



Bevel gearing with straight, oblique and curved teeth [inch/AGMA]

i Calculation without errors. Pinion Gear

ii Project information

? Input section

1.0 Options of basic input parameters

1.1 Transferred power	Pw	10,000	9,834	[HP]
1.2 Speed (Pinion / Gear)	n [min]	1000,0	550,0	[/min]
1.3 Torsional moment (Pinion / Gear)	Torq [lb.in]	630,00	1126,43	[Nm]
1.4 Transmission ratio / from table	i	1,80		
1.5 Actual transmission ratio / deviation	i	1,8182	1,00%	

2.0 Options of material, loading conditions, operational and production parameters

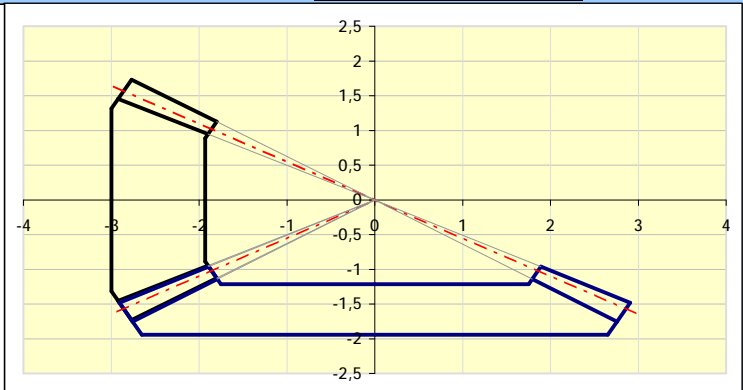
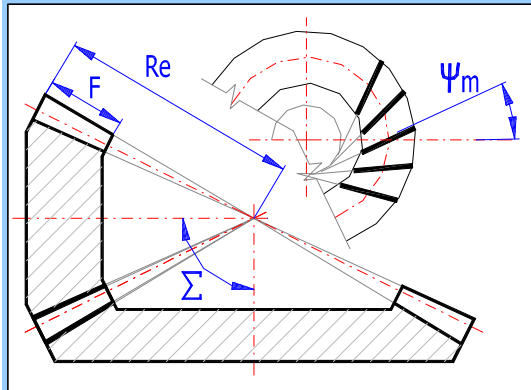
2.1 Material of the pinion :	E,F...Alloy structural steel AISI 6150 (S=142 Mpsi) face hardened			▼
2.2 Material of the gear :	E,F...Alloy structural steel Gr.5135(ASTM A322) (S=114 Mpsi) tooth face hard.			▼
2.3 Loading of the gearbox, driving machine - examples	A...Continuous			▼
2.4 Loading of gearbox, driven machine - examples	A...Continuous			▼
2.5 Type of gearing mounting	C...Double-sided supported gearing - type 1			▼
Type of gearing mounting	C...Precision enclosed gearbox			▼
2.6 Accuracy grade - AGMA (Ra min Ra max)	Qv	8.....(Ra min.= 63 / Ra max.= 125)		▼
2.7 Failure probability (fewer than one failure in:)	FP	1000		▼
2.8 Desired service life	Lh	10000		[h]
2.9 Coefficient of safety (contact/bend)	SH / SF	1,30	1,60	
2.10 Automatic design	A. Spur gearing			▼

3.0 Parameters of the tooth profile, gearing type

3.1 Guiding curve of the toothing (Type of toothing)	A,B. Straight line, type I (Standard straight and oblique toothing)			▼ <input checked="" type="checkbox"/>
3.2 Addendum - Coefficient of the height of the tooth head	ha*	1,000	1,000	[modul]
3.3 Unit head clearance	c*	0,200	0,200	[modul]
3.4 Recommended coefficient of the root radius		0,304	0,304	[modul]
3.5 Coefficient of the root radius	rf*	0,304	0,304	[modul] <input checked="" type="checkbox"/>
3.6 Type of tooth shape	Without modification			▼

4.0 Design of a module (Diametral Pitch) and geometry of toothing

4.1 Number of teeth Pinion / Gear	N	22	40	
4.2 Angle of shaft axes	Σ	90	90	[°] ▼
4.3 A. Transverse pressure angle	Φ	20,0	20,0	[°] ▼
4.4 Base helix angle	Ψ_m	0,0	35	[°] ▼
4.5 Direction of the teeth pitch (pinion)	Left-Hand			▼
4.6 Width of toothing to the surface straight line of the cone (b/Re)	◀ ▶			
4.7 Width of toothing to the surface straight line of the cone (b/Re)	Re/F	0,3	< 0,35	
4.8 Diametral Pitch (transverse, outer)	Pt	7		
Circular Pitch / Modul (transverse, outer)	CP/met	0,4488	0,1429	[in]
4.9 Face width / max. recommendet value	F	1,141	< 1,141	[in] <input checked="" type="checkbox"/>
4.10 Approximate weight of the gearing	m	5,224		[lb]
4.11 Minimum coefficient of safety	SH / SF	1,405	2,899	



