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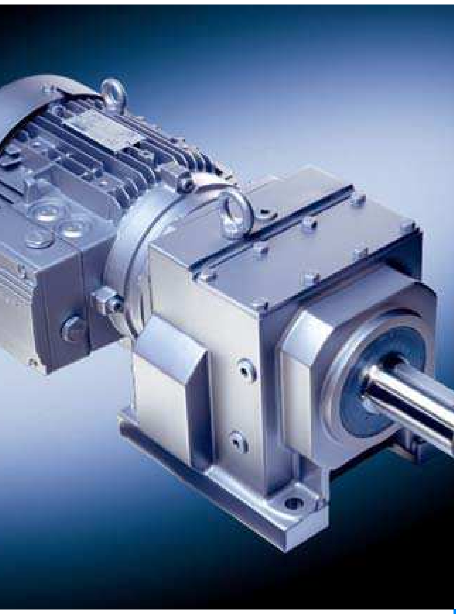


Guide to selecting and ordering geared motors

Description of the range of geared motors

MOTOX geared motors are available in an almost infinite number of combinations for adaptation to a wide range of drive scenarios. All geared motors can be supplied with a mounted brake. All the usual additional components and variants are also offered.

Made-to-measure solutions for all kinds of drive technology tasks are achieved with different gear unit types
(helical, parallel shaft, bevel helical, helical worm, and worm).

Electronic catalog

MOTOX Configurator (CD)

The MOTOX Configurator makes it easy to select the right geared motor, providing you with not only the correct geared motor order numbers, but also prices and relevant documentation.

Data sheets and dimension drawings can be created for the different products.

Product range

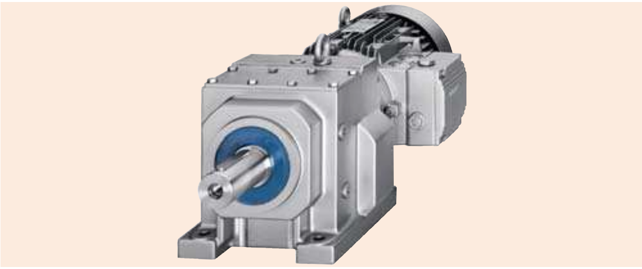
The printed catalog contains the basic selection of standard MOTOX geared motors.
The MOTOX Configurator, however, contains practically all combinations of MOTOX geared motors which are theoretically possible. It also contains additional sector-specific applications, such as:

- Monorail conveyor drives
- Extruder geared motors
- Cooling tower drives
- Mixer and agitator geared motors

You can also use the electronic catalog to configure explosion-proof ATEX geared motors for zones 1, 2, 21, and 22.

The MOTOX Configurator can also be accessed online at:
www.siemens.com/gearedmotors.

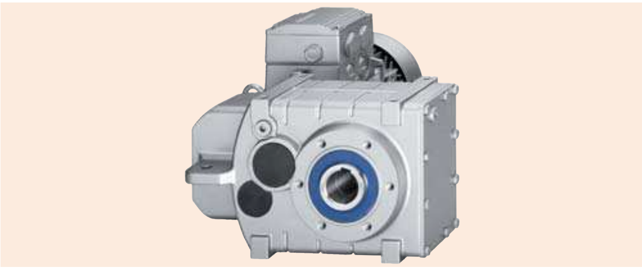
Description of the range of geared motors (continued)



Helical geared motor D/Z

Helical geared motors and gear units

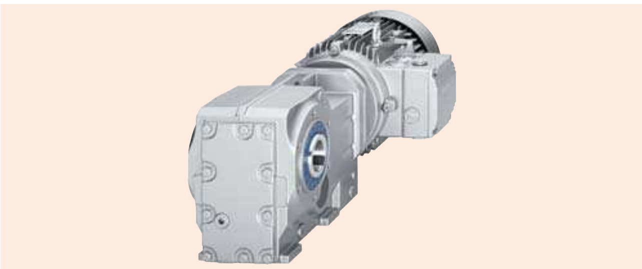
Torque	20,000 Nm
Power (50 Hz)	200 kW
(60 Hz)	240 kW
Output speed (50 Hz)	0.05 ... 1,088 / min
(60 Hz)	0.06 ... 1,306 / min



Parallel shaft geared motor

Parallel shaft geared motors and gear units

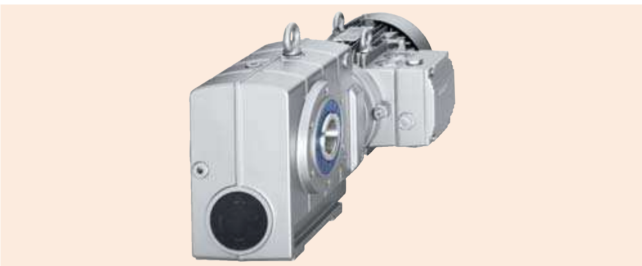
Torque	20,000 Nm
Power (50 Hz)	200 kW
(60 Hz)	240 kW
Output speed (50 Hz)	0.05 ... 365 / min
(60 Hz)	0.06 ... 440 / min



Bevel helical geared motor

Bevel helical geared motors and gear units

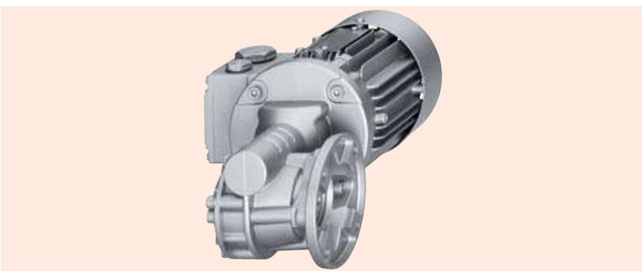
Torque	20,000 Nm
Power (50 Hz)	200 kW
(60 Hz)	240 kW
Output speed (50 Hz)	0.05 ... 306 / min
(60 Hz)	0.06 ... 367 / min



Helical worm geared motor

Helical worm geared motors and gear units

Torque	1,590 Nm
Power (50 Hz)	9.2 kW
(60 Hz)	11 kW
Output speed (50 Hz)	0.05 ... 148 / min
(60 Hz)	0.05 ... 178 / min



Worm geared motor

Worm geared motors and gear units

Torque	224 Nm
Power (50 Hz)	1.5 kW
(60 Hz)	1.8 kW
Output speed (50 Hz)	14 ... 201 / min
(60 Hz)	17 ... 241 / min

Geared motors
Introduction

Guide to selecting and ordering geared motors

Guide to drive selection

This "guide to drive selection" takes you to the geared motor you require in easy-to-follow steps.

1st step	**Technical requirements of the geared motor** **-> see the "Configuring guide" section of this chapter**
Determine the required product profile, the following are required:	Gear unit type
	Power
	Output speed
	Service factor
	Radial force
	Ambient temperature
2nd step	**Preselection of the geared motor -> see subsequent pages**
Determine the range of possible geared motors	Size of the gear unit and the motor in accordance with the power and output speed
3rd step	**Detailed selection of the geared motor** **-> see the individual chapters for the different gear unit types**
Determine the basic order number	Define the order number in accordance with the power / torque and output speed
	Add more details to the order number in accordance with the mounting type, shaft, and mounting position of the geared motor
	Define the order code for the mounting type / mounting position
4th step	**Selection of motor options** **-> see the chapter titled "Technical explanations and motor options"**
Complete the order number	Add more details to the order number in accordance with the voltage and frequency
	Define additional components and the associated order codes

Guide to selecting and ordering geared motors

Order number code

The order number consists of a combination of digits and letters and is divided into three blocks linked with hyphens for a better overview,

e.g.:

2KJ1503-1CE13-1AE2-Z

+D06+M55

The first block (positions 1 to 7) identifies the gear unit type, the second (positions 8 to 12) codes the output shaft and the motor type and additional design characteristics are coded in the third block (positions 13 to 16).

Ordering data:

- Complete order number, with a **-Z** suffix, and order code(s) or plain text.
- If a quotation is available, please specify the quotation number in addition to the order number.
- When ordering a complete geared motor as a spare part, please specify the works serial number for the previously supplied geared motor as well as the order number.

Structure of the order number	Position	1	2	3	4	5	6	7	–	8	9	10	11	12	–	13	14	15	16		
MOTOX geared motors																					
1st to 5th positions: Digit, letter, Letter, digit, Digit	Helical gear unit E, single-stage	**2**	**K**	**J**	**1**	**0**															
	Helical gear unit Z, two-stage	**2**	**K**	**J**	**1**	**1**															
	Helical gear unit D, three-stage	**2**	**K**	**J**	**1**	**2**															
	Parallel shaft gear unit FZ, two-stage	**2**	**K**	**J**	**1**	**3**															
	Parallel shaft gear unit FD, three-stage	**2**	**K**	**J**	**1**	**4**															
	Bevel helical gear units B and K	**2**	**K**	**J**	**1**	**5**															
	Helical worm gear unit C	**2**	**K**	**J**	**1**	**6**															
	Worm gear unit SC	**2**	**K**	**J**	**1**	**7**															
6th and 7th position: Digit, digit	Gear unit size																				
8th position: Digit	Output shaft																				
9th to 10th positions: Letter Letter	Motor size																				
11th position: Digit	Without motor												**0**								
	Standard motor												**1**								
12th position: Digit	Motor generation													**3**							
13th position: Digit	Frequency, voltage																				
14th position: Letter	Foot-mounted design																**A**				
	Foot / flange-mounted design																**B**				
	Torque arm																**D**				
	Extruder flange																**E**				
	Flange-mounted design (A-type)																**F**				
	Housing flange (C-type)																**H**				
	Mixer flange																**M**				
	Flange for agitator																**R**				
15th to 16th positions: Letter, digit	Transmission ratio																				
	Special order versions: • Coded: order code also required • Non-coded: plain text also required																			**–**	**Z**

Guide to selecting and ordering geared motors

Order number code (continued)

Ordering example:

A bevel helical geared motor is required:
- Gear unit type / -size K48
- Motor 0.37 kW, 4-pole with 50 Hz line frequency
- Input speed 13, transmission ratio i = 107.47
- Solid shaft V 30 x 60
- Mounting type / mounting position B3-00-A
- Connection box position 1A

This results in the order number and order codes below:

Selection criteria	Requirements	Structure of the order number
Gear unit type	Bevel helical gear unit K, size 48	**2KJ1503**-■■■■■-■■■■
Output shaft	Solid shaft V 30 x 60	2KJ1503-**1**■■■■-■■■■
Motor size	Size 71; 0.37 kW; 4-pole	2KJ1503-1**CE**■■-■■■■
Motor type	Standard motor	2KJ1503-1CE**1**■-■■■■
Motor generation	LA/LG	2KJ1503-1CE1**3**-■■■■
Frequency, line voltage	50 Hz, 220 ... 240 / 380 ... 420 V, D/Y (S100)	2KJ1503-1CE13-**1**■■■
Mounting type	Foot-mounted design	2KJ1503-1CE13-1**A**■■
Transmission ratio	i = 107.47	2KJ1503-1CE13-1A**E2**
Mounting position	B3-00-A	2KJ1503-1CE13-1AE2**-Z+D06**
Connection box position	1A	2KJ1503-1CE13-1AE2-Z+D06**+M55**

Guide to selecting and ordering geared motors

Determining the gear unit type in accordance with the power and input speed

Power P_{Motor} kW (50 Hz)	Output speed n_2 (50 Hz) 1/min	Torque T_2 Nm	Gear ratio i_{tot}	For further information, see page
	Helical geared motors E, D, and Z			
0.09	3.00 … 6.6	285 … 130.0	208.77 … 133.57	2/10
0.12	0.05 … 302.0	16373 … 3.8	28260.00 … 4.47	2/10 … 2/13
0.18	0.05 … 377.0	24136 … 4.6	24996.00 … 3.58	2/13 … 2/17
0.25	0.08 … 486.0	23171 … 5.1	16361.00 … 3.33	2/17 … 2/20
0.37	0.12 … 383.0	24391 … 9.2	11066.00 … 3.58	2/21 … 2/24
0.55	0.20 … 415.0	23539 … 13.0	7008.00 … 3.31	2/24 … 2/28
0.75	0.27 … 558.0	23419 … 13.0	5107.00 … 2.50	2/28 … 2/32
1.1	0.40 … 890.0	24043 … 12.0	3580.00 … 1.59	2/32 … 2/36
1.5	0.64 … 934.0	24512 … 15.0	2666.00 … 1.52	2/36 … 2/40
2.2	0.84 … 934.0	22829 … 22.0	1682.00 … 1.52	2/40 … 2/44
3	1.10 … 934.0	23331 … 31.0	1255.00 … 1.52	2/44 … 2/49
4	1.60 … 1021.0	21939 … 37.0	896.00 … 1.41	2/49 … 2/52
5.5	2.00 … 1032.0	24909 … 51.0	746.00 … 1.41	2/53 … 2/57
7.5	2.70 … 1032.0	24896 … 69.0	546.00 … 1.41	2/57 … 2/61
9.2	5.00 … 1032.0	17465 … 85.0	289.23 … 1.41	2/61 … 2/64
11	4.40 … 1035.0	24093 … 101.0	243.82 … 1.41	2/65 … 2/68
15	6.00 … 1074.0	23923 … 133.0	243.82 … 1.36	2/68 … 2/71
18.5	7.10 … 1081.0	24799 … 163.0	206.34 … 1.36	2/71 … 2/74
22	9.60 … 1081.0	21885 … 194.0	153.12 … 1.36	2/75 … 2/77
30	12.10 … 1081.0	23713 … 265.0	121.67 … 1.36	2/78 … 2/80
37	14.70 … 1088.0	24104 … 325.0	100.96 … 1.36	2/80 … 2/82
45	18.30 … 1088.0	23453 … 395.0	80.77 … 1.36	2/82 … 2/85
55	21.00 … 905.0	24551 … 580.0	69.41 … 1.64	2/85 … 2/86
75	35.00 … 512.0	20716 … 1399.0	42.95 … 2.90	2/86 … 2/87
90	35.00 … 512.0	24859 … 1678.0	42.95 … 2.90	2/88
110	88.00 … 179.0	11927 … 5871.0	16.86 … 8.30	2/89
132	88.00 … 179.0	14312 … 7046.0	16.86 … 8.30	2/89
160	88.00 … 179.0	17348 … 8540.0	16.86 … 8.30	2/89
200	88.00 … 179.0	21685 … 10675.0	16.86 … 8.30	2/89
	Parallel shaft geared motors FZ and FD			
0.09	2.30 … 4.6	367 … 186.0	280.41 … 191.34	3/8
0.12	0.05 … 121.0	16802 … 9.5	29000.00 … 11.16	3/8 … 3/11
0.18	0.05 … 248.0	24429 … 8.3	25299.00 … 6.53	3/11 … 3/14
0.25	0.09 … 355.0	22462 … 6.7	15519.00 … 3.80	3/14 … 3/17
0.37	0.13 … 73.0	23944 … 49.0	10863.00 … 18.86	3/17 … 3/19
0.55	0.19 … 171.0	24059 … 31.0	7163.00 … 8.06	3/19 … 3/22
0.75	0.28 … 362.0	23016 … 20.0	5021.00 … 3.80	3/22 … 3/25
1.1	0.38 … 372.0	25111 … 28.0	3739.00 … 3.80	3/25 … 3/28
1.5	0.98 … 374.0	21689 … 38.0	2359.00 … 3.80	3/28 … 3/31
2.2	0.98 … 366.0	23887 … 57.0	1760.00 … 3.80	3/31 … 3/34
3	1.10 … 374.0	22960 … 77.0	1236.00 … 3.80	3/35 … 3/38
4	2.40 … 333.0	16239 … 115.0	411.98 … 4.33	3/38 … 3/40
5.5	2.40 … 366.0	22329 … 143.0	403.86 … 3.97	3/40 … 3/43
7.5	3.20 … 366.0	22323 … 195.0	403.86 … 3.97	3/43 … 3/45
9.2	3.60 … 366.0	24387 … 288.0	403.86 … 3.97	3/45 … 3/47
11	4.90 … 306.0	21528 … 343.0	299.20 … 4.77	3/48 … 3/49

