Course R-DVD
Double Vacuum Debulk Repair

Course Summary

The 5-day DVD repair course is designed as a direct follow-on to our R-2 course for repair designers, technicians, mechanics, supervisors, and quality assurance personnel directly involved in providing high performance repairs to advanced composite structures. Multiple DVD methods are demonstrated in class and some panels will be tested using short beam shear (SBS) testing to evaluate the interlaminar shear strength (ILSS) of coupons.

Introduction

The Double Vacuum Debulk (DVD) process is a specialized repair process developed by the U.S. Navy and adopted by OEMs and military organizations for use in structural repairs to highly loaded structures. The DVD process provides a low-void, well consolidated repair patch, achieved in an out of autoclave (OoA) process. (Organizations operating new-generation Boeing equipment may require DVD repairs.)

Three methods of DVD repair processing will be covered are:

1.Method 1 - Precure a repair patch and secondary bond it to a flat part.

2.Method 2 – Gel-stage a repair patch laminate against a contoured surface followed by a free-standing post cure, then secondary bond the repair patch to a contoured part.

3.Method 3 – Cobond patch to contoured feature.This method is used to simultaneously cure the laminate and adhesive bond it to the part surface.

In addition to employing the DVD laminates using three different repair methods, the class participants will fabricate carbon fiber laminate specimens for testing in accordance with (IAW) ASTM D5687M and conduct Short Beam Shear Strength testing of DVD laminate specimens IAW ASTM D2344M.

Topics

Key Lecture Topics:

- Review of advanced composite materials: fibers: dry cloth and wet resins vs. prepregs, weave/styles, etc.
- Resin/adhesive systems: thermosets vs. thermoplastics, mix ratios, viscosity, service temperature limits, cold storage requirements/shelf-life limits, pot life, etc.
- Review of adhesive bonding methods and practices.
- Background and evolution of the DVD process.
- B-staging composite repair laminates using DVD.
- Comparisons of different OEM requirements for DVD repair processing.
- Resin selection for the DVD process (liquid resin and dry fabric vs prepreg materials).
- Equipment Required to Perform the DVD process.
- ASTM D5687M Standard Guide for Preparation of Flat Composite Panels with Processing Guidelines for Specimen Preparation.
- ASTM D2344M Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates.
- Comparison of ILSS of DVD and non-DVD laminates tested using SBS methods.
- Methods of repair utilizing DVD laminates. Three methods of repair will be covered.

Workshop Exercises:

- Fabricate two 9.0 x 9.0-inch square panels IAW ASTM D5687M. One panel will be processed in the DVD chamber and the other will be processed using vacuum bag only (VBO) oven processing. SBS test coupons will be created from both panels.
- Fabricate a five-ply repair patch and process it in the DVD chamber. Precure the DVD laminate to a flat surface and use the precured DVD laminate in a secondary bonded repair to a flat panel.
- Fabricate a five-ply repair patch and process it in the DVD chamber. Prepare a contoured repair area for release. Gel-stage the laminate to the contoured area, followed by a free-standing oven post cure of the DVD laminate. Use post-cured DVD repair patch to secondary bond to a contoured part.

- Fabricate a five-ply repair patch, process in the DVD chamber, use uncured DVD repair patch in a Co-Cured repair to a contoured surface.

- Fabricate (cut) test coupons from 9 ply laminates made on day one. Test coupons will be created from both DVD and non-DVD processed panels.

· Conduct Interlaminar strength test IAW ASTM D2344M on SBS coupons.

Course Benefits

The students will receive a thorough understanding of, and ability to perform the Double Vacuum Debulk process. This is a repair process that has seen increased adoption though all areas of aerospace, both commercial and military.

Prerequisites

M-1/R-1 Advanced Composite Structures: Fabrication and Damage Repair, Phase 1

and

R-2 Advanced Composite Structures: Fabrication and Damage Repair, Phase 2

Teaching Method

Active classroom lecture and workshop exercises: aproximately 40% theory and 60% practical.

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