KISSsoft Release 03/2018 A

KISSsoft evaluation

File

Name : Unnamed
Changed by: J on: 25.01.2019 at: 22:21:29

Important hint: At least one warning has occurred during the calculation:

1-> Profile modification:
The value for the tip relief is probably too small!

Change the type of profile modification in the dialog 'Define details of strength'
to "without (only running-in)" or to "without (no running-in value)".

(In the 'System data' tab, in the 'Strength details' window.)

2-> For internal gears and racks
the use of method B with tooth form factor YF method C
is suggested!

CALCULATION OF A CYLINDRICAL SPUR GEAR PAIR

Drawing or article number:
Gear 1: PlanetGear2(Planet2Ring)
Gear 2: RingGear(Planet2Ring)

Calculation method DIN 3990:1987 Method B

During calculation, the system takes into account the fact that this gear is a planet gear:

			2
Speed planet carrier (1/min)	[nSteg]		-6.2
Absolute speed (1/min)	[n]	27.6	-7.8

		------- GEAR 1	-------- GEAR 2 --
Power (W)	[P]	174.537	
Speed (1/min)	[n]	33.8	9.5
Torque (Nm)	[T]	49.2	175.4
Application factor	[KA]	1.25	
Required service life (h)	[H]	2000.00	
Gear driving (+) / driven (-)		+	-

Working flank gear 1: Left flank
Sense of rotation gear 1 clockwise

1. TOOTH GEOMETRY AND MATERIAL

(geometry calculation according to DIN 3960:1987)

		------- GEAR 1	-------- GEAR 2 --
Center distance (mm)	[a]	-22.805	
Center distance tolerance	ISO 286:2010 Measure js7		
Normal module (mm)	[mn]	1.1000	
Pressure angle at normal section (°)	[alfn]	20.0000	
Helix angle at reference circle (°)	[beta]	0.0000	

Number of teeth	[z]	16	-57
Facewidth (mm)	[b]	15.00	15.00
Hand of gear		Spur gear	
Accuracy grade	[Q-DIN 3961:1978]	6	6
Inner diameter (mm)	[di]	11.00	
External diameter (mm)	[di]		80.00
Inner diameter of gear rim (mm)	[dbi]	0.00	
Outer diameter of gear rim (mm)	[dbi]		0.00

Material

Gear 1: Steel, Grade 3, HRC58-64(AGMA), Case-carburized steel, case-hardened AGMA 2001-C95

Gear 2: Steel, Grade 3, HRC58-64(AGMA), Case-carburized steel, case-hardened AGMA 2001-C95

		------- GEAR 1	-------- GEAR 2 --
Surface hardness		HRC 60	HRC 60
Fatigue strength. tooth root stress (N/mm²)	[σFlim]	515.00	515.00
Fatigue strength for Hertzian pressure (N/mm²)	[σHlim]	1895.00	1895.00
Tensile strength (N/mm²)	[σB]	1035.00	1035.00
Yield point (N/mm²)	[σS]	887.00	887.00
Young's modulus (N/mm²)	[E]	206843	206843
Poisson's ratio	[v]	0.300	0.300
Roughness average value DS, flank (µm)	[RAH]	0.63	0.63
Roughness average value DS, root (µm)	[RAF]	2.40	2.40
Mean roughness height, Rz, flank (µm)	[RZH]	5.00	5.00
Mean roughness height, Rz, root (µm)	[RZF]	16.00	16.00

Gear reference profile 1 :

Reference profile	1.25 / 0.38 / 1.0 ISO 53:1998 Profil A	
Dedendum coefficient	[hfP*]	1.250
Root radius factor	[rhofP*]	0.380 (rhofPmax*=0.472)
Addendum coefficient	[haP*]	1.000
Tip radius factor	[rhoaP*]	0.000
Protuberance height coefficient	[hprP*]	0.000
Protuberance angle	[alfprP]	0.000
Tip form height coefficient	[hFaP*]	0.000
Ramp angle	[alfKP]	0.000
	not topping	

Gear reference profile 2 :

Reference profile	1.25 / 0.38 / 1.0 ISO 53:1998 Profil A	
Dedendum coefficient	[hfP*]	1.250
Root radius factor	[rhofP*]	0.380 (rhofPmax*=0.472)
Addendum coefficient	[haP*]	1.000
Tip radius factor	[rhoaP*]	0.000
Protuberance height coefficient	[hprP*]	0.000
Protuberance angle	[alfprP]	0.000
Tip form height coefficient	[hFaP*]	0.000
Ramp angle	[alfKP]	0.000
	not topping	

