

AIRCRAFT COMPOSITES

MANUFACTURING

INSPECTION

REPAIR

COURSE OUTLINE: LEVEL 1- BASIC

GENERAL COMPOSITE STRUCTURAL BONDED REPAIR

ACRATS
TRAINING SERVICES

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ABOUT ACRATS

Our facility locations in the Netherlands and Singapore gives the trainee the learning experience of working in a EASA part 145 work environment. This shop environmental experience will give the trainee the opportunity to perform various tasks within the composites. Together with the instructors, who have the skills in aviation and various other industries, brings your training to the highest level. The customers satisfactory not stops after the training has been accomplished, next to the trainings we are able to help you further to optimize your shop: in tooling, shop mapping, quality processes.

CUSTOMERS

Below: A selection of our customers

Company Name	Country
Air Dolomiti	Italy
Nepal Airlines	Nepal
Yeti Airlines	Nepal
West Air Aviation	Namibia
Nigerian Navy	Nigeria
Bangladesh Navy	Bangladesh
KLM	Netherlands
TUI Fly	Netherlands
OMNI Aero taxi	Brazil
TAP	Brazil
Chili Royal Airforce	Chile
ST Aero	Singapore
Gulf Helicopters	Qatar
Air Maldives	Maldives
S7 Engineering	Russia
Silk Way Technics	Azerbaijan
SPECTO Aerospace	Netherlands
Brussel Airlines	Belgium
Sabena Aerospace	Belgium
Royal Thai Airforce	Thailand
Yakutivka Airlines	Russia
Albawings	Albania
TAM	Denmark

Company Name	Country
Atlantic Aviation Group	Ireland
Royal Dutch Airforce	Netherlands
Royal Belgian Airforce	Belgium
Mongolian Airlines	Mongolia
Fokker Techniek	Netherlands
Fokker Aerostructures	Netherlands
Singapore Airlines	Singapore
Royal Flight of Oman	Oman
Royal Police of Oman	Oman
Singapore Polytechnic	Singapore
Republic Polytechnic	Singapore
FATEC Polytechnic	Singapore
VLOC	Belgium
Kenia Airforce	Kenia
Oman Air	Oman
Execujet	Dubai
Air Maroc	Maroc
Airborne	Netherlands
Austrian Airlines	Austria
Flying Group	Belgium
GMR Aero Repair	India
Airworks	India
Widerøe	Norway

TRAININGS LOCATIONS

NETHERLANDS

Located in the South of the Netherlands, the center of the Aviation MRO.

In collaboration with the Aircraft Maintenance and Training School we provide you the best of the best Aircraft Structure Courses: Sheet Metal, Composites and Painting. ACRATS Specialized in Aircraft Structures.



SINGAPORE

Located in the hearth of Singapore.

In collaboration with Singapore Polytechnic we are providing the Advanced Composite Modules. We have created a state of the art training center in the aircraft maintenance hangar.



ON-SITE

We go wherever you are.

This training courses can be conducted by an experienced and skilled trainer at your facility. The training will be tailored to have Face-to-face answers to specific trainee questions, the content will be tailored to your organization's specific needs and practices. The classroom can be filled until it is full.



SCOPE

This basic training course has been developed to list down the required knowledge and skill requirements of a composite and/or metal bond repair technician/specialist.

This training course and the other 3 courses of the complete training course are developed accordance the **SAE AIR4938, Revision B, Revised 2017-06**.

Basic: General Composite Structure Bonded Repair curriculum, independent of the application.

Advanced: Aircraft Composite Structure Bonded Repair curriculum.

Additional: Aircraft Composite Structure Bolted Repair curriculum.

Additional: Aircraft Structure Metal-bond Repair curriculum.

This document contains ATA104 level IV curricula.

