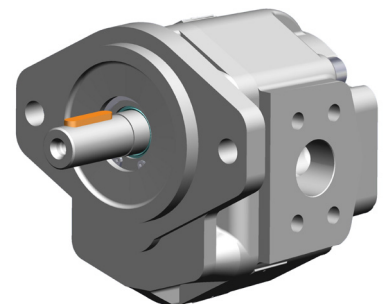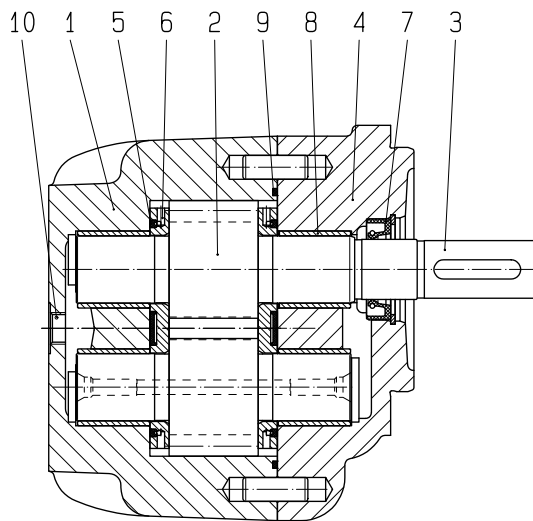# KRACHT®
FLUID TECHNOLOGY AND SYSTEMS

High pressure
gear motors
KM 2

Construction

1 Housing
2 Gearing
3 Drive shaft end
4 Flange cover
5 Pressure field sealing for axial clearance compensation
6 Sliding plates
7 Rotary shaft lip-type seal
8 Plain bearing
9 Sealing of the housing
10 Drain port

Function

The construction (design principle) and materials of the KRACHT KM 2 series external gear motors make them perfect for use under the most extreme operating conditions. The main components form the housing and flange cover (see sectional drawing). They can be dynamically highly loaded, making them insensitive to pressure peaks and continuous vibrations. Large-surface-dimensioned, PTFE-Pb coated, bronze plain bearings on steel backs in the housing and flanged cover support the micro-finish ground bearing journals of the gear, which comprises the driving shaft pinion and driven shaft pinion. To realise optimum running properties the tooth flanks of the gear, which are produced from case-hardened steel, are ground. The high number of teeth ($z = 14$) in combination with a tooth shape developed for the special requirements of the hydraulics as well as the optimal layout of the expansion slots in the trapped-oil area achieve a considerable reduction in the volume flow variation and thus the pressure pulsation.

This leads to significantly lower noise level values in the motors or even in whole systems and machines. This functioning of the indispensable active axial-tolerance-allowance compensation is implemented by the slide plates located beside the gears. They have hydraulically-loaded pressure-fields, through which a compensation of the axial tolerance allowance is guaranteed at every operating pressure. The slide plates are structured to implement viscosity-independent play-compensation. That ensures a high level of volumetric and mechanical efficiency at every operating point. Multiple motor combinations are possible, as are mounting valves (pressure relief valves can be set to fixed or proportional values, directional control valves for switching the direction of rotation). A suction valve is available as the integrated valve.

Motors with one or two direction of rotation are available. The variant with two directions of rotations has connections of the same size and a leakage oil connection. These motors can be pressurised on the discharge side. The single direction of rotation variant is in fact a pump. Right-handed pumps means left-handed motors and vice versa. Lacking a leakage oil connection, these motors are internally connected to the discharge side and cannot be pressurised on that side. See the datasheet for the high pressure gear pumps KP 2 / KP 3 for dimensions and weights.

Notes:

1. External loads

Radial or axial loads acting on the shaft end impair the functions of the gland bearings. Radial loads can possibly be absorbed in dependence on the extent and the direction of the loads. Axial loads are NOT permissible. To absorb external loads the motor type with outboard bearing must be used.
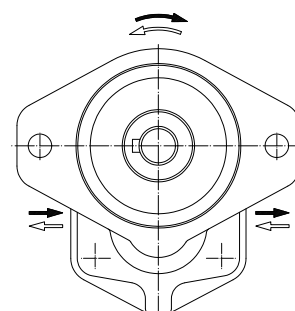
2. Direction of rotation

Regarding the direction of rotation basically the following applies provided the view is directed toward the drive shaft end:

Drive shaft end rotating clockwise: Oil flow from left to right.

Drive shaft end rotating anticlockwise: Oil flow from right to left.

Materials

Housing	cast iron / spheroidal cast iron
Bearing	multi-compound plain bearing bushes
Journals and gears	case hardening steel acc. to DIN 17210 surface hardened and ground
Seals	NBR rotary shaft lip-type seal and PU-pressure field sealing ϑ 90 °C FKM rotary shaft lip-type seal and PU-pressure field sealing ϑ 100 °C

Characteristics

Mounting		flange
Pipe connection		flange
Direction of rotation		right, left, right + left
Weight		refer to dimensional sheet
Fitting position		optional
Ambient temperature	$\vartheta_{u\ min}$ $\vartheta_{u\ max}$	= − 20 °C = 60 °C
Working pressure input	p_{max}	= 350 bar (refer to technical data)
Drain pressure		5 bar max (n = 1000) 3 bar max (n = 2000)
Working pressure output	p_{max}	= 150 bar
Fluid temperature	$\vartheta_{m\ max}$ $\vartheta_{m\ max}$	90 °C NBR rotary shaft lip-type seal and PU pressure field sealing 100 °C for FKM rotary shaft lip-type seal and PU pressure field sealing (Special No. 261)
Viscosity	ν_{min} ν_{max}	= 10 mm²/s = 1000 mm²/s
Recommended oil cleanliness		according to ISO 4406 : 1999 Code 21/19/16 $\Rightarrow$ according to NAS 1638 Class 10
Recommended filtration		Filter with filtration quotient β_{25} 75 for … 300 bar β_{40} 75 for … 100 bar
Recommended Viscosity range	ν	= 30 … 45 mm²/s
Characteristic curves		refer to pages 7 – 10
Hydraulic fluids		Mineral oil acc. DIN 51524/25 Motor oil acc. DIN 51511 Flame resistant pressure fluids on request bio-oils of type „HEES", can be used up to 70 °C , max. pressure must be reduced minus 20 % (use only on request)

Time / Pressure chart
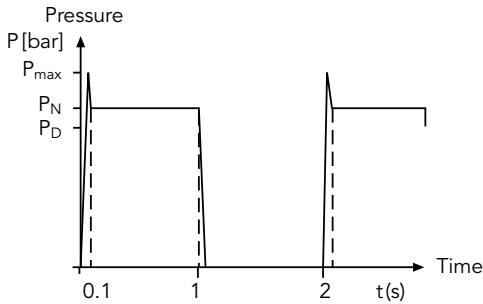
Maximum pressure $\triangleq$ pressure peak
Rated pressure p_N < 6 s $\triangleq$ 50 % ED
see time / pressure chart
max. perm. working cycles: 30 / min
Pressures as specified are applicable
to $\nu \geqq 30$ mm^2/s

