

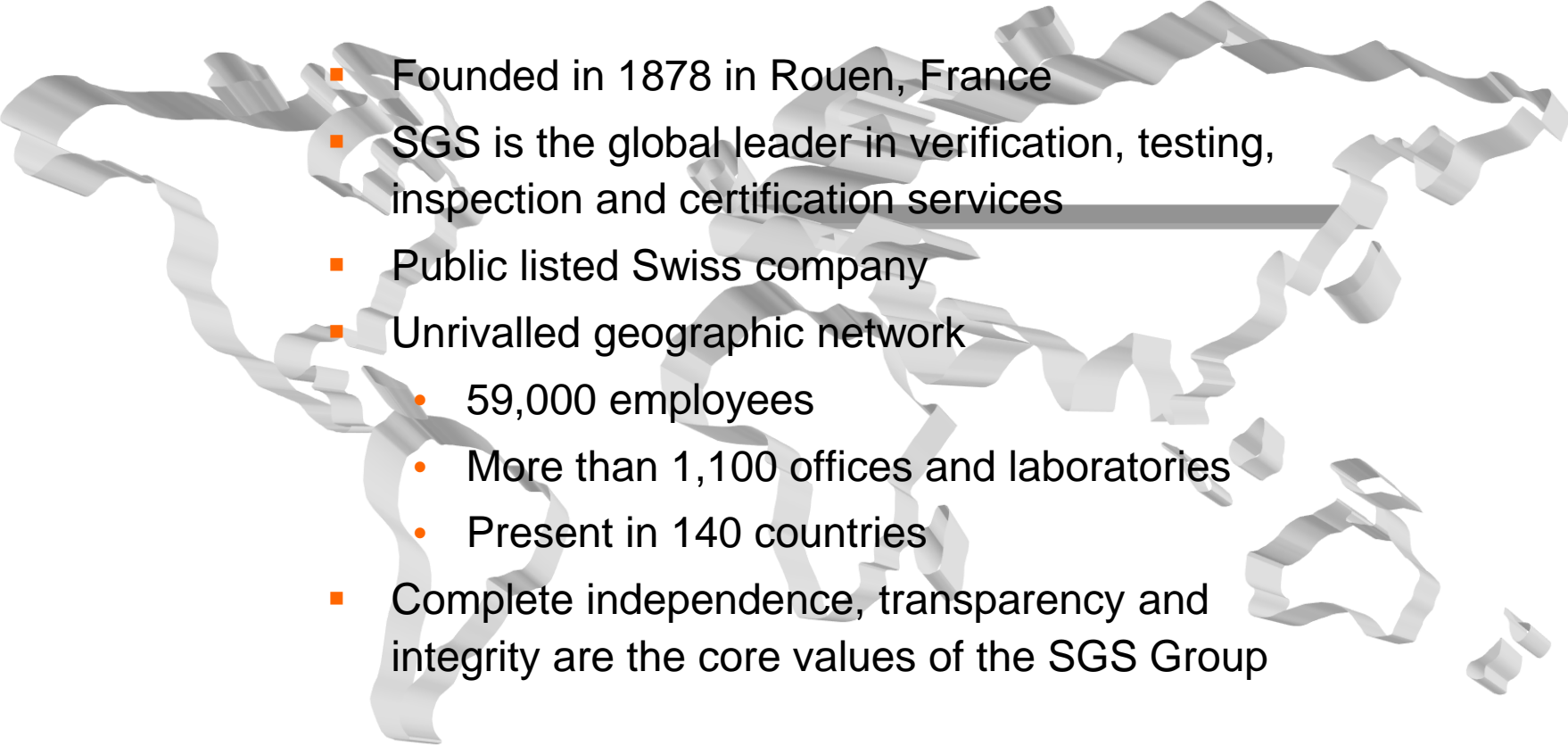


SGS

**SGS Germany GmbH**  
**Wind Energy Services**  
**Proactive Maintenance Concepts**

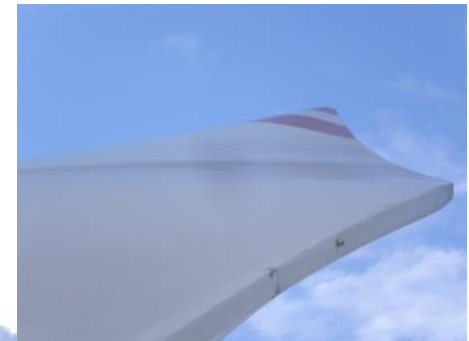
*“ Vorwegnehmende Instandhaltung von Windenergie-  
anlagen“ 10./12. November 2015*

*von Axel Schweighardt*  
*Technical Wind Energy Expert*

- 
- Founded in 1878 in Rouen, France
  - SGS is the global leader in verification, testing, inspection and certification services
  - Public listed Swiss company
  - Unrivalled geographic network
    - 59,000 employees
    - More than 1,100 offices and laboratories
    - Present in 140 countries
  - Complete independence, transparency and integrity are the core values of the SGS Group

- **SGS Wind Energy Technical Competence Centre**
  - Hamburg / Germany
  
- **SGS Wind Energy Technical Offices**
  - Germany, UK, USA
  - China, Spain, India
  
