Design

Torque and speed:

at input (shaft D): $T_D = \frac{P_D \times 9550}{n_D}$

at output (shaft A / C): $T_{AC} = T_D \times i \times \eta$

$P_{AC} = \frac{T_{AC} \times n_{AC}}{9550}$

$n_{AC} = \frac{n_D}{i}$

Equivalent torque for load spectrum: $T_{AC} = \sqrt[6.6]{\frac{\Sigma(T_{AC;n}^{6.6} \times n_{AC;n} \times t_n)}{\Sigma(n_{AC;n} \times t_n)}}$

$n_{AC} = \frac{\Sigma\, n_{AC;n} \times t_n}{\Sigma\, t_n}$

Rated torque / rated power for gearbox selection: $T_{a;AC} = T_{AC} \times f_b \times f_t \times f_d$

$P_a = P_{AC} \times f_b \times f_t \times f_d$

Thermal limit power: $P_t = P_{AC} \times f_d \times f_t \times f_e$

A breather is required from 80% P_t!

The derivation of the factors is described on the following pages

Example calculation:

Initial situation:
Three-phase motor for fan, with 0.75 kW, 1390 rpm, operation 16 h/d, max. 100% ED/10 min, max. 100 starts / hour, fan speed 500–750 rpm, 20°C ambient temperature, 350 N radial force at output shaft

Selected: Bevel gearbox with drive ratio 2:1

1) Input: $T_D = \frac{0{,}75 \text{ kW} \times 9550}{1390 \text{ min}^{-1}} = 5{,}15 \text{ Nm}$

2) Output: $T_{AC} = 5{,}15 \text{ Nm} \times \frac{2}{1} \times 0{,}97 = 10{,}0 \text{ Nm}$

$P_{AC} = \frac{10{,}0 \text{ Nm} \times 695 \text{ min}^{-1}}{9550} = 0{,}73 \text{ kW}$

3) Including factors for gearbox selection:
f_b = 1,1 (application case I, 16 h/d, 100 c/h)
f_d = 1,15 (n_D 1000..1700)
f_t = 1,0 (20°C)
f_e = 1,0 (100% ED/10 min)

$T_{a;AC}$ = 10,0 Nm x 1,1 x 1,15 x 1,0 = **12,65 Nm**
P_t = 0,73 kW x 1,15 x 1,0 x 1,0 = **0,84 kW**

4) Gearbox selection:
Comparison of calculated values with permissible values according to tables

$T_{a;AC}$: 12,65 Nm < 14,5 Nm ✓
$F_{r;AC}$: 350 N < 390 N ✓
P_t: 0,84 kW < 1,3 kW ✓
P_t: 0,84 kW < 1,04 kW (= 1,3 kW x 80 %) ✓

→ **ZK-065-2:1**, without breather

Explanations:

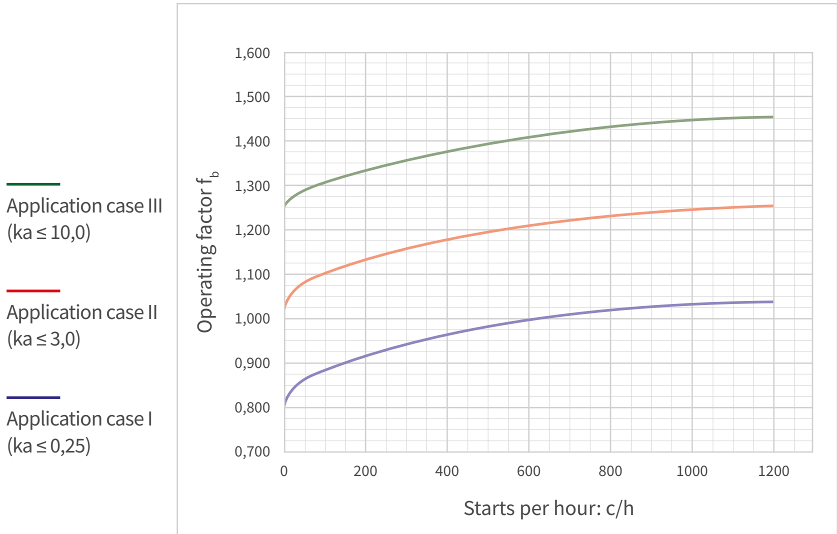
T_D **Input torque [Nm]**
P_D **Input power [kW]**
n_D **Input speed [min⁻¹]**

