U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:	Date:	AC No:
ESTABLISHING THE CERTIFICATION BASIS OF CHANGED AERONAUTICAL PRODUCTS	**4/28/03**	**21.101-1**
	Initiated By: AIR-110	**Change: 1**

1. PURPOSE.

a. This advisory circular (AC) provides guidance for establishing the certification basis for changed aeronautical products and identifying the conditions under which it will be necessary to apply for a new type certificate. Title 14, Code of Federal Regulations (14 CFR) § 21.101 requires an applicant for a change to a type certificate to meet the latest requirements, except where the change is not significant, where areas of the product are not affected, where it would be impractical, or where it would not contribute materially to the level of safety of the changed product. Title 14 CFR § 21.19 identifies the conditions under which an applicant for a design change is required to make application for a new type certificate. This AC discusses and explains the criteria of 14 CFR §§ 21.19 and 21.101, and their application. It provides guidance as to the assessment of significant vs. not significant changes to the type certificated product. This document also provides guidance for the determination of substantial vs. significant changes.

b. The intent of 14 CFR § 21.101 is to enhance safety through the incorporation of the latest requirements in the certification basis for changed products. This AC describes the application of the latest airworthiness requirements for the certification of significant design changes to aircraft, aircraft engines, and propellers. Significant changes are generally distinct from the vast majority of major changes. In the assessment of whether a change is significant, all previous relevant design changes need to be taken into consideration along with any previous updates to the certification basis. All changes must be FAA approved, however, an applicant may comply with earlier amendments to the regulations based upon a finding by the Administrator that the change is not significant, an area is not affected by a change, or compliance with the latest regulation is impractical or does not contribute materially to the level of safety. Each change must be judged on its own merit when making the final determination of the certification basis.

c. This AC is not mandatory and is not a regulation. It outlines one method of compliance with 14 CFR § 21.101. The applicant may elect to follow an alternate method, provided the alternate method is acceptable to the Administrator. Because the method of compliance presented in this AC is not mandatory, the term “must” used herein applies only to an applicant who chooses to follow this particular method without deviation.

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2. APPLICABILITY.

a. This document supersedes AC 21.101-1, dated August 8, 2001. This AC is applicable to changes to a type certificate under 14 CFR § 21.101. Minor design changes are approved under 14 CFR § 21.95, and are considered to be not significant under 14 CFR § 21.101. This AC applies equally to applications made for type certificate amendments, supplemental type certificates (STCs), or amended STCs.

b. This AC is also applicable to all significant design changes to aircraft (other than rotorcraft) of 6,000 lbs. or less maximum weight, or to a non-turbine rotorcraft of 3,000 lbs. or less maximum

weight (excepted aircraft per 14 CFR § 21.101 (c)). Unless the Administrator finds the change significant in an area, an applicant may show that the changed product complies with the requirements incorporated in the type certificate.

c. This AC is also applicable for aircraft certificated under 14 CFR §§ 21.17(b), 21.24, 21.25, and 21.27.

3. RELATED CODE OF FEDERAL REGULATIONS PARAGRAPHS.

a. 14 CFR § 21.16, Special conditions.

b. 14 CFR § 21.17, Designation of applicable regulations.

c. 14 CFR § 21.19, Changes requiring a new type certificate.

d. 14 CFR § 21.21, Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers.

e. 14 CFR § 21.93, Classification of changes in type design.

f. 14 CFR § 21.101, Designation of applicable regulations.

g. 14 CFR § 21.115, Applicable requirements.

4. EXPLANATION OF TERMINOLOGY. The following is a summary of the terminology used throughout this advisory material. Further explanation of some of these terms is found in paragraphs 6, 7, and 8.

a. Certification basis – The applicable airworthiness requirements as established in 14 CFR §§ 21.17 and 21.101, as appropriate; special conditions; equivalent level of safety findings; and exemptions applicable to the product to be certificated.

> **NOTE**: This AC is not intended to be used to determine the applicable aircraft noise, fuel venting, and exhaust emission requirements for changed products.

b. Earlier requirements – The requirements in effect prior to the date of application for the change, but not prior to the existing certification basis.

c. Existing certification basis – The requirements incorporated by reference in the type certificate of the product to be changed.

d. Latest requirements – The requirements in effect on the date of application for the change.

e. 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 regulations were applied.

f. 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). Product level change is defined at the aircraft, aircraft engine, or propeller level of change.

g. 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 applicable regulations. Not all changes or product level changes are significant.

h. Substantial change – A change which is so extensive that a substantially complete investigation of compliance with the applicable regulations is required, and consequently a new type certificate, in accordance with 14 CFR § 21.19.

5. GENERAL OVERVIEW OF 14 CFR § 21.101.

a. Title 14 CFR § 21.19 specifies changes that require a new type certificate. When a new type certificate is required, 14 CFR § 21.17 specifies the applicable requirements for the changed product.

b. When an application for a new type certificate is not required by 14 CFR § 21.19, 14 CFR § 21.101 defines the designation of applicable requirements for determining the certification basis for the changed product.

c. Title 14 CFR § 21.101(a) requires a change to a type certificated product to comply with the latest requirements, unless the change meets the criteria for the exceptions identified in 14 CFR §§ 21.101(b) and (c). The certification basis should not be dependent on whether the type certificate holder or an applicant for a supplemental type certificate is originating the change. Where compliance with a later amendment for a significant change does not contribute materially to the level of safety, would be impractical, or is in an area not affected by the change, the applicant may comply with earlier requirements. However, the applicant may not use requirements prior to those specified by the existing certification basis.

d. Title 14 CFR § 21.101(b) pertains to changes for which earlier requirements provide adequate standards. Earlier requirements may be used when the change is not significant. In cases where design changes involve features that have no associated regulatory standard in the existing certification basis, the Administrator will review the proposed certification plan to ensure the adequacy of the requirements against the proposed design change.

e. Title 14 CFR § 21.101(b)(1) allows the applicant to show compliance with an earlier amendment when the Administrator determines the change is not significant. Title 14 CFR

21.101(b)1(i) and (ii) pertains to changes that meet the automatic criteria where the change is significant. Title 14 CFR §§ 21.101(b)(2) and (b)(3) allows the use of earlier requirements for significant changes for areas of the product not affected by the change and for cases where compliance to the latest requirements would not contribute materially to the level of safety or would be impractical. Note that earlier amendments may not precede either the corresponding regulation incorporated in the type certificate, or any requirement found in 14 CFR §§ 23.2, 25.2, 27.2, or 29.2.

f. Title 14 CFR § 21.101(c) provides an exception to the requirements of 14 CFR § 21.101(a). An applicant for a change to an aircraft (other than rotorcraft) of 6,000 pounds or less maximum weight, or to a non-turbine rotorcraft of 3,000 pounds or less maximum weight, may show that the changed product complies with the regulations incorporated by reference in the type certificate. The applicant may elect to comply with the later regulations. If the Administrator finds that the change is significant in an area, the Administrator may designate compliance with a later amendment to the regulations incorporated by reference in the type certificate that applies to the change and any regulation the Administrator finds is directly related. See paragraph 9 of the AC for specific guidance on this provision.