- **SGS-TÜV GmbH**
- **SGS Fresenius, SGS Gotfeld**
  - testing (NDT)
  - inspection (side, blade, manufacture)
  - certification (project, TDD)
  - monitoring services

for wind turbines in Germany



- 175 people world wide
- 10 wind energy staff in German office (HH)
- External experts with frame agreement



# proactive maintenance concepts







- Project Certification On- and Offshore Wind Farms
- QA/QC Management and inspections
- Design Approval Foundation
- Risk Management Consultancy
- Non Destruction Testing (NDT) Steel Design and Blades
- Approval Coating Plan and Inspection
- Construction Supervision, NDT, Transformer station, Foundation, Blades and Tower
- Failure analysis, Subcontractor Audit
- Measurement Data Verification
- Laboratory Analysis Oil Sample and Metal Sample
- New Technology for Measurement and Install Management (as Sample intellifast)



## Main Causes for damages on Wind Turbines

- Site Specific Conditions not considered in the Design
- Unforeseen Loads
- Poor material quality
- Wrong choice of materials
- Specifications not followed
- Manufacturing faults
- Transportation damages
- Improper mounting / fastening
- Inadequate Service and Maintenance
- Improper In-Service Condition Monitoring

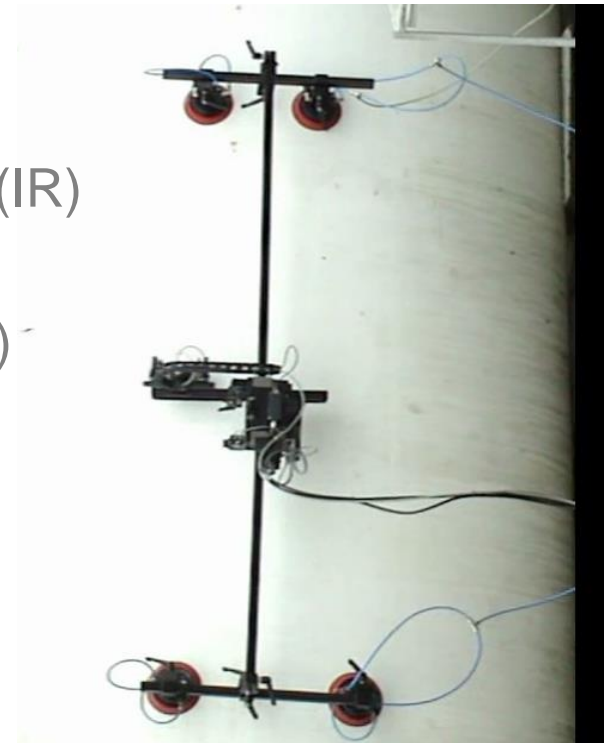


## Rotor Blade Monitoring – Advanced Inspection Technology (1)

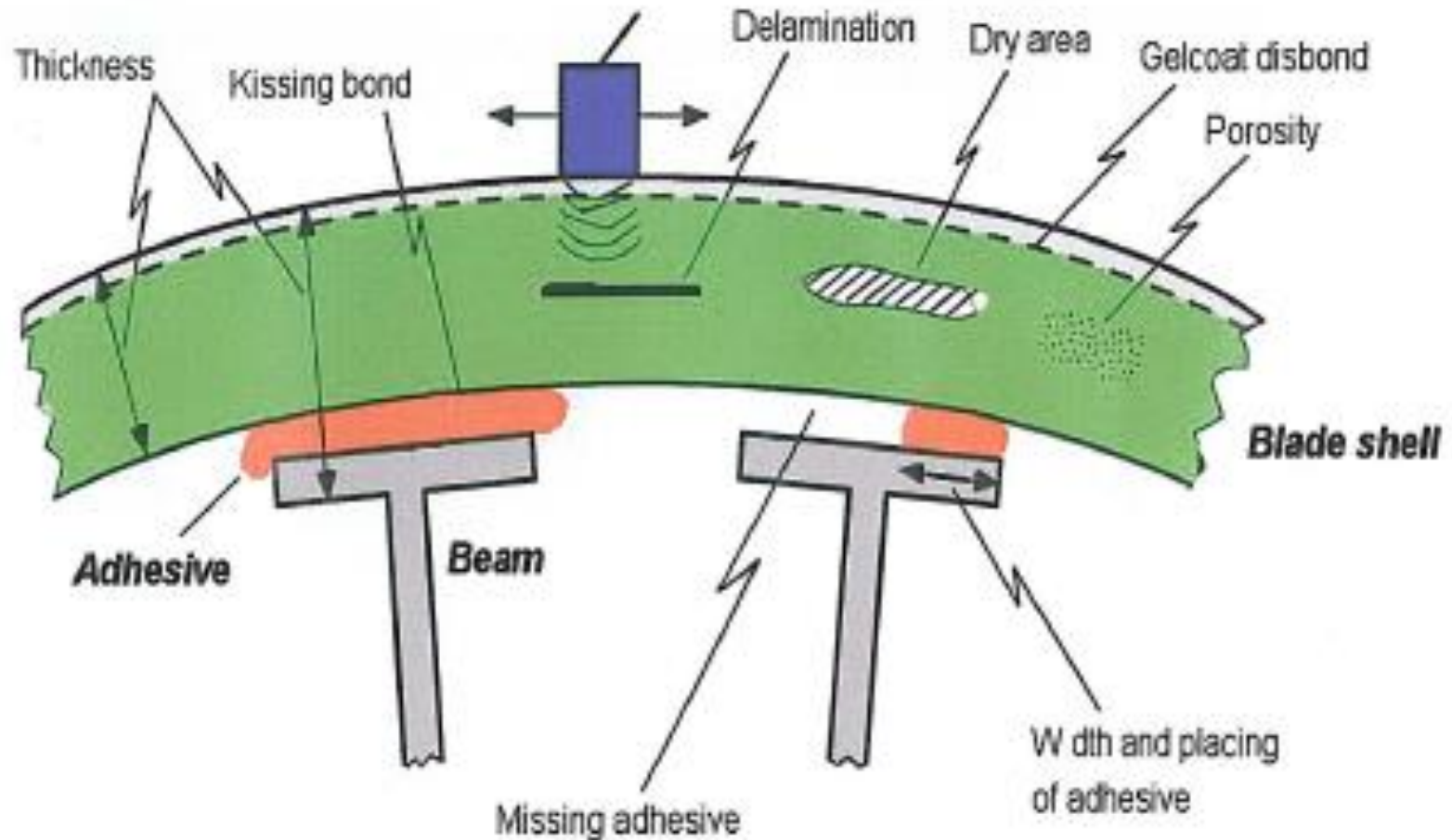
- Structural defects (incorrect bonding at LE & TE and between beam & shell, Delamination, internal cracks)



