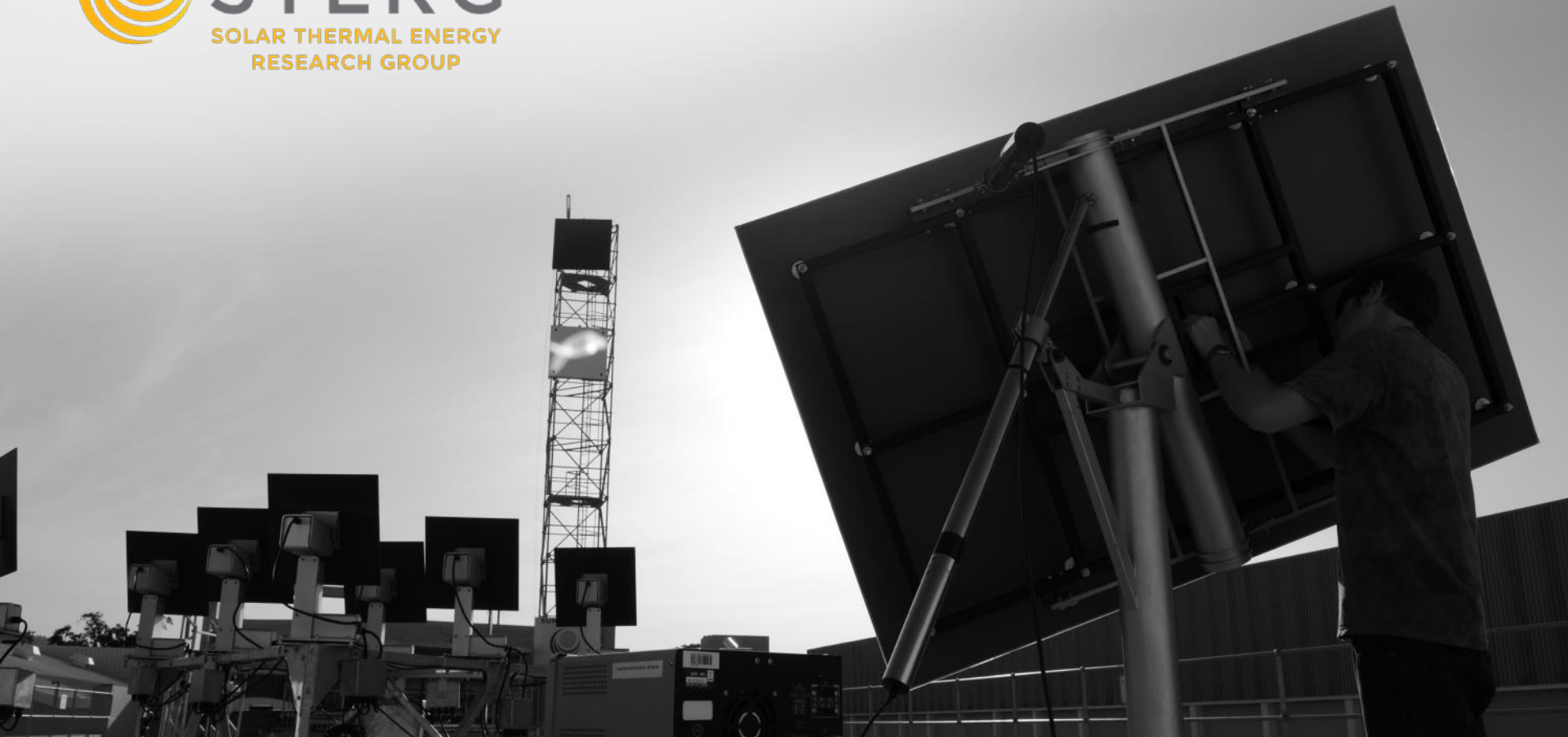
STERG

SOLAR THERMAL ENERGY RESEARCH GROUP



Investigation, evaluation and selection of optimal bearings to be employed in a newly designed heliostat

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Supervisor: Frank Dinter

Overview

- Introduction and Background
- Problem Statement
- Maintenance Free Bearings
- Test Rig
- Loading Conditions

Introduction and Background

- sbp sonne
- Pentagon Shaped Concentrator ($47{,}5m^2$)
- Drive Design similar to Helio 100

Three Significant Innovations

- Reduced Cost by Sloped Drive Axis
- Pentagon Shaped Concentrator
- Unprecedented Optical Quality