Calculation Formulas for Hydraulic Pumps and Motors

Characteristic data, formula signs, units

1.	Discharge flow / input flow	Q	l/min
2.	Pump / motor displacement	V_g	cm^3/r
3.	Pressure	p	bar
4.	Speed	n	1/min
5.	Torque	M	Nm
6.	Power	P	kW
7.	Total efficiency	η_{tot}	—
8.	Volumetric efficiency	η_{vol}	—
9.	Hydr. / mech. efficiency	η_{hm}	—
10.	Flow velocity	v	m/s
11.	Piping diameter	d	mm

General

1 $\triangleq$ input, driven
2 $\triangleq$ output, driving

$$Q_{th} = V_g \cdot n, \quad \eta_{tot} = \eta_{vol} \cdot \eta_{hm}$$

$$M = 9549 \cdot \frac{P}{n}, \quad v = 21.22 \, \frac{Q}{d^2}$$

		Pump	Motor
Characteristic data for:	Volumetric flow	Discharge flow $\quad Q_2 = \dfrac{V_g \cdot n_1 \cdot \eta_{vol}}{10^3} \left[\dfrac{l}{min}\right]$	Input flow $\quad Q_1 = \dfrac{V_g \cdot n_2}{10^3 \cdot \eta_{vol}} \left[\dfrac{l}{min}\right]$
	Torque	Drive torque $\quad M_1 = \dfrac{p \cdot V_g}{20 \cdot \pi \cdot \eta_{hm}}$ [Nm]	Output torque $\quad M_2 = \dfrac{\Delta p \cdot V_g \cdot \eta_{hm}}{20 \cdot \pi}$ [Nm]
	Power	Input power $\quad P_1 = \dfrac{p \cdot Q_2}{600 \cdot \eta_{tot}}$ [kW]	Output power $\quad P_2 = \dfrac{\Delta p \cdot Q_1 \cdot \eta_{tot}}{600}$ [kW]

Technical Data

KM 2 ... 4DL

Nominal motor displacement	Geom. motor displacement	Working pressure	Rated pressure	Peak pressure	max. working speed	Moment of inertia x 10^{-5}	Lowest-Speed
	V_g cm^3/r	p_D bar	p_N bar	p_{max} bar	N_{max} 1/min	J kg m^2	n_{min} 1/min
20	19.7	250	280	300	3000	34.3	300
25	24.6	250	280	300	3000	40.5	300
28	27.7	230	250	280	3000	44.3	300
32	31.5	230	250	280	3000	49.2	300
40	39.4	210	230	250	3000	59.0	300
50	49.2	210	230	250	3000	71.4	300
62	61.2	180	190	200	2200	86.5	300

KM 2 ... 4VL

Nominal motor displacement	Geom. motor displacement	Working pressure	Rated pressure	Peak pressure	max. working speed	Moment of inertia x 10^{-5}	Lowest-Speed
	V_g cm^3/r	p_D bar	p_N bar	p_{max} bar	N_{max} 1/min	J kg m^2	n_{min} 1/min
20	19.7	315	350	400	3000	34.3	300
25	24.6	315	350	400	3000	40.5	300
28	27.7	315	350	400	3000	44.3	300
32	31.5	315	350	400	3000	49.2	300
40	39.4	280	350	400	3000	59.0	300
50	49.2	280	350	400	3000	71.4	300

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Guidance for use of the Characteristic Curves

Required: Torqe output M at speed n
Unknown: Pressure difference Δp and
the required Input flow Q

