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of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: ESTABLISHING THE CERTIFICATION BASIS OF CHANGED AERONAUTICAL PRODUCTS

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Foreword

This advisory circular (AC) provides guidance for the application of the Changed Product Rule, Title 14 of the Code of Federal Regulations (14 CFR) § 21.101 and 21.19, for changes made to type certificated aeronautical products.

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Chapter 1. Introduction

1. Purpose.

a. The Federal Aviation Administration (FAA) wrote this advisory circular (AC) to provide guidance for establishing the certification basis for changed aeronautical products and to help identify if it will be necessary to apply for a new type certificate.

b. Title 14 of the Code of Federal Regulations (14 CFR) § 21.101 requires an applicant for a change to a type certificate to comply with the airworthiness requirements that apply to the category of the product in effect on the date of application for the change, except:

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

c. The intent of 14 CFR § 21.101 is to enhance safety through the incorporation of the latest requirements in the certification basis for changed products, to the greatest extent practicable. This AC describes the application of the § 21.101 and details the conditions when the latest airworthiness requirements for the certification of changes to aircraft, aircraft engines, and propellers must be used, and in which cases it is possible to use earlier amendments to these requirements.

d. Title 14 CFR § 21.19 identifies the conditions under which an applicant for a type design change is required to make application for a new type certificate. This AC provides guidance at which stage of the process this assessment is to be performed and explains the criteria for application of 14 CFR §§ 21.19 for the determination of substantial changes.

e. All changes must be FAA approved. The applicant may comply with earlier amendments of the regulations consistent with the requirements of 14 CFR § 21.101(b) and (c) discussed later in this AC.

f. This AC is not mandatory and is not a regulation. This AC describes an acceptable means, but not the only means, to comply with 14 CFR § 21.101. However, if you use the means described in this AC, you must follow it entirely.

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

2. Intended Audience. This AC is for applicants applying for supplemental type certificates (STCs), amended type certificates (ATCs), or amended STCs.

3. Applicability.

a. This document supersedes AC 21.101-1 Change 1, dated April 28, 2003.

b. This AC applies to major type design changes under 14 CFR § 21.101 for aeronautical products certificated under 14 CFR §§ 21, 23, 25, 27, 29, 31, 33, and 35.

c. Minor type design changes are approved under 14 CFR § 21.95, and are considered to be not significant under 14 CFR § 21.101.

d. This AC also applies to aircraft certificated under 14 CFR §§ 21.17(b), 21.19, 21.24, 21.25, and 21.27.

e The term aeronautical products, or products, means type certificated aircraft, engines, and propellers.

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

Chapter 2. Overview of 14 CFR §§ 21.19 and 21.101

1. 14 CFR § 21.19.

a. 14 CFR § 21.19 requires that you obtain a new type certificate (TC) for a changed product if the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required. As an applicant, you should propose whether your type design change will require a new type certificate. The FAA will review the proposal and make the determination if a new TC is required. When a new type certificate is required the certification basis is determined in accordance with § 21.17.

b. Changes that require a substantial re-evaluation of the product's compliance findings (referred to as "substantial changes") will require application for a new type certificate as required by § 21.19. For guidance see section 3 of Chapter 3 below and appendix 1 for examples of type design changes that will require a new type certificate.

c. If the FAA has determined through § 21.19 that your proposed design change does not require a new type certificate, see § 21.101 for the applicable requirements to develop the certification basis for your proposed design change.

2. 14 CFR § 21.101.

a. Title 14 CFR § 21.101(a) requires a change to a type certificate to comply with the latest requirements, unless the change meets the criteria for the exceptions identified in 14 CFR §§ 21.101(b) and (c).

b. You can comply with the earlier requirements consistent with the requirements of 14 CFR § 21.101(b), when:

- A change is not significant (see 21.101 (b) (1)), or
- An area, system, component, equipment or appliance are not affected by the change (see 21.101 (b) (2)), or
- Compliance with a later amendment for a significant change does not contribute materially to the level of safety (see 21.101 (b) (3)) , or
- Compliance with a latest amendment would be impractical (see 21.101 (b) (3)).

c. 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, 29.2 or part 26 that is related to the change.

d. 14 CFR § 21.101(b) pertains to changes for which earlier requirements provide adequate standards. In cases where design changes involve features that have no associated regulatory standard in the existing certification basis, we will review the proposed certification basis to ensure the adequacy of the requirements for the proposed design change. Later amendments and/or special conditions will be applied if the earlier standards are deemed inadequate to cover the proposed change.

e. 14 CFR § 21.101(b)(1) allows you to comply with an earlier amendment when we determine the change is not significant. 14 CFR 21.101(b)(1)(i) and (ii) pertain to changes that meet the automatic criteria where the change is significant. 14 CFR §§ 21.101(b)(2) and (b)(3) allows the use of earlier requirements for significant changes for areas, systems, components, equipment or appliances 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. For transport category aircraft, the applicant must show compliance with each applicable provision of part 26 for the change, unless the applicant has elected or was required to comply with a corresponding amendment to part 25 that was issued on or after the date of the applicable part 26 provisions.

f. 14 CFR § 21.101(c) provides an exception from the requirements of 14 CFR § 21.101(a) for a change to certain aircraft with less then specified maximum weight. If you apply for a type design change to an aircraft (other than rotorcraft) of 6,000 pounds or less maximum weight, or to a non-turbine powered rotorcraft of 3,000 pounds or less maximum weight, you can show that the changed product complies with the regulations incorporated by reference in the type certificate. You can also elect to comply with the later regulations. Note that if we find that the change is significant in an area, we will designate compliance with a later amendment to the regulations incorporated by reference in the type certificate that applies to the change and any regulation we find directly related, unless we find it would not contribute materially to the level of safety of the changed product or would be impractical. See chapter 4, section 2 in this AC for specific guidance on this provision.

g. 14 CFR § 21.101(d) provides for the use of special conditions, under § 21.16, when the proposed certification basis and any later regulations do not provide adequate standards to the proposed change because of a novel or unusual design feature.

