KISSsoft
Calculation programs for machine design

KISSsoft 03/2017 – 教程 16

包络蜗轮蜗杆的几何分析

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1 任务

1.1 任务

计算中心距为 100 mm 的一对蜗轮蜗杆。蜗杆齿数为 2，蜗轮齿数 41。轴向/端面模数是 4。法向压力角是 20° 。蜗杆宽度是 60mm。应该选择一个合适的蜗轮宽度。中心距公差是 js7。

蜗杆的法向齿厚偏差是 0 到-0.04mm，蜗轮齿厚偏差差是从-0.128 到-0.168，蜗杆外径 44-0.01mm，齿根圆直径 26.4-0.110mm，有效顶隙是 0.8mm，齿根圆角系数为 0.2，内圆直径是 134.4mm。

蜗轮外径公差是 0 到-0.01，有效齿根圆直径公差是从-0.360 到-0.473。蜗杆加工精度等级是 DIN3974 的 6 级，蜗轮的加工精度等级是 7 级。导程方向为向右。蜗杆是 ZI 型。

1.2 启动蜗轮蜗杆传动的设计模块

你可以在软件安装并激活后打开 KISSsoft。通常可以点击"Start→Program Files→KISSsoft 03-2017→KISSsoft 03-2017"启动程序。打开后用户界面如下所示：

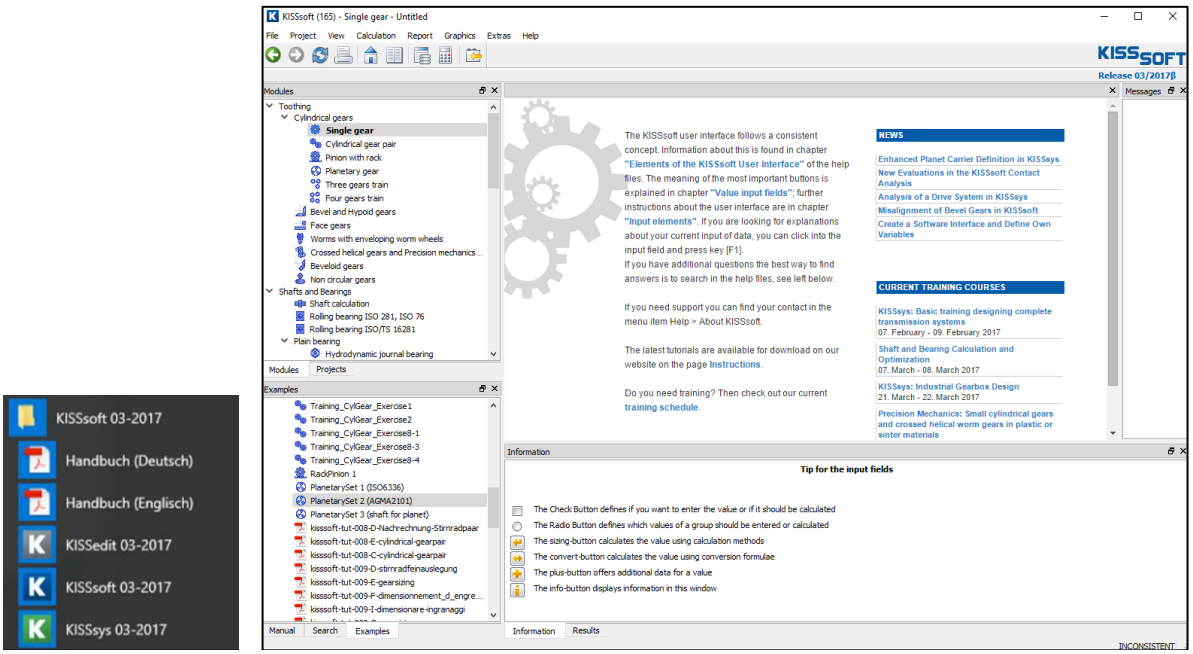

图 1. 打开 KISSsoft，初始界面

在模型树窗口中，点击**"Modules 模块"** 标签去启动 **"Worms with enveloping worm wheels 包络蜗轮蜗杆"** 计算模块：

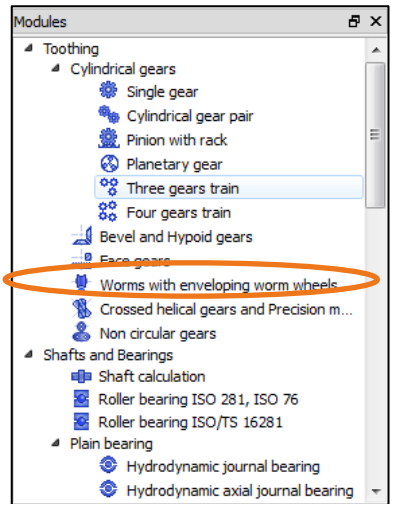

图 2. 启动蜗轮蜗杆计算模块

1.3 主界面参数的输入

启动**'Worms with enveloping worm wheels 包络蜗轮蜗杆'**模块后，会出现输入参数的主界面。如果只需要执行几何计算部分，可取消菜单选项中的**"Calculation 计算 -> Rating 校核"** 。

