

17.3.4 Examples of Bevel Gear Bending Strength Calculations

Table 17-24A Gleason Straight Bevel Gear Design Details

No.	Item	Symbol	Unit	Pinion	Gear
1	Shaft Angle	Σ	degree	90°	
2	Module	m	mm	2	
3	Pressure Angle	α	degree	20°	
4	Central Spiral Angle	β_m		0°	
5	Number Of Teeth	z		20	40
6	Pitch Circle Diameter	d	mm	40.000	80.000
7	Pitch Cone Angle	δ	degree	26.56505°	63.43495°
8	Cone Distance	R_e	mm	44.721	
9	Tooth Width	b		15	
10	Central Pitch Circle Diameter	d_m		33.292	66.584
11	Precision Grade			JIS 3	JIS 3
12	Manufacturing Method			Gleason No. 104	
13	Surface Roughness			12.5 μ m	12.5 μ m
14	Revolutions per Minute	n	rpm	1500	750
15	Linear Speed	v	m/s	3.142	
16	Direction of Load			Unidirectional	
17	Duty Cycle		Cycle	More than 107 Cycles	
18	Material			SCM 415	
19	Heat Treatment			Carburized	
20	Surface Hardness			HV 600 ... 640	
21	Core Hardness			HB 260 ... 280	
22	Effective Carburized Depth		mm	0.3 ... 0.5	

Table 17-24B Bending Strength Factors for Gleason Straight Bevel Gear

No.	Item	Symbol	Unit	Pinion	Gear
1	Central Spiral Angle	β_m	degree	0°	
2	Allowable Bending Stress at Root	σ_{Flim}	kgf/mm ²	42.5	42.5
3	Module	m	mm	2	
4	Tooth Width	b		15	
5	Cone Distance	R_e		44.721	
6	Tooth Profile Factor	Y_F		2.369	2.387
7	Load Distribution Factor	Y_ϵ		0.613	
8	Spiral Angle Factor	Y_β		1.0	
9	Cutter Diameter Effect Factor	Y_C		1.15	
10	Life Factor	K_L		1.0	
11	Dimension Factor	K_{FX}		1.0	
12	Tooth Flank Load Distribution Factor	K_M		1.8	1.8
13	Dynamic Load Factor	K_V		1.4	
14	Overload Factor	K_O		1.0	
15	Reliability Factor	K_R		1.2	
16	Allowable Tangential Force at Central Pitch Circle	F_{tlim}	kgf	178.6	177.3

17.4 Surface Strength Of Bevel Gears

This information is valid for bevel gears which are used in power transmission in general industrial machines. The applicable ranges are:

- Radial Module: m 1.5 to 25mm
- Pitch Diameter: d Straight bevel gear under 1600 mm
Spiral bevel gear under 1000 mm
- Linear Speed: v less than 25 m/sec
- Rotating Speed: n less than 3600 rpm

17.4.1 Basic Conversion Formulas

The same formulas of **SECTION 17.3** apply. (See page 84).

17.4.2 Surface Strength Equations

In order to obtain a proper surface strength, the tangential

force at the central pitch circle, F_{tm} , must remain below the allowable tangential force at the central pitch circle, F_{tlim} , based on the allowable Hertz stress σ_{Hlim} .

$$F_{tm} \leq F_{tlim} \quad (17-37)$$

Alternately, the Hertz stress σ_H , which is derived from the tangential force at the central pitch circle must be smaller than the allowable Hertz stress σ_{Hlim} .

$$\sigma_H \leq \sigma_{Hlim} \quad (17-38)$$

The allowable tangential force at the central pitch circle, F_{tlim} , in kgf can be calculated from **Equation (17-39)**.

$$F_{tlim} = \left[\left(\frac{\sigma_{Hlim}}{Z_M} \right)^2 \frac{d_1}{\cos \delta_1} \frac{R_e - 0.5b}{R_o} b \frac{u^2}{u^2 + 1} \right] \cdot \left[\left(\frac{K_{HL} Z_L Z_R Z_V Z_W K_{HX}}{Z_H Z_I Z_\beta} \right)^2 \frac{1}{K_{H\beta} K_V K_O} \frac{1}{C_R^2} \right] \quad (17-39)$$