



Federal Aviation
Administration

Composite Safety & Certification Initiatives

Presented at: AMTAS Spring 2006 Meeting

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Agenda

- Background
 - Objectives
 - Technical thrust areas
 - Approach and industry teammates
 - Timelines
- Technical status of recent initiatives
 - Bonded structure
 - Maintenance research & training
- Summary



Ongoing Composite Safety & Certification Initiatives*

Objectives

- 1) Work with industry, other government agencies, and academia to ensure safe and efficient deployment of composite technologies used in existing and future aircraft
- 2) Update policies, advisory circulars, training, and detailed background used to support standardized composite engineering practices

** Efforts started in 1999 to address issues associated with increasing composite applications*

Technical Thrust Areas

Advancements depend on close integration between areas

Material Control, Standardization
and Shared Databases

Structural Substantiation

- Advances in analysis & test building blocks
- Statistical significance
- Environmental effects
- Manufacturing integration

FAA and NASA
R&D is currently
active in most
of these areas



Damage Tolerance and Maintenance Practices

- Critical defects (impact & mfg.)
- Bonded structure & repair issues
- Fatigue & damage considerations
- Life assessment (tests & analyses)
- Accelerated testing
- NDI damage metrics/service POD
- Equivalent levels of safety
- Training standards

Bonded Joint
Processing Issues

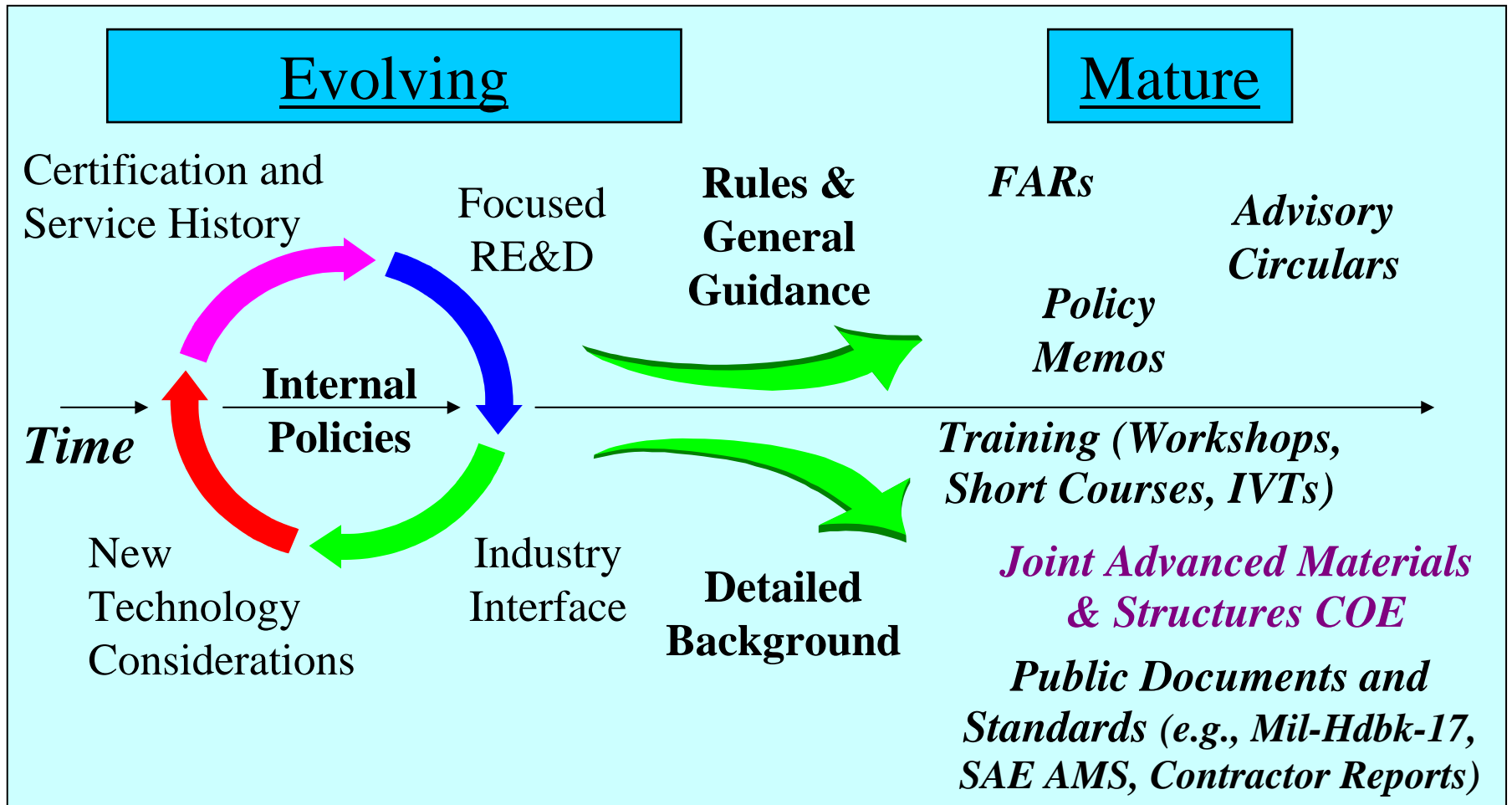
Advanced Material
Forms and
Processes

Flammability &
Crashworthiness

*Support from cabin
safety research groups*

Significant progress, which has relevance to all aircraft products, has been gained to date

FAA Approach to Composite Safety and Certification Initiatives



Important Teammates

- NASA has been a leader for composite applications
 - Significant research support since 1970/1980s
 - AA587, A300-600 accident investigation
 - NCAMP support to material standardization
- Partnerships with industry have been essential, e.g., Mil-17, SAE P-17, CACRC, ASTM, SAMPE, AGATE, SATS, RITA, SAS/IAB/AACE

