

HBK Engineering Services in the Americas

STRAIN CAPABILITIES, AMERICAS 2021

CONFIDENTIAL

Organizational Information

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- Today's presentation will be E-mailed to all attendees. The webinar will also be posted on our website: <http://www.hbm.com/en/3157/webinars/>
- If you have additional technical questions, feel free to contact our Americas technical support team at support@usa.hbm.com

Introduction – David Blanco



- Americas Field Service Team Leader
- B.S. Electrical Engineering. European University of Madrid, Spain
- Started in HBM Spain in Sept 2007
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- Phone: +1 217-607-5755

Agenda



INTRODUCTION TO HBK
AND ENGINEERING
SERVICES



WHAT ARE STRAIN
GAUGES AND WHY
DO WE USE THEM?



HARDWARE
TRAINING



RESOURCES



TROUBLESHOOTING
AND DATA
INTERPRETATION



QUESTIONS &
ANSWERS

Brüel & Kjær

BEYOND MEASURE

- The global leader in **sound & vibration** test and measurement, with a history going back 75 years
- Designs and delivers across the **entire measurement chain**
- A premium brand, recognized for **quality, reliability and performance**

MAIN BUSINESS AREAS	KEY FIGURES	CORE VALUES
<ul style="list-style-type: none">• Automotive, Aerospace, Defence and Telecom/Audio• NVH (Noise, Vibration, Harshness)• Sound• Vibration	<ul style="list-style-type: none">• 1000+ employees• Located in Nærum, Denmark• A global company with a third of business coming from The Americas, EMEA and Asia respectively	<ul style="list-style-type: none">• A trusted partner• Reliability and premium quality products• The most accurate and advanced technologies• Delivering value beyond measure

Founded 1942



Per V. Brüel & Viggo Kjær



HBK
HÖTTINGER BRÜEL & KJÆR



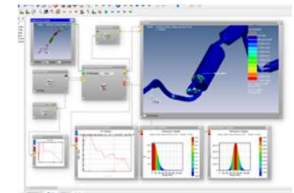
- A technology- and market-leader in measuring, testing, and analysis, with a focus on **durability, reliability, structural design, industrial control and weighing**
- A global player offering the **complete measurement chain** in key disciplines from sensors and instruments, to analysis software and engineering services
- Production and engineering facilities located in Germany, USA, China and Europe

MAIN BUSINESS AREAS	KEY FIGURES	CORE VALUES
<ul style="list-style-type: none"> • Automotive, Aerospace, Transport • System integrators/ Machine makers • Weighing • Durability Design and Validation 	<ul style="list-style-type: none"> • 1900+ employees • Located in Darmstadt, Germany • 29 subsidiaries and sales offices worldwide 	<ul style="list-style-type: none"> • Creating better products for a more productive, efficient and safer world • Maximum accuracy • Precise and reliable test and measurement products

