Jordan Civil Aviation Regulatory Commission

AMC and GM to JCAR-Part 21

Acceptable Means of Compliance and Guidance Material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organizations

May/2011

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TERMINOLOGY

For information purposes:

Certification Specifications (CS) refers when used in the text to the JCAR Part-Certification Specifications and the associated acceptable means of compliance adopted or developed by the CARC.

Acceptable Means of Compliance (AMC) illustrate a means, but not the only means, by which a specification contained in JCAR Part-Certification Specifications or a requirement in JCAR Part 21 can be met.

Guidance Material (GM) helps to illustrate the meaning of a specification or requirement.

SUBPART A-General Provisions

GM 21.3(a) The system for collection, investigation and analysis of data

In the context of that requirement the word "Collection" means, the setting up, of systems and procedures which will enable relevant malfunctions, failures and defects to be properly reported when they occur.

GM 21.3(b) Occurrence reporting

For occurrence reporting, refer to AMC 20-8, in AMC 20.

AMC 21.3(b) (2) Reporting to the CARC

Within the overall limit of 72 hours the degree of urgency for submission of a report should be determined by the level of hazard judged to have resulted from the occurrence.

Where an occurrence is judged by the person identifying the possible unsafe condition to have resulted in an immediate and particularly significant hazard, CARC expects to be advised immediately and by the fastest possible means (telephone, fax, email, telex, etc.) of whatever details are available at that time. This initial report must be followed up by a full written report within 72 hours. A typical example would be an uncontained engine failure resulting in damage to aircraft primary structure.

Where the occurrence is judged to have resulted in a less immediate and less significant hazard, report submission may be delayed up to the maximum of three days in order to provide more details.

GM 21.3B (d) (4) Defect correction-Sufficiency of proposed corrective action

This GM provides guidelines to assist in establishing rectification campaigns to remedy discovered defects.

1. STATUS

This document contains GM of a general nature for use in conjunction with engineering judgment, to aid airworthiness engineers in reaching decisions in the state of technology at the material time. While the main principles of this GM could be applied to small private aeroplanes, helicopters, etc. the numerical values chosen for illustration are appropriate to large aeroplanes for public transport.

2. INTRODUCTION

2.1 Over the years, target airworthiness risk levels underlying airworthiness requirements have developed on the basis of traditional qualitative airworthiness approaches; they have been given more precision in recent years by being compared with achieved airworthiness levels (judged from accident statistics) and by the general deliberations and discussions which accompanied the introduction of rational performance requirements, and more recently, the Safety Assessment approach in requirements. Although the target

airworthiness risk level tends to be discussed as a single figure (a fatal accident rate for airworthiness reasons of not more than 1 in 10,000,000 flights/flying hours for large aeroplanes) it has to be recognized that the requirements when applied to particular aircraft types will result in achieved airworthiness levels at certification lying within a band around the target level and that thereafter, for particular aircraft types and for particular aircraft, the achieved level will vary within that band from time to time.

2.2 The achieved airworthiness risk levels can vary so as to be below the target levels, because it is difficult if not impossible to design to the minimum requirements without being in excess of requirements in many areas; also because aircraft are not always operated at the critical conditions (e.g., aircraft weight, cg position and operational speeds; environmental conditions-temperature, humidity, degree of turbulence). The achieved level may vary so as to be above the target level because of undetected variations in material standards or build standards, because of design deficiencies, because of encountering unforeseen combinations of failures and/or combinations of events, and because of unanticipated operating conditions or environmental conditions.

2.3 There is now recognition of the need to attempt to monitor the conditions which tend to increase the level and to take appropriate corrective action when the monitoring indicates the need to do so in order to prevent the level rising above a predetermined "ceiling".

2.4 CARC also has a duty in terms of providing the public with aviation services and therefore should consider the penalties associated with curtailment or even removal (by "grounding") of aviation services when establishing the acceptability of any potential variation in airworthiness level.

2.5 Thus, the purpose of this GM is:

(a) To postulate basic principles which should be used to guide the course of actions to be followed so as to maintain an adequate level of airworthiness risk after a defect has occurred which, if uncorrected, would involve a potential significant increase of the level of risk for an aircraft type.

(b) For those cases where it is not possible fully and immediately to restore an adequate level of airworthiness risk by any possible alleviating action such as an inspection or limitation, to state the criteria which should be used in order to assess the residual increase in risk and to limit it to an appropriate small fraction of the mean airworthiness through life risk.

3. DISCUSSION

3.1 Several parameters are involved in decisions on safety matters. In the past the cost of proposed action has often been compared with the notional 'risk cost', i.e. the cost of a catastrophe multiplied by its probability of occurrence.

3.2 This can be a useful exercise, but it should be held within the constraint of acceptable airworthiness risk levels, i.e., within airworthiness risk targets which represent the maximum levels of risk with which an aircraft design must comply, i.e., in the upper part of the 'band'. Currently for large aeroplanes the mean airworthiness risk level is set at a catastrophe rate for airworthiness reasons of not more than one in every ten- million flights/flying hours. The constraint is overriding in that any option, which could be permitted on risk cost considerations, or other grounds, is unacceptable if it leads to significant long-term violation of this safety requirement.

3.3 While it should clearly be the objective of all to react to and eliminate emergency situations, i.e., those involving a potentially significant increase of airworthiness risk levels, without unreasonable delay, CARC should be able finally to rule on what is a minimum acceptable campaign program. It has therefore seemed desirable to devise

guidelines to be used in judging whether a proposed campaign of corrective actions is sufficient in airworthiness terms, and clearly this ought to be based on determining the summation of the achieved airworthiness risk levels for the aircraft and passengers during any periods of corrective action and comparing them with some agreed target.

3.4 As the period of corrective action will not be instantaneous (unless by grounding), there is potentially an increase in the achieved airworthiness risk level possibly to and, without controls, even above the higher part of the 'band', and the amount by which the level is above the mean target figure, and the period for which it should be allowed to continue, has been a matter of some arbitrary judgment.

3.5 It would appear desirable to try to rationalize this judgment. For example, if an aircraft were to spend 10% of its life at a level such that the risk of catastrophe was increased by an order of magnitude, the average rate over its whole life would be doubled which may not be in the public interest. A more suitable criterion is perhaps one which would allow an average increase in risk of, say one third on top of the basic design risk when spread over the whole life of the aircraft an amount which would probably be acceptable within the concept (See Figure 1). It would then be possible to regard the 'through life' risk to an aircraft - e.g., a mean airworthiness target of not more than one airworthiness catastrophe per 10 million (10^7) hours, as made up of two parts, the first being 3/4 of the total and catering for the basic design risk and the other being 1/4 of the total, forming an allowance to be used during the individual aircraft's whole life for unforeseen campaign situations such as described above.

3.6 Investigation has shown that a total of ten such occasions might arise during the life of an individual aircraft.

3.7 Using these criteria, there could then be during each of these emergency periods (assumed to be ten in number) a risk allowance contributed by the campaign alone of:

1×10^{-7} for 2.5% of the aircraft's life; or
5×10^{-7} for 0.5% of the aircraft's life; or
1×10^{-6} for 0.25% of the aircraft's life; or
1×10^{-5} for 0.025% of the aircraft's life, etc.

Without exceeding the agreed 'allowance' set -aside for this purpose.

3.8 Thus a 'reaction table' can be created as indicated in Table 1 (the last two columns assuming a typical aircraft design life of 60,000 hours and an annual utilization of 3000 hours per annum) showing the flying or calendar time within which a defect should be corrected if the suggested targets are to be met.

Table 1

Estimated catastrophe rate to aircraft due to the defect under consideration (per a/c hour)	**Average reaction time for aircraft at risk (hours)**	**On a calendar basis**
4×10^{-8}	3750	15 months
5×10^{-8}	3000	12 months
1×10^{-7}	1500	6 months
2×10^{-7}	750	3 months
5×10^{-7}	300	6 weeks
1×10^{-6}	150	3 weeks
1×10^{-5}	15	Return to base

3.9 These principles may be applied to a single aircraft or a number of aircraft of a fleet but in calculating risk, all the risk should be attributed to those aircraft which may carry it, and should not be diluted by including other aircraft in the fleet which are known to be free of risk. (It is permissible to spread the risk over the whole fleet when a source is known to exist without knowing where). Where a fleet of aircraft is involved Column 2 may be interpreted as the mean time to rectification and not the time to the last one.

3.10 There is one further constraint. However little effect a situation may have on the 'whole life' risk of an aircraft, the risk should not be allowed to reach too high a level for any given flight. Thus while a very high risk could be tolerated for a very short period without unacceptable degradation of the overall airworthiness target, the few flights involved would be exposed to a quite unacceptable level of risk. It is therefore proposed that the Table 1 should have a cut-off at the 2×10^{-6} level so that no flight carries a risk greater than 20 times the target. At this level the defect is beginning to contribute to a greater likelihood of catastrophe than that from all other causes, including non-airworthiness causes, put together. If the situation is worse than this, grounding appears to be the only alternative with possibly specially authorized high-risk ferry flights to allow the aircraft to return to base empty. Figures 2 and 3 show a visualization chart equivalent to Table 1, giving average rectification time (either in flight hours or months) based on probability of defect that must be corrected.

3.11 It will be seen that the above suggestions imply a probability of catastrophe from the campaign alone of 1.5/10,000 per aircraft during each separate campaign period (i.e., p = 0.015 per 100 aircraft fleet).

3.12 In addition, in order to take into account large fleet size effect, the expected probability of the catastrophic event during the rectification period on the affected fleet shall not exceed 0.1. See Figure 4.

3.13 It should also be noted that in assessing campaign risks against 'design risk', an element of conservatism is introduced, since the passenger knows only 'total risk' (i.e. airworthiness plus operations risks) and the fatal accident rate for all reasons is an order of magnitude greater than that for airworthiness reasons only (i.e., 10^{-6} as against 10^{-7}). The summated campaign risk allowance proposed by this GM is therefore quite a small proportion of the total risk to which a passenger is subject. When operating for short periods at the limit of risk proposed (2×10^{-6} per hour) the defect is however contributing 100% more risk than all other causes added together.

3.14 A similar approach is proposed to cover the case of defects associated to hazardous failure conditions for which the safety objectives defined by the applicable airworthiness requirements are not met. According to CS 25.1309, the allowable probability for each hazardous failure condition is set at 10^{-7} per flight hour compared to 10^{-9} per flight hour for a catastrophic failure condition. Figure 5 is showing a visualization chart giving average rectification time based on probability of defect that should be corrected. This is similar to figure 2 but with lower and upper boundaries adapted to cover the case of hazardous failure conditions (probabilities of 10^{-7} and 2×10^{-4} respectively).

3.15 In addition, in order to take into account large fleet size effect, the expected probability of the hazardous event during the rectification period on the affected fleet shall not exceed 0.5. See Figure 6.

4. GUIDELINES

4.1 The above would lead to the following guidelines for a rectification campaign to remedy a discovered defect associated to a catastrophic failure condition without grounding the aircraft:

(i) Establish all possible alleviating action such as inspections, crew drills, route restrictions, and other limitations.
(ii) Identify that part of the fleet, which is exposed to the residual risk, after compliance has been established with paragraph (i).
(iii) Using reasonably cautious assumptions, calculate the likely catastrophic rate for each aircraft carrying the risk in the affected fleet.
(iv) Compare the speed with which any suggested campaign will correct the deficiency with the time suggested in Figure 2. The figure should not be used beyond the $2x10^{-6}$ level, except for specially authorized flights.
(v) Also ensure that the expected probability of the catastrophic event during the rectification period on the affected fleet is in accordance with Figure 4.

4.2 Similarly, the following guidelines would be applicable for a rectification campaign to remedy a discovered defect associated to a hazardous failure condition without grounding the aircraft:

(i) Establish all possible alleviating action such as inspections, crew drills, route restrictions, and other limitations.
(ii) Identify that part of the fleet, which is exposed to the residual risk, after compliance has been established with paragraph (i).
(iii) Using reasonably cautious assumptions, calculate the likely hazardous rate for each aircraft carrying the risk in the affected fleet.
(iv) Compare the speed with which any suggested campaign will correct the deficiency with the time suggested in Figure 5.
(v) Also ensure that the expected probability of the hazardous event during the rectification period on the affected fleet is in accordance with Figure 6.

4.3 It must be stressed that the benefit of these guidelines will be to form a datum for what is considered to be the theoretically maximum reaction time. A considerable amount of judgment will still be necessary in establishing many of the input factors and the final decision may still need to be tempered by non-numerical considerations, but the method proposed will at least provide a rational 'departure point' for any exercise of such judgment.

4.4 It is not intended that the method should be used to avoid quicker reaction times where these can be accommodated without high expense or disruption of services.

Figure 1

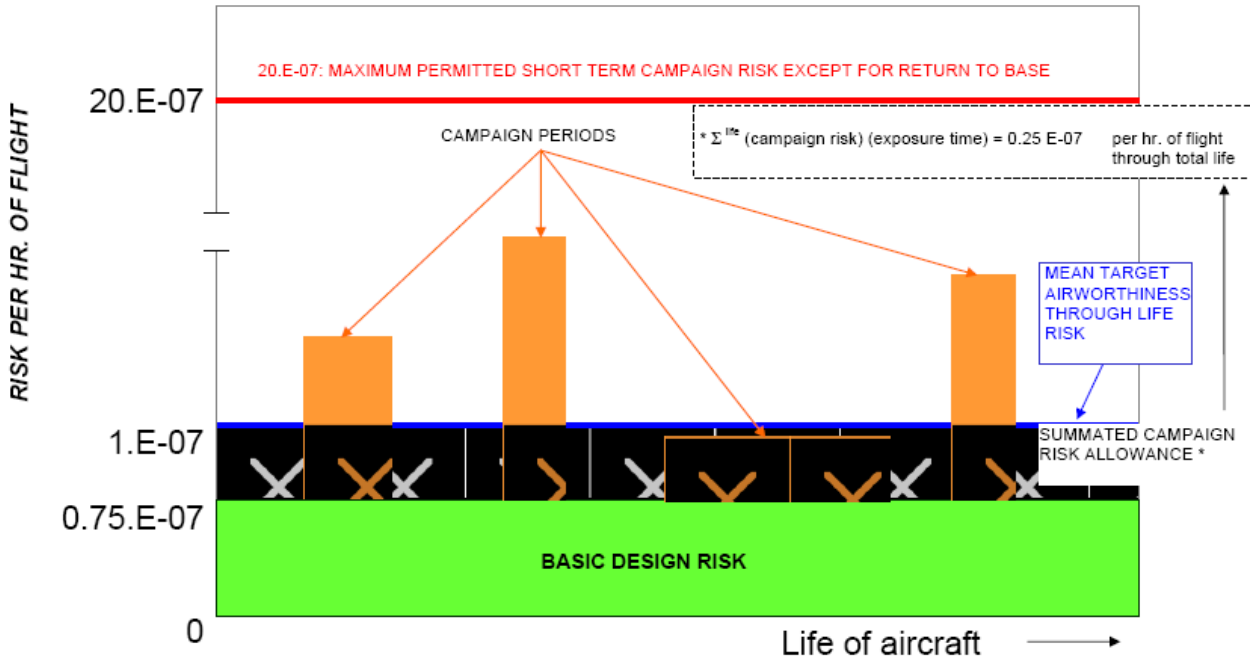


Figure 2 - Visualisation Chart for CS-25 (Flight hours)

Assumptions: - aircraft life of 60,000 hours
- 10 'catastrophic events' campaigns

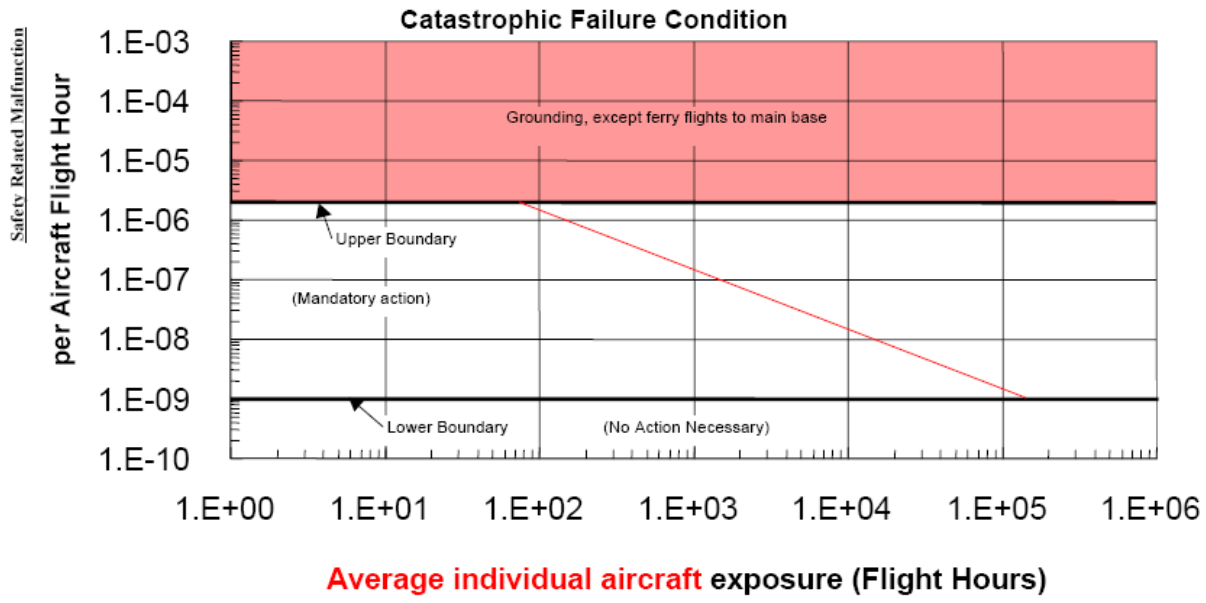


Figure 3 - Visualisation Chart for CS-25 (Calendar basis)

Assumptions: - aircraft life of 60,000 hours, 3000 hours per year
- 10 'catastrophic events' campaigns

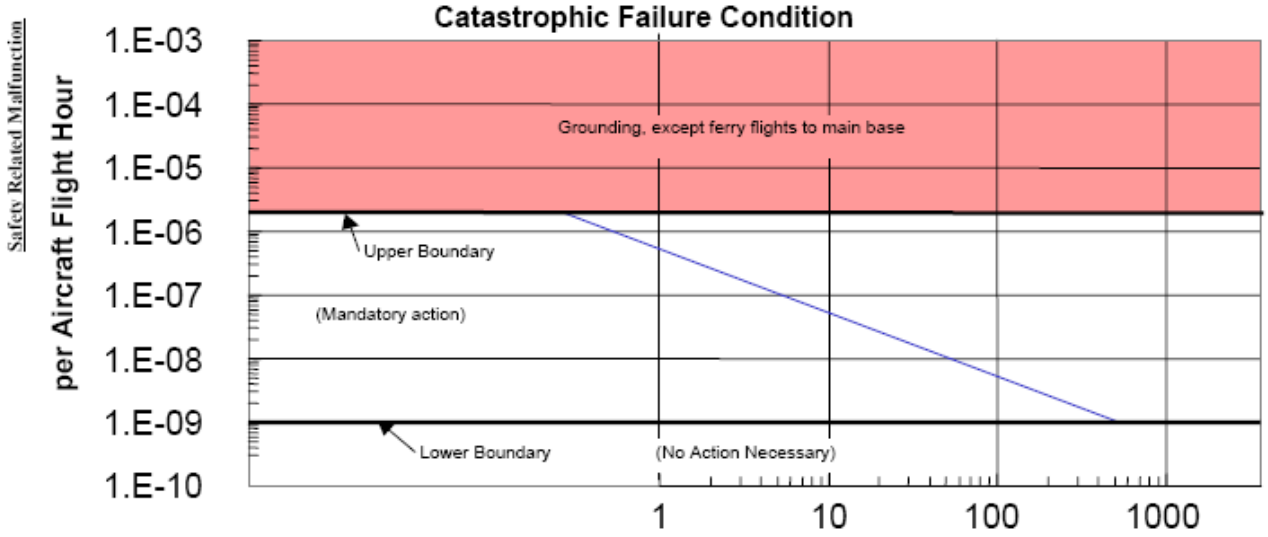


Figure 4 - Visualisation Chart for CS-25

(Flight Hours)

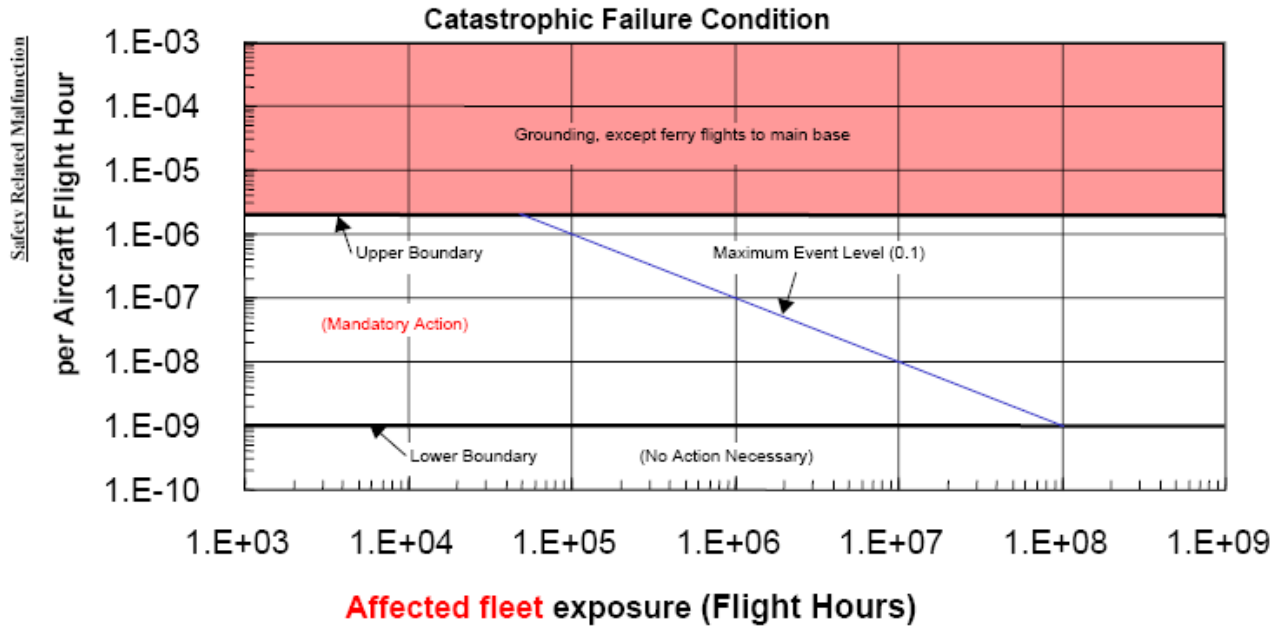


Figure 5 - Visualisation Chart for CS-25 (Flight hours)

