4 Project planning for drives

4.1 Additional publications

For more detailed information about the project planning for drives, refer to the website of SEW-EURODRIVE where you can order or download the following documentations.

- Drive Engineering - Practical Implementation
  - EMC in Drive Engineering – Basic Theoretical Principles and EMC-Compliant Installation in Practice
  - Efficient Plant Automation with Mechatronic Drive Solutions
- Manuals
  - Project Planning for BE.. Brakes

4.2 Drive and gear unit selection data

Determining application data

To select the proper drive, you first need the data (weight, speed, setting range, etc.) of the machine to be driven. These data help determine the required power, torque and speed. Refer to the documentation "Drive Engineering – Practical Implementation, Project Planning" or the SEW-Workbench project planning software for assistance.

Selecting the correct drive

Calculate power, rotational speed, torque, and overhung load of the drive. Observe all mechanical requirements. Then, the suitable drive can be determined.

Application data required for project planning:

Designation	Meaning	Unit
n_{G_min}	Minimum output speed	min^{-1}
n_{G_max}	Maximum output speed	min^{-1}
P_{a_nmin}	Output power at minimum output speed	kW
P_{a_nmax}	Output power at maximum output speed	kW
M_{a_nmin}	Output torque at minimum output speed	Nm
M_{a_nmax}	Output torque at maximum output speed	Nm
F_O	Axial load (tension and compression) on the output shaft	N
F_{R_a}	Overhung loads acting on the output shaft	N
J_L	Mass moment of inertia to be driven	10^{-4} kgm^2
R, F, K, S, W M1 - M6	Mounting position and required gear unit type, see chapter "Gear unit mounting positions" (→ 🗎 63) and "Project planning notes R, F, K, S, W gear units" (→ 🗎 48)	-
IP..	Required degree of protection	-
T_{amb}	Ambient temperature	°C
h	Installation altitude	m above sea level
S.., ..% cdf	Duty type and cyclic duration factor cdf – the exact load cycle can be entered instead	-
Z	Starting frequency – or exact load cycle can be specified	h^{-1}
f_{line}	Line frequency	Hz
U_{Mot}	Motor operating voltage	V
U_B	Brake operating voltage	V
M_{B_req}	Required braking torque	Nm
For inverter operation: required control mode and setting range		

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4.3 Project planning procedure for DR.. gearmotors

4.3.1 Drive selection – non-controlled operation

The following flow diagram illustrates the project planning procedure for a non-controlled drive. The drive consists of a gearmotor operated on the grid.

Necessary information regarding the machine to be driven

- Technical data and environmental conditions
- Stopping accuracy
- Output speed
- Starting acceleration and deceleration
- Cyclic duration factor and starting frequency

↓

Calculation of the relevant application data

- Static and dynamic power
- Rotational speeds
- Torques, power ratings
- Travel diagram, if required
- Determination of the required service factor f_{B_req}

↓

Motor selection

- Torque/power/speed (number of poles)
- Acceleration torque/starting torque
- Switching frequency
- Determination of the energy efficiency class IE
- Mechanical brake (braking work, braking torque, brake service life)
- Motor equipment (brake, plug connector, thermal motor protection, etc.)

↓

Gear unit selection

- Definition of gear unit type, gear unit size, gear unit ratio, and gear unit design
- Checking the positioning accuracy
- Checking the service factor f_B

↓

Ensuring that all requirements have been met.

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4.3.2 Drive selection – controlled operation

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 regarding the machine to be driven
- Technical data and environmental conditions
- Positioning accuracy
- Speed setting range
- Travel cycle calculation

↓

Calculation of the relevant application data
- Travel diagram
- Rotational speeds
- Static, dynamic torques
- Regenerative power

↓

Gear unit selection
- Definition of gear unit type, gear unit size, gear unit ratio, and gear unit design
- Checking the positioning accuracy
- Checking the gear unit utilization ($M_{a\,max} \geq M_a$)
- Checking the input speed (churning losses)

↓

Motor selection
- Maximum torque
- With dynamic drives: effective torque at medium speed
- Maximum speed
- Determination of the energy efficiency class IE
- Observing of dynamic and thermal torque curves
- Selection of the correct encoder
- Mechanical brake (braking work, braking torque, brake service life)
- Motor equipment (brake, plug connector, thermal motor protection, etc.)

↓

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

↓

Braking resistor selection
- Based on the calculated regenerative power, cdf and peak braking power

↓

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Options

- EMC measures
- Operation/communication
- Additional functions

↓

Ensuring that all requirements have been met.

