

MIL-HDBK-400  
NOTICE 1  
20 March 1988

MILITARY HANDBOOK

CRITERIA FOR PREPARATION OF GEAR AND  
SPLINE ENGINEERING DRAWINGS

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1. SCOPE

1.1 Purpose. The purpose of this handbook is to standardize the specification of gears and splines on engineering drawings and related documents. In so doing, it will clarify interpretation of these items making them more suitable for competitive procurement by both, the Government and prime contractors responsible for the quality of gear products procured under subcontracts.

1.2 Scope. This handbook covers parallel, intersecting, and nonintersecting axes gears, whose respective pitch surfaces of revolution are cylinders, cones and hyperboloids. It limits its coverage of splines to involute, parallel sided and straight nonparallel sided tooth forms. It does not attempt to cover either helical or tapered splines. Coverage of gear and spline types is, however, broad enough to permit adequate specification of special gear and spline configurations by supplementing or modifying comparable types within the scope of this handbook.

1.3 Application. This handbook is applicable to all non engineering drawings and related documents utilized in the procurement of gears and splines. It is intended as a reference guide to be used in both the development of new engineering drawings and related documents, and in the review and/or revision of those already in existence. It is also applicable to any contract in which it is specifically referenced.

1.4 General. Because this handbook will be utilized in both the specification of new gears and splines as well as updating of existing data, flexibility is sometimes required for the latter. This flexibility is provided by permitting certain types of data to be considered as non-mandatory in the updating of existing data. The type of data under discussion is data not absolutely essential to the manufacture and inspection of the product. While this data may be very helpful in the expansion or alteration of product application by the design engineer, it is often difficult to obtain. Original design criteria and calculations required to establish this data are frequently no longer available. Gear and spline design sheets, formulas, and tables were included in this pamphlet primarily for new designs. However, the user will find them convenient for reestablishing design criteria required for updating existing gear and spline specifications.

1.5 Cost reduction techniques. The use of cost reduction techniques in engineering drawing preparation maybe used when these techniques do not impair the reproducibility quality of MIL-M-9868, clarity and design disclosure requirements for the kind(s) and levels of engineering drawings being prepared. Specifically, techniques currently identified as photographic drafting and use of permanently adhering, non-fading, front printed and mounted decals and paste-ons for repetitive features should be used to the maximum extent practicable.

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P		GEAR DESIGN SHEET SG-1 EXTERNAL SPUR GEAR TOOTH DIMENSIONS STANDARD CENTER DISTANCE					DATE:	
Ø							SHEET 1 OF 3	
Pressure Angle *	Ø		inv Ø		cos Ø			
Diametral Pitch *	P		sin Ø		tan Ø			
Gear Backlash at D	B <sub>G</sub>		Circular Pitch	p = π ÷ P				
Pinion Backlash at D	B <sub>P</sub>		Base Pitch	p <sub>b</sub> = π cos Ø ÷ P				
Addendum	a	1 ÷ P	Other		cos (90°/N <sub>G</sub> )			
Dedendum	b	1.25 ÷ P	Other		cos (90°/N <sub>P</sub> )			
Clearance	c̄	c̄ = b - a		γ (see note 3) =				
AGMA Quality/Class Number				Measuring Wire Diameter *		d <sub>w</sub>		
Gear Major Diameter Runout			Q <sub>G</sub>	Gear Major Diameter Tolerance		ΔD <sub>oG</sub>		
Pinion Major Diameter Runout			Q <sub>P</sub>	Pinion Major Diameter Tolerance		ΔD <sub>oP</sub>		
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)		
Part Number *				-				
Drawing Number *				-	Rev.	Rev.		
Number of Teeth *				N				
Pitch Diameter *		N ÷ P		D				
Base Diameter *		D cos Ø		D <sub>b</sub>				
Center Distance *		(N <sub>G</sub> + N <sub>P</sub> ) ÷ 2P		C		+ .00		
Tooth Thickness At Pitch Diameter (Round off to 4 Decimal Places)	*	π - B <sub>min</sub>	Max	t				
	*	π - B <sub>max</sub>	Min					
Major Diameter	*	D + 2a	Max	D <sub>o</sub>				
	*	D <sub>o max</sub> - ΔD <sub>o</sub>	Min					
Minimum Tooth Tip Chamfer or Radius Height				Δtip <sub>min</sub>				
Maximum Tooth Tip Chamfer or Radius Height				Δtip <sub>max</sub>				
sec Ø <sub>o</sub>		D <sub>o max</sub> ÷ D <sub>b</sub>		sec Ø <sub>o</sub>				
inv Ø <sub>o</sub>		Table of Functions		inv Ø <sub>o</sub>				
Tooth Thickness at D <sub>o</sub>		D <sub>o max</sub> ( t <sub>min</sub> / D + inv Ø - inv Ø <sub>o</sub> )		t <sub>o</sub>				

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P		GEAR DESIGN SHEET SG-1			SHEET 2 OF 3	
ø		EXTERNAL SPUR GEAR TOOTH DIMENSIONS			STANDARD CENTER DISTANCE	
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Top Land		$t_o - 2 \Delta tip_{max}$ (should be greater than .005)				
Profile Major Diameter		$D_{o_{max}} - 2 \Delta tip_{min}$	Max	$D_M$		
		$D_{o_{min}} - 2 \Delta tip_{max}$	Min			
$x = 2C_{min} \sin \theta$		$y = \sqrt{D_{MG_{max}}^2 - D_{bG}^2}$		$z = \sqrt{D_{MP_{max}}^2 - D_{bP}^2}$		
$x_1 = 2C_{max} \sin \theta$		$y_1 = \sqrt{D_{MG_{min}}^2 - D_{bG}^2}$		$z_1 = \sqrt{D_{MP_{min}}^2 - D_{bP}^2}$		
NOTE: x and $x_1$ must be greater than y and $y_1$ and z and $z_1$ respectively.						
Active Profile Diameter		$\sqrt{(x - z)^2 + D_{bG}^2} - Q_p$ Gear $\sqrt{(x - y)^2 + D_{bP}^2} - Q_G$ Pinion		APD		
Hob Displacement for Backlash		$B_{max} \div 2 \tan \theta$		$\Delta e$		
Minor Diameter		$D - 2b$	Max	$D_R$		
		$D - 2b - 2 \Delta e$	Min			
Form Diameter Max		$\sqrt{\left(D_{R_{max}} + 2\bar{c}\right)^2 + \left(\frac{D - D_{R_{max}} - 2\bar{c}}{\tan \theta}\right)^2}$ $(D - D_{R_{max}} - 2\bar{c})$ must be a positive value		$D_F$		
Contact ratio		$(y_1 + z_1 - x_1) \div 2p_b$ To assure continuity of action, value must be greater than 1.05, preferably 1.2 or greater.		$m_p$		
$W_G ; W_P$ (may be positive or negative values)		$W_G = \text{inv } \theta + \frac{d_w}{D_{bG}} - \frac{\pi}{N_G}$ $W_P = \text{inv } \theta + \frac{d_w}{D_{bP}} - \frac{\pi}{N_P}$		$W_G$		
				$W_P$		



