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KISSsoft Tutorial: Bevel Gears

1 Starting KISSsoft

1.1 Starting the software

Once you have installed and activated KISSsoft either as a test or licensed version, follow these steps to call the KISSsoft system. Start the program by clicking "Start→Program Files→KISSsoft 03-2011→KISSsoft". This opens the following KISSsoft user interface:

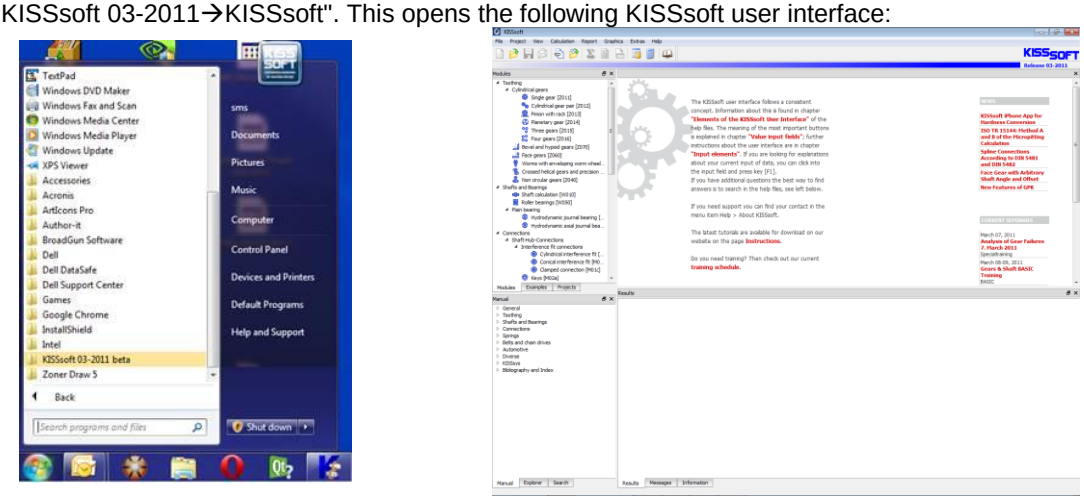


Figure 1.1 Starting KISSsoft, initial window

1.2 Starting the calculation module

Start the **"Bevel and hypoid gears"** calculation module by double-clicking the corresponding entry in the **"Modules"** window in the top left-hand corner of the main window.

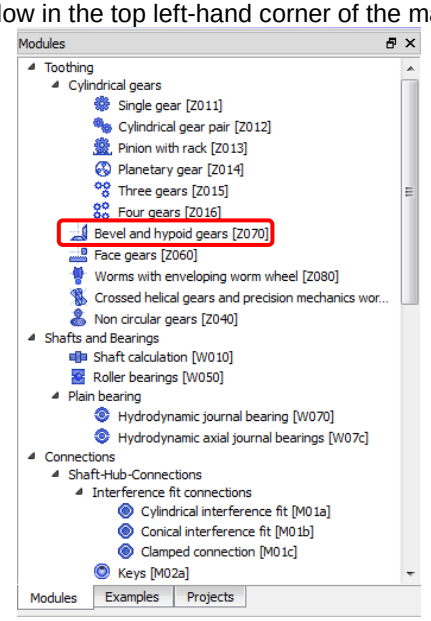


Figure 1.2 Selecting the "Bevel and hypoid gears" calculation module from the "Modules" window

2 Introduction

There are various different types of bevel gears, and every design has special features that must be taken into consideration. This tutorial describes these various designs and provides information about how they can be analyzed in the KISSsoft system.

2.1 Differential bevel gears

Differential bevel gears are usually straight toothed. For manufacturing reasons, their construction is usually very different from the theoretical design. Therefore, we recommend you use a different approach to analyze an existing set of bevel gears from a drawing.

The drawings for differential bevel gears often contain very little theoretical data. Usually, the drawing does not show a theoretical external tip diameter d_{ae} or an external reference diameter d_e. Instead it shows the finished external diameter so that the external reference diameter must be estimated.
It is also often not clear whether the module is the middle or external module. However, this can be checked quite easily with $m_{te} = d_e/z$. The transverse and normal modules are identical because the gear is straight toothed.

2.2 Calculating geometry in KISSsoft

1. In the **"Geometry"→"System data"** tab, select the **"Standard, fig 2 (Tip, Pitch and Root apex NOT in one point)"** option. This type allows you to input tip and root angles (see **Figure**).

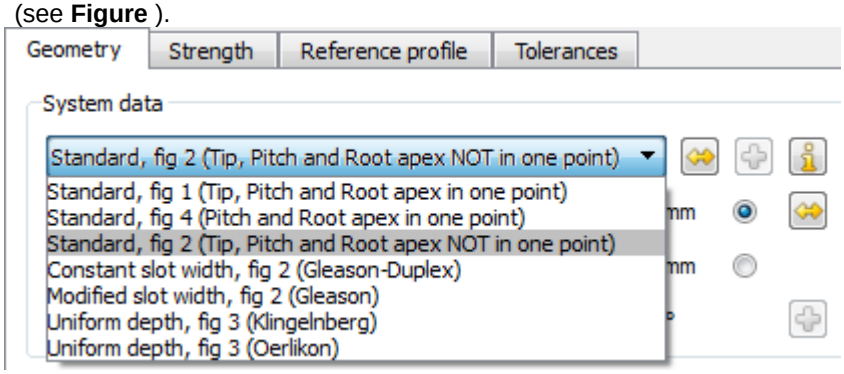


Figure 2.1 Selecting "Standard, fig 2" type

2. Input "Reference diameter gear 2 (outside)" or "Normal module (in middle)" according to the drawing. If the values are not specified on the drawing, use the graphics on the drawing to determine them.
3. Input the "Pressure angle" and "Number of teeth" in accordance with the drawing.
4. Input the "Facewidth". If the facewidth is not predefined, you must measure it on the drawing. Here, use the reference cone length.
5. Input the "Profile shift coefficient" and "Tooth thickness modification factor"= 0.
6. Before you can input the "Tip and root angle gear 2", you must first run the calculation with  or press "F5" to calculate the reference cone angle. Right-click on "Convert"  to input the tip and root angle. Then click "Calculate" to calculate the tooth angle and include this in the calculation (see **Figure**).

