

# NDT of Aerospace Composites

by  
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# R-CON NDT Inc.

- Training  
Basic NDT Training and NDT of Composites
- Consulting  
Level III – NDT Programs -
- Equipment Sales  
Portable – Large Scanning



# Topics of Discussion

- Material and defect knowledge
- NDT Methods used for Inspection of Composite materials
  - ◆ Focus on Ultrasonic and Bond Testing
- Damage Assessment
- Test Standards
- Training

# Introduction

- Composite Materials have been used in aircraft since the early days
- Fiberglass, Aluminum core materials on DC-9 and 727 A/C
- New programs such as 787 and the JSF have heighten the need for testing of Composites
- NDT of Composites is still a relatively unknown area

# What are Composite Materials

- A composite material by definition is the combination of two or more materials.
- Example:
  - ◆ Clay = Straw and Brick
- Real World Examples
  - ◆ Fiberglass Corvette Body (E-Glass and resin)
  - ◆ Carbon Bicycle Frame (Carbon and resin)
  - ◆ Laminate and Bonded A/C materials

# Material Knowledge

## Defects: Sampling

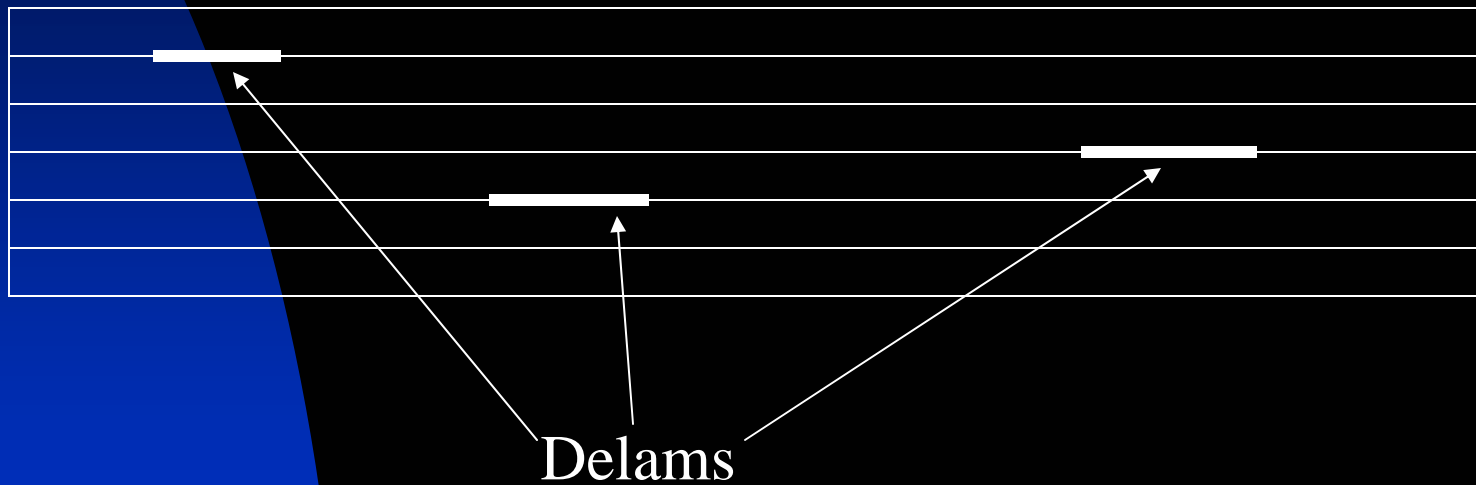
- **Delaminations:** Separation of the layers of material in a laminate, either local or covering a wide area.
- **Disbond/Unbond:** An area within a bonded interface between two adherents in which adhesion failure or separation has occurred.
- **Porosity:** A condition of trapped air, gas or vacuum within a solid material.
- **Crack:** An actual separation of material visible on opposite surfaced of the part, and extending through the thickness. A fracture.

