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Cylindrical Gear Pair Calculation

Input data

Geometry

Normal module	mn	4.5000 mm
Normal pressure angle	$\alpha_n$	20.000 °
Helix direction	Helix left hand	
Helix angle	$\beta$	11.000 °
Center distance	a	182.880 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	15	63
Face width	b	78.7400	76.2000 mm
Profile shift coefficient	x	0.541	0.439
Upper tooth thickness allowance	Esns	-0.1793	-0.1060 mm
Lower tooth thickness allowance	Esni	-0.1793	-0.1060 mm

Reference profile

Tool addendum	haP01	1.516 · mn
Tool tip radius	paP01	0.4 · mn
Tool dedendum	hfP01	1.2 · mn
Protuberance angle	$\alpha_{prP01}$	10.000 °
Tool form addendum	hFaP01	0.883427 · mn
Height of protuberance	hprP01	0.632573 · mn
Amount of protuberance	prP01	0.0593333 · mn
Amount of protuberance	prP1	0.2670 mm
Basic rack addendum	haP1	1 · mn
Machining allowance	q1	0.0488889 · mn
Machining allowance	q1	0.2200 mm
Finishing tool addendum	haP0F1	1.25 · mn
Finishing tool tip radius	paP0F1	0.25 · mn
Tip alteration	k1	-0.049453 · mn
Tip alteration	k1	-0.2225 mm
Tool addendum	haP02	1.516 · mn
Tool tip radius	paP02	0.4 · mn
Tool dedendum	hfP02	1.2 · mn
Protuberance angle	$\alpha_{prP02}$	10.000 °
Tool form addendum	hFaP02	0.883427 · mn
Height of protuberance	hprP02	0.632573 · mn

# MESYS Shaft and Rolling Bearing Calculation

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Amount of protuberance	prP02	0.0593333 · mn
Amount of protuberance	prP2	0.2670 mm
Basic rack addendum	haP2	1 · mn
Machining allowance	q2	0.0488889 · mn
Machining allowance	q2	0.2200 mm
Finishing tool addendum	haP0F2	1.25 · mn
Finishing tool tip radius	paP0F2	0.25 · mn
Tip alteration	k2	-0.0233019 · mn
Tip alteration	k2	-0.1049 mm
<b><u>Material</u></b>		
Material gear 1	Own Input	
Youngs modulus	E1	206000 MPa
Poisson number	nu1	0.3
Thermal elongation coefficient	α1	11.500 10 <sup>-6</sup> /°C
Material type	Eh	
Material quality	MQ	
Case hardness	HRC	58
Core hardness	HRC	30
Limiting tooth root stress	sigFlim1	500.000 MPa
Limiting contact stress	sigHlim1	1500.0 MPa
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	58
Core hardness	HRC	30
Limiting tooth root stress	sigFlim2	500.000 MPa
Limiting contact stress	sigHlim2	1500.0 MPa
<b><u>Loading</u></b>		
Required life	H	10000.0 h
Application factor	KA	1
Speed	n1	1430.0 rpm
Torque	T1	1494.0 Nm
Power	P	223725 W
<b><u>Strength calculation</u></b>		
Mesh load factor	Ky	1
Bearing span	l	331.724 mm
Offset of pinion center	s	67.560 mm
Pinion shaft diameter	dsh	63.500 mm
Pinion shaft inner diameter	dshi	0.0000 mm
Stiffening by pinion	No	
Profile modifications compensate deflections	No	

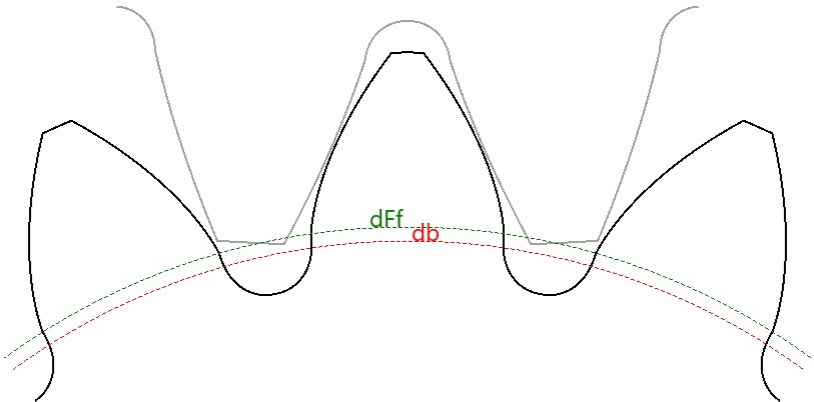
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Limited pitting allowable	No	
Flank modification (fZCa)	According to experience	
Contact pattern	Favourable	
Helix modification	Helix correction and crowning (5)	
Required safety factor root	SFmin	1
Required safety factor flank	SHmin	1