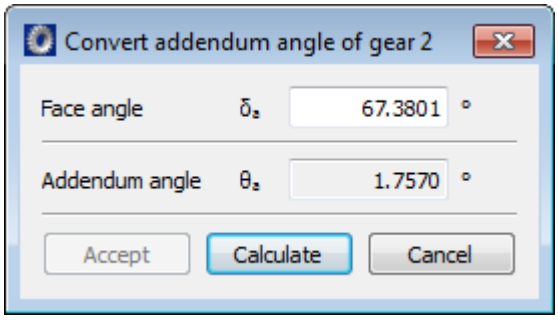


Figure 2.2 Input and convert tip and root angle

7. You do not need to enter anything under "Manufacturing data" because this data will be ignored
8. Either click Σ or press "F5" to run the calculation. To generate and open the report, click or press "F6". You can then compare the results in the report with the default data on the drawing, for example the angle (see **Figure**).

Additional angles (°):	[dela]	25.852	67.380
	[thea=dela-delta]	3.232	0.000
	[delf]	22.620	64.148
	[thef=delta-delf]	0.000	3.232

Figure 2.3 Bevel gear report, section 1 tooth geometry

2.3 Calculation of static strength

Differential bevel gears are usually calculated with static load because they usually operate in static applications. The static calculation only takes root fracture due to bending into account.

1. In the **"Strength"→"System data"** tab, select the **"Differential, static calculation"** calculation method (see **Figure**)

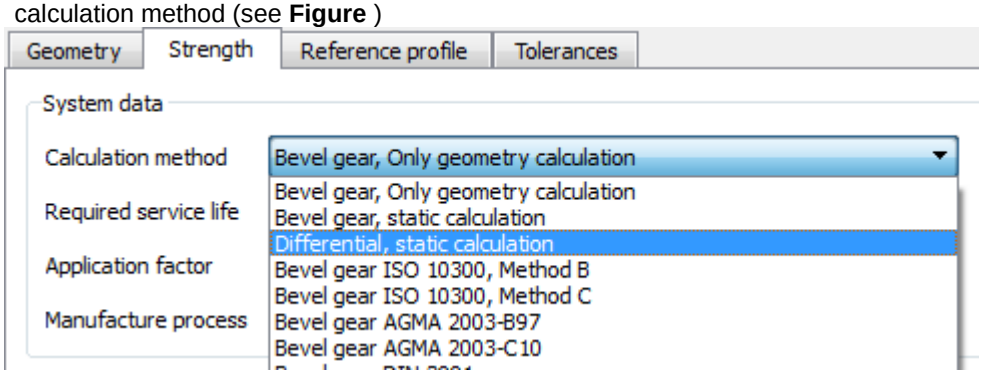


Figure 2.4 "Differential, static calculation" strength calculation

2. Input performance/torque/rotation data using the default values
3. Differential bevel gears are normally used with several strands. Check and input the **"Number of strands"** under **"Pair data"→"Details"**. The default value is 2, because this is the most common situation.
4. Either click Σ or press "F5" to run the calculation. To generate and open the report, click or press "F6".

2.4 Inputting an existing set of bevel gears from a Gleason data sheet

To analyze an existing set of bevel gears (with spiral toothing) using drawings or Gleason datasheets ("Gleason dimension sheets"), follow this procedure.

Bevel gear drawings and the Gleason dimension sheet usually contain precise, comprehensive information about intermeshing. In KISSsoft, use the **"Conversion from GLEASON data sheets"** function to input this data. The required data is m_{te2} (or d_{e2}), β_{m1}, Σ, a_v, r_{c0}, z_1, z_2, b, d_{ae}, h_e, δ_a

2.4.1 Calculating the geometry

1. In the **"Geometry"→"System data"** tab, select the **"Constant slot width"** or **"Modified slot width"** type (see **Figure**).

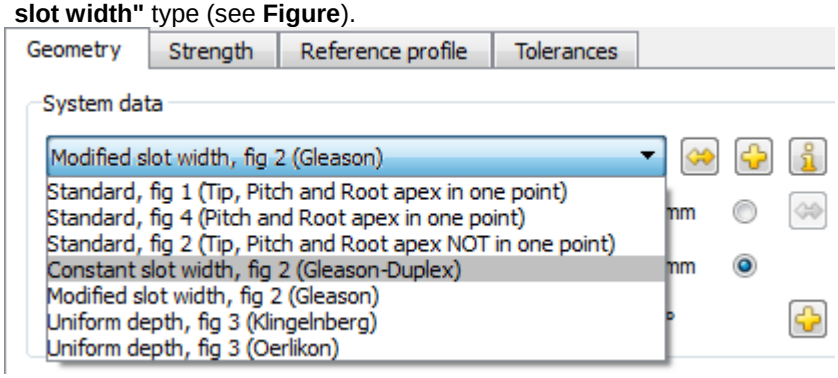


Figure 2.5 Selecting "constant slot width" type or "non constant slot width" type

2. Click on **"Conversion from GLEASON data sheets"** to the right of the type and input the data (see **Figure** and **Figure**).

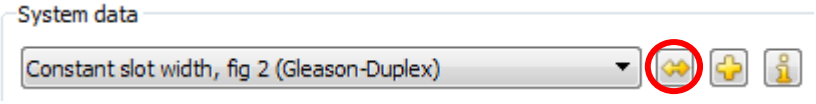


Figure 2.6 Conversion from GLEASON data sheets

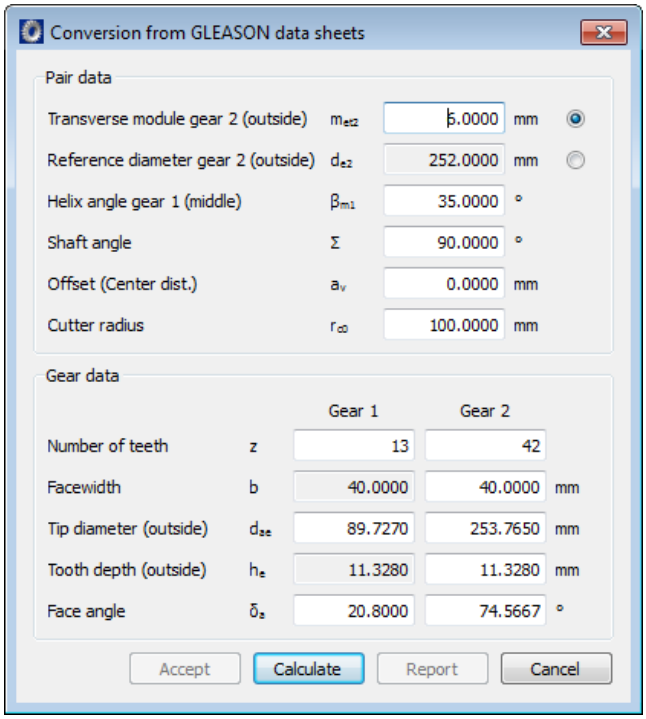


Figure 2.7 Inputting data from Gleason datasheets

Unfortunately, the cutter tip cutter radius is often not specified on the drawings. However, this value is usually present on Gleason datasheets.

