4.2 Project planning procedure

The following flowchart presents a schematic view of the procedure for planning a project incorporating a gear unit with a component on the input side.

Necessary information regarding the machine to be driven
- Technical data and environmental conditions
- Positioning accuracy
- Travel cycle calculation

↓

Calculation of the relevant application data
- Static, dynamic, and regenerative power
- Speeds
- Torques
- Travel diagram

↓

Gear unit selection
- Define gear unit size, gear unit reduction ratio and gear unit type
- Check the positioning accuracy
- Check the gear unit utilization ($M_{o\ max} \geq M_{o\ (t)}$)

↓

Selecting components on the input side
- Specify component type and version
- Define component size
- Check the component load

↓

Options
- Monitoring functions (devices, equipment)
- Brake for AT
- Backstop
- Centering shoulder
- Motor mounting platform

↓

Make sure that all requirements have been met.

For thermal project planning of R, F, K, S, W gear units, please contact SEW-EURODRIVE.

4.3 *Project planning information*

4.3.1 Efficiency of gear units

General information

The efficiency of gear units is mainly determined by the gearing and bearing friction. 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.

R, F, K gear units

The efficiency of helical, parallel shaft and helical-bevel gear units varies with the number of gear stages, between 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. As a result, these gear units have higher gearing losses than R, F or K gear units and therefore lower efficiency.

The efficiency depends on the following factors:

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

Helical-worm gear units from SEW-EURODRIVE are helical gear/worm combinations that are significantly more efficient than plain worm gear units.

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

The SPIROPLAN® gear unit W37/W47 from SEW-EURODRIVE has an efficiency of more than 90%, which drops only slightly even for large gear unit ratios.

Self-locking

Retrodriving torques on helical-worm or SPRIOPLAN® gear units produce an efficiency of $\eta' = 2 - 1/\eta$, which is significantly less favorable than the forward efficiency η. The helical-worm or SPIROPLAN® gear unit is self-locking if the forward efficiency is $\eta \leq 0.5$. Some SPIROPLAN® gear units are dynamically self-locking. Contact SEW-EURODRIVE if you wish to make technical use of the braking effect of self-locking characteristics.

	INFORMATION
i	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. This fact results in a greater friction angle and less efficiency than during later operation. This effect intensifies with increasing gear unit ratio. Subtract the following values from the listed efficiency during the running-in phase:

	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® W..
i range	**η reduction**
approx. 30 ... 75	approx. 8 %
approx. 10 ... 30	approx. 5 %
approx. 3 ... 10	approx. 3 %

The run-in phase usually lasts 48 hours. Helical-worm and SPIROPLAN® gear units achieve their listed rated efficiency values when the following conditions have been met:

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

Churning losses

In certain gear unit mounting positions (see chapter "Gear Unit Mounting Positions"), the first gearing stage is completely immersed in the lubricant. When the circumferential velocity of the input stage is high, considerable churning losses occur in larger gear units that must be taken into account. Contact SEW-EURODRIVE if you wish to use gear units of this type.

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

4.3.2 Service factor

Determining the service factor

The effect of the driven machine on the gear unit is taken into account to a sufficient level of accuracy using the service factor f_B. The service factor is determined according to the daily operating time and the starting 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 figure 3. The service factor determined from this diagram must be smaller than or equal to the service factor according to the selection tables.

$$M_a \cdot f_b \leq M_{a\,max}$$

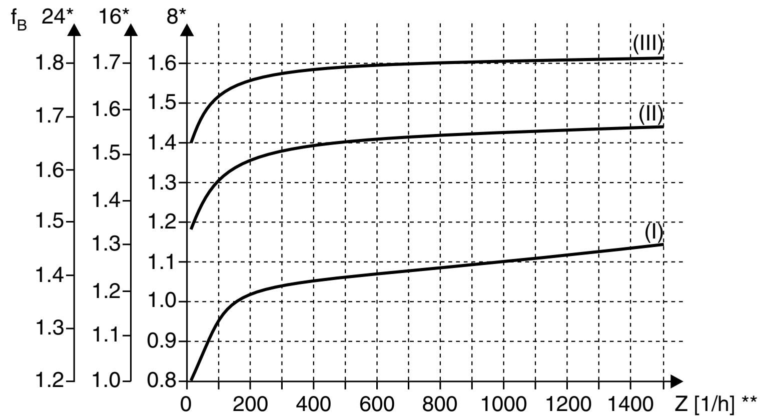

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Figure 1: Service factor f_B

* Daily operating time in hours/day
** Starting frequency Z: The cycles include all starting and braking procedures as well as changeovers from low to high speed and vice versa.

Load classification

There are three load classifications:

(I) Uniform, permitted mass acceleration factor ≤ 0.2
(II) Non-uniform, permitted mass acceleration factor ≤ 3
(III) Non-uniform, permitted mass acceleration factor ≤ 10

Mass acceleration factor

The mass acceleration factor is calculated as follows:

$$\text{Mass acceleration factor} = \frac{\text{All external mass moments of inertia}}{\text{Mass moment of inertia on the motor end}}$$

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

$$J_X = J \bullet \left(\frac{n}{n_M}\right)^2$$

J_X = Mass moment of inertia scaled down to the motor shaft
J = Mass moment of inertia with reference to the output speed of the gear unit
n = Output speed of the gear unit
n_M = Motor speed

"Mass moment of inertia at the motor end" is the mass moment of inertia of the motor and, if installed, the brake and the flywheel fan (Z fan).

Service factors f_B > 1.8 can occur with large mass acceleration factors (> 10), high levels of backlash in the transmission elements or large overhung loads. Contact SEW-EURODRIVE in such cases.

Service factor: SEW f_B

The method for determining the maximum permitted continuous torque M_{amax} and using this value to derive the service factor $f_B = M_{amax} / M_a$ is not defined in a standard and varies greatly from manufacturer to manufacturer. Even at a SEW service factor of $f_B = 1$, the gear units afford an extremely high level of safety and reliability in the fatigue strength range (exception: Wearing of the worm wheel of the helical-worm gear unit). The service factor may differ from specifications of other gear unit manufacturers. If you are in doubt, contact SEW-EURODRIVE for more detailed information on your specific drive.

Example

Mass acceleration factor 2.5 (load classification II), 14 hours of daily operation (read at 16 h/d) and 300 cycle times/hour result in the service factor $f_B = 1.51$. According to the selection tables, the selected gearmotor must then have an SEW f_B value = 1.51 or greater.

Helical-worm gear units

Two further service factors have to be taken into account with helical-worm gear units in addition to the service factor f_B shown the above figure. These are:

- f_{B1} = Service factor from ambient temperature
- f_{B2} = Service factor from cyclic duration factor

The additional service factors f_{B1} and f_{B2} can be determined by referring to the diagram below. For f_{B1}, the load classification is taken into account in the same way as for f_B.

