

## 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.

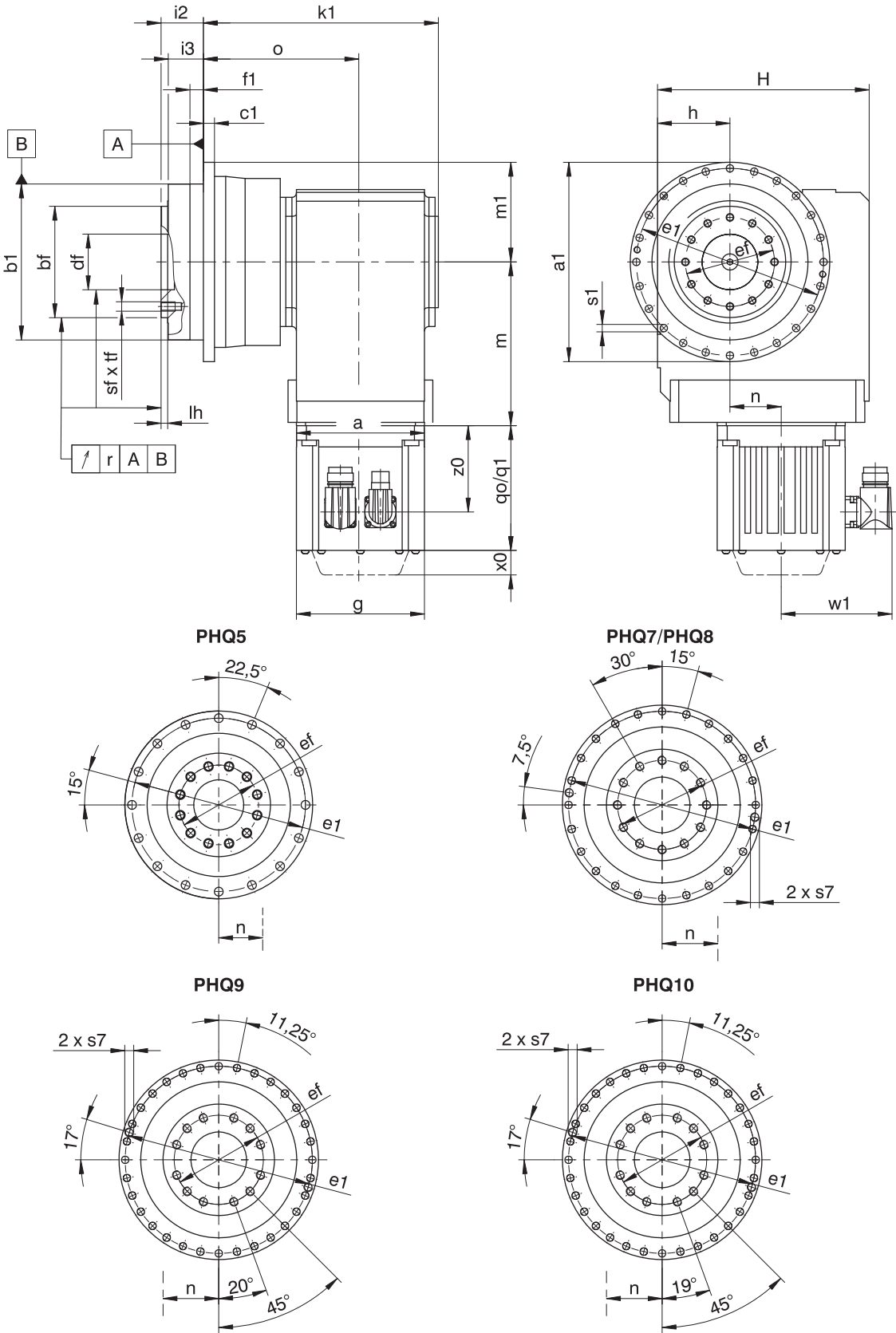
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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.  
x0 Applies to encoders using an optical measuring method

q1 Applies to motors with brake.  
w1 Different for the One Cable Solution (OCS), see the chapter [17.4](#)

