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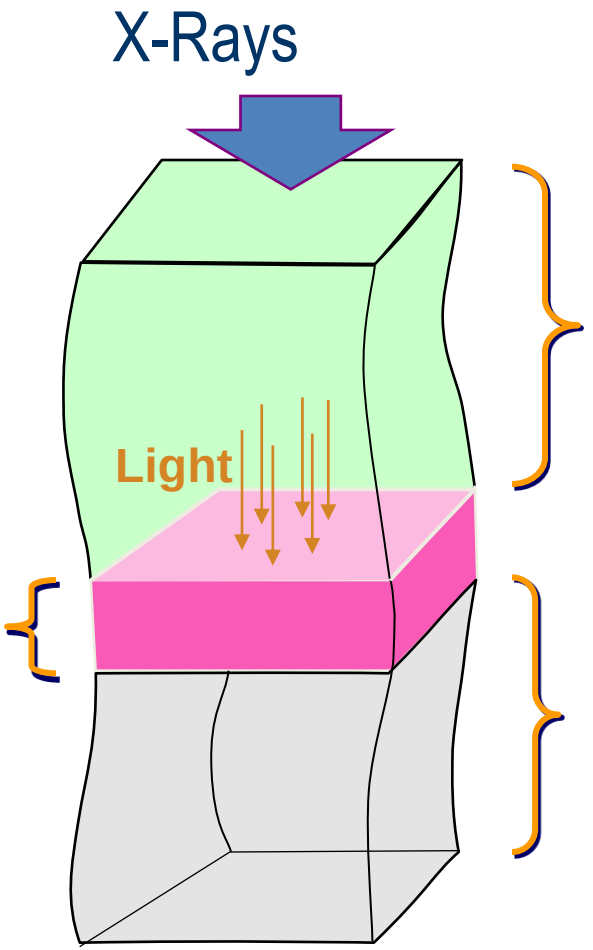
DDA In the Service of Aerospace

Ron Pincu

NDT Division Manager

Flat Panel (DDA) Technology



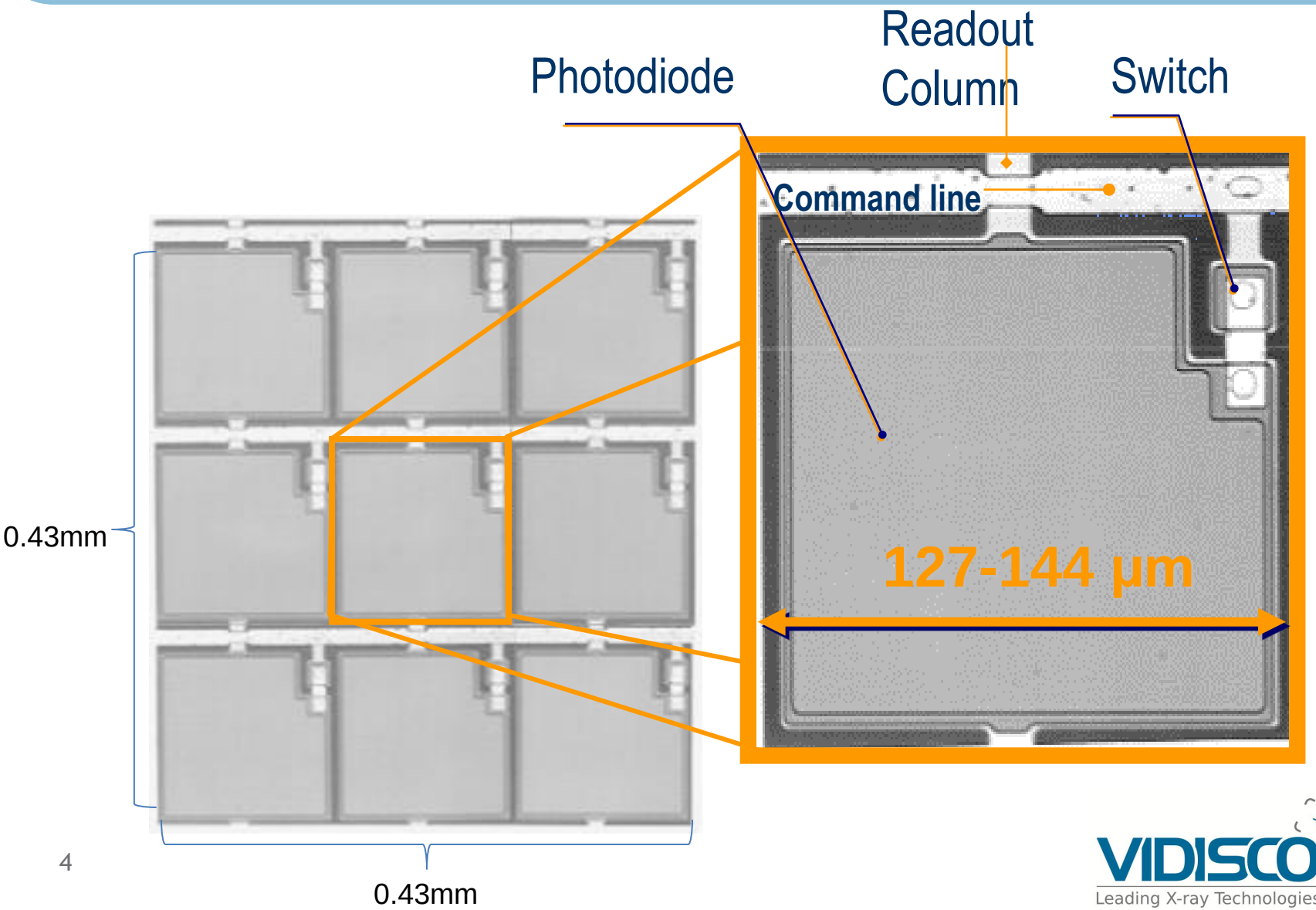
Gadox or CsI converts X-Rays into light

Amorphous silicon Photodiode converts light into electrical signals

Substrate

Source: Thales Electron Devises

Pixel Layout



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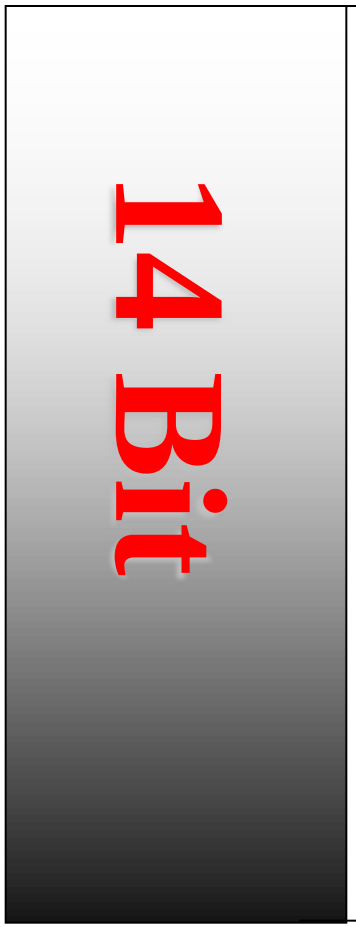
Dynamic Range



16,383

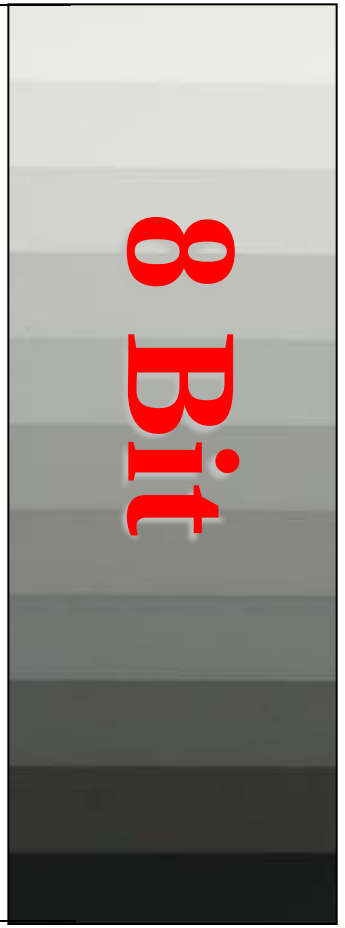
$2^{14} = 16{,}384$

$2^{16} = 65{,}536$

Number of
Gray Levels
In Every Pixel

0

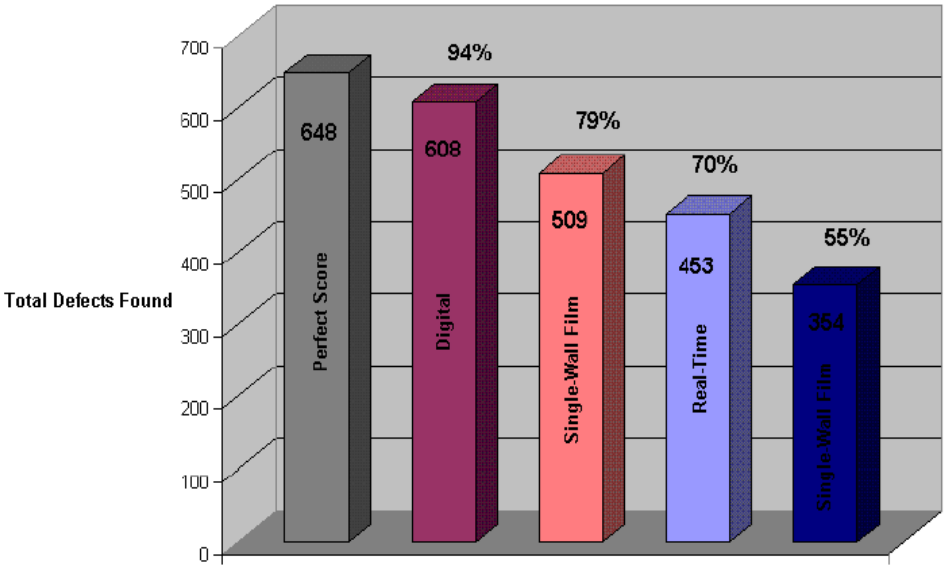
256



0

DR vs Film/CR

Inconel pipe: Class A welds (100% inspection required)
Controlling Specification BAC5975



Boeing's Conclusions:

94% POD Double wall pipe using DDA ➡ 55% POD using film

Process: 150 min using Film ➡ 12.5 min using DDA

Source: Boeing Commercial Aircraft Study 2003

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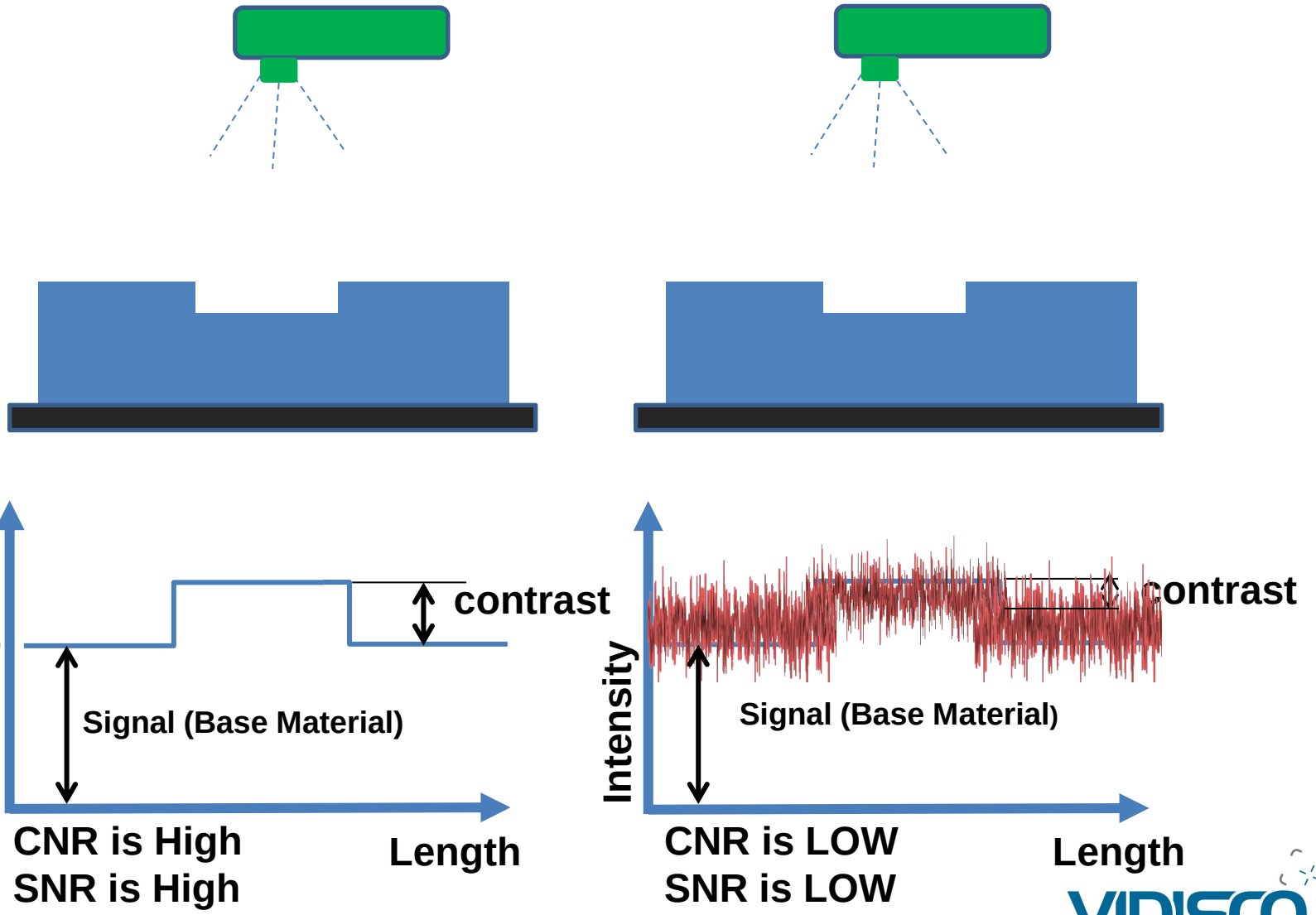
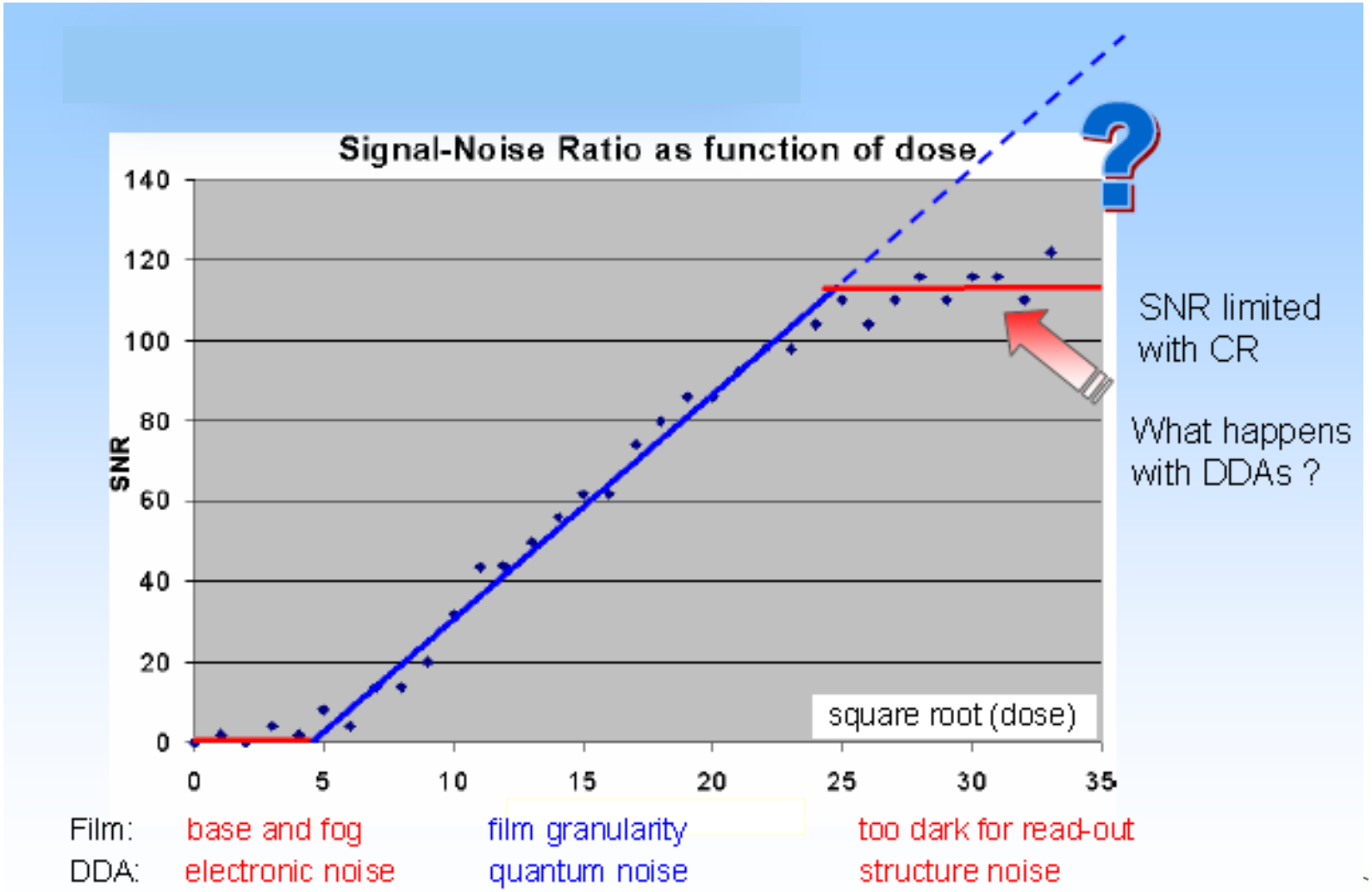
Influence of image Noise on Visibility

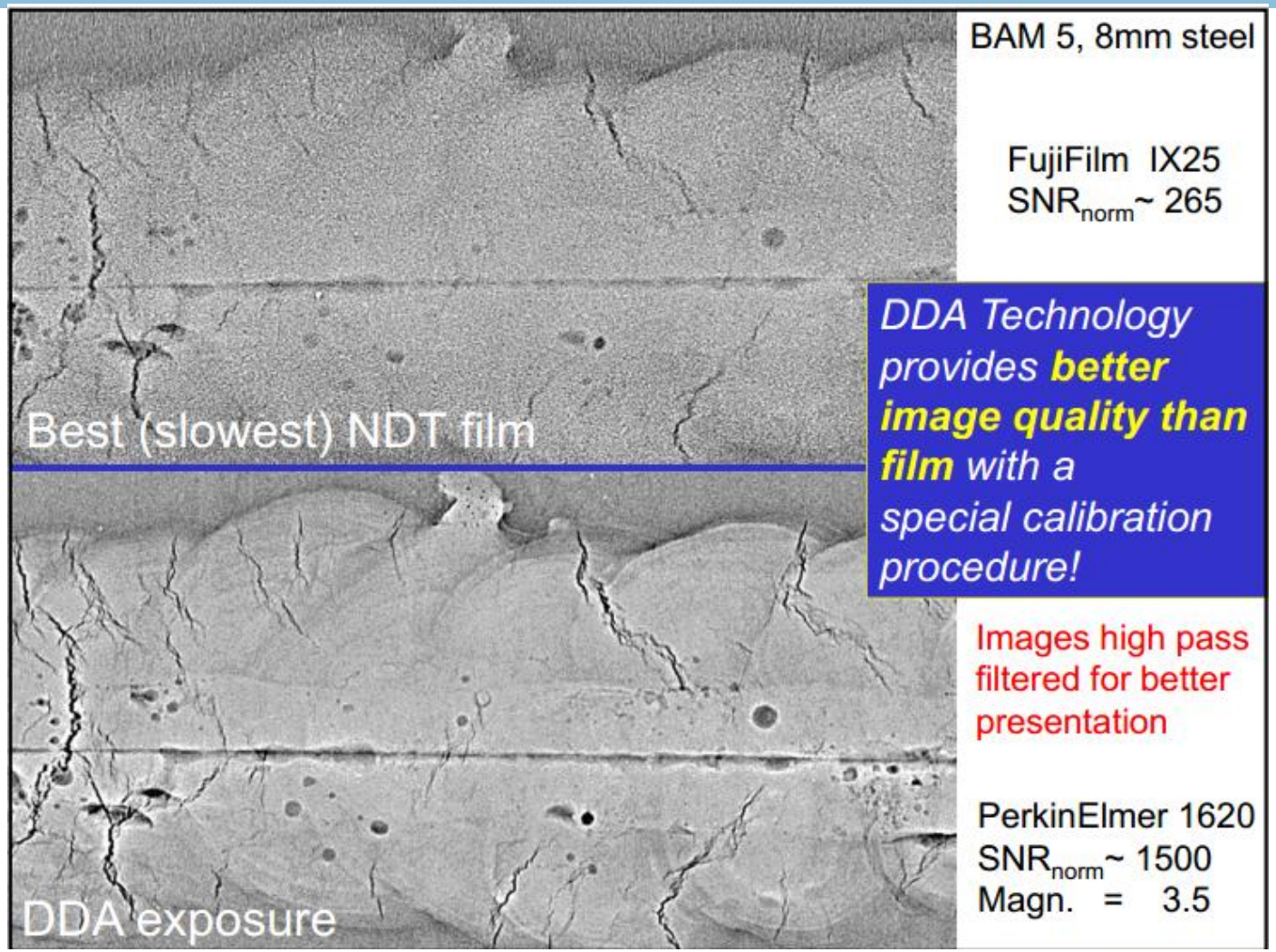


Noise in Films and Digital systems



Source: BAM Presentation DIR Lyon 2008

Image Quality



Source: BAM Presentation DI ASNT Fox Wood 2011

Summary DR Vs Film

Image Quality:

- High Probability of Detection (POD).
- Wide dynamic range (16,384/ 65,536 gray levels)
- Ability to Increase SNR and CNR

Summary DR Vs Film

Fast Setup & Immediate Results:

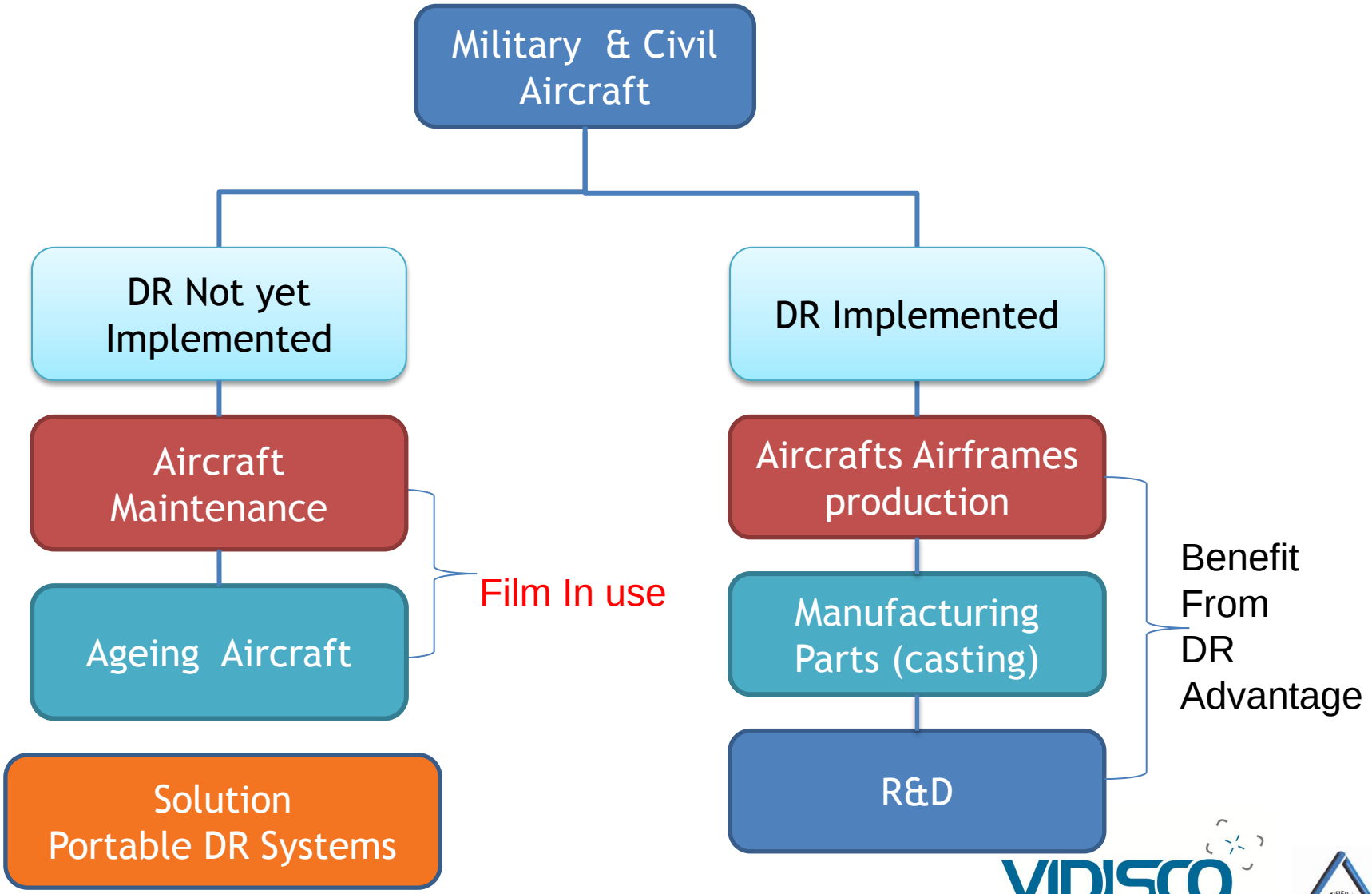
- Near Real-Time results.
- Object does **NOT** need to be moved.
- Objects of all sizes and materials can be inspected.