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P	GEAR DESIGN SHEET SG-1 EXTERNAL SPUR GEAR TOOTH DIMENSIONS STANDARD CENTER DISTANCE			SHEET 3 OF 3
Ø	TERMINOLOGY	FORMULA	SYMBOL	GEAR (G)    PINION (P)
	Involute at Wire Center	$W_G + \frac{t_{G_{max}}}{D_G} ; W_P + \frac{t_{P_{min}}}{D_P}$ Max	inv $\phi_w$	
		$W_G + \frac{t_{G_{min}}}{D_G} ; W_P + \frac{t_{P_{min}}}{D_P}$ Min		
	sec $\phi_w$	Table of Functions	$\frac{Max}{Min}$	sec $\phi_w$
	$\tan \phi_{w_{max}}$	Table of Functions	tan $\phi_w$	
	Wire Contact Diameter	$\sqrt{(D_b \tan \phi_w - d_w)^2 + D_b^2}$	$D_c$	
	Measurement over Wires (Even Teeth) *	$D_b \sec \phi_w + d_w$	$\frac{Max}{Min}$	$M_E$
	Wire Clearance	$d_{w_c} = .5(M_{E_{min}} - 2d_w - D_{R_{max}})$ (value must be positive)	$d_{w_c}$	
	Measurement over Wires (Odd Teeth) *	$D_b \cos(90^\circ/N) \sec \phi_w + d_w$	$\frac{Max}{Min}$	$M_O$
	Face Width *		F	
COARSE PITCH GEARS				GEAR (G)    PINION (P)
	Maximum Runout Tolerance of Pitch Diameter		*	
	Lead Tolerance Across Face Width		*	
	Pitch (Tooth-to-Tooth Spacing) Tolerance		*	
	Profile Tolerance		*	
NOTES:				
1. All values designated with an asterisk (*) shall be shown on drawing.				
2. To insure accuracy, calculate to a minimum of seven decimal places.				
3. Use $\pi$ to a minimum of seven decimal places.				
4. These calculations were performed to _____ decimal places.				



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P		GEAR DESIGN SHEET SG-2 EXTERNAL SPUR GEAR TOOTH DIMENSIONS NON-STANDARD CENTER DISTANCE					DATE:	
ø							SHEET 1 OF 4	
Pressure Angle *	ø		inv ø		cos ø			
Diametral Pitch *	P		tan ø					
Gear Backlash at $D_x$	$B_{xG}$		Circular Pitch at $D_x$	$p_x = \pi D_x \div N$				
Pinion Backlash at $D_x$	$B_{xP}$		Base Pitch	$p_b = \pi \cos \theta \div P$				
Addendum	a	$1 \div P$	Other		$\cos (90^\circ/N_G)$			
Dedendum	b	$1.25 \div P$	Other		$\cos (90^\circ/N_P)$			
Clearance	$\bar{c}$	$\bar{c} = b - a$		Measuring Wire Diameter *	$d_w$			
AGMA Quality/Class Number			Operating Center Distance *	$C_x$				+0.00
Operating Pitch Diameter *	$2NC_x \div (N_G + N_P)$		$D_{xG}$		$D_{xP}$			
$\sec \theta_x = D_x \div D_b$			Operating Pressure Angle *	$\theta_x$				
$\pi$ (see note 3) =			inv $\theta_x$		sin $\theta_x$			
Gear Major Diameter Runout	$Q_G$		Gear Major Diameter Tolerance	$\Delta D_{oG}$				
Pinion Major Diameter Runout	$Q_P$		Pinion Major Diameter Tolerance	$\Delta D_{oP}$				
TERMINOLOGY	FORMULA				SYMBOL	GEAR (G)	PINION (P)	
Part Number *					-			
Drawing Number *					-	Rev.	Rev.	
Number of Teeth *					N			
Nominal Pitch Diameter *	$N \div P$				D			
Base Diameter *	$D \cos \theta$				$D_b$			
Actual Tooth Thickness at $D_x$	$.5p_x - B_{xG_{min}} ; .5p_x - B_{xP_{min}}$ Max				$t_x$			
	$.5p_x - B_{xG_{max}} ; .5p_x - B_{xP_{max}}$ Min							
Actual Tooth Thickness at D (Round off to 4 Decimal Places) *	$D \left( \frac{t_x}{D_x} + \text{inv } \theta_x - \text{inv } \theta \right)$ Max				t			
						Min		
Hob Displacement for Backlash	$\left( t - \frac{\pi}{2P} \right) \div 2 \tan \theta$ Max				$\Delta e$			
						Min		

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P		GEAR DESIGN SHEET SG-2 EXTERNAL SPUR GEAR TOOTH DIMENSIONS NON-STANDARD CENTER DISTANCE			SHEET 2 OF 4	
Ø						
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Major Diameter	*	$D + 2 a + 2 \Delta e_{\max}$	Max	$D_o$		
	*	$D_{o_{\max}} - \Delta D_o$	Min			
Minimum Tooth Tip Chamfer or Radius Height				$\Delta tip_{\min}$		
Maximum Tooth Tip Chamfer or Radius Height				$\Delta tip_{\max}$		
$\sec \theta_o$		$D_{o_{\max}} \div D_b$		$\sec \theta_o$		
$\text{inv } \theta_o$		Table of Functions		$\text{inv } \theta_o$		
Tooth Thickness at $D_o$		$D_{o_{\max}} \left( \frac{t_{\min}}{D} + \text{inv } \theta - \text{inv } \theta_o \right)$		$t_o$		
Top Land		$t_o - 2 \Delta tip_{\max}$ (should be greater than .005)		$L_T$		
Profile Major Diameter	*	$D_{o_{\max}} - 2 \Delta tip_{\min}$	Max	$D_M$		
	*	$D_{o_{\min}} - 2 \Delta tip_{\max}$	Min			
$x = 2C_{x_{\min}} \sin \theta_x$		$y = \sqrt{D_{MG_{\max}}^2 - D_{bG}^2}$		$z = \sqrt{D_{MP_{\max}}^2 - D_{bP}^2}$		
$x_1 = 2C_{x_{\max}} \sin \theta_x$		$y_1 = \sqrt{D_{MG_{\min}}^2 - D_{bG}^2}$		$z_1 = \sqrt{D_{MP_{\min}}^2 - D_{bP}^2}$		
NOTE: x and $x_1$ must be greater than y and $y_1$ and z and $z_1$ respectively.						
Active Profile Diameter	*	$\sqrt{(x - z)^2 + D_{bG}^2} - Q_p$	Gear	APD		
	*	$\sqrt{(x - y)^2 + D_{bP}^2} - Q_G$	Pinion			
Nominal Tooth Thickness at D		$D \left( \frac{.5p_x}{D_x} + \text{inv } \theta_x - \text{inv } \theta \right)$		$t_{\text{nom}}$		
Hob Displacement at Zero Backlash		$\left( t_{\text{nom}} - \frac{\pi}{2P} \right) \div 2 \tan \theta$		$\Delta e_{\text{nom}}$		
Minor Diameter	*	$D - 2b + 2 \Delta e_{\text{nom}}$	Max	$D_R$		
	*	$D - 2b + 2 \Delta e_{\min}$	Min			

