

Technical Airworthiness Authority Advisory (TAA Advisory)	
Title	Structural Non-Standard Repairs
TAA Advisory Number	2019-07e
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TAM Reference	Part 3, Chapter 2 – Design Change Certification
OPI / Telephone	DTAES 7-2 / 819-939-4790
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1. Purpose

- 1.1 This Technical Airworthiness Authority (TAA) Advisory provides clarification on the regulatory requirements and the appropriate process for categorizing structural repairs.
- 1.2 Given their nature, structural repairs are difficult to categorize by using the standard categorization questionnaire for the design change process described in the Technical Airworthiness Manual (TAM) (reference 3.2.a), Part 3, Chapter 2, Section 2. To avoid mis-categorizations, the method described in this advisory requires a determination of whether or not the proposed repair is within the envelope of already approved or specified data, as defined in paragraph 3.1. In short, if the repair is covered by existing approved or specified data, no additional certification activity is required. Otherwise, the data generated in the design of the repair must show that the repair meets the Certification Basis of the fleet.

2. Applicability

- 2.1 This TAA Advisory can be used by TAA-accredited Acceptable Technical Organizations (ATOs) and Acceptable Design Organizations (ADOs) whose scope of authority includes design repairs for DND/CAF-registered aircraft.
- 2.2 The scope of this advisory is limited to the structure of the aircraft, which includes repairs to the following:
 - a. Aircraft structure (including landing gear);
 - b. Seats and their associated mountings;
 - c. Cockpit and cabin furnishings, equipment racks, mission consoles, etc.;
 - d. Transparencies;
 - e. Radomes; and
 - f. Control surfaces.
- 2.3 The following exceptions apply:
 - a. Any aircraft structural repairs that are linked to the embodiment of modifications to portions of a fleet, or to the entire fleet, will be categorized according to the process described in TAA Advisory 2019-03 (reference 3.2.b).
 - b. The TAA may accept, either from Weapon System Management (WSM) organizations or from industry organizations, other structural repair process(es), as defined by recognized regulatory authorities, when applicable and documented in the Aerospace Equipment Program Management (AEPM) Division's Engineering Process Manual (EPM) (C-05-005-P12/AM-001)

or the fleet's EPM Supplement (EPMS). TAA Advisory 2016-04 (reference 3.2.c) provides a list of all airworthiness authorities recognized by the TAA.

- c. When there is an operational need to return to service the structurally damaged aircraft, the use of a deviation to the Approved Maintenance Program is the appropriate method to allow temporary repairs or deferrals, while maintaining the airworthiness of the affected aircraft. Following the deviation process will require an Airworthiness Impact Assessment (AWIA) to support the deviation. If the AWIA determines that the temporary repair or deferral will result in the aircraft operating below an acceptable level of safety, a Record of Airworthiness Risk Management (RARM) must be staffed to support the deviation. Operational pressure shall not infringe on the need for proper certification of repairs. While deviations are available to expedite or delay repairs due to an urgent operational need, they are temporary by definition and should not be constantly used to streamline the workflow at a repair facility.

3. Related Material

3.1 **Definitions.** The definitions for most of the airworthiness-related terms in this document can be found in the TAM (reference 3.2.a) Glossary. The following definitions are not in the TAM Glossary:

- a. **Aircraft Maintenance Engineer (AME).** A Transport Canada licenced aircraft maintenance technician that has the authority to allow an aircraft to return to service by signing a maintenance release, and thereby maintaining the validity of the Certificate of Airworthiness for that specific aircraft.
- b. **Approved Data.** Data approved through an acceptable certification process. This includes:
 - (1) type certificates, approved modifications via Aerospace Modification Approval Forms (AMAFs), supplemental type certificates, repair design approvals, including Non-Standard Repairs (NSRs), part design approvals, Canadian Technical Standard Order (CAN-TSO) design approvals, approved Canadian Forces Technical Orders (CFTOs), including equivalent foreign documents that have undergone the type design examination process set out in TAM (reference 3.2.a) Part 2, Chapter 5; and
 - (2) other drawings and methods approved by the TAA, or authorized individual, in accordance with TAM Part 2.
- c. **Non-Standard Repair (NSR).** Repair instructions for a defect that cannot be addressed by the Approved Maintenance Program. Many civil regulators and civil-approved organizations use the term “repair design,” which is equivalent to NSR. NSRs are designed and certified for specific tail numbers, in most cases for a single tail number. This means that the NSR can only be considered approved data for the specific tail number for which it was designed. It follows that a NSR must be re-evaluated before being re-used for other aircraft.
- d. **Specified Data.** Information contained in authoritative documents, which – although not approved by the TAA – has been specified by the TAA or authorized individual as appropriate for the purpose of modifications and repairs in conformity with TAM Part 3, Chapter 2. In effect, specified data is approved indirectly when referred to in approved documents, such as the ones described in 3.1.b. The following are examples of specified data:
 - (1) drawings or methods described or referenced in Airworthiness Directives, approved modifications (via AMAFs), or approved NSRs;
 - (2) data issued by the manufacturer of the aircraft, component or appliance, such as modification orders, service bulletins or engineering orders, which include a statement of approval by the TAA, or a delegated representative of any such authority. Where the data issued by the aircraft manufacturer are incompatible with those of the component or appliance manufacturer, the data of the aircraft manufacturer shall prevail;
 - (3) manufacturer's Structural Repair Manuals (SRMs) (as defined in 3.1.e); and

- (4) recognized Military Airworthiness Authority (MAA)/Civil Aviation Authority (CAA) Advisory Circulars proposing generic repair or alteration methods, when there are no manufacturer repair or maintenance instructions.
- e. **Structural Repair Manual.** A compendium of structural repairs. There are three different types of SRMs:
 - (1) **Aircraft-specific SRM:** Contains repairs and methods designed for use on a specific aircraft type. If the document is approved and therefore part of the fleet's Approved Maintenance Program, repairs specified in this type of SRM can be used without further review or approval by engineering;
 - (2) **Original Equipment Manufacturer (OEM) SRM:** Contains repairs and methods that can be applied to any of the OEM products. Some examples are the Boeing, Lockheed or Northrop design manuals. This kind of manual is not considered approved data, but applicable parts can be referenced as specified data in repair designs, as long as the manual is up to date and recognized as valid by the appropriate OEM. If the currency or validity of this type of SRM cannot be verified with the OEM, then any information used requires full engineering review and certification; and
 - (3) **RCAF generic manuals:** The TR series of CFTOs make up this category, and these manuals are considered too generic to be used as specified data. Engineering uses the TR series as useful reference information to design a repair, which would still require a full engineering review and certification.

3.2 References

- a. [C-05-005-001/AG-001](#) – Technical Airworthiness Manual (TAM)
- b. [TAA Advisory 2019-03](#) – Design Change Categorization – Major or Minor
- c. [TAA Advisory 2016-04](#) – Recognition of Airworthiness Authorities

4. TAA Regulatory Requirements

4.1 TAM Rule 3.2.2.R1 – Design Change Categorization states the following:

- “1. Where a proposed design change is assessed for its potential effects on airworthiness and categorized as minor by an authorized individual, in accordance with 3.2.2.S1, no further airworthiness certification activity is required. Sufficient technical data must be available to substantiate and formally document the categorization.

ADVISORY NOTE

Although no technical airworthiness approval requirements are attached to a minor design change, other requirements such as the details and control of the design change must still be met. These include description documentation, publication amendments, maintenance program changes, etc.

- 2. Where a proposed design change is assessed and categorized as Major by an authorized individual, in accordance with 3.2.2.S1, design change certification shall be conducted in accordance with the rules and standards of this chapter.”

NOTE

It is important to note that a TAC is still required for minor design changes, to cover potential logistics aspects.

