6 Project Planning

6.1 Electrical characteristics

Suitable for inverter operation

DR series AC (brake) motors can be operated on inverters thanks to the high quality winding with which they are equipped as standard.

Frequency

On request, AC motors from SEW-EURODRIVE are designed for a supply frequency of 50 Hz or 60 Hz. As standard, the technical data in this motor catalog is based on a supply frequency of 50 Hz.

There are also special DRS and DRE motor variants that can be operated on both 50 Hz and 60 Hz supply systems. Different regional electrical regulations can be met by one motor. Especially the different national regulations about minimum efficiency levels (see chapter "Energy-efficient motors of the DR motor series" on page 13 ff) are combined in an ideal way. Please contact SEW-EURODRIVE for these motors.

Motor voltage

AC motors in the standard and energy efficient design are available for rated voltages of 220 - 720 V.

2, 4 and 6-pole motors

Motors with power ratings up to 5.5 kW are usually available in the following designs:

- For voltage range 220 - 242 V △ / 380 - 420 V ⅄ , 50 Hz
- Or for rated voltage 230 V △ / 400 V ⅄, 50 Hz.

Motors with power ratings from 7.5 kW are usually available in the following designs:

- For voltage range 380 - 420 V △ / 690 - 720 V ⅄, 50 Hz
- Or for rated voltage 400 V △ / 690 V ⅄, 50 Hz.

If not specified in the order, the motors are designed for the above mentioned voltages for 50 Hz.

The other optional motor voltages available as standard are listed in the following table.

For 50 Hz power supply

The **standards voltages** are:

Motors		Motor sizes up to 5.5 kW	Motor sizes from 7.5 kW	
4-pole motors				
Standard **High** **Premium**		**DRS71S4 - 132S4** **DRE80M4 - 132M4** **DRP90M4 - 160S4**	**DRS132M4 - 225MC4** **DRE132MC4 - 225M4** **DRP160MC4 - 225M4**	**DRS315K4 - 315L4** **DRE315K4 - 315L4** **DRP315K4 - 315L4**
2-pole motors				
Standard **High** **Premium**		**DRS71S2 - 132S2** **DRE80M2 - 132M2** **DRP80M2 - 132M2**	**DRS132M2 - 132MC2** **DRE132MC2** **-**	**-** **-** **-**
6-pole motors				
Standard **High** **Premium**		**DRS71S6 - 160S6** **DRE90L6 - 160M6** **DRP90L6 - 160M6**	**DRS160M6** **-** **-**	**-** **-** **-**
Voltage range	△/⅄	**AC 220 - 242 / 380 - 420 V**	**AC 380 - 420 / 690 - 720 V**	
Rated voltage	△/⅄ △/⅄ △/⅄ △/⅄	**AC 230 / 400 V** **AC 290 / 500 V** **AC 400 / 690 V** **AC 500 / -**		**-** **AC 290 / 500 V** **AC 400 / 690 V** **AC 500 / -**

For the table listing the brake voltages, see page 75.

Motors and brakes for AC 230 / 400 V and motors for AC 690 V may also be operated on supply systems with a rated voltage of AC 220 / 380 V or AC 660 V respectively. The voltage-dependent data changes only slightly.

The technical data of motor size DR.315 only refer to a rated voltage of 400 / 690 V. Please consult SEW-EURODRIVE for other voltages.

Motor voltage for pole-changing motors

The standard pole-changing AC motors are available for rated voltages from 220 V to 720 V.

If not specified otherwise in the order, the motors are designed for the above mentioned voltages for 50 Hz.

Other motor voltages available as standard are listed in the following table.

Motors **Standard**	**8/2-pole motors** **DRS71S8/2 - 132M8/2**	**8/4-pole motors** **DRS132M8/4 - 225M8/4**
Voltage range	AC 380 - 420 V ⅄/⅄	AC 380 - 420 V △/⅄⅄
Rated voltage	AC 400 V ⅄/⅄	AC 400 V △/⅄⅄

8/2-pole motors

The pole-changing motors with separate winding are usually available in the following variants:

- For the voltage range 380 - 420 ⅄/⅄ V 50 Hz,
- Rated voltage 400V ⅄/⅄ 50 Hz.

8/4-pole motors

The pole-changing motors with Dahlander winding are usually available in the following variants:

- For the voltage range 380 - 420 △/⅄⅄ 50 Hz,
- Rated voltage 400 V △/⅄⅄, 50 Hz.

Forced cooling fan voltage

Forced cooling fan voltage		
Motors	**DR.71 - 225**	**DR.315**
Voltage range	1 × AC 230 - 277 V△ (with capacitor) 3 × AC 200 - 290 V△ 3 × AC 346 - 500 V⅄	- 3 × AC 200 - 290 V△ 3 × AC 346 - 500 V⅄

Brake voltage

Brake voltage		
Brakes	**BE05 - BE20**	**BE30 - BE122**
Voltage range	AC 220 - 242 V AC 380 - 420 V	
Rated voltage	DC 24 V AC 230 V AC 400 V	- AC 230 V AC 400 V

Standard connections 50 Hz motors

Number of poles	Synchronous speed n_{syn} at 50 Hz [rpm]	Connection
2-pole 4-pole 6-pole	3000 1500 1000	⅄ / △ ⅄ / △ ⅄ / △
8/2-pole 8/4-pole	750 / 3000 1500 / 3000	⅄⅄ △ / ⅄⅄

50 Hz motor on 60 Hz supply system

The rated data of motors designed for 50 Hz supply systems are slightly different when the motors are operated on 60 Hz supply systems.

Motor voltage At 50 Hz	Motor connection	U [V] at 60 Hz	Modified rated data			
			n_N	P_N	M_N	M_A/M_N
AC 230 / 400 V △/⅄	△	230	+20%	0%	-17%	-17%
AC 230 / 400 V △/⅄	⅄	460	+20%	+20%	0%	0%
AC 400 / 690 V △/⅄	△					

If you want to operate motors designed for 50 Hz supply systems with a 60 Hz supply system, please consult SEW-EURODRIVE.

60 Hz motors

This motor catalog contains the technical data of DR motors for supply systems with a frequency of 50 Hz.

The DR motors can also be supplied for supply systems with a frequency of 60 Hz. They are also available as standard and energy-efficient variants.

Regional requirements such as NEMA MG1 (USA), CSA C22.2 (Canada) or ABNT (Brazil) and others are met.

The power assignment of the 60 Hz variants is different for some sizes from that of 50 Hz.

Power ratings with a local market significance outside the IEC series are also provided for, e.g. with a 3.7 kW / 5 hp motor or a 4.5 kW / 6 hp motor.

6.2 Thermal characteristics - DR, DRL

Thermal classification according to IEC 60034-1 (EN 60034-1)

Single-speed AC motors/AC brakemotors are designed in thermal class 130 (B) as standard. Thermal classes 155 (F) or 180 (H) are available on request.

The table below lists the overtemperatures to IEC62114 and IEC 60034-1 (EN 60034-1).

Thermal classification		Overtemperature limit [K]
New	Old	
130	B	80 K
155	F	105 K
180	H	125 K

Power reduction

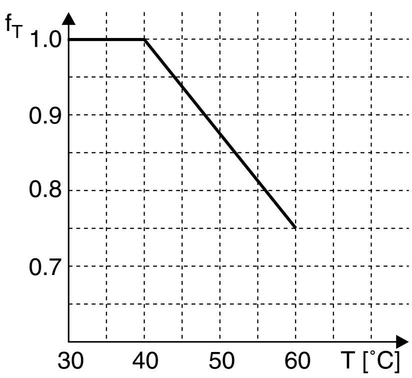
The rated power P_N of a motor depends on the ambient temperature and the altitude. The rated power stated on the nameplate applies to an ambient temperature of 40 °C and a maximum altitude of 1,000 m above sea level. The rated power must be reduced according to the following formula in the case of higher ambient temperatures or altitudes:

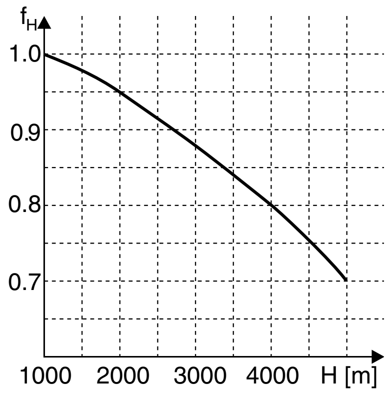
$$PNred = PN \times fT \times fH$$

AC motors

The following diagrams show the power reduction depending on the ambient temperature and the installation altitude.

They list the factors f_T and f_H for AC motors:





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T = Ambient temperature
H = Installation altitude above sea level

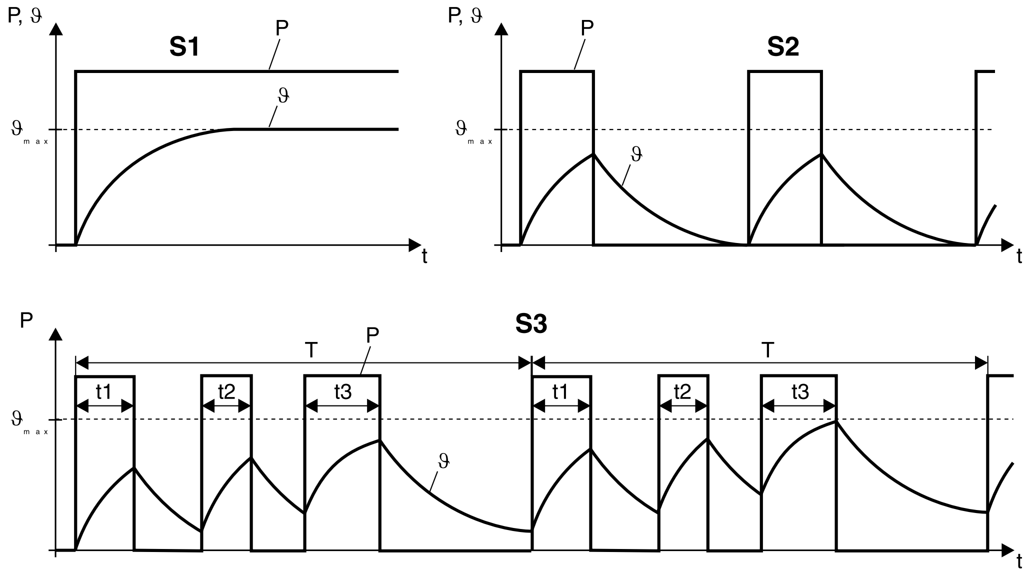
Operating modes According to IEC60034-1 (EN60034-1), the following duty types are defined:

Operating mode	Explanation
S1	**Continuous duty:** Operation at a constant load; the motor reaches thermal equilibrium.
S2	**Short-time duty:** Operation at constant load for a given time followed by a time at rest. The motor returns to ambient temperature during the rest period.
S3	**Intermittent periodic duty:** The starting current does not significantly affect the temperature rise. Characterized by a sequence of identical duty cycles, each including a time of operation at constant load and a time at rest. Described by the "cyclic duration factor (cdf)" in %.
S4-S10	**Intermittent periodic duty:** The switch-on sequence affecting the temperature rise. Characterized by a sequence of identical duty cycles, each including a time of operation at constant load and a time at rest. Described by the "cyclic duration factor (cdf)" in % and the number of cycles per hour.

