



Advisory Circular

Subject: Repair Design Approvals

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1.0 INTRODUCTION

- (1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

1.1 Purpose

- (1) The purpose of this document is to provide guidance in applying for and obtaining a repair design approval (RDA) in accordance with Subpart 521 of the *Canadian Aviation Regulations (CARs)*. It is to be used in conjunction with AC 521-004.

1.2 Applicability

- (1) This document applies to:
 - (a) applicants for and holders of an RDA;
 - (b) Transport Canada Civil Aviation (TCCA) personnel;
 - (c) delegates; and
 - (d) the aviation industry.
- (2) This AC does not apply to products approved by a Canadian Technical Standard Order (CAN-TSO) design approval.

1.3 Description of Changes

- (1) Not applicable.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

- (1) It is intended that the following reference materials be used in conjunction with this document:
 - (a) *Aeronautics Act* (R.S., 1985, c. A-2);
 - (b) Part I, Subpart 4 of the *CARs—Charges*;
 - (c) Part V, Subpart 21 of the *CARs—Approval of the Type Design or a Change to the Type Design of an Aeronautical Product*;
 - (d) Advisory Circular (AC) 500-016,—*Establishing the Certification Basis of Changed Aeronautical Products*;
 - (e) AC 521-002,— *Type Certification Requirements of Aircraft, Engines and Propellers*;
 - (f) AC 521-004,—*Changes to the Type Design of an Aeronautical Product*;
 - (g) Notice of Proposed Amendment (NPA) 2010-021—*Approval of the Type Design or Change to the Type Design of an Aeronautical Product*; and
 - (h) Transport Canada form number 26-0469—*Design Change Approval Application*.

2.2 Cancelled Documents

- (1) Not applicable.
- (2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

2.3 Definitions

- (1) The following **definitions** are used in this document:

- (a) **Aeronautical Product:** an aircraft, aircraft engine, aircraft propeller or aircraft appliance or part, or a component part of any of those things, including any computer system and software (Ref. Aeronautics Act and Section 521.01 of the CARs).
- (b) **Certification Basis:** refers to the applicable standards as established in Section 521.157 of the CARs, as appropriate, including any special conditions—airworthiness (SCA), findings of equivalent level of safety, and exemptions applicable to the product to be certified.
- (c) **Conformity with the Certification Basis:** demonstrating compliance with all of the applicable standards and requirements of the certification basis.
- (d) **Delegate:** any person or class of persons authorized under the authority of Subsection 4.3(1) of the *Aeronautics Act* to perform functions on behalf of the Minister, subject to the requirements in Chapter 505 of the *Airworthiness Manual (AWM)*.
- (e) **Major Change to the type design:** an alteration to the type design of an aeronautical product in respect of which a type certificate has been issued that has other than a negligible effect on the weight and centre-of-gravity limits, structural strength, performance, power plant operation, flight characteristics or other qualities affecting its airworthiness or environmental characteristics. This refers to Section 521.152 of the CARs.
- (f) **Minor Change to the type design:** other than a major change to the type design (for the purpose of this AC). This refers to Section 521.154 of the CARs.
- (g) **Repair:** The restoration of an aeronautical product to an airworthy condition as defined by the appropriate airworthiness requirements.
(Ref: International Civil Aviation Organization (ICAO) Annex 8).
- (h) **Repair Design Approval (RDA):** a document, including a repair design certificate (RDC) issued before December 1, 2009 under Section 513.11 or 513.22 of the CARs, issued by the Minister to record the approval of:
 - (i) a repair design in respect of a repair to an aeronautical product identified in the document by a serial number; or
 - (ii) a repair process in respect of a repair to an aeronautical product or any of its components, identified in the document by a serial number, by a part number or by some other identification unique to the component.
(Ref: Subsection 101.01(1) of the CARs).
- (i) **Standards of Airworthiness:** design requirements as defined in the AWM. For repairs, the standards of airworthiness may also be listed on the type certificate data sheet (TCDS).
- (j) **Type Design:**
 - (i) the drawings and specifications, and a listing of those drawings and specifications that are necessary to define the design features of an aeronautical product in compliance with the standards applicable to the aeronautical product;
 - (ii) the information on dimensions, materials and manufacturing processes that is necessary to define the structural strength of an aeronautical product;
 - (iii) the approved sections of the *Aircraft Flight Manual (AFM)*, where required by the applicable standards of airworthiness;
 - (iv) the airworthiness limitations section of the instructions for continued airworthiness specified in the applicable chapters of the AWM; and

- (v) any other data necessary to allow, by comparison, the determination of the airworthiness and, where applicable, the environmental characteristics of later aeronautical products of the same type or model.

(Ref: Subsection 101.01(1) of the CARs).