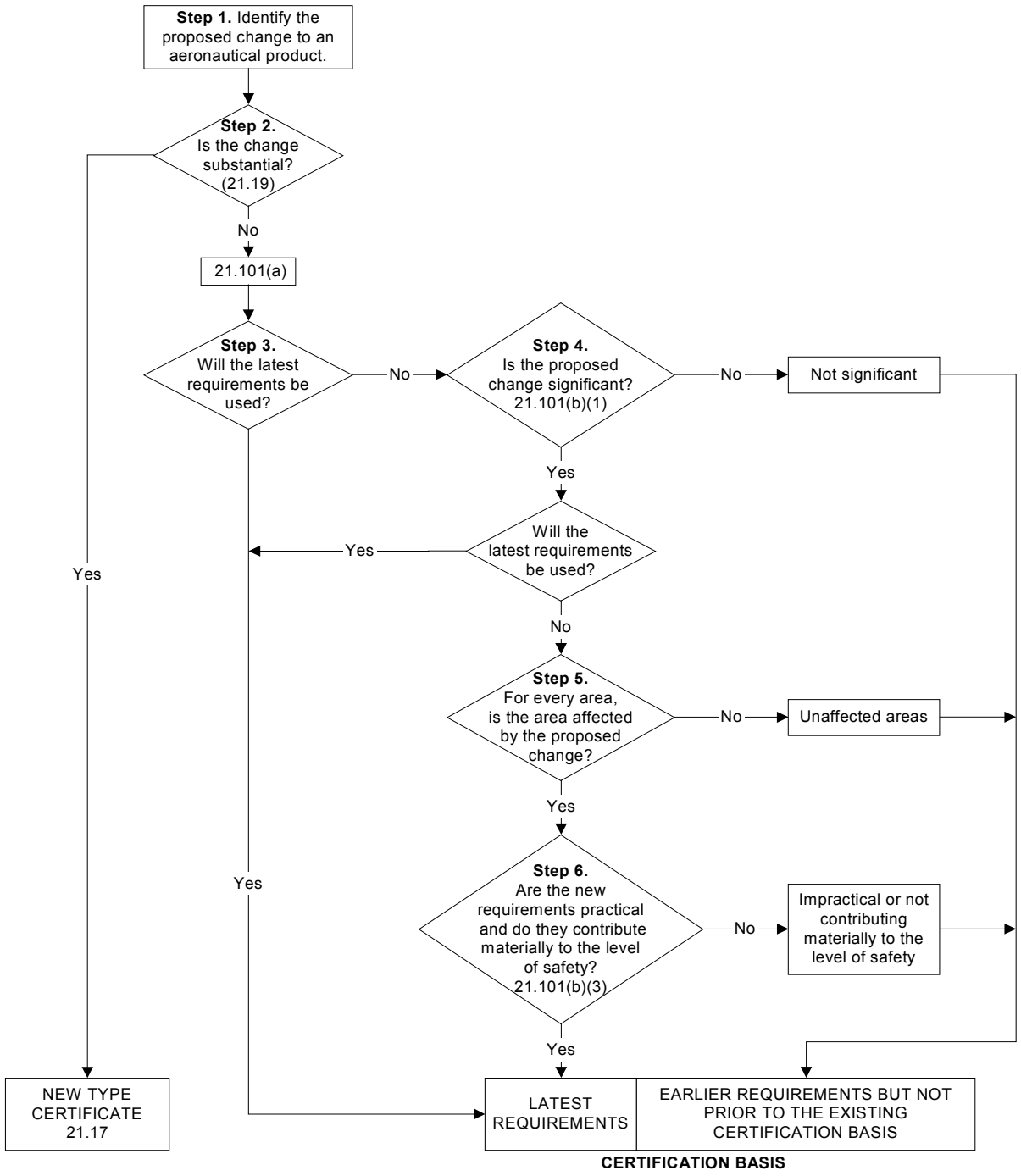
g. Title 14 CFR § 21.101(d) provides for the use of special conditions, as prescribed under 14 CFR § 21.16, when the existing certification basis or the latest regulations do not provide adequate standards with respect to the proposed change because of a novel or unusual design feature.

h. Title 14 CFR § 21.101(e) prescribes the effective period an application will remain valid for a change to a type certificate. This section is consistent with the requirements of 14 CFR § 21.17 for a new type certificate.

i. Title 14 CFR § 21.101(f) pertains to aircraft certificated under the requirements of 14 CFR §§ 21.17(b), 21.24, 21.25, and 21.27 airworthiness requirements.

j. Figure 1 provides a flowchart of the process to determine the applicable certification basis for a proposed design change under 14 CFR § 21.101, following a determination that the proposed design change is not substantial under 14 CFR § 21.19.

FIGURE 1: ESTABLISHING THE CERTIFICATION BASIS FOR CHANGED PRODUCT



NOTE 1: In the vast majority of cases, the applicant will proceed to Step 4 as the initial step in the process. See paragraph 6 for guidance.

NOTE 2: For excepted products under 14 CFR § 21.101(c), see paragraph 9. For conditions under 14 CFR § 21.101(d), see paragraph 10.

6. ESTABLISHING THE CERTIFICATION BASIS FOR CHANGED PRODUCTS, 14 CFR §§ 21.101(b)(1).

a. The administrative burden for the applicant is to demonstrate, and for the Administrator to find, that a changed product is significant or not significant, and to determine the resulting certification basis. The certification basis can vary depending on the magnitude and scope of the change. The steps below present a streamlined approach of making this determination. In addition to assisting in the determination of significance, this guidance will help establish the appropriate amount of coordination required between the applicant and the Administrator.

b. Classifications of typical changes are in the tables of Appendix 1, Classification of Changes. For instructions on how to use the appendix 1 tables, proceed to step 4 below. In cases where the classification in appendix 1 is not applicable or immediately obvious for the proposed change, the following steps should be used in conjunction with Figure 1 to determine the appropriate certification basis for the changed product. All other areas of the aircraft are considered to be unchanged or not affected by the change and continue to comply with the existing certification basis.

c. ***Step 1 of Figure 1. Identify the proposed change to an aeronautical product.***

(1) The applicant must, as a first step, identify the proposed change to the aeronautical product. An applicant for a change to a type certificate must consider all previous relevant design changes to the aeronautical product. Changes to a product can include physical design changes, changes to an operating envelope, and/or performance changes. The change may be a single change or a collection of changes.

(2) For each change, it is important that the effects of the change on other systems, components, equipment, or appliances of the product are properly assessed. The characteristics affected by the change are not only physical changes. 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 reviewed, updated, or rewritten. All other areas of the aircraft are considered to be unchanged or not affected by the change and can continue to comply with the existing certification basis.

d. ***Step 2 of Figure 1. Is the change substantial?***

(1) Title 14 CFR § 21.19 requires that an applicant obtain a new type certificate 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 type certificate 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. The need for a new type certificate may be obvious when the change is first considered or may need a more extensive evaluation through application of 14 CFR § 21.101.

(2) A "substantially complete investigation" of compliance is required when most of the existing substantiation is not applicable to the changed product. The question of whether a change

is substantial must be addressed at the beginning of the process. However, if at any point while developing the certification basis, it becomes clear that the proposed change is a substantial change, the process ceases to be an amendment process under 14 CFR part 21, Subpart D and becomes a new type certificate process under 14 CFR Part 21, Subpart B.

(3) If it is not initially clear that a new type certificate is required, appendix 1 provides some examples of substantial changes to aid in this classification.