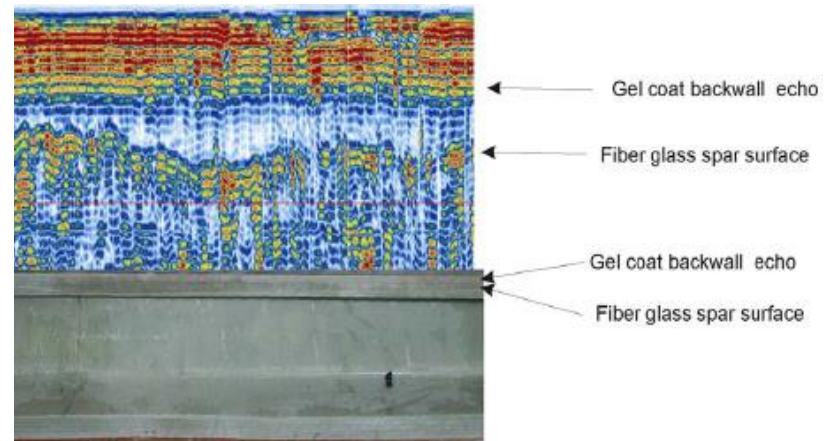
- Infrared Thermography (IR)
- Ultra sound Testing (UT)

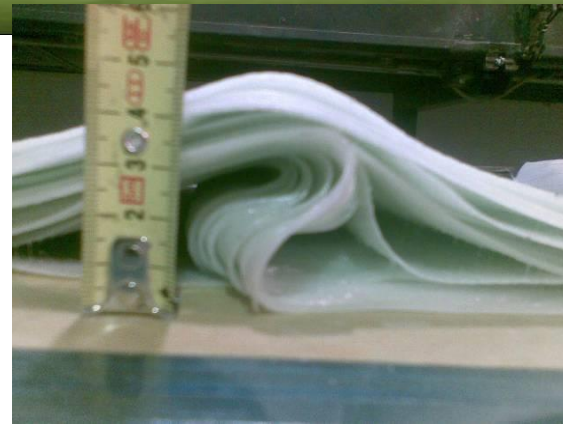


### Information from NDT Inspections:



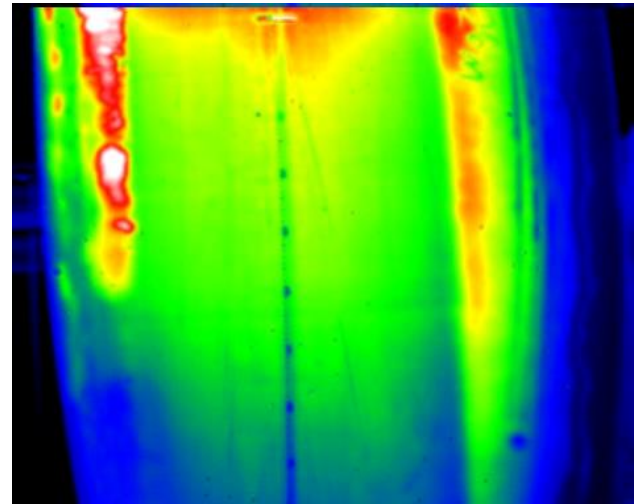
### Ultrasonic Testing (UT)





Wrinkled, undulated glass  
fibres are weak points in GFRP  
(Glass Fibre Reinforced Polymers)  
Materials/structures subject to  
fatigue loading

