SHEAROGRAPHY – A FAST AND FLEXIBLE NDI TECHNIQUE FOR COMPOSITE MATERIALS NEW APPLICATIONS IN VARIOUS INDUSTRIES

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Abstract

Modern hi-tech products today widely are made of composite materials, which are specifically designed for the purpose of their application. Other than a precise knowledge of the characteristics of these materials, which often are anisotropic, quality control is of the essence. As said components, e.g. in aerospace, aircraft, or also boat industry and other thriving industries such as wind power industry are safety relevant, and also of great economic value, rapid defect recognition has to be carried out in production as well as in maintenance.

Shearography is a full field inspection technique, which is specifically suited to do fast defect detection. It is widely accepted as a reliable and fast inspection method especially designed for modern composite material.

Latest generation of Shearography technique and software are presented and the potential is outlined.

Different challenges are presented in production control and in maintenance, specifically in Aircraft and Wind Energy.

Keywords: Shearography; Optical Measurement Techniques; NDI; NDT; Composite Materials; Wind Power Rotor Blades

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Shearography

Fast, Optical NDT Method for Composite Inspection

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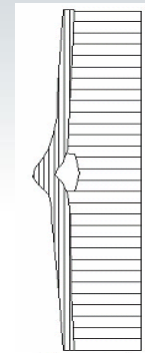
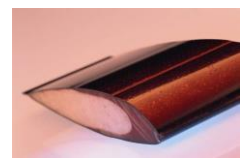
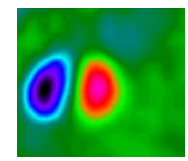
Non-Destructive Inspection With Shearography

- Technique to identify defects in almost any material
- Slightest surface excitation leads to surface deformations from the internal flaws
- The shearography system can detect these very small deformations
- Full-field, non-contact technique







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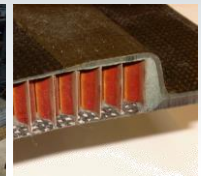
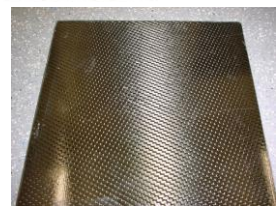
Which materials can be tested ?


- CRFP
- Glare
- Honeycomb
- Laminates
- Foam
- etc.





Boeing: Q-810

EADS: Q-810

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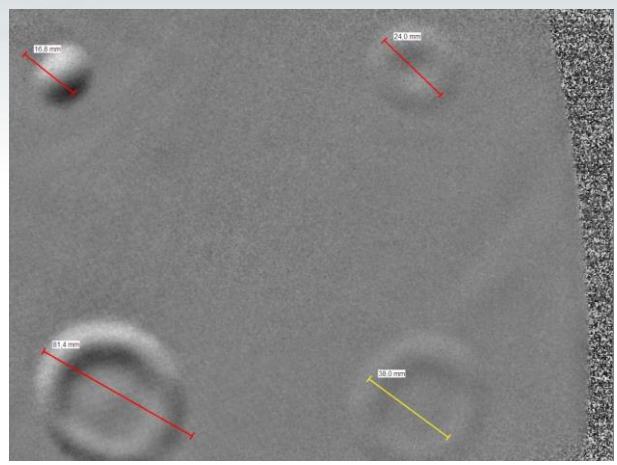
Honey Comb Carbon Fibre Fabric



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On the field:

Different Curvatures Available for non flat surfaces

Applications: Mobile Inspection

Quality control in aircraft assembly

Service inspection on aircraft wings

NDT Expert
Quality control in marine racing manufacturing

Shearography on Yacht

Verification of plug sample repair

Large Area scanning on Curved surfaces

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Application Example of Portable Inspection Hood