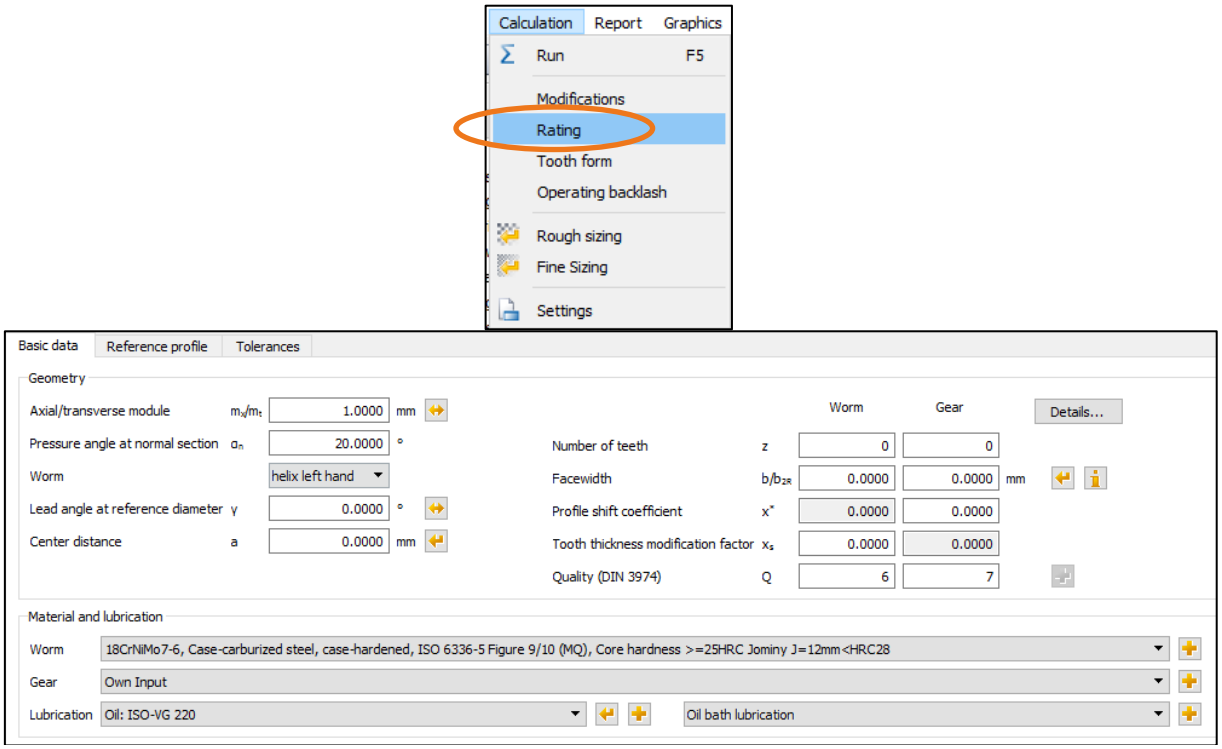

图 3. 蜗轮蜗杆的输入界面

在**"Basic data 基本参数"** 中输入轴向/端面模数、齿数、精度、及蜗轮蜗杆齿宽的值。中心距（1）的必须给定的。 接下来可以计算导程角。 可点击 **"转换按钮"**  （2） 扭矩并点击 **"Calculate"** （3） 去计算导程角。最后，点击接受 （4）将数据导入到主界面（见图 4）。

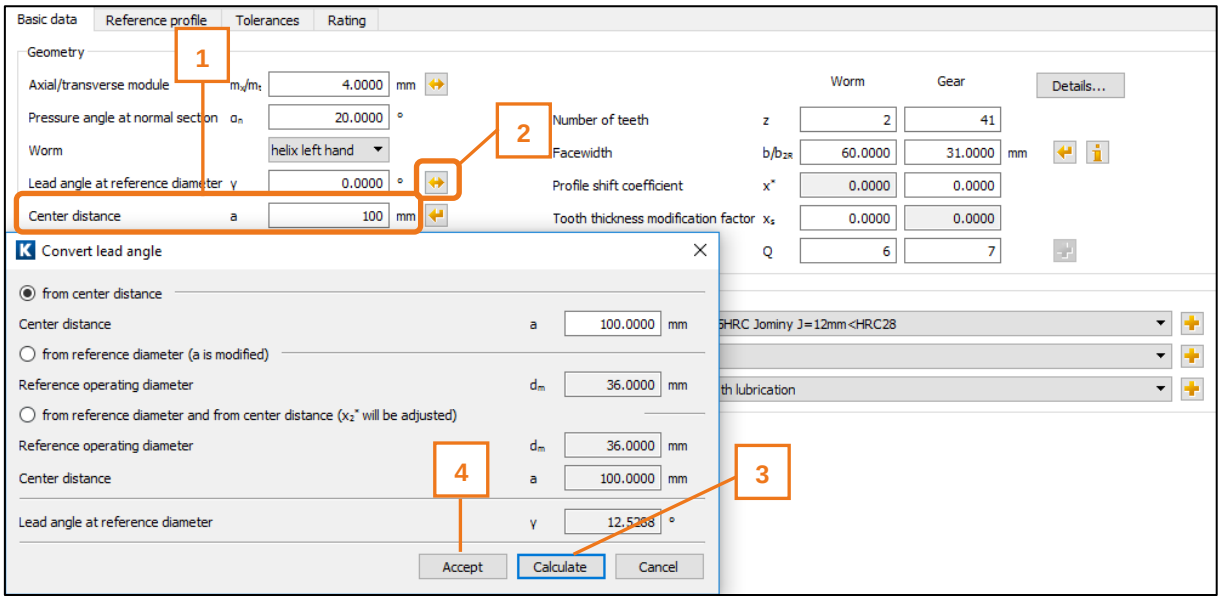

图 4. 计算导程角的转换输入界面

点击 **"Details 详细"** 按钮，打开**"Define details of geometry 几何细节定义"** 子屏幕，然后选择合适的齿形 ZI。需要输入蜗轮内径是 134.4 mm。

