

Cylindrical Gear Pair Calculation

Input data

Geometry

Normal module	mn	32.000 mm	
Normal pressure angle	α_n	20.000 °	
Helix direction		Spur gear	
Center distance	a	3504.0 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	27	192
Face width	b	500.0000	500.0000 mm
Profile shift coefficient	x	0.000	0.000
Upper tooth thickness allowance	Esns	-0.5324	-0.5324 mm
Lower tooth thickness allowance	Esni	-0.5324	-0.5324 mm

Reference profile

Basic rack dedendum	hfP1	1.25 · mn
Basic rack root radius	ρfP1	0.39 · mn
Basic rack addendum	haP1	1 · mn
Tip alteration	k1	0 · mn
Basic rack dedendum	hfP2	1.25 · mn
Basic rack root radius	ρfP2	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		IF	
Material quality		ML	
Case hardness	HV	550	
Core hardness	HV	166	
Limiting tooth root stress	sigFlim1	243.750 MPa	
Limiting contact stress	sigHlim1	1009.0 MPa	
Material gear 2		Own Input	
Youngs modulus	E2	202000 MPa	
Poisson number	nu2	0.3	
Thermal elongation coefficient	α_2	11.500 10 ⁻⁶ /°C	

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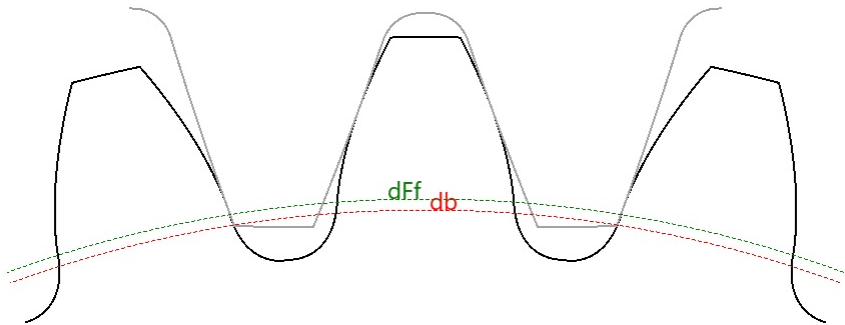
Material type	St (cast)	
Material quality	MQ	
Case hardness	HBW	200
Core hardness	HBW	0
Limiting tooth root stress	sigFlim2	124.600 MPa
Limiting contact stress	sigHlim2	328.200 MPa

Loading

Speed	n1	200.000 rpm
Torque	T1	120000 Nm
Power	P	2.51327e+06 W
Application factor	KA	1
Required life	H	25000.0 h

Results

Geometry



		Gear 1	Gear 2
Profile shift coefficient	x.s	-0.0229	-0.0229
Profile shift coefficient	x.i	-0.0229	-0.0229
Reference diameter	d.nom	864.0000	6144.0000 mm
Base diameter	db.nom	811.8944	5773.4715 mm
Tip diameter	da.s	928.0000	6208.0000 mm
Tip diameter	da.i	928.0000	6208.0000 mm
Root diameter	df.s	782.5372	6062.5374 mm
Root diameter	df.i	782.5372	6062.5374 mm
Root form diameter	dFf.s	818.6999	6081.5864 mm
Root form diameter	dFf.i	818.6999	6081.5864 mm
Normal tooth thickness at tip	san.s	22.7091	25.8210 mm
Normal tooth thickness at tip	san.i	22.7091	25.8210 mm
Spanned teeth	k	3	21
Base tangent length	Wk.s	247.771	2022.148 mm
Base tangent length	Wk.i	247.771	2022.148 mm
Contact diameter for base tangent length	dMWk.s	848.86	6117.36 mm

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		Gear 1	Gear 2
Contact diameter for base tangent length	dMWk.i	848.86	6117.36 mm
Measurement ball diameter	DM	60.0000	54.0000 mm
Radial single ball distance	MrK.s	477.948	3108.054 mm
Radial single ball distance	MrK.i	477.948	3108.054 mm
Distance over two balls	MdK.s	954.381	6216.109 mm
Distance over two balls	MdK.i	954.381	6216.109 mm
Distance over two pins	MdR.s	954.381	6216.109 mm
Distance over two pins	MdR.i	954.381	6216.109 mm
Contact diameter for ball distance	dMBall.s	872.23	6143.44 mm
Contact diameter for ball distance	dMBall.i	872.23	6143.44 mm
Transverse contact ratio	$\epsilon\alpha.s$	1.7694	
Transverse contact ratio	$\epsilon\alpha.i$	1.7694	
Overlap contact ratio	$\epsilon\beta$	0.0000	
Total contact ratio	$\epsilon\gamma.s$	1.7694	
Total contact ratio	$\epsilon\gamma.i$	1.7694	
Working center distance	aw.s	3504.0000	mm
Working center distance	aw.i	3504.0000	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	3529.5212	mm
Center distance for $\epsilon\alpha = 1$	amax.i	3529.5212	mm
Center distance for zero clearance	amin.s	3502.5350	mm
Center distance for zero clearance	amin.i	3502.5350	mm
Circumferential backlash at the reference circle	jt.s	1.0648	mm
Circumferential backlash at the reference circle	jt.i	1.0648	mm
Circumferential backlash at the working pitch circle	jwt.s	1.0648	mm
Circumferential backlash at the working pitch circle	jwt.i	1.0648	mm
Transverse backlash	jbt.s	1.0006	mm
Transverse backlash	jbt.i	1.0006	mm
Normal backlash	jbn.s	1.0006	mm
Normal backlash	jbn.i	1.0006	mm
Radial backlash	jr.s	1.4627	mm
Radial backlash	jr.i	1.4627	mm
Working pitch diameter	dw.s	864.0000	6144.0000 mm
Working pitch diameter	dw.i	864.0000	6144.0000 mm
Active root diameter	dNf.s	820.0192	6093.0632 mm
Active root diameter	dNf.i	820.0192	6093.0632 mm
Active tip diameter	dNa.s	928.0000	6208.0000 mm
Active tip diameter	dNa.i	928.0000	6208.0000 mm
Specific sliding at root	$\zeta f.s$	-1.7866	-0.6412
Specific sliding at root	$\zeta f.i$	-1.7866	-0.6412
Specific sliding at tip	$\zeta a.s$	0.3907	0.6411