4.2 TAA staff's experience shows that the use of design change categorization checklists (DCCC) for the purpose of determining the type of NSR/repair design is not an effective classification method. As a result, a DCCC for a Minor/Major assessment of a repair is not required to determine certification requirements for a NSR/repair design. Instead, NSR/repair design certification requirements (Minor/Major) can be determined by the data used to support the development of the NSR/repair design. The certification requirements for repair will be actioned according to the methodology provided in this advisory.

5. Discussion

5.1 Structural Repair Categories

5.1.1 The Transport Canada structural repair process permits minor repairs to be normally handled by AMEs, while major repairs must first be approved by Delegated Engineers. For structural repairs, Transport Canada's methodology for defining a minor repair facilitates a quick response to many small, less significant repairs. However, within the DND/CAF Airworthiness Program, the RCAF aircraft maintenance technicians are neither trained, nor qualified as AMEs, and therefore do not have the same authorizations and latitude to carry out minor structural repairs without the involvement of engineering.

5.1.2 For repairs to DND/CAF aircraft, RCAF technicians are provided with a set of 'approved' or 'certified' repairs in a SRM that details standard repairs to be applied without the involvement of engineering. Standard repairs can also be found in a fleet's Approved Maintenance Manual. A defect that cannot be addressed by a repair specified in the SRM is considered a design change to the Approved Maintenance Manual, and the resulting repair will be identified as a NSR. To avoid the widely encountered issues with the minor/major categorization of NSRs, the guidance provided in this TAA advisory should be followed. NSRs can be categorized based on the availability of certification data, which results in two categories: "in accordance with existing approved or specified data", or "not in accordance with existing approved or specified data." The remainder of this advisory will deal with NSRs for these two data availability categories.

5.2 NSRs in Accordance with Existing Approved or Specified Data

5.2.1 In cases where an engineering organization can certify the repair by using existing approved or specified data, as defined in paragraphs 3.1.b and 3.1.d, there is no requirement for additional certification data. This approved or specified data must contain information showing that the condition that is reported in the NSR is indeed maintained within the certified limits.

5.2.2 Repairs not requiring additional certification data are simpler to develop but nonetheless require substantiation to comply with documentation requirements. Even if no additional certification data is required, a repair substantiation must be plainly evident so it can be reviewed, reused or audited. The link to approved/specify data and applicability to the aircraft of concern must be clear, unambiguous and well documented.

5.2.3 An example of NSR that would not require additional certification data would be a blend-out on a part that exceeds SRM blend out depth limits, but where the measured part thickness at the blend-out is still greater than if the blend-out limit were applied to the lower drawing tolerances (e.g., if the part was manufactured thicker than the minimum drawing tolerance, and this extra thickness was greater than the blend-out depth exceedance of the SRM blend-out limit). In this case, the approved drawings contained the needed approved or specified data, and no engineering calculations were needed. The NSR substantiation must make reference to the drawing number, version and appropriate dimensions.

5.2.4 This type of NSR requires no additional certification activity, since the existing airworthiness approval based on previously approved/specify data is still valid. The level of review of the technical engineering work requires the same degree of engineering independence as with any

technical work documentation (prepared/reviewed/approved). As a result, the following elements must be documented (no Findings of Compliance and Design Change Categorization are required in this case):

- a. Repair Instruction – required.
- b. Structural Substantiation – required: this is where the previously approved/specified data is listed and the applicability to the current situation established.
- c. Approval – technical approval only, no airworthiness component is required.

5.2.5 For the repair described at para 5.2.3, if the final thickness of the material ends up being below the minimum specified on drawings (including tolerances) with the SRM blend-out limit applied, then a calculation or engineering assessment will be required to substantiate the continued use of the repaired component. This would then be a NSR based on newly-developed data (per Section 5.3) and findings of compliance will be required against the appropriate certification basis elements, as discussed in Section 5.5.

