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Cylindrical Gear Pair Calculation

Warning: The contact points for span measurement are outside of the involute of gear 1!
(178.914mm is outside of range 211.75mm to 169.767mm)
Warning: The contact points for span measurement are outside of the involute of gear 2!
(1340.93mm is outside of range 1166mm to 1212.3mm)

Input data

Geometry

Normal module	mn	12.000 mm	
Normal pressure angle	αn	20.000 °	
Helix direction		Spur gear	
Center distance	a	500.000 mm	
Center distance upper tolerance	Δa.s	0.0000 mm	
Center distance lower tolerance	Δa.i	0.0000 mm	
		Gear 1	Gear 2
Number of teeth	z	15	-99
Face width	b	125.0000	125.0000 mm
Profile shift coefficient	x	0.323	0.000
Upper tooth thickness allowance	Esns	-0.1598	-0.1591 mm
Lower tooth thickness allowance	Esni	-0.1598	-0.1591 mm

Reference profile

Basic rack dedendum	hfP1	1.25 · mn	20
Basic rack root radius	pfP1	0.39 · mn	
Basic rack addendum	haP1	1 · mn	
Tip alteration	k1	-0.000138995 · mn	
Tip alteration	k1	-0.0017 mm	
Tool number of teeth	z02		
Tool profile shift	x02	0 · mn	
Tool addendum	haP02	1.25 · mn	
Tool tip radius	paP02	0.001 · mn	
Tool dedendum	hfP02	1.2 · mn	
Basic rack addendum	haP2	1 · mn	
Tip alteration	k2	-0.0833333 · mn	
Tip alteration	k2	-1.0000 mm	

Material

Material gear 1		Own Input
Youngs modulus	E1	206000 MPa
Poisson number	nu1	0.3

MESYS Shaft and Rolling Bearing Calculation

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Thermal elongation coefficient	α1	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
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	1.3
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	200.000 mm
Offset of pinion center	s	0.0000 mm
Pinion shaft diameter	dsh	100.000 mm
Pinion shaft inner diameter	dshi	0.0000 mm
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

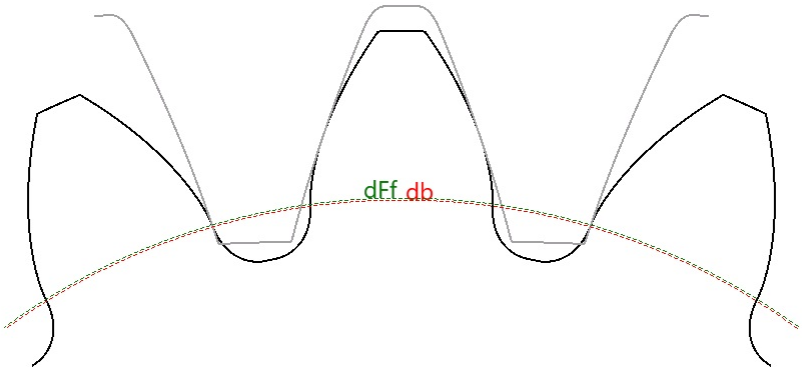
		Gear 1	Gear 2	
Tip relief	Ca	0.07	0.07	mm
Root relief	Cf	0	0	mm
Surface roughness flank	RzH	0.006	0.018	mm
Surface roughness root	RzF	0.018	0.018	mm
Web thickness	bs	0	0	mm
Number of meshes	NM	1	1	

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		Gear 1	Gear 2
Reversed bending		No	No
Life factor limit root	YNTlim	0.85	0.85
Life factor limit flank	ZNTlim	0.85	0.85

Results

Geometry



		Gear 1	Gear 2
Profile shift coefficient	x.s	0.3048	-0.0182
Profile shift coefficient	x.i	0.3048	-0.0182
Reference diameter	d.nom	180.0000	1188.0000 mm
Base diameter	db.nom	169.1447	1116.3548 mm
Tip diameter	da.s	211.7500	1166.0000 mm
Tip diameter	da.i	211.7500	1166.0000 mm
Root diameter	df.s	157.3143	1218.4363 mm
Root diameter	df.i	157.3143	1218.4363 mm
Root form diameter	dFf.s	169.6622	1212.7934 mm
Root form diameter	dFf.i	169.6622	1212.7934 mm
Normal tooth thickness	sn.s	21.5117	18.6905 mm
Normal tooth thickness	sn.i	21.5117	18.6905 mm
Normal tooth thickness at tip	san.s	5.6710	11.0750 mm
Normal tooth thickness at tip	san.i	5.6710	11.0750 mm
Spanned teeth	k	2	21
Base tangent length	Wk.s	58.161	743.012 mm
Base tangent length	Wk.i	58.161	743.012 mm
Contact diameter for base tangent length	dMWk.s	178.86	1341.01 mm
Contact diameter for base tangent length	dMWk.i	178.86	1341.01 mm
Measurement ball diameter	DM	26.0000	21.6000 mm
Radial single ball distance	MrK.s	114.647	577.524 mm
Radial single ball distance	MrK.i	114.647	577.524 mm

MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
Distance over two balls	MdK.s	228.181	1154.900 mm
Distance over two balls	MdK.i	228.181	1154.900 mm
Distance over two pins	MdR.s	228.181	1154.900 mm
Distance over two pins	MdR.i	228.181	1154.900 mm
Contact diameter for ball distance	dMBall.s	190.11	1183.65 mm
Contact diameter for ball distance	dMBall.i	190.11	1183.65 mm
Transverse contact ratio	$\epsilon\alpha.s$	1.5722	
Transverse contact ratio	$\epsilon\alpha.i$	1.5722	
Overlap contact ratio	$\epsilon\beta$	0.0000	
Total contact ratio	$\epsilon\gamma.s$	1.5722	
Total contact ratio	$\epsilon\gamma.i$	1.5722	
Working center distance	aw.s	500.0000	mm
Working center distance	aw.i	500.0000	mm
Working transverse pressure angle	$\alpha_{wt.s}$	18.7000	°
Working transverse pressure angle	$\alpha_{wt.i}$	18.7000	°
Center distance for $\epsilon\alpha = 1$	amax.s	0.0000	mm
Center distance for $\epsilon\alpha = 1$	amax.i	0.0000	mm
Center distance for zero clearance	amin.s	500.4654	mm
Center distance for zero clearance	amin.i	500.4654	mm
Circumferential backlash at the reference circle	jt.s	0.3189	mm
Circumferential backlash at the reference circle	jt.i	0.3189	mm
Circumferential backlash at the working pitch circle	jwt.s	0.3163	mm
Circumferential backlash at the working pitch circle	jwt.i	0.3163	mm
Transverse backlash	jbt.s	0.2996	mm
Transverse backlash	jbt.i	0.2996	mm
Normal backlash	jbn.s	0.2996	mm
Normal backlash	jbn.i	0.2996	mm
Radial backlash	jr.s	0.4673	mm
Radial backlash	jr.i	0.4673	mm
Working pitch diameter	dw.s	178.5714	-1178.5714 mm
Working pitch diameter	dw.i	178.5714	-1178.5714 mm
Active root diameter	dNf.s	169.8996	-1202.8944 mm
Active root diameter	dNf.i	169.8996	-1202.8944 mm
Active tip diameter	dNa.s	211.7500	-1166.0000 mm
Active tip diameter	dNa.i	211.7500	-1166.0000 mm
Specific sliding at root	$\zeta f.s$	-2.1878	-0.8767
Specific sliding at root	$\zeta f.i$	-2.1878	-0.8767
Specific sliding at tip	$\zeta a.s$	0.4672	0.6863
Specific sliding at tip	$\zeta a.i$	0.4672	0.6863

Tolerances

		Gear 1	Gear 2
Tolerance class ISO 1328-1	A	6	8
Single pitch tolerance	fpT	14	31 μm
Cumulative pitch tolerance	FpT	40	118 μm
Profile slope tolerance	fH α T	13	28 μm
Profile form tolerance	ff α T	16	33 μm
Profile tolerance, total	F α T	21	43 μm
Helix slope tolerance	fH β T	12	27 μm
Helix form tolerance	ff β T	14	32 μm
Helix tolerance, total	F β T	19	42 μm
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	fidT	70	140 μm
Total radial composite tolerance	FidT	78	159 μm

Strength

		Gear 1	Gear 2
Torque	T	1000.0000	6600.0000 Nm
Speed	n	360.0000	54.5455 rpm
Tip diameter	da	211.7500	1166.0000 mm
Root diameter	df	157.7533	1218.0000 mm
Root form diameter	dFf	169.7672	1212.2963 mm
Transverse contact ratio	ϵ_α	1.5722	
Overlap contact ratio	ϵ_β	0.0000	
Total contact ratio	ϵ_γ	1.5722	
Mean meshing stiffness	$c_{\gamma\alpha}$	20.8017	N/mm/ μm
Mean meshing stiffness	$c_{\gamma\beta}$	17.6815	N/mm/ μm
Misalignment due to deformations	fsh	1.4064	μm
Misalignment due to manufacturing deviations	fma	29.5466	μm
Dynamic factor	KV	1.0973	
Mesh load factor	K γ	1.0000	
Transverse load factor	KH α	1.2357	
Face load factor	KH β	2.2366	
Elasticity factor	ZE	189.8117	
Zone factor	ZH	2.5868	
Helix angle factor	Z β	1.0000	
Contact ratio factor	Z ϵ	0.8996	
Roughness factor	ZR	0.8632	0.8719
Velocity factor	Zv	0.9438	0.9475
Lubricant factor	ZL	1.0895	1.0832
Single pair tooth contact factor	ZB	1.0072	1.0000
Life factor for contact stress	ZNT	0.9561	1.0326

MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
Nominal contact stress	σ_{H0}	285.9182	MPa
Contact stress	σ_H	571.8104	567.6977 MPa
Pitting stress limit	σ_{HG}	661.9434	660.0611 MPa
Safety factor for pitting	SH	1.1576	1.1627
Transverse load factor	KF α	1.3053	
Face load factor	KF β	1.8918	
Load distribution influence factor	f ϵ	1.0000	
Helix angle factor	Y β	1.0000	
Tooth form factor	YF	1.3525	1.1429
Stress correction factor	YS	2.0444	3.4210
Rim thickness factor	YB	1.0000	1.0000
Relative notch sensitivity factor	YdrelT	0.9890	1.1035
Relative surface factor	YRrelT	0.9639	0.9639
Deep tooth factor	YDT	1.0000	1.0000
Size factor	YX	0.9580	0.9580
Life factor for tooth root stress	YNT	0.9179	0.9533
Nominal tooth root stress	σ_{F0}	20.4822	28.9613 MPa
Tooth root stress	σ_F	72.1470	102.0140 MPa
Tooth root stress limit	σ_{FG}	534.3949	577.9571 MPa
Safety factor for tooth breakage	SF	7.4070	5.6655