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Cylindrical Gear Pair Calculation

Input data

Geometry

Normal module	mn	32.000	mm
Normal pressure angle	$\alpha_n$	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
		<b>Gear 1</b>	<b>Gear 2</b>
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	pfP1	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	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	$\alpha_1$	11.500 10 <sup>-6</sup> /°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

MESYS Shaft and Rolling Bearing Calculation

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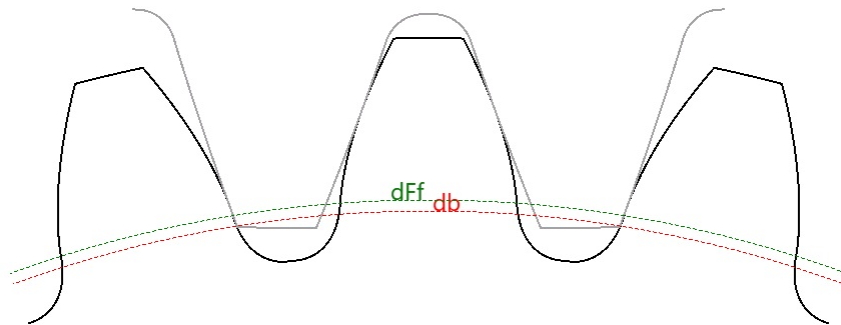
Thermal elongation coefficient	α2	11.500 10 <sup>-6</sup> /°C		
Material type	St (cast)			
Material quality	MQ			
Case hardness	HBW	200		
Core hardness	HBW	0		
Limiting tooth root stress	sigFlim2	124.600 MPa		
Limiting contact stress	sigHlim2	328.200 MPa		
Loading				
Required life	H	25000.0 h		
Application factor	KA	1		
Speed	n1	200.000 rpm		
Torque	T1	120000 Nm		
Power	P	2.51327e+06 W		
Strength calculation				
Mesh load factor	Kγ	1		
Bearing span	l	1000.0 mm		
Offset of pinion center	s	0.0000 mm		
Pinion shaft diameter	dsh	400.000 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	0	mm
Root relief	Cf	0	0	mm
Surface roughness flank	RzH	0.015	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	

Results

Geometry

# MESYS Shaft and Rolling Bearing Calculation

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		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	sn.s	49.7331	49.7331 mm
Normal tooth thickness	sn.i	49.7331	49.7331 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
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	

# MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
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	$a_{w.s}$	3504.0000	mm
Working center distance	$a_{w.i}$	3504.0000	mm
Working transverse pressure angle	$\alpha_{wt.s}$	20.0000	°
Working transverse pressure angle	$\alpha_{wt.i}$	20.0000	°
Center distance for $\epsilon_{\alpha} = 1$	$a_{max.s}$	3529.5212	mm
Center distance for $\epsilon_{\alpha} = 1$	$a_{max.i}$	3529.5212	mm
Center distance for zero clearance	$a_{min.s}$	3502.5350	mm
Center distance for zero clearance	$a_{min.i}$	3502.5350	mm
Circumferential backlash at the reference circle	$j_{t.s}$	1.0648	mm
Circumferential backlash at the reference circle	$j_{t.i}$	1.0648	mm
Circumferential backlash at the working pitch circle	$j_{wt.s}$	1.0648	mm
Circumferential backlash at the working pitch circle	$j_{wt.i}$	1.0648	mm
Transverse backlash	$j_{bt.s}$	1.0006	mm
Transverse backlash	$j_{bt.i}$	1.0006	mm
Normal backlash	$j_{bn.s}$	1.0006	mm
Normal backlash	$j_{bn.i}$	1.0006	mm
Radial backlash	$j_{r.s}$	1.4627	mm
Radial backlash	$j_{r.i}$	1.4627	mm
Working pitch diameter	$d_{w.s}$	864.0000	6144.0000 mm
Working pitch diameter	$d_{w.i}$	864.0000	6144.0000 mm
Active root diameter	$d_{Nf.s}$	820.0192	6093.0632 mm
Active root diameter	$d_{Nf.i}$	820.0192	6093.0632 mm
Active tip diameter	$d_{Na.s}$	928.0000	6208.0000 mm
Active tip diameter	$d_{Na.i}$	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
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	$f_pT$	26	96 $\mu m$
Cumulative pitch tolerance	$F_pT$	74	359 $\mu m$
Profile slope tolerance	$f_{H\alpha}T$	25	92 $\mu m$
Profile form tolerance	$ff_{\alpha}T$	32	90 $\mu m$

