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Gear Motor Selection

Selection of geared motors

Information for inquiries and orders

Bauer Gear Motor GmbH
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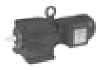
Application: ____
(e.g. traction drive, hoist/lift drive, roller conveyor, feedscrew, etc.)

Gearbox type


BG ☐


BF ☐


BK ☐


BS ☐

Number of items ________

Type ____
Power ________ kW or motor torque __________ Nm
Output speed ________ 1/min
Output torque ________ Nm Service factor f_B= __________
Mounting arrangement
Type of installation ________ Terminal box position __________
☐ **RAL 7031** or ☐ special RAL shade __________
Korrosionsschutz ☐ **Standard** or ☐ CORO1 ☐ CORO2 ☐ CORO3
Nominal frequency of the motor _________ Hz
Ambient temperature _________ °C Altitude [m] __________
Ambient conditions & installation site ____
Transmission component (direct, chain, gearwheel, belt, etc.) __________________________
Radial force on output shaft _______ N at a distance x from the shaft junction _______ mm
Axial force on output shaft ________ N

Operating on field-oriented inverter suitable for operation of permanent magnet synchronous motors

Speeds of ______ 1/min to ________ 1/min

Gear unit design
☐ Foot with clearance holes
☐ A-Flange with clearance holes D = _____ mm
☐ C-Flange with tapped holes
☐ Torque restraining arms with rubber buffers in ☐ L ☐ T ☐ B direction
☐ Foot with tapped holes on
☐ L ☐ R ☐ LR ☐ T ☐ B side

Output shaft
☐ Solid shaft on ☐ F ☐ B ☐ FB end
☐ Hollow shaft
☐ Hollow shaft for shrink-on disk ☐ with shrink disc ☐ with cover
☐ Hollow shaft with spline acc. to DIN 5480

Motor-mounted components
☐ Brake
Type _______________ Braking torque = __________ Nm
Supply voltage = _______ VAC ______ Hz or __________ V DC
Manual release yes ☐ no ☐
Microswitch Function monitoring ☐ Wear monitoring ☐

☐ Encoder

☐ Absolute Multiturn ☐ with Profibus
☐ Resolver
☐ Sin/Cos
☐ Forced ventilation

Special design features

____

____

Drive configuration

Motions are necessary in production plants and equipment for the manufacture of goods and products. Geared motors are used to implement these motions in stationary production equipment. The objective of drive configuration is to obtain the optimal motor for each type of motion.

Motions in machines and equipment vary considerably. Experienced design engineers reduce the necessary motions to a few standard types:

These are:

- continuous linear motion
- reciprocating linear motion
- horizontal linear motion
- vertical or oblique linear motion for lifting and lowering loads
- continuous rotary motion and reciprocating rotary motion

All motions can be divided into:

- an acceleration phase
- a constant-velocity phase
- a braking (deceleration) phase

These motion phases must be examined separately when sizing a drive, in order to determine the phase with the highest load. After the maximum load has been determined, the drive system can be selected.
See our separate "Design Guide" publication for assistance with various use cases.

Required data for drive configuration

In addition to the data on (Specification of geared motors), the following data is necessary for drive configuration:

Designation	Description	Unit
t_d	Operating time per day	[h]
t_a	Deceleration time	[s]
n_2	Output speed	[rpm]
n	Rated rotor shaft speed	[rpm]
J	Moment of inertia	[kgm²]
J_{ext}	External moment of inertia	[kgm²]
J_{ext}	External moment of inertia referred to the rotor shaft	[kgm²]
J_{rot}	Rotor moment of inertia	[kgm²]
F	Force	[N]
m	Mass	[kg]
v	Velocity	[m/s]
a	Acceleration	[m/s²]
g	Earth gravitational constant	[m/s²]
P_{dyn}	Dynamic power	[kW]
P_s	Static power	[kW]
P	Power	[kW]
M_2	Output torque	[Nm]
M_N	Rated torque at rotor shaft	[Nm]
M_a	Deceleration torque	[Nm]
M_L	Braking or driving load torque	[Nm]
M_{grenz}	Specific limiting torque of gearbox at gear ratio i	[Nm]
M_{Br}	Rated braking torque	[Nm]
i	Gear reduction ratio	
FI	Inertia ratio	

Drive configuration process

Motor configuration

Determining the motor power

The required power can generally be calculated as follows:

$$P = \frac{F \times v}{\eta}$$

As previously described, all motions are divided into an acceleration phase (dynamic power), a constant-velocity phase (static power), and a braking (deceleration) phase. Depending on the type of motion, the force F necessary to overcome all opposing forces such as rolling friction, linear friction, gravitational force, acceleration and so on arising from the drive train has a strong influence on the required power and must be determined explicitly for each use case.

