



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:

$$T_{AC} = \sqrt{\frac{\sum (T_{AC;n}^{6,6} \times n_{AC;n} \times t_n)}{\sum (n_{AC;n} \times t_n)}}$$

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

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



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

Application case III (ka ≤ 10,0)
 Application case II (ka ≤ 3,0)
 Application case I (ka ≤ 0,25)

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)

$$T_{a;AC} = 10,0 \text{ Nm} \times 1,1 \times 1,15 \times 1,0 = \mathbf{12,65 \text{ Nm}}$$

$$P_t = 0,73 \text{ kW} \times 1,15 \times 1,0 \times 1,0 = \mathbf{0,84 \text{ kW}}$$

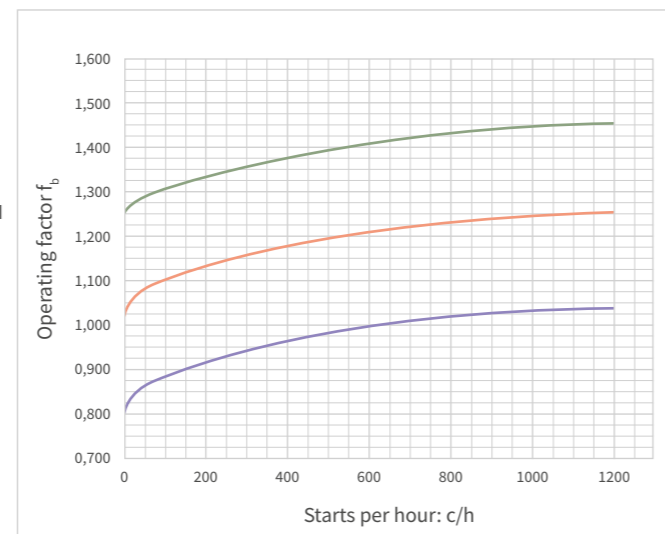
4) Gearbox selection:

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

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 Elevators, light-duty Screw conveyors, light-duty Fans Lifting platforms Mixers, light-duty Roller grilles Conveyor belts, light-duty Packaging machines Workpiece drives Centrifuges	Rotary table drives Elevators, heavy-duty Reels Kneading machines Mixers, heavy-duty Mills Agitators, light-duty Gate drives Conveyor belts, heavy-duty Packaging machines Winches	Crushers Calenders Press brakes Piston pumps Presses Agitators, heavy-duty Vibrators Shears Punching machines Rolling mills 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

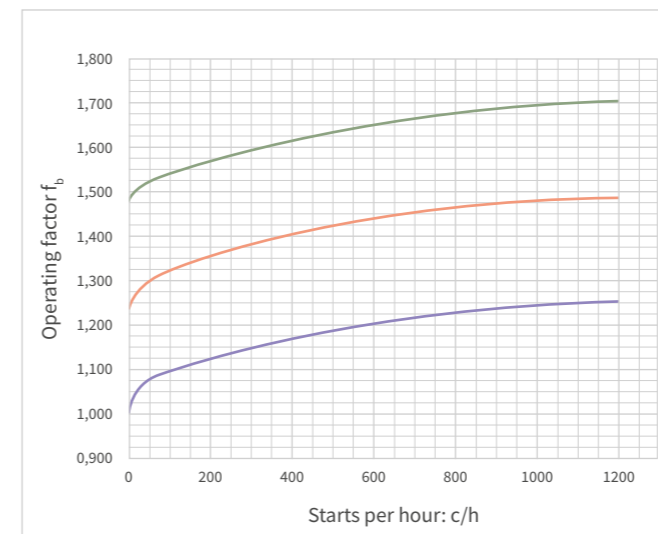
Temperature factor f_t

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

