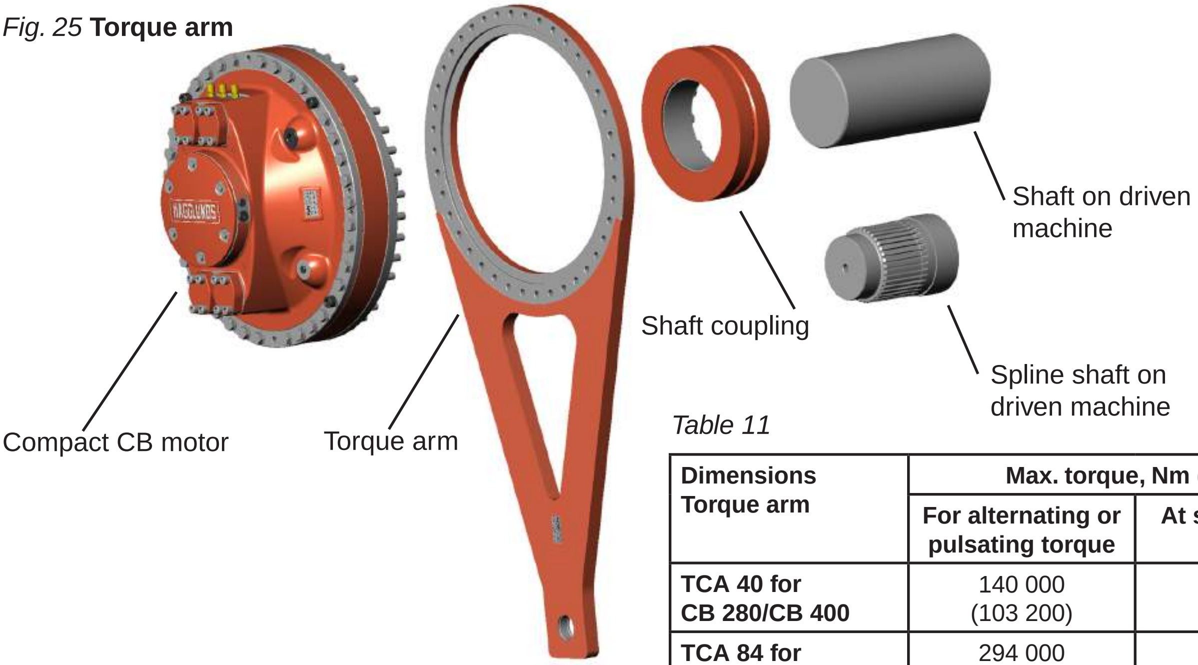


Table 11

Dimensions Torque arm	Max. torque, Nm (lbf·ft)	
	For alternating or pulsating torque	At static torque
TCA 40 for CB 280/CB 400	140 000 (103 200)	170 000 (125 300)
TCA 84 for CB 560/CB 840	294 000 (216 700)	350 000 (258 000)
TCA 112 for CB 1120	392 000 (289 000)	470 000 (347 000)

Table 12

Torque arm	A mm (in)	B mm (in)	C mm (in)	D Ø	E mm (in)	T mm (in)	Weight kg (lb)
TCA 40 for CB 280 and CB 400	1721 (67.76)	1250 (49.21)	545 (21.46)	M20	820 (32.28)	36 (1.42)	162 (357)
TCA 84 for CB 560 and CB 840	2088 (82.21)	1500 (59.05)	545 (21.46)	M24	1088 (42.84)	36 (1.42)	258 (568)
TCA 112 for CB 1120	2588 (101.89)	2000 (78.74)	545 (21.46)	M24	1088 (42.84)	36 (1.42)	344 (759)

Fig. 26

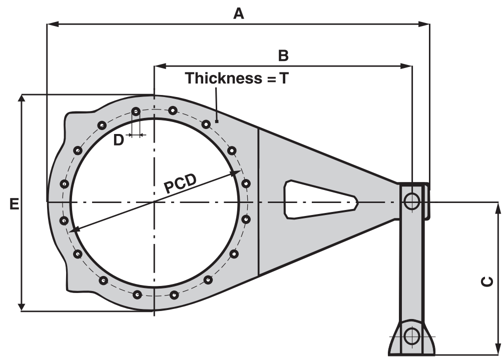
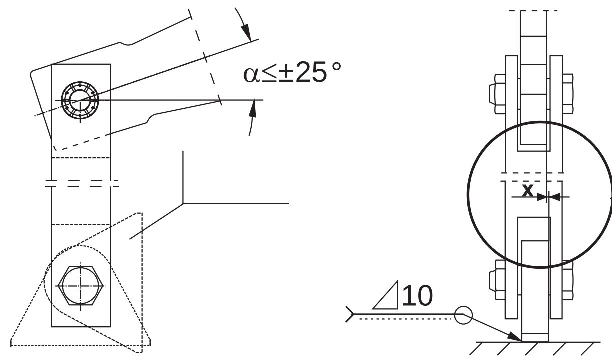


Fig. 27 **Mounting of pivoted attachment**



x = ±2 mm (0.079) misalignment in installation.
x ≤ ±15 mm (0.59) movement when in use.

Note: Ideal angle = 0°

Double ended torque arm, DTCB 40 - DTCB 84

Double ended torque arm, including double acting hydraulic cylinder and pivoted attachment. Following are included in delivery:
- Screws and washers (motor-torque arm)
- Hose kit + clamps
- Hose flange connections

Fig. 28

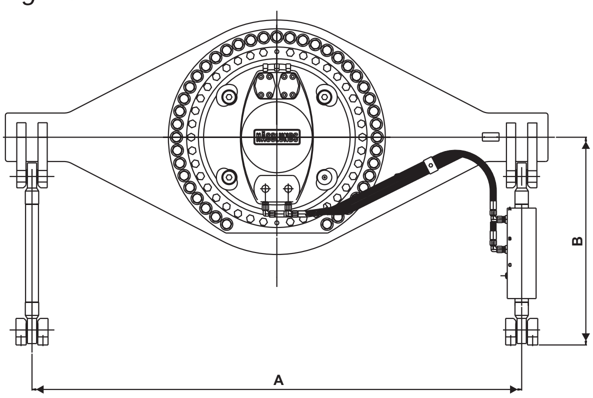


Table 13

Torque arm	Motor type	Ordering code	A mm (in)	B mm (in)	Weight kg (lb)
DTCB 40	**CB 280**	078 1476-802	2120 (83.46)	900 (35.43)	335 (739)
	CB 280-240	078 1476-801			
	CB 400	078 1476-804			
	CB 400-560				
	CB 400-520				
	CB 400-480				
	CB 400-440				
	CB 400-360	078 1476-802			
	CB 400-320				
	CB 400-280				
	CB 400-240	078 1476-801			
DTCB 84	**CB 560**	078 1476-806	3000 (118.11)		500 (1102)
	CB 560-520				
	CB 560-480	078 1476-805			
	CB 560-440				
	CB 840	078 1476-809			
	CB 840-800				
	CB 840-760	078 1476-808			
	CB 840-720				
	CB 840-680				
	CB 840-640				
	CB 840-600	078 1476-807			
	CB 1120	078 1476-809			
	CB 1120-1080				
	CB 1120-1040				
	CB 1120-1000				
	CB 1120-960				
	CB 1120-920				
	CB 1120-880				

Mounting set SMCB1 for speed encoder

Speed encoder kit for Compact CB 280-CB 1120 motors where the speed encoder is enclosed and well protected.

The mounting set can be used for both spline and shaft coupling motors.

The encoder is used for detection of speed by pulse- frequency or/either direction of rotation by pulse-train.

Fig. 29

Fig. 30 CB 280-CB 1120 with SMCB1

Cross-over valve, COCB 1000

The valve is designed for use with Compact motors CB 280-CB 1120. The valve is bolted directly on the motor, and the valve protects the motor and system from too high pressure, if the motor is suddenly stopped.

The relief valves have a standard pressure settings of 350 bar (5075 psi), but are fully adjustable between 50 bar (500 psi) to 350 bar (5075 psi). Pressure setting is made without charge pressure.

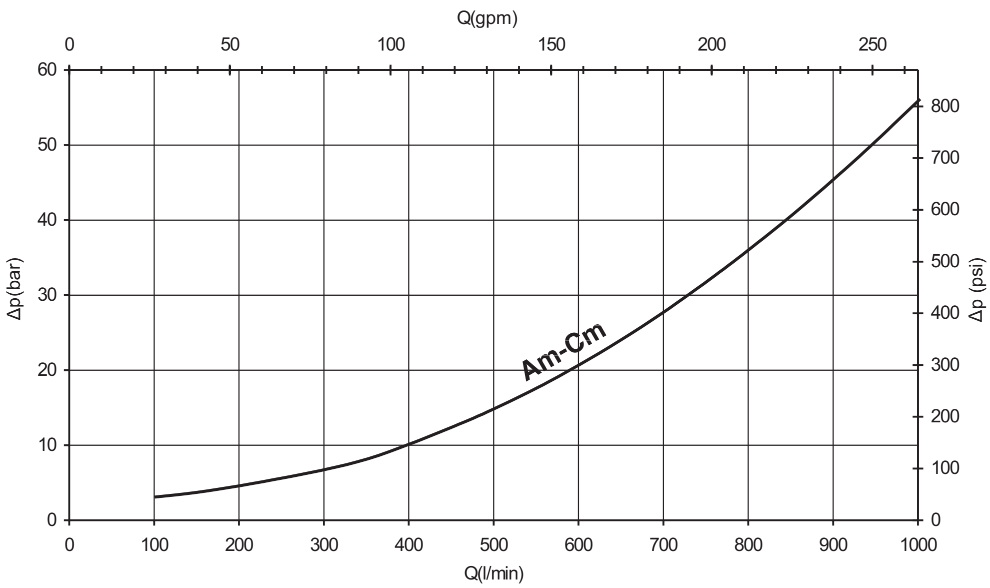
Screws and O-rings are included in delivery.

The valve for charge pressure have a standard pressure setting of 15 bar (214 psi), but are fully adjustable down to 3 bar (42 psi).

Anti-cavitation check valves are built into the block, and makes it possible to arrange for external supply of charge pressure.

Fig. 31 **COCB mounted on motor**

Diagram 1 **Pressure loss, COCB**



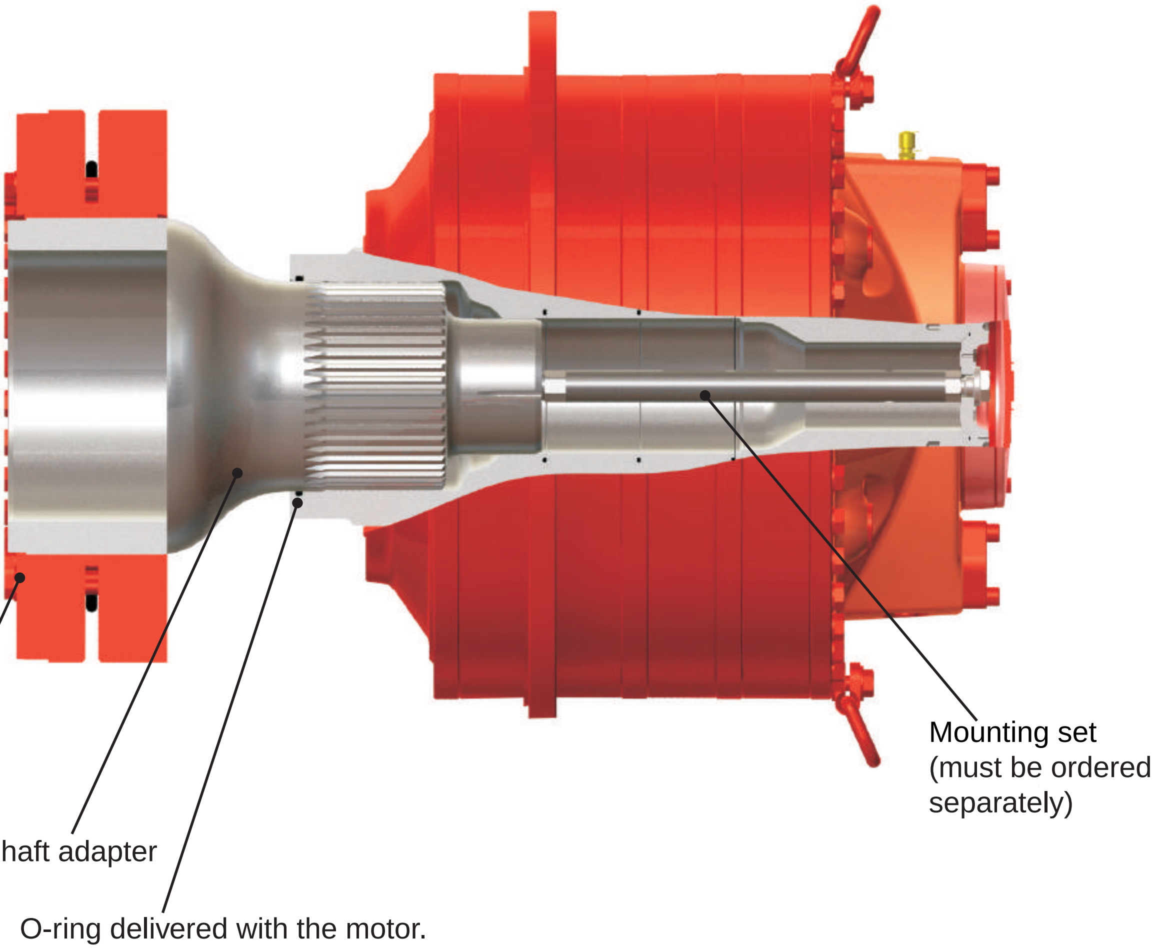
Shaft coupling set, CB 1120

The set includes shaft coupling and shaft adapter. Mounting set must be ordered separately.
The kit is designed for shaft, that can not be made with splines.

Ordering Code

Shaft coupling set CB 1120	078 1322-801

Fig. 32



Weight of complete set: 573 kg (1263 lb).

Diagrams for Compact CB

Diagram 2 **Charge pressure - Compact CB 2-port connection**

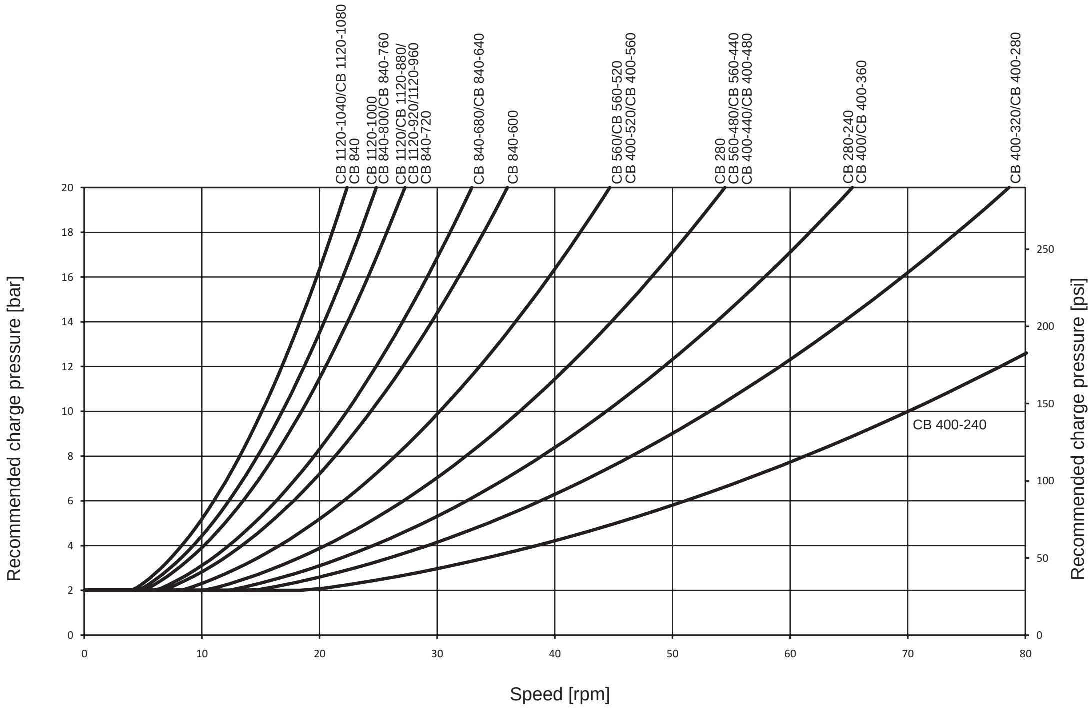
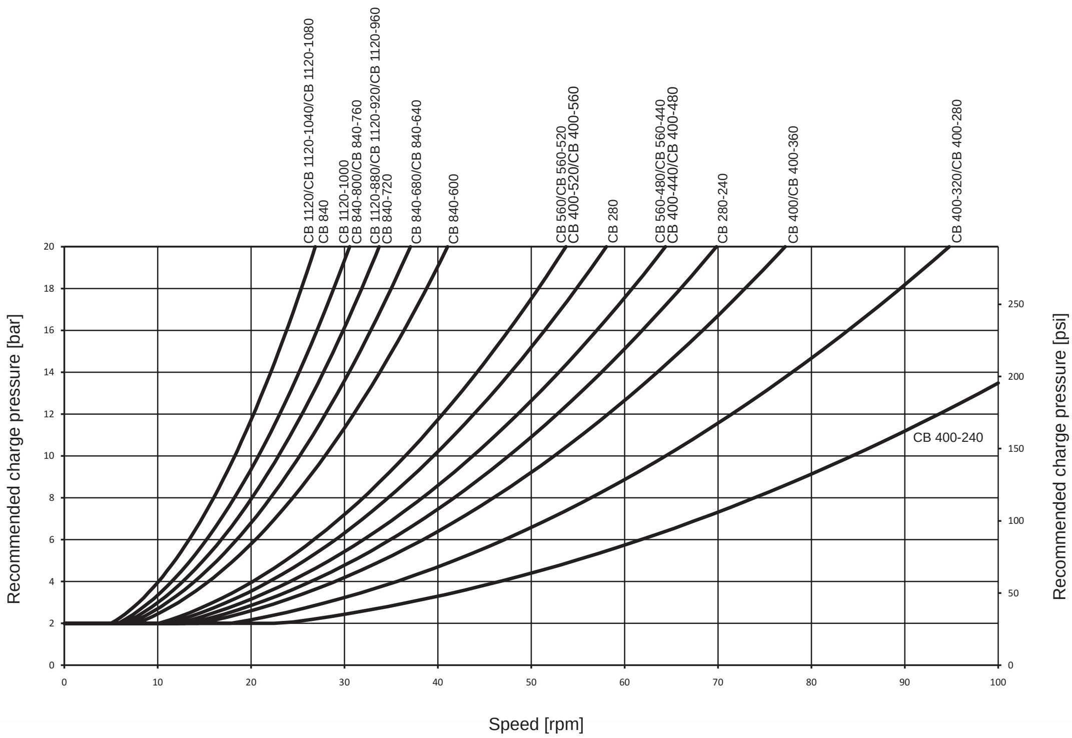


Diagram 3 **Charge pressure - Compact CB 4-port connection**



Case 1: The motor works in braking mode. Required charge pressure at the inlet port is according to diagram above.

Case 2: The motor works in driving mode only. Required back pressure at the outlet port corresponds to 30% of value given in diagram above, but may not be lower than 2 bar (29 psi).

Diagrams for Compact CB

Overall efficiency, oil viscosity 40 cSt/187 SSU, Pc = 15 bar (217 psi)

Diagram 4 **CB 280, 2 ports**

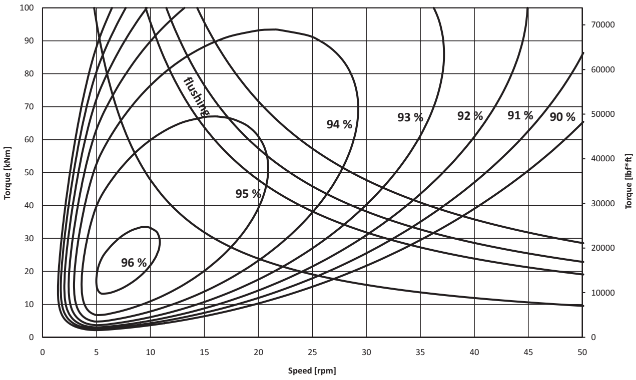


Diagram 5 **CB 280, 4 ports**

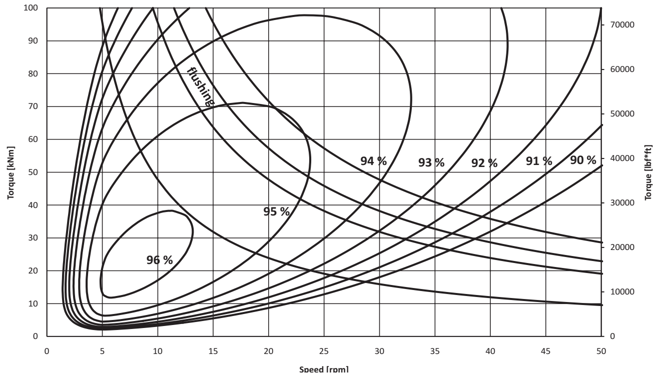


Diagram 6 **CB 400, 2 ports**

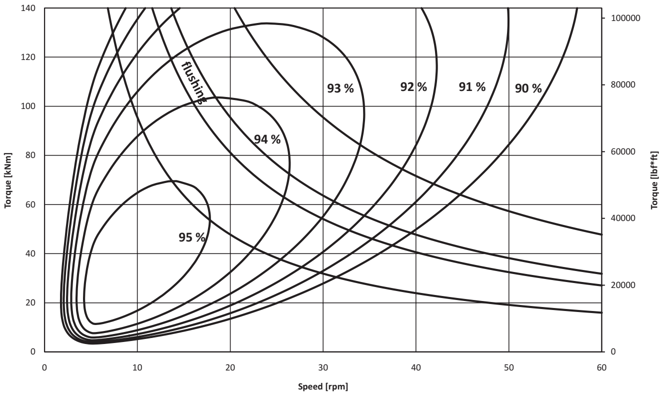


Diagram 7 **CB 400, 4 ports**

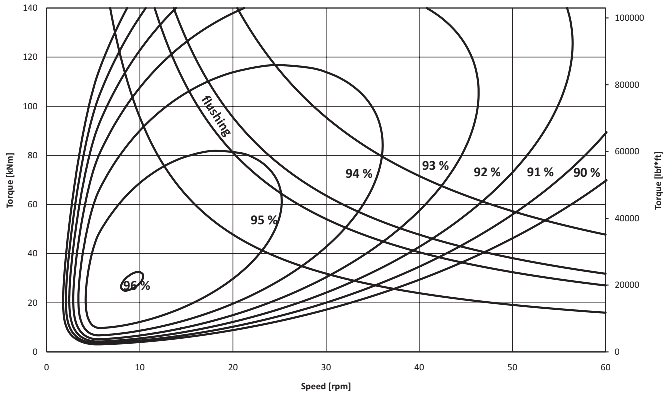


Diagram 8 **CB 560, 2 ports**

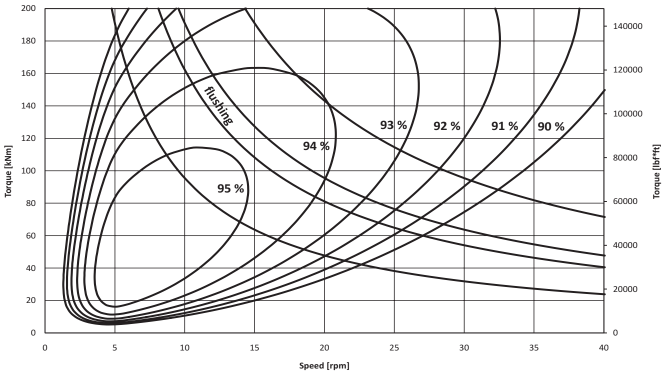


Diagram 9 **CB 560, 4 ports**

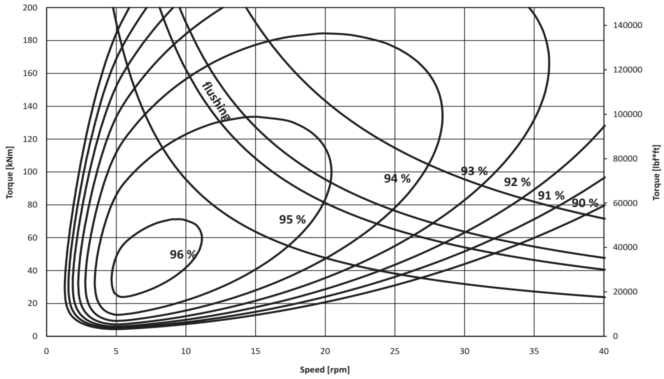


Diagram 10 **CB 840, 2 ports**

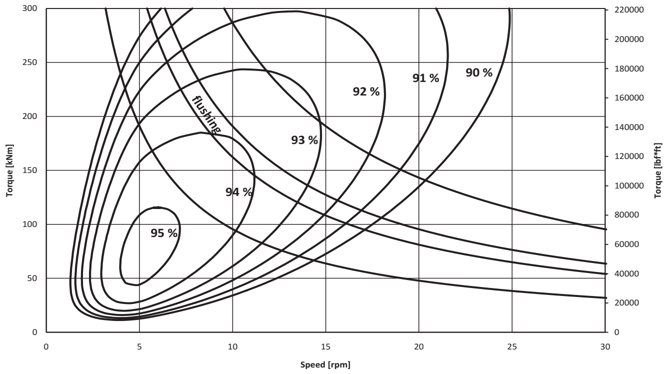


Diagram 11 **CB 840, 4 ports**

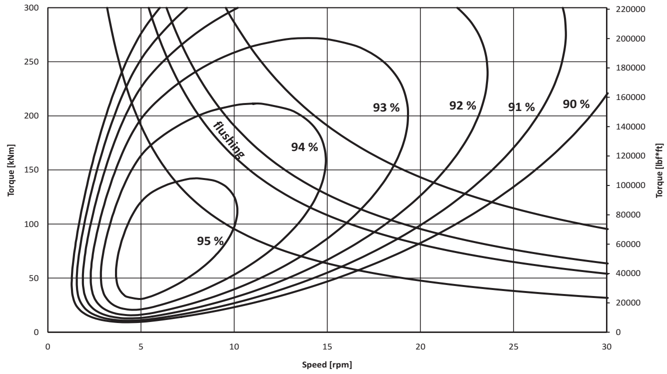


Diagram 12 **CB 1120, 2 ports**

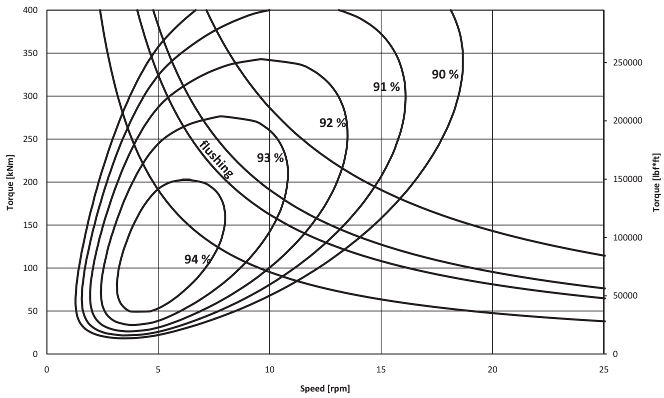
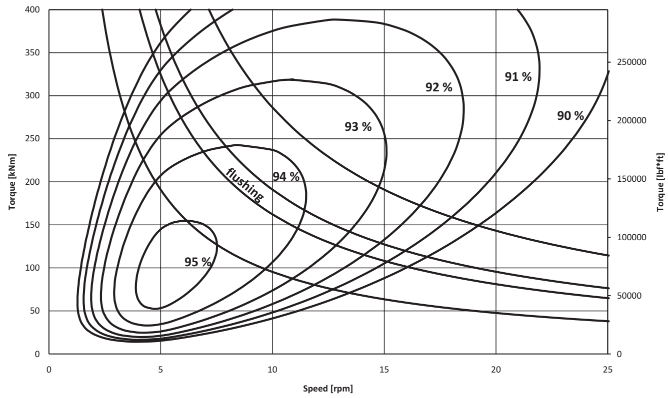


Diagram 13 **CB 1120, 4 ports**



For more information about flushing of motor case please see ACB-4.5.

Flushing of motor case

The Compact CB motors have very high total efficiency, and they are now frequently used in applications with high power. To avoid high temperature in the motor case, the losses generated in the motors must be cooled away, because high temperature gives lower viscosity and this gives reduction in rating life and max allowed power for the motor.
For continuous duty the motor case must be flushed when the power exceed the following max power:

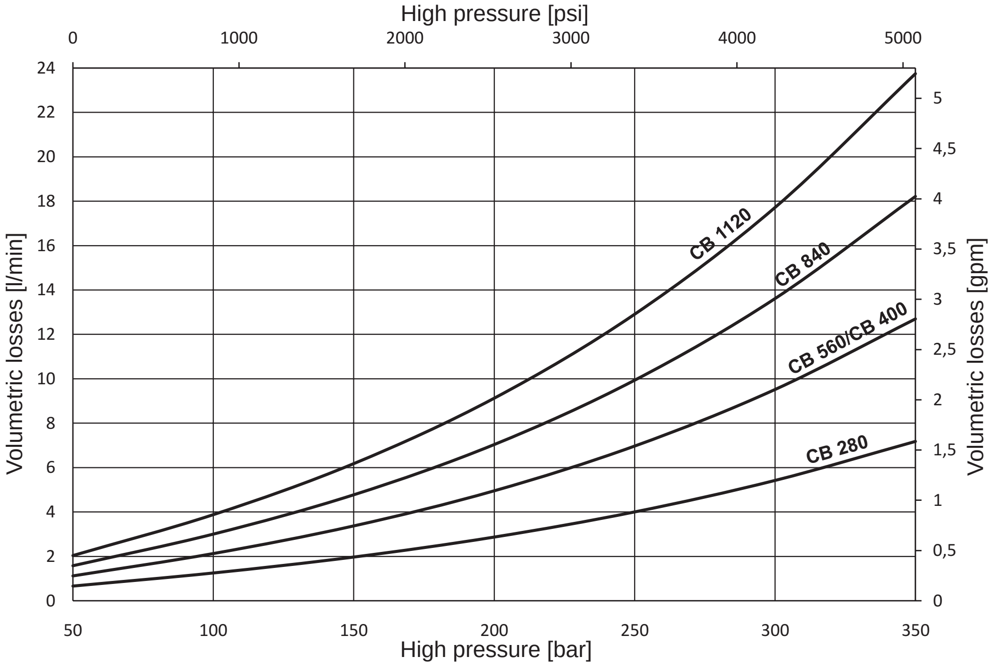
Max power without flushing

CB 280	120 kW	(160 hp)
CB 400/560/840/1120	170 kW	(227 hp)

Volumetric losses - Compact CB motors

Valid for an oil viscosity of 40 cSt/187 SSU.

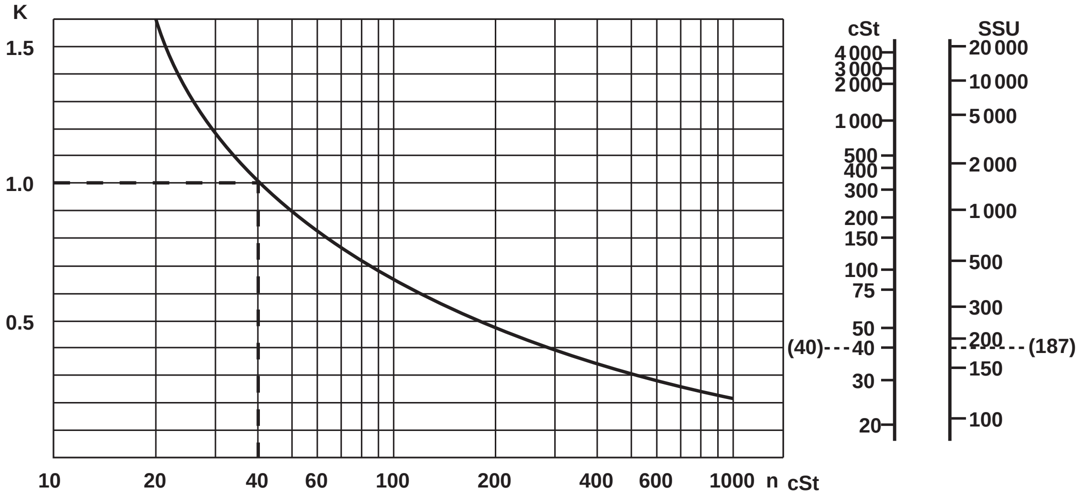
Diagram 14



Variation in volumetric loss at different oil viscosities for Compact motors

When calculating volumetric losses using other viscosities than 40 cSt/187 SSU, multiply the value given in the volumetric loss diagram by the factor K.

Diagram 15



Diagrams for Compact

Pressure loss, oil viscosity 40 cSt/187 SSU

Diagram 16 **CB 280 pressure loss 2 ports**

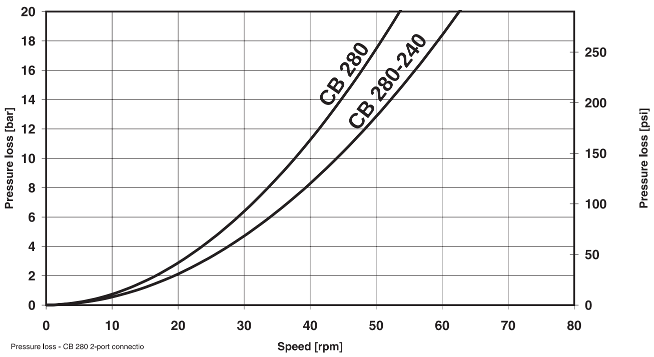


Diagram 17 **CB 280 pressure loss 4 ports**

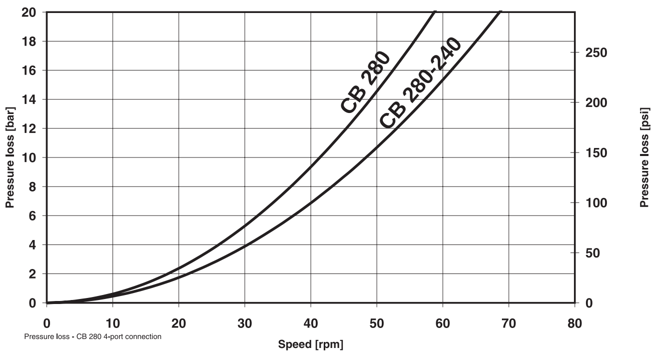


Diagram 18 **CB 400 pressure loss 2 ports**

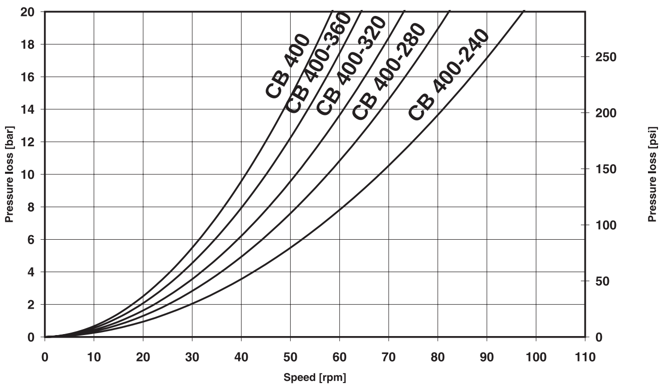


Diagram 19 **CB 400 pressure loss 4 ports**

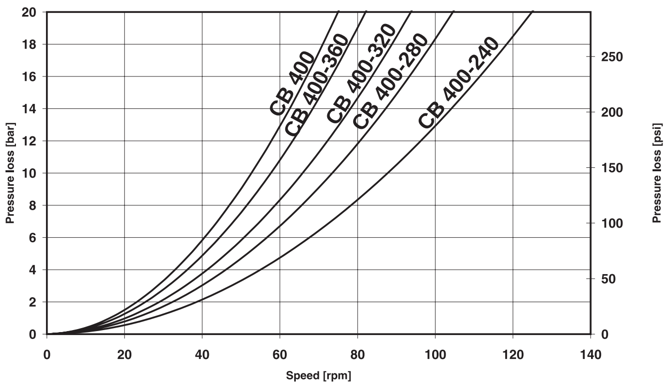


Diagram 20 **CB 560 pressure loss 2 ports**

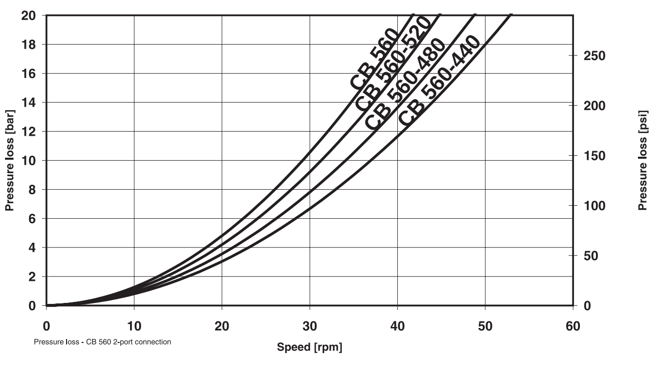


Diagram 21 **CB 560 pressure loss 4 ports**

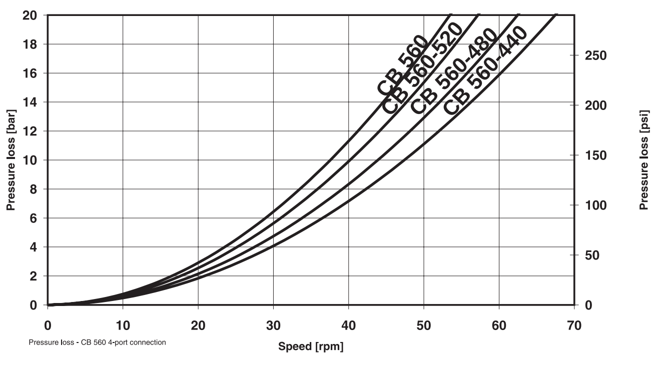


Diagram 22 **CB 840 pressure loss 2 ports**

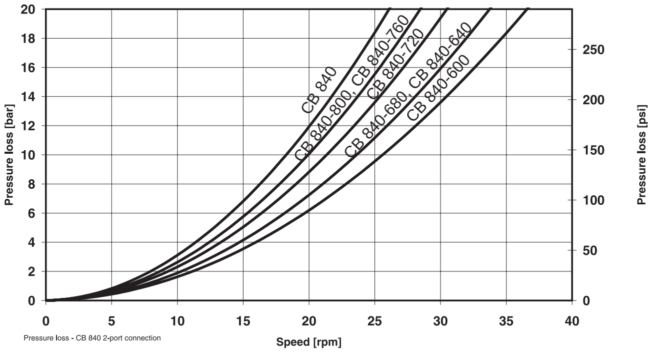


Diagram 23 **CB 840 pressure loss 4 ports**

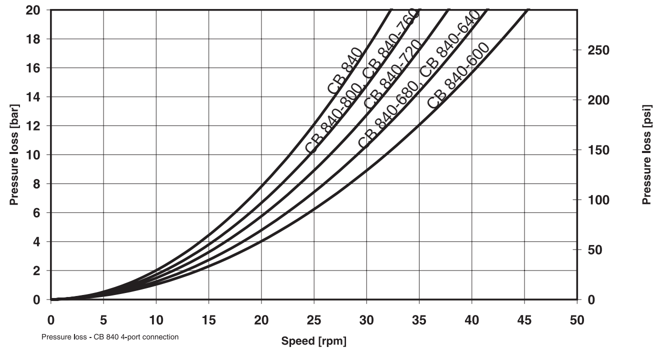


Diagram 24 **CB 1120 pressure loss 2 ports**

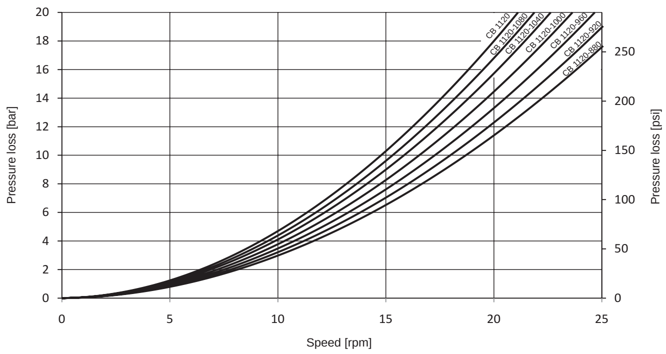
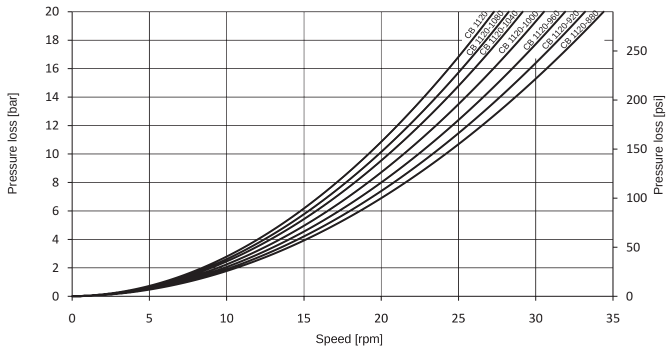
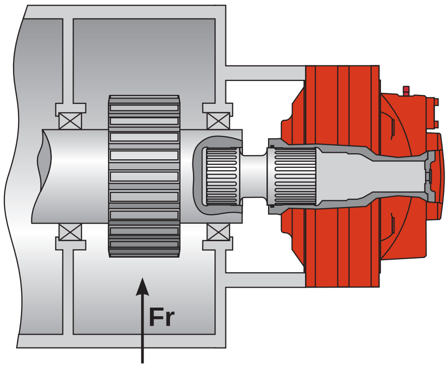


Diagram 25 **CB 1120 pressure loss 4 ports**



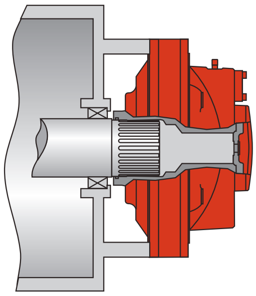
Versatile mounting - examples of installations

Fig. 33



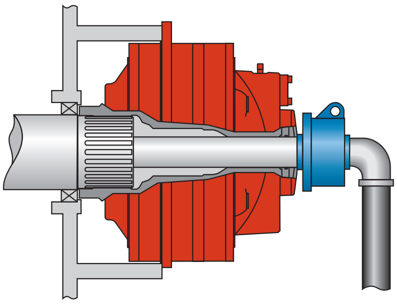
Flange mounted motor with splines and high radial load Fr on driven shaft.

Fig. 34



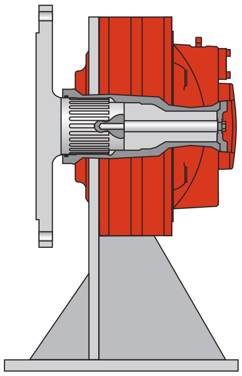
Flange mounted motor with splines and low radial load from driven shaft.

Fig. 35



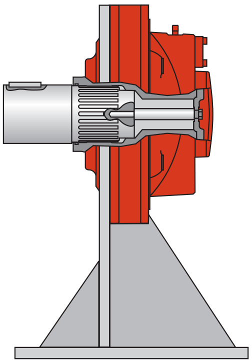
Flange mounted motor with spline and through hole for cooling of driven machine.

Fig. 36



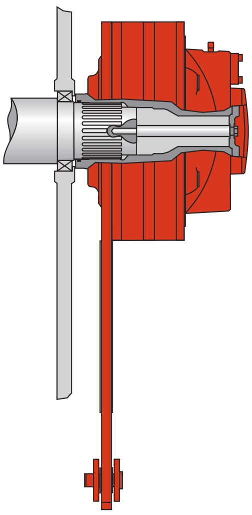
Bracket mounted motor with flange adapter.

Fig. 37



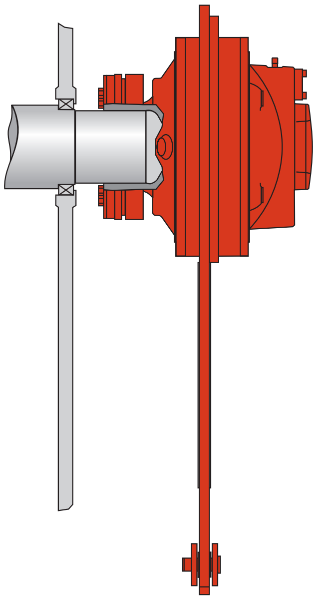
Bracket mounted motor with stub shaft.

Fig. 38



Torque arm mounted motor with splines.

Fig. 39



Torque arm mounted motor with shaft cou-pling.

Choice of hydraulic fluid

The Hägglunds hydraulic motors are primarily designed to operate on conventional petroleum based hydraulic oils. The hydraulic oil can be chosen in consultation with the oil supplier of your local sales office, bearing the following requirements in mind:

GENERAL

The oil shall have FZG (90) fail stage minimum 11 described in IP 334 (DIN 51354). The oil must also contain inhibitors to prevent oxidation, corrosion and foaming. The viscosity of mineral oil is highly dependent of the temperature. The final choice of oil must depend on the operating temperature that can be expected or that has been established in the system and not in the hydraulic tank. High temperatures in the system greatly reduce the service life of oil and rubber seals, as well as resulting in low viscosity, which in turn provides poor lubrication. Content of water shall be less than 0,1%. In industrial applications with high demands for service life, the content of water shall be less than 0,05%.

Viscosity index = 100 is recommended. Viscosity index = 150 can be used for operation with large temperature difference, however many hydraulic fluids are subject to temporary and permanent reductions of the viscosity. Hägglunds recommendation is always to use the base oil viscosity when calculating the rated life and max allowed power. For heavy-duty applications we recommend synthetic oils.

**RECOMMENDED VISCOSITY IN MOTOR CASE AT OPERATING TEMPERATURE 40-150 cSt/187-720 SSU.
FOR SPEEDS BELOW 3 RPM, COATED PISTON OR HIGH VISCOSITY SHALL BE USED.**

Temperature limits	
Normal operating temperature should be less than +50 °C (122 °F)	
Nitrile seals (std motor) Viton seals	-35 °C to +70 °C -20 °C to +100 °C
Nitrile seals (std motor) Viton seals	-31 °F to +158 °F -4 °F to +212 °F

Minimum viscosity limits at operating temperature in motor case	
Standard motors with uncoated piston and uncoated cam rollers	20 cSt/98 SSU *
Motors type C (coated pistons and coated cam rollers) for speed below 3 rpm or when charge pressure exceeds 50 bar (725 psi) at speed above 50 rpm	10 cSt/59 SSU

* Low viscosity gives reduced service life for the motors

Maximum permitted viscosity is 10 000 cSt/48 000 SSU.

Fire resistant fluid

The following fluids are tested for Hägglunds motors (ISO/DP 6071).

Fluid	Approved	Seals	Internal paint
HFA: Oil (3-5%) in water emulsion	No	-	-
HFB: Inverted emulsion 40-45% water in oil	Yes	Nitrile (std motor)	Not painted*
HFC: Water-glycol	Yes	Nitrile (std motor)*	Not painted*
HFD synthetic fluids			
HFD:R - Phosphate esters	Yes	Viton	Not painted*
HFD:S - Chlorinated hydrocarbons	Yes	Viton	Not painted*
HFD:T - Mixture of the above	Yes	Viton	Not painted*
HFD:U - Other compositions	Yes	Viton	Not painted*

* Must be specified in the order.

Choice of hydraulic fluid

Down rating of pressure data and basic rating life

Down rating of pressure, for motors used in systems with fire resistant fluids, the maximum pressure for motor given on data sheet must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.7 x maximum pressure for motor
HFC-fluid	0.7 x maximum pressure for motor
HFD-fluid	0.9 x maximum pressure for motor

Down rating of basic rating life, for motors used in systems with fire resistant fluids, the "expected basic rated life" must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.26 x expected life with mineral oil
HFC-fluid	0.24 x expected life with mineral oil
HFD-fluid	0.80 x expected life with mineral oil

Filtration

The oil in a hydraulic system must always be filtered and also new oil from your supplier has to be filtered when adding it to the system. The grade of filtration in a hydraulic system is a question of service life v.s. money spent on filtration.
In order to obtain stated service life it is important to follow our recommendations concerning contamination level.
When choosing the filter it is important to consider the amount of dirt particles that the filter can absorb and still operate satisfactory. For that reason we recommend a filter with an indicator that gives a signal when it is time to change the filter cartridge.

Filtering recommendations

Before start-up, check that the system is thoroughly cleaned.
1. For industrial applications the contamination level should not exceed ISO 4406:1999 18/16/13 (NAS 1638, class 7).
2. When filling the tank and motor case, we recommend the use of a filter with the grade of filtration $\beta10=75$.

Explanation of "Grade of Filtration"

Grade of filtration β**10=75** indicates the following:
β**10** means the size of particle $\geq 10 \mu m$ that will be removed by filtration.
=75 means the grade of filtration of above mentioned size of particle. The grade of filtration is defined as number of particles in the oil before filtration in relation to number of particles in the oil after filtration.

Ex. Grade of filtration is β**10=75**.
Before the filtration the oil contains N number of particles $\geq 10 \mu m$ and after passing the filter once the oil contains $\frac{N}{\mathbf{75}}$ number of particles $\geq 10 \mu m$.
This means that $N - \frac{N}{\mathbf{75}} = \frac{74 \cdot N}{\mathbf{75}}$ number of particles have been filtered (=98.6%).

Environmentally acceptable fluids

Fluid	Approved	Seals	Internal paint
Vegetable */** Fluid HTG	Yes	Nitrile (std motor)	-
Synthetic ** Esters HE	Yes	Nitrile (std motor)	-

*Vegetable fluids give good lubrication and small change of viscosity with different temperature. Vegetable fluids must be controlled every 3 months and temperature shall be less than +45 °C (113 °F) to give good service life for the fluid.

**Environmentally acceptable fluid give the same service life for the drive, as mineral oil.

Declaration of Conformity

Example of the Declaration of Conformity given by Hägglunds Drives AB

HÄGGLUNDS

Declaration of Incorporation of partly completed machinery

As defined by the EC Machinery Directive 2006/42/EC, Appendix II B

The manufacturer

Hägglunds Drives AB

hereby declares that the partly completed machinery

Name: Compact CB
Function: Hydraulic motor
Model: Compact
Type: CB
Trade name: Compact CB

satisfies the following essential requirements of Machinery Directive 2006/42/EC in accordance with the chapter numbers in Appendix I:

General principle no. 1.									
1.1.3	1.1.5	1.3.1	1.3.2	1.3.3	1.3.4	1.3.6	1.3.7	1.5.3	1.5.4
1.5.5	1.5.6	1.5.8	1.5.13	1.6.1	1.6.3	1.7.3	1.7.4		

The requirements are fulfilled provided that the data in the product documentation (fitting instructions, operating instructions, project management and configuration documents) are implemented by the product user. The requirements of Appendix I to Machinery Directive 2006/42/EC not mentioned here are not applied and have no relevance for the product.

It is also declared that the special technical documents for this partly completed machinery have been compiled in accordance with Appendix VII, Part B. These are transferred on request to the market surveillance body in paper-based/electronic format.

Conformity with the provisions of further EU Directives, Standards or Specifications:

SS-EN 982
SS-EN ISO 12100-1
SS-EN ISO 12100-2

The partly completed machinery may only be put into operation when it has been established that the machine into which the partly completed machinery is to be incorporated conforms to the provisions of EC Machinery Directive 2006/42/EC, where relevant according to this directive.

The individual below is authorized to compile the relevant technical files:

Name: Björn Leidelöf
Address: Hägglunds Drives AB, S-890 42 Mellansel

Björn Leidelöf Mellansel, 2009-12-29

We reserve the right to make changes to the content of the Declaration of Incorporation. Current issue on request.

The Declaration of Conformity above, is available on request for deliveries from Hägglunds Drives AB. Translations into other languages are also available.

www.hagglunds.com

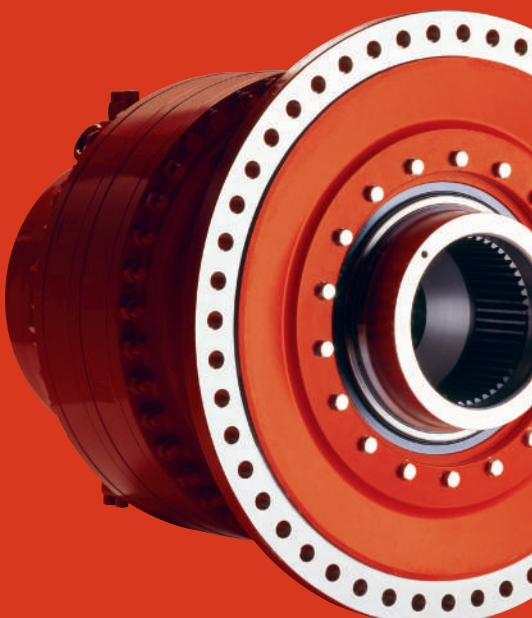
Hägglunds Drives AB
SE-895 80 Mellansel, Sweden
Tel: + 46 (0)660 870 00.
E-mail: info@se.hagglunds.com
www.hagglunds.com

Our drive is your performance.

EN 734-7H. Repro: Öviks Repro. Printer: Ågrens Tryckeri 2011.

Compact CBP

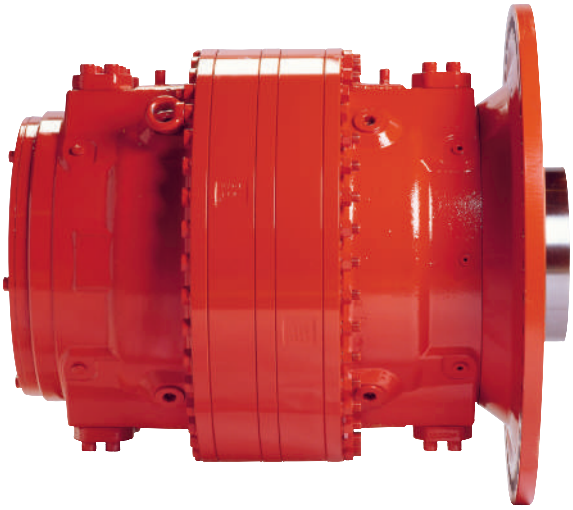
PRODUCT MANUAL



HÄGGLUNDS

Product Manual

COMPACT CBP
EN 834-4h 2011



One partner all over the world

Hägglunds Drives

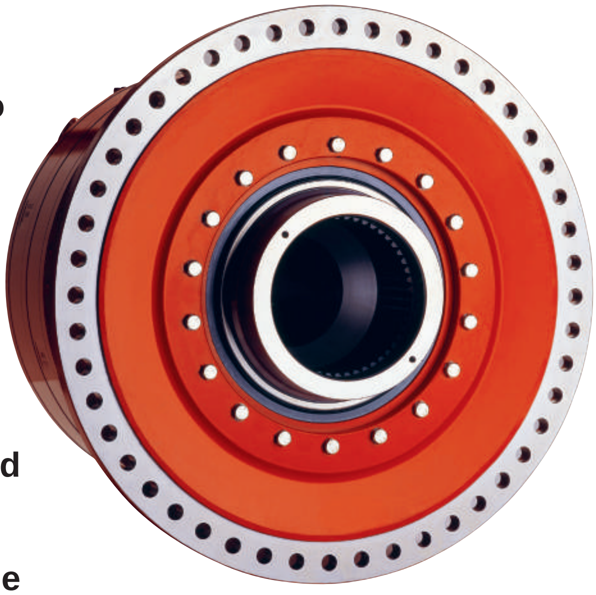
is the worlds leading manufacturer of heavy duty hydraulic drive systems. If what you need is low speed and high torque, then Hägglunds Drives should be your partner. If what you need is a durable drive system that will work under the toughest conditions with a minimum of maintenance, then Hägglunds Drives should be your partner. We develop, manufacture & market complete drive systems and components of the highest quality, based upon our unique radial piston motors. Our industrial and marine customers are to be found all over the world. They know that when they need solutions, support or service, they have in us a partner they can trust. Hägglunds Drives main office and manufacturing plant is situated in Mellansel, Sweden. In addition Hägglunds is represented in 40 countries worldwide.

Original EN834-3h, 2010

The content in this manual is subject to change without notice or obligation, unless certified referring to a certain purchase order. Information contained herein should be confirmed before placing orders.

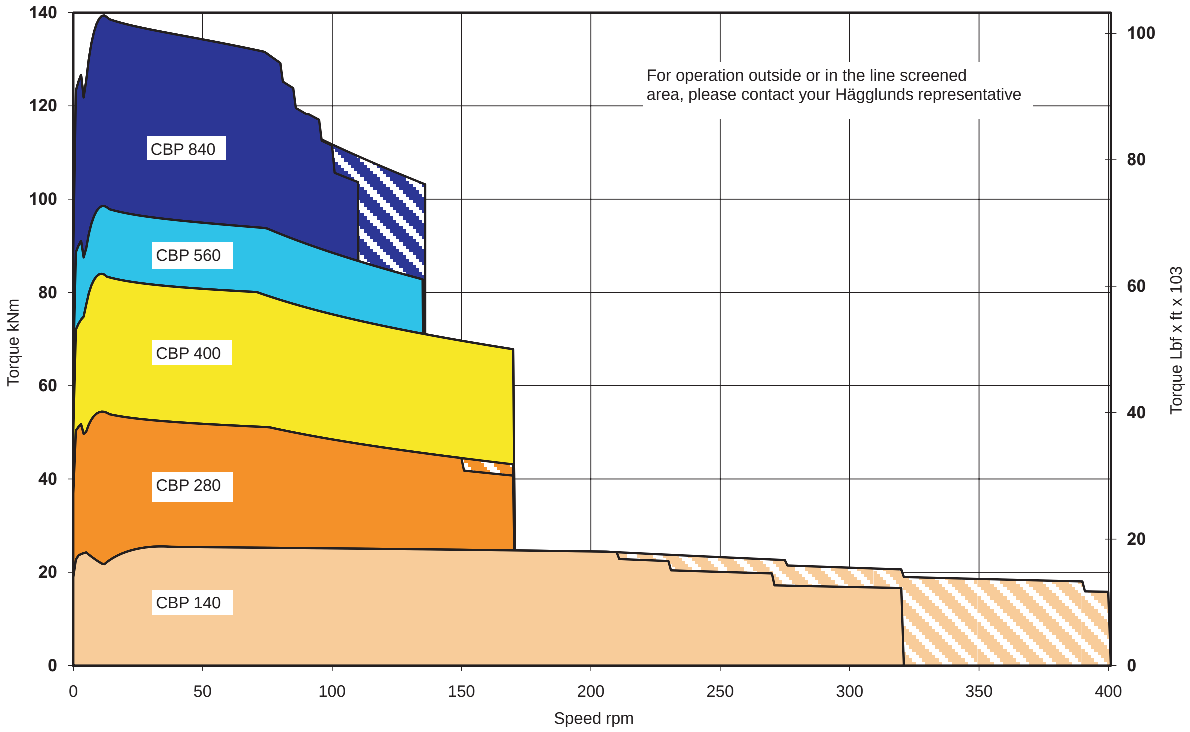
Features of Hägglunds Drives Compact CBP motor

- Powerful, high power
- Higher speeds
- High efficiency
- High output torque and power to weight ratio
- Through hole
- Full torque from zero to maximum speed
- Small outer diameter
- Resistant against shock loads
- 8 ports for convenient piping and improved performance
- Flexible mounting by using splines, suitable for torque arm or flange mounting



Quick selection diagram for Compact CBP motors

The graphs below represents the torque and speed, corresponding to a modified rating life L_{10aah} = 40 000 hours. Oil viscosity in the motor case 40 cSt (187 SSU).
Contamination level not exceeding ISO 4406:1999 18/16/13 (NAS 1638, class 7). The diagram is based on a charge pressure of 15 bar (218 psi).



Functional description

Hägglunds hydraulic industrial motor COMPACT CBP is of the radial-piston type with a rotating cylinder block/hollow shaft and a stationary housing. The cylinder block is mounted in fixed roller bearings in the housing. An even number of pistons are radially located in bores inside the cylinder block, and the valve plate directs the incoming and outgoing oil to and from the working pistons. Each piston is working against a cam roller.

When the hydraulic pressure is acting on the pistons, the cam rollers are pushed against the slope on the cam ring that is rigidly connected to the housing, thereby producing a torque. The cam rollers transfer the reaction force to the piston which are guided in the cylinder block. Rotation therefore occurs, and the torque available is proportional to the pressure in the system.

Oil main lines are connected to ports A and C in the connection block and drain lines to ports D1, D2, D3 or D4 in the motor housing.

The motor is connected to the shaft of the driven machine through the hollow shaft of the cylinder block. The torque is transmitted by splines.

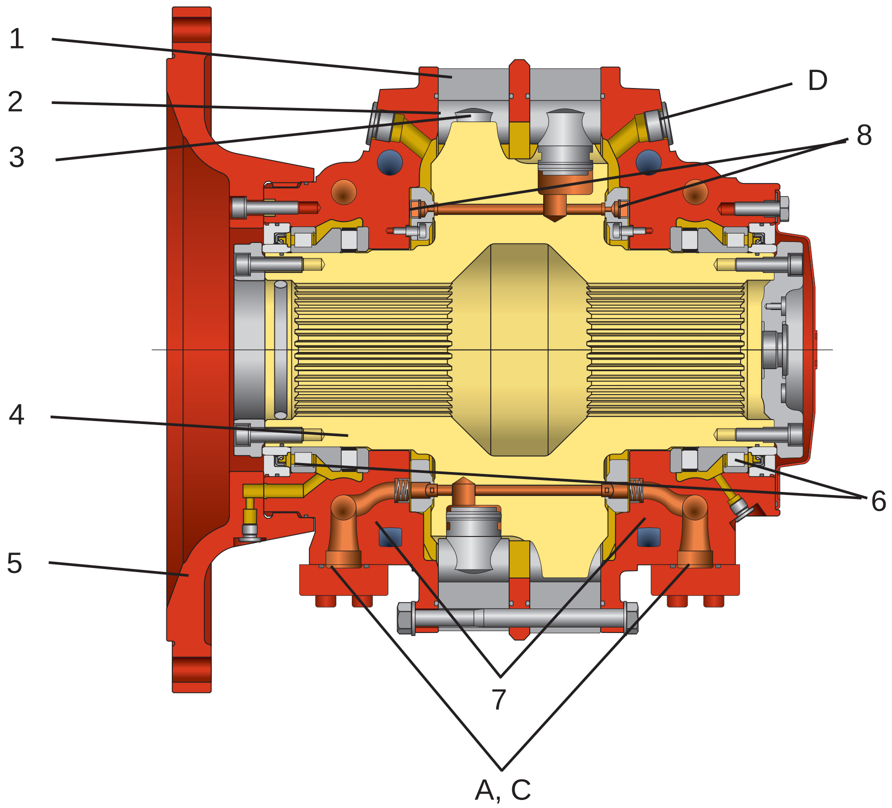
Valid patents

US 4522110, US 005979295A, SE 9101950-5, EP 0102915, JP 83162704, GB 1524437, EP NL 0524437, EP DE 69211238.3.

Quality

To assure our quality we maintain a Quality Assurance system, certified to standard ISO 9001, EN 29001 and BS 5750; Part 1.

CBP 140

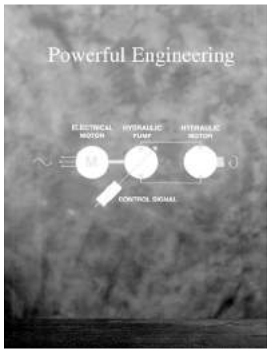


1. Cam ring
2. Cam roller
3. Piston
4. Cylinder block with splines
5. Flange
6. Cylindrical roller bearing
7. Connection block
8. Valve plate

A = Inlet or outlet port »A«
C = Inlet or outlet port »C«
D = Drain port

Calculation fundamentals

Output power	$P = \frac{T \cdot n}{9549}$	(kW) on driven shaft	$P = \frac{T \cdot n}{5252}$	(hp) on driven shaft
Output torque (η_m=98%)	$T = T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m$	(Nm)	$T = \frac{T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m}{1000}$	(lbf·ft)
Pressure required (η_m=98%)	$p = \frac{T}{T_s \cdot \eta_m} + \Delta p_l + p_c$	(bar)	$p = \frac{T \cdot 1000}{T_s \cdot \eta_m} + \Delta p_l + p_c$	(psi)
Flow rate required	$q = \frac{n \cdot V_i}{1000} + q_l$	(l/min)	$q = \frac{n \cdot V_i}{231} + q_l$	(gpm)
Output speed	$n = \frac{q - q_l}{V_i} \cdot 1000$	(rpm)	$n = \frac{q - q_l}{V_i} \cdot 231$	(rpm)
Inlet power	$P_{in} = \frac{q \cdot (p - p_c)}{600}$	(kW)	$P_{in} = \frac{q \cdot (p - p_c)}{1714}$	(hp)



For more information
See Powerful Engineering (EN347-4).

Quantity	Symbol		Metric	US
Power	P	=	kW	hp
Output torque	T	=	Nm	lbf·ft
Specific torque	T_s	=	Nm/bar	lbf·ft/ 1000 psi
Rotational speed	n	=	rpm	rpm
Required pressure	p	=	bar	psi

Quantity	Symbol		Metric	US
Pressure loss	Δp	=	bar	psi
Charge pressure	p_c	=	bar	psi
Flow rate required	q	=	l/min	gpm
Total volumetric loss	q_l	=	l/min	gpm
Displacement	V_i	=	cm^3/rev	in^3/rev
Mechanical efficiency	η_m	=	0.98*	

***Not valid for starting efficiency**

Definitions

Rated speed[1)]
Rated speed is the highest allowed speed for a charge pressure of 12 bar (175 psi) above case pressure. When a closed loop system is used, a minimum of 15% of oil is to be exchanged in the main loop.

Max speed
Maximum speed is the maximum allowed speed. Special considerations are necessary regarding charge pressure, cooling and choice of hydraulic system for speeds rated above.

[1)] Operating above rated conditions requires Hägglunds Drives approval.

Accepted conditions for standard type of motor:
1. Oil viscosity 20 - **40** - 10000 cSt (98 - **187** - 4650 SSU). See page 26.
2. Temperature -35 °C to +70 °C (-31 °F to +158 °F).
3. Running case pressure 0-3 bar (0-45 psi) Max case pressure 8 bar (116 psi)
4. Charge pressure (see page 18).
5. Volumetric losses (see page 22).

Motor data

Metric	Displacement	Specific torque	Rated * speed	Max.**** speed	Max. ** pressure
	$V_i \frac{cm^3}{rev}$	$T_s \frac{Nm}{bar}$	n rpm	n rpm	p bar
CBP 140-80	5 024	80	320	400	350***
CBP 140-100	6 280	100	270	390	350***
CBP 140-120	7 543	120	230	320	350***
CBP 140	8 800	140	210	275	350***
CBP 280-160	10 100	160	170	170	350
CBP 280-200	12 600	200	170	170	350
CBP 280-240	15 100	240	170	170	350
CBP 280	17 600	280	150	170	350
CBP 400-240	15 100	240	170	170	350
CBP 400-280	17 600	280	170	170	350
CBP 400-320	20 100	320	170	170	350***
CBP 400-360	22 600	360	170	170	350***
CBP 400	25 100	400	170	170	350***
CBP 560-440	27 600	440	135	135	350***
CBP 560-480	30 200	480	135	135	350***
CBP 560-520	32 700	520	135	135	350***
CBP 560	35 200	560	135	135	350***
CBP 840-600	37 700	600	110	135	350
CBP 840-640	40 200	640	100	135	350
CBP 840-680	42 700	680	100	135	350
CBP 840-720	45 200	720	95	135	350
CBP 840-760	47 800	760	90	125	350
CBP 840-800	50 300	800	85	120	350
CBP 840	52 800	840	80	115	350

* Related to a required charge pressure of 12 bar/175 psi for motors in braking mode. (Special considerations regarding charge pressure, cooling and choice of hydraulic system for speeds above rated, 8 ports must be used).

** The motors are designed according to DNV-rules. Test pressure 420 bar/6000 psi.
Peak/transient pressure 420 bar/6000 psi maximum, allowed to occur 10000 times.