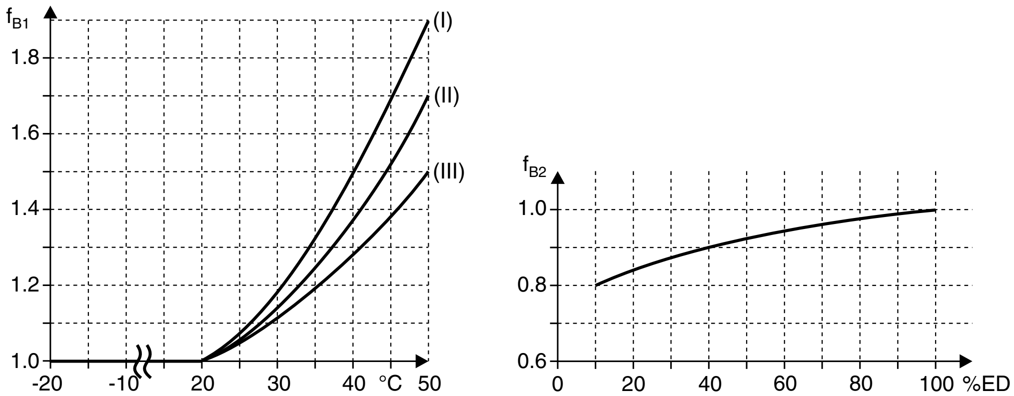

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Figure 2: Additional service factors f_{B1} and f_{B2}

$$\textbf{cdf (\%)} = \frac{\textbf{Time under load in min/h}}{\textbf{60}} \bullet \textbf{100}$$

Contact SEW-EURODRIVE in case of temperatures below -20°C (→ f_{B1}).

The total service factor for helical-worm gear units is calculated as follows:

$$f_{Btotal} = f_B \bullet f_{B1} \bullet f_{B2}$$

Example

The gearmotor with the service factor f_B = 1.51 in the previous example is to be a helical-worm gearmotor.

Ambient temperature ϑ = 40 °C → f_{B1} = 1.38 (read off at load classification II)

Time under load = 40 min/h →cdf = 66.67 % → f_{B2} = 0.95

The total service factor is f_{Btotal} = 1.51 × 1.38 × 0.95 = 1.98

According to the selection tables, the selected helical-worm gearmotor must have an SEW f_B service factor of 1.98 or greater.

4.3.3 Overhung and axial loads

Determining overhung loads

An important factor for determining the resulting overhung load is the type of transmission element mounted to the shaft end. The following transmission element factors f_Z have to be considered for various transmission elements.

Transmission element	Transmission element factor f_Z	Comments
Gears	1.15	< 17 teeth
Chain sprockets	1.40	< 13 teeth
Chain sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Influence of the pre-tensioning
Flat belt pulleys	2.50	Influence of the pre-tensioning
Toothed belt pulleys	2.00 - 2.50	Influence of the pre-tensioning
Gear rack pinion, pre-tensioned	2.00	Influence of the pre-tensioning

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

$$F_R = \frac{M_d \times 2000}{d_0} \times f_Z$$

F_R = Overhung load in N

M_d = Torque in Nm

d_0 = Mean diameter of the installed transmission element in mm

f_Z = Transmission element factor

Permitted overhung load

The basis for determining the permitted overhung loads is the calculation of the rated bearing service life L_{10h} of the rolling bearings (according to ISO 281).

For special operating conditions, the permitted overhung loads can be determined with regard to the modified service life on request.

INFORMATION

The values refer to force applied to the center of the shaft end (in right-angle gear units as viewed onto drive end). The values for the force application angle α and direction of rotation are based on the most unfavorable conditions.

INFORMATION

Reduction of overhung loads

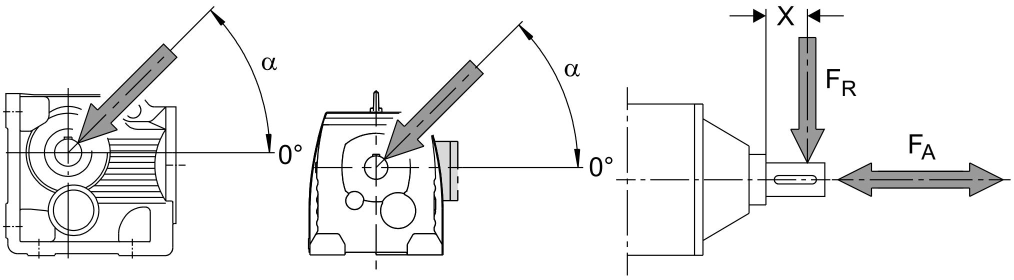
- Only 50% of the F_{Ra} value specified in the selection tables is permitted in mounting position M1 with wall attachment on the front face for K and S gear units. Helical-bevel gearmotors K167 and K187 in mounting positions M1 to M4: A maximum of 50% of the overhung load F_{Ra} specified in the selection tables in the case of gear unit mounting other than as shown in the mounting position sheets. Foot and flange-mounted helical gearmotors (R..F): A maximum of 50% of the overhung load F_{Ra} specified in the selection tables in the case of torque transmission via the flange mounting.

Higher permitted overhung loads

Exactly considering the force application angle α and the direction of rotation makes it possible to achieve a higher overhung load. 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.

Definition of force application

The force application is defined according to the following figure:



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F_X = Permitted overhung load at point x [N]

F_A = Permitted axial load [N]

Permitted axial forces

If there is no overhung load, then an axial force FA (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..137... to R..167...
- Parallel shaft and helical-bevel gearmotors with solid shaft except for F97...
- Helical-worm gearmotors with solid shaft

INFORMATION

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

Overhung load conversion for off-center force application

Important: only applies to gear units with input shaft assembly:

Please contact SEW-EURODRIVE for off-center force application on the drive end.

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

The permitted overhung loads must be calculated according the selection tables using the following formulae in the event that force is not applied at the center of the shaft end. The smaller of the two values F_{xL} (according to bearing life) and F_{xW} (according to shaft strength) is the permitted value for the overhung load at point x. Note that the calculations apply to $M_{a\ max}$.

F_{xL} based on bearing life:

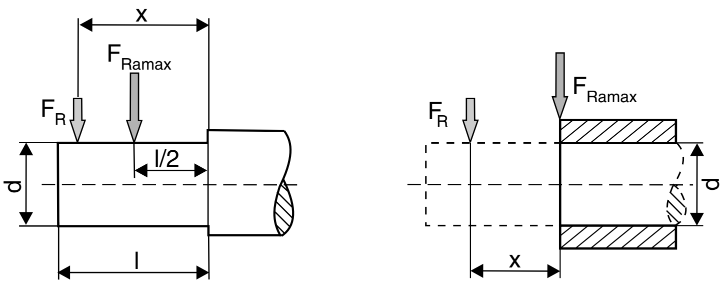
$$F_{xL} = F_{Ramax} \cdot \frac{a}{b + x} \ [N]$$

F_{xW} from the shaft strength:

$$\mathbf{F_{xW} = \frac{c}{f + x} \ [N]}$$

F_{Ra}	= Permitted overhung load (x = l/2) for foot-mounted gear units according to the selection tables in [N]
x	= Distance from the shaft shoulder to the force application point in [mm]
a, b, f	= Gear unit constant for overhung load conversion [mm]
c	= Gear unit constant for overhung load conversion [Nmm]

