FAA BONDING WORKSHOP

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FAA Adhesive Bonding Workshop

THE LEARFAN 2100 (Started 1978) All bonded, plus rivets spars to skins

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Starship--All Carbon Fiber All Bonded Airframe, Certified 1989
Cabin fail safe with rivets, wing fail safe multi-spar


Raytheon Premier I, certified 2001
Bonded plus rivets

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Multi-Spar Metal Wing—Machined spars, ribs and skins; rivet/bond assembly (the shop hated it, changed to all rivets)

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FUSELAGE AUTOMATED FIBER PLACEMENT

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PRESSURE CABIN SHELL, ONE PIECE CO-CURE

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The Perennial Question: Fork Lift Damage

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Automated Ultrasonic Inspection for Cabin Shells

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FUSELAGE IN-JIG ASSEMBLY

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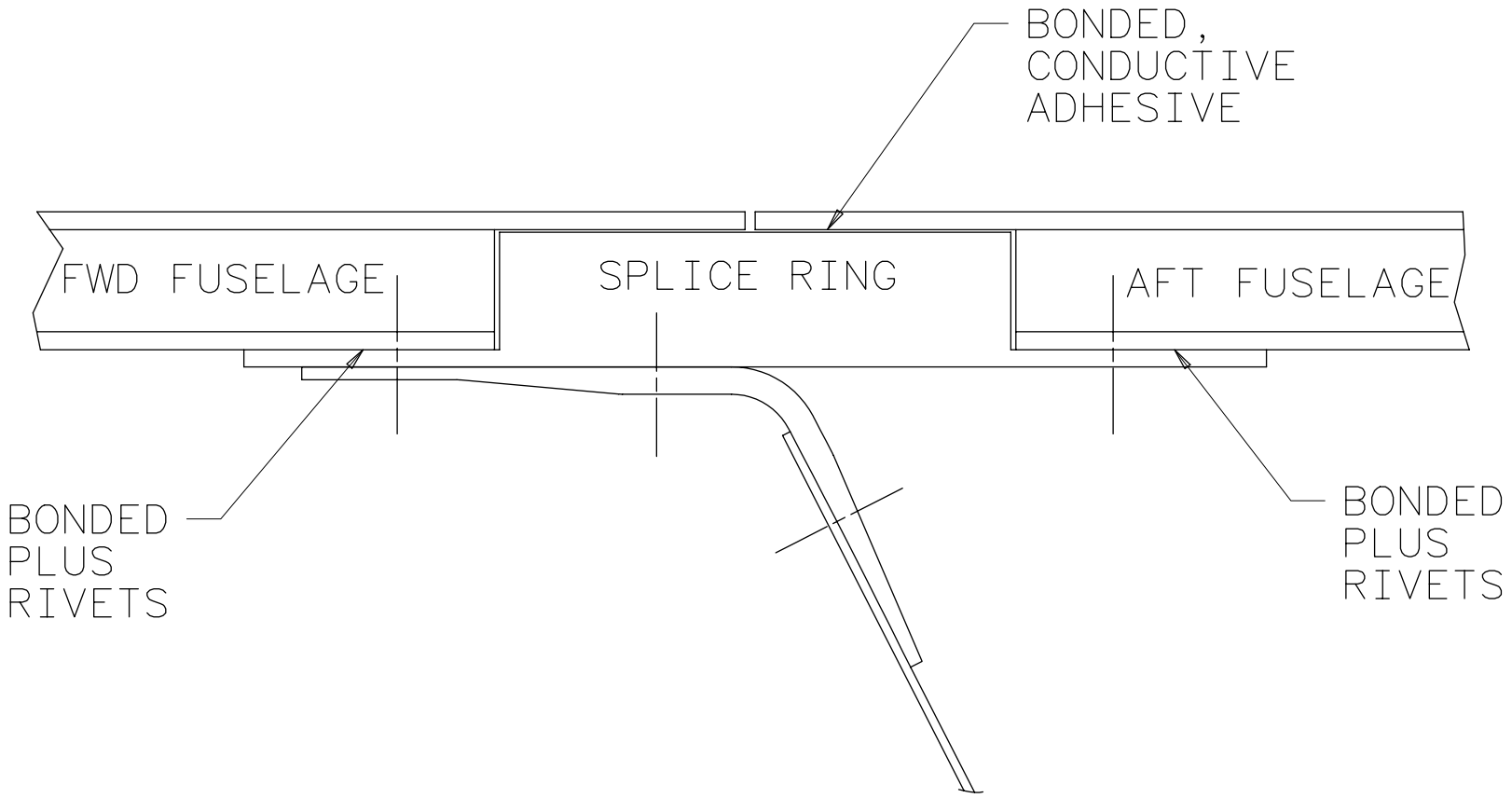
CONDUCTIVE FUSELAGE SPLICE, BOND PLUS RIVETS