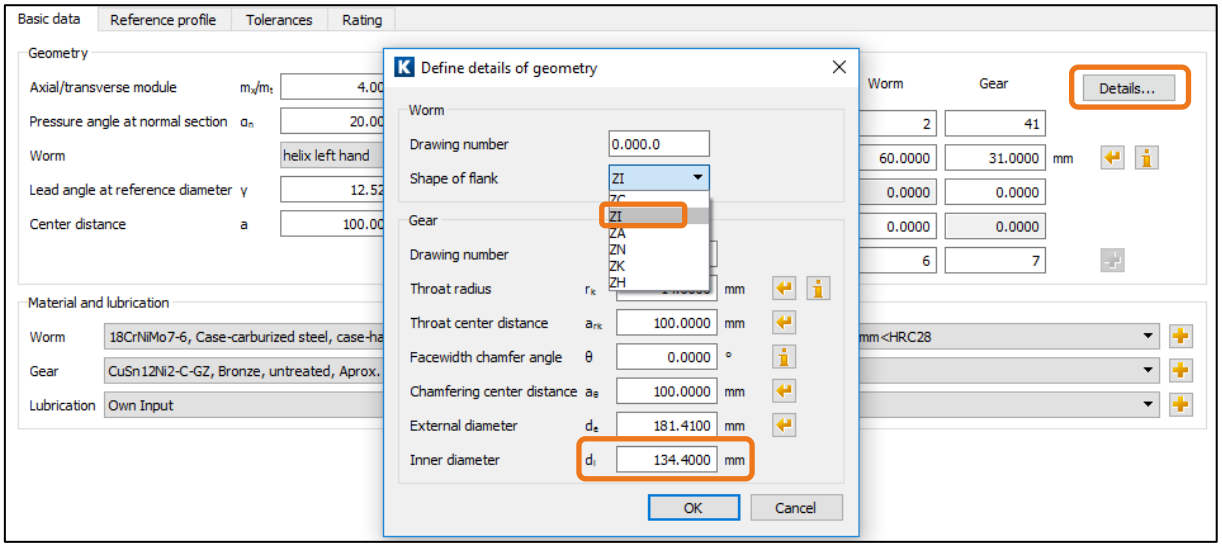

图 5. "Define details of geometry" 输入子界面

1.4 蜗轮齿面特征

蜗轮几何齿廓在标准中定义的概念，跟圆柱齿轮是不同的方式。

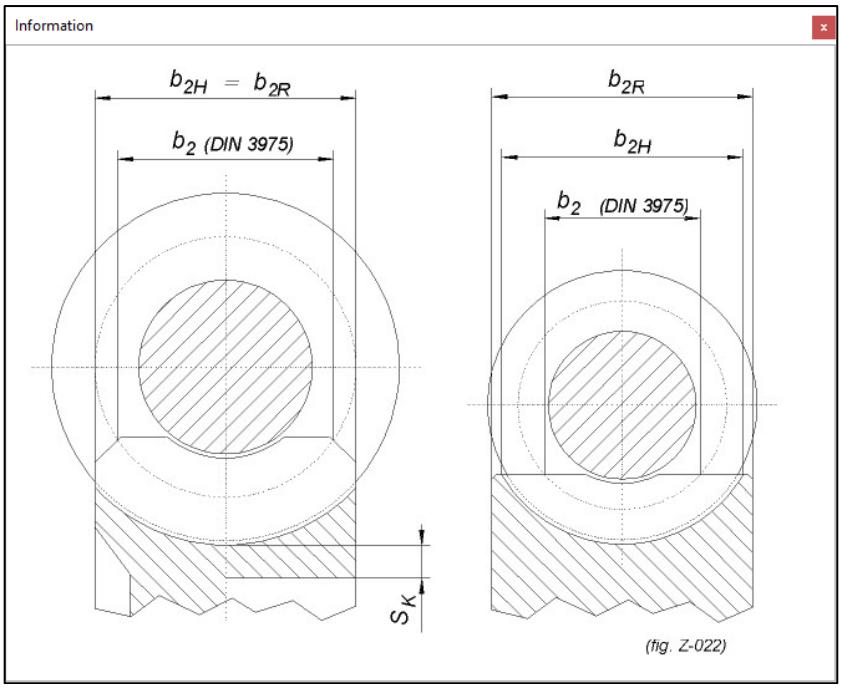

图 6. 信息显示图中描述了轮毂宽度 b_{2R} 和蜗轮齿宽 b_{2H}

点击 **"Sizing 选型"**  按钮去计算齿宽。

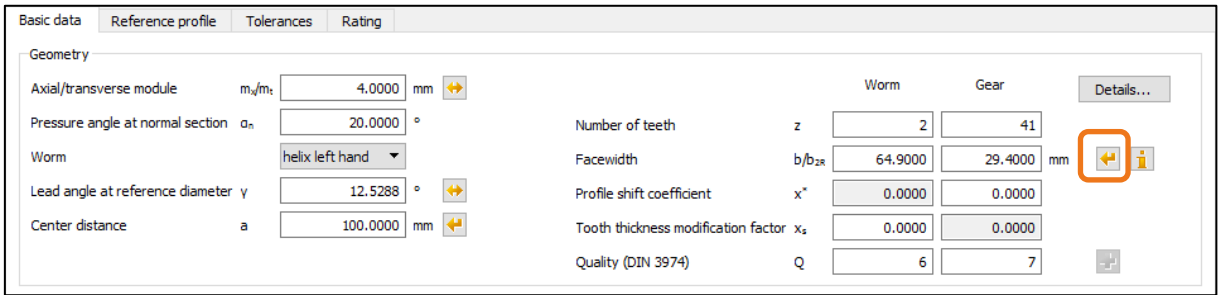

图 7. 计算轮毂宽 b_{2R}

1.5 蜗轮副参数的输入

在 **"Reference profile 基准齿廓"** 标签内，选择**"Own Input 自定义"** 作为预定义的刀具齿廓 。然后点击合适的**转换**  按钮去计算蜗杆的齿顶圆直径、齿顶高系数和齿根高系数。然后点击接受后，这些值都会转移到主界面上。

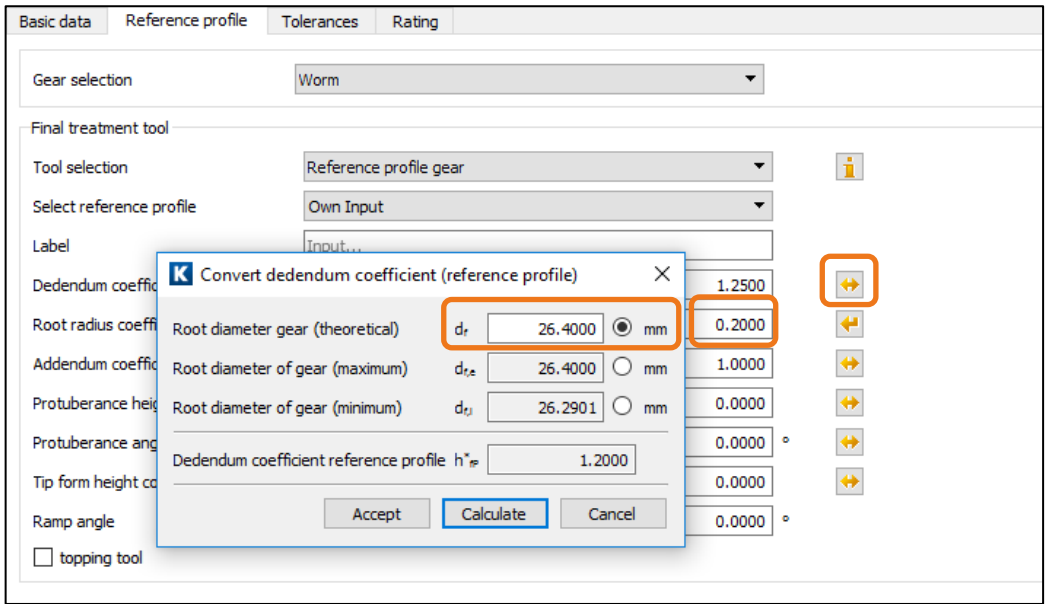

图 8.计算蜗杆齿根圆或齿顶圆直径

输入齿根圆角系数为 0.2。有效顶隙决定了蜗轮齿顶圆或齿根圆直径。
齿根圆直径计算公式：
（中心距 – 蜗杆齿顶圆直径/2 – 顶隙）·2 =（100 - 44/2 - 0.8）·2 = 154.4 mm。
齿顶圆直径计算公式：
（中心距 – 蜗杆齿根圆直径/2 – 顶隙）·2 =（100 - 26.4/2 - 0.8）·2 = 172 mm。

