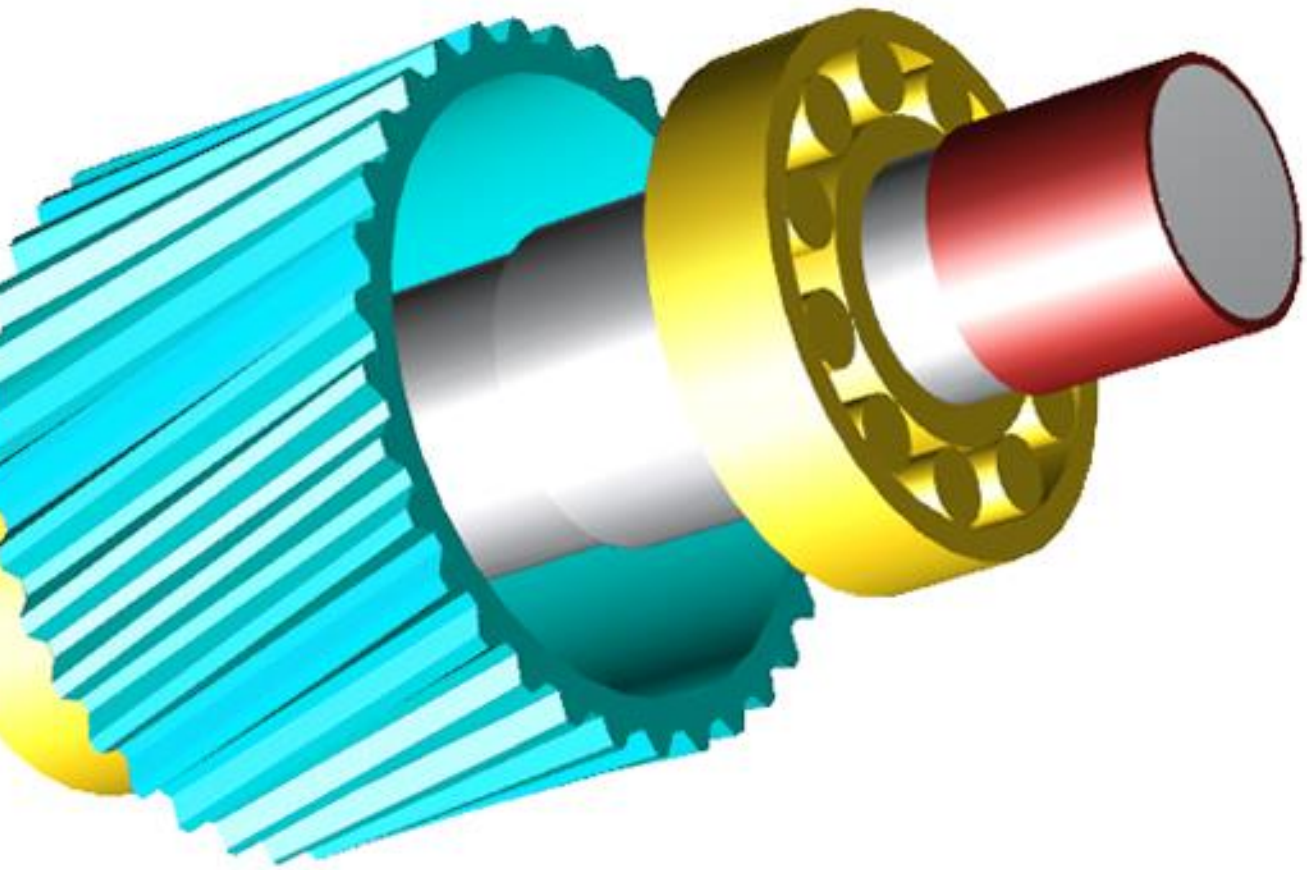
A Gleason Company KISSsoft

KISSsoft Specifications

Shafts and Bearings



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Sharing Knowledge

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1 Shaft calculation

The shaft calculation module allows in-depth analysis and verification of the static, time, and fatigue limit of shafts and axles, optionally in accordance with the DIN, FKM, or AGMA standards. Based on a beam model, stresses and deformations are calculated to verify the strength at critical or self-defined cross sections and to determine the bearing reaction forces.
The calculation can include several coaxial shafts and their connecting bearings. In addition, buckling loads as well as torsional and bending-critical eigenfrequencies from imbalance the shafts can be calculated, optionally with iso- or anisotropic bearings and a display in the Campbell diagram.
The shaft calculation can be linked to the gear calculation. This enables the deformation of the gear flanks to be calculated, and the results used to determine the optimum tooth trace modification. A load distribution calculation determines the face load factor Khβ based on ISO 6336 Annex E.

2 Shaft geometry

A graphical shaft editor is available for defining the shaft geometry, including notches, supports, and loads. The shaft geometry can be entered directly using graphical elements, visually supported by background graphics. Optionally, geometries can also be imported from DXF files. Loads can be modeled directly either as forces and moments, or as predefined force elements such as cylindrical gears, bevel gears, worm wheels, couplings, pulleys, magnetic loads, etc. Individual load spectra can be assigned to all force elements.
For shaft support, rolling bearings can be selected directly from an extensive database. Furthermore, radial plain bearings or general supports can be defined specifying the various degrees of freedom. KISSsoft allows the use of multiple bearings and statically over-determined systems.