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AFT PRESSURE BULKHEAD

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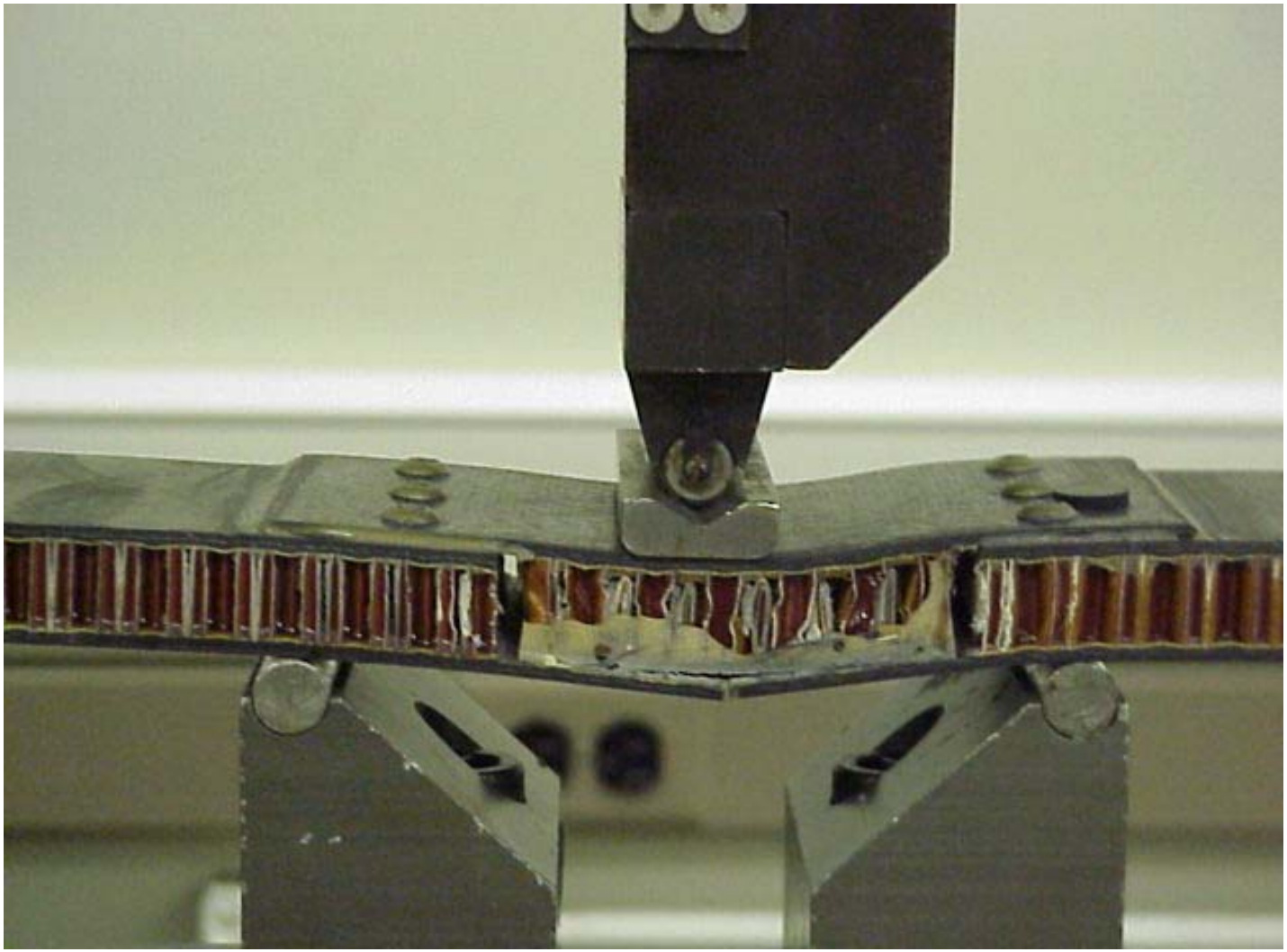
ELEMENT TEST with bond gaps



