



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

$$\mathbf{f} \mathbf{x} \left[\mathbf{z} = (\cos(\psi))^3 \cdot \mathbf{z}' \right]$$

Open Calculator 🗗

2) Addendum Circle Diameter of Gear

$$\left| \mathbf{f}_{\mathbf{a}}
ight| \mathrm{d}_{\mathrm{a}} = \mathrm{m}_{\mathrm{n}} \cdot \left(\left(rac{\mathrm{z}}{\mathrm{\cos}(\psi)}
ight) + 2
ight)
ight|$$

Open Calculator 🛂

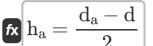
$$extbf{ex} \left[128.4749 ext{mm} = 3 ext{mm} \cdot \left(\left(rac{37}{\cos(25°)}
ight) + 2
ight)$$

3) Addendum Circle Diameter of Gear given Pitch Circle Diameter

fx
$$d_{
m a}=2\cdot h_{
m a}+d$$



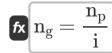
4) Addendum of Gear given Addendum Circle Diameter



Open Calculator

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

5) Angular Velocity of Gear given Speed Ratio



Open Calculator

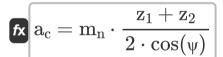
 $8.272727 {
m rad/s} = rac{18.2 {
m rad/s}}{2.2}$

6) Angular Velocity of Pinion given Speed Ratio

fx $\left[\mathrm{n_{p}} = \mathrm{i} \cdot \mathrm{n_{g}}
ight]$

Open Calculator 🗗

7) Center to Center distance between Two Gears



 $= 2 \times \left[99.30401 \mathrm{mm} = 3 \mathrm{mm} \cdot \frac{18 + 42}{2 \cdot \cos(25^\circ)} \right]$



fx $ext{d}_{ ext{f}} = ext{d} - 2 \cdot ext{d}_{ ext{h}}$

8) Dedendum Circle Diameter of Gear given Pitch Circle Diameter 🗗

Open Calculator 2

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

9) Normal Module of Helical Gear

Open Calculator $\mathbf{f}\mathbf{x} \left[\mathbf{m}_{\mathrm{n}} = \mathbf{m} \cdot \cos(\mathbf{y})
ight]$

 $\texttt{ex} \ 3.081446 \text{mm} = 3.4 \text{mm} \cdot \cos(25\degree)$

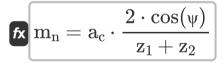
10) Normal Module of Helical Gear given Addendum Circle Diameter 🗗

fx $m_{
m n}=rac{d_{
m a}}{rac{z}{\cos(\omega)}+2}$

Open Calculator

= $\frac{3.222418 \mathrm{mm}}{\frac{37}{\cos(25^{\circ})} + 2}$

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



$$2.999879 \mathrm{mm} = 99.3 \mathrm{mm} \cdot \frac{2 \cdot \cos(25°)}{18 + 42}$$



12) Normal Module of Helical Gear given Pitch Circle Diameter

fx $\mathbf{m}_{\mathrm{n}} = \mathbf{d} \cdot rac{\cos(\psi)}{\mathbf{z}}$

Open Calculator 🚰

 $2.890387 \mathrm{mm} = 118 \mathrm{mm} \cdot \frac{\cos(25°)}{37}$

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

 $\mathbf{f}\mathbf{x} | m_n = rac{d}{z^{,}} \cdot \left(\cos(\psi)^2
ight)$

Open Calculator

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

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

 $\mathbf{z}_1 = \mathrm{a_c} \cdot rac{2 \cdot \mathrm{cos}(\psi)}{\mathrm{m_r}} - \mathrm{z}_2$