Determining the required torque

After the motor power has been determined, the required gearbox output torque can be calculated with:

$$M_2 = \frac{P \times 9550}{n_2}$$

Determining the gear reduction ratio

The gear reduction ratio is the ratio of the rated speed of the motor (see the motor data in Section 13) to the desired output speed of the geared motor.

$$i = \frac{n}{n_2}$$

Gearbox size selection

Determining the factor of inertia

The inertia ratio is the ratio of the sum of the moments of inertia of all masses driven by the motor and converted to the motor speed, including the moment of inertia of the motor rotor, to the moment of inertia of the rotor:

$$FI = \frac{J_{ext'} + J_{rot}}{J_{rot}} \qquad \text{where} \qquad J_{ext'} = \frac{J_{ext}}{i^2}$$

Determining the shock load

The shock load (see Sections 6, 7, 8 and 9) is determined from the inertia factor, the type of transmission component and the relative moment of acceleration.

Determining the minimum service factor f_{Bmin}

Based on the operating time per day, the cycle rate and the ascertained shock load, the service factor f_{Bmin} can be taken from the tables in Sections 6, 7, 8 and 9.

Based on this minimum service factor f_{Bmin}, select a geared motor from the tables that has a higher service factor as well as the required output speed, output torque and motor power.

Note: The service factor relates solely to the required torque for static operation needed by the application, which should be covered by the output torque of the selected geared motor.
The dynamic portion is not taken into consideration here.

The actual service factor of the geared motor with regard to required torque for static operation can therefore be calculated as follows:

$$f_B = \frac{M_{gr}}{M_{2erf}}$$

The final step is to specify the accessory options for the geared motor.

Brake specification

Essentially it is necessary to determine, based on the amount of friction energy to be dissipated by the brake, whether the brake is a holding brake or a service brake.
See Section 14 for the definitions of holding brakes and service brakes.

Once all the necessary data and requirements are known, the required braking torque can be calculated as follows:

$$M_{Br} = M_a \pm M_L$$

$$M_a = \frac{J \times n}{9{,}55 \times t_a}$$

If the specific application data is not known, for horizontally driven equipment we recommend selecting a braking torque that is 1.0 to 1.5 times the rated torque of the motor.

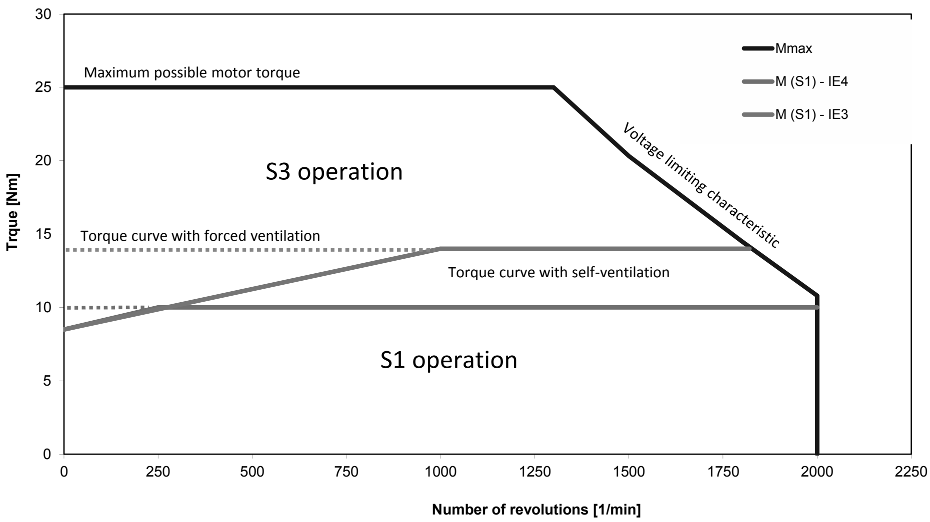
In the case of applications with significant external moments of inertia (FI greater than 2) and with operating cycles per hour, the brake size must always be selected on the basis of the thermally allowable braking energy. See Section 14 for detailed information on brake configuration.

