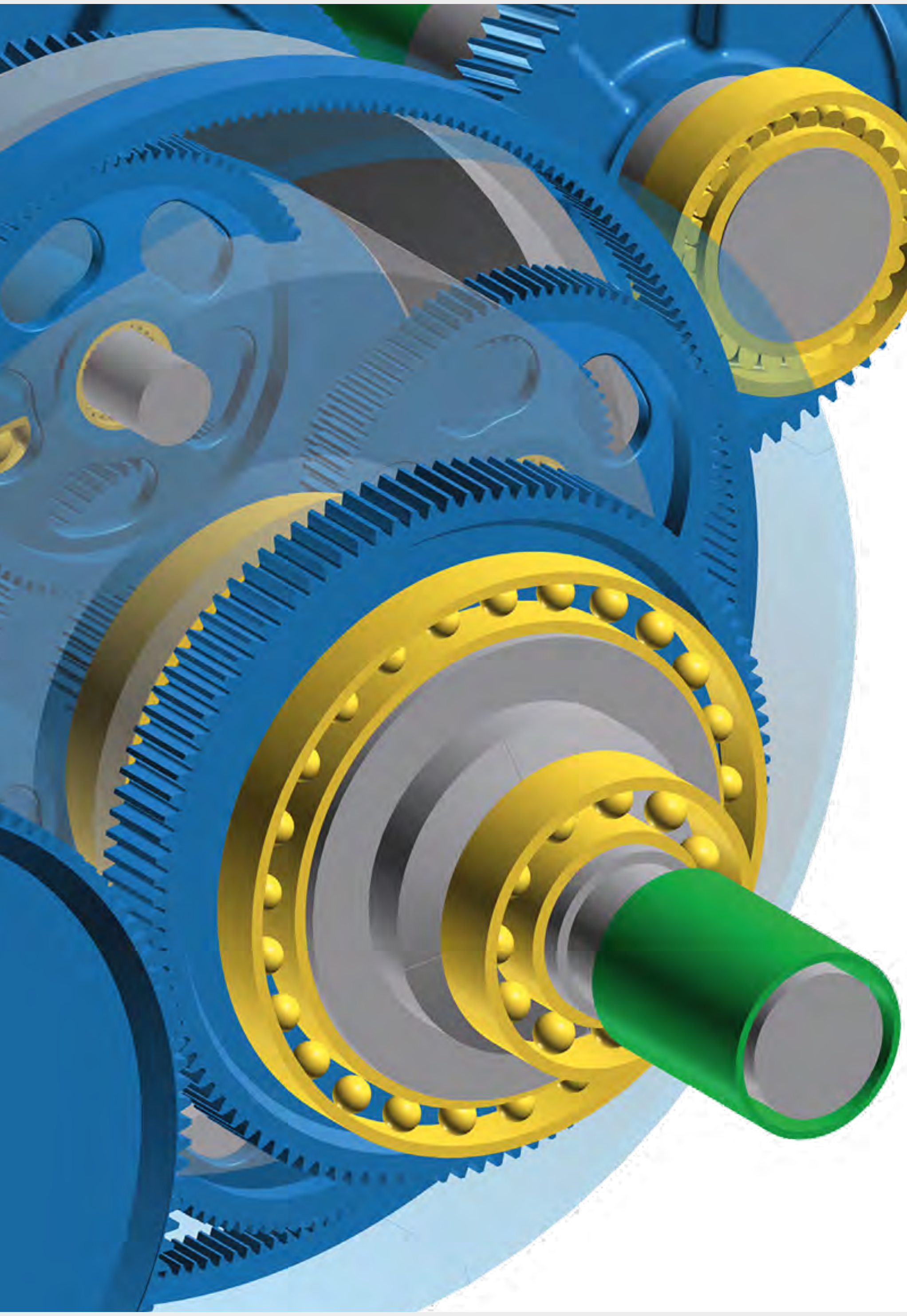
Total Gear Solutions Gleason



KISSsoft Gear Design Software

KISSsoft AG
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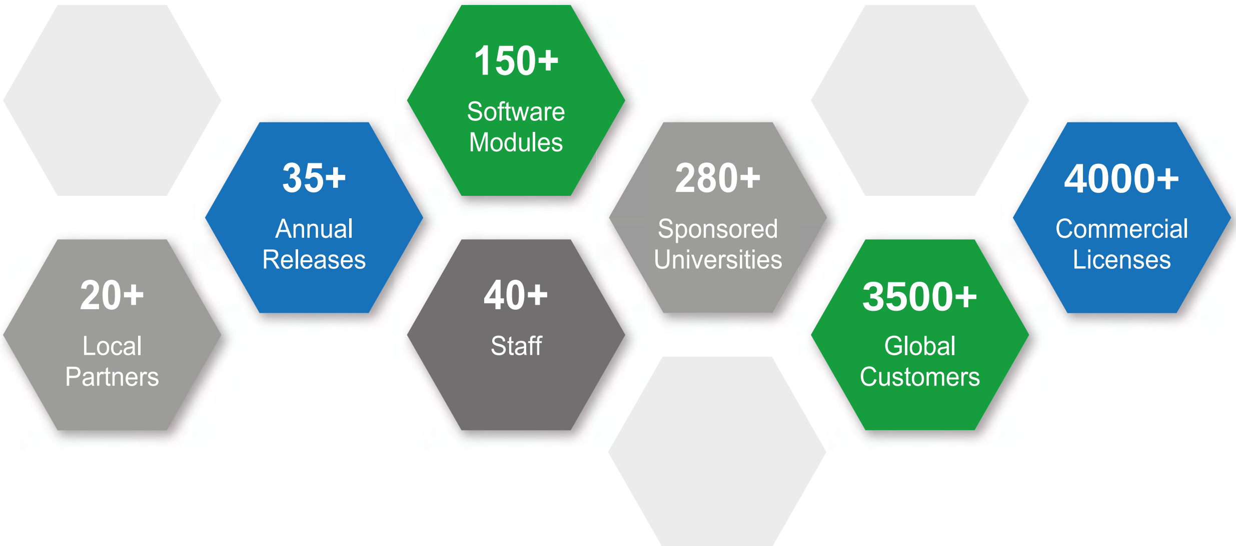
Content

45 years experience

- **1980** First in-house software
- **1986** Sale of first KISSsoft® license
- **1998** Foundation of KISSsoft AG
- **2005** Foundation of KISSsoft USA LLC
- **2012** Foundation of KISSsoft China Pvt., Ltd.
- **2016** Global partner network established
- **2017** Gleason Corporation acquires KISSsoft AG

Original development of KISSsoft at Kissling gearbox company

Facts



Global partner network

Local presence

- Gleason group headquarters in Rochester NY, USA
- Company headquarters in Bubikon, Switzerland
- Gleason offices with KISSsoft® support in USA, China, Taiwan, Japan, Korea
- Long time partners in Italy, Argentina, UK, Spain, Czech Republic, Slovenia, Turkey, UAE, South Africa, India and Singapore

KISSsoft is used wherever there are gears!

KISSsoft® covers all common gear types, shafts, bearings, shaft-hub connections, bolts, springs etc. It is used for the analysis of a single element and to design complex transmissions and drive trains.

Gears keep track of time.
Non involute gears of low friction are needed to drive watches, clocks, and timepieces accurately. KISSsoft works with proverbial Swiss watch accuracy, keeping you up with time.

8 billion humans need food.
Tractors and other agricultural equipment are one of the pillars on which food security is based. KISSsoft is used by most of the top tractor manufacturers to design and strengthen transmissions and axles.

You like to go to the dentist?
KISSsoft helps to reduce the noise and vibration in the gears used in dental drills. Lower noise level means less nervous patients and therefore less pain during the treatment.

Whether you play the violin or do water skiing, gears drive your hobby.
Any hobby relying on a vehicle or a mechanism (think of the worm gear in a violine to tune it) features gears. KISSsoft makes hobbies fun, safe and affordable.

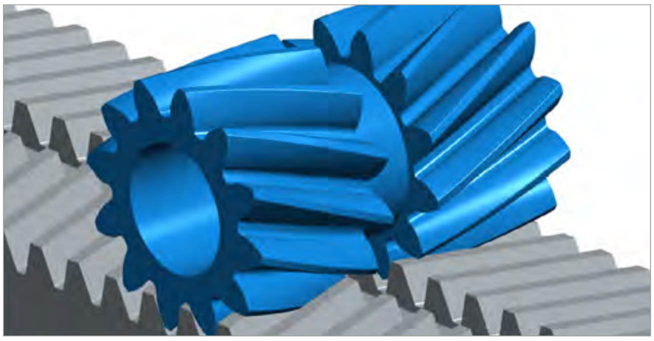
Use Cases

The train is on time.
KISSsoft ensures that the root cause for a delay is not a gearbox failure in the locomotive. The high reliability and lifetime needed in rail transport, is achieved through detailed life and failure probability calculation methods.

The center of the milky way is 25'000 light years away.
KISSsoft is used to maximize the slewing bearing stiffness to maintain antennae and telescope elevation and azimuth accurately. Highly detailed images of our solar system are the result.

We all pay water bills.
Fluid flow sensors, require high ratio, low friction geared transmissions to drive the clocks metering usage. KISSsoft allows for optimization of the gears to achieve high metering precision at low cost.

Space travel, the hobby of the ultra-rich.
And yes, there are gears used in rovers, satellites, rockets and their actuators. And of course, KISSsoft is used for the design for highest reliability at lowest mass.



Gears are everywhere.
Every day, new applications for this time-tested machine element are found.
Where do you use gears? Ask for our assistance with your gear design, be it through our software, training, or consultancy services.

Applications

Fine pitch, plastic, and sintered gearing
- Printers, copiers, tray drives
- Geared motors, gearheads
- Automotive actuators
- Medical, building automatization, HVAC
- Power tools, kitchen appliances
- Watches, meters, and sensors
- ...

Energy generation
- Turbo gears
- Wind turbine main gearboxes
- Generator shafts
- Engine gear trains
- Pitch and yaw drives
- …

Aerospace
- Rovers, satellites
- Geared turbo fans
- Helicopter MGB, IGB, TGB transmission
- Fuel, oil pumps, alternator drives
- Turbine power take off, starter gears
- Civil and military drones
- Flap actuators, unmanned aerial vehicles
- …

Industrial
- General purpose and heavy-duty gearboxes
- Mining and raw materials handling
- Cranes and winches, mill drives
- Servomotors, geared motors
- Robotics, spindle drives
- Open gears, girth gears
- 5 axis CNC milling of gears
- Bearings, slewing bearings
- …

Vehicles
- EV transmissions, E-axles, hybrid transmissions
- Cars, LCV, trucks, buses
- Tractors, harvesters
- Motorbikes, three wheelers, RVs
- On-road, off-road motorsport
- Military, tracked, armored vehicles
- Construction equipment, forklifts
- Engine drive trains, valve drive train
- …

Software Modules

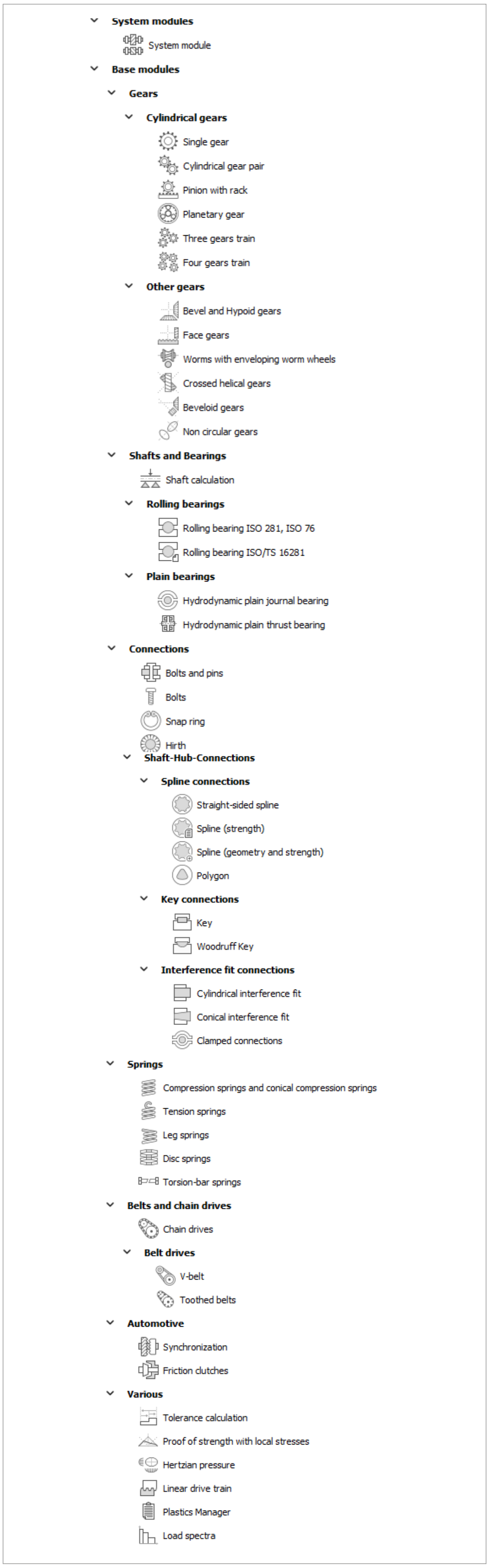
General
- KISSsoft module as individual modules
- System Module for complex systems
- Interfaces to other Gleason software, CAD systems and bearing OEM online tools

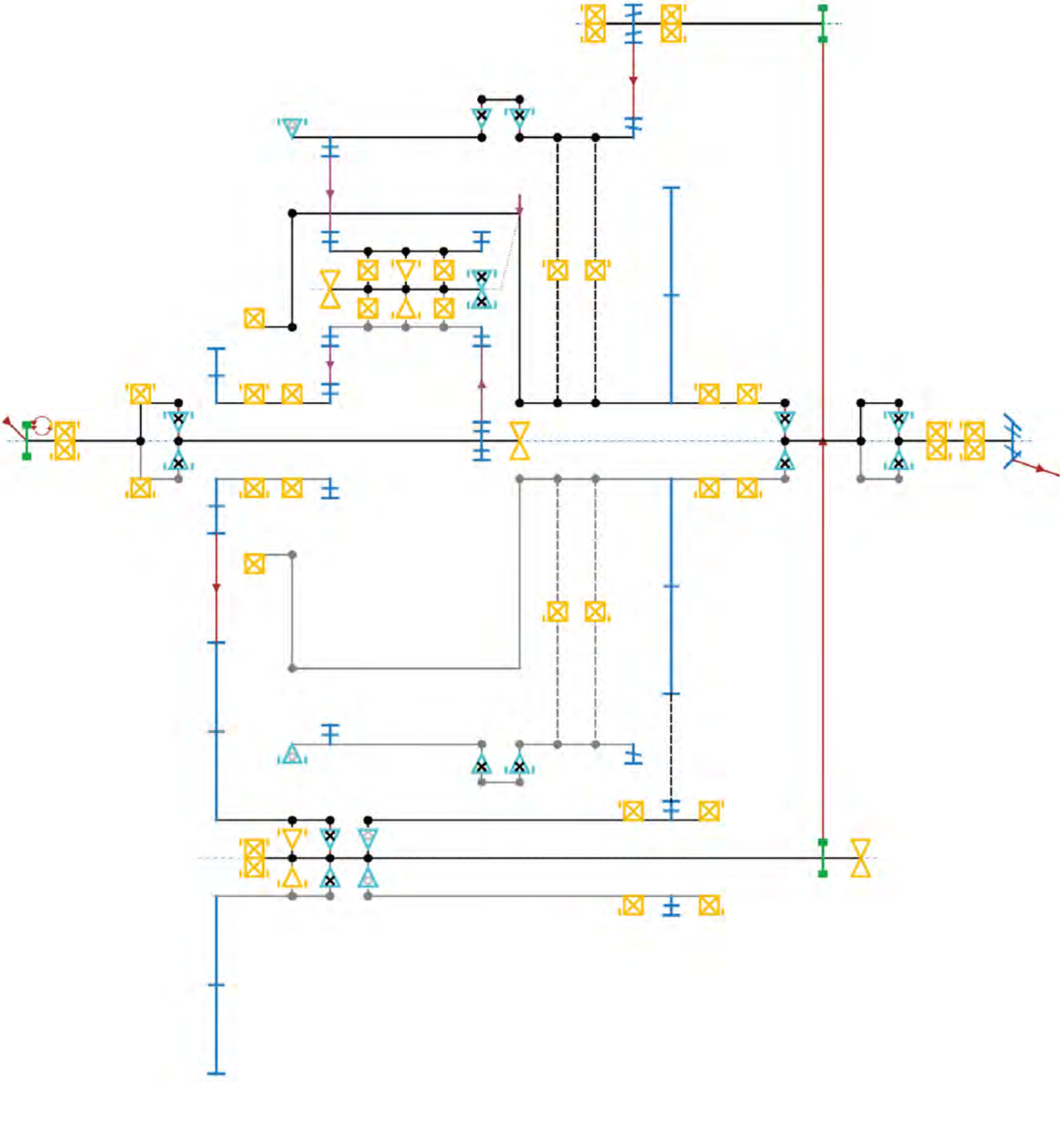
Components
- Cylindrical, rack & pinion, bevel / hypoid, beveloid, worm, face gears, crossed axis helical, non-circular gears
- Involute and non-involute gears, symmetrical and asymmetrical involute teeth
- Shafts and rolling element bearings, hydrodynamic bearings, coaxial shaft systems, bearing stress and load distribution
- Shaft modal analysis and unbalance response
- Shaft-hub connections, bolted connections
- Spring analysis, chains and belts, clutches
- Tolerance stack-up, local stress analysis, Hertzian contact stress, spindles
- Plastic gear materials manager
- Load spectrum from time series

System Module
- Includes scripting language
- Machine element library to build own models
- Programming language module
- Housing stiffness import from FEM (ABAQUS, ANSYS, NASTRAN, …)
- System efficiency calculation, thermal rating
- Load spectrum rating on system level
- Modal analysis / natural frequencies calculation on system level
- Forced response analysis (gear mesh excitation, torque ripple, …)

CAD interfaces and supported formats
- Interfaces to Gleason software like GEMS®, GAMA®
- 2D CAD export in neutral / graphic formats
- Gear geometry 3D export to CAD systems
- Interfaces to multi body systems software

Databases
- User editable database
- Bearing data from OEM: FAG / INA, SKF, Koyo, Timken, …
- For catalogue bearing data and bearing inner geometry

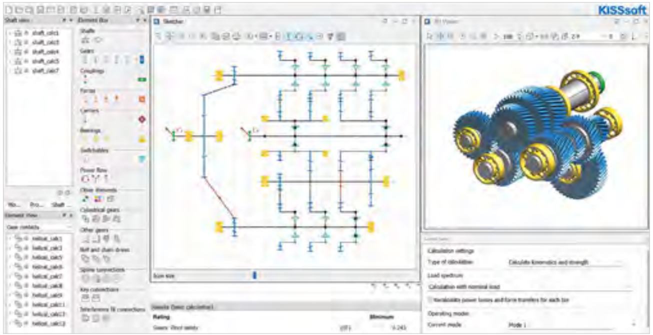




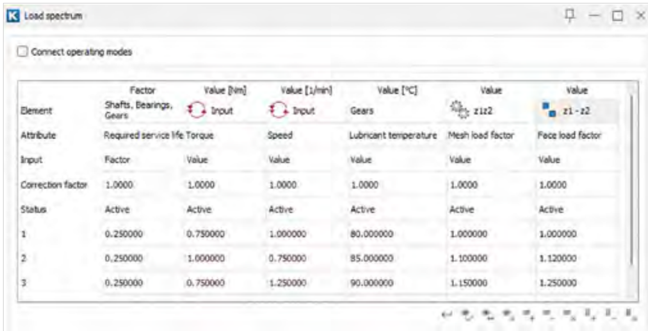
System Module, Introduction

Overview

The System Module software combines kinematic analysis, lifetime calculation, 3D graphics, system reports with a programming language. It is the tool of choice for strength and lifetime analysis of various kinds of drive trains and gearboxes. The System Module lets the user do quick and detailed parametric studies of a complete power train in very little time to compare different variants of a concept or to analyze a given design for different loads.



In the System Module, all parts (gears, shafts, bearings, connections) of the gearbox are linked and the strength/lifetime analysis is performed simultaneously for all elements. A three-dimensional graphical presentation of the current state of the system immediately shows the geometrical influence of every change in parameters. This approach greatly accelerates the design process and results in a much more balanced design even during the concept phase.



Load spectrum

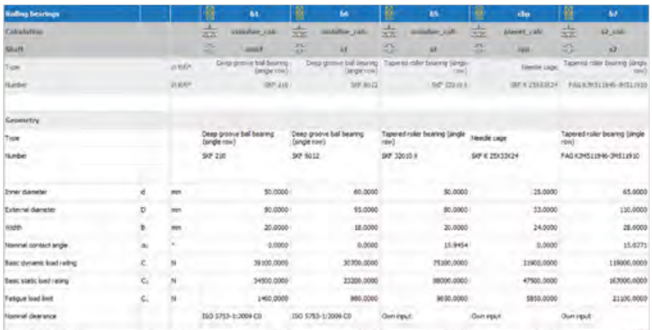
Connect operating modes

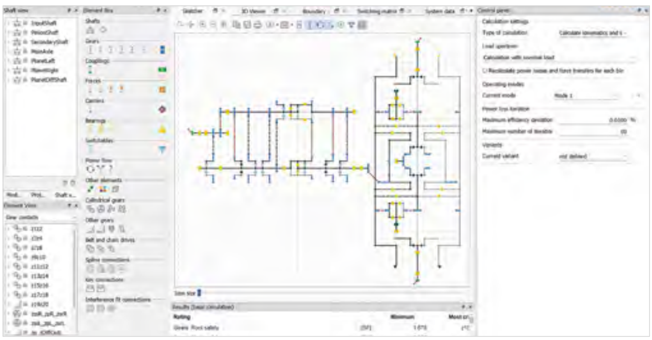
	Factor	Value [Nm]	Value [1/min]	Value [°C]	Value	Value
Element	Shafts, Bearings, Gears	Input	Input	Gears	z1z2	z1 - z2
Attribute	Required service life	Torque	Speed	Lubricant temperature	Mesh load factor	Face load factor
Input	Factor	Value	Value	Value	Value	Value
Correction factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Status	Active	Active	Active	Active	Active	Active
1	0.250000	0.750000	1.000000	80.000000	1.000000	1.000000
2	0.250000	1.000000	0.750000	85.000000	1.100000	1.120000
3	0.250000	0.750000	1.250000	90.000000	1.150000	1.250000

The machine elements calculated range from gears, shafts, bearings to shaft-hub connections. This will result in a more balanced starting design and fewer modifications will be necessary further down in the design process to reach an optimized design. Furthermore, documentation of the calculation is simplified and all calculation data for a whole drive train or gearbox is stored in a single file. The System Module uses KISSsoft for the strength and lifetime calculations of the various machine elements.

Kinematics Calculation

- Speed, torque, and power for complex systems including gears, couplings, speed and torque limiter, multiple boundary conditions
- Modelling of planetary systems like Ravigneaux, Wolfrom, Wilson, Simpson
- Differentials, (with bevel or spur gears), chain and belt transmissions
- Couplings can be activated and deactivated, slippage considered
- Allows for modelling of CVT transmissions
- System ratio and mesh ratio table in Kinematics tab
- Switching matrix for defining gear speeds





System Module, Modelling

Calculations in The System Module

Integrated strength and lifetime calculation:

- With integrated KISSsoft calculation modules
- System deflection is considered in tooth contact analysis
- Calculations with load spectra for all machine elements in the model
- Integrated programming language for implementation of special functions
- Animation of gear movement
- Cut view and deformed systems display
- Wizards, libraries, and toolboxes for quick modelling

Machine element library

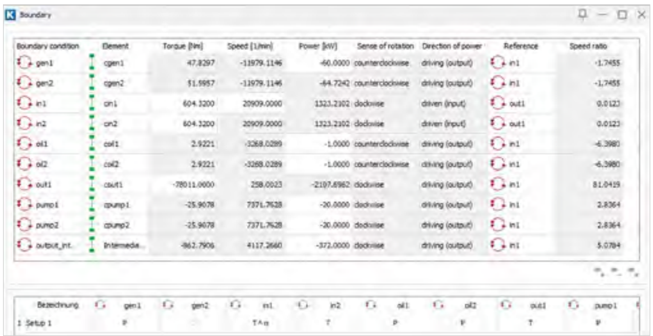
- Spur / helical gear pair and chain of gears
- Planetary gears, compound planetary gears
- Bevel and hypoid gears
- Worm gears, crossed axis helical gears
- Face gears with and without offset
- Shaft-bearing systems, coaxial shafts
- Shaft-hub connections
- Synchronizer

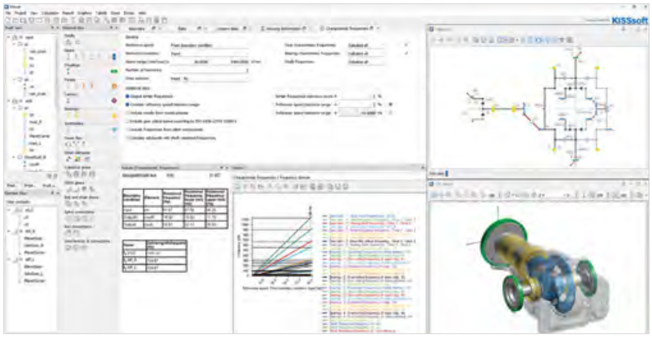
3D representation

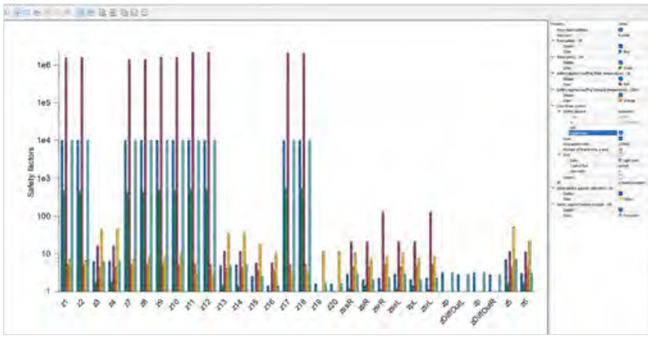
- Automatic 3D-display (based on the data defined in KISSsoft)
- 3D-model export to CAD platforms, gearbox housing import, *.step file
- Collision check with imported CAD geometry

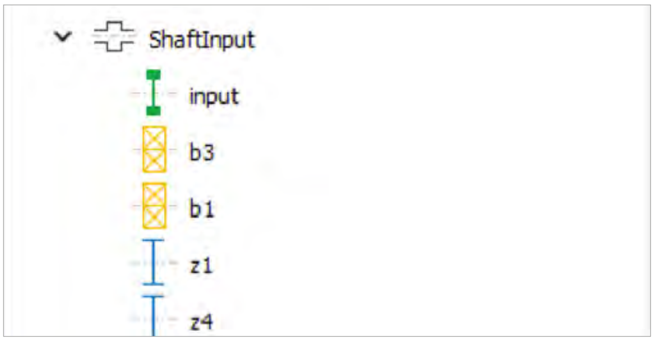
Typical applications

- Analyze wind turbine gearboxes for different loading conditions
- Check that of a plastic gear set for an automotive actuator fits into the design space
- Calculate power flow in CVT transmission
- Maintain a database of geared motor gears
- Compare different transmission layouts with respect to efficiency
- Estimate the manufacturing cost of a gearbox even during the design phase
- Optimize bearing lifetime by variation of the gear's positions on a shaft
- Create specific reports e.g., for certification
- And many more ...







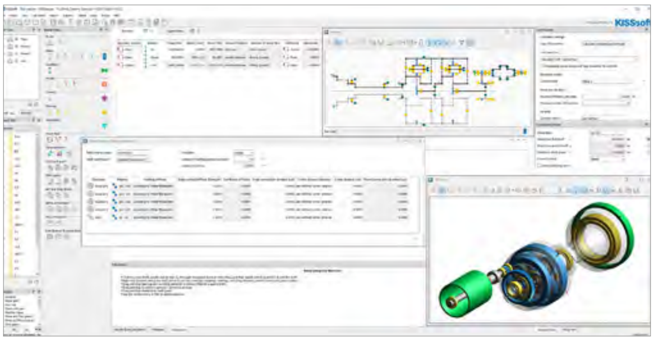


System Module, Modelling

Housing stiffness matrix import

The housing stiffness and the housing deformation may be considered for the loaded tooth contact analysis in the System Module by means of

- Import of housing stiffness matrix / reduced stiffness matrix from supported FEM codes
- ABAQUS
- ANSYS
- NASTRAN

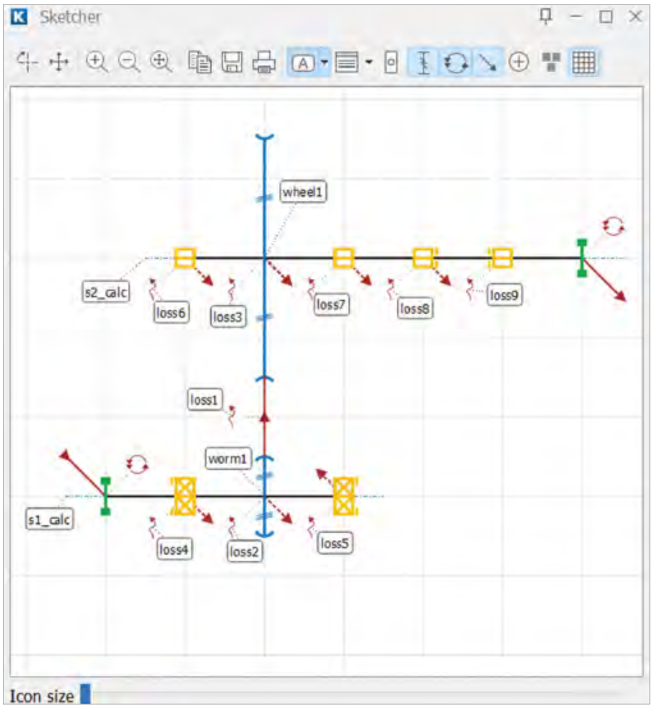


Features

- Node mapping: connect master nodes of stiffness matrix to the System Module model bearings
- Deformation vector is calculated inside the System Module using bearing forces and stiffness matrix
- Automatic alignment of stiffness matrix coordinate system to the system model coordinate system

Modal analysis

- System natural modes and natural frequencies
- Considers bearing operating stiffness matrix
- Considers gear mesh stiffness
- Considers shaft stiffness, inertias and masses
- Animation of modes on system level
- Comprehensive report

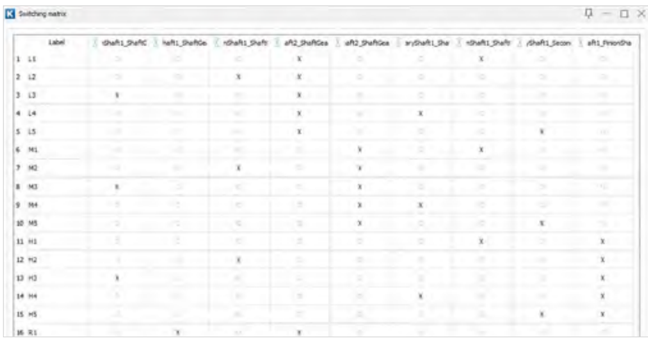


Thermal rating

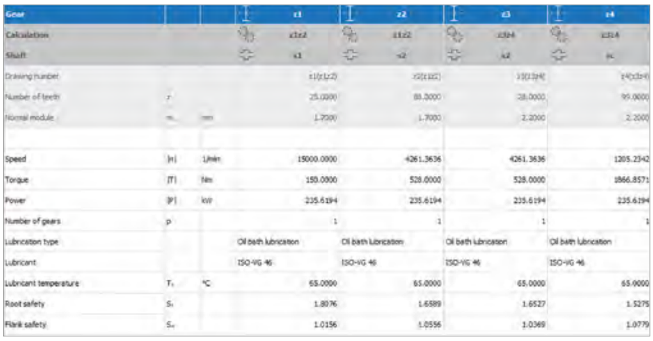
- Calculates power losses due to gear meshes, bearing friction, churning and seal friction torque
- Based on ISO/TS 14179-1 / ISO/TS 14179-2
- For oil bath or forced lubricated systems
- Calculates and lists individual power losses and system efficiency
- Sizing of cooler, calculation of thermal equilibrium, calculation of required oil flow

Gleason GEMS® interface

- Export EPGΣ data from KISSsoft
- Interface to GEMS® and GAMA® through KISSsoft modules



System Module, User Input and Output

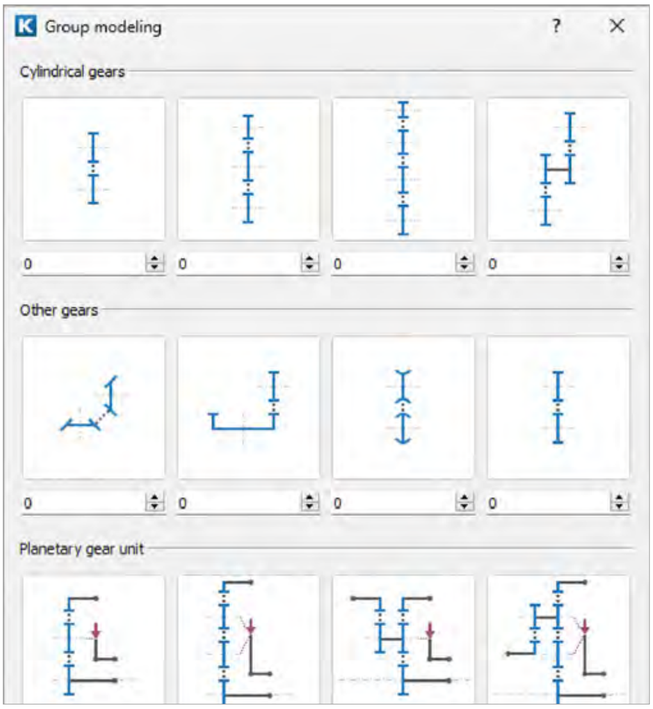


Gear			z1	z2	z3	z4
Calculation			z1z2	z1z2	z3z4	z3z4
Shaft			s1	s2	s2	[illegible]
Drawing number			z1(z1z2)	z2(z1z2)	z3(z3z4)	z4(z3z4)
Number of teeth	z		25.0000	88.0000	28.0000	99.0000
Normal module	m_n	mm	1.7000	1.7000	2.2000	2.2000
Speed	|n|	1/min	15000.0000	4261.3636	4261.3636	1205.2342
Torque	|T|	Nm	150.0000	528.0000	528.0000	1866.8571
Power	|P|	kW	235.6194	235.6194	235.6194	235.6194
Number of gears	p		1	1	1	1
Lubrication type			Oil bath lubrication	Oil bath lubrication	Oil bath lubrication	Oil bath lubrication
Lubricant			ISO-VG 46	ISO-VG 46	ISO-VG 46	ISO-VG 46
Lubricant temperature	T_L	°C	65.0000	65.0000	65.0000	65.0000
Root safety	S_F		1.8076	1.6589	1.6527	1.5275
Flank safety	S_H		1.0156	1.0556	1.0369	1.0779

Sketcher

The sketcher allows for definition of the topology of a gearbox or transmission as if using pen and paper. Using mouse and keyboard, the system is drawn on a grid. Shafts are the basis of the sketch; elements are put on the shaft by mouse click and elements are connected by a drag and drop approach to define e.g., gear meshes. Layers in the sketch show different information, e.g., the element name. Other features include:

- Manage elements in groups, copy paste
- Arrange elements inside the sketcher to represent the spatial arrangement
- Different graphic options for the representation of elements, power flow, sense of rotation
- …



Reports

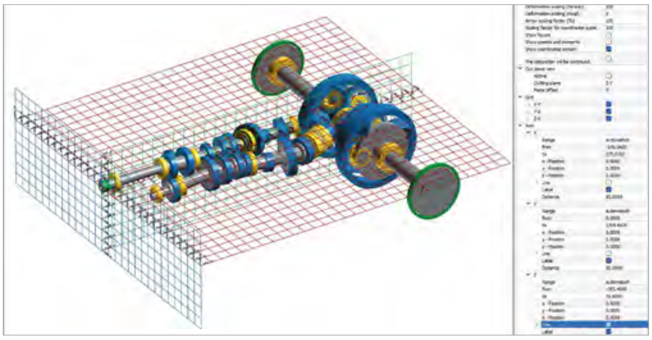
Reports are generated for the whole system or for each calculation. On system level, reports include:

- Summary report showing the most relevant results and input data
- List of all bearings, gears, and bearings, to be used as a part list
- Bearing displacements and tilting values, forces, and moments
- Thermal rating report
- …

Modeling assistance

Assistants for creating models include

- Initial sizing of gears
- Group modeling containing 16+ standard configurations including
- Parallel shaft arrangements, chains of gears
- Planetary sets with double planet, Ravigneaux, …
- Shiftable gears
- …



Graphics

- 3D System visualization with coordinate grid
- Deformed vs. undeformed system
- Element color and translucency user controlled, cut view, video recording
- Gear teeth 3D geometry representation for cylindrical, bevel and worm gear
- ...