T_{AC} **Output torque [Nm]**
P_{AC} **Output power [kW]**
n_{AC} **Output speed [min⁻¹]**
i **Drive ratio**
η **Gearbox efficiency**

$T_{AC;n}$ **Output torque of a load case [Nm]**
$n_{AC;n}$ **Output speed of a load case [min⁻¹]**
t_n **Time share of a load case [min⁻¹]**

$T_{a;AC}$ **Design torque at the output [Nm]**
P_a **Design power at the gearbox [kW]**
P_t **Thermal limit power [kW]**
f_b **Operating factor**
f_t **Temperature factor**
f_d **Speed factor**
f_e **Duty factor**

Determining the operating factor f_b for 8 h/d operating time



Design

Factors:
Operating factor f_b

Derivation:
1) Select the appropriate application case
2) Select the diagram according to the duty factor
3) Enter the switching frequency per hour on the x-axis and read off the operating factor

smooth, shock-free operation low accelerations	irregular, shock-loaded operation medium accelerations	highly irregular operation, heavy shocks, high accelerations, alternating load
Application case I (ka ≤ 0,25)	**Application case II (ka ≤ 3,0)**	**Application case III (ka ≤ 10,0)**
Filling machines	Rotary table drives	Crushers
Elevators, light-duty	Elevators, heavy-duty	Calenders
Screw conveyors, light-duty	Reels	Press brakes
Fans	Kneading machines	Piston pumps
Lifting platforms	Mixers, heavy-duty	Presses
Mixers, light-duty	Mills	Agitators, heavy-duty
Roller grilles	Agitators, light-duty	Vibrators
Conveyor belts, light-duty	Gate drives	Shears
Packaging machines	Conveyor belts, heavy-duty	Punching machines
Workpiece drives	Packaging machines	Rolling mills
Centrifuges	Winches	Cement mills

Speed factor f_d

Input speed n_D [min⁻¹]	0..500	500..1000	1000..1700	1700..2400	2400..3000
Speed factor f_d	0,90	1,00	1,15	1,23	1,30

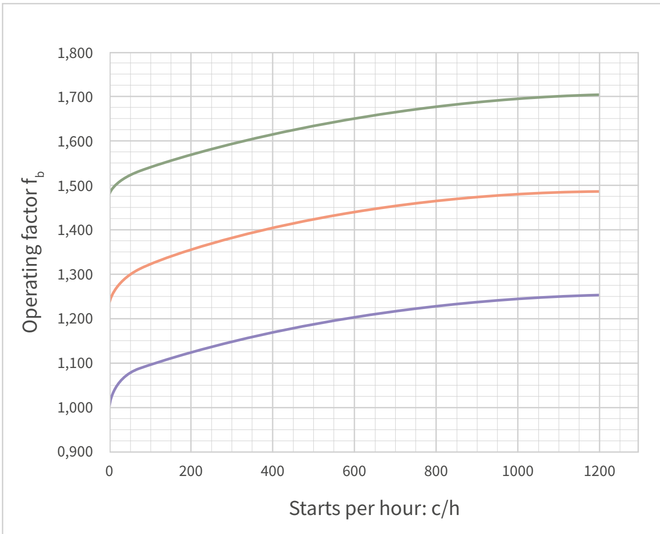
Temperature factor f_t

Ambient temperature [°C]	10	15	20	25	30	35	40	45	50
Temperature factor f_t	0,90	0,95	1,00	1,10	1,20	1,30	1,40	1,50	1,60

Duty factor f_e

max. duty factor [% / 10 min]	100	80	60	40	20	10
Duty factor f_e	1,00	0,95	0,80	0,60	0,30	0,15

Determining the operating factor f_b for 16 h/d operating time



Determining the operating factor f_b for 24 h/d operating time