

## AIRBUS Bonded Repairs Sessions

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**Sept 2015: FAA/Bombardier  
Composite Transport DT &  
Maintenance Workshop**

***Airbus Bonded Repairs  
Applications to Composite  
Pressurized fuselage.***



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l'évolution de la mobilité

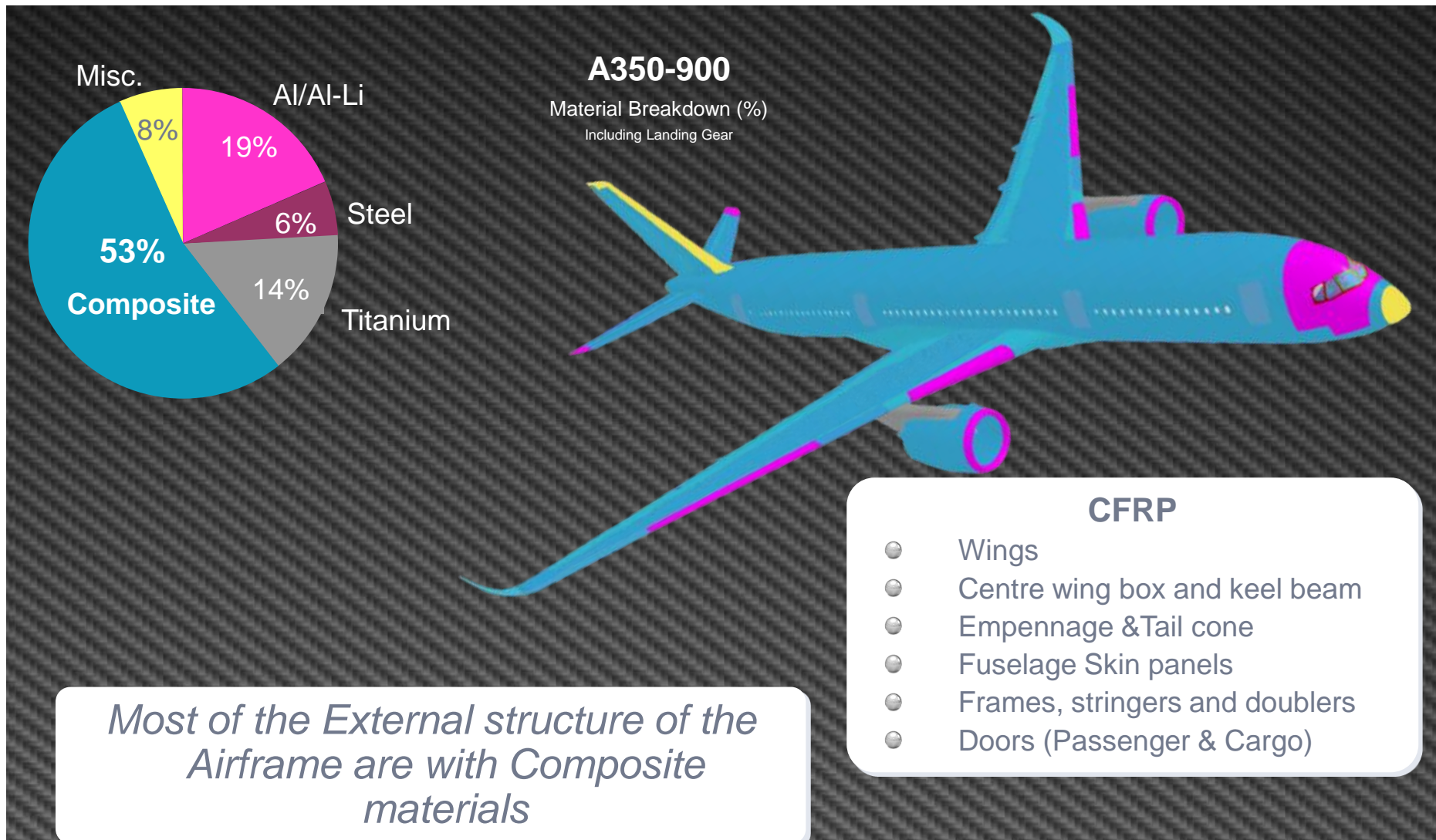


Transport  
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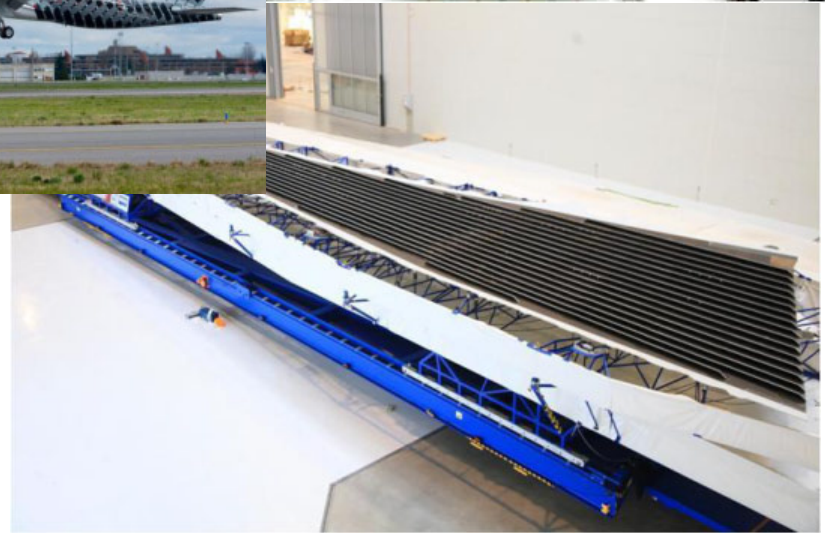
Transports  
Canada



# A350XWB – Composite Materials overview



# A350XWB – Composite Parts: large structural parts



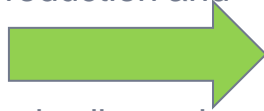
# A350 XWB: Primary Structure Composite Repairs

Extensive experience to repair regardless whether it's metal or composite

- Majority of events involved secondary structure like belly fairing panels, nacelles...
- Primary structure
  - Empennages (since A300), ATR72 Wing, A380 Rear Fuselage
  - Example on Recent event of tail cone damage
    - Tail cone cut by winglet of passing aircraft
    - Repaired in situ



Repair definition,  
production and



embodiment in  
same time as for  
metallic structure



# A350XWB: Primary Structural Bonded Repairs

## Part of a solution set for the SRM

Repairs solutions to Wing, Fuselage, Empennage CFRP structures

### Non-structural repair

- Permanent Bonded Repair (incl. ECF\* restoration)
- ECF: Expanded Copper Foil

### Structural repair

- Temporary bolted repair
- Permanent bolted repair
- **Permanent bonded Repair.**

# A350XWB: Primary Structural Bonded Repairs – Concept

- **Flush Bonded repair** (permanent, no inspection) bonded repair on **Principal Structural Elements**.