3. Click "Calculate" and check the calculated values. Then click "Accept" to transfer them to the main input screen.
4. Either click  or press "F5" to run the calculation. To generate and open the report, click  or press "F6".

2.5 Dimensioning a bevel gear set with "Rough sizing"

You can use the **"Rough sizing"** function to dimension a new bevel gear set. Rough sizing uses formulae defined at Klingelnberg (in accordance with the Klingelnberg "Bevel gear" book), no matter which calculation method you select (ISO, DIN, AGMA:, Klingelnberg).

Important note:
This calculation process is designed for bevel gear sets without offset, and made of case-hardened steel, with a pressure angle of 20°. Other conditions in the main input screen are ignored. Despite that, Rough sizing can also be used for other bevel gears and supplies good initial values for further developments.

1. In the **"Geometry"→ "System data"** tab, select the required type (standard, Klingelnberg, Gleason).
2. Then input the performance data in the **"Strength"** tab (see **Figure**).

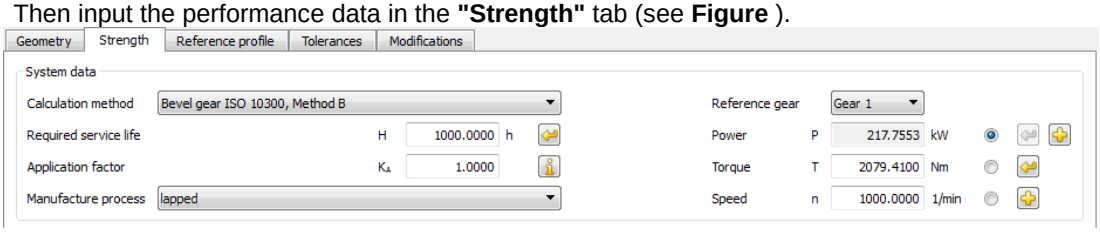


Figure 2.8 Inputting performance data

3. Select Rough sizing via **"Calculation"→"Rough sizing"** or click on 
4. Input the data to meet your requirements (see **Figure**)
   - Face width to normal module ratio: 8 to 12
   Values closer to 8 lead to higher modules and resistance to bending, and values closer to 12 lead to smaller modules and a higher contact ratio
   - Ratio of length of reference cone to tooth width: Re/b = 3.5.
   To avoid manufacturing problems using standard machines, the ratio should not be less than 3.
   - Helix angle: usually in the range 20° to 35° for the bevel gear (Gear 2)

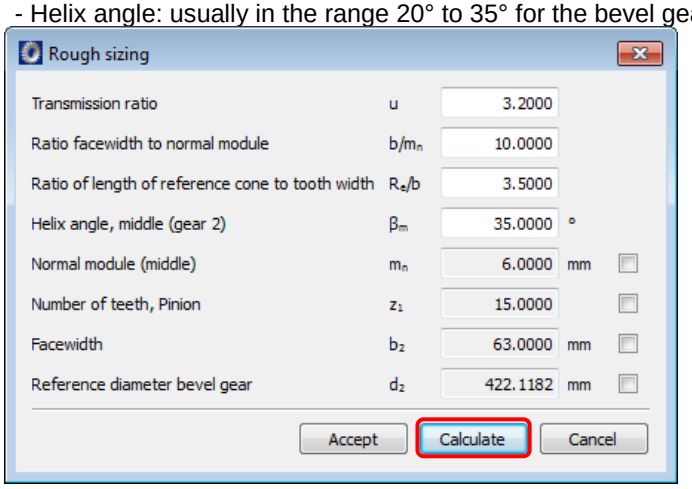


Figure 2.9 Rough sizing

5. Click "Calculate" to calculate the values.
6. If the calculated data cannot be output as required (e.g. the bevel gear reference circle is too large), you can predefine the value by setting the input flag and clicking "Calculate" again.
7. Click "Accept" to transfer the data to the main input screen.

2.6 Gleason spiral bevel gear and hypoid bevel gear

Gleason bevel gears are usually manufactured in a single part process (face milling). Due to their arc-shaped tooth length form, these gears can be ground after being heat treated. In the automobile industry, bevel gears are also lapped. However, Gleason also uses a continual hobbing process (face hobbing).

In the examples that follow, dimensioning has already been performed using **Rough sizing** so that the majority of the required data is already present (see section 2.5). For this reason only the specific entries for each method are described. However, if **Rough sizing** has not already been performed, you must input all the values manually.

2.6.1 Gleason, 5-section method

1. In the **"Geometry"→ "System data"** tab, select **"Modified slot width"** type (see **Figure**). The pinion space width changes due to the different machine settings for each flank.

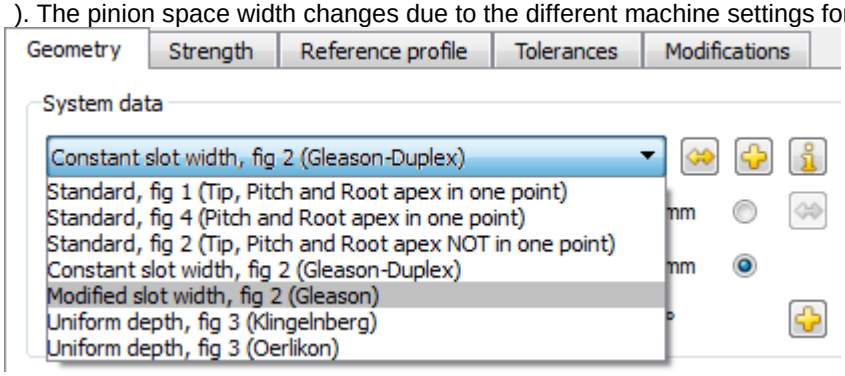


Figure 2.10 Selecting "Modified slot width" for 5-section bevel gears

2. Input the "pressure angle".
3. Click on the **"Plus button"**  to the right of "Pressure angle". Under **"Additional data hypoid gears"** you can input values for the "Nominal pressure angle" and the "Influencing factor limit pressure angle" (usually 1 for "Modified slot width"). If an offset (hypoid gear) is predefined, the influence of the "generated and effective contact angle" is included in the calculation.
4. Input the "spiral direction" for the pinion.
5. Click on the **"Plus button"**  to the right of "Helix angle". Then go to **"Additional data for spiral teeth"** and activate spiral toothing. If the Rough sizing function was used, spiral toothing is active.
6. Input the "Offset (Center dist.)" using the default conditions.
7. You can either input the **"Profile shift coefficient"** manually or click the Sizing button  to calculate it automatically. If the KISSsoft software determines an undercut, the profile shift coefficient is set to prevent undercut. All the other criteria (optimal specific sliding, etc.) are listed in the report and can be entered manually.
8. We recommend you use the Sizing function to calculate the tip and root angle. As the angles are affected by the cutter head radius, the reference profile and the profile shift, you must run the sizing function again if you want to change one of these values at a later point in time (see **Figure**).