(4) In considering the above, a substantial change will require a new type certificate, therefore, 14 CFR § 21.19 applies; if the change is not substantial, 14 CFR § 21.101 applies.

e. ***Step 3 of Figure 1. Will the latest requirements be used?***

(1) Where the latest requirements are used, the intent of 14 CFR § 21.101 has been met, including the case where the applicable requirements have not changed since the previous update of the certification basis, or where the applicant elects to comply with the latest amendments.

f. ***Step 4 of Figure 1. Is the proposed change significant? 14 CFR § 21.101(b)(1)***

(1) Significant changes are typically product level changes and, by their very nature, 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 major change rising to the product level that makes the changed product distinct from others. Additionally, 14 CFR § 21.101(b)(1) defines a significant change as existing when one or more of three automatic criteria apply: (1) the general configuration is not retained; (2) principles of construction are not retained; and (3) the assumptions used for certification of the product do not remain valid. 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.

(2) Previous relevant design changes of the product can trigger one or more of the automatic criteria listed in 14 CFR §§ 21.101(b)(1)(i) and (ii) for the proposed design change. When assessing the design change, either singularly or collectively, the cumulative effect of previous relevant design changes must be considered. These design changes may have been incorporated through earlier changes in the type certificate on areas related to the current proposed change and the associated areas, systems, components, equipment, or appliances. The collective result may be a product considerably different from the latest updated certification basis for the product or model. For example, previous relevant aircraft design changes may address incremental increases in weight or thrust that, while individually not significant (for example, 2 percent, 4 percent, 5 percent discrete increases), can, through a series of changes, achieve a significant product level change.

(3) The applicant may use the tables in appendix 1 and the criteria described in paragraph 7 as guidance to make the classification of significant. The examples of significant and not significant changes in appendix 1 are predicated upon more than 10 years of international certification experience. One or more of the three automatic criteria in 14 CFR § 21.101(b)(1) were found in all cases where the changes were identified as significant. Other criteria reflecting

significance were not found. The concept of having only the three automatic criteria seems to fit most projects. Therefore, typically only when one or more of the three criteria is affected is the design change considered significant. The starting point to begin accumulating previous relevant design changes is the time the latest applicable requirements were applied in the affected area, system, component, equipment, or appliance.

(4) Typically, a change to a single area, system, or component will 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.

7. USING THE CRITERIA TO DETERMINE SIGNIFICANCE AT THE PRODUCT LEVEL, 14 CFR §§ 21.101(b)(1)(i) and (ii) (Step 4).

a. Typically, significant product level changes result in a model change necessitating an amendment to the type certificate or an STC that rises to the level of an amended type certificate. Applications for a new model not associated with hardware changes, that is, commercial considerations, are not an indication of a significant change under 14 CFR § 21.101. All changes are considered in light of the change itself and its classification.

b. The following definitions build upon the criteria identified in the rule and provide additional guidance on how to apply the criteria when classifying product level changes. In cases of doubt, and to ensure a consistent outcome, the applicant is encouraged to seek the advice of the Aircraft Certification Office.

(1) Changes Where the General Configuration is Not Retained (Significant Change to General Configuration). A change to the general configuration of the product level that is likely to require a new model designation because of the need to distinguish the different product from other product models, for example, performance or interchangeability of major components.

(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.

(3) Changes that Invalidate the Assumptions used for Certification (Significant Change to the Assumptions used for Certification). A change to the product level assumptions associated with the compliance demonstration, performance, or operating envelope that by itself is so different that the original assumptions are invalidated. Examples may include:

(a) Change of an aircraft from an unpressurized to pressurized fuselage;

(b) Change of operation of a fixed wing aircraft from land-based to water-based; and

(c) Operation envelope expansions that are outside the existing design parameters and capabilities.

> **NOTE:** Merely operating a product to an expanded envelope for which it was originally designed is generally not a significant change. In this case, the assumptions used for certification of the basic product remain valid and the results can be applied to cover the changed product with predictable effects or can be demonstrated without significant physical changes to the product.

c. The above criteria are used to determine if a change is significant. In applying the automatic criteria and the examples in appendix 1, the applicant should focus on the change itself. Consideration of only the latest certification requirements is not reason enough to cause a classification of significance under 14 CFR § 21.101.

d. Appendix 1 includes tables of typical changes for transport aircraft, small aircraft, rotorcraft, and engines/propellers that meet the definition of a significant change for each product line. 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.

e. If the change is classified as:

(1) Significant (14 CFR §§ 21.101(b)(1) and (2)). The applicant will comply with the latest amendments of the applicable requirements for certification of the changed product. The applicant can use the exceptions in 14 CFR §§ 21.101(b)(2) and/or (3) to show compliance with earlier amendments. The final certification basis may consist of a combination of the latest, and earlier or existing requirements for the change.

(2) Not Significant (14 CFR § 21.101(b)(1)). The applicable requirements are those contained in the existing certification basis. The applicant may elect to comply with later amendments.

> **NOTE:** In cases where no regulatory standards are defined in the existing certification basis for the design change but applicable regulatory standards exist in a subsequent amendment to the regulations, the subsequent amendment will be made part of the certification basis.

f. Making the Classification. A classification of significant or not significant can be made (the application of 14 CFR § 21.101(b)(1)) in one of two ways:

(1) By delegation, where appropriate guidelines are in place to support a classification of not significant by the applicant. The Administrator may accept the not significant determination without further evaluation and rely on the applicant's design control system and the Administrator's oversight system to monitor and validate decisions; or

(2) By the Administrator accepting the determination of significance relevant to a major modification based on the data submitted by the applicant.

g. At this point the determination of significant or not significant has been made. For significant changes, if the applicant proposes to show compliance with an earlier requirement, the procedure outlined in paragraph 8 should be used.

8. SHOWING COMPLIANCE WITH AN EARLIER REQUIREMENT, 14 CFR §§ 21.101(b)(2) AND (3).

a. For a design change that has been determined to be significant, 14 CFR §§ 21.101(b)(2) and (3) provide the exceptions from the requirement of 14 CFR § 21.101(a) to meet the latest requirements for design changes. An applicant may elect to show compliance with an earlier amendment level or with the existing certification basis for areas not affected by the change, and areas affected by the change for which compliance with the latest requirements would not contribute materially to the level of safety or would be impractical.

b. The earlier amendment level with which the applicant intends to show compliance may not precede the corresponding requirements in the existing certification basis. It is incumbent upon the applicant to demonstrate to the Administrator that compliance with the latest requirements does not contribute materially to the level of safety, or is impractical.

c. The following steps should be used in conjunction with figure 1, when an applicant wishes to comply with an earlier requirement for a significant change:

(1) ***Step 5 of Figure 1. Is the area affected by the proposed change? 14 CFR § 21.101(b)(2)***

(a) A not affected area is any area, system, component, equipment, or appliance that is not affected by the proposed product level change. For a product level change, it is important that the effects of such change on other systems, components, equipment, or appliances of the product are properly assessed because areas that have not been changed may be affected. If the significant change does not affect the area, then the certification basis of that area need not be revisited.

(b) In assessing the affected areas, it may be necessary to identify secondary changes resulting from a product level change. The secondary changes may be changes in both physical aspects and/or performance characteristics that are part of, and consequential to, the overall product level change. Secondary changes may be evaluated to the existing certification basis for the product being changed; however, care should be taken to ensure that affected areas are not overlooked. The intent is to encompass all aspects where there is a need for re-evaluation.

