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FAA - WORKSHOP ON ADHESIVE BONDING

GATWICK 26-27 OCTOBER 2004

Civil Aviation Authority

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AGUSTA EXPERIENCE WITH ADHESIVE BONDING

- HISTORICAL OVERVIEW
- AGUSTA MAIN ADHESIVE BONDING
- DESIGN AND CERTIFICATION
- CRITICAL ISSUES ANALYSIS
- ISSUES / IMPROVEMENTS

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HISTORICAL OVERVIEW

Agusta entered in 1952 the world of vertical flight after signing an agreement with Bell to produce its helicopters under licence.

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HISTORICAL OVERVIEW

AB47

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HISTORICAL OVERVIEW

AB412

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HISTORICAL OVERVIEW

Agusta in a relatively short time started to develop independently helicopters design.

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HISTORICAL OVERVIEW

A109

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HISTORICAL OVERVIEW

A129

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HISTORICAL OVERVIEW

EH101

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HISTORICAL OVERVIEW

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.

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HISTORICAL OVERVIEW

AB139

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HISTORICAL OVERVIEW

BA609

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MAIN ADHESIVE BONDINGS

- **ROTOR PARTS**

  Blades, Hubs,Tension Links

- **PRIMARY AND SECONDARY STRUCTURES**

  Ailerons, Fuselages Panels

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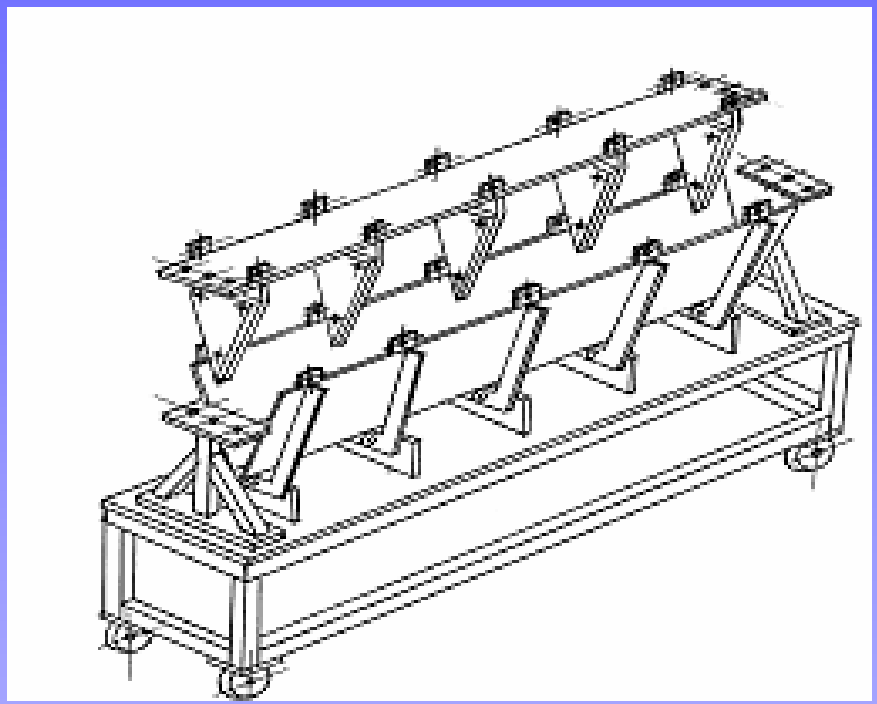
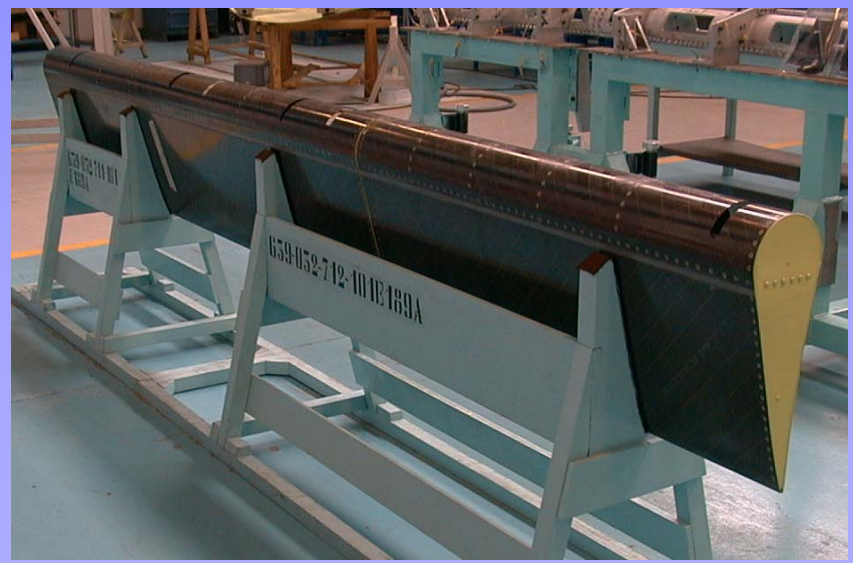
Ailerons Bonding