For Hazardous Failure Condition

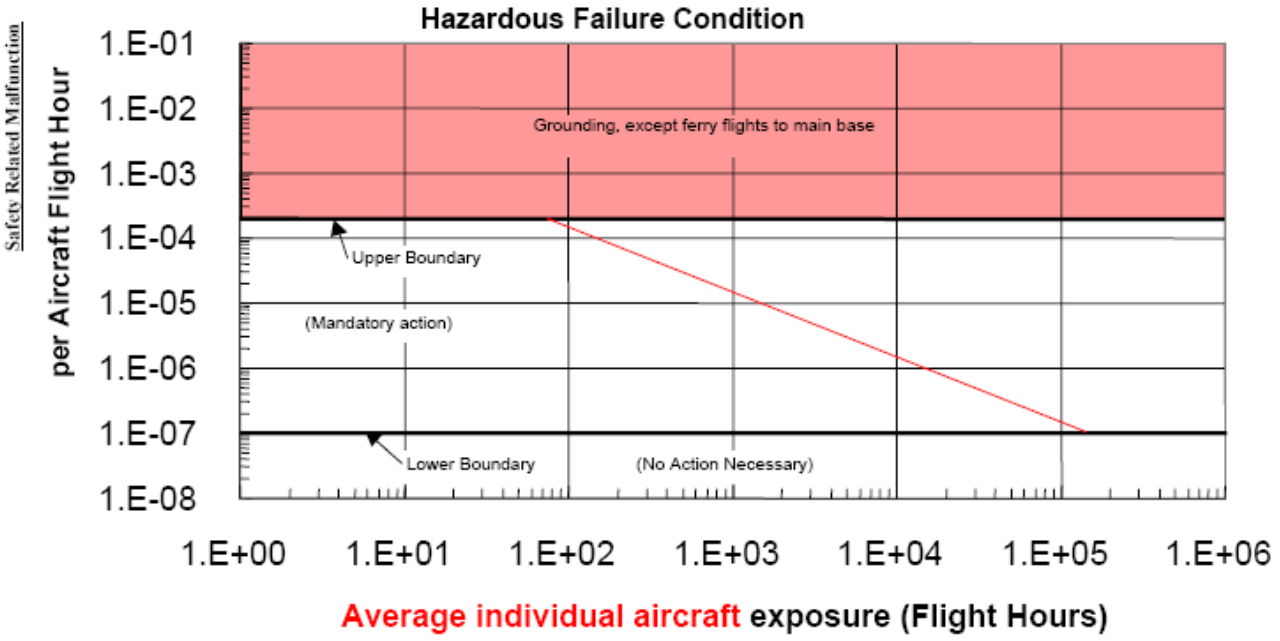
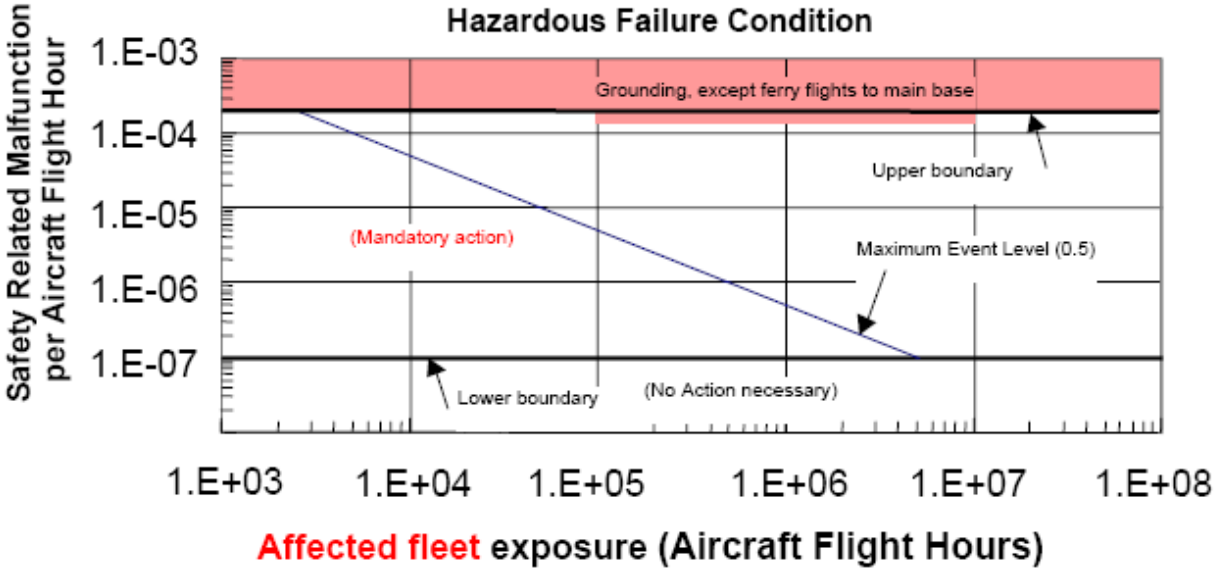


Figure 6 - Visualisation Chart for CS-25 (Flight Hours)



AMC 21.3B (b) Unsafe condition

An unsafe condition exists if there is factual evidence (from service experience, analysis or tests) that:

(a) An event may occur that would result in fatalities, usually with the loss of the aircraft, or reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be:

(i) A large reduction in safety margins or functional capabilities, or
(ii) Physical distress or excessive workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely, or
(iii) Serious or fatal injury to one or more occupants unless it is shown that the probability of such an event is within the limit defined by the applicable airworthiness requirements, or

(b) There is an unacceptable risk of serious or fatal injury to persons other than occupants, or
(c) Design features intended to minimize the effects of survivable accidents are not performing their intended function.

Note 1: Non-compliance with applicable airworthiness requirements is generally considered as an unsafe condition, unless it is shown that possible events resulting from this non-compliance do not constitute an unsafe condition as defined under paragraphs (a), (b) and (c).

Note 2: An unsafe condition may exist even though applicable airworthiness requirements are complied with.

Note 3: The above definition covers the majority of cases where CARC considers there is an unsafe condition. There may be other cases where overriding safety considerations may lead CARC to issue an airworthiness directive.

Note 4: There may be cases where events can be considered as an unsafe condition if they occur too frequently (significantly beyond the applicable safety objectives) and could eventually lead to consequences listed in paragraph (a) in specific operating environments. Although having less severe immediate consequences than those listed in paragraph (a), the referenced events may reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew workload, or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries.

GM 21.3B (b) Determination of an unsafe condition

It is important to note that these guidelines are not exhaustive. However, this material is intended to provide guidelines and examples that will cover most cases, taking into account the applicable certification requirements.

1. INTRODUCTION

Certification or approval of a product, part or appliance is a demonstration of compliance with requirements which are intended to ensure an acceptable level of safety. This demonstration however includes certain accepted assumptions and predicted behaviors, such as:

- fatigue behavior is based on analysis supported by test,
- modeling techniques are used for Aircraft Flight Manual performances calculations,
- the systems safety analyses give predictions of what the systems failure modes, effects and probabilities may be,
- the system components reliability figures are predicted values derived from general experience, tests or analysis,
- the crew is expected to have the skill to apply the procedures correctly, and
- the aircraft is assumed to be maintained in accordance with the prescribed instructions for continued airworthiness (or maintenance program), etc.

In service experience, additional testing, further analysis, etc., may show that certain initially accepted assumptions are not correct. Thus, certain conditions initially demonstrated as safe, are revealed by experience as unsafe. In this case, it is necessary to mandate corrective actions in order to restore a level of safety consistent with the applicable certification requirements.

See AMC 21.3B (b) for definition of "unsafe condition" used in 21.3(b).

2. GUIDELINES FOR ESTABLISHING IF A CONDITION IS UNSAFE

The following paragraphs give general guidelines for analyzing the reported events and determining if an unsafe condition exists, and are provided for each type of product, part or appliance subject to a specific airworthiness approval: type-certificates (TC) or supplemental type-certificates (STC) for aircraft, engines or propellers, or Technical Standard Orders (TSO). This analysis may be qualitative or quantitative, i.e. formal and quantitative safety analyses may not be available for older or small aircraft. In such cases, the level of analysis should be consistent with that required by the airworthiness requirements and may be based on engineering judgment supported by service experience data.

2.1 Analysis method for aircraft

2.1.1 **Accidents or incidents without any aircraft, engines, system, propeller or part or appliance malfunction or failure**

When an accident/incident does not involve any component malfunction or failure but when a crew human factor has been a contributing factor, this should be assessed from a man-machine interface standpoint to determine whether the design is adequate or not. Paragraph 2.5 gives further details on this aspect.

2.1.2 **Events involving an aircraft, engines, system, propeller or part or appliance failure, malfunction or defect**

The general approach for analysis of in service events caused by malfunctions, failures or defects will be to analyze the actual failure effects, taking into account previously unforeseen failure modes or improper or unforeseen operating conditions revealed by service experience.

These events may have occurred in service, or have been identified during maintenance, or been identified as a result of subsequent tests, analyses, or quality control.

These may result from a design deficiency or a production deficiency (non conformity with the type design), or from improper maintenance. In this case, it should be determined if improper

maintenance is limited to one aircraft, in which case an airworthiness directive may not be issued, or if it is likely to be a general problem due to improper design and/or maintenance procedures, as detailed in paragraph 2.5.

2.1.2.1 Flight

An unsafe condition exists if:

- There is a significant shortfall of the actual performance compared to the approved performance (taking into account the accuracy of the performance calculation method), or
- The handling qualities, although having been found to comply with the applicable airworthiness requirements at the time of initial approval, are subsequently shown by service experience not to comply.

2.1.2.2 Structural or mechanical systems

An unsafe condition exists if the deficiency may lead to a structural or mechanical failure which:

- Could exist in a Principal Structural Element that has not been qualified as damage tolerant. Principal Structural Elements are those which contribute significantly to carrying flight, ground, and pressurization loads, and whose failure could result in a catastrophic failure of the aircraft. Typical examples of such elements are listed for large aeroplanes in AMC 25.571(a) "damage tolerance and fatigue evaluation of structure", and in the equivalent material for rotorcraft.
- Could exist in a Principal Structural Element that has been qualified as damage tolerant, but for which the established inspections, or other procedures, have been shown to be, or may be, inadequate to prevent catastrophic failure.
- Could reduce the structural stiffness to such an extent that the required flutter, divergence or control reversal margins are no longer achieved.
- Could result in the loss of a structural piece that could damage vital parts of the aircraft, cause serious or fatal injuries to persons other than occupants.
- Could, under ultimate load conditions, result in the liberation of items of mass that may injure occupants of the aircraft.
- Could jeopardize proper operation of systems and may lead to hazardous or catastrophic consequences, if this effect has not been taken adequately into account in the initial certification safety assessment.

2.1.2.3 Systems

The consequences of reported systems components malfunctions, failures or defects should be analyzed. For this analysis, the certification data may be used as supporting material, in particular systems safety analyses.

The general approach for analysis of in service events caused by systems malfunctions, failures or defects will be to analyze the actual failure effects.

As a result of this analysis, an unsafe condition will be assumed if it cannot be shown that the safety objectives for hazardous and catastrophic failure conditions are still achieved, taking into account the actual failure modes and rates of the components affected by the reported deficiency.

The failure probability of a system component may be affected by:

- A design deficiency (the design does not meet the specified reliability or performance).
- A production deficiency (non conformity with the certified type design) that affects either all components, or a certain batch of components.
- Improper installation (for instance, insufficient clearance of pipes to surrounding structure).
- Susceptibility to adverse environment (corrosion, moisture, temperature, vibrations etc.).
- Ageing effects (failure rate increase when the component ages).
- Improper maintenance.

When the failure of a component is not immediately detectable (hidden or latent failures), it is often difficult to have a reasonably accurate estimation of the component failure rate since the only data available are usually results of maintenance or flight crew checks. This failure probability should therefore be conservatively assessed.

As it is difficult to justify that safety objectives for the following systems are still met, a deficiency affecting these types of systems may often lead to a mandatory corrective action:

- back up emergency systems, or
- Fire detection and protection systems (including shut off means).

Deficiencies affecting systems used during an emergency evacuation (emergency exits, evacuation assist means, emergency lighting system ...) and to locate the site of a crash (Emergency Locator Transmitter) will also often lead to mandatory corrective action.

2.1.2.4 Others

In addition to the above, the following conditions are considered unsafe:

- There is a deficiency in certain components which are involved in fire protection or which are intended to minimize/retard the effects of fire / smoke in a survivable crash, preventing them to perform their intended function (for instance, deficiency in cargo liners or cabin material leading to non-compliance with the applicable flammability requirements).
- There is a deficiency in the lightning or High Intensity Radiated Fields protection of a system which may lead to hazardous or catastrophic failure conditions.
- There is a deficiency which could lead to a total loss of power or thrust due to common mode failure.

If there is a deficiency in systems used to assist in the enquiry following an accident or serious incident (e.g., Cockpit Voice Recorder, Flight Data Recorder), preventing them to perform their intended function, CARC may take mandatory action.

2.2 Engines

The consequences and probabilities of engine failures have to be assessed at the aircraft level in accordance with paragraph 2.1, and also at the engine level for those failures considered as Hazardous in CS E-510.
The latter will be assumed to constitute unsafe conditions, unless it can be shown that the consequences at the aircraft level do not constitute an unsafe condition for a particular aircraft installation.

2.3 Propellers

The consequences and probabilities of propeller failures have to be assessed at the aircraft level in accordance with paragraph 2.1, and also at the propeller level for those failures considered as hazardous in CS P-70.
The latter will be assumed to constitute unsafe conditions, unless it can be shown that the consequences at the aircraft level do not constitute an unsafe condition for a particular aircraft installation

2.4 Parts and appliances

The consequences and probabilities of equipment failures have to be assessed at the aircraft level in accordance with paragraph 2.1.

2.5 Human factors aspects in establishing and correcting unsafe conditions

This paragraph provides guidance on the way to treat an unsafe condition resulting from a maintenance or crew error observed in service.

It is recognized that human factors techniques are under development. However, the following is a preliminary guidance on the subject.

Systematic review should be used to assess whether the crew or maintenance error raises issues that require regulatory action (whether in design or other areas), or should be noted as an isolated event without intervention. This may need the establishment of a multidisciplinary team (designers, crews, human factors experts, maintenance experts, operators etc.)

The assessment should include at least the following:

- Characteristics of the design intended to prevent or discourage incorrect assembly or operation;
- Characteristics of the design that allow or facilitate incorrect operation,
- Unique characteristics of a design feature differing from established design practices;
- The presence of indications or feedback that alerts the operator to an erroneous condition;
- The existence of similar previous events, and whether or not they resulted (on those occasions) in unsafe conditions;
- Complexity of the system, associated procedures and training (has the crew a good understanding of the system and its logic after a standard crew qualification program?);
- Clarity/accuracy/availability/currency and practical applicability of manuals and procedures;
- Any issues arising from interactions between personnel, such as shift changeover, dual inspections, team operations, supervision (or lack of it), or fatigue.

Apart from a design change, the corrective actions, if found necessary, may consist of modifications of the manuals, inspections, training programs, and/or information to the operators about particular design features. CARC may decide to make mandatory such corrective action if necessary.

AMC 21A.4 Transferring of information on eligibility and approval status from the design holder to production organizations

Where there is a need to provide (normally outside the design organization) a visible statement of approved design data or airworthiness or environmental protection data associated with the approved design data, the following minimum information must be provided. The need for a visible statement may be in relation to Company holding a production organization approval (POA) in relation to 21.163(c).

The procedures related to the use of forms or other electronic means to provide this information must be agreed with CARC.

Information to be provided:

Company Name: the name of the responsible design organization (TC, STC, approval of repair or minor change design, TSO authorization holder) issuing the information.

Date: the date at which the information is released.

Eligibility: indicate the specific products or articles, in case of TSO authorization, for which data have been approved.

Identification: the part number of the part or appliance. Preference should be given to the use of the Illustrated Parts Catalogue (IPC) designation. Alternatively the reference to the instruction for continued airworthiness (e.g., SB, AMM, etc.) could be stated. Marking requirements of Part 21 Subpart Q should be taken into account.

Description: the name or description of the part or document should be given. In the case of a part or appliance preference should be given to use of IPC designation. The description is to include reference to any applicable TSO authorization or JPA marking, or previous approvals still valid.

Purpose of data: the reason for the provision of the information should be stated by the design approval holder.

Examples:

a) Provision of approved design data to a production organization to permit manufacture (AMC No 1 to 21.133(b) and (c))

b) Information regarding eligibility for installation (replacement parts, repair, modification, etc.)

c) Direct Delivery Authorization (AMC No 1 to 21.133(b) and (c))

If the data is in support of a change or repair, then reference to the aircraft level approval should be given (make reference to the approved STC, change or repair).

Limitations/Remarks: state any information, either directly or by reference to supporting documentation that identifies any particular data or limitations (including specific importing requirements) needed by a production organization to complete Block 13 of CARC Form 227.

Approval: provide reference information related to the approval of the data (CARC document or DOA privilege).
Authorized signature: name and hand-written normal or electronic signature of a person who has written authority from the design organization, as indicated in the procedures agreed with CARC.

Subpart B-Type Certificates

GM 21.14(b) Eligibility for alternative procedures

Design organizations approved under Part 21 Subpart J should be the normal approach for type certification, supplemental type certification, approval of major changes to type design or approval of major repair design, except when agreed otherwise by CARC in accordance with 21.14, 21.112B and 21.432B. The acceptance of alternative procedures, as defined in AMC 21.14(b), should be limited where CARC finds it more appropriate for the conduct of type certification, supplemental type certification, and approval of changes to type design, approval of repair design.

AMC 21.14(b) Alternative Procedures

Alternative procedures are an acceptable means to demonstrate design capability in the cases described in 21.14, 21.112B or 21.432B. This concept is the implementation, in the context of specific projects, of procedures required in Subpart J DOA, to ensure that the applicant will perform relevant activities as expected by CARC, but without the requirements on the organization itself that can be found in Subpart J. The establishment of these alternative procedures may be seen as a starting phase for a Subpart J DOA, allowing at a later stage, at the discretion of the applicant, to move towards a full Subpart J DOA by the addition of the missing elements.

1. Scope

1.1 As alternative to DOA, a manual of procedures must set out specific design practices, resources and sequence of activities relevant for the specific projects, taking account of Part 21 requirements.

1.2 These procedures must be concise and limited to the information needed for quality and proper control of activities by the applicant/holder, and CARC.

2. Management of the (supplemental) type certification process

2.1 For a particular project, at the beginning of the process, the applicant must propose to CARC for acceptance a certification program that includes:

Part 1: Procedures for the management of the certification program: creation and update all along the certification process to integrate the progress of the activities, distribution. This part must also include the milestones of the project development up to the type certification or approval of the major change, with the minimum administrative delays imposed by CARC when necessary.

Part 2: The attribution of responsibilities, as follows:

- names of the persons having specific responsibilities in the frame of the certification program,
- the description of their tasks, responsibilities and associated competences
- Scope of authority of signatories.

Part 3: The airworthiness requirements applicable to the project, corresponding interpretations, and the equivalence of safety or other specific cases related to the applicable requirements.

Part 4: Working methods for showing of compliance and providing to CARC the means by which such compliance has been shown. This includes all or part of the following, depending on the complexity of the product:

- the means by which compliance will be shown (means of compliance), in relation with the requirements and/or their detailed interpretation,
- the technical criteria associated with the means of compliance,
- milestones specific to particular technical areas in relation with the general planning of the project,
- the decision process, especially the key points where CARC decision is needed before further action,
- the flow of information to CARC,
- the configuration control, especially of the test specimen used to show compliance,
- the organization of the work for the interfaces or multidisciplinary subjects,
- those compliance documents that will be subject to verification by CARC,
- the establishment of the compliance documentation, including the time schedule and availability to CARC,
- the control of the time schedule, for the accomplishment of the tasks in due time.

The applicant must submit all revisions of the certification program to CARC for acceptance.

2.2 The applicant must establish procedures for creating compliance documents in such a way that:

- the kind of document and the technical objectives for each document are determined at the beginning of the process,
- the production of the documents is carefully managed all along the process, in accordance with the milestones defined in the certification program,
- the various issues of a document are controlled.

Each document must contain:

- the reference of the requirements covered by the document,
- data showing compliance and a statement by the applicant declaring compliance with these requirements.

A numbering system to identify the compliance documents must be defined in order to have an adequate link with the certification program. Except as otherwise agreed with CARC, all compliance documents must be produced before issuance of the final statement of compliance required by 21.20(b) or 21.97(a)(3).

2.3 There are no privileges associated with alternative procedures, however CARC will decide on the extent of its involvement in the verification of compliance documents. This involvement may vary according to CARC knowledge of the applicant from previous and on-going activities and the resulting assessment of competence, and must be addressed in the certification program.

3. Management of design changes

3.1 Approval of changes to type design, repairs and production deviations from the approved design data.

The TC or STC applicant must provide procedures acceptable to CARC for classification and approval of changes to type design (see paragraphs 3.2 and 3.3), and repairs and production deviations from the approved design data (see paragraph 3.4).

3.2 Classification

3.2.1 Content

The procedure must address the following points:

- identification of changes to type design,
- airworthiness classification,
- changes to type design initiated by subcontractors,
- documents to justify the classification,
- authorized signatories.

Criteria used for classification must be in compliance with 21.91 and corresponding interpretations.

3.2.2 Identification of changes to type design

The procedure must indicate how the following are identified:

- major changes to type design,
- those minor changes to type design where additional work is necessary to show compliance with the airworthiness requirements,
- other minor changes to type design requiring no further showing of compliance.

3.2.3 Airworthiness classification

The procedure must show how the effects on airworthiness are analyzed, from the very beginning, by reference to the applicable requirements. If no specific requirements are applicable to the change, the above review must be carried out at the level of the part or system where the change is integrated and where specific requirements are applicable.

3.2.4 Control of changes to type design initiated by subcontractors

The procedure must indicate, directly or by cross-reference to written procedures, how changes to type design initiated by subcontractors are controlled.

3.2.5 Documents to justify the classification

All decisions of classification of changes to type design must be documented and approved by CARC. It may be in the format of meeting notes or register.

3.2.6 Authorized signatories

The procedure should identify the persons authorized to sign the proposed classification before release to CARC for approval.

3.3 Approval of changes to type design

3.3.1 Content

The procedure must address the following points:

- compliance documentation,
- approval process,
- authorized signatories.

3.3.2 Compliance documentation

For major changes and those minor changes to type design where additional work to show compliance with the applicable airworthiness requirements is necessary, compliance documentation must be established following guidelines of paragraph 2.2.

3.3.3 Approval process

a) For the approval of major changes to type design, a certification program as defined in paragraph 2.1 must be established.
b) For major changes and those minor changes to type design where additional work to show compliance with the applicable airworthiness requirements is necessary, the procedure should define a document to support the approval process. This document must include at least :

- identification and brief description of the change and its classification,
- applicable requirements,
- reference to the compliance documents,
- effects, if any, on limitations and on the approved documentation,
- authorized signatory.

c) For the other minor changes, the procedure must define a means:

- to identify the change,
- to present the change to CARC for approval.

3.3.4 Authorized signatories

The procedure must identify the persons authorized to sign the change before release to CARC for approval.

3.3.5 Repairs and production deviations from the approved design data

A procedure following the principles of paragraphs 3.2 and 3.3 must be established for the classification and approval of repairs and unintentional deviations from the approved design data occurring in production (concessions or non-conformance's). For repairs, the procedure must be

established in accordance with Part 21 Subpart M and associated acceptable means of compliance (AMC) or guidance material (GM).

4. Issue of information and instructions to owners

4.1 General

The information or instructions issued by a TC, STC, approval of changes to type design, approval of repair design holder are intended to provide the owners of a product with all necessary data to implement a change on the product, or a repair, or to inspect it. The information or instructions may be issued in a format of a Service Bulletin as defined in ATA 100 system, or in Structural Repair Manuals, Maintenance Manuals, Engine and Propeller Manuals, etc. The preparation of this data involves design, production and inspection. The three aspects should be properly addressed and a procedure should exist.

4.2 Procedure

The procedure should address the following points:

- Preparation,
- verification of technical consistency with corresponding approved change(s), repair(s) or approved data, including effectivity, description, effects on airworthiness, especially when limitations are changed,
- verification of the feasibility in practical applications.

The persons authorized to sign before release of information and instructions to CARC for approval should be identified in the procedure. The procedure should include the information or instructions prepared by subcontractors or vendors, and declared applicable to its products by the TC, STC, approval of changes to type design or approval of repair design holders.

4.3 Statement

The information and instructions should contain a statement showing CARC approval.

5. Obligations addressed in 21.44 (TC holder), 21.118A (STC holder) or 21.451 (repair design approval holder)

The applicant should establish the necessary procedures to show to CARC how it will fulfill the obligations required under 21.44, 21.118A or 21.451, as appropriate.

6. Control of design subcontractors

The applicant should establish the necessary procedures to show to CARC how it will control design subcontractors.

GM 21.16B Special Conditions

21.16B introduces 3 categories of Special Conditions:

a) Novel and unusual design features;
b) Unconventional use of product;
c) Service experience has shown that unsafe conditions may exist.

