Software & Service

Simple Exchange of Gearbox Data with REXS

The new version 1.4 of the REXS standard creates a common, comprehensive, and open description for gearbox structures

In modern gearbox development processes, many tasks have been digitalized using simulation tools. This leads to gearbox models being created in many different software applications. Although these tools work with the same data (number of teeth, center distance, etc.), they are generally not compatible with each other. The result: time-consuming manual data entry and a high risk of running simulations with outdated data.

The Reusable Engineering EXchange Standard (REXS) offers a solution to these problems. REXS is a freely accessible parametric data model which enables all involved tools to exchange data. Models no longer need to be generated in each of the individual tools, which minimizes both data exchange errors and the amount of effort required for creating models in the various CAE tools.

"REXS 1.4 creates a common, comprehensive, and open description for transmission structures."

Dr. Moritz Keuthen, Head of Modeling and Simulation at FVA GmbH

REXS 1.4 was published on 1 November, 2021. This new version supports the exchange of additional model data between programs, making it possible to represent new component types and create automatic workflows across various simulation tools. REXS 1.4 is an important step toward independence from manufacturer-specific data formats.

The release includes the following new functions:

- Generic representation of point clouds for FE mesh modeling
- Modeling of the geometry and load carrying capacity of shaft-hub connections
- Introduction of a component which enables the analysis of load carrying capacity according to FKM for various machine elements
- Base64 encoding option

The REXS standard - gearbox development's digital twin

The standard REXS interface has been developed since 2017 on behalf of FVA (Forschungsvereinigung Antriebstechnik e.V., the Research Association for Drive Technology) under the CC-BY-SA-4.0 license. Leading research institutes such as TU Dresden IMM, RWTH Aachen WZL, and TU Munich FZG, as well as leading drive technology companies such as Schaeffler AG and ZF, are involved in the development. REXS has been developed with the common goal of exchanging and enriching data along the value chain to create a complete digital twin of a drive.

"REXS is a real step toward new business models based on digital services, and can be used as a standardized data container for digital twins."

Stephan Evert

Head of Bearing Analysis Tools Development in the R&D Bearing division of Schaeffler Technologies AG & Co KG

What's new in REXS 1.4?

Generic representation of point clouds

One of the most important new developments is the generic representation of point clouds. One possible use case for point clouds is FE meshes. FE meshes typically consist of node points and an allocation of which nodes are connected to each other.

In REXS, FE nodes are represented by a point list, and the element structure is represented by an element list. The point list includes the unique ID's and coordinates of the nodes. The FE element types (e.g., 20 node hex element), the element structure, and the element IDs are stored in the element list.

The modeling approach differentiates between the points, element structures, and the data (e.g., stresses). This differentiation makes it possible to represent a variety of data on the same mesh.

Other use cases for the new structures include transferring tooth geometries, 3D load distributions of various gears, and tooth root data.

