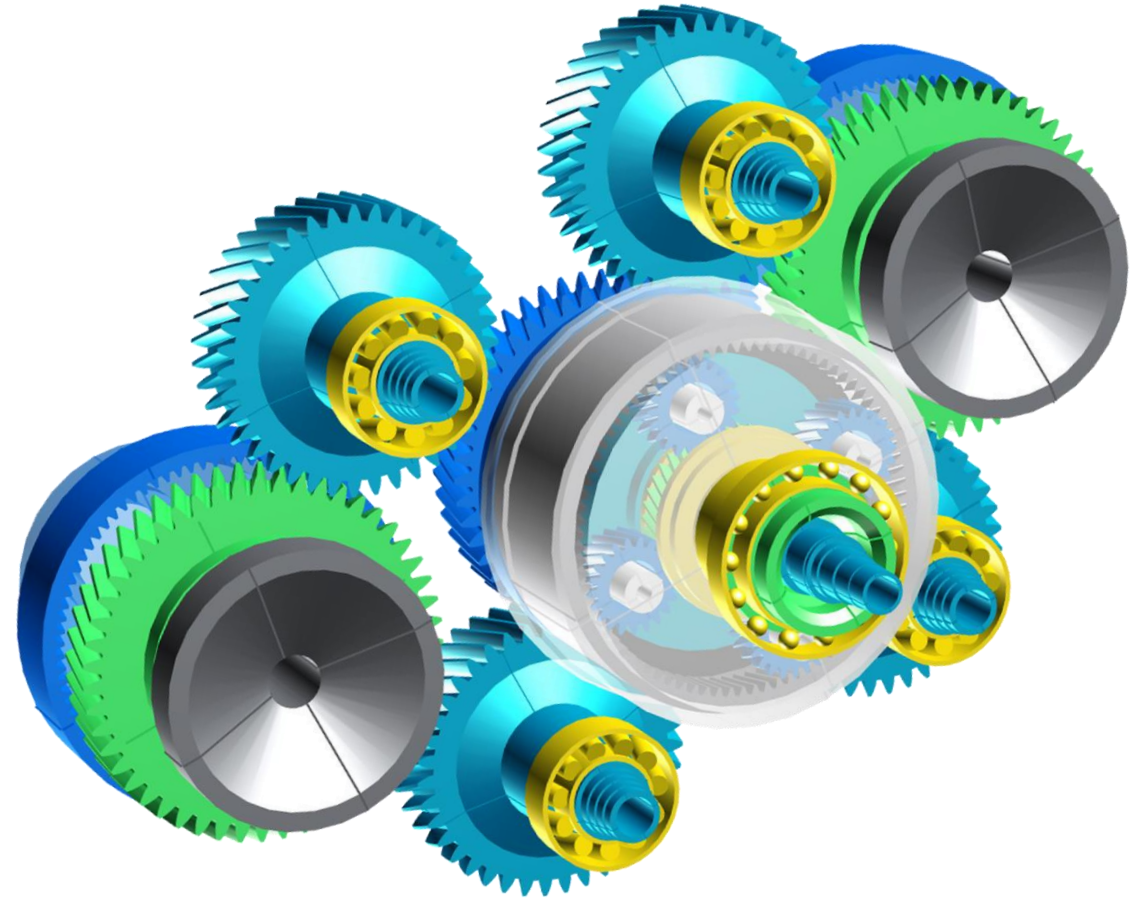


Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

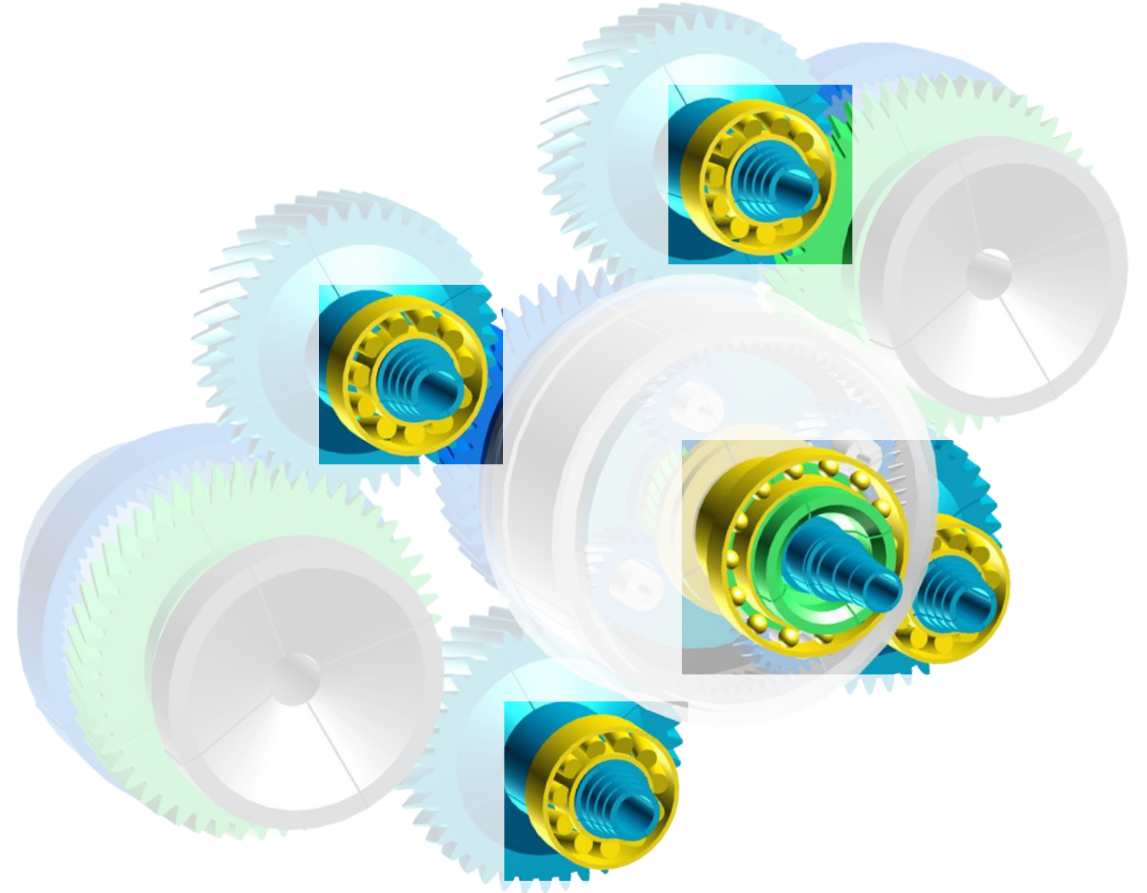
KUM International, October 23, 2019
Johannes Wüthrich



Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

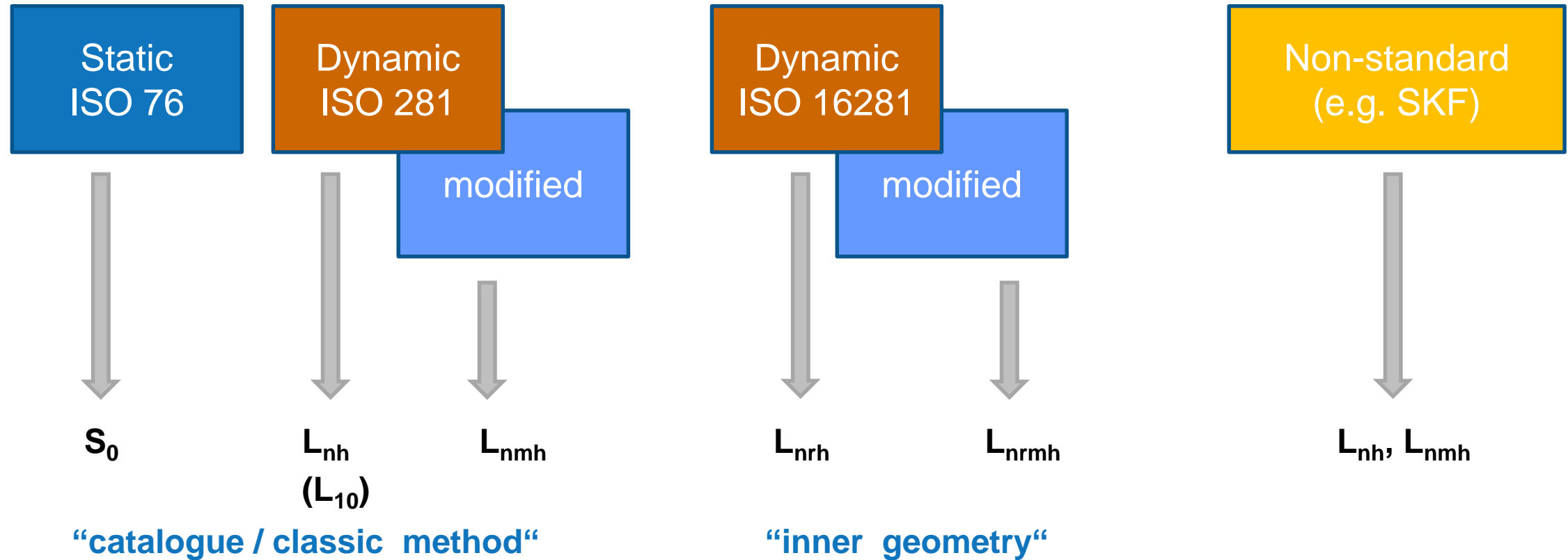
Topics

- Overview calculation methods
- Bearing data in KISSsoft
- Handling missing bearing data



Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Calculation methods



Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

The screenshot displays the KISSsoft software interface for shaft calculation. The title bar indicates 'KISSsoft - License number 165 - Shaft calculation - Untitled'. The menu bar includes File, Project, View, Calculation, Report, Graphics, Extras, and Help. The toolbar contains icons for New, Open, Open exclusively, Save, Mail to, Restore, New, Open, Run, Generate, Settings, Rough sizing, Database tool, Script Editor, Calculator, Manual, and Display element name. The KISSsoft logo and 'Release 2019B-230' are in the top right corner.