Example: M = 45 Nm → ①
n = 1400 1/min ↑ ②

The Intersection of ① and ② is
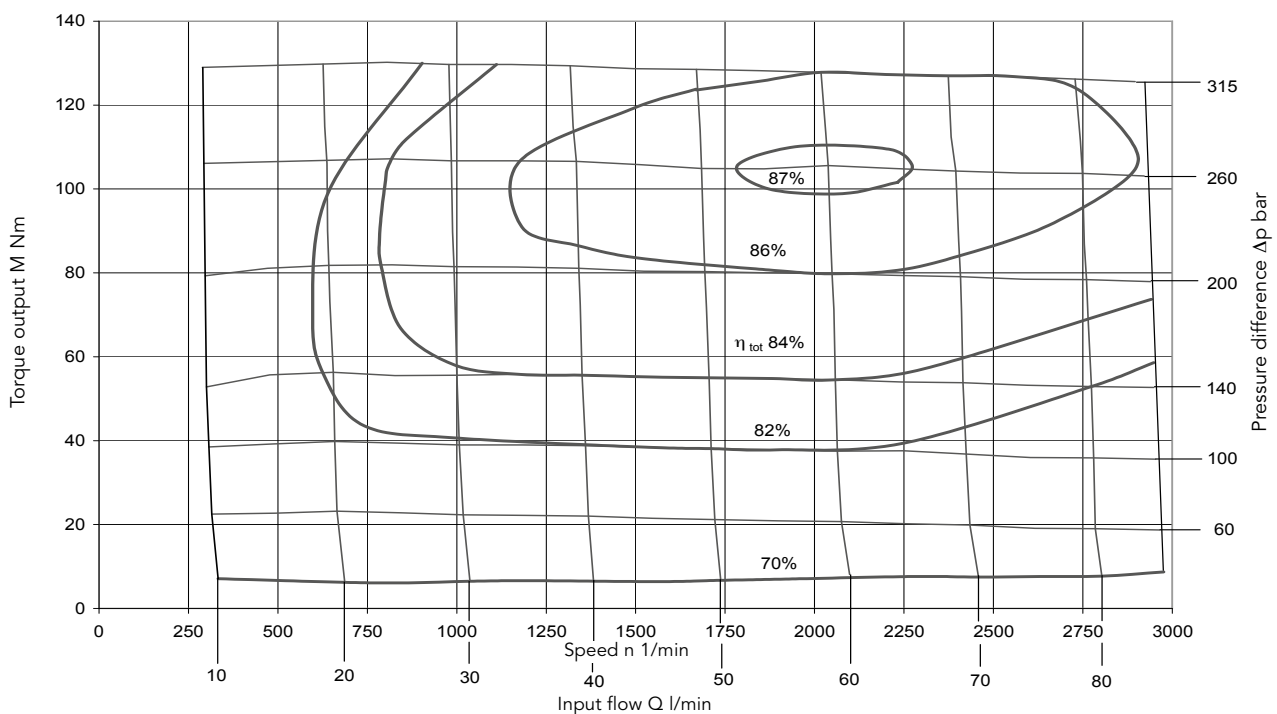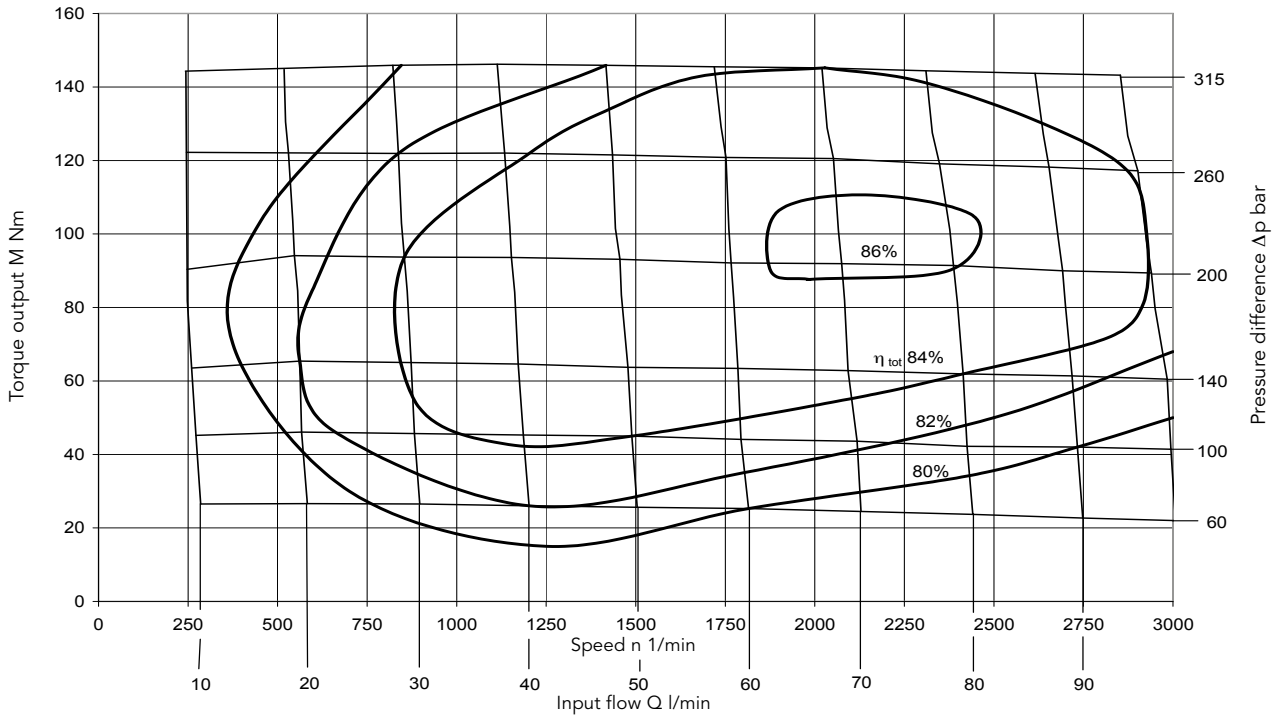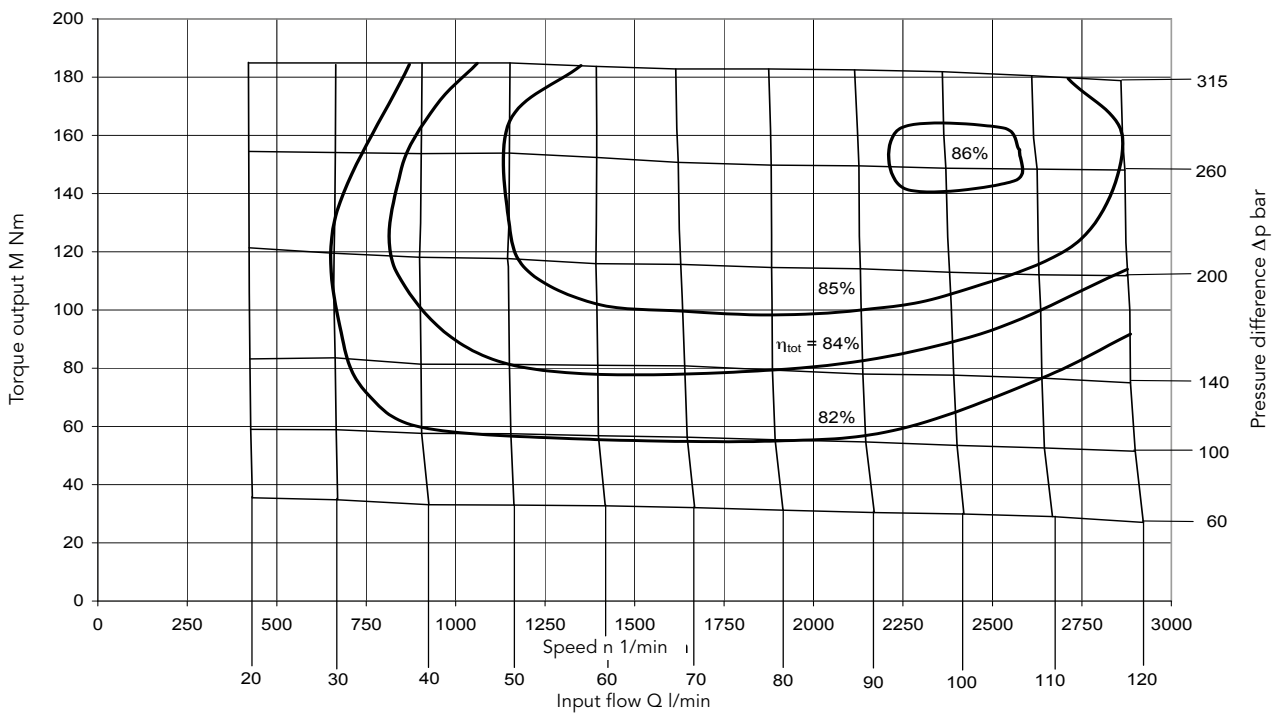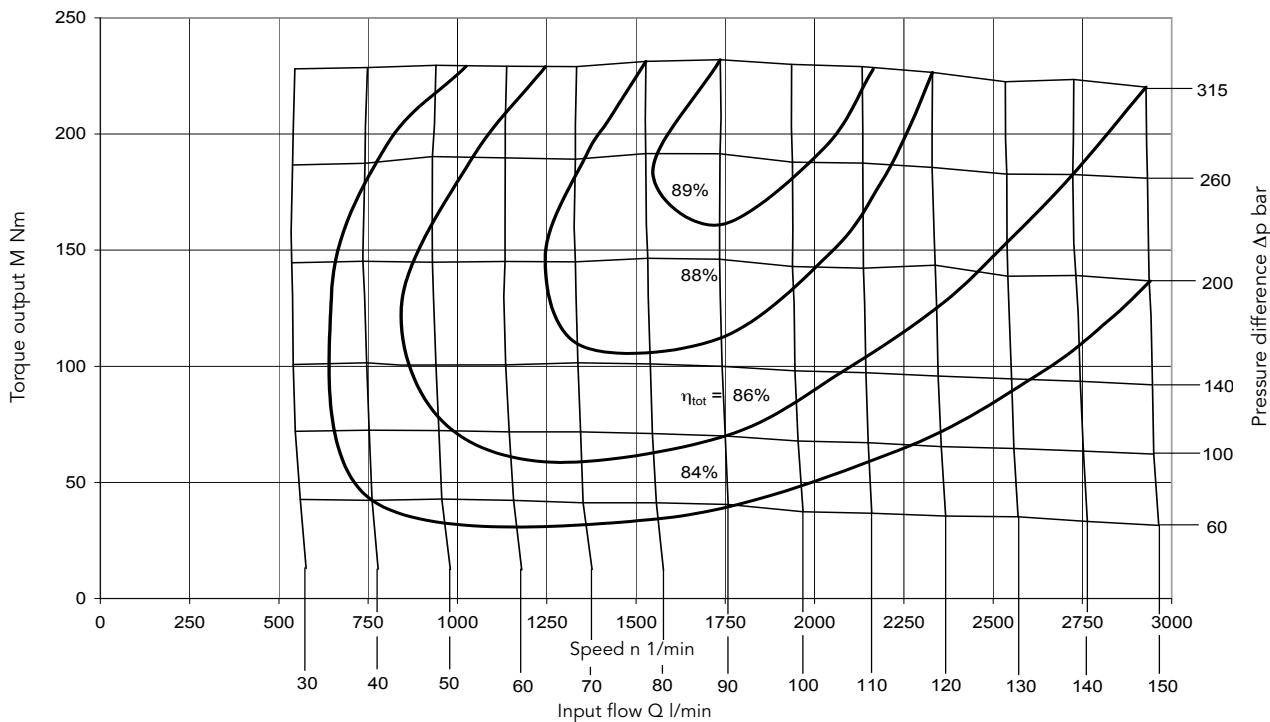the motor working point with:
Δp = 142 bar → ③
Q = 32.2 l/min ↓ ④
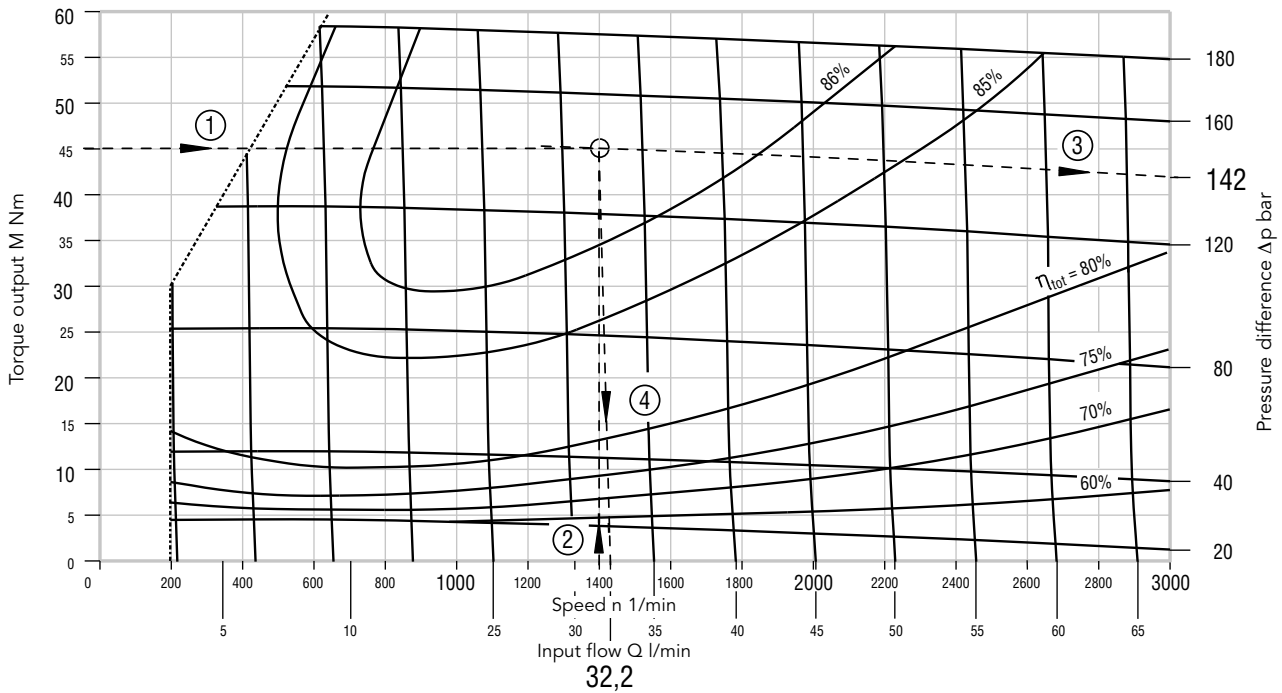
Characteristic Curves for KM 2/20 ... 4.L.