However, the need for a Special Condition based on in-service experience should be judged by using the following points as benchmarks:

- The words "unsafe conditions" are used in GM 21.3B (b) to justify the basis for an airworthiness directive.
- The words "continued safe flight and landing", according to AMC 25.1309, mean the capability for continued controlled flight and landing, possibly using emergency procedures, but without requiring exceptional pilot skill or strength. Some aircraft damage may be associated with a failure condition, during flight or upon landing.

GM 21.33 Investigation and Tests

The requirements of 21.33(a) should not preclude the applicant requesting CARC to make flight or other tests of particular aspects of the product during its development and before the type design is fully defined and a Declaration of Compliance can be issued for all the applicable certification specifications (CS). However in case of flight test the applicant should have performed subject tests before CARC tests and should ensure that no features of the product preclude the safe conduct of the evaluation requested. CARC may require repeating any such tests once the type design is fully defined to ensure that subsequent changes have not adversely affected the conclusions from any earlier evaluation. A statement of compliance with sub-paragraph 21.33(b) is also required for the above tests.

GM 21.35 Flight Tests

Detailed material on flight testing is included in the applicable CS.

GM 21.35(b) (2) Objective and Content of Function and Reliability Testing

1. OBJECTIVE

The objective of this testing is to expose the aircraft to the variety of uses, including training, that are likely to occur when in routine service to provide an assurance that it performs its intended functions to the standard required for certification and should continue to do so in service.

2. CONTENT OF FUNCTION AND RELIABILITY TESTING

The testing should cover both routine operations and some simulation of abnormal conditions. The details of the program should be agreed with CARC prior to commencement of testing. It may be possible to combine this testing with any required to show compliance with the applicable CS. This will be agreed on a case-by-case basis with CARC.

Where possible, testing conditions should be defined with the co-operation of an operator. A substantial proportion of the flying should be on a single aircraft. The flying should be carried out to a continuous schedule on an aircraft that is very close to the final type design, operated as though it were in service and should include a range of representative ambient operating conditions and airfields.

GM 21.35(f) (1) Flying Time for Function and Reliability Testing

All flying carried out with engines and associated systems not significantly different from the final type-certificate standard may count towards the 300 hours airframe flight time required by 21.35(f) (1). At least 150 of the 300 flying hours should be conducted on a dedicated production configured aircraft. The requirement for 300 hours relevant flight time whenever a new turbine engine is incorporated applies regardless of whether the airframe/engine combination is subject to a new type-certificate or is to be certificated as a change or supplement to an existing type-certificate.

GM 21.35(f) (2) Flying Time for Function and Reliability Testing

All flying carried out on an aircraft not significantly different from the final type design may count towards the 150 hours airframe flight time required by 21.35(f) (2).

Subpart C
(Reserved)

Subpart D- Changes to type-certificates

GM 21.91 Classification of changes to a type design

1. PURPOSE OF CLASSIFICATION

Classification of changes to a type design into MAJOR or MINOR is to determine the approval route to be followed in Part 21 Subpart D, i.e., either 21.95 or 21.97, or alternatively whether application and approval has to be made in accordance with Part 21 Subpart E.

2. INTRODUCTION

2.1 Para. 21.91 propose criteria for the classification of changes to a type design as minor and major.

(i) This GM is intended to provide guidance on the term appreciable effect affecting the airworthiness of the product from 21.91, where "airworthiness" is interpreted in the context of a product in conformity with type design and in condition for safe operation. It provides complementary guidelines to assess a design change in order to fulfill the requirements of 21.91 and 21.117 where classification is the first step of a procedure.

Note: For classification of Repairs see GM 21.435.

(ii) Although this GM provides guidance on the classification of major changes, as opposed to minor changes as defined in 21.91, the GM and 21.91are deemed entirely compatible.

2.2 For a TSO authorization, 21.611 give specific additional requirements for design changes to TSO articles.
For APU, this GM should be used.

3. ASSESSMENT OF A DESIGN CHANGE FOR CLASSIFICATION

3.1 Changes to the type design

JCAR 21.31 defines what constitutes the type design. Alteration to any of the data included within the scope of 21.31 is considered a change to the type design.

3.2 Classification Process (see attached diagram)

JCAR 21.91 requires all changes to be classified as either major or minor, using the criteria of 21.91 and the complementary guidance of paragraph 3.3.

On some occasions, the classification process is initiated at a time when some data necessary to make a classification decision are not yet available. Therefore, the applicant should wait for availability of data before making a decision.

Wherever there is doubt as to the classification of a change, CARC should be consulted for clarification.

When the strict application of the paragraph 3.3 criteria results in a major classification, the applicant may request re-classification, if justified, and CARC could take the responsibility in re-classifying the change.

A simple design change planned to be mandated by an airworthiness directive may be reclassified minor due to the involvement of CARC in the continued airworthiness process.

Reasons for a classification decision should be recorded.

3.3 Complementary guidance for classification of changes.

A change to the type design is judged to have an "appreciable effect on other characteristics affecting the airworthiness of the product" and therefore should be classified major, in particular but not only, when one or more of the following conditions are met:

(i) Where the change requires an adjustment of the type-certification basis (such as special condition, equivalent safety finding, elect to comply, exemption, reversion, later requirements).
(ii) Where the applicant proposes a new interpretation of the requirements used for the type type-certification basis, that has not been published as AMC material or otherwise agreed with CARC.
(iii) Where the demonstration of compliance uses methods that have not been previously accepted as appropriate for the nature of the change to the product or for similar changes to other products designed by the applicant.
(iv) Where the extent of new substantiation data necessary to comply with the applicable airworthiness requirements and the degree to which the original substantiation data has to be re-assessed and re-evaluated is considerable.
(v) The change alters the Airworthiness Limitations or the Operating Limitations.
(vi) The change is made mandatory by an airworthiness directive or the change is the terminating action of an airworthiness directive (ref. 21.3B). See note 1.
(vii) Where the change introduces or affects functions where the failure effect is classified catastrophic or hazardous.

Note 1: The design change previously classified minor and approved prior to the airworthiness directive issuance decision needs no re-classification. However, CARC retains the right to review the change and re-classify/re-approve if found necessary.

Note 2: These above conditions are an explanation of the criteria noted in 21.91.

For an understanding of how to apply the above conditions it is useful to take note of the examples given in Appendix A to GM 21.91.

Appendix A to GM 21.91: Examples of Major Changes per discipline

The information below is intended to provide a few major change examples per discipline, resulting from application of 21.91 and paragraph 3.3 conditions. It is not intended to present a comprehensive list of all major changes. Examples are categorized per discipline and are applicable to all products (aircraft, engines and propellers). However a particular change may involve more than one discipline, e.g., a change to engine controls may be covered in engines and systems (software).

Those involved with classification should always be aware of the interaction between disciplines and the consequences this will have when assessing the effects of a change (i.e., operations and structures, systems and structures, systems and systems, etc.; see example in paragraph 2 (ii).

Specific rules may exist which override the guidance of these examples.

In the Part 21 a negative definition is given of minor changes only. However in the following list of examples it was preferred to give examples of major changes.
Where in this list of examples the words “has effect” or “affect(s)” are used, they have always to be understood as being the opposite of “no appreciable effect” as in the definition of minor change in 21.91. Strictly speaking the words “has appreciable effect” and “appreciably affect(s)” should have been used, but this has not been done to improve readability.

1. Structure

(i) changes such as a cargo door cut-out, fuselage plugs, change of dihedral, addition of floats;
(ii) changes to materials, processes or methods of manufacture of primary structural elements, such as spars, frames and critical parts;
(iii) changes that adversely affect fatigue or damage tolerance or life limit characteristics;
(iv) changes that adversely affect aeroelastic characteristics.

2. Cabin Safety

(i) changes which introduce a new cabin layout of sufficient change to require a reassessment of emergency evacuation capability or which adversely affect other aspects of passenger or crew safety. Items to consider include, but are not limited to:

- changes to or introduction of dynamically tested seats.
- change to the pitch between seat rows.
- change of distance between seat and adjacent obstacle like a divider.
- changes to cabin lay outs that affect evacuation path or access to exits.
- installation of new galleys, toilets, wardrobes, etc.
- installation of new type of electrically powered galley insert.

(ii) changes to the pressurization control system which adversely affect previously approved limitations.

3. Flight

(i) Changes which adversely affect the approved performance, such as high altitude operation, brake changes that affect braking performance.
(ii) Changes which adversely affect the flight envelope.
(iii) Changes which adversely affect the handling qualities of the product including changes to the flight controls function (gains adjustments, functional modification to software) or changes to the flight protection or warning system.

4. Systems

For systems assessed under CS 25.1309, the classification process is based on the functional aspects of the change and its potential effects on safety.

(i) Where failure effect is 'Catastrophic' or 'Hazardous', the change should be classified as major.
(ii) Where failure effect is 'major', the change should be classified as major if:

- aspects of the compliance demonstration use means that have not been previously accepted for the nature of the change to the system; or
- the change affects the pilot/system interface (displays, controls, approved procedures); or
- the change introduces new types of functions/systems such as GPS primary, TCAS, Predictive windshear, HUD.

The assessment of the criteria for software changes to systems also needs to be performed. When software is involved, account should be taken also of the following guidelines:

Where a change is made to software produced in accordance with the guidelines of EUROCAE ED12B/RTCA DO-178B "Software Considerations in Airborne Systems and Equipment Certification", the change should be classified as major if either of the following applies, and the failure effect is Catastrophic, Hazardous or Major:

(1) the executable code for software, determined to be Level A or Level B in accordance with the guidelines, is changed unless that change involves only a variation of a parameter value within a range already verified for the previous certification standard; or
(2) the software is upgraded to or downgraded from Level A, Level B or Level C; or
(3) the executable code, determined to be level C, is deeply changed, e.g., after a software reengineering process accompanying a change of processor.

For software developed to guidelines other than ED-12B/DO-178B, the applicant should assess changes in accordance with the foregoing principles.

For other codes the principles noted above may be used. However, due consideration should be given to specific requirements/interpretations.

5. Propellers

Changes to:

(i) Diameter,
(ii) Airfoil,
(iii) Planform
(iv) Material
(v) blade retention system, etc.

6. Engines

Changes:

(i) that adversely affect operating speeds, temperatures, and other limitations.
(ii) that affect or introduce parts identified by CS E-510 where the failure effect has been shown to be hazardous.
(iii) that affect or introduce engine critical parts (CS E-515) or their life limits.
(iv) to a structural part which requires a re-substantiation of the fatigue and static load determination used during certification.
(v) to any part of the engine which adversely affects the existing containment capability of the structure.
(vi) that adversely affect the fuel, oil and air systems, which alter the method of operation, or require reinvestigation against the type-certification basis.
(vii) that introduce new materials or processes, particularly on critical components.

7. Rotors and drive systems

Changes that:

(i) Adversely affect fatigue evaluation unless the service life or inspection interval are unchanged. This includes changes to materials, processes or methods of manufacture of parts, such as

- rotor blades
- rotor hubs including dampers and controls
- gears
- drive shafts
- couplings

(ii) affect systems the failure of which may have hazardous or catastrophic effects. The design assessment will include:

- cooling system
- lubrication system
- rotor controls

(iii) Adversely affect the results of the rotor drive system endurance test, the rotor drive system being defined in CS 27/29-917.

(iv) adversely affect the results of the shafting critical speed analysis required by CS 27/29-931.

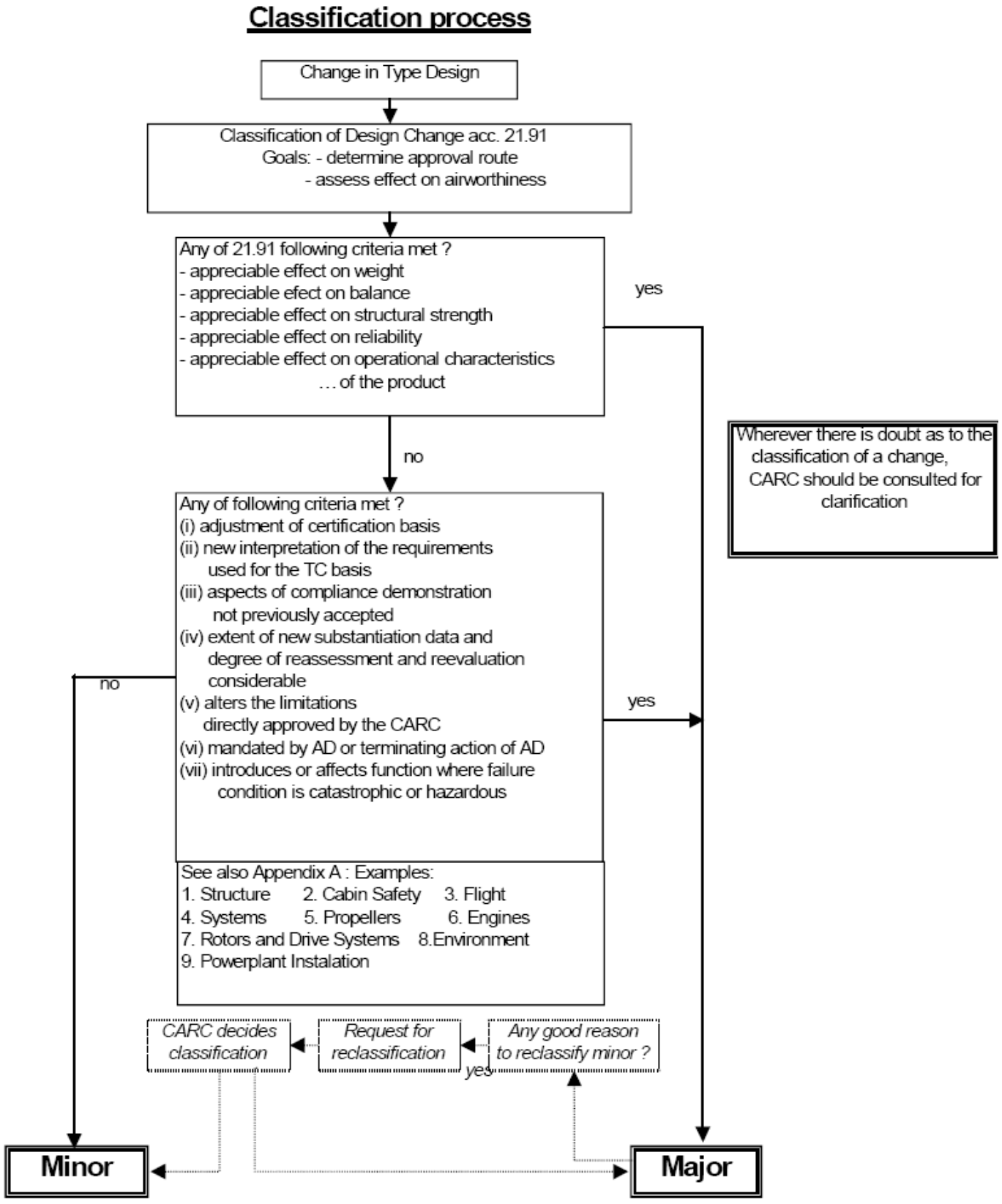
8. Environment

A change that introduces an increase in noise or emissions.

9. Power plant Installation

Changes which include:

(i) control system changes which affect the engine/propeller/airframe interface;
(ii) new instrumentation displaying operating limits;
(iii) modifications to the fuel system and tanks (number, size and configuration);
(iv) change of engine/propeller type.


Classification process
Change in Type Design
Classification of Design Change acc. 21.91
Goals: - determine approval route
- assess effect on airworthiness
Any of 21.91 following criteria met ?
- appreciable effect on weight
- appreciable efect on balance
- appreciable effect on structural strength
- appreciable effect on reliability
- appreciable effect on operational characteristics
… of the product
yes
no
Wherever there is doubt as to the classification of a change, CARC should be consulted for clarification
Any of following criteria met ?
(i) adjustment of certification basis
(ii) new interpretation of the requirements used for the TC basis
(iii) aspects of compliance demonstration not previously accepted
(iv) extent of new substantiation data and degree of reassessment and reevaluation considerable
(v) alters the limitations directly approved by the CARC
(vi) mandated by AD or terminating action of AD
(vii) introduces or affects function where failure condition is catastrophic or hazardous
no
yes
See also Appendix A : Examples:
1. Structure 2. Cabin Safety 3. Flight
4. Systems 5. Propellers 6. Engines
7. Rotors and Drive Systems 8.Environment
9. Powerplant Instalation
CARC decides classification
Request for reclassification
Any good reason to reclassify minor ?
yes
Minor
Major

GM 21.93(b) Major Changes: Application

Identification of re-investigations necessary to show compliance does not mean the showing of compliance itself, but the list of affected type design requirement paragraphs for which a new demonstration is necessary, together with the means (calculation, test or analysis) by which it is proposed to show compliance.

GM 21.101 Establishment of the type-certification basis of Changed Aeronautical Products

1. PURPOSE

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

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

2. APPLICABILITY

This GM is applicable to all major changes to type design of aircraft, engines and propellers. For the purposes of this GM an application for a change to a type-certificate (type design) described in 21.101(a) and 21.90 is considered as an application for a major change. Minor changes as defined in 21.91 are considered to have no appreciable effect on airworthiness and are therefore by definition not significant. This GM applies equally to applications made for type-certificates amendments, supplemental type-certificates, or amended supplemental type-certificates.

This GM is also applicable to all significant changes to aircraft (other than rotorcraft) of 2722 kg (6,000 lbs.) or less maximum weight, or to a non-turbine rotorcraft of 1361 kg (3,000 lbs.) or less maximum weight. Unless CARC finds the change significant in an area, an applicant may show that the changed product complies with the requirements incorporated in the type-certificate.

3. RELATED PART 21 PARAGRAPHS

a) 21.16B Special Conditions,
b) 21.17 Type-certification basis,
c) 21.19 Changes requiring a new type-certificate,
d) 21.91 Classification of changes in type design,
e) 21.101 Applicable CS and environmental protection requirements.

4. EXPLANATION OF TERMINOLOGY

The following is a summary of the terminology used throughout this advisory or guidance material. Further explanations of some of these terms can be found in paragraphs 5, 6, 7, and 8.

a) Type-certification basis: the applicable airworthiness codes as established in 21.17 and 21.101, as appropriate, special conditions, equivalent level of safety findings; and exemptions applicable to the product to be certificated.

Note: This GM is not intended for determining the applicable aircraft noise, fuel venting and engine emissions requirements for changed products.

b) Earlier requirements: the requirements in effect prior to the date of application for the change, but not prior to the existing type-certification basis.
c) Existing type-certification basis: the requirements incorporated by reference in the type-certificate of the product to be changed.
d) Latest requirements: the requirements in effect on the date of application for the change.
e) Previous relevant design changes: previous design changes, the cumulative effect of which could result in a product significantly or substantially different from the original product or model, when considered from the last time the latest requirements were applied.
f) Product level change: a change or combination of changes that makes the product distinct from other models of the product (e.g., range, payload, speed). Product level change is defined at the aircraft, engine or propeller level of change.
g) Significant change: a product level change to the type-certificate to the extent that it changes one or more of the following: general configuration; principles of construction; or the assumptions used for the certification criteria, but not to the extent to be considered a substantial change. Not all product level changes are significant.
h) Substantial change: a product level design change which is so extensive that a substantially complete investigation of compliance with the applicable requirements is required, and consequently a new type-certificate, in accordance with 21.19.

5. GENERAL OVERVIEW OF 21.101

a) 21.19 specifies changes that require a new type-certificate. When a new type-certificate is required, 21.17 specifies the applicable type-certification basis for the changed product.
b) When an application for a new type-certificate is not required by 21.19, 21.101 defines the designation of applicable requirements for determining the type-certification basis for the changed product.
c) 21.101(a) requires a change to a type-certificated product to comply with the latest requirements, unless the change meets the criteria for the exceptions identified in 21.101(b) and (c). The type-certification basis should not be dependent on whether the holder of a type

certificate or an applicant for a supplemental type-certificate is originating the change. Where compliance with a later amendment for a significant change does not contribute materially to the level of safety, would be impractical, or is in an area not affected by the change, the applicant may comply with earlier requirements. However the applicant may not use requirements prior to those specified by the existing type-certification basis.

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

e) 21.101(b) (1) allows the applicant to show compliance with an earlier amendment when CARC determines the change is not significant. 21.101(b)(1)(i) and (ii) pertains to changes that meet the automatic criteria where the change is significant. 21.101(b)(2) and (b)(3) allows the use of earlier requirements for significant changes for areas of the product not affected by the change and for cases where compliance to the latest requirements would not contribute materially to the level of safety or would be impractical. Note that earlier amendments may not precede the corresponding requirement incorporated in the type-certificate.

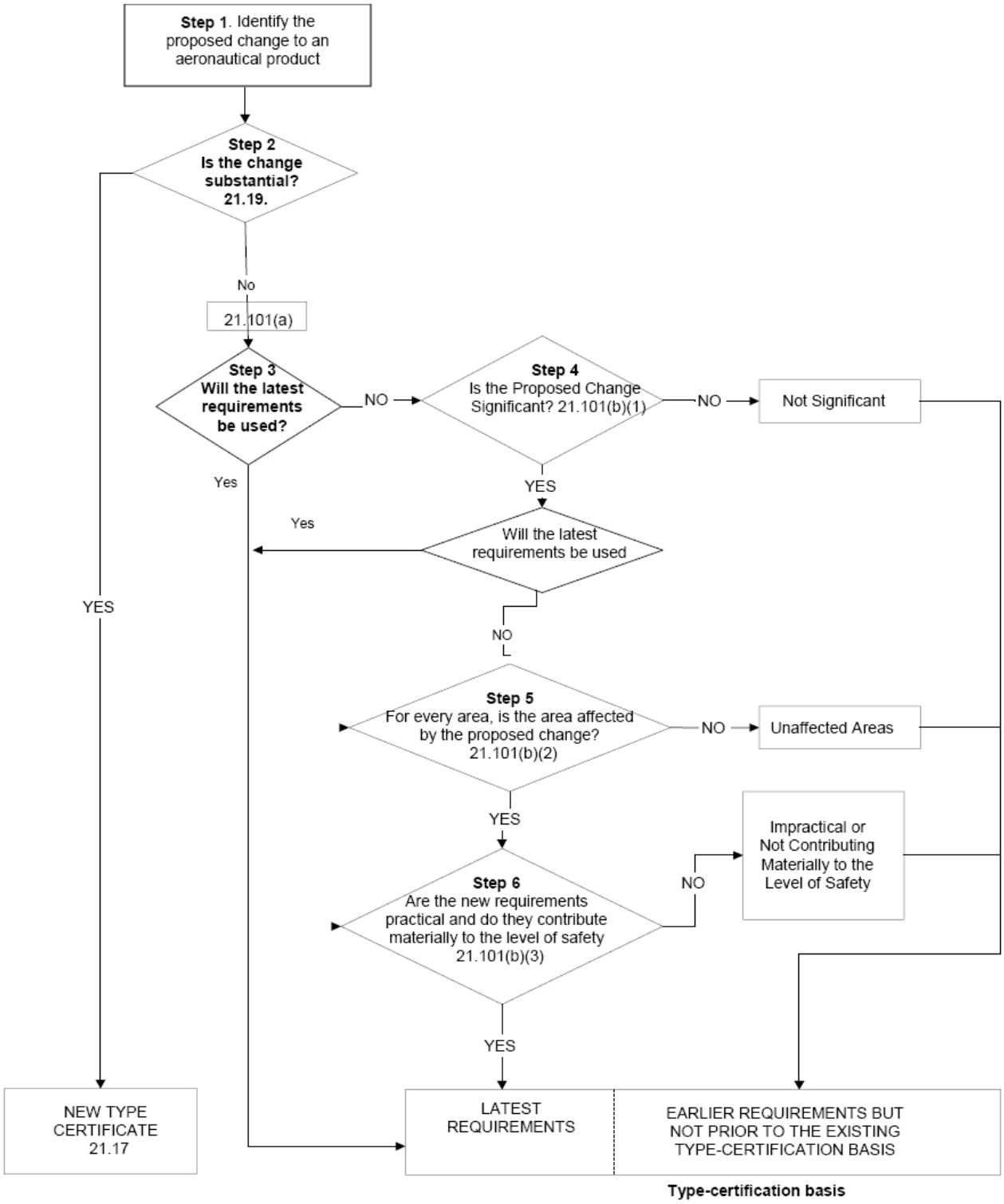
f) 21.101(c) provides an exception to the requirements of 21.101(a). An applicant for a change to an aircraft (other than rotorcraft) of 2 722 kg (6 000 lbs) or less maximum weight, or to a non-turbine rotorcraft of 1 361 kg (3 000 lbs) or less maximum weight may show that the changed product complies with the type-certification basis incorporated by reference in the type-certificate. The applicant may elect to comply with the later requirements. If CARC finds that the change is significant in an area, CARC may designate compliance with a later amendment to the requirements incorporated by reference in the type-certificate that applies to the change and any requirement CARC finds is directly related. Reference paragraph 9.

g) 21.101(d) provides for the use of special conditions as prescribed under 21.16B when the existing type-certification basis or the latest requirements do not provide adequate standards with respect to the proposed change.

h) 21.101(e) prescribes the effective period an application to remain valid for a change to a type certificate, which is consistent with the requirements of 21.17 for a new type-certificate.

i) Figure 1 provides a flowchart of the process to determine the applicable type-certification basis for a proposed design change under 21.101, following a determination that the proposed design change is not substantial under 21.19.

