Design, Manufacturing and Measuring

KISSsoft is a well-known gear design software with some 4000 licenses sold globally. Functionalities specifically related to gear manufacturing and measuring facilitate close collaboration and data exchange between design, manufacturing and quality assurance engineers.

As KISSsoft calculations provide a common data basis for gear design, manufacturing and measuring, they offer a solution for a range of questions and issues occurring at the workshop level.
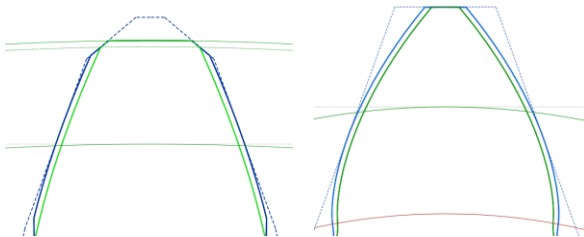
Pre-machining tool

- Tool addendum length
- Required amount of protuberance
- Use existing tool from database

As pre-machining tools, hobs and pinion type cutters are available. When pre-machining is applied, the tool addendum needs to be enlarged to compensate the manufacturing profile shift. To avoid grinding notches and increased stress concentration, the protuberance is applied on the pre-machining tool.

Chamfering and topping tools

- Avoid interference using a chamfer
- Noise excitation due to reduced contact ratio

The chamfering of the gear when pre-machining requires an individual tool. KISSsoft allows the definition of the ramp angle and chamfer size.

As a result, the tip form diameter is reduced and the reduced contact ratio is shown. This affects both the noise and strength of the gear.

Grinding depth and grinding dresser

- Minimum required grinding depth
- Avoid meshing interference/collision
- The trace of tooth tip during meshing

In different industries, different grinding techniques and strategies are used. While in industrial and automotive gears, the root land is typically not ground, it is ground in most cases for aerospace gears.

The addendum of the grinding tool is calculated for various conditions such as required minimum active root diameter, maximum root form diameter, grinding the root, etc.

KISSsoft checks if an existing grinding dresser can be used. This allows reducing tool costs and eliminating tool lead time.

The resulting gear modifications such as tip relief or pressure angle modifications and the tolerance band of the modifications are shown.

Additionally, the modifications using an existing dressing wheel are evaluated by contact analysis and the influence on the noise excitation can be rated.

Sharing Knowledge

Diameters, meshing interference & collisions

- Tooth thickness tolerance
- Influence of machining stock & tool tip shape

The manufacturing profile shift of the pre-machining and final machining tool affect the tip and root form diameters and thereby the length of active profile.

For different tolerance conditions, KISSsoft visualizes the tooth form as well as meshing interferences or collisions. Animations provide a comprehensive display of the meshing or manufacturing process.

Hob database

- Use of existing tools from a database
- Design a new tool for specific gears

To check for re-usability of existing tools, the tools can be imported into the KISSsoft database.

This allows the gear designers to check on the availability of a suitable tool for a new gear design in an early design phase. Also, if a new tool is required, the gear profile data can be exported and sent to Gleason tool manufacturer as a request for quotation.

Short lead hob

- Hob module and pressure angle
- Short lead hob and gear strength

Short lead hobs are applied for improving tool life and minimizing tool wear. Vice versa, short lead hobs create a different root shape, which results in different root stresses.

When using a short lead hob, it is recommended to use the FEM calculation in KISSsoft considering the machined root geometry and curvature.

The simulation of rolling gears shows interference for several tolerance conditions. The trace curve of the tooth tip shows the potential collision clearly.
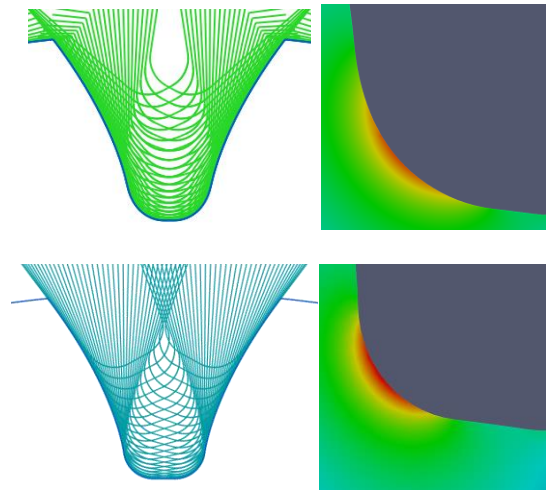

Power skiving

- Create tooth profile with power skiving
- Sufficient runout of the tool

KISSsoft allows to estimate the manufacturability of gears using the power skiving manufacturing process. Based on crossing angle and tool diameter, the manufacturing of the tooth geometry is checked regarding process limitations.

For external gears, the risk of collision between the cutting tool and the shaft shoulder on both front and back side is rated. For internal gears, the risk for collisions between the tool shaft and the bore is checked. This allows a rating of the manufacturability as a preliminary check. For a detailed analysis, the collision check by Gleason is recommended.

Root radius and tooth root stresses

- Level of stress concentration
- Root stresses for non-trochoidal root forms
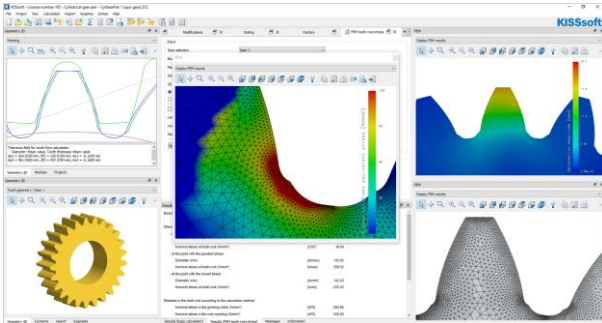
Gear root strength is assessed using applicable DIN, ISO or AGMA rating standards. However, in the case of nonstandard root shapes or grinding notches, a FEM calculation is required.

