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Cylindrical Gear Pair Calculation

Input data

Geometry

Normal module	mn	1.6933 mm
Normal pressure angle	α_n	20.000 °
Helix direction	Double helical (left-right)	
Helix angle	β	18.310 °
Center distance	a	460.375 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	86	429
Face width	b	165.1000	165.1000 mm
Profile shift coefficient	x	0.361	0.287
Upper tooth thickness allowance	Esns	-0.2167	-0.2169 mm
Lower tooth thickness allowance	Esni	-0.2167	-0.2169 mm

Reference profile

Basic rack dedendum	hfP1	1.25 · mn
Basic rack root radius	pfP1	0.38 · mn
Basic rack addendum	haP1	1 · mn
Tip alteration	k1	-0.00457106 · mn
Tip alteration	k1	-0.0077 mm
Basic rack dedendum	hfP2	1.25 · mn
Basic rack root radius	pfP2	0.38 · mn
Basic rack addendum	haP2	1 · mn
Tip alteration	k2	-0.0056925 · mn
Tip alteration	k2	-0.0096 mm

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		V (alloy)
Material quality		ML
Case hardness	HBW	342
Core hardness	HBW	0
Limiting tooth root stress	sigFlim1	256.000 MPa
Limiting contact stress	sigHlim1	661.000 MPa

MESYS Shaft and Rolling Bearing Calculation

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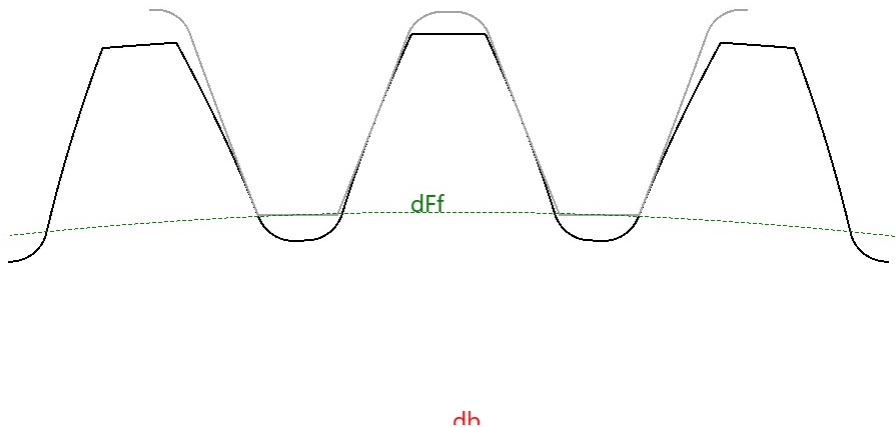
Material gear 2		Own Input	
Youngs modulus	E2	206000 MPa	
Poisson number	nu2	0.3	
Thermal elongation coefficient	$\alpha 2$	$11.500 \cdot 10^{-6} / ^\circ\text{C}$	
Material type		V (alloy)	
Material quality		ML	
Case hardness	HBW	300	
Core hardness	HBW	0	
Limiting tooth root stress	sigFlim2	238.000 MPa	
Limiting contact stress	sigHlim2	603.000 MPa	
Loading			
Required life	H	30000.0 h	
Application factor	KA	1	
Speed	n1	5400.0 rpm	
Torque	T1	528.000 Nm	
Power	P	298577 W	
Strength calculation			
Mesh load factor	Ky	1	
Bearing span	l	355.600 mm	
Offset of pinion center	s	0.0000 mm	
Pinion shaft diameter	dsh	63.500 mm	
Pinion shaft inner diameter	dshi	0.0000 mm	
Stiffening by pinion		No	
Profile modifications compensate deflections		No	
Limited pitting allowable		Yes	
Flank modification (fZCa)		According to experience	
Contact pattern		Favourable	
Helix modification		None	
Required safety factor root	SFmin	1	
Required safety factor flank	SHmin	1	
		Gear 1	Gear 2
Tip relief	Ca	0.013	0.013 mm
Root relief	Cf	0	0 mm
Surface roughness flank	RzH	0.006	0.006 mm
Surface roughness root	RzF	0.018	0.018 mm
Web thickness	bs	0	0 mm
Number of meshes	NM	1	1
Reversed bending		No	No
Life factor limit root	YNTlim	0.85	0.85
Life factor limit flank	ZNTlim	0.85	0.85