### Infrared Thermography

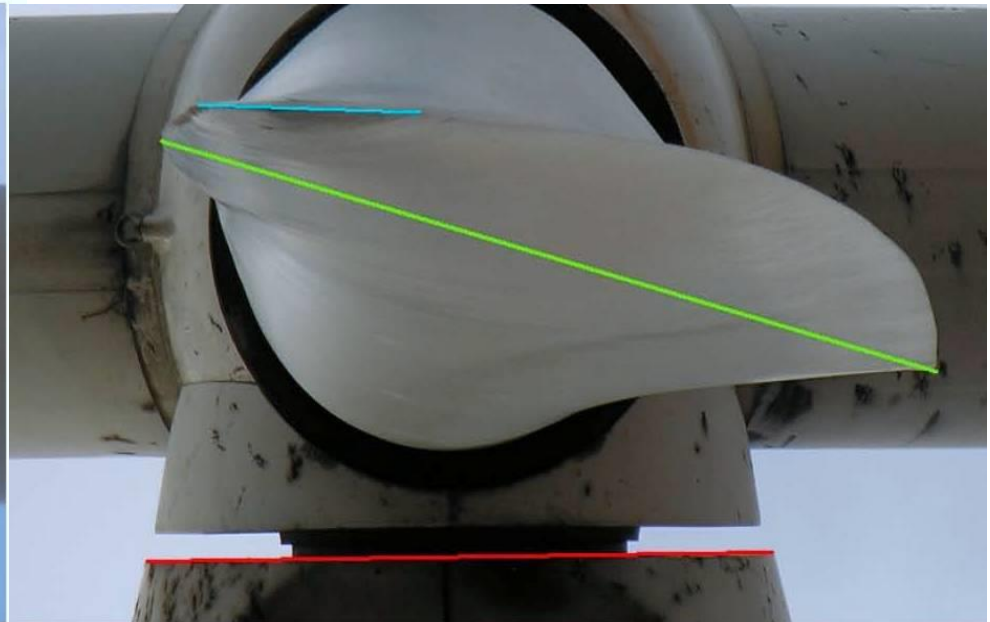


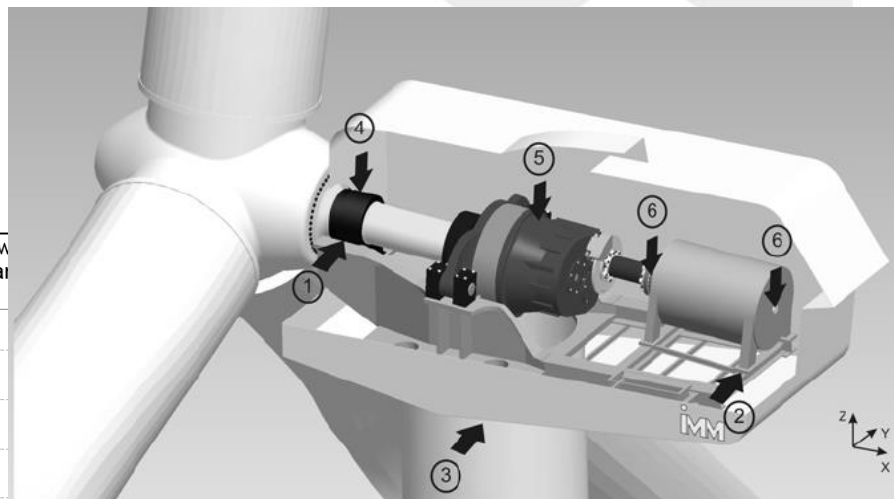
## Visual Inspection

- Outside surface defects
- Flaking, Erosion, Cracks, open structure, Sink holes and Pin holes

