NOTICE OF PROPOSED AMENDMENT (NPA) NO 2010-02

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION SAFETY AGENCY

Amending Decision No 2003/01/RM of the Executive Director of the European Aviation Safety Agency of 17 October 2003 on acceptable means of compliance and guidance material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations ("AMC and GM to Part-21")

"Improvement of GM to 21A.101"

(Establishment of the type-certification basis of Changed Aeronautical Products)

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A. Explanatory Note

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending Decision No 2003/01/RM of the Executive Director of 17 October 2003[1] on acceptable means of compliance and guidance material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations ("AMC and GM to Part-21"). The scope of this rulemaking activity is outlined in the Terms of Reference (ToR) 21.018 and is described in more detail below.

2. The European Aviation Safety Agency (hereinafter referred to as the Agency) is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation[2] which are adopted as "Opinions" (Article 19(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 19(2)).

3. When developing rules, the Agency is bound to follow a structured process as required by Article 52(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as "The Rulemaking Procedure"[3].

4. This rulemaking activity is included in the Agency's Rulemaking Programme for 2010-2013. It implements the rulemaking task 21.018 "Improvement of GM 21A.101".

5. The text of this NPA has been developed by the Agency based on the input from the Changed Product Rule International Implementation Team (CPR-IIT) established by a joint decision of the US Federal Aviation Administration (FAA), Transport Canada Civil Aviation (TCCA) and the Agency. It is submitted for consultation of all interested parties in accordance with Article 52 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.

II. Consultation

6. To achieve optimal consultation, the Agency is publishing the draft decision of the Executive Director on its Internet site. Comments should be provided within 3 months in accordance with Article 6(4) of the Rulemaking Procedure. Comments on this proposal should be submitted by one of the following methods:

CRT: Send your comments using the Comment-Response Tool (CRT) available at **http://hub.easa.europa.eu/crt/**.

E-mail: In case the use of CRT is prevented by technical problems, these should be reported to the CRT webmaster and comments should be sent by e-mail to NPA@easa.europa.eu.

Correspondence: If you do not have access to Internet or e-mail, you can send your comment by mail to:

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1 Decision as last amended by Decision 2009/011/R of 24 August 2009.

2 Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.03.2008, p. 1).

3 Management Board decision concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material (Rulemaking Procedure), EASA MB 08-2007, 13.6.2007.

Process Support
Rulemaking Directorate
EASA
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be submitted by 17 June 2010. If received after this deadline, they might not be taken into account.

III. Comment response document

7. All comments received in time will be responded to and incorporated in a comment response document (CRD). The CRD will be available on the Agency's website and in the Comment-Response Tool (CRT).

IV. Content of the draft decision

Scope and applicability

8. The scope of this rulemaking task and content of this NPA is a proposal for an improved content of the guidance material GM 21A.101 (ref. Section D "Changes to type-certificates and restricted type-certificates" of "AMC and GM to Part-21"). GM 21A.101 provides guidance on application of paragraphs 21A.101 and 21A.19 of Part-21 (Annex to the Regulation 1702/2003[4]) for establishing the type-certification basis for airworthiness certification of changed aeronautical products (aircraft, engines and propellers)[5]. GM 21A.101 is not intended to be used for designation of the applicable environmental protection requirements.

9. Paragraph 21A.101 contains procedural requirements for designation of the applicable certification specifications and environmental protection requirements for airworthiness and environmental certification of a change to a type-certificated product[6]. 21A.101 applies to design changes applied for either by the type-certificate holder (see 21A.92) to be approved as a change to the existing type-certificate under the procedures of Subpart D or by applicants for supplemental type-certificates (STCs) and their changes under the procedures of Subpart E (see 21A.112 and 21A.117). The main objective of 21A.101 is the determination of the conditions and criteria, including the criteria for classification of a change as *"significant"* or *"not significant"*, which are relevant for designation of the applicable airworthiness certification specifications for the type-certification basis of a changed product. The type design changes classified according to 21A.91 as *"minor changes"* are considered to be *"not significant"* under 21A.101 and are approved under 21A.95.

10. Paragraph 21A.19 determines the conditions under which an application for a new type-certificate will be required to certify a substantially changed product. 21A.19 applies to changes found so extensive that a substantially complete investigation of compliance with an updated type-certification basis established in accordance with 21A.17 is required. Such changes are referred to as *"substantial changes"*.

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4 Commission Regulation (EC) No 1702/2003 of 24 September 2003 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (OJ L 243, 27.9.2003, p. 6). Regulation as last amended by Commission Regulation (EC) No 1194/2009 of 30 November 2009 (OJ L 321, 8.12.2009, p. 5).

5 According to 21A.604(b) in Subpart O of Part-21 the procedural requirements of Subpart D (including 21A.101) and E are also applicable for approval of design changes to Auxiliary Power Units (APUs). See also paragraph 43 below.

6 According to 21A.91 in Subpart D of Part-21 the references to type-certificates include type-certificate and restricted type-certificate.

Background

11. The content of Part-21 and AMC and GM to Part-21, as initially issued in 2003, was based on the content of JAR-21 (Amendment 5) of the Joint Aviation Authorities (JAA) as a formal transposition of JAR-21 into the new EU legal framework. Consequently, the content of paragraphs 21A.19, 21A.101, and related guidance material GM 21A.101 was based on the corresponding paragraphs JAR 21.19, JAR 21.101 and ACJ 21.101 of JAR-21 in Amendment 5.

12. 21A.19, 21A.101, and GM 21A.101 have not been amended since the initial issues of Part-21 and AMC and GM to Part-21. Their current contents still correspond in substance to the contents of the corresponding JAR 21.19, JAR 21.101 and ACJ 21.101 of JAR-21 after Amendment 2 (introduction of CPR rule changes to JAR 21.19 and JAR 21.101), Amendment 3 (introduction of a new ACJ 21.101) and Amendment 5 (postponement of the original effective dates and upgrade to ACJ 21.101).

13. Therefore, the current content of 21A.19, 21A.101, and GM 21A.101 can still be considered a result of a harmonised rulemaking activity by the FAA, JAA and TCCA which led to important amendments to the corresponding paragraphs of their respective certification codes and adoption of new revisions of the applicable advisory/guidance material to support their implementation. This rulemaking activity and the resulting changes to the rules are known under the title “Changed Product Rule” or in short “CPR”.

14. The CPR was a milestone in certification of major changes to type-certificated aeronautical products as it introduced a fundamentally different approach to designation of the applicable requirements for establishing the applicable certification basis. CPR has replaced the previous “bottom-up approach”, in which the applicant could choose to comply by default with the requirements incorporated by reference in the type certificate, with a new “top-down approach”, which requires the applicant to comply by default with the latest airworthiness requirements unless the applicant is able to demonstrate that the proposed change meets one of the conditions of the 21.101 permitting in specific cases use of earlier requirements.

15. At the time CPR became finally effective (June 2003), a joint team was set up by the FAA, JAA and TCCA to monitor and standardise the CPR implementation process. The team was composed of representatives of the FAA, TCCA, JAA NAAs and later the Agency and was active under the name “Continuous Improvement Team” (CIT) from September 2003 until September 2005. The results of the CIT activity, which also involved consultations and meetings with the North American and European industry representatives, are recorded in the CIT’s Final Report. The Final Report contains 12 recommendations addressed to one or more of the three Authorities. The main conclusion of the CIT was that despite several areas were identified for potential improvements the CPR implementation process went smoother than originally expected with no major implementation problems reported. According to the industry, CPR was not a major burden for them. On the other side, the CIT Final Report stressed the fact that the actual number of changes classified as significant was considerably smaller than originally expected. This finding raised a question about efficiency of CPR implementation in achieving its main objective, i.e. the use of later airworthiness standards for the certification basis of changed products.

16. In 2007, the FAA, TCCA and the Agency formed a new team that under the name “CPR International Implementation Team” (CPR-IIT) aimed to serve a similar purpose – to oversee and evaluate CPR implementation. Its Charter (Terms of Reference) tasked the CPR-IIT to evaluate more recent experience gained and lessons learned by each authority from implementation of CPR and recommend, as necessary, harmonised changes to their applicable guidance material and to their respective implementation policies for CPR. The ToR for the CPR-IIT indicated a number of implementation issues to be evaluated and addressed as necessary.

17. CPR-IIT has investigated those issues and concluded that changes to 21.101 are not necessary and that these issues can be addressed through appropriate changes to the applicable guidance material. Under the lead of the FAA and TCCA and as supported by the Agency, the CPR-IIT prepared a draft of revised guidance material in the format of a draft FAA AC (21.101-1A). Two workshops (Industry outreach meetings) were held, the first one in Cologne on 23 September 2009, the second one in Washington D.C. on 7 October 2009, in order to introduce representatives of the European and North American industry into the intent and substance of the amendments to be proposed for a revised guidance material, and get a preliminary feedback.

18. On 15 January 2010, the FAA published a draft FAA AC 21.101-1A for comments with the commenting period closing on 26 February. Comments on the FAA draft AC and comments on this EASA NPA are planned to be disposed jointly by the CPR-IIT to achieve a guidance material harmonised to the greatest extent possible.

Main changes against the current GM 21A.101

19. The format of the proposed GM 21A.101 has changed compared to the previous format. The new format has introduced a different numbering and rearranged the text in new chapters, sections and appendices. Some parts of the GM text have been rewritten using different wording to make the guidance more precise and clear. However, these wording changes have not introduced any changes of substance. As to the presentation of these more or less formal changes and text rearrangements in this NPA, the standard means for their highlighting would make the text difficult to read and see the actual changes to be noted. Therefore, the original GM 21A.101 text has been replaced by the revised text without changes highlighted. The purpose of the following paragraphs is to point out and briefly describe the changes to be noted.

20. The Figure 1 with the process flow chart is amended to introduce certain new tasks (see paragraphs 21, 22, 23, 26 and 27 below) required to be performed by the applicant.

21. Prior to identifying the proposed change, the applicant is requested to identify the reference type design configuration of the product to be changed. Guidance is provided with examples (see chapter 3, paragraph 2(a)).

22. More detailed guidance with examples is provided on how to take into consideration and evaluate for cumulative effects all the previous relevant changes made since the last update of the applicable certification specifications of the type-certification basis (see chapter 3, paragraphs 2(b) and (c)).

23. When identifying the proposed change, the applicant is requested to first describe the change using high-level descriptions to characterise the intent or the reason for the change before going to details (see chapter 3, paragraph 2(d)).

24. Guidance is provided on the criteria for “substantially complete investigation” for classification under 21A.19 (see chapter 3, paragraphs 3(b) and (c)). However, it was recognised that more detailed guidance and detailed criteria for application of 21A.19 would be needed with consideration of potential changes to the rule itself. Such a task was, however, found to be out of the scope of the current CPR-IIT Charter and the issue was deferred for a future rulemaking action.

25. It is clarified that if an applicant voluntarily decides at the beginning of the process to use the latest certification specifications for the proposed change, then the process stops and no further classification or justification is needed since the intent of the rule was met (see chapter 3, section 4).

26. A new step (step 4 – Arrange changes into related and unrelated groups) is introduced into the process, requesting the applicant to determine if any of the individual changes from which the overall proposed change is composed, considering also the previous relevant changes, are related to each other or not. Guidance is provided with examples on how to create groups of related changes and identify the changes considered unrelated (stand-alone) (see chapter 3, section 5).

27. The guidance for the classification whether the proposed change is significant (see chapter 3, section 6) is expanded to provide more details to applicants on how to evaluate, separately for each grouping of related changes and for each unrelated change, if they trigger, either separately or in an accumulation, one or more of the three automatic criteria for a significant change.

28. The amended guidance clarifies that while the applicant is responsible for making the assessment “significant/not significant” for the proposed change and providing appropriate justifications, the final determination of this classification is retained by the Agency (see chapter 3, paragraph 6(k)).

29. More detailed guidance is provided on the determination of adequacy of the type-certification basis, including consequences of finding that the proposed type-certification basis has inadequate or missing standard in relation to the proposed change (see chapter 3, paragraphs 6(h)(3) and 8(c); and chapter 4, section 3).

30. More detailed guidance with examples is provided for the “secondary changes”, including their description and relation to the “would not materially contribute to safety” exception as a qualification criteria for a secondary change (see chapter 3, paragraph 6(i)).

31. Guidance is provided with examples on how to maintain improved design features in areas affected by a significant change when they do not meet the latest certification specifications but exceed those in the existing TC. Guidance describes conditions for acceptance of those design features based on a justification that compliance with the latest certification specifications “would not materially contribute to the level of safety” or would be “impractical” (see Chapter 3, paragraph 10 (a)(1) and (b)(2)).

32. The guidance on how to use the “impracticality” rationale is improved and supplemented by examples (see chapter 3, paragraph 10(b)(3)).

33. A new reference is made to design-related operating requirements (such as referred to in EU-OPS) to be considered when showing of compliance (see chapter 4, section 1).

34. The guidance for the “excepted” products under 21A.101(c) is supplemented by application of the “automatic criteria” to support the classification if the change is “significant in an area” (see chapter 4, section 2).

35. The guidance for use of special conditions according to 21A.101(d) is improved clarifying that the fact of “missing or inadequate standards” in the proposed type-certification basis justifies the application of special conditions.

36. Clarifications have been made throughout the guidance material on who bears the burden for what actions in various steps of the process, i.e. what are the obligations and responsibilities of the applicant and what are the obligations and the responsibilities of the Agency.

37. The content of tables in the Appendix 1 “Classification of changes” has been amended to introduce new examples, to change some previous classifications in the three columns against the automatic criteria, to detail some change descriptions and rationales, and to remove certain inconsistencies and errors identified. All the changes made in the tables are traceable.

38. The Appendix 2 “Procedure for Evaluating Impracticality of Applying Latest Certification Specifications to a Changed Product” has been revised to introduce new

segmentation and numbering of the text. Some paragraphs have been partially reworded but without changing the substance of the information given. A detailed highlighting of all the (mainly formal) changes would not help the readers to identify the changes to be noted and could make the text difficult to read. Therefore, the current Appendix 2 is replaced in full with a revised version. The changes to be noted are in Example 2: paragraphs (1), (2), (3)(d), (7)(b), and (9).

39. The Appendix 3 "The use of Service Experience in the Certification Process" has been amended by minor wording changes but the text has not been changed in substance. The changes are traceable.

40. The new Appendix 4 contains updated and complemented definitions and terminology used in the revised GM 21A.101. The new Appendix 5 contains updated references to related Part-21 requirements.

Main changes against the draft FAA AC 21.101-1A

41. The text of the proposed GM 21A.101, as presented in section B below, is a result of a transposition by the Agency of the draft AC 21.101-1A prepared by the CPR-IIT. This transposition was necessary to adapt the draft AC text to the EU legal framework and to reflect the differences which still exist between the (EU) Part-21 and FAR Part 21. These differences result from the different legal frameworks, different regulatory developments and the fact that the system of EU regulations for aviation is not yet fully developed. Paragraphs below discuss and justify the main differences.

42. Compared to the draft FAA AC, GM21A.101 is also applicable to changed products with a restricted type-certificate (see 21A.90 in Subpart D). The applicability of GM 21A.101 was expanded accordingly. It should be noted that the Part-21 concept of restricted type-certificates is similar to but not the same as the FAR Part-21 concept of type-certificates for aircraft in the restricted category (see Chapter 1, section 3).

43. Compared to the draft FAA AC, GM 21A.101 is also applicable to design changes to approved Auxiliary Power Units (APUs). Despite the fact that APUs are considered ETSO articles and not products, some certification procedures for products, including those in Subpart D and E of Part-21, are applicable to APUs (see 21A.604(b) in Subpart O of Part-21). The applicability of GM 21A.101 was expanded accordingly. Just for the purpose of this GM 21A.101 and its easier readability, APUs were added to the definition of "products" to which GM 21A.101 applies (see Chapter 1, section 3).

44. 21A.101 of (EU) Part-21 does not have an equivalent for 14 CFR § 21.101(f) since (EU) Part-21 does not contain equivalents for 14 CFR § 21.17(b) (Special Classes Aircraft), § 21.24 (Primary category aircraft), § 21.25 (Restricted category aircraft, including military aircraft designs), § 21.27 (Surplus military aircraft). Consequently, the relevant parts of the FAA AC text applicable to "other category aircraft" had to be removed from GM21A.101.

