NDTherm

Active Thermography Imaging - an Innovative Approach for NDT Inspection

OPGAL
Beyond the Visible

Opgal: Leader in Thermal Imaging

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30 Years of Infrared Imaging Technology Innovation

Aircraft

Security & Safety

Defense

Gas detection

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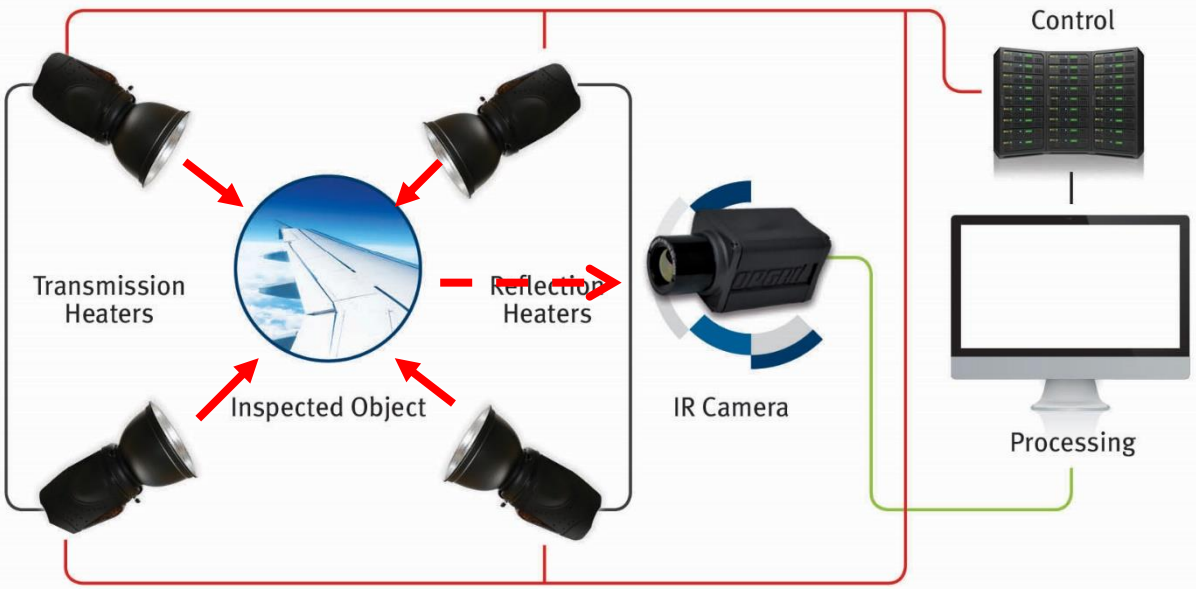
The Principles of Thermographic NDT

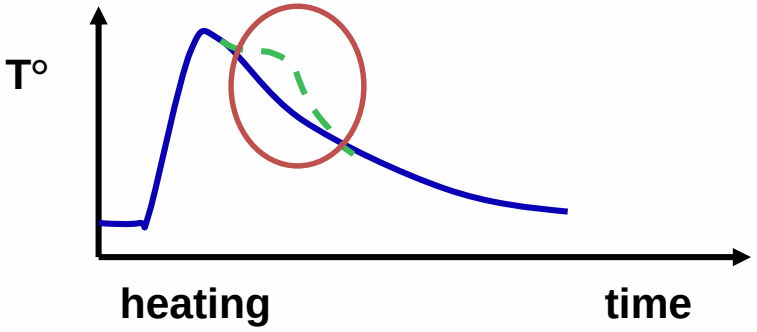
- An active approach, where an energy source induces a temperature gradient to the environment, to be examined by a specially tuned IR thermal camera.
- Opgal NDTherm includes:
  - Patent pending technologies
  - Dedicated energy sources
  - Unique sensors
  - Proprietary algorithms
  - Powerful analytics