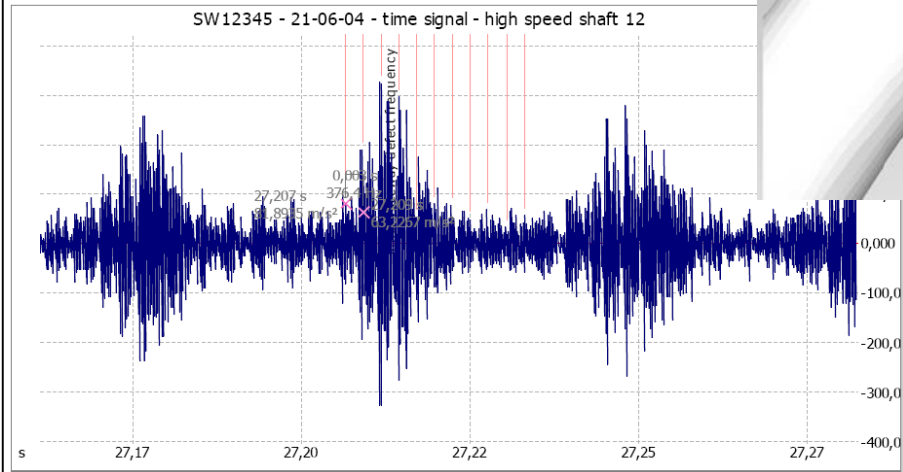


### Pitch Angle Measurement





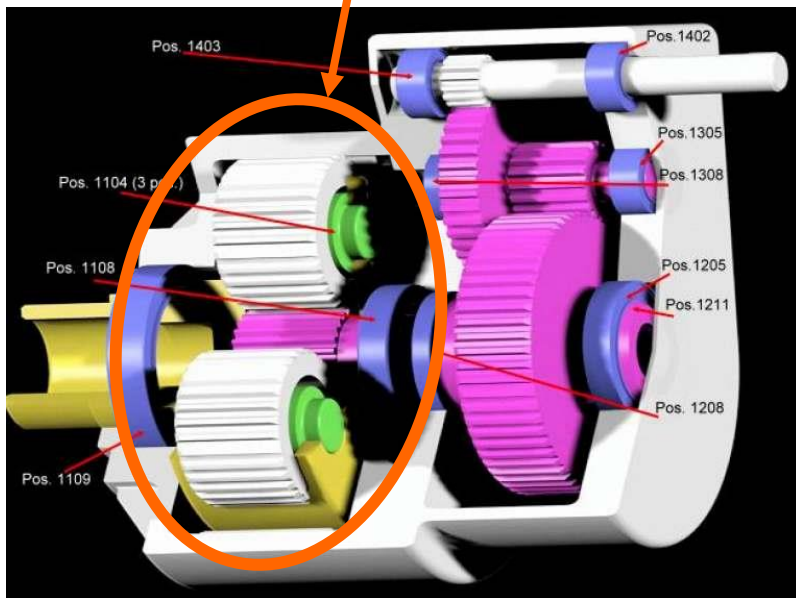
The time waveform of the measurement 'high speed shaft 12' shows pulses w of the inner raceway defect frequency of the non driven high speed shaft bear be an indication for an inner race defect.



high speed shaft bearing 2 █ Alarm

The inner race of the bearing is seriously damaged. The bearing has to be replaced to avoid further defects.

Damage detection in planetary stage supported by oil analysis



Vernolab

HYDRAU-SERVICES

Customer Name :  
Internet Login : xxxxxxxx

EQUIPMENT	SAMPLE
<b>Registration nr : 00137888</b> <b>Component : BHY</b> Equipment desc. : HYDRAULIC Fleet no. : 117 CHE Ref. ID : Equipment (km/hr) : 0,0*	<b>Sample number : 02388863</b> Date Sample taken : 09/04/xxxx Date of analysis : 19/04/xxxx Lubricant in use : SHELL TELLUS 46 Lubricant (km/hr) : 15500 Top-up (l) : 0,0

**CONTACTS:**

Technician: Mr. TECHNIK	Administration: Miss PENCIL	Commercial: Mr. SELLER
Phone :	Phone :	Phone :

Sample number	1874044	1876038	1876090	1876446	2385893	02388863
Date Sample taken	20/06/xxxx	20/10/xxxx	22/01/xxxx	14/05/xxxx	03/10/xxxx	09/04/xxxx
Equipment life (km/h)	0,0*	0,0*	0,0*	0,0*	0,0*	0,0*
Lubricant life (km/hr)	4000	6000	7000	10000	12500	15500
Top-Up (Wg)	0,0	0,0	0,0	0,0	0,0	0,0

POLLUTION  
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WEAR  
-----

LUBRICANT  
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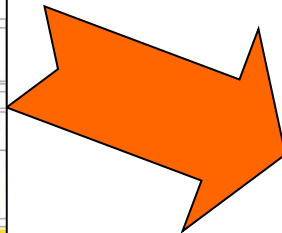
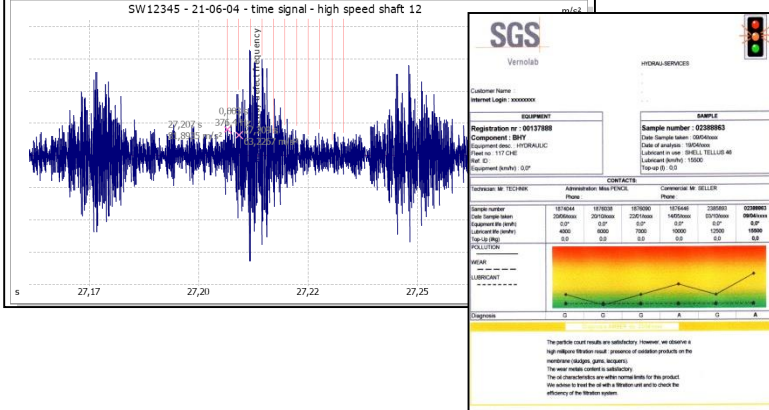
Diagnosis	G	G	G	A	G	A
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Diagnosis AMBER du 23/04/xxxx

The particle count results are satisfactory. However, we observe a high millipore filtration result : presence of oxidation products on the membrane (sludges, gums, lacquers).  
 The wear metals content is satisfactory.  
 The oil characteristics are within normal limits for this product.  
 We advise to treat the oil with a filtration unit and to check the efficiency of the filtration system.

### Information from Video Endoscopy:

The time waveform of the measurement 'high speed shaft 12' shows pulses with a distance of the inner raceway defect frequency of the non driven high speed shaft bearing. This could be an indication for an inner race defect.



- **Visual impression** of inspected components
- **Validation** of oil analysis and vibration measurement results



# Manufacture Inspektung Supplier Assessment and Audit



The purpose of the supplier audit is to:

- establish confidence in that the components produced are in compliance with specifications and the manufacturer's quality system.
- establish confidence in that components are produced in such a way that they will sustain the environment seen and function without failure in specified life time.





