FAA - WORKSHOP ON ADHESIVE BONDING

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AGUSTA
AGUSTA EXPERIENCE WITH ADHESIVE BONDING

- HISTORICAL OVERVIEW
- AGUSTA MAIN ADHESIVE BONDING
- DESIGN AND CERTIFICATION
- CRITICAL ISSUES ANALYSIS
- ISSUES / IMPROVEMENTS
Agusta entered in 1952 the world of vertical flight after signing an agreement with Bell to produce its helicopters under licence.
Agusta in a relatively short time started to develop independently helicopters design.
HISTORICAL OVERVIEW

A109
HISTORICAL OVERVIEW

EH101
In 1998 Agusta signed the agreement with Bell helicopters for the development of the AB139 helicopter and BA609 Tiltrotor. These products opened a new chapter in the company history.
HISTORICAL OVERVIEW

BA609
MAIN ADHESIVE BONDINGS

• ROTOR PARTS
  Blades, Hubs, Tension Links

• PRIMARY AND SECONDARY STRUCTURES
  Ailerons, Fuselages Panels
Ailerons Bonding
MAIN STEPS OF BLADES MANUFACTURING

- Skins manufacturing and cure
- Skins/honeycomb bonding
- Honeycomb milling
- Spars manufacturing/erosion shield bonding
- Final assembly and bonding
Blades Bonding
Blades Manufacturing Process

Spar assembly cured and co-cured parts
Spar assembly
cured and co-cured
parts

Un-cured

Un-cured
Blades Manufacturing Process

Cured Spar
• Film adhesive Bonding process is reliable.

• Bonding lines are analysed through several very-film and destructive testing.

• Only 10-15% of Serial Production non-conformities are due to de-bonding defects.

• Film adhesive Bonding manufacturing process is flexible.

  guarantees good performance after several additional bondings and different cure cycles
CRITICAL ISSUES ANALYSIS

• De-bonding defects are always associated to:
  - mistakes in surfaces preparation
  - material variations (prepreg / adhesive physical properties)
  - Tooling Failures
Design instructions to manufacturing are given by

- Drawings (3D Models, 2D DW, part list)
- Product specification (manufacturing instructions and acceptance criteria)
PRODUCT SPEC CONTENTS: QUALITY REQUIREMENTS

• NDT plan
• Defects acceptance criteria (type, size, position)
• Coupons test on sacrificial parts on each blade
• Coupons test on entire blade (frequency based on monthly production)
• Coupons test results acceptance criteria
CERTIFICATION PLAN FOR COMPOSITE BLADES

- Test article including defects
- Impact damage $\leftrightarrow$ Full scale test
- Environment effects $\leftrightarrow$ load factors based on coupons/structural elements tests
- Fatigue $\leftrightarrow$ Full scale test
- Static residual strength $\leftrightarrow$ Full scale test
- Lightning strike damage $\leftrightarrow$ Full scale test
• Reduce the number of pre-cured parts before final assembly bonding:
  - pre-cured parts bonding increases the probability of defect occurrence (due to surfaces discontinuity).
  - one shot processes guarantee cost reduction.

• On line pressure/temperature control (inside the part) during closed mould cure process.