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Cylindrical Gear Pair Calculation

Input data

Geometry

Normal module	mn	8.0000 mm
Normal pressure angle	$\alpha_n$	20.000 °
Helix direction	Helix left hand	
Helix angle	$\beta$	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	1.4 · 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	1.4 · 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	$\alpha_1$	11.500 10 <sup>-6</sup> /°C
Material type		Eh
Material quality		MQ
Case hardness	HRC	60
Core hardness	HRC	30
Limiting tooth root stress	sigFlim1	500.000 MPa
Limiting contact stress	sigHlim1	1500.0 MPa

# MESYS Shaft and Rolling Bearing Calculation

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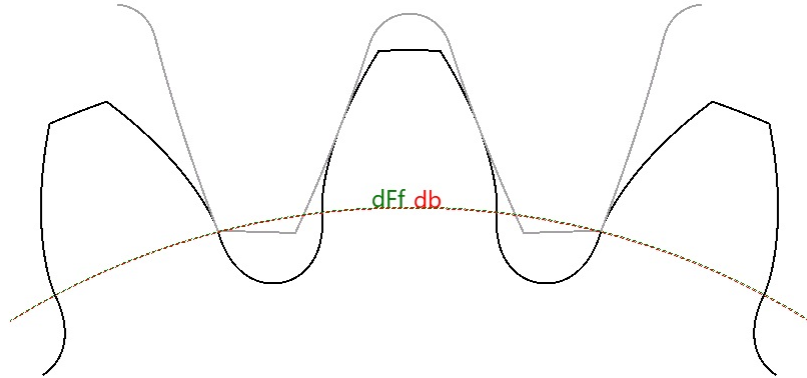
Material gear 2		Own Input	
Youngs modulus	E2	206000 MPa	
Poisson number	nu2	0.3	
Thermal elongation coefficient	α2	11.500 10 <sup>-6</sup> /°C	
Material type	Eh		
Material quality	MQ		
Case hardness	HRC	60	
Core hardness	HRC	30	
Limiting tooth root stress	sigFlim2	500.000 MPa	
Limiting contact stress	sigHlim2	1500.0 MPa	
<b>Loading</b>			
Required life	H	50000.0 h	
Application factor	KA	1	
Speed	n1	360.000 rpm	
Torque	T1	9000.0 Nm	
Power	P	339292 W	
<b>Strength calculation</b>			
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	
Stiffening by pinion	No		
Profile modifications compensate deflections	Yes		
Limited pitting allowable	No		
Flank modification (fZCa)	For uniform distribution		
Contact pattern	Unproven		
Helix modification	None		
Required safety factor root	SFmin	1	
Required safety factor flank	SHmin	1	
		<b>Gear 1</b>	<b>Gear 2</b>
Tip relief	Ca	0.07	0.07 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

# MESYS Shaft and Rolling Bearing Calculation

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		<b>Gear 1</b>	<b>Gear 2</b>
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	120.8247	833.5151 mm
Root diameter	df.i	120.8247	833.5151 mm
Root form diameter	dFf.s	132.2482	839.0838 mm
Root form diameter	dFf.i	132.2482	839.0838 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	13.0000 mm
Radial single ball distance	MrK.s	84.420	436.181 mm
Radial single ball distance	MrK.i	84.420	436.181 mm
Distance over two balls	MdK.s	168.189	872.262 mm
Distance over two balls	MdK.i	168.189	872.262 mm
Distance over two pins	MdR.s	168.841	872.362 mm
Distance over two pins	MdR.i	168.841	872.362 mm
Contact diameter for ball distance	dMBall.s	145.69	854.89 mm
Contact diameter for ball distance	dMBall.i	145.69	854.89 mm
Transverse contact ratio	εα.s	1.5491	

# MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
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	$a_{w.s}$	500.0000	mm
Working center distance	$a_{w.i}$	500.0000	mm
Working transverse pressure angle	$\alpha_{wt.s}$	21.0661	°
Working transverse pressure angle	$\alpha_{wt.i}$	21.0661	°
Center distance for $\epsilon_{\alpha} = 1$	$a_{max.s}$	504.9769	mm
Center distance for $\epsilon_{\alpha} = 1$	$a_{max.i}$	504.9769	mm
Center distance for zero clearance	$a_{min.s}$	499.5663	mm
Center distance for zero clearance	$a_{min.i}$	499.5663	mm
Circumferential backlash at the reference circle	$j_{t.s}$	0.3324	mm
Circumferential backlash at the reference circle	$j_{t.i}$	0.3324	mm
Circumferential backlash at the working pitch circle	$j_{wt.s}$	0.3331	mm
Circumferential backlash at the working pitch circle	$j_{wt.i}$	0.3331	mm
Transverse backlash	$j_{bt.s}$	0.3109	mm
Transverse backlash	$j_{bt.i}$	0.3109	mm
Normal backlash	$j_{bn.s}$	0.3005	mm
Normal backlash	$j_{bn.i}$	0.3005	mm
Radial backlash	$j_{r.s}$	0.4324	mm
Radial backlash	$j_{r.i}$	0.4324	mm
Working pitch diameter	$d_{w.s}$	141.6667	858.3333 mm
Working pitch diameter	$d_{w.i}$	141.6667	858.3333 mm
Active root diameter	$d_{Nf.s}$	132.9207	845.2252 mm
Active root diameter	$d_{Nf.i}$	132.9207	845.2252 mm
Active tip diameter	$d_{Na.s}$	159.6600	872.3500 mm
Active tip diameter	$d_{Na.i}$	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	5	5
Single pitch tolerance	$f_pT$	8.5	9 $\mu\text{m}$
Cumulative pitch tolerance	$F_pT$	24	35 $\mu\text{m}$
Profile slope tolerance	$f_{H\alpha}T$	7.5	8 $\mu\text{m}$
Profile form tolerance	$ff_{\alpha}T$	9.5	9.5 $\mu\text{m}$

# MESYS Shaft and Rolling Bearing Calculation

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		<b>Gear 1</b>	<b>Gear 2</b>
Profile tolerance, total	F $\alpha$ T	12	12 $\mu$ m
Helix slope tolerance	fH $\beta$ T	8	9 $\mu$ m
Helix form tolerance	ff $\beta$ T	9.5	11 $\mu$ m
Helix tolerance, total	F $\beta$ T	12	14 $\mu$ m
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	fidT	67	117 $\mu$ m
Total radial composite tolerance	FidT	75	133 $\mu$ m

## Strength

		<b>Gear 1</b>	<b>Gear 2</b>
Torque	T	9000.0000	54529.4118 Nm
Speed	n	360.0000	59.4175 rpm
Tip diameter	da	159.6600	872.3500 mm
Root diameter	df	121.2637	833.9548 mm
Root form diameter	dFf	132.2881	839.4550 mm
Transverse contact ratio	$\epsilon\alpha$	1.5491	
Overlap contact ratio	$\epsilon\beta$	1.0834	
Total contact ratio	$\epsilon\gamma$	2.6325	
Mean meshing stiffness	c $\gamma\alpha$	17.4656	N/mm/ $\mu$ m
Mean meshing stiffness	c $\gamma\beta$	14.8458	N/mm/ $\mu$ m
Misalignment due to deformations	fsh	14.7052	$\mu$ m
Misalignment due to manufacturing deviations	fma	12.0416	$\mu$ m
Dynamic factor	KV	1.0029	
Mesh load factor	K $\gamma$	1.0000	
Transverse load factor	KH $\alpha$	1.0000	
Face load factor	KH $\beta$	1.1561	
Elasticity factor	ZE	189.8117	
Zone factor	ZH	2.3953	
Helix angle factor	Z $\beta$	1.0194	
Contact ratio factor	Z $\epsilon$	0.8035	
Roughness factor	ZR	0.9660	0.9660
Velocity factor	Zv	0.9691	0.9691
Lubricant factor	ZL	1.0474	1.0474
Single pair tooth contact factor	ZB	1.0000	1.0000
Life factor for contact stress	ZNT	0.9101	0.9618
Nominal contact stress	$\sigma$ H0	1206.5821	MPa
Contact stress	$\sigma$ H	1299.2332	1299.2332 MPa
Pitting stress limit	$\sigma$ HG	1338.4805	1414.5255 MPa
Safety factor for pitting	SH	1.0302	1.0887
Transverse load factor	KF $\alpha$	1.0000	
Face load factor	KF $\beta$	1.1253	

		Gear 1	Gear 2
Load distribution influence factor	$f_{\epsilon}$	0.7767	
Helix angle factor	$Y_{\beta}$	0.9747	
Tooth form factor	$Y_F$	1.2609	1.0673
Stress correction factor	$Y_S$	1.7884	2.0460
Rim thickness factor	$Y_B$	1.0000	1.0000
Relative notch sensitivity factor	$Y_{drelT}$	0.9918	0.9986
Relative surface factor	$Y_{RrelT}$	0.9639	0.9639
Deep tooth factor	$Y_{DT}$	1.0000	1.0000
Size factor	$Y_X$	0.9700	0.9700
Life factor for tooth root stress	$Y_{NT}$	0.8888	0.9214
Nominal tooth root stress	$\sigma_{F0}$	349.8758	338.8343 MPa
Tooth root stress	$\sigma_F$	394.8601	382.3991 MPa
Tooth root stress limit	$\sigma_{FG}$	824.1726	860.3132 MPa
Safety factor for tooth breakage	$SF$	2.0873	2.2498