



Jordan Civil Aviation Regulatory Commission

Guidance Procedure: AWS 39

Approved Maintenance Organization- Composite Repair Workshop

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0.2 Abbreviations

AMC	Acceptable Means of Compliance
AMO	Approved Maintenance Organization
AMTO	Approved Maintenance Training Organization
AOG	Aircraft On Ground
BIPM	International Bureau of Weights and Measurements
CAO	Continuing Airworthiness Organization
CAP	Corrective Action Plan
CIPM	International Committee on Weights and Measurements
C/S	Certifying Staff
CC/S	Component Certifying Staff
GM	Guidance Material
ILAC	International Laboratory Accreditation Cooperation
IORS	Internal Occurrence Reporting System
MOA	Maintenance Organization Approval
MOAP	Maintenance Organization Approval Procedures
MOC	Maintenance Oversight Coordinator
MOE	Maintenance Organization Exposition
MOR	Mandatory Occurrence Reporting
MRA	Mutual Recognition Arrangement
NAA	National Aviation Authority
NRAB	National Recognized Accreditation Body
OEM	Original Equipment Manufacturer
PPB	Principal Place of Business
QE	Qualified Entity
RAB	Regional Accreditation Body
S/S	Support Staff
STCH	Supplemental Type Certificate Holder
TCH	Type Certificate Holder
WH	Working Hours

0.3 Purpose

This guidance procedure is intended to assist maintenance organizations and inspectors on the conditions to obtain JCAR Part-145 approval (Composite repair workshop).

0.4 Distribution

This procedure shall be published on the CARC official website. The holders of this procedure are CARC airworthiness standards specialists and the key management (post holders) of CARC approved maintenance organizations. Holders are responsible to download this procedure and follow its guidelines.

0.5 Amendments

This procedure will be reviewed each time there is a regulation change that affects it and as long as it is considered necessary by CARC.

Any amendment to this procedure shall be approved by the Chief Commissioner/CEO and becomes effective only after incorporation to this procedure and publishing it on CARC official website.

0.6 Scope and Applicability

This guidance procedure is applicable to JCAR Part-145 applicant and CARC approved Part-145 AMOs' (hereafter referred as maintenance organizations).

The provisions of this guidance procedure are complementary to the requirements of Part-145 regulation "as amended" and does not supersede or replace the associated regulatory requirements.

0.7 Definitions

Part 145.42 (c) provides the possibility for a maintenance organizations to have the permission to Composite repair workshop under restricted range of parts to be used in the course of maintenance within its own facilities.

However, it is not the intent of the JCAR Part-145 regulation to provide an alternative mean to manufacture parts outside an approved Part-21 production organization (POA) .

1. JCAR Part-145 regulation overview

1.1 Maintenance and/or manufacturer

Composites aircraft structure activities in a maintenance organization may be considered in terms of maintenance (e.g., repair, overhaul, etc.) and/or in terms of parts fabrication (normally limited to "Fabrication of secondary structural elements").

In particular, requirements for the fabrication of parts under the scope of an CARC Part-145 approval is given in 145.42 (c) and related AMC.

1.2 JCAR Part-145 approval (Ratings required)

The activities may be performed under an Ax rating (Line or Base aircraft maintenance scope of work), under Cx rating (components maintenance scope of work) or Bx rating (engines/APU). In addition, an NDT capability is needed (e.g., to establish the presence/extent of a damage, inspect the repair at the end of the process, etc.) which may be, as an example, performed by the maintenance organization "in the course of maintenance" within one of the above mentioned ratings.

In order to establish the correct JCAR Part-145 approval for the intended level of maintenance, the requirements (JCAR Part-M) apply (class and rating system to be used for the approval of maintenance organizations). The decision of whether to perform such activity within the Ax, Bx or Cx rating is determined by the maintenance data, when particular equipment and/or facilities are required for which a Workshop (Components maintenance environment) needs to be considered..