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P		GEAR DESIGN SHEET SG-2 EXTERNAL SPUR GEAR TOOTH DIMENSIONS NON-STANDARD CENTER DISTANCE			SHEET 3 OF 4	
Ø						
TERMINOLOGY		FORMULA	SYMBOL	GEAR (G)	PINION (P)	
Form Diameter Maximum *		$\sqrt{\left(D_{R_{\max}} + 2\bar{c}\right)^2 + \left(\frac{D - D_{R_{\max}} - 2\bar{c}}{\tan \theta}\right)^2}$ (D - D <sub>R<sub>max</sub></sub> - 2c̄ must be a positive value)	D <sub>F</sub>			
Contact Ratio		$(y_1 + z_1 - x_1) \div 2p_b$ To assure continuity of action, value must be greater than 1.05 preferably 1.2 or greater	m <sub>p</sub>			
W <sub>G</sub> ; W <sub>P</sub> (may be a positive or negative value)		$W_G = \text{inv } \theta + \frac{d_w}{D_{bG}} - \frac{\pi}{N_G}$ $W_P = \text{inv } \theta + \frac{d_w}{D_{bP}} - \frac{\pi}{N_P}$	W <sub>G</sub> W <sub>P</sub>			
Involute at Wire Center		$W_G + \frac{t_{G_{\max}}}{D_G} ; W_P + \frac{t_{P_{\max}}}{D_P}$ $W_G + \frac{t_{G_{\min}}}{D_G} ; W_P + \frac{t_{P_{\min}}}{D_P}$	inv θ <sub>w</sub>			
sec θ <sub>w</sub>		Table of Functions	sec θ <sub>w</sub>			
tan θ <sub>wmax</sub>		Table of Functions	tan θ <sub>w</sub>			
Wire Contact Diameter		$\sqrt{\left(D_b \tan \theta_w - d_w\right)^2 + D_b^2}$	D <sub>c</sub>			
Measurement Over Wires (Even Teeth) *		D <sub>b</sub> sec θ <sub>w</sub> + d <sub>w</sub>	M <sub>E</sub>			
Wire Clearance		$d_{w_c} = .5 \left(M_{e_{\min}} - 2d_w - D_{R_{\max}}\right)$ (value must be positive)	d <sub>wc</sub>			
Measurement over Wires (Odd Teeth) *		D <sub>b</sub> cos(90°/N) sec θ <sub>w</sub> + d <sub>w</sub>	M <sub>o</sub>			
Face Width *			F			

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P		GEAR DESIGN SHEET SG-2 EXTERNAL SPUR GEAR TOOTH DIMENSIONS NON-STANDARD CENTER DISTANCE	SHEET 4 OF 4	
Ø				
COARSE PITCH GEARS		GEAR (G)	PINION (P)	
Maximum Runout Tolerance of Pitch Diameter		*		
Lead Tolerance Across Face Width		*		
Pitch (Tooth-to-Tooth Spacing) Tolerance		*		
Profile Tolerance		*		
NOTES:				
1. All values designated with an asterisk (*) shall be shown on drawing.				
2. To insure accuracy, calculate to a minimum of seven decimal places.				
3. Use $\pi$ to a minimum of seven decimal places.				
4. These calculations were performed to _____ decimal places.				



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P		GEAR DESIGN SHEET SG-3 EXTERNAL SPUR GEAR TOOTH DIMENSIONS LONG ADDENDUM—SHORT ADDENDUM STANDARD CENTER DISTANCE					DATE:	
Ø							SHEET 1 OF 4	
Pressure Angle *	Ø		inv Ø		cos Ø			
Diametral Pitch *	P		sin Ø		tan Ø			
Gear Backlash at D	B <sub>G</sub>		Circular Pitch	$p = \pi \div P$				
Pinion Backlash at D	B <sub>P</sub>		Base Pitch	$p_b = \pi \cos \theta \div P$				
Addendum	a	$1 \div P$	Other		$\cos(90^\circ/N_G)$			
Dedendum	b	$1.25 \div P$	Other		$\cos(90^\circ/N_P)$			
Clearance	c	$c = b - a$			$\pi$ (see note 3) =			
AGMA Quality/Class Number				Measuring Wire Diameter *	d <sub>w</sub>			
Gear Major Diameter Runout	Q <sub>G</sub>		Gear Major Diameter Tolerance	$\Delta D_{OG}$				
Pinion Major Diameter Runout	Q <sub>P</sub>		Pinion Major Diameter Tolerance	$\Delta D_{OP}$				
TERMINOLOGY	FORMULA				SYMBOL	GEAR (G)	PINION (P)	
Part Number *					-			
Drawing Number *					-	Rev.	Rev.	
Number of Teeth *					N			
Pitch Diameter *	$N \div P$				D			
Base Diameter *	$D \cos \theta$				D <sub>b</sub>			
Center Distance *	$(N_G + N_P \div 2P)$				C		+ .00	
Hob Displacement (Show Plus or Minus)	$e_G = -e_P ; e_{P_{max}} = .5D_G \sin^2 \theta - a$ $e_P \leq e_{P_{max}} ; e_{P_{min}} = a - .5D_P \sin^2 \theta$ $e_{P_{min}} \leq e_P \leq e_{P_{max}}$				e			
Hob Displacement for Backlash	$B_{min} \div 2 \tan \theta$		Min		Δe			
	$B_{max} \div 2 \tan \theta$		Max					
Total Hob Displacement (may be plus or minus)	$e - \Delta e_{min}$		Max		E			
	$e - \Delta e_{max}$		Min					