再次点击相关 **"转换"**  按钮去计算出蜗轮齿根高系数和齿顶高系数。然后点击接受将值转移到主界面中。

注释：当打开蜗轮计算时，系统已经提供了预定义的基本设置。当然，这些默认的齿廓参数 1.25/ 0.38/ 1 ISO 53 A 并不符合设计的需要。软件已经在以上窗口中显示出计算的详细齿顶圆直径。
圆柱蜗杆的详细几何参数还包括喉圆半径和外圆直径 d_{e2} 。

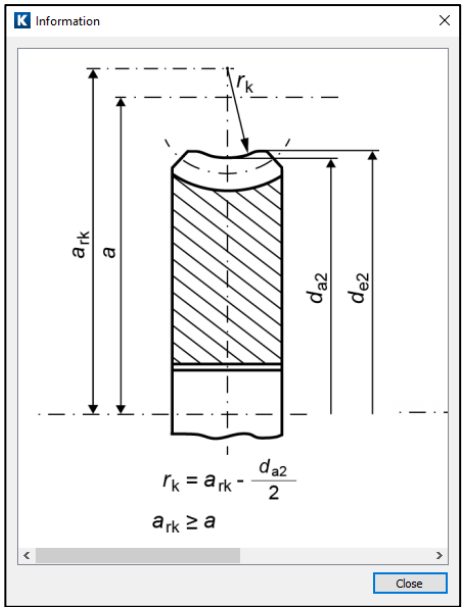

图 9.圆柱蜗杆的几何参数

在 **"Basic data 基本参数"** 标签中，点击 **"Details 详细"** 按钮打开**"Define details of geometry 几何细节定义"** 子界面。然后点击选型按钮计算出所需的喉圆半径 r_k 和外圆直径 d_{e2} 。更多信息见图 10。