APPLICABLE DOCUMENTS

The applicable documents on this training course:

SAE Publication:

AIR4844 Composites and Metal Bonding Glossary

AIR5719 Teaching Points for an Awareness Class on "Critical Issues in Composite Maintenance and Repair"

AIR6291 Guidelines for Repair Process Evaluation of Aluminum Bonded Structure

ARP6262 Basic Composite Repair Technician Certification Standard

TEACHING LEVELS

Teaching levels have been assigned to the training course to define the knowledge, skills, and abilities participants will need to make repairs to composite and/ or metal-bond structure(s).

Level 1	Requires knowledge of general principles and includes instruction by lecture, demonstration, and discussion, but does not include practical application or development of manipulative skill
Level 2	Requires knowledge of general principles and includes instruction by lecture, demonstration, discussion, and limited practical application, but does not include development of sufficient manipulative skill to perform basic operations.
Level 3	Requires knowledge of general principles and includes instruction by lecture, demonstration, discussion, and a high degree of practical application to develop sufficient manipulative skill to accomplish return to service (normal operation). This teaching level requires hands-on skill, as well as sufficient and appropriate instructional aides to train the students to develop manipulative skills sufficient to simulate return to service mechanical skill.
Level 4	Requires knowledge of general principles and includes In-depth classroom discussion at the engineering level; high degree of detail and knowledge required, including applications of engineering analysis techniques.

BASIC - GENERAL COMPOSITE STRUCTURAL BONDED REPAIR

SCOPE

Participants who successfully complete this part 1 of this advanced composite training program are considered to be able to perform bonded composite repairs to composite structures in compliance with the manufacturers repair documentation or other acceptable repair data.

MODULE OVERVIEW

Module	Module Description	Teaching Level	Theoretical Hours	Practical Hours
1	Introduction to Composites	1	1,5	1
2	Human Factors	1	1	1
3	Reinforcement Fibers	1	1	
4	Matrix Systems	1	1	
5	Safety and Environment	1	1	
6	Pre-Impregnated Materials	1	1	
7	Adhesives	1	1	
8	Structural Design Considerations	1	1	
9	Material Handling and Storage	1	1	
10	Facilities and Equipment	1	1	
11	Vacuum Bagging	1	1	
12	Heating Devices	1	1	
13	Source Documents	1	1	
14	Protective Coatings and Finishes	1	1	
15	Repair Selection Considerations	1	1	
16	Inspection Techniques	2	1	
17	Machining of Composites	2	1	
18	Hands-on Exercises	3	1	50
19	Written Test		1	
20	Practical Assessment Logbook Evaluation		1	
Total Hours			26	50
Course Length: General Composite Structural Bonded Repair Curriculum			76 Hours	

TOPICS AND OBJECTIVES, MODULE 1-3

Module: 1	Introduction to Composites		
Duration in hour(s): 1,5	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Describe the basics of composite materials technology and their applications related to aerospace, marine, automotive, and civil, energy and consumer products. • Will discuss the merits and general failure modes of composite materials to the extent that a material properties comparison can be established between metallic and composite structures as evaluated by the instructor. 			
Topics			
Definition of Composites	Advantages/ Disadvantages	Applications	
History of Composites	Conductivity	Product Forms	

Module: 2	Human Factors		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Explain the concept of "Human Factors" to the extent that a brief explanation of the "personal minimums" and a minimum of two factors that are likely causes of accidents and incidents be given. 			
Topics			
Definition	FAA/ EASA Resources	Personal Minimums	

Module: 3	Reinforcement Fibers		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Visually recognize common composite fibers, list the properties, and associate the terms related to the fabric manufacturing process. • Describe the fiber placement levels used during manufacturing and repairing of composite structures to the extent that the fabric weaves, warp direction, and part warp clock can be referenced as evaluated by the instructor. 			
Topics			
Materials	Fiberglass	Aramid	Carbon
Ceramics	Hybrids	Forms Terminology	Filament
Strand	Tow	Yarn	Unidirectional tape
Non-Woven	Mat- Chopped	Mat- Continuous Filament	Stitched
Woven	Plain	Twill	Harness Satin
Biaxial	Triaxial	Fiber Sizing and Finishes	Balance and Symmetry
Warp Clock	Tracers	Ply Orientation	Nesting