System Module, Modal Analysis

The eigenfrequencies and eigenmodes of a complete shaft system, including the effect of gear connections between shafts are calculated.

Meshing Stiffness

- ISO 6336 Method B
- Contact analysis per gear pair: with this option, the contact analysis of all active gears is carried out to calculate the mean value of the tangent stiffness at mating gears.
- Infinite: the tooth contact stiffness is assumed to be infinite. Select this option if you want to check limiting conditions.
- Ignored: the tooth contact stiffness is assumed to be zero and therefore, no connection between the vibrating shafts is considered.

Modelling approach

- Only torsional vibrations
- Torsional and bending vibrations
- Gyroscopic effect can be activated or deactivated.

Graphics

- Normalized displacements and rotations
- 3D deformation

Campbell Diagram

A Campbell diagram can be used to investigate the effect of shaft speed on the eigenfrequencies. This calculation can be used to define the critical eigenfrequencies for each speed.

Meshing Stiffness

- Includes the same four options as in the modal analysis.

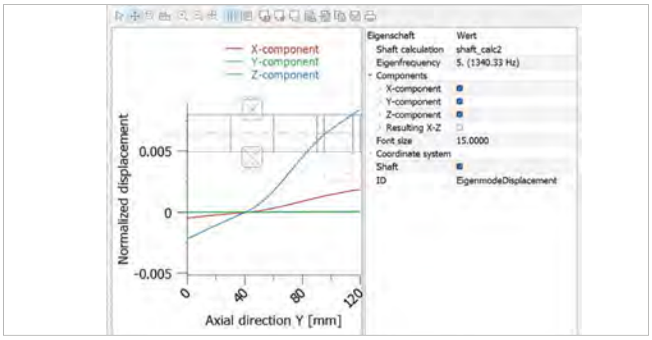
Speed range and number of speeds

- The minimum and maximum values of the speed range of the reference boundary can be given. The Campbell diagram calculation iteratively is carried out at all speeds in the given speed range and produce the required outputs.
- Number of resonance curves can be assigned to see the intersection of orders and eigenfrequencies.

Results (Modal analysis)

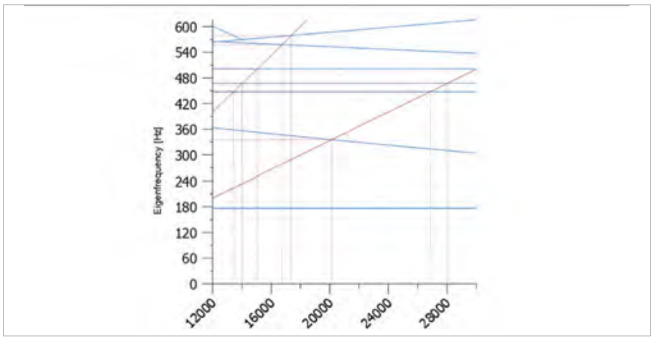
Eigenfrequencies

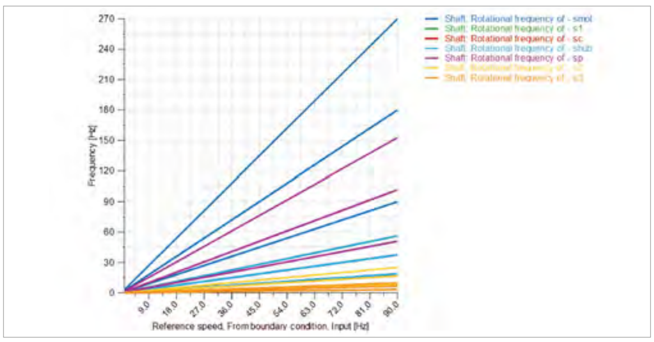
Eigenmode	Eigenfrequencies (Hz)	Eigenfrequencies (1/min)	Description
1	0.0	0.1	Rigid body
2	290.6	17433.1	Bending YZ
3	741.3	44480.9	Bending YZ
4	768.4	46103.7	Bending YZ
5	1167.8	70066.0	Bending YZ



Campbell diagram

Calculation			
Number of eigenfrequencies		5	
Meshing stiffness	according to ISO 6336 Method B		
Reference boundary	boundary1		
Speed range (min/max)	n 100.0000	10000.0000	1/min
Number of calculation steps		10	
Number of resonance curves		5	





System Module, Forced Response

Introduction

The powerful and user-friendly forced response analysis in KISSsoft provides the analysists and engineers to perform the dynamic analysis of powertrain systems quickly and efficiently. The vibration characterization of the system under periodic excitations is performed to assess the NVH behavior of a system.

Excitation sources

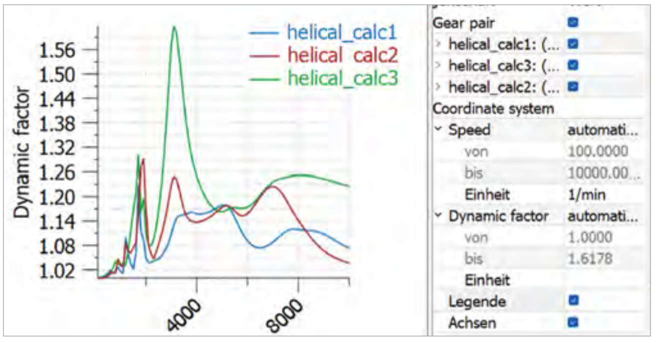
Three sources of excitation can be modeled:

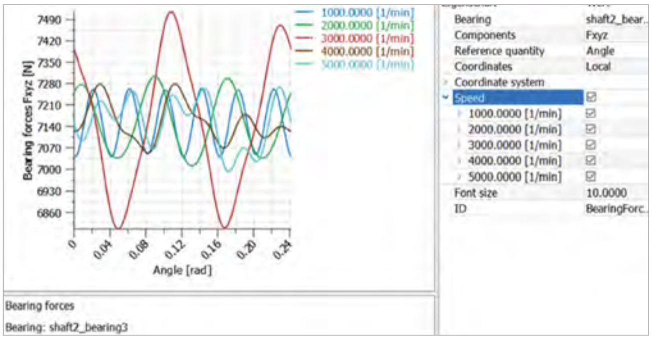
- Unbalanced masses
- Gear meshing forces: as the main source of excitation, the effects of variable meshing stiffness and transmission error at mating gears are considered.
- Torque ripples: they are periodic excitations in torque, which can result in vibration and noise.
- This effect can usually be observed in many electric motor and combustion engine designs, referring to a periodic fluctuation in the output torque as the motor shaft rotates.

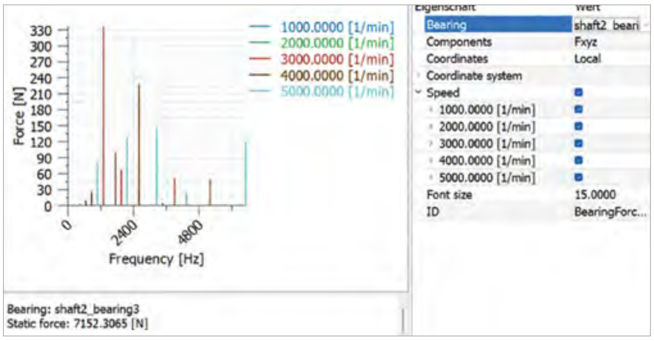
Calculation

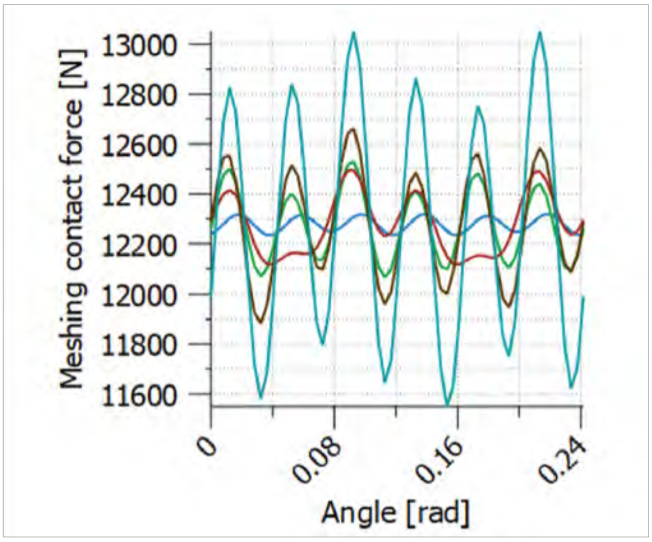
The main settings for the calculation process include:

- Minimum and maximum values of the speed range of the reference boundary for the analysis can be given. Forced response iteratively solves the system at all speeds in the given speed range and produce the required outputs.
- Number of harmonics: The number of frequencies of the excitation forces from different sources can be considered.
- Meshing stiffness and transmission error are used to calculate the excitation forces. Forced response offers different types of stiffness calculation based on contact analysis per gear pair as well as the system contact analysis.
- Excitation force type: three different approaches including “tangential stiffness”, “secant stiffness”, and “excitations forces in contact module”.
- Two modelling strategies are available; eighter to consider only torsional DOF, or bending and torsional DOFs of the flexible shafts to calculate system dynamic responses.









System Module, Forced Response

Material damping

In powertrain systems, all deformable elements can dissipate energy when subjected to dynamic deformations. In the forced response analysis of a model in KISSsoft, three different damping sources can be given:

- Damping of bearings and supports
- Structural damping of shafts
- Gear mesh damping

Output data specification

- The results of the forced response analysis can be generated in both the frequency and time domains.
- The quality of the results in time domain can be adjusted by setting the resolution to low, medium, high, or very high.
- In time domain analysis, the end time and step time for generating the output data is adjusted in a way to capture all possible excitations and to complete full periods of the vibrations for all excitation frequencies.
- The output data can be saved in a user-defined folders for further process in other software packages.
- The response and movement of the system`s elements as the result of the excitations can be visualized in a 3D view to provide more insights to the response of the system`s elements.

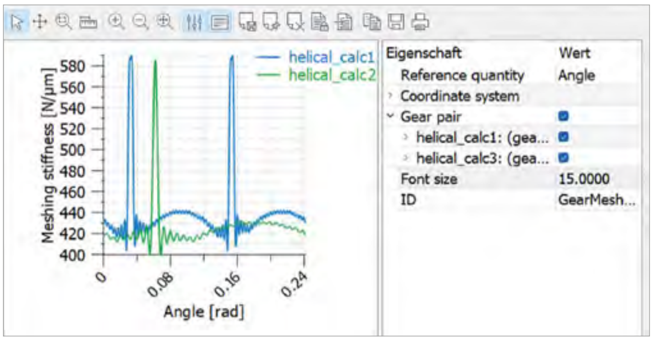
Result window

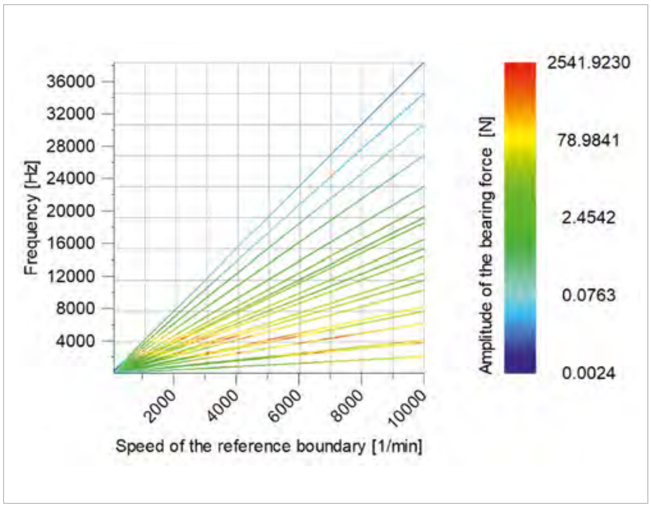
For all active gear pairs, some important results such as gear meshing frequency, maximum dynamic force and dynamic factor at all running speeds are presented.

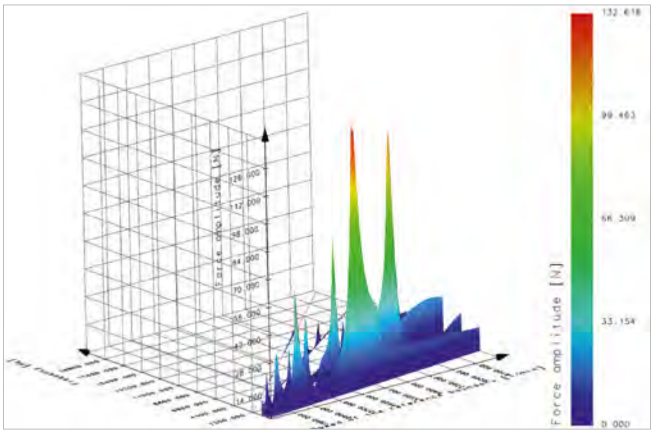
Graphics

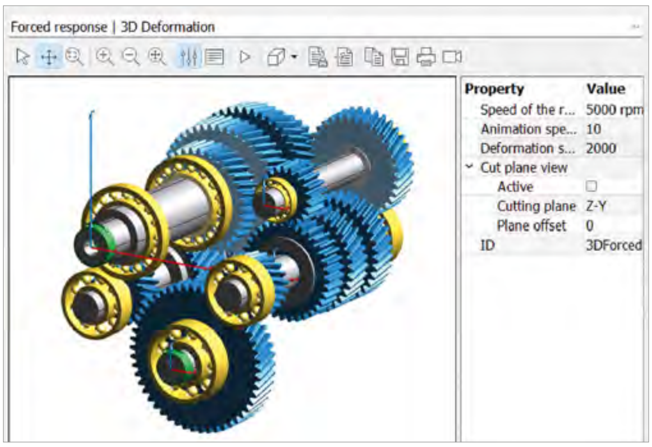
The results and outputs of the forced response analysis can be accessed in the graphics menu including:

- Dynamic factor
- Bearing force and moments
- Shaft outputs
- Gear mesh outputs
- Campbell diagram
- Whirl orbit parameters





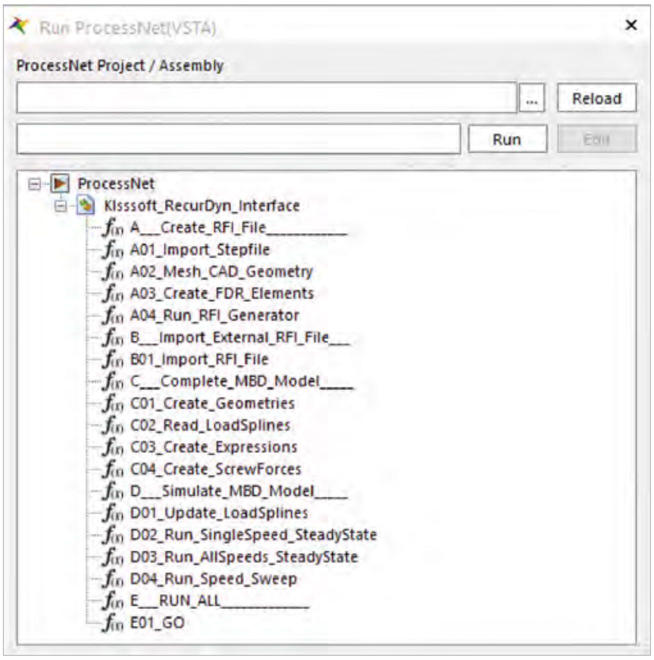




System Module, Housing Vibration and Noise

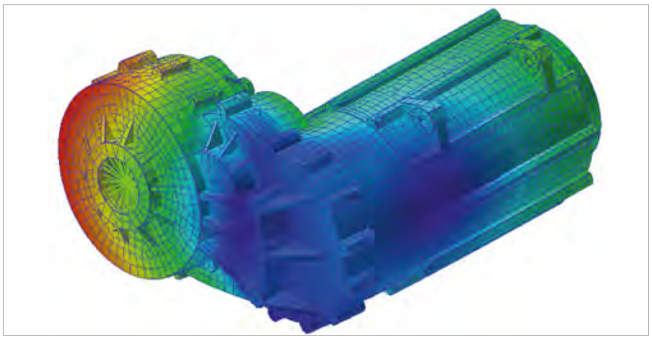
Overview

For characterization of the NVH properties, a calculation process using KISSsoft and RecurDyn software is offered. By exporting the transient bearing forces from KISSsoft to RecurDyn and applying them to a housing, the housing response may be computed. The approach is fully automated through an interface window in RecurDyn.



Linking System Module and RecurDyn®

RecurDyn, by FunctionBay, is a Multibody Dynamics based software with an integrated nonlinear Finite Element Method and a noise tool kit extension. RecurDyn/Acoustics is a noise analysis toolkit that performs the predictive analysis for noise of the mechanical system by confirming which parts of the surface of a flexible body emit more noise and which frequency band ERP is dominant.



Modelling in RecurDyn

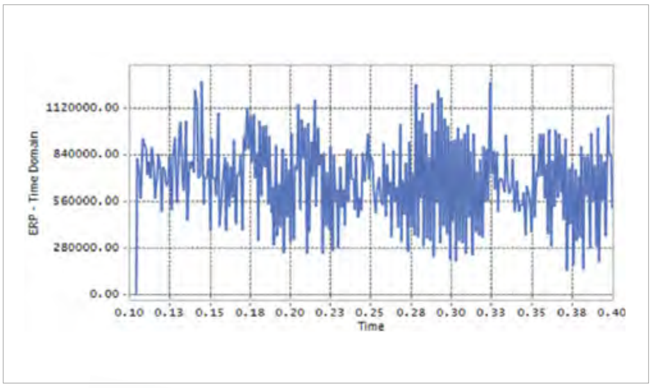
FEM modelling in pre-processor, housing or housing with internals

- Mesh generation, define bearing points
- Fix housing to ground, add force distributing element, set damping ratio
- Reading load splines from the System Module

Data exchange from System Module to RecurDyn

The forced response calculation in the System Module generates the load data used to excite the housing modelled in RecurDyn

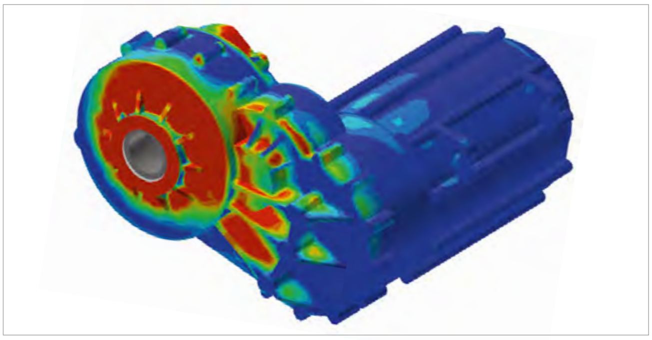
- Force vector for each bearing in time domain
- Speed sweep, user defined speed increments
- Export of text files from the System Module, import in RecurDyn using script

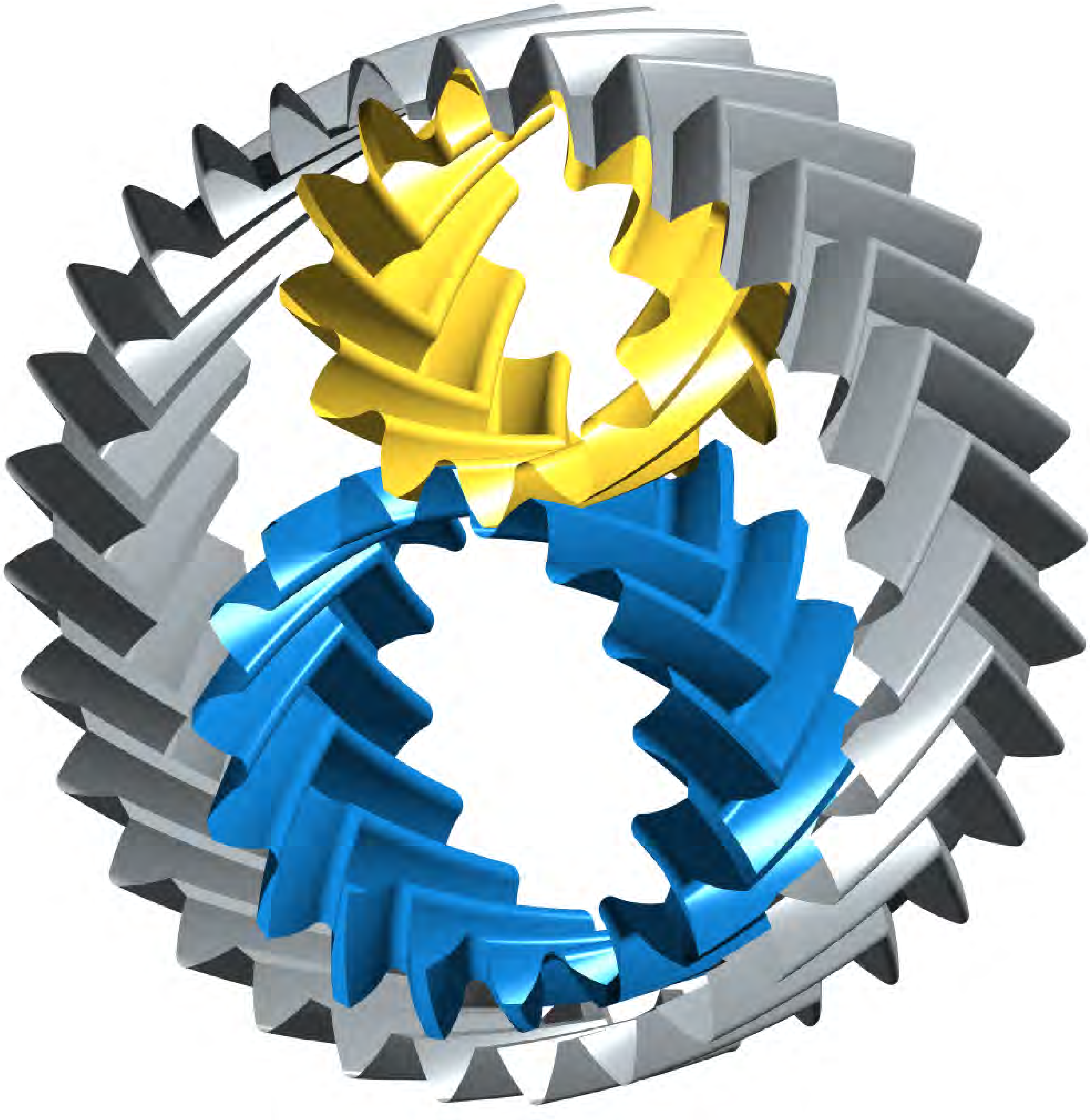


Results

Distribution of ERP over housing surfaces is as basis for predictive analysis of noise emitted.

- Accelerometer evaluation
- ERP (effective radiated power) for structure borne noise assessment, in time and frequency domain
- SPL (sound pressure level) measured using virtual microphones
- NVH analysis for speed ramp, by interpolation between singular speed levels
- Campbell diagram 2D and 3D
- Evaluation of individual modes in time domain and frequency domain





Cylindrical Gears, Overview

Configurations

- Spur and helical gear, double helical, herringbone, with or without face width offset
- Grease or oil lubricated or dry running gears
- Metallic and plastic gears
- Involute and non-involute gears
- Any number of teeth, any type of tooth height, internal or external gears
- Symmetrical and asymmetrical profile

Gear geometry calculation

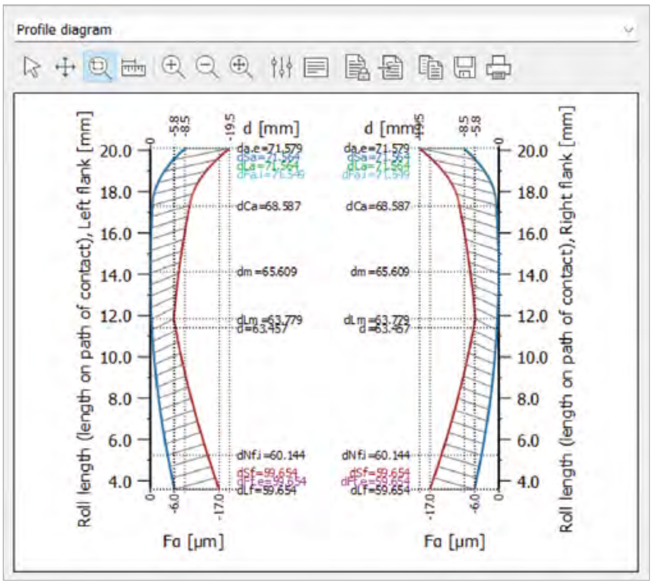
- Gear geometry along ISO 21771, DIN 3960
- Reference profile along ISO 53, DIN 867, JIS B 1701, GOST 13755, DIN 3972, DIN 58400, BS 5482
- Tooth thickness tolerances along DIN 3967, ISO 1328, DIN 58405, GOTS 1643
- Centre distance along ISO 286, DIN ISO 2768, DIN 7168, DIN 58405, GOST 1643
- Gear quality along ISO 1328, AGMA 2015, DIN 3961-3963, AGMA 2000, GOST 1643, JIS B 1702
- Own input

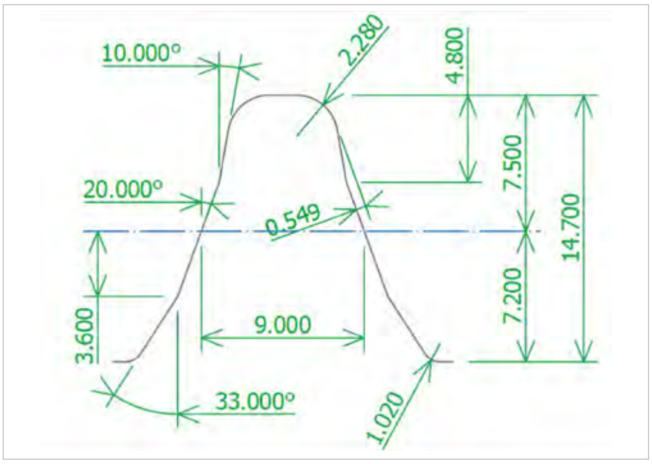
Gear rating

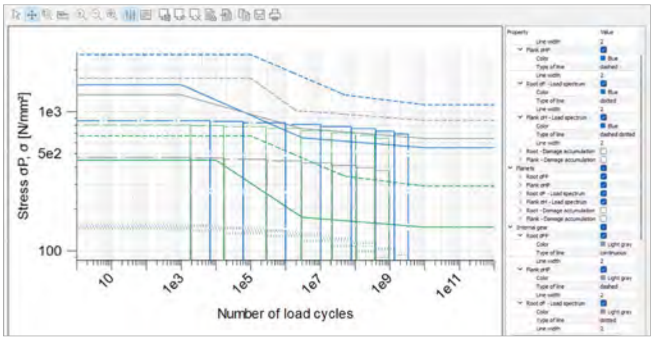
- DIN 3990 method B, DIN 3990 method B with YF along method C, DIN 3990 Part 41 (vehicles)
- ISO 6336:2006 and ISO 6336:2019
- Static rating against yield
- AGMA 2001-C95, AGMA 2101-D04, AGMA 2001-D04
- AGMA 6004-F88, AGMA 6011-J14, API 613 :2021, AGMA 6014-B15, AGMA 6015-A13, GOST 21354-87
- Plastic gears along Niemann, VDI 2545, VDI 2545 modified, VDI2736
- BV / Rina FREMM3.1, Rina 2010, DNV41.2, Loyds Register 2013
- ISO 13691:2001 (high speed gears)
- For nominal load or load spectrum

Reports

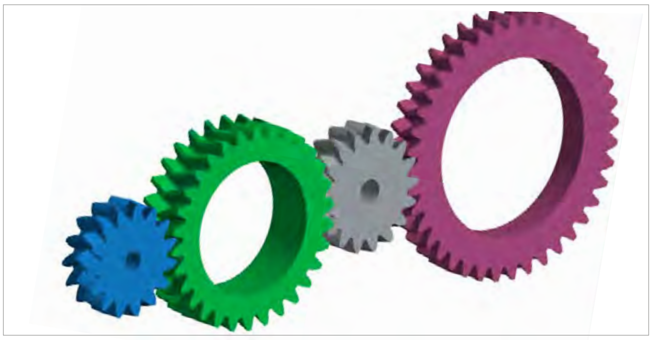
- Default report or user specific template
- Geometry and strength reports
- Tooth scuffing, micropitting and wear
- Tooth thickness dimensions, tooth tolerances
- Modifications, manufacturing
- X-Y coordinates of tooth profile



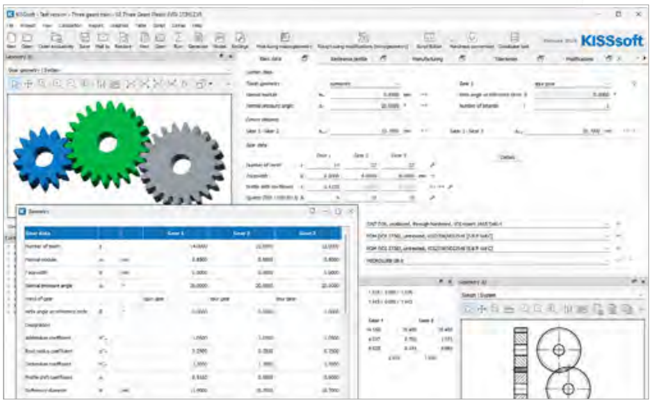




Chain of Gears / Idler Gears



Configurations
- Three gear chain with one idler gear
- Four gear chain with two idlers
- Input on first and output on last gear
- Alternating bending is considered on idler
- Definition of two or three center distances



Calculations
- Same calculations as for gear pair and planetary gears
- Independent hardness definitions
- ISO 6336-3, Annex B mean stress influence
- Fine sizing function
- Calculation as double planet for several strands
- Definition of fourth gear in the chain as internal gear
- Including assembly condition and collision check

Cylindrical Gears, General Modules

Gear geometry calculation

- Based on gear or tool reference profile with protuberance, buckling root, reference thickness, semi-non- full topping
- Or based on *.dxf import of tool geometry
- Calculation based on mating gear geometry
- Import and export of gear or tool geometry from CAD system
- Calculation of theoretical, acceptance and operating backlash for metallic and plastic gears and housings

Load spectrum calculation

- Direct input of load spectrum or import from text or Excel file or time series
- Calculation of lifetime based on required safety factor, safety factors based on required lifetime and permissible torque based on required safety factor and lifetime
- Calculation of partial damages
- Calculation of equivalent torque
- For DIN 3990, ISO 6336 and AGMA 2001 rating

AGMA925 calculations

- Calculation of scuffing safety
- Calculation of contact stress, lubricant film thickness

Micropitting and scuffing calculation

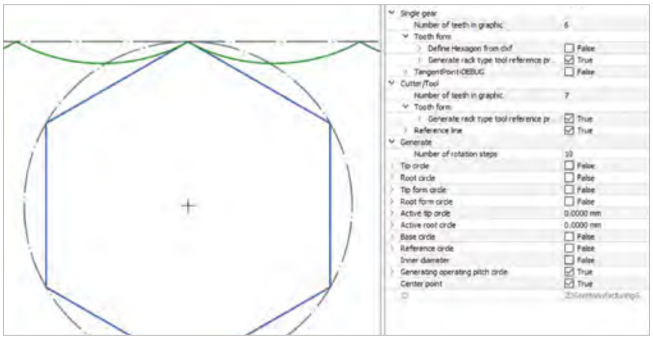
- Micropitting rating along ISO/TS 6336-22
- Specific lubricant film thickness calculation along AGMA 925
- Lubricant film thickness calculation along ISO/TS 6336-22 based on true contact stress
- Scuffing rating along ISO 6336-20, ISO 6336-21, DIN 3990-4

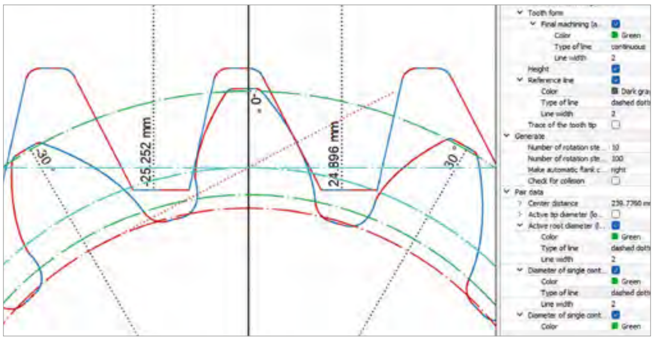
Flank fracture calculation

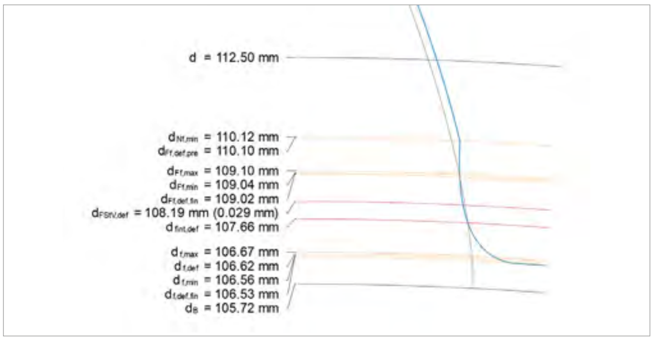
- Along ISO/TS 6336-4 method
- Along method A (based on LTCA) or method B (based on formulas)
- Case crushing calculation along DNV 41.2

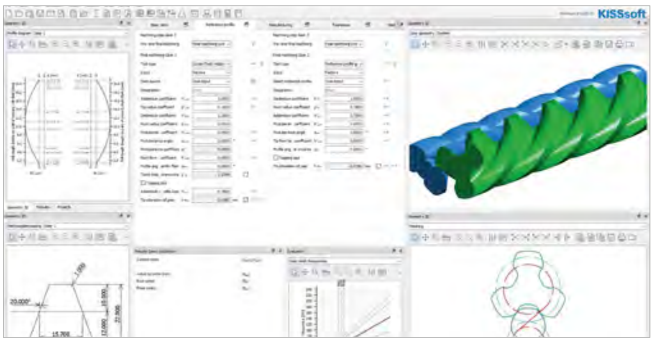
Master gear calculation

- Calculation of master gear geometry
- Meshing of master gear with workpiece
- Sizing function for form diameters









Cylindrical Gears, Sizing Modules

Configurations

- Sizing functions to find optimized gears (in terms of mass, power density, stiffness, space, … requirements)
- Functions to reverse engineer gears
- Functions to optimize gear properties

Rough sizing

- Proposal of several gear solutions for required power rating, required ratio, given material
- Considers gear quality, permissible ratio error
- For single load level or load spectrum

Fine sizing

- Define permissible ranges for module, pressure angle, helix angle, center distance, face width, gear quality, profile shift, …
- Define target ratio and permissible deviation
- Define maximum number of solutions
- Set maximum permissible tip diameter and minimum permissible root diameter
- For pre-defined number of teeth or varying number of teeth
- Different filter and sorting functions
- Report with assessment of solutions for different criteria

Profile shift sizing

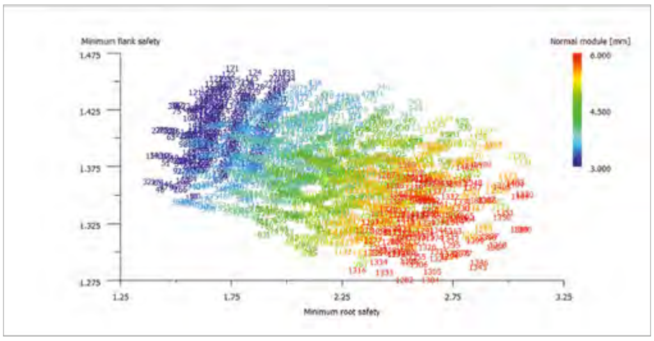
- Sizing from gear pair data
- Sizing for target profile shift sum
- For balanced specific sliding / speed increaser
- To avoid pointed tooth or undercut
- For maximized strength on flank or root or maximized scuffing strength

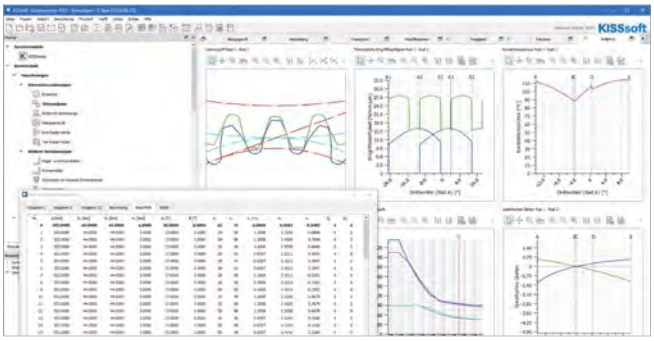
Sizing of tooth height / reference profile

