Welcome to the webinar

‘Residual stress measurements by hole drilling: Calculation in accordance with ASTM E837-2013 standard’

The webinar starts at 10 a.m.

Speaker

- Alessio Benincasa
  Sales & Product Manager
  SINT Technology srl
- Degree in mechanical engineering
- 10 years experience in
  SINT Technology
- 9 years experience in the
  residual stress field
- 5 years experience as Product Manager
  of the MTS3000
- Certified at 3rd level as strain gage expert

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Summary

- Who is SINT Technology
- What are residual stresses
- The hole-drilling strain-gage method
- The MTS3000 system
- The ASTM E837 standard
- The new EVAL 7 software
- Typical measurement results
- Live test elaboration

Who is SINT Technology – General info

SINT Technology is located in Calenzano, near **Florence**. The company was founded in 1990.

SINT Technology has **50 employees**. Most of them are engineers with average age of about 30 years.
The company turnover is about **4 M€**.

Certified company and
Accredited Test Lab

LAB N° 0910

SINT Technology - Main business activities

Measurement Services:

- Sound Intensity, Vibrations
- Experimental and residual stress analysis
- Power plant performance tests

Production of measuring equipments:

- Restan-MTS3000
- DRMS Cordless
- Custom products

Design engineering

Software solutions

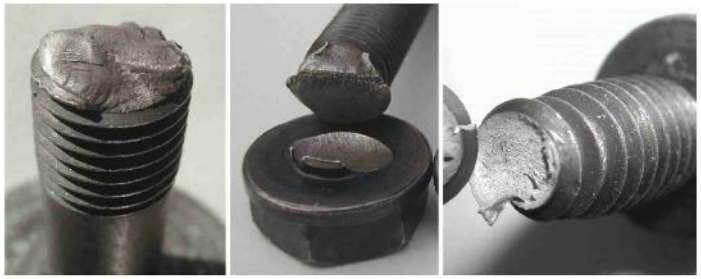
What are residual stresses

All stresses that occur in the materials, also without the application of any external load, are termed residual stresses.

Residual stresses influence a mechanical component's behaviour as they:

- Affect structural and dimensional stability
- Reduce fatigue strength and crack resistance
- Encourage surface crack growth

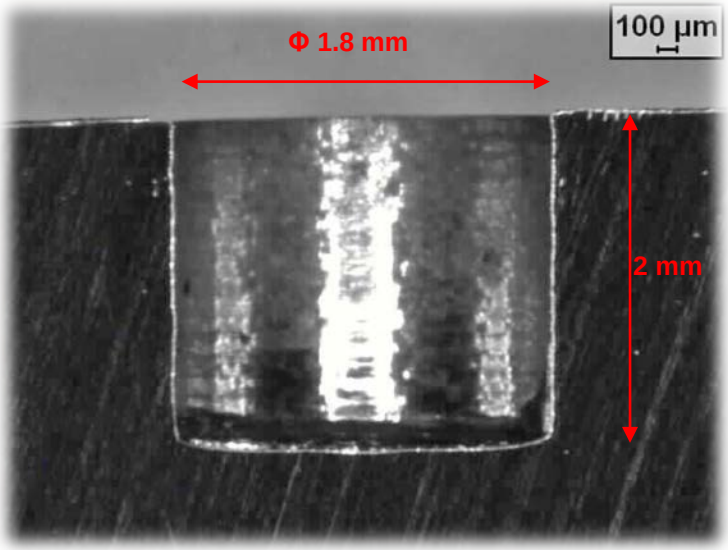
Residual stresses therefore limit load capacity and safety of mechanical components during operation.

