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Design of Helical Gears Formulas

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List of 55 Design of Helical Gears Formulas

Design of Helical Gears

Core Design Parameters

1) Actual Number of Teeth on Gear given Virtual Number of Teeth

Open Calculator

fx $z = (\cos(\psi))^3 \cdot z'$

ex $40.19952 = (\cos(25^\circ))^3 \cdot 54$

2) Addendum Circle Diameter of Gear

Open Calculator

fx $d_a = m_n \cdot \left(\left(\frac{z}{\cos(\psi)}\right) + 2\right)$

ex $128.4749\text{mm} = 3\text{mm} \cdot \left(\left(\frac{37}{\cos(25^\circ)}\right) + 2\right)$

3) Addendum Circle Diameter of Gear given Pitch Circle Diameter

Open Calculator

fx $d_a = 2 \cdot h_a + d$

ex $126\text{mm} = 2 \cdot 4\text{mm} + 118\text{mm}$

4) Addendum of Gear given Addendum Circle Diameter

Open Calculator

fx $$h_a = \frac{d_a - d}{2}$$

ex $$10\text{mm} = \frac{138\text{mm} - 118\text{mm}}{2}$$

5) Angular Velocity of Gear given Speed Ratio

Open Calculator

fx $$n_g = \frac{n_p}{i}$$

ex $$8.272727\text{rad/s} = \frac{18.2\text{rad/s}}{2.2}$$

6) Angular Velocity of Pinion given Speed Ratio

Open Calculator

fx $$n_p = i \cdot n_g$$

ex $$18.04\text{rad/s} = 2.2 \cdot 8.2\text{rad/s}$$

7) Center to Center distance between Two Gears

Open Calculator

fx $$a_c = m_n \cdot \frac{z_1 + z_2}{2 \cdot \cos(\psi)}$$

ex $$99.30401\text{mm} = 3\text{mm} \cdot \frac{18 + 42}{2 \cdot \cos(25^\circ)}$$

8) Dedendum Circle Diameter of Gear given Pitch Circle Diameter

Open Calculator

fx $d_f = d - 2 \cdot d_h$

ex $108\text{mm} = 118\text{mm} - 2 \cdot 5\text{mm}$

9) Normal Module of Helical Gear

Open Calculator

fx $m_n = m \cdot \cos(\psi)$

ex $3.081446\text{mm} = 3.4\text{mm} \cdot \cos(25^\circ)$

10) Normal Module of Helical Gear given Addendum Circle Diameter

Open Calculator

fx $m_n = \dfrac{d_a}{\frac{z}{\cos(\psi)} + 2}$

ex $3.222418\text{mm} = \dfrac{138\text{mm}}{\frac{37}{\cos(25^\circ)} + 2}$

11) Normal Module of Helical Gear given Center to Center Distance between Two Gears

Open Calculator

fx $m_n = a_c \cdot \dfrac{2 \cdot \cos(\psi)}{z_1 + z_2}$

ex $2.999879\text{mm} = 99.3\text{mm} \cdot \dfrac{2 \cdot \cos(25^\circ)}{18 + 42}$

12) Normal Module of Helical Gear given Pitch Circle Diameter

Open Calculator

fx $$m_n = d \cdot \frac{\cos(\psi)}{z}$$

ex $$2.890387\text{mm} = 118\text{mm} \cdot \frac{\cos(25^\circ)}{37}$$

13) Normal Module of Helical Gear given Virtual Number of Teeth

Open Calculator

fx $$m_n = \frac{d}{z'} \cdot \left(\cos(\psi)^2\right)$$

ex $$1.794898\text{mm} = \frac{118\text{mm}}{54} \cdot \left(\cos(25^\circ)^2\right)$$

14) Number of Teeth on First Gear given Center to Center Distance between Two Gears

Open Calculator

fx $$z_1 = a_c \cdot \frac{2 \cdot \cos(\psi)}{m_n} - z_2$$

ex $$17.99758 = 99.3\text{mm} \cdot \frac{2 \cdot \cos(25^\circ)}{3\text{mm}} - 42$$

15) Number of Teeth on Gear given Addendum Circle Diameter

Open Calculator

fx $$z = \left(\frac{d_a}{m_n} - 2\right) \cdot \cos(\psi)$$

ex $$39.87754 = \left(\frac{138\text{mm}}{3\text{mm}} - 2\right) \cdot \cos(25^\circ)$$