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4.4 Project planning notes – R, F, K, S, W gear units

4.4.1 Efficiency of gear units

General information

The efficiency of the gear units is mainly determined by the gearing and bearing friction as well by churning losses. Keep in mind that the starting efficiency of a gear unit is always less than its efficiency at operating speed. This factor is particularly true for helical-worm and SPIROPLAN® right-angle gear units.

INFORMATION

For information on churning losses and thermal rating, refer to chapter "Churning losses and thermal rating" (→ 🗎 49).

R, F, K gear units

Depending on the number of gear stages, the gearing efficiency of helical, parallel-shaft and helical-bevel gear units is up to 96% (3-stage), 97% (2-stage) and 98% (1-stage).

S and W gear units

The gearing in helical-worm and SPIROPLAN® gear units produces a high proportion of sliding friction. This is the reason why these gear units have higher gearing losses and lower efficiency than R, F or K gear units.

Other factors influencing the efficiency:

- Gear ratio of the helical-worm or SPIROPLAN® stage
- Input speed
- Ambient temperature

Helical-worm gear units from SEW-EURODRIVE are helical gear/worm combinations that have a significantly higher efficiency than plain worm gear units, see chapter "Technical data of S., SF., SA., SAF 37" (→ 🗎 793) and following.

The efficiency may reach $\eta < 0.5$ if the helical-worm gear stage has a very high gear ratio.

Self-locking

Retrodriving torque in helical-worm or SPIROPLAN® gear units produces an efficiency of $\eta' = 2 - 1/\eta$, which is significantly less favorable than the forward efficiency. The helical-worm or SPIROPLAN® gear unit is statically self-locking if the forward efficiency η is ≤ 0.5. The SPIROPLAN® gear units W..10 – W..30 are to some extent (with high ratios) dynamically self-locking. Contact SEW-EURODRIVE if you want to make technical use of the braking effect of self-locking characteristics.

INFORMATION

Note that the self-locking effect of helical-worm and SPIROPLAN® gear units is not permitted as the sole safety function for hoists.

Run-in phase

The tooth flanks of new helical-worm and SPIROPLAN® gear units are not yet completely smooth. That fact makes for a greater friction angle and less efficiency than during later operation. This effect intensifies with increasing gear ratio.

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During the run-in phase, the nominal efficiency of the gear unit is reduced by the relevant value from the following tables.

	Worm	
	i range	η reduction
1-start	approx. 50 – 280	approx. 12%
2-start	approx. 20 – 75	approx. 6%
3-start	approx. 20 – 90	approx. 3%
5-start	approx. 6 – 25	approx. 3%
6 start	approx. 7 – 25	approx. 2 %

SPIROPLAN® W10 to W30		SPIROPLAN® W37 and W47	
i range	η reduction	i range	η reduction
approx. 35 – 75	approx. 15%	-	-
approx. 20 – 35	approx. 10%	-	-
approx. 10 – 20	approx. 8%	approx. 30 – 70	approx. 8%
approx. 8	approx. 5%	approx. 10 – 30	approx. 5%
approx. 6	approx. 3%	approx. 3 – 10	approx. 3%

The run-in phase usually lasts 48 hours. The following conditions must be met for helical-worm and SPIROPLAN® gear units to achieve their nominal efficiency ratings:

- The gear unit has been completely run-in.
- The gear unit has reached nominal operating temperature.
- The recommended lubricant has been filled.
- The gear unit is operating in the nominal load range.

Churning losses and thermal rating

* (→ 🗎 X)

Churning losses may occur with the following conditions. They must be considered during thermal check:

- A mounting position where the first gear unit stage is fully immersed in the lubricant. The respective mounting positions of the gear units are indicated with a * in chapter Mounting position sheets.
- A high mean input speed and thus a high circumferential velocity of the gear wheels of the input gear stage.

If one or both requirements are met, determine the requirements of the application and the corresponding operating conditions (see chapter "Data for calculating the thermal rating" (→ 🗎 50)) and contact SEW-EURODRIVE. SEW-EURODRIVE can calculate the thermal rating based on the actual operating conditions. The thermal rating of the gear unit can be increased by appropriate measure e.g. by using a synthetic lubricant with higher thermal endurance properties.

INFORMATION

To reduce churning losses to a minimum, use gear units preferably in M1 mounting position.