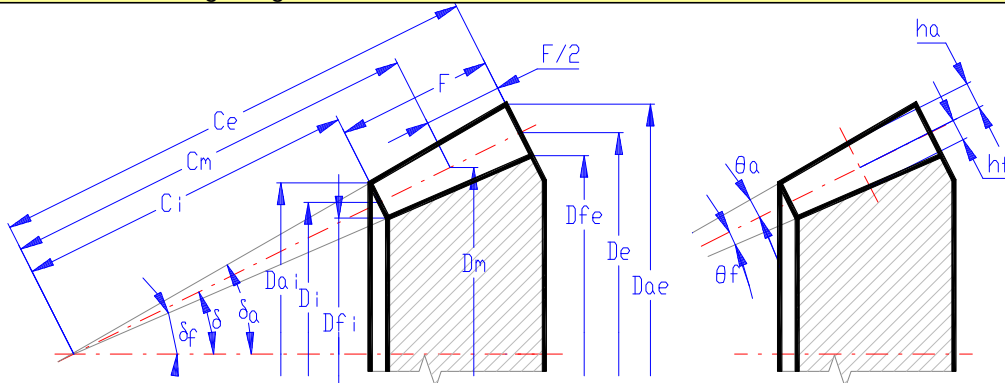
5.0 Correction of toothing (Addendum modification)

5.1 Correction type A. Straight toothing VN, increased bending strength ▼

5.2	Recommendet value	$x_1 / x_{\tau 1}$	0,511	0,000
5.3	- Permissible undercutting of teeth (min. value)	x_1 / x_2	-0,6352	-4,0213
5.4	- Preventing undercutting of teeth (min. value)	x_1 / x_2	-0,4685	-3,8547
5.5	Pinion addendum modification coefficient setting			
5.6	Addendum modification coefficient	x_1 / x_2	0,2700	-0,2700
5.7	Tooth thicknes modification coefficient	$x_{\tau 1} / x_{\tau 2}$	0,0000	0,0000
5.8	Total contact ratio	ϵ_{γ}	1,6678	
5.9	Unit tooth thickness on the tip diameter	s_{ae}^*	0,7930	1,1215
5.10	Safety coefficient for surface durability	SH	1,405	1,760
5.11	Safety coefficient for bending durability	SF	5,10	2,90

Results section

6.0 Basic dimensions of gearing



		N	22	40		
6.1	Number of teeth Pinion / Gear	N	22	40		
6.2	Diametral Pitch transverse (vnější, střední, vnitřní)	Pet,Pmt,Pit	7,0000	8,4844	10,7679	
6.3	Diametral Pitch (outer, midle, inner)	Pen,Pmn,Pin	7,0000	8,4844	10,7679	
6.4	Transverse module (outer, midle, inner)	met,mmt,mit	0,1429	0,1179	0,0929	[in]
6.5	Normal module (outer, midle, inner)	men,mmn,min	0,1429	0,1179	0,0929	[in]
6.6	Cone length (outer, midle, inner)	Ce,Cm,Ci	3,2608	2,6903	2,1198	[in]
6.7	Pitch cone angle	δ	28,8108	61,1892		[°]
6.8	Addendum cone angle	δ_a	31,9954	63,0210		[°]
6.9	Dedendum cone angle	δ_f	26,4776	57,5043		[°]
6.10	Tip diameter (outer)	Dae	3,4608	5,8148		[in]
6.11	Tip diameter (midle)	Dam	2,8553	4,7975		[in]
6.12	Tip diameter (inner)	Dai	2,2498	3,7801		[in]
6.13	Pitch diameter (outer)	De	3,1429	5,7143		[in]
6.14	Pitch diameter (midle)	Dm	2,5930	4,7145		[in]
6.15	Pitch diameter (inner)	Di	2,0431	3,7148		[in]
6.16	Root diameter (outer)	Dfe	2,9100	5,5119		[in]
6.17	Root diameter (midle)	Dfm	2,4009	4,5475		[in]
6.18	Root diameter (inner)	Dfi	1,8918	3,5832		[in]
6.19	Addendum angle	θ_a	3,1846	1,8318		[°]
6.20	Dedendum angle	θ_f	2,3332	3,6849		[°]
6.21	Addendum (outer)	hae	0,1814	0,1043		[in]
6.22	Addendum (midle)	ha	0,1497	0,0860		[in]
6.23	Addendum (inner)	hai	0,1179	0,0678		[in]
6.24	Dedendum (outer)	hfe	0,1329	0,2100		[in]
6.25	Dedendum (midle)	hf	0,1096	0,1733		[in]
6.26	Dedendum (inner)	hfi	0,0864	0,1365		[in]
6.27	Normal pressure angle	Φ_n	20,0000			[°]
6.28	Transverse pressure angle	Φ_t	20,0000			[°]
6.29	Helix angle	Ψ	0,0000			[°]
6.30	Base helix angle	Ψ_b	0,0000			[°]
6.31	Pressure angle at the pitch cylinder	Φ_{wn}	20,0000			[°]
6.32	Transverse pressure angle at the pitch cylinder	Φ_{wt}	20,0000			[°]
6.33	Circular pitch	pe	0,4488			[in]

