



Teamwork and Disposition

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The Joint Advanced Materials and Structures Center of Excellence



Teamwork and Disposition



- **Understand Roles and Responsibilities (Module C)**
- **Identify and Describe Information Contained in Documentation (Module E)**
- **Team Case Studies (Module K)**



Teamwork and Disposition



- **Understand Roles and Responsibilities (Module C)**

- **C1:** Understand the steps required in repair design, process planning, inspection and approval
- **C2:** Describe the steps in composite bonded and bolted repair processes, including details of damage removal through repair completion and approval
- **C3:** List the basic NDI methods with their limitations, including damage assessment and post-repair inspection
- **C4:** Distinguish between skills needed for inspectors, engineers and technicians concerned with composite maintenance and repair
- **C5:** Know your skills limits and who to go to for help



Understand Roles and Responsibilities (Module C)



C1: Understand the steps required in repair design, process planning, inspection and approval

- *Repair design*
 - Qualified engineering personnel must use approved information and data to design repairs
 - the intent of permanent repairs to structural components is to restore the original component strength and stiffness
- *Repair process and inspection planning*
 - When damages are detected, the instructions within the approved repair documentation must be strictly followed



Understand Roles and Responsibilities



C2: Describe the steps in composite bonded and bolted repair processes, including details of damage removal through repair completion and approval

- Damage detection and assessment
- Compare damage to SRM ADLs and RDLs
- Damage cleanup or removal and surface preparation
- Repair materials preparation
- Repair processing, bonded and bolted
- In-process QC plan
- Repair inspection and approval procedure
- Component surface protection restoration



Understand Roles and Responsibilities



C3: List the basic NDI methods with their limitations, including damage assessment and post-repair Inspection

- Visual inspection
- Tap test
- Ultrasonic inspection, TTU and P/E
- X-ray
- Eddy current
- Thermography
- Bond testers
- Moisture meters
- Interferometry



Understand Roles and Responsibilities



C4: Distinguish between skills needed for inspectors, engineers and technicians concerned with composite maintenance and repair

Engineers, inspectors and technicians have differing training needs and skills

– **Structures engineer**

- Academic training in mechanical or aerospace engineering
- Formal training and experience in analysis of composite aircraft structures
- Detailed knowledge of aircraft structural components, source and regulatory documents

– **Inspector**

- Formal training in the use of a variety of inspection techniques
- Good eyesight and hearing
- Detailed knowledge of aircraft structural components, SRM, NDI and MPD documents



Understand Roles and Responsibilities



C4: Distinguish between skills needed for inspectors, engineers and technicians concerned with composite maintenance and repair (cont'd)

- **Repair technician**

- Formal training in repair processing and in the use of repair equipment
- Good hand-eye coordination
- Familiar with OEM drawing systems and SRM
- Detailed knowledge of aircraft structural components



Understand Roles and Responsibilities



C5: Know your skills limits and who to go to for help

- ***Ramp –v- maintenance depot***
 - **Availability of approved repair documentation**
 - SRM, MPD and regulatory documents
 - **Qualified personnel availability**
 - **Inspectors**
 - Trained in use of NDI equipment
 - **Repair technicians**
 - Trained to perform proper repair processing
 - **Maintenance engineering**
 - Detailed knowledge of regulatory and source documents
 - Capable of structural analysis



Understand Roles and Responsibilities



Safety Message

All aspects of composite maintenance and repair are interlinked:

- 1) The damage to a composite aircraft component must be first discovered (if discovered by operations personnel, it must be reported to maintenance)
- 2) The damage must be assessed by qualified maintenance personnel
- 3) Damage disposition must include an interface with engineering personnel familiar with approved data for the structure in question
- 4) If repair is necessary, the repair design must be approved by the appropriate authority (previously approved data such as may be documented in a SRM or other approved repair method)



Understand Roles and Responsibilities



Safety Message (cont'd)

- 5) The chosen repair method must also be of an approved type (previously approved data such as may be documented in a SRM or FAA DER)
- 6) The approved repair process must be performed by a qualified technician, using qualified materials, and strictly adhering to the appropriate in-process controls
- 7) The completed repair must be inspected for approval by a qualified inspector

If any of the above maintenance actions contain errors or flaws, then a deficient repair may result. It is essential for safety that qualified inspectors, technicians and engineers are involved in composite maintenance and repair.



Teamwork and Disposition



- **Identify and Describe Information Contained in Documentation (Module E)**
 - **E1:** Describe requirements in material and process specifications and approved repair information
 - **E2:** Demonstrate the use of source documents
 - **E3:** Identify and demonstrate use of regulatory documents
 - **E4:** Understand the requirements and engineering approvals necessary for valid sources of technical information and maintenance instructions



Identify and Describe Information Contained in Documentation (Module E)



E1: Describe requirements in material and process specifications and approved repair information

- *Material and process specifications*
 - Sufficient research and testing has been done to establish repeatable material characteristics such as workability, shelf-life, out-time, bonding compatibility, and guaranteed strength and stiffness.
- *Approved repair information*
 - **SRM:** Component information, ADLs, repair options, repair process instructions
 - **Other sources of approved information:** Internal operator repair schemes, previous OEM or DER approved repairs