Summary of reference profile gears:

Dedendum reference profile	[hfP*]	1.250	1.250
Tooth root radius Refer. profile	[rofP*]	0.380	0.380
Addendum Reference profile	[haP*]	1.000	1.000
Protuberance height coefficient	[hprP*]	0.000	0.000
Protuberance angle (°)	[alfprP]	0.000	0.000

Tip form height coefficient	[hFaP*]	0.000	0.000
Ramp angle (°)	[alfKP]	0.000	0.000

Type of profile modification:for high load capacity gearboxe

Tip relief (µm)	[Ca]	0.0	0.0

Lubrication type	Oil bath lubrication
Type of oil	Oil: ISO-VG 220
Lubricant base	Mineral-oil base

Kinem. viscosity oil at 40 °C (mm²/s)	[nu40]	220.00
Kinem. viscosity oil at 100 °C (mm²/s)	[nu100]	17.50
Specific density at 15 °C (kg/dm³)	[roOil]	0.895
Oil temperature (°C)	[TS]	70.000

		------- GEAR 1	-------- GEAR 2 --
Overall transmission ratio	[itot]	3.563	
Gear ratio	[u]	-3.563	
Transverse module (mm)	[mt]	1.100	
Pressure angle at pitch circle (°)	[alft]	20.000	
Working transverse pressure angle (°)	[alfwt]	21.691	
	[alfwt.e/i]	21.624 / 21.757	
Working pressure angle at normal section (°)	[alfwn]	21.691	
Helix angle at operating pitch circle (°)	[betaw]	0.000	
Base helix angle (°)	[betab]	0.000	
Reference center distance (mm)	[ad]	-22.550	
Sum of profile shift coefficients	[Summexi]	-0.2412	
Profile shift coefficient	[x]	0.3098	-0.5510
Tooth thickness (Arc) (module) (module)	[sn*]	1.7963	1.1697
Tip alteration (mm)	[k*mn]	0.010	0.000
Reference diameter (mm)	[d]	17.600	-62.700
Base diameter (mm)	[db]	16.539	-58.919
Tip diameter (mm)	[da]	20.502	-61.712
(mm)	[da.e/i]	20.502 / 20.492	-61.712 / -61.722
Tip diameter allowances (mm)	[Ada.e/i]	0.000 / -0.010	0.000 / -0.010
Tip form diameter (mm)	[dFa]	20.502	-61.712
(mm)	[dFa.e/i]	20.502 / 20.492	-61.712 / -61.722
Active tip diameter (mm)	[dNa]	20.502	-61.712
Active tip diameter (mm)	[dNa.e/i]	20.502 / 20.492	-61.712 / -61.722
Operating pitch diameter (mm)	[dw]	17.799	-63.409
(mm)	[dw.e/i]	17.791 / 17.807	-63.379 / -63.438
Root diameter (mm)	[df]	15.532	-66.662
Generating Profile shift coefficient	[xE.e/i]	0.2424/ 0.2049	-0.6384/ -0.6884
Manufactured root diameter with xE (mm)	[df.e/i]	15.383 / 15.301	-66.855 / -66.964
Theoretical tip clearance (mm)	[c]	0.275	0.285
Effective tip clearance (mm)	[c.e/i]	0.442 / 0.361	0.416 / 0.349
Active root diameter (mm)	[dNf]	16.606	-65.657
(mm)	[dNf.e/i]	16.615 / 16.601	-65.624 / -65.682
Root form diameter (mm)	[dFf]	16.614	-66.242
(mm)	[dFf.e/i]	16.578 / 16.563	-66.392 / -66.475
Internal toothing: Calculation dFf with pinion type cutter (z0= 37, x0= 0.000)			
Reserve (dNf-dFf)/2 (mm)	[cF.e/i]	0.026 / 0.012	0.425 / 0.355
Addendum (mm)	[ha=mn*(haP*+x+k)]	1.451	0.494
(mm)	[ha.e/i]	1.451 / 1.446	0.494 / 0.489
Dedendum (mm)	[hf=mn*(hfP*-x)]	1.034	1.981
(mm)	[hf.e/i]	1.108 / 1.150	2.077 / 2.132
Roll angle at dFa (°)	[xsi_dFa.e/i]	41.973 / 41.914	17.851 / 17.884