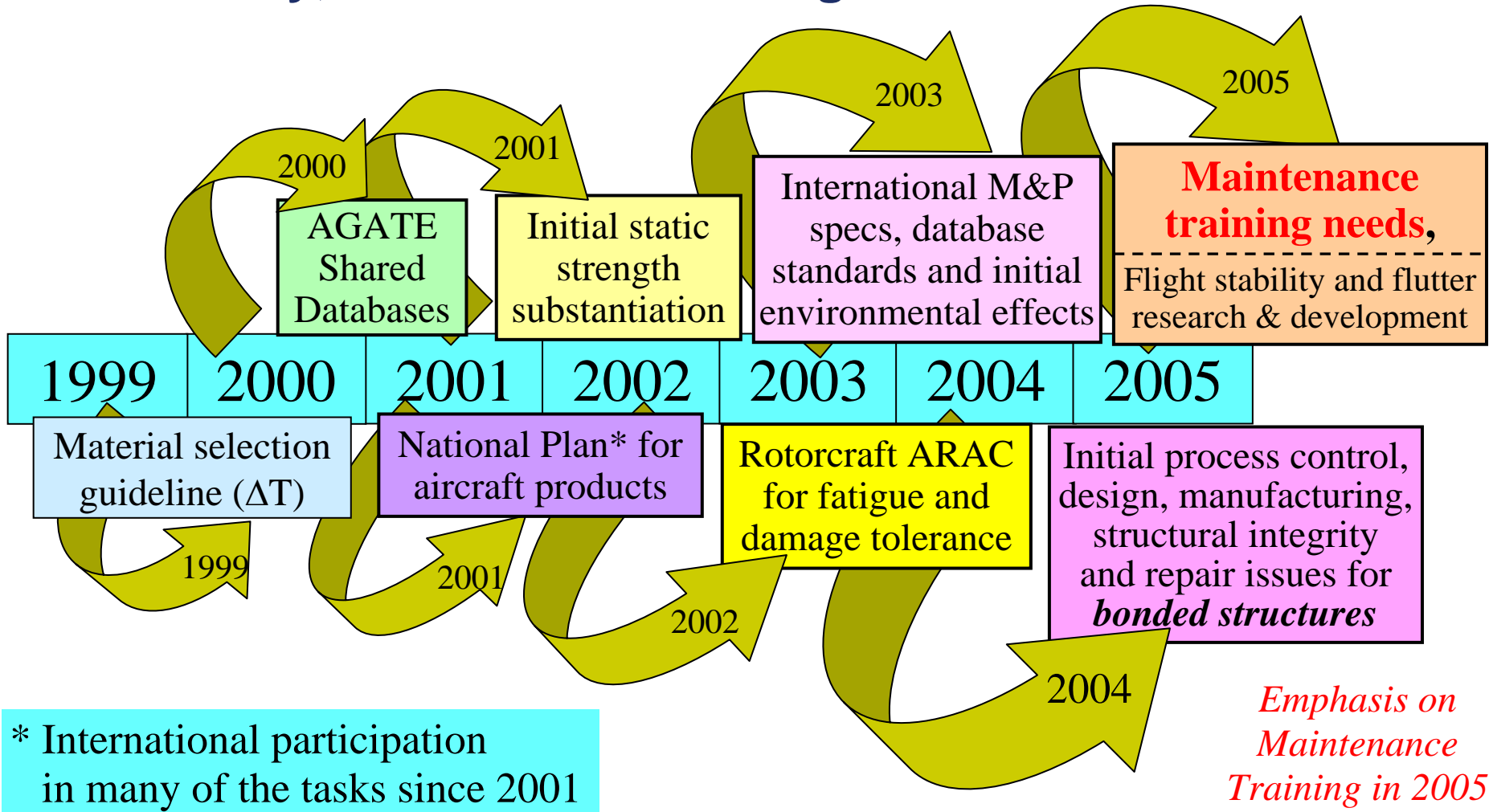


Training
Databases
Standardization
Engineering guidelines

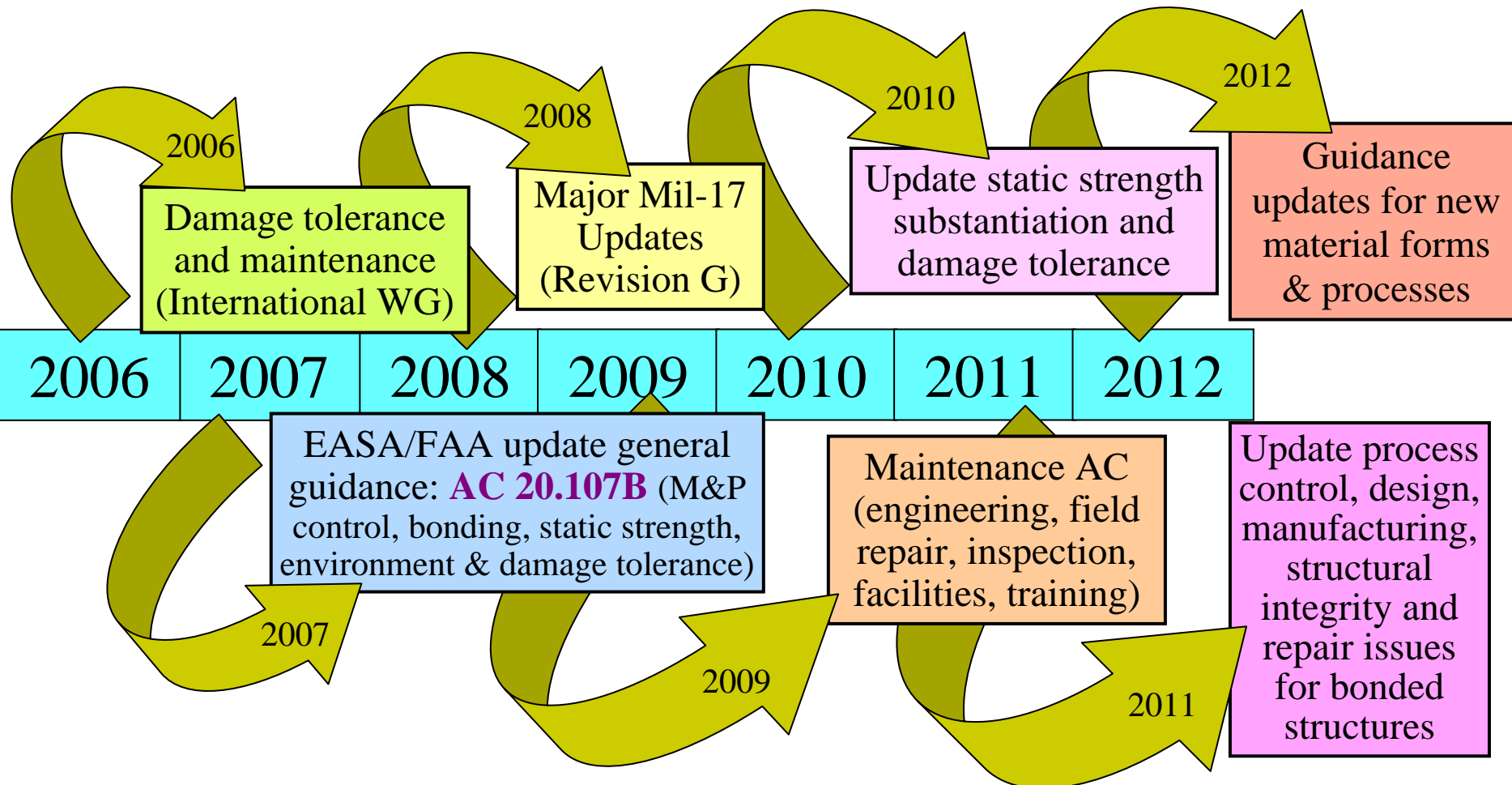


- DOD and DARPA research
- EASA and other foreign research/standardization
- Joint Advanced Materials & Structures Center of Excellence

Milestones for Composite Safety and Certification Policy, Guidance & Training



Milestones for Composite Safety and Certification Policy, Guidance & Training



2004 Bonded Structures Initiative

Justification and Purpose

- Bonding applications for the manufacture & repair of aircraft structures exist throughout the industry
 - New applications are expanding faster than the qualified workforce, making documentation and training a priority
- Technical issues are complex and cross-functional, requiring extensive teamwork for successful applications
 - Known production and service bonding problems highlight a need to properly document the associated technical issues

Collectively, the industry and regulatory agencies should be able to combine our bonding experiences and technical insights to the mutual benefits of improved safety and efficiency in development & certification

2004 Bonded Structure Initiative

Objectives for 6/04 Workshop & Follow-on Report(s)

Primary objective

Collect & document technical details that need to be addressed for bonded structures, including critical safety issues and certification considerations

Secondary objectives

- 1) Give examples of proven engineering practices*