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P		GEAR DESIGN SHEET SG-3			SHEET 2 OF 4	
Ø		EXTERNAL SPUR GEAR TOOTH DIMENSIONS				
		LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE				
TERMINOLOGY		FORMULA	SYMBOL	GEAR (G)	PINION (P)	
Tooth Thickness at Pitch Diameter (Round off to 4) (Decimal Places)	*	$.5p + 2E_{\max} \tan \theta$	Max	t		
	*	$.5p + 2E_{\min} \tan \theta$	Min			
Major Diameter	*	$D + 2a + 2e$	Max	$D_o$		
	*	$D_{o_{\max}} - \Delta D_o$	Min			
Minimum Tooth Tip Chamfer or Radius Height				$\Delta tip_{\min}$		
Maximum Tooth Tip Chamfer or Radius Height				$\Delta tip_{\max}$		
$\sec \theta_o$		$D_{o_{\max}} \div D_b$		$\sec \theta_o$		
$\text{inv } \theta_o$		Table of Functions		$\text{inv } \theta_o$		
Tooth Thickness at $D_o$		$D_{o_{\max}} \left( \frac{t_{\min}}{D} + \text{inv } \theta - \text{inv } \theta_o \right)$		$t_o$		
Top Land		$t_o - 2 \Delta tip_{\max}$ (should be greater than .005)		$L_T$		
Profile Major Diameter	*	$D_{o_{\max}} - 2 \Delta tip_{\min}$	Max	$D_M$		
	*	$D_{o_{\min}} - 2 \Delta tip_{\max}$	Min			
$x = 2C_{\min} \sin \theta$		$y = \sqrt{D_{MG_{\max}}^2 - D_{bG}^2}$		$z = \sqrt{D_{MP_{\max}}^2 - D_{bP}^2}$		
$x_1 = 2C_{\max} \sin \theta$		$y_1 = \sqrt{D_{MG_{\min}}^2 - D_{bG}^2}$		$z_1 = \sqrt{D_{MP_{\min}}^2 - D_{bP}^2}$		
NOTE: x and $x_1$ must be greater than y and $y_1$ and z and $z_1$ respectively.						
Active Profile Diameter	*	$\sqrt{(x - z)^2 + D_{bG}^2} - Q_P$	Gear	APD		
	*	$\sqrt{(x - y)^2 + D_{bP}^2} - Q_G$	Pinion			

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NOTICE 1

P		GEAR DESIGN SHEET SG-3			
Ø		EXTERNAL SPUR GEAR TOOTH DIMENSIONS			
		LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE		SHEET 3 OF 4	
TERMINOLOGY		FORMULA	SYMBOL	GEAR (G)	PINION (P)
Minor Diameter *	*	$D - 2b + 2e$	Max	$D_R$	
	*	$D - 2b + 2E_{\min}$	Min		
Form Diameter Maximum *	*	$\sqrt{\left(D_{R_{\max}} + 2\bar{c}\right)^2 + \left(\frac{D - D_{R_{\max}} - 2\bar{c}}{\tan \theta}\right)^2}$ ( $D - D_{R_{\max}} - 2\bar{c}$ must be a positive value)		$D_F$	
Contact Ratio		$(y_1 + z_1 - x_1 \div 2p_b)$ To assure continuity of action, value must be greater than 1.05 preferably 1.2 or greater		$m_p$	
$W_G ; W_P$ (may be a positive or negative value)		$W_G = \text{inv } \theta + \frac{d_w}{D_{bG}} - \frac{\pi}{N_G}$ $W_P = \text{inv } \theta + \frac{d_w}{D_{bP}} - \frac{\pi}{N_P}$		$W_G$ $W_P$	
Involute at Wire Center		$W_G + \frac{t_{G_{\max}}}{D_G} ; W_P + \frac{t_{P_{\max}}}{D_P}$	Max	$\text{inv } \theta_w$	
		$W_G + \frac{t_{G_{\min}}}{D_G} ; W_P + \frac{t_{P_{\min}}}{D_P}$	Min		
$\sec \theta_w$		Table of Functions	Max Min	$\sec \theta_w$	
$\tan \theta_{w_{\max}}$		Table of Functions		$\tan \theta_w$	
Wire Contact Diameter	*	$\sqrt{\left(D_b \tan \theta_w - d_w\right)^2 + D_b^2}$		$D_c$	
Measurement Over Wires (Even Teeth) *	*	$D_b \sec \theta_w + d_w$	Max	$M_E$	
	*		Min		
Wire Clearance		$d_{w_c} = .5 (M_{e_{\min}} - 2d_w - D_{R_{\max}})$ (value must be positive)		$d_{w_c}$	



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NOTICE 1

P		GEAR DESIGN SHEET SG-3			SHEET 4 OF 4	
Ø		EXTERNAL SPUR GEAR TOOTH DIMENSIONS				
		LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE				
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Measurement over Wires (Odd Teeth)	* *	$D_b \cos(90^\circ/N) \sec \phi_w + d_w$	$\frac{\text{Max}}{\text{Min}}$	$M_o$		
Face Width	*			F		
COARSE PITCH GEARS					GEAR (G)	PINION (P)
Maximum Runout Tolerance of Pitch Diameter				*		
Lead Tolerance Across Face Width				*		
Pitch (Tooth-to-Tooth Spacing) Tolerance				*		
Profile Tolerance				*		
NOTES:						
1. All values designated with an asterisk (*) shall be shown on drawing.						
2. To insure accuracy, calculate to a minimum of seven decimal places.						
3. Use $\pi$ to a minimum of seven decimal places.						
4. These calculations were performed to _____ decimal places.						

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NOTICE 1

P <sub>n</sub>		GEAR DESIGN SHEET HG-1 EXTERNAL HELICAL GEAR TOOTH DIMENSIONS STANDARD CENTER DISTANCE				DATE:	
θ <sub>n</sub>						SHEET 1 OF 4	
Normal Diametral Pitch	*	P <sub>n</sub>		Helix Angle	*	ψ	
Normal Pressure Angle	*	θ <sub>n</sub>		sin ψ		cos ψ	
tan θ = tan θ <sub>n</sub> ÷ cos ψ				sin θ <sub>n</sub>		tan θ <sub>n</sub>	
Transverse Pressure Angle		θ		cos ψ <sub>b</sub> = sin θ <sub>n</sub> ÷ sin θ			
Normal Backlash of Gear		B <sub>nG</sub>		sin θ		cos θ	
Normal Backlash of Pinion		B <sub>nP</sub>		inv θ		π (see note 3) =	
Addendum	a	1 ÷ P <sub>n</sub>	Other		Normal Circular Pitch	p <sub>n</sub> = π ÷ P <sub>n</sub>	
Dedendum	b	1.25 ÷ P <sub>n</sub>	Other		Circular Pitch	p = π ÷ P <sub>n</sub> cos ψ	
Clearance	c̄	c̄ = b - a			AGMA Quality/Class Number		
Base Pitch		p <sub>b</sub> = p cos θ			Measuring Wire Diameter	*	d <sub>w</sub>
Gear Major Diameter Runout		Q <sub>G</sub>			Gear Major Diameter Tolerance	ΔD <sub>oG</sub>	
Pinion Major Diameter Runout		Q <sub>P</sub>			Pinion Major Diameter Tolerance	ΔD <sub>oP</sub>	
TERMINOLOGY	FORMULA			SYMBOL	GEAR (G)	PINION (P)	
Part Number	*				-		
Drawing Number	*				-	Rev.	Rev.
Number of Teeth	*				N		
Pitch Diameter	*	N ÷ P <sub>n</sub> cos ψ			D		
Base Diameter	*	D cos θ			D <sub>b</sub>		
Center Distance	*	(N <sub>G</sub> + N <sub>P</sub> ) ÷ 2P <sub>n</sub> cos ψ			C		+ .00
Normal Tooth Thickness at Pitch Diameter (Round off to 4 Decimal Places)	*	.5p <sub>n</sub> - B <sub>nG<sub>min</sub></sub> ; .5p <sub>n</sub> - B <sub>nP<sub>min</sub></sub> Max			t <sub>n</sub>		
	*	.5p <sub>n</sub> - B <sub>nG<sub>max</sub></sub> ; .5p <sub>n</sub> - B <sub>nP<sub>max</sub></sub> Min					
Transverse Arc Tooth Thickness		t <sub>nG<sub>max</sub></sub> ÷ cos ψ ; t <sub>nP<sub>max</sub></sub> ÷ cos ψ Max			t		
		t <sub>nG<sub>min</sub></sub> ÷ cos ψ ; t <sub>nP<sub>min</sub></sub> ÷ cos ψ Min					