Figure 2.11 Sizing function for tip and root angle

9. Under "Manufacturing data", select **"Face milling"** as the manufacturing process and then input the "Cutter radius". We recommend you use the sizing function  to the right of the "Cutter radius" input field to get a suggested value for the minimum cutter tip size (in accordance with Klingelnberg "Bevel gears", page 70) and then enter the cutter tip radius that was actually used during production. In addition, the system displays a warning message if the milling tip radius is smaller than the recommended value. This is because the meshing may not be correct for a practical application (see **Figure**).

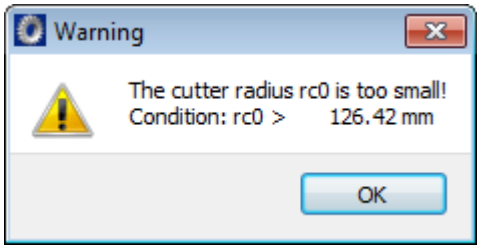


Figure 2.12 Warning if the cutter radius is smaller than the recommendation

The cone length (for hypoid gears) and the external and internal spiral angles are affected by the cutter tip radius. KISSsoft therefore checks whether the values are suitable.

10. In the **"Reference profile"** tab, either select a suitable reference profile or click **"Own input"**. The recommended tip clearance factor for a "modified slot width" is 0.3 (in accordance with Klingelnberg "Bevel gears", page 72), which is why you should input 1.3/0.3/1 manually.
11. In the **"Strength"** tab, select the required "Calculation method" (ISO, DIN, AGMA, VDI, or ISO proposition for hypoid gears). Under **"Materials, manufacturing types and lubrication"**, select the "For generated gears" or "Made by form cutting" settings to influence the tooth thickness at root. As a rule of thumb, for conversions i>2.5 the "Made by form cutting" process is selected for bevel gears because they can be manufactured more quickly with this process. The pinion is always generated. (See **Figure**).

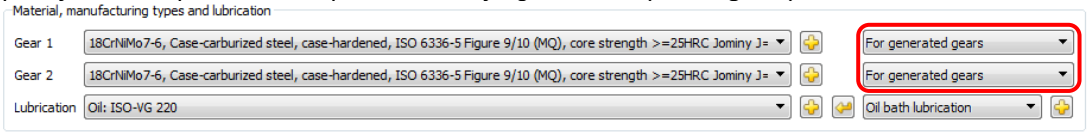


Figure 2.13 "For generated gears" and "Made by form cutting" manufacturing types

12. In the **"Tolerances"** tab, select tooth thickness deviation "ISO23509" to ensure the flank clearance and the appropriate tooth thickness allowance can be set automatically in accordance with the module. The **"No backlash"** option is also often selected because the clearance value is not set until the gear is assembled by changing the assembly dimensions.
13. Either click  or press "F5" to run the calculation. To generate and open the report, click  or press "F6".

2.6.2 Gleason, duplex method

1. In the **"Geometry"→"System data"** tab, select **"Modified slot width"** type (see **Figure**). The pinion has a constant space width because both flanks are created in the same manufacturing run.

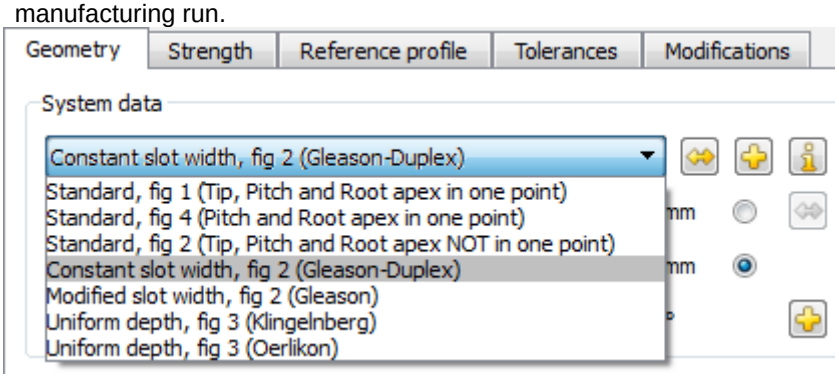


Figure 2.14 Selecting "Constant slot width" type for duplex bevel gears

2. Input the "pressure angle".
3. Click on the **"Plus button"**  to the right of "Pressure angle". Under **"Additional data hypoid gears"** you can input values for the "Nominal pressure angle" and the "Influencing

factor limit pressure angle" (usually 0 for "Constant slot width"). If an offset (hypoid gear) is predefined, the influence of the "generated and effective contact angle" is included in the calculation.

4. Input the "spiral direction" for the pinion.
5. Click on the **"Plus button"** to the right of "Helix angle". Then go to **"Additional data for spiral teeth"** and activate spiral toothing. If the Rough sizing function was used, spiral toothing is active.
6. Input the "Offset (Center dist.)" using the default conditions.
7. You can either input the **"Profile shift coefficient"** manually or click the Sizing button to calculate it automatically. If the KISSsoft software determines an undercut, the profile shift coefficient is set to prevent undercut. All the other criteria (optimal specific sliding, etc.) are listed in the report and can be entered manually.
8. We recommend you use the Sizing function to calculate the tip and root angle. As the angles are affected by the cutter head radius, the reference profile and the profile shift, you must run the sizing function again if you want to change one of these values at a later point in time (see **Figure**).