Problem Statement

- Task at sbp sonne?
- Low cost – Maintenance Free Solution
- 24 000 Heliostats
- 12 Bearings per Heliostat (288 000)
- Impact of Dust and Misalignments
- Difficult to Predict Lifetime (Catalogues)

Typical Bearing Life Calculation

- Operation (0,08 RPM)
- Stick Slip Condition
- Impact of Dust not Considered (Temperature Factors)
- Only Radial Loading is Considered

Bearing Requirements

- Maintenance Free
- Low Friction
- 25 Year lifetime
- High tolerances
- Misalignments

Maintenance Free Bearings

- Metal - PTFE Flanged Bearings
- Fibre Composite
- Plastic Bearings (Not Considered)

Metal – PTFE Flanged Bearings

- Sintered Metal Base with PTFE coating
- Low Cost
- Ability to Absorb Small particles
- Allows for Misalignments

Fibre Composite Bearings

- PTFE sliding layer on glass-fibre reinforced carrying layer
- High Static and Dynamic Loading
- Lower Wear Rate
- Designed for low sliding speeds
- Higher Cost Solution

Bearing Applications

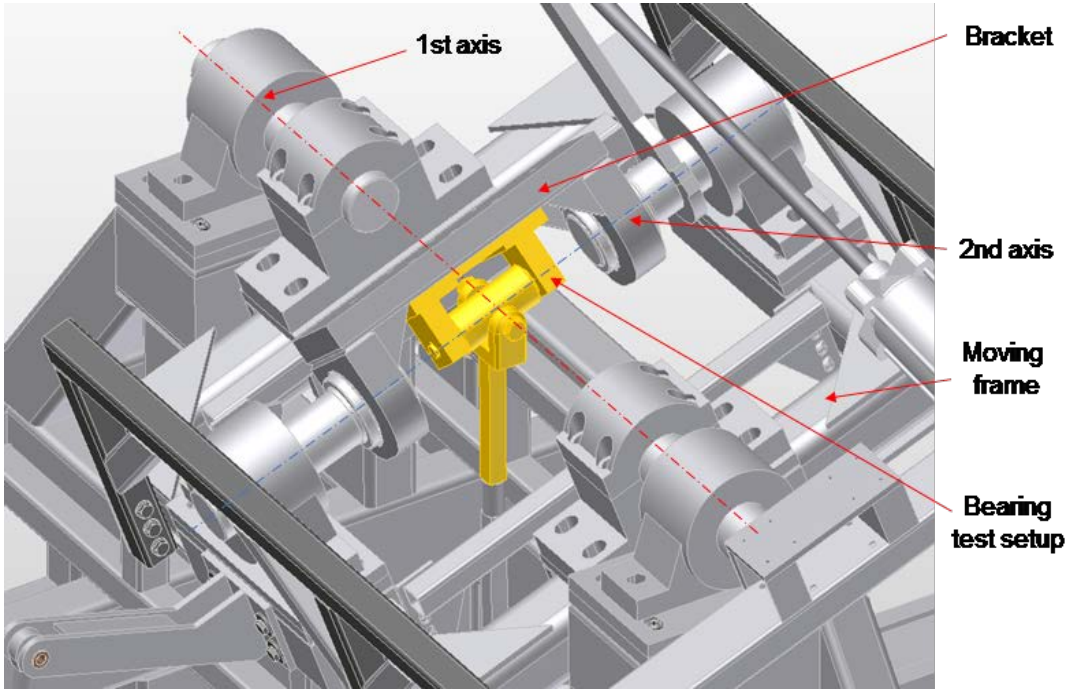
- Both Solutions are adequate
- Risk Assessment
- Main and Secondary Axis – Fibre Composite
- Trunnion and Cardan Joint – Metal – PTFE

Test Rig Requirements

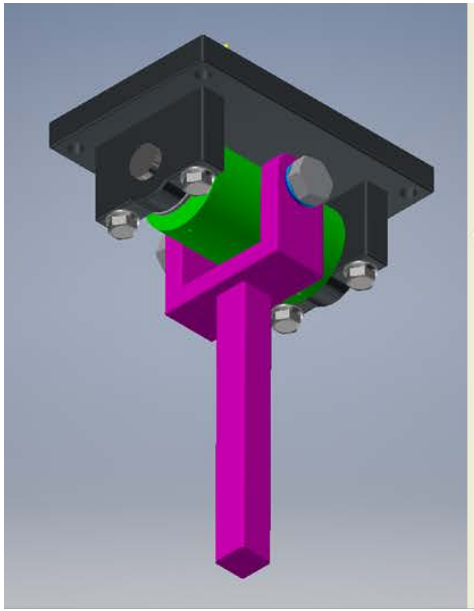
- Rotational Cyclic Motion
- Axial and Radial Loading
- Testing of Misalignments
- Simulate Dust