Shearography Inspection on AWACS

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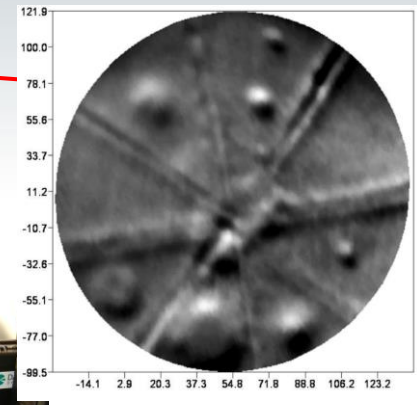
Royal Airforce UK, Inspection of Radome

RAF AWACS Aircraft



SR Technics

Inlet fitted to engine Prior to test

SR Technics

Creates and enclosed out-of-plane inspection system to detect weaknesses in the composite sandwich construction

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Q-800 Portable Shearography System

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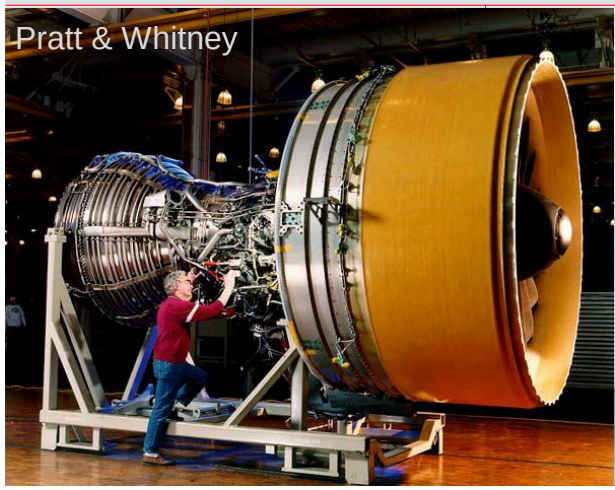
Applications

- In-field use of large area NDT inspections
- Delaminations, Disbonds, Kissing bonds, Wrinkles, Impact Damages, Crushed Core
- Defect detection in Composite Materials CFRP, GRP, Laminates, Honeycomb, etc.
- Inspect structural integrity, Separation of Structural Components and Bond Lines.

Features

- Rapid full-field inspection rate
- 300 mm x 200 mm every 10 seconds.
- Adaptive seals for usage on highly curved surfaces.
- Operates independent of the local environmental
- conditions and can be used for production or in-field
- inspections

Jet Engine Abradable Seal Inspection



- PW 4000 jet engine

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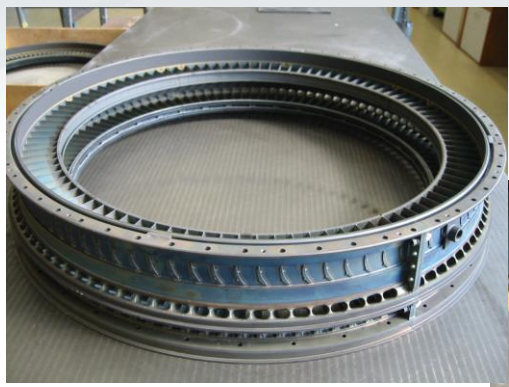
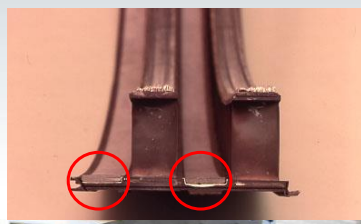
Jet Engine Abradable Seal Inspection





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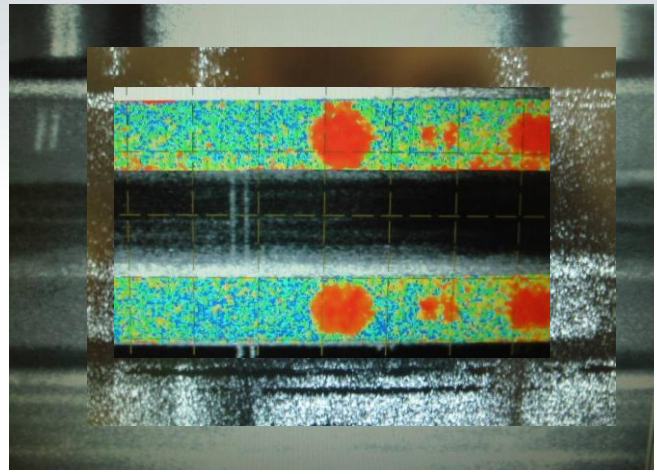
Jet Engine Abradable Seal Inspection