In the case of lifting equipment, for safety reasons a braking torque twice as large as the rated torque of the motor should always be selected.

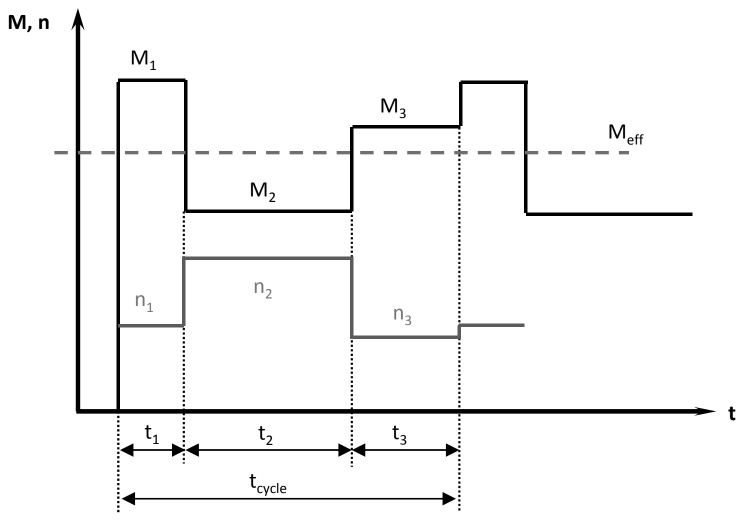
Torque–speed characteristic

The torque versus speed curve shows the operating characteristics of the PMSM.
The reference points shown schematically on the torque versus speed curve are significant criteria for motor selection.

Torque vs. Speed Curve



The motor is determined by the effective motor torque and the average motor speed. Both values Meff and neff must be below the S1 limit characteristic curve of the motor to be selected.



Effective torque

$$M_{eff} = \sqrt{\frac{M_1^2 \cdot t_1 + M_2^2 \cdot t_2 + M_3^2 \cdot t_3 + \ldots + M_n^2 \cdot t_n}{t_1 + t_2 + t_3 + \ldots + t_n}}$$

Effective rpm

$$n_{eff} = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + n_3 \cdot t_3 + \ldots + n_n \cdot t_n}{t_1 + t_2 + t_3 + \ldots + t_n}$$

Acceleration

Dynamic power
The dynamic power is the power that accelerates the entire system (load, transmission components, gears and motor)

$$P_{dyn} = \frac{m \times a \times v}{\eta}$$

P_{dyn}	Dynamic power [W]
m	Mass [kg]
a	Acceleration [m/s²]
v	Speed [m/s]
η	Level of efficiency

Dynamic load torque

$$M_{dyn_1} = m \cdot a \cdot \frac{1}{\eta} \cdot \frac{D}{2} \cdot \frac{1}{i}$$

D	Impeller diameter
i	Gear reduction ratio

Constant speed

Static performance
The static power takes into account all forces that occur in the unaccelerated state. These include: rolling friction, frictional forces, lifting capacity on slopes and wind force.

$$P_S = \frac{F_F \times v}{\eta}$$

P_S	Static power [W]
F_F	Driving resistance [N]

Static load torque (simplified)

$$M_{statt} = m \cdot g \cdot \frac{1}{\eta} \cdot \frac{D}{2} \cdot \frac{1}{i}$$

g	Acceleration due to gravity

Deceleration

Deceleration torque

$$M_{dyn2} = m \cdot (-a) \cdot \eta_L \cdot \frac{D}{2} \cdot \frac{1}{i}$$

$$M_{Verz} = M_{stat} + M_{dyn2}$$

M_{Verz} Deceleration torque

Load torques in the driving cycle

Acceleration phase

$$M_{Motor} = M_{stat} + M_{dyn1}$$

Constant speed

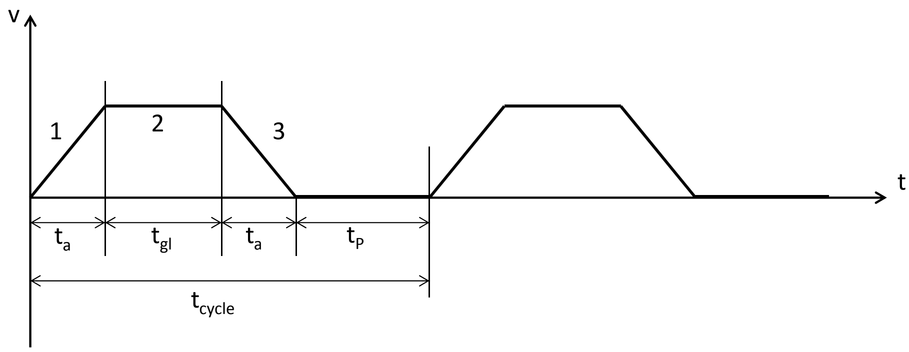
$$M_{Motor} = M_{stat}$$

Braking phase

$$M_{Motor} = M_{stat} + M_{dyn2}$$

Motor selection

Example:



Required dynamic torque on the motor (acceleration):	M1	=	20Nm
Required static torque on the motor:	M2	=	8,0Nm
Deceleration torque:	M3	=	10Nm
Acceleration time/deceleration time	t_a	=	0,5s
Duration constant travel	t_{gl}	=	5s
Cycle time	t_{Zykl}	=	10s
Motor speed for constant travel	n	=	1450 1/min

Effective motor torque and moderate motor speed

$$M_{eff} = \sqrt{\frac{M_1^2 \cdot t_a + M_2^2 \cdot t_{gl} + M_3^2 \cdot t_a}{t_{Zykl}}} = 7{,}55 \text{ Nm}$$

$$n_{eff} = \frac{n \cdot t_a + n \cdot t_{gl} + n \cdot t_a}{t_{Zykl}} = \frac{n \cdot (2 \cdot t_a + t_{gl})}{t_{Zykl}} = 870 \text{ min}^{-1}$$

The following motor is selected:

Type: S08LA4
Rated power P_n = 1,5 kW
Rated torque M_n = 9,55 Nm
Rated speed n_n = 1500 min^{-1}

Motor Data		S08LA4					
Rated output P_n	kW	1,1	1,5	1,65	2,2	2,2	3
Rated torque M_n	Nm	7	9,55	7	9,55	7	9,55
Rated current I_n	A	2,5	3,4	4,4	6	5,1	6,9
No. of Motor Poles 2p		4	4	4	4	4	4
Motor power n_n	1/min	1500	1500	2250	2250	3000	3000
Nominal Frequency	Hz	50	50	75	75	100	100
Motor efficiency η	%	IE4 - 88,0	IE3-85,3	IE4-89,3	IE3-86,7	IE4-91,0	IE4-89,8
Motorcircuit		Y	Y	D	D	Y	Y
Phase Resistance U-V R_{20}	Ohm	11,34	11,34	3,74	3,74	2,86	2,86
Winding Resistance Rs_{20}	Ohm	5,64	5,67	5,67	5,67	1,43	1,43
Inductance D-Axis Ld	mH	80	80	26,7	26,7	20,2	20,2
Inductance Q-Axis Lq	mH	118	118	39,3	39,3	29,4	29,4
Voltage constant ke	V/1000 1/min	174	174	100	100	84	84
Torque constant kt	Nm/A	2,8	2,8	1,6	1,6	1,4	1,4
Peak Torque $M_{max\,(60s)}$	Nm	16	16	16	16	16	16
Peak Current $I_{max\,(60s)}$	A	5,9	5,9	10,5	10,5	12	12
Moment of inertia	kgm^2	0,0015					

With proper utilisation of the gears by doubling the reduction and increasing the revs of the motor to 3000 min-1, the torque requirement for the motor can be halved, and this makes it possible to decrease the size of the motor.

Instead of the S08LA4, the following motor could be selected in this case:

Type: S08MA4
Rated power P_n=1,5 kW
Rated torque M_n=4,75 Nm
Rated speed n_n=3000 min^{-1}

Motor Data		S08MA4				
Rated output P_n	kW	0,75	1,1	1,65	1,5	2,2
Rated torque M_n	Nm	4,75	4,75	7	4,75	7
Rated current I_n	A	1,7	2,9	4,3	3,4	5
No. of Motor Poles 2p		4	4	4	4	4
Motor power n_n	1/min	1500	2250	2250	3000	3000
Nominal Frequency	Hz	50	75	75	1000	100
Motor efficiency η	%	IE4-87,4	IE4-89,0	IE3-84,7	IE4-90,1	IE3-87,8
Motorcircuit		Y	D	D	Y	Y
Phase Resistance U-V R_{20}	Ohm	18,8	6,27	6,27	4,8	4,8
Winding Resistance Rs_{20}	Ohm	9,4	9,4	9,4	2,4	2,4
Inductance D-Axis Ld	mH	114	38	38	29,3	29,3
Inductance Q-Axis Lq	mH	136	45	45	34,2	34,2
Voltage constant ke	V/1000 1/min	177	102	102	89	89
Torque constant kt	Nm/A	2,8	1,6	1,6	1,4	1,4
Peak Torque $M_{max\,(60s)}$	Nm	12	12	12	12	12
Peak Current $I_{max\,(60s)}$	A	4,5	7,5	7,5	8,9	8,9
Moment of inertia	kgm^2	0,00115				