		<b>Gear 1</b>	<b>Gear 2</b>
Profile tolerance, total	F $\alpha$ T	41	129 $\mu$ m
Helix slope tolerance	fH $\beta$ T	19	63 $\mu$ m
Helix form tolerance	ff $\beta$ T	23	78 $\mu$ m
Helix tolerance, total	F $\beta$ T	30	100 $\mu$ m
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	fidT	118	490 $\mu$ m
Total radial composite tolerance	FidT	133	556 $\mu$ m

## Strength

		<b>Gear 1</b>	<b>Gear 2</b>
Torque	T	120000.0000	853333.3333 Nm
Speed	n	200.0000	28.1250 rpm
Tip diameter	d <sub>a</sub>	928.0000	6208.0000 mm
Root diameter	d <sub>f</sub>	784.0000	6064.0000 mm
Root form diameter	d <sub>Ff</sub>	819.2612	6082.9317 mm
Transverse contact ratio	$\epsilon_{\alpha}$	1.7694	
Overlap contact ratio	$\epsilon_{\beta}$	0.0000	
Total contact ratio	$\epsilon_{\gamma}$	1.7694	
Mean meshing stiffness	c $\gamma_{\alpha}$	22.4184	N/mm/ $\mu$ m
Mean meshing stiffness	c $\gamma_{\beta}$	19.0556	N/mm/ $\mu$ m
Misalignment due to deformations	f <sub>sh</sub>	5.3981	$\mu$ m
Misalignment due to manufacturing deviations	f <sub>ma</sub>	65.8027	$\mu$ m
Dynamic factor	K <sub>V</sub>	1.2615	
Mesh load factor	K <sub><math>\gamma</math></sub>	1.0000	
Transverse load factor	K <sub>H<math>\alpha</math></sub>	1.3301	
Face load factor	K <sub>H<math>\beta</math></sub>	1.4677	
Elasticity factor	Z <sub>E</sub>	188.8790	
Zone factor	Z <sub>H</sub>	2.4946	
Helix angle factor	Z <sub><math>\beta</math></sub>	1.0000	
Contact ratio factor	Z <sub><math>\epsilon</math></sub>	0.8623	
Roughness factor	Z <sub>R</sub>	0.8802	0.8832
Velocity factor	Z <sub>v</sub>	0.9941	0.9942
Lubricant factor	Z <sub>L</sub>	0.9938	0.9940
Single pair tooth contact factor	Z <sub>B</sub>	1.0563	1.0000
Life factor for contact stress	Z <sub>NT</sub>	0.9465	1.0129
Nominal contact stress	$\sigma$ <sub>H0</sub>	347.9410	MPa
Contact stress	$\sigma$ <sub>H</sub>	576.7352	546.0093 MPa
Pitting stress limit	$\sigma$ <sub>HG</sub>	830.4211	290.1717 MPa
Safety factor for pitting	S <sub>H</sub>	1.4399	0.5314
Transverse load factor	K <sub>F<math>\alpha</math></sub>	1.3301	
Face load factor	K <sub>F<math>\beta</math></sub>	1.3902	

		Gear 1	Gear 2
Load distribution influence factor	$f_{\epsilon}$	1.0000	
Helix angle factor	$Y_{\beta}$	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	$\sigma_{F0}$	44.6492	45.7116 MPa
Tooth root stress	$\sigma_F$	104.1438	106.6219 MPa
Tooth root stress limit	$\sigma_{FG}$	340.2919	197.0415 MPa
Safety factor for tooth breakage	$SF$	3.2675	1.8480