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Jet Engine Abradable Seal Inspection

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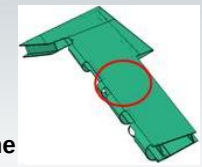
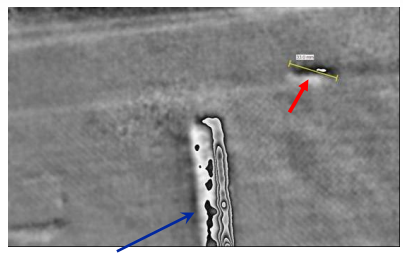
Aerospace- Phenom 100

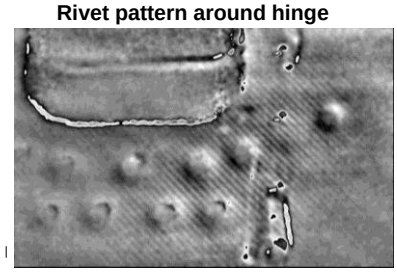


- Composite Elevator
- Decrease inspection time
- Avoid soaking part with water (UT)



Embedded defect

Rivet pattern around hinge



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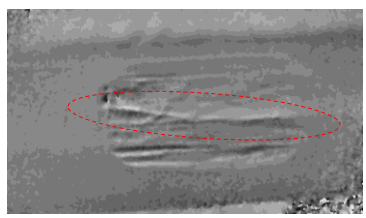
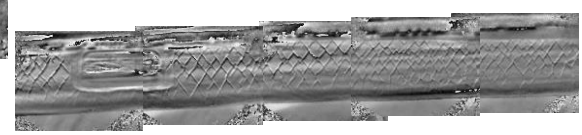
Aerospace- Heavy Lift Helicopters

- Wooden blades
  - -Very hard to inspect
- Rubber coating
- Cracks





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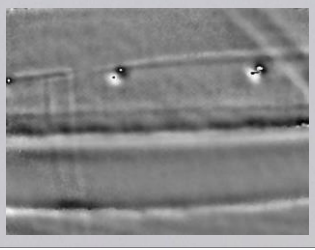
Aerospace- Predator program



- Approved by USAF Predator program
- Heavy landing and impact damage

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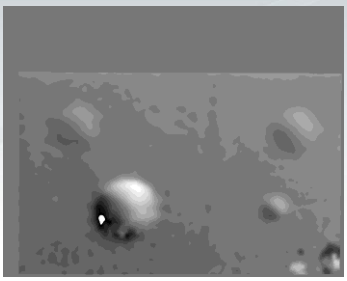
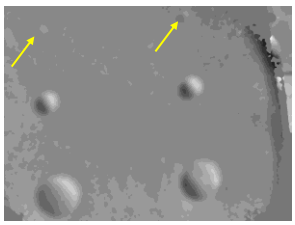
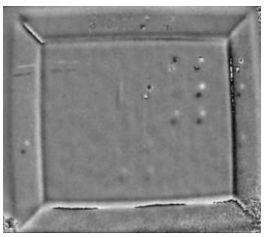
Calibration Standards



- Most Calibration Standards can be used
  - Some simply unsuitable for shearography
  - e.g. Bonded in UT reflectors ☹
- Must be representative of real part
  - Active loading vs thin panels ☹
- Must be 'real' weaknesses





