



CWD Aachen 2023

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# The DG03: An Outline of Suggested Changes

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NREL/PR-5000-85562

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# Introduction

The DG03 helps wind turbine and bearing designers to calculate pitch and yaw bearings. It covers all wind-specific aspects and is widely used in the wind industry.

The DG03 was written in 2009. The knowledge about oscillating bearings, large slewing bearings, and wind turbines has grown immensely since then.

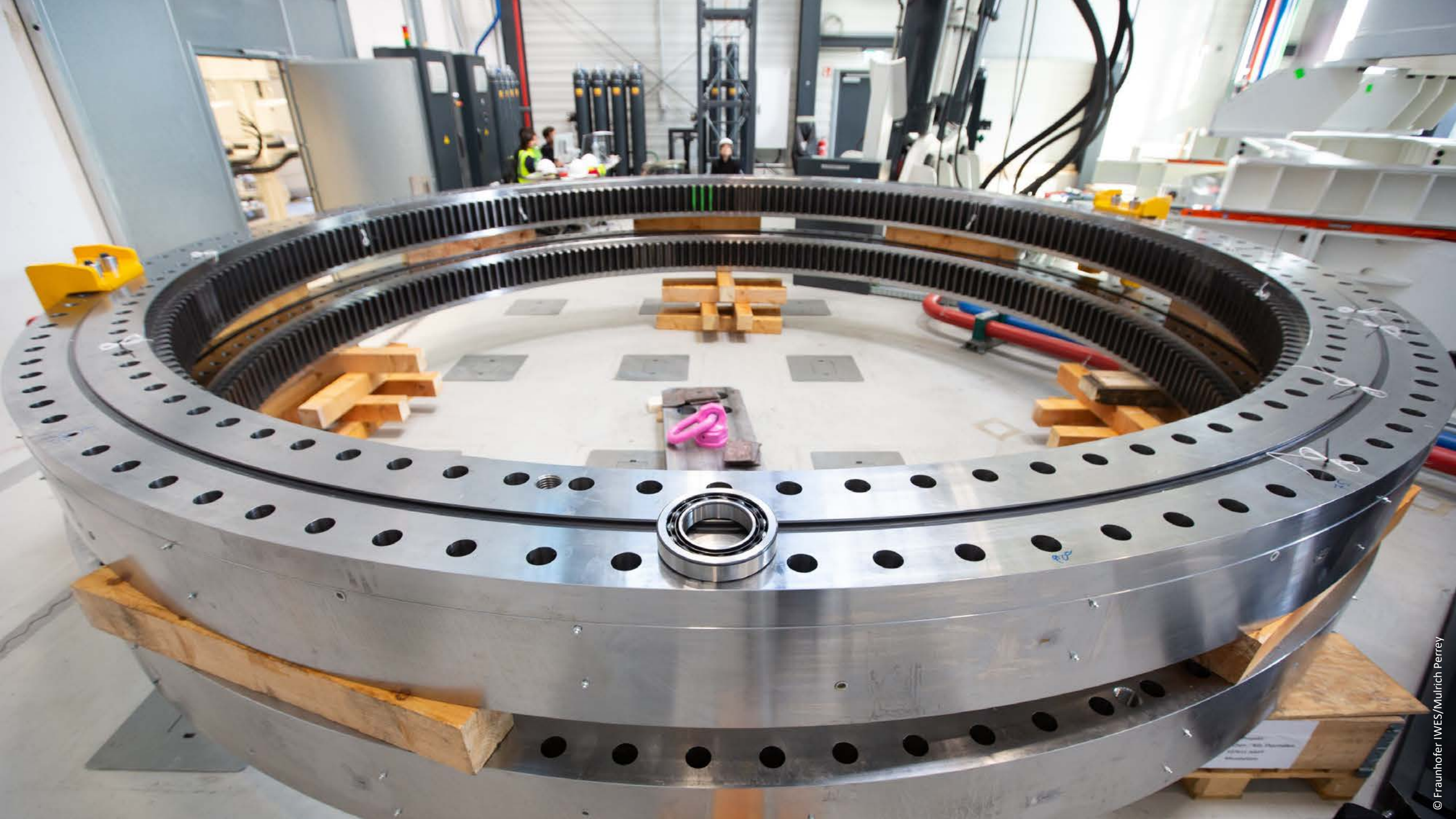
Fraunhofer IWES, NREL, and DTU are going to revise the DG03 throughout 2023 and publish it as a technical report at the end of the year.