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

i. 14 CFR § 21.101(f) pertains to aircraft certificated in certain categories and special classes (e.g. gliders, airships, and other nonconventional aircraft), including the engine and propellers installed thereon, under the requirements of §§ 21.17(b), 21.24, 21.25, and 21.27 airworthiness requirements

j. 14 CFR § 21.101(g) pertains to regulatory compliance for transport category airplanes with applicable provisions of part 26 and/or corresponding later amendments to part 25

Chapter 3. The Process for Establishing the Certification Basis for Changed Products 14 CFR § 21.101(b)(1)

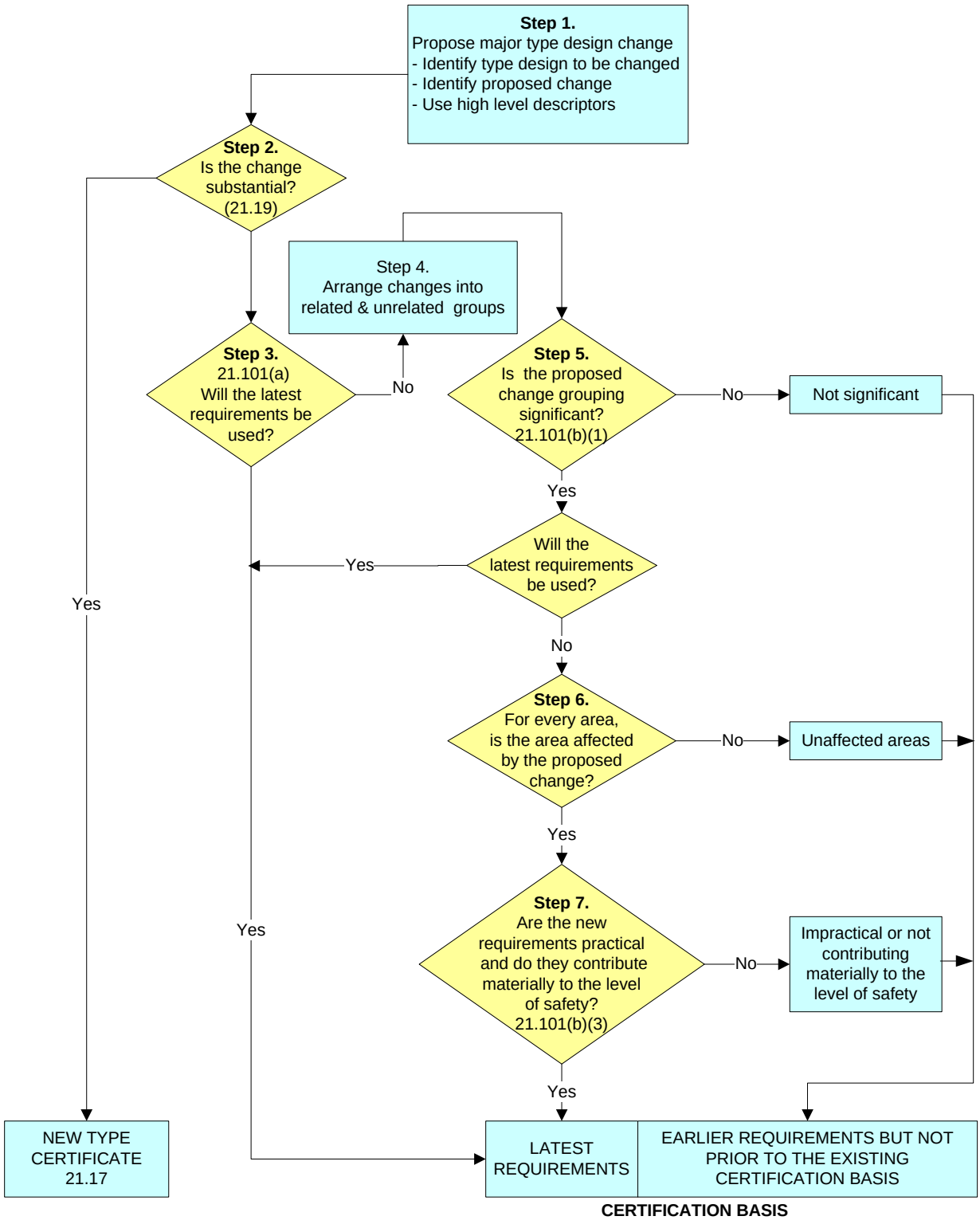
1. Overview.

a. The applicant and the FAA each have a responsibility under 14 CFR § 21.101. As an applicant for the certification of a type design change, you should make a preliminary classification whether the change is significant or not significant, and propose an appropriate certification basis. The FAA has the responsibility to determine whether your classification of the change and proposal for the certification basis are acceptable. The certification basis can vary depending on the magnitude and scope of the change. The steps below present a streamlined approach for making this determination. In addition to assisting in the determination of significance and establishing the certification basis, this guidance will help to establish the appropriate amount of coordination required between the applicant and the FAA.

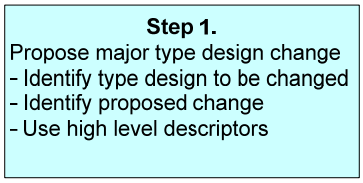
b. Classifications of typical type design changes are in the tables of appendix 1, *Classification of Changes*. See paragraph 5 (c), of this chapter for instructions on how to use the appendix 1 tables.

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

Figure 1. Establishing the Certification Basis for Changed Product



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



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

> **Note:** An STC is not a product; it is a change to a product. When changing or amending an STC the starting point is the existing modified product (TC with existing STC installed). For example, if you were amending an STC for a external cargo locker and you proposed changing the configuration of the locker then your starting point would be the existing TC with the existing STC installed. You would then compare that configuration (TC with existing STC installed) to the changed product (TC with proposed amended STC installed).

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

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

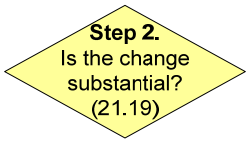
c. When identifying the changes being proposed as part of a modification, consider previous relevant changes that create a cumulative effect, as these may influence the decisions regarding substantial and significant changes later in the process. By previous relevant changes we mean design changes whose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

(1) Example 1: A 5% weight increase is currently being proposed, but a previous 10% and another 15% weight increase has been incorporated into this aircraft without upgrading the existing certification basis. In the current proposal for a 5% weight increase, the cumulative effects of the two previous weight increases that did not involve upgrade of the certification basis will now be accounted for as a 30% increase in weight, for the purpose of making the substantial and/or significant decisions. Note that the cumulative effects to be considered are only those incremental increases from the last time the applicable requirements in the certification basis were upgraded.

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

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

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



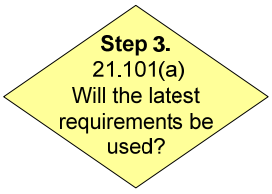
a. 14 CFR § 21.19 requires that you obtain a new type certificate (TC) for a changed product if the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required. A new TC could be required for either an extensive change to a previously type certificated product or for a new design derived through a series of design changes from a previously type certificated product.