Roll angle to dNa (°)	[xsi_dNa.e/i]	41.973 /	41.914		17.851 /	17.884		
Roll angle to dNf (°)	[xsi_dNf.e/i]	5.509 /	4.999		28.103 /	28.230		
Roll angle at dFf (°)	[xsi_dFf.e/i]	3.972 /	3.137		29.759 /	29.935		
Tooth height (mm)	[h]	2.485			2.475			
Virtual gear no. of teeth	[zn]	16.000			-57.000			
Normal tooth thickness at tip circle (mm)	[san]	0.551			0.935			
(mm)	[san.e/i]	0.495 /	0.453		0.869 /	0.827		
Normal tooth thickness on tip form circle (mm)	[sFan]	0.551			0.935			
(mm)	[sFan.e/i]	0.495 /	0.453		0.869 /	0.827		
Normal space width at root circle (mm)	[efn]	0.000			0.468			
(mm)	[efn.e/i]	0.000 /	0.000		0.441 /	0.425		
Max. sliding velocity at tip (m/s)	[vga]	0.007			0.006			
Specific sliding at the tip	[zetaa]	0.329			0.709			
Specific sliding at the root	[zetaf]	-2.436			-0.490			
Mean specific sliding	[zetam]	0.511						
Sliding factor on tip	[Kga]	0.224			0.205			
Sliding factor on root	[Kgf]	-0.205			-0.224			
Pitch on reference circle (mm)	[pt]	3.456						
Base pitch (mm)	[pbt]	3.247						
Transverse pitch on contact-path (mm)	[pet]	3.247						
Length of path of contact (mm)	[ga, e/i]	5.308 (	5.336 /	5.254)				
Length T1-A, T2-A (mm)	[T1A, T2A]	0.750(	0.721/	0.795)	-9.178(	-9.178/	-9.195)	
Length T1-B (mm)	[T1B, T2B]	2.810(	2.810/	2.802)	-11.239(	-11.267/	-11.202)	
Length T1-C (mm)	[T1C, T2C]	3.289(	3.300/	3.278)	-11.718(	-11.757/	-11.678)	
Length T1-D (mm)	[T1D, T2D]	3.997(	3.969/	4.042)	-12.426(	-12.426/	-12.443)	
Length T1-E (mm)	[T1E, T2E]	6.058(	6.058/	6.049)	-14.486(	-14.515/	-14.450)	
Length T1-T2 (mm)	[T1T2]	-8.429 (	-8.457 /	-8.400)				
Diameter of single contact point B (mm)	[d-B]	17.468(	17.468/	17.462)	-63.061(	-63.081/	-63.035)	
Diameter of single contact point D (mm)	[d-D]	18.369(	18.345/	18.409)	-63.945(	-63.945/	-63.958)	
Addendum contact ratio	[eps]	0.853(	0.849/	0.853)	0.782(	0.794/	0.765)	
Minimal length of contact line (mm)	[Lmin]	15.000						
Transverse contact ratio	[eps_a]	1.635						
Transverse contact ratio with allowances	[eps_a.e/m/i]	1.643 /	1.631 /	1.618				
Overlap ratio	[eps_b]	0.000						
Total contact ratio	[eps_g]	1.635						
Total contact ratio with allowances	[eps_g.e/m/i]	1.643 /	1.631 /	1.618				

2. FACTORS OF GENERAL INFLUENCE

		------- GEAR 1 -------- GEAR 2 --
Nominal circum. force at pitch circle (N)	[Ft]	5596.4
Axial force (N)	[Fa]	0.0
Radial force (N)	[Fr]	2036.9
Normal force (N)	[Fnorm]	5955.5
Nominal circumferential force per mm (N/mm)	[w]	373.09
Only as information: Forces at operating pitch circle:		
Nominal circumferential force (N)	[Ftw]	5533.8
Axial force (N)	[Faw]	0.0
Radial force (N)	[Frw]	2201.2
Circumferential speed reference circle (m/s)	[v]	0.03
Circumferential speed operating pitch circle (m/s)	[v(dw)]	0.03
Running-in value (µm)	[yp]	0.5
Running-in value (µm)	[yf]	0.4
Correction factor	[CM]	0.800
Gear blank factor	[CR, bs/b, sr/mn]	0.812 (0.250, 1.955)