Guide to selecting and ordering geared motors

Determining the gear unit type in accordance with the power and input speed (continued)

Power P_{Motor} **kW (50 Hz)**	**Output speed** n_2 **(50 Hz) 1/min**	**Torque** T_2 **Nm**	**Gear ratio** i_{tot}	For further information, see page
Parallel shaft geared motors FZ and FD				
15	5.9 … 306	24416 … 306	248.85 … 4.77	3/49 … 3/51
18.5	7.6 … 259	23263 … 683	193.56 … 5.68	3/51 … 3/53
22	8.8 … 387	23873 … 543	167.03 … 3.80	3/53 … 3/54
30	11.6 … 387	24766 … 741	127.07 … 3.80	3/54 … 3/56
37	15.7 … 389	22509 … 907	94.28 … 3.80	3/56 … 3/57
45	17.3 … 389	24838 … 1103	85.54 … 3.80	3/57 … 3/58
55	24.0 … 281	22397 … 1868	63.32 … 5.28	3/59
75	31.0 … 281	23373 … 2547	48.46 … 5.28	3/60
90	40.0 … 281	21461 … 3056	37.08 … 5.28	3/60 … 3/61
110	88.0 … 178	11991 … 5900	16.95 … 8.34	3/61
132	88.0 … 178	14389 … 7080	16.95 … 8.34	3/61
160	88.0 … 178	17441 … 8581	16.95 … 8.34	3/61
200	88.0 … 178	21801 … 10727	16.95 … 8.34	3/61
Bevel helical geared motors B and K				
0.09	3.70 … 7.1	244 … 121.0	179.13 … 124.78	4/9
0.12	0.05 … 180.0	16116 … 6.4	27817.00 … 7.49	4/9 … 4/12
0.18	0.06 … 296.0	23355 … 5.8	24187.00 … 4.56	4/12 … 4/15
0.25	0.08 … 378.0	24007 … 6.3	16951.00 … 3.57	4/15 … 4/18
0.37	0.12 … 93.0	24723 … 38.0	11463.00 … 14.75	4/18 … 4/21
0.55	0.19 … 302.0	24264 … 17.0	7224.00 … 4.56	4/21 … 4/24
0.75	0.26 … 385.0	24777 … 19.0	5405.00 … 3.57	4/24 … 4/28
1.1	0.41 … 396.0	22902 … 26.0	3410.00 … 3.57	4/28 … 4/31
1.5	0.55 … 398.0	23914 … 36.0	2601.00 … 3.57	4/31 … 4/35
2.2	0.92 … 389.0	21051 … 54.0	1551.00 … 3.57	4/35 … 4/38
3	1.10 … 398.0	23889 … 72.0	1286.00 … 3.57	4/38 … 4/41
4	1.50 … 269.0	23702 … 142.0	968.00 … 5.36	4/41 … 4/43
5.5	2.20 … 271.0	22338 … 193.0	669.00 … 5.36	4/44 … 4/46
7.5	2.70 … 271.0	24988 … 264.0	548.00 … 5.36	4/46 … 4/48
9.2	3.40 … 271.0	24013 … 324.0	429.00 … 5.36	4/48 … 4/50
11	4.20 … 264.0	25035 … 399.0	191.34 … 5.54	4/50 … 4/51
15	6.00 … 264.0	24036 … 544.0	191.34 … 5.54	4/51 … 4/53
18.5	7.70 … 207.0	22997 … 853.0	191.34 … 7.10	4/53 … 4/54
22	8.50 … 304.0	24695 … 690.0	172.78 … 4.83	4/54 … 4/55
30	12.20 … 304.0	23419 … 941.0	120.16 … 4.83	4/56 … 4/57
37	15.50 … 306.0	22796 … 1153.0	95.48 … 1153.00	4/57 … 4/58
45	18.70 … 306.0	23006 … 1402.0	79.23 … 4.83	4/58 … 4/59
55	23.00 … 307.0	22418 … 1708.0	63.38 … 4.83	4/59 … 4/60
75	35.00 … 225.0	20465 … 3188.0	42.43 … 6.61	4/60 … 4/61
90	35.00 … 225.0	24558 … 3826.0	42.43 … 6.61	4/61
110	76.00 … 123.0	13837 … 8560.0	19.56 … 12.10	4/61
132	76.00 … 123.0	16604 … 10272.0	19.56 … 12.10	4/61
160	76.00 … 123.0	20126 … 12450.0	19.56 … 12.10	4/61
200	98.00 … 123.0	19589 … 15563.0	15.23 … 12.10	4/61

Determining the gear unit type in accordance with the power and input speed (continued)

Power P_{Motor} **kW (50 Hz)**	**Output speed** n_2 **(50 Hz) 1/min**			**Torque** T_2 **Nm**			**Gear ratio** i_{tot}			For further information, see page
Helical worm geared motors C										
0.09	2.00	…	4	241	…	126	320.67	…	223.36	5/8
0.12	0.20	…	53	1980	…	20	6722.00	…	25.28	5/8… 5/10
0.18	0.36	…	53	1911	…	30	3719.00	…	25.28	5/10 … 5/11
0.25	0.60	…	53	1782	…	41	2256.00	…	25.28	5/11 … 5/13
0.37	0.91	…	54	1918	…	60	1510.00	…	25.28	5/13 … 5/14
0.55	1.70	…	54	1870	…	68	440.70	…	20.31	5/14 … 5/16
0.75	2.3 0	…	144	1987	…	44	440.70	…	9.67	5/16 … 5/18
1.1	4.00	…	146	1851	…	63	354.55	…	9.67	5/18 … 5/19
1.5	6.2 0	…	147	1671	…	86	228.00	…	9.67	5/20 … 5/21
2.2	11.30	…	147	1369	…	126	126.18	…	9.67	5/21 … 5/23
3	14.50	…	147	1686	…	172	98.17	…	9.67	5/23 … 5/24
4	22.00	…	149	1482	…	227	65.32	…	9.67	5/24 … 5/25
5.5	35.00	…	130	1293	…	364	41.85	…	11.15	5/25 … 5/26
7.5	62.00	…	130	992	…	497	23.56	…	11.15	5/26
9.2	82.00	…	130	966	…	609	17.67	…	11.15	5/26
11	109.00	…	131	872	…	726	13.39	…	11.15	5/26
Worm gear unit SC										
0.09	6.3	…	30	74	…	21	100	…	30	6/5
0.12	6.4	…	68	96	…	14	100	…	20	6/5
0.18	8.4	…	135	111	…	11	100	…	10	6/5 … 6/6
0.25	8.3	…	193	155	…	11	100	…	7	6/6
0.37	11.5	…	196	187	…	16	100	…	7	6/7
0.55	11.4	…	61	282	…	71	80	…	15	6/7
0.75	23.0	…	199	203	…	33	60	…	7	6/7 … 6/8
1.1	47.0	…	202	165	…	48	30	…	7	6/8
1.5	71.0	…	203	167	…	65	20	…	7	6/8

Guide to selecting and ordering geared motors

Determining the gear unit type in accordance with the max. torque, transmission ratio, and size

Max. gear unit torque Nm	Gear unit type	Order number	Transmission ratio			For further information, see page
	Helical gear unit E					
82	E38	**2KJ1001**	1.59	…	9.33	2/90
170	E48	**2KJ1002**	1.52	…	11.30	2/90
250	E68	**2KJ1003**	1.41	…	12.40	2/91
450	E88	**2KJ1004**	1.71	…	10.33	2/91
745	E108	**2KJ1005**	1.81	…	5.46	2/92
1000	E128	**2KJ1006**	1.36	…	10.14	2/92
1550	E148	**2KJ1007**	1.64	…	13.67	2/92
	Helical gear unit Z					
90	Z18	**2KJ1100**	3.58	…	43.15	2/93
140	Z28	**2KJ1101**	3.33	…	51.35	2/94
220	Z38	**2KJ1102**	4.77	…	44.12	2/96
450	Z48	**2KJ1103**	4.28	…	51.28	2/98
800	Z68	**2KJ1104**	3.49	…	48.09	2/100
1680	Z88	**2KJ1105**	3.11	…	50.73	2/102
3100	Z108	**2KJ1106**	3.42	…	59.05	2/105
5100	Z128	**2KJ1107**	3.07	…	44.19	2/108
8000	Z148	**2KJ1108**	4.44	…	57.50	2/111
14000	Z168	**2KJ1110**	4.46	…	46.61	2/113
20000	Z188	**2KJ1111**	8.30	…	52.35	2/115
220	Z38 - Z28	**2KJ1112**	207.00	…	1258.00	2/95
220	Z38 - D28	**2KJ1113**	1343.00	…	5905.00	2/95
	Helical gear unit D					
90	D18	**2KJ1200**	32.26	…	200.36	2/93
140	D28	**2KJ1201**	48.38	…	241.05	2/94
220	D38	**2KJ1202**	30.74	…	191.75	2/96
450	D48	**2KJ1203**	35.59	…	208.77	2/98
800	D68	**2KJ1204**	37.80	…	281.01	2/100
1680	D88	**2KJ1205**	34.14	…	300.41	2/102
3100	D108	**2KJ1206**	42.61	…	359.30	2/105
5100	D128	**2KJ1207**	37.57	…	268.16	2/108
8000	D148	**2KJ1208**	34.15	…	336.11	2/111
14000	D168	**2KJ1210**	40.99	…	341.61	2/113
20000	D188	**2KJ1211**	42.95	…	243.82	2/115
450	D48 - Z28	**2KJ1212**	223.00	…	5019.00	2/97
450	D48 - D28	**2KJ1213**	5608.00	…	27940.00	2/97
800	D68 - Z28	**2KJ1214**	320.00	…	7548.00	2/99
800	D68 - D28	**2KJ1215**	8422.00	…	41961.00	2/99
800	D88 - Z28	**2KJ1218**	341.00	…	8305.00	2/101
800	D88 - D28	**2KJ1220**	9279.00	…	46233.00	2/101
3100	D108 - Z38	**2KJ1223**	392.00	…	15853.00	2/104
3100	D108 - D38	**2KJ1224**	15280.00	…	68896.00	2/103
5100	D128 - Z38	**2KJ1225**	1280.00	…	51420.00	2/106
5100	D128 - D38	**2KJ1226**	11404.00	…	51420.00	2/106
5100	D128 - Z48	**2KJ1227**	285.00	…	1271.00	2/107
8000	D148 - Z38	**2KJ1228**	1604.00	…	14830.00	2/109
8000	D148 - D38	**2KJ1230**	14294.00	…	64450.00	2/109
8000	D148 - Z48	**2KJ1231**	398.00	…	1631.00	2/110
14000	D168 - Z48	**2KJ1232**	1463.00	…	17519.00	2/112

Determining the gear unit type in accordance with the max. torque, transmission ratio, and size (continued)

Max. gear unit torque Nm	Gear unit type	Order number	Transmission ratio	For further information, see page
	Helical gear unit D			
14000	D168 - D48	**2KJ1233**	17080 … 71317	2/112
14000	D168 - Z68	**2KJ1234**	376 … 1226	2/112
20000	D188 - Z48	**2KJ1235**	1044 … 12504	2/114
20000	D188 - D48	**2KJ1236**	12191 … 50901	2/114
20000	D188 - Z68	**2KJ1237**	322 … 896	2/114
	Parallel shaft gear unit FZ			
150	FZ28	**2KJ1300**	56.20 … 280.00	3/62
290	FZ38B	**2KJ1301**	4.52 … 56.72	3/64
540	FZ48B	**2KJ1302**	4.33 … 60.71	3/66
1000	FZ68B	**2KJ1303**	3.97 … 61.17	3/68
1900	FZ88B	**2KJ1304**	4.77 … 64.58	3/70
3400	FZ108B	**2KJ1305**	5.68 … 64.21	3/72
6100	FZ128B	**2KJ1306**	3.80 … 56.42	3/74
9000	FZ148B	**2KJ1307**	5.39 … 68.23	3/76
14000	FZ168B	**2KJ1308**	5.28 … 53.48	3/78
20000	FZ188B	**2KJ1310**	8.34 … 52.63	3/80
290	FZ38B - Z28	**2KJ1313**	303.00 … 1617.00	3/63
290	FZ38B - D28	**2KJ1314**	1726.00 … 7591.00	3/63
	Parallel shaft gear unit FD			
150	FD28	**2KJ1400**	3.80 … 59.65	3/62
290	FD38B	**2KJ1401**	56.28 … 280.41	3/64
540	FD48B	**2KJ1402**	43.09 … 268.80	3/66
1000	FD68B	**2KJ1403**	50.48 … 296.18	3/68
1900	FD88B	**2KJ1404**	54.47 … 404.92	3/70
3400	FD108B	**2KJ1405**	48.24 … 424.49	3/72
6100	FD128B	**2KJ1406**	53.13 … 447.96	3/74
9000	FD148B	**2KJ1407**	62.93 … 449.21	3/76
14000	FD168B	**2KJ1408**	41.85 … 369.26	3/78
20000	FD188B	**2KJ1410**	48.46 … 403.86	3/80
540	FD48B - Z28	**2KJ1413**	299.00 … 4197.00	3/65
540	FD48B - D28	**2KJ1414**	4480.00 … 19701.00	3/65
1000	FD68B - Z28	**2KJ1417**	317.00 … 4454.00	3/67
1000	FD68B - D28	**2KJ1418**	4755.00 … 39638.00	3/67
1900	FD88B - Z28	**2KJ1422**	461.00 … 6000.00	3/69
1900	FD88B - D28	**2KJ1423**	6703.00 … 54705.00	3/69
3400	FD108B - Z38	**2KJ1426**	466.00 … 15230.00	3/71
3400	FD108B - D38	**2KJ1427**	16603.00 … 66190.00	3/71
6100	FD128B - Z38	**2KJ1428**	1970.00 … 15663.00	3/73
6100	FD128B - D38	**2KJ1430**	17075.00 … 68070.00	3/73
6100	FD128B - Z48	**2KJ1431**	439.00 … 1504.00	3/73
9000	FD148B - Z38	**2KJ1432**	1757.00 … 16239.00	3/75
9000	FD148B - D38	**2KJ1433**	17704.00 … 70576.00	3/75
9000	FD148B - Z48	**2KJ1434**	477.00 … 1634.00	3/75
14000	FD168B - Z48	**2KJ1435**	1337.00 … 16007.00	3/77
14000	FD168B - D48	**2KJ1436**	17454.00 … 65160.00	3/77
14000	FD168B - Z68	**2KJ1437**	398.00 … 1298.00	3/77
20000	FD188B - Z48	**2KJ1438**	1465.00 … 17537.00	3/79
20000	FD188B - D48	**2KJ1440**	19122.00 … 71388.00	3/79
20000	FD188B - Z68	**2KJ1441**	444.00 … 1449.00	3/79