(c) The following aspects of a product level change should be considered:

1 Physical aspects. The physical aspects include, but are not limited to, structures, systems, equipment, components, and appliances (physical aspects can cover both "hardware" and "software"). When evaluating the physical aspects, it is necessary to make a distinction between the product level change and the resulting secondary effects. An example of a

secondary effect may be the lengthening and re-routing of the various airplane circuits as a result of a fuselage plug.

2 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 provisions, fire protection, structural integrity, aeroelastic characteristics, or crashworthiness. These characteristics may be affected by a product level change. For example, adding a fuselage plug could significantly affect performance and handling qualities.

(d) All areas affected by the proposed design change must comply with the latest requirements, unless the applicant shows that demonstrating compliance with an amendment of a requirement would not contribute materially to the level of safety or would be impractical. Step 6 provides further explanation.

(2) ***Step 6 of Figure 1. Are the new requirements practical and do they contribute materially to the level of safety? 14 CFR § 21.101(b)(3)***

(a) Not contributing materially to the level of safety. Compliance with the latest requirements could be considered "not to contribute materially to the level of safety" if the change to type design and/or relevant experience demonstrates a level of safety comparable to that provided by the latest requirements, or if compliance may compromise the existing level of safety for that particular changed product. The applicant must provide sufficient justification to allow the Administrator to make this determination. This exception could be applicable in the situations described in the paragraphs below:

1 Design.

(aa) 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 be materially increased by applying the latest requirements only to the changed parts since the entire modified design may not be any safer than the original design. Similarly, there may be no safety benefit in applying later requirements to both the new and unaltered components. Compliance of the new areas with the existing certification basis may be acceptable.

(bb) However, a fuselage plug may be large relative to the original certificated structure, seats, bins, doors, and cargo compartment. The change may require a new compliance substantiation that is comparable with that required for a new model airplane. In these circumstances the proposed certification basis should encompass the requirements in effect on the date of application for the change.

2 Service experience.

(aa) This provision permits the use of relevant service experience, such as fleet hours, to demonstrate that compliance with the latest requirements would not contribute

materially to the level of safety, and as such the use of earlier requirements may be appropriate. Appendix 3, The Use of Service Experience in the Certification Process, provides additional guidance on the use of service experience, along with examples.

(bb) There may be cases for rotorcraft and small airplanes where sufficient and relevant data may not be available because of the reduced utilization 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 requirements, 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 entities.

(cc) 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 the Administrator.

3 Other exceptions. Compliance with later requirements would not be required where the amendment is of an administrative nature and has been made only to correct errors or omissions, consolidate text, or clarify an existing requirement.

(b) Impractical. Compliance with the latest requirements may be considered impractical if the applicant can substantiate that it would result in additional resource requirements that are not commensurate with the safety benefits. The additional resource requirements could include those arising from design changes required for compliance and the effort required to demonstrate compliance, but would not include resource expenditures for prior product changes.

1 Substantiating data and analyses must support an applicant's position that compliance is impractical, and the Administrator must agree with this position. In evaluating an applicant's position and substantiating data regarding impracticality, the Administrator may consider other factors (for example, the costs and safety benefits for a comparable new design).

2 A review of transport category projects showed that in certain cases, where an earlier amendment to applicable requirements was allowed, design changes were made to nearly comply with the latest amendments. In these cases the applicant successfully demonstrated that full compliance would require a substantial increase in the outlay of resources with a very small increase in the level of safety. These cases reflect an appropriate application of "impracticality" to a changed product.

3 A proposal that a product design change would be impractical would be used, in most cases, where compliance with the latest requirements would contribute materially to the level of safety, but this contribution may not be commensurate with the associated resource expenditures.

4 Appendix 2, Procedures for Evaluating Impracticality of Applying Latest Requirements to a Changed Product, provides additional guidance and examples for determining proceures for evaluating impracticality of applying latest requirements to a changed product rule.

(c) This completes the step-by-step process used in determining the certification basis for the changed product.

9. EXCEPTED PRODUCTS UNDER 14 CFR § 21.101(c).

a. An applicant for a change to an aircraft (other than rotorcraft) of 6,000 pounds or less maximum weight, or to a non-turbine rotorcraft of 3,000 pounds or less maximum weight, may show that the changed product complies with the regulations incorporated by reference in the type certificate. The applicant may elect to comply with the later regulations. If the Administrator finds that the change is significant in an area, the Administrator may designate compliance with a later amendment to the regulations incorporated by reference in the type certificate that applies to the change and any regulation the Administrator finds is directly related. Beginning with the existing certification basis, the Administrator will step through each progressive regulation to determine the amendment appropriate for the change. However, if the Administrator also finds that compliance with the amendment or regulation would not contribute materially to the level of safety of the changed product or would be impractical, the Administrator may allow compliance with an earlier amendment to that requirement initially designated or with the existing certification basis, depending on the proposed design change.

b. For a change that contains new design features that are novel and unusual, the Administrator will designate the applicable special conditions at the appropriate amendment level, beginning with the existing certification basis and progressing to the most appropriate later amendment level for the change. For a change that contains new features, which are not covered in the existing certification basis, the Administrator will designate the applicable airworthiness requirements at the appropriate amendment level, beginning with the existing certification basis and progressing to the most appropriate later amendment level for the change.

c. The exception for products under 14 CFR § 21.101(c) applies at the aircraft level only. Design changes to engines and propellers installed on these excepted aircraft are assessed as separate products using 14 CFR §§ 21.101(a) and (b).

10. SPECIAL CONDITIONS, 14 CFR § 21.101(d). Title 14 CFR 21.101(d) allows for the application of special conditions, or for changes to existing special conditions, to address the changed design. The objective is to achieve, for the significant change, a level of safety consistent with that provided by the requirements in effect on the date of application for the design change. 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 not significant, the special conditions must be consistent with the agreed certification basis.

11. EFFECTIVE PERIOD FOR AN APPLICATION TO CHANGE A TYPE CERTIFICATE, 14 CFR § 21.101(e). Title 14 CFR 21.101(e) is intended to ensure that, at the time the changed product is certificated, no longer than three or five years, as appropriate to the

product, had elapsed from the date of application. This is to ensure that the certification basis for the changed product is as current as practical. This is consistent with the requirements of 14 CFR § 21.17 for a new type certificate and prescribes the process of updating the certification basis if these time limits are exceeded.

12. OTHER CATEGORY AIRCRAFT, 14 CFR § 21.101(f). For aircraft type certificated under 14 CFR §§ 21.17(b), 21.24, 21.25, and 21.27, the certification basis for the changed product will consist of the amendment levels of the applicable regulations that the Administrator finds appropriate for the change in effect on the date of application for the change. When selecting a certification basis for a change, an applicant may elect to propose compliance to an earlier amendment using the provisions of 14 CFR § 21.101(b). The exceptions in 14 CFR § 21.101(c) do not apply to categories of products defined in 14 CFR § 21.101(f).

a. Special Classes Aircraft. For special classes of aircraft, including the engines and propellers installed thereon (for example, gliders, airships), certificated in accordance with 14 CFR § 21.17(b), the applicable requirements will be portions of those other airworthiness requirements in 14 CFR Parts 23, 25, 27, 29, 31, 33, and 35 found by the Administrator to be appropriate for the aircraft and applicable to the specific type design, or such airworthiness criteria that the Administrator may find provide an equivalent level of safety to those Parts.

b. Primary Category Aircraft. For primary category aircraft certificated under 14 CFR § 21.24, the applicable airworthiness requirements are in 14 CFR Parts 23, 27, 31, 33, and 35, or such other requirements as the Administrator may find appropriate. These requirements must be applicable to the specific design and intended use of the aircraft and provide a level of safety acceptable to the Administrator.

c. Restricted Category Aircraft. For aircraft certificated in the restricted category under 14 CFR § 21.25(a)(1), the application of the latest regulations would not normally be considered to contribute materially to the level of safety or be practical for its intended use. However, if the regulations incorporated by reference in the type certificate do not provide an appropriate level of safety for its intended use, the application of a later regulation would be considered.