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Data for calculating the thermal rating

The following information is required for calculating the thermal rating:

Gear unit type and design:

- Gear unit ratio i
- Mean input speed $\overline{n}_{Mot}$ or mean output speed $\overline{n}_G$ in min^{-1}
- Effective motor torque M_{Mot_eff} in Nm
- Input motor power P_{Mot} in kW
- Mounting position M1 – M6 or pivoting angle

Installation site:

- Ambient temperature T_{amb} in °C
- In small, closed rooms or in large rooms (halls) or outdoors

Installation on site:

- Space-critical or well ventilated
- Steel or concrete base

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4.5 Service factor

4.5.1 Service factor f_B

The method for determining the maximum permitted continuous torque M_{a_max} and using this value to derive the service factor $f_B = M_{a\_max} / M_a$ is not defined in a standard and varies greatly from manufacturer to manufacturer. With a service factor $f_B = 1$, gear units by SEW-EURODRIVE in any case offer an extremely high level of safety and reliability in the fatigue strength range (With exception of: Low temperatures and wear of the worm gear with helical-worm gear units). The service factor may differ from specifications of other gear unit manufacturers. If in doubt, contact SEW-EURODRIVE.

For the service factor, refer to the order confirmation and the selection tables in the gearmotor catalogs from SEW-EURODRIVE (→ 🗎 176).

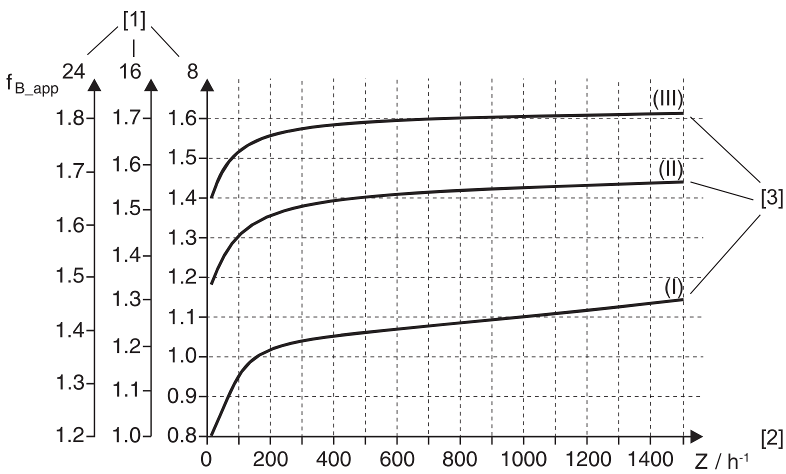
4.5.2 Required service factor f_{B_req}

The operating conditions are considered in order to determine the required service factor f_{B_req} for the gearmotor selection. Decisive factors are the requirements of the driven machine, as well as the ambient temperature and gear unit type, if applicable.

The service factor f_{B_req} result from other service factors described in the following chapters.

4.5.3 Application service factor

The effect of the driven machine on the gear unit is taken into account to a sufficient level of accuracy using the application service factor f_{B_app}. The service factor is determined according to the daily operating time and the switching frequency Z. Three load classifications are taken into account depending on the mass acceleration factor. You can read the service factor applicable to your application from the following diagram.



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[1] Service factor f_{B_app} in relation to the daily operating time in hours/day
[2] Switching frequency Z: The cycles include all starting and braking procedures as well as changeovers from low to high speed and vice versa.
[3] Curves for load classification I, II and III

Definition of the load classification

The following 3 load classifications are distinguished:

- Load classification I: Uniform, almost no shock load, permitted mass acceleration factor ≤ 0.2
- Load classification II: Non-uniform, moderate shock load, permitted mass acceleration factor ≤ 3
- Load classification III: Very non-uniform, severe shock load, permitted mass acceleration factor ≤ 10

Mass acceleration factor

The mass acceleration factor is calculated as follows:

$$f_a = \frac{J_{Lx}}{J_{Mot}}$$

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f_O	=	Mass acceleration factor	
J_{Lx}	=	Mass moment of inertia, reduced to motor shaft	$[J_{Lx}] = kgm^2$
J_{Mot}	=	Motor moment of inertia	$[J_{Mot}] = kgm^2$

The motor moment of inertia J_{Mot} is the mass moment of inertia of the motor and, if installed, the brake and the flywheel fan (Z fan).

The load moment of inertia J_{Lx} includes all external mass moments of inertia are the mass moments of inertia of the driven machine and the gear unit, scaled down to the motor shaft.

Scaling down the mass moment of inertia on the motor shaft

The calculation for scaling down to motor speed is performed using the following formula:

$$J_{Lx} = J_L \times \left(\frac{1}{i_G}\right)^2$$

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J_{Lx}	=	Mass moment of inertia, reduced to motor shaft	$[J_{Lx}] = kgm^2$
J_L	=	Mass moment of inertia with reference to the output speed of the gear unit	$[J_L] = kgm^2$
i_G	=	Gear unit ratio	

Service factors f_{B_app} > 1.8 may be required with large mass acceleration factors (> 10), high levels of backlash in the transmission elements or large overhung loads. Contact SEW-EURODRIVE in such a case.

4.5.4 Service factor at low temperatures

At an ambient temperature < -30 °C observe the additional service factor f_{B_T-30} = 1.2.

