



AEROSPACE INFORMATION REPORT	AIR4938	REV. A
	Issued 1996-09 Revised 2014-03	
	Superseding AIR4938	
Composite and Bonded Structure Technician/Specialist Training Document		

RATIONALE

This revision is to support ARP6262 Basic Composite Repair Technician Certification Standard and a new modular curriculum for composite and metalbond repair curricula.

1. SCOPE

This is a general curriculum that has been developed to identify the minimum knowledge and skill requirements of a composite and/or metal bond repair technician/specialist. This revision changes the document from an all-inclusive curriculum into a modular set of curricula.

Teaching levels have been assigned to the curriculum to define the knowledge, skills and abilities graduates will need to make composite repairs. Minimum hours of instruction have been provided to ensure adequate coverage of all subject matter - lecture and laboratory. These minimums may be exceeded, and may include an increase in the total number of training hours and/or increases in the teaching levels.

Each curriculum is a subpart of this document.

Part 1 is the basic curriculum independent of product and is the companion to ARP6262

Part 2 is the aircraft specific curriculum and is currently under development and will be released in the next revision to this document.

Part 3 is the metal bond specific curriculum and is currently under development and will be released in the next revision to this document.

Part 4 is bolted repairs of composite structure curriculum and is currently under development.

This document contains ATA104 level IV curricula.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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<http://www.sae.org/technical/standards/AIR4938A>

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AIR4844 Composites and Metal Bonding Glossary

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

ARP6262 Basic Composite Repair Technician Certification Standard

2.2 EASA Publications

Available from European Aviation Safety Agency, Postfach 10 12 53, D-50452 Cologne, Germany, Tel: +49-221-8999-000, www.easa.eu.int.

EASA AMC 20-29

2.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAA AC 20-107B

FAA AC 65-33

FAA AC 43-214

2.4 Other Publications

Title 14 Code of Federal Regulations, Part 147

3. STUDENT PREREQUISITES

Student success will be in part based on the knowledge and skills possessed or developed in the following disciplines:

Basic technical mathematics

Fundamentals of engineering and technical drawings

General shop and hand tool usage

Use of precision measurement tools

Basic physics

Basic Chemistry

Health and Safety regulatory awareness (need for PPE (Personal Protection Equipment))

The above listed disciplines may be learned prior to or in conjunction with the training programs. Evaluation of prior education can be accomplished by examination of school transcripts, and/or by review of the training received through approved training providers.

4. EXAMINATIONS

Training Providers will be required to monitor student performance throughout the program. Students will be administered written exams in lecture classes and practical skill demonstration tests in laboratory classes. The minimum passing grade for all written tests shall be 75% and all grades shall be recorded in the individual's training records.

The final examination covering the principles of the applicable curriculum:

1. **Written Examination:** The written examination shall contain a minimum of 50 multiple choice questions. The examination shall contain a minimum of three questions from each of the teaching Level 2 and above subjects. Successful completion of the written exam is 75% correct answers. The examination will be closed book.
2. **Practical Assessment:** By the end of the training program the trainee must demonstrate to the approved training provider that they can perform the basic tasks required to perform a composite repair.
3. **Reexamination:** If the trainee fails the written examination, they may request to retake a written examination. The written examination must not contain more than 20% of the questions that were on the failed examinations.

5. TEACHING LEVELS

The following definitions of minimum teaching levels are derived from Title 14 Code of Federal Regulations, Part 147 and may be exceeded.

- a. **Level 1:** Level 1 requires knowledge of general principles, but no practical application; no development of manipulative skill; and instruction by lecture, demonstration, and discussion. This teaching level generally refers to classroom discussion and does not require practical application. Teaching aids or instructional equipment may include charts, books, diagrams, or other visual teaching aids. If a training organization chooses to teach Level 1 courses incorporating actual components, the components do not have to be operational.
- b. **Level 2:** Level 2 requires knowledge of general principles and limited practical application; development of sufficient manipulative skill to perform basic operations; and instruction by lecture, demonstration, discussion, and limited practical application. This teaching level requires some hands-on manipulative skills and their accompanying actual or simulated components/equipment, but still may be taught primarily in the classroom environment.
- c. **Level 3:** Level 3 requires knowledge of general principles; performance of a high degree of practical application; development of sufficient manipulative skill to accomplish return to service (normal operation); and instruction by lecture, demonstration, discussion, and a high degree of practical application. This teaching level requires hands-on skill, as well as sufficient and appropriate instructional aids to train the students to develop manipulative skills sufficient to simulate return to service mechanical skill. At this level, the teaching aids must be similar to or be the actual items of equipment on which the student is expected to develop required skill levels. A Level 3 subject cannot be taught solely by lecture in the classroom; the appropriate training aids and hands-on experience must be used.

PART 1 BASIC COMPOSITE STRUCTURAL REPAIR CURRICULUM

Scope

Persons who successfully complete this basic training program are considered to be able to perform composite repairs to composite structures in compliance with the manufacturers' repair documentation or other acceptable repair data. This curriculum should be considered a prerequisite for more advanced training.

