



The values given in the load table are based upon uniform, smooth operation, $K_{H\beta}=1.0$ and reliable grease lubrication. Since, in practice, the applications are very diverse, it is important to consider the given conditions by using appropriate factors S_B , K_A , $L_{KH\beta}$ and f_n (see below).

Formulas for Determining the Tangential Force

$$a = \frac{v}{t_b} \quad [\text{m/s}^2]$$

$$F_u = \frac{m \cdot g + m \cdot a}{1000} \quad (\text{for lifting axle}) \quad [\text{kN}]$$

$$F_u = \frac{m \cdot g \cdot \mu + m \cdot a}{1000} \quad (\text{for driving axle}) \quad [\text{kN}]$$

$$F_{u \text{ perm.}} = \frac{F_{u \text{ Tab}}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}} \quad [\text{kN}]$$

Formula dimensions see page ZD-3

The Condition $F_u < F_{u \text{ perm.}}$ Must be Fulfilled.

Load Factor K_A

Drive	Type of load from the machines to be driven		
	Uniform	Medium Shocks	Heavy Shocks
Uniform	1.00	1.25	1.75
Light Shocks	1.25	1.50	2.00
Medium Shocks	1.50	1.75	2.25

Safety Coefficient S_B

The safety coefficient should be allowed for according to experience ($S_B = 1.1$ to 1.4).

Life-Time Factor f_n

considering of the peripheral speed of the pinion and lubrication.

Lubrication	Continuous	Daily	Monthly
Peripheral Speed of Gearing			
m/sec m/min			
0.5 30	0.85	0.95	
1.0 60	0.95	1.10	from
1.5 90	1.00	1.20	3
2.0 120	1.05	1.30	to
3.0 180	1.10	1.50	10
5.0 300	1.25	1.90	

Linear Load Distribution Factor $L_{KH\beta}$

The linear load distribution factor considers the contact stress, while it describes unintegrated load distribution over the tooth width ($L_{KH\beta} = \sqrt{K_{H\beta}}$).

$L_{KH\beta} = 1.1$ for counter bearing, e.g. Torque Supporter

$= 1.2$ for preloaded bearings on the output shaft e.g. ATLANTA HT, HP and E servo-worm gear unit, BG bevel-gear unit

$= 1.5$ for unpreloaded bearings on the output shaft e.g. ATLANTA B servo-worm gear unit





Calculation Example

Values Given

- ⊗ Travelling Operation
- Mass to be Moved $m = 820$ kg
- Speed $v = 2$ m/s
- Acceleration Time $t_b = 1$ s
- Acceleration Due to Gravity $g = 9.81$ m/s²
- Coefficient of Friction $\mu = 0.1$
- Load Factor $K_A = 1.5$
- Life-Time Factor $f_n = 1.05$ (cont. lubrication)
- Safety Coefficient $S_B = 1.2$
- Linear Load Distribution Factor $L_{KH\beta} = 1.5$

Calculation Process

$$a = \frac{v}{t_b} \quad a = \frac{2}{1} = 2 \text{ m/s}^2$$

$$F_u = \frac{m \cdot g \cdot \mu + m \cdot a}{1000}$$

$$F_u = \frac{820 \cdot 9.81 \cdot 0.1 + 820 \cdot 2}{1000} = 2.44 \text{ kN}$$

Assumed feed force: rack C45, ind. hardened, straight tooth, module 3, pinion 16MnCr5, case hardened, 20 teeth, page ZB-40 with $F_{uTab} = 11.5$ kN

$$F_{u \text{ zul./per.}} = \frac{F_{uTab}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}} ;$$

$$F_{u \text{ zul./per.}} = \frac{11.5 \text{ kN}}{1.5 \cdot 1.2 \cdot 1.05 \cdot 1.5} = 4.05 \text{ kN}$$

Condition

$$F_{u \text{ zul./per.}} > F_u ; 4.05 \text{ kN} > 2.44 \text{ kN} \quad \Rightarrow \text{fulfilled}$$