Characteristic values applicable to viscosity ν = 34 mm²/s · Dispersion of the speed values n = ± 75 1/min
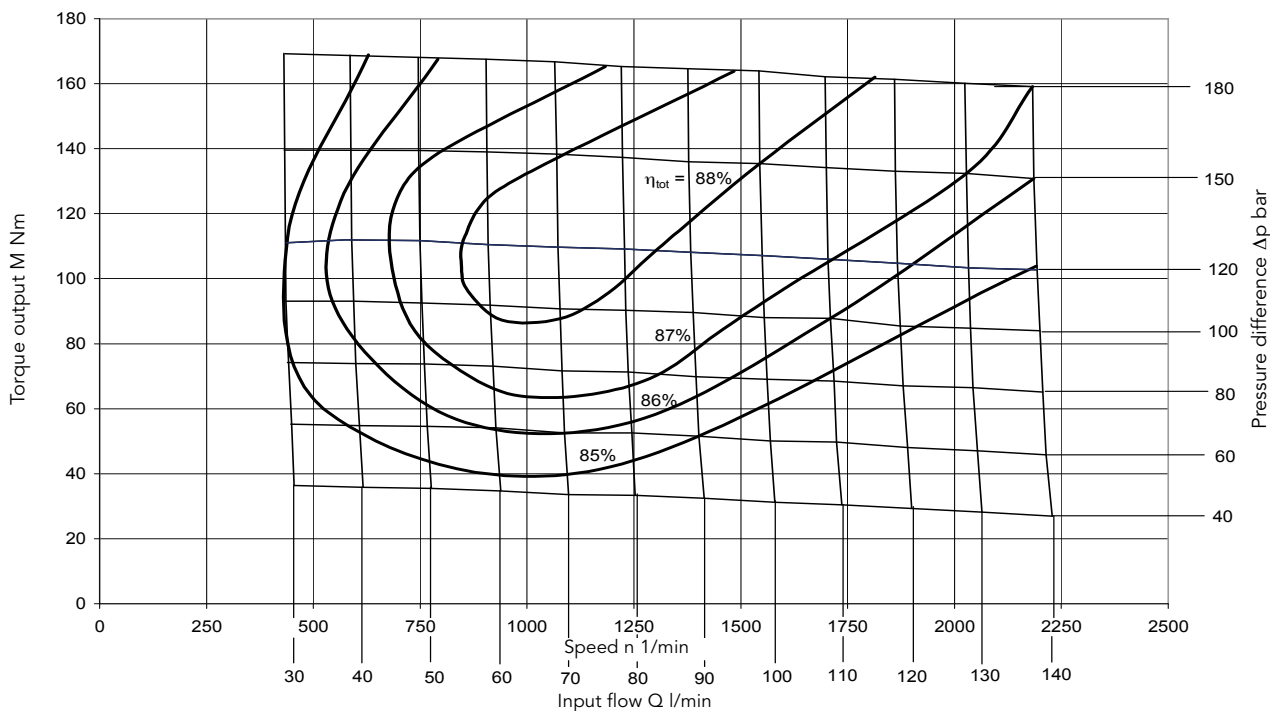Dispersion of the torque output M = ± 3.0 Nm at Δp = constant and Q = constant