The 'Modules' panel on the left shows a tree structure with 'Shafts and Bearings' expanded, highlighting 'Shaft calculation', 'Rolling bearing ISO 281, ISO 76', and 'Rolling bearing ISO/TS 16281'. The 'Shaft editor' tab is active, showing the 'Basic data' section. The 'General' section includes fields for Load spectra (Don't consider load spectrum), Gears (Gears mounted by interference fit, with stiffness accord), Position of shaft axis in space (horizontal), Angle β (0.0000 °), Number of eigenfrequencies i (0), and Number of buckling cases j (0). The 'Rolling bearings' section shows a dropdown menu for 'Rolling bearings' with options: 'Stiffness: Not calculated. Life: ISO 281, using manufacture...', 'Stiffness: ISO/TS 16281. Life: ISO 281, using manufacture...', 'Stiffness: ISO/TS 16281. Life: ISO/TS 16281', and 'Oil: ISO-VG 220'. The 'Tolerance field' is set to 'Through hardening steel' and 'C45 (1), unalloyed, throu'. The 'Lubricant' is 'Oil: ISO-VG 220'. The 'Housing' section shows 'Housing material' as 'Through hardening steel' and 'C45 (1), unalloyed, throu'. The 'Speed' is 1500.0000 1/min, 'Sense of rotation' is clockwise, 'Consider weight' is checked, 'Consider gyroscopic effect' is unchecked, and 'Consider deformation due to shearing (Timoshenko beam, not Euler-Bernoulli beam)' is checked. The 'Modified rating life according ISO 281' is unchecked. The 'Lubricant temperature T_B ' is 20.0000 °C and the 'Housing temperature T_C ' is 20.0000 °C.

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

K Database tool [read-only]

Database: Table:

ID	Order	Bearing label	d [mm]
8903	1706	SKF RNU 2211 ECP	66.00
8949	1707	SKF RNU 2212 ECP	72.00
14798	1708	SKF RNU 2217 ECP	100.50
14802	1709	SKF RNU 2224 ECML	143.50
14803	1710	SKF RNU 226 ECM	153.50
8541	1711	SKF RNU 2304 ECP	27.50
14801	1712	SKF RNU 2319 ECML	121.50
14807	1713	SKF RNU 236 ECMA	217.00
14808	1714	SKF RNU 236 ECML	217.00
14785	1715	SKF RNU 304	28.50
14787	1716	SKF RNU 305	35.00
14788	1717	SKF RNU 306	42.00
8708	1718	SKF RNU 307 ECP	46.20
8758	1719	SKF RNU 308 ECJ	52.00
8759	1720	SKF RNU 308 ECP	52.00
8809	1721	SKF RNU 309 ECP	58.50
8893	1722	SKF RNU 310 ECJ	65.00
8894	1723	SKF RNU 310 ECP	65.00
14804	1724	SKF RNU 324 ECJ	154.00
4000	1725	FAG F-573050.ZL-K-C3	160.00
19050	1726	FAG F-800479.ZL-K-C5	360.00
19051	1727	FAG F-800480.ZL-K-C5	380.00
19052	1728	FAG F-800481.ZL-K-C5	440.00
19053	1729	FAG F-800482.ZL-K-C5	460.00
19054	1730	FAG F-800483.ZL-K-C5	480.00
19055	1731	FAG F-800484.ZL-K-C5	500.00
19056	1732	FAG F-800485.ZL-K-C5	560.00
19057	1733	FAG F-800592.ZL-K-C5	630.00
19058	1734	FAG F-800593.ZL-K-C5	670.00
19059	1735	FAG F-800594.ZL-K-C5	710.00
19060	1736	FAG F-803158.ZL-K-C3	100.00
19061	1737	FAG F-803186.ZL-K-C3	75.00
19062	1738	FAG F-803723.ZL-K-C3	85.00
19063	1739	FAG F-803792.ZL-K-C3	180.00
19064	1740	FAG F-804203.ZL-K-C3	80.00
19065	1741	FAG F-804272.ZL-K-C3	150.00
19066	1742	FAG F-804305.ZL-K-C3	130.00
19067	1743	FAG F-804415.ZL-K-C3	170.00
19068	1744	FAG F-804415.ZL-K-C5	170.00

Search the shown columns for...