The following figure shows the overhung load F_R with increased distance x to the gear unit:



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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	$1.51 \bullet 10^5$	34.2	20	40
RX67	52.5	27.5	$2.42 \bullet 10^5$	39.7	25	50
RX77	60.5	30.5	$1.95 \bullet 10^5$	0	30	60
RX87	73.5	33.5	$7.69 \bullet 10^5$	48.9	40	80
RX97	86.5	36.5	$1.43 \bullet 10^6$	53.9	50	100
RX107	102.5	42.5	$2.47 \bullet 10^6$	62.3	60	120
R07	72.0	52.0	$4.67 \bullet 10^4$	11	20	40
R17	88.5	68.5	$6.527 \bullet 10^4$	17	20	40
R27	106.5	81.5	$1.56 \bullet 10^5$	11.8	25	50
R37	118	93	$1.24 \bullet 10^5$	0	25	50
R47	137	107	$2.44 \bullet 10^5$	15	30	60
R57	147.5	112.5	$3.77 \bullet 10^5$	18	35	70
R67	168.5	133.5	$2.65 \bullet 10^5$	0	35	70
R77	173.7	133.7	$3.97 \bullet 10^5$	0	40	80
R87	216.7	166.7	$8.47 \bullet 10^5$	0	50	100
R97	255.5	195.5	$1.06 \bullet 10^6$	0	60	120
R107	285.5	215.5	$2.06 \bullet 10^6$	0	70	140
R137	343.5	258.5	$4.58 \bullet 10^6$	0	90	170
R147	402	297	$8.65 \bullet 10^6$	33	110	210
R167	450	345	$1.26 \bullet 10^7$	0	120	210
F27	109.5	84.5	$1.13 \bullet 10^5$	0	25	50
F37	123.5	98.5	$1.07 \bullet 10^5$	0	25	50
F47	153.5	123.5	$1.40 \bullet 10^5$	0	30	60
F57	170.7	135.7	$2.70 \bullet 10^5$	0	35	70
F67	181.3	141.3	$4.12 \bullet 10^5$	0	40	80
F77	215.8	165.8	$7.87 \bullet 10^5$	0	50	100
F87	263	203	$1.06 \bullet 10^6$	0	60	120
F97	350	280	$2.09 \bullet 10^6$	0	70	140
F107	373.5	288.5	$4.23 \bullet 10^6$	0	90	170
F127	442.5	337.5	$9.45 \bullet 10^6$	0	110	210
F157	512	407	$1.05 \bullet 10^7$	0	120	210
K37	123.5	98.5	$1.30 \bullet 10^5$	0	25	50
K47	153.5	123.5	$1.40 \bullet 10^5$	0	30	60
K57	169.7	134.7	$2.70 \bullet 10^5$	0	35	70
K67	181.3	141.3	$4.12 \bullet 10^5$	0	40	80
K77	215.8	165.8	$7.69 \bullet 10^5$	0	50	100
K87	252	192	$1.64 \bullet 10^6$	0	60	120
K97	319	249	$2.8 \bullet 10^6$	0	70	140
K107	373.5	288.5	$5.53 \bullet 10^6$	0	90	170
K127	443.5	338.5	$8.31 \bullet 10^6$	0	110	210
K157	509	404	$1.18 \bullet 10^7$	0	120	210
K167	621.5	496.5	$1.88 \bullet 10^7$	0	160	250
K187	720.5	560.5	$3.04 \bullet 10^7$	0	190	320
W10	84.8	64.8	$3.6 \bullet 10^4$	0	16	40
W20	98.5	78.5	$4.4 \bullet 10^4$	0	20	40
W30	109.5	89.5	$6.0 \bullet 10^4$	0	20	40
W37	121.1	101.1	$6.95 \bullet 10^4$	0	20	40
W47	145.5	115.5	$4.26 \bullet 10^5$	35.6	30	60
S37	118.5	98.5	$6.0 \bullet 10^4$	0	20	40
S47	130	105	$1.33 \bullet 10^5$	0	25	50
S57	150	120	$2.14 \bullet 10^5$	0	30	60
S67	184	149	$3.04 \bullet 10^5$	0	35	70
S77	224	179	$5.26 \bullet 10^5$	0	45	90
S87	281.5	221.5	$1.68 \bullet 10^6$	0	60	120
S97	326.3	256.3	$2.54 \bullet 10^6$	0	70	140

Values for types not listed are available on request.

4.4 Project planning for components on the input side

4.4.1 Gear units with IEC or NEMA adapter AM

Power values, mass moments of inertia

Type (IEC)	Type (NEMA)	P_m[1] [kW]	$J_{Adapter}$ [kgm²]
AM63	-	0.25	0.44×10^{-4}
AM71	AM56	0.37	0.44×10^{-4}
AM80	AM143	0.75	1.9×10^{-4}
AM90	AM145	1.5	1.9×10^{-4}
AM100	AM182	3	5.2×10^{-4}
AM112	AM184	4	5.2×10^{-4}
AM132S/M	AM213/215	7.5	19×10^{-4}
AM132ML	-	9.2	19×10^{-4}
AM160	AM254/256	15	91×10^{-4}
AM180	AM284/286	22	90×10^{-4}
AM200	AM324/326	30	174×10^{-4}
AM225	AM364/365	45	174×10^{-4}
AM250	-	55	173×10^{-4}
AM280	-	90	685×10^{-4}

1) Maximum rated power of the mounted standard electric motor at 1400 rpm

Selecting the gear unit

Determine the gear unit type

↓

Determine the gear unit size based on
- the maximum output torque (M_{amax})
- gear ratio (i)

in the gear unit selection tables with adapter AM

↓

Check the maximum permitted overhung load value on the output (F_{Ra})

↓

Check the maximum permitted input power at the adapter (P_m)
(see "Power ratings, mass moments of intertia" on page 54)

↓

Is the required adapter size available?

↓

Is the required combination feasible?

Check the input power at the gear unit (P_n)

The values in the selection tables refer to an input speed of n_e = 1400 rpm. The input power at the gear unit corresponds to a maximum torque at the input side. Convert the input power using the maximum torque for different speeds.

Backstop AM../RS

If the application requires only one direction of rotation, the AM adapter can be configured with a backstop. Backstops with centrifugal lift-off sprags are used. The advantage of this design is that the sprags move around inside the backstop without making contact above a certain speed (lift-off speed). This means the backstops operate wear-free, without losses, maintenance-free and are suited for high speeds.

Dimensions:

The backstop is completely integrated in the adapter. This means the dimensions are the same as with adapter without backstop (see dimension sheets in the Adapter AM chapter).

Locking torques:

Type	Maximum locking torque of the backstop [Nm]	Minimum lift-off speed [rpm]
AM80/90/RS, AM143/145/RS	65	820
AM100/112/RS, AM182/184/RS	425	620
AM132/RS, AM213/215/RS	850	530
AM160/180/RS, AM254/286/RS	1450	480
AM200/225/RS, AM324-365/RS	1950	450
AM250/280/RS	**1950**	**450**

4.4.2 AR adapter with torque limiting coupling

Multi-stage gear unit with adapter and torque limiting coupling

In combination with multi-stage gear units, the adapter with torque limiting coupling is preferably installed between the two gear units. Please contact SEW-EURODRIVE if required.