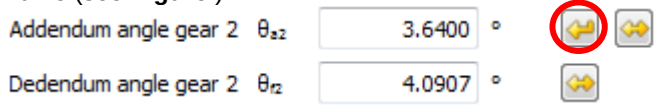


Figure 2.15 Sizing function for tip and root angle

9. Under "Manufacturing data", select **"Face milling"** as the manufacturing process and then input the "Cutter radius". We recommend you use the sizing function to the right of the "Cutter radius" input field to get a suggested value for the minimum cutter tip size (in accordance with Klingelnberg "Bevel gears", page 70) and then enter the cutter tip radius that was actually used during production. In addition, the system displays a warning message if the milling tip radius is smaller than the recommended value. This is because the meshing may not be correct for a practical application (see **Figure**).

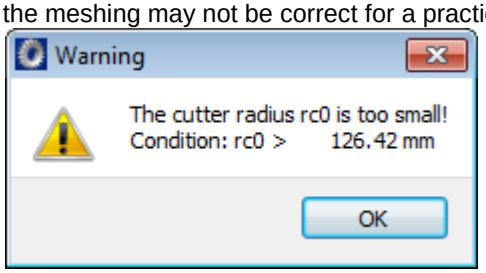


Figure 2.16 Warning if the cutter radius is smaller than the recommendation

The cone length (for hypoid gears) and the external and internal spiral angles are affected by the cutter tip radius. KISSsoft therefore checks whether the values are suitable.

10. In the **"Reference profile"** tab, either select a suitable reference profile or click **"Own input"**. The recommended tip clearance factor for a "Constant slot width" is 0.35 (in accordance with Klingelnberg "Bevel gears", page 72), which is why you should input 1.35/0.3/1 manually.
11. In the **"Strength"** tab, select the required "Calculation method" (ISO, DIN, AGMA, VDI, or ISO proposition for hypoid gears). Under **"Materials, manufacturing types and lubrication"** select the "For generated gears" or "Made by form cutting" settings to influence the tooth thickness at root. As a rule of thumb, for conversions i>2.5 the "Made by form cutting" process is selected for bevel gears because they can be manufactured more quickly with this process. The pinion is always generated. (See **Figure**).

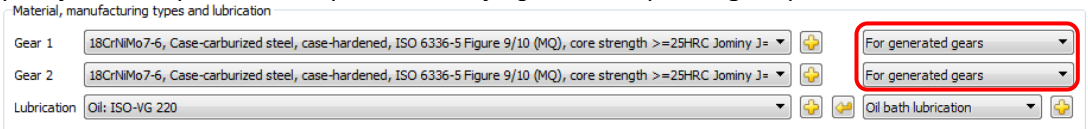


Figure 2.17 "For generated gears" and "Made by form cutting" manufacturing types

12. In the **"Tolerances"** tab, select tooth thickness deviation "ISO23509" to ensure the flank clearance and the appropriate tooth thickness allowance can be set automatically in accordance with the module. The **"No backlash"** option is also often selected because the clearance value is not set until the gear is assembled by changing the assembly dimensions.
13. Either click  or press "F5" to run the calculation. To generate and open the report, click  or press "F6".

2.6.3 Gleason, face hobbing

If the Gleason face hobbing method is to be used (i.e. Triac, Pentac FH), we recommend you use the Oerlikon method (see **Figure**).

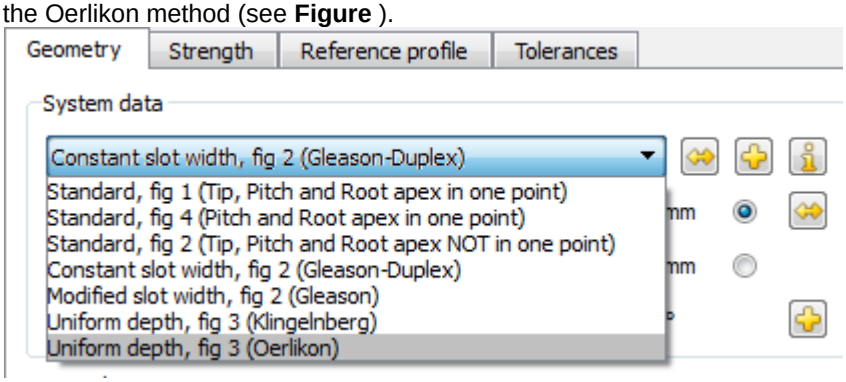


Figure 2.18 Selecting "Uniform depth, fig 3 (Oerlikon)" type

2.7 Klingelnberg cyclo-palloid

The cyclo-palloid procedure a continuous hobbing process (face hobbing). The bevel gears have a uniform depth. Cyclo-palloid bevel gears are often used for small series gears or large bevel gear sets.

In the examples that follow, dimensioning has already been performed using **Rough sizing** so that the majority of the required data is already present (see section 2.5). For this reason only the specific entries for each method are described. However, if **Rough sizing** has not already been performed, you must input all the values manually.

1. In the **"Geometry"→ "System data"** tab, select the **"Uniform depth, fig 3 (Klingelnberg)"** type (see **Figure**).

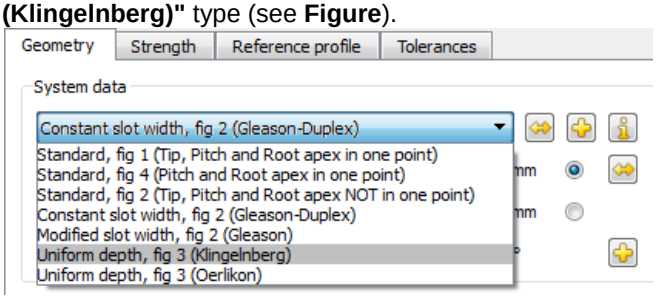


Figure 2.19 Selecting "Uniform depth" type for cyclo-palloid procedure

2. Input the "pressure angle".
3. Click on the **"Plus button"**  to the right of "Pressure angle". Under **"Additional data hypoid gears"** you can input values for the "Nominal pressure angle" and the "Influencing factor limit pressure angle" (usually 0 for "Cyclo-palloid procedure"). If an offset (hypoid gear) is predefined, the influence of the "generated and effective contact angle" is included in the calculation.
4. Input the "spiral direction" for the pinion.