K Display entry

ID: Created by: on:

Status: Changed by: on:

Basic data Additional data Internal geometry

Input data

Correction factor (dynamic rating) f_c Correction factor (static rating) f_{co}

Axial displacement possibility non-locating bearing v_l mm

Axial displacement possibility fixed bearing v_f mm

Number of rollers Z

Diameter of roller D_W mm

Rolling body pitch circle diameter D_{PW} mm

Inside diameter of the rim, pressure side D_{BI} mm

Outside diameter of the rim, pressure side D_{BA} mm

Effective roller length L_{WE} mm

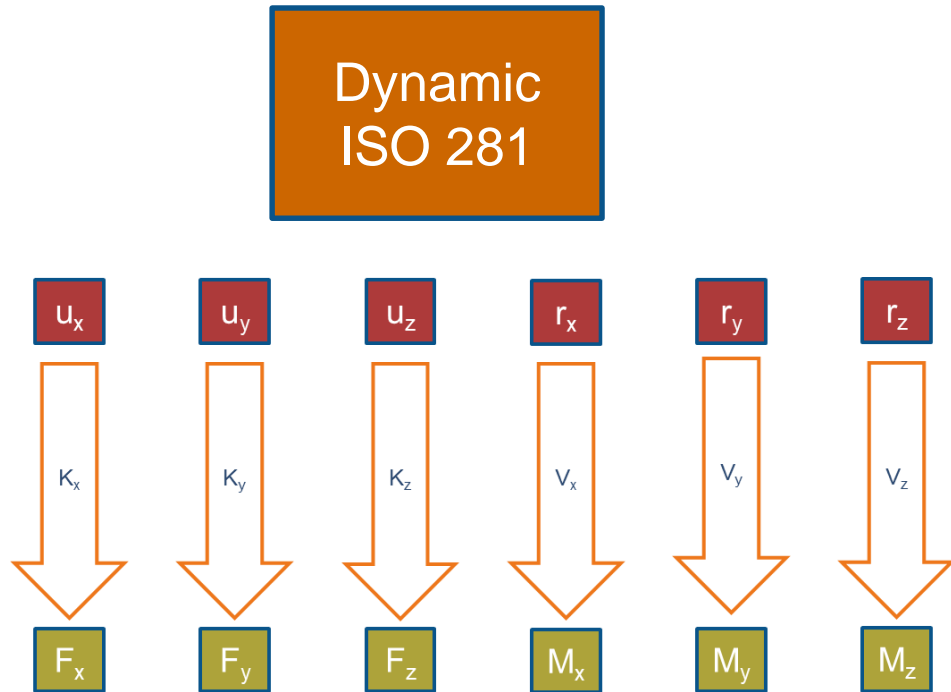
File for roller profile modification

Additional data

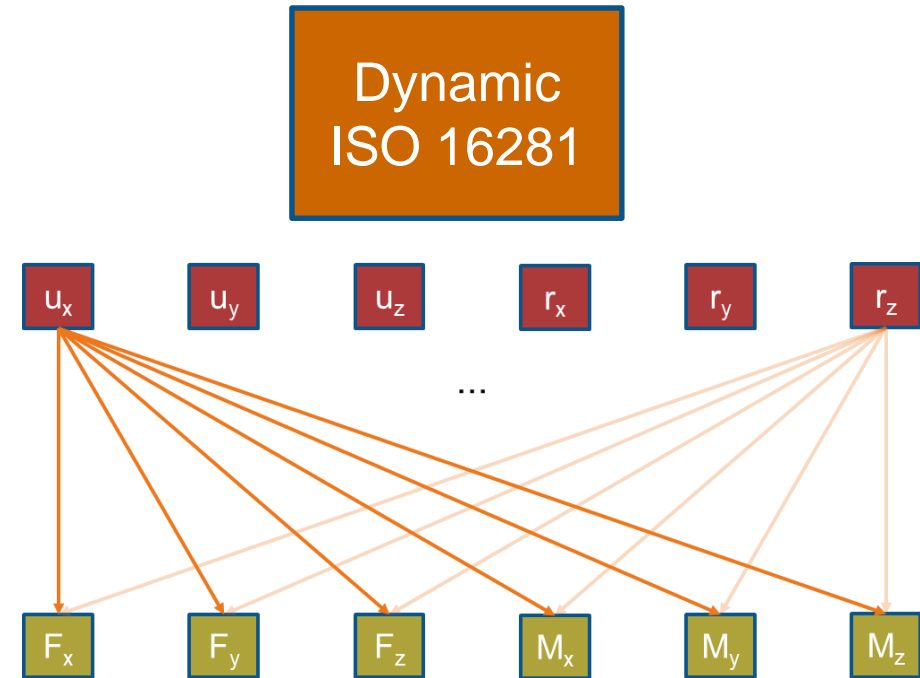
Without inner ring Without outer ring

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Calculation methods

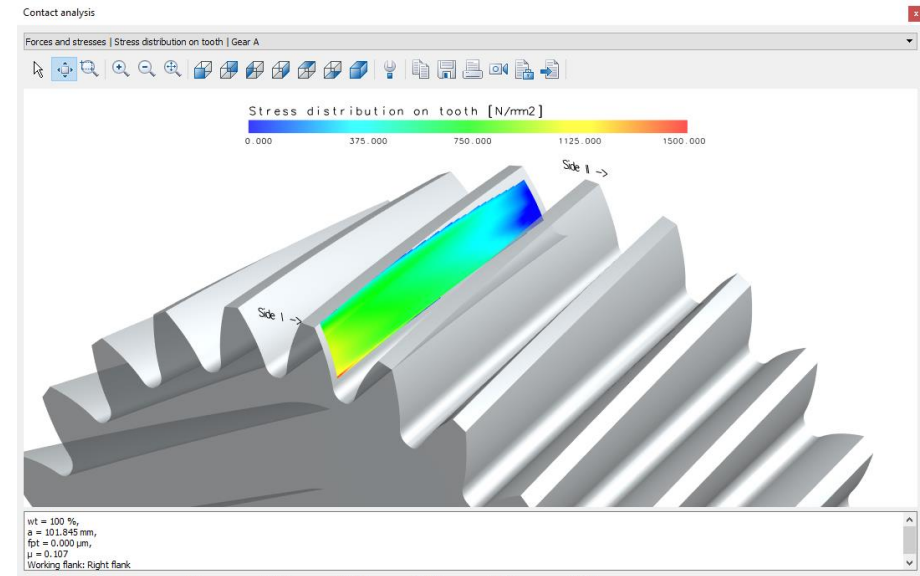
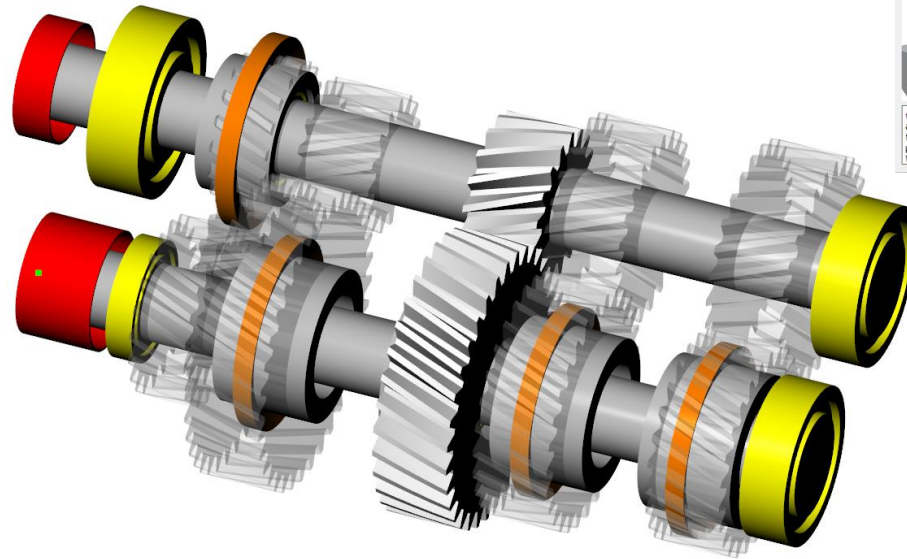
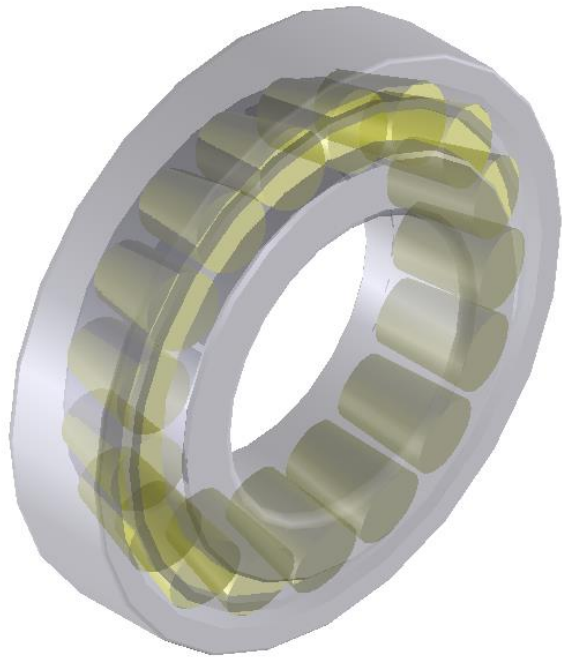


“catalogue / classic method”