Founded 1950



Karl Hottinger

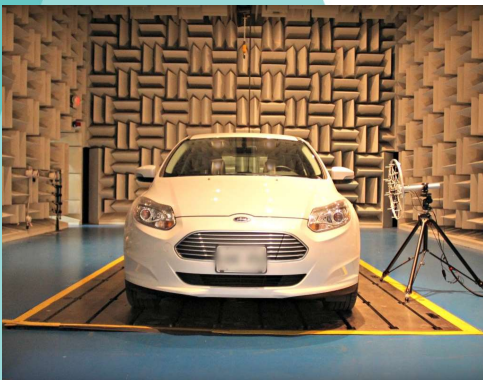
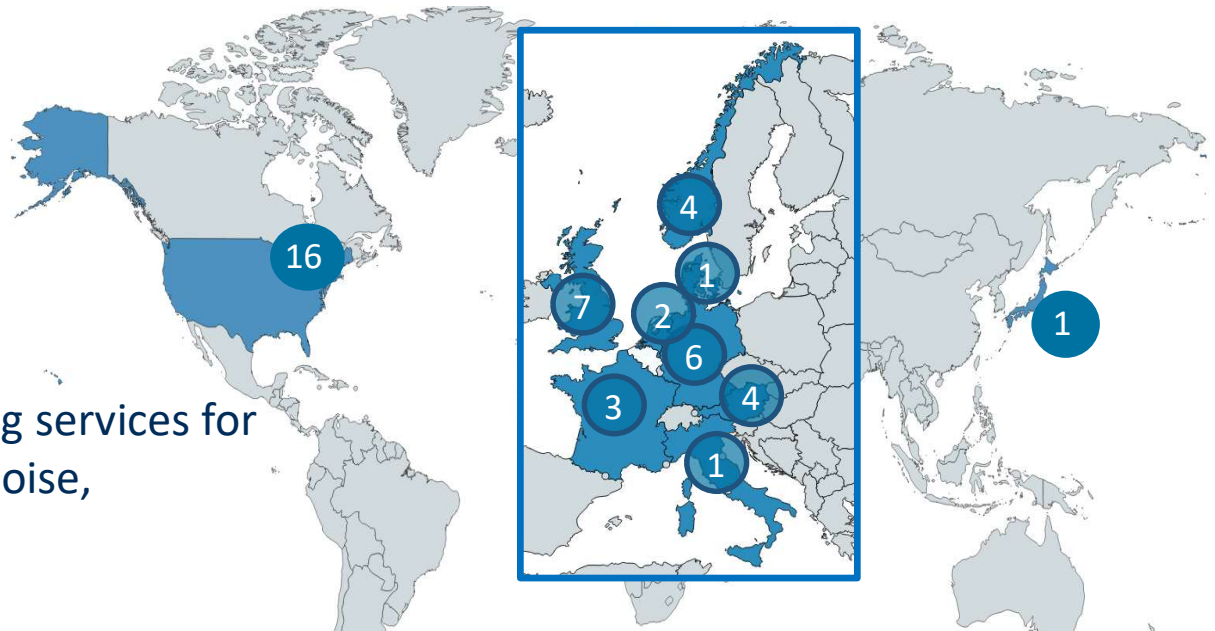


Engineering Services

Global Footprint

- 16 in NA (Canton, MI)
- 28 in EMEA
- 1 in JAPAN (Tokyo)

Our team specializes in consulting services for customers who need help with noise, vibration, force, and/or strain.



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Engineering Services, Offerings

1. Strain Expertise:

- Gauge application, strain data acquisition and analysis in many products and infrastructures



2. Sound and Vibration Expertise

- Assessing product S&V performance and improvement via smart testing, troubleshooting and countermeasures recommendations



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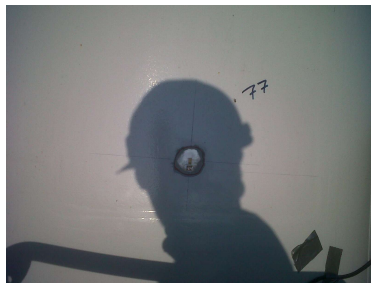
HBK Engineering Services – *Look what we got!*

David Blanco has joined the Engineering Services team located in Canton, MI.

- Will lead our focus on strain-based testing for various industries:

Customer's needs

Measure mechanical quantities - Strain



Monitoring

As built reports

Under water



"Calibrate" FEA

Offshore & Onshore

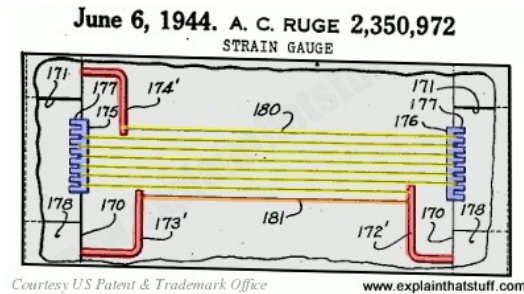
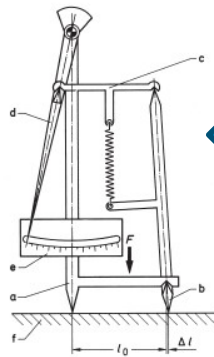
Wet, oily, dirty, rusty



