

Part 4 Commercial Aircraft Structure Metal Bond Repair

This curriculum is intended to meet the formal training requirement for individuals who intend to become certified as aircraft metal bond repair technicians.

Persons who successfully complete this aircraft structural repair training program are considered to be able to perform metal bonded repairs to metal structures in compliance with the manufacturers' repair documentation or other acceptable repair data. The teaching levels listed are considered the minimum required for a given task.

The hours for lecture and hands-on repair projects are the minimums required for each. Many of the subjects require reinforcement through practical exercises.

Qualification to repair the structure to a serviceable condition will require additional experience in the form of on the job training under the supervision of a qualified individual.

This course complies SAE-Int. PART 4 SAE-, CACRC AIR 4938 and EASA and FAA standards

SAE publications:

- AIR 4844 – Composites and Metal Bonding Glossary
- AIR 6291- Guidelines for Repair Process Evaluation of Aluminum Bonded Structure
- FAA and EASA publications:
- Title 14 Code of Federal Regulations, Part 147
- EASA AMC 20-29 Composite Aircraft Structure
- FAA AC 20-107B Composite Aircraft Structure
- FAA AC 43-214 Repairs and Alterations to Composite and Bonded Aircraft Structure

EFC Course ID : TECH-104

Nr. of days: 5



Find the most up to date price @
www.efcomposites.com



You can find our total portfolio @
www.efcomposites.com



Visit the online course info @
www.efcomposites.com

Advised pre-requisites

Successful completion of Part 1 – General Composite Structural Bonded Repair Course or demonstrated mastery (bypass exam of Part 1) or equivalent knowledge.

Student success will be in part based on the knowledge and skills possessed prior to course enrolment:

And including the following disciplines:

- Basic technical mathematics
- Reading comprehension
- Fundamentals of engineering and technical drawings
- General shop and hand tool usage
- Use of precision measurement tools
- Basic physics
- Basic chemistry
- Aircraft health and safety regulatory awareness
(Need for PPE – Personal Protection Equipment)

Participants

Personnel of technical departments or staff with some basic knowledge of composites who want to get familiar with Aircraft Structural Metal Bonded Repairs able to read and understand/repair metal bonded structure damage in accordance with the Aircraft type related OEM Repair Manuals.

Minimum required 2 and maximum 12 per course. The course will be confirmed by EFC as soon as sufficient applications are received!



Objectives

- Must be able to work in groups of two with minimum supervision
- Must be attentive to details
- Will be able to repair adhesively bonded aluminium structure components by the OEM manual of the specific type of aircraft
- Can work according to Safety regulations and can recognise hazardous materials & situations
- Can assess the kind of damage by NDI, photography & Recordkeeping
- Can perform various types of damage according to the OEM manual:
 - half dept core repair with septum placement
 - full dept core repair with aerodynamically flush
- Can surface prep. aluminium structure repair before bonding following the OEM manual using Corrosion Inhibiting primer – Surface pre-treatment Boe-gel / Sol-Gel AC130-2
- Can successfully fabricate aluminium ASTM D test coupons (witness samples) along with the repairs such as: Floating Roller Peel, Lap shear, Climbing Drum peel and Wedge test.
- Will be able to handle and install foam and film adhesives and positioning cloth
- Will be able to monitor total material, Lifecycle, 'Out time' of all frozen materials using a 'Freezer Out time form'.
- Knows how to use and program and monitor different heat and hot bonding systems for curing
- Can and can fabricate quick composite reinforced support tooling for aluminium bonded structure
- Must be able to understand criteria required in SAE- Aerospace AIR4844 (last revision)
- Can perform a Post-Repair inspection, photography repair & Recordkeeping

Course content theory

1- Introduction to Aircraft Metal bond Structure

Level 1 (0,5 hour)

Objective: Given discussion, lecture, and feedback, the student will be able to describe the metal bond application and describe critical elements as evaluated by the instructor.

- Common Metal bond Applications
- Critical Issues in Aircraft Metalbond Maintenance, Repair, and Overhaul
- AIR6291, Guidelines for Repair Process Evaluation of Aluminum Bonded Structure

2- Metalbond-Specific Repair Material Requirements

Level 1 (1 hour)

Objective: Given discussion, lecture, and feedback, the student will be able to describe and identify the correct aluminum alloy and core for a specific repair as evaluated by the instructor.

Aluminum Alloy Selection

- Bare versus Clad
- Pre-Primed Sheet
- Heat Treatments
- B. Core Materials
- Forms
- Alloys
- Surface Treatments
- Discussion of Bonding Other Metals



3 Adhesion

Level 1 (1 hour)

Objective: Given discussion, lecture, feedback, the student will be able to describe the factors of adhesion as evaluated by the instructor.

- Chemical Bonding Compared to Mechanical Bonding
- Surface Tension and Surface Energy
- Types of Failure
- Adhesion
- Corrosion
- Surface Prep and Contamination
- Cohesion
- Mixed Mode

4 Safety and Environment

Level 1 (1 hour)

Objective: Given discussion, lecture, feedback, the student will be able to demonstrate proper Personal Protective Equipment (PPE) use and describe the data available to safely use and dispose of the hazardous material as evaluated by the instructor.