- 2) Identify needs for engineering guidelines, shared databases and standard tests & specs*
- 3) Provide directions for research and development*

Presentations at <http://www.niar.wichita.edu/faa/>

Technical Scope of the Bonded Structures Workshop

Material &
Process
Qualification
and Control

Regulatory Considerations

- Proof of structure: static strength
- Fatigue and damage tolerance
- Design and construction
- Materials and workmanship
- Durability
- Material strength properties & design values
- Production quality control
- Instructions for continued airworthiness
- Maintenance and repair

*General aviation, rotorcraft
and transport aircraft*

Design
Development
and Structural
Substantiation

*Commercial
and military
applications
were reviewed*

Repair
Implementation
and Experience

*Bonding
applications
where at least
one side of the
joint is metal or
pre-cured composite*

Manufacturing
Implementation
and Experience

Small Airplane Directorate Policy for Bonded Joints & Structures



U.S. Department
of Transportation

Federal Aviation
Administration

Memorandum

*Posted to Federal Registrar for
public comments in April, 2005*

Subject: **INFORMATION:** Bonded Joints and Structures -
Technical Issues and Certification Considerations;
PS-ACE100-2005-10038

Date: *Released to Federal
Registrar in September, 2005*

From: Acting Manager, Small Airplane Directorate,
ACE-100

Reply to
Attn. of: Lester Cheng; 316-946-4111

To: See Distribution

Purpose

1. To review the critical safety/technical issues
2. To highlight some of the successful engineering practices employed in the industry
3. To present regulatory requirements and certification considerations pertinent to bonded structures



Future FAA Plans for Bonded Structures Initiatives

- Draft FAA Technical Center Reports (2005 & 2006)

**“Assessment of Industry Practices for Aircraft Bonded Joints and Structures”
2005 FAA research report is available at <http://actlibrary.tc.faa.gov/>**

- Primary content: information collected on bonding issues critical to safety & certification (before/during/after workshops)
- Secondary content: Give examples of proven engineering practice, future R&D directions and standards support needs
- Publicly release reports for purposes of training, coordination and standardization
- Continue to work on composite safety and certification initiatives related to bonded structures
 - Future advisory circular and updates to policy
 - Establish training through JAMS COE

2004 - 2006 Composite Maintenance Initiatives

- FAA research at JAMS COE
 - Continued evaluation of existing procedures with CACRC
 - Evaluate training needs and establish a standard intro course
- 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



Training Initiative: *Critical Composite Maintenance & Repair Issues*

- Practical, introductory-level course for engineers, technicians and inspectors is under development
 - 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
- 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*
 - **2006 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

