TCO K [LAB #6] Module – Case Team Studies

Laboratory equipment
Various damaged configured composite panels
Data book containing component information, component master work sheet, and SRM data for each damaged panel
Marker pens
Flash light
Tap hammer
P/E ultra sonic equipment
Work sheets for recording repair disposition, repair process and in-process Q.C. plan, and post-repair approval plan

Introduction

This is the final laboratory of the training course. This is an opportunity for the students to have the chance to show what they have learned from the preceding modules. The class will be divided up into teams of 3 students each to make repair dispositions, and prepare repair processing plans for damaged configured composite panels. In each team, one student will assume the duties of the “Maintenance Engineer,” another will act as the “Inspector,” and the third student will assume the role of the “Repair Technician.”

In the previous laboratories (Labs #3-5), the demonstrations and hands-on work were performed on simple carbon laminate coupons. In this laboratory, students will be faced with performing repair dispositions (up to the point of actually performing any actual surface preparation, damage cleanup and repair processing) on configured structural composite panels. The repair options will include a bolted repair for a damaged stiffened laminate panel. One student team will be faced with sufficient damage to a laminate stiffened panel that will require a bolted repair. Each member of the teams is expected to contribute to the complete assignment, i.e. damage assessment, repair disposition and repair plan.

The intent of this module is to show the students that the “real world” of aircraft component maintenance is complex and repair dispositions to actual aircraft composite parts can be quite complicated. Instead of assessing damage and performing repair dispositions on flat panels, the students will be faced with parts that are of complex construction with curvature and varying details. One major difference faced by the “real world” maintenance personnel is that many parts must remain on the aircraft due to difficulties of removal (e.g. a laminate stiffened stabilizer main torque-box skin panel or a fuselage skin panel). This complication will be missing from this training course for obvious reasons, but a video presenting examples of field repairs will be shown to the students so that they can get a feel for actual aircraft maintenance repair practices. The students will also get a feel for the need of good team coordination, clear, precise process instructions, and the need to provide written records of the specific damages, and repairs performed.

Various damaged configured composite panels of both sandwich and stiffened laminate construction will be provided for the laboratory. These panels are from stockpiles of scrapped or rejected parts kindly donated by an OEM. The reasons for their rejection by the OEM are not the issue for this laboratory; the panels will contain damage that was deliberately inflicted for the purposes of this Case Team Studies Laboratory #6.

Source information and data will be provided. This information and data will include the component descriptions, locations on the aircraft, component configurations, materials and basic construction details. In addition, allowable damage limit data and a set of repair options with step by step repair instructions will be provided for each damaged panel. This data will be in the form of SRM information kindly donated by the OEM which provided the laboratory parts. This data will be not be provided in separate sets for each team, but in the form of a loose leaved book for the whole class. It is expected that the students will pick out the data that pertains to their team's damaged component. Also included in the data book for each damaged component is the Component Master Worksheet. This document is described in TCO C1, and the information that must be understood from this document can be found there.

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Each "repair team" will perform a damage assessment, a repair disposition, prepare repair and in-process QC plans, and prepare a post-repair approval plan to deal with the damage and intended repair of their specific panel. All of the panels will either be of a differing configuration or contain differing degrees of damage. It is expected that the students will refer to the information provided in preceding modules for their damage assessments and repair dispositions and plans. The modules which they will be able to find specific information in are as follows:

a) TCO C Module, Understand Roles and Responsibilities
b) TCO D, Recognize Composite Damage Types and Sources
c) TCO E, Identify and Describe Information Contained in Documentation
d) TCO F, Describe Composite Laminate Fabrication and Bonded Repair Methods
e) TCO G, Perform a Bonded Composite Repair
f) TCO H, Describe Composite Damage and Repair Inspection Procedures
g) TCO I, Describe Composite Laminate Bolted Assembly and Repair Methods

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

Each student repair team will identify the component, location on the aircraft, component construction and details of materials used. They are expected to select, from the laboratory data book, the correct data for the damaged component provided for their team. They are expected to understand the proximity of the damage to details such as core ramps and stringers and the implications that any close proximity might bring about.