Open Calculator

 $ext{ex} 17.99758 = 99.3 ext{mm} \cdot rac{2 \cdot \cos(25°)}{3 ext{mm}} - 42$

15) Number of Teeth on Gear given Addendum Circle Diameter

 $\mathbf{z} = \left(rac{d_a}{m_n} - 2
ight) \cdot \cos(\psi)$

Open Calculator 🗗

extstyle ext







16) Number of Teeth on Gear given Pitch Circle Diameter

 $\mathbf{f}\mathbf{z} = \mathrm{d} \cdot rac{\cos(\psi)}{\mathrm{m_n}}$

Open Calculator 🗗

 $ext{ex} 35.64811 = 118 ext{mm} \cdot rac{\cos(25°)}{3 ext{mm}}$

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

 $\textbf{fx} \mathbf{z} = \mathbf{Z}_p \cdot \mathbf{i}$

Open Calculator

 $\boxed{\textbf{ex}} \boxed{44 = 20 \cdot 2.2}$

18) Number of Teeth on Pinion given Speed Ratio

fx $Z_{
m p}=rac{
m z}{
m i}$

Open Calculator 🖸

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

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

 $\mathbf{z}_2 = \mathrm{a_c} \cdot rac{2 \cdot \mathrm{cos}(\psi)}{\mathrm{m_n}} - \mathrm{z_1}$

$$41.99758 = 99.3 \mathrm{mm} \cdot rac{2 \cdot \cos(25°)}{3 \mathrm{mm}} - 18$$





20) Pitch Circle Diameter of Gear given Addendum Circle Diameter 🗗

fx $d = d_{
m a} - 2 \cdot h_{
m a}$

fx $\mathrm{d} = \mathrm{d_f} + 2 \cdot \mathrm{d_h}$

Open Calculator 2

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

21) Pitch Circle Diameter of Gear given Dedendum Circle Diameter 🗗

Open Calculator 2

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

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

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

Open Calculator

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

23) Pitch Circle Diameter of Helical Gear

 $\mathbf{f}\mathbf{z} \, \mathrm{d} = \mathbf{z} \cdot rac{\mathrm{m_n}}{\mathrm{cos}(\psi)}$

Open Calculator

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



24) Speed Ratio for Helical Gears 🚰



Open Calculator 🖸

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

25) Transverse Module of Helical Gear given Normal Module

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

Open Calculator

 $\boxed{\textbf{ex} \ 3.310134 \text{mm} = \frac{3 \text{mm}}{\cos(25°)}}$

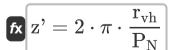
26) Transverse Module of Helical Gear given Transverse Diametrical Pitch



Open Calculator

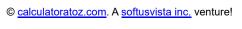
= $3.448276 \mathrm{mm} = rac{1}{0.29 \mathrm{mm}^{-1}}$

27) Virtual Number of Teeth on Helical Gear



Open Calculator 2

 $\boxed{\textbf{ex} \left[20.94395 = 2 \cdot \pi \cdot \frac{32 \text{mm}}{9.6 \text{mm}} \right]}$





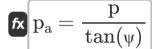
28) Virtual Number of Teeth on Helical Gear given Actual Number of Teeth

fx
$$z' = rac{z}{\left(\cos(\psi)
ight)^3}$$

Open Calculator

Helix Geometry

29) Axial Pitch of Helical Gear given Helix Angle



Open Calculator

$$=$$
 22.90333 mm $=$ $\frac{10.68$ mm $}{\tan(25\degree)}$

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

$$\psi = a \cos \left(\left(rac{\mathrm{z}}{\mathrm{z}'}
ight)^{rac{1}{3}}
ight)$$

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





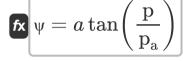
31) Helix Angle of Helical Gear given Addendum Circle Diameter 🗗

 $\psi = a \cos \left(rac{\mathrm{z}}{rac{\mathrm{d_a}}{\mathrm{m_n}}-2}
ight)$

Open Calculator 🗗

 $22.76376° = a \cos \left(\frac{37}{\frac{138 \text{mm}}{3 \text{mm}} - 2} \right)$

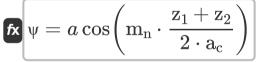
32) Helix Angle of Helical Gear given Axial Pitch



Open Calculator

 $extbf{ex} \left[25.59087^{\circ} = a an \left(rac{10.68 ext{mm}}{22.3 ext{mm}}
ight)
ight]$

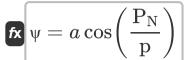
33) Helix Angle of Helical Gear given Center to Center Distance between Two Gears



$$\mathbf{ex} \left[24.99503 \, \mathrm{^\circ} = a \cos \left(3 \mathrm{mm} \cdot rac{18 + 42}{2 \cdot 99.3 \mathrm{mm}}
ight)
ight]$$