Outline for Initial Composite Certification

	<i>Topic</i>	<i>Level</i>	<i>Classroom Hours</i>	<i>Lab Hours</i>
1	Introduction to composites	2	1.5	0
2	Human Factors	1	0.5	0
3	Critical issues in composite Maintenance.	1	1.5	0
4	Reinforcement fibers	2	1.5	4
5	Matrix systems	2	1	4
6	Safety and environment	2	1	2
7	Pre-Impregnated materials	2	1	9
8	Adhesives	2	1	2.5
9	Structural Design	2	1	2.5
10	Material Handling and Storage	2	1.5	2
11	Facilities & equipment	2	2	1
12	Vacuum bagging	2	2	7
13	Heating Devices	2	1.5	6
14	Documents	2	2	3
15	Additional Design Considerations	2	1	0
16	Repair design considerations	2	1.5	0
17	Inspection Techniques	2	1	1
18	Machining of composites	2	2	4.5
19	Hands on exercises, total hours	2	0	48.5
20	Written Test		2	0
	Total Hours		26.5	48.5
	Course Length Minimum		75 Hours	

Introduction to Composites, Level 2, 1.5 Hours*Objective:*

Given discussion, lecture, practice and feedback; the student will describe the basics of composite materials technology and their applications related to aerospace, marine, automotive, and civil, energy and consumer products. In addition, the student 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.

- a. Definition of composites
- b. History of Composites
- c. Advantages/Disadvantages
 - i. Conductivity
- d. Applications
- e. Product forms

1. Human Factors, Level 1, 30 minutes*Objective:*

Given discussion, lecture, practice and feedback; the student will explain the concept of "Human Factors"; to the extent that a brief explanation of the "personal minimums" be given and a minimum of two factors that are likely causes of accidents and incidents, plus the student will develop two personal safety nets as they apply to their own experiences, as evaluated by the instructor.

- a. Definition
- b. FAA/EASA resources
- c. Personal minimums
- d. Safety Nets

2. Critical Issues in Composite Maintenance, Repair and Overhaul (AIR5719), Level 1, 1.5 hours*Objective:*

Given discussion, lecture, practice and feedback; the student will identify team member skills roles and responsibilities as related to composite repair processes. The student will state the differences between structural classifications, repair categories, source documentation, materials and process specifications and repair substantiation to the extent that each issue is explained and sources for locating critical issues are listed as evaluated by the instructor.

- a. Roles and responsibilities
 - i. Engineer
 - ii. Inspector
 - iii. Technician

- b. Structure classifications
 - i. Principal structural elements (PSE's)
 - ii. Primary
 - iii. Secondary
 - iv. Fatigue Critical Baseline Structure
- c. Repair Categories
 - i. A,B,C
- d. Source Documentation
 - i. OEM
 - ii. Internal
 - iii. SAE (ARP's)
- e. Material and Processes Specifications
 - i. OEM
 - ii. Vendor
 - iii. Internal
- f. Repair substantiation
 - i. OEM repair data
 - ii. Reverse engineering
 - iii. Allowable damage limits
 - iv. References
 - 1. FAA reports
 - 2. Others

3. Reinforcement Fibers, Level 2, 1.5 Hours

Objective:

Given discussion, lecture, practice and feedback; the student will visually recognize common composite fibers, and list the properties and associate the terms related to the fabric manufacturing process. In, addition the student will 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.

- a. Materials
 - i. Fiberglass
 - ii. Aramid

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- iii. Carbon
- iv. Ceramics
- v. Hybrids
- b. Forms Terminology
 - i. Filament
 - ii. Strand
 - iii. Etc.
- c. Unidirectional Tape
- d. Non-woven
 - i. Mat
 - 1. Chopped/continuous filament
 - ii. stitched
- e. Woven
 - i. Weave styles
 - 1. Plain
 - 2. Twill
 - 3. Harness satin
 - 4. Biaxial
 - 5. Triaxial
 - 6. others
- f. Fiber sizing & finishes
- g. Balance and symmetry
 - i. Warp clock
 - ii. Tracers
 - iii. Ply Orientation
 - iv. Nesting

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4. Matrix Systems, Level 2, 1 hour

Objective:

Given discussion, lecture, practice and feedback; the student will state the difference between thermoplastic and thermosetting matrix materials, describe the roles and limitations of matrix materials, determine and calculate various mix ratios, describe the cure cycle and the matrix cross-linking terminologies. In addition, the student will describe and select appropriate filler materials along with storage and handling requirements 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.

- a. Thermoplastics
 - i. PEEK
 - ii. Polyimide
 - iii. Polyphenylene sulfide
 - iv. Others
- b. Thermoset
 - i. Polyester
 - ii. Vinyl Ester
 - iii. Epoxy
 - iv. Others
- c. Mixing and Mix Ratios
 - i. Weight vs. Volume
- d. Curing of resins
 - i. A, B & C stages
 - ii. Flow vs. Gelation
 - iii. Glass Transition
 - iv. Viscosity
 - v. Curing reactions
- e. Potting
 - i. Fillers
 - ii. Microballons
 - iii. Chopped fiber
 - iv. Fumed silica

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5. Safety and Environment, Level 2, 1 hour

Objective:

Given discussion, lecture, practice and feedback; the student will state the personal hazards working with polymeric materials and describe the 4 common paths of entry. The student will evaluate a typical Material Safety Data Sheet (MSDS) to the extent that selection of recommended personal protection equipment and waste disposal procedures are located as evaluated by the instructor.

