Progress Report of the

ATA / IATA / SAE
Commercial Aircraft Composite Repair Committee (CACRC)

Presented at :
EACMT 59th General Meeting
Prepared by Carlos Blohm
Issue : June 2004
History: The CACRC is an airline maintenance committee, formed in 1991 as a combination of ATA, IATA and SAE committees, with a common charter.

Charter:
"To develop and improve maintenance, inspection and repair of commercial aircraft composite structure and components"

Ultimate goal:
- Lower maintenance cost of existing composite structures, via standardization among OEMs and airlines.
- Minimize life cycle cost of future designs.
**Philosophy:**
- Create/establish standard solutions to the most common airline problems.
- Use task groups of industry experts to discuss the existing solutions and write specifications.

**Scope:**
- Address areas that impact airlines most frequently.
- Consensus documents – Disapproving votes to be resolved
  1. Where consensus is not reached, all options are listed
  2. Not a research organization - best practices are selected
Organization of CACRC

Entities:
- Airline Operators
- Aircraft Original Equipment Manufacturers
- FAA, EASA / JAA, repair stations, vendors, material suppliers, training institutes, academia, any other interested parties
- SAE as secretariat and publisher of standards

Meetings:
- Main Committee: twice per year
  (alternating between Europe / N. America)
- Executive Committee: before and after Main Committee
- Task Groups (TGs): 2 or 3 working meetings per year
Membership of CACRC

USER MEMBER: A commercial air transport operator, a manufacturer of an aerospace vehicle subsystem or part, or a government organization. Only User Members Vote on documents.

SUPPLIER MEMBER: Producers of the various materials and processes are an integral part of the AMS operation. Supplier members have no formal vote but can comment on documents.

LIAISON MEMBER: Liaisons relay information to and from parallel activities of other committees and organizations. Liaisons have no formal vote but can comment on documents.

CONSULTANT MEMBER: A person having specific technical knowledge. Consultants have no formal vote but can comment on documents.

MAILING LIST: A person that only receives the minutes, agendas, and announcements. Does not receive balloted documents.
Structure of CACRC

Executive Committee

MAIN COMMITTEE

Task Groups

- Repair Materials
- Repair Techniques
- Analytical Repair Techniques
- Design
- Inspection
- Training
- Airline Inspection & Repair Conditions
Task Group Summary

- **Repair Materials Task Group**
  Chairperson: David Walter – Boeing Materials & Technology
  **Charter:** To develop "Common Repair Material Specifications“ and support the qualification process.

- **Repair Techniques Task Group**
  Chairperson: Philip R. Griggs - GE Aircraft Engines
  **Charter:** To develop "Standardized Repair Techniques“

- **Analytical Repair Techniques Task Group**
  Chairperson: William F. Cole – Aurora Flight Sciences Co.
  **Charter:** To develop a guide for commercial aircraft composite engineers, containing generally accepted stress analysis methods, used for the design and evaluation of composite repairs for approval submission.
Task Group Summary (cont.)

- Design Task Group
  Chairperson: Eric Chesmar – United Airlines
  Charter: Task 1: To improve composite design through operator feedback.
  Task 2: To develop a “Maintenance Life Cycle Cost Model for Commercial Aircraft Composite”

- Inspection Task Group
  Chairperson: John Hewitt - Airbus
  Charter: Task 1: To develop a “Standard Guideline for Composite inspection”.
  Task 2: Steering Committee for “Composite Reference Standards” program at FAA and Sandia Labs.
Task Group Summary (cont.)

x Training Task Group
Chairperson: Ralph Edwards – Northwest Airlines
Charter: To develop guidelines for composite training.

x Airline Inspection & Repair Conditions Task Group
Chairperson: William F. Cole and John Player – United Airlines, Oksana Bardygula - FedEx
Charter: Task 1: To define time, equipment, training and materials available for normal airline operation, so OEMs can design inspection and repair schemes for composite structure, with minimum impact.
Task 2: Prioritize Parts for enlarged Allowable Damage Limits and Repairable Damage Limits.
Progress Status