TOPICS AND OBJECTIVES, MODULE 4-6

Module: 4	Matrix System		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • State the difference between thermoplastic and thermosetting matrix materials. • Describe the roles and limitations of matrix materials, • Describe the storage and handling requirements, • Determine and calculate various mix ratios, • Describe the cure cycle, and describe the matrix cross-linking terminologies. • Describe and select appropriate filler materials to the extent that a given resin system mix ratio with filler materials can be calculated using an established ratio as evaluated by the instructor. 			
Topics			
Thermoplastics	Thermosets	Mixing and Mix Ratios	Weight
Volume	Mixing Process	Curing of resins	A,B and C stage
Flow versus Gelation	Glass Transition	Viscosity	Curing Reactions
Potting	Fillers	Micro-Balloons	Chopped Fiber

Module: 5	Safety and Environment		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • State the personal hazards working with polymeric materials and describe the four common paths of entry. T • Evaluate a typical Safety Data Sheet (SDS) and demonstrate they can select proper personal protection equipment (PPE) and • Describe waste disposal procedures as evaluated by the instructor. 			
Topics			
Fumes, Vapors and Dust	Skin Contact	Safety Data Sheets (SDS)	Personal Protective Equipment (PPE)
Exothermic Reactions	Waste Disposal	Flammability	

Module: 6	Pre-impregnated Materials		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • describe the pre-impregnation manufacturing levels and state the stages of the matrix material, storage and handling requirements, re-certification, and disposal procedures to the extent that the correct handling procedures are stated as evaluated by the instructor. 			
Topics			
Resin Bath	Hot Melt	Stages	Matrix Cure Temperatures

TOPICS AND OBJECTIVES, MODULE 7-9

Module: 7	Adhesives		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Explain the properties of adhesives and their usage, surface preparation levels, bond line control levels, and their common failure modes to the extent that adhesive materials can be selected given repair documentation as evaluated by the instructor. 			
Topics			
Film	Liquid	Paste	Supported/Unsupported
Chemical Bonding Compared to Mechanical Bonding	Surface Preparation	Surface Energy	Bond Line Control
Micro Beads	Carries	Scrim Cloth	Core Splices
Veil	Failure Modes	Adhesion	Cohesion

Module: 8	Structural Design Considerations		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Describe the differences between sandwich structures and solid laminate structures (including monolithic structure) to the extent that the different materials used in construction will be described in detail as evaluated by the instructor. 			
Topics			
Advantages/ Disadvantages	Typical Sandwich Design	Solid Laminate and Monolithic Design	Joint Types
Bolted	Bonded	Wood	Foam
Honeycomb	Material Types	Densities	Cell Shapes and Sizes
Ribbon Directions	Filleting	Cleanliness	Splices

Module: 9	Material Handling and Storages		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Explain the importance of proper storage and handling of materials utilized in the various composites industries to the extent that storage containers (refrigerators, freezers, cabinets, etc.), storage life, handling concerns, out times, recertification, and disposals will be discussed in detail as evaluated by the instructor. 			
Topics			
Flammable Storage Cabinets	Refrigerators/ Freezers	Shipping: Handling and Temperature Requirements	Storage Temperatures
Thawing	Kitting	Out Time	Storage Life (Shelf Life)
Mechanical Life and Handling Life	Handling of Polymeric Materials	Handling of Dry Goods	Rectifying of Polymeric Materials