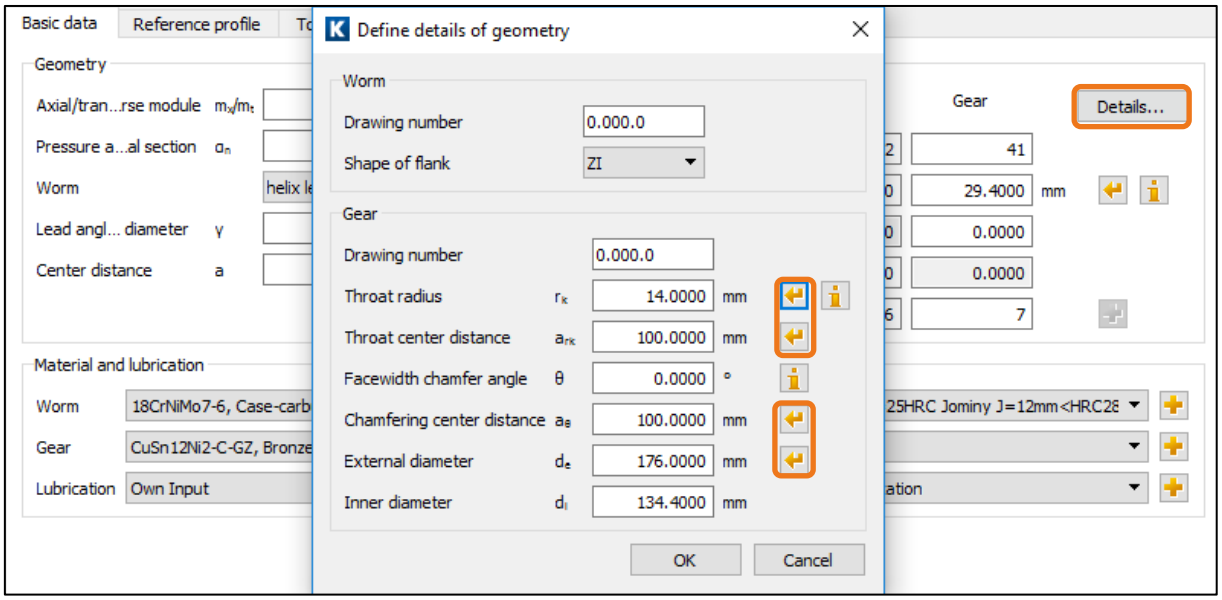

图 10. 计算喉圆半径 r_k 和外圆直径 d_e， 喉圆中心距 a_{rk} 及 倒角中心距 a_e

1.6 公差输入

在**"Tolerances 公差"** 标签中，选择 **"Own Input 自定义"** 来代替预定义尺寸。然后根据默认值输入齿厚公差及齿顶圆直径公差。

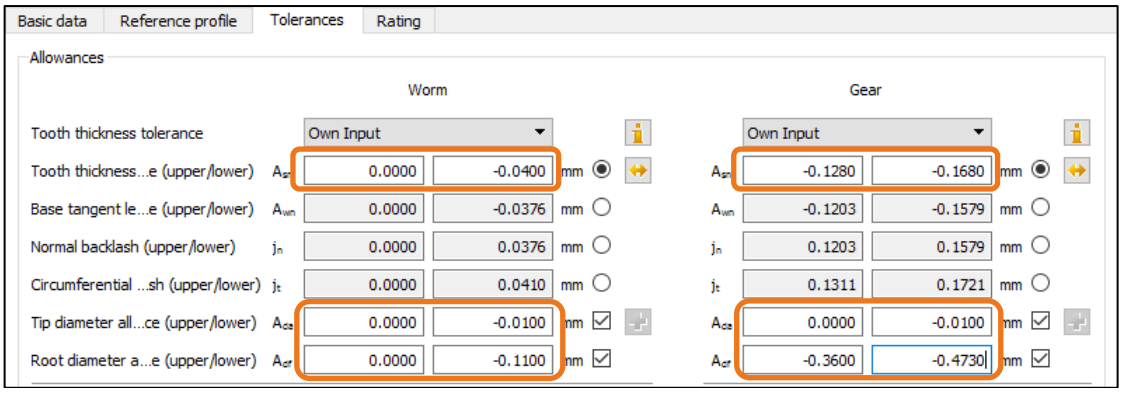

图 11. 输入齿厚公差和齿顶圆直径公差

然后检查齿根直径公差，必要时可修改它。
现在选择中心距公差。

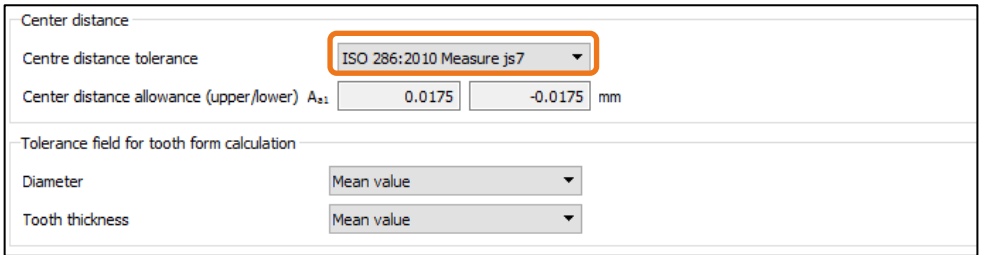

图 12. 输入中心距公差

在执行强度计算前，需要设置以下参数：蜗杆宽度为 60mm，增加蜗轮宽度 b_{2R} 到 31mm，外圆直径 d_{e2} 到 181.41mm。

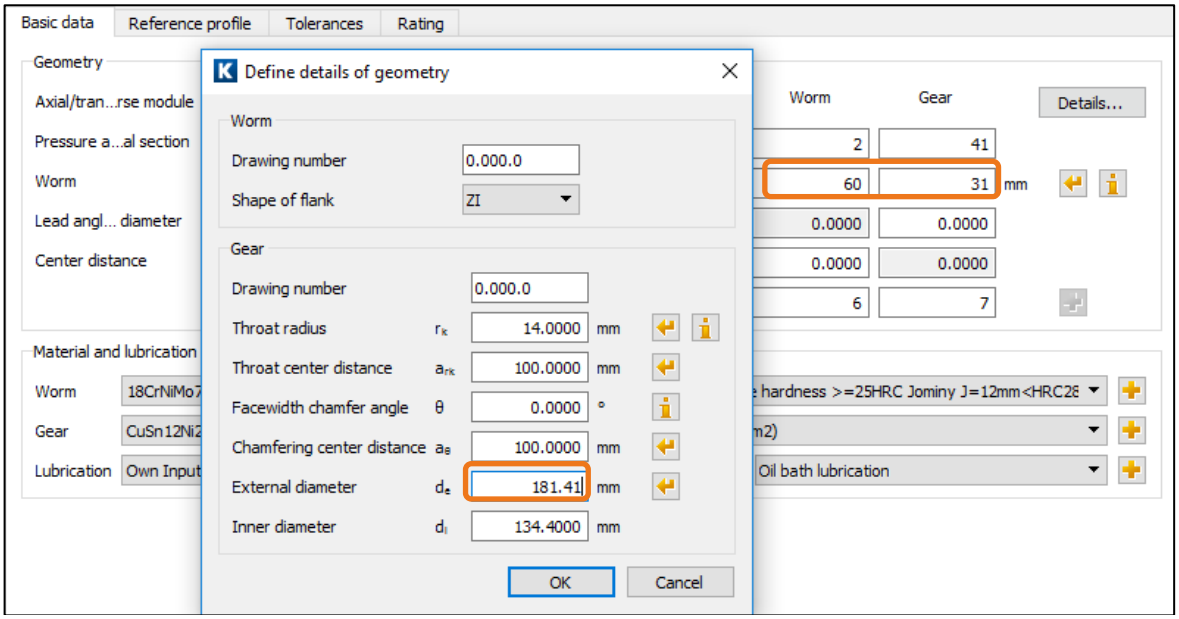

图 13. 最终输入

这些都是计算的结果。

2 强度计算

各种不同的算法已经都以文件的方式集成到手册中（章节 16）。如果有任何问题可以参照注释说明。通过点击" File 文件→Open 打开 "并选择"WormGear 1 (DIN3996 Example 1)"，打开本教程集成好的例子。

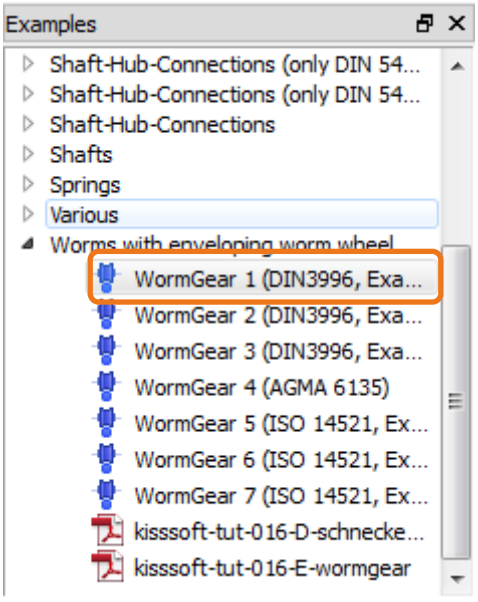

图 14. 打开计算案例

2.1 强度计算和几何计算结果

KISSsoft Release 03/2017 β

KISSsoft Calculation programs for machine design

File

Name : WormGear 1 (DIN3996, Example 1)
Description: KISSsoft example
Changed by: jreis on: 23.02.2017 at: 10:19:55

WORM GEAR ANALYSIS

Drawing or article number:
Worm: 0.000.0
Gear: 0.000.0

Calculation method DIN 3996:2012
(Geometry: DIN 3975:2002)
Geometry calculation from axial module