3.0 BACKGROUND

- (1) With the implementation of Subpart 521 of the CARs, new documents have been created to support the regulations. All guidance material such as Staff Instructions (SIs), ACs and Policy Letters that supported the previous CARs including Chapters 511, 513, 591 and 593 of the AWM have been reviewed and the relevant material included in the 521 series ACs and SIs.
- (2) This AC is organized to mirror Sections and Subsections of Division VI, of Subpart 521 of the CARs, so that it can be easily read in conjunction with Subpart 521 of the CARs.
- (3) Although Subpart 521 of the CARs introduced a change in terminology in the English version from “compliance” to “conformity” this AC will be using “compliance” wherever possible to minimize confusion in this document.

Note:

In December 2010, a Notice of Proposed Amendment (NPA) to CAR 521 (NPA 2010-021) was introduced to revert the terminology “conform” and “conformity” back to “comply” and “compliance”.

4.0 OVERVIEW OF THE REPAIR DESIGN APPROVAL PROCESS

- (1) The requirements that must be fulfilled to obtain an RDA as a result of a repair are defined in Divisions VI— *Repair Design Approvals* and IV— *Changes to a Type Design* of Subpart 521 of the CARs. This AC should be used in conjunction with AC 521-004.
- (2) Section 521.251 of the CARs defines to whom and what this division applies.
- (3) Section 521.253 of the CARs defines the requirements of an applicant for an RDA.
- (4) Sections 521.254 and 521.255 and 521.157 to 521.160 of the CARs define what actions are required by an applicant for an RDA document.
- (5) Sections 521.256, 521.257 and 521.161 of the CARs define the requirements of the design approval issuance and subsequent revisions.

5.0 PRE-APPLICATION PHASE

5.1 Application — Section 521.251

- (1) Section 521.251 of the CARs applies to applicants and holders in respect of a repair of an aeronautical product.
- (2) The actions and requirements of the applicant may be undertaken by a person acting as their representative. However, such an arrangement in no way relieves the applicant of their responsibilities to the CARs.
- (3) Any Canadian individual or organization may apply for an RDA. Canadian design approval documents are not issued directly to foreign applicants. Refer to Division XI of Subpart 521 of the CARs for more information on foreign applicants.

5.2 Eligibility Requirements — Section 521.252

- (1) Section 521.252 of the CARs requires the applicant to have or have access to the required technical capabilities specific to the repair under consideration. An applicant could meet this requirement by:
 - (a) Having a level of knowledge and capability appropriate for the repair; or
 - (b) Showing that an arrangement exists for the applicant to have access to a level of knowledge and capability appropriate for the repair.
- (2) For more detailed information on how the Minister determines technical capability, refer to AC 521-002.

6.0 PHASE I — APPLICATION AND ESTABLISHING CERTIFICATION BASIS**6.1 Application for a Repair Design Approval — Section 521.253**

- (1) The applicant applies for an RDA by completing Transport Canada Form, 26-0469, *Design Change Approval Application*, (or alternate TCCA accepted form or process).
- (2) The application is to be accompanied by:
 - (a) a repair design description;
 - (b) a proposed certification basis; and
 - (c) a certification plan, where appropriate, as required by Section 521.155 of the CARs.
- (3) There are two types of repairs that can be applied for:
 - (a) A single repair is a repair that can be incorporated on a single aeronautical product intended to rectify damage resulting from an incident/accident or normal deterioration. This type of RDA shall be limited to a single aircraft serial number or for rotatable parts to a single serial number component. This type of repair shall only apply to a specific aeronautical product. E.g. an RDA on a non-detachable part of the aircraft structure such as a main spar recorded against the aircraft serial number.
 - (b) A process repair design is applicable to several units of a given type of aeronautical product where the repair is suitable for repeated incorporations during overhaul and maintenance activities. Such repairs are usually intended to correct the effects of normal deterioration associated with the aeronautical product; and may be used as alternative repairs to those repair schemes normally provided by the manufacturer of the aeronautical product. For example, an RDA intended to restore the interior wall of a landing gear oleo strut by a honing repair process, which may be repeated during overhauls and installed on different products should be applied for against the component manufacturers' name and part number of the oleo strut assembly.
- (4) For additional details of the application process, including submittal procedures refer to AC 521-004.

6.2 Certification Basis — Section 521.254

- (1) RDAs will have a certification basis as defined by Subsection 521.158(2) of the CARs.

7.0 PHASE II — ESTABLISHING MEANS OF COMPLIANCE AND TRANSPORT CANADA CIVIL AVIATION LEVEL OF INVOLVEMENT

- (1) SI 521-004 provides information on establishing means of compliance and TCCA's level of involvement.

8.0 PHASE III — DEMONSTRATE AND RECORD COMPLIANCE**8.1 Compliance with Certification Basis — Section 521.255**

- (1) Section 521.255 of the CARs:
- (a) requires the applicant to comply with Section 521.160 of the CARs in regards to compliance with the certification basis; and
 - (b) defines the effective period of an application for the approval of a repair to the type design as per section 521.156 of the CARs.