*** Alternating torque direction is not allowed for front mounting flange.

**** For continuous duty, the service life of the shaft seal is affected by case oil temp, case pressure and speed. See Engineering manual ACBP-4.2

US	Displacement	Specific torque	Rated * speed	Max. **** speed	Max. ** pressure
	$V_i \frac{in^3}{rev}$	$T_s \frac{lbf \cdot ft}{1000\ psi}$	n rpm	n rpm	p psi
CBP 140-80	306.6	4 068	320	400	5000***
CBP 140-100	383.2	5 085	270	390	5000***
CBP 140-120	460.3	6 102	230	320	5000***
CBP 140	537	7 119	210	275	5000***
CBP 280-160	610	8 100	170	170	5000
CBP 280-200	760	10 200	170	170	5000
CBP 280-240	920	12 200	170	170	5000
CBP 280	1070	14 200	150	170	5000
CBP 400-240	920	12 200	170	170	5000
CBP 400-280	1070	14 200	170	170	5000
CBP 400-320	1230	16 300	170	170	5000***
CBP 400-360	1380	18 300	170	170	5000***
CBP 400	1530	20 300	170	170	5000***
CBP 560-440	1690	22 400	135	135	5000***
CBP 560-480	1840	24 400	135	135	5000***
CBP 560-520	1990	26 400	135	135	5000***
CBP 560	2150	28 500	135	135	5000***
CBP 840-600	2300	30 500	110	135	5000
CBP 840-640	2450	32 500	100	135	5000
CBP 840-680	2610	34 600	100	135	5000
CBP 840-720	2760	36 600	95	135	5000
CBP 840-760	2910	38 700	90	125	5000
CBP 840-800	3070	40 700	85	120	5000
CBP 840	3220	42 700	80	115	5000

* Related to a required charge pressure of 12 bar/175 psi for motors in braking mode. (Special considerations regarding charge pressure, cooling and choice of hydraulic system for speeds above rated, 8 ports must be used).

** The motors are designed according to DNV-rules. Test pressure 420 bar/6000 psi. Peak/transient pressure 420 bar/6000 psi maximum, allowed to occur 10000 times.

*** Alternating torque direction is not allowed for front mounting flange.

**** For continuous duty, the service life of the shaft seal is affected by case oil temp, case pressure and speed. See Engineering manual ACBP-4.2.

Ordering codes

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Compact CBP motors

Example: C B P 1 4 0 S A 0 V0 C F 0 0 0 0

C B P □□□ □□□ □□□□□□□ □□ □□

Motor series

Generation

High power

Motor size
- CBP 140
- CBP 280
- CBP 400
- CBP 560
- CBP 840

Specific torque (Nm/bar)

Mounting alternatives, shaft
- Splines S

Multi disc brake or Tandem kit
- Motor without brake or TA kit A
- Motor prepared for brake* or TA** B

Displacement shift valve
- Motor not prepared for displacement shift 0

Type of seal
- Viton V

Through hole kit
- No 0
- Yes H

Coated pistons and coated cam rollers
- Yes C

Mounting type
- Center: 140, 400, 560, 840 C
- Front: 140, 280, 400, 560 F

Modification 00-99

Design
- Standard 00
- Special index 01-99

To be filled in by Hägglunds

Painting
- Orange Standard
- Other Option

* Only CBP 140
** Only CBP 140

Torque arm

Example: T C A 14 - 0 - 0 - 0 0

T C □ □□ - □ - □ - □□

Torque arm

Generation

Torque arm size
TCA 14 for CBP 140
TCA 40 for CBP 280, CBP 400
TCA 84 for CBP 400*, CBP 560, CBP 840

Attachment
Pivoted 2
Other 9

Modification 0-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

Note: Torque arm incl. Pivot attachment.
TCA 14 - bolts & washers supplied with torque arm.

* For CBP 400 with center mounting

Tandem motors

Example: T B P 1 4 H 0 0 0

Tandemkit

Generation

High power

Size
14
21
40

Through hole
No 0
Yes H

Modification 0-9

Design
Standard 00
Special index 01-99

To be filled in by Hägglunds

Dimensions, motor with splines for front mounting

Motor type	**A** (mm)	**B** (mm)	**C** (mm)	**D** (mm)	**E**
CBP 140	600	570	510	54	N120x5x30x22x9H
CBP 280	782	858	680	11.5	N200x5x30x38x9H
CBP 400	782	976	680	11.5	N200x5x30x38x9H
CBP 560	940	1036	800	65.5	N260x5x30x50x9H

Motor type	**A** (in)	**B** (in)	**C** (in)	**D** (in)	**E**
CBP 140	23.62	22.44	20.08	2.13	N120x5x30x22x9H
CBP 280	30.79	33.78	26.77	0.45	N200x5x30x38x9H
CBP 400	30.79	38.43	26.77	0.45	N200x5x30x38x9H
CBP 560	37.01	40.79	31.50	2.58	N260x5x30x50x9H

Dimensions, motor with splines for centre mounting

Motor type	**A** (mm)	**B** (mm)	**C** (mm)	**D** (mm)	**E**
CBP 140	600	511	510	246	N120x5x30x22x9H
CBP 400	940	959	800	457	N200x5x30x38x9H
CBP 560	940	1036	800	534	N260x5x30x50x9H
CBP 840	940	1154	800	534	N260x5x30x50x9H

Motor type	**A** (in)	**B** (in)	**C** (in)	**D** (in)	**E**
CBP 140	23.62	20.12	20.08	9.69	N120x5x30x22x9H
CBP 400	37.01	37.76	31.50	17.99	N200x5x30x38x9H
CBP 560	37.01	40.79	31.50	21.02	N260x5x30x50x9H
CBP 840	37.01	45.43	31.50	21.02	N260x5x30x50x9H

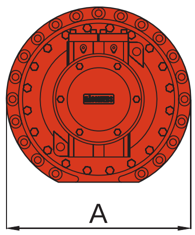
Weight

Front mounting	kg (lb)
CBP 140	410 (900)
CPB 280	1580 (3480)
CBP 400	1930 (4250)
CBP 560	1990 (4390)

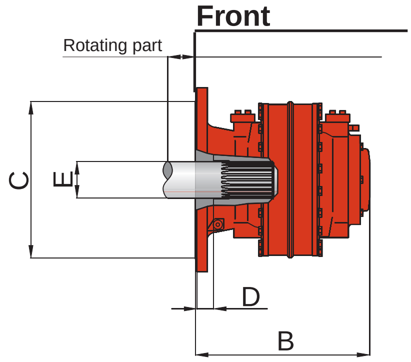
Centre mounting	kg (lb)
CBP 140	360 (780)
CPB 400	1880 (4150)
CBP 560	1890 (4170)
CBP 840	2170 (4780)

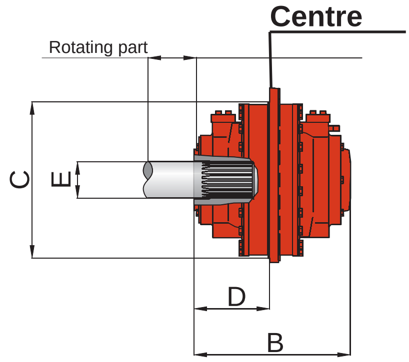
Compact CBP 140

Alternative mounting flange



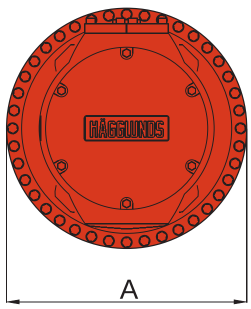
Through hole
ø 110 (4.33)



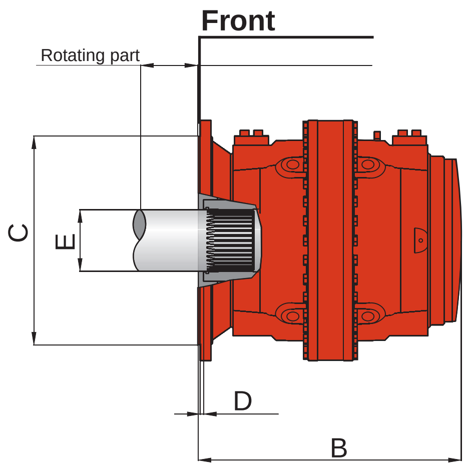


Compact CBP 280, 400

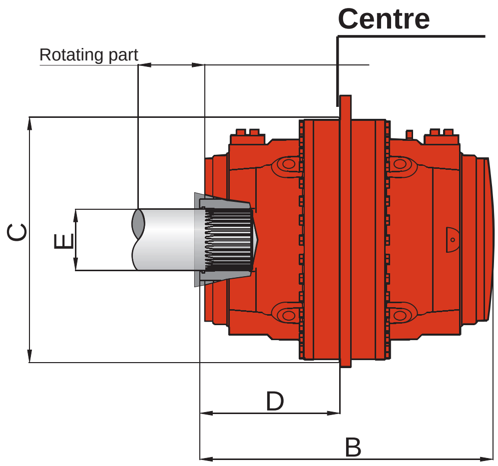
Alternative mounting flange



Through hole
ø 170 (6.69)



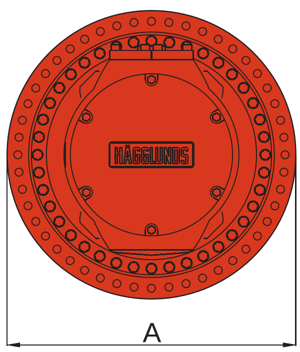
CBP 280, CBP 400



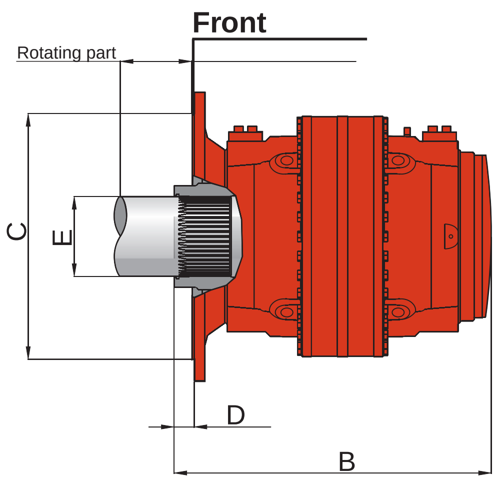
CBP 400 only

Compact CBP 560, 840

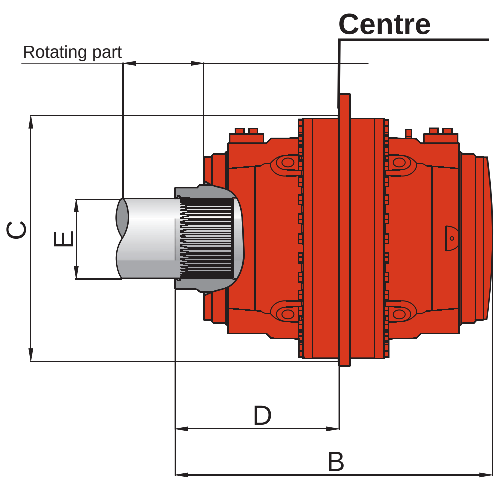
Alternative mounting flange



Through hole
ø 170 (6.69)



CBP 560 only



CBP 560, CBP 840

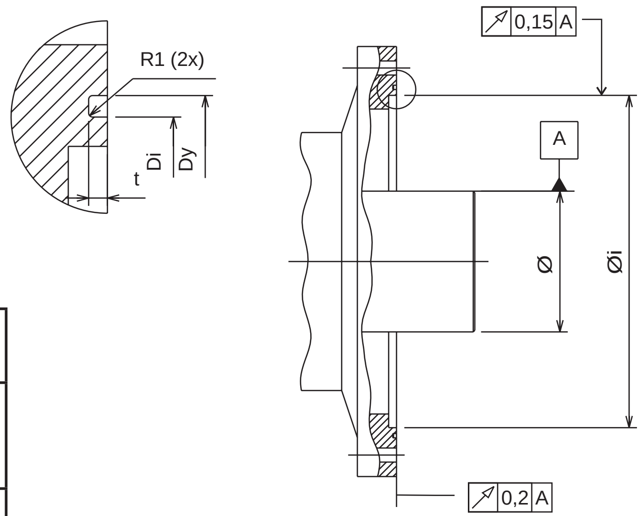
Dimensions
Installation dimensions and material for driven shaft

Spline

The splines shall be lubricated, either oiled with hydraulic oil at assembly, or filled with transmission oil from the connected gearbox. To avoid wear in the splines, the installation must be within the specified tolerances in figure. For control of spline, see table.

When splines are used for torque arm mounting, the spline shall be lubricated with oil at assembly. For production of shaft see, 078 0150, 078 0162, 078 0163, 278 5023, 278 5024, 278 5025 and 278 5026.

Flange mounting



Motor	**CBP 140**	**CBP 280/400**	**CBP 560/840**
Tooth profile and bottom form	DIN 5480	DIN 5480	DIN 5480
Tolerance	8f	8f	8f
Guide	Flank centring	Flank centring	Flank centring
Pressure angle	30°	30°	30°
Module	5	5	5
Number of teeth	22	38	50
Pitch diameter	Ø 110	Ø 190	Ø 250
Minor diameter	Ø 109 $^{0}_{-0.870}$	Ø 188 $^{0}_{-1.201}$	Ø 248 $^{0}_{-1.201}$
Major diameter	Ø 119 $^{0}_{-0.220}$	Ø 199 $^{0}_{-0.290}$	Ø 259 $^{0}_{-0.320}$
Measure over measuring pins	129.781 $^{-0.083}_{-0.147}$	210.158 $^{-0.088}_{-0.157}$	270.307 $^{-0.103}_{-0.181}$
Diameter of measuring pins	Ø 10	Ø 10	Ø 10
Addendum modification X M	+2.25	+2.25	+2.25

Unidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm^2
Bidirectional drives
Steel with yield strength Rel_{min} = 700 N/mm^2

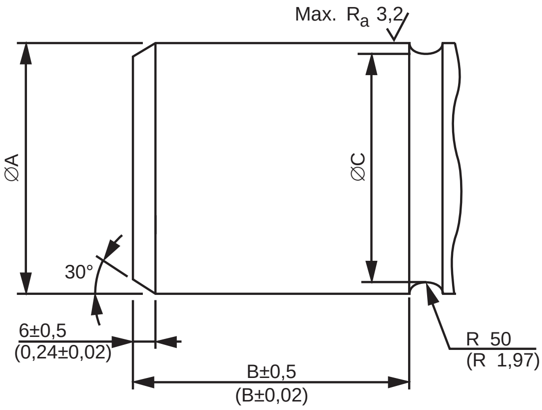
	Øi	**Dy**	**Di**	**t**	**O-ring***
CBP 140	510 $^{+0.1}_{0}$	ø529	ø515	4.4±0.1	2152 2115-566
CBP 280/400	600 $^{+0.20}_{+0.05}$	ø714	ø700	4.4±0.1	2152 2115-743
CBP 560/840	800 $^{+0.20}_{+0.05}$	ø820	ø806	4.4±0.1	2152 2115-793

* O-ring to be used in submerged applications, or for external lubrication of the splines.

Dimensions
With hollow shaft, shaft coupling.

Design of driven shaft end on heavily loaded shaft.

Where the driven shaft is heavily loaded and is subject to high stresses, for example for changes in the direction of rotation and/or load, it is recommended that the driven shaft should have a stress relieving groove; see figure below and tables.



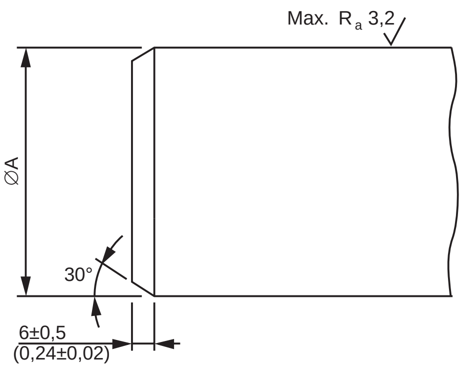
Dim	CBP 280	CBP 400	CBP 560/840
A mm	$180^{-0.014}_{-0.054}$	$200^{-0.015}_{-0.061}$	$260^{-0.017}_{-0.069}$
A in	$7.0866^{-0.00055}_{-0.00215}$	$7.8740^{-0.00059}_{-0.00240}$	$10.2362^{-0.00067}_{-0.00272}$
B mm	106	117	153
B in	4.17	4.61	6.02
C mm	174	194	254
C in	6.85	7.64	10

Note: The dimensions are valid for +20 °C (68 °F)

Unidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm^2
Bidirectional drives
Steel with yield strength Rel_{min} = 700 N/mm^2

Normally loaded shaft

In drives with only one direction of rotation and/or load where the stresses in the shaft are moderate, the shaft can be plain, see figure and tables.



CBP 280 - 840		
D	M20	UNC 5/8"
E	>17 (0.67)	>13.5 (0.53)
F	25 (0.98)	22 (0.87)
G	50 (1.97)	30 (1.18)

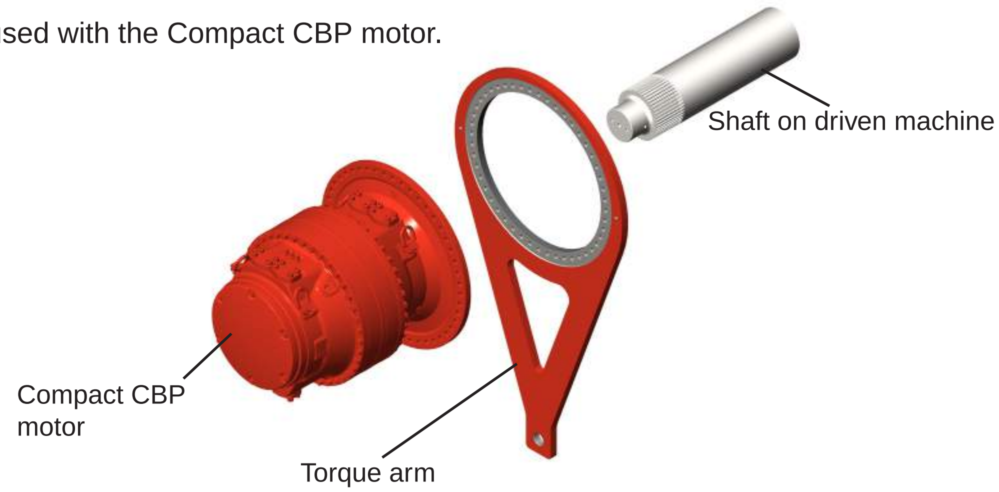
Accessories

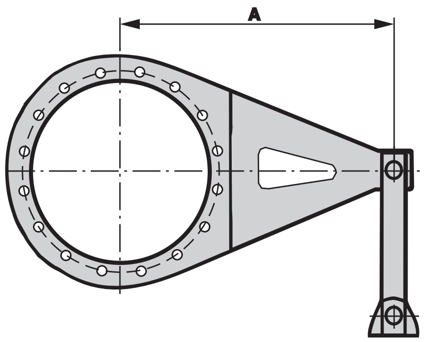
Torque arm, type TCA

Easy to apply - Hägglunds torque arms.

A shaft mounted gearless drive is achieved by utilizing the standard Hägglunds torque arm. As a result, alignment problems, expensive flexible couplings and bed plates are eliminated (see figure below).
For CBP 140/280/400/560 front flange is recommended to be used, to reduce load on splines.

To be used with the Compact CBP motor.

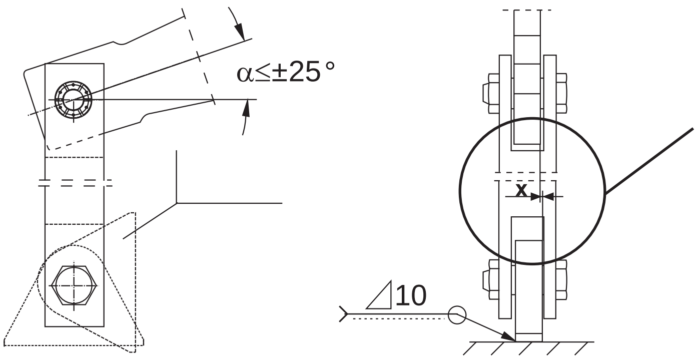




Torque arm	A	
	mm	in
TCA 14	800	31.50
TCA 40	1250	49.21
TCA 84	1500	59.06

Torque arm	Max torque (Nm) For alternating or pulsating torque	Max torque (lbf·ft) For alternating or pulsating torque	Max torque (Nm) At static torque	Max torque (lbf·ft) At static torque
TCA 14 for CBP 140	70 000	51 600	84 000	62 000
TCA 40 for CBP 280/CBP 400	140 000	103 200	170 000	125 300
TCA 84 for CBP 400*/CBP 560/ CBP 840	294 000	216 700	350 000	258 000

* For CBP 400 with centre mounting



x = ±2 mm (0.079) misalignment in installation.
x ≤ ±15 mm (0.59) movement when in use.

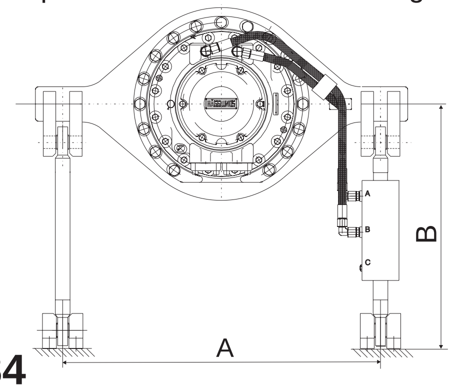
Note: Ideal angle = 0°

Double ended torque arm, type DTCA 140

The double ended torque arm is designed for CBP 140 (not reduced displacement), to eliminate external forces from the torque arm.

Double ended torque arm, including double acting hydraulic cylinder and pivoted attachment. Following are included in delivery:

- Screws and washers (motor-torque arm)
- Hose kit + clamps
- Hose flange connections

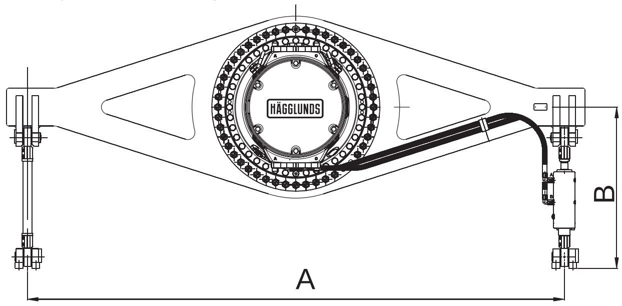


Torque arm	A mm (in)	B mm (in)	Weight kg (lb)
DTCA 140	1165 (45.9)	780 (30.7)	155 (341)

Double ended torque arm, DTCB 40 - DTCB 84

Double ended torque arm, including double acting hydraulic cylinder and pivoted attachment. Following are included in delivery:

- Screws and washers (motor-torque arm)
- Hose kit + clamps
- Hose flange connections



	Motor		**Tandem motor**				
Torque arm	**Motor type**	**Ordering code**	**Tandem motor type**	**Ordering code**	**A mm (in)**	**B mm (in)**	**Weight kg (lb)**
DTCB 40	**CBP 280 F**	078 1476-812	CBP280 F + TBP 14 + CBP140	078 1476-814	2120 (83.46)	900 (35.43)	335 (739)
	CBP 280-240 F	078 1476-811	CBP400 F + TBP 14 + CBP140				
	CBP 400 F	078 1476-814					
	CBP 400-360 F	078 1476-813					
	CBP 400-320 F	078 1476-812					
	CBP 400-280 F						
	CBP 400-240 F	078 1476-811					
DTCB 84	**CBP 400 C**	078 1476-805	CBP400 C + TBP 14 + CBP140	078 1476-805	3000 (118.11)		500 (1102)
	CBP 400-360 C	078 1476-810	CBP560 F + TBP 14 + CBP140	078 1476-808			
	CBP 400-320 C		CBP560 C + TBP 14 + CBP140				
	CBP 400-280 C		CBP840 C + TBP 14 + CBP140	078 1476-809			
	CBP 400-240 C		CBP840 C + TBP 21 + CA210 S28				
	CBP 560 F/C	078 1476-806	CBP560 C + TBP 40 + CBP280	078 1476-808			
	CBP 560-520 F/C		CBP560 C + TBP 40 + CBP400	078 1476-809			
	CBP 560-480 F/C	078 1476-805					
	CBP 560-440 F/C						
	CBP 840 C	078 1476-809					
	CBP 840-800 C						
	CBP 840-760 C	078 1476-808					
	CBP 840-720 C						
	CBP 840-680 C						
	CBP 840-640 C						
	CBP 840-600 C	078 1476-807					

F = Front C = Centre

Mounting set SMCB1 for speed encoder

Speed encoder kit for Compact CBP 140 motors where the speed encoder is enclosed and well protected.

The mounting set can be used for both spline and shaft coupling motors.

The encoder is used for detection of speed by pulse- frequency or/either direction of rotation by pulse-train.

The speed encoder kit is also available in a explosion proof version, please see Engineering Manual ACBP-3.4.1.

CBP 140 with SMCB1

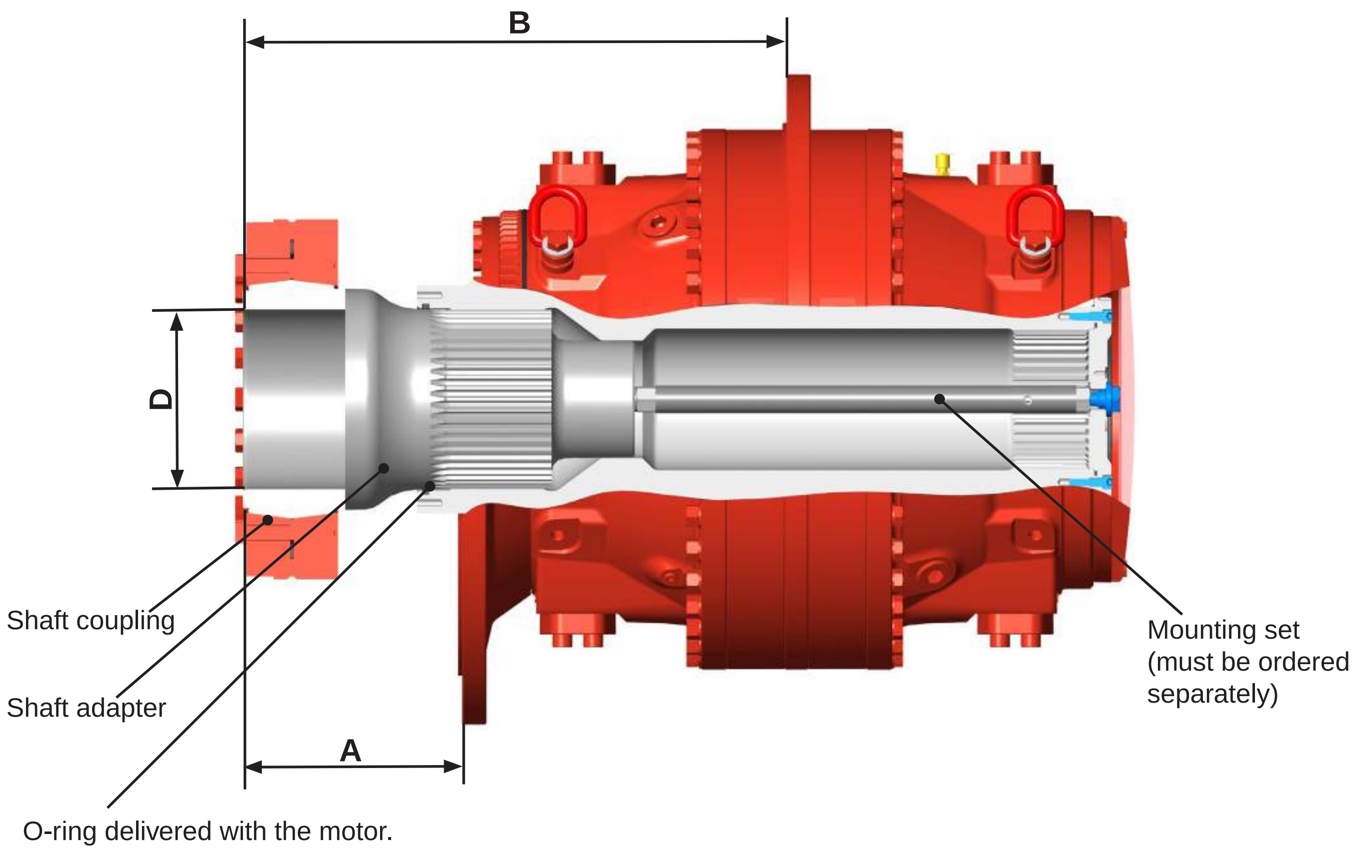
CBP 560 with SMCB1

Shaft coupling set, CBP 140-840

The set includes shaft coupling and shaft adapter. Mounting set must be ordered separately.
The kit is designed for shaft, that can not be made with splines.

Ordering Code

Shaft coupling set CBP 140	078 0693-804
Shaft coupling set CBP 280	078 0693-803
Shaft coupling set CBP 400	078 0693-802
Shaft coupling set CBP 560/840	078 0693-801



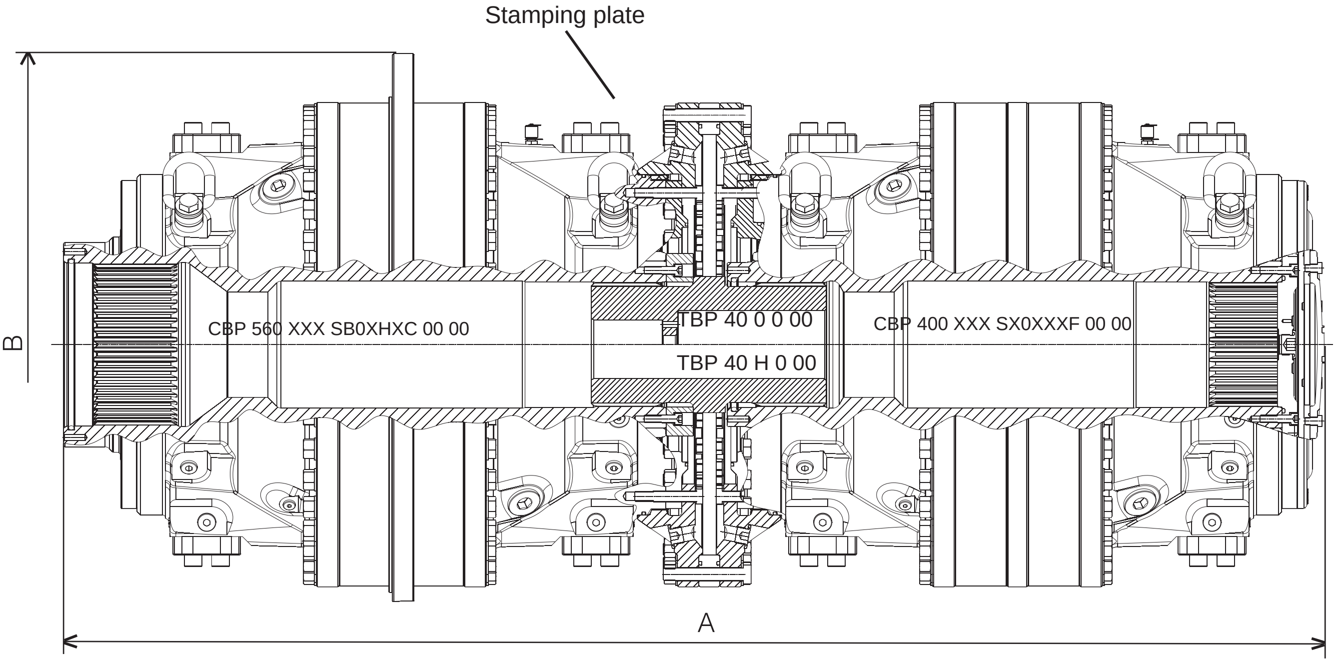
Motor	A mm (in)	B mm (in)	D mm (in)	Weight kg (lb)
CBP 140	94 (3.7)	394 (15.51)	140 (5.5)	84 (185)
CBP 280	161 (6.3)	N/A	180 (7.1)	134 (295)
CBP 400	183 (7.2)	651 (25.6)	200 (7.9)	160 (353)
CBP 560	315 (12.4)	783 (30.8)	260 (10.2)	277 (611)
CBP 840	N/A	783 (30.8)	260 (10.2)	277 (611)

Compact Tandem Motors

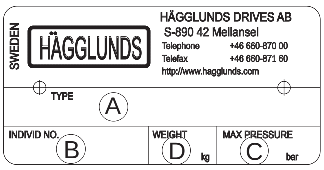
A Tandem motor consists of 3 major units, Front motor + Tandem kit TBP xx + Rear motor. The Tandem kit (TBP 14/21/40) shall always be chosen according to the rear Standard spline motor. On the stamping sign on the Tandem kit, are the <u>max pressure</u> and the <u>total weight</u> for the complete unit declared. Note that the complete Ordering code for a Tandem motor, contains of 3 individual Ordering codes (3 parts).

Example:

CBP 560 XXX SB0XHXC 00 + TBP 40 X 00 + CBP 400 XXX SX0XXXF 00 00



Stamping for TBP-unit

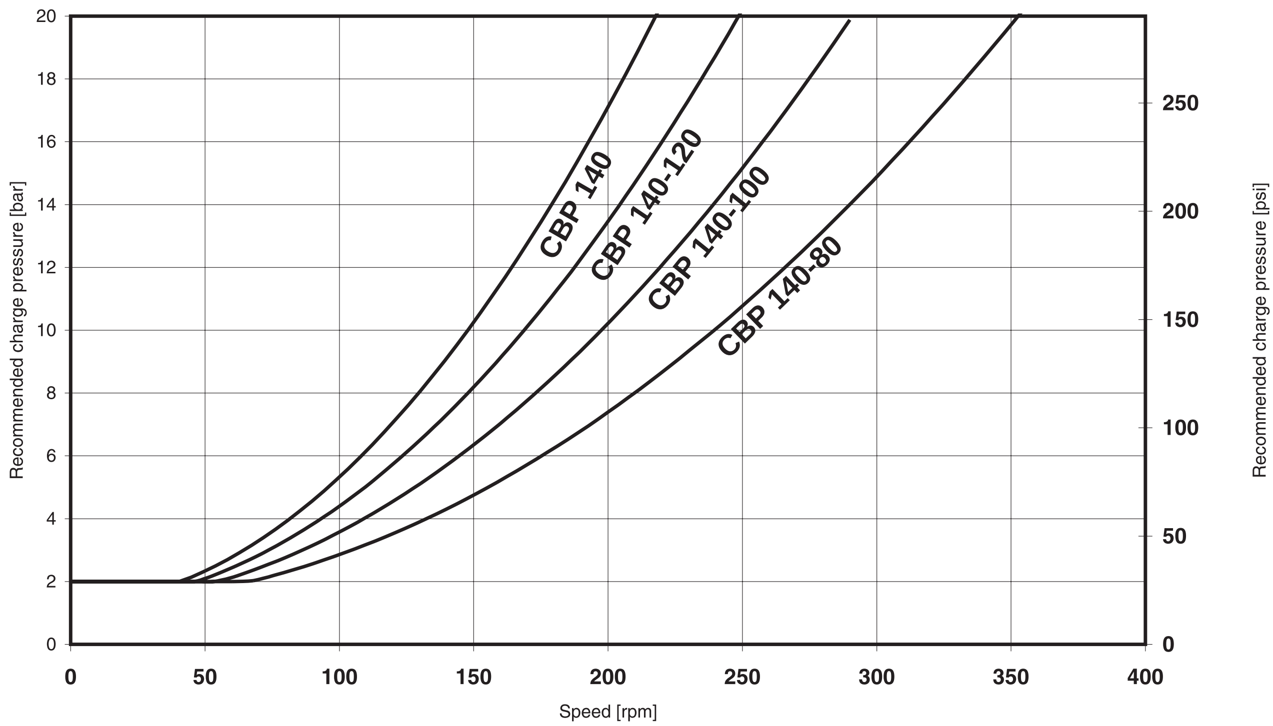


A: TA-type, same as Ordering code
B: Week of assembly (yy-ww)
C: <u>Max working pressure</u> for the assembly
D: <u>Total weight</u> of the assembly

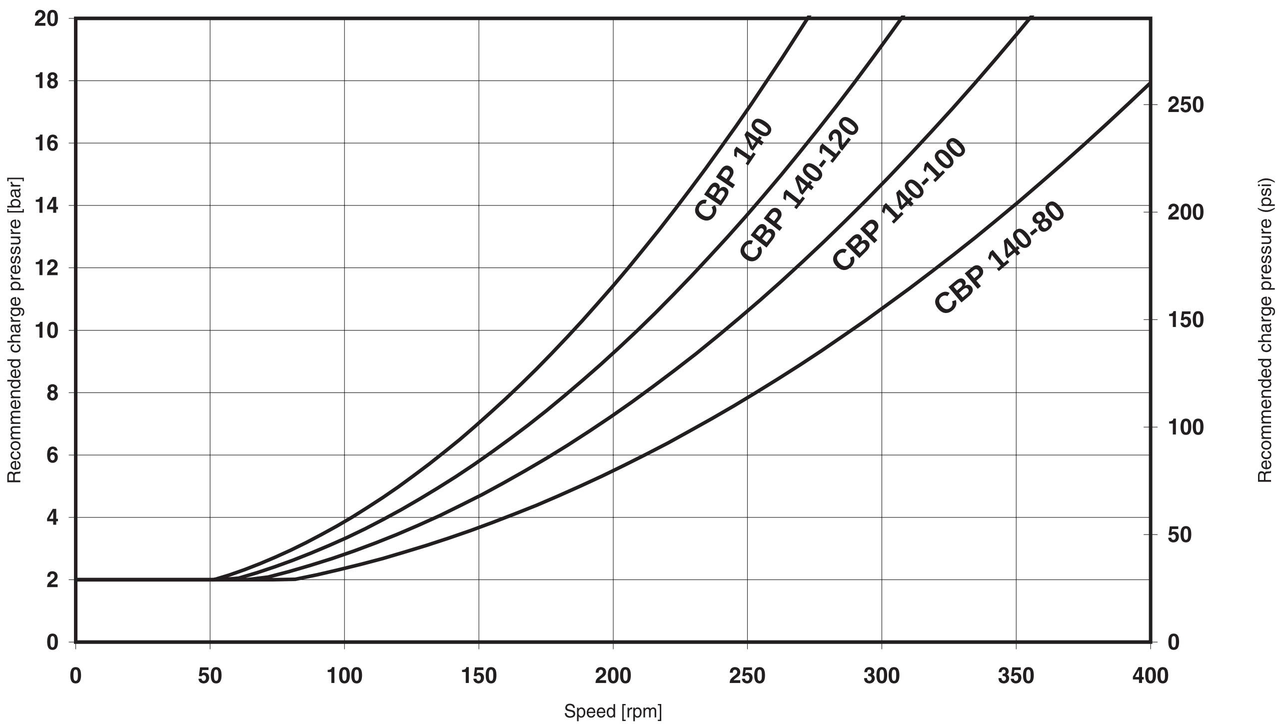
Tandem motor	Max. pressure bar (psi)	Total weight kg (lb)	A Length mm (in)	B Diameter mm (in)	Max. torque to driven shaft* Nm (lbf·ft)
CBP280 F + TBP 14 + CBP140	350 (5000)	2080 (4586)	1387 (54.6)	782 (30.8)	147 000 (108 422)
CBP400 F + TBP 14 + CBP140	350 (5000)	2430 (5357)	1505 (59.3)		189 000 (139 399)
CBP400 C + TBP 14 + CBP140	350 (5000)	2380 (5247)	1494 (58.8)	940 (37.0)	
CBP560 F + TBP 14 + CBP140	350 (5000)	2500 (5512)	1505 (59.3)		245 000 (180 703)
CBP560 C + TBP 14 + CBP140	350 (5000)	2400 (5291)	1571 (61.9)		
CBP840 C + TBP 14 + CBP140	350 (5000)	2670 (5886)	1689 (66.5)		343 000 (252 984)
CBP840 C + TBP 21 + CA210 S28	350 (5000)	2860 (6305)	1664 (65.5)		367 500 (271 054)
CBP560 C + TBP 40 + CBP280	350 (5000)	3690 (8135)	1929 (75.9)		294 000 (216 843)
CBP560 C + TBP 40 + CBP400	350 (5000)	4040 (8906)	2047 (80.6)		392 000 (289 124)

Diagrams for Compact CBP

Charge pressure - Compact CBP 140, 4-port connection



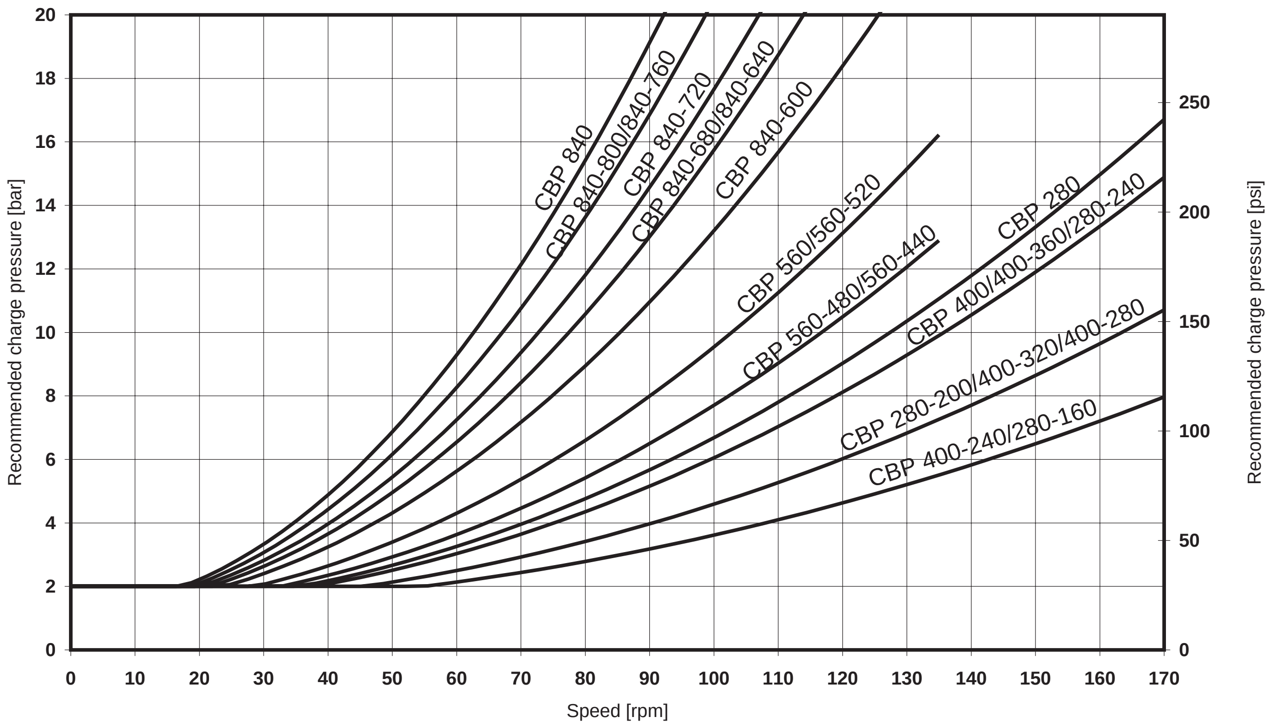
Charge pressure - Compact CBP 140, 8-port connection



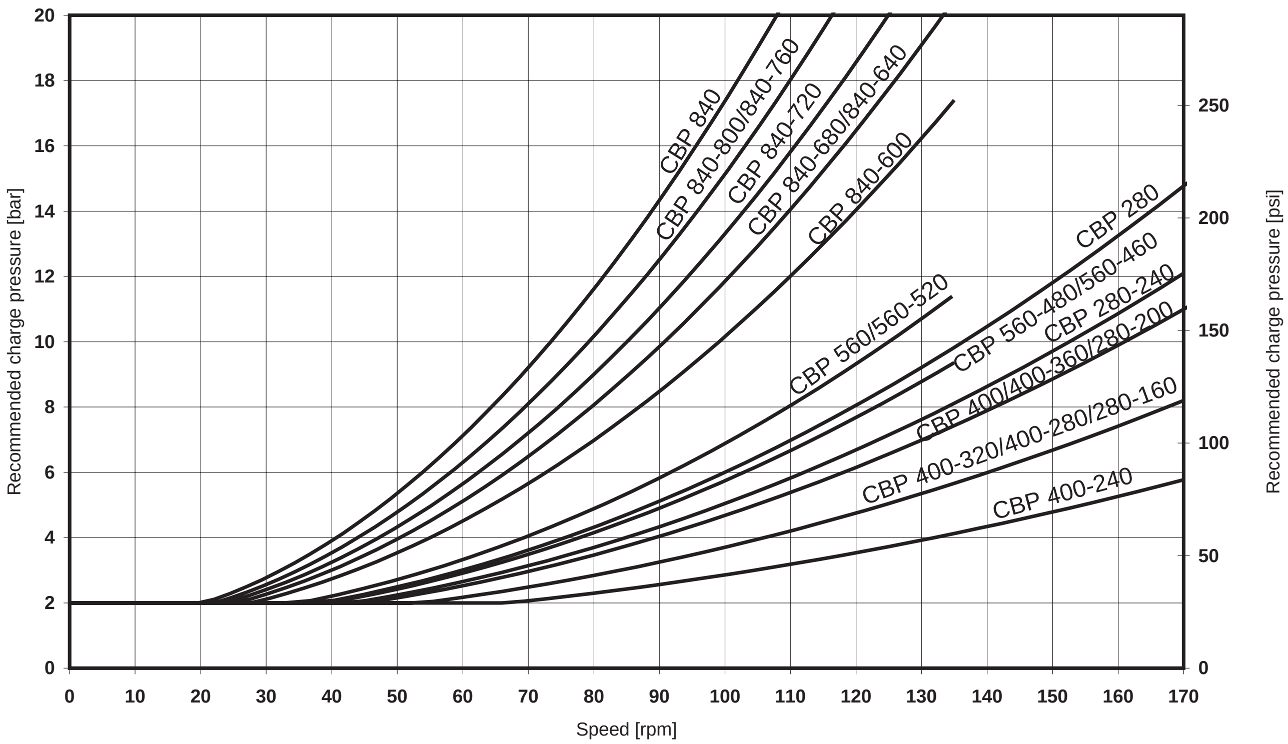
Case 1: The motor works in braking mode. Required charge pressure at the inlet port is according to diagram above.

Case 2: The motor works in driving mode only. Required back pressure at the outlet port corresponds to 30% of value given in diagram above, but may not be lower than 2 bar (29 psi).

Charge pressure - Compact CBP 280-840, 4-port connection



Charge pressure - Compact CBP 280-840, 8-port connection

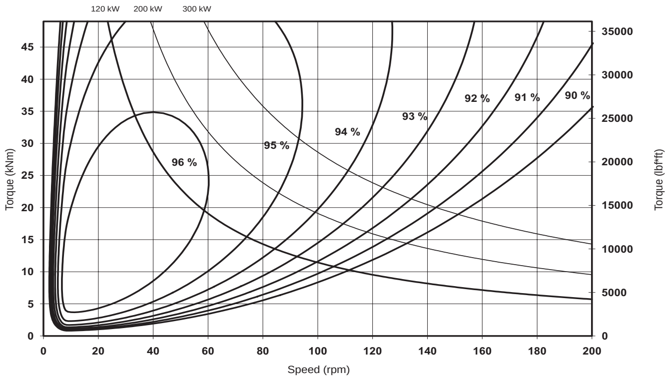


Case 1: The motor works in braking mode. Required charge pressure at the inlet port is according to diagram above.

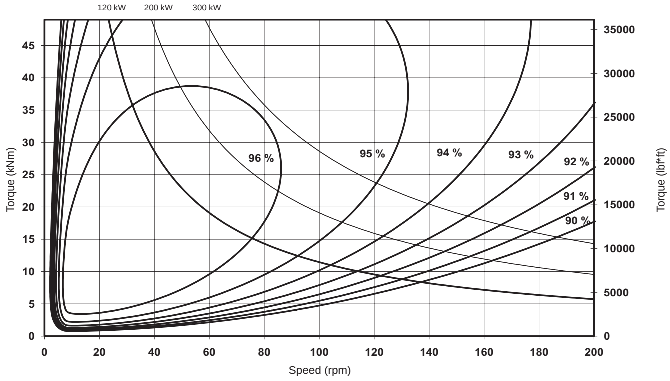
Case 2: The motor works in driving mode only. Required back pressure at the outlet port corresponds to 30% of value given in diagram above, but may not be lower than 2 bar (29 psi).

Overall efficiency, oil viscosity 40 cSt/187 SSU, Pc = 15 bar (217 psi)

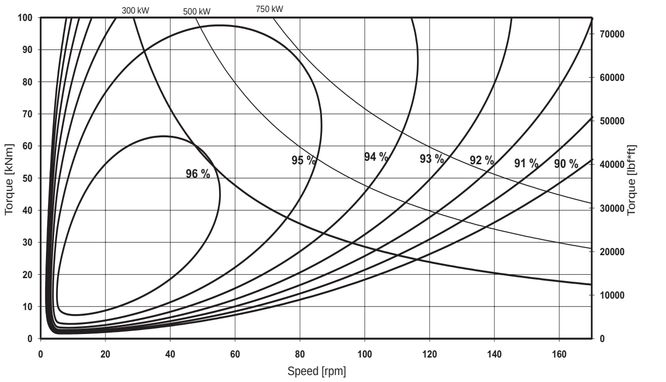
CBP 140, 4 ports



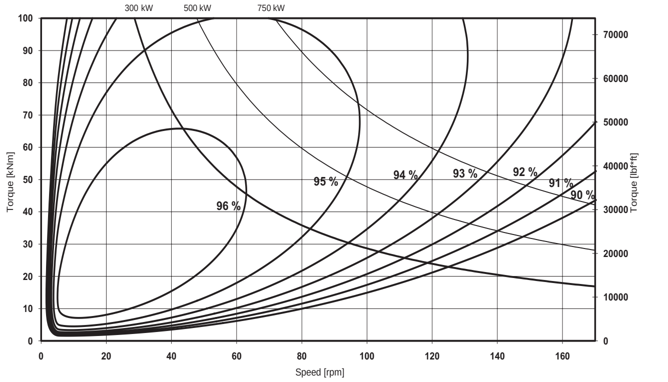
CBP 140, 8 ports



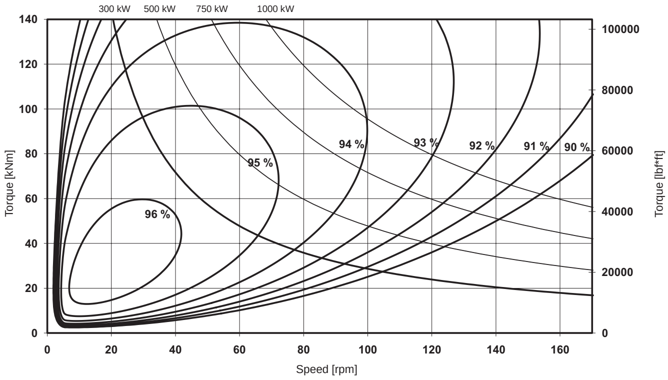
CBP 280, 4 ports



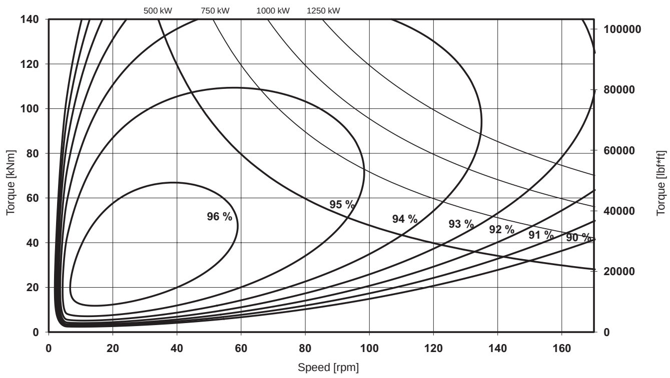
CBP 280, 8 ports



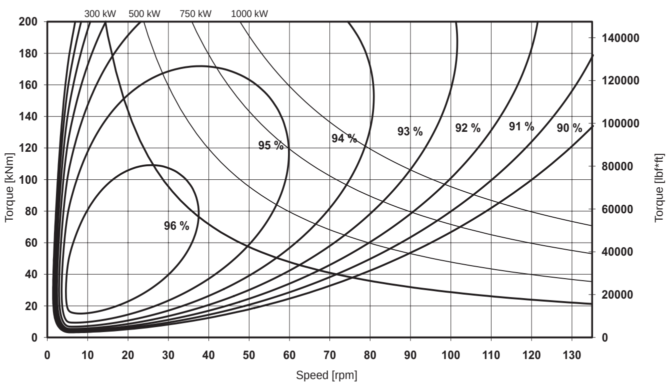
CBP 400, 4 ports



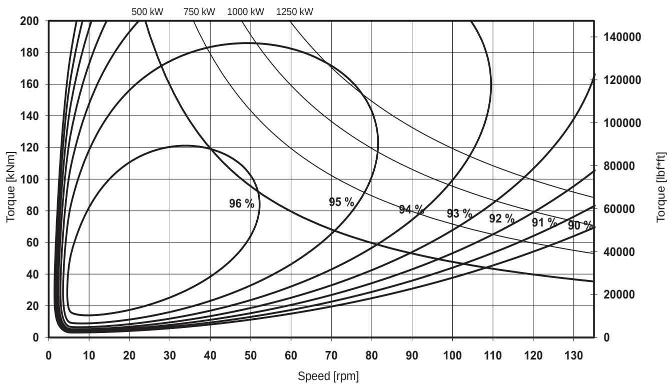
CBP 400, 8 ports



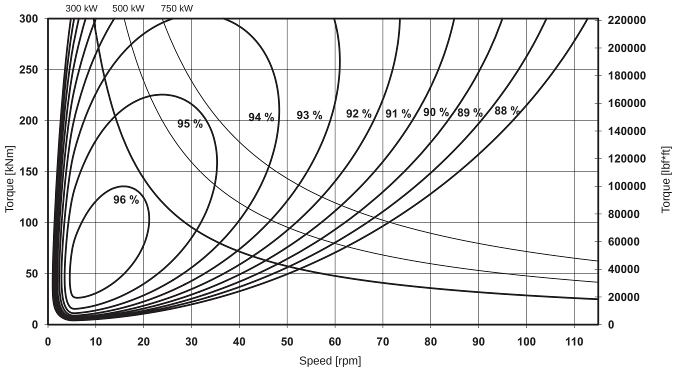
CBP 560, 4 ports



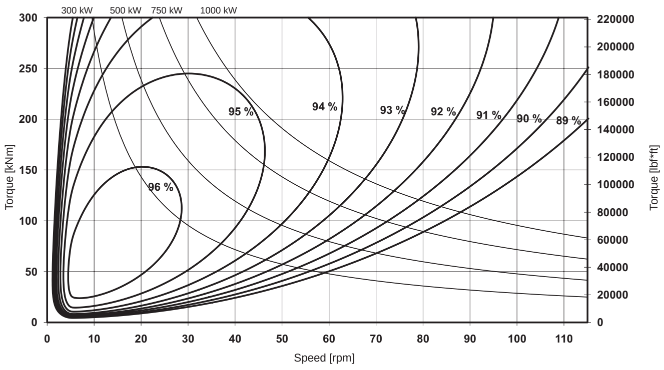
CBP 560, 8 ports



CB 840, 4 ports



CBP 840, 8 ports



For more information about flushing of motor case please see Engineering manual ACBP-4.5.

Flushing of motor case

The Compact CBP motors have very high total efficiency and are now frequently used in applications with high power. To avoid high temperature in the motor case, the losses generated in the motors must be cooled away, because high temperature gives lower viscosity and this gives reduction in rating life and maximum allowed power for the motor.

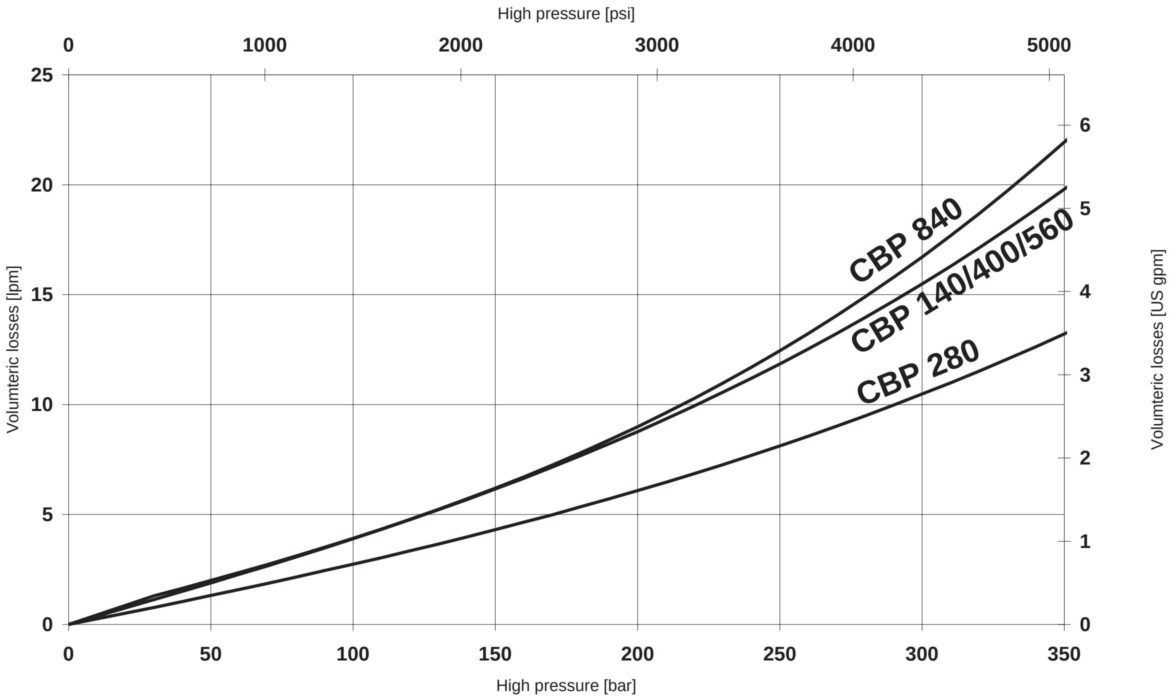
For continuous duty the motor case must be flushed when the power exceed the following maximum power:

Max power without flushing

CBP 140/280	120 kW	(160 hp)
CBP 400/560/840	170 kW	(227 hp)

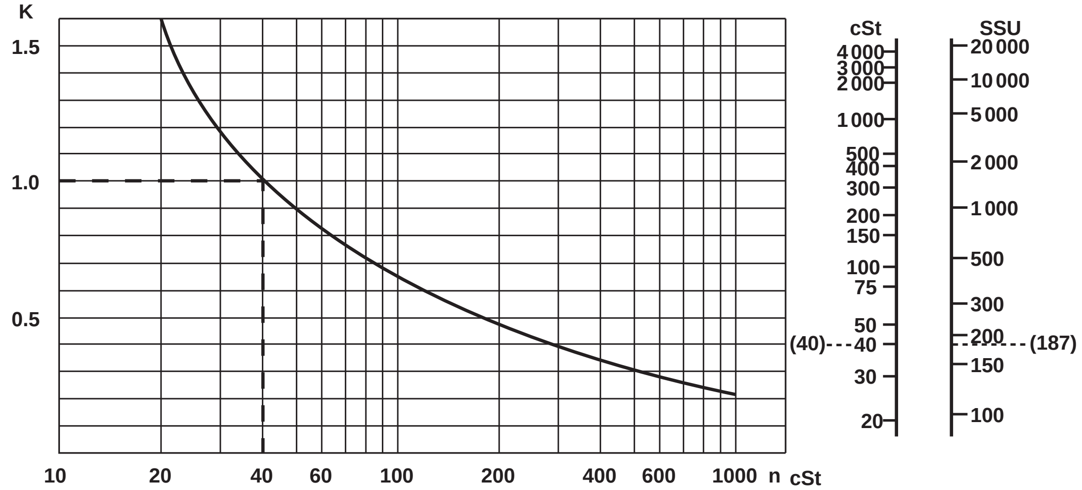
Volumetric losses - Compact CBP motors

Valid for an oil viscosity of 40 cSt/187 SSU.



Variation in volumetric loss at different oil viscosities for Compact motors

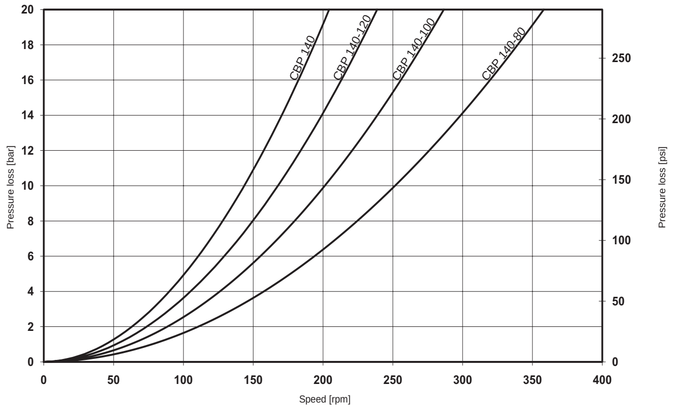
When calculating volumetric losses using other viscosities than 40 cSt/187 SSU, multiply the value given in the volumetric loss diagram by the factor K.



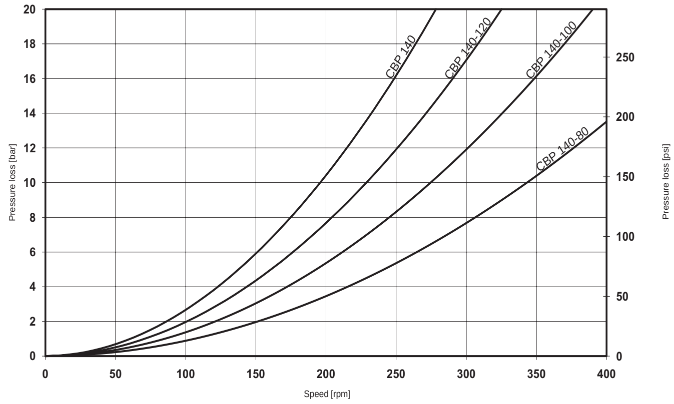
Diagrams for Compact CBP

Pressure loss, oil viscosity 40 cSt/187 SSU

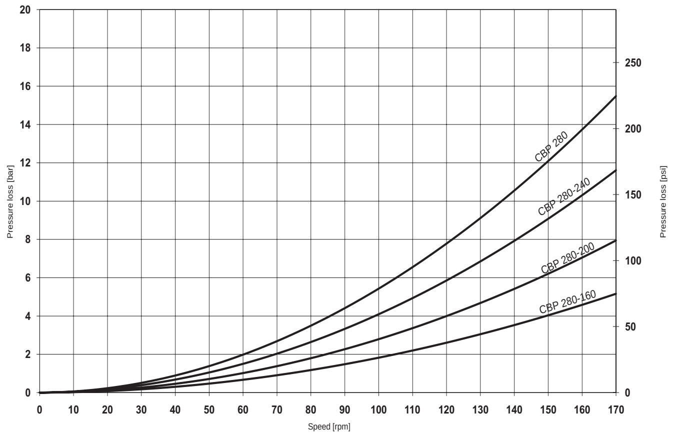
CBP 140 pressure loss 4 ports



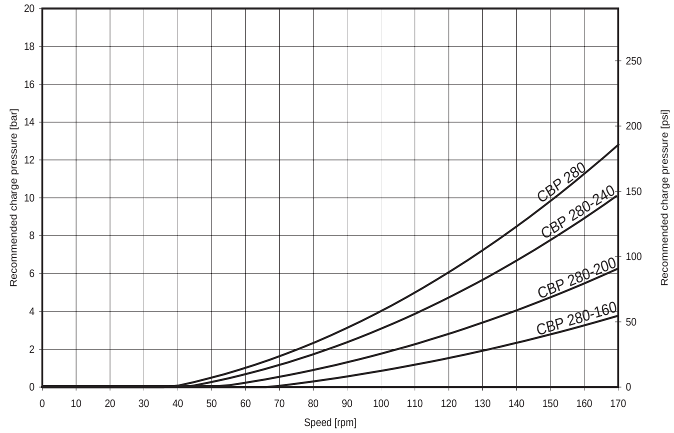
CBP 140 pressure loss 8 ports



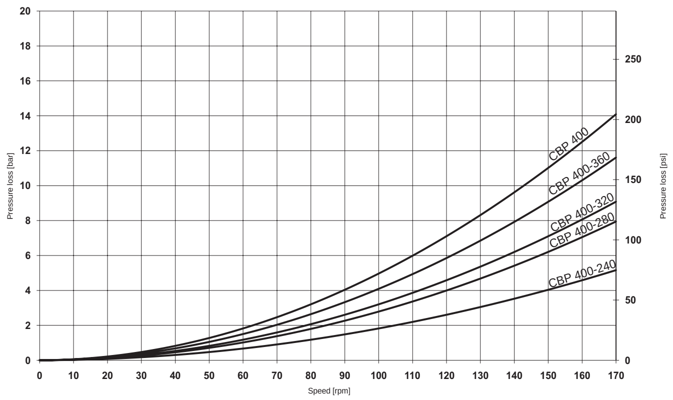
CBP 280 pressure loss 4 ports



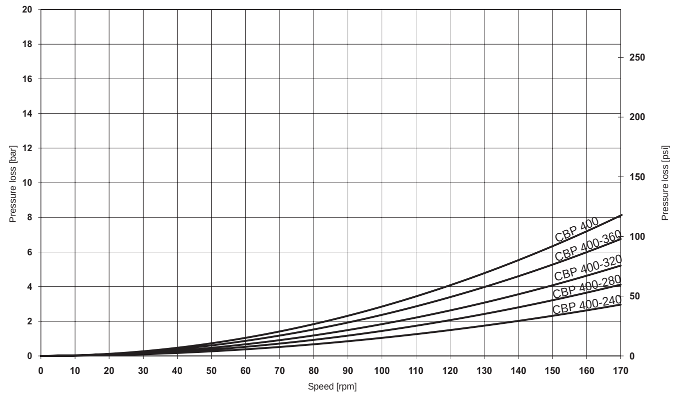
CBP 280 pressure loss 8 ports



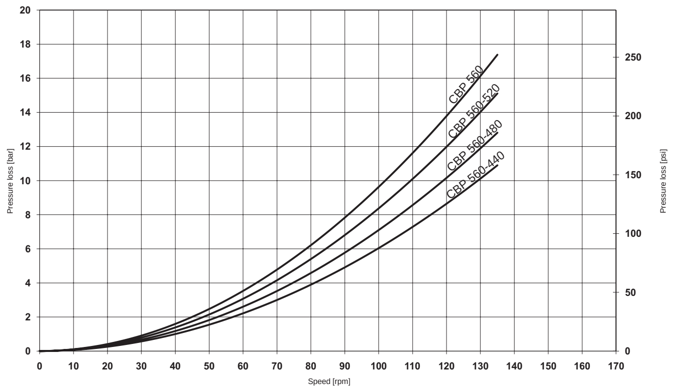
CBP 400 pressure loss 4 ports



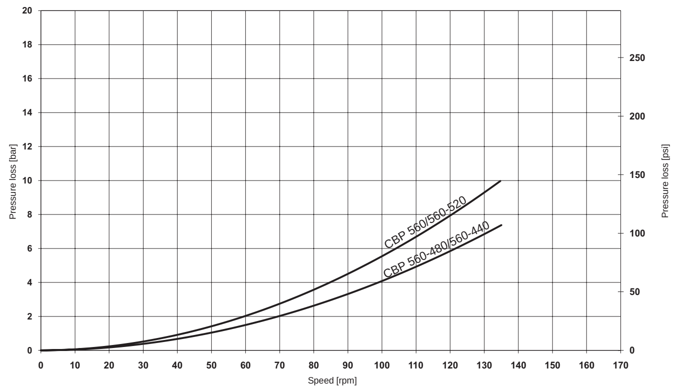
CBP 400 pressure loss 8 ports



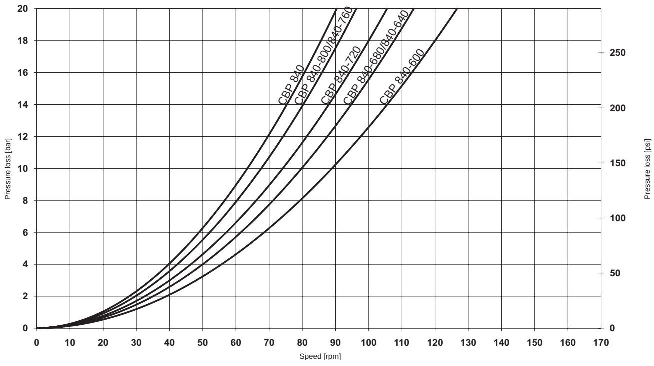
CBP 560 pressure loss 4 ports



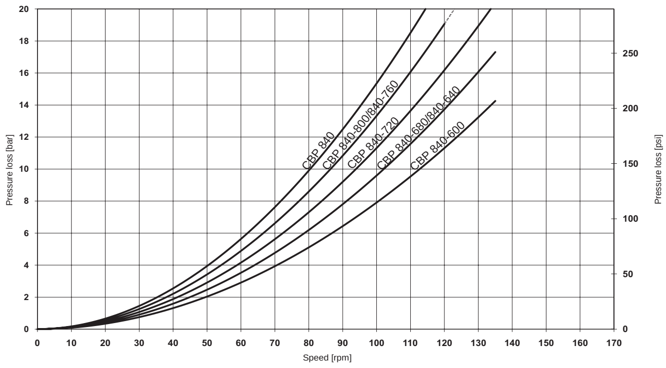
CBP 560 pressure loss 8 ports



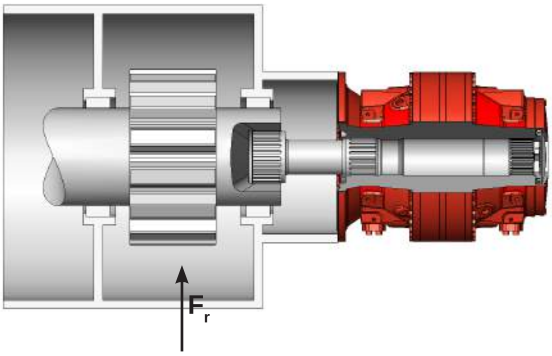
CBP 840 pressure loss 4 ports



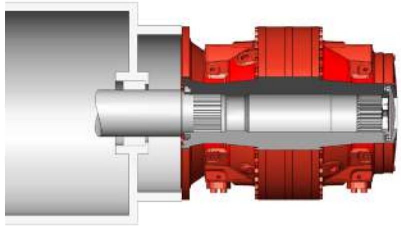
CBP 840 pressure loss 8 ports



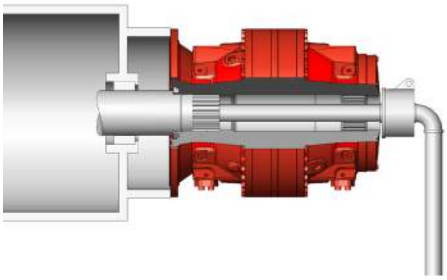
Versatile mounting - examples of installations



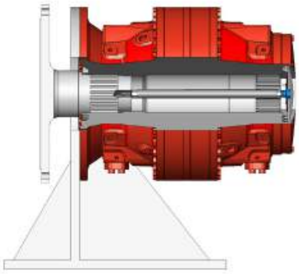
Flange mounted motor with splines and high radial load F_r on driven shaft.



