14.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gear unit dimensions, motor dimensions and geared motor dimensions.

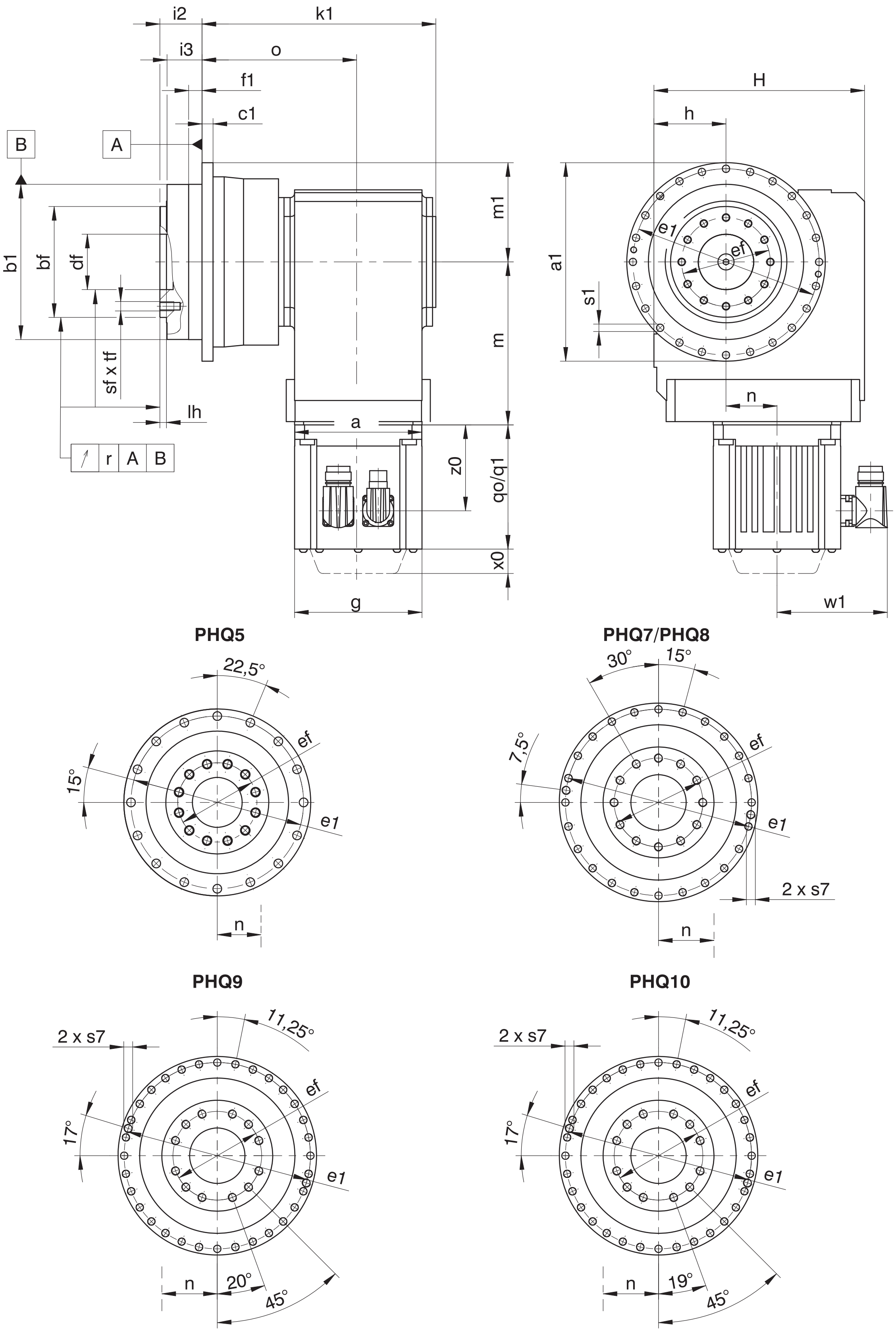
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.

14.3.1 PHQ5 – PHQ10 F shaft design (flange shaft)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method	w1	Different for the One Cable Solution (OCS), see the chapter [▸ 17.4]

Dimensions of gear units

Type	∅a1	∅b1	∅bf	c1	∅df	∅e1	∅ef	f1	h	H	i2	i3	k1	lh	m1	o	r	∅s1	s7	sf	tf
PHQ531_K102_	145_{h7}	110_{h7}	80_{h7}	8	40^{H6}	135	63	12	60	160	29	23	180.0	6	72.5	124.0	0.020	5.5	–	M8	12.0
PHQ731_K202_	179_{h7}	140_{h7}	100_{h7}	10	50^{H6}	168	80	12	65	190	38	32	211.0	6	89.5	141.0	0.025	6.6	–	M10	16.0
PHQ831_K402_	247_{h7}	200_{h7}	160_{h7}	12	80^{H6}	233	125	15	90	240	50	42	289.0	8	123.5	199.0	0.030	9.0	M10	M12	17.0
PHQ941_K513_	300_{h7}	255_{h7}	180_{h7}	18	90^{H6}	280	145	20	160	260	66	55	292.5	12	150.0	196.5	0.030	13.5	M8	M20	28.0
PHQ1041_K713_	330_{h7}	285_{h7}	200_{h7}	20	95^{H6}	310	166	20	212	342	75	60	354.5	10	165.0	238.0	0.040	13.5	M10	M24	35.0