The scope of the supplier audit is to verify that:

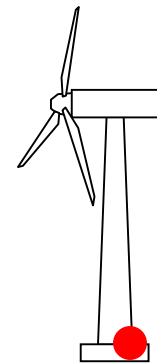
- the documentation used for manufacturing of components are sufficient taken into account the actual process used.
- the quality plan, process flow chart, work instructions and test instructions are sufficient and followed.
- processes are capable and kept within specified limits
- the components produced fulfils the design basis and that non-compliance is dealt with.
- documentation is under configuration control to ensure traceability of parts produced.

- **Manufacture Inspection**, Design Approval and Audits
- Save your Risk and Approval Quality of Turbines, Blades, Gearboxes, Generator and Foundation
- The Design are according to Site Specific Conditions
- Turbulence and Distance of the Turbines
- Take care of Quality and Manufacture
- Observe the **1:10:100 Rule**
- **Park Leader Model** for implementation  
RCM Relifabbility – centred Maintenance (Zuverlässigkeit-orientierte Instandhaltung)
- Technical Management Software and IPS-System
- Minimize Spare Parts
- Control Service and Maintenance
- Condition Monitoring (detective maintenance)



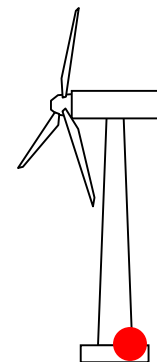


**Improper sealing**





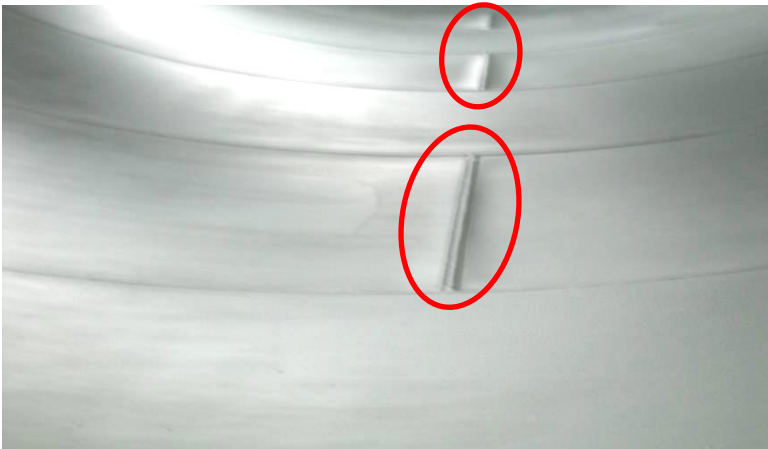
**Cracks inside  
cast down  
part**



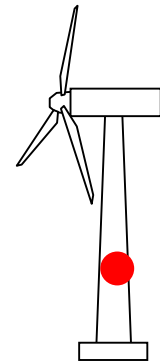
## Defect painting



## Corrosion

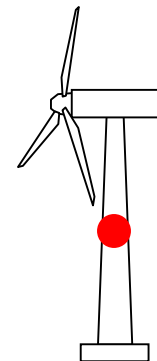


## Imperfection



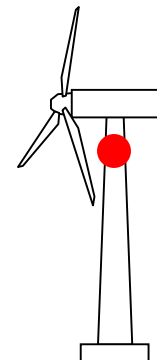


**Safety rail mounting**

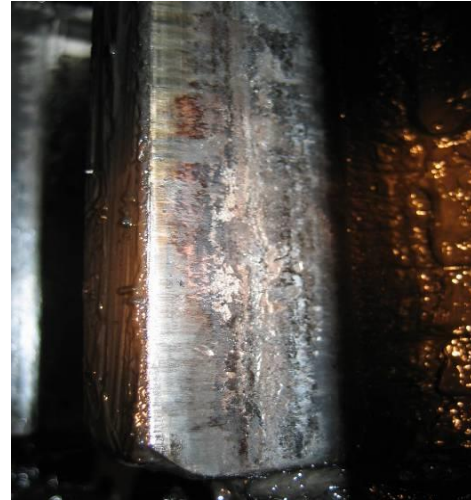




**Cables worn on  
panel frame**

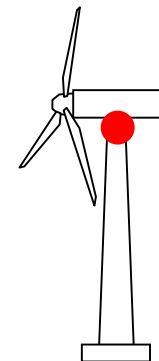
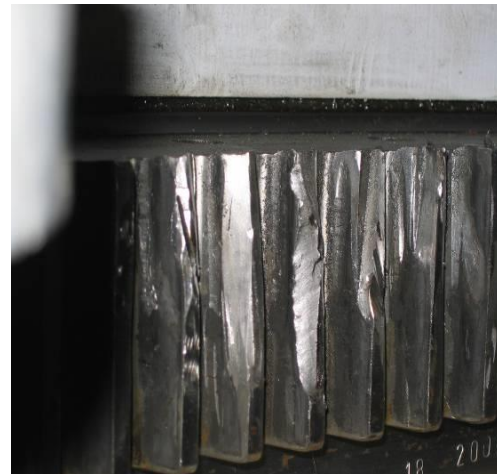