6.34	Transverse circular pitch	pte	0,4488		[in]
6.35	Tooth thickness on the pitch diameter	sne	0,2525	0,1963	[in]
6.36	Tooth thickness on the pitch diameter	sn	0,2083	0,1620	[in]
6.37	Tooth thickness on the pitch diameter	sni	0,1641	0,1276	[in]
6.38	Tooth thickness on the tip diameter	sae	0,1133	0,1602	[in]
6.39	Tooth thickness on the tip diameter	sa	0,0935	0,1322	[in]
6.40	Tooth thickness on the tip diameter	sai	0,0736	0,1042	[in]
6.41	Unit tooth thickness on the tip diameter	sae*	0,7930	1,1215	[modul]

7.0 Virtual spur gear toothing

7.1	Number of teeth of a virtual wheel with oblique teeth	zvn'	25,108	83,002	
7.2	Number of teeth of a virtual wheel with straight teeth	zv	25,108	83,002	
7.3	Reference diameter	dv'	2,959	9,783	[in]
7.4	Tip diameter	dva'	3,259	9,955	[in]
7.5	Base diameter	dvb'	2,781	9,193	[in]
7.6	Root diameter	dvf'	2,740	9,436	[in]
7.7	Virtual center distance	av	6,3711		[in]
7.8	Virtual Gear Ratio	iv	3,3058		

8.0 Qualitative indexes of a gearing

8.1	Transverse contact ratio / overlap ratio	$\epsilon_{\alpha} \epsilon_{\beta}$	1,6678	0,0000	
8.2	Total contact ratio	ϵ_{γ}	1,6678		
8.3	Resonance speed	nE1	19987,30		[/min]
8.4	Resonance ratio	N	0,05		
8.5	Approximate weight of the gearing	m	5,2241		[lb]
8.6	Efficiency of the gearing	μ	98,34%		
8.7	Selected / Recommended lubricant viscosity	v50	0,46		[in^2/sec]

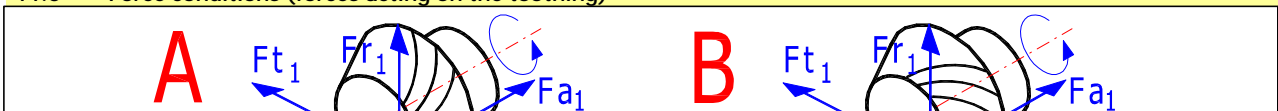
9.0 Coefficients for safety calculation

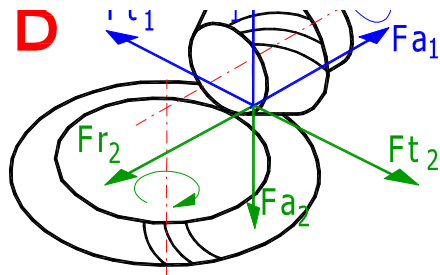
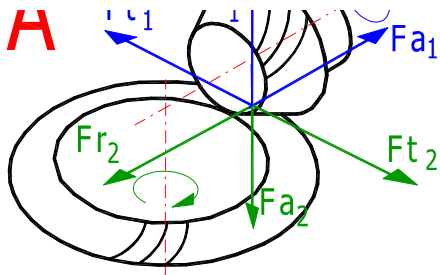
9.1 Common for the gearing					
9.2	Application factor	Ka	1,00		
9.3	Dynamic coefficient	Kv'	0,82		
9.4	Loading distribution coefficient	Km	1,13		
9.5	Temperature coefficient	KT	1,00		
9.6	Reliability coefficient	KR	1,25		
9.7	Number of cycles	NK	6,00E+08	3,30E+08	
9.8 For bending safety calculation					
9.9	Geometry coefficient (bending)	J	0,243	0,209	
9.10	Size coefficient	Ks	0,83		
9.11	Tooth lengthwise curvature factor	Kx	1,00		
9.12	Life factor for bending stress	KL	0,88	0,89	
9.13 For pitting safety calculation					
9.14	Geometry coefficient (pitting)	I	0,078		
9.15	Elasticity coefficient	Cp	2799,68		
9.16	Stress adjustment factor	Cb	0,634		
9.17	Crowning factor	Cxc	1,00		
9.18	Surface condition coefficient	Cf	1,00		
9.19	Design pinion torque	TD	564,79	1803,24	
9.20	Hardness ratio coefficient	CH	1,00	1,00	
9.21	Life factor for contact	CL	0,91	0,92	

