Design Development and Structural Substantiation of Bonded Structure
- Breakout Session -

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Purpose of Breakout Session

- Reach agreement on "critical safety and certification issues"
- Focus on "what we need to worry about"
- Discuss "how-to's" if time permits

- Initial design and repair development
  - Design
  - Data and analysis methods
  - Substantiation tests and analyses

Bonded Structure Design

- Design of part (and repair)
  - Design/size structure to fail outside bonded joint
  - Provide for redundant design features/load paths
  - Establish defect and damage sizes
    - Linked to inspection methods, policies (factory, in-service)
  - Consider tooling/manufacturing constraints
  - Consider maintenance (inspection) constraints
  - Establish sizing guidelines
- Design for repair
  - Include provisions in original design
  - Provide for repair access
  - Define max allowable repair size on primary structure
    - Structure w/ disbonded repair must sustain limit load

Bonded Structure Data and Analyses

- Data
  - Material properties and Statistical allowables
    - Stress-strain response as f(env., thickness, etc.)
    - Fracture toughness for adherend and adhesive
    - Manufacturing variations (surface prep, curing, bondline thickness)
    - Manufacturing defects/anomalies
  - Strength with small damages, disbonds
  - Environmental durability
  - Point design data (lap shear, pull-off, etc.)

Appropriate scale for statistical assurance?

- Analysis Methods
  - Validated over range of design variables, environments
  - Predict static strength w/ and w/o defects
  - Predict durability: load cycling, env. exposure, long-term degradation
  - Predict damage tolerance w/ large disbond and/or damage

Bonded Structure Substantiation

- Static Strength
  - Validation of analysis methods
  - Validation of manufacturing process, including process “failures”
  - Validation of non-detectable defects, damages
- Durability
  - Demonstrate 2+ lifetimes load cycling + env. effects
  - Large scale tests at environment
  - Include non-detectable defects, damages
  - Demonstrate no-growth or validate growth predictions
  - Tests to protect on-going durability of the fleet
- Damage Tolerance
  - Demonstrate inspectability of potential damage
  - Demonstrate crack (disbond) arrestment ability
  - Test at worst realistic condition (cold?)

Appropriate scale for tests?

Engineering Practices to Address Key Issues

Industry Standards and/or Guidance Needs

Additional Research Needs