45. The references and guidance in the draft FAA AC for application of the retroactive airworthiness requirements 14 CFR §§ 23.2, 25.2, 27.2 and 29.2 were removed since the EASA CSs (CS-23, CS-25, CS-27 and CS-29) do not contain corresponding paragraphs.

46. 21A.101 of (EU) Part-21 does not contain an equivalent for 14 CFR § 21.101(g) which refers to FAR Part-26 (Requirements for continued airworthiness and safety improvements). An EU equivalent for FAR Part 26 has not yet been adopted. Consequently, the relevant parts of the AC text referring to 21.101(g) and Part-26 were removed from GM 21A.101.

47. Apart from the above changes of substance, the standard formal changes (such as the replacement of ‘the FAA’ by ‘the Agency’) have been made to reflect the EU regulatory framework. Also, the terminology of GM 21A.101 had to be adapted to fit the terminology used in Part-21 and, in particular, in the 21A.101.

V. Regulatory Impact Assessment

48. Purpose and Intended Effect

a. Issue which the NPA is intended to address

(Note: see paragraphs 11-18 for background)

Since the harmonised CPR rule became effective in June 2003, a considerable certification experience has been gained by the authorities (the FAA, TCCA and the Agency), as well as by the affected industry stakeholders (product designers and modifiers), from practical application of the new CPR approach in a number of certification projects for changed products.

Whilst the certification experience has not revealed any fundamental problems hindering the CPR implementation, certain issues or areas with a room for improvement were identified and brought to the attention of the CPR-IIT established jointly by the authorities to monitor and standardise the CPR implementation. The CPR-IIT was charted to evaluate 17 specific issues of attention and recommend changes, if considered necessary, to the applicable guidance material.

The CPR-IIT evaluated these 17 issues in detail with the conclusion that some of them need to be addressed by a substantially complete revision of the applicable guidance material. Changes to the 21.101 were not found as a condition necessary to deal with these issues. The CPR-IIT prepared a draft of a revised guidance material which intends to address the identified implementation issues.

b. Scale of the issue

An introduction of the proposed improved guidance would affect conduct of all the certification projects in which CPR is to be applied, i.e. the projects of certification of significantly changed type-certificated products (aircraft of all categories, engines, propellers) and APUs. The proposed guidance would affect both the applicants and the Agency's certification staff involved in the application of the CPR in the applicable certification projects.

c. Brief statement of the NPA objectives

The objective is to provide the applicants for changes to type-certificated products with an improved guidance material for application of the paragraphs 21A.101 and 21A.19 of Part-21 for establishing the type-certification basis of changed products. The improved guidance will reflect the experience and lessons learned so far from the application of CPR and will address identified implementation issues.

49. Options

a. The options identified

Option 1: Do nothing

Option 1 is used just as a reference baseline for the Option 2.

Option 2: Amend GM 21A.101 to introduce a new improved guidance material based on the draft text prepared by the CPR-IIT, as adapted by the Agency to fit the EU/Part-21 regulatory framework.

b. The preferred option selected

See paragraph 49 below.

50. Sectors concerned

Designers of major type design changes to type-certificated and restricted type-certificated aircraft, engines and propellers and approved APUs.

51. Impacts

a. All identified impacts

i. Safety

Option 1: None

Option 2: No major safety impacts have been identified because the rules 21A.101 and 21A.19 remain unchanged. However, establishment of the correct type-certification basis for a changed product is of safety relevance for the certified product. Any error in the designation of the applicable certification specifications or an error in determining their correct amendment level may have an adverse impact on safety. Option 2 is therefore envisaged to have a positive safety impact.

ii. Economic

Option 1: None

Option 2: Option 2 has a potential to make the CPR related certification processes more transparent, understandable and smoother which could reduce, both for the Agency certification staff and the applicants, the administrative burden and related certification cost.

iii. Environmental

No environmental impacts have been identified.

iv. Social

No social impacts have been identified.

v. Foreign comparable regulatory requirements

The CPR related rules (21.101 and 21.19) of the FAA and TCCA and the applicable guidance material are harmonised to the greatest extent possible with corresponding regulatory and guidance material of the Agency. Common objective of the authorities is to maintain or, if possible, to improve the level of harmonisation in any further developments of the CPR rules and the applicable guidance material.

b. Equity and fairness in terms of distribution of positive and negative impacts among concerned sectors.

No equity and fairness impacts have been identified.

52. Summary and Final Assessment

a. Comparison of the positive and negative impacts for each option

In contrary to the reference Option 1, Option 2 would reflect the experience gained by the authorities and lessons learned from applications of CPR in certification projects. The proposed amended GM 21A.101 would further facilitate the application of the CPR by means of a more transparent, clearer and precise guidance for designation of the applicable certification specifications for the type-certification basis of changed products with a positive effect on their safety. The proposed improved guidance material should also facilitate a more transparent and smoother conduct of the CPR related certification projects with envisaged reduction in the related administrative burden and cost.

b. Final assessment and recommendation of a preferred option.

After due consideration, adoption of the improved guidance material under Option 2 is recommended as the preferred option.

B. PROPOSALS

The text of the amendment is arranged to show deleted text, new text or new paragraph as shown below:

1. deleted text is shown with a strike through: ~~deleted~~
2. new text is highlighted with grey shading: new
3. … indicates that remaining text is unchanged in front of or following the reflected amendment.

Proposal 1: GM 21A.101 Establishing the type-certification basis of Changed Aeronautical Products

Replace existing GM 21A.101 with the following:

Book 2

SUBPART D CHANGES TO TYPE-CERTIFICATES AND RESTRICTED TYPE-CERTIFICATES

GM 21A.101 Establishing the type-certification basis of Changed Aeronautical Products

Foreword

This GM provides guidance for the application of the Changed Product Rule, 21A.101 and 21A.19, for changes made to type-certificated aeronautical products.

Chapter 1. Introduction

1. Purpose

a. The Agency wrote this GM to provide guidance for establishing the type-certification basis for changed aeronautical products and to help identify if it will be necessary to apply for a new type-certificate.

b. 21A.101 requires an applicant for a change to a type-certificate to comply with the airworthiness code that applies to the changed product and that is in effect on the date of application for the change, except:

- when the change is not significant,
- in areas, systems, components, parts or appliances of the product not affected by the change,
- when it would not contribute materially to the level of safety of the changed product, or
- when it would be impractical.

c. The intent of 21A.101 is to enhance safety through the incorporation of the latest certification specifications in the type-certification basis for changed products to the greatest extent practicable. This GM describes the application of 21A.101 and details the conditions when the latest airworthiness certification specifications for the certification of changes to aircraft, aircraft engines, and propellers must be used, and in which cases it is possible to use earlier amendments to these specifications.

d. 21A.19 identifies the conditions under which an applicant for a type design change is required to submit application for a new type-certificate. This GM provides guidance on the stage of the process at which this assessment is to be performed and helps explain the criteria for application of 21A.19 for the determination of substantial changes.

e. All changes within the scope of this GM must be approved by the Agency. The applicant may comply with earlier amendments of the airworthiness code consistent with the requirements of 21A.101(b) and (c) discussed later in this GM.

f. This GM describes an acceptable means, but not the only means to comply with 21A.101. However, if an applicant chooses to use the means described in this GM, they must follow it entirely.

Note: This GM is not intended to be used to determine the applicable environmental protection requirements (aircraft noise, fuel venting and exhaust emission requirements) for changed products.

2. Intended Audience

This GM is for applicants applying for major changes to type design under 21A.97, for applicants applying for supplemental type-certificates (STCs) under 21A.113, or applying for major changes to STCs under 21.117 (b).

3. Applicability

a. Reserved.

b. This GM applies to major type design changes under 21A.101 for aeronautical products type-certificated, restricted type-certificated or supplemental type certificated under Part-21 and the applicable CS (CS-VLA, CS-22, CS-23, CS-25, CS-27, CS-29, CS-VLR, CS-31HB, CS-E, CS-P and CS-APU).

c. Minor type design changes are approved under 21A.95, and are not considered to be significant under 21A.101.

d. This GM also applies to changes requiring a new type-certificate under 21A.19.

e. For the purpose of this GM the term aeronautical products, or products, means type-certificated or restricted type-certificated aircraft, engines, and propellers or approved Auxiliary Power Units (APUs).

f. This GM is not intended to be used to determine the applicable environmental protection requirements (aircraft noise, fuel venting and exhaust emission requirements) for changed products.

Chapter 2. Overview of 21A.19 and 21A.101

1. 21A.19

a. 21A.19 requires an applicant to obtain a new type-certificate (TC) for a changed product if the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable type-certification basis is required. The applicant should propose whether the type design change will require a new type-certificate. The Agency will review the proposal and determine if a new TC is required. When a new type-certificate is required the type-certification basis is determined in accordance with 21A.17.

b. Changes that require a substantial re-evaluation of the product's compliance findings (referred to as "substantial changes") will require application for a new type-certificate as required by 21A.19. For guidance see section 3 of Chapter 3 below and appendix 1 for examples of type design changes that will require a new type-certificate.

c. If the Agency has determined through 21A.19 that the proposed design change does not require a new type-certificate, then see 21A.101 for the applicable certification specifications to develop the type-certification basis for the proposed design change.

2. 21A.101

a. 21A.101(a) requires a change to a type-certificate to comply with the certification specifications of the latest amendment of the applicable airworthiness code, unless the change meets one of the criteria for the exceptions identified in 21A.101(b) and (c).

b. An applicant can comply with certification specifications of an earlier amendment of the airworthiness code consistent with the requirements of 21A.101(b), when:

- a change is not significant (see 21A.101(b)(1)), or
- an area, system, component, part or appliance is not affected by the change (see 21A.101 (b) (2)), or
- compliance with the latest amendment for a significant change does not contribute materially to the level of safety (see 21A.101(b)(3)), or
- compliance with the latest amendment would be impractical (see 21A.101(b)(3)).

c. Note that earlier amendments may not precede either the corresponding airworthiness code incorporated in the type-certificate.

d. 21A.101(b) pertains to changes for which an earlier amendment of the airworthiness code provides adequate standards. In cases where design changes involve features that have no associated airworthiness standard in the existing type-certification basis, the Agency will review the proposed type-certification basis to ensure the adequacy of the certification specifications for the proposed design change. Later amendments and/or special conditions will be applied if the earlier standards are deemed inadequate to cover the proposed change.

e. 21A.101(b)(1) allows the applicant to comply with an earlier amendment when the Agency determines the change is not significant. 21A.101(b)(1)(i) and (ii) pertain to changes that meet the automatic criteria where the change is significant. 21A.101(b)(2) and (b)(3) allows the use of an earlier amendment for significant changes for areas, systems, components, parts or appliances of the product not affected by the change and for cases where compliance to the latest certification specifications would not contribute materially to the level of safety or would be impractical. Note that earlier amendments may not precede the corresponding airworthiness code incorporated in the type–certificate.

f. 21A.101(c) provides an exception from the requirements of 21A.101(a) for a change to certain aircraft with less than specified maximum weight. If the applicant applies for a type design change to an aircraft (other than rotorcraft) of 2 722 kg (6,000 pounds) or less maximum weight, or to a non-turbine powered rotorcraft of 1 361 kg (3,000 pounds) or less maximum weight, the applicant can show that the changed product complies with the type-certification basis incorporated by reference in the type-certificate. The applicant can also choose to comply with a later amendment. Note that if the Agency finds that the change is significant in an area, it will designate compliance with a later amendment to the type-certification basis incorporated by reference in the type-certificate that applies to the change and any certification specification the Agency finds directly related, unless the Agency finds it would not contribute materially to the level of safety of the changed product or would be impractical. See chapter 4, section 2 in this GM for specific guidance on this provision.

g. 21A.101(d) provides for the use of special conditions, under 21A.16B, when the proposed type-certification basis and any later amendment do not provide adequate standards to the proposed change .

h. 21A.101(e) prescribes the effective period an application will remain valid for a change. This section is consistent with the requirements of 21.17 for a new type-certificate.

Chapter 3. The Process for Establishing the Type-certification Basis for Changed Products 21A.101(b)(1)

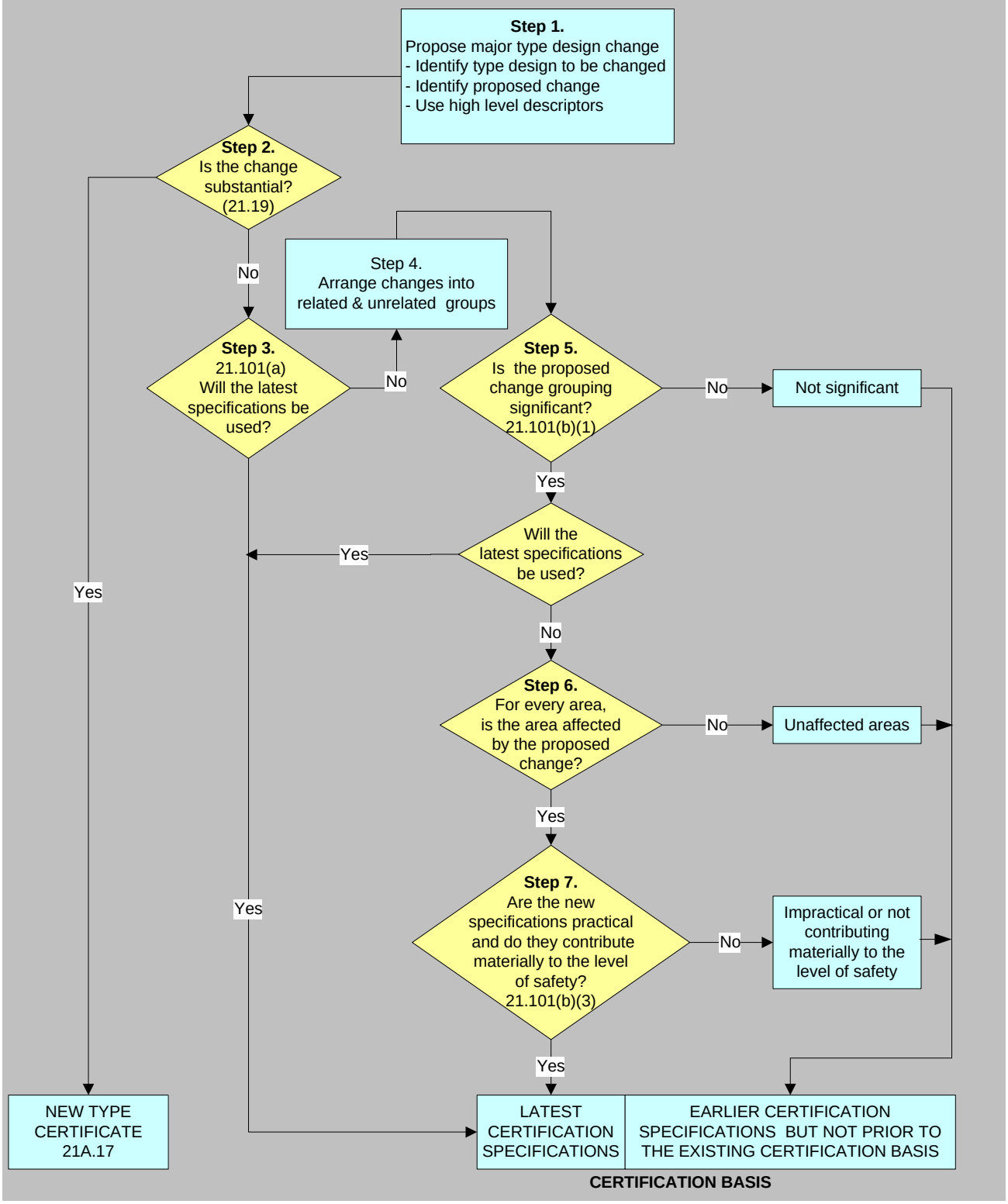
1. Overview

a. Both the applicant and the Agency have responsibility under 21A.101. The applicant should make a preliminary classification whether the change is significant or not significant, and propose an appropriate type-certification basis. The Agency has the responsibility to determine whether the applicant's classification of the change and proposal for the type-certification basis are acceptable. The type-certification basis can vary depending on the magnitude and scope of the change. The steps below present a streamlined approach for making this determination. In addition to assisting in the determination of significance and establishing the type-certification basis, this guidance will help to establish the appropriate amount of coordination required between the applicant and the Agency.

b. Classifications of typical type design changes are in the tables of appendix 1, *Classification of Changes*. See paragraph 5(c) of this chapter for instructions on how to use the appendix 1 tables.

c. In cases where the examples in appendix 1 are not applicable for the proposed change, use the following steps in conjunction with Figure 1 on the next page to develop the appropriate type-certification basis for the type design change. All other areas of the aircraft are considered to be unchanged or not affected by the change and may continue to comply with the existing type-certification basis.