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MAIN STEPS OF BLADES MANUFACTURING

- Skins manufacturing and cure
- Skins/honeycomb bonding
- Honeycomb milling
- Spars manufacturing/erosion shield bonding
- Final assembly and bonding

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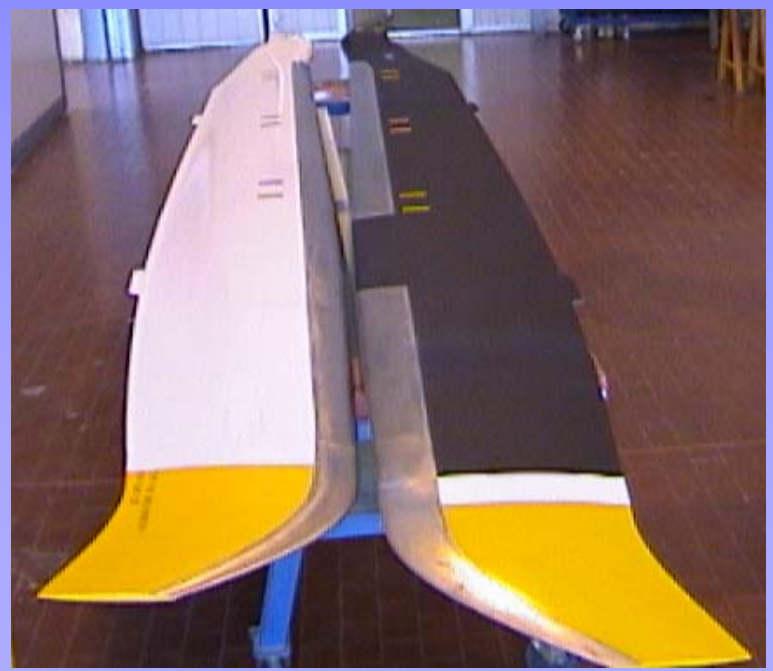
Blades Bonding