- SDS (Safety Data Sheet)
- Waste Disposal
- PPE

5. Surface Preparation and Time Limitations

(Level 3) 2 hours

Objective: Given discussion, lecture, practice, and feedback, the student will be able to describe and prepare the metal surface as required by the repair document, to include prior surface treatment removal, surface cleaning, chemical treatment, and correct primer application as evaluated by the instructor. Two of the surface preparation methods listed below are taught at Level 3.

- Solvent Cleaning
- Anodizing
 - Phosphoric Acid
 - Phosphoric Acid Non-Tank Anodizing (PANTA)
 - Tank Method
 - Phosphoric Acid Containment System (PACS)
 - Boric/Sulphuric Acid
 - Chromic Acid
 - Chemical Conversion-Hydrofluoric Acid/Alodine
 - Sol-Gel
 - Boe-Gel (AC 130)
 - Pasa Gel
 - Grit Blast Silane
 - FPL Etch (improved)
- Mechanical Abrasion Primers
- Primer Thickness Requirements
- Time Limits
- Proper Handling and Storage of Prepared Surfaces
- Acceptance Criteria
 - Water Break Free Test
 - Use of Polarizing Filter



6. Adhesives

Level 1 (0,5 hour)

Objective: Given discussion, lecture, feedback, the student will be able to describe and identify the correct adhesive, its application, handling, and storage requirements as evaluated by the instructor.

- Film & Foam Adhesives
- Paste Adhesives
- Core Splice Adhesive
- Proper Handling and Storage

7. Metal bond-Specific Design Considerations

Level 1 (1 hour)

Objective: Given discussion, lecture, and feedback, the student will be able to describe metal bond part design requirements as evaluated by the instructor.

- Impact Shields
- Corrosion Resistance
 - Interfacial Hydration (Moisture Ingression)
- Drainage Paths
- Isolation Layers
- Acoustical Treatments and Layers
- Electromagnetic Concerns
- Aerodynamic Considerations

8. Heat Transfer and Cure Cycle Management

Level 3 (1 hour)

Objective: Given discussion, lecture, practice, and feedback, the student will be able to describe and control the cure cycle to meet the repair document requirements as evaluated by the instructor. At least two types of equipment listed below are trained at Level 3.

- Heat Transfer Basics
- Equipment Limitations
 - Autoclave
 - Oven
 - Hot Bonders
 - Heat Blankets
 - Hot Air Blowers
 - Heat Lamp
 - Infrared Heaters
- Thermocouple Placement
- Insulation and Airflow Control

9. Pressure Requirements

Level 3 (1 hour)

Objective: Given discussion, lecture, practice, and feedback, the student will be able to describe pressure requirements, place the correct core vent materials, and control the pressure to meet the repair document requirements as evaluated by the instructor.

- Vacuum Levels
- Positive Pressure
- Core Venting
- Air Entrapment



10. Source Documents

Level 2 (1 hour)

Objective: Given discussion, lecture, practice, and feedback, the student will be able to identify, describe, and comply with repair documents as evaluated by the instructor.

ATA Spec 2200/S1000

Structural Repair Manuals:

- Allowable Damage Limits (ADL)
- Repair Limits

Component Maintenance Manual

Engineering Orders

Maintenance Organization Specific Documents

SAE AMS-CACRC ARPs

Regulatory Documents:

- Airworthiness Directives
- Service Bulletins
- Advisory Circulars
- Rule Making Task

Material and Processes Specifications

- OEM
- Vendor
- Internal

11. Repair Considerations

Level 3 (3 hours)

Objective: Given discussion, lecture, practice, and feedback, the student will be able to identify damage; evaluate repair considerations; and select, form, and fit check the repair parts to the requirements of the repair document as assessed by the instructor.

Damage Assessment and Limitation Corrosion

- Contamination
- Dents
- Disbonds
- Scratches, Nick's, and Gouges
- Punctures
- Cracks

Lightning Strike/Heat Damage

- Proximity to Other Damage and Repairs
- Material Selection and Substitution
- Repair Part Sizing
- Very film Check
- Core Selection and Sizing
- Septum
- Bondline Thickness Control
- Tooling Requirements
- Contour Management/Material Forming
- Damage Removal/Previous Repair Removal
- Contaminant Removal/Prevention
- Thermal Management
- Effect of Vacuum Levels on Film Adhesives
- Techniques
 - Vacuum Bagging
 - Contact Materials



12. Inspection Techniques

Level 1 (1 hour)

Objective: Given discussion, lecture, practice, and feedback, the student will be able to describe inspection methods and conduct at least tap test, visual, and polarised light inspections to Level 3 as evaluated by the instructor.