As general guidance, maintenance of aircraft composite structure may be considered under:

- an A rating (Line or Base) when performed in accordance with the aircraft maintenance data (e.g., SRM) or if agreed by the competent authority in accordance with component maintenance data, only whilst such components are fitted to the aircraft, the normal objective being for example the recovery of an AOG condition (Line Maintenance) and/or the performance of a temporary repair (Line or Base Maintenance);

Note 1: The temporary removal of the component for maintenance, in order to improve access to that component, may be also allowed except when such removal generates the need for additional maintenance. This will be subject to a control procedure in the MOE to be approved by the competent authority. The limitation section will specify the scope of such maintenance thereby indicating the extent of approval.

Note 2: Maintenance of aircraft composite structure outside the hangar should be avoided

- a Bx rating (engine and/or APU), when the activity is carried out on an installed engine/APU and engine and/or APU components, in accordance with engine and/or APU maintenance data or, if agreed by the competent authority, in accordance with component maintenance data, only whilst such components are fitted to the engine and/or APU. In the case of composite repairs done according to the component maintenance manual, which require the component to be removed from the engine/APU a Cx rating is to be normally expected.
- a Cx rating (component maintenance):
 1. in all cases when a component overhaul task is performed in accordance with component maintenance data;
 2. In the case of components repair, when it is necessary to work on the uninstalled component and at the same time particular facilities and equipment are required for which a Workshop is to be expected, the normal objective being the performance of a permanent repair.
Fabrication of parts could be considered under both ratings provided it remains within the limitations of JCAR Part- 145.

2. Composite structure repair

2.1 Basic families of composite structure

There are two basic types of composite structures:

- a. Sandwich: Thin, high strength skins are separated by, and bonded to lightweight honeycomb cores;
- b. Solid Laminate: assembled so that the fiber orientation provides most of the desired mechanical properties and the solid matrix largely determines the environmental performance.

2.1.1 Basic types of composite repairs

There are two basic types of composite repairs: bonded and bolted.

The choice between the two types of repairs (which is not a Part-145 decision) is associated with advantages and disadvantages in both case (e.g., bonded repairs provide more uniform stress distribution but require a more rigid process regarding control and time, etc.). In general terms non-critical repairs may be bonded or bolted, while critical repairs will be bolted.

2.2 Compliance of the composite repairs workshop to JCAR Part-145

The bonded repair dominates today and in order to perform such repairs the maintenance organization shall be specifically organized in terms of personnel, facilities and equipment, process control, etc.

In the following chapters of this user guide minimum requirements have been established for the set-up of a composite repairs workshop.

Note: This guidance material does not supersede the need to comply with any applicable maintenance data or requirement

3. General requirements

3.1 Approved data

As stated in 145.45 (a) “The maintenance organization shall hold and use applicable current maintenance data in the performance of maintenance, including modifications and repairs”. In the 145.45 (b) and related AMC it is clarified what is intended to be the applicable “maintenance data”.

The JCAR Part-145 organization, shall take particular care to the following topics:

- as stated in 145.A.65.(b)(4) “maintenance procedures shall be established to ensure that damage is assessed and modifications and repairs are carried out using data specified in point M.304”. (Data for modifications and repairs)

3.2 Maintenance records

Composite aircraft structures repair is to be considered a complex maintenance task. The maintenance organization shall use work cards to record the repair, which shall be subdivided into clear stages to ensure a record of the accomplishment of the complete maintenance task. Particular care shall be taken to record:

- Part identification: P/N, approved repair data used;
- Raw material traceability: adhesives, Prepreg1, resins, fasteners, etc. by using a reference which allows traceability to the relevant Certificate;
- Process application, curing time, out of fridge time, etc..
- Product conformity: the records shall be able to demonstrate compliance with approved repair procedures.

3.3 Training for composite technicians

The maintenance organization is required by 145.30.(e) to “establish and control the competence of personnel involved in any maintenance.....in accordance with a procedure and to a standard agreed by the competent authority”. (The organization shall establish a program for continuation training for certifying staff and support staff, including a procedure to ensure compliance with the relevant points of 145.35 as the basis for issuing certification authorizations under this Part to certifying staff, and a procedure to ensure compliance with Part-66.