Results

Geometry

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		Gear 1	Gear 2
Profile shift coefficient	x.s	0.1857	0.1109
Profile shift coefficient	x.i	0.1857	0.1109
Reference diameter	d.nom	153.3925	765.1791 mm
Base diameter	db.nom	143.2274	714.4717 mm
Tip diameter	da.s	157.9880	769.5180 mm
Tip diameter	da.i	157.9880	769.5180 mm
Root diameter	df.s	149.7881	761.3215 mm
Root diameter	df.i	149.7881	761.3215 mm
Root form diameter	dFf.s	150.8065	762.2087 mm
Root form diameter	dFf.i	150.8065	762.2087 mm
Normal tooth thickness	sn.s	2.8888	2.7966 mm
Normal tooth thickness	sn.i	2.8888	2.7966 mm
Normal tooth thickness at tip	san.s	1.0887	1.1935 mm
Normal tooth thickness at tip	san.i	1.0887	1.1935 mm
Spanned teeth	k	12	56
Base tangent length	Wk.s	60.068	289.367 mm
Base tangent length	Wk.i	60.068	289.367 mm
Contact diameter for base tangent length	dMWk.s	154.30	766.10 mm
Contact diameter for base tangent length	dMWk.i	154.30	766.10 mm
Measurement ball diameter	DM	2.9000	21.6000 mm
Radial single ball distance	MrK.s	79.014	417.233 mm
Radial single ball distance	MrK.i	79.014	417.233 mm
Distance over two balls	MdK.s	158.028	834.460 mm
Distance over two balls	MdK.i	158.028	834.460 mm
Distance over two pins	MdR.s	158.028	834.465 mm
Distance over two pins	MdR.i	158.028	834.465 mm
Contact diameter for ball distance	dMBall.s	154.09	803.23 mm
Contact diameter for ball distance	dMBall.i	154.09	803.23 mm
Transverse contact ratio	εα.s	1.6846	

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		Gear 1	Gear 2
Transverse contact ratio	$\epsilon_{\alpha.i}$	1.6846	
Overlap contact ratio	ϵ_{β}	4.8750	
Total contact ratio	$\epsilon_{\gamma.s}$	6.5596	
Total contact ratio	$\epsilon_{\gamma.i}$	6.5596	
Working center distance	$a_{w.s}$	460.3750	mm
Working center distance	$a_{w.i}$	460.3750	mm
Working transverse pressure angle	$\alpha_{wt.s}$	21.3266	°
Working transverse pressure angle	$\alpha_{wt.i}$	21.3266	°
Center distance for $\epsilon_{\alpha} = 1$	$a_{max.s}$	461.6898	mm
Center distance for $\epsilon_{\alpha} = 1$	$a_{max.i}$	461.6898	mm
Center distance for zero clearance	$a_{min.s}$	459.7863	mm
Center distance for zero clearance	$a_{min.i}$	459.7863	mm
Circumferential backlash at the reference circle	$j_{t.s}$	0.4567	mm
Circumferential backlash at the reference circle	$j_{t.i}$	0.4567	mm
Circumferential backlash at the working pitch circle	$j_{wt.s}$	0.4578	mm
Circumferential backlash at the working pitch circle	$j_{wt.i}$	0.4578	mm
Transverse backlash	$j_{bt.s}$	0.4264	mm
Transverse backlash	$j_{bt.i}$	0.4264	mm
Normal backlash	$j_{bn.s}$	0.4074	mm
Normal backlash	$j_{bn.i}$	0.4074	mm
Radial backlash	$j_{r.s}$	0.5862	mm
Radial backlash	$j_{r.i}$	0.5862	mm
Working pitch diameter	$d_{w.s}$	153.7563	766.9937 mm
Working pitch diameter	$d_{w.i}$	153.7563	766.9937 mm
Active root diameter	$d_{Nf.s}$	151.3938	763.1461 mm
Active root diameter	$d_{Nf.i}$	151.3938	763.1461 mm
Active tip diameter	$d_{Na.s}$	157.9880	769.5180 mm
Active tip diameter	$d_{Na.i}$	157.9880	769.5180 mm
Specific sliding at root	$\zeta_{f.s}$	-0.1681	-0.2403
Specific sliding at root	$\zeta_{f.i}$	-0.1681	-0.2403
Specific sliding at tip	$\zeta_{a.s}$	0.1937	0.1439
Specific sliding at tip	$\zeta_{a.i}$	0.1937	0.1439