10.0 Safety coefficients

10.1	Bending stress	St	14,06	16,09	[kpsi]
10.2	Permissible bending stress	Sat	71,67	46,64	[kpsi]
10.3	Contact stress	Sc	87,18	69,34	[kpsi]
10.4	Permissible contact stress	Sac	122,50	122,06	[kpsi]
10.5	Safety coefficient for bending durability	SF	5,10	2,90	
10.6	Safety coefficient for surface durability	SH	1,41	1,76	

11.0 Force conditions (forces acting on the toothing)





11.1 Tangential force	Ft	485,93	[lb]	
11.2 Normal force	Fn	517,11	[lb]	
11.3 Axial force - (rotation acc. to the picture)	Fa	85,23	154,97	[lb]
11.4 Radial force (rotation acc. to the picture)	Fr	154,97	85,23	[lb]
11.5 Axial force (rotation opposite to the picture)	Fa	85,23	154,97	[lb]
11.6 Radial force (rotation opposite to the picture)	Fr	154,97	85,23	[lb]
11.7 Peripheral speed on the pitch diameter	v vmax	678,84	< 1000	[ft/min]

12.0 Parameters of the chosen material

12.1 Density	p	491,3	491,3	[lb/ft^3]
12.2 Young's Modulus (Modulus of Elasticity)	E	29,9	29,9	[psi*1e9]
12.3 Tensile Strength, Ultimate	Rm	142,1	113,9	[psi*1e6]
12.4 Tensile Strength, Yield	Rp0.2	123,3	78,2	[psi*1e6]
12.5 Poisson's Ratio		0,3	0,3	
12.6 Contact Fatigue Limit	SHlim	168,2	165,3	[psi*1e6]
12.7 Bending Fatigue Limit	SFlim	102,3	65,3	[psi*1e6]
12.8 Tooth Hardness - Side	HB	529,1	529,1	[HB]
12.9 Tooth Hardness - Core	HB	299,3	237,3	[HB]
12.10 Base Number of Load Cycles in Contact	NHlim	1,00E+08	1,00E+08	
12.11 Wohler Curve Exponent for Contact	qH	10	10	
12.12 Base Number of Load Cycles in Bend	NFlim	3,00E+06	3,00E+06	
12.13 Wohler Curve Exponent for Bend	qF	9	6	

Additions section

13.0 Power, warming-up, gearbox surface

13.1 Ambient air temperature	90,00	[°F]
13.2 Maximum oil temperature	140,00	[°F]
13.3 Coefficient of heat dissipation	2,00	[BTU/ft2/h/°F]
13.4 Power losses	0,17	[HP]
13.5 Gearbox surface (min.)	4,23	[ft^2]

14.0 Preliminary design of shaft diameters (steel)

Recommended shaft diameter for:

14.1 - Main power-transmitting shafts	DA	2,00	2,42	[in]
14.2 - Small, short shafts	DB	1,55	1,88	[in]

15.0 Auxiliary calculations

15.1 Transmission ratio calculation using the number of teeth	NP,NG = i	14	43	= 3,0714
15.2 Transmission ratio calculation using the speed	nP,nG = i	2000,0	750,0	= 2,6667
15.3 Power calculation using the pinion speed and torque moment	Torq,nP=P	1500,0	700,0	= 16,6667

16.0 Graphical output, CAD systems

16.1 2D drawing output to:	AutoCAD LT xx		
16.2 2D Drawing scale	Automatic		
16.3 Detail:	Gear		
16.4 Radius of the machining tool (for 3D model)	R	1,7115	1,7115 <input checked="" type="checkbox"/> [in]
16.5 Amount of the inner offset	a	0,065	0,082 <input checked="" type="checkbox"/> [in]
16.6 Amount of the outer offset	b	0,157	0,214 [in]
16.7 Text description (Information for BOM)	Pinion	Bevel gear - Pinion <input checked="" type="checkbox"/>	
Row 1 (BOM attribute 1)	N1=22; P=7; beta=0		
Row 2 (BOM attribute 2)	Material: AISI 6150		
Row 3 (BOM attribute 3)			
	Gear	<input checked="" type="checkbox"/>	

Row 1 (BOM attribute 1)

Row 2 (BOM attribute 2)

Row 3 (BOM attribute 3)

Bevel gear - Gear

N2=40; P=7; beta=0

Material: Gr.5135(ASTM A322)



16.8 Table of parameters

Table of wheel parameters