A training program should be therefore developed for qualification of composite technicians. The SAE AIR 5719 and FAA AC 65-33 documents (refer to chapter 7) provide detailed guidelines and a sample course syllabus, which can be used in order to develop training/qualification programs for composite maintenance technicians.

In addition to that, It is recommended that the technicians training would include an aircraft type training module (limited to the Structure ATA chapters) at least for those structural repair technicians which are authorized for aircraft on-board repairs (e.g., requiring interpretation of the SRM to define corrective actions). Such structural repair technicians should be authorized on the specific aircraft type.

3.4 Safety precautions

Aircraft maintenance chemicals (e.g., abrasives, cleaners, corrosion preventatives, paint stripes, surface treatments, sealants, paints, solvents, etc.) may be hazardous. The maintenance organization is responsible for the evaluation of the hazards in the workplace, awareness of

personnel and to address safety precautions. The following elements should be taken into account:

- Understand the warnings for using specific chemicals as published by the chemical manufacturer. Refer to the Material Safety Data Sheet which accompany the material. This is the primary source of information when determining the risk associated with any substance used in the workplace;
- observe the aircraft/component manufacturer's warning and cautions in the applicable maintenance data;
- Use personal protective equipment (e.g., gloves, respirators, glasses, boots, etc.) to prevent skin, eyes, respiratory and digestive tracts from being exposed to chemicals;
- Make sure that sufficient ventilation exist;
- Many combination of chemicals are incompatible and may produce toxic fumes and violent reactions. Extreme caution is required to ensure that maintenance chemicals are only mixed in accordance with the specific mixing procedure;
- Set up first-aid measures in the workplace (e.g., eye washers, etc.).

4. Peculiarities of maintenance organization's facilities and processes

4.1 Incoming inspection of raw material

145.42 (a) and AMC M.501 (d) requires the Maintenance organization to ensure that purchased raw and consumable materials meet the required specification and has appropriate traceability (to the manufacturing and supplier source). In the case of materials used for composite repairs (e.g., Prepregs, resins, etc.) Supplier laboratory test reports should also accompany each batch of material received. In addition the maintenance organization may perform sample verification testing (by itself or using an independent laboratory) in order to establish confidence in the quality of materials received from the suppliers.

4.2 Material handling and storage

Materials used for bonded repairs are subject to specific handling and storage conditions, which requires adequate facilities and equipment (see also chapter 4.5 "NDT to support the composite") to be available.

The conditions of storage and shelf life limitation shall be in accordance with the manufacturer's instructions to prevent deterioration and damage to the stored items. In particular, the maintenance organization shall refer to the Material Safety Data Sheet which accompany the material plus any other instructions which may be published in the relevant maintenance data.

In particular the maintenance organization needs to establish procedures to cover the following aspects.

4.2.1 Shelf life and temperature considerations

Materials specifications normally specify shelf life when the material is stored at the specified temperatures. Prepreg and adhesives need to be stored in sealed containers often near -18°C in order to retard the "aging" or partial curing and extend the shelf life. The period of time the material is outside the freezer shall be recorded (ex. "out time" record log) in order to demonstrate that the total allowable out of freezer time is not exceeded.

4.2.2 Storage and handling recommendations

Particular care should be taken to prevent contamination of Prepreg materials and film adhesives during handling (e.g., skin oil), by the use of appropriate gloves, protective container/moisture-tight bags.

Freezer storage conditions shall be strictly controlled (regularly monitored temperature, highest allowed temperature, location/orientation of the stored roll to prevent fiber breaking or resin migration).

If the maintenance organization cuts the roll into “kits” before refreezing, procedures should be in place to ensure the materials are not contaminated during handling and kitting process (i.e. the out time is recorded and the material is correctly bagged before refreezing).

4.2.3 Unserviceable aircraft components incoming area

An incoming area for unserviceable components is expected at least in the case of maintenance organization working under the Cx rating (components maintenance). In this area an inspection process should be carried out to ensure as a minimum the availability of a “clear work order”, approved data for the required repair, all required information from the customer/operator necessary for the issue of the CRS (e.g., identification, hours, cycles, origin, AD/SB, etc.).