		Gear 1	Gear 2	
Tip relief	Ca	0.013	0.013	mm
Root relief	Cf	0	0	mm
Surface roughness flank	RzH	0.0023	0.0023	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	1	1	
Life factor limit flank	ZNTlim	1	1	

Results

Geometry



		Gear 1	Gear 2
Profile shift coefficient	x.s	0.4866	0.4069
Profile shift coefficient	x.i	0.4866	0.4069
Reference diameter	d.nom	68.7634	288.8062 mm
Base diameter	db.nom	64.4741	270.7913 mm
Tip diameter	da.s	82.1900	301.5500 mm
Tip diameter	da.i	82.1900	301.5500 mm
Root diameter	df.s	60.7850	280.1110 mm
Root diameter	df.i	60.7850	280.1110 mm
Root form diameter	dFf.s	65.8749	284.0333 mm

# MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
Root form diameter	dFf.i	65.8749	284.0333 mm
Normal tooth thickness	sn.s	8.6625	8.4016 mm
Normal tooth thickness	sn.i	8.6625	8.4016 mm
Normal tooth thickness at tip	san.s	1.7956	3.2417 mm
Normal tooth thickness at tip	san.i	1.7956	3.2417 mm
Spanned teeth	k	3	9
Base tangent length	Wk.s	35.706	118.358 mm
Base tangent length	Wk.i	35.706	118.358 mm
Contact diameter for base tangent length	dMWk.s	73.42	294.76 mm
Contact diameter for base tangent length	dMWk.i	73.42	294.76 mm
Measurement ball diameter	DM	10.0000	8.0000 mm
Radial single ball distance	MrK.s	44.518	151.929 mm
Radial single ball distance	MrK.i	44.518	151.929 mm
Distance over two balls	MdK.s	88.602	303.766 mm
Distance over two balls	MdK.i	88.602	303.766 mm
Distance over two pins	MdR.s	89.035	303.858 mm
Distance over two pins	MdR.i	89.035	303.858 mm
Contact diameter for ball distance	dMBall.s	73.78	292.78 mm
Contact diameter for ball distance	dMBall.i	73.78	292.78 mm
Transverse contact ratio	$\epsilon\alpha.s$	1.3865	
Transverse contact ratio	$\epsilon\alpha.i$	1.3865	
Overlap contact ratio	$\epsilon\beta$	1.0285	
Total contact ratio	$\epsilon\gamma.s$	2.4150	
Total contact ratio	$\epsilon\gamma.i$	2.4150	
Working center distance	aw.s	182.8800	mm
Working center distance	aw.i	182.8800	mm
Working transverse pressure angle	$\alpha_{wt.s}$	23.5622	°
Working transverse pressure angle	$\alpha_{wt.i}$	23.5622	°
Center distance for $\epsilon\alpha = 1$	amax.s	185.0281	mm
Center distance for $\epsilon\alpha = 1$	amax.i	185.0281	mm
Center distance for zero clearance	amin.s	182.5375	mm
Center distance for zero clearance	amin.i	182.5375	mm
Circumferential backlash at the reference circle	jt.s	0.2906	mm
Circumferential backlash at the reference circle	jt.i	0.2906	mm
Circumferential backlash at the working pitch circle	jwt.s	0.2973	mm
Circumferential backlash at the working pitch circle	jwt.i	0.2973	mm
Transverse backlash	jbt.s	0.2725	mm
Transverse backlash	jbt.i	0.2725	mm
Normal backlash	jbn.s	0.2681	mm
Normal backlash	jbn.i	0.2681	mm