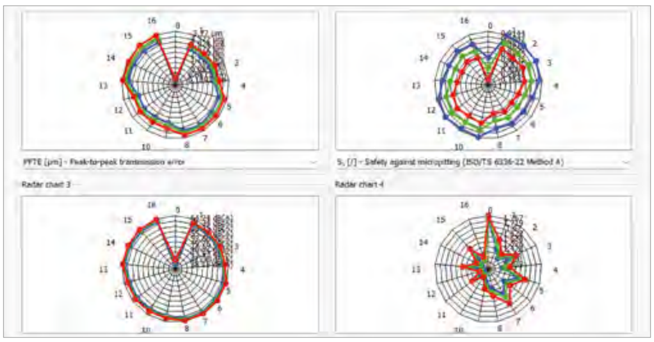
- Sizing of reference profile for target transverse contact ratio
- Sizing of maximum possible root radius

Sizing of profile and lead modifications

- Sizing of tip and root relief Sizing of end relief and crowning
- Automatic search for optimum modifications







Cylindrical Gears, Modifications

Configurations

- Combine modifications in profile and lead direction, combined and topological modifications
- Create K chart and lead diagram
- Define tolerances range based on AGMA 2000, using constant band width or import tolerance bands from GAMA®
- Display each modification separately in 2D diagram, display resulting combination
- Show flank modifications in 3D, combining all modifications
- Gear 3D geometry includes modifications
- Tip chamfer, tip rounding in different sections
- Face chamfer, tip face chamfer
- Modifications manager using variants of sets of modifications

Root modifications

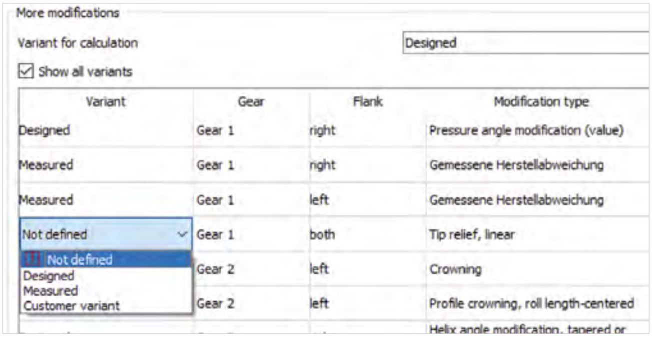
- Root with pre-machining and or final machining, independent root diameter tolerances
- Grinding notch, partial final machining of root
- Root geometry optimization for minimized root stresses

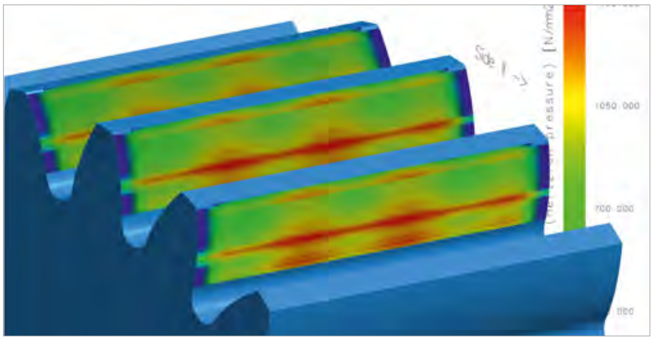
Manufacturing errors as modifications

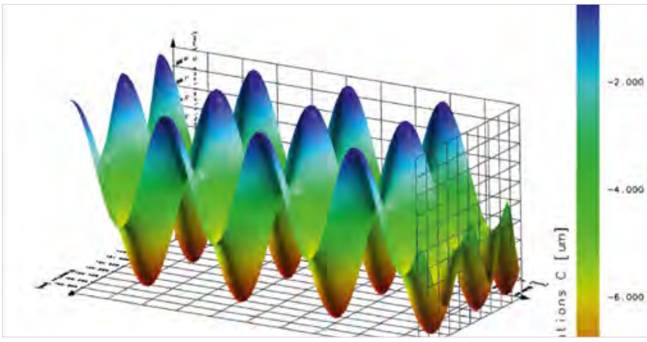
- Flank waviness with wavelength, amplitude and angle
- Natural twist from generating grinding
- Profile and helix form and slope deviation

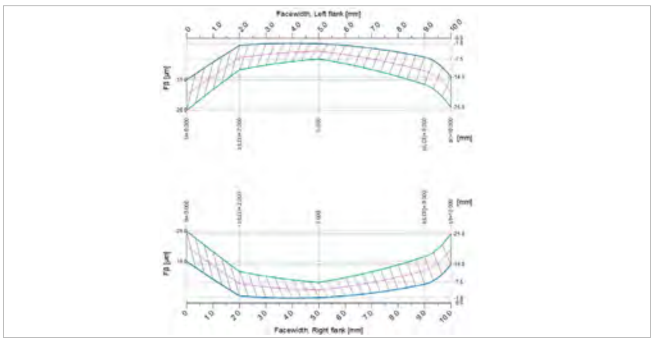
Lead and profile modifications

- End relief (left and right end), flank line crowning (centrical, eccentrical)
- Helix angle modification
- Linear and progressive tip / root modification
- Profile crowning (barreling), also in combination with tip relief, roll length or diameter centered
- Pressure angle modification
- Tip chamfer or rounding
- Flank twist
- Triangular end relief (left and right end)
- Topological modification









Cylindrical Gears, Gear Body Deformation

Modelling and FEM

- Hub / web / rim arrangement
- Parametrized geometry
- Automatic meshing, parabolic tet elements
- Automatic meshing, parabolic prism elements
- Modeling of local radii
- Automatic defeaturing capabilities
- Geometry preview, mesh preview
- Import of *.stp files
- Multibody modelling (separate materials for rim and body)
- Result review per body

Calcualtions and integration

- Calculation of deformation and reduced stiffness matrix
- Stiffness matrix connected to shaft calculation
- In combination with LTCA
- 2D and 3D-gear body deformation

Tooth geometry export

- With or without profile / lead modifications
- Modifications may be different per tooth
- Modifications may be different per flank
- Output in transverse, normal and axial section
- Output of tooth or gap, single or half tooth
- Output as x, y format (e.g. in spreadsheet calculations)
- Output as x, y, z format in line with Gleason or Klingelnberg format for measuring machines

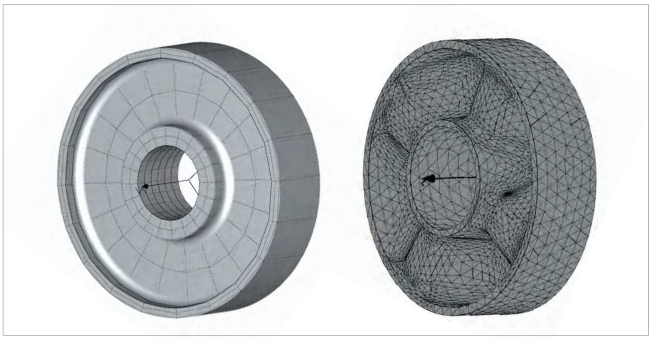
Rating with time series

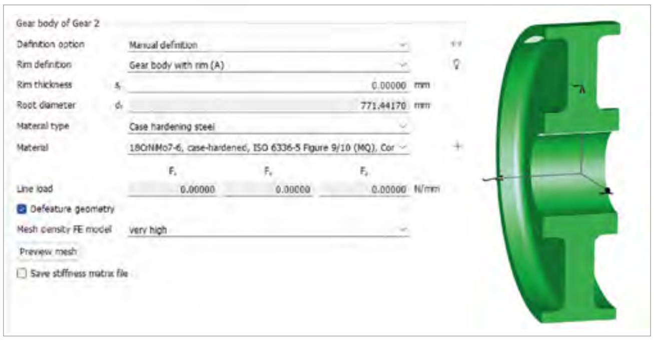
Import and conversion

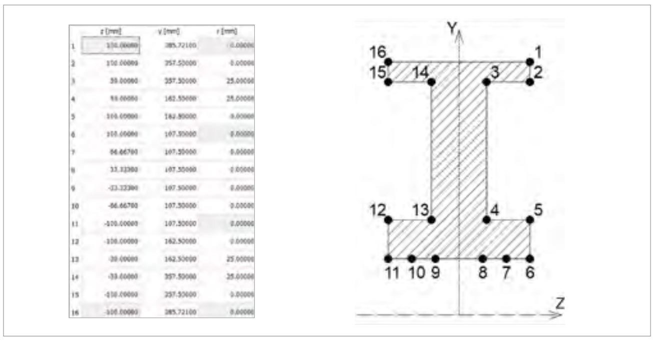
- Import time series of speed and torque from text file
- Convert to load duration distribution load spectrum (LDD), save LDD for gear rating
- Considers changes in torque direction
- Considers changes in speed direction
- Graphical display of resulting load and speed distribution

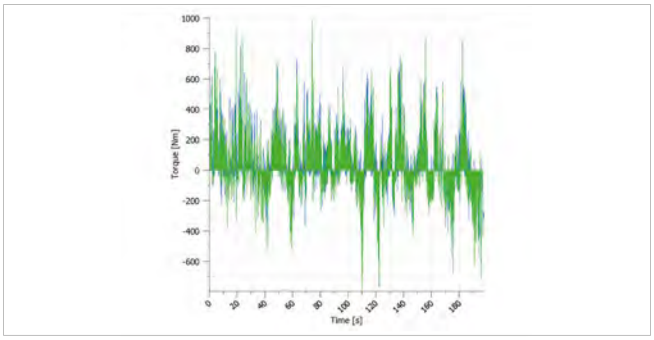
Configurations

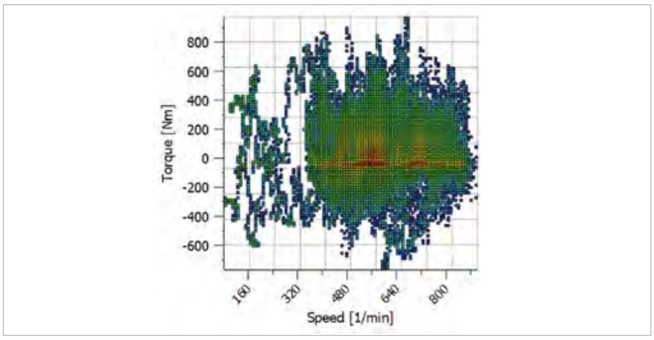
- Rain flow count method according to Amzallag or ASME
- Simple count method







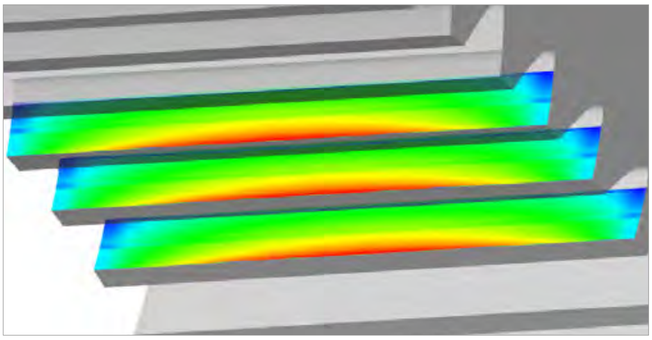


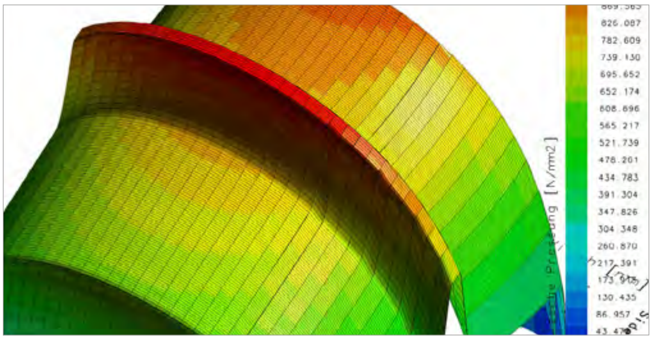


Cylindrical Gears, Loaded Tooth Contact Analysis

Configurations

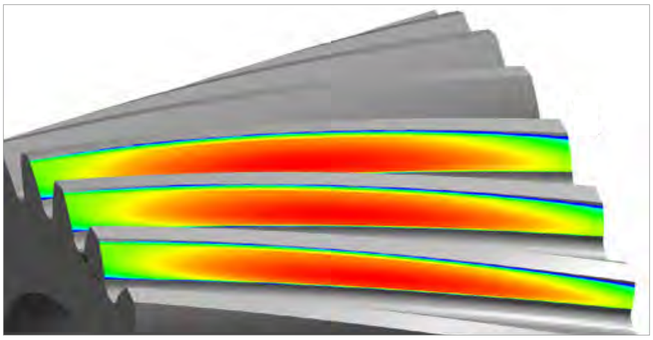
- Considers all modifications in profile and lead direction and topological modifications
- Calculation over one or several pitches
- Pitch errors may be considered in part or fully
- Calculation for nominal or operating center distance
- Calculation for nominal or partial load level
- Meshing friction considered in calculation
- Considers true gear geometry from manufacturing simulation
- For internal and external gears
- User defined resolution in calculation
- Line load calculation along ISO 6336-1, Annex E with consideration of manufacturing errors

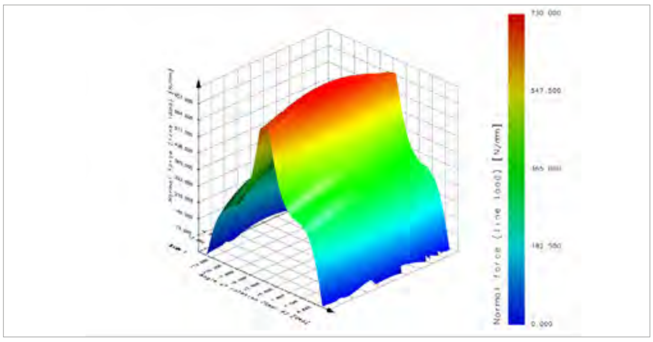




Mesh stiffness calculation

- Calculation of transmission error TE for spur and helical gears, showing peak to peak transmission error PPTE, average and standard deviation
- Calculation of normal force, torque variation, contact stiffness, bearing forces, kinematics, specific sliding, and local heat generated over meshing cycle
- Results displayed vs. roll angle, pinion diameter, length on path of action, pinion angle of rotation
- Calculation has been verified in benchmarks against reference software, practical experience in full load tests and FEM calculations
- Different methods for slice linking spring stiffness



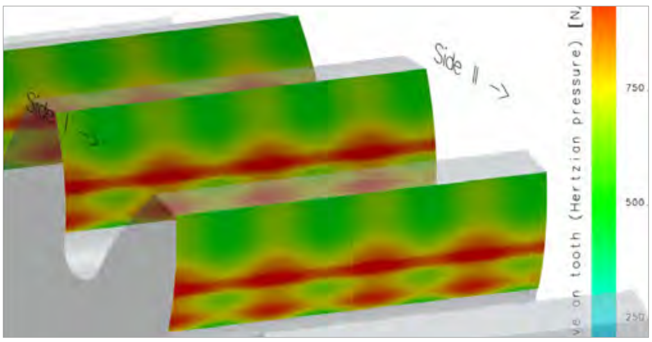


Output

- Graphics, exportable as graphic format or *.dxf
- Report including calculation settings and results summary
- Report including all graphics

True contact ratio calculation

- Calculation of true transverse contact ratio under load
- Calculation of true total contact ratio under load



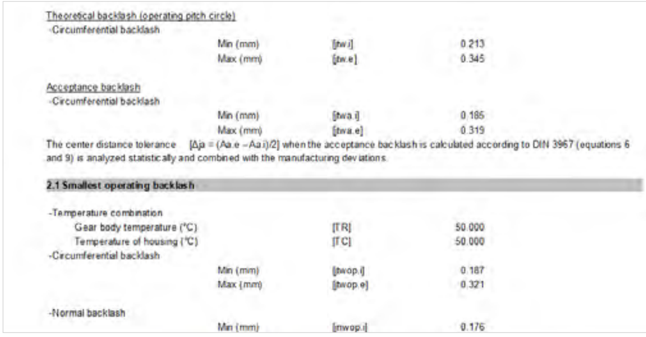
Cylindrical Gears, Backlash

Backlash from true tooth form

- Backlash is calculated as an angular backlash.
- Theoretical backlash is calculated based on true tooth form. Tooth form may be involute, involute with modifications or non-involute. For non-involute tooth form or involute tooth form with modifications, backlash is not constant over the meshing cycle.
- Backlash is calculated for highest, lowest and mean tooth thickness / diameter / center distance combination, resulting in three curves.
- Collisions and tip to root interferences are indicated by zero backlash condition
- Gear modifications in lead direction are considered, backlash is calculated for a number of slices along the face width
- Tooth deformation and temperature influence are not considered
- Works also for tooth form from imported *.dxf files

Backlash, acceptance backlash, operating backlash

- Theoretical backlash in transverse and normal section, chordal and arc value, considering tooth thickness and center distance tolerances.
- Acceptance backlash considering runout, manufacturing errors and axis misalignment.
- Operating backlash considering housing and gear temperatures and moisture absorption.
- Contact and collision check in 2D graphic in transverse section for any tooth thickness, diameter and center distance tolerance combination.
- Recommendation of tooth thickness tolerances in case of gear jamming.
- Backlash definition through manufacturing profile shift or tooth thickness tolerances.
- Calculation of tooth thickness / backlash from span measurement or from diameter over pins.
- Strength calculation on theoretical gear or on gear with backlash.



Theoretical backlash (operating pitch circle)
-Circumferential backlash

	Min (mm)	[jtw.i]	0.213
	Max (mm)	[jtw.e]	0.345

Acceptance backlash
-Circumferential backlash

	Min (mm)	[jtwa.i]	0.185
	Max (mm)	[jtwa.e]	0.319

The center distance tolerance [Δja = (Aa.e – Aa.i)/2] when the acceptance backlash is calculated according to DIN 3967 (equations 6 and 9) is analyzed statistically and combined with the manufacturing deviations

2.1 Smallest operating backlash

-Temperature combination

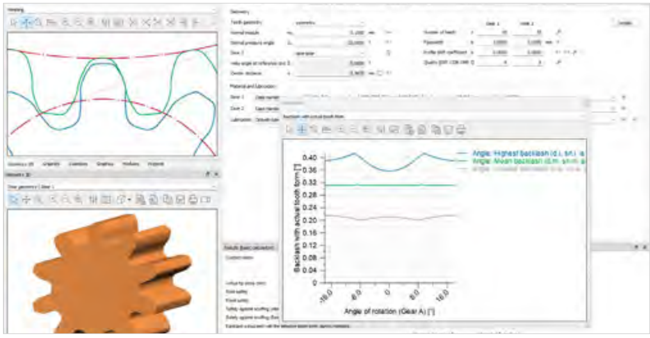
Gear body temperature (°C)		[TR]	50.000
Temperature of housing (°C)		[TC]	50.000

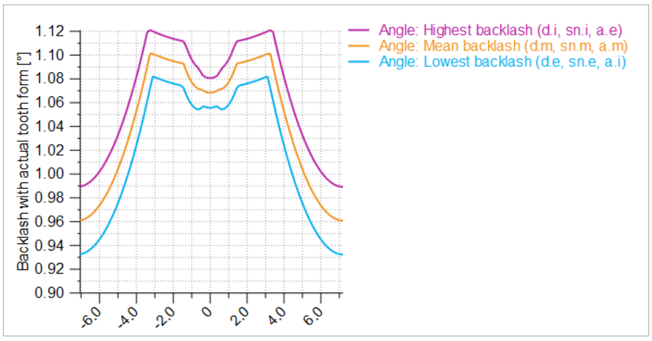
-Circumferential backlash

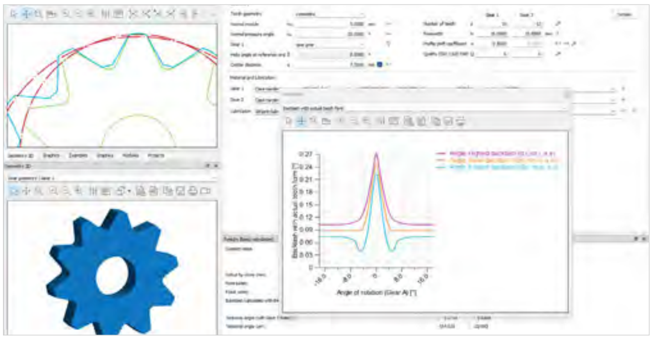
	Min (mm)	[jtwop.i]	0.187
	Max (mm)	[jtwop.e]	0.321

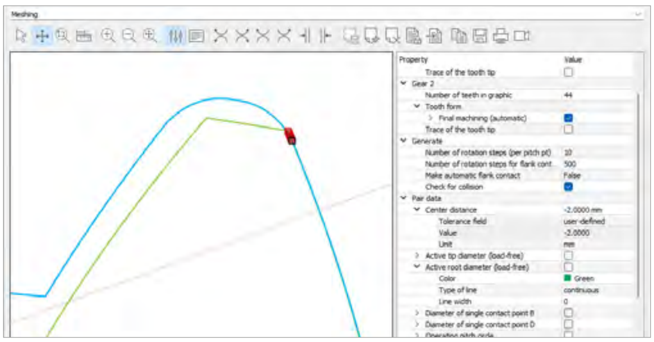
-Normal backlash

	Min (mm)	[jnwop.i]	0.176









Cylindrical Gears, Root Stress by FEM

FEM models

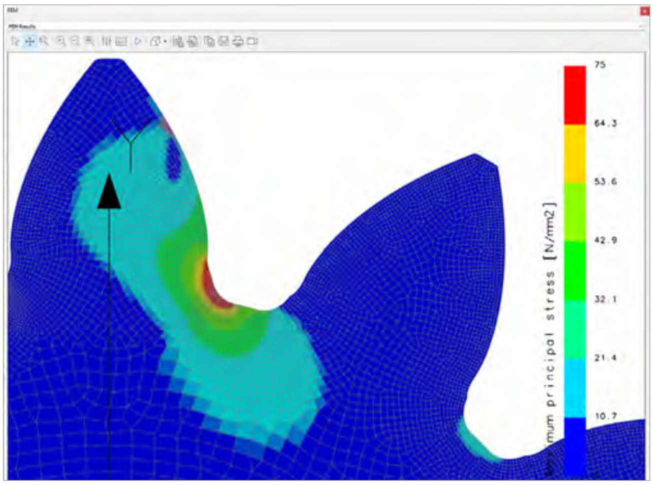
- 2D plane stress model using parabolic triangular elements with variable mesh density
- Mesh density is maximized for critical area in the root
- Resulting stress levels are calculated for contact point of 30° (60°) tangent to theoretical tooth form, for contact point of 30° (60°) tangent to actual tooth form and for point with highest stress
- Stress levels are reported and compared to nominal stress calculated along ISO 6336
- FEM pre-processor (Salome) and solver (Code Aster) are remote controlled requiring no interaction.
- Pre- and post-processor may be opened after calculation to check mesh, boundary condition and results
- Different stress values like von Mises, max and min principal and others may be shown. Different color bars may be used.

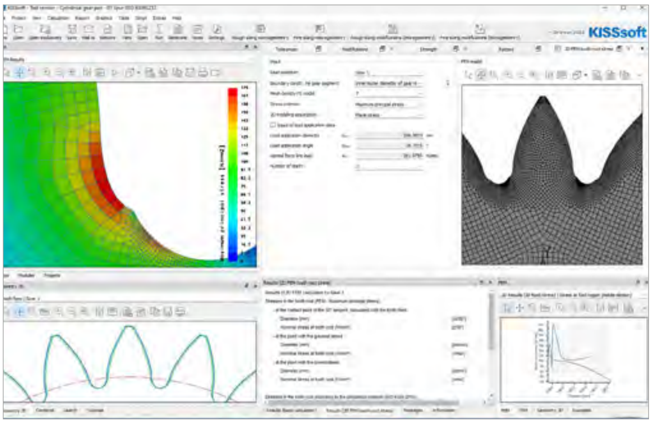
Root stress calculation

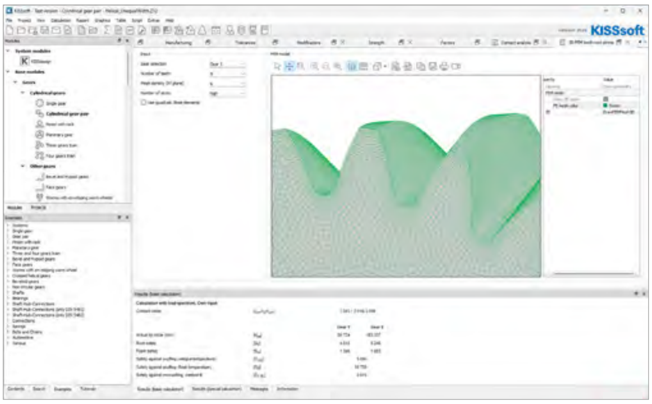
- For standard gear geometry with trochoidal fillet based on circular tip of tool
- For non-standard gear root geometry including machining notches / grinding notches
- For non-trochoidal, e.g., circular, or elliptic root shape
- Also, for cycloidal and circle shaped (non-involute) gears
- For asymmetrical involute gears

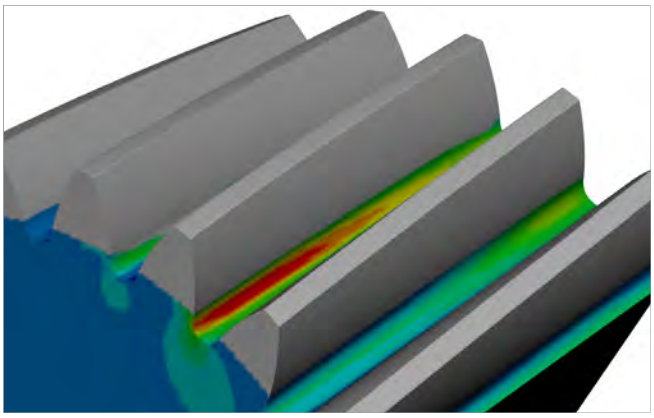
3D FEM

- For spur and helical gears
- Using parabolic tetraeder elements









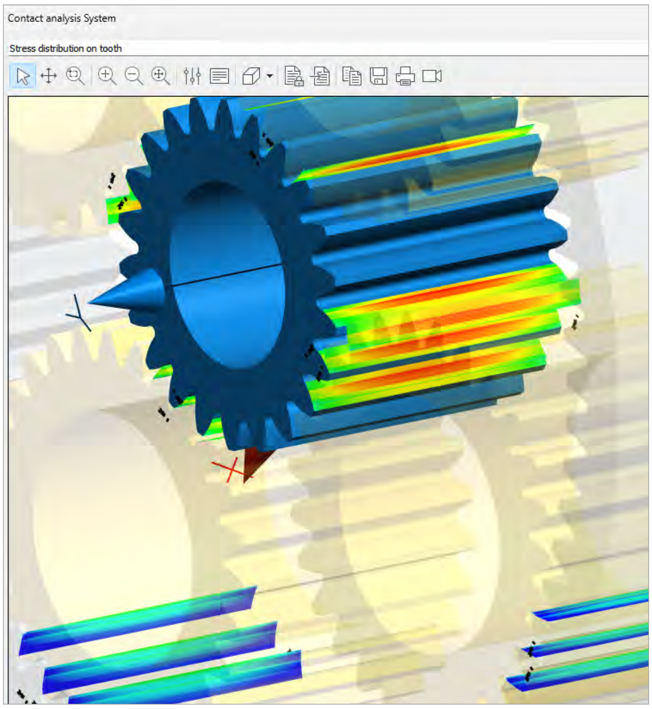
Cylindrical Gears, Planetary Tooth Contact Analysis

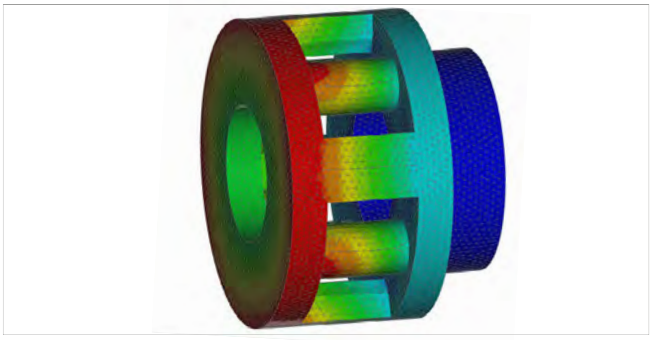
FEM calculation of planetary carrier
- Planetary carrier torsion is calculated inside KISSsoft with FEM
- Salome / Code Aster is used as pre-processor and solver, using Python scripts
- Based on parameterized model of the carrier (import of carrier geometry is not directly possible)
- Mesh generation is automatic
- Includes sizing function for planetary carrier geometry
- Results may also be directly imported from FEM results file

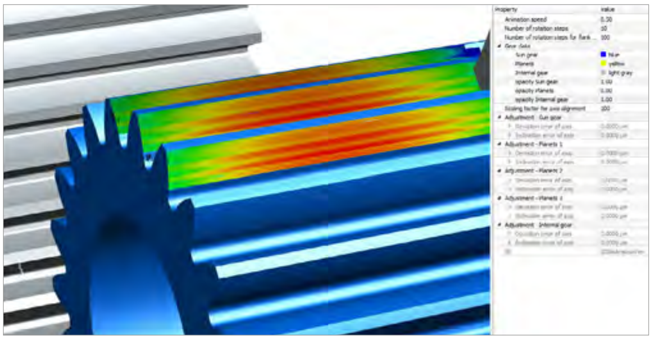
Ring gear deformation
- In case of ring gears supported only on one side, the conical deformation may be considered for the planet – ring gear mesh

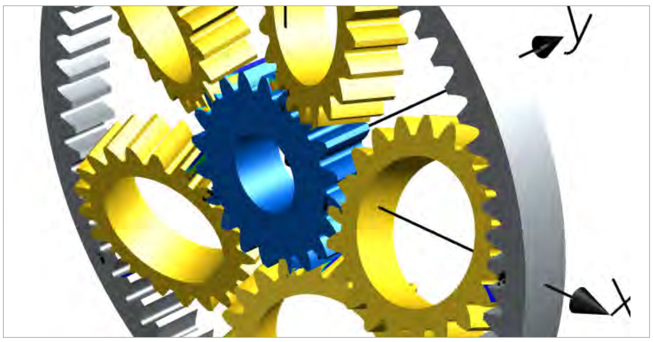
Sun gear arrangement
- Floating or fixed sun gear
- In case of floating sun gear, quasistatic momentary equilibrium is calculated

Link to shaft calculations
- Planetary carrier tilting in carrier bearings or due to manufacturing errors may be considered from shaft calculation
- Sun shaft twist, sun shaft tilting may be considered in LTCA with planets
- Planet pin deformation and planet bearing deformations is automatically imported from shaft calculation
- Planetary tooth contact analysis may be integrated into system models

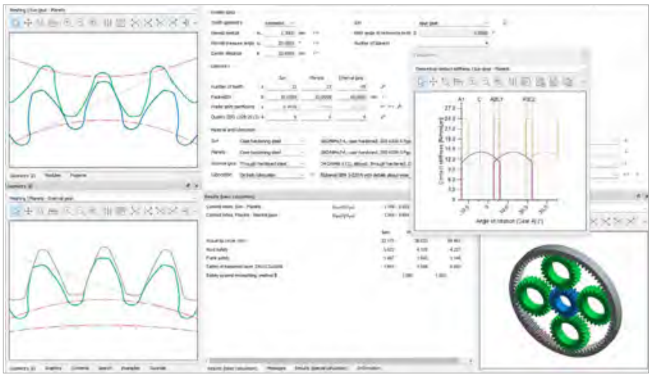






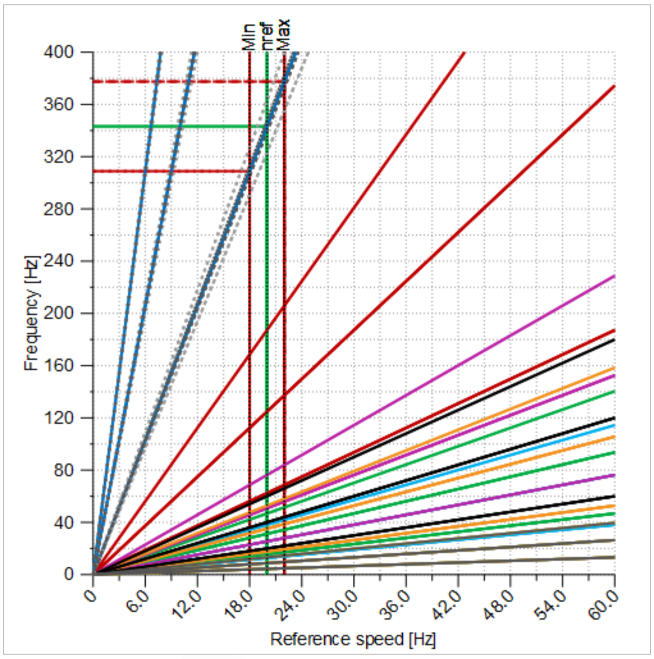


Cylindrical Gears, Planetary Gears



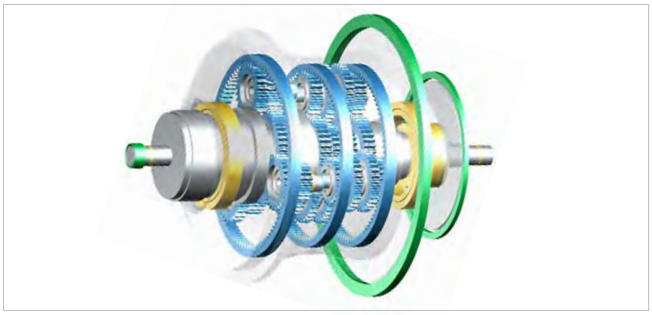
Overview

- Based on helical gear calculation modules
- Calculation of planet pin location for non-evenly spaced planets
- Influence of rim thickness of ring gear and planet gears considered
- Assembly check
- Sizing function for load distribution factor along AGMA 6123
- Rough and fine sizing function



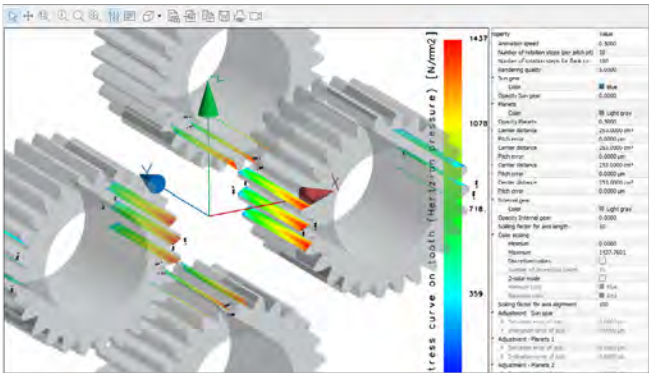
Strength rating, planets

- DIN 3990 method B, DIN 3990 method B with YF along method C, DIN 3990 Part 41 (vehicles)
- ISO 6336:2006 and ISO 6336:2019
- Static rating against yield
- AGMA 2001-C95, AGMA 2101-D04, AGMA 2001-D04
- AGMA 6004-F88, AGMA 6011-J14, API 613 :2021, AGMA 6014-B15, AGMA 6015-A13, GOST 21354-87
- Plastic gears along Niemann, VDI 2545, VDI 2545 modified, VDI2736
- BV / Rina FREMM3.1, Rina 2010, DNV41.2, Loyds Register 2013
- ISO 13691:2001 (high speed gears)
- For nominal load or load spectrum
- Planet system reliability
- Micropitting rating along ISO/TS 6336-22, scuffing rating along ISO 6336-20, ISO 6336-21, DIN 3990, AGMA 925
- Flank fracture rating along ISO/TS 6336-4 and case crushing rating along DNV 41.2



Kγ calculation

- For systems with perfect pin position or for pins with positioning error
- Quasi-static load distribution neglecting dynamic effects
- Sun may be floating or stationary
- Kγ is calculated for momentary force equilibrium for different meshing positions
- Considering system equilibrium for in-phase and out-of-phase systems
- Phasing check



