

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

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
FAA/Edmonds C.C. Cooperative Agreement (2004-2006)
 - 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

**Coordinated Release
Through SAE CACRC and
FAA Technical Center**

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

**Edmonds C.C.
Website**


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

SAE CACRC AIR Training Documents


 <p>400 Commonwealth Drive, Warrendale, PA 15096-0001</p> <p>Submitted for recognition as an American National Standard</p>	<p>AEROSPACE INFORMATION REPORT</p>	<p>SAE AIR4938</p>
		<p>Issued 1996-09</p>
<p>COMPOSITE AND BONDED STRUCTURE TECHNICIAN/SPECIALIST: TRAINING DOCUMENT</p>		

AIR4938
Technician/Specialist

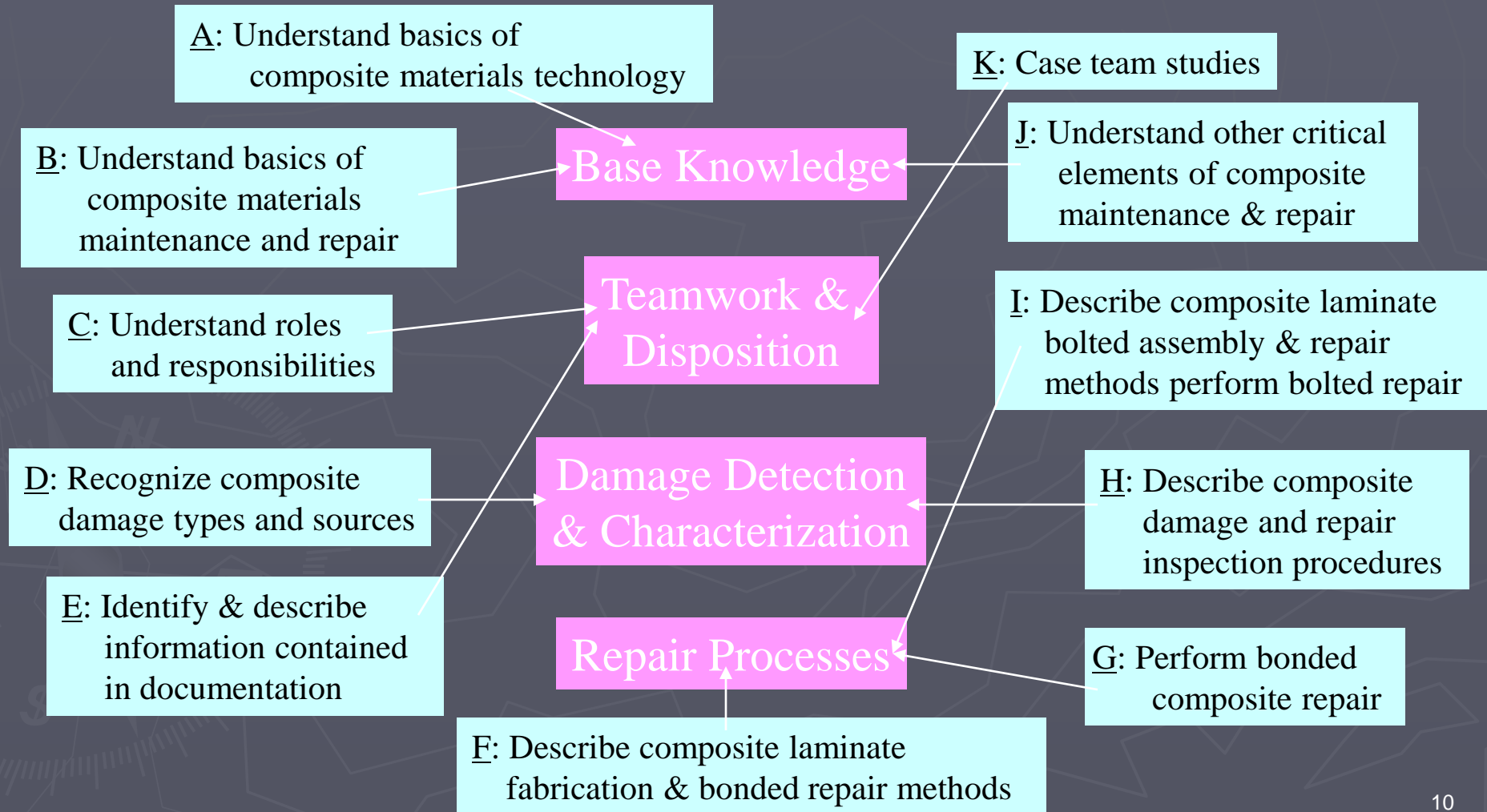
AIR5278
Engineer

 <p>400 Commonwealth Drive, Warrendale, PA 15096-0001</p> <p>Submitted for recognition as an American National Standard</p>	<p>AEROSPACE INFORMATION REPORT</p>	<p>SAE AIR5278</p>
		<p>Issued 1999-03</p>
<p>Composite and Bonded Structure Engineers: Training Document</p>		

AIR5279
Inspector

 <p>400 Commonwealth Drive, Warrendale, PA 15096-0001</p> <p>Submitted for recognition as an American National Standard</p>	<p>AEROSPACE INFORMATION REPORT</p>	<p>SAE AIR5279</p>
		<p>Issued 1999-03</p>
<p>Composite and Bonded Structure Inspector: Training Document</p>		

TCOs Organized by Key Subjects



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

Elements (public domain)	Road Map	Custom Curriculum is a unique blend of:
TCOs & Content		Learning techniques
Flight Safety Messages	Story Board (next slide for example)	Modified mix of elements
Testimonials		Teaching format
Videos		Target audience characteristics