Figure 1. Establishing the Type-certification Basis for Changed Product



2. Step 1 of Figure 1. Identify The Proposed Type Design Change To An Aeronautical Product

Step 1.
Propose major type design change
- Identify type design to be changed
- Identify proposed change
- Use high level descriptors

a. Prior to describing the proposed change(s), it is important to clearly identify the type design configuration to be changed. A series of derivative aircraft (or engines, propellers, etc.) (for example, x-100, x-200, x-300) may evolve based on predecessor type designs, each with its own design changes that make it distinct from the other series. The applicant should identify which series or model number within that series is the specific configuration that will be modified.

Note: An STC is not a product; it is a change to a product.
When changing or amending an STC the starting point is the existing modified product (TC with existing STC installed).

For example, if an applicant were amending an STC for an external cargo locker and the applicant proposed changing the configuration of the locker, then the starting point would be the existing TC with the existing STC installed. The applicant would then compare that configuration (TC with existing STC installed) to the changed product (TC with proposed amended STC installed).

b. Changes to a product can include physical design changes, changes to an operating envelope and/or performance changes. The change can be a single change or a collection of changes. The purpose of this process step is to identify and describe the change to the aeronautical product. The applicant for a type design change should consider all previous related design changes. For example, for a change to a type-certificate, the related design changes to be considered are those incorporated since the last time the applicable certification specifications for the change in the type-certification basis were upgraded.

Note: Substantiating data for the proposed type design change can include compliance findings from a previously approved design change, in supporting compliance findings for the proposed change. However, the applicant's proposal to use previously approved compliance findings should be considered part of the entire proposed type design change and should be approved as part of the proposed design change. Previous classification (such as significant yes/no determination) of a previous design bears no relevance for the proposed design change.

c. When identifying the changes being proposed as part of a modification, consider previous relevant changes that create a cumulative effect, as these may influence the decisions regarding substantial and significant changes later in the process. By previous relevant changes those design changes are meant whose effects accumulate, such as successive thrust increases, incremental weight increases, or sectional increases in fuselage length. Any previous relevant design changes that did not involve an upgrade of the existing type-certification basis should be taken into account in the next design change proposal.

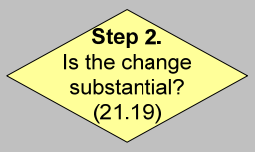
(1) Example 1: A 5% weight increase is currently being proposed, but a previous 10% and another 15% weight increase has been incorporated into this aircraft without upgrading the existing type-certification basis. In the current proposal for a 5% weight increase, the cumulative effects of the two previous weight increases that did not involve upgrade of the type-certification basis will now be accounted for as a 30% increase in weight, for the purpose

of making the substantial and/or significant decisions. Note that the cumulative effects to be considered are only those incremental increases from the last time the applicable certification specifications in the type-certification basis were upgraded.

(2) Example 2: The type-certificate for aeroplane model X lists three series, namely X-300, X-200, and X-100. The X-300 is a derivative of the X-200 which is a derivative of the original X-100 series. An applicant proposes a design change to the X-300 series aeroplane. During the review of the X-300 type-certification basis and the certification specifications affected by the proposed change, it was identified that one certification specification CS-25.571 (damage tolerance) remained at the same amendment level as the X-100 original type-certification basis (derogation from 21A101(a) was allowed). Since the amendment level for this particular regulation was not changed for the two subsequent aeroplane series (X-200 and X-300), the cumulative effects of these two previous design changes that are related to the proposed change and the damage tolerance requirements should now be addressed.

d. To identify and describe the proposed changes to any aeronautical product, use a high level description of the design change that characterises the intent of, or the reason for, the change. No complex technical details are necessary at this stage. For example, a proposal to increase maximum passenger-carrying capacity may require an addition of a fuselage plug, and as such a “fuselage plug” becomes one possible high-level description of this design change.
Similarly, a thrust increase, a new or complete interior, an avionics system upgrade, or a passenger-to-cargo conversion are all high level descriptions that characterise typical changes to the aircraft, each driven by a specific goal, objective or purpose.

3. Step 2 of Figure 1. Is the change substantial?



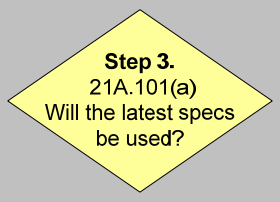
a. 21A.19 requires an applicant to obtain a new type-certificate (TC) for a changed product if the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required. A new TC could be required for either an extensive change to a previously type-certificated product or for a new design derived through a series of design changes from a previously type-certificated product.

b. A “substantially complete investigation” of compliance is required when most of the existing substantiation is not applicable to the changed product. A substantial change will require the need to re-comply with a large percentage (if not all) of the certification specifications applicable to a particular category of aircraft. It is not simply the number of certification specifications to which compliance must be re-established for the changed product that determines whether it is substantial, but rather the extent of effort to establish compliance, or the depth of investigation required to be done. In other words, the design change may be considered substantial if it is so extensive (making the product sufficiently different from its predecessor) that the design models, methodologies and approaches used to demonstrate a previous compliance finding could not be used in a similarity argument, since the data for the new model would most likely be extrapolated. A change is considered substantial when these approaches, models or methodologies of how compliance was shown must be re-validated to apply to the changed product. Also, extrapolation from previous data becomes unreliable or impossible, as the new product has changed to the extent that the baseline data is no longer relevant.

c. To address the question if a change is substantial at the beginning of the process, the applicant should evaluate the total or combined effect of all the proposed changes identified in Step 1, including the cumulative effects of previous relevant design changes since the last update of the type-certification basis (as explained in Step 1).

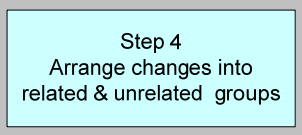
d. If it is not initially clear that a new TC is required, appendix 1 provides some examples of substantial changes to aid in this classification. A substantial change requires application for a new TC. Reference 21A.17 and 21A.19. If the change is not substantial, follow 21A.101.

4. Step 3 of Figure 1. Will the Latest Certification Specifications be Used?



a. The applicant can use the latest certification specifications for their proposed type design change. If the latest certification specifications are used, the applicant will have met the intent of 21A.101 and no further classification (significant or not significant) and justification is needed. If the latest certification specifications are not used, then proceed as follows:

5. Step 4 of Figure 1. Relation of Changes



a. Once the proposed changes are identified using high-level descriptions, the next step is to determine if any of these changes are related to each other. Related changes are those that cannot exist without another, are interdependent, or a prerequisite of another. For example, a need to carry more passengers could require the addition of a fuselage plug, which will result in a weight increase, and necessitate a thrust increase. Thus the fuselage plug, weight increase and thrust increase are all related high-level changes that will be needed to achieve the goal of carrying more passengers. A decision to upgrade the cockpit to more modern avionics at the same time as these other design changes may be considered unrelated, as the avionics upgrade is not necessarily needed to carry more passengers (it has a separate purpose, likely just modernisation). The proposed avionics upgrade would then be considered an unrelated (or a stand-alone) change. However, the simultaneous introduction of a complete new interior may be considered related if it is intended that the entire new cabin (and passengers) benefit from new or additional features offered by newer or improved technology (such as new entertainment system, new smoke detection system, use of lightweight seats, etc.), where otherwise the existing interior design or features could have simply been retained for the added fuselage plug.

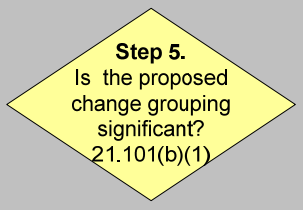
b. Once the change(s) are organised into groupings of those that are related and those that are unrelated (or stand-alone), the applicant is ready for Step 5 of Figure 1. The grouping of related and unrelated changes is particularly relevant to the significant Yes/No decision, (21A.101(b)(1)), described in Step 5 of Figure 1. Each group of related changes and each unrelated (stand-alone) change is evaluated on its own merit for significance. As such, there will be as many evaluations for significance as there are many groupings of related and unrelated changes.

c. After describing the groupings and the associated or supporting technical details for each change, the applicant should identify areas, systems, components, parts or appliances of the product that are affected by the design change and the corresponding regulatory standards associated with these areas. For each group, the applicant should assess the physical and/or functional effects of the change on other areas, systems, components, parts, or appliances of the product. The characteristics affected by the change are not only physical changes, but also

functional changes brought about by the physical changes. Examples of physical aspects are: structures, systems, parts, component and appliances, software in combination with the affected hardware. Examples of functional characteristics are performance, handling qualities, fire protection, aeroelastic characteristics, and emergency egress. The intent is to encompass all aspects where there is a need for re-evaluation, that is where the substantiation presented for the product being changed should be updated or rewritten.

d. All unaffected areas of the aircraft can continue to comply with the existing type-certification basis.

6. Step 5 of Figure 1. Is the Proposed Change Significant? 21A.101*(b)(1)*



a. In Step 5 it is the applicant's responsibility to justify that a grouping of related changes or an unrelated change does not qualify as a significant change. Significant changes are product level changes and are distinct from the vast majority of major changes. In general, these changes are either the result of an accumulation of changes or occur through an isolated extensive change that makes the changed product distinct from its predecessors. Step 1 explains the accumulation of changes that should be considered. Additionally, 21A.101(b)(1) defines a significant change as existing when one or more of three automatic criteria apply:

(1) **Changes where the general configuration is not retained (significant change to general configuration)**. A change to the general configuration at the product level that distinguishes the resulting product from other product models, for example performance or interchangeability of major components. Typically, for these changes an applicant will designate a new aircraft model number, although this is not required. For examples see appendix 1.

(2) **Changes where the principles of construction are not retained (significant change to principles of construction)**. A change at the product level to the materials and/or construction methods that affect the overall products' operating characteristics or inherent strength and would require extensive reinvestigation to show compliance. For examples see appendix 1.

(3) **Changes that invalidate the assumptions used for certification (significant change to the assumptions used for certification)**. A change to the assumptions associated with the compliance demonstration, performance or operating envelope that by itself is so different that the original assumptions or methodologies of demonstrating compliance are invalidated. For examples see appendix 1.

b. The above criteria are used to determine if each change grouping is significant. These 3 criteria are assessed at the product level. When applying the automatic criteria and the examples in appendix 1, the applicant should focus on the technical merits of the design change itself. Consideration of the regulatory importance or safety benefit only of the latest certification specifications is not a justification by itself to cause a design change to be classified or re-classified as a significant change.

c. Appendix 1 includes tables of typical changes for large aeroplanes, small aeroplanes, rotorcraft, and engines/propellers that meet the definition of significant. The appendix also

includes typical changes that do not achieve the significant level. The tables can be used in one of two ways:

(1) To classify a proposed change that is listed in the table, or

(2) In conjunction with the three automatic criteria, to help classify a proposed change not listed in the table by comparison to determinations made for changes with similar type and magnitude.

d. In many cases, a significant change may involve more than one of these criteria and will be obvious and distinct from other product improvements or production changes.

e. Design changes can trigger one or more of the automatic criteria listed in 21A.101(b)(1)(i) and (ii) for the proposed design change. When assessing the design change grouping, consider the cumulative effect of previous relevant design changes. These design changes may have been incorporated through earlier changes in the type-certificate on changed areas related to the current proposed change and all the other areas, systems, components, parts, or appliances otherwise affected by the proposed change. The collective result may be a product considerably different from the latest updated type-certification basis for the product or model.

f. Each grouping of related changes and each unrelated (stand-alone) change, identified using high-level descriptions, will be evaluated to determine if it is a significant or not significant change. Use the tables in appendix 1 as guidance to make the classification of significant or not significant. One or more of the three automatic criteria in 21A.101(b)(1) were found in all cases where the changes were identified as significant. Experience has shown the concept of having only the three automatic criteria seems to fit most projects. Only when one or more of the three criteria is met can the type design change be considered significant. The starting point for assessing the cumulative effects of previous relevant design changes is from the last time the applicable certification specifications in the type-certification basis for the affected area, system, component, part, or appliance was upgraded.

g. Typically, a change to a single area, system, component, or appliance may not result in a product level change. However, there may be distinct cases where the change to a single system or component may, in fact, result in a significant change due to its effect on the product overall.

h. If an unrelated (stand-alone) change or a grouping of related changes is classified as:

(1) Significant (21A.101(a)). The applicant will comply with the latest amendment of the airworthiness code for certification of the changed product unless they can justify use of one of the exceptions provided in 21A.101(b)(2) and/or (3) to show compliance with earlier amendment(s). The final type-certification basis may consist of a combination of the latest, and earlier or existing TC basis certification specifications for the change.

(2) Not Significant (21A.101(b)(1)). The use of the earlier certification specifications, but not earlier than those which are recorded in the existing type-certification basis for the change or group of related changes being evaluated, is acceptable, unless the standards in the proposed type-certification basis are deemed inadequate. In cases where inadequate or no airworthiness standards are defined in the proposed type-certification basis for the design change but applicable standards already exist in a subsequent amendment to the airworthiness code, the subsequent amendment will be made part of the type-certification basis.

(3) Adequate Standards (21A.101(d) and 21A.21(b)(2)). Regardless of whether the change is significant or not, your proposed type-certification basis may be deemed inadequate – that is, the change includes features that were not foreseen in the

proposed type-certification basis. The change must comply with later airworthiness standards (such as, a later amendment or a special condition). An example is adding a flight critical system such as an electronic air data display on a CS-25 aeroplane whose existing type-certification basis did not have lightning and high intensity radiated fields (HIRF) protection certification specifications. In this case, compliance with the certification specifications for lightning and HIRF protection will be required for this not significant change.

i. Secondary Changes. A secondary change is a physical change that is part of and consequential to an overall significant change. A secondary change is a physical change that restores without changing the system, structural capacity or functionality, but is necessary to support a significant change. Based on this description, a secondary change is not required to comply with the latest certification specifications because it is considered “not contributing materially to the level of safety”, and therefore eligible for an exception under 21A.101. Determining whether a change meets the description for secondary change, and thus is eligible for an exception, should be straightforward. If this determination is not straightforward, then the proposed change is very likely not a secondary change.

(1) In some cases, however, the change which restores functionality may in fact contribute materially to the level of safety by meeting a later amendment. If this is the case, it would not be considered a secondary change. For example, a simple rerouting of a wire to accommodate the installation of a cargo door may not add any new capacity, but it may implicate a later amendment such as 25.981, fuel tank ignition prevention.

(2) An example of secondary change is lengthening existing control cables passing through the new fuselage plug, to restore existing functions to systems that could be situated within or beyond the new plug. The lengthening of these cables can be accepted as not adding system capacity or capability, so these changes can be identified as secondary changes and not be required to meet the latest amendment. An example of what would not be considered a secondary change would be the replacement of existing smoke detectors with newer technology, addition of a circuit breaker in existing wiring, or replacing passenger windows with window plugs.

(3) The applicant can identify an affected area as a secondary change only if the change meets the description and can be substantiated or justified as not contributing materially to the level of safety according to paragraph (i) above. If the applicant plans to use the 21A.101(b)(3), the necessary supporting rationale should be provided.

j. A new model number designation to a changed product is not necessarily indicative that the design change is significant under 21A.101. Conversely, retaining the existing model designation does not mean that the design change is not significant. All changes are considered in light of the magnitude of the type design change.

k. Making the determination. The final determination of whether a design change is significant or not significant is retained by the Agency. To assist the applicant in their assessment, the Agency has predetermined the classification of several typical design changes that can be used for reference, and these examples are listed in appendix 1.

l. At this point, the determination of significant or not significant for each of the groupings of related changes and each stand-alone change has been made. For significant changes, if the applicant proposes to comply with an earlier requirement, the procedure outlined in paragraph 7 below should be used.