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NOTICE 1

P <sub>n</sub>		GEAR DESIGN SHEET HG-1 EXTERNAL HELICAL GEAR TOOTH DIMENSIONS STANDARD CENTER DISTANCE			SHEET 2 OF 4	
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Major Diameter	* *	$D + 2a$ $D_{o_{max}} - \Delta D_o$	$\frac{\text{Max}}{\text{Min}}$	D <sub>o</sub>		
Minimum Tooth Tip Chamfer or Radius Height				Δtip <sub>min</sub>		
Maximum Tooth Tip Chamfer or Radius Height				Δtip <sub>max</sub>		
sec θ <sub>o</sub>		$D_{o_{max}} \div D_b$		sec θ <sub>o</sub>		
inv θ <sub>o</sub>		Table of Functions		inv θ <sub>o</sub>		
Tooth Thickness at D <sub>o</sub>		$D_{o_{max}} \left( \frac{t_{min}}{D} + \text{inv } \theta - \text{inv } \theta_o \right)$		t <sub>o</sub>		
Top Land		$t_o - 2\Delta \text{tip}_{max}$ (should be greater than .010)		L <sub>T</sub>		
Profile Major Diameter	* *	$D_{o_{max}} - 2\Delta \text{tip}_{min}$ $D_{o_{min}} - 2\Delta \text{tip}_{max}$	$\frac{\text{Max}}{\text{Min}}$	D <sub>M</sub>		
$x = 2C_{min} \sin \theta$		$y = \sqrt{D_{MG_{max}}^2 - D_{bG}^2}$		$z = \sqrt{D_{MP_{max}}^2 - D_{bP}^2}$		
$x_1 = 2C_{max} \sin \theta$		$y_1 = \sqrt{D_{MG_{min}}^2 - D_{bG}^2}$		$z_1 = \sqrt{D_{MP_{min}}^2 - D_{bP}^2}$		
NOTE: x and x <sub>1</sub> must be greater than y and y <sub>1</sub> and z and z <sub>1</sub> respectively.						
Active Profile Diameter	* *	$\sqrt{(x - z)^2 + D_{bP}^2} - Q_p$ $\sqrt{(x - y)^2 + D_{bP}^2} - Q_G$	$\frac{\text{Gear}}{\text{Pinion}}$	APD		
Hob Displacement for Backlash		$B_{nG_{max}} \div 2 \tan \theta_n; B_{nP_{max}} \div 2 \tan \theta_n$		Δe		
Minor Diameter	* *	$D - 2b$ $D - 2b - 2\Delta e$	$\frac{\text{Max}}{\text{Min}}$	D <sub>R</sub>		

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NOTICE 1

P <sub>n</sub>		GEAR DESIGN SHEET HG-1			SHEET 3 OF 4
Ø <sub>n</sub>		EXTERNAL HELICAL GEAR TOOTH DIMENSIONS STANDARD CENTER DISTANCE			
TERMINOLOGY	FORMULA	SYMBOL	GEAR (G)	PINION (P)	
Form Diameter * Max	$\sqrt{(D_{R_{max}} + 2\bar{c})^2 + \left(\frac{D - D_{R_{max}} - 2\bar{c}}{\tan \phi}\right)^2}$ (D - D <sub>R<sub>max</sub></sub> - 2c̄ must be a positive value)	D <sub>F</sub>			
Face Width *		F			
Total Contact Ratio	$\left[ (y_1 + z_1 - x_1) \div 2p_b \right] + \frac{F \sin \phi}{P_n}$	m <sub>p</sub>			
W <sub>G</sub> ; W <sub>P</sub> (may be positive or negative values)	$W_G = \text{inv } \phi + \frac{d_w \sec \phi b}{D_{bG}} - \frac{\pi}{N_G}$ $W_P = \text{inv } \phi + \frac{d_w \sec \phi b}{D_{bP}} - \frac{\pi}{N_P}$	W <sub>G</sub> W <sub>P</sub>			
Involute at Wire Center	$W_G + \frac{t_{G_{max}}}{D_G} ; W_P + \frac{t_{P_{max}}}{D_P} \quad \text{Max}$ $W_G + \frac{t_{G_{min}}}{D_G} ; W_P + \frac{t_{P_{min}}}{D_P} \quad \text{Min}$	inv φ <sub>w</sub>			
sec φ <sub>w</sub>	Table of Functions	$\frac{\text{Max}}{\text{Min}}$	sec φ <sub>w</sub>		
tan φ <sub>wmax</sub>	Table of Functions		tan φ <sub>w</sub>		
Wire Contact Diameter	$\sqrt{(D_b \tan \phi_w - d_w \cos \phi_b)^2 + D_b^2}$	D <sub>C</sub>			
Measurement Over Wires * (Even Teeth)	D <sub>b</sub> sec φ <sub>w</sub> + D <sub>w</sub>	$\frac{\text{Max}}{\text{Min}}$	M <sub>E</sub>		
Wire Clearance	$d_{w_c} = .5 (M_{E_{min}} - 2d_w - D_{R_{max}})$ (value must be positive)	d <sub>wc</sub>			

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NOTICE 1

$P_n$		GEAR DESIGN SHEET HG-1 EXTERNAL HELICAL GEAR TOOTH DIMENSIONS STANDARD CENTER DISTANCE			SHEET 4 OF 4	
$\phi_n$						
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Measurement Over One Wire (Odd Teeth)	*	$\frac{1}{2} M_E$	Max	$M_o$		
	*		Min			
Lead	*	$\pi N \div P_n \sin \psi$		L		
COARSE PITCH GEARS					GEAR (G)	PINION (P)
Maximum Runout Tolerance of Pitch Diameter				*		
Lead Tolerance Across Face Width				*		
Pitch (Tooth-To-Tooth Spacing) Tolerance				*		
Profile Tolerance				*		
NOTES:						
1. All values designated with an asterisk (*) shall be shown on drawing.						
2. To insure accuracy, calculate to a minimum of seven decimal places.						
3. Use $\pi$ to a minimum of seven decimal places.						
4. These calculations were performed to _____ decimal places.						