TOPICS AND OBJECTIVES, MODULE 10-12

Module: 10	Facilities and Equipment		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> List the various equipment needed to properly operate a composite facility to the extent that a detailed list of tools, dust extraction equipment, trim rooms, and Controlled Contamination Area (CCA) be discussed in detail as evaluated by the instructor 			
Topics			
Trim Rooms	Booths	Vacuums	Downdraft Tables
Controlled Contamination Area	Resin Mixing Areas	Mixing Booth	Disposal Equipment
Vacuum Equipment	Ports and Cauges	Pumps	Hoses

Module: 11	Vacuum Bagging		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> Explain the importance of vacuum bagging to the extent that an explanation be given on the principals of vacuum and how it affects laminate properties, and provide a detailed list of materials utilized in the vacuum bagging process as evaluated by the instructor. 			
Topics			
Vacuum/ Pressure	Altitude	Peel Ply	Bleeder/Breather
Release Film	Bagging Films	Bag Sealant	Cauls
Types of Bags	Bag to Part	Bag to Tools	Envelope
Bleeding	Fiber Resin Ratio	Void Content	Ply Compaction Requirements

Module: 12	Heating Devices		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> Explain the different types of heating devices utilized in the composite industry to the extent that an explanation be given on their primary uses, advantages/disadvantages, their limitations, and the concerns of the devices as evaluated by the instructor. 			
Topics			
Autoclave	Oven	Hot Bonders	Heat Blankets
Hot Air Blowers	Heat Lamps	Infrared	Heatguns

TOPICS AND OBJECTIVES, MODULE 13-15

Module: 13	Source Documents		
Duration in hour(s): 2,5	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Describe the use of repair documents and manuals for composite structures. 			
Topics			
ATA Specification 100	Original Equipment Manufacturer (OEM)	Structural Repair Manual	Component Maintenance Manual
Engineering Orders	SAE AMS-CACRC ARPs	Regulatory Documents	Drawing Systems
Process Specifications	Material Specifications	Data Sheets	Vendor Manuals

Module: 14	Protective Coatings and Finishes		
Duration in hour(s): 1	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Discuss the protective coating requirements, their handling procedures involving fiber reinforced plastic structures, and determine the type, application, and restoration procedures using approved manuals. 			
Topics			
Sealants	Primers	Finishes	Conductive
Metal Foil	Flame Spray	Metal Coated Fabrics	Anti-Static Paint
Metal Meshes	Interwoven-Wire		

Module: 15	Repair Selection Considerations		
Duration in hour(s): 1,5	Teaching Level: 1	Teaching Method: Discussion Lecture and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Describe the differences between prepreg repairs, wet lay-up repairs, and bolted repairs. 			
Topics			
Repair Design	Pre-Preg	Wat Lay-Up	Support Tooling Requirements
Doubler Overlay	Pre-Cured Patch	Bolted	Nonstructural (cosmetic)
Taper Sanding	Step Sanding	Part Drying Requirements	Physical Water
Absorbed Moisture	Ply Stack Up	Small and Large Ply Down	Repair Area Limitations

TOPICS AND OBJECTIVES, MODULE 16-17

Module: 16	Inspection Techniques		
Duration in hour(s): 1	Teaching Level: 2	Teaching Method: Discussion Lecture, Practice and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • List the various types of Non-Destructive Inspection (NDI) techniques and their limitations during manufacture and repair of composite structures. • Perform a visual and tap test inspection on a sandwich constructed part and correctly map the damaged area as evaluated by the instructor. 			
Topics			
Types of Damage	Mapping of Damage	Pre- and Post-Repair Inspection	Visual
Tap Testing	Ultrasonic	Thermography	X-Ray

Module: 17	Machining of Composites		
Duration in hour(s): 1	Teaching Level: 2	Teaching Method: Discussion Lecture, Practice and Feedback	
Learning Goals: After successful completion of this module, the student will be able to: <ul style="list-style-type: none"> • Select and safely operate air powered tools, including drill motors, die grinders, and dual orbital sanders. • Recommended grinding materials along with speeds and feed for machining of carbon and fiberglass materials to the extent that a minimum of 10 holes are drilled to the correct size without fiber breakout damage and taper sand a four-ply face sheet without bond ply damage as evaluated by the instructor. 			
Topics			
Sanding	Drilling	Speeds and Feeds	Types of Drills
Reamers	Tools and Equipment	Trimming	Core Machining