7. Proposing an Amendment Level for a Significant Change

a. If the classification of the change is significant, the applicant must comply with certification specifications of the applicable airworthiness code at the amendment level in effect on the date of application for the change (ref. 21A.101 (a)), unless they can justify use of the exceptions in 21A.101(b)(2) and (3) to show compliance with an earlier amendment but no earlier than the one in existing type-certification basis.

b. *Reserved.*

c. For areas not affected by the change, or areas affected by the change but compliance with later amendments in these areas would not contribute materially to the level of safety or would be impractical, the applicant should provide acceptable justification to support your rationale for the application of earlier amendments.

d. It is important when seeking to use earlier amendments that you demonstrate to us that an area, system component, parts, or appliance is not affected by the change or, when affected by the change, compliance with the latest amendment would not contribute materially to the level of safety, or would be impractical.

e. The final type-certification basis may combine certification specifications at the latest amendment level, earlier (intermediate) amendment levels, and the amendment level of the existing type-certification basis, but cannot contain certification specifications preceding the existing type-certification basis.

8. Selecting an Amendment Level for a Not Significant Change

a. When the type design change is classified not significant, the rule allows compliance with earlier amendments of but not prior to the existing type-certification basis.

b. The applicant can elect to comply with certification specifications at later amendments, but should consult the Agency to ensure that compliance will also be shown with any other certification specifications the Agency finds directly related. Some later certification specifications may be less restrictive. Ensure compliance with all associated certification specifications.

c. Adequacy of type-certification basis: The type-certification basis for a changed product under 21A.101 is considered adequate when the Agency determines that the designated certification specifications of the applicable airworthiness code (referenced in existing type-certification basis, later, or latest amendments) and prescribed special conditions ensure that physical features, performance characteristics and/or functions introduced by the design change do not result in any unsafe design features. These airworthiness standards are to be the highest practicable level of safety for the changed product, and not just for the change itself.

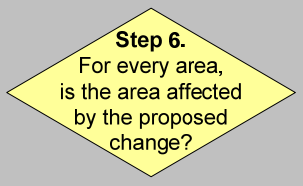
d. Exceptions in 21A.101(b)(2) and (3). Use the following steps with figure 1 when you wish to comply with an earlier requirement for a significant change:

e. For a group of related design changes or an unrelated design change that has been determined to be significant, 21A.101(b)(2) and (3) provide exceptions from the requirement of 21A.101(a). The applicant can comply with an earlier amendment level or with the existing type-certification basis for areas not affected by the change, and any areas affected by the change for which compliance with the latest certification specifications would not contribute materially to the level of safety or would be impractical.

f. The earlier amendments may not precede the corresponding certification specifications in the existing type-certification basis. It is important when seeking to use earlier amendments

that the applicant can demonstrate to the Agency that compliance with the latest certification specifications does not contribute materially to the level of safety, or is impractical.

9. Step 6 of Figure 1. Is the Area Affected By the Proposed Change? 21A.101(b)(2)



a. A not affected area is any area, system, component, parts, or appliance and their associated certification specifications that are not affected by the proposed type design change. For a type design change, it is important that the effects of such change on other areas, systems, components, parts, or appliances of the product are properly assessed because areas that have not been physically changed may still be considered part of the affected area. If a new compliance finding is required, regardless of its amendment level, it is an affected area. If the significant change does not affect the area, then the type-certification basis of that area needs not to be revisited, in other words the certification specifications associated with the unaffected area continue to be compliant to the existing amendment level without further substantiation.

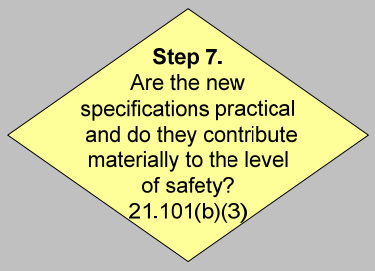
b. Consider the following aspects of a type design change:

- **Physical aspects.** The physical aspects include direct changes to structures, systems, parts, components and appliances (physical aspects include software changes and the resulting effect on hardware or systems).

- **Performance/functional characteristics.** The less obvious aspect of the word "areas" covers general characteristics of the type-certificated product, such as performance features, handling qualities, emergency egress, structural integrity, aeroelastic characteristics, or crashworthiness. These characteristics may be affected by a product level change. For example, adding a fuselage plug could affect performance and handling qualities, and thus regulations associated with these aspects would be considered part of the affected area.

c. All areas affected by the proposed design change must comply with the latest certification specifications, unless the applicant can show that demonstrating compliance with the latest amendment of a certification specification would not contribute to the level of safety or would be impractical. Step 7 provides further explanation.

10. Step 7 of Figure 1. Are the New Certification Specifications Practical and Do They Contribute Materially to the Level of Safety? 21A.101(b)(3)



a. Not contributing materially to the level of safety. Compliance with the latest certification specifications could be considered "not to contribute materially to the level of safety" if the existing type design and/or relevant experience demonstrates a level of safety comparable to that provided by the latest certification specifications. The applicant should provide sufficient

justification to allow the Agency to make this determination. This exception could be applicable in the situations described in the paragraphs below:

Note: Compliance with later certification specifications would not be required where the amendment is of an administrative nature and has been made only to correct inconsequential errors or omissions, consolidate text, or clarify an existing certification specification.

(1) Design features that exceed the existing certification specifications, but not the latest certification specifications, can be used as a basis for granting an exception under the "does not contribute materially" exception. These design features, if accepted as a justification for an exception, must be incorporated in the amended type design configuration and recorded, where necessary, in the basis of certification. For example[7], an applicant proposes to install winglets on a Part-25 airplane, and part of the design involves adding a small number of new wing fuel tank fasteners. The latest § 25.981 at amendment 25-102 requires structural lightning protection. The applicant proposes an exception from these latest structural lightning protection requirements because the design change uses new wing fuel tank fasteners with cap seals installed. The cap seal is a design feature that exceeds the requirement of § 25.981 at a previous amendment level, but does not meet the latest amendment 25-102. If the applicant can successfully substantiate that compliance with amendment 25-102 would not materially increase the level of safety of the changed product, then this design feature can be accepted as an exception to compliance with the latest amendment.

(2) Design:

- This provision gives the opportunity to consider the consistency of design. For example, when a small fuselage plug is added, additional seats and overhead bins are likely to be installed, and the lower cargo hold extended. These components may be identical to the existing components. The level of safety may not materially increase by applying the latest certification specifications. Similarly, there may be no safety benefit in applying later certification specifications to both new and unaltered components. Compliance of the new areas with the existing type-certification basis may be acceptable.

- However, if a fuselage plug is large enough in relation to the original certificated aircraft structure, seats, bins, doors, and cargo compartment, the change may require compliance with the latest certification specifications, comparable with what will be required for a new model airplane. In these circumstances the proposed type-certification basis should encompass the certification specifications in effect on the date of application for the change.

(3) Service experience: Relevant service experience, such as experience based on fleet performance or utilisation over time (relevant flight hours or cycles), is one way of showing that a later amendment may not contribute materially to the level of safety, so the use of earlier certification specifications could be appropriate. Appendix 3 provides additional guidance on the use of service experience, along with examples.

- There may be cases for rotorcraft and small aeroplanes where relevant data may not be sufficient or not available at all because of the reduced utilisation and the different amount and type of data available. In such cases, other service history information may provide sufficient data to justify the use of earlier certification specifications, such as: warranty, repair, and parts usage data; accident, incident, and service difficulty reports; service bulletins; airworthiness directives; or other pertinent and sufficient data collected by the manufacturers, authorities, or other

[7] This example is taken from the FAA experience gained prior to the Agency's start, therefore the references to the FAA sections and amendments are kept.

entities.

- The service experience levels necessary to demonstrate the appropriate level of safety as they relate to the proposed design change would have to be reviewed and agreed to by us.

b. Impractical. Compliance with the latest certification specifications may be considered impractical if the applicant can justify that it would result in additional resource requirements that are not commensurate with the incremental safety benefit (difference between the latest and the proposed type-certification basis). The additional resource requirements could include those arising from design changes required for compliance and the effort required to demonstrate compliance, but excludes resource expenditures for prior product changes.

(1) The position that compliance is impractical should be supported with a substantiating data and analyses. The Agency must agree with this position and while evaluating the applicant's position and their substantiating data regarding impracticality, the Agency may consider other factors (for example, the costs and safety benefits for a comparable new design).

(2) A review of large aeroplane projects showed that in certain cases, where an earlier amendment to applicable certification specifications was allowed, design changes were made to nearly comply with the latest amendments. In this case, the applicants were able to successfully demonstrate that full compliance would require a substantial increase in the outlay or expenditure of resources with a very small increase in the level of safety. These design features can be used as a basis for granting an exception under the "impracticality" exception.

(3) Appendix 2 provides additional guidance and examples for determining procedures for evaluating impracticality of applying latest certification specifications to a changed product rule.

(a) The exception of impracticality is a highly subjective assessment for which it is difficult to specify clear criteria. Experience to-date with applicants has shown that justification of impracticality is more feasible when both applicant and authority agree at an earlier discussion that the effort (in terms of cost, changes in manufacturing, etc.), required to comply would not be commensurate with a small incremental safety gain. This would be clear even without the need to perform any detailed financial analysis (although financial analysis could always be used to support an appropriate amendment level).

Note: The impractical exception should not be based on the size of the applicant's company or their financial resources. Costs to comply with a later amendment should be evaluated against the safety benefit of complying with the later amendment. Applicants with fewer resources may not be able to afford the cost of a product level change when it is comparable to the safety benefit achieved by complying with a later amendment.

(b) For example, a complex redesign of an area of a new derivative aircraft may be required to comply with a new certification specification, and that redesign may make the new derivative model uncommon with respect to design and manufacturing processes from the existing family of derivatives. Relevant service experience of the existing fleet of the derivative family would be required to show that there has not been a history of problems associated with the hazard that the new amendment in question was meant to address. In this way, the incremental cost/impact to the applicant is onerous and the incremental safety benefit that would be realised by complying with the later amendment would be minimal, and

this would be justified with a demonstrated acceptable service experience in relation to the hazard that the new rule addresses.

Chapter 4. Other Considerations

1. Design Related Operating Requirements. The use of exceptions under 21A.101 is not intended to alleviate or preclude compliance with operating regulations (such as EU-OPS) that prescribes compliance with the applicable retroactive airworthiness (design-related) requirements.

2. Excepted Products under 21A.101(c)

a. An applicant for a design change to an excepted product may show that the changed product complies with the existing type-certification basis incorporated by reference in the TC. If the Agency finds that the change is significant "in an affected area", the Agency will require compliance with a later amendment to the existing type-certification basis that applies to that affected area and any certification specification the Agency finds is directly related. For excepted products, changes that meet one of the following criteria, in the area of change, are automatically considered significant if:

b. The general configuration or the principles of construction are not retained, or

c. The assumptions used for certification of the product to be changed do not remain valid.

d. However, the Agency may allow the applicant to comply with an earlier amendment to the airworthiness code initially designated or with the existing type-certification basis if the Agency agrees to the applicant's justification.

e. For design change to an excepted product that contains new features, which are not covered in the existing type-certification basis, the Agency will designate the applicable certification specifications at the appropriate amendment level, beginning with the existing type-certification basis and progressing to the most appropriate later amendment level for the change. For a change that contains new design features that are novel and unusual for which there are no later applicable certification specifications at a later amendment level, the Agency will designate special conditions. Special conditions may also be applied under 21A.16B when the intended use of the changed product is unconventional or experience from other similar products in service or products having similar design features, has shown that unsafe conditions may develop.

f. The exception provided for excepted products under 21A.101(c) applies to the aircraft level only. Design changes to type-certificate d engines and propellers installed on these excepted aircrafts are assessed as separate products using 21A.101(a) and (b).

3. Special Conditions, 21A.101(d). 21A.101(d) allows for the application of special conditions, or for changes to existing special conditions, to address the changed designs where the proposed type-certification basis has missing or inadequate standards for an area, system, component, part or appliance related to the change. The objective is to achieve a level of safety consistent with that provided for other areas, systems, components, parts or appliances affected by the change by the other certification specifications of the proposed type-certification basis. The application of special conditions to a design change is not, in itself, a reason for it to be classified as either a substantial change or a significant change. When the change is significant with earlier certification specifications allowed through exceptions, or not significant, the level of safety intended by the special conditions should be consistent with the agreed type-certification basis. Special conditions may also be applied under 21A.16B when the intended use of the changed product is unconventional or experience from other similar products in service or products having similar design features, has shown that unsafe conditions may develop.

4. Effective Period for an Application to Change a Type-Certificate, 21A.101(e). According to 21A.101(e), an application for, or a change to, a type-certificate for large

aeroplanes and large rotorcraft is effective for 5 years, and an application for a change to any other type-certificate is effective for 3 years. This is intended to ensure that the type-certification basis for the changed product is as current as practical. This is consistent with the requirements of 21A.17 for a new type-certificate and defines the process of updating the type-certification basis if these time limits are exceeded.

5. *Reserved*

6. Documentation. All changes that result in a revision to the product's type-certification basis must be reflected on the amended TC or STC. The resulting type-certification basis should be retained as it forms part of the compliance record required by the applicable Agency's internal working procedures.

Appendix 1 to GM 21A.101
Classification of Changes

Book 2

SUBPART D CHANGES TO TYPE-CERTIFICATES AND RESTRICTED TYPE-CERTIFICATES

Proposal 2: Amend existing Appendix 2 to GM 21A.101 with the following:

~~Appendix 1 includes tables of typical changes for small aeroplanes (figure 1), large aeroplanes (figure 2), rotorcraft (figure 3), and engines/propellers (figure 4) that meet the definition of a significant change or substantial change for each product line. The Appendix also includes typical changes that do not achieve the significant level.~~

~~a) The examples in the tables were developed from data collected from regulatory files and included industry review and input. They clearly are changes that we have seen in the past and will likely continue to see in the future. The Agency has made the determination, based on applying the automatic criteria, that these changes are significant or not significant.~~

~~b) The columns "Change to General Configuration", "Change to Principles of Construction" and "Assumptions of Certification" reflect the automatic criteria of 21A.101(b)(1)(i) and (ii). The "Notes" column provides typical rationales that are considered in evaluating the designation of the criteria.~~

~~c) The tables may be used in one of two ways:~~

~~(i) to classify a proposed change that is listed in the table, or~~

~~(ii) in conjunction with the three automatic criteria, to understand the logic used in the table to help classify a proposed change not in the table.~~

~~d) The classification may change due to cumulative effects and/or combinations of individual changes~~.

The following tables of substantial and significant changes are adopted by the FAA, EASA and TCCA through an international collaboration. The classification may change due to cumulative effects and/or combinations of individual changes. The "N/A" indicated in the substantial example tables indicates "Not Applicable" at the "21A.19 Substantial Evaluation" phase.

~~**Figure 1. Table of e**~~
Examples of Changes for Small Aeroplanes (CS-23)

The following examples are for SUBSTANTIAL changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration? 21A.101(b)(1)(i)**	**Is there a change to the principles of construction? 21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 21A.101(b)(1)(ii)**	**Notes**
Change in wing location (tandem, forward, canard, high/low)	~~Yes~~ N/A	~~No~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Fixed wing to tilt wing	~~Yes~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Increase in the number of engines from one to two	~~Yes~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Replacement of piston or turbo-prop engines with turbojet or turbofan engines	~~Yes~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

The following examples are for SUBSTANTIAL changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration? 21A.101(b)(1)(i)**	**Is there a change to the principles of construction? 21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 21A.101(b)(1)(ii)**	**Notes**
Change in engine configuration (tractor/pusher)	~~Yes~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Increase from subsonic to supersonic flight regime	~~Yes~~ N/A	~~No~~ N/A	~~Yes~~ N/A	
Change from an all metal aeroplane to all composite primary structure (fuselage, wing, empennage)	~~No~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	~~Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.~~ Change in principles of construction and design from conventional practices. Likely change in design/certification assumptions.