		------- WORM	---------- WHEEL ----
Worm driving			
Working flank gear 1: Right flank			
Power (kW)	[P]	5.302	4.500
Speed (1/min)	[n]	1500.0	73.2
Torque (Nm)	[T]	33.754	587.282
Application factor	[KA]	1.00	
Required service life	[H]	25000.00	
Number of starts (1/h)	[Ns]	0.00	

1. TOOTH GEOMETRY AND MATERIAL

Shape of flank: ZI (ISO/DTR 10828.2:2011)

		------- WORM	---------- WHEEL ----	
Center distance (mm)	[a]	100.000		
Centre distance tolerance				ISO 286:2010
Measure js7				
Shaft angle (°)	[Sigma]	90.0000		
Transverse module (mm)	[mt]		4.0000	
Normal module (mm)	[mn]	3.9047		
Axial module (mm)	[mx]	4.0000		
Pressure angle at normal section (°)	[alfn]	20.0000		
Mean lead angle (°)	[gamma]	12.5288		
Hand of gear		left	left	
Number of teeth	[z]	2		41
Facewidth (mm)	[b1]	60.00		
Wheel rim width b2R (mm)	[b2R]		31.00	
Wheel width b2H (mm)	[b2H]		31.00	
Facewidth for calculation (mm)	[b1, b2]	60.00	30.83	
Accuracy grade (manufacturing)	[Vqual]	6		7
Internal diameter gearbody (mm)	[di]	0.00	134.40	

Material
Worm: 16 MnCr 5 (1), Case-carburized steel, case-hardened
ISO 6336-5 Figure 9/10 (MQ), Core hardness >=25HRC Jominy J=12mm<HRC28
Gear 2: CuSn12Ni2-C-GZ, Bronze, untreated
DIN 3996:2005

			------- WORM	---------- WHEEL ----	
Surface hardness			HRC 59		HBW
95					
Pulsating shear strength (N/mm²)		[τFlim]	430.00	90.00	
Fatigue strength for Hertzian pressure (N/mm²)		[σHlim]	1500.00	520.00	
Material Coefficient YW		[YW]		0.95	
Material lubrication coefficient		[WML_PolyG]		1.75	
Tensile strength (N/mm²)	[σB]		1000.00	300.00	
Yield point (N/mm²)	[σS]		695.00	180.00	
Young's modulus (N/mm²)	[E]		206000		98100
Poisson's ratio	[v]		0.300	0.350	
Roughness average value DS, flank (µm)	[RAH]		0.50	2.00	
Roughness average value DS, root (µm)	[RAF]		0.50	2.00	
Mean roughness height, Rz, flank (µm)	[RZH]		3.00	8.00	
Mean roughness height, Rz, root (µm)	[RZF]		3.00	8.00	

Gear reference profile	1 :			
Reference profile	1.20 / 0.20 / 1.0 DIN 867:1986			
Dedendum coefficient		[hfP*]	1.200	
Root radius factor		[rhofP*]	0.200	(rhofPmax*= 0.498)
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	1.20 / 0.20 / 1.0 DIN 867:1986			
Dedendum coefficient		[hfP*]	1.200	
Root radius factor		[rhofP*]	0.200	(rhofPmax*= 0.498)
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*]	1.200	1.200
Tooth root radius Refer. profile	[rofP*]	0.200	0.200
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:	none (only running-in)		
Tip relief (µm)	[Ca]	0.0	0.0

Lubrication type	Oil bath lubrication
Type of oil (Own input)	Öl: ISO-VG 220
Lubricant base	Synthetic oil based on Polyglycol

Kinem. viscosity oil at 40 °C (mm²/s)	[nu40]	220.00
Kinem. viscosity oil at 100 °C (mm²/s)	[nu100]	37.00
Specific density at 15 °C (kg/dm³)	[roOil]	1.020
Oil temperature (°C)	[TS]	73.226
Ambient temperature (°C)	[TU]	20.000

		------- WORM---------- WHEEL ----
Generating angle (°)	[alfa0]	20.000
Pressure angle at normal section (°)	[alfn]	20.000

Indications for the manufacture of the worm wheel according to ISO 14521:
(Only valid for worm wheels which are manufactured with a hob similar to the worm.)

Mean lead angle of the worm (°)	[gamma]	12.5288
Transverse module (mm)	[mt]	4.0000
Reference diameter (mm)	[d]	164.000
Reference operating diameter (mm)	[dm]	164.000
Throat radius (mm)	[rk]	14.000
Throat center distance (mm)	[a_rk]	100.000
Facewidth chamfer angle (°)	[theta]	0.0000
Chamfering center distance (mm)	[a_theta]	100.000
External diameter (mm)	[de]	181.410
Tip diameter (mm)	[da]	172.000
Profile shift coefficient	[x-worm]	0.0000
Pitch on reference circle (mm)	[p2]	12.566

Indications for the manufacture of the worm wheel as a cylindrical gear
(This specification is only a suggestion. It is necessary to do a calculation of the exact geometry using the crossed-helical calculation!)

Pressure angle at Transverse section (°)	[alft]	(59.205)	20.448
Pressure angle at axial section (°)	[alfx]	(20.448)	59.205
Helix angle at reference circle (°)	[beta]	(77.471)	12.529
Lead angle at reference diameter (°)	[gamma]	(12.529)	77.471
Transverse module (mm)	[mt]	(18.000)	4.000
Axial module (mm)	[mx]	(4.000)	18.000
Helix angle at operating pitch circle (°)	[betas]	(77.471)	12.529
Operating pitch diameter (mm)	[dw]	(36.000)	164.000
Profile shift coefficient	[x-DIN3960]	(0.0000)	0.0000

Overall transmission ratio	[itot]	-20.500	
Gear ratio	[u]	20.500	
Base helix angle (°)	[betab]		11.762
Reference centre distance (mm)	[ad]	100.000	
Diametral factor q	[q]	9.000	
Sum of profile shift coefficients	[Summexi]	0.0000	
Profile shift coefficient	[x-worm]	0.0000	0.0000
Profile shift (x*m) (mm)	[x*mx]	0.0000	0.0000

(The profile shift is related to the axial module of the worm subject to ISO TR 14521:2010/DIN 3975:2002.)