4.5.5 Service factors for helical-worm gear units

In case of helical-worm gear units, the following 2 service factors must be observed:

- $f_{B\_S\_T}$ = Service factor based on ambient temperature
- $f_{B\_S\_cdf}$ = Service factor based on cyclic duration factor

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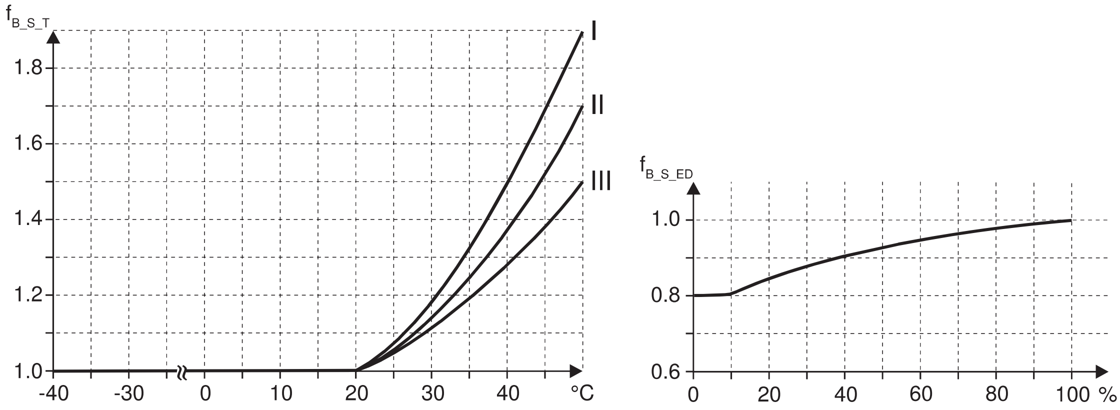
The additional service factors $f_{B\_S\_T}$ and $f_{B\_S\_cdf}$ can be determined by referring to the diagram below. For $f_{B\_S\_T}$, the load classification is taken into account in the same way as for f_{B_app}. The following diagram shows the additional service factor $f_{B\_S\_T}$ and $f_{B\_S\_cdf}$:



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Cyclic duration factor

$$ED = \frac{t_{L\_tot}}{60} \times 100$$

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ED	= Cyclic duration factor	[cdf] = %
t_{L_tot}	= Load period	$[t_{L\_tot}]$ = min h^{-1}

4.5.6 Conditions for selecting gear units based on the service factor

The determined required service factor f_{B_req} must be lower or equal to the service factor according to the selection tables (see chapter "Structure of the selection tables" (→ 🗎 176)).

$$f_{B\_req} \leq f_B$$

$$f_{B\_app} \times \left[f_{B\_T-30} \times f_{B\_S\_T} \times f_{B\_S\_ED} \right] \leq f_B$$

or

$$M_a \times f_{B\_req} \leq M_{a\_max}$$

$$M_a \times f_{B\_app} \times \left[f_{B\_T-30} \times f_{B\_S\_T} \times f_{B\_S\_ED} \right] \leq M_{a\_max}$$

The service factors in square brackets are only taken into consideration at the respective application and ambient conditions. Otherwise, the value is 1.

f_B	= Service factor	
f_{B_req}	= Required service factor	
f_{B_app}	= Application service factor based on load classification and switching frequency	
f_{B_T-30}	= Low temperature service factor, only applies to ambient temperatures < -30 °C	
$f_{B\_S\_T}$	= Service factor for helical-worm gear units only, based on ambient temperature	
$f_{B\_S\_cdf}$	= Service factor for helical-worm gear units only, based on cdf	
M_a	= Gearmotor output torque ($M_{Mot} \times i_G$)	$[M_a]$ = Nm
M_{a_max}	= Maximum permitted output torque	$[M_{a\_max}]$ = Nm

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Additional requirements for selecting gear units based on the service factor

When special ambient or application-related conditions need to be observed, additional requirements on gear unit selection based on the service factor need to be adhered to:

- SPIROPLAN® gearmotors with food grade oil:
  - W..10 – W..30: $f_B \geq 1{,}0$
  - W..37, W..47: $f_B \geq 1{,}2$
- Gear units and compound gear units in combination with explosion-proof motors: $f_B \geq 1.0$

4.5.7 Examples

- An application with mass acceleration factor 2.5 (load classification II), operating time 14 hours/day (read off at 16 h/d^{-1} (→ 🗎 51)) and 300 cycles/hour produce a service factor f_B = 1.5 as shown in the figure. The f_B value of the required gearmotor must therefore be ≥ 1.5.

