

Important Design of Bevel Gears Formulas PDF



Formulas Examples with Units

List of 20 Important Design of Bevel Gears Formulas

1) Force Distribution Formulas

1.1) Axial or Thrust Component of Force on Bevel Gear Formula

Formula

$$P_a = P_t \cdot \tan(\alpha_{\text{Bevel}}) \cdot \sin(\gamma)$$

Example with Units

$$260.0084\text{N} = 743.1\text{N} \cdot \tan(22^\circ) \cdot \sin(60^\circ)$$

Evaluate Formula

1.2) Radial Force Component Acting on Bevel Gear Formula

Formula

$$P_r = P_t \cdot \tan(\alpha_{\text{Bevel}}) \cdot \cos(\gamma)$$

Example with Units

$$150.1159\text{N} = 743.1\text{N} \cdot \tan(22^\circ) \cdot \cos(60^\circ)$$

Evaluate Formula

1.3) Range ratio in preferred Series Formula

Formula

$$R = \frac{UL}{LL}$$

Example with Units

$$9.8261 = \frac{113\text{mm}}{11.5\text{mm}}$$

Evaluate Formula

1.4) Tangential Force on Bevel Gear Teeth Formula

Formula

$$P_t = \frac{M_t}{r_m}$$

Example with Units

$$743.1304\text{N} = \frac{17092\text{N}\cdot\text{mm}}{23\text{mm}}$$

Evaluate Formula

2) Geometric Properties Formulas

2.1) Actual Number of Teeth on Bevel Gear Formula

Formula

$$z_g = z' \cdot \cos(\gamma)$$

Example with Units

$$12 = 24 \cdot \cos(60^\circ)$$

Evaluate Formula

2.2) Back Cone Radius of Bevel Gear Formula

Formula

$$r_b = \frac{m \cdot z'}{2}$$

Example with Units

$$66.024\text{mm} = \frac{5.502\text{mm} \cdot 24}{2}$$

Evaluate Formula



2.3) Cone Distance of Bevel Gear Formula

Formula

$$A_0 = \sqrt{\left(\frac{D_p}{2}\right)^2 + \left(\frac{D_g}{2}\right)^2}$$

Example with Units

$$70.0206_{\text{mm}} = \sqrt{\left(\frac{76.5_{\text{mm}}}{2}\right)^2 + \left(\frac{117.3_{\text{mm}}}{2}\right)^2}$$

Evaluate Formula 

2.4) Geometric step ratio Formula

Formula

$$a = R^{\frac{1}{n-1}}$$

Example

$$1.7783 = 10^{\frac{1}{5-1}}$$

Evaluate Formula 

2.5) Radius of Pinion at Midpoint along Face Width for Bevel Gear Formula

Formula

$$r_m = \frac{D_p - (b \cdot \sin(\gamma))}{2}$$

Example with Units

$$23.0946_{\text{mm}} = \frac{76.5_{\text{mm}} - (35_{\text{mm}} \cdot \sin(60^\circ))}{2}$$

Evaluate Formula 

2.6) Radius of Pinion at Midpoint given Torque and Tangential Force for Bevel Gear Formula

Formula

$$r_m = \frac{M_t}{P_t}$$

Example with Units

$$23.0009_{\text{mm}} = \frac{17092_{\text{N*mm}}}{743.1_{\text{N}}}$$

Evaluate Formula 

2.7) Virtual or Formative Number of Teeth of Bevel Gear Formula

Formula

$$z' = \frac{2 \cdot r_b}{m}$$

Example with Units

$$23.9913 = \frac{2 \cdot 66_{\text{mm}}}{5.502_{\text{mm}}}$$

Evaluate Formula 

3) Material Properties Formulas

3.1) Beam Strength of Tooth of Bevel Gear Formula

Formula

$$S_b = m \cdot b \cdot \sigma_b \cdot Y \cdot \left(1 - \frac{b}{A_0}\right)$$

Example with Units

$$5700.072_{\text{N}} = 5.502_{\text{mm}} \cdot 35_{\text{mm}} \cdot 185_{\text{N/mm}^2} \cdot 0.320 \cdot \left(1 - \frac{35_{\text{mm}}}{70_{\text{mm}}}\right)$$

Evaluate Formula 



3.2) Material Constant for Bevel Gear Wear Strength Formula

Formula

Evaluate Formula 

$$K = \frac{\sigma_c^2 \cdot \sin(\alpha_{\text{Bevel}}) \cdot \cos(\alpha_{\text{Bevel}}) \cdot \left(\frac{1}{E_p} + \frac{1}{E_g} \right)}{1.4}$$

Example with Units

$$2.5055 \text{ N/mm}^2 = \frac{350 \text{ N/mm}^2 \cdot \sin(22^\circ) \cdot \cos(22^\circ) \cdot \left(\frac{1}{20600 \text{ N/mm}^2} + \frac{1}{29500 \text{ N/mm}^2} \right)}{1.4}$$

3.3) Material Constant for Bevel Gear Wear Strength given Brinell Hardness Number Formula

Formula

Example with Units

Evaluate Formula 

$$K = 0.16 \cdot \left(\frac{\text{BHN}}{100} \right)^2$$

$$2.5091 \text{ N/mm}^2 = 0.16 \cdot \left(\frac{396}{100} \right)^2$$

3.4) Wear Strength of Bevel Gear by Buckingham's Equation Formula

Formula

Example with Units

Evaluate Formula 

$$S_w = \frac{0.75 \cdot b \cdot Q_b \cdot D_p \cdot K}{\cos(\gamma)}$$

$$15060.9375 \text{ N} = \frac{0.75 \cdot 35 \text{ mm} \cdot 1.5 \cdot 76.5 \text{ mm} \cdot 2.5 \text{ N/mm}^2}{\cos(60^\circ)}$$