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History of the Strain Gauges

Long Beach Earthquake - 1933



Arthur C. Ruge
(1905-2000) MIT



Edward E. Simmons
(1911-2004) Caltech

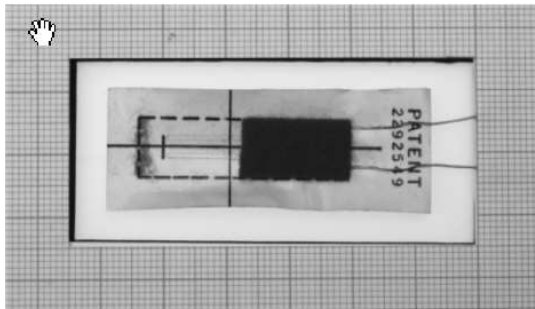


Fig. 1.4 SR-4 strain gage with paper carrier from 1941 the protective felt layer is half removed

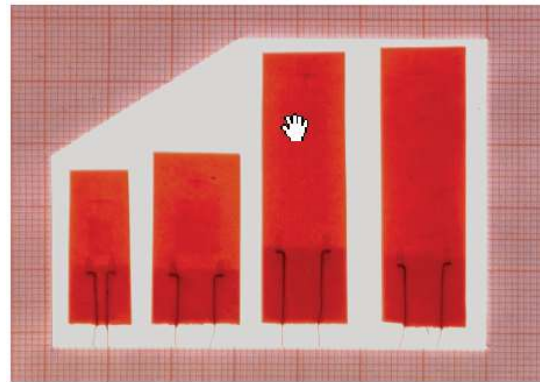
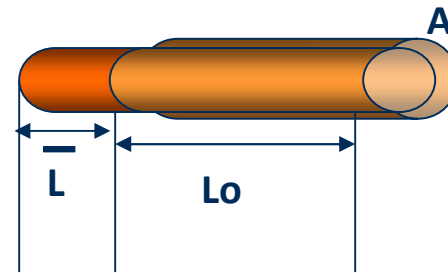


Fig. 1.14 First strain gauges manufactured by Hottinger Messtechnik GmbH in Darmstadt; they were flat-grid Bakelite gages

Introduction – What is a Strain Gauge (preferred) or Strain Gage

It is an electrical conductor that changes its resistance with mechanical stress, e.g. through tension or compression forces.

$$R_0 = \rho \frac{L_0}{A}$$



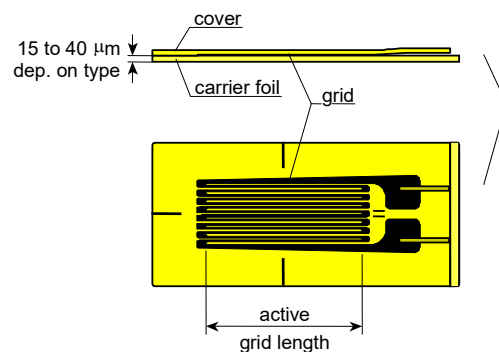
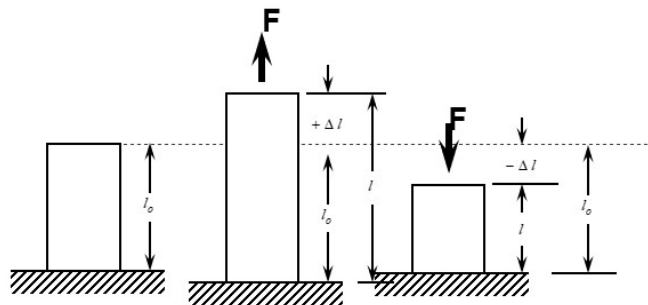
The resistance change is partially due to the conductor's deformation and partially due to the change in the resistivity ρ of the conductor material as a result of microstructural changes