## Dimensions of gear units

Type	Øa1	Øb1	Øbf	c1	Ødf	Øe1	Øef	f1	h	H	i2	i3	k1	lh	m1	o	r	Øs1	s7	sf	tf
PHQ531_K102_	145 <sub>h7</sub>	110 <sub>h7</sub>	80 <sub>h7</sub>	8	40 <sup>H6</sup>	135	63	12	60	160	29	23	180.0	6	72.5	124.0	0.020	5.5	–	M8	12.0
PHQ731_K202_	179 <sub>h7</sub>	140 <sub>h7</sub>	100 <sub>h7</sub>	10	50 <sup>H6</sup>	168	80	12	65	190	38	32	211.0	6	89.5	141.0	0.025	6.6	–	M10	16.0
PHQ831_K402_	247 <sub>h7</sub>	200 <sub>h7</sub>	160 <sub>h7</sub>	12	80 <sup>H6</sup>	233	125	15	90	240	50	42	289.0	8	123.5	199.0	0.030	9.0	M10	M12	17.0
PHQ931_K513_	300 <sub>h7</sub>	255 <sub>h7</sub>	180 <sub>h7</sub>	18	90 <sup>H6</sup>	280	145	20	160	260	66	55	292.5	12	150.0	196.5	0.030	13.5	M8	M20	28.0
PHQ1031_K713_	330 <sub>h7</sub>	285 <sub>h7</sub>	200 <sub>h7</sub>	20	95 <sup>H6</sup>	310	166	20	212	342	75	60	354.5	10	165.0	238.0	0.040	13.5	M10	M24	35.0