TIP

S1 continuous duty is usually assumed for inverter operation. In the case of a high number of cycles per hour, it might be necessary to assume S9 intermittent duty.

The following figure shows the duty types S1, S2, S3.



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Cyclic duration factor (cdf)

The cyclic duration factor (cdf) is the ratio between the period of loading and the duration of the duty cycle. The duration of the duty cycle is the sum of times of operation and times at rest and de-energized. A typical value for the duration of the duty cycle is ten minutes.

$$\mathbf{CDF} = \frac{\textbf{sum of times of operation (t1 + t2 + t3)}}{\textbf{duty cycle duration (T)}} \cdot \mathbf{100\ [\%]}$$

Power increasing factor K

Unless specified otherwise, the rated power of the motor refers to duty type S1 (100 % cdf) according to IEC60034 (EN60034). If a motor designed for S1 and 100 % cdf is operated in mode S2 "short-time duty" or S3 "intermittent periodic duty", the rated power can be multiplied by the power increasing factor K specified on the nameplate.

Operating mode			Power increasing factor K
S2	Operating time	60 min 30 min 10 min	1.1 1.2 1.4
S3	Cyclic duration factor (cdf)	60% 40% 25% 15%	1.1 1.15 1.3 1.4
S4-S10	The following information must be specified to determine the rated power and the duty type: number and type of cycles per hour, starting time, time at load, braking type, braking time, idle time, cycle duration, period at rest and power demand.		On request

In the case of high counter-torques and high mass moments of inertia (heavy starting), please contact SEW-EURODRIVE with exact information about the technical data.

6.3 Switching frequency

A motor is usually rated according to its thermal loading. In many applications the motor is started only once (S1 = continuous running duty = 100 % cdf). The power demand calculated from the load torque of the driven machine is the same as the rated motor power.

High switching frequency

Many applications call for a high switching frequency at low counter-torque, such as in travel drives. In this case, it is not the power demand that is the decisive factor in determining the size of the motor, but rather the number of times the motor has to start up. Frequent starting means the high starting current flows every time, leading to disproportionate heating of the motor. The windings become overheated if the heat absorbed is greater than the heat dissipated by the motor ventilation system. The thermal load capacity of the motor can be increased by selecting a suitable thermal classification or by means of forced cooling (see section "Thermal characteristics - DR, DRL" on page 76).

No-load switching frequency Z_0

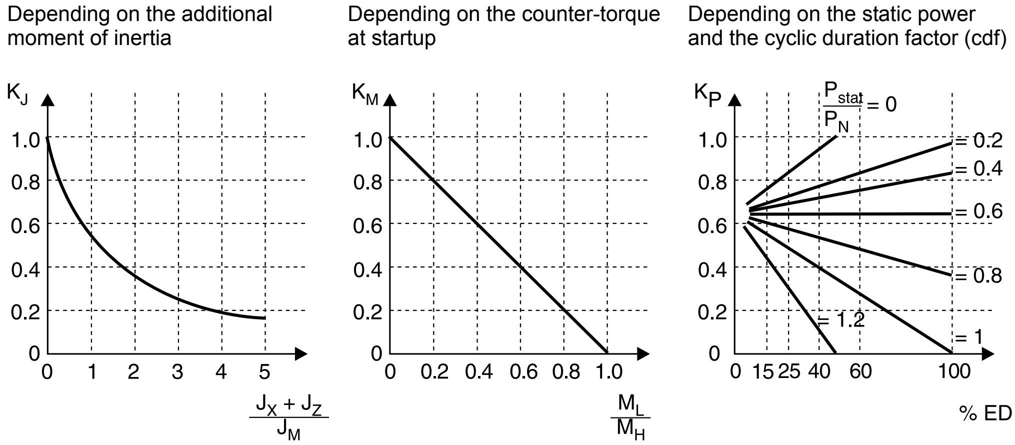
SEW-EURODRIVE specifies the permitted switching frequency of a motor as the no-load switching frequency Z_0 at 50 % cdf. This value indicates the number of times per hour that the motor can accelerate the mass moment of inertia of its rotor up to speed without counter-torque at 50 % cdf. If an additional mass moment of inertia has to be accelerated or if an additional load torque occurs, the starting time of the motor will increase. Increased current flows during this acceleration time. This means the motor is subjected to increased thermal load and the permitted switching frequency is reduced.

Permitted motor switching frequency

You can determine the permitted switching frequency Z of the motor in cycles/hour [1/h] using the following formula:

$Z = Z_0 \times \mathbf{K_J} \times \mathbf{K_M} \times \mathbf{K_P}$

You can determine the factors K_J, K_M and K_P using the following diagrams:



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J_X	=	Total of all external mass moments of inertia in relation to the motor axis	M_H	=	Acceleration torque of the motor
J_Z	=	Mass moment of inertia flywheel fan	P_{stat}	=	Power requirement after start-up (static power)
J_M	=	Motor's mass moment of inertia	P_N	=	Rated motor power
M_L	=	Counter-torque during startup	%cdf	=	cyclic duration factor

Example

Brakemotor: DRS71M4 BE1

No-load switching frequency Z_0 = 11000 per h

1. $(J_X + J_Z) / J_M = 3.5$: $K_J = 0.2$
2. $M_L / M_H = 0.6$: $K_M = 0.4$
3. $P_{stat} / P_N = 0.6$ and 60% cdf : $K_P = 0.65$

$Z = Z_0 \times K_J \times K_M \times K_P = 11000\ 1/h \times 0.2 \times 0.4 \times 0.65 = 572\ 1/h$

The cycle duration is 6.3 s, the operating time 3.8 s.

Permitted brake switching frequency

If you are using a brakemotor, you have to check whether the brake is approved for use with the required switching frequency "Z". Refer to the information in section "Permitted braking work of the BE brake in hoist applications" on page 274 ff and in section "Permitted braking work of the BE brake in hoist applications" on page 278 ff.

6.4 Mechanical characteristics

Degrees of protection to EN 60034 (IEC 60034-5)

AC motors and AC brakemotors are available with degree of protection IP54 as standard. Enclosures IP55, IP56, IP65 or IP66 are available upon request.

IP	1. digit		2. digit
	Touch guard	**Protection against foreign objects**	**Protection against water**
0	No protection	No protection	No protection
1	Protected against access to hazardous parts with the back of your hand	Protection against solid foreign objects ∅ 50 mm and larger	Protection against dripping water
2	Protected against access to hazardous parts with a finger	Protection against solid foreign objects ∅ 12 mm and larger	Protection against dripping water if the housing is tilted by up to 15°
3	Protected against access to hazardous parts with a tool	Protection against solid foreign objects ∅ 2.5 mm and larger	Protection against spraying water
4	Protected against access to hazardous parts with a wire	Protection against solid foreign objects ∅ 1 mm and larger	Protection against splashing water
5		Dust-proof	Protection against water jets
6		Dust-proof	Protection against powerful water jets
7	-	-	Protected against temporary immersion in water
8	-	-	Protected against permanent immersion in water

Vibration class of motors

The rotors of AC motors are dynamically balanced with a half key. The motors are in vibration class "A" according to IEC 60034-14:2003 or vibration level "N" according to DIN ISO 2373 (EN60034-14:1997). For special requirements on the mechanical running smoothness, single-speed motors without options installed (without brake, forced cooling fan, encoder, etc.) are available in a low-vibration design, vibration class "B" according to IEC 60034-14:2003 or vibration level "R" according to DIN ISO 2373.

Corrosion protection KS

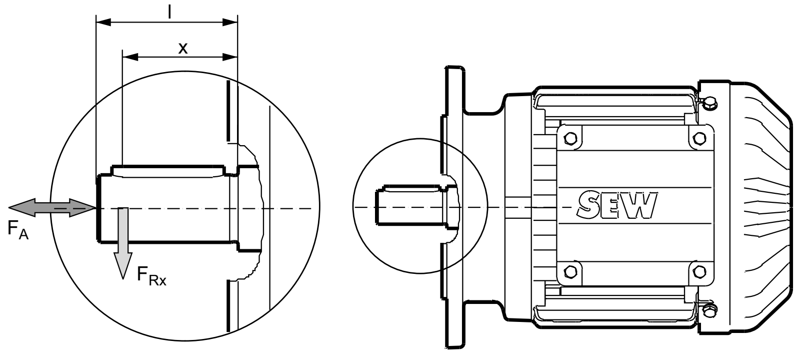
If the motors are exposed to the weather, e.g. outdoor use without roof, the KS corrosion protection variant must be used.

6.5 Overhung loads - DR, DRL

Permitted overhung load for DR motors

Refer to the following diagrams for the permitted overhung load F_{Rx} for DR AC (brake) motors. In order to read the permitted overhung load from the diagram, you must know what the distance x is between the force application point of the overhung load F_R and the shaft shoulder.

