HELICAL GEAR FORMULAS

To Obtain	Having	Formula
Transverse Diametral Pitch (P)	Number of Teeth (N) & Pitch Diameter (D)	$P = \frac{N}{D}$
	Normal Diametral Pitch (P_n) Helix Angle (ψ)	$P = P_N \text{Cos}\psi$
Pitch Diameter (D)	Number of Teeth (N) & Transverse Diametral Pitch (P)	$D = \frac{N}{P}$
Normal Diametral Pitch (P_N)	Transverse Diametral Pitch (P) & Helix Angle (ψ)	$P_N = \frac{P}{\text{Cos}\psi}$
Normal Circular Tooth Thickness (τ)	Normal Diametral Pitch (P_N)	$\tau = \frac{1.5708}{P_N}$
Transverse Circular Pitch (p_t)	Diametral Pitch (P) (Transverse)	$p_t = \frac{\pi}{P}$
Normal Circular Pitch (p_n)	Transverse Circular Pitch (p)	$p_n = p_t \text{Cos}\psi$
Lead (L)	Pitch Diameter and Pitch Helix Angle	$L = \frac{\pi D}{\text{Tan}\psi}$

TRANSVERSE VS. NORMAL DIAMETRAL PITCH FOR BOSTON 45° HELICAL GEARS

P Transverse Diametral Pitch	P_N Normal Diametral Pitch
24	33.94
20	28.28
16	22.63
12	16.97
10	14.14
8	11.31
6	8.48

HELICAL GEAR LEWIS FORMULA

The beam strength of Helical Gears operating on *parallel shafts* can be calculated with the Lewis Formula revised to compensate for the difference between Spur and Helical Gears, with modified Tooth Form Factors Y.

$$W = \frac{SFY}{P_N}\left(\frac{600}{600 + V}\right)$$

W = Tooth Load, Lbs. (along the Pitch Line)
S = Safe Material Stress (static) Lbs. per Sq. In. (Table III)
F = Face Width, Inches
Y = Tooth Form Factor (Table IV)
P_N = Normal Diametral Pitch
(Refer to Conversion Chart)
D = Pitch Diameter
V = Pitch Line Velocity, Ft. Per Min. = .262 x D x RPM

TABLE III–VALUES OF SAFE STATIC STRESS (S)

Material	(s) Lb. per Sq. In.
Bronze	10000
Cast Iron	12000
Steel — .20 Carbon (Untreated)	20000
Steel — .20 Carbon (Case-hardened)	25000
Steel — .40 Carbon (Untreated)	25000
Steel — .40 Carbon (Heat-treated)	30000
Steel — .40 C. Alloy (Heat-treated)	40000

TABLE IV—VALUES OF TOOTH FORM FACTOR (Y)

FOR 14-1/2°PA—45° HELIX ANGLE GEAR			
No. of Teeth	Factor Y	No. of Teeth	Factor Y
8	.295	25	.361
9	.305	30	.364
10	.314	32	.365
12	.327	36	.367
15	.339	40	.370
16	.342	48	.372
18	.345	50	.373
20	.352	60	.374
24	.358	72	.377

HORSEPOWER AND TORQUE

Max. allowable torque (T) that should be imposed on a gear will be the safe tooth load (W) multiplied by $\frac{D}{2}$ or $T = \frac{W \times D}{2}$

The safe horsepower capacity of the gear (at a given RPM) can be calculated from $HP = \frac{T \times RPM}{63{,}025}$ or directly from (W) and (V);

$HP = \frac{WV}{33{,}000}$

For a known HP, $T = \frac{63025 \times HP}{RPM}$