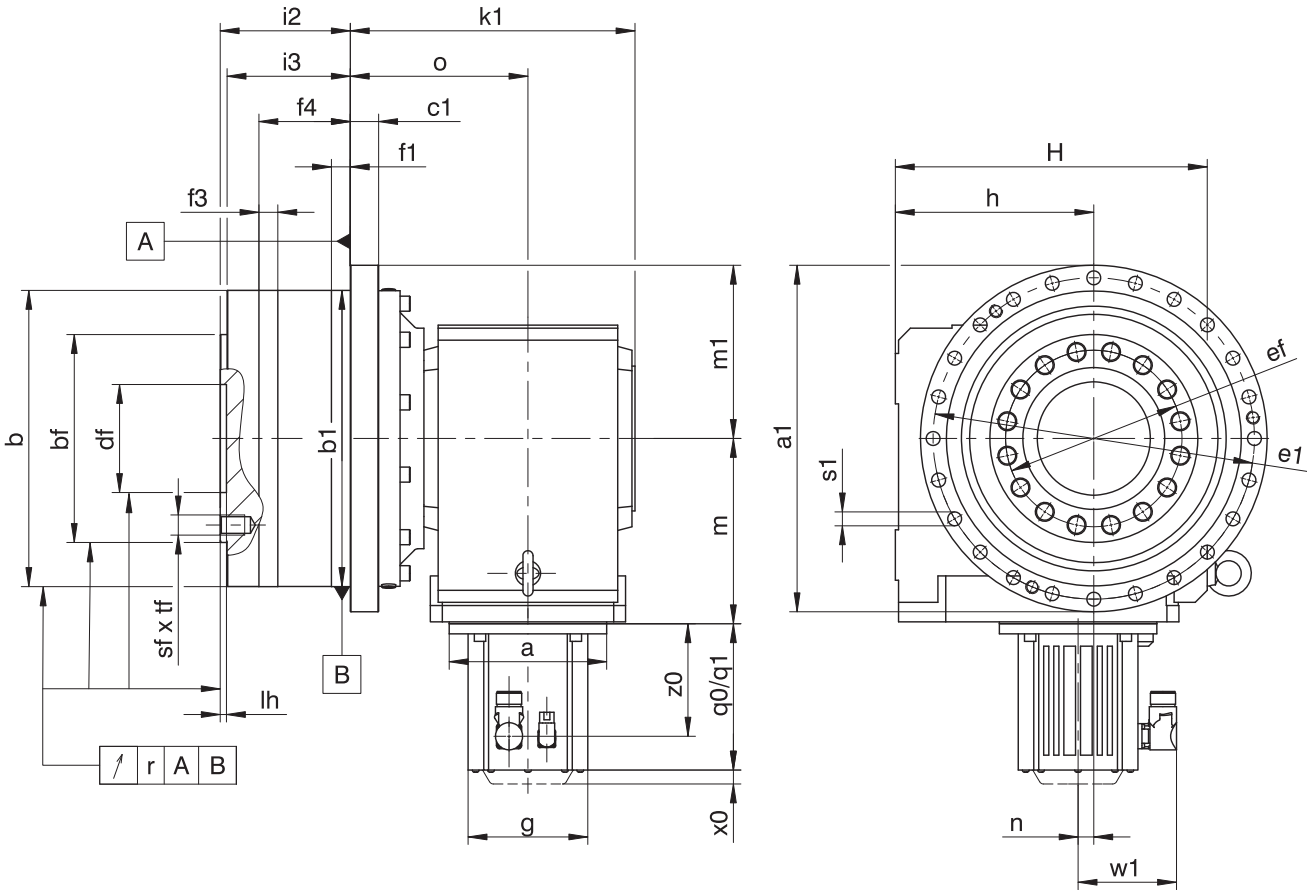
## Dimensions of motors

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

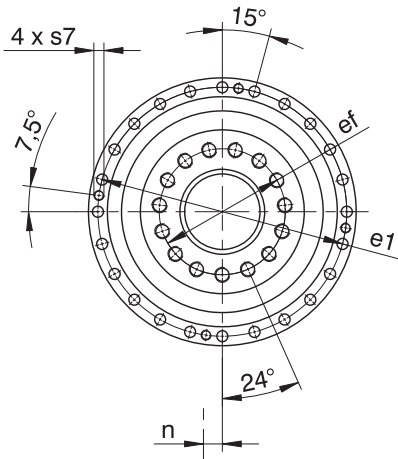
## Dimensions of geared motors

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_	–	–	–	–	–	–	Ø160	187	60.0	□145	189	60.0	□190	192	60.0
PHQ931_K513_	–	–	–	–	–	–	Ø160	172	15.0	□145	174	15.0	□190	177	15.0
PHQ1031_K713_	–	–	–	–	–	–	–	–	–	Ø200	221	20.0	□190	224	20.0

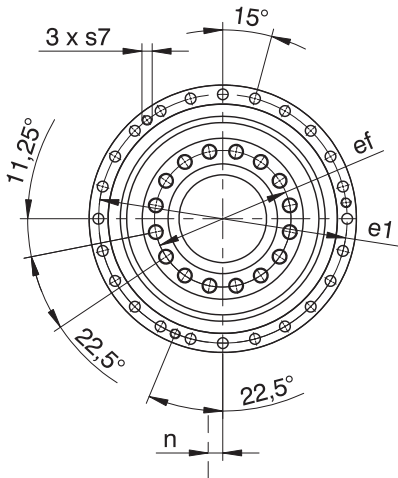
14.3.2 PHQ11 – PHQ12 F shaft design (flange shaft)



PHQ11



PHQ12



- q0

Applies to motors without brake.
- x0

Applies to encoders using an optical measuring method
- q1

Applies to motors with brake.
- w1

Different for the One Cable Solution (OCS), see the chapter [17.4](#)

Dimensions of gear units

Type	Øa1	Øb	Øb1	Øbf	c1	Ødf	Øe1	Øef	f1	f3	f4	h	H	i2	i3	k1	lh	m1	o	r	Øs1	s7	sf	tf
PHQ1131_K813_	425	365 <sub>g6</sub>	365 <sub>h6</sub>	260 <sub>h7</sub>	32	120 <sup>H6</sup>	395	200	30	30	120	265	410	190	180	381.5	10	212.5	236.5	0.040	17.5	M16	M24	35.5
PHQ1231_K913_	550	470 <sub>g6</sub>	470 <sub>h6</sub>	330 <sub>h7</sub>	45	180 <sup>H7</sup>	510	280	30	30	145	315	495	206.5	195.5	452.0	10	275.0	282.0	0.040	22.0	M16	M30	48.0
PHQ1231_K914_	550	470 <sub>g6</sub>	470 <sub>h6</sub>	330 <sub>h7</sub>	45	180 <sup>H7</sup>	510	280	30	30	145	315	495	206.5	195.5	452.0	10	275.0	282.0	0.040	22.0	M16	M30	48.0

## 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
PHQ1131_K813_	Ø200	247	24	Ø250	249	24
PHQ1231_K913_	–	–	–	Ø250	294	25
PHQ1231_K914_	Ø200	353	25	Ø250	365	25

# 14.4 Type designation

## 14.4.1 Type designation PHQ5K\_ – PHQ8K\_

In this chapter, you can find 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
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Explanation

Code	Designation	Design
PHQ	Type	Planetary gear unit
7	Size	7 (example)
3	Generation	Generation 3
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
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 [\[▶ 14.6.4\]](#)

## 14.4.2 Type designation PHQ9K\_ – PHQ12K\_

In this chapter, you can find 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	9	3	1	F	0060	K513VF	0115	EZ802U
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### Explanation

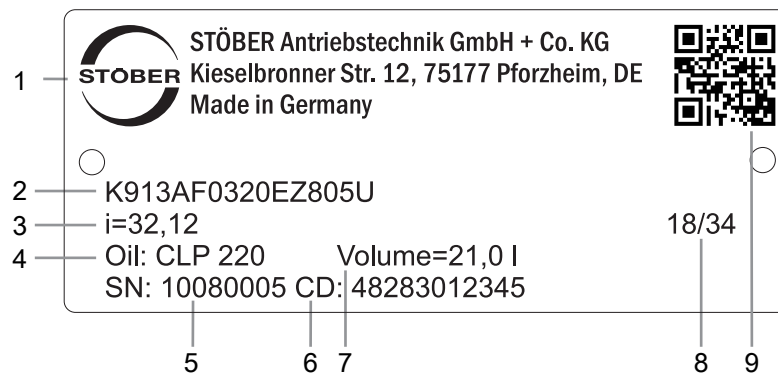
Code	Designation	Design
PHQ	Type	Planetary gear unit
9	Size	9 (example)
3	Generation	Generation 3
1	Stages	Single-stage
F	Shaft	Flange shaft
0060	Transmission ratio of output (i x 10)	i = 6 (example)
K513VF	Input	K5 right-angle gear unit (example)
0115	Transmission ratio of input (i x 10 rounded)	i = 11.55 (example)
EZ802U	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  $\pm 20^\circ$  to  $\pm 90^\circ$  and horizontal installation, note the chapter [\[▶ 14.6.4\]](#)