Tolerances

		Gear 1	Gear 2
Tolerance class ISO 1328-1	A	5	5
Single pitch tolerance	f_pT	6	6.5 μm
Cumulative pitch tolerance	F_pT	20	30 μm
Profile slope tolerance	$f_{H\alpha}T$	4.8	5.5 μm
Profile form tolerance	$ff_{\alpha}T$	6	6 μm

		Gear 1	Gear 2
Profile tolerance, total	F α T	7.5	8 μ m
Helix slope tolerance	fH β T	8	8.5 μ m
Helix form tolerance	ff β T	9	10 μ m
Helix tolerance, total	F β T	12	13 μ m
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	fidT	67	82 μ m
Total radial composite tolerance	FidT	76	93 μ m

Strength

		Gear 1	Gear 2
Torque	T	528.0000	2633.8605 Nm
Speed	n	5400.0000	1082.5175 rpm
Tip diameter	da	157.9880	769.5180 mm
Root diameter	df	150.3835	761.9173 mm
Root form diameter	dFf	151.3354	762.7901 mm
Transverse contact ratio	$\epsilon\alpha$	1.6846	
Overlap contact ratio	$\epsilon\beta$	4.8750	
Total contact ratio	$\epsilon\gamma$	6.5596	
Mean meshing stiffness	c $\gamma\alpha$	19.2660	N/mm/ μ m
Mean meshing stiffness	c $\gamma\beta$	16.3761	N/mm/ μ m
Misalignment due to deformations	fsh	1.4032	μ m
Misalignment due to manufacturing deviations	fma	11.6726	μ m
Dynamic factor	KV	1.6839	
Mesh load factor	K γ	1.0000	
Transverse load factor	KH α	1.3686	
Face load factor	KH β	1.3811	
Elasticity factor	ZE	189.8117	
Zone factor	ZH	2.3693	
Helix angle factor	Z β	1.0263	
Contact ratio factor	Z ϵ	0.7705	
Roughness factor	ZR	0.9402	0.9402
Velocity factor	Zv	1.0919	1.0919
Lubricant factor	ZL	0.8458	0.8458
Single pair tooth contact factor	ZB	1.0344	1.0344
Life factor for contact stress	ZNT	0.8517	0.9540
Nominal contact stress	σ H0	203.1472	MPa
Contact stress	σ H	374.9035	374.9035 MPa
Pitting stress limit	σ HG	488.8254	499.4963 MPa
Safety factor for pitting	SH	1.3039	1.3323
Transverse load factor	KF α	1.3686	
Face load factor	KF β	1.3607	

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		Gear 1	Gear 2
Load distribution influence factor	f_{ϵ}	0.7361	
Helix angle factor	Y_{β}	0.9904	
Tooth form factor	Y_F	0.8580	0.8943
Stress correction factor	Y_S	2.2967	2.3573
Rim thickness factor	Y_B	1.0000	1.0000
Relative notch sensitivity factor	Y_{drelT}	1.0008	1.0028
Relative surface factor	Y_{RrelT}	0.9639	0.9639
Deep tooth factor	Y_{DT}	1.0000	1.0000
Size factor	Y_X	1.0000	1.0000
Life factor for tooth root stress	Y_{NT}	0.8505	0.8783
Nominal tooth root stress	σ_{F0}	48.0540	51.4122 MPa
Tooth root stress	σ_F	150.7017	161.2332 MPa
Tooth root stress limit	σ_{FG}	420.0469	404.1041 MPa
Safety factor for tooth breakage	SF	2.7873	2.5063