		Gear 1	Gear 2
Specific sliding at tip	$\zeta_{a,i}$	0.3907	0.6411

Tolerances

		Gear 1	Gear 2
Tolerance class ISO 1328-1	A	6	9
Single pitch tolerance	$f_p T$	26	96 μm
Cumulative pitch tolerance	$F_p T$	74	359 μm
Profile slope tolerance	$f_{H\alpha} T$	25	92 μm
Profile form tolerance	$ff_{\alpha} T$	32	90 μm
Profile tolerance, total	$F_{\alpha} T$	41	129 μm
Helix slope tolerance	$f_{H\beta} T$	19	63 μm
Helix form tolerance	$ff_{\beta} T$	23	78 μm
Helix tolerance, total	$F_{\beta} T$	30	100 μm
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	$f_{id} T$	118	490 μm
Total radial composite tolerance	$F_{id} T$	133	556 μm

Strength

		Gear 1	Gear 2
Torque	T	120000.0000	853333.3333 Nm
Speed	n	200.0000	28.1250 rpm
Tip diameter	d_a	928.0000	6208.0000 mm
Root diameter	d_f	784.0000	6064.0000 mm
Root form diameter	d_{Ff}	819.2612	6082.9317 mm
Transverse contact ratio	ε_{α}	1.7694	
Overlap contact ratio	ε_{β}	0.0000	
Total contact ratio	ε_{γ}	1.7694	
Mean meshing stiffness	$c_{\gamma\alpha}$	22.4184	N/mm/ μm
Mean meshing stiffness	$c_{\gamma\beta}$	19.0556	N/mm/ μm
Misalignment due to deformations	f_{sh}	5.3981	μm
Misalignment due to manufacturing deviations	f_{ma}	65.8027	μm
Dynamic factor	K _V	1.2615	
Mesh load factor	K _{γ}	1.0000	
Transverse load factor	K _{Hα}	1.3301	
Face load factor	K _{Hβ}	1.4677	
Elasticity factor	Z _E	188.8790	
Zone factor	Z _H	2.4946	
Helix angle factor	Z _{β}	1.0000	
Contact ratio factor	Z _{ε}	0.8623	
Roughness factor	Z _R	0.8802	0.8832
Velocity factor	Z _v	0.9941	0.9942
Lubricant factor	Z _L	0.9938	0.9940
Single pair tooth contact factor	Z _B	1.0563	1.0000
Life factor for contact stress	Z _{N_T}	0.9465	1.0129

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		Gear 1	Gear 2
Nominal contact stress	σ_{H0}	347.9410	MPa
Contact stress	σ_H	576.7352	546.0093 MPa
Pitting stress limit	σ_{HG}	830.4211	290.1717 MPa
Safety factor for pitting	S_H	1.4399	0.5314
Transverse load factor	$K_{F\alpha}$	1.3301	
Face load factor	$K_{F\beta}$	1.3902	
Load distribution influence factor	f_ϵ	1.0000	
Helix angle factor	Y_β	1.0000	
Tooth form factor	Y_F	1.3288	1.1463
Stress correction factor	Y_S	1.9355	2.2970
Rim thickness factor	Y_B	1.0000	1.0000
Relative notch sensitivity factor	Y_{drelT}	0.9927	1.0035
Relative surface factor	Y_{RrelT}	0.9639	0.9774
Deep tooth factor	Y_{DT}	1.0000	1.0000
Size factor	Y_X	0.8000	0.8500
Life factor for tooth root stress	Y_{NT}	0.9119	0.9484
Nominal tooth root stress	σ_{F0}	44.6492	45.7116 MPa
Tooth root stress	σ_F	104.1438	106.6219 MPa
Tooth root stress limit	σ_{FG}	340.2919	197.0415 MPa
Safety factor for tooth breakage	S_F	3.2675	1.8480