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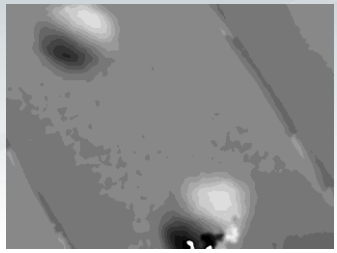
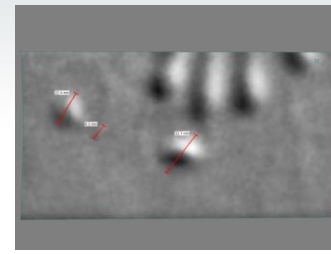
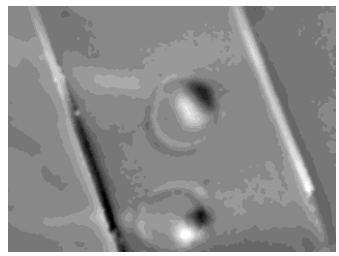
Aerospace- Defect Examples



- **Delaminations on bonded cork**





- **Contamination in production**

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Production Inspection: ARIANE 5

- Shearography inspection of composite materials

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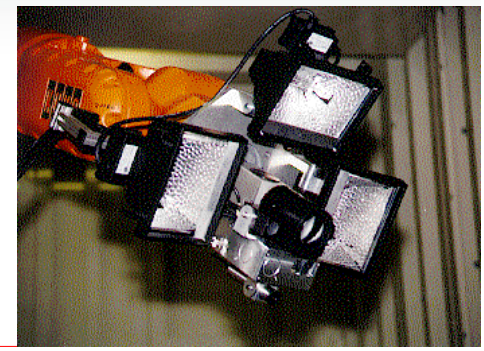
ARIANESPACE

Robotic Inspection System

- Inspection of heat protection parts of booster support structure
- Industry robot for flexible application
- Combined vacuum and heat loading for different material combinations



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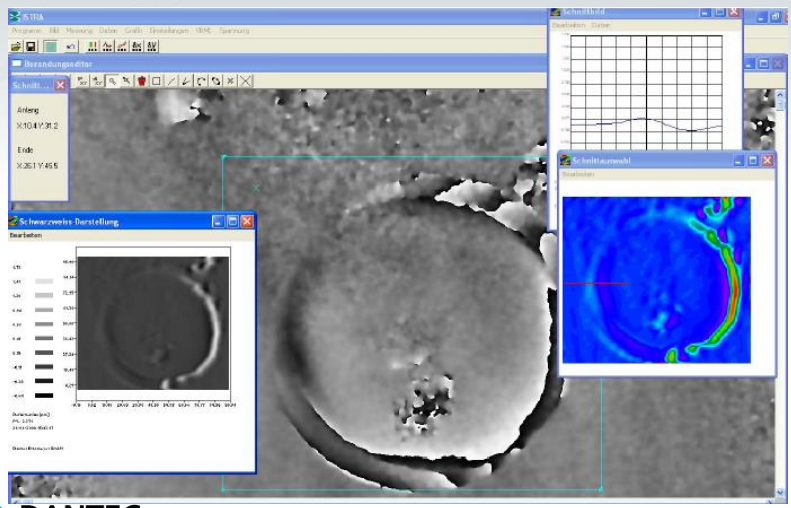
Repair of composite material



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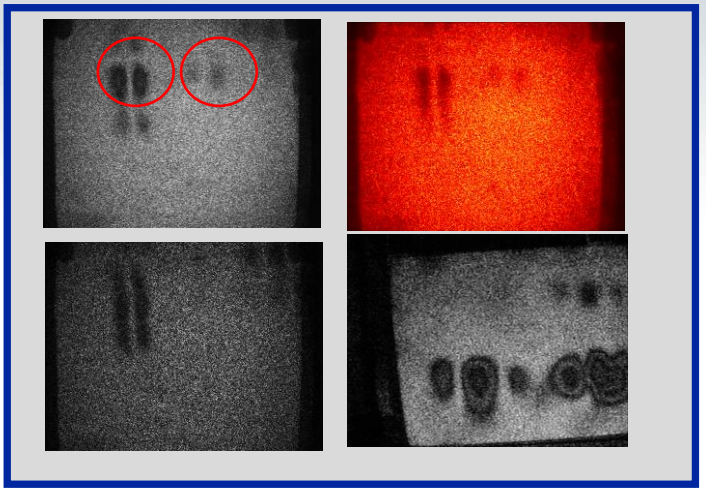
Time Average Acquisition