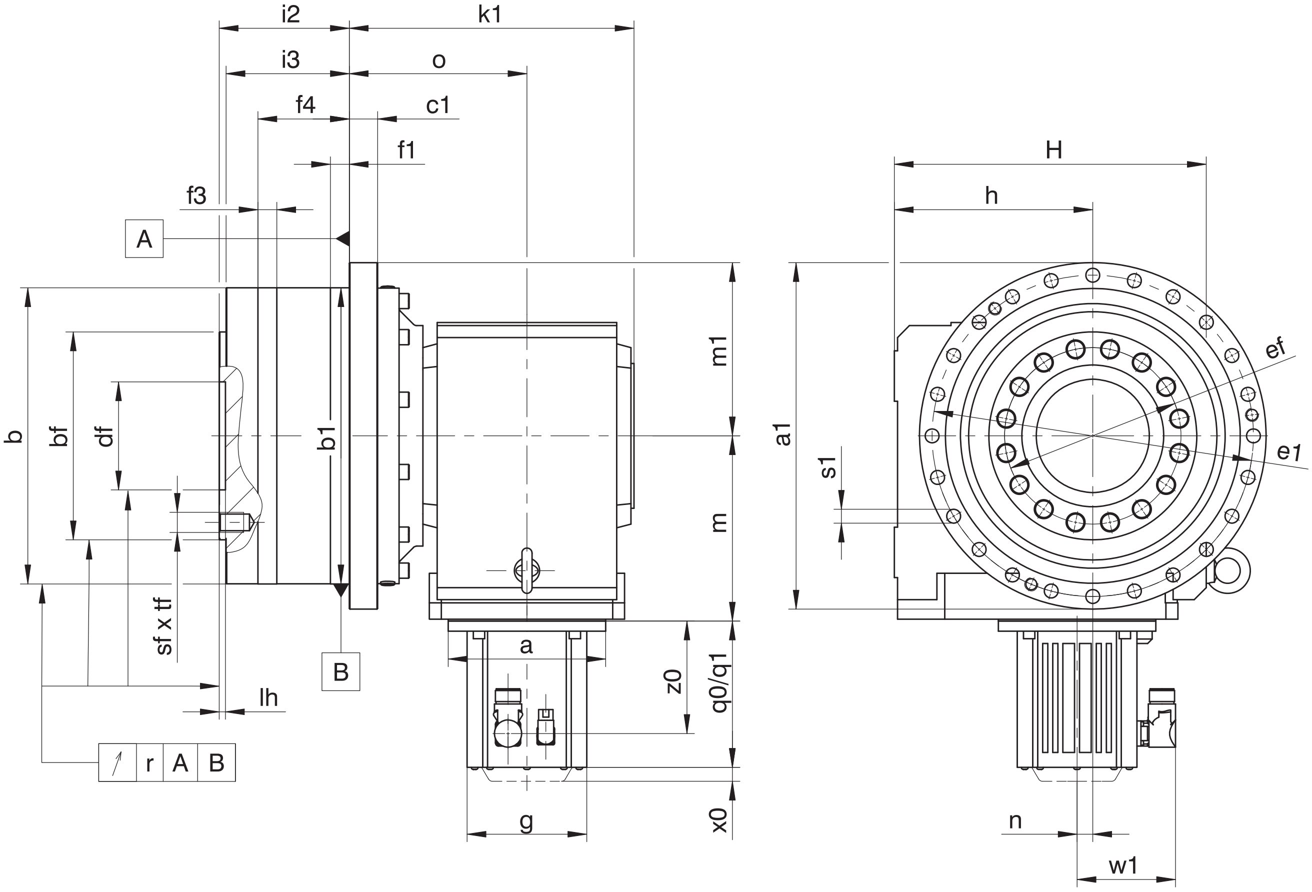
Dimensions of motors

Type	□g	q0	q1	w1	x0	z0
EZ301U	72	114.0	154.0	55.5	21	78.5
EZ302U	72	136.0	176.0	55.5	21	100.5
EZ303U	72	158.0	198.0	55.5	21	122.5
EZ401U	98	118.5	167.0	91.0	22	76.5
EZ402U	98	143.5	192.0	91.0	22	101.5
EZ404U	98	193.5	242.0	91.0	22	151.5
EZ501U	115	112.0	166.5	100.0	22	77.5
EZ502U	115	137.0	191.5	100.0	22	102.5
EZ503U	115	162.0	216.5	100.0	22	127.5
EZ505U	115	212.0	266.5	100.0	22	177.5
EZ701U	145	125.0	184.0	115.0	22	87.0
EZ702U	145	150.0	209.0	115.0	22	112.0
EZ703U	145	175.0	234.0	115.0	22	137.0
EZ705U	145	230.0	289.0	134.0	22	188.0
EZ802U	190	232.5	309.5	156.5	22	178.5
EZ803U	190	273.5	350.5	156.5	22	219.5
EZ805U	190	355.5	432.5	156.5	22	301.5