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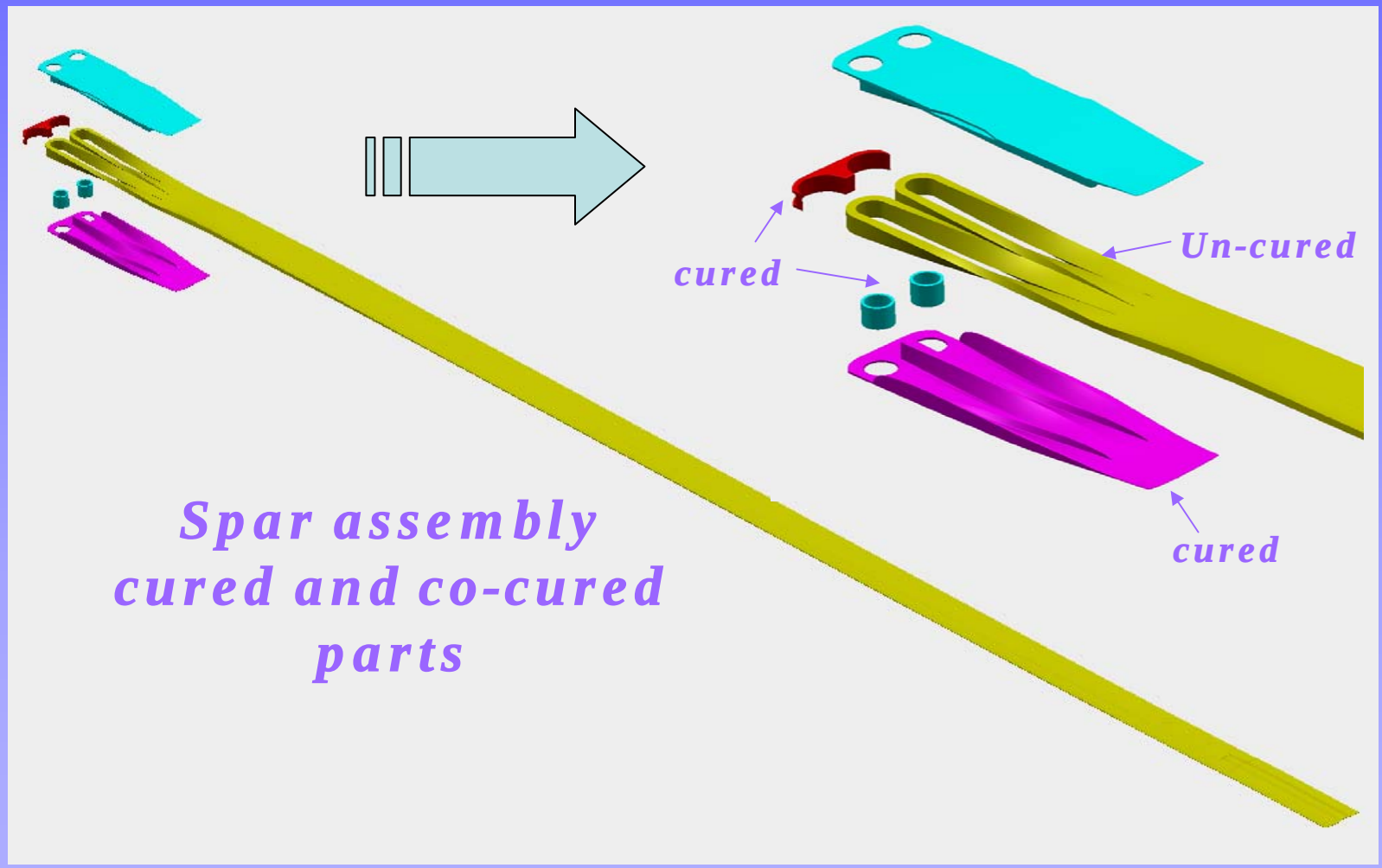
Blades Manufacturing Process



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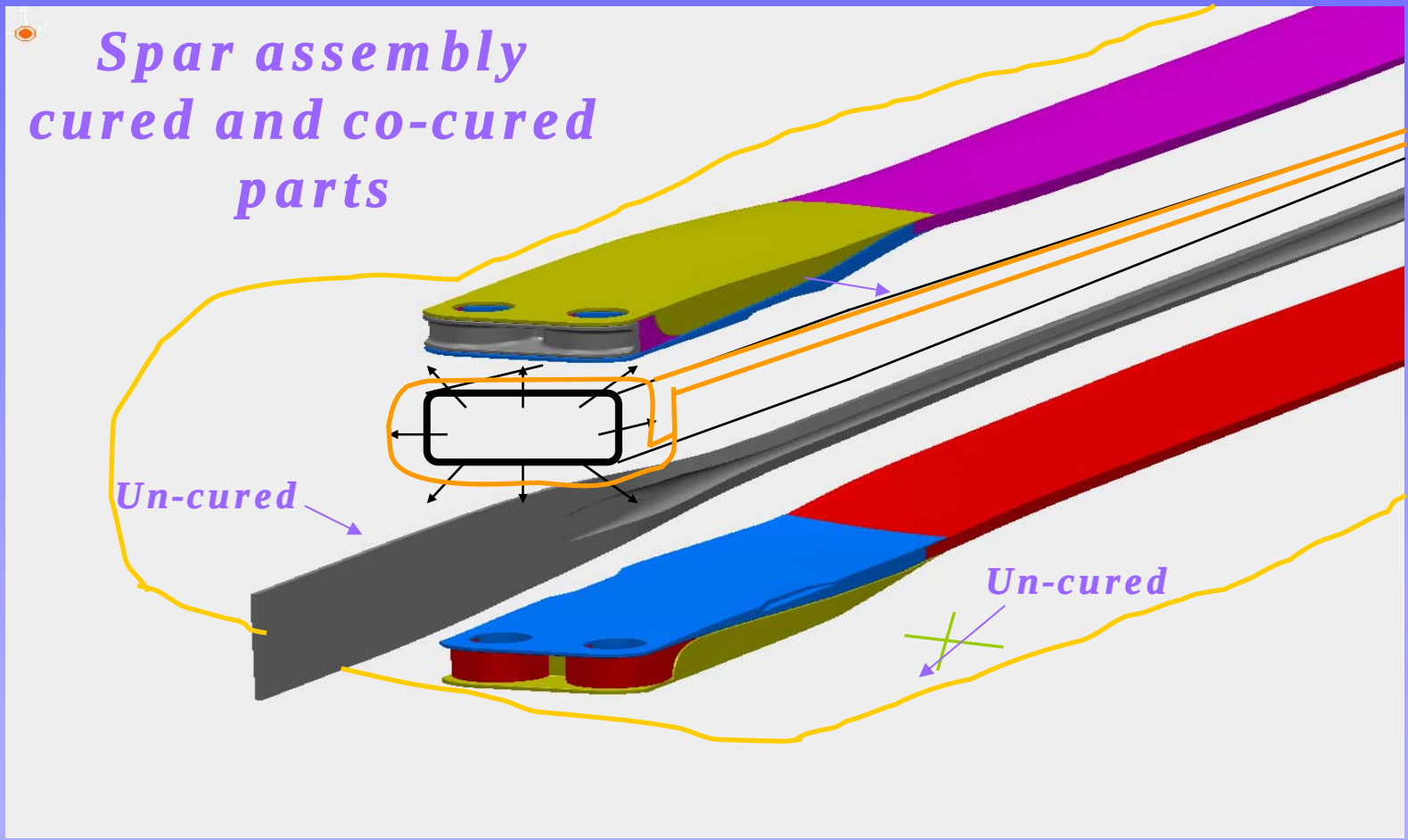
Blades Manufacturing Process