Published documents

- 10 SAE / Aerospace Materials Specifications (AMS)
- 4 SAE / Aerospace Information Reports (AIR)
- 10 SAE / Aerospace Recommended Procedures (ARP)
- 1 SAE / Aerospace Engineering Report (AE)

Documents have been implemented in OEM Manuals and Procedures!! (see document implementation status)

26 further documents in development or in revision cycle
## Document implementation status

<table>
<thead>
<tr>
<th>Document sponsor</th>
<th>Document</th>
<th>Status</th>
<th>Implementation</th>
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<tbody>
<tr>
<td>Main Committee</td>
<td>AC 145-6 Repair Station for Composite and Bonded Aircraft Structure</td>
<td>issued</td>
<td>used as reference by:</td>
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<td></td>
<td></td>
<td>a) FAA inspectors auditing Repair Stations</td>
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<td>b) MRO establishing procedures and quality manuals</td>
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<tr>
<td>T/G Repair Materials</td>
<td>AMS 2980, /1, /2, /3, /4 Technical Specification&quot;Carbon Fiber Fabric and Epoxy Resin Wet Lay-Up Repair material&quot;</td>
<td>issued 01.Nov.96</td>
<td>Qualification completed</td>
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<td>a) A.I.: incorporated in AIMS 08-01-00</td>
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<td>b) Boeing :</td>
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<td>c) P&amp;W :</td>
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<td>d) GE :</td>
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<td>e) BF Goodrich:</td>
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<tr>
<td>T/G Repair Materials</td>
<td>AMS 2960, /1, /5 Glass Fabric with Epoxy Resin Wet Lay-Up Repair Material</td>
<td>in Progress</td>
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<tr>
<td>T/G Repair Materials</td>
<td>AMS 2950 Paste Adhesive and Core Restoration</td>
<td>in Progress</td>
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| T/G Repair Techniques | ARP 4916 Masking and Cleaning of Epoxy and Polyester Matrix Thermosetting Composite Materials. | issued 01.Mar.97 | a) A.I.: Methods reflecting AI process included in SRM 51-77  
   b) Boeing:                                                         
   c) P&W:                                                          
   e) BF Goodrich:                                                   |
| T/G Repair Techniques | ARP 4977 Drying of Thermosetting Composite Materials. | issued 01.Aug.96 | a) A.I.: implemented  
   b) Boeing: commitment to reference in SRM in near future  
   d) GE: used as a resource in the answer of customer questions  
   e) BF Goodrich:                                                   |
| T/G Repair Techniques | ARP 5256 Mixing Resins, Adhesives and Potting Compounds | issued 01.Mar.97 | a) A.I.: Used in training course  
   b) Boeing:                                                         
   c) P&W: implemented in 1997  
   d) GE: used as a resource in the answer of customer questions  
   e) BF Goodrich:                                                   |
| T/G Repair Techniques | ARP 4991 Core Restoration of Thermosetting Composite Materials | issued 01.Dec.98 | a) A.I.: existing technique in SRM 51-77 very close to ARP  
   b) Boeing:                                                         
   c) P&W: implemented in 1998  
   d) GE:                                                             
   e) BF Goodrich:                                                   |
| T/G Repair Techniques | ARP 5143 Vacuum Bagging of Thermosetting Composite Repairs | issued 26.Jul.02 | a) A.I.: Methods reflecting AI process included in SRM 51-77  
   b) Boeing:                                                         
   c) P&W: implemented in 1998  
   e) BF Goodrich:                                                   |
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b) Boeing :  
c) P&W : implemented in 1998  
d) GE : ARP is referenced directly in SPM 70-46-02 and 70-46-03  