## Wind Turbine Design Guideline DG03: Yaw and Pitch Rolling Bearing Life

T. Harris  
J.H. Rumbarger  
C.P. Butterfield

*Technical Report*  
NREL/TP-500-42362  
December 2009





# Table of Contents

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2009 DG03 section	2023 DG03 section
Design Types	Basic Principles
Summary of Calculation Methods	Summary of Damage Modes and Calculation Methods
	Finite Element Models
Calculation of Bearing Fatigue Life	Calculation of Bearing Fatigue Life*
Bearing Static Capacity	Bearing Static Capacity
Estimation of Case-Core Interface Depth	Estimation of Case-Core Interface Depth

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\*Rolling Contact Fatigue *and* Structural Fatigue

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## 2009 DG03 section

Effective Lubrication

Bearing Friction Torque

Miscellaneous Design Considerations

## 2023 DG03 section

Effective Lubrication and Wear Prevention

Bearing Friction Torque

Miscellaneous Design Considerations

# Today's Agenda

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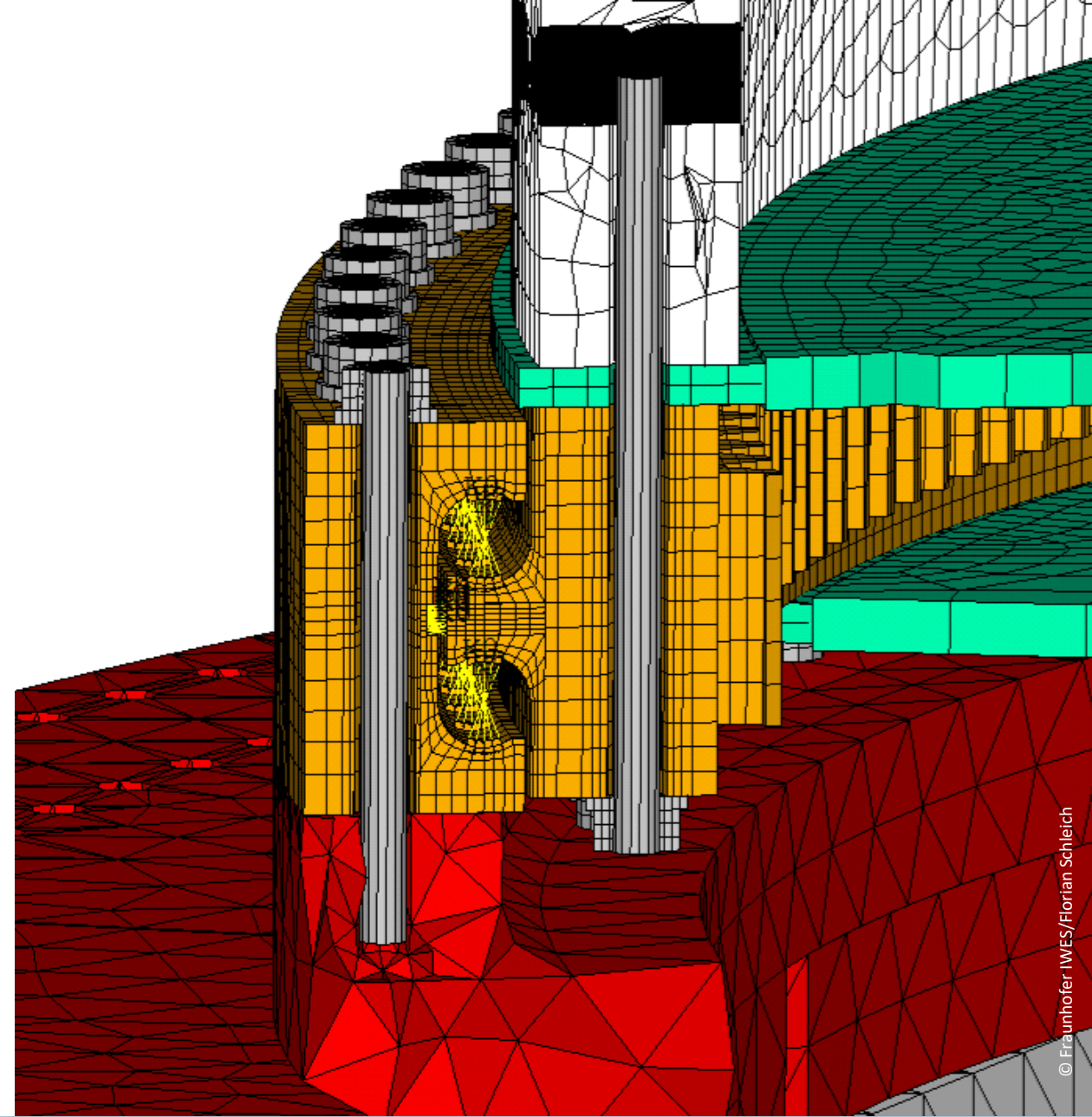
- Finite Element Models
- Rolling Contact Fatigue
- Raceway Wear
- Friction Torque
- Bolt Pretension