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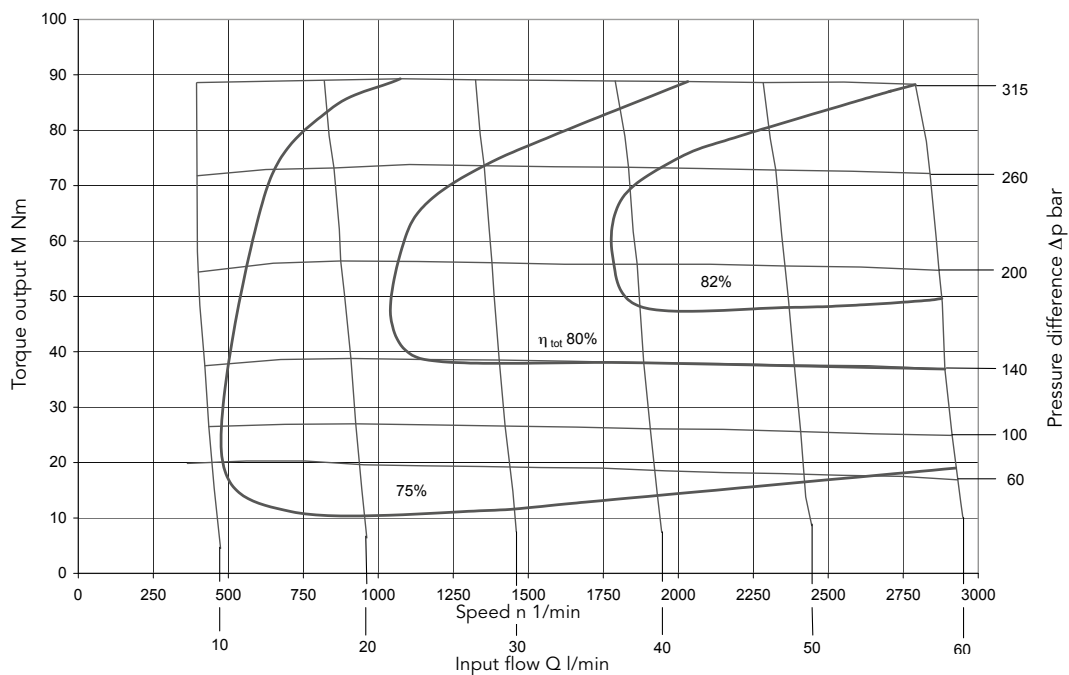
Characteristic Curves for KM 2/25 … 4.L.