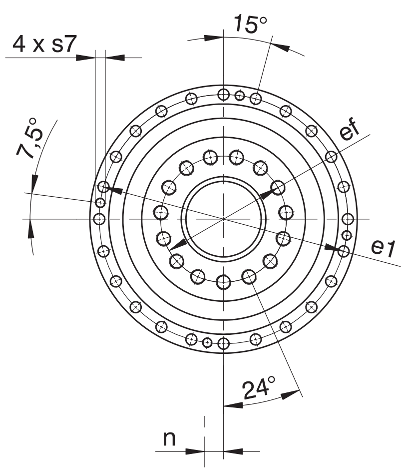
Dimensions of geared motors

Type	EZ3			EZ4			EZ5			EZ7			EZ8		
	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n
PHQ531_K102_	□72	124	36.0	□98	124	36.0	□115	128	36.0	□145	130	36.0	–	–	–
PHQ731_K202_	□72	143	46.0	□98	143	46.0	□115	147	46.0	□145	149	46.0	–	–	–
PHQ831_K402_	–	–	–	–	–	–	∅160	187	60.0	□145	189	60.0	□190	192	60.0
PHQ941_K513_	–	–	–	–	–	–	∅160	172	15.0	□145	174	15.0	□190	177	15.0
PHQ1041_K713_	–	–	–	–	–	–	–	–	–	∅200	221	20.0	□190	224	20.0

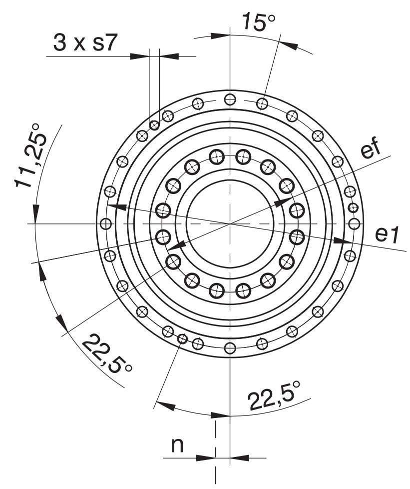
14.3.2 PHQ11 – PHQ12 F shaft design (flange shaft)



PHQ11



PHQ12



q0	Applies to motors without brake.
q1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method
w1	Different for the One Cable Solution (OCS), see the chapter [▷ 17.4]

Dimensions of gear units

Type	∅a1	∅b	∅b1	∅bf	c1	∅df	∅e1	∅ef	f1	f3	f4	h	H	i2	i3	k1	lh	m1	o	r	∅s1	s7	sf	tf
PHQ1141_K813_	425	365_{g6}	365_{h6}	260_{h7}	32	120^{H6}	395	200	30	30	120	265	410	190	180	381.5	10	212.5	236.5	0.040	17.5	M16	M24	35.5
PHQ1241_K913_	550	470_{g6}	470_{h6}	330_{h7}	45	180^{H7}	510	280	30	30	145	315	495	206.5	195.5	452.0	10	275.0	282.0	0.040	22.0	M16	M30	47.0
PHQ1241_K914_	550	470_{g6}	470_{h6}	330_{h7}	45	180^{H7}	510	280	30	30	145	315	495	206.5	195.5	452.0	10	275.0	282.0	0.040	22.0	M16	M30	47.0

Dimensions of motors

Type	□g	q0	q1	w1	x0	z0
EZ701U	145	125.0	184.0	115.0	22	87.0
EZ702U	145	150.0	209.0	115.0	22	112.0
EZ703U	145	175.0	234.0	115.0	22	137.0
EZ705U	145	230.0	289.0	134.0	22	188.0
EZ802U	190	232.5	309.5	156.5	22	178.5
EZ803U	190	273.5	350.5	156.5	22	219.5
EZ805U	190	355.5	432.5	156.5	22	301.5

Dimensions of geared motors

Type	EZ7			EZ8		
	a	m	n	a	m	n
PHQ1141_K813_	∅200	247	24	∅250	249	24
PHQ1241_K913_	–	–	–	∅250	294	25
PHQ1241_K914_	∅200	353	25	∅250	365	25

