Supplemental Type Certificate NDT Inspections: Successes and Challenges

A4A NDT Forum, Tuesday, September 23rd, 2014

Alex Melton
Product Line Manager
Delta TechOps - NDT Programs

The STC Challenge

- By its very nature Supplemental Type Certificate (STC) NDT development involves coordination between more parties than the typical OEM / Operator dynamic
  - The communication loop often includes STC holders, Airlines, OEM's, Regulatory Authorities and those who hold Delegated Authority
- There is substantial variation in NDT expertise amongst STC holders
  - Not all STC holders have well developed in-house NDT expertise
- Over the last 10 years there has been substantial STC growth in ATA Chapter 23 – Communications, ATA Chapter 25 Equipment Furnishings, ATA Chapter 34 – Navigation, and ATA Chapter 57 installations (Winglets)
- Growth in the volume of STC installations has, in some respects, outpaced industry framework and processes.
- In 2014 US Airlines averaged $1Billion in monthly spend (ATA 23 & 34) *Avionics Today*
  - Collectively the 9 largest passenger airlines in the US spent $7 Billion for the first half of 2014 *Airlines for America (A4A)*

ATA Chapters

In this presentation we will take a high level look at select STC installations. STC installations and associated NDT requirements are covered under Instructions for Continued Airworthiness (ICA) and must be integrated into an airlines' maintenance program

- ATA Chapter 23 – Communications
  - WiFi (Domestic & International)
  - In Flight Entertainment (IFE)
  - SATCOM
- ATA Chapter 30 – Ice and Rain Protection
  - MD88 Overwing Heater Blanket
- ATA Chapter 34 – Navigation
  - Future Air Navigation System (FANS)
  - Global Positioning System (GPS)
- ATA Chapter 57 – Wings
  - Winglets

Delta’s Diverse Fleet

- Airbus
  - A319, CFM56 Powered
  - A320, CFM56 Powered
  - A321’s on order, CFM56 Powered
  - A330’s PW 4168 + CF6 Powered A330’s on order

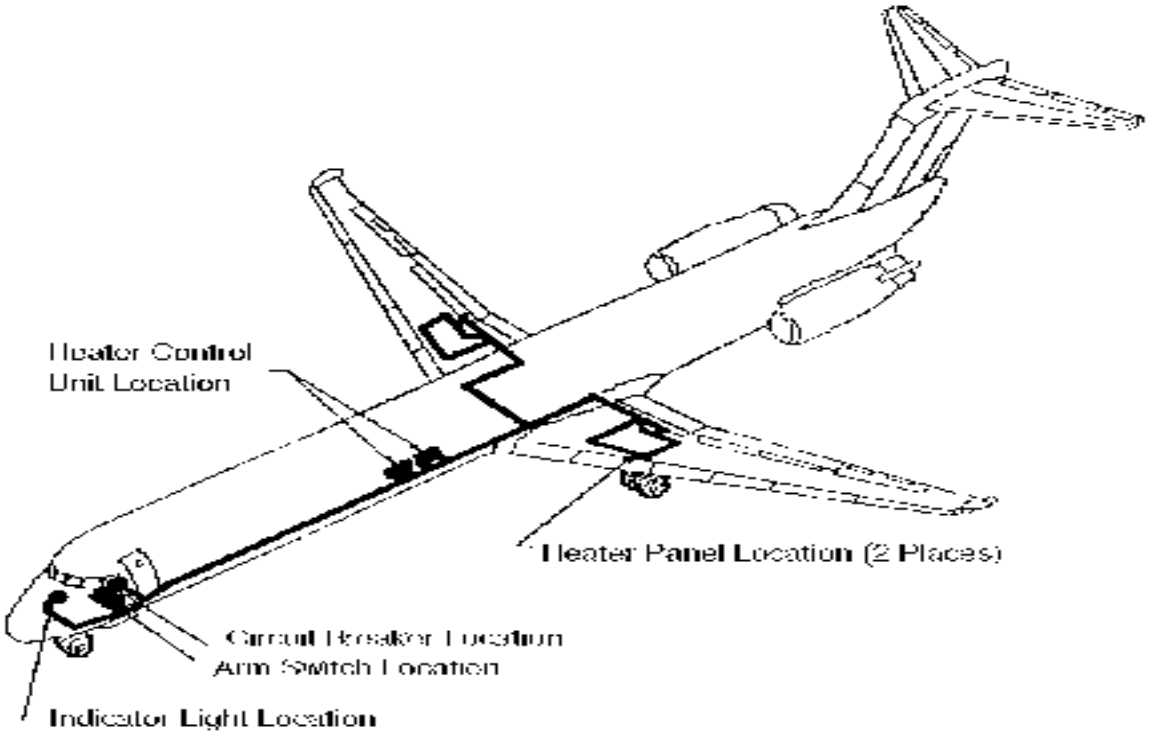
- Boeing
  - MD80, JT8-219
  - MD90, IAE V2500
  - B717 (MD95), BR715
  - B737, CFM56
  - B747, PW4000
  - B757, PW2000
  - B767, PW 4000 & CF6
  - B777, GE90 & RR Trent 800