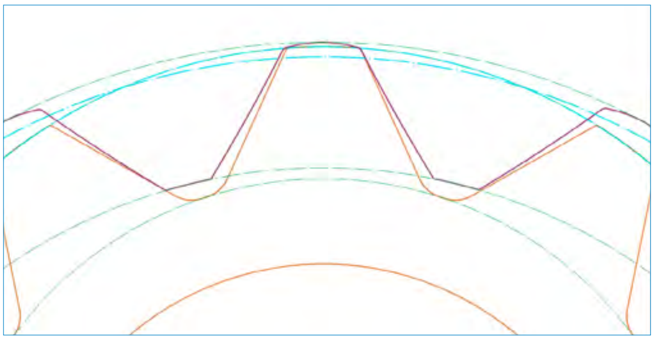
Cylindrical Gears, Gear Pumps

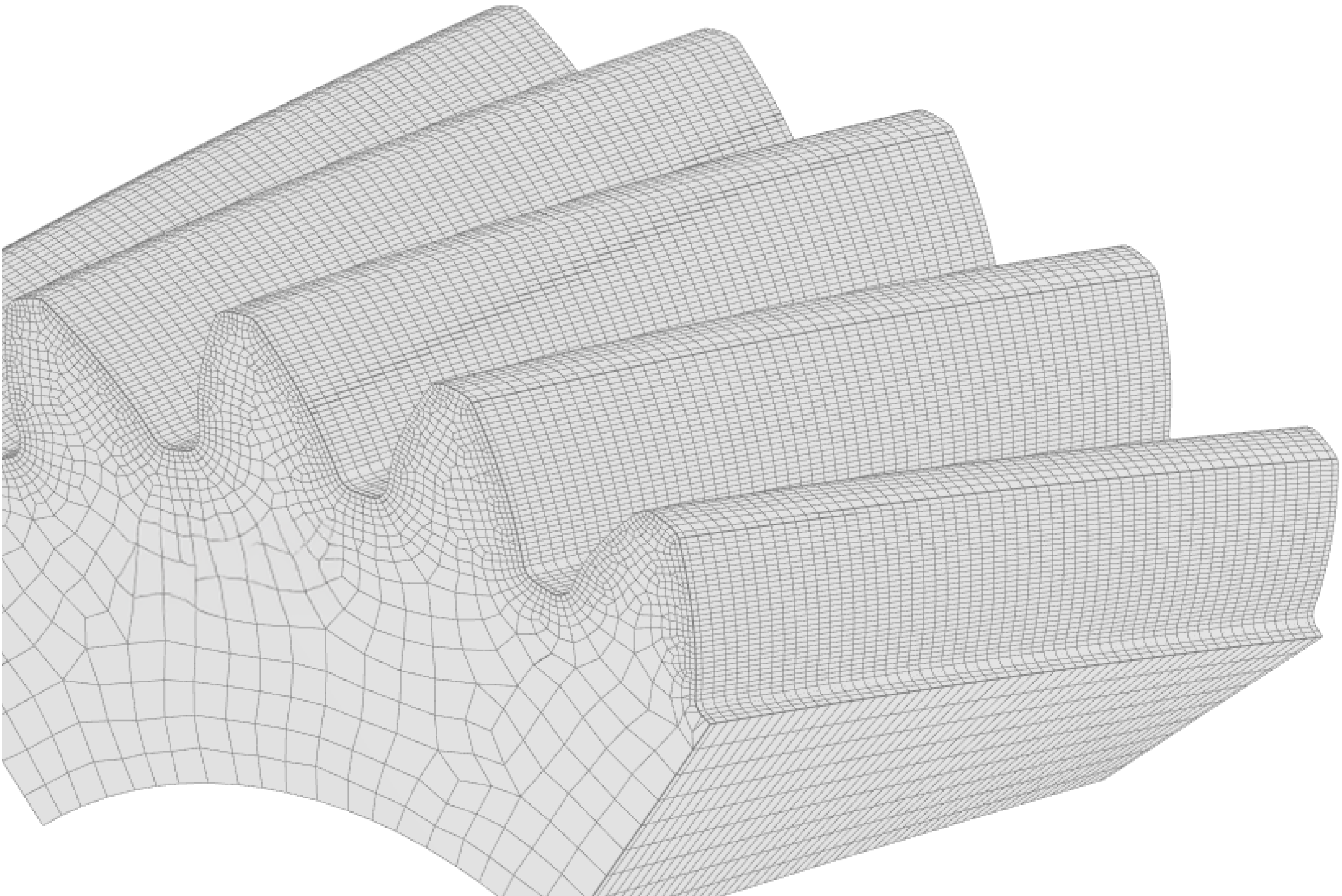
General

- For involute and non-involute tooth shape
- For external or internal gear pumps
- Calculation of tooth form, tooth load and volume flow
- Nominal flow calculation or considering elastic deformation of teeth
- Flow calculation can be combined with sizing functions

Expert options

- Changes in important parameters of pump during contact are calculated
- Includes enclosed volume, the volume with critical in-flow, narrowest point between flanks of first tooth pair not engaging marking the boundary of critical in-flow area, in flow velocity, oil flow, Fourier analysis for evaluation of noise potential, and total volume under entry chamber pressure





Cylindrical Gears, Rack and Pinion

Strength rating

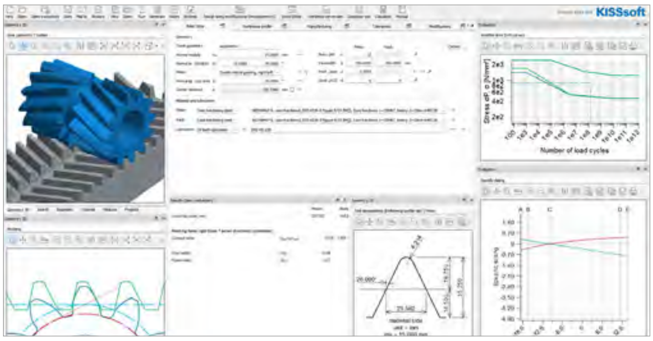
- DIN 3990 method B, DIN 3990 method B with YF along method C, DIN 3990 Part 41 (vehicles)
- ISO 6336:2006 and ISO 6336:2019
- Static rating against yield
- AGMA 2001-C95, AGMA 2101-D04, AGMA 2001-D04
- AGMA 6004-F88, AGMA 6011-J14, API 613 :2021, AGMA 6014-B15, AGMA 6015-A13, GOST 21354-87
- Plastic gears along Niemann, VDI 2545, VDI 2545 modified, VDI2736
- BV / Rina FREMM3.1, Rina 2010, DNV41.2, Loyds Register 2013
- ISO 13691:2001 (high speed gears)
- For nominal load or load spectrum
- Micropitting rating along ISO/TS 6336-22, scuffing rating along ISO 6336-20, ISO 6336-21, DIN 3990, AGMA 925
- Flank fracture rating along ISO/TS 6336-4 and case crushing rating along DNV 41.2

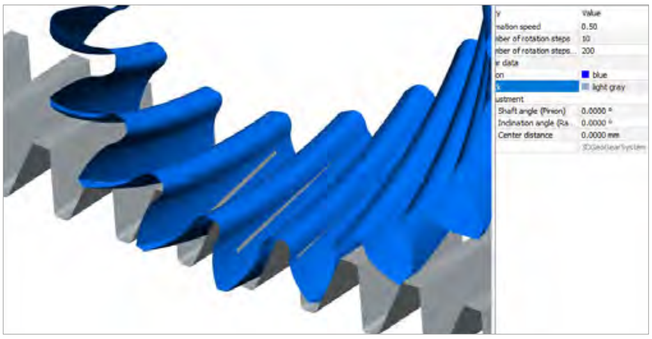
Output

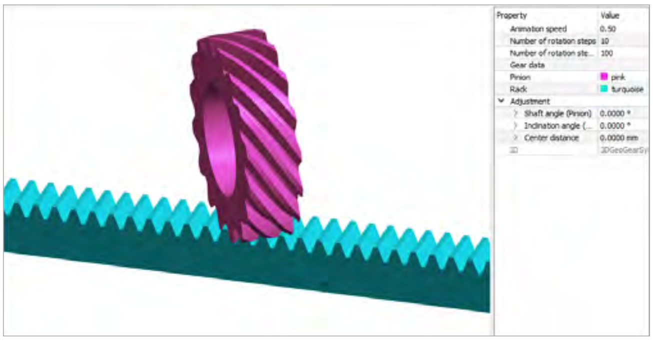
- Reports for manufacturing tolerances, drawing data, hardness depth proposal, geometry calculations and strength rating
- Life and strength results
- 2D and 3D gear geometry

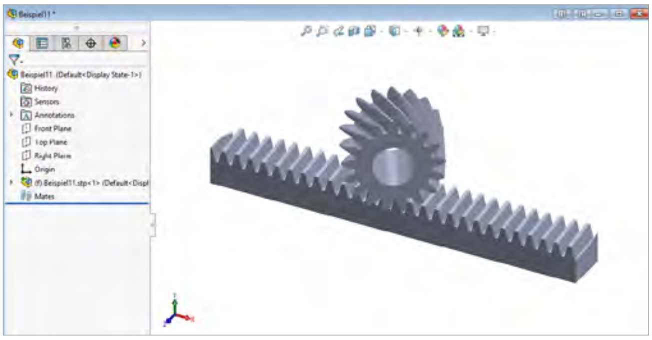
Crossed axis rack and pinion

- Axis angle ≠ 0°
- Calculation of contact ellipse size
- Stress calculation, strength rating
- No load contact pattern
- Consider pinion lead and profile modifications
- Export of 3D geometry in neutral format









Cylindrical Gears, Asymmetrical Teeth

General

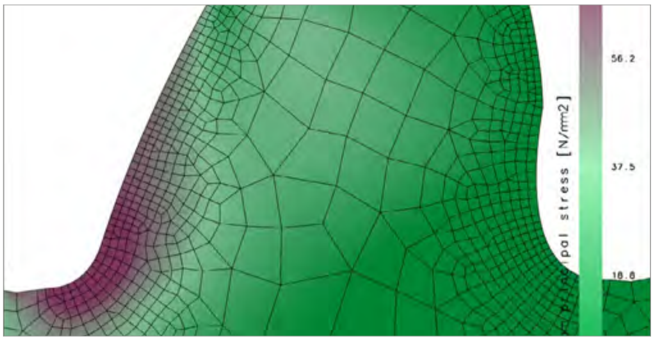
- Strength rating along ISO 6336, VDI 2545 and VDI 2736 for left and right flank / root
- Different pressure angle and root rounding for left and right side
- Face width offset may be positive or negative
- 3D models include solid model, skin model, cutting model
- Calculation of subsystem reliability based on pinion and gear life, using three parametric Weibull distribution

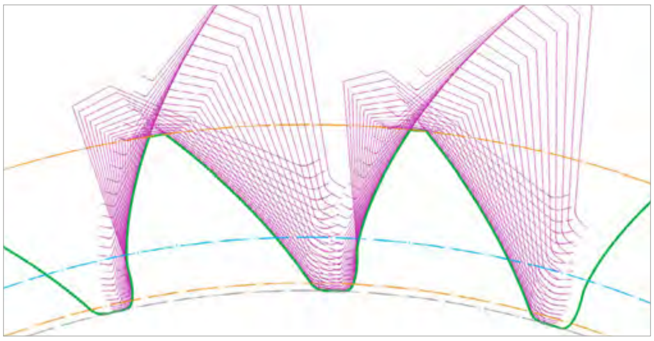
Configurations

- Spur, helical, double helical
- Gear pair calculation where pinion is driving or driven
- Rack and pinion, chain of three gears, chain of four gears
- Planetary gears consisting of sun, planet and ring gear, with any possible number of planets
- Export of 2D or 3D geometry considering tolerances such as tooth thickness tolerances, tip and root diameter tolerances
- Gear modifications in lead and profile direction

Features

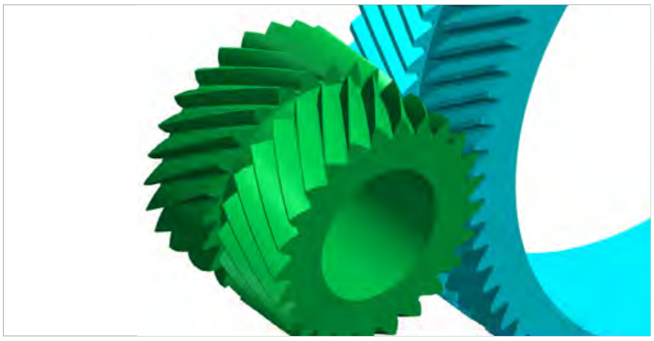
- Export of 3D geometry or of 2D geometry
- Allows for LTCA in loaded tooth contact analysis module
- No load contact analysis (intersection of skin models)
- Loaded tooth contact analysis for both flanks considering shaft misalignment and modifications
- Lead and profile modifications may be applied differently for left and right flank.

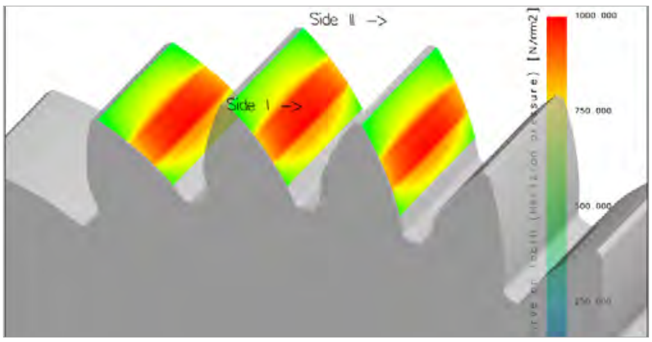




Final machining Gear 1

		left	right	
Tool type		Reference profile gear		
Input		Factors with diameters		
Designation		Enter...		
Dedendum coefficient	h^*_{fP}	1.4500		
Root diameter	d_f	172.9162		mm
Root radius coefficient	ρ^*_{fP}	0.0500	0.2000	
Addendum coefficient	h^*_{aP}	1.2500		
Tip diameter	d_a	205.2362		mm
Protuberance height coefficient	h^*_{prP}	0.0000	0.0000	
Root form diameter	d_{Ff}	180.7850	174.3878	mm
Protuberance angle	α_{prP}	0.0000	0.0000	°
Tip form height coefficient	h^*_{FaP}	0.8500	0.8000	



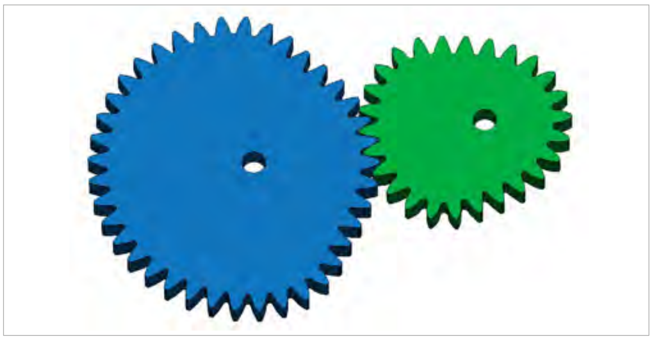


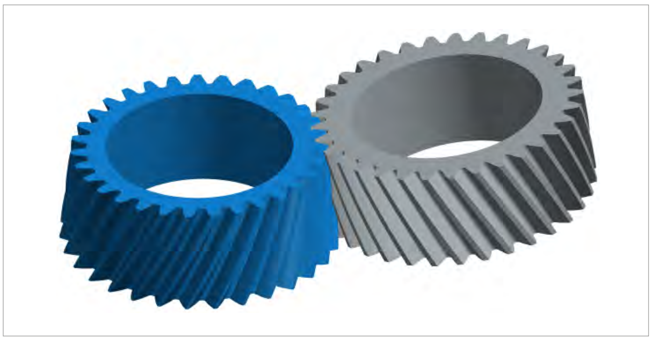
Non-circular Gears

They are calculated in KISSsoft based on an operating pitch curve. Gears may be closed or open.

Design of geometry
- Required momentary ratio may be defined
- Required meshing curve may be defined

From there, the following is calculated
- Calculation of meshing curve from
- momentary ratio
- Calculation of shaping cutter from gear / tooth data
- Calculation of backlash such that no
- jamming occurs
- Calculation of non-circular gear contour
- Export to CAD with different levels of
- accuracy (up to 800 points per flank)
- Add tip rounding
- Modify root geometry to increase strength
- Check of meshing / collisions in 2D
- Calculation of position of rolls for dimension over rolls measuring

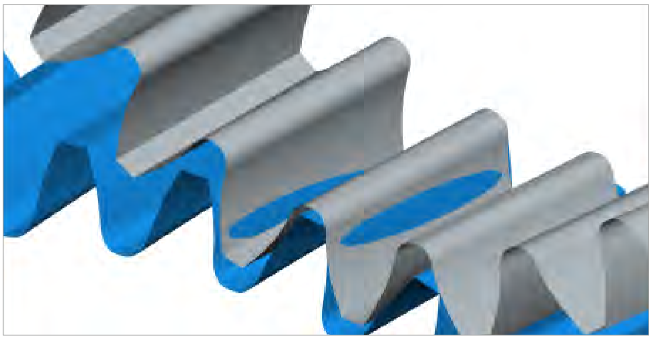




Beveloid Gears

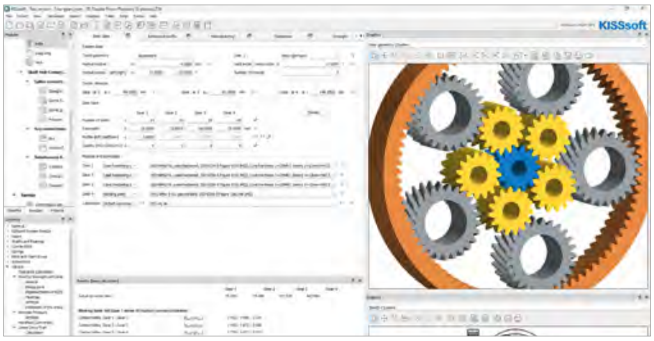
Beveloid gears (conical gears) can be modelled and rated in KISSsoft for small shaft and cone angles.

Calculations, geometry and strength
- Cone angle on both gears may be different
- Considers shaft and cone angles
- Spur and helical gears
- Includes micro geometry model
- Strength rating as per DIN, ISO, AGMA
- Based on equivalent cylindrical gear
- No load tooth contact analysis



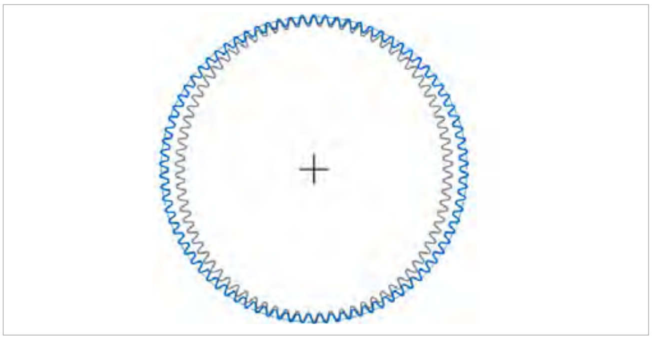
Double Planet

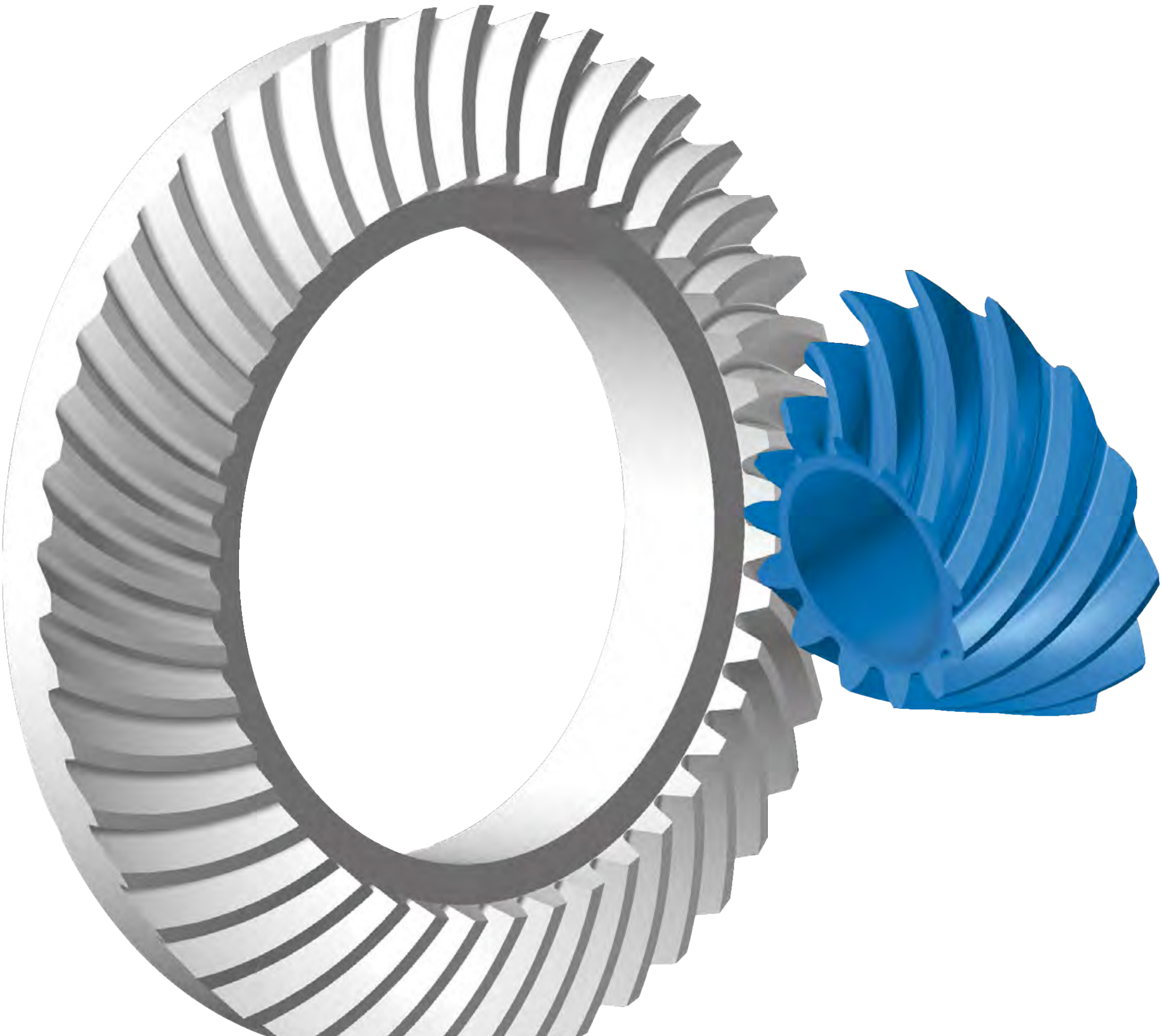
- Assembly condition and collision check
- Strength rating as for cylindrical gear modules
- 2D and 3D geometry

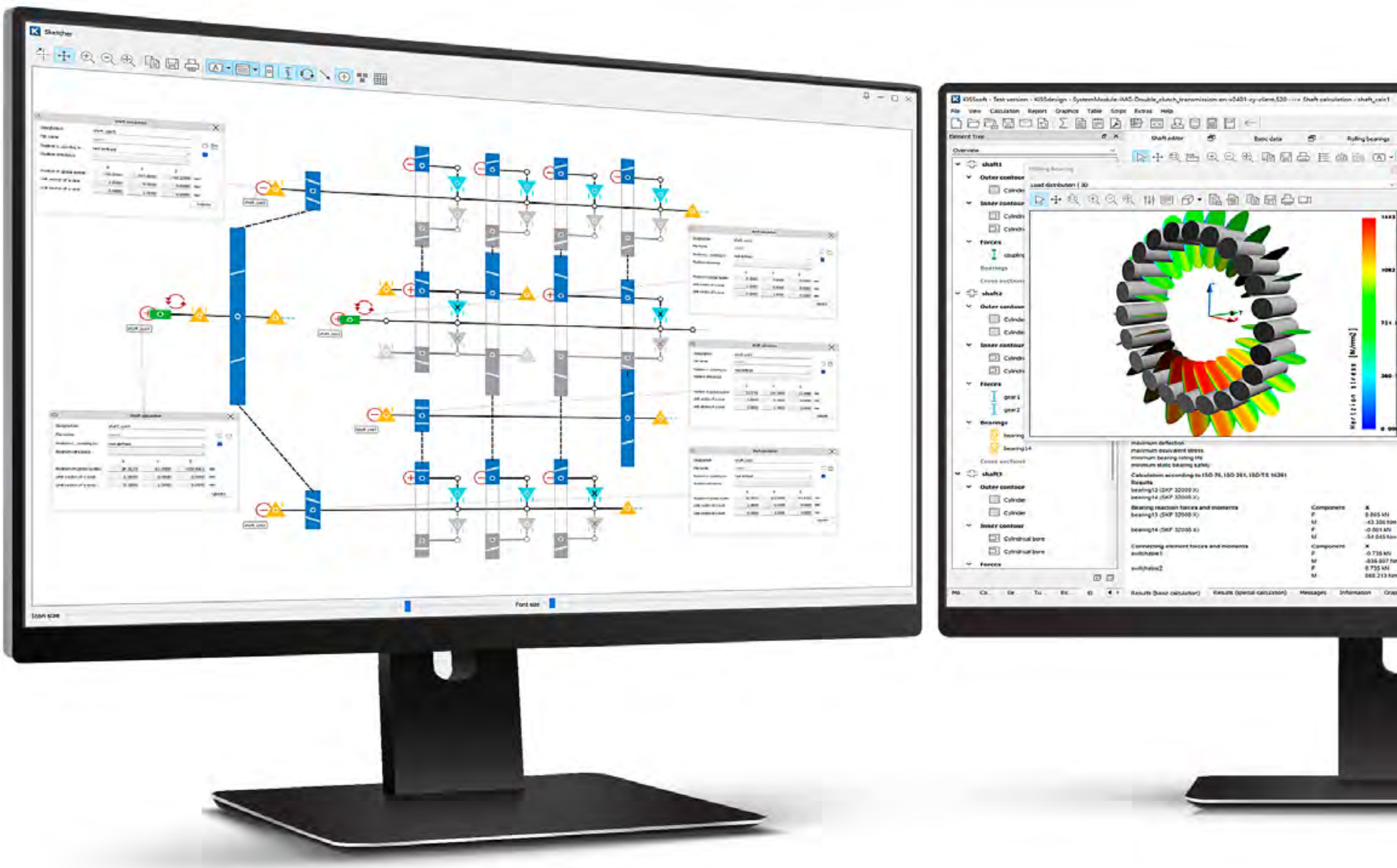


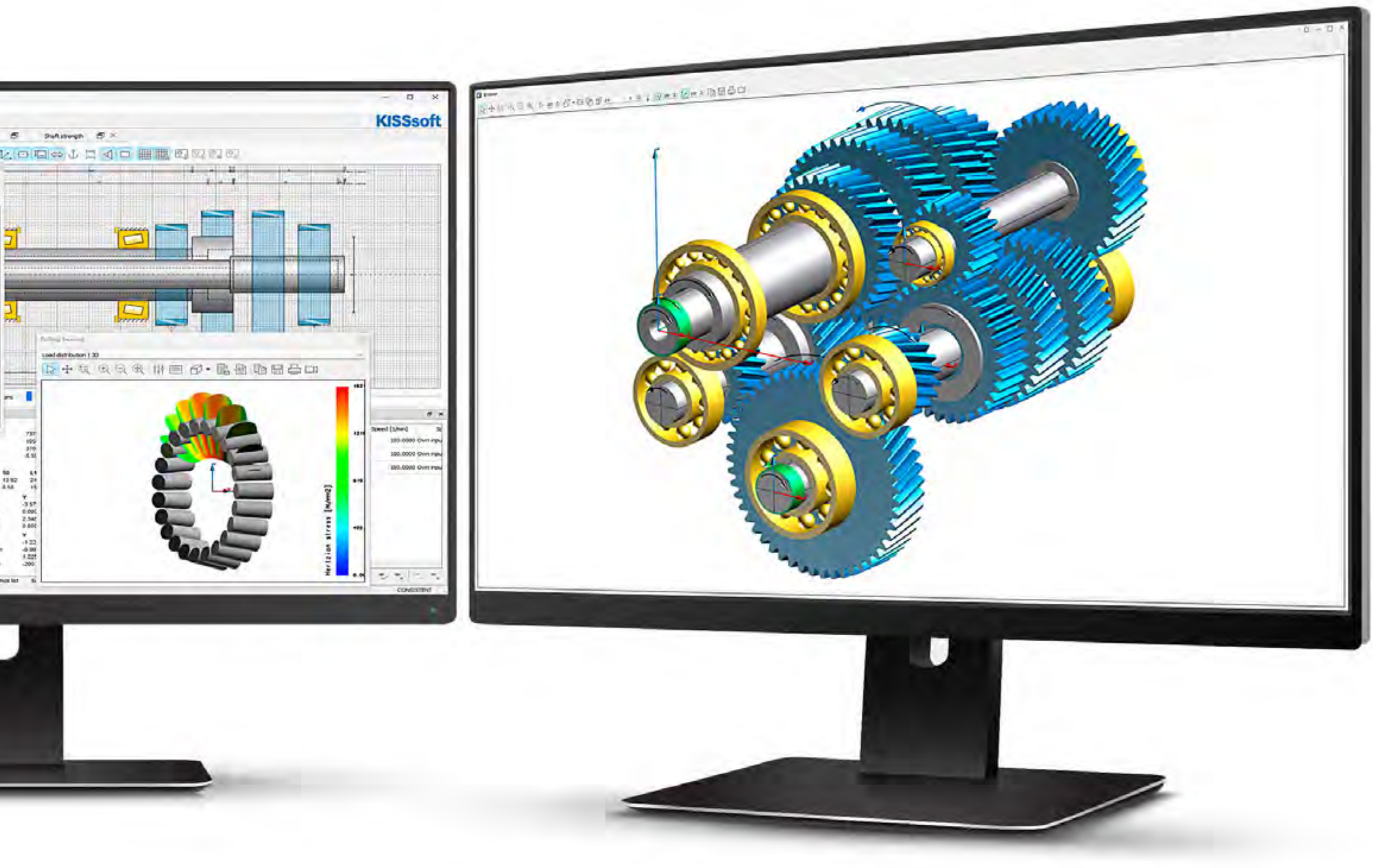
Elliptical Gears

- Definition of elliptical external gear
- Definition of circular internal gear
- With low number of teeth difference
- Graphical representation of mesh





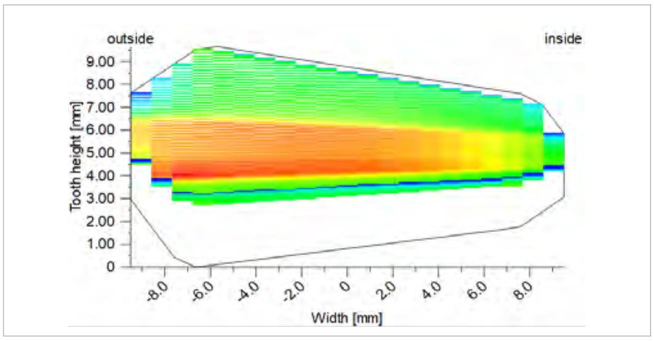

Sketcher


KISSsoft
Shaft strength

Bevel Gears, Overview

General

- Strength, life and reliability rating for nominal load and load spectrum
- Database for reference profile and tolerances
- Different geometry configurations with uniform tooth depth, constant slot width, modified slot width, different root and tip apex positions
- For spur, helical, zerol or spiral bevel gears
- Rough and fine sizing function, fine sizing function for modifications
- Calculation of measurement grid for Klingelnberg, Gleason or Zeiss gear tester

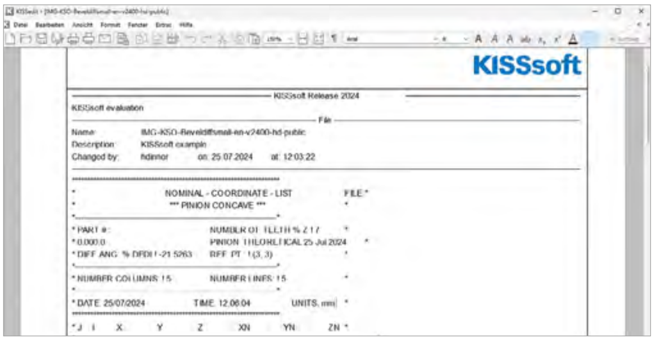


Strength rating

- Strength rating along ISO 10300, DIN 3991, AGMA 2003, KN3028 / KN3030 for Cyclo-Palloid gears and along KN3025 / KN3030 for Palloid gears
- Hypoid gear calculation along KN3029 / KN3030 for Cyclo-Palloid gears, KN3026 for Palloid gears, ISO 10300
- Plastic gear rating along VDI 2545 or Niemann, static strength rating and rating of differential planetary gears
- Efficiency along Wech, Niemann, ISO/TS 1300-20
- Flank breakage calculation along ISO/DTS 10300-4
- Scuffing rating along DIN 3990-4, ISO/TS 6336-20, ISO/TS 6336-21, ISO/TS 10300-21

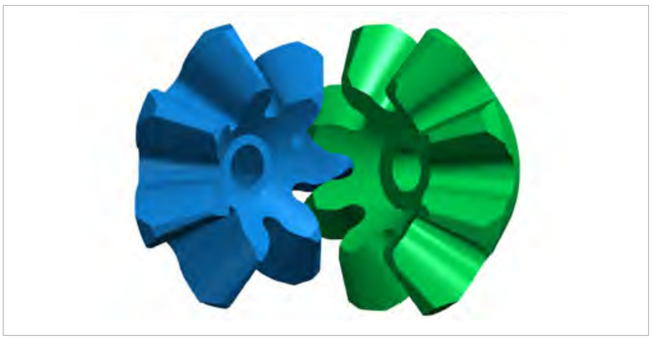
Manufacturing

- For face hobbed or face milled gears
- Considering Klingelnberg machine list
- Accurate 3D gear geometry for CNC machining, based on planar involute geometry
- No load tooth contact analysis considering lead and profile modifications



No load tooth contact

- Calculated of loaded tooth contact with low load
- Considers all gear modifications
- Direct input of misalignment values
- For verification of contact patterns after manufacturing



Bevel Gears, Loaded Tooth Contact Analysis

Loaded tooth contact analysis
- LTCA of spur, helical and spiral bevel gears
- For nominal load or with consideration of KA and Kv and for load spectrum
- Using slice model
- Line load distribution over whole face width (contact pattern under load)
- Momentary line load distribution as contact lines for different mesh positions

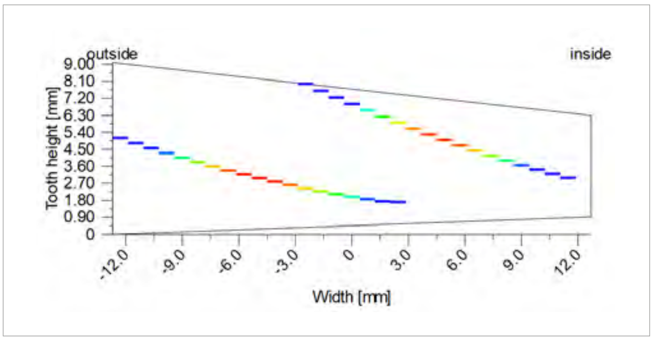
Bevel gear transmission error
- Loaded or non-loaded (lightly loaded) TE
- PPTE values
- FFT of transmission error

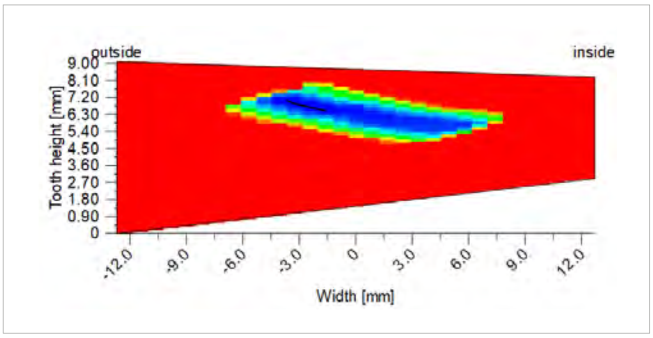
Further load distribution-based results
- Flash and contact temperature
- Scuffing safety factor
- Flank fracture safety factor
- Micropitting (adapted from cylindrical gear calculation)

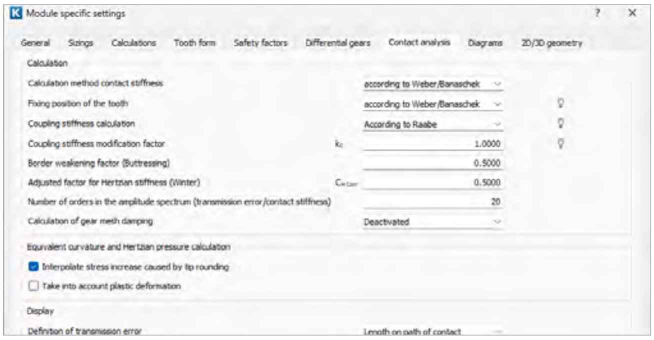
Contact for misaligned systems
- Input of HGV misalignment
- Input of shaft angle deviation
- For drive and coast side
- Considering housing, bearing and shaft deformation

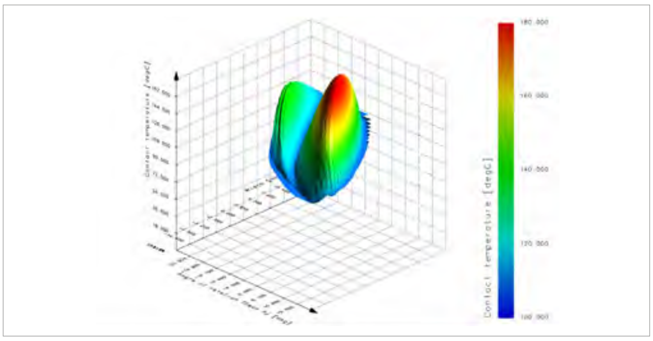
Tooth flank fracture calculation
- Calculated hardness distribution
- Hardness distribution input from measurements
- Calculation along ISO/DTS 6336-4 and Annast

