

# TERMINAL COURSE OBJECTIVES (TCOs)

## September, 2005

### General Comments:

- *How will TCO's be incorporated?* Rule making is a long-term process, but there's a short term need in this area that can only be met by policies. This class will eventually lead to a regulation describing what training is required for practitioners. There will be an FAA policy out next year describing what must be contained in courses of this nature. (per Larry I) There isn't any hard rule that says you have to take the course. Understand the need, but nobody there to make them do it! (Money based issue) Should the course be mandatory? Need to administer the policy that we have.
- *Class scope must be limited:* Modules must include only what is necessary. This class should not specify which data to be discussed. (Doug Larson) This class needs to be focused on "What you need to worry about" (Larry I) There should be a large caveat that says. "This is an overview only class." Noting that approved data must be used should be the intent of this class. Course content will be covered in different ways by different training providers. The key here is that the TCO's are covered, and that different Training Providers will achieved covering these TCO's in different ways. (Gary Oakes) Consensus needs to be developed and this course could aid in developing consensus.
- *Identify roles relative to target audience:* (Engineering staff, quality control staff – fundamentally decide the definition of target audience.

*Enlarge the scope of the audience (fixed base operation – repair station, buyers, receiving personnel, management).*

- *How to enact these TCO's at Training Providers:* How will the content of this course be incorporated by the Training Providers if they aren't forced to by the FAA? Angie K suggested that practitioners may want to take the class voluntarily. Tim H said practitioners won't spend money for training unless forced to. The new 145 rule requires training per Rusty Jones(?), which is approved by PMI.

*Don't feel urgency. FAA solve by developing policy. First - technical document develop lesson plan ; 207 work with flight standard to generate policy and procedure.*

- *Written Text may need an iteration:* Orient written material into supporting paragraphs that detail each specific point being made. Photographs may be valuable in conveying ideas. **Be careful not to use contradictory terms.** Terminology – be specific, more universal.

# TCO D Module – Recognize Composite Damage Types and Sources

## General Comments:

- *Content Readability:* Flow of sub-modules could be improved
- *Module Depth:* Is there too much depth in certain areas of module? (SRM)

## D1: Identify Sources and Characteristics of Damage to Composite Sandwich and Laminate Stiffened Structures

- *Other Players who need to know:* How will the composites message be transmitted to the wider aircraft operational community (i.e. pilots, baggage handlers, fuelers, cargo handlers, etc)

*Larry Coulter's USAF video, and potentially CACRC video*

- Clarify process allowed anomalies vs. anomalies requiring Material Review Board (MRB) review/

*Compare to acceptable damage limits.*

*Acceptable Process variations (handled by MRB) occur during fabrication and can be expected to be discovered in service*

- Clarify the liaison process, its regulatory basis, and the regulatory relationship

*Tied with MRB board discussion*

- Add discussion regarding the FARs on lightning strike and HIRF

*Look for references for this information*

- Clarify the current electrical property differences between metallics and composites

*Combine with previous comment*

- Missed damage introduced during paint stripping either by mechanical or chemical means

*Refer to Keith Armstrong's presentation. Add brief discussion here.*

- Describe indicators/issues with heat damage detection

*Paint discoloration; there may be damage beyond what you can see. Do you look beyond if there is no visual damage? Not without a recorded event.*

*Map with tap tester or instrumented NDI and compare to ADLs. Total damage difficult to assess, may have to cut away*

## D2: Describe Damage Types and their Significance to Structural Integrity

- Describe the general philosophical approach to the design of composite primary structure (i.e. BVID-VID-Discrete Source)

*Add short high-level discussion. Could drive MPD*

- Discussion of matrix cracking appears too detailed for a maintenance level discussion

*Amend.*

- Delete in-depth discussion of relationship between matrix cracking and potential subsequent finish cracking

*May be deleted or combine with above comment? Check with Larry to understand Kevlar/paint cracking problem.*

### **D3: Understand the information and analysis necessary for repair design and process development/substantiation**

- *Engineer Qualifications?:* Is a B.S. in engineering technology or similar a must?

*Or equivalent*

- *OEM's Repair Designs:* Repair cannot be designed outside of the OEM

*Proper knowledge of lay-up or structural details is necessary to design repairs*

*Maybe some words to discuss reverse engineering*

- *Is an SRM Needed for course Content:* How important is SRM experience? (can we make a generic without proprietary issues) Yes, there is a need understand the process of SRM usage. May only need to make reference to SRM, not actually use it in class. Recognition that SRM is a pre-repair document, determine how covered beyond this point. SRM is a limited document.