Tip alteration (mm)	[k*mn]	0.000	0.000
Theoretical tip clearance (mm)	[c]	0.800	0.800
Effective tip clearance (mm)	[c.e/i]	1.059/ 0.963	0.877/ 0.782
Reference operating diameter (mm)	[dm]	36.000	164.000
Reference diameter (mm)	[d]		164.000
Base diameter (mm)	[db]		153.666
Tip diameter (mm)	[da]	44.000	172.000
Tip form diameter (mm)	[dFa]	44.000	172.000
(mm)	[dFa.e/i]	44.000/ 43.990	172.000/ 171.990

Tip diameter allowances (mm)	[Ada.e/i]	0.000/ -0.010	0.000/ -0.010
Root diameter (mm)	[df]	26.400	154.400
Generating Profile shift coefficient	[xE.e/i]		-0.0450/ -0.0591
Manufactured root diameter with xE (mm)	[df.e/i]	26.400/ 26.290	154.040/ 153.927
Lead height (mm)	[pz]	25.133	
Axial pitch (mm)	[px]	12.566	
Transverse contact ratio (approximate value following Thomas-Charchut)	[eps_a]	1.911	
For ZI-worms:			
Base diameter (mm)	[db]	18.431	
Base lead angle (°)	[gamb]	23.463	
Base pitch (mm)	[pb]	11.527	

2. FACTORS OF GENERAL INFLUENCE

		------- WORM----------	WHEEL ----
Nominal circum. force at pitch circle (N)	[Ft]	1875.2	7162.0
Axial force (N)	[Fa]	-7162.0	-1875.2
Radial force (N)	[Fr]	2847.3	-2847.3
Normal force (N)	[Fn]	8343.7	
Circumferential speed reference circle (m/s)	[v]	2.827	0.628
Sliding velocity an mean circle (m/s)	[vgm]	2.896	
Number of load cycles (in mio.)	[NL]	2249.999	109.756
Data of reference gearbox:			
Equivalent Young's modulus (N/mm²)	[EredT]	150622.00	
Surface roughness of worm (µm)	[RaT]	0.500	
Center distance (mm)	[aT]	100.000	
Transmission ratio	[uT]	20.500	
Reference operating diameter (mm)	[dm1T]	36.000	164.000
Characteristic value for mean Hertzian pressure	[pmT*]	0.962	
Characteristic value for mean lubricant gap thickness	[hT*]	0.070	
Characteristic value for mean sliding path	[sT*]	30.800	
Physical characteristic values:			
Characteristic value for mean lubrication Space width	[h*]	0.0692	
Characteristic value for mean Hertzian pressure	[pm*]	0.9470	
Characteristic value for mean sliding path	[s*]	30.2850	
Efficiency according method C:			
Rolling bearing with set support			
Bearing loss-power (kW)	[PVLP]	0.126	
Number of sealings (worm-shaft)	[nVD]	2	
Sealing loss power (kW)	[PVD]	0.046	
Idle loss power (kW)	[PV0]	0.153	
Base friction number	[muOT]	0.0245	
Size factor	[YS]	1.000	
Geometry factor	[YG]	1.006	
Roughness factor	[YR]	1.000	
Material Coefficient YW	[YW]	0.950	
Mean tooth friction number	[muzm]	0.0234	
Tooth friction angle (°)	[roz]	1.341	
Meshing efficiency (%)	[etaz]	90.002	
Mesh loss power (kW)	[PVZ]	0.477	
Total loss power (kW)	[PV]	0.802	
Total efficiency (%)	[etaGes]	84.872	

Gear mass temperature:		
Lubrication type		Oil bath lubrication
Worm submerges into lubricant		
Cooling area of wheel-pair (cm²)	[AR]	50.840
Heat-transfer coefficient wheels (W/m²/K)	[alfL]	24439.990
Gear mass temperature (°C)	[theM]	77.1
Oil sump temperature (°C)	[theS]	73.2

3. WEAR STRENGTH ACCORDING METHOD B,C

Mean lubricant gap thickness (µm)	[hminm]	0.2480
(hminm calculated with etaOM= 0.0642 Ns/m2 theM=77.1°)		
Pressure factor	[WH]	1.0000
Factor for lubricant structure	[WS]	2.6140
Factor for start	[WNS]	1.0000
Characteristic value	[Kw]	0.6484
Wear intensity	[JOT]	5.10181e-010
Wear intensity	[Jw]	8.92817e-010
Wear path (m)	[sWm]	815829
Wear removal (mm)	[delWn]	0.728
Permissible tooth thickness reduction (coefficient in module)	[DeltaS]	0.300
Permissible mass decrease (kg)		
Normal tooth thickness at tip circle (mm)	[san]	2.907
(mm) [san.e/i]		2.778/ 2.731
Permissible wear on flank (mm)	[delWlimn]	1.171
Limited by: Permissible tooth thickness decrease		
Safety against wear	[SW]	1.608
Required safety	[SWmin]	1.100
As information:		
Achievable service life (with SW = 1.100) (h)	[Lh]	36551.07

4. PITTING RESISTANCE ACCORDING METHOD B,C

		------- WORM---------- WHEEL ----
Equivalent Young's modulus (N/mm²)	[Ered]	149673.38
Mean contact stress (N/mm²)	[sigHm]	367.36
Life coefficient	[Zh]	1.000
Speed factor	[ZV]	0.851
Size factor	[ZS]	1.000
Lubrication factor	[Zoil]	1.000
Ratio factor	[Zu]	1.000
Boundary value of average contact stress (N/mm²)	[sigHG]	442.766
Safety factor for contact stress	[SH]	1.205
Required safety	[SHmin]	1.000
As information:		
Achievable service life (with SHmin = 1.000) (h)	[Lh]	76640.67

5. DEFLECTION SAFETY

Bearing distance l1 (mm)	[l1]	150.000
Distance l11 (mm)	[l11]	75.000
Deflection (mm)	[delm]	0.030
Boundary value bending (mm)	[dellim]	0.080
Safety for deflection	[Sdel]	2.632

Required safety	[Sdelmin]	1.000

6. TOOTH ROOT STRENGTH ACCORDING METHOD C

		------- WORM	---------- WHEEL ----
Calculation taking into account the decrease of the tooth thickness due to wear			
(with minimum (delWn, delWlimn))			
Tooth thickness at root (mm)	[sft2]		9.663
Tooth form factor	[YF2]		1.200
Contact ratio factor	[Yeps]		0.500
Lead coefficient	[Ygam]		1.024
Rim thickness (mm)	[sk2]		10.000
Rim thickness coefficient	[YK2]		1.000
Nominal shear stress at tooth root (N/mm²)	[tauF2]		35.51
No Quality reduction by small plastic deformation is accepted.			
Life coefficient	[YNL]		1.000
Boundary value of shear stress at tooth root (N/mm²)	[tauFG]		90.00
Safety for tooth root stress	[SF]		2.534
Required safety	[SFmin]		1.100

