TriboTechnologies

APPLICATIONS FOR HIGHER EFFICIENCY

SIMULATION
TESTING
ANALYSES
TEST RIGS

www.tribo-technologies.com

TriboTechnologies

APPLICATIONS FOR HIGHER EFFICIENCY

Innovative Tribology for You

When it comes to tribology, i.e. friction, lubrication and wear, we are your partner. Tribological issues require an understanding of the system, which we can develop in collaboration with you for your specific product. Our technologies as well as their combination and the flexibility of an agile company guarantee you first-class solutions for your product.

Our Mission

We are an engineering service provider with expertise in software development, numerical simulation, test rig development as well as testing services, damage analyses and consulting. We combine this broad portfolio of expertise to satisfy your needs, so that your products can be continuously improved in line with our slogan "Applications for higher Efficiency." We want to make sure that our expertise enables sustainable and future-proof solutions.

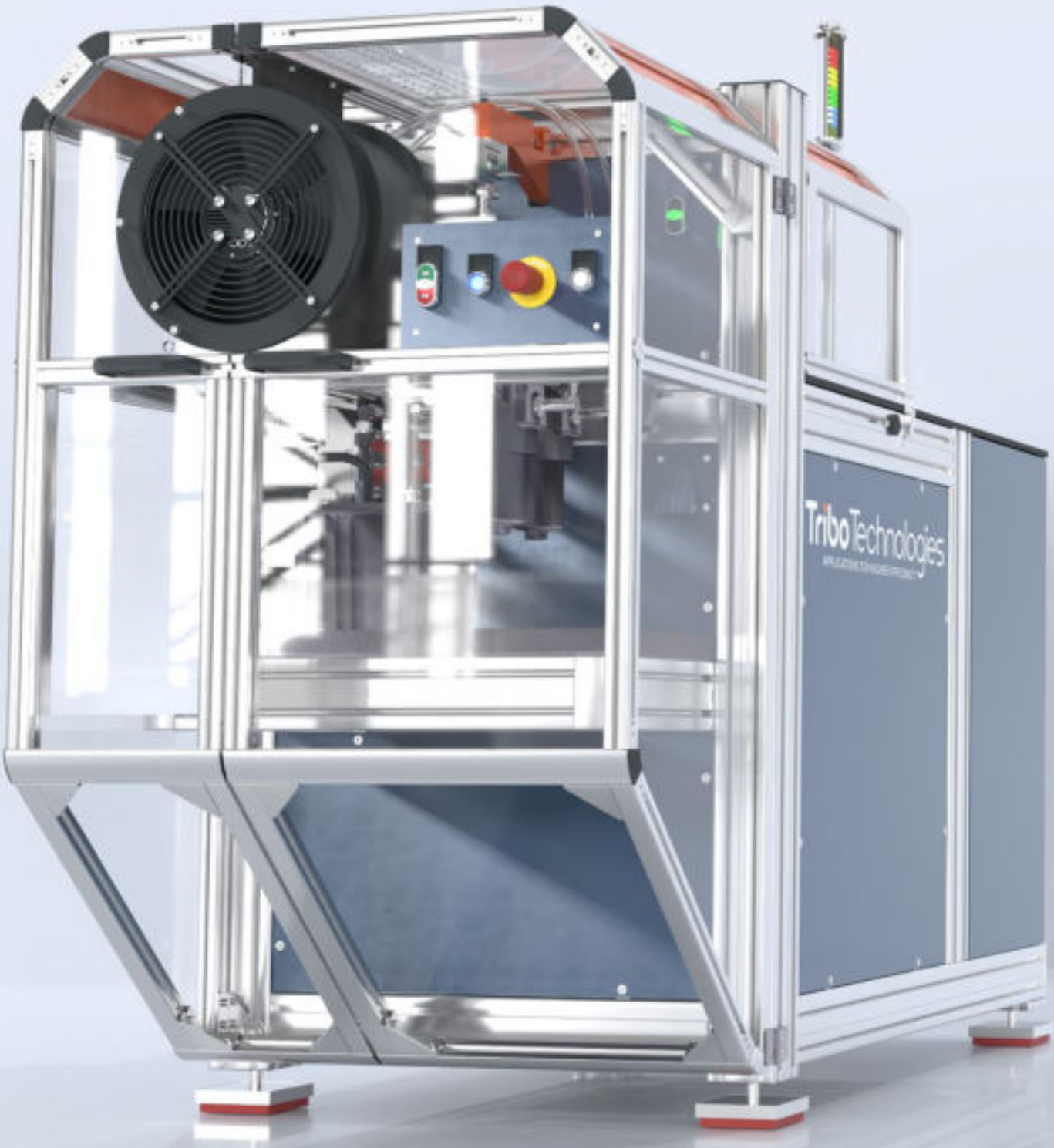
We pursue the goal of transferring the latest methods, findings and developments from tribology research into practice. To ensure this, we have a close link to the Chair of Machine Elements and Tribology of the Otto von Guericke University Magdeburg.

Our quality management system is certified according to ISO 9001:2015 and we are continuously developing our services and processes with a focus on high customer satisfaction.

TEST RIGS

FE8 Rolling Bearing Test Rig

In Accordance to Standard DIN 51819-1



- Wear and Fatigue Tests in Accordance to Several Standards
- Modern Graphical User Interface and Ready for Remote Control
- Customer Specific Test Procedures
- Adaptations according to Customer Specification

The Standard for Lubricant Testing

The FE8 rolling bearing test rig in accordance to DIN 51819-1 is equipped with a test head that is cantilever supported to carry out mechanical-dynamic testing of lubricating oils and greases under conditions similar to those encountered in practical use. The wear of the rolling bearing elements, the friction behavior during the test and the development of fatigue damage on the rolling bearing elements are used to qualify lubricants for application.

Our modern and ergonomically designed test rig fulfills the European Machinery Directive 2006/42/EC at a high level. The entire electronics are fully integrated, so that trouble-free commissioning (plug and play) is possible in the test field. Thanks to its modern graphical user interface and signal regulation concept, it can be configured and monitored directly on site or remotely using a mobile device such as a tablet or laptop. This means that some of the activities can be transferred from the test field to the office.

The desired test procedure can be easily defined and adapted. In addition, the most important test standards and test specifications are already preconfigured in the software and can be started right away.

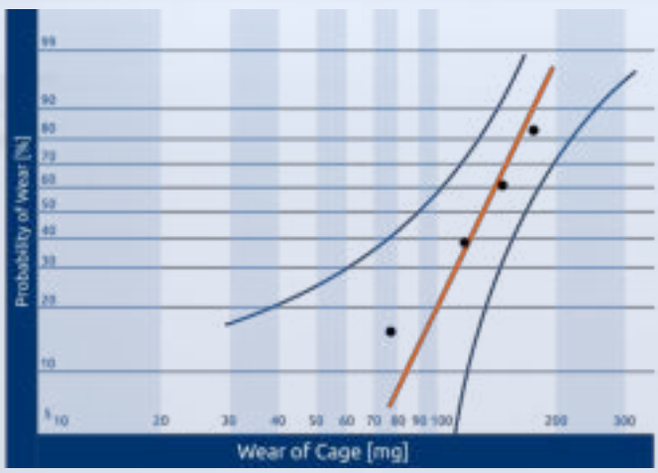
The test head can be equipped with a measuring system for analyzing the structure-borne noise, which can be used to reliably detect fatigue damage (condition monitoring). In this way, the test run can be terminated at an early stage of damage development.

An oscillation unit is available for oscillating applications, e.g. grease-lubricated rolling bearings. Therefore, switching between rotating and oscillating operation is fast and easy.

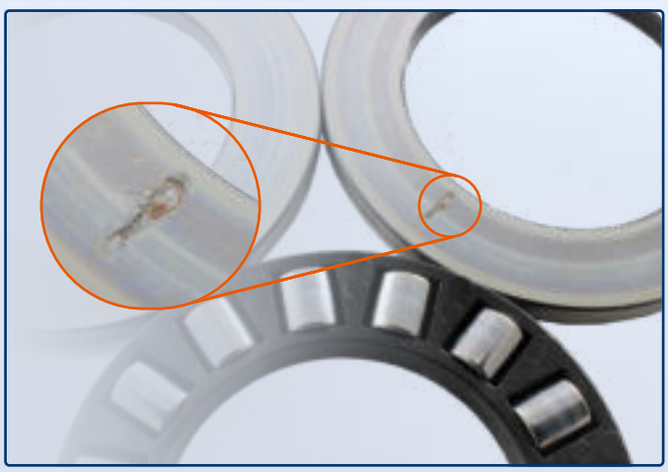
Test Procedures

- wear test conforming to DIN 51819-2 and DIN EN 14865-1 for greases
- wear test according to DIN 51819-3 for oils
- pitting test according to VW PV 1483 for gear oils
- pitting test according to ZF 0000 702 232 for gear oils
- white etching crack (WEC) - test according to FVA 707 for oils
- customer specific test procedures
- test of oscillating rolling bearings

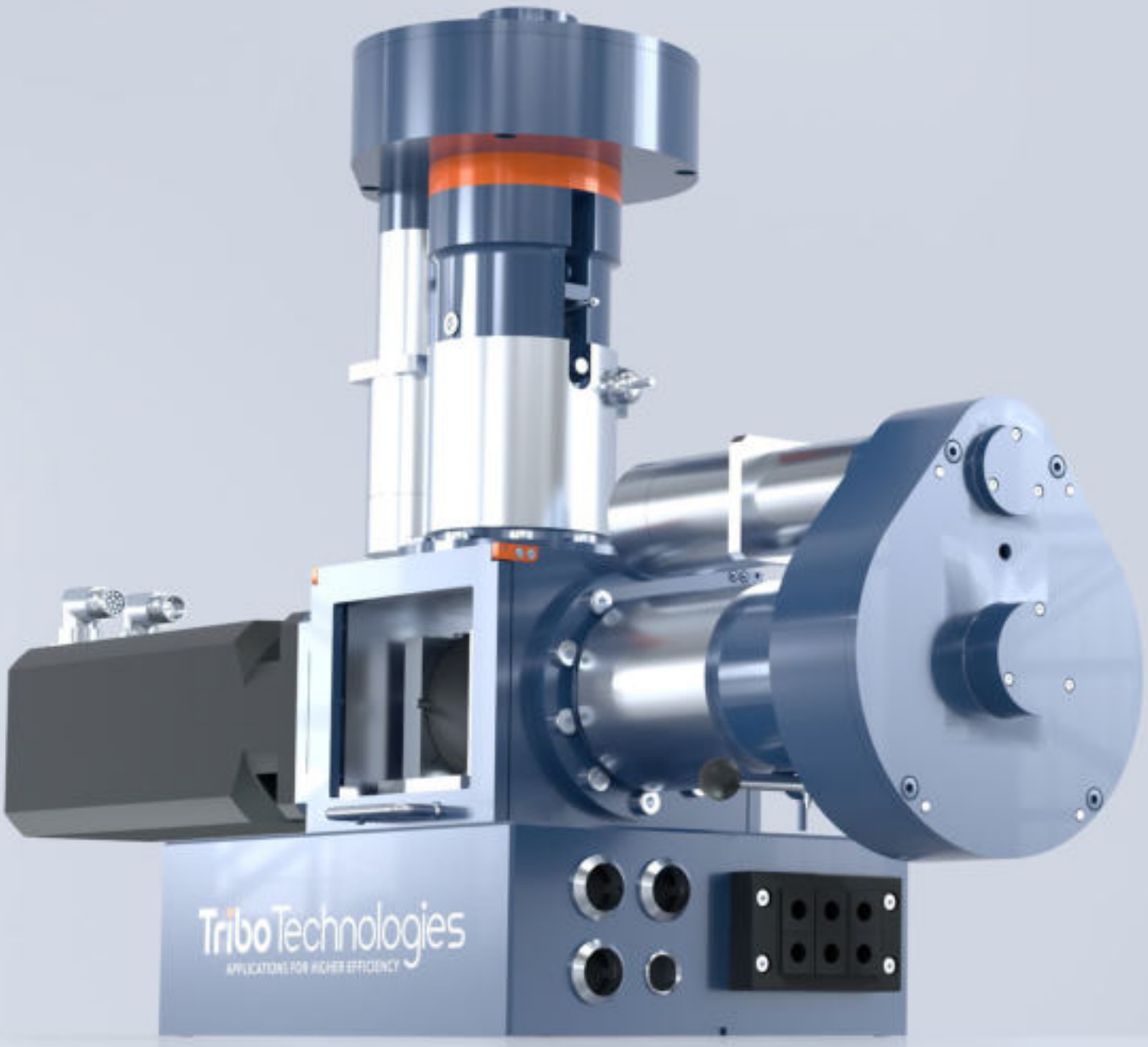
Wear of Bearing Cage
(DIN 51819-3)