- Current focus on most likely damage scenarios & locations:
  - **Fuselage skin** delamination and perforation.
  - **Fuselage stringer** delamination & disbond.
- **Selected repair material set**
  - **M20/IM7** tape prepreg, low and medium grades (Hexcel) and **FM300-2M** adhesive (Cytec).
  - Material selection & Qualification in the framework of the CACRC (Civil Aircraft Composite Repair Committee).

Fuselage shell. Lightning strike



Rear fuselage. Double curvature



Skin perforation and two stringers disbonded



Repair of impact damage on stringer head



# A350XWB: Primary Structural Bonded Repairs

## – Embodiment process



- **Environment conditions.** A/C in hangar. Preparation of prepreg plies in a humidity & temperature controlled environment.
- **Stepping** *either* by hand *or* with portable automated machining GSE
- **Curing.** Conventional hot bonder & heating blanket and single vacuum bag cover most damage scenarios & locations.
- **Checks & inspection:**
  - Water break test.
  - Conventional ultrasonic method.
  - Destructive tests on specimen made on the spot may be required.



Automated machining



Repair patch curing set-up



Water break test

# A350XWB: Extensive Validation process

## Large used of physical demonstrators to trial repair procedures and support analysis validation

### Development of out-of-autoclave bonded repairs standard

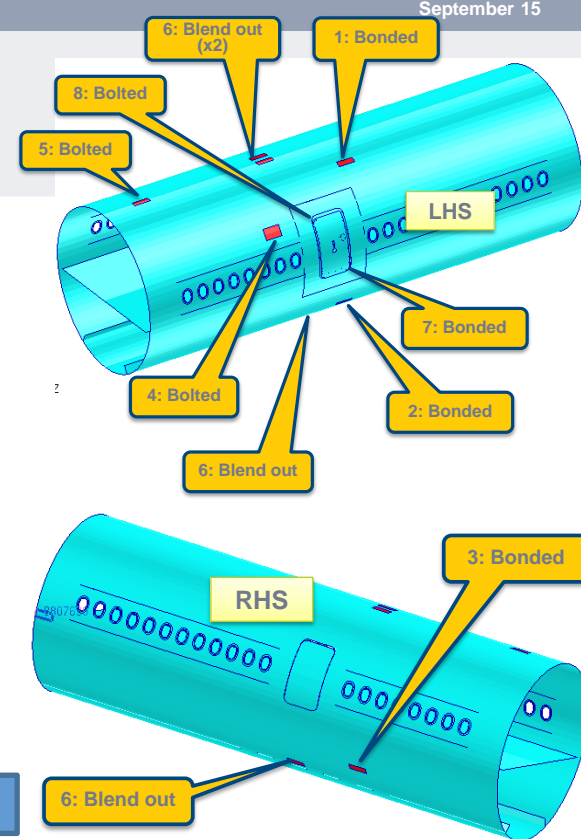
- Extend coverage of bolted repairs → Large bolted repair, stacked doubler
- Installation of “fast” bonded repairs

