

IV. IS THE PROPOSED CHANGE *SIGNIFICANT* ?

**Is the Proposed Change
Significant?**

Section IV

CPR 3/03 94

A. Overview

Section IV, Purpose

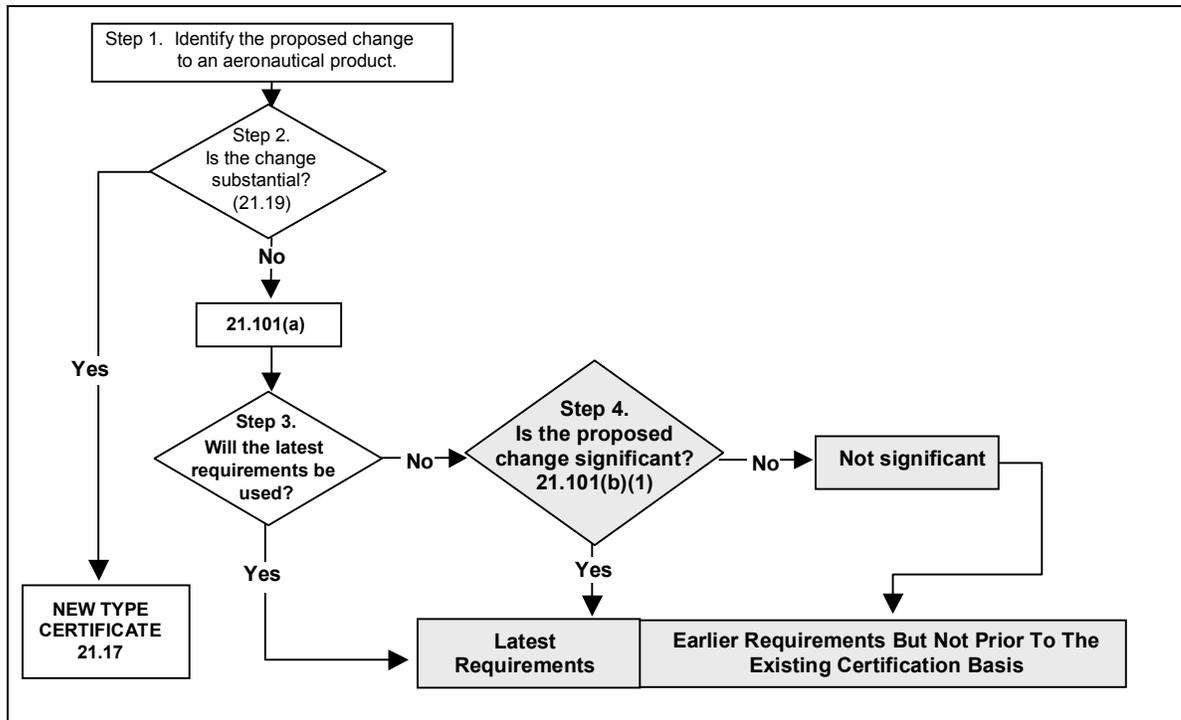


- Identify and apply 3 key criteria that automatically lead to *significant*
- Identify and apply cumulative effects of previous relevant design changes that must be considered for *significant*
- Determine if proposed change correctly classified as *not significant*

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- The organization of this section is as follows:
 - Overview,
 - Introduction of basic concepts,
 - Explanation of determination of *not significant* as required in 21.101,
 - Discussion of the automatic criteria for *significant*,
 - Considerations of the change in context of previous relevant design changes,
 - Discussion of related changes,
 - Discussion of adequacy of existing certification basis for *not significant* changes,
 - Looking at the Case Study in regards to Step 4 of Figure 1 of the AC,
 - Discussion of determining significance for excepted aircraft [21.101(c)], and
 - Discussion of determining significance for other category aircraft [21.101(f)].

B. Basic Concepts



- As illustrated in this **overhead** taken from Figure 1, by Step 4 the change has been evaluated and:
 - It consists of one or more major changes,
 - It is not a substantial change,
 - The applicant has decided **not** to use the latest requirements, so
 - The applicable requirements must be determined.