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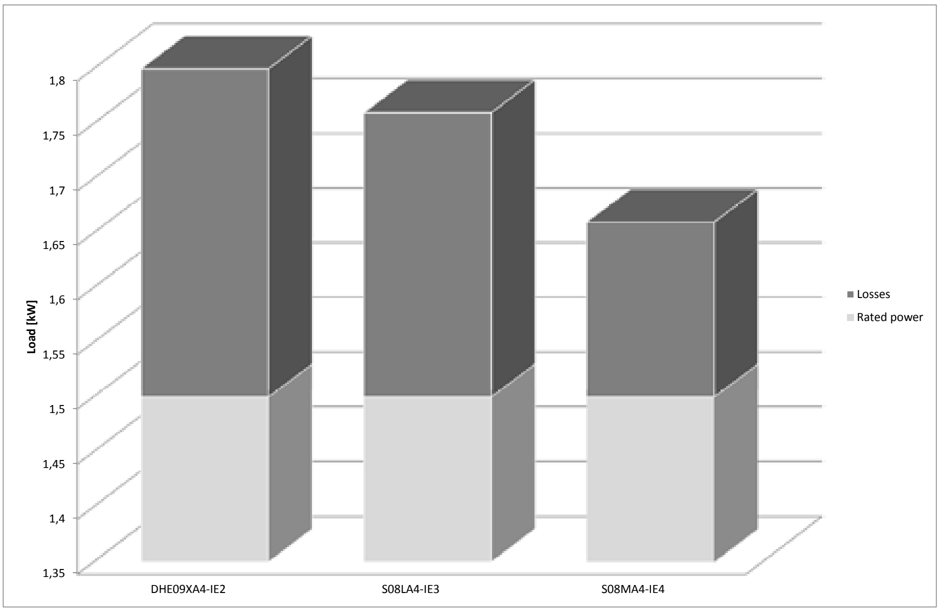
This increases the efficiency of the motor on the one hand, while also reducing the package length. The result is a cheaper drive with increased energy savings.

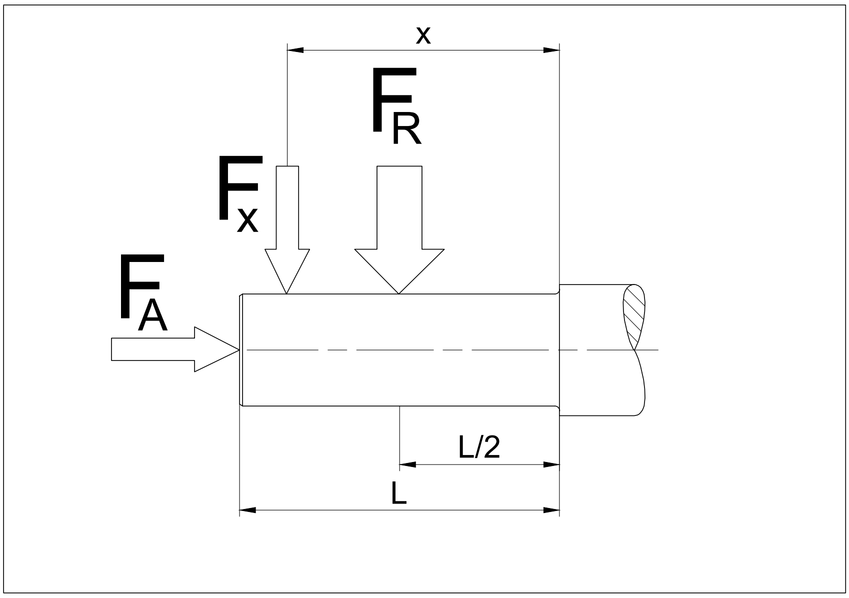
The diagram below shows the potential energy savings of using the different IE efficiency motors.
With the utilisation of the gears and the **use** of the **S08MA4 IE4** motor, **compared** with the **IE3 S08LA4** the **power loss can be reduced by 36.24%** and **by 45.58%** compared with the **IE2 DHE09XA4**.
With 8 hours of operation, 5 days a week and 50 weeks of the year, this results in an **energy saving** of **187.37 kW/h** compared with the **IE3 S08LA4** and **276.14 kW/h compared with** the **IE2 DHE09XA4**.