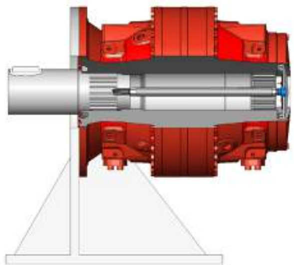
Flange mounted motor with splines and low radial load from driven shaft.



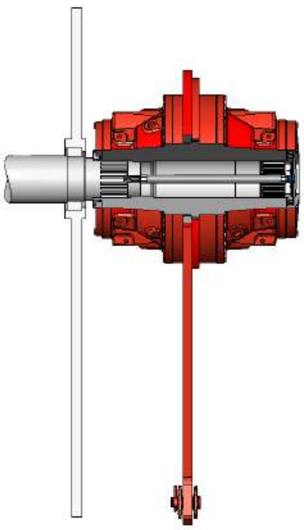
Flange mounted motor with spline and through hole for cooling of driven machine.



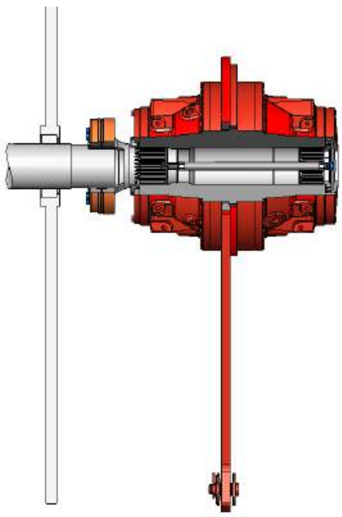
Bracket mounted motor with flange adapter.



Bracket mounted motor with stub shaft.



Torque arm mounted motor with splines.



Torque arm mounted motor with shaft coupling.

Choice of hydraulic fluid

The Hägglunds hydraulic motors are primarily designed to operate on conventional petroleum based hydraulic oils. The hydraulic oil can be chosen in consultation with the oil supplier or your local sales office, bearing the following requirements in mind:

General

The oil shall have FZG (90) fail stage minimum 11 described in IP 334 (DIN 51354). The oil must also contain inhibitors to prevent oxidation, corrosion and foaming. The viscosity of mineral oil is highly dependent of the temperature. The final choice of oil must depend on the operating temperature that can be expected or that has been established in the system and not in the hydraulic tank. High temperatures in the system greatly reduce the service life of oil and rubber seals, as well as resulting in low viscosity, which in turn provides poor lubrication. Content of water shall be less than 0.1%. In industrial applications with high demands for service life, the content of water shall be less than 0.05%.

Minimum viscosity limits at operating temperature in motor case	
CBP 140 motors type C (coated pistons and coated cam rollers)	10 cSt/ 59 SSU*
CBP 280-840 motors type C (coated pistons and coated cam rollers) up to 80 rpm	10 cSt/ 59 SSU*
CBP 280-840 motors type C (coated pistons and coated cam rollers) up to 170 rpm	30 cSt/ 142 SSU*

Temperature limits	
Normal operating temperature should be less than +50 °C (122 °F). When operating with synthetic fluids, temperature should be less than +65 °C (150 °F).	
Viton seals	-20 °C to +100 °C
Viton seals	-4 °F to +212 °F

*Low viscosity gives reduced service life for the motors.
Max permitted viscosity is 10000 cSt/48000 SSU
Viscosity index = 100 is recommended. Viscosity index = 150 can be used for operation with large temperature difference, however many hydraulic fluids with VI-improvers are subject to temporary and permanent reductions of the viscosity. Hägglunds recommendation is always to use the base oil viscosity when calculating the rated life and max allowed power. For heavy-duty applications we recommend synthetic oils.

RECOMMENDED VISCOSITY IN MOTOR CASE AT OPERATING TEMPERATURE 40-150 cSt/187-720 SSU.

Fire resistant fluid

The following fluids are tested for Hägglunds motors (ISO/DP 6071).

Fluid	Approved	Internal paint
HFA: Oil (3-5%) in water emulsion	No	-
HFB: Inverted emulsion 40-45% water in oil	Yes	Not painted*
HFC: Water-glycol	Yes	Not painted*
HFD synthetic fluids		
HFD:R - Phosphate esters	Yes	Not painted*
HFD:S - Chlorinated hydrocarbons	Yes	Not painted*
HFD:T - Mixture of the above	Yes	Not painted*
HFD:U - Other compositions	Yes	Not painted*

* Must be specified in the order.

Choice of hydraulic fluid

Down rating of pressure data and basic rating life

Down rating of pressure, for motors used in systems with fire resistant fluids, the maximum pressure for motor given on data sheet must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.7 x maximum pressure for motor
HFC-fluid	0.7 x maximum pressure for motor
HFD-fluid	0.9 x maximum pressure for motor

Down rating of basic rating life, for motors used in systems with fire resistant fluids, the "expected basic rated life" must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.26 x expected life with mineral oil
HFC-fluid	0.24 x expected life with mineral oil
HFD-fluid	0.80 x expected life with mineral oil

Filtration

The oil in a hydraulic system must always be filtered and also new oil from your supplier has to be filtered when adding it to the system. The grade of filtration in a hydraulic system is a question of service life v.s. money spent on filtration.

In order to obtain stated service life it is important to follow our recommendations concerning contamination level.

When choosing the filter it is important to consider the amount of dirt particles that the filter can absorb and still operate satisfactory. For that reason we recommend a filter with an indicator that gives a signal when it is time to change the filter cartridge.

Filtering recommendations

Before start-up, check that the system is thoroughly cleaned.

1. For industrial applications the contamination level should not exceed ISO 4406:1999 18/16/13 (NAS 1638, class 7).
2. When filling the tank and motor case, we recommend the use of a filter with the grade of filtration $\beta 10=75$.

Explanation of "Grade of Filtration"

Grade of filtration β**10=75** indicates the following:
β**10** means the size of particle ≥10 μm that will be removed by filtration.
=75 means the grade of filtration of above mentioned size of particle. The grade of filtration is defined as number of particles in the oil before filtration in relation to number of particles in the oil after filtration.

Ex. Grade of filtration is β**10=75**.

Before the filtration the oil contains *N* number of particles ≥10 μm and after passing the filter once the oil contains $\frac{N}{75}$ number of particles ≥10 μm.

This means that $N - \frac{N}{75} = \frac{74 \cdot N}{75}$ number of particles have been filtered (=98.6%).

Environmentally acceptable fluids

Fluid	Approved	Internal paint
Vegetable */** Fluid HTG	Yes	-
Synthetic ** Esters HE	Yes	-

* Vegetable fluids give good lubrication and small change of viscosity with different temperature. Vegetable fluids must be controlled every 3 months and temperature shall be less than +45 °C (113 °F) to give good service life for the fluid.

** Environmentally acceptable fluid give the same service life for the drive, as mineral oil.

Declaration of Conformity

Example of the Declaration of Conformity given by Hägglunds Drives AB

HÄGGLUNDS

Declaration of Incorporation of partly completed machinery
As defined by the EC Machinery Directive 2006/42/EC, Appendix II B

The manufacturer

Hägglunds Drives AB

hereby declares that the partly completed machinery

Name: Compact CBP
Function: Hydraulic motor
Model: Compact
Type: CBP
Trade name: Compact CBP

satisfies the following essential requirements of Machinery Directive 2006/42/EC in accordance with the chapter numbers in Appendix I:

General principle no. 1.									
1.1.3	1.1.5	1.2.1	1.3.1	1.3.2	1.3.3	1.3.4	1.3.6	1.3.7	1.5.3
1.5.4	1.5.5	1.5.6	1.5.8	1.5.13	1.6.1	1.6.3	1.7.2	1.7.3	1.7.4

The requirements are fulfilled provided that the data in the product documentation (fitting instructions, operating instructions, project management and configuration documents) are implemented by the product user. The requirements of Appendix I to Machinery Directive 2006/42/EC not mentioned here are not applied and have no relevance for the product.

It is also declared that the special technical documents for this partly completed machinery have been compiled in accordance with Appendix VII, Part B. These are transferred on request to the market surveillance body in paper-based/electronic format.

Conformity with the provisions of further EU Directives, Standards or Specifications:

SS-EN 982
SS-EN ISO 12100-1
SS-EN ISO 12100-2

The partly completed machinery may only be put into operation when it has been established that the machine into which the partly completed machinery is to be incorporated conforms to the provisions of EC Machinery Directive 2006/42/EC, where relevant according to this directive.

The individual below is authorized to compile the relevant technical files:

Name: Björn Leidelöf
Address: Hägglunds Drives AB, S-890 42 Mellansel

Björn Leidelöf   Mellansel, 2009-12-29

We reserve the right to make changes to the content of the Declaration of Incorporation. Current issue on request.

The Declaration of Conformity above, is available on request for deliveries from Hägglunds Drives AB. Translations into other languages are also available.

www.hagglunds.com

Hägglunds Drives AB
SE-890 42 Mellansel, Sweden
Tel: + 46 (0)660 870 00.
E-mail: info@se.hagglunds.com
www.hagglunds.com

Our drive is your performance.

EN 834-4h. Repro: Öviks Repro. Printer: Ågrens Tryckeri 2011.

Product Manual

VIKING

EN397-4a 2009

One partner all over the world

Hägglunds Drives

is one of the worlds leading manufacturer of heavy duty hydraulic drive systems. If what you need is low speed and high torque, then Hägglunds Drives should be your partner. If what you need is a durable drive system that will work under the toughest conditions with a minimum of maintenance, then Hägglunds Drives should be your partner. We develop, manufacture & market complete drive-systems and components of the highest quality, based upon our unique radial piston motors. Our industrial and marine customers are to be found all over the world. They know that when they need solutions, support or service, they have in us a partner they can trust. Hägglunds Drives main office and manufacturing plant is situated in Mellansel, Sweden. In Addition Hägglunds Drives is represented in 40 countries worldwide.

Original EN397-3, 1999

The content in this manual is subject to change without notice or obligation, unless certified referring to a certain purchase order. Information contained herein should be confirmed before placing orders.

Features

High torques
The Viking motor is a high-torque low speed motor, which can be mounted directly on a winch drum or to a shaft without intermediate gears. This presents many practical benefits which appeal to the users of the equipment.

Variable speed control
The Viking can drive and brake in both directions with variable speed by smoothly controlling the flow of oil in the circuit.

Severe environments
The Viking motor is designed to be highly resistant to severe working conditions and environments. The Viking has proven itself on board ships, in underwater applications, in explosive and chemically corrosive industrial environments, in extreme heat and freezing cold.

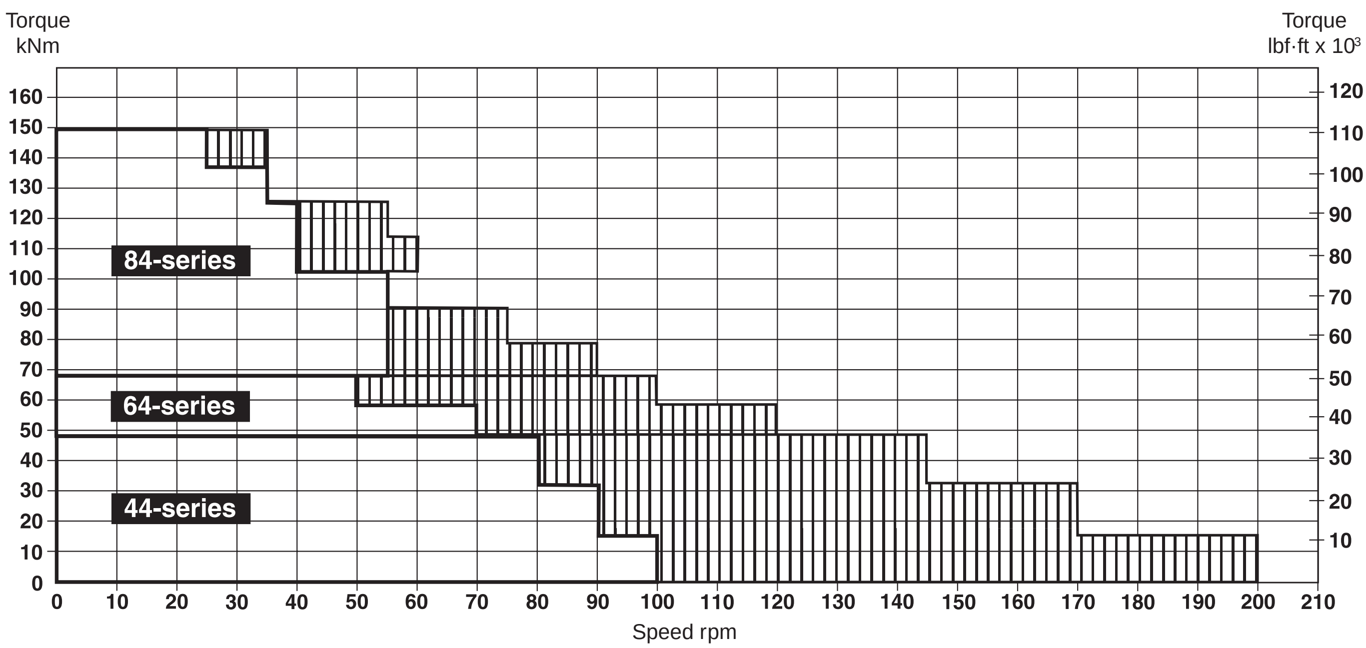
High efficiency
The mechanical efficiency as well as the starting efficiency is 97%. Because of the extremely low moment of inertia the motor is virtually insensitive to shock loads, and protects the driven equipment.
Viking is still the best tension control motor available.

Low speeds
Smooth, low speed performance from zero to rated speed without the need of reduction gears and no compromise on output torque.

Safety
For cranes and hoists Viking motors and brake assemblies are DNV approved. You don`t need to take risks.

Quick selection diagram for Viking motors

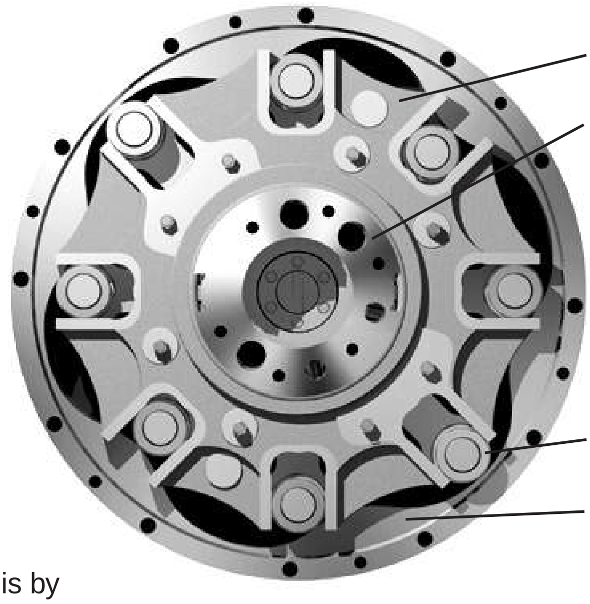
The diagram below represents the torque and speed, for winch applications.
Oil viscosity in the motor case 40 cSt (187 SSU).



For continuous duty and/or operation in line screened area, please contact your Hägglunds Drives representative for final selection.

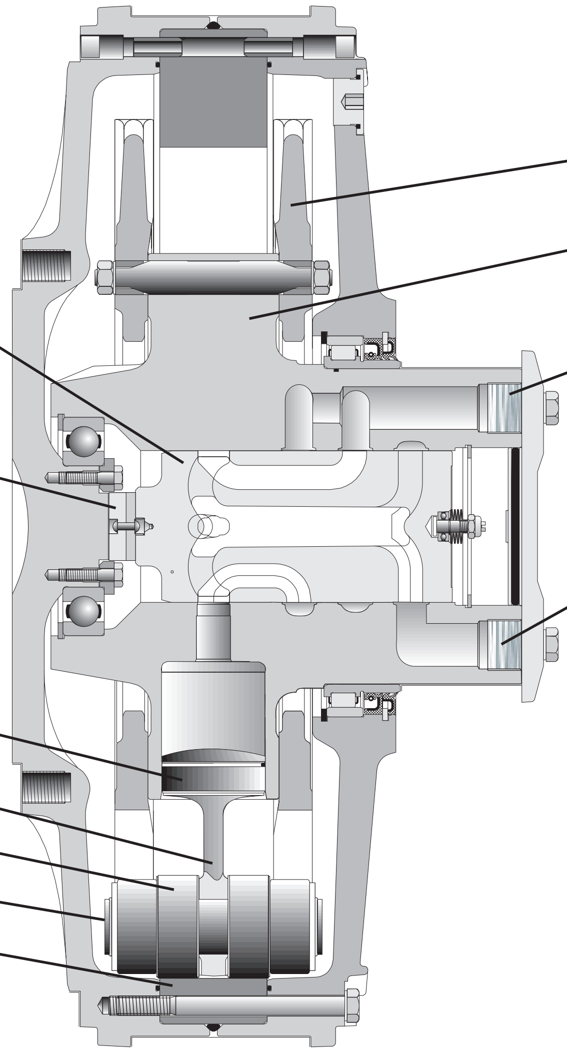
Functional description

The Viking motors are radial piston type with rotating case. The case is supported on the stationary cylinder block (5) by two main bearings. An even number of radially positioned pistons (3) work in cylinder bores in the cylinder block, which also houses the inlet and outlet ports (A and C). Each piston is coupled by a piston rod (2) to a cross head pin (6) upon which four cam rollers (7) are mounted. The two inner cam rollers press against the cam ring (8) while the two outer rollers work within their respective guide plates (1). The cam ring is anchored to the rotating case. The distributor (4) directs the input oil to the pistons during their work strokes and returns the exhausted oil back to the tank. The distributor is coupled to the rotating case via a safety coupling (9). The motor can be connected to a driven machine via two mounting surfaces on the rear end of the motor. The symmetrical design of the motor has made it possible to construct it as a 2-speed motor. This means that two different speeds are obtained for a given flow.



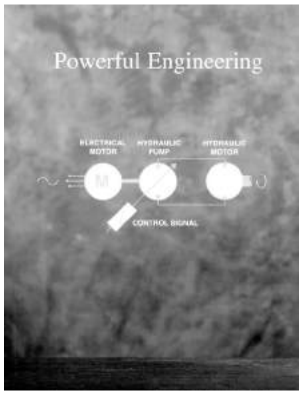
The simplest way of performing displacement change over is by connecting a special valve, known as a 2-speed valve, direct to the connecting flange on the cylinder block. The motor is designed so that pressure pulsations in the motor case are avoided. This has the advantage that impurities are not sucked into the case.

Fig. 1 **Viking motor**



Calculation fundamentals

Output power	$P = \frac{T \cdot n}{9549}$ (kW) on driven shaft	$P = \frac{T \cdot n}{5252}$ (hp) on driven shaft
Output torque* ($\eta_m = 98\%$)	$T = T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m$ (Nm)	$T = \frac{T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m}{1000}$ (lbf·ft)
Pressure required ($\eta_m = 98\%$)	$p = \frac{T}{T_s \cdot \eta_m} + \Delta p_l + p_c$ (bar)	$p = \frac{T \cdot 1000}{T_s \cdot \eta_m} + \Delta p_l + p_c$ (psi)
Flow rate required	$q = \frac{n \cdot V_i}{1000} + q_l$ (l/min)	$q = \frac{n \cdot V_i}{231} + q_l$ (gpm)
Output speed	$n = \frac{q - q_l}{V_i} \cdot 1000$ (rpm)	$n = \frac{q - q_l}{V_i} \cdot 231$ (rpm)
Inlet power	$P_{in} = \frac{q \cdot (p - p_c)}{600}$ (kW)	$P_{in} = \frac{q \cdot (p - p_c)}{1714}$ (hp)



For more information
See Powerful Engineering (EN347-4).

Quantity	Symbol		Metric	US
Power	P	=	kW	hp
Output torque	T	=	Nm	lbf·ft
Specific torque	T_s	=	Nm/bar	lbf·ft/1000 psi
Rotational speed	n	=	rpm	rpm
Required pressure	p	=	bar	psi

Quantity	Symbol		Metric	US
Pressure loss	Δp_l	=	bar	psi
Charge pressure	p_c	=	bar	psi
Flow rate required	q	=	l/min	gpm
Total volumetric loss	q_l	=	l/min	gpm
Displacement	V_i	=	cm^3/rev	in^3/rev
Mechanical efficiency	η_m	=	0,97	

Definitions

Rated speed[1)]

Rated speed is the highest allowed speed for a charge pressure of 12 bar (175 psi) above case pressure. When a closed loop system is used, a minimum of 15% of oil is to be exchanged in the main loop.

1) Operating above rated conditions requires engineering approval.

Max speed

Maximum speed is the maximum allowed speed. Special considerations are necessary regarding charge pressure, cooling and choice of hydraulic system for speeds rated above.

Accepted conditions for standard type of motor:

1. Oil viscosity 20 - **40** - 10000 cSt (98 - **187** - 4650 SSU). See page 23.
2. Temperature -35°C to +70°C (-31°F to +158°F).
3. Case pressure 0-3 bar (0-45 psi) Pressure peaks and at standstill 8 bar (116 psi)
4. Charge pressure (see diagram).
5. Volumetric losses (see diagram).

Data

Motor type	FULL DISPACEMENT				Max.*** pressure	DISPACEMENT SHIFT				Ratio
	Displace-ment	Specific torque**	Rated speed*	Max. Speed		Displace-ment	Specific torque**	Rated speed*	Max. speed	
	V_i	T_s	n	n	p	V_i	T_s	n	n	
44-03300	3325	53	100	200	320	1662	26	100	200	1:2
44-04700	4710	75	100	200	320	2356	37	100	200	1:2
44-06800	6790	108	90	170	320	3393	54	90	170	1:2
44-09200	9240	147	80	145	320	4618	74	80	145	1:2
64-11100	11080	176	70	120	320	5542	88	70	120	1:2
64-13500	13599	215	60	110	250	6750	107	60	110	1:2
64-16300	16340	260	50	100	250	8171	130	50	100	1:2
84-14800	14840	236	55	90	320	-	-	-	-	-
84-17900	17961	286	55	85	320	-	-	-	-	-
84-21300	21375	340	55	80	320	-	-	-	-	-
84-25100	25090	399	55	75	320	-	-	-	-	-
84-38000	38000	605	40	60	250	-	-	-	-	-
84-22300	22300	355	55	55	320	11150	177	60	85	1:2
84-33800	33780	538	35	35	250	16889	269	50	70	1:2
84-25100	25090	399	40	55	250	8362	133	45	75	1:3
84-38000	38000	605	25	35	250	12667	202	35	60	1:3
84-25100	25090	399	40	55	250	16724	266	45	75	2:3
84-38000	38000	605	25	35	250	25334	403	35	60	2:3

Motor type	FULL DISPLACEMENT				Max.*** pressure	DISPLACEMENT SHIFT				Ratio
	Displace-ment	Specific torque**	Rated speed*	Max. speed		Displace-ment	Specific torque**	Rated speed*	Max. speed	
	V_i	T_s	n	n	p	V_i	T_s	n	n	
44-03300	203	2695	100	200	4650	101	1347	100	200	1:2
44-04700	287	3814	100	200	4650	144	1907	100	200	1:2
44-06800	414	5492	90	170	4650	207	2746	90	170	1:2
44-09200	564	7475	80	145	4650	282	3738	80	145	1:2
64-11100	676	8971	70	120	4650	338	4485	70	120	1:2
64-13500	823	10935	60	110	3600	411	5467	60	110	1:2
64-16300	997	13227	50	100	3600	499	6613	50	100	1:2
84-14800	906	12017	55	90	4650	-	-	-	-	-
84-17900	1096	14546	55	85	4650	-	-	-	-	-
84-21300	1304	17292	55	80	4650	-	-	-	-	-
84-25100	1531	20306	55	75	4650	-	-	-	-	-
84-38000	2320	30756	40	60	3600	-	-	-	-	-
84-22300	1361	18048	55	55	4650	680	9024	60	85	1:2
84-33800	2064	27339	35	35	3600	1031	13669	50	70	1:2
84-25100	1531	20306	40	55	3600	510	6769	45	75	1:3
84-38000	2319	30756	25	35	3600	773	10252	35	60	1:3
84-25100	1531	20306	40	55	3600	1021	13537	45	75	2:3
84-38000	2319	30756	25	35	3600	1546	20504	35	60	2:3

* Related to a required charge pressure of 12 bar (175 psi) for motors in braking mode. Special considerations regarding charge pressure, cooling and choice of hydraulic system for speeds above rated.
** Theoretical value
*** The motors are designed according to DNV-rules. Test pressure 70 bar/1000 psi. Peak/transient pressure 70 bar/1000 psi maximum, allowed to occur 10000 times.

Ordering codes

In order to identify Hägglunds Drives equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Viking motors

Example: M K 6 4 1 6 3 0 0 A 0 R N 0 1 0 0

Mounting alternative
(rotating part)
Metric M
UNC U

Mounting alternative
(stationary part)
Key (44/64-series) K
Bolt (84-series) B

Motor
44-series 44
64-series 64
84-series 84

Displacement cm^3

Distributor
Normal A
Severe temp-shocks B
Extremly low speed D

Internal displacement shift valve
No valve 0
2-position valve 1
3-position valve 2
2-position valve (ratio 2:3) 3
3-position valve (ratio 2:3) 4

Direction of rotation
(viewed from oil connection end)
Clockwise R
Counter-clockwise L

Type of sealing
Nitrile N
Viton V

Modification 01-99
Standard design 00
Special design 01-99

611

Product group
Class of distributor

Motor 44-series 4
Motor 64-series 6
Motor 84-series 8

Individual serial number

To be filled in by the manufacturer

Torque arm

TAC - 1 0 0 0 - K - 0 - 0 0 0

Example: TAC - □□□□ - □ - □ - □□□

Torque arm

Effective length in mm
44/64-series 1000
84-series 1250

Mounting alternative
Key (44/64-series) K
Bolt (84-series) B

Attachment
None 0
Stiff 1
Pivoted 2

Modification 0-9
Standard design* 00
Special design 01-99

Batch number: ....

*Bolts and washers are included at delivery

To be filled in by the Hägglunds

Band brake

BA - 4 3 - S D - R - 0 0 0

Example: BA - □□ - □D - □ - □□□

Brake assembly

For motors
44-series 43
64-series 63
84-series 85

Standard S
Marine M
(eccentric shaft in acidproof steel)

Double brake band

Braking force direction
(viewed from the brake cylinder side)
Clockwise R
Counter-clockwise L
Double acting D

Modification 0-9
Standard design 00
Special design 01-99

Week number: ....

To be filled in by Hägglunds

Brake cylinder

BCI - M - 1 1 - 0 0 0

Example: BCI - M - □□ - □□□

Brake cylinder

Marine

Low pressure operation 1
4-8 bar (58-116 psi)
High pressure operation 3
16-26 bar (232-377 psi)

Without flushing 0
With flushing - restrictor ∅ 1mm 1
(low pressure cylinder only)

Modification 0-9
Standard design 00
Special design 01-99

641 - □□□□

Product group
Individual serial number

To be filled in by the Hägglunds

Brake bracket

BB - 4 6 - K - S 0 - 0 0 0

Example: BB - □□ - □ - □□ - □□□

Brake bracket

For motors
44/64-series 46
84-series 85

Mounting alternative
Key (44/64-series) K
Bolt (84-series) B

Single acting SO
Double acting DO
Single & double acting (84-series) SD

Modification 0-9
Standard design 00
Special design 01-99

Batch number: ....

To be filled in by the Hägglunds

Ordering codes

In order to identify Hägglunds Drives equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Valve V46-C

Example: **V46 - C - 1 - 1 - 0 0 - 3 0 0 - 0 0 0**

V46 - C - □ - 1 - □□ - □□□ - □□□

Valve

For motors
44/64-series

Closed system

Control block 1
Cover 2

Unloading spool

Charge pressure relief valve
Plugged 00
12 bar (174 psi) 12

Relief valve
Max working pressure on motor (bar) 300
350

Modification 0-9
Standard design 00
Special design 01-99

To be filled in by the Hägglunds

Valve V46-O

Example: **V46 - O - 1 - 1 - 0 0 - 3 0 0 - 0 0 0**

V46 - O - □ - 1 - □□ - □□□ - □□□

Valve

For motors
44/64-series

Open system

Control block 1
Cover 2

Balance spool

Motor case circulation
Plugged 00
Standard 02

Relief valve
Max working pressure on motor (bar) 280
350

Modification 0-9
Standard design 00
Special design 01-99

To be filled in by the Hägglunds

Rear bracket

Example: **RBC - 4 6 - 0 0 0**
RBC - □□ - □□□

Rear bracket

For motors
44/64-series 46
84-series 84

Modification 0-9
Standard design 00
Special design 01-99

Batch number: ....

To be filled in by the Hägglunds

Speed encoder

Example: **SPLL 85 A - 2 5 0**
SPLL 85 A - □ □ □

Speed encoder

Analogue

Full scale output (rpm)
02
03
04
06
08
10
15
20
25
30
35
40
60
100
150
200
250
300

Flange adapter

Example: **FA - 46 - M K - 0 0 0**
FA - 46 - □ K - □□□

Flange adapter

For motors
44/64-series

Metric M
UNC U

Key

Modification 0-9
Standard design 00
Special design 01-99

Batch number: ....

To be filled in by the Hägglunds

Mounting set for Speed encoder

Example: **SM - 4 4 - 0 0 0**
SM - □□ - □□□

Mounting set for Speed encoder
(incl. Cover and screws)

For motors
44-series 44
64-series 64
84-series 84

Modification 0-9
Standard design 00
Special design 01-99

To be filled in by the Hägglunds

Feature	Advantage	Benefits
Radial piston	Small axial length	Compact - low weight
Multiple stroke design	Large displacement - direct drive Constant displacement High torque/inertia-ratio	Low speed - low noise level Full torque in all positions Quick reversing capacity
Even number of pistons	Main bearings unloaded	High external load capacity
Guide plate design	Transverse piston force avoided High mechanical efficiency	Reduced piston/cylinder wear Full starting torque Superior low speed performance
Cam & guide plate roller bearings	Stick-slip eliminated High mechanical efficiency	Superior low speed performance Full starting torque
Rotating case	Non-rotating pistons Brake surface machined Machined spigots	Free wheeling capability Bandbrake available Direct mounting to winch drum

Dimensions
44/64-series

Fig. 2

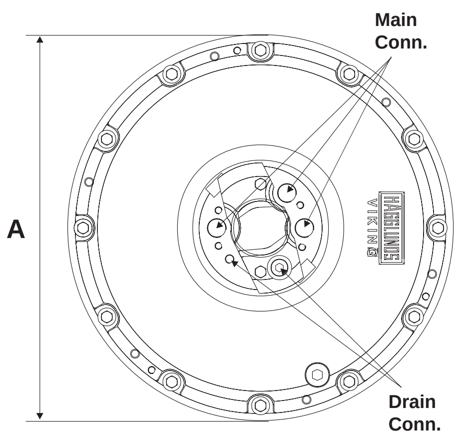


Fig. 3

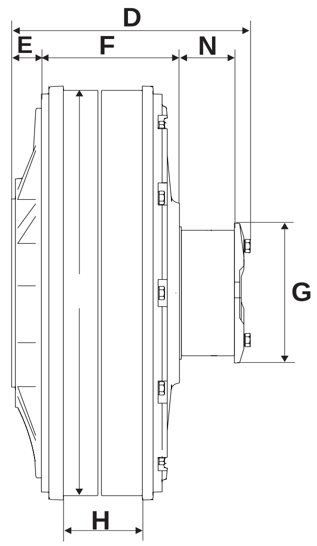
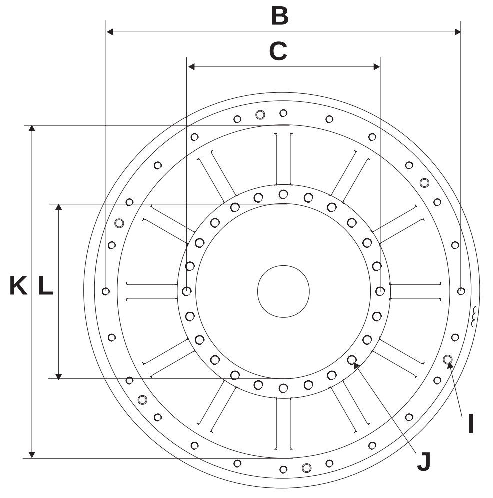


Fig. 4



84-series

Fig. 5

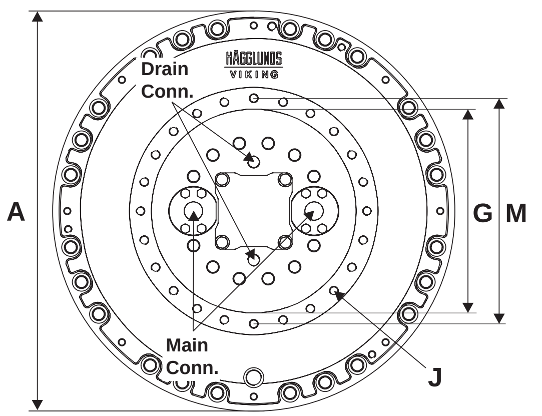


Fig. 6

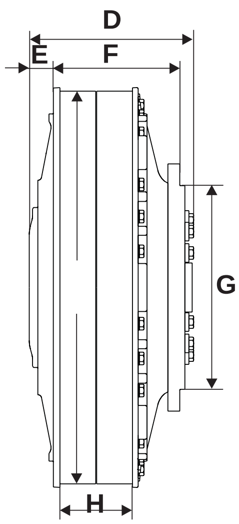


Fig. 7

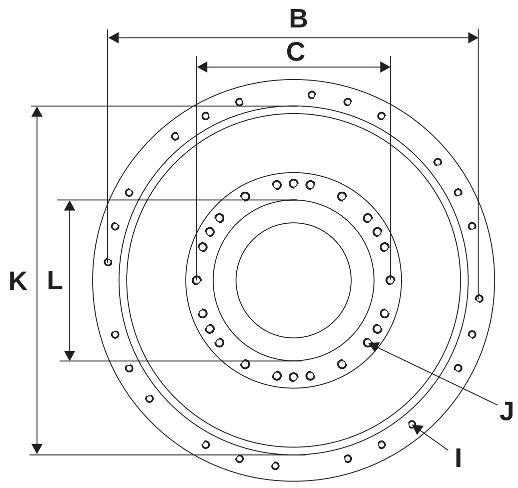


Table 1 **Dimensions for the motor**

Motor	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	F mm (in)	G mm (in)	H mm (in)	I holes	J holes	K mm (in)	L mm (in)	M mm (in)	N mm (in)	Weight kg (lb)	Main conn.	Drain conn.
44 -series	770 (30,31)	700 (27,56)	360 (14,17)	438 (17,24)	51 (2,00)	257 (10,12)	260 (10,24)	149 (5,87)	24x M16/ UNC 5/8"	24x M20/ UNC 3/4"	676 (26,61)	320 (12,59)	-	100 (3,93)	520 (1150)	BSP 1 1/4"	BSP 3/4"
64 -series	858 (33,78)	790 (31,10)	430 (16,93)	450 (17,72)	56 (2,19)	264 (10,39)					766 (30,16)	390 (15,35)			750 (1653)		
84 -series	1100 (43,31)	1020 (40,16)	530 (20,87)		66,5 (2,61)	346,5 (13,64)	560 (22,05)	198,5 (7,81)	24x M20	24x M24	955 (37,59)	440 (17,32)	620 (24,41)	-	1550 (3417)	BSP 2"	BSP 1"

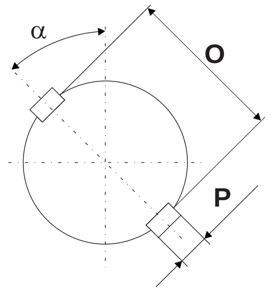
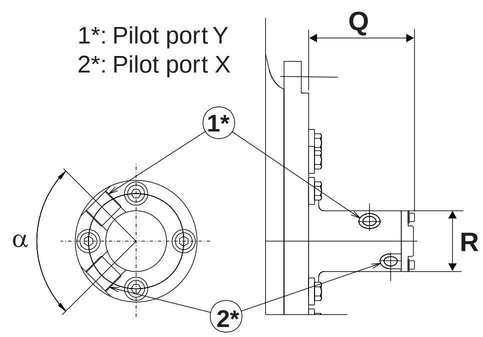


Table 1a **Key & 2-speed adapter dimensions**

Motor	O mm (in)	P mm (in)	Q mm (in)	R mm (in)	α
44/64 -series	274 (10,78)	50 (1,96)	-	-	45°
84 -series	-	-	200 (7,87)	115 (4,52)	90°



Dimensions
Torque arm

Fig. 10 **Torque arm TAC-1000-K**

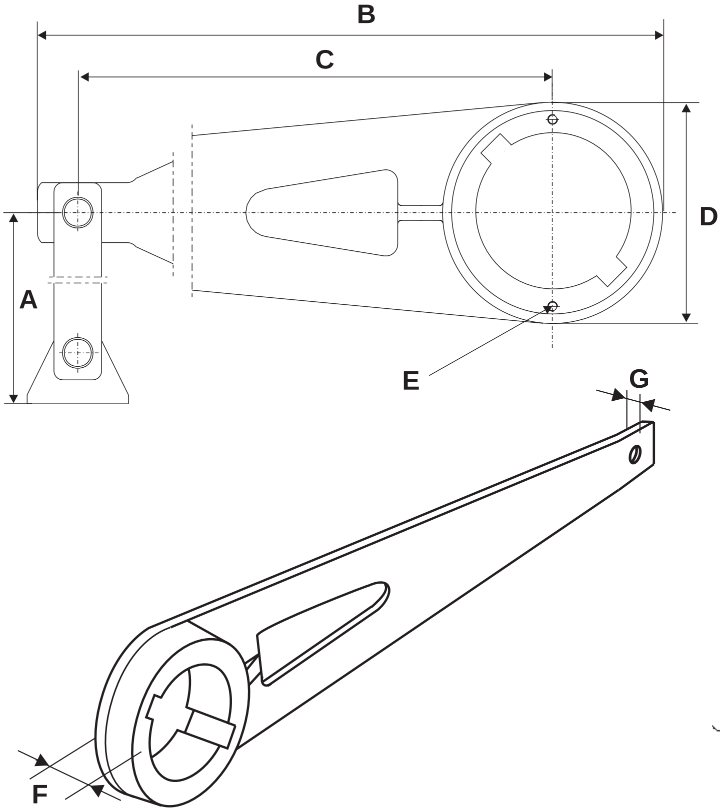
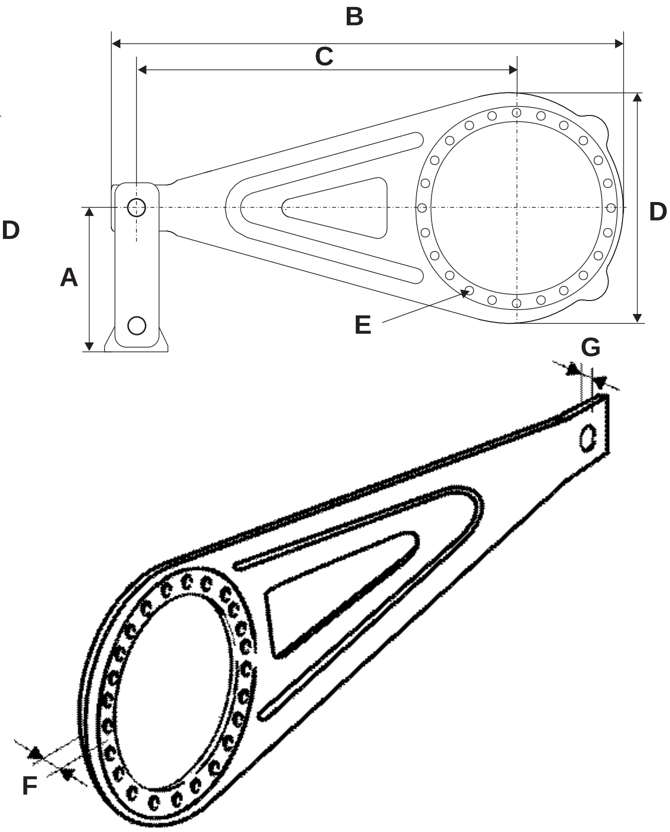
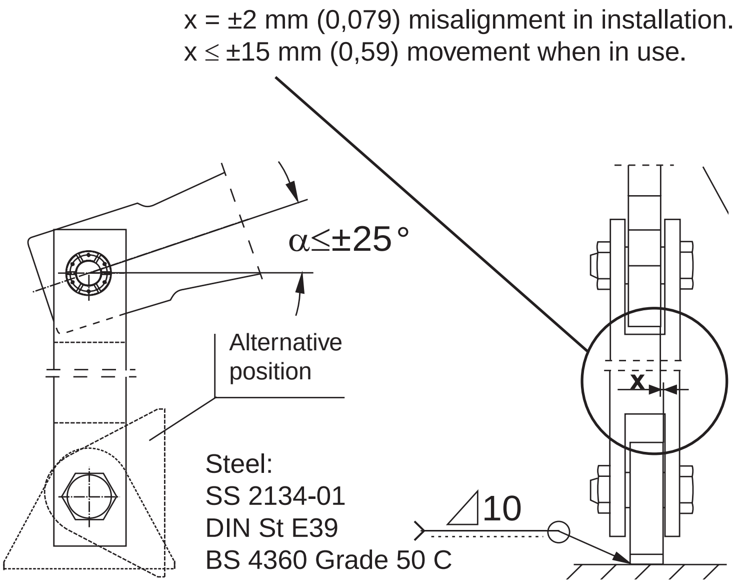


Fig. 9 **Torque arm TAC-1250-B**



Torque arm	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E holes	F mm (in)	G mm (in)	Weight kg (lb)
TAC-1000-K	435 (17,12)	1235 (48,62)	1000 (39,37)	370 (14,57)	2xM16	99 (3,90)	35 (1,38)	85 (187)
TAC-1250-B	545 (21,46)	1680 (66,14)	1250 (49,21)	750 (29,52)	24xM24	37 (1,45)	40 (1,57)	155 (342)

Fig. 11 **Mounting of pivoted attachment**

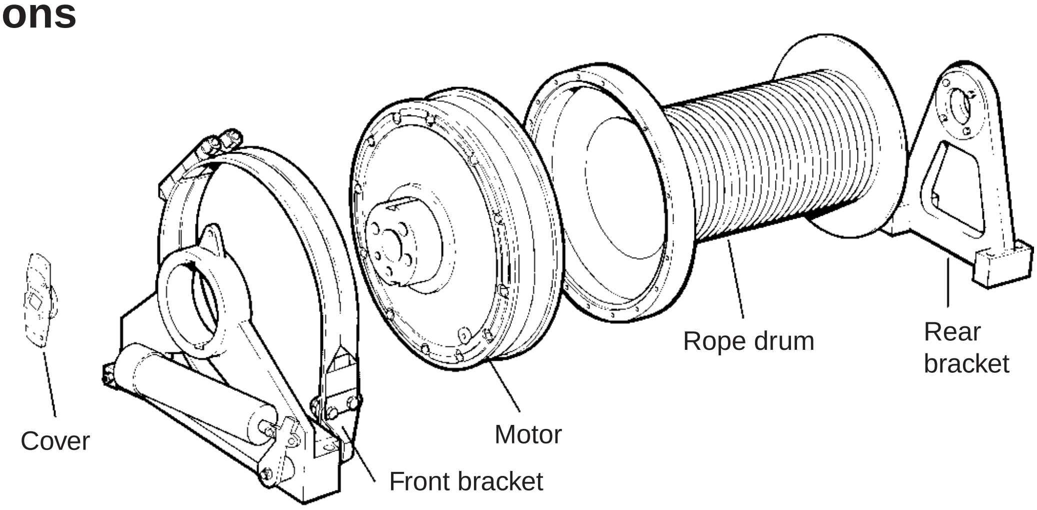


Note: Ideal angle α = 0°

Torque arm	**Max. torque (Nm) For alternating direction of torque**	**Max. torque (Nm) For pulsating torque**	**Max. torque (Nm) At static torque**
TAC-1000-K For 44-series	34000*	65000**	65000
TAC-1000-K For 64-series	34000*	65000**	65000
TAC-1250-B For84-series	152000	152000	182000
Torque arm	**Max. torque (lbf·ft) For alternating direction of torque**	**Max. torque (lbf·ft) For pulsating torque**	**Max. torque (lbf·ft) At static torque**
TAC-1000-K For 44-series	25000*	48000**	48000
TAC-1000-K For 64-series	25000*	48000**	48000
TAC-1250-B For84-series	112000	112000	134000

*Exceeding this value result in greater wear on keys and keyways.
** Do not exceed M_B for motor cover, see page 21.

Dimensions
Brackets



<table>
<tr><th>Bracket</th><th>For motor</th><th>A mm (in)</th><th>B mm (in)</th><th>C mm (in)</th><th>D mm (in)</th><th>E mm (in)</th><th>F mm (in)</th><th>G mm (in)</th><th>Attachment mm (in)</th><th>Weight kg (lbs)</th></tr>
<tr><td>BA-43
single acting</td><td>44-series</td><td rowspan="2">871
(34,29)</td><td rowspan="4">480
(18,90)</td><td>208
(8,19)</td><td rowspan="4">323
(12,72)</td><td rowspan="2">906
(35,67)</td><td rowspan="4">900
(35,43)</td><td>583
(22,95)</td><td rowspan="4">ø28 (1,102)
4 holes</td><td rowspan="4">220
(485)</td></tr>
<tr><td>BA-43
double acting</td><td>44-series</td><td>224
(8,82)</td><td>-</td></tr>
<tr><td>BA-63
single acting</td><td>64-series</td><td rowspan="2">915
(36,02)</td><td>208
(8,19)</td><td rowspan="2">950
(37,40)</td><td>583
(22,95)</td></tr>
<tr><td>BA-63
double acting</td><td>64-series</td><td>224
(8,82)</td><td>-</td></tr>
<tr><td>BA-85
single and
double acting</td><td>84-series</td><td>-</td><td>630
(24,80)</td><td>-</td><td>550
(21,65)</td><td>1188
(46,77)</td><td>1160
(45,67)</td><td>-</td><td>ø28 (1,102)
11 holes</td><td>670
(1480)</td></tr>
<tr><td>RBC-46
rear bracket</td><td>44/64-series</td><td>590
(23,23)</td><td>480
(18,89)</td><td>40
(1,57)</td><td>190
(7,48)</td><td>80
(3,15)</td><td>540
(21,26)</td><td>-</td><td>ø28 (1,102)
4 holes</td><td>60
(132)</td></tr>
<tr><td>RBC-84
rear bracket</td><td>84-series</td><td>750
(29,53)</td><td>630
(24,80)</td><td>50
(1,96)</td><td>230
(9,05)</td><td>100
(3,94)</td><td>710
(27,95)</td><td>-</td><td>ø35 (1,38)
4 holes</td><td>107
(236)</td></tr>
</table>

Fig. 12 **BA-43 and BA-63, single acting**

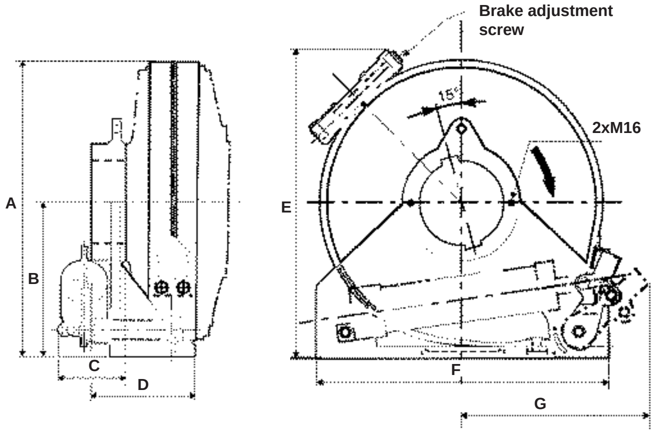


Fig. 13 **BA-43 and BA-63, double acting**

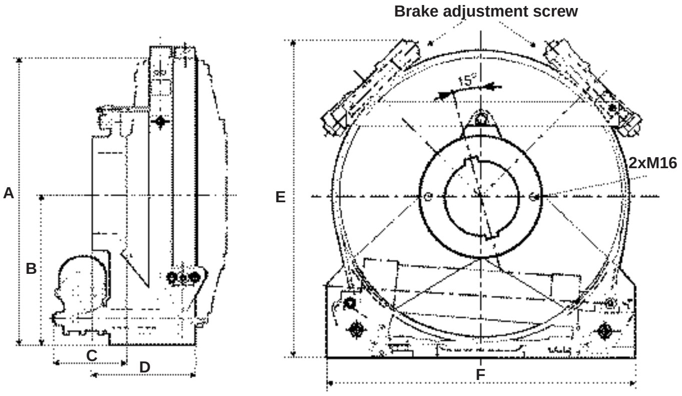


Fig. 14 **BA-85, single and double acting**

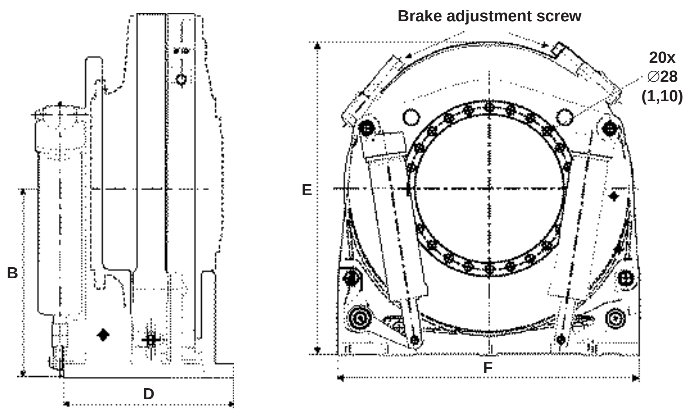
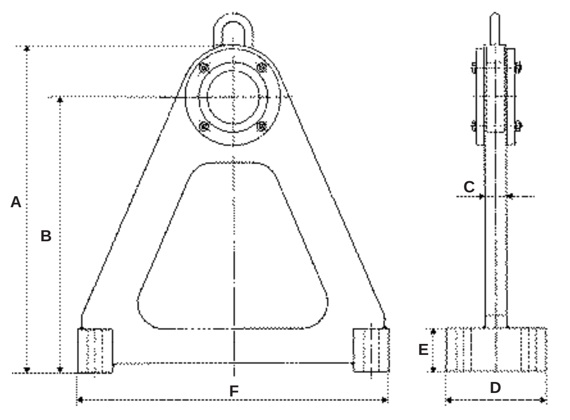


Fig. 15 **RBC-46/84 rear bracket**

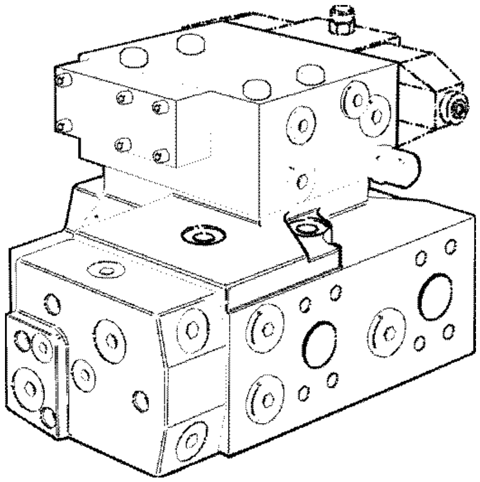


Accessories

Winch valve for open systems, type V46-O

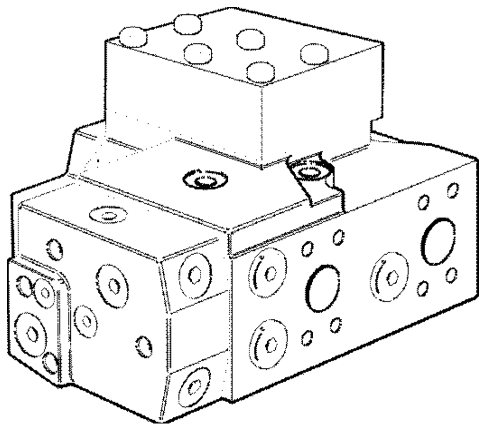
Winch valve V46-O is designed for open systems together with motors of series 44 and 64, and particularly for suspended load applications. It is a counter balance valve, controlled from the low pressure side, combined with a displacement shifting function. It also includes crossover relief valves and a special valve for brake operation. The valve is mounted directly on the motor.
Working pressure: 210-350 bar (3000-5000 psi)   Capacity: 800 l/min (211 US. gal/min)
Weight: V46-O-1, 110 kg (242 lb) and V46-O-2, 100 kg (220 lb)

Fig. 16 **Valve V46-O-1, with control block**



V46-O-1: The valve is delivered with a control block, affording advanced safety and control function for displacement shifting.

Fig. 17 **Valve V46-O-2, without control block**

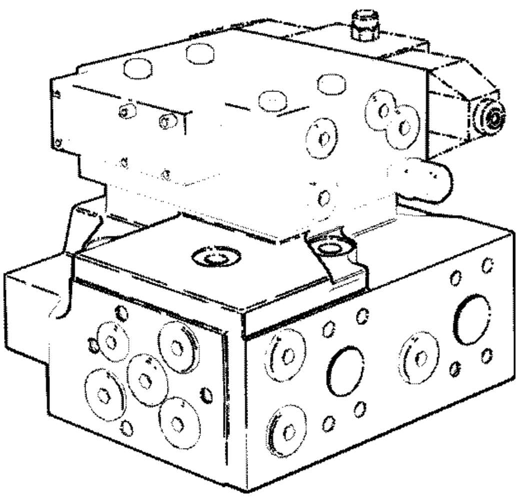


V46-O-2: The valve is delivered without a control block and must be supplemented with control function.

Winch valve for closed systems, type V46-C

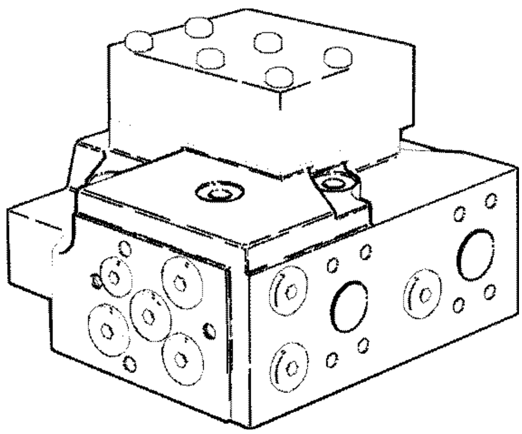
Winch valve V46-C is designed for closed systems together with motors of series 44 and 64, and particularly for suspended load applications. It is a combined unloading and displacement shifting valve with built-in functions for pressure limitation and oil exchange, thus eliminating the need for a transmission valve. The valve is mounted directly on the motor.
Working pressure: 210-350 bar (3000-5000 psi)   Capacity: 800 l/min (211 US. gal/min)
Weight: V46-C-1, 90 kg (190 lb) and V46-C-2, 80 kg (175 lb)

Fig. 18 **Valve V46-C-1, with control block**



V46-C-1: The valve is delivered with a control block, affording advanced safety and control functions. Functions needing to be actuated are start, stop and selection of motor displacement. This is accomplished by a solenoid valve (must be ordered separately), which is mounted directly on the control block.

Fig. 19 **Valve V46-C-2, without control block**



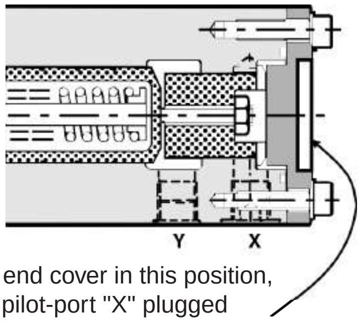
V46-C-2: The valve is delivered without a control block and must be supplemented with all directional control and control functions.

Accessories

2-speed valve for 84-series

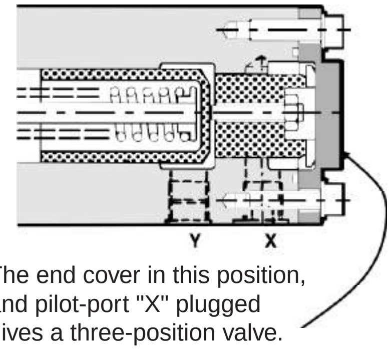
The 84-series motor it is possible, if a two speed valve is selected to set displacement ratios 1:2 and 1:3. The differences between a two-position and three-position valve are only the position of the end cover and that the "X-port" is plugged.
Note: Displacement shifting is not allowed when the motor is running.

Fig. 20 **Two-position valve**



The end cover in this position, and pilot-port "X" plugged gives a two-position valve.

Fig. 21 **Three-position valve**

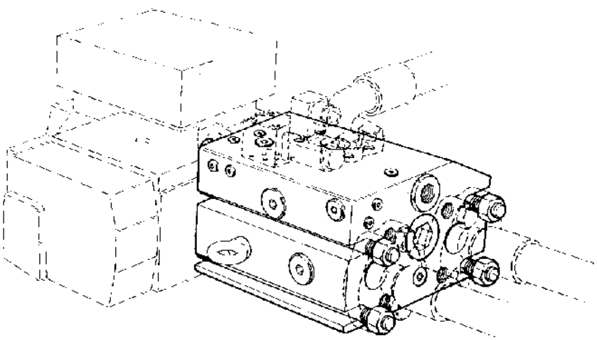


The end cover in this position, and pilot-port "X" plugged gives a three-position valve.

Free wheeling valve for closed and open loop systems, type VFW

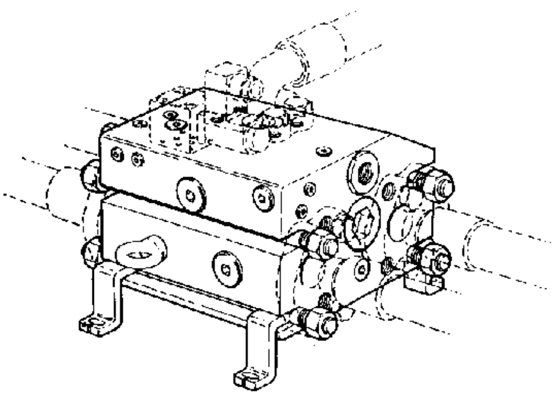
Free wheeling valve VFW is designed for both closed and open hydraulic systems together with motors of series 44, 64 and 84.
Working pressure: max 350 bar (5000 psi). Capacity: 800 l/min (211 US. gal/min)
Weight: 56 kg (124 lb)

Fig. 22 **Valve VFW, mounted with valve V46**



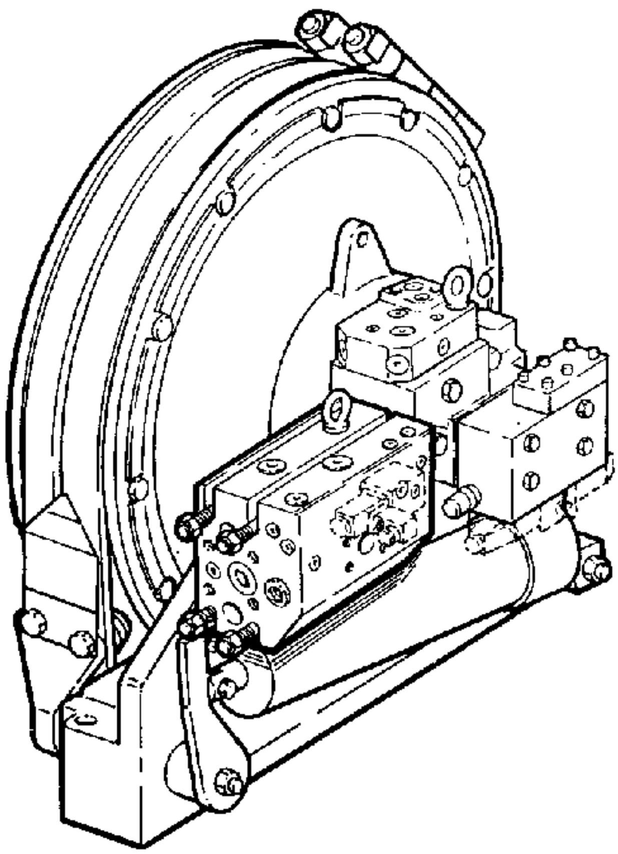
The VFW valve is mounted directly on the winch valve type V46-C or V46-O (44/64-series).

Fig. 23 **Valve VFW, mounted separately**



The VFW valve is mounted to the system with hoses. Directional control valve has to be added (84-series).

Fig. 24 **Fitting of valve V46 and valve VFW on motor series 44/64**



Accessories

Brake bracket, type BB-46 and BB-85
Brake assembly, type BA-43, BA-63 and BA-85

Each brake is available in three versions depending on their brake direction, clockwise, counter clockwise and double acting. The Viking band brakes are fatigue resistant for the maximum motor torque in each motor series. The brake is intended to be used as a parking brake. For hanging loads in wet environments we recommend the use of a protective cover over the band brake. The brake linings are of non-asbestos material and have DNV type approval.

Fig. 25 **Single acting double band, type BB 46 and BA 43/63**

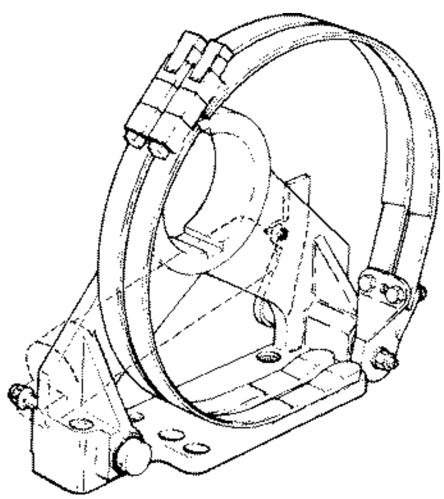


Fig. 26 **Single acting double band, type BB 85 and BA 85**

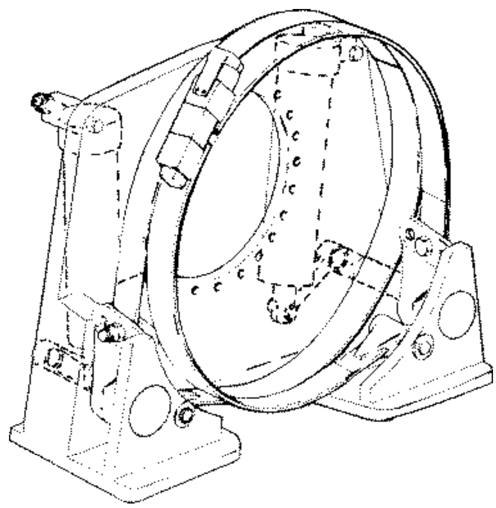


Fig. 27 **Double acting, one band in either direction type BB 46 and BA 43/63**

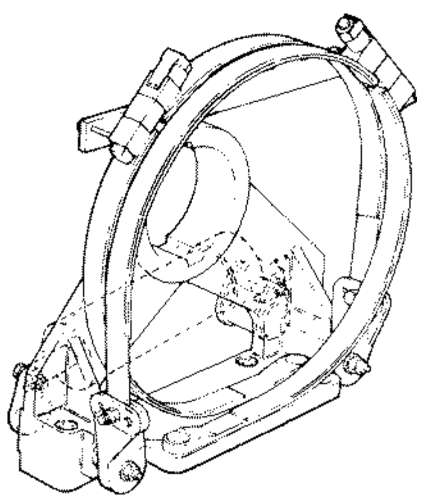
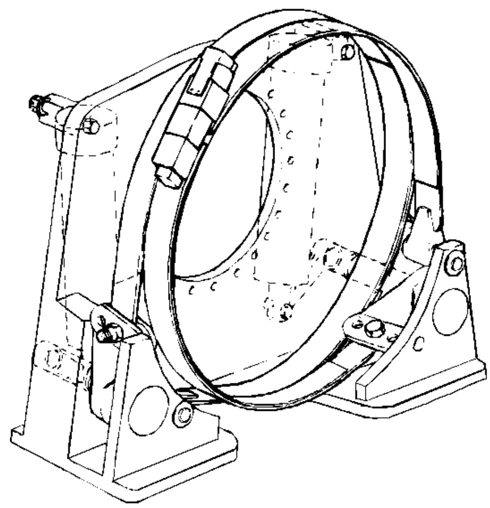
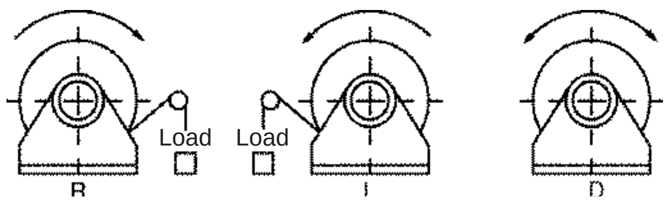


Fig. 28 **Double acting, one band in either direction type BB 85 and BA 85**



Braking force direction



Clockwise Counter Clockwise Double acting

Braking torque

Braking torque in braking force direction, friction factor μ = 0,35 after running-in period.