Summary DR Vs Film

Fast Return on Investment:

- "Cost Free" imaging – Extend work more, pay less per image.
- No development or scanning time is required
- No cost of chemicals
- No cost of storage space (digital data base)

Digital Radiography Systems in the Aerospace Market



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Solutions
Field Portable DR systems

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Solution: Portable Digital Radiography

- **Time to Image:**
  - Instant image
  - Immediate analysis
  - Short exposure time (seconds)
- **Safety**
  - Minimal shut-down area
  - Lowest dose per image
- **Field Design**
  - Extreme temperatures (-20 to 40 Celsius)
  - Thin and light imager

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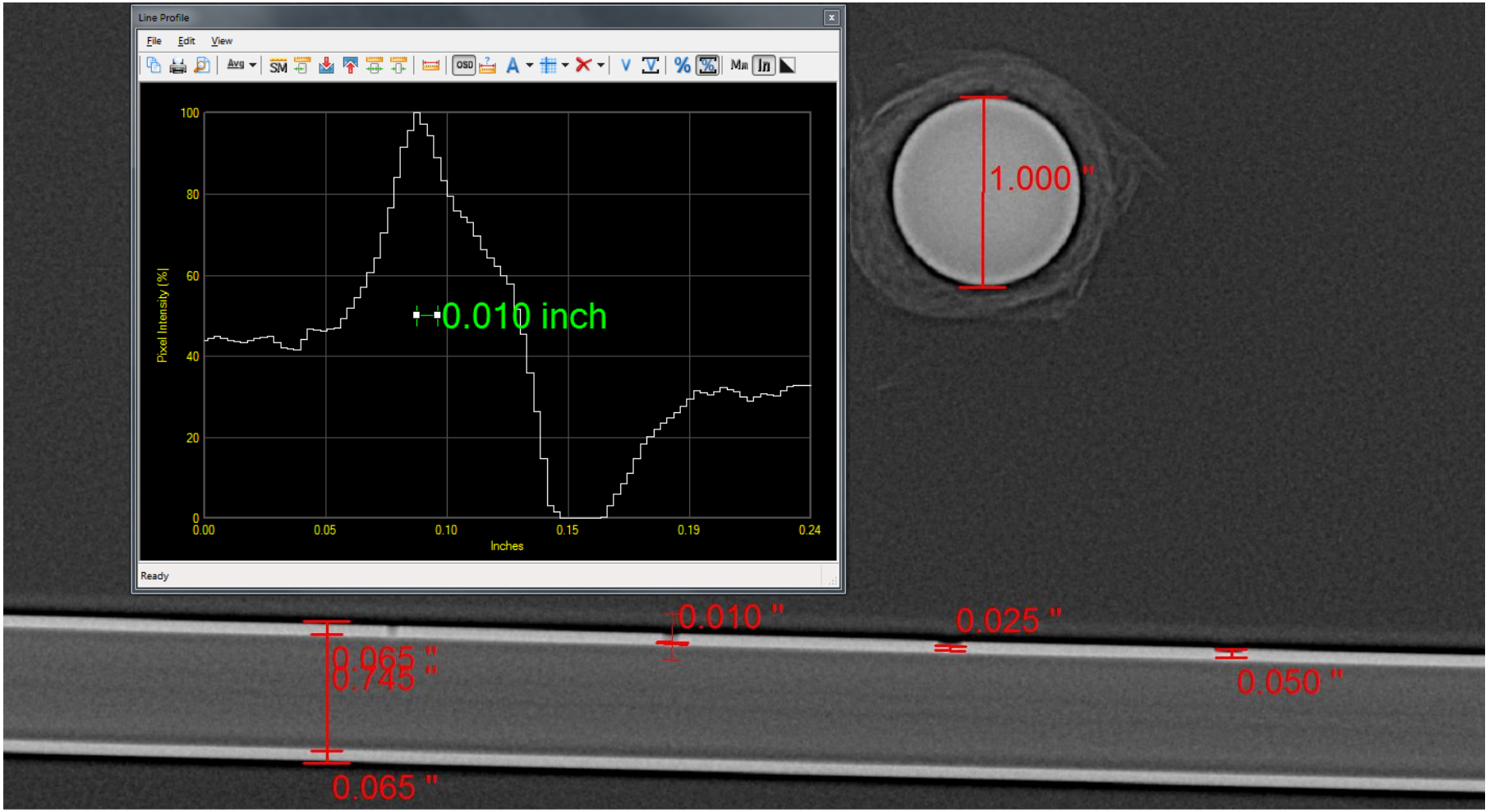
Xbit Pro Software Tools

High Accuracy Measurements

Tangential Wall Thickness Measurement



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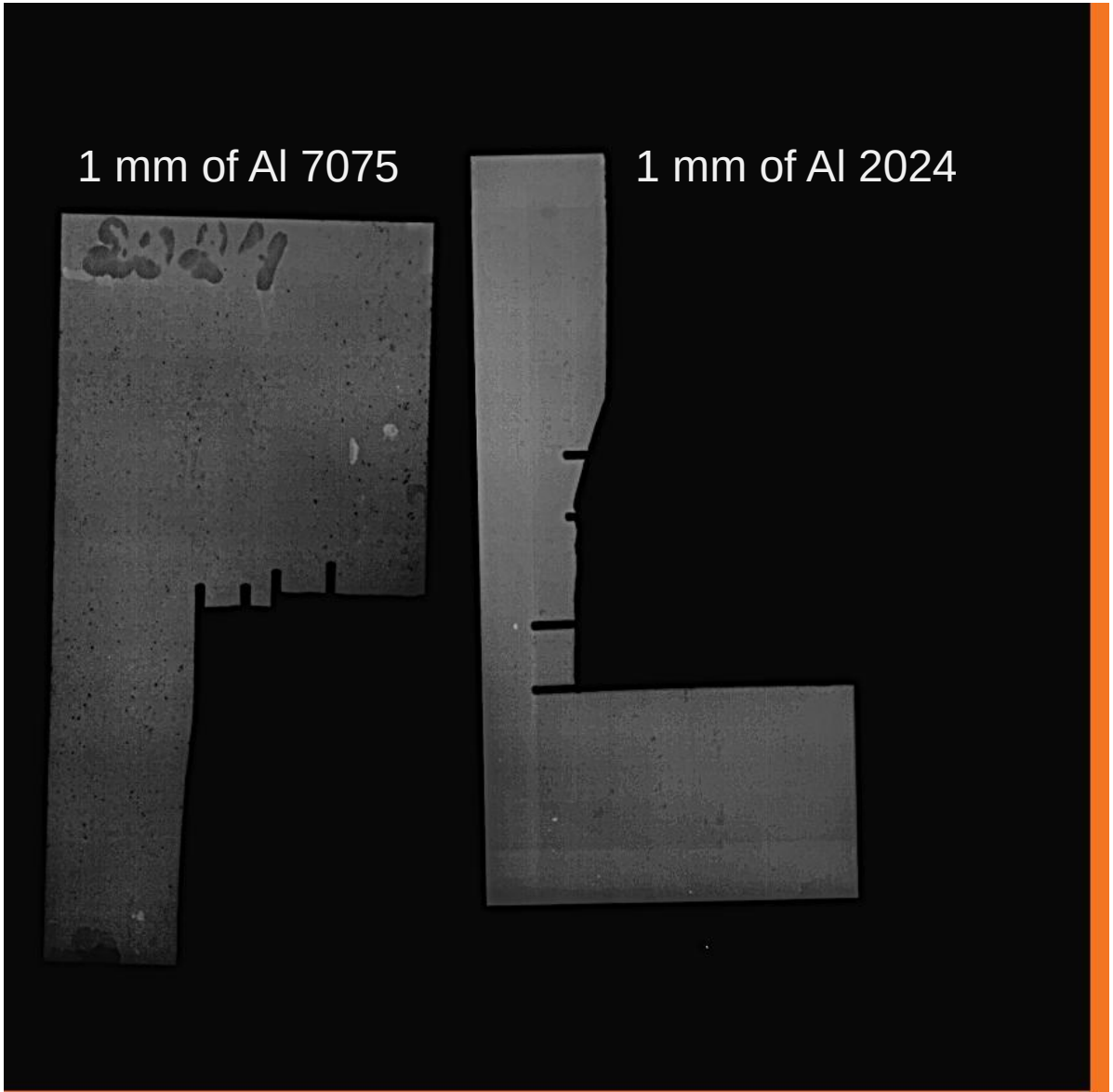
Early Corrosion Recognition



A special algorithm is used to increase Signal to Noise Ratio (SNR)

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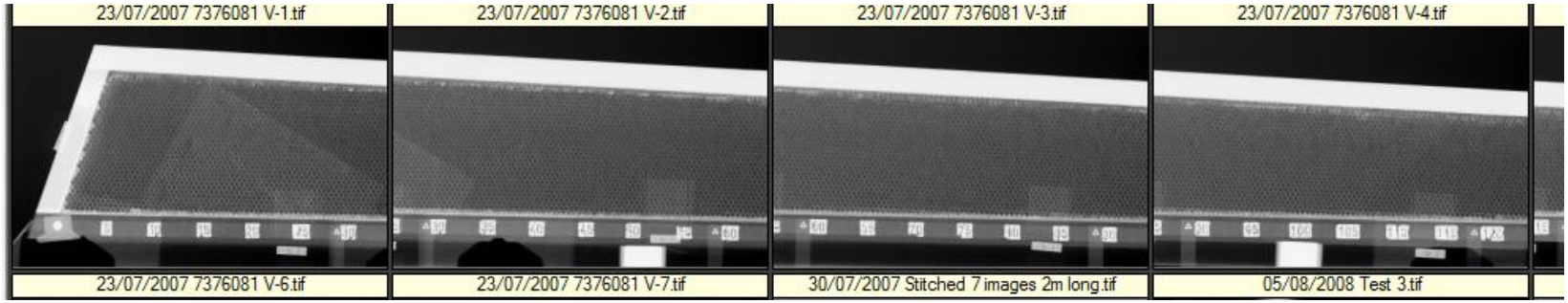
Automatic Stitching Capabilities

(Pixel Level Accuracy)



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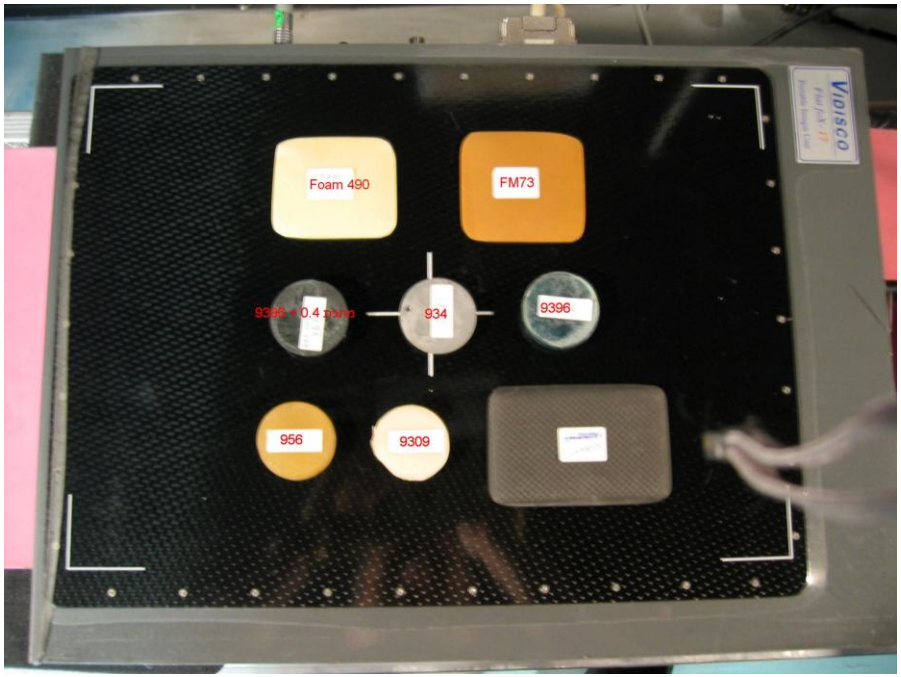
Dual Energy (Organic/Inorganic Differentiation)

Familiar with this?

