Workforce
Education: Composite
Materials Technology
Agenda

► Review of course development: Critical Composite Maintenance and Repair Issues
► Online Learning – Overview
Critical Composite Maintenance and Repair Issues

► Motivation and Key Issues
  - Practical, introductory-level course for engineers, technicians and inspectors

► Objective
  - Develop framework, content and assessment criteria as a basis for curriculum training
  - Online course, with ‘hands-on’ laboratory, which will increase awareness of critical safety issues in composites’ maintenance

► Approach
  - Series of workshops and ‘beta’ class with experienced practitioners
  - Industry, regulatory and academic collaboration

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FAA Sponsored Project Information

► Principal Investigators & Researchers
  ▪ Charles Seaton, PI, Edmonds Community College
  ▪ Cyndi Schaeffer, Executive Director, EdCC

► FAA Technical Monitor
  ▪ Peter Shyprykevich

► Other FAA Personnel Involved
  ▪ Larry Ilcewicz, Curt Davies

► Industry Participation
  ▪ Boeing, Airbus, EASA, Hexcel, Heatcon, Abaris and others
Motivation and Key Issues
Outcomes

► Practical, introductory-level course for engineers, technicians and inspectors


- Short course (5–7 days), incl. labs, worth 3-5 credits
- Current efforts include web-based, distance learning
- Applicable for other decision-makers, such as production planners, purchasing agents and executive management

► FAA guidelines on training needs (precursor to policy)
Motivation and Key Issues

Critical Composite

Maintenance and Repair Issues

- Understand roles & responsibilities (importance of teamwork)
- Recognize composite damage types & sources
  (proper team reaction to possible service damage)
- Understand the inspection methods & procedures needed for
detection, characterization and disposition of damage
- Understand regulations and importance of approved source
documentation (+ process for cases requiring new approval)
- Realize the unique processing issues and quality controls
  needed for bonded composite repairs
- Realize the unique processing issues and quality controls
  needed for bolted composite repairs
- Realize need for more training to acquire technician, inspector or
  engineering skills (avoid working beyond skill limits)
Approach

► Series of workshops to bring regulators and industry together on technical issues
  - FAA/NRC Workshop in Wash. DC (May 18 & 19, 2004) *Executive review of systematic, repair, NDI & training issues*
  - 2004 Kickoff for FAA research to evaluate training needs
  - 2005 and 2006 FAA Workshops to review progress in establishing training needs

► Industry & government experts recruited to support the development of training *standards*
  - 2004 Seattle workshop defined terminal course objectives (TCO)
  - 2005 Chicago workshop used to review draft modules that will be released with the TCO as *industry standards*
  - Boeing/Airbus/EASA WG review – recommend updates
  - Initial course scheduled to be completed in 2006
  - FAA report with *industry standard modules* released in 2006
Primary Deliverables

- Terminal Course Objectives (TCO) + Course Description Abstract
- Modules *(industry standards)* Safety Messages
- Standard Student Assessments

- Testimonials (volunteers support)
- Storyboard of a typical course outline

- FAA guidelines (precursor to policy) on training needs: *Critical Composite Maintenance & Repair Issues*

Coordinated Release Through SAE CACRC and FAA Technical Center

Edmonds C.C. Website

Edmonds Community College
# SAE CACRC AIR Training Documents

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<tr>
<th>SAE AIR4938</th>
<th>AEROSPACE INFORMATION REPORT</th>
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<td>Submitted for recognition as an American National Standard</td>
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**COMPOSITE AND BONDED STRUCTURE TECHNICIAN/SPECIALIST:**  
**TRAINING DOCUMENT**

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<th>SAE AIR5278</th>
<th>AEROSPACE INFORMATION REPORT</th>
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**Composite and Bonded Structure Engineers:**  
**Training Document**

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<tr>
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**Composite and Bonded Structure Inspector:**  
**Training Document**

**Edmonds Community College**
TCOs Organized by Key Subjects

**Base Knowledge**
- A: Understand basics of composite materials technology
- B: Understand basics of composite materials maintenance and repair
- C: Understand roles and responsibilities
- D: Recognize composite damage types and sources
- E: Identify & describe information contained in documentation

**Teamwork & Disposition**
- F: Describe composite laminate fabrication & bonded repair methods

**Damage Detection & Characterization**
- G: Perform bonded composite repair
- H: Describe composite damage and repair inspection procedures