Active thermography -Principle

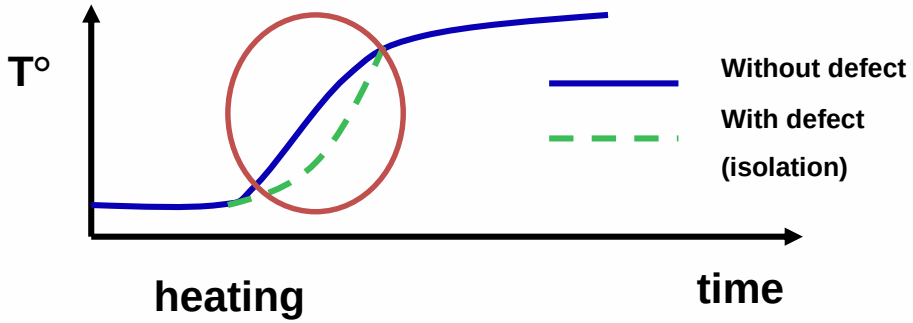


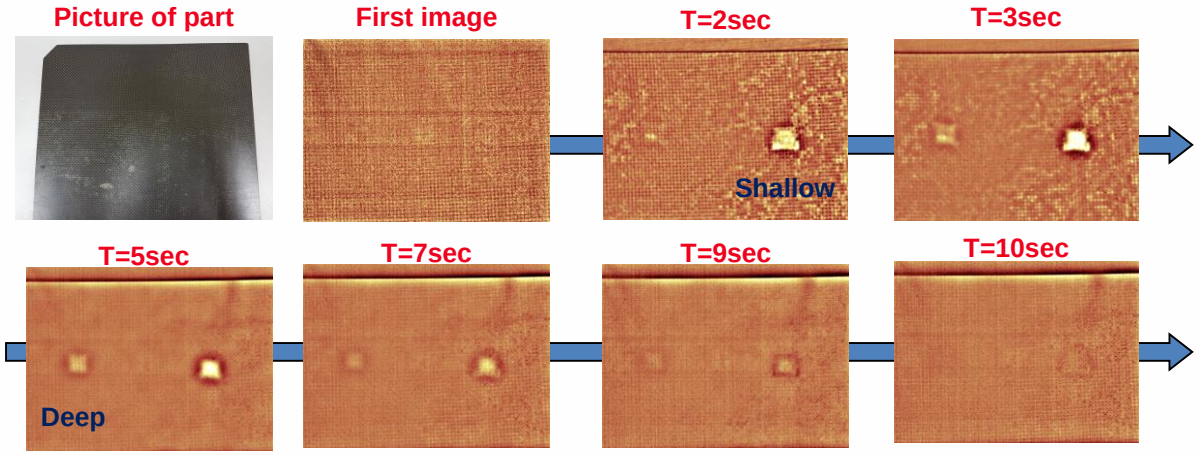
Active thermography -Principle

Reflection



Transmission





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Opgal NDTherm™ Key Benefits

- **Contactless:** No physical contact between the sensor and the inspected object is needed
- **Safe**: Minor temperature differences suffice.
- **Fast**: Imaging technology allows for a global and instant inspection.
- **Easy :** No special setup or calibration needed.
- **Single side access:** Application dependent.
- **Cost effective:** Compared to competing NDT technologies.
- **Flexible:** Production line or portable in the field. Manual or fully automated configurations.

Typical NDT Usage for Aircraft Mainframe

- Delamination
- Voids
- Skin to Core Disbond
- Impact Damage
- Adhesive Bonding
- Paint Adhesion
- Corrosion
- Moisture Ingress
- Porosity
- Wall Thickness
- Wall Thinning
- Contaminations

- Spot Weld Inspection
- Paint Thickness
- Coating Thickness
- Crack Detection
- Fiber Orientation
- Thermal Diffusivity

NDT Methods of CFRP Testing

NDT of CFRP	State of cure	Porosity	Moisture	Fibre orientation	Fibre debonding	Delamination	Cracking	Global inspection	Proof tests	Strain measurement
Radiography										
White light										
Coherent light										
Thermography										
Microwave										
Eddy Current										
Dielectric										
Electric										
Spectroscopy										
Ultrasonics										
Acoustic Emission										
Vibration										

Established technique

Potential technique

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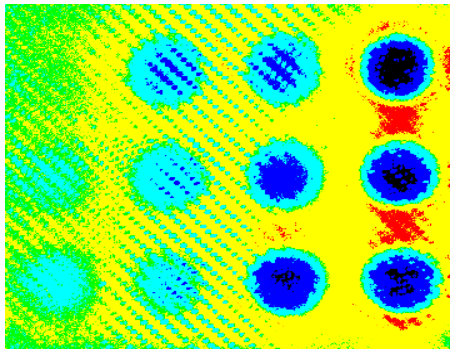
Comparison of main NDT Methods for composite structures

Method	Ultra-sonic	X-Ray	Eddy Current	Thermo-graphy
Resolution	+	+++		+
Depth penetration	-	+++	-	-
Depth measurements	+	---	+	+
Ease of operation	-	---	+	++
Portability	+	-	+	+
Safety limitations	+	---	-	+++
Time to result	+	-	+	++
Geometry sensitive	-	+++	-	+
Material sensitive	+	+	---	+
Capital cost	-	---	+	++
Running cost	-	-	++	++
Automation	++	---	+	+

5.5mm CFRP laminate (Reflection)