Guide to selecting and ordering geared motors

Determining the gear unit type in accordance with the max. torque, transmission ratio, and size (continued)

Max. gear unit torque Nm	Gear unit type	Order number	Transmission ratio	For further information, see page
	Bevel helical gear units B and K			
130	B28	**2KJ1500**	3.57 … 57.53	4/62
250	B38	**2KJ1501**	3.84 … 65.69	4/63
250	K38	**2KJ1502**	5.65 … 179.13	4/65
450	K48	**2KJ1503**	7.22 … 169.53	4/68
820	K68	**2KJ1504**	5.36 … 243.72	4/70
1650	K88	**2KJ1505**	5.54 … 302.68	4/72
3000	K108	**2KJ1506**	7.68 … 307.24	4/74
4700	K128	**2KJ1507**	7.10 … 295.38	4/77
8000	K148	**2KJ1508**	4.83 … 306.08	4/79
13500	K168	**2KJ1510**	6.61 … 287.95	4/81
20000	K188	**2KJ1511**	12.10 … 191.34	4/83
250	K38 - Z28	**2KJ1514**	181.00 … 2797.00	4/64
250	K38 - D28	**2KJ1515**	2986.00 … 13129.00	4/64
450	K48 - Z28	**2KJ1516**	181.00 … 2798.00	4/67
450	K48 - D28	**2KJ1517**	2987.00 … 13135.00	4/66
820	K68 - Z28	**2KJ1518**	277.00 … 4282.00	4/69
820	K68 - D28	**2KJ1520**	4572.00 … 20103.00	4/69
1650	K88 - Z28	**2KJ1523**	344.00 … 5309.00	4/71
1650	K88 - D28	**2KJ1524**	5667.00 … 24920.00	4/71
3000	K108 - Z38	**2KJ1527**	1466.00 … 13556.00	4/73
3000	K108 - D38	**2KJ1528**	13066.00 … 58914.00	4/73
3000	K108 - Z48	**2KJ1530**	301.00 … 1343.00	4/74
4700	K128 - Z38	**2KJ1531**	1410.00 … 13032.00	4/75
4700	K128 - D38	**2KJ1532**	12562.00 … 56640.00	4/75
4700	K128 - Z48	**2KJ1533**	313.00 … 1400.00	4/76
8000	K148 - Z38	**2KJ1534**	1466.00 … 13505.00	4/78
8000	K148 - D38	**2KJ1535**	13017.00 … 58692.00	4/78
8000	K148 - Z68	**2KJ1536**	296.00 … 1392.00	4/78
13500	K168 - Z48	**2KJ1537**	1233.00 … 14767.00	4/80
13500	K168 - D48	**2KJ1538**	14397.00 … 60115.00	4/80
13500	K168 - Z68	**2KJ1540**	317.00 … 1033.00	4/80
20000	K188 - Z68	**2KJ1541**	669.00 … 9201.00	4/82
20000	K188 - D68	**2KJ1542**	8689.00 … 53767.00	4/82
20000	K188 - Z88	**2KJ1543**	225.00 … 669.00	4/83

Guide to selecting and ordering geared motors

Determining the gear unit type in accordance with the max. torque, transmission ratio, and size (continued)

Max. gear unit torque Nm	Gear unit type	Order number	Transmission ratio	For further information, see page
	Helical worm gear unit C			
118	C28	**2KJ1600**	25.28 … 372.00	5/27 … 5/28
243	C38	**2KJ1601**	9.67 … 320.67	5/30 … 5/32
387	C48	**2KJ1602**	9.67 … 320.67	5/34 … 5/36
687	C68	**2KJ1603**	11.67 … 364.00	5/38 … 5/40
1590	C88	**2KJ1604**	11.15 … 440.70	5/42 … 5/44
225	C38 - Z28	**2KJ1605**	324.00 … 4222.00	5/29
222	C38 - D28	**2KJ1606**	4717.00 … 23503.00	5/29
369	C48 - Z28	**2KJ1607**	324.00 … 4222.00	5/33
364	C48 - D28	**2KJ1608**	4717.00 … 23503.00	5/33
680	C68 - Z28	**2KJ1610**	398.00 … 5066.00	5/37
675	C68 - D28	**2KJ1611**	5661.00 … 28203.00	5/37
1590	C88 - Z28	**2KJ1614**	6722.00 … 33491.00	5/41
1590	C88 - D28	**2KJ1615**	462.00 … 6016.00	5/41
	Worm gear unit SC			
43	SC36	**2KJ1700**	7 … 60	6/9
80	SC50	**2KJ1701**	7 … 100	6/9
166	SC63	**2KJ1702**	7 … 100	6/9

Guide to selecting and ordering geared motors

Overview of "special versions"

Order code	Special version	For further information, see page
	Input units	
A00	Input unit A with free shaft extension	7/3, 7/13
A03	Input unit K2 with coupling for connecting IEC motors	7/3, 7/7
A04	Input unit K4 for connecting IEC motors	7/3, 7/9
A07	Input unit KQ for attaching servo motors (with parallel key)	7/3, 7/11
A08	Input unit KQS for attaching servo motors (with plain shaft)	7/3, 7/11
A09	Input unit P with free shaft extension and piggy back	7/3, 7/13
A10	Input unit PS with free shaft extension, piggy back, and protective belt cover	7/3
N61	Size index .2 for KQ/KQS coupling lantern for servo motors	7/3
N62	Size index .3 for KQ/KQS coupling lantern for servo motors	7/3
N63	Size index .4 for KQ/KQS coupling lantern for servo motors	7/3
	Backstop in the input unit	
A15	Backstop X	7/16
	Coupling types and input unit options	
A16	Flexible coupling	7/3
A17	Slip clutch	7/16
A18	Proximity switch	7/16
A19	Speed monitor	7/16
	Piggy back position	
A22	3h	7/39 … 7/44
A23	9h	7/39 … 7/44
A24	12h	7/39 … 7/44
	Brake type	
B00 to B62	Brake types according to size and braking torque	8/24 … 8/25
	Brake design	
C01	Enclosed brake (G)	8/33
C02	Manual release (H)	8/31
C03	Manual release, lockable (HA)	8/31
C04	Microswitch for monitoring release for brake	8/30
C06	Reduced-noise rotor / hub connection	8/29
C09	Basic anti-corrosion protection	8/33
C10	Increased anti-corrosion protection	8/33
C11	Enclosed brake (G) with condensation drainage hole	8/33
	Manual brake release lever position	
C26	1	8/31
C27	2	8/31
C28	3	8/31
C29	4	8/31
	Brake control voltage	
C46 + C30	190 … 240 V AC	8/26
C47 + C30	380 … 440 V AC	8/26
C48 + C33	95 … 120 V AC	8/26
C52	92 … 110 V DC	8/26
C53	170 … 200 V DC	8/26
C61 + C33	190 … 220 V AC	8/26
C62 + C33	205 … 240 V AC	8/26
C63 + C31	410 … 480 V AC	8/26
C64	184 … 218 V DC	8/26

Overview of "special versions" (continued)

Order code	Special version	For further information, see page
	Brake control voltage (continued)	
C65 + C33	230 V AC	8/26
C66	24 V DC ±10 %	8/26
C67 + C30	400 V AC	8/26
C68 + C30	460 V AC	8/26
C69 + C33	24 ... 29 V AC	8/26
C70 + C30	48 ... 58 V AC	8/26
	Mounting types / mounting positions	
D00 to E17	Geared motor mounting types and mounting positions	2/119-2/128, 3/87-3/88, 4/90-4/92, 5/49-5/50, 6/15
	Flange-mounted designs (worm gear unit)	
G06	Short flange	6/14
G07	Long flange	6/14
	Torque arm figure	
G09	Figure 1	4/85, 5/46
G10	Figure 2	4/85, 5/46
	Bearing arrangement	
G20	Radial reinforced output bearings	2/132, 3/92, 4/97, 5/54
	Sealing	
G23	Dual sealing	2/131, 3/91, 4/96, 5/53
G24	Combination of seals	2/131, 3/91, 4/96, 5/53
G25	Viton sealing	2/131, 3/91, 4/96, 5/53
	Oil level control	
G34	Oil sight glass	2/130, 3/90, 4/94, 5/52
G37	Electrical oil level monitoring system: capacitive sensor	2/130, 3/90, 4/94, 5/52
G39	Electrical oil level monitoring system: isolation amplifier 24 V	2/130, 3/90, 4/94, 5/52
	Gear unit ventilation	
G44	Breather filter	2/130, 3/90, 4/95, 5/52
G45	Pressure breather valve	2/130, 3/90, 4/95, 5/52
	Oil drain	
G53	Magnetic oil drain plug	2/131, 3/91, 4/96, 5/53
G54	Straight oil drain valve	2/131, 3/91, 4/96, 5/53
	Non-drive-end cover	
G60	Steel protective cover	3/92, 4/97, 5/54
G61	Steel protective cover, sealed	3/92, 4/97, 5/54
G62	Cast iron protective cover	3/92, 4/97, 5/54
G63	Cast iron protective cover, sealed	3/92, 4/97, 5/54
	Backstop for bevel helical gear unit	
G72	Backstop (gear unit)	4/98
	Options for gear unit output shafts	
G73	Second output shaft extension	4/98, 5/54, 6/16
	Dry-well options for mixer and agitator drives	
G89	Dry-well design with sight glass	2/132, 3/93, 4/99
G90	Dry-well design with capacitive sensor	2/132, 3/93, 4/99

Guide to selecting and ordering geared motors

Overview of "special versions" (continued)

Order code	Special version	For further information, see page
	Flange diameter	
H01 to H06	Flange diameter	2/118, 3/86, 4/89, 5/48, 6/14
	Foot position for worm gear units	
H32	6h	6/12
H33	9h	6/12
H44	12h	6/12
	Degree of protection	
K01	IP55	8/6
K03	IP65	8/6
	Lubricants	
K06	Mineral oil CLP ISO VG 220	1/45, 2/130, 3/90, 4/94
K07	Synthetic oil ISO CLP PG VG 220	1/45, 2/130, 3/90, 4/94
K08	Synthetic oil ISO CLP PG VG 460	1/45, 2/130, 3/90, 4/94, 5/52
K10	Oil for use in the food industry in acc. with USDA-H1 CLP ISO PAO VG 460	1/45, 2/130, 3/90, 4/94, 5/52
K11	Biologically degradable oil CLP ISO E VG 220	1/45, 2/130, 3/90, 4/94
K12	Synthetic oil CLP ISO PAO VG 220 for low temperature usage	1/45, 2/130, 3/90, 4/94, 5/52
K13	Synthetic oil CLP ISO PAO VG 68 for lowest temperature usage	1/45, 2/130, 3/90, 4/94
	Long-term preservation	
K17	Long-term preservation up to 36 months	1/45
	Direction of rotation of the output shaft (required with backstop)	
K18	Clockwise	1/42, 4/98
K19	Counterclockwise	1/42, 4/98
	Rating plate and additional plates	
K41	Additional rating plate	1/47
	Coats of paint	
L00	Unpainted	1/46
L01	Primed	1/46
L02	Acrylic coating	1/46
L03	2-component PUR	1/46
L04	2-component epoxy	1/46
	RAL colors	
L50	5015 sky blue	1/46
L51	7011 iron gray	1/46
L52	2004 pure orange	1/46
L53	7031 blue gray (standard with 2-component PUR)	1/46
L54	7035 light gray (standard with 2-component epoxy)	1/46
	Other colors can be selected by entering order code Y80 and plain text.	1/46
	Insulating material class	
M09	Special insulation for inverter-fed operation up to 690 V + 5 %	8/76
	Thermal motor protection	
M10	PTC thermistor for shutdown	8/17
M11	PTC thermistor for warning and shutdown	8/17
M12	Winding thermostat for shutdown (WT)	8/17
M13	Winding thermostat for warning and shutdown for sizes 71 to 200 (WT)	8/17
M16	Temperature sensor KTY84-130	8/17

Overview of "special versions" (continued)

Order code	Special version	For further information, see page
	Fan	
M21	Metal fan	8/7
M22	High inertia fan	8/7
M23	Separate fan	8/7
	Forced ventilation supply voltage	
M34	Separate fan standard voltage	8/7
	Anti-condensation heating	
M40	115 V supply voltage	8/21
M41	230 V supply voltage	8/21
	Terminal box position	
M55 to M70	Position of the terminal box and cable entry	8/9
	ECOFAST motor plugs	
N04	ECOFAST motor plug HAN10E	8/14
N05	ECOFAST motor plug HAN10E with ECOFAST counterplug HAN10B	8/14
N06	ECOFAST motor plug HAN10E, EMC design	8/14
N07	ECOFAST motor plug HAN10E with ECOFAST counterplug HAN10B, EMC design	8/14
	Worm gear unit SC for attaching IEC motors	
N19	Flange B5 on the input side	6/16
N21	Flange B14 on the input side	6/16
	Protection cover	
N22	Protection cover	8/6
	Backstop on motor	
N23	Motor backstop	8/46
	Second shaft extension on motor	
N39	Second shaft extension	8/46
	Designs in accordance with standards and specifications	
N30	Design in accordance with GOST	1/38, 8/3
N65	Design in accordance with NEMA (electrical)	1/37, 8/3
N67	Design in accordance with CCC	1/38, 8/3
	Pole number of the motor	
P00	2-pole	8/50
P01	6-pole	8/52 - 8/53, 8/60 - 8/61, 8/72 - 8/73
P02	8-pole	8/62 - 8/63, 8/68 - 8/69, 8/74 - 8/75
P08	8/4-pole	8/56 - 8/57

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Overview of "special versions" (continued)