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

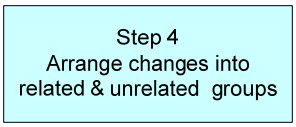
c. To address the question if a change is substantial at the beginning of the process, you must evaluate the total or combined effect of all the proposed changes identified in Step 1, including the cumulative effects of previous relevant design changes since the last update of the certification basis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

d. If it is not initially clear that a new TC is required, appendix 1 provides some examples of substantial changes to aid in this classification. A substantial change requires application for a new TC. Reference 14 CFR §§ 21.17 and 21.19. If the change is not substantial, follow § 21.101.

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



a. You can use the latest requirements for your proposed type design change. If you use the latest requirements you will have met the intent of § 21.101 and no further classification (significant or not-significant) and justification is needed. If you are not using the latest requirements then proceed as follows.



5. Step 4 of Figure 1. Relation of Changes.

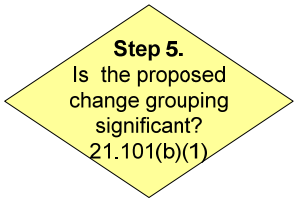
a. Once the proposed changes are identified using high level descriptions, the next step is to determine if any of these changes are related to each other. Related changes are those that cannot exist without another, are co-dependent, or a pre-requisite of another. For example, a need to carry more passengers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

b. Once the change(s) are organized into groupings of those that are related and those that are unrelated (or stand alone), you are ready for Step 5 of Figure 1. The grouping of related and unrelated changes is particularly relevant to the significant Yes/No decision, (21.101(b)(1)), described in Step 5 of Figure 1. Each group of related changes and each unrelated (stand alone) change is evaluated on its own merit for significance. As such, there will be as many evaluations for significance as there are many groupings of related and unrelated changes.

c. After describing the groupings and the associated or supporting technical details for each change, you must identify areas, systems, components, equipment, or appliances of the product that are affected by the design change and the corresponding regulatory standards associated with these areas. For each group, you must assess the physical and/or functional effects of the change on other areas, systems, components, equipment, or appliances of the product. The characteristics affected by the change are not only physical changes, but also functional changes brought about by the physical changes. Examples of physical aspects are: structures, systems, equipment, component and appliances, software in combination with the affected hardware. Examples of functional characteristics are performance, handling qualities, fire protection, aeroelastic characteristics, and emergency egress. The intent is to encompass all aspects where there is a need for re-evaluation, that is, where the substantiation presented for the product being changed should be updated or rewritten.

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

6. Step 5 of Figure 1. Is the Proposed Change Significant? 14 CFR § 21.101*(b)(1).*



a. In Step 5 it is your responsibility to justify that a grouping of related changes or an unrelated change does not qualify as a significant change. Significant changes are product level changes and are distinct from the vast majority of major changes. In general, these changes are either the result of an accumulation of changes or occur through an isolated extensive change that makes the changed product distinct from its predecessors. Step 1 explains the accumulation of changes that must be considered. Additionally, § 21.101(b)(1) defines a significant change as existing when one or more of three automatic criteria apply:

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

(2) **Changes Where the Principles of Construction are Not Retained (Significant Change to Principles of Construction)**. A change at the product level to the materials and/or construction methods that affect the overall products' operating characteristics or inherent strength and would require extensive reinvestigation to show compliance. For examples see appendix 1.

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

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

c. Appendix 1 includes tables of typical changes for transport aircraft, small aircraft, rotorcraft, and engines/propellers that meet the definition of significant. The appendix also includes typical changes that do not achieve the significant level. The tables can be used in one of two ways:

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

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

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

e. Design changes can trigger one or more of the automatic criteria listed in § 21.101(b)(1)(i) and (ii) for the proposed design change. When assessing the design change grouping, consider the cumulative effect of previous relevant design changes. These design changes may have been incorporated through earlier changes in the type certificate on changed areas related to the current proposed change and all the other areas, systems, components, equipment, or appliances otherwise affected by the proposed change. The collective result may be a product considerably different from the latest updated certification basis for the product or model.

f. Each grouping of related changes and each unrelated (stand alone) change, identified using high level descriptions, will be evaluated to determine if it is a significant or not significant change. Use the tables in appendix 1 as guidance to make the classification of significant, or not significant. One or more of the three automatic criteria in § 21.101(b)(1) were found in all cases where the changes were identified as significant. Experience has shown the concept of having only the three automatic criteria seems to fit most projects. Only when one or more of the three criteria is met can the type design change be considered significant. The starting point for assessing the cumulative effects of previous relevant design changes is from the last time the applicable requirements in the certification basis for the affected area, system, component, equipment, or appliance was upgraded.

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

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

(1) Significant (14 CFR §§ 21.101(a)). You will comply with the latest amendments of the requirements for certification of the changed product unless you justify use of one of the exceptions provided in §§ 21.101(b)(2) and/or (3) to show compliance with earlier amendment(s). 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 use of the earlier requirements, but not earlier than those which are recorded in the existing certification basis for the change or group of related changes being evaluated, is acceptable, unless the standards in the proposed certification basis are deemed inadequate. In cases where inadequate or no regulatory standards are defined in the proposed certification basis for the design change but applicable regulatory standards already exist in a subsequent amendment to the regulations, the subsequent amendment will be made part of the certification basis

(3) Adequate Standards (14 CFR §§ 21.101(d) and 21.21(b)(2)). Regardless of whether the change is significant or not, your proposed certification basis may be deemed inadequate – that is, the change includes features that were not foreseen in the proposed certification basis. The change must comply with later regulations (such as, a later amendment or a special condition). An example is adding a flight critical system such as an electronic air data display on a part 25 airplane whose existing certification basis did not have lightning and high intensity radiated fields (HIRF) protection requirements. In this case, compliance with the regulations for lightning and HIRF protection will be required for this not significant change.

i. Secondary Changes. A secondary change is a physical change that is part of and consequential to an overall significant change. A secondary change is a physical change that restores without changing the system, structural capacity, or functionality, but is necessary to support a significant change. Based on this description, a secondary change is not required to comply with the latest requirements because it is considered "not contributing materially to the level of safety", and therefore eligible for an exception under § 21.101. Determining whether a change meets the description for secondary change, and thus eligible for an exception, should be straightforward. If this determination is not straightforward, then your proposed change is very likely not a secondary change.