## 14.4.3 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)

14.4.3.1 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:

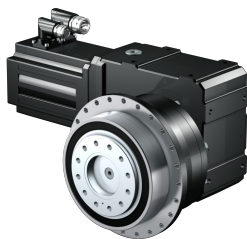
<https://id.stober.com>

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.stober.de/en/downloads/>

Enter the ID of the catalog in the search field.

14.5.2 Installation conditions

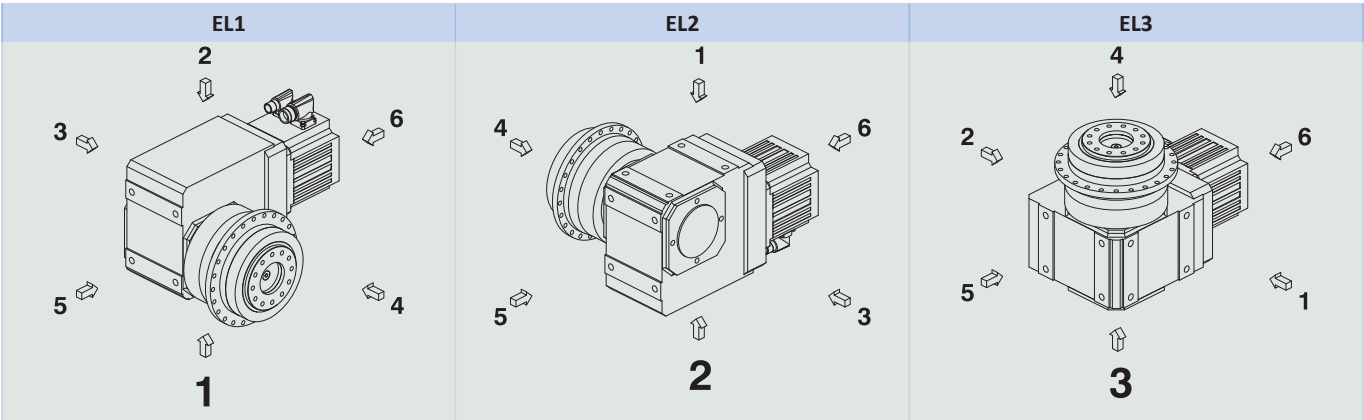
The torque and force values listed in this catalog are valid under the following conditions:

- 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  $\varnothing b1$ , and also at pilot  $\varnothing b$  for sizes PHQ11 and PHQ12. The machine-side fit must be H7.
- When the flange shaft is adjusted using the connecting element at pilot  $\varnothing bf$  or  $\varnothing df$