*Use SRM as an example of approved repair documentation/GA airplanes*

- *Could alternatives to an SRM be Used?:* You have generic procedures that can be used without using a proprietary SRM, and confer to ATA 100 standard. Others say this is not a huge problem.

*AMM/CMM/ Engine manual*

- Clarify the regulatory relationship vis-à-vis acceptance and approval of repairs (repair will be inspected by an authorized maintenance organization inspector, not by a regulatory agency or DER)

*OK*

- Add discussion of the CACRC Analytical Repair Techniques T/G document as a method for validation of a repair

*Add in this section*

- Add discussion on purchasing of repair materials (i.e. approved sources, purchaser quality control, etc). See AC 145-6

*Add some words from AC 145-6.*

### **D4: Distinguish differences in repair disposition procedures for those damages covered by source documentation, and those that aren't**

- Paragraph 3 is very awkward and needs a complete re-write to clarify the classification of repair as a function of a repair materials exhibited durability and mechanical properties-not cure temperature or the structure it is being applied to.

*Need to adjust for Gary*

### **D5: Describe the regulatory approval process for damages not covered by source documentation**

- *MRB vs Field Disposition:* There are two different processes held between MRB and Airline disposition

*Save as separate comment for possible inclusion into other module/delete.*

- Add discussion on damage tolerance requirements on repairs to Principal Structural Elements

*Delete, discussed in module C. Add comment about metal patch to discussion in C.*

## **TCO H Module – Describe Composite Damage and Repair Inspection Procedures**

### **General Comments:**

- *NDI can't guarantee Bondline Integrity:* NDT and NDI have its limitations. See other aspect of QC being ignored. See on both sides where they are being ignored (H1 – discussion of what you can and can't find)

*Add some words about importance of QC in H3*

Grammatical: Change i.e. to e.g on module H2

*OK*

### **H1: Describe NDI techniques currently available in the field**

- *Content may be too vague:* Too general and vague with regards to OEM inspection-more specifics needed here on the relationship between OEM production NDT techniques and in-service NDT techniques

*Reference CACRC Inspector Handbook and Mil-17 for more detail. Add table from Mil-17 handbook. Sandia Labs report by Dennis Roach.*

- *Moisture Meters Aren't Used:* Refine discussion on moisture meter-applications are incorrect, technology has been supplanted by thermography (digital and liquid crystal)-Describe thermographic techniques

*Include up-to-date technology replacing moisture meters. Check with Curt Davies about blotters and ohm meters to check for moisture*

- *CACRC NDI calibration standards:* Add discussion about CACRC developed NDI calibration standards

*Standards are required for accurate interpretation of NDI readouts.*

- *Add following NDI techniques:*
  - UT Resonance
  - Rapid Image Based NDI (MAUS, etc)

*Air coupled TTU*

*Instrumented tap testers*

*Navy have banned use of tap test do to technicians causing more damage*

*Add some discussion about extending NDI inspection away from damage to check for potential associated anomalies that might complicate a repair*

*Add references for CACRC Inspectors Handbook and SAE document*

*Add MIL HNDB-17 table for advantages and limitations and maybe reduce the descriptions of inspection methods*

*Add some discussion (or reference) role of engineers from CACRC in Module C*

**H2: Describe critical steps necessary for making damage dispositions, including inspection and a draft process for QC plan for repair**

- *QC Process is Linked to FAA:* Emphasize the key link in validating bonded repairs; is the QC process in relationship to FAA approved repair data (i.e. SRM)

*Appropriate regulatory agency (not just FAA). Consistency on detailed information versus general information for QC plans.*

- *Correct Documentation of Aircraft Release Process:* Clarify and remove inconsistencies between described processes and regulatory requirements for A/C release

*Recommended (not required) to have release (QC) plan as per approved maintenance organizations operational plan (Paragraph one of H2) Consistent verbiage among modules.*

- *Revise Leak Check Process:* Add leak check requirement and rectification process (not bag removal) to QC plan for repair

*OK*

**H3: Describe the critical steps necessary for inspecting a completed bonded repair, including NDI and interpretation of results**

- Emphasize that inspection and interpretation of results must be done in accordance with ~~OEM SRM~~ Approved Repair Documentation and NDT manuals using approved standards.
- Inspection for conductivity/grounding for lightning strike protection

*OK*

*Add discussion concerning check for clearances and balance as required*

**H4: [LAB #2]: Demonstate, and have students perform various damage assessments, including visual inspection, tap test and ultrasonic inspection**

*Add video showing field use of inspection techniques*

**H5: [LAB #4]: Demonstrate, and have students perform various post-repair acceptance inspections, including visual inspection, tap test and ultrasonic inspection**