14.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

PHQ	7	3	1	S	F	S	S	0055	K202VF	0115	EZ401U

Explanation

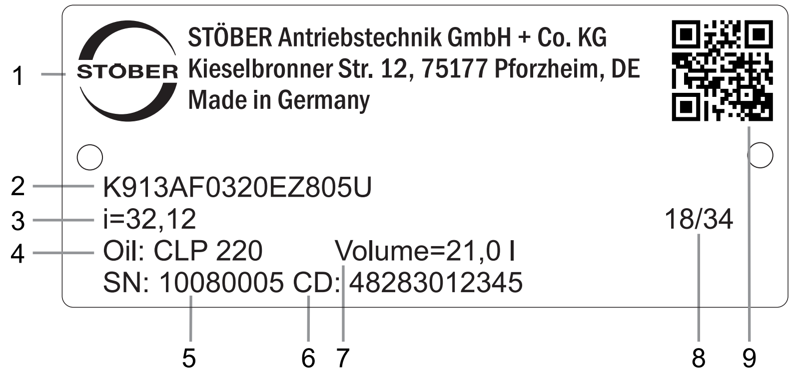
Code	Designation	Design
PHQ	Type	Planetary gear unit
7	Size	7 (example)
3	Generation	Generation 3
4		Generation 4
1	Stages	Single-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PHQ4 – PHQ5)
S	Backlash	Standard
R		Reduced (PHQ4 – PHQ9)
0055	Transmission ratio of output (i x 10)	i = 5.5 (example)
K202VF	Input	K2 right-angle geared motor (example)
0115	Transmission ratio of input (i x 10 rounded)	i = 11.57 (example)
EZ401U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- For a detailed type designation of the motor, see the chapter [▸ 17]
- For the mounting position, see the chapter [▸ 14.5.3]
- Output gear unit side 3 or 4, see the chapter [▸ 14.5.3]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▸ 14.6.3]
- Position of the plug connectors, see the chapter [▸ 14.5.5]
- Reverse operation of the output shaft from ±20° to ±90° and horizontal installation, note the chapter [▸ 14.6.4]

14.4.1 Nameplate

An example gear unit nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Gear ratio of the gear unit
4	Lubricant specification
5	Serial number of the gear unit
6	Customer-specific data
7	Lubricant fill volume
8	Date of manufacture (year/calendar week)
9	QR code (link to product information)

14.4.1.1 Supporting documents

You can view or download supporting documents for the product by reading off the serial number on the nameplate of the product and entering it at the following address online:
https://id.stober.com

Alternatively, you can use a suitable mobile device to scan in the QR code on the nameplate of the product in order to be linked to the supporting documents.

14.5 Product description

14.5.1 Input options

EZ synchronous servo motor

Catalog ID 442437_en

MB motor adapter +
EZ synchronous servo motor

Catalog ID 443311_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

14.5.2 Installation conditions

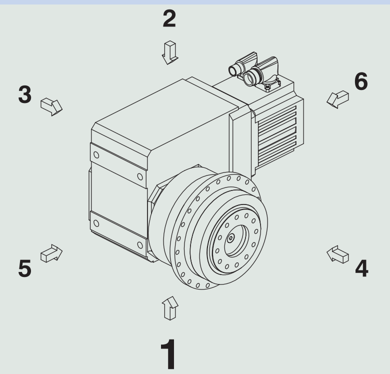
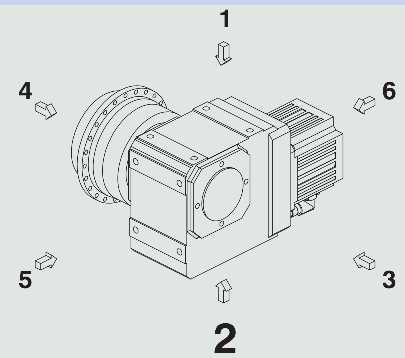
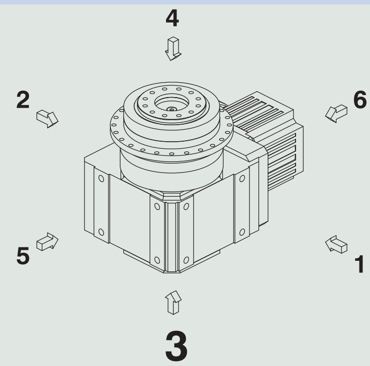
The torque and force values listed in this catalog are valid under the following conditions:

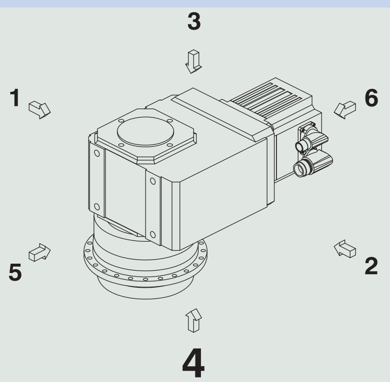
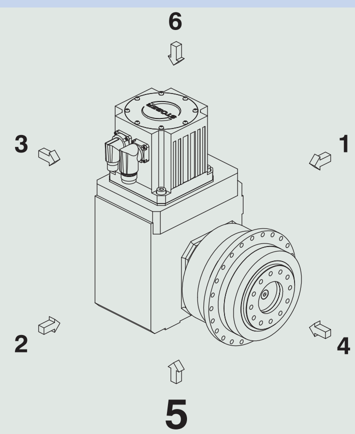
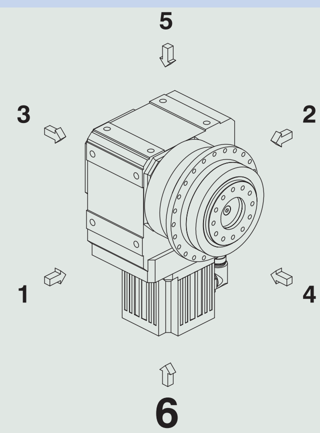
- When the flange shaft and gear housing are fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øb1, and also at pilot Øb for sizes PHQ11 and PHQ12. The machine-side fit must be H7.
- When the flange shaft is adjusted using the connecting element at pilot øbf or ødf

14.5.3 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.

EL1	EL2	EL3
		

EL4	EL5	EL6
		

Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

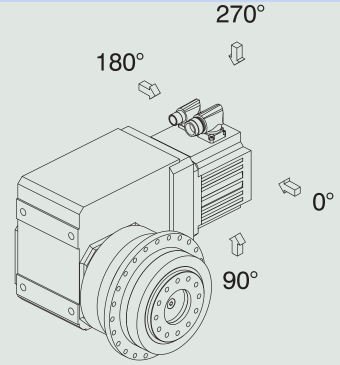
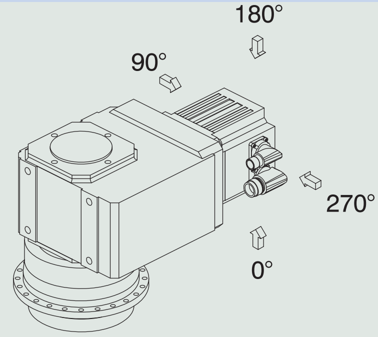
14.5.4 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

You will receive lubricants for use in the food industry upon request.

14.5.5 Position of the plug connectors

<table>
<tr><th>Mounting position EL1
Plug connector in 270° position (standard)</th><th>Mounting position EL4
Plug connector in 270° position (standard)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

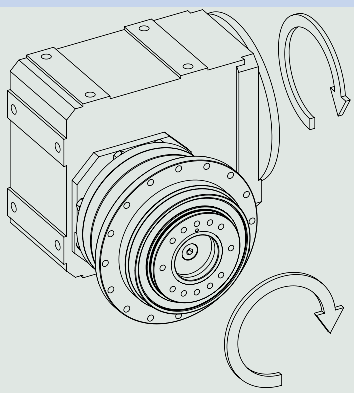
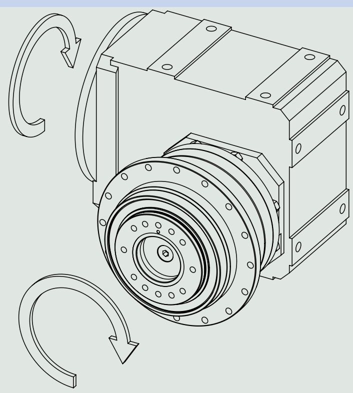
Indicate variations for your geared motor in the order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

14.5.6 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 90 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} three-stage	93%
η_{get} four-stage	92%
η_{get} five-stage	90%
Protection class:[1]	
Gear unit	IP65
Motor	IP56, optionally IP66

14.5.7 Direction of rotation

<table>
<tr><th>Output side 4</th><th>Output side 3</th></tr>
<tr><td></td><td></td></tr>
</table>

The pictures show mounting position EL1.

[1] Observe the protection class of all the components.

14.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft for free at https://www.stoeber.de/en/ServoSoft.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