The following figure shows the application point of the overhung load.



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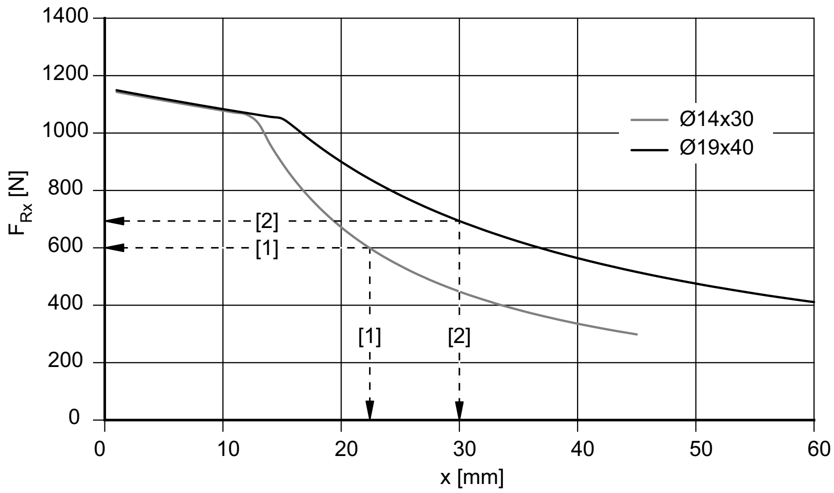
- l = Length of the shaft end
- x = Distance between overhung load application point and shaft shoulder
- F_{Rx} = Overhung load at force application point
- F_A = Axial force

The following diagram shows an example of how you can read the overhung load from the diagram:



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[1] Motor with shaft diameter 14 mm, force application x at 22 mm, permitted overhung load F_{Rx} = 600 N

[2] Motor with shaft diameter 19 mm, force application x at 30 mm, permitted overhung load F_{Rx} = 700 N

Permitted axial load for DRL motors

The determined value F_{Rx} for the DR motors is reduced by 0.8 to calculate the permitted overhung load $F_{Rx\text{-}DRL}$ for the DRL motors:

$$F_{Rx\text{-}DRL} = 0.8 \times F_{Rx}$$

Permitted axial load for DR and DRL motors

You can then determine the permitted axial force F_A by means of the previously determined overhung load F_{Rx}:

$F_A = 0.2 \times F_{Rx}$

$F_{A\text{-}DRL} = 0.2 \times F_{Rx\text{-}DRL}$

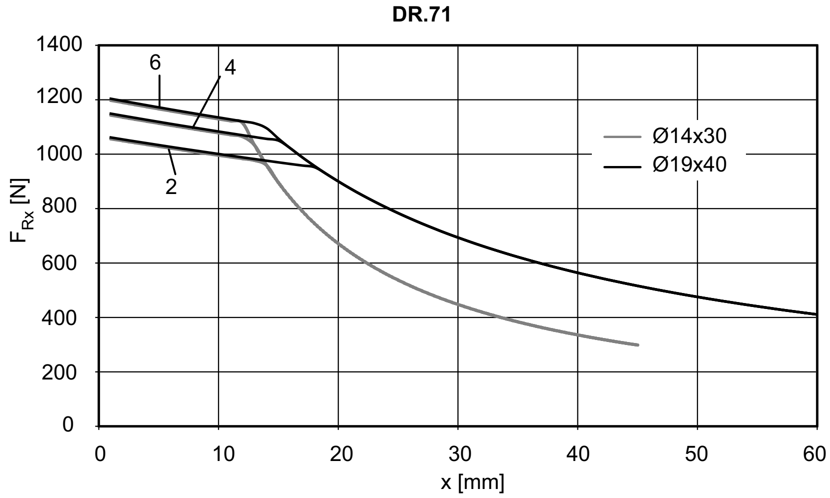
Permitted overhung loads of pole-changing motors

The permitted overhung loads for pole-changing motors are the same as those for 4-pole motor.

Overhung load diagrams of 2, 4 and 6-pole DR motors

Overhung load diagram for DR.71

Overhung load diagram for 2, 4, 6-pole DR.71 motors:



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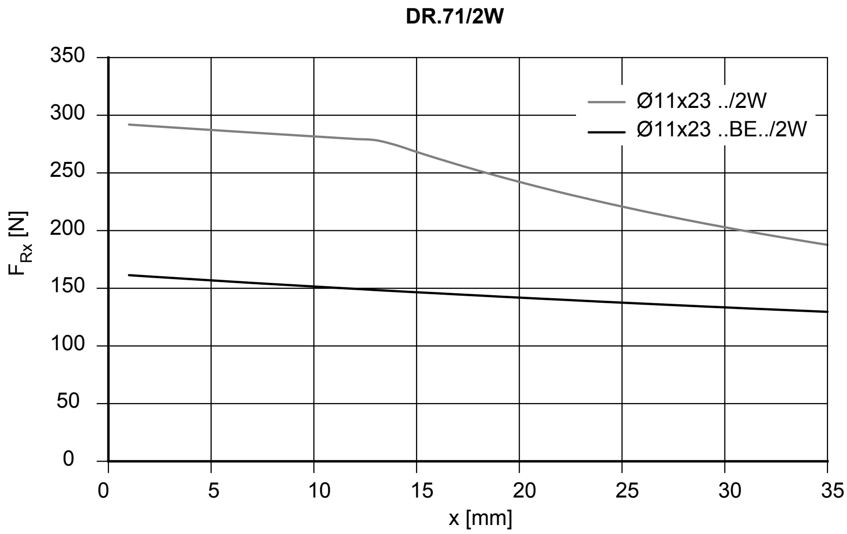
2 2-pole 4 4-pole 6 6-pole

Overhung load diagram DR.71 at second shaft end

Overhung load diagram for 2, 4, 6-pole DR.71 motors on the 2nd shaft end:



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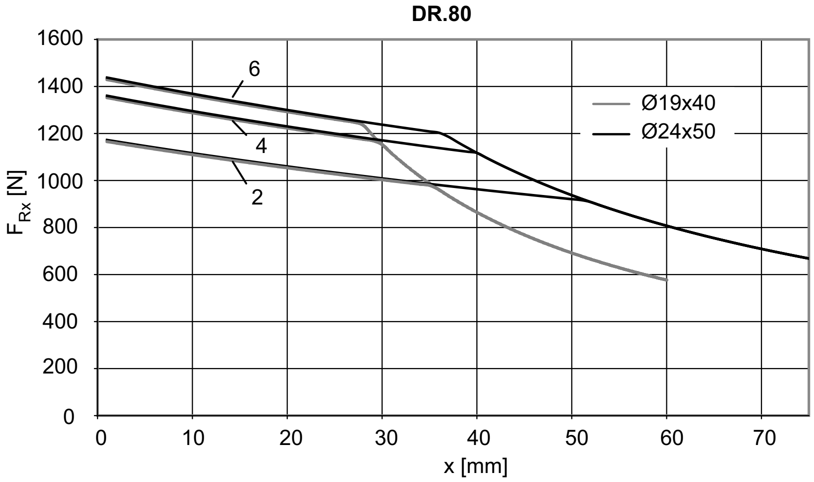
Overhung load diagram for DR.80

Overhung load diagram for 2, 4, 6-pole DR.80 motors:



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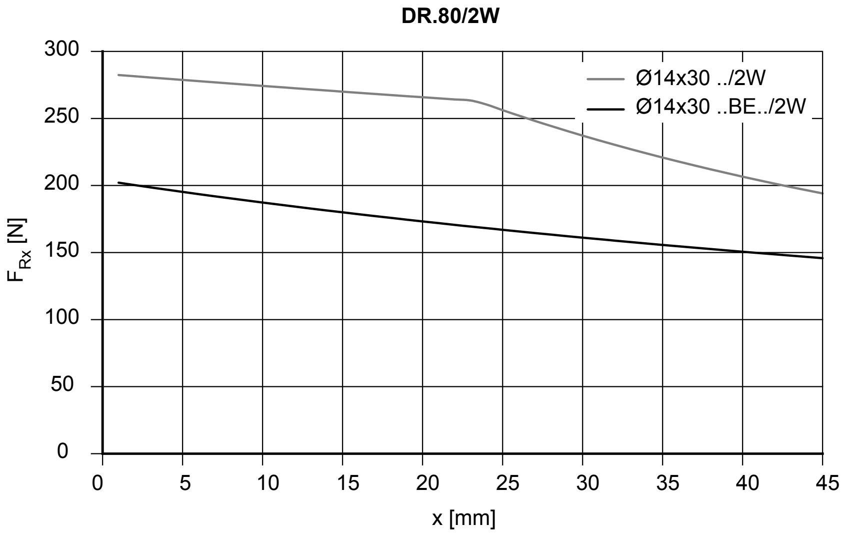
2	2-pole	4	4-pole	6	6-pole

Overhung load diagram DR.80 at second shaft end

Overhung load diagram for 2, 4, 6-pole DR.80 motors on the 2nd shaft end:



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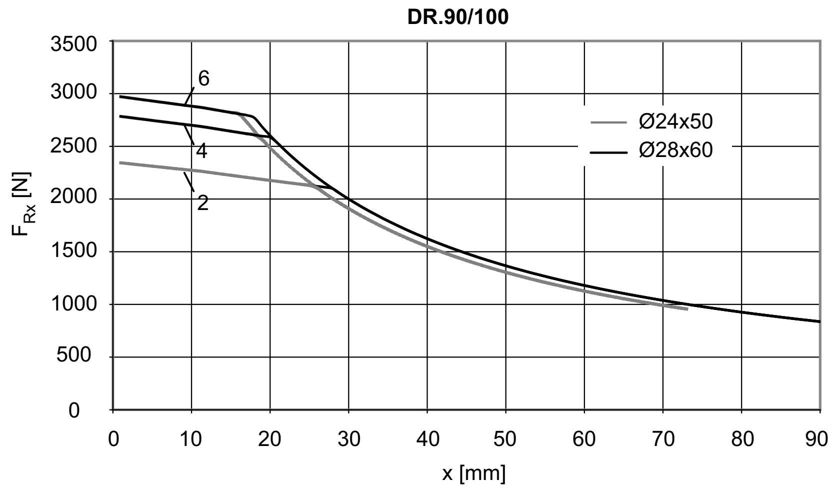
Overhung load diagram DR.90 and DR.100