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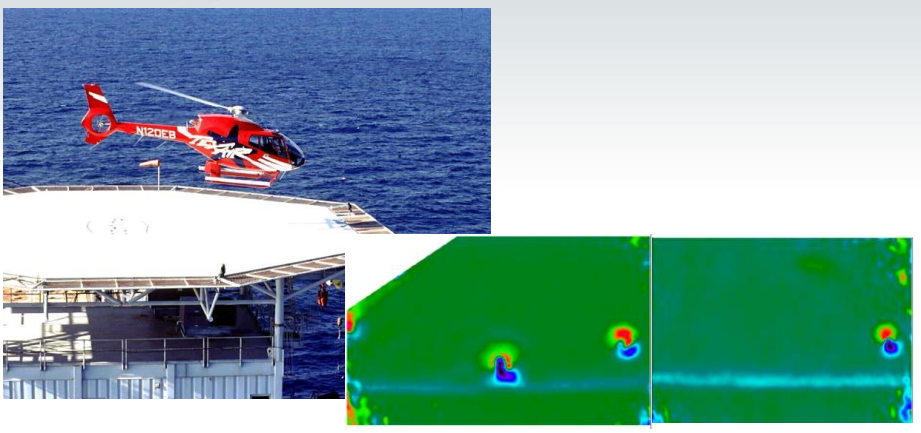
Eurocopter



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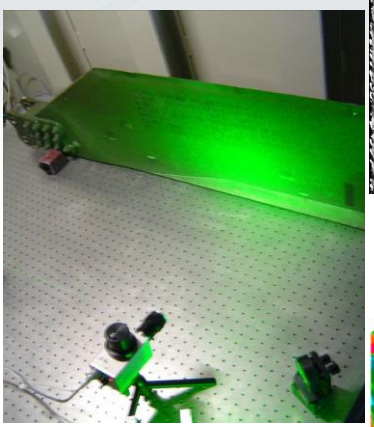
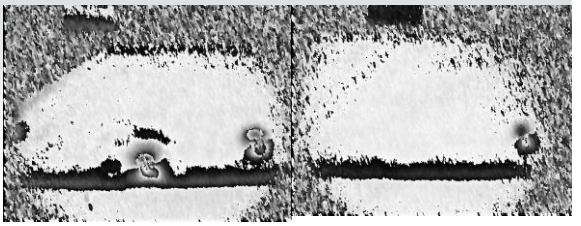
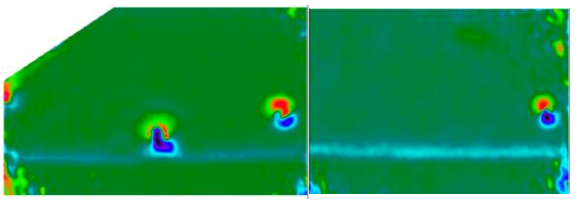
Eurocopter





2 – 10 mbar



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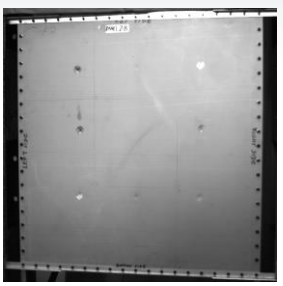
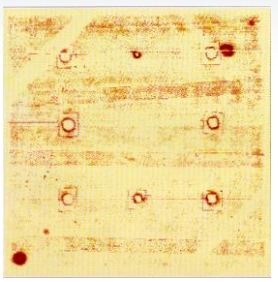
Benchmark Performance

Helicopter Structural Element Panel (80x80 cm²)

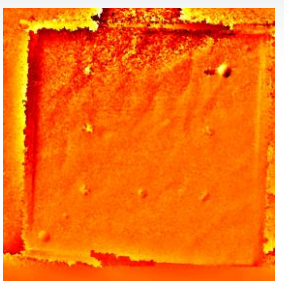


80 cm

Mechanical Impedance Test
Duration: 2 hours !