5. Click on the **"Plus button"** to the right of "Helix angle". Then go to **"Additional data for spiral teeth"** and activate spiral toothing. If the Rough sizing function was used, spiral toothing is active.
6. Input the "Offset (Center dist.)" using the default conditions.
7. You can either input the **"Profile shift coefficient"** manually or click the Sizing button to calculate it automatically. If the KISSsoft software determines an undercut, the profile shift coefficient is set to prevent undercut. All the other criteria (optimal specific sliding, etc.) are listed in the report and can be entered manually.
8. If necessary, input "Angle modification gear 1".
9. Under **"Manufacturing data"** select **"Face hobbing"** as the manufacturing process, and enter the "Cutter radius" and the "Number of tools blade groups". We recommend you use the sizing function to the right of the "Cutter radius" input field to get a suggested value for the minimum cutter tip size (in accordance with Klingelnberg "Bevel gears", page 70) and then enter the cutter tip radius that was actually used during production. As an alternative you can transfer the cutter tip from the **"List of Klingelnberg machines"** if the checkbox is active (see **Figure**).

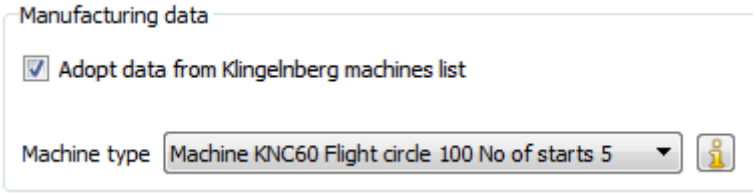


Figure 2.20 Selecting the cutter tip from the list of Klingelnberg machines

In addition, the system displays a warning message if the milling tip radius is smaller than the recommended value. This is because the meshing may not be correct for a practical application (see **Figure**).

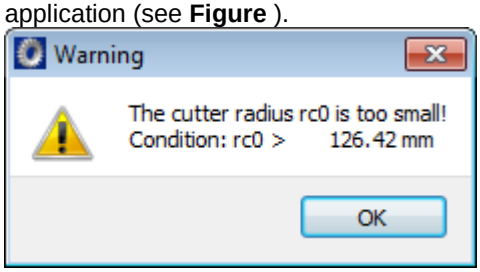


Figure 2.21 Warning if the cutter radius is smaller than the recommendation

The cone length (for hypoid gears) and the external and internal spiral angles are affected by the cutter tip radius. KISSsoft therefore checks whether the values are suitable.

10. In the **"Reference profile"** tab, either select a suitable reference profile or click **"Own input"**. The recommended tip clearance factor for a "cyclo-palloid procedure" is 0.25 (in accordance with Klingelnberg "Bevel gears", page 72), and can be selected in the list with **"1.25/0.3/1 CYCLOPALLOID"**.
11. In the **"Strength"** tab, select the required "Calculation method" (Klingelnberg 3028, ISO, DIN, AGMA, VDI, or Klingelnberg 3029 or ISO proposition for hypoid gears). In **"Material, manufacturing types and lubrication"**, "Generating process" is selected automatically because cyclo-palloid gears are always generated. (See **Figure**).

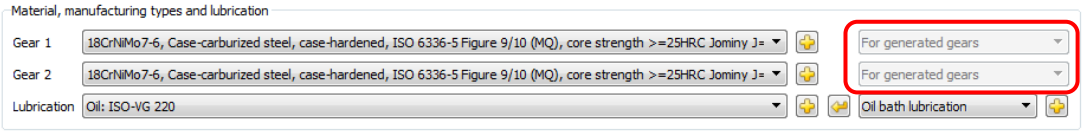


Figure 2.22 Manufacturing type "For generated gears" for cyclo-palloid

12. In the **"Tolerances"** tab, select **"No backlash"** because the clearance value is not set until the gear is assembled by changing the assembly dimensions.
13. Either click  or press "F5" to run the calculation. To generate and open the report, click  or press "F6".

2.8 Klingelnberg palloid

The palloid procedure is a continuous hobbing process. The bevel gears have a uniform depth. Palloid bevel gears are often used for smaller bevel gear sets (up to module 6 mm).

In the examples that follow, dimensioning has already been performed using **Rough sizing** so that the majority of the required data is already present (see section 2.5). For this reason only the specific entries for each method are described. However, if **Rough sizing** has not already been performed, you must input all the values manually.

1. In the **"Geometry"→ "System data"** tab, select the **"Uniform depth, fig 3 (Klingelnberg)"** type (see **Figure**).

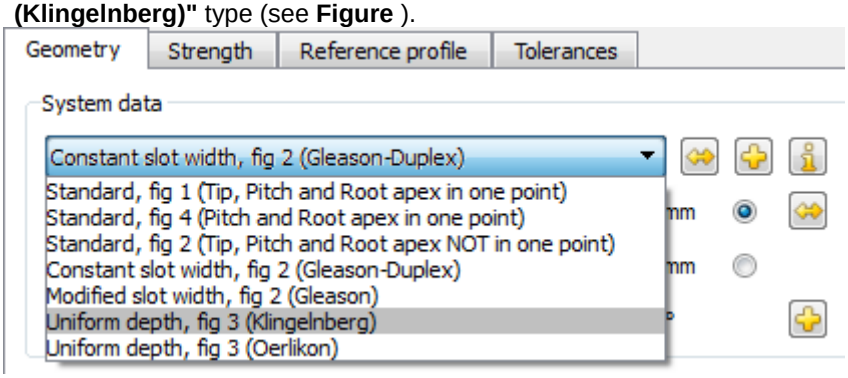


Figure 2.23 Selecting "Uniform depth" type for palloid procedure

2. In the **"Strength"** tab, select the "Klingelnberg Palloid 3025" calculation method (see **Figure**).

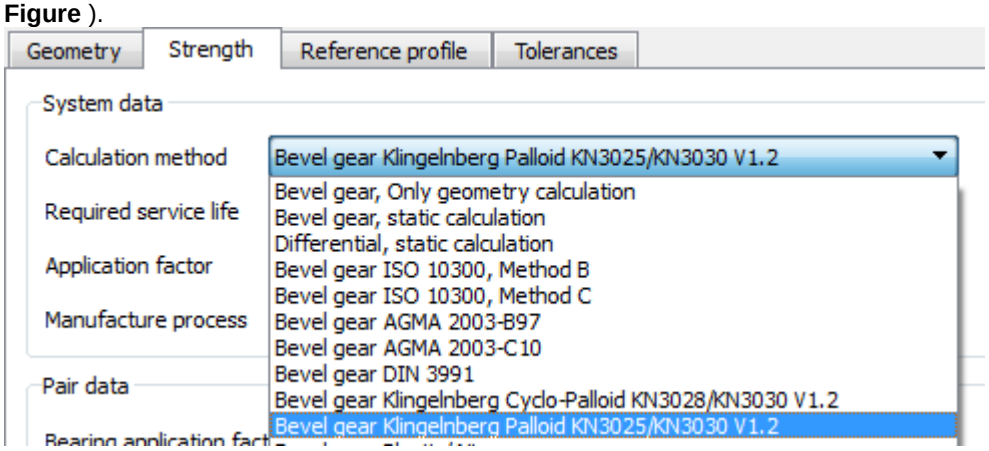


Figure 2.24 Selecting the "Palloid" strength calculation method

In **"Material, manufacturing types and lubrication"**, "Generating process" is selected automatically because cyclo-palloid gears are always generated.