4) Performance Factors Formulas

4.1) Bevel Factor Formula

Formula

Example with Units

Evaluate Formula 

$$B_f = 1 - \frac{b}{A_0}$$

$$0.5 = 1 - \frac{35 \text{ mm}}{70 \text{ mm}}$$

4.2) Power Transmitted Formula

Formula

Example with Units

Evaluate Formula 

$$W_{\text{shaft}} = 2 \cdot \pi \cdot N \cdot \tau$$

$$4.9135 \text{ kW} = 2 \cdot 3.1416 \cdot 17 \frac{1}{\text{s}} \cdot 46000 \text{ N*mm}$$

4.3) Ratio Factor for Bevel Gear Formula

Formula

Example with Units

Evaluate Formula 

$$Q_b = \frac{2 \cdot z_g}{z_g + z_p \cdot \tan(\gamma)}$$

$$1.0718 = \frac{2 \cdot 12}{12 + 6 \cdot \tan(60^\circ)}$$



4.4) Velocity Factor for Cut Teeth of Bevel Gear Formula

Formula

$$C_{v \text{ cut}} = \frac{6}{6 + v}$$

Example with Units

$$0.75 = \frac{6}{6 + 2_{\text{m/s}}}$$

Evaluate Formula 

4.5) Velocity Factor for Generated Teeth of Bevel Gear Formula

Formula

$$C_{v \text{ gen}} = \frac{5.6}{5.6 + \sqrt{v}}$$

Example with Units

$$0.7984 = \frac{5.6}{5.6 + \sqrt{2_{\text{m/s}}}}$$

Evaluate Formula 



Variables used in list of Design of Bevel Gears Formulas above

- **a** Geometric Step Ratio
- **A₀** Cone Distance (Millimeter)
- **b** Face Width of Bevel Gear Tooth (Millimeter)
- **B_f** Bevel Factor
- **BHN** Brinell Hardness Number for Bevel Gear
- **C_{v cut}** Velocity Factor for Cut Teeth
- **C_{v gen}** Velocity Factor for Generated Teeth
- **D_g** Pitch Circle Diameter of Gear (Millimeter)
- **D_p** Pitch Circle Diameter of Bevel Pinion (Millimeter)
- **E_g** Modulus of Elasticity of Spur Gear (Newton per Square Millimeter)
- **E_p** Modulus of Elasticity of Spur Pinion (Newton per Square Millimeter)
- **K** Material Constant (Newton per Square Millimeter)
- **LL** Minimum Dimension/Rating of Product (Millimeter)
- **m** Module of Bevel Gear (Millimeter)
- **M_t** Torque Transmitted by Bevel Pinion (Newton Millimeter)
- **n** Quantity of Product
- **N** Speed of Rotation (1 per Second)
- **P_a** Axial or Thrust Component on Bevel Gear (Newton)
- **P_r** Radial Force on Bevel Gear (Newton)
- **P_t** Tangential Force Transmitted by Bevel Gear (Newton)
- **Q_b** Ratio Factor for Bevel Gear
- **R** Range Ratio in Preferred Series
- **r_b** Back Cone Radius (Millimeter)
- **r_m** Radius of Pinion at Midpoint (Millimeter)
- **S_b** Beam Strength of Bevel Gear Teeth (Newton)
- **S_w** Wear Strength of Bevel Gear Tooth (Newton)

Constants, Functions, Measurements used in list of Design of Bevel Gears Formulas above

- **constant(s):** pi, 3.14159265358979323846264338327950288
Archimedes' constant
- **Functions:** cos, cos(Angle)
Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- **Functions:** sin, sin(Angle)
Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- **Functions:** sqrt, sqrt(Number)
A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- **Functions:** tan, tan(Angle)
The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- **Measurement: Length** in Millimeter (mm)
Length Unit Conversion 
- **Measurement: Pressure** in Newton per Square Millimeter (N/mm²)
Pressure Unit Conversion 
- **Measurement: Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement: Power** in Kilowatt (kW)
Power Unit Conversion 
- **Measurement: Force** in Newton (N)
Force Unit Conversion 
- **Measurement: Angle** in Degree (°)
Angle Unit Conversion 
- **Measurement: Torque** in Newton Millimeter (N*mm)
Torque Unit Conversion 
- **Measurement: Vorticity** in 1 per Second (1/s)
Vorticity Unit Conversion 
- **Measurement: Stress** in Newton per Square Millimeter (N/mm²)
Stress Unit Conversion 



- **UL** Maximum Dimension/Rating of Product (Millimeter)
- **v** Pitch Line Velocity of Bevel Gear (Meter per Second)
- **W_{shaft}** Shaft Power (Kilowatt)
- **Y** Lewis Form Factor
- **z_g** Number of Teeth on Bevel Gear
- **z_p** Number of Teeth on Pinion
- **z[']** Virtual Number of Teeth for Bevel Gear
- **α_{Bevel}** Pressure Angle (Degree)
- **γ** Pitch Angle for Bevel Gear (Degree)
- **σ_b** Bending Stress in Bevel Gear Teeth (Newton per Square Millimeter)
- **σ_c** Compressive Stress in Bevel Gear Tooth (Newton per Square Millimeter)
- **T** Torque Applied (Newton Millimeter)



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