Overhung load diagram for 2, 4, 6-pole DR.90 and DR.100 motors:



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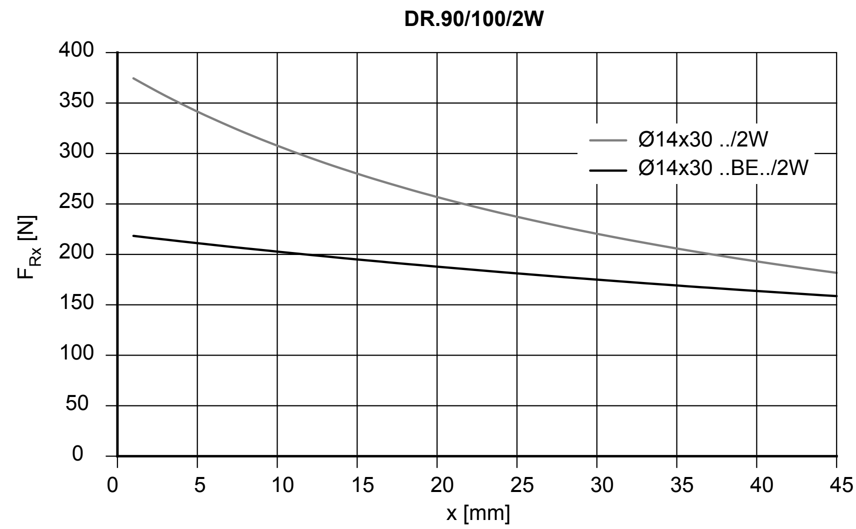
2 2-pole 4 4-pole 6 6-pole

Overhung load diagram DR.90 and DR.100 at second shaft end

Overhung load diagram for 2, 4, 6-pole DR.90 and DR.100 motors on the 2nd shaft end:



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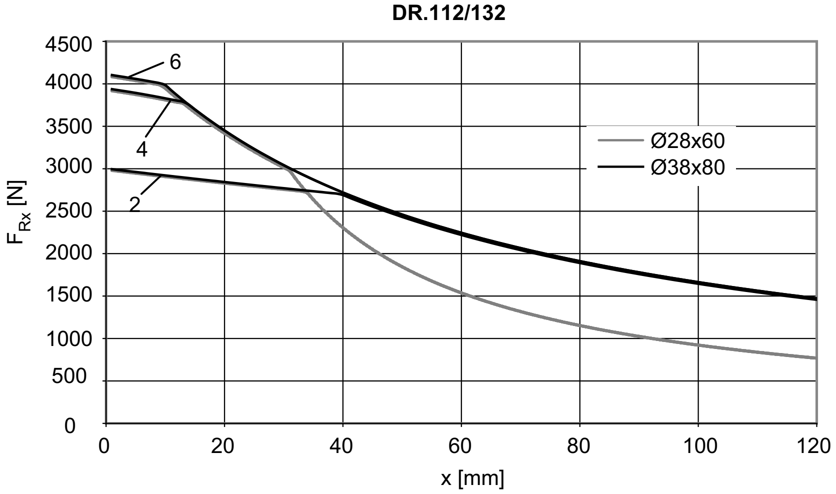
Overhung load diagram DR.112 and DR.132

Overhung load diagram for 2, 4, 6-pole DR.112 and DR.132 motors:



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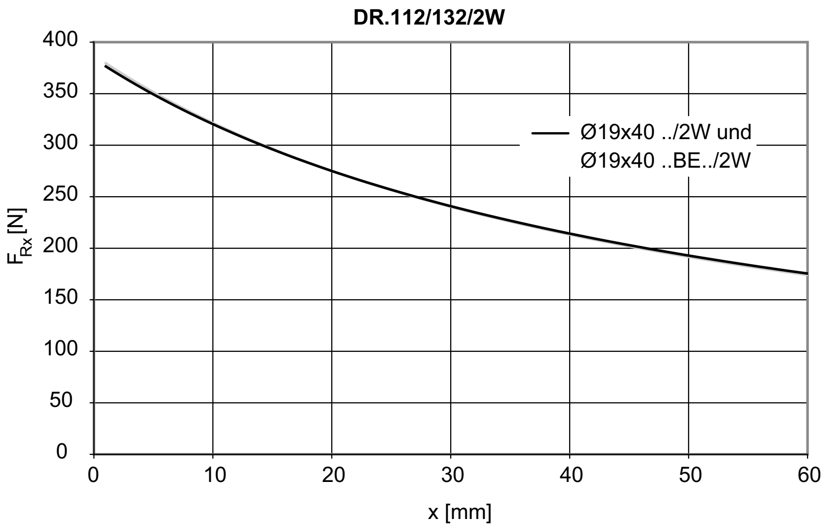
2 2-pole 4 4-pole 6 6-pole

Overhung load diagram DR.112 and DR.132 at second shaft end

Overhung load diagram for 2, 4, 6-pole DR.112 and DR.132 motors on the 2nd shaft end:



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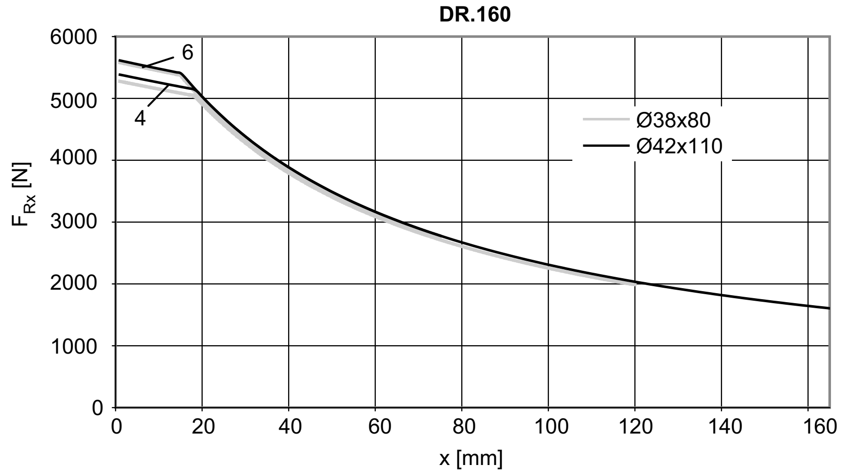
Overhung load diagram DR.160

Overhung load diagram for 4, 6-pole DR.160 motors:



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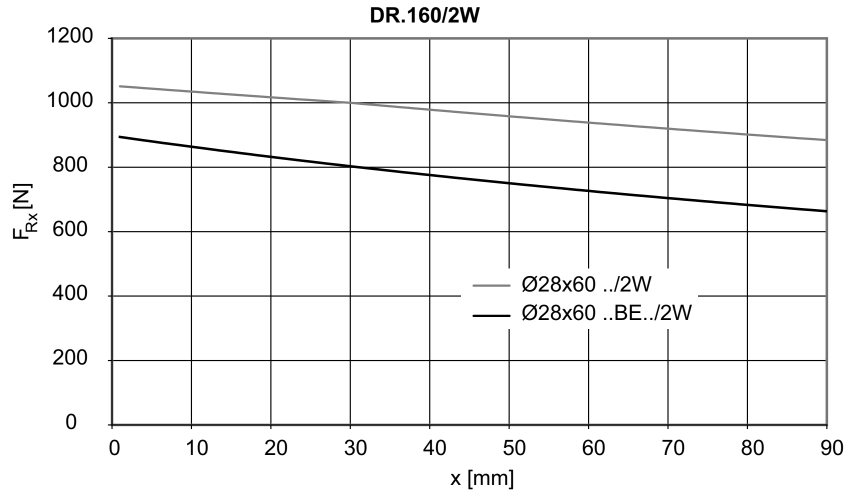
4 4-pole 6 6-pole

Overhung load diagram DR.160 at second shaft end

Overhung load diagram for 4, 6-pole DR.160 motors at second shaft end:



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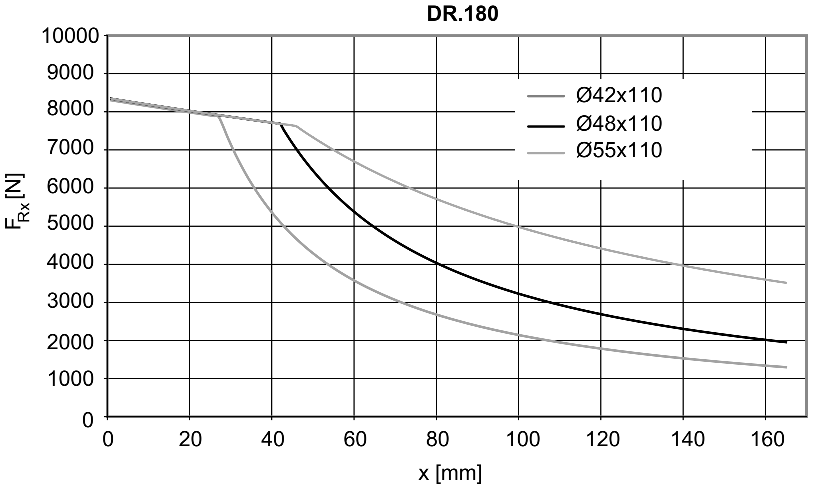
Overhung load diagram DR.180

Overhung load diagram for 4-pole DR.180 motors:



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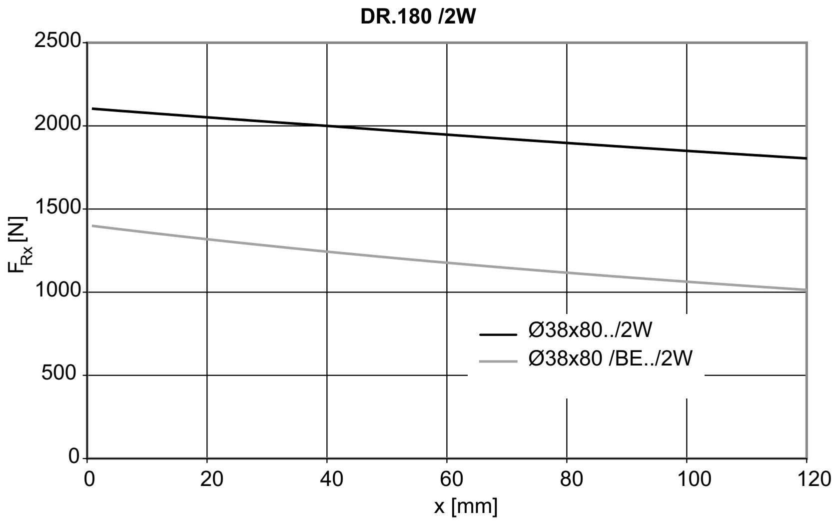
Overhung load diagram DR.180 at second shaft end

Overhung load diagram for 4-pole DR.180 motors at second shaft end:



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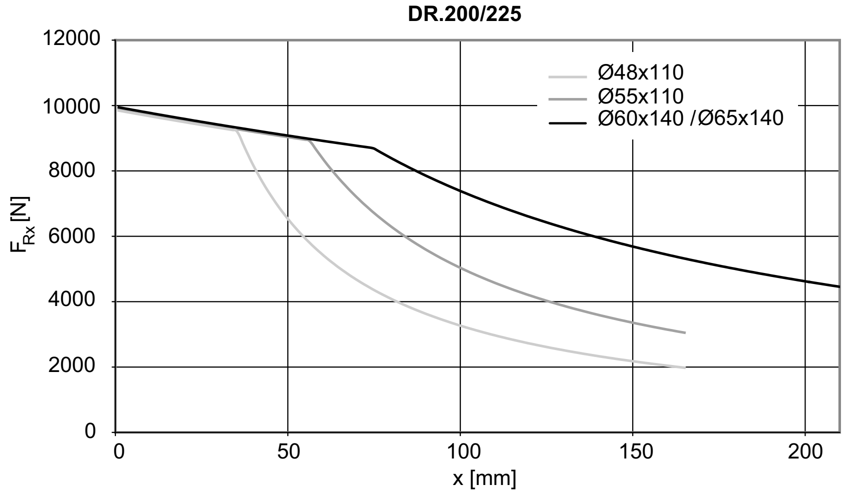
Overhung load diagram DR.200 and DR.225

Overhung load diagram for 4-pole DR.200 and DR.250 motors:



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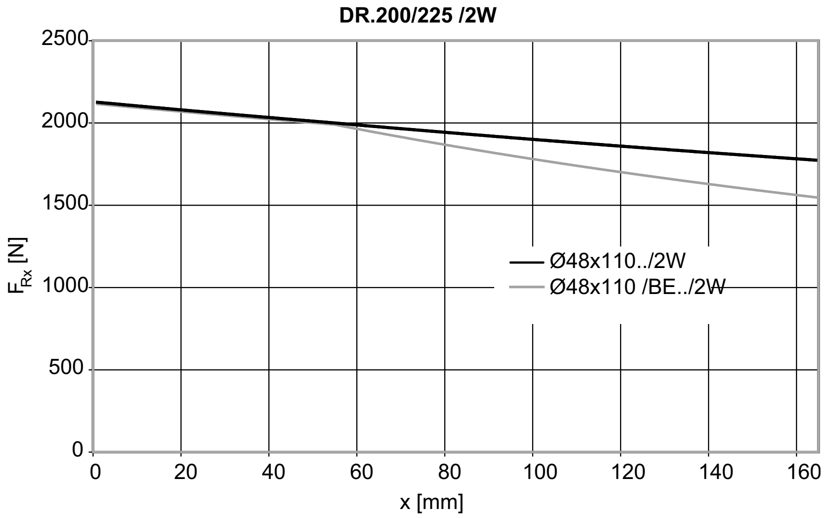
Overhung load diagram DR.200 and DR.225 at second shaft end

Overhung load diagram for 4-pole DR.200 and DR.225 motors at second shaft end:



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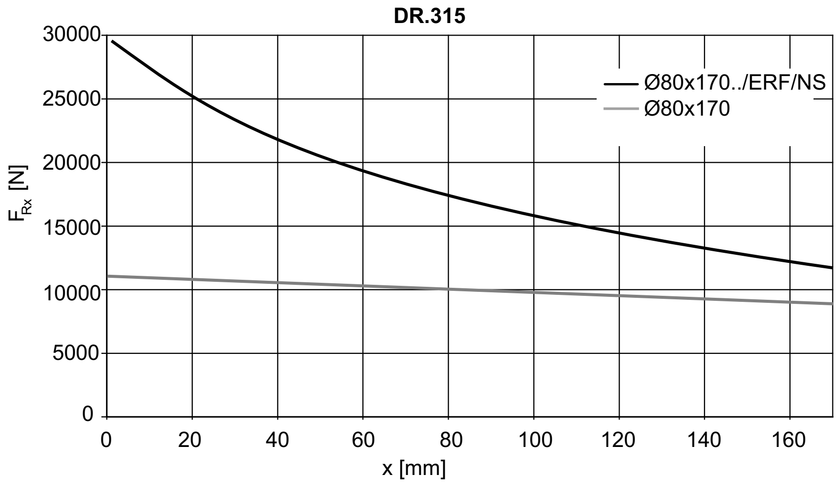
Overhung load diagram DR.315

Overhung load diagram for 4-pole DR.315 motors:



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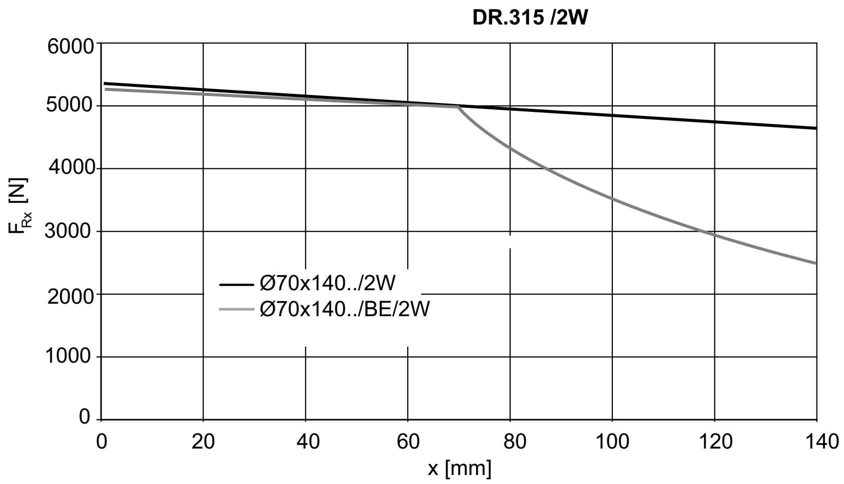
TIP

Conversion of the overhung load into the axial load as described on page 83 must not be used with reinforced bearings (../ERF).

Overhung load diagram DR.315 at second shaft end

Overhung load diagram for 4-pole DR.315 motors at second shaft end:



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Permitted ball bearing types

The following table shows the permitted ball bearing types:

Motor type	A-side bearing		B-side bearing	
	IEC motor	Gearmotor	AC motor	Brakemotor
DR.71	6204-2Z-J-C3	6303-2Z-J-C3	6203-2Z-J-C3	6203-2RS-J-C3
DR.80	6205-2Z-J-C3	6304-2Z-J-C3	6304-2Z-J-C3	6304-2RS-J-C3
DR.90-DR.100	6306-2Z-J-C3		6205-2Z-J-C3	6205-2RS-J-C3
DR.112-DR.132	6308-2Z-J-C3		6207-2Z-J-C3	6207-2RS-J-C3
DR.160	6309-2Z-J-C3		6209-2Z-J-C3	6209-2RS-J-C3
DR.180	6312-2Z-J-C3		6213-2Z-J-C3	6213-2RS-J-C3
DR.200-DR.225	6314-2Z-J-C3		6314-2Z-J-C3	6314-2RS-J-C3

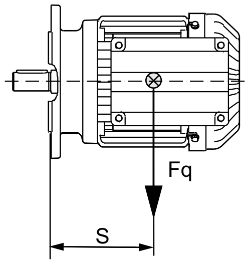
Motor type	A-side bearing		B-side bearing	
	IEC motor	Gearmotor	IEC motor	Gearmotor
DR.315K /315S	6319-J-C3	6319-J-C3	6319-J-C3	6319-J-C3
DR.315M /315L		6322-J-C3		6322-J-C3
DR.315K /315S /ERF[1)]	NU319E		6319-J-C3	6319-J-C3
DR.315M /315L /ERF[1)]				6322-J-C3

1) Reinforced bearing

6.6 Center of gravity of the DR. motors

The center of gravity of a motor is a theoretical variable which assumes that the entire mass of the motor (see technical data page 44 ff) is concentrated in one point and acts on this point with the weight F_q.

Please take this into account when combining IEC motors with gear units that are mounted using adapters.



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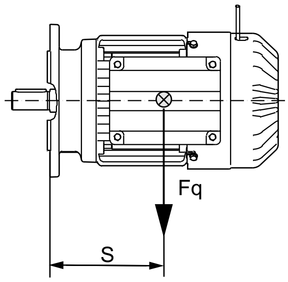
Motor type	Center of gravity S [mm]
DR.71S	86
DR.71M	92
DR.80S	106
DR.80M	119
DR.90M	118
DR.90L	124
DR.100M	137
DRP100M	140
DR.100L / LC	153
DR.112M	153
DR.132S	167
DR.132M / MC	193
DR.160S / M / MC	205
DR.180S / M	224
DR.180L / LC	237
DR.200L	228
DR.225S	250
DR.225M / MC	264
DR.315K / S	419
DR.315M / L	505

6.7 Center of gravity of the DR. brakemotors

The center of gravity of a brakemotor is a theoretical variable which assumes that the entire mass of the brakemotor (see technical data page 44 ff) is concentrated in one point and acts on this point with the weight F_q.