$$\Delta R/R \rightarrow k \times \epsilon$$

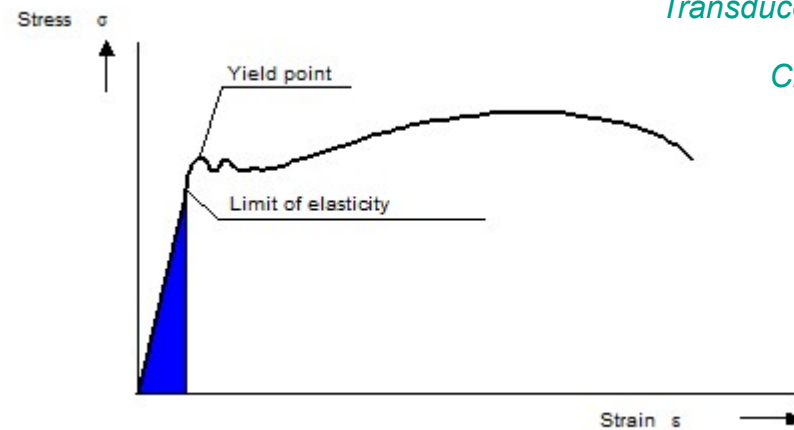
When a metal elongates, it gets longer and thinner and the resistance increases.

Introduction – Overview of Strain

- Strain = Elongation or Compression of a section
- Possible causes by Mechanical or Thermal cases



$$(\varepsilon) = \left\{ \frac{\Delta l}{l_o} \right\} \left[\frac{um}{m} \right]$$



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Transducer Manufacturing

Crack Propagation

FEA «Calibration»

Material Testing

Fatigue Analysis

Applications – Hardware Training

More than 100 trainings with topics such as:

- Strain gauges techniques (Cold and Hot Curing)
- Amplifiers
- Transducers
- Catman data acquisition software
- Visual Basic Script
- PCB (Printed Circuit Board) strain-related measurements

Applications – Hardware Training



Tailored

Real practise on customer's project

Focused on Client's Application



Applications – Resources

- Article Strain Gauge Installation (Onsite or Inhouse)



Applications – Resources

- Hot Curing (Onsite or Inhouse)



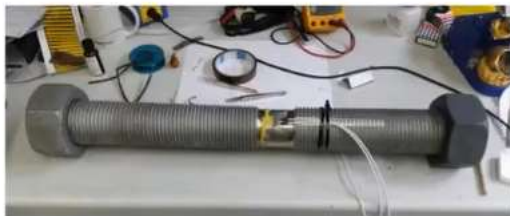
- Optical Gauges

Applications – Resources

Channel machined for wires to escape - thread removed to no deeper than shank diameter

Wires to amplifier

Area of bolt which sits in the middle of the joint (where the bolted surfaces, such as a flange) meet, is machined to the shank diameter.
The core axial strength of the bolt is unaffected



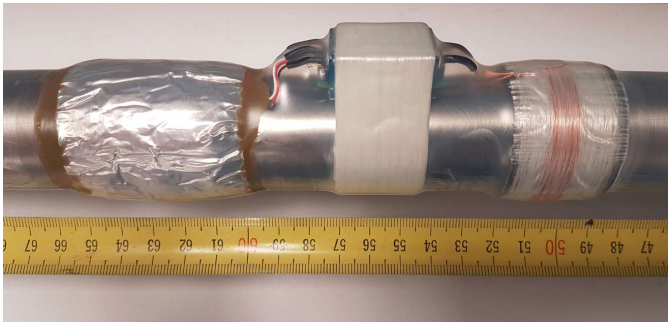
**Application - M72
bolt in wind turbine
tower flange**

(Note; Protective materials not shown)