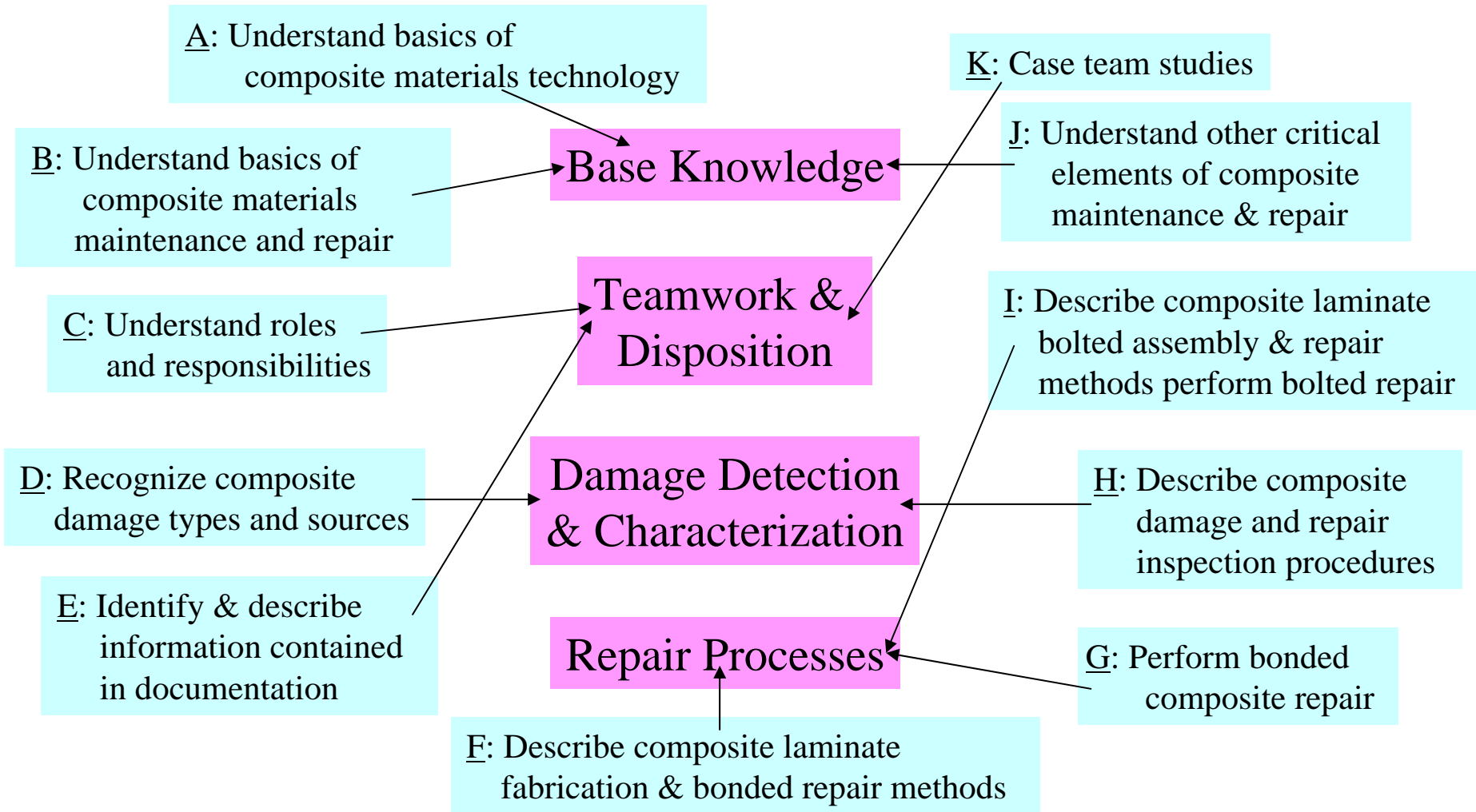
Coordinated Release
Through SAE CACRC and
FAA Technical Center

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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

TCO Broken into Key Subjects for Purpose of Overview



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

Summary

- FAA Composite Safety & Certification Initiatives (CS&CI) rely on industry support to meet needs of expanding composite applications
- FAA JAMS COE universities support CS&CI with both research and training tasks
 - Current research emphasis on bonding, damage tolerance and repair
 - Some research will be used to develop training
 - Efforts to benchmark the industry provide key technical references for practical training
- Recent CS&CI progress provides a basis for training in key areas
 - 2005 Bonded Joints & Structures policy and detailed background provide a basis for training
 - Ongoing efforts at Edmonds C.C. are scheduled to provide industry training standards on critical maintenance & repair issues in 2006