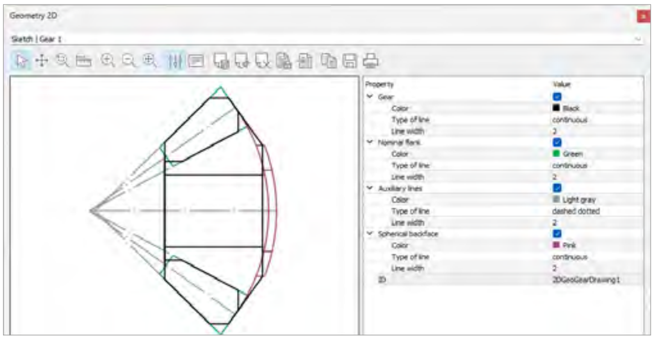
Differential gears
- Fine sizing of differential gears
- LTCA for spur gears with modifications











Bevel Gears, GEMS Interface

Two software solutions, one common goal

- System Module: Design, optimization and analysis of systems. Considering power losses, load spectra, housing deformation …
- GEMS®: Design, optimization and analysis of spiral bevel and hypoid gears, preparation of data for Gleason gear production machines
- System Module: System deformation (EPG / VHJ values) for pinion and wheel considering housing, bearings, shafts.
- GEMS®: 2D / 3D LTCA including interactive root bending stress and contact stress output with S-N curves.
- Interface for gear data and displacement values between GEMS® and System Module

Value proposition

- Improved customer experience, human efficiency and part quality by connecting system design, gear design and gear manufacturing software systems
- Closed loop to manage manufacturing process using GEMS® based on gears sized and designed in KISSsoft
- Gear micro geometry preliminary design in KISSsoft and final design in GEMS® / CAGE®
- Flank and root strength, scuffing resistance, micropitting safety, flank fracture risk and static strength calculation in KISSsoft

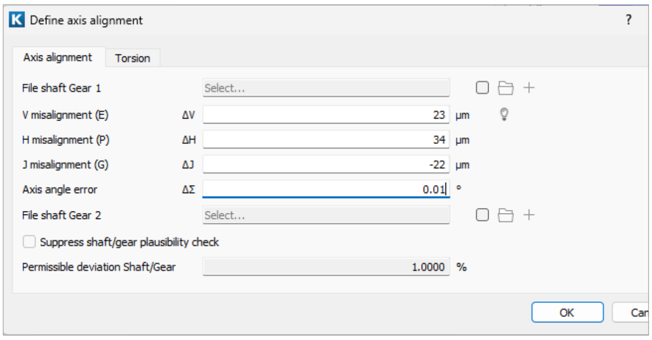
KISSsoft®

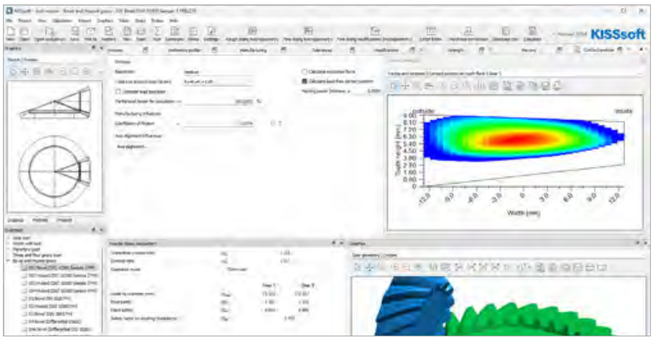
- Flank and root strength, scuffing resistance, micropitting safety, flank fracture risk, life rating with LDD and static strength
- Rough and fine sizing, modifications sizing
- 3D geometry export

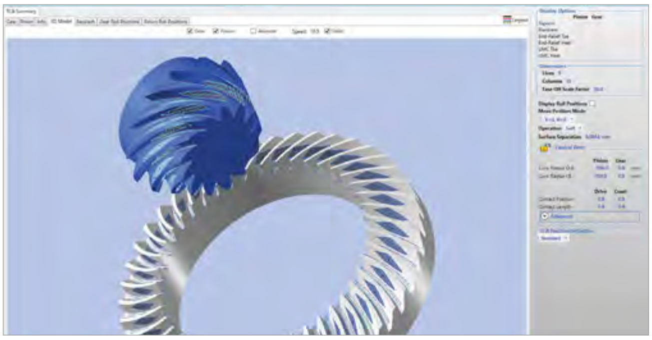
GEMS®

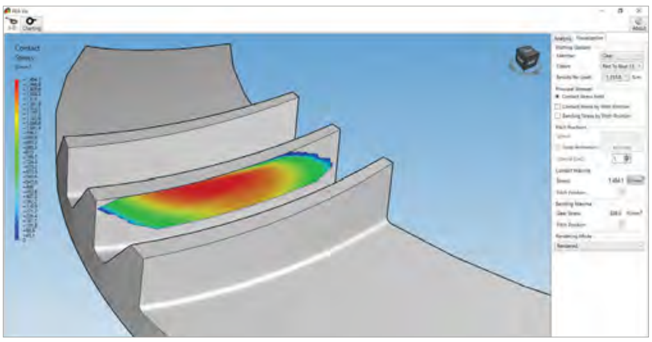
- Transfer data with, CAGETM®,
- UNICAL®, and common design software
- Import design data files from CAGE® and UNICAL®
- Connect with GEMS® on-line via web app
- Generate data for blade grinding machines
- Closed loop to manage manufacturing process

GEMS
Gleason Engineering and Manufacturing System







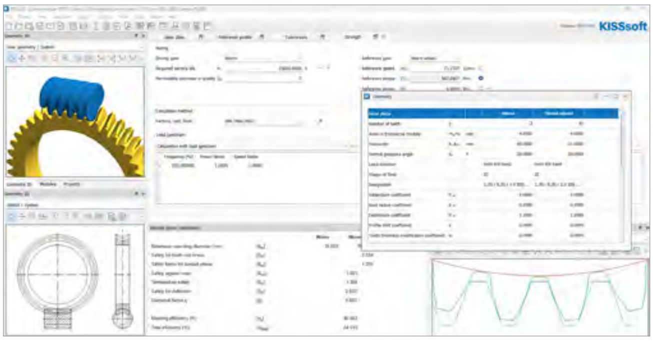


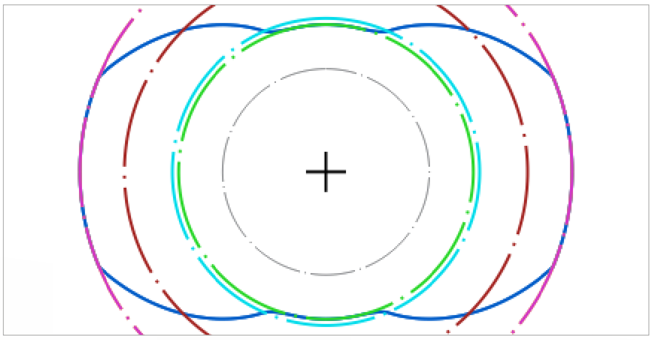
Worm Gears

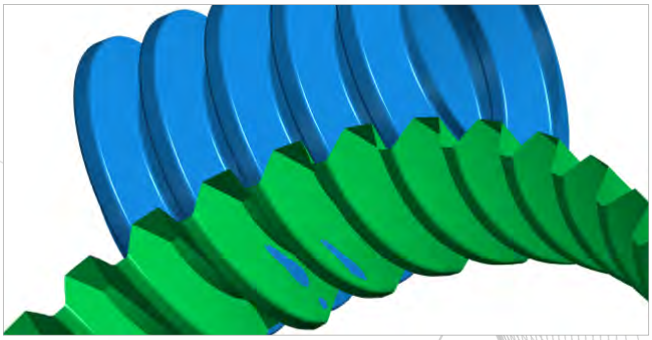
General
- For ZC, ZI, ZA, ZN, ZK, ZH geometry
- Includes rough and fine sizing function
- Accurate 3D geometry

Strength rating
- Based on E DIN 3996:2012, DIN 3996:1998, ISO/TR 14521:2010, AGMA 6034, AGMA 6135
- No load contact analysis

System data
- Considers drive direction, bearing power loss, seal loss, permissible wear
- Considers cooling through housing and lubricant and running time



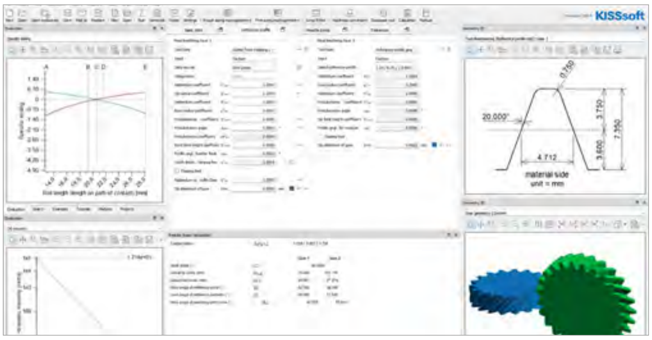


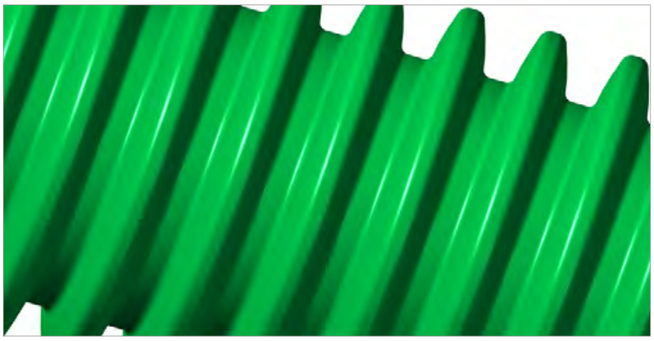


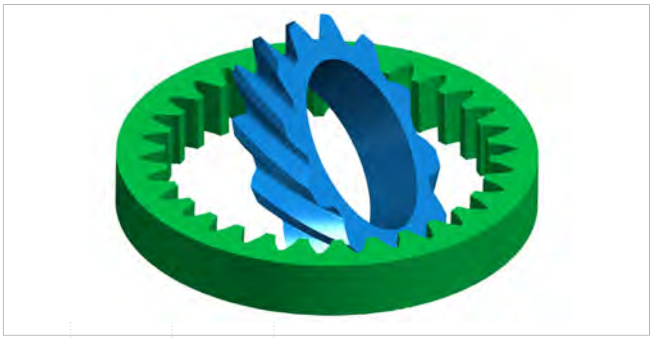
Crossed Axis Helical Gears

General

- Strength rating along ISO 6336 (modified along Niemann), along Hoechst for worm gears and along Hirn for worm gears. For plastic gears along VDI 2545 and VDI 2736
- Calculation of theoretical backlash, acceptance, and operating backlash
- Calculation of flank, root and scuffing safety factor with single load or load spectrum
- Output of control measures like dimension over pins and balls
- With rough and fine sizing function







Configurations

- For plastic and metallic materials
- Calculation with lead or helix angle
- Calculation of meshing efficiency
- For worm type or helical gear type mesh (any helix angle)
- Tooth form calculation with modifications like tip and root relief, chamfer, tip rounding, elliptic root rounding for improved noise and strength properties

Face Gears

General

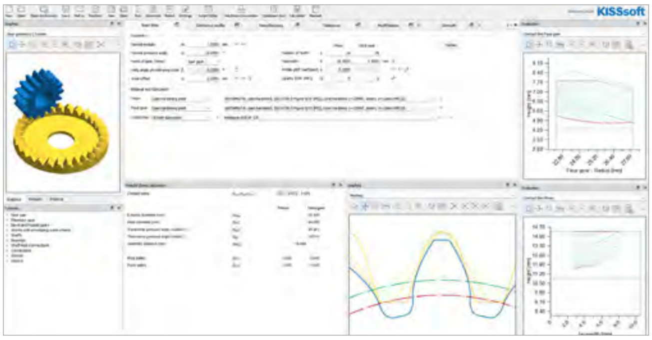
- Strength rating along ISO 6336 (modified along Niemann, Roth and Basstein), ASS / Crown Gear / DIN 3990, based on ISO 10300, based on DIN 3991
- For 90° or greater shaft angle, with axis offset, for spur and helical gears
- Axis offset may be positive or negative
- 3D models include solid model, skin model, cutting model (based on shaping cutter geometry) and solid model of single toot and single gap of face gear
- Calculation of subsystem reliability based on pinion and face gear life, using three parametric Weibull distribution

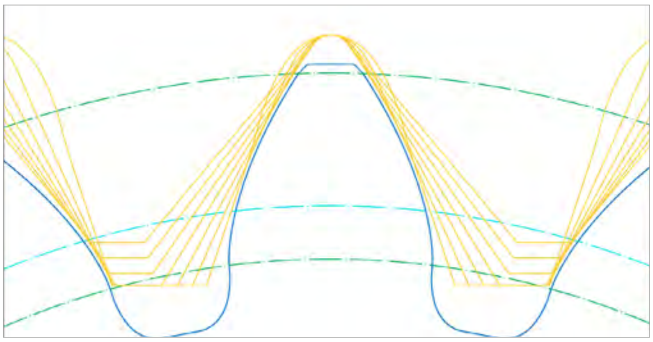
Configurations

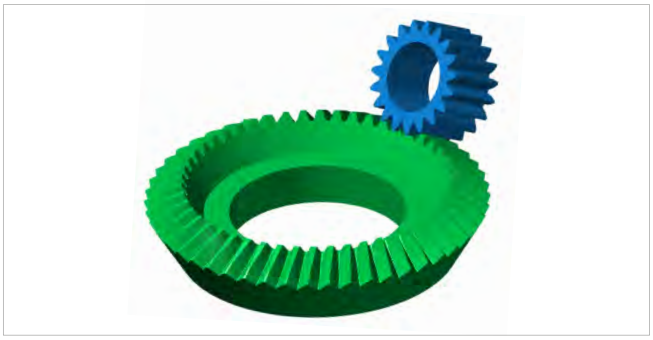
- Face gear with cylindrical pinion as spur or helical gear
- Calculation of face gear geometry at different diameters by simulating manufacturing with a pinion type cutter
- Check against undercut and pointed tooth by varying tooth height
- Export of 2D or 3D geometry considering tolerances such as tooth thickness tolerances, tip and root diameter tolerances
- Crowning of face gear through modifications on pinion type cutter
- Output of contact lines on face gear
- Corner modification on inner and outer diameter

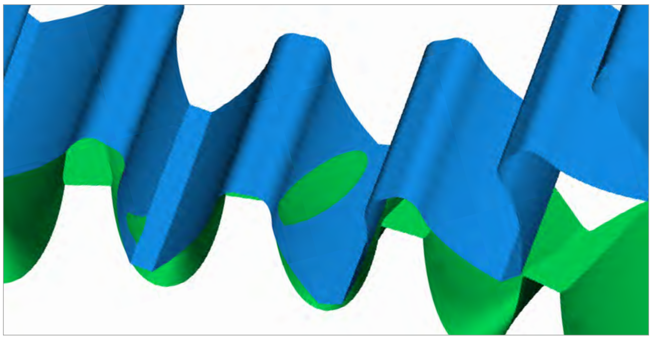
Export

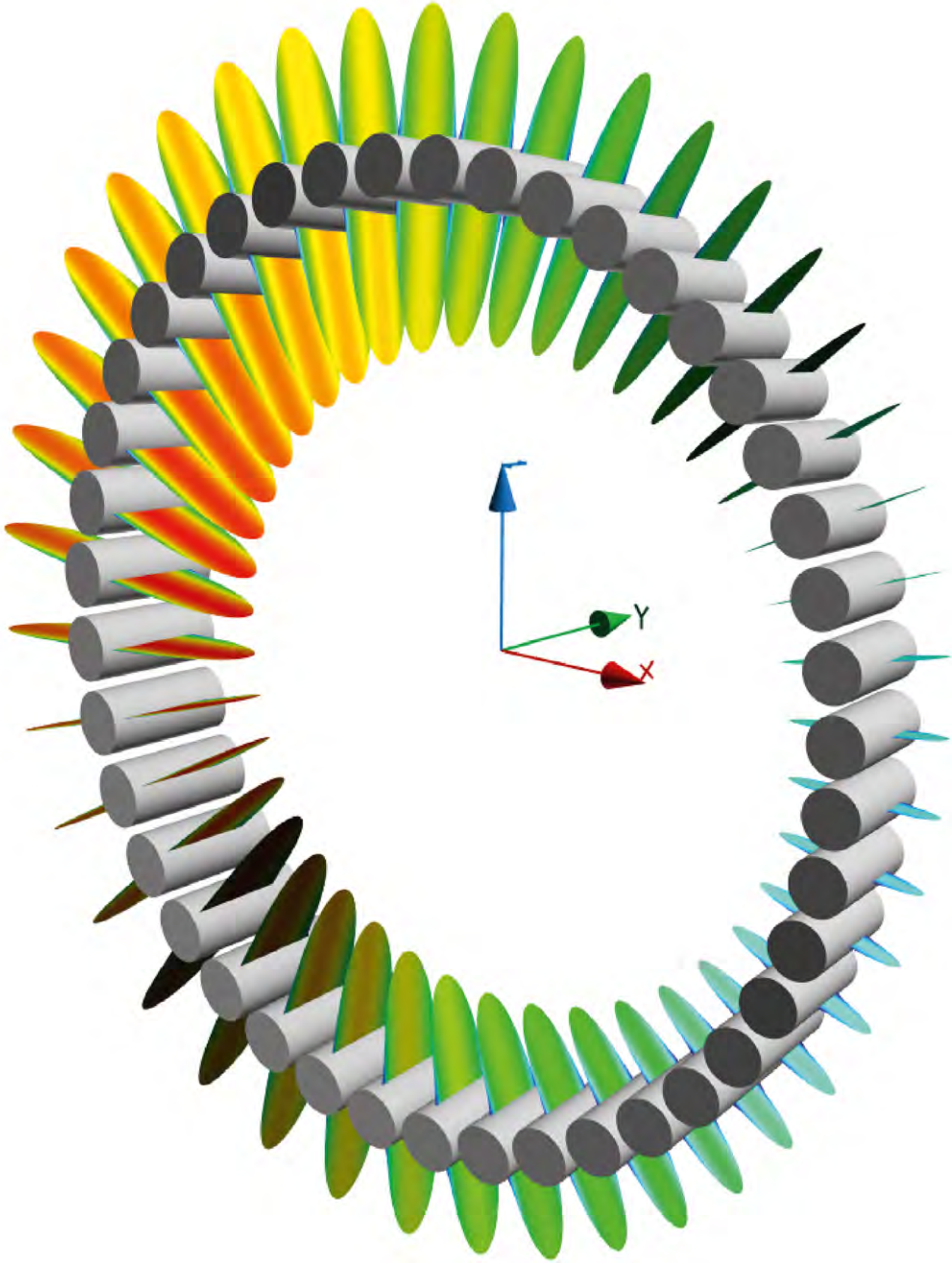
- Export of 3D geometry of pinion, face gear and system as *.stp file
- Export of 2D geometry of pinion, shaping cutter and face gear sections as *.dxf file
- Export of surface topology / measurement grid using Klingelnberg and Gleason data format, for pinion and face gear, for a user defined number of grid points
- Export of pinion and face gear data table for CAD drawings










Y
X

Shafts, Coaxial Shaft Systems

General
- Graphical shaft editor for fast modelling
- Calculates stress concentrations from feature geometry
- Add force elements like gears, pulleys or couplings for simple load definition
- Materials, bearings, lubricants databases
- Automatic identification of critical sections

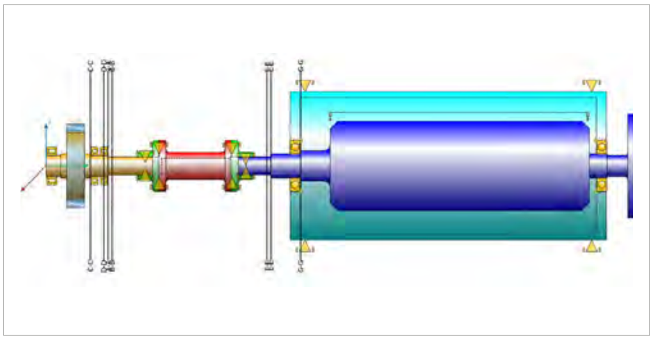
Configurations
- Single shaft or coaxial shaft systems
- Static deformation, modal analysis
- General supports or rolling element bearings, pilot bearings, internal bearings
- Linear or non-linear calculation with Euler or Timoshenko beam model considering temperature effects

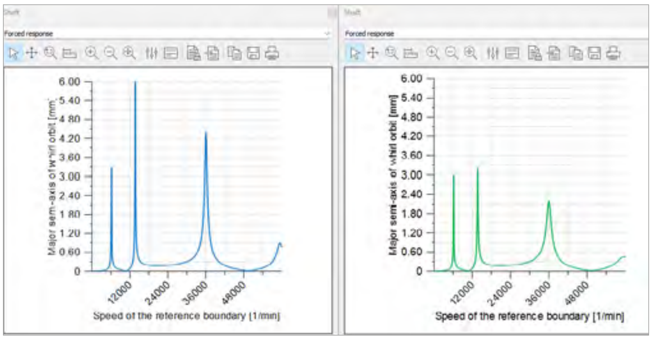
Strength rating
- Strength rating along DIN 743, FKM guideline, Hänchen & Decker or AGMA 6101
- For static and fatigue strength, for single load case or load spectrum
- Using material database or own definition for S-N curve, different Miner rules
- Independent load factors and stress ratios for static and fatigue rating

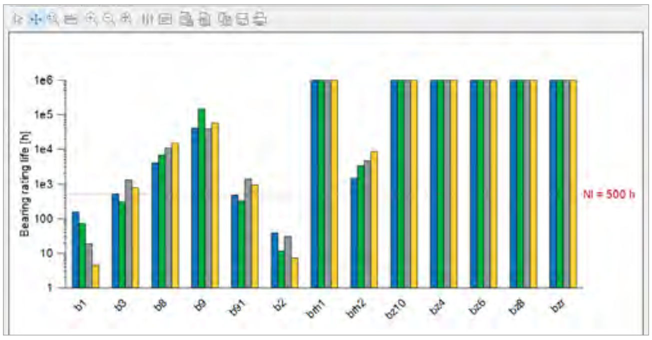
Modal and forced response analysis
- Modal analysis
- Forced response analysis, with damping
- Considers bearing stiffness

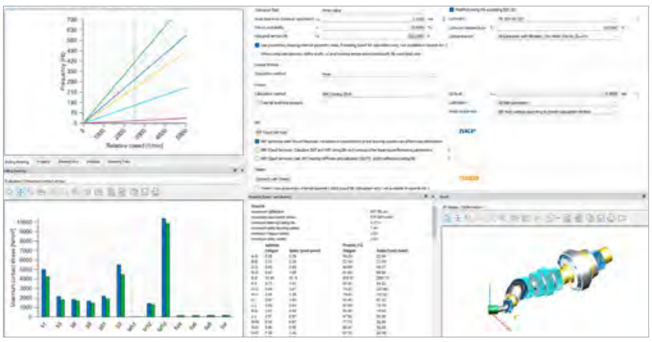
Deformation and stiffness calculation
- Non-linear bearing stiffness is calculated based on inner bearing geometry
- Housing deformation, machining errors and similar may be defined as initial bearing offset
- Any number of loads may be added

Tooth trace calculation
- Calculation of shaft deformation of pinion shaft, calculation of necessary lead modification
- Housing stiffness, bearing stiffness and shaft stiffness may be considered









Rolling Bearings

Configuration
- Calculation of single bearing or bearing-shaft system, any number of bearings in system
- With single load or load spectrum
- Sizing function for bearing selection

Bearing life rating
- Basic rating using load capacity numbers
- Modified rating considering lubricant properties
- Reference rating considering load distribution
- Modified reference rating
- Along ISO 281, ISO/TS 16281, ISO 76

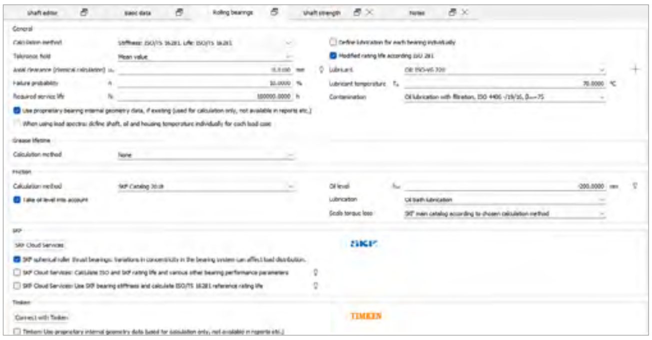
Bearing stiffness and clearance
- Based on bearing inner geometry
- Shaft-bearing interaction for shaft and bearing systems
- Considers operating clearance / pre-tension
- Considers bearing, shaft, hub tolerances

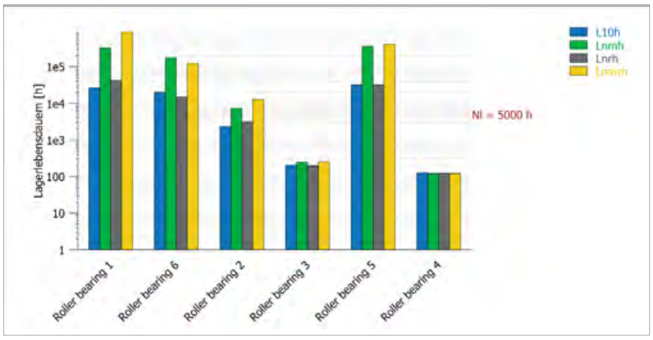
Load distribution calculation
- Load distribution among rolling elements
- Contact stresses for balls
- Contact stresses for rollers, considering roller geometry modification (logarithmic)
- Contact stress distribution on raceway

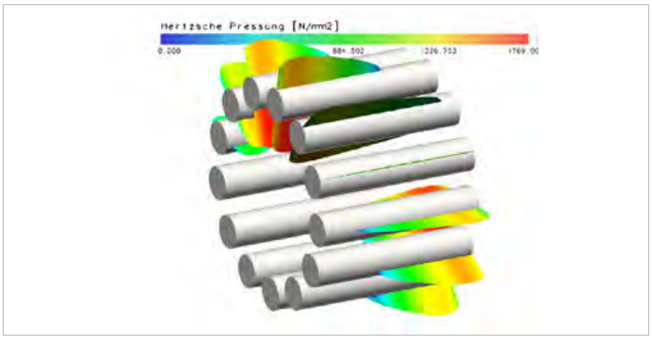
Thermal rating
- Along DIN 732

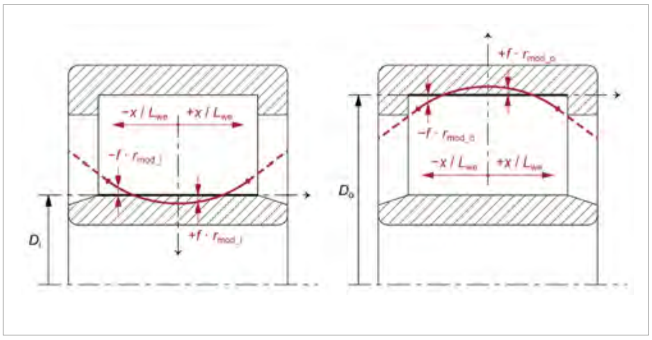
Bearing database
- Bearing data from different bearing suppliers
- For different bearing types
- Basic bearing properties
- Bearing inner geometry, user editable
- Separate database for lubricants, lubricant purity definitions along ISO 4406

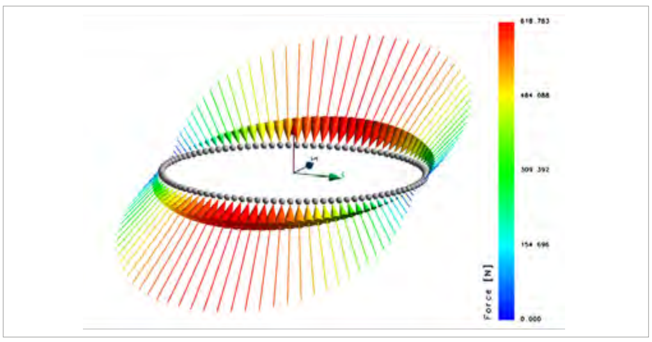
Hydrodynamic bearings
- Axial bearings DIN 31653, ISO 12130, DIN 31654
- Radial bearings ISO 7902, DIN 31652, DIN 31657, Niemann and Spiegel for grease lubricated bearings











Bearing designer

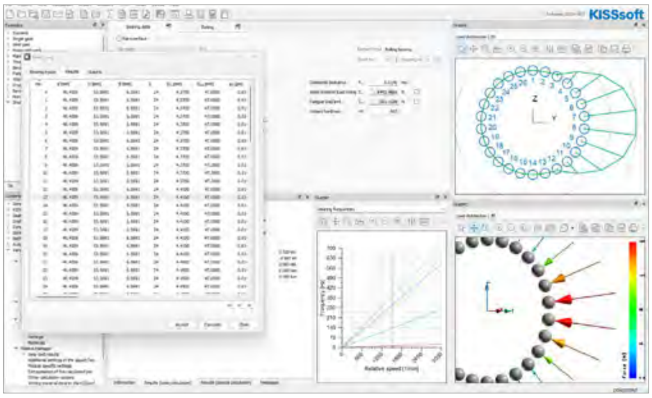
- Sizing function for bearing inner geometry
- Define ranges e.g., for rolling element diameter, pitch diameter, no. of rolling elements and others
- Software calculates possible bearing designs
- For each design, load capacity and properties of inner geometry are calculated
- Allows for specific, optimized design of bearings, in particular slewing bearings

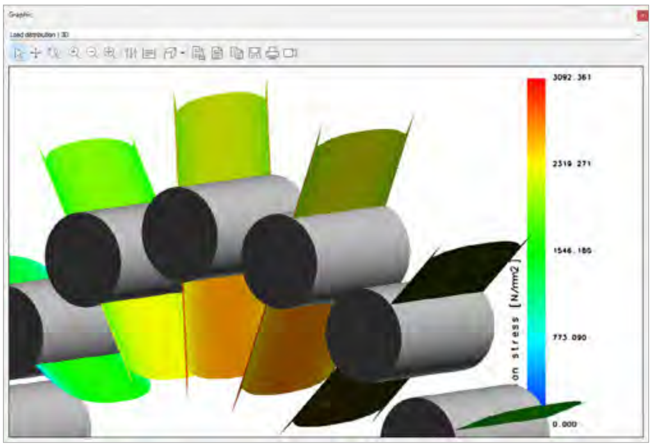
Load distribution with elastic rings

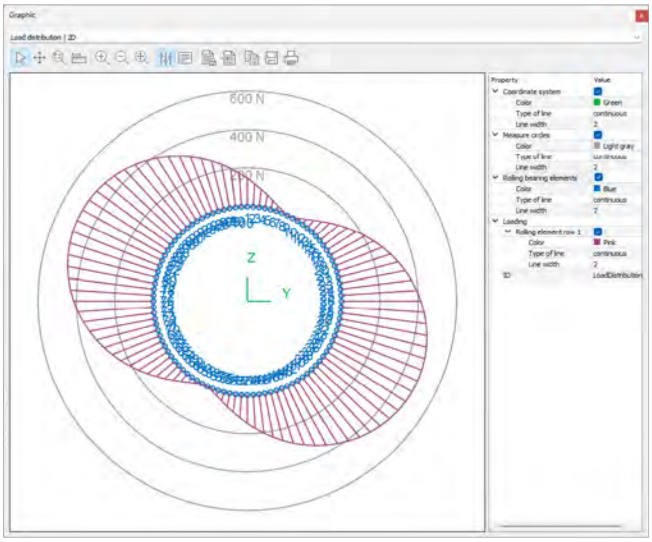
- Elastic or stiff rings
- Ring deformation influencing load distribution

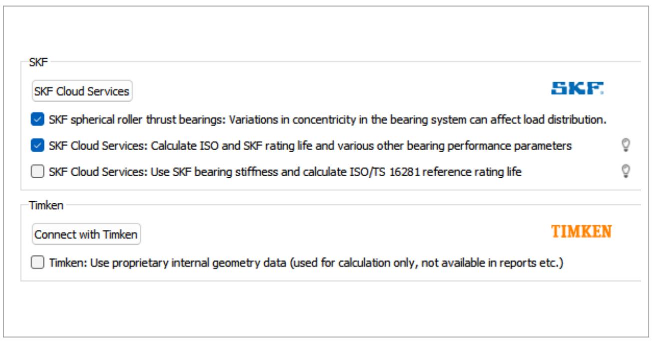
Calculation by SKF® and TIMKEN®

- Cloud based calculation
- Bearing forces are transmitted from KISSsoft to SKF® cloud-based tool
- Bearings are rated by SKF®, and results are sent back to KISSsoft









Shaft-Hub Connections

Cylindrical interference fit
- Strength rating along DIN 7190
- Sizing function for tolerances
- Stress calculation for stepped hub and hollow shaft
- Considers torsional, radial, and bending load, including centrifugal loads
- Calculation of mounting temperatures

Conical interference fit
- For different mounting procedures
- Calculation along Kollmann
- Considers cone angle and cone angle tolerances

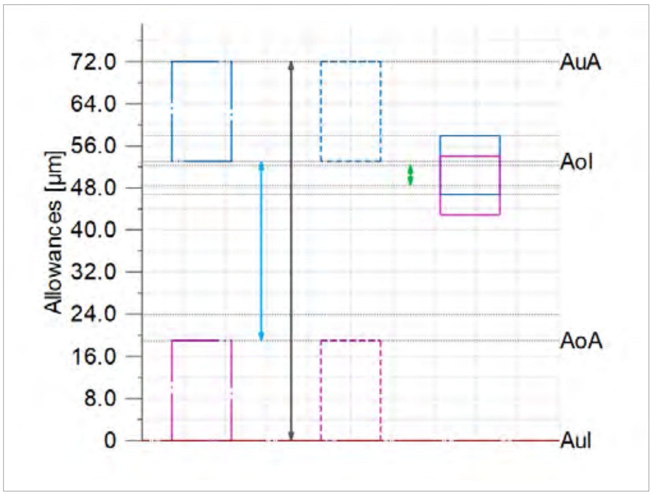
Key
- Geometry along DIN 6885, ANSIB17.1
- Strength rating along DIN 6892
- Woodruff key

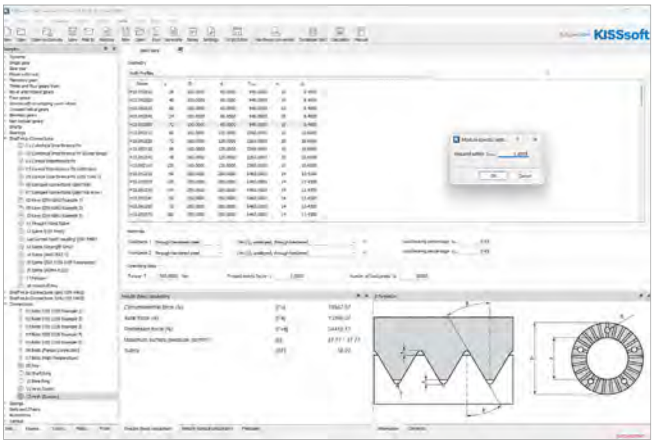
Involute spline
- Geometry along DIN 5480, ISO 4156, ANSIB92, own definition
- Tolerances along DIN 5480, ISO 4156, ANSIB92, own definition
- Reference profiles along DIN 5480, ISO 4156, ANSIB92, own definition
- Strength rating along Niemann or DIN 5466
- Crowned spline

Straight sided spline
- Geometry along DIN 5464, DIN 5471, DIN 5472, ISO 14, own definition
- Strength rating along Niemann
- Graphical output

Serrated spline, polygons
- Geometry along DIN 5481
- Strength rating along Niemann
- 3-sided and 4-sided polygon along DIN 32711, DIN 32711

Hirth coupling
- Includes Voith ® profiles
- Strength and geometry calculation

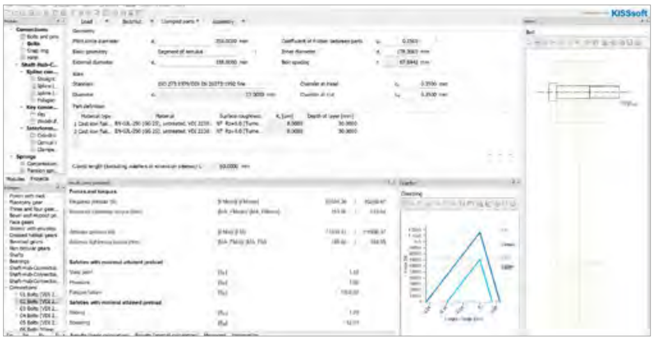




Bolted Joints

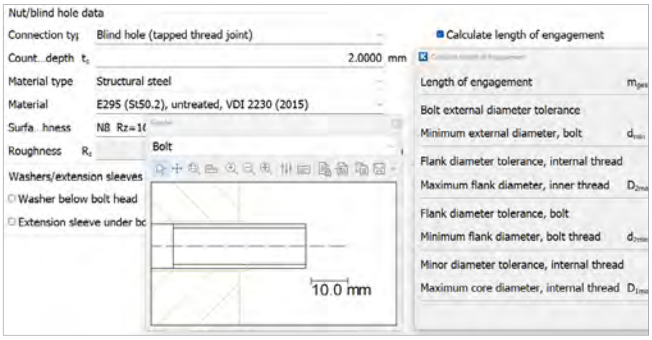
Bolt rating along VDI2230, configurations