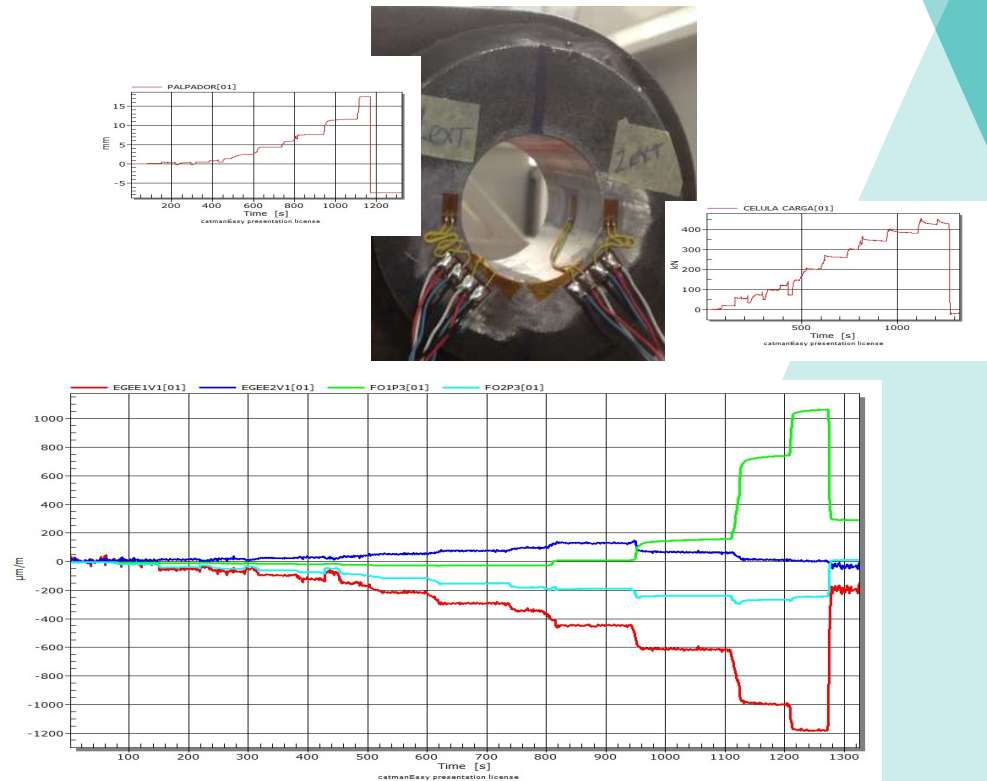
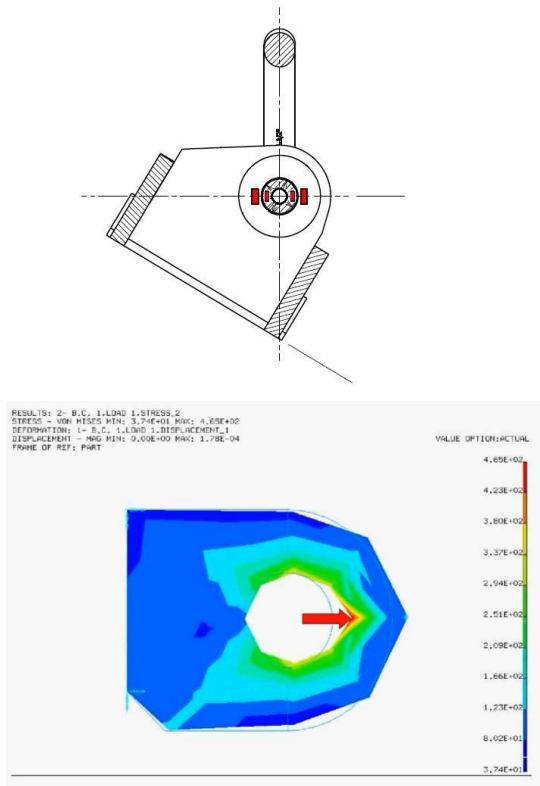
Applications – Resources

- We love to be challenged! And we would get our head and brain in to it....
...literally if needed !

