Course MQA-1
Fundamentals of Advanced Composites for Auditors

Course Summary

This course is designed for the supplier quality auditor, internal auditor, quality engineer, inspector, or any other individuals wanting to gain knowledge in advanced composite manufacturing practices and procedures. The course is designed to provide an in-depth look at how composite products are fabricated and the quality controls that go along with each step in the process.

Introduction

This course provides the student with a better understanding of advanced composite materials, processes, layup/lamination, vacuum bagging, adhesive bonding, tooling, repair, and inspection methods and techniques used in industry today. A large focus of the course is to provide the attendee with knowledge of the quality issues inherent to manufacturing advanced composite panels, components, and assemblies.

Balanced with theoretical lectures and practical workshop exercises, this course highlights many fundamental composite material control, layup, processing, and in-process inspection challenges as they might be experienced in an actual manufacturing environment. It provides the auditor a view of the details associated with each step in the composite manufacturing process and what to look for when conducting a site visit.

During the course the students will actually work with composite materials, learning firsthand about material handling characteristics, the importance of ply orientation, vacuum bagging principles, curing, and a host of other important issues that influence the quality of the end product.

Topics

Key Lecture Elements

- Introduction to advanced composite manufacturing methods and techniques; wet layup, prepreg layup, filament winding, RTM, infusion, press molding, Pultrusion, automated tape layup (ATL) and fiber placement (AFP).
- Resin/adhesive systems: thermosets vs. thermoplastics, mix ratios, viscosity, service temperature limits, cold storage requirements/shelf life limits, pot life, etc. and auditing associated records, in-transit temperature recorders, material certificates, and product storage.
- Material Forms: unidirectional tape, fabric weave/styles, multi-axial forms, etc., and auditing material defects, storage & handling, and product traceability.
- Receiving Inspection: mechanical, physical, analytical, and flammability testing and auditing test laboratories, test methods, equipment, specimen traceability, and documentation.
- Core materials: Honeycomb and foam core; machining, splicing, potting forming, etc.; and auditing storage and handling procedures; dimensional inspection, environmental monitored areas.
- Fundamentals of Fabrication: prepreg cloth handling, ply orientation, layup procedures, vacuum bagging, and auditing kit cutting, laminator techniques, knowledge of requirements, work instructions, proper use of expendable materials, and in-process inspection.
- Curing methods: oven/autoclave/hot bonder cures. Viscoelastic properties, and auditing associated cure records.
- Health and Safety Issues: proper handling, personal protection, allergic reactions, waste disposal.
- Facility requirements: controlled contamination areas (CCA); positive pressure systems, temperature and humidity recorders, particulate/dust controls, and auditing associated records, CCA maintenance, and verification of the enforcement of prohibited materials and practices in the CCA.
- Introduction to adhesive bonding technology: co-curing vs. secondary bonding, surface preparation, cleanliness, bond line thickness and clamping pressure requirements and auditing handling & storage of pre-cured details.
- Principles of Tooling: types of tools, thermal characteristics of various tooling materials. Auditing associated tooling, solvent double wipe cleaning, and application of mold release agents.
- Drilling and fastening; proper speed and feed requirements, use of mechanical and adhesively bonded fasteners.
- Digital Product Definition: firmware, software, part specific programs and auditing configuration & traceability of programs used for automated kit cutting machines, AFP/ATL machines, laser ply locators, cure, etc.
- Overview of repair design; permanent vs. temporary repairs, scarf vs. stepped vs. mechanical patch repair scenarios.
- Inspection methods & techniques: destructive and non-destructive inspection methods, defect detection, documentation, acceptable vs. unacceptable defects, defect prevention. Auditing test lab procedures.

Workshop Exercises

- Panel layup using prepreg carbon uni-tape materials; symmetric and asymmetric laminate examples.

- Sandwich panel layup, bagging and processing of CFRP-honeycomb core sandwich panels.
- Vacuum bagging using non-autoclave bleeder/breather schedules. Installation of pleats to minimize bridging in high-angle core transitions. Vacuum debulking, leak checking, and identification of other potential bagging problems.
- Oven curing; vacuum, ramp rate, soak, and cooling requirements.
- Composite repair; damage removal, scarf preparation, core and skin repair using prepreg materials and processes.
- Use of hot-bond repair equipment; demonstration of bonders, heat blankets and thermocouple placement.

Course Benefits

The attendee will gain insight into composite materials and manufacturing practices as it relates to verification of practices and procedures used to ensure supplier quality.

Prerequisites

None

Teaching Method

Active classroom lecture and workshop exercises: 55% Theory and 45% Practical

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