KISSsoft Release 03/2015 F

KISSsoft evaluation

File

Name : BevelGear 1 (Klingelnberg)
Description: KISSsoft example
Changed by: kspl on: 07.03.2016 at: 10:50:06

BEVEL-GEAR-CALCULATION (BEVEL-GEAR-PAIR)

Drawing or article number:
Gear 1: 0.000.0
Gear 2: 0.000.0

Calculation method Bevel gear Klingelnberg Cyclo-Palloid KN3028/KN3030 V1.2
Geometry calculation according ISO 23509:2006, method 3
Uniform depth, fig 3 (Klingelnberg)
Manufacture process: ground/hard-cut
Spiral toothing
Face hobbing (continuing indexing method)

		------- GEAR 1 --------	GEAR 2 -------
Power (kW)	[P]	100.000	
Speed (1/min)	[n]	1450.0	295.4
Rotation direction, wheel 1, viewed on cone tip:		left	
Torque (Nm)	[T]	658.6	3233.0
Application factor	[KA]	1.25	
Power distribution factor	[Kgam]	1.00	
Required service life	[H]	20000.00	
Gear driving (+) / driven (-)		+	-

1. TOOTH GEOMETRY AND MATERIAL

		------- GEAR 1 --------	GEAR 2 -------
Hypoid offset (mm)	[a]	0.000	
Shaft angle (°)	[Sigma]	90.0000	
Mean normal module (mm)	[mmn]	5.0000	
Pressure angle at normal section (°)	[alfn]	20.0000	
Mean spiral angle (°)	[betm]	30.0000	
Hand of gear		left	right
Number of teeth	[z]	11	54
Facewidth (mm)	[b]	50.00	50.00

Assumed and measured contact pattern width (mm)	[be]	42.50	42.50
Accuracy grade according to DIN 3965	[Q-DIN3965]	6	6
Internal diameter gearbody (mm)	[di]	0.000	0.000
Pitch apex to front of gear blank (mm)	[yi]	133.359	40.360
Pitch apex to back of gear blank (mm)	[yo]	182.353	50.340
H misalignment (P misalignment) (µm)	[DeltaH]	0.000	
G misalignment (µm)	[DeltaG]	0.000	
V misalignment (E misalignment) (µm)	[DeltaV]	0.000	

Material

Gear 1:	18CrNiMo7-6, Case-carburized steel, case-hardened ISO 6336-5 Figure 9/10 (MQ), core strength >=25HRC Jominy J=12mm<HRC28
Gear 2:	18CrNiMo7-6, Case-carburized steel, case-hardened ISO 6336-5 Figure 9/10 (MQ), core strength >=25HRC Jominy J=12mm<HRC28

Surface hardness		HRC 61	HRC 61
Fatigue strength. tooth root stress (N/mm²)	[sigFlim]	430.00	430.00
Fatigue strength for Hertzian pressure (N/mm²)	[sigHlim]	1500.00	1500.00
Tensile strength (N/mm²)	[Rm]	1200.00	1200.00
Yield point (N/mm²)	[Rp]	850.00	850.00
Young's modulus (N/mm²)	[E]	206000	206000
Poisson's ratio	[ny]	0.300	0.300
Roughness average value DS, flank (µm)	[RAH]	0.60	0.60
Roughness average value DS, root (µm)	[RAF]	3.00	3.00
Mean roughness height, Rz, flank (µm)	[RZH]	4.80	4.80
Mean roughness height, Rz, root (µm)	[RZF]	20.00	20.00

Gear reference profile 1 :

Reference profile	1.25 / 0.30 / 1.0 Cyclo-Palloid	
Dedendum coefficient	[hfP*]	1.250
Root radius factor	[rhofP*]	0.300 (rhofPmax*= 0.429)
Addendum coefficient	[haP*]	1.000
Tip radius factor	[rhoaP*]	0.000
Protuberance height factor	[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 / 0.30 / 1.0 Cyclo-Palloid	
Dedendum coefficient	[hfP*]	1.250

Root radius factor	[rhofP*]	0.300 (rhofPmax*= 0.515)
Addendum coefficient	[haP*]	1.000
Tip radius factor	[rhoaP*]	0.000
Protuberance height factor	[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*]	0.300	0.300
Addendum Reference profile	[haP*]	1.000	1.000
Protuberance height factor	[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 (without running-in)

Tip relief (µm)	[Ca]	33.0	33.0

Tip alteration, outside, height (mm)	[hake]	0.000	0.000
Tip alteration, outside, length (mm)	[l_hake]	0.000	0.000
Tip alteration, inside, height (mm)	[haki]	0.110	0.000
Tip alteration, inside, length (mm)	[l_haki]	3.200	0.000

Reduction of tooth contact area through tip alteration (%) [delF] 0.035

Notice: Tip alteration are used only for 3D geometry and measurement grid generation.
The strength calculation will ignore the input.

