

## Welcome to the webinar: "Composite materials - Practical hints for strain gauge installations and measurements"







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## Agenda



- 1. Introduction composite materials
- 2. Chosing the right parameters/setup for strain measurements on composites
- 3. Live Demo on CFK blade



## Advantages of composite materials

- Outstanding ratio of strength to weight
  - (Improved fuel efficiency)
- High load and bending
- Designability of materials (strength, rigidity, thermal, electrical resistance, shape, function)
- Temperature resistant
- Chemically resistant
- High corrosion resistance



Nanocomposites: the fiber reinforcement is on the extremely small "nano scale" (1\*10-9 meters)



#### Composites are used in a lot of branches...



- Aerospace (fuselage, engine parts..)
- Automotive/Motor sports (Aerodynamic and chassis parts, side panels, caravans)
- Big vehicle bodies (trains, trucks, buses)
- Marine (Fuselages)
- Wind power (Blades)
- Energy (Tanks, tubings)
- Sport articles (Bikes, Ski)
- Infrastructure and buildings (repair of buildings, GFRP bridges)
- Medical technology (human prostheses, x-ray tables)







Short fibers





Challenging thermoelastic behavior



 $\alpha_1$  $\varepsilon_{l}$  $\alpha_2 \Delta T$  $\varepsilon_2$ = 0

## Strain measurements typically performed on composites



# Full Scale (Static + Fatigue testing) Strain measurements on relevant part area with risk of Potential failure **Copyright IABG Components (Static + Fatigue testing)** Tests in special test rigs or universal test machines Designlife/Glyphworks Coupon tests (Static + Fatigue testing) Test standards ASTM D 3039/DIN 65378 (Tensile) ASTM D 695 (Plane compression) • ASTM D 3518 (In plane shear) ASTM D 707 (V-notched rail shear)

#### And many many more....

#### Gauge resistance





#### Gauge selection





#### Surface treatment of composites

![](_page_9_Figure_1.jpeg)

#### Gauge orientation

![](_page_10_Picture_1.jpeg)

![](_page_10_Figure_2.jpeg)

Download whitepaper: https://www.hbm.com/en/3452/li66-strain-gauge/

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![](_page_10_Picture_5.jpeg)

#### Adhesive selection for composite materials

![](_page_11_Picture_1.jpeg)

#### Excitation voltage for composite materials

![](_page_12_Picture_1.jpeg)

## Strain gauge for integration in composites

![](_page_13_Picture_1.jpeg)

#### Integrated stain gauge (HBM LI 66)

- in bonded components ۲
- thermal stresses (hybrid structures) .
- for hard accessible locations
- for monitoring and stress analysis

Integration gives lower strain/stress results than on surface on bending loads Integration is more difficult and only possible during manufacturing of composite

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#### Content:

- 1. Fiber Composite Materials
- 2. Composite Material Theory
- 3. Basic Laminat Calculation
- 4. Integration of SG

Publication:

- free online version
- charge for print version

![](_page_13_Figure_16.jpeg)

![](_page_13_Picture_17.jpeg)

## Optical fibers for embedment in composites

- Integration of FBG based sensors into composites
- No influence on laminate strength from FBG
- Type of fiber coating Ormocer <sup>®</sup> or polyimide preferred
- Fiber with low bending radius helpful (micro and macro bending)
- Terminal FBG free from strain inside protecting tube for temperature compensation
- Temperature compensation through software

![](_page_14_Picture_8.jpeg)

![](_page_14_Figure_9.jpeg)

![](_page_14_Figure_10.jpeg)

#### 6. How can you test composites with HBM equipment

![](_page_15_Picture_1.jpeg)

![](_page_15_Figure_2.jpeg)

#### Live Demo on Blade Model

- Use case similar to a rotor blade test on helicopters
- Fullbridge configuration of linear and shear strain gauges

![](_page_16_Figure_3.jpeg)

#### Starting working with strain gauges....

![](_page_17_Picture_1.jpeg)

Many sources of potential hazards during strain gauge installations on composites...

1. Get in personal contact with our experts and visit our **HBM Academy** or book our experts for a seminar in your company

2. HBM offers complete **starter packages** including adhesives, strain gauges...

(DAK1 + DAK2)

3. Contact our **Service team** for your complex projects for help

4. Start thinking in **lifecycles** when designing, testing and validating your product

- 5. Profit from short delivery times
- 6. Order quickly and flexible via Web shop

![](_page_17_Picture_10.jpeg)

## Additional information (knowledge transfer)

![](_page_18_Picture_1.jpeg)

More information can be found on our website:

- https://www.hbm.com/en/7074/strain-gauge-fundamentals/
- https://www.hbm.com/en/0014/strain-gauges/

![](_page_18_Picture_5.jpeg)

#### Strain Gauge Fundamentals

Strain gauges have been around for almost 80 years and continue to be key assets for measuring fatigue and testing materials for productivity and safety reasons. But how do I calculate material stress from strain? How can I select the right strain gauge and install it correctly? Our experts dug deep to provide their best answers for you about all the important questions regarding strain measurement using strain gauges. Click an option below to direct you to the content on the page.

- 1. Basics of Strain Measurements and Experimental Stress Analysis
- 2. Selecting the Right Strain Gauges, Adhesives, Covering Agents and More
- 3. Installations of Strain Gauges: All there is to Know
- 4. Reduction and Elimination of Measurement Errors
- 5. Acquiring Data with the Right Hardware and Software
- 6. Training, Webinars and References on Strain Measurements

1. Basics of Strain Measurements and Experimental Stress Analysis

#### Strain measurement glossary

You can benefit from our practical on-line glossary by looking up the most important technical terms in the field of strain measurement.

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#### Experimental Stress Analysis (ESA) using strain gauges

The principle of Experimental Stress Analysis (ESA) consists in using strain gauges to measure the strain on a component's surface. The absolute value and direction of the mechanical stress is determined from the measured strain

![](_page_19_Picture_1.jpeg)

# Any questions?

- If you have any questions, please do not hesitate to contact us: webinar@hbm.com
- Or email the presenter directly: <u>manuel.schultheiss@hbm.com</u>

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