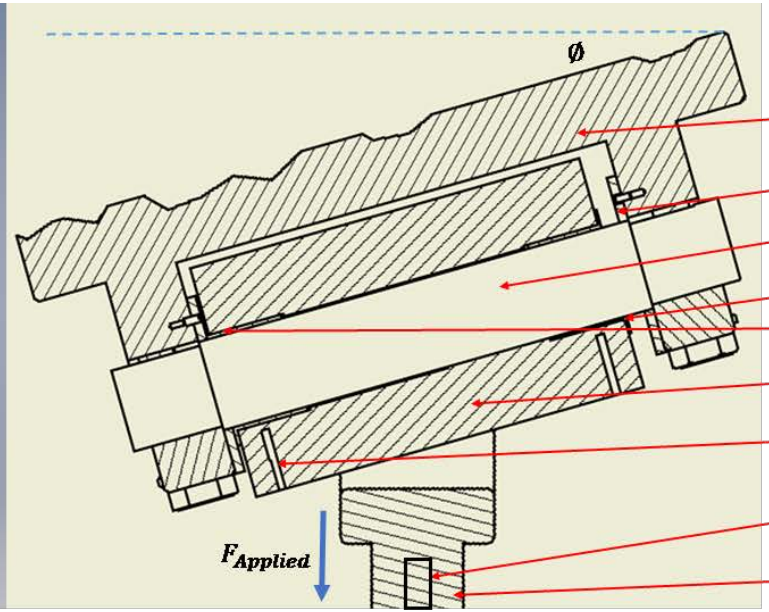
Test Rig Final Design

- Adaptation of Cardan Joint Test Rig
- Rotation About Two Axis



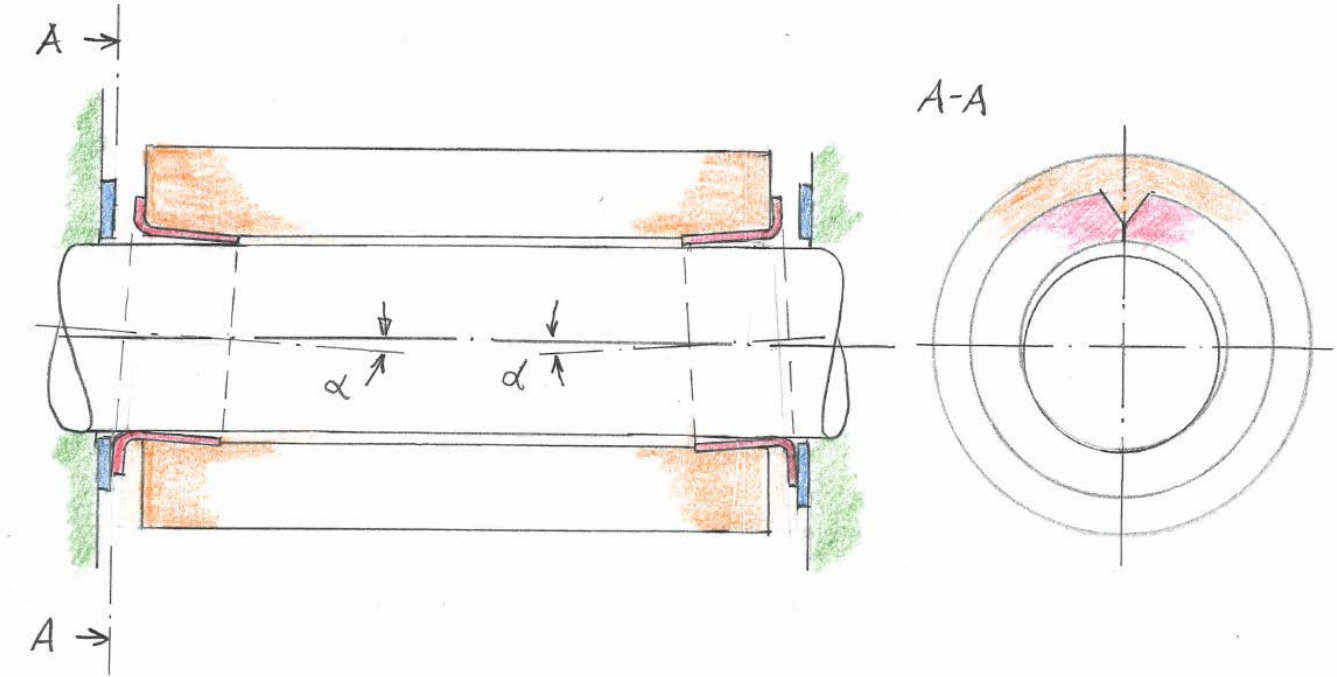
Bearing Test Rig



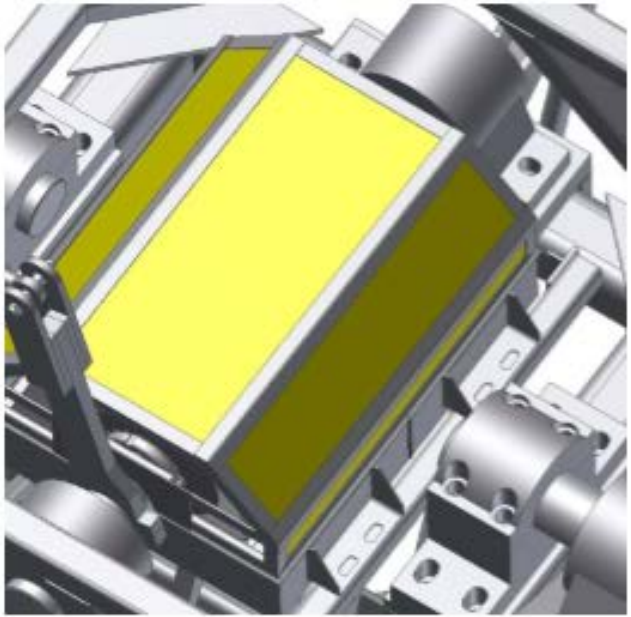


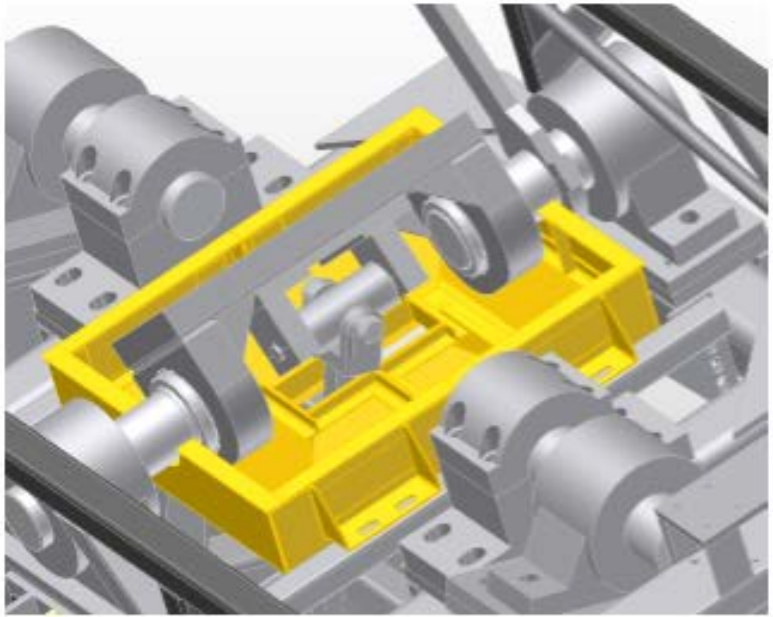
Base Plate
Thrust Washer
Shaft
Bearing B
Bearing A
Bearing Housing
Thermo-couple Placement
Strain Gauge Placement
Loading Arm

Accounting For Misalignments



Dust Simulation





What Dust Should be Used??

- $150\mu m$
- Several ISO and MIL Standards

Loading Conditions

- Worst Case Identified
- 4 Load Steps Reduced to a single

Condition	Fibre Composite	Metal - PTFE
Axial Pressure (MPa)	28	67
Radial Pressure (MPa)	40	57
Sliding Distance (m)	305,7	259,3
Number of Cycles	6371	5406

THANK YOU

ACKNOWLEDGEMENTS:

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Ingemetal Solar
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