- Connection under axial load only
- Connection under axial and shear load
- Flange type bolted connection
- Arbitrary bolting pattern
- Import of FEM results for loading condition
- Sizing function for bolt length and bolt diameter



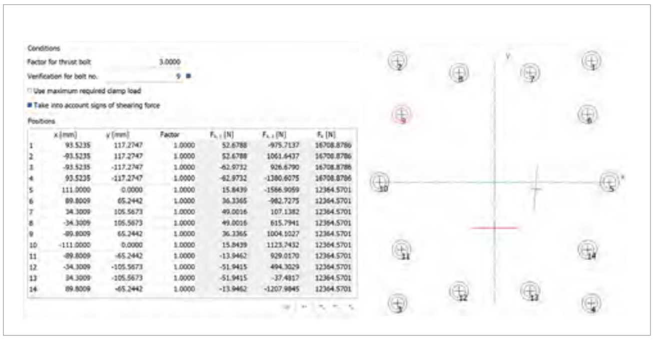
Bolt, nut and washer types

- Own bolt geometry definitions
- Own nut and washer definition
- Washers: ISO 7089, ISO 7090, ISO 7093-1, ISO 7093-2, ANSI / ASME 18.22.1, own definition
- Nut: ISO 274, DIN EN 2432, DIN EN 24035, DIN EN 28673, DIN EN 28675, ANSI / ASME B.18.2.2, own definition
- Bolt: ISO 4762, ISO 4014, ISO 4017, ISO 1207, ISO 8765, ISO 8676 and others
- Strength classes, 8.8, 10.9, 12.9, A1…A5, SAE J492, own definition
- Extension sleeves under bolt and nut



Tightening

- Considers different tightening procedures
- Considers pre-tension loss
- Considers friction in thread and under head / nut

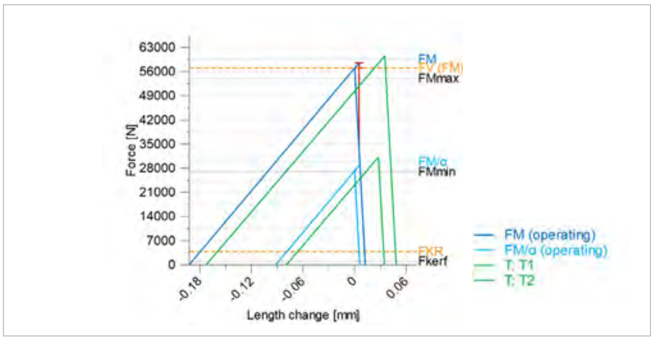


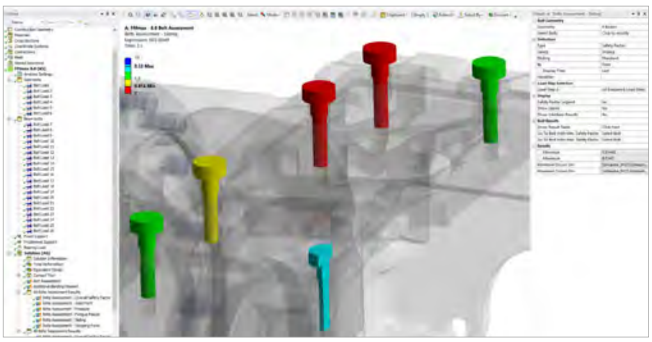
Temperatures

- For low and high temperatures
- Considers assembly temperature, temperature of bolt and temperature of clamped parts

ANSYS Integration

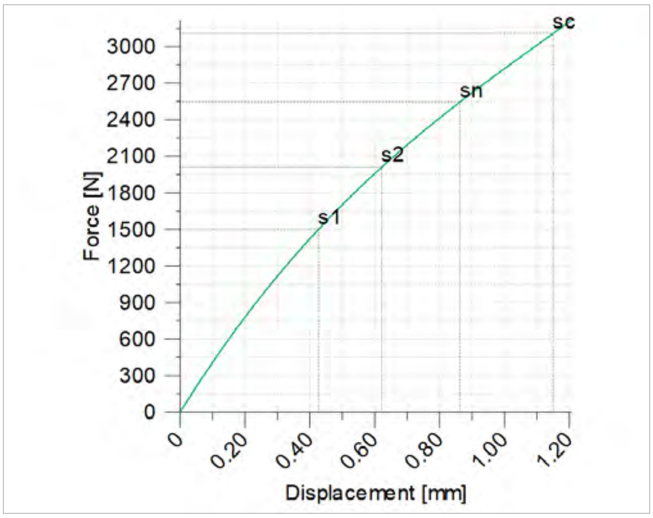
- KISSsoft integrated in ANSYS by CADFEM
- Calculate bolt loads in ANSYS and perform strength rating along VDI 2230 based on KISSsoft
- For arbitrary bolting patterns, considering clamped parts elasticity



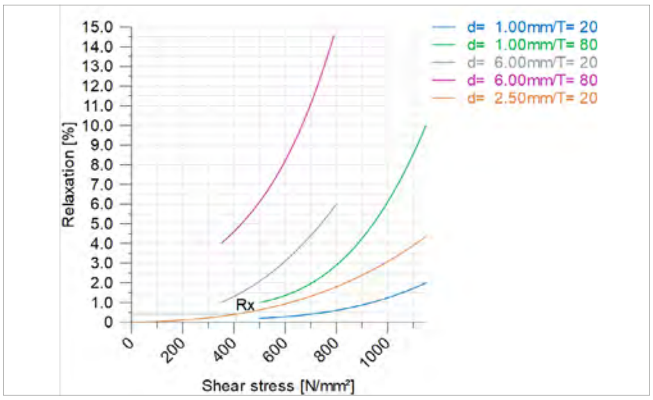


Springs

Compression springs
- Geometry along DIN 2098 or own definition
- Tolerances along DIN 2095 or DIN 2096
- Calculation along EN 13906-1
- Goodman diagram for spring / wire strength
- Spring relaxation
- Sizing for wire diameter and active coils / windings

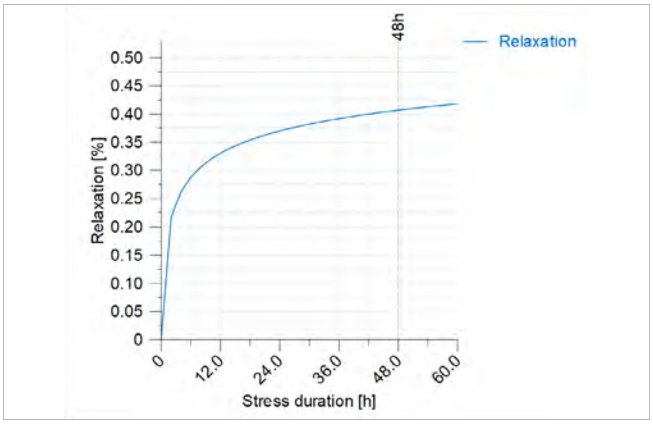


Tensile springs
- Different end geometries
- Tolerances along DIN 2097 or DIN 2096
- Calculation along EN 13906-2
- Goodman diagram for spring / wire strength
- Spring relaxation
- Sizing for wire diameter and active coils / windings

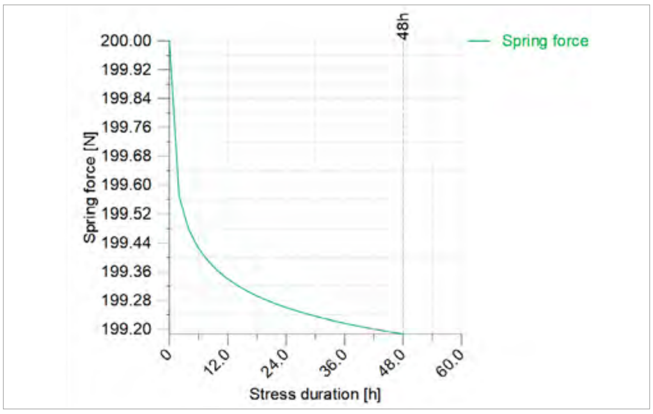


Garter springs
- Tolerances along DIN 2194
- Calculation along EN 13906-3
- Sizing function for wire diameter and active coils / windings
- For static or dynamic stress loading

Spring disks
- Geometry along DIN 2093, Series A / B / C or own definition
- Calculation along DIN 2092
- Sizing function for number of disks in stack
- For static or dynamic stress loading
- Non-linear spring stack stiffness



Torsional spring
- Different head forms
- Single or multiple springs
- Calculation along DIN 2091
- Sizing function for selection of torsion bar diameter and shank length

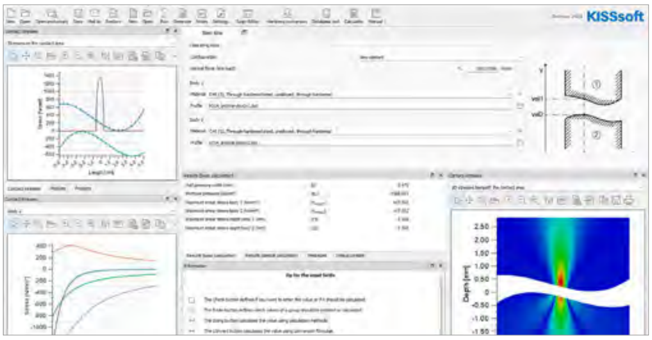


Conical spring
- Tolerances along DIN EN 15800
- Spring standard DIN 2076, DIN EN 10270, DIN EN 10218

Further Machine Elements

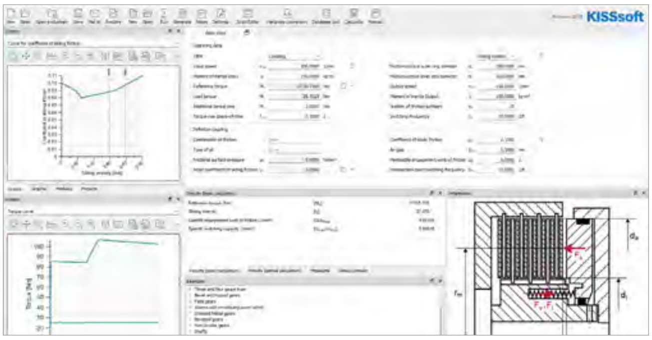
Various

Hertzian contact
- Contact between balls, cylinders, ellipsoid and plane, arbitrary body
- Calculation of contact ellipse dimension
- Calculation of contact and sub-surface stress



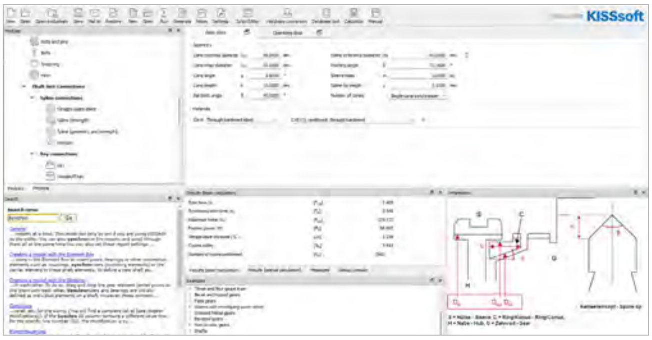
Local stress analysis
- Strength verification along FKM guideline
- For steel and aluminum
- For 1, 2 and 3-dimensional stress state

Tolerance analysis
- Min / Max values, statistical calculation
- Standardized or user defined tolerances



Belt drives, chain drives, clutches
- Chain sprocket geometry
- Belt and chain length
- Belt and chain strength
- Wet clutches along VDI 2241-1

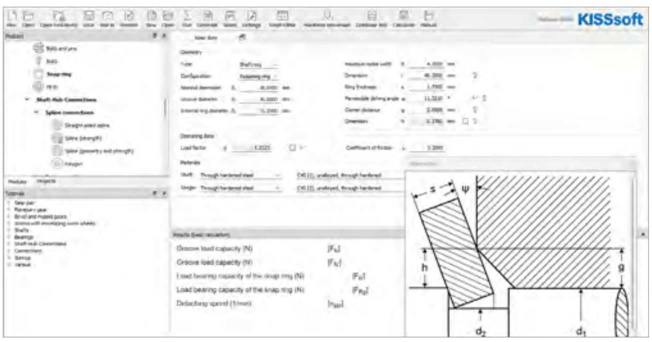
Spindle Drives



Calculations
- Safety factor against buckling, contact pressure and torsion
- Geometry along DIN 103 and own definition
- For static, alternating and pulsating loads

Shear Pins, Circlips

Calculation along Niemann / Seeger
- Bolt under shearing
- Cross pin under torque
- Longitudinal pin under torque
- Pin under bending
- Shear pin system
- Hub and shaft circlip



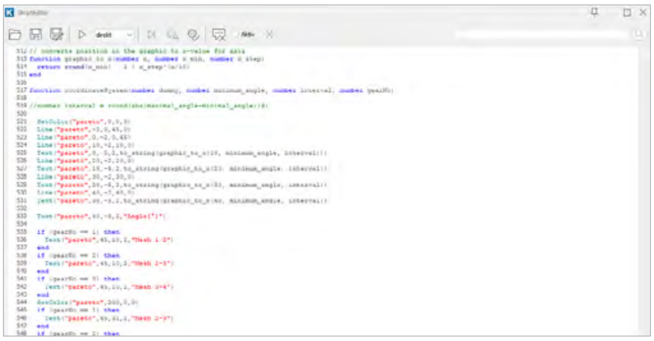
Calculations
- Static or fatigue loads
- For full or notched type pins
- Material database
- Sizing function for pin diameter

```
            write(Text)
            Counter = Counter + 1
            DAmp[Counter] = ZR[0].Corr.rechts[El].C
            PPTE[Counter] = caResults.TransmissionError.delta

          next
      next
      PPTEmed = PPTEmed / (Zahler+1)
      sigmed = sigmed  / (Zahler+1)
      Text = "Mean Values: PPTE " + round(1000*PPTEmed)/1000 + "; sigH " + round(1
      write(Text)

      CounterMean = CounterMean + 1
      MeanDAmp[CounterMean] = ZR[0].Corr.rechts[El].C
      MeanPPTE[CounterMean] = PPTEmed
      //Standard-Abweichung
      number StAbw = 0
      for m=0 to Zahler
        StAbw = StAbw + square(PPTE[Counter - m] - PPTEmed)
//        Text = m + " " + square(PPTE[Counter - m] - PPTEmed) + " " + StAbw
//        write(Text)
      next
      if Zahler == 0 then
        StAbwPPTE[CounterMean] = 0
      else
        StAbwPPTE[CounterMean] = sqrt(StAbw / Zahler)
      end
      Text = "Standart deviation: PPTE " + round(1000*StAbwPPTE[CounterMean])/1000
      write(Text)
      //In probability and statistics, 1.96 is the approximate value of the 97.5 pe
  area under a normal curve lies within roughly 1.96 standard deviations of the mea
  used in the construction of approximate 95% confidence intervals. Its ubiquity is
  intervals with 95% coverage rather than other coverages (such as 90% or 99%).[1]
  statistics,[5][6][7] but is also common in other areas of application, such as ea
      Percentile975PPTE[CounterMean] = StAbwPPTE[CounterMean]*1.96
      Text = "97.5% percentile: PPTE " + round(1000*(MeanPPTE[CounterMean]-Percent
  round(1000*(MeanPPTE[CounterMean]+Percentile975PPTE[CounterMean]))/1000 + "; "
      write(Text)

    next

    for j=0 to Counter
//      Text = j + "; " + DAmp[j] + "; " + PPTE[j]
//      write(Text)
      if MaxDAmp < DAmp[j] then
        MaxDAmp = DAmp[j]
      end
      if MaxPPTE < PPTE[j] then
```

Scripts and Data Exchange

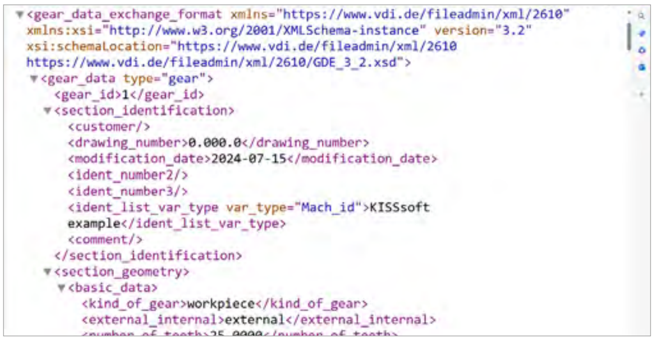
Several scripting options
- Scripting language integrated with KISSsoft
- Control of KISSsoft through COM interface
- Address COM interface e.g., through MATLAB®, VBA® or PYTHON®

Features
- Access to KISSsoft calculation parameters to automate input
- Calculations and functions executed through scripting
- Results readily available for post processing
- Automate data management, including calculation reports, STEP files, and DXF files
- Integration with other software tools for enhanced workflow
- Enables the implementation of company-specific rules and calculations

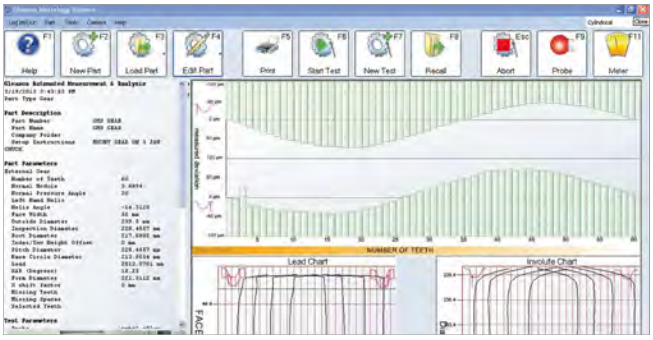


Gear data exchange GDE
- Defined by VDI, VDI/VDE 2610
- Format for the exchange of gear and tooth data
- Based on XML language
- Seamless and error free exchange of gear data between design, manufacturing and quality control

REXS
- Reusable Engineering Exchange Standard
- REXS definition by FVA
- Neutral format for gearbox data exchange
- Exchange gearbox data between non-compatible software
- Further information www.rexs.info

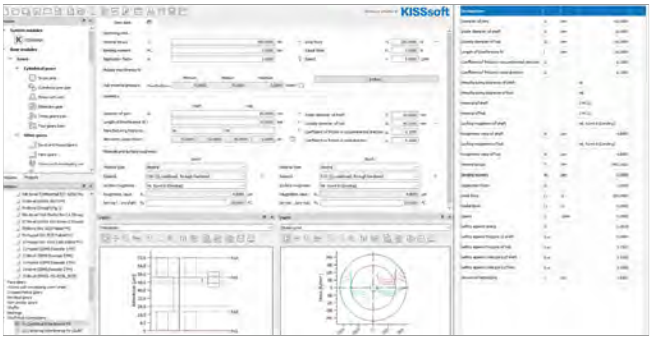


Data exchange to Gleason GAMA®
- Export of macro geometry of cylindrical gear
- Import to GAMA® measuring software
- Export lead and profile diagram tolerance bands from GAMA® to KISSsoft



Data Representation in Tables

System level tables

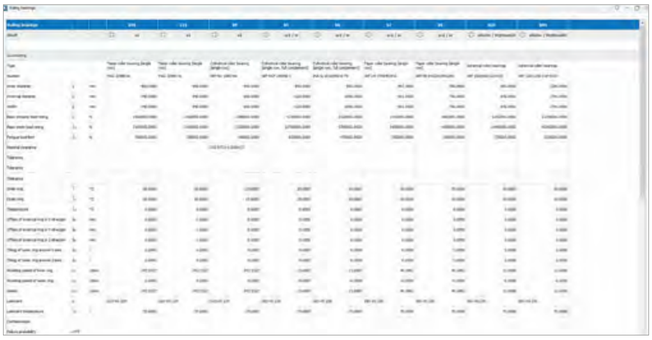


System tables, component data
- Overview of all components data in the system model
- Covering gears, shafts, bearings, shaft-hub connections
- Show tables in separate tabs, undock and arrange tabs as needed
- Tables include all components of the type selected

System table, part lists

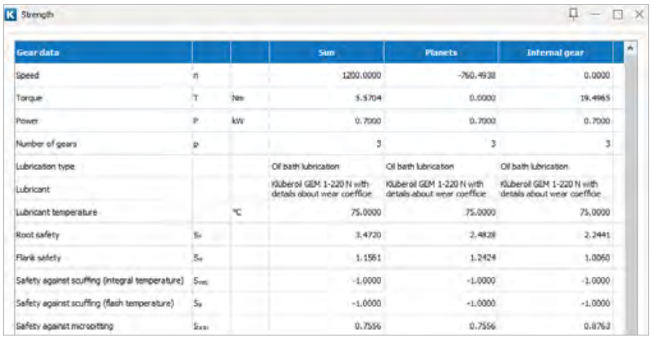
On system level, a part list of bearings is generated as a report
- In the same manner, an overview of the gears in the system is documented
- In a similar approach, the overall shaft dimensions are listed
- Allowing for a preliminary check of purchase of raw material or long lead items

Component level titles



Component tables, geometry
- For rolling bearings, load capacity numbers, clearance information and nominal geometry is shown
- Bearing type, designation, number, manufacturer, clearance class and other listed
- For gears, typical values as used on drawings are shown
- Geometry information may include tolerances, surface roughness and similar

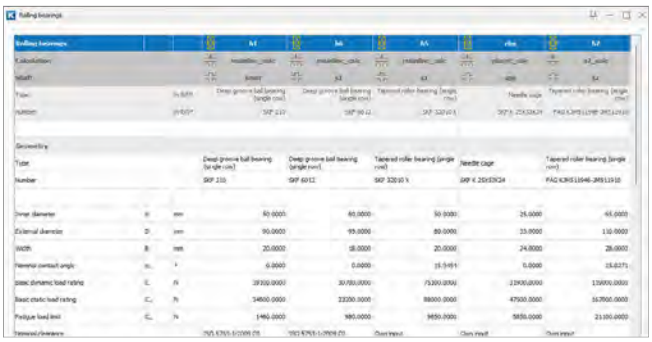
Component tables, strength
- Displays safety factors, frequencies, life or other key results depending on the element type
- Informs about nominal load data like speed, torque, power
- Indicates e.g. lubrication data or other relevant additional input



Strength

Gear data			Sun	Planets	Internal gear
Speed	n		1200.0000	-760.4932	0.0000
Torque	T	Nm	5.5704	0.0000	19.4965
Power	P	kW	0.7000	0.7000	0.7000
Number of gears	p		3	3	3
Lubrication type			Oil bath lubrication	Oil bath lubrication	Oil bath lubrication
Lubricant			Klüberoil GEM 1-220 N with details about wear coeffice	Klüberoil GEM 1-220 N with details about wear coeffice	Klüberoil GEM 1-220 N with details about wear coeffice
Lubricant temperature		°C	75.0000	75.0000	75.0000
Root safety	S_F		3.4720	2.4828	2.2441
Flank safety	S_H		1.1561	1.2424	1.0060
Safety against scuffing (integral temperature)	S_{int}		-1.0000	-1.0000	-1.0000
Safety against scuffing (flash temperature)	S_B		-1.0000	-1.0000	-1.0000
Safety against micropitting	$S_{\lambda min}$		0.7556	0.7556	0.8763

Functionality
- Copy paste content and sort ascending, descending
- Access through menu «Table»
- Header for identification including e.g. drawing number
- Indicates parent elements
- Property, symbol, unit values
- Combined tables for Geometry and Strength or separate tables
- Tables combining gear and mesh data, e.g. for planetary gears

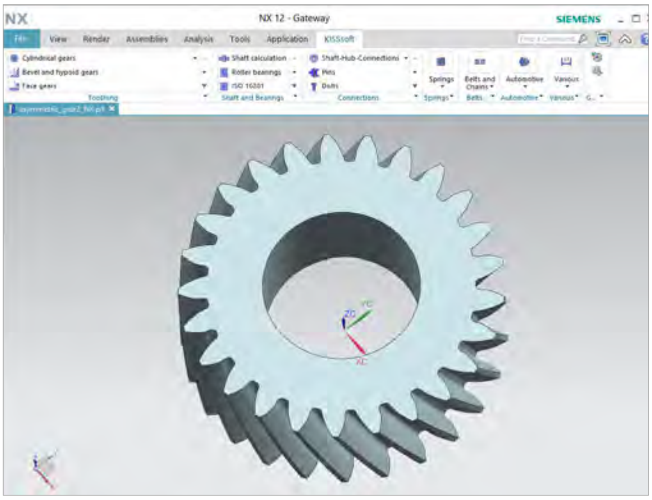


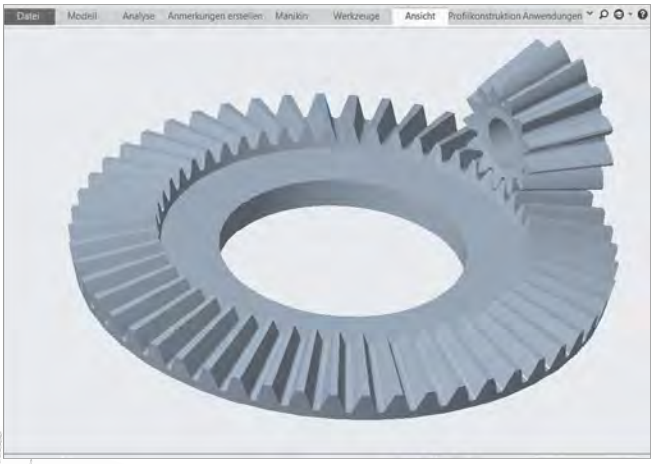
CAD Interfaces

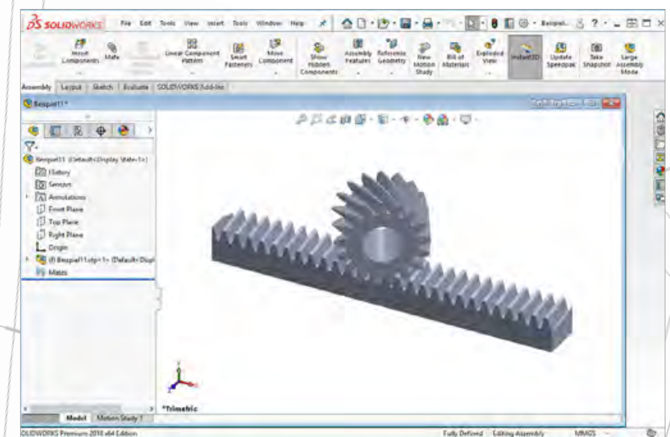
KISSsoft includes the below CAD interfaces to various systems. Thus, at the pressing of a button, the gears defined in KISSsoft can be exported to any of the below-mentioned CAD platforms. Gear Geometries supported are indicated above.

A gear can be generated for an existing construction or, simply, as a new part. Gears are generated by polylines, circular arc approximation or splines. The exact tooth profile is generated by manufacturing simulation considering tools like shaping cutter or protuberance hob. In addition, it is possible to place several gears on shafts already modelled in the CAD environment.

Neutral interfaces in 2D and 3D formats complete the CAD-specific export functions.



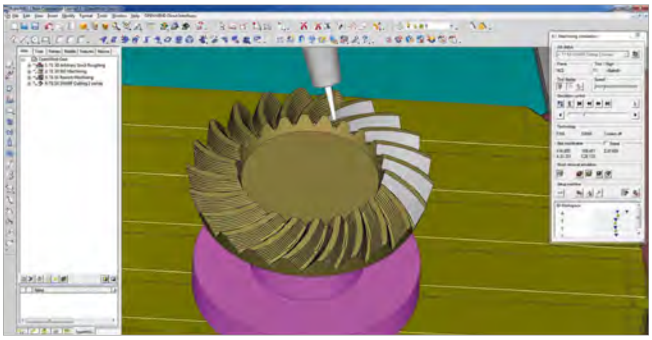




Geometry Data for CAM

KISSsoft includes a highly accurate detailed modeler for 3D gear geometries. Based on the geometry generated in KISSsoft, mold cavities, electrodes or final parts may be machined using 5-axis CNC machines.

For most gears, the 3D models can be generated including a protuberance to facilitate a roughing and a final machining operating. 3D models include gear modifications like lead, profile or topological modifications including chamfers or tip rounding.

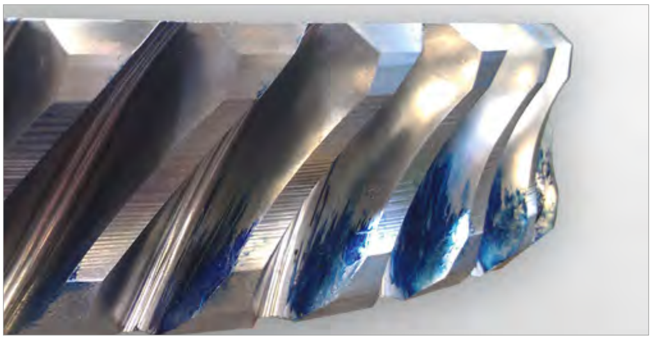


Applications

Gears or cavities successfully machined by our customers include:

- Spur, helical and herringbone gears
- Spur, helical and spiral bevel gears
- Bevel gears with constant or varying tooth height
- Spur and helical face gears
- Worm gears (different shapes)

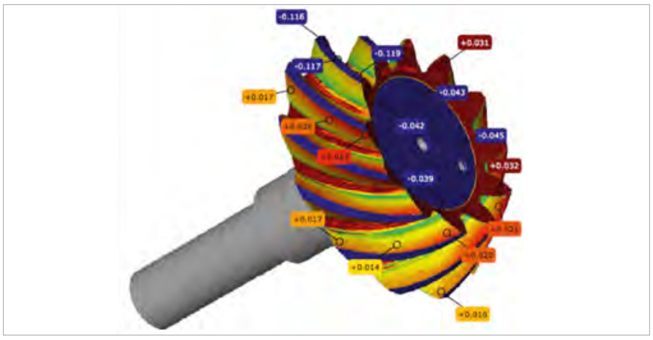
Geometries may be imported into any CAM software. Imported geometry includes profile and lead modifications, root geometry simulated from manufacturing, inner diameter, tip chamfer or rounding. Geometry resolution is finer than 0.1um.



Verification

Tests have confirmed that contact patterns of e.g., spiral bevel gears are matching with predictions calculated in KISSsoft.

Request specific information and technical papers on the subject from your local authorized reseller.



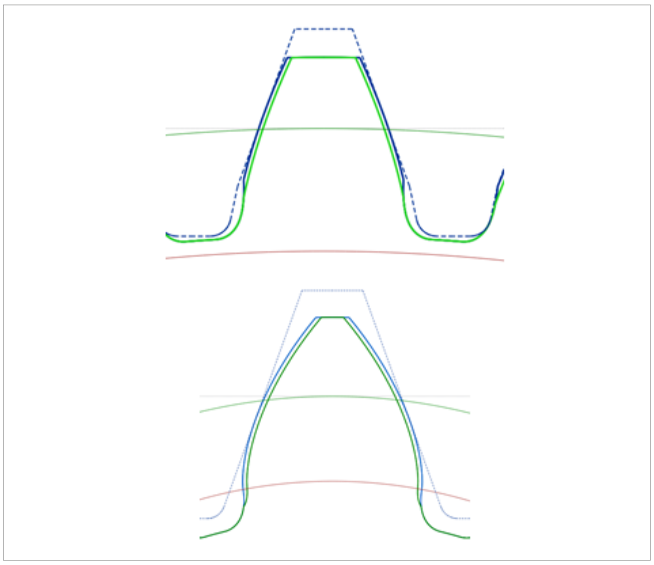
Gear geometry measurement may be controlled using KISSsoft measuring data (flank and root coordinates on measurement grid) and point normal vectors exported in different formats (e.g., to suit Gleason, Klingelnberg or Wenzel gear testers).

Pre-machining tool

- How to define the tool addendum length, to achieve the required gear dedendum?
- Which protuberance amount is needed to avoid the grinding notch with certainty?
- Can I use any existing tool for pre-manufacturing a new gear?

When pre-machining is applied, the tool addendum needs to be enlarged to compensate the manufacturing profile shift. To avoid grinding notches, the protuberance is applied on the pre-machining tool, to avoid the increased stress concentration.

The root radius is applied as large as possible to reduce the root stresses ("full fillet" design), but to be checked for root form diameter.

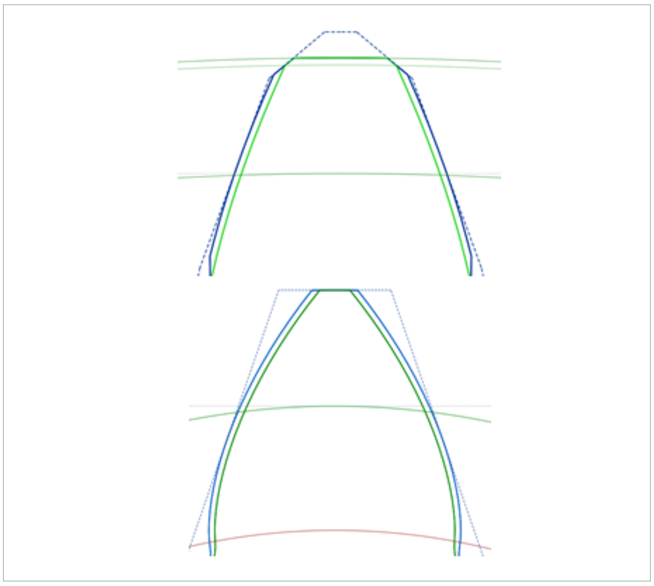


Chamfering and topping tools

- What is the contact ratio change due to a chamfer?
- Is the noise behavior still ok with the reduced contact ratio due to chamfer?

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 shown. Also, the reduced contact ratio is shown, what affects also both the noise and strength rating of the gear and has to be documented for further processing. As pre-machining tools, hobs and pinion type cutters are available.

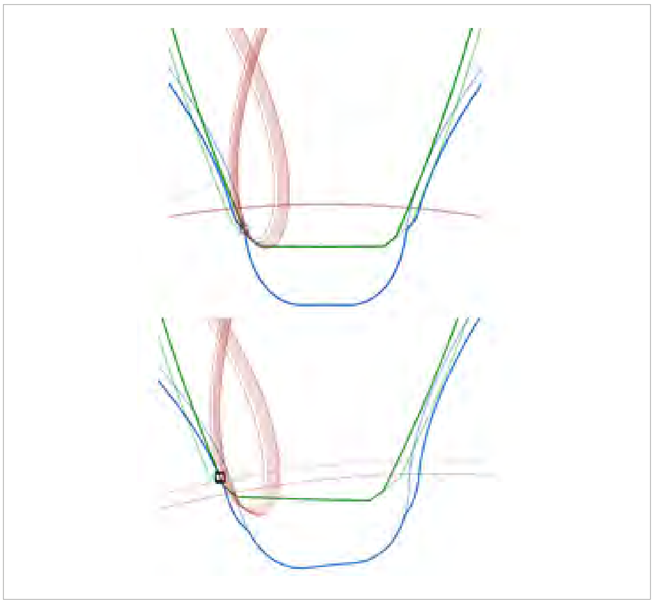


Grinding depth

- What minimum grinding depth (root grinding, flank grinding) is required?
- Is the grinding depth sufficient to avoid interference/ collision when meshing?
- What is the trace of tooth tip when meshing?

The addendum of the hard-finishing tool is calculated for required minimum active root diameter, maximum root form diameter or to avoid grinding the root etc.

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



Grinding dresser

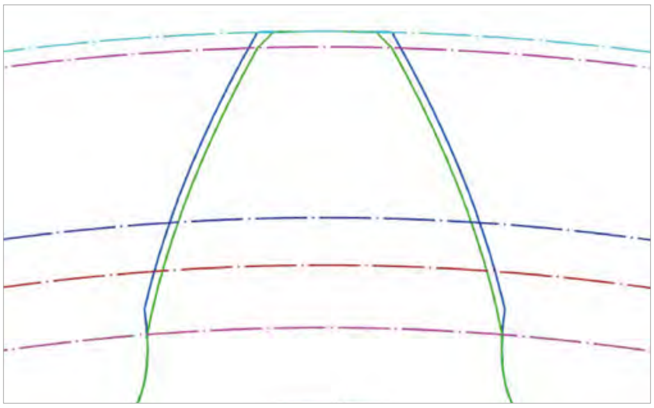
- Can we reuse a grinding dresser for another workpiece?
- What is the effect on the gear design if we use an existing grinding dresser?

KISSsoft checks whether, for a given gear design, an existing grinding dresser can be used or re-used.
The software shows the resulting gear modifications if an existing grinding dresser is used, reducing tool costs and eliminating tool lead time. The difference between the designed modifications and the machined modifications is evaluated and the effect can be checked using KISSsoft functionality.