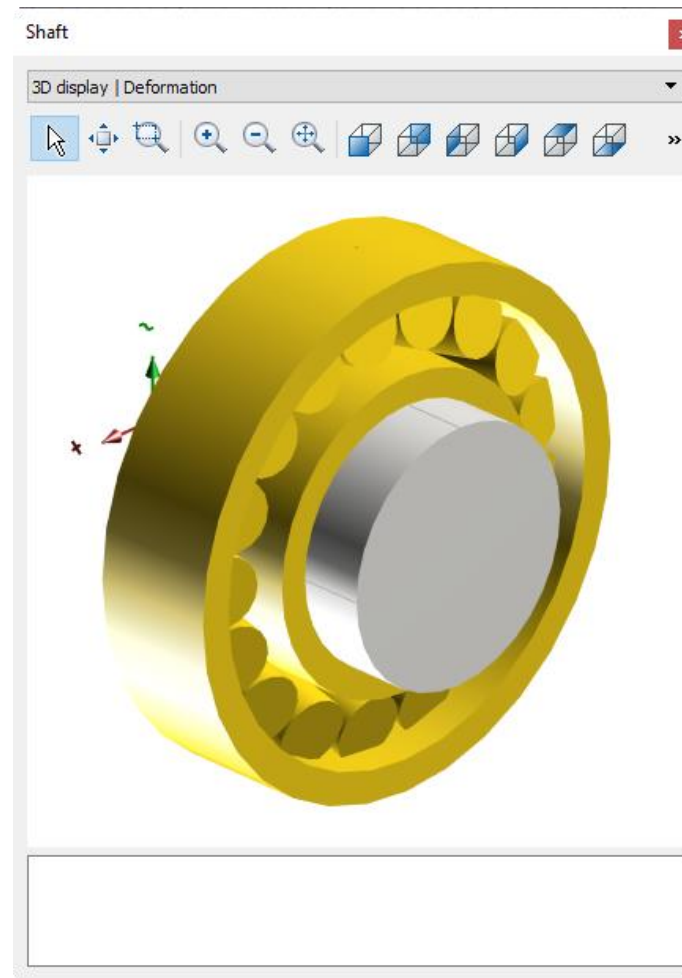
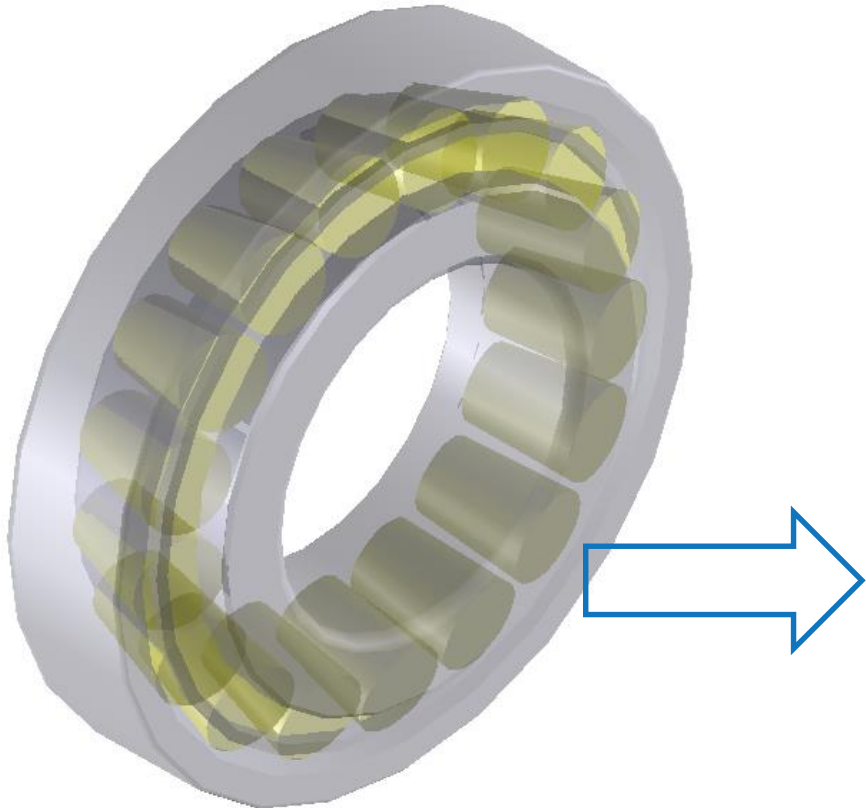
“inner geometry”

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft



Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Getting the bearing inner geometry



ISO 76
ISO 281

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

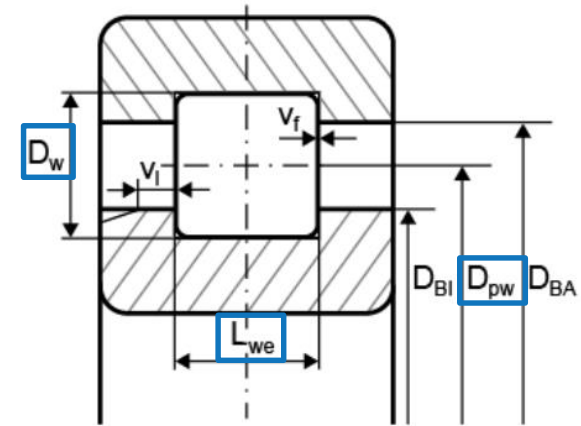
Getting the bearing inner geometry (radial roller bearings)

ISO 76

$$C_{0r} = 44 \cdot \left(1 - \frac{D_{we} \cdot \cos \alpha}{D_{pw}} \right) \cdot i \cdot Z \cdot L_{we} \cdot D_{we} \cdot \cos \alpha$$