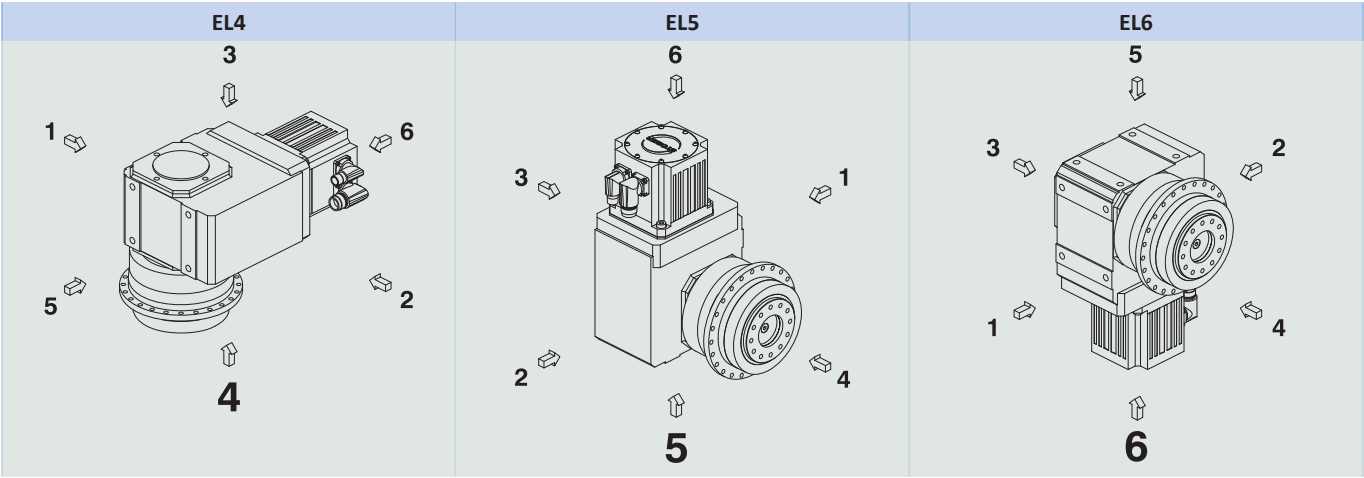
14.5.3 Mounting positions

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.







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

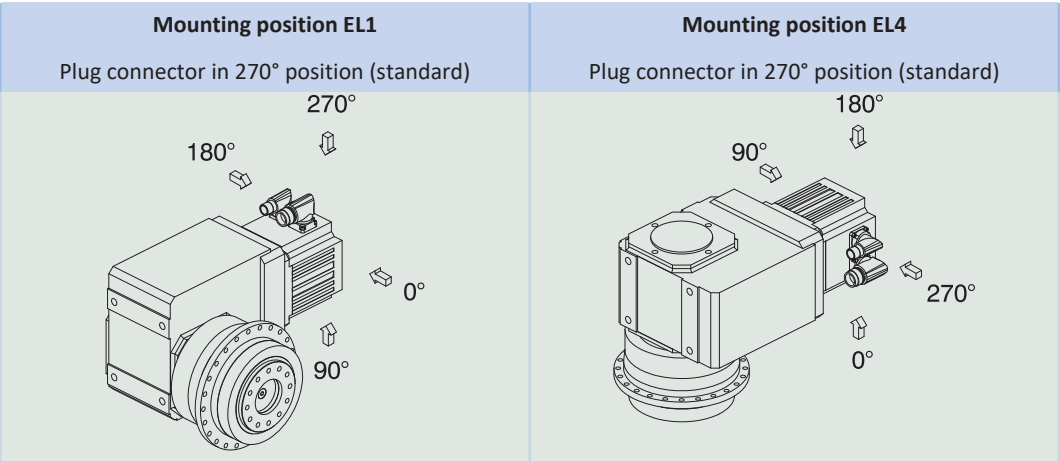
14.5.4 Lubricants

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



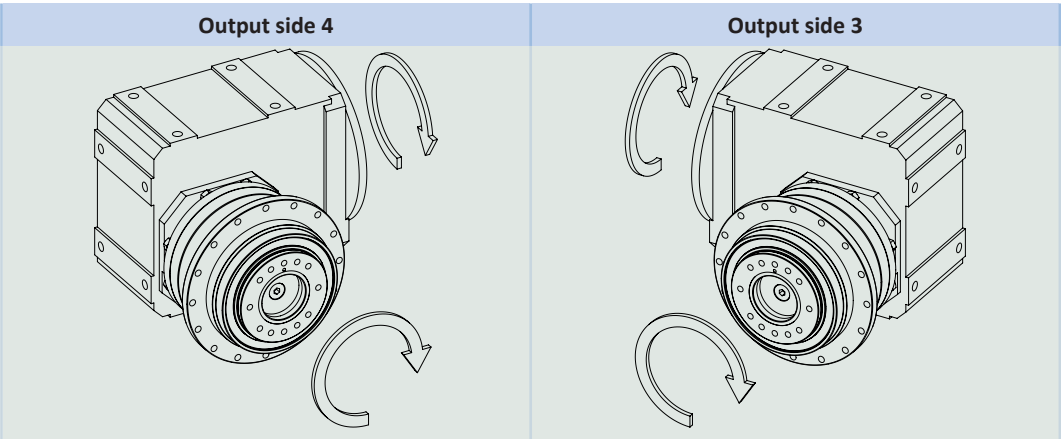
Indicate variations for your geared motor in the order.

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:	
$\eta_{\text{get}}$ three-stage	93%
$\eta_{\text{get}}$ four-stage	92%
$\eta_{\text{get}}$ five-stage	90%
Protection class: <sup>1</sup>	
Gear unit	IP65
Motor	IP56, optionally IP66

14.5.7 Direction of rotation



The pictures show mounting position EL1.

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.