Front side

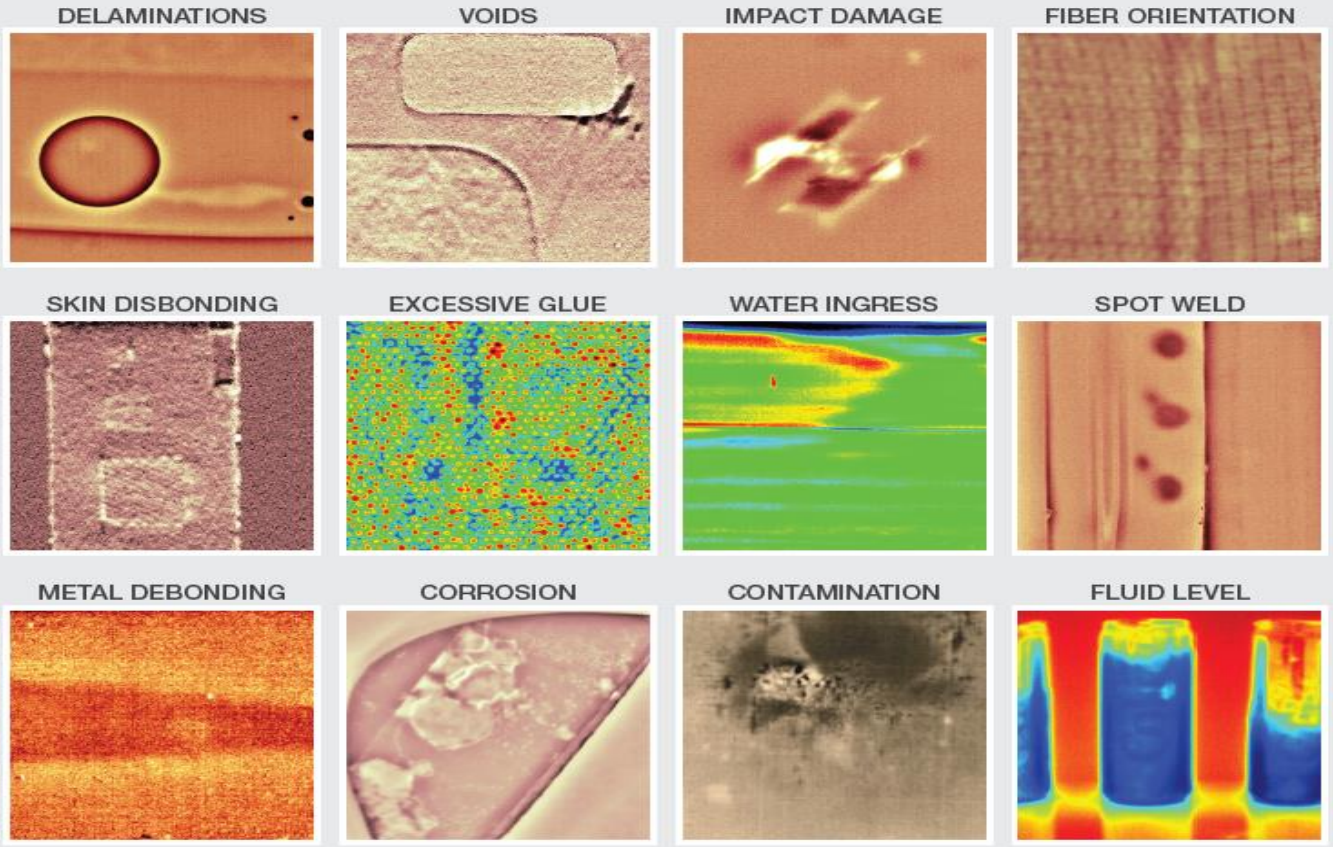
Back side



Active thermography image




NDTherm can detect



NDTherm® can also detect: Paint Adhesion and Thickness, Thermal Diffusivity, Porosity, Wall Thickness and

NDTherm standard Product line

BOEING
BSS7050

AIRBUS
55-40-50

Automated

NDTherm® AU

Fixed

NDTherm® FX

Portable

NDTherm® NT/LF

NDTherm NT / NDTherm LF

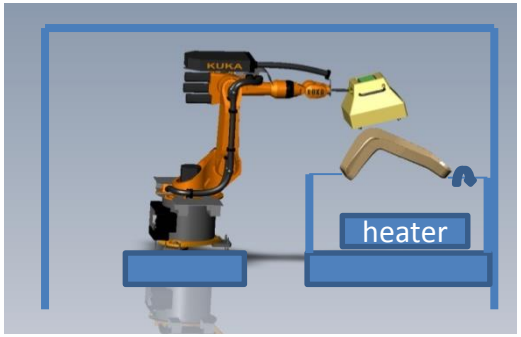
- One man portable (<9Kg)
- No special setup required
- Fast Go – No Go inspection
- Predetermined setups configuration
- Utilizes “Reflection” mode testing

NDTherm FX

- Utilizes “Reflection” and “Transmission” modes testing
- Flexible configuration to handle different parts and shapes
- Predetermined setups configuration
- Enhanced reporting tools

NDTherm AU

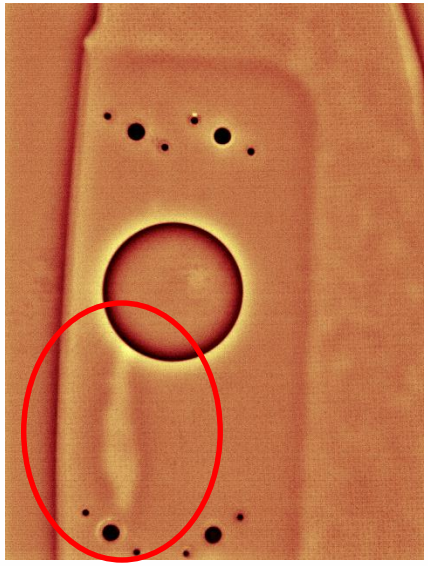
- Robotic manipulator
- Flexible configuration
- Implementing Active thermography “reflection approach”
- Cage for safety provisions
- Multiple predetermined setups for various parts inspection



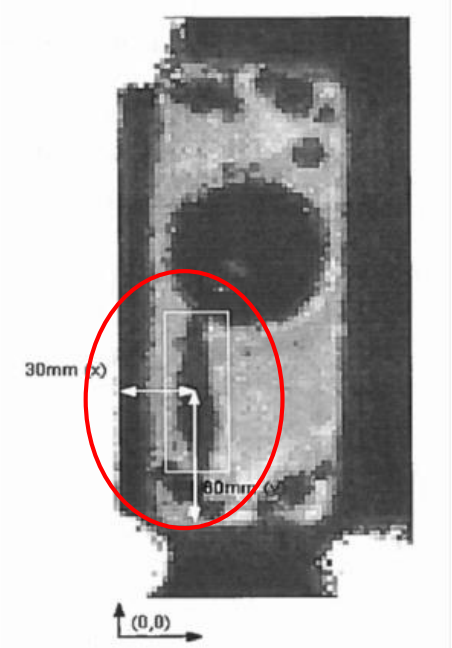
Sample testing

Review of test results preformed on various materials and structures:

NDT : Thermographic Vs. Ultrasonic



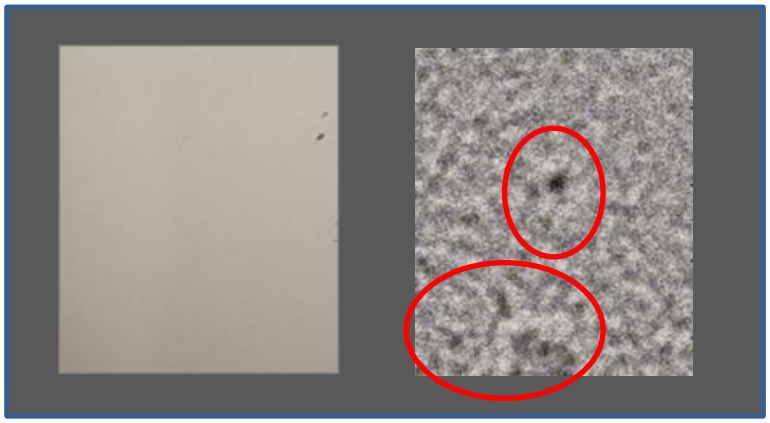
Thermographic



Ultrasonic

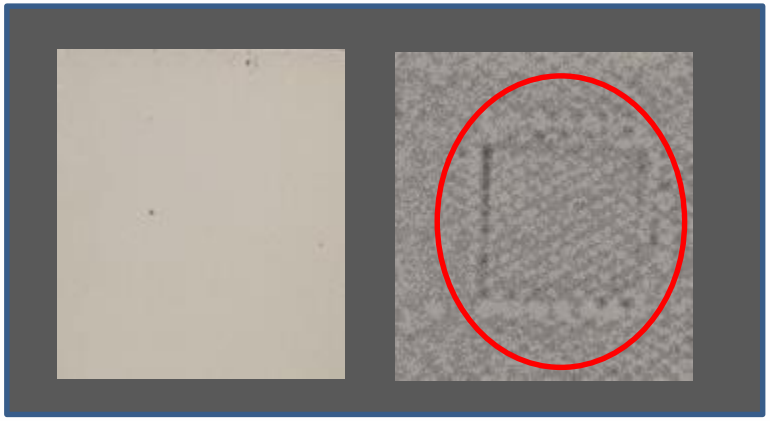
Adhesive to Core Disbond Detection

Rohacell



Visible NDTherm

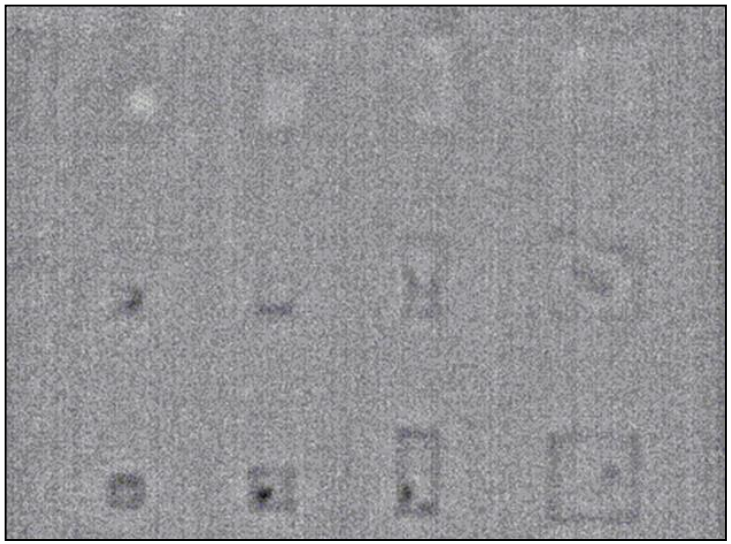
Honeycomb



Visible NDTherm

Laminate Defects Detection

Fiber Glass



Test plate

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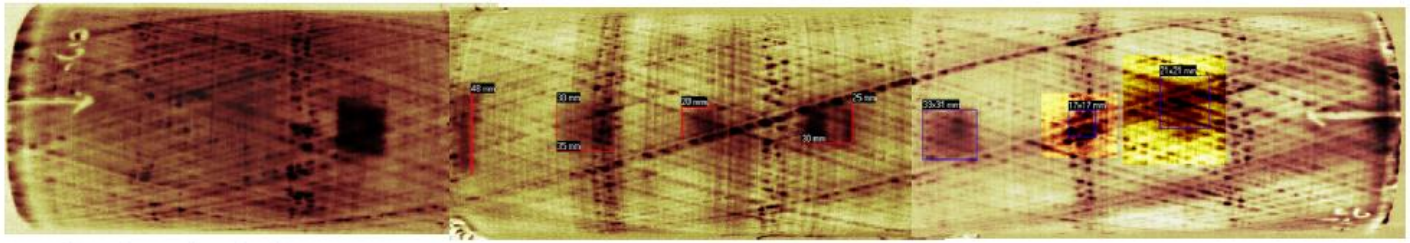
CFRP laminate tube defects detection