An Overview of The Process

- Airline incorporates a Supplemental Type Certificate (STC) onto an aircraft. Some STC's are elective while others involve compliance to Airworthiness Directives.
  - At Delta the process starts with the development of an Engineering Order (EO) to cover the incorporation of the STC
  - Principal parties: STC holder + Partners and Contractors, Airline, Regulatory Authority (FAA) and OEM's
    - Depending on the specifics of the STC involved parties may vary
  - STC Holder develops Instructions for Continued Airworthiness (ICA) which sometimes include NDT. Compliance with ICA is compulsory.
  - Airline integrates ICA's into Engineering Order and Maintenance Program
  - ICA's are FAA approved or they are approved by an entity who holds properly delegated authority
  - Correcting errors, omissions, or shortcomings in STC's can be time consuming and resource intensive

Example

- MD88 Over-Wing NO-FOD Heater Blanket Ice Protection System
- AD 92-22-8R1
- AD 2002-21-06



Heater Blanket in operation

MD88 AMM 30-80-02 Inspection

- Heater Blanket is mechanically fastened at leading and trailing edges and adhesively bonded. Adhesive (1422-B2) also serves to provide environmental protection.
  - The term blanket is actually a bit of a misnomer in that the “blanket” is really more of a honeycomb sandwich sheet with aluminum face sheets and bullnose perimeter. The heating elements are interwoven into the honeycomb sandwich.
  - The heater blanket must conform to the upper wing surface geometry. This is typically accomplished by applying adhesive to both surfaces, vacuum, and ballast bags
- AD Driven so all enhancements to inspection procedure require FAA AMOC
- Edge is inspected using the high frequency bond test/resonance mode and the body is inspected using the low frequency pitch-catch mode
  - Edge bull nose geometry is not conducive to high frequency bond test
  - Body low frequency pitch-catch is challenging due to the attentive properties of the adhesive (1422 B2)