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NOTICE 1

P <sub>n</sub>		GEAR DESIGN SHEET HG-2 EXTERNAL HELICAL GEAR TOOTH DIMENSIONS NON-STANDARD CENTER DISTANCE				DATE:	
ø <sub>n</sub>						SHEET 1 OF 4	
Normal Diametral Pitch *	P <sub>n</sub>	Helix Angle *		ø			
Normal Pressure Angle *	ø <sub>n</sub>	sin ø		cos ø			
sin ø <sub>n</sub>	tan ø <sub>n</sub>	tan ø = tan ø <sub>n</sub> ÷ cos ø					
cos ø <sub>n</sub>	Transverse Pressure Angle ø		cos ø				
inv ø	sin ø	cos ø <sub>b</sub> = sin ø <sub>n</sub> ÷ sin ø					
Normal Gear Backlash at D	B <sub>nG</sub>	Addendum	a	1 ÷ P <sub>n</sub>	Other		
Normal Pinion Backlash at D	B <sub>nP</sub>	Dedendum	b	1.25 ÷ P <sub>n</sub>	Other		
Operating Center Distance *	C <sub>x</sub>	+0.00	Clearance	c̄	b - a		
Operating Pitch Diameter *	2NC <sub>x</sub> ÷ (N <sub>G</sub> + N <sub>P</sub> )		D <sub>xG</sub>	D <sub>xP</sub>			
Circular Pitch	p = π ÷ P <sub>n</sub> cos ø		Base Pitch	p <sub>b</sub> = p cos ø			
Normal Circular Pitch	p <sub>n</sub> = π ÷ P <sub>n</sub>		π (see note 3) =				
Circular Pitch at D <sub>x</sub>	p <sub>x</sub> = π D <sub>x</sub> ÷ N		cos ø <sub>x</sub> = D <sub>b</sub> ÷ D <sub>x</sub>				
Operating Pressure Angle *	ø <sub>x</sub>	sin ø <sub>x</sub>		inv ø <sub>x</sub>			
AGMA Quality/Class Number			Measuring Wire Diameter *	d <sub>w</sub>			
Gear Major Diameter Runout	Q <sub>G</sub>	Gear Major Diameter Tolerance		ΔD <sub>oG</sub>			
Pinion Major Diameter Runout	Q <sub>P</sub>	Pinion Major Diameter Tolerance		ΔD <sub>oP</sub>			
TERMINOLOGY	FORMULA		SYMBOL	GEAR (G)	PINION (P)		
Part Number *			-				
Drawing Number *			-	Rev.	Rev.		
Number of Teeth *			N				
Pitch Diameter *	N ÷ P <sub>n</sub> cos ø		D				
Base Diameter *	D cos ø		D <sub>b</sub>				
Backlash In Transverse Plane at D <sub>x</sub>	$B_{x\min} = \frac{B_{n\min} \cos \theta}{\cos \theta_n \cos \phi \cos \theta_x}$		B <sub>x</sub>				
	$B_{x\max} = \frac{B_{n\max} \cos \theta}{\cos \theta_n \cos \phi \cos \theta_x}$						

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P <sub>n</sub>		GEAR DESIGN SHEET HG-2			SHEET 2 OF 4	
θ <sub>n</sub>		EXTERNAL HELICAL GEAR TOOTH DIMENSIONS			NON-STANDARD CENTER DISTANCE	
TERMINOLOGY		FORMULA	SYMBOL	GEAR (P)	PINION (P)	
Actual Transverse Tooth Thickness at D <sub>x</sub>		.5p <sub>x</sub> - B <sub>x<sub>min</sub></sub> Max	t <sub>x</sub>			
		.5p <sub>x</sub> - B <sub>x<sub>max</sub></sub> Min				
Normal Tooth Thickness at D (Round off to 4 Decimal Places)	*	$D \left( \frac{t_x}{D_x} + \text{inv } \theta_x - \text{inv } \theta \right) \cos \psi$	t <sub>n</sub>			
	*			Max Min		
Total Hob Displacement		$\left( t_n - \frac{\pi}{2P_n} \right) \div 2 \tan \theta_n$	Δe			
Major Diameter	*	D + 2a + 2Δe <sub>max</sub> Max	D <sub>o</sub>			
	*	D <sub>o<sub>max</sub></sub> - ΔD <sub>o</sub> Min				
Minimum Tooth Tip Chamfer or Radius Height			Δtip <sub>min</sub>			
Maximum Tooth Tip Chamfer or Radius Height			Δtip <sub>max</sub>			
sec θ <sub>o</sub>		$D_{o\max} \div D_b$	sec θ <sub>o</sub>			
inv θ <sub>o</sub>		Table of Functions	inv θ <sub>o</sub>			
Tooth Thickness at D <sub>o</sub>		$D_{o\max} \left( \frac{t_{n\min}}{D} + \text{inv } \theta - \text{inv } \theta_o \right)$	t <sub>o</sub>			
Top Land		t <sub>o</sub> - 2 Δtip <sub>max</sub> (should be greater than .010)	L <sub>T</sub>			
Profile Major Diameter	*	D <sub>o<sub>max</sub></sub> - 2 Δtip <sub>min</sub> Max	D <sub>M</sub>			
	*	D <sub>o<sub>min</sub></sub> - 2 Δtip <sub>max</sub> Min				
$x = 2C_{x\min} \sin \theta_x$		$y = \sqrt{D_{MG\max}^2 - D_{bG}^2}$		$z = \sqrt{D_{MP\max}^2 - D_{bP}^2}$		
$x_1 = 2C_{x\max} \sin \theta_x$		$y_1 = \sqrt{D_{MG\min}^2 - D_{bG}^2}$		$z_1 = \sqrt{D_{MP\min}^2 - D_{bP}^2}$		
NOTE: x and x <sub>1</sub> must be greater than y and y <sub>1</sub> and z and z <sub>1</sub> respectively.						



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P <sub>n</sub>		GEAR DESIGN SHEET HG-2			SHEET 3 OF 4	
ø <sub>n</sub>		EXTERNAL HELICAL GEAR TOOTH DIMENSIONS			NON-STANDARD CENTER DISTANCE	
TERMINOLOGY		FORMULA	SYMBOL	GEAR (G)	PINION (P)	
Active Profile Diameter	*	$\sqrt{(x - z)^2 + D_{bG}^2} - Q_p$	Gear	APD	/	/
	*	$\sqrt{(x - y)^2 + D_{bP}^2} - Q_G$	Pinion			
Normal Nominal Tooth Thickness at D		$D \left( \frac{.5p_x}{D_x} + \text{inv } \theta_x - \text{inv } \theta \right) \cos \phi$	$t_{nN}$			
Hob Displacement at Zero Backlash		$\left( t_{nN} - \frac{\pi}{2P_n} \right) \div 2 \tan \theta_n$	$\Delta e_{nom}$			
Minor Diameter	*	$D - 2b + 2 \Delta e_{nom}$	Max	$D_R$		
	*	$D - 2b + 2 \Delta e_{min}$	Min			
Form Diameter Max	*	$\sqrt{\left( D_{Rmax} + 2\bar{c} \right)^2 + \left( \frac{D - D_{Rmax} - 2\bar{c}}{\tan \theta} \right)^2}$ <small>(D - D<sub>Rmax</sub> - 2c̄ must be a positive value)</small>	$D_F$			
Face Width	*		F			
Total Contact Ratio		$\left[ (y_1 + z_1 - x_1) \div 2p_b \right] + \frac{F \sin \phi}{P_n}$	$m_p$			
W <sub>G</sub> ; W <sub>P</sub> (may be positive or negative values)		$W_G = \text{inv } \theta_x + \frac{d_w}{D_{bG} \cos \phi_b} - \frac{\pi}{N_G}$	W <sub>G</sub>			
		$W_P = \text{inv } \theta_x + \frac{d_w}{D_{bP} \cos \phi_b} - \frac{\pi}{N_P}$	W <sub>P</sub>			
Involute at Wire Center		$W_G + \frac{t_{xGmax}}{D_{xG}}$ ; $W_P + \frac{t_{xPmax}}{D_{xP}}$	Max	inv Q <sub>w</sub>		
		$W_G + \frac{t_{xGmin}}{D_{xG}}$ ; $W_P + \frac{t_{xPmin}}{D_{xP}}$	Min			