Type	Single acting - double band Nm	lbf·ft	Double acting Nm	lbf·ft
BA-43	76000	56000	55000	40500
BA-63	90000	66300	65000	47900
BA-85	195000	143800	120000	88500

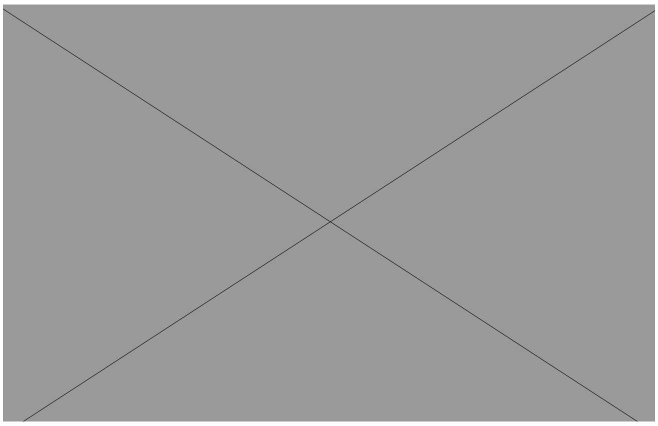
Accessories

Speed encoder with mounting set SM

Speed encoder with mounting set SM mounted on the motor (fig. 30). The Speed encoder could be ordered in 15 different models, full scale output from 2 to 300 rpm.

Fig. 29 **Speed encoder**

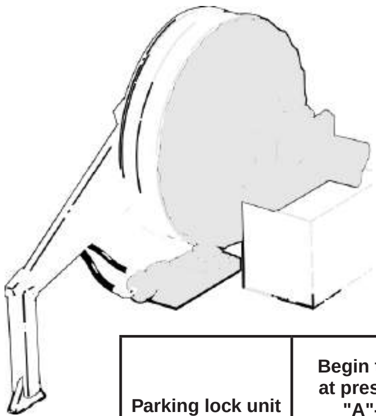
Fig. 30 **Speed encoder mounted on the motor**



Parking lock unit

Parking lock unit for winch and industrial applications e.g. belt conveyor installations. The parking lock can only be used were there is no demand for dynamic braking. In addition to the locking cylinder with bracket, a ratchet-wheel (with data according to dimension drawing) must be installed on the outer mounting surface of the hydraulic motor rear cover.

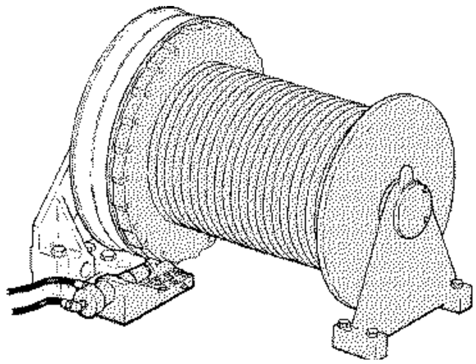
Fig. 31 **Industrial applicaton**



ON - The piston rod with it´s head, is pressed against the ratchet-wheel due to spring-force.

OFF - The piston rod is released from the ratchet-wheel by means of oil pressure.

Fig. 32 **Winch applicaton**

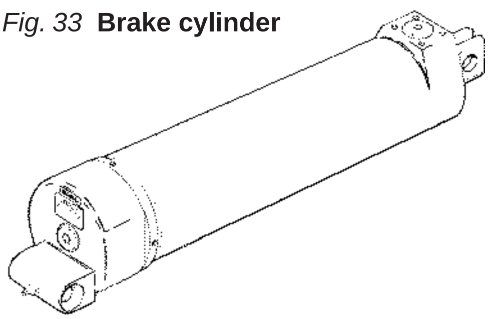


Parking lock unit	Begin to open at pressure in "A"-port		Completely open at pressure in "A"-port		Max allowed pressure "A"-port and "D"-port		Displacement		Weight	
	bar	psi	bar	psi	bar	psi	cm³	in³	kg	lb
Cylinder	2,7	39	4,3	62	70	1000	134	8,2	23	51

Brake cylinder, type BCI-M

For brake assembly BA-43, BA-63 and BA-85. The brake cylinder is the actuator for the Viking brakes. The band brake, including brake cylinder, is the fail-safe type. This means that the brake comes on due to spring force from a strong spring inside the brake cylinder, if the pressure to the cylinder is released. For good resistance to corrosion, the piston-rod is chrome plated and made of stainless steel.

Fig. 33 **Brake cylinder**



Brake cylinder type	Begin to open at pressure in "A"-port		Completely open at pressure in "A"-port		Max allowed pressure "A"-port and "D"-port		Displacement		Weight	
	bar	psi	bar	psi	bar	psi	cm³	in³	kg	lb
BCI-M-1X-XXX	4	58	8	115	320	4600	1300	79,3	70	154
BCI-M-30-XXX	16	230	26	380			350	21,4	70	154

Accessories

Protective cover, type WP-43, WP-63 and WP-85

For applications in open and wet conditions we recommend a cover to be mounted over the bandbrake. This is due to some brake efficiency losses in case of water on the lining and braking surface. The covers are made of 4 mm (0,158 in) glass fibre reinforced plastic, and are to be used with brake bracket BB-46 / BB-85.

Fig. 34 **WP-43 or WP-63**

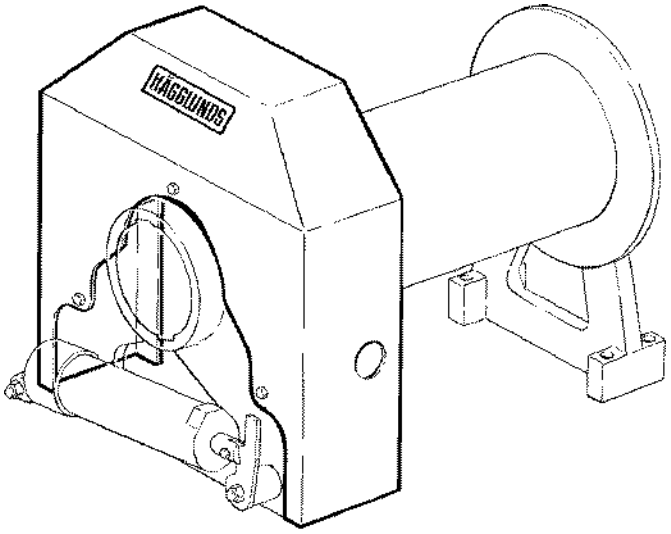
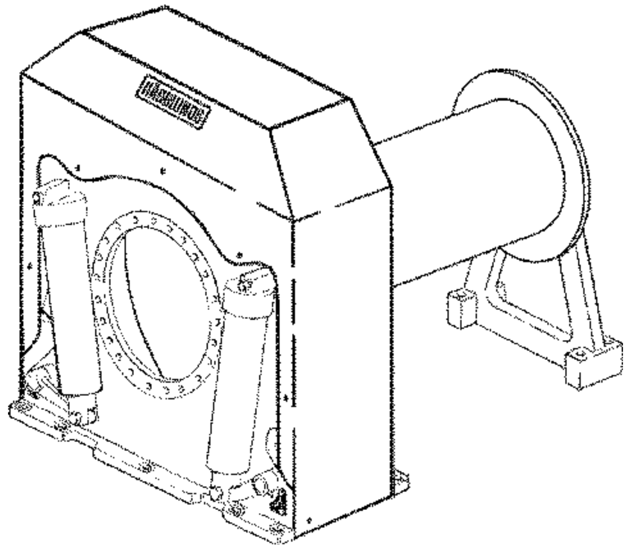


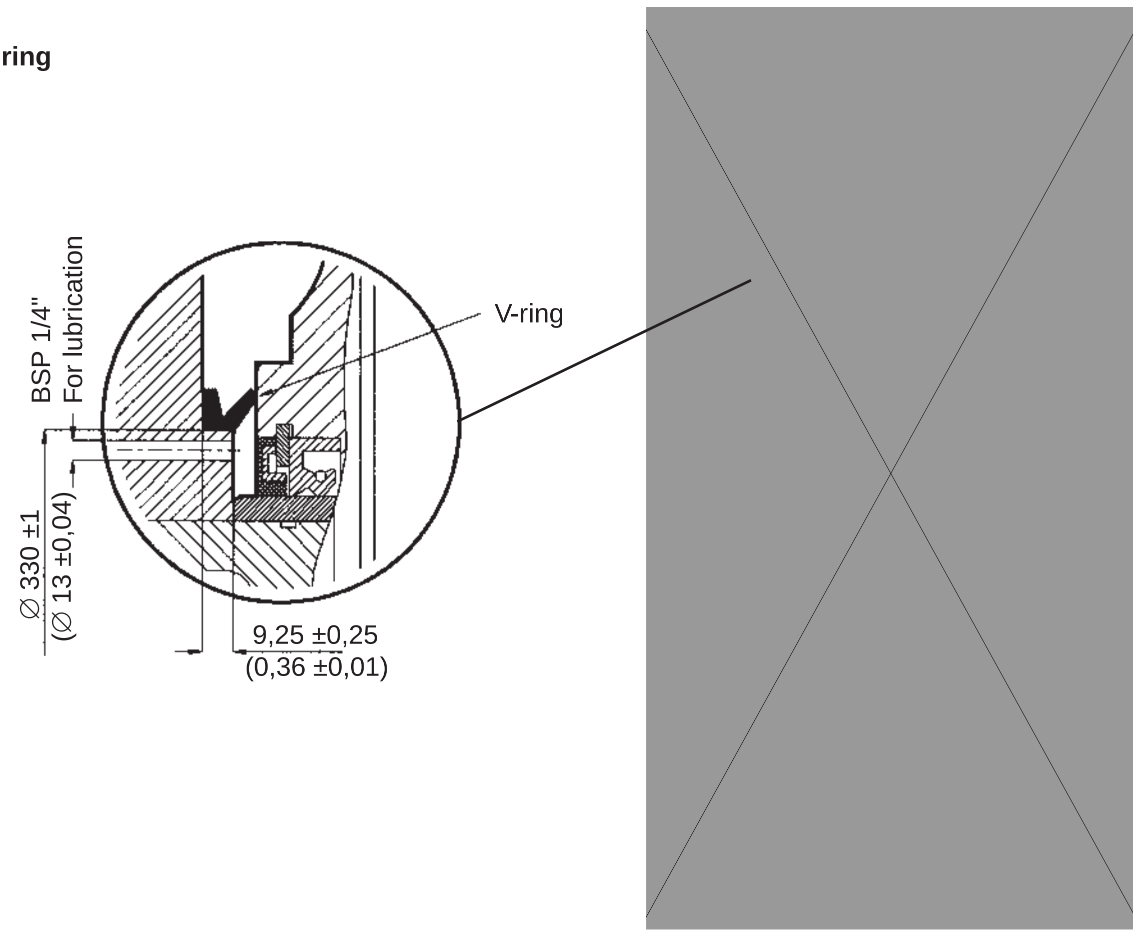
Fig. 35 **WP-85**



Harsh industrial environment

To protect the main seal when the motor is used in harsh environment, an extra V-ring can be mounted on the 44- and 64-series motors. When using Hägglunds Drives bracket type BB-46, the guiding diameter is already machined.

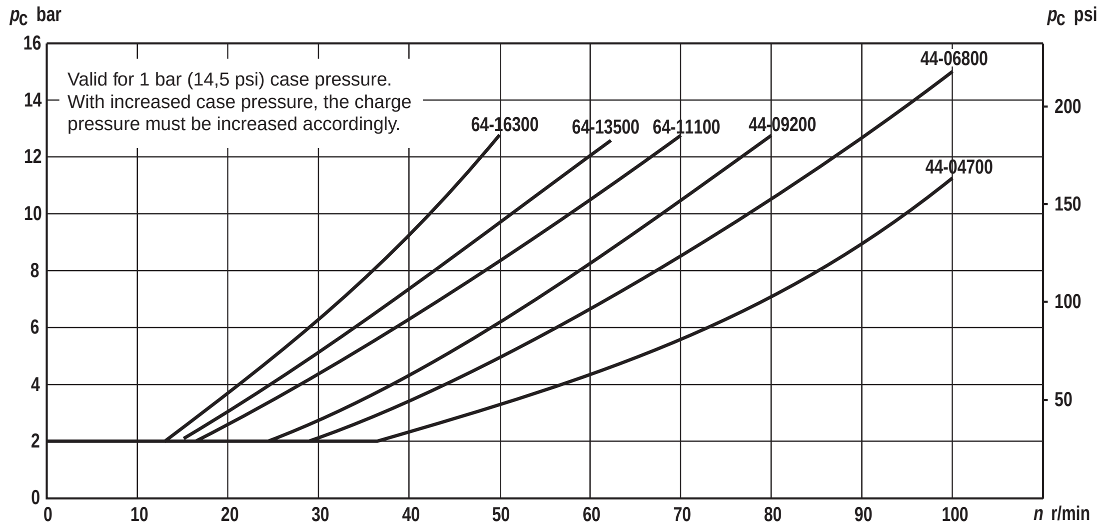
Fig. 36 **V-ring**



Diagrams for Viking

Viking motors

Diagram 1 **Charge pressure - Motor series 44 & 64**



Case 1: The motor works in braking mode. Required charge pressure at the inlet port is according to diagram above.

Case 2: The motor works in driving mode only. Required back pressure at the outlet port corresponds to 30% of value given in diagram above, but may not be lower than 2 bar (29 psi).

Case 3: The motor is used with 2-speed valve. Required charge pressure at inlet port for valve is according to diagrams.

Diagram 2 **Charge pressure - Motor series 84 without 2-speed valve (A & B type)**

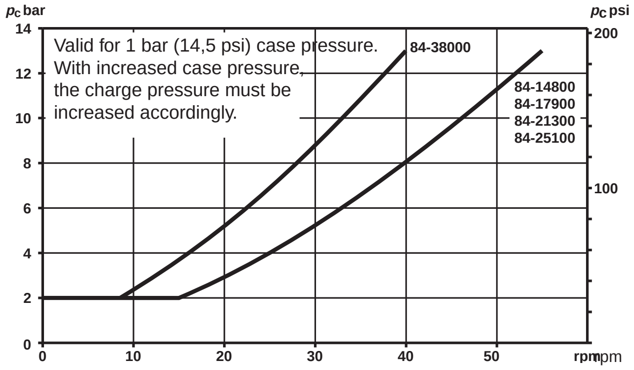
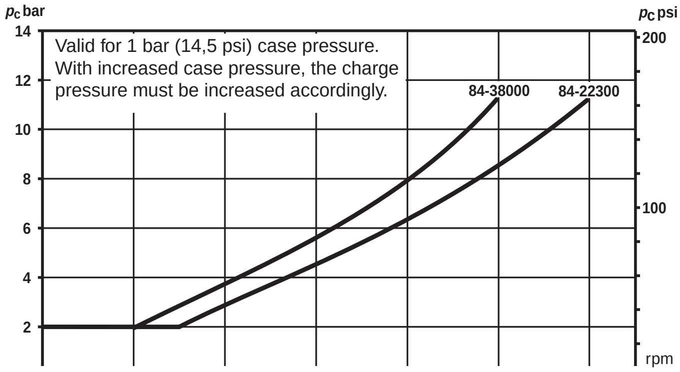


Diagram 3 **Charge pressure - Motor series 84 with 2-speed valve (A & B type)**



Diagrams for Viking

Viking motors

Diagram 4 **Pressure loss through motor case**

Pressure loss through motor case from D_1 - D_2 (opposite flow direction gives the same pressure loss). Pressure loss represents in equal parts inlet- and outlet flow pressure loss. Viscosity 40 cSt/187 SSU.

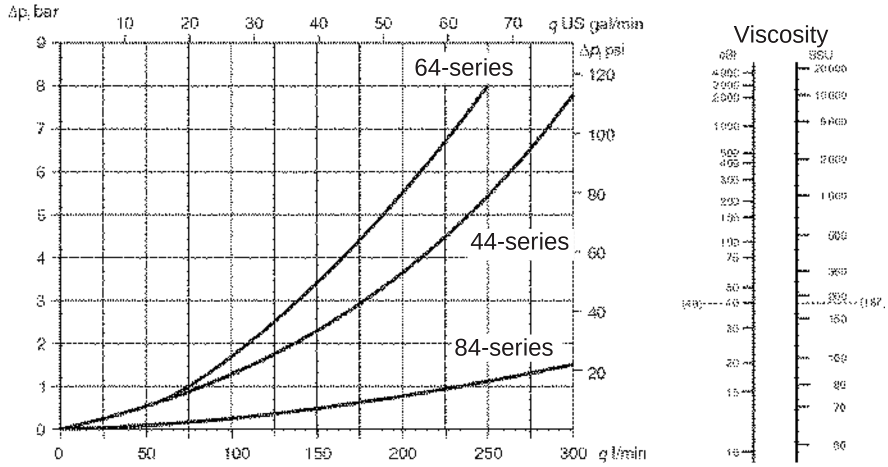


Diagram 5 **Pressure loss - Motor series 44 40 cSt/187 SSU**

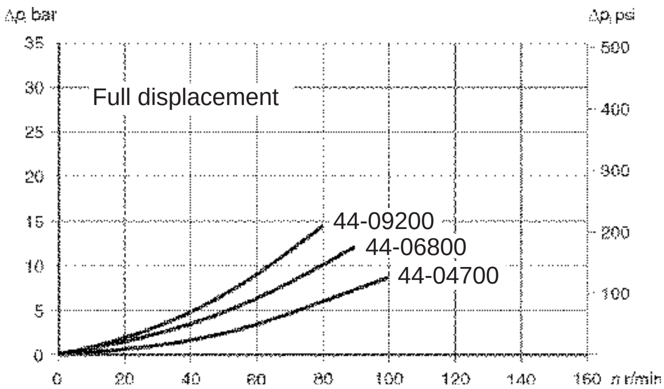


Diagram 6 **Pressure loss - Motor series 64 40 cSt/187 SSU**

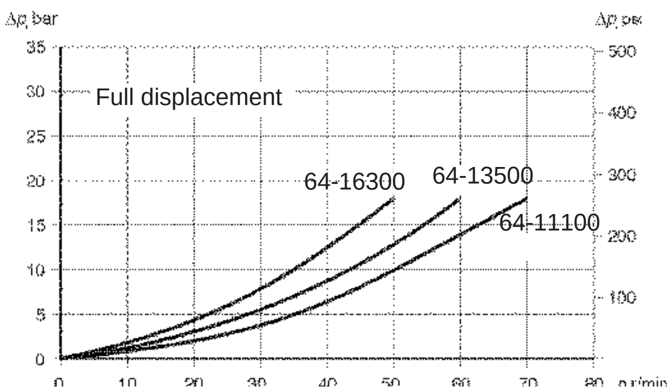
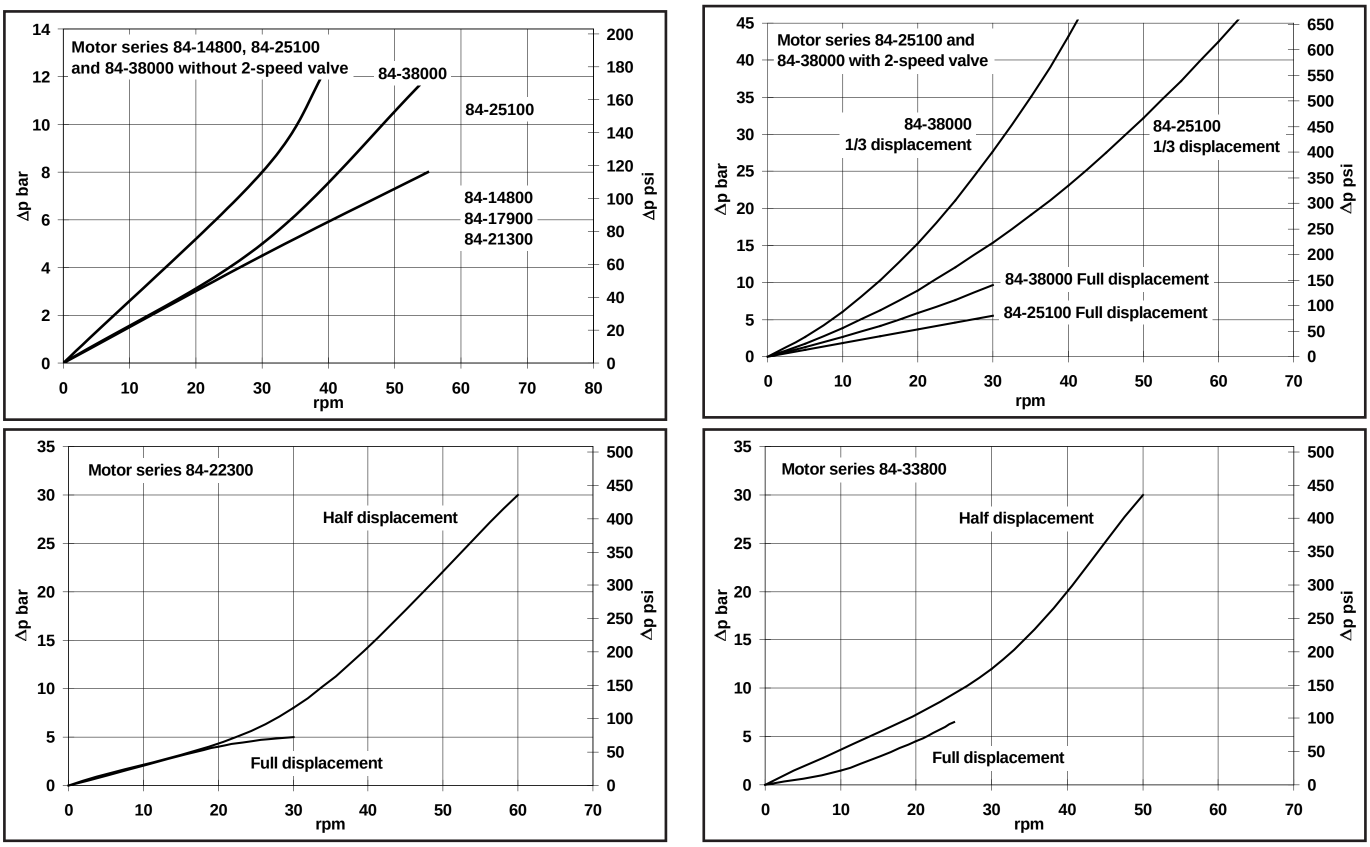


Diagram 7 **Pressure loss - Motor series 84, 40 cSt/187 SSU**



Diagrams for Viking

Viking motors

Diagram 8 **Volumetric loss - Motor series 44 40 cSt/187 SSU**

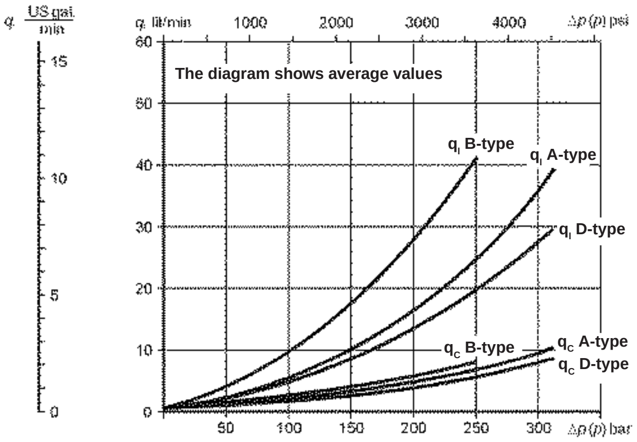
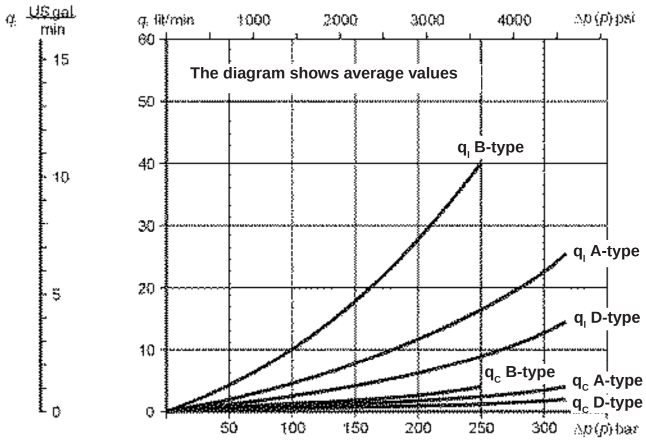


Diagram 9 **Volumetric loss - Motor series 64 40 cSt/187 SSU**



q_l = Volumetric losses (incl. case drain flow).

q_C = Casing drain flow from D port.

Diagram 10 **Volumetric loss - Motor series 84 without 2-speed valve, 40 cSt/187 SSU**

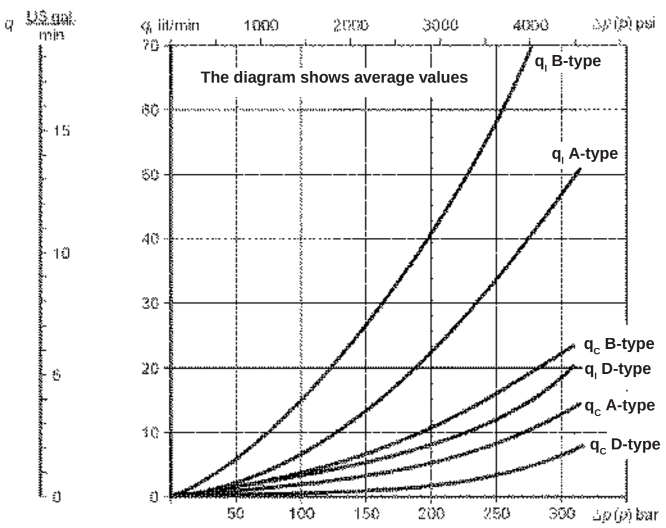
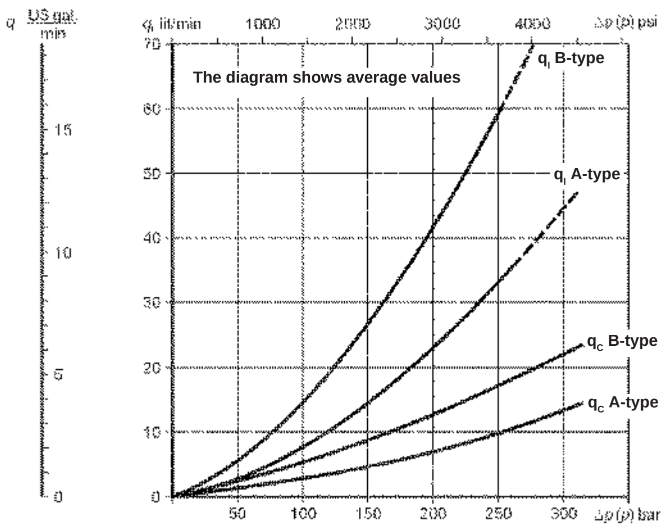
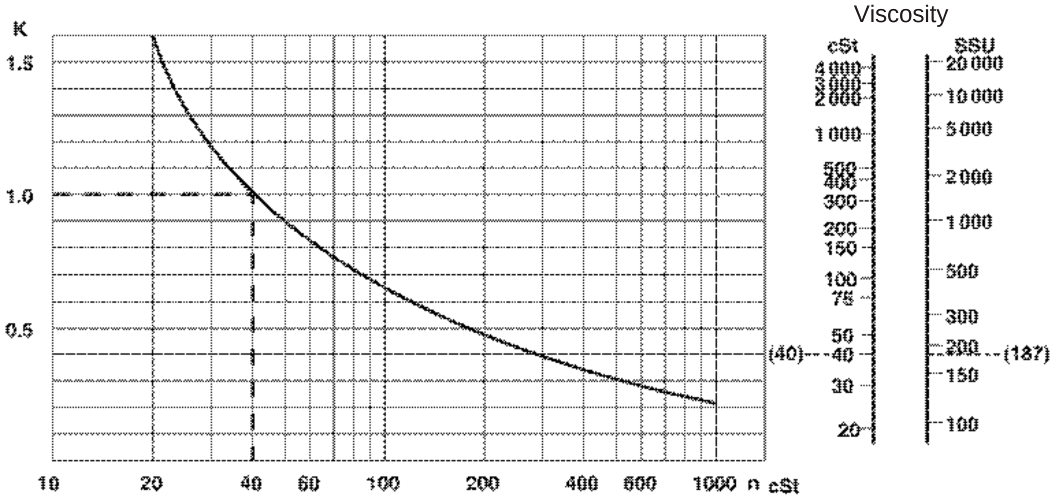


Diagram 11 **Volumetric loss - Motor series 84 with 2-speed valve, 40 cSt/187 SSU**



The diagrams above shows the average values. When calculating volumetric losses using other viscosities, multiply the value given in the diagram by the factor K.

Diagram 12 **Factor K - Variation in volumetric losses**



Diagrams for Viking

Viking motors

Diagram 13 **Overall efficiency - Motor type 44-04700 (A-distributor), 40 cSt/187 SSU Pc=12 bar (174 psi)**

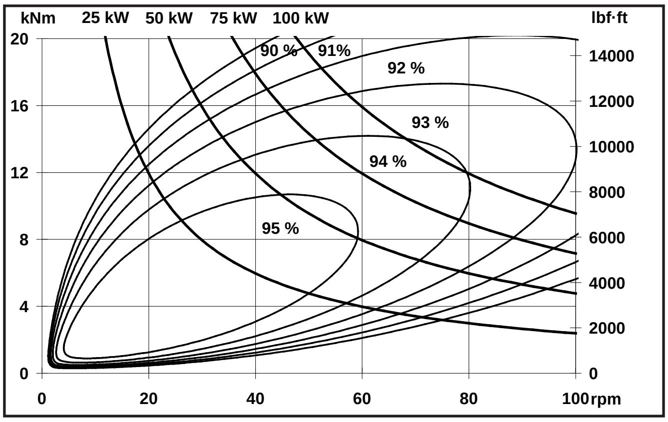


Diagram 14 **Overall efficiency - Motor type 64-11100 (A-distributor), 40 cSt/187 SSU Pc=12 bar (174 psi)**

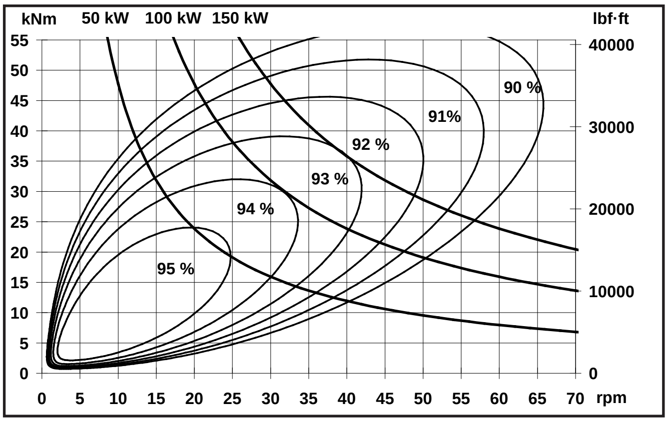
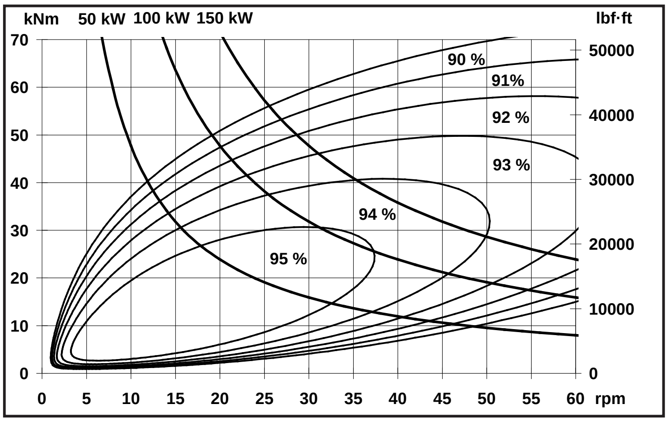


Diagram 15 **Overall efficiency - Motor type 84-14800 (A-distributor), 40 cSt/187 SSU Pc=12 bar (174 psi)**



Flushing of motor case

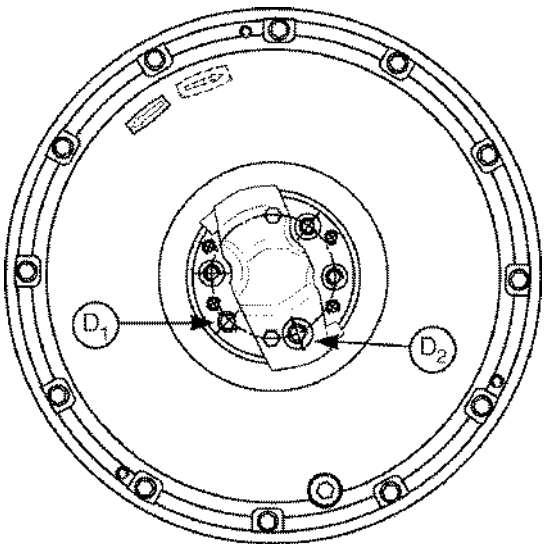
The Viking motors have very high total efficiency, and they are now frequently used in applications with high power. To avoid high temperature in the motor case the heat must be cooled away, because high temperature gives lower viscosity and that gives reduction in basic rating life.

- For continuous duty in applications with an ambient temperature of +20°C (68°F), the motor case must be flushed when the output power exceeds the values shown below.

Max power without flushing

Viking 44/64	120 kW	(161 hp)
Viking 84	140 kW	(188 hp)

Fig. 37 **Flushing connection D_1 and D_2 on motor series 44 & 64**



Examples of installations

Fig. 38 **Complete Winch drive**

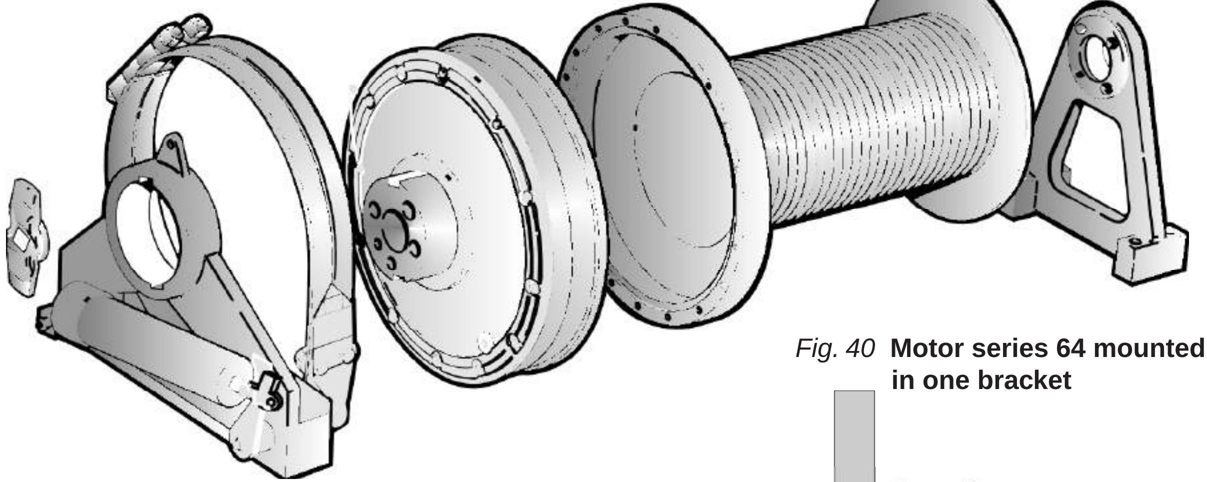


Fig. 40 **Motor series 64 mounted in one bracket**

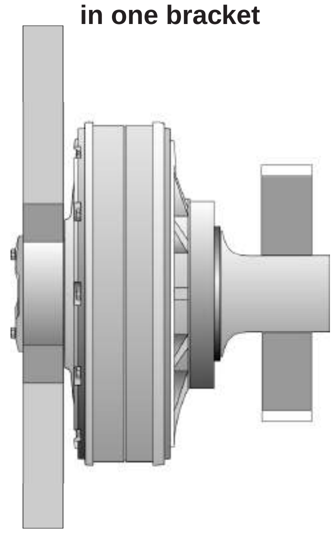


Fig. 39 **Motor series 84 shaft mounted with torque arm**

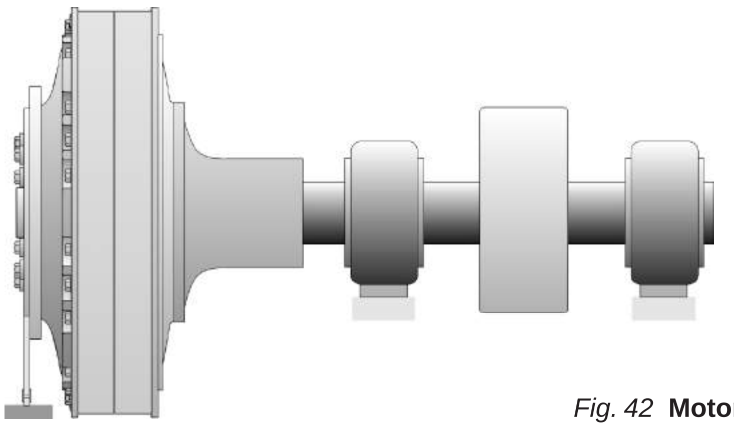


Fig. 41 **Motor series 44 mounted in two brackets**

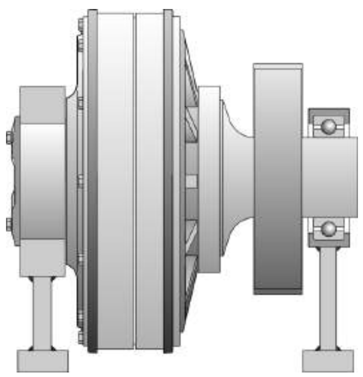


Fig. 42 **Motor series 64 with V46 valve and brake bracket**

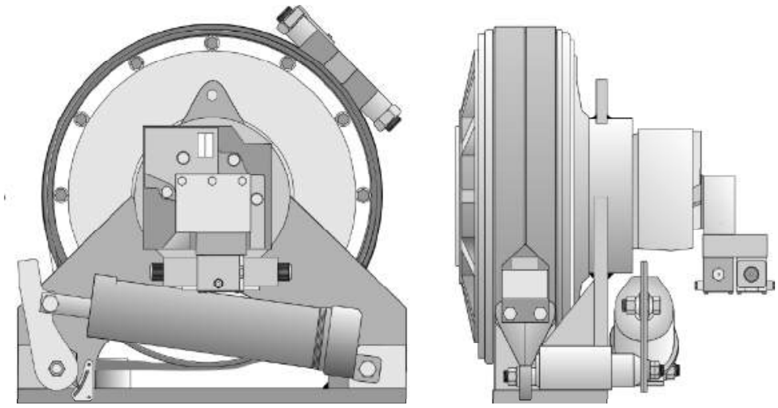


Fig. 43 **Motor series 44/64 with brake bracket**

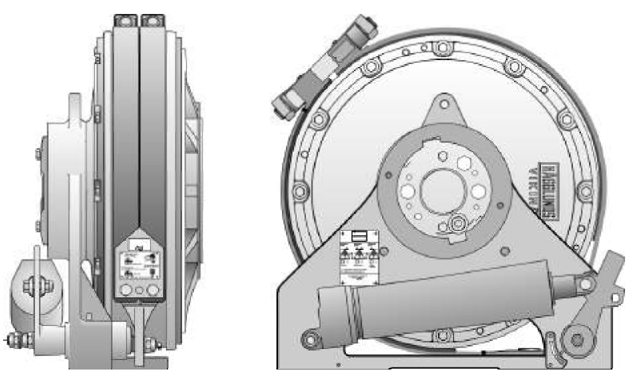
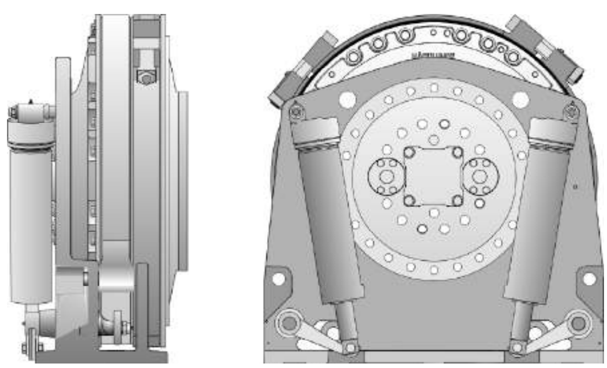


Fig. 44 **Motor series 84 with brake bracket**



Calculation of external loads for Viking

Fig. 45 **Motor series 44 & 64**

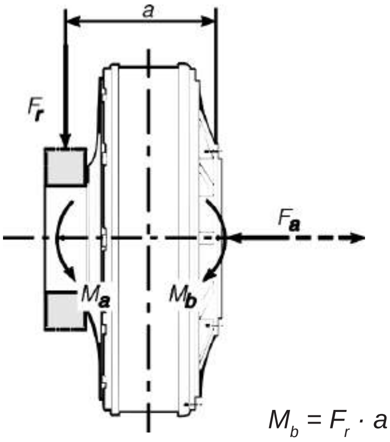
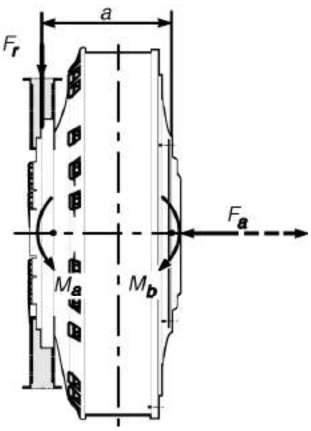
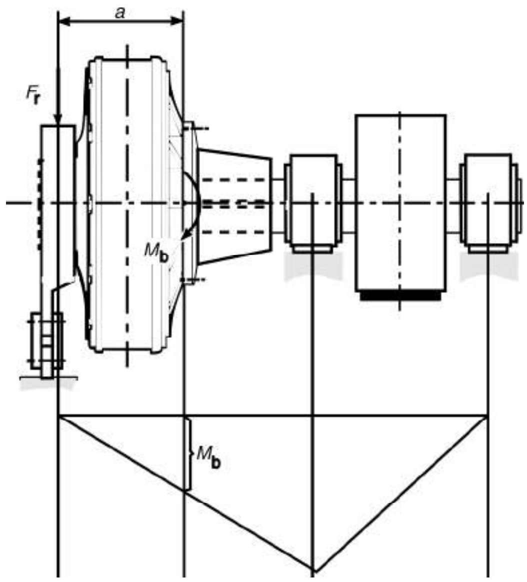


Fig. 46 **Motor series 84**



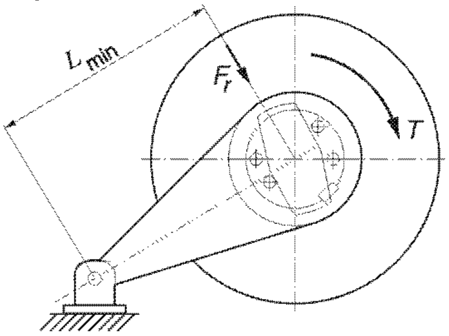
$M_b = F_r \cdot a$

Fig. 47 **Shaft mounted motor with torque arm**



$M_b = F_r \cdot a$

Fig. 48 **Torque arm**

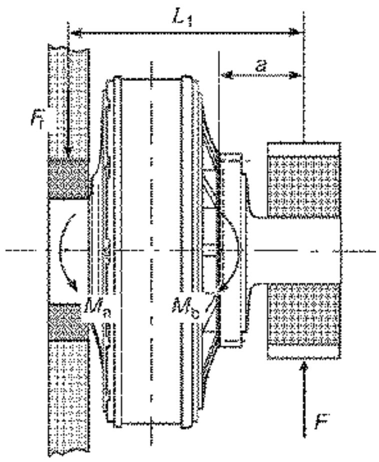


$T = F_r \cdot l_{min}$

$L_{min} = \dfrac{T \cdot a}{M_b}$

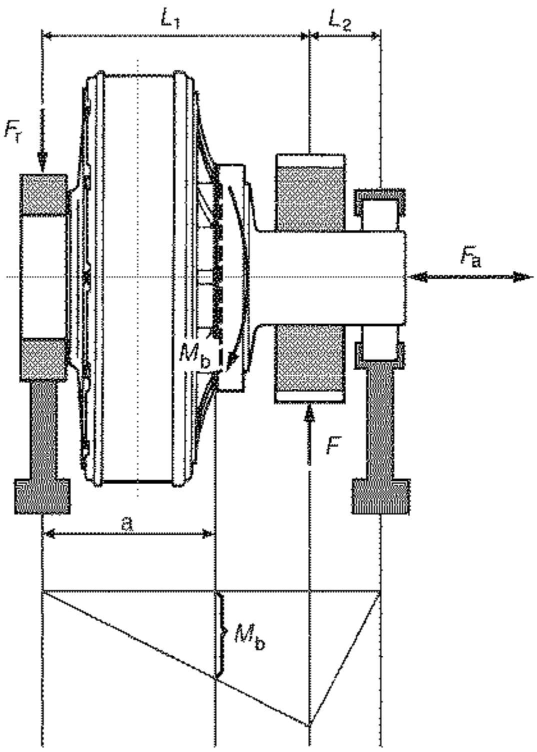
a = 350 mm (13,8 in) - 44 series
a = 362 mm (14,3 in) - 64 series
a = 390 mm (15,4 in) - 84 series

Fig. 49 **Motor mounted in one bracket**



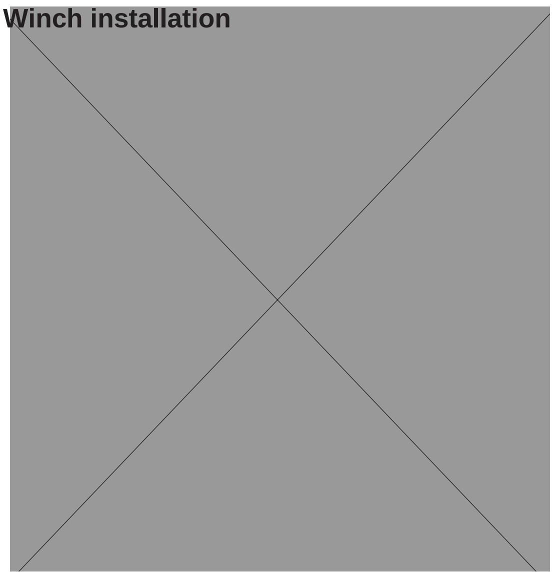
$M_b = F_r \cdot a \qquad M_a = l_1 \cdot F \qquad F_r = F$

Fig. 50 **Motor mounted in two brackets**



$F_r = F \cdot \dfrac{l_2}{l_1 + l_2} \qquad M_b = F_r \cdot a$

Fig. 51 **Winch installation**



$R_l = \dfrac{F \cdot l}{a + l}$

Max permitted external static and dynamic loads for Viking

If the torque M_b exceeds the values in the table below, static or dynamic, the outer flange must be used. In case of higher axial forces F_a than listed in the table, please contact your nearest Hägglunds Drives representative for consultation.

Motor series	Torque, M_b		Max. Axial force, F_a	
	Nm	lbf·ft	N	lbf
44	13000	9581	20000	4480
64	18000	13266	20000	4480
84	40000	29480	60000	13440

Diagram 16 **Motor series 44**

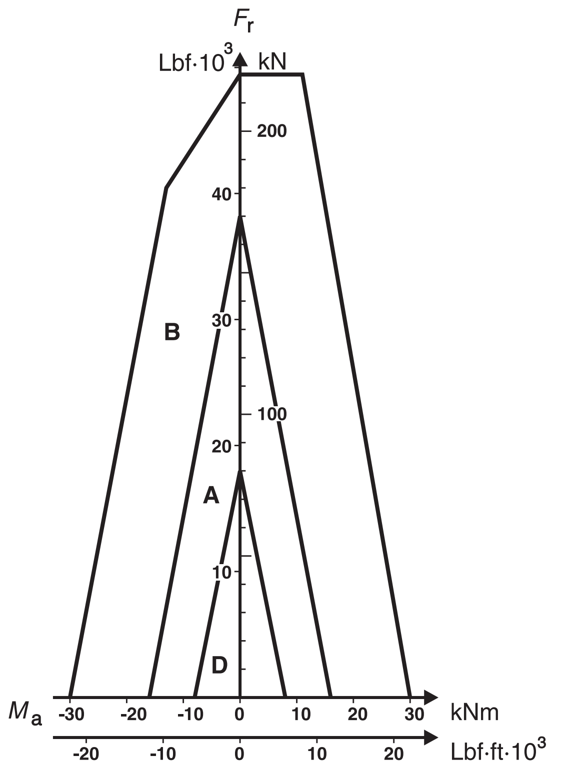


Diagram 17 **Motor series 64**

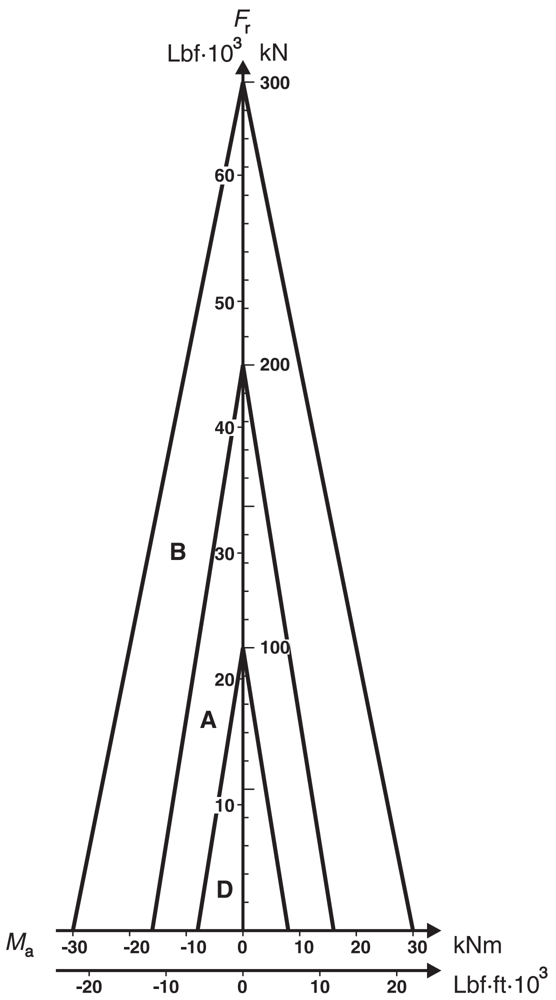
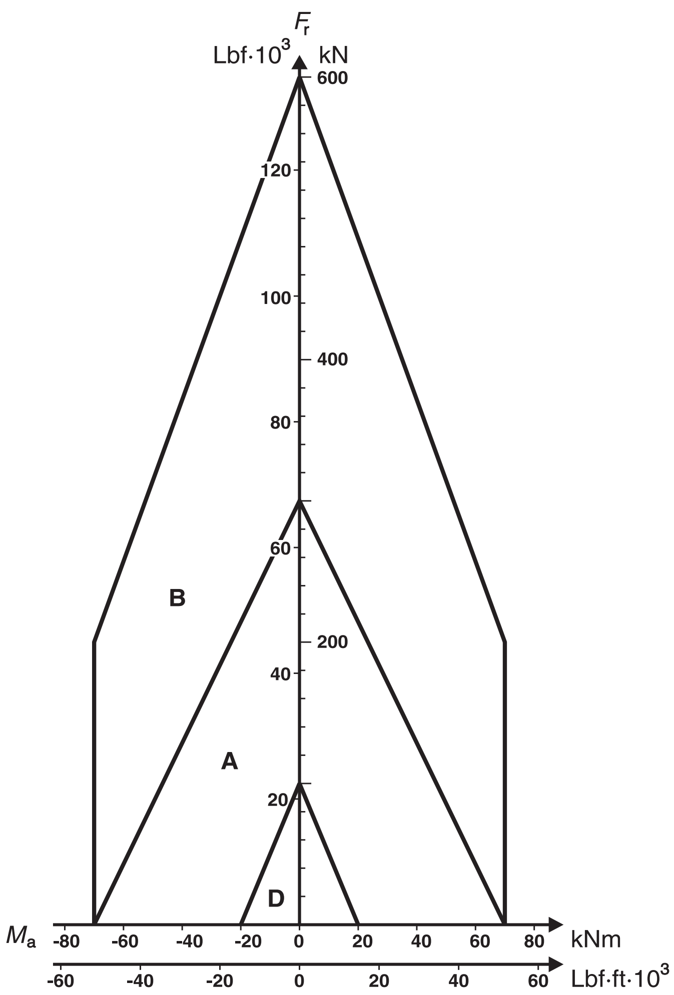


Diagram 18 **Motor series 84**



Choice of hydraulic fluid

The Hägglunds Drives hydraulic motors are primarily designed to operate on conventional petroleum based hydraulic oils. The hydraulic oil can be chosen in consultation with the oil supplier or your local sales office, bearing the following requirements in mind:

General

The oil shall have FZG (90) fail stage minimum 11 described in IP 334 (DIN 51354). The oil must also contain inhibitors to prevent oxidation, corrosion and foaming. The viscosity of mineral oil is highly dependent of the temperature. The final choice of oil must depend on the operating temperature that can be expected or that has been established in the system and not in the hydraulic tank. High temperatures in the system greatly reduce the service life of oil and rubber seals, as well as resulting in low viscosity, which in turn provides poor lubrication. Content of water shall be less than 0,1%. In Industrial applications with high demands for service life, the content of water shall be less than 0,05%.

Recommended viscosity

At operating temperature: 40-150 cSt/187-720 SSU.

Viscosity limits	
Viscosity index	=100 recommended =150* for operation with large temperature differ-ence
Min. permitted in continuous duty Min. permitted in intermittent duty Max. permitted	40 cSt/187 SSU 20 cSt/98 SSU** 10000 cSt/48000 SSU

* Many hydraulic fluids with VI-improvers are subject to temper-ary and permanent reductions of the viscosity.
** Low viscosity gives reduced basic rating life for the motors and reduction of max allowed power.

Temperature limits	
Normal operating temperature should be less than +50°C (122°F)	
Nitrile seals (std motor) Viton seals Silicone seals	-35°C to +70°C -20°C to +100°C -60°C to +70°C
Nitrile seals (std motor) Viton seals Silicone seals	-31°F to +158°F -4°F to +212°F 76°F to +158°F

Fire resistant fluid

The following fluids are tested for Hägglunds Drives motors (ISO/DP 6071).

Fluid	Approved	Seals	Internal paint
HFA: Oil (3-5 %) in water emulsion	No	-	-
HFB: Inverted emulsion, 40-45 % water in oil	Yes	Nitrile (std motor)	Not painted*
HFC: Water-glycol	Yes	Nitrile (std motor)	Not painted*
HFD: Synthetic fluids			
HFD:R - Phosphate esters	Yes	Viton	Not painted*
HFD:S - Chlorinated hydrocarbons	Yes	Viton	Not painted*
HFD:T - Mixture of the above	Yes	Viton	Not painted*
HFD:U - Other compostitions	Yes	Viton	Not painted*

Environmentally acceptable fluids

Fluid	Approved	Seals	Internal paint
Vegetable */** Fluid HTG	Yes	Nitrile (std motor)	-
Synthetic ** Esters HE	Yes	Nitrile (std motor)	-

*Vegetable fluids give good lubrication and small change of viscosity with different temperature. Vegetable fluids must be controlled every 3 months and temperature shall be less than +45°C (113°F) to give good service life for the fluid.
**Environmentally acceptable fluid give the same service life for the drives, as mineral oil.

Choice of hydraulic fluid

Down rating of pressure data and basic rating life

Down rating of pressure, for motors used in systems with fire resistant fluids, the maximum pressure for motor given on data sheet must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0,7 x maximum pressure for motor
HFC-fluid	0,7 x maximum pressure for motor
HFD-fluid	0,9 x maximum pressure for motor

Down rating of basic rating life, for motors used in systems with fire resistant fluids, the "expected basic rated life" must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0,26 x expected life with mineral oil
HFC-fluid	0,24 x expected life with mineral oil
HFD-fluid	0,80 x expected life with mineral oil

Filtration

The oil in a hydraulic system must always be filtered and also new oil from your supplier has to be filtered when adding it to the system. The grade of filtration in a hydraulic system is a question of service life v.s. money spent on filtration.
In order to obtain stated service life it is important to follow our recommendations concerning contamination level.
When choosing the filter it is important to consider the amount of dirt particles that the filter can absorb and still operate satisfactory. For that reason we recommend a filter with an indicator that gives a signal when it is time to change the filter cartridge.

Filtering recommendations

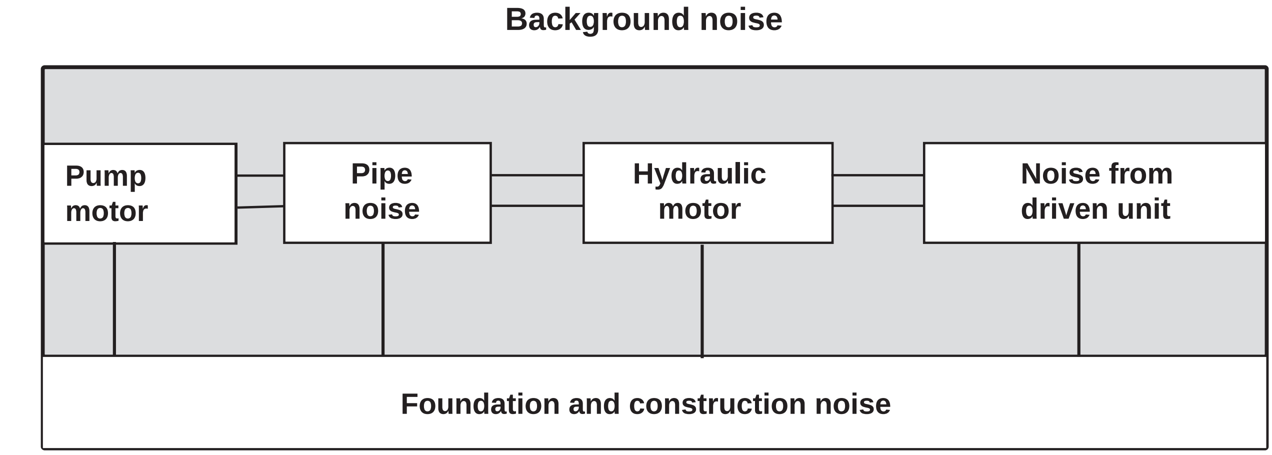
Before start-up, check that the system is thoroughly cleaned.
1. In general the contamination level in our motors should not exceed ISO 4406 19/15 (NAS 10).
2. For heavy-duty applications the contamination level should not exceed ISO 4406 16/13 (NAS 7).
3. When filling the tank and motor case, we recommend the use of a filter with the grade of filtration β**10=75**.

Explanation of "Grade of Filtration"

Grade of filtration β**10=75** indicates the following:
β**10** means the size of particle ≥10μm that will be removed by filtration.
=75 means the grade of filtration of above mentioned size of particle. The grade of filtration is defined as number of particles in the oil before filtration in relation to number of particles in the oil after filtration.

Ex. Grade of filtration is β**10=75**.
Before the filtration the oil contains *N* number of particles ≥10μm and after passing the filter once the oil contains $\frac{N}{75}$ number of particles ≥10μm.
This means that $N - \frac{N}{75} = \frac{74 \cdot N}{75}$ number of particles have been filtered (=98,6%).

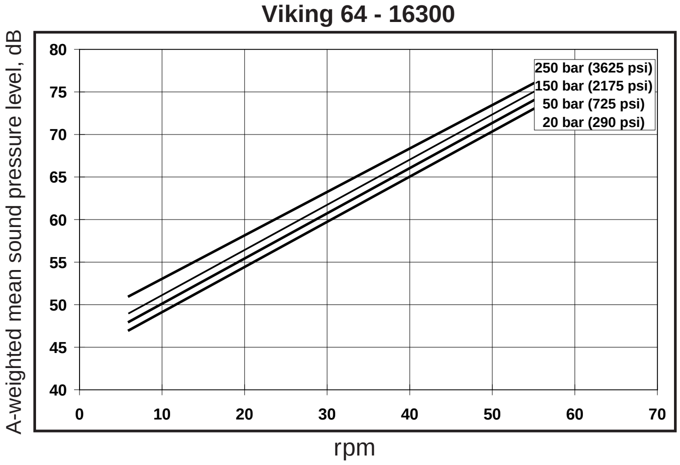
Noise from a complete installation



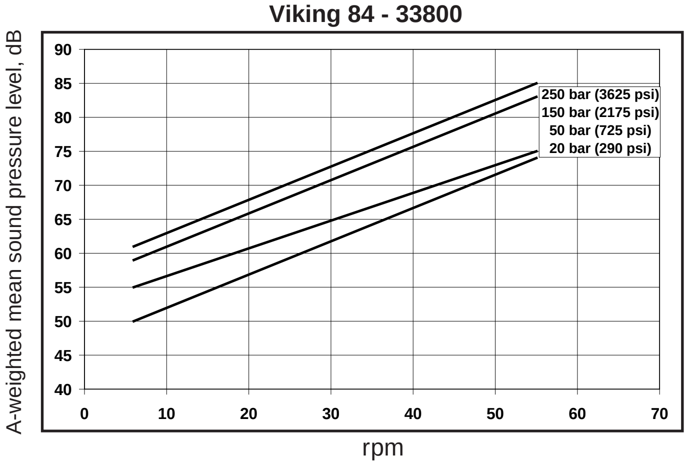
A-weighted mean sound pressure level of Viking

The levels refer to the actual measurement room at Hägglunds Drives AB. In a measurement room with no sound reflections from walls or ceiling, the sound pressure levels are estimated to become 2-3 dB lower. All values refer to a position of the test object > 1 m. (3,28 ft).

Viking 64 - 16300



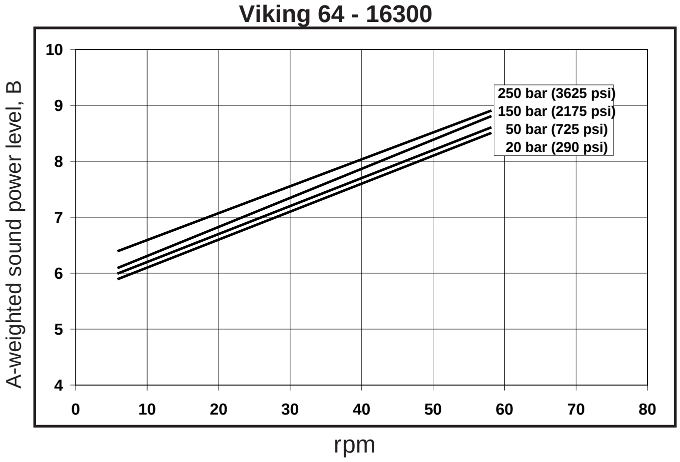
Viking 84 - 33800



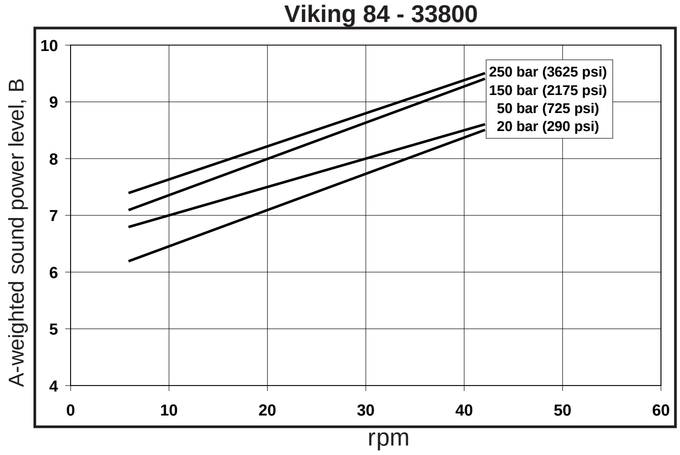
A-weighted sound power level of Viking

Value determined according to ISO/DIS 3747.

Viking 64 - 16300



Viking 84 - 33800



Physics and Electrotechnics

TEST REPORT

1985-12-17

Enclosure 1,2,7,8

85F30077-1,2,7,8

P3

Declaration of Incorporation

Example of the Declaration of Incorporation given by Hägglunds Drives AB

HÄGGLUNDS

Declaration of Incorporation of partly completed machinery

As defined by the EC Machinery Directive 2006/42/EC, Appendix II B

The manufacturer

Hägglunds Drives AB

hereby declares that the partly completed machinery

Name: Viking
Function: Hydraulic motor
Model: Viking
Type: Viking
Trade name: Viking

satisfies the following essential requirements of Machinery Directive 2006/42/EC in accordance with the chapter numbers in Appendix I:

General principle no. 1.									
1.1.3	1.1.5	1.3.1	1.3.2	1.3.3	1.3.4	1.3.6	1.3.7	1.5.3	1.5.4
1.5.5	1.5.6	1.5.8	1.5.13	1.6.1	1.6.3	1.7.2	1.7.3	1.7.4	

The requirements are fulfilled provided that the data in the product documentation (fitting instructions, operating instructions, project management and configuration documents) are implemented by the product user. The requirements of Appendix I to Machinery Directive 2006/42/EC not mentioned here are not applied and have no relevance for the product.

It is also declared that the special technical documents for this partly completed machinery have been compiled in accordance with Appendix VII, Part B. These are transferred on request to the market surveillance body in paper-based/electronic format.

Conformity with the provisions of further EU Directives, Standards or Specifications:

SS-EN 892
SS-EN ISO 12100-1
SS-EN ISO 12100-2

The partly completed machinery may only be put into operation when it has been established that the machine into which the partly completed machinery is to be incorporated conforms to the provisions of EC Machinery Directive 2006/42/EC, where relevant according to this directive.

The individual below is authorized to compile the relevant technical files:

Name: Björn Leidelöf
Address: Hägglunds Drives AB, S-890 42 Mellansel

Björn Leidelöf Mellansel, 2009-12-29

Signature *Place, date*

We reserve the right to make changes to the content of the Declaration of Incorporation. Current issue on request.

The Declaration of Incorporation above, is available on request for deliveries from Hägglunds Drives AB. Translations into other languages are also available.

The Drive & Control Company

High Torque Vane Motors
MV015, MV037, MV057, MV125

Unique vane crossing vane design provides maximum versatility

This motor is created around the patented "vane crossing vane" design, a leading-edge concept in fluid power transmission, which allows for low speed/high torque and high speed/high torque. With over 50 displacements combined with a variety of optional features, this is one of the most versatile hydraulic motors in the world.

Optimum power-to-weight ratio
Four frame sizes with displacements ranging from 6 to 250+ cubic inch (98 to 4096+ cc) displacements (CID).

Starting & stall torque
Applications requiring maximum torque at zero rpm benefit from the vane crossing vane design. Torque curves are virtually flat, with maximum torque at start and stall conditions.

Smooth output over a wide speed range
From less than 10 rpm to 2000 rpm and beyond, this motor generates low torque ripple and steady acceleration for smooth operation.

Dynamic braking
The motor is constructed of hardened materials and does not include any non-ferrous metals. This is a plus when designing for dynamic braking and overrunning loads. The cavitation that typically occurs in these circuits does not affect motor integrity.

4-ported series
4-port motors are available in the 37, 57, and 125 Series. These motors are made up of two cartridges separated by a center ported housing. Equal or dissimilar displacements may be combined to attain desired total cc/rev (CID). When supplied with external valving, they can be used as either 2- or 3-speed motors.

High performance series
The 37D, 57D, and 125H are now part of the family of motors. This high performance design is for 4500 psi (310 bar) "continuous" service, and boosts torque and horsepower by 50% providing the same wide speed range of standard motors.

The power difference – Vane crossing vane patented technology

The vane crossing vane motor is a bi-rotational power converter utilizing working vanes in the rotating member (rotor) and sealing vanes in the stationary member (stator).

With 10 rotor vanes working in four cavities, the motor provides an uninterrupted output torque regardless of angular position. This equates to 40 power strokes per revolution, delivering higher average torque with low torque ripple.