Delta’s removal rate was greater than industry average

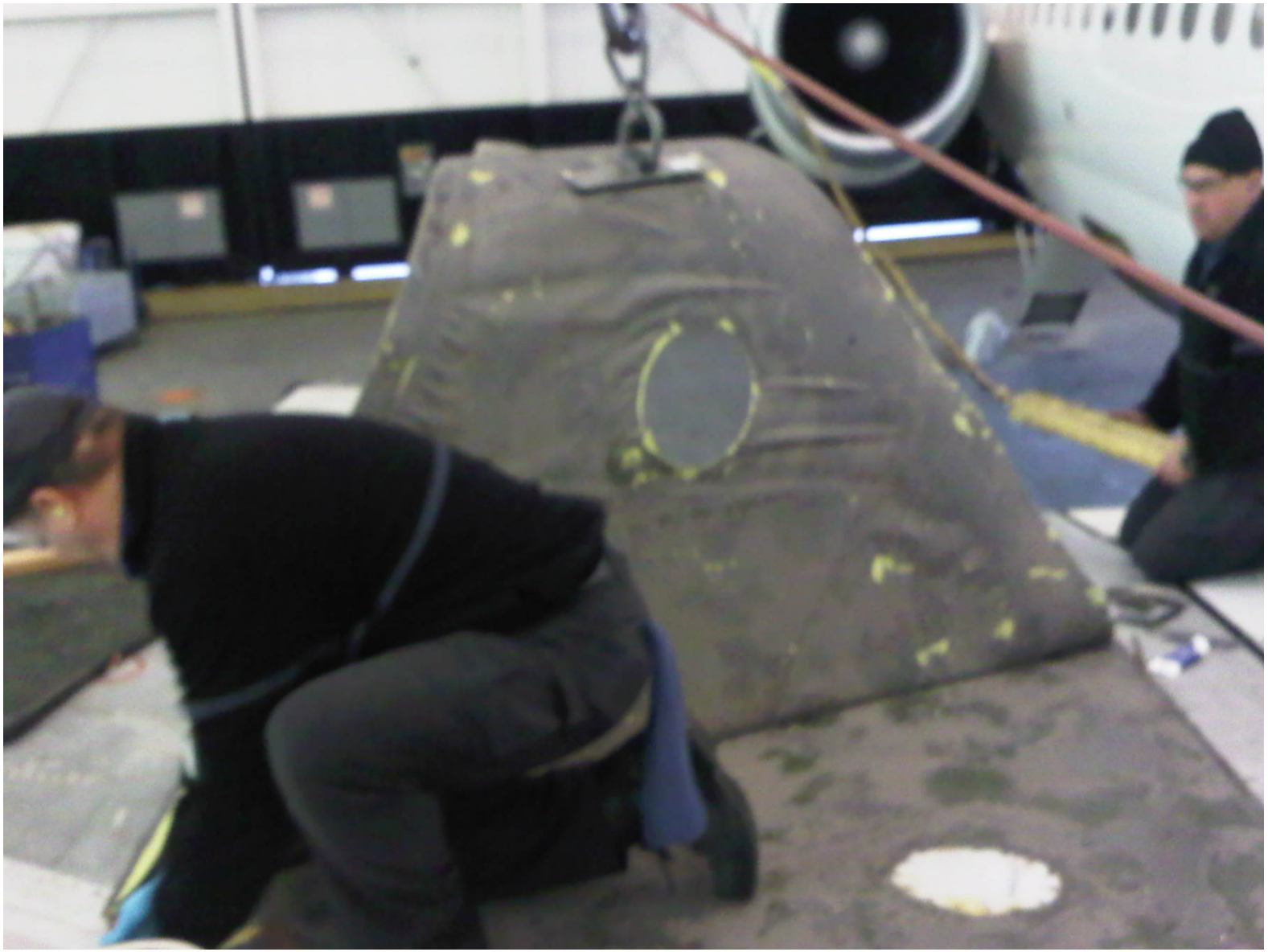
Accurate void (disbond) mapping is essential

STC instructions fairly nondescript, BUT, they mandated select equipment and had not been revised in many years