3. Input the "pressure angle".
4. Click on the **"Plus button"**  to the right of "Pressure angle". Under **"Additional data hypoid gears"** you can input values for the "Nominal pressure angle" and the "Influencing factor limit pressure angle" (usually 0 for "Palloid procedure"). If an offset (hypoid gear) is predefined, the influence of the "generated and effective contact angle" is included in the calculation.
5. Input the "spiral direction" for the pinion.

6. Click on the **"Plus button"** to the right of "Helix angle". Then go to **"Additional data for spiral teeth"** and activate spiral toothing. If the Rough sizing function was used, spiral toothing is active.
7. Input the "Offset (Center dist.)" using the default conditions.
8. You can either input the **"Profile shift coefficient"** manually or click the Sizing button to calculate it automatically. If the KISSsoft software determines an undercut, the profile shift coefficient is set to prevent undercut. All the other criteria (optimal specific sliding, etc.) are listed in the report and can be entered manually.
9. If necessary, input "Angle modification gear 1".
10. Under **"Manufacturing data"** the **"Face hobbing"** manufacturing process is already selected. Input the "Cutter cutting length" and "Cutters small diameter" tool data. Click the information button to display a table that lists the standard palloid cutters. However, you can also input data for special milling cutters (see **Figure**).

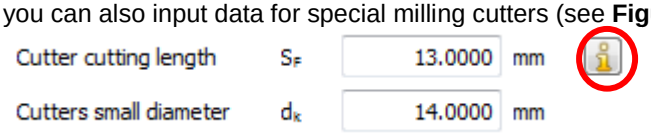


Figure 2.25 Input palloid cutter data

In addition, the system displays a warning message if the palloid milling cutter is too small to be able to mill the gear (see **Figure**).

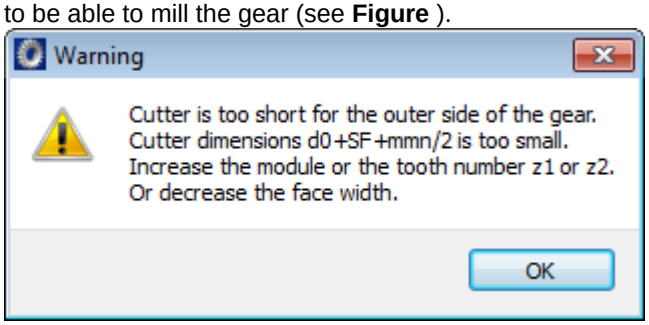


Figure 2.26 Warning if the palloid milling cutter is too small

11. In the **"Reference profile"** tab, either select a suitable reference profile or click **"Own input"**. The recommended tip clearance factor for a "palloid procedure" is 0.3 (in accordance with Klingelnberg "Bevel gears", page 72), and can be selected in the list with **"1.3/0.38/1 PALLOID"**.
12. In the **"Tolerances"** tab, select **"No backlash"** because the clearance value is not set until the gear is assembled by changing the assembly dimensions.
13. Either click or press "F5" to run the calculation. To generate and open the report, click or press "F6".

3 3D model of a bevel gear with spiral teeth

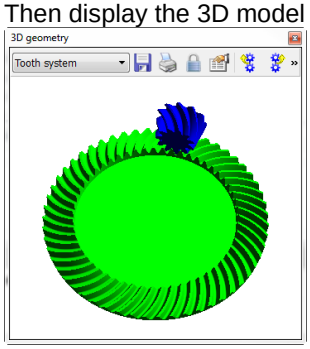
Straight-, helical- and spiral-toothed bevel gears can be given flank modifications and output in STEP format. This section tells you how to create, check and output a bevel gear.

1. Click on the "Examples" tab and upload the "BevelGear 1 (Klingelnberg)" file. Then click on "File → Save as..." to save it to a specific directory.
   In the "Tolerances" tab, change the tooth thickness allowance to "No backlash". This not only simplifies subsequent processing but also corresponds to the procedure used to create a gear using standardized cutter radiuses. In this case, the clearance is usually set by adjusting the bevel gear assembly dimension (G-displacement).

2. Set the values under "Graphics → Settings → Parasolid":

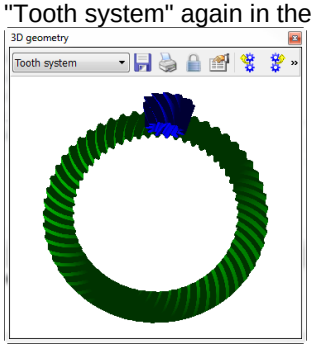
Model:	Volume model
Number of cutting steps:	11 (not considered)
Number of sections across facewidth:	11
Scaling factor for the cutting mode:	5 (not considered)
Modeling operation tolerance:	1 µm
Rendering quality	5 µm

3. Then display the 3D model under "Graphics → 3D geometry →Tooth system":



TIP: After you perform the calculation (by pressing F5) it may happen that the **graphics window appears in the background**. To change this, simply minimize the KISSsoft program and then maximize it again.

4. Check the contact pattern by changing the model type under "Graphics → Settings → Parasolid":
   Model: Skin model
   The graphic is displayed as soon as you either recalculate it (by pressing F5) or select "Tooth system" again in the selection list in the "3D geometry" window:

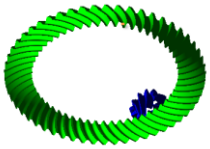
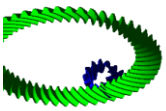
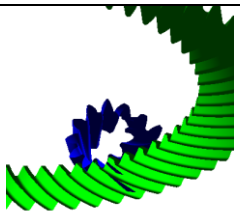


5. Position the model so that you can see the contact lines for the drive side (convex bevel gear). To do this, view the bevel gear from below. To do this, click the right-hand mouse

button on the "Bottom-up view" setting on the graphic.