34) Helix Angle of Helical Gear given Normal Circular Pitch



Open Calculator 🚰

 $25.98923^{\circ} = a \cos \left(rac{9.6 ext{mm}}{10.68 ext{mm}}
ight)$

35) Helix Angle of Helical Gear given Normal Module

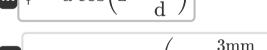


Open Calculator

 $oxed{ex} 28.07249^\circ = a \cosigg(rac{3\mathrm{mm}}{3.4\mathrm{mm}}igg)$

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

36) Helix Angle of Helical Gear given Pitch Circle Diameter



Open Calculator 🖸

 $oxed{ex} 19.83427^{\circ} = a \cosigg(37 \cdot rac{3 ext{mm}}{118 ext{mm}}igg)$

37) Helix Angle of Helical Gear given Pressure Angle

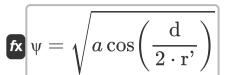
$$\psi = a \cos igg(rac{ an(lpha_{
m n})}{ an(lpha)} igg)$$

Open Calculator 🗗

 $extbf{ex} 25.07509 \degree = a \cos igg(rac{ an(20.1 \degree)}{ an(22 \degree)} igg)$

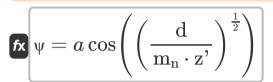


38) Helix Angle of Helical Gear given Radius of Curvature at Point 🗗



Open Calculator 🗗

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



Open Calculator

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

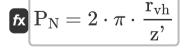
40) Normal Circular Pitch of Helical Gear 🖸

fx
$$P_{
m N} = {
m p} \cdot {
m cos}({
m \psi})$$

Open Calculator 🖸

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

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



Open Calculator

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





42) Normal Pressure Angle of Helical Gear given Helix Angle

 $a_{
m n} = a \tan(\tan(\alpha) \cdot \cos(\psi))$

Open Calculator 2

Open Calculator 2

Open Calculator G

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

43) Pitch Circular Diameter of Gear given Radius of Curvature

fx $d'=2\cdot r'$ Open Calculator

44) Pitch Circular Diameter of Gear given Virtual Gear

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

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

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

 $\mathbf{f} \mathbf{z} \, \mathrm{d} = \mathrm{m_n} \cdot \mathbf{z}' \cdot \left(\mathrm{cos}(\mathbf{y})^2 \right)$

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

46) Pitch of Helical Gear given Axial Pitch

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

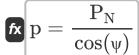
Open Calculator

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





47) Pitch of Helical Gear given Normal Circular Pitch

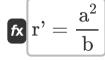


Open Calculator 🖸

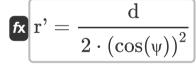
Open Calculator

ex $10.59243 \mathrm{mm} = \frac{9.6 \mathrm{mm}}{\cos(25°)}$

48) Radius of Curvature at Point on Helical Gear



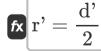
49) Radius of Curvature at Point on Virtual Gear



Open Calculator

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

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



Diameter
Open Calculator

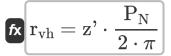
 $\boxed{71.5 \text{mm} = \frac{143 \text{mm}}{2}}$







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



Open Calculator

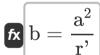
 $82.50592 ext{mm} = 54 \cdot rac{9.6 ext{mm}}{2 \cdot \pi}$

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

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

Open Calculator

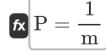
53) Semi Minor Axis of Elliptical Profile given Radius of Curvature at Point



Open Calculator G

= $5.28125 \mathrm{mm} = rac{(19.5 \mathrm{mm})^2}{72 \mathrm{mm}}$

54) Transverse Diametrical Pitch of Helical Gear given Transverse Module



$$0.294118 \mathrm{mm}^{-1} = rac{1}{3.4 \mathrm{mm}}$$





55) Transverse Pressure Angle of Helical Gear given Helix Angle 🗗



$$lpha = a anigg(rac{ an(lpha_{
m n})}{\cos(\psi)}igg)$$

$$oxed{ex} 21.98782^\circ = a anigg(rac{ an(20.1^\circ)}{\cos(25^\circ)}igg)$$



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)
- da 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_q 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





- Z₁ Number of Teeth on 1st Helical Gear
- Z₂ 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

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