TOPICS AND OBJECTIVES, MODULE 18-20

Module: 18	Hands-On Exercises		
Duration in hour(s): 50	Teaching Level: 3	Teaching Method: Discussion Lecture, Practice and Feedback	
<p>Learning Goals: After successful completion of this module, the student will be able to:</p> <ul style="list-style-type: none"> • develop the basic skills necessary to repair fiber reinforced structures utilizing wet-lay and prepreg materials, vacuum bagging techniques, and hot bond equipment to the extent that personal protective equipment is worn and the repairs are accomplished using approved documentation and deemed airworthy as evaluated by the instructor and approved acceptance criteria. 			
Topics			
Symmetrical/Asymmetrical Lay-Up Exercise	Wet Lay-Up	Bleeder Exercise	Prepreg Lay-Up
Panel Build	Core Repair	Foaming Adhesive	Film Adhesive
Potting	Scarf Repair	Wet Lay-Up	Prepreg
<p>Assessment Criteria:</p> <ol style="list-style-type: none"> 1. Core removed without causing additional damage to far side inner skin. 2. Taper sanding meets repair document requirements. 3. Correct material and orientation of original plies identified. 4. Repair plies are positioned and oriented correctly. 5. Cure cycle(s) meets repair document requirements. 6. Repair meets post repair inspection requirements. <p style="text-align: center;">Note: See Logbook for detailed information.</p>			

Module: 19	Written Exam	
Duration in hour(s): 2	Teaching Level: N/A	Teaching Method: N/A
<p>Examination Criteria: The written examination shall contain a minimum of 50 multiple choice questions.</p> <p>The examination shall contain a minimum of 3 questions from each of the Topics listed in the outline for each Part. The examination will be closed book.</p>		

Module: 20	Practical Assessment Logbook Evaluation	
Duration in hour(s): 1	Teaching Level: N/A	Teaching Method: N/A
<p>Note: The practical assessment can be either the last repair project or a separate practical hands-on assessment.</p>		

DAY BY DAY SCHEDULE

GENERAL

Start Time: 08:00
 Coffee Break: 09:45 - 10:00
 Lunch: 12:00 - 13:00
 Coffee Break: 14:45 - 15:00
 End Time: 17:00

DETAILED OVERVIEW

Time Day	08:00-09:00	09:00-09:45	Break 15 min	10:00-11:00	11:00-12:00	Lunch 60 min	13:00-14:00	14:00-14:45	Break 15 min	15:00-16:00	16:00-17:00
1	Module 1	Module 1		Module 2	Module 3		Module 4	Module 5		Module 6	Module 7
2	Module 9	Module 10		Module 10	Module 18		Module 18	Module 18		Module 11	Module 18
3	Module 17	Module 18		Module 18	Module 18		Module 18	Module 18		Module 18	Module 18
4	Module 8	Module 13		Module 13	Module 13		Module 15	Module 16		Module 18	Module 18
5	Module 17	Module 11		Module 12	Module 18		Module 18	Module 18		Module 18	Module 18
6	Module 18	Module 15		Module 18	Module 18		Module 18	Module 18		Module 18	Module 18
7	Module 14	Module 18		Module 18	Module 18		Module 18	Module 18		Module 18	Module 18
8	Module 18	Module 18		Module 18	Module 18		Module 18	Module 18		Module 18	Module 18
9	Module 18	Module 18		Module 18	Module 18		Module 18	Module 18		Module 18	Module 18
10	Module 18	Module 18		Module 18	Module 18		Module 19	Module 19		Module 20	



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