Figure 1: Establishing the type-certification basis for changed products



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

Note 2: For excepted products under 21.101(c) see paragraph 9. For special conditions under 21.101(d) see paragraph 10.

6. Establishing the type-certification basis for changed products, 21.101(b)(1).

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

Classifications of typical changes are provided in the tables of Appendix 1 to GM 21.101. For instructions on how to use Appendix 1 to GM 21.101 tables, proceed to step 4 below. In cases where the classification in Appendix 1 is not applicable or immediately obvious for the proposed change, the following steps should be used in conjunction with Figure 1 to determine the appropriate type-certification basis for the changed product.

Step 1 of Figure 1: Identify the Proposed Change to an Aeronautical Product.

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

For each change, it is important that the effects of the change on other systems, components, equipment, or appliances of the product are properly assessed. The characteristics affected by the change are not only physical changes. The intent is to encompass all aspects where there is a need for re-evaluation, that is, where the substantiation presented for the product being changed should be reviewed, updated, or rewritten. All other areas of the aircraft are considered to be unchanged or not affected by the change.

Step 2 of Figure 1: Is the Change Substantial?

21.19 requires that an applicant obtain a new type-certificate for a changed product if the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable requirements is required. A new type certificate could be required for either an extensive change to a previously type-certificated product or for a new design derived through a series of design changes from a previously type-certificated product. The need for a new type-certificate may be obvious when the change is first considered or may need a more extensive evaluation through application of 21.101.

A "substantially complete investigation" of compliance is required when most of the existing substantiation is not applicable to the changed product. The question of whether a change is substantial should be addressed at the beginning of the process. However, if at any point while developing the type-certification basis, it becomes clear that the proposed change is a substantial change, the process ceases to be an amendment process under Part 21 Subpart D and becomes a new type-certification process under Part 21 Subpart B.

If it is not initially clear that a new type-certificate is required, Appendix 1 to GM 21.101 provides some examples of substantial changes to aid in this classification.

In considering the above, a substantial change will require a new type-certificate; 21.19 applies. If the change is not substantial, 21.101 applies.

Step 3 of Figure 1: Will the Latest Requirements Be Used?

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

Step 4 of Figure 1: Is the Proposed Change Significant? 21.101(b) (1)

Significant changes are product level changes and by their very nature, distinct from the vast majority of major changes. In general, these changes are either the result of an accumulation of changes or occur through an isolated extensive major change rising to the product level that makes the changed product distinct from others. Additionally, 21.101(b)(1) defines a significant change based on whether or not one or more of three automatic criteria applies:

(1) the general configuration is not retained,
(2) the principles of construction are not retained, and
(3) the assumptions used for certification of the product do not remain valid.

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

The applicant may use the tables in Appendix 1 to GM 21.101 and the criteria described in paragraph 7 as guidance to make the classification of significance.

Previous relevant design changes of the product 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, either singularly or collectively, the cumulative effect of previous relevant design changes should be considered. These design changes may have been incorporated through earlier changes in the type-certificate on areas related to the current proposed change and the associated areas, systems, components, equipment, or appliance. The collective result may be a product considerably different from the latest updated type certification basis for the product or model. Two examples of previous relevant aeroplanes design changes address those incremental increases in weight or thrust that, while individually not significant (e.g., 2%, 4%, 5% discrete increases), can, through a series of changes, achieve a significant product level change.

The assessment of a proposed design change together with any previous relevant design changes is based on whether any of the three automatic criteria are triggered. 21.101(b) states that changes that meet one of the three criteria are automatically considered significant. The examples of significant and not significant changes in Appendix 1 to GM 21.101 are predicated upon more than 10 years international certification experience. The concept of having only three criteria fits these examples and is therefore considered that no other criteria apply. Therefore, only when one or more of the three criteria is affected is the design change considered significant. The starting point to begin accumulating previous relevant design changes is the time the latest applicable requirements were applied in the affected area, system, component, equipment, or appliance.

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

7. USING THE CRITERIA TO DETERMINE SIGNIFICANCE (21.101(b)(1)(i) and (ii)) (Step 4):

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

b. The following definitions build upon the criteria identified in Part 21and provide additional guidance on how to apply the criteria when classifying product level changes. In cases of doubt, and to ensure a consistent outcome, the applicant is encouraged to seek the advice of the CARC.

(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 is likely to require a new model designation because of the need to distinguish the different product with other product models, e.g., performance, interchangeability of major components, etc.

(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 affects the overall product's operating characteristics or inherent strength and would require extensive re-investigation to show compliance.

(3) Changes That Invalidate the Assumptions Used for Certification (Significant Change to the Assumptions Used for Certification)

A change to the product level assumptions associated with the compliance demonstration, performance, or operating envelope that by itself is so different that the original assumptions are invalidated.

Examples may include:

(a) Change of an aircraft from an unpressurised to pressurized fuselage,
(b) Change of operation of a fixed wing aircraft from land based to water based, and
(c) Operation envelope expansions that are outside the existing design parameters and capabilities.

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

NOTE: The word "assumptions" in 21.101 bears a meaning different from CS E-30 and CS P-30. CS-E and CS-P address the conditions that may be imposed on the engine or propeller when it is eventually installed in the aircraft and are published in the installation manual.

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

d. Appendix 1 includes tables of typical changes for large aeroplanes, small aeroplanes, rotorcraft, and engines/propellers that meet the definition of significant change for each product line. The appendix also includes typical changes that do not achieve the significant level. The tables may be used in one of two ways:

(1) To classify a proposed change that is listed in the table, or
(2) In conjunction with the three automatic criteria, to help classify a proposed change not listed in the table.

e. If, based on Appendix 1 and/or the automatic criteria, the change is classified as:

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

(2) Not significant (21.101(b) (1).The applicable requirements are those contained in the existing type-certification basis. The applicant may elect to comply with later amendments.

Note: In cases where no regulatory standards are defined in the existing type-certification basis for the design change but applicable regulatory standards exists in a subsequent amendment to the requirements, the subsequent amendment will be made part of the type-certification basis.

f. Making the Classification A classification of significant or not significant can be made (the application of 21.101(b)) in one of two ways;

(1) By the CARC agreeing to appropriate controls and procedures that enables the applicant to make a declaration of not significant. In all cases the CARC retains the option to become involved. An appropriate declaration by the applicant to the CARC would be acceptable for this purpose.

(2) By the CARC accepting the determination of significance relevant to a major modification based on the applicant's submission.

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

8. SHOWING COMPLIANCE WITH AN EARLIER REQUIREMENT, 21.101(b) (2) and (3)

a. For a design change that has been determined to be significant, 21.101(b)(2) and (3) provide the exceptions from the requirement of 21.101(a) to meet the latest requirements for design changes.

b. 21.101(b)(2) and (3) identify conditions under which an applicant may show that the changed product complies with an earlier amendment level or with the existing type-certification basis and, therefore, would not be required to comply with latest requirements. The earlier amendment level with which the applicant intends to show compliance may not precede the corresponding requirements in the existing type-certification basis. An applicant may elect to show compliance with an earlier amendment level or with the existing type-certification basis for areas not affected by the change, and areas affected by the change for which compliance with the latest requirements would not contribute materially to the level of safety or would be impractical. It is incumbent upon the applicant to demonstrate to the CARC that compliance with the latest requirements does not materially contribute to the level of safety, or is impractical.

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

Step 5 of Figure 1; for every area, is the area affected by the proposed change? 21.101 (b)(2).

a. A “not affected area” is any area, system, component, equipment, or appliance that is not affected by the proposed product level change. For a product level change, it is important that the effects of such change on other systems, components, equipment, or appliances of the product are properly assessed because areas that have not been changed may be affected. If the significant change does not affect the area, then the type-certification basis for that area need not be revisited.
b. In assessing not affected areas, it may be necessary to identify secondary changes resulting from a product level change. The secondary changes may be changes in both physical aspects and/or performance characteristics that are not part of, but consequential to, the overall product level change. Secondary changes may be evaluated to the existing type-certification basis for the product being changed; however, care should be taken to ensure that affected areas are not overlooked. The intent is to encompass all aspects where there is a need for re-evaluation.
c. The following aspects of a product level change should be considered:

   (1) Physical aspects. The physical aspects include, but are not limited to, structures, systems, equipment, components and appliances (physical aspects can cover both "hardware" and "software"). When evaluating the physical aspects, it is necessary to make a distinction between the product level change and the resulting secondary effects. An example of a secondary effect may be the lengthening and re-routing of the various aeroplane circuits as a result of the fuselage plug.
   (2) Performance/functional characteristics. The less obvious aspect of the word "areas" covers general characteristics of the type-certificated product such as performance features, handling qualities, emergency provisions, fire protection, structural integrity, aero elastic characteristics, or crashworthiness. These characteristics may be affected by a product level change. For example, adding a fuselage plug could significantly affect performance and handling qualities

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

Step 6 of Figure 1; Are the new requirements practical and/or do they contribute materially to the level of safety, 21.101(b) (3)?

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

(1) 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 additional seats, bins, extended lower cargo hold and structural plug may be identical to the existing parts. Applying the latest requirements only to the changed parts may not contribute materially to the level of safety, as the entire design as modified may not necessarily be any safer than the original design. It also may be inappropriate to require compliance to the latest requirements for the entire fuselage, seats, bins, doors and cargo holds. For this reason, compliance of the new fuselage structure, seats, bins and cargo hold area with the requirements in effect when the original fuselage, seats, bins and cargo hold area were certified may be acceptable.

(2) However, the extent of the fuselage change may be large relative to the original certificated structure, seats, bins, doors and cargo compartment, and/or the change may require a new compliance substantiation that is comparable with that required for a new model aeroplane. Here, it would be expected that the proposed type-certification basis would encompass the requirements in effect at the date of application for the entire fuselage, seats, bins, doors and cargo hold.
In the example above, it would be incumbent upon the applicant to show that compliance with the latest requirements does not materially contribute to the level of safety.

(3) Service experience

(a) This provision permits the use of relevant service experience, such as fleet hours, to demonstrate that compliance with the latest requirements would not contribute materially to the level of safety, and as such the use of earlier requirements may be appropriate. Appendix 3 provides additional guidance on the use of service experience, along with examples.

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

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

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

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

(1) Substantiating data and analyses must support an applicant's position that compliance is impractical, and the CARC must agree with this position. In evaluating an applicant's position and substantiating data regarding impracticality the CARC may consider other factors (e.g., the costs and safety benefits for a comparable new design.
(2) A review of transport category projects showed that in certain cases, where an earlier amendment to applicable requirements was allowed, design changes were made to nearly comply with the latest amendments. In these cases the applicant successfully demonstrated that full compliance would require a substantial increase in the outlay of resources with a very small increase in the level of safety. These cases reflect an appropriate application of "impracticality" to a changed product.
(3) A proposal that a product design change would be impractical would be used, in most cases, where compliance with the latest requirements would contribute materially to the level of safety, but this contribution may not be commensurate with the associated resource expenditures.
(4) Appendix 2 to GM 21.101 provides additional guidance and examples for determining impracticality.

c. This completes the step by step process used in the determination of the type-certification basis for the changed product.

9. EXCEPTED PRODUCTS UNDER 21.101(c)

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

b. For a change that contains new design features that are novel and unusual, the CARC will designate the applicable special conditions at the appropriate amendment level beginning with the existing type-certification basis and progress to the most appropriate later amendment level for the change. For a change that contains new features, which are not covered in the existing type-certification basis, the CARC will designate the applicable airworthiness requirements at the appropriate amendment level, beginning with the existing type-certification basis and progress to the most appropriate later amendment level for the change.
c. The exception for products under 21.101(c) applies at the aircraft level only. Design changes to engines and propellers installed on these excepted aircraft are assessed as separate products using 21.101(a) and (b).

10. SPECIAL CONDITIONS, 21.101(d)

21.101(d) allows for the application of special conditions, or for changes to existing special conditions, to address the changed design. The objective is to achieve, for the significant change, a level of safety consistent with that provided by the requirements in effect on the date of application for the design change. The application of special conditions to a design change is not in itself a reason for it to be classified as either a substantial change or a significant change. When the change is not significant, the Special Conditions should be consistent with the agreed type-certification basis.

11. EFFECTIVE PERIOD FOR AN APPLICATION TO CHANGE A TYPE-CERTIFICATE, 21.101(e)

21.101(e) is intended to ensure that, at the time the changed product is certificated, no longer than three or five years, as appropriate to the product, has elapsed from the date of application. This is to ensure that the type-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 prescribes the process of updating the type-certification basis if these limits are exceeded.

12. DOCUMENTATION

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

Appendix 1 to GM 21.101: CLASSIFICATION OF CHANGES

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

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

b) The columns "Change to General Configuration", "Change to Principles of Construction" and "Assumptions of Certification" reflect the automatic criteria of 21.101(b)(1)(i) and (ii). The "Notes" column provides typical rationales that are considered in evaluating the designation of the criteria.
c) The tables may be used in one of two ways:

(i) to classify a proposed change that is listed in the table, or
(ii) in conjunction with the three automatic criteria, to understand the logic used in the table to help classify a proposed change not in the table.

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

Figure 1. Table of examples of changes for Small Aeroplanes:

The following are examples of substantial changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Change in wing location (tandem, forward, canard, high/low)	Yes	No	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Fixed wing to tilt wing	Yes	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Increase in the number of engines from one to two	Yes	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Replacement of piston or turbo-prop engines with turbojet or turbofan engines	Yes	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Change in engine configuration (tractor to pusher)	Yes	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Change from an all metal airplane to all composite primary structure (fuselage, wing, empennage).	No	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.

Increase from subsonic to supersonic flight regime	Yes	No	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.

The following are examples of significant changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 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 re-investigation. Requires new AFM to address performance and flight characteristics.
Changes in wing configuration (addition of tail strakes or change in dihedral, or changes in wing span, flap or aileron span, angle of incidence of the tail, addition of winglets, or wing sweep of more than 10%	Yes	No	Yes	Change in general configuration. Likely requires extensive changes to wing structure. Requires new AFM to address performance and flight characteristics. Note: Small changes to wingtip are not significant changes. See table for not significant changes.
Tricycle / tailwheel undercarriage change or addition of floats	Yes	No	No	Change in general configuration. Likely, at airplane level, general configuration and certification assumptions remain valid.
Increase in seating capacity resulting in a different certification category (e.g., from normal to commuter category where configuration or principles of construction changes or assumptions do not remain valid.	Yes	Yes	Yes	Change in general configuration. Change in principles of construction. Requires extensive construction reassessment. Change in certification assumptions. Requires new AFM and pilot type rating.
Passenger to freighter configuration	Yes	No	Yes	Change in general configuration

conversion which involves the introduction of a cargo door or an increase in floor loading of more than 20%, or provision for carriage of passengers and freight together				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.
Addition of a turbo-charger that changes the power envelope, operating range, or limitations appreciably.	No	No	Yes	Invalidates certification assumptions due to changes in operating envelope and limitations. Requires new AFM to address performance and flight characteristics.
The replacement of an engine of higher rated power or increase thrust would be considered significant if it would invalidate the existing substantiation, or would change the primary structure, aerodynamics, or operating envelope sufficiently to invalidate the assumptions of certification	No	Yes	Yes	Invalidates certification assumptions. Requires new AFM to address performance and flight characteristics. Likely changes to primary structure. Requires extensive construction reinvestigation.
A change in the type of material, such as composites in place of metal (or one composite fiber material system with another (e.g., carbon for fiberglass), for primary structure would normally be	No	Yes	Yes	Change in principles of construction and design from conventional practices . Likely change in design/certification assumptions.

assessed as a significant change.				
Change involving appreciable increase in design speeds V_d, Vmo, Vc, or Va	No	Yes	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
STOL kit	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
A change in the rated power or thrust is likely to be regarded as significant if the design speeds are thereby changed so that compliance needs to be re-justified with a majority of requirements.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
Fuel state: such as compressed gaseous fuels, or fuel cells. This could completely alter the fuel storage and handling systems and possibly affect the aeroplane structure.	No	No	Yes	Changes in design/certification assumptions. Extensive alteration of fuel storage and handling systems.
A design change that alters the aircraft flight characteristics or performance from the type design would normally be significant if it appreciably changes the kinematics or dynamics of the aeroplane.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.
Weight increase which places the aircraft into the commuter category (i.e., above 12500 lbs.)	No	No	Yes	Certification assumptions invalidated. Requires new AFM.
A change in the flight control concept for an aircraft, for example to fly by wire (FBW) and side-stick control, or a change from hydraulic to electronically actuated flight controls, would in	No	No	Yes	Changes in design and certification assumptions. Requires extensive systems architecture and integration re-investigation. Requires new AFM.

isolation normally be regarded as a significant change.				
Addition of cabin pressurization	No	Yes	Yes	Extensive airframe changes affecting load paths, fatigue evaluation, aero elastic characteristics, etc. Requires extensive construction re-investigation. 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.
A change in the required number of flight crew, which necessitates a complete cockpit re-arrangement, and/or an increase in pilot workload would be a significant change.	No	No	Yes	Extensive changes to avionics and aircraft systems. Invalidates certification assumptions. Requires new AFM.
An appreciable expansion of an aircraft's operating envelope or operating capability would normally be a significant change. e.g., an increase in maximum altitude limitation, approval for flight in known icing conditions, an increase in airspeed limitations	No	No	Yes	Invalidates certification assumptions. Requires new AFM to address performance and flight characteristics.
A major flight deck upgrade	No	No	Yes	Extensive changes to avionics and electrical systems design. Invalidates certification assumptions. Extensive re-assessments of systems integration, flight crew workload, human factors evaluation are required. Requires new AFM.
Introduction of autoland	No	No	Yes	Invalidates original design assumptions.

Conventional tail to T-tail or Y-tail, or vice versa	Yes	No	Yes	Change in general configuration. Requires extensive structural, flying qualities and performance re-investigation. Requires new AFM to address performance and flight characteristics.

The following are examples of not significant changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Addition of wingtip modifications (not winglets)	No	No	No	Although 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 remains 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 remains valid.

Addition of a turbo-charger that does not appreciably change the power envelope, operating range, or limitations (e.g., a turbo— normalized engine), (e.g., where the additional power is used to enhance high altitude or hot day performance.)	No	No	No	Not an airplane level change.
Replace a petrol engine with a diesel engine or approximately the same horsepower	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remains valid.
Substitution of one method of bonding for another (e.g., change in type of adhesive)	No	No	No	Not an airplane level change.
Substitution of one type of metal for another	No	No	No	Not an airplane level change.
Any change in construction or fastening not involving primary structure	No	No	No	Not an airplane level change.
A new fabric type for fabric skinned aircraft	No	No	No	Not an airplane level change.
Increase in flap speed or undercarriage limit speed	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remains valid.
Structural strength increases	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remains valid.

IFR upgrades involving installation of components (where the original certification does not indicate that the aeroplane is not suitable as an IFR platform, e.g., special handling concerns).	No	No	No	Not an airplane level change.
Fuel lines, where engine horsepower is increased but fuel flow is not increased beyond the certified maximum amount.	No	No	No	Not an airplane level change.
Fuel tanks, where fuel is changed from gasoline to diesel fuel and tank support loads are small enough that an extrapolation from the previous analysis would be valid. Chemical compatibility would have to be substantiated	No	No	No	Not an airplane level change.
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 re-substantiated if the original test data is invalidated.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remains valid.
Install a quieter exhaust system	No	No	No	Not an airplane level change.
Changes in engine cooling or cowling	No	No	No	Not an airplane level change.

Fuel type: Avgas to Diesel/Jet A, Avgas to Ethanol/Methanol. Changing to Multiple fuel systems containing fuel types (other than systems used for starting): such systems using 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 remains 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 remains valid.
Fuels that specify different levels of "conventional" fuel additives that do not change the primary fuel type. Different additive levels (controlled) of MTBE, ETBE, Ethanol, Amines, etc. in Avgas would not be considered a significant change.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remains valid.

A change to the maximum take-off weight of less than 5% unless assumptions made in justification of the design are thereby invalidated.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction and certification assumptions remains 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 remains 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 aeroplane 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 remains valid.
Increased battery capacity or relocate battery	No	No	No	Not an airplane level change.
Replace generator with alternator	No	No	No	Not an airplane level change.
Additional lighting (e.g., navigation lights, strobes)	No	No	No	Not an airplane level change.
Higher capacity brake assemblies	No	No	No	Not an airplane level change.
Increase in fuel tank capacity	No	No	No	Not an airplane level change.
Addition of an oxygen system	No	No	No	Not an airplane level change.
Relocation of a galley.	No	No	No	Not an airplane level change.

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 remains valid. Requires certification substantiation applicable to freighter requirements.
Installation of new seat belt or shoulder harness	No	No	No	Not an airplane level change.
A small increase in cg range.	No	No	No	At airplane level, no change in general configuration, principles of construction & certification assumptions.
APU Installation that is not flight essential	No	No	No	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.
Addition of Class B Terrain Awareness and Warning Systems (TAWS)	No	No	No	Not an airplane level change.

Figure 2. Table of examples of changes for Large Aeroplanes,
The following are examples of substantial changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 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.	Yes	No	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Change from a high wing to low wing configuration.	Yes	No	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Change from an all metal airplane to all composite primary structure (fuselage, wing, empennage).	Yes	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.

The following are examples of significant changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Derivative model, e.g., increased passenger payload, freighter version or complete update of a certified aeroplane.	Yes	Yes	Yes	Multiple changes packaged into a new model. Increased payload new freighter would change the general configuration and assumptions. Updated aeroplane could change principles of construction.
Reduction in the number of flight crew (In conjunction with flight deck update).	Yes	No	No	Extensive changes to avionics and aircraft systems. Impact to crew workload and human factors, pilot type rating.

Modify an aeroplane for flight in known icing conditions by adding systems for ice detection and elimination	Yes	No	Yes	New aircraft operating envelop. 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	Essentially a recertification of airframe and systems associated with operating envelope change.
Addition of leading edge slats	Yes	No	No	Requires extensive changes to wing structure, adds aircraft level systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Fuselage length change – lengthen or shorten fuselage	Yes	No	No	Requires extensive changes to fuselage structure, affects aircraft level systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
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 level systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Changing the number of axles or number of landing gear done in context with a product level change which involves changing the aeroplane gross weight.	Yes	No	No	Requires extensive changes to aircraft structure, affects aircraft l 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%	No	No	Yes	When it requires extensive re-substantiation of aircraft structure, aircraft performance and flying qualities and associated systems.