Order code	Special version	For further information, see page
	Rotary pulse encoders	
Q50	Rotary pulse encoder 1XP8 012-20 (IN 1024 TTL with flange socket)	8/39
Q51	Rotary pulse encoder 1XP8 012-21 (IN 2048 TTL with flange socket)	8/39
Q52	Rotary pulse encoder 1XP8 012-22 (IN 512 TTL with flange socket)	8/39
Q53	Rotary pulse encoder 1XP8 012-10 (IN 1024 HTL with flange socket)	8/39
Q54	Rotary pulse encoder 1XP8 012-11 (IN 2048 HTL with flange socket)	8/39
Q55	Rotary pulse encoder 1XP8 012-12 (IN 512 HTL with flange socket)	8/39
Q56	Rotary pulse encoder 1XP8 022-20 (IN 1024 TTL with cable terminal box)	8/40
Q57	Rotary pulse encoder 1XP8 022-21 (IN 2048 TTL with cable terminal box)	8/40
Q58	Rotary pulse encoder 1XP8 022-22 (IN 512 TTL with cable terminal box)	8/40
Q59	Rotary pulse encoder 1XP8 022-10 (IN 1024 HTL with cable terminal box)	8/40
Q60	Rotary pulse encoder 1XP8 022-11 (IN 2048 HTL with cable terminal box)	8/40
Q61	Rotary pulse encoder 1XP8 022-12 (IN 512 HTL with cable terminal box)	8/40
Q62	Connector	8/44
Q63	Cable with wire end ferrules, 2 m	8/44
Q64	Cable with wire end ferrules, 8 m	8/44
Q65	Cable with wire end ferrules, 15 m	8/44
Q66	Cable with coupling socket, 2 m	8/45
Q67	Cable with coupling socket, 8 m	8/45
Q68	Cable with coupling socket, 15 m	8/45
Q69	Cable with connector and wire end ferrules, 2 m	8/44
Q70	Cable with connector and wire end ferrules, 8 m	8/44
Q71	Cable with connector and wire end ferrules, 15 m	8/44
Q72	Cable with coupling socket, 2 m	8/45
Q73	Cable with coupling socket, 8 m	8/45
Q74	Cable with coupling socket, 15 m	8/45
Q80	Absolute encoder 1XP8014-20 (IA SSI protocol with flange socket)	8/43
Q81	Absolute encoder 1XP8024-20 (IA SSI protocol cable with coupling socket)	8/43
Q82	Absolute encoder 1XP8014-10 (IA EnDat protocol with flange socket)	8/43
Q83	Absolute encoder 1XP8024-10 (IA EnDat protocol cable with coupling socket)	8/43
Q85	Resolver 1XP8013-10 (IR with flange socket)	8/42
Q86	Resolver 1XP8023-10 (IR cable with coupling socket)	8/42

Determining the drive data

Data relating to the machine to be driven (machine type, mass, input speed, speed range, etc.) is required in order to size the machine correctly. This data is then used to determine the required power, torque, and input speed of the geared motor. The correct drive can be selected based on its calculated power and speed.

Data required for selection

The following data is required in order to select the correct gear unit:

1. Type of driven machine
2. Daily operating time [h]
3. Required input power [kW] or torque [Nm]
4. Required input speed n_2 of the geared motor [rpm] or gear ratio *i*
5. Operating voltage [V] and frequency [Hz]
6. Operating mode, number of starts, inverter-fed operation, type of startup
7. Mass moment of inertia J_{Load} [kgm^2] of the driving machine reduced to the motor shaft
8. Type of power transmission on gear unit shafts (direct, coupling, belt, chain, gear wheel)
9. Radial force F_r [N] at the input shaft and direction of force with distance from the shaft shoulder to the point of application and axial force F_{ax} [N] with direction of force
10. Ambient temperature [°C]
11. Degree of protection
12. Mounting position
13. Required braking torque [Nm]
14. Any regulations (CSA, VIK, etc.)

Required output torque T_{req}

$$T_{req} = \frac{9550 \cdot P_1}{n_2} \cdot f_{Btot}$$

Code	Description	Unit
P_1	Input power of the motor	kW
T_{req}	Required output torque of the gear unit	Nm
n_2	Output speed of the gear unit	rpm
f_{Btot}	Service factor of the driving machine	
r	Radius of the output element	m
η	Efficiency of the gear unit	%

Efficiency of the geared motor

The efficiency of the gear unit is determined by the gear teeth, rolling-contact bearing friction, and the shaft seals, among other things. The starting efficiency also has to be taken into account, particularly as regards helical worm and worm gear units.
Efficiency may be impaired at high input speeds and high transmission ratios, if a relatively large amount of oil is used (depending on mounting position), and during cold operation in low temperature ranges.

Helical, bevel helical, and parallel shaft gear units

MOTOX helical, parallel shaft, and bevel helical gear units are extremely efficient. As a rule, efficiencies of 98 % (1-stage), 96 % (2-stage), and 94 % (3-stage) can be assumed.

Helical worm and worm gear units

The gear teeth of the worm gear units lead to high sliding friction losses at high transmission ratios. Therefore, these gear units can be less efficient than other types. The efficiencies of the helical worm and worm gear units primarily depend on the transmission ratio in question.
With helical worm gear units, some of the transmission ratio is realized by the helical gear stage. In this way, higher degrees of efficiency can be achieved.
For further information see the selection data in the chapter dealing with helical worm gear units.

Self-locking with worm gear units

In respect of restoring torques on worm gear units, the efficiency is considerably reduced in comparison to standard efficiency.
The restoring efficiency can be calculated as follows:
$\eta' = 2 - 1/\eta$. At a standard efficiency of $\eta \leq 0.5$, worm gear units are usually self-locking, which is determined by the particular lead angle of the worm gear teeth.
Self-locking only occurs with certain combinations of MOTOX gear units and is not always of benefit, as the associated loss of efficiency is then relatively high, which in turn requires increased motor power.

A worm gear unit is "self-locking while stationary" (static self-locking), if it is not possible to start from stationary when the worm wheel is driving.
A worm gear unit is "self-braking while running" (dynamic self-locking), if it is not possible to continue running when the worm wheel is driving while the gear unit is running - that is, if the running gear unit comes to a stop while the worm wheel is driving.

Shocks can neutralize self-locking.
A self-locking gear unit is, therefore, no substitute for a brake or backstop. If you want to use the self-locking braking effect for a technical purpose, please contact us.

Run-in phase for helical worm and worm gear units

The tooth flanks on new helical worm and worm gear units will not yet be fully smoothed, meaning that the friction angle will be greater and efficiency lower during initial operation. The higher the transmission ratio, the more pronounced the effect.

The run-in procedure should take approximately 24 hours of operation at full load. In most cases, the catalog values will then be reached.

Losses of splashing

With certain gear unit mounting positions, the first stage can become completely immersed in the gear lubricant. In the case of large gear units with a high input speed, particularly with vertical mounting positions, this may lead to increased losses of splashing, which must not be ignored. Please contact us if you want to use such gear units. If at all possible, you should choose horizontal mounting positions in order to keep losses of splashing to a minimum.

Determining the required service factor

The operating conditions are crucial in determining the service factor and for selecting the geared motor. These conditions are taken into account with service factor f_B.

The gear unit size or rated gear torque and the resulting service factor are not standardized and depend on the manufacturer.

In standard operation, i.e. with a uniform load provided by the driving machine, small masses to be accelerated, and a low number of starts, the service factor of f_B = 1 can be selected.

For different operating conditions see the tables found under "Service factor". If the motor power and the gear unit output speed are known, a gear unit type is selected from the types page with a service factor that meets the following condition:

$$f_{Btot} \leq f_B$$

For drives operating under special conditions, e.g. frequent reversing, short-time or intermittent duty, abnormal temperature ratios, reversal braking, extreme or rotating transverse forces on the gear output shaft, etc. please contact us for advice on how to design the drive configuration.

The operating conditions can vary greatly.
To determine the service factor, empirical values can be derived from the configuration of other similar applications. The driving machines can be assigned to three load groups according to their shock load. These groups can be assessed by means of their mass acceleration factor (*MAF*).

In the case of high mass acceleration factors (*MAF* > 10), a large amount of play in the transmission elements, or high transverse forces, unexpected additional loads may arise.
Please contact us in such an event.

The mass acceleration factor MAF is calculated as follows:

$$MAF = \frac{J_{Load}}{(J_M + J_B + J_{add})}$$

All external mass moments of inertia are mass moments of inertia of the driving machine and the gear unit, which are to be reduced to the motor speed. In most cases the mass moment of inertia of the gear unit has no effect and can be ignored.
The calculation is done using the following formula:

$$J_{Load} = J_2 \cdot \left(\frac{n_2}{n_1}\right)^2 = \frac{J_2}{i^2}$$

Code	Description	Unit
f_{Btot}	Service factor of the driving machine	–
f_B	Service factor of the geared motor	–
MAF	Mass acceleration factor	–
J_{Load}	All external mass moments of inertia (based on the motor shaft)	kgm^2
J_M	Mass moment of inertia of the motor	kgm^2
J_B	Mass moment of inertia of the brake	kgm^2
J_{add}	Additional moment of inertia (e.g. centrifugal mass or high inertia fan)	kgm^2
J_2	Mass moment of inertia based on the output speed of the gear unit	kgm^2
n_1	Input speed of the motor	rpm
n_2	Output speed of the gear unit	rpm
i	Gear ratio	–
DC	Duty cycle	%

Required service factor

Service factor for helical, parallel shaft, and bevel helical gear units

The service factor of the driving machine f_{Btot} is determined from the tables by taking the load classification, number of starts, and duration of service per day into account.
Contact our drive experts to check drive sizing in the case of high shock loads and, for example, high motor and braking torques that are greater than 2.5x the rated motor torque.

$$f_{Btot} = f_{B1}$$

Load classification for driving machines

Shock load	Driving machine
I Light shock loads	Mass acceleration factor ≤ 0.3: Electric generators, belt conveyors, apron conveyors, screw conveyors, lightweight elevators, electric hoists, machine tool feed drives, turbo blowers, centrifugal compressors, mixers and agitators for uniform densities.
II Moderate shock loads	Mass acceleration factor ≤ 3: Machine tool main drives, heavyweight elevators, turning tools, cranes, shaft ventilators, mixers and agitators for non-uniform densities, piston pumps with multiple cylinders, metering pumps.
III Heavy shock loads	Mass acceleration factor ≤ 10: Punching presses, shears, rubber kneaders, machinery used in rolling mills and the iron and steel industry, mechanical shovels, heavyweight centrifuges, heavyweight metering pumps, rotary drilling rigs, briquetting presses, pug mills.

Service factors f_{B1}:

Daily operating duration		4 hours			8 hours			16 hours			24 hours		
Starts* / h		< 10	10 … 200	> 200	< 10	10 … 200	> 200	< 10	10 … 200	> 200	< 10	10 … 200	> 200
Shock load	I	0.8	0.9	1.0	0.9	1.0	1.1	1.0	1.1	1.2	1.2	1.3	1.5
	II	1.0	1.1	1.3	1.1	1.2	1.3	1.2	1.4	1.5	1.4	1.5	1.6
	III	1.3	1.4	1.5	1.4	1.5	1.6	1.5	1.6	1.7	1.6	1.7	1.8

* The number of starts is calculated from the sum of times it is switched on, braking operations, and changeovers.

Service factors for helical worm and worm gear units:

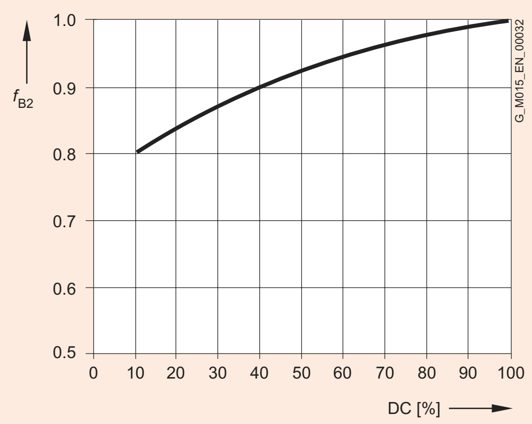
With worm gear units, two additional service factors are used, which take the duty cycle and ambient temperature into account. These additional factors can be determined from the graph opposite.

$$f_{Btot} = f_{B1} \cdot f_{B2} \cdot f_{B3}$$

In the standard design the gear units can operate at an ambient temperature of –20 °C to +40 °C.

In the case of a service factor f_{B3} < 1 for temperatures below 20 °C please contact us.

Service factor f_{B2} for short-time duty:



$$DC = \frac{\text{Loading time in min/h}}{60} \cdot 100$$

Required service factor (continued)

Example worm gear unit:

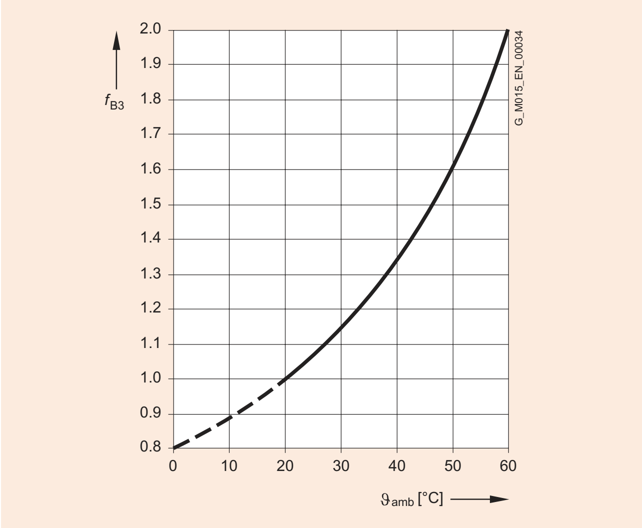
Mass acceleration factor 2.5 (shock load II), runtime 15 hours per day (read off at 16 hours), and 70 starts/h gives a service factor of f_{B1} = 1.4 for service factor f_{B1} according to the table.

A load duration of 30 minutes per hour gives a duty cycle (DC) of 50 %. According to the diagram, this results in a service factor of f_B = 0.94 for service factor f_{B2}.

At an ambient temperature of ϑ_{amb} = 20 °C, the diagram gives a service factor of f_{B3} = 1.0 for service factor f_{B3}.

So, the required service factor is $f_{Btot} = 1.4 \cdot 0.94 \cdot 1.0 = 1.32$.

Service factor f_{B3} for the ambient temperature:



ϑ_{amb}= Ambient temperature

Maximum speed

At high motor speeds (>1,500 rpm) you will generally experience higher than average noise emissions and a lower than average bearing service life. This depends to a large extent on the transmission ratio and gear unit size in question. Furthermore, high speeds affect the gear unit's thermal properties and service intervals.

The maximum input speed of the gear unit is usually 3,600 rpm. If you require higher speeds, please contact us.