Selecting the gear unit

The type sizes of the AR adapter with torque limiting coupling correspond to those of the AM adapter for IEC motors.

This means you can select the gear unit using the selection tables for AM adapters. In this case, substitute the unit designation AM with AR and determine the required slip torque.

Determining the slip torque

The slip torque should be about 1.5 times the rated torque of the drive. When determining the slip torque, bear in mind the maximum permitted output torque of the gear unit as well as the variations in the slip torque of the coupling (+/-20%) which are a feature of the design.

When you order a gear unit with adapter and torque limiting coupling, you have to specify the required slip torque of the coupling.

If you do not specify the slip torque, it will be set according to the maximum permitted output torque of the gear unit.

Torques, slip torques

Type	P_m 1) [kW]	M_R 2) [Nm]	M_R 2) [Nm]	M_R 2) [Nm]
AR71	0.37	1 - 6	6.1 - 16	-
AR80	0.75	1 - 6	6.1 - 16	-
AR90	1.5	1 - 6	6.1 - 16	17 - 32
AR100	3.0	5 - 13	14 - 80	-
AR112	4.0	5 - 13	14 - 80	-
AR132S/M	7.5	15 - 130	-	-
AR132ML	9.2	15 - 130	-	-
AR160	15	30 - 85	86 - 200	-
AR180	22	30 - 85	86 - 300	-

1) Maximum rated power of the mounted standard electric motor at 1400 rpm

2) Adjustable slip torque according to cup springs

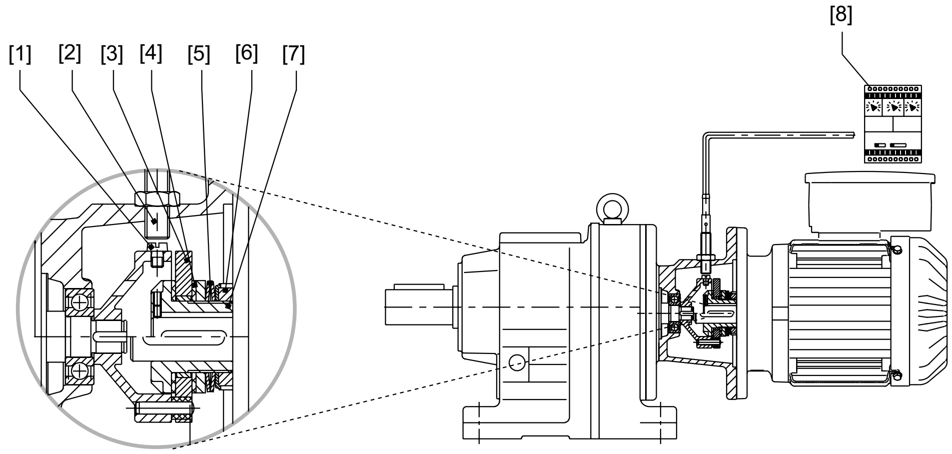
Speed monitor option /W

We recommend monitoring the speed of the coupling using a speed monitor to avoid uncontrolled slippage of the coupling and the associated wear to the friction ring pads.

The speed of the output end coupling half of the torque limiting coupling is detected in a proximity-type method using a trigger cam and an inductive encoder. The speed monitor compares the pulses with a defined reference speed. The output relay (NC or NO contact) trips when the speed drops below the specified speed (overload). The monitor is equipped with a start bypass to suppress error messages during the startup phase. The start bypass can be set within a time window of 0.5 to 15 seconds.

Reference speed, start bypass and switching hysterisis can be set on the speed monitor.

The following figure shows the adapter with torque limiting coupling and speed monitor /W:



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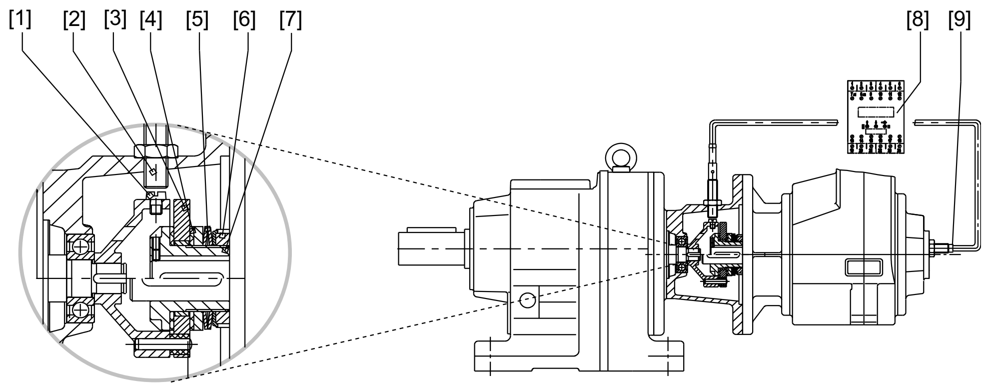
[1] Trigger cam
[2] Encoder (adapter)
[3] Driving disk
[4] Friction ring pads
[5] Cup spring
[6] Slotted nut
[7] Friction hub
[8] Speed monitor

Slip monitor option /WS

In conjunction with VARIBLOC® variable speed gear units (see "Variable Speed Gear Units" catalog), the speed monitor is replaced by a slip monitor for monitoring the speed difference between the input and output halves of the coupling.

The signal pick-up depends on the size of the variable speed gear unit and consists of two encoders or one encoder and an AC tachogenerator.

The following figure shows the adapter with torque limiting coupling and slip monitor /W:



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[1] Trigger cam
[2] Encoder (adapter)
[3] Driving disk
[4] Friction lining
[5] Spring washer
[6] Slotted nut
[7] Slip hub
[8] Slip monitor /WS
[9] Encoder IG

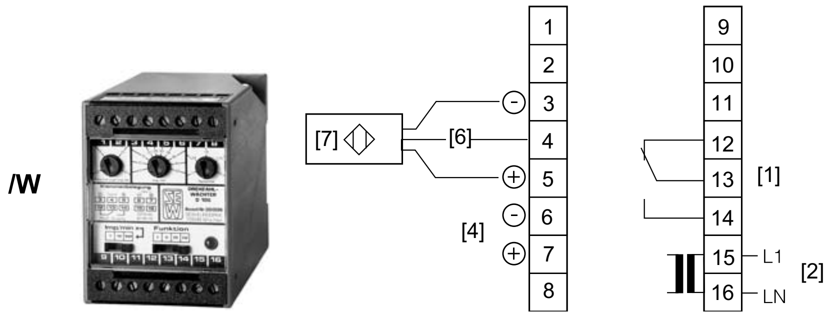
Connection

The encoder is connected to the slip monitor using a two or three-core cable (depending on the encoder type).