Pitting Damage
(ZF 0000 702 232)



False Brinelling Test Rig



- Dynamic Radial and/or Axial Loading
- Oscillating and Rotating Operation
- Test Temperature of -40°C to 40°C in a Climate Chamber
- Preconfigured (FVA 540) and Customer Specific Test Procedures
- Angular Ball and Deep Groove Ball Bearings as well as Taper Roller Bearings can be tested
- Modern Graphical User Interface and Ready for Remote Control

Lubricant Testing for Mircomotions

False brinelling damages can occur in rolling bearings if a non rotating bearing is subjected to dynamic loads and/or oscillating motions with very small amplitudes.

The dynamic loads and very small pivoting motions can be generated, for example, by machine and aggregate vibrations, but also during the transportation of machines or vehicles by road, rail and ship. False brinelling has the potential to significantly reduce the service life of rolling bearings. In addition, false brinelling damages can lead to increased noise emissions, which have a negative impact on the performance of machines.

False brinelling results from relative motions of the contact partners in the Hertzian contact zone and leads to damages on the surfaces of the rolling elements and rolling bearing rings.

Measures to reduce dynamic loads and micromotions are often very costly and cannot always reduce false brinelling damage to the desired extent. The use of lubricants that can specifically prevent the formation of false brinelling damage is more effective and economical.

Our modern false brinelling test rig and the test methods and evaluation criteria used, have become established in the industry and are used to evaluate lubricants and to investigate the influence of operating conditions on false brinelling damage.

Experience and a large number of studies show that the development of false brinelling damage is more pronounced at low temperatures. The false brinelling test bench can be operated fully automatically in a climate chamber for testing at lower temperatures.

Analyzing the corrosive attack, wear volume and wear depth have proven to be useful for evaluating false brinelling damages. With our Wear Analyzer software, false brinelling marks can be evaluated in terms of wear volume, material transfer volume and wear depth.

False Brinelling Marks on Bearing Inner Ring

False Brinelling Marks for Different Lubricants

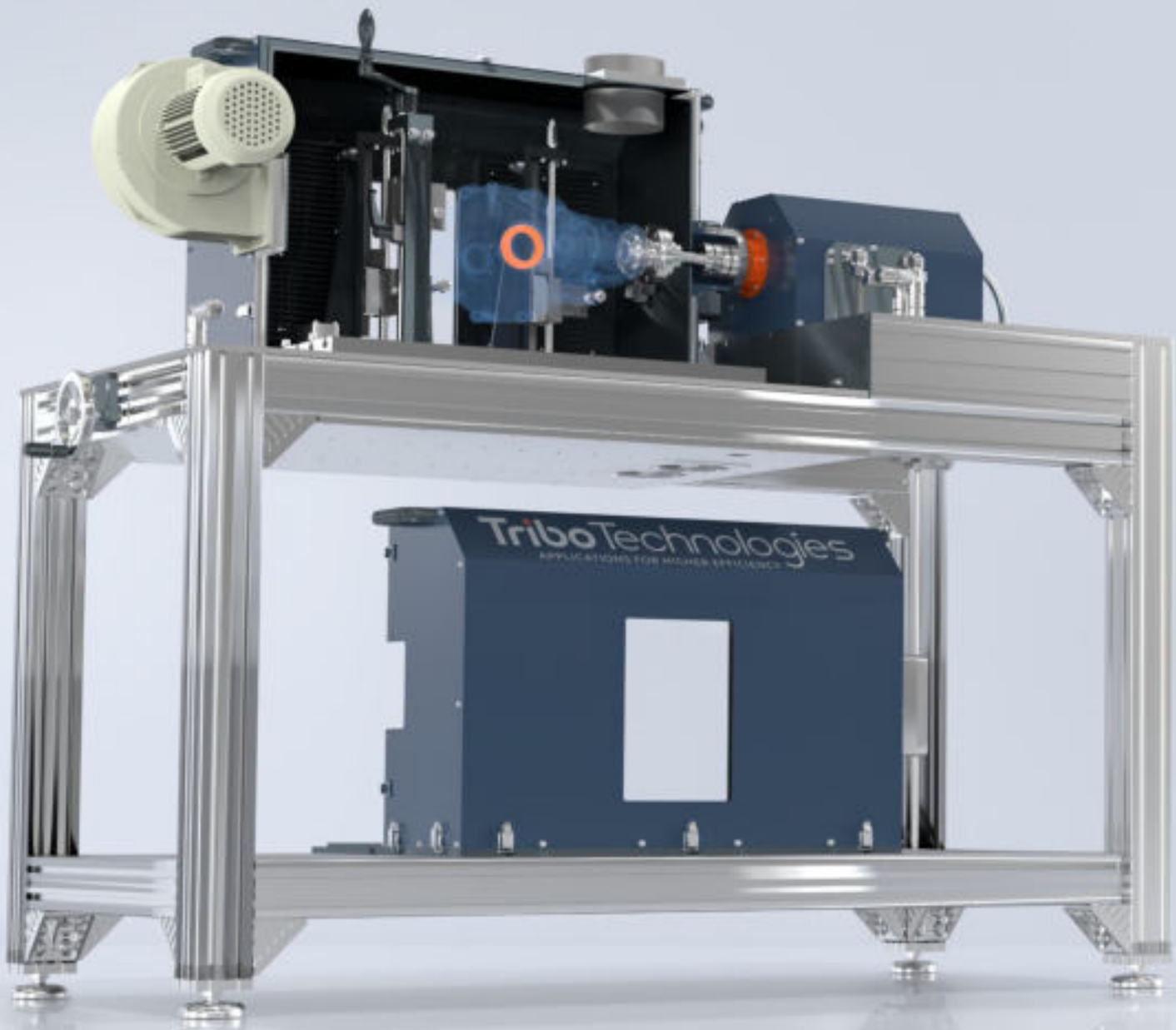
Lubricant A

Lubricant B

Lubricant C

Customized Test Rigs

According to Customer Specification



Example for a Customer Test Rig:
Sealing test rig for the investigation and evaluation of the leakage behavior of seals

Your Partner when it Comes to Tribology

As an operator of tribological test rigs, we know exactly what is important in the development and construction of test rigs for tribological tests. In addition to standardized test rigs, we also design and build customized test rigs according to customer specification. Whether friction, wear or durability test rigs, tell us your requirements and we will implement them. Our range of services for test rig construction:

- conception and development
- design, circuit diagram creation and construction
- design and programming of the test rig software
- delivery, commissioning and instruction
- advice on the selection of analysis methods for the tested components
- maintenance and repair

Do you have a test rig that no longer meets your current requirements? We would be happy to overhaul your test bench.

Example 1: Sealing Test Rig

The testing and analysis of seals regarding their leakage behavior, lubricant compatibility or robustness against media or particles is an important aspect in the development of sealing systems. Good leakage behavior is achieved when the sealing system, consisting of seal, shaft, medium and environmental influences, is precisely matched to each other.

To obtain meaningful results for a seal, realistic installation and test conditions are required. For gearbox seals, we have developed a test rig according to customer specifications for testing radial shaft seals (RSS) with the following features (image last page).

- testing of axle and electric transmissions
- speeds up to 26,000 rpm
- test temperatures from 30 °C ... 200 °C
- customizable test procedures
- leakage detection through image evaluation

In addition to online leakage detection during the test, the wear of the sealing lip of a radial shaft seal after the test is important. An optical investigation of the sealing lip and a determination of the wear amount can be used to evaluate the wear of the sealing lip.

Example 2: Friction Lining Test Rig

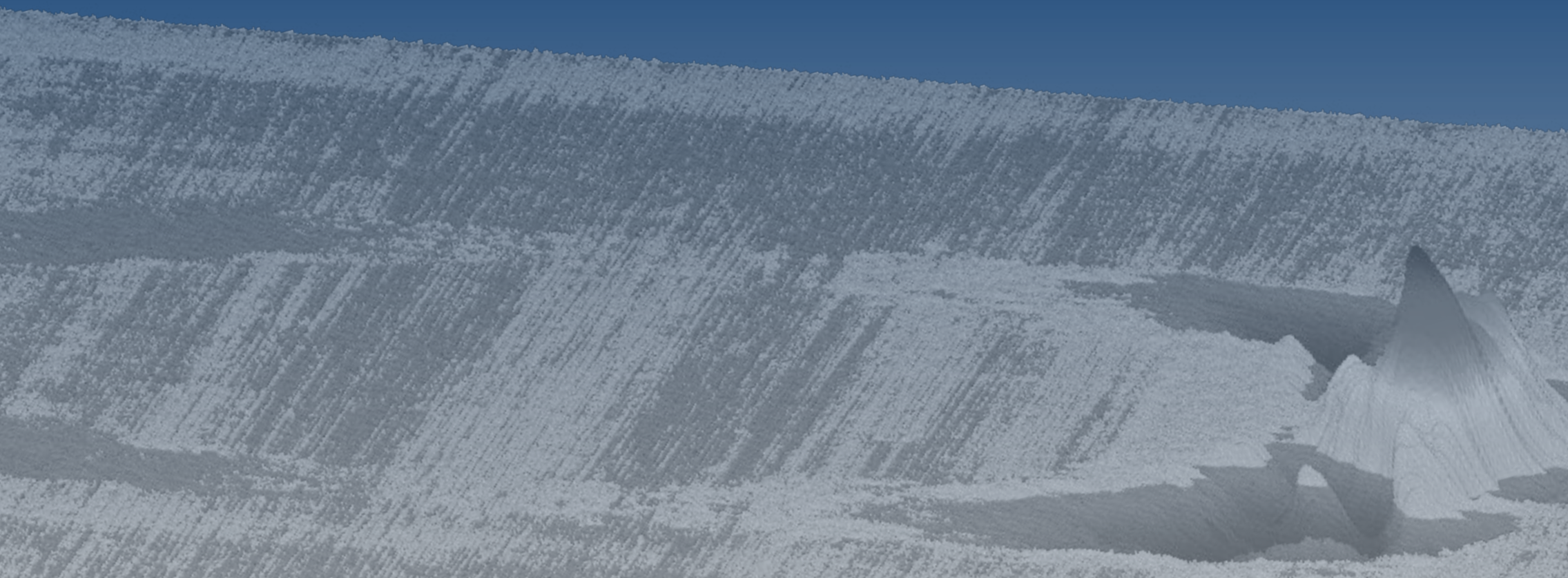
Friction linings are used in friction clutches or brakes. Friction clutches must have a good control quality and good shifting comfort in vehicle applications. Both criteria require a positive gradient of the friction coefficient. This is the case when the friction increases with increasing relative speed. Component test rigs with application-related test conditions can be used to efficiently preselect suitable friction linings and friction pairings.