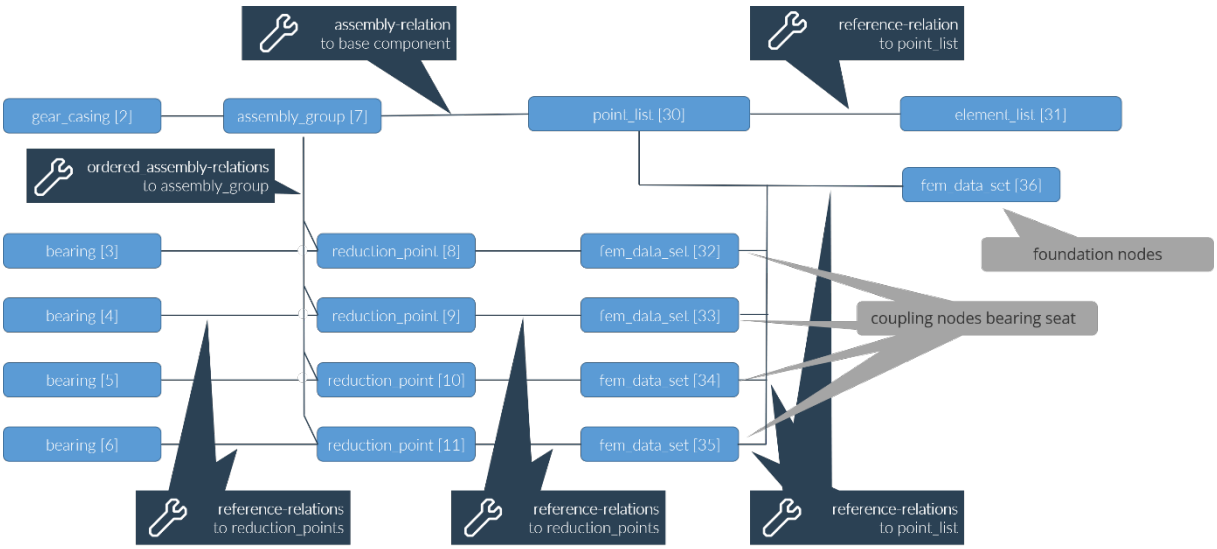


Figure 1: Modeling of FE meshes independent of proprietary interfaces

Description of shaft-hub connections

REXS has also been extended to include the general description of shaft-hub connections. The main focus is on geometric descriptions and defining standard load capacity attributes.

The following methods are available:

Machine element	Geometry	Load carrying capacity
Interference fits	-	DIN 7190, DIN 743
Feather key connections	DIN 6885	DIN 6892, DIN 743
Involute splines	DIN 5480	-

Table 1: Available descriptions for shaft-hub connections

Load capacity analysis according to FKM

The FKM Guideline includes verification of structural durability according to the current state of research. In contrast to DIN 743, the FKM Guideline can be used for any component, and with nominal or locally-solved stresses. Modeling in REXS is performed using a so-called FKM evaluation point, which is associated with existing components via an assembly relation. Components can be associated with notches, shaft-hub connections, and FE assemblies.

BASE64 encoding

BASE64 encoding has become the standard for efficiently transporting large amounts of data. Libraries for encoding and decoding are available for various programming languages. As of version 1.4, REXS can encode Base64 data. This can reduce file size by up to 75% and write and read times by up to 80%.

REXS in commercial and in-house software tools

REXS is already used by a large number of CAE tools. The FVA-Workbench simulation software supports import and export of all REXS versions. With the release of the FVA-Workbench version 7.0, REXS 1.4 is also supported.

"With REXS 1.4, the FVA-Workbench is a data donor for digital twins in drive system development."
Norbert Haefke, Managing Director of FVA GmbH

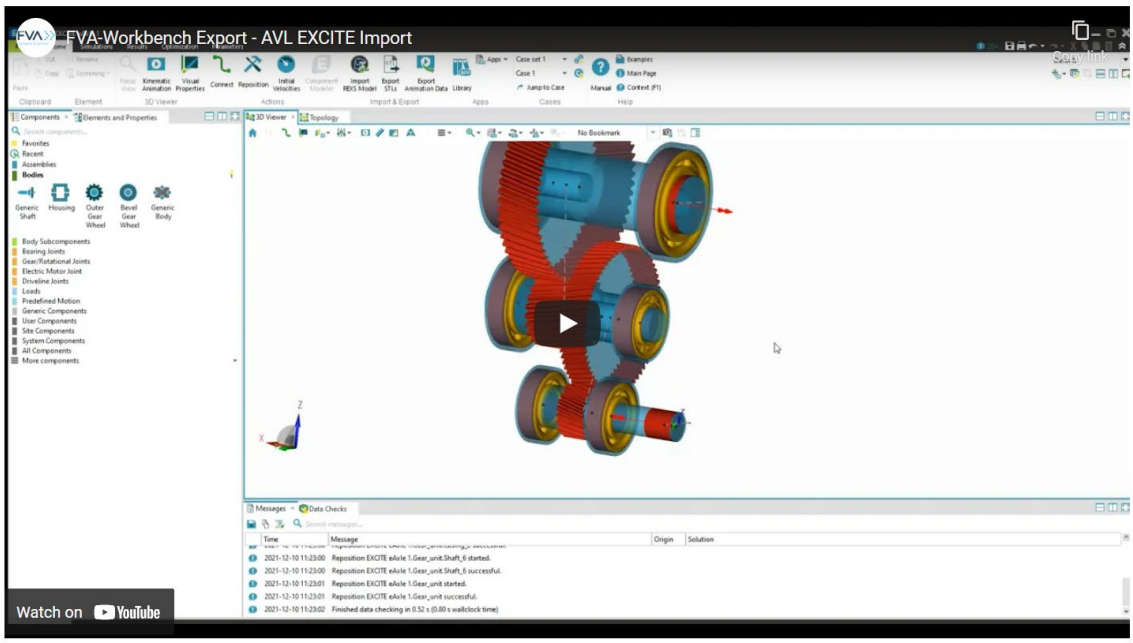
The REXS interface is not only used in commercial calculation programs. Drive manufacturers such as ZF Friedrichshafen AG are also basing their in-house calculation landscape on the open standard for automated calculations.