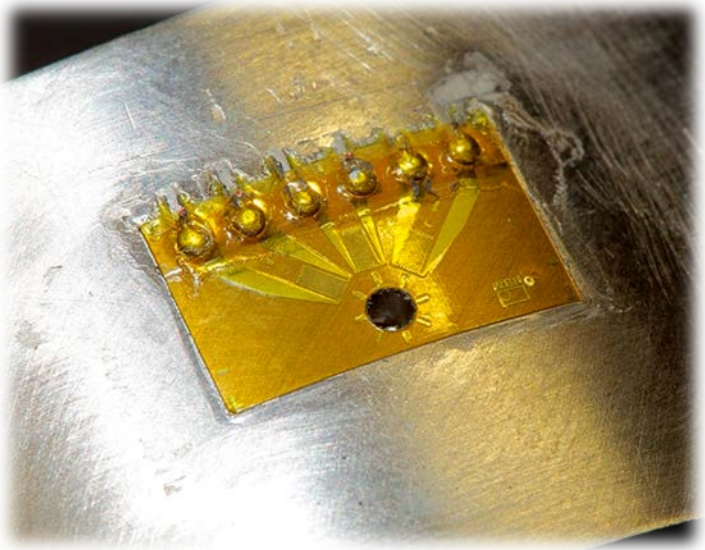


The hole-drilling strain-gage method

The hole drilling method consists in drilling a small hole **(approx. 1.8 mm x 2.0 mm)** into the center of a special 3-element strain rosette.

The hole changes the initial strain allowing redistribution of the residual stresses originally existing in the material.