Please take this into account when combining IEC motors with gear units that are mounted using adapters.



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Motor type	Brake	Center of gravity S [mm]
DR.71S	BE05	108
DR.71M	BE1	112
DR.80S	BE1	148
DR.80M	BE2	150
DR.90M	BE2	142
DR.90L	BE5	151
DR.100M	BE5	165
DR.100L / LC	BE5	180
DR.112M	BE5	179
DR.132S	BE11	202
DR.132M / MC	BE11	226
DR.160S	BE20	265
DR.160M / MC	BE20	255
DR.180S	BE20	287
DR.180M / L	BE30	302
DR.180LC	BE32	318
DR.200L	BE32	340
DR.225S	BE32	340
DR.225M	BE32	363
DRS225MC	BE32	354
DR.315K / S	BE122	489
DR.315M / L	BE122	550

6.8 *Project planning notes for asynchronous servomotors*

You can tap the full potential of the asynchronous servomotor just by projecting it appropriately.

The schematic process is shown on page 96 .

Dynamics package D1 or D2

You must decide during project planning which dynamics package is required and will be implemented.

This will affect the dimensioning, especially the size of the inverter.

The higher mass moments of inertia of the motor compared to the synchronous servomotor, roughly factor 10 or more, offer advantages for controlling loads with high intrinsic inertia, also when considering the reduced ratio through the gear unit reduction ratio.

For detailed information, refer to page 17.

For motors at a glance, see page 22 ff.

Sine encoder

/ES7S /EG7S

The sine encoder included in the drive package has a resolution of 1024 sine periods.

In a closed-loop control system with inverter, the inverter evaluates and details this 10 bit speed signal with a factor of 3 bits. This allows for a speed setting range of 1:5000. Speeds below 1 rpm can be realized with great precision.

Startup is simplified by the electronic nameplate included in the encoder.

For detailed information, refer to page 285 ff.

Absolute encoder

/AS7. /AG7.

Instead of the sine encoder, you can install an absolute encoder in the same place without additional length.

In addition to the absolute information, the RS485 encoder also offers better motor control (by one bit = 2048 sine periods).

The SSI encoder establishes the connection to the safety elements in the control cabinet.

For detailed information, refer to page 285 ff.

Forced cooling fan

/V

The optional use of a forced cooling fan prevents torque reduction at low speed.

The relationship is even reversed, that means the permitted standstill torque at speed "0" with a forced cooling fan is 10 - 15% higher that the rated torque.

For detailed information, refer to page 311 ff.

For limit characteristic curves, see "AC Motors" manual.

Inverter utilization

DRL with MDx and MX

During project planning for an asynchronous servomotor, you determine

- an average speed and the average torque,
- the maximum speed and the maximum dynamic torque.

To select a suitable inverter, you must check the thermally decisive elements in the limit characteristic curves with 100% I_n and the peak values in the diagrams with 150% / 200% I_n.

For technical data of DRL motors, see page 64.

For combinations of DRL-MDx, combinations of DRL-MX, limit characteristic curves, see "AC Motors" manual.

6.9 Project planning procedure - DR, DRL

The following flow diagram illustrates the project planning procedure for a positioning drive. The drive consists of a gearmotor that is powered by an inverter.

Necessary information on the machine to be driven
Technical data and environmental conditions
Positioning accuracy
Speed setting range
Calculation of the travel cycle

↓

Calculate the relevant application data
Travel diagram
Speeds
Static, dynamic torques
Regenerative power

↓

Gear unit selection
Definition of gear unit size, gear unit reduction ratio and gear unit type
Check the positioning accuracy
Check for gear unit utilization ($M_{a\ max} \geq M_{a\ (t)}$).
Check the input speed (churning losses)

↓

Motor selection
Maximum torque
For dynamic drives: Effective torque at medium speed
Maximum speed
Observe dynamic and thermal torque curves
Select the correct encoder
Motor equipment (brake, plug connector, TF selection, etc.)

↓

Selecting the inverter
Motor/inverter assignment
Continuous current and peak current in current-controlled inverters/axes.

↓

Selecting the braking resistor
based on the calculated regenerative power, cdf and peak breaking power.

↓

Options
EMC measures
Operation/communication,
Additional functions

↓

Make sure that all requirements have been met.

6.10 *Project planning example for asynchronous servomotors*

In the example, the drive for a trolley is determined.

The following data is provided:

- Weight of the load: m_L = 300 kg
- Weight of the carriage: m_W = 800 kg
- Traveling velocity: v = 2 m/s
- Acceleration: a_1 = 2 m/s^2
- Deceleration: a_2= 2 m/s^2
- Diameter of gear rack pinion: D_0 = 80 mm
- Resistance to motion: F_F = 90 N / 1000 kg
- Efficiency of the machine: η = 90 %

Calculated values:

- Maximum output torque: M = 102.2 Nm
- Maximum output speed: n = 477 1/min

Gear unit selection

- Gear unit reduction ratio: $i_{setp.}$ = 6.28
- Selecting the gear unit size and reduction ratio: K47 with i = 5.81

  Caution: The overhung load is too high with the recommended gear rack pinion factor f_z = 2 (see catalog "Synchronous Servo Gearmotors") (F_R = 5437 N). This must either be compensated by a suitable bearing for the gear rack pinion, or a larger gear unit must be selected.

Motor selection

Maximum operating point

- Converting the torque to the motor side

  $M_{\mathbf{max}}$ = 19.56 Nm at n = 2774 rpm

  $n_{\mathbf{max}}$ = 2774 rpm at M = 19.56 Nm

  M_{max} and n_{max} indicate the maximum operating point; in this case it is identical for M_{max} and n_{max}.

Effective operating point

$M_{\mathbf{eff}}$ = 8.26 Nm at $\overline{n}$ = 1981 rpm

Motor pre-selection

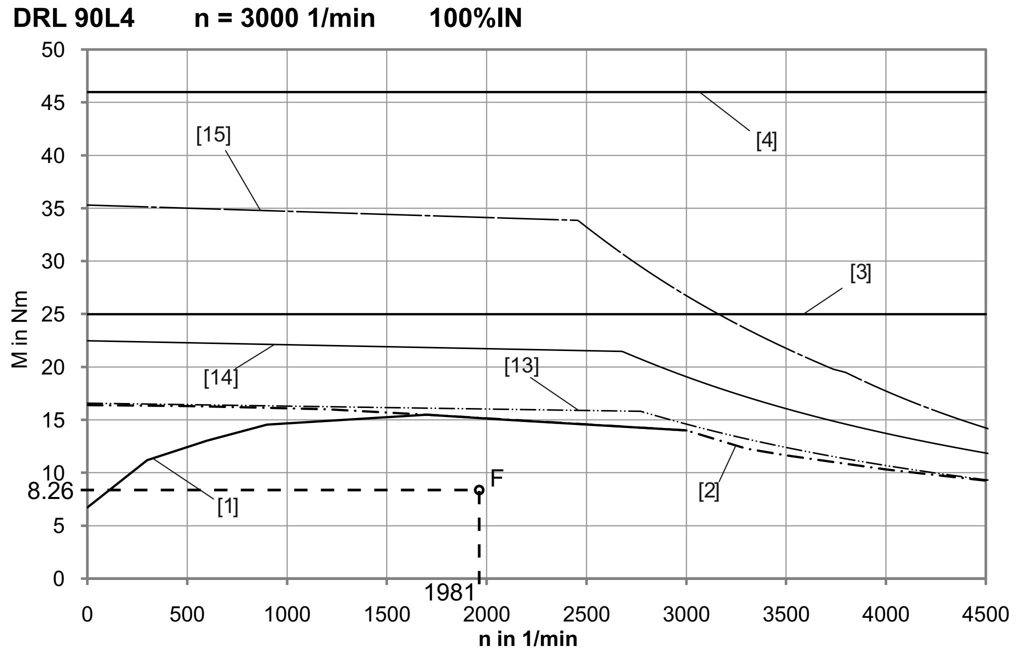
- DRL90L4 with n_{base} = 2683 rpm and M_{max} = 19.9 Nm
- Checking the mass moment of inertia: J_{ext}/J_{mot} = 12.03

MOVIDRIVE® inverter selection

- The effective operating point (F) for the motor must be below the S_1 limit curve. This means the thermal load on the motor is within the permitted range.
- Furthermore, the effective operating point (F) must be below the characteristic curve for the designated motor-inverter combination in the speed/torque diagram for 100% inverter utilization. This means the load on the inverter (continuous duty) is within the permitted range.

DRL90L4, n_N = 3000 rpm, 100% I_N

Determining the effective operating point:



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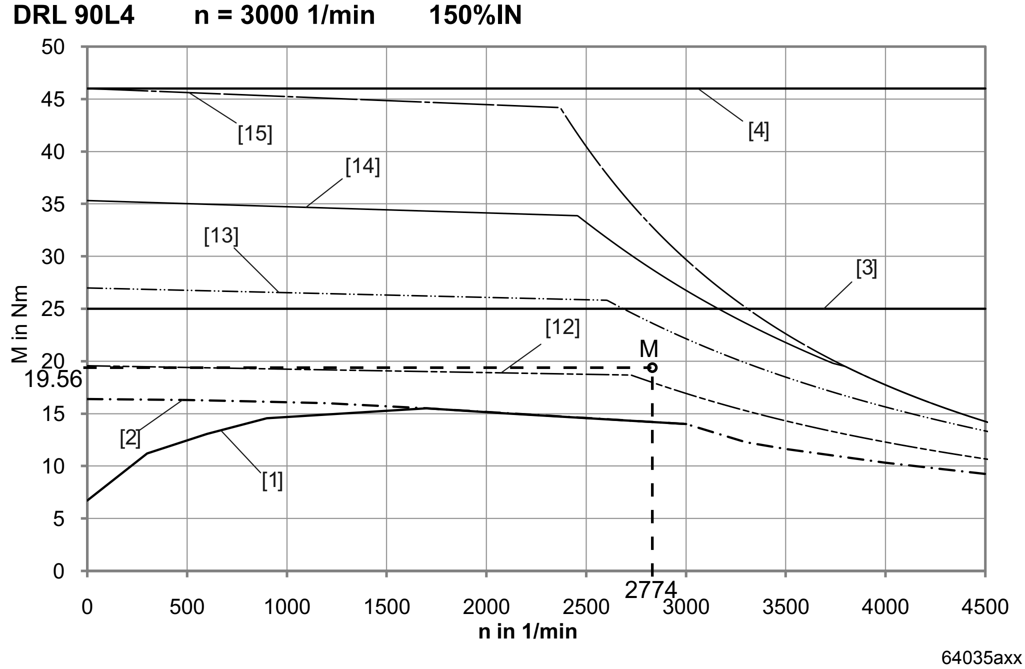
Key

[1]	S1 characteristic curve	[12]	4 kW inverter output
[2]	S1 characteristic curve with forced cooling fan	[13]	5.5 kW inverter output
[3]	Maximum limit torque of dynamics package 1	[14]	7.5 kW inverter output
[4]	Maximum limit torque of dynamics package 2	[15]	11 kW inverter output

- In the speed/torque diagram for 150% inverter utilization, the maximum operating point (M) (probably two different points for maximum speed and maximum torque) must be below the characteristic curve for the designated motor-inverter combination. This means the load on the inverter (maximum operation) is within the permitted range.