- Maximum cable length: 500 m with a line cross section of 1.5 mm^2
- Standard supply cable: 3-core / 2 m
- Route the signal lines separately (not in multicore cables) and shield them, if necessary.
- Degree of protection: IP40 (terminals IP20)
- Operating voltage: AC 220 V or DC 24 V
- Maximum switching capability of the output relay: 6 A (AC 250 V)

Terminal assignment W

The following figure shows the terminal assignment for /W:



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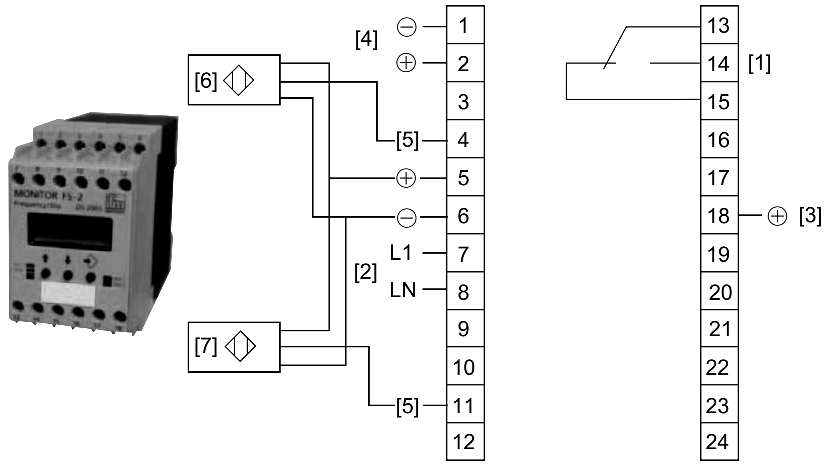
[1]	Relay output	[6]	Signal
[2]	Connection voltage AC 230 V (47 to 63 Hz)	[7]	Encoder
[3]	External slip reset	[/W]	Speed monitor
[4]	DC 24 V supply voltage		
[5]	Jumper for synchronous operation monitoring		

Terminal assignment WS

The following figure shows the terminal assignment for /WS:

/WS



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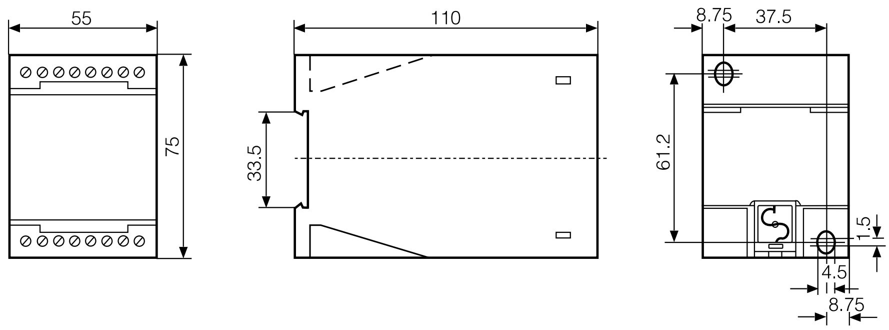
[1]	Relay output	[5]	Signal
[2]	Connection voltage AC 230 V (47 to 63 Hz)	[6]	Encoder 1
[3]	External slip reset	[7]	Encoder 2
[4]	DC 24 V supply voltage	[/W]	Slip monitor

Dimensions

The following figure shows the dimensions for /W:



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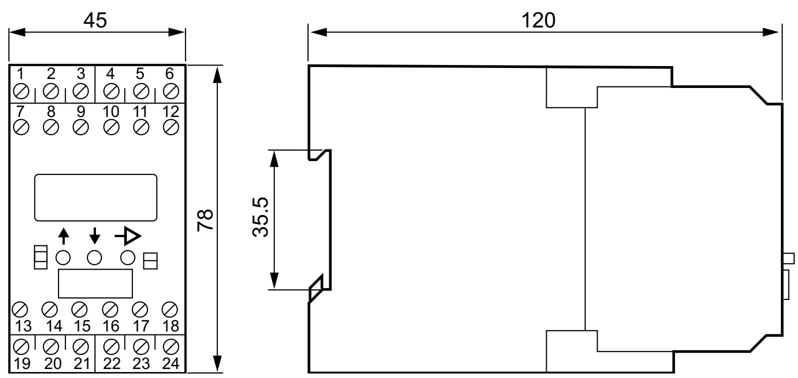
WS dimensions

The following figure shows the dimensions for /WS:



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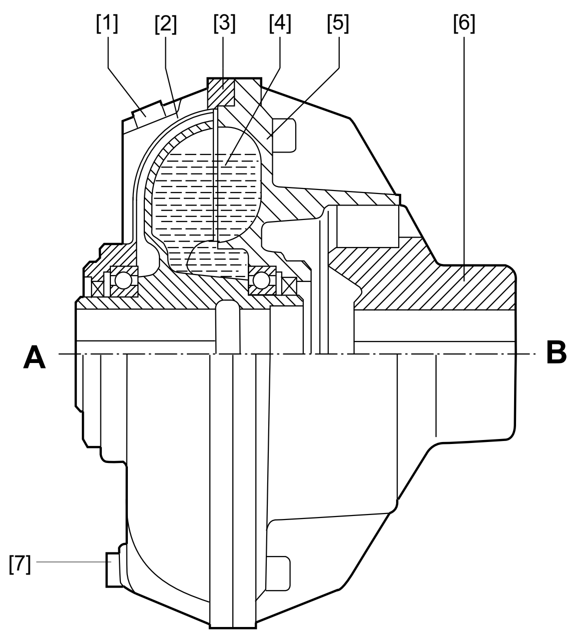
4.4.3 AT adapter with hydraulic centrifugal coupling

Centrifugal coupling

The centrifugal coupling used is a hydrodynamic coupling that operates according to the Föttinger principle. The coupling is filled with oil and consists of a pump wheel (motor side) and a turbine wheel (gear unit side). The pump wheel converts the input mechanical energy into fluid energy and the turbine wheel converts this energy back into mechanical energy.