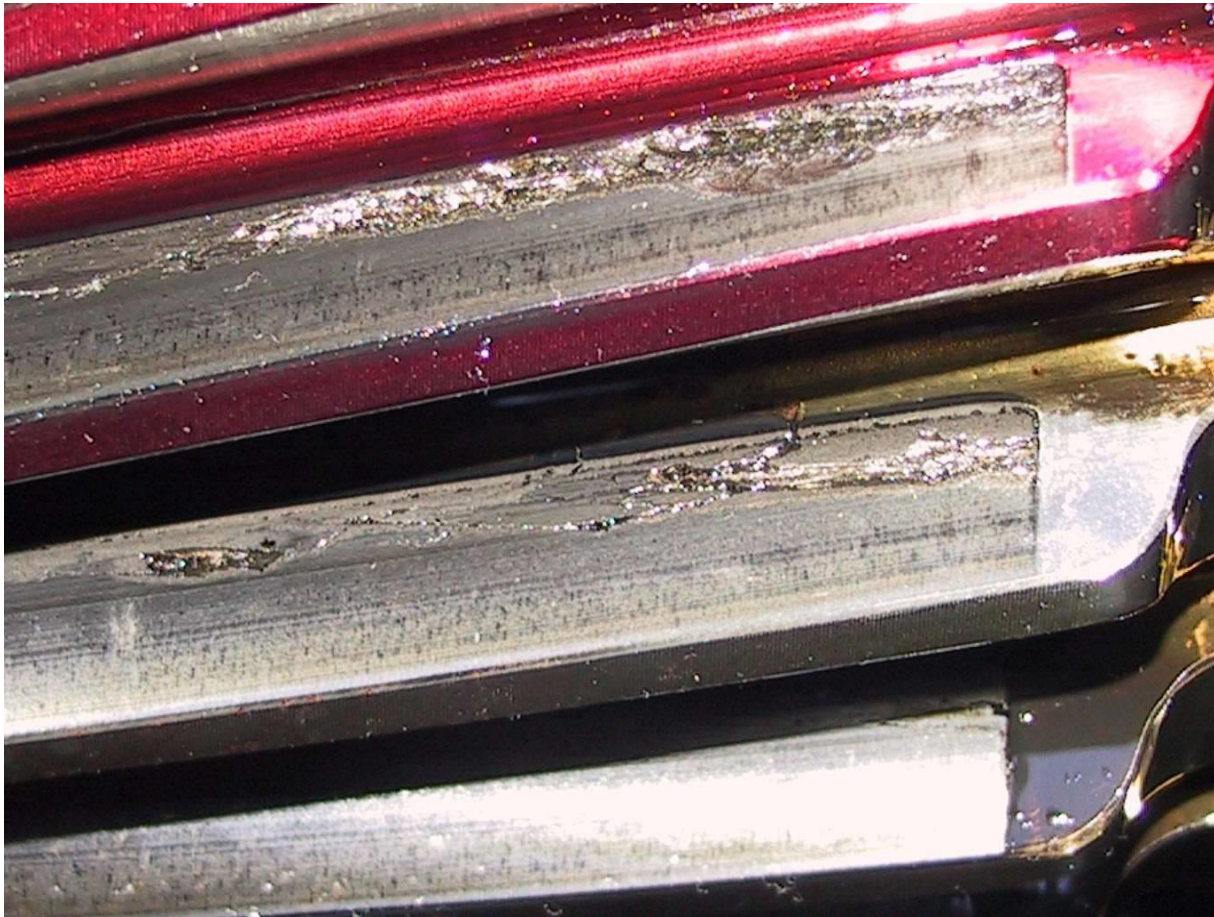
**Corrosion**



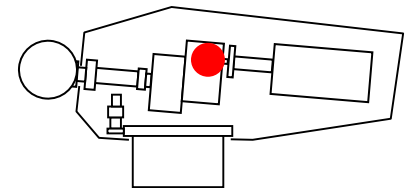
**Macro pitting**

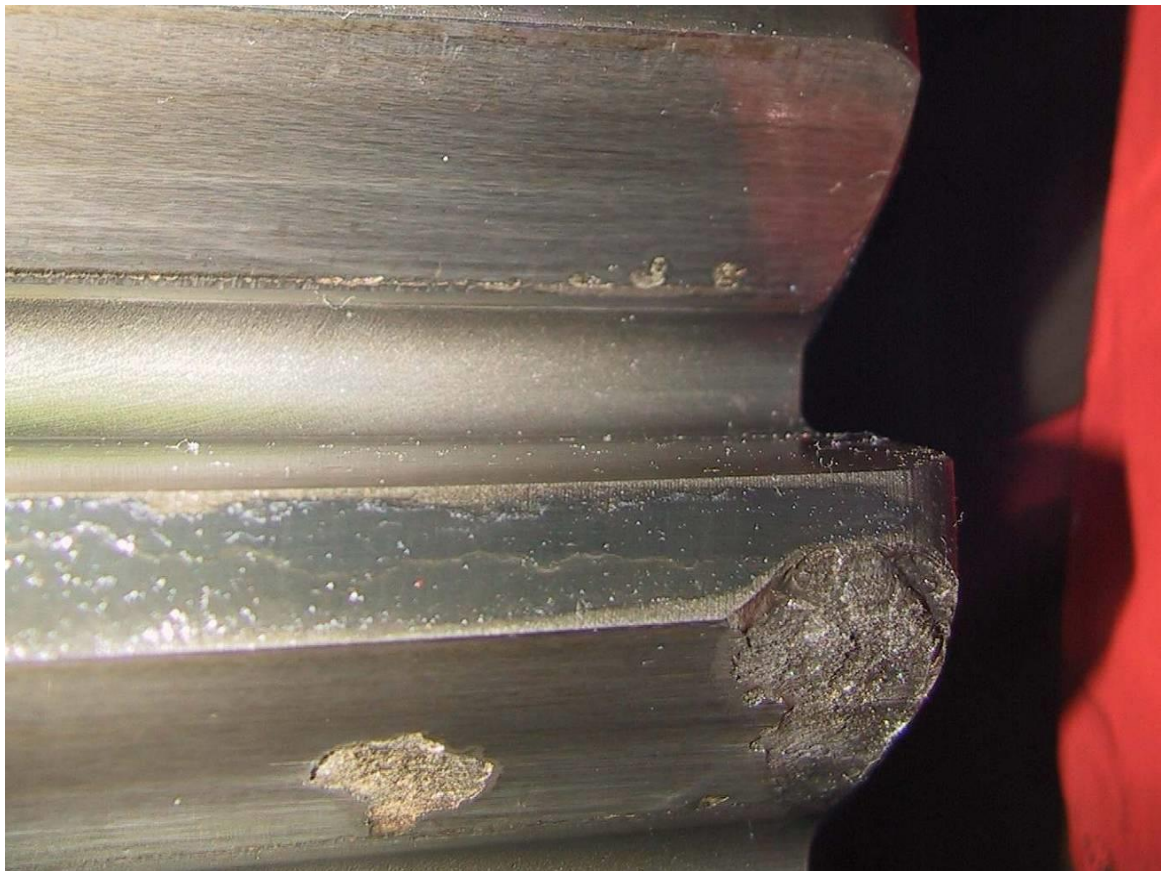
**Broken teeth**



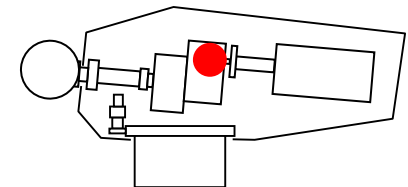


**Macro pitting**



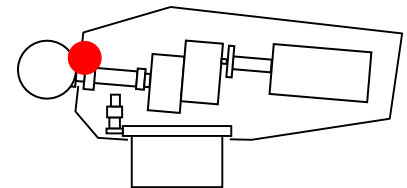


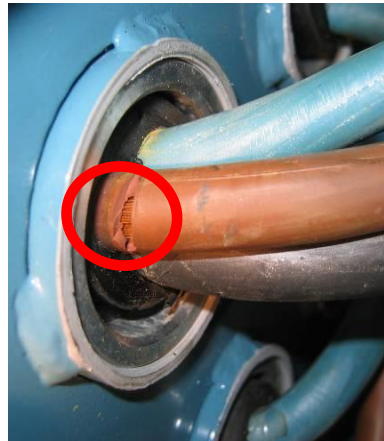
**Macro pitting**





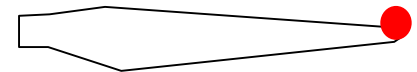
**Scaling on inner race**

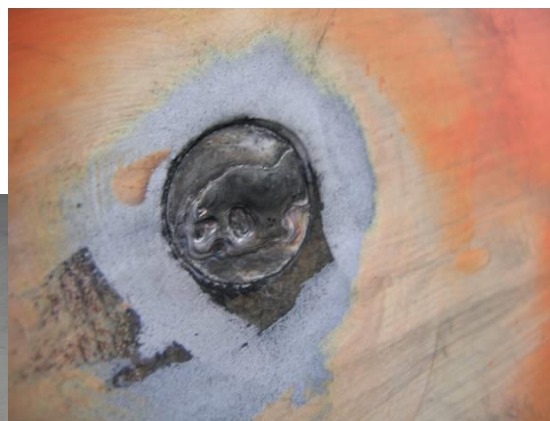