Reference standards not consistent with industry norms

Legacy product with limited support for NDT

Heater Blanket Removal



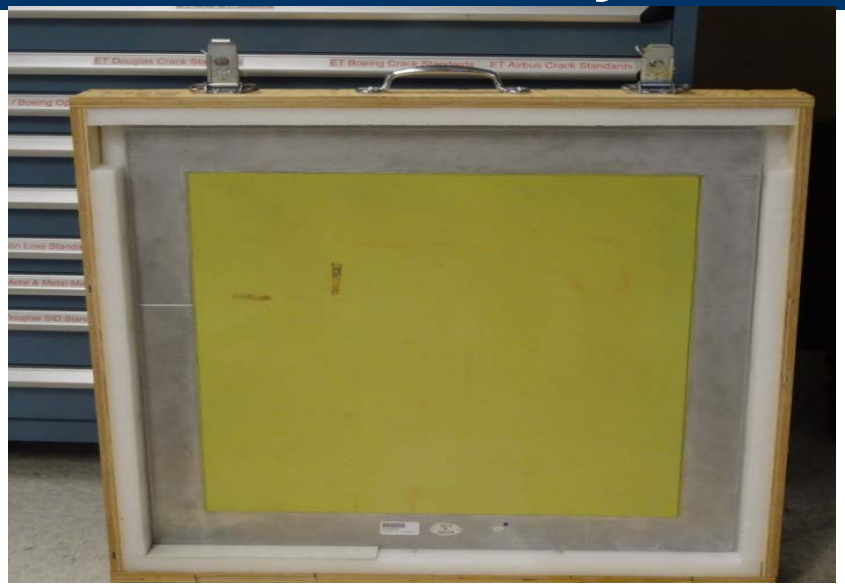
Edge Reference Standard, fig. 1

½” wide Inspection/calibration area

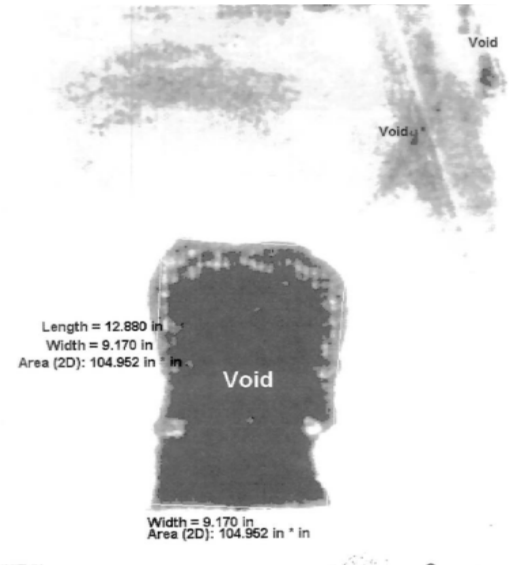
Bottom of standard from STC holder shown/ calibration done from other side

- Accomplishing resonance inspection on a curve / tapered edge looking for disbonds in the acoustically attentive 1422-B2 adhesive often yielded inconsistent results.
- Challenges along the edge:
  - Maintaining adequate coupling of the resonance probe
  - Attenuation of sound from rubberized sealant and inspection area geometry
  - Probe rock due tapered curve surface
  - ***Flaws not in inspection area for calibration***

Body Standard, Fig. 2



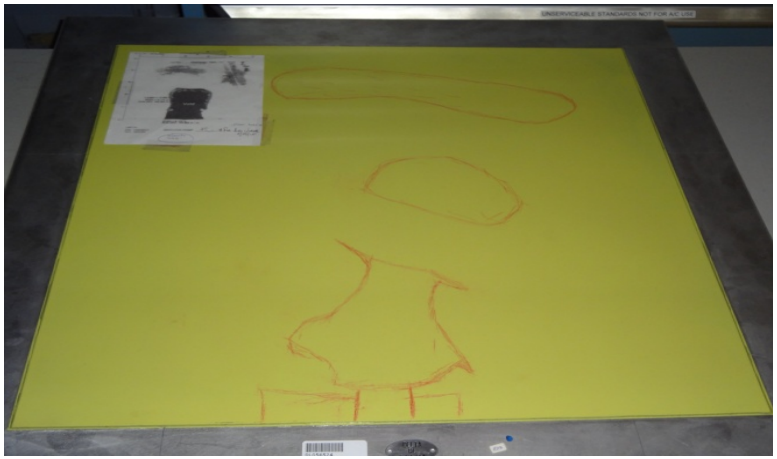
Honeycomb sandwich bonded to aluminum backing - calibration standard for body area bond test inspection



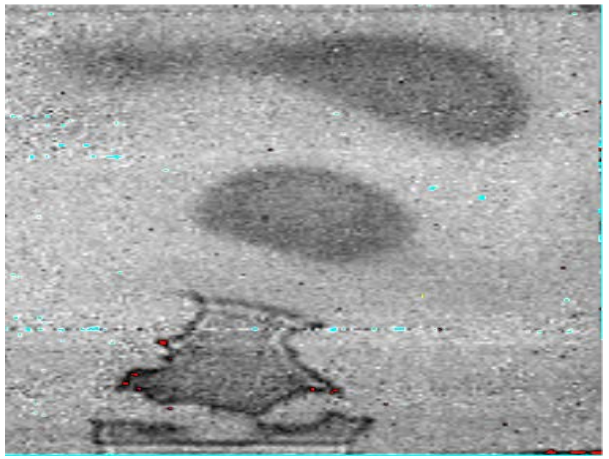
UT C-scan image from cert for calibration standard. Note that is certified as having only one large void

