

Cylindrical Gear Pair Calculation

Warning: Gear 1 has undercut. Undercut limit is xLim = 0.149077.

Input data

Geometry

Normal module	mn	8.0000 mm	
Normal pressure angle	α_n	20.000 °	
Helix direction		Spur gear	
Center distance	a	500.000 mm	
Center distance upper tolerance	$\Delta a.s$	0.0000 mm	
Center distance lower tolerance	$\Delta a.i$	0.0000 mm	
		Gear 1	Gear 2
Number of teeth	z	17	108
Face width	b	100.0000	100.0000 mm
Profile shift coefficient	x	0.100	-0.100
Upper tooth thickness allowance	Esns	-0.1592	-0.1593 mm
Lower tooth thickness allowance	Esni	-0.1592	-0.1593 mm

Reference profile

Basic rack dedendum	hfP1	1.4 · mn
Basic rack root radius	pfP1	0.39 · mn
Basic rack addendum	haP1	1 · mn
Tip alteration	k1	0.0625 · mn
Tip alteration	k1	0.5000 mm
Basic rack dedendum	hfP2	1.4 · mn
Basic rack root radius	pfP2	0.39 · mn
Basic rack addendum	haP2	1 · mn
Tip alteration	k2	0 · mn

Material

Material gear 1		Own Input
Youngs modulus	E1	206000 MPa
Poisson number	nu1	0.3
Thermal elongation coefficient	α_1	11.500 10 ⁻⁶ /°C
Material type		Eh
Material quality		MQ
Case hardness	HRC	60
Core hardness	HRC	30
Limiting tooth root stress	sigFlim1	500.000 MPa
Limiting contact stress	sigHlim1	1500.0 MPa
Material gear 2		Own Input

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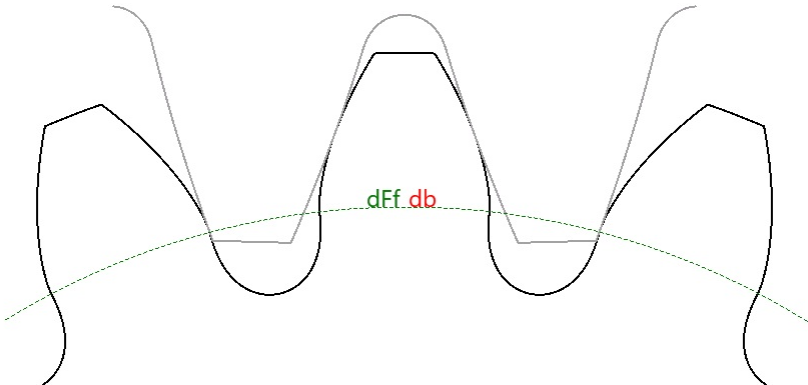
Youngs modulus	E2	206000 MPa
Poisson number	nu2	0.3
Thermal elongation coefficient	α2	11.500 10 ⁻⁶ /°C
Material type	Eh	
Material quality	MQ	
Case hardness	HRC	60
Core hardness	HRC	30
Limiting tooth root stress	sigFlim2	500.000 MPa
Limiting contact stress	sigHlim2	1500.0 MPa

Loading

Speed	n1	360.000 rpm
Torque	T1	9000.0 Nm
Power	P	339292 W
Application factor	KA	1
Required life	H	50000.0 h

Results

Geometry



		Gear 1	Gear 2
Profile shift coefficient	x.s	0.0727	-0.1273
Profile shift coefficient	x.i	0.0727	-0.1273
Reference diameter	d.nom	136.0000	864.0000 mm
Base diameter	db.nom	127.7982	811.8944 mm
Tip diameter	da.s	154.6000	878.4000 mm
Tip diameter	da.i	154.6000	878.4000 mm
Root diameter	df.s	114.7627	839.5625 mm
Root diameter	df.i	114.7627	839.5625 mm
Root form diameter	dFf.s	127.8101	845.5156 mm
Root form diameter	dFf.i	127.8101	845.5156 mm
Normal tooth thickness at tip	san.s	4.2291	6.3761 mm
Normal tooth thickness at tip	san.i	4.2291	6.3761 mm
Spanned teeth	k	2	12