When grinding notches or other machining errors are created, KISSsoft provides a 2D and 3D FEM calculation where the stress increase is shown.

Natural and designed twist

- Amount of natural twist from thread grinding
- Deviations from the designed flank geometry

In threaded wheel grinding process for helical gears with lead modifications, usually a natural twist will result. Its effect on the contact under load and the vibration excitation may be assessed using KISSsoft. Furthermore, a desired twist amount to mitigate the negative effect of gear misalignment under load may be designed and optimized.

Sizing functions in KISSsoft automatically find the optimal flank twist amount to achieve optimal contact pattern under load.

Tool profile for non-involute gears

- Define the tool shape for non-involute gears
- Gear profile with a generating process

Non-involute gears with straight flank or positive radius of flank curvature can typically be manufactured in a

generating process using rack type or pinion cutter type tools.

KISSsoft calculates the tool reference profile or the tool shape through a reverse generating process for non-involute gears. The rack profile or the tool geometry may then be exported as 2D *.dxf for tool production.

Measurement grid coordinates

- 3D models as STEP and measurement grid
- Data export in GDE and GAMA format
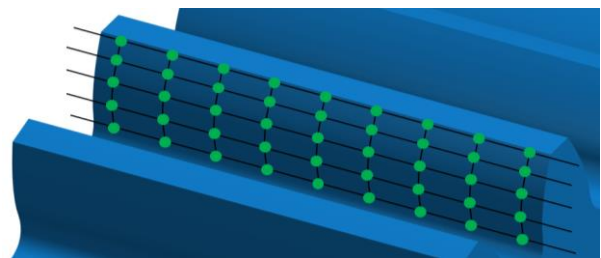
To control a CMM or for the sake of verification, the measuring grid coordinates and the normal vectors are calculated and reported in KISSsoft for a user defined number of flank points. This is available for most of the gear types such as cylindrical gears, bevel gears, worm gears or beveloid gears.

The export formats for GDE and GAMA® are available and allow a fast as well as safe data transfer between various manufacturing and measurement machines.

The VDI/VDE 2610 guideline provides an accurate and unique way to describe gear geometry and manufacturing data.

Tooth thickness measurement

- Span width and dimension over balls
- Available also for splines or HCR gears

For measuring the tooth thickness, the span width and dimensions over ball are required for all the manufacturing steps. By help of the tooth form analysis in KISSsoft, the analysis of tooth thickness at any position of tooth height is possible.

For special cases such as involute splines, a flattened ball needs to be applied to avoid the touching of the

gear root. For HCR gears, the ball resp. pin diameter is provided so that the measurement is possible.

Calculated diameter over pin for theoretical, meaning upper and lower value may then be compared to measured DOP using Gleason over pins gauges.

Profile and tooth trace modification

- Lead, profile and combined modifications
- Topological modifications
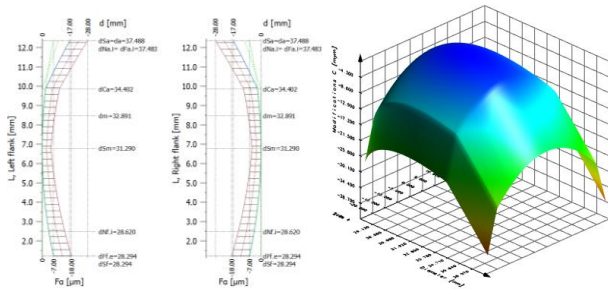
Various gear modifications can be defined for right and left flanks independently for optimum running performance for each flank.

The K-charts are provided in KISSsoft for reference of the measurement machine. Also, the cumulated modifications per flank are available in 3D graphics.

Master gears

- Use of existing master gears for machined gear
- Check meshing conditions for EAP/SAP etc.

For a machined gear and the required diameters to be in contact with a master gear, the suitability of a existing master gear is checked. The gear pair is checked for the form circle and start resp. end of meshing, including the respective tolerances due to manufacturing. This helps minimizing the number of required master gears in the shopfloor.

Alternatively, a new master gear is calculated considering the machined gear's dimensions. Master gears may then be used on Gleason machines and other testers.

Design-manufacture-measure

- Vibration characteristics of the machined gear
- Machining errors & contact pattern under load

The design-manufacture-measure loop integrates KISSsoft, Gleason gear machines and metrology solutions.

Machining errors may result in increased noise levels or unfavorable contact patterns in operation. To predict the performance characteristics of a machined gear, the measured flank topography is imported in KISSsoft.

By using the contact analysis, the machined gear is analyzed, either as a gear pair or in a transmission system. This allows to compare the designed and the manufactured performance in parallel. Based on this, the manufactured gear with its deviations may be approved or not.

Assembly contact pattern

- Verification of contact patterns after assembly
- Bearing play and assembly tolerances
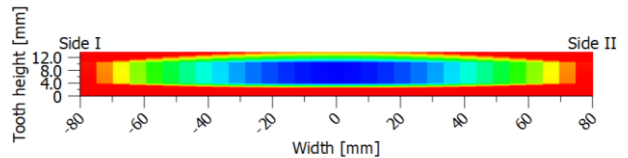
No load contact patterns after assembly are typically available towards the final phase of the gearbox assembly only. The contact pattern at no load, but considering bearing clearances, can be predicted with KISSsoft.

It then serves as a basis for the acceptance of the unit under assembly. The marking compound thickness may be given in the calculation as an additional parameter.

Contact us for a demonstration of the software through +41 55 254 20 50 or info@KISSsoft.com