For component testing of the friction lining/ friction counterpart pairing, a customer's existing test rig infrastructure, consisting of a machine bed and drive motor, was converted to the following specifications:

- dynamic test conditions
- test temperatures up to 400 °C
- online wear measurement
- customizable test procedures

A detailed analysis of the friction partners in the test as well as a subsequent material and chemical analysis of the friction partners enables a better understanding of the processes in the contact and a classification of the effects observed in the test.

ANALYSIS SOFTWARE



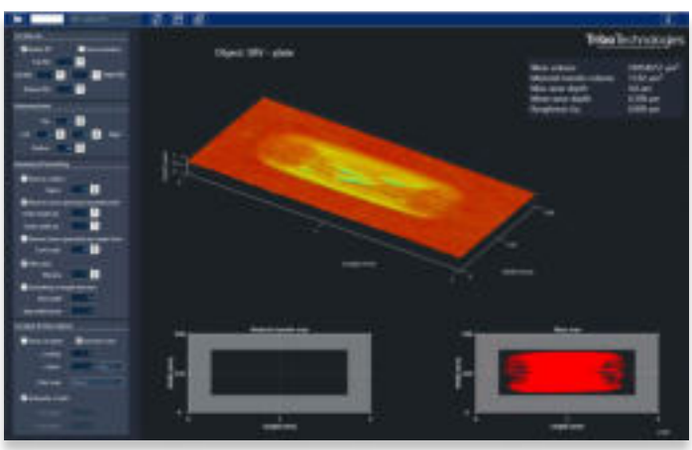
Wear Analyzer

Measuring wear marks can be time-consuming with conventional analysis tools. Curved surfaces and overlapping of the wear zone and technical roughness of the surface can make a reproducible evaluation of wear zones difficult.
With our Wear Analyzer software, wear marks from any test can be analyzed quickly and easily on the basis of 3D measurements. Relevant characteristic values are determined automatically:

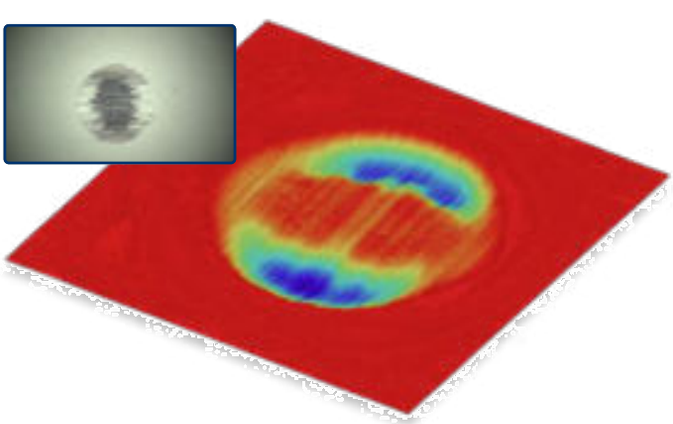
- wear volume
- material transfer volume
- wear depth

The wear marks can be analyzed directly on the basis of the optical measurement data derived from the tested specimen. Cropping and processing of the curved macro geometry as well as filtering of the surface data can be carried out directly in the software.
Once the analysis system has been set up for a tested specimen, several surface scans can be automatically evaluated under identical analysis conditions, reducing the amount of work involved in the evaluation of the scans and guaranteeing reproducibility of the results.

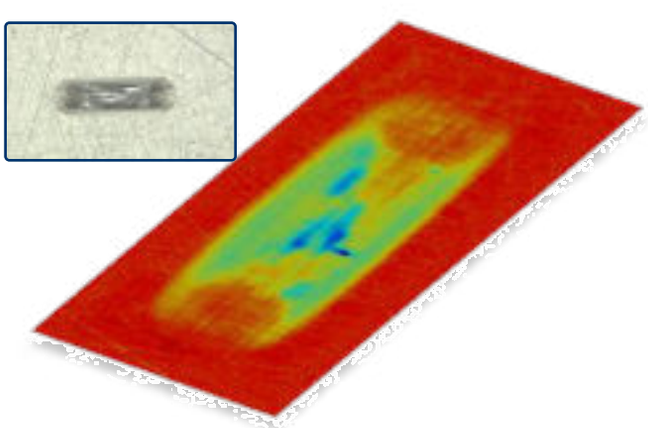
User Interface of the Wear Analyzer



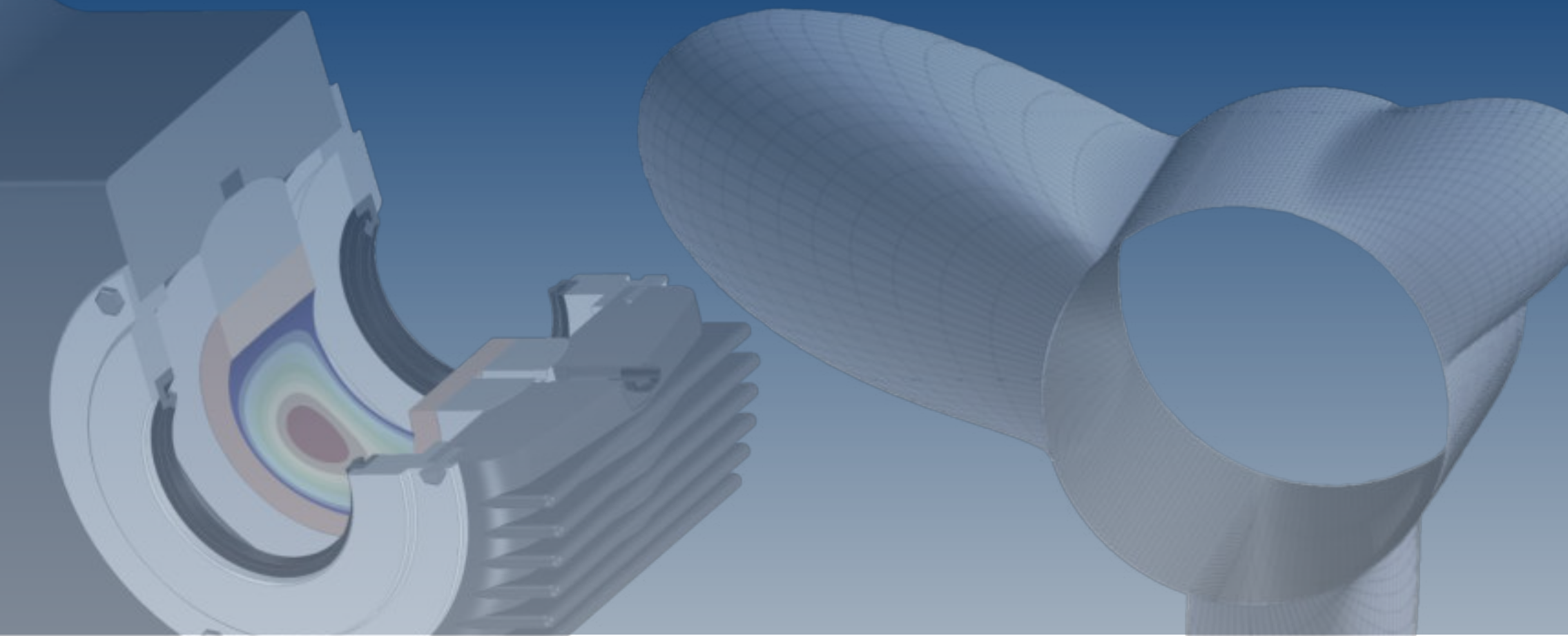
Analysis of the Wear Mark of the Ball after an SRV Test



Analysis of the Wear Mark of the Flat Specimen after an SRV Test



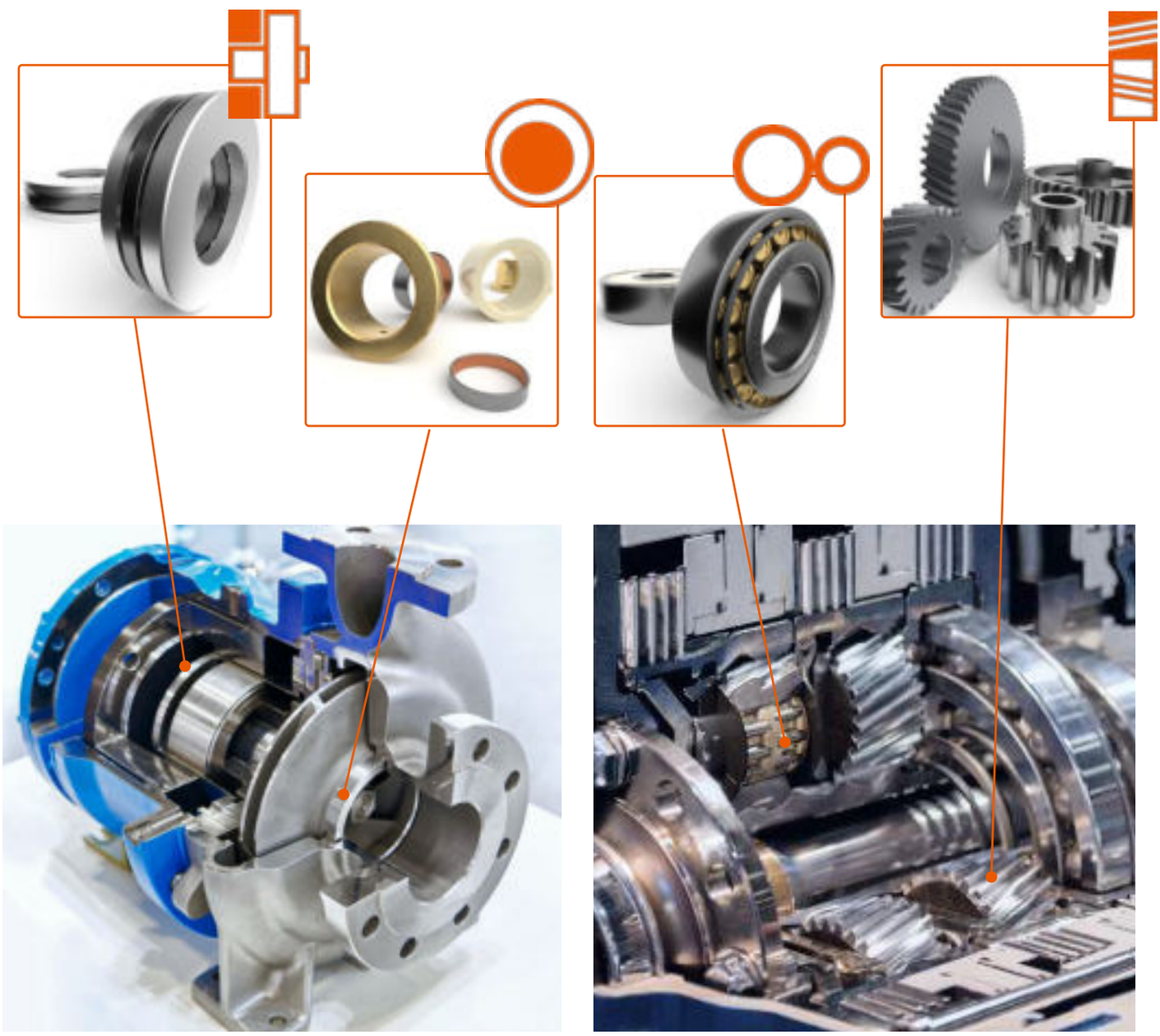
Tribo-X



Tribo Simulation

Tribo-X is a simulation software for the calculation of lubricated machine elements and can be applied in research and product development, for the analysis of component damage and for product optimization.
Using a fully coupled multiphysics solver, lubricated contacts can be modeled using thermo-elastohydrodynamic (TEHD) simulation. In addition, powerful models for essential effects in the lubricating gap are available. This enables the evaluation of the lubrication condition, tribological stresses, temperatures and friction depending on the respective operating conditions.

