Gear Calculations with Profile Shift.

Diametral Pitch: $DP := 0$

Normal Module: $M_n := 3.0$

$$M_n := \begin{cases} M_n \leftarrow \dfrac{25.4}{DP} & \text{if } DP \neq 0 \\ M_n \leftarrow M_n & \text{otherwise} \end{cases}$$

Normal Pressure Angle: $\alpha := 20.0\,deg$

Helix Angle: $\beta := 30.0\,deg$

Transverse Module: $M_t := \dfrac{M_n}{\cos(\beta)}$ $\qquad M_t = 3.46$

No. of Teeth (Pinion): $Z_1 := 12$

No. of Teeth (Gear): $Z_2 := 60$

Profile Shift Coefficient (Pinion): $x_1 := 0.09809$

Profile Shift Coefficient (Gear): $x_2 := 0.0$

Transverse Pressure Angle: $\alpha_t := \operatorname{atan}\left(\dfrac{\tan(\alpha)}{\cos(\beta)}\right)$ $\qquad \alpha_t = 22.80\,deg$

Involute of Transverse Pressure Angle: $inv\alpha_t := \tan(\alpha_t) - \alpha_t$ $\qquad inv\alpha_t = 0.02241351$

Involute of Working Pressure Angle: $inv\alpha_w := 2 \cdot \tan(\alpha) \cdot \left(\dfrac{x_1 + x_2}{Z_1 + Z_2}\right) + inv\alpha_t$ $\qquad inv\alpha_w = 0.02340523$

Estimate of Working Transverse Pressure Angle: $\alpha wt_{Est} := (3 \cdot inv\alpha_t)^{\frac{1}{3}}$ $\qquad \alpha wt_{Est} = 0.40664027$

Correction Factor: $k := \dfrac{inv\alpha_w - (\tan(\alpha wt_{Est}) - \alpha wt_{Est})}{\tan(\alpha wt_{Est})^2}$ $\qquad k = -0.0032$

Working Pressure Angle:

$$\alpha_w := \left| \begin{array}{l} kL \leftarrow k \\ \alpha L \leftarrow \alpha wt_{Est} \\ \text{for } j \in 1 .. 10 \\ \quad \left| \begin{array}{l} kL \leftarrow \dfrac{inv\alpha_w - (\tan(\alpha L) - \alpha L)}{\tan(\alpha L)^2} \\ \alpha L \leftarrow \alpha L + kL \\ \text{break if } |kL| < 10^{-10} \end{array} \right. \\ \alpha L \end{array} \right.$$

$\alpha_w = 23.1126\,deg$

Standard Pitch Diameter:

$$PD_1 := \frac{Z_1 \cdot M_n}{\cos(\beta)} \qquad PD_1 = 41.5692$$

$$PD_2 := \frac{Z_2 \cdot M_n}{\cos(\beta)}* \qquad PD_2 = 207.8461$$

Center Distance (not shifted):

$$CD_0 := \frac{PD_1 + PD_2}{2} \qquad CD_0 = 124.7077$$

Center Distance (shifted):

$$CD_s := CD_0 \cdot \frac{\cos(\alpha_t)}{\cos(\alpha_w)} \qquad CD_s = 125.000001$$

Base Diameter:

$$BD_1 := PD_1 \cdot \cos(\alpha_t) \qquad BD_1 = 38.32229$$

$$BD_2 := PD_2 \cdot \cos(\alpha_t) \qquad BD_2 = 191.61145$$

Working Pitch Diameter:

$$WPD_1 := \frac{BD_1}{\cos(\alpha_w)} \qquad WPD_1 = 41.666667$$

$$WPD_2 := \frac{BD_2}{\cos(\alpha_w)} \qquad WPD_2 = 208.333335$$

Tip correction Factor:

$$k_t := x_1 + x_2 - \frac{CD_s - CD_0}{M_n} \qquad k_t = 0.0006$$

Addendum:

$$ha_1 := M_n \cdot (1 + x_1 - k_t) \qquad ha_1 = 3.2923$$

$$ha_2 := M_n \cdot (1 + x_2 - k_t) \qquad ha_2 = 2.9981$$

Whole Depth:

$$h := M_n \cdot (2.25 - k_t) \qquad h = 6.7481$$

Outside Diameter:

$$OD_1 := PD_1 + 2 \cdot ha_1 \qquad OD_1 = 48.1539$$

$$OD_2 := PD_2 + 2 \cdot ha_2 \qquad OD_2 = 213.8422$$

Root Diameter:

$$RD_1 := OD_1 - 2 \cdot h \qquad RD_1 = 34.6578$$

$$RD_2 := OD_2 - 2 \cdot h \qquad RD_2 = 200.3461$$

Tooth thickness at Pitch Diameter:

$$PD_{t1} := \frac{M_n}{\cos(\beta)} \cdot \left(\frac{\pi}{2} + 2 \cdot x_1 \cdot \tan(\alpha)\right) \qquad PD_{t1} = 5.6887$$

$$PD_{t2} := \frac{M_n}{\cos(\beta)} \cdot \left(\frac{\pi}{2} + 2 \cdot x_2 \cdot \tan(\alpha)\right) \qquad PD_{t2} = 5.4414$$

Calculations to plot involute:

$i := 0, 1 .. 100$ $\theta_i := \frac{i}{2}deg$ $inv\theta_i := tan(\theta_i) - \theta_i$

$\delta_{Rot1_i} := inv\theta_i - \left(inv\alpha_t + \frac{PD_{t1}}{PD_1}\right)$ $\frac{PD_{t1}}{PD_1} = 0.136850$

