

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
Material gear 2		Own Input

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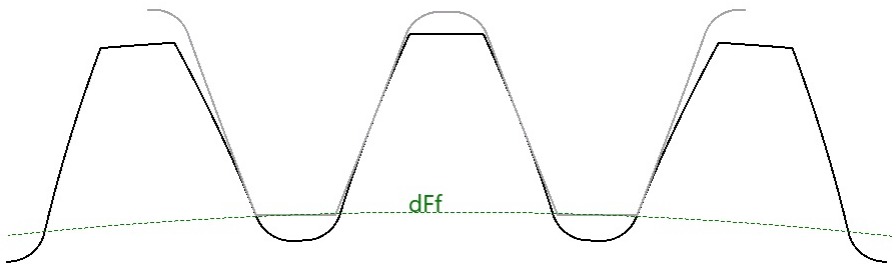
Youngs modulus	E2	206000 MPa
Poisson number	nu2	0.3
Thermal elongation coefficient	α2	11.500 10 ⁻⁶ /°C
Material type	V (alloy)	
Material quality	ML	
Case hardness	HBW	300
Core hardness	HBW	0
Limiting tooth root stress	sigFlim2	238.000 MPa
Limiting contact stress	sigHlim2	603.000 MPa

Loading

Speed	n1	5400.0 rpm
Torque	T1	528.000 Nm
Power	P	298577 W
Application factor	KA	1
Required life	H	30000.0 h

Results

Geometry



dh

		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 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

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		Gear 1	Gear 2
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	$\epsilon\alpha.s$	1.6846	
Transverse contact ratio	$\epsilon\alpha.i$	1.6846	
Overlap contact ratio	$\epsilon\beta$	4.8750	
Total contact ratio	$\epsilon\gamma.s$	6.5596	
Total contact ratio	$\epsilon\gamma.i$	6.5596	
Working center distance	aw.s	460.3750	mm
Working center distance	aw.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 $\epsilon\alpha = 1$	amax.s	461.6898	mm
Center distance for $\epsilon\alpha = 1$	amax.i	461.6898	mm
Center distance for zero clearance	amin.s	459.7863	mm
Center distance for zero clearance	amin.i	459.7863	mm
Circumferential backlash at the reference circle	jt.s	0.4567	mm
Circumferential backlash at the reference circle	jt.i	0.4567	mm
Circumferential backlash at the working pitch circle	jwt.s	0.4578	mm
Circumferential backlash at the working pitch circle	jwt.i	0.4578	mm
Transverse backlash	jbt.s	0.4264	mm
Transverse backlash	jbt.i	0.4264	mm
Normal backlash	jbn.s	0.4074	mm
Normal backlash	jbn.i	0.4074	mm
Radial backlash	jr.s	0.5862	mm
Radial backlash	jr.i	0.5862	mm
Working pitch diameter	dw.s	153.7563	766.9937 mm
Working pitch diameter	dw.i	153.7563	766.9937 mm
Active root diameter	dNf.s	151.3938	763.1461 mm
Active root diameter	dNf.i	151.3938	763.1461 mm
Active tip diameter	dNa.s	157.9880	769.5180 mm
Active tip diameter	dNa.i	157.9880	769.5180 mm

		Gear 1	Gear 2
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	$f_p T$	6	6.5 μm
Cumulative pitch tolerance	$F_p T$	20	30 μm
Profile slope tolerance	$f_{H\alpha} T$	4.8	5.5 μm
Profile form tolerance	$ff_{\alpha} T$	6	6 μm
Profile tolerance, total	$F_{\alpha} T$	7.5	8 μm
Helix slope tolerance	$f_H \beta T$	8	8.5 μm
Helix form tolerance	$ff_{\beta} T$	9	10 μm
Helix tolerance, total	$F_{\beta} T$	12	13 μm
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	$f_{id} T$	67	82 μm
Total radial composite tolerance	$F_{id} T$	76	93 μm

Strength

		Gear 1	Gear 2
Torque	T	528.0000	2633.8605 Nm
Speed	n	5400.0000	1082.5175 rpm
Tip diameter	d_a	157.9880	769.5180 mm
Root diameter	d_f	150.3835	761.9173 mm
Root form diameter	d_{Ff}	151.3354	762.7901 mm
Transverse contact ratio	ϵ_{α}	1.6846	
Overlap contact ratio	ϵ_{β}	4.8750	
Total contact ratio	ϵ_{γ}	6.5596	
Mean meshing stiffness	$c_{\gamma\alpha}$	19.2660	N/mm/ μm
Mean meshing stiffness	$c_{\gamma\beta}$	16.3761	N/mm/ μm
Misalignment due to deformations	f_{sh}	1.4032	μm
Misalignment due to manufacturing deviations	f_{ma}	11.6726	μm
Dynamic factor	KV	1.6839	
Mesh load factor	K_{γ}	1.0000	
Transverse load factor	$K_{H\alpha}$	1.3686	
Face load factor	$K_{H\beta}$	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	Z_v	1.0919	1.0919

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		Gear 1	Gear 2
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	$K_{F\alpha}$	1.3686	
Face load factor	$K_{F\beta}$	1.3607	
Load distribution influence factor	f_ϵ	0.7361	
Helix angle factor	Y_β	0.9904	
Tooth form factor	YF	0.8580	0.8943
Stress correction factor	YS	2.2967	2.3573
Rim thickness factor	YB	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	YDT	1.0000	1.0000
Size factor	YX	1.0000	1.0000
Life factor for tooth root stress	YNT	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