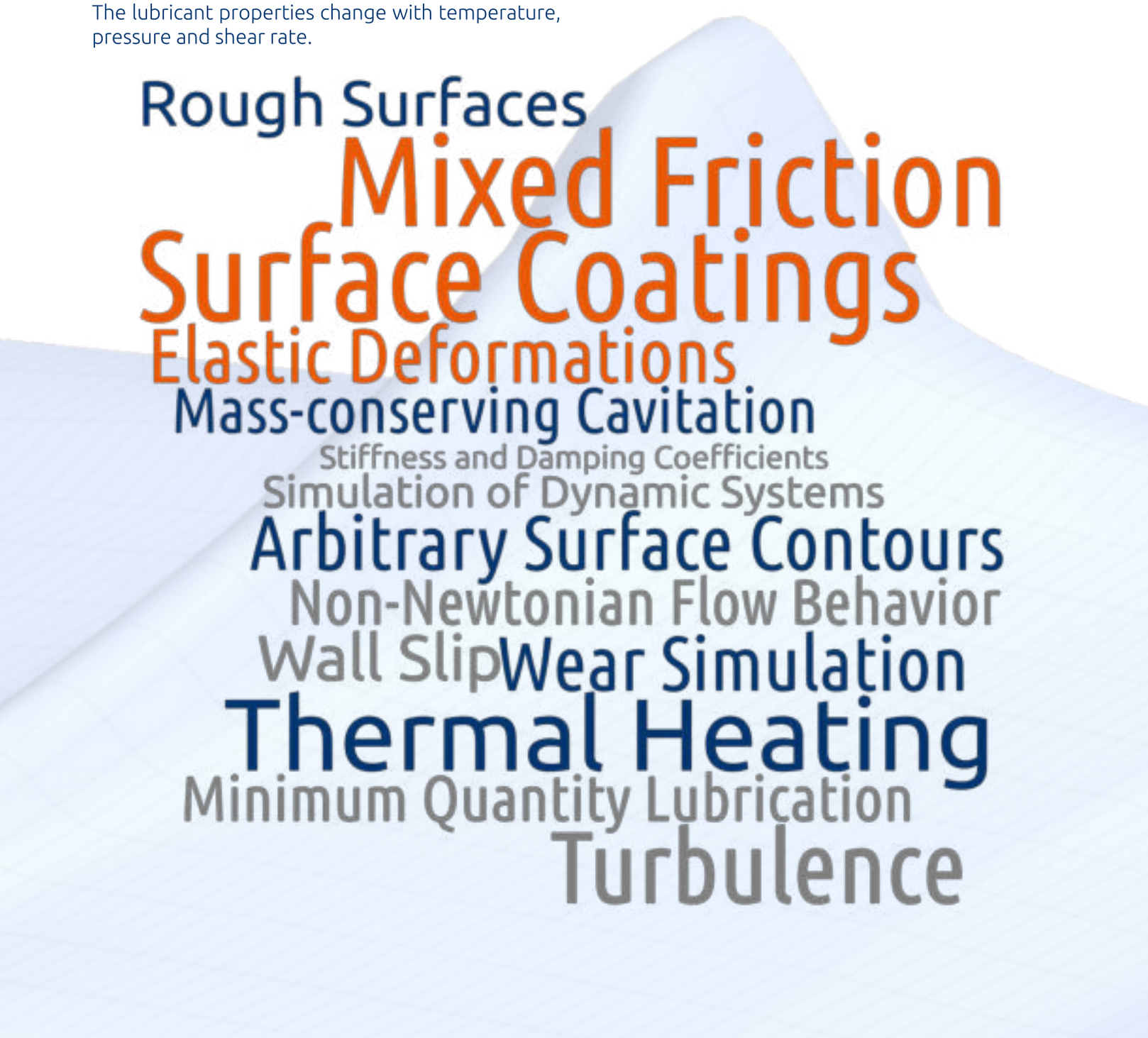
Tribo-X focuses on lubricated contacts and can be used as a numerical magnifying glass for the evaluation of concentrated contacts such as those found in gears, cam contacts or rolling bearings as well as for conformal contacts such as those found in journal and thrust bearings as well as piston/cylinder systems. The design of these systems is often experience-based and only possible with extensive and costly component testing. Tribo-X is an efficient simulation tool that supports you in the design and optimization of lubricated systems and can thus directly reduce cost-intensive testing of machine elements. Tribo-X has a modular structure and can be adapted to the product range of your company.



Everything in One Tool

Lubrication conditions are influenced by a variety of effects. To correctly dimension and analyze lubricated machine elements those effects must be taken into account during simulation.
In addition to a powerful multiphysics solver that evaluates flow, elastic deformations and thermal heating in the lubricating gap, other models have to be considered.
The surface roughness has a profound effect on the contact of lubricated systems, especially when the application is operated in or close to the mixed friction regime. Tribo-X offers a powerful and performant mixed friction model that allows for exact representation of the surface roughness while keeping calculation times low.
The lubricant properties change with temperature, pressure and shear rate.

In Tribo-X, the properties of the lubricant can be precisely described in order to correctly predict the load carrying capacity and friction of the system.
Surface coatings are often used in tribological systems to reduce friction and wear. Tribo-X offers the possibility to consider one or more layers on the substrate surfaces and thus to render their influence on the contact and analyze the stress in the individual layers of the coating system. This enables the optimization of coating systems for your application.
The models available in Tribo-X are state of the art and ensure a reliable design of lubricated systems.



Software Modules

Rolling Contacts

Simulation of rolling contacts e.g. in rolling bearings, cylindrical gears, cam/follower contacts or wet-running friction gears

Cylindrical Gears

Simulation of spur and helical gears

Bevel Gears

Simulation of helical, spiral, hypoid and straight bevel gears

Cam Contacts

Simulation of cam/ follower contacts

Stress

Simulation of sub-surface stress

Journal Bearings

Simulation of journal bearings e.g. in engines, pumps, compressors or gear boxes

Thrust Bearings

Simulation of thrust bearings e.g. in engines, pumps, compressors or gear boxes

Piston/Cylinder

Simulation of piston/cylinder pairings e.g. in radial and axial piston pumps

MicroSim

Consideration of microhydrodynamics and mixed friction

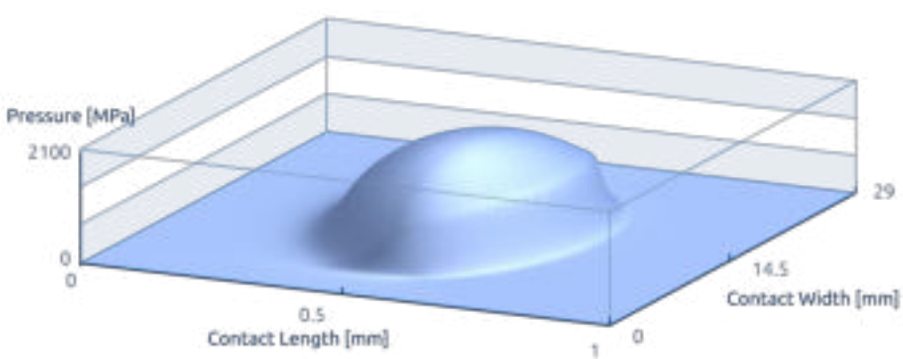
Developer Mode

Enables coupling of Tribo-X modules with each other or to third party software as well as batch processing

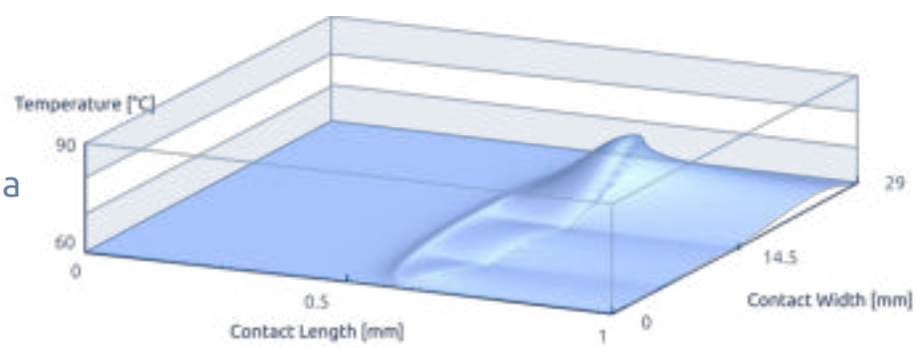
Rolling Contacts

The base module Rolling Contacts is used to simulate rolling contacts where a rolling and sliding motion is present at the same time. This type of contact is found among others in rolling bearings, gears and cam follower contacts. The Rolling Contacts module can be used to describe arbitrary rolling contacts. The add-on modules Cylindrical Gears, Cam Contacts and Bevel Gears provide a convenient solution for calculating these systems using simple input data. A complex description of the kinematics and contact ratios is not necessary.
The additional module Stresses can be combined with the base module Rolling Contacts as well as with the add-on modules and enables the evaluation of stresses occurring below the component surfaces. The Stress module can therefore be used to evaluate the analyzed contact regarding their tendency to micro and macro pitting damage.

Coatings can be used to influence the tribological behavior of contacts. Tribo-X can be used to determine both stresses and temperatures in the individual layers of a coating system. This provides the basis for the design of coatings in lubricated applications.
Rolling contacts are usually characterized by very high contact pressures. A correct evaluation of these systems requires a correct description of the lubricant and its properties. In Tribo-X, a large number of lubricant models can be used, which enable the consideration of changing lubricant properties with changing temperatures, pressures and shear rates.
The Rolling Contacts module and its add-on modules therefore provide the basis for designing a large number of concentrated contacts.