(1) Features of the changed product that are "novel" or "unusual" to the original certificated restricted category product may be assessed against a later requirement that addresses the feature. In this case, the requirements in effect at the time of the existing restricted category type certificate may be viewed as a starting point, with subsequent amendments being examined, if necessary, to arrive at a requirement that provides an appropriate level of safety.

(2) For the installation of turbo propeller engines instead of reciprocating engines, either in a restricted category aircraft that was originally certificated based on satisfactory military service experience or in a restricted category aircraft for which the original certification basis did not contain regulations for turbine engine installations, later amendments must be used to provide an appropriate level of safety for its intended operation.

d. Military aircraft designs. Aircraft type certificated in the restricted category under 14 CFR § 21.25(a)(2) are accepted on the basis of the U.S. military use instead of showing compliance with airworthiness standards in 14 CFR Chapter 1. Many of these aircraft were not certificated to a specific set of airworthiness standards, therefore, an appropriate equivalent civilian certification basis could be determined using the table in 14 CFR § 21.27 for surplus military aircraft. Title 14 CFR § 21.101(f) requires the application of the latest amendments to significant changes to these products. However, since the latest amendments may not be appropriate for the aircraft's intended use, earlier regulations are acceptable. They may not predate the equivalent certification basis. If these regulations do not include design standards applicable to the change, later regulations appropriate to the product category will be applied. The goal is to maintain a level of safety at least equivalent to the original design and appropriate for the aircraft's intended use.

e. Surplus military aircraft. Aircraft type certificated under 14 CFR § 21.27 are entitled to a TC in the normal, utility, acrobatic, commuter, or transport category. These aircraft were designed and constructed in the United States, accepted for operational use, and declared surplus by the U.S. Armed Forces. These aircraft may be counterparts, and are considered equivalent, to the previously civil certificated aircraft. Product changes or modifications to these aircraft are certificated in the same manner as their civil counterparts.

f. Limited category aircraft. Limited category aircraft are surplus military aircraft, mostly from World War II, that were type certificated under Part 9 of the Civil Air Regulations for use in other than air transport. These aircraft were not intended to carry persons or property for hire, and normally were accepted on the basis of their previous military qualifications acceptance and service record. However, a change to these aircraft not supported by the military service history must comply with appropriate airworthiness standards. The appropriate standard should be determined with recognition that the aircraft has not been type certificated to a civil aircraft airworthiness standard. Therefore, a change to an aircraft of this type may not realize a safety benefit by complying with later airworthiness standards.

13. DOCUMENTATION. All changes that result in a revision to the product's certification basis must be reflected on the type certification data sheet. Similarly, the certification basis must be noted on all STCs.

Original signed by

David W. Hempe
Manager, Aircraft Engineering Division,
Aircraft Certification Service

APPENDIX 1. CLASSIFICATION OF CHANGES

Appendix 1 includes tables of typical changes for small aircraft (Figure 1), transport aircraft (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 using data from Administrator 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 Administrator has made the determination, based on applying the automatic criteria, that these changes are significant or not significant.

> **NOTE:** The small airplane table (Figure 1) was developed working with industry representatives who identified 500+ distinct, typical changes for these airplanes. These examples were validated by a comprehensive review of Part 23 Certification Project Notifications (CPNs) for 1998, 1999, 2000, and 2001 (approximately 1,800 cases). The examples in appendix 1 reflect many of the significant, product level changes we would expect to see. The transport airplane table (Figure 2) was developed, in part, by reviewing all STC/ATC Certification Project Notifications for 2000 and 2001. The 3,000+ change projects for these two years represented 324 distinct major change projects the Transport Airplane Directorate reviewed over the two-year period. Part 25 industry representatives further reviewed and validated the examples.

(1) The Figure 3 rotorcraft table was developed by a working group of Administrator and industry representatives. They were validated by the Rotorcraft Directorate review of recent applications for product changes and reflect changes the rotorcraft community typically makes.

(2) The Engine and Propeller Directorate developed the Figure 4 engine and propeller table, and representatives of the engine manufacturers reviewed and validated it. They reflect the types of changes the engine and propeller industry would typically make to their products.

(b) The columns "Change to General Configuration," "Change to Principles of Construction," and "Assumptions of Certification" reflect the automatic criteria of 14 CFR §§ 21.101(b)(1)(i) and (ii). The "Notes" column provides typical rationales that are considered in evaluating the designation of the criteria.

(c) The tables can be used:

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

(2) With the three automatic criteria to understand the table's logic and to help classify a proposed change not in the table.

APPENDIX 1. CLASSIFICATION OF CHANGES (CONTINUED)

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

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23)

The following tables of substantial and significant changes are based on 10 years of international experience, and were added/revised by revisitation of the Directorates & U.S. Industry.

The following are examples of SUBSTANTIAL changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Change in wing location (tandem, forward, canard, high/low)	NA	NA	NA	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	NA	NA	NA	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	NA	NA	NA	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	NA	NA	NA	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
Change in engine configuration (tractor/pusher)	NA	NA	NA	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SUBSTANTIAL changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Change from an all metal airplane to all composite primary structure (fuselage, wing, empennage)	NA	NA	NA	
Increase from subsonic to supersonic flight regime	NA	NA	NA	

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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 percent	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/tailwheel undercarriage change or addition of floats	Yes	No	No	Change in general configuration. Likely, at airplane level, general configuration and certification assumptions remain valid.
Increase in seating capacity resulting in a different certification category (e.g., from normal to commuter category) where configuration or principles of construction changes or assumptions do not remain valid.	Yes	Yes	Yes	Change in general configuration. Change in principles of construction. Requires extensive construction reassessment. Change in certification assumptions. Requires new AFM and pilot type rating.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **14 CFR § 21.101(b)(1)(ii)**	**Notes**
Passenger to freighter configuration conversion which involves the introduction of a cargo door or an increase in floor loading of more than 20 percent, 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.
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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Addition of a turbo-charger that changes the power envelope, operating range, or limitations appreciably	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 increase 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 reinvestigation.
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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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.
STOL kit	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
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 rejustified with a majority of requirements.	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 airplane structure.	No	No	Yes	Changes in design/certification assumptions. Extensive alteration of fuel storage and handling systems.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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.
Weight increase that places the aircraft into the commuter category (i.e., above 12,500 lbs)	No	No	Yes	Certification assumptions invalidated. Requires new AFM.
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 cabin pressurization	No	Yes	Yes	Extensive airframe changes effecting load paths, fatigue evaluation, aero elastic characteristics, etc. Requires extensive construction reinvestigation. Invalidates design assumptions.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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.
A change in the required number of flight crew, which necessitates a complete cockpit rearrangement, 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 expansion of an aircraft's operating envelope or 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	No	No	Yes	Invalidates certification assumptions. Requires new AFM to address performance and flight characteristics.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
A major flight deck upgrade	No	No	Yes	Extensive changes to avionics and electrical systems design. Invalidates certification assumptions. Extensive reassessments of systems integration, flight crew workload, and human factors evaluation are required. Requires new AFM.
Introduction of autoland	No	No	Yes	Invalidates original design assumptions.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