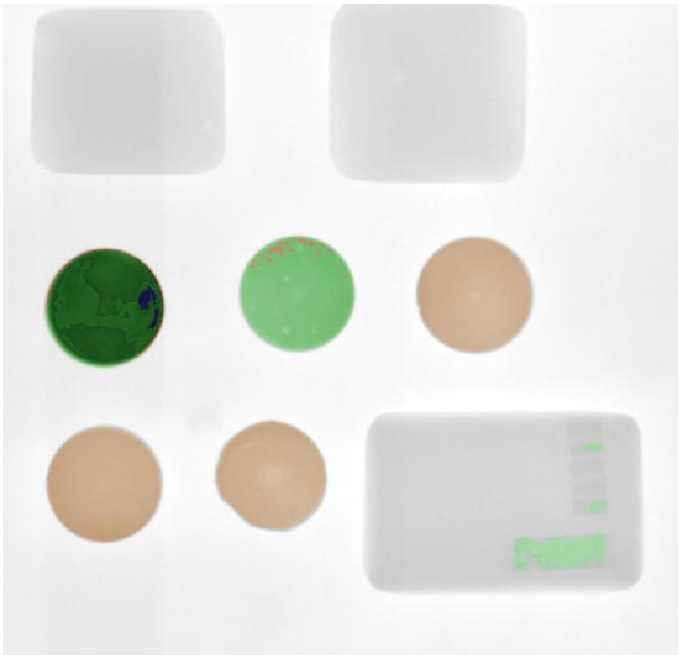
Dual Energy Use

- In composite materials, some adhesive materials feature the same density as water
- Problem: To distinguish between adhesive material and water in honeycomb structures
- Solution: Use the special Dual Energy algorithm in order to distinguish between water and adhesive materials

Dual Energy Solution for NDT



Typical Adhesive Materials



Dual Energy X ray Image

Orange = Organic material
Green = Thin inorganic material
Blue = Inorganic material
Black/Gray = Out of scale

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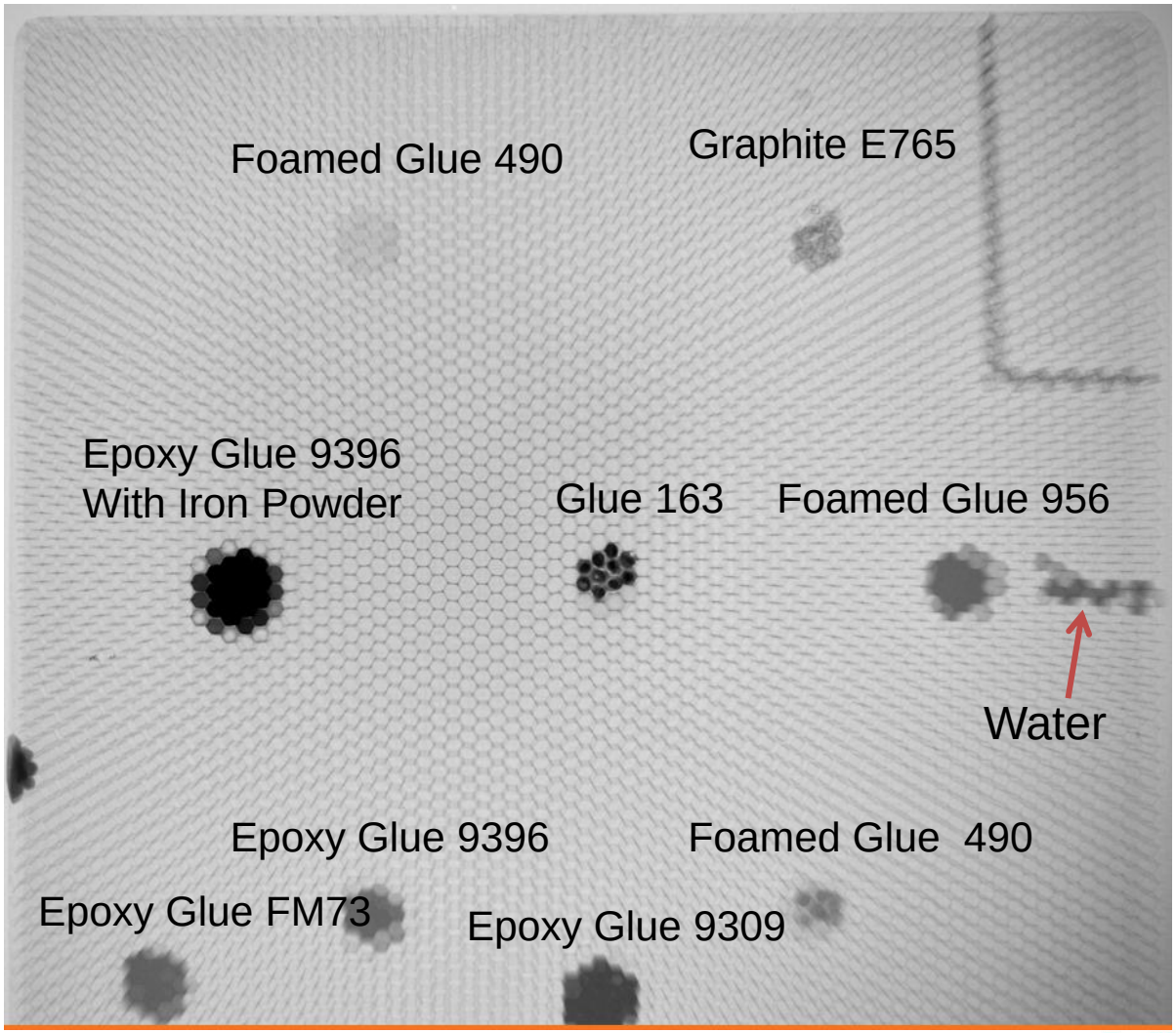
Dual Energy Solution for NDT

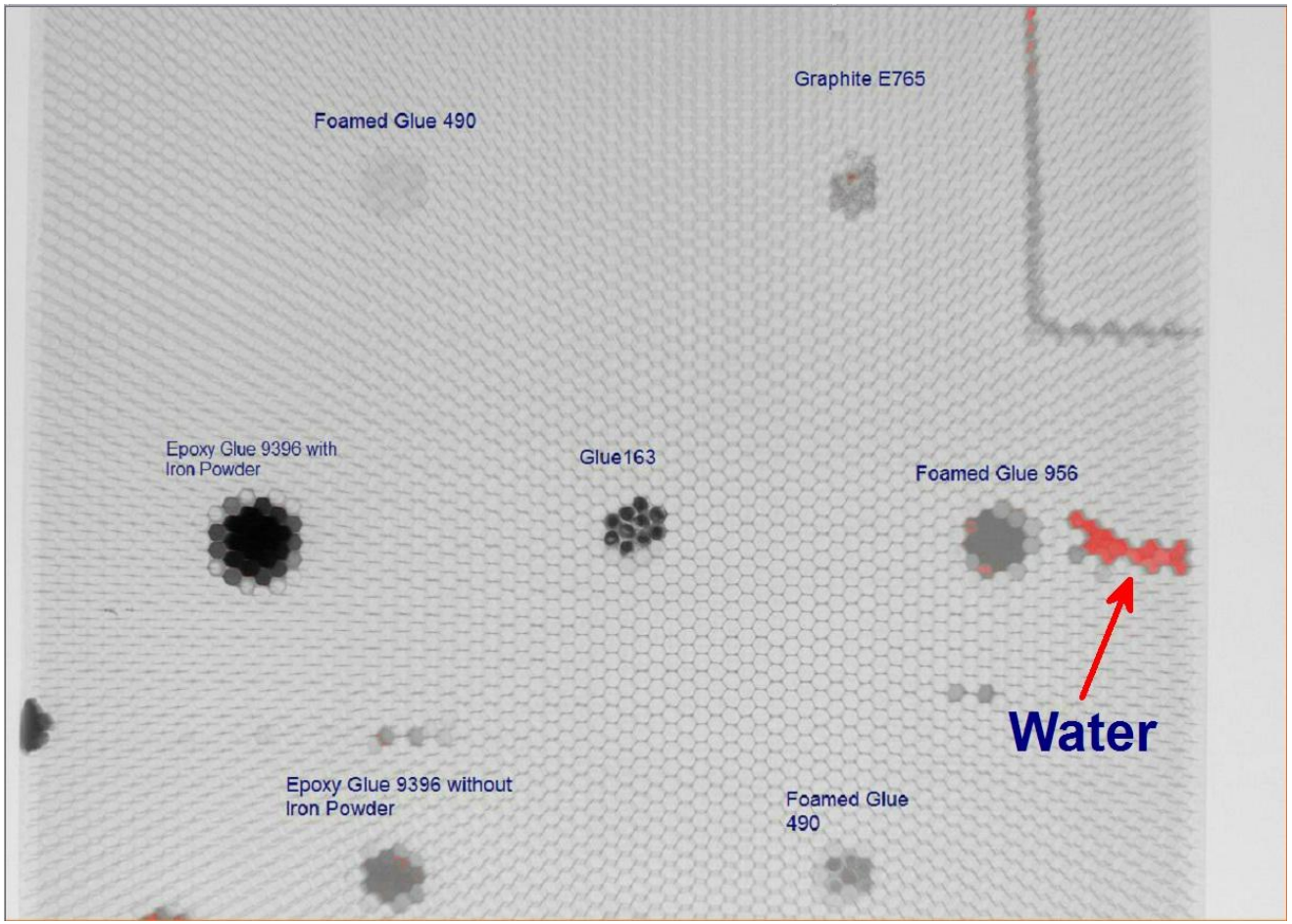
Carbon skin on Honeycomb Structure

Dual Energy Solution for NDT



Dual Energy Solution for NDT

Distinguishes between adhesive material and water in honeycomb structures



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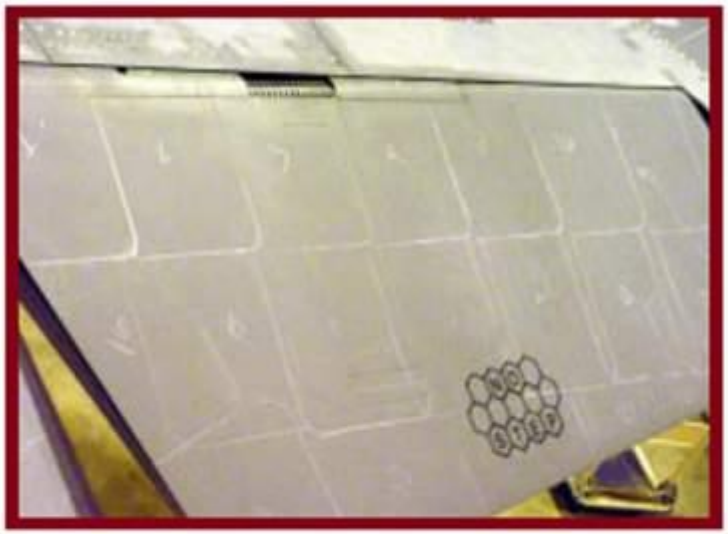
Portable DR in Field use