$XCoord_{1_i} := \frac{BD_1}{2 \cdot cos(\theta_i)} \cdot cos(inv\theta_i)$ $YCoord_{1_i} := \frac{BD_1}{2 \cdot cos(\theta_i)} \cdot sin(inv\theta_i)$ $r1_i := \left[\left(XCoord_{1_i}\right)^2 + \left(YCoord_{1_i}\right)^2\right]^{0.5}$

$XCoord_{1r_i} := r1_i \cdot cos\left(\delta_{Rot1_i}\right)$ $YCoord_{1r_i} := r1_i \cdot sin\left(\delta_{Rot1_i}\right)$

$\delta_{Rot2_i} := inv\theta_i - \left(inv\alpha_t + \frac{PD_{t2}}{PD_2}\right)$ $\frac{PD_{t2}}{PD_2} = 0.026180$

$XCoord_{2_i} := \frac{BD_2}{2 \cdot cos(\theta_i)} \cdot cos(inv\theta_i)$ $YCoord_{2_i} := \frac{BD_2}{2 \cdot cos(\theta_i)} \cdot sin(inv\theta_i)$ $r2_i := \left[\left(XCoord_{2_i}\right)^2 + \left(YCoord_{2_i}\right)^2\right]^{0.5}$

$XCoord_{2r_i} := r2_i \cdot cos\left(\delta_{Rot2_i}\right)$ $YCoord_{2r_i} := r2_i \cdot sin\left(\delta_{Rot2_i}\right)$

$j := 0 .. 1$

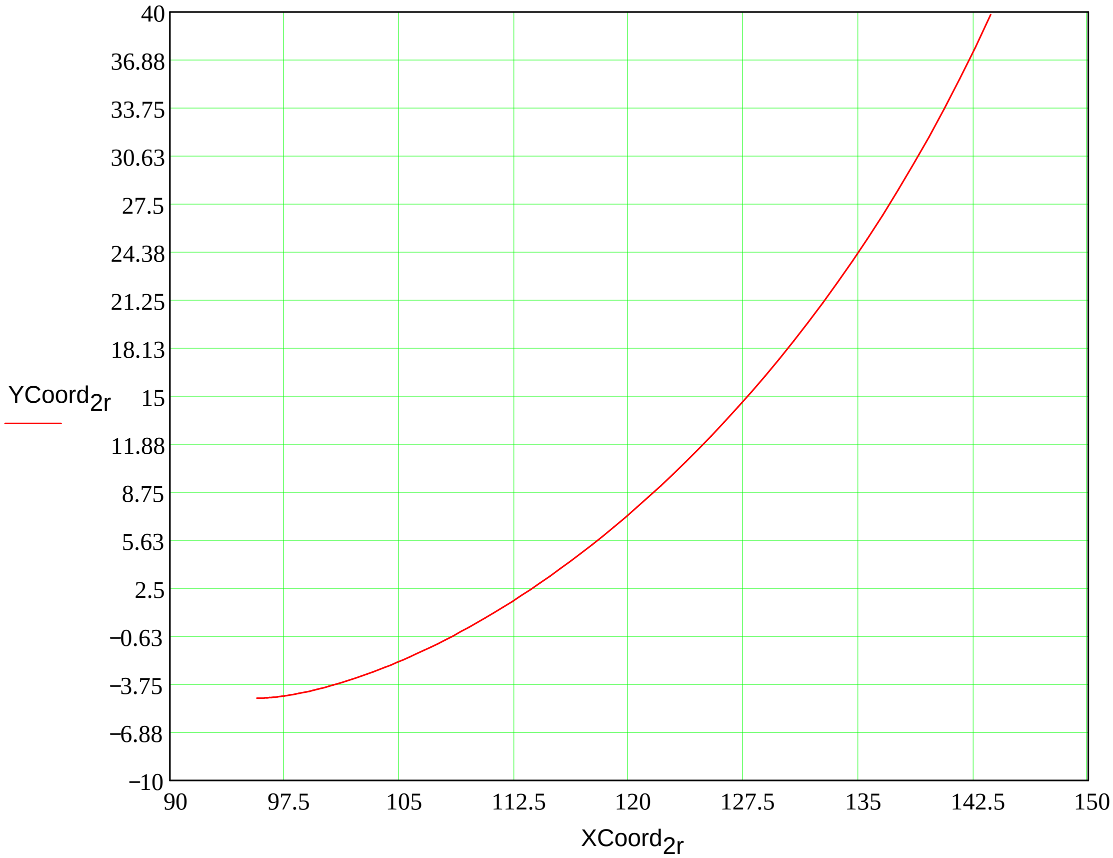
$Inv\_Rot_{1_{i,j}} := if\left(j = 0, XCoord_{1r_i}, YCoord_{1r_i}\right)$ $Inv\_Rot_{2_{i,j}} := if\left(j = 0, XCoord_{2r_i}, YCoord_{2r_i}\right)$

PRNPRECISION := 8

WRITEPRN("C:\Documents and Settings\Dieter\My Documents\Mathcad\Output\Involute.txt") := Inv_Rot_1

Involute1_Rot.xls Involute2_Rot.xls

Inv_Rot_1 Inv_Rot_2



40
36.88
33.75
30.63
27.5
24.38
21.25
18.13
15
11.88
8.75
5.63
2.5
−0.63
−3.75
−6.88
−10
YCoord2r
90
97.5
105
112.5
120
127.5
135
142.5
150
XCoord2r