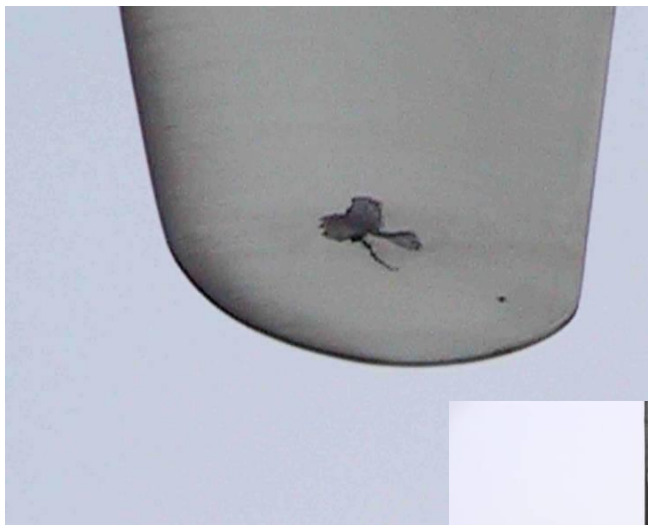




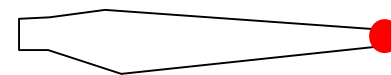


Air pocket due to improper glue filling





Damages from lightning stroke



**Thank you for your  
attention!**

# Minimizing Maintenance Cost and Coffer your Risks.

**Thank you.**

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email: [axel.schweighardt@sgs.com](mailto:axel.schweighardt@sgs.com)