The American Air Force Uses Flat FoX-17

United States Air Force Battlelab Contract

Using a Digital Panel to X-ray Wing Portions



Pattern developed to apply 8 x 10 inch digital imager

A stand is used while inspecting vertical stabilizer

Portable and Easily Transported

Example: A US Air Force & Air Expeditionary Force Battlelab Study on portable DR inspection systems proved that a portable system such as Vidisco's, could provide a 97% reduction in the equipment footprint

Traditional Film Based Equipment

Portable DR System on Pallet

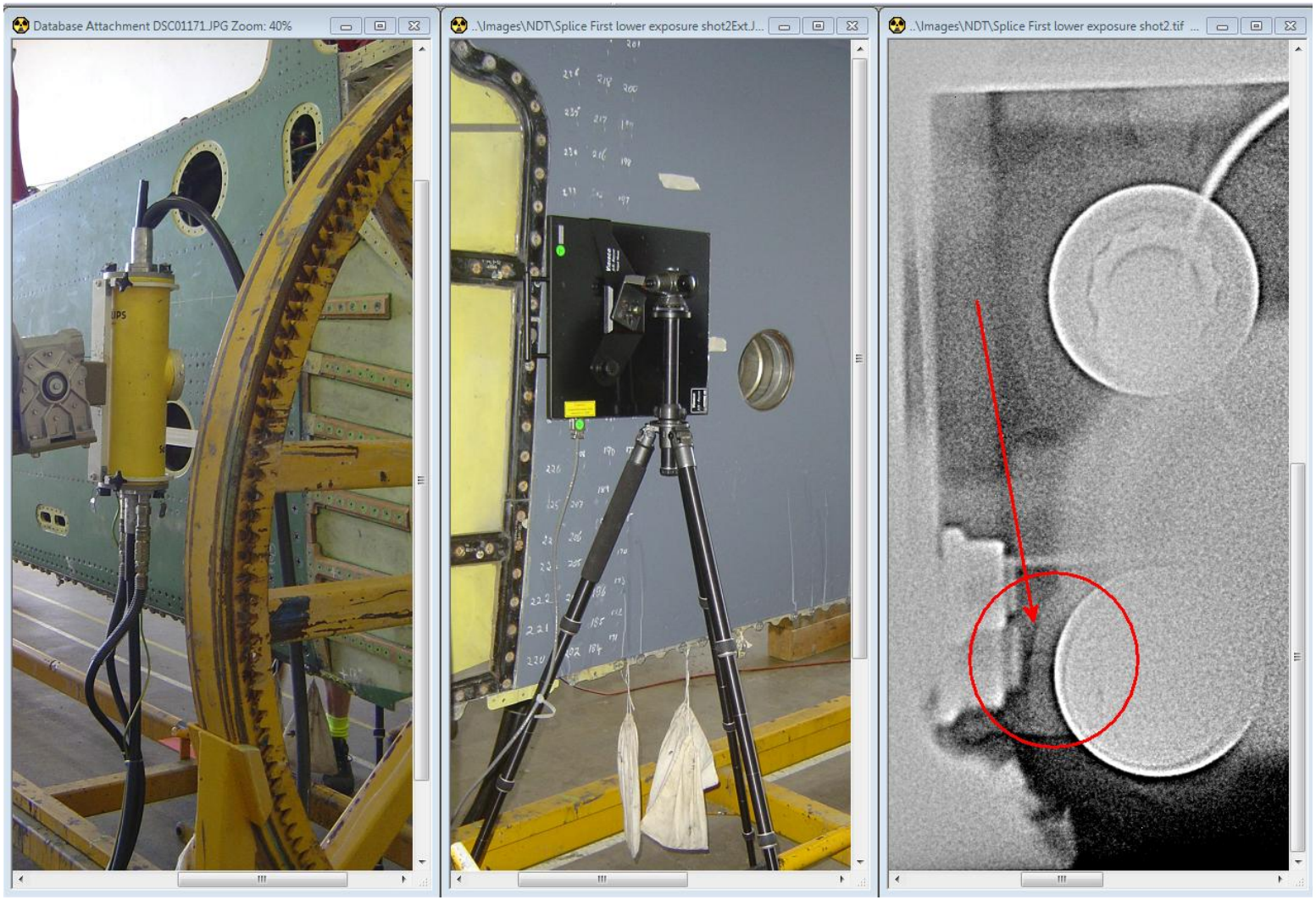
The American Air Force Uses Flat FoX-17

Flat FoX-17 Imager used on F-15

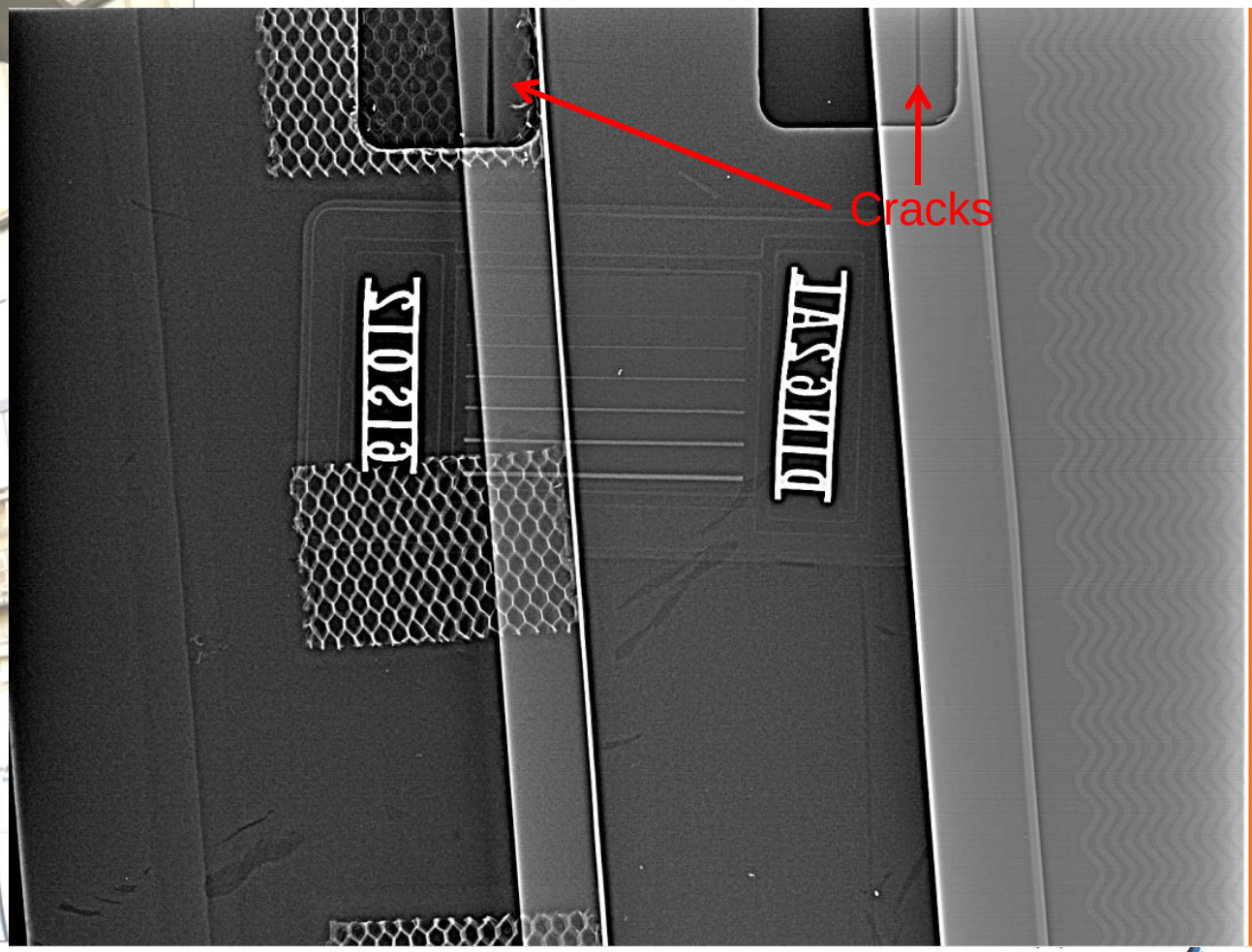
by the US Air Force

Tripod Mounted
Flat FoX-17 Imager

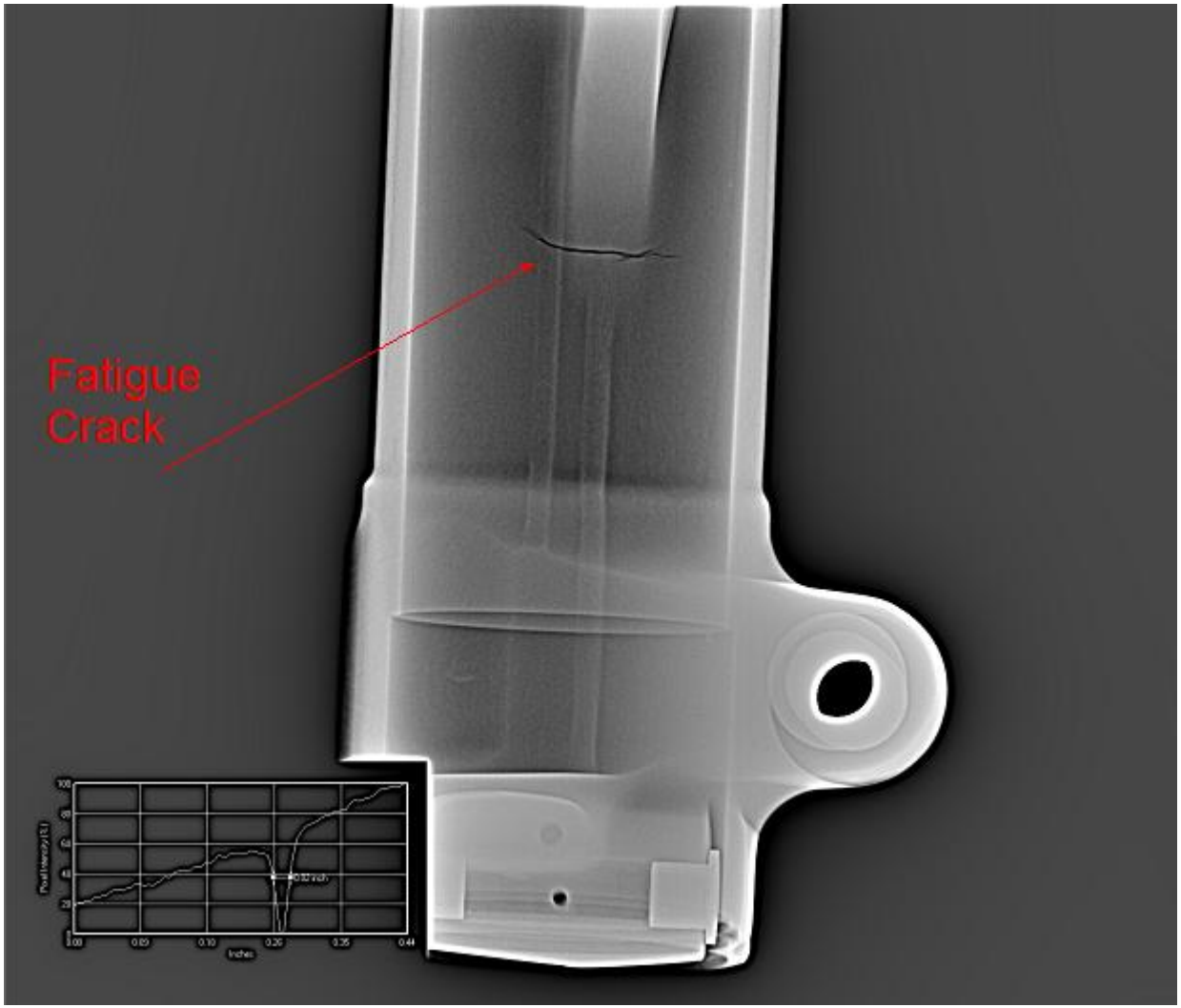
F111 Crack From Bolt Hole Right Wing



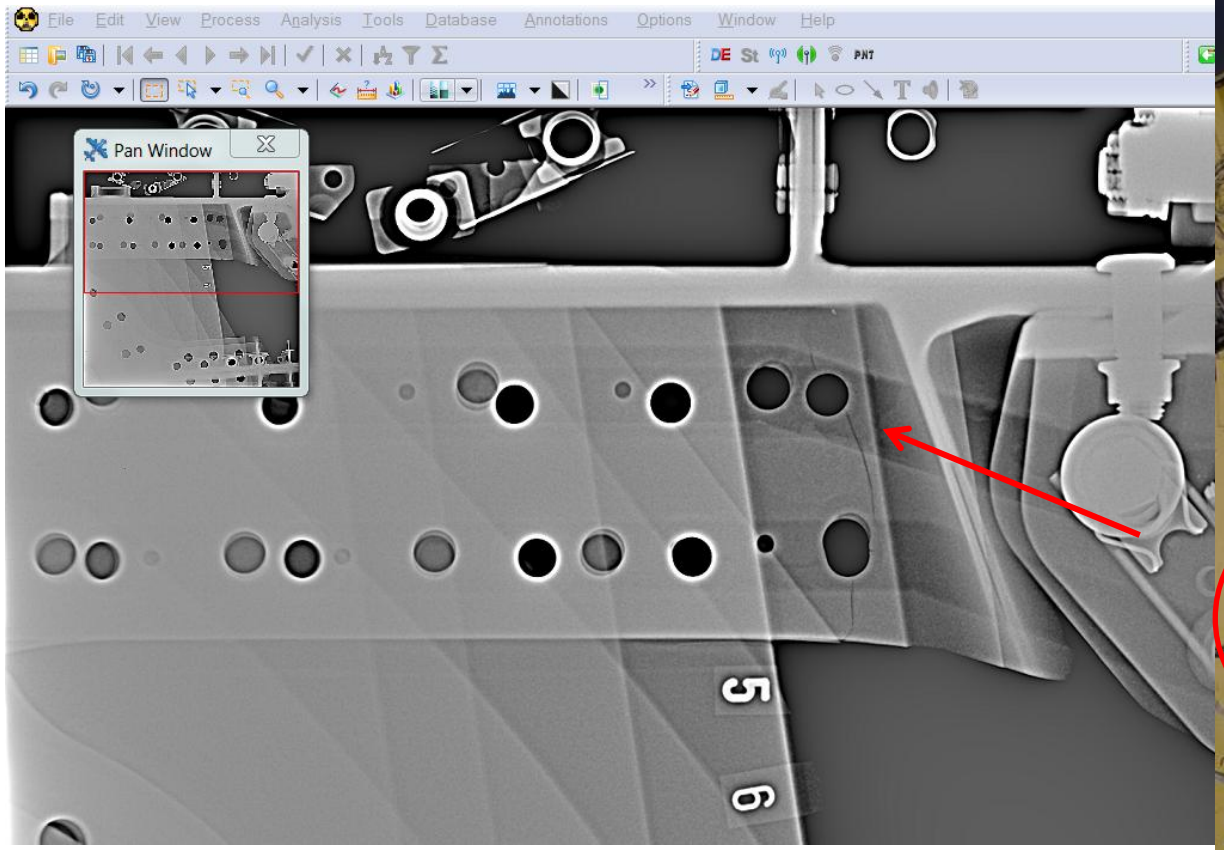
Field Solution for Apache Rotor Blades

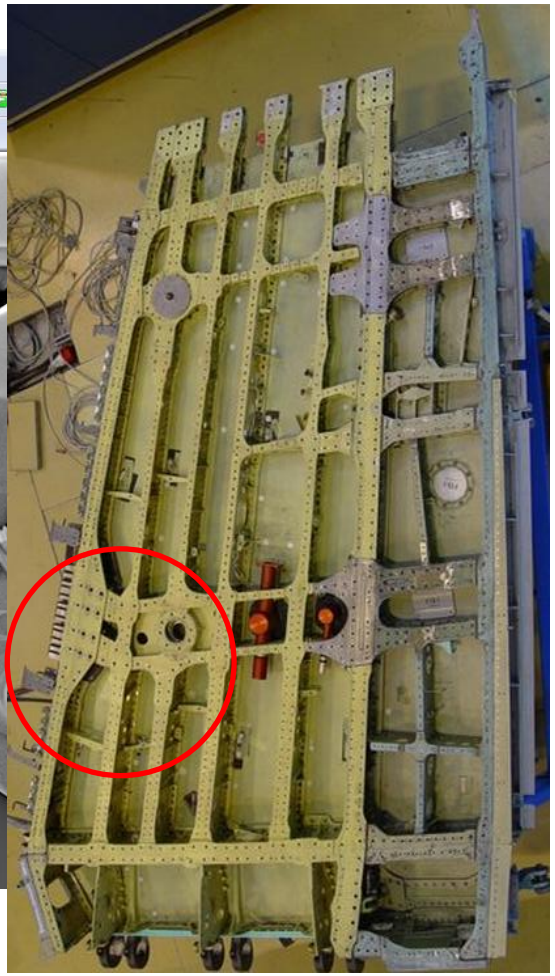


Aircraft Crash Investigation



F18 Crack In Lower Flange, Front Spar Ruag Industries (Swiss)





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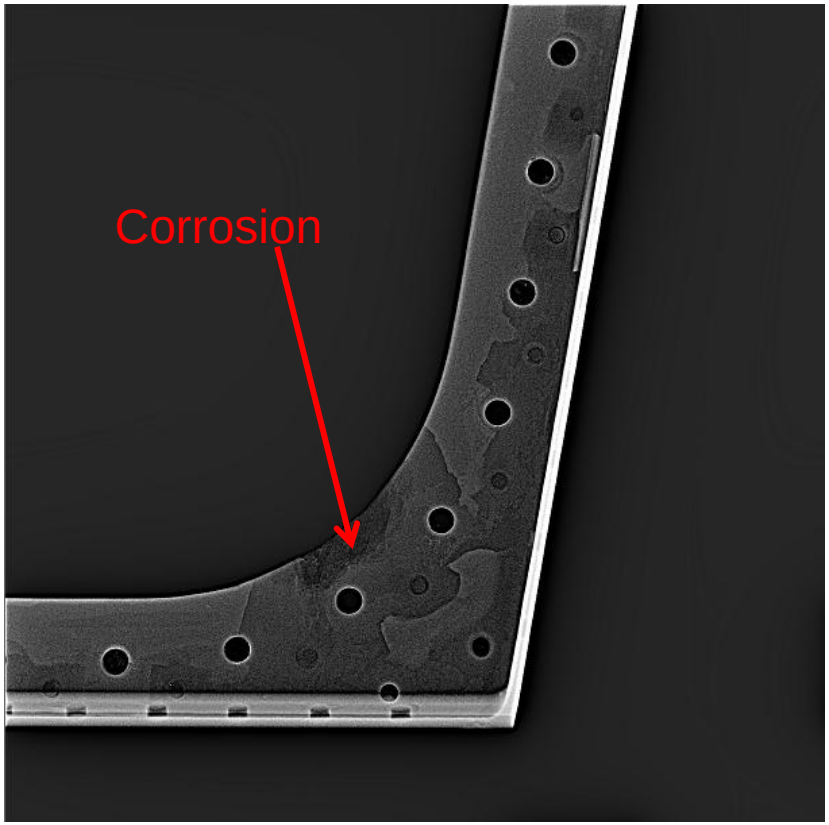
Ageing Aircraft Project in China



Window frame Tupolev154 Aircraft

Dual Use System for Civil Aircraft

Requirements:

- Boeing DR standard BSS-7075/7044
- Dual use system (field and stationary)
- Fully automated (customer operated)
- Synchronized with Philips MGC41 (industrial source)
- Meets RT Classes A & B

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Boeing Qualification Approval BSS7044 & BSS7075

July 5, 2007
6-20D2-07-0699

Mr. Eli Shabtai