Radial and axial forces on the output shaft

For each geared motor with a solid shaft, the allowable radial force $F_{R(N,V)}$ referred to the centre of the output shaft, x = l/2, is listed in the selection tables. The listed data applies to both foot-mounted and flange-mounted versions. If the force application point F_x is off centre, the allowable radial force must be recalculated taking into account the bearing lifetime and the shaft strength.

Maximum allowable radial force at force application point X



$F_{R(N,V)}$	Allowable radial force (x = l/2) according to the selection tables [N]
X	Distance from shaft junction to the force application point [mm]
F_A	Axial force [N]

To evaluate the radial force present at the force application point X, the allowable radial forces at position X must be determined with respect to the load limits of the bearings and the shaft strength.

If the calculated allowable radial forces at the force application point X are greater than the radial force that is present, the gearbox may be selected for the application.
If the calculated values are not sufficient or the force application point X is not within the stub shaft length l, please consult us.

Bearing load limit

$$F_{XL1} = F_q \times \frac{0,5 + b}{\left(\frac{X}{l} + b\right)}$$

$$F_{XL2} = F_q \times \frac{0,5 + a}{\left(\frac{X}{l} + a\right)}$$

Gear Motor Selection

Radial and axial forces on the output shaft

Shaft strength

$$F_{XW1} = F_{qmax} \times \frac{0{,}5}{\left(\frac{X}{l}\right)}$$

$$F_{XW2} = F_{qmax} \times \frac{0{,}5 + c}{\left(\frac{X}{l} + c\right)}$$

For the selected gear ratio and bearing type (normal or reinforced), F_q is the allowable perpendicular force F_{RN} or F_{RV} from the geared motor selection tables.

F_{qmax} is the maximum allowable perpendicular force for the selected gearbox size as listed in the geared motor selection tables, independent of the bearing type (normal or reinforced).

The factors a, b and c for the individual gearbox types are listed in the following tables.

Helical gear unit BG series

Frame size	Bearings	Output shaft code	l	a	b	c
BG04	Normal	-.1	24	0,5625	1,5	-
BG05	Normal	-.1	28	0,5893	1,3929	-
BG06	Normal	-.1	30	0,6667	1,4167	-
BG10	Normal	-.1	40	0,7125	1,6750	-
		-.7		1,1000	2,0625	-
BG20	Normal	-.1	50	0,6100	2,2500	-
		-.7		0,9400	2,5800	-
BG30	Normal	-.1	60	0,5917	2,1750	-
		-.7		0,9417	2,5250	-
BG40	Normal	-.1	60	0,6917	2,3667	-
		-.7		1,0083	2,6833	-
BG50	Normal	-.1	80	0,5625	2,0000	-
		-.7		0,8563	2,2938	-
BG60	Normal	-.1	100	0,5300	2,0200	-
		-.7		0,7650	2,2550	-
BG70	Normal	-.1	120	0,4750	1,7292	-
		-.7		0,7292	1,9833	-
BG80	Normal	-.1	140	0,4286	1,7000	-
		-.7		0,6000	1,8714	-
BG90	Normal	-.1	200	0,3675	1,5300	-
		-.7		0,5825	1,7450	-
BG100	Normal	-.1	220	0,3477	1,4341	-
		-.7		0,5386	1,625	-

Shaft-mounted gear unit BF series

Frame size	Bearings	Output shaft code	l	a	b	c
BF06	Normal	-.1	50	0,4500	1,4100	-
BF10	Normal	-.1	60	0,5083	1,4833	-
		-.2		0,6500	1,6250	-
BF20	Normal	-.1	70	0,4286	1,3571	-
		-.2		0,5571	1,4857	-
BF30	Normal	-.1	80	0,3875	1,2563	-
		-.2		0,5688	1,4375	-
BF40	Normal	-.1	100	0,4050	1,2250	-
		-.2		0,5250	1,3450	-
BF50	Normal	-.1	120	0,3125	1,0625	-
		-.2		0,3959	1,1458	-
BF60	Normal	-.1	140	0,3286	1,0821	-
		-.2		0,4036	1,1571	-
	Reinforced	-.1		-	-	0,2750
		-.2		-	-	0,3643
BF70	Normal	-.1	180	0,2722	1,0566	-
		-.2		0,3056	1,0889	-
	Reinforced	-.1		-	-	0,2194
		-.2		-	-	0,2639
BF80	Normal	-.1	220	0,2878	1,3536	-
		-.2		0,2873	1,3518	-
	Reinforced	-.1		-	-	0,2364
		-.2		-	-	0,2268