16) Number of Teeth on Gear given Pitch Circle Diameter

Open Calculator

fx $$z = d \cdot \frac{\cos(\psi)}{m_n}$$

ex $$35.64811 = 118\text{mm} \cdot \frac{\cos(25^\circ)}{3\text{mm}}$$

17) Number of Teeth on Helical Gear given Speed Ratio for Helical Gears

Open Calculator

fx $$z = Z_p \cdot i$$

ex $$44 = 20 \cdot 2.2$$

18) Number of Teeth on Pinion given Speed Ratio

Open Calculator

fx $$Z_p = \frac{z}{i}$$

ex $$16.81818 = \frac{37}{2.2}$$

19) Number of Teeth on Second Helical Gear given Center to Center Distance between Two Gears

Open Calculator

fx $$z_2 = a_c \cdot \frac{2 \cdot \cos(\psi)}{m_n} - z_1$$

ex $$41.99758 = 99.3\text{mm} \cdot \frac{2 \cdot \cos(25^\circ)}{3\text{mm}} - 18$$

20) Pitch Circle Diameter of Gear given Addendum Circle Diameter

Open Calculator

fx $$d = d_a - 2 \cdot h_a$$

ex $$130\text{mm} = 138\text{mm} - 2 \cdot 4\text{mm}$$

21) Pitch Circle Diameter of Gear given Dedendum Circle Diameter

Open Calculator

fx $$d = d_f + 2 \cdot d_h$$

ex $$136\text{mm} = 126\text{mm} + 2 \cdot 5\text{mm}$$

22) Pitch Circle Diameter of Gear given Radius of Curvature at Point

Open Calculator

fx $$d = 2 \cdot r' \cdot (\cos(\psi))^2$$

ex $$118.2807\text{mm} = 2 \cdot 72\text{mm} \cdot (\cos(25^\circ))^2$$

23) Pitch Circle Diameter of Helical Gear

Open Calculator

fx $$d = z \cdot \frac{m_n}{\cos(\psi)}$$

ex $$122.4749\text{mm} = 37 \cdot \frac{3\text{mm}}{\cos(25^\circ)}$$

24) Speed Ratio for Helical Gears

Open Calculator

fx $i = \frac{n_p}{n_g}$

ex $2.219512 = \frac{18.2\text{rad/s}}{8.2\text{rad/s}}$

25) Transverse Module of Helical Gear given Normal Module

Open Calculator

fx $m = \frac{m_n}{\cos(\psi)}$

ex $3.310134\text{mm} = \frac{3\text{mm}}{\cos(25^\circ)}$

26) Transverse Module of Helical Gear given Transverse Diametrical Pitch

Open Calculator

fx $m = \frac{1}{P}$

ex $3.448276\text{mm} = \frac{1}{0.29\text{mm}^{-1}}$

27) Virtual Number of Teeth on Helical Gear

Open Calculator

fx $z' = 2 \cdot \pi \cdot \frac{r_{vh}}{P_N}$

ex $20.94395 = 2 \cdot \pi \cdot \frac{32\text{mm}}{9.6\text{mm}}$

28) Virtual Number of Teeth on Helical Gear given Actual Number of Teeth

Open Calculator

fx $$z' = \frac{z}{(\cos(\psi))^3}$$

ex $$49.70208 = \frac{37}{(\cos(25^\circ))^3}$$

Helix Geometry

29) Axial Pitch of Helical Gear given Helix Angle

Open Calculator

fx $$p_a = \frac{p}{\tan(\psi)}$$

ex $$22.90333\text{mm} = \frac{10.68\text{mm}}{\tan(25^\circ)}$$

30) Helix Angle of Helical Gear given Actual and Virtual Number of Teeth

Open Calculator

fx $$\psi = a\cos\left(\left(\frac{z}{z'}\right)^{\frac{1}{3}}\right)$$

ex $$28.16458^\circ = a\cos\left(\left(\frac{37}{54}\right)^{\frac{1}{3}}\right)$$

31) Helix Angle of Helical Gear given Addendum Circle Diameter

Open Calculator

fx $$\psi = a\cos\left(\frac{z}{\frac{d_a}{m_n} - 2}\right)$$

ex $$32.76376^\circ = a\cos\left(\frac{37}{\frac{138\text{mm}}{3\text{mm}} - 2}\right)$$

32) Helix Angle of Helical Gear given Axial Pitch

Open Calculator

fx $$\psi = a\tan\left(\frac{p}{p_a}\right)$$

ex $$25.59087^\circ = a\tan\left(\frac{10.68\text{mm}}{22.3\text{mm}}\right)$$

33) Helix Angle of Helical Gear given Center to Center Distance between Two Gears

