3.3 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.

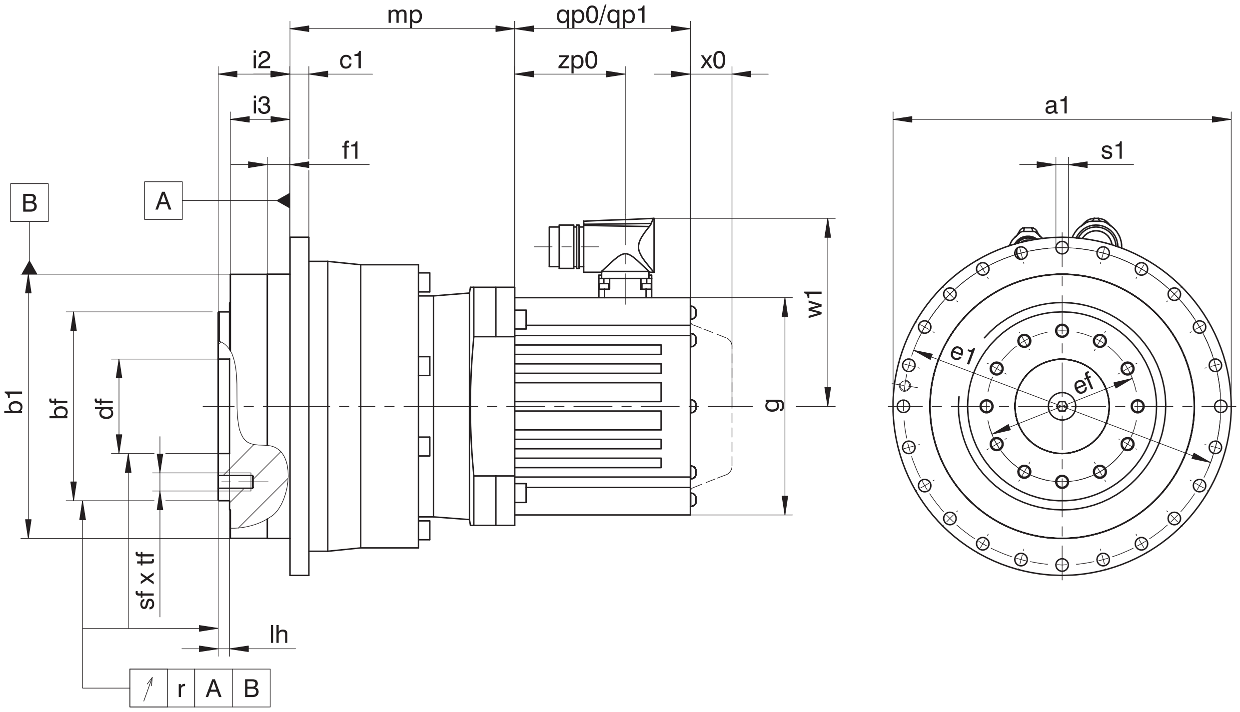
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

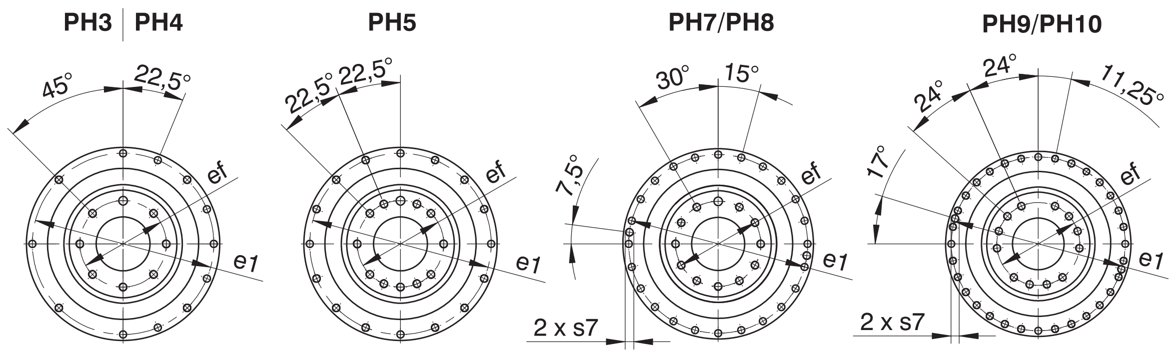
We reserve the right to make dimensional changes due to ongoing technical development.

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/.