Lubrication type		oil injection lubrication
Type of oil		Oil: BP XP 100
Lubricant base		Mineral-oil base
Kinem. viscosity oil at 40 °C (mm²/s)	[nu40]	96.00
Kinem. viscosity oil at 100 °C (mm²/s)	[nu100]	11.10
FZG test A/8.3/90 (ISO 14635-1:2006)	[FZGtestA]	12
Specific density at 15 °C (kg/dm³)	[roOil]	0.901
Oil temperature (°C)	[TS]	70.000

		------- GEAR 1 --------	GEAR 2 -------
Overall transmission ratio	[itot]	-4.909	
Gear ratio	[u]	4.909	
Outer spiral angle (°)	[bete]	37.8519	37.8519

Mean spiral angle (°)	[betm]	30.0000		30.0000
Inner spiral angle (°)	[beti]	21.8411		21.8411
Pinion offset angle in axial plane (°)	[zetm]		0.0000	
Pinion offset angle in pitch plane (°)	[zetmp]		0.0000	
Offset in pitch plane (mm)	[ap]		0.000	
Outer normal module (mm)	[men]		5.2752	
Outer transverse module (mm)	[met]	6.6808		6.6808
Mean normal module (mm)	[mmn]		5.0000	
Mean transverse module (mm)	[mmt]	5.7735		5.7735
Inner normal module (mm)	[min]		4.5169	
Inner transverse module (mm)	[mit]	4.8662		4.8662
Sum of profile shift coefficients	[xhm1+xhm2]		0.0000	
Profile shift coefficient	[xhm]	0.4000		-0.4000
Undercut boundary	[xGrenz]	0.3720		
Profile shift coef. for balanced sliding	[xGleit]	0.4758		
Tooth thickness modification coefficient	[xsmn]	0.0300		-0.0300
Outer pitch diameter (mm)	[de]	73.489		360.763
Outer tip diameter (mm)	[dae]	87.207		361.961
Outer root diameter (mm)	[dfe]	65.160		357.470
Mean pitch diameter (mm)	[dm]	63.509		311.769
Mean tip diameter (mm)	[dam]	77.227		312.967
Mean root diameter (mm)	[dfm]	55.180		308.476
Inner pitch diameter (mm)	[di]	53.528		262.775
Inner tip diameter (mm)	[dai]	67.247		263.973
Inner root diameter (mm)	[dfi]	45.199		259.482
Addendum (mm)	[hae]	7.000		3.000
(mm)	[ham]	7.000		3.000
(mm)	[hai-haki]	6.890		3.000
Dedendum (mm)	[hfe]	4.250		8.250
(mm)	[hfm]	4.250		8.250
(mm)	[hfi]	4.250		8.250
Tooth height (mm)	[he]	11.250		11.250
(mm)	[hm]	11.250		11.250
(mm)	[hi]	11.140		11.250
Working depth (mm)	[whe]		10.000	
(mm)	[whm]		10.000	
(mm)	[whi]		9.890	
Tip clearance (mm)	[ce]	1.250		1.250
(mm)	[cm]	1.250		1.250
(mm)	[ci]	1.250		1.360
Outer cone distance (mm)	[Re]	184.086		184.086
Mean cone distance (mm)	[Rm]	159.086		159.086
Inner cone distance (mm)	[Ri]	134.086		134.086
Pitch angle (°)	[delta]	11.5138		78.4862

Face angle (°)		[dela]	11.5138	78.4862
Addendum angle (°)		[thea=dela-delta]	0.0000	0.0000
Root angle (°)		[delf]	11.5138	78.4862
Dedendum angle (°)		[thef=delta-delf]	0.0000	0.0000
Distance along axis to crossing point (mm)		[txo]	178.984	33.805
	(mm)	[txi]	129.990	23.825
Distance apex to crossing point (mm)		[tz]	0.000	-0.000
	(mm)	[tzF]	35.069	3.062
	(mm)	[tzR]	-21.292	-8.419
Distance in axial direction to the cone tip (mm)		[ye]	180.382	36.744
	(mm)	[yae]	178.984	33.805
	(mm)	[yai]	129.990	23.825