Shearographic Measurement
Duration: 1 minute



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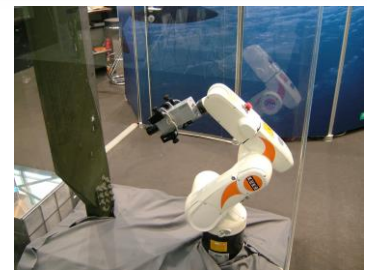
Robot Shearography NDT

- Manual NDT inspections are no better than the daily shape of the operator
- today's aerospace composite subassemblies becoming more complex, the NDT systems used need to be more sophisticated.
- This also forces the NDT inspection methods to become contactless to be able to achieve a high inspection quality and speed.
- With Dantecs ISTROB Systems
- Speeds of 1m2/ minute is possible



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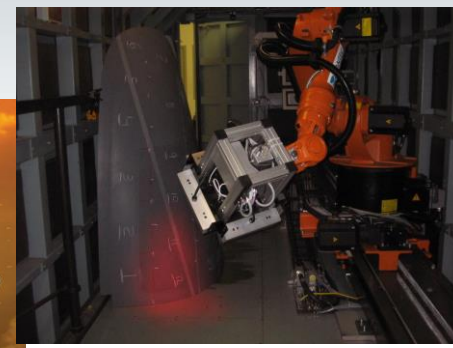
Automatic Robot System for Aerospace Delivered Fall 2008



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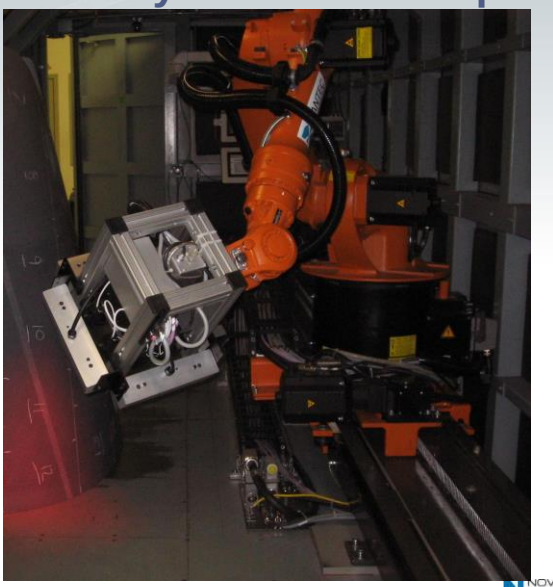
Automatic Robot System for Aerospace



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Robotic Inspection system

- Robot installation, control room and new measuring head
- Combination of thermal and vacuum loading