  In case the gearmotor is intended for operation at -35 °C, the following applies:

  $f_{B\_req} = f_{B\_app} \times f_{B\_T\text{-}30} = 1.5 \times 1.2 = 1.8$

  The gearmotor to be selected now requires an f_B value ≥ 1.8.
- The gearmotor with the service factor f_{B_app} = 1.5 in the previous example is to be a helical-worm gearmotor, at an ambient temperature of 40 °C:

  → $f_{B\_S\_T}$ = 1.36 (read off at load classification II (→ 🗎 52))

  Time under load = 40 min h^{-1}→ cdf = 66.67% → $f_{B\_S\_cdf}$ = 0.95

  The required service factor is:

  $f_{B\_req} = f_{B\_app} \times f_{B\_S\_T} \times f_{B\_S\_cdf} = 1.5 \times 1.36 \times 0.95 = 1.94$

  The selected helical-worm gearmotor requires a service factor f_B ≥ 1.94.

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4.6 Overhand and axial loads of R, F, K, S, and W gear units

4.6.1 Determining the overhung load

When determining the resulting overhung load, the type of transmission element mounted on the shaft end must be considered. The following transmission element factors f_Z must be considered for various transmission elements.

Transmission element	Transmission element factor f_Z	Comments
Gear wheels	1.15	< 17 teeth
Sprockets	1.40	< 13 teeth
Sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Consider influence of pre-tension force
Flat belt pulleys	2.50	Consider influence of pre-tension force
Toothed belt pulleys	1.50	Consider influence of pre-tension force
Gear rack pinion, pretensioned	2.00	Consider influence of pre-tension force
Gear rack pinion, not pretensioned	1.15	< 17 teeth

Transmission element factor at low temperatures

For temperatures < -30 °C observe a transmission element factor $f_{Z\_T\text{-}30}$ = 1.2.

The overhung load exerted on the motor or gear shaft is calculated as follows:

$$F_R = \frac{M_{G\_max} \times 2000}{d_{FR}} \times f_Z \times f_{Z\_T-30}$$

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F_R	=	Overhung load	$[F_R]$ = N
M_{G_max}	=	Torque	$[M_{G\_max}]$ = Nm
f_Z	=	Transmission element factor	
$f_{Z\_T\text{-}30}$	=	A transmission element factor of 1.2 for ambient temperatures ≤ -30 °C. For ambient temperatures > 30 °C observe $f_{Z\_T\text{-}30}$ = 1.	
d_{FR}	=	Overhung load determined by diameter of the installed transmission element	[d] = mm

4.6.2 Permitted overhung load F_{R_a}

The following important information refers to the overhung load value F_{R_a} in the relevant tables of this catalog:

F_{R_a} is calculated from the nominal bearing service life L_{10h} (according to ISO 281). For special operating conditions, the permitted overhung loads can be determined based on the modified bearing service life L_{na}. Consult SEW-EURODRIVE in this case.

The permitted overhung load is influenced by the direction of rotation and the force application angle. The values F_{R_a} listed in the catalog are based on the least favorable conditions.

The permitted overhung loads F_{R_a} for the output shafts of foot-mounted gear units with a solid shaft are listed in the selection tables for gearmotors. For other designs, please contact SEW-EURODRIVE.

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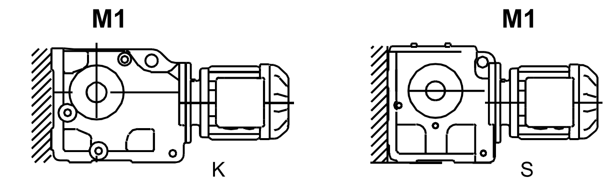
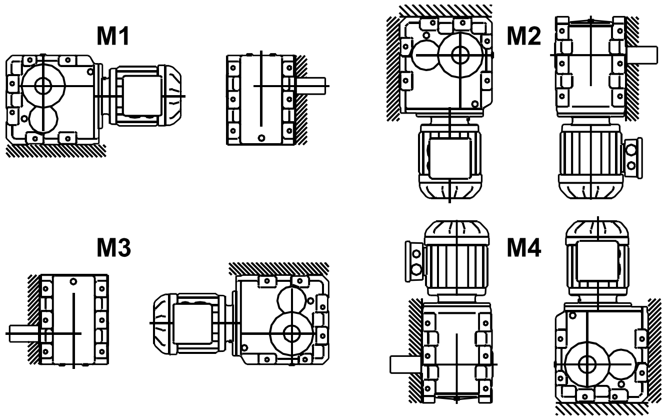
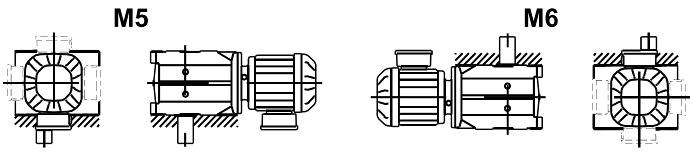
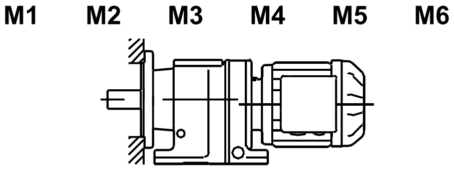
The overhung load data refers to a force application at the center of the output shaft 0.5 × l. With right-angle gear units, the application point is assumed to be at the A-side.