The following are examples of NOT SIGNIFICANT changes:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
Addition of wingtip modifications (not winglets)	No	No	No	A major change to the airplane. 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 airplane, 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 airplane certification.
Litter, berth and cargo tie down device installation	No	No	No	Not an airplane level change.
Increased tire size, including tundra tires	No	No	No	Not an airplane 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 assumptions remain valid.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
Addition of a turbo-charger that does not change the power envelope, operating range, or limitations (e.g., a turbo-normalized engine, where the additional power is used to enhance high altitude or hot day performance).	No	No	No	Not an airplane level change.
Replacement of 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 airplane level change.
Substitution of one type of metal for another	No	No	No	Not an airplane level change.
Any change in construction or fastening not involving primary structure	No	No	No	Not an airplane level change.
A new fabric type for fabric skinned aircraft	No	No	No	Not an airplane level change.
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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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 airplane is not suitable as an IFR platform, e.g., special handling concerns).	No	No	No	Not an airplane 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 airplane level change.
Fuel tanks, where fuel is changed from gasoline to 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.	No	No	No	Not an airplane level change.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Limited changes in a pressurization system, e.g., number of outflow valves, type of controller, or size of pressurized compartment, but the system must be resubstantiated if the original test data are invalidated.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Install a quieter exhaust system	No	No	No	Not an airplane level change.
Changes in engine cooling or cowling	No	No	No	Not an airplane 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 fuel system of different fuel types: such as AvGas/Diesel or Jet A/Ethanol.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
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 airplane, 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 airplane, 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 percent, unless assumptions made in justification of the design are thereby invalidated.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
An additional aileron tab (e.g., on the other wing)	No	No	No	Although a major change to the airplane, 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 airplane level change.
Autopilot installation (for IFR use, where the original certification does not indicate that the airplane is not suitable as an IFR platform)	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.
Increased battery capacity or relocate battery	No	No	No	Not an airplane level change.
Replace generator with alternator	No	No	No	Not an airplane level change.
Additional lighting (e.g., navigation lights, strobes)	No	No	No	Not an airplane level change.
Higher capacity brake assemblies	No	No	No	Not an airplane level change.
Increase in fuel tank capacity	No	No	No	Not an airplane level change.
Addition of an oxygen system	No	No	No	Not an airplane level change.
Relocation of a galley	No	No	No	Not an airplane level change.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 23) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Passenger to freight (only) conversion with no change to basic fuselage structure.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid. Requires certification substantiation applicable to freighter requirements.
Installation of new seat belt or shoulder harness	No	No	No	Not an airplane level change.
A small increase in cg range	No	No	No	At airplane 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 airplane level, likely the original general configuration, principles of construction, and certification assumptions remain valid. Requires certification substantiation applic. to APU installation requirements.
An alternative autopilot	No	No	No	Not an airplane level change.
Addition of Class B Terrain Awareness and Warning Systems (TAWS)	No	No	No	Not an airplane level change.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 2. EXAMPLES OF CHANGES FOR TRANSPORT AIRPLANES (Part 25)

The following are examples of SUBSTANTIAL changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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.	NA	NA	NA	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.	NA	NA	NA	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 airplane to all composite primary structure (fuselage, wing, empennage).	NA	NA	NA	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 25) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Derivative model, e.g., increased passenger payload, freighter version or complete update of a certificated airplane.	Yes	Yes	Yes	Multiple changes packaged into a new model. Increased payload or new freighter would change the general configuration and assumptions. Updated airplane 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 airplane 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 combo 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.
Change to pressurized cabin, including the introduction of a pressurization system.	No	No	Yes	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 airplane flight manual to address performance and flight characteristics.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 2. EXAMPLES OF CHANGES FOR TRANSPORT AIRPLANES (Part 25) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **14 CFR § 21.101(b)(1)(ii)**	**Notes**
Fuselage length change – lengthen or shorten fuselage	Yes	No	No	Only when it requires extensive changes to fuselage structure, affects aircraft systems, and requires a new airplane flight manual to address performance and flight characteristics.
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 airplane 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 airplane 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.
Typically, an increase in design weight of more than 10 percent.	No	No	Yes	Requires extensive resubstantiation of aircraft structure, aircraft performance and flying qualities and associated systems.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 25) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Wing changes in span, sweep, and 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 airplane flight manual to address performance and flight characteristics.
Change in type or number of emergency exits 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.	No	No	Yes	Affects avionics and electrical systems integration and architecture concepts and philosophies. This drives a reassessment of flight crew workload and other human factors issues, and requires a re-evaluation of the original design assumptions used for the cockpit.
Change in primary flight controls to fly by wire (FBW) system. (Some airplanes have some degree of FBW. Achieving full FBW may be a not significant change on some airplanes.)	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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 2. EXAMPLES OF CHANGES FOR TRANSPORT AIRPLANES (Part 25) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Replace reciprocating with turbo-propeller engines.	Yes	No	No	Requires extensive changes to airframe structure, addition of aircraft systems, and new airplane flight manual to address performance and flight characteristics.
Typically a thrust increase of more than 10 percent.	No	No	Yes	Requires resubstantiation of powerplant installation, and has a marked affect on aircraft performance and flying qualities.
Initial installation of an autoland system.	No	No	Yes	Baseline airplane not designed for autoland operation, potential crew workload and systems compatibility issues.
Installation of a new fuel tank, (horizontal stabilizer tank or auxiliary fuel tank in the fuselage outside the wing in conjunction with increased maximum takeoff 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 25) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 2. EXAMPLES OF CHANGES FOR TRANSPORT AIRPLANES (Part 25) (CONTINUED)

The following are examples of NOT SIGNIFICANT changes:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
Alternate engine installation or hush kit at same position.	No	No	No	Typically it is not significant so long as there is not more than a 10 percent 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 radome for cruise performance reasons, where such changes do not require extensive structural, systems, or AFM changes.
Refairing of wing tip caps (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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 1. EXAMPLES OF CHANGES FOR SMALL AIRPLANES (Part 25) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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, etc.
Initial installation of an autopilot system.	No	No	No	Modification is generally adaptive in nature, with no change to original certification assumptions.
Integrated modular avionics.	No	No	No	The basic functionality of the systems is unchanged. No change from analog to digital.
Installation or rearrangement of an interior in an aircraft.	No	No	No	Special conditions could be required 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 2. EXAMPLES OF CHANGES FOR TRANSPORT AIRPLANES (Part 25) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Redesign floor structure.	No	No	No	By itself, not a significant product change. It could be significant if part of a cargo converted passenger airplane.
Novel or unusual method of construction of a component.	No	No	No	The component change does not rise to the product level. Special conditions could be required if there are no existing regulations that adequately address these features.
Initial installation of a non-essential APU.	No	No	No	A stand-alone initial APU installation on an airplane 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29)