# Material Knowledge

- Laminates
- Sandwich Structure

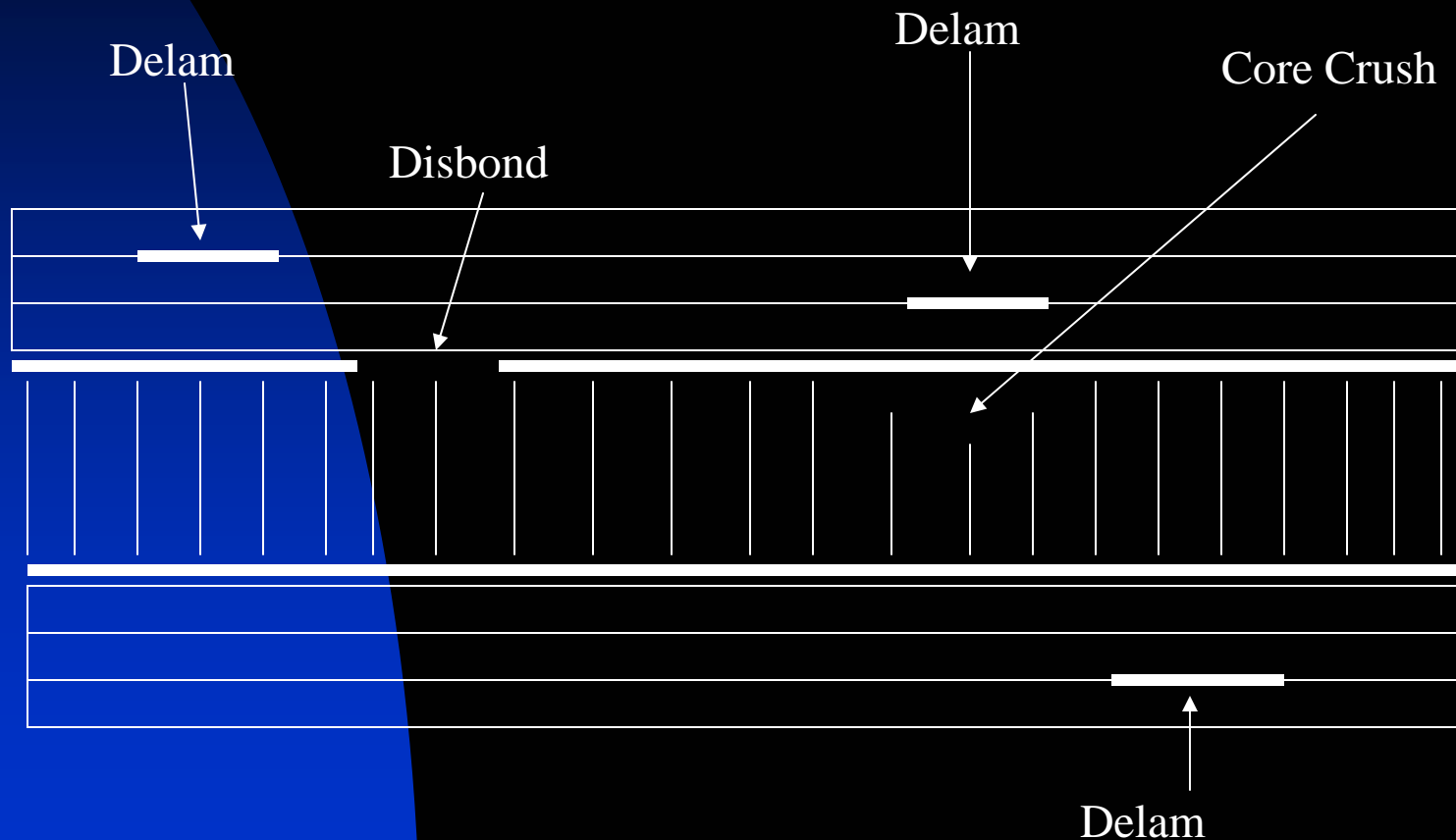
# Laminate

**GR/Epoxy or Glass Laminate**



# Sandwich Structure

GR/Epoxy Laminate Nomex Core



# NDT Methods

- Visual Inspection: Using the eye alone or in conjunction with aids
- Ultrasonic Testing: Most Common NDT Method for the inspection of Composites
- Bond Testing: Single sided Bond Testing utilizing Pitch Catch or Resonance testing modes
- Tap Testing: Oldest and simplest method of Bond Testing. Viable method, Need to understand limitations

# NDT Methods Con't

- Radiography: Detects changes in material density. Typically used in core inspection.
- Thermography: Detects local increases or decreases in heat capacity or thermal conductivity  
[www.thermalwave.com](http://www.thermalwave.com)
- Laser Shearography: Detects local stress areas by utilizing heat or vacuum to change the surface structure.  
[www.laserndt.com](http://www.laserndt.com)

# Ultrasonic Inspection

Ultrasonic is based on the Principal of transmitting high frequency sound into a test part and monitoring the received ultrasonic energy.