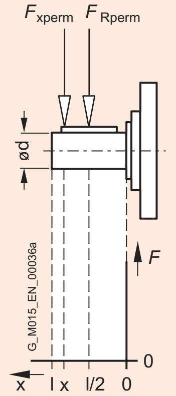
Permissible radial force

Available radial force

The available radial force F_{Ravail} at the shaft journals results from the available output torque of the geared motor T and the diameter d and type of the output element (e.g. sprocket wheel). The type of output element determines factor C (see table below), by which the available radial force is to be increased.

$$F_{Ravail} = 2000 \cdot \frac{T_{avail}}{d} \cdot C$$

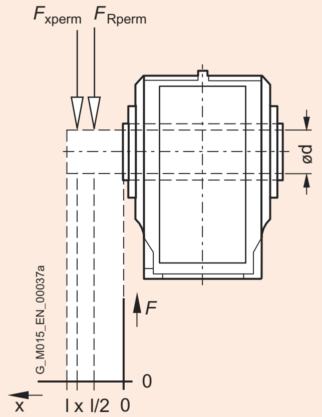
Code	Description	Unit
F_{Ravail}	Available radial force resulting from the output torque and the diameter of the output element	N
F_{Rperm}	Permissible radial force at the center of shaft extension (l/2)	N
d	Diameter of the output element	mm
T	Available output torque of the geared motor	Nm
F_{xperm1}	Permissible radial force, limited by the bearing service life, at a distance of x from the shaft shoulder	N
F_{xperm2}	Permissible radial force, limited by the shaft strength, at a distance of x from the shaft shoulder	N
C	Factor for the type of the output element	–
b, d, l, y, z	Gear unit constants	mm
a	Gear unit constants	kNmm
F_{ax}	Axial force at d	N
α	Angle of action of the radial force	°



Factor C for the type of the output element

Input element	Design	C
Gear wheel	> 17 teeth	1.00
	≤ 17 teeth	1.15
Sprocket wheel	≥ 20 teeth	1.00
	14 – 19 teeth	1.25
	≤ 13 teeth	1.40
Toothed belt 1)	Preload	1.50
V belt 1)	Preload	2.00
Flat belt 1)	Preload	2.50
Agitator / mixer	Rotating radial force	2.00

1) Pretensioning in accordance with belt manufacturer's instructions



Permissible radial force

The permissible radial force F_{Rperm} is determined by the required bearing service life, among other things. The nominal service life L_{h10} is determined in accordance with ISO 281.
The bearing service life can be calculated for special operating conditions on request, based on the calculation procedure for the modified service life L_{na}.

Furthermore, the permissible radial force is determined by the housing and shaft strength of the gear unit. The selection tables specify the permissible radial force F_{Rperm} for the input shafts. These values refer to the point of load at the center of the shaft extension and are minimum values, which apply to the worst possible conditions in the gear unit (force angle, mounting position, direction of rotation).

If the point of load is not at the center of the shaft extension, the permissible radial force must be calculated as follows: the smaller value of F_{xperm1}(bearing service life) and F_{xperm2} (shaft strength) is the permissible radial force.
The calculation does not include additional axial forces.

If the direction of rotation of the output shaft and the additional axial forces are known, or the values in the table are insufficient, our drive experts have to perform the calculation. Our agitator and mixer drives allow you to achieve higher permissible radial forces. These drives are particularly well suited to large and rotating radial forces.

Permissible radial force in accordance with bearing service life for all gear unit types:

$$F_{xperm1} = F_{Rperm} \cdot \frac{y}{(z+x)}$$

Permissible radial force in accordance with shaft strength for helical and worm gear units:

$$F_{xperm2} = \frac{a}{(b+x)}$$

Permissible radial force in accordance with shaft strength for bevel helical, parallel shaft, and helical worm gear units:

$$F_{xperm2} = \frac{a}{x}$$

The shaft strength only has to be calculated for solid shafts, with hollow shafts this step can be omitted.

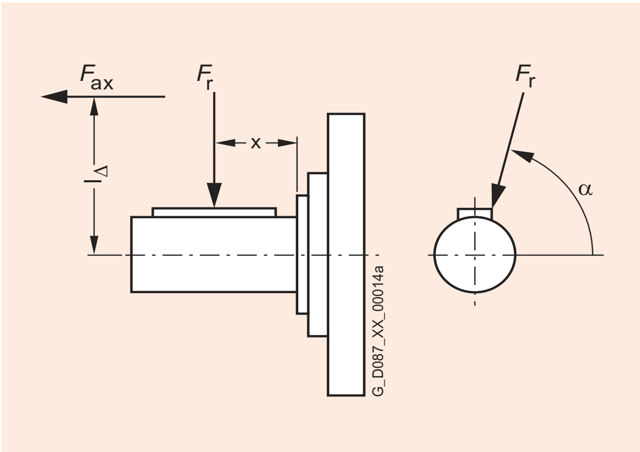
Higher permissible radial forces

The permissible radial force load can be increased, taking the angle of force action α and the direction of rotation into account. Installing reinforced bearings also means that higher loads are permitted on the input shaft.

Permissible axial loads

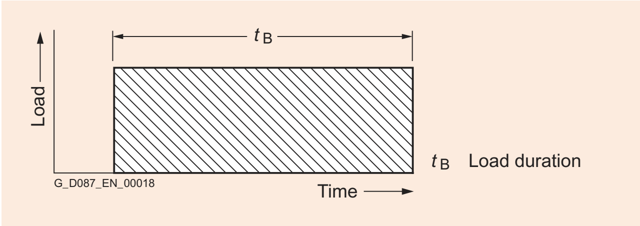
If no transverse force load is present, an axial force F_{ax} (tension or compression) of around 50 % of the specified radial force with standard bearings can be achieved for gear unit sizes 18 to 148.

You can use our "Calculation of input shaft bearing arrangement" assistant in the MOTOX Configurator to calculate the permissible forces. Combined forces with an axial and a radial component can also be calculated. Please contact us in case of doubt.



Determining the operating mode

The powers specified in the power tables apply to the **S1 operating mode** (continuous duty with constant load) according to EN 60034-1. The same regulation defines the groups of operating modes specified below:



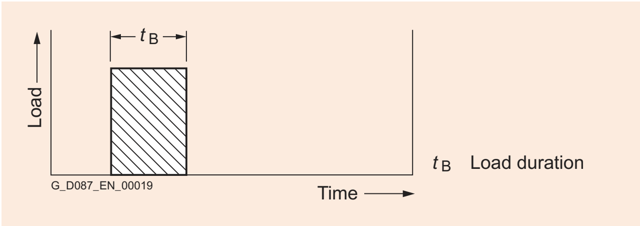
Operating mode S1 · Continuous duty

Operating modes in which starting and electrical braking **do not affect the overtemperature of the stator winding** of the motor:

Operating mode **S2**:

Short-time duty

Operating times of 10, 30, 60, and 90 min. are recommended. After each period of duty the motor remains at zero current until the winding has cooled down to the coolant temperature.

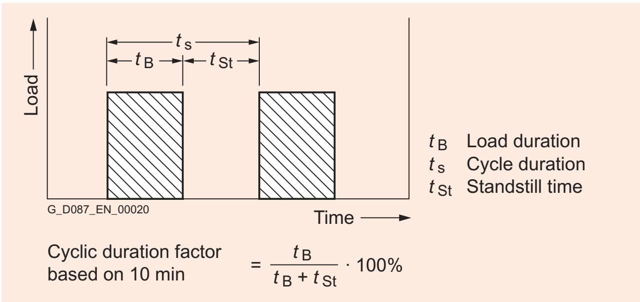


Operating mode S2 · Short-time duty

Operating mode **S3**:

Intermittent duty

Starting does not affect the temperature. Unless any agreement is made to the contrary, the cycle duration is 10 minutes. Values of 15 %, 25 %, 40 %, and 60 % are recommended for the cyclic duration factor.

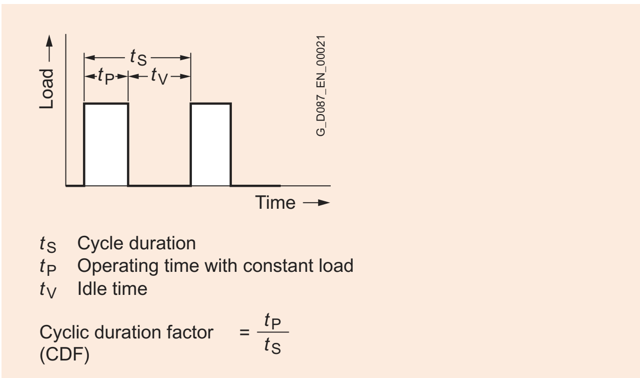


Operating mode S3 · Intermittent periodic duty

Operating mode **S6**:

Continuous duty with intermittent loading

Unless any agreement is made to the contrary, the cycle duration here is also 10 minutes. Values of 15 %, 25 %, 40 %, and 60 % are recommended for the load duration factor.

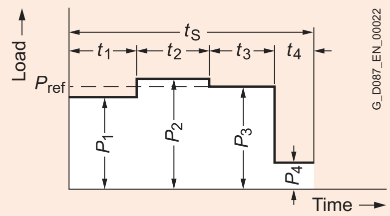


Determining the operating mode (continued)

Operating mode **S10**:

Duty with discrete constant loads

In this mode a maximum of four discrete loads are available, of which each load achieves the thermal steady state.
A load of the same value as the one used in S1 operating mode should be selected for this operating mode.

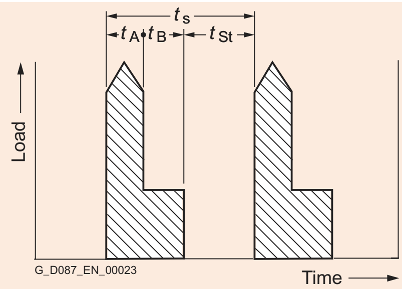


P_i Constant load within one load cycle
P_{ref} Reference load
t_S Cycle duration

Operating modes in which starting and braking have a corresponding **effect on the overtemperature of the stator winding** and of the rotor cage:

Operating mode **S4**:

Intermittent duty where starting affects the temperature



t_A Starting time
t_B Load duration
t_s Cycle duration
t_{St} Standstill time

Cyclic duration factor based on 10 min $= \frac{t_A + t_B}{t_A + t_B + t_{St}} \cdot 100\%$

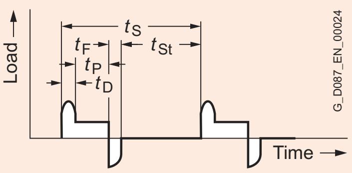
Operating mode S4 · Intermittent periodic duty with starting

Operating mode **S5**:

Intermittent duty where starting and braking affects the temperature

For the **S4** and **S5 operating modes**, this code should be followed by the cyclic duration factor, the mass moment of inertia of the motor (J_M), and the mass moment of inertia of the load (J_{Load}), both based on the motor shaft.

Unless any agreement is made to the contrary, the cycle duration here is also 10 minutes. Values of 15 %, 25 %, 40 %, and 60 % are recommended for the cyclic duration factor.



t_S Cycle duration
t_D Starting time
t_P Operating time with constant load
t_F Time with electrical braking
t_{St} Standstill time with windings at zero current

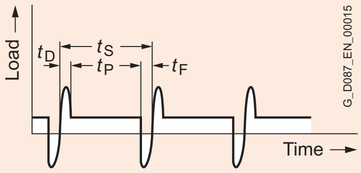
Cyclic duration factor (CDF) $= \frac{t_D + t_P + t_F}{t_S}$

Determining the operating mode (continued)

Operating mode **S7**:

Continuous-operation periodic duty with starting and braking

For the S7 and S8 operating modes, the mass moment of inertia of the load (J_{Load}) based on the motor shaft must be known.



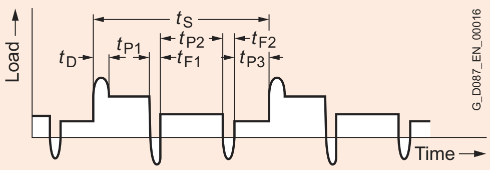
t_S Cycle duration
t_D Starting time
t_P Operating time with constant load
t_F Time with electrical braking

Cyclic duration factor = 1

Operating mode **S8**:

Continuous-operation duty with non-periodic load and speed variations (inverter-fed operation)

Most of the intermittent operating conditions which occur in real situations are a combination of the operating modes defined above. All operating conditions must be specified in order to accurately define a suitable motor.



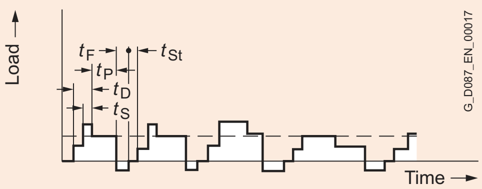
t_S Cycle duration
t_D Starting time
t_P Operating time with constant load (P1, P2, P3)
t_F Time with electrical braking (F1, F2)

Cyclic duration factor (CDF) $= \frac{t_D + t_{P1}}{t_S} \cdot \frac{t_{F1} + t_{P2}}{t_S} \cdot \frac{t_{F2} + t_{P3}}{t_S}$

Operating mode **S9**:

Continuous-operation duty with non-periodic load and speed variations (inverter-fed operation)

Most of the intermittent operating conditions which occur in real situations are a combination of the operating modes defined above. All operating conditions must be specified in order to accurately define a suitable motor.



t_D Starting time
t_P Operating time with constant load
t_F Time with electrical braking
t_{St} Standstill time with windings at zero current
t_S Time with overload

Determining the operating mode (continued)

Operating modes according to EN 60034 (IEC 34-1)

Operating mode	Description	Information required		k_{DC}
S1	Continuous duty with 100 % DC	–		
S2	Constant load for brief period, e.g. S2 - 30 min	Load duration	60 min	1.10
			30 min	1.20
			10 min	1.40
S3	Intermittent periodic duty without starting (cyclic operation), e.g. S3 - 40 %	Cyclic duration factor DC in % (based on 10 min)	60 %	1.10
			40 %	1.15
			25 %	1.30
			15 %	1.40
S4 … S10	Intermittent periodic duty with starting	Cyclic duration factor DC in %, times switched on per hour, load torque, and moment of inertia The operating mode and motor power can be determined if the number of starts per hour, starting time, load duration, type of braking, braking time, idle time, cycle time, standstill time, and required power are specified.	On request	

According to the table below, the motor list powers can be converted to the lower duty cycle using the corresponding k_{DC} factors for the S1, S2, and S3 operating modes.

With enhanced performance, you should note that the breakdown torque ratio must not fall below 1.6.

$$\frac{T_{Bd}}{T_{DC}}$$

$$P_{DC} = P_{rated} \cdot k_{DC}$$
$$T_{DC} \sim T_{rated} \cdot k_{DC}$$

Code	Description	Unit
P_{DC}	Power for the new duty cycle	–
P_{rated}	Rated motor power	kW
k_{DC}	Factor for enhanced performance	kgm²
T_{DC}	Torque for the new duty cycle	Nm
T_{Bd}	Breakdown torque	Nm
T_{rated}	Nominal torque	Nm

Coolant temperature and site altitude

The rated power specified in the selection tables in section 8 applies to continuous duty (S1) or inverter-fed operation (S9) according to DIN EN 60034-1 at the corresponding rated frequency, a coolant temperature of 40 °C and a site altitude of 1,000 m above sea level.
Please contact us if higher coolant temperatures are to be used. The table containing correction factors provides a rough idea of derating if conditions are different.

This results in a permissible motor power of:

$$P_{perm} = P_{rated} \cdot k_{HT}$$

If the permissible motor power is no longer adequate for the drive, a check should be performed as to whether or not the motor with the next higher rated power fulfills the requirements.