Wing changes in span, sweep, and tip designs or wing chord. (Note: Potentially substantial if it is a change from a high wing to a low wing, or a new wing.)	Yes	No	No	When it requires extensive changes to wing structure, adds aircraft level systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Change in type or number of emergency exits in conjunction with an increase in the number of passengers demonstrated.	No	No	Yes	The new emergency egress requirements exceed those previously substantiated.
Comprehensive flight deck upgrade.	No	No	Yes	Affects avionics and electrical systems integration and architecture concepts and philosophies. This drives a re-assessment of flight crew workload and other human factors issues, and requires a re-evaluation of the original design assumptions used for the cockpit.
Change in primary flight controls to fly by wire (FBW) system. (Some airplanes have some degree of FBW. Achieving full FBW may be a not significant change on some airplanes.)	Yes	No	Yes	When the degree of change is so extensive that it affects basic aircraft systems integration and architecture concepts and philosophies. This drives a complete reassessment of flight crew workload, handling qualities, and performance evaluation, which are different from the original design assumptions.
Replace reciprocating with turbo-propeller engines	Yes	No	No	Requires extensive changes to airframe structure, adds aircraft level systems, and requires a new aeroplane flight manual to address performance and flight characteristics.
Typically a thrust increase of more than 10%	No	No	Yes	When it requires extensive re-substantiation of powerplant installation, and has a marked effect on aircraft performance and flying qualities.
Initial installation of an autoland system	No	No	Yes	Baseline airplane not designed for autoland operation, potential crew work load and systems compatibility issues
Installation of a new fuel tank, e.g., horizontal stabilizer tank or auxiliary fuel tank in the fuselage outside the wing in conjunction with increased maximum	No	No	Yes	Requires changes to airframe, systems and AFM. Results in performance changes.

takeoff weight and takeoff thrust.				
Main deck cargo door installation.	Yes	No	No	Redistribution of internal loads, change in aeroelastic characteristics, system changes.
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 are examples of not significant changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Alternate engine installation or hush kit at same position	No	No	No	Although an aeroplane level change, it is not significant so long as there is not more than a 10% increase in thrust or a change in the principles of propulsion.
Fuselage length change – lengthen or shorten fuselage	No	No	No	A small change in fuselage length due to re-fairing the aft body or radome for cruise performance reasons, where such changes do not require extensive structural, systems or AFM changes
Re-fairing of wing tip caps (e.g., for lights, fuel dump pipes) and addition of splitter plates to the trailing edge thickness of the cruise airfoil.	No	No	No	Does not require extensive structural, AFM, or systems changes.

Additional power used to enhance high altitude or hot day performance	No	No	No	Usually no change in basic operating envelope. Existing cert 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.
General avionics changes.	No	No	No	These modifications are generally adaptive* in nature, and do not change the original certification assumptions, alter basic cockpit design architecture concepts and philosophies, and do not have a major impact on crew workload or man/machine. *Adaptive means the change adapts to the existing airplane buses, power, structure, …
Initial installation of an autopilot system	No	No	No	Modification is generally adaptive in nature, with no change to original certification assumptions.
Integrated modular avionics	No	No	No	The basic functionality of the systems are unchanged. No change from analogue to digital.
Installation or rearrangement of an interior in an aircraft.	No	No	No	Special conditions could be used for new and novel features
Change from assembled primary structure to monolithic or integrally machined structure	No	No	No	Method of construction is well understood.
Modification to ice protection systems	No	No	No	Re-certification required, but type-certification basis is adequate.
Brakes: design or material change, e.g., steel to carbon	No	No	No	Re-certification required, but type-certification basis is adequate.
Redesign floor structure	No	No	No	By itself, this is not a significant product level change. It could be a significant change if part of a cargo converted passenger airplane.
Novel or unusual method of construction of a component.	No	No	No	Special conditions could be required if there are no existing requirements that adequately

				address these features. The component change does not rise to the product level change
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.

Figure 3. Table of examples of Changes for Rotorcraft.
The following are examples of substantial changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 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.	Yes	No	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.
Change from an all-metal rotorcraft to all composite rotorcraft.	Yes	Yes	Yes	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable requirements is required.

The following are examples of significant changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Comprehensive Flight Deck Upgrade	Yes	No	Yes	The degree of change is so extensive that it affects basic avionics and electrical systems integration and architecture concepts and philosophies. This drives a complete reassessment of flight crew workload and other human factor issues, and requires a reevaluation of the original design assumptions used for the cockpit.
Certification for flight into known icing conditions.	No	No	Yes	

(Fixed) flying controls from mechanical to fly by wire	Yes	Yes	Yes	
Addition of an engine; e.g., from single to twin or reduction of the number of engines; e.g., from twin to single	Yes	No	Yes	May be Substantial depend upon project details
A fuselage modification that changes the primary structure, aerodynamics, or 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 .
Emergency Medical Service Configuration with primary structural changes sufficiently to invalidate the certification assumptions	Yes	No	Yes	Any EMS configuration will not be classified as significant. Modifications made for EMS is typically internal and the general external configuration is normally not affected. These changes should not automatically be classified as significant.
Skid landing gear to wheel landing gear or wheel landing to skid	Yes	No	Yes	If the rotorcraft is such that the skid or wheel configuration is inherent in the basic certification design, the change may be not significant.

Change of the number of rotor blades	Yes	No	No	The addition/deletion of rotor blades may not be significant provided the remainder of the basic propulsion system remains essentially unchanged.
Change tail anti-torque device (e.g., tail rotor, ducted fan or other technology)	Yes	Yes	No	

The following are examples of not significant changes:

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Emergency floats	No	No	No	Must Comply to 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	Certified per rotorcraft HTAWS AC guidance material

Health Usage Monitoring System (HUMS) for Maintenance Credit	No	No	No	Certified per rotorcraft HTAWS 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 a/c 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
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 to the specific applicable requirements for external loads. This installation, in itself, does not change the rotorcraft configuration, overall performance, or operational capability. Expanding an operating envelope (such as operating altitude and temperature) and mission profile (such as passenger carrying operations to external load operations, or flight over water, or operations in snow conditions) are not by themselves so different that the

				original certification assumptions are no longer valid at the type-certificated product level.
IFR upgrades involving installation of components (where the original certification does not indicate that the rotorcraft is not suitable as an IFR platform, e.g., special handling concerns).	No	No	No	Not a rotorcraft level change.
An upgrade to CAT A certification approval	No	No	No	Typically these are engine and drive systems rating changes appropriate for CAT A and rotorcraft performance requirements. Rotorcraft modifications, if any necessary, do not typically invalidate the certification assumptions, or change the general configuration of principles of construction.
Reducing the number of pilots for IFR from 2 to 1	No	No	No	May be significant if there are extensive equipment and design changes such that the certification assumptions are invalidated or the general configuration of the rotorcraft is changed.

Figure 4. Engines and Propellers
The following are examples of significant changes: Turbine engines

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Traditional turbofan to geared-fan engine	Yes	No	Yes	This change would affect the engine in terms of FOD ingestion, containment, 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 l 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 ingestion, icing, blade out criteria, etc. Note that this change is l most likely substantial under 21.19
Turbo-shaft to turbo-propeller	Yes	No	Yes	Change in configuration such as an additional gearbox Change in model designation. Change in mission profile. Assumptions for certification may no longer be valid in terms of flight envelope, ratings, etc Note that this change is l 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 l most likely substantial under 21.19

Conventional engine for subsonic operation to after-burning 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 l most likely substantial under 21.19
Increase/decrease in the number of compressor/turbine stages with resultant change in approved limitations*. (* excludes life limits)	No	No	Yes	Change is associated with other changes that would affect performance envelope and may affect 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.
Hydro-Mechanical to FADEC/EEC without hydromechanical backup	Yes	Yes	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

A change in the containment case from hard-wall to composite or vice-versa, that could not be retrofitted without additional major changes to the engine or restrictions in the initial limitations in the installation manual	No	Yes	No	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.
Replacement of the gas generator (core) with a different one that is associated with changes in approved limitations* (* excludes life limits)	No	No	Yes	Change is associated with other changes that would affect performance envelope and may affect the dynamic behavior of the engine Assumptions used for certification may no longer be valid

Piston engines

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Convert from Mechanical to Electronic Control System	Yes	Yes	No	Change in engine control 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 engine configuration Change in operating envelope and performance

Convert from air-cooled cylinders to liquid cooled cylinders.	Yes	No	Yes	Change in 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.

Propellers

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the Assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Introduction of a different principle of blade retention	Yes	Yes	No	Change in propeller configuration Likely change in model designation Propeller's operating characteristics and inherent strength require re-evaluation

Figure 4. Engines and Propellers
The following are examples of not significant changes:
Turbine engines

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
Change in the material from one type of metal to another type of metal of a compressor drum	No	No	No	No change in performance No likely change in model designation Assumptions are still valid

Increase/decrease in the number of compressor/turbine stages without resultant change in performance envelope	No	No	No	No change in performance Model designation may or may not change Assumptions are still valid
New components internal to the FADEC/EEC the introduction of which does not change the function of the system	No	No	No	No change in configuration Retrofitable Assumptions used for certification are still valid Possible changes in principles of construction are insignificant
Software changes	No	No	No	
Rub-strip design changes	No	No	No	Component Level Change
A new combustor that does not change the approved limitations*, or dynamic behavior (* excludes 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 re-design that can be retrofitted	No	No	No	Component Level Change
Oil tank re-design	No	No	No	Component Level Change
Change from one hydro-mechanical	No	No	No	Component Level Change
control to another hydro-mechanical control				
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 that are limited to such changes as blade re-stagger, 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

Piston engines

Description of change	**Is there a Change to the General Configuration? 21.101(b)(1)(i)**	**Is there a Change to the Principles of Construction? 21.101(b)(1)(i)**	**Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)**	**Notes**
A change in principal physical properties and mechanics of load transfer of a material of primary structure or highly loaded components. For example, change from traditional metal to either an exotic alloy or a composite material on a highly loaded component	No	No	No	Component Level Change
New or redesigned cylinder head, or valves or pistons.	No	No	No	Component Level Change

Changes in crankshaft	No	No	No	Component Level Change
Changes in crankcase	No	No	No	Component Level Change
Changes in carburetor	No	No	No	Component Level Change
Changes in mechanical fuel injection system	No	No	No	No controversy-No comments
Changes in mechanical fuel injection pump	No	No	No	Component Level Change
Engine model change to accommodate new airplane installation. No change in principles of operation of major subsystems; no significant expansion in power or operating envelopes or in limitations	No	No	No	
No change in basic principles of operation, or a simple mechanical change. For example, change from dual magneto to two single magnetos on a model	No	No	No	

Subsystem change produces no change in base 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
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

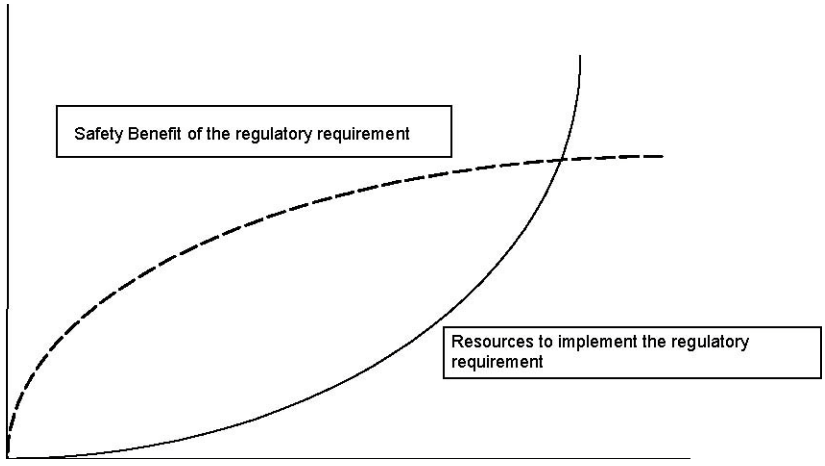
Description of change	Is there a Change to the General Configuration? 21.101(b)(1)(i)	Is there a Change to the Principles of Construction? 21.101(b)(1)(i)	Have the assumptions used for Certification been invalidated? 21.101(b)(1(ii)	Notes
Change in the material of a blade bearing	No	No	No	Component Level Change
Change to a component in the control system	No	No	No	Component Level Change
Change to a de-icer boot	No	No	No	Component Level Change

Appendix 2 to GM 21.101: PROCEDURES FOR EVALUATING IMPRACTICALITY OF APPLYING LATEST REQUIREMENTS TO A CHANGED PRODUCT

1. INTRODUCTION

The basic tenet of the changed product rule is that compliance of significant changes with the latest requirements will enhance the level of safety of these aviation products. However, in certain cases the cost of complying fully with a later requirement may not be commensurate with a small safety benefit achieved. It is also understood that the existing fleet and newly produced aeroplanes, engines and propellers are safe, and that any unsafe condition is immediately addressed through the airworthiness directive process. These concepts form the basis of finding it to be impractical to comply with a later requirement, allowing compliance with an earlier requirement is acceptable. This appendix gives one method of determining if compliance with a later requirement is impractical; however this does not preclude the use of other methods that have as a goal improving the safety of aeronautical products.

This GM recognizes that other procedures have been used for some products and have been historically been accepted on a case-by-case basis. These procedures have not been fully harmonized and may not be acceptable for all products. It is envisaged that other methods will be developed and become part of this GM. Regardless of which method is used, the fundamental premise of these methods must be for the applicant to demonstrate a resource effective type-certification basis showing a positive safety benefit for the overall product. In this regard, any method used must also encourage incorporating the safety enhancements that will have the most dramatic impact on the accident rate and recognize the effective utilization of limited resources. This important point is illustrated graphically in the accompanying figure. This figure notionally shows the interrelation between the total resources required for incorporating each potential safety enhancement with the corresponding net increase in safety benefit. Typically one will find that there are proposals that will produce a positive safety benefit that can be introduced very resource effectively. Conversely, there are those that may produce small safety benefit but may require a large amount of resources to implement. Clearly, there will be a point where a large percentage of the potential safety benefit can be achieved with a reasonable expenditure of resources. The focus of the methods used should be to determine the most appropriate set of safety-significant regulatory standards relative to the respective cost to reach this point.



Potential Safety Enhancements

This Appendix to GM 21.101 provides procedural guidance that maybe used as a starting point to determine the practicality of applying a requirement at a particular amendment level to a changed product. This guidance can be used for evaluating the safety benefit and resource impact of implementing the latest airworthiness requirements in the type-certification basis of a changed product. The procedure is generic in nature and describes the steps and necessary inputs that any applicant may use on any project to develop a position.

a. 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 requirements.

b. This procedure provides a means, but not the only means, for an applicant to present its position in regards to impracticality.

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

d. 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.

Step 1: Identify the Regulatory Change Being Evaluated

In this step it will be necessary to document:

The specific requirement (e.g. 25.365), The amendment level of the existing type-certification basis for the requirement, and The latest amendment level of the requirement.

Step 2: Identify the Specific Hazard that the Requirement Addresses

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

b. In many cases the hazard and the cause of the hazard will be obvious. When the hazard and its related cause are not immediately obvious it may be necessary to review the explanatory note and comment/response document to the NPA and discuss the hazard with the CARC.

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

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

(1) Incidents where only injuries occurred,
(2) Accidents where less than 10% of the passengers succumbed to their injuries,
(3) Accidents where 10% or more passengers succumbed to their injuries, and
(4) Accidents where a total hull loss occurred.

b. The explanatory note and comment/response document to the NPA may provide useful information regarding the consequences of the hazard the requirement is intended to address.

Step 4: Identify the Historical and Predicted Frequency of each Consequence

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

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

c. The explanatory note and comment/response document to the NPA may provide useful information regarding the frequency of occurrence.

Step 5: Determine How Effective Full Compliance with the Latest Amendment of the Requirement would be at Addressing the Hazard

a. When each amendment is promulgated it is 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 type-certification basis to the latest amendment level it is useful to estimate the effectiveness of both amendment levels in dealing with the hazard.

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

b. The following five levels of effectiveness are provided as a guideline.

(1) Fully effective in all cases Compliance with the requirement eliminates the hazard or provides a means to completely avoid the hazard.
(2) Considerable potential for eliminating or avoiding the hazard Compliance with the requirement eliminates the hazard or provides a means to completely avoid the hazard for all probable or likely cases. However it does not cover all situations or scenarios.
(3) Adequately deals with the hazard Compliance with the requirement eliminates the hazard or provides a means to completely avoid the hazard in many cases. However, the hazard is not eliminated or avoided in all probable or likely cases. Usually this action only addresses a significant part of a larger or broader hazard.
(4) Hazard only partly addressed In some cases compliance with the requirement partly eliminates the hazard or does not completely avoid the hazard. The hazard is not eliminated or avoided in all probable or likely cases. Usually this action only addresses part of a hazard.
(5) Hazard only partly addressed but action has negative side effect Compliance with the requirement does not eliminate or avoid the hazard or may have negative safety side

effects. The action is of questionable benefit.

Step 6: Determine Resource Costs and Cost Avoidance

a. There is always a cost associated with complying with a requirement. This cost may range from minimal administrative efforts to the resource expenditures necessary to 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 facilitate certification of a product by the CARC of a third country.

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

c. When evaluating the 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 aeroplane. In many cases, an estimate for the cost of incorporation in a new aeroplane is provided in the regulatory evaluation by the CARC that was presented when the corresponding requirement was first promulgated. Incremental costs of retrofit/incorporation on existing designs may be higher than that for production. Examples of costs may include, but are not limited to:

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

(a) 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.

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

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

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

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

(2) Cost Avoidance

(a) Avoiding cost of accidents including investigation of accidents, lawsuits, public relations activities, insurance, and lost revenue.
(b) Foreign Certification: Achieve a singular effort that would demonstrate compliance with the requirements of most competent authorities, thus minimizing certification costs.

Step 7: Document Conclusion Regarding Practicality

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

(1) Compliance with the latest requirement is necessary. The applicant would pursue the change at the latest amendment level.
(2) Compliance with an amendment level between the existing type-certification basis and the latest amendment would adequately address the hazard at an acceptable cost, while meeting the latest amendment level would be impractical. The applicant would then propose the intermediate amendment level of the requirement.
(3) The increased level of safety is not commensurate with the increased costs associated with meeting the latest amendment instead of the existing type-certification basis. Therefore, the applicant would propose the existing type-certification basis.
(4) The results of this analysis were inconclusive. Further discussions with the CARC are warranted.

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

2. EXAMPLES

The following examples are for large aeroplanes and are illustrative of the typical process followed by an applicant. The process will be the same for all product types.

2.1 Example 1: § 25.963 Fuel Tank Access Covers

(NOTE: This example is taken from a FAA certification, so references are made to FAR sections and amendments.)

a. This change is part of a significant transport aeroplane model change that increases passenger payload and gross weight by extending the fuselage 20 feet. The model change will feature increased thrust engines, strengthened wing and fuselage, and a completely redesigned landing gear. To accommodate the higher design weights, increased braking requirements and to reduce runway loading, the applicant will change the landing gear from a two-wheel to four-wheel configuration. The new model aeroplane will be required to comply with the latest applicable requirements based on the date of application.

b. 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, it proposes that it would be impractical to redesign the fuel tank access covers.

b. The applicant proposes to change the landing gear from a two-wheel configuration to a four-wheel configuration. This changes the debris scatter on the wing from the landing gear.

Step 1: Identify the Regulatory Change Being Evaluated

a. The existing type-certification basis of the aeroplane that is being changed is part 25 prior to amendment 69.

b. Amendment 25-69 added the requirement that fuel tank access covers on transport category aeroplanes be designed to minimize penetration by likely foreign objects, and be fire resistant.

Step 2: Identify the Specific Hazard that the Requirement 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 aeroplane. 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.

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

Occurrences with injuries, and with more than 10% deaths

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

a. In 200 million departures of large jets,

(1) 1 occurrence with more than 10% deaths, and
(2) 1 occurrence with injuries.

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

Step 5: Determine How Effective Full Compliance with the Latest Amendment of the Requirement would be at addressing the Hazard

- Considerable potential for eliminating or avoiding the hazard,
- Compliance with amendment 25-69 eliminates the hazard or provides a means to completely avoid the hazard for all probable or likely cases. However, it does not cover all situations or scenarios.

Step 6: Determine Resource Costs and Cost Avoidance

a. Costs:

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

b. Cost avoidance:
(1) There were 2 accidents in 200 million departures. The applicant believes that it will

manufacture more than 2000 of these aeroplanes or derivatives of these aeroplanes. These aeroplanes would average 5 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 type-certification basis for FAA and foreign requirements.

Step 7: Document Conclusion Regarding Practicality

It is concluded that compliance with the latest requirement 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 CARC determined that meeting the latest amendment would not be impractical.

2.2 Example 2: § 25.365 Pressurized Compartment Loads

(NOTE: This example is taken from a FAA certification, so references are made to FAR sections and amendments.)

a. For the product change described in Example 1, the lengthened fuselage affects the size of the main deck passenger compartment and the lower centre cargo compartment. The applicant plans to comply fully with the latest pressurized compartment loads except for one interior partition for which the applicant believes compliance would be impractical.
b. The applicant proposes to increase the length of the fuselage by installing fuselage plugs. This change affected the size of the main deck passenger compartment and the lower centre cargo compartment.

Step 1: Identify the Regulatory Change Being Evaluated

a. The existing type-certification basis of the aeroplane that is being changed includes § 25.365 at amendment 25-54. The initial release of § 25.365 required that 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 § 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 §25.365(e)(2), or the maximum opening caused by a failure not shown to be extremely improbable.
c. Amendment 25-71 extended the requirement to all pressurized compartments, not just passenger compartments, and to the pressurization of unpressurised areas. The later requirement had previously been identified as an unsafe feature under § 21.21(b)(2).

Step 2: Identify the Specific Hazard that the Requirement 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 by 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.

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

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

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

a. In 200 million departures of large jets,

(1) 2 occurrences with more than 10% deaths,
(2) 1 occurrence with less than 10% deaths, and
(3) 1 occurrence with injuries.

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

Step 5: Determine How Effective Full Compliance with the Latest Amendment of the Requirement would be at addressing the Hazard

a. Fully effective in all cases Compliance with amendment 25-71 eliminates the hazard or provides a means to completely avoid the hazard.
b. Considerable potential for eliminating or avoiding the hazard Compliance with amendment 25-54 eliminates the hazard or provides a means to completely avoid the hazard for all probable or likely cases. However, it does not cover all situations or scenarios.
c. Adequately deals with the hazard Compliance with the original type-certification basis eliminates the hazard or provides a means to completely avoid the hazard in many cases. However, the hazard is not eliminated or avoided in all probable or likely cases. Usually this action only addresses a significant part of a larger or broader hazard.
d. Design changes made to the proposed derivative aeroplane bring it nearly into compliance with §25.365 amendment 25-71. Analyses show that one interior partition would fail when subjected to the pressure differential defined by the latest requirement. However, its failure would not have an impact on continued safe flight and landing. This is because none of the critical or essential systems are affected by failure of this partition and its failure would not present a hazard to a crewmember. Design solutions were considered for this partition, including structural reinforcement and additional venting area, but all were found to require substantial changes. With this design the applicant believes that most of the safety benefits have been achieved and that no appreciable increase in safety would be achieved by complying fully with amendment 25-71.

Step 6: Determine Resource Costs and Cost Avoidance

a. Costs:

(1) For a newly developed aeroplane there would be a significant increase in costs related to labor and capital to comply with amendment 25-71 instead of the original type-certification basis.
(2) There would be a negligible increase in costs related to materials, operating costs, and revenue utility loss.
(3) There would be savings in both labor and capital costs if compliance were shown to amendment 25-54 instead of amendment 25-71.

c. Cost Avoidance:

(1) There were 4 accidents in 200 million departures. The applicant believes that it will manufacture more than 2000 of these aeroplanes or derivatives of these aeroplanes. These aeroplanes would average 5 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 type-certification basis for FAA and foreign requirements.

Step 7: Document Conclusion Regarding Practicality

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

Appendix 3 to GM 21.101 THE USE OF SERVICE EXPERIENCE IN THE CERTIFICATION PROCESS.