Diameters, meshing interference and collisions

- How does the tooth thickness tolerance range affect the range for dFf, dFa and df?
- What is the influence of machining stock and tool tip shape on the upper root form diameter?

The manufacturing profile shift of the pre-machining and final machining tool affect the form diameters and thereby the available involute length. A display of all relevant diameter, for different tolerance conditions, and for different machining steps visualizes the calculated values. Meshing interferences, safety distances and collisions may be detected in high resolution graphics with animation functions.



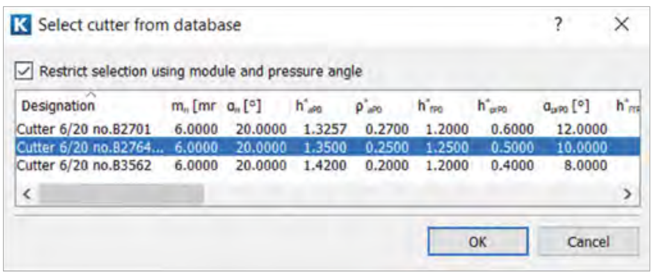
Hob database

- How can we ensure that gear designers consider existing tools when choosing a workpiece design?
- How can I request for a new tool based on the current gear design?

The reference profile, pressure angle, module and a tool reference number can be imported into KISSsoft

database from a text file. The tool inventory is then reflected in the gear design software.

Gear designers may then check on the availability of a suitable tool for a gear design and reducing the number of new tools needed. If a new tool is required, the gear profile data can be exported and sent to Gleason tool manufacturer on one click.



Rollout graphic

Rollout functionality

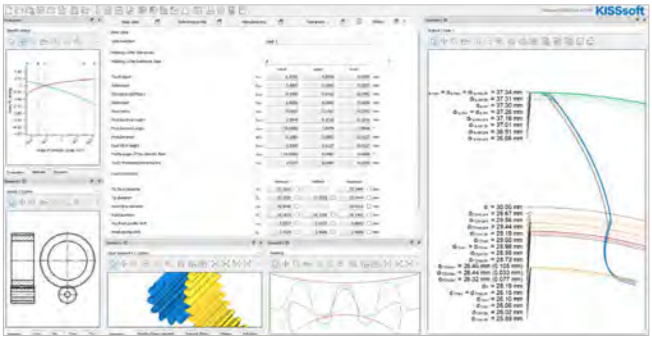
- Check of rollout for hobbing cutters
- Advanced hobbing cutter design
- Hobbing cutter tolerances from standard or own input
- Minimal, nominal and maximal stock evaluation
- Influence of hobbing cutter tolerances on the tooth form
- Calculation of different parameters: dFa, dFf, max undercut and others

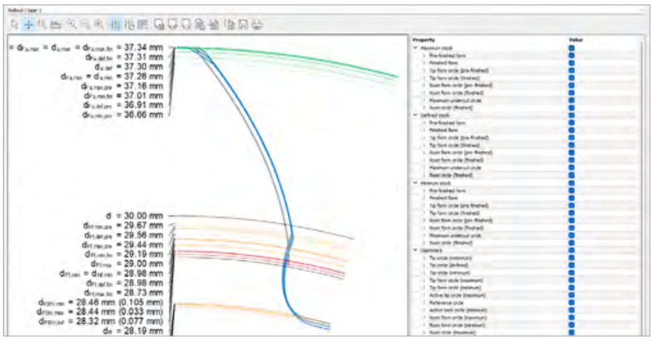
Data input

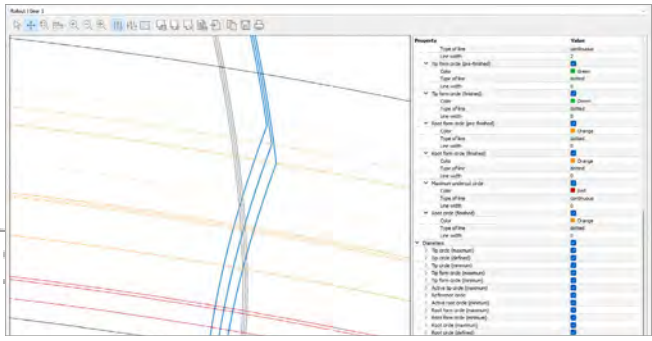
- Define hob in Reference profile
- Define hobbing tolerances in Rollout tab
- Choose tolerance class from an existing standard (database)
- Input custom tolerances via Own input
- Adjust specific gear tolerances if necessary

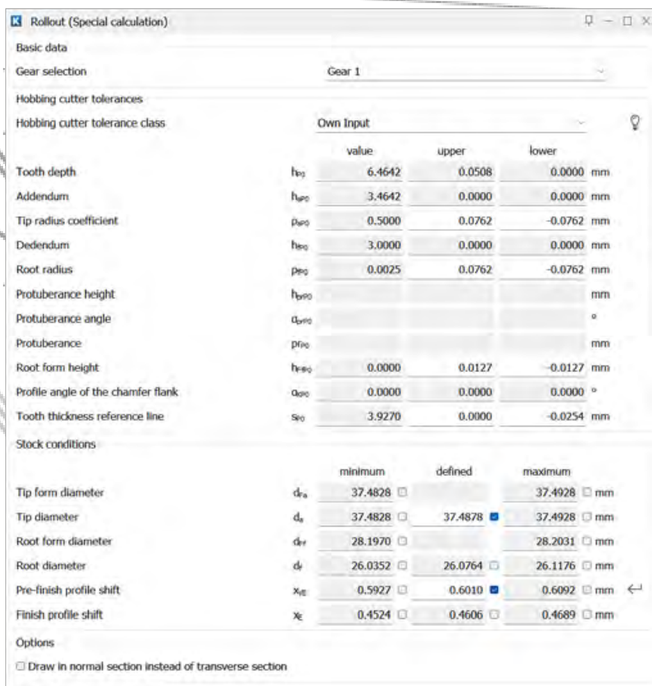
Create three hobbing cutters and generate three tooth shapes that have

- Maximum stock
- Minimum stock
- Defined stock



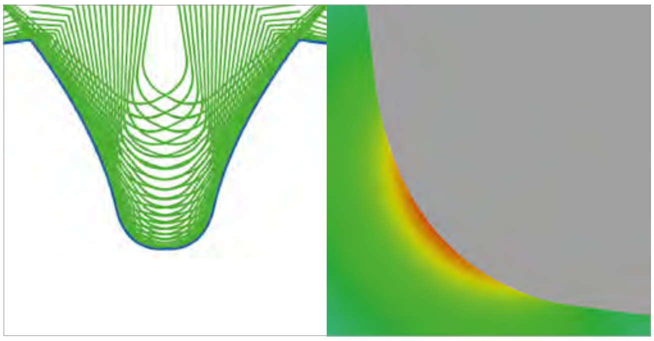


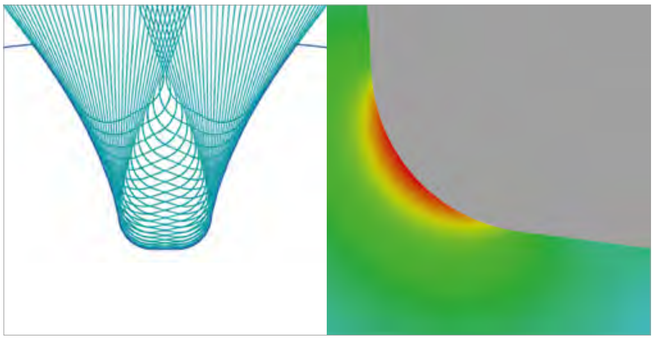




Short lead hob
- What is the influence of the hob module on the workpiece root shape?
- How does a short lead hob affect the gear strength?

Short lead hobs create a different root shape resulting in different stress levels that cannot be assessed using DIN, ISO or AGMA gear rating standards. When using a short lead hob, it is then recommended to use the FEM calculation in KISSsoft considering the root geometry and curvature as manufactured. A comparison of stress levels for different hob modules allow for an approval of a certain hob design.

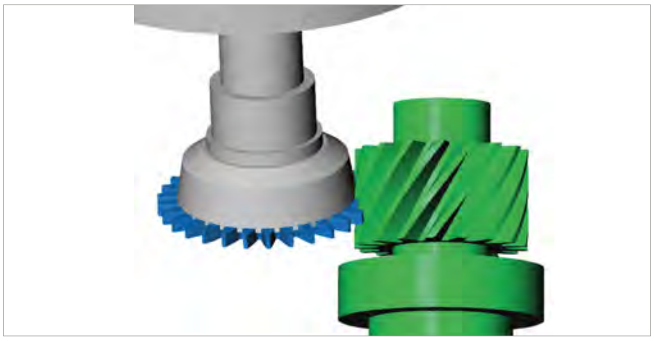




Power skiving
- Can a tooth profile be manufactured with power skiving?
- Is there sufficient runout for the tool regarding the shaft shoulder?

KISSsoft allows to estimate the manufacturability of gears using power skiving. On one hand, the tooth geometry is checked regarding machine and tool limitations, on the other hand, the gear can optionally also be checked for collisions with the tool. Collisions scenarios which shall be checked can be activated.

In addition, it is also possible to export the corresponding tool-gear helical calculation as a KISSsoft file which can then be opened separately and may be used for visualization or problem-solving purposes.



Forming and generating final machining
- How can we avoid grinding notches for generating and forming grinding operation?
- For a given final machining stock on the flank, how can we achieve a desired material removal in the root?

In different industries, different grinding techniques and strategies are used. While in industrial gears, the root is typically not ground, it is ground in most cases for aerospace gears. For large gears, a forming final machining process (e.g. hard hobbing with form cutter) may be used whereas for e.g. car transmission gears, a generating grinding process is common.

Grinding notches should be avoided for high performance application while they may be found in gears produced with small batches.

KISSsoft allows to tune the stock removal on the flank and root separately and final machining tool runout is checked.

Tool profile for non-involute gears

- How can we determine the tool profile for non-involute gears?
- Is the workpiece profile manufacturable with a generating process?

Non involute gears with positive radius of curvature on the flank can typically be manufactured in a generating process using rack type or pinion cutter type tools. KISSsoft calculates the gear reference profile through a reverse generating process. The rack profile may then be exported as 2D *.dxf for tool production.

Measurement and quality

Measurement grid coordinates

- 3D models as STEP and measurement grid
- Data export in GDE and GAMA® format
- Including microgeometry and tolerances

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.

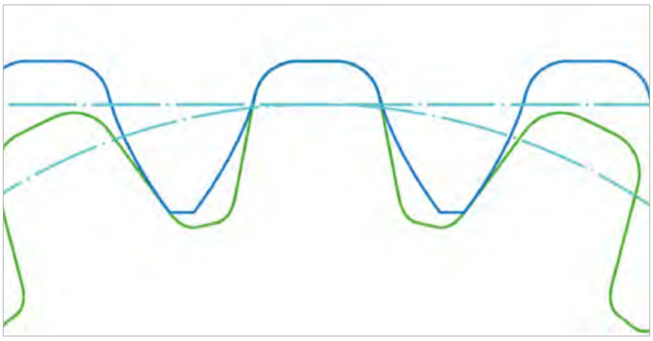
The export formats for GDE and GAMA® are available. They allow for a fast and safe data transfer between various manufacturing and measurement machines.

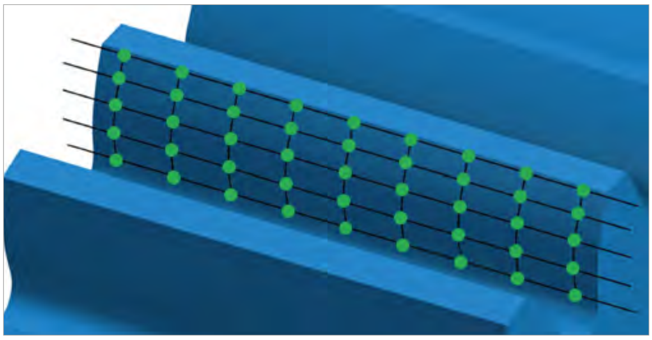
Tooth thickness and span width

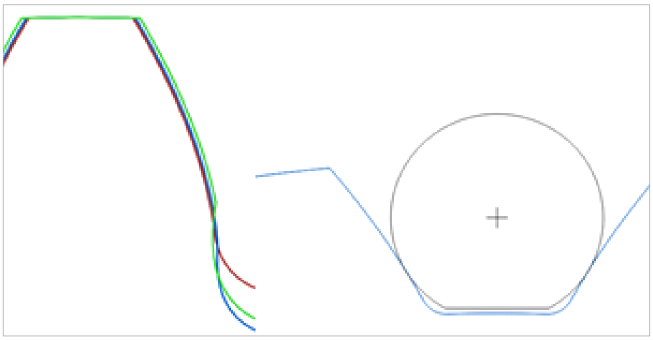
- What are the required tooth thickness values for pre-machining and final machining?
- What are the permitted tooth thickness values including the tolerances?
- Flattened ball for splines

For involute splines, flattened ball needs to be applied to avoid the touching of the gear root.

Tooth thickness is calculated for a given diameter, for theoretical gear or considering tooth thickness allowances. Calculated diameter over pin for theoretical, mean, upper and lower value may then be compared to measured DOP using Gleason over pins gauges.







		Gear 1	Gear 2	
Tip diameter	d_a	164.9820	465.0180	mm
Root diameter	d_f	137.9820	438.0180	mm
Base diameter	d_B	140.9539	428.4998	mm
Required diameter	d_c	150.0000	456.0000	mm
Without tooth thickness allowance (theoretical toothing)				
Normal tooth thickness	s_{nc}	10.5101	8.3394	mm
Normal space width	e_{nc}	8.3394	10.5101	mm

Cylindrical Gears, Manufacturing

Profile and tooth trace modification

- Lead, profile and combined modifications
- Topological modifications
- Tabular, graphical data for manufacturing drawings

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.

GDE format for data exchange

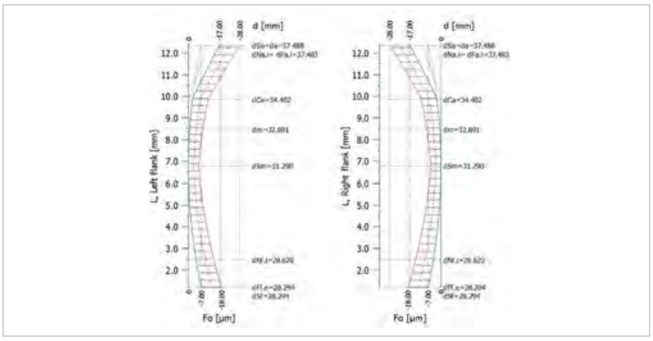
- How do we communicate gear data easily and error free between different departments or companies?
- How do we get relevant gear geometry data that is missing on a drawing?

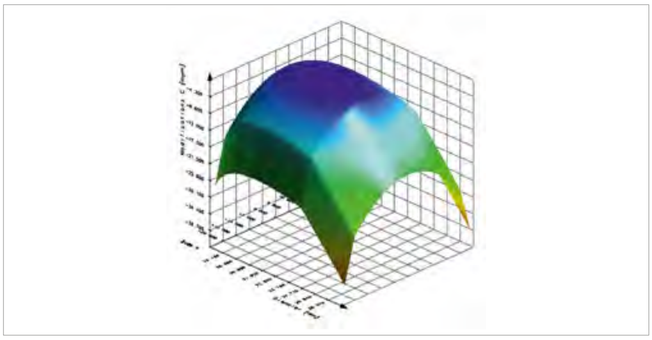
A unique, simple, accurate and flexible way to describe gear geometry and manufacturing data is implemented in KISSsoft based on VDI/VDE 2610 guideline. The data exchange between design department, production and quality inspection group, or with customers, is thereby simplified and accelerated. It serves as a digital gear table and is used in parallel to a drawing.

Master gears

- Can we use an available master gear or is a new one required?
- Which area of the involute is checked?

Based on a given workpiece design and the required diameters to be in contact with a master gear, the suitability of a given master gear is checked. Alternatively, a new master gear design is calculated considering workpiece diameter tolerances. Master gears may then be used on Gleason and other testers.





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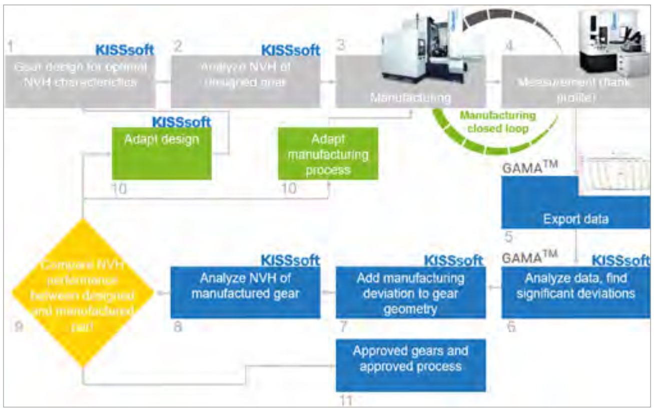
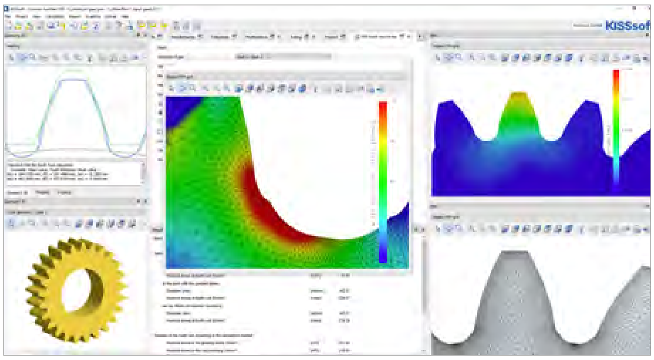
Analysis of manufactured gears

Design-manufacture-measure

- What is the vibration characteristic of the machined gear compared to the designed gear?
- How do machining errors influence the contact pattern under load?

The design-manufacture-measure loop integrates KISSsoft, Gleason gear machines and metrology solutions. Machining errors may result in elevated noise levels or poor contact patterns in operation. To predict if the performance characteristics of a machined gear are satisfactory, the measured flank deviations are imported into KISSsoft. There, the designed and the measured geometry are analyzed (contact pattern under load, transmission error, force excitation, …) and performance characteristics are compared in parallel. Based on this, the manufacturing process with its deviations may be approved or the need for a more accurate or stable process may be identified.



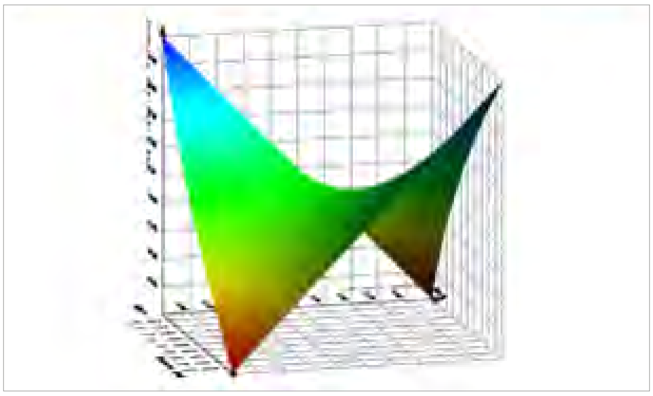


Root radius and tooth root stresses

- What is the stress concentration due to a grinding notch?
- How can we assess root stresses for non-trochoidal root shapes?

Gear root strength is usually 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.

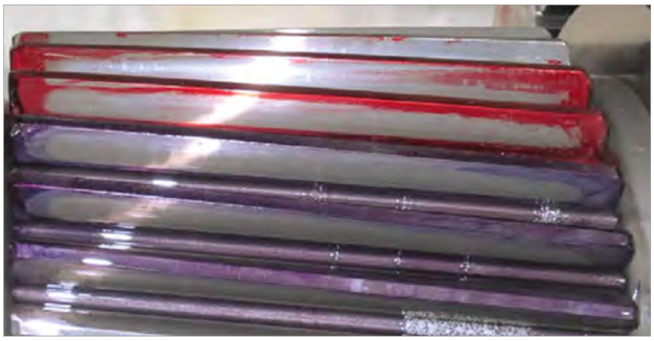
When grinding notches or other machining errors are created, KISSsoft provides a 2D FEM calculation where the stress increase is shown. Based on the stress level, gears may be safe for operation or need to be scrapped.

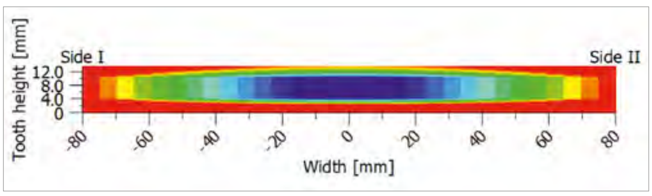


Natural and designed twist

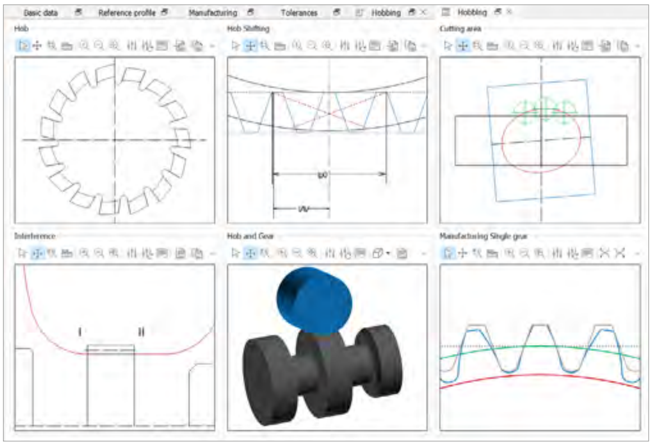
- What amount of natural twist results from threaded wheel grinding?
- What are the resulting deviations from the designed flank geometry?

In threaded wheel grinding process for helical gears with lead modifications, a natural twist results (unless it is compensated). 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.





Cylindrical Gears, Hobbing Process

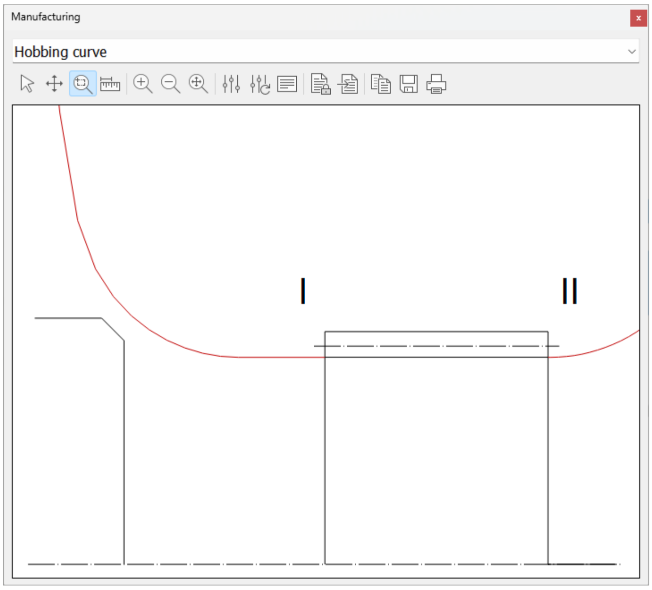


Process Definition

- Configure cutting direction: conventional or climb, define infeed type: axial or radial
- Input parameters: cutting material, quality class, outer diameter, threads, gashes, and tool sizing
- Sizing button proposes optimized tool parameters; additional details via the plus button

Tool Definition

- Hob configuration, gash angle, depth, radius, relief angle, and rake angle
- Optional end-view graphics, shaft shoulder definition, configurable for side I or II
- Impacts tool sizing and interference with contours
- Visual representation of cutter path vs. interfering contours

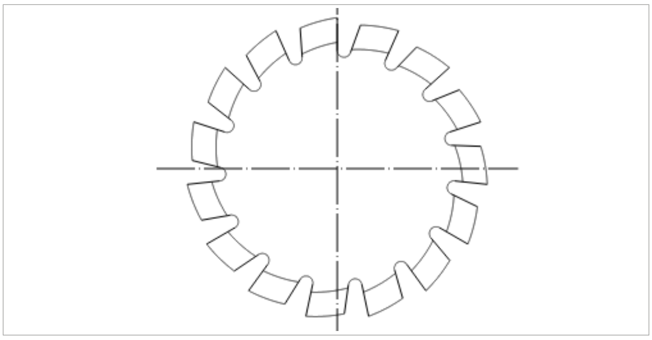


Interference and Cuts

- Define single or multiple cuts with specific parameters
- Axial and radial feed rates, cutting speed, and dwell rotations
- Chip thickness and feed marks influence axial feed calculations
- Multi-cut configurations presented in a tabular format

Process Time

- Includes cutting time and chip-to-chip time derived from process parameters
- Chip-to-chip time requires additional inputs for loading, spin-off, chamfering, and auxiliary times
- Process time subject to ongoing refinements

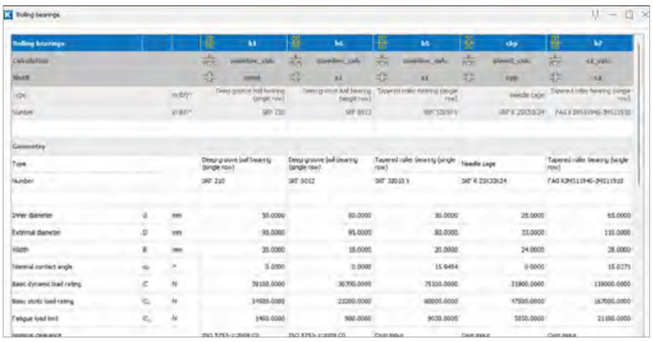


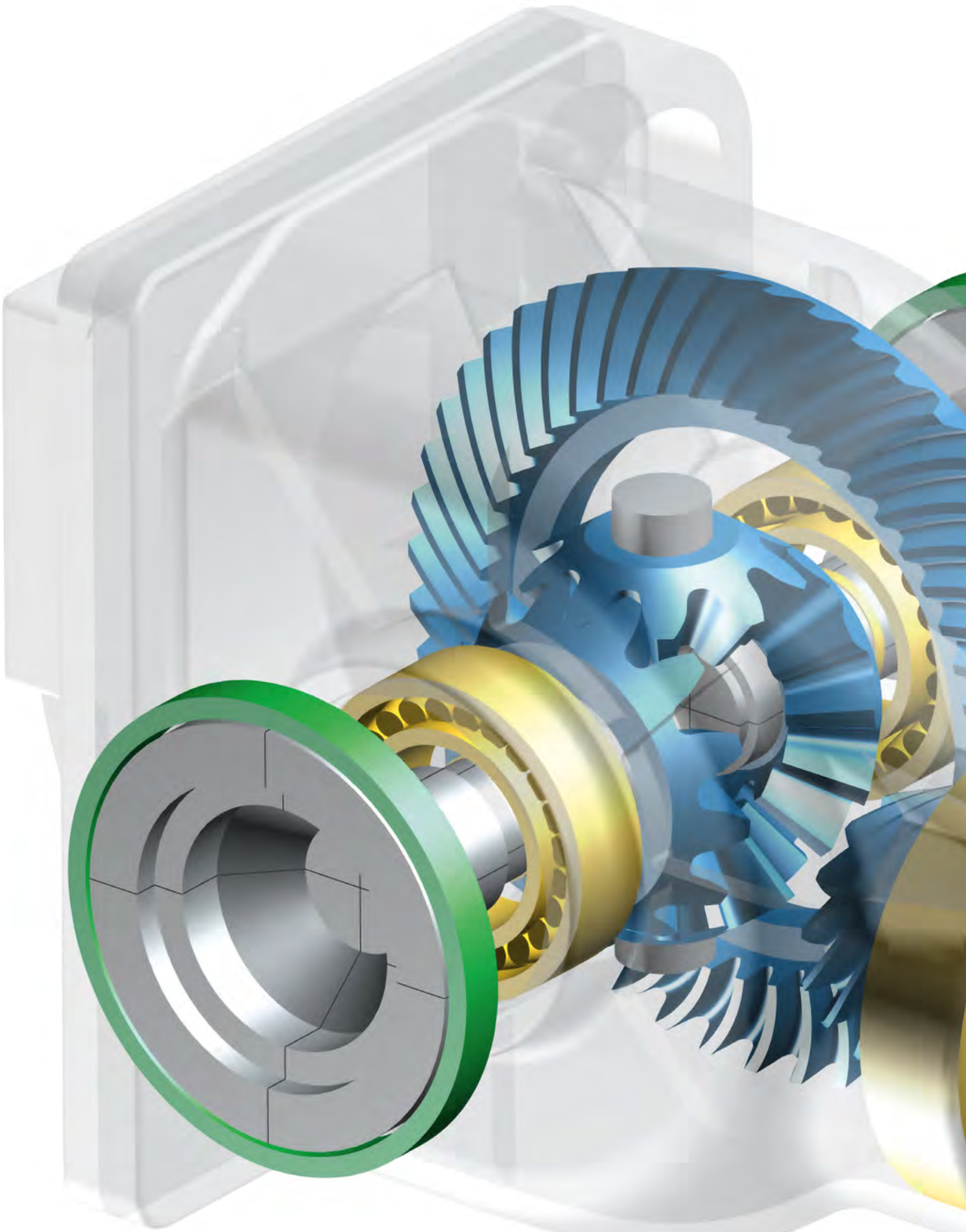
Cost Calculation

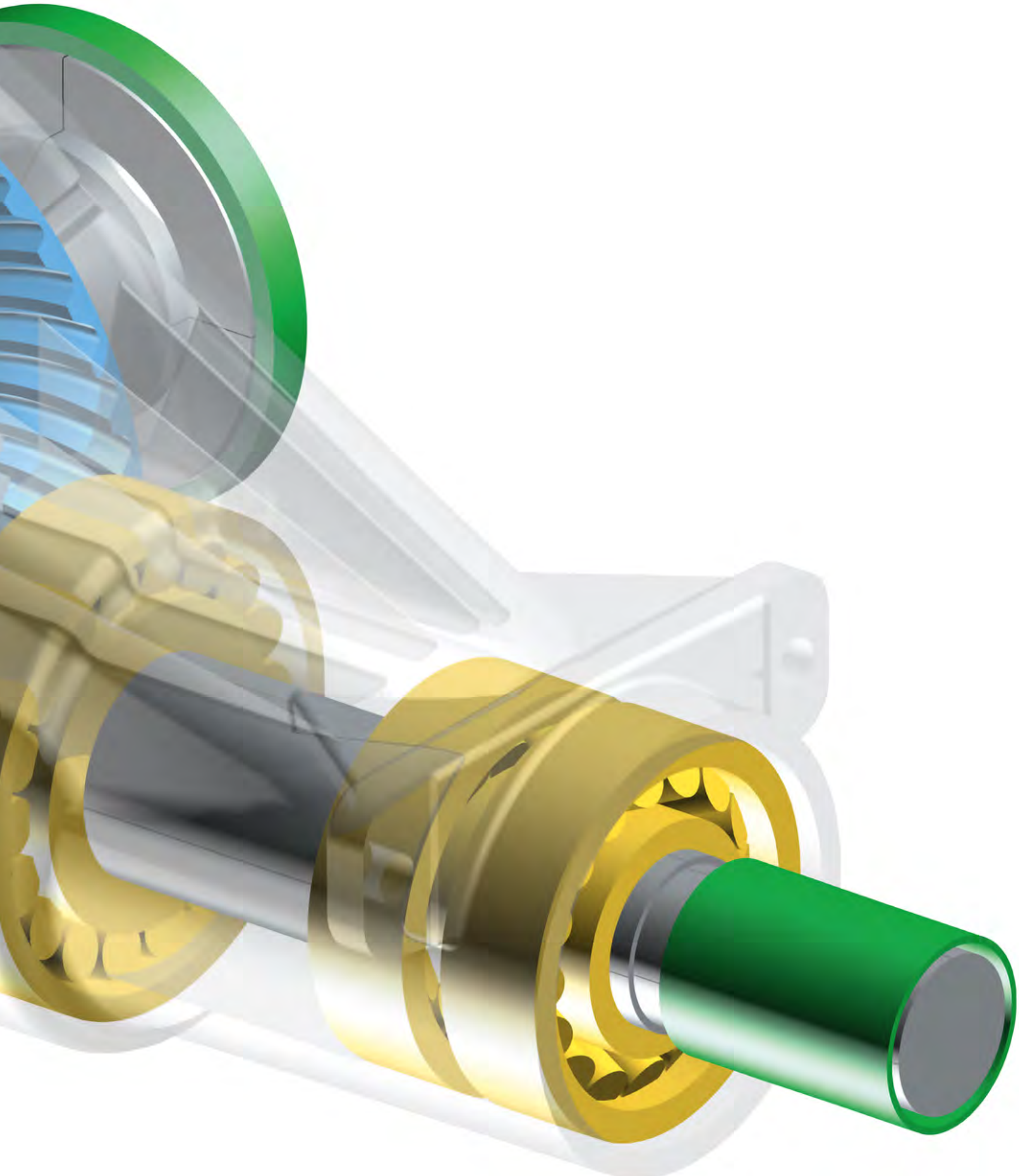
- Inputs required are tool life (in meters), tool costs
- Including hob purchase, decoating, resharpening, and recoating
- Outputs provide a comprehensive cost analysis for the process

Key Features

- Automation enhancements for seamless workflows
- Intuitive tools for precision configuration and visualization
- Customizable processes for optimized performance and cost efficiency





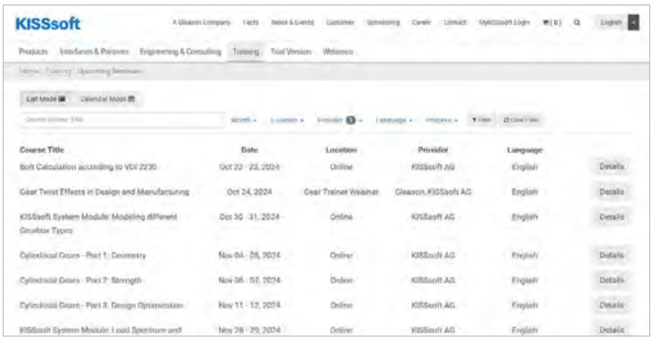


Services

Training

Types of training
- Public trainings and technology seminars
- Company specific training, worldwide
- At KISSsoft AG training center, Switzerland
- On site or virtual classes by web meeting

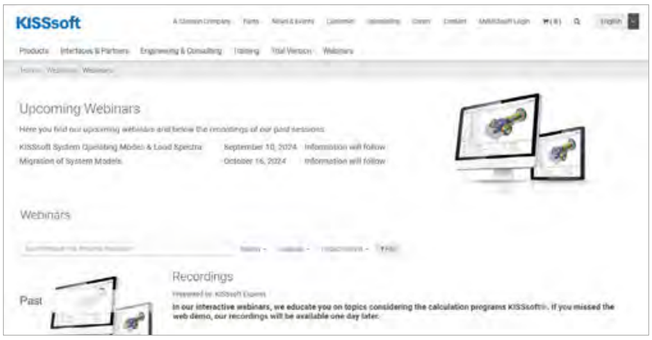
Topics
- **KISSsoft & System Module software usage**
- **System Module programming, scripting**
- **Gear theory, gear design technology**
- **Fine pitch and plastic gearing technology**

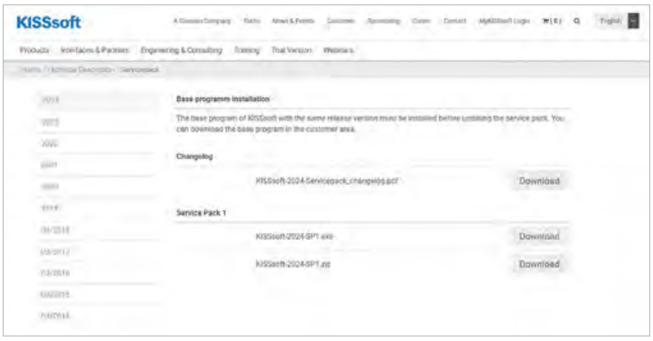


Updates and Support

Services
- Software updates on annual basis
- Service Packs as required
- Installation and configuration support
- Software support (software usage)
- Technical support (software application)

USF modalities
- Perpetual by service contract
- Annual renewal





Engineering and Consultancy

Design, optimization and analysis
- Engineers with application specific experience
- Holistic range of services

Technology studies
- Literature and patent reviews
- Network of experts for many fields

Workshops and co-engineeering
- Training on the project, best practices
- Know-how transfer within the project

Plastic gear design
- Cylindrical, crossed helical, face gears
- Root, flank, shear, static strength, wear
- Noise and vibration optimization