Result:	Rack	27 30 101	Page ZB-13
	Pinion	24 35 220	Page ZB-23 case hardened

Your Calculation

Values Given

- ⊗ Travelling Operation
- Mass to be Moved $m =$ _____ kg
- Speed $v =$ _____ m/s
- Acceleration Time $t_b =$ _____ s
- Acceleration Due to Gravity $g =$ 9.81 m/s²
- Coefficient of Friction $\mu =$ _____
- Load Factor $K_A =$ _____
- Life-Time Factor $f_n =$ _____
- Safety Coefficient $S_B =$ _____
- Linear Load Distribution Factor $L_{KH\beta} =$ _____

Calculation Process

$$a = \frac{v}{t_b} \quad a =$$
 _____ = _____ m/s²

$$F_u = \frac{m \cdot g \cdot \mu + m \cdot a}{1000} ; F_u =$$
 _____ = _____ kN

Permissible Feed Force F_{uTab}

$$F_{u \text{ zul./per.}} = \frac{F_{uTab}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}} ;$$

$$F_{u \text{ zul./per.}} =$$
 _____ = _____ kN

Condition

$$F_{u \text{ zul./per.}} > F_u ;$$
 _____ kN > _____ kN \Rightarrow fulfilled





Calculation Example

Values Given

⊗ Lifting Operation

Mass to be Moved $m = 300 \text{ kg}$

Speed $v = 1.08 \text{ m/s}$

Acceleration Time $t_b = 0.7 \text{ s}$

Acceleration Due to Gravity $g = 9.81 \text{ m/s}^2$

Load Factor $K_A = 1.2$

Life-Time Factor $f_n = 1.1$ (Cont. Lubrication)

Safety Coefficient $S_B = 1.2$

Linear Load Distribution Factor $L_{KH\beta} = 1.2$

Calculation Process

Results

$$a = \frac{v}{t_b} \quad a = \frac{1.08}{0.27} = 4 \text{ m/s}^2$$

$$F_u = \frac{m \cdot g + m \cdot a}{1000} \quad F_u = \frac{300 \cdot 9.81 + 300 \cdot 4}{1000} = 4.1 \text{ kN}$$

Assumed feed force: rack C45, ind. hardened, helical, module 2, pinion 16MnCr5, case hardened, 20 teeth, page ZA-31 with $F_{uTab} = 12 \text{ kN}$

$$F_{u \text{ zul./per.}} = \frac{F_{uTab}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}} ; F_{u \text{ zul./per.}} = \frac{11.5 \text{ kN}}{1.2 \cdot 1.2 \cdot 1.1 \cdot 1.2} = 5.9 \text{ kN}$$

Condition

$$F_{u \text{ zul./per.}} > F_u ; 6.0 \text{ kN} > 4.1 \text{ kN} \Rightarrow \text{fulfilled}$$

Result: Rack 29 20 105 Page ZA-7

Pinion 24 29 520 Page ZA-24



Your Calculation

Values Given

⊗ Lifting Operation

Mass to be Moved $m = \underline{\hspace{2cm}} \text{ kg}$

Speed $v = \underline{\hspace{2cm}} \text{ m/s}$

Acceleration Time $t_b = \underline{\hspace{2cm}} \text{ s}$

Acceleration Due to Gravity $g = \underline{9.81} \text{ m/s}^2$

Load Factor $K_A = \underline{\hspace{2cm}}$

Life-Time Factor $f_n = \underline{\hspace{2cm}}$

Safety Coefficient $S_B = \underline{\hspace{2cm}}$

Linear Load Distribution Factor $L_{KH\beta} = \underline{\hspace{2cm}}$

Calculation Process

Results

$$a = \frac{v}{t_b} \quad a = \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ m/s}^2$$

$$F_u = \frac{m \cdot g + m \cdot a}{1000} \quad F_{u \text{ erf./req.}} = \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ kN}$$

Permissible Feed Force F_{uTab}

$$F_{u \text{ zul./per.}} = \frac{F_{uTab}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}} ; F_{u \text{ zul./per.}} = \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ kN}$$

Condition

$$F_{u \text{ zul./per.}} > F_u ; \underline{\hspace{2cm}} \text{ kN} > \underline{\hspace{2cm}} \text{ kN} \Rightarrow \text{fulfilled}$$