<p>Morning</p> <p> 8:00 to 9:50</p>	<p>Primary Mode[s]:</p> <p> Lecture</p> <hr/> <p>Supplemental Mode[s]:</p> <p> P. Pt Presentation</p> <p> Testimonial from Practitioner</p>	<p>Topics: <u>TCO [E] Identify & describe information contained in documentations</u></p> <p>E1: Describe requirements in material & process specifications and structural repair manuals E2: Demonstrate use of source documents E3: Identify & demonstrate use of regulatory documents E4: Understand the requirements and engineering approvals necessary for valid sources of technical information & maintenance instructions</p> <p>Fight Safety Message #3  Total Time: 1hr 50min</p>
<p>Morning</p> <p> 9:10 to 10:10</p>	<p> Intermission  Total Time: 20 min</p>	
<p>Morning</p> <p> 10:10 to 12:00</p>	<p>Primary Mode[s]:</p> <p> Lecture</p> <hr/> <p>Supplemental Mode[s]:</p> <p> P. Pt Presentation</p> <p> Video</p> <p> Testimonial from Practitioner</p>	<p>Topics: <u>TCO [F] Describe composite laminate fabrication & bonded repair methods</u></p> <p>F1: Understand the basics of composite laminate fabrication F2: Understand the basics of composite bonded repair F3: Describe the detailed processing steps necessary for laminate fabrication [factory], bonded repair [field], and Material Review Board (OEM) F4: Describe key characteristics and processing parameters for laminate fabrication F5: Identify typical processing defects which occur in composite laminate fabrication & bonded repair.</p> <p>Fight Safety Message #4  Total Time: 1hr 50min</p>
<p>Afternoon</p> <p> 12:00 to 1:00</p>	<p> Lunch Edmonds Community College  Total Time: 1 hr</p>	

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.mppdc.biz



Industry Involvement

CACRC Introduction to Process (Oct 04)

Global Teleconference (Apr 05)

