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Cylindrical Gear Pair Calculation

Input data

Geometry

Normal module	mn	8.0000 mm	
Normal pressure angle	α_n	20.000 °	
Helix direction		Helix left hand	
Helix angle	β	15.800 °	
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	103
Face width	b	100.0000	100.0000 mm
Profile shift coefficient	x	0.145	0.000
Upper tooth thickness allowance	Esns	-0.1598	-0.1600 mm
Lower tooth thickness allowance	Esni	-0.1598	-0.1600 mm

Reference profile

Basic rack dedendum	hfP1	1.25 · mn
Basic rack root radius	pfP1	0.39 · mn
Basic rack addendum	haP1	1 · mn
Tip alteration	k1	-0.00022916 · mn
Tip alteration	k1	-0.0018 mm
Basic rack dedendum	hfP2	1.25 · mn
Basic rack root radius	pfP2	0.39 · mn
Basic rack addendum	haP2	1 · mn
Tip alteration	k2	-0.000300169 · mn
Tip alteration	k2	-0.0024 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		MQ
Case hardness	HV	310
Core hardness	HV	0
Limiting tooth root stress	sigFlim1	318.750 MPa
Limiting contact stress	sigHlim1	780.030 MPa

MESYS Shaft and Rolling Bearing Calculation

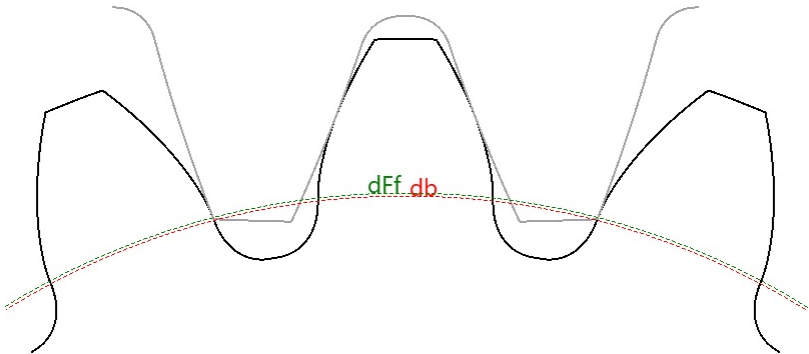
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Material gear 2		Own Input	
Youngs modulus	E2	206000 MPa	
Poisson number	nu2	0.3	
Thermal elongation coefficient	α2	11.500 10 ⁻⁶ /°C	
Material type	V (alloy)		
Material quality	MQ		
Case hardness	HV	260	
Core hardness	HV	0	
Limiting tooth root stress	sigFlim2	297.500 MPa	
Limiting contact stress	sigHlim2	714.380 MPa	
Loading			
Required life	H	10000.0 h	
Application factor	KA	1	
Speed	n1	360.000 rpm	
Torque	T1	1000.0 Nm	
Power	P	37699.1 W	
Strength calculation			
Mesh load factor	Ky	1	
Bearing span	l	125.000 mm	
Offset of pinion center	s	0.0000 mm	
Pinion shaft diameter	dsh	100.000 mm	
Pinion shaft inner diameter	dshi	0.0000 mm	
Equivalent misalignment (input)	customFsh	0.0150 mm	
Mesh misalignment (input)	customFma	0.0050 mm	
Stiffening by pinion	No		
Profile modifications compensate deflections	No		
Limited pitting allowable	No		
Flank modification (fZCa)	None		
Contact pattern	Unproven		
Helix modification	None		
Required safety factor root	SFmin	1	
Required safety factor flank	SHmin	1	
		Gear 1	Gear 2
Tip relief	Ca	0.07	0.07 mm
Root relief	Cf	0	0 mm
Surface roughness flank	RzH	0.018	0.018 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

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Results

Geometry



		Gear 1	Gear 2
Profile shift coefficient	x.s	0.1178	-0.0275
Profile shift coefficient	x.i	0.1178	-0.0275
Reference diameter	d.nom	141.3401	856.3548 mm
Base diameter	db.nom	132.1986	800.9678 mm
Tip diameter	da.s	159.6600	872.3500 mm
Tip diameter	da.i	159.6600	872.3500 mm
Root diameter	df.s	123.2247	835.9151 mm
Root diameter	df.i	123.2247	835.9151 mm
Root form diameter	dFf.s	132.6076	841.1301 mm
Root form diameter	dFf.i	132.6076	841.1301 mm
Normal tooth thickness	sn.s	13.2523	12.4063 mm
Normal tooth thickness	sn.i	13.2523	12.4063 mm
Normal tooth thickness at tip	san.s	4.8871	6.3335 mm
Normal tooth thickness at tip	san.i	4.8871	6.3335 mm
Spanned teeth	k	2	13
Base tangent length	Wk.s	38.196	307.943 mm
Base tangent length	Wk.i	38.196	307.943 mm
Contact diameter for base tangent length	dMWk.s	137.26	854.50 mm
Contact diameter for base tangent length	dMWk.i	137.26	854.50 mm
Measurement ball diameter	DM	16.0000	14.0000 mm
Radial single ball distance	MrK.s	84.420	438.093 mm
Radial single ball distance	MrK.i	84.420	438.093 mm
Distance over two balls	MdK.s	168.189	876.086 mm
Distance over two balls	MdK.i	168.189	876.086 mm
Distance over two pins	MdR.s	168.841	876.186 mm
Distance over two pins	MdR.i	168.841	876.186 mm
Contact diameter for ball distance	dMBall.s	145.69	857.27 mm

MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
Contact diameter for ball distance	dMBall.i	145.69	857.27 mm
Transverse contact ratio	$\epsilon\alpha.s$	1.5491	
Transverse contact ratio	$\epsilon\alpha.i$	1.5491	
Overlap contact ratio	$\epsilon\beta$	1.0834	
Total contact ratio	$\epsilon\gamma.s$	2.6325	
Total contact ratio	$\epsilon\gamma.i$	2.6325	
Working center distance	aw.s	500.0000	mm
Working center distance	aw.i	500.0000	mm
Working transverse pressure angle	$\alpha_{wt.s}$	21.0661	°
Working transverse pressure angle	$\alpha_{wt.i}$	21.0661	°
Center distance for $\epsilon\alpha = 1$	amax.s	504.9769	mm
Center distance for $\epsilon\alpha = 1$	amax.i	504.9769	mm
Center distance for zero clearance	amin.s	499.5663	mm
Center distance for zero clearance	amin.i	499.5663	mm
Circumferential backlash at the reference circle	jt.s	0.3324	mm
Circumferential backlash at the reference circle	jt.i	0.3324	mm
Circumferential backlash at the working pitch circle	jwt.s	0.3331	mm
Circumferential backlash at the working pitch circle	jwt.i	0.3331	mm
Transverse backlash	jbt.s	0.3109	mm
Transverse backlash	jbt.i	0.3109	mm
Normal backlash	jbn.s	0.3005	mm
Normal backlash	jbn.i	0.3005	mm
Radial backlash	jr.s	0.4324	mm
Radial backlash	jr.i	0.4324	mm
Working pitch diameter	dw.s	141.6667	858.3333 mm
Working pitch diameter	dw.i	141.6667	858.3333 mm
Active root diameter	dNf.s	132.9207	845.2252 mm
Active root diameter	dNf.i	132.9207	845.2252 mm
Active tip diameter	dNa.s	159.6600	872.3500 mm
Active tip diameter	dNa.i	159.6600	872.3500 mm
Specific sliding at root	$\zeta f.s$	-3.1226	-1.0096
Specific sliding at root	$\zeta f.i$	-3.1226	-1.0096
Specific sliding at tip	$\zeta a.s$	0.5024	0.7574
Specific sliding at tip	$\zeta a.i$	0.5024	0.7574

Tolerances

		Gear 1	Gear 2
Tolerance class ISO 1328-1	A	8	6
Single pitch tolerance	fpT	24	13 μm
Cumulative pitch tolerance	FpT	69	50 μm

MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
Profile slope tolerance	$fH\alpha T$	21	11 μm
Profile form tolerance	$ff\alpha T$	27	13 μm
Profile tolerance, total	$F\alpha T$	34	18 μm
Helix slope tolerance	$fH\beta T$	23	13 μm
Helix form tolerance	$ff\beta T$	26	15 μm
Helix tolerance, total	$F\beta T$	35	20 μm
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	$fidT$	67	117 μm
Total radial composite tolerance	$FidT$	75	133 μm

Strength

		Gear 1	Gear 2
Torque	T	1000.0000	6058.8235 Nm
Speed	n	360.0000	59.4175 rpm
Tip diameter	d_a	159.6600	872.3500 mm
Root diameter	d_f	123.6637	836.3548 mm
Root form diameter	d_{ff}	132.7108	841.5103 mm
Transverse contact ratio	ϵ_α	1.5491	
Overlap contact ratio	ϵ_β	1.0834	
Total contact ratio	ϵ_γ	2.6325	
Mean meshing stiffness	$c_{y\alpha}$	18.9211	N/mm/ μm
Mean meshing stiffness	$c_{y\beta}$	16.0829	N/mm/ μm
Misalignment due to deformations	f_{sh}	15.0000	μm
Misalignment due to manufacturing deviations	f_{ma}	5.0000	μm
Dynamic factor	KV	1.0431	
Mesh load factor	K_γ	1.0000	
Transverse load factor	$KH\alpha$	1.5819	
Face load factor	$KH\beta$	1.7760	
Elasticity factor	ZE	189.8117	
Zone factor	ZH	2.3953	
Helix angle factor	Z_β	1.0194	
Contact ratio factor	Z_ϵ	0.8035	
Roughness factor	ZR	0.7948	0.8048
Velocity factor	Z_v	0.9338	0.9373
Lubricant factor	ZL	1.0895	1.0844
Single pair tooth contact factor	ZB	1.0954	1.0954
Life factor for contact stress	ZNT	0.9561	1.0259
Nominal contact stress	σ_{H0}	402.1940	MPa
Contact stress	σ_H	754.2292	754.2292 MPa
Pitting stress limit	σ_{HG}	603.0645	599.5232 MPa
Safety factor for pitting	SH	0.7996	0.7949

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		Gear 1	Gear 2
Transverse load factor	KF_{α}	1.5819	
Face load factor	KF_{β}	1.6060	
Load distribution influence factor	f_{ϵ}	0.7767	
Helix angle factor	Y_{β}	0.9747	
Tooth form factor	Y_F	1.1079	1.0166
Stress correction factor	Y_S	1.9281	2.1247
Rim thickness factor	Y_B	1.0000	1.0000
Relative notch sensitivity factor	Y_{dreIT}	0.9821	0.9974
Relative surface factor	Y_{RrelT}	0.9639	0.9639
Deep tooth factor	Y_{DT}	1.0000	1.0000
Size factor	Y_X	0.9820	0.9820
Life factor for tooth root stress	Y_{NT}	0.9179	0.9516
Nominal tooth root stress	σ_{F0}	36.8278	37.2394 MPa
Tooth root stress	σ_F	97.5964	98.6872 MPa
Tooth root stress limit	σ_{FG}	543.9314	534.5307 MPa
Safety factor for tooth breakage	SF	5.5733	5.4164