Note: Section 521.160 of the CARs will point the applicant back to Section 521.44 with respect to Inspections and Tests. More information on Inspections and Tests can be found in AC 521-002.

- (2) In demonstrating compliance with the certification basis, it is the complete repaired product, and not just the repair itself, that is to be considered.
- (3) The following are examples of some areas that may have been considered in the original approval of the aeronautical product. Continued compliance after repair is to be shown where applicable:
- (a) Structural strength (static, strength, hardness, flexibility);
 - (b) Fatigue life;
 - (c) Damage tolerance;
 - (d) Corrosion protection;
 - (e) Noise attenuation;
 - (f) Thermal conductivity;
 - (g) Accessibility for maintenance;
 - (h) Vibration;
 - (i) Colour and reflectance (e.g. ultraviolet absorption, thermal radiation);
 - (j) Process specifications (nitriding, etc.);
 - (k) Surface finish, aerodynamic smoothness;
 - (l) Environmental factors, such as heat, cold, reduced pressure at altitude;
 - (m) Electrical conductivity (lightning strike);
 - (n) Electronic Magnetic Interference protection;
 - (o) Flammability protection; and
 - (p) Failure modes and effects analysis.

8.2 Analyses, Inspections and Tests

- (1) Considerations that may be an acceptable means of demonstrating compliance with the associated airworthiness standards should include:
- (a) Demonstration that the repair represents a negligible change to the form, fit and function of the aeronautical product being repaired, and, other than improved reliability or durability, that it does not enhance the functionality of the aeronautical product being repaired;
 - (b) Conduct all tests, analyses and inspections necessary to demonstrate compliance with the applicable airworthiness standards. Comparative analyses may contribute towards meeting this requirement, but shall not be used alone. Test and computation are the only means by which an applicant may demonstrate compliance with the applicable airworthiness standards:

- (i) test means testing related to the criticality and complexity of the repair. If required, the component testing shall be designed to test the performance and durability of the repair to the extent required by the applicable airworthiness standards. Certification testing (as opposed to developmental testing) include protocols such as conformity inspections of the test article and acceptance of a proposed test plan that should be discussed and agreed to by the regional engineer before proceeding with the testing. The tests must be supported by appropriate analysis and engineering assessment to both the next higher assembly, and the aeronautical product as a whole of the consequences should the repair fail to perform its intended function;
- (ii) computation means demonstration by analysis that the design of the repair meets the requirements of all applicable airworthiness standards. This analysis should discuss how the repair meets these requirements and address elements such as material composition, condition, fabrication, configuration, and interface with other parts;
- (c) Ensure that the repair complies with the certification basis, that no interference with mating or adjacent hardware occurs, and that the repaired product performs its intended function;
- (d) Demonstrate that the repair can be manufactured and installed on the aeronautical product in compliance with pertinent drawings and/or instructions; and
- (e) Demonstrate that the operating and maintenance instructions, if affected, provide adequate information for safe operation and continuing airworthiness of the repaired product.

9.0 PHASE IV — APPROVAL OF A REPAIR

9.1 Issuance of a Repair Design Approval — Section 521.256

- (1) Section 521.256 of the CARs defines the requirements for the issuance of an RDA.
- (2) The applicant must provide a signed undertaking signed by the intended holder to fulfill the responsibilities of a design approval document holder. More information on this item is provided in AC 521-004.
- (3) The issuance of an RDA signifies that the repair design is approved by the Minister and the approval forms part of the aeronautical product type design, when the repair is incorporated.
- (4) The certificate numbering system shall be specified by TCCA. TCCA is responsible for issuing certificate numbers, including those of delegates.
- (5) An RDA may be issued to record the approval of either a single repair, or a process repair. See section 6.1 of this AC for detailed information on these types of repairs.

10.0 PHASE V — POST CERTIFICATION ACTIVITIES

10.1 Change to a Repair Design Approved in a Repair Design Approval — Section 521.257

- (1) Section 521.257 of the CARs refers the holder of an RDA, who proposes to make a change to the repair design approved in the RDA, to comply with the requirements in Section 521.152 of the CARs.
- (2) Changes to an RDA that are major (not minor), shall be treated as an alternate configuration of repair that restores airworthiness and may be processed as a new RDA or as an alternate

configuration added to the existing RDA via a reissue. Minor changes shall be dealt with under Section 521.154 of the CARs.

11.0 INFORMATION MANAGEMENT

(1) Not applicable.

12.0 DOCUMENT HISTORY

(1) Not applicable.

13.0 CONTACT OFFICE

Suggestions for amendment to this document are invited, and should be submitted to:

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Transport Canada documents or intranet pages mentioned in this document are available upon request.