1. INTRODUCTION

Service experience may be utilized to support the application of an earlier type-certification basis if the earlier type-certification basis in conjunction with the applicable service experience and other compliance measures provides a level of safety comparable to that provided by the latest requirements. It is incumbent on the applicant to provide sufficient substantiation to allow the CARC to make this determination. A statistical approach may be used, subject to the availability and relevance of data, however 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.

3. GUIDELINES

The Certification Review Item (CRI) procedure 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 of the latest requirements the proposed changed product would not meet.
c. Evidence showing that the proposed type-certification basis for the changed product, together with applicable service experience, 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 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 (WAAS) Data
(i) Service Difficulty Reports
(j) Reports from Accident Investigation Bureau
(k) Warranty, repair and parts usage data

(2) Show that the data presented represents all relevant service experience for the product, including the results of any operator surveys, and is comprehensive enough to be representative
(3) Show that the service experience is relevant to the issue.
(4) Identification and evaluation of each of the main areas of concern, with regard to:

(a) recurring and/or common failure modes
(b) cause
(c) probability, by qualitative reasoning
(d) measures already taken and their effects

(5) Relevant data pertaining to aircraft of similar design and construction may be included
(6) Evaluation of failure modes and consequences through analytical processes. The analytical processes should be supported by:

(a) A review of previous test results; and
(b) Additional detailed testing.

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

3. EXAMPLE

The following example is for large aeroplanes and is illustrative of the typical process followed by an applicant. The process will be the same for all product types.

a. Transport Aeroplanes: §25.1141(f) Auxiliary Power Unit (APU) Fuel Valve Position Indication

(NOTE: This example is taken from a FAA certification, so references are made to FAR sections and amendments.)

b. This example comes from a new generation model transport aeroplane where extensive changes were made to the main airframe components, engines and systems. The baseline aeroplane has

an extensive service history. The purpose of the example is to show how the use of service experience is used to support a finding that compliance with the latest requirement would not contribute materially to the level of safety, and that application of the existing type-certification basis (or earlier amendment) would be appropriate. The example is for significant derivatives of transport aeroplanes with extensive service history. It is provided to illustrate the process, following the guidelines given in this Appendix, but does not include the level of detail that would normally be required.

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

The existing type-certification basis of the aeroplane that is being changed is the initial release of part 25. Amendment 25-40 added the requirement §25.1141(f) 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 latest requirements the proposed changed product would not be met.

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 §25.1141(f).

(3) Evidence that the proposed type-certification basis for the changed product, together with applicable service experience and other compliance measures provide an acceptable level of safety.
The APU fuel shut off valve and actuator are unchanged from those used on the current family of aeroplanes, and have been found to comply with the earlier amendment 25-11 of §25.1141(f). The existing fleet has achieved approximately xx 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 requirement. In addition, the system design for the changed product incorporates features, which increase the level of functionality and safety.

(4) A description of the design feature and its intended function.
The fuel shut off valve, actuator design, and operation is essentially unchanged, with the system design ensuring that the valve is monitored for proper cycling from closed to open at start initiation. 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, albeit the system does not indicate valve position as required by §25.1141(f).

(5) Data for the product pertinent to the requirement.
An issue paper was co-ordinated which 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

aeroplane complies with the latest amendment of §25.1141. Information is presented to support the applicant's argument that compliance with the latest amendment would not materially increase the level of safety. Comparative data pertaining to aircraft of similar design and construction are also presented.

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

Subpart E-Supplemental type certificates

GM 21.112B Demonstration of capability for supplemental type certificate cases

See also AMC 21.14(b) for the details of the alternative procedures.

The following examples of major changes to type design (ref: 21.91) are classified in two groups. Group 1 contains cases where a design organization approved under Part 21 Subpart J ("Subpart J DOA") should be required and Group 2 cases where the alternative procedure may be accepted.

They are typical examples but each STC case should be addressed on its merits and there would be exceptions in practice. This classification is valid for new STCs, not for evolution of STCs, and may depend upon the nature of the STC (complete design or installation).

Product	**Discipline**	**Kind of STC**	**Group**
CS-23 (products where J DOA is required for TC)			
Notes : • STC which leads to reassess the loads on large parts of primary structure should be in group 1. • 2/1 means that an assessment of consequences in terms of handling qualities, performance or complexity of showing of compliance may lead to classification in group 1.			
	Aircraft		
		Conversion to tail wheel configuration	1
		Auxiliary fuel tank installations	2/1
		Glass fiber wing tips	2/1
		Fairings: nacelle, landing gear	2
		Gap seals: aileron, flap, empennage, doors	2
		Vortex generators	2/1
		Spoiler installation	1
	Structures	Increase in MTOW	1
		Stretcher installation	2
		Change to seating configuration	2
		Windshield replacement (heated, single piece, etc)	2
		Light weight floor panels	2
		Ski installations	2/1

Product	Discipline	Kind of STC	Group
	Propulsion		
		Engine model change	1
		Fixed pitch propeller installation	2
		Constant speed propeller installation	2/1
		Installation of exhaust silencer	2
		Installation of Graphic engine monitor	2
		Installation of fuel flow meter	2
		Accessory replacement (alternator, magnetos, etc.)	2
		Inlet modifications: oil cooler; induction air	2
	Equipment		
		Avionics upgrades (EFIS, GPS, etc)	2/1
		Engine instrument replacements	2
		Carburetor ice detection system	2
		Autopilot system installation	1
		Wing tip landing light; recognition lights	2
		WX radar installation	2
		Aeromedical system installations	2
		De- and anti-ice system installations	1
		Emergency power supply installations	2
CS-25			
	Cabin Safety		
Note : Basically all changes related to cabin configuration should be in Group 2.		Cabin layout (installation of seats (16G), galleys, single class or business / economy class, etc)	2
		Floor path marking	2
		Crew rest compartment	1
		Change of cargo compartment classification (from class D to class C)	1
	Structure		
Note : STC which leads to reassess the loads on large parts of primary structure should be in Group 1.		Cargo door	1
		Change from Passenger to Freighter configuration	1
	Avionics		

Product	Discipline	Kind of STC	Group
Notes : For CS-008 products, the existence of ETSO is not taken into account for the classification ; Impact on aircraft performance, and influence of aircraft performance are criteria to assess the classification ; Subjective assessment of human factors is considered for determination of classification.		CVR	2
		VHF	2
		NAV (ADF, VOR, GPS, BRNAV)	2
		Autopilot, HUD, EFIS, FMS	1
		DFDR	2/1
		Meteo radar	2
		ILS Cat 3	1
		RVSM	1
		TCAS, EGPWS	1
		GPWS	2
	Powerplant		
		Auxiliary fuel tanks	1
		Thrust Reverser system	1
		Hushkit	1
		Fire detection	1
		Fuel gauging	1
		Change of Engine or Propeller	1
CS-27 or 29	**All disciplines**		
Note : 2/1 means that an assessment of consequences in terms of handling qualities and performance may lead to classification in Group 1.		Main rotor or tail rotor blades replacement	1
		Autopilot	1
		Engine type change	1
		GPS installation	2
		Jettisonable overhead raft installation	2
		Utility basket installation	2/1
		Nose or side mount camera installation	2/1
		Passenger access step installation	2/1
		Protection net & handle installation (parachuting)	2
		VIP cabin layout	2
		Navigation system installation	2
		Fuel boost pump automatic switch-on installation	2
		Decrease of maximum seating capacity	2

		Agricultural spray kit installation	2/1
		Long exhaust pipe installation	2
		Flotation gear installation	2/1
		Wipers installation	2
		Engine oil filter installation	2
Product	**Discipline**	**Kind of STC**	**Group**
		Skid gear covering installation	2/1
		Gutter installation (top pilot door)	2
		Cable cutter installation	2
		Auxiliary fuel tank fixed parts installation	2
		Cabin doors windows replacement	2
		Radio-altimeter aural warning installation	2
		Stand-by horizon autonomous power supply	2
		Fire attack system	2/1
		Hoisting system installation	2/1
		External loads hook installation	2
		Emergency flotation gear installation	2/1
		Heating/demisting (P2 supply)	2

Subpart F – Production without production organization approval

GM No. 1 to 21.121 Applicability - Individual product, part or appliance

In this context, "demonstrating the conformity with the applicable design data of a product, part and appliance" means that conformity with the applicable design data has to be established and shown for each and every product, part, appliance, or material produced.

GM No. 2 to 21.121 Applicability – Applicable design data

Applicable design data is defined as all necessary drawings, specifications and other technical information provided by the applicant for, or holder of a design organization approval, TC, STC, approval of repair or minor change design, or JTSO authorization (or equivalent when Part 21 Subpart F is used for production of products, parts or appliances, the design of which has been approved other than according to Part 21), and released in a controlled manner to the manufacturer producing under Part 21 Subpart F. This should be sufficient for the development of production data to enable manufacture in conformity with the design data.
Prior to issue of the TC, STC, approval of repair or minor change design or JTSO authorization, or equivalent, design data is defined as 'not approved', but parts and appliances may be released with a CARC form 227 or equivalent as a certificate of conformity.

After issue of the TC, STC, approval of repair or minor change or JTSO authorization, or equivalent, this design data is defined as 'approved' and items manufactured in conformity are eligible for release on a CARC form 227 or equivalent for airworthiness purposes.

AMC No. 1 to 21.122 Eligibility-Link between design and production

An "arrangement" is considered suitable if it is documented and satisfies the CARC that co-ordination is satisfactory.

To achieve satisfactory co-ordination the documented arrangements must at least define the following aspects irrespective of whether the design organization and the person producing or intending to produce under Part 21 Subpart F are separate legal entities or not:

1 The responsibilities of a design organization which assure correct and timely transfer of up-to-date applicable design data (e.g., drawings, material specifications, dimensional data, processes, surface treatments, shipping conditions, quality requirements, etc.);

2 The responsibilities and procedures of the manufacturer for receiving, managing and using the applicable design data provided by the design organization.

3 The responsibilities and procedures of the manufacturer for developing, where applicable, its own manufacturing data in compliance with the applicable design data package.

4 The responsibilities of the manufacturer to assist the design organization in dealing with continuing airworthiness matters and for required actions (e.g., traceability of parts in case of direct delivery to users, retrofitting of modifications, traceability of processes' outputs and approved deviations for individual parts as applicable, technical information and assistance, etc.);

5 The scope of the arrangements covering Subpart F requirements, in particular: 21.126(a)(4)

and 21.129(d) and (f) and any associated GM or AMC.

6 The responsibilities of the manufacturer, in case of products prior to type certification to assist a design organization in showing compliance with CS (access and suitability of production and test facilities for manufacturing and testing of prototype models and test specimen);

7 The procedures to deal adequately with production deviations and non conforming parts;

8 The means to achieve adequate configuration control of manufactured parts, to enable the manufacturer to make the final determination and identification for conformity or airworthiness release and eligibility status;

9 The identification of responsible persons/offices who controls the above.

10 The acknowledgment by the holder of the TC/STC/repair or change approval/ETSO authorization that the approved design data provided, controlled and modified in accordance with the arrangement are recognized as approved.

In many cases the person producing or intending to produce under Part 21 Subpart F may receive the approved design data through an intermediate production organization. This is acceptable provided an effective link between the design approval holder and the production organization can be maintained to satisfy the intent of 21.122.

When the design organization and the manufacturer are two separate legal entities a Direct Delivery Authorization should be available for direct delivery to end users in order to guarantee continued airworthiness control of the released parts and appliances.

Where there is no general agreement for Direct Delivery Authorization, specific permissions may be granted (see AMC 21.4).

AMC No. 2 to 21.122 Eligibility – Link between design and production

In accordance with AMC No.1 to 21.122 the person producing or intending to produce under Part 21 Subpart F should demonstrate to the authority that it has entered into an arrangement with the design organization. The arrangement must be documented irrespective of whether the two organizations are separate legal entities or not.

The documented arrangement must facilitate the person producing or intending to produce under Part 21 Subpart F to demonstrate compliance with the requirement of 21.122 by means of written documents agreed.

In the case where the design organization and the person producing or intending to produce under Part 21 Subpart F are part of the same legal entity these interfaces may be demonstrated by company procedures accepted by the CARC.

In all other cases to define such a design/production interface the following sample format is offered:

Arrangement Sample Form

<table>
<tr><td colspan="2">ARRANGEMENT
i.a.w. 21.122</td></tr>
<tr><td>The undersigned agree on the following commitments:</td><td>relevant interface procedures</td></tr>
<tr><td>The design organization [NAME] takes responsibility to
assure correct and timely transfer of up-to-date applicable design data (e.g., drawings, material specifications, dimensional data, processes, surface treatments, shipping conditions, quality requirements, etc.) to the person producing under Part 21 Subpart F [NAME]
provide visible statement(s) of approved design data</td><td></td></tr>
<tr><td>The person producing under Part 21 Subpart F [NAME] takes responsibility to
assist the design organization [Name] in dealing with continuing airworthiness matter and for required actions
assist the design organization [Name] in case of products prior to type certification in showing compliance with airworthiness requirements
develop, where applicable, its own manufacturing data in compliance with the airworthiness data package</td><td></td></tr>
<tr><td>The design organization [Name] and the person producing under Part 21 Subpart F [Name] take joint responsibility to
deal adequately with production deviations and non conforming parts in accordance with the applicable procedures of the design organization and the manufacturer producing under Part 21 Subpart F.
achieve adequate configuration control of manufactured parts, to enable the manufacturer producing under Part 21 Subpart F to make the final determination and identification for conformity or airworthiness release and eligibility status.</td><td></td></tr>
<tr><td colspan="2">The scope of production covered by this arrangement is detailed in ... [DOCUMENT REFERENCE/ ATTACHED LIST]</td></tr>
<tr><td colspan="2">[When the design organization is not the same legal entity as the manufacturer producing under Part 21 Subpart F]

Transfer of approved design data
The TC/STC/ETSO Authorization holder [NAME] acknowledges that the approved design data provided, controlled and modified in accordance with the arrangement are recognized as approved.</td></tr>
<tr><td colspan="2">[When the design organization is not the same legal entity as the manufacturer producing under Part 21 Subpart F]

Direct Delivery Authorization
This acknowledgment includes also [OR does not include] the general agreement for direct delivery to end users in order to guarantee continued airworthiness control of the released parts and appliances.</td></tr>
<tr><td>for the [NAME of the design organization/DOA holder]
date signature
xx.xx.xxxx ([NAME in block letters])</td><td>for the [NAME of the person producing under Part 21 Subpart F]
date signature
xx.xx.xxxx ([NAME in block letters])</td></tr>
</table>

Instructions for completion:

Title: The title of the relevant document must clearly indicate that it serves the purpose of a design/production interface arrangement in accordance with 21.122.

Commitment: The document must include the basic commitments between the design organization and the manufacturer producing under Part 21 Subpart F as addressed in AMC 21.4 and AMC No. 1 to 21.122.

Relevant Procedures: Identify an entry point into the documentary system of the organizations with respect to the implementation of the arrangement (for example a contract, quality plan, handbooks, common applicable procedures, working plans etc.).

Scope of arrangement: The scope of arrangement must state by means of a list or reference to relevant documents those products, parts or appliances that are covered by the arrangement.

Transfer of approved design data: Identify the relevant procedures for the transfer of the applicable design data required by 21.122 and AMC No. 1 to 21.122 from the design organization to the person producing under Part 21 Subpart F. The means by which the design organization advises the person producing under Part 21 Subpart F whether such data is approved or not approved must also be identified (ref. 21.4 / AMC 21.4).

Direct Delivery Authorization: Where the design organization and the person producing under Part 21 Subpart F are separate legal entities the arrangement must clearly identify whether Authorization for direct delivery to end users is permitted or not.

Where any intermediate production/design organization is involved in the chain between the original design organization and the person producing under Part 21 Subpart F, evidence must be available that this intermediate organization has received authority from the design organization to grant Direct Delivery Authorization.

Signature: AMC No. 1 to 21.122 requests the identification of the responsible persons/offices who control the commitments laid down in the arrangement. Therefore the basic document must be signed mutually by the authorized representatives of the design organization and the manufacturer producing under Part 21 Subpart F in this regard.

GM 21.124(a) Application-Application form

CARC Form 286 should be obtained from the CARC and completed by the applicant.

An application may be accepted from:

- An individual applying on his or her own behalf, or
- In the case of an organization, an individual with the authority to make agreements on behalf of the organization.

The completed form should be forwarded to the CARC.

GM 21.124(b)(1)(i) Applicability-Inappropriate approval under Subpart G

The issue of a letter of agreement of production under Part 21 Subpart F may be agreed by the CARC when:

1 The applicant produces or intends to produce aeronautical products, parts, appliances and/or materials intended for airborne use as part of a type-certificated product (this excludes simulators, ground equipment and tools), and

2 The CARC determines that Part 21 Subpart G would be inappropriate, and consequently Part 21 Subpart F applies. The main difference between Part 21 Subparts G and F is that Subpart G requires the existence of a Quality System which provides the CARC with the necessary confidence to grant to the manufacturer the privileges of certifying its own production. There are situations where a Quality System, including independent monitoring and continuous internal evaluation functions, is not justified and /or feasible. In making the determination that Subpart F may apply, the CARC may take into account one or a combination of parameters such as the following:

- no flow production (infrequent or low volume of production).
- simple technology (enabling effective inspection phases during the manufacturing process).
- very small organization.

GM 21.124(b) (1)(ii) Certification or approval needed in advance of the issue of a POA

In cases where Part 21 Subpart G is applicable, but when some time is needed for the organization to achieve compliance with Subpart G, i.e., to establish the necessary documented quality system, the CARC may agree to use Part 21 Subpart F for a limited period (transient phase).
In cases where Part 21 Subpart G is applicable, such as to produce ETSO articles or material, a letter of agreement to produce under Part 21 Subpart F should not be given unless an application has been made for organization approval under Subpart G, and reasonable progress is being made towards compliance with Subpart G. Long-term production under Part 21 Subpart F will not be permitted.

GM 21.124(b)(2) Application - Minimum information to include with the application

At this early stage, provision of the complete manual is not necessary, but at least the following items should be covered:

1 Table of Contents of the Manual (including list of existing inspection system documents or procedures)
2 Description of items to be manufactured (including intended quantities /deliveries)
3 List of possible suppliers
4 General description of facilities
5 General description of production means
6 Human resources

GM No. 1 to 21.125 Letter of agreement - Meaning of individual

“Individual” means that each part number or type of item (i.e., product, part, appliance, or material) to be produced should be specifically referenced, either directly or through a referenced capability

list, in the letter of agreement from the CARC. The letter may also specify any limitation in the production rate.

GM No. 1 to 21.125(b) Letter of agreement - Contents of the Manual

The manual referred in 21.125(b) should include, at least the following information:

1. Declaration by the applicant of undertaking in respect of.

    1.1 the requirements defined in Part 21 Subpart F
    1.2 the procedures contained in the manual and in the documentation mentioned herein
    1.3 every legal provision laid down for the carrying on of the business activities (statutory declaration).

2. Declaration by the applicant certifying the conformity of the manual to the requirements defined in Part 21 Subpart F,
3. Jobs, power and responsibilities of the accountable personnel,
4. Organization chart, if required by the CARC,
5. Description of the resources, including human resources, with an indication of the personnel qualification criteria,
6. Description of location and equipment,
7. Description of the scope of work, the production processes and techniques, and reference to the "capability list",
8. Communications with the CARC, and specifically those required by 21.125(c),
9. Assistance and communication with the design approval holder, and the means of compliance with 21.125 (c),
10. Amendments to the Manual,
11. Description of the Inspection System (including test, see GM No. 2 to 21.125(b), and 21.127 and 21.128), and the procedures to meet 21.126 and associated GM,
12. List of suppliers,
13. Issuing of the Statement of Conformity and CARC inspection for validation

Note: If the information is listed in the Manual in a different order a cross reference to the above list should be made available in the Manual.

GM No. 2 to 21.125(b) Letter of agreement - Production Inspection System: Functional Tests

All items produced should be subject to inspection to be carried out at suitable phases which permit an effective verification of conformity with the design data.
These inspections may provide for the execution of tests to measure performances as set out in the applicable design data.
Considerations of complexity of the item and/or its integration in the next level of production will largely determine the nature and time for these tests, for example:

- appliances - will require full functional testing to the specifications
- parts - will at least require basic testing to establish conformity, but due allowance may be made for further testing carried out at the next level of production
- material - will require verification of its stated properties.

GM 21.125(c) Letter of agreement – Assistance

CARC should be provided with material which defines the means of providing assistance as required by 21.125(c). Suitable descriptive material should be included in the Manual, as described in GM No. 1 to 21.125(b).

GM No. 1 to 21.125B (a) Uncontrolled non-compliance with applicable design data

An uncontrolled non-compliance with applicable design data is a non-compliance:

- that cannot be discovered through systematic analysis or
- that prevents identification of affected products, parts, appliances, or material

GM No. 2 to 21.125B (a) Examples for level one findings

Examples for level 1 findings are non-compliances with any of the following paragraphs, that could affect the safety of the aircraft:

21.126, 21.127, 21.128, 21.129.

It should be anticipated that a non-compliance with these paragraphs is only considered a level one finding when objective evidence has been found that this finding is an uncontrolled non-compliance that could affect the safety of the aircraft.

GM 21.126 Production Inspection System

GM 21.126 (a) and (b) has been developed for persons producing under Part 21 Subpart F on the long term basis as defined in 21.124(b)(1)(i).

For those persons producing under Part 21 Subpart F as a transient phase under 21.124(b)(1)(ii), compliance with 21.126 may also be demonstrated to the satisfaction of the CARC by using the equivalent Part 21 Subpart G AMC/GM.

GM 21.126(a)(1) Production Inspection System – Conformity of supplied parts, appliances and material

1. The person producing under Subpart F is responsible for determining and applying acceptance standards for physical condition, configuration status and conformity, as appropriate, of raw materials, subcontracted works, and supplied products, parts, appliances or material, whether to be used in production or delivered to customers as spare parts. This responsibility also includes BFE (Buyer Furnished Equipment) items.

2. Control may be based upon use of the following techniques, as appropriate:

   2.1 first article inspection, including destruction if necessary, to verify that the article conforms to the applicable data for new production line or new supplier,
   2.2 incoming inspections and tests of supplied parts or appliances that can be satisfactorily inspected on receipt,
   2.3 identification of incoming documentation and data relevant to the showing of conformity to be included in the certification documents,
   2.4 any additional work, tests or inspection which may be needed for parts or appliances which are to be delivered as spare parts and which are not subject to the checks

normally provided by subsequent production or inspection stages.

3. The person producing under Part 21 Subpart F may rely upon an JCAR form 227 or equivalent issued in accordance with Part 21 if provided as evidence of conformity with applicable design data
4. For suppliers not holding a POA the inspection system of the person producing under Part 21 Subpart F should establish a system for control of incoming materials and bought or subcontracted items which provides for inspections and tests of such items by the person producing under Part 21 Subpart F at the supplier's facility, if the item cannot or will not be completely inspected upon receipt.

GM 21.126(a)(2) Production Inspection System - Identification of incoming materials and parts

All parts and materials coming from external parties should be identified and inspected to ascertain that they have not been damaged during transport or unpacking, that the incoming parts and materials have the appropriate and correct accompanying documentation and that the configuration and condition of the parts or materials is as laid down in that documentation'.

Only on completion of these checks and of any incoming further verifications laid down in the procurement specification, may the part or material be accepted for warehousing and used in production.

This acceptance should be certified by an inspection statement.

A suitable recording system should allow reconstruction at any time of the history of every material or part.

The areas where the incoming checks are carried out and the materials or parts are stored pending completion of the checks should be physically segregated from other departments.

GM No. 1 to 21.126(a)(3) Production Inspection System - List of specifications

It is the responsibility of:

1. The designer, to define all necessary processes, techniques and methods to be followed during manufacture (21.31) and this information will be provided as part of the applicable design data.
2. The manufacturer, to ensure that all processes are carried out strictly in accordance with the specifications provided as part of the applicable design data.