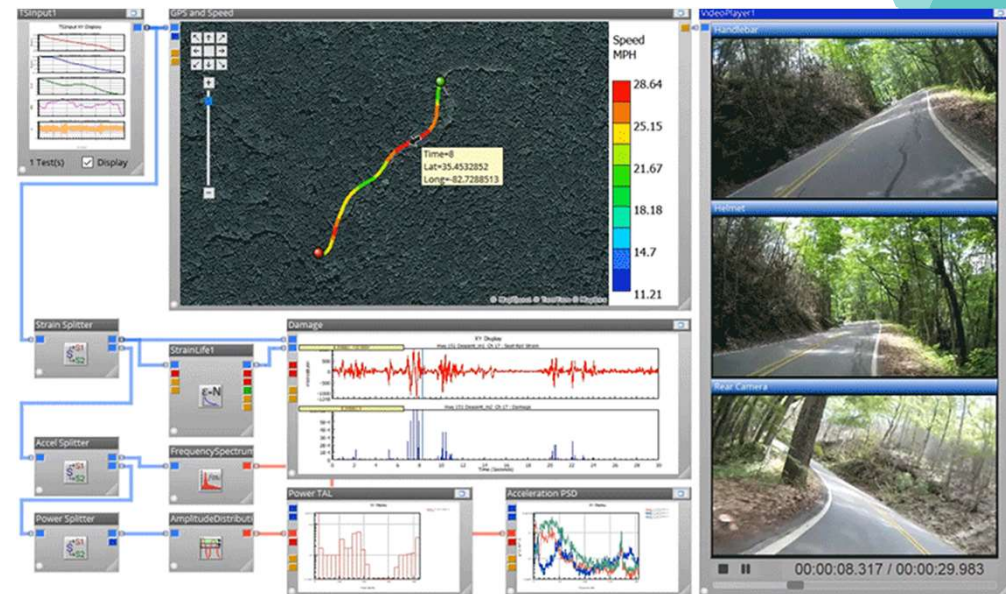
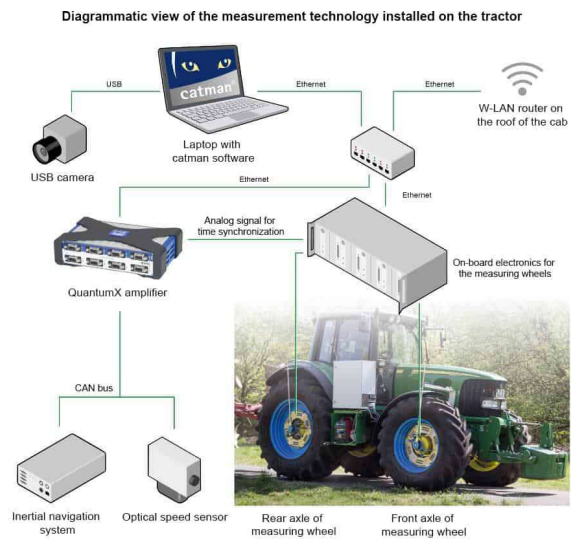


- Tight spaces,
- Dirty,
- Oily,
- Rust,
- Special certification (for example: Offshore training)

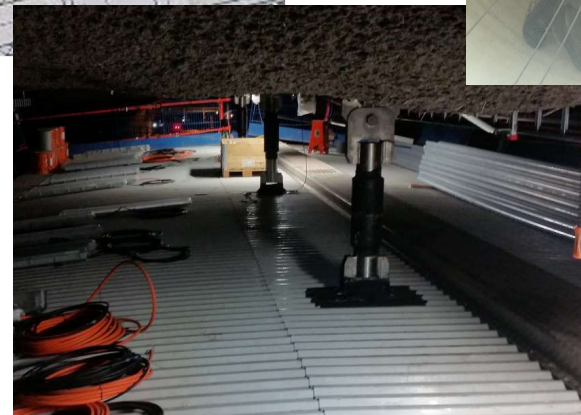
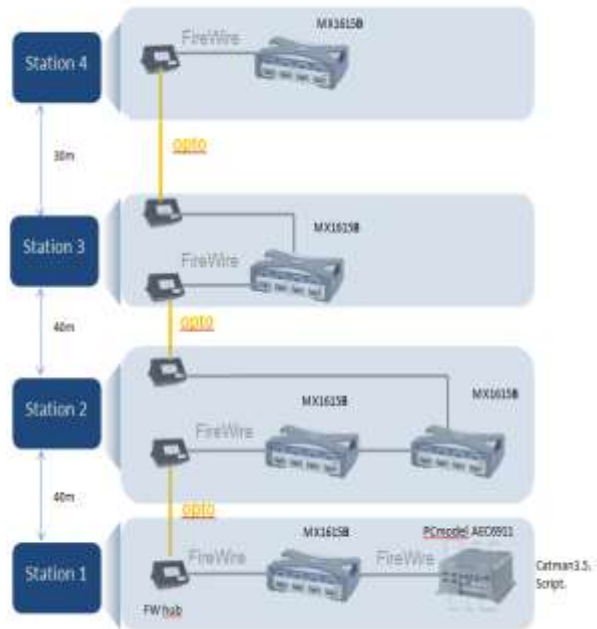
Applications – Troubleshooting & Data Interpretation