The following are examples of SUBSTANTIAL changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Change from the number and or configuration of rotors (e.g., main & tail rotor system to two main rotors.	NA	NA	NA	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.	NA	NA	NA	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Comprehensive flight deck upgrade.	No	No	Yes	The degree of change is so extensive that it affects basic avionics and electrical systems integration and architecture concepts and philosophies. This drives a complete reassessment of flight crew workload and other human factor issues, and requires a re-evaluation of the original design assumptions used for the cockpit.
Certification for flight into known icing conditions.	No	No	Yes	
(Fixed) flying controls from mechanical to fly by wire.	Yes	Yes	Yes	
Addition of an engine; e.g., from single to twin or reduction of the number of engines; e.g., from twin to single.	Yes	No	Yes	May be a substantial change depending upon project details.
A fuselage modification that changes the primary structure, aerodynamics, and operating envelope sufficiently to invalidate the certification assumptions.	Yes	No	Yes	

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated?** **14 CFR § 21.101(b)(1)(ii)**	**Notes**
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 increase performance).	No	Yes	Yes	
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	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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

Examples of SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Change of the number of rotor blades.	Yes	No	No	Thee addition/deletion of rotorblades may not be significant, provided the remainder of the basic propulsion system remains essentially unchanged.
Change tail anti-torque device (e.g., tail rotor, ducted fan or other technology).	Yes	Yes	No	

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

The following are examples of NOT SIGNIFICANT changes:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
Emergency floats	No	No	No	Must comply with the specific applicable requirements 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.
Helicopter Terrain Awareness Warning System (HTAWS) for operational credit	No	No	No	Certificated per rotorcraft HTAWS AC guidance material.
Health Usage Monitoring System (HUMS) for Maintenance Credit	No	No	No	Certificated per rotorcraft HUMS AC guidance material.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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/max 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
Snow skis, "Bear Paws"	No	No	No	Must comply with specific requirements 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 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 3. EXAMPLES OF CHANGES FOR ROTORCRAFT (Parts 27 and 29) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
IFR upgrades involving installation of components (where the original certification does not indicate that the rotorcraft is not suitable as an IFR platform, e.g., special handling concerns).	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. These changes do not typically invalidate the 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS
(Parts 33 and 35)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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, etc. Note that this change is most likely substantial under 21.19
Low bypass ratio engine to high bypass 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 21.19
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 lifting, ingestion, icing, blade out criteria, etc. Note that this change is most likely substantial under 21.19

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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 21.19
Conventional ducted fan to unducted fan	Yes	Yes	Yes	Change in configuration Change in type Not interchangeable Assumptions for certification may no longer be valid Note that this change is most likely substantial under 21.19
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 21.19

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Increase/decrease in the number of compressor/turbine stages with resultant change in approved 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 behavior, 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 affect engine thrust/power limitations and have affected the dynamic behavior of the engine in terms of backbone bending, torque spike effects on casing, foreign object ingestion behavior, burst model protection for the aircraft. If there is a diameter change, installation will be also affected.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Hydro-Mechanical control to FADEC/EEC without hydro mechanical backup	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, 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	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 associated with changes in approved limitations* *exclude life limits	No	No	Yes	Change is associated with other changes that would affect engine thrust/power and have affected the dynamic behavior of the engine. Assumptions used for certification may no longer be valid

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)	Notes
Piston Engines				
Convert from Mechanical to Electronic Control System	Yes	Yes	No	Change in engine configuration: 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 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: 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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

The following are examples of SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
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.

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

The following are examples of NOT SIGNIFICANT changes:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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 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 behavior* *exclude life limits	No	No	No	Component Level Change
Bearing changes	No	No	No	Component Level Change

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
New blade designs with similar material that can be retrofitted	No	No	No	Component Level Change
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	

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	**Is there a change to the general configuration?** **14 CFR § 21.101(b)(1)(i)**	**Is there a change to the principles of construction?** **14 CFR § 21.101(b)(1)(i)**	**Have the assumptions used for certification been invalidated? 14 CFR § 21.101(b)(1)(ii)**	**Notes**
Changes in mechanical fuel injection system	No	No	No	
Changes in mechanical fuel injection pump	No	No	No	Component Level Change
Engine model change to accommodate new airplane 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	

APPENDIX 1. CLASSIFICATION OF CHANGES
FIGURE 4. EXAMPLES OF CHANGES FOR ENGINES AND PROPELLERS (Parts 33 and 35) (CONTINUED)

Examples of NOT SIGNIFICANT changes, continued:

Description of change	Is there a change to the general configuration? 14 CFR § 21.101(b)(1)(i)	Is there a change to the principles of construction? 14 CFR § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? 14 CFR § 21.101(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

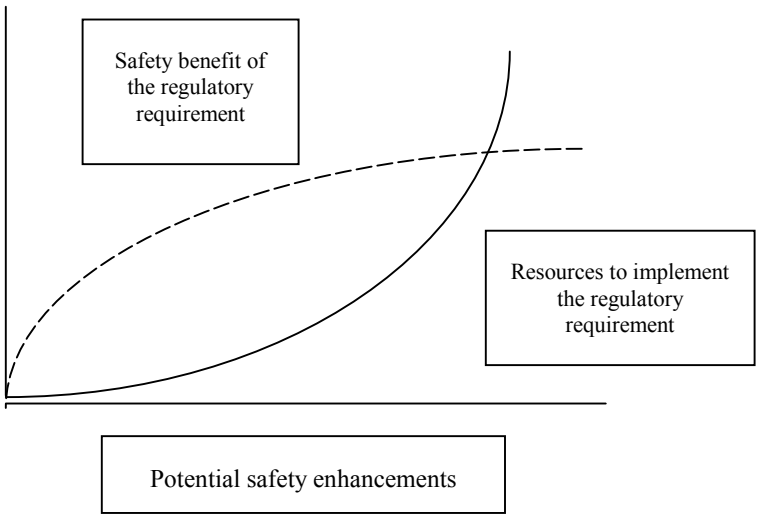
APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT

1. INTRODUCTION.

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

b. This AC recognizes that other procedures have been used for some products and have historically been accepted on a case-by-case basis. These procedures have not been fully harmonized and may not be acceptable for all products. It is envisaged that other methods will be developed and become part of future versions of this AC. Regardless of which method is used, the method must show that a proposed certification basis is resource-effective when it is able to achieve a positive safety benefit for the overall product.

c. In this regard, any method used must also encourage incorporating the safety enhancements that will have the most dramatic impact on the accident rate and recognize the effective use of limited 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.



APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

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 set of safety-significant regulatory standards relative to the respective cost to reach this point.

e. This appendix provides procedural guidance for determining the practicality of applying a requirement 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 requirements in the 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 regulations. It provides a means, but not the only means, for an applicant to present its position in regard to impracticality.

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

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

(1) Step 1: Identify the Regulatory Change Being Evaluated. In this step, document:

(a) The specific requirement (for example, 14 CFR § 25.365);

(b) The amendment level of the existing certification basis for the requirement; and

(c) The latest amendment level of the requirement.

(2) Step 2: Identify the Specific Hazard that the Requirement Addresses.

(a) Each requirement 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 regulation at addressing the hazard.

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

(b) 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 preamble of the regulation. It may also be helpful to discuss the hazard with the responsible FAA office.

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

(a) 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:

1 Incidents where only injuries occurred;

2 Accidents where less than 10 percent of the passengers died;

3 Accidents where 10 percent or more passengers died; and

4 Accidents where a total hull loss occurred.

(b) The preamble to the regulation may provide useful information regarding the consequences of the hazard the requirement is intended to address.

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

(a) 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 occurrence for the hazard can be determined. It is important to recognize that the frequency of occurrence may be higher or lower in the future. Therefore, it also is necessary to predict the frequency of future occurrences.