GM No. 2 to 21.126(a)(3) Production Inspection System - Means of checking of the production processes

The Production Inspection System should be provided with appropriate means of checking that production processes, whether performed by the person producing under Part 21 Subpart F or by subcontractors under its control, are carried out in accordance with applicable data, including:

1. A system for the control and authorized amendment of data provided for the production, inspection and test to ensure that it is complete and up-to-date at the point of use,

2. Availability of personnel with suitable qualification, experience, and training for each required production, inspection, and test task. Special attention should be paid to tasks requiring specialized knowledge and skill, e.g., NDT/NDI, welding...
3. A working area where the working conditions and environment are controlled as appropriate in respect of: cleanliness, temperature, humidity, ventilation, lighting, space/access, protection against noise and pollution,
4. Equipment and tools sufficient to enable all specified tasks to be accomplished in a safe and effective manner without detrimental effect on the items under production. Calibration control of equipment and tools which affect critical dimensions and values must show compliance with, and be traceable to, recognized national or international standards.

GM 21.126(a)(4) Production Inspection System – Applicable design/production data procedures

1. When a person producing under Part 21 Subpart F is developing its own manufacturing data from the design data package delivered by a Design holder, procedures should demonstrate the correct transcription of the original design data.
2. Procedures should define the manner in which applicable design data is used to issue and update the production/inspection data, which determines the conformity of products, parts, appliances and materials. The procedure should also define the traceability of such data to each individual product, part, appliance or material for the purpose of stating the condition for safe operation and for issuing a Statement of Conformity.
3. During execution, all works should be accompanied by documentation giving either directly or by means of appropriate references, the description of the works as well as the identification of the personnel in charge of inspection and execution tasks for each of the different work phases.

GM 21.126(b)(1) Production Inspection System - Inspection of parts in process

The purpose of the Production Inspection System is to check at suitable points during production and provide objective evidence that the correct specifications are used, and that processes are carried out strictly in accordance with the specification.

During the manufacturing process, each article should be inspected in accordance with a plan which identifies the nature of all inspections required and the production stages at which they occur. The plan should also identify any particular skills or qualification required of person(s) carrying out the inspections (e.g., NDT personnel). A copy of the plan should be included in, or referenced by, the manual required by 21.125(b).

If the parts are such that, if damaged, they could compromise the safety of the aircraft, additional inspections for such damage should be performed at the completion of each production stage.

GM 21.126(b)(2) Production Inspection System-Suitable storage and protection

1. Storage areas should be protected from dust, dirt, or debris, and adequate blanking and packaging of stored items should be practiced.
2. All parts should be protected from extremes of temperatures and humidity and, where needed, temperature-controlled or full air-conditioned facilities should be provided.
3. Racking and handling equipment should be provided such as to allow storage, handling and movement of parts without damage.

4. Lighting should be such as to allow safe and effective access and handling, but should also cater for items which are sensitive to light e.g., rubber items.
5. Care should be taken to segregate and shield items which can emit fumes (e.g., wet batteries), substances or radiation (e.g., magnetic items) which are potentially damaging to other stored items.
6. Procedures should be in place to maintain and record stored parts identities and batch information.
7. Access to storage areas should be restricted to authorized personnel who are fully trained to understand and maintain the storage control arrangements and procedures.
8. Provisions should be made for segregated storage of non conforming items pending their disposition (see GM 21.126(b)(4)).

GM 21.126(b)(3) Production Inspection System-Use of derived data instead of original design data

Where derived data, e.g., worksheets, process sheets, fabrication/inspection instructions, etc., is used instead of original design drawings, documents identification and control procedures should be used to ensure that the documentation in use is always accurate and current.

GM 21.126(b)(4) Production Inspection System-Segregation of rejected material

All materials and parts which have been identified at any stage in the manufacturing process as not conforming to the specific working and inspection instructions must be suitably identified by clearly marking or labeling, to indicate their non-conforming status.

All such non-conforming material or parts should be removed from the production area and held in a restricted access segregated area until an appropriate disposition is determined in accordance with 21.126(b)(5).

GM 21.126(b)(5) Production Inspection System-Engineering and manufacturing review procedure

1. The procedure should permit to record the deviation, to present it to the Design holder under the provisions of 21.122, and to record the results of the review and actions taken consequently as regards the part/product.
2. Any unintentional deviation from the manufacturing/inspection data should be recorded and handled in accordance with Part 21 Subpart D or E as changes to the approved design.

GM 21.126(b)(6) Production Inspection System – Recording and record keeping

1. Records within a production environment satisfy two purposes. Firstly, they should, during the production process to ensure that products, parts, or appliances are in conformity with the controlling data throughout the manufacturing cycle. Secondly, certain records of milestone events are needed to subsequently provide objective evidence that all prescribed stages of the production process have been satisfactorily completed and that compliance with the applicable design data has been achieved.

   Therefore, the person producing under Part 21 Subpart F should implement a system for the compilation and retention of records during all stages of manufacture, covering short-term and long-term records appropriate to the nature of the product and its production processes.

The management of such information should be subject to appropriate documented procedures in the Manual required by 21.125(b).

All forms of recording media are acceptable (paper, film, magnetic ...) provided they can meet the required duration for archiving under the conditions provided.

2. The related procedures should:

2.1 Identify records to be kept.
2.2 Describe the organization of and responsibility for the archiving system (location, compilation, format) and conditions for access to the information (e.g., by product, subject).
2.3 Control access and provide effective protection from deterioration or accidental damage.
2.4 Ensure continued readability of the records.
2.5 Demonstrate to the CARC proper functioning of the records system.
2.6 Clearly identify the persons involved in conformity determination.
2.7 Define and archiving period for each type of data taking into account importance in relation to conformity determination subject to the following:

a. Data which supports conformity of a product, part, or appliance should be kept for not less than three years from the issue date of the related Statement of Conformity or Authorized Release Certificate.
b. Data considered essential for continuing airworthiness should be kept throughout the operational life of the product, part or appliance.

2.8 Data related to supplied parts may be retained by the supplier if the supplier has a system agreed under Part 21 Subpart F by the CARC. The manufacturer should, in each case, define the archiving period and satisfy himself or herself and the CARC that the recording media are acceptable.

GM 21.127 Approved production ground and flight tests

The production ground and flight tests for new aircraft will be specified by the aircraft design organization.

GM No. 1 to 21.128 Acceptable functional test – Engines

The functional test required for a new engine will be specified by the engine design organization and will normally include at least the following:

1. Break-in runs that include a determination of fuel and oil consumption and a determination of power characteristics at rated maximum continuous power or thrust and, if applicable, at rated takeoff power or thrust.
2. A period of operation at rated maximum continuous power or thrust. For engines having a rated takeoff power or - thrust, part of that period should be at rated takeoff power or - thrust.

The test equipment used for the test run should be capable of output determination of accuracy sufficient to assure that the engine output delivered complies with the specified rating and

operation limitations.

GM No. 2 to 21.128 Acceptable functional test –Variable pitch propellers

The functional tests required for a new propeller will be specified by the propeller design organization and should normally include a number of complete cycles of control throughout the propeller pitch and rotational speed ranges. In addition, for feathering and/or reversing propellers, several cycles of feathering operation and reversing operation from the lowest normal pitch to the maximum reverse pitch, should normally be required.

GM No. 3 to 21.128 Acceptable functional test - Engines and Propellers

After functional test, each engine or propeller should be inspected to determine that the engine or propeller is in condition for safe operation. Such inspection will be specified by the design organization and should normally include internal inspection and examination. The degree of internal inspections will normally be determined on the basis of the positive results of previous inspections conducted on the first production engines, and on the basis of service experience.

GM 21.129(a) Availability for inspection by CARC

Each product, part, appliance or material should be made available for inspection at any time at the request of the CARC.
It is recommended that a pre-defined plan of inspection points be established and agreed with the CARC to be used as a basis for such inspections. The manufacturer should provide such documentation, tools, personnel, access equipment etc. as necessary to enable the CARC to perform the inspections.

AMC No. 1 to 21.129(c) Obligations of the manufacturer – Conformity of prototype models and test specimens

21.33 requires determination of conformity of prototype models and test specimens to the applicable design data. For a complete aircraft a 'conformity document', that has to be validated by the CARC, should be provided as part of the assistance to the design approval applicant. For products other than a complete aircraft, and for parts and appliances, a JCAR form 227 or equivalent validated by the CARC may be used as a conformity document as part of the assistance to the design approval applicant.

AMC No. 2 to 21.129(c) Obligations of the manufacturer – Conformity with Applicable Design Data

Individual configurations are often based on the needs of the customer and improvements or changes which may be introduced by the type-certificate holder. There are also likely to be unintentional divergences (concessions or non-conformances) during the manufacturing process. All these changes are required to have been approved by the design approval applicant/holder, or when necessary by the CARC.

AMC No. 3 to 21.129(c) Obligations of the manufacturer – Condition for safe operation

Before issue of the Statement of Conformity to the CARC the manufacturer under this Subpart should make an investigation so as to be satisfied in respect to each of the items listed below. The

documented results of this investigation should be kept on file by the manufacturer. Certain of these items may be required to be provided (or made available) to the operator or owner of the aircraft, and, for validation of the statement of conformity, to the CARC.

1. Equipment or modifications which do not meet the requirements of the state of manufacture but have been accepted by the CARC of the importing country.

2. Identification of products, parts or appliances which:

   1.2 Are not new
   1.3 Are furnished by the buyer or future operator (including those identified in 21.801 and 805).

3. Technical records which identify the location and serial numbers of significant components including those identified in 21.801 and 21.805.

4. Log book and a modification record book for the aircraft as required by the CARC.

5. Log books for products identified in 21.801 installed as part of the type design as required by the CARC.

6. A weight and balance report for the completed aircraft.

7. A record of missing items or defects which do not affect airworthiness these for example could be furnishing or BFE (Items may be recorded in a technical log or other suitable arrangement such that the operator and CARC are formally aware).

8. Product support information required by other associated implementing rules and CS or GM, such as a Maintenance Manual, a Parts Catalogue, or MMEL all of which are to reflect the actual build standard of the particular aircraft. Also an Electrical load analysis and a wiring diagram.

9. Records which demonstrate completion of maintenance tasks appropriate to the test flight flying hours recorded by the aircraft. These records should show the relationship of the maintenance status of the particular aircraft to the manufacturers recommended maintenance task list and the Maintenance Review Board (MRB) document/report.

10. Details of the serviceability state of the aircraft in respect of, a) the fuel and oil contents, b) provision of operationally required emergency equipment such as life rafts, etc.

11. Details of the approved interior configuration if different from that approved as part of the type design.

12. An approved Flight Manual which conforms to the build standard and modification state of the particular aircraft should be available.

13. Show that inspections for foreign objects at all appropriate stages of manufacture have been satisfactorily performed.

14. The registration has been marked on the exterior of the aircraft as required by national legislation. Where required by national legislation fix a fireproof owners nameplate.

15. Where applicable, there should be a certificate for noise and, for the aircraft radio station.

16. The installed compass and or compass systems have been adjusted and compensated and a deviation card displayed in the aircraft.

17. Software criticality list.

18. A record of rigging and control surface movement measurements.

19. Details of installations which will be removed before starting commercial air transport operations (e.g., ferry kits for fuel, radio or navigation).

20. List of all applicable Service Bulletins and airworthiness directives that have been implemented.

AMC No. 1 to 21.130(b) Statement of Conformity for Complete Aircraft

1. PURPOSE AND SCOPE

The description under this AMC refers only to the use of the aircraft Statement of Conformity issued under Part 21 Subpart F. Statement of Conformity under Part 21 Subpart F for products other than complete aircraft, and for parts and appliances is described in AMC No. 2 to 21.130(b).

Use of the aircraft Statement of Conformity issued by an approved production organization is described in 21.163(b) under Part 21 Subpart G and the completion instructions are to be found in the Appendices to Part 21.

The purpose of the aircraft Statement of Conformity (CARC Form 287) issued under Part 21 Subpart F is to present to the CARC a complete aircraft. The CARC only validates the Statement of Conformity if it finds, as described in 21.130 and its associated GM, that the aircraft conforms with the type design and is in condition for safe operation.

2. GENERAL

The Statement of Conformity must comply with the format attached including block numbers and the location of each Block. The size of each Block may however be varied to suit the individual application, but not to the extent that would make the Statement of Conformity unrecognizable. If in doubt consult CARC.

The Statement of Conformity must either be pre-printed or computer generated but in either case the printing of lines and characters must be clear and legible. Pre-printed wording is permitted in accordance with the attached model but no other certification statements are permitted.

Statements of Conformity must be issued in one or more of the official language(s) of the issuing CARC with translations in English shown below, if required. Completion may be either machine/computer printed or hand-written using block letters to permit easy reading.

A copy of the Statement of Conformity and all referenced attachments are to be retained by the manufacturer. A copy of the validated Statement of Conformity is to be retained by CARC.

3. COMPLETION OF THE AIRCRAFT STATEMENT OF CONFORMITY BY THE ORIGINATOR

There must be an entry in all Blocks to make the document a valid Statement.

A Statement of Conformity must not be issued for validation by the CARC, unless the design of the aircraft and its installed products are approved.

The information required in Blocks 9, 10, 11, 12, 13 and 14 may be by reference to separate identified documents held on file by the manufacturer, unless the CARC agrees otherwise.

This Statement of Conformity is not intended to provide for the complete equipment fit required by the applicable operational rules. However, some of these individual items may be included in Block 10 or in the approved type design. Operators are therefore reminded of their responsibility to ensure compliance with the applicable operational rules for their own particular operation.

Block 1 Enter name of the State of manufacture.

Block 2 CARC.

Block 3 A unique serial number should be pre-printed in this Block for Statement control and traceability purposes. Except that in the case of a computer generated document the number need not be pre-printed where the computer is programmed to produce and print a unique number.

Block 4 The full name and location address of the manufacturer issuing the statement. This Block may be pre-printed. Logos, etc., are permitted if the logo can be contained within the Block.

Block 5 The aircraft type in full as defined in the type-certificate and its associated data sheet.

Block 6 The type-certificate reference numbers and issue for the subject aircraft.

Block 7 If the aircraft is registered then this mark will be the registration mark. If the aircraft is not registered then this will be such a mark that is accepted by the CARC of the Member State and, if applicable, by the CARC of a third country.

Block 8 The identification number assigned by the manufacturer for control and traceability and product support. This is sometimes referred to as a Manufacturers Serial No or Constructors No.

Block 9 The engine and propeller type(s) in full as defined in the relevant type-certificate and its associated data sheet. Their manufacturer identification No and associated location should also be shown.

Block 10 Approved design changes to the Aircraft Definition.

Block 11 A listing of all applicable airworthiness directives (or equivalent) and a declaration of compliance, together with a description of the method of compliance on the subject individual aircraft including products and installed parts, appliances and equipment. Any future compliance requirement time should be shown.

Block 12 Approved unintentional deviation to the approved type design sometimes referred to as concessions, divergences, or non-conformances.

Block 13 Only agreed exemptions, waivers or derogations may be included here.

Block 14 Remarks: Any statement, information, particular data or limitation which may affect the airworthiness of the aircraft. If there is no such information or data, state; 'NONE'.

Block 15 Enter 'Certificate of Airworthiness' or 'Restricted Certificate of Airworthiness' for the Certificate of Airworthiness requested.

Block 16 Additional Requirements such as those notified by an importing country should be noted in this Block.

Block 17 Validity of the Statement of Conformity is dependent on full completion of all Blocks on the form. A copy of the flight test report together with any recorded defects and rectification details should be kept on file by the manufacturer. The report should be signed as satisfactory by the appropriate certifying staff and a flight crew member, e.g., test pilot or flight test engineer. The flight tests performed are those required by 21.127 and GM 21.127, to ensure that the aircraft conforms to the applicable design data and is in condition for safe operation.
The listing of items provided (or made available) to satisfy the safe operation aspects of this statement should be kept on file by the manufacturer.

Block 18 The Statement of Conformity may be signed by the person authorized to do so by the manufacturer in accordance with 21.130(a). A rubber stamp signature should not be used.

Block 19 The name of the person signing the certificate should be typed or printed in a legible form.

Block 20 The date the Statement of Conformity is signed must be given.

Block 21 For production under Part 21 Subpart F, state "N/A"

Additionally, for production under Part 21 Subpart F, this Block must include validation by the CARC. For this purpose, the validation statement below should be included in the Block 21 itself, and not referred in a separate document. The statement can be pre-printed, computer generated or stamped, and should be followed by the signature of the representative of the CARC validating the certificate, the name and the position/identification of such representative of the CARC, and the date of such validation by the CARC.

VALIDATION STATEMENT: "After due inspection *CARC* is satisfied that this document constitutes an accurate and valid Statement of Conformity in accordance with Part 21 Subpart F."

AMC No. 2 to 21.130(b) Statement of Conformity for Products (other than complete aircraft), parts, appliances and materials - The Authorized Release Certificate (CARC Form 227)

A. INTRODUCTION

This GM relates only to the use of the JCAR form 227 or equivalent for manufacturing purposes. Attention is drawn to Part 21, and Appendix I to Part 145 which covers the use of the JCAR form 227 or equivalent for maintenance purposes.

1. PURPOSE AND SCOPE

Under Part 21 Subpart F, the primary purpose of the certificate is to release products (other than complete aircraft), parts, appliances (hereafter referred to as 'item(s)') and/or material as identified in Blocks 7 through 11 as applicable after manufacture, or to release maintenance work carried out on items under the approval of the CARC.

The JCAR form 227 or equivalent is prepared and signed by the manufacturer. For production under Part 21 Subpart F it is presented for validation by the CARC.

- The Certificate referenced JCAR form 227 or equivalent is called the Authorized Release Certificate.
- The Certificate is to be used for import purposes, as well as for domestic and intra-Community purposes, and serves as an official certificate for the delivery of items from the manufacturer to users. The Certificate is not a delivery or shipping note.
- Under Subpart F the Certificate may only be issued by the CARC.
- Aircraft are not to be released using the Certificate.
- A mixture of 'New' and 'Used' items is not permitted on the same Certificate.
- A mixture of items certified in conformity with 'approved data' and to 'non-approved data' is not permitted on the same Certificate, and consequently only one box in Block 14 can be ticked.
- A mixture of items released under Subpart G and under Subpart F of Part 21 is not permitted on the same Certificate.

2. GENERAL

By reference to Part 21, the Certificate must comply with the format attached including block numbers and the location of each Block. The size of each Block may however be varied to suit the individual application, but not to the extent that would make the Certificate unrecognizable. The overall size of the Certificate may be significantly increased or decreased so long as the Certificate remains recognizable and legible. If in doubt consult the CARC.

Please note that the User responsibility statements are normally placed on the reverse of this Certificate, but they may be added to the front of the Certificate by reducing the depth of the Form.

All printing must be clear and legible to permit easy reading.

The Certificate may either be pre-printed or computer generated but in either case the printing of lines and characters must be clear and legible. Pre-printed wording is permitted in accordance with the attached model but no other certification statements are permitted.

English and, where required, Bilingual English and Arabic language are acceptable.

The details to be entered on the Certificate may be either machine/computer printed or handwritten using block letters, and must permit easy reading. Abbreviations must be restricted to a minimum. The space remaining on the reverse side of the Certificate may be used by the originator for any additional information but must not include any certification statement.

The original Certificate must accompany the items and correlation must be established between the Certificate and the item(s). A copy of the Certificate must be retained by the manufacturer of the item and the CARC. Where the Certificate format and the data is entirely computer generated, subject to acceptance by the CARC, it is permissible to retain the Certificate format and data on a secure database.

There is no restriction in the number of copies of the Certificate sent to the customer or retained by the originator.

The Certificate that accompanies the item may be attached to the item by being placed in an envelope for durability.

3. COMPLETION OF THE RELEASE CERTIFICATE BY THE ORIGINATOR

By reference to Part 21, except as otherwise stated, there must be an entry in all Blocks to make the document a valid certificate.

- Block 1 pre-printed “CARC”

- Block 2 Pre-printed “Authorized Release Certificate/CARC Form 227”.

- Block 3 A unique number must be pre-printed in this Block for Certificate control and traceability purposes except that in the case of a computer generated document, the unique number need not be pre-printed where the computer is programmed to produce the number.

- Block 4 The information in this Block needs to satisfy two objectives:

    1) To relate the Certificate to the manufacturer, for the purposes of verifying authenticity and authority of the Certificate;
    2) To provide a ready means of rapidly identifying the place of manufacture and release, to facilitate traceability and communication in the event of problems or queries.
    Therefore, the name entered in the box is that of the manufacturer, who is responsible for making the final determination of conformity or airworthiness. The name must be entered in exactly the same form as appears in the letter of agreement.

    The address(es) entered in Block 4 will assist in the identification of the manufacturer AND in identifying the place of release.

If the place of manufacture and release is one of the organization addresses listed on the letter of agreement, then that is the only address needed in this Block.

If the place of manufacture and release is a location which is NOT listed in the letter of agreement then two addresses are required. The first address will be the address of the manufacturer (as listed in the letter of agreement) and a second address entered to identify the place of manufacture and release.

This Block may be pre-printed. Logo of the manufacturer, etc., is permitted if it can be contained within the Block.

- Block 5 The purpose of this Block is to reference work order/contract/invoice or any other internal organizational process such that a fast traceability system can be established. The use of the Block for such traceability is strongly recommended in the absence of item Serial Numbers or batch numbers. When not used, state "N/A".

- Block 6 The Block is provided for the convenience of the manufacturer issuing the Certificate to permit easy cross-reference to the 'Remarks' Block 13 by the use of line item numbers. Block 6 must be completed where there is more than one line item.

  Where a number of items are to be released on the Certificate, it is permissible to use a separate listing cross-referring Certificate and list to each other.

- Block 7 The name or description of the item must be given. Preference must be given to use of the Illustrated Parts Catalogue (IPC) designation. The description is to include reference to any applicable JTSO Authorization or EPA marking.

- Block 8 State the Part Number. Preference must be given to use of the IPC number designation.

- Block 9 Used to indicate the type-approved applications for which the released items are eligible for installation, based on the information provided by the design approval holder by virtue of the arrangement described in 21.4 and 21.122.

  The following entries are permitted;

  a. At least one specific or series aircraft, propeller, or engine model as identified by the design approval holder. In case of engine or propeller release, state the aircraft approved applications, or, if application is not specific, state "type certificated engine/propeller". In case of JTSO article state either the type-approved applications or "JTSO article N/A". In case of items to be installed in a JTSO article, state either "JTSO article N/A" or the JTSO article part number.

  b. 'None', to be used only when it is known that the items do not yet have a type-approved application, for example: pending type-certificate, for test only, pending approved data. If this category is used, then appropriate explanatory information must be provided in Block 13 and new items may only be released for Conformity purposes.

c. 'Various' if known by virtue of the arrangements under 21.122 to be eligible for installation on multiple type approved products, according to a procedure approved by the CARC in charge of the manufacturer under Part 21 Subpart F surveillance.

In the case of multiple type-approved application it is acceptable for this Block to contain cross reference to an attached document which lists such applications.

Any information in Block 9 does not constitute authority to fit the item to a particular aircraft, engine or propeller. The User/Installer must confirm via documents such as the Parts Catalogue, Service Bulletins, etc., that the item is eligible for the particular installation.

Any information in Block 9 does not necessarily mean that the items are only eligible for installation on the listed model(s). Nor does it guarantee that the items are eligible for installation on all entries in Block 9. Eligibility may be affected by modification or configuration changes.

Where a part is identified by the design holder in accordance with officially recognized Standards, then the part is considered a Standard Part and release with a CARC form 227 or equivalent is not necessary. However where a manufacturer under Part 21 Subpart F releases a Standard Part with a CARC form 227 or equivalent then he or she should be able to demonstrate that it is in control of the manufacture of that part.

- Block 10 State the quantity of items being released.

- Block 11 State the item Serial Number or Batch Number if applicable, if neither applicable, state 'N/A'.