Characteristic values applicable to viscosity ν = 34 mm²/s · Dispersion of the speed values n = ± 75 1/min
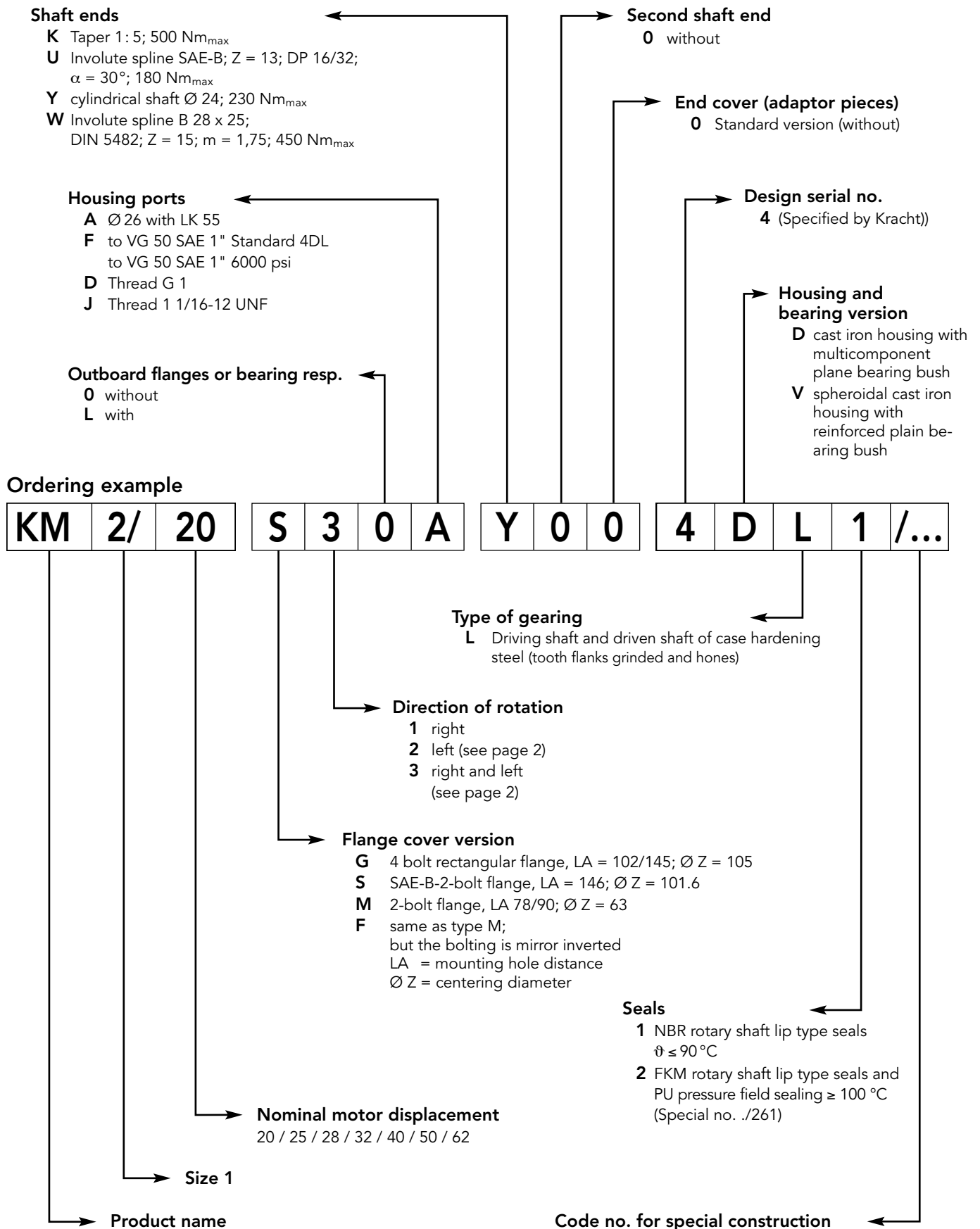Dispersion of the torque output M = ± 4.5 Nm at Δp = constant and Q = constant
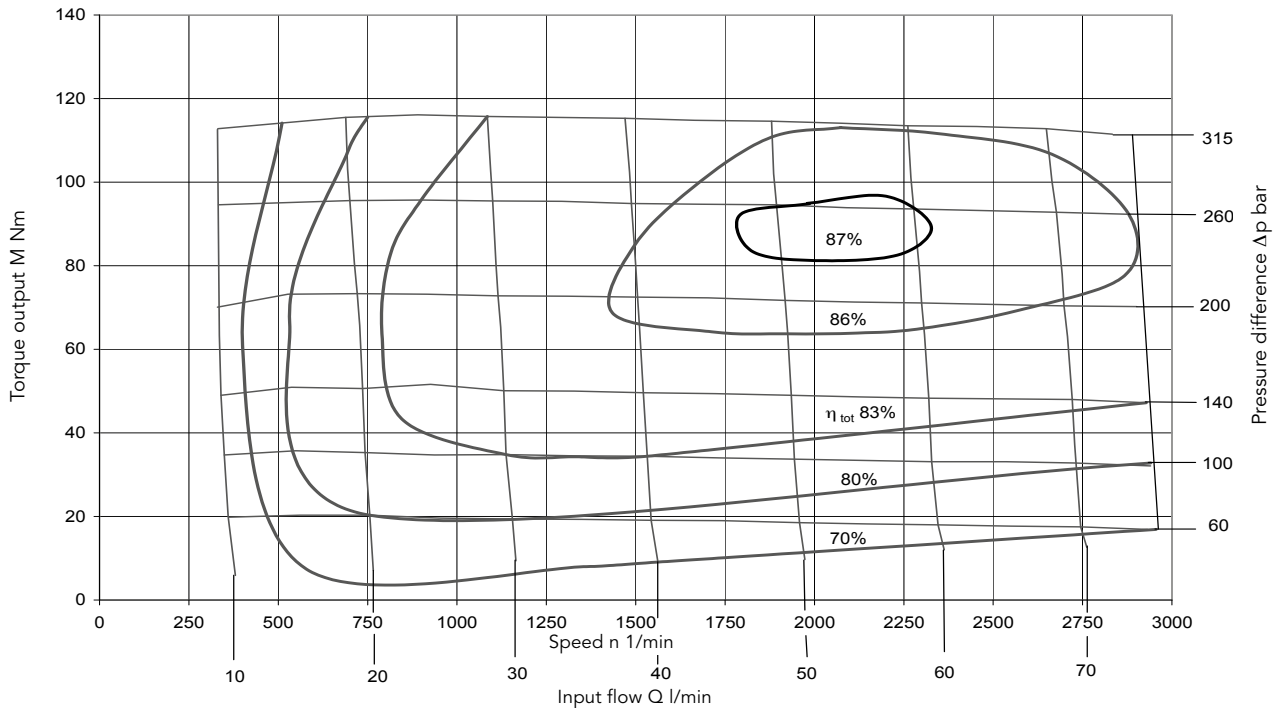
Characteristic Curves for KM 2/28 … 4.L.

Characteristic values applicable to viscosity ν = 34 mm²/s · Dispersion of the speed values n = ± 75 1/min
Dispersion of the torque output M = ± 5.0 Nm at Δp = constant and Q = constant

Characteristic Curves for KM 2/32 ... 4.L.

Characteristic values applicable to viscosity ν = 34 mm^2/s · Dispersion of the speed values n = ± 75 1/min
Dispersion of the torque output M = ± 5.5 Nm at Δp = constant and Q = constant

Characteristic Curves for KM 2/40 ... 4.L.

Characteristic values applicable to viscosity ν = 34 mm^2/s · Dispersion of the speed values n = ± 75 1/min
Dispersion of the torque output M = ± 6.0 Nm at Δp = constant and Q = constant

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Characteristic Curves for KM 2/50 ... 4.L.

Characteristic values applicable to viscosity ν = 34 mm²/s · Dispersion of the speed values n = ± 75 1/min
Dispersion of the torque output M = ± 7.5 Nm at Δp = constant and Q = constant

Characteristic Curves for KM 2/62 ... 4.L.

Characteristic values applicable to viscosity ν = 34 mm²/s · Dispersion of the speed values n = ± 75 1/min
Dispersion of the torque output M = ± 8.0 Nm at Δp = constant and Q = constant

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Type Key

Shaft ends
K Taper 1 : 5; 500 Nm$_{max}$
U Involute spline SAE-B; Z = 13; DP 16/32;
α = 30°; 180 Nm$_{max}$
Y cylindrical shaft Ø 24; 230 Nm$_{max}$
W Involute spline B 28 x 25;
DIN 5482; Z = 15; m = 1,75; 450 Nm$_{max}$

Housing ports
A Ø 26 with LK 55
F to VG 50 SAE 1" Standard 4DL
to VG 50 SAE 1" 6000 psi
D Thread G 1
J Thread 1 1/16-12 UNF

Outboard flanges or bearing resp.
0 without
L with

Second shaft end
0 without

End cover (adaptor pieces)
0 Standard version (without)

Design serial no.
4 (Specified by Kracht))

Housing and bearing version
D cast iron housing with multicomponent plane bearing bush
V spheroidal cast iron housing with reinforced plain bearing bush

Ordering example

| KM | 2/ | 20 | S | 3 | 0 | A | Y | 0 | 0 | 4 | D | L | 1 | /... |

Type of gearing
L Driving shaft and driven shaft of case hardening steel (tooth flanks grinded and hones)

Direction of rotation
1 right
2 left (see page 2)
3 right and left (see page 2)

Flange cover version
G 4 bolt rectangular flange, LA = 102/145; Ø Z = 105
S SAE-B-2-bolt flange, LA = 146; Ø Z = 101.6
M 2-bolt flange, LA 78/90; Ø Z = 63
F same as type M; but the bolting is mirror inverted
LA = mounting hole distance
Ø Z = centering diameter

Seals
1 NBR rotary shaft lip type seals $\vartheta \leq 90\,°C$
2 FKM rotary shaft lip type seals and PU pressure field sealing ≥ 100 °C (Special no. ./261)