### Assess Structural validation combining :

- Complex design feature: Door surround
- Damages prone area: Bonded door corner repair with impacts:
  - Excellent behavior demonstrated

### In progress:

- Bonded repairs application in SRM
- Simplify approach for repair justification



Large bolted

Impact propagation during MR



“Fast”





# A350 XWB: Primary Structure Composite Repairs

## Conclusion

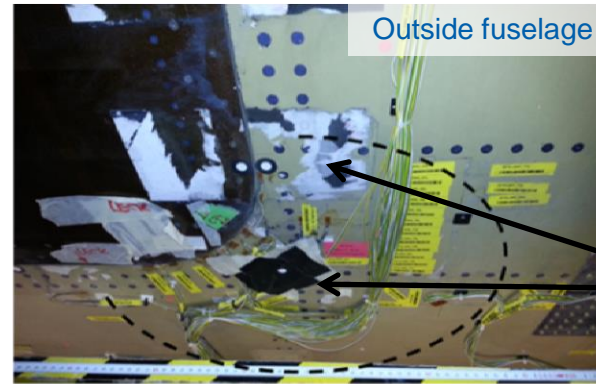
- Prioritization of bonded repair as alternative to Bolted repairs
  - In Fuselage structures, at damage prone area
  - In service application ready
  - Development of standard practice in SRM chap. 51
  - Training, specific GSE & materials available for MROs to enable start of MRO preparation activity
- Extensive test program develop to assess structural capability for fuselage :
  - Extend applicability to other components & configurations.

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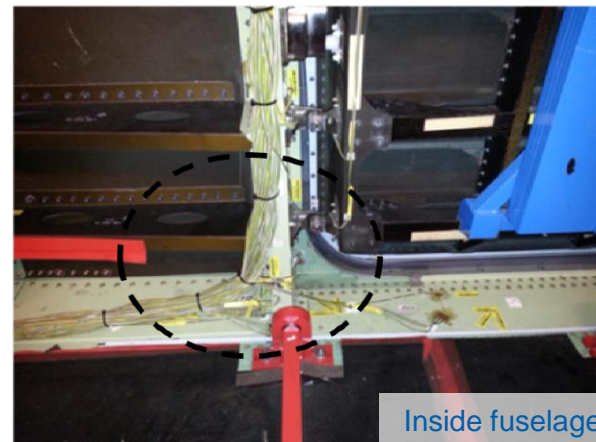
# Thank you for your attention

# A350 XWB: OoA bonded repairs Fuselage Test demonstrator

- Complex design feature : details on door corner.



Impact damages  
(delamination) before  
repair.



Key ? Fine tuning of repair procedures for adequate quality level

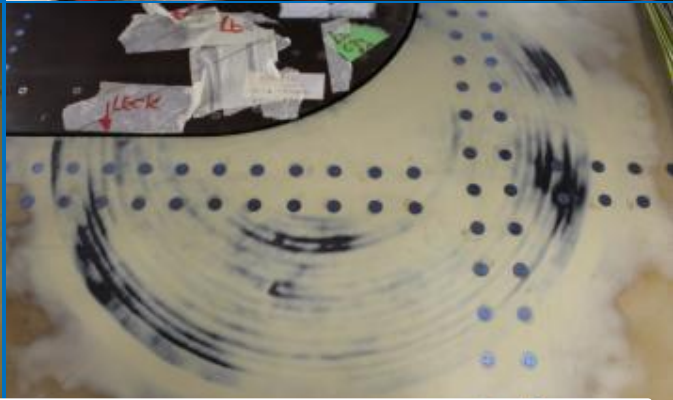
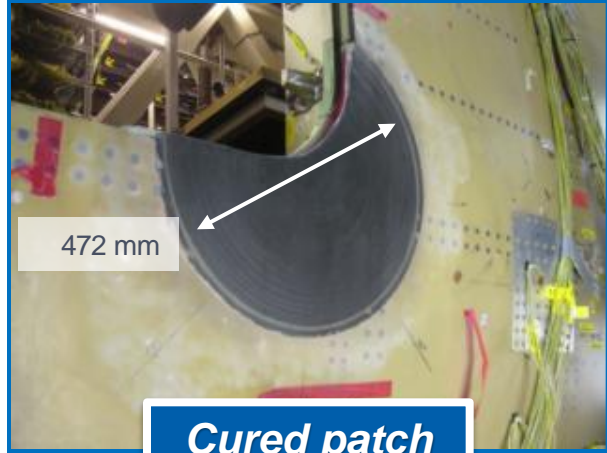


# A350 XWB: OoA bonded repairs Fuselage Test demonstrator

- out-of-autoclave bonded repair on door corner.



4,4 mm deep (24 plies medium grade) on 12,5 mm skin (68 plies)



\* See list of assumptions + Assuming 35 hours for preliminary thermal behaviour..  
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