Appendix: List of Standards used in KISSsoft

DIN Standards

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
103	1977	1977	K015	Metrisches ISO-Trapezgewinde; Gewindeprofile
125	1990		M040	Scheiben - Produktklasse A, bis Härte 250 HV, vorzugsweise für Sechskantschrauben und -muttern
509	2006	2022		Technische Zeichnungen - Freistiche - Formen, Maße
620-2	?	1988-02	W010	Rolling bearings; tolerances for rolling bearings; tolerances for radial bearings
620-3	?	1982-06	W010	Rolling bearings; tolerances for thrust bearings
620-4	?	2004-06	W010	Rolling bearings - Rolling bearing tolerances - Part 4: Radial internal clearance
625-1	/	2011-04	W050	Wälzlager - Radial-Rillenkugellager - Teil 1: Einreihig
625-3	/	2011-01	W050	Wälzlager - Radial-Rillenkugellager - Teil 3: Zweireihig
625-4	/	2010-05	W050	Wälzlager - Radial-Rillenkugellager - Teil 4: Mit Flansch am Außenring
630		2011-02	W050	Wälzlager - Radial-Pendelkugellager - Zweireihig, zylindrische und kegelige Bohrung
720	/	2008-08	W050	Wälzlager - Kegelrollenlager
722	/	2005-08	W050	Wälzlager - Axial-Zylinderrollenlager - Einseitig wirkend
732	2010	2010	W050	Wälzlager –Thermisch zulässige Betriebsdrehzahl - Berechnung und Beiwerte
867	1986	1986	Z000	Basic rack tooth profiles for involute teeth of cylindrical gears for general engineering and heavy engineering
743 Teil 1, Beiblatt 1	2024	2024	W010	Tragfähigkeitsberechnung von Wellen und Achsen
743 Teil 2-4, Beiblatt 2	2012	2012	W010	Tragfähigkeitsberechnung von Wellen und Achsen
1024	1982		W010	Stabstahl; Warmgewalzter rundkantiger T-Stahl; Maße, Gewichte, zulässige Abweichungen, statische Werte
1025-1	2009	2009	W010	Warmgewalzte I-Träger - Teil 1: Schmale I-Träger, I-Reihe - Maße, Masse, statische Werte
1025-2	1995		W010	Warmgewalzte I-Träger - Teil 2: I-Träger, IPB-Reihe; Maße, Masse, statische Werte
1025-3	1994	1994	W010	Warmgewalzte I-Träger; Breite I-Träger, leichte Ausführung, IPBl-Reihe; Maße, Masse, statische Werte
1025-4	1994	1994	W010	Formstahl; Warmgewalzte I-Träger, Breite I-Träger, verstärkte Ausführung, IPBv-Reihe, Maße, Gewichte, Zulässige Abweichungen, statische Werte
1025-5	1994	1994	W010	Formstahl; Warmgewalzte I-Träger, Mittelbreite I-Träger, IPE-Reihe, Maße, Gewichte, zulässige Abweichungen, statische Werte
1026-1	2009	2009	W010	Warmgewalzter U-Profilstahl - Teil 1: U-Profilstahl mit geneigten Flanschflächen - Maße, Masse und statische Werte
1681	1985		KMAT	Stahlguss - Stahlguss für allgemeine Anwendungen; Deutsche Fassung EN 10293:2015
2076	1964	1964	F000	Runder Federdraht; Maße, Gewichte, zulässige Abweichungen
2077	1979	1979	F000	Federstahl, rund, warmgewalzt; Maße, zulässige Maß- und Formabweichungen

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
DIN 2089-2	1992	1992	M040	Zylindrische Schraubenfedern aus runden Drähten und Stäben - Zugfedern - Berechnung und Konstruktion
2091	1981	1981	F000	Drehstabfedern mit rundem Querschnitt; Berechnung und Konstruktion
2096	-1(1981), -2 (1988)	-1(1981), -2 (1988)	F010	Zylindrische Schraubendruckfedern aus runden Drähten und Stäben
2098 Beiblatt 1	1968	1968	F000	Zylindrische Schraubenfedern aus runden Drähten; Baugrößen für kaltgeformte Druckfedern ab 0,5 mm Drahtdurchmesser
2194	2002	2002	F030	Zylindrische Schraubenfedern aus runden Drähten und Stäben - Kaltgeformte Drehfedern (Schenkelfedern) - Gütenorm
3960	Mrz. 87	Mrz. 87	Z010	Begriffe und Bestimmungsgrößen für Stirnräder (Zylinderräder) und Stirnradpaare (Zylinderradpaare) mit Evolventenverzahnung
3961	Aug. 78	Aug. 78	Z010	Toleranzen für Stirnradverzahnungen; Grundlagen
3962	Aug. 78	Aug. 78	Z010	Toleranzen für Stirnradverzahnungen
3963	Nov. 80	Nov. 80	Z010	Toleranzen für Stirnradverzahnungen; Toleranzen für Wälzabweichungen
3964	Nov. 80	Nov. 80	Z010	Achsabstandsabmaße und Achslagetoleranzen von Gehäusen für Stirnradgetriebe
3965	Aug. 86	Aug. 86	Z070	Toleranzen für Kegelradverzahnungen
3967	Aug. 78	Aug. 78	Z000	Getriebe-Paßsystem; Flankenspiel, Zahndickenabmaße, Zahndickentoleranzen, Grundlagen
3971	Jul. 80	Jul. 80	Z070	Begriffe und Bestimmungsgrößen für Kegelräder und Kegelradpaare
3972	1952	1952	Z000	Bezugsprofile von Verzahnwerkzeugen für Evolventen-Verzahnungen nach DIN 867
3974		Nov. 95	Z080	Toleranzen für Schneckengetriebe-Verzahnungen
3975		2017	Z080	Begriffe und Bestimmgrößen für Zylinder-Schneckengetriebe mit sich rechtwinklig kreuzenden Achsen
3990	1987	Dez. 1987 (3990-1/2/3/4/5), 02.1994 (3990-6)	Z010	Tragfähigkeitsberechnung von Stirnrädern
3991	2024	2024	Z070	Trägfähigkeitsberechnung von Kegelrädern ohne Achsversetzung
3992	Mrz. 64	Mrz. 64	Z010	Profilverschiebung bei Stirnrädern mit Außenverzahnung
3993	Aug. 81	Aug. 81	Z010	Geometrische Auslegung von zylindrischen Innenradpaaren mit Evolventenverzahnung
3996	2019	2019	Z170	Calculation of load capacity of cylindrical worm gear pairs with rectangular crossing axes
5464	2010	2010	M02B	Passverzahnungen mit Keilflanken - Schwere Reihe
5466-1	2000	2000	M02C/ Z09A	Tragfähigkeitsberechnung von Zahn- und Keilwellen-Verbindungen - Teil 1: Grundlagen
5466-2 Draft	2002	2002	M02C/ Z09A	Tragfähigkeitsberechnung von Zahn- und Keilwellen-Verbindungen - Teil 2: Zahnwellen-Verbindungen nach DIN 5480
5471	1974	1974	M02B	Werkzeugmaschinen; Keilwellen- und Keilnaben-Profile mit 4 Keilen, Innenzentrierung, Maße
5472	1980	1980	M02B	Werkzeugmaschinen; Keilwellen- und Keilnaben-Profile mit 6 Keilen, Innenzentrierung, Maße
5480-1	2006 (Vorzugsreihe 1991)	2006 (Vorzugsreihe 1991), DIN 5480-1:2025 Entwurf	M02C/ Z09A	Passverzahnungen mit Evolventenflanken und Bezugsdurchmesser - Teil 1: Grundlagen

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
5480-2	2015	2015; DIN 5480-2:2025 Entwurf	M02C/ Z09A	Passverzahnungen mit Evolventenflanken und Bezugsdurchmesser - Teil 2: Nennmaße und Prüfmaße
5480-15	2006 (Berichtigung 2009)	2006 (Berichtigung 2009); DIN 5480-2:2025 Entwurf	M02C/ Z09A	Passverzahnungen mit Evolventenflanken und Bezugsdurchmesser - Teil 15: Qualitätsprüfung
5480-16		2006 (Berichtigung 2009)	M02C/ Z09A	Passverzahnungen mit Evolventenflanken und Bezugsdurchmesser - Teil 16: Werkzeuge
5481	2019	2019	M02C/ Z09A	Passverzahnungen mit Kerbflanken
5482	1973	1973	M02C/ Z09A	Zahnnabenprofile Und Zahnwellenprofile Mit Evolventenflanken, Maße
6885 (-1/2/3)	1968	2021	M02A	Mitnehmerverbindungen ohne Anzug, Passfedern, Nuten - Hohe Form - Teil 1: Maße, Toleranzen, Masse
6888	1956	2012	M02A/ M02E	Mitnehmerverbindungen ohne Anzug; Scheibenfedern, Abmessungen und Anwendung
6892	2012	2012; DIN 6892:2025 Entwurf	M02A	Mitnehmerverbindungen ohne Anzug – Passfedern – Berechnung und Gestaltung
7168	1991	1991	K010	Allgemeintoleranzen; Längen- und Winkelmaße, Form und Lage; Nicht für Neukonstruktionen
7190-1	2017	2017	M01A	Pressverbände - Teil 1: Berechnungsgrundlagen und Gestaltungsregeln für zylindrische Pressverbände
7190-2	2017	2017	M01B	Pressverbände –Teil 2: Berechnungsgrundlagen und Gestaltungsregeln für kegelige,selbsthemmende Pressverbände
7753	7753-1 (1988), 7753-2 (1976), 7753-3 (1986), 7753-4 (1988)	7753-1 (1988), 7753-2 (1976), 7753-3 (1986), 7753-4 (1988)	Z090	Endlose Schmalkeilriemen für den Maschinenbau
7984	2009	2022	M040	Zylinderschrauben mit Innensechskant mit niedrigem Kopf mit reduzierter Belastbarkeit
17222	1979		F000	Kaltgewalzte Stahlbänder für Federn; Technische Lieferbedingungen
17223-1	1984	1984	F000	Runder Federstahldraht - Patentiert-gezogener Federdraht aus unlegierten Stählen - Technische Lieferbedingungen
17224	1982		F000	Federdraht und Federband aus nichtrostenden Stählen; Technische Lieferbedingungen
30910-4	2010	2010		Sintermetalle - Werkstoff-Leistungsblätter (WLB) - Teil 4: Sintermetalle für Formteile
31652-1/-2/-3	2017	2017	W070	Gleitlager - Hydrodynamische Radial-Gleitlager im stationären Betrieb - Teil 1: Berechnung von Kreiszylinderlagern
31653-1/-2/-3	1991	1991	W07C	Gleitlager; Hydrodynamische Axial-Gleitlager im stationären Betrieb; Berechnung von Axialsegmentlagern
31654-1/-2/-3	1991	1991	W07C	Gleitlager; Hydrodynamische Axial-Gleitlager im stationären Betrieb; Berechnung von Axial-Kippsegmentlagern
31657-1/-2/-3	1996	1996	W070	Gleitlager –Hydrodynamische Radial-Gleitlager im stationären Betrieb –Berechnung von Mehrflächen- und Kippsegmentlagern
32711-1	2023	2023	M02D	Welle-Nabe-Verbindung; Polygonprofil P3G - Allgemeines und Geometrie
32711-2	2023	2023	M02D	Welle-Nabe-Verbindung; Polygonprofil P3G - Berechnung und Dimensionierung

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
32712-1	2009	2009	M02D	Welle-Nabe-Verbindung; Polygonprofil P4C - Allgemeines und Geometrie
32712-2	2012	2012	M02D	Welle-Nabe-Verbindung; Polygonprofil P4C - Berechnung und Dimensionierung
51818	1981	2024	Z000	Schmierstoffe - Konsistenz-Einteilung für Schmierfette - NLGI-Klassen
58405	1972	1972	Z010	Stirnradgetriebe der Feinwerktechnik

ISO Standards

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
53	1998	1998	Z000	Cylindrical gears for general and heavy engineering — Standard basic rack tooth profile
76	2006-05	2006-05	W050/W010	Rolling bearings - Static load ratings
262	1973	2023	K010	ISO general purpose metric screw threads - Selected sizes for screws, bolts and nuts
273	1979	1979	M040	Fasteners; Clearance holes for bolts and screws
281	2007-02	2007-02	W050/W051/ W010	Rolling bearings - Dynamic load ratings and rating life
286	2010	2010		Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits
1328	1995, 2013 (1328-1), 1997, 2020 (1328-2)	2013 (1328-1), 2020 (1328-2)	Z010	Stirnräder (Zylinderräder) - ISO-Toleranzsystem
1940		Aug. 03 (1940-1), Juli 97 (1940-2)		Mechanische Schwingungen - Anforderungen an die Auswuchtgüte von Rotoren in konstantem (starrem) Zustand
4156	4156-1/2/3 : 2021	4156-1/2/3 : 2021	Z09A	Gerade zylindrische Envolventenverzahnung; metrischer Modul, Flankenpassung; Allgemeines, Abmessungen und Kontrollen
4184	1992	1992	Z09A	Riemengetriebe; Klassische Keilriemen und Schmalkeilriemen; Längen im Richtsystem
5753-1	2009-10	2009-10	W050/W010	Rolling bearings - Internal clearance - Part 1: Radial internal clearance for radial bearings
5753-2	2010-12	2010-12	W050/W010	Rolling bearings - Internal clearance - Part 2: Axial internal clearance for four-point-contact ball bearings
6336	2006	2006	Z010	Calculation of load capacity of spur and helical gears
6336-1	2019	2019	Z010	Calculation of load capacity of spur and helical gears — Part 1: Basic principles, introduction and general influence factors
6336-2	2019	2019	Z010	Calculation of load capacity of spur and helical gears — Part 2: Calculation of surface durability (pitting)
6336-3	2019	2019	Z010	Calculation of load capacity of spur and helical gears — Part 3: Calculation of tooth bending strength
6336-4	2019	2019	Z000	Calculation of load capacity of spur and helical gears — Part 4: Calculation of tooth flank fracture load capacity
6336-5	2016	2016	Z000	Calculation of load capacity of spur and helical gears — Part 5: Strength and quality of materials
6336-20	2022	2022	Z000	Calculation of load capacity of spur and helical gears — Part 20: Calculation of scuffing load capacity — Flash temperature method
6336-21	2022	2022	Z000	Calculation of load capacity of spur and helical gears — Part 21: Calculation of scuffing load capacity — Integral temperature method
6336-22	2018	2018	Z000	Calculation of load capacity of spur and helical gears — Part 22: Calculation of micropitting load capacity

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
7902-1/-2/-3	2020	2020	W070	Hydrodynamische Radial-Gleitlager im stationären Betrieb - Kreiszylinderlager - Teil 1: Berechnung
9085	Feb 98	Feb. 02		Tragfähigkeitsberechnung von Stirnrädern - Anwendung für Industriegetriebe
10064-3	1996	1996	Z000	Code of inspection practice — Part 3: Recommendations relative to gear blanks, shaft centre distance and parallelism of axes
10300-1 to 3	2001	2001	Z070	Calculation of load capacity of bevel gears
10300-1	2014	2014	Z070	Calculation of load capacity of bevel gears — Part 1: Introduction and general influence factors
10300-2	2014	2014	Z070	Calculation of load capacity of bevel gears — Part 2: Calculation of surface durability (pitting)
10300-3	2014	2014	Z070	Calculation of load capacity of bevel gears — Part 3: Calculation of tooth root strength
10300-20	2021	2021	Z070	Calculation of load capacity of bevel gears — Part 20: Calculation of scuffing load capacity — Flash temperature method
12110-2	2013	2013	K019	Metallic materials - Fatigue testing - Variable amplitude fatigue testing - Part 2: Cycle counting and related data reduction methods
12130-1/-2/-3	1 (2001), 2 and 3 (2001)	1 (2021), 2 and 3 (2020)	W07C	Plain bearings - Hydrodynamic plain tilting pad thrust bearings under steady-state conditions - Part 1: Calculation of tilting pad thrust bearings
13691	2001	2001	Z000	Petroleum and natural gas industries — High-speed special-purpose gear units
14521	2020	2020	Z080	Gears — Calculation of load capacity of worm gears
15312	2019	2019	W050	Rolling bearings — Thermal speed rating — Calculation
17485	2006	2006	Z070	Bevel gears — ISO system of accuracy
21771	2007	2007	Z000	Gears — Cylindrical involute gears and gear pairs — Concepts and geometry
21771-1		2024	Z010	Cylindrical involute gears and gear pairs Part 1: Concepts and geometry
21771-2		2025?	Z010	Cylindrical involute gears and gear pairs Part 2: Calculation and measurement of tooth thickness and backlash
23509	2016	2016	Z070	Bevel and hypoid gear geometry

DIN EN ISO

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
4762	2004	2004	M040	Zylinderschrauben mit Innensechskant (ISO 4762:2004); Deutsche Fassung EN ISO 4762:2004
683-1	2018	2018	KMAT	Für eine Wärmebehandlung bestimmte Stähle, legierte Stähle und Automatenstähle - Teil 1: Unlegierte Vergütungsstähle (ISO 683-1:2016); Deutsche Fassung EN ISO 683-1:2018
683-2	2018	2018	KMAT	Für eine Wärmebehandlung bestimmte Stähle, legierte Stähle und Automatenstähle - Teil 2: Legierte Vergütungsstähle (ISO 683-2:2016); Deutsche Fassung EN ISO 683-2:2018
683-3	2019	2022	KMAT	Für eine Wärmebehandlung bestimmte Stähle, legierte Stähle und Automatenstähle - Teil 3: Einsatzstähle (ISO 683-3:2022); Deutsche Fassung EN ISO 683-3:2022
683-4	2018	2018	KMAT	Für eine Wärmebehandlung bestimmte Stähle, legierte Stähle und Automatenstähle - Teil 4: Automatenstähle (ISO 683-4:2016); Deutsche Fassung EN ISO 683-4:2018
1207	2011	2011	M040	Zylinderschrauben mit Schlitz - Produktklasse A (ISO 1207:2011); Deutsche Fassung EN ISO 1207:2011

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
4014	2011	2022	M040	Sechskantschrauben mit Schaft - Produktklassen A und B (ISO 4014:2011); Deutsche Fassung EN ISO 4014:2011
4017	2011	2022	M040	Sechskantschrauben mit Gewinde bis Kopf - Produktklassen A und B (ISO 4017:2011); Deutsche Fassung EN ISO 4017:2011
4032	2013	2023	M040	Sechskantmuttern (Typ 1) - Produktklassen A und B (ISO 4032:2012); Deutsche Fassung EN ISO 4032:2012
4035	2013	2023	M040	Niedrige Sechskantmuttern mit Fase (Typ 0) - Produktklassen A und B (ISO 4035:2012); Deutsche Fassung EN ISO 4035:2012
6931-1	2020	2020	F000	Nichtrostende Stähle für Federn - Teil 1: Draht (ISO 6931-1:2016); Deutsche Fassung EN ISO 6931-1:2020
7089	2000	2000	M040	Flache Scheiben - Normale Reihe, Produktklasse A (ISO 7089:2000);
7090	2000	2000	M040	Flache Scheiben mit Fase - Normale Reihe, Produktklasse A (ISO 7090:2000)
7093-1	2000	2000	M040	Flache Scheiben - Große Reihe - Teil 1: Produktklasse A (ISO 7093-1:2000); Deutsche Fassung EN ISO 7093-1:2000
8673	2013	2023	M040	Sechskantmuttern (Typ 1) mit metrischem Feingewinde - Produktklassen A und B (ISO 8673:2012); Deutsche Fassung EN ISO 8673:2012
8675	2013	2023	M040	Niedrige Sechskantmuttern mit Fase (Typ 0) mit metrischem Feingewinde - Produktklassen A und B (ISO 8675:2012); Deutsche Fassung EN ISO 8675:2012
8676	2011	2022	M040	Verbindungselemente - Sechskantschrauben mit Gewinde bis Kopf und Feingewinde - Produktklassen A und B (ISO 8676:2022); Deutsche Fassung EN ISO 8676:2022
8748	2007	2007	M03A	Spiralspannstifte - Schwere Ausführung
8750	2007	2007	M03A	Spiralspannstifte - Regelausführung (ISO 8750:2007)
8751	2007	2007	M03A	Spiralspannstifte - Leichte Ausführung (ISO 8751:2007)
8752	1997	2009	M03A	Spannstifte (-hülsen) - Geschlitzt, schwere Ausführung (ISO 8752:2009)
8765	2011	2022	M040	Verbindungselemente - Sechskantschrauben mit Schaft und Feingewinde - Produktklassen A und B (ISO 8765:2022); Deutsche Fassung EN ISO 8765:2022
13337	1997	2009	M03A	Spannstifte (-hülsen) - Geschlitzt, leichte Ausführung (ISO 13337:2009)
18265	2014	2014	K09	Metallische Werkstoffe - Umwertung von Härtewerten (ISO 18265:2013); Deutsche Fassung EN ISO 18265:2013
58400	1984	1984	Z000	Basic rack for involute teeth of cylindrical gears for fine mechanics
58412	1987	1987	Z000	Basic rack tooth profile for gear tools for fine mechanics; involute gears according DIN 58400 and DIN 867

ANSI

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
ASME B1.1	2003	2019	M040	Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
B17.1	1967(R98)	1967(R98)	M02A	Keys and Keyseats
B18.2.1	2012	2012	M040	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
B18.2.2	2010	2022	M040	Square and Hex Nuts (Inch Series)
B92.1	1996	1996	Z09A	Involute Splines and Inspection
B92.2M	1989	1989	Z09A	ANSI B92.2M, 1980 (R1989) - Metric Module Involute Splines
ASME B18.22.1	1965 (R1998)	1965 (R1998)	M040	Plain Washers

DIN EN

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
1561	2012	2024	KMAT	Gießereiwesen - Gusseisen mit Lamellengraphit; Deutsche Fassung EN 1561:2011
1563	2012	2019	KMAT	Gießereiwesen - Gusseisen mit Kugelgraphit; Deutsche Fassung EN 1563:2018
1662	1998	1998	M040	Sechskantschrauben mit Flansch, leichte Reihe (ISO/DIS 15071:1996, modifiziert); Deutsche Fassung EN 1662:1997
1665	1998	1998	M040	Sechskantschrauben mit Flansch, schwere Reihe; Deutsche Fassung EN 1665:1997
1982	2008	2024	KMAT	Kupfer und Kupferlegierungen - Blockmetalle und Gussstücke; Deutsche Fassung EN 1982:2017
10025	2005	2005, Enwurf 2011	KMAT	Warmgewalzte Erzeugnisse aus Baustählen - Teil 1: Allgemeine technische Lieferbedingungen; Deutsche Fassung EN 10025-1:2004
10055	1995	1995	W010	Warmgewalzter gleichschenkliger T-Stahl mit gerundeten Kanten und Übergängen - Maße, Grenzabmaße und Formtoleranzen; Deutsche Fassung EN 10055:1995
10085	2001		KMAT	Für eine Wärmebehandlung bestimmte Stähle, legierte Stähle und Automatenstähle - Teil 5: Nitrierstähle (ISO 683-5:2017); Deutsche Fassung EN ISO 683-5:2021
10088-1	2014	2024	KMAT	Nichtrostende Stähle - Teil 1: Verzeichnis der nichtrostenden Stähle; Deutsche Fassung EN 10088-1:2014
10088-2	2014	2025	KMAT	Nichtrostende Stähle - Teil 2: Technische Lieferbedingungen für Blech und Band aus korrosionsbeständigen Stählen für allgemeine Verwendung; Deutsche und Englische Fassung prEN 10088-2:2021
10088-3	2014	2024	KMAT	Nichtrostende Stähle - Teil 3: Technische Lieferbedingungen für Halbzeug, Stäbe, Walzdraht, gezogenen Draht, Profile und Blankstahlerzeugnisse aus korrosionsbeständigen Stählen für allgemeine Verwendung; Deutsche Fassung EN 10088-3:2014
10089	2003	2003	F000	Warmgewalzte Stähle für vergütbare Federn - Technische Lieferbedingungen; Deutsche Fassung EN 10089:2002
10132	2000	2022	KMAT	Kaltband aus Stahl für eine Wärmebehandlung - Technische Lieferbedingungen; Deutsche Fassung EN 10132:2021
10218-2	2012	2012	F000	Stahldraht und Drahterzeugnisse - Allgemeines - Teil 2: Drahtmaße und Toleranzen; Deutsche Fassung EN 10218-2:2012
10250-3	1999	2022		Freiformschmiedestücke aus Stahl für allgemeine Verwendung - Teil 3: Legierte Edelstähle; Deutsche Fassung EN 10250-3:2022
10270-1	2017	2024	F000	Stahldraht für Federn - Teil 1: Patentiert-gezogener unlegierter Federstahldraht
10270-2	2012	2012	F000	Stahldraht für Federn - Teil 2: Ölschlussvergüteter Federstahldraht
10270-3	2012	2012	F000	Stahldraht für Federn - Teil 3: Nichtrostender Federstahldraht
12164	2016	2024	KMAT	Kupfer und Kupferlegierungen - Stangen für die spanende Bearbeitung; Deutsche Fassung EN 12164:2016
13906-1	2013	2021	F010	Berechnung und Konstruktion - Druckfedern
13906-2	2013	2013	F020	Berechnung und Konstruktion - Zugfedern
13906-3	2014	2014	F030	Berechnung und Konstruktion - Drehfedern
15800	2009	2099	F000	Zylindrische Schraubenfedern aus runden Drähten –Gütevorschriften für kaltgeformte Druckfedern;
16983	2017	2017	F040	Tellerfedern - Qualitätsanforderungen - Maße; Deutsche Fassung EN 16983:2016
16984	2017	2017	F040	Tellerfedern - Berechnung; Deutsche Fassung EN 16984:2016
20273	1992	1992	M040	Mechanische Verbindungselemente; Durchgangslöcher für Schrauben (ISO 273:1979); Deutsche Fassung EN 20273:1991

AGMA

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
908-B89	1989	1989	Z000	Information Sheet - Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth
925-A03	2003	2003	Z000	Effect of Lubrication on Gear Surface Distress
927-A01	2001	2001	Z000	Load Distribution Factors - Analytical Methods for Cylindrical Gears
929-A06	2006	2006	Z070	Calculation of Bevel Gear Top Land and Guidance on Cutter Edge Radius
2000-A88	1988	1988	Z000	Gear Classification and Inspection Handbook - Tolerances and Measuring Methods for Unassembled Spur and Helical Gears (including Metric Equivalents)
2001-B88	1988	1988	Z000	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
2001-C95	1995	1995	Z000	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
2001-D04 (2101-D04 Metric)	2016	2016	Z000	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
2002-C16	2016	2019	Z000	Tooth Thickness Specification and Measurement
2003-D19	2019	2019	Z070	Rating the Pitting Resistance and Bending Strength of Generated Straight Bevel, Zerol Bevel and Spiral Bevel Gear Teeth
6001-F19 (6101-F19)	2019	2019	W010	Design and Selection of Components for Enclosed Gear Drives
6004-F88	2015	2015	Z000	Gear Power Rating for Cylindrical Grinding Mills, Kilns, Coolers, and Dryers
6006-B20	2016	2016	Z010	Standard for Design and Specifications of Gearboxes for Wind Turbines
6011-J14	2019	2019	Z000	Specification for High Speed Helical Gear Units
6014-B15	2019	2019	Z000	Gear Power Rating for Cylindrical Shell and Trunnion Supported Equipment
6015-A13	2013	2013	Z000	Power Rating of Single and Double Helical Gearing for Rolling Mill Service
6034-B92	1992	1992	Z080	Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors
6123-C16	2016	2016	Z09A	Design Manual for Enclosed Epicyclic Gear Drives
6135-A02	2008	2008	Z080	Design, Rating and Application of Industrial Globoidal Wormgearing

ASTM

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
E1049-85	2017	2017	K019	Simple Fast Rainflow Counting Algorithm

FKM

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
Ausgabe	2020	2020	W010/ K120	Rechnerischer Festigkeitsnachweis für Maschinenbauteile

EN

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
755-2	2014	2014	KMAT	Aluminium und Aluminiumlegierungen - Stranggepresste Stangen, Rohre und Profile - Teil 2: Mechanische Eigenschaften; Deutsche Fassung EN 755-2:2016
10025-1	2004	2005	KMAT	Warmgewalzte Erzeugnisse aus Baustählen - Teil 1: Allgemeine technische Lieferbedingungen; Deutsche Fassung EN 10025-1:2004
EN 10085	2001		KMAT	Für eine Wärmebehandlung bestimmte Stähle, legierte Stähle und Automatenstähle - Teil 5: Nitrierstähle (ISO 683-5:2017); Deutsche Fassung EN ISO 683-5:2021
EN 10088-1	2014	2014	KMAT	Nichtrostende Stähle - Teil 1: Verzeichnis der nichtrostenden Stähle; Deutsche Fassung EN 10088-1:2014
EN 10088-3	2014	2014	KMAT	Nichtrostende Stähle - Teil 3: Technische Lieferbedingungen für Halbzeug, Stäbe, Walzdraht, gezogenen Draht, Profile und Blankstahlerzeugnisse aus korrosionsbeständigen Stählen für allgemeine Verwendung; Deutsche und Englische Fassung prEN 10088-3:2021
10277-3	2018	2018	KMAT	Blankstahlerzeugnisse - Technische Lieferbedingungen; Deutsche Fassung EN 10277:2018
10293	2005		KMAT	Stahlguss - Stahlguss für allgemeine Anwendungen; Deutsche Fassung EN 10293:2015

DIN ISO

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
14	1986	1986	M02B	Keilwellen-Verbindungen mit geraden Flanken und Innenzentrierung; Maße, Toleranzen, Prüfung; Identisch mit ISO 14, Ausgabe 1982
606	2012	2018	Z092	Kurzgliedrige Präzisions-Rollen- und Buchsenketten, Anbauteile und zugehörige Kettenräder (ISO 606:2015)
281	Apr. 03	Okt. 10	W050	Wälzlager; Dynamische Tragzahlen und nominelle Lebensdauer
965-1	2017	2017, 2024 Entwurf	M040	Metrisches ISO-Gewinde allgemeiner Anwendung - Toleranzen - Teil 1: Prinzipien und Grundlagen (ISO 965-1:2013)
2768	1991	1991	K010	Allgemeintoleranzen; Toleranzen für Längen- und Winkelmaße ohne einzelne Toleranzeintragung; Identisch mit ISO 2768-1:1989
3448	2010	2010	KLUB	Flüssige Industrie-Schmierstoffe - ISO-Viskositätsklassifikation (ISO 3448:1992)
10823	2006	2006	Z092	Hinweise zur Auswahl von Rollenkettentrieben (ISO 10823:2004)

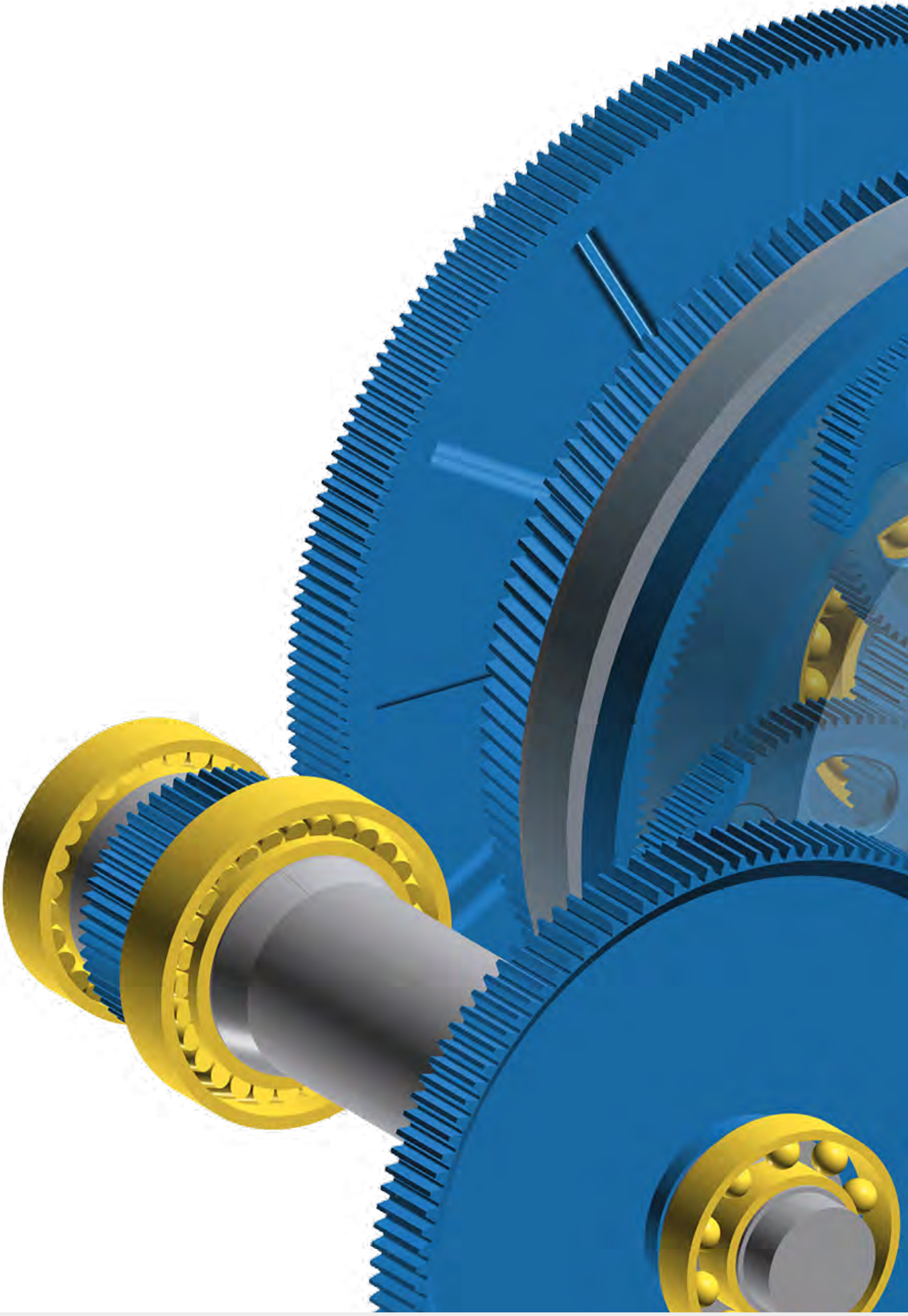
VDI

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
2230 - Blatt 1	2015	2015	M040	Systematische Berechnunghochbeanspruchter Schraubenverbindungen -Zylindrische Einschraubenverbindungen
2230 - Blatt 2	2014	2014	M040	Systematische Berechnunghochbeanspruchter Schraubenverbindungen -Zylindrische Einschraubenverbindungen
2230 - Blatt 3 - Entwurf	2024	2024	M040	Systematische Berechnunghochbeanspruchter Schraubenverbindungen -Zylindrische Einschraubenverbindungen

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
2241	Blatt 1 (1982), Blatt 2 (1984)		A020	Schaltbare fremdbetätigte Reibkupplungen und -bremsen; Begriffe, Bauarten, Kennwerte, Berechnungen
2545	1981	1981	Z010,Z170	Zahnräder aus thermoplastischen Kunststoffen
2610	2021	2021	Z000	Exchange format for gear data - Gear Data Exchange Format (GDE Format) - Definition

Other

Standard No.	Version used in KISSsoft	Latest Version of Standard	Module	Title
DNV CG-0036	2021	2021	Z000	Calculation of gear rating for marine transmissions
API 613	2021	2021	Z000	Special-purpose Gears for Petroleum, Chemical, and Gas Industry Services
GOST 21354-87	1987	1987	Z000	Cylindrical evolvent gears of external engagment. Strength calculation
GOST 13755-81	1981	1981	Z010	Basic requirements for interchangeability. Gearings cylindrical evolvent gears. Basic rack
GOST 1643-81	1981	1981	Z000	Cylindrical gears pairs. Accuracy
BS 4582-1	1970	1970	Z000	Specification for Fine Pitch Gears (Metric Module) Part 1: Involute Spur and Helical Gears
BS970	1972	1983	KMAT	Wrought steels in the form of bars, billets and forgings up to 6 in. ruling section for automobile and general engineering purposes
VDMA 23904	2019	2019	Z000	Reliability Assessment for Wind Energy Gearboxes
FVA 271	2001	2001	Z010	Härtetiefe Grosszahnräder (Hardness depth factor of large gears)
FVA report 410 II	2011	2011	Z000	Überprüfung der Grübchen-und Zahnfußtragfähigkeit gerad-und Schrägverzahnter, KleinmoduligerZahnräder und Zusammenfassung von Empfehlungen zum Erreichen Optimaler Tragfähigkeit für Zahn-räder mit Modul ≤ 1mm, FVA-Forschungsvorhaben
FVA report 610 IV	2021	2021	Z000	Erweiterte Datenanalyse zur Bewertung des Eintlusses von werkstoff-und wärmebehandlungseigenschalten auf die Zahnradtragtähigkeit
FVA report 700 I	2015	2015	W010	Berechnung von Mehrfachkerben nach DIN 743 durch Einbindung von FEM-Ergebnissen
JIS B 1701-1	2009?	2021	Z000	Cylindrical gears for general and heavy engineering - Part 1: Standard basic rack tooth profile
KN3025/ KN3030 V1.2			Z070	
KN3026/ KN3030 V1.2			Z070	
KN3028/ KN3030 V1.2			Z070	
KN3029/ KN3030 V1.2			Z070	
UNI 4838	1980	1980	KMAT	Free-cutting steels
UNI 7846	1978	1978	KMAT	Cementation steels



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