Boeing Perspectives

Agenda – HEWABI Recap

- Boeing Industry Experiences and Safety Risk Mitigation Efforts
  - Customer Concerns
  - AMM Approach to Category 5 Damage
  - Video
High Energy Impact Events

- Responses to concerns voiced by operators:
  - What is different about a composite airplane? (Do I have to do something different than I do for my existing fleet?)
    - Aside from how the damage may manifest itself, treat a composite airplane with the same care as for existing fleet
    - Metal structure – dents, cracks, distorted fasteners
    - Composite structure – cracks (dents often spring back)

- How to differentiate from ‘normal’ airplane contacts?
  - Use practical judgment
  - As described in the 787 AMM conditional inspection:
    a) An airport jetway that hits the fuselage at more than normal operational speeds or angles
    b) Ground Support Equipment that hits the structure at more than 2 mph (3 km/h) or violently shakes the airplane
    c) Impact by a blunt, high mass object at low speed
    d) NOTE: Impacts which can cause damage to the airplane structure are different from usual contact with the structure made during servicing and maintenance of the airplane.
High Energy Impact Events

What inspections must be performed?

Examine the structure in the area that you think or know that the impact incident occurred and at the adjacent support structure.

- Use visual and instrumented NDI procedures to examine the external area of high energy impact.
- Visually examine and instrumented NDI the external surfaces of the airplane in the general area of the impact which includes the nearest support structure.
- If you find signs of damage in the skin at the adjacent support structure or in skin below a stiffener, do internal visual and instrumented NDI procedures.
- Refer to Boeing if more clarification is necessary.
High Energy Impact Events

- Responses to concerns voiced by operators, continued:

  - Why is structural substantiation for these events not a certification requirement?
    - Such events are the direct result of human action, occurring on the ground in the ramp or hanger environment
      - Reasonable expectation that such events will be reported
    - Potential threats present ability to impart nearly unbounded energy
      - Severe design penalty to account for all potential damage scenarios
    - Regulatory Policy
      - Design-in sufficient damage resistance such that Category 5 events are self-evident to the operations personnel involved
      - Define a suitable conditional inspection based on available information from the anomalous event
      - Provide operator training to ensure events are properly evaluated and dispositioned prior to the next flight
High Energy Impact Events

- **787 AMM Chapter 5 Conditional Inspection “Ground Handling Equipment Hits Airplane - Inspection”**
  - **General**
    - Procedure contains the steps to do an inspection after ground handling equipment hits the airplane with high energy
    - Listing of types of damage to look for
  - **Description of High Energy Impact Events**
    “A high energy impact is when the type, force, or cause is significant with or without the result of damage you can visually see.”
    “Examples of low velocity, high energy blunt impacts”
  - **Examine the Airplane Structure**
    - Examine the structure in the area where the impact occurred, and also at the adjacent support structure
    - NDI is necessary if visible indications are seen or not seen
  - **Boeing developed training aids – videos**
    - Technical video aimed at engineering personnel – to help understanding of what constitutes a high energy wide area blunt impact
    - High level video segment – module within ground handling training
High Energy Impact Events

Conclusions

- 787 composite structure is robust, but not indestructible or impervious to all damage
  - Consideration of high energy wide area blunt impact events was made during design development, but not as certification requirement

- Anomalous impact events must be reported & dispositioned prior to further flight, just as they would on a conventional metallic airplane

- The 787 AMM provides a conditional inspection procedure defining inspection requirements
  - Boeing-developed training materials aid understanding, differentiation from ‘normal’ ground handling equipment contact with airplane