Theoretical tip clearance (mm)	[c]	1.250	1.250
Effective tip clearance (mm)	[c.e/i]	1.250 / 1.260	1.250 / 1.260

According to Klingelnberg instruction for bevel gears:

Transverse contact ratio	[epsa]	1.231
Overlap ratio	[epsb]	1.588

****** **Virtual cylindrical gear toothing** ******

Pressure angle at normal section (°)	[alfvn]	20.0000	
Pressure angle at pitch circle (°)	[alfvt]	22.7959	
Helix angle at reference circle (°)	[betv]	30.0000	
Base helix angle (°)	[betvb]	28.0243	
Virtual centre distance (mm)	[av]	813.373	
Working transverse pressure angle (°)	[alfvwt]	22.7959	
Number of teeth	[zv]	11.226	270.535
Gear ratio	[uv]	24.099	

Generating Profile shift coefficient	[xvE.e/i]	0.4000 / 0.4000	-0.4000 / -0.4000
Theoretical tip clearance (mm)	[c]	1.250	1.250
Effective tip clearance (mm)	[c.e/i]	1.250 / 1.260	1.250 / 1.260
Reference diameter (mm)	[dv]	64.813	1561.932
Base diameter (mm)	[dvb]	59.750	1439.931
Tip diameter (mm)	[dva]	78.813	1567.932
Tip form diameter (mm)	[dvFa]	78.813	1567.932
Active tip diameter (mm)	[dvNa]	78.813	1567.932
Operating pitch diameter (mm)	[dvw]	64.813	1561.932
Root diameter (mm)	[dvf]	56.313	1545.432
Root form diameter (mm)	[dvFf]	60.320	1547.792
Active root diameter (mm)	[dvNf]	60.547	1551.938
Reserve (dNf-dFf)/2 (mm)	[cF]	0.114	2.073
Normal-tooth thickness at tip circle (mm)	[svan]	2.782	3.903
Normal-tooth thickness on tip form circle (mm)	[svFan]	2.782	3.903

Virtual gear no. of teeth	[zvn]	16.635	400.884
Maximum sliding speed at tip (m/s)	[vga]	2.036	1.187
Pitch on reference circle (mm)	[pvt]	18.138	
Base pitch (mm)	[pvbt]	16.721	
Transverse pitch on contact-path (mm)	[pvet]	16.721	
Length of path of contact (mm)	[gva]	20.802	

Virtual cylindrical gear toothing (ISO 10300:2001, Annex A):

Referenced to facewidth	[bveff]	50.000
Transverse contact ratio	[epsva]	1.244
Overlap ratio	[epsvb]	1.592
Total contact ratio	[epsvg]	2.020

(DIN 3991: epsva = 1.244, epsvb = 1.353, epsvg = 2.597)

Characteristic values for sizing	[Re2/b2]	3.682
	[b2/mmn]	10.000

2. FACTORS OF GENERAL INFLUENCE

		------- GEAR 1 --------	GEAR 2 -------
Nominal circum. force at pitch circle (N)	[Fmt]	20739.6	20739.6
		Drive side	
Axial force (N)	[Fa]	13472.9	6150.9
Radial force (N)	[Fr]	6150.9	13472.9
Normal force (N)	[Fnorm]	25485.0	25485.0
Axial force (%)	[Fa/Ft]	64.962	29.658
Radial force (%)	[Fr/Ft]	29.658	64.962

Remarks:

Forces if rotation goes in opposite direction (coast side):

Axial force (N)	[Fa]	-9993.3	10931.1
Radial force (N)	[Fr]	10931.1	-9993.3
Normal force (N)	[Fnorm]	25485.0	25485.0
Axial force (%)	[Fa/Ft]	-48.184	52.706
Radial force (%)	[Fr/Ft]	52.706	-48.184

.184

Tangent.load at p.c.d.per mm (N/mm) (N/mm)	[w]	487.99	
Circumferential speed reference circle (m/s)	[v]	4.82	4.82
Singular tooth stiffness (N/mm*µm)	[c']	14.00	
Meshing stiffness (N/mm*µm)	[cg]	20.00	
Single pitch deviation (µm)	[fp]	12.00	14
.00			
Running-in value y.a (µm)	[ya]	1.05	
Reduced mass (kg/mm)	[mRed]	0.013	
Resonance speed (min-1)	[nE1]	33432	
Under critical range - resonance ratio	[N]	0.043	
Dynamic factor	[KV]	1.01	
Mounting factor	[KHbbe]	1.25	
Face load factor - flank	[KHb]	1.88	
- Tooth root	[KFb]	1.88	
- Scuffing	[KBb]	1.88	
Transverse load factor - flank	[KHa]	1.00	
- Tooth root	[KFa]	1.00	
- Scuffing	[KBa]	1.00	
Helical load factor scuffing	[Kbg]	1.24	
Number of load cycles (in mio.)	[NL]	1740.000	354
.444			