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Gear Motor Selection

Radial and axial forces on the output shaft

Bevel gear unit BK series

Frame size	Bearings	Output shaft code	l	a	b	c
BK06	Normal	-.1	40	0,4375	1,9875	-
		-.2		0,4375	1,9875	-
		-.7		0,9125	2,4625	-
		-.8		0,9125	2,4625	-
BK10	Normal	-.1	60	0,5917	2,2417	-
		-.2		0,5917	2,2417	-
BK20	Normal	-.1	70	0,5071	2,2357	-
		-.2		0,5071	2,2357	-
	Reinforced	-.1		-	-	0,3929
		-.2		-	-	0,3929
BK30	Normal	-.1	80	0,5250	2,2750	-
		-.2		0,5250	2,2750	-
	Reinforced	-.1		-	-	0,4125
		-.2		-	-	0,4125
BK40	Normal	-.1	100	0,4300	2,1700	-
		-.2		0,4300	2,1700	-
	Reinforced	-.1		-	-	0,3400
		-.2		-	-	0,3400
BK50	Normal	-.1	120	0,4083	1,9417	-
		-.2		0,4083	1,417	-
	Reinforced	-.1		-	-	0,3250
		-.2		-	-	0,3250
BK60	Normal	-.1	140	0,3536	1,8036	-
		-.2		0,3536	1,0836	-
	Reinforced	-.1		-	-	0,3121
		-.2		-	-	0,2979
BK70	Normal	-.1	180	0,2861	1,6694	-
		-.2		0,2861	1,6694	-
	Reinforced	-.1		-	-	0,2428
		-.2		-	-	0,2317
BK80	Normal	-.1	220	0,2818	1,5545	-
		-.2		0,2818	1,5545	-
	Reinforced	-.1		-	-	0,2305
		-.2		-	-	0,2214
BK90	Normal	-.1		0,2519	1,6096	-
		-.2		0,2519	1,6096	-
	Reinforced	-.1		-	-	0,1989
		-.2		-	-	0,1912

Worm gear unit BS series

Frame size	Bearings	Output shaft code	l	a	b	c
BS02	Normal	-.1	30	0,6	2,1	-
		-.2		-	-	-
		-.7		1,3333	2,8333	-
		-.8		-	-	-
BS03	Normal	-.1	40	0,4375	1,9875	-
		-.2		-	-	-
		-.7		0,9125	2,4625	-
		-.8		-	-	-
BS04	Normal	-.1	40	0,5375	1,7875	-
		-.2		-	-	-
BS06	Normal	-.1	50	0,4800	1,9400	-
		-.2		-	-	-
BS10	Normal	-.1	60	0,5917	2,3083	-
		-.2		-	-	-
BS20	Normal	-.1	70	0,5500	2,4357	-
		-.2		-	-	-
BS30	Normal	-.1	80	0,5312	2,4313	-
		-.2		-	-	-
BS40	Normal	-.1	120	0,4292	1,7042	-
		-.2		-	-	-

Transmission components

If a transmission component is used (gearwheels, chainwheels, V-belt, etc.), the resulting radial forces can be determined as follows.

$$F_R = \frac{2000 \times M}{D_T} \times f_Z \leq F_{R(N,V)}$$

F_R	Radial force [N]
M	Torque [Nm]
D_T	Pitch radius of the transmission component [mm]
f_Z	Safety factor

A safety factor f_Z depending on the type of transmission component attached to the output shaft must be included when determining the value of the radial force FR that is present.

4

Radial and axial forces on the output shaft

Factor f_z for the type of transmission component

Transmission component	Safety factor f_z	Note
Gearwheel	1	=> 17 teeth
Gearwheel	1,15	< 17 teeth
Chainwheel	1	=> 17 teeth
Chainwheel	1,25	< 17 teeth
Toothed rack	1,15	< 17 teeth (pinion)
V-belt	2……2,5	From tensioning force
Flat belt	2….3	From tensioning force
Friction wheel	3….4	

Axial force

The following specification applies to the allowable axial force FA on the output shaft (either tension or compression) for all Bauer geared motors and for foot, flange or hollow-shaft versions:

$$F_A = 0{,}5 \times F_{R(N,V)}$$

Please consult us in case of larger axial forces.