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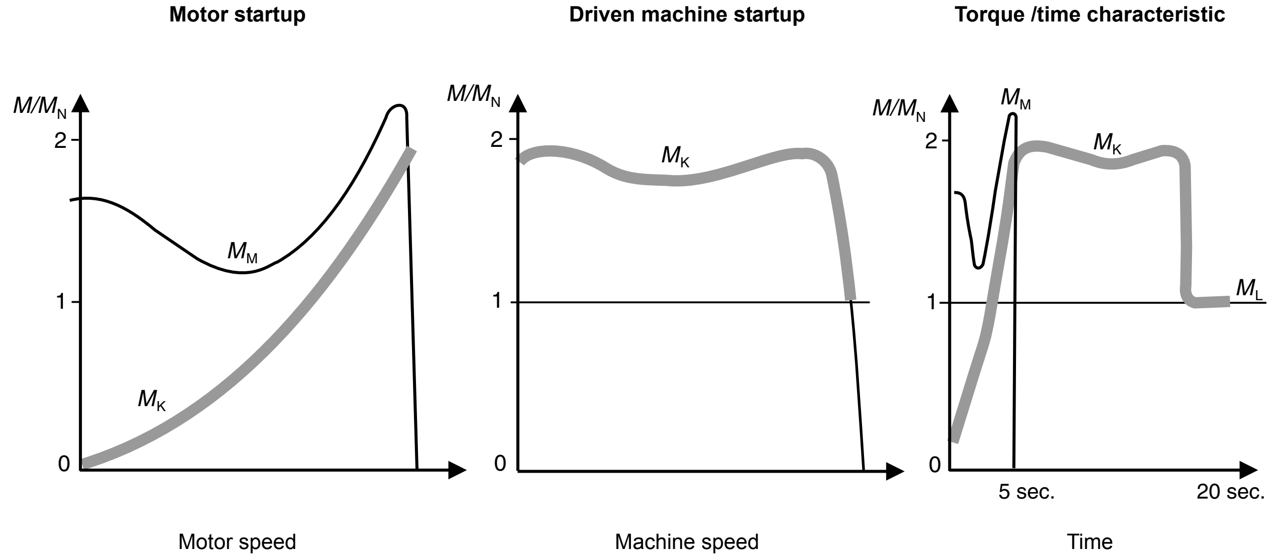
[1]	Filler screw	[6]	Flexible connecting coupling
[2]	Turbine wheel	[7]	Fusible safety plug
[3]	Coupling half	[A]	Gear unit side
[4]	Operating fluid (hydraulic oil)	[B]	Motor end
[5]	Pump wheel		

The power which the coupling can transmit significantly depends on the speed. A distinction is made between startup phase and stationary operation. During the startup phase, the motor starts without load until the coupling transmits torque. The machine is accelerated slowly and smoothly during this phase. One the stationary operating condition is reached, an operating slip occurs between motor and gear unit due to the operating principle of the coupling. The coupling attenuates load peaks so that only the load torque of the system is required from the motor.

The hydraulic centrifugal coupling is equipped with fusible safety plugs that allow the operating fluid to be evacuated in the event of excessive temperature (severe overload, blockage). In this way the coupling and system are protected from damage.

Characteristic curves



M_N	Motor torque	M_K	Coupling torque
M_L	Load torque	M_N	Fusible safety plug

Selecting the gear unit

Determine the gear unit type

↓

Determine the gear unit size based on the
- maximum output torque ($M_{a\ max}$)
- gear ratio (i)

in the gear unit selection tables with **adapter AM**

↓

Determine the adapter type by means of the
- motor speed (n_M)
- gear unit size
- rated power of the driving motor (P_m)

in the selection tables for **adapter AT**

Backstop AT../RS option

If the application requires only one permitted direction of rotation, the hydraulic centrifugal coupling can be configured with a backstop. Backstops with centrifugal lift-off sprags are used. The advantage of this design is that the sprags move around in the backstop without making contact above a certain speed. This means the backstops operate wear-free, without losses, maintenance-free and are suited for high speeds.

Dimensions

The dimensions of the hydraulic centrifugal coupling with backstop AT../RS are identical to those of the hydraulic centrifugal coupling AT.. (see dimension drawings in chapter "Hydraulic centrifugal coupling AT..").

Locking torques

Type	Maximum locking torque of the backstop [Nm]	Lift-off speed [rpm]
AT311/RS - AT322/RS	425	620
AT421/RS - AT422/RS	850	530
AT522/RS - AT542/RS	1450	480

Disk brake AT../BM(G) option

Braking torques

Type	d_{rz} [1)] [mm]	M_{Bmax} [2)] [Nm]	Reduced braking torques (guide values) [Nm]					
AT311/BMG - AT322/BMG	10	9.5						
	12	12.6	9.5					
	16	30	19	12.6	9.5			
	22	55	45	37	30	19	12.6	9.5
AT421/BMG - AT422/BMG	16	30	19	12.6	9.5			
	22	55	45	37	30	19	12.6	9.5
	28	55	45	37	30	19	12.6	9.5
AT522/BM - AT542/BM	22	75	50					
	28	150	125	100	75	50		
	32	250	200	150	125	100	75	50

1) The pinion spigot diameter depends on the gear ratio, please contact SEW-EURODRIVE.

2) Maximum braking torque

Order information

Specify the required braking torque and brake voltage when ordering a gear unit with adapter, centrifugal coupling and brake. If this is not specified in the order, the maximum permitted braking torque will be set.

4.4.4 AD input shaft assembly

Selecting the gear unit

Determine the gear unit type
↓
Determine the gear unit size based on the • maximum output torque ($M_{a\ max}$) • gear ratio (i) in the gear unit selection tables with input shaft assembly AD When selecting AD/P, please observe the selection note on page 64 .
↓
Check the maximum permitted overhung load value on the output (F_{Ra}).
↓
Check the maximum permitted input power at the gear unit (P_e) by taking account of the thermal limit rating (see page 66).
↓
Check the overhung load at the input (F_{Re}).
↓
If the case of higher requirements (e.g. larger overhung load on the input end) please contact SEW-EURODRIVE.

Centering shoulder AD../ZR

The input shaft assembly can be configured with a centering shoulder as an option. In this way, a customer's application can be attached to the cover centrally in relation to the input shaft side.

Backstop AD../RS

The input shaft assembly can be supplied with a backstop if the application only requires one permitted direction of rotation. Backstops with centrifugal lift-off sprags are used. The advantage of this design is that the sprags move around inside the backstop without making contact above a certain speed (lift-off speed). This means the backstops operate wear-free, without losses, maintenance-free and are suited for high speeds.

Dimensions:

The backstop is completely integrated in the cover. This means there is no difference in dimensions between an input shaft assembly with or without backstop (see dimension sheets in the "Input shaft assembly AD" chapter).

Locking torques:

Type	Maximum locking torque of the backstop [Nm]	Minimum lift-off speed [rpm]
AD2/RS	65	820
AD3/RS	425	620
AD4/RS	850	530
AD5/RS	1450	480
AD6/RS	1950	450
AD7/RS	1950	450
AD8/RS	1950	450

Motor mounting platform AD.. /P

Selection note (available combinations)

See the following table for motors available for the various motor mounting platforms.