**Repair Processes**
- I: Describe composite laminate bolted assembly & repair methods perform bonded repair
- J: Understand other critical elements of composite maintenance & repair
- K: Case team studies

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Base Knowledge

Prerequisite modules (to be provided as self study)
- Module A: Understand basics of composite materials
- Module B: Understand basics of composite maintenance and repair
- Module J: Realize other critical elements of composite maintenance and repair

Developed by Keith Armstrong
- Basic composite knowledge that will be useful for engineers, inspectors, technicians and others that will take the course
- Many elements covered in Module J are also intended to make students aware of some important areas that will not be covered by the main course
Teamwork and Disposition

Unique modules with critical safety messages

- **Module C**: Understand roles and responsibilities
- **Module E**: Identify & describe info contained in documentation
- **Module K**: Case team studies [Lab #6]

Successful maintenance & repair relies on teamwork

- Engineers, inspectors & technicians have diverse training needs and acquired skills
- Good communication between OEM and users

Approved maintenance practices and repair procedures are developed & substantiated to meet requirements

- Specific product design, process and database dependence
- Limits and constraints of approved source documentation
Damage Detection & Characterization

► Essential modules for detecting and solving a problem
  Module D: Recognize composite damage types and sources
  Module H: Describe composite damage and repair inspection procedures

► Working outside the limits of approved documentation
  - Difficult to substantiate repair of all possible environmental and accidental damage cases in initial type certification
  - Standard designs, analyses & shared databases don’t exist to support the substantiation of composite field repairs

► Some damage scenarios require special inspections
  - Communication between operations, maintenance and OEM personnel for anomalous damaging events
Repair Processes

- Modules needed to realize critical issues in composite repair processes and quality control procedures
  - **Module F**: Describe composite laminate fabrication and bonded repair methods
  - **Module G**: Perform bonded composite repair
  - **Module I**: Describe composite laminate bolted assembly & repair methods and perform/inspect bolted repair

- Hands-on labs, videos and testimonials help gain an appreciation for process-related safety messages

- Design and process detail differences are likely in advanced, product-specific, “how-to” training
# Elements of Curriculum

**Relationship to Course Design**

<table>
<thead>
<tr>
<th>Elements (public domain)</th>
<th>Road Map</th>
<th>Custom Curriculum is a unique blend of:</th>
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<tbody>
<tr>
<td>TCOs &amp; Content</td>
<td></td>
<td>Learning techniques</td>
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<tr>
<td>Flight Safety Messages</td>
<td>Story Board (next slide for example)</td>
<td>Modified mix of elements</td>
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<tr>
<td>Testimonials</td>
<td></td>
<td>Teaching format</td>
</tr>
<tr>
<td>Videos</td>
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<td>Target audience characteristics</td>
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Edmonds Community College
<table>
<thead>
<tr>
<th>Time</th>
<th>Primary Mode[s]</th>
<th>Supplemental Mode[s]</th>
<th>Topics: TCO [E] Identify &amp; describe information contained in documentations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>8:00 to 9:50</td>
<td>Lecture</td>
<td>E1: Describe requirements in material &amp; process specifications and structural repair manuals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. Pt Presentation</td>
<td>E2: Demonstrate use of source documents</td>
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<tr>
<td></td>
<td></td>
<td>Testimonial from Practitioner</td>
<td>E3: Identify &amp; demonstrate use of regulatory documents</td>
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<td>E4: Understand the requirements and engineering approvals necessary for valid sources of technical information &amp; maintenance instructions</td>
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<tr>
<td>Morning</td>
<td>9:10 to 10:10</td>
<td>Intermission</td>
<td>Total Time: 20 min</td>
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<tr>
<td>Morning</td>
<td>10:10 to 12:00</td>
<td>Lecture</td>
<td>Topics: TCO [F] Describe composite laminate fabrication &amp; bonded repair methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P. Pt Presentation</td>
<td>F1: Understand the basics of composite laminate fabrication</td>
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<tr>
<td></td>
<td></td>
<td>Video</td>
<td>F2: Understand the basics of composite bonded repair</td>
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<td>F3: Describe the detailed processing steps necessary for laminate fabrication [factory], bonded repair [field], and Material Review Board (OEM)</td>
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<td>F4: Describe key characteristics and processing parameters for laminate fabrication</td>
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<td>F5: Identify typical processing defects which occur in composite laminate fabrication &amp; bonded repair.</td>
</tr>
<tr>
<td>Afternoon</td>
<td>12:00 to 1:00</td>
<td>Lunch</td>
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Total Time: 1hr 50min

