The values given in the load table are based upon uniform, smooth operation, $K_{Hß}$=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, $L_{KHß}$ and f_n (see below).

Formulas for Determining the Tangential Force

$$a = \frac{\nu}{t_b} \qquad [m/s^2]$$

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

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

$$F_{u\ perm.} = \frac{F_{u\ Tab}}{K_A \cdot S_B \cdot f_n \cdot L_{KHß}} \qquad [kN]$$

Formula dimensions see page ZD-3

The Condition $F_u < F_{u\ perm.}$ 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 $L_{KHß}$

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

$L_{KHß}$ = 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 μ = 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 **Results**

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

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

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

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

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

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

Condition

$F_{u\ zul./per.} > F_u$; 4.05 kN > 2.44 kN => 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 μ = ______________

Load Factor K_A = ______________

Life-Time Factor f_n = ______________

Safety Coefficient S_B = ______________

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

Calculation Process **Results**

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

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

Permissible Feed Force $F_{u\ Tab}$

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

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

Condition

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

Calculation Example

Values Given

⊗ Lifting Operation

Mass to be Moved	m	= 300 kg
Speed	v	= 1.08 m/s
Acceleration Time	t_b	= 0.7 s
Acceleration Due to Gravity	g	= 9.81 m/s²
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**

$a = \frac{v}{t_b}$ $\quad a = \frac{1.08}{0.27}$ $\quad = 4$ m/s²

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

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

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

$= 5.9$ kN

Condition

$F_{u\ zul./per.} > F_u$; 6.0 kN > 4.1 kN => 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	= ______	kg
Speed	v	= ______	m/s
Acceleration Time	t_b	= ______	s
Acceleration Due to Gravity	g	= 9.81	m/s²
Load Factor	K_A	= ______	
Life-Time Factor	f_n	= ______	
Safety Coefficient	S_B	= ______	
Linear Load Distribution Factor	$L_{KH\beta}$	= ______	

Calculation Process **Results**

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

$F_u = \frac{m \cdot g + m \cdot a}{1000}$ $\quad F_{u\ erf./req.} = \frac{\_\_\_\_\_\_}{1000}$ = ____ kN

Permissible Feed Force $F_{u\ tab}$

$F_{u\ zul./per.} = \frac{F_{u\ Tab}}{K_A \cdot S_B \cdot f_n \cdot L_{KH\beta}}$; $F_{u\ zul./per.} =$ ______ = ____ kN

Condition

$F_{u\ zul./per.} > F_u$; ____ kN > ____ kN => fulfilled