- a. Fumes & vapors
- b. Skin contact
- c. MSDS
- d. Personal protective Equipment (PPE)
- e. Exothermic Reactions
- f. Waste Disposal
- g. Explosive environment

6. Pre-Impregnated Materials (PREPREG), Level 2, 1 Hour

Objective:

Given discussion, lecture, practice and feedback; the student will 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.

- a. Levels
 - i. Resin Bath
 - ii. Hot melt
 - iii. Stages
- b. Matrix cure temperatures
 - i. Various temperatures

7. Adhesives, Level 2, 1 hour

Objective:

Given discussion, lecture, practice and feedback; the student will 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.

- a. Film
- b. Liquid
- c. Paste
- d. Supported/Unsupported
- e. Surface preparation

- f. Bond line control
 - i. Micro Beads
 - ii. Carriers
 - 1. Scrim Cloth
 - 2. Knit
 - 3. Veil
- g. Failure Modes
 - i. Adhesive
 - ii. Cohesive
- h. Foams
 - i. Core splice

8. Structural Design, Level 2, 1 hour

Objective:

Given discussion, lecture, practice and feedback; the student will 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.

- a. Purpose
- b. Typical sandwich design
- c. Solid laminate and monolithic design
 - i. Joint types
 - 1. Bolted
 - 2. Bonded
- d. Advantages/disadvantages
- e. Wood
- f. Foam
- g. Honeycomb
- h. Material types
 - i. Densities
 - j. Cell shapes & sizes
 - k. Ribbon direction

- I. Filleting
- m. Cleanliness
- n. Splices
 - i. Septum
 - ii. Peg/crush

9. Materials Handling and Storage, Level 2, 1.5 hours

Objective:

Given discussion, lecture, practice and feedback; the student will 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.

- a. Flammable storage cabinets
- b. Refrigerators/Freezers
- c. Storage temperatures
- d. Thawing
- e. Out time
- f. Storage life
- g. Mechanical life
- h. Handling of polymeric materials
- i. Handling of dry goods
- j. Recertifying of polymeric materials
- k. Disposal

10. Facilities and Equipment, Level 2, 2 hours

Objective:

Given discussion, lecture, practice and feedback; the student will 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, clean rooms, heating equipment (Autoclaves, ovens, hot bonders, etc.) and paint areas be discussed in detail as evaluated by the instructor.

- a. Trim rooms
- b. Dust extraction levels
 - i. Booths
 - ii. Vacuums
 - iii. Downdraft tables

- c. Clean rooms
 - i. Requirements
- d. Resin mixing areas
 - i. Mixing booth
 - ii. Disposal
- e. Heating equipment
 - i. Autoclave
 - ii. Oven
 - iii. Hot bonders
 - iv. others

11. Vacuum Bagging, Level 2, 2 hours

Objective:

Given discussion, lecture, practice and feedback; the student will 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 a detail list of materials utilized in the vacuum bagging process; as evaluated by the instructor.

- a. Theory
 - i. Vacuum/pressure
 - ii. Altitude
- b. Materials
 - i. Peel ply
 - 1. Surface condition
 - ii. Bleeders/Breather
 - iii. Release films
 - iv. Bagging films
 - v. Bag sealant
 - vi. Vacuum ports
- c. Types of bags
 - i. Bag to part
 - ii. Bag to tool
 - iii. Envelope

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- d. Bleeding
 - i. Fiber resin ratio
 - ii. Void content
 - iii. Thickness

12. Heating Devices, Level 2, 1.5 hours

Objective:

Given discussion, lecture, practice and feedback; the student will explain the different types of heating devices utilized in the composite industry; to the extent that an explanation be given on their primary uses, their limitation and the concerns of the devices; as evaluated by the instructor.

- a. Autoclave
- b. Oven
- c. Hot Bonders
- d. Heat Blankets
- e. Hot air Blowers
- f. Heat lamps
- g. Infrared
- h. Heat guns

13. Source Documents, Level 2, 2 hours

Objective:

Given discussion, lecture, practice and feedback; the student will describe Air Transportation Association (ATA) specification 100 standardization and state common OEM manuals used for manufacture and repair of composite structures. The student will describe the manual revision process involving controlled documents and state the need to follow written instructions when repairing composite structures to the extent that the Chapter, Section and Subject of a given aircraft composite part can be located as evaluated by the instructor.

- a. ATA Specification 100
- b. OEM (Original Equipment Manufacturer)
 - i. Structural Repair Manuals
 - ii. Component Maintenance Manual
 - iii. others
- c. Engineering Orders
- d. SAE AMS-CACRC ARP's
- e. Regulatory Documents
 - i. 8100