Pressure Distribution in a Concentrated Contact



Temperature Distribution in a Concentrated Contact

Add-on Modules

Cylindrical Gears

- external and internal gearing
- spur and helical gears
- modeling of real involute geometry
- consideration of flank corrections

Bevel Gears

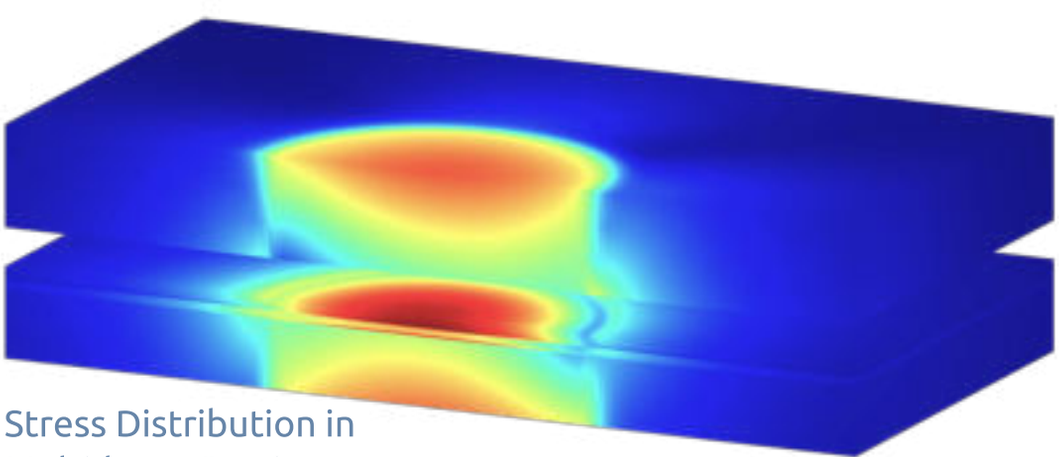
- straight, helical and spiral bevel gears as well as hypoid gears
- real octoid geometry of the tooth flanks
- modeling of single part method (circular arc) and continuous part method (extended epicycloid)
- calculation of gear geometry according to ISO 23509

Cam Contacts

- arbitrary cam contours
- flat and roller tappet can be modeled
- fully integrated calculation of effective velocities and forces

Stress

- consideration of uncoated and multi-layer coated surfaces
- calculation of the triaxial stress state and common equivalent stresses
- output of all normal and tangential stresses for evaluation (e.g. for service life models)



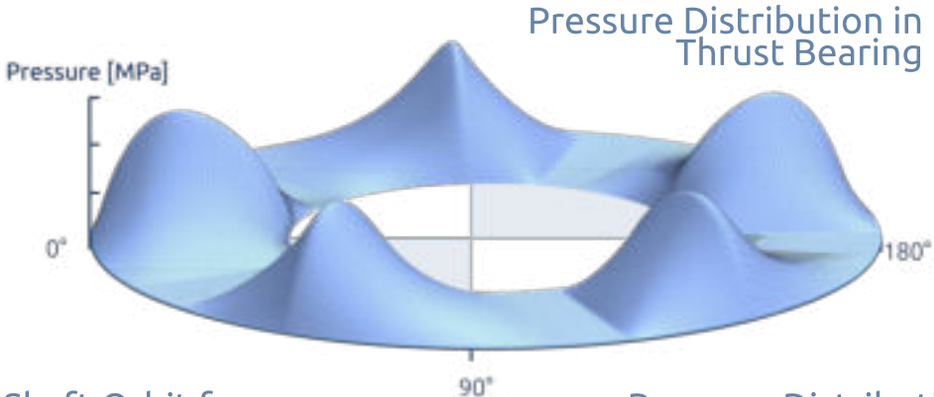
Stress Distribution in Multi-layer Coating

Journal and Thrust Bearings

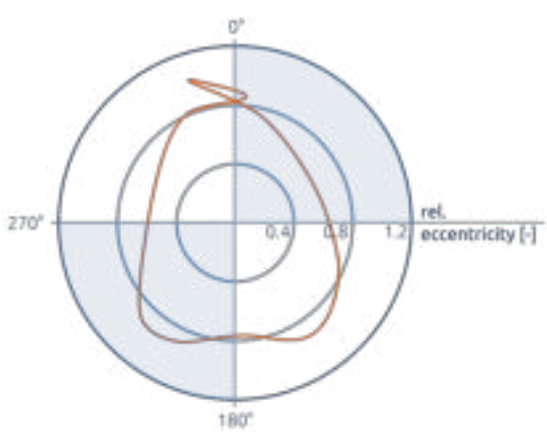
Journal and thrust bearings must be designed with the application in mind. It is not possible to choose a bearing based on predesigned bearings as it is common for rolling bearings. Therefore, the plain bearing design is heavily dependent on the design space and operating conditions of the application.
The Journal and Thrust Bearing modules of Tribo-X are used to evaluate plain bearing designs and support you in the design or optimization of your bearing configuration. Among others it allows the simulation of heavily loaded plain bearings, bearings lubricated with fluids such as water or bearings subjected to time-varying and repetitive load cycles.
The journal and thrust bearing modules represent a comprehensive and flexible tool for bearing design that can be used in various industries.

- simulation with time-varying boundary conditions such as load, velocity, temperatures, etc.
- laminar and turbulent flow
- modeling of different bearing designs
- consideration of manufacturing or wear profiles
- consideration of deformations using FEM compliance matrices or elastic half-space
- lubricant supply via end faces, bore holes, supply pockets or ring grooves
- mixed friction (additional MicroSim module required)
- wear simulation

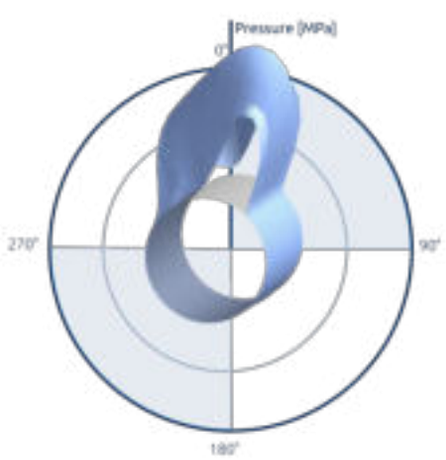
Pressure Distribution in Thrust Bearing



Shaft Orbit for Cyclic Load



Pressure Distribution in Journal Bearing

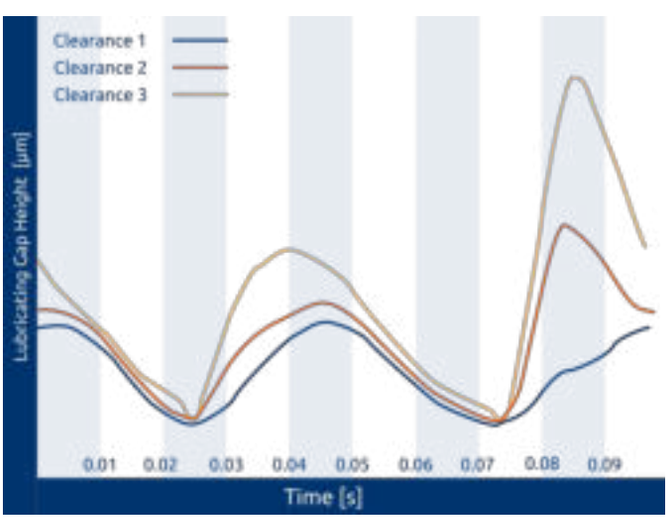


Piston/Cylinder

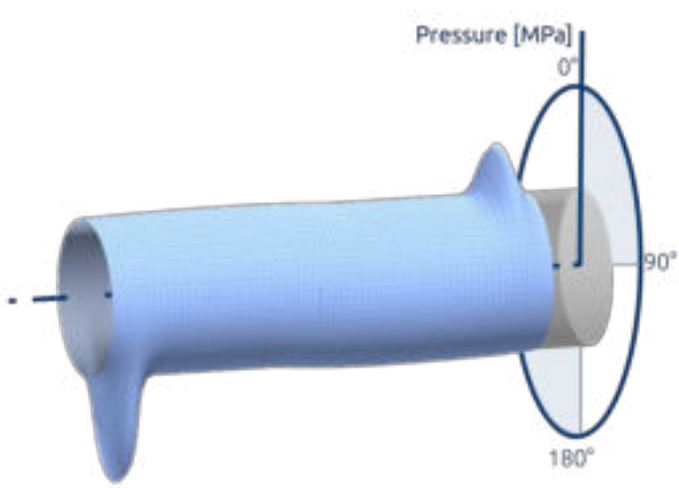
Piston-cylinder applications are characterized by very small gaps in which the piston oscillates. During operation a misalignment can occur, which causes the piston to tilt.
The Piston/Cylinder module from Tribo-X is used to evaluate piston/cylinder applications with one-piece pistons. The resulting gap and the determined tilting angle of the piston during operation can be used for the evaluation and as the basis for optimizing the tribo system. In addition, cyclic loads as well as run-up or other arbitrary load conditions can be analyzed. The conditions taking place in the working chamber can be modeled by specifying time-varying pressure values at the upper end of the gap.

- simulation with time-varying boundary conditions such as pressure, load, speed, temperatures, etc.
- rotational and translational motion as well as tilting of the piston in the cylinder
- laminar and turbulent flow
- arbitrary contours of piston and cylinder
- consideration of manufacturing or wear profiles
- consideration of deformations using FEM compliance matrices or elastic half-space
- lubricant supply via end faces, bore holes, supply pockets or ring grooves
- mixed friction (additional MicroSim module required)
- wear simulation

Investigation of the Influence of the Clearance on the Operating Behavior



Pressure Distribution in Piston Cylinder Gap

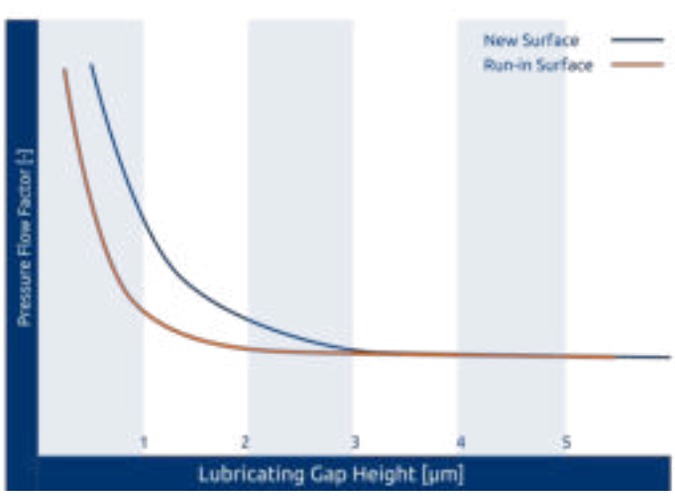


MicroSim

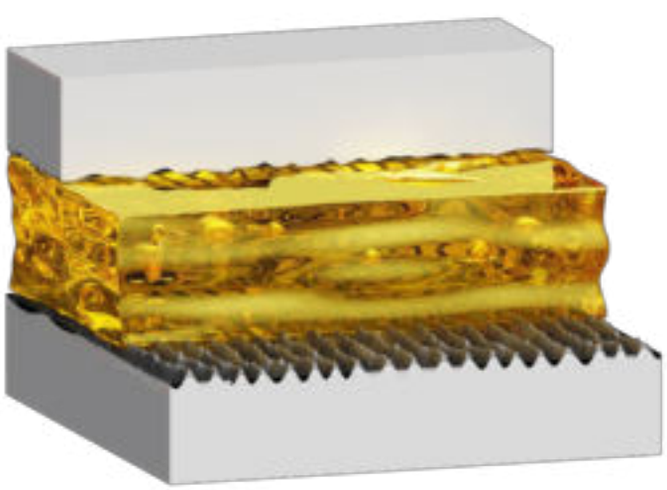
The MicroSim module is a supplement for the base modules Rolling Contacts with Add-on modules, Journal and Thrust Bearings as well as Piston/ Cylinder and allows the consideration of rough surfaces on the basis of measured component surfaces in the TEHD simulation. This enables the analysis of mixed friction conditions that can occur during the operation of the tribo system.
Both the microhydrodynamics, i.e. the influence of the roughness on the flow in the gap, and a possible solid contact between the roughness of both surfaces are included in the simulation.
With the MicroSim module, the influence of roughness is determined as part of a prior contact and flow simulation. This allows the evaluation of surface topographies as well as their influence on the lubricated contact. The results can therefore be used as an input for subsequent TEHD simulations.