Basic rack factor	[CBS]		0.975
Material coefficient	[E/Est]		1.004
Singular tooth stiffness (N/mm/µm)	[c']		11.601
Meshing stiffness (N/mm/µm)	[cg]		17.122
Reduced mass (kg/mm)	[mRed]		0.00097
Resonance speed (min-1)	[nE1]		79168
Resonance ratio (-)	[N]		0.000
Subcritical range			
Bearing distance l of pinion shaft (mm)	[l]		30.000
Distance s of pinion shaft (mm)	[s]		3.000
Outside diameter of pinion shaft (mm)	[dsh]		14.080
Load according to Figure 6.8, DIN 3990-1:1987 (0:6.8a, 1:6.8b, 2:6.8c, 3:6.8d, 4:6.8e)	[-]	4	
Coefficient K' according to Figure 6.8, DIN 3990-1:1987	[K']	-0.60	
With support effect			
Tooth trace deviation (active) (µm)	[Fby]		3.40
from deformation of shaft (µm)	[fsh*B1]		2.24
(fsh (µm) = 4.48, B1= 0.50, fHb5 (µm) = 6.00)			
Tooth trace: width-crowned [Cbeta = 0.5*(fma+fsh)]			
Position of Contact pattern: favorable			
from production tolerances (µm)	[fma*B2]		4.00
(B2= 0.50)			
Tooth trace deviation, theoretical (µm)	[Fbx]		4.00
Running-in value (µm)	[yb]		0.60
Dynamic factor	[KV]		1.000
Face load factor - flank	[KHb]		1.062
- Tooth root	[KFb]		1.052
- Scuffing	[KBb]		1.062
User specified factor KHa:			
Transverse load factor - flank	[KHa]		1.000
- Tooth root	[KFa]		1.000
- Scuffing	[KBa]		1.000
Helical load factor scuffing	[Kbg]		1.000
Number of load cycles (in mio.)	[NL]	4.061	3.420

3. TOOTH ROOT STRENGTH

Calculation of Tooth form coefficients according method: B

		------- GEAR 1	-------- GEAR 2 --
Calculated with manufacturing profile shift	[xE.e]	0.2424	-0.6384
Tooth form factor	[YF]	1.38	0.90
Stress correction factor	[YS]	2.01	2.75
Load application angle (°)	[alfFen]	20.58	20.00
Bending moment arm (mm)	[hF]	1.04	1.25
Tooth thickness at root (mm)	[sFn]	2.22	3.03
Tooth root radius (mm)	[roF]	0.55	0.42

(hF* = 0.944/ 1.139 sFn* = 2.018/ 2.756 roF* = 0.499/ 0.380)
(den (mm) =
18.369/ -63.061 dsFn(mm) = 15.748/ 0.000 alfsFn(°) = 30.00/ 30.00 qs = 2.022/ 3.626)

Contact ratio factor	[Yeps]	1.000

Helix angle factor	[Ybet]		1.000	
Effective facewidth (mm)	[beff]	15.00		15.00
Nominal stress at tooth root (N/mm²)	[sigF0]	944.72		839.21
Tooth root stress (N/mm²)	[sigF]	1242.02		1103.30
Permissible bending stress at root of Test-gear				
Notch sensitivity factor	[YdrelT]	0.995		1.010
Surface factor	[YRrelT]	0.972		0.972
size factor (Tooth root)	[YX]	1.000		1.000
Finite life factor	[YNT]	1.000		1.000
	[YdrelT*YRrelT*YX*YNT]	0.967		0.981
Alternating bending factor (mean stress influence coefficient)	[YM]		1.000	1.000
Load on left / right flank (%):		100.0, 0.0		100.0, 0.0
Stress correction factor	[Yst]		2.00	
Yst*sigFlim (N/mm²)	[sigFE]	1030.00		1030.00
Permissible tooth root stress (N/mm²)	[sigFP=sigFG/SFmin]	711.56		721.91
Limit strength tooth root (N/mm²)	[sigFG]	996.18		1010.67
Required safety	[SFmin]	1.40		1.40
Safety for tooth root stress	[SF=sigFG/sigF]	0.80		0.92
Transmittable power (W)	[WRating]	99.99		114.20