Open Calculator

fx $$\psi = a\cos\left(m_n \cdot \frac{z_1 + z_2}{2 \cdot a_c}\right)$$

ex $$24.99503^\circ = a\cos\left(3\text{mm} \cdot \frac{18 + 42}{2 \cdot 99.3\text{mm}}\right)$$

34) Helix Angle of Helical Gear given Normal Circular Pitch

Open Calculator

fx $$\psi = a\cos\left(\frac{P_N}{p}\right)$$

ex $$25.98923^\circ = a\cos\left(\frac{9.6\text{mm}}{10.68\text{mm}}\right)$$

35) Helix Angle of Helical Gear given Normal Module

Open Calculator

fx $$\psi = a\cos\left(\frac{m_n}{m}\right)$$

ex $$28.07249^\circ = a\cos\left(\frac{3\text{mm}}{3.4\text{mm}}\right)$$

36) Helix Angle of Helical Gear given Pitch Circle Diameter

Open Calculator

fx $$\psi = a\cos\left(z\cdot\frac{m_n}{d}\right)$$

ex $$19.83427^\circ = a\cos\left(37\cdot\frac{3\text{mm}}{118\text{mm}}\right)$$

37) Helix Angle of Helical Gear given Pressure Angle

Open Calculator

fx $$\psi = a\cos\left(\frac{\tan(\alpha_n)}{\tan(\alpha)}\right)$$

ex $$25.07509^\circ = a\cos\left(\frac{\tan(20.1^\circ)}{\tan(22^\circ)}\right)$$

38) Helix Angle of Helical Gear given Radius of Curvature at Point

Open Calculator

fx $$\psi = \sqrt{a\cos\left(\frac{d}{2 \cdot r'}\right)}$$

ex $$44.76246^\circ = \sqrt{a\cos\left(\frac{118\text{mm}}{2 \cdot 72\text{mm}}\right)}$$

39) Helix Angle of Helical Gear given Virtual Number of Teeth

Open Calculator

fx $$\psi = a\cos\left(\left(\frac{d}{m_n \cdot z'}\right)^{\frac{1}{2}}\right)$$

ex $$31.40991^\circ = a\cos\left(\left(\frac{118\text{mm}}{3\text{mm} \cdot 54}\right)^{\frac{1}{2}}\right)$$

