



Research & Technology

AMTAS Structural Bonding Industry Feedback

31 October 2012

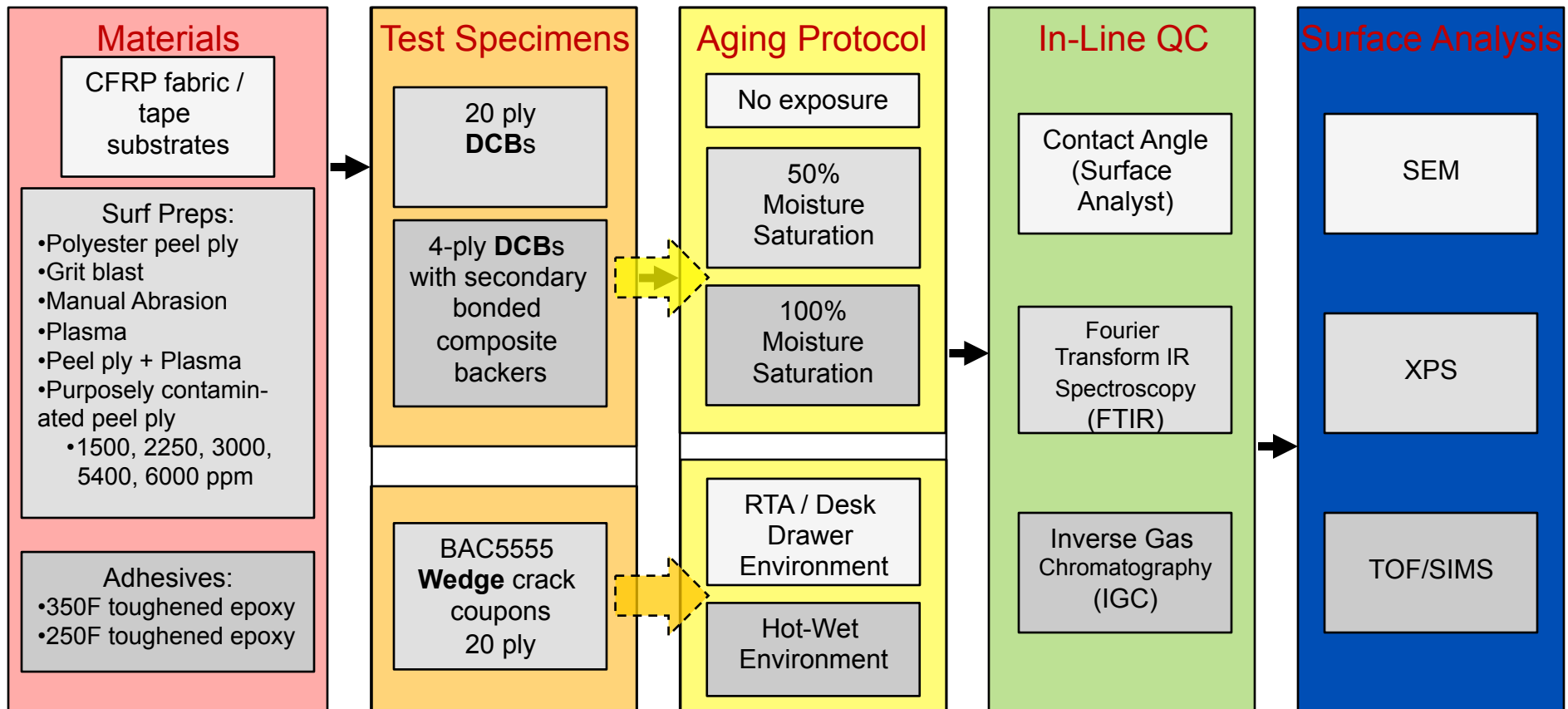
Current Working Group Projects-Feedback

- **Effect of Surface Contamination on Composite Bond Integrity and Durability**
 - Florida International University
- Improving Adhesive Bonding of Composites through Surface Characterization
 - Univ of Washington
- Durability of Adhesively Bonded Joints for Aircraft Structures (Metals)
 - Univ of Utah

Composite Bond Long-Term Durability Testing

OBJECTIVES:

- Assess the **long term environmental durability** performance of “good” composite adhesive bonds and “**compromised**” composite adhesive bonds
- Develop efficient, **accelerated test methods** that are predictive of long-term exposure behavior
- Mature **in-line QC methods** for assessment of prebond surface quality



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QC Method Status - Comparison Table

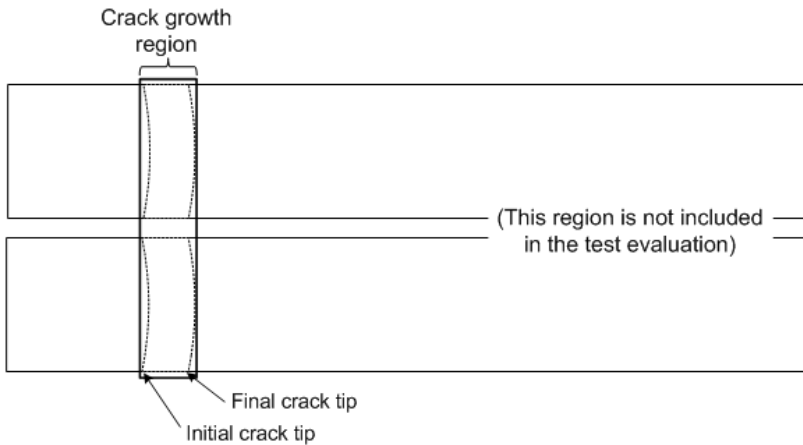
| Method | Comments/Status |
|----------------------------|---|
| Visual/Gloss | Can only detect gross defects. Not precise enough |
| Surface Texture/ Roughness | Surface Texture is only one factor for adhesion |
| Contact Angle | Need to relate process parameters to contact angle results |
| Infrared Spectroscopy | New tools maturing to meet multiple assessment needs |
| ESCA / XPS | Tools not yet suitable for factory use |
| Atomic Force Microscopy | Immature, tools not yet suitable for factory use |
| Electrochemical | Immature, need to relate to bond process parameters |
| Witness Panels | May not be exactly the same as part surface and give false readings |