For gear units with hollow shaft and key (shaft-mounted design), the values refer to force application to the front end of the hollow shaft.

Reduced permitted overhung load

The following table lists the cases that require the overhung load to be limited:

Mounting surface	Gear units	Mounting position	Restriction
	K37 – K157 S37 – S97	M1	Maximally 50% of the overhung load F_{R_a} specified in the selection tables is permitted in the case of mounting at the front-end (highlighted surfaces).
	K167 K187	M1 M2 M3 M4	No reduction when the unit is mounted using the highlighted feet. A maximum of 50% of the overhung load F_{R_a} specified in the selection tables is permitted in the case of deviating mounting.
	K167 K187	M5 M6	No reduction when the unit is mounted using the highlighted feet. In case of deviating mounting, contact SEW-EURODRIVE.
	R07F – R87F	M1 – M6	In case of all foot-mounted/flange-mounted gear units (R..F) with torque transmission via the flange connection, maximally 50% of the overhung load F_{R_a} specified in the selection tables is permitted.

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4.6.3 Higher permitted overhung loads

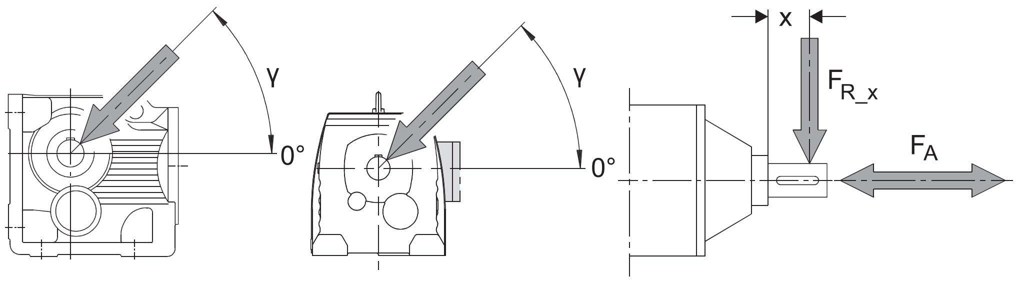
Exactly considering the force application angle γ and the direction of rotation makes it possible to achieve a higher overhung load than listed in the selection tables.

Furthermore, higher output shaft loads are permitted if heavy duty bearings are installed, especially with R, F and K gear units.

Contact SEW-EURODRIVE in such cases.

4.6.4 Definition of the force application

Force application is defined according to the following figure:



γ	=	Force application angle	[γ] = °
F_{R_x}	=	Permitted overhung load at distance x	[F_{R_x}] = N
F_O	=	Permitted axial force	[F_A] = N

4.6.5 Permitted axial forces

If there is no overhung load, then an axial load F_A (tension or compression) amounting to 50% of the overhung load given in the selection tables is permitted. This condition applies to the following gearmotors:

- Helical gearmotors except for R..127.. to R..167..
- Parallel-shaft helical and helical-bevel gearmotors with solid shaft except for F97...
- Helical-worm gearmotors with solid shaft

INFORMATION

Contact SEW-EURODRIVE for all other gear unit designs and in the event of significantly greater axial loads or combinations of overhung load and axial load.

4.6.6 Input side: Overhung load conversion for off-center force application

INFORMATION

Contact SEW-EURODRIVE with regard to the project planning of gear units with input shaft assemblies and off-center force application.

4.6.7 On the output side: Overhung load conversion for off-center force application

The permitted overhung loads must be calculated according to the selection tables using the following formulas in the event of force application to areas other than the center of the shaft end. The smaller of the two values $F_{R\_x\_b}$ (according to bearing service life) and $F_{R\_x\_w}$ (according to shaft strength) is the permitted value for the overhung

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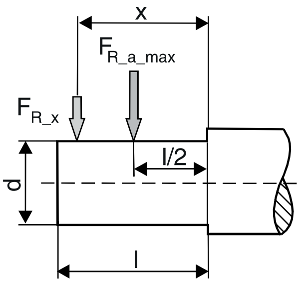
load at distance x. Note that the calculations apply to M_{a_max}. The permitted overhung load values $F_{R\_a\_max}$ and $F_{R\_a\_pk}$ listed in the data tables are valid for force application at 0.5 × l (solid shaft) or force application at the shaft end face (front end surface of the hollow shaft).