7. TEMPERATURE SAFETY ACCORDING METHOD C

Housing with cooler		
Ambient temperature (°C)	[TU]	20.0
Oil temperature (°C)	[theOil]	73.2
Boundary value oil temperature (°C)	[theSlim]	100.0
Temperature safety	[ST=theSlim/theOil]	1.366
Required safety	[STmin]	1.100
Oil sump temperature (°C)	[theS]	73.2
(Safety	[theSlim/theS]	1.366)

8. ALLOWANCES FOR TOOTH THICKNESS

Tooth thickness deviation

Worm:	Own Input
Gear:	Own Input

		------- WORM	---------- WHEEL ----
Tooth thickness allowance (normal section) (mm)	[As.e/i]	0.000/ -0.040	-0.128/ -0.168
Backlash free center distance (mm)	[aControl]	99.820/ 99.707	
Backlash free center distance, allowances (mm)	[jta]	-0.180/ -0.293	
Number of teeth spanned	[k]		5.000
Base tangent length (mm)	[Wk]		54.275
Actual base tangent length ('span') (mm)	[Wk.e/i]		54.155/ 54.117
Diameter of contact point (mm)	[dMWk.m]		162.549
Base tangent length (span): Can only be measured, if the worm-wheel is manufactured like a cylindrical gear!			
Theoretical diameter of ball/pin (mm)	[dm]	6.545	6.615
Effective diameter of ball/pin (mm)	[DMeff]	7.000	7.000
Radial single-ball measurement backlash free (mm)	[MrK]		87.190
Radial single-ball measurement (mm)	[MrK.e/i]	87.034/ 86.985	
Diameter of contact point (mm)	[dMMr.m]	37.166	164.455
Diametral measurement over two balls without clearance (mm)	[MdK]		174.257

Diametral two ball measure (mm)	[MdK.e/i]	173.946/173.848		
Theoretical dim. over 3 wires (mm)	[Md3R]	46.559		
Measurement over 3 pins (mm)	[Md3R.e/i]	46.559/46.452		
Normal tooth thickness (chord) in the reference circle (mm)	[sc]	6.133	6.132	
(mm)	[sc.e/i]	6.133/6.093	6.004/5.964	
Tooth thickness in the transverse section (chord) in the reference circle (mm)	['st]			6.282
(mm)	['st.e/i]		6.151/6.110	
Tooth thickness in the transverse section (Arc) (mm)	[st]		6.283	
(mm)	[st.e/i]		6.152/6.111	
Tooth thickness on axial cut (mm)	[smx]	6.283		
(mm)	[smx.e/i]	6.283/6.242		
Tooth space in axial cut (mm)	[emx]	6.283		
(mm)	[emx.e/i]	6.283/6.324		
Reference chordal height from da.m (mm)	[ham1, ha2]	3.997	4.052	

Centre distance allowances (mm)	[Aa.e/i]	0.018/-0.018
Circumferential backlash (transverse section) (mm)	[jt]	0.226/0.118
Normal backlash (mm)	[jn]	0.207/0.108

9. GEAR ACCURACY

		------- WORM	---------- WHEEL ----	
According to DIN 3974:1995:				
Accuracy grade	[Vqual]	6		7
Single pitch deviation (µm)	[fpx, fp2]	8.50	13.00	
Adjacent pitch difference (µm)	[fux, fu2]	11.00	16.00	
Total deviation of the slope (µm)	[Fpz]	11.00		
Total cumulative pitch deviation (µm)	[Fp2]		51.00	
Profile slope deviation (µm)	[fHa]	7.50	11.00	
Profile form deviation (µm)	[ffa]	11.00	15.00	
Total profile deviation (µm)	[Fa]	13.00	19.00	
Runout (µm)	[Fr]	18.00	35.00	
Single flank composite, total (µm)	[Fi']	29.00	56.00	
Single flank composite, tooth-to-tooth (µm)	[fi']	15.00	22.00	

10. ADDITIONAL DATA

Weight - calculated with da (kg)	[Mass]	0.456	1.812
Start under load:			
Tooth friction number (acc. Niemann)	[muzm_S]	0.140	
Torque (Nm)	[T1_S]	48.195	587.282

11. SERVICE LIFE, DAMAGE

Required safety for tooth root	[SFmin]	1.10	
Required safety for tooth flank	[SHmin]	1.00	
Service life (calculated with required safeties):			
System service life (h)	[Hatt]	36551	
Tooth root service life (h)	[HFatt]	1e+006	1e+006
Tooth flank service life (h)	[HHatt]	1e+006	7.665e+004

Note: The entry 1e+006 h means that the Service life > 1,000,000 h.

Damage calculated on the basis of the required service life [H] (25000.0 h)

F1%	F2%	H1%	H2%
0.00	0.00	0.00	32.62

Damage calculated on basis of system service life [Hatt] (36551.1 h)

F1%	F2%	H1%	H2%
0.00	0.00	0.00	47.69

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

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

Gear		fac	b	t0	T	R(H)%
1	Tooth root	90000	1.7	9.654e+029	1.484e+030	100.00
1	Tooth flank	90000	1.3	9.014e+029	4.295e+030	100.00
2	Tooth root	4390	1.7	9.654e+029	1.484e+030	100.00
2	Tooth flank	4390	1.3	3.033e+008	1.445e+009	100.00

Reliability of the configuration for required service life (%) 100.00 (Bertsche)

REMARKS:

- Specifications with [.e/i] imply: Maximum [e] and Minimal value [i] with consideration of all tolerances
- The specification of circumferential backlash (as well as the backlash-free distance for the tooth thickness check) is not yet fully checked, and serves only as a guide.
- The details of the chordal tooth thickness are imprecise and merely an indication (The calculation is done according to ISO TR 14521:2010/DIN 3975:2002, without taking into account the exact shape of flank.).
- In ISO14521 and DIN3996, the necessary data for each material are not always complete. In such a case you get the message: "Not calculated (material data missing)'

End of Report lines: 428