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Conventional tail to T-tail or Y-tail, or vice versa	Yes	No	Yes	Change in general configuration. Requires extensive structural, flying qualities and performance reinvestigation. Requires new AFM to address performance and flight characteristics.
Changes in wing configuration, addition of tail strakes or change in dihedral, or changes in wing span, flap or aileron span, angle of incidence of the tail, addition of winglets, or wing sweep of more than 10%	Yes	No	Yes	Change in general configuration. Likely requires extensive changes to wing structure. Requires new AFM to address performance and flight characteristics. **NOTE:** Small changes to wingtip are not significant changes. See table for not significant changes.
Tricycle/tail wheel undercarriage change or addition of floats	Yes	No	No	Change in general configuration. Likely, at aeroplane level, general configuration and certification assumptions remain valid.
Increase in seating capacity resulting in a different certification category (e.g.,	Yes	Yes	Yes	Change in general configuration. Change in principles of construction. Requires extensive construction re-

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
from normal to commuter category) where configuration or principles of construction changes or assumptions do not remain valid.				assessment. Change in certification assumptions. Requires new AFM and pilot type rating.
Passenger to freighter configuration conversion which involves the introduction of a cargo door or an increase in floor loading of more than 20%, or provision for carriage of passengers and freight together	Yes	No	Yes	Change in general configuration affecting load paths, aeroelastic characteristics, aircraft related systems, etc. Change in design assumptions.
A fuselage stretch would be considered significant if it would invalidate the existing substantiation, or would change the primary structure, aerodynamics, or operating envelope sufficiently to invalidate the assumptions of certification.	Yes	No	Yes	Likely extensive changes to fuselage structure, aerodynamics, aircraft systems performance, and operating envelope. Requires new AFM to address performance and flight characteristics.

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Replace reciprocating engines with the same number of turbo-propeller engines where the operating envelope is expanded.	No	No	Yes	Invalidates certification assumptions. Requires new AFM to address performance and flight characteristics.
Addition of a turbo-charger that changes the power envelope, operating range, or limitations.	No	No	Yes	Invalidates certification assumptions due to changes in operating envelope and limitations. Requires new AFM to address performance and flight characteristics.
The replacement of an engine of higher rated power or increased thrust would be considered significant if it would invalidate the existing substantiation, or would change the primary structure, aerodynamics or operating envelope sufficiently to invalidate the assumptions of certification.	No	Yes	Yes	Invalidates certification assumptions. Requires new AFM to address performance and flight characteristics. Likely changes to primary structure. Requires extensive construction re-investigation.

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
A change in the type of material, such as composites in place of metal, or one composite fiber material system with another (e.g., carbon for fiberglass), for primary structure would normally be assessed as a significant change.	No	Yes	Yes	Change in principles of construction and design from conventional practices. Likely change in design/certification assumptions.
Change involving appreciable increase in design speeds Vd, Vmo, Vc, or Va.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
Short take-off and landing "STOL" kit.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
A change in the rated power or thrust is likely to be regarded as significant if the design speeds are thereby changed so that compliance needs to be re-justified with a majority of specifications.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
Fuel state: such as compressed gaseous fuels, or fuel cells. This could completely alter the fuel storage and handling systems and possibly affect the aeroplane structure.	No	No	Yes	Changes in design/certification assumptions. Extensive alteration of fuel storage and handling systems.
A design change that alters the aircraft flight characteristics or performance from the type design would normally be significant if it appreciably changes the kinematics or dynamics of the airplane.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Weight increase that places the aircraft into the commuter category (i.e., above 5670 kg (12,500 lbs)).	No	No	Yes	~~Changes in design and certification assumptions.~~ Certification assumptions invalidated. Requires new AFM. Compliance with commuter category rules is required. This change may be determined a substantial change.
A change in the flight control concept for an aircraft, for example to fly by wire (FBW) and side-stick control, or a change from hydraulic to electronically actuated flight controls, would in isolation normally be regarded as a significant change.	No	No	Yes	Changes in design and certification assumptions. Requires extensive systems architecture and integration reinvestigation. Requires new AFM.
~~Addition of~~ Increase in cabin pressurisation	No	Yes	Yes	A change greater than 5% in operational cabin pressure differential. Extensive airframe changes affecting load paths, fatigue

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				evaluation, aeroelastic characteristics, etc. Requires extensive construction reinvestigation. Invalidates design assumptions.
Changes in types and number of emergency exits or an increase in passenger capacity in excess of maximum passenger capacity demonstrated for the aircraft type.	No	No	Yes	Emergency egress requirements exceed those previously substantiated. Invalidates assumptions of certification. Commuter category emergency egress requirements apply.
A change in the required number of flight crew, which necessitates a complete cockpit re-arrangement, and/or an increase in pilot workload would be a significant change.	No	No	Yes	Extensive changes to avionics and aircraft systems. Invalidates certification assumptions. Requires new AFM.
~~An appreciable~~ E~~e~~xpansion of an aircraft's operating envelope ~~or~~	No	No	Yes	~~Invalidates certification assumptions. Requires new AFM to address~~

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
~~operating capability would normally be a significant change. e.g., an increase in maximum altitude limitation, approval for flight in known icing conditions, an increase in airspeed limitations~~.				~~performance and flight characteristics.~~ An expansion of operating capability would normally be a significant change (e.g., an increase in maximum altitude limitation, approval for flight in known icing conditions, or an increase in airspeed limitations). An increase in cg range (5% mean aerodynamic chord) will typically cause a significant increase in wing loads, as compared to moving the aft cg limit further aft. The change in cg limit should be considered with any increases or decreases in aircraft weight. An increase in wing loads of greater than 5% is considered to be a significant change."

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Replacement of an aviation gasoline engine with a diesel engine of approximately the same horsepower.	No	No	Yes	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
A ~~major~~ comprehensive flight deck upgrade.	No	No	Yes	~~Extensive changes to avionics and electrical systems design.~~ ~~Invalidates certification assumptions.~~ ~~Extensive re-assessments of systems integration, flight crew workload, human factors evaluation are required.~~ The degree of change is so extensive that it affects basic avionics and electrical systems integration, architecture concepts, or philosophies. This may drive a complete re-assessment of flight crew workload or other human factor issues, or requires a re-evaluation of the original design assumptions used for the cockpit.

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				Example: changing from federated display (e.g. separate attitude, altitude, and airspeed) architecture to an integrated electronic flight information system. Requires new AFM ~~to address performance and flight characteristics~~.
Introduction of auto-land.	No	No	Yes	Invalidates original design assumptions.
~~Conventional tail to T-tail or Y-tail, or vice versa~~	~~Yes~~	~~No~~	~~Yes~~	~~Change in general configuration. Requires extensive structural, flying qualities and performance re-investigation. Requires new AFM to address performance and flight characteristics.~~
Conversion from normal category to commuter category aeroplane.	Yes	No	Yes	Requires compliance with all commuter regulatory standards.
Airframe life extension.	No	No	Yes	This modification pertains to fuselage and/or wing limits.
Install a plug in fuselage and add interior in the plug – no change	Yes	Yes	Yes	

The following examples are for SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
forward or aft of plug.				
Fuselage stretch and entire new interior.	Yes	Yes	Yes	
New interior or revised arrangement with a new/revised attachment system for interior components (e.g. seats, galleys or closets).	No	Yes	Yes	

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Addition of wingtip modifications (not winglets).	No	No	No	A major change to the aeroplane. Likely the original general configuration, principles of construction and certification assumptions remain valid.
Installation of skis or wheel skis.	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction and certification assumptions remain valid.
FLIR or surveillance camera installation.	No	No	No	Additional flight or structural evaluation may be necessary, but the change does not alter basic aeroplane certification.
Litter, berth and cargo tie down device installation.	No	No	No	Not an aeroplane level change.
Increased tire size, including tundra tires.	No	No	No	Not an aeroplane level change.
Replacement of one propeller type with another (irrespective of increase in number of blades).	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				assumptions remain valid.
Addition of a turbo-charger that does not change the power envelope, operating range, or limitations (e.g. a turbo-normalised engine, where the additional power is used to enhance high altitude or hot day performance).	No	No	No	Not an aeroplane level change.
~~Replace a petrol engine with a diesel engine or approximately the same horsepower.~~	~~No~~	~~No~~	~~No~~	~~Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remain valid.~~
Substitution of one method of bonding for another (e.g. change in type of adhesive).	No	No	No	Not an aeroplane level change.
Substitution of one type of metal for another.	No	No	No	Not an aeroplane level change.
Any change in construction or fastening not involving primary structure.	No	No	No	Not an aeroplane level change.
A new fabric type for fabric skinned aircraft.	No	No	No	Not an aeroplane level change.

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Increase in flap speed or undercarriage limit speed.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Structural strength increases	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
IFR upgrades involving installation of components (where the original certification does not indicate that the aeroplane is not suitable as an IFR platform, e.g. special handling concerns).	No	No	No	Not an aeroplane level change.
Fuel lines, where engine horsepower is increased but fuel flow is not increased beyond the certificated maximum amount.	No	No	No	Not an aeroplane level change.
Fuel tanks, where fuel is changed from gasoline to	No	No	No	Not an aeroplane level

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
diesel fuel and tank support loads are small enough that an extrapolation from the previous analysis would be valid. Chemical compatibility would have to be substantiated.				change.
Limited changes in a pressurisation system, e.g. number of outflow valves, type of controller or size of pressurised compartment, but the system must be re-substantiated if the original test data are invalidated.	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Install a quieter exhaust system.	No	No	No	Not an aeroplane level change.
Changes in engine cooling or cowling.	No	No	No	Not an aeroplane level change.
Fuel type: AvGas to Diesel/Jet A, AvGas to Ethanol/Methanol. Changing to multiple fuel systems containing fuel types (other than systems used for starting): such as AvGas/Ethanol, or Jet A/AutoGas (turbine). Unrestricted mixtures in one	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
fuel system of different fuel types: such as AvGas/Diesel or Jet A/Ethanol.				
Fuels of substantially the same type: such as AvGas to AutoGas, AvGas (80/87) to AvGas (100LL), ethanol to isopropyl alcohol, Jet B to Jet A (although Jet A to Jet B may be considered significant due to the fact that Jet B is considered potentially more explosive).	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Fuels that specify different levels of "conventional" fuel additives that do not change the primary fuel type. Different additive levels (controlled) of MTBE, ETBE, ethanol, amines, etc., in AvGas would not be considered a significant change.	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
A change to the maximum take-off weight of less than 5%, unless assumptions made in justification of the design are thereby invalidated.	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
An additional	No	No	No	Although a

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
aileron tab (e.g., on the other wing).				major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Larger diameter flight control cables with no change in routing, or other system design.	No	No	No	Not an aeroplane level change.
Auto-pilot installation (for IFR use, where the original certification does not indicate that the aeroplane is not suitable as an IFR platform).	No	No	No	Although a major change to the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Increased battery capacity or relocate battery.	No	No	No	Not an aeroplane level change.
Replace generator with alternator.	No	No	No	Not an aeroplane level change.
Additional lighting (e.g. navigation lights, strobes).	No	No	No	Not an aeroplane level change.
Higher capacity brake assemblies.	No	No	No	Not an aeroplane level change.
Increase in fuel tank capacity.	No	No	No	Not an aeroplane level change.
Addition of an oxygen system.	No	No	No	Not an aeroplane level change.
Relocation of a galley.	No	No	No	Not an aeroplane level change.
Passenger to freight (only)	No	No	No	Although a major change to

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
conversion with no change to basic fuselage structure.				the aeroplane, likely the original general configuration, principles of construction, and certification assumptions remain valid. Requires certification substantiation applicable to freighter requirements.
No fuselage stretch but complete new interior.	No	No	No	Not significant unless you are using a new/revised attachment system.
Existing type design – complete new interior but no new/revised attachment system, i.e. green completion.	No	No	No	Not significant (assuming no new attachment system).
Installation of new seat belt or shoulder harness.	No	No	No	Not an aeroplane level change.
A small increase in cg range.	No	No	No	At aeroplane level, no change in general configuration, principles of construction, and certification assumptions.
APU installation that is not flight essential	No	No	No	Although a major change to the aeroplane level, likely the original general configuration, principles of

The following examples are for NOT SIGNIFICANT changes for Small Aeroplanes (CS-23):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				construction, and certification assumptions remain valid. Requires certification substantiation applicable to APU installation requirements.
An alternative auto-pilot.	No	No	No	Not an aeroplane level change.
Addition of Class B Terrain Awareness and Warning Systems (TAWS).	No	No	No	Not an aeroplane level change.

~~Figure 2.~~ Table of examples of changes for Large Aeroplanes

The following examples are for SUBSTANTIAL changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Change in the number or location of engines, e.g. four to two wing-mounted engines or two wing-mounted to two body-mounted engines.	~~Yes~~ N/A	~~No~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Change from a high-wing to low-wing configuration.	~~Yes~~ N/A	~~No~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Change from an all-metal aeroplane to all composite primary structure (fuselage, wing and empennage).	~~Yes~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Change of empennage configuration for larger aeroplanes (cruciform vs. 'T' or 'V' tail).	N/A	N/A	N/A	
Increase from subsonic to supersonic flight regime.	N/A	N/A	N/A	

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
~~Derivative model, e.g., increased passenger payload, freighter version or complete update of a certified aeroplane.~~	~~Yes~~	~~Yes~~	~~Yes~~	~~Multiple changes packaged into a new model. Increased payload new freighter would change the general configuration and assumptions. Updated aeroplane could change principles of construction.~~
Reduction in the number of flight crew (in conjunction with flight deck update).	Yes	No	No	Extensive changes to avionics and aircraft systems. Impact to crew workload and human factors, pilot type rating.
Modify an aeroplane for flight in known icing conditions by adding systems for ice detection and elimination.	Yes	No	Yes	New aircraft operating envelope. Requires major new systems installation and aircraft evaluation. Operating envelope changed.
Conversion – passenger or combi to all freighter, including cargo door, redesign floor structure and 9g net or rigid barrier.	Yes	No	Yes	Extensive airframe changes affecting load paths, aeroelastic characteristics, aircraft related systems for fire protection, etc. Design assumptions changed from passenger to freighter.

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Change to pressurised cabin, including the introduction of a pressurisation system.	No	No	Yes	A change greater than 5% in operational cabin pressure differential. Essentially a recertification of airframe and systems associated with operating envelope change.
Addition of leading edge slats.	Yes	No	No	Requires extensive changes to wing structure, adds aircraft systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Fuselage ~~length change – lengthen or shorten fuselage~~ stretch (or shortening) and entire new interior.	Yes	No	No	Requires extensive changes to fuselage structure, affects aircraft level systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Install a plug in fuselage and add interior in the plug – with no interior changes forward or aft of the plug.	Yes	Yes	Yes	
New interior or revised arrangement with a	No	Yes	Yes	

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
new/revised attachment system for interior components (e.g. seats, galleys, or closets).				
Extensive structural airframe modification, such as installation of a large telescope with large opening in fuselage.	Yes	No	No	Requires extensive changes to fuselage structure, affects aircraft systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Changing the number of axles or number of landing gear done in context with a product change that involves changing the aeroplane gross weight.	Yes	No	No	Requires extensive changes to aircraft structure, affects aircraft systems, and requires AFM changes.
Primary structure changes from metallic material to composite material.	No	Yes	No	Change in principles of construction and design from conventional practices.