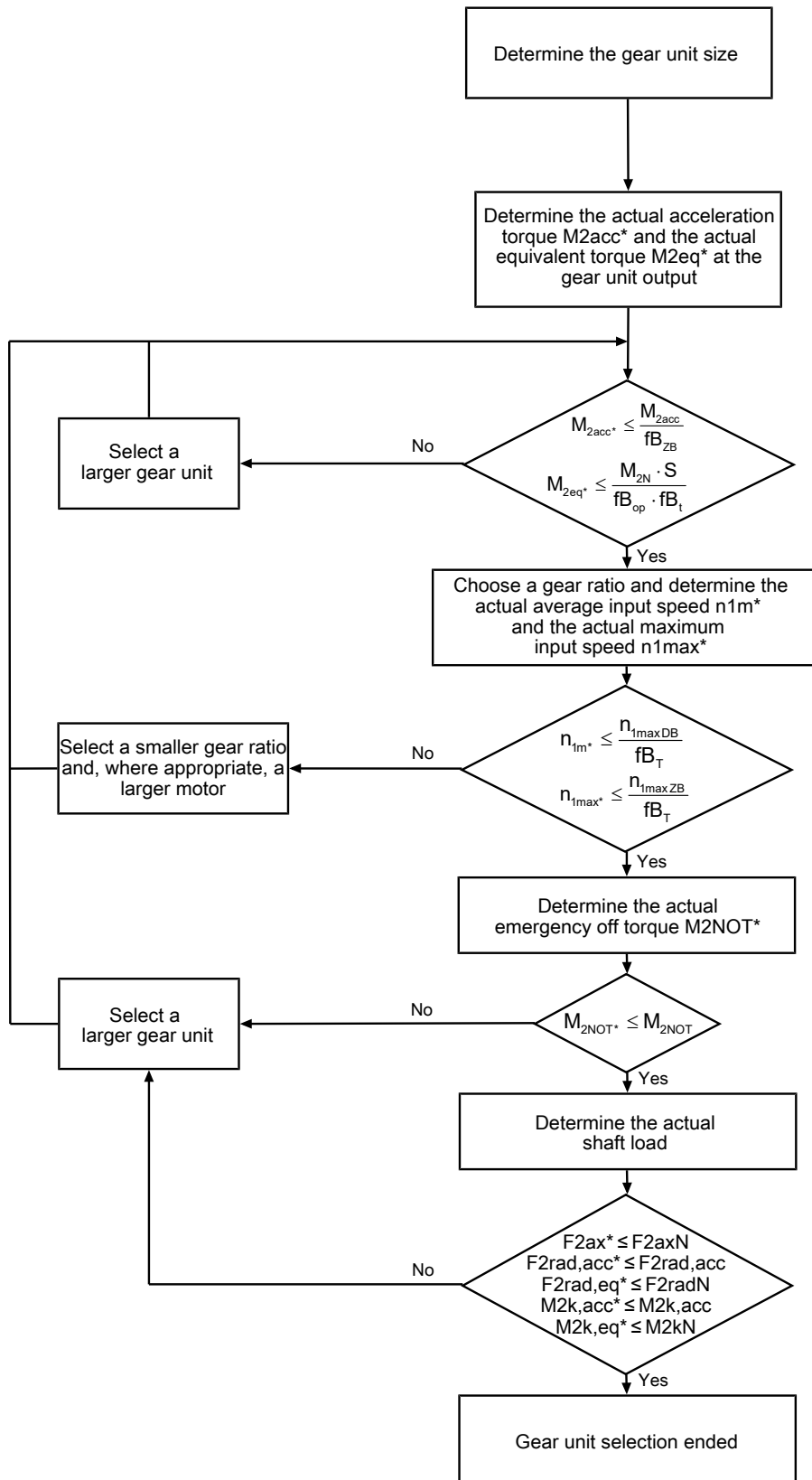
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in Chapter [▶ 23.1](#).