# Finite Element Models

# Finite Element Models

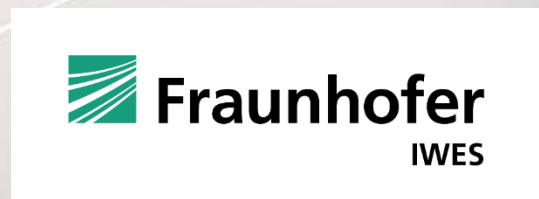
- Interfaces
- Frictional Contacts
- Rolling Bodies
- Bolt Modelling







DG03 will define minimum requirements for FE models of pitch and yaw bearings.



# Rolling Contact Fatigue



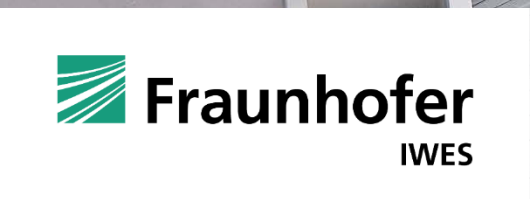
# Rolling Contact Fatigue

- Lubrication factor
- Fatigue life vs. service life
- FE vs. approximated calculations
- Time series vs. binning





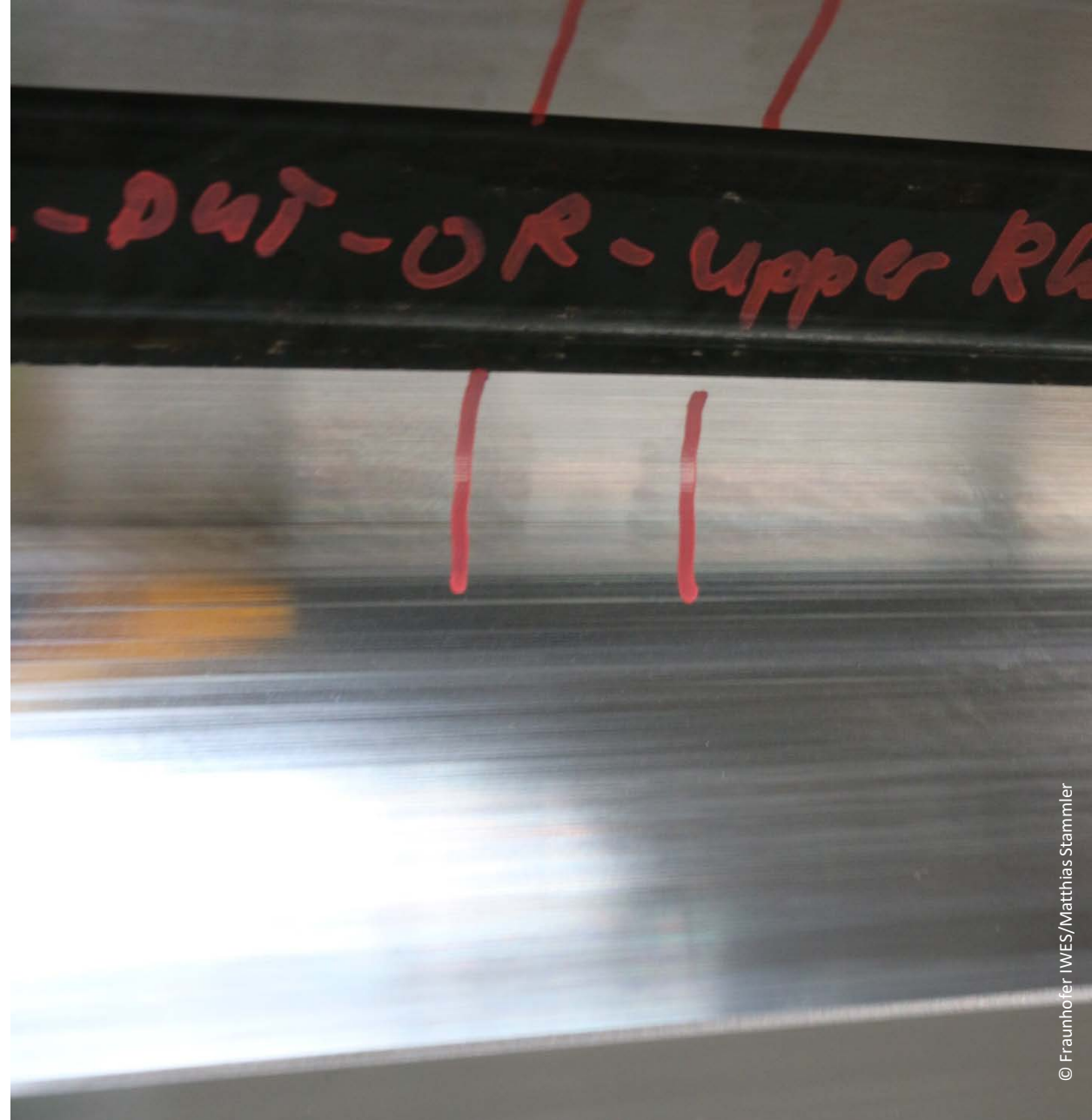
DG03 will provide concise, unified, state-of-the-art RCF approaches



# Raceway Wear

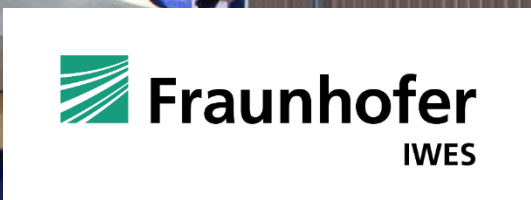
## Raceway Wear

- Overall risk of wear
- Geometrical thresholds
- Prevention of wear by the controller





DG03 will...