3 Tooth trace deviation

To optimize the meshing of an individual tooth and to compensate for shaft deformation, tooth trace modifications (flank line crowning, helix angle) are typically applied. In this case, the function calculates the shaft deformation instead of the gear.
With KISSsoft, the displacement in a definable interval along the axis can be easily determined and the deformation components can be clearly displayed.
The corresponding modification can be defined by the user or sized automatically by KISSsoft and displayed graphically. The helix angle and the crowning values are generated in their own report.

4 Calculation of deflection and bearing reaction

In addition to the shaft's diagrams of bending, with or without consideration of shear deformation, all essential variables are calculated, such as shearing force and bending moment progression on different planes (torsional moment, axial force, stress components: tension/compression, bending, shearing, torsion, equivalent stresses). The weight force can optionally be taken into account in relation to the effective shaft position. For more detailed analysis, critical cross sections can be automatically identified and analyzed, and any self-defined cross sections can be evaluated.

In 2D and 3D diagrams, the various results and sizes can be clearly displayed and analyzed. The results can be saved and then compared with new calculations.

The reaction forces and moments are calculated for all bearings and supports. The stress on rolling bearings can also be clearly visualized in various 2D and 3D displays.

5 Shaft strength

The static, time, and fatigue limit of shafts and axles can be verified according to DIN, FKM, or AGMA standards. The strength calculation according to DIN 743 (“Calculation of Load Capacity of Shafts and Axles”) defines the determination of the security verification against permanent deformation and fatigue fracture, but does not include a service life calculation. In KISSsoft, an extension of the standard is implemented analogous to a proposal by the FVA, which allows both the calculation of fatigue strength and the treatment of load spectra.

The current edition of the FKM Guideline (Strength Verification edition) is the most comprehensive calculation method available today. It goes far beyond the scope of DIN 743. However, it is much more demanding in the interpretation of the results.

Furthermore, the strength can also be calculated according to the American standard AGMA 6101/AGMA 6001 “Design and Selection of Components for Enclosed Gear Drives.”

6 Critical speed

It is possible to calculate any number of torsional and bending-critical eigenfrequencies of individual shafts for standstill (eigenfrequency), synchronous or reverse rotation. Additional masses can be taken into account, whereby KISSsoft for gears enables the mass and moments of inertia to be automatically calculated. Non-linear properties can also be taken into account.

The stiffness of housings and bearings can be factored in by entering the stiffness values in the graphical shaft editor. In the case of flywheel masses, the gyro effect is also taken into account. The results can be clearly displayed in the Campbell diagram.

7 Rolling bearing calculation

A comprehensive database of bearing data from various manufacturers is available. Additional bearings can easily be added by the user. At the touch of a button, KISSsoft searches the bearings database to find bearings with a suitable geometry. It then calculates the service life, the static characteristic number, and displays the results in a table. A bearing can then be chosen directly from this table.
The calculation determines the static safety and also the modified rating life, either with or without taking into account the effect of the lubricant and load spectra. In addition to the classical calculation method, consideration of the inner bearing geometry according to ISO/TS 16281 is implemented for many bearing types. This calculation method not only supplies a clearly more accurate and detailed service life calculation method but also determines the non-linear bearing stiffness.

All common bearing types are supported:

- Deep groove ball bearings
- Angular contact ball bearings

- Taper roller bearings
- Needle cages
- Needle roller bearing
- Self-aligning ball bearings
- Self-aligning roller bearings
- Barrel-shaped and spherical roller bearings
- Four-point contact bearings
- Cylindrical roller bearing
- Thrust needle cages
- Axial spherical roller bearings
- Axial deep groove ball bearings
- Axial angular contact ball bearings
- Axial angular contact roller bearings
- Axial cylindrical roller bearings
- Axial taper roller bearings

8 Modified rating life calculation

The modified service life can be calculated according to ISO 281 for any load spectrum. Thus, influences such as load, lubricant condition, material properties, type, residual stresses of the materials, and ambient conditions can be taken into account.

9 Thermally safe reference speed

The calculation of thermal reference speed implemented in KISSsoft in accordance with DIN ISO 15312 is based on a thermal rating in the bearing. The thermally safe operating speed according to DIN 732 is calculated from the thermal nominal speed according to DIN ISO 15312 using the speed ratio. The speed is defined that will be reached at the permissible temperature of the bearing in an actual situation. This limit can differ greatly from other permitted service speeds because the reference conditions only apply to fully defined cases.

10 Plain bearing calculation

Hydrodynamic and grease-lubricated plain journal bearings and hydrodynamic plain thrust bearings in stationary operation can be calculated in KISSsoft. Different oil types (ISO VG) and greases are already defined in the database, and you can also enter own data for lubricants.
The most important results in the calculations are the friction power, operating temperature, and the smallest lubricant film thickness.

11 Hydrodynamic plain thrust bearings

For plain thrust bearings, the standards DIN 31653 (axial segment bearings) and DIN 31654/ISO 13120 (axial tilting pad plain bearings) are available.

12 Hydrodynamic plain journal bearings

For the high-speed range of plain journal bearings, either the Niemann method or DIN 31657 (multi-surface and tilting pad plain bearings) can be used. For the small and medium speed range, good results can be achieved with DIN 31652 or ISO 7902. The calculation is performed for cylindrical bore plain bearings (however, using different construction types only gives a small variation in results).

13 Lubricated plain journal bearings

The calculation of bearing data in operation, and during the transfer to mixed friction, is carried out based on the literature ‘Calculation of lubricated plain bearings’ according to Prof. Spiegel.