Evaluate 21.101(b)



- Each change follows CPR process to determine if *not significant*
- Describe change in context of overall product
- To classify a proposed change:
 - Use tables in Appendix 1 of CPR AC
 - Use tables in conjunction with automatic criteria
 - Consider effects of previous relevant design changes

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Evaluate 21.101(b), cont.



- *Significant* changes must comply with latest applicable regulatory requirements
 - Applicant may apply remaining exceptions
- *Not significant* changes may comply with existing certification basis if they are “adequate”

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Significant as per 21.101



➤ Course focus is *significant* defined by 21.101

- Terms specified in rule reference change to a type certificated product
- ***NOT*** talking about a significant *project* as defined in Order 8100.5
- *Significant* change will always be a significant project
- Guidance in 8100.5 and 8110.4 will be revised

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- While a significant *change* will always be a significant *project*, the reverse is not necessarily true.
 - For example, refairing the wing tip caps on a **presidential airplane** to accommodate new lights. Typically, this would be a *not significant* change. However, according to Order 8100.5, it would likely be a significant project due to the high visibility of the aircraft.
 - Another example might be a change in “...an area that has been the subject of a major service difficulty or accident.” By Order 8100.5, this is a significant project, but may not be a *significant* change.

Certification Project Notification 

➤ Revised CPN will provide boxes to identify:

- *Significant and not significant* projects per Order 8100.5
- *Significant and not significant* changes per §21.101

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C. Determination of *Not Significant* As Required in 21.101(b)(1)

21.101(b)(1), *Not Significant* 

➤ First determine whether change is *significant or not significant* at product level

➤ Changes *significant* at product level comply with latest regulations unless one of the other exceptions applies

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21.101(b)(1), cont.



- Changes *not significant* at product level comply with earlier or existing amendment
- Changes meeting 21.101(b)(1)(i) or (ii), automatic criteria, at product level must be classified as *significant*
- If automatic criteria do not apply, change may comply with existing certification basis

D. Automatic Criteria for *Significant*

21.101(b)(1), Automatic Criteria 

➤ **Automatic Criteria:**

- **General configuration not retained**
- **Principles of construction not retained**
- **Assumptions used for certification do not remain valid**

➤ **Must meet latest regulations if any of these criteria are met at product level**

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- **AC 21.101-1, Appendix 1** has are examples of *significant* and *not significant* changes based on the three automatic criteria.
 - **If it’s on the table**, you have your answer.
 - **If it’s not on the table, try to find something as near as possible to it**, something similar. You will have to determine if you can extrapolate from the example in table to the change that you are evaluating.
 - **If the change that you are evaluating is not on the table at all**, then apply the three criteria listed in the rule, make a recommendation, and then work with the Standards Staff to finalize a decision.

- **General configuration is not retained.**

General Configuration

- **Change that distinguishes changed product from existing product; likely requires new model designation**
 - **Length or diameter change in fuselage**
 - **Passenger-seating configuration to cargo configuration**

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- **Principles of construction are not retained.**

Principles of Construction

- **Change at product level to materials or construction methods such that overall product's operating characteristics or inherent strength affected**
 - **Material change from metallic to composite for primary structure at product level**
 - **Change from unpressurized to pressurized cabin**

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- The assumptions used to certificate the original product do not remain valid.

Certification Assumptions Do Not Remain Valid



- Assumptions associated with compliance demonstration, performance, or operating envelope no longer valid
- Consider assumptions made during product development
 - Design assumptions
 - Engineering assumptions

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Certification Assumptions Do Not Remain Valid



- Design assumptions
 - Passenger capacity
 - Maximum operating altitude
 - Aircraft configuration
 - Flight loads
 - Expected life limits
 - Environmental operating range (flight into known icing, HIRF)

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**Certification Assumptions
Do Not Remain Valid, cont.**



➤ **Engineering assumptions**

- **Are changed product's physics, kinematics, or other scientific principles different from original product's?**
- **Assumptions may not remain valid if change cannot be validly analyzed by extrapolating analysis used on original product**

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**Certification Assumptions
Do Not Remain Valid, cont.**



➤ **Change is *significant* if analytical model or fundamental approach used in initial compliance demonstration**

- **Becomes unacceptable**
- **Must be redone to accommodate a new or expanded performance or operating envelope for the product**

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- This includes a change to the way the aircraft will be used, that is, VFR to IFR, unpressurized to pressurized cabin, or land- to water-based operation.