3. TOOTH ROOT STRENGTH

		------- GEAR 1 --------	GEAR 2 -------
Calculation of Tooth form coefficients according method: C			
Manufacture process: generated			
Calculated with profile shift	[x]	0.00	0.00
Tooth form factor	[YF]	2.24	2.26
Stress correction factor	[YS]	1.81	1.93
Bending lever arm (mm)	[hF]	10.02	9.74
Working angle (deg)	[alfh]	34.86	20.35
Tooth thickness at root (mm)	[sFn]	10.83	11.36
Tooth root radius (mm)	[roF]	1.97	1.82
(hF* = 2.003/ 1.947 sFn* = 2.166/ 2.272 roF* = 0.395/ 0.365)			
Contact ratio factor	[Yeps]	0.72	
Helix angle factor	[Ybet]	0.75	

Effective facewidth (mm)	[b]	42.50		42.50
Bevel gear factor (root)	[YK]		1.000	
Nominal stress at tooth root (N/mm²)	[sigF0]	213.77		229.82
Tooth root stress (N/mm²)	[sigF]	507.67		545.81
Permissible bending stress at root of Test-gear				
Notch sensitivity factor	[YdrelT]	1.002		1.006
Surface factor	[YRrelT]	1.015		1.015
size factor (Tooth root)	[YX]	1.000		1.000
Finite life factor	[YNT]	1.000		1.000
[YdrelT*YRrelT*YX*YNT]		1.017		1.021
Alternating bending factor (mean stress influence coefficient)				
	[YM]	1.000		1.000
Stress correction factor	[Yst]		2.00	
Yst*sigFlim (N/mm²)	[sigFE]	860.00		860.00
Permissible tooth root stress (N/mm²)	[sigFP=sigFG/SFmin]	624.90		626.96
Limit strength tooth root (N/mm²)	[sigFG]	874.87		877.74
Required safety	[SFmin]	1.40		1.40
Safety for Tooth root stress	[SF=sigFG/sigF]	1.72		1.61

4. SAFETY AGAINST PITTING (TOOTH FLANK)

		------- GEAR 1 --------	GEAR 2 -------
Zone factor	[ZH]		2.22
Elasticity coefficient (√N/mm)	[ZE]		189.81
Contact ratio factor	[Zeps]		0.897
Helix angle factor	[Zbet]		0.931
Bevel gear factor (flank)	[ZK]		0.850
Nominal flank pressure (N/mm²)	[sigH0]		838.07
Effective flank pressure (N/mm²)	[sigH]		1291.52
Lubrication coefficient at NL	[ZL]	1.000	1.000
Speed coefficient at NL	[ZV]	1.000	1.000
Roughness coefficient at NL	[ZR]	1.000	1.000
Work hardening factor at NL	[ZW]	1.000	1.000
Finite life factor	[ZNT]	1.000	1.000
	[ZL*ZV*ZR*ZNT]	1.000	1.000
Small no. of pittings permissible:	no		
Size factor (flank)	[ZX]	1.000	1.000
Permissible surface pressure (N/mm²)	[sigHP=sigHG/SHmin]	1500.00	1500.00
Limit strength pitting (N/mm²)	[sigHG]	1500.00	1500.00
Safety for surface pressure at operating pitch circle	[SHw]	1.16	1.16
Single tooth contact factor	[ZB/ZD]	1.00	1.00
Flank pressure (N/mm²)	[sigHB/D]	1291.52	1291.52

Required safety	[SHmin]	1.00	1.00
Safety for surface pressure on flank	[SH=sigHG/sigHB/D]	1.16	1.16

4c. Safety of the hardened layer (EHT) according to DNV41.2:2012

Required hardening depth EHT (mm)	[t550]	0.45/ 0.55	0.45/ 0.55
Required hardness at t550 (HV)	[HV.t]	550	550
Condition for hardness on the surface (HV)	[HV.0]	> 630 (HRC57)	> 630 (HRC 57)