3.3.1 F shaft design (flange shaft)





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	EZ2: Applies only to motors with brake and encoders using an optical or inductive measuring method EZ3 – EZ8: 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	i2	i3	lh	r	∅s1	s7	sf	tf
PH331	86$_{h7}$	64$_{h7}$	40$_{h7}$	4	20.0^{H6}	79	31.5	7	19.5	16.5	4	0.020	4.5	–	M5	7
PH332	86$_{h7}$	64$_{h7}$	40$_{h7}$	4	20.0^{H6}	79	31.5	7	19.5	16.5	4	0.020	4.5	–	M5	7
PH431	118$_{h7}$	90$_{h7}$	63$_{h7}$	7	31.5^{H6}	109	50.0	10	30.0	24.0	6	0.020	5.5	–	M6	11
PH432	118$_{h7}$	90$_{h7}$	63$_{h7}$	7	31.5^{H6}	109	50.0	10	30.0	24.0	6	0.020	5.5	–	M6	11
PH531	145$_{h7}$	110$_{h7}$	80$_{h7}$	8	40.0^{H6}	135	63.0	12	29.0	23.0	6	0.020	5.5	–	M6	11
PH532	145$_{h7}$	110$_{h7}$	80$_{h7}$	8	40.0^{H6}	135	63.0	12	29.0	23.0	6	0.020	5.5	–	M6	11
PH731	179$_{h7}$	140$_{h7}$	100$_{h7}$	10	50.0^{H6}	168	80.0	12	38.0	32.0	6	0.025	6.6	–	M8	14
PH732	179$_{h7}$	140$_{h7}$	100$_{h7}$	10	50.0^{H6}	168	80.0	12	38.0	32.0	6	0.025	6.6	–	M8	14
PH831	247$_{h7}$	200$_{h7}$	160$_{h7}$	12	80.0^{H6}	233	125.0	15	50.0	42.0	8	0.030	9.0	M10	M10	18
PH832	247$_{h7}$	200$_{h7}$	160$_{h7}$	12	80.0^{H6}	233	125.0	15	50.0	42.0	8	0.030	9.0	M10	M10	18
PH942	300	255$_{h7}$	180$_{h7}$	18	90.0^{H6}	280	140.0	20	66.0	55.0	12	0.030	13.5	M8	M16	24
PH1042	330	285$_{h7}$	200$_{h7}$	20	95.0^{H6}	310	160.0	20	75.0	60.0	10	0.040	13.5	M10	M20	28

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ802U	190	197	274.0	156.5	22	143.0
EZ803U	190	238	315.0	156.5	22	184.0
EZ805U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ2	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp	mp
PH331	–	51.0	47.5	–	–	–
PH332	71.0	84.5	–	–	–	–
PH431	–	–	54.5	54.0	–	–
PH432	–	99.0	95.5	–	–	–
PH531	–	–	–	61.0	64.0	–
PH532	–	–	103.0	102.5	–	–
PH731	–	–	–	–	71.0	81.0
PH732	–	–	–	119.0	122.0	–
PH831	–	–	–	–	–	110.0
PH832	–	–	–	–	161.0	171.0
PH942	–	–	–	–	–	210.5
PH1042	–	–	–	–	–	217.5

3.4 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

PH	5	3	2	S	F	S	S	0250	EZ401U

Explanation

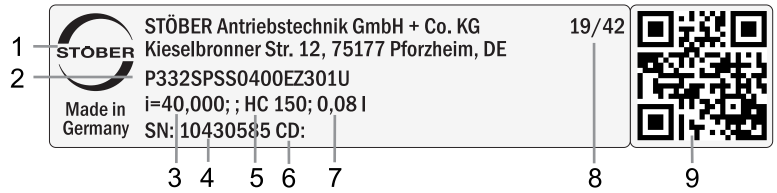
Code	Designation	Design
PH	Type	Planetary gear unit
5	Size	5 (example)
3	Generation	Generation 3
4		Generation 4
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PH3 – PH5)
S	Backlash	Standard
R		Reduced (PH3 – PH9)
0250	Transmission ratio (i x 10)	i = 25 (example)
EZ401U	Motor	EZ synchronous servo motor

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

- A detailed type designation of the motor, see the chapter [▷ 17]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▷ 3.6.3]
- Reverse operation of the output shaft from ±20° to ±90° and horizontal installation, note the chapter [▷ 3.6.4]

3.4.1 Nameplate

An example geared motor nameplate is explained in the figure below.



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

3.4.1.1 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.

3.5 Product description

3.5.1 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.