**Certification Assumptions
Do Not Remain Valid, cont.**



- **Operating a product to an expanded envelope from which originally designed generally a *NOT* significant change**
 - **Assumptions (analytical model or fundamental approach) used for certification of basic product remain valid**
 - **Model or approach can be applied, with predictable effects, to cover changed product**

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**Certification Assumptions
Do Not Remain Valid - Example**



- **Applicant wishes to go from unpressurized to pressurized cabin on part 23 airplane**
 - **Original assumptions with regard to load distribution on fuselage no longer valid**
 - **Model or simulation used to demonstrate compliance has to be altered to reflect new load distribution**

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Automatic Criteria Examples



- Applicant proposes to change non-primary flap on part 25 airplane from metal to composite
 - Flap carries no wing load
 - Functionality of flap unchanged
- Consider whether criteria are met in terms of the product as a whole, that is, the effect of the change on the airplane

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Automatic Criteria Examples, cont.



- Change is *not significant*
- Overall *Principles of Construction* has been retained for the *airplane*

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Automatic Criteria Examples, cont.



- **Applicant proposes change from metal to composite wing spar**
 - **Change will affect external load distribution and aeroelastic characteristics of product**

Are automatic criteria met in terms of product as a whole?

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Model Change Example



- **Applicant proposes to add skis to a part 23 airplane**
 - **Model would be distinct from other product models**

Are automatic criteria met in terms of product as a whole?

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Automatic Criteria Summary 

- **Product-level concept is frame of reference used to make assessment of whether change significant**
- **Use good engineering judgment to apply criteria appropriately**
- **When evaluating proposed change, use clues on next slide to help distinguish between component and product level**

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- There are **additional clues** you can use to help make the determination and distinguish between the product or component level. These are *clues*, they are not criteria. These generally will relate to a finding relative to the validity of certification assumptions.

Additional Clues 

- **Change in aircraft performance or flying qualities?**
- **Need to substantially revise AFM?**
- **Have operating characteristics changed?**

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Additional Clues, cont.



- **Change in crew workload requiring a revisit of human factors considerations?**
- **Change to aircraft's operating envelope?**
- **Can substantiation data used for compliance of existing product still apply to PLC?**

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When Applying the Criteria:



- **Focus on magnitude of the change**
- **Changes in the regulations alone are not reason enough to cause a change to be *significant***

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Exercise IV-1



- Add leading edge slats on part 25
- Install comprehensive flight deck upgrade, including electrical systems and architecture changes, & new electronic flight information system (EFIS) on a part 25 (reduce flight crew)
- Install forward-looking infra-red (FLIR) or surveillance camera on part 27
- Install quieter exhaust system on part 23

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Exercise IV-1, cont.



Are any of these 4 changes significant at the product level?



- Leading edge? (25)
- Flight deck upgrade? (25)
- FLIR or Surveillance camera? (27)
- Quieter exhaust system? (23)

Use AC 21.101-1, Appendix 1

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Exercise IV-1, cont.



- **Addition of leading edge slats**



Exercise IV-1, cont.



- **Comprehensive flight deck upgrade,
reduction in flight crew**



Exercise IV-1, cont.



- **Install FLIR or surveillance camera to part 27 rotorcraft**

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Exercise IV-1, cont.



- **Install quieter exhaust system on part 23 aircraft**

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E. Change in Context of Previous Relevant Design Changes

Previous Relevant Design Changes



- **“Cumulative effect of previous relevant design changes”**
 - **Consider each change within context of all previous relevant design changes**
 - **Incremental updates may be modest, while cumulative effect can be equivalent to significant design change**
 - **Consider changes since certification basis was last updated**

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Previous Relevant Design Changes, cont.



- **Current proposal: Increase engine thrust by 3% to allow takeoff from shorter runway**
- **History: Total of 9% thrust bump with no concurrent update of the certification basis**
- **Consequently, consider total 12% thrust increase when evaluating the criteria used to assess significance of change**

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Previous Relevant Design Changes, cont.