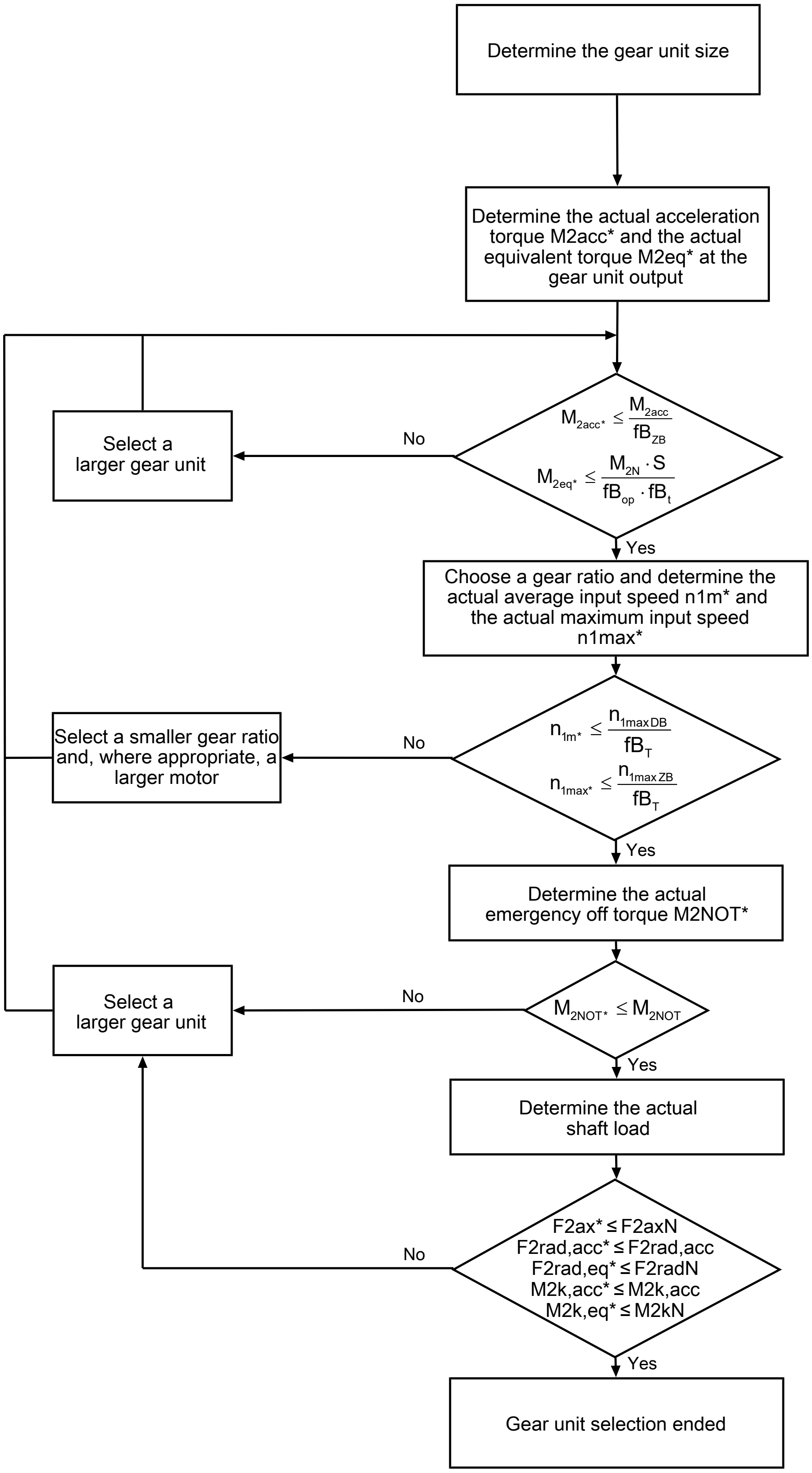
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in Chapter [▷ 20.1].

The formula symbols for values actually present in the application are marked with *.