Method: Pulsed Phase:

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*Sample courtesy of Kar[illegible]

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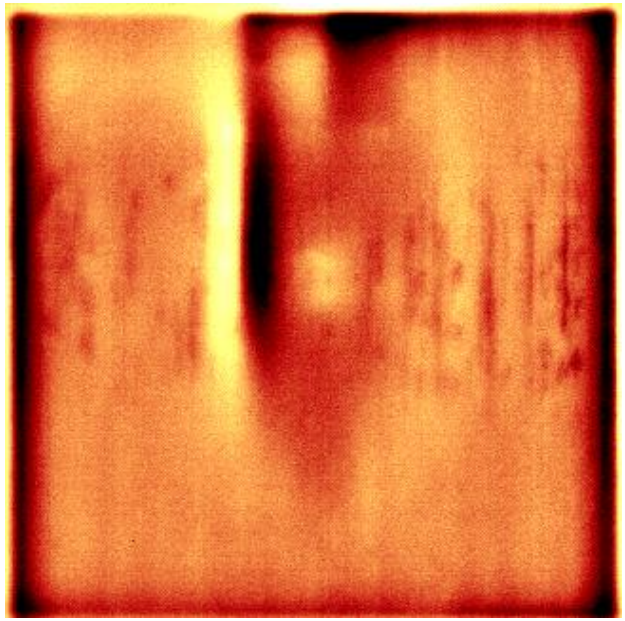
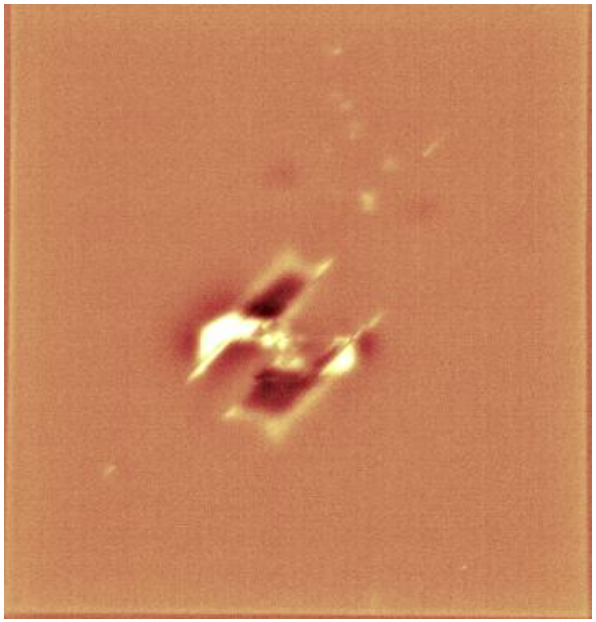
CFRP Impact damage



Second Der.



Second Der.

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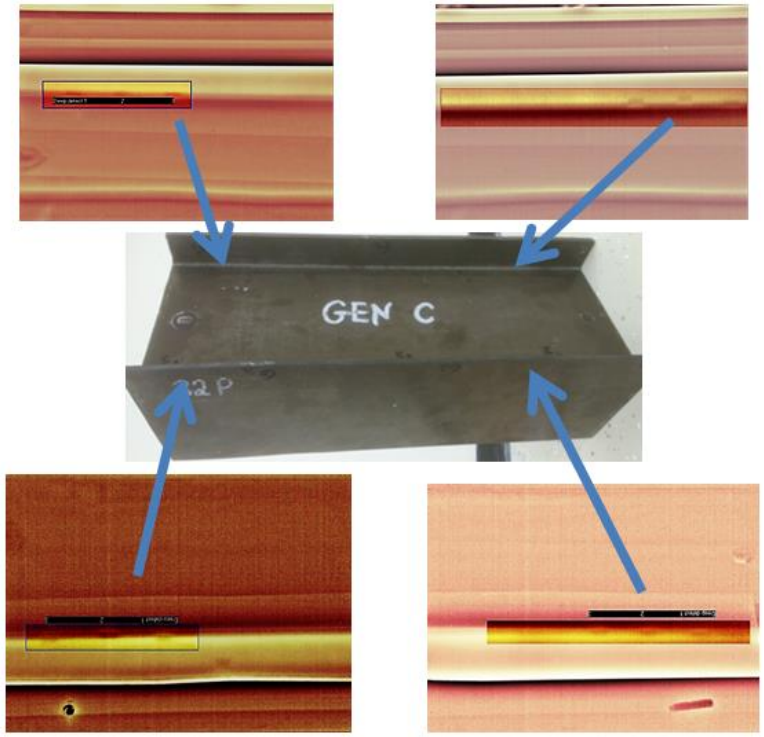
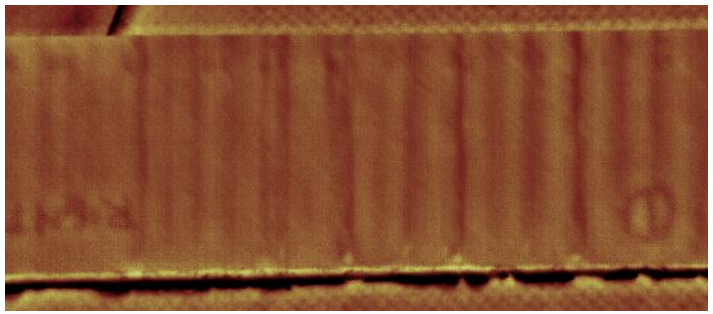
Testing of “Boeing 32-44 Layer H shape CFRP calibration sample”