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NOTICE 1

$P_n$		GEAR DESIGN SHEET HG-2 EXTERNAL HELICAL GEAR TOOTH DIMENSIONS NON-STANDARD CENTER DISTANCE		SHEET 4 OF 4	
$\phi_n$					
TERMINOLOGY		FORMULA	SYMBOL	GEAR (G)	PINION (P)
$\sec \phi_w$		Table of Functions Max Min	$\sec \phi_w$		
$\tan \phi_{w_{max}}$		Table of Functions	$\tan \phi_w$		
Wire Contact Diameter		$\sqrt{(D_b \tan \phi_w - d_w \cos \phi_b)^2 + D_b^2}$	$D_c$		
Measurement Over Wires (Even Teeth) *	*	$D_b \sec \phi_w + d_w$ Max Min	$M_E$		
Wire Clearance		$d_{w_c} = (.5 M_{E_{min}} - 2d_w - D_{R_{max}})$ (value must be positive)	$d_{w_c}$		
Measurement Over One Wire (Odd Teeth) *	*	$\frac{1}{2} M_E$ Max Min	$M_o$		
Lead *	*	$\pi N \div P_n \sin \phi$	$L$		
COARSE PITCH GEARS				GEAR (G)	PINION (P)
Maximum Runout Tolerance of Pitch Diameter			*		
Lead Tolerance Across Face Width			*		
Pitch (Tooth-to-Tooth Spacing) Tolerance			*		
Profile Tolerance			*		
NOTES:					
1. All values designated with an asterisk (*) shall be shown on drawing.					
2. To insure accuracy, calculate to a minimum of seven decimal places.					
3. Use $\pi$ to a minimum of seven decimal places.					
4. These calculations were performed to _____ decimal places.					

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NOTICE 1

$P_n$		GEAR DESIGN SHEET HG-3 EXTERNAL HELICAL GEAR TOOTH DIMENSIONS LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE					DATE:	
$\theta_n$							SHEET 1 OF 4	
Normal Diametral Pitch *	$P_n$		Helix Angle *		$\psi$			
Normal Pressure Angle *	$\theta_n$		$\sin \psi$		$\cos \psi$			
$\tan \theta = \tan \theta_n \div \cos \psi$			$\sin \theta_n$		$\tan \theta_n$			
Transverse Pressure Angle	$\theta$		$\cos \psi_b = \sin \theta_n \div \sin \theta$					
Normal Gear Backlash at D	$B_{nG}$		$\sin \theta$		$\cos \theta$			
Normal Pinion Backlash at D	$B_{nP}$		$\text{inv } \theta$		$\pi$ (see note 3) =			
Addendum	a	$1 \div P_n$	Other		Normal Circular Pitch	$p_n = \pi \div P_n$		
Dedendum	b	$1.25 \div P_n$	Other		Circular Pitch	$p = \pi \div P_n \cos \psi$		
Clearance	$\bar{c}$	$\bar{c} = b - a$			Measuring Wire Diameter *	$d_w$		
Base Pitch	$p_b = p \cos \theta$				AGMA Quality/Class Number			
Gear Major Diameter Runout	$Q_G$				Gear Major Diameter Tolerance	$\Delta D_{oG}$		
Pinion Major Diameter Runout	$Q_P$				Pinion Major Diameter Tolerance	$\Delta D_{oP}$		
TERMINOLOGY	FORMULA				SYMBOL	GEAR (G)	PINION (P)	
Part Number *					-			
Drawing Number *					-	Rev.		Rev.
Number of Teeth *					N			
Pitch Diameter *	$N \div P_n \cos \psi$				D			
Base Diameter *	$D \cos \theta$				$D_b$			
Center Distance *	$(N_G + N_P) \div 2P_n \cos \psi$				C		+.00	
Hob Displacement (Show plus or minus)	$e_G = -e_P ; e_{P_{max}} = .5D_G \sin^2 \theta_n - a$ $e_P \leq e_{P_{max}} ; e_{P_{min}} = a - .5D_P \sin^2 \theta_n$				e			
Hob Displacement for Backlash	$B_{nG_{min}} \div 2 \tan \theta_n ; B_{nP_{min}} \div 2 \tan \theta_n$ Min $B_{nG_{max}} \div 2 \tan \theta_n ; B_{nP_{min}} \div 2 \tan \theta_n$ Max				$\Delta e$			

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NOTICE 1

$P_n$		GEAR DESIGN SHEET HG-3			SHEET 2 OF 4	
$\theta_n$		EXTERNAL HELICAL GEAR TOOTH DIMENSIONS				
		LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE				
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Total Hob Displacement (may be plus or minus)		$e - \Delta e_{\min}$	Max	E		
		$e - \Delta e_{\max}$	Min			
Normal Tooth Thickness at D (Round off to 4 Decimal Places)	*	$.5p_n + 2E_{\max} \tan \theta_n$	Max	$t_n$		
	*	$.5p_n + 2E_{\min} \tan \theta_n$	Min			
Transverse Arc Tooth Thickness		$t_{n_{\max}} \div \cos \phi$	Max	t		
		$t_{n_{\min}} \div \cos \phi$	Min			
Major Diameter	*	$D + 2a + 2e$	Max	$D_o$		
	*	$D_{o_{\max}} - \Delta D_o$	Min			
Minimum Tooth Tip Chamfer or Radius Height				$\Delta tip_{\min}$		
Maximum Tooth Tip Chamfer or Radius Height				$\Delta tip_{\max}$		
$\sec \theta_o$		$D_{o_{\max}} \div D_b$		$\sec \theta_o$		
$\text{inv } \theta_o$		Table of Functions		$\text{inv } \theta_o$		
Tooth Thickness at $D_o$		$D_{o_{\max}} \left( \frac{t_{\min}}{D} + \text{inv } \theta - \text{inv } \theta_o \right)$		$t_o$		
Top Land		$t_o - 2 \Delta tip_{\max}$ (should be greater than .010)		$L_T$		
Profile Major Diameter	*	$D_{o_{\max}} - 2 \Delta tip_{\min}$	Max	$D_M$		
	*	$D_{o_{\min}} - 2 \Delta tip_{\max}$	Min			
$x = 2C_{\min} \sin \theta$		$y = \sqrt{D_{MG_{\max}}^2 - D_{bG}^2}$		$z = \sqrt{D_{MP_{\max}}^2 - D_{bP}^2}$		
$x_1 = 2C_{\max} \sin \theta$		$y_1 = \sqrt{D_{MG_{\min}}^2 - D_{bG}^2}$		$z_1 = \sqrt{D_{MP_{\min}}^2 - D_{bP}^2}$		
NOTE: x and $x_1$ must be greater than y and $y_1$ and z and $z_1$ respectively.						