The stator vanes function as seals between high- and low-pressure ports within the stator. This allows for more displacement in the stator, giving the motor an optimum power-to-weight ratio.

With this patented technology (vane crossing vane design), the motor produces improved mechanical and volumetric efficiencies—the ***Power Difference.***

The broadest vane motor product line for a variety of fluid power demands

◀ **MV015 – 2000 rpm 509 lb-ft (690 Nm)**
Offered in single, two-speed, double output shafts, wheel-bearing style, and retractable shafts along with splined, tapered, or straight keyed shafts. Through-hole and thrust bearing options also available. SAE C mount.

◀ **MV057 – 500 rpm 3016 lb-ft (4089 Nm)**
Offered in A [3000 psi (207 bar)] or D version [4500 psi (310 bar)]. The same features offered in the 37 Series are available in a motor that's one inch longer. Modified SAE D mount.

◀ **MV037 – 1000 rpm 2007 lb-ft (2721 Nm)**
Offered in A [3000 psi (207 bar)] or D version [4500 psi (310 bar)]. Splined, tapered, straight keyed, and double output shafts are standard, along with through holes to 1 1/2". Optional thrust and radial load bearings with substantial capacity, tach pickups, double stacks (up to twice the torque), and brake mounts available. SAE D mount.

◀ **MV037/057 4-Port – 500 rpm 6032 lb-ft (8178 Nm)**
Combines any two displacements from the 37 and/or 57 series displacement choices in a 4-port configuration. Allows for 2- or 3-speed operation using external valving. Available in both A and D designs. Many of the same optional choices listed above are available.

High-torque motors manufactured to the tightest tolerances for maximum volumetric efficiencies

◄ **MV125 – 300 rpm 6903 lb-ft (9359 Nm)**
Offered in A [3000 psi (207 bar)] or H version [4500 psi (310 bar)]. Splined, tapered, straight keyed, female, and double output shafts are standard, along with through holes to 3”. Optional thrust and radial load bearings with substantial capacity, tach pickups, double stacks, and brake mounts available.

◄ **Drill Motors**
Available in 37, 57 and 125 series as 2 or 4 port models. Numerous bearing/shaft configurations and through-hole options are available, including API box threads. Sublock system is standard.

◄ **MV125 4-Port – 300 rpm 13,806 lb-ft (18,718 Nm)**
Combines any two displacements for the 125 A or H series in a 4-port configuration. Allows for 2- or 3-speed operation using external valving.

◄ **Cross Series 4-Ports**
37, 57 and 125 Series can have a rear motor from a smaller series, including the 15 Series. This allows for many displacement combinations or speed ratios when used in 2- or 3-speed circuits. Available in both pressure designs.

Motor specifications

Standard Series Code 61	Displacement		Pressure				Speed		*Torque @ 3,000 psi (207 bar)	
			Continuous		Intermittent		Continuous	Intermittent	Continuous	
	(in^3/rev)	(cm^3/rev)	(psi)	(bar)	(psi)	(bar)	(rpm)	(rpm)	(lb-ft)	(Nm)
MV015	6	98	3000	207	3500	241	2000	2600	183	248
	7	115					1900	2600	230	312
	8	131					1800	2600	274	372
	9.5	156					1700	2300	308	418
	10.5	172					1600	2300	352	477
	11.5	188					1600	2300	395	536
	13	213					1500	2000	428	580
	15	246					1500	2000	509	690
MV037 A, C	12	197	3000	207	3500	241	1000	1200	410	556
	16	262					1000	1200	553	750
	20	328					1000	1200	722	979
	26	426					800	1000	920	1247
	32	524					700	950	1143	1550
	37	606					600	800	1315	1783
MV057 A, C	48	787	3000	207	3500	241	500	600	1702	2308
	55.5	909					500	600	1976	2679
MV125 A, C	60	983	3000	207	3500	241	350	400	2188	2967
	68	1114					350	400	2507	3399
	82	1344					300	350	3024	4100
	98	1606					300	350	3589	4866
	113	1852					300	350	4130	5600
	125	2048					300	350	4602	6239

* – Torque values are average performance data measured at maximum speeds with 102 SUS (21cSt) and standard rotating group.

Note:

1. When considering double stack or 4-port motors, any 2 displacements in a given series can be combined. The resultant torque is the sum of the 2 displacements. This does not apply to the 15 series.

2. Higher speeds may be permissible under certain conditions. Consult factory.

High Performance Series Code 62	Displacement		Pressure				Speed		*Torque @ 4,500 psi (310 bar)	
			Continuous		Intermittent		Continuous	Intermittent	Continuous	
	(in³/rev)	(cm³/rev)	(psi)	(bar)	(psi)	(bar)	(rpm)	(rpm)	(lb-ft)	(Nm)
MV037 D	12	197	4500	310	5000	345	1000	1200	637	864
	16	262					1000	1200	851	1154
	20	328					1000	1200	1104	1497
	26	426					800	1000	1399	1897
	32	524					700	950	1735	2352
	37	606					600	800	2007	2721
MV057 D	48	787	4500	310	5000	345	500	600	2553	3461
	55.5	909					500	600	3016	4089
MV125 H	60	983	4500	310	5000	345	300	350	3282	4450
	68	1114							3761	5099
	82	1344							4536	6150
	98	1606							5383	7298
	113	1852							6194	8398
	125	2048							6903	9359

* – Torque values are average performance data measured at maximum speeds with 102 SUS (21cSt) and standard rotating group.

Note:

1. When considering double stack or 4-port motors, any 2 displacements in a given series can be combined. The resultant torque is the sum of the 2 displacements. This does not apply to the 15 series.

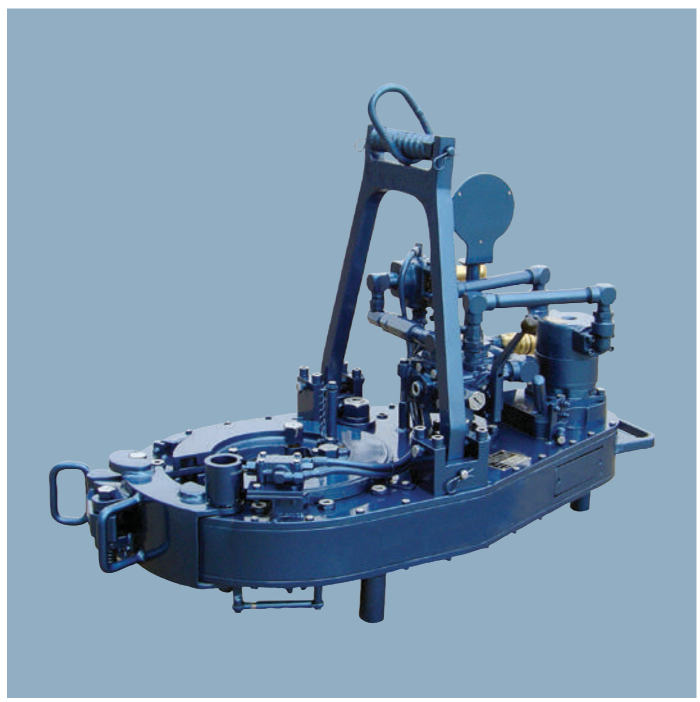
2. Higher speeds may be permissible under certain conditions. Consult factory.

The first choice for the toughest jobs

- Augers
- Blast Hole Rigs
- Bow Thrusters
- Conveyors
- Coring/Drilling
- Directional Drills
- Fan Drives
- Feeder Mixers
- Injection Molding
- Planer Tables
- Power Tongs
- Pump Drives
- Roof Bolters
- Rotary Table Drives
- Shredders
- Timber Harvesting
- Top Head Drives
- Wheel & Tracks
- Winches

Driven to design better solutions to meet your unique needs

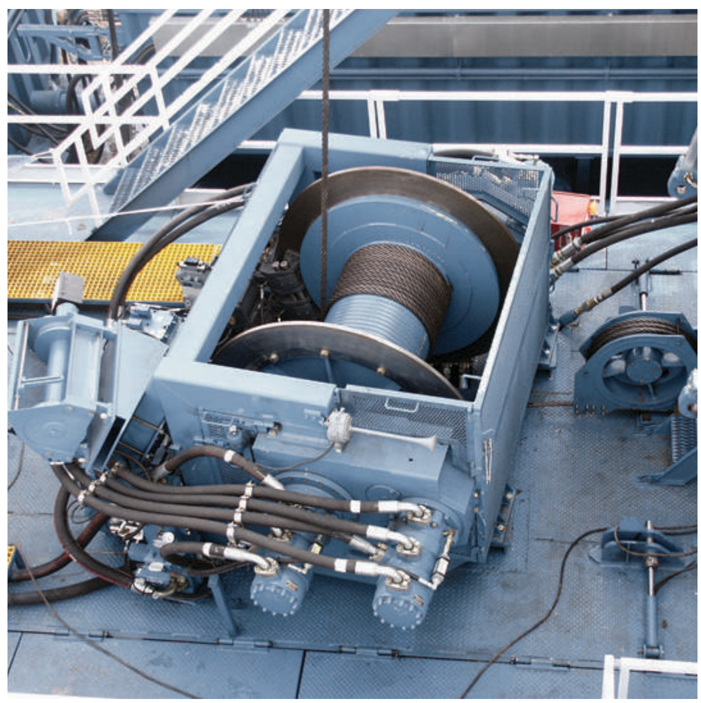
Working together, we constantly strive to deliver more power where you need it, when you need it, to get the job done!



◄ **Caisson drill rigs use 4-ported motors along with a multi-speed circuit to vary bit rpm and torque.**

▲ **Power tongs are a staple of the oil field. Our vane crossing vane motors have been providing the torque to make and break pipe joints for over 40 years.**

Designed & manufactured to withstand the most demanding applications



◄ **Vane crossing vane motors power top drives for oil and gas exploration.**

▲ **A large capacity winch is driven by two 4096 cc (250 cubic inch) motors plugged into the drum via a gearbox.**

Engineering the right motors for over 40 years

Rineer Hydraulics, Inc. was formed in 1967, and is recognized worldwide as a leading manufacturer of quality hydraulic motors. Rineer has been integrated with Bosch Rexroth since 2008 and is a strong complement to our hydraulic portfolio.

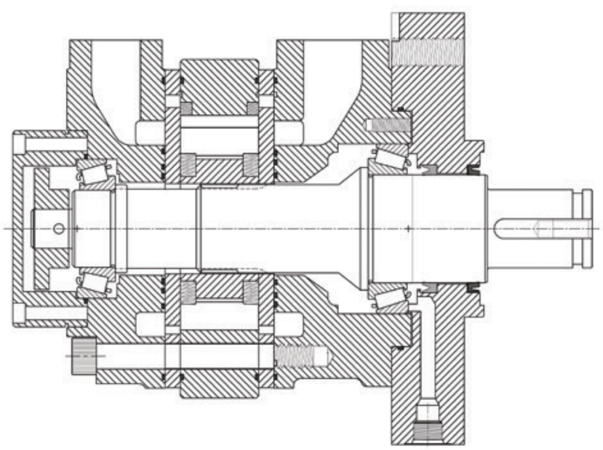
Highly skilled engineers
Our team of dedicated engineers, working with a state-of-the-art CAD system, responds quickly to customer requests.

Extensive R&D testing
Once a design modification is completed, drawings are forwarded to manufacturing for machining. Upon completion, units are sent to the R&D Lab for extensive mechanical and hydraulic testing.

State-of-the-art equipment
The lab is equipped with computer monitored dynamometers with capabilities exceeding 1,000 horsepower. Coupled with numerous special devices, we can perform a wide array of testing.

Quality assurance
To ensure maximum control over tolerances and quality, all major components of the vane crossing vane motor are manufactured in-house using the latest technology.

Customer satisfaction is our priority
Our company mission is to provide our customers with a reliable, performance-proven product. Customers are welcome to share ideas with our staff in order to assure complete satisfaction.



- ▲ **Customized motor with customer specified shaft and mount**
- ▲ **Load specific bearing selection**
- ▲ **Speed sense capability**

The Drive & Control Company

Rexroth
Bosch Group

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Hydraulics
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www.boschrexroth-us.com

Find your local contact person here:
www.boschrexroth-us.com/contactus

RA 10540/10.13 Replaces: RA 10540/10.12

Printed in the United States

RE 15 190/07.03

Replaces: 02.92

Radial piston hydraulic motors with a fixed displacement Types MKM, MRM

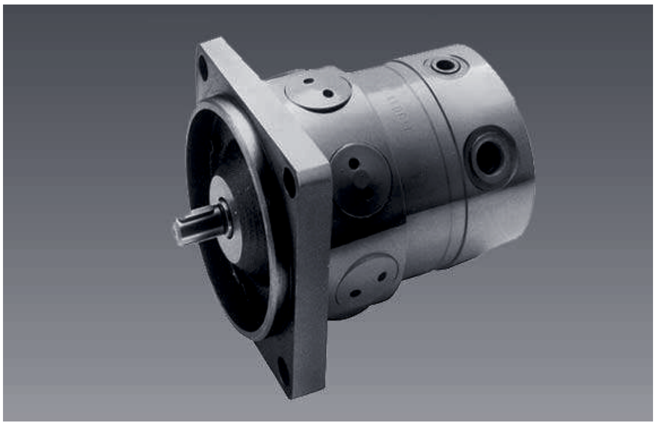
Nominal sizes 11 to 250

Series 1X

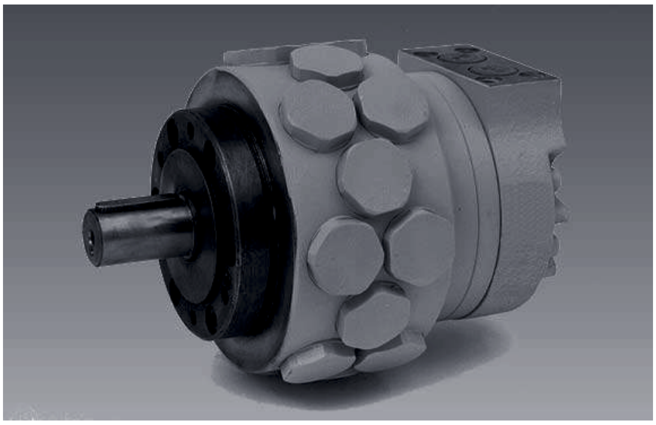
Maximum operating pressure 315 bar

Maximum displacement 251 L/min

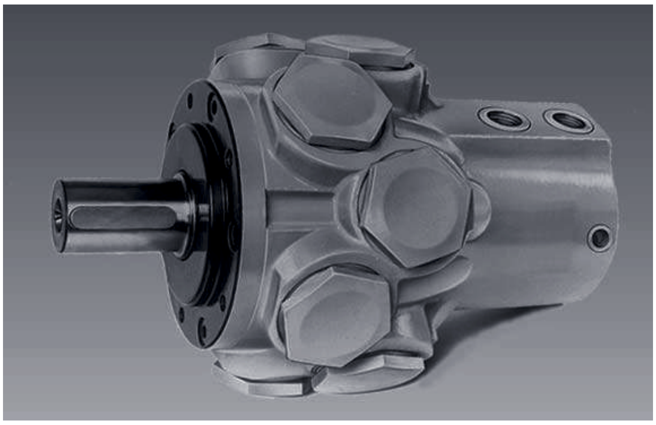
Maximum torque 1165 Nm



Type MKM 11 AZ 1X/M2 A0



Type MKM 90 AZ 1X/M1 A1



Type MRM 160 AZ 1X/M1 A0

Overview of contents

Features

– Wide speed range
– Linear acting backlash compensation control
– Smooth rotation even at very low speeds
– Extremely small moment of inertia permitting high reversal frequency
– Very suitable for control applications
– Suitable for fire resistant fluids
– Very low operating noise level
– Versions with:
  • Shaft for tachometer
  • Through shaft
  • Built-on valves
  • With brakes

Ordering details

				1X/						*

Motor type
Standard motor (NS 11, 22, 32, 45, 63, 90, 110) = **MKM**
Motor with backlash compensation control (NS 11, 80, 125, 160, 250) = **MRM**

Displacement – NS

	MKM	MRM	
11 cm^3 = NS 11	•	•	= **11**
22 cm^3 = NS 22	•	–	= **22**
33 cm^3 = NS 32	•	–	= **32**
44 cm^3 = NS 45	•	–	= **45**
66 cm^3 = NS 63	•	–	= **63**
81 cm^3 = NS 80	–	•	= **80**
89 cm^3 = NS 90	•	–	= **90**
110 cm^3 = NS 110	•	–	= **110**
126 cm^3 = NS 125	–	•	= **125**
161 cm^3 = NS 160	–	•	= **160**
251 cm^3 = NS 250	–	•	= **250**

• = Available

1st shaft end
Cylindrical, key DIN 6885 = **A**
Splined shaft DIN 5480 (**only** motor type **MRM** without NS 11) = **K**
Internally splined shaft DIN 5480 (**only** motor type **MRM** without NS 11) = **H**

2nd shaft end
Without 2nd shaft end = **Z**
Cylindrical Ø 10 mm for tacho connection = **M**
Splined Ø 28 mm DIN 5480 (**only** motor type **MKM** without NS 11) = **M10-**

Series 10 to 19 (10 to 19, unchanged installation and connection dimensions) = **1X**

NBR seals, suitable for HLP mineral oil to DIN 51 524 part 2 = **M**
FKM seals, suitable for phosphate ester (HFD) for HFB and HFC – pressure reduced to 70 % = **V**

Flange version
1 = Face mounting - standard version (**not** for type **MKM** NS 11)
2 = Flange mounting
3 = Face mounting (**only** for NS 22, 32, 45, 63, 90, 110)

Pipe connections
A0= Threaded connection, radial
A1= Flange connection, radial (for NS 80, 125, 160, 250-SAE 3/4")
B5= Threaded connections, axial (**only** NS 22, 32, 45, 63, 90, 110)

Additional details
No code = Standard
S99 = Flushing connection (**not** for NS 11)
T = Increased clearance for very high speeds and very high temperatures

Built-on valves, subplate mounting
(only in conjunction with line connections **A1**)
No code = None
N01 = Pressure-anti-cavitation valve (pressure stage in clear text)
N61 = Pressure-anti-cavitation valve Valve connection NS 6 to DIN 24 340
N101 = Pressure-anti-cavitation valve Valve connection NS 10 to DIN 24 340

Holding brake
No code = Without brakes
LBD9A2, **LBD11A2**, **LBD124A2**, **LBD249A2** (see technical data on page 5)

Further details in clear text e. g. gear unit tacho/valves

Ordering example: MKM 45 AZ1X/M2A0

Technical data (for applications outside these parameters, please consult us!)

General

Design	Radial piston motor, fixed displacement
Type	MKM; MRM
Mounting style	Flange mounting; front face mounting
Connection type	Threaded; flange (depending on version)
Installation	Optional
Shaft loading, bearing life	See page 6

			11[1]	11[2]	22	32	45	63	80	90	110	125	160	250
Nominal size	*NS*		11[1]	11[2]	22	32	45	63	80	90	110	125	160	250
Moment of inertia	*J*	kg cm²	2.63	2.63	2.8	2.8	3.3	3.3	17	3.9	4.1	17	23	23
Weight	*m*	kg	12	12	17.4	17.4	18.8	18.8	40	21.4	21.4	40	58	58

Hydraulic

Displacement		V	cm³	11	11	22	33	44	66	81	89	110	126	161	251
Torque	Specific theoretic	T	Nm/bar	0.17	0.17	0.35	0.52	0.7	1.05	1.29	1.41	1.75	2	2.56	4
	Specific average	T	Nm/bar	0.15	0.15	0.32	0.48	0.63	0.95	1.16	1.27	1.59	1.8	2.38	3.7
	Continuous	T	Nm	21	24	50	76.8	100	152	290	178	223	360	595	740
	Max.	T	Nm	31.5	37.5	78	120	157	237	365	266	334	567	750	1165
Pressure differential	Continuous pressure	Δp	bar	140	160	160	160	160	160	250	140	140	200	250	200
	Operating pressure, max	Δp	bar	210	250	250	250	250	250	315	210	210	315	315	315
	Peak pressure [3]	Δp	bar	250	315	315	315	315	315	400	250	250	350	400	350
Max. summated pressure in ports A + B		p	bar	250	315	315	315	315	315	400	250	250	350	400	350
Leakage fluid pressure		p	bar	1.5 bar (special seals for higher pressures on request.)											
Speed range	From	n	min⁻¹	10	5	10	10	5	5	5	5	5	5	5	5
	Up to	n	min⁻¹	3000	3600	2250	1500	1800	1200	800	900	750	600	800	600
				For speeds ≤ 10 min⁻¹ please take the operating instructions into account, depending on the application minimum speeds of 0.1 min⁻¹ are possible in closed loop applications.											
Power	Continuous	P	kW	3.5	4.7	6	6	9.5	9.5	12	8.5	8.5	12	24	24
	Intermittent	P	kW	4.3	5.8	7.5	7.5	11	11	15	10	10	15	30	30

$P_{continuous}$ Continuous working power (with a max. return pressure of 10 bar): If continuously exceeded, then rotary group flushing should be provided.
$P_{intermittent}$ Power that intermittently (max. 10 % ED within an operating period of one hour) can be demanded.

Pressure fluid			HLP mineral oil to DIN 51 524 part 2
			HFB and HFC fluids – pressures reduced to 70 %,
			Phosphate ester (HFD), FKM seals required
Pressure fluid temperature range	ϑ	°C	– 30 to + 90
Viscosity range	ν	mm²/s	20 to 150 recommended operating range 30 to 50, up to 1000 on start-up
Cleanliness class to ISO code			Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 class 20/18/15

The cleanlines class stated for the components must be adhered too in hydraulic systems. Effective filtration prevents faults from occurring and at the same time increases the component service life.
For the selection of filters see catalogue sheets RE 50 070, RE 50 076 and RE 50 081.

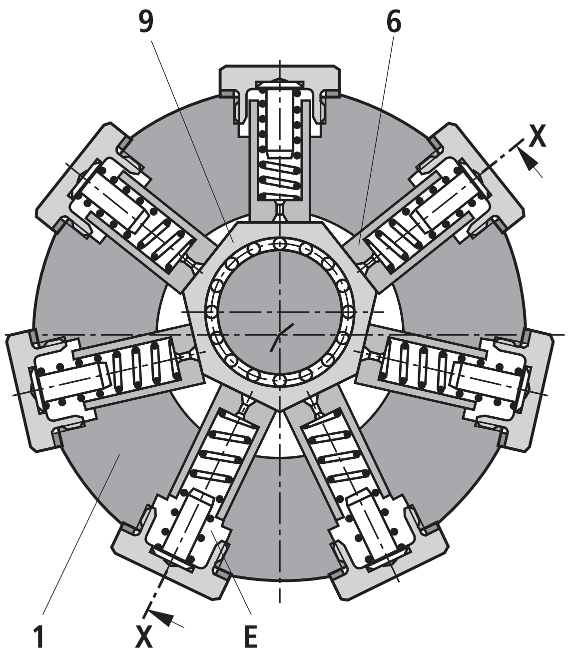
Technical data for the holding brake

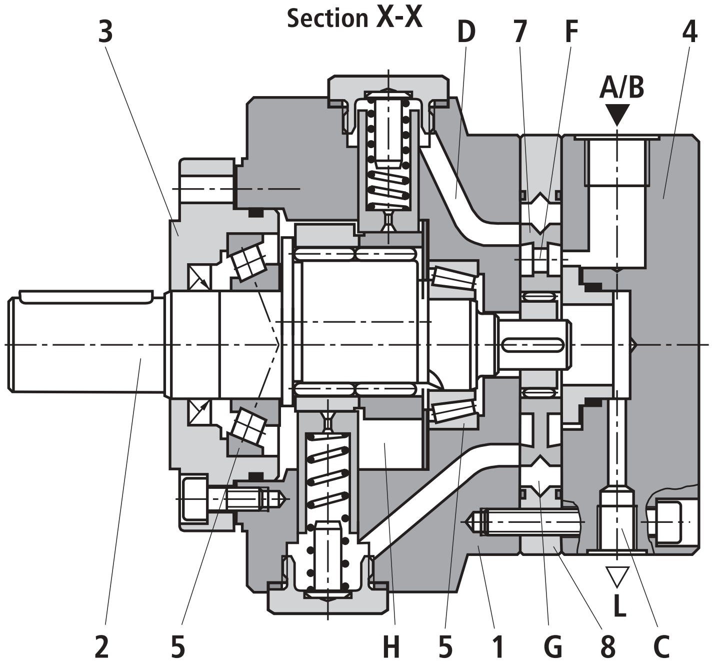
Design			Spring pressure multiple disc brake, static holding brake; dynamic operation only in the case of an emergency			
Brake type			LBD9A2	LBD11A2	LBD124A2	LBD249A2
Static braking moment (wet running)	$T_ü$	Nm	17	190	400	740
Dynamic braking moment (wet running)	T_s	Nm	11	140	300	500
Air pressure	p	bar	20 – 250	30 – 320	30 – 320	30 – 320
Weight	m	kg	8	9.5	28	32
Motor type cross reference			MKM 11 A2 MRM 11 A2	MKM 22 A1 MKM 32 A1 MKM 45 A1 MKM 63 A1 MKM 90 A1 MKM 110 A1	MRM 80 K2 MRM 125 K2	MRM 160 K2 MRM 250 K2

[1] MKM; [2] MRM

[3] Definition to DIN 24 312 peak pressure = pressure curve which temporarily exceeds the maximum operating pressure and at which the motor continues to remain operable.

Function, section





Types MKM and MRM hydraulic motors are fixed displacement external radial piston motors.

Design

The main components are housing (1), crankshaft (2), cover (3), cover plate (4), tapered roller bearings (5), pistons (6), control (7).

Rotary group details

The radial pistons (6) act on the crankshaft (2) via needle bearings (9) or via heptagonal rings with needle bearings.

Crankshaft bearings:

Pre-stressed, generously sized tapered roller bearings (5) in the X-arrangement.

Power transmission pistons (6) – crankshaft (2):

Via needle bearings (9) (or heptagon ring with needle bearings)

Low friction losses, very long life, not sensitive to contamination, also suitable for maximum pressures and motor speeds, high starting torque, no stick/slip at low motor speeds, minimal leakage and high efficiency.

Operating medium, feed and return

The operating medium is supplied to and carried away from the motor by way of ports A or B. The cylinder chambers (E) are filled or emptied by way of the control and the channels (D) in the housing (1).

Torque generation; operating stroke

The operating medium in the cylinder chambers (E), which are at present connected to the supply, are pressurised. The pistons (6) are pushed from the outside (external loading!) onto the eccentric of the crankshaft (operating stroke) and the crankshaft rotates.

Operating medium return

The pistons (6), which are again pushed outwards by the rotation of the crankshaft (2) eccentric, expel the fluid from the cylinder chambers (E), which are at present connected to the return flow line.

Control

Design:

A flat distributor which moves in a linear manner.

Purpose:

Distribution of incoming flow to the cylinder chambers, collection of return flow.

Operating principle:

The control plate (7) incorprates an inner annular area (F) and forms with the annulus (8) an external annular chamber (G). By offsetting the control plate (7) radially between the motor housing (1) and locking cover (4) with the help of the eccentric which is connected firmly relative to the crankshaft (2) the inner and the outer annular areas are alternately brought into contact with the cylinders. The annular areas themselves open out into ports A or B on the outside.

Leakages

Leakages occurring at piston (6) and control (7) are collected in the motor casing (H) and discharged via drain port (C).

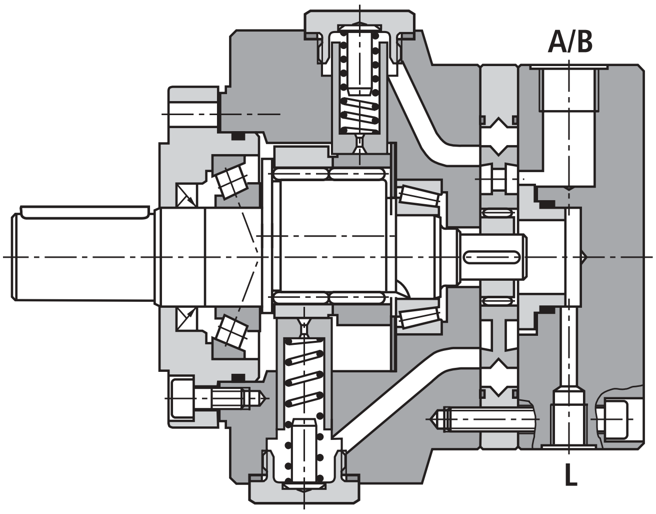
Flushing

With high powers and/or temperatures we recommend the use of rotary group flushing.

Dependent on the type, 1 to 4 litres of flushing oil is fed into the drain connection L (4) and is then passed together with the motor leakage via the flushing port S99 to tank.

Features

MKM



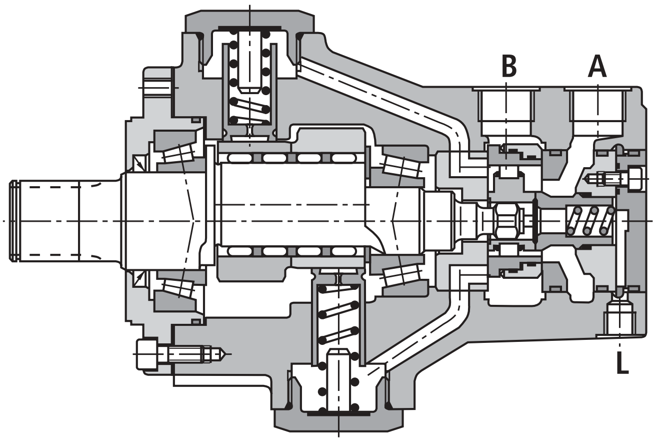
Rotary group

– 7, 14 or 21 radially arranged pistons
– Power transmission piston - crankshaft: by means of pistons via heptagonal ring with needle cage

Control

– Needle cage between the control plate and eccentric
– A flat distributor plate that moves in a linear manner with gap seals to counter internal leakage and gap compensating sealing against external leakage.
– Hydrostatic spring supported pressing of the pressure piece onto the control plate
– Reduction in external leakage with minimal friction losses

MRM



Rotary group

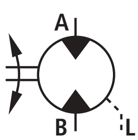
– 5 or 10 radially arranged pistons
– Power transmission piston - crankshaft: by means of hydrostatically unloaded pistons and pentagonal ring with needle cage

Control

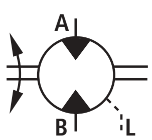
– Roller bearings between the control rings and eccentric
– A flat distributor plate that moves in a linear manner with backlash compensation
– Hydrostatic spring supported pressing of the control rings onto the flat surfaces
– Hydrostatic backlash compensation of the flat eccentric surfaces, spring supported via the pressure piece
– Reliable backlash compensation even at high reversing frequencies
– Only very slight leakage with minimal friction losses
– The miniaturised shuttle valve ensures: that within the ring chamber. between the control lands. the higher pressure that the motor is being subjected too is applied

Symbols

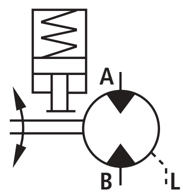
With one shaft end



With 2 shaft ends



With holding brake



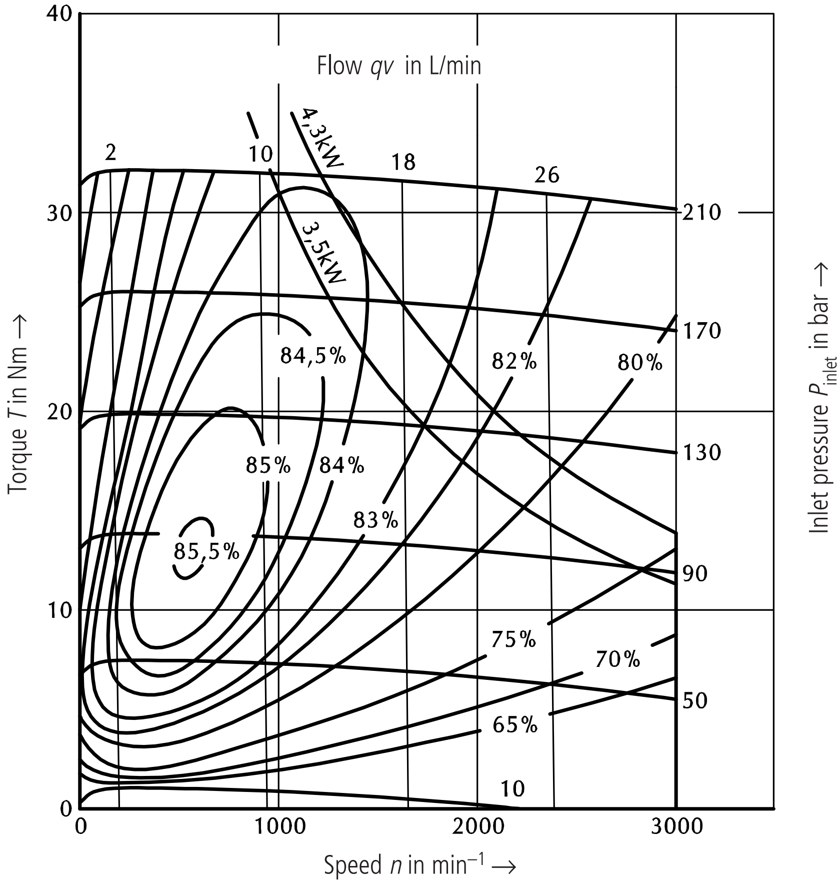
Bearing life, shaft strength

$L_{n\text{-hyd10}}$ is the modified nominal bearing life using mineral oil with a viscosity of n = 36 mm^2/s in operating hours where 10 % of the bearings may fail. 90 % achieve a higher bearing life. The average mean bearing life $L_{n\text{-hyd50}}$ with mineral oil is approximately five times $L_{n\text{-hyd10}}$. In practice a minimum of $L_{n\text{-hyd50}}$ can be expected for hydraulic drives with mineral oil. As the operating speed is incorporated into the calculation approximately as a proportionate figure, the table value is converted accordingly.

Type	Speed n (min^{-1})	$L_{n\text{-hyd10}}$ in operating hours at a defined Δp and speed n with no external forces on the drive shaft.						
		100 bar	140 bar	160 bar	180 bar	210 bar	250 bar	315 bar
MKM / MRM11	1000	>100000	88950	56995	38489	23024		
MKM 22/32	500	>100000	>100000	81400	54969	32883	18388	
MKM 45/63	350	43679	14228	9119	6157	3683	2059	
MKM 90/110	250	15719	5121	3281	2216	1325		
MRM 80	400	>100000	>100000	>100000	>100000	97424	54484	25217
MRM 125	400	>100000	85030	54484	36792	22009	12308	5697
MRM 160	400	>100000	38925	24941	16843	10075	5634	2608
MRM 250	300	31319	10203	6537	4415	2641	1477	684

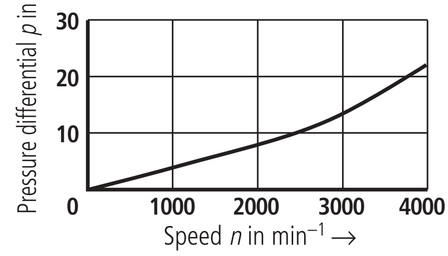
Type	Speed n (min^{-1})	$L_{n\text{-hyd10}}$ in operating hours at a defined Δp and speed n MKM 11, 22, 32, 45, 63 max. permissible radial force at the centre of the output shaft = 4500 N MKM 90, 110 max. permissible radial force at the centre of the output shaft = 3000 N MRM 80, 125, 160, 250 max. permissible radial force at the centre of the output shaft = 10 000 N						
		100 bar	140 bar	160 bar	180 bar	210 bar	250 bar	315 bar
MKM / MRM11	1000	4963	4485	4235	3983	3614		
MKM 22/32	500	5838	5092	4717	4353	3839	3225	
MKM 45/63	350	9319	5898	4713	3788	2767	1704	
MKM 90/110	250	11423	4689	3098	2115	1281		
MRM 80	400	27172	22727	20610	18623	15923	12872	9118
MRM 125	400	20998	15203	12872	10897	8514	6190	3810
MRM 160	400	25074	14939	11648	9167	6523	4289	2344
MRM 250	300	14150	6882	4977	3681	2421	1387	656

MKM 11

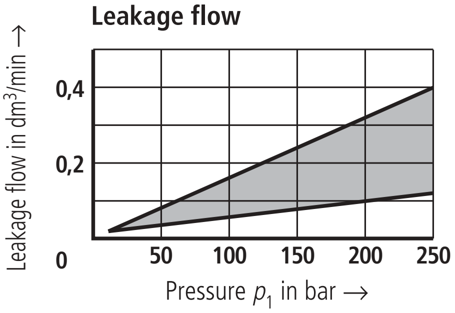


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

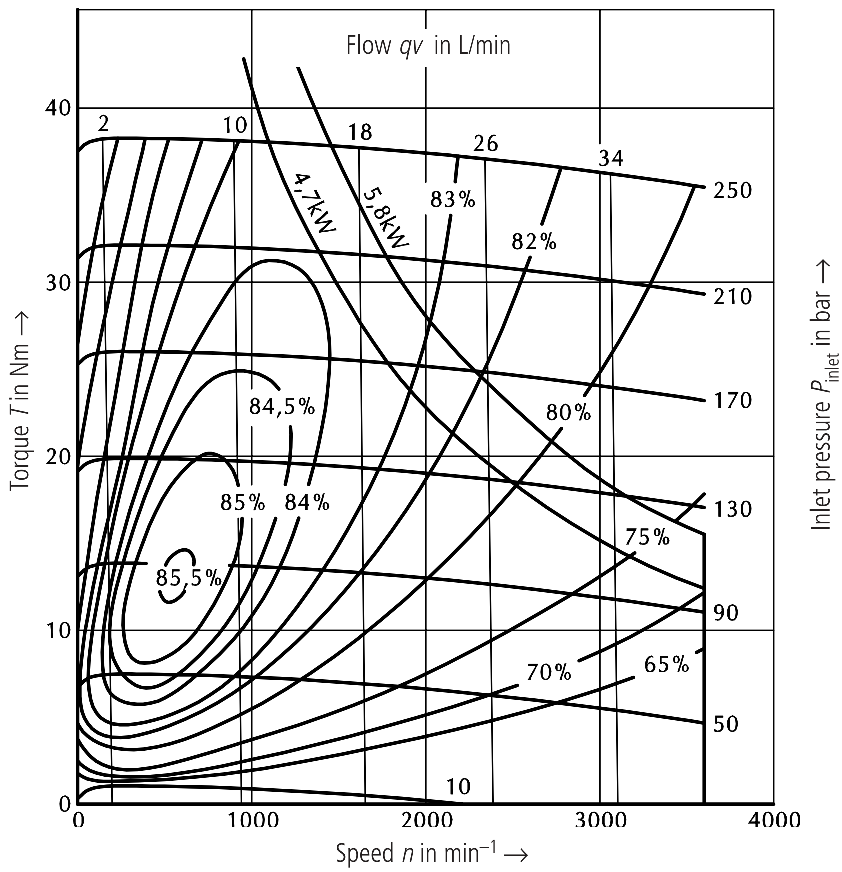
Off-load characteristi curve



Leakage flow

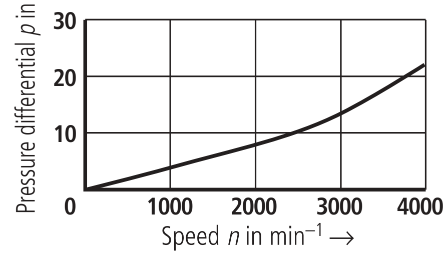


MRM 11

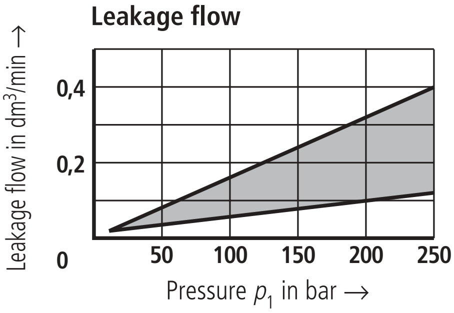


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

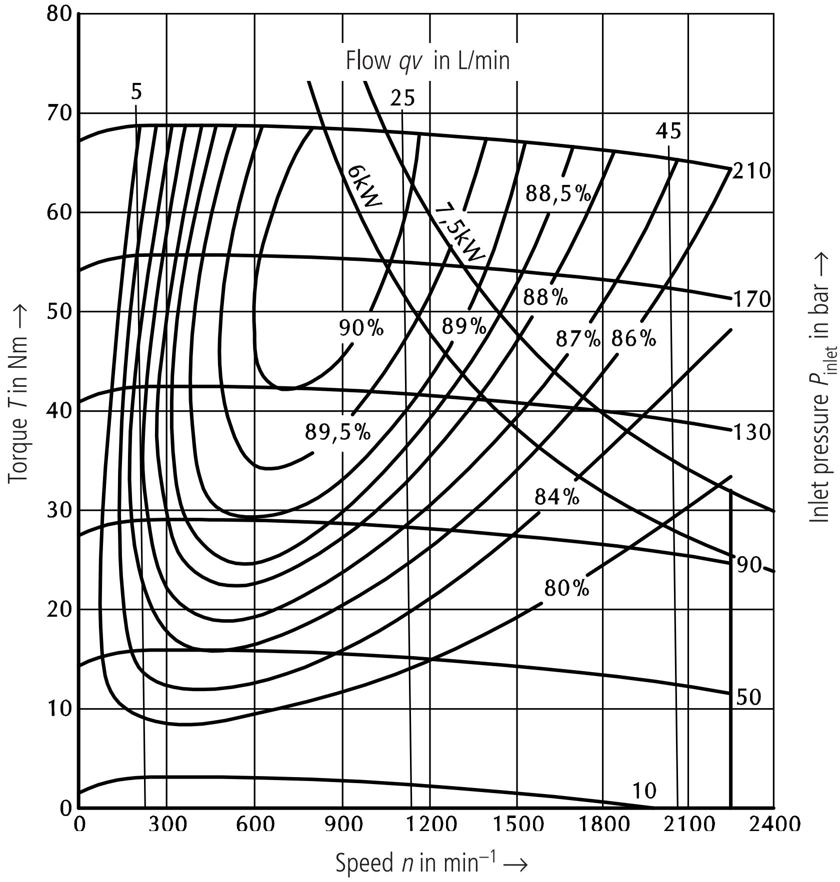
Off-load characteristic curve



Leakage flow

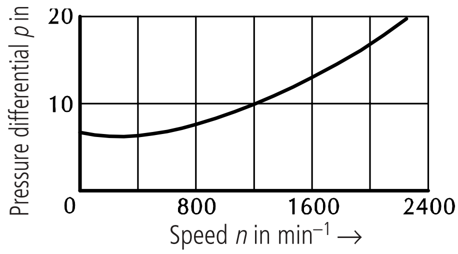


MKM 22

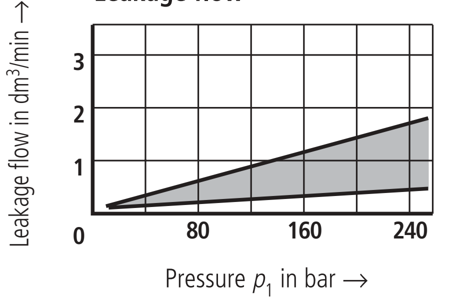


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

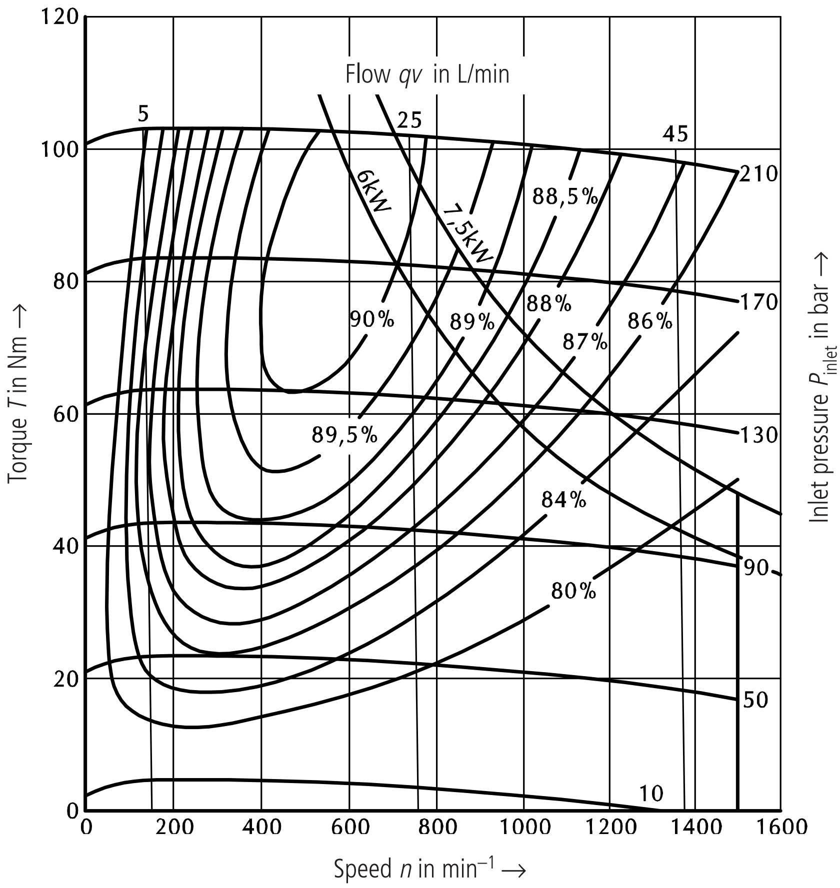
Off-load characteristic curve



Leakage flow

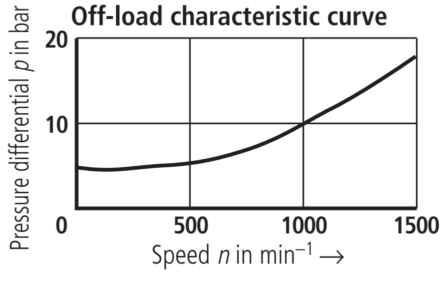


MKM 32

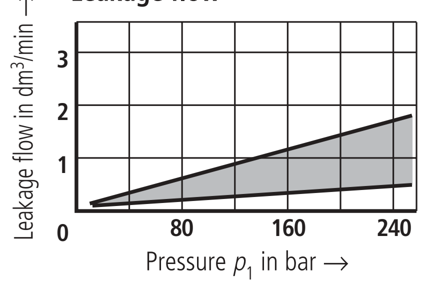


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

Off-load characteristic curve

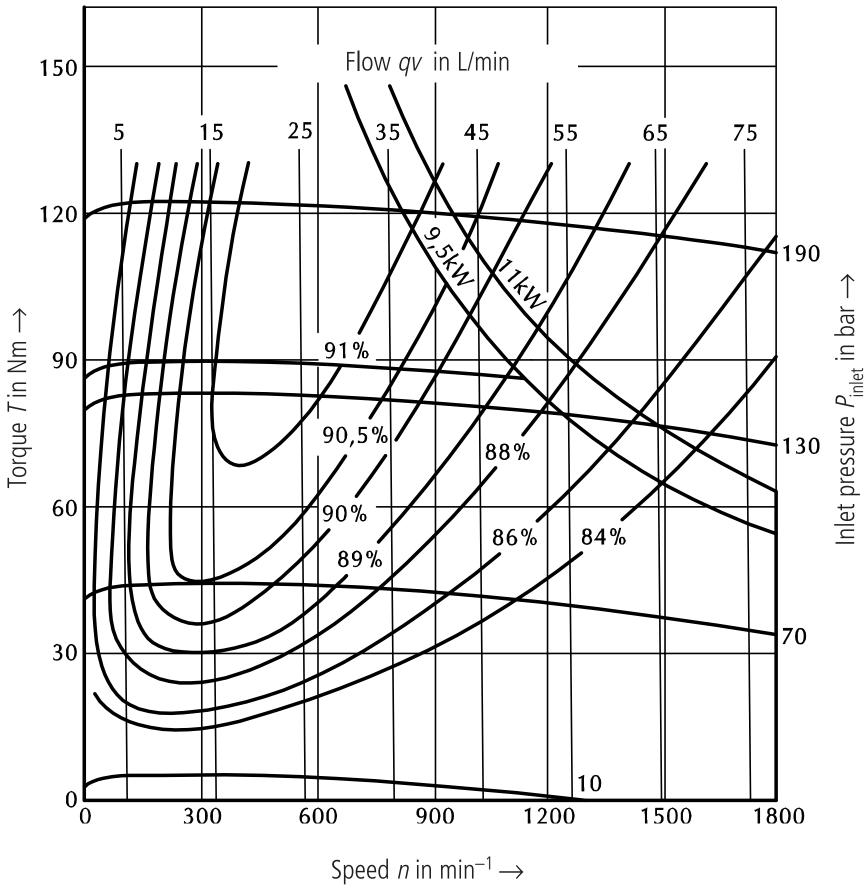


Leakage flow



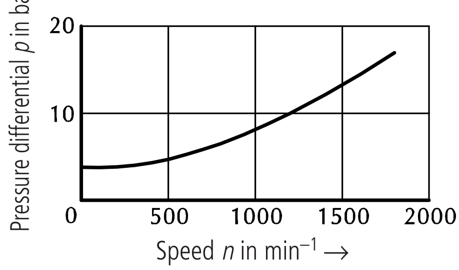
Characteristic curves (average value) measured at $\nu = 36\ mm^2/s$; $\vartheta_{oil} = 50\ °C$; $p_{outlet} = 0$ bar; $p_{leakage\ oil} = 0$ bar

MKM 45

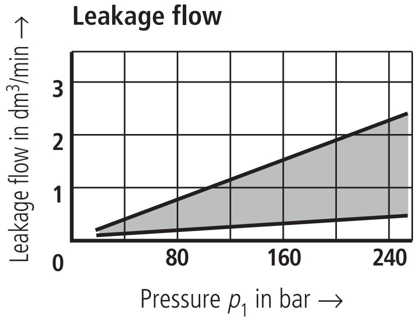


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

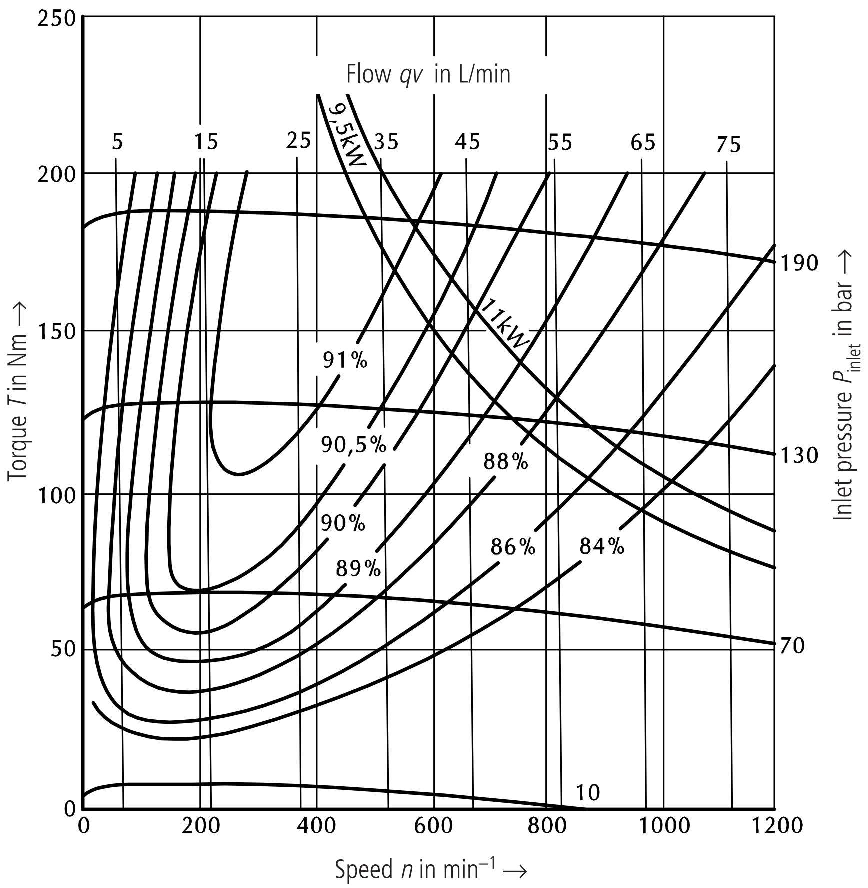
Off-load characteristic curve



Leakage flow

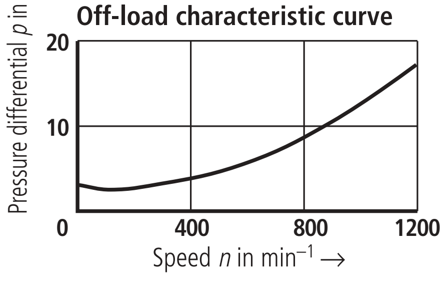


MKM 63

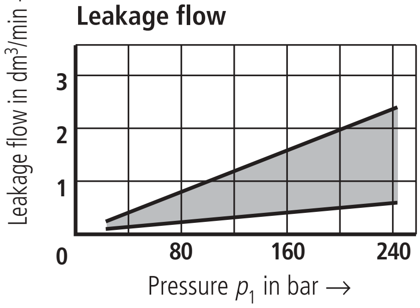


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

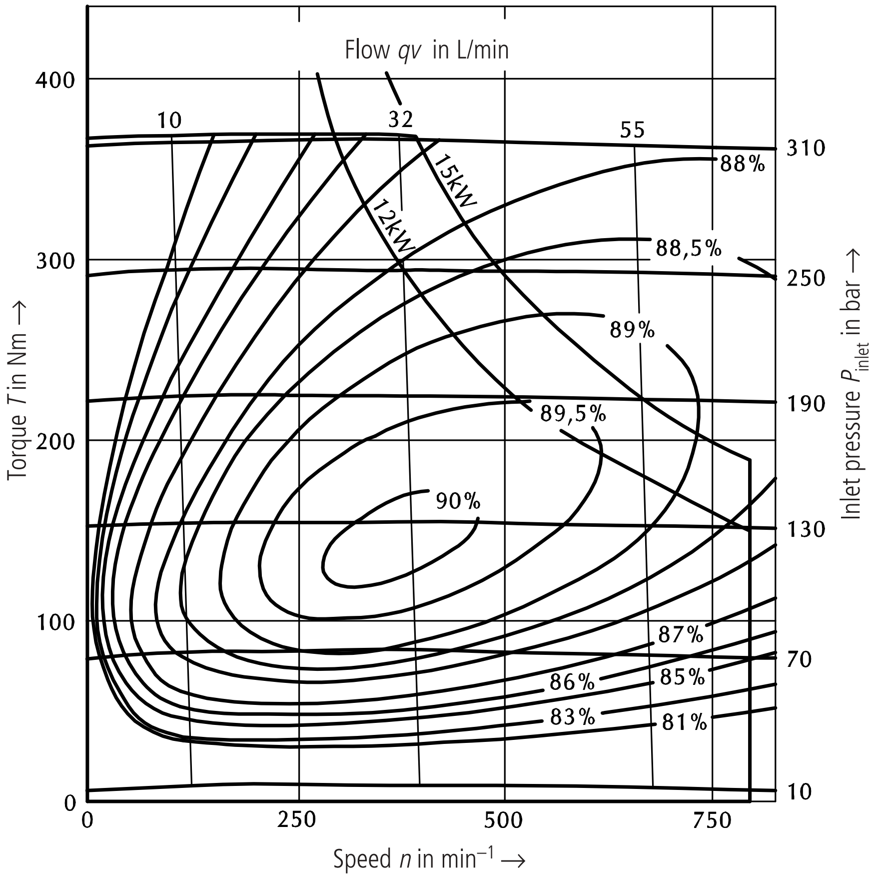
Off-load characteristic curve



Leakage flow

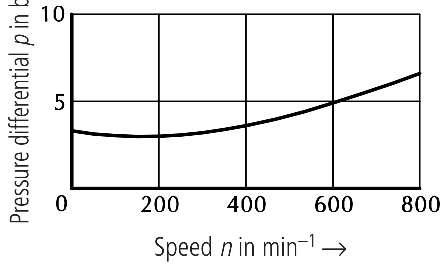


MRM 80

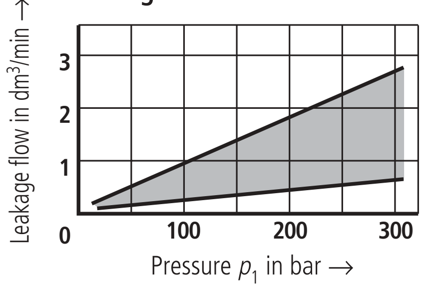


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

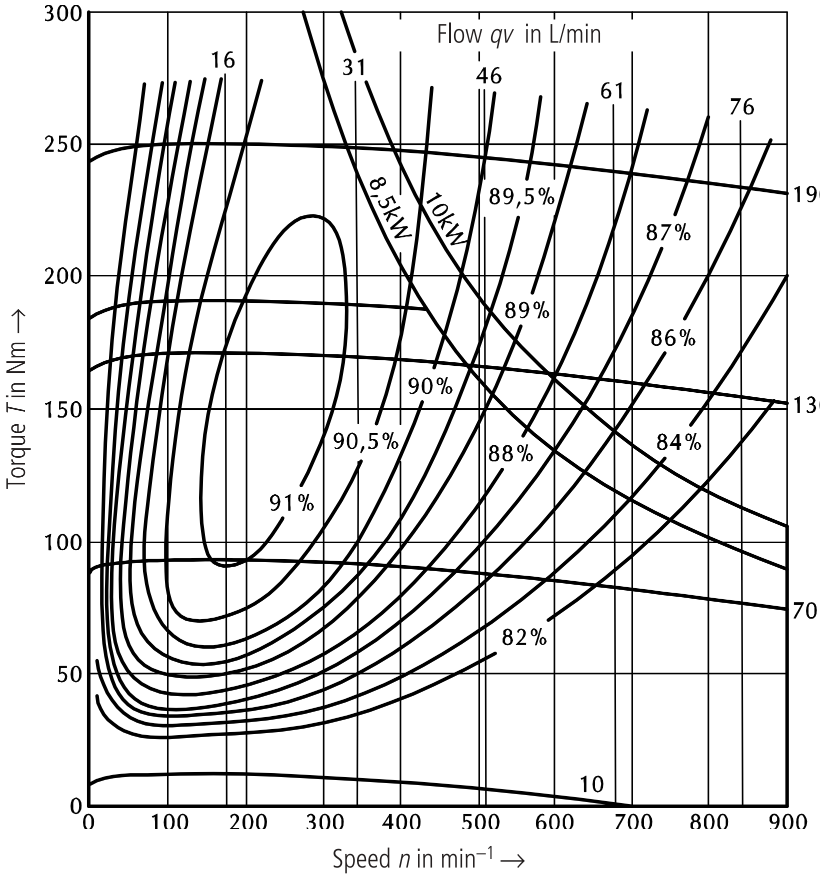
Off-load characteristic curve



Leakage flow

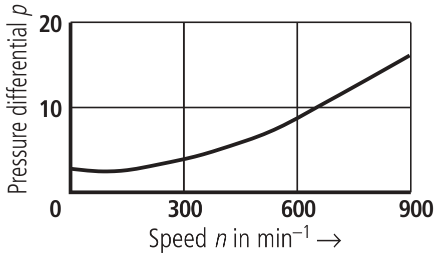


MKM 90

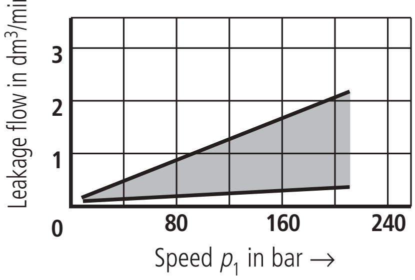


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

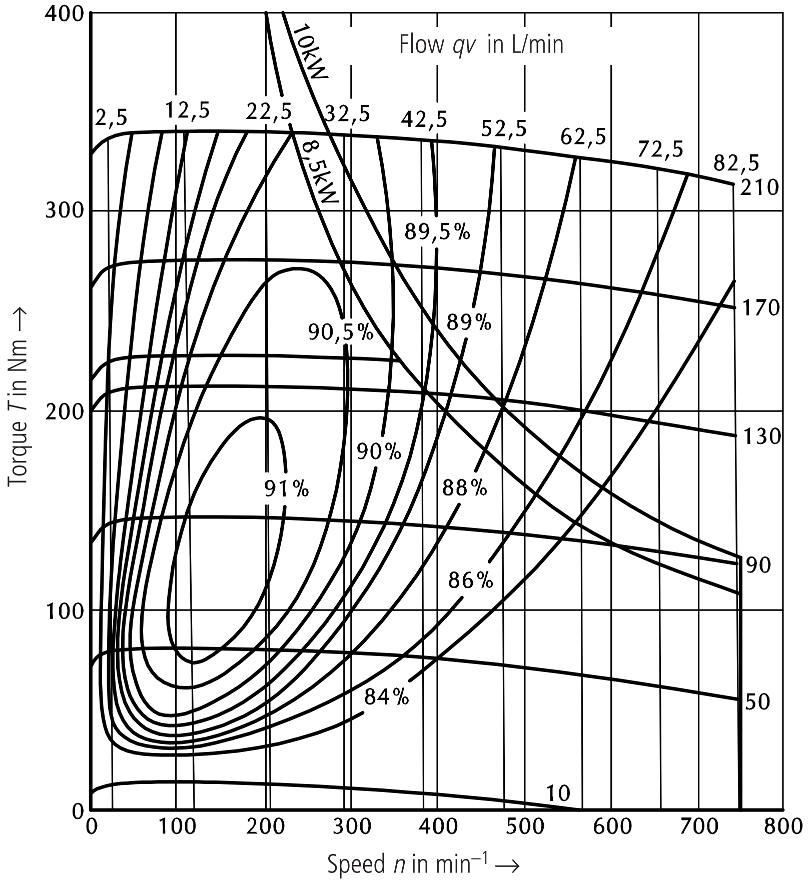
Off-load characteristic curve



Leakage flow

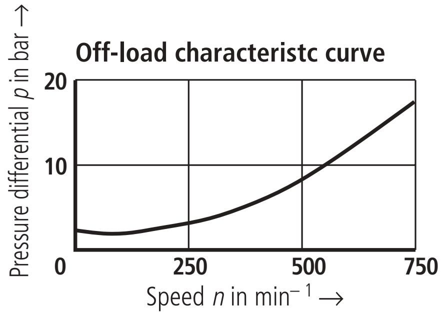


MKM 110

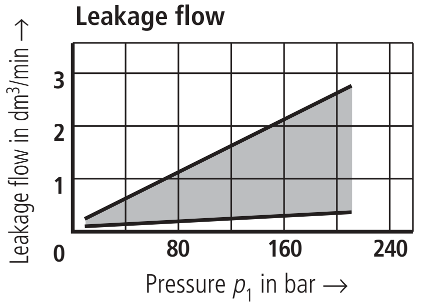


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

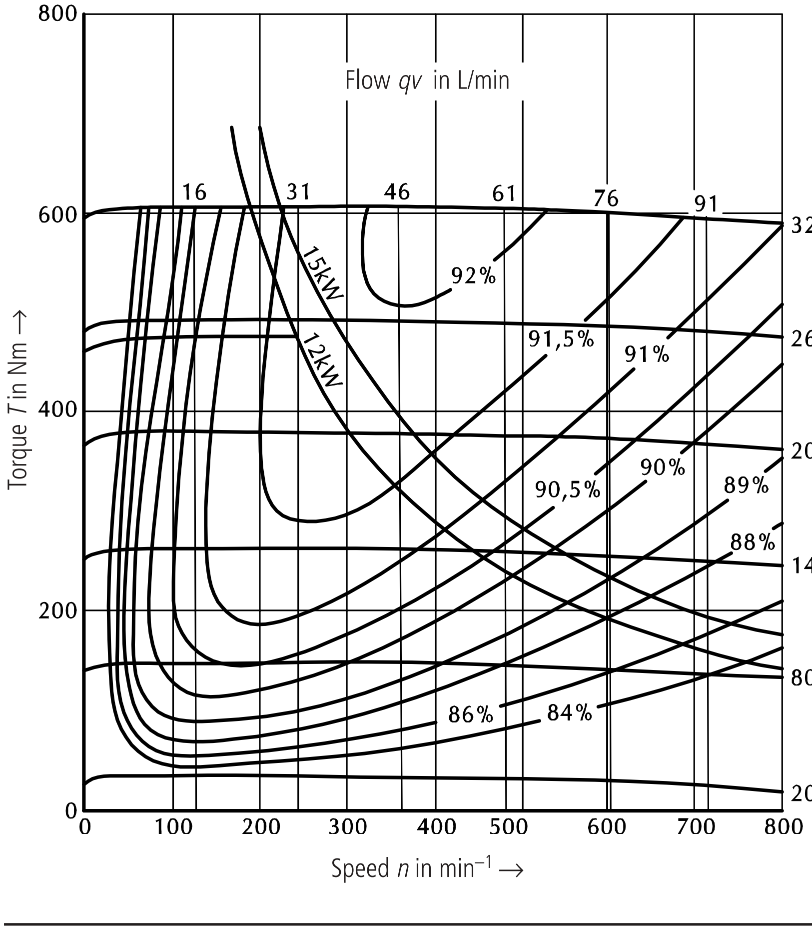
Off-load characteristc curve



Leakage flow

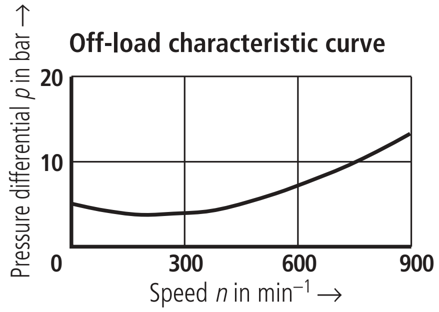


MRM 125

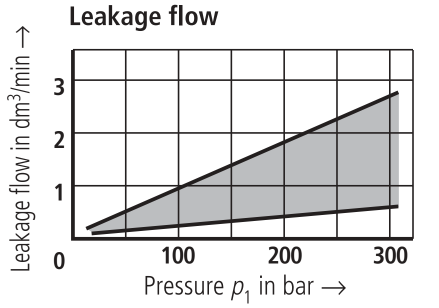


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

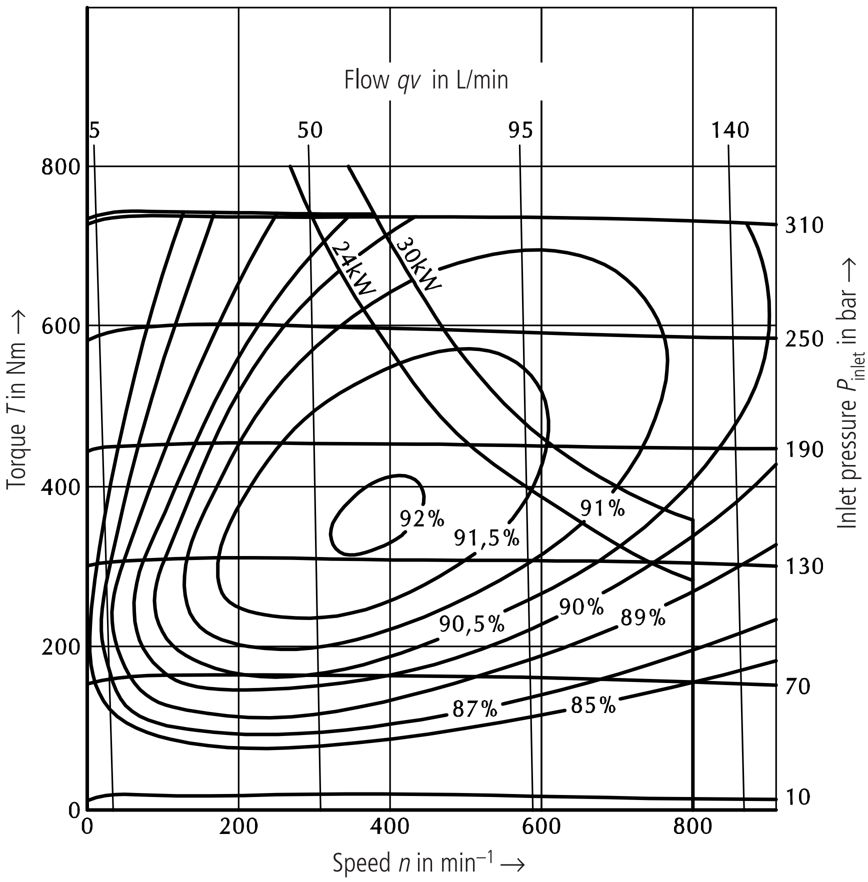
Off-load characteristic curve



Leakage flow

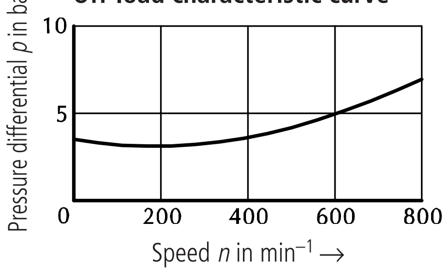


MRM 160

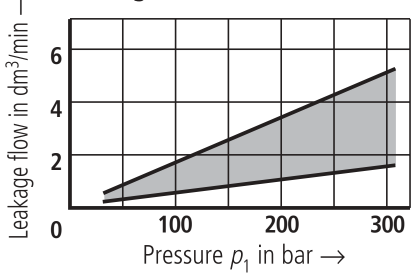


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

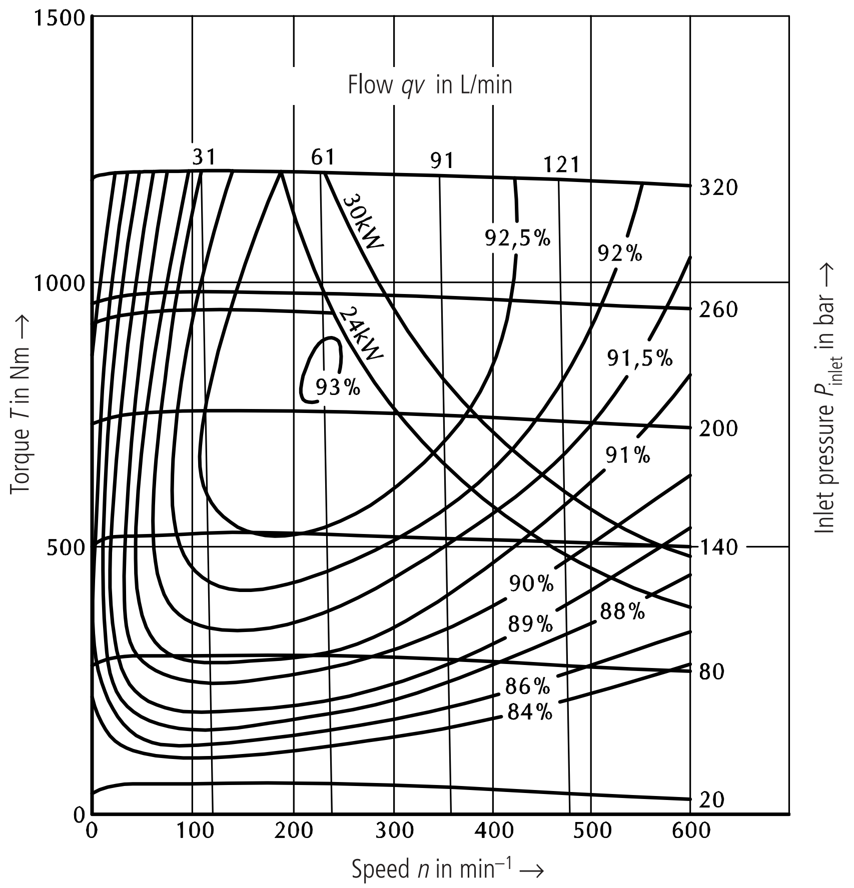
Off-load characteristic curve



Leakage flow

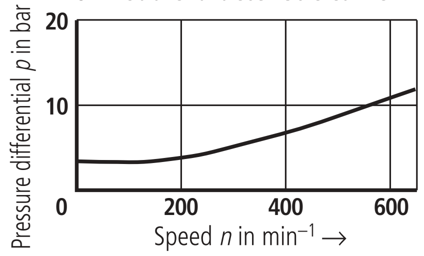


MRM 250

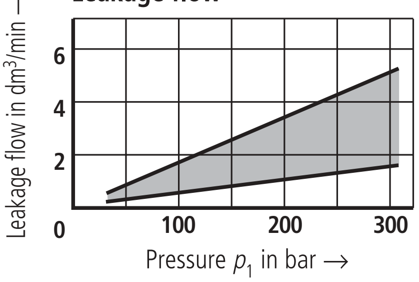


Minimum feed pressure during brake operation and closed circuit operation to the off-load characteristic curve.