4. SAFETY AGAINST PITTING (TOOTH FLANK)

		------- GEAR 1	-------- GEAR 2 --
Zone factor	[ZH]		2.386
Elasticity factor (√N/mm²)	[ZE]		190.200
Contact ratio factor	[Zeps]		0.888
Helix angle factor	[Zbet]		1.000
Effective facewidth (mm)	[beff]		15.00
Nominal contact stress (N/mm²)	[sigH0]		1573.71
Contact stress at operating pitch circle (N/mm²)	[sigHw]		1813.66
Single tooth contact factor	[ZB,ZD]	1.10	1.00
Contact stress (N/mm²)	[sigHB, sigHD]	2003.43	1813.66
Lubrication coefficient at NL	[ZL]	1.012	1.011
Speed coefficient at NL	[ZV]	0.960	0.962
Roughness coefficient at NL	[ZR]	0.962	0.964
Material pairing coefficient at NL	[ZW]	1.000	1.000
Finite life factor	[ZNT]	1.209	1.225
	[ZL*ZV*ZR*ZNT]	1.130	1.149
Limited pitting is permitted:	No		
Size factor (flank)	[ZX]	1.000	1.000
Permissible contact stress (N/mm²)	[sigHP=sigHG/SHmin]	2142.00	2176.82
Pitting stress limit (N/mm²)	[sigHG]	2142.00	2176.82
Required safety	[SHmin]	1.00	1.00
Safety factor for contact stress at operating pitch circle			
	[SHw]	1.18	1.20
Safety for stress at single tooth contact	[SHBD=sigHG/sigHBD]	1.07	1.20
(Safety regarding transmittable torque)	[(SHBD)^2]	1.14	1.44
Transmittable power (W)	[WRating]	199.52	251.43

4b. MICROPITTING ACCORDING TO ISO/TR 15144-1:2014

Calculation did not run. (Lubricant: Load stage micropitting test is unknown.)

5. SCUFFING LOAD CAPACITY

Calculation method according to DIN 3990:1987

Lubrication coefficient (for lubrication type)	[XS]	1.000	
Scuffing test and load stage	[FZGtest]	FZG - Test A / 8.3 / 90 (ISO 14635 - 1)	12
Relative structure coefficient (Scuffing)	[XWrelT]	1.000	
Thermal contact factor (N/mm/s^.5/K)	[BM]	13.780	13.780
Relevant tip relief (µm)	[Ca]	0.00	0.00
Optimal tip relief (µm)	[Ceff]	40.20	
Ca taken as optimal in the calculation (0=no, 1=yes)		0	0
Effective facewidth (mm)	[beff]	15.000	
Applicable circumferential force/facewidth (N/mm)	[wBt]	495.537	
Angle factor	[Xalfbet]	1.002	
(ε1:0.853, ε2:0.782)			

Flash temperature-criteria		
Tooth mass temperature (°C)	[theMB]	76.06
(theMB = theoil + XS*0.47*theflamax)		
Maximum flash temperature (°C)	[theflamax]	12.89
Scuffing temperature (°C)	[theS]	408.58
Coordinate gamma (point of highest temp.)	[Gamma]	-0.524
[Gamma.A]=-0.772 [Gamma.E]=0.842		
Highest contact temp. (°C)	[theB]	88.95
Flash factor (°K*N^-.75*s^.5*m^-.5*mm)	[XM]	50.109
Geometry factor	[XB]	0.174
Load sharing factor	[XGam]	0.340
Dynamic viscosity (mPa*s)	[etaM]	33.04 (70.0 °C)
Coefficient of friction	[mym]	0.512
Required safety	[SBmin]	2.000
Safety factor for scuffing (flash temperature)	[SB]	17.860

Integral temperature-criteria		
Tooth mass temperature (°C)	[theMC]	73.08
(theMC = theoil + XS*0.70*theflaint)		
Mean flash temperature (°C)	[theflaint]	4.40
Integral scuffing temperature (°C)	[theSint]	408.58
Flash factor (°K*N^-.75*s^.5*m^-.5*mm)	[XM]	50.109
Contact ratio factor	[Xeps]	0.250
Dynamic viscosity (mPa*s)	[etaOil]	41.90 (70.0 °C)
Mean coefficient of friction	[mym]	0.348
Geometry factor	[XBE]	0.119
Meshing factor	[XQ]	1.000
Tip relief factor	[XCa]	1.000
Integral tooth flank temperature (°C)	[theint]	79.68
Required safety	[SSmin]	1.800
Safety factor for scuffing (intg.-temp.)	[SSint]	5.128
Safety referring to transmittable torque	[SSL]	34.966