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

## 14.6.1 Drive selection

Drive selection for gear units

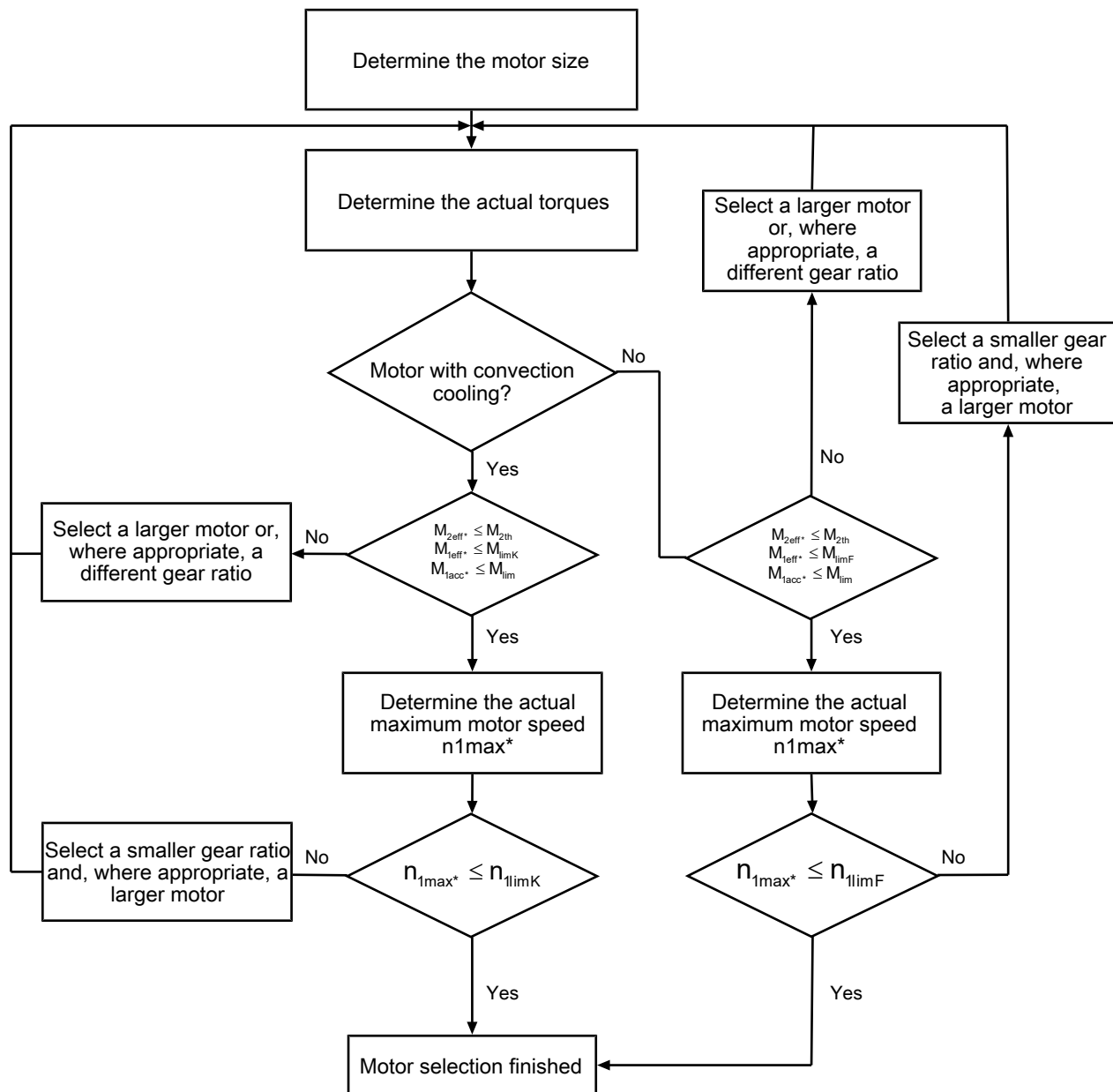


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

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.

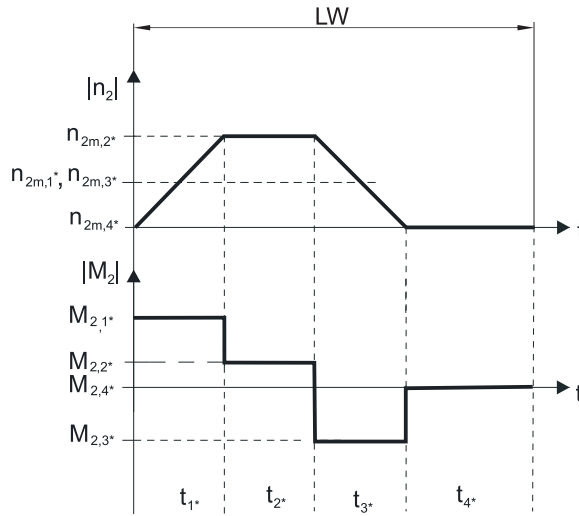
## Drive selection for motors



The value for  $M_{lim}$ ,  $M_{limK}$ ,  $M_{limF}$ ,  $n_{limK}$  and  $n_{limF}$  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**

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

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

If  $t_{1*} + \dots + t_{3*} \geq 6 \text{ min}$ , 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**

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

**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**

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

**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  $K_{mot,th} \leq 0$  you must reduce the average input speed  $n_{1m*}$  accordingly or select another geared motor size.)