	Motor mounting platform					
Motor type DRS	**AD2/P**	**AD3/P**	**AD4/P**	**AD5/P**	**AD6/P**	**AD7/P**
DRS71S	5.5					
DRS71M	5.5					
DRS80S	5.5					
DRS80M	5.5	11				
DRS90M	5.5	11				
DRS90L		11				
DRS100M		11				
DRS100L		11				
DRS100LC		11				
DRS112M		11				
DRS132S			23			
DRS132M			23			
DRS132MC			23			
DRS160S			23	41		
DRS160M				41		
DRS160MC				41		
DRS180S				41		
DRS180M				41		
DRS180L				41		
DRS180LC				41		
DRS200L					62	
DRS225S					62	
DRS225M					62	
DRS225MC					62	
DV250						103
DV280						103

Motor type DRE	Motor mounting platform					
	AD2/P	AD3/P	AD4/P	AD5/P	AD6/P	AD7/P
DRE80S	5.5					
DRE80M	5.5					
DRE90M	5.5	11				
DRE90L	5.5	11				
DRE100M		11				
DRE100L		11				
DRE100LC		11				
DRE112M		11				
DRE132S		11				
DRE132M			23			
DRE132MC			23			
DRE160S			23	41		
DRE160M				41		
DRE160MC				41		
DRE180S				41		
DRE180M				41		
DRE180L				41		
DRE180LC				41		
DRE200L					62	
DRE225S					62	
DRE225M					62	
DVE250						103
DVE280						103

Motor type DRP	Motor mounting platform					
	AD2/P	AD3/P	AD4/P	AD5/P	AD6/P	AD7/P
DRP80M	5.5					
DRP90M	5.5	11				
DRP90L	5.5	11				
DRP100M		11				
DRP100L		11				
DRP100LC		11				
DRP112M		11				
DRP132M			23			
DRP132MC			23			
DRP160S			23	41		
DRP160M			23	41		
DRP160MC				41		
DRP180S				41		
DRP180M				41		
DRP180L				41		
DRP180LC				41		
DRP200L					62	
DRP225S					62	
DRP225M					62	
DRP225MC					62	

(shaded) Combination is available / additional weight in kg

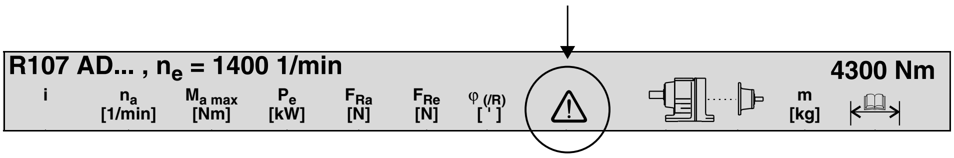
If the selected inspection cover (motor mounting platform) cannot be combined with the required motors, please contact SEW-EURODRIVE.

The available gear unit/motor combinations for input shaft assemblies with motor mounting platforms can be found in the corresponding dimension sheets L_N.

- R gear units from page 222
- F gear units from page 320
- K gear units from page 326
- S gear units from page 424
- W gear units from page 535

Thermal limit power for gear units with input shaft assembly

The power values given in the selection tables for gear units with input shaft assemblies are mechanical limit powers. Depending on the mounting position, however, gear units may become thermally overloaded before they reach the mechanical power limit. For mineral oils, such cases are indicated in the selection tables by the mounting position specification (see the column marked in the figure).



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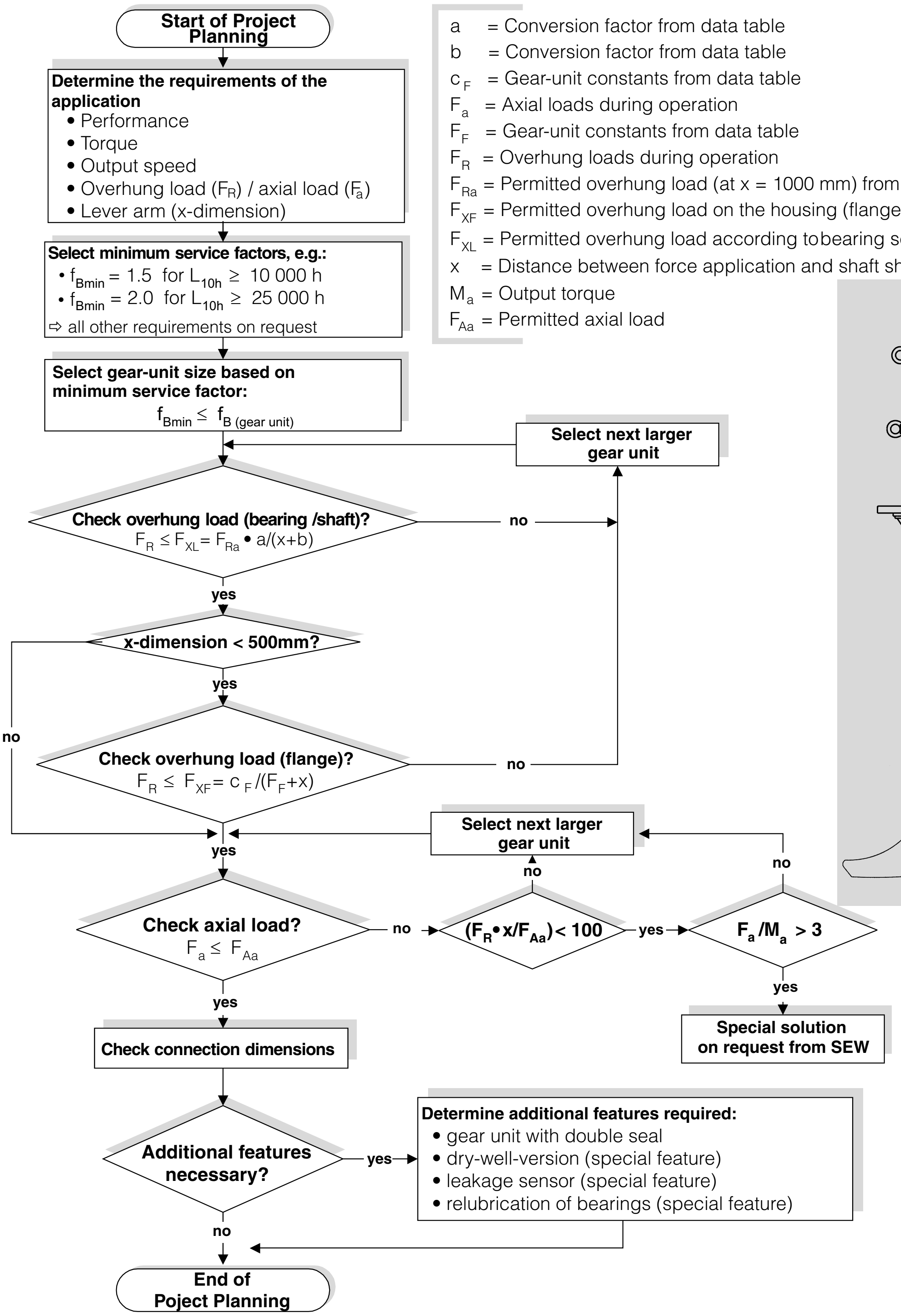
Please contact SEW-EURODRIVE if the mounting position you require is the same as one of those indicated. By considering the actual operating conditions, it will then be possible to recalculate the thermal limit rating based on the specific application. Alternatively, suitable measures can be taken (e.g. using a synthetic lubricant with higher thermal stability) to increase the thermal limit rating of the gear unit. The following data are required for recalculation:

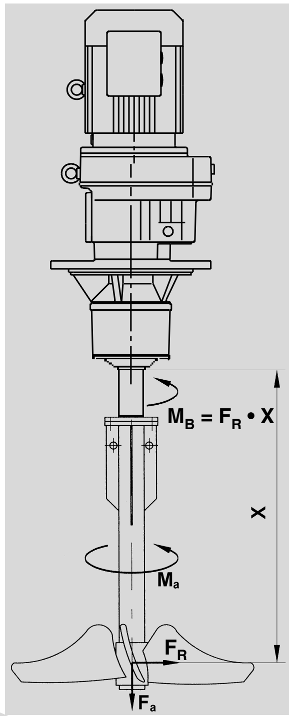
Gear unit type			
Output speed [na]	.... rpm	**Gear ratio i**	....
Ambient temperature	.... °C	**Cyclic duration factor CDF**	..........................%
Power drawn [P]	.... kW		
Installation site: ....in small, enclosed rooms ...in large rooms, halls ...outdoors			
Installation:.. e.g. base made of steel or concrete			

4.5 RM gear units

Project Planning You must take account of the higher overhung and axial loads when planning projects with RM helical gear units with extended bearing hub. Observe the following project planning procedure:



- a = Conversion factor from data table
- b = Conversion factor from data table
- c_F = Gear-unit constants from data table
- F_a = Axial loads during operation
- F_F = Gear-unit constants from data table
- F_R = Overhung loads during operation
- F_{Ra} = Permitted overhung load (at x = 1000 mm) from data table
- F_{XF} = Permitted overhung load on the housing (flange tensile strength)
- F_{XL} = Permitted overhung load according tobearing service life
- x = Distance between force application and shaft shoulder
- M_a = Output torque
- F_{Aa} = Permitted axial load



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Permitted overhung loads and axial forces

The permitted overhung loads F_{Ra} and axial forces F_{Aa} are specified for various service factors f_B and nominal bearing service life L_{10h}.

f_{Bmin} = 1.5; L_{10h} = 10 000 h

			Output speed n_a [1/min]							
			< 16	16-25	26-40	41-60	61-100	101-160	161-250	251-400
RM57	F_{Ra}	[N]	400	400	400	400	400	405	410	415
	F_{Aa}	[N]	18800	15000	11500	9700	7100	5650	4450	3800
RM67	F_{Ra}	[N]	575	575	575	580	575	585	590	600
	F_{Aa}	[N]	19000	18900	15300	11900	9210	7470	5870	5050
RM77	F_{Ra}	[N]	1200	1200	1200	1200	1200	1210	1210	1220
	F_{Aa}	[N]	22000	22000	19400	15100	11400	9220	7200	6710
RM87	F_{Ra}	[N]	1970	1970	1970	1970	1980	1990	2000	2010
	F_{Aa}	[N]	30000	30000	23600	18000	14300	11000	8940	8030
RM97	F_{Ra}	[N]	2980	2980	2980	2990	3010	3050	3060	3080
	F_{Aa}	[N]	40000	36100	27300	20300	15900	12600	9640	7810
RM107	F_{Ra}	[N]	4230	4230	4230	4230	4230	4230	3580	3830
	F_{Aa}	[N]	48000	41000	30300	23000	18000	13100	9550	9030
RM137	F_{Ra}	[N]	8710	8710	8710	8710	7220	5060	3980	6750
	F_{Aa}	[N]	70000	70000	70000	57600	46900	44000	35600	32400
RM147	F_{Ra}	[N]	11100	11100	11100	11100	11100	10600	8640	10800
	F_{Aa}	[N]	70000	70000	69700	58400	45600	38000	32800	30800
RM167	F_{Ra}	[N]	14600	14600	14600	14600	14600	14700	-	-
	F_{Aa}	[N]	70000	70000	70000	60300	45300	36900	-	-

f_{Bmin} = 2.0; L_{10h} = 25 000 h

			Output speed n_a [1/min]							
			< 16	16-25	26-40	41-60	61-100	101-160	161-250	251-400
RM57	F_{Ra}	[N]	410	410	410	410	410	415	415	420
	F_{Aa}	[N]	12100	9600	7350	6050	4300	3350	2600	2200
RM67	F_{Ra}	[N]	590	590	590	595	590	595	600	605
	F_{Aa}	[N]	15800	12000	9580	7330	5580	4460	3460	2930
RM77	F_{Ra}	[N]	1210	1210	1210	1210	1210	1220	1220	1220
	F_{Aa}	[N]	20000	15400	11900	9070	6670	5280	4010	3700
RM87	F_{Ra}	[N]	2000	2000	2000	2000	2000	1720	1690	1710
	F_{Aa}	[N]	24600	19200	14300	10600	8190	6100	5490	4860
RM97	F_{Ra}	[N]	3040	3040	3040	3050	3070	3080	2540	2430
	F_{Aa}	[N]	28400	22000	16200	11600	8850	6840	5830	4760
RM107	F_{Ra}	[N]	4330	4330	4330	4330	4330	3350	2810	2990
	F_{Aa}	[N]	32300	24800	17800	13000	9780	8170	5950	5620
RM137	F_{Ra}	[N]	8850	8850	8850	8830	5660	4020	3200	5240
	F_{Aa}	[N]	70000	59900	48000	37900	33800	31700	25600	23300
RM147	F_{Ra}	[N]	11400	11400	11400	11400	11400	8320	6850	8440
	F_{Aa}	[N]	70000	60600	45900	39900	33500	27900	24100	22600
RM167	F_{Ra}	[N]	15100	15100	15100	15100	15100	13100	-	-
	F_{Aa}	[N]	70000	63500	51600	37800	26800	23600	-	-

Conversion factors and gear unit constants

The following conversion factors and gear unit constants apply to calculating the permitted overhung load F_{xL} at point x ≠ 1000 mm for RM gearmotors:

Gear unit type	a	b	c_F (f_B = 1.5)	c_F (f_B = 2.0)	F_F
RM57	1047	47	1220600	1260400	277
RM67	1047	47	2047600	2100000	297.5
RM77	1050	50	2512800	2574700	340.5
RM87	1056.5	56.5	4917800	5029000	414
RM97	1061	61	10911600	11124100	481
RM107	1069	69	15367000	15652000	554.5
RM137	1088	88	25291700	25993600	650
RM147	1091	91	30038700	31173900	756
RM167	1089.5	89.5	42096100	43654300	869

Additional weight of RM gear units

Type	Additional weight compared to RF with reference to the smallest RF flange ∆m [kg]
RM57	12.0
RM67	15.8
RM77	25.0
RM87	29.7
RM97	51.3
RM107	88.0
RM137	111.1
RM147	167.4
RM167	195.4

4.6 Additional documentation

In addition to the information in this manual, SEW-EURODRIVE offers extensive documentation covering the entire topic of electrical drive engineering. These are mainly the publications of the "Drive Engineering - Practical Implementation" series as well as the manuals and catalogs for gear units and electronically controlled drives.

You will find additional links to a wide selection of our documentation in many languages for download on the SEW-EURODRIVE homepage (http://www.sew-eurodrive.com). The list below includes other documents that are of interest in terms of project planning. You can order these publications from SEW-EURODRIVE.

Technical data for motors and gear units

The following price catalogs and catalogs are available from SEW-EURODRIVE in addition to this "Gear Units" catalog:

- AC motors
- DR gearmotors
- Synchronous servo gearmotors
- Servo gear units

Drive Engineering Practical Implementation

- Project Planning for Drives
- Servo Technology
- Explosion-Proof Drives to EU Directive 94/9/EC