6. MEASUREMENTS FOR TOOTH THICKNESS

	------- Gear 1	------ Gear 2 --
Tooth thickness deviation	DIN 3967 cd25	DIN 3967 cd25

Tooth thickness allowance (normal section) (mm)	[As.e/i]	-0.054 / -0.084	-0.070 / -0.110
Number of teeth spanned	[k]	3.000	-8.000
(Internal toothing: k = (Measurement gap number)			
Base tangent length (no backlash) (mm)	[Wk]	8.598	-25.648
Actual base tangent length ('span') (mm)	[Wk.e/i]	8.547 / 8.519	-25.714 / -25.751
(mm)	[ΔWk.e/i]	-0.051 / -0.079	-0.066 / -0.103
Diameter of measuring circle (mm)	[dMWk.m]	18.610	-64.293
Theoretical diameter of ball/pin (mm)	[DM]	2.128	1.856
Effective diameter of ball/pin (mm)	[DMeff]	2.500	2.000
Radial single-ball measurement backlash free (mm)	[MrK]	11.238	-30.406
Radial single-ball measurement (mm)	[MrK.e/i]	11.192 / 11.167	-30.499 / -30.552
Diameter of measuring circle (mm)	[dMMr.m]	18.592	-63.791
Diametral measurement over two balls without clearance (mm)	[MdK]	22.475	-60.787
Diametral two ball measure (mm)	[MdK.e/i]	22.384 / 22.334	-60.975 / -61.080
Diametral measurement over pins without clearance (mm)	[MdR]	22.475	-60.787
Measurement over pins according to DIN 3960 (mm)	[MdR.e/i]	22.384 / 22.334	-60.975 / -61.080
Measurement over 3 pins (axial) according to AGMA 2002 (mm)			
	[dk3A.e/i]	22.384 / 22.334	-60.975 / -61.080
Dimensions over 3 pins without clearance (mm)	[Md3R]	0.000	-60.763
Effective dimensions over 3 pins (mm)	[Md3R.e/i]	0.000 / 0.000	-60.951 / -61.057
Chordal tooth thickness (no backlash) (mm)	[sc]	1.972	1.287
Actual chordal tooth thickness (mm)	[sc.e/i]	1.918 / 1.888	1.217 / 1.177
Reference chordal height from da.m (mm)	[ha]	1.504	0.485
Tooth thickness (Arc) (mm)	[sn]	1.976	1.287
(mm)	[sn.e/i]	1.922 / 1.892	1.217 / 1.177
Backlash free center distance (mm)	[aControl.e/i]	-22.959 / -23.044	
Backlash free center distance, allowances (mm)	[jta]	-0.154 / -0.239	
dNf.i with aControl (mm)	[dNf0.i]	16.540	-66.220
Reserve (dNf0.i-dFf.e)/2 (mm)	[cF0.i]	-0.019	0.086
Tip clearance (mm)	[c0.i(aControl)]	0.133	0.121
Center distance allowances (mm)	[Aa.e/i]	0.011 / -0.011	
Circumferential backlash from Aa (mm)	[jtw_Aa.e/i]	0.008 / -0.008	
Radial clearance (mm)	[jrw.e/i]	0.249 / 0.144	
Circumferential backlash (transverse section) (mm)	[jtw.e/i]	0.205 / 0.117	
Normal backlash (mm)	[jnw.e/i]	0.192 / 0.110	
Torsional angle at entry with fixed output:			
Entire torsional angle (°)	[j.tSys]	1.3169/ 0.7536	

7. GEAR ACCURACY

		------- GEAR 1 --------	GEAR 2 --
According to DIN 3961:1978			
Accuracy grade	[Q-DIN3961]	6	6
Profile form deviation (µm)	[ff]	6.00	6.00
Profile slope deviation (µm)	[fHa]	5.00	5.00
Total profile deviation (µm)	[Ff]	8.00	8.00
Helix form deviation (µm)	[fbf]	4.00	4.00
Helix slope deviation (µm)	[fHb]	8.00	8.00
Total helix deviation (µm)	[Fb]	9.00	9.00
Normal base pitch deviation (µm)	[fpe]	7.00	7.00
Single pitch deviation (µm)	[fp]	7.00	7.00
Adjacent pitch difference (µm)	[fu]	8.00	9.00