- Consider only previous *relevant* design changes since the last update of the certification basis
- Suppose applicant had updated certification basis when thrust was increased by 9%
 - Then consider only current 3% increase when applying the criteria

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Previous Relevant Design Changes, cont.



- Applicant evaluates change and cumulative effects of previous *relevant* changes
 - Includes concurrent or previous changes functionally necessary for change to operate
- Applicant makes proposal to Administrator
- Administrator evaluates proposal and information on all previous relevant design changes

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- The key is to remember that a *relevant* design change is one that is **functionally necessary for the change to operate**.

Previous Relevant Design Changes, Example



- **Helicopter manufacturer is doing a comprehensive flight deck upgrade**
 - **Installation of state-of-the-art fly-by-wire system to replace current primary flight control system**
 - **Other independent STCs to be installed in conjunction with, and integral to, new fly-by-wire system**
 - **STCs required to make modification functional**

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- Consequently, the helicopter manufacturer will consider not only the manufacturer's design changes implemented since the certification basis was last updated for the product, but also will consider the STCs that are relevant and installed as part of the proposed changed product.
- Likewise, if an after-market modifier proposes a change that includes another modifier's STC, this other STC must be included in the assessment of significance.

F. Related Changes

Related Changes



➤ **When applicant proposes multiple changes, each change is evaluated at product level for significance on its own merit**

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Related Changes, cont.



➤ **Related changes must be considered together**

- **Consider both performance and functional characteristics, as well as physical aspects**
- **Seemingly unrelated changes that affect same area or functional characteristic may be related**
- **Include effects of change on other systems, components, equipment, or appliances**

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Related Changes, cont. 

- **May be several changes to a product and only some may be significant**
 - ***Significant* changes must comply with latest applicable regulations**
 - ***Not significant* changes may comply with existing certification basis if adequate**

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G. Adequacy of the Existing Certification Basis for *Not Significant* Changes

If the Existing Requirements Are Adequate 

- **Certification basis is inadequate if:**
 - **Change includes features not envisioned in original design**
 - **Certification basis has no standards that address the change**

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***If the Existing Requirements
Are Adequate, cont.***



- ***If I were to have included the technology/
change in the original approval, would I
have developed a special condition?***
- ***If yes,***
 - ***Existing certification basis inadequate,
and***
 - ***Change must comply with later regulations***

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***Adequacy of Certification Basis
Not Significant Changes***



- ***If there are no standards in cert. basis:***
 - ***Apply first appropriate later amendment
that addresses particular requirements,
if they exist***
 - ***If no subsequent standard exists, special
conditions apply***

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Intermediate Summary



- For Administrator to make determination of *not significant*, applicant must:
 - Evaluate automatic criteria at product level, *and*
 - Consider cumulative effects of previous relevant design changes

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Intermediate Summary, cont.



- If change *significant* at product level, then all parts of product-level change significant
 - Meet amendment of regulations in effect on date of application
 - May request exceptions 21.101(b)(2) or (b)(3)
- If change *not significant* at product level, it may comply with existing cert. basis, if adequate

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H. Case Study: Determination of Significant/ Not Significant

- The next page of this Guide summarizes the material we've learned so far about the Case Study.
- We are ready to move to **Step 4** to determine if the *not significant* exception provided by 21.101(b)(1) may be applied to the four proposed changes.

Case Study: Changed Product for Part 25 Airplane

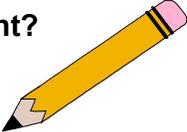
Product Being Changed: Twin jet engine transport, existing certification basis at Amendment 25-41. Date of application: June, 30, 2003, latest regulations at Amendment 25-109.