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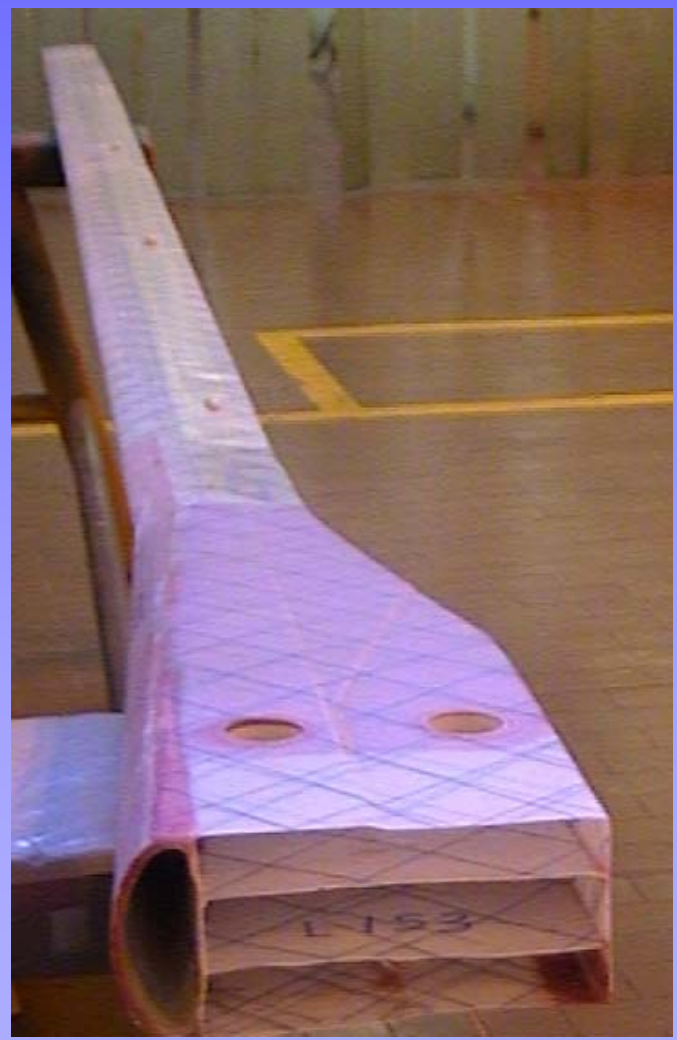
Blades Manufacturing Process

Cured Spar



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CRITICAL ISSUES ANALYSIS

- 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

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CRITICAL ISSUES ANALYSIS

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

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DESIGN

- **Design instructions to manufacturing are given by**
- Drawings (3D Models, 2D DW, part list)
- Product specification (manufacturing instructions and acceptance criteria)

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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

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CERTIFICATION PLAN FOR COMPOSITE BLADES

- Test article including defects
- Impact damage ←→ Full scale test
- Environment effects ←→ load factors based on coupons/structural elements tests
- Fatigue ←→ Full scale test
- Static residual strength←→ Full scale test
- lightning strike damage ←→ Full scale test

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ISSUES / IMPROVEMENTS

- 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.