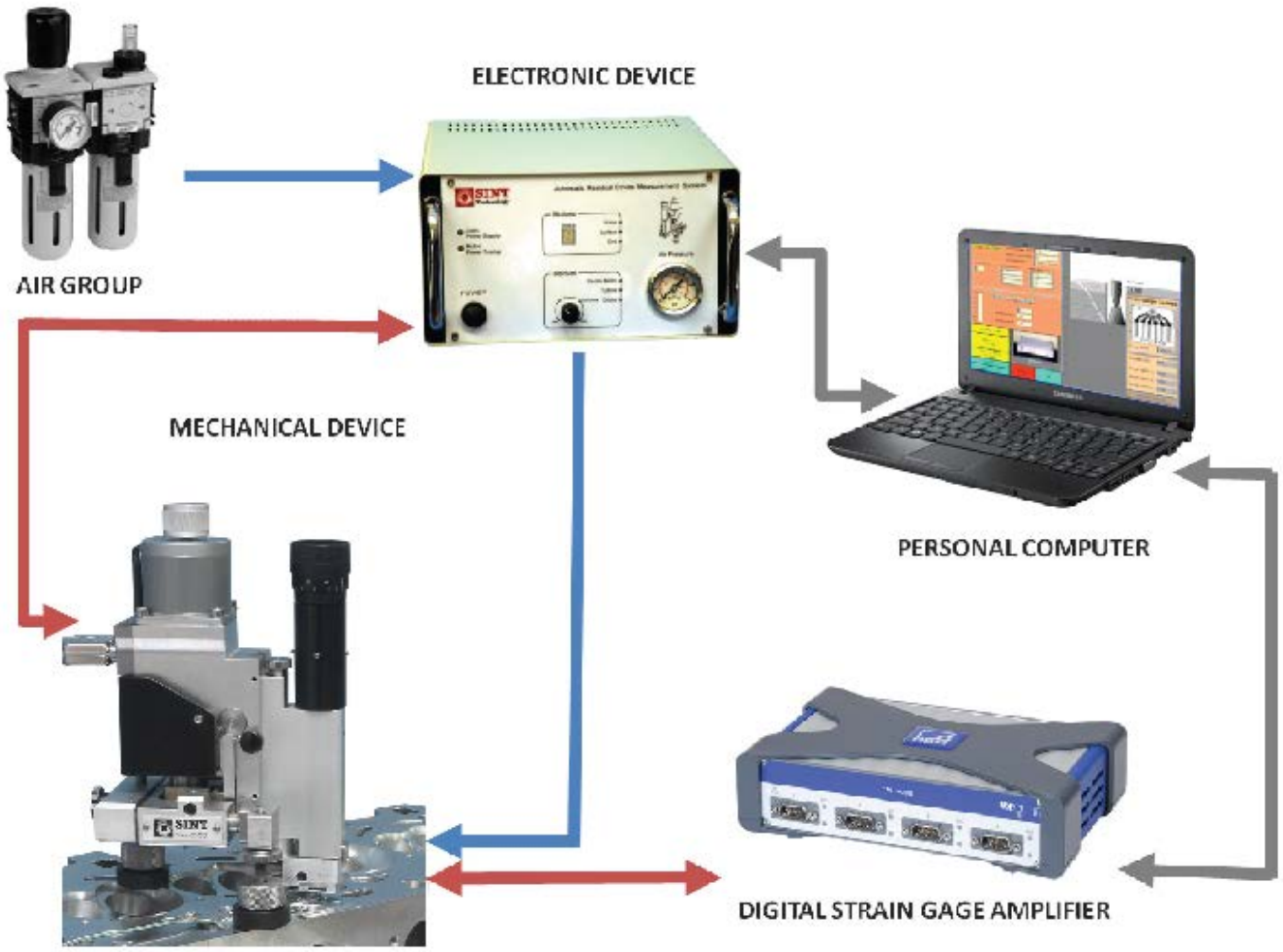
The MTS3000 system

The **MTS3000 system** is the only fully **AUTOMATIC** and portable instrument in the world for determining residual stress by the hole-drilling strain-gage method.

The MTS3000 system **consists of**:

- A mechanical setup housing the optical system and drilling system
- An electronic control unit
- A digital strain gage amplifier
- Control and back-calculation software

The MTS3000 system: measuring chain



Hole-drilling strain-gage method to ASTM E837

The hole-drilling strain-gage method is the only method for calculating residual stress that is **STANDARDIZED** at world level (**ASTM E837**).

The first version of this standard dates back to 1995, the latest upgrade is available since the end of 2013.

Designation: E837 – 13a

Standard Test Method for Determining Residual Stresses by the Hole-Drilling Strain-Gage Method[1]

Standard ASTM E837 specifies:

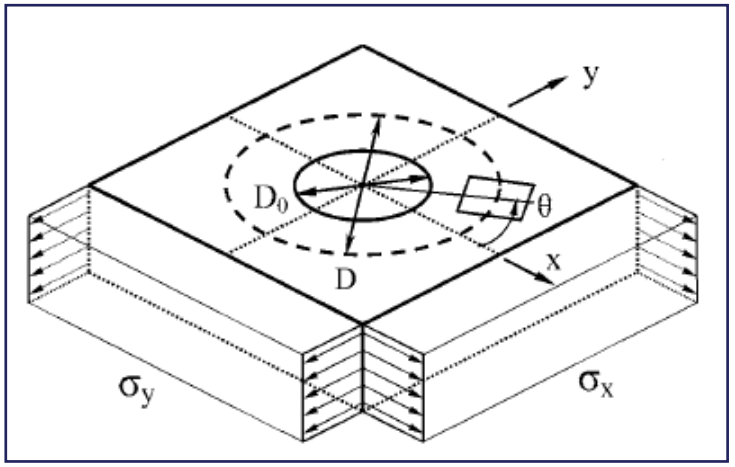
- The number of **drilling increments** required
- The **numerical coefficients** for determining the value of residual stresses
- The **data processing** method
- The measurement-related **uncertainty**

Different types of holes, based on the workpiece thickness:

THROUGH HOLE - THIN WORKPIECE

Workpiece thickness < $0.2 \cdot D_{GAGE}$ (std. 1mm)

stresses are considered uniform over the drilling depth



- Drilling depth: entire thickness
- Stresses are assumed to be uniform
- Acquisition of a set of 3 strain values once the through hole is completed

INTERMEDIATE HOLE

Workpiece thickness between $0.2 \cdot D_{GAGE}$ e D_{GAGE} (std. between 1mm and 5mm)

- Approximate results
- The elaboration of the test result is outside the scope of the ASTM E837-13 standard

BLIND HOLE (Typical) – THICK WORKPIECE

Workpiece thickness > D_{GAGE} (std. 5mm)

UNIFORM STRESSES

- Drilling depth: 0.2 · D_{GAGE} (std 1mm)
- Stress value over the drilling depth
- 10 drilling steps of 0.02 · D_{GAGE} (std 0.1 mm)

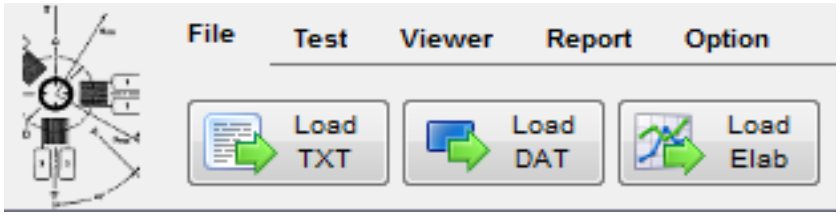
NOT UNIFORM STRESSES

- Drilling depth: 0.2 · D_{GAGE} (std 1mm)
- Residual stress pattern over the drilling depth
- 20 drilling steps of 0.01 · D_{GAGE} (std 0.05 mm)
- Evolution of the “old” Integral Method

A “uniform stress” calculation is appropriate when **prior information** is available, for example, based on workpiece geometry or processing procedure.