14.6.1 Drive selection

Drive selection for gear units

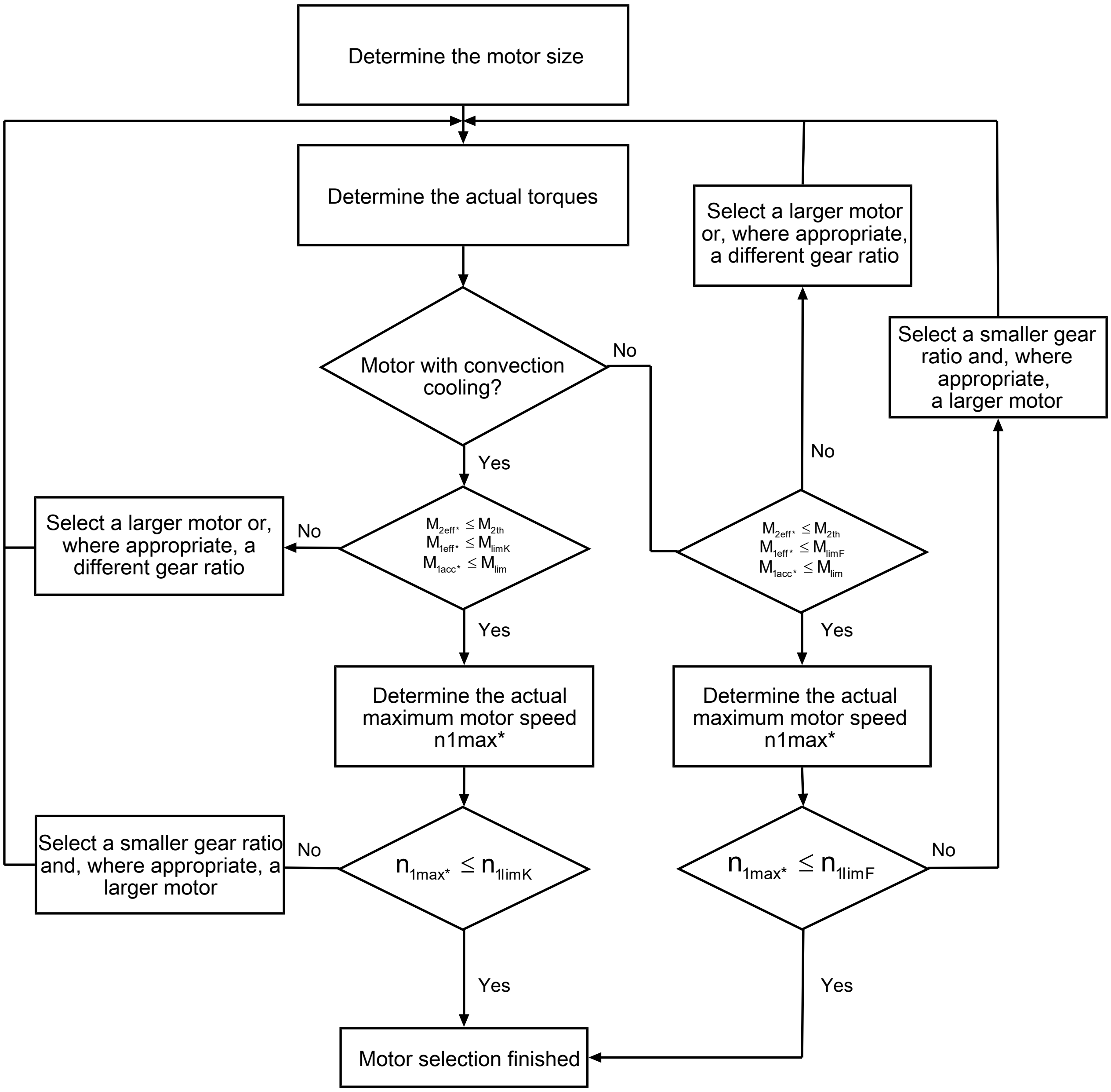


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc} (M_{2accHT} for reduced backlash), M_{2NOT}, M_{2N} and S.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

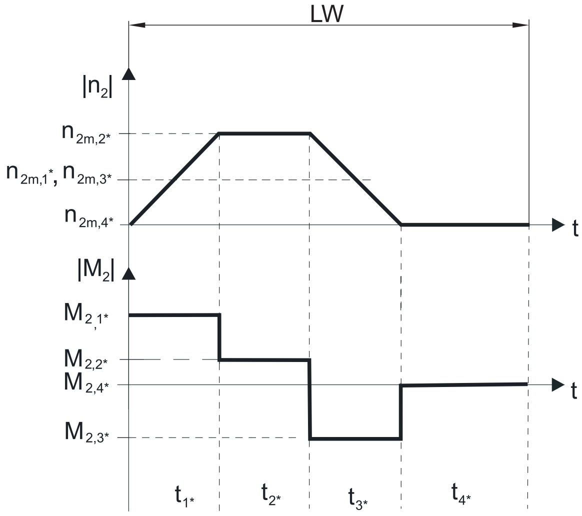
Drive selection for motors



The value for M_{lim}, M_{limK}, M_{limF}, n_{1limK} and n_{1limF} can be found in the motor characteristic curve in the chapter [▸ 17.3]. Note the size, nominal speed n_N and cooling type of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L*}$$

$$M_{1acc*} = \frac{M_{2acc*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m*} = n_{2m*} \cdot i$$

$$n_{2m*} = \frac{|n_{2m,1*}| \cdot t_{1*} + \ldots + |n_{2m,n*}| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If t_{1*} + ... + t_{3*} ≥ 6 min, calculate n_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^2 + \ldots + t_{n*} \cdot M_{2,n*}^2}{t_{1*} + \ldots + t_{n*}}}$$

Calculation of the actual emergency-off torque

$$M_{2NOT*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L*}$$

Calculation of the actual equivalent torque

$$M_{2eq*} = \sqrt[3]{\frac{|n_{2m,1*}| \cdot t_{1*} \cdot |M_{2,1*}^3| + \ldots + |n_{2m,n*}| \cdot t_{n*} \cdot |M_{2,n*}^3|}{|n_{2m,1*}| \cdot t_{1*} + \ldots + |n_{2m,n*}| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th}$ ≤ 0 you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

