

# Fracture Analysis of a Cycloidal Gearbox as a Yaw Drive on a Wind Turbine

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## Introduction

Reliable components are essential to Wind Turbines. Their improvement undoubtedly passes through understanding the failure modes in the field and researching ways to boost their technology level.

## Methods

- Fracture surface analysis
- Hardness tests
- Finite Element Method (FEM)
- Lifetime calculation

## Results

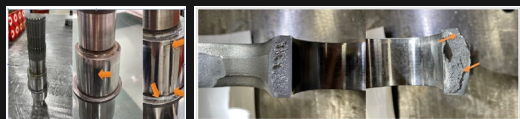
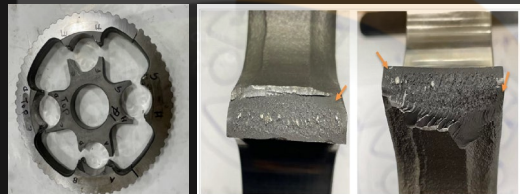
- Hardness complies with specs
- Cracks nucleated at highest stresses regions revealed by FEM
- No signs of high impacts that could have led to the failure

## Discussion

- A premature failure happened
- Cracks propagation was by fatigue benchmarks
- Fracture analysis complies with fatigue phenomena preconditions
- Fracture was by high-cycle fatigue



<https://www.power-eng.com/om/whats-the-next-big-thing-in-wind-turbine-monitoring/#gref>

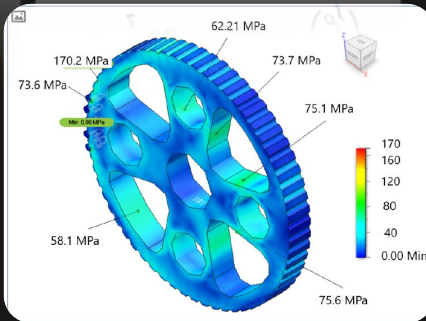


Conditions to have Fatigue:

- Cyclical loading ✓
- Tensile stress ✓
- Residual stress (tensile) ✓

$$\sigma_a = \frac{\Delta \epsilon_e}{2} \cdot E = \sigma'_f \cdot (2N)^b$$

$$\therefore \frac{\Delta \epsilon_e}{2} \cdot E = 2N = \left( \frac{\sigma_a}{\sigma'_f} \right)^{\frac{1}{b}}$$



## Overview of the yaw drive parts



Description	Condition	Hardness
Spur gear	Preserved	55 HRC
Output Flange	Preserved	220 HB
Crankshaft	Deformed	59 HRC
Cycloidal disc (OD)	Broken	60 HRC
Cycloidal disc (ID)	Broken	55 HRC

## Acknowledgments

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## References

[www.etasr.com](http://www.etasr.com). Martins & Romao:  
Fracture Analysis of a Cycloidal Gearbox  
as a Yaw Drive on a Wind Turbine

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