Another purpose of doing a uniform stress calculation is to determine a **representative size** of the residual stresses that are present.

Test elaboration: the new EVAL 7 software



- **Flexible** design of the software versions
- Users can buy only the function they need, depending on the types of the measurement
- Possibility to **upgrade** your software version
- **Easy** functions for the users that move the first steps into the hole drilling measurements
- **Complete** and further analysis of residual stress for the more skilled users
- Possibility to **customize** the software versions

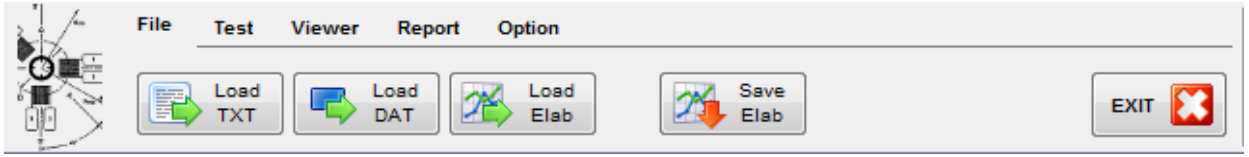
Software Features	Base	Professional	Premium	Enterprise
Automatic input of .txt/.dat file	✓	✓	✓	✓
Edit Input Windows	✓	✓	✓	✓
Strains interpolation	✓	✓	✓	✓
Calculation as per ASTM E837-13 for uniform stress	✓	✓	✓	✓
Calculation as per ASTM E837-13 for non-uniform stress	✓	✓	✓	✓
Calculation by the Integral method	✓	✓	✓	✓
Calculation by the Schwartz-Kockelmann method	✓	✓	✓	✓
Export by .txt format	✓	✓	✓	✓
Strain gage rosette / calculation coefficients database	✗	✓	✓	✓
Extended version of ASTM E837-13 for uniform stress	✗	✓	✓	✓
Extended version of ASTM E837-13 for non-uniform stress	✗	✓	✓	✓
Viewer (Stress Graph, Direction Graph, Mohr Graph)	✗	✓	✓	✓
Load / Save calculation config	✗	✓	✓	✓
Automatic report of the measurement	✗	✓	✓	✓
HDM calculation algorithms	✗	✗	✓	✓
Eccentricity correction algorithms	✗	✗	✓	✓
Plasticity correction algorithms	✗	✗	✓	✓
Measurement uncertainty for uniform stress calculation	✗	✗	✗	✓
Measurement uncertainty for non-uniform stress calculation	✗	✗	✗	✓

Test elaboration: the new EVAL 7 software

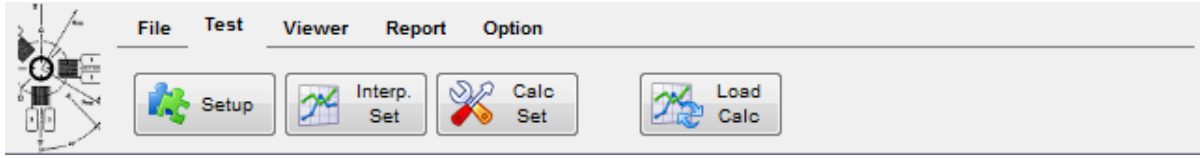
The main key features of the **EVAL7** software are:

- **Fully** compliant to the MTS3000 - RESTAN system
- Implementation of the **HDM method**
- Implementation of **eccentricity** correction
- Implementation of **local plasticity** correction
- **Upgraded** strain gage rosette database
- **New** graphical layout
- **Better** algorithms for the interpolation of acquired strains
- Graphical **comparison** between different calculation methods
- Plot of residual stress **Mohr circles**
- Calculation of residual stress in **any direction** (grids and custom direction)
- **Automatic** measurement report