- Bond test calibration is generic in nature.
- Challenges:
  - Size and weight of standard make it difficult for shipping. Current standard size is 3’ X 3’ and weighs 70lbs in shipping container. Shipping container is 40” X 40”.
  - Most MRO providers not willing to purchase standard due to cost ($44,000.00).
  - Calibration procedure doesn’t differentiate between porosity and disbonding
  - Calibration procedure does not recognize new bond test equipment

Body Standard, Fig. 2 continued

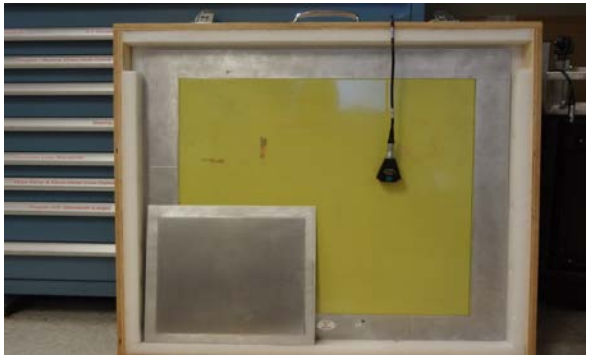


The areas marked in red are the findings of flaws found using a conventional bond test equipment



C-scan bond test image using MAUS V

- The bond tester and MAUS V indicated that standard is only disbonded in the red lines in the bottom indication, the rest of these showed a combination of bonding and porosity in the sealant.
- From removed heater blankets we have seen porosity in the sealant is fairly common.
- If a blanket fails for body area disbonding from the wing, the blanket is destroyed during the removal process.



This picture shows the current standard, bondtest probe used for the inspection along with the new standard that Delta received AMOC approval to use.
The new standard less than ¼ the size of the original and has 3 flaws.

Communication & Navigation

- Diverse fleet:
  - ATA Chapter 23 & 34 installations and associated modifications are found on all Delta fleets as well as those of our regional partners

- In many cases STC Holder developed NDT tasks embedded into ICA's lack clarity
  - In some instances the tasks could not accomplished as written
    - STC ICA drawings lacking adequate description of inspection area
    - Incorrect manual references (NDT Manual / NTM)
    - Inspections that were inconsistent with Damage Tolerance Analysis (DTA)
    - Revision control of referenced drawings; ICA's referring to a specific revision level drawing that has since been revised
    - STC installation in AD area affecting AD compliance

- Post approval revisions to ICA's can be cumbersome and resource intensive

Winglets

- Winglets are an example of well executed STC integration
- Winglet STC holder worked closely with airframe OEM
- Actively participated in NDT community
- Inspections are ongoing and appear to be working as designed

- Key takeaways:
  - ICA’s were well written
  - Good clarity, use of ATA MSG-3 terminology
  - Inspections were highly consistent with similar OEM developed tasks

Summary

- Industry challenges demand industry solutions

- Dynamic nature of STC's requires industry coordination between STC holder and their partners, Airlines, Regulators, and OEM's
- Growth in STC's has outpaced industry process controls
- Need to bring the resources of the NDT community to bear. Some STC holders lack sufficient expertise and could benefit from increased engagement with the NDT community
- Improved review process will benefit all:
  - FAA and internal ODA's
  - Airline Engineering Team
  - Airline NDT Experts
  - STC Organization
- Appropriate review during ICA development can help ensure seamless roll-out

Conclusion

- We need greater regulatory involvement to bring parties together
- Increased engagement and collaboration between parties will ensure appropriate and coherent inspections are applied
- Thorough review of Instructions for Continued Airworthiness (ICA)
- Where parties collaborate on the front end the results are favorable.

Acknowlegements

- **Malcolm Berner**
  NDT Inspection Procedural Training Instructor (NDT IPTI)

- **Robert Hager**
  Technical Specialist, Nondestructive Testing

- **David Piotrowski**
  Principal Engineer

Questions?