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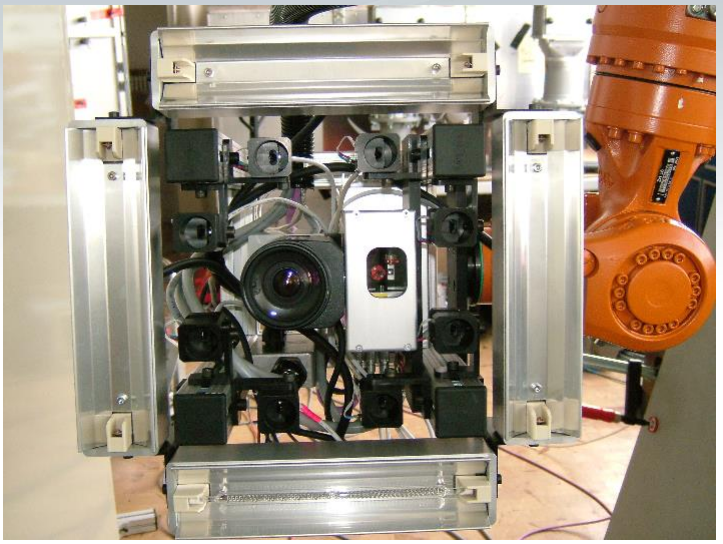
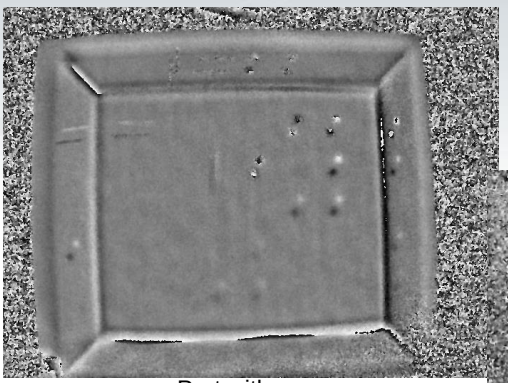
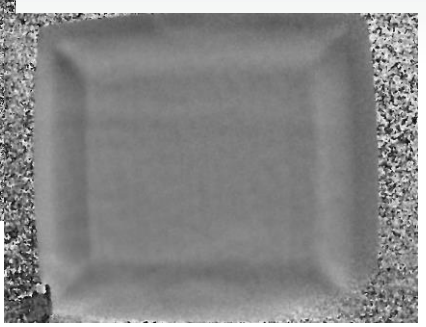


Results



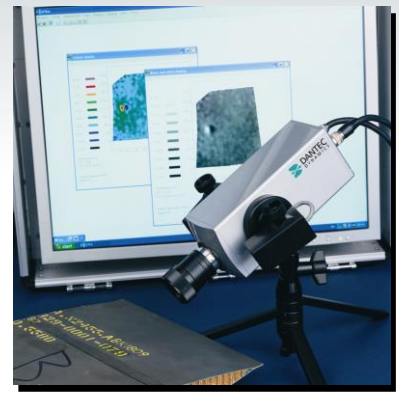
Part with defects



Part with no defects

Standard Q-800 System

Q-800 Shearography Sensor for various applications in production or in-Field



- Variable field-of-view
- Lightweight
- Compact design
- Any excitation method

For most materials no surface preparation required

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Q-810 Vacuum Hood System

Q-810 portable Shearography System for applications in production or in-Field Service

- Large area coverage (15sqm/hr)
- Hood mounted touch-screen monitor
- Thermal and vacuum loading
- Lightweight
- Long cable connection >20m

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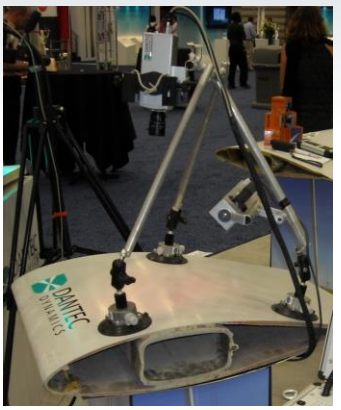
New Up-tower Sensor mounting system

- Mil-Connector for Q-800 sensor with up to 8 LDs and Digital interface for Heat Control
- Lightweight mounting frame for sensor and heat lamp
- Vacuum cups with ball-joints
- Shrouded for wind and sunlight



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New System for up-tower inspection with ropes

- Pelicase with Mil Connectors, Water and Dust proofed (IP 65)
- Ruggedized Magnesium Laptop IP65 and MIL-STD 810G
- 14“ Sunlight Readable screen
- Shock and Vibration damped electronics
- Size: 52.4 x 42.9 x 20.6 cm3
- Weight: 16 kg incl. Notebook (35lbs)
- One button: Pre-defined recording routines

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Our Shearography Customers

Automotive

Aerospace

Electronic/etc

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Thank you for your attention!

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