- delivers basis for the consideration of mixed friction conditions in the TEHD simulation
- consideration of rough, three-dimensionally measured surfaces
- elastic-plastic half-space contact model for rough surfaces
- consideration of the influence of rough surfaces on the gap flow
- calculation of gap height-dependent pressure, shear flow and shear stress factors in x and y directions

Example for Pressure Flow Factors Used to Describe the Microhydrodynamics

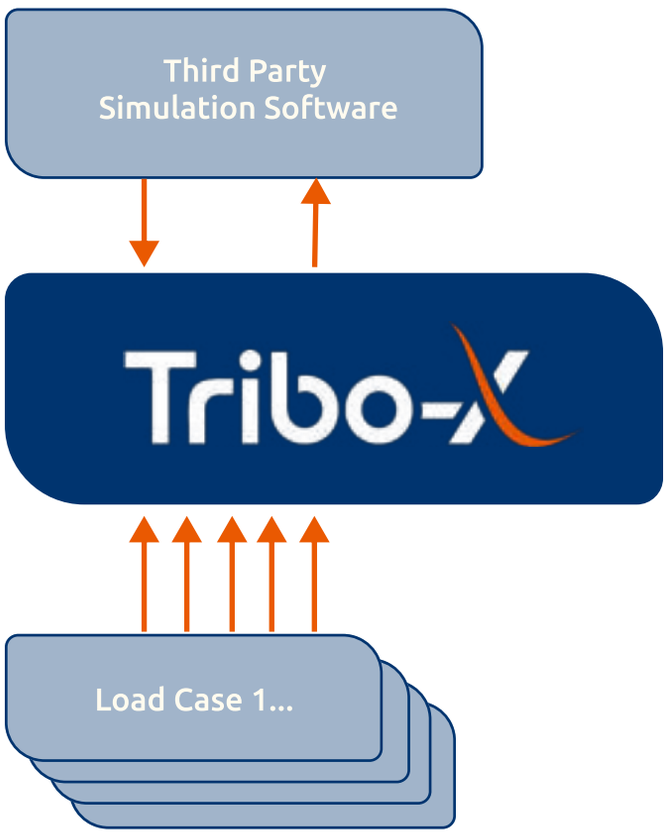


Lubricant inbetween Two Rough Surfaces



Developer Mode

The Developer Mode module allows Tribo-X to be controlled independently of the graphical user interface. On the one hand, this allows automated batch processing of a large number of variation calculations to be carried out, and on the other hand it enables Tribo-X to be fully coupled with other simulation programs (example: Tribo-X inside Ansys) by integrating individual or several Tribo-X modules into these programs.
Complex systems with several lubricated contacts that interact with each other can also be represented. Tribo-X is controlled via a file interface and can be fully automated.



Possible Applications for the Developer Mode Module

A Strong Partnership

Tribo-X inside Ansys

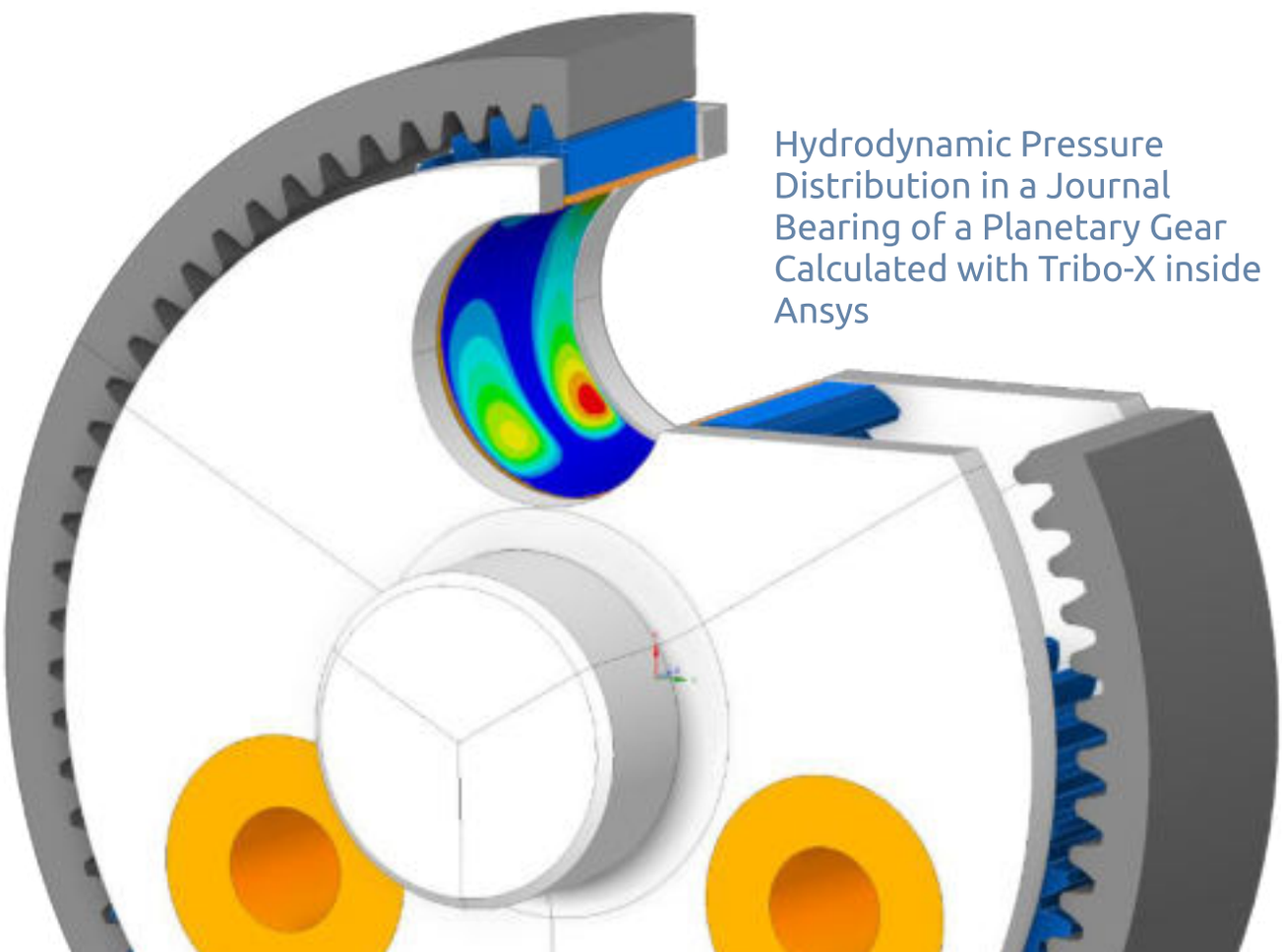
Single Bearing Analysis

Tribo-X inside Ansys is an extension for Ansys Mechanical and offers a solution for the design and analysis of hydrodynamic journal bearings, where a possible interaction between several journal bearings can be neglected.
By determining customized rotordynamic coefficients, journal bearings can be described in a follow-up system simulation based on the linear rotor dynamic.

Tribo-X for Ansys Motion

System Analysis

We are a technology partner of Ansys and with Tribo-X for Ansys Motion we provide our Tribo-X solver for journal bearings in the Drivetrain Toolkit of Ansys Motion and thus enable multi-body simulations of highly dynamic systems with journal bearings. With Tribo-X for Ansys Motion it is possible to model one or multiple journal bearings including their interactions.



Hydrodynamic Pressure Distribution in a Journal Bearing of a Planetary Gear Calculated with Tribo-X inside Ansys

Tribo-X inside Ansys

With Tribo-X inside Ansys, the advantages of the Journal Bearing module from Tribo-X can be combined with the benefits of Ansys. Tribo-X inside Ansys offers a completely new analysis system for journal bearings in which CAD models can be used as the basis for a journal bearing analysis. The Ansys-typical workflow in conjunction with automatic gap detection enables optimum dimensioning of shaft, bearing and bearing housing. With Tribo-X inside Ansys, quick parameter studies can be carried out within seconds or minutes to adapt the bearing design to different applications. A combined application with the Ansys DesignXplorer or OptiSlang allows a convenient, automatic optimization of your journal bearing.

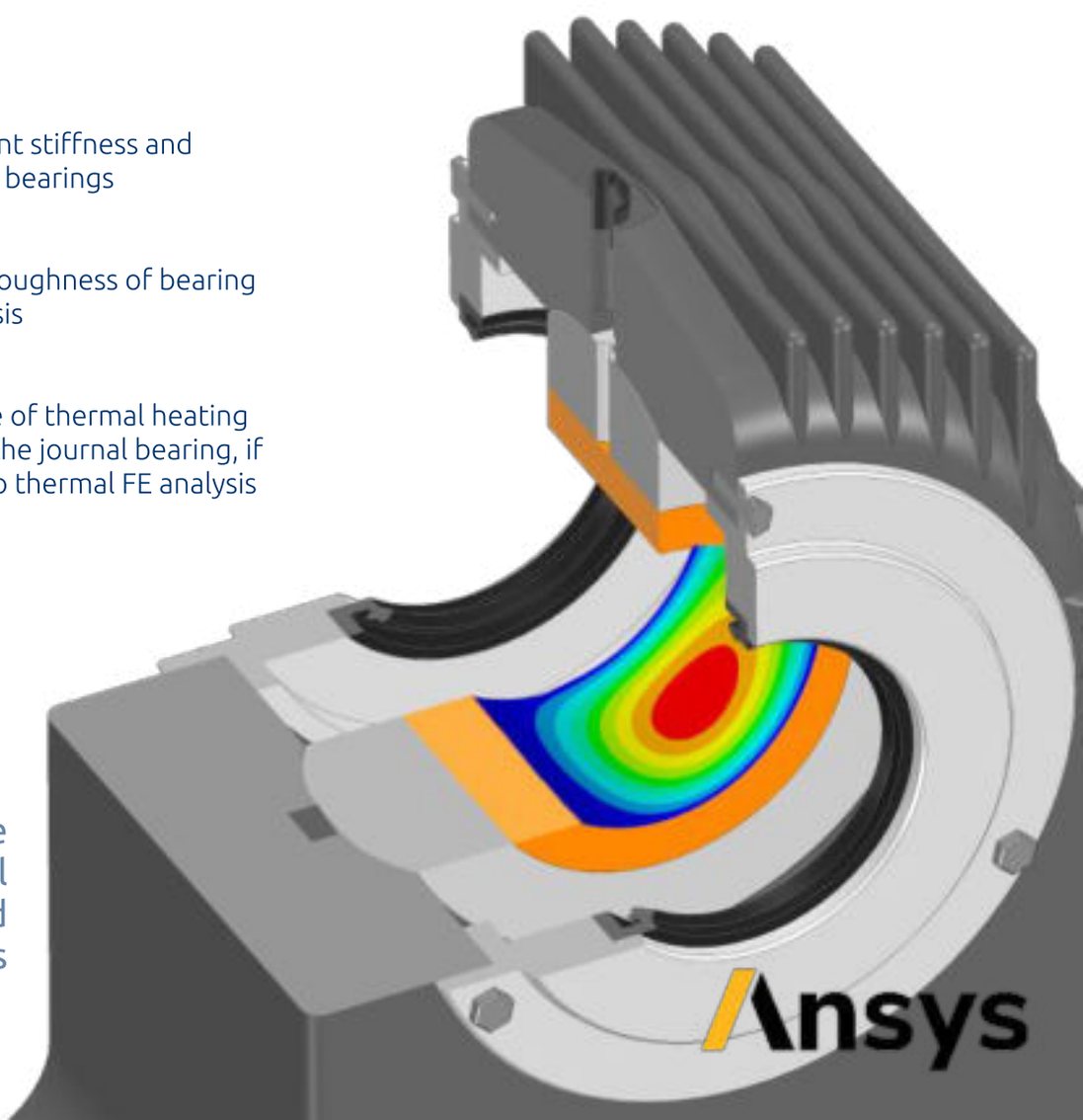
- short calculation times with a high level of detail
- simple execution of parameter studies thanks to fully parametric workflow
- consideration of elastic deformations of the bearing (EHD) and their influence on the gap geometry
- identification of speed- and load-dependent bearing coefficients for follow-up linear rotor dynamic analyses (add-on module Linear Rotor Dynamics)
- consideration of surface roughness and identification of wear areas in the journal bearing (add-on module Mixed Friction)