- Film Thickness Measurement
- Bond Testers
 - Harmonics Resonance
 - Ultrasonic
- Tap Test
- Visual (Corrosion, Contaminants, Exposed Metal, Water Break Free Test)
- Polarized Filter Inspection
- X-Ray
- Thermography
- Eddy Current
- Conductivity
- Hardness

Workshop exercises

13. Hands-On Exercises

Level 3 25.5 hours

Objective:

Given discussion, lecture, practice, and feedback, the student will be able to demonstrate proper safety practices while exhibiting the skills necessary to repair metal bond structures utilizing pre-bond treatments, film, and paste adhesives, metal parts, vacuum bagging techniques, and hot bond equipment. By the end of the training program, the students must demonstrate these skills by accomplishing a minimum of three of the repairs listed below to the instructor and meet the criteria in the repair documentation. The student must also destructively test one of the repairs listed below and identify failure mode in addition to the wedge test.

A. Repairs

- i. Dent Repair
- ii. Skin and Core Repair
- iii. Trailing Edge Repair
- iv. One Side Flush Repair
- v. Skin Crack Repair

B. Destructive Test

- i. Identify Failure Modes
- ii. Wedge Test

Assessment Criteria:

- a. Damage removed without causing additional damage
- b. Surface preparation meets repair document requirements
- c. Correct repair materials identified
- d. Repair patch is positioned correctly
- e. Cure cycle(s) meets repair document requirements
- f. Repair meets post repair inspection requirements



Examinations

14. Written Exam (1 hour)

15. Practical Assessment

The practical assessment will be a separate, hands-on repair. The practical assessment shall be similar to one of the hands-on exercises.

Assessment:

- Damage Assessment
- Damage Removal
- Repair Preparation
- Repair Lay-up
- Vacuum Bagging
- Repair Cure
- Post Repair Inspection
- Record Keeping

- The examination will be Multiple choice questions from each of the teachings Level 1-3
- The minimum passing grade for all written exams shall be 75% and all grades shall be recorded in the individual's training records.
- Successful completion is 75% correct answers. (The test will be a closed book)

The final mark will be the average of all scores gained from the actual exercises.

- Practical Assessment; a checklist is used to evaluate the practical. Student's performance will be daily monitored throughout the program.
- Assessment activities by the instructor are built into our courses, to give positive feedback on the achievement and personal potential and kept on record in an individual student logbook.
- All grades will be recorded in the participant individual training records and kept on file for unlimited time*.
*Compliant with Reference EASA Commission Regulation (EU) No 1321/2014
- EFC applies to the Dutch AVG and European GDPR rules.
The **General Data Protection Regulation (GDPR)** (EU) [2016/679](#) is a [regulation](#) in [EU law](#) on [data protection](#) and privacy for all individuals within the [European Union](#). It also addresses the export of personal data outside the EU. The GDPR aims primarily to give control to citizens and residents over their personal data and to simplify the regulatory environment for [international business](#) by unifying the regulation within the EU.
- A certificate of accomplishment is handed out to each participant.



Leipzig, Germany

This course can also be held on our new location nearby Leipzig Airport, Germany. Here we use classrooms and practical workshop in the HEICO Aircraft Maintenance Part 145 facility. We can run this course on a course start date of your choice.

Please contact our purchasing manager [Rolf Hovener](#) via his personal page on the website of Eart & Flight Composites: <https://www.efcomposites.com>.

Course run on site and at special request

- For your company to benefit, this course can be held 'On-Site' at your facility under certain conditions.
- Click on this link to the [Onsite information webpage!](#)
- Courses as noted on our [course schedule page](#) can be run on request to meet your required start and end date.

Course pricing

All listed course prices are **Excl VAT**. (Dutch VAT is 21%). EFC complies with Dutch tax laws. On request, companies can be sent an invoice instead of paying direct On-line with PayPal, IDEAL or credit card. Payment is securely arranged via Mollie.nl . More information can be found on [the website of Mollie](#).

Mollie





Did you already visit our webshop?

Vacuum Valves/ Vacuum Sniffers



Smart vacuum Valve/Ports for a curved surface
In the images shown the vacuum valves/ports are fitted with standard quick connect couplings.

These quick connect standard couplings are not supplied with the vacuum valves/ports. They merely serve to show the connectivity options. These conventional couplings, male or female type, are available at many vacuum equipment suppliers. EFC can deliver them to you if required.

Contact us by email at info@efcomposites.com
These Vacuum ports/valves are specially designed and patented by EFC owner Bert Groenewoud
Tha can be used use with Hot bonders, in ovens, autoclaves on flat and curved surfaces.

Visit our [webshop](#) for more information!

B- Aluminium tap hammer



The B- Aluminium tap hammer, is used to detect delamination (separation of plies) and dis-bonds from the core in advanced composite structures.

This tap Hammer is a must have, for Composite Repair Technicians, Composites certifying staff Composite engineers and Quality inspectors to perform a correct damage assessment in thin laminates and metal bonded parts!

It is fabricated to OEM standard drawings and sizes and anodized for a better protection of the material. The material used is Alum type EN_AW_ 6082-T6
let us know if you want to order the B-tap hammer in larger quantities and ask us for a quotation
Coming soon; A tap-hammer lanyard with a B-tap-hammer plastic click-in holder

Visit our [webshop](#) for more information!