HV.0 calculated with SH = min(1.2, SEHT), tz/aH = 0.5

Safety of the hardened layer	[SEHT]	1.04	1.04
Required safety	[SHssmin]	1.00	1.00
Result		3	3

(-1:Not checked 0:EHT too small 1:EHT too large or HV.0 too low 2:EHT too large (> 0.25*mn)
3:Proof performed and fulfilled, 4:Proof performed but not fulfilled)

4d. Tooth flank fracture according to ISO DTR 19042-1

Calculation according to Method B

Calculation at point (0:A, 1:AB, 2:B, 3:C, 4:D, 5:DE, 6:E, -1:No Point)		1	1
Diameter (mm)	[dy]	61.339	1566.322
Relative radius of curvature (mm)	[ρred]	7.684	7.684
Flank pressure (N/mm²)	[pH]	1583.013	1583.013
Flank pressure (N/mm²)	[pdyn]	2439.537	2439.537
Required hardening depth EHT (mm)	[t550]	0.45/ 0.55	0.45/ 0.55

The calculation is performed with the minimum hardening depth

Core hardness (HV)	[HV_{core}]	342	342

Hardness curve from: ISO/DTR 19042, chapter 7.3.2

Maximum utilization	[AFFmax]	1.669	1.669
Depth of maximum load (mm)	[y]	-0.855	-0.855
Material shear strength (N/mm²)	[τper]	170.406	170.406
Equivalent shear stress (N/mm²)	[τeff]	277.594	277.594
Safety	[SFF]	0.735	0.735

5. STRENGTH AGAINST SCUFFING

Calculation method according to Klingelnberg

Lubrication coefficient (for lubrication type)	[XS]	1.200	
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]	33.00	33.00

Optimal tip relief (µm)	[Ceff]	25.92	
Ca taken as optimal in the calculation (0=no, 1=yes)		0	0
Effective facewidth (mm)	[beff]	42.500	
Applicable circumferential force/facewidth (N/mm)	[wBt]	1436.529	
Angle factor (ε1:0.786, ε2:0.458)	[Xalfbet]	0.992	

Integral temperature-criteria			
Tooth mass temperature (°C)	[theM-C]	110.86	
theM-C = theoil + XS*0.70*theflaint	[theflaint]	48.64	
Integral scuffing temperature (°C)	[theSint]	363.42	
Flash factor (°K*N^-.75*s^.5*m^-.5*mm)	[XM]	50.058	
Contact ratio factor	[Xeps]	0.312	
Dynamic viscosity (mPa*s)	[etaOil]	23.13 (70.0 °C)	
Mean coefficient of friction	[mym]	0.088	
Geometry factor	[XBE]	0.433	
Meshing factor	[XQ]	1.000	
Tip relief factor	[XCa]	1.166	
Integral tooth flank temperature (°C)	[theint]	183.82	
Required safety	[SSmin]	1.800	
Safety factor for scuffing (intg.-temp.)	[SSint]	1.977	
Safety referring to transferred torque	[SSL]	2.578	

6. ALLOWANCES FOR TOOTH THICKNESS

		------- GEAR 1 --------	GEAR 2 -------
Tooth thickness deviation		No backlash	No backlash
Tooth thickness allowance (normal section) (mm)	[As.e/i]	0.000 / 0.000	0.000 / 0.000
The following data apply on the middle of the facewidth		(ISO23509):	
Tooth thickness (chordal) in pitch diameter (mm)	[smnc]	9.588	6.098
(mm)	[smnc.e/i]	9.588 / 9.588	6.098 / 6.098
Reference chordal height from dam (mm)	[hamc]	7.272	3.001
Circumferential backlash (mm)	[jmt]	-0.000 / -0.000	
(mm)	[jet]	-0.000 / -0.000	
Normal backlash (mm)	[jmn]	-0.000 / -0.000	
(mm)	[jen]	-0.000 / -0.000	

7. GEAR ACCURACY

		------- GEAR 1 --------	GEAR 2 --
According to DIN 3965:1986:			
Accuracy grade	[Q-DIN3965]	6	6

Total cumulative pitch deviation (µm)		[Fp]	41.00	55.00
Runout (µm)		[Fr]	31.00	40.00
Single flank composite, tooth-to-tooth	(µm)	[fi']	21.00	22.00
Single flank composite, total (µm)		[Fi']	47.00	59.00
Adjacent pitch difference (µm)		[fu]	15.00	17.00
According to Klingelnberg:				
Single pitch deviation (µm)		[fp]	12.00	14.00