4.3 Composite bonded repair workshop

The workshop represents the core area of the repair process and may have different layout and size depending on the intended scope of work. For:

- an Ax/Bx rated maintenance organization, as a minimum, a support workshop area should be expected. The possibility to perform such repairs “on-wing” outside the hangar/workshop should be evaluated case by case by the organization;
- a Cx rated maintenance organization, the repair process flow should be evaluated in order to establish the workshop layout that is tailored to the needs. A possible basic example is the following:
 - a) Sanding room: where paint removal is performed in order to have complete access to the damaged area;
 - b) Preparation room: where the component is prepared for the repair (e.g., cleaning, surface preparation, etc);
 - c) Clean room: this is the area where the structural bonding is performed. Care should be taken to accomplish the repair within the remaining allowable “out time” of the material and the maintenance organization should specify in its procedures the maximum time for accomplishment. Additional information is provided in chapter 5.2 “bonded repairs”
 - d) Cure room: curing should be accomplished by controlling the appropriate parameters such as vacuum, pressure, temperature, etc. with respect to time in accordance with maintenance data;
 - e) Inspection: the final inspection process is performed (e.g., NDT, CRS, records, etc.).

4.4 Tools and equipment

Regardless the identified layout of the facilities, the following tools and equipment should be available and managed in accordance with 145.A.40, depending on the intended scope of work:

- Autoclave: capable of providing positive pressure and temperatures consistent with the repair process;
- Oven: an air-circulating oven capable of providing the required cure or drying temperature and equipped with vacuum capability when required;
- Temperature and pressure controller: a method of temperature and pressure control (e.g., vacuum bag, thermal blanket, heat lamp, etc.);
- Lay-up and Clean rooms: shall be environmentally and operationally controlled in terms of temperature and humidity, air filtration and pressurization (capable of providing slight

positive over-pressure), designed to minimize dirt traps (e.g., sealed floors, recessed lights, etc.), subject to routine cleaning schedule (established and recorded), restricted to avoid potential contaminations (ex. eating, smoking, cutting, uncontrolled sprays, dust, oily vapours, etc.);

- Freezer: capable of maintaining the required storage conditions of materials (e.g., adhesives, Prepreg, etc.);
- Cleaning: equipment to accomplish the various cleaning processes;
- Spray room: for spraying the primer & paint finish (adhesively bonded metallic structures);
- Honeycomb core cutters: capability to cut, rout and profile the honeycomb;
- Part drying capability: should be used to dry the part from moisture before lay-up and bonding of the repair (ex. large oven with integral vacuum capability and dry air input into the vacuum bag of the part);
- Laboratory test facilities: recommended to perform in-process quality control;
- Cutting tools: diamond or carbide saws and router bits are suitable for cutting and trimming of composites;
- Kit storage area: a dedicated area for storage of kitted detail parts prior to bond helps to reduce contamination of detail parts;

4.5 NDT to support composite repairs

Various NDT methods should be available in order to perform the required inspections before (to establish the extent of the damage) and after the repair process (to confirm the condition of repair). The need of specific training in composite repair NDT techniques shall be assessed.

4.6 Workshop procedures

The maintenance organization shall ensure the overall composite repair processes is controlled according to procedures which are available to the maintenance personnel, relevant for the work to be carried out and up to date. In particular, those procedure shall ensure that the minimum requirement of this user guide are followed (i.e. records of material handling, tooling, clean room control, work cards, etc.).

In case company procedures are used to establish material/adhesive alternatives, the associated equivalency assessment shall be appropriately documented and compliant with approved data.

5. Samples of repairs

5.1 Bolted repairs

The basic concept of the bolted repair is that the damaged area is covered by a doubler which is mechanically joined to the structure using fasteners.