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P <sub>n</sub>		GEAR DESIGN SHEET HG-3				
Ø <sub>n</sub>		EXTERNAL HELICAL GEAR TOOTH DIMENSIONS			SHEET 3 OF 4	
		LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE				
TERMINOLOGY		FORMULA		SYMBOL	GEAR (G)	PINION (P)
Active Profile Diameter	*	$\sqrt{(x - z)^2 + D_{bG}^2}$	- Q <sub>P</sub>	Gear	APD	
	*	$\sqrt{(x - y)^2 + D_{bP}^2}$	- Q <sub>G</sub>	Pinion		
Minor Diameter	*	D - 2b + 2e		Max	D <sub>R</sub>	
	*	D - 2b + 2E <sub>min</sub>		Min		
Form Diameter Max	*	$\sqrt{\left(D_{R_{max}} + 2\bar{c}\right)^2 + \left(\frac{D - D_{R_{max}} - 2\bar{c}}{\tan \phi}\right)^2}$ (D - D <sub>R<sub>max</sub></sub> - 2c̄ must be a positive value)			D <sub>F</sub>	
Face Width	*				F	
Total Contact Ratio		$\left[ \frac{y_1 + z_1 - x_1}{2p_b} \right] + \frac{F \sin \phi}{p_n}$			m <sub>p</sub>	
W <sub>G</sub> ; W <sub>P</sub> (may be positive or negative values)		$W_G = \text{inv } \phi + \frac{d_w}{D_{bG} \cos \phi} - \frac{\pi}{N_G}$ $W_P = \text{inv } \phi + \frac{d_w}{D_{bP} \cos \phi} - \frac{\pi}{N_P}$			W <sub>G</sub> W <sub>P</sub>	
Involute at Wire Center		$W_G + \frac{t_{G_{max}}}{D_G} ; W_P + \frac{t_{P_{max}}}{D_P}$		Max	inv φ <sub>w</sub>	
		$W_G + \frac{t_{G_{min}}}{D_G} ; W_P + \frac{t_{P_{min}}}{D_P}$		Min		
sec φ <sub>w</sub>		Table of Functions		Max Min	sec φ <sub>w</sub>	
tan φ <sub>w max</sub>		Table of Functions			tan φ <sub>w</sub>	

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P <sub>n</sub>		GEAR DESIGN SHEET HG-3			SHEET 4 OF 4
Ø <sub>n</sub>		EXTERNAL HELICAL GEAR TOOTH DIMENSIONS LONG ADDENDUM-SHORT ADDENDUM STANDARD CENTER DISTANCE			
TERMINOLOGY		FORMULA	SYMBOL	GEAR (G)	PINION (P)
Wire Contact Diameter		$\sqrt{(D_b \tan \phi_w - d_w \cos \phi_b)^2 + D_b^2}$	D <sub>C</sub>		
Measurement Over Wires (Even Teeth) *		$D_b \sec \phi_w + d_w$	$\frac{\text{Max}}{\text{Min}}$	M <sub>E</sub>	
Wire Clearance		$d_{wC} = .5 (M_{E\text{min}} - 2d_w - D_{R\text{max}})$ (value must be positive)	d <sub>wC</sub>		
Measurement Over One Wire (Odd Teeth) *		$\frac{1}{2} M_E$	$\frac{\text{Max}}{\text{Min}}$	M <sub>O</sub>	
Lead *		$\pi N \div P_n \sin \phi$	L		
COARSE PITCH GEARS				GEAR (G)	PINION (P)
Maximum Runout Tolerance of Pitch Diameter			*		
Lead Tolerance Across Face Width			*		
Pitch (Tooth-to-Tooth Spacing) Tolerance			*		
Profile Tolerance			*		
NOTES:					
1. All values designated with an asterisk (*) shall be shown on drawing.					
2. To insure accuracy, calculate to a minimum of seven decimal places.					
3. Use π to a minimum of seven decimal places.					
4. These calculations were performed to _____ decimal places.					

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6. NOTES

6.1 Supersession data. This handbook supersedes USA TACOM Pamphlet No. 11-46, 31 August 1973.

6.2 Subject term (key word) listing.

Engineering drawings, gear and spline  
Gear and spline, preparation of engineering drawings  
Spline and gear, preparation of engineering drawings

Custodian:

Army - AT  
Air Force - 99

Preparing activity:

Army - AT

(Project 3020-0109)

Review activities:

Army - ME



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APPENDIX

10.1 General. For convenience, the appendix contains tables, examples, formulas, etc., frequently used by the designer in the preparation of gear and spline drawings.

- a. It is recommended that designers familiarize themselves with the instructions outlined in the text prior to the use of the tables and formulas.
- b. To assist the designer in the interpretation of the requirements of this handbook, several examples of drawings are included in the appendix. These sample drawings shall be construed as informational only and are complete to the degree necessary to illustrate a condition. Actual drawings shall comply with the instructions set forth in the handbook.
- c. Specification of measuring wire or ball sizes on drawings shall be to sizes listed in the table and/or according to the instructions contained in the appendix.
- d. Involute profile controls require the specification of roll angles, as in profile charts. A table of roll angles is listed here for the convenience of the user.
- e. Specific instructions for the use of all tables and formulas are outlined in the text.

10.2 Wire size policy. Recent practice has shown that measurement of gears, splines, and serrations is frequently accomplished through the use of two or three identical sized wires or pins. This method necessitates the use of proper diameter of measuring wire or pin in order to obtain reliable readings. The reasons for using this method are cost and procurement considerations, especially for small quantities. It is sometimes used in the early production of large orders.

- a. It is desirable to use wires that contact the profile at or near the pitch diameters and/or reference diameter. With such wires the measurement at or near the pitch diameter is least affected by profile deviations. To illustrate this, consider figure 116 which shows a full line depicting a true outline and a dotted line showing a profile of the same pitch diameter but with a profile deviation. The same conditions would affect circular gears, splines, and serrations. The wire (B) contacts both outlines at or near the pitch diameter, and the measurement will be affected very little by profile deviations. It is evident from the same figure that a maximum wire (M) will give false results unless the profile deviation is considered in the computation.