Quality Management Director
IAI – Aero-Assemblies Division
Ben Gurion International Airport
70100 Israel

Subject: Qualification Approval for Vidisco Digital X-ray System

BOEING

Dear Mr. Shabtai:

In accordance with the requirements of BSS7044 (Rev A), IAI's Vidisco Digital Radiography system has been evaluated for qualification for the inspection of Composite structure inspected in accordance with BAC5980. Based on the results of the demonstrated functional tests, and review of the data from process control checks of the system equipment, the subject Vidisco Radiographic system has been found acceptable for secondary inspection of composite structure.

Primary use of this system will be to evaluate unknown or suspicious indications when found with Ultrasonic Inspection. Refer to BAC5980 Section 11.3 c & d for application and description of use. This equipment shall be used in conjunction with IAI procedures and techniques approved by the IAI Cognizant Level 3 in Radiography.

Michael Horky
Principal Level 3, RT
Boeing Commercial Airplanes
(206)331-5829

Concurrence:

Robert Goldrich
Procurement Quality Assurance
Sincerely,

Robert N. Goldrich
Global Partners – SPQ
Manager, Israel & Ethiopia
Commercial Airplanes
Phone: +972-(0)8-976-3117
Cell Phone: +972-(0)525-777-209

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IAI In-house Laboratory Civil Aircraft with Vidisco Flat FoX-17 System

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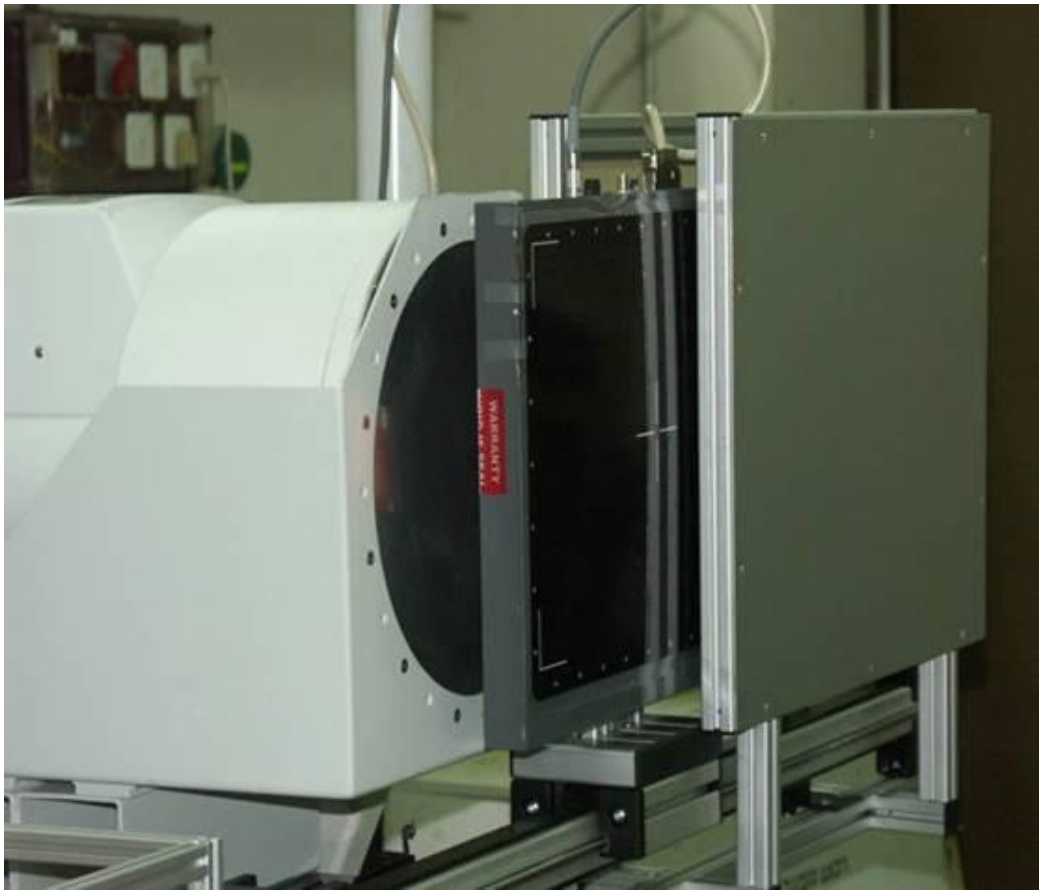
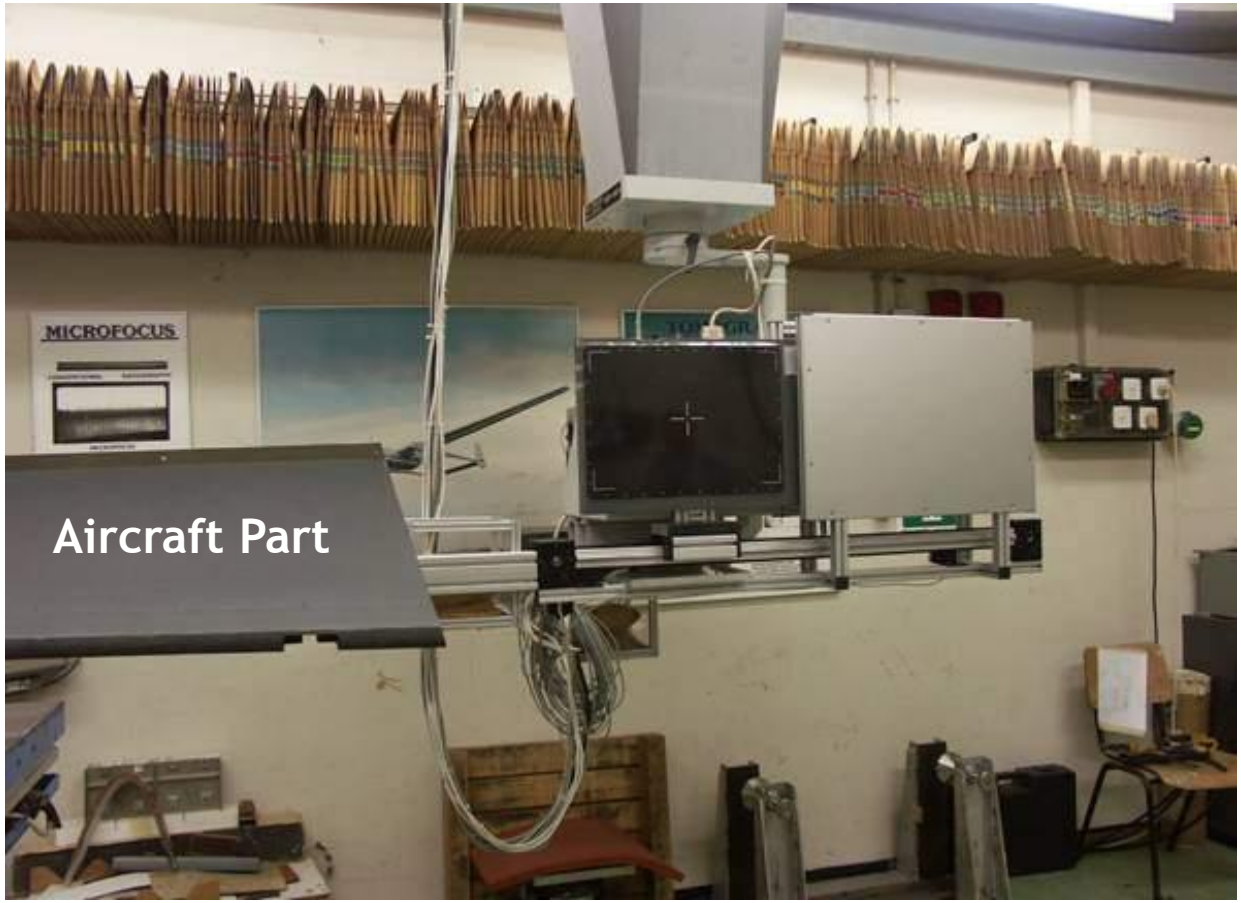
Flat FoX-17 System in Front of Real-Time Image Intensifier