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

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

(3) The applicant can identify an affected area as a secondary change only if the change meets the description and can be substantiated or justified as not contributing materially to the level of safety per paragraph (i) above. If you plan to use the § 21.101(b)(2) exception, you must have the necessary supporting rationale.

j. A new model number designation to a changed product is not necessarily indicative that the design change is significant under § 21.101. Conversely, retaining the existing model designation does not mean that the design change is not significant. All changes are considered in light of the magnitude of the type design change.

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

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

7. Proposing an Amendment Level for a Significant Change.

a. If the classification of the change is significant, you must comply with the regulatory requirements at the amendment level in effect on the date of application for the change, unless you can justify use of the exceptions in §§ 21.101(b)(2) and (3) to show compliance with an earlier amendment but no earlier than the existing certification basis. You must comply with any retroactive requirement found in 14 CFR §§ 23.2, 25.2, 27.2, 29.2 applicable on the date of the application for the change.

b. For transport category airplanes only, you must also comply with any applicable provision of part 26 (related to the change) which is applicable on the date of the application for the change, unless you elected or were required to comply with later corresponding part 25 requirements.

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

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

e. The final certification basis may combine latest, earlier (intermediate), and existing regulations, but cannot contain regulations preceding the existing certification basis.

8. Selecting an Amendment Level for a Not Significant Change.

a. When the type design change is classified not significant, the rule allows compliance with earlier amendments but not prior to the existing certification basis except that you must comply with the retroactive requirements found in 14 CFR §§ 23.2, 25.2, 27.2, 29.2 applicable on the

date of the application for the change. For transport category airplanes only, you must also comply with any part 26 requirements related to the change applicable on the date of the application for the change, unless you elected or were required to comply with later corresponding part 25 requirements. However, if the existing certification basis does not provide adequate standards for the design change, that is, the change includes features that were not foreseen in the existing certification basis; the change must comply with later appropriate regulations and/or special conditions.

b. You can elect to comply with later amendments, but consult us to ensure you are also complying with any other, directly related regulations. Some later regulatory requirements may be less restrictive. Ensure that you comply with all associated regulatory requirements.

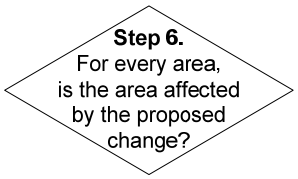
c. Adequacy of Certification Basis: The certification basis for a changed product under § 21.101 is considered adequate when the FAA determines that the prescribed airworthiness requirements (existing, later, or latest amendments, including special conditions) ensure that physical features, performance characteristics, and/or functions introduced by the design change, do not result in any unsafe design features. These requirements are to be the highest practicable level of safety for the changed product, and not just for the change itself.

d. Exceptions in 14 CFR § 21.101(b)(2) and (3). Use the following steps with figure 1, when you wish to comply with an earlier requirement for a significant change:

a. For a group of related design changes or an unrelated design change that has been determined to be significant, 14 CFR §§ 21.101(b)(2) and (3) provide exceptions from the requirement of § 21.101(a). You can comply with an earlier amendment level or with the existing certification basis for areas not affected by the change, and any 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 amendments may not precede the corresponding requirements in the existing certification basis or any requirement found in 14 CFR §§ 23.2, 25.2, 27.2, 29.2, or for transport category airplanes only, part 26 that is related to the change. It is important when seeking to use earlier amendments that you demonstrate to us that compliance with the latest requirements does not contribute materially to the level of safety, or is impractical.

9. Step 6 of Figure 1. Is the Area Affected By the Proposed Change? 14 CFR § 21.101(b)(2).



a. A not affected area is any area, system, component, equipment, or appliance and their associated regulatory requirements that are not affected by the proposed type design change. For a type design change, it is important that the effects of such change on other areas, systems,

components, equipment, or appliances of the product are properly assessed because areas that have not been physically changed may still be considered part of the affected area. If a new compliance finding is required, regardless of its amendment level, it is an affected area. If the significant change does not affect the area, then the certification basis of that area need not be revisited, in other words the requirements associated with the unaffected area continue to be compliant to the existing amendment level without further substantiation.

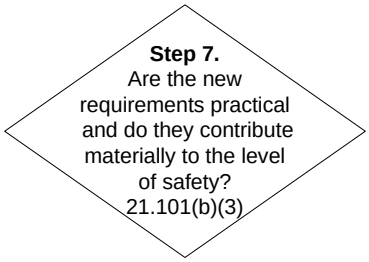
b. Consider the following aspects of a type design change:

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

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

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

10. Step 7of 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 existing type design and/or relevant experience demonstrates a level of safety comparable to that provided by the latest requirements. You must provide sufficient justification to allow us to make this determination. This exception could be applicable in the situations described in the paragraphs below:

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

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

(2) Design:

- This provision gives the opportunity to consider the consistency of design. For example, when a small fuselage plug is added, additional seats and overhead bins are likely to be installed, and the lower cargo hold extended. These components may be identical to the existing components. The level of safety may not materially increase by applying the latest requirements. 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.

- However, if a fuselage plug is large enough relative to the original certificated aircraft structure, seats, bins, doors, and cargo compartment, the change may require compliance with the latest requirements, comparable with what will be 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.

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

- There may be cases for rotorcraft and small airplanes where relevant data may not be sufficient or not available at all 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.

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

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

(1) Support your position that compliance is impractical with a substantiating data and analyses. We must agree with this position and while evaluating your position and your substantiating data regarding impracticality, we 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 this case, the applicants were able to successfully demonstrate that full compliance would require a substantial increase in the outlay or expenditure of resources with a very small increase in the level of safety. These design features can be used as a basis for granting an exception under the “impracticality” exception.

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

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

Note: The impractical exception should not be based on the size of the applicant’s company or their financial

resources. Costs to comply with a later amendment must be evaluated against the safety benefit of complying with the later amendment. Applicants with fewer resources may not be able to afford the cost of a product level change when it is comparable to the safety benefit achieved by complying with a later amendment.

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

Chapter 4. Other Considerations

1. Design Related Operating Requirements. The use of exceptions under § 21.101 is not intended to alleviate or preclude compliance with operating regulations (such as part 121) that prescribes compliance with a specific or later amendment of the airworthiness (design-related) requirements.

2. Excepted Products under 14 CFR § 21.101(c).

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

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

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

d. However, we may allow you to comply with an earlier amendment to the requirement initially designated or with the existing certification basis if we agree to your justification.

e. For design change to an excepted product that contains new features, which are not covered in the existing certification basis, we 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. For a change that contains new design features that are novel and unusual for which there are no later applicable requirements at a later amendment level, we will designate special conditions.