"REXS enables us to uniformly describe and process drivetrains and components from multiple internal tools. This also creates synergies for us; for example, with the FVA-Workbench."

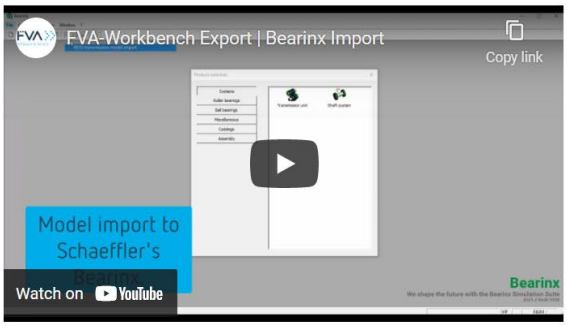
Klemens Humm, Head of Gear Development, ZF Friedrichshafen AG

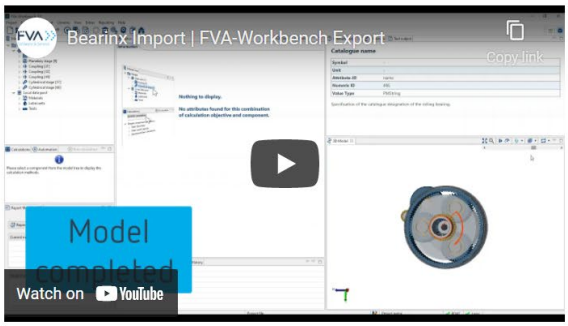
Exchanging data between software tools

The following videos are impressive demonstrations of how the standard can be used to exchange gear data between calculation programs. All geometric data is included when transferring data between the FVA-Workbench and AVL EXCITE™. Calculations can continue directly in the new program without specifying the same data over again.



The requirements of the rolling bearing manufacturer Schaeffler AG played a decisive role in shaping REXS. Furthermore, Schaeffler's internal calculation software Bearinx also supports REXS as a data interface. REXS enables the simple exchange of Schaeffler models with customers for further processing in Bearinx.





For a simple introduction to REXS, sample datasets for version 1.4 are available at www.rexs.info. The free tool can also be used to validate exported datasets. This is an easy way to verify conformity with the specification and ensure that the REXS files can also be used in other programs.

Key takeaways:

- With the release of version 1.4, REXS creates a comprehensive data model for almost all gearbox development processes.
- The geometry and load capacity of shaft-hub connections can now be modeled.
- With generic point clouds, FE meshes can now also be transferred in the REXS data format.
- With the new option to encode interface files using Base64, large arrays and matrices can be transferred quickly and easily in accordance with the specification.
- The industry-driven development process ensures that new use cases for REXS are always represented.