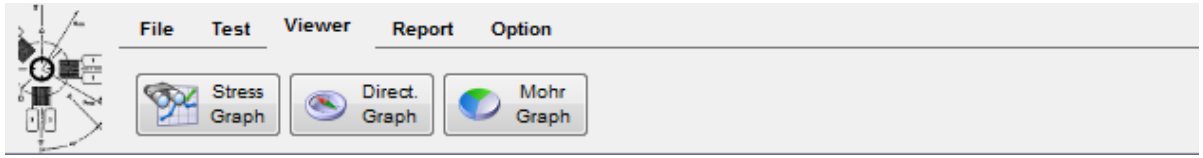
EVAL 7: Live test elaboration



LOAD TEST



TEST SETUP

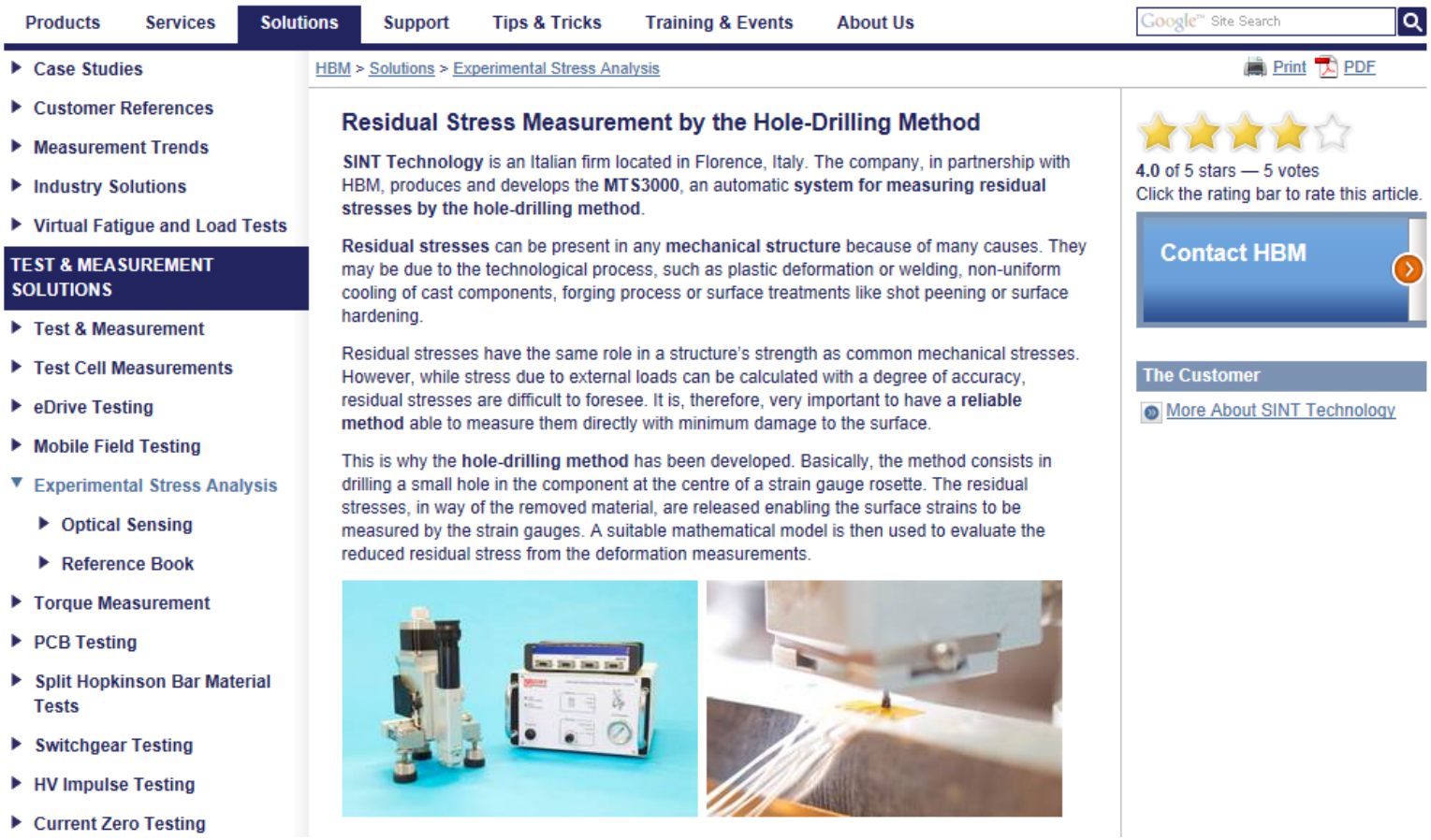


VIEW GRAPH

TEST REPORT