5.3 NSRs Not in Accordance with Existing Approved or Specified Data

5.3.1 If no previous certification data is available to certify the repair, it must be generated by analysis, comparison, equivalent strength or any acceptable engineering method. A NSR not in accordance with previously approved or specified data must be certified based on newly developed data, which supports proper findings of compliance against the certification basis. This newly developed data generally expands on the existing approved/specified data.

5.3.2 For example, the equivalent strength calculations shall be certified against the appropriate sections of the aircraft certification basis, and associated design standards and specifications. It is not appropriate to assume that a repair automatically meets the certification basis based on a qualitative equivalent strength review (“passed by inspection” or “passed by comparison”). This kind of qualitative assessment must clearly show why no further analysis is required. For example, a substantiation reading “The loss of area from the blend-out is no greater than the loss of area from the attachment hole in the adjacent net section. The hole has higher stress concentrations (kt) in comparison to the blend-out, and the blend-out does not affect the stress concentration of the hole. Therefore, this blend-out is cleared by comparison”, with the appropriate description of locations, would be acceptable.

5.3.3 Although all repairs need to meet the certification basis, to ensure efficiency, the method of compliance can be adapted to the criticality of the structure. For example, repairs to primary structure, such as a wing carry-through bulkhead, may need a more in-depth and elaborate substantiation, including (but not limited to) finite element analysis, crack growth models, testing, etc. Alternatively, repairs to secondary or tertiary structure, such as fairings, may be substantiated by less involved methods.

5.3.4 For certification purposes, the documentation requirements for this type of NSR are documented in AF9000 procedures or EPMS, as applicable. The certification basis matrix described in Section 5.5 can be used as a guide to establish a certification basis. Design change categorization is not required.

5.4 Repeat NSRs

5.4.1 Re-using existing repairs for new and similar (or even identical) damage is a common practice, which is summarized in the following paragraphs.

5.4.2 When the existing repair has been certified by using a certification matrix, this matrix can serve as a basis for the new certification matrix. The new repair must have its own certification matrix,

however the line signatures can refer to the previous repair's matrix. Section 5.5 and Annex A contain the information required to complete the certification matrix.

5.4.3 In some cases, repairs that are re-used pre-date the current airworthiness certification system and, therefore, have no certification matrices attached. In this case, the previous repair is still valid but findings against a certification matrix are required for the re-use of the repair. The findings can be substantiated using the engineering work that was developed for the original repair, thus requiring no new engineering work, but certification is required in accordance with the current airworthiness procedures. Any changes or improvements to the previous repair need substantiation and re-certification.

5.4.4 It is important to remember that a NSR is designed for a single tail number and for a very specific defect. The fact that it is approved for one tail number does not necessarily make it applicable to other aircraft. For a repair to be made applicable to all aircraft of a given fleet (or a specific configuration), it must take into consideration all possible configurations and defects, and be technically ready for insertion into the SRM. Standard repairs require significant engineering effort to produce a costly and time-consuming process, which is incompatible with the short response times normally required of most NSRs. A standard repair has to go through a design effort that is similar to a fleet-wide design change or modification. Only a few NSRs are ever made into standard repairs, and only when the cost/benefit analysis shows it to be advantageous. For those reasons, it is not practical to develop every NSR into a repair that can be applied to any aircraft without the need for certification.

5.5 NSR Certification

5.5.1 Structural NSR certification matrices are largely similar, and cover a set of standard certification criteria. As such, once set, they can be re-used 'as-is'. Exceptions include very specific cases, such as repairs that involve other specialties (such as flight sciences or mechanical systems) where appropriate lines need to be added to the certification basis. A sample of a certification matrix is provided in Annex A to this advisory, for illustration purposes only. Matrices can be tailored to meet specific fleet and certification requirements. Advice on customizing a fleet certification matrix for structural repairs may be requested from the following OPIs:

- DTAES 7-2 – for fixed-wing fleets; and
- DTAES 7-3 – for helicopters.