Total cumulative pitch deviation (µm)	[Fp]	19.00	25.00
Sector pitch deviation over z/8 pitches (µm)	[Fpz/8]	12.00	15.00
Runout (µm)	[Fr]	14.00	16.00
Tooth Thickness Variation (µm)	[Rs]	8.00	10.00
Single flank composite, total (µm)	[Fi']	22.00	26.00
Single flank composite, tooth-to-tooth (µm)	[fi']	10.00	11.00
Radial composite, total (µm)	[Fi"]	17.00	20.00
Radial composite, tooth-to-tooth (µm)	[fi"]	6.00	8.00

According to DIN 58405:1972 (Feinwerktechnik):

Tooth-to-tooth composite error (µm)	[fi"]	6.00	8.00
Composite error (µm)	[Fi"]	18.00	22.00
Axis alignment error (µm)	[fp]	3.88	3.88
Flank direction error (µm)	[fbeta]	5.00	5.00
Runout (µm)	[Trk, Fr]	18.00	24.00

Axis alignment tolerances (recommendation acc. to ISO TR 10064-3:1996, Quality) 6)

Maximum value for deviation error of axis (µm)	[fSigbet]	11.00 (Fb= 11.00)
Maximum value for inclination error of axes (µm)	[fSigdel]	22.00

8. ADDITIONAL DATA

Maximal possible center distance (eps_a=1.0)	[aMAX]	-22.126	
Mass (g)	[m]	18.78	210.32
Total mass (g)	[m]	229.10	
calculation without consideration of the exact tooth shape			
single gears ((da+df)/2...di) (kg*m²)	[TraeghMom]	1.046e-006	0.0002766
Torsional stiffness on input for stopped output:			
Torsional stiffness (MNm/rad)	[cr]	0.017	
Torsion when subjected to nominal torque (°)	[delcr]	0.162	
Mean coeff. of friction (acc. Niemann)	[mum]	0.167	
Wear sliding coef. by Niemann	[zetw]	0.835	
Gear power loss (W)	[PVZ]	2.904	
(Meshing efficiency (%)	[etaz]	98.336)	
Sound pressure level (according to Masuda, without contact analysis)			
	[dB(A)]	28.1	

9. MODIFICATIONS AND TOOTH FORM DEFINITION

Data for the tooth form calculation :
Data not available.

10. SERVICE LIFE, DAMAGE

Required safety for tooth root	[SFmin]	1.40
Required safety for tooth flank	[SHmin]	1.00

Service life (calculated with required safeties):

System service life (h)	[Hatt]	13.829	
Tooth root service life (h)	[HFatt]	13.83	108.5
Tooth flank service life (h)	[HHatt]	4080	1.4e+004

Damage calculated on the basis of the required service life [H] (2000.0 h)

F1%	F2%	H1%	H2%
9999.99	1843.9904	49.0152	14.2903

Damage calculated on basis of system service life [Hatt] (13.8 h)

F1%	F2%	H1%	H2%
100.00	12.7499	0.3389	0.0988

Calculation of the factors required to define reliability R(t) according to B. Bertsche with Weibull distribution; t in (h):

R(t) = 100 * Exp(-((t*fac - t0)/(T - t0))^b) %

Gear		fac	b	t0	T	R(H)%
1	Tooth root	2031	1.7	2.711e+004	4.166e+004	0.00
1	Tooth flank	2031	1.3	7.469e+006	3.558e+007	100.00
2	Tooth root	1710	1.7	1.79e+005	2.752e+005	0.00
2	Tooth flank	1710	1.3	2.157e+007	1.028e+008	100.00

Reliability of the configuration for required service life (%) 0.00 (Bertsche)

REMARKS:

- Specifications with [.e/i] imply: Maximum [e] and Minimal value [i] with consideration of all tolerances
  Specifications with [.m] imply: Mean value within tolerance
- For the backlash tolerance, the center distance tolerances and the tooth thickness deviation are taken into account. Shown is the maximal and the minimal backlash corresponding the largest resp. the smallest allowances
  The calculation is done for the operating pitch circle.
- Details of calculation method:
  cg according to method B
  KV according to method B
  KHb, KFb according method C
  KHa, KFa according to method B

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