3.5.2 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. The machine-side fit must be H7.
- When the flange shaft is adjusted using the connecting element at pilot øbf or ødf

3.5.3 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

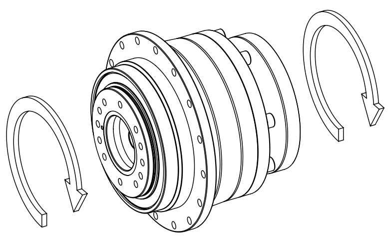
You will receive lubricants for use in the food industry upon request.

3.5.4 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} single-stage	96%
η_{get} two-stage	93%
Protection class:[1]	
Gear unit	IP65
Motor	IP56, optionally IP66

3.5.5 Direction of rotation

The input and output rotate in the same direction.



3.6 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.

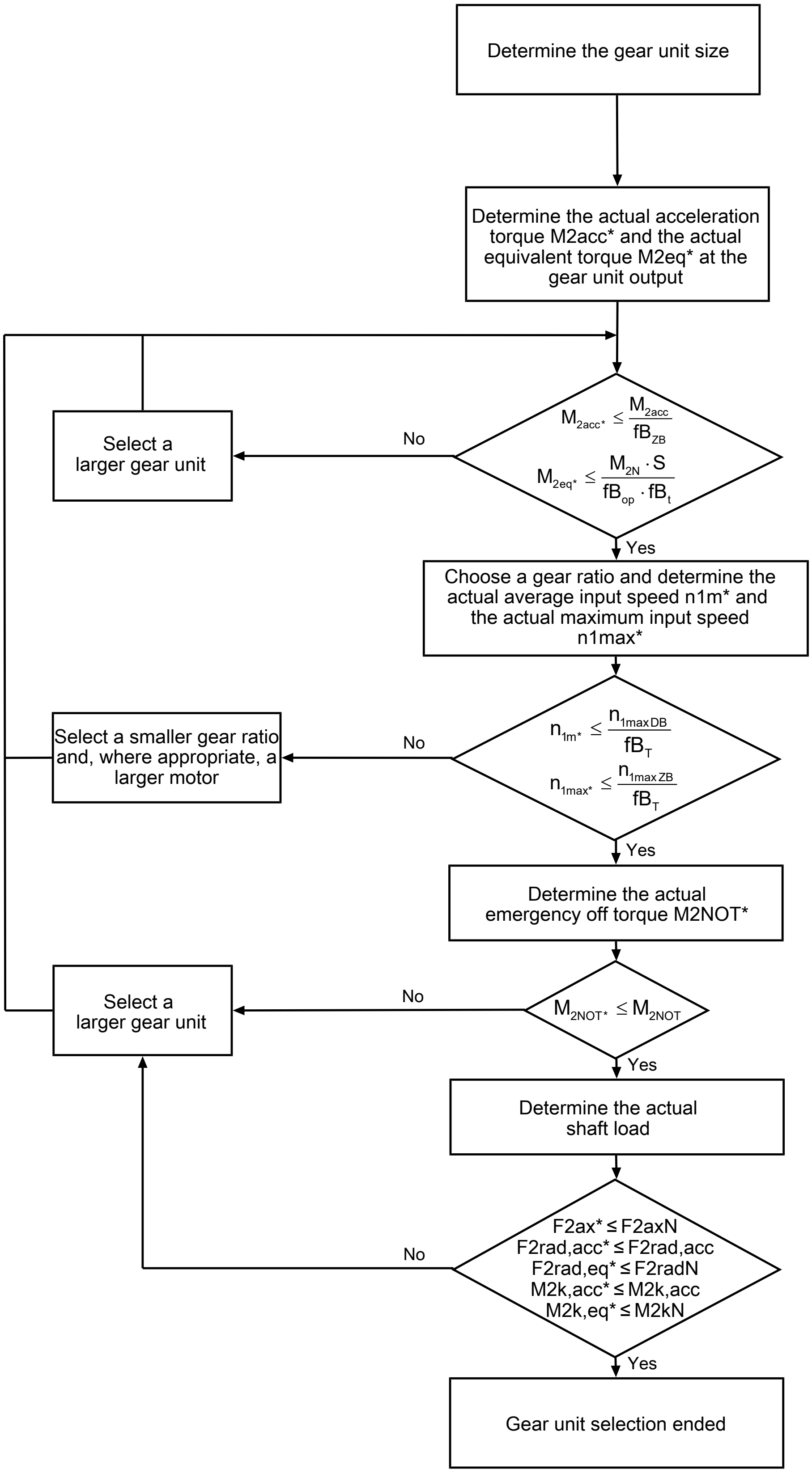
An explanation of the formula symbols can be found in Chapter [▷ 20.1].