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

3. Special Conditions, 14 CFR § 21.101(d). 14 CFR § 21.101(d) allows for the application of special conditions, or for changes to existing special conditions, to address the changed designs where the proposed certification basis has missing or inadequate standards for an area, system, component, equipment or appliance related to the change. The objective is to achieve a level of safety consistent with that provided for other areas, systems, components, equipment or appliances affected by the change by the other requirements of the proposed certification basis. The application of special conditions to a design change is not, in itself, a reason for it to be classified as either a substantial change or a significant change. When the change is significant with earlier requirements allowed through exceptions, or not significant, the

level of safety intended by the special conditions must be consistent with the agreed certification basis.

4. Effective Period for an Application to Change a Type Certificate, 14 CFR § 21.101(e). Per 14 CFR § 21.101(e), an application for, or a change to, a type certificate for transport category aircraft is effective for 5 years, and an application for a change to any other type certificate is effective for 3 years. This is intended to ensure that the certification basis for the changed product is as current as practical. This is consistent with the requirements of § 21.17 for a new type certificate and defines the process of updating the certification basis if these time limits are exceeded.

5. Clarification of 21.101 (g) (Part 26 Requirements).

a. Part 26 establishes requirements for support of continued airworthiness of and safety for transport category airplanes. The applicant must show compliance with each applicable provision of part 26, unless the applicant has elected or was required to comply with a corresponding amendment to part 25 that was issued on or after the date of the applicable part 26 provision. Section 21.101(g) does not allow an applicant to use an exception under § 21.101(b) for relief from complying with the applicable provisions of part 26.

b. The language in § 21.101(g) also recognizes that future part 25 amendments will be issued after the requirements in part 26 are established. A later amendment to part 25 could be elected or required to comply with § 21.101 (a). However, earlier part 25 requirements, but not earlier than those established in the existing certification basis (containing part 26 requirements) could be justified using the exceptions in § 21.101 (b).

6. Documentation. All changes that result in a revision to the product's certification basis must be reflected on the amended TC or STC. The resulting certification basis must be retained as it forms part of the compliance record required by FAA Order 8110.4, *Type Certification*.

7. Other Category Aircraft. For aircraft type certificated under §§ 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 we find appropriate for the change in effect on the date of application for the change. When selecting a certification basis for a change, you can propose compliance to an earlier amendment using the provisions of § 21.101(b). The exceptions in § 21.101(c) do not apply to categories of products defined in § 21.101(f).

a. Special Classes Aircraft. For special classes of aircraft (for example, gliders, airships, etc.) including any installed engines and propellers certificated in accordance with § 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 FAA to be appropriate for the aircraft and applicable to the specific type design, or such airworthiness criteria that the we may find provide an equivalent level of safety to those parts.

b. Primary Category Aircraft. For primary category aircraft certificated under § 21.24, the applicable airworthiness requirements are in 14 CFR parts 23, 27, 31, 33, and 35, or such other requirements as we 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 us.

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

(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 TC 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 will 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 § 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 § 21.27 for surplus military aircraft. 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 appropriate for the aircraft's intended use.

e. Surplus military aircraft. Aircraft type certificated under § 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 CAR for use other than air transport. These aircraft were not intended to carry persons or property for hire, and normally were accepted based on their previous military qualifications and service record. A change to aircraft not supported by the military service history must comply with appropriate airworthiness standards. The level of safety associated with earlier standards may be acceptable for limited category aircraft.

Appendix 1. Classification of Changes

The following tables of substantial and significant changes are adopted by the FAA, EASA and TCCA through an international collaboration. The classification may change due to cumulative effects and/or combinations of individual changes. The "NA" indicated in the substantial example tables indicates "Not Applicable" at the "21.19 Substantial Evaluation" phase.

Examples of Changes for Small Airplanes (Part 23)

The following examples are for SUBSTANTIAL changes for Small Airplanes (Part 23):				
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.

The following examples are for SUBSTANTIAL changes for Small Airplanes (Part 23):				
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**
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.
Increase from subsonic to supersonic flight regime	NA	NA	NA	
Change from an all metal airplane to all composite primary structure (fuselage, wing, empennage)	NA	NA	NA	Change in principles of construction and design from conventional practices. Likely change in design/certification assumptions.

The following examples are for SUBSTANTIAL changes for Small Airplanes (Part 23):				
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/tail wheel undercarriage change or addition of floats	Yes	No	No	Change in general configuration. Likely, at airplane level, general configuration and certification assumptions remain valid.

The following examples are for SUBSTANTIAL changes for Small Airplanes (Part 23):				
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 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.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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	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.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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 the type of material, such as composites in place of metal, or one composite fiber material system with another (e.g., carbon for fiberglass), for primary structure would normally be assessed as a significant change.	No	Yes	Yes	Change in principles of construction and design from conventional practices. Likely change in design/certification assumptions.
Change involving appreciable increase in design speeds Vd, Vmo, Vc, or Va	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
Short take off and landing "STOL" kit	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
A change in the rated power or thrust is likely to be regarded as significant if the design speeds are thereby changed so that compliance needs to be re-justified with a majority of requirements.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
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.
A design change that alters the aircraft flight characteristics or performance from the type design would normally be significant if it appreciably changes the kinematics or dynamics of the airplane.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
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. Compliance with commuter category rules is required. This change may be determined a substantial change.
A change in the flight control concept for an aircraft, for example, to fly by wire (FBW) and side-stick control, or a change from hydraulic to electronically actuated flight controls, would in isolation normally be regarded as a significant change.	No	No	Yes	Changes in design and certification assumptions. Requires extensive systems architecture and integration reinvestigation. Requires new AFM.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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 in cabin pressurization	No	Yes	Yes	A change greater than 5% in operational cabin pressure differential. Extensive airframe changes effecting load paths, fatigue evaluation, aeroelastic characteristics, etc. Requires extensive construction reinvestigation. Invalidates design assumptions.
Changes in types and number of emergency exits or an increase in passenger capacity in excess of maximum passenger capacity demonstrated for the aircraft type.	No	No	Yes	Emergency egress requirements exceed those previously substantiated. Invalidates assumptions of certification. Commuter category emergency egress requirements apply.
A change in the required number of flight crew, which necessitates a complete cockpit 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.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
Expansion of an aircraft's operating envelope	No	No	Yes	An expansion of operating capability would normally be a significant change (e.g., an increase in maximum altitude limitation, approval for flight in known icing conditions, or an increase in airspeed limitations). An increase in cg range (5% mean aerodynamic chord) will typically cause a significant increase in wing loads, as compared to moving the aft cg limit further aft. The change in cg limit should be considered with any increases or decreases in aircraft weight. An increase in wing loads of greater than 5% is considered to be a significant change."
Replacement of an aviation gasoline engine with a diesel engine of approximately the same horsepower.	No	No	Yes	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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 comprehensive flight deck upgrade	No	No	Yes	The degree of change is so extensive that it affects basic avionics and electrical systems integration, architecture concepts, or philosophies. This may drive a complete reassessment of flight crew workload or other human factor issues, or requires a re-evaluation of the original design assumptions used for the cockpit. Example: changing from federated display (e.g. separate attitude, altitude, and airspeed) architecture to an integrated electronic flight information system. Requires new AFM.
Introduction of autoland	No	No	Yes	Invalidates original design assumptions.
Conversion from normal category to commuter category airplane	Yes	No	Yes	Requires compliance with all commuter regulatory standards.
Airframe life extension	No	No	Yes	This modification pertains to fuselage and/or wing limits.
Install a plug in fuselage and add interior in the plug - no change forward or aft of plug	Yes	Yes	Yes	

