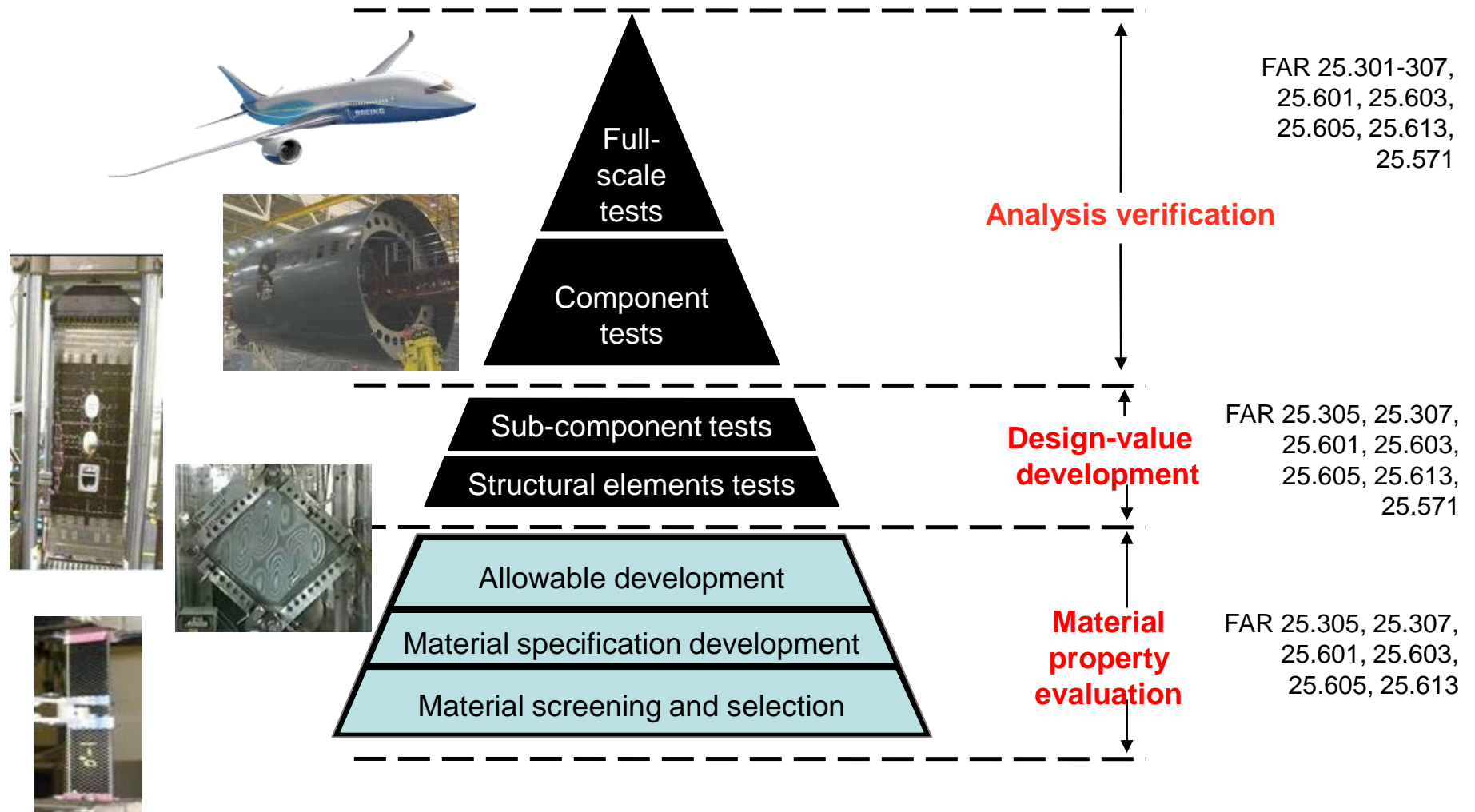# Substantiation of Bonded Repairs

Boeing Commercial Airplane
15 September 2015

FAA/Bombardier/TCCA/EASA/Industry
Composite Transport Damage
Tolerance and Maintenance Workshop

Structural Substantiation of Bonded Repairs

FAR 25.301-307, 25.601, 25.603, 25.605, 25.613, 25.571

Analysis verification

Full-scale tests

Component tests

FAR 25.305, 25.307, 25.601, 25.603, 25.605, 25.613, 25.571

Design-value development

Sub-component tests

Structural elements tests

FAR 25.305, 25.307, 25.601, 25.603, 25.605, 25.613

Material property evaluation

Allowable development

Material specification development

Material screening and selection

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Structural Substantiation of Bonded Repairs

- **Material Screening**
  - **Only done if evaluating new or improved repair materials**
- **Material Specification Development**
  - **Process development/improvement testing to account for the "repair environment" (e.g. vacuum pressure, less controlled humidity, etc.).**
- **Allowables Development**
  - **To the extent necessary to develop repair process induced corrections to baseline allowables. Repair specific materials require full allowables development.**
- **Sub-Component/Structural Element**
  - **Bulk of substantiation and methods validation testing is done at this level, verifying structural properties at a larger scale as well as failure modes and locations.**
- **Component Test(s)**
  - **Planned and unplanned repairs were fabricated. Substantiation and analysis validation of repair performance on complicated scale and loading.**
- **Full Scale Test(s)**
  - **Rarely done as part of repair substantiation although any unplanned repairs are monitored**

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■ **Issues and Concerns from an OEM's perspective w/substantiation of beyond SRM limit for bonded repairs:**

1. **Difficult to impossible to replicate OEM configured panel testing, fabrication of test panels requires qualification to production process specification(s), testing requires knowledge of boundary conditions, loading conditions, environments, etc. from original OEM substantiation testing**

2. **Requires prior knowledge of the critical failure mode(s) and margins are not available outside of the OEM.**

3. **Unconfigured panel testing (or smaller element/coupon testing) yields results not representative of the structural requirements of the configured structure (combined loads interactions, stability modes, etc.).**

4. **Coupon/small element data cannot be analytically "bridged" to configured panel performance without item 2 knowledge (and is very difficult/impossible) even with that knowledge.**

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