Breakout Session on Damage/Defect Types and Inspection Technology

The following charts document the results of a session conducted at the July 2006 FAA Composite Damage Tolerance & Maintenance Workshop.

The basic charts were prepared in advance of the session to facilitate brainstorming and discussion, and the text and/or slides highlighted in red represent comments and feedback provided by workshop participants during the session.

On chart number 5, the yellow-shaded cells are intended to improve visualization of “Good” techniques for participants. Likewise, the blue-shaded row label cells represent defects/conditions for which there are no “Fair” or “Good” NDI techniques identified.
Breakout Session on Damage/Defect Types and Inspection Technology

Primary objective: Address safety concerns & technical issues for damage/defect types and inspection technology.

Secondary objectives
1. Discuss damage & defect types and inspection technology used for manufacturing, field inspection and repair
2. Discuss elements of safety management
3. Identify needs for regulatory requirements & guidance
4. Identify training developments needs for inspection
5. Identify needs for standards (guidelines, inspection samples)
6. Provide directions for research
Damage/Defect Types & Inspection Technology

• Discussion of damage/defect types associated with each category, and inspection methods/strategies for each
  – Category 1: Allowable damage that may go undetected
  – Category 2: Damage detected by field inspection
  – Category 3: Obvious damage detected within a few flights
  – Category 4: Discrete source damage known to pilot
  – Category 5: Severe damage created by anomalous ground or flight events (not covered by design and maintenance experience)

• Safety concerns: if associated technical issues for detection, disposition and subsequent repair inspection for a given category of damage are not covered by current industry practices

• Other discussion points (as time allows)
  – Damage assessments
  – Structural design construction
Types of Defects/Damage

- Defects/Damage Types
  - NVID/BVID
  - Visible impact damage and penetrations
  - Scratches, gouges, surface and coating imperfections
  - Fluid and moisture intrusion (in sandwich structures)
  - Delaminations and disbonds
  - Chemical/corrosion damage
  - Thermal damage
  - Other
Inspection Technologies

• Visual inspection
• Tap testing
• Ultrasonic – various techniques
• Shearography
• Thermography
• Microwave (or Millimeter Wave)
• Radiography
• Thermo Sonics
Safety Concerns for Damage Detection, Disposition and Repair Inspection

- Ability to rapidly inspect large areas
- Safety impact of large damage to secondary structures
- Blunt impact damage detection and assessment
- Inspection of bonded repair integrity
- Damage selective method
  - Human factors associated with interpretation
  - Baseline information on the structure
- Access to the damage for visual inspection
- Environment, lighting and human factors (limitations) in inspection
- Engineering data to assess the extent of deterioration of a damaged part
Safety Concerns for Damage Detection, Disposition and Repair Inspection

- Economic pressures (safety management issue – lack of proper inspection detection, standards and training, water vs. debond)
- Qualification of inspectors and inspection technique (more for NDI world, not the airline community)
- Older aircraft documentation – obsolete documentation and lack of support
- Heat damage – validated NDI method
- Inspection for contamination (skydrol and water combination) What other combos of environments and materials were not evaluated in the initial qualification?
- Identify methodology for detection of contaminants and deteriorations.
Discussions of Inspection Technology Used for Different Damage/Defect Types

• Other safety concerns (not addressed in the discussion on previous chart for damage detection, disposition and repair)
  – None

• Present practices & associated challenges
  – Ability to relate allowable damage to the individual parts structural requirement.
  – Training issues
    • Ability to understand the damage and implications.
    • Transfer of experts in metal to composite structures
    • Training for ground operators and pilots
    • Ground operations (jacking, etc…)
Discussions of Inspection Technology Used for Different Damage/Defect Types

• Technical “Gaps”
  – Detection of minor impact (see slide 6 for details)
  – Detection of Kissing debonds, uneven bond and weak bond
  – Data on the original strength and degradation over time. How much is acceptable? Prevenatative action is preferred.

• Regulation needs (missing rules, guidance & training)
  – Training requirements for operators (ground handling personnel and pilots), engineers (DER and OEM), inspectors (DMIR, airlines, IA and A&P mechanics) and technicians

• Urgent issues for next workshop
  – Certification of new aircraft (SRM, allowable damage, inspection validation, etc…)
  – More time in breakout session (shift time away from presentations given the audience’s experience)
Discussion on Damage Assessments
(Damage/Defect Types and Inspection Methods)

• Impact damage caused by different threats
  – Paint shop induced

• Damage from extreme temperature, moisture & chemical exposure
  – Covered in previous slides

• Inspection data to support engineering assessments
  – Residual stiffness in damaged area - Sub-laminate definition

• Efficient inspection methods for different damage/defect types
  – Visual inspection protocol – “Kissing” disbonds or “weak bonds”
  – Large and/or severe damage that is not clearly visible from exterior

• Process to disposition Category 5 damage
  – Clarify definition of Category 4 vs. 5 (overlap?)
  – What is OEM responsibility in this? (repair is part of the airline’s support)