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Typically, an increase in design weight of more than 10 %.	No	No	Yes	~~When it r~~Requires extensive resubstantiation of aircraft structure, aircraft performance and flying qualities and associated systems.
Wing changes in span, sweep, tip designs or wing chord. (NOTE: Potentially substantial if it is a change from a high wing to a low wing, or a new wing.)	Yes	No	No	When it requires extensive changes to wing structure, adds aircraft systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Change in type or number of emergency exits ~~in conjunction with~~ or an increase in the number of passengers demonstrated.	No	No	Yes	The new emergency egress requirements exceed those previously substantiated.
Comprehensive flight deck upgrade, such as conversion from entirely federated, independent electro-mechanical flight instruments to highly integrated and combined electronic display systems with extensive	No	No	Yes	Affects avionics and electrical systems integration and architecture concepts and philosophies. ~~This drives a re-assessment of flight crew workload and other human factors issues, and requires a re-evaluation of the~~

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
use of software and possibly complex hardware.				~~original design assumptions used for the cockpit.~~
Change in primary flight controls to fly by wire (FBW) system. (Some aeroplanes have some degree of FBW. Achieving full FBW may be a not significant change on some aeroplanes.)	Yes	No	Yes	When the degree of change is so extensive that it affects basic aircraft systems integration and architecture concepts and philosophies. This drives a complete reassessment of flight crew workload, handling qualities, and performance evaluation, which are different from the original design assumptions.
Replace reciprocating with turbo-propeller engines.	Yes	No	No	Requires extensive changes to airframe structure, addition of aircraft systems, and new aeroplane flight manual to address performance and flight characteristics.
Typically a thrust increase of more than 10 %.	No	No	Yes	~~When it r~~Requires re-substantiation of powerplant installation, and has a marked affect on aircraft performance and flying qualities.
Initial installation of an auto-land	No	No	Yes	Baseline aeroplane not designed for auto-land operation,

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
system.				potential crew workload and systems compatibility issues.
Installation of a new fuel tank, (horizontal stabiliser tank or auxiliary fuel tank in the fuselage outside the wing in conjunction with increased maximum take-off weight and takeoff thrust).	No	No	Yes	Requires changes to airframe, systems and AFM. Results in performance changes.
Main deck cargo door installation.	Yes	No	No	Redistribution of internal loads, change in aeroelastic characteristics, system changes.
Expansion of an aircraft's operating envelope.	No	No	Yes	An expansion of operating capability would normally be a significant change (e.g. an increase in maximum altitude limitation, approval for flight in known icing conditions, or an increase in airspeed limitations). An increase in cg range (5% mean aerodynamic chord) will typically cause a significant increase in wing loads, as

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				compared to moving the aft cg limit further aft. The change in cg limit should be considered with any increases or decreases in aircraft weight. An increase in wing loads of greater than 5% is considered to be a significant change.
Conversion from a passenger floor to a cargo floor and installation of a cargo handling system.	No	No	Yes	Completely new floor loading and design. Redistribution of internal loads, change in cabin safety requirements, system changes.
Initial installation of an APU essential for aircraft flight operation.	No	No	Yes	Changes emergency electrical power requirements, change in flight manual and operating characteristics.
Conversion from hydraulically actuated brakes to electrically actuated brakes.	Yes	Yes	Yes	Completely new electro-mechanical actuators in lieu of hydraulic pistons in each brake – assembly, no hydraulic hoses, new wire bundles, new ETSO, change in applicable specifications.
Change to	Yes	No	Yes	An increase

The following examples are for SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
aeroplane's cabin operating altitude, or operating pressure change to aeroplane's design limit.				greater than 5% in maximum cabin pressure differential invalidates a basic certification assumption and fundamental approach used in the structural fatigue analysis.

The following examples are for NOT SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **1A.101(b)(1)(ii)**	**Notes**
Alternate engine installation or hush kit at same position.	No	No	No	~~Although an aeroplane level change,~~ Typically, it is not significant any longer as there is not more than a 10 % increase in thrust or a change in the principles of propulsion.
Fuselage length changes – lengthen or shorten fuselage.	No	No	No	A small change in fuselage length due to refairing the aft body or radom for cruise performance reasons, where such changes do not require extensive structural, systems, or AFM changes.
Refairing of wing tip caps (~~e.g.~~ for lights, fuel dump pipes) and addition of splitter plates to the trailing edge thickness of the cruise airfoil.	No	No	No	Does not require extensive structural, AFM, or systems changes.
Additional power used to enhance high altitude or hot day performance.	No	No	No	Usually no change in basic operating envelope. Existing certification data can be extrapolated. Could be significant product change if the additional power is provided by installation of a rocket motor or additional, on demand engine due to changes in certification assumptions.

The following examples are for NOT SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **1A.101(b)(1)(ii)**	**Notes**
~~General avionics changes.~~	~~No~~	~~No~~	~~No~~	~~These modifications are generally adaptive* in nature, and do not change the original certification assumptions, alter basic cockpit design architecture concepts and philosophies, and do not have a major impact on crew workload or man/machine.~~ ~~*Adaptive means the change adapts to the existing airplane buses, power, structure, …~~
Installation of an auto-pilot system.	No	~~No~~ N/A	~~No~~ See note	It may be possible that the ~~m~~Modification is ~~generally~~ adaptive in nature, with no change to original certification assumptions. However, in certain cases the installation of an auto-pilot may include extensive changes and design features which change both the general configuration and the assumptions for certification (i.e. installation of the auto-pilot may introduce a number of additional mechanical and electronic failure modes and change the hazard classification of given aircraft level failures).
~~Integrated~~	~~No~~	~~No~~	~~No~~	~~The basic functionality of the~~

The following examples are for NOT SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **1A.101(b)(1)(ii)**	**Notes**
~~modular avionics~~				~~systems are unchanged. No change from analog to digital.~~
~~Installation or rearrangement of an interior in an aircraft.~~	~~No~~	~~No~~	~~No~~	~~Special conditions could be used for new and novel features~~
Change from assembled primary structure to monolithic or integrally machined structure.	No	No	No	Method of construction must be well understood.
Modification to ice protection systems.	No	No	No	Recertification required, but certification basis is adequate.
Brakes: design or material change, e.g. steel to carbon.	No	No	No	Recertification required, but certification basis is adequate.
Redesign floor structure.	No	No	No	By itself, not a significant product ~~level~~ change. It ~~could be a~~ is significant if part of a cargo conversion of a passenger aeroplane.
No fuselage stretch but complete new interior.	No	No	No	Not significant unless you are using a new/revised attachment system.
Existing type design – complete new interior but no new/revised attachment system, i.e. Green completion.	No	No	No	Not significant (assuming no new attachment system).
Novel or unusual method of construction of a component.	No	No	No	The component change does not rise to the product level. Special conditions

The following examples are for NOT SIGNIFICANT changes for Large Aeroplanes (CS-25):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **1A.101(b)(1)(ii)**	**Notes**
				could be required if there are no existing specifications that adequately address these features.
Initial installation of a non-essential APU.	No	No	No	A stand-alone initial APU installation on an aeroplane originally designed to use ground/airport supplied electricity, and air-conditioning. In this case, the APU would be an option to be independent of airport power.

~~Figure 3. Table of examples of Changes for Rotorcraft~~

~~The following are examples of substantial changes:~~

Table of examples of Changes for Rotorcraft

The following examples are for SUBSTANTIAL changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Change from the number and/or configuration of rotors (e.g. main & tail rotor system to two main rotors).	~~Yes~~ N/A	~~No~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Change from an all metal rotorcraft to all composite rotorcraft.	~~Yes~~ N/A	~~Yes~~ N/A	~~Yes~~ N/A	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

The following examples are for SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Comprehensive flight deck upgrade.	~~Yes~~ No	No	Yes	The degree of change is so extensive that it affects basic avionics and electrical systems integration, architecture concepts ~~and~~ or philosophies. This ~~drives~~ may drive a complete reassessment of the flight crew workload or other human factor issues, ~~and~~ or requires a re-evaluation of the original design assumptions used for the cockpit. Example: changing from federated display (e.g. separate attitude, altitude, and airspeed) architecture to an integrated electronic flight information system.
Certification for flight into known icing conditions.	No	No	Yes	
(Fixed) flying controls from mechanical to fly by wire.	~~Yes~~ No	~~Yes~~ No	Yes	This drives a complete reassessment of the rotorcraft controllability and flight control failure.
Addition of an engine, e.g. from single to twin or reduction of the number of engines, e.g., from twin to	Yes	~~No~~ Yes	Yes	May be a substantial change depending upon project details.

The following examples are for SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
single.				
A change of rotor drive system primary gearbox splash type lubrication system to a pressure lubricated system due to an increase in horsepower of an engine or changing a piston engine to a turbine engine.	No	Yes	Yes	
A fuselage or tail boom modification that changes the primary structure, aerodynamics, ~~or~~ and operating envelope sufficiently to invalidate the certification assumptions.	Yes	No	Yes	
Application of an approved primary structure to a different approved model (e.g. installation on a former model of the main rotor approved on a new model that results in increased performance).	No	Yes	Yes	

The following examples are for SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Extensive primary structure changes from metallic material to composite material.	No	Yes	Yes	Change in principles of construction and assumptions used for certification for the product level change. Changes of a few individual elements from metal to composite are not typically considered a significant change.
Emergency Medical Service (EMS) Configuration with primary structural changes sufficient to invalidate the certification assumptions.	No	No	Yes	~~Any~~ Many EMS configurations will not be classified as significant. Modifications made for EMS are typically internal, and the general external configuration is normally not affected. These changes should not automatically be classified as significant.
Skid landing gear to wheel landing gear or wheel landing to skid.	Yes	No	Yes	~~If the rotorcraft is such that the skid or wheel configuration is inherent in the basic certification design, the change may be not significant.~~
Change of the number of rotor blades.	Yes	No	~~No~~ Yes	~~The addition/deletion of rotor blades may not be significant provided the remainder of the basic propulsion system remains essentially unchanged.~~

The following examples are for SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Change tail anti-torque device (e.g. tail rotor, ducted fan or other technology).	Yes	Yes	No	
Passenger configured helicopter to a fire fighting equipment configured helicopter.	Yes	No	Yes	
Passenger configured helicopter to an agricultural configured helicopter.	Yes	No	Yes	
A new Category A certification approval to an existing configuration.	No	No	Yes	
Instrument Flight Rules (IFR) upgrades involving installation of upgraded components for new IFR configuration.	No	No	Yes	
Human External Cargo (HEC) certification approval.	No	No	Yes	Must comply with the latest HEC Certification specifications in order to obtain operational approval. HEC include fatigue, Quick Release Systems, HIRF, OEI performance and OEI procedures.
Reducing the	No	No	Yes	

The following examples are for SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
number of pilots for IFR from 2 to 1.				

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Emergency floats	No	No	No	Must comply with the specific applicable specifications for emergency floats. This installation, in itself, does not change the rotorcraft configuration, overall performance or operational capability. Expanding an operating envelope (such as operating altitude and temperature) and mission profile (such as passenger carrying operations to external load operations, or flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type-certificated product level.
FLIR or surveillance camera installation	No	No	No	Additional flight or structural evaluation may be necessary but the change does not alter the basic rotorcraft certification.

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Helicopter Terrain Awareness Warning System (HTAWS) for operational credit.	No	No	No	Certificated per rotorcraft HTAWS guidance material and FAA TSO-C194.
Health Usage Monitoring System (HUMS) for Maintenance Credit.	No	No	No	Certificated per rotorcraft HUMS guidance material.
Expanded limitations with minimal or no design changes, following further tests/justifications or different mix of limitations (CG limits, oil temperatures, altitude, minimum/maximum weight, minimum/maximum external temperatures, speed, ratings structure).	No	No	No	Expanding an operating envelope (such as operating altitude and temperature) and mission profile (such as passenger carrying operations to external load operations, or flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type-certificated product level.
Installation of a new engine type, equivalent to the former one; leaving aircraft installation and limitations substantially unchanged.	No	No	No	Refer to AC 27-1 or AC 29-2 for guidance
Windscreen installation	No	No	No	Does not change the rotorcraft overall product configuration.

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Snow skis, “Bear Paws”	No	No	No	Must comply with specific certification specifications associated with the change. Expanding an operating envelope (such as operating altitude and temperature) and mission profile (such as passenger carrying operations to external load operations, or flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type-certificated product level.
External cargo hoist	No	No	No	Must comply with the specific applicable requirements for external loads. This installation, in itself, does not change the rotorcraft configuration, overall performance or operational capability. Expanding an operating envelope (such as operating

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				altitude and temperature) and mission profile (such as passenger carrying operations to external load operations, excluding HEC, or flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type-certificated product level.
IFR upgrades involving installation of upgraded components ~~(where the original certification does not indicate that the rotorcraft is not suitable as an IFR platform, e.g., special handling concerns)~~ to replace existing components.	No	No	No	Not a rotorcraft level change.
~~An upgrade to CAT A certification approval~~	~~No~~	~~No~~	~~No~~	~~Typically these are engine and drive systems rating changes appropriate for CAT A and rotorcraft performance requirements. Rotorcraft modifications, if any necessary, do not typically invalidate the~~

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (CS-27 and CS-29):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				~~certification assumptions, or change the general configuration of principles of construction.~~
Reducing the number of pilots for IFR from 2 to 1.	No	No	No	May be significant if there are extensive equipment and design changes such that the certification assumptions are invalidated or the general configuration of the rotorcraft is changed.

~~Figure 4. Engines and Propellers~~

~~The following are examples of significant changes:~~

~~Turbine engines~~

Examples for Engines and Propellers

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Turbine Engines				
Traditional turbofan to geared-fan engine.	Yes	No	Yes	This change would affect the engine in terms of foreign object ingestion (FOD), containment etc. Note that this change is most likely substantial under 21A.19.
Low by-pass ratio engine to high by-pass ratio engine with an increased inlet area.	Yes	No	Yes	Change in general configuration. Likely change in model designation. Not interchangeable Assumptions for certification may no longer be valid in terms of ingestion, icing etc. Note that this change is most likely substantial under 21A.19.

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Turbojet to Turbofan	Yes	No	Yes	Change in general configuration. Likely change in model designation. Not interchangeable Assumptions for certification may no longer be valid in terms of lifting, ingestion, icing, blade out criteria etc. Note that this change is most likely substantial under 21A.19.
Turbo-shaft to turbo-propeller	Yes	No	Yes	Change in configuration such as an additional gearbox. Change in model designation. Change in mission profile. Assumptions for certification may no longer be valid in terms of flight envelope, ratings etc. Note that this change is most likely substantial under 21A.19.
Conventional ducted fan to	Yes	Yes	Yes	Change in

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
unducted fan.				configuration. Change in type. Not interchangeable Assumptions for certification may no longer be valid. Note that this change is most likely substantial under 21A.19.
Conventional engine for subsonic operation to afterburning engine for supersonic operation.	Yes	Yes	Yes	Change in configuration. Change in type. Not interchangeable Assumptions for certification may no longer be valid. Change in operating envelope. Note that this change is most likely substantial under 21A.19.
Combining engine modules from uncertified (military) and Agency approved into a single engine configuration.	No	No	Yes	Uncertified (military) engines are not approved or monitored using Agency approved standards. Flight cycles, missions, maintenance programs and experience of the military engine are not

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				known. The combined modules have structural and operational characteristics that have not been evaluated and do not meet Agency's approved certification basis. This change requires an establishment of a new performance centreline and could be considered substantial.
Increase/decrease in the number of compressor/turbine stages with resultant change in approved operational limitations* (*exclude life limits)	No	No	Yes	Change is associated with other changes that would affect the rating of the engine and have affected the dynamic behaviour, in terms of backbone bending, torque spike effects on casing, surge and stall characteristics, etc.
New design fan blade and fan hub, or a bladed fan disk to a blisk, or a fan diameter change, that could not be retrofitted.	Yes	No	Yes	Likely change in model designation. Change is associated with other changes that would

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				affect engine thrust/power limitations and have affected the dynamic behaviour of the engine in terms of backbone bending, torque spike effects on casing, foreign object ingestion behaviour, burst model protection for the aircraft. If there is a diameter change, installation will be also affected.
Hydro-Mechanical control to FADEC/EEC without hydro mechanical back-up.	Yes	~~Yes~~ No	Yes	Change in engine control configuration. Likely change in model designation. Not interchangeable Likely fundamental change to engine operation. Assumptions used for certification are no longer valid or were not addressed in the original certification, i.e. HIRF and Lightning Protection,

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				Fault Tolerance, Software Certification and other aspects associated with FADEC/EEC's systems.
A change in the containment case from hard-wall to composite construction or vice versa, that could not be retrofitted without additional major changes to the engine or restricting the initial limitations or restrictions in the initial installation manual.	No	Yes	~~No~~ Yes	Change in methods of construction that have affected inherent strength, backbone bending, blade to case clearance retention, containment wave effect on installation, effect on burst model, torque spike effects.
Replace gas generator (core, turbine/compressor /combustor) with a different one that is associated with changes in approved operational limitations*. *Exclude life limits.	No	No	Yes	Change is associated with other changes that would affect engine thrust/power and have affected the dynamic behaviour of the engine. Assumptions used for certification may no longer be valid.
Piston Engines				
Convert from Mechanical to Electronic Control	Yes	Yes	No	Change in engine configuration:

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
System.				installation interface of engine changed. Changes to principles of construction: digital controllers and sensors require new construction techniques and environmental testing.
Add Turbocharger that increases performance and changes in overall product.	Yes	No	Yes	Change in general configuration: installation interface of engine changed (exhaust system). Certification assumptions invalidated~~.~~: ~~Change in engine configuration~~ change in operating envelope and performance.
Convert from air cooled cylinders to liquid cooled cylinders.	Yes	No	Yes	Change to general configuration: installation interface of engine changed (cooling lines from radiator, change to cooling baffles). Certification assumptions invalidated~~.~~:

The following are examples of SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
				change in operating envelope and engine temperature requirements.
Convert from spark-ignition to compression-ignition.	Yes	No	Yes	Change in general configuration: installation interface of engine changed (no mixture lever). Certification assumptions invalidated: change in operating envelope and performance.
Propellers				
Introduction of a different principle of blade retention.	Yes	Yes	No	Change in propeller configuration. Likely change in model designation. Propeller's operating characteristics and inherent strength require re-evaluation.