DRL90L4, n_N = 3000 rpm, 150% I_N

Determine the maximum operating point:



Key

[1]	S1 characteristic curve	[12]	4 kW inverter output
[2]	S1 characteristic curve with forced cooling fan	[13]	5.5 kW inverter output
[3]	Maximum limit torque of dynamics package 1	[14]	7.5 kW inverter output
[4]	Maximum limit torque of dynamics package 2	[15]	11 kW inverter output

TIP

The inverter current at motor standstill should be less than 70% of the rated motor current.

This means the required inverter has been determined:

- MDX61B0055-5A3, 5.5 kW

Project planning result

Selected motor:

- DRL90L4/F./TF/ES7S

Selected drive inverter:

- MDX61B0055-5A3 with 5.5 kW inverter output

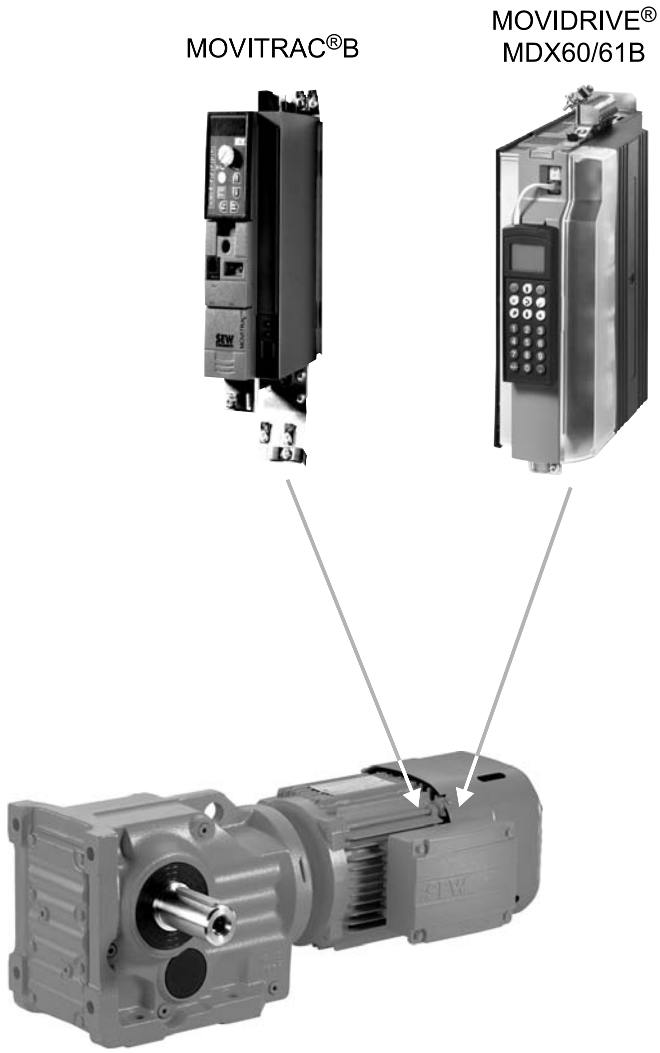
6.11 Operation on inverter

Range of products

The extensive product range of SEW-EURODRIVE inverters is available for designing electronically controlled drives. SEW-EURODRIVE offers the following inverter series:

- MOVITRAC® **B:** Compact and inexpensive frequency inverter for the power range 0.25 – 160 kW. Single-phase and three-phase supply system connection for AC 230 V and three-phase supply system connection for AC 400 – 500 V.
- MOVIDRIVE® **MDX60/61B:** High-performance drive inverter for dynamic drives in the 0.55 – 160 kW power range. Great diversity of applications due to extensive expansion options with technology and communication options. Three-phase supply system connection for AC 230 V and AC 400 – 500 V.
- MOVIAXIS® **MX:** Powerful and versatile multi-axis servo inverter in the power range from 10 kW rated power to 187 kW peak power. Great diversity of applications due to extensive expansion options with technology and communication options. Sinusoidal power regeneration as an option. 3-phase supply system connection for AC 380 – 500 V.

Range of inverters for DRS, DRE, DRP series AC motors:



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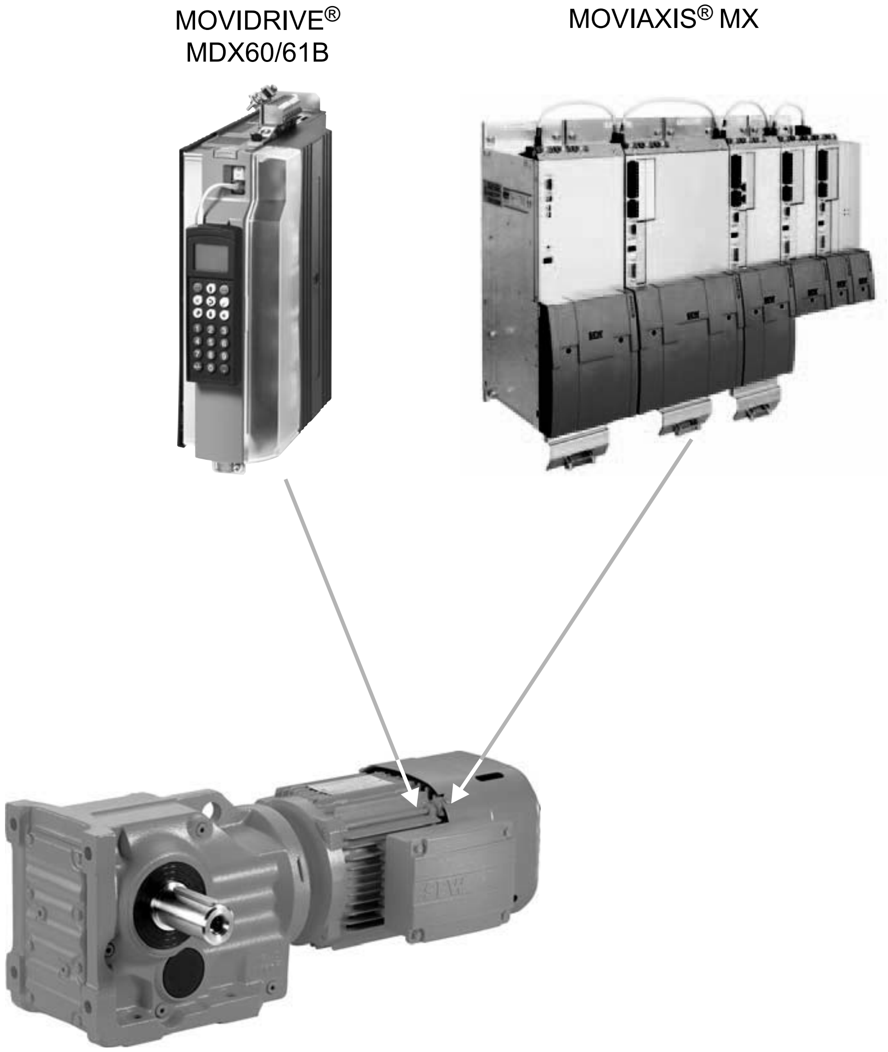
Range of inverters for asynchronous DRL servomotors:



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Product characteristics

The following table lists the most important product characteristics for the various inverter series. You can choose the inverter series matching your application based on these product features.

Product features	MOVITRAC® B	MOVIDRIVE® MDX60/61B	MOVIAXIS® MX
Voltage range	1 × AC 200 – 240 V (limited power range) 3 × AC 200 – 240 V (limited power range) 3 × AC 380 – 500 V	3 × AC 200 – 240 V (limited power range) 3 × AC 380 – 500 V	3 × AC 380 – 500 V
Power range	0.25 – 160 kW	0.55 – 250 kW	10 – 75 kW
Rated current range of the axis modules		4 – 250 A	2 – 133 A
Overload capacity	150% I_N[1)] briefly and 125% I_N permanently during operation without overload		250% for max. 1 second
4Q capable	Yes, with integrated brake chopper as standard.		
Integrated line filter	At 1 × AC 200 - 240 V: according to class B limit At 3 × AC 200 - 240 V and 3 × AC 380 - 500 V: sizes 0, 1 and 2 according to class A limit	Sizes 0, 1 and 2 According to limit class A	External line filter
TF input	Yes		
Control modes	V/f or voltage-controlled flux vector control (VFC)	V/f or voltage-controlled flux vector control (VFC), with speed feedback speed control and current-controlled flux vector control (CFC).	Current-controlled flux vector control
Speed feedback	No	Option	Integrated in basic unit
Integrated positioning and sequence control system	No	Standard	Standard
Serial interfaces	System bus (SBus) and RS-485		CAN-based system bus, optional EtherCAT-based system bus
Fieldbus interfaces	Optional via gateway PROFIBUS, INTERBUS, CANopen, DeviceNet, Ethernet	Optional PROFIBUS-DP, INTERBUS, INTERBUS LWL, CANopen, DeviceNet, Ethernet	Optional PROFIBUS-DP, EtherCAT,
Application options	IEC-61131 control	Input/output card Synchronous operation Absolute encoder card IEC-61131 control	Synchronous operation, electronic gear, touch probe, event control, electronic cam, virtual encoder, single-axis positioning
Max. speed		6000 rpm	10000 rpm
Safe stop	Yes	Yes	Option
Approvals	UL and cUL approval, C-tick		

1) Only for MOVIDRIVE® MDX60/61B: The temporary overload capacity of size 0 units (0005 – 0014) is 200% I_N.