Nominal motor displacement
20 / 25 / 28 / 32 / 40 / 50 / 62

Size 1

Product name

Code no. for special construction

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Flange type

4 bolt rectangular flange G
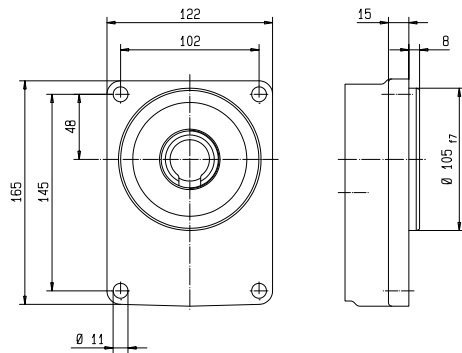
SAE-B-2-bolt flange S

2-bolt flange F

MA =
110 + 10 Nm
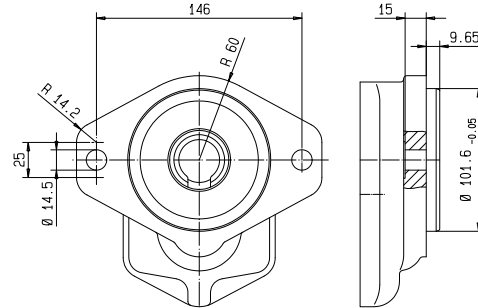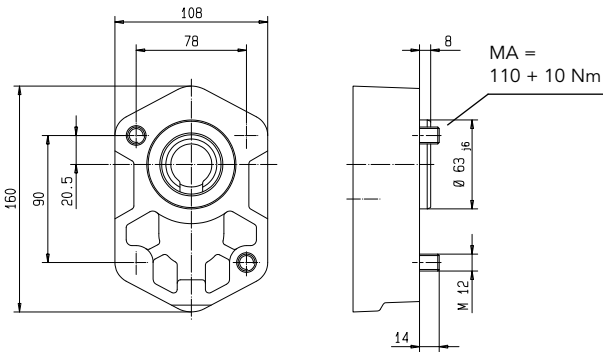
2-bolt flange M

MA =
110 + 10 Nm
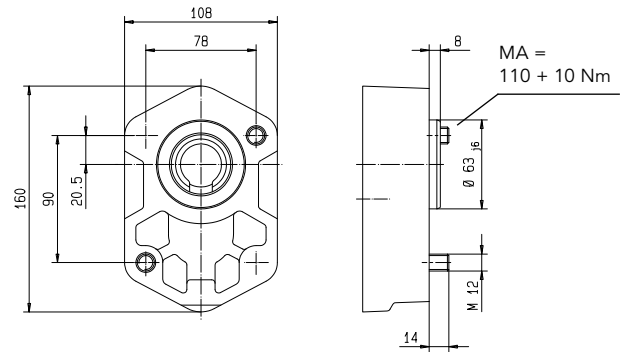
4 bolt rectangular flange G with drain port front / Special no. /04
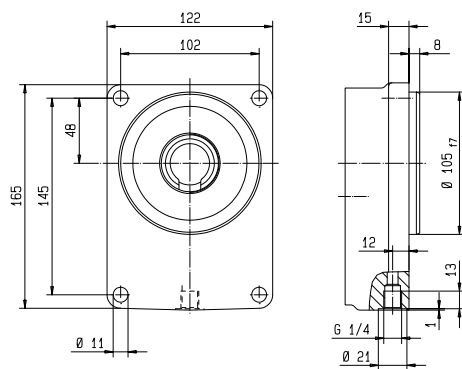
2 bolt flange F with drain port front / Special no. /04
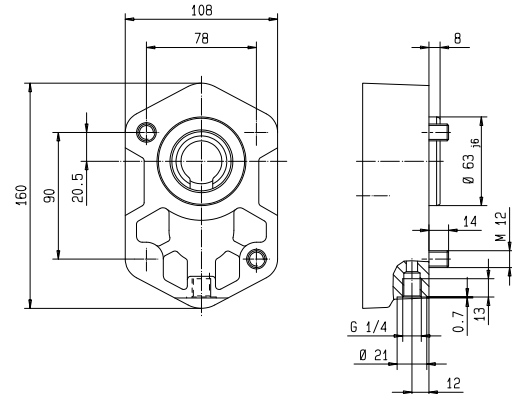
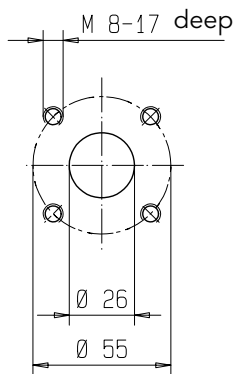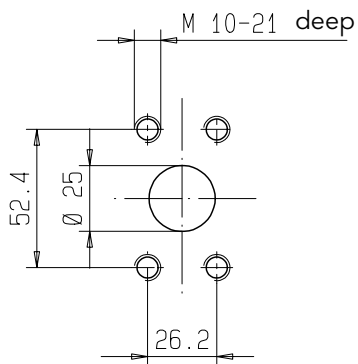### 2 bolt flange M with drain port front / Special no. /04
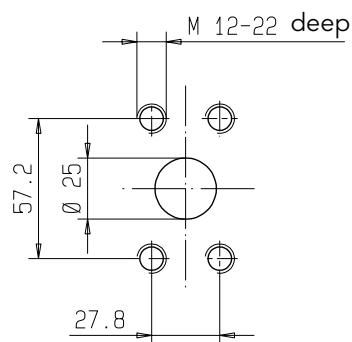

Dimensions in mm
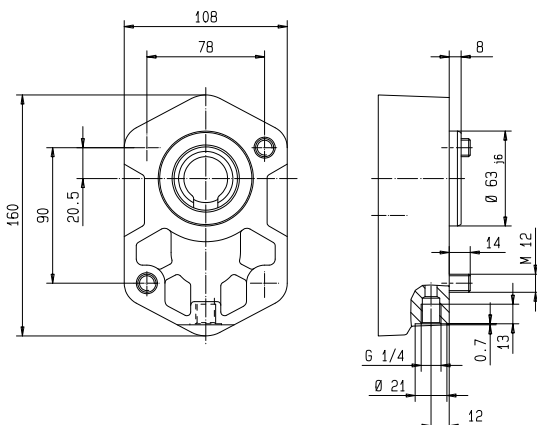
Side ports

Housing Side Ports A

Housing Side Ports F
Displacement / motor displacement 20… 50

SAE 1 Standard KM 2 … 4DL

SAE 1 6000 psi … KM 2… 4VL

Housing Side Ports D
G 1"
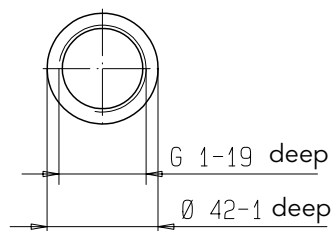
Housing Side Ports J
1 1/16-12 UNF
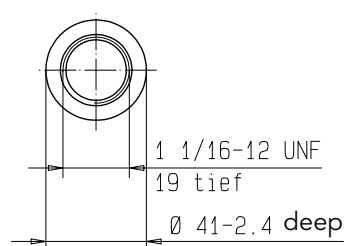
Dimensions in mm
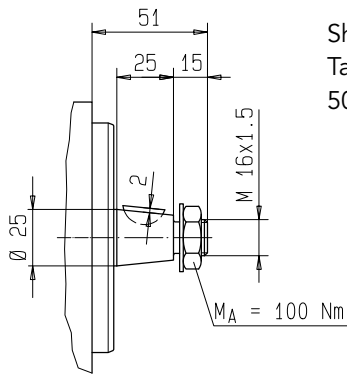
Shaft end