More detailed information

- www.hbm.com/sint



More detailed information

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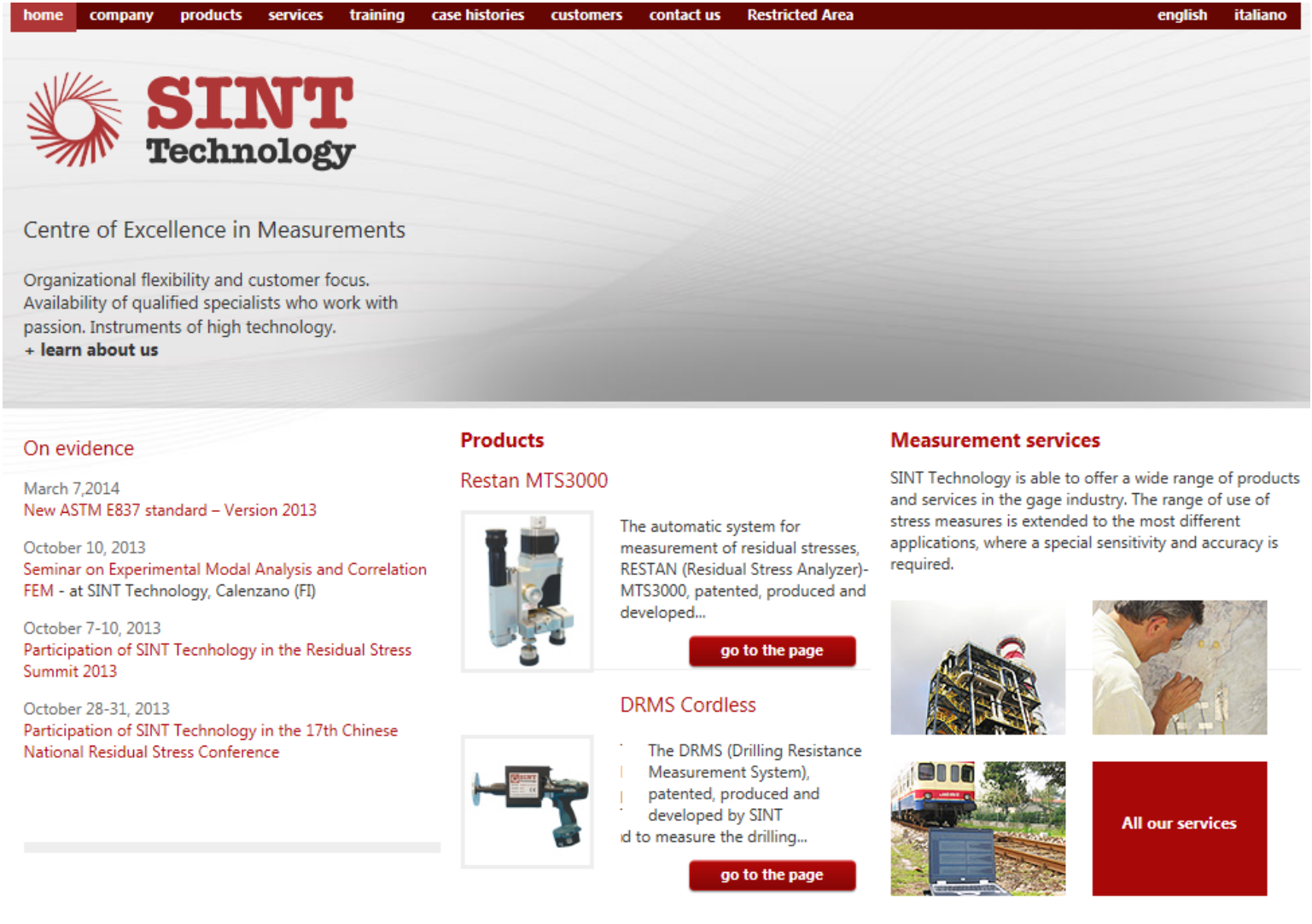