Add-on Modules

Linear Rotor Dynamics
Calculation of speed dependent stiffness and damping properties of journal bearings

Mixed Friction
Consideration of the surface roughness of bearing and shaft in the bearing analysis

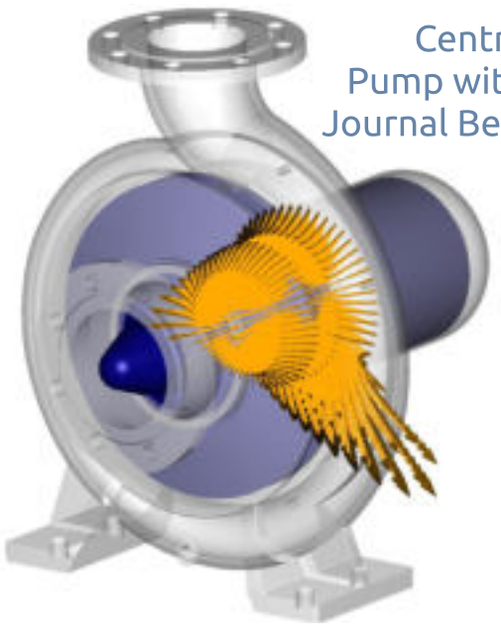
Thermo
Consideration of the influence of thermal heating on the operating behavior of the journal bearing, if needed with direct coupling to thermal FE analysis



Hydrodynamic Pressure Distribution in a Pedastal Journal Bearing Calculated with Tribo-X inside Ansys

Tribo-X for Ansys Motion

Tribo-X for Ansys Motion combines the advantages of the Journal Bearing module from Tribo-X with the multi-body simulation in Ansys Motion to enable you to perform high-performance system analyses with one or more journal bearings in dynamically operated applications.
Thanks to our close cooperation with Ansys as a technology partner, we can ensure a robust and powerful integration of our solver in Ansys Motion. Tribo-X for Ansys Motion enables the user to accurately model journal bearings, which includes the consideration of elastic deformations, surface roughness and several lubricant supply designs.

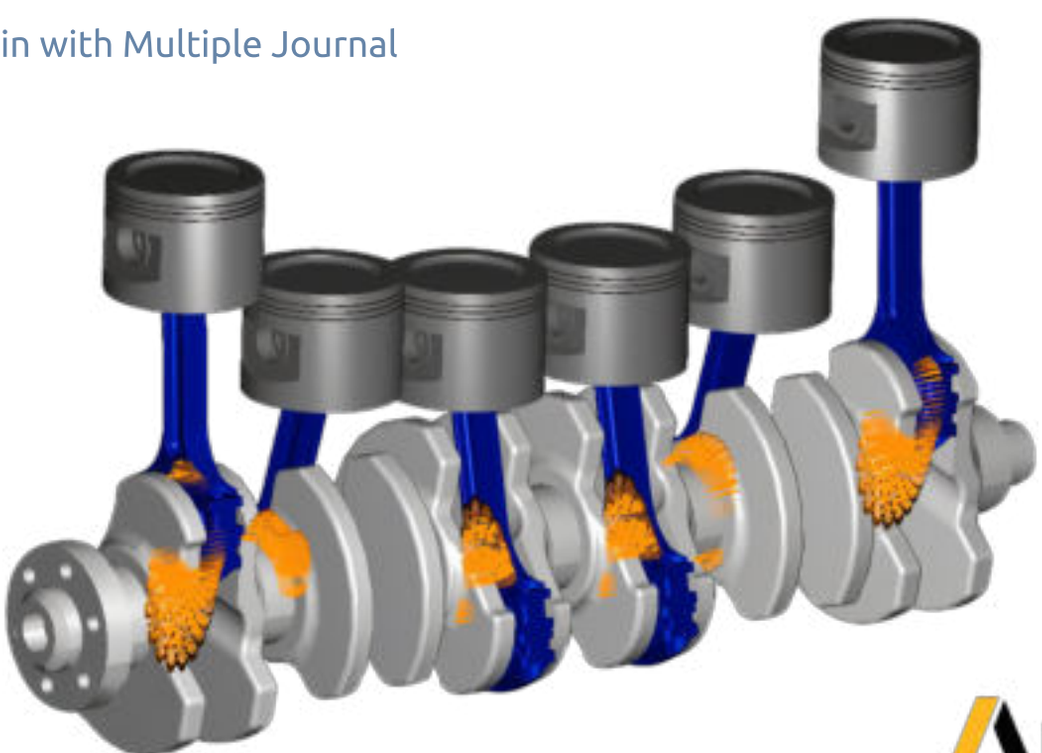


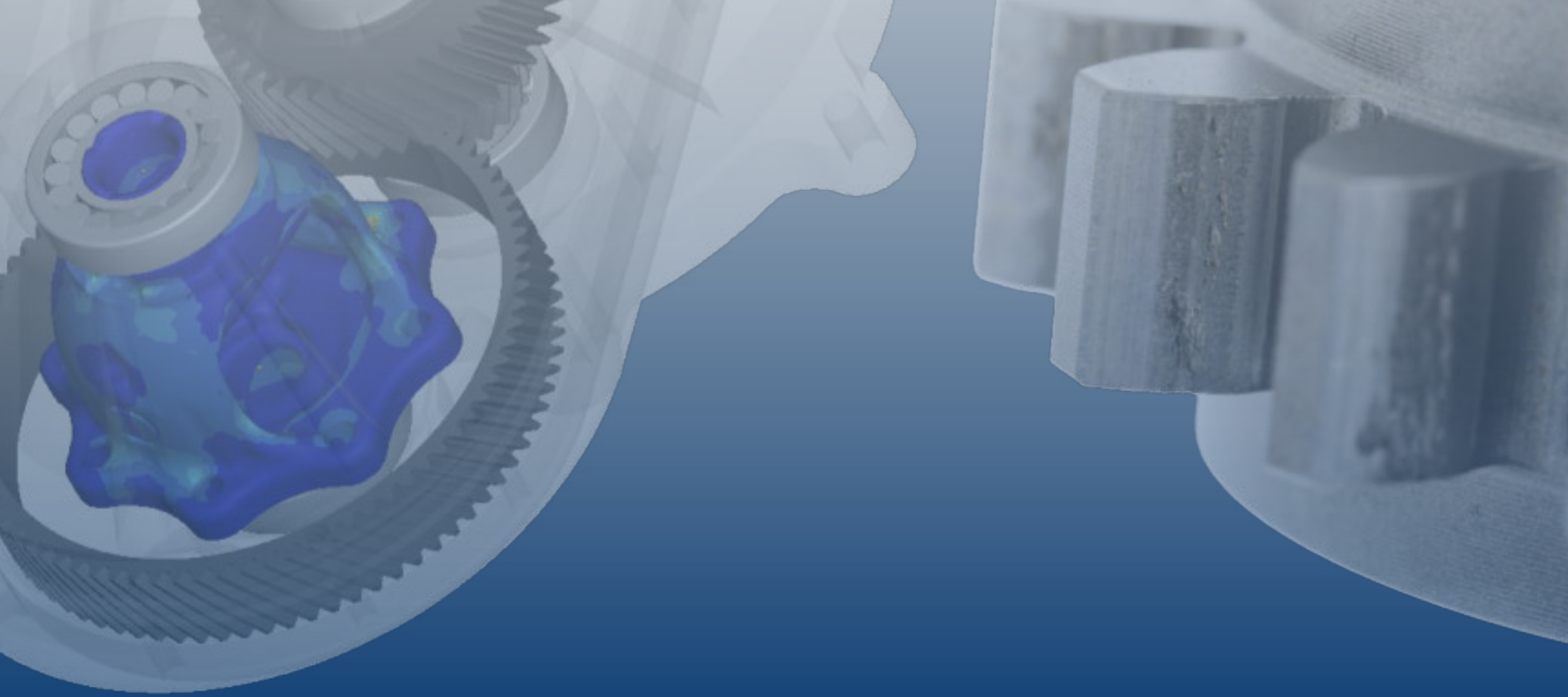
Centrifugal Pump with Two Journal Bearings

- integration of the Tribo-X solver in the multi-body simulation tool Ansys Motion
- detailed modeling of journal bearings for dynamically operated systems
- high-performance solver guarantees short calculation times

At the same time, the combination of the high-performance solvers of Ansys Motion and Tribo-X guarantees short calculation times to accelerate the development of your products. Tribo-X for Ansys Motion is an integral part of the Drivetrain Toolkit and is directly available to you after the installation of Ansys Motion.

Crank Train with Multiple Journal Bearings





SERVICES

Tribological Tests

Lubricants, materials as well as friction and wear behavior can be investigated on test rigs. This contributes to a reliable development of a product or create a better understanding. As a test rig manufacturer and tribology expert, we offer our expertise in testing on test rigs developed in-house as well as on third party test rigs. Let us carry out friction, wear and service life tests for you on model and component test rigs with high quality results. If required, we can supplement these tests with comprehensive analyses of the test parts using state-of-the-art methods.

Our testing technology is subject to constant adaptation and expansion. The following test rigs and tribometers are therefore only a selection.

The system you are looking for is not listed? Please contact us and we will check your request.