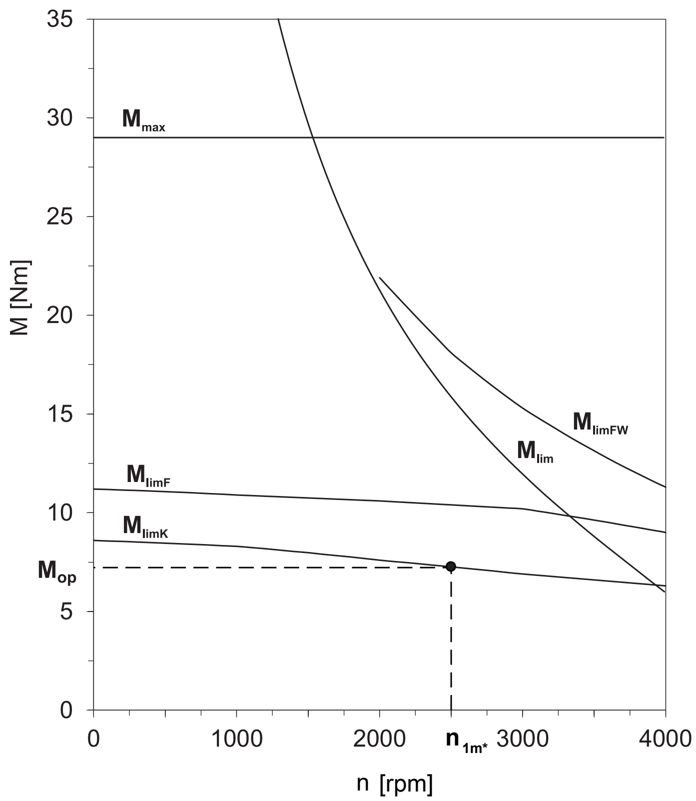
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^2$$

The values for i and a_{th} can be found in the selection tables.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter [▶ 17.3]. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2	1.0
EL3, 4, 5, 6	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.25
Reversing load cyclic operation	1.40

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gear unit temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gear unit torques (M_{2acc}, M_{2NOT}) in the selection tables.

14.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds n_{2m*} ≤ 100 rpm ($F^{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if radial forces on the gear unit are stabilized by its pilots (housing, flange shaft)

Permitted shaft loads for standard bearing S

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]	C_{2k} [Nm/ arcmin]
PHQ4	83.0	2150	3095	3929	257	326	192
PHQ5	97.0	4150	4536	4897	440	475	429
PHQ7	86.0	6150	17045	17045	1466	1466	500
PHQ8	125.5	10050	27778	33333	3486	4183	1550
PHQ9	155.0	33000	48387	70968	7500	11000	7500
PHQ10	171.0	50000	51462	73099	8800	12500	9500
PHQ11	231.0	60000	47619	69264	11000	16000	11500
PHQ12	281.0	70000	64057	106761	18000	30000	14000

Permitted shaft loads for reinforced bearing V

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]	C_{2k} [Nm/ arcmin]
PHQ4	88.5	2900	4000	4000	354	354	217
PHQ5	104.0	5000	5500	5500	572	572	478

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table "Permitted shaft loads" in this chapter.

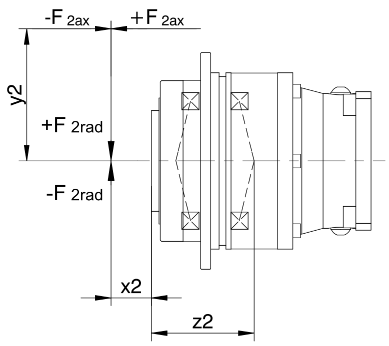


Fig. 1: Force application points

You can determine the permitted radial forces from the permitted tilting torque M_{2kN} and $M_{2k,acc}$. The actual radial forces may not exceed the permitted radial forces. The permitted radial forces pertain to the shaft end (x2 = 0).

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax100}, $F_{2rad100}$ and M_{2k100} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

The following apply to the bearing service life L_{10h} (ED_{10} ≤ 40%):

L_{10h} > 10000 h with 1 < M_{2kN}/M_{2k^*} < 1.25

L_{10h} > 20000 h with 1.25 < M_{2kN}/M_{2k^*} < 1.5

L_{10h} > 30000 h with 1.5 < M_{2kN}/M_{2k^*}

For different duty cycles:

$$L_{10h} > L_{10h(ED_{10}=40\%)} \cdot \frac{40\%}{ED_{10}}$$

14.6.3 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gear units are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gear unit. If you use a gear unit with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gear unit lubricant in case of a leak.

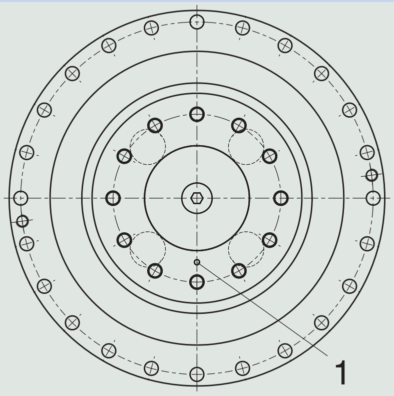
14.6.4 Reverse operation

To ensure lubrication for circulating gearing parts during cyclic reverse operation from ± 20° to ± 90° at the output, pay careful attention to the position of the output shaft for the horizontal mounting of the gear unit, as shown in the diagrams below.

The images show the center position of reverse operation.

Cyclic reverse operation ≤ ± 20° on request.

PHQ4 – PHQ12



1 Position of the mark: bottom

Please note that the hole pattern may be different, depending on the size of the planetary gear unit.

14.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gear units, geared motors PHQ53K – PHQ83K, PHQ94K – PHQ124K	443357_en