Shaft end K
Taper 1 : 5
500 Nm$_{max}$

51
25   15
$M\ 16x1.5$
$\emptyset\ 2$
$\emptyset\ 25$
$M_A = 100\ Nm$
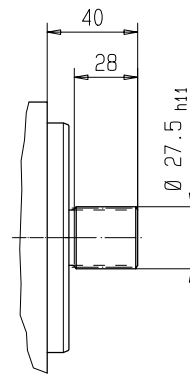
Shaft end W
involute spline B 28 x 25
DIN 5482
z = 15 m = 1.75
450 Nm$_{max}$

40
28
$\emptyset\ 27.5\ h11$
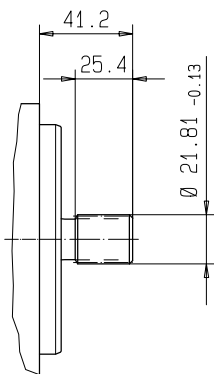
Shaft end U
involute spline SAE-B
z = 13 DP 16/32, $\alpha = 30°$
180 Nm$_{max}$

41.2
25.4
$\emptyset\ 21.81\ -0.13$
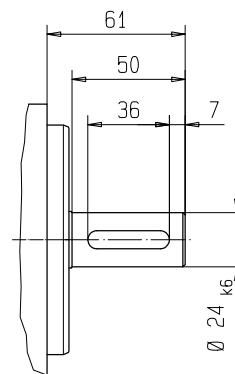
Shaft end Y
Cylindrical shaft
230 Nm$_{max}$

61
50
36   7
$\emptyset\ 24\ k6$
8
27
$M\ 8$
19
25

Dimensions in mm

13

KRACHT®
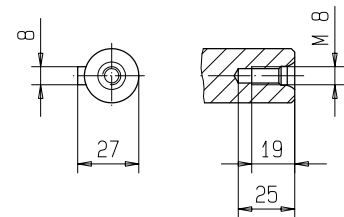
Dimensions, weight
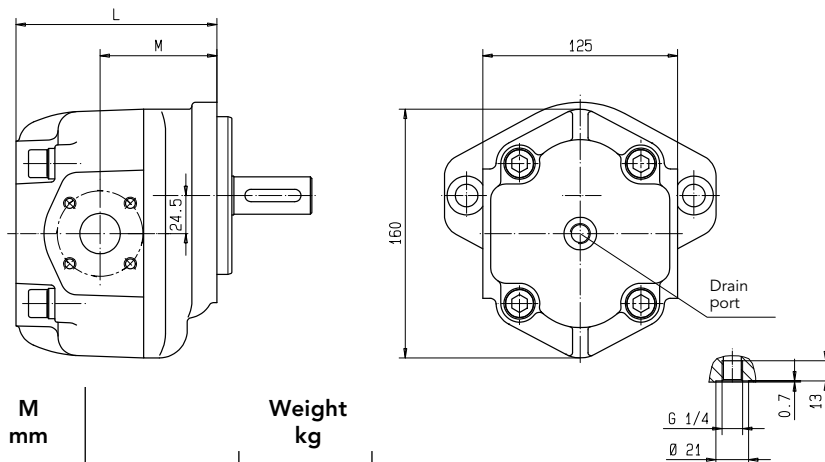
Nominal motor displacement	L mm	M mm	Weight kg		
			G-Flange	S-Flange	F/M-Flange
20	129	75	11.0	10.0	9.0
25			11.5	10.5	9.5
28			12.0	11.0	10.0
32			12.5	11.5	10.5
40	142	85	13.0	12.5	11.5
50			13.5	13.0	12.0
62	152		15	14.0	13.0

Ordering example:

KM 2/20 S30A Y00 4DL1

Dimensions, weight with outboard bearing
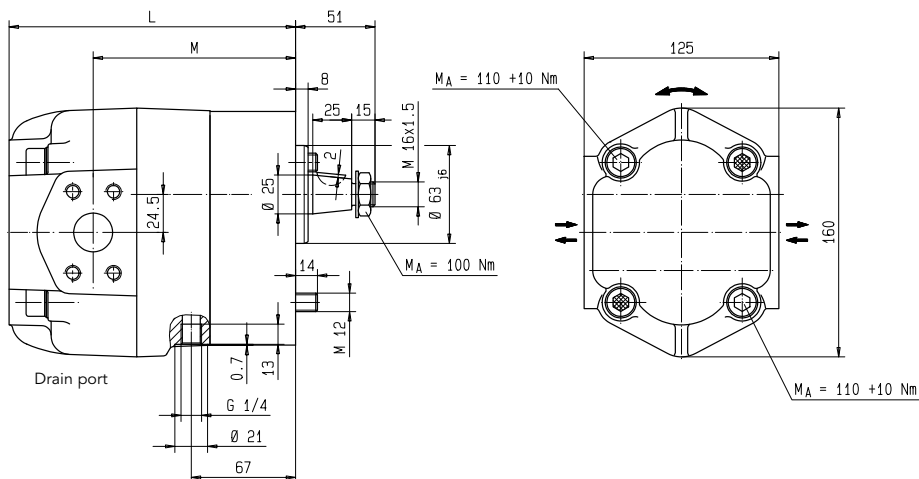
Nominal motor displacement	L mm	M mm	Weight kg
20	184	130	12.0
25			12.5
28			13.0
32			13.5
40	197	140	14.5
50			15.0
62	207		16.0

Ordering example:

KM 2/20 M3LF K00 4DL1/410

Dimensions in mm

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Permissible Load – Outboard Bearing …/410, Tapered Shaft End
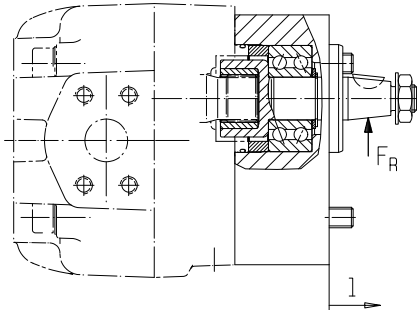
Permissible radial load $F_{R\,max}$ as function of the supporting distance l for a given axial force

F_A (for L_h = 10.000 h), medium wave at l = 22.8 mm

F_A = 0 N

F_A = 500 N

F_A = 750 N

F_A = 1000 N

F_A = 1250 N

F_A = 1500 N

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