Fight Safety Message #3

Fight Safety Message #4
AMTAS Awareness Course: Composite Materials Maintenance and Repair (FAA Cooperative Agreement)

**Define Framework**

Methodology
Define Course Objectives (TCOs) based on expected skill base

Results
450 Skills/62 Course Objectives
www.mpdc.biz

**Industry Involvement**

CACRC Introduction to Process (Oct 04)
Global Teleconference (Apr 05)
Workshop: Tukwila Nov 04

**Results**
450 Skills/62 Course Objectives
www.mpdc.biz

**Define Framework**

Methodology
Expertise Support

Results
200+ pages in draft FAA Tech Center Report
Safety messages
2 minute testimonials
www.mpdc.biz

**Industry Involvement**

CACRC Update to Process (May 05)
Conference among Boeing/Airbus/EASA/FAA organizations (Mar 06)
Workshop: Chicago (Sep 05)
Beta courses involving practitioners (May-Jun 06)
Reference CACRC documents where/if appropriate

**Outcome: Established TCOs/2 courses**

**Develop Content**

Methodology
Expertise Support

Results
200+ pages in final FAA Tech Center Report
Safety messages
2 minute testimonials
www.mpdc.biz

**Industry Involvement**

CACRC Update to Process (May 05)
Conference among Boeing/Airbus/EASA/FAA organizations (Mar 06)
Workshop: Chicago (Sep 05)
Beta courses involving practitioners (May-Jun 06)
Reference CACRC documents where/if appropriate

**Outcome: Updated content based on feedback**

**Disseminate to Learning Organizations**

Methodology
Materials in ‘Public Domain’ (Updates throughout 2006)
EdCC global on-line course
EdCC regional laboratories

Results
200+ pages in final FAA Tech Center Report
Identified additional enhancements
www.mpdc.biz

**Recommended Industry Involvement**

Publish TCOs and Teaching Points through CACRC Concurrent with FAA Tech Center Report – Focus on Awareness, not Skill Building
CACRC to support a Training Repair Manual utilizing ATA 100 format
Summary
Curriculum Development Approach and Timelines

Consensus on TCO’s & Modules
- Expert Reviewers
- Industry Practitioners
- CACRC
- FAA SME’s

Edmonds CC Class Uses Modules for Curriculum
- AMTAS instructors
- Industry practitioners (engineers, inspectors, technicians)
- FAA
- Others

Experts recommend standards
- Specific
- Measurable
- Focus on safety

Standards Published by FAA (TCO’s & Modules)

Training Providers Incorporate Standards into their Curriculum
- Boeing
- Airbus
- Carriers
- Alteon
- Ababris
- ACT
- Others

Training Providers Adopt Standards as part of Curriculum
- Industry practitioners
- FAA
- Others

Developers help Training Providers add Standards

Document on Maintenance Training Standards Drafted by FAA
- FAA
- Industry review
- Others review

Sept ’05 Winter ‘05 Spring ‘06 Summer ‘06 Fall ‘06
Edmonds Community College
Online Learning

► Two Approaches: Face-to-face (traditional) and Online/Distance Learning

► Research indicates that learning effectiveness is equal to or better than entirely face-to-face courses

► Online Learning advantages
  - Geographical Flexibility ➔ Economical & Accessible
  - Time Flexibility ➔ Asynchronous
  - Opportunity to involve Experts on specific topics
  - Adaptable to technology from central database
Online Learning Techniques

► Platform for training is well developed (examples)
  - Blackboard: Edmonds Community College
  - eCollege: DeVry University
  - Outlook: University of Phoenix

► Critical element: Asynchronous discussion
  - 1 to 2 discussion questions (mini-case studies) per topic and week
  - Use of questions to direct student learning (‘self-discovery’ through a ‘Socratic questioning process’)

► Central course administration database
  - Course Objectives; PowerPoint; Written Content; Hyperlinks; testing/assessments
  - Online learning encourages equal treatment of students by its nature