- U.T Portable equipment techniques:
  - ◆ Pulse Echo - Laminate Inspection
  - ◆ Through Transmission – Bonded Panels

Composite Inspection:  
Freq Range 1.0 Mhz – 5 Mhz  
Good Near Surface Resolution

[www.sonatest.com](http://www.sonatest.com)



# Ultrasonic Inspection

## Large Area Scanner

High Scanning speeds

Larger scan areas

Pulse Echo

Through  
Transmission



11/24/2005

[www.sdindt.com](http://www.sdindt.com)

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# Bond Testing

Modes:

Pitch Catch

Resonance



Disbonds/Unbonds

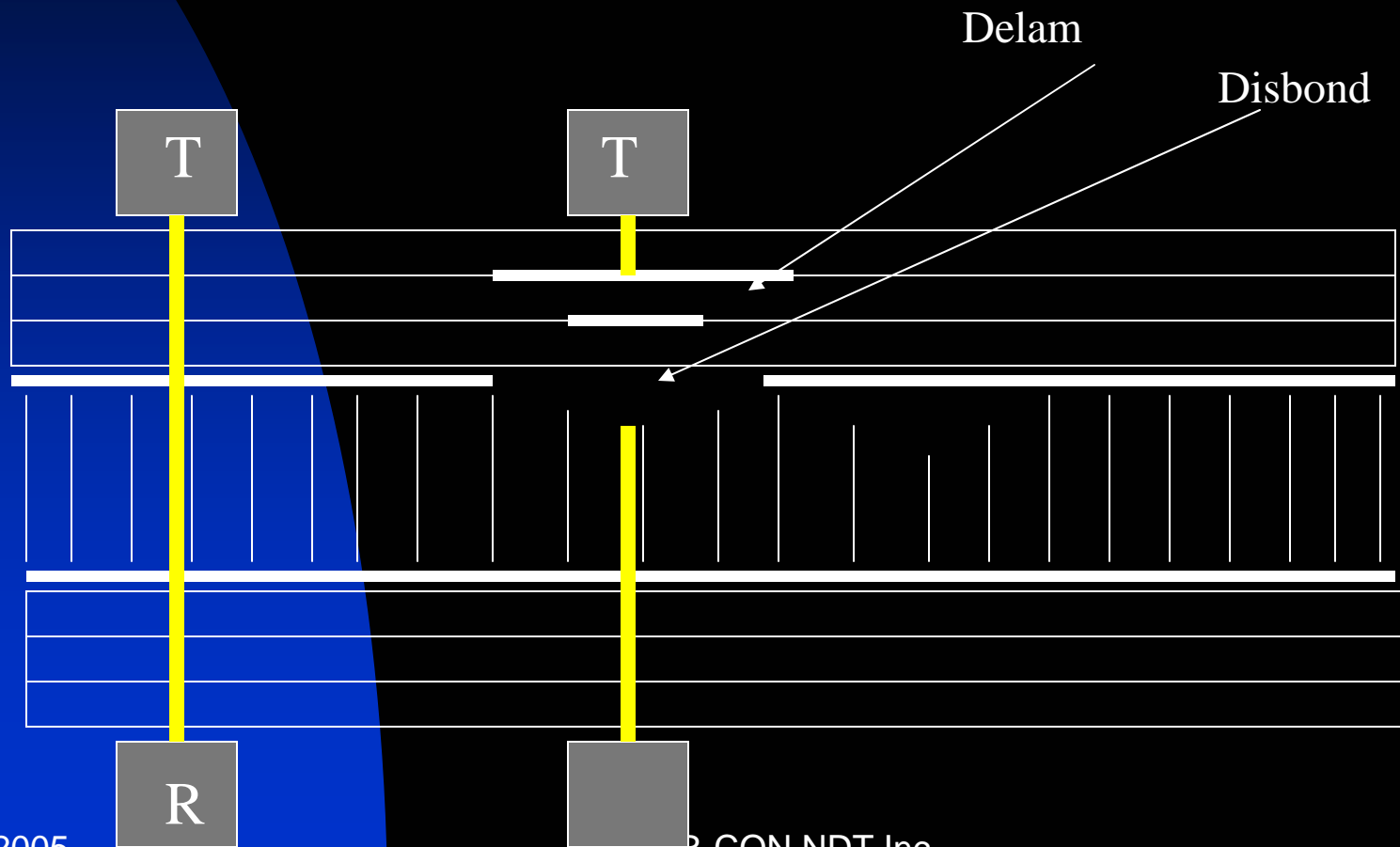
Delams/Disbonds/Unbonds

ZETEC INSTRUMENTS