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

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

3.6.1 Drive selection

Drive selection for gear units

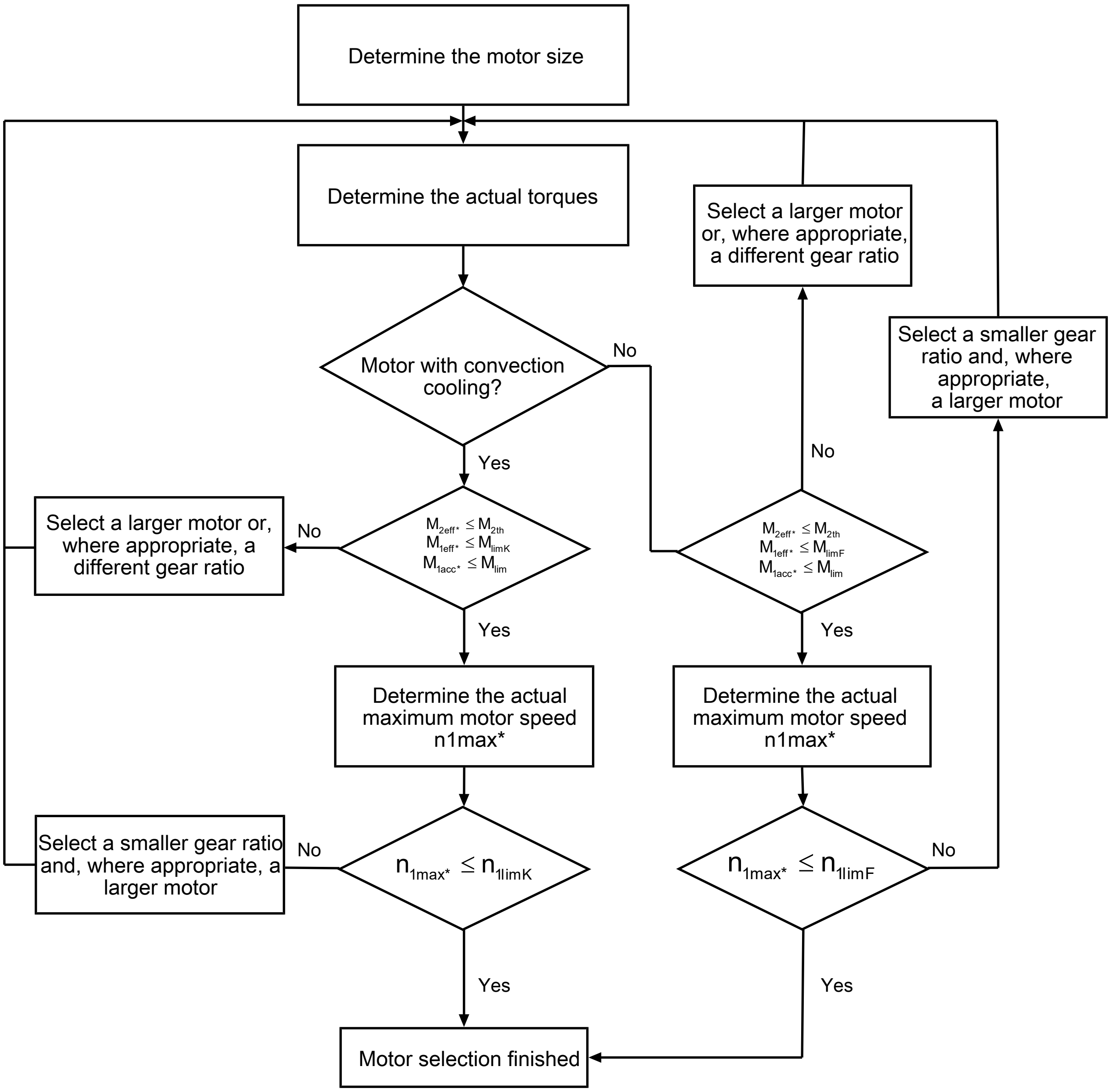


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

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.