ISO 281

$$C_r = b_m \cdot f_c \cdot (i \cdot L_{we} \cdot \cos \alpha)^{\frac{7}{9}} \cdot Z^{\frac{3}{4}} \cdot D_{we}^{\frac{29}{27}}$$



KISSsoft

+ hard constraints (physical limits, design features)
+ soft constraints (statistics, characteristics)

Significantly improved in 2019

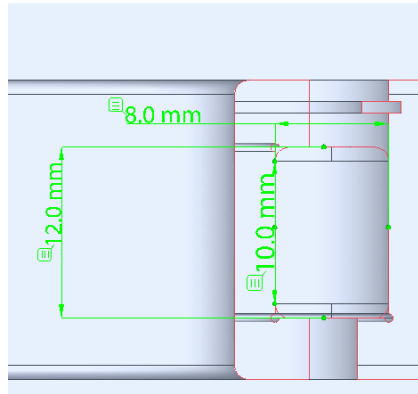
3 unknowns, 2 equations and additional constraints

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Full complement cylindrical roller bearing

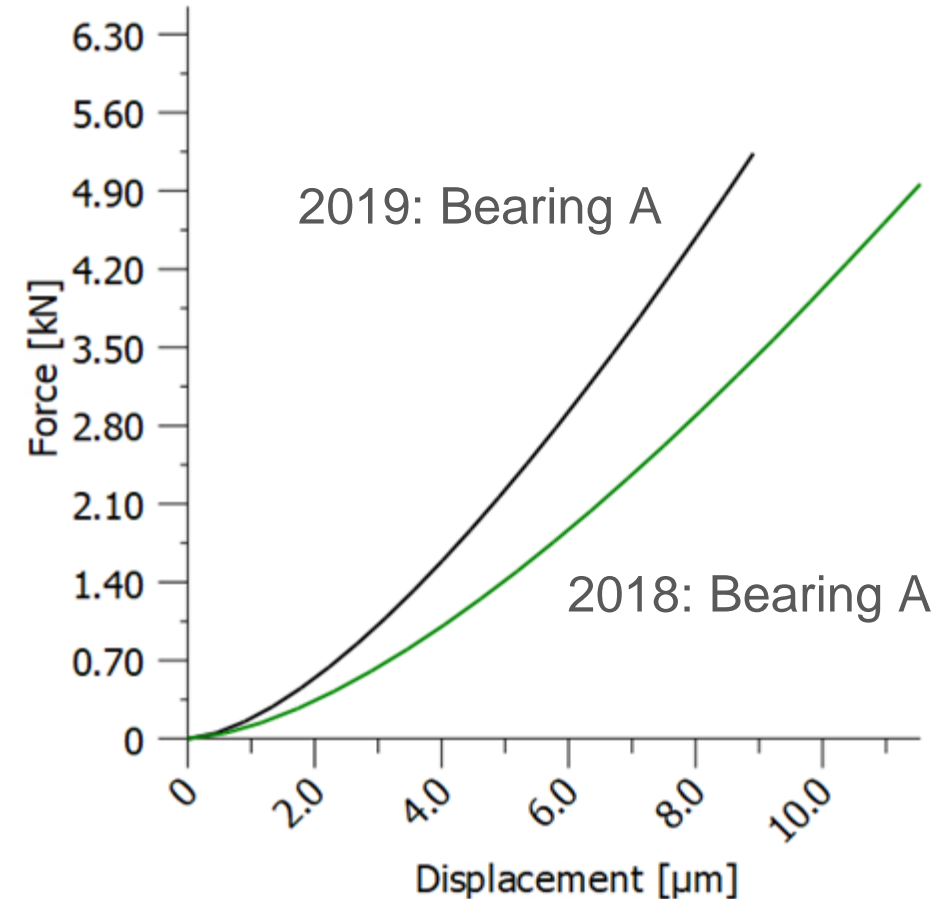
2018: Bearing A

Number of rolling elements	[Z]	13	
Diameter of rolling element	[D _{wd}]	10.990	mm
Effective length of roller	[L _{we}]	13.415	mm
Reference diameter	[D _{pw}]	53.433	mm
Diameter of inner ring	[d _i]	42.443	mm
Diameter of outer ring	[d _o]	64.423	mm



2019: Bearing A

Number of rolling elements	[Z]	20	
Diameter of rolling element	[D _{wd}]	8.439	mm
Effective length of roller	[L _{we}]	10.693	mm
Reference diameter	[D _{pw}]	54.000	mm
Diameter of inner ring	[d _i]	45.561	mm
Diameter of outer ring	[d _o]	62.439	mm

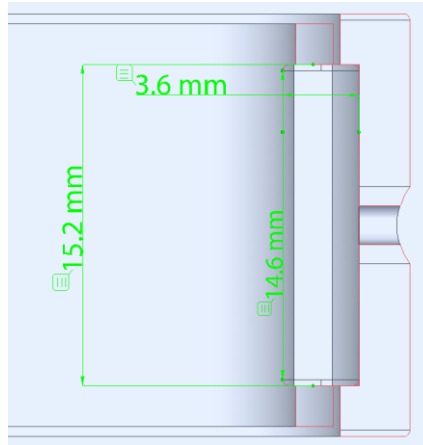


Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Without inner and/or outer ring