5.5.2 For the purposes of NSR certification, a NSR can only use approved data from the same specific aircraft type. Generic CFTOs (e.g., the TR series) are not considered approved data. An approved NSR is limited to a specific repair, for a specific aircraft tail number. As described in paragraph 5.4.4, unless approved as a standard repair, the NSR is not transferable as a possible repair to other damage or aircraft without re-certification.

ANNEX A
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Sample Certification Matrix for Structural Repairs

This sample is provided for illustration purposes only. Certification Matrices are tailored to specific fleet and certification requirements. Specific guidance may be requested from DTAES 7-2 – for fixed-wing fleets; and DTAES 7-3 – for rotary-wing fleets.

Applicable Requirements TCCA AWM 525 (change)	Compliance Method ¹	Remarks	Documents	References	Compliant? (Y, N, N/A)	Authority for Compliance
AWM 525 Subchapter C –Structure – General						
Factor of safety						
525.303 (change -)			EXAMPLE: PV-15-0001-SR	EXAMPLE: PV-15-0001-TRPT C-12-130-000/MN-001		
Strength and Deformation						
525.305 (a) (<i>Change 525-8</i>)						
525.305 (b) (<i>Change 525-8</i>)						
Proof of Structure						
525.307 (a) (<i>Change 525-3</i>)						
Flight Loads						
525.321 (a) (<i>Change 525-8</i>)						
General Emergency Landing Conditions						
525.561 (a) (<i>Change 525-8</i>)						
525.561 (b) (<i>Change 525-8</i>)						
525.561 (c) (<i>Change 525-8</i>)						
525.561 (d) (<i>Change 525-8</i>)						
Damage-tolerance and Fatigue Evaluation of Structure						
525.571 (a) (<i>Change 525-8</i>)						
525.571 (b) (<i>Change 525-8</i>)						
525.571 (c) (<i>Change 525-8</i>)						
AWM 525 Subchapter D – Design and Construction						
General						
525.601 (<i>Change -</i>)						
Materials						
525.603 (a) (<i>Change -</i>)						
525.603 (b) (<i>Change -</i>)						
525.603 (c) (<i>Change -</i>)						

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Applicable Requirements TCCA AWM 525 (change)	Compliance Method ¹	Remarks	Documents	References	Compliant? (Y, N, N/A)	Authority for Compliance
Fabrication Methods						
525.605 (a) (Change -)						
525.605 (b) (Change -)						
Fasteners						
525.607 (a) (Change -)						
525.607 (b) (Change -)						
525.607 (c) (Change -)						
Protection of Structure						
525.609 (a) (Change -)						
525.609 (b) (Change -)						
Accessibility Provisions						
525.611 (a) (Change -)						
525.611 (b) (Change -)						
Material Strength Properties and Material Design Values						
525.613 (a) (Change 525-3)						
525.613 (b) (Change 525-3)						
525.613 (c) (Change 525-3)						
525.613 (e) (Change 525-3)						
525.613 (f) (Change 525-3)						
Special Factors						
525.619 (a) (Change -)						
525.619 (b) (Change -)						
525.619 (c) (Change -)						
Casting Factors						
525.621 (a) (Change -)						
525.621 (b) (Change -)						
525.621 (c) (Change -)						
525.621 (d) (Change -)						
Bearing Factors						
525.623 (a) (Change -)						
525.623 (b) (Change -)						

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Applicable Requirements TCCA AWM 525 (change)	Compliance Method ¹	Remarks	Documents	References	Compliant? (Y, N, N/A)	Authority for Compliance
Fitting Factors						
525.625 (a) (<i>Change 525-3</i>)						
525.625 (b) (<i>Change 525-3</i>)						
525.625 (c) (<i>Change 525-3</i>)						
525.625 (d) (<i>Change 525-3</i>)						
Additional Airworthiness Standards, Special Conditions or Exemptions						
-	N/A					
Airworthiness Approval Signature in Section A2						