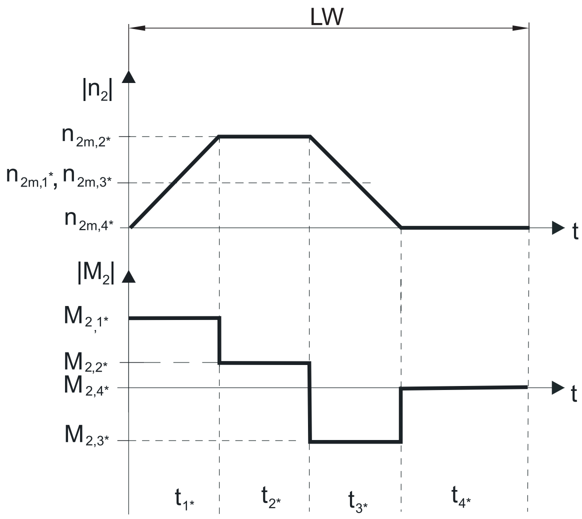
Drive selection for motors



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.)

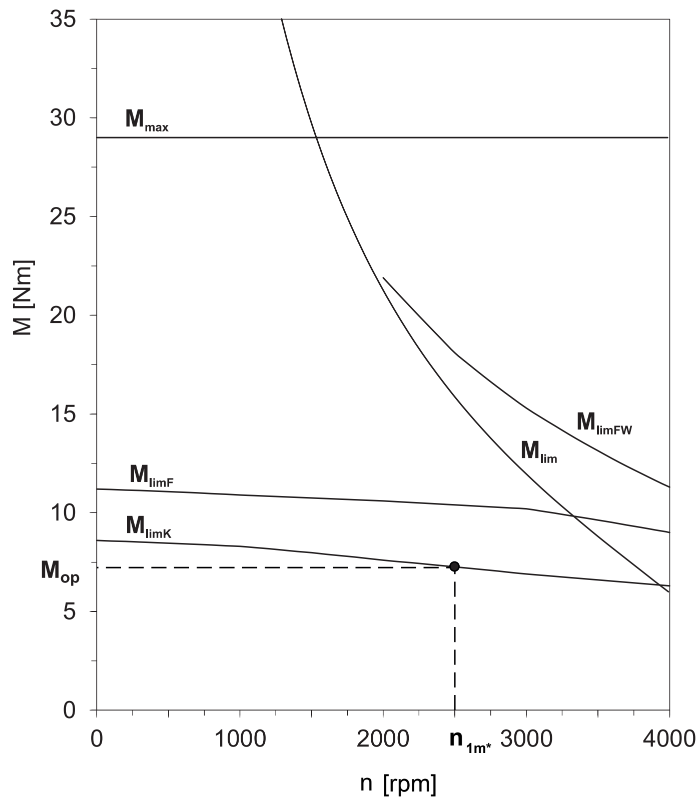
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table 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

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

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.

3.6.2 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]
PH3	62.5	1650	1613	1613	101	101	75
PH4	83.0	2150	3095	3571	257	296	192
PH5	97.0	4150	4536	4897	440	475	429
PH7	86.0	6150	17045	17045	1466	1466	500
PH8	125.5	10050	27778	27778	3486	3486	1550
PH9	155.0	33000	48387	70968	7500	11000	7500
PH10	171.0	50000	51462	73099	8800	12500	9500

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]
PH3	66.5	2200	2250	2250	150	150	80
PH4	88.5	2900	4000	4000	354	354	217
PH5	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.

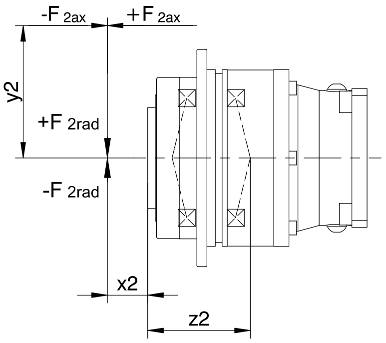


Fig. 1: Force application points

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:

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

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

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:

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

3.6.3 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.

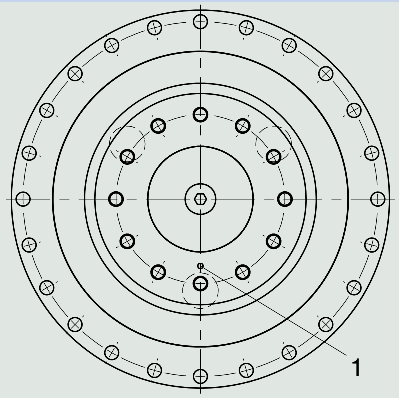
3.6.4 Reverse operation

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.

Size 3 – 10



1 Position of the mark: bottom

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

3.7 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 PH33 – PH83, PH94 – PH104	443354_de