The following conditions must be met:

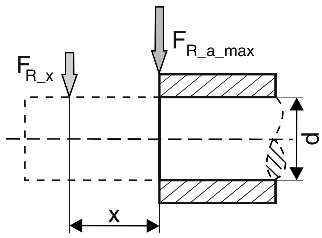
$F_{R\_x\_b}$ according to bearing service life: $$F_{R\_x\_b} = F_{R\_a\_max} \times \frac{a}{b + x}$$

$F_{R\_x\_w}$ according to shaft strength: $$F_{R\_x\_w} = \frac{c}{f + x}$$

F_{R_x}	Permitted overhung load at distance x in N	$[F_{R\_x}]$ = N
$F_{R\_a\_max}$	permitted overhung load in N	$[F_{R\_a\_max}]$ = N
x	Distance from the shaft shoulder to the force application point in mm	[x] = mm
a, b, f	Gear unit constants for overhung load conversion in mm	[a, b, f] = 1
c	Gear unit constant for overhung load conversion in Nmm	[c] = 1



Solid shaft



Hollow shaft

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Gear unit constants for overhung load conversion

Gear unit type	a mm	b mm	c Nmm	f mm	d mm	l mm
RX57	43.5	23.5	1.51×10^5	34.2	20	40
RX67	52.5	27.5	2.42×10^5	39.7	25	50
RX77	60.5	30.5	1.95×10^5	0	30	60
RX87	73.5	33.5	7.69×10^5	48.9	40	80
RX97	86.5	36.5	1.43×10^6	53.9	50	100
RX107	102.5	42.5	2.47×10^6	62.3	60	120
R07	72.0	52.0	4.67×10^4	11	20	40
R17	88.5	68.5	6.53×10^4	17	20	40
R27	106.5	81.5	1.56×10^5	11.8	25	50
R37	118	93	1.24×10^5	0	25	50
R47	137	107	2.44×10^5	15	30	60
R57	147.5	112.5	3.77×10^5	18	35	70
R67	168.5	133.5	2.65×10^5	0	35	70
R77	173.7	133.7	3.97×10^5	0	40	80
R87	216.7	166.7	8.47×10^5	0	50	100
R97	255.5	195.5	1.06×10^6	0	60	120
R107	285.5	215.5	2.06×10^6	0	70	140
R127	311	226	$4.93 \text{ x } 10^6$	0	90	170
R137	343.5	258.5	4.58×10^6	0	90	170
R147	402	297	8.65×10^6	33	110	210
R167	450	345	1.26×10^7	0	120	210
F27	109.5	84.5	1.13×10^5	0	25	50
F37	123.5	98.5	1.07×10^5	0	25	50
F47	153.5	123.5	1.40×10^5	0	30	60
F57	170.7	135.7	2.70×10^5	0	35	70
F67	181.3	141.3	4.12×10^5	0	40	80
F77	215.8	165.8	7.87×10^5	0	50	100
F87	263	203	1.06×10^6	0	60	120
F97	350	280	2.09×10^6	0	70	140
F107	373.5	288.5	4.23×10^6	0	90	170
F127	442.5	337.5	9.45×10^6	0	110	210
F157	512	407	1.05×10^7	0	120	210
K19	103.7	83.7	8.66×10^4	0	20	40
K29	124.5	99.5	1.26×10^5	0	25	50
K37	123.5	98.5	1.30×10^5	0	25	50

Gear unit type	a mm	b mm	c Nmm	f mm	d mm	l mm
K39	155.5	125.5	2.25×10^5	0	30	60
K47	153.5	123.5	1.40×10^5	0	30	60
K49	183.5	148.5	2.63×10^5	0	35	70
K57	169.7	134.7	2.70×10^5	0	35	70
K67	181.3	141.3	4.12×10^5	0	40	80
K77	215.8	165.8	7.69×10^5	0	50	100
K87	252	192	1.64×10^6	0	60	120
K97	319	249	2.80×10^6	0	70	140
K107	373.5	288.5	5.53×10^6	0	90	170
K127	443.5	338.5	8.31×10^6	0	110	210
K157	509	404	1.18×10^7	0	120	210
K167	621.5	496.5	1.88×10^7	0	160	250
K187	720.5	560.5	3.04×10^7	0	190	320
S37	118.5	98.5	6.0×10^4	0	20	40
S47	130	105	1.33×10^5	0	25	50
S57	150	120	2.14×10^5	0	30	60
S67	184	149	3.04×10^5	0	35	70
S77	224	179	5.26×10^5	0	45	90
S87	281.5	221.5	1.68×10^6	0	60	120
S97	326.3	256.3	2.54×10^6	0	70	140
W10	84.8	64.8	3.6×10^4	0	16	40
W20	98.5	78.5	4.4×10^4	0	20	40
W30	109.5	89.5	6.0×10^4	0	20	40
W37	121.1	101.1	6.95×10^4	0	20	40
W47	145.5	115.5	4.26×10^5	35.6	30	60

Values for designs not listed are available on request.