The following examples are for SIGNIFICANT changes for Small Airplanes (Part 23):				
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 stretch and entire new interior	Yes	Yes	Yes	
New interior or revised arrangement with a new/revised attachment system for interior components (e.g., seats, galleys, or closets).	No	Yes	Yes	

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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.
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.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
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.
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.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
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.
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	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
additive levels (controlled) of MTBE, ETBE, ethanol, amines, etc., in AvGas would not be considered a significant change.				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.
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.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
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.
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.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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**
No fuselage stretch but complete new interior	No	No	No	not significant unless you are using a new/revised attachment system
Existing type design - complete new interior but no new /revised attachment system, i.e. green completion.	No	No	No	not significant (assuming no new attachment system)
Installation of new seat belt or shoulder harness	No	No	No	Not an 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 applicable to APU installation requirements.
An alternative autopilot	No	No	No	Not an airplane level change.

The following examples are for NOT SIGNIFICANT changes for Small Airplanes (Part 23):				
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 Class B Terrain Awareness and Warning Systems (TAWS)	No	No	No	Not an airplane level change.

The following examples are for SUBSTANTIAL changes for Transport Airplanes (Part 25):				
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.
Change of empennage configuration for larger airplanes (cruciform vs. ‘T’ or ‘V’ tail)	NA	NA	NA	
Increase from subsonic to supersonic flight regime	NA	NA	NA	

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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**
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 combi to all freighter, including cargo door, redesign floor structure and 9g net or rigid barrier	Yes	No	Yes	Extensive airframe changes affecting load paths, aeroelastic characteristics, aircraft related systems for fire protection, etc. Design assumptions changed from passenger to freighter.
Change to pressurized cabin, including the introduction of a pressurization system.	No	No	Yes	A change greater than 5% in operational cabin pressure differential. Essentially a recertification of airframe and systems associated with operating envelope change.

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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 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.
Fuselage stretch (or shortening) and entire new interior	Yes	No	No	
Install a plug in fuselage and add interior in the plug – with no interior changes forward or aft of the plug	Yes	Yes	Yes	
New interior or revised arrangement with a new/revised attachment system for interior components (e.g., seats, galleys, or closets).	No	Yes	Yes	
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.

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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**
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 re-substantiation of aircraft structure, aircraft performance and flying qualities and associated systems.
Wing changes in span, sweep, tip designs or wing chord. (NOTE: Potentially substantial if it is a change from a high wing to a low wing, or a new wing.)	Yes	No	No	When it requires extensive changes to wing structure, adds aircraft systems, and requires a new 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.

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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, such as conversion from entirely federated, independent electro-mechanical flight instruments to highly integrated and combined electronic display systems with extensive use of software and possibly complex hardware.	No	No	Yes	Affects avionics and electrical systems integration and architecture concepts and philosophies.
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.
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.

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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**
Typically a thrust increase of more than 10 percent.	No	No	Yes	Requires re-substantiation 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.

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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**
Expansion of an aircraft's operating envelope	No	No	Yes	An expansion of operating capability would normally be a significant change (e.g., an increase in maximum altitude limitation, approval for flight in known icing conditions, or an increase in airspeed limitations). An increase in cg range (5% mean aerodynamic chord) will typically cause a significant increase in wing loads, as compared to moving the aft cg limit further aft. The change in cg limit should be considered with any increases or decreases in aircraft weight. An increase in wing loads of greater than 5% is considered to be a significant change."
Conversion from a passenger floor to a cargo floor and installation of a cargo handling system.	No	No	Yes	Completely new floor loading and design. Redistribution of internal loads, change in cabin safety requirements, system changes.
Initial installation of an APU essential for aircraft flight operation.	No	No	Yes	Changes emergency electrical power requirements, change in flight manual and operating characteristics.

The following examples are for SIGNIFICANT changes for Transport Airplanes (Part 25):

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 hydraulically actuated brakes to electrically actuated brakes	Yes	Yes	Yes	Completely new electro-mechanical actuators in lieu of hydraulic pistons in each brake- assembly, no hydraulic hoses, new wire bundles, New TSO, change in applicable regulations
Change to airplane's cabin operating altitude, or operating pressure change to airplane's design limit.	Yes	No	Yes	An increase greater than 5% in maximum cabin pressure differential invalidates a basic certification assumption and fundamental approach used in the structural fatigue analysis.

The following examples are for NOT SIGNIFICANT changes for Transport Airplanes (Part 25):				
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 random 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.

The following examples are for NOT SIGNIFICANT changes for Transport Airplanes (Part 25):				
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**
Installation of an autopilot system.	No	N/A	See note	It may be possible that the modification is adaptive in nature, with no change to original certification assumptions. However, in certain cases the installation of an autopilot may include extensive changes and design features which change both the general configuration and the assumptions for certification (i.e., installation of the autopilot may introduce a number of additional mechanical and electronic failure modes and change the hazard classification of given aircraft level failures).
Change from assembled primary structure to monolithic or integrally machined structure.	No	No	No	Method of construction must be well understood.
Modification to ice protection systems.	No	No	No	Recertification required, but certification basis is adequate.
Brakes: design or material change, e.g., steel to carbon.	No	No	No	Recertification required, but certification basis is adequate.
Redesign floor structure.	No	No	No	By itself, not a significant product change. It is significant if part of a cargo conversion of a passenger airplane.