e) BF Goodrich: |
b) Boeing :  
c) P&W :  
d) GE :  
e) BF Goodrich: |
| T/G Repair Techniques     | AIR 5367 Machining                            | in Progress  | a) A.I. :  
b) Boeing :  
c) P&W :  
d) GE :  
e) BF Goodrich: |
| T/G Repair Techniques     | AIR 5431 Tooling                              | in Progress  | a) A.I. :  
b) Boeing :  
c) P&W :  
d) GE :  
e) BF Goodrich: |
| T/G Repair Techniques     | Repair design                                 |              | a) A.I. :  
b) Boeing :  
c) P&W :  
d) GE :  
e) BF Goodrich: |
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| T/G Inspection   | ARP 5089 Composite Repair NDT / NDI Handbook | issued 01.Nov.96 | FAA: internal use  
Boeing: internal use  
A.I.: Internal use |
| T/G Inspection   | ARP 5605 Solid Composite Laminate NDI Reference Standards | issued 01.Sep.01 | a) A.I.: Internal use  
b) Boeing :  
c) P&W :  
d) GE :  
e) BF Goodrich: |
| T/G Inspection   | ARP 5606 Composite Honeycomb NDI Reference Standards | issued 01.Sep.01 | a) A.I.: Range of possible applications under review  
b) Boeing :  
c) P&W :  
d) GE :  
e) BF Goodrich: |
b) Presentation to BF Goodrich Aerospace designers Feb.98.  
c) Presentation to Boeing designers May 98.  
d) Presentation at SAMPE conference  
e) BF Goodrich: implemented in Design & Best Practice Nacelle manuals.  
g) Boeing: implemented in Design Handbook.  
h) A.I.: presented to partners and implemented in Design Hbk.  
i) Presentation at EADS Stade Sep 01. |
| T/G Design       | AIR 5416 Maintenance Life Cycle Cost Model | in Progress | |
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<tr>
<td>T/G Training</td>
<td>AIR 4938 Composite and Bonded Structure Technician / Specialist: Training Doc.</td>
<td>issued 01.Sep.96</td>
<td>Flight Safety: uses as basis (100%) A.I.: Reduced content used, to match course length</td>
</tr>
<tr>
<td>T/G Training</td>
<td>AIR 5278 Composite and Bonded Structure Engineers: Training Doc.</td>
<td>issued 01.Mar.99</td>
<td>Flight Safety: uses as basis (100%) A.I.: Reduced content used, to match course length</td>
</tr>
<tr>
<td>T/G Training</td>
<td>AIR 5279 Composite and Bonded Structure Inspector: Training Doc.</td>
<td>issued 01.Mar.99</td>
<td>Flight Safety: uses as basis (100%) A.I.: Reduced content used, to match course length</td>
</tr>
<tr>
<td>T/G Training</td>
<td>AIR 4844 Composites and Metal Bonding Glossary</td>
<td>issued 01.Mar.97</td>
<td>a) A.I.: Internal use b) Boeing: c) P&amp;W: d) GE: used as a resource in house e) BF Goodrich:</td>
</tr>
<tr>
<td>T/G Training</td>
<td>Composite Structures Awareness, Video</td>
<td>available</td>
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<tr>
<td>T/G Training</td>
<td>Proper Handling of Composite Parts, Video</td>
<td>available</td>
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<tr>
<td>T/G Analytical Repair Techniques</td>
<td>AIR 5946 Design and Application of Composite Repairs for Thermosetting Composites</td>
<td>in Progress</td>
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Other Successes for CACRC to date:

Forum to act as the source for industry to obtain airline input / feedback, such as:

- Comments on Advisory Circular Number 145-6 “Repair Station for Composite and Bonded Aircraft Structures”
- Sandia NDT Program Steering group.
- FAR Revisions
- Airline contacts for design reviews.
Summary

- Operator input remains absolute necessity.
- CACRC proved to be effective to improve maintainability of composite structures.
- CACRC proves to be worthwhile for operators, OEM's and material supplier.
- CACRC is breaking new ground in industry cooperation.
Next meetings

North American Fall meeting:
  October 18th to 21st, 2004, Manasses, VA, USA, Aurora Flight Sciences Co.

European Spring meeting:
  April/May 2005, Bremen, Germany, Airbus

Main committee detailed meeting information can be found on the SAE web page:
http://forums.sae.org/access/dispatch.cgi/TEAAMSCACRC_pf
You are invited to join CACRC

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