- Block 12 Enter one or a combination of appropriate standard words from the following table. The table lists, in quotes, the standard words permitted for use when releasing new items prior to entry into service, i.e., the items have not been previously used in operational service. It also details the circumstances and conditions under which they may be used. In all cases the certification rules relating to Block 14 apply, the appropriate box is to be marked, and Block 15 is to be signed.

TABLE OF STANDARD WORDS FOR NEW ITEMS

1. 'MANUFACTURED'

a. The production of a new item in conformity with the applicable design data.
b. Re-certification by the original manufacturer after rectification work on a item, previously released under 1(a) above, which has been found to be unserviceable prior to entry into service, e.g., defective, in need of inspection or test, or shelf life expired. Details of the original release and the rectification work are to be entered in Block 13; or Re-certification of new items from Conformity purpose to airworthiness purpose at the time of approval of the applicable design data, provided that the items conform to the approved design data. An explanation of the basis of release and details of the original release are to be entered in Block 13.

2. ‘INSPECTED’/’TESTED’

The examination of a previously released new item;

a. to establish conformity with the applicable design data, or

b. in accordance with a customer-specified standard or specification, details of which are to be entered in Block 13, or

c. to establish serviceability and condition for safe operation prior to re-release as a spare, where the item has been obtained with a CARC Form 227. An explanation of the basis of release and details of the original release are to be entered in Block 13.

3. ‘MODIFIED’

The alteration, by the original manufacturer, of a previously released item prior to entry into service. Details of the alteration and the original release are to be entered in Block 13.

The above statements must be supported by reference to the approved data/ manual/specification. Such information shall be identified in either Block 12 or 13.

Block 13 It is necessary to state any information in this Block, either directly or by reference to supporting documentation, that identifies particular data or limitations relating to the item being released that are necessary for the User/Installer to make the final airworthiness determination of the item. The information must be clear, complete, and provided in a form and manner which is adequate for the purpose of making such a determination.

Each statement must be clearly identified as to which item it relates.

If there is no statement, state ‘None’.

Examples of conditions which would necessitate statements in Block 13 are;

- When the certificate is used for Conformity purposes the following statement must be entered at the beginning of Block 13:

  ‘ONLY FOR CONFORMITY, NOT ELIGIBLE FOR INSTALLATION ON IN SERVICE TYPE-CERTIFICATED AIRCRAFT/ENGINE/PROPELLER’.

- When the design data is not approved by the CARC , then the CARC of a third country responsible for the approval of the design data must be identified and the following statement must be entered together with a reference identifying the approval:

  “Design data approved by <identify the responsible authority of a third country and the approval reference>”.

- Re-certification of new items from Conformity purpose to airworthiness purpose at the time of approval of the applicable design data, provided that the items conform to the approved design data.

Provided that no change in design has occurred during the design data approval process, the manufacturer may state that the design data has been approved and that provided the specific component is still in the condition it was when it was shipped to the user/installer, the component is now eligible to be installed. The manufacturer must make this statement on a second CARC form 227 or equivalent where in addition to any other necessary remarks, appropriate explanatory information must be provided. The following wording must be used: 'RE-CERTIFICATION OF NEW PARTS FROM CONFORMITY TO AIRWORTHINESS: THIS DOCUMENT ONLY CERTIFIES THE APPROVAL OF THE DESIGN DATA TO WHICH THIS ITEM (THESE ITEMS) WERE MANUFACTURED, BUT DOES NOT COVER CONFORMITY/CONDITION AFTER RELEASE OF THE INITIAL CARC FORM 227 OR EQUIVALENT REF .....'. CARC form 227 or equivalent (both for 'Conformity purposes' and for 'Airworthiness purposes') must be generated by the same organization, i.e., the original manufacturer or prime manufacturer, whichever raised the original CARC form 227 or equivalent for Conformity purposes.

- For complete engines and propellers the applicable type-certificate must be referenced.
- For complete engines and propellers, any additional export statement required by the importing country, as normally defined in the type-certificate data sheet.
- For complete engines, a statement of compliance with the applicable emissions requirements current at the date of manufacture of the engine
- For JTSO articles state the applicable JTSO Authorization number
- Usage restriction for repaired items
- Modification standard
- Alternative approved items supplied
- Concessions applicable
- Non-compliance with CS
- Details of repair work carried out or reference to a document where this is stated
- Compliance with or non-compliance with airworthiness directives or Service Bulletins
- Information on life limited items
- Condition of items or reference to a document detailing this information
- Manufacturing date or cure date
- Shelf life data
- Shortages
- Time Since New (TSN), Time Since Overhaul (TSO), etc.
- Exceptions to the notified special requirements of the importing country
- Specially configured to meet the notified special requirements of the importing country
- Re-certification of previously released 'new' items

Additionally, for production under Subpart F, this Block must include the Statement of Conformity by the manufacturer under 21.130. For this purpose, the appropriate Block 14 statement must be included in the Block 13 and not referred in a separated document. The Statement may be pre-printed, computer generated or stamped, and must be followed by the signature of the manufacturer authorized person under 21.130(a), the name and the position/identification of such person and the date of the signature.

Block 14 This Block must only be used to indicate the status of new items.

The main purpose of the Certificate is to release items for airworthiness purposes, which means conformity with approved design data and in condition for safe operation.

This airworthiness certification is considered by the CARC to be valid world-wide unless there are specific notified import conditions.

When using the CARC form 227 or equivalent issued for airworthiness purposes to satisfy such notified import conditions, compliance with these import conditions is certified according to bilateral agreement or other working arrangement. As the Part number is stated in Block 8 and compliance with any specific import conditions is entered in Block 13, 'approved' then means approved by the Authority of the importing country.

The certificate may also be used as a Conformity Certificate when items conform to applicable design data which are not approved for a reason which is stated in Block 13 (e.g., pending type-certificate, for test only, pending approved data).

In this case the following additional statement must be entered at the beginning of Block 13 itself and not in a separate document:

'ONLY FOR CONFORMITY, NOT ELIGIBLE FOR INSTALLATION ON IN-SERVICE TYPE-CERTIFICATED AIRCRAFT/ENGINE/PROPELLER'.

Mixtures of items released for Airworthiness and for Conformity purposes are not permitted in the same certificate. Also refer to the notes for completion of Block 9.

Block 15 The hand-written normal signature of the CARC representative validating the Block 13 manufacturer Statement of Conformity, under 21.130(d).

Use of a stamp instead of a signature is not permitted, but the authorized person may add a stamp impression to his or her signature to aid recognition.

Block 16 State the full reference of the letter of agreement given by the CARC to the manufacturer working under Part 21 Subpart F.

Block 17 The name of the person signing Block 15, printed, typed, or written in a legible form.

Block 18 The date on which Block 15 is signed, in the format day/month/year. The month must be stated in letters (sufficient letters must be used so there can be no ambiguity as to the month intended).

Block 19 Not used and strike out for release of new items.
Block 20 Not used and strike out for release of new items.

Block 21 Not used and strike out for release of new items.

Block 22 Not used and strike out for release of new items.

Block 23 Not used and strike out for release of new items.

AMC 21.130(c) Validation of the Statement of Conformity

It is the responsibility of the applicant to ensure that each and every product, part and appliance

conforms to the applicable design data and is in condition for safe operation before issuing and signing the relevant Statement of Conformity. During manufacture, the applicant is expected to use such facilities, systems, processes and procedures as are described in the Manual and have been previously agreed with the CARC.

The CARC must then make such inspection and investigation of records and product, part or appliance as are necessary to determine that the agreed facilities, systems, processes and procedures have been used, and that the Statement of Conformity may be regarded as a valid document.

To enable timely inspection and investigation by the CARC, the Statement of Conformity must be prepared and submitted to the CARC immediately upon satisfactory completion of final production inspection and test.

AMC 21.130(c)(1) Initial transfer of ownership

Upon transfer of ownership:

a) For a complete aircraft, whether or not an application for a Certificate of Airworthiness is to be made, a CARC Form 287 must be completed and submitted to the CARC for validation.

b) For anything other than a complete aircraft a CARC Form 287 is inappropriate, and a CARC Form 227 must be completed and submitted to the CARC for validation.

NOTE: If there is any significant delay between the last production task and presentation of the CARC Form 287 or CARC form 227 or equivalent to the CARC, then additional evidence relating to the storage, preservation and maintenance of the item since its production must be presented to the CARC.

Subpart G-Production organization approval for products, parts and appliances

GM 21.131 Scope-Applicable design data

Applicable design data is defined as all necessary drawings, specifications and other technical information provided by the applicant for, or holder of a design organization approval, TC, STC, approval of repair or minor change design, or JTSO Authorization (or equivalent when Part 21 Subpart G is used for production of products, parts or appliances, the design of which has been approved other than according to Part 21) and released in a controlled manner to a production organization approval holder. This should be sufficient for the development of production data to enable repeatable manufacture to take place in conformity with the design data.

Prior to issue of the TC, STC, approval of repair or minor change design or JTSO Authorization, or equivalent, design data is defined as ‘not approved’ but parts and appliances may be released with CARC form 227 or equivalent as a certificate of conformity.

After issue of the TC, STC, approval of repair or minor change or JTSO Authorization, or equivalent, this design data is defined as ‘approved’ and items manufactured in conformity are eligible for release on a CARC form 227 or equivalent for airworthiness purposes.

GM 21.133(a) Eligibility-Approval appropriate for showing conformity

'Appropriate' should be understood as follows:

- The applicant produces or intends to produce aeronautical products, parts, appliances and/or materials intended for airborne use as part of a type-certificated product (this excludes simulators, ground equipment and tools).

- The applicant will be required to show a need for an approval, normally based on one or more of the following criteria:

  1. Production of aircraft, engines or propellers (except if the CARC considers a POA inappropriate)

  2. Production of JTSO articles and parts marked JPA

  3. Direct delivery to users such as owners or operators maintenance organizations with the need for exercising the privileges of issuing Authorized Release Certificates-CARC form 227 or equivalent

  4. Participation in an international co-operation program where working under an approval is considered necessary by the CARC

  5. Criticality and technology involved in the part, appliance, or material being manufactured. Approval in this case may be found by the CARC as the best tool to exercise its duty in relation to airworthiness control

  6. Where an approval is otherwise determined by CARC as being required to satisfy the essential requirements of JCAR.

- It is not the intent of CARC to issue approvals to manufacturing firms that perform only sub-contract work for main manufacturers of products and are consequently placed under their direct surveillance.

- Where standard parts, materials, processes or services are included in the applicable design data (see guidance on applicable design data in GM 21.131) their standards should be controlled by the POA holder in a manner which is satisfactory for the final use of the item on the product, part or appliance. Accordingly, the manufacturer or provider of the following will not at present be considered for production organization approval:

  - consumable materials
  - standard parts
  - parts identified in the product support documentation as 'industry supply' or 'no hazard'
  - non-destructive testing or inspection
  - processes (heat treatment, surface finishing, shot peening, etc.

AMC No. 1 to 21.133(b) and (c) Eligibility-Link between design and production organizations

An arrangement is considered appropriate if it is documented and satisfies the CARC that co-ordination is satisfactory.

To achieve satisfactory coordination the documented arrangements must at least define the following aspects irrespective of whether the two organizations are separate legal entities or not:

- The responsibilities of a design organization which assure correct and timely transfer of up-to-date airworthiness data (e.g., drawings, material specifications, dimensional data, processes, surface treatments, shipping conditions, quality requirements, etc.);

- The responsibilities and procedures of a POA holder/applicant for developing, where applicable, its own manufacturing data in compliance with the airworthiness data package;

- The responsibilities of a POA holder/applicant to assist the design organization in dealing with continuing airworthiness matters and for required actions (e.g., traceability of parts in case of direct delivery to users, retrofitting of modifications, traceability of processes' outputs and approved deviations for individual parts as applicable, technical information and assistance, etc.);

- The scope of the arrangements must cover Part 21 Subpart G requirements and associated AMC and GM, in particular: 21.145(b), 21.165(c), (f) and (g);

- The responsibilities of a POA holder/applicant, in case of products prior to type certification to assist a design organization in showing compliance with CS (access and suitability of production and test facilities for manufacturing and testing of prototype models and test specimen);

- The procedures to deal adequately with production deviations and non conforming parts;

- The procedures and associated responsibilities to achieve adequate configuration control of manufactured parts, to enable the production organization to make the final determination and identification for conformity or airworthiness release and eligibility status;

- The identification of the responsible persons/offices who control the above;

- The acknowledgment by the holder of the TC/STC/repair or change approval/JTSO Authorization that the approved design data provided, controlled and modified in accordance with the arrangement are recognized as approved.

In many cases the production organization may receive the approved design data through an intermediate production organization. This is acceptable provided an effective link between the design approval holder and the production organization can be maintained to satisfy the intent of 21.133.

When the design and production organizations are two separate legal entities a Direct Delivery Authorization must be available for direct delivery to end users in order to guarantee continued airworthiness control of the released parts and appliances.

Where there is no general agreement for Direct Delivery Authorization, specific permissions may be granted (refer to AMC 21.4).

AMC No. 2 to 21.133(b) and (c) Eligibility-Link between design and production organizations

In accordance with AMC No.1 to 21.133(b) and (c) the POA holder must demonstrate to the CARC that it has entered into an arrangement with the design organization. The arrangement must be documented irrespective of whether the two organizations are separate legal entities or not.

The documented arrangement must facilitate the POA holder to demonstrate compliance with the requirement of 21.133(b) and (c) by means of written documents agreed.

In the case where the design organization and POA holder are part of the same legal entity these interfaces may be demonstrated by company procedures accepted by the CARC.

In all other cases to define such a design/production interface the following sample format is offered:

Arrangement Sample Form

ARRANGEMENT **i.a.w. 21.133(b) and (c)**	
The undersigned agree on the following commitments:	relevant interface procedures
The design organization [NAME] takes responsibility to: • assure correct and timely transfer of up-to-date applicable design data (e.g., drawings, material specifications, dimensional data, processes, surface treatments, shipping conditions, quality requirements, etc.) to the production organization approval holder [NAME] • provide visible statement(s) of approved design data	
The production organization approval holder [NAME] takes responsibility to: • assist the design organization [Name] in dealing with continuing airworthiness matter and for required actions • assist the design organization [Name] in case of products prior to type certification in showing compliance with airworthiness requirements • develop, where applicable, its own manufacturing data in compliance with the airworthiness data package	
The design organization [Name] and the POA holder [Name] take joint responsibility to: • deal adequately with production deviations and non conforming parts in accordance with the applicable procedures of the design organization and the production organization approval holder • achieve adequate configuration control of manufactured parts, to enable the POA holder to make the final determination and identification for conformity or airworthiness release and eligibility status.	
The scope of production covered by this arrangement is detailed in ... [DOCUMENT REFERENCE/ ATTACHED LIST]	

<table>
<tr><td colspan="2">[When the design organization is not the same legal entity as the production organization approval holder]

Transfer of approved design data
The TC/STC/JTSO holder [NAME] acknowledges that the approved design data provided, controlled and modified in accordance with the arrangement are recognized as approved.</td></tr>
<tr><td colspan="2">[When the design organization is not the same legal entity as the production organization approval holder]

Direct Delivery Authorization
This acknowledgment includes also [OR does not include] the general agreement for direct delivery to end users in order to guarantee continued airworthiness control of the released parts and appliances.</td></tr>
<tr><td>for the [NAME of the design organization/DOA holder]

date signature
xx.xx.xxxx

([NAME in block letters])</td><td>for the [NAME of the POA holder]

date signature
xx.xx.xxxx

([NAME in block letters])</td></tr>
</table>

Instructions for completion:

Title: The title of the relevant document must clearly indicate that it serves the purpose of a design/production interface arrangement in accordance with 21.133(b) and (c).

Commitment: The document must include the basic commitments between the design organization and the POA holder as addressed in AMC 21.4 and AMC No. 1 to 21.133(b) and (c).

Relevant Procedures: Identify an entry point into the documentary system of the organizations with respect to the implementation of the arrangement (for example a contract, quality plan, handbooks, common applicable procedures, working plans etc.).

Scope of arrangement: The scope of arrangement must state by means of a list or reference to relevant documents those products, parts or appliances that are covered by the arrangement.

Transfer of applicable design data: Identify the relevant procedures for the transfer of the applicable design data required by 21.131 and AMC 21.131 from the design organization to the POA holder. The means by which the design organization advises the POA holder whether such data is approved or not approved must also be identified (ref. 21.4/AMC 21.4).

Direct Delivery Authorization: Where the design organization and the POA holder are separate legal entities the arrangement must clearly identify whether Authorization for direct delivery to end users is permitted or not.

Where any intermediate production/design organizations are involved in the chain between the original design organization and the POA holder evidence must be available that this intermediate organization has received authority from the design organization to grant Direct Delivery Authorization.

Signature: AMC No. 1 to 21.133(b) and (c) requests the identification of the responsible persons/offices who control the commitments laid down in the arrangement. Therefore the basic document must be signed mutually by the authorized representatives of the design organization and

the POA holder in this regard.

GM 21.134 Application-Application form and manner

CARC Form 286 should be obtained from the CARC, and completed by the accountable manager of the organization.

The completed form, an outline of the production organization exposition, and details of the proposed terms of approval are to be forwarded to the CARC.

GM No. 1 to 21.139(a) Quality System

The quality system is an organizational structure with responsibilities, procedures, processes, and resources which implement a management function to determine and enforce quality principles.

The quality system should be documented in such a way that the documentation can be made easily available to personnel who need to use the material for performing their normal duties, in particular:

- procedures, instructions, data to cover the issues of 21.139(b)(1) are available in a written form,
- distribution of relevant procedures to offices/persons is made in a controlled manner,
- procedures which identify persons responsible for the prescribed actions are established,
- the updating process is clearly described.

The manager responsible for ensuring that the quality system is implemented and maintained should be identified.

The CARC will verify on the basis of the exposition and by appropriate investigations that the production organization has established and can maintain their documented quality system.

GM No. 2 to 21.139(a) Quality System-Conformity of supplied parts or appliances

The POA holder is responsible for determining and applying acceptance standards for physical condition, configuration status and conformity of supplied products, parts or appliances, whether to be used in production or delivered to customers as spare parts. This responsibility also includes BFE (Buyer Furnished Equipment) item.

To discharge this responsibility the quality system needs an organizational structure and procedures to adequately control external suppliers.

Control can be based upon use of the following techniques (as appropriate to the system or product orientation necessary to ensure conformity).

- qualification and auditing of supplier’s quality system,
- evaluation of supplier capability in performing all manufacturing activities, inspections and tests necessary to establish conformity of parts or appliances to type design,
- first article inspection, including destruction if necessary, to verify that the article conforms to the applicable data for new production line or new supplier,
- incoming inspections and tests of supplied parts or appliances that can be satisfactorily inspected on receipt,

- identification of incoming documentation and data relevant to the showing of conformity to be included in the certification documents,
- a vendor rating system which gives confidence in the performance and reliability of this supplier,
- any additional work, tests or inspection which may be needed for parts or appliances which are to be delivered as spare parts and which are not subjected to the checks normally provided by subsequent production or inspection stages.

The POA holder may rely on inspection/tests performed by supplier if it can establish that:

- personnel responsible in charge of these tasks satisfy the competency standards of the POA quality system,
- quality measurements are clearly identified,
- the records or reports showing evidence of conformity are available for review and audit.

The control of suppliers holding a POA for the parts or appliances to be supplied can be reduced, to a level at which a satisfactory interface between the two quality systems can be demonstrated. Thus, for the purpose of showing conformity, a POA holder can rely upon documentation for parts or appliances released under suppliers 21.163 privileges.

A supplier who does not hold a POA is considered as a sub-contractor under the direct control of the POA quality system.

The POA holder retains direct responsibility for inspections/tests carried out either at its own facilities or at supplier's facilities.

GM 21.139(b)(1) Quality System-Elements of the quality system

1. The control procedures covering the elements of 21.139(b) (1) should document the standards to which the production organization intends to work.
2. An organization having a Quality system designed to meet a recognized Standard such as ISO 9002 (relevant to the scope of approval being requested) should expand it to include at least the following additional topics, as appropriate, in order to show compliance with the requirements of Part 21 Subpart G:

- Mandatory Occurrence Reporting and continued airworthiness as required by 21.165(e)
- Control of work occasionally performed (outside the POA facility by POA personnel)
- Co-ordination with the applicant for, or holder of, an approved design as required by 21.133(b) and (c) and 21.165(g)
- Issue of certifications within the scope of approval for the privileges of 21.163
- Incorporation of airworthiness data in production and inspection data as required in 21.133(b) and (c) and 21.145(b)
- When applicable, ground test and/or production flight test of products in accordance with procedures defined by the applicant for, or holder of, the design approval
- Procedures for traceability including a definition of clear criteria of which items need such traceability. Traceability is defined as a means of establishing the origin of an article by reference to historical records for the purpose of providing evidence of conformity
- Personnel training and qualification procedures especially for certifying staff as required in 21.145(d).

3. An organization having a quality system designed to meet a recognized aerospace quality standard will still need to ensure compliance with all the requirements of Subpart G of Part 21. In all cases, the CARC will still need to be satisfied that compliance with Part 21 Subpart G is established.

GM No. 1 to 21.139(b)(2) Quality System-Independent quality assurance function

The quality assurance function which is part of the organization is required to be independent from the functions being monitored. This required independence relates to the lines of reporting, authority and access within the organization and assumes an ability to work without technical reliance on the monitored functions.

GM No. 2 to 21.139(b)(2) Quality System-Adequacy of procedures and monitoring function

Adequacy of procedures means that the quality system, through the use of the procedures as set forth, is capable of meeting the conformity objectives identified in 21.139(a).
The quality assurance function to ensure the above should perform planned continuing and systematic evaluations or audits of factors that affect the conformity (and, where required, safe operation) of the products, parts, appliances and/or materials to the applicable design. This evaluation should include all elements of the quality system in order to show compliance with Part 21 Subpart G.

GM 21.143 Exposition-Production organization exposition

The purpose of the POE is to set forth in a concise document format the organizational relationships, responsibilities, terms of reference, and associated authority, procedures, means and methods of the organization.

The information to be provided is specified in 21.143(a). Where this information is documented and integrated in manuals, procedures and instruction, the POE should provide a summary of the information and an appropriate cross reference.

The CARC requires the POE to be an accurate definition and description of the production organization. The document does not require approval in itself, but it will be considered as such by virtue of the approval of the organization.

When changes to the organization occur, the POE is required to be kept up to date per a procedure, laid down in the POE. Significant changes to the organization (as defined in GM 21.147(a)) should be approved by the CARC prior to update of the POE.

When an organization is approved against any other implementing rule containing a requirement for an exposition, a supplement covering the differences may suffice to meet the requirements of Part 21 Subpart G except that the supplement should have an index identifying where those parts missing from the supplement are covered. Those items then formally become part of the POE. In any combined documents the POE should be easily identifiable.

GM 21.145(a) Approval Requirements

A facility is a working area where the working conditions and the environment are controlled as appropriate in respect of: cleanliness, temperature, humidity, ventilation, lighting, space/access, noise, air pollution.

Equipment and tools should be such as to enable all specified tasks to be accomplished in a repeatable manner without detrimental effect. Calibration control of equipment and tools which affect critical dimensions and values should show compliance with, and be traceable to, national or international standards.

Sufficient personnel means that the organization has for each function according to the nature of the work and the production rate, a sufficient quantity of qualified personnel to accomplish all specified manufacturing tasks and to attest the conformity. Their number should be such that airworthiness consideration may be applied in all areas without undue pressure.

An evaluation of the competence of personnel is performed as part of the quality system. This should include, where appropriate, verification that specific qualification standards have been implemented, for example NDT, welding, etc. Training should be organized to establish and maintain the personal competence levels determined by the organization to be necessary.

GM 21.145(b)(2) Approval Requirements-Airworthiness, noise, fuel venting and exhaust emissions /production data procedures

1. When a POA holder/applicant is developing its own manufacturing data, such as computer based data, from the design data package delivered by a design organization, procedures are required to demonstrate the right transcription of the original design data.

2. Procedures are required to define the manner in which airworthiness, noise, fuel venting and exhaust emissions data is used to issue and update the production