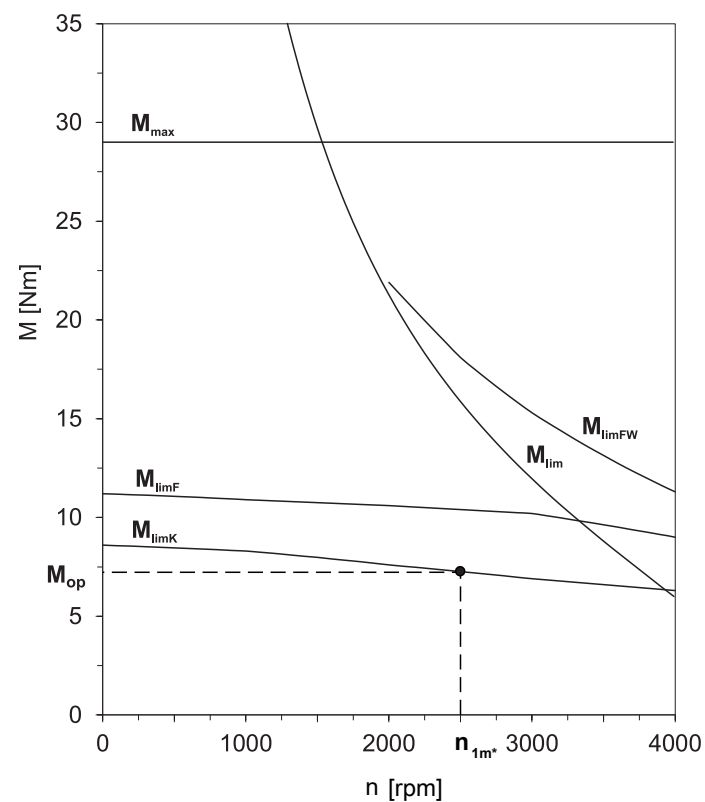
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

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

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  $n_{2m^*} \leq 100$  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	160
PHQ5	97.0	4150	4536	4897	440	475	380
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	60606	11000	14000	11500
PHQ12	281.0	70000	53380	71040	15000	20000	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	160
PHQ5	104.0	5000	5500	5500	572	572	380

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

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

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

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

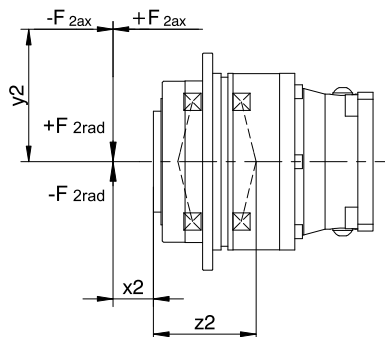


Fig. 1: Force application points

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 ( $x_2 = 0$ ).

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

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:**

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

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

**The following apply to the bearing service life  $L_{10h}$  ( $ED_{10} \leq 40\%$ ):**

$L_{10h} > 10000$  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.

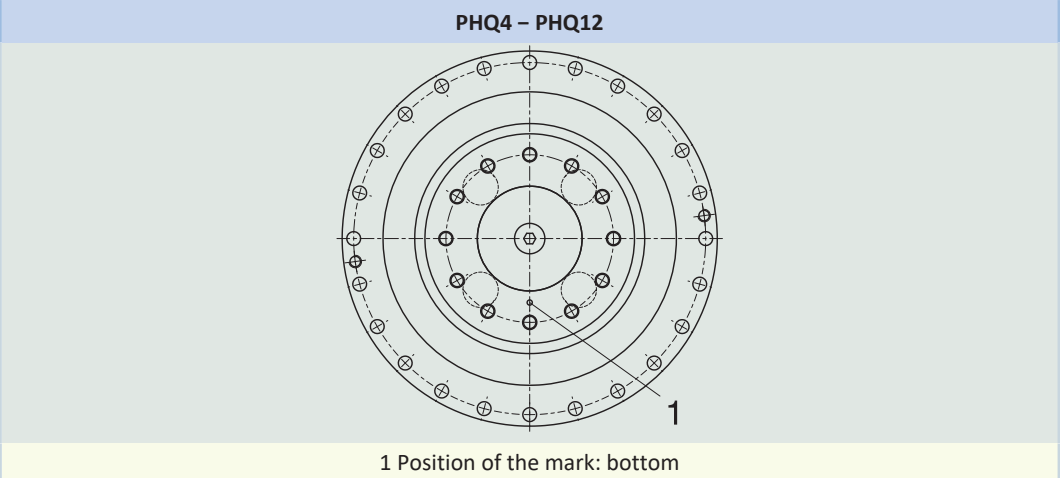


14.6.4 Reverse operation

To ensure lubrication for circulating gearing parts during cyclic reverse operation from  $\pm 20^\circ$  to  $\pm 90^\circ$  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  $\leq \pm 20^\circ$  on request.



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 field.

Documentation	ID
Operating manual for KL/KS/PHK/PHKX/PHQK/PK/PKX right-angle servo gear units and right-angle servo geared motors	443150_en