- 100% detection Demonstrated
- “Reflection setup” was proved to achieve full detection



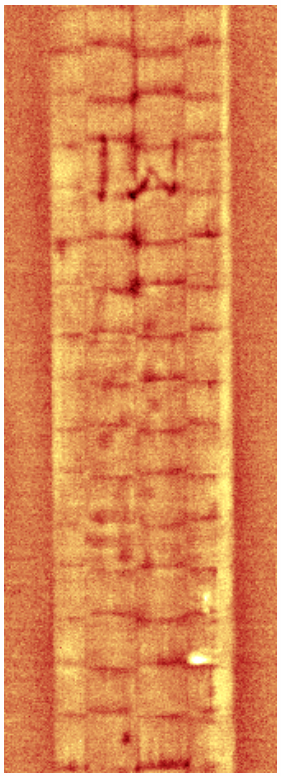
Boeing CFRP wrinkles sample



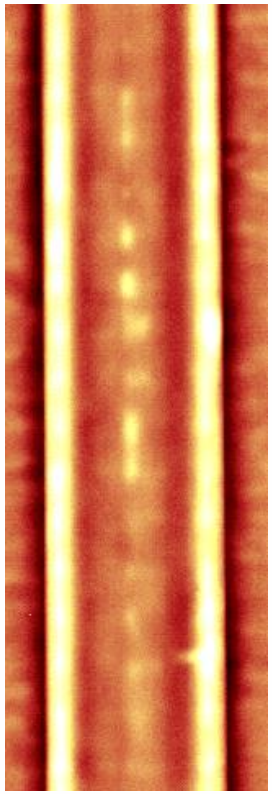
Pulsed phase

Correlations

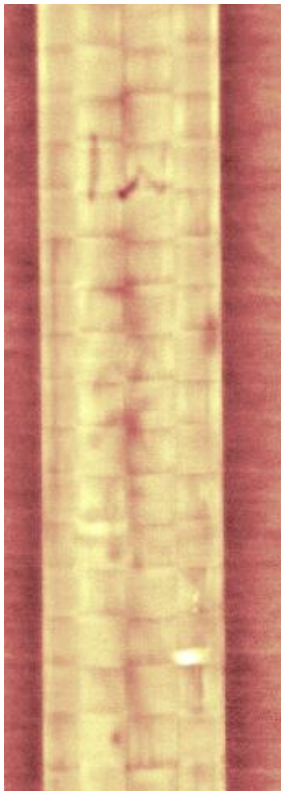
CFRP 2mm thick. pipe inspection



Second Der.



Pulsed Phase



Pulsed Phase

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Published article in cooperation with IAI

A NDT Study of Complex CFRP/GFRP Structure by Means of Active Thermography

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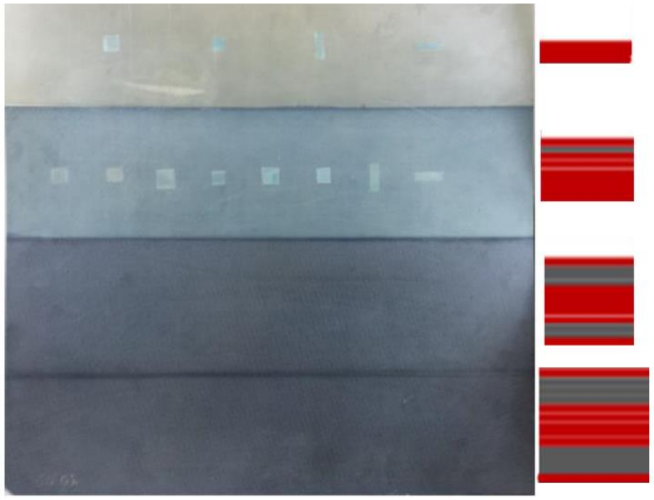
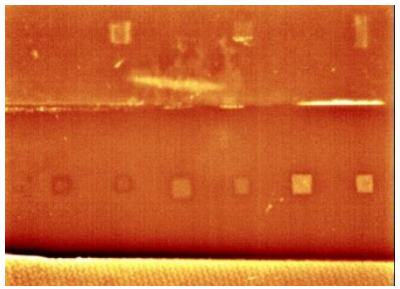
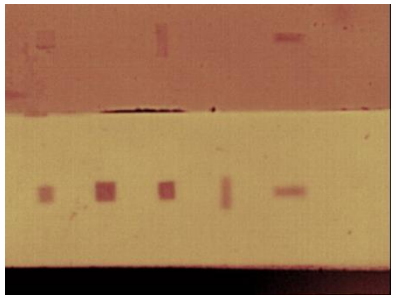
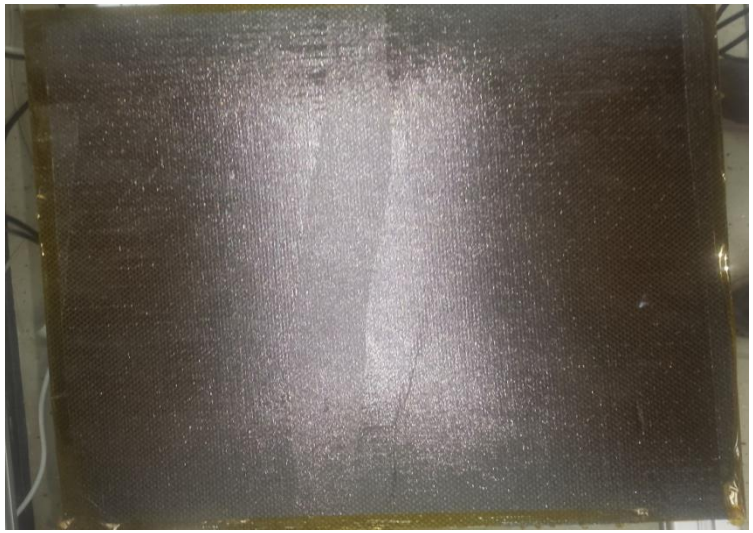