More detailed information

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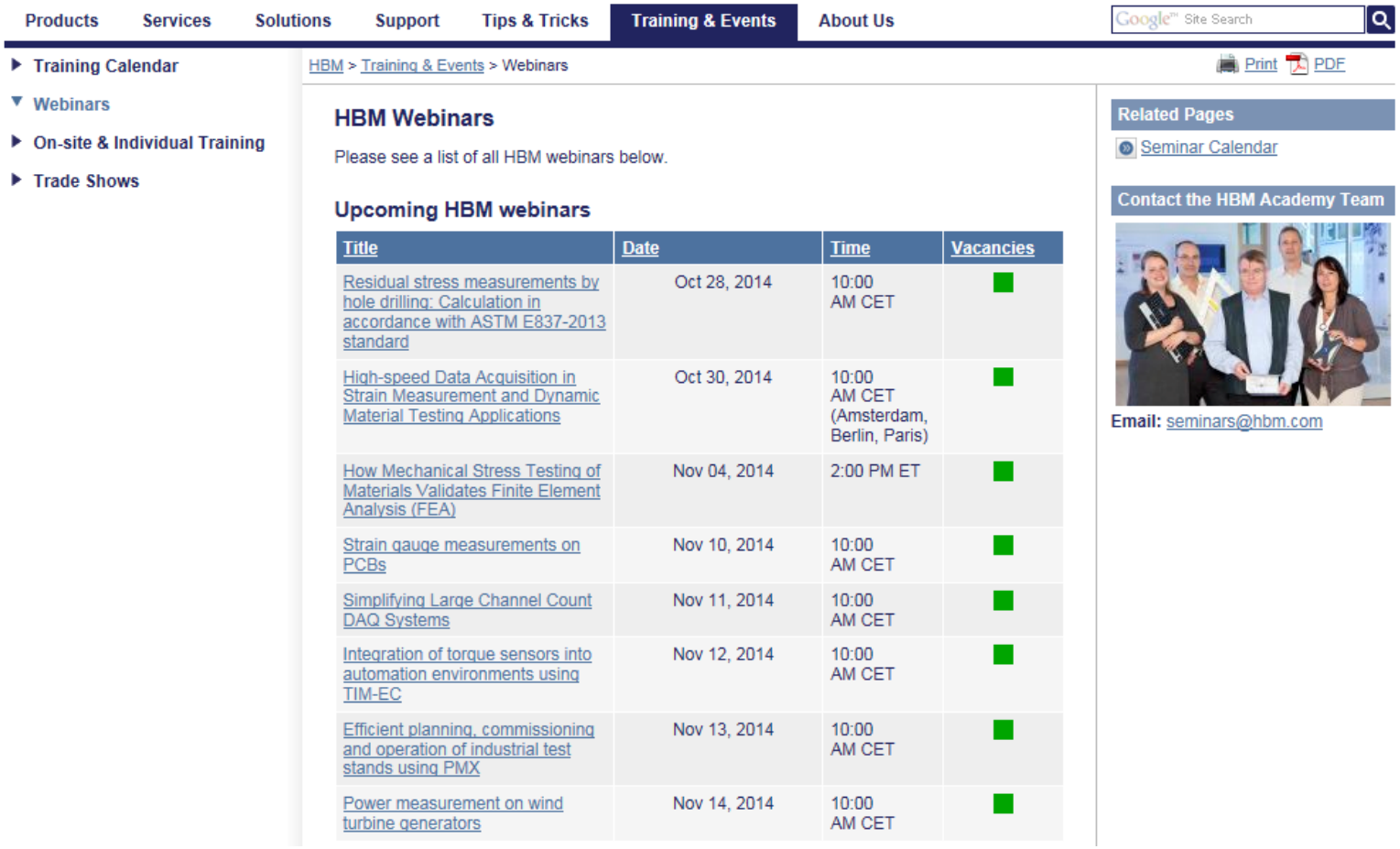

Any questions?

- Please contact our Support Team for further questions.
  We look forward to your email: info@de.hbm.com

- Or email the speaker directly:
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