		Gear 1	Gear 2
Radial backlash	jr.s	0.3408	mm
Radial backlash	jr.i	0.3408	mm
Working pitch diameter	dw.s	70.3385	295.4215 mm
Working pitch diameter	dw.i	70.3385	295.4215 mm
Active root diameter	dNf.s	65.8782	287.0505 mm
Active root diameter	dNf.i	65.8782	287.0505 mm
Active tip diameter	dNa.s	82.1900	301.5500 mm
Active tip diameter	dNa.i	82.1900	301.5500 mm
Specific sliding at root	ζf.s	-1.3351	-1.2479
Specific sliding at root	ζf.i	-1.3351	-1.2479
Specific sliding at tip	ζa.s	0.5552	0.5718
Specific sliding at tip	ζa.i	0.5552	0.5718

## Tolerances

		Gear 1	Gear 2
Tolerance class ISO 1328-1	A	6	6
Single pitch tolerance	fpT	9.5	10 μm
Cumulative pitch tolerance	FpT	28	35 μm
Profile slope tolerance	fHαT	8.5	8.5 μm
Profile form tolerance	ffαT	11	11 μm
Profile tolerance, total	FαT	13	14 μm
Helix slope tolerance	fHβT	11	11 μm
Helix form tolerance	ffβT	12	13 μm
Helix tolerance, total	FβT	16	17 μm
Tolerance class ISO 1328-2	R	41	41
Tooth-to-tooth radial composite tolerance	fidT	62	77 μm
Total radial composite tolerance	FidT	70	87 μm

## Strength

		Gear 1	Gear 2
Torque	T	1494.0000	6274.8000 Nm
Speed	n	1430.0000	340.4762 rpm
Tip diameter	da	82.1900	301.5500 mm
Root diameter	df	60.7850	280.1110 mm
Root form diameter	dFf	65.8749	284.0333 mm
Transverse contact ratio	εα	1.3865	
Overlap contact ratio	εβ	1.0285	
Total contact ratio	εγ	2.4150	
Mean meshing stiffness	cγα	17.2719	N/mm/ μm
Mean meshing stiffness	cγβ	14.6811	N/mm/ μm
Misalignment due to deformations	fsh	78.9064	μm
Misalignment due to manufacturing	fma	15.5563	μm

# MESYS Shaft and Rolling Bearing Calculation

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		Gear 1	Gear 2
deviations			
Dynamic factor	KV	1.0177	
Mesh load factor	K <sub>γ</sub>	1.0000	
Transverse load factor	KH <sub>α</sub>	1.0238	
Face load factor	KH <sub>β</sub>	1.0591	
Elasticity factor	ZE	189.8117	
Zone factor	ZH	2.2654	
Helix angle factor	Z <sub>β</sub>	1.0093	
Contact ratio factor	Z <sub>ε</sub>	0.8493	
Roughness factor	ZR	1.0250	1.0250
Velocity factor	Z <sub>v</sub>	0.9829	0.9829
Lubricant factor	ZL	1.0200	1.0200
Single pair tooth contact factor	ZB	1.0344	1.0344
Life factor for contact stress	ZNT	1.0000	1.0000
Nominal contact stress	σH0	1181.0479	MPa
Contact stress	σH	1283.3580	1283.3580 MPa
Pitting stress limit	σHG	1541.2889	1541.2889 MPa
Safety factor for pitting	SH	1.2010	1.2010
Transverse load factor	KF <sub>α</sub>	1.0238	
Face load factor	KF <sub>β</sub>	1.0508	
Load distribution influence factor	f <sub>ε</sub>	0.8355	
Helix angle factor	Y <sub>β</sub>	0.9603	
Tooth form factor	YF	1.2519	1.2793
Stress correction factor	YS	1.9788	2.0353
Rim thickness factor	YB	1.0000	1.0000
Relative notch sensitivity factor	YdrelT	0.9977	1.0008
Relative surface factor	YRrelT	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	1.0000	1.0000
Nominal tooth root stress	σF0	291.7388	316.8587 MPa
Tooth root stress	σF	319.3897	346.8905 MPa
Tooth root stress limit	σFG	961.6677	964.6256 MPa
Safety factor for tooth breakage	SF	3.0110	2.7808