The following examples are for NOT SIGNIFICANT changes for Transport Airplanes (Part 25):				
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**
No fuselage stretch but complete new interior	No	No	No	not significant unless you are using a new/revised attachment system
Existing type design - complete new interior but no new/revised attachment system, i.e. Green completion	No	No	No	not significant (assuming no new attachment system)
Novel or unusual method of construction of a component.	No	No	No	The component change does not rise to the product level. Special conditions 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
Examples of Changes for Rotorcraft (Parts 27 and 29)

The following examples are for SUBSTANTIAL changes for Rotorcraft (Parts 27 and 29):				
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.

The following examples are for SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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, architecture concepts, or philosophies. This may drive a complete reassessment of flight crew workload or other human factor issues, or requires a re-evaluation of the original design assumptions used for the cockpit. Example: changing from federated display (e.g. separate attitude, altitude, and airspeed) architecture to an integrated electronic flight information system.
Certification for flight into known icing conditions.	No	No	Yes	
(Fixed) flying controls from mechanical to fly by wire.	No	No	Yes	This drives a complete reassessment of the rotorcraft controllability and flight control failure.
Addition of an engine; e.g., from single to twin or reduction of the number of engines; e.g., from twin to single.	Yes	Yes	Yes	May be a substantial change depending upon project details.
A change of rotor drive system primary gearbox splash type	No	Yes	Yes	

The following examples are for SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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**
lubrication system to a pressure lubricated system due to an increase in horsepower of an engine or changing a piston engine to a turbine engine.				
A fuselage or tail boom modification that changes the primary structure, aerodynamics, and operating envelope sufficiently to invalidate the certification assumptions.	Yes	No	Yes	
Application of an approved primary structure to a different approved model (e.g., installation on a former model of the main rotor approved on a new model that results in 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.

The following examples are for SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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 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	
Change of the number of rotor blades.	Yes	No	Yes	
Change tail anti-torque device (e.g., tail rotor, ducted fan or other technology).	Yes	Yes	No	
Passenger configured helicopter to a Firefighting equipment configured helicopter	Yes	No	Yes	
Passenger configured helicopter to a agricultural configured helicopter	Yes	No	Yes	

The following examples are for SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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 new Category A certification approval to an existing configuration	No	No	Yes	
Instrument Flight Rules (IFR) upgrades involving installation of upgraded components for new IFR configuration	No	No	Yes	
Human External Cargo (HEC) certification approval	No	No	Yes	Must comply with the latest HEC Certification requirements in order to obtain operational approval. HEC include fatigue, Quick Release Systems, HIRF, OEI performance and OEI procedures.
Reducing the number of pilots for IFR from 2 to 1	No	No	Yes	

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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 and FAA TSO-C194.

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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**
Health Usage Monitoring System (HUMS) for Maintenance Credit	No	No	No	Certificated per rotorcraft HUMS AC guidance material.
Expanded limitations with minimal or no design changes, following further tests/justifications or different mix of limitations (CG limits, oil temperatures, altitude, minimum/maximum weight, minimum/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.

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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, excluding HEC, or flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type certificated product level.

The following examples are for NOT SIGNIFICANT changes for Rotorcraft (Parts 27 and 29):				
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 upgraded components to replace existing components.	No	No	No	Not a rotorcraft level change.
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
Examples of Changes for Engines and Propellers
(Parts 33 and 35)

The following are examples of SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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

The following are examples of SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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

The following are examples of SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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**
Combining engine modules from uncertified (military) and FAA approved into a single engine configuration.	No	No	Yes	Uncertified (military) engines are not approved or monitored using FAA approved standards. Flight cycles, missions, maintenance programs and experience of the military engine are not known. The combined modules have structural and operational characteristics that have not been evaluated and do not meet FAA approved certification basis. This change requires an establishment of a new performance centerline and could be considered substantial.
Increase/decrease in the number of compressor/turbine stages with resultant change in approved operational limitations* (* exclude life limits)	No	No	Yes	Change is associated with other changes that would affect the rating of the engine and have affected the dynamic 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.

The following are examples of SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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 operational limitations* *exclude life limits	No	No	Yes	Change is associated with other changes that would affect engine thrust/power and have affected the dynamic behavior of the engine. Assumptions used for certification may no longer be valid

The following are examples of SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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.

The following are examples of SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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 requires re-evaluation.

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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 operational performance envelope	No	No	No	No change in performance Model designation may or may not change Assumptions are still valid
New components internal to the FADEC/EEC the introduction of which does not change the function of the system	No	No	No	No change in configuration Retrofitable Assumptions used for certification are still valid Possible changes in principles of construction are insignificant
Software changes	No	No	No	
Rub-strip design changes	No	No	No	Component Level Change
A new combustor that does not change the approved limitations, or dynamic behavior* *exclude life limits	No	No	No	Component Level Change
Bearing changes	No	No	No	Component Level Change
New blade designs with similar material that can 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

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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 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	
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

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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 Engine				
A change in principal physical properties and mechanics of load transfer of a material of primary structure or highly loaded components. For example, change from traditional metal to either an exotic alloy or a composite material on a highly loaded component	No	No	No	Component Level Change
New or redesigned cylinder head, or valves, or pistons	No	No	No	
Changes in crankshaft	No	No	No	Component Level Change
Changes in crankcase	No	No	No	Component Level Change
Changes in carburetor	No	No	No	Component Level Change
Changes in mechanical fuel injection system	No	No	No	
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	

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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**
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	
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

The following are examples of NOT SIGNIFICANT changes for Engines and Propellers (Parts 33 and 35):				
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 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

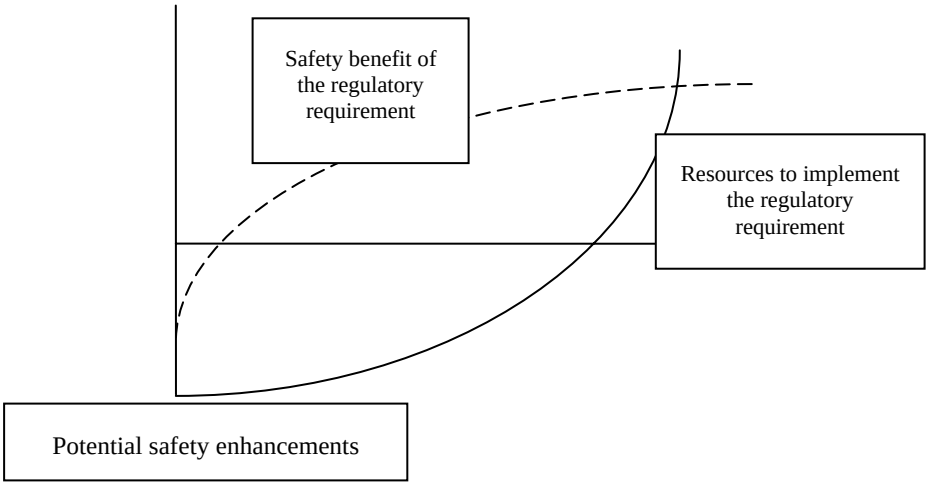
Appendix 2. Procedure for Evaluating Impracticality of Applying Latest Requirements to a Changed Product