Workshop: Tukwila Nov04

Outcome: Established TCOs/2 courses

Develop Content

Methodology

Expertise Support

Results

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



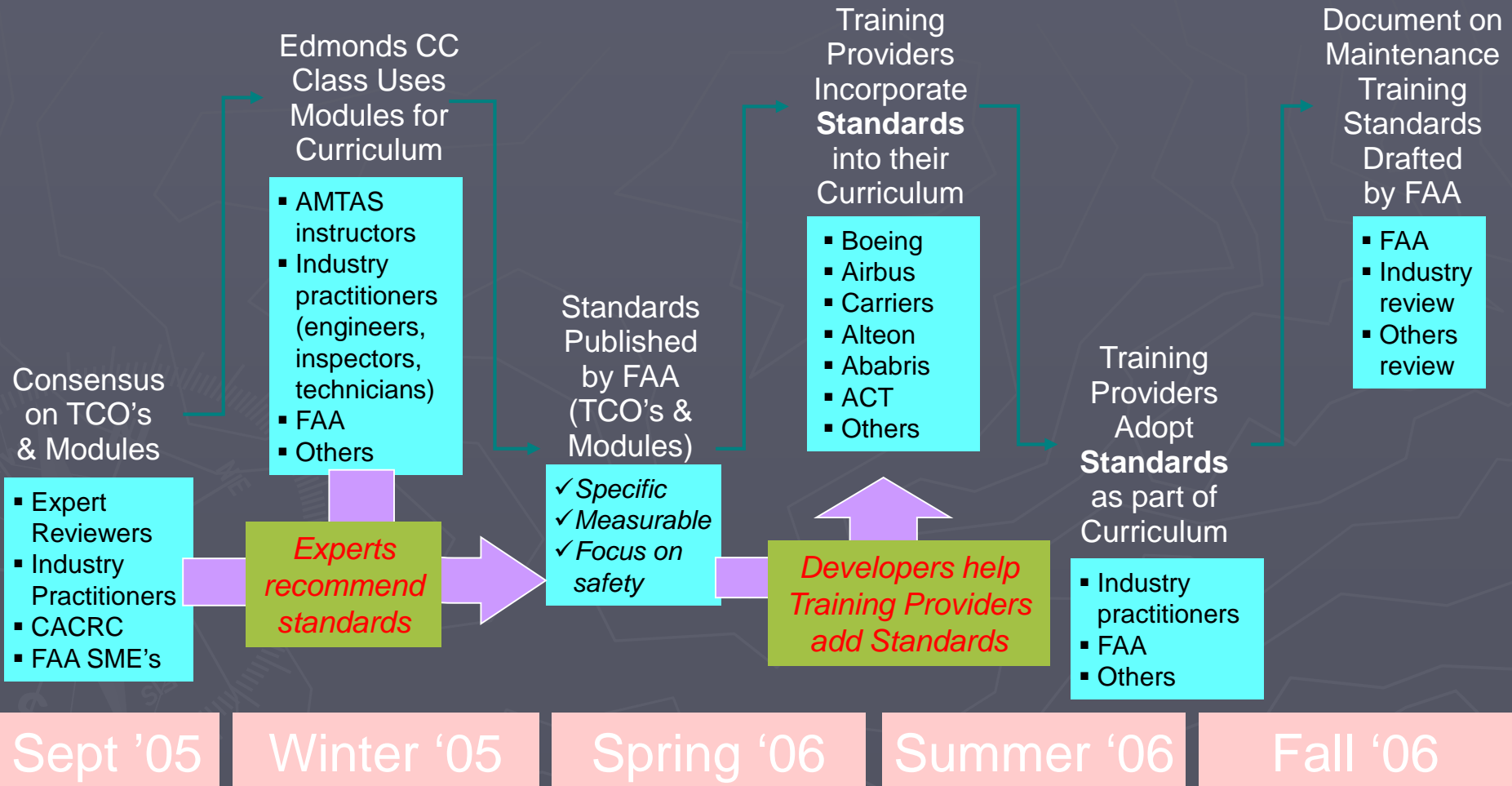
Recommended Industry Involvement

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



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