8. MANUFACTURING ACCORDING KLINGELNBERG-PLANT STANDARD KN 3028

Machine type			AMK400	
Maximal machining distance (mm)	[MdGrenz]		250.0000	
Machine distance (mm)	[Md]		159.9791	
Cutter radius (mm)	[R, rc0]		135.00	
Number of cutter blade groups	[z0]		5.00	
Cutter blade module (mm)	[m0]		5.00	
Cutter edge radius (module) (module)	[roa0*]	0.300		0.300
Angle modification (°)	[thek]	0.0000		-0.0000
Reference diameter (mm)	[de]	73.49		360.76
Tooth no of plane gear	[ZP]		55.1090	
Base circle radius (mm)	[ro]		146.6717	
Outer spiral angle (°)	[bete]		37.8519	
Helix angle at tooth middle (°)	[betm]		30.0000	
Inner spiral angle (°)	[beti]		21.8411	
Outer normal module (mm)	[men]		5.2752	
Outer transverse module (mm)	[met]		6.6808	
Inner normal module (mm)	[min]		4.5169	
Inner transverse module (mm)	[mit]		4.8662	
Undercut limit (mm)	[Rv]		120.6375	
Spacewidth at tooth root at RY2 (mm)	[efny]	3.51		4.11
Spacewidth at tooth root at RE2 (mm)	[efne]	3.44		4.04
Spacewidth at tooth root at RI2 (mm)	[efni]	2.25		2.85
Head width of universal cutter (mm)	[sa0]		1.72	
Profile shift at inner diameter	[xi]	0.4000		
Tooth tip height (mm)	[ha]	7.000		3.000
Tooth height (mm)	[H]	11.250		11.250
Tooth tip thickness Middle (mm)	[sanm]	2.715		3.902
Tooth tip thickness inside (mm)	[sani]	1.501		3.135
Tip relief coefficient inside	[k]	0.022		0.000
Width of Tip relief (mm)	[bk]	3.201		0.000
Tip reduction cone angle (°)	[delak]	13.4837		0.0000
Virtual gear no. of teeth	[zn]	16.635		400.884
Transverse contact ratio	[epsa]		1.231	
Overlap ratio	[epsb]		1.588	

Dimensions according to Klingelnberg: (mm)		[dae]	87.207	361.961
	(mm)	[dai]	67.247	263.973
	(mm)	[(dai)k]	67.031	263.973
	(mm)	[LH]	180.382	36.744
	(mm)	[LA]	48.994	9.980
	(mm)	[LAK]	48.972	9.980
	(mm)	[LW]	129.990	23.825
	(mm)	[LWK]	130.012	23.825

Pinion designed with tip relief (condition: sani1 = 0.3*mmn)

9. DETERMINATION OF TOOTH FORM

Profile and tooth trace modifications for gear 1

Symmetric (both flanks)

- Profile crowning (barreling) Ca = 33.000µm
- Crowning Cb = 50.000µm ()

Profile and tooth trace modifications for gear 2

Symmetric (both flanks)

- Profile crowning (barreling) Ca = 33.000µm

Data for the tooth form calculation :
Data not available.

10. ADDITIONAL DATA

Input data for calculating the gear measurements according to ISO 23509:2006
Data of type 1 (according to table 3, ISO 23509:2006):
xhm1= 0.4000 khap= 1.0000 khfp= 1.2500 xsmn= 0.0300
Data of type 2 (according to table 3, ISO 23509:2006):
cham= 0.3000 kd= 2.0000 kc= 0.1250 kt= 0.0600

Calculation according to
Wech

Coefficient of friction	[mum]	0.071
Compound velocity (m/s)	[vSigm]	5.604
Loss factor	[HV]	0.173
Gear power loss (kW)	[PVZ]	1.219
Meshing efficiency (%)	[etaz]	98.781

Wech-Data: VR = 1.179 VS = 1.000 VZ = 0.959
XL = 1.000 Kgm = 0.088 (0.200)
ronC = 13.66 mm Fn*Cos(betb2)/b2 = 449.94 N/mm
etaOil(Oil) = 23.13 mPa*s VSigm = 5.60 m/s

Weight - calculated with da (kg)	[Mass]	1.807	6.061

11. 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]	>	1000000

Tooth root service life (h)	[HFatt]	1e+006	1e+006
Tooth flank service life (h)	[HHatt]	1e+006	1e+006

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

Damage calculated on basis of required service life

[H] (20000.0 h)

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

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
- Positive sign set for the apexes (tzF,tzR) means: Apex before the centerline. According to ISO 23509.

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