All members of each team are expected to understand the component configuration and construction details including materials used (e.g. sandwich face sheets and core, or stiffened laminate layups, and adjacent sub-structure such as a stringer or a rib).

The "maintenance engineer" must determine from the provided component master work sheets if previous maintenance or repairs might complicate any new repair to the damaged area.

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

The designated "technician" must first visually discover the damage on the exterior surface of the damaged panel allocated to his team. He will utilize a flash light to enhance his visual detection capability. He should assess and mark the extent of the damage. He will also examine the backside of the component to determine if there is any through penetration or damage to any substructure. He will provide his findings to the designated "inspector" for a more complete damage assessment.

The designated "inspector" will first interrogate the source documentation for any specific inspection procedure required for inspection of the component. He will then re-assess and map the extent of the damage. He is expected to use a tap test and/or an instrumented NDI procedure. He is expected to utilize the P/E ultra sonic equipment, but a tap test method may be used if the source documentation allows this method. When using the P/E equipment he is expected to first understand what signals undamaged structure will return before mapping the extent of the damage. The provided source documentation may allow a tap test if it has been shown that a defect or damage that is less than or equal to the component maximum allowable damage size can be reliably found. He will examine both sides of the component to fully understand the extent of the damage. He will map the extent of the damage and report his findings to the designated maintenance engineer.

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

The designated "maintenance engineer" is expected to consult the specific SRM information to determine if the damage is within the allowable damage limits for the component. He is expected to determine if the damage is within any designated critical area of the component. If the damage is determined to be beyond the allowable damage limits for the component, he is expected to choose an approved permanent repair from the provided SRM data to restore the component stiffness and strength. He will consult the repair damage size limits contained in the SRM data to ensure that the repair is appropriate for the damage present. He will communicate his repair disposition to the designated "technician" with written instructions.

If his selection is for a bonded repair, he will ensure that the “technician” has the correct repair layup instructions for the approved repair so that the component strength and stiffness can be restored with a well executed repair. He will list the orientation of each ply and the order in which they are to be laid down.

If he selects a bolted repair, he will list the appropriate repair plate required (e.g. material, thickness and dimensions) and fastener details (e.g. sizes, grip lengths). He will provide the “technician” with a diagram of the fastener pattern to be used. All of this information is either in the data book provided for the laboratory, or from the previous modules.

The “maintenance engineer” is expected to record the damage details and repair disposition in the component master work sheet for the specific component.

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

The designated “technician” is expected to write down an appropriate repair procedure for the chosen repair. He is expected to consult the appropriate SRM information for the specific component repair instructions.

If a bonded repair has been chosen by the “maintenance engineer”, he is expected to list details of moisture removal, surface preparation, damage removal including ply scarf machining and core cutting (if applicable), and preparation of repair materials. He is also expected to list the safety equipment required.

If the repair disposition is for a bolted repair, He will list the process steps and special equipment (e.g. drill bits, reamer type and size, and backing plate, safety equipment, etc.) necessary for such a repair. He will list details of surface preparation, protruding damage removal, hole drilling and fastener installation.

For either type of repair, he is expected to write down his repair process plan together with the required in-process quality control plan on the provided work sheet.

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

The designated “inspector” is expected to understand the need to check the in-process repair quality control data that should be provided to him after a bonded or bolted repair. He will write a post-repair inspection and approval plan assuming that a repair has been performed. He is expected to refer to the module information that pertains to this subject. He is expected to list the in-process quality control information that would be recorded to ensure knowledge of an actual repair. He will record details of ply layup and dimensions, debulk cycle (if used), cure cycle with details of vacuum and temperature profiles, and fasteners (types, size, grip lengths and fastener patterns) and repair plates (material type and dimensions) if the repair was a bolted one. He will list the inspection techniques to

be used to determine the adequacy of a repair of the damaged component. He will be expected to understand the limits of each of the inspection techniques available to him, and he must write these limitations down.
The “inspector” is expected to understand what procedure must be followed in the event of him detecting an anomaly in the repair.

In the event that the repair is found to be acceptable, the “technician” is expected to write down, in the provided work sheet, the procedure that is necessary to restore the repaired component to service. He is expected to consult the provided data book for the restoration instructions.