40) Normal Circular Pitch of Helical Gear

Open Calculator

fx $$P_N = p \cdot \cos(\psi)$$

ex $$9.679367\text{mm} = 10.68\text{mm} \cdot \cos(25^\circ)$$

41) Normal Circular Pitch of Helical Gear given Virtual Number of Teeth

Open Calculator

fx $$P_N = 2 \cdot \pi \cdot \frac{r_{vh}}{z'}$$

ex $$3.723369\text{mm} = 2 \cdot \pi \cdot \frac{32\text{mm}}{54}$$

42) Normal Pressure Angle of Helical Gear given Helix Angle

Open Calculator

fx $\alpha_n = a\tan(\tan(\alpha)\cdot\cos(\psi))$

ex $20.11132^\circ = a\tan(\tan(22^\circ)\cdot\cos(25^\circ))$

43) Pitch Circular Diameter of Gear given Radius of Curvature

Open Calculator

fx $d' = 2\cdot r'$

ex $144\text{mm} = 2\cdot 72\text{mm}$

44) Pitch Circular Diameter of Gear given Virtual Gear

Open Calculator

fx $d = 2\cdot r'\cdot(\cos(\psi))^2$

ex $118.2807\text{mm} = 2\cdot 72\text{mm}\cdot(\cos(25^\circ))^2$

45) Pitch Circular Diameter of Gear given Virtual Number of Teeth

Open Calculator

fx $d = m_n\cdot z'\cdot\left(\cos(\psi)^2\right)$

ex $133.0658\text{mm} = 3\text{mm}\cdot 54\cdot\left(\cos(25^\circ)^2\right)$

46) Pitch of Helical Gear given Axial Pitch

Open Calculator

fx $p = p_a\cdot\tan(\psi)$

ex $10.39866\text{mm} = 22.3\text{mm}\cdot\tan(25^\circ)$

47) Pitch of Helical Gear given Normal Circular Pitch

Open Calculator

fx $$p = \frac{P_N}{\cos(\psi)}$$

ex $$10.59243\text{mm} = \frac{9.6\text{mm}}{\cos(25^\circ)}$$

48) Radius of Curvature at Point on Helical Gear

Open Calculator

fx $$r' = \frac{a^2}{b}$$

ex $$69.13636\text{mm} = \frac{(19.5\text{mm})^2}{5.5\text{mm}}$$

49) Radius of Curvature at Point on Virtual Gear

Open Calculator

fx $$r' = \frac{d}{2 \cdot (\cos(\psi))^2}$$

ex $$71.82913\text{mm} = \frac{118\text{mm}}{2 \cdot (\cos(25^\circ))^2}$$

50) Radius of Curvature of Virtual Gear given Pitch Circular Diameter

Open Calculator

fx $$r' = \frac{d'}{2}$$

ex $$71.5\text{mm} = \frac{143\text{mm}}{2}$$

51) Radius of Curvature of Virtual Gear given Virtual Number of Teeth

Open Calculator

fx $r_{vh} = z' \cdot \frac{P_N}{2 \cdot \pi}$

ex $82.50592\text{mm} = 54 \cdot \frac{9.6\text{mm}}{2 \cdot \pi}$

52) Semi Major Axis of Elliptical Profile given Radius of Curvature at Point

Open Calculator

fx $a = \sqrt{r' \cdot b}$

ex $19.89975\text{mm} = \sqrt{72\text{mm} \cdot 5.5\text{mm}}$

53) Semi Minor Axis of Elliptical Profile given Radius of Curvature at Point

Open Calculator

fx $b = \frac{a^2}{r'}$

ex $5.28125\text{mm} = \frac{(19.5\text{mm})^2}{72\text{mm}}$

54) Transverse Diametrical Pitch of Helical Gear given Transverse Module

Open Calculator

fx $P = \frac{1}{m}$

ex $0.294118\text{mm}^{-1} = \frac{1}{3.4\text{mm}}$

55) Transverse Pressure Angle of Helical Gear given Helix Angle

Open Calculator

fx $$\alpha = a\tan\left(\frac{\tan(\alpha_n)}{\cos(\psi)}\right)$$

ex $$21.98782^\circ = a\tan\left(\frac{\tan(20.1^\circ)}{\cos(25^\circ)}\right)$$

Variables Used

- **a** Semi Major Axis of Helical Gear Teeth *(Millimeter)*
- a_c Center to Center Distance of Helical Gears *(Millimeter)*
- **b** Semi Minor Axis of Helical Gear Teeth *(Millimeter)*
- **d** Diameter of Pitch Circle of Helical Gear *(Millimeter)*
- **d'** Pitch Circular Diameter of Helical Virtual Gear *(Millimeter)*
- d_a Addendum Circle Diameter of Helical Gear *(Millimeter)*
- d_f Dedendum Circle Diameter of Helical Gear *(Millimeter)*
- d_h Dedendum of Helical Gear *(Millimeter)*
- h_a Addendum of Helical Gear *(Millimeter)*
- **i** Helical Gear Speed Ratio
- **m** Transverse Module of Helical Gear *(Millimeter)*
- m_n Normal Module of Helical Gear *(Millimeter)*
- n_g Speed of Helical Gear *(Radian per Second)*
- n_p Speed of Pinion Helical Gear *(Radian per Second)*
- **p** Pitch of Helical Gear *(Millimeter)*
- **P** Transverse Diametrical Pitch of Helical Gear *(1 per Millimeter)*
- p_a Axial Pitch of Helical Gear *(Millimeter)*
- P_N Normal Circular Pitch of Helical Gear *(Millimeter)*
- **r'** Radius of Curvature of Helical Gear *(Millimeter)*
- r_{vh} Virtual Pitch Circle Radius for Helical Gear *(Millimeter)*
- **z** Number of Teeth on Helical Gear
- **z'** Virtual Number of Teeth on Helical Gear

- z_1 Number of Teeth on 1st Helical Gear
- z_2 Number of Teeth on 2nd Helical Gear
- Z_p Number of Teeth on Helical Pinion
- α Transverse Pressure Angle of Helical Gear *(Degree)*
- α_n Normal Pressure Angle of Helical Gear *(Degree)*
- ψ Helix Angle of Helical Gear *(Degree)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **acos**, acos(Number)
  The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.
- Function: **atan**, atan(Number)
  Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **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.
- Function: **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: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion

- Measurement: **Reciprocal Length** in 1 per Millimeter (mm^{-1})
  Reciprocal Length Unit Conversion

Check other formula lists

- **Design of Bevel Gears Formulas**
- **Design of Helical Gears Formulas**

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