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Evaluation of Crack Growth Region

Example Specimen #1:
100% cohesion failure



- **Crack Growth Region Evaluation Guide**
 - Rectangular crack growth region
 - Corresponding non-cohesion failure regions

| Example Specimen #2: (crack growth region only) 90% cohesion failure | Example Specimen #3: (crack growth region only) 80% cohesion failure | Example Specimen #4: (crack growth region only) 50% cohesion failure | Example Specimen #5: (crack growth region only) 0% cohesion failure |
|---|---|---|---|
| <p>Crack growth region</p> <p>Crack growth region</p> <p>Corresponding non-cohesion failure regions</p> <p>Final crack tip</p> <p>Initial crack tip</p> | <p>Crack growth region</p> <p>Crack growth region</p> <p>Corresponding non-cohesion failure regions</p> <p>Final crack tip</p> <p>Initial crack tip</p> | <p>Crack growth region</p> <p>Crack growth region</p> <p>Corresponding non-cohesion failure regions</p> <p>Final crack tip</p> <p>Initial crack tip</p> | <p>Crack growth region</p> <p>Crack growth region</p> <p>Corresponding non-cohesion failure regions</p> <p>Final crack tip</p> <p>Initial crack tip</p> |

Figure: Evaluation Guide

Evaluation of Failure Mode

■ Failure Mode Evaluation Guide

1. Measurement Method

2. Grid Method with a 0.10 inch grid standard

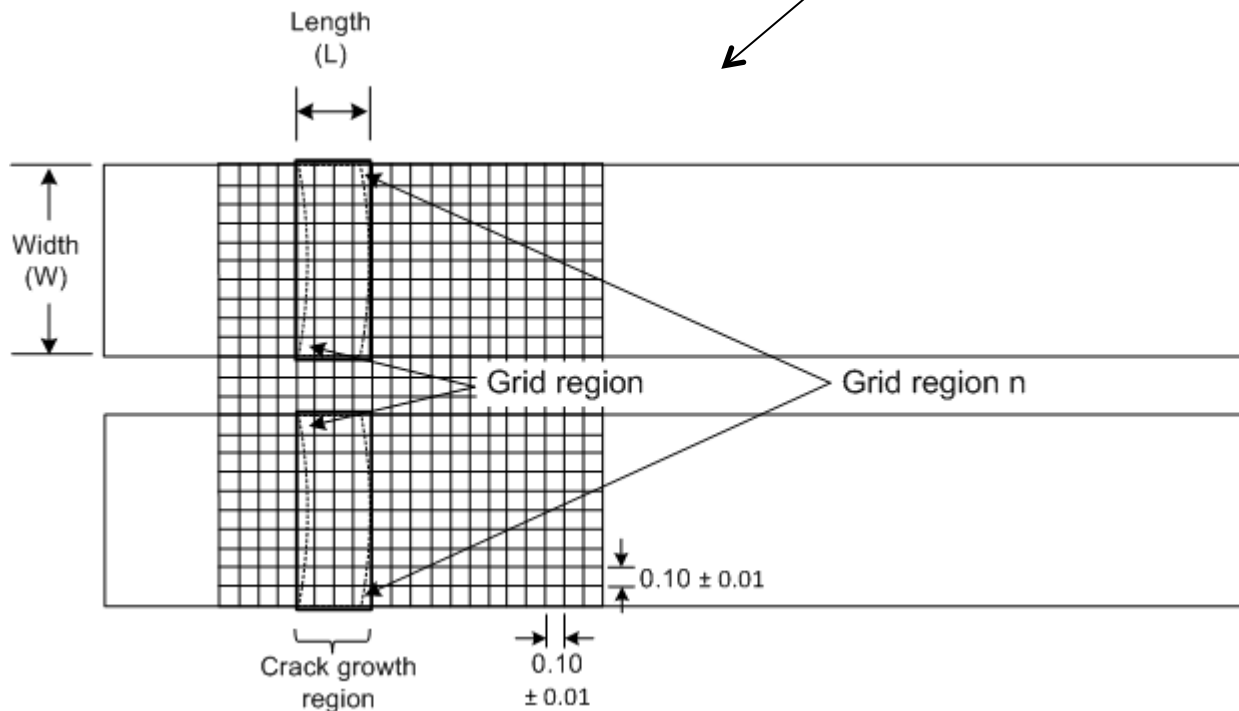


Figure: Grid Method Evaluation Guide

Future Adhesive Bonding Working Group Collaboration Areas

- **Accelerated Durability Testing**
 - Composites
 - Metals
- **Lean, Efficient Test Methods**
- **Adhesive Properties Database for Analyses**
 - Test Methods
 - Database
- **Bond Process Monitoring**
 - Maturation of In-Line QC Processes
 - Vision Systems