Code	Description	Unit
P_{perm}	Permissible motor power	kW
P_{rated}	Rated power	kW
k_{HT}	Factor for abnormal coolant temperature and site altitude	–

Factor k_{HT} for different site altitudes and / or coolant temperatures

Site altitude (SA)	Coolant temperature (CT)					
m	< 30 °C	30…40 °C	45 °C	50 °C	55 °C	60 °C
1000	1.07	1.00	0.96	0.92	0.87	0.82
1500	1.04	0.97	0.93	0.89	0.84	0.79
2000	1.00	0.94	0.90	0.86	0.82	0.77
2500	0.96	0.90	0.86	0.83	0.78	0.74
3000	0.92	0.86	0.82	0.79	0.75	0.70
3500	0.88	0.82	0.79	0.75	0.71	0.67
4000	0.82	0.77	0.74	0.71	0.67	0.63

Selecting the brake

MOTOX geared motors can be supplied with fail-safe spring-operated disk brakes in order to reduce the motor's follow-on time or to hold loads, for example. Our MODULOG modular system can be used to assign / attach several brake sizes to one motor size. See Chapter 8 for information on assigning brake sizes to motor sizes, and on possible brake options.

The following information is required in order to select and check the brake:

- Speed
- Load torque
- Moments of inertia
- Number of starts

Selecting the braking torque

The braking torque must be selected in accordance with the particular drive scenario. The following criteria are crucial when it comes to making this selection: static safety, required braking time, permissible deceleration rate, and possible braking distance and brake wear. The ambient conditions and number of starts are also important. Our drive experts will be able to provide optimum brake sizing.

In principle the selection is made according to the formula:

$$T_{br} > T_x \cdot \frac{k}{\eta}$$

Where k = 1.0 - 2.5 is selected. As a general rule of thumb, the factor for horizontal motion is around 1.0 - 1.5 and for vertical motion around 2.0 - 2.5. However, the exact specification of the braking torque depends to a large extent on the particular operating conditions.

Operating time of the brake

The time it takes the motor to come to a standstill comprises the following components: the application time of the brake t_1 and the braking time t_{br}. The first is the time it takes the brake to reach 90 % of its braking torque. This time may be circuit- and actuation-dependent. This information is provided for each brake in Chapter 8.
The braking time can be calculated as follows:

$$t_{br} = \frac{(J_M + J_{add} + J_x \cdot \eta) \cdot n_{br}}{9{,}55 \cdot (T_{br} \pm T_x \cdot \eta)}$$

If T_x supports the braking operation, T_x is positive, otherwise it is negative.

Braking distance and positioning accuracy

Braking distance s_{br} is the distance traveled by the driven machine during braking time t_{br} and application time t_1.
The formula below applies to horizontal motion and upward vertical motion. With linear motion, a positioning accuracy of around ± 15 % can be assumed. However, this can be heavily influenced by the condition of the brake.

$$s_{br} = v \cdot 100 \cdot (t_1 + 0{,}5 \cdot t_{br})$$

Code	Description	Unit
T_{br}	Rated braking torque	Nm
T_x	Load torque	Nm
k	Factor for taking operating conditions into account	kgm²
η	Efficiency	%
t_{br}	Braking time	s
t_1	Application time of the brake	ms
J_M	Mass moment of inertia of the motor	kgm²
J_{add}	Additional mass moment of inertia (e.g. centrifugal mass or high inertia fan)	kgm²
J_x	Reduced mass moment of inertia of the load	kgm²
n_{br}	Braking speed	rpm
s_{br}	Braking distance	–
v	Conveying speed	m/s
W	Friction energy per braking operation	J
Q_{perm}	Permissible operating energy	J
L_{rated}	Service life of the brake lining until readjustment	–
$L_{ratedmax}$	Service life of the brake lining until replacement	
v	Conveying speed	m/s
W_V	Friction energy until the brake is adjusted	MJ
W_{tot}	Friction energy until the brake lining is replaced	MJ
Z	Number of starts	1/h

Selecting the braking torque (continued)

Braking energy per braking operation

The braking energy W per braking operation comprises the energy of the moments of inertia to be braked and the energy which must be applied in order to brake against a load torque:

$$W = \frac{T_{br}}{T_{br} \pm T_x \cdot \eta} \cdot \frac{(J_M + J_{perm} + J_x \cdot \eta) \cdot n_{br}^2}{182{,}5}$$

T_x is positive if the load torque is working against the braking torque (horizontal motion, upward vertical motion).

T_x is negative if it supports the braking operation (downward vertical motion).

The permissible operating energy Q_{perm} must be checked against the relevant number of starts using the "Permissible operating energy" diagram (see Chapter 8). This is of particular importance for emergency-stop circuits.

$$W < Q_{perm}$$

Brake service life

The brake lining wears due to friction, which increases the air gap and the application time of the brake. The air gap can be readjusted. The friction lining should be replaced after it has been readjusted a certain number of times.

Service life of the brake lining until readjustment:

$$L_{rated} = \frac{W_V}{W \cdot Z}$$

Service life of the brake lining until replacement:

$$L_{ratedmax} = \frac{W_{tot}}{W \cdot Z}$$

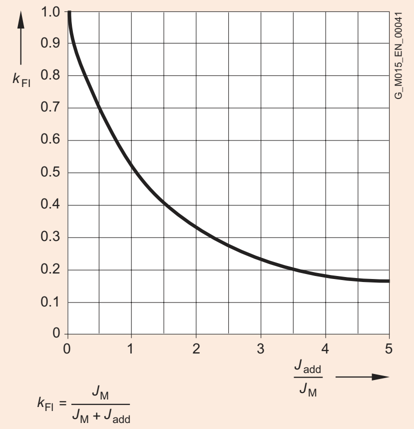
Determining the permissible number of starts Z_{perm}

A high number of starts means that the motor winding will be subject to a thermal load. The permissible no-load operating frequency Z_0 for brake motors is specified in the no-load operating frequency tables. The permissible number of starts Z_{perm} has to be determined for different operating cases.
This value is influenced by the corresponding load torque, any additional mass moment of inertia, the power requirement, and the cyclic duration factor. These can be evaluated using the factors k_M, k_{FI}, and k_P.

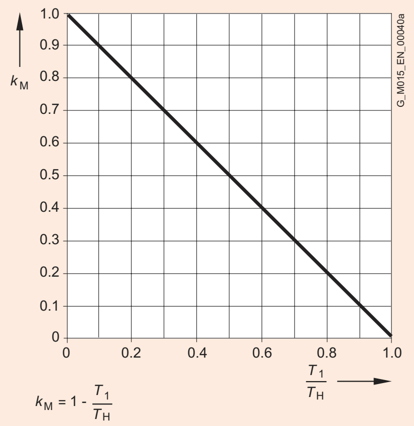
$$Z_{perm} = Z_0 \cdot k_M \cdot k_{FI} \cdot k_P$$

Code	Description	Unit
J_M	Mass moment of inertia of the motor	kgm^2
J_{add}	Additional moment of inertia based on the motor shaft	kgm^2
k_M	Factor for taking the counter torque during run-up into account	–
k_{FI}	Factor for taking the additional moment of inertia into account	–
k_P	Factor for taking the required power and duty cycle into account	–
T_{1mot}	Continuous torque of the motor	Nm
T_H	Run-up torque of the motor	Nm
P_1	Input power of the motor	kW
P_{rated}	Rated motor power	kW
Z_{perm}	Permissible number of starts	rph
Z_0	No-load operating frequency from the list	rph

During operation at 60 Hz, the calculated permissible number of starts Z_{perm} must be reduced by 25 %. See the technical data for brakes found in Chapter 8 for the permissible number of starts during operation with function rectifiers.



Additional moment of inertia



Torque during run-up

Checking input torques for mounted units

Geared motors are usually integrated, i.e. they are mounted on the gear unit directly and the products are supplied as complete drives. Alternatively, the gear units can also be supplied with various input units for motor mounting. The criteria below must be taken into account, particularly for special motors.

Maximum input speed

We recommend that four-pole motors are mounted in order to achieve optimum gear unit service life. Higher input speeds can have an effect on bearing service life and the gear unit's thermal properties, among other things.
See the section titled "Maximum speed", page 1/23.

Permissible radial force of the input unit

Input units A and P can be powered by a V belt drive, for example. This results in a radial load on the input shaft. The permissible radial forces are specified in the section titled "Input unit".

Maximum input torque

The input units are primarily designed for four-pole standard three-phase AC motors. Considerably higher motor torques, which are above the maximum permissible input torque, may occur with special motors.

First of all, the continuous torque T_{1mot} of the motor and the permissible input torque of the input unit T_1 must be checked, along with the maximum torques (starting, breakdown, and braking). The torques for input units are specified in the section titled "Input unit". Please contact us if you have any questions.

$$T_{1mot} < T_1$$

$$T_{1max} < 2{,}5 \cdot T_1$$

T_1 = Permissible input torque of the input unit

T_{1mot} = Continuous torque of the motor

T_{1max} = Temporarily permissible max. input torque of the input unit

General technical data

Overview of drive sizing data

Code	Description	Unit
a	Gear unit constant	kNmm
b, d, l, y, z	Gear unit constants	mm
C	Factor for the type of the output element	–
d	Diameter of the input element	mm
DC	Cyclic duration factor (CDF)	%
f_{Btot}	Service factor of the driving machine	–
f_B	Service factor of the geared motor	–
F_{ax}	Axial force at d	N
F_r	Radial force at the output shaft	N
F_{Ravail}	Available radial force resulting from the output torque and the diameter of the output element	N
F_{Rperm}	Permissible radial force at the center of shaft extension (l/2)	N
F_{xperm1}	Permissible radial force, limited by the bearing service life, at a distance of x from the shaft shoulder	N
F_{xperm2}	Permissible radial force, limited by the shaft strength, at a distance of x from the shaft shoulder	N
i	Gear ratio	–
J_2	Mass moment of inertia based on the input speed of the gear unit	kgm^2
J_{Load}	All external mass moments of inertia (based on the motor shaft)	kgm^2
J_M	Mass moment of inertia of the motor	kgm^2
J_x	Reduced mass moment of inertia of the load	kgm^2
J_{add}	Additional mass moment of inertia (e.g. centrifugal mass or high inertia fan)	kgm^2
k	Factor for taking operating conditions into account	–
k_{DC}	Factor for enhanced performance	–
k_{FI}	Factor for taking the additional moment of inertia into account	–
k_{HT}	Factor for abnormal coolant temperature or site altitude	–
k_M	Factor for taking the counter torque during run-up into account	–
k_P	Factor for taking the required power and duty cycle into account	–
L_{rated}	Service life of the brake lining until readjustment	–
$L_{ratedmax}$	Service life of the brake lining until replacement	–
MAF	Mass acceleration factor	–
n_1	Input speed of the motor	rpm
n_2	Output speed of the gear unit	rpm
n_{br}	Braking speed	rpm

Code	Description	Unit
P_1	Input power of the motor	kW
P_2	Output power of the gear unit	kW
P_{DC}	Power for the new duty cycle	kW
P_{rated}	Rated motor power	kW
P_{perm}	Permissible motor power	kW
Q_{perm}	Permissible operating energy	J
r	Radius of the output element	m
s_{br}	Braking distance	m
t_1	Application time of the brake	ms
t_{br}	Braking time	s
T_1	Permissible input torque of the input unit	Nm
T_{1mot}	Continuous torque of the motor	Nm
T_{1max}	Temporarily permissible max. input torque of the input unit	Nm
T_2	Output torque of the geared motor	Nm
T_{br}	Rated braking torque	Nm
T_{DC}	Torque for the new duty cycle	Nm
T_H	Run-up torque of the motor	Nm
T_{Bd}	Breakdown torque	Nm
T_{rated}	Nominal torque	Nm
T_{avail}	Available torque of the geared motor	Nm
T_x	Load torque	Nm
v	Conveying speed	m/s
W	Friction energy per braking operation	J
W_{tot}	Friction energy until the brake lining is replaced	MJ
W_V	Friction energy until the brake is adjusted	MJ
Z	Number of starts	1/h
Z_{perm}	Permissible number of starts	1/h
Z_0	No-load operating frequency from the list	1/h
α	Angle of action of the radial force	°
η	Efficiency	%
ϑ_{amb}	Ambient temperature	°C

Important drive technology variables

SI unit					
Variable	Abbreviation		Unit abbreviation		Relationship or conversion rate *
	SI	Previously	SI	Previously	
Length (distance)	L(s)	L, s	m	m	1 km = 1,000 m
Area	A	F	m^2	m^2	1 m^2 = 100 dm^2
Volume	V	V	m^3	m^3	1 m^3 = 1,000 dm^3 1 dm^3 = 1 l
Plane angle	a, b, g	a, b, g	rad	Degrees °	1 rad = 1 m/m 1 L = π/2 rad 1° =π/180 rad
Rotation angle	f	j		Degrees °	1' = 1°/60; 1'' = 1'/60
Time					1 min = 60 s 1 h = 60 min
Time range	t	t	s	s	1 d = 24 h
Duration					1 a = 24 h
Frequency	f	f	Hz	1/s	1 Hz = 1/s
Speed	n	n	rpm	rev/min rpm	Revolutions per minute
Velocity	v	v	m/s	m/s	1 km/h = $\frac{1}{3.6}$ m/s
Acceleration Free-fall acceleration	a g	b g	m/s^2	m/s^2	g = 9.81 m/s^2
Angular velocity	w	W	rad/s	1/s	
Angular acceleration	a	x	rad/s^2	$1/s^2$	
Mass	m	m	kg	kg	1
Density		d	kg/dm^3	kg/dm^3	10^3
Force Weight force	F G	P, K G	N	kp	9.81 1 N = 1 kg · 1 m/s^2
Pressure Mechanical tension	p σ	p σ	Pa N/m^2 N/mm^2	 kp/cm^2 kp/mm^2	1 Pa = 1 N/m^2 9.81 · 10^4 9.81
Work Energy Quantity of heat	W W Q	A E Q	J	kpm kcal	9.81 4,187 1 J = 1 Nm = 1 Ws
Force torque Torque Bending torque	T	M_t M_d M_b	Nm	kpm	9.81 1 Nm = 1 J
Power	P	N	W	PS	735.5; 1 W = 1 J/s = 1 Nm/s = $\frac{kgm^2}{s^3}$
Mass moment of inertia	J	q	kgm^2	kpm^2	9.81

* The numerical value of a variable in previously used units multiplied by the conversion rate gives the numerical value of the variable in the SI unit.

General technical data

Important drive technology variables (continued)

SI unit					
Variable	Abbreviation		Unit abbreviation		Relationship or conversion rate *
	SI	Previously	SI	Previously	
Dynamic viscosity	h	h	Pa · s	P	10^{-1}
Kinematic viscosity	u	u	m^2/s	St	10^{-4}
Electrical current intensity	I	I	A	A	1 A = 1 W/V = 1 V/Ω
Electrical voltage	U	U	V	V	1 V = 1 W/A
Electrical resistance	R	R	W	W	1 Ω = 1 V/A = 1/S
Electrical conductance	G	G	S	S	1 S = 1/Ω
Electrical capacitance	C	C	F	F	1 F = 1 C/V
Electric Charge	Q	Q	C	C	1 C = 1 A · s
Inductance	L	L	H	H	1 H = 1 Vs/A
Magnetic flux density Induction	B	B	T	G	10^4 1 T = 1 Wb/m^2
Magnetic field strength	H	H	A/m	A/m	
Magnetic flux	f	f	Wb	M	10^8 1 Wb = 1 V · s
Temperature	T(ϑ)	t	K(°C)	°C	0 K = -273.15°C

Overview

MOTOX geared motors are available in an almost infinite number of combinations for adaptation to a wide range of drive scenarios. All the usual additional components and variants are also offered.