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4.7 Multi-stage gearmotors

4.7.1 General information

You can achieve particularly low output speeds by using compound gear units or compound gearmotors. This means an additional second gear unit, usually a helical gear unit, is installed in front of the gear unit or between gear unit and motor.

The resulting total reduction ratio might make protecting the gear unit from high output torques necessary.

4.7.2 Limiting the motor power

Reduce the maximum output motor power according to the maximum permitted output torque on the gear unit (M_{a_max}). For this purpose you first have to determine the maximum permitted motor torque (M_{Mot_max}).

You can calculate the maximum permitted motor torque as follows:

Maximum permitted motor torque

$$M_{Mot\_max} = \frac{M_{a\_max}}{i_{tot} \times \eta_{tot}}$$

M_{Mot_max}	Maximum permitted motor torque	$[M_{Mot\_max}]$ = Nm
M_{a_max}	Maximum permitted output torque	$[M_{a\_max}]$ = Nm
i_{tot}	Total gear unit ratio	$[i_{tot}]$ = 1
η_{tot}	Overall efficiency	$[\eta_{tot}]$ = %

Use this maximum permitted motor torque M_{Mot_max} and the load diagram of the motor to determine the associated value for the motor current.

Take appropriate measures to prevent the continuous current consumption of the motor from exceeding the pre-determined value for the motor torque M_{Mot_max}. An appropriate measure would be to set the tripping current of the motor protection switch to this maximum current value. A motor protection switch offers the option to compensate for a brief overload, for example during the startup phase of the motor. A suitable measure for inverter drives is to limit the output current of the inverter according to the determined motor current.

4.7.3 Checking brake torques

If you use a multi-stage brakemotor, you have to limit the braking torque (M_B) according to the maximum permitted motor torque M_{Mot_max}. The maximum permitted braking torque is 200% M_{Mot_max}.

Maximum braking torque

$M_{B\_max} \leq 200\%\ M_{Mot\_max}$

M_{B_max}	Maximum braking torque in Nm
M_{Mot_max}	Maximum permitted motor torque in Nm

If you have questions regarding the permitted switching frequency of multi-stage brakemotors, please contact SEW-EURODRIVE.

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4.7.4 Preventing blocking

Blockage on the output side of the double gear unit or multi-stage gearmotor is not permitted. The reason is that indeterminable torques and uncontrolled overhung and axial loads may occur. The gear units may suffer irreparable damage as a result.

INFORMATION

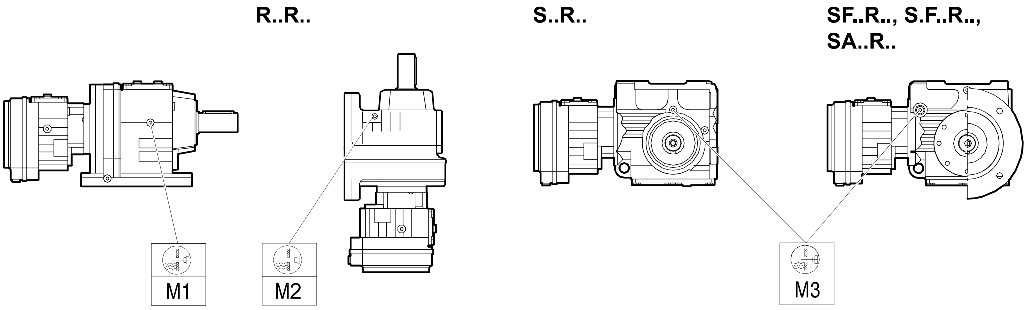
Contact SEW-EURODRIVE if blockages of the double gear unit or multi-stage gearmotor cannot be avoided due to the application.

4.7.5 Position of the oil level plug of compound gear units

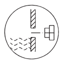
To ensure sufficient lubrication of the first gear unit (larger gear unit) in case of compound gear units, the following gear units have a higher oil level in the specified mounting positions:

- Helical gear unit type R..R in mounting position M1 and M2
- Helical-worm gear unit type S..R in mounting position M3

The oil level plugs are located at the following positions, deviating from the specifications on the mounting position sheets:



15987248395

Icon	Meaning
	Oil level plug

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