Off-load characteristic curve

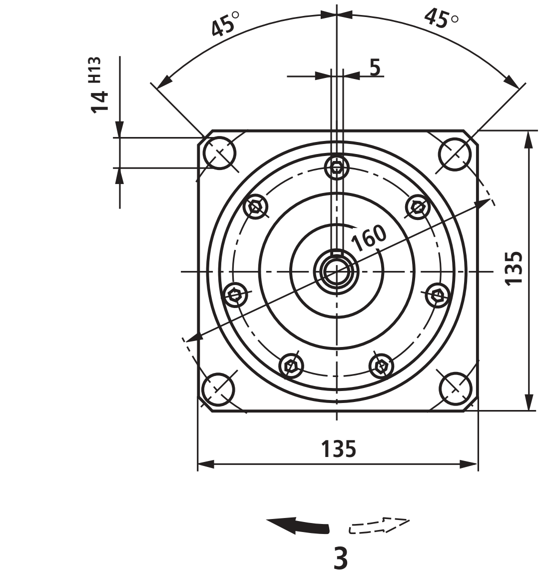


Leakage flow

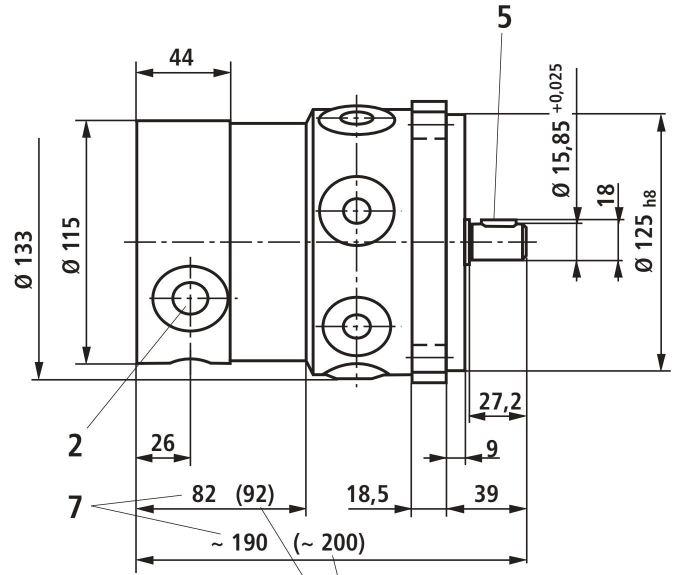


Flange version „2“ (ISO 3019/2)

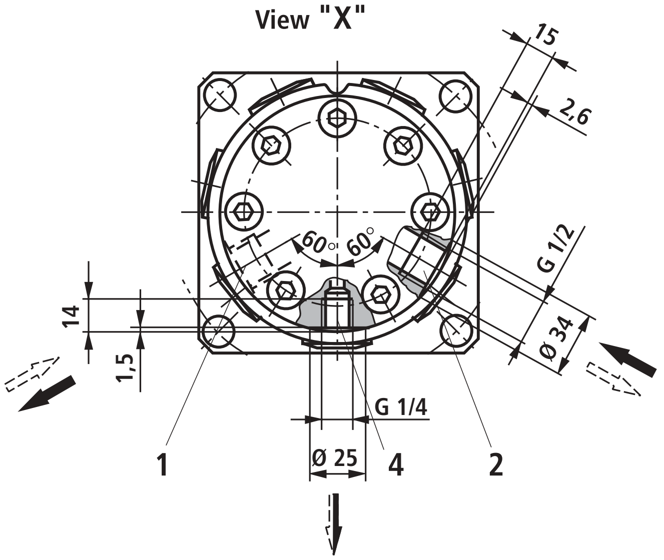
Pipe connection „A0“



"X"

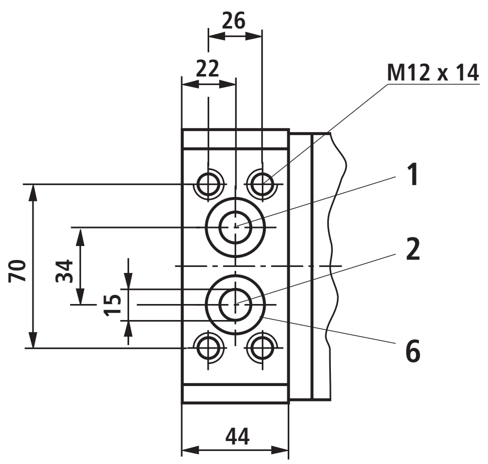


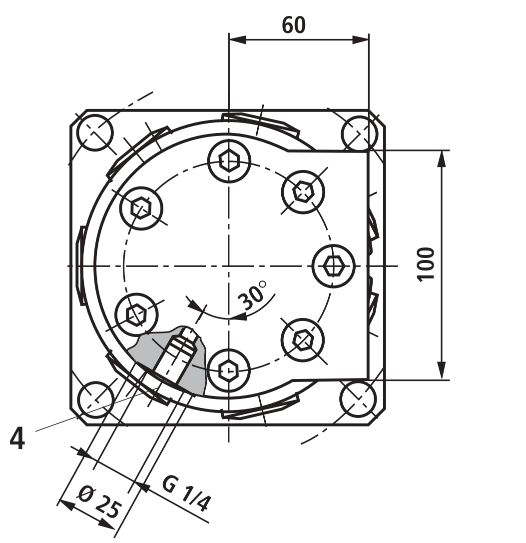
View "X"



1 Port A
2 Port B
3 Direction of rotation viewed on the shaft end
Right: With flow from port B to A
Left: With flow from port A to B
4 Leakage port
5 Key A 5 x 5 x 20 DIN 6885
6 Counterbore for O-ring 21.89 x 2.62
7 Type MKM 11
8 Type MRM 11

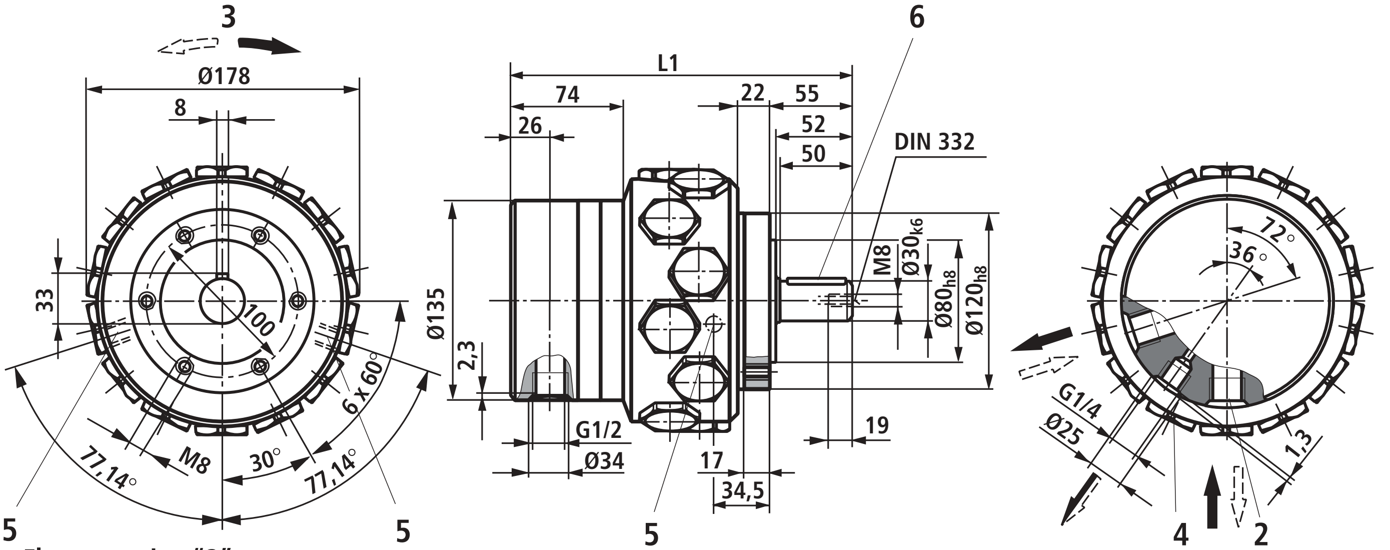
Pipe connection “A1”





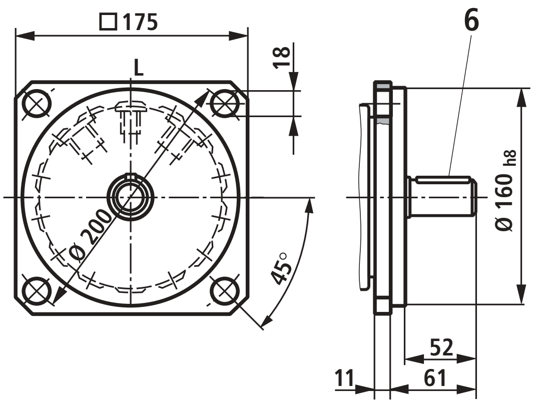
Flange version „1"

Pipe connection „A0"



Flange version "2"

DIN ISO 3019/2



Type	L1	Piston row(s)
MKM 22	208	1
MKM 32	208	1
MKM 45	226	2
MKM 63	226	2
MKM 90	248	3
MKM 110	248	3

1 Port A

2 Port B

3 Direction of rotation viewed on the shaft end

Right: With flow from port B to A

Left: With flow from port A to B

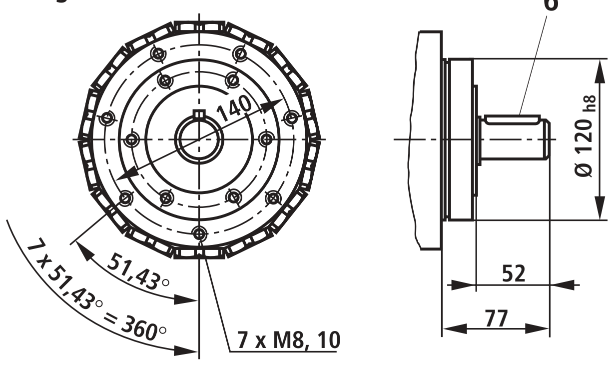
4 Leakage port G1/4

5 Flushing connection 2 x G1/4 (version **„S99"**)

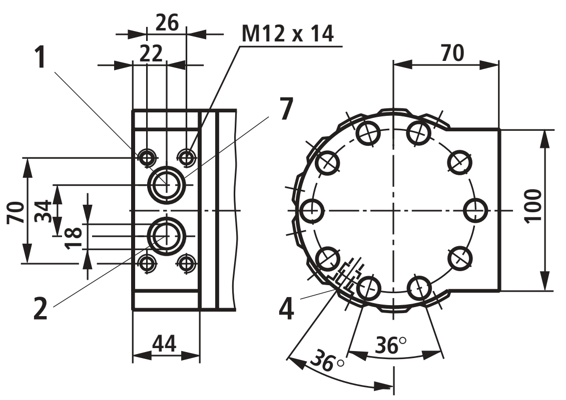
6 Key A 8 x 7 x 45 DIN 6885

7 Counterbore for O-ring 21.89 x 2.62

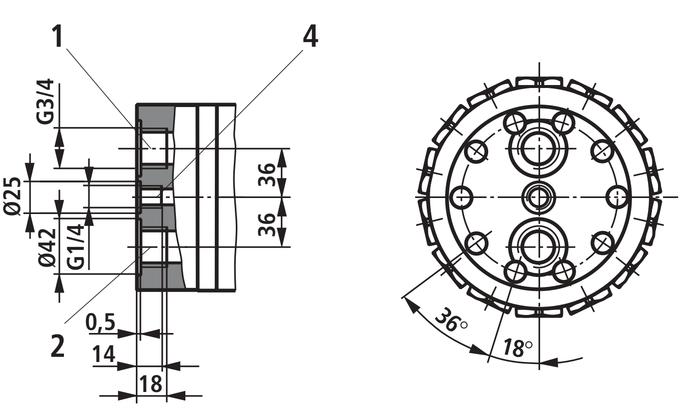
Flange version "3"



Pipe connection "A1"

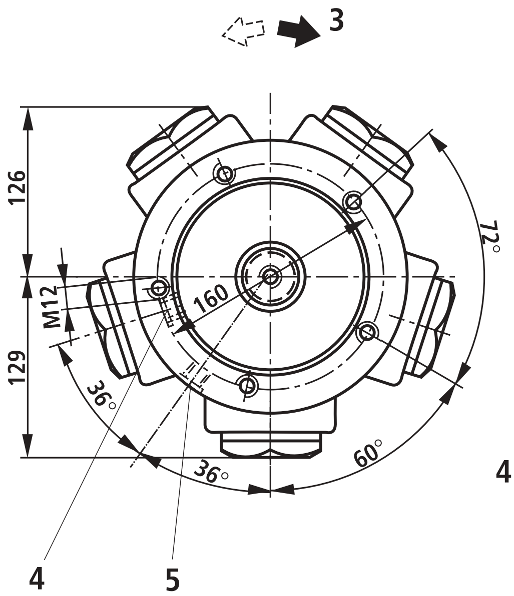


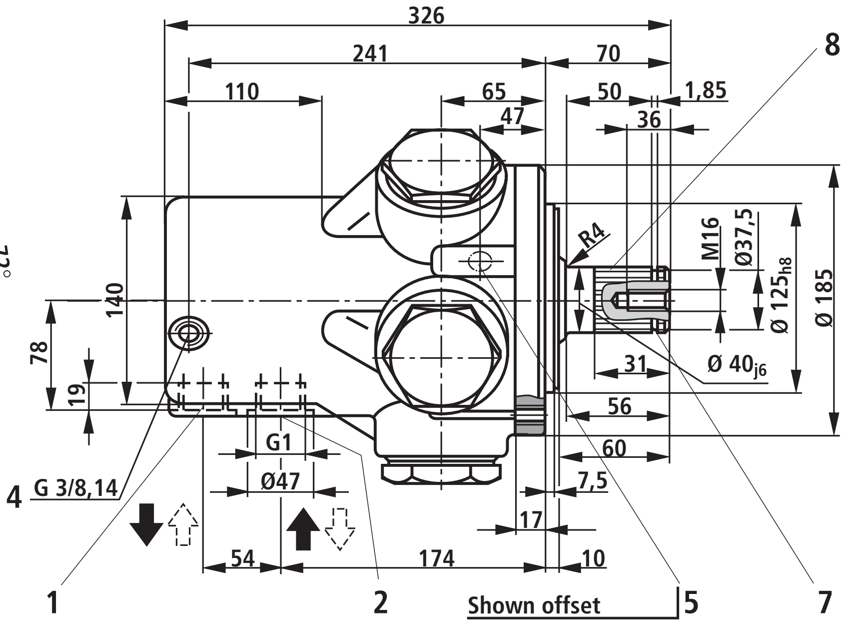
Pipe connection "B5"



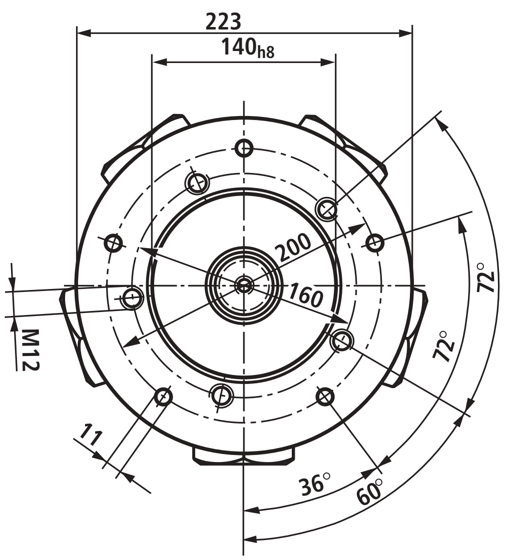
Unit dimensions: MRM 80 and 125 (dimensions in mm)

Flange version „1" with splined shaft „K"
Pipe connection „A0"





Flange version "2"
with through holes



1 Port A G 1

2 Port B G 1

3 Direction of rotation viewed on the shaft end
Right: With flow from port B to A
Left: With flow from port A to B

4 Leakage port G 3/8
Counterbore Ø 28 mm, offset 72° in relation to ports A and B

5 Flushing connection G 3/8 (version **„S99"**)

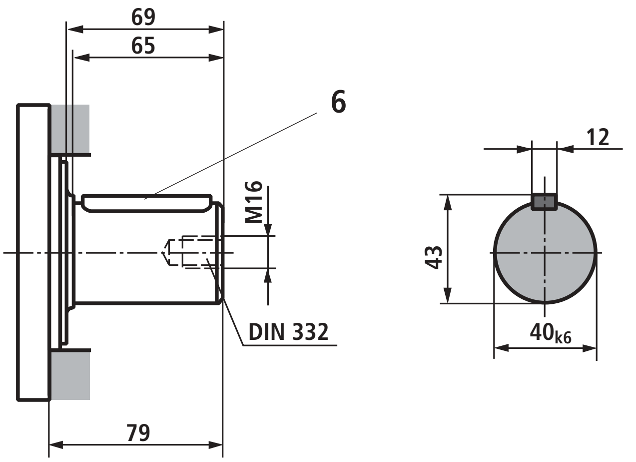
6 Key A 12 x 8 x 56 DIN 6885

7 Shaft groove for retaining ring DIN 471

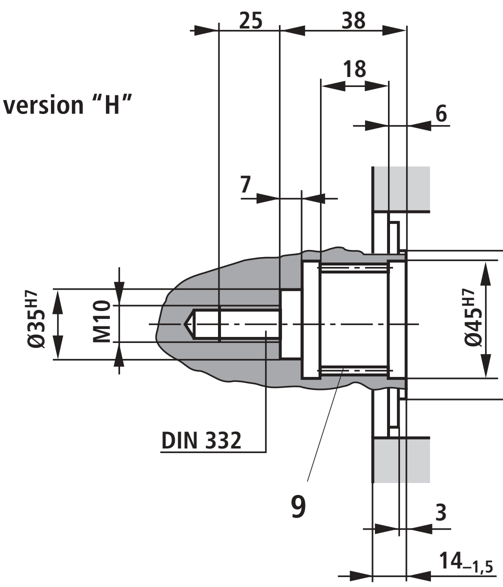
8 Splined shaft connection DIN 5480
W40 x 2 x 18 x 7h

9 Splined shaft connection DIN 5480
N45 x 2 x 21 x 9H

Shaft version "A"

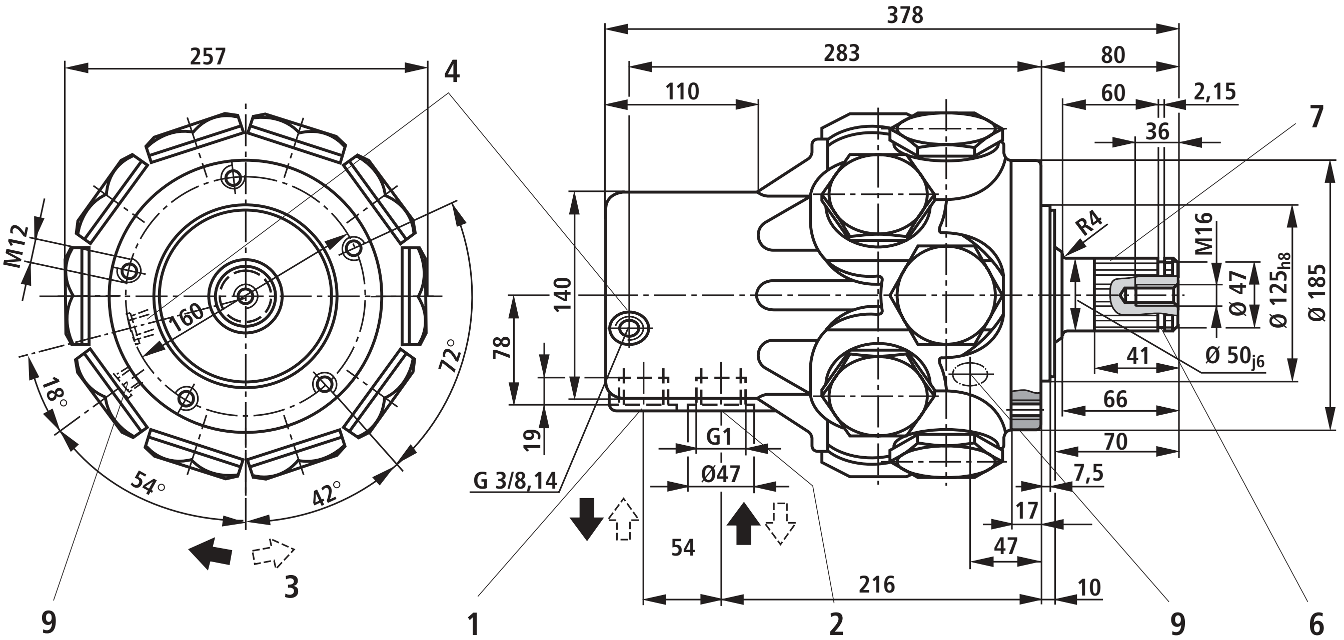


Shaft version "H"

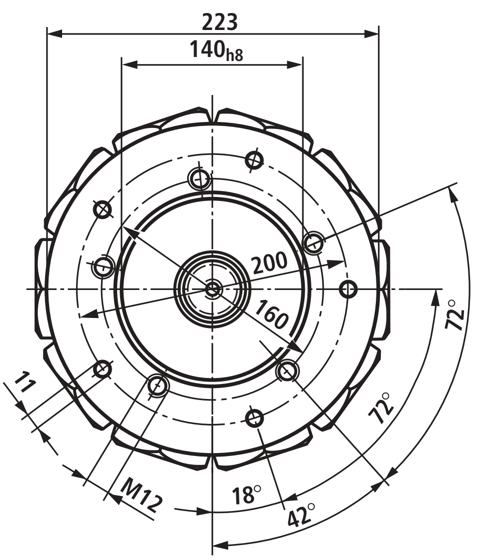


Unit dimensions: MRM 160 and 250 (dimensions in mm)

Flange version „1“ with splined shaft „K“
Pipe connection „A0“

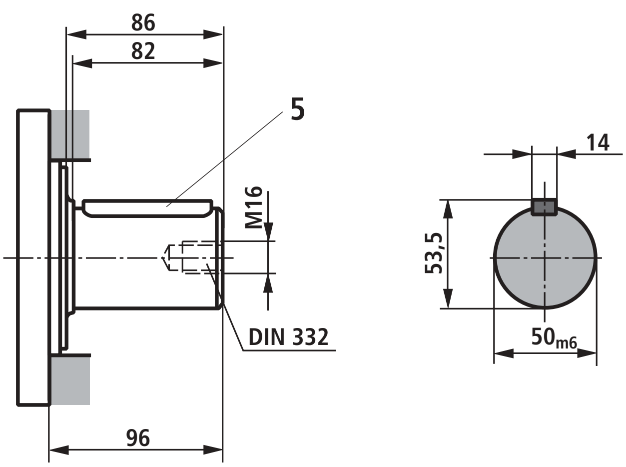


Flange version "2"
with through holes

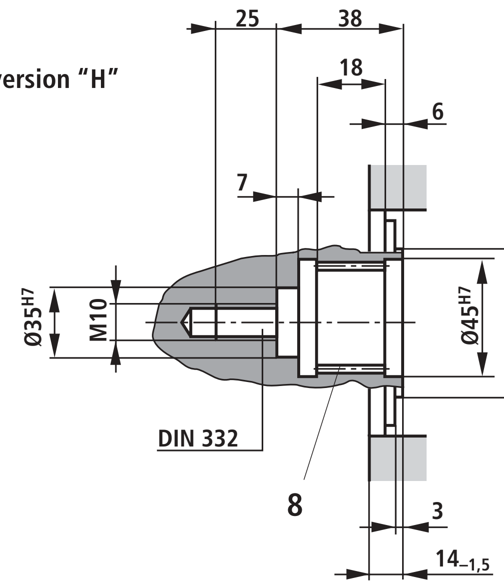


1. Port A G 1
2. Port B G 1
3. Direction of rotation viewed on the shaft end
   Right: With flow from port B to A
   links: With flow from port A to B
4. Leakage port
   Counterbore Ø 28 mm, offset 72 ° in relation to ports A and B
5. Key A 14 x 9 x 70 DIN 6885
6. Shaft groove for retaining ring DIN 471
7. Splined shaft connection DIN 5480
   W50 x 2 x 24 x 7h
8. Splined shaft connection DIN 5480
   N45 x 2 x 21 x 9H
9. Flushing connection G 3/8 (version **„S99“**)

Shaft version "A"



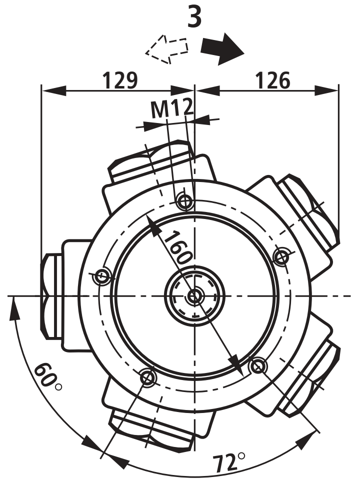
Shaft version "H"

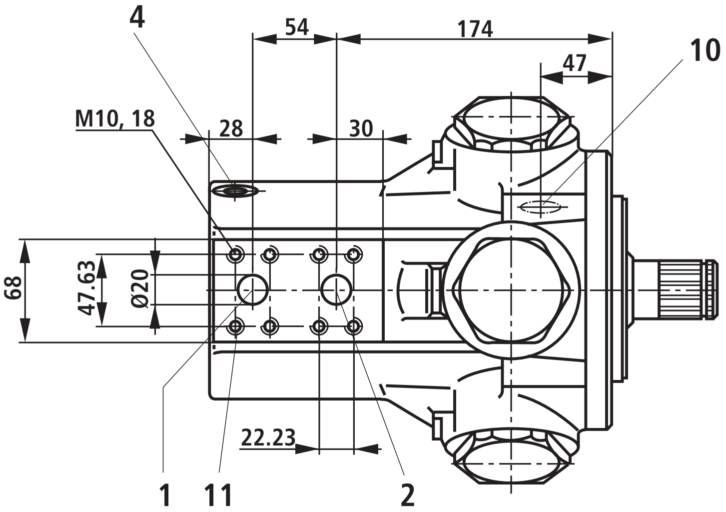


Unit dimensions MRM 80, 125, 160 a und 250 (dimensions in mm)

MRM 80, MRM 125
Flange version "1"
with splined shaft "K"
Pipe connection "A1"

For dimensions see page 15





1 Port A SAE J 518 3/4" standard

2 Port B SAE J 518 3/4" standard

3 Direction of rotation viewed on the shaft end
Right: With flow from port B to A
Left: With flow from port A to B

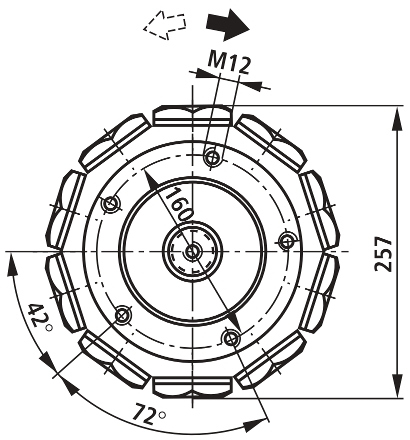
4 Leakage port G 3/8
Counterbore Ø 28 mm, offset 72° in relation to ports A and B

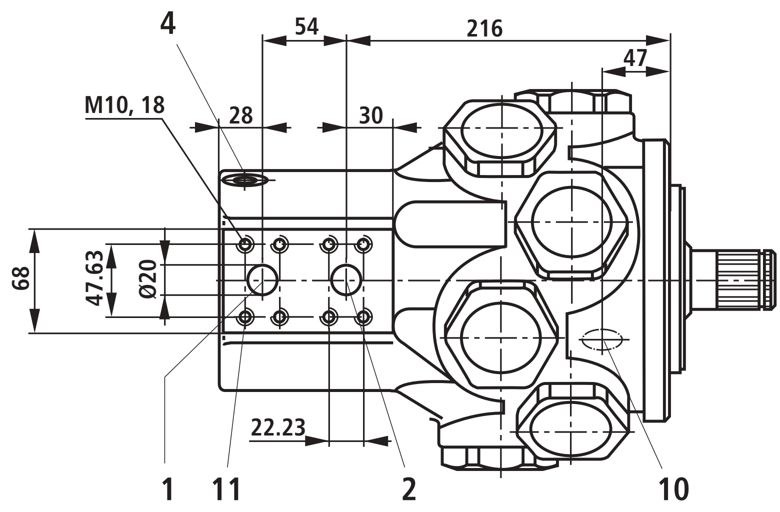
10 Flushing connection G 3/8 (version **„S99"**)

11 Flange height from centre of shaft $80^{+0.5}$ mm

MRM 160, MRM 250
Flange version "1"
with splined shaft "K"
Pipe connection "A1"

For dimensions see page 16

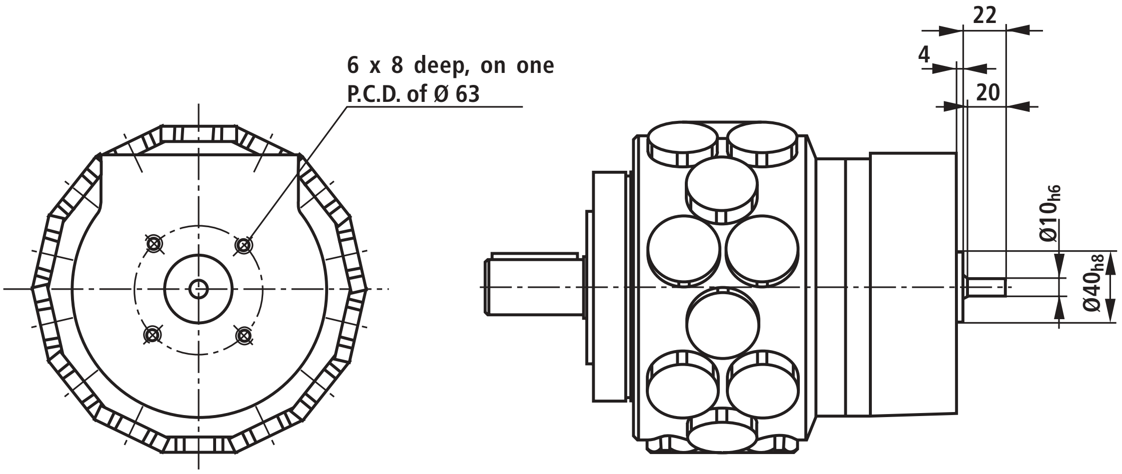




Motor with tachometer shaft (dimensions in mm)

Ordering detail **"M"**

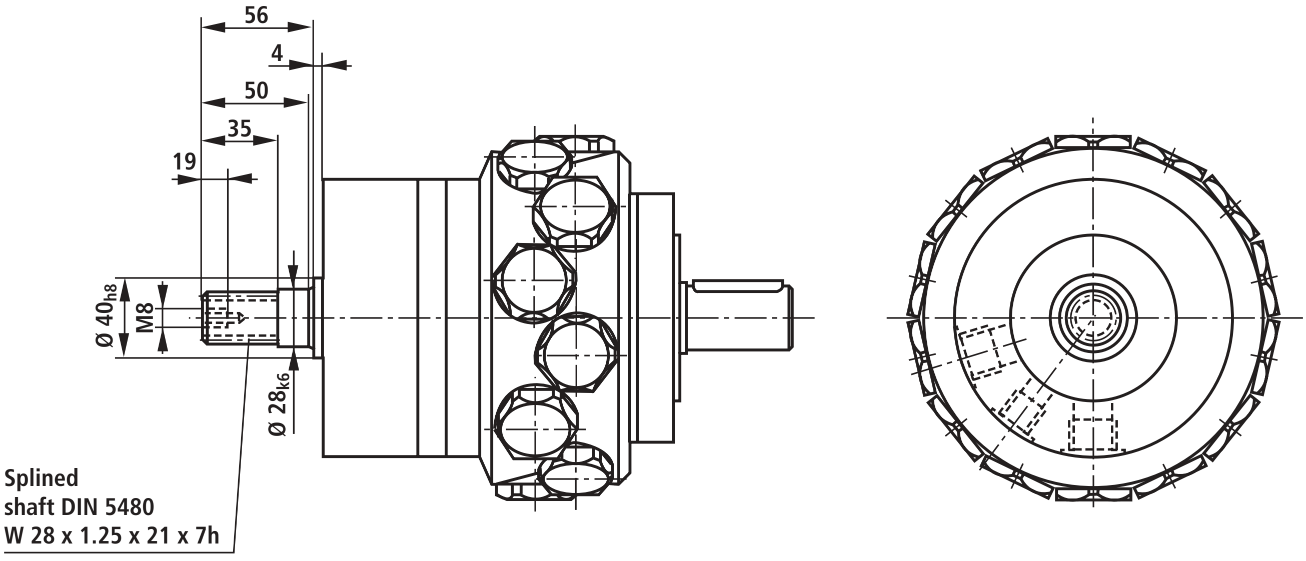
One size of tachometer shaft for all types, for measuring the motor speed, transmits a maximum torque of 5 Nm (for higher output torques please consult us).



Motor with through shaft (dimensions in mm)

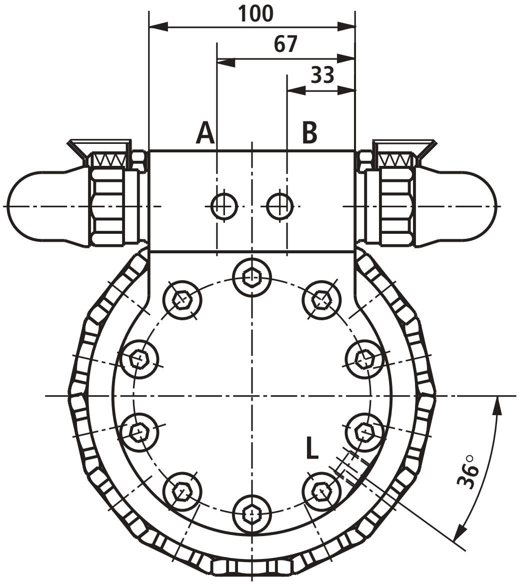
Ordering detail **"M10–"** (only for MKM 22 to 110)

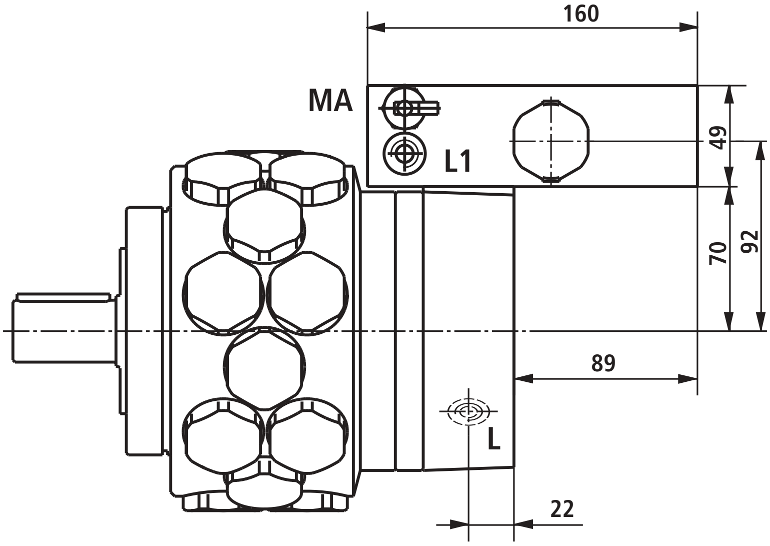
All of the radial piston motors of series MKM without the MKM 11 can be supplied with a through shaft, ordering detail M10-, for transmitting the full motor torque.



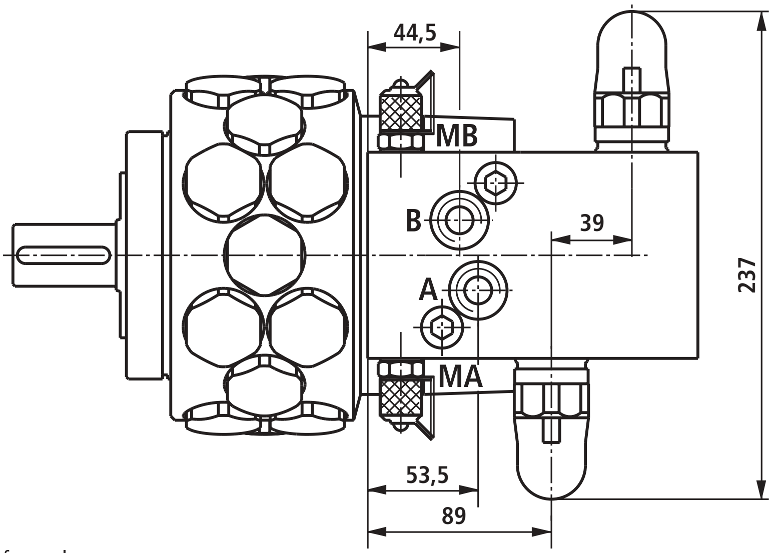
Valve design: pressure relief, anti-cavitation/feed, MKM...N01 (dimensions in mm)

Series MKM radial piston motors with two direct operated pressure relief valves, gauge port G 1/4, anti-cavitation/feed via two 0.1 bar check valves and G 1/2 pipe connections.





Port			Counter bore	
	Thread	Depth	Ø	Depth
A	G 1/2	16	28	$1.3^{+0.1}$
B	G 1/2	16	28	$1.3^{+0.1}$
L	G 1/4	14	25	$1.3_{-0.3}$
L1	G 1/4	14	20	1
L2	G 1/4	14	20	1
MA	G 1/4	12	20	1
MB	G 1/4	12	20	1
Pressure stage I			Up to 100 bar	
Pressure stage II			Up to 200 bar	
Pressure stage III			Up to 315 bar	

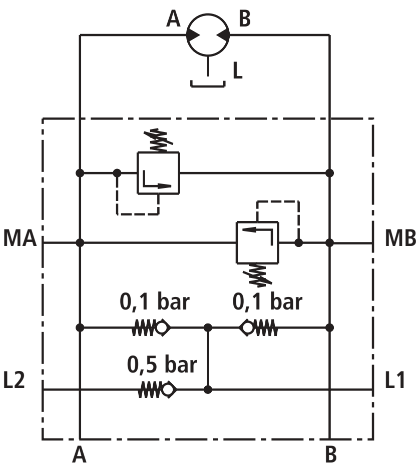


Note:

The valve cartridges are **not** included within the scope of supply, they must be ordered separately!

Pressure stage to be stated in clear text!

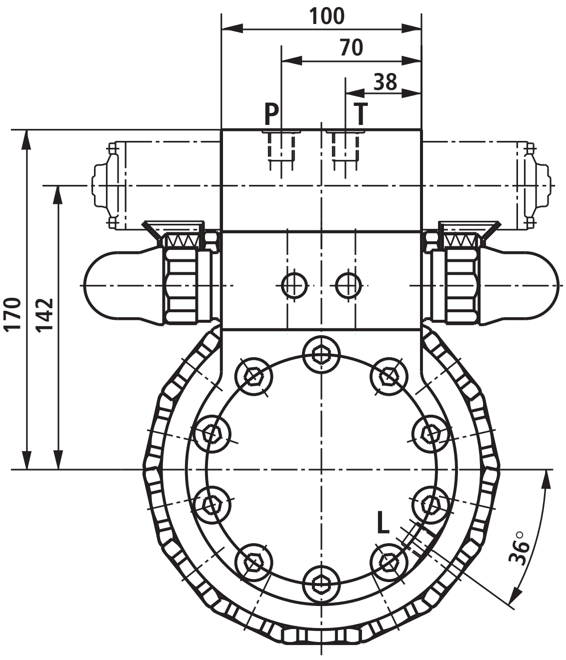
Symbol (Version „MKM...N01"), function

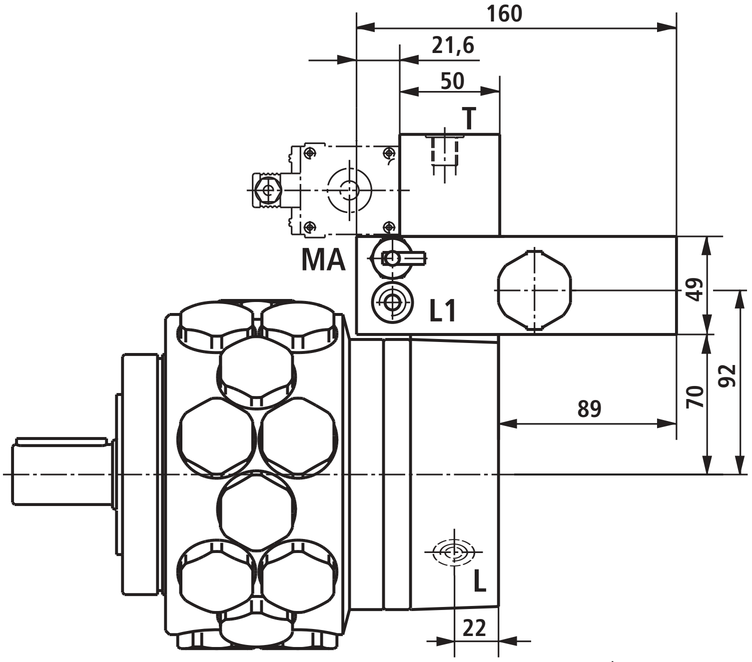


Two individually adjustable DBDS 10 K1X/... valves protect the drive from overloads. Via port L1 and two 0.1 bar check valves the occurring leakage is fed back into the drive. A flow control valve can be screwed into port L1 so that the feed flow can be controlled. For the anti-cavitation function, the motor connection L is connected to L1 on the block and L2 is connected to tank. The leakage back pressure of 0.5 bar causes the motor leakage oil to be fed into the circuit.

Valve design: pressure relief, anti-cavitation/feed, valve connection NS 6, MKM...N61 (in mm)

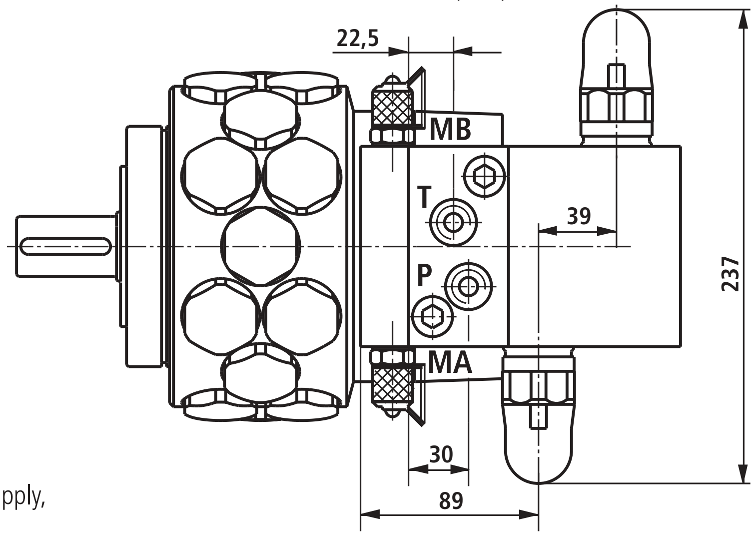
Series MKM radial piston motors with two direct operated pressure relief valves, gauge ports G 1/4, anti-cavitation/feed via two 0.1 bar check valves, G 1/2 pipe connections and valve connections NS 6 to DIN 24 340 form A6 (CETOP 3).





Port	Thread	Depth	Counter bore Ø	Depth
A, B	G 1/2	16	28	$2.1^{+0.1}$
P, T	G 3/8	12	23	$0.5^{+0.1}$
L	G 1/4	14	25	$1.3_{-0.3}$
L1, L2	G 1/4	14	20	1
MA, MB	G 1/4	12	20	1

Pressure stage I	Up to 100 bar
Pressure stage II	Up to 200 bar
Pressure stage III	Up to 315 bar

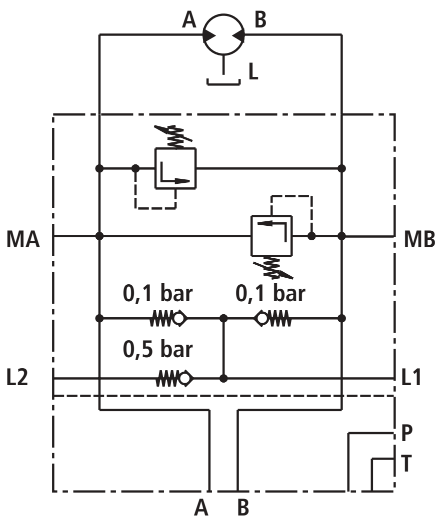


Note:

The valve cartridges are **not** included within the scope of supply, they must be ordered separately!

Pressure stage to be stated in clear text!

Symbol (version „MKM...N61"), function

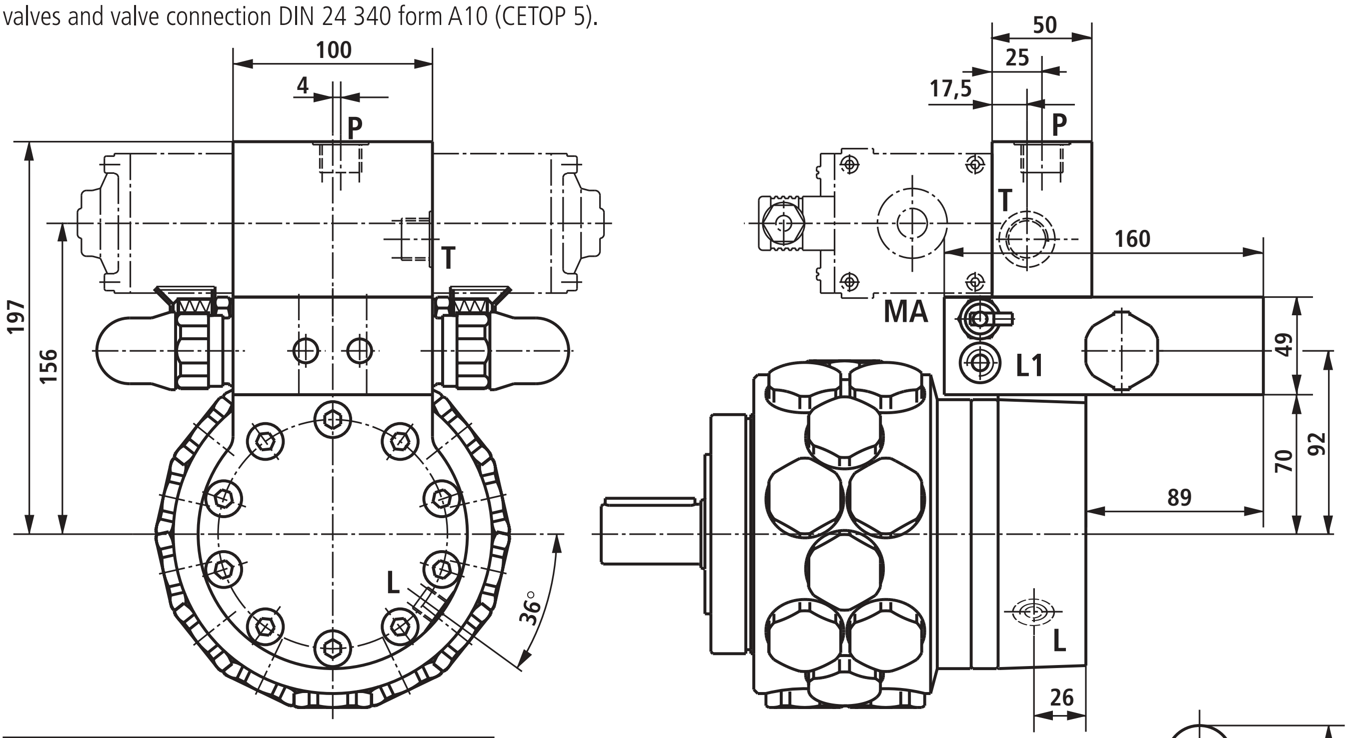


With this block design valves with a porting pattern to DIN 24 340 form A6 are bolted directly onto the motor.

Two individually adjustable DBDS 10 K1X/... valves protect the drive from overloads. Via port L1 and two 0.1 bar check valves, the occurring leakage is fed back into the drive. A flow control valve can be screwed into port L1 so that the feed flow can be controlled. For the anti-cavitation function the motor connection L is connected to L1 on the block and L2 is connected to tank. The leakage back pressure of 0.5 bar causes the motor leakage oil to be fed into the circuit.

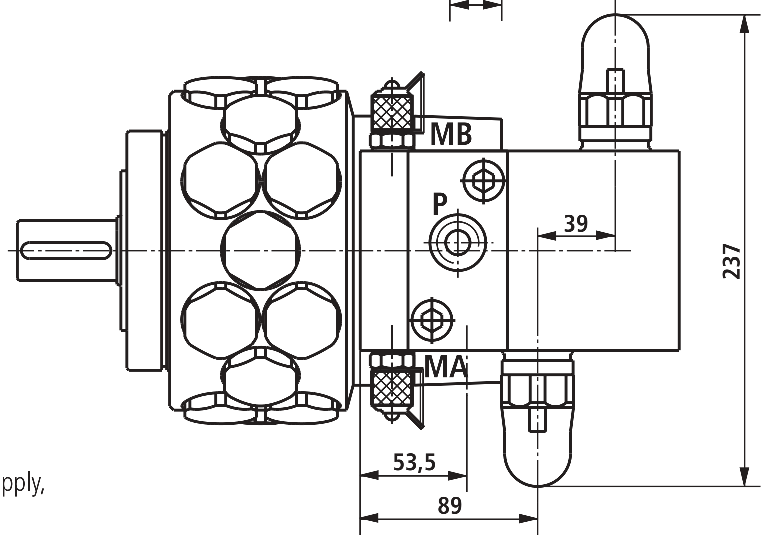
Valve design: pressure relief, anti-cavitation/feed, valve connection NS 10, MKM...N101 (in mm)

Series MKM radial piston motors with two direct operated pressure relief valves, gauge port G 1/4, anti-cavitation/feed via two 0.1 bar check valves and valve connection DIN 24 340 form A10 (CETOP 5).



	Port Thread	Port Depth	Counter bore Ø	Counter bore Depth
A, B	G 1/2	16	28	$2.1^{+0.1}$
P, T	G 1/2	14	28	0.5
L	G 1/4	14	25	$1.3_{-0.3}$
L1, L2	G 1/4	14	20	1
MA, MB	G 1/4	12	20	1

Pressure stage I	Up to 100 bar
Pressure stage II	Up to 200 bar
Pressure stage III	Up to 315 bar

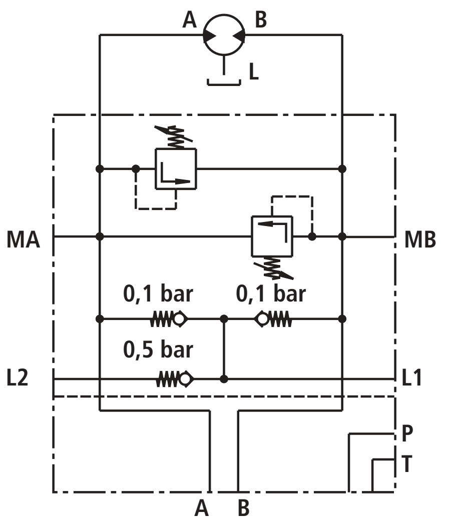


Note:

The valve cartridges are **not** included within the scope of supply, they must be ordered separately!

Pressure stage to be stated in clear text!

Symbol (version „MKM...N101"), function

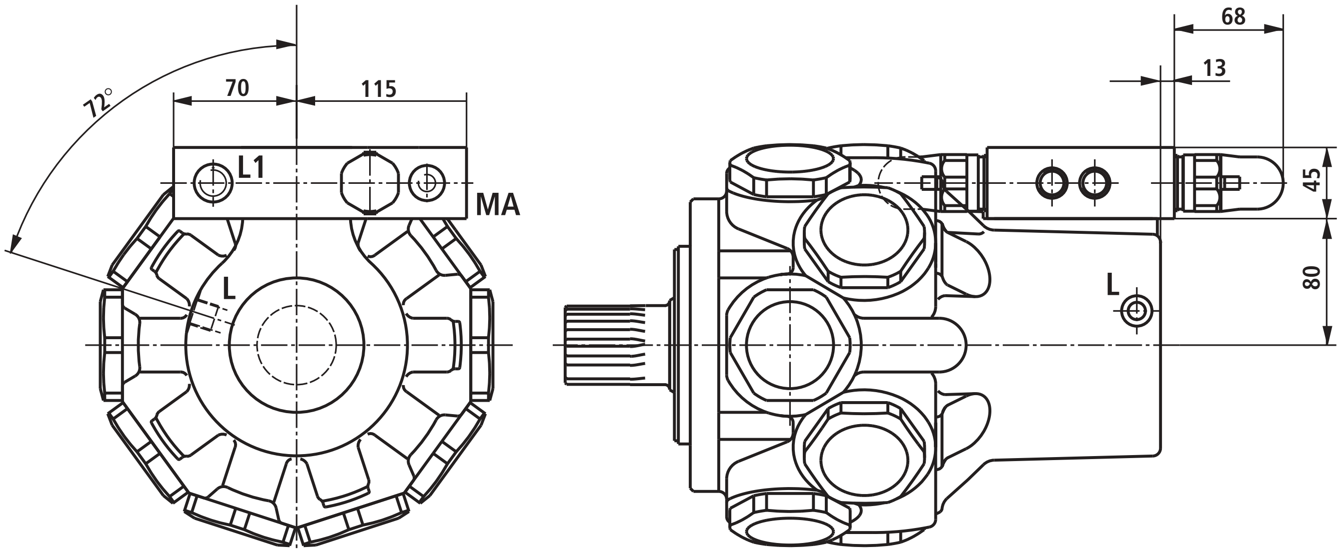


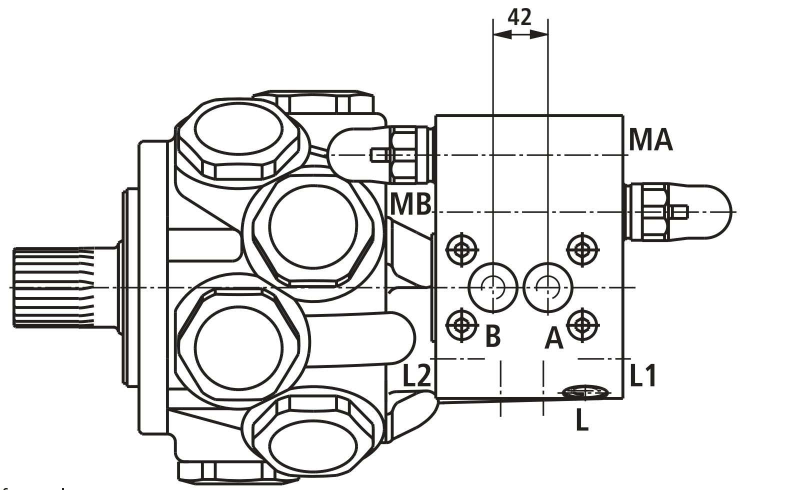
With this block design, directional, proportional or servo valves with a porting pattern to DIN 24 340 form A10 are bolted directly onto the motor.

Two individually adjustable DBDS 10 K1X/... valves protect the drive from overloads. Via port L1 and two 0.1 bar check valves the occurring leakage is fed back into the drive. A flow control valve can be screwed into port L1 so that the feed flow can be controlled. For anti-cavitation function the motor connection L is connected to L1 on the block and L2 is connected to tank. The leakage back pressure of 0.5 bar causes the motor leakage oil to be fed into the circuit.

Valve design: pressure relief, anti-cavitation/feed, MRM...N01 (dimensions in mm)

Series MRM radial piston motors with two direct operated pressure relief valves, gauge ports G1/4, anti-cavitation/feed via two 0.1 bar check valves and G 3/4 pipe connections.





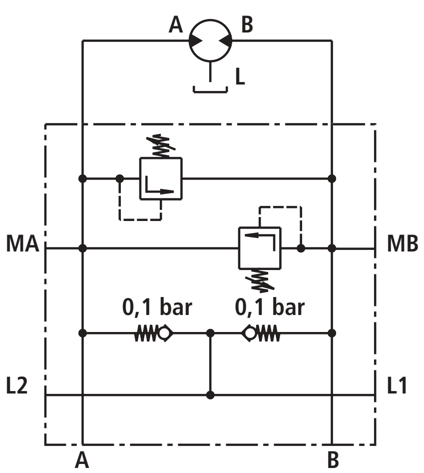
Port	Thread	Depth	Counter bore Ø	Depth
A, B	G 3/4	17	33	$2.1^{+0.1}$
L	G 3/8	14	28	1.5
L1, L2	G 3/8	14	24	1
MA, MB	G 1/4	14	20	1
Pressure stage I			Up to 100 bar	
Pressure stage II			Up to 200 bar	
Pressure stage III			Up to 315 bar	

Note:

The valve cartridges are **not** included within the scope of supply, they must be ordered separately!

Pressure stage to be stated in clear text!

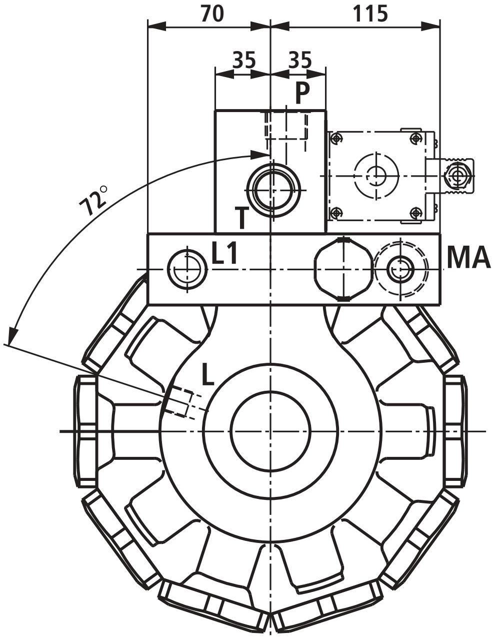
Symbol (version „MRM...N01“), function

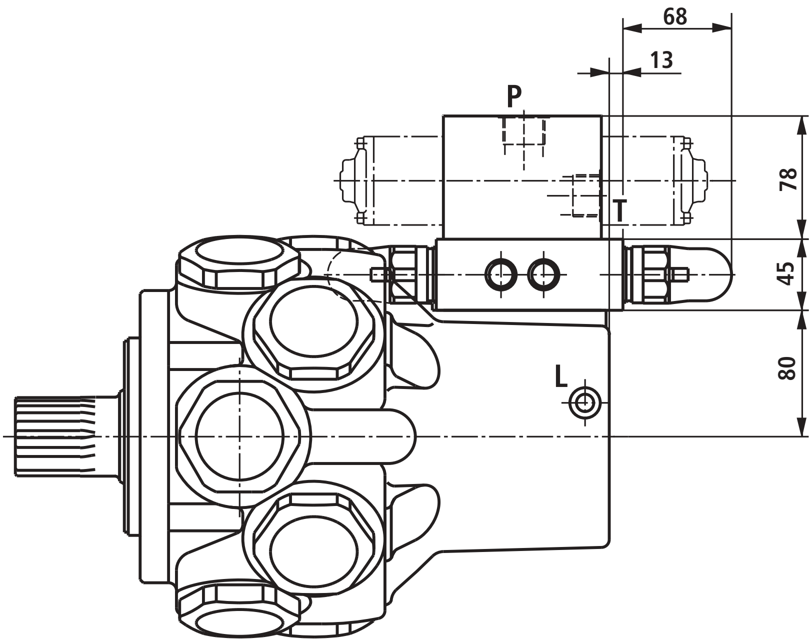


Two individually adjustable DBDS 10 K1X/... valves protect the drive from overloads. Via port L1 and two 0.1 bar check valves the occurring leakage is fed back into the drive. A flow control valve can be screwed into port L1 so that the feed flow can be controlled. When there is sufficient back pressure L1 can be connected with the tank line.

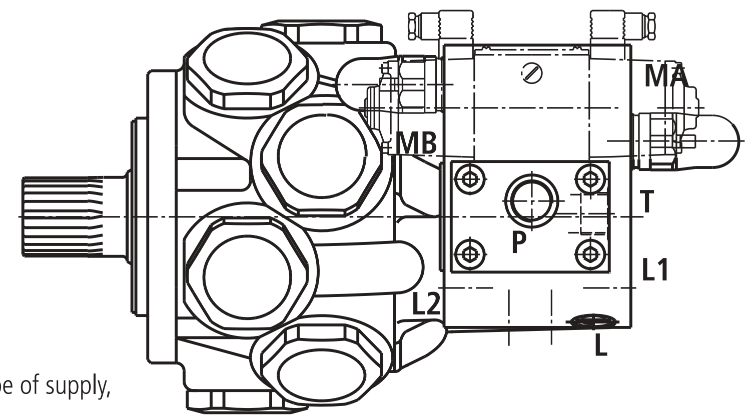
Valve design: pressure relief, anti-cavitation/feed, valve connection NS 6, MRM...N61 (in mm)

Series MRM radial piston motors with two direct operated pressure relief valves, gauge port G 1/4, anti-cavitation/feed via two 0.1 bar check valves and valve connection DIN 24 340 form A6 (CETOP 3).





	Port		Counter bore	
	Thread	Depth	Ø	Depth
P, T	G 1/2	17	28	1
L	G 3/8	14	28	1.5
L1, L2	G 3/8	14	24	1
MA, MB	G 1/4	14	20	1
Pressure stage I			Up to 100 bar	
Pressure stage II			Up to 200 bar	
Pressure stage III			Up to 315 bar	

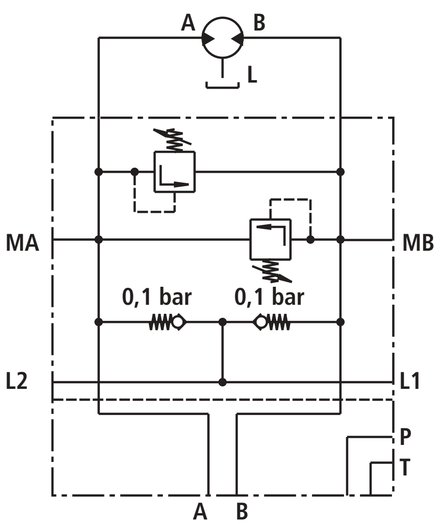


Note:

The valve cartridges are **not** included within the scope of supply, they must be ordered separately!

Pressure stage to be stated in clear text!