(**b)** 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.

(c) The preamble of the regulation may provide useful information regarding the frequency of occurrence.

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

(a) When each amendment is promulgated, it is usually expected that compliance with the requirement would be completely effective at addressing the associated hazard. It is

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

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 certification basis to the latest amendment level, it is useful to estimate the effectiveness of both amendment levels in dealing with the hazard.

(b) It is recognized 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.

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

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

2 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.

3 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.

4 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.

5 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.

(6) Step 6: Determine Resource Costs and Cost Avoidance.

(a) 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 requirement may also help a foreign authority certificate a product.

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

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

(c) When evaluating the incremental cost, it may be beneficial for the applicant to compare the increase in cost to comply with the latest requirements to the cost to incorporate the same design feature in a new airplane. In many cases an estimate for the cost of incorporation in a new airplane is provided in the regulatory evaluation by the Administrator, which was presented when the corresponding regulation 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:

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

(aa) Labor: 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 labor requirements, including training, should be considered.

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

(cc) Material: Cost associated with product materials, product components, inventory, kits, and spares.

(dd) Operating Costs: Costs associated with fuel, oil, fees, and expendables.

(ee) 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.

(2) Cost Avoidance:

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

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

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

(7) Step 7: Document Conclusion.

(a) 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 requirement is necessary. The applicant would pursue the change at the latest amendment level.

2 Compliance with an amendment level between the existing 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 requirement.

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

4 The results of this analysis were inconclusive. Further discussions with the FAA are warranted.

> **NOTE:** This process may result in a required certification basis that renders the proposed modification economically not viable.

2. EXAMPLES OF HOW TO CERTIFY CHANGED AIRCRAFT. The following examples are for transport airplanes and illustrate the typical process an applicant follows. The process will be the same for all product types.

a. Example 1: 14 CFR § 25.963 Fuel Tank Access Covers.

(1) This change is part of a significant transport airplane change that increases passenger payload and gross weight by extending the fuselage 20 feet. To accommodate the higher design weights and increased braking requirements, 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 recognizes 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.

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

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

(a) The existing certification basis of the airplane that is being changed is Part 25 prior to Amendment 25-69.

(b) Amendment 25-69 added the requirement that fuel tank access covers on transport category airplanes be designed to minimize 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 25-69 will ensure that all access covers on all fuel tanks are designed or located to minimize 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 10percent deaths.

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

(a) In 200 million departures of large jets:

(1) One occurrence with more than 10 percent deaths; and

(2) 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 25-69 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.

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

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

(a) Costs:

1 For a newly developed airplane, there would be minor increases in labor resulting from design and fabrication.

2 There would be a negligible increase in costs related to materials, operating costs, and revenue utility loss.

(b) Cost Avoidance:

1 There were two 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 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.

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

(9) Conclusion. It is concluded that compliance with the latest regulation increases the level of safety at a minimal cost to the applicant. Based on the arguments and information presented by the applicant through the issue paper process, the Administrator determined that meeting the latest amendment would be practical.

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

(1) For the product change described in Example 1, the lengthened fuselage affects the size of the main deck passenger compartment and the lower center cargo compartment. The applicant plans to comply fully with the latest pressurized compartment loads, except for one interior partition for which the applicant believes compliance would be impractical.

(2) The applicant proposes to increase the length of the fuselage by installing fuselage plugs. This change affected the size of the main deck passenger compartment and the lower center cargo compartment.

(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

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

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.

(c) Amendment 25-71 extended the regulation to all pressurized compartments, not just passenger compartments, and to the pressurization of unpressurized areas. The later regulation had previously been identified as an unsafe feature under 14 CFR § 21.21(b)(2).

(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).

(a) Occurrences with injuries, less than 10 percent deaths, and more than 10 percent deaths.

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

(a) In 200 million departures of large jets:

1 Two occurrences with more than 10 percent deaths;

2 One occurrence with less than 10 percent deaths; and

3 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) Fully effective in all cases. Compliance with Amendment 25-71 eliminates the hazard or provides a means to avoid the hazard completely.

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

(b) Considerable potential for eliminating or avoiding the hazard. Compliance with Amendment 25-54 eliminates the hazard or provides a means to avoid the hazard completely for all probable or likely cases, but it does not cover all situations or scenarios.

(c) Adequately deals with the hazard. Compliance with the original certification basis 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) Design changes made to the proposed derivative airplane bring it nearly into compliance with 14 CFR § 25.365 at Amendment 25-71. Analyses show that one interior partition would fail when subjected to the pressure differential defined by the latest regulation. However, its failure would not have an impact on continued safe flight and landing. This is because none of the critical or essential systems are affected by failure of this partition, and its failure would not present a hazard to a crewmember. Design solutions were considered for this partition, including structural reinforcement and additional venting area, but all were found to require extensive redesign. With this design the applicant believes that most of the safety benefits have been achieved fully with Amendment 25-71.

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

(a) Costs:

1 For a newly developed airplane, there would be a considerable increase in costs related to labor and capital to comply with Amendment 25-71 instead of the original certification basis.

2 There would be a negligible increase in costs related to materials, operating costs, and revenue utility loss.

3 There would be savings in both labor and capital costs if compliance were shown to Amendment 25-54 instead of Amendment 25-71.

(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 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.

APPENDIX 2. PROCEDURE FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT (CONTINUED)

(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 is in compliance with 14 CFR § 25.365 at Amendment 25-54 and nearly in full compliance to Amendment 25-71. The design would adequately address the hazard at an acceptable cost. Therefore, based on arguments of impracticality discussed in an issue paper, the Administrator accepts the applicant's proposal to comply with 14 CFR § 25.365 at Amendment 25-54.

APPENDIX 3. THE USE OF SERVICE EXPERIENCE IN THE CERTIFICATION PROCESS

1. INTRODUCTION. Service experience may support the application of an earlier regulatory 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 requirements. The applicant must provide sufficient substantiation to allow the Administrator to make this determination. A statistical approach may be used, subject to the availability and relevance of data, but sound engineering judgment must be used. 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 Issue Paper process would be used, and the applicant should provide documentation to support the following:

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

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

c. Evidence showing that the proposed certification basis for the changed product, together with applicable service experience, provides a level of safety consistent with complying with the latest requirements.

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

e. Data for the product pertinent to the requirement.

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

(a) Accident reports;

(b) Incident reports;

(c) Service bulletins;

(d) Airworthiness directives;

(e) Repairs;

APPENDIX 3. THE USE OF SERVICE EXPERIENCE IN THE CERTIFICATION PROCESS (CONTINUED)

(f) Modifications;

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

(h) World airline accident summary data;

(i) Service difficulty reports;

(j) National Transportation Safety Board reports; and

(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 issue.

(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; and

(b) Additional detailed testing.

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 requirement to be addressed.

APPENDIX 3. THE USE OF SERVICE EXPERIENCE IN THE CERTIFICATION PROCESS (CONTINUED)

3. EXAMPLE: 14 CFR § 25.1141(f) TRANSPORT AIRPLANES.

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 new generation 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 transport airplanes 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 regulation. 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 certification basis for the changed product, together with applicable service experience of the existing design, provide a level of safety comparable to that intended by the latest regulation. 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

APPENDIX 3. THE USE OF SERVICE EXPERIENCE IN THE CERTIFICATION PROCESS (CONTINUED)

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 regulation. 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) Conclusion, drawing together the data and rationale. 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.