Figure 3: Visible image and layer design of the GFRP/CFRP calibration plate

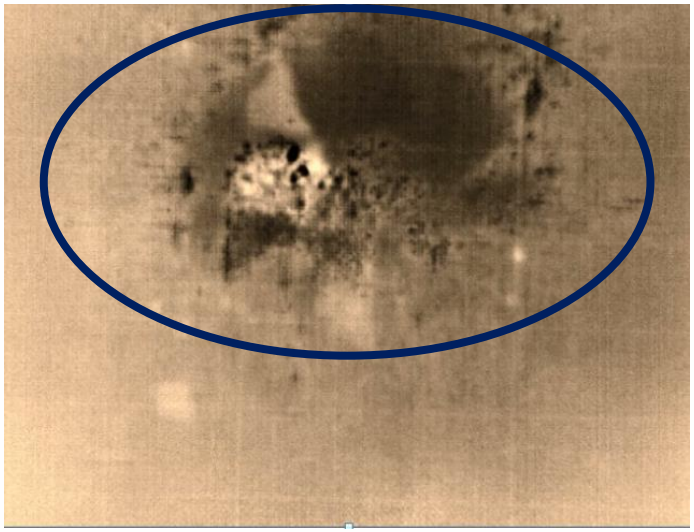




Corrosion detection of Metal / CFRP structure



Part



Second Der.

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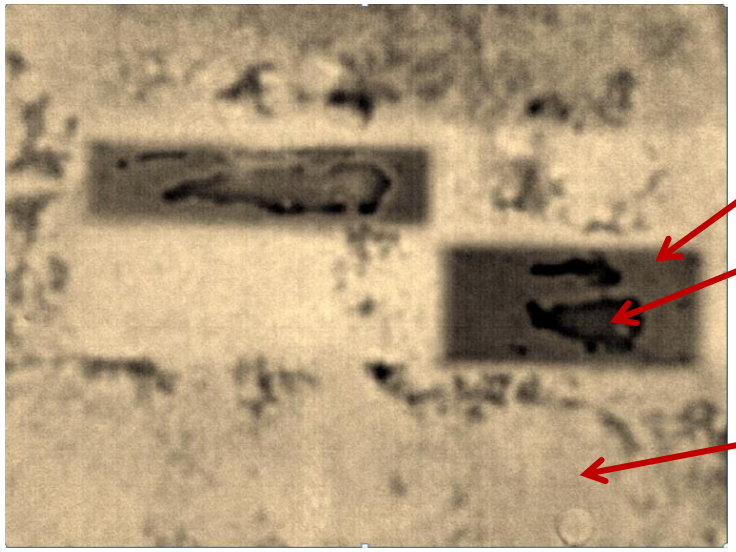
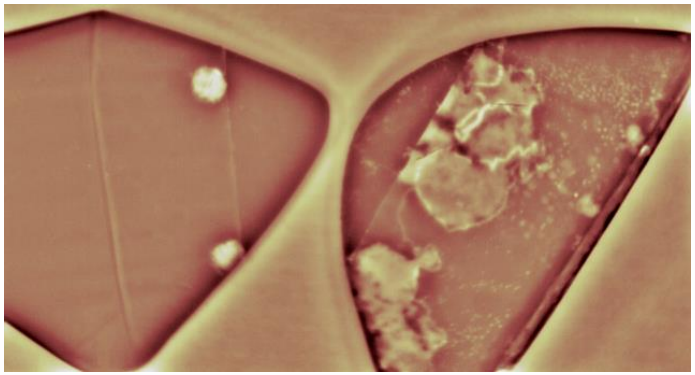
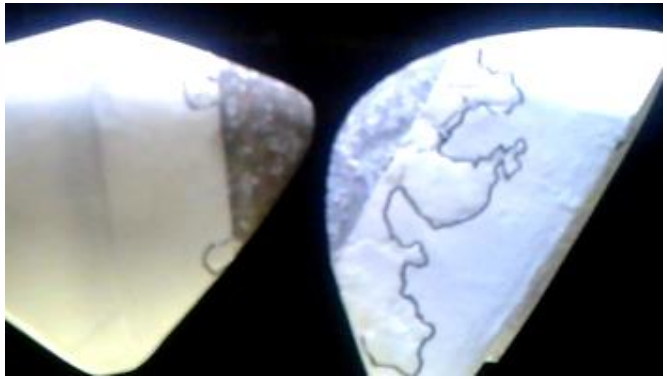
Delamination Dection on Rohacell/ CFRP structure (Derivative method)