# Friction Torque



# Friction Torque

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- Results of tests show a huge variation in friction torque even between same-make four-point bearings
- Significant influence of preload
- Old formula is very conservative



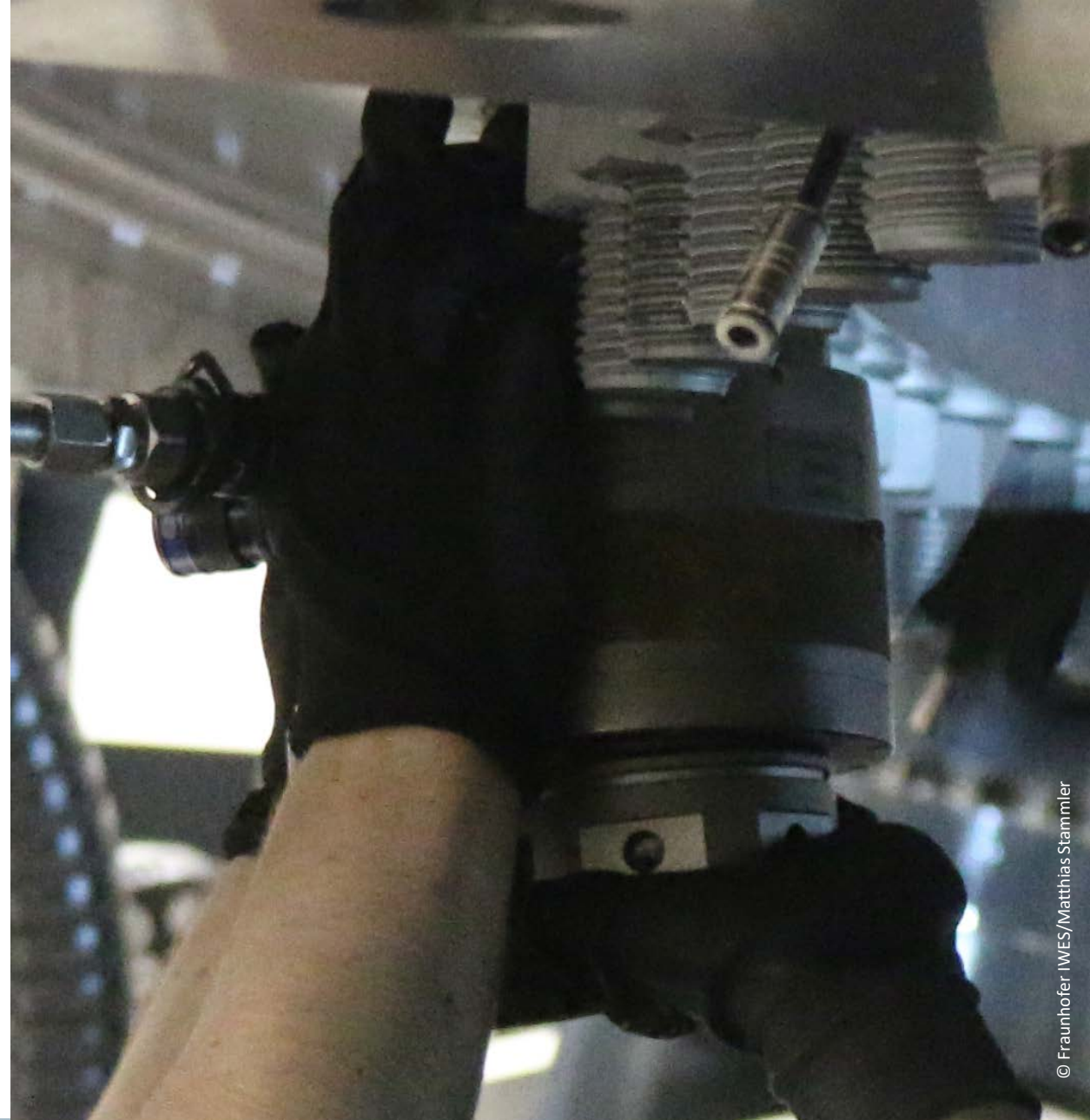
Friction torque formulas will stay the same.



# Bolt Pretension

# Bolt Tensioning

- Bolt pretension influences bearing deformation under load
- Bolt pretension drives rolling body pretension with split-ring bearings





DG03 will contain best practices for bolted connections.



Thanks a lot for  
your attention!  
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# Contact

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