6.12 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR asynchronous AC motors with inverter. The following factors determine the thermally permitted torque:

- Duty cycle
- Type of cooling: Self-ventilation or forced cooling
- Base frequency: f_{base} = 50 Hz (400 V ⅄) or f_{base} = 87 Hz (230 V △)

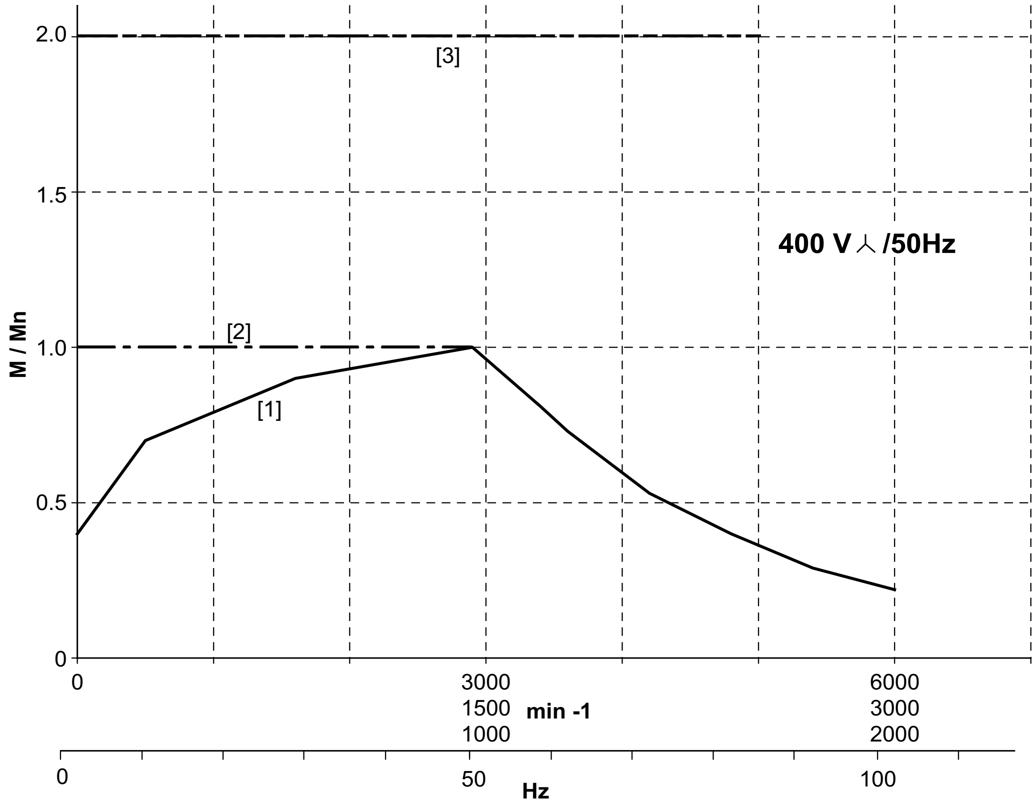
Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves of 4-pole asynchronous DR AC motors with f_{base} = 50 Hz and f_{base} = 87 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter V_{line} = 3 × AC 400 V
- Motor in thermal class 155 (F)

6

f_{base} = 50 Hz (400 V ⅄/50 Hz)

The following diagram shows the limit curves for operation at f_{base} = 50 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).



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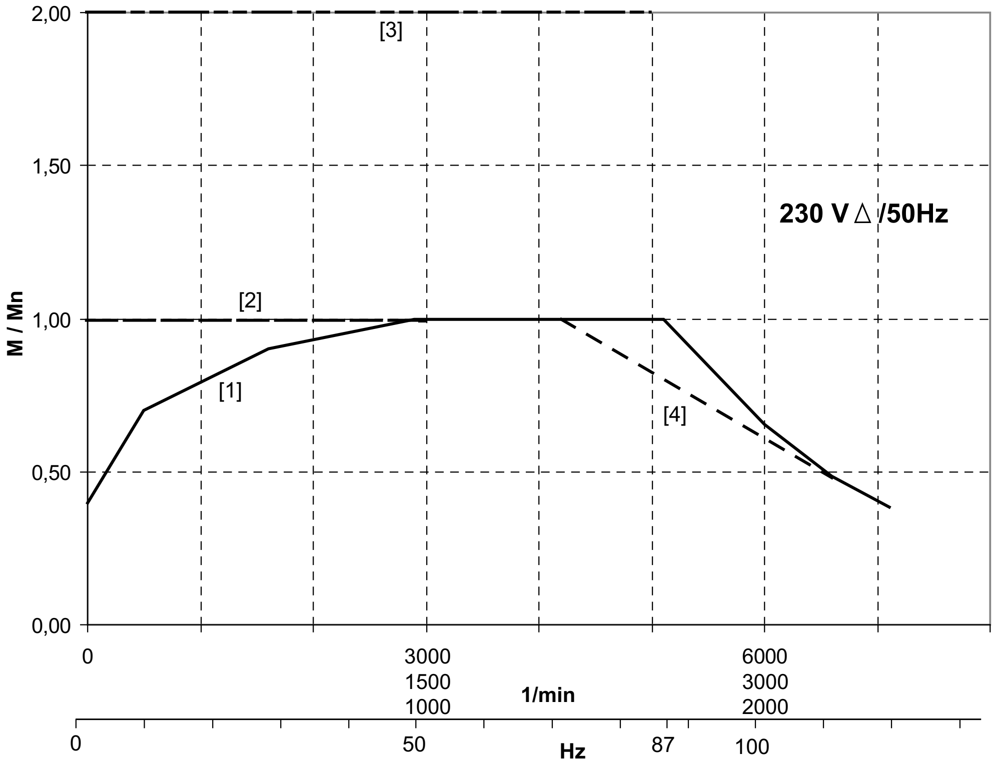
[1] S1 operation with self-ventilation (= without forced cooling fan)

[2] S1 operation with forced cooling (= with forced cooling fan)

[3] Mechanical limitations for gearmotors

f_{base} = 87 Hz (230 V △/50 Hz)

The following diagram shows the limit curves for operation at f_{base} = 87 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).



62582axx

[1] S1 operation with self-ventilation (= without forced cooling fan)

[2] S1 operation with forced cooling (= with forced cooling fan)

[3] Mechanical limitation for gearmotors

[4] Limitation for shaft heights 280 – 315

Mechanical limit

For electric machines operated on a frequency inverter, the maximum torque and the maximum speed must be regarded as the mechanical limit.

The maximum torque is based on the mechanical limit (curve [3]) in the diagrams. Only DRL motors can be operated with a higher torque for a short time due to their design.

Additional loads caused by the customer system, such as overhung or axial loads due to belt drives, must be taken into account for all motors.

Do not exceed the maximum speed of the motor. The following table lists these values for the standard motors. They refer to motors with FKM (fluoroelastomers) oil seals.

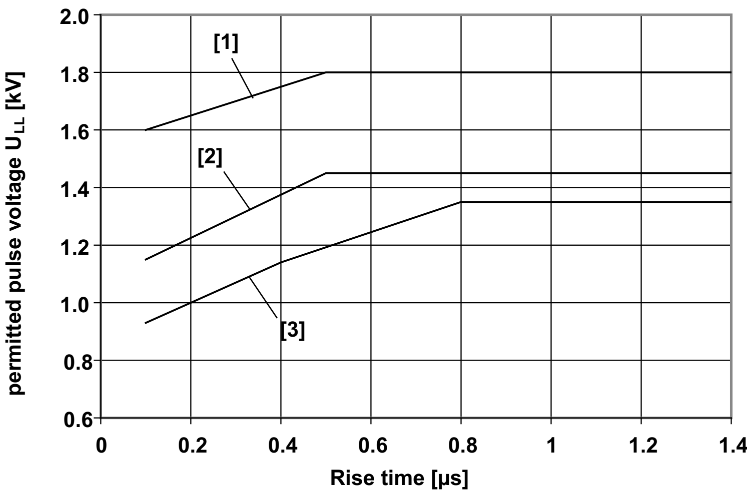
Additional motor options influence these speeds. Contact SEW-EURODRIVE in such cases. For brakemotors, additional project planning guidelines for the braking work must be observed.

Size	n_{max} [rpm]	
	Normal motor	Brakemotor
56	6000	4500
63	6000	4500
71	6000	4500
80	6000	4500
90	6000	4500
100	5200	4500
112	5200	3600
132	4500	3600
160	4500	3600
180	4500	3600
200/225	4000	3600
250/280	2600	2500
315	2500	2500

6.13 DR series AC motors operated on non-SEW inverters

When motors are powered from inverters, you must adhere to the wiring instructions issued by the inverter manufacturer. It is essential to observe the operating instructions for the frequency inverter.

Operation on non-SEW frequency inverters is permitted if the pulse voltages at the motor terminals indicated in the following figure are not exceeded.



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[1] Permitted pulse voltage for DR motors with reinforced insulation (../RI)

[2] Permitted pulse voltage for DR standard

[3] Permitted pulse voltage according to IEC60034-17

TIP

Compliance with the following limit values must be checked and considered:

- The supply voltage level at the non-SEW inverter
- The threshold of the brake chopper voltage
- The operating mode of the motor (motive/regenerative)

If the permitted pulse voltage is exceeded, you must install limiting measures, such as filters, chokes or special motor cables. You should also consult the manufacturer of the frequency inverter.