Under paint corrosion

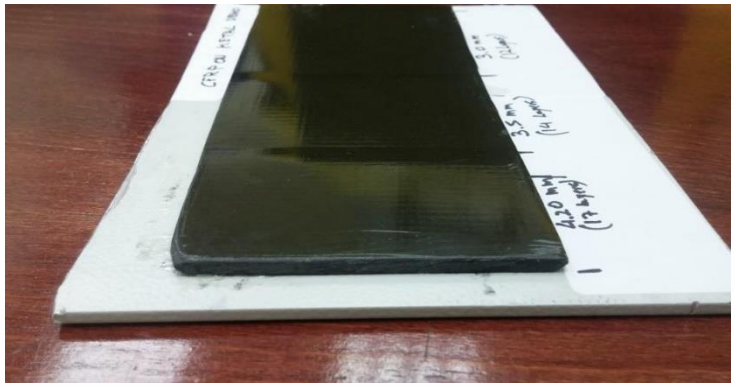


Reconstructed

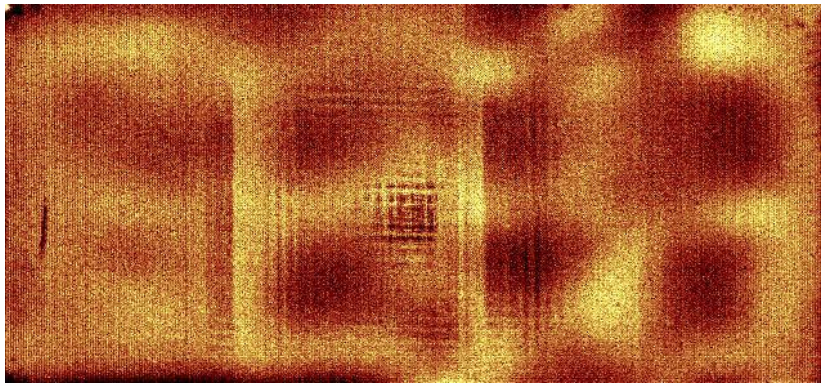


Part image

3.0-4.2mm CFRP debonding on aluminum

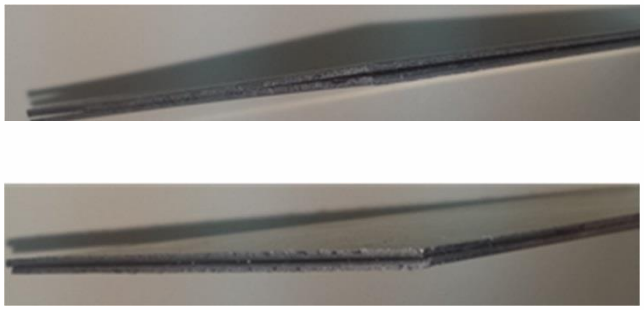


Test Sample

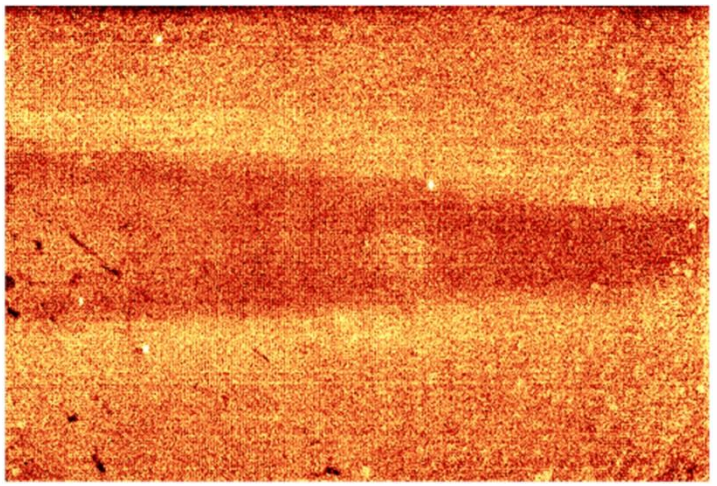


Inspected Debonding
(Marked dark)

1.2mm metal – debonding inspection



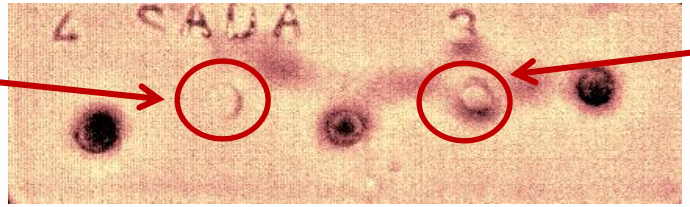
Test Sample



Inspected Debonding
(Marked dark)

Spot welding inspection

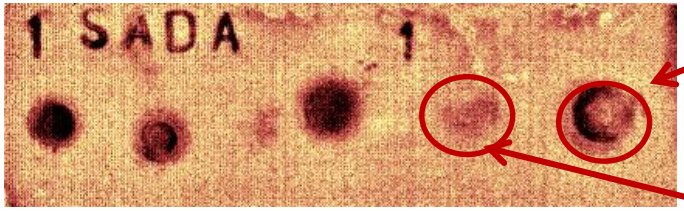
1.1mm



No weld

Stick weld

1.4mm



Burnt spot

No weld

NDTherm™ – Your NDT Solution

- **Contact information:**

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Email: segev@opgal.com

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