Source: IAI

IAI In-house Laboratory Civilian Airplanes with Vidisco Flat FoX-17 System at Work



Source: IAI

Israel Aircraft Industries–Comparison Chart

prepared by Mr. D. Belo IAI Radiography Level III Expert at the recent ISR ASNT Section

Film Technology			DR Digital Panel Technology			
Procedure	**Cost per single image**	**Annual Cost Based on X 7,250 images/year**	**Procedure**	**Cost**	**Annual Cost Based on X 7,250 images/year**	**Total Annual Savings**
Imaging (exposure)	$6	$43,500	Imaging (exposure)	$3	$21,750	$21,750
Development time	$4.5	$32,625	Development time	$0	$0	$32,625
Film + chemicals	$2.5	$18,125	CD	$0.03	$217.5	$17,907.5
Analysis & Report Preparation	$3	$21,750	Analysis & Report Preparation	$3	$21,750	$0
Laboratory management	$1	$7,250	Laboratory management	$1	$7,250	$0
Developing machine cost and maintenance	$1	$7,250	Flat panel system maintenance cost and running	$2.2	$15,950	- $8,700
Storage room, archiving cost	$.02	$1450	Storage room, archiving cost	$0.05	$362.50	$1,088
Total Annual Cost	$18.2	$131,950	Total Annual Cost	$9.28	$67,280	$64,670.50

Source: IAI

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IAI Laboratory X-ray Images

IAI ISRAEL AIRCRAFT INDUSTRIES

Nitrogen Pressure Tank

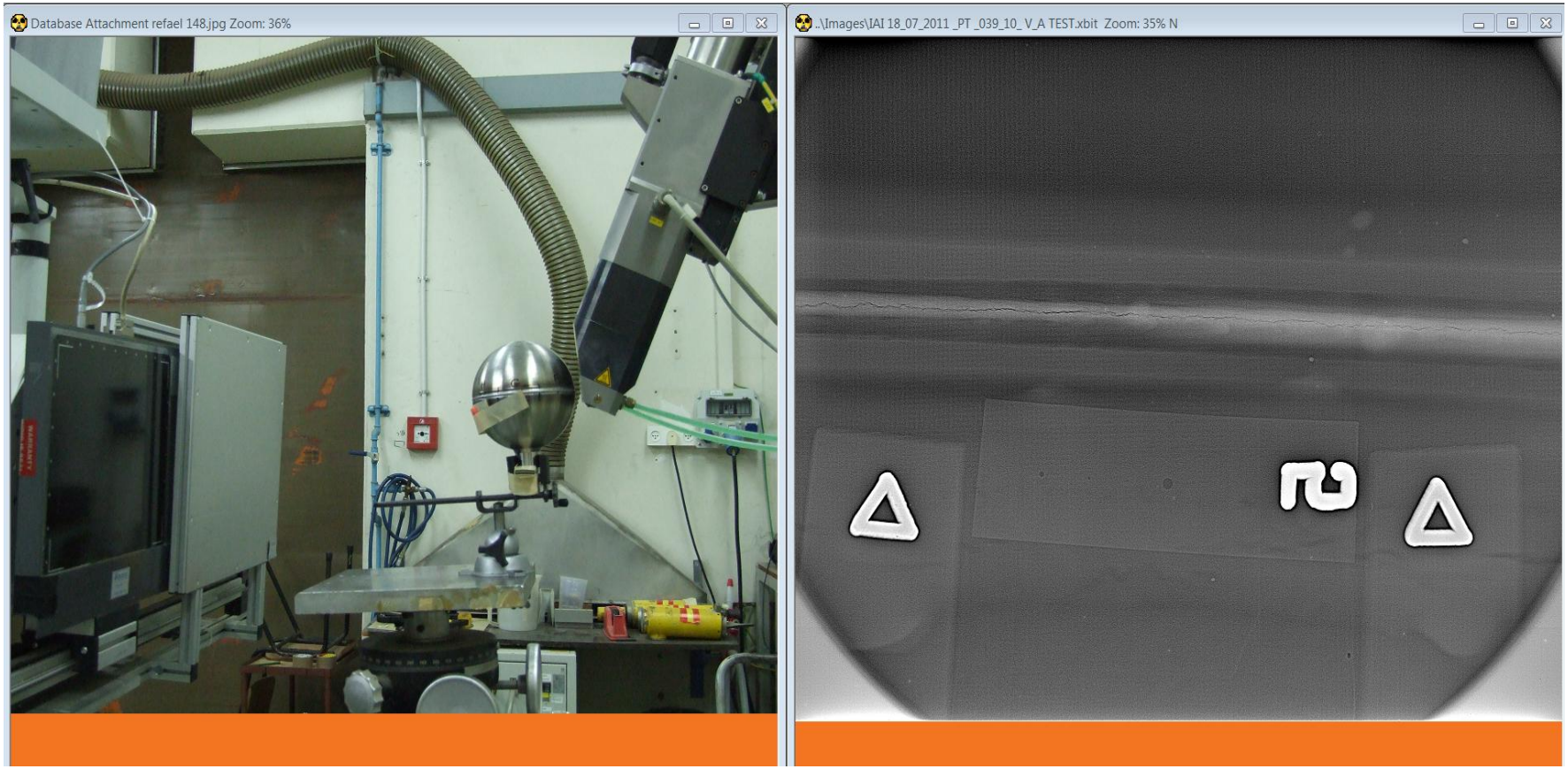
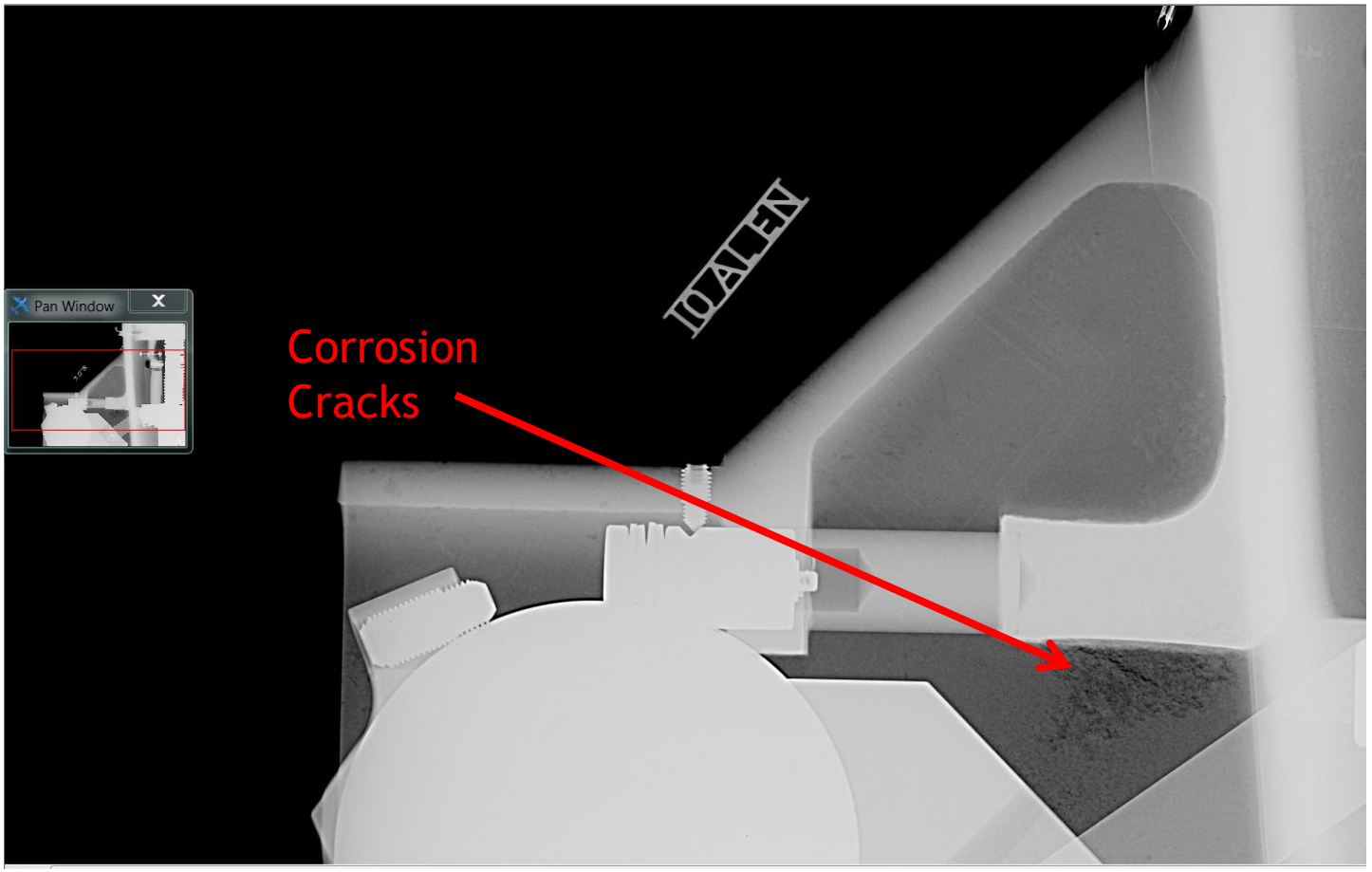


