

- The following charts were shown in the Damage Tolerance breakout session on Friday May 11, 2007 in order to initiate discussions



# Damage Tolerance Breakout Session Notes



Federal Aviation  
Administration

May 11, 2007

Amsterdam, Netherlands

# Objectives of DT Breakout Session:

Primary Objectives: Address safety concerns & technical issues for substantiation of structural damage tolerance and identify acceptable means of compliance & associated technical issues for demonstration of fatigue, damage tolerance and static strength substantiation of composite airframe structures

## Secondary Objectives:

1. Discuss engineering practices used for substantiation
2. Discuss elements of safety management needed for selection of design criteria and engineering practices
3. Discuss existing methods of compliance
4. Discuss elements of building block
5. Discuss incorporation of realistic service damage scenarios and categories
6. Discuss practical problems crucial to airframe substantiation
7. Identify needs for regulatory requirements & guidance
8. Identify needs for engineering guidelines
9. Provide directions for research and development



# Definition of Damage

- Where does damage start?
- Pre-existing/known damage?
- In-service damage
- Related to detectability
- Flaws are included in definition of allowables and during building block testing
  - e.g., porosity
  - factor in variability in manufacturing



# Definition of Damage – Cont'd

- “We don’t fly with known cracks” (not true)
- Damage should show no growth?
  - need to demonstrate this
- Need to establish Allowable Damage Limits
  - structure should be able to operate with certain amount of damage
- Guidance on this topic needs to be clarified
- Primary Structural Elements vs. Secondary
  - definitions getting blurred due to reduced part count, bigger structure, integral parts



# Matrix of Service Induced Impact Damage: Composite Structures

Threat	Test Protocol	Simulation Models	Threat Allowable	Self Evident Event	Impact Location(s); Zones 1 & 2
Bird Strike	Gel-pack	Yes	“B” FAR’s (Wt. & Vel.)	Yes	YES
Hail	Simulated Hail Ice, SHI	Yes Maturing	“B” Up-date MIL HDBK 310	Yes	YES
Runway Debris	Lead Ball ? Drop-tower?	?	“B” Up-date JSSG-2006 ?	Sometimes	Usually
Tire Rupture	Rubber Puck	?	?	Yes	Sometimes
Panels Lost In-flight	?	?	?	Yes	Sometimes
Tool-drop	Steel or Aluminum Hemisphere Drop-tower	?	JSSG-2006 Structures	Sometimes	Yes
Incidental Contact With Ground Vehicles	TBD	TBD	TBD	Sometimes ?	Yes
Others? Lighting Strike	----	-----	-----	-----	-----



# Matrix of Damage – Contd.

(refer to Table on previous page)

- Need to establish common database and guidance
- Not specific to OEMs
  - ex. is bird strike development
- Incidental ground vehicle / blunt impact characterization



# Damage After Entering Service

- Allowable Damage Limits should be defined
- Inspection for cause – increases likelihood of finding damage
- Feedback from operators to OEMs on incidents/damage
  - helps to define database of the threats/damage
  - guidelines needed on which incidents and what information should be reported
  - what level of incident should be reported? rogue events vs. reporting everything – “if you report everything then nothing’s important”
- Need guidelines for how to define when structure reaches limit load.
- Guidelines must adjust to changing materials and technology.
- OEMs should sit down and establish common guidelines – e.g., CACRC model
- Seek support/funding from US and EU to establish these common databases.





# Documentation and Traceability of Repairs

- Some aircraft change hands several times.
- New customer requirements means documentation on the repairs are needed to show that new requirements can be met after:
  - repairs
  - supplemental installations
- An Advisory Circular does exist requiring this documentation
  - generic, but leans towards metal structures
  - ACTION: needs revisiting to be inclusive of composites
- Multiple BVID rule (after entering to service) – ACTION: definition of requirements on documenting and monitoring multiple damage sites
  - in metals this is “easy” since dents are readily visible
- Supplemental Type Certificate also need documenting and monitoring.
- Above points become critical elements if aircraft increases significantly in weight and/or if one needs to reassess damage tolerance of structure.



# D&DT Limits for Adhesive Bond Repairs – DLL and DUL

- Question: are you allowed to use bonded repair on damaged structure having capability below limit load?
  - ACTION: need discussion on large-area damage repair in future meeting
  - clarification needed on topic of secondary vs. cobonded



# Detection of Damage/BVID

- Qualification of inspectors – e.g. require eye exams
- Can steps be taken to maximize detection of BVID – e.g., paint color, lighting conditions, etc.
- Existing document: ATA (Air Transport Association) MSG3 - gives guidance on inspection
  - geared towards metals
  - needs to be updated to reflect solid laminate structure technology



# Incidental Localized Overheating and Lightning Damage

- Example: hot bleed air duct leakage
- Can see indications of overheating damage relatively easily on metal surfaces
- Need technologies that will give clear indication of these events – e.g., paint coatings are being developed that will show overheating locations through color change
- Need guidance on NDI for determining extent of damage to laminate and necessary level of repair.



# Guidance Materials Revisions

- AC20-107A is coming up for revision
  - action for next meeting: bring up your inputs
- Using FAR23.573 for Part 25
  - have a look at it to provide feedback