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		Gear 1	Gear 2
Base tangent length	Wk.s	37.728	283.000 mm
Base tangent length	Wk.i	37.728	283.000 mm
Contact diameter for base tangent length	dMWk.s	133.25	859.80 mm
Contact diameter for base tangent length	dMWk.i	133.25	859.80 mm
Measurement ball diameter	DM	17.0000	13.0000 mm
Radial single ball distance	MrK.s	82.901	439.218 mm
Radial single ball distance	MrK.i	82.901	439.218 mm
Distance over two balls	MdK.s	165.168	878.437 mm
Distance over two balls	MdK.i	165.168	878.437 mm
Distance over two pins	MdR.s	165.168	878.437 mm
Distance over two pins	MdR.i	165.168	878.437 mm
Contact diameter for ball distance	dMBall.s	140.85	861.02 mm
Contact diameter for ball distance	dMBall.i	140.85	861.02 mm
Transverse contact ratio	$\epsilon\alpha.s$	1.6992	
Transverse contact ratio	$\epsilon\alpha.i$	1.6992	
Overlap contact ratio	$\epsilon\beta$	0.0000	
Total contact ratio	$\epsilon\gamma.s$	1.6992	
Total contact ratio	$\epsilon\gamma.i$	1.6992	
Working center distance	aw.s	500.0000	mm
Working center distance	aw.i	500.0000	mm
Working transverse pressure angle	$\alpha_{wt.s}$	20.0000	°
Working transverse pressure angle	$\alpha_{wt.i}$	20.0000	°
Center distance for $\epsilon\alpha = 1$	amax.s	505.8859	mm
Center distance for $\epsilon\alpha = 1$	amax.i	505.8859	mm
Center distance for zero clearance	amin.s	499.5611	mm
Center distance for zero clearance	amin.i	499.5611	mm
Circumferential backlash at the reference circle	jt.s	0.3184	mm
Circumferential backlash at the reference circle	jt.i	0.3184	mm
Circumferential backlash at the working pitch circle	jwt.s	0.3184	mm
Circumferential backlash at the working pitch circle	jwt.i	0.3184	mm
Transverse backlash	jbt.s	0.2992	mm
Transverse backlash	jbt.i	0.2992	mm
Normal backlash	jbn.s	0.2992	mm
Normal backlash	jbn.i	0.2992	mm
Radial backlash	jr.s	0.4374	mm
Radial backlash	jr.i	0.4374	mm
Working pitch diameter	dw.s	136.0000	864.0000 mm
Working pitch diameter	dw.i	136.0000	864.0000 mm
Active root diameter	dNf.s	127.9757	851.0044 mm
Active root diameter	dNf.i	127.9757	851.0044 mm
Active tip diameter	dNa.s	154.6000	878.4000 mm
Active tip diameter	dNa.i	154.6000	878.4000 mm

		Gear 1	Gear 2
Specific sliding at root	$\zeta_{f.s}$	-6.8324	-1.1673
Specific sliding at root	$\zeta_{f.i}$	-6.8324	-1.1673
Specific sliding at tip	$\zeta_{a.s}$	0.5386	0.8723
Specific sliding at tip	$\zeta_{a.i}$	0.5386	0.8723

Tolerances

		Gear 1	Gear 2
Tolerance class ISO 1328-1	A	5	5
Single pitch tolerance	$f_p T$	8.5	9 μm
Cumulative pitch tolerance	$F_p T$	24	35 μm
Profile slope tolerance	$f_{H\alpha} T$	7.5	8 μm
Profile form tolerance	$ff_{\alpha} T$	9.5	9.5 μm
Profile tolerance, total	$F_{\alpha} T$	12	12 μm
Helix slope tolerance	$f_{H\beta} T$	8	9 μm
Helix form tolerance	$ff_{\beta} T$	9.5	11 μm
Helix tolerance, total	$F_{\beta} T$	12	14 μm
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	$f_{id} T$	67	117 μm
Total radial composite tolerance	$F_{id} T$	75	133 μm

Strength

		Gear 1	Gear 2
Torque	T	9000.0000	57176.4706 Nm
Speed	n	360.0000	56.6667 rpm
Tip diameter	d_a	154.6000	878.4000 mm
Root diameter	d_f	115.2000	840.0000 mm
Root form diameter	d_{Ff}	127.8032	845.8736 mm
Transverse contact ratio	ϵ_{α}	1.6992	
Overlap contact ratio	ϵ_{β}	0.0000	
Total contact ratio	ϵ_{γ}	1.6992	
Mean meshing stiffness	$c_{\gamma\alpha}$	18.9455	N/mm/ μm
Mean meshing stiffness	$c_{\gamma\beta}$	16.1036	N/mm/ μm
Misalignment due to deformations	f_{sh}	16.5362	μm
Misalignment due to manufacturing deviations	f_{ma}	12.0416	μm
Dynamic factor	K _V	1.0047	
Mesh load factor	K _{γ}	1.0000	
Transverse load factor	K _{Hα}	1.0000	
Face load factor	K _{Hβ}	1.1752	
Elasticity factor	Z _E	189.8117	
Zone factor	Z _H	2.4946	
Helix angle factor	Z _{β}	1.0000	
Contact ratio factor	Z _{ϵ}	0.8757	
Roughness factor	Z _R	0.9638	0.9638
Velocity factor	Z _v	0.9684	0.9684

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		Gear 1	Gear 2
Lubricant factor	ZL	1.0474	1.0474
Single pair tooth contact factor	ZB	1.0694	1.0000
Life factor for contact stress	ZNT	0.9101	0.9632
Nominal contact stress	σ_{H0}	1391.6747	MPa
Contact stress	σ_H	1617.1696	1512.2137 MPa
Pitting stress limit	σ_{HG}	1334.5225	1412.3948 MPa
Safety factor for pitting	SH	0.8252	0.9340
Transverse load factor	KF_α	1.0000	
Face load factor	KF_β	1.1395	
Load distribution influence factor	f_ϵ	1.0000	
Helix angle factor	Y_β	1.0000	
Tooth form factor	YF	1.7667	1.3585
Stress correction factor	YS	1.7164	2.0132
Rim thickness factor	YB	1.0000	1.0000
Relative notch sensitivity factor	Y_{drelT}	0.9905	0.9973
Relative surface factor	Y_{RrelT}	0.9639	0.9639
Deep tooth factor	YDT	1.0000	1.0000
Size factor	YX	0.9700	0.9700
Life factor for tooth root stress	YNT	0.8888	0.9223
Nominal tooth root stress	σ_{F0}	501.6884	452.4923 MPa
Tooth root stress	σ_F	574.3929	518.0673 MPa
Tooth root stress limit	σ_{FG}	823.0404	859.9896 MPa
Safety factor for tooth breakage	SF	1.4329	1.6600