Made-to-measure solutions for all kinds of drive technology tasks are achieved with different gear unit types (helical, parallel shaft, bevel helical, helical worm, and worm), combined with motors by means of modular mounting technology.

Designs in accordance with standards and specifications

Energy-saving motors with European efficiency classification in accordance with EU/CEMEP (European Committee of Manufacturers of Electrical Machines and Power Electronics)

Low-voltage motors in the power range 1.1 to 90 kW, 2-pole and 4-pole are marked in accordance with the EU/CEMEP agreement with the efficiency class EFF2 (Improved Efficiency) or EFF1 (High Efficiency).

The active parts of the motor have been optimized in order to meet the requirements of efficiency classes EFF1 and EFF2. The procedure for calculating the efficiency is based on the loss-summation method according to IEC 60034-2.

Motors for the North American market

For motors which comply with North American regulations (NEMA, CSA, UL, etc.), a check must always be performed as to whether or not the motors will be used in the USA or Canada and whether they could be subject to state laws.

Minimum efficiencies required by law

In 1997, an act was passed in the USA to define minimum efficiencies for low-voltage three-phase AC motors (EPACT = Energy Policy Act). An act is in force in Canada that is largely identical, although it is based on different verification methods.
The efficiency is verified for these motors for the USA using IEEE 112, Test Method B and for Canada using CSA-C390. Apart from a few exceptions, all low-voltage three-phase AC motors exported to the USA or Canada must comply with the legal efficiency requirements.

The law demands minimum efficiency levels for motors with a voltage of 230 and 460 V at 60 Hz, in the power range 1 to 200 HP (0.75 to 160 kW) with 2, 4, and 6 poles.
Explosion-proof motors must also be included. The EPACT efficiency requirements exclude, for example: Motors whose size power classification does not correspond with the standard series according to NEMA MG1-12, flange-mounting motors without feet, brake motors, inverter-fed motors.

For more information on EPACT: http://www.eren.doe.gov/

Special requirements for the USA: Energy Policy Act

The act lays down that the nominal efficiency at full load and a "CC" number (Compliance Certification) must be included on the rating plate.

The "CC" number is issued by the US Department of Energy (DOE). The following information is stamped on the rating plate of EPACT motors which must be marked by law:
nominal efficiency (service factor SF 1.15), design letter, code letter, CONT, CC no. CC 032A (Siemens), and NEMA MG1-12.

Special requirements for Canada: CSA – Energy Efficiency Verification

These motors fulfill the minimum efficiency requirements laid down by the CSA standard C390. These motors can be ordered and feature the CSA-E mark on their rating plates.

NEMA – National Electrical Manufacturers Association

The motors with increased efficiency according to EPACT are designed to meet the NEMA MG1-12 electrical standard and are marked accordingly.

The mechanical design of all motors is compliant only to IEC, not to NEMA dimensions.

All motors correspond to NEMA Design A (i.e. standard torque characteristic in accordance with NEMA and no starting current limitation).

For Design B, C, and D, a special version is required (on request).

Data on the rating plate: rated voltage (voltage tolerance of ±10 %) or rated voltage range (voltage tolerance ±5 %), nominal efficiency, design letter, code letter, CONT, and NEMA MG1-12.

Order code for NEMA design: **N65**

Designs in accordance with standards and specifications (continued)

UL-R – Underwriters Laboratories Inc. listing

The motors based on the LA/LG basic series are listed for up to 600 V by Underwriters Laboratories Inc.
("Recognition Mark" = R/C).

"UL Recogn. Mark" is included on the rating plate of the motor.

In addition, the motor is designed to meet the NEMA MG1-12 electrical standard and includes the following data on the rating plate: rated voltage (voltage tolerance of ±10 %) or rated voltage range (voltage tolerance ±5 %), nominal efficiency, design letter, code letter, CONT, and NEMA MG1-12.

Externally or internally mounted components such as:

- Motor protection
- Heating element
- External fan unit
- Brake
- Encoder
- Power connection
- Plug connection

are UL-R/C, CSA, or C-US listed or used by manufacturers in accordance with regulations. It may have to be decided whether the motor is suitable for the application. The motors can be operated on a frequency inverter at 50/60 Hz.

CSA – Canadian Standard Association

Motors based on the LA/LG basic series are approved for up to 690 V in accordance with the Canadian regulations of the "Canadian Standard Association" (CSA). Externally or internally mounted components which are used are listed by CSA or are used by manufacturers in accordance with regulations.
The CSA mark and the rated voltage (voltage tolerance of ±10 %) or rated voltage range (voltage tolerance ±5 %) are included on the rating plate.

When energy-saving motors (1LA9, 1LG6) are ordered, they also include the CSA-E mark on the rating plate.

Export of low-voltage motors to China

CCC – China Compulsory Certification

"Small power motors" which are exported to China must be certified up to a rated power of:

2-pole: ≤ 2.2 kW

4-pole: ≤ 1.1 kW

6-pole: ≤ 0.75 kW

8-pole: ≤ 0.55 kW

The **LA motors which must be certified** are certified by the CQC (China Quality Cert. Center). When one of these motors is ordered, the logo "CCC (Safety Mark)" is included on the rating plate and the packaging.

Notes:

Chinese customs checks the need for certification of imported products by means of the commodity code.

The following do not need to be certified:

- Motors imported to China which have already been installed in a machine
- Repair parts

Order code for CCC design: **N67**

Export of geared motors and gear units to Russia

GOST-R conformity

The following gear units can be supplied separately or as part of geared motors, certified according to GOST-R:

- Helical gear units
- Bevel helical gear units
- Parallel shaft gear units
- Helical worm gear units
- CAVEX worm gear units

Order code for GOST geared motors or gear units: **N30**

VIK design

Geared motors up to motor size 160 L can be supplied in accordance with VIK (Verband der Industriellen Energie- und Kraftwirtschaft e.V.) technical requirements on request.

Designs in accordance with standards and specifications (continued)

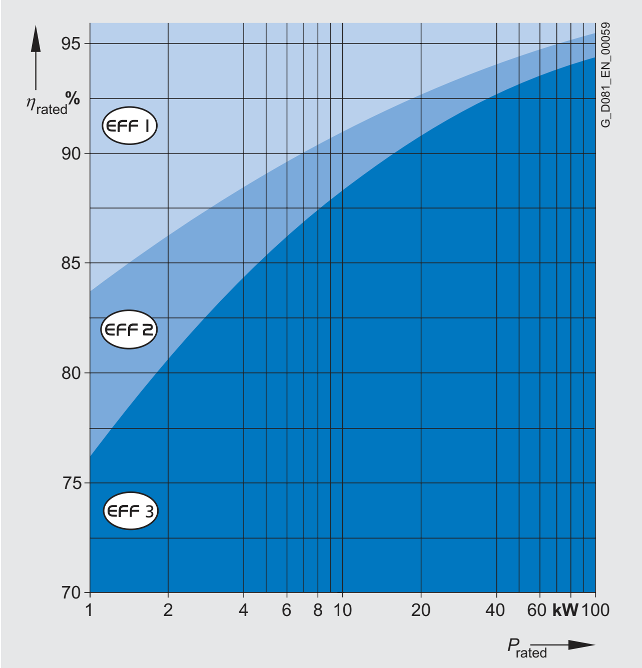
Classified energy-saving motors for an efficient energy balance

Depending on requirements, energy-saving motors are available for an efficient energy balance – for EU requirements in accordance with CEMEP (European Committee of Manufacturers of Electrical Machines and Power Electronics) and for the North American market in accordance with EPACT (US Energy Policy Act).

Efficiency requirements according to CEMEP

CEMEP classifies efficiency levels for 2-pole and 4-pole motors with powers of 1.1 to 90 kW.
Three efficiency classes are defined:

- EFF1 (High Efficiency motors)
- EFF2 (Improved Efficiency motors)
- EFF3 (Conventional Efficiency motors)



At a glance: EU/CEMEP for Europe

- Status:
  Voluntary compliance with efficiency classification
- Covers:
  2-pole, 4-pole 50 Hz squirrel-cage motors from 1.1 to 90 kW (at 400 V)
- Required marking:
  Efficiency class on the motor rating plate η_{rated}, $\eta_{3/4}$ load and efficiency class in the documentation

Efficiency requirements according to EPACT

In 1997, an act was passed in the USA to define minimum efficiencies for low-voltage three-phase AC motors (EPACT).

An act is in force in Canada that is largely identical, although it is based on different verification methods. The efficiency is verified for these motors for the USA using IEEE 112, Test Method B and for Canada using CSA-C390.

Apart from a few exceptions, all low-voltage three-phase AC motors imported into the USA or Canada must comply with the legal efficiency requirements.

The law demands minimum efficiency levels for motors with a voltage of 230 and 460 V at 60 Hz, in the power range 1 to 200 HP (0.75 to 160 kW) with 2, 4, and 6 poles. Explosion-proof motors must also be included.

The EPACT efficiency requirements exclude, for example:

- Motors whose size power classification does not correspond with the standard series according to NEMA MG1-12
- Flange-mounting motors
- Brake motors
- Inverter-fed motors
- Motors with design letter C and higher.

EPACT lays down that the nominal efficiency at full load and a "CC" number (Compliance Certification) must be included on the rating plate. The "CC" number is issued by the US Department of Energy (DOE).

The following information is stamped on the rating plate of EPACT motors which must be marked by law:

- Nominal efficiency
- Design letter
- Code letter
- CONT
- CC no. CC 032A (Siemens) and NEMA MG1-12.

At a glance: EU/CEMEP for North America

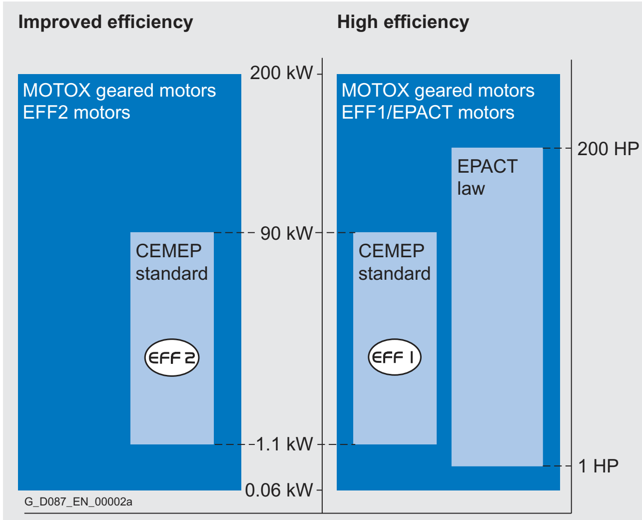
- Status:
  Minimum efficiencies required by law
- Covers:
  2-pole, 4-pole, and 6-pole 60 Hz squirrel-cage motors from 1 to 200 HP (0.75 to 150 kW) for 230 V and/or 460 V 60 Hz
- Required marking:
  Efficiency $_N$ on the motor rating plate.

General technical data

Energy-saving motors in accordance with CEMEP/EPACT

The product range of geared motors exclusively comprises motors in the EU efficiency classes EFF1 "High Efficiency" and EFF2 "Improved Efficiency". The active parts of the motor have been optimized in order to meet the requirements of the CEMEP efficiency classes EFF1 and EFF2. The procedure for calculating the efficiency is based on the loss-summation method according to IEC 60034-2. With these energy-saving motors a significant reduction in energy costs can be achieved as compared to conventional motors according to EFF3.

EPACT motors from Siemens are available CC-certified, marked with the number CC32A on the rating plate and, optionally, also according to UL with the Recognition Mark. Siemens offers motors with the CSA Energy Efficiency Verification Mark especially for the Canadian market.



Explosion protection as per ATEX

In the European market ATEX Directive 94/9/EC applies to all types of equipment used in potentially explosive atmospheres - which include geared motors. It became mandatory on July 1, 2003 and has unrestricted validity for the use of all geared motors within the European Union. Other countries too have now complied with this regulation.

Helical gear units, parallel shaft gear units, bevel helical gear units, and helical worm gear units are available to comply with this Directive. A wide range of gear unit and motor designs and sizes are approved for zones 1, 2 (gases) and zones 21 and 22 (dusts).

Ex-atmosphere / Zone		Category	Frequency
G (gas and steam)	D (dust)		
0	20	1	Continuously or long-term
1	21	2	Intermittent
2	22	3	Rarely or briefly

MOTOX-N geared motors can be provided for categories 2 and 3.

Use in explosive atmospheres caused by gases is permissible for temperature classes T1 to T4. With use in explosive atmospheres caused by dust, the maximum temperature of 120 °C must be taken into consideration for the gear unit. An oil level sensor can be integrated for monitoring in inaccessible areas.

Motors are available in the following protection types: flameproof enclosure (Exd), flameproof enclosure and terminal box with increased safety (Exde), increased safety (Exe), and non sparking (Exn) as well as motors for dust explosion protection.

Standards

The motors comply with all applicable international (IEC), European (EN, CENELEC), and national (DIN/VDE) standards:

IEC	EN / HD	DIN / VDE	Title
IEC 60027-4	HD 245.4	DIN 1304-7	Letter symbols for physical quantities, symbols to be used for electrical machines
IEC 60034-1	EN 60034-1	DIN EN 60034-1 VDE 0530-1	Rotating electrical machines: - Rating and performance
IEC 60034-2	EN 60034-2	DIN EN 60034-2 VDE 0530-2	- Methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
IEC 60034-5	EN 60034-5	DIN EN 60034-5 VDE 0530-5	- Degrees of protection provided by integral design of rotating electrical machines (IP code) - Classification
IEC 60034-6	EN 60034-6	DIN EN 60034-6 VDE 0530-6	- Methods of cooling (IC Code)
IEC 60034-7	EN 60034-7	DIN EN 60034-7 VDE 0530-7	- Classification of types of construction, mounting arrangements and terminal box position (IM code)
IEC 60034-8	EN 60034-8	DIN EN 60034-8 VDE 0530-8	- Terminal markings and direction of rotation
IEC 60034-9	EN 60034-9	DIN EN 60034-9 VDE 0530-9	- Noise limits
IEC 60034-12	EN 60034-12	DIN EN 60034-12 VDE 0530-12	- Starting performance of single-speed three-phase cage induction motors
IEC 60034-14	EN 60034-14	DIN EN 60034-14 VDE 0530-14	- Mechanical vibration of certain machines with shaft heights 56 mm and higher
IEC TS 60034-17	–	DIN IEC/TS 60034-17 VDE 0530-17	- Cage induction motors when fed from converters - Application guide
IEC 60038	HD 472	DIN IEC 60038	IEC standard voltages
–	EN 50347	DIN EN 50347	General purpose three-phase induction motors having standard dimensions and outputs
IEC 60085	HD 566	DIN IEC 60085	Thermal evaluation and designation of electrical insulation
IEC 60445	EN 60445	DIN EN 60445	Identification of equipment terminals and conductor terminations
IEC 60529	EN 60529	DIN EN 60529 VDE 0470-1	Degrees of protection provided by enclosures (IP code)
–	EN 50262	DIN EN 50262	Cable glands for electrical installations
–	–	EDIN 42925	Terminal box cable entries for three-phase cage induction motors at rated voltages from 400 V to 690 V

The main dimensions of all gear units comply with the following DIN standards:

Shaft heights	DIN 747
Shaft ends	DIN 748/1
Mounting flange	DIN 42948
Concentricity of shaft extensions, concentricity and axial eccentricity of mounting flange	DIN 42955
Parallel keys	DIN 6885/1
Second motor shaft end	DIN 748/3
Center holes in shaft ends	DIN 332/2

General technical data

Fits

Flange form A, C:

b1 ≤ ø 230 = j6

b1 > ø 230 = h6

Drive-side shaft end:

d1 < ø 55 : k6

d1 ≥ ø 55 : m6

See the dimension drawings for other fits.