Description of Changes in the Application:

- I. Lengthen fuselage (same gross weight, trade range for payload)**
 - A. Physical changes
 1. Add 10 ft. fuselage plug; total fuselage length is now 80 ft.
 2. Extend floor
 3. Add two rows of seats
 4. Add overhead bins
 5. Increase size of cargo compartment by 30%
 6. Lengthen control cable runs
 7. Extend services (O₂, plumbing, etc.)
 8. Increase local skin gauges at wing root
- II. Increase engine thrust (to takeoff on shorter runway)**
 - A. Physical changes
 1. Increase engine thrust by 3% (9% previous increase without update of the certification basis)
 2. Change nacelle cooling flow
 3. Redesign pylon to increase strength
- III. Landing gear product improvement (no performance credit)**
 - A. Physical changes
 1. Brake model revision to prolong life
 2. Increase tire plies 16 to 18
 3. Change oleo strut orifice
 4. Local wing changes at strut attachment
- IV. Flight deck avionics update**
 - A. Physical changes
 1. Add a new Electronic Flight Information System (EFIS) that displays critical engine parameters, and warning and advisory information to the crew
 2. Revise the Flight Management System (FMS) to incorporate software updates
 3. Minimal changes to the overall configuration of the current system – only those changes necessary to accommodate new EFIS

 **Case Study** 

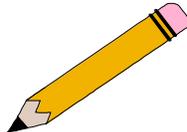
- **Is the fuselage stretch significant?
Why or why not?**
- **Is the thrust bump increase significant?
Why or why not?**
- **Is the landing gear change significant?
Why or why not?**
- **Is the avionics change significant?
Why or why not?**



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 **Case Study, cont.** 

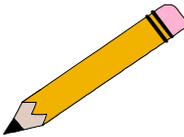
- **Answer:**



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 **Case Study, cont.**

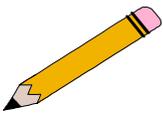
➤ **Answer: Fuselage plug**



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 **Case Study, cont.**

Answer: Thrust bump

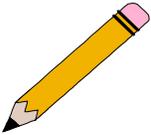


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 **Case Study, cont.**

Answer: Landing gear





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 **Case Study, cont.**

Answer: Avionics change





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 **Avionics Change** 

- **New EFIS requires lightning protection**
 - Existing cert. basis (25-41) doesn't include lightning protection, added at amendment 25-80
 - 25-80 added to cert. basis to pick up 25.1316
 - All other regulations remain at amendment level in existing cert. basis

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- **If lightning protection were included** in the original certification basis, compliance with amendment 25-80 would not be required.
- Let's **talk for a moment about HIRF**. This is also required for the new EFIS. The existing certification basis does not include a special condition for HIRF protection. The HIRF special condition would be added to provide an adequate certification basis for the avionics change. **This is current practice.**

I. Summary of *Not Significant* Exception

Summary Questions 

- **What are the three automatic criteria used to determine significance?**

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Summary Questions, cont. 

- **What happens if the changed product is found to be *not significant*, however the existing certification basis is not adequate?**

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Summary Questions, cont.



- **What is the difference between a change that triggers an automatic criteria at the *component level* vs. the *product level*?**

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Summary Questions, cont.



- **What can you use as a major resource for determining if a change is *not significant*?**
- **Is a model change automatically significant?**

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Summary Questions, cont.



- **What is the role of cumulative effects in determination of not significant?**

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Summary: *Not Significant*



- **Applicant must show proposed *significant* change *complies with regulations* in effect on the date of application**
- **If change *not significant*, it may comply with existing certification basis**
- **Existing certification basis must provide adequate standards for the proposed change; if no applicable regulations, use special conditions**

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Summary: Not Significant, cont.



- **If change is significant, applicant may propose to use exceptions in 21.101(b)(2) or (b)(3)**
- **Certification procedures for special conditions are unchanged**
 - **Use when regulations in effect on date of application do not provide adequate standards for proposed change**

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J. Determination of Significance for Excepted Aircraft [14 CFR 21.101(c)]

Excepted Products, 21.101(c)



- **CPR applies**
- **Burden shifted from applicant to Administrator**
- **Excepted products are:**
 - **Aircraft, other than rotorcraft, \leq 6,000 lb**
 - **Non-turbine rotorcraft \leq 3,000 lb**

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Excepted Aircraft, cont.



- All changes assumed to be *not significant* unless Administrator finds otherwise
- If change *significant*, then:
 - Administrator designates appropriate requirements
 - Applicant may propose to use 21.101(b)(2) or (b)(3) exceptions

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Excepted Aircraft, cont.



- If change has novel or unusual features, Administrator will designate
 - Applicable special conditions at the appropriate amendment level, beginning with existing certification basis and progressing to most appropriate later amendment level
 - Special condition should be appropriate to and consistent with agreed-upon certification basis for excepted product

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Excepted Aircraft, cont.