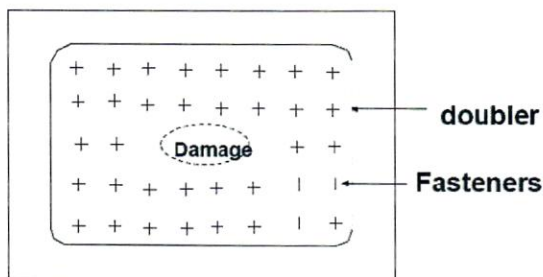


Fig. 1 Basic elements of a bolted repair

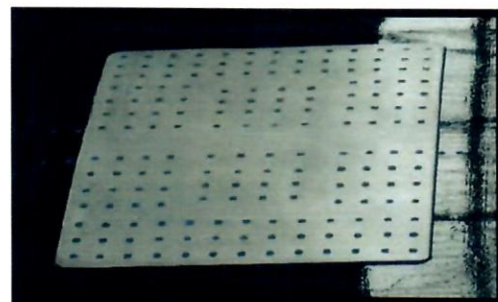


Fig. 2 Example of bolted repair

5.2 Bonded repairs

Various types of bonded repairs are possible: resin injection, core replacement, structural repairs using Prepreg and adhesive film, bonding plates and wire mesh replacement, etc.

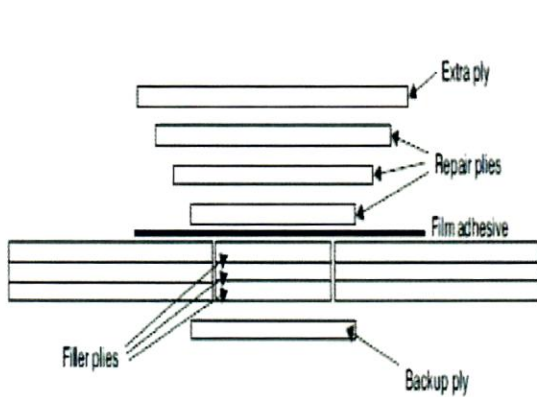


Fig.3 Typical laminate bonded repair

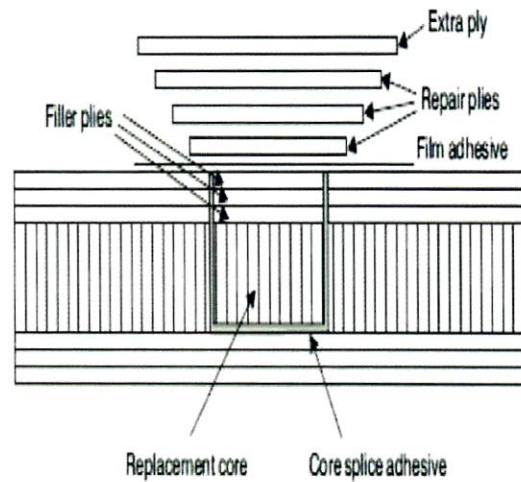


Fig.4 Typical sandwich panel bonded repair

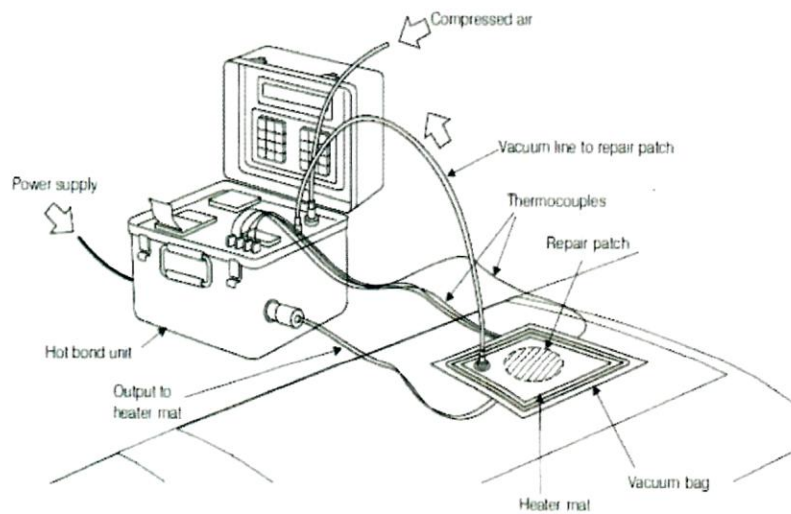


Fig. 5 Example of portable equipment for one side access bonded repair.