Applications – Operations



Applications – Troubleshooting & Data Interpretation



Questions?

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Upcoming Webinars

WEBINARS:



- **Is a Newton always a Newton?**

March 31, 2021 3:00 PM CET / 9:00 AM EST

Register here: <https://www.hbm.com/en/10067/webinar-is-a-newton-always-a-newton/>

- **Electric Motors 201 for N&V Engineers**

April 14, 2021 4:00 PM CET / 10:00 AM EST

Register here: <https://www.hbm.com/en/10082/electric-motors-201-for-n-v-engineers-2/>

- **4 Steps to Easily Integrate Optical Sensors**

May 20, 2021 4:00 PM CET / 10:00 AM EST

Register here: <https://www.hbm.com/en/10155/4-steps-to-integrate-optical-sensors/>

- **Calibration and Re-calibration of Torque Transducers**

May 20, 2021 5:00 PM CET / 11:00 AM EST

Register here: <https://www.hbm.com/en/10106/webinar-calibration-re-calibration-of-torque-transduce/>

The HBK Academy

Through the **HBK Academy's** online seminars, our trainers will virtually take you by the hand and guide you to the “right” result. From the selection and installation of the sensors, through safe measurement data acquisition, to the analysis and evaluation of your results.

- **Strain Gauge Workshop, Canton, MI, April 20-21, 2021**

Register here: https://www.hbm.com/index.php?id=5788&no_cache=1

- **Measuring Torque Correctly, Online, April 26-28, 2021**

Register here: <https://www.hbm.com/en/9277/online-seminar-with-costs-torque-measurement/>

- **Data Acquisition Systems – Setting the Parameters, Online, April 22-23, 2021**

Register here: <https://www.hbm.com/en/10118/online-seminar-setting-the-parameters-correctly-daq2/>

- **Working with catman, Online, May 18-20, 2021**

Register here: <https://www.hbm.com/en/9141/online-seminar-working-with-catman/>



Schedule training in 2021! Our online calendar is updated and includes courses open for registration.

Commonly Asked Questions

- Q: *Can you come to California and instrument my test article?*
- A: Absolutely (Covid-dependent). We can work on projects in our facility or yours.
- Q: *A part of the suspension in this car keeps breaking. Can you use Strain to understand why?*
- A: Yes, one of the most common uses of strain is to predict fatigue. We can collect data to feed your fatigue model or include our colleagues from Prensicia to build a model for you.
- Q: *I want to instrument a part of my product. I would like help with the gauge installation, and I don't have a measurement device. Do I have to purchase it?*
- A: We can provide the turnkey solution. That is, we provide the full instrumentation, then we do the test with our equipment. We can give you the data or a full tailored report.

Commonly Asked Questions

- *Q: I have a spinning device and want to instrument it, is it possible?*
- *A: We can use slip rings or a telemetry system to read the signal and therefore it would be treated as a standard test.*
- *Q: My test needs more than just strain gauges – what else can you provide?*
- *A: We very often measure other physical properties like force, torque, temperature and displacement.*

Contact Information

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