Identify and Describe Information Contained in Documentation



E2: Demonstrate the use of source documents

- ***Service bulletins***
 - OEM transmittal of important information
- ***Service newsletters***
 - OEM transmittal of advice and/or troubleshooting
- ***Maintenance planning data (MPD) document***
 - Issued by OEMs to operators and MROs to provide specific inspection requirements and overhaul instructions
- ***Structural repair manual (SRM)***
 - Issued and maintained by an OEM, the SRM is the source document that is consulted when damage to a structural component is discovered



Demonstrate the use of source documents



E3: Identify and demonstrate use of regulatory documents

- *Federal Airworthiness Regulations (FARs)*
 - US airworthiness regulation documents
 - FAR, Part 145 Repair station certification requirements
 - FAR, Part 43 Maintenance, rebuilding and alterations
- *Joint Airworthiness Regulations (JARs)*
 - Joint European airworthiness regulation documents
 - Similar to FARs
- *Advisory Circulars (ACs)*
 - AC 20-107A “Composite Aircraft Structure”
 - AC 145-6 “Repair Stations for composite and Bonded Aircraft Structures”
- *Airworthiness Directives (ADs)*
 - E.g. AD 2002-07-08, inspection of specific aircraft structure for cracking



Demonstrate the use of source documents



E4: Understand the requirements and engineering approvals necessary for valid sources of technical information and maintenance instructions

- *In order for the safe use of composite materials in the manufacture and repair of aircraft structural parts, the FAA and JAA require compliance with the requirements of the FAR or JAR that covers the operation of each type of aircraft.*
 - Material strength properties must be based on enough tests of material meeting approved specifications to establish design values on a statistical basis
 - When repair procedures are provided in FAA approved documents or the maintenance manual, it should be demonstrated by analysis and test that methods and techniques of repair will restore the structure to an airworthy condition



Identify and Describe Information Contained in Documentation



Safety Message

The approved sources of technical data, maintenance and repair instructions, guidelines and regulatory requirements contain information vital to proper aircraft maintenance and repair.

It is essential to be familiar with the specific aircraft structure drawing system and approved maintenance methods for the particular component in question.

The use of inappropriate or unapproved maintenance instructions for a given part, including inspection and repair processes or alternate repair materials used on other structures, is not allowed.



Identify and Describe Information Contained in Documentation



Safety Message (Cont'd)

While it is not included in the roles of inspectors and technicians to be fully cognizant with the FARs, ACs and ADs, it is appropriate that all members of the repair team be aware that these regulatory requirements exist and are understood by at least one person in the repair process.

Any lack of understanding of the structural detail, or deviation from the approved data, maintenance and repair instructions or regulatory requirements can lead to unacceptable maintenance procedures and a defective repair.



Teamwork and Disposition



- **Team Case Studies-Laboratory (Module K)**

- **K1:** Identify the structural component and understand the specific configuration and materials used for fabrication of the damaged component.
- **K2:** Perform a damage assessment and map the damage as accurately as possible using visual inspection, the tap test or P/E ultrasonic equipment
- **K3:** Interrogate the SRM to understand the component allowable damage limits, and review any repair options contained in the SRM based on the mapped damage
- **K4:** Write an appropriate repair procedure and in-process QC plan based on the chosen repair option.
- **K5:** Write an appropriate post-repair inspection and approval plan



Team Case Studies



K1: Identify the structural component and understand the specific configuration and materials used for fabrication of the damaged component.

- Identify the damaged component in the SRM: elevator, flap track “canoe” fairing
- Component construction: sandwich or stiffened laminate
- Materials used in construction: CFRP or GFRP face sheets and laminate, Aramid core
- Proximity of damage to design details: core ramp, sandwich edge band, fasteners, substructure
- Previous component maintenance activities: previous repairs, etc.



Team Case Studies



K2: Perform a damage assessment and map the damage as accurately as possible using visual inspection, the tap test or P/E ultrasonic equipment

- Visual inspection for damage detection (use flashlight for enhancement)
- Tap test or P/E inspection to map the extent of the damage
- Inspect both sides of the component and any adjacent structure, e.g. stringer or rib attachment



Team Case Studies



K3: Interrogate the SRM to understand the component allowable damage limits, and review any repair options contained in the SRM based on the mapped damage

- Allowable damage limits (ADLs)
- Critical areas of components (e.g. restricted repairs)
- Repair options and repair damage limits (RDLs)
- Specific repair details, including repair ply layup (if bonded repair selected), fasteners and repair plate required (if bolted repair selected)



Team Case Studies



K4: Write an appropriate repair procedure and in-process QC plan based on the chosen repair option

- *Consult the specific SRM section for details of:*
 - Damage removal
 - Surface preparation
 - Preparation of repair materials and equipment
 - Replacement plies and film adhesive stack and lay-down sequence (if bonded repair)
 - Drill fastener holes in repair plate and damaged part (if bolted repair)
 - repair processing and in-process QC



Team Case Studies



K5: Write an appropriate post-repair inspection and approval plan

- *Consult the specific SRM section for detailed instructions:*
 - A review in-process QC printout of cure vacuum and temperature profiles
 - List post-repair inspection techniques to be used
 - Write down procedure if an unacceptable defect is detected
 - In the event of an acceptable repair, write down the restoration to service procedure