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

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



d. Typically one will find that there are proposals that can achieve a positive safety benefit that are resource effective. Conversely, there are proposals that may achieve a small safety

benefit at the expense of a large amount of resources to implement. Clearly, there will be a point where a large percentage of the potential safety benefit can be achieved with a reasonable expenditure of resources. The focus of the methods used should be to determine the most appropriate 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 or any requirement found in 14 CFR §§ 23.2, 25.2, 27.2, 29.2 or part 26 that is related to the change.. 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.

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

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

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

(2) The amendment level of the existing certification basis for the requirement, and

(3) The latest amendment level of the requirement.

b. Step 2: Identify the Specific Hazard that the Requirement Addresses.

(1) 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.

(2) In many cases the hazard and the cause of the hazard will be obvious. When the hazard and its related cause are not immediately obvious, it may be necessary to review the preamble of the regulation. It may also be helpful to discuss the hazard with the responsible FAA office.

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

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

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

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

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

(1) Another source for determining impracticality is the historical record of the consequences of the hazard that led to a requirement or an amendment to a requirement. From these data, a frequency of 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.

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

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

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

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

(2) It is 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.

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

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

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

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

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

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

f. Step 6: Determine Resource Costs and Cost Avoidance.

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

(2) 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.

(3) 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:

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

- 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.

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

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

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

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

(b) Cost Avoidance:

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

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

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

(1) Compliance with the latest 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.

3. 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.

(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:

- One occurrence with more than 10 percent deaths; and
- One occurrence with injuries.

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

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

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

(b) Compliance with Amendment 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.

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

(a) Costs:

- For a newly developed airplane, there would be minor increases in labor resulting from design and fabrication.
- There would be a negligible increase in costs related to materials, operating costs, and revenue utility loss.

(b) Cost Avoidance:

- There were two accidents in 200 million departures. The applicant believes that it will manufacture more than 2,000 of these 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.
- 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) This example is a passenger to freighter conversion STC.

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

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

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

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

(c) Amendment 25-71/72 (Amendments 25-71 and 25-72 are identical) extended the 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).

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

(4) **Step 2: Identify the Specific Hazard that the Regulation Addresses.** The hazard is a catastrophic structure and/or system failure produced by a sudden release of pressure through an opening in any compartment in flight. This opening could be caused by an uncontained engine failure, an opening of a prescribed size due to the inadvertent opening of an external door in flight, or an opening caused by a failure not shown to be extremely improbable. The opening could be produced by an event that has yet to be identified.

(5) **Step 3: Review the History of the Consequences of the Hazard(s).** Occurrences with injuries, less than 10 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:

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

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

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

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

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

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

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

(b) Cost Avoidance:

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

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

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

Appendix 3. 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 (either a standalone issue paper or included in the G-1 issue paper) 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, relative to the hazard, 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;

(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 hazard.

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

(a) Recurring and/or common failure modes;

(b) Cause;

(c) Probability, by qualitative reasoning; and

(d) Measures already taken and their effects.

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

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

(a) A review of previous test results; and

(b) Additional detailed testing as required.

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

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

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

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 derivative model transport airplane where significant changes were made to the main airframe components, engines and systems, and APU. The baseline airplane has an extensive service history. The example shows how the use of service experience supports a finding that compliance with the latest regulation would not contribute materially to the level of safety and that application of the existing certification basis (or earlier amendment) would be appropriate. The example is for significant derivatives of 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) Determine 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) The applicant provides 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) The applicant provides a description of the design feature and its intended function. The fuel shut-off valve, actuator design, and operation is essentially unchanged; with the system design ensuring that the valve is monitored for proper cycling from closed to open at start. If the valve is not in the appropriate position (i.e., closed), then the APU start is terminated, an indication is displayed on the flight deck, and any further APU starts are prevented. Design improvements using the capability of the APU Electronic Control Unit (ECU) have been incorporated in this proposed product change. These design changes ensure that the fuel valve

indication system will indicate failure of proper valve operation to the flight crew, but the system does not indicate valve position as required by 14 CFR § 25.1141(f).

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

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

Appendix 4. Definitions and Terminology

Adequate Certification Basis - The certification basis for a changed product under § 21.101 is considered adequate when the FAA determines that the prescribed airworthiness requirements (existing, later, or latest amendments, including special conditions) ensure that physical features, performance characteristics, and/or functions introduced by the design change, do not result in any unsafe design features. These requirements are to be the highest practicable level of safety for the changed product, and not just for the change itself.

Aeronautical product – The terms aeronautical product or product(s) used in this guidance material includes type certificated aircraft, engines, and propellers.

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.

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

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

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

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

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

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

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

Significant change – A change to the type certificate is significant to the extent that it changes one or more of the following: general configuration, principles of construction, or the assumptions used for certification, but not to the extent to be considered a substantial change.

The significance of the change must be considered in the context of all previous relevant design changes and all related revisions to the applicable regulations. Not all changes or product level changes are significant.

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

Appendix 5. Related Code of Federal Regulations Sections

1. Related Code of Federal Regulations Paragraphs.

- 14 CFR § 21.16, Special conditions.
- 14 CFR § 21.17, Designation of applicable regulations.
- 14 CFR § 21.19, Changes requiring a new type certificate.
- 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.
- 14 CFR § 21.93, Classification of changes in type design.
- 14 CFR § 21.101, Designation of applicable regulations.
- 14 CFR § 21.115, Applicable requirements.

2. How to Get Publications.

- Order copies of 14 CFR, parts from the Superintendent of Documents, Government Printing Office, P.O. 979050, St. Louis, MO 63197. For general information telephone (202) 512-1800 or fax (202) 512-2250. You can order copies online at www.access.gpo.gov. Select "Access" then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

- Order copies of FAA Orders and Advisory Circulars from the U.S. Department of Transportation, Subsequent Distribution Office, M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785. You can also get copies from our FAA website at www.airweb.faa.gov or www.faa.gov.