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Hybrid (Metal/Composite) Bonded Structure

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A Few Comments on the Workshop

- **Excellent presentations**
- **Extremely wide scope of co-curing / bonding / repair**
- **A session on the FAA regulations, AC's, and recent methods of compliance would have been beneficial**
- **Proof test can be viable in special cases**
- **Wedge test is really an environmental resistance test**
- **A durability test ideally would be relatable directly to service life (accelerated test)**
- **Environmental resistance (interface corrosion path) less of an issue in composite bonding**

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Comments, continued

- Apparently, surface prep / cleanliness is the number one issue
- Scaling should be substantiated by the full scale tests
- Tooling must bring the surfaces in contact or a means of showing bondline filling should be employed
- Loved the concept of employing fracture mechanics (Hoyt, et al) to show damage tolerance of bonded joint

    Unfortunately FAR 23 doesn’t allow for this approach

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Comments, continued

- Repair technicians must be trained and certificated
- Small repair shops must have access to approved data and be able to purchase qualified materials
  - No long term freezer storage
  - Acceptance tests by the supplier
- UMIST data showed adherend moisture not serious unless unusually high (over 1.5%)

  FAA regs do not require fail safety of repairs as the only long term substantiation

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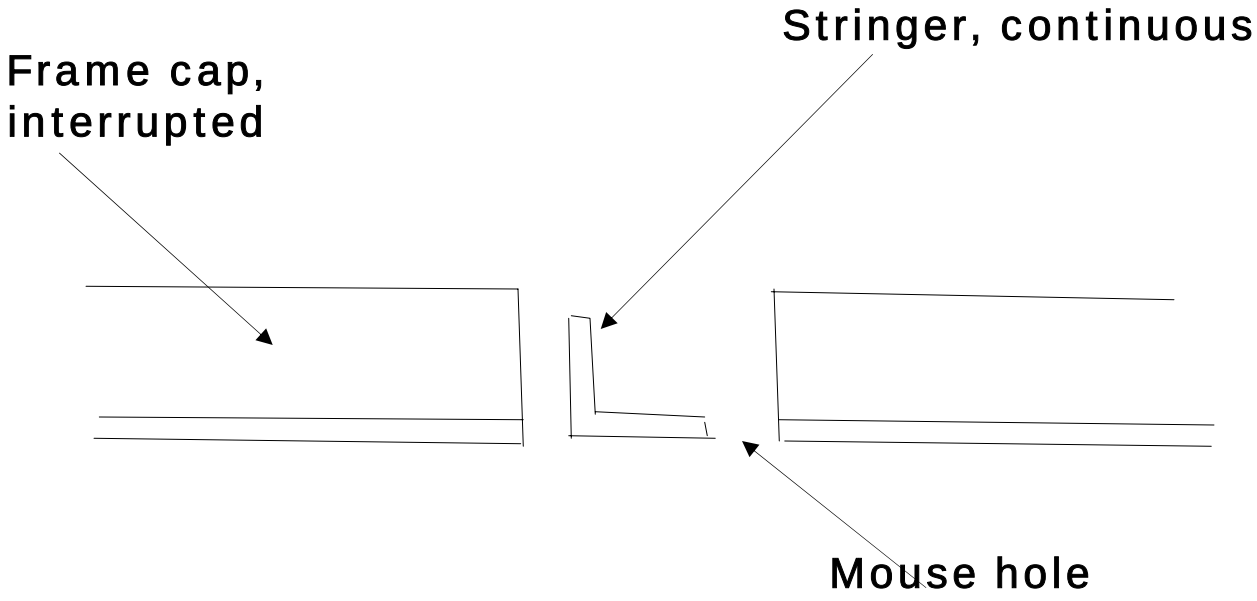
Comments, continued

- Could have used more info on honeycomb issues, service problems, and solutions
- Good to hear from the users: Air Force and airlines

Comments (continued)

- **Citation III barrel test showed need to avoid "mouse holes" with tear straps at under frame caps**



R and D NEEDS

- Obviously, NDI for bond strength
- Simple field NDI
- Inspection for appropriate surface condition
- Damage tolerance methods and standards

  eg., equivalent to 0.05 inch corner crack, two inspection intervals

ONE-PIECE RTM WING FLAPS (BEST KIND OF JOINT—NONE)