Approximation, 2018

Number of rolling elements	[Z]	13	
Diameter of rolling element	[D _w]	4.767	mm
Effective length of roller	[L _{we}]	19.494	mm
Reference diameter	[D _{pw}]	44.809	mm
Diameter of inner ring	[d _i]	40.041	mm
Diameter of outer ring	[d _o]	49.576	mm



Actual values (typical data)

Number of rolling elements	[Z]	21	
Diameter of rolling element	[D _w]	4.000	mm
Effective length of roller	[L _{we}]	15.179	mm
Reference diameter	[D _{pw}]	44.000	mm
Diameter of inner ring	[d _i]	40.000	mm
Diameter of outer ring	[d _o]	48.000	mm

Approximation, 2019

Number of rolling elements	[Z]	17	
Diameter of rolling element	[D _w]	4.831	mm
Effective length of roller	[L _{we}]	14.730	mm
Reference diameter	[D _{pw}]	44.831	mm
Diameter of inner ring	[d _i]	40.000	mm
Diameter of outer ring	[d _o]	49.663	mm

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Limitations

ISO 76

$$C_{0r,ISO} = f_{C_0,ISO} \cdot C_{0r} = 44 \cdot \left(1 - \frac{D_{we} \cdot \cos \alpha}{D_{pw}}\right) \cdot i \cdot Z \cdot L_{we} \cdot D_{we} \cdot \cos \alpha$$

ISO 281

$$C_{r,ISO} = f_{C,ISO} \cdot C_r = b_m \cdot f_c \cdot (i \cdot L_{we} \cdot \cos \alpha)^{\frac{7}{9}} \cdot Z^{\frac{3}{4}} \cdot D_{we}^{\frac{29}{27}}$$

K Display entry

ID: 8135 Created by: KISSsoft on: 24.11.2006

Status: active Changed by: KISSsoft on: 30.10.2018

Basic data Additional data Internal geometry

Input data

Correction factor (dynamic rating) f_c 1.0000

Correction factor (static rating) f_{c0} 1.0000

Axial displacement possibility non-locating bearing v_l 0.0000 mm

Axial displacement possibility fixed bearing v_f 0.0000 mm

Number of rollers Z 13

Diameter of roller D_w 18.0000 mm

Rolling body pitch circle diameter D_{pw} 88.5000 mm

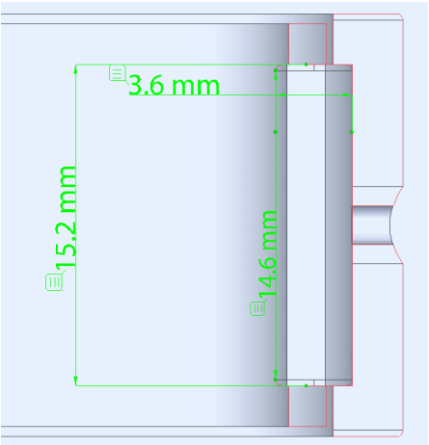
$$f_{C,ISO} \sim 0.8 \dots 0.9$$

Improvements for the bearing calculation according to ISO/TS 16281 in KISSsoft

Without inner and/or outer ring

Approximation, 2018

Number of rolling elements	[Z]	13	
Diameter of rolling element	[D _w]	4.767	mm
Effective length of roller	[L _{we}]	19.494	mm
Reference diameter	[D _{pw}]	44.809	mm
Diameter of inner ring	[d _i]	40.041	mm
Diameter of outer ring	[d _o]	49.576	mm



Typical values (typical data)

Number of rolling elements	[Z]	21	
Diameter of rolling element	[D _w]	4.000	mm
Effective length of roller	[L _{we}]	15.179	mm
Reference diameter	[D _{pw}]	44.000	mm
Diameter of inner ring	[d _i]	40.000	mm
Diameter of outer ring	[d _o]	48.000	mm

Approximation, 2019

Number of rolling elements	[Z]	17	
Diameter of rolling element	[D _w]	4.831	mm
Effective length of roller	[L _{we}]	14.730	mm
Reference diameter	[D _{pw}]	44.831	mm
Diameter of inner ring	[d _i]	40.000	mm
Diameter of outer ring	[d _o]	49.663	mm

Approximation, 2018, f_{ISO}=0.85

Number of rolling elements	[Z]	22	
Diameter of rolling element	[D _w]	3.569	mm
Effective length of roller	[L _{we}]	14.975	mm
Reference diameter	[D _{pw}]	43.569	mm
Diameter of inner ring	[d _i]	40.000	mm
Diameter of outer ring	[d _o]	47.138	mm

Thank you for your attention!

Sharing Knowledge

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