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Turbine Engines				
Change in the material from one type of metal to another type of metal of a compressor drum.	No	No	No	No change in performance. No likely change in model designation. Assumptions are still valid.
Increase/decrease in the number of compressor/turbine stages without resultant change in operational performance envelope.	No	No	No	No change in performance. Model designation may or may not change. Assumptions are still valid.
New components internal to the FADEC/EEC the introduction of which does not change the function of the system.	No	No	No	No change in configuration. Retrofitable. Assumptions used for certification are still valid. Possible changes in principles of construction are insignificant.
Software changes	No	No	No	
Rub-strip design changes	No	No	No	Component level change
A new combustor that does not change the approved limitations, or dynamic behaviour* *exclude life limits.	No	No	No	Component level change
Bearing changes	No	No	No	Component level change
New blade designs with similar material that can	No	No	No	Component level change

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
be retrofitted.				
Fan blade redesign that can be retrofitted.	No	No	No	Component level change
Oil tank redesign	No	No	No	Component level change
Change from one hydro-mechanical control to another hydro-mechanical control.	No	No	No	Component level change
Change to limits on life limited components.	No	No	No	Component level change
Changes to limits on exhaust gas temperature.	No	No	No	
Changes in certification maintenance requirements (CMR) with no configuration changes.	No	No	No	
Bump ratings within the product's physical capabilities that may be enhanced with gas path changes such as blade restaggered, cooling hole patterns, blade coating changes, etc.	No	No	No	

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
A change in principal physical properties and mechanics of load transfer of a material of primary structure or highly loaded components. For example, change from traditional metal to either an exotic alloy or a composite material on a highly loaded component.	No	No	No	Component level change
Piston Engine				
A change in principal physical properties and mechanics of load transfer of a material of primary structure or highly loaded components. For example, change from traditional metal to either an exotic alloy or a composite material on a highly loaded component.	No	No	No	Component level change
New or redesigned cylinder head, or valves, or pistons.	No	No	No	
Changes in crankshaft.	No	No	No	Component level change
Changes in crankcase.	No	No	No	Component level change
Changes in carburetor	No	No	No	Component level change
Changes in mechanical fuel injection system.	No	No	No	~~No controversy No comments~~
Changes in mechanical fuel	No	No	No	Component level change

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
injection pump.				
Engine model change to accommodate new aeroplane installation. No change in principles of operation of major subsystems; no significant expansion in power or operating envelopes or in limitations.	No	No	No	
No change in basic principles of operation, or a simple mechanical change. For example, change from dual magneto to two single magnetos on a model.	No	No	No	
Subsystem change produces no changes in base engine input parameters, and previous analysis can be reliably extended. For example, a change in turbocharger where induction system inlet conditions remain unchanged, or if changed, the effects can be reliably extrapolated.	No	No	No	

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (CS-E and CS-P):				
Description of change	**Is there a change to the general configuration?** **21A.101(b)(1)(i)**	**Is there a change to the principles of construction?** **21A.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **21A.101(b)(1)(ii)**	**Notes**
Change in material of secondary structure or not highly loaded component. For example, a change from metal to composite material in a non-highly loaded component, such as an oil pan that is not used as a mount pad.	No	No	No	Component level change
Change in material that retains the physical properties and mechanics of load transfer. For example, a change in trace elements in a metal casting for ease of pouring or to update to a newer or more readily available alloy with similar mechanical properties.	No	No	No	Component level change
Propellers				
Change in the material of a blade bearing.	No	No	No	Component level change
Change to a component in the control system.	No	No	No	Component level change
Change to a propeller de-icer boot.	No	No	No	Component level change

Appendix 2 to GM 21A.101. Procedure for Evaluating Impracticality of Applying Latest Certification Specifications to a Changed Product

Book 2

SUBPART D CHANGES TO TYPE-CERTIFICATES AND RESTRICTED TYPE-CERTIFICATES

Proposal 3: Replace existing Appendix 2 to GM 21A.101 with the following:

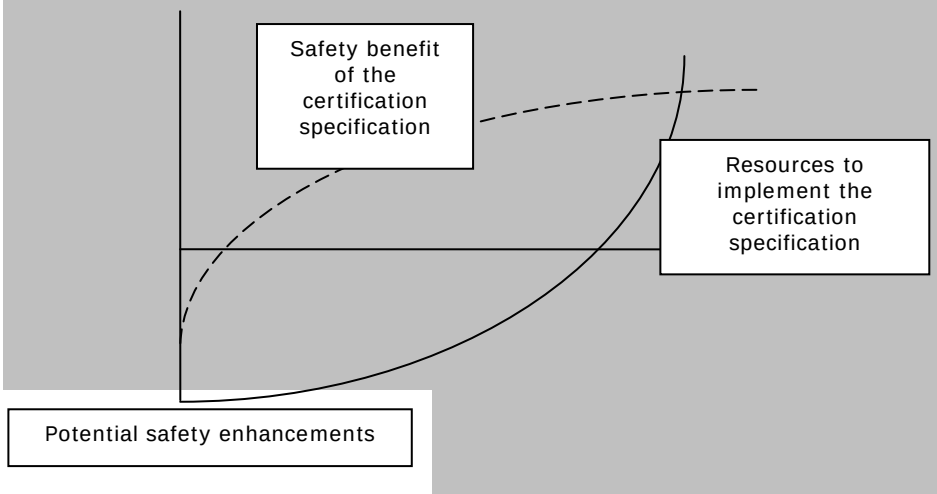
Appendix 2 to GM 21A.101 PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST CERTIFICATION SPECIFICATIONS TO A CHANGED PRODUCT

1. Introduction

a. The basic principle of enhancing the level of safety of changed aeronautical products is to apply the latest certification specifications for significant design changes to the greatest extent practical. In certain cases, the cost of complying fully with a later certification specification may not be commensurate with the small safety benefit achieved. It is recognised that the existing fleet and newly produced aeroplanes, engines and propellers are safe, and any unsafe condition is immediately addressed through the airworthiness directive process. These factors form the basis where compliance with the latest certification specification may be considered impractical, thereby allowing compliance with an earlier certification specification. This appendix gives one method of determining if compliance with a later standard is impractical, however, this does not preclude the use of other methods for improving the safety of aeronautical products.

b. This GM recognises that other procedures can be used and have historically been accepted on a case-by-case basis. The acceptance of results through the use of these procedures may vary from State to State. Consequently, they may not be accepted through all bilateral certification processes. Regardless of which method is used, the process should show that a proposed type-certification basis is able to achieve a positive safety benefit for the overall product.

c. In this regard, any method used should encourage incorporating safety enhancements that will have the most dramatic impact on the level of safety of the aircraft while considering effective use of resources. This important point is illustrated graphically in the accompanying figure. This figure notionally shows the interrelation between the total resources required for incorporating each potential safety enhancement with the corresponding net increase in safety benefit.



d. Typically one will find that there are proposals that can achieve a positive safety benefit that are resource effective. Conversely, there are proposals that may achieve a small safety benefit at the expense of a large amount of resources to implement. Clearly, there will be a point where a large percentage of the potential safety benefit can be achieved with a reasonable expenditure of resources. The focus of the methods used should be to determine the most appropriate standards relative to the respective cost to reach this point.

e. This appendix provides procedural guidance for determining the practicality of applying a certification specification at a particular amendment level to a changed product. This guidance can be used to evaluate the safety benefit and resource impact of implementing the latest airworthiness certification specifications in the type-certification basis of a changed product. The procedure is generic in nature and describes the steps and necessary inputs that any applicant can use on any project to develop a position.

f. The procedure is intended to be used, along with good engineering judgment, to evaluate the relative merits of a changed product complying with the latest certification specifications. It provides a means, but not the only means, for an applicant to present its position in regard to impracticality.

g. The type-certification basis for a change to a product will not be at an amendment level earlier than the existing type-certification basis. Therefore, when determining the impracticality of applying a certification specification at the latest amendment level, only the increase in safety benefits and costs beyond compliance with the existing type-certification basis should be considered.

2. Procedure for Evaluating Impracticality of Applying Latest Certification Specifications to a Changed Product

The following are steps to determine the impracticality of applying a certification specification at a particular amendment level. The first step will be to identify the regulatory change being evaluated.

a. Step 1: Identify the Regulatory Change Being Evaluated.

In this step, document:

(1) The specific certification specification (for example, CS 25.365),

(2) The amendment level of the existing type-certification basis for the certification specification, and

(3) The latest amendment level of the certification specification.

b. Step 2: Identify the Specific Hazard that the Certification Specification Addresses

(1) Each certification specification and subsequent amendments are intended to address a hazard or hazards. In this step the specific hazard(s) is/are identified. This identification will allow for a comparison of the effectiveness of amendment levels of the certification specification at addressing the hazard.

(2) In many cases the hazard and the cause of the hazard will be obvious. When the hazard and its related cause are not immediately obvious, it may be necessary to review the available background information from development and adoption of this certification specification (Explanatory Note and Comment/Response Document to the NPA. It may also be helpful to discuss the hazard with the Agency).

c. Step 3: Review the Consequences of the Hazard(s)

(1) Once the hazard has been identified, it is possible to identify the types of consequences that may occur because of the presence of the hazard. More than one consequence can be attributed for the same hazard. Typical examples of consequences would include, but are not be limited to:

- Incidents where only injuries occurred;
- Accidents where less than 10 % of the passengers died;
- Accidents where 10 % or more passengers died; and
- Accidents where a total hull loss occurred.

(2) The background information from development and adoption of the certification specification may provide useful information regarding the consequences of the hazard the requirement is intended to address.

d. Step 4: Identify the Historical and Predicted Frequency of Each Consequence

(1) Another source for determining impracticality is the historical record of the consequences of the hazard that led to a requirement or an amendment to a requirement. From these data, a frequency of hazard occurrence can be determined. It is important to recognise that the frequency of occurrence may be higher or lower in the future. Therefore, it is also necessary to predict the frequency of future occurrences.

(2) More than one consequence can be attributed for the same hazard. Therefore, when applicable, the combination of consequences and frequencies of those consequences should be considered together.

(3) The background information from development and adoption of the certification specification may provide useful information regarding the frequency of occurrence.

e. Step 5: Determine How Effective Full Compliance with the Latest Amendment of the Requirement Would Be at Addressing the Hazard

(1) When each amendment is promulgated, it is usually expected that compliance with the certification specification would be completely effective at addressing the associated hazard. It is expected that the hazard would be eliminated, avoided, or dealt with. However, in a limited number of situations, this may not be the case. It is also possible that earlier amendment levels may have addressed the hazard but were not completely effective. Therefore, in comparing the benefits of compliance with the existing type-certification basis to the latest amendment level, it is useful to estimate the effectiveness of both amendment levels in dealing with the hazard.

(2) It is recognised that the determination of levels of effectiveness is normally of a subjective nature. Therefore, prudence should be exercised when making these determinations. In all cases, it is necessary to document the assumptions and data that support the determination.

(3) The following five levels of effectiveness are provided as a guideline:

(a) Fully effective in all cases.
Compliance with the requirement eliminates the hazard or provides a means to avoid the hazard completely.

(b) Considerable potential for eliminating or avoiding the hazard.
Compliance with the requirement eliminates the hazard or provides a means to avoid completely the hazard for all probable or likely cases, but it does not cover all situations or scenarios.

(c) Adequately deals with the hazard.
Compliance with the requirement eliminates the hazard or provides a means to avoid the hazard completely in many cases. However, the hazard is not eliminated or avoided in all probable or likely cases. Usually this action only addresses a significant part of a larger or broader hazard.

(d) Hazard only partly addressed.
In some cases compliance with the requirement partly eliminates the hazard or does not completely avoid the hazard. The hazard is not eliminated or avoided in all probable or likely cases. Usually this action only addresses part of a hazard.

(e) Hazard only partly addressed but action has negative side effect.
Compliance with the requirement does not eliminate or avoid the hazard or may have negative safety side effects. The action is of questionable benefit.

f. Step 6: Determine Resource Costs and Cost Avoidance

(1) There is always cost associated with complying with a requirement. This cost may range from minimal administrative efforts to the resource expenditures that support full scale testing or the redesign of a large portion of an aircraft. However, there are also potential cost savings from compliance with a requirement. For example, compliance with a requirement may avoid aircraft damage or accidents and the associated costs to the manufacturer for investigating accidents. Compliance with the latest amendment of a certification specification may also facilitate certification of a product by the competent authority of a third country.

(2) When determining the impracticality of applying a certification specification at the latest amendment level, only the incremental costs and safety benefits from complying with the existing type-certification basis should be considered.

(3) When evaluating the incremental cost, it may be beneficial for the applicant to compare the increase in cost to comply with the latest certification specifications to the cost to incorporate the same design feature in a new aeroplane. In many cases an estimate for the cost of incorporation in a new aeroplane is provided in the regulatory evaluation by the Agency, which was presented when the corresponding certification specification was first promulgated. Incremental costs of retrofit/incorporation on existing designs may be higher than that for production. Examples of costs may include but are not limited to:

(a) Costs: The accuracies of fleet size projections, utilisation, etc. may be different than that experienced for derivative product designs and must be validated.

• Labour: Work carried out in the design, fabrication, inspection, operation or maintenance of a product for the purpose of incorporating or demonstrating compliance with a proposed action. Non-recurring labour requirements, including training, should be considered.

• Capital: Construction of new, modified or temporary facilities for design, production, tooling, training, or maintenance.

• Material: Cost associated with product materials, product components, inventory, kits, and spares.

• Operating Costs: Costs associated with fuel, oil, fees, and expendables.

• Revenue/Utility Loss: Costs resulting from earning/usage capability reductions from departure delays, product downtime, capability reductions of performance loss due to seats, cargo, range, or airport restrictions.

(b) Cost Avoidance:

• Avoiding cost of accidents, including investigation of accidents, lawsuits, public relations activities, insurance, and lost revenue.

• Foreign Certification: Achieve a singular effort that would demonstrate compliance to the requirements of most certifying agencies, thus minimizing certification costs.

g. Step 7: Document Conclusion. Once the information from previous steps has been documented and reviewed, the applicant's position and rationale regarding practicality can be documented. Examples of possible positions would include, but are not limited to:

(1) Compliance with the latest certification specification is necessary. The applicant would pursue the change at the latest amendment level.

(2) Compliance with an amendment level between the existing type-certification basis and the latest amendment would adequately address the hazard at an acceptable cost, while meeting the latest amendment level would be impractical. The applicant would then propose the intermediate amendment level of the certification specification.

(3) The increased level of safety is not commensurate with the increased costs associated with meeting the latest amendment instead of the existing type-certification basis. Therefore, the applicant would propose the existing type-certification basis.

(4) The results of this analysis were inconclusive. Further discussions with the Agency are warranted.

Note: This process may result in a required type-certification basis that renders the proposed modification economically not viable.

3. Examples of How to Certify Changed Aircraft. The following examples are for large aeroplanes and illustrate the typical process an applicant follows. The process will be the same for all product types.

a. Example 1: CS 25.963 (e) Fuel Tank Access Covers

(1) This change is part of a significant large aeroplane change that increases passenger payload and gross weight by extending the fuselage by 20 feet. To accommodate the higher design weights and increased braking certification specification, and to reduce runway loading, the applicant will change the landing gear from a two-wheel to four-wheel configuration; this changes the debris scatter on the wing from the landing gear. The new model airplane will be required to comply with the latest applicable regulations based on the date of application.

(2) The wing will be strengthened locally at the side of the body and at the attachment of engines and landing gear, but the applicant would not like to alter wing access panels and the fuel tank access covers. Although the applicant recognises that the scatter pattern and impact loading on the wing from debris being thrown from the landing gear will change, he proposes that it would be impractical to redesign the fuel tank access covers.