- **If change has design features not covered by existing certification basis that are covered by later amendments to the regulations**
 - **Administrator will designate applicable airworthiness requirements at next appropriate amendment level, beginning with existing certification basis**

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Excepted Aircraft, cont.



- **Exception provided by 21.101(c) applicable to aircraft**
 - **Does NOT apply to engines or propellers installed on excepted aircraft**
 - **Engines and propellers separate type certificated products; they may be installed on aircraft not in excepted class**

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K. Determination of Significance for Other Category Aircraft [14 CFR 21.101(f)]

Other Category Aircraft, 21.101(f) 

➤ **Product-level changes assumed to be *significant* for aircraft certificated as:**

- **Special Class - 21.17(b)**
- **Primary Category - 21.24**
- **Restricted Category - 21.25**
- **Surplus Military – 21.27**
- **Limited Category – CAR 9**

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Other Category Aircraft, cont. 

➤ **Airworthiness requirements are those applicable to the category of the product in effect on the date of application for the change**

- **Includes airworthiness requirements the Administrator finds to be appropriate for the type certification of the aircraft**

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Other Category Aircraft, cont.



- **For significant changes, consider:**
 - Operational environment
 - Intended use of aircraft
 - Latest requirements may not be appropriate
- **Appropriate amendment level of applicable regulation**
 - Based on specific design & intended use of aircraft
 - Has level of safety acceptable to Administrator

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- However, there are considerations specific to the other category aircraft. Based on the operational environment and intended use of the aircraft, the latest requirements may not be the appropriate amendment for these other category aircraft. They may use earlier amendments, however the amendments may not be prior to the existing certification basis.
- **The appropriate amendment level of the applicable regulations will be based on the specific design and intended use of the aircraft and provide a level of safety acceptable to the Administrator.**
- This paragraph in the rule covers a wide range of aircraft that can be used in many ways.

Establishing the Certification Basis for Significant Changes to Other Category Aircraft [14 CFR 21.101(f)]

| Category 21.101(f) | If the certification basis is ... | Then, the starting point for modifications to existing aircraft is ... | And the applicant should ... |
|--|--|---|--|
| 21.17(b) Special Class | Portions of 14 CFR parts 23, 25, 27, 29, 31, 33, or 35 | Latest amendment of applicable 14 CFR sections | Consider intended use (passengers, flight instruction) |
| | Other than 14 CFR, for example, JAR 22, JAR VLA | Existing certification basis | Use later or latest “other” standard based on intended use |
| 21.24 Primary | Portions of 14 CFR parts 23, 27, 31, 33, or 35 | Latest amendment of applicable 14 CFR sections | Consider intended use (passengers, flight instruction) |
| | Other than 14 CFR, for example, JAR | Existing certification basis | Use later or latest “other” standard based on intended use |
| 21.25(a)(1) Restricted | Portions of 14 CFR parts 23, 25, 27, 29, 31, 33, or 35; CAR 3, CAM 8 | Latest amendment of applicable 14 CFR sections | Consider intended use based on special purpose |
| 21.25(a)(2) Restricted or Limited (CAR 9) | Based on military qualification acceptance and service history | 14 CFR § 21.27(f) table | Consider intended use based on special purpose |
| 21.27 Surplus Military | Portions of 14 CFR parts 23, 25, 27, 29, 31, 33, or 35 and predecessor regulations | Latest amendment of applicable 14 CFR sections | Consider intended use, including standard airworthiness certificates |

L. Summary for Excepted and Other Category Products

Summary for Excepted Aircraft 

- **Excepted aircraft – 21.101(c)**
 - **Use existing certification basis unless Administrator finds change significant**
 - **If *significant*, Administrator designates applicable amendment level or applicant may propose to use exceptions**

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Summary for Other Category Aircraft 

- **Other category – 21.101(f)**
 - **Must comply with applicable regulations in effect on date of application when original certification basis included FARs or their predecessor regulations**
 - **If aircraft certified using something other than FARs, then starting point for determining certification basis is existing certification basis**
 - **Consider acceptable level of safety for intended use**

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