Image received using a Micro Focus source and the Flat Fox 17 imager

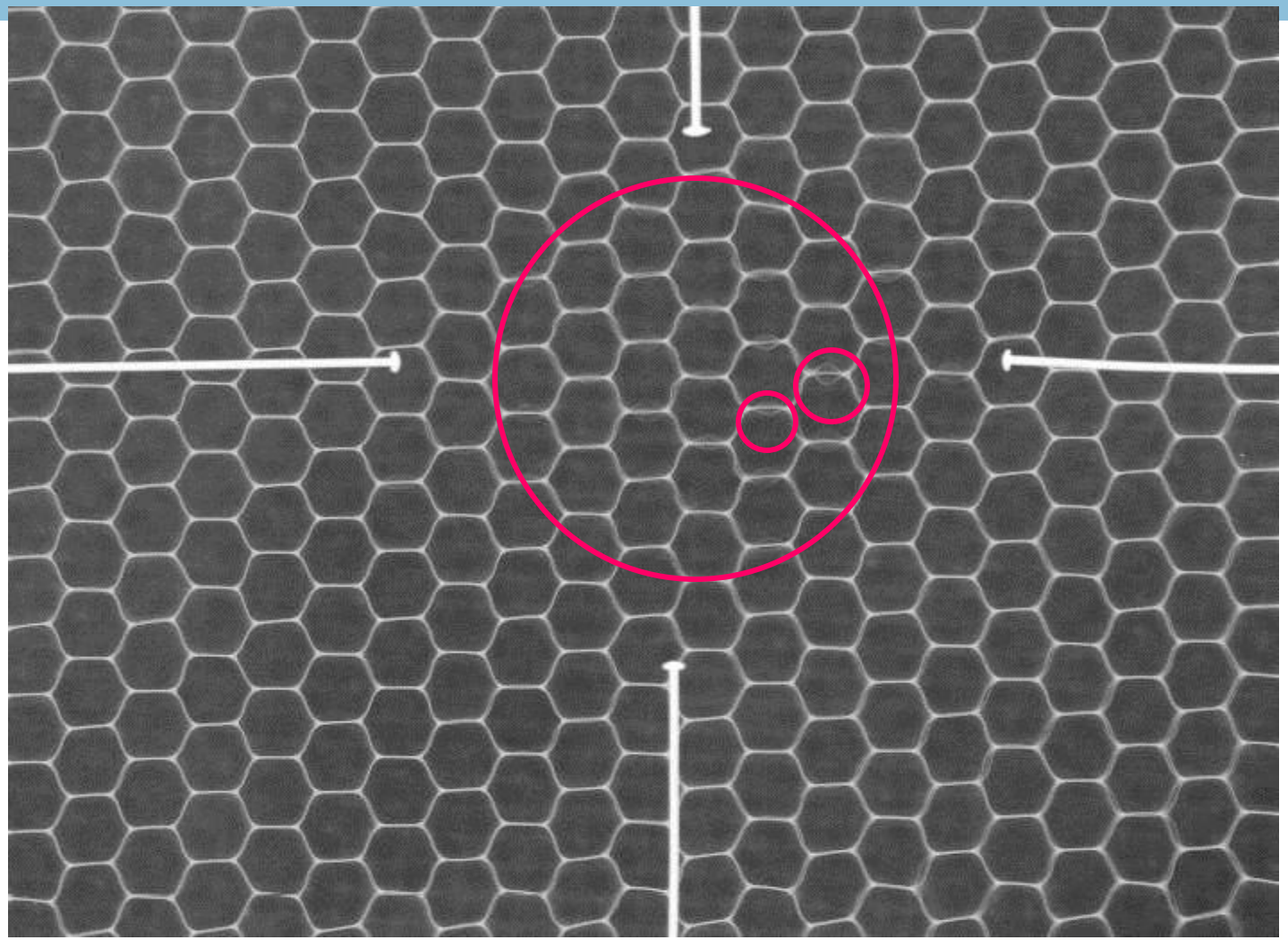
Source: IAI

Casting Aluminum



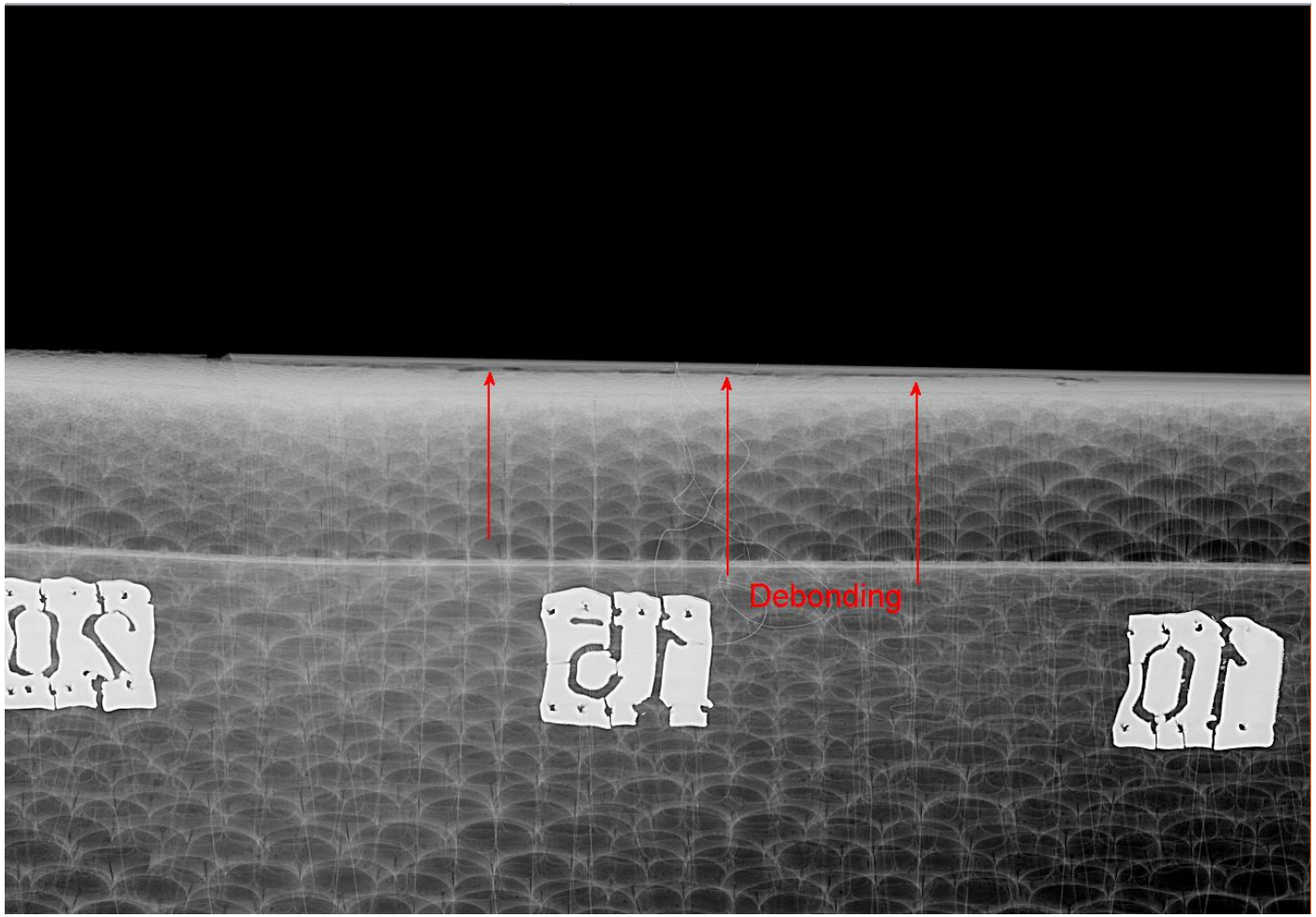
Source: IAI

Composite Material Crash Core



Source: IAI

Composite Material Showing De-bonding Area



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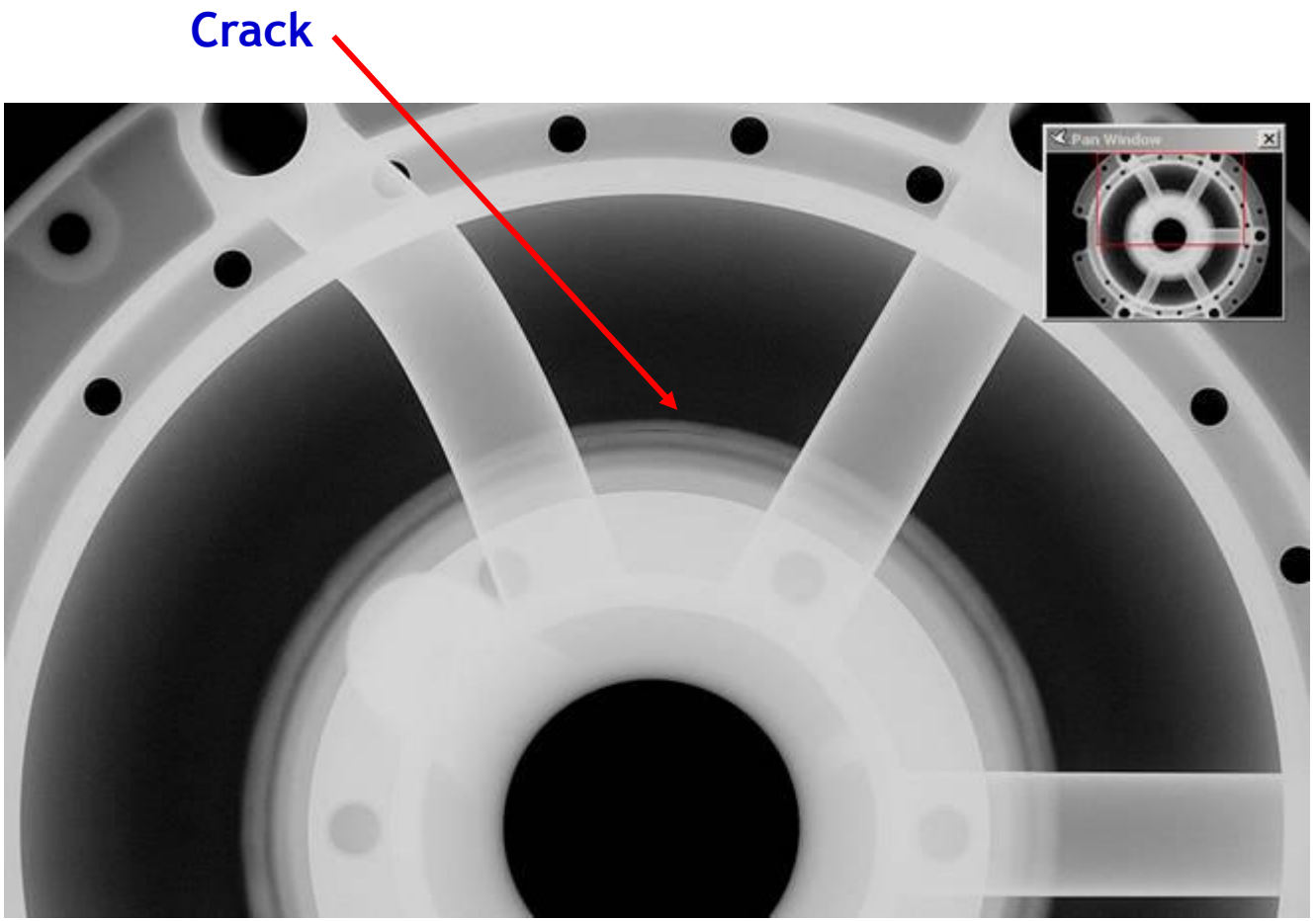
G100 Oil Tank Head



Source: IAI

Summary

Image Quality:

- Sensitivity combined with a wide dynamic range (16,384,65,536 gray levels)
- High **Probability of Detection** (POD).

Fast Setup & Immediate Results:

- Nera Real-Time results.
- Object does **NOT** need to be moved.
- Objects of all sizes and materials can be inspected.

Fast Return on Investment:

- "Cost Free" imaging – work more, pay less per image.
- No development or scanning time is required
- No cost of chemicals
- No cost of storage space (digital data base)

Portable & Convenient:

- Efficient inspection anywhere, confidential and secure

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Thank You

ndt@vidisco.com

www.vidisco.com