TriboTechnologies

Selection of our Test Rigs

- **FE8 rolling bearing test rigs** for testing rolling bearing lubricants
  - Wear test according to DIN 51819-2 and DIN EN 14865-1 for greases
  - Wear test according to DIN 51819-3 for oils
  - Pitting test according to VW PV 1483 for gear oils
  - Pitting test according to ZF 0000 702 232 for gear oils
  - White Etching Crack (WEC) test according to FVA 707 for oils
  - Wear and pitting test for oil- and grease-lubricated oscillating rolling bearings
  - Individual tests according to customer specifications for oils and greases
- **rolling bearing test rigs for radial loads**
- **false brinelling test rigs** for oils and greases down to -40 °C. The test rig and the test method were developed and validated as part of several research projects. The test results show very good transferability into practice.
- **gear test rig** for spur and helical gears with variable center distance (89 mm ... 140 mm) and dynamic load clutch
- **spherical plain bearing test rig** for oscillating operation
- **drag torque test rig** for wet-running clutch plates
- **friction lining test rigs** for dry-running friction linings
- **rotary shaft seal test rig** for leakage tests up to 26,000 rpm
- **EHD2 tribometer** for measuring lubricant film thickness in concentrated contacts
  - Central lubricant film thickness (point measurement)
  - Lubicant film thickness distribution (3D mapping)
- **two-disk test rigs**
- **SRV tribometer test rigs**
- **model tribometer** (e.g. pin, ball, cylinder, ring against disk)

Tribological Simulation

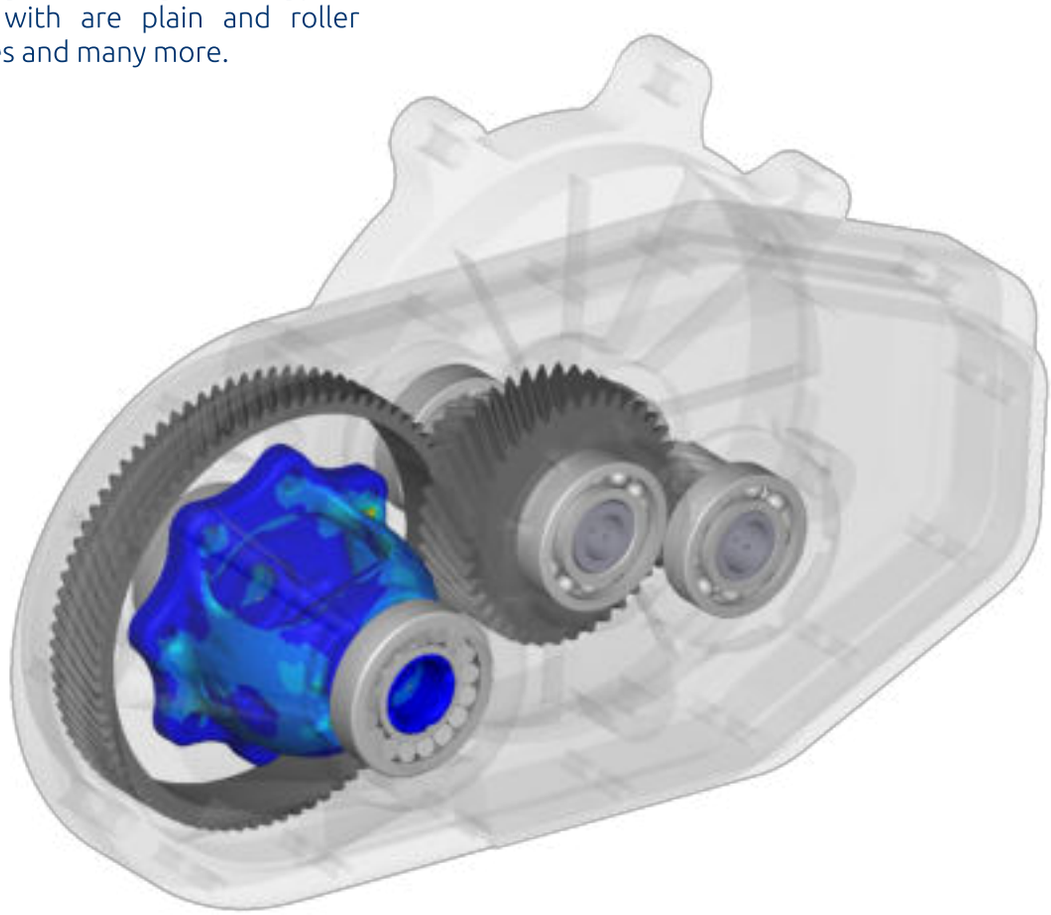
Simulations can be used to gain an understanding of the processes in tribological systems. Gap flow, thermal heating, deformation and stress on components can be calculated and evaluated. With our many years of experience in the field of simulation and a wide range of simulation solutions, we can support you with your project.
We deal with the simulation of technical systems on a daily basis. Therefore, we use simulation tools we have developed ourselves as well as supplementary simulation tools for our projects:

- Tribo-X
- Tribo-X inside Ansys
- Tribo-X for Ansys Motion
- finite element method (FEM)
- computational fluid dynamics (CFD)
- multi-body system simulation (MBS)

If you need support with the design or simulation of tribological systems, we are your partner. We deal with all tribological systems, whether they are highly dynamic or highly stressed systems. Typical applications we deal with are plain and roller bearings, gears, clutches and many more.

CFD Simulation of the Grease Distribution in an Thrust Roller Bearing

Multi-body Simulation of a Gear Box



TriboTechnologies

A close exchange with our customers is particularly important to us. We share our experience and knowledge with you and enable to develop the best solution for your problem. We are committed to you.
We develop an understanding of the system, select the right simulation tools for your problem, set up suitable simulation models and carry out the calculations. From the simulations, we derive findings and recommendations for action for your system and can thus contribute to a robust design or to the optimization of your product.
With our simulation solutions, our many years of experience and our own test facility with innovative testing technology, we are your partner for successful product development.

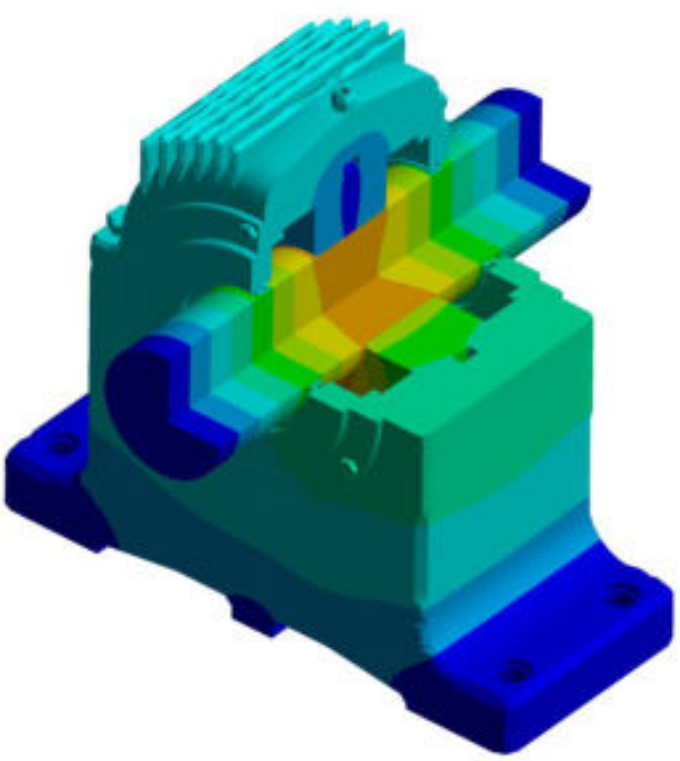
Try it out for yourself!

Do you want to...

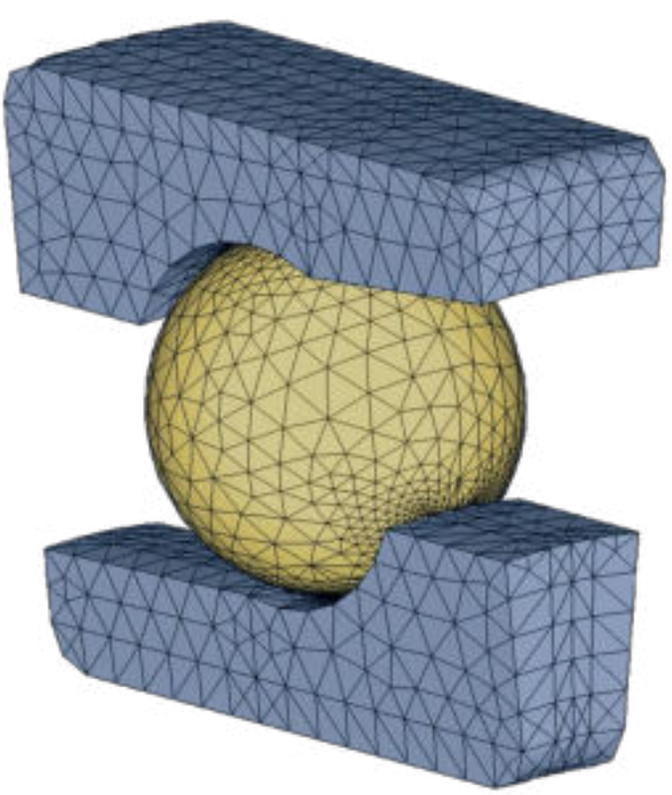
- ... **understand** your system and **design** it correctly?
- ... get to the bottom of the **cause of a damage** that has occured?
- ... further **optimize** your system?
- **... evaluate design variants** before carrying out costly tests?
- ... find a **competent partner** for the simulation of your applications?

Then we can help you.

Multiphysics Simulation of a Journal Bearing



FEM Simulation of a Segment of an Angular Contact Ball Bearing



Analyses and Consulting

Tribological analyses are of great importance. They are used when a better understanding of the processes taking place in the contact has to be created or the causes of tribologically induced component damages have to be determined. Those analyses then lay the foundation to identify and initiate target-oriented counter measures. For this purpose, we use a wide range of state-of-the-art methods and devices, which we combine to address your problem.

- measurement of form and shape deviations
- optical and tactile roughness measurement
- microscopy
- scanning electron microscopy (SEM)
- various chemical and physical analyses of materials and lubricants

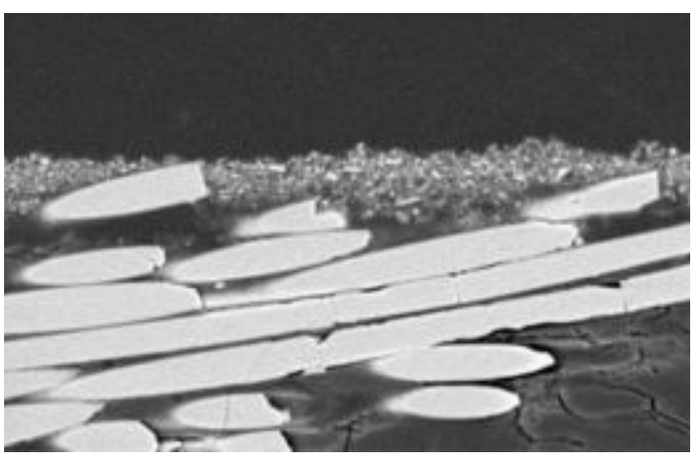
We will be happy to advise you on possible counter measures and the optimization of your products. Therefore, we can draw on our extensive experience and the latest findings from research.

Do you want to...

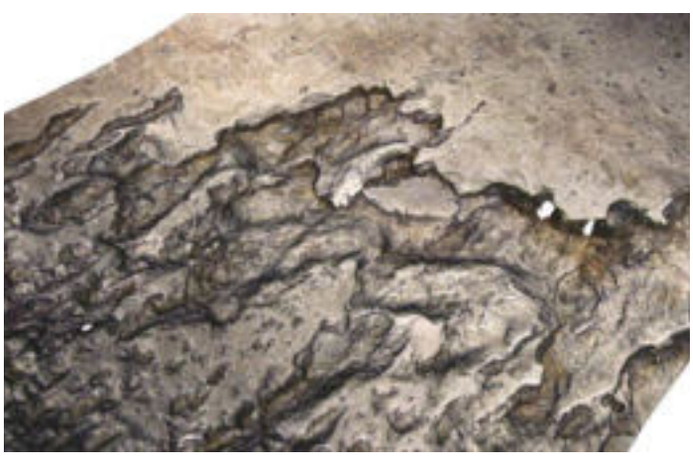
- ... **perform your tests not by yourself** and need a competent partner?
- ... analyze **damaged components** or **lubricants**?
- ... improve the performance of your product by **improving the service life** and **reduce frictional losses**?
- ... select the **best material combination** for your product and need support?

Then we can help you.

Cross-section of a
Glass Fiber Reinforced Friction Lining



Fatigue Damage on the Raceway of a
Linear Rolling Guiding System



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