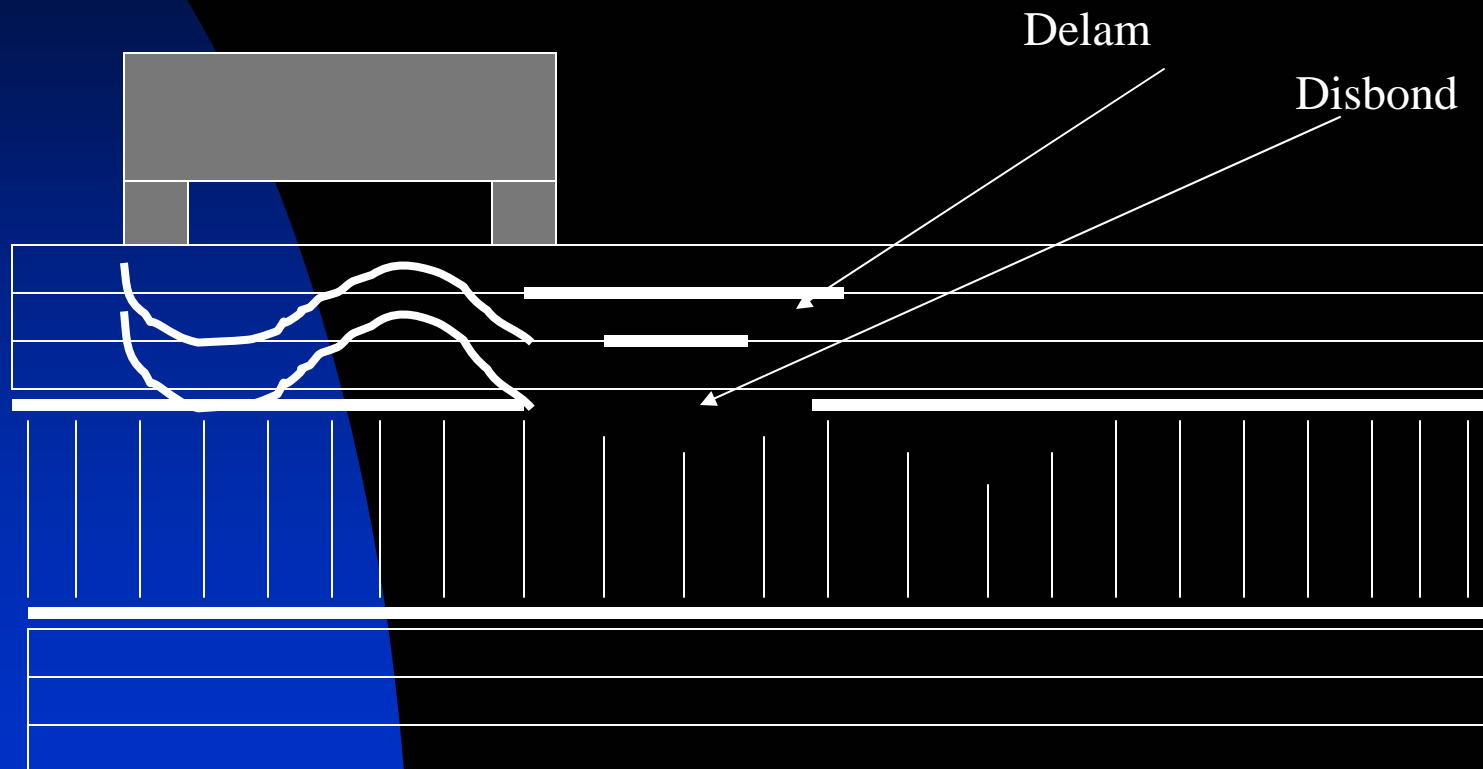
[www.zetec.com](http://www.zetec.com)



# Damage Assessment



# Damage Assessment



# Test Standards

- Standards should represent the part under test:
  - ◆ Manufacturing Method
  - ◆ Material
- Standards should contain induced flaws that represent type of defect sought.
- In some cases the part can be used as the test standard

# Training

- Training is required for Technicians testing Aerospace Composites
- Composite Inspection differs from Metallics
- Equipment considerations are key to successful Inspection of Composites

# Contact Information

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