Shock loads for various types of machinery are listed in standards and guidelines as well as industry-specific documents and manufacturer's documents. If for example a crusher or a press is listed here with an shock load class of III, this is justified. On the other hand, under favourable conditions a belt conveyor could have an shock load class of I, but this could quickly change to III with on/off operation, high speed and overdrive due to a loose chain. Consequently, the classifications in the following table should by no means be taken blindly. They provide a rough point of reference, but the ultimate classification of the shock load should always take into account the factors specified by Bauer, in particular the inertia ratio, the cycle rate and the transmission component(s).

Drive	Shock load		
Construction machinery			
Construction lifts		II	
Concrete mixers		II	
Road construction machinery		II	
Chemical industry			
Cooling drums		II	
Mixers		II	
Stirrers (light media)	I		
Stirrers (viscous media)		II	
Drying drums		II	
Centrifuges (light)	I		
Centrifuges (heavy)		II	
Transport and conveying systems			
Hauling winches		II	
Conveying machines			III
Apron conveyors		II	
Belt conveyors (bulk material)	I		
Belt conveyors (piece goods)		II	
Bucket belt conveyors		II	
Chain conveyors		II	
Circular conveyors		II	
Freight lifts		II	
Flour bucket conveyors	I		
Passenger lifts		II	
Flat belts		II	
Screw conveyors		II	
Gravel bucket conveyors		II	
Inclined lifts			III
Steel belt conveyors		II	
Chain conveyors		II	
Blowers and fans			
Roots blowers		II	
Blowers (axial and radial)	I		
Cooling tower fans		II	
Suction blowers		II	

Drive	Shock load		
Rubber			
Extruders			III
Calenders		II	
Kneaders			III
Mixers		II	
Rolling mills			III
Timber processing and woodworking			
Debarking drums			III
Planers		II	
Woodworking machinery	I		
Saw frames			III
Crane systems			
Luffing mechanisms	I		
Traversing mechanisms			III
Hoisting mechanisms	I		
Slewing mechanisms		II	
Jib mechanisms		II	
Plastics			
Extruders		II	
Calenders		II	
Mixers		II	
Grinders and pulverisers		II	
Metalworking			
Plate bending machines		II	
Plate straightening machines			III
Hammers			III
Planers			III
Presses			III
Shears		II	
Forging presses			III
Punches			III
Countershafts and driveshafts	I		
Machine tools (principal)		II	
Machine tools (ancillary)	I		

Gear Motor Selection

Shock loads of machinery

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Drive	Shock load		
Food processing			
Filling machines	I		
Kneading machines		II	
Mashing machines		II	
Packaging machines	I		
Sugar cane cutters		II	
Sugar cane mills			III
Sugar beet cutters		II	
Sugar beet washers		II	
Paper			
Couching			III
Smoothing rolls			III
Hollander		II	
Pulp grinder			III
Calender		II	
Wet presses			III
Shredders			III
Suction presses			III
Suction rolls			III
Drying rolls			III
Stone and soil			
Crushers			III
Rotary kilns			III
Hammer mills			III
Tube mills			III
Beating mills			III
Tile and block presses			III
Fabrics			
Winders		II	
Printing and dying machines		II	
Tanning vats		II	
Shredders		II	
Looms		II	

Drive	Shock load		
Rolling mills			
Plate shears			III
Plate turners		II	
Billet presses			III
Billet and slab lines			III
Billet conveyors			III
Wire drawing machines		II	
Descaling machines			III
Sheet metal mills			III
Plate mills			III
Winders (strip and wire)		II	
Cold rolling mills			III
Chain transports		II	
Billet shears			III
Cooling beds		II	
Cross transports		II	
Roller tables (light)		II	
Roller tables (heavy)			III
Roll straighteners		II	
Tube welders			III
Trimming shears		II	
Cropping shears			III
Continuous casting machines			III
Roll adjustment devices		II	
Manipulators			III
Laundry			
Drum dryers		II	
Washing machines		II	
Water treatment			
Centrifugal aerators		II	
Archimedes screw		II	