Symbol (version „MRM...N61"), function

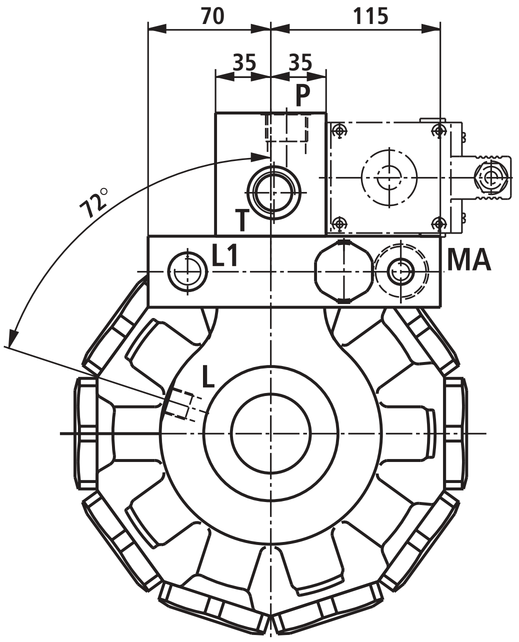


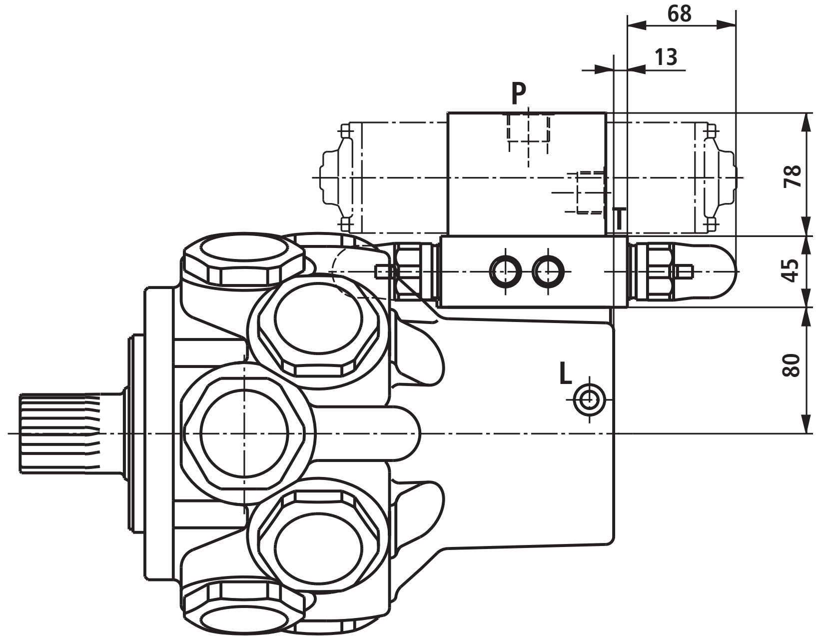
With this block design, valves with a porting pattern to DIN 24 340 form A6 are bolted directly onto the motor, due to the low entrapped volume of oil, this gives the drive good open loop or closed loop control characteristics.

Two individually adjustable DBDS 10 K1X/... valves protect the drive from overloads. Via port L1 and two 0.1 bar check valves the occurring leakage is fed back into the drive. A flow control valve can be screwed into port L1 so that the feed flow can be controlled. When there is sufficient back pressure L1 can be connected with the tank line. L2 is plugged.

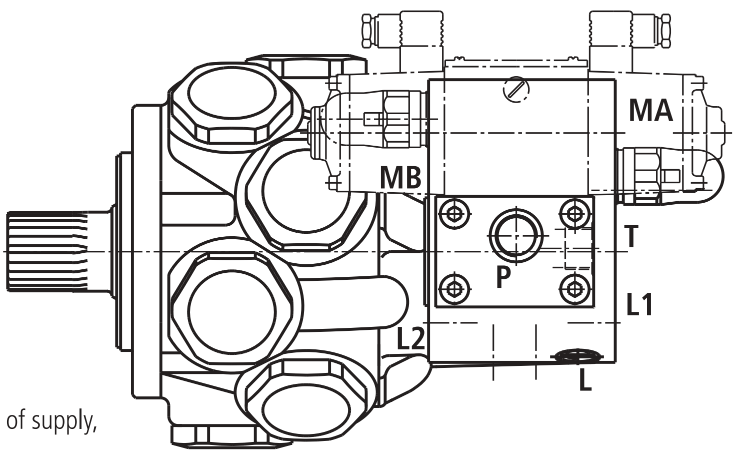
Valve design: pressure relief, anti-cavitation/feed, valve connection NS 10, MRM...N101 (in mm)

Series MRM radial piston motors with two direct operated pressure relief valves, gauge port G 1/4, anti-cavitation/feed via two 0.1 bar check valves and valve connection DIN 24 340 form A10 (CETOP 5).





	Port		Counter bore	
	Thread	Depth	Ø	Depth
P, T	G 3/4	18	33	0.5
L	G 3/8	14	28	1.5
L1, L2	G 3/8	14	24	1
MA, MB	G 1/4	14	20	1
Pressure stage I			Up to 100 bar	
Pressure stage II			Up to 200 bar	
Pressure stage III			Up to 315 bar	

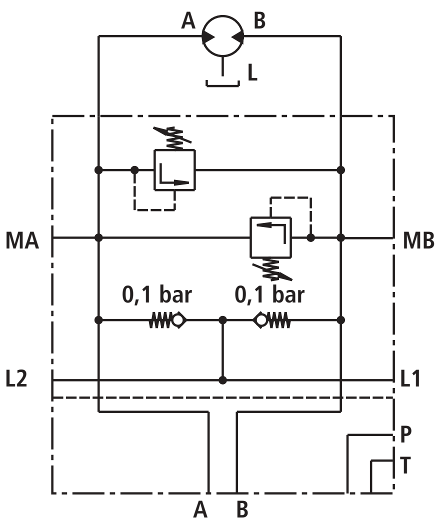


Note:

The Valve cartridges are **not** included within the scope of supply, they must be ordered separately!

Pressure stage to be stated in clear text!

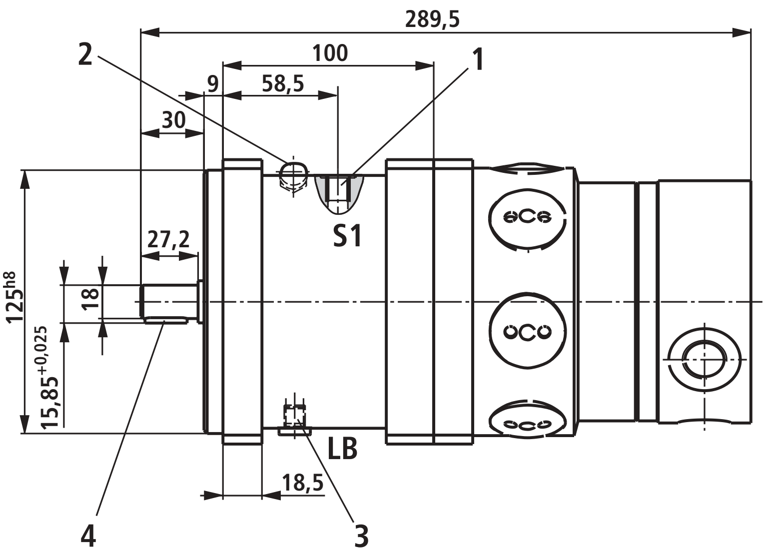
Symbol (version „MRM...N101"), function

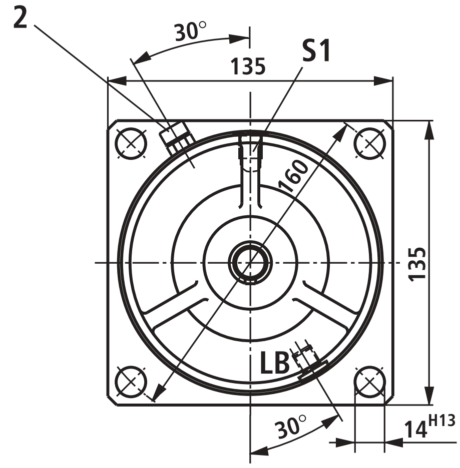


With this block design, valves with a porting pattern to DIN 24 340 form A10 are bolted directly onto the motor, due to the low entrapped volume of oil, this gives the drive good open loop or closed loop control characteristics.

Two individually adjustable DBDS 10 K1X/... valves protect the drive from overloads. Via port L1 and two 0.1 bar check valves the occurring leakage is fed back into the drive. A flow control valve can be screwed into port L1 so that the feed flow can be controlled. When there is sufficient back pressure L1 can be connected with the tank line. L2 is plugged.

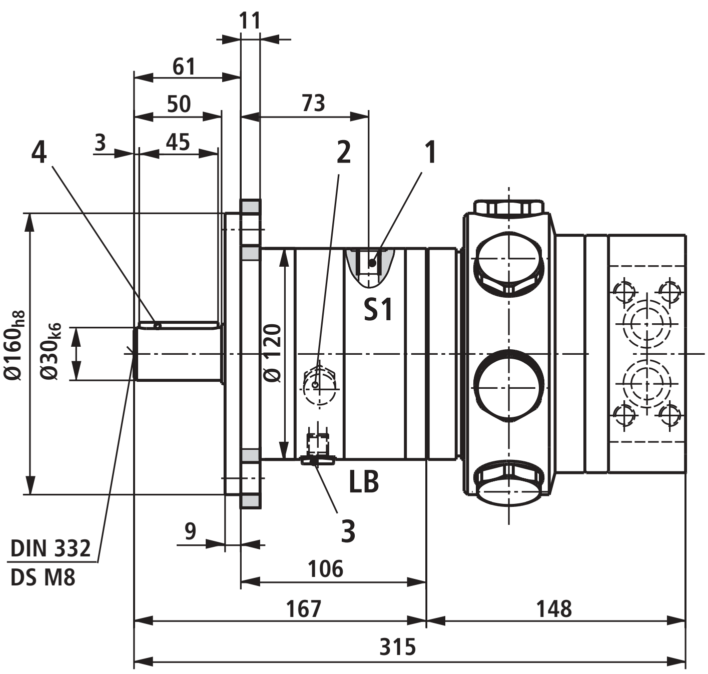
Holding brake type LBD9A2 for motor types MKM 11 and MRM 11 (dimensions in mm)

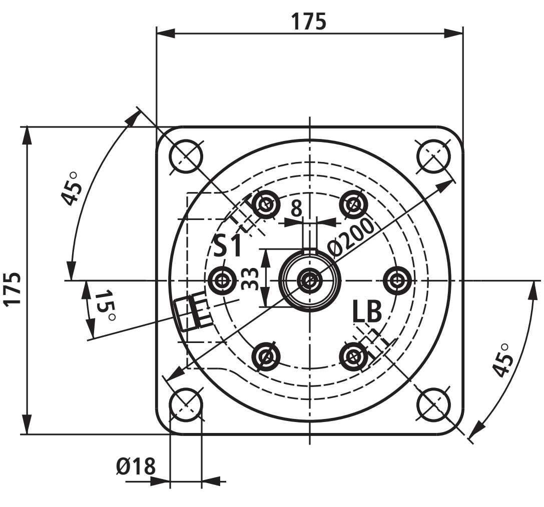




1 Control line G 1/4 to bleed the brake
2 Breather filter (brake) M12 x 1.5
3 Brake drain oil connection M12 x 1.5
4 Key A5x5x20 DIN 6885

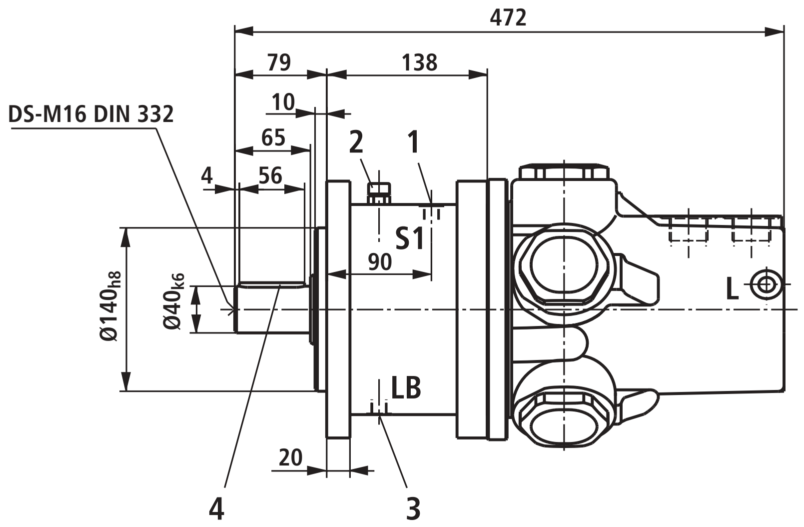
Holding brake type LBD11A2 for motor types MKM 22 to 110 (dimensions in mm)

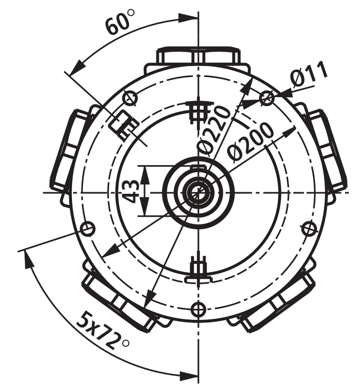




1 Control line G 1/4 to bleed the brake
2 Breather filter (brake) M12 x 1.5
3 Brake drain oil connection M12 x 1.5
4 Key A8 x 7 x 45 DIN 6885

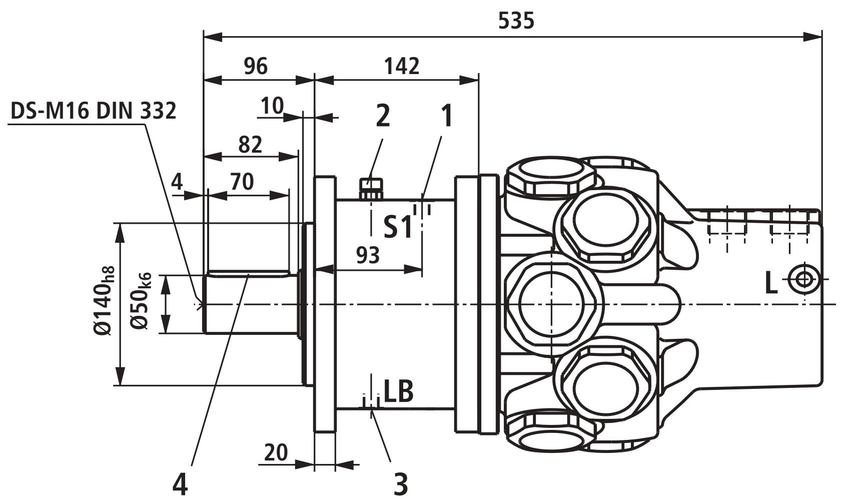
Holding brake type LBD124A2 for motor types MRM 80 / MRM 125 (dimensions in mm)

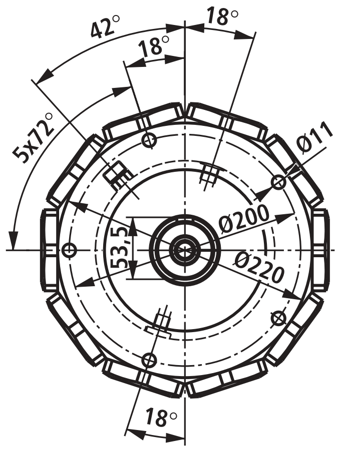




1 Control line G 1/4 to bleed the brake
2 Breather filter (brake) M12 x 1.5
3 Brake drain oil connection M12 x 1.5
4 Key A12 x 8 x 56 DIN 6885

Holding brake type LBD249A2 for motor types MRM 160 / MRM 250 (dimensions in mm)

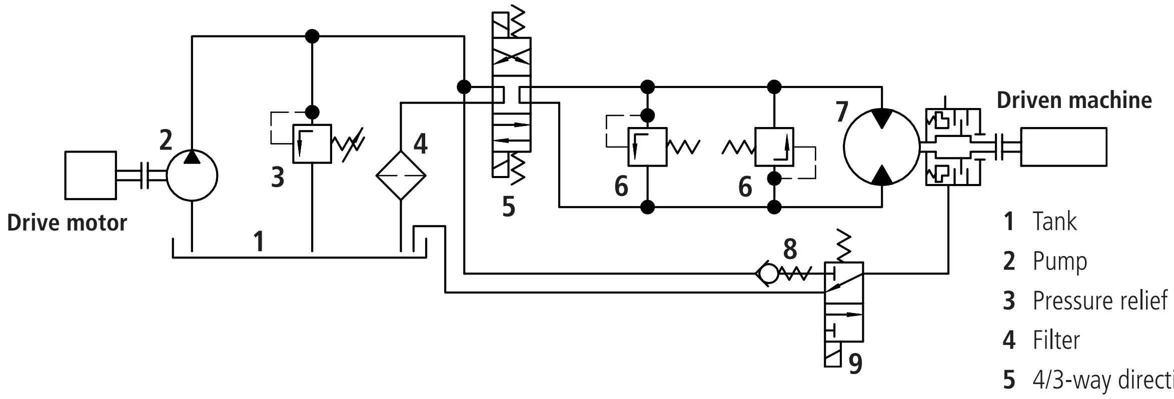




1 Control line G 1/4 to bleed the brake
2 Breather filter (brake) M12 x 1.5
3 Brake drain oil connection M12 x 1.5
4 Key A14 x 9 x 70 DIN 6885

Circuit example

Open circuit with brake control



1 Tank
2 Pump
3 Pressure relief valve
4 Filter
5 4/3-way directional valve
6 Pressure relief valve
7 Hydraulic brake motor
8 Check valve
9 3/2-way directional valve

Storage, assembly, commissioning

Storage

As delivered all of the connection holes in the motor housing are plugged with plastic plugs. The internal components are coated with hydraulic oil from the run on the test rig. The drive shaft and connection flange are protected by an anti-corrosion oil. The motor can be stored in this condition, in a dry room, for approx. 6 months.

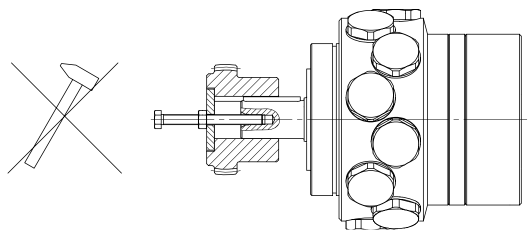
For longer storage periods the motor is to be fully filled with a water emulsifing hydraulic oil H-LPD. All ports are to be plugged or have blanking flanges, these are to be oil tight. After no later than 12 months the hydraulic oil must be replaced and the drive shaft rotated by hand approx. 10 times.

Mounting, assembly

– The installation orientation is optional.
– Never use a hammer to drive on the couplings, pinions, etc., use screws to pull them on. Use the threaded hole in the drive shaft.
– The mounting surface must be flat and rigid.
– Use fixing screws with a minimum tensile strength class of 10.9, with reversal operation used location bolts.
– Correctly line up the motor during assembly.
– Tighten the bolts to the prescribed tightening torque.

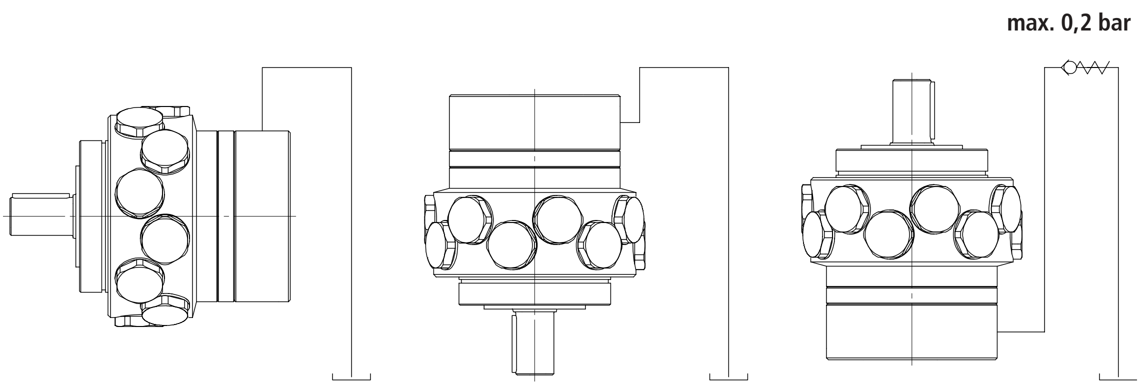
The brakes have a leakage oil connection and a breather filter M12x1.5. Both of the connections can be exchanged. Fit the filter to the highest point so that oil cannot run out.

When installing the holding brake apply it with pilot pressure so that the shaft can be rotated.



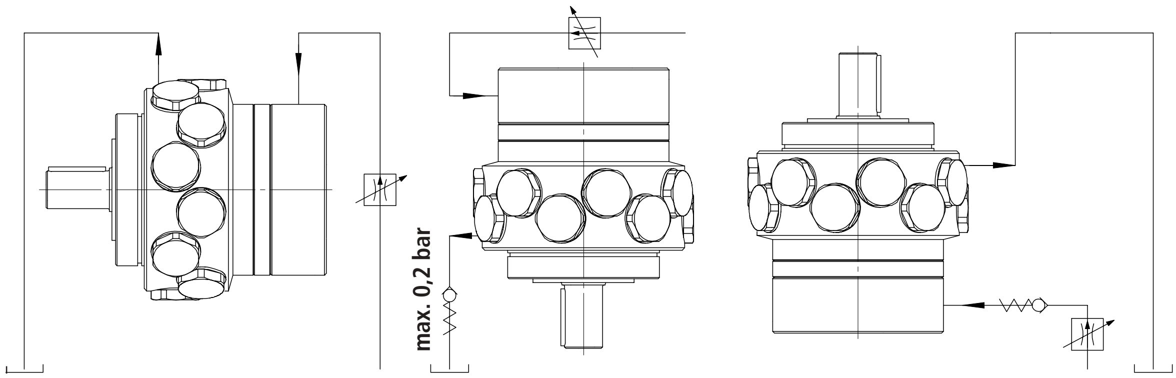
Drain oil line

Lay the drain oil line so that the motor housing cannot drain, if necessary fit a check valve with maximum opening pressure of 0.2.



Flushing connection

Flushing the motor with approx. 1 - 3 L/min (dependent on the type) is recommended for high temperatures and powers. Leakage and flushing fluid is passed back to the reservoir. The maximum permissible housing pressure in the leakage chamber is 1.5 bar.



Commissioning

Motor

Before the initial commissioning the motor has to be filled with filtered operating medium via the drain connection. Drive the motor at a low power until leakage oil escapes, then full power can be applied.

For motors with a separate flushing circuit first switch on the flushing circuit then the motor.

Check the housing pressure: maximum of 1.5 bar leakage pressure.

Brake

Fill the brake before commissioning via the breather filter, remove the filter to access the filling point (wet running).

LBD9A2	LBD11A2	LBD124A2	LBD249A2
0.01 litre	0.01 litre	0.02 litre	0.04 litre

Switch the holding brake more than once and check for correct function.

During operation the motor and holding brake must not become warmer than the operating medium.

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Radial piston hydraulic motor

Type Hägglunds CBM

RE 15300
Edition: 2012-08

- Size: 2000 ... 6000
- Capacity: 75 838 ... 380 133 cm^3/rev *[4 628 - 23 197 in^3/rev]*
- Specific torque: 1 200 ... 6 000 Nm/bar *[61 024 ... 305 119 ft-lbs/1000 psi]*
- Nominal speed: 8 ... 53 rpm
- Maximum operating pressure: 350 bar *[5 076 psi]*

Features

- The most powerful direct drive in the world.
- 50 % more torque - now torque up to 1970 kNm
- High torque to weight ratio
- Modular design

Contents

Quick selection diagram for Hägglunds CBM motors

The diagram below represents the torque and speed, corresponding to a modified rating life L10mh= 40 000 h. Oil viscosity in motor case 40 cSt. Contamination level not exceeding ISO 4406:1999 18/16/13 (NAS 1638, class 7). The diagram is based on a charge pressure of 15 bar (218 psi).

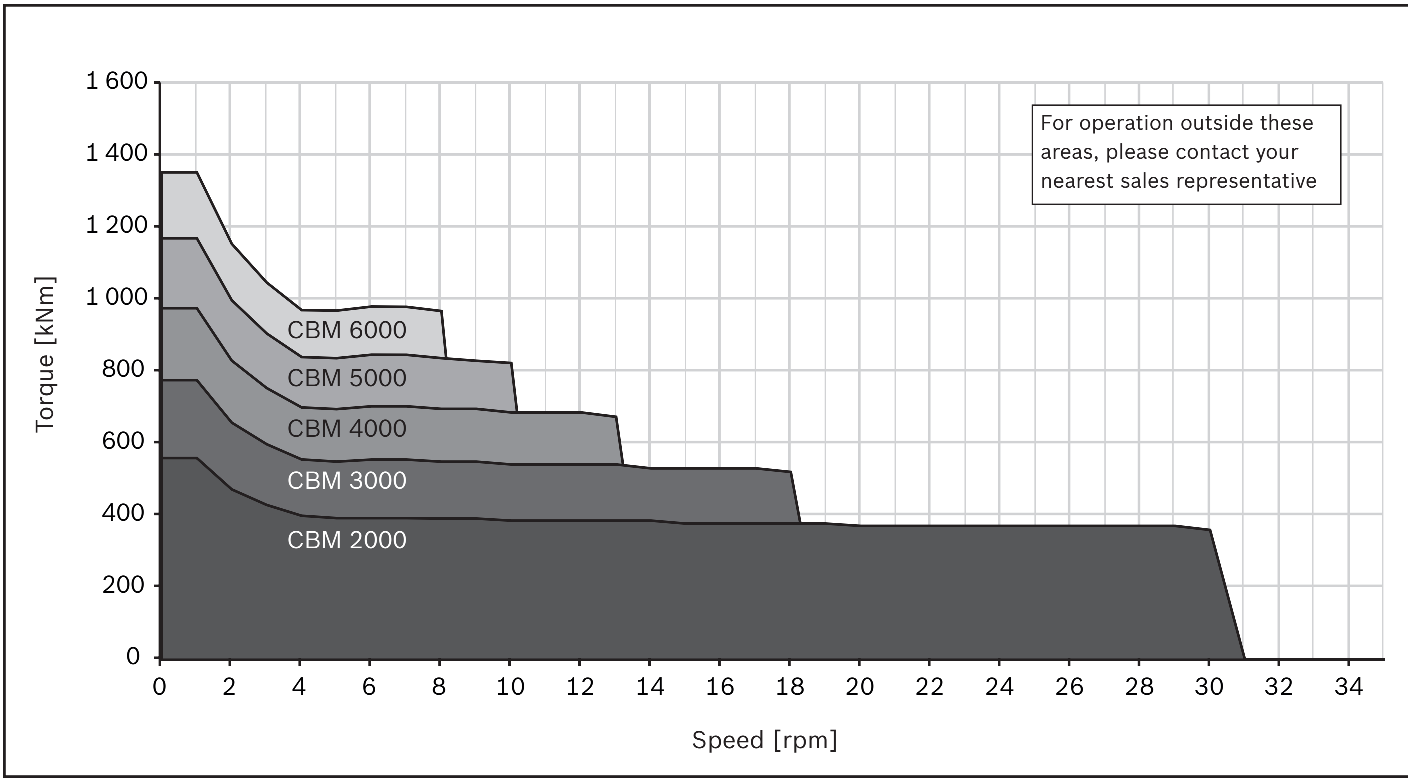


Fig 1a: Quick selection diagram

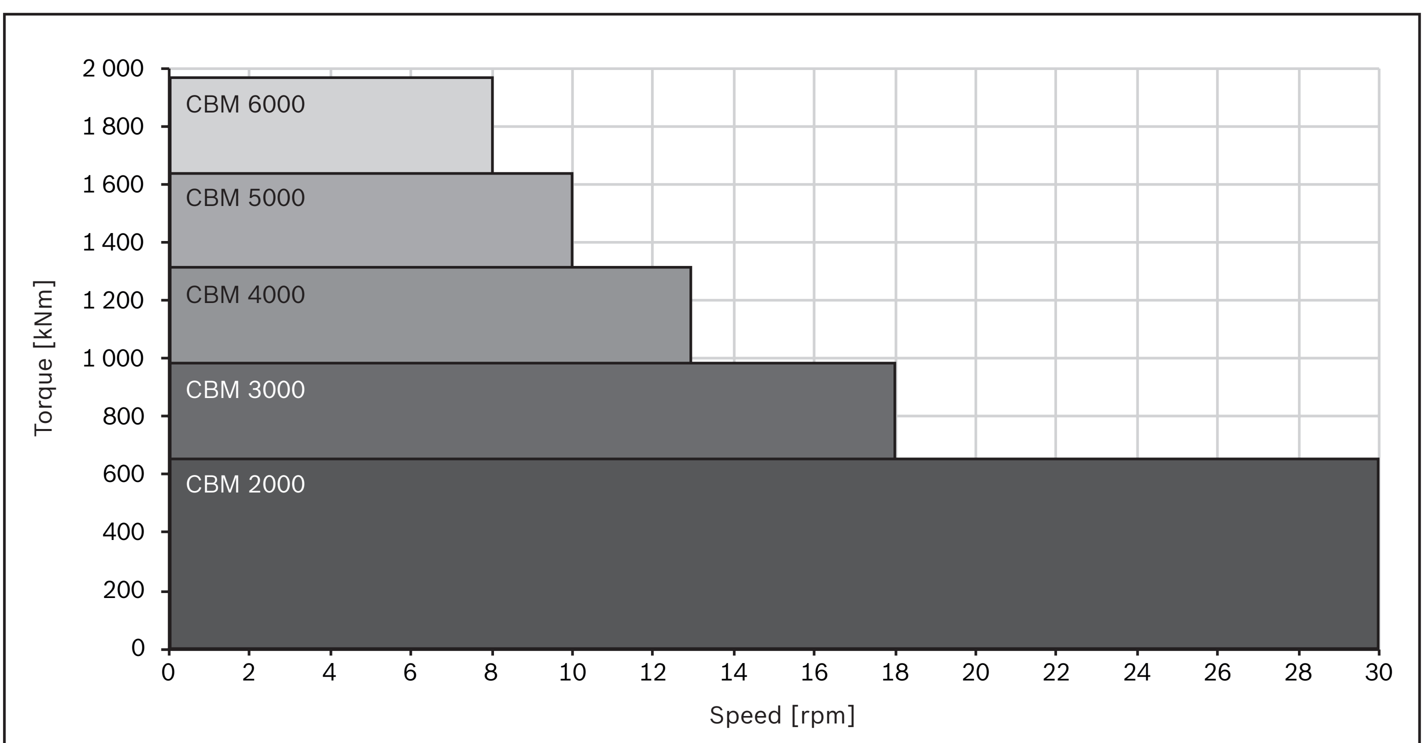


Fig 1b: Max torque diagram

Functional description

Bosch Rexroth's hydraulic industrial motor Hägglunds CBM is of the radial-piston type with a rotating cylinder block/ hollow shaft and a stationary housing. The cylinder block is mounted in fixed roller bearings in the housing. An even number of pistons are radially located in bores inside the cylinder block, and the valve plate directs the incoming and outgoing oil to and from the working pistons. Each piston is working against a cam roller.
When the hydraulic pressure is acting on the pistons, the cam rollers are pushed against the slope on the cam ring that is rigidly connected to the housing, thereby producing a torque. The cam rollers transfer the reaction force to the pistons which are guided in the cylinder block. Rotation therefore occurs, and the torque available is proportional to the pressure in the system.
Oil main lines are connected to ports A and C in the connection block and drain lines to ports D1, D2, D3 or D4 in the motor housing.
The motor is connected to the shaft of the driven machine through the hollow shaft of the cylinder block. The torque is transmitted by splines.

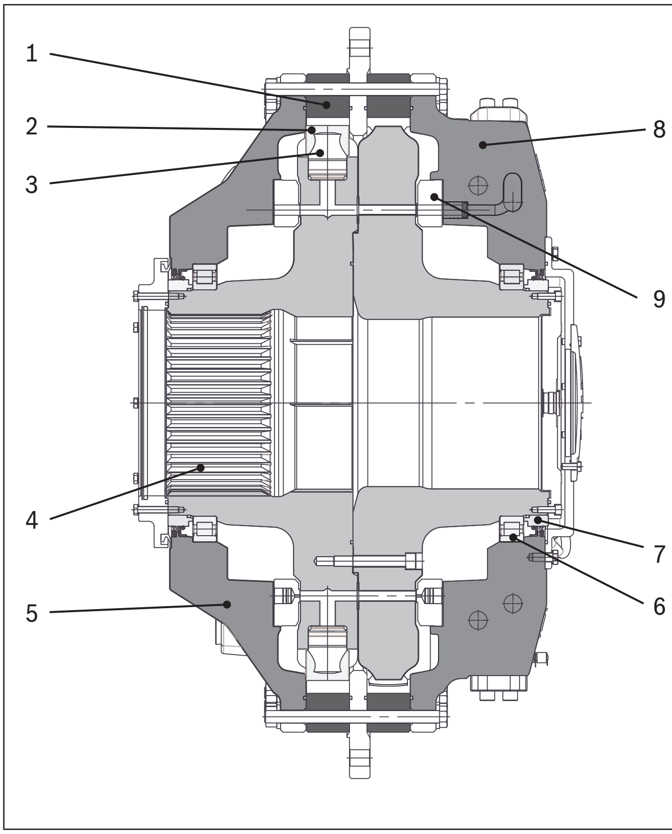


Fig. 2: Hägglunds CBM motor

1.	Cam ring	6.	Cylindrical roller bearing
2.	Cam roller	7.	Wearing part
3.	Piston	8.	Connection housing
4.	Cylinder block, spline	9.	Distributor
5.	Housing cover		

Valid patents

US 4522110, US 005979295A, SE 456517, EP 0102915, JP 83162704, GB 1385693, EP 0524437.

Quality

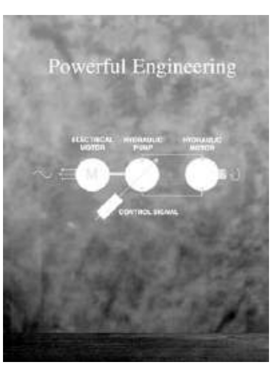
To assure our quality we maintain a Quality Assurance System, certified to standard ISO 9001.

Calculation fundementals

	Metric		US	
Output power	$P = \frac{T \cdot n}{9549}$	(kW) on driven shaft	$P = \frac{T \cdot n}{5252}$	(hp) on driven shaft
Output torque (η_m=98%)	$T = T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m$	(Nm)	$T = \frac{T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m}{1000}$	(lbf·ft)
Pressure required (η_m=98%)	$p = \frac{T}{T_s \cdot \eta_m} + \Delta p_l + p_c$	(bar)	$p = \frac{T \cdot 1000}{T_s \cdot \eta_m} + \Delta p_l + p_c$	(psi)
Flow rate required	$q = \frac{n \cdot V_i}{1000} + q_l$	(l/min)	$q = \frac{n \cdot V_i}{231} + q_l$	(gpm)
Output speed	$n = \frac{q - q_l}{V_i} \cdot 1000$	(rpm)	$n = \frac{q - q_l}{V_i} \cdot 231$	(rpm)
Inlet power	$P_{in} = \frac{q \cdot (p - p_c)}{600}$	(kW)	$P_{in} = \frac{q \cdot (p - p_c)}{1714}$	(hp)

Quantity	**Symbol**		**Metric**	**US**
Power	P	=	kW	hp
Output torque	T	=	Nm	ft-lbs
Specific torque	Ts	=	Nm/bar	ft-lbs/1000
psi				
Rotational speed	n	=	rpm	rpm
Required pressure	p	=	bar	psi
Pressure loss	Δp	=	bar	psi
Charge pressure	pc	=	bar	psi
Flow rate required	q	=	l/min	gpm
Total volumetric loss	ql	=	l/min	gpm
Displacement	Vi	=	cm3/rev	in3/rev
Mechanical efficiency	ηm	=	0.98*	

*Not valid for starting efficiency



For more information, see Powerful Engineering (EN347-4)

Definitions

Rated speed[1)]
Rated speed is the highest allowed speed for a charge pressure of 12 bar (174 psi) above case pressure. When a closed loop system is used, a minimum of 15% of oil is to be exchanged in the main loop.

Max speed
Maximum speed is the maximum allowed speed. Special considerations are necessary regarding charge pressure, cooling and choice of hydraulic system for speeds rated above.

[1)] Operating above rated conditions requires approval from Bosch Rexroth.

Accepted conditions for standard type of motor:

1. Oil viscosity 15 - **40** - 10000 cSt. See page 21.
2. Temperature -35 °C to +70 °C (-31 °F to +158 °F).
3. Running case pressure 0-3 bar (0-43,5 psi) Max case pressure 8 bar (116 psi)
4. Charge pressure (see diagram).
5. Volumetric losses (see diagram).

Motor data

Table 1a: Metric motor data Hägglunds CBM motor

Motor type	Displacement	Specific torque	Rated speed* 1)	Max speed	Max pressure**	Max torque2)	Max power intermittent3)
	cm^3/rev	Nm/bar	rpm	rpm	bar	kNm	kW
CBM 2000-1200	75 838	1 200	53	53	350	394	2 186
CBM 2000-1400	88 279	1 400	44	44	350	460	2 118
CBM 2000-1600	100 782	1 600	38	38	350	525	2 090
CBM 2000-1800	113 726	1 800	33	33	350	591	2 042
CBM 2000	126 732	2 000	30	30	350	657	2 063
CBM 3000-2200	138 670	2 200	27	27	350	722	2 042
CBM 3000-2400	151 173	2 400	24	24	350	788	1 980
CBM 3000-2600	164 117	2 600	22	22	350	854	1 966
CBM 3000-2800	177 123	2 800	20	20	350	919	1 925
CBM 3000	190 066	3 000	18	18	350	985	1 856
CBM 4000-3200	201 565	3 200	16	16	350	1 051	1 793
CBM 4000-3400	214 508	3 400	15	15	350	1 116	1 774
CBM 4000-3600	227 514	3 600	14	14	350	1 182	1 755
CBM 4000-3800	240 458	3 800	13	13	350	1 248	1 738
CBM 4000	253 464	4 000	13	13	350	1 313	1 722
CBM 5000-4600	290 849	4 600	11	11	350	1 510	1 678
CBM 5000	316 798	5 000	10	10	350	1 642	1 653
CBM 6000-5600	354 246	5 600	8	8	350	1 838	1 619
CBM 6000	380 133	6 000	8	8	350	1 970	1 599

Table 1b: US motor data Hägglunds CBM motor

Motor type	Displacement	Specific torque	Rated speed* 1)	Max speed	Max pressure**	Max torque2)	Max power intermittent3)
	in^3/rev	lbf*ft/1000 psi	rpm	rpm	psi	lbf*ft	hp
CBM 2000-1200	4 628	61 024	53	53	5 076	290 543	2 932
CBM 2000-1400	5 387	71 194	44	44	5 076	338 967	2 840
CBM 2000-1600	6 150	81 365	38	38	5 076	387 391	2 803
CBM 2000-1800	6 940	91 536	33	33	5 076	435 815	2 738
CBM 2000	7 734	101 706	30	30	5 076	484 239	2 766
CBM 3000-2200	8 462	111 877	27	27	5 076	532 663	2 738
CBM 3000-2400	9 225	122 047	24	24	5 076	581 087	2 655
CBM 3000-2600	10 015	132 218	22	22	5 076	629 511	2 637
CBM 3000-2800	10 809	142 389	20	20	5 076	677 935	2 582
CBM 3000	11 599	152 559	18	18	5 076	726 359	2 489
CBM 4000-3200	12 300	162 730	16	16	5 076	774 783	2 405
CBM 4000-3400	13 090	172 901	15	15	5 076	823 206	2 378
CBM 4000-3600	13 884	183 071	14	14	5 076	871 630	2 354
CBM 4000-3800	14 674	193 242	13	13	5 076	920 054	2 331
CBM 4000	15 467	203 412	13	13	5 076	968 478	2 309
CBM 5000-4600	17 749	233 924	11	11	5 076	1 113 750	2 251
CBM 5000	19 332	254 266	10	10	5 076	1 210 598	2 217
CBM 6000-5600	21 617	284 777	8	8	5 076	1 355 870	2 171
CBM 6000	23 197	305 119	8	8	5 076	1 452 717	2 144

*) Related to a required pressure of 12 bar for motors in braking mode.

**) The motors are designed according to DNV-rules. Test pressure 420 bar. Peak/transient pressure 420 bar maximum, allowed to occur 10000 times.

1) Special considerations regarding charge pressure, cooling and choice of hydraulic system for speed above rated, 8 ports must be used for higher speed.

2) Calculated as: Metric= Ts·(350-15)·0,98.

3) Valid for minimum permissible oil viscosity 15 cSt in the motor case.

Ordering codes

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Example Hägglunds CBM motor:

C	B	M		2000			S	A	0	N	0	A		00		00
01	02	03		04		05	06	07	08	09	10	11		12		13

01	Motor series	**C**
02	Generation	**B**
03	Magnum	**M**
04	**Motor size**	
	CBM 2000	**2000**
	CBM 3000	**3000**
	CBM 4000	**4000**
	CBM 5000	**5000**
	CBM 6000	**6000**
05	Specific torque (Nm/bar)	
06	**Mounting alternatives, shaft**	
	Splines	**S**
07	**Tandem kit**	
	Motor not prepared for TA kit	**A**
	Motor prepared for TA kit	**B**
08	**Displacement shift valve**	
	Motor not prepared for displacement shift	**0**
09	**Type of seal**	
	Nitrile	**N**
	Viton	**V**
10	**Through hole kit**	
	No	**0**
	Yes	**H**
11	**Piston set**	
	Coated pistons and uncoated cam rollers	**A**
12	Modification*	**00-99**
13	**Design***	
	Standard	**00**
	Special index	**01-99**

* To be filled in by DC-IA/EHD

Painting	
Orange	**Standard**
Other	**Option**

Order code example Torque arm for Hägglunds CBM:

TC	A		200	-	0	-	0	-	00
01	02		03		04		05		06

01	Torque arm	**TC**
02	Generation	**A**
03	**Torque arm size**	
	TCA 200 for CBM 2000	**200**
	TCA 400 for CBM 3000 and CBM 4000	**400**
	TCA 600 for CBM 5000 and CBM 6000	**600**
04	**Attachment**	
	Pivoted	**2**
	Other	**9**
05	Modification*	**00-99**
06	**Design***	
	Standard	**00**
	Special index	**01-99**

* To be filled in by DC-IA/EHD

Order code example for tandem kit for Hägglunds CBM:

T	B	M		40		H		00		00
01	02	03		04		05		06		07

01	Tandem kit	**T**
02	Generation	**B**
03	Magnum	**M**
04	Size	**40**
05	**Through hole**	
	No	**0**
	Yes	**H**
06	Modification*	**00-99**
07	**Design***	
	Standard	**00**
	Special index	**01-99**

* To be filled in by DC-IA/EHD

Dimensions, motor with splines for torque arm mounting

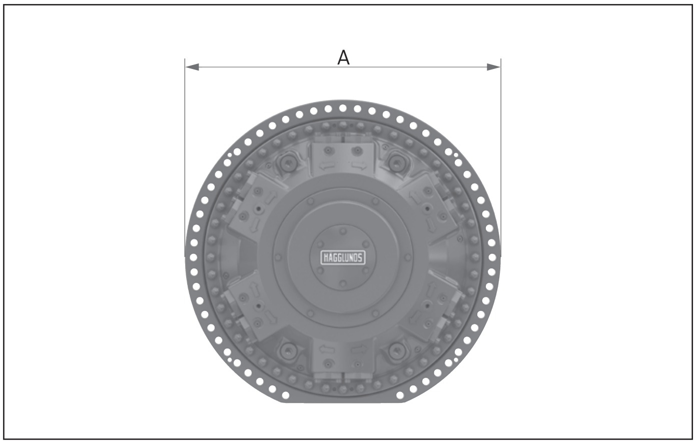


Fig. 3

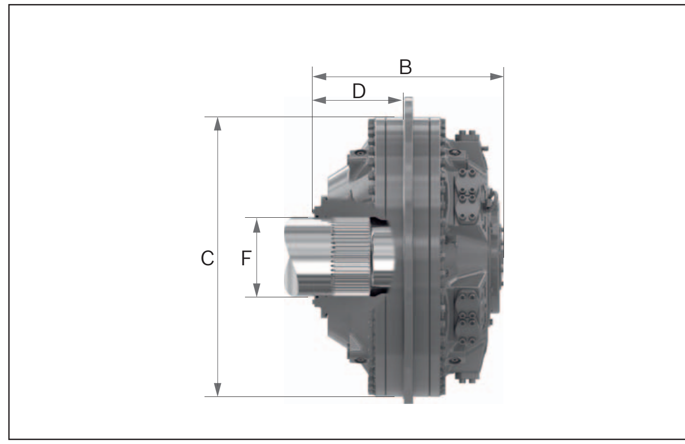


Fig. 4: CBM 2000

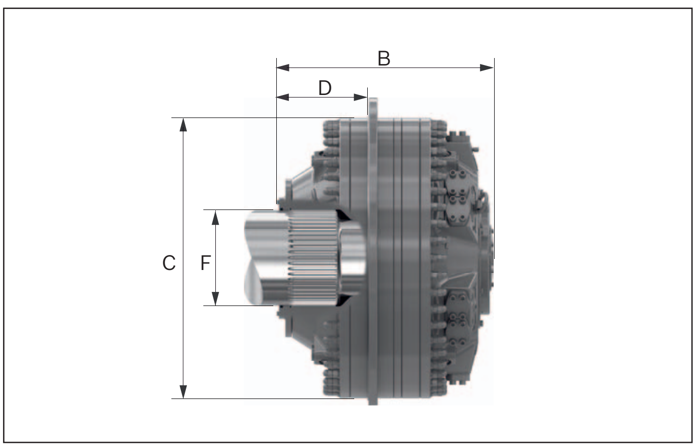


Fig. 5: CBM 3000

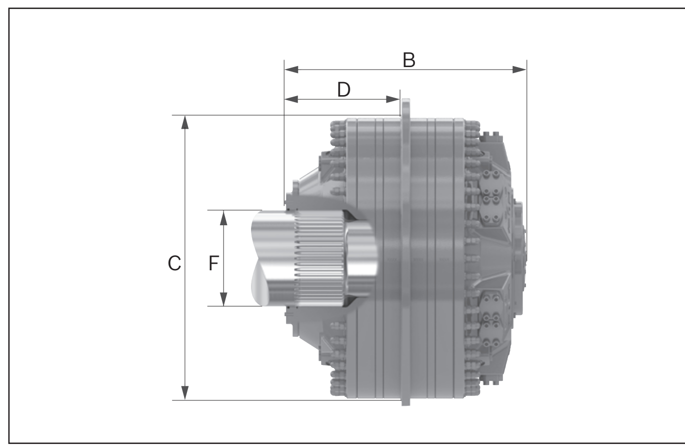


Fig. 6: CBM 4000

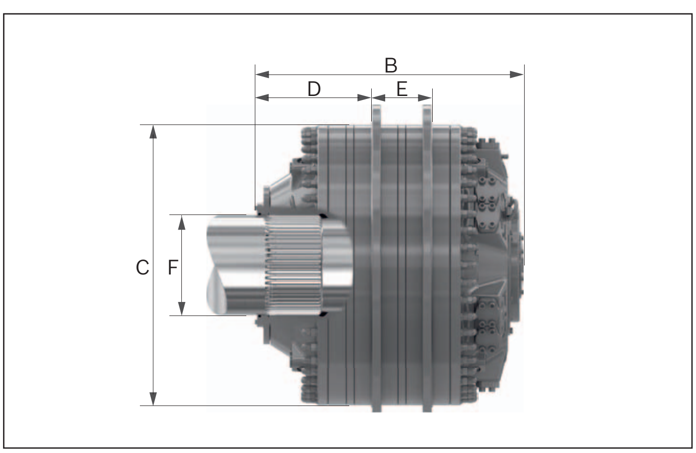


Fig. 7: CBM 5000

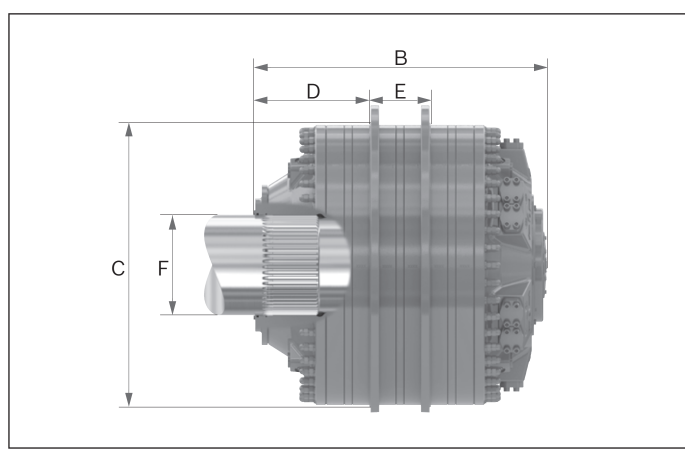


Fig. 8: CBM 6000

Table 2: Dimensions, motor with splines for torque arm mounting

Motor type	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Weight (kg)	Main conn.	Drain conn.
CBM 2000	1 460	872	1 300	419	-	N360x8x30x44x9H	4 100	SAE 2”	BSP 1 1/4” and 2”
CBM 3000	1 460	990	1 300	419	-	N440x8x30x54x9H	5 000	SAE 2”	BSP 1 1/4” and 2”
CBM 4000	1 460	1 108	1 300	537	-	N440x8x30x54x9H	5 800	SAE 2”	BSP 1 1/4” and 2”
CBM 5000	1 460	1 224	1 300	535	270	N460x8x30x56x9H	6 700	SAE 2”	BSP 1 1/4” and 2”
CBM 6000	1 460	1 342	1 300	535	270	N460x8x30x56x9H	7 500	SAE 2”	BSP 1 1/4” and 2”

With splines for flange or torque arm mounting.

The splines shall be lubricated, either oiled with hydraulic oil at assembly, or filled with transmission oil from the connected gearbox. To avoid wear in the splines, the installation must be within the specified tolerances in fig. 9. For control of spline, see table 4. When splines are used for torque arm mounting, the splines shall be lubricated with oil at assembly, see fig. 10. For control of spline, see table 4.

Table 3: Recommeded material in the shaft

Unidirectional drives	Bidirectional drives
Steel with yield strength Rel_{min} = 450 N/mm²	Steel with yield strength Rel_{min} = 700 N/mm²

Table 4

Spline	CBM 2000		CBM 3000/4000		CBM 5000/6000	
Tooth data	W360		W440		W460	
Tooth profile and bottom form	DIN 5480		DIN 5480		DIN 5480	
Tolerance	8f		8f		8f	
Guide	Flank		Flank		Flank	
Pressure angle	30°		30°		30°	
Module	8		8		8	
Number of teeth	44		54		56	
Pitch diameter	Ø352		Ø432		Ø448	
Bottom diameter	Ø340,8	0 / -1,801	Ø420,8	0 / -1,825	Ø440,8	0 / -1,825
Tip diameter	Ø358,4	h11	Ø438,4	h11	Ø458,4	h11
Measure over measuring pins	377,099	-0,107 / -0,188	457,155	-0,121 / -0,212	476,907	-0,118 / -0,208
Diameter of measuring pins	Ø16		Ø16		Ø16	
Addendum modification x*m	-0,4		-0,4		-1,6	

Flange mounting

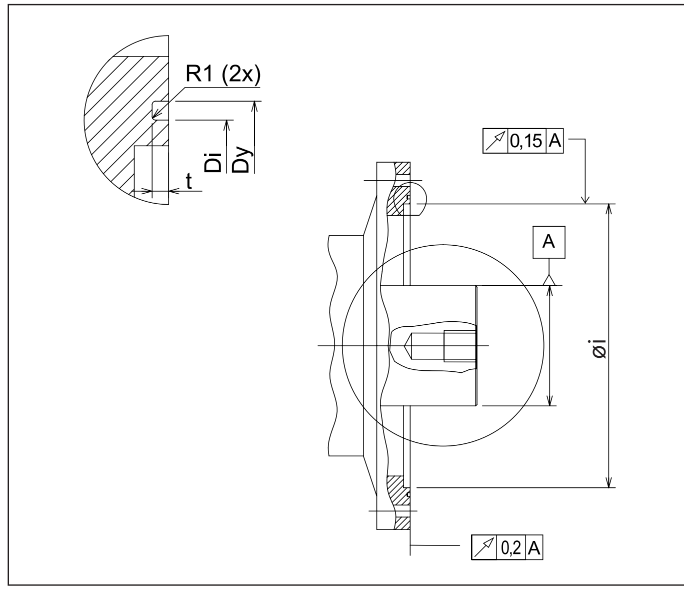


Fig. 9

For production of shaft see dwg 078 2432, 078 2451 and 078 2673.

Table 5

	øi	Dy	Di	t
CBM 2000-4000	1 300 +0.125 / 0	ø 1 329	ø 1 315	4.4±0.1

* O-ring to be used in submerged applications, or for external lubrication of the splines.

Torque arm mounting

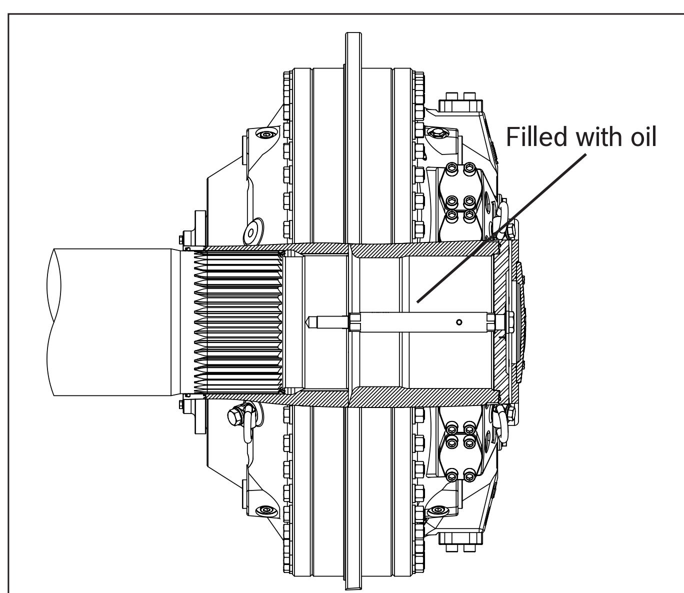


Fig. 10

For production of shaft see dwg 078 2432, 078 2451 and 078 2673.

Dimensions, motor with hollow shaft, coupling adapter

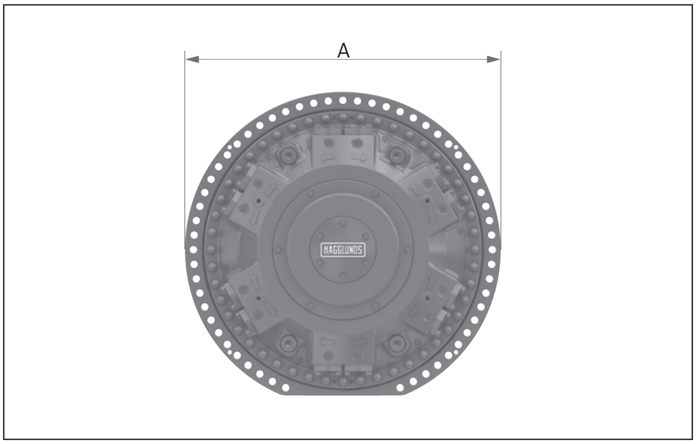


Fig. 11

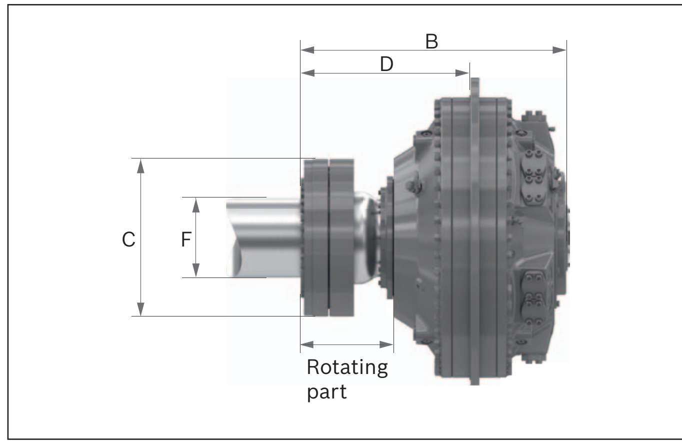


Fig. 12: CBM 2000

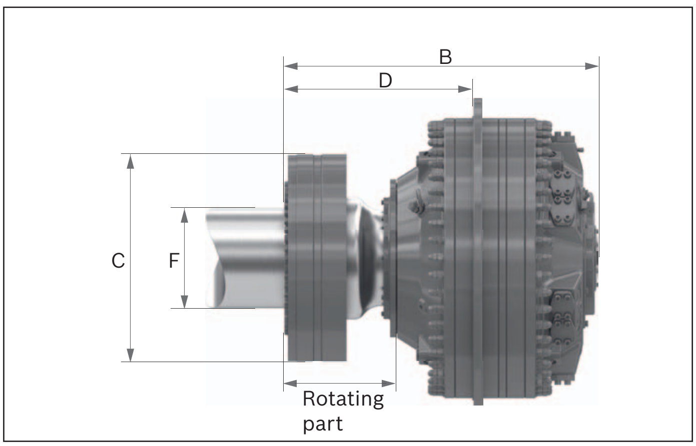


Fig. 13: CBM 3000

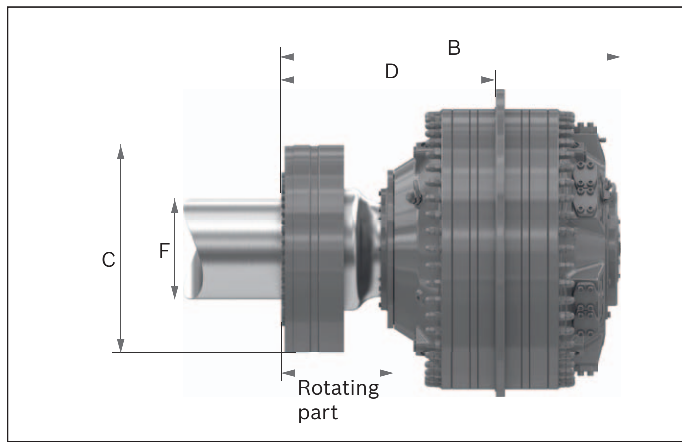


Fig. 14: CBM 4000

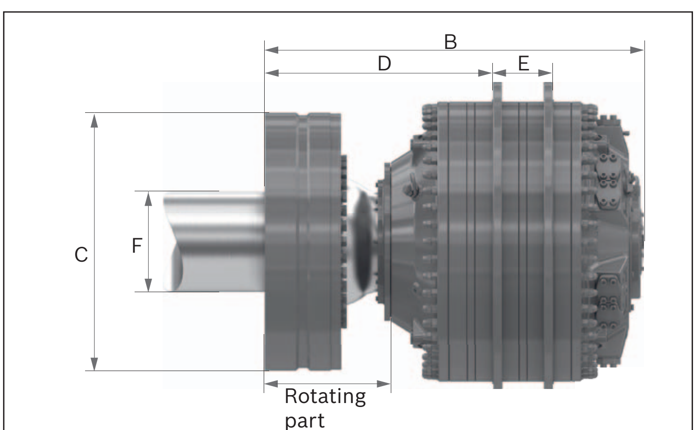


Fig. 15: CBM 5000

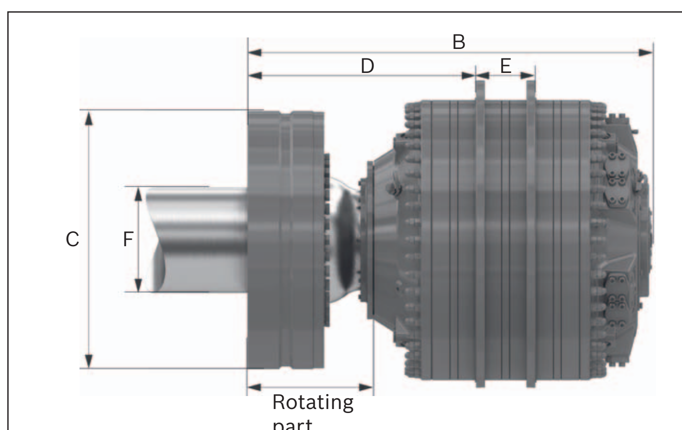


Fig. 16: CBM 6000

Table 6: Dimensions motor with hollow shaft, shaft coupling

Motor	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Weight (kg)	Main conn.	Drain conn.
CB 2000	1 460	1 227	720	773	-	360	4 850	2"	1 1/4" och 2"
CB 3000	1 460	1 434	950	863	-	460	6 600	2"	1 1/4" och 2"
CB 4000	1 460	1 552	950	981	-	460	7 450	2"	1 1/4" och 2"
CB 5000	1 460	1 719	1 180	1 030	270,2	480	9 700	2"	1 1/4" och 2"
CB 6000	1 460	1 838	1 180	1 030	270,2	480	10 500	2"	1 1/4" och 2"

Design of driven shaft end on heavily loaded shaft

Where the driven shaft is heavily loaded and is subject to high stresses, for example for changes in the direction of rotation and/or load, it is recommended that the driven shaft should have a stress relieving groove; see figure below and tables 8 and 9.

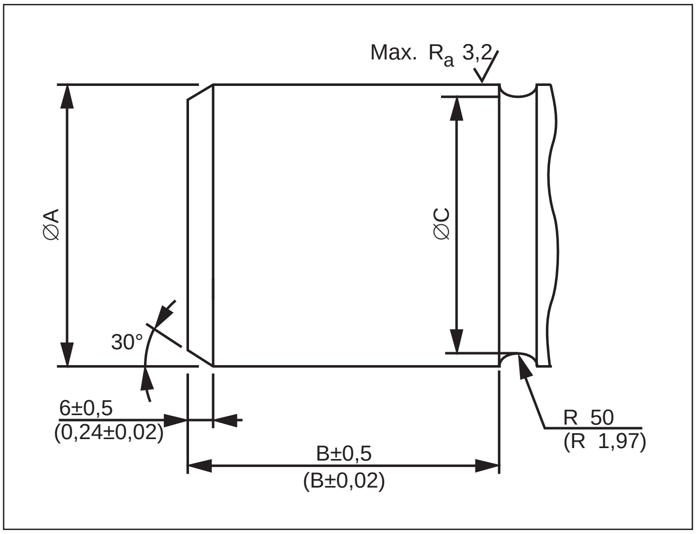


Fig. 17

Normally loaded shaft

In drives with only one direction of rotation and/or load where the stresses in the shaft are moderate, the shaft can be plain, see fig. 18 and tables 8 and 9.

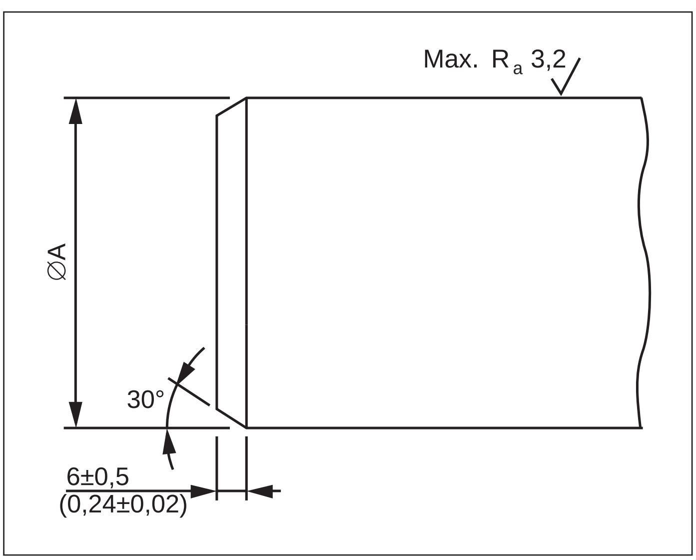


Fig. 18

Table 7

Dim		CBM 2000		CBM 3000 CBM 4000		CBM 5000 CBM 6000	
A	mm	ø360	-0,018	ø460	-0,020	ø480	-0,020
			-0,075		-0,083		-0,083
	in	ø14,1732	-0,00068	ø18,1102	-0,00075	ø18,8976	-0,00075
			-0,00292		-0,00323		-0,00323
B	mm	257		300		320	
	in	10,12		11,81		12,60	
C	mm	354		454		474	
	in	13,94		17,87		18,66	

Note! The dimensions are valid for +20 °C (68 °F)

Table 8: Recommeded material in the shaft

Unidirectional drives	Bidirectional drives
Steel with yield strength Rel_{min} = 300 N/mm²	Steel with yield strength Rel_{min} = 450 N/mm²

Accessories

Torque arm, type TCA 200 - 600

Easy to apply - Hägglunds torque arms.
A shaft mounted gearless drive is achieved by utilizing the standard Hägglunds torque arm. Spline shaft for external load, or shaft for shaft coupling can be used. As a result, alignment problems, expensive flexible couplings and bed plates are eliminated.