(3) **Step 1: Identify the Regulatory Change Being Evaluated**

(a) The existing certification basis of the aeroplane that is being changed is CS-25 prior to Amendment3.

(b) Amendment 3 to CS-25 added the requirement that fuel tank access covers on large aeroplanes be designed to minimise penetration by likely foreign objects, and be fire resistant.

(4) **Step 2: Identify the Specific Hazard that the Regulation Addresses**

Fuel tank access covers have failed in service due to impact with high-energy objects such as failed tire tread material and engine debris following engine failures. In one accident, debris from the runway impacted a fuel tank access cover, causing its failure and subsequent fire, which resulted in fatalities and loss of the airplane. Amendment 3 ensures that all access covers on all fuel tanks are designed or located to minimise penetration by likely foreign objects, and are fire resistant.

(5) **Step 3: Review the History of the Consequences of the Hazard(s)**

Occurrences with injuries and with more than 10 % deaths.

(6) **Step 4: Identify the Historical and Predicted Frequency of Each Consequence**

(a) In 200 million departures of large jets:
- One occurrence with more than 10 % deaths; and
- One occurrence with injuries.

(b) There is no reason to believe that the future rate of accidents will be significantly different than the historical record.

(7) **Step 5: Determine How Effective Full Compliance with the Latest Amendment of the Regulation Would Be at Addressing the Hazard**

(a) Considerable potential for eliminating or avoiding the hazard.

(b) Compliance with Amendment 3 eliminates the hazard or provides a means to avoid the hazard completely for all probable or likely cases. However, it does not cover all situations or scenarios.

(8) **Step 6: Determine Resource Costs and Cost Avoidance**

(a) Costs:
- For a newly developed aeroplane, there would be minor increases in labour resulting from design and fabrication.
- There would be a negligible increase in costs related to materials, operating costs, and revenue utility loss.

(b) Cost Avoidance:
- There were two accidents in 200 million departures. The applicant believes that it will manufacture more than 2,000 of these aeroplanes or derivatives of these aeroplanes. These aeroplanes would average five flights a day. Therefore, statistically there will be accidents in the future if the hazard is not alleviated. Compliance will provide cost benefits related to avoiding lawsuits, accident investigations, and public relation costs.

• There are cost savings associated with meeting a single type-certification basis for the Agency and foreign regulations.

(9) **Conclusion.** It is concluded that compliance with the latest certification specification increases the level of safety at a minimal cost to the applicant. Based on the arguments and information presented by the applicant through the Certification Review Item (CRI) process, the Agency determined that meeting the latest amendment would be practical.

b. Example 2: 14 CFR § 25.365 Pressurised Compartment Loads

NOTE: This example is taken from the FAA certification experience gained before the Agency's start, so references to FAR sections and amendments are kept.

(1) This example is a passenger to freighter conversion STC.

(2) This change affects the floor loads on the airplane as well as the decompression venting.

(3) **Step 1: Identify the Regulatory Change Being Evaluated**

(a) The existing certification basis of the airplane that is being changed includes 14 CFR § 25.365 at Amendment 25-54. The initial release of 14 CFR § 25.365 required that the interior structure of passenger compartments be designed to withstand the effects of a sudden release of pressure through an opening resulting from the failure or penetration of an external door, window, or windshield panel, or from structural fatigue or penetration of the fuselage, unless shown to be extremely remote.

(b) Amendment 25-54 revised 14 CFR § 25.365 to require that the interior structure be designed for an opening resulting from penetration by a portion of an engine, an opening in any compartment of a size defined by 14 CFR § 25.365(e)(2), or the maximum opening caused by a failure not shown to be extremely improbable. The most significant change is the "formula hole size" requirement introduced § 25.365(e)(2) at Amendment 25-54.

(c) Amendment 25-71/72 (Amendments 25-71 and 25-72 are identical) extended the requirement to all pressurised compartments, not just passenger compartments, and to the pressurisation of unpressurised areas. The later requirement had previously been identified as an unsafe feature under 14 CFR § 21.21(b)(2).

(d) Amendment 25-87 redefined the pressure differential load factor that applies above an altitude of 45,000 feet. Compliance with Amendment 25-87 is not affected since the airplane does not operate above an altitude of 45,000 feet. The applicant proposes to meet the "pressurisation into unpressurised areas" requirement introduced in Amendment 25-71/72. The applicant does not propose to comply with the formula hole size requirement introduced in § 25.365(e)(2) at Amendment 25-54.

(4) **Step 2: Identify the Specific Hazard that the Regulation Addresses**

The hazard is a catastrophic structure and/or system failure produced by a sudden release of pressure through an opening in any compartment in flight. This opening could be caused by an uncontained engine failure, an opening of a prescribed size due to the inadvertent opening of an external door in flight, or an opening caused by a failure not shown to be extremely improbable. The opening could be produced by an event that has yet to be identified.

(5) **Step 3: Review the History of the Consequences of the Hazard(s)**

Occurrences with injuries, less than 10 % deaths, and more than 10 % deaths.

(6) **Step 4: Identify the Historical and Predicted Frequency of Each Consequence**

(a) In 200 million departures of large jets:

- Two occurrences with more than 10 % deaths;
- One occurrence with less than 10 % deaths; and
- One occurrence with injuries.

(b) There is no reason to believe that the future rate of accidents will be significantly different than the historical record.

(7) **Step 5: Determine How Effective Full Compliance with the Latest Amendment of the Regulation Would Be at Addressing the Hazard**

(a) Compliance with the latest amendment eliminates the hazard or provides a means to avoid the hazard completely.

(b) Design changes made to the proposed derivative airplane bring it closer to full compliance with 14 CFR § 25.365 at Amendment 25-54. The original airplane was shown to meet the requirements for a hole size of 1.1 square feet. Amendment 25-54 would require a hole size of 5.74 square feet, and the current reinforcements for the converted airplane can sustain a hole size of 3.65 square feet in the forward area and 2.65 at the aft area. This is 3.1 and 2.4 times respectively better than the original design condition of Amendment 25-0 and is a significant improvement over the worldwide passenger fleet in service.

(8) **Step 6: Determine Resource Costs and Cost Avoidance**

(a) Costs: There would be savings in both labour and capital costs if compliance were shown to Amendment 25-0 instead of Amendment 25-54. Major modifications to the floor beams would be necessary to meet the formula hole size requirement in Amendment 25-54.

(b) Cost Avoidance:

(1) There were four accidents in 200 million departures. The applicant believes that it will manufacture more than 2,000 of these airplanes or derivatives of these airplanes. These airplanes would average two flights a day. Therefore, statistically there will be accidents in the future if the hazard is not alleviated. Compliance will provide cost benefits related to avoiding lawsuits, accident investigations, and public relation costs.

(2) There are cost savings associated with meeting a single certification basis for FAA and foreign regulations.

(9) **Step 7: Document Conclusion Regarding Practicality.** The design complies with 14 CFR § 25.365 at Amendment 25-0, 25-71/72, and 25-87, and is nearly in full compliance with Amendment 25-54. The design would adequately address the hazard at an acceptable cost. Therefore, based on arguments of impracticality discussed in an issue paper, the FAA accepts the applicant's proposal to comply with 14 CFR § 25.365 at Amendment 25-0.

Appendix 3 to GM 21A.101. The Use of Service Experience in the Certification Process

1. Introduction.

Service experience may support the application of an earlier airworthiness standard if, in conjunction with the applicable service experience and other compliance measures, the earlier standard provides a level of safety comparable to that provided by the latest certification specifications. The applicant must provide sufficient substantiation to allow the Agency to make this determination. A statistical approach may be used, subject to the availability and relevance of data, but sound engineering judgment should be used as a minimum. For service history to be acceptable, the data must be both sufficient and pertinent. The essentials of the process involve:

a. A clear understanding of the requirement change and the purpose for the change;

b. A determination based on detailed knowledge of the proposed design feature;

c. The availability of pertinent and sufficient service experience data; and

d. A comprehensive review of that service experience data.

2. Guidelines.

The Certification Review Item (CRI) process (either a stand-alone CRI or included in the CRI.A-1) would be used, and the applicant should provide documentation to support the following:

a. The identification of the differences between the certification specification in the existing basis and the certification specification as amended, and the effect of the change in the certification specification.

b. A description as to what aspect(s) of the latest certification specifications the proposed changed product would not meet.

c. Evidence showing that the proposed type-certification basis for the changed product, together with applicable service experience, relative to the hazard, provides a level of safety consistent with complying with the latest certification specifications.

d. A description of the design feature and its intended function.

e. Data for the product pertinent to the certification specification.

(1) Service experience from such data sources as the following:

(a) Accident reports;

(b) Incident reports;

(c) Service bulletins;

(d) Airworthiness directives;

(e) Repairs;

(f) Modifications;

(g) Flight hours/cycles for fleet leader and total fleet;

(h) World airline accident summary data;

(i) Service difficulty reports;

(j) Reports from Accident Investigation Boards

(k) Warranty, repair and parts usage data.

(2) Show that the data presented represent all relevant service experience for the product, including the results of any operator surveys, and is comprehensive enough to be representative.

(3) Show that the service experience is relevant to the hazard.

(4) Identification and evaluation of each of the main areas of concern with regard to:

(a) Recurring and/or common failure modes;

(b) Cause;

(c) Probability, by qualitative reasoning; and

(d) Measures already taken and their effects.

(5) Relevant data pertaining to aircraft of similar design and construction may be included.

(6) Evaluation of failure modes and consequences through analytical processes. The analytical processes should be supported by:

(a) A review of previous test results;

(b) Additional detailed testing as required;

(c) Review aircraft Functional Hazard Assessments (FHA) and any applicable System Safety Assessments (SSA) as required.

f. A conclusion that draws together the data and the rationale.

g. These guidelines are not intended to be limiting, either in setting required minimum elements or in precluding alternative forms of submission. Each case may be different, based on the particulars of the system being examined and the certification specification to be addressed.

3. Example:

NOTE: This example is taken from a FAA certification gained prior to the Agency's start, so references to FAR sections and amendments are kept.

a. The following example, for transport airplanes (14 CFR § 25.1141(f) Auxiliary Power Unit (APU) Fuel Valve Position Indication System), illustrates the typical process an applicant follows. The process will be the same for all product types.

b. This example comes from a derivative model transport airplane where significant changes were made to the main airframe components, engines and systems, and APU. The baseline airplane has an extensive service history. The example shows how the use of service experience supports a finding that compliance with the latest regulation would not contribute

materially to the level of safety and that application of the existing certification basis (or earlier amendment) would be appropriate. The example is for significant derivatives of large aeroplanes with extensive service history, and illustrates the process, following the guidelines in this appendix, but does not include the level of detail normally required.

(1) The differences between the regulation in the existing certification basis and the regulation as amended, and the effect of the change in the requirement

The existing certification basis of the airplane that is being changed is the initial release of Part-25. Amendment 25-40 added requirement 14 CFR § 25.1141(f), which mandates that power-assisted valves must have a means to indicate to the flight crew when the valve is in the fully open or closed position, or is moving between these positions.

(2) What aspect of the proposed changed product would not meet the latest regulations?

The proposed APU fuel valve position indication system does not provide the flight crew with fuel valve position or transition indication and, therefore, does not comply with the requirements of 14 CFR § 25.1141(f).

(3) Evidence_that the proposed type-certification basis for the changed product, together with applicable service experience and other compliance measures provide an acceptable level of safety

The APU fuel shut-off valve and actuator are unchanged from those used on the current family of airplanes, and have been found to comply with the earlier Amendment 25-11 of 14 CFR § 25.1141(f). The existing fleet has achieved approximately (#) flights during which service experience of the existing design has been found to be acceptable. If one assumes a complete APU cycle, i.e., start-up and shutdown for each flight, the number of APU fuel shut-off valve operations would be over 10^8 cycles, which demonstrates that the valve successfully meets its intended function and complies with the intent of the regulation. In addition, the system design for the changed product incorporates features that increase the level of functionality and safety.

(4) A description of the design feature and its intended function

The fuel shut-off valve, actuator design, and operation is essentially unchanged; with the system design ensuring that the valve is monitored for proper cycling from closed to open at start. If the valve is not in the appropriate position (i.e. closed), then the APU start is terminated, an indication is displayed on the flight deck, and any further APU starts are prevented. Design improvements using the capability of the APU Electronic Control Unit (ECU) have been incorporated in this proposed product change. These design changes ensure that the fuel valve indication system will indicate failure of proper valve operation to the flight crew, but the system does not indicate valve position as required by 14 CFR § 25.1141(f).

(5) Data for the product pertinent to the requirement

The FAA and applicant record the data in an issue paper (G-1 or a technical issue paper). An issue paper was coordinated, included data, or referenced reports, documenting relevant service experience that has been compiled from incident reports, fleet flight hour/cycle data, and maintenance records. The issue paper also discussed existing and proposed design details, failure modes and analyses showing to what extent the proposed airplane complies with the latest amendment of 14 CFR § 25.1141. Information is presented to support the applicant's argument that compliance with the latest amendment would not materially increase the level of safety. Comparative data pertaining to aircraft of similar design and construction are also presented.

(6) The conclusion, drawing together the data and rationale

Conclusion is documented in the G-1 issue paper. The additional features incorporated in the APU fuel shut-off valve will provide a significant increase in safety to an existing design with satisfactory service experience. The applicant proposes that compliance with the latest amendment would not materially increase the level of safety and that compliance with 14 CFR § 25.1141 at Amendment 25-11 would provide an acceptable level of safety for the proposed product change.

Appendix 4 to GM 21A.101. Definitions and Terminology

Adequate Type-certification Basis – The type-certification basis for a changed product under 21A.101 is considered adequate when the Agency determines that the designated certification specifications of the applicable airworthiness code (referenced in existing type-certification basis, later or latest amendments) and prescribed special conditions ensure that physical features, performance characteristics and/or functions introduced by the design change, do not result in any unsafe design features. These airworthiness standards are to be the highest practicable level of safety for the changed product, and not just for the change itself.

Aeronautical product – The terms aeronautical product or product(s) used in this guidance material include type-certificated aircraft, engines, propellers and approved Auxiliary Power Units (APUs).

Type-certification basis – The certification specifications of the applicable airworthiness code as established in 21A.17 and 21A.101, as appropriate; special conditions; and equivalent level of safety findings applicable to the product to be certificated.

Design Change – A change in the type design of an aeronautical product or a change in the certificated configuration of the product. In the context of this document the terms “change”, “design change” and “type design change” are synonymous.

Earlier certification specifications – The certification specifications of the applicable airworthiness code in effect prior to the date of application for the change, but not prior to the existing type-certification basis.

Existing type-certification basis – The certification specifications of the applicable airworthiness code, special conditions and equivalent level of safety findings incorporated by reference in the type-certificate of the product to be changed.

Latest certification specifications – The certification specifications of the applicable airworthiness code in effect on the date of application for the change.

Previous relevant design changes – Previous design changes, the cumulative effect of which could result in a product significantly or substantially different from the original product or model, when considered from the last time the latest certification specifications were applied.

Product level change – A change or combination of changes that makes the product distinct from other models of the product (for example, range, payload, speed, design philosophy). Product level change is defined at the aircraft, aircraft engine, or propeller level of change.

Secondary change – A secondary change is a physical change that is part of and consequential to an overall significant change. A secondary change is a physical change that restores without changing the system, structural capacity, or functionality, but is necessary to support a significant change.

Significant change – A change to the type-certificate is significant to the extent that it changes one or more of the following: general configuration, principles of construction, or the assumptions used for certification, but not to the extent to be considered a substantial change. The significance of the change must be considered in the context of all previous relevant design changes and all related revisions to the certification specifications of the applicable airworthiness code. Not all changes or product level changes are significant.

Substantial change – A change which is so extensive that a substantially complete investigation of compliance with the applicable type-certification basis is required, and consequently a new type certificate, in accordance with 21A.19.

Appendix 5 to GM 21A.101. Related Part-21 Requirements

- 21A.16A, Airworthiness codes
- 21A.16B, Special conditions
- 21A.17, Type-certification basis
- 21A.19, Changes requiring a new type-certificate
- 21A.21, Issue of type-certificate
- 21A.93, Classification of changes in type design
- 21A.97, Major changes
- 21A.101, Designation of applicable certification specifications and environmental protection requirements
- 21A.114, Showing of compliance