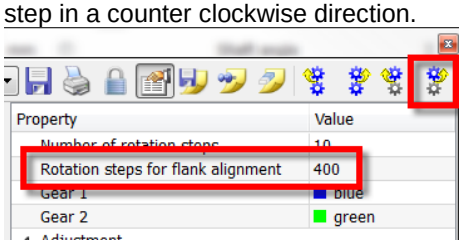
TIP: Alternatively you can select the following procedure: Rotate the gear so that you can easily see the contact lines at a 5 o'clock position from below. Use the direction keys to move the graphic upwards and to the right and then use the zoom function (+ key).

TIP: you can enlarge the window as an alternative to using the zoom function.

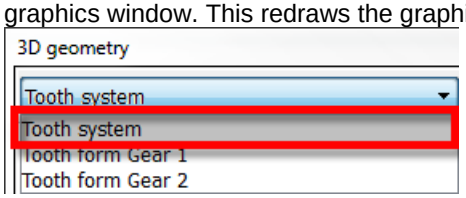
		
Graphic at a 5 o'clock position	Move with the ← and ↑ arrows	Zoom with + key or scroll

TIP: If you want to see the contact lines in greater detail, you can also move the pinion in addition to the bevel gear so that it contacts with the bevel gear flank. To achieve a realistic comparison, make sure that the **amount of contact is not too great**. For example, rolling the bevel gear set over a tester should also only remove a small amount of contact colour.

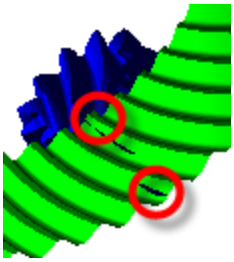
For example, set the rotation steps for the flank alignment to 400 and rotate the pinion one step in a counter clockwise direction.



To reset the gear to its **initial position**, select the tooth system once more within the graphics window. This redraws the graphic with the gears in a neutral position.



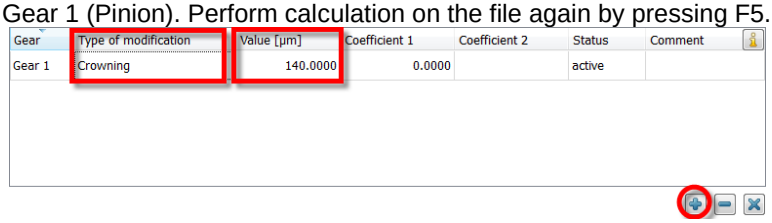
6. Check the flank contact when rotating the gear with  . In a rotation not under load, the contact pattern should not reach the inside and outside edges ("toe" and "heel"). If it does, the gear would react too sensitively to axle misalignments and lead to edge contact and pressure peaks when operating under load.



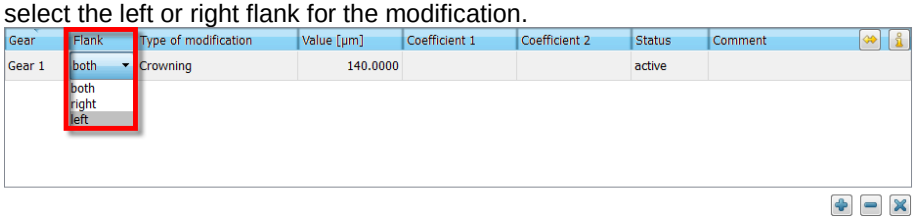
Edge contact under load can be prevented by making flank modifications such as length corrections and profile crowning. Use the pressure angle and helix angle flank modifications to set the position of the contact pattern.

7. Enter the **flank modifications**. In the technical literature ("Kegelräder", by: Jan Klingelnberg, page 74) a standard length correction is between b2/250 and b2/600 (for normal misalignment) or b2/350 and b2/800 (for low misalignment). Here, the facewidth b2 is 50 mm, so the length correction range lies between 0.200 to 0.084 mm (for normal misalignment) or 0.140 to 0.063 mm (for low misalignment).

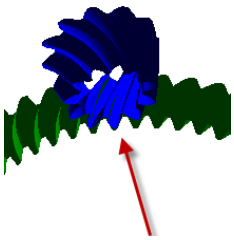
   Select "Calculation → Modifications" to enable the "Modifications" tab, and click the Plus button in the "Modifications" tab to add a modification. Then, enter a crowning of 140µm for Gear 1 (Pinion). Perform calculation on the file again by pressing F5.



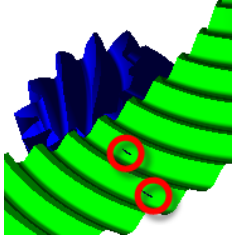
   TIP: If you want the **modifications to be flank-specific**, i.e. you would like to use different crownings etc. on the driving flank and on the driven flank, select the "Allow unsymmetrical modifications" option under "Calculation → Setting → General". This will enable you to select the left or right flank for the modification.



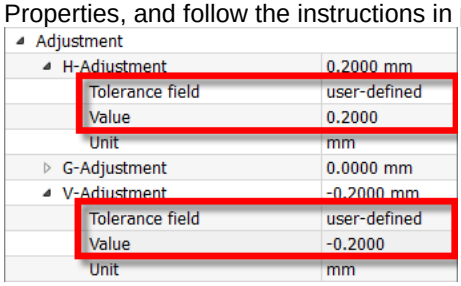
   The **definition of the flank side** is seen from the direction of the apex. In the case of the left-hand pinion, the left flank side is the concave side, and consequently the driving side.



8. Check the contact lines again. Now continue as described in points 5 to 7. The contact lines then no longer touch the edges. The crowning is consequently technically correct.



9. In KISSsoft it is possible to use the **VH-Check** to position the contact pattern, and so to determine the sensitivity of the meshing. To do so, enter the position values under Properties, and follow the instructions in points 5 to 7 to check the contact pattern position.



For more information about the VH-Check, please refer to the ISO/TR 10064-6 "Code of inspection practice", for example.

You can change the **cutter head size** to any value: it does not relate to any existing standard series. This makes it easier for you to influence the load-free position behavior. For more information about the effect of the cutter head size, please refer to ISO/TR 22849 "Design recommendations for bevel gears".

10. In the case of **a small number of teeth on the pinion**, it can happen that the teeth become sharp at the tip (tooth inside face, "toe"). Then it is not possible to create the 3D model of the pinion.
These are ways to overcome this problem:
- smaller profile shift on the pinion
- lower tooth tip height on the pinion, by changing the reference profile data
- lower facewidth
- change from face hobbing (constant tooth height, Klingelnberg) to face milling (not constant tooth height, Gleason). For more information see also example file "BevelGear 5 (Gleason)" with ratio 8:36.