Table 9

Dimensions Torque arms	Max, torque, Nm (lbf.ft)	
	For alternating or pulsating torque	At static torque
TCA 200 for CBM 2000	700 000 (516 300)	840 000 (619 600)
TCA 400 for CBM 3000/CBM 4000	1 400 000 (1 032 600)	1 680 000 (1 239 100)
TCA 600 for CBM 5000/CBM 6000	2 100 000 (1 548 900)	2 520 000 (1 858 700)

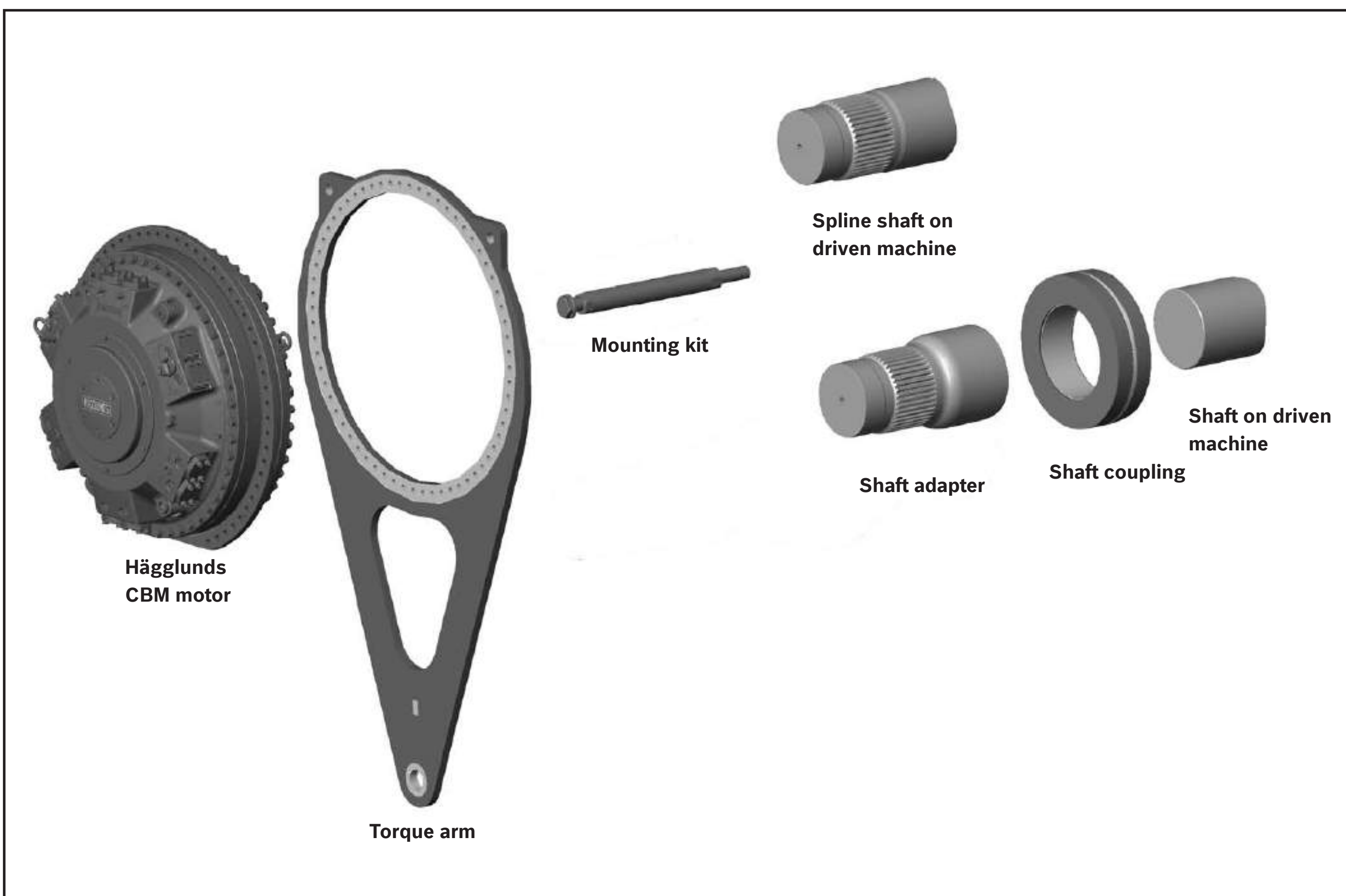


Fig. 19: Torque arm

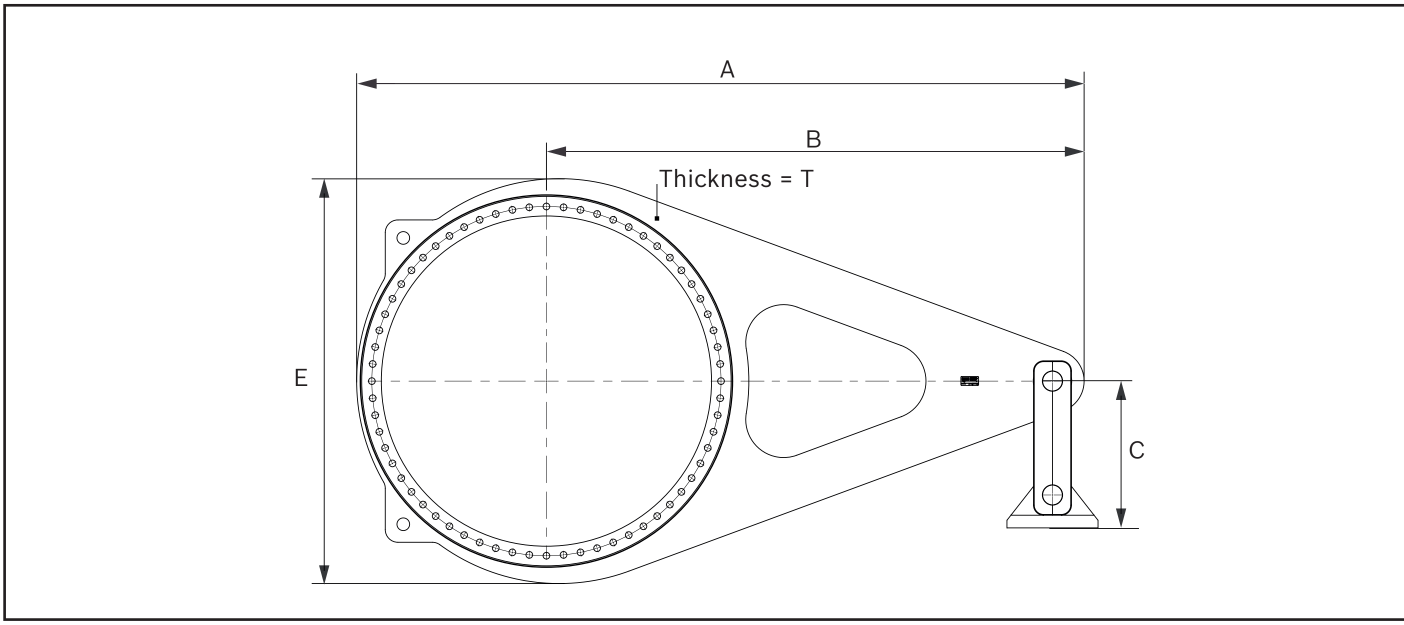


Fig. 20: Dimensions torque arm

Table 10: Dimensions torque arm

Torque arm	A mm (in)	B mm (in)	C mm (in)	D	E mm (in)	T mm (in)	Weight kg (lb)
TCA 200 for CBM 2000	2 875 (113,19)	2 000 (78,74)	580 (22,83)	M30	1 600 (62,99)	40 (1,57)	445 (981)
TCA 400 for CBM 3000/ CBM 4000	3 900 (153,54)	3 000 (118,11)	690 (27,17)	M30	1 600 (62,99)	50 (1,97)	875 (1 929)
TCA 600 for CBM 5000/ CBM 6000	3 900 (153,54)	3 000 (118,11)	840 (33,07)	M30	1 600 (62,99)	50 (1,97)	2 000 (4 409)

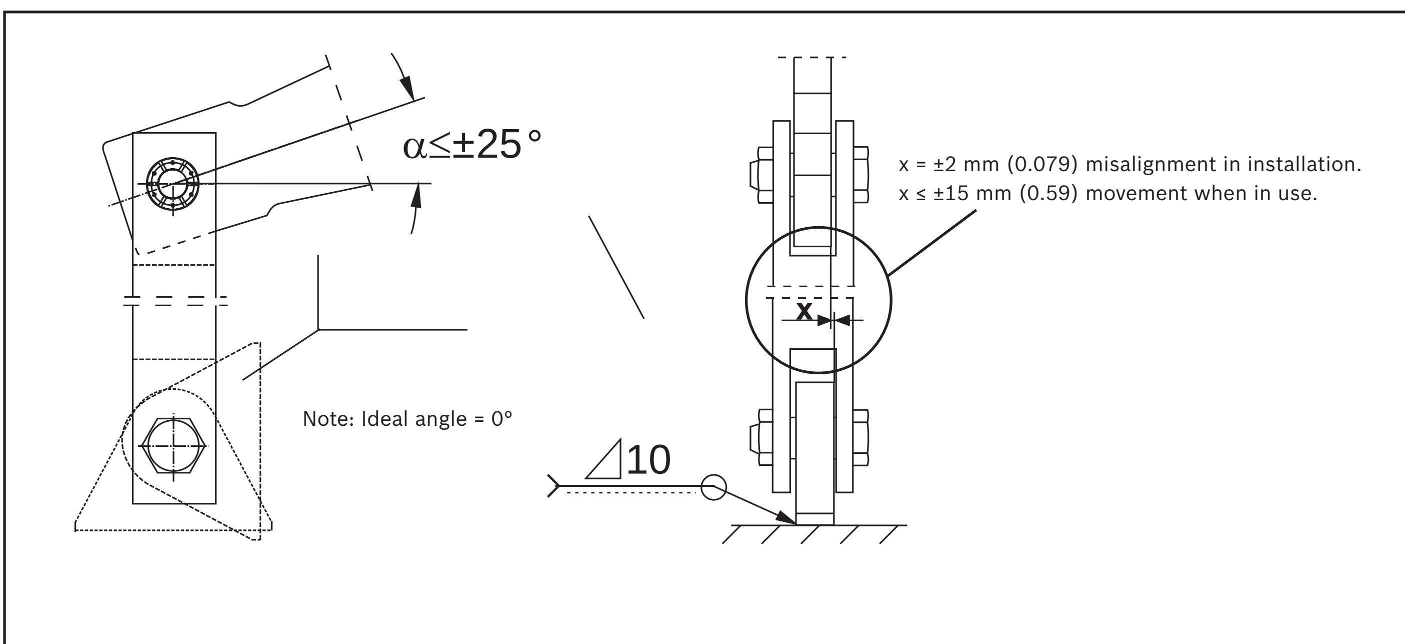


Fig 21: Mounting of pivoted attachment

Double ended torque arm, DTCBM 2000-1200 - DTCBM 6000

Double ended torque arm, including double acting hydraulic cylinder and pivoted attachment.
Following are included in delivery:

- Screws and washers (motor-torque arm)
- Hose kit + clamps
- Hose flange connections

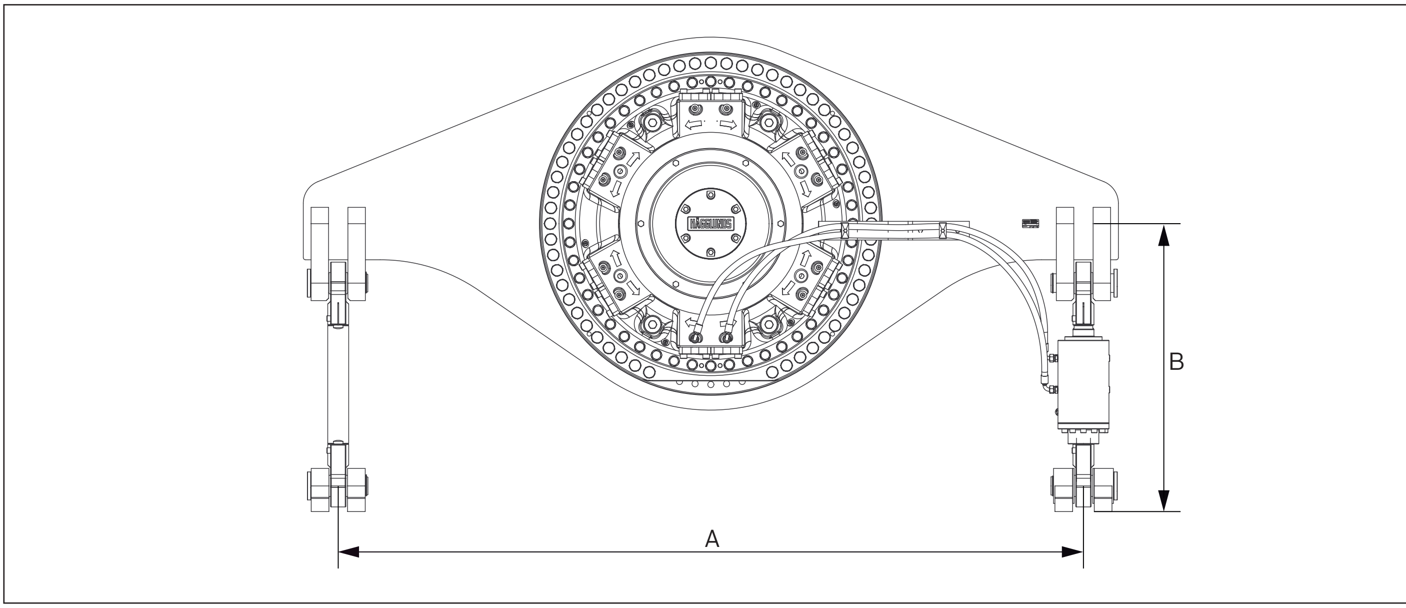


Fig. 22: Dimensions double torque arm

Table 11: Dimensions double torque arm

<table>
<tr><th>Torque Arm</th><th>Motor type</th><th>Ordering code</th><th>A mm (In)</th><th>B mm (In)</th><th>Weight Kg (lb)</th></tr>
<tr><td>078 2510-801
R939056847</td><td>CBM 6000-6000</td><td>DTCBM 6000</td><td>3 600 (141,73)</td><td rowspan="19">1 235 (48,62)</td><td>2 170 (4 784)</td></tr>
<tr><td rowspan="2">078 2510-802
R939056848</td><td>CBM 6000-5600</td><td rowspan="2">DTCBM 6000-5600</td><td rowspan="2">3 200 (125,98)</td><td rowspan="2">1 960 (4 321)</td></tr>
<tr><td>CBM 5000-5000</td></tr>
<tr><td>078 2510-803
R939056849</td><td>CBM 5000-4600</td><td>DTCBM 5000-4600</td><td>2 800 (110,23)</td><td>1 760 (3 880)</td></tr>
<tr><td rowspan="2">078 2509-801
R939056144</td><td>CBM 4000-4000</td><td rowspan="2">DTCBM 4000</td><td rowspan="2">4 200 (165,35)</td><td rowspan="2">1 130 (2 491)</td></tr>
<tr><td>CBM 4000-3800</td></tr>
<tr><td rowspan="3">078 2509-802
R939056145</td><td>CBM 4000-3600</td><td rowspan="3">DTCBM 4000-3600</td><td rowspan="5">3 600 (141,73)</td><td rowspan="5">950 (2 094)</td></tr>
<tr><td>CBM 4000-3400</td></tr>
<tr><td>CBM 4000-3200</td></tr>
<tr><td rowspan="2">078 2509-803
R939056850</td><td>CBM 3000-3000</td><td rowspan="2">DTCBM 3000</td></tr>
<tr><td>CBM 3000-2800</td></tr>
<tr><td rowspan="2">078 2509-804
R939056851</td><td>CBM 3000-2600</td><td rowspan="2">DTCBM 3000-2600</td><td rowspan="5">3 200 (125,98)</td><td rowspan="5">850 (1 874)</td></tr>
<tr><td>CBM 3000-2400</td></tr>
<tr><td rowspan="2">078 2509-805
R939056146</td><td>CBM 3000-2200</td><td rowspan="2">DTCBM 3000-2200</td></tr>
<tr><td>CBM 2000-2000</td></tr>
<tr><td>078 2509-806
R939056852</td><td>CBM 2000-1800</td><td>DTCBM 2000-1800</td></tr>
<tr><td rowspan="2">078 2509-807
R939056853</td><td>CBM 2000-1600</td><td rowspan="2">DTCBM 2000-1600</td><td rowspan="3">2 800 (110,24)</td><td rowspan="3">740 (1 631)</td></tr>
<tr><td>CBM 2000-1400</td></tr>
<tr><td>078 2509-808
R939056854</td><td>CBM 2000-1200</td><td>DTCBM 2000-1200</td></tr>
</table>

Mounting set SMCB1 for speed encoder

Speed encoder kit for Compact CBM 2000-6000 motors where the speed encoder is enclosed and well protected.
The mounting set can be used for both spline and shaft coupling motors.
The encoder is used for detection of speed by pulse-frequency or/either direction of rotation by pulse-train.

Fig. 23

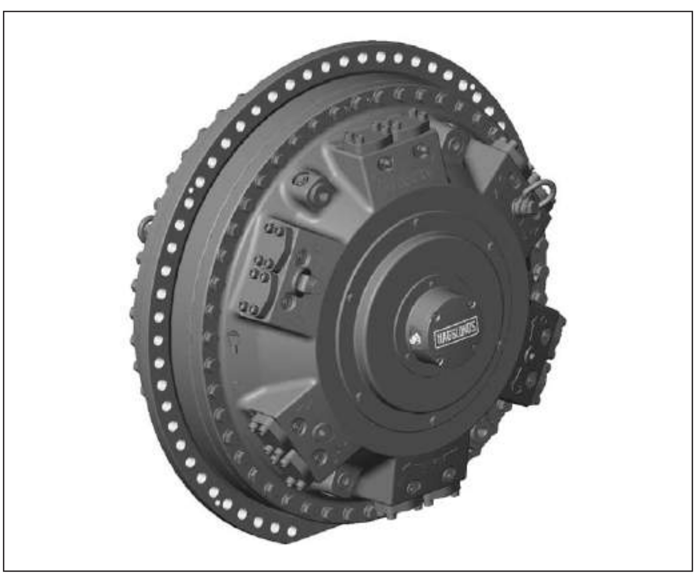


Fig. 24 CBM 2000 with SMCB1

Cross-over valve, COCB 1000

The valve can be used on CBM motors with adapter 041 0523-801. The valve is bolted on the adapter which is bolted on the motor, and the valve protects the motor and system from too high pressure, if the motor is suddenly stopped.
The relief valves have a standard pressure settings of 350 bar (5076 psi), but are fully adjustable between 50 bar (725 psi) to 350 bar (5076 psi). Pressure setting is made without charge pressure.
Screws and O-rings are included in delivery.
The valve for charge pressure have a standard pressure setting of 15 bar (218 psi), but are fully adjustable down to 3 bar (43,5 psi).
Anti-cavitation check valves are built into the block, and makes it possible to arrange for external supply of charge pressure.

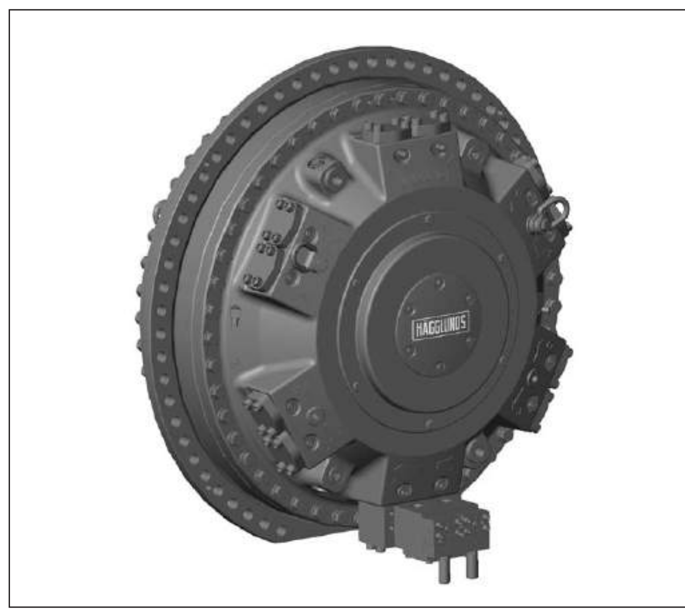


Fig. 25

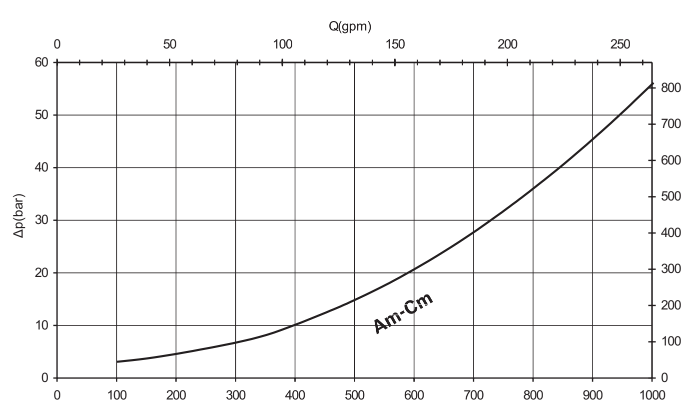


Fig. 25: Pressure loss COCB

Coupling adapter, CBM 2000-6000

The adapter includes shrink disk and shaft adapter. Mounting kit must be ordered separately.
The coupling adapter is designed for shaft, that can not be made with splines.

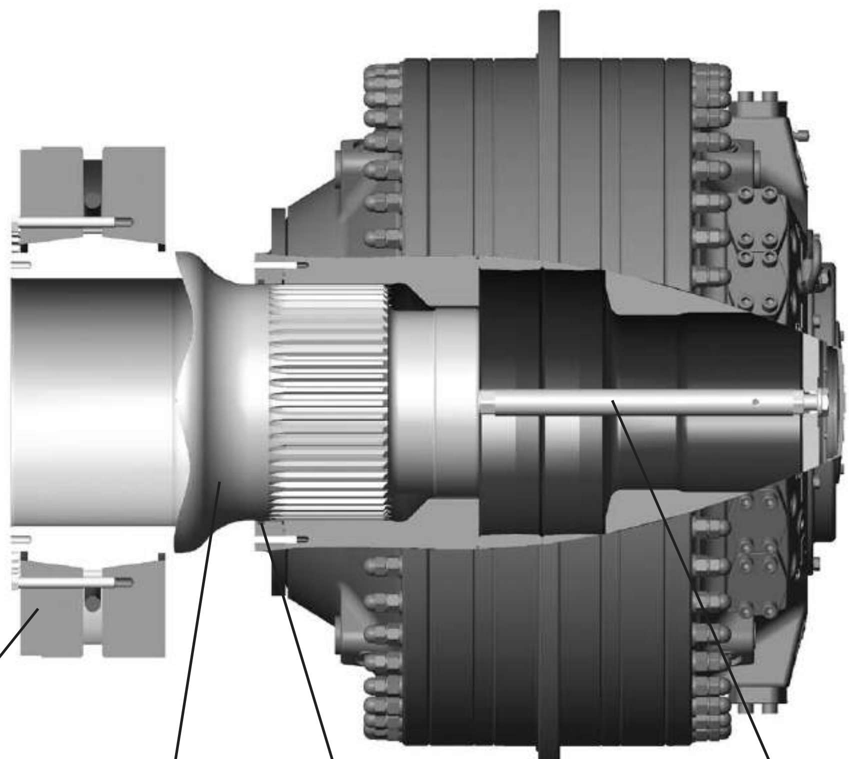


Fig. 26

Table 12: Ordering code, coupling adapter

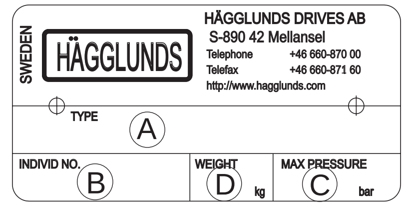
Motor type	Unidirectional drive	Bidirectional drive
CBM 2000	078 2411-801 R939055538	078 2412-801 R939055544
CBM 3000/4000	078 2411-802 R939056668	078 2412-802 R939056674
CBM 5000/6000		078 2412-803 R939056676

Table 13: Ordering code

Motor type	Ordering code
CBM 2000	R939055413 078 2315-801
CBM 3000	R939055509 078 2315-802
CBM 4000	R939055497 078 2315-803
CBM 5000	R939055505 078 2315-804
CBM 6000	R939055506 078 2315-805

Hägglunds tandem motors

A Tandem motor consists of 3 major units, Front motor + Tandem kit TBM xx + Rear motor. On the stamping sign on the Tandem kit, the max pressure and the total weight for the complete unit are declared. Note that the complete Ordering code for a Tandem motor, contains of 3 individual Ordering codes (3 parts).



A: TBM-type, same as Ordering code
B: Week of assembly (yy-ww)
C: Max working pressure for the assembly
D: Total weight of the assembly

Fig 27: Stamping for TBM-unit

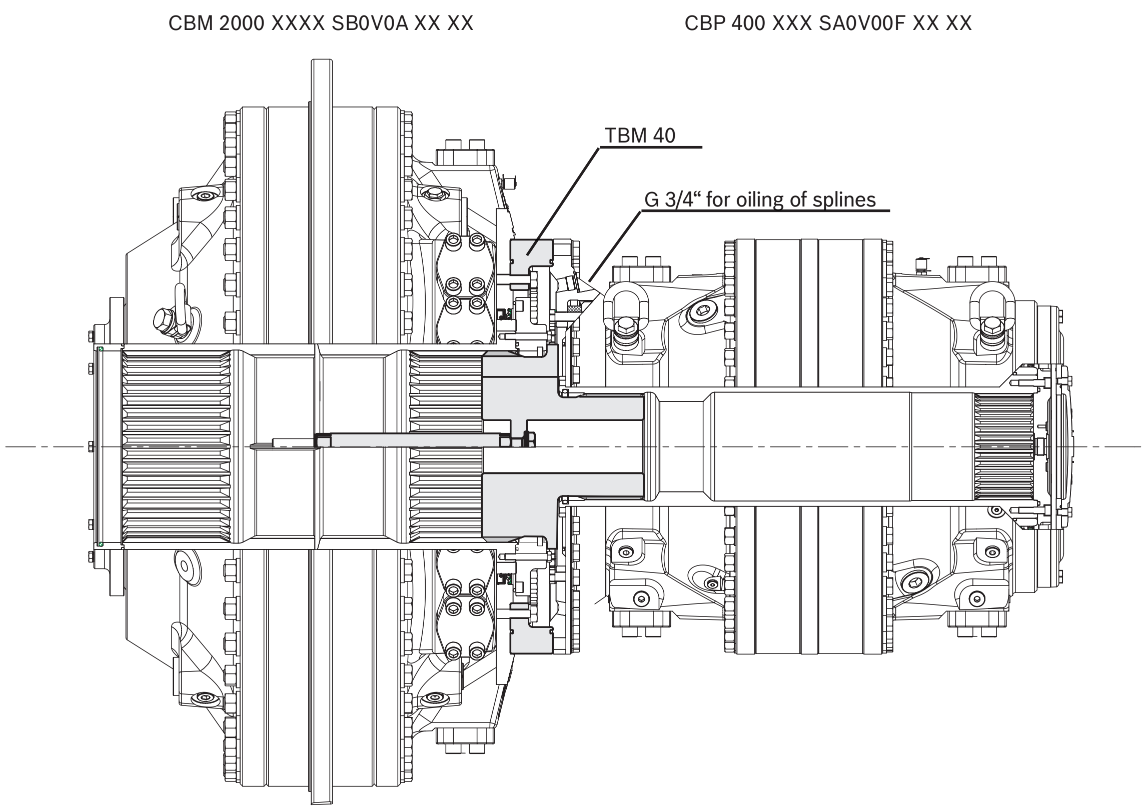


Fig. 27: Example, CBM 2000 XXXX SB0V0A XX XX + TBM 40 X 00 00 + CBP 400 XXX SA0V00F XX XX

Table 14

Tandem motor	Max. pressure		Total weight		A Lenght		B Diameter		Max. torque to driven shaft	
	bar	psi	kg	lb	mm	in	mm	in	Nm	lbf•ft
CBM 2000 + TBM 40 +CBP 400			6 505	14 344	1 845	72,6			840 000	619 554
CBM 3000 + TBM 40 +CBP 400			7 437	16 399	1 963	77,3			1 190 000	877 702
CBM 4000 + TBM 40 +CBP 400	350	5 076	8 320	18 346	2 081	81,9	1 460	57,5	1 540 000	1 135 850
CBM 5000 + TBM 40 +CBP 400			9 140	20 154	2 199	86,6			1 890 000	1 393 997
CBM 6000 + TBM 40 +CBP 400			10 005	22 061	2 317	91,2			2 240 000	1 652 145

Diagrams for Hägglunds CBM

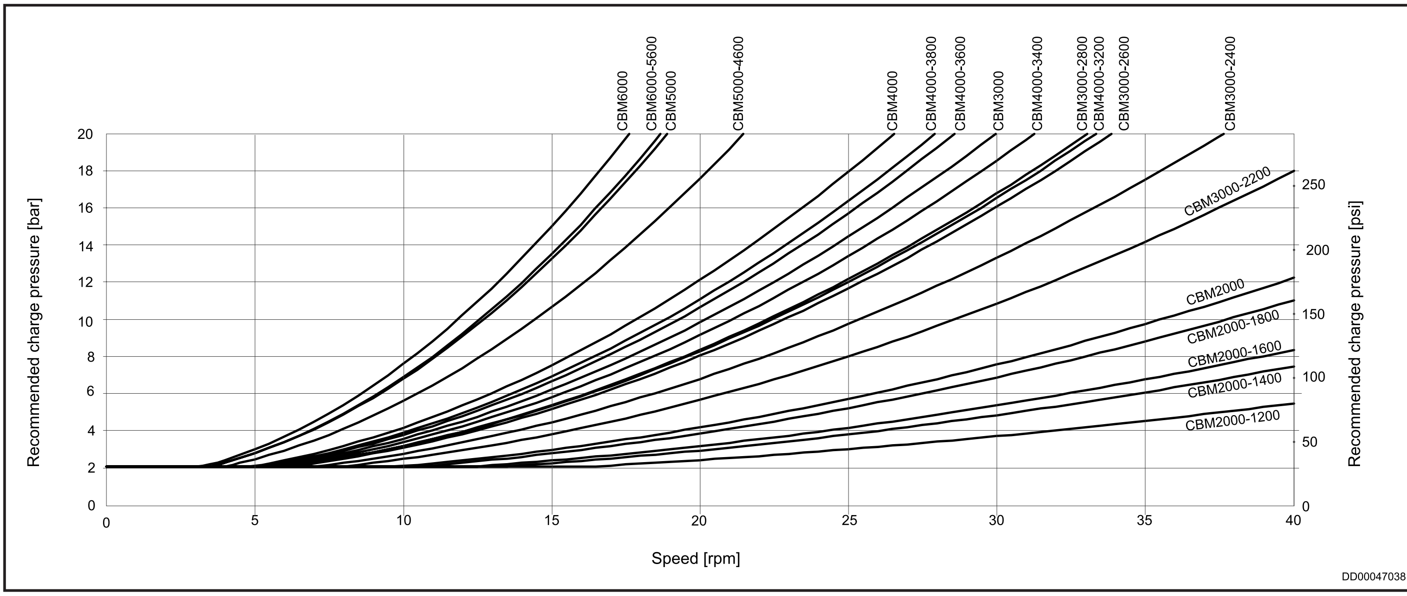


Fig 28: Recommended charge pressure - Compact CBM motors 4-port connection. Valid for oil viscosity 40 cSt.

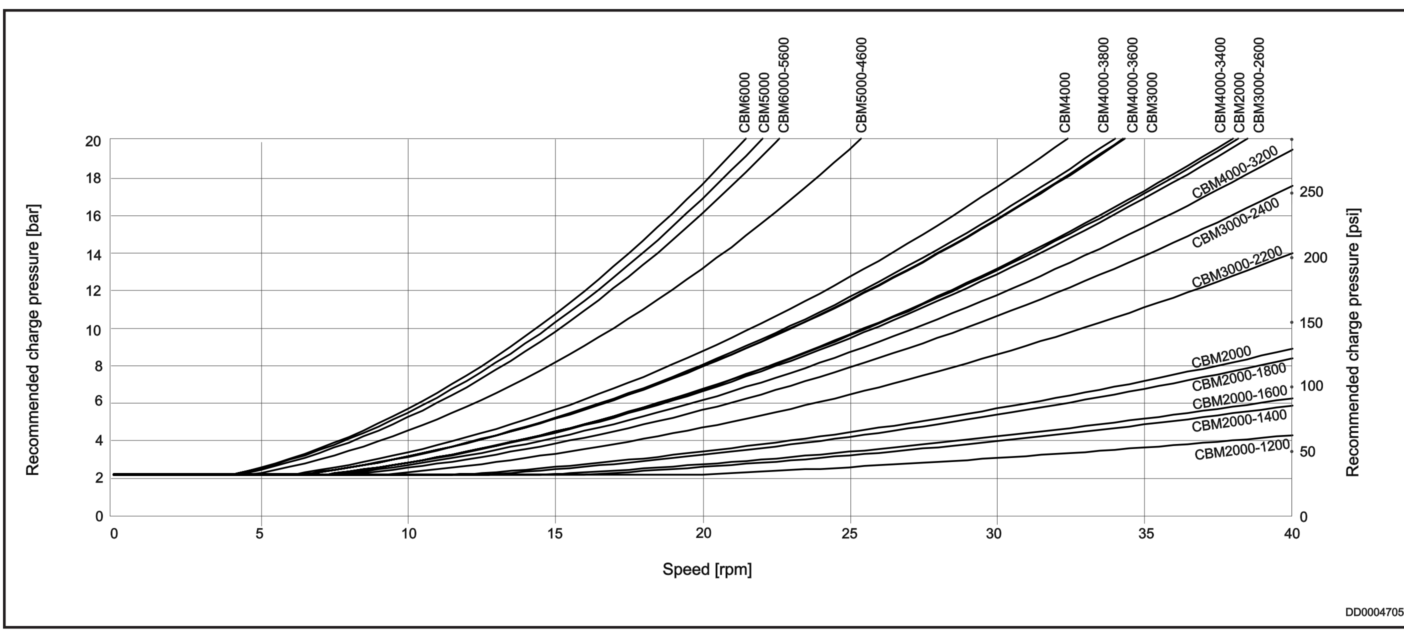


Fig 29: Recommended charge pressure -Compact CBM motors 8-port connection. Valid for oil viscosity 40 cSt.

Case 1: The motor works in braking mode. Required charge pressure at the inlet port is according to diagram above.
Case 2: The motor works in driving mode only. Required back pressure at the outlet port corresponds to 30% of value given in diagram above, but may not be lower than 2 bar (29 psi).

Overall efficiency, oil viscosity 40 cSt, Pc = 15 bar (217 psi)

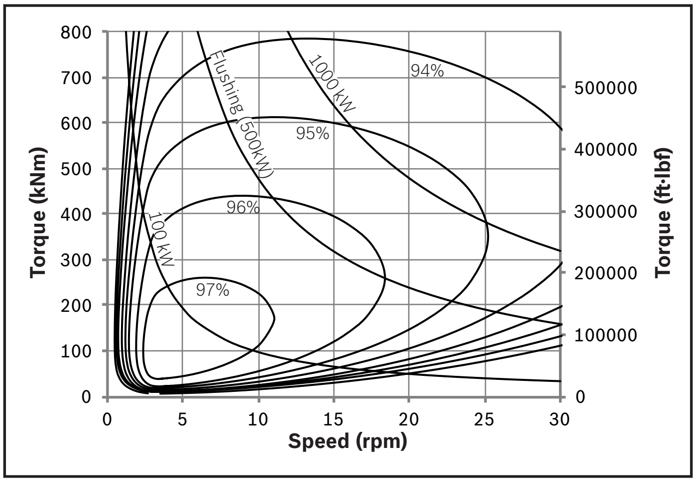


Fig 30: CBM 2000 8-port

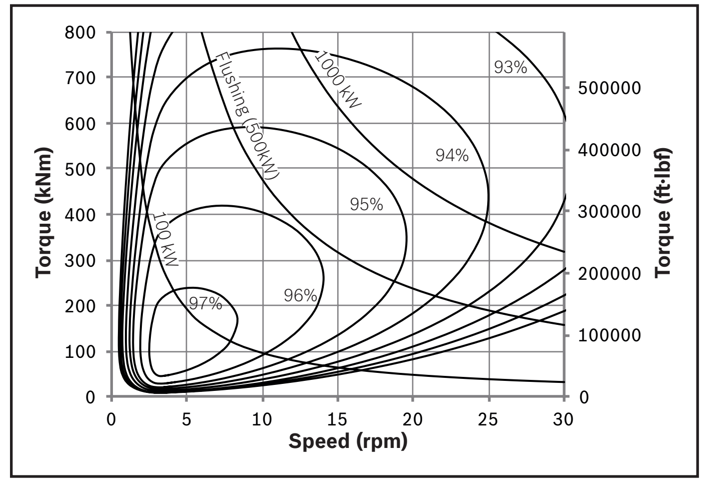


Fig 31: CBM 2000 4-port

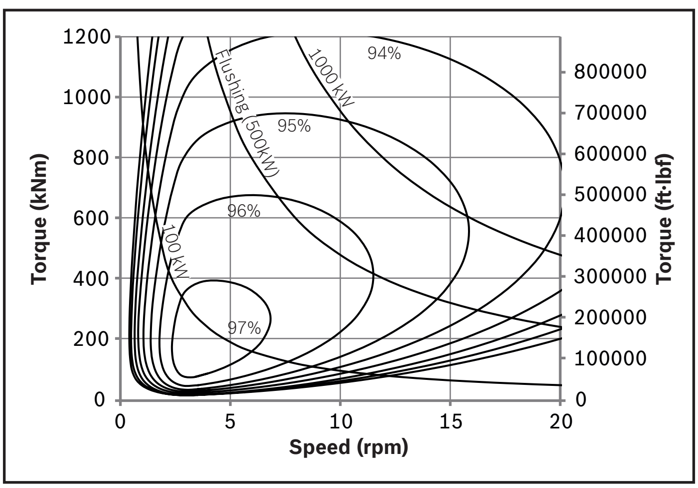


Fig 32: CBM 3000 8-port

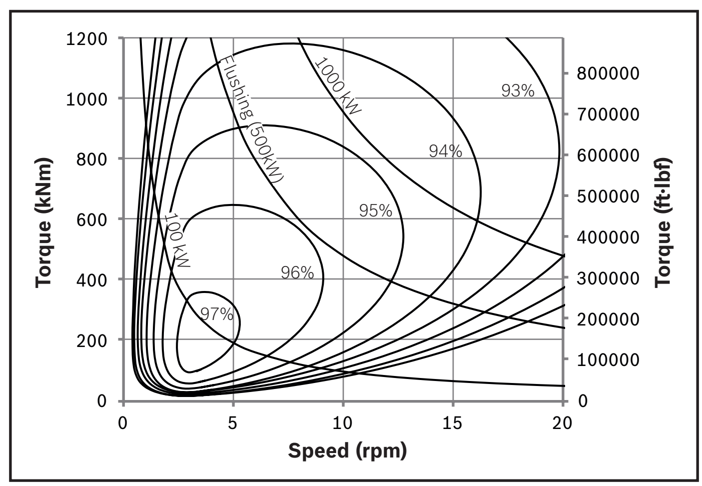


Fig 33: CBM 3000 4-port

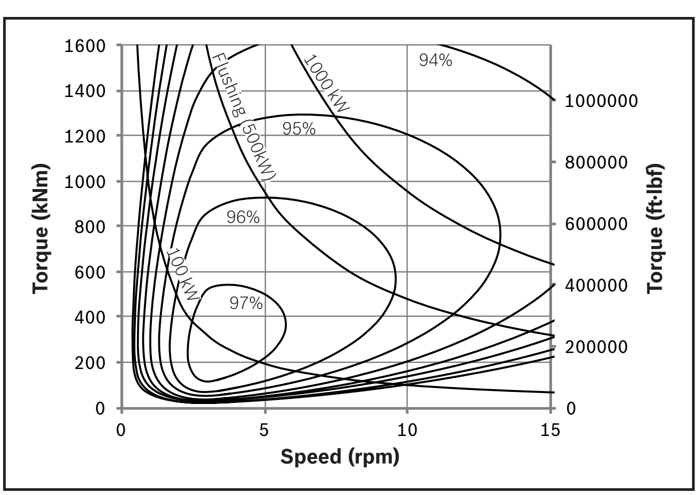


Fig 34: CBM 4000 8-port

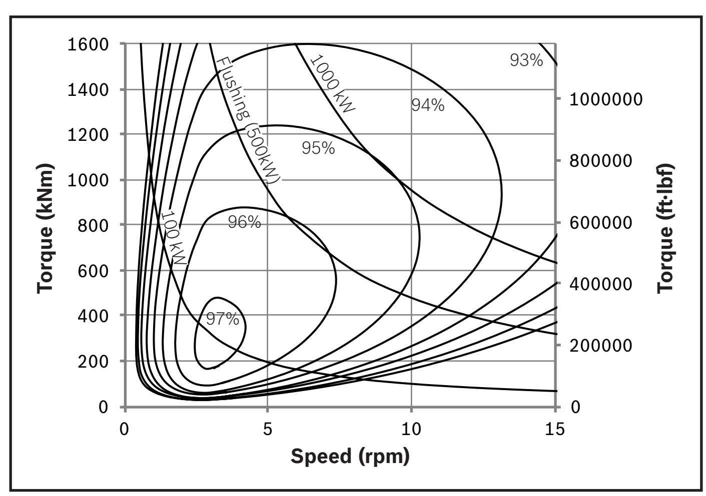


Fig 35: CBM 4000 4-port

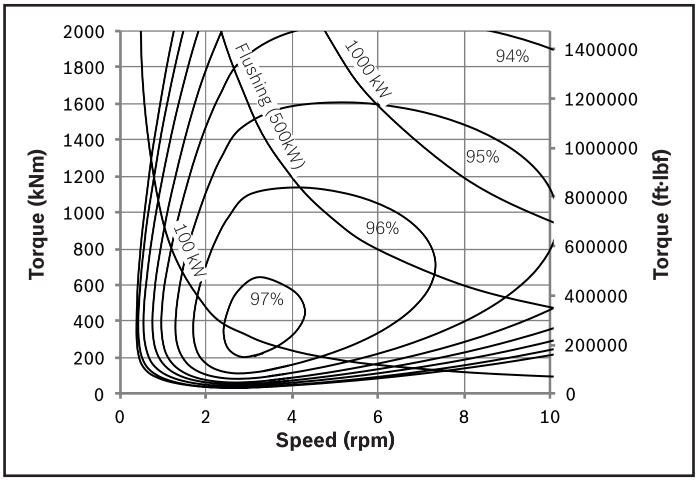


Fig 36: CBM 5000 8-port

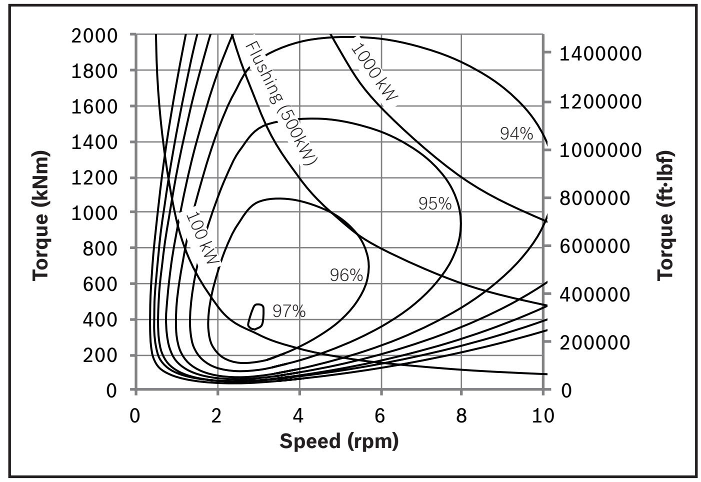


Fig 37: CBM 5000 4-port

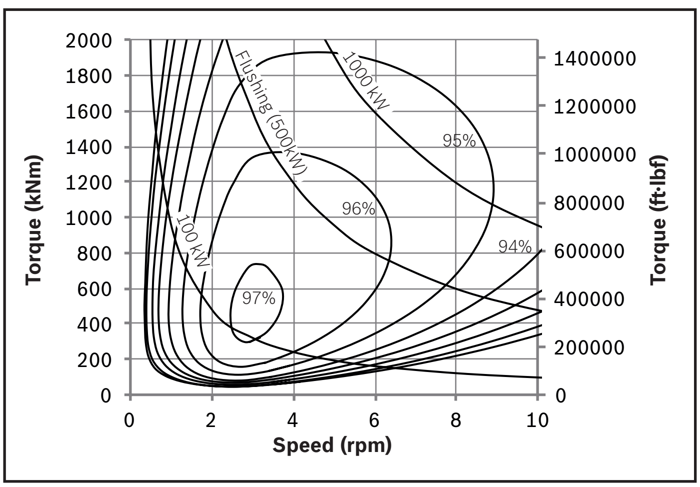


Fig 38: CBM 6000 8-port

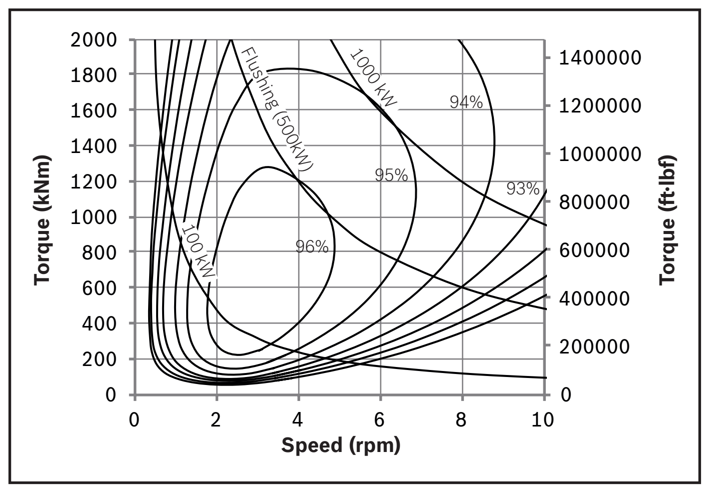


Fig 39: CBM 6000 4-port

Flushing of motor case

The Hägglunds CBM motors have very high total efficiency, and they are now frequently used in applications with high power. To avoid high temperature in the motor case, the losses generated in the motors must be cooled away, because high temperature gives lower viscosity and this gives reduction in rating life and max allowed power for the motor.
For continuous duty the motor case must be flushed when the power exceed the following max power:

Max power without flushing

- CBM 2000 - 6000 500 kW (670 hp)

Volumetric losses - Compact CBM motors

Valid for an oil viscosity of 40 cSt.

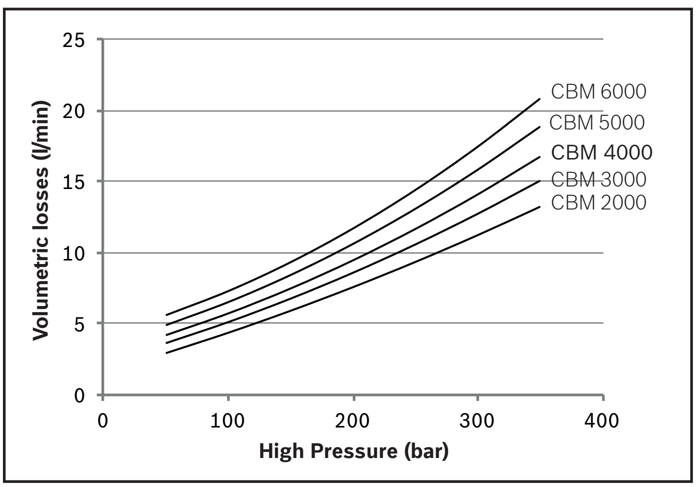


Fig 40: volumetric loss

Variation in volumetric loss at different oil viscosities for Compact motors

When calculating volumetric losses using other viscosities than 40 cSt, multiply the value given in the volumetric loss diagram by the factor K.

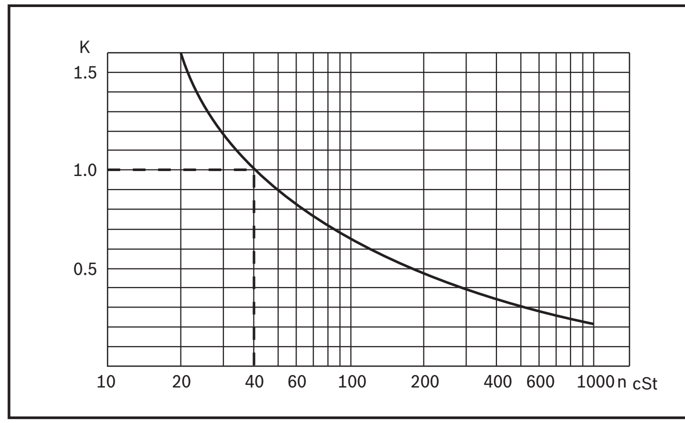


Fig 41

Diagrams for Hägglunds CBM

Pressure loss, oil viscosity 40 cSt

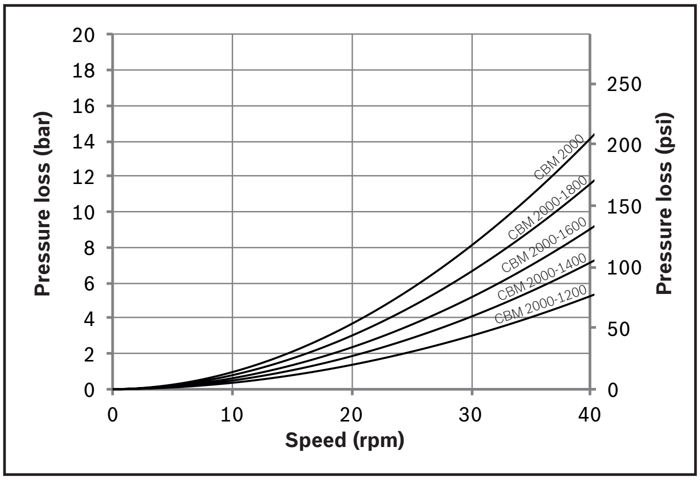


Fig 42: CBM 2000 pressure loss 4 ports

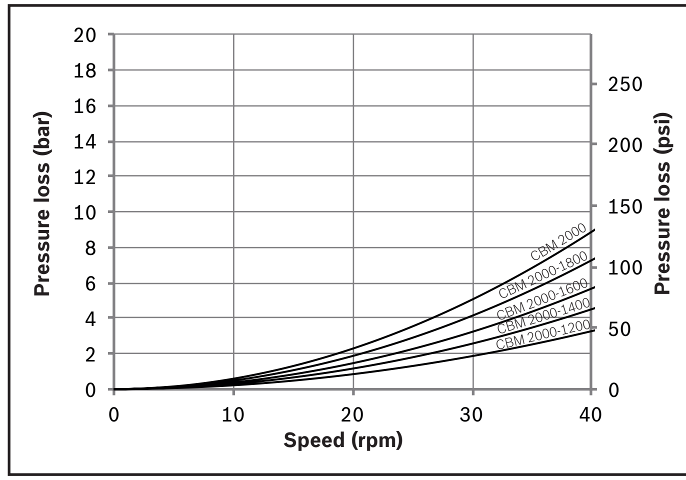


Fig 43: CBM 2000 pressure loss 8 ports

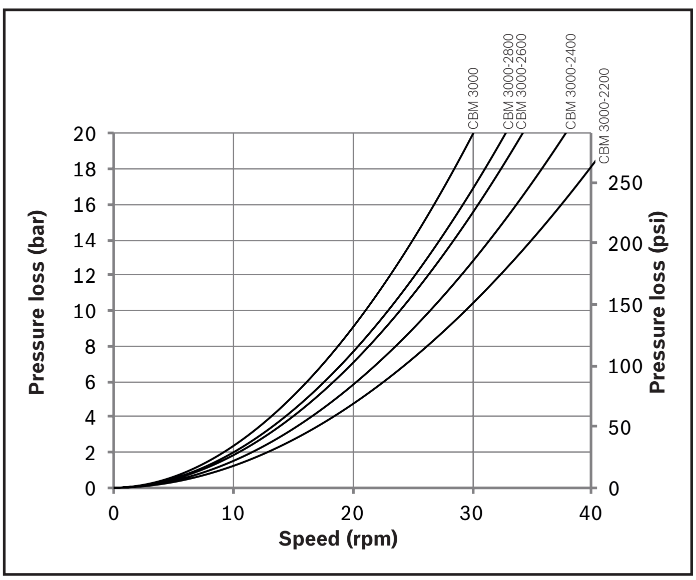


Fig 44: CBM 3000 pressure loss 4 ports

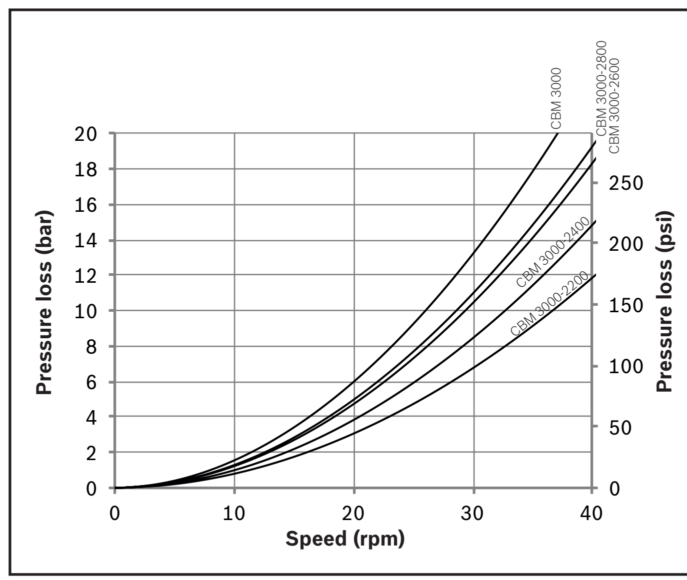


Fig 45: CBM 3000 pressure loss 8 ports

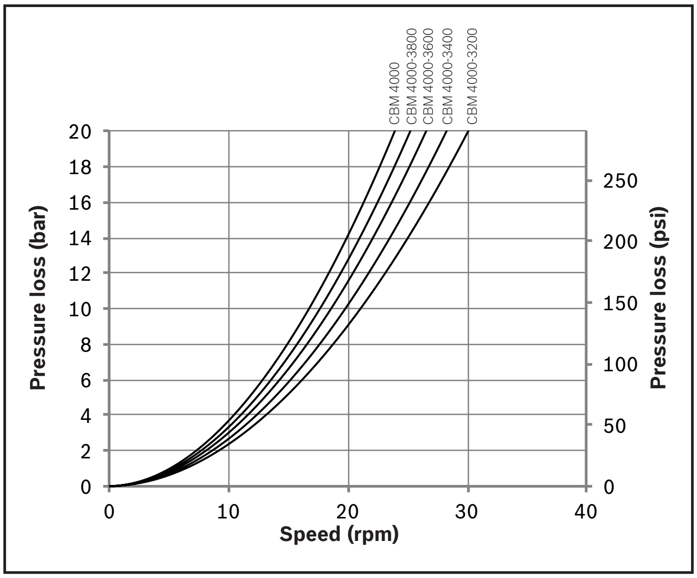


Fig 46: CBM 4000 pressure loss 4 ports

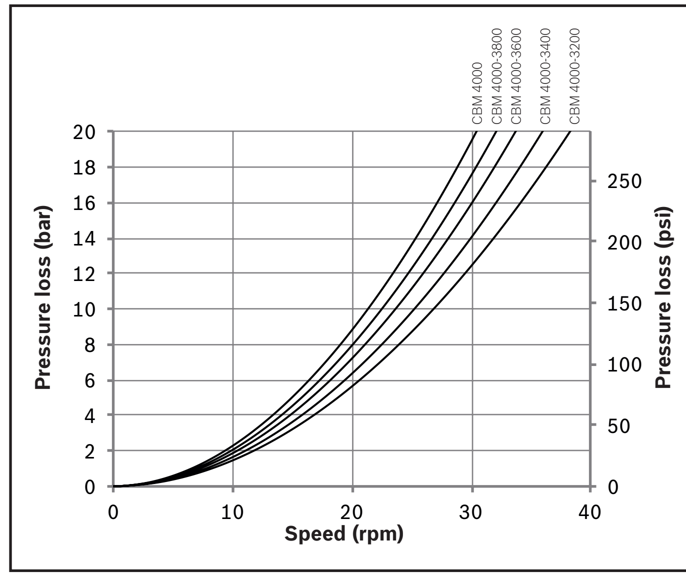


Fig 47: CBM 4000 pressure loss 8 ports

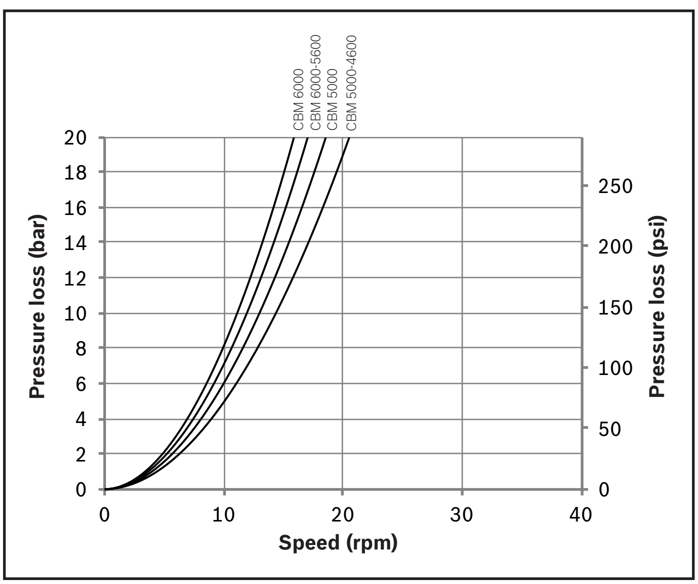


Fig 48: CBM 5000, 6000 pressure loss 4 ports

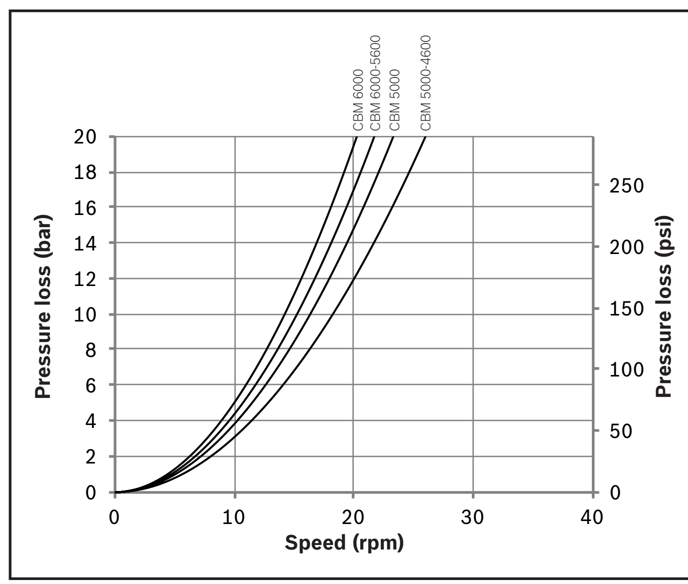


Fig 49: CBM 5000, 6000 pressure loss 8 ports

Choice of hydraulic fluid

The Hägglunds hydraulic motors are primarily designed to operate on conventional petroleum based hydraulic oils. The hydraulic oil can be chosen in consultation with the oil supplier of your local sales office, bearing the following requirements in mind:

General

The oil shall have FZG (90) fail stage minimum 11 described in IP 334 (DIN 51354). The oil must also contain inhibitors to prevent oxidation, corrosion and foaming. The viscosity of mineral oil is highly dependent of the temperature. The final choice of oil must depend on the operating temperature that can be expected or that has been established in the system and not in the hydraulic tank. High temperatures in the system greatly reduce the service life of oil and rubber seals, as well as resulting in low viscosity, which in turn provides poor lubrication. Content of water shall be less than 0,1%. In industrial applications with high demands for service life, the content of water shall be less than 0,05%.
Viscosity index = 100 is recommended. Viscosity index = 150 can be used for operation with large temperature difference, however many hydraulic fluids are subject to temporary and permanent reductions of the viscosity. Hägglunds recommendation is always to use the base oil viscosity when calculating the rated life and max allowed power. For heavy-duty applications we recommend synthetic oils.

Recomended viscosity in motor case at operating temperature: 40-150 cSt.

Table 15: Temperature limits

Normal operating temperature should be less than +50 °C (122 °F)		
	Temp °C	**Temp °F**
Nitrile seals (std motor)	-35 °C to +70 °C	-31 °F to +158 °F
Viton seals	-20 °C to +100 °C	-4 °F to +212 °F

Table 16: Viscosity limits

Minimum viscosity limits at operating temprature in motor case	
Standard motors with coated piston, uncoated cam rollers and charge pressure below 50 bar (725 psi).	15 cSt *

*) Low viscosity gives reduced service life for the motors. Maximum permitted viscosity is 10.000 cSt.

Fire resistant fluid

The following fluids are tested for Hägglunds motors (ISO/DP 6071).

Table 17

Fluid	Approved	Seals	Internal paint
HFA: Oil (3-5%) in water emulsion	No	-	-
HFB: Inverted emulsion 40-45% water in oil	Yes	Nitrile (std motor)	Not painted*
HFC: Water-glycol	Yes	Nitrile * (std motor)	Not painted*
HFD synthetic fluids			
HFD:S - Chlorinated hydrocarbons	Yes	Viton	Not painted*
HFD:T - Mixture of the above	Yes	Viton	Not painted*
HFD:U - Other compositions	Yes	Viton	Not painted*

* Must be specified in the order.

Down rating of pressure data and basic rating life

Down rating of pressure, for motors used in systems with fire resistant fluids, the maximum pressure for motor given on data sheet must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.7 x maximum pressure for motor
HFC-fluid	0.7 x maximum pressure for motor
HFD-fluid	0.9 x maximum pressure for motor

Down rating of basic rating life, for motors used in systems with fire resistant fluids, the “expected basic rated life” must be multiplied with following factors:

HFA-fluid	not fit for use
HFB-fluid	0.26 x expected life with mineral oil
HFC-fluid	0.24 x expected life with mineral oil
HFD-fluid	0.80 x expected life with mineral oil

Filtration

The oil in a hydraulic system must always be filtered and also new oil from your supplier has to be filtered when adding it to the system. The grade of filtration in a hydraulic system is a question of service life v.s. money spent on filtration.
In order to obtain stated service life it is important to follow our recommendations concerning contamination level.
When choosing the filter it is important to consider the amount of dirt particles that the filter can absorb and still operate satisfactory. For that reason we recommend a filter with an indicator that gives a signal when it is time to change the filter cartridge.

Filtering recommendations
Before start-up, check that the system is thoroughly cleaned.

- 1. For industrial applications the contamination level should not exceed ISO 4406:1999 18/16/13 (NAS 1638, class 7).
- 2. When filling the tank and motor case, we recommend the use of a filter with the grade of filtration β10≥75.
-

Explanation of "Grade of Filtration"
Grade of filtration **β10≥75** indicates the following:
β10 means the size of particle ≥10μm that will be removed by filtration.
=75 means the grade of filtration of above mentioned size of particle. The grade of filtration is defined as number of particles in the oil before filtration in relation to number of particles in the oil after filtration.

Ex. Grade of filtration is **β10≥75**.
Before the filtration the oil contains N number of particles ≥10μm and after passing the filter once the oil contains

$$\frac{N}{\mathbf{75}}$$

number of particles ≥10μm.
This means that

$$N - \frac{N}{\mathbf{75}} = \frac{74 \cdot N}{\mathbf{75}}$$

number of particles have been filtered (=98.6%).

Environmentally acceptable fluids

Table 18

Fluid	Approved	Seals	Internal paint
Vegetable */** Fluid HTG	Yes	Nitrile (std motor)	-
Synthetic ** Esters HE	Yes	Nitrile (std motor)	-

* Vegetable fluids give good lubrication and small change of viscosity with different temperature. Vegetable fluids must be controlled every 3 months and temperature shall be less than +45 °C (113 °F) to give good service life for the fluid.

** Environmentally acceptable fluid give the same service life for the drive, as mineral oil.

Versatile mounting - examples of installations

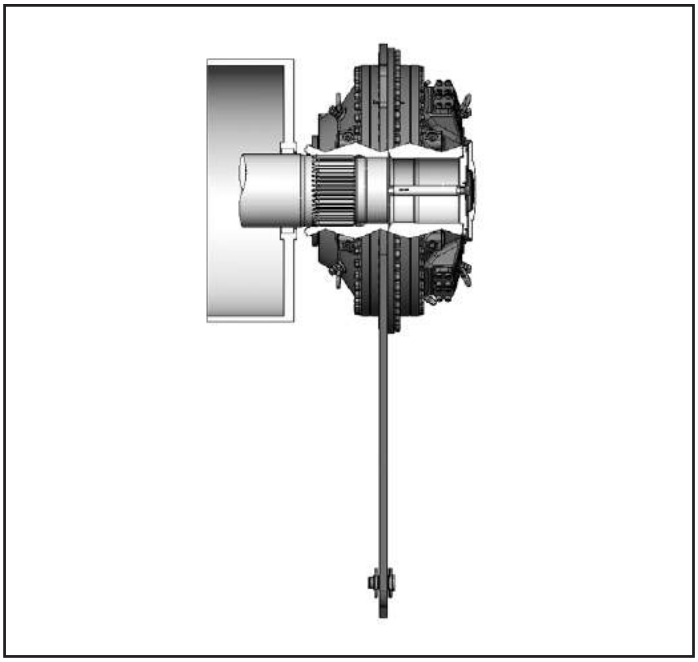


Fig 50: Torque arm mounted motor with splines.

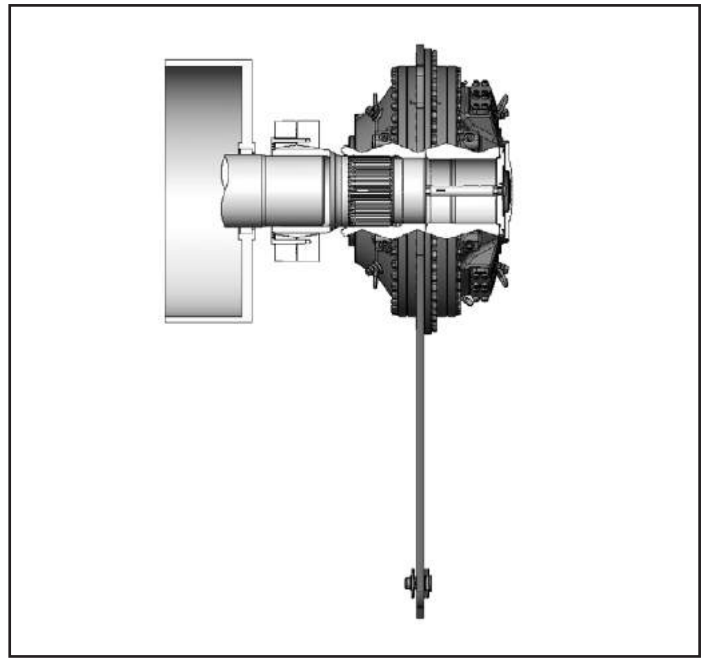


Fig 51: Torque arm mounted motor with coupling adapter.

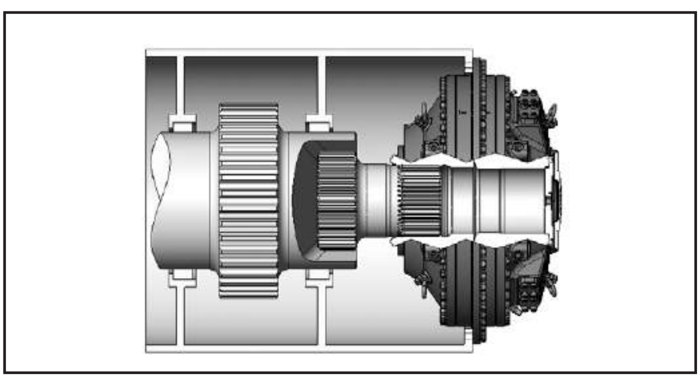


Fig 52: Flange mounted motor with splines and high radial load Fr on driven shaft.

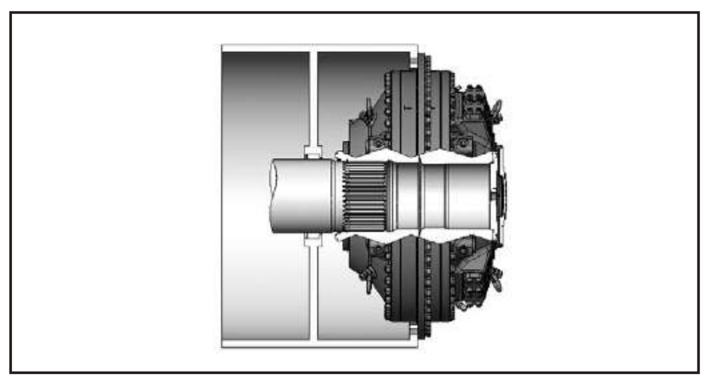


Fig 53: Flange mounted motor with splines and low radial load from driven shaft.

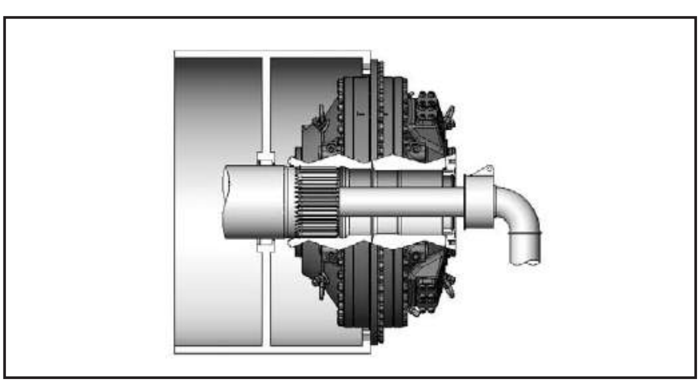


Fig 54: Flange mounted motor with splines and through hole for cooling of the driven machine.

Declaration of Conformity

Example of the Declaration of Conformity given by Hägglunds Drives AB

Rexroth
Bosch Group

Declaration of Incorporation (Translation of the Declaration of Incorporation)
As defined by the EC Machinery Directive 2006/42/EC, Appendix II B

Doc. No.:

Date:

The manufacturer
Hägglunds Drives AB, Bosch Rexroth

hereby declares that the partly completed machinery

Name:	Hägglunds CBM
Function:	Hydraulic motor
Model:	Compact
Type:	CBM
Serial number:	
Trade name:	Hägglunds CBM

satisfies the following essential requirements of Machinery Directive 2006/42/EC in accordance with the chapter numbers in Appendix I:

General principle no. 1.												

The requirements are fulfilled provided that the data in the product documentation (fitting instructions, operating instructions, project management and configuration documents) are implemented by the product user. The requirements of Appendix I to Machinery Directive 2006/42/EC not mentioned here are not applied and have no relevance for the product.

It is also declared that the special technical documents for this partly completed machinery have been compiled in accordance with Appendix VII, Part B. These are transferred on request to the market surveillance body in paper-based/electronic format.

Conformity with the provisions of further EU Directives, Standards or Specifications:

SS-EN 982
SS-EN 12100-1
SS-EN 12100-2

The partly completed machinery may only be put into operation when it has been established that the machine into which the partly completed machinery is to be incorporated conforms to the provisions of EC Machinery Directive 2006/42/EC, where relevant according to this directive.

The individual below is authorized to compile the relevant technical files:

Name:
Address: Hägglunds Drives AB, Bosch Rexroth, 895 80 Mellansel

Place/date/signature as indicated in the original declaration

Mellansel 01.06.12

We reserve the right to make changes to the content of the Declaration of Incorporation. Current issue on request.

Doc.-No. page 1 / 4

The Declaration of Conformity above, is available on request for deliveries from Hägglunds Drives AB. Translations into other languages are also available.

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