Degrees of protection

The geared motors are supplied with IP55 to standards IEC 60529 (gear units) and IEC 60034-5 (motors).
For higher degrees of protection for motors, see Chapter 8, "Motor degrees of protection".

Direction of rotation of geared motors

The three-phase AC motors are configured so the motor shaft rotates clockwise (IEC 60034-8).

The direction of rotation of the gear unit output shaft can be reversed by swapping two external connection wires on the motor.

Specifying the direction of rotation for geared motors and gear units with backstop

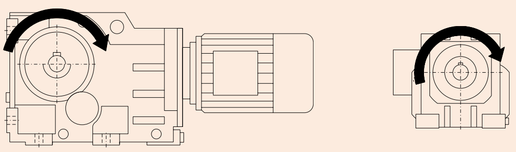
It is necessary to specify the desired direction of rotation of the input shaft when ordering a gear unit with backstop. The direction of rotation is determined by the front view of the input shaft (shaft end face). With parallel shaft, bevel helical, and helical worm gear units, it is again necessary to specify the side on which the input shaft is located, i.e. either "Input side A" or "Input side B". The input side is defined by specifying the mounting position.

<u>Direction of rotation of the geared motor when viewing the input shaft</u>

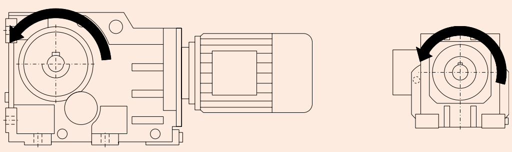
Output shaft direction of rotation order codes:

Clockwise: **K18**

Counterclockwise: **K19**



Clockwise



Counterclockwise

Powers and torques

The specified powers and torques refer to standard designs, mounting positions B3../ B5../H01 and other comparable mounting positions, whereby the first stage is not completely immersed in oil. Normal ambient conditions and standard lubrication are also required.

Speeds

The specified output speeds are guide values, rounded to the first decimal place. You can use the rated motor speed and the gear unit speed to calculate the rated drive speed. Please note that the actual output speed will depend on the motor load and the power supply conditions.

Noise

Noise emitted by the motors during mains operation

Noise is measured in accordance with DIN EN ISO 1680 in a dead room. The noise level is specified as A-weighted measuring surface sound pressure level L_{pfA} in dB (A). This value is the spatial average value of the sound pressure levels measured at the measuring surface. The measuring surface is a cube 1 m away from the surface of the motor. The sound power level is also specified as L_{WA} in dB (A).

The values specified in the motor selection tables apply to the motor without gear unit at 50 Hz (see the selection and ordering data in the corresponding sections of the catalog).
The tolerance is +3 dB. At 60 Hz, the values are approximately 4 dB (A) higher. Please enquire about noise levels for pole-changing motors, geared motors, and inverter-fed motors.

Noise emitted by the geared motors

The geared motors do not exceed the permissible noise levels defined for gear units in VDI guideline 2159 and for motors in EN 60034. Experience tells us that the geared motors emit a noise that is around 3 - 5 dB (A) louder than that emitted by the motors. Precise data is available on request.

Weight of geared motors

The weight data contained in the dimension drawings are averaged values and do not take account of oil. The weights vary according to the gear unit design and size. The oil quantity depends on the mounting position. You will find oil quantity guide values in the gear unit chapters, "Oil quantities" section.
The exact weight of the drive will be specified on the order confirmation.

Three-phase AC motors

Three-phase AC motors are designed to be perfectly coordinated with the gear unit system and can be supplied with or without a brake.

The motor series covers sizes 71 to 315.
The powers of the 2-, 4-, 6-, and 8-pole motors are classified in accordance with IEC. Pole-changing designs with pole numbers 8/2; 8/4; 4/2; 6/4 are available on request. The housings of motors up to size 160 are made from high-quality aluminum alloy. Housings for sizes 180 and above are made from gray cast iron.

Brakes

The motors can be supplied with spring-operated disk brakes. These are double-disk brakes, which are spring-operated at zero current.

The torque can be set within certain limits for every brake size.

General technical data

Lubricants

All gear units are filled with lubricant at the factory. The lubricants used meet the requirements of DIN 51502. The gear units are filled with varying oil quantities (see operating instructions and rating plate) depending on their mounting position.
If no specifications are made to the contrary, the standard lubricant is used.

Required quality of gear lubricants

The oils used in the MOTOX gear units are subject to stringent quality control. For MOTOX gear units, only CLP-quality oils are approved which contain ingredients to DIN 51517-3 for improvement of corrosion protection, resistance to ageing, and which reduce wear in mixed-friction areas. The scuffing resistance in the FZG test to DIN 51354-2 must comply with stage 12 or higher under A/8.3/90 test conditions. In the FE-8 rolling bearing test to DIN 51817-3 rolling element wear must be under 30 mg and cage wear under 100 mg under D-7.5/80-80 test conditions.

In addition, the lubricants must meet the following quality requirements demanded by FLENDER:

- Sufficiently high gray-staining resistance in accordance with FVA 54 gray-staining test
- Low degree of foaming with less than 15 % foam formation in the FLENDER foam test
- Suitable for the elastomer material used in the radial shaft seals of FLENDER gear units
- Compatible with residues of corrosion-protection agent and run-in oils used by FLENDER
- Compatible with the paints used by FLENDER in its gear unit interiors
- Compatible with liquid seals between bolted-joint surfaces.

Furthermore, for use in worm gear units:

Low wear, high pitting resistance, and high efficiency (low temperature) in the cylindrical worm gear unit test.

For a list of approved oils from different manufacturers please refer to the Operating Instructions BA 7300.

Lubricants (continued)

Lubricants for helical gear units E/D/Z, parallel shaft gear unit F, bevel helical gear unit K:

Area of application	Ambient temperature			DIN ISO designation	Order code
Standard oils					
Standard temperature	-10	…	+40 °C	CLP ISO VG 220	K06
Improved oil service life	-20	…	+50 °C	CLP ISO PG VG 220	K07
High temperature usage	0	…	+60 °C	CLP ISO PG VG 460	K08
Low temperature usage	-30	…	+50 °C	CLP ISO PAO VG 220	K12 *)
Lowest temperature usage	-40	…	+40 °C	CLP ISO PAO VG 68	K13 *)
Physiologically safe oils (for use in the food industry) in acc. with USDA-H1					
Standard temperature	-30	…	+40 °C	CLP ISO PAO VG 460	K10 *)
Biologically degradable oils					
Standard temperature	-20	…	+40 °C	CLP ISO E VG 220	K11 *)

*) On request

Lubricants for bevel helical gear unit B and helical gear unit C:

Area of application	Ambient temperature			DIN ISO designation	Order code
Standard oils					
Standard temperature	0	…	+60 °C	CLP ISO PG VG 460	K08
Low temperature usage	-20	…	+50 °C	CLP ISO PAO VG 220	K12 *)
Physiologically safe oils (for use in the food industry) in acc. with USDA-H1					
Standard temperature	-30	…	+50 °C	CLP ISO PAO VG 460	K10 *)

*) On request

The ambient temperatures are applicable for gear units in standard operation. The data is based on our experience with standard applications. The oil sump temperature is a decisive factor for the service life of the lubricant and depends to a large extent on the gear unit type, gear unit size, transmission ratio, mounting position, input speed, and operating mode.

The data on usage in high, low, and lowest temperature ranges only refers to the lubricant. It may be necessary to take other design measures. Please contact us.

With low ambient temperatures, critical startup characteristics need to be taken into account.

With higher ambient temperatures (> 40 °C), the permissible oil sump temperature must not be exceeded. Please contact us if you require your drive to be thermally tested.

Long-term preservation

Helical gear units, parallel shaft gear units, bevel helical gear units, and helical worm gear units can be delivered with a long-term preservation of up to 36 months. The free shaft extensions, sealing elements, and flanges are coated with a protective layer of grease.
The gear unit is completely filled with oil for long-term preservation. See the operating instructions for information on storage and commissioning.

Order code for long-term preservation up to 36 months: **K17**

General technical data

Paint coat

We offer three high-quality paint systems in various hues to protect drives against corrosion and external influences.

Geared motors of size 38 and above are painted in RAL 5015 (sky blue) with a synthetic resin base as standard. This ensures that they are protected against corrosion for installation in a moderate outdoor climate.

Gear units of size 18 and 28 with an aluminum housing are supplied unpainted as standard.

For transport, the bare parts are coated with anti-corrosion paint which will last for a limited amount of time.

Paint system	Hue	Typical area of application	Repaint characteristics*	Chem. phys. resistance	Thermal stability of the paint	Comments
Plastic (standard) Order code: **L02**	Standard: RAL 5015 On request: RAL 1003, 1007, 1012, 1018, 1023, 2000, 2004, 3000, 5007, 5009, 5010, 5012, 6011, 6018, 7001, 7011, 7030, 7031, 7032, 7035, 9005, 9006, 9010, others on request	Standard 1-layer paint finish for interior areas	With acrylic coating or synthetic resin paint, can be repainted after 3 days' drying time	Good resistance to detergents, oil and petrol, resistant to temporary exposure to diluted acid and alkaline solutions (≤3 %), not resistant to solvents, not resistant to steam	-40 °C … 100 °C Short-term up to 140 °C	Standard paint finish with excellent adhesive properties; not suitable for outdoor storage or installation
2C PUR (surcharge) Order code: **L03**	Standard: RAL 7031 On request: RAL 1003, 1012, 1018, 1023, 2004, 300, 5002, 5007, 5009, 5010, 5012, 5015, 6011, 6018, 7000, 7001, 7011, 7030, 7032, 7035, 9005, 9006, 9010, 9011, 9016, others on request	Standard 2-layer paint finish, especially for outdoor installation or higher anti-corrosion protection requirements	After preliminary rub-down with: 2C PUR paint 2C epoxy paint	Excellent resistance to oil, grease, petrol, water, sea water, and detergents; good resistance to weather conditions and diluted acid and alkaline solutions (≤3 %); good mechanical resistance to abrasion	-40 °C … 150 °C	Standard paint finish for cooling tower and agitator drives or, if requested, resistance to sea water below deck, etc.
2C epoxy (surcharge) Order code: **L04**	Standard: RAL 7035 On request: RAL 1007, 1018, 1023, 2000, 5002, 5007, 5009, 5010, 5015, 6011, 6018, 7001, 7030, 7032, 9010, 9011, others on request	High-quality paint finish for outdoor applications or where exposed to diluted acid and alkaline solutions (≤5 %)	After preliminary rub-down with: 2C PUR paint 2C epoxy paint 2C AC paint	Excellent resistance to weak acid and alkaline solutions (≤5 %), oil, grease, petrol, cooling emulsion, salt, solvents; toughened and scratch-resistant coating film	-40 °C … 150 °C	2C epoxy paint becomes chalky when installed outside (without affecting quality), high gloss with good mechanical resistance
Primed Order code: **L01**	(RAL 7032)	For repainting: adhesion promoter for all common paint systems, temporary anti-corrosion protection	Very good with: acrylic coating, synthetic resin paint, 2C PUR paint, 2C epoxy paint, SH paint, 2C AC paint	Good resistance to detergents and salt spray and resistant to oil and petrol	-40 °C … 150 °C	Adhesion promoter with very good adhesive properties and good anti-corrosion protection
Unpainted Order code: **L00**	–	For repainting: temporary anti-corrosion protection	Very good with: synthetic paint, synthetic resin paint, oil paint, bitumen paint, 2C PUR paint, 2C epoxy paint	–	(-40 °C … 150 °C)	GCI parts, dip-primed, steel parts, primed or zinc-plated, aluminum and plastic parts, untreated

Order codes for RAL colors:

5015 sky blue (standard for plastic)	**L50**
7011 iron gray	**L51**
2004 pure orange	**L52**
7031 blue gray (standard for 2-component PUR)	**L53**
7035 light gray (standard for 2-component epoxy)	**L43**

The colors listed above can be specified using order code Y80 and the RAL color code in plain text.

Example:

Reseda green

Order code: **Y80*RAL @ 6011***

Rating plate and additional plates

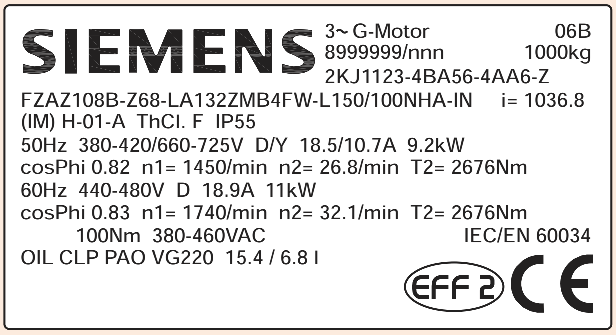
In accordance with DIN EN 60034-1, the approximate total weight is specified on the rating plate for all geared motors (as of around 30 kg).

In the standard version, the rating plate is available labeled in international format or in the English / German language.

An additional rating plate can be supplied loose for all motors.

Order code for additional rating plate: **K41**

Example of a rating plate:



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Documentation

The geared motors are supplied with the following documentation as standard:

- Operating instructions (paper) incl. spare part documentation and EC manufacturer's declaration in English / German
- Manual Collection (on CD) with all operating instructions in Czech, Dutch, English, French, German, Italian, Russian, Spanish, and Swedish.

The following documents are optionally available:

- Order-specific lists of spare parts
- Certificate of compliance with the order EN 10204-2.1 and works test certificate EN 10204-2.2 for the geared motor
- Works test certificate EN 10204-2.2 for the material
- Works test certificate EN 10204-3.1 for the gear unit, tests carried out on:

  - The input / output shaft diameter
  - The concentricity of the input shaft
  - The concentricity of the input shaft (for solo gear units only)
  - The torsional backlash
  - The noise (subjective evaluation).

A works test certificate EN 10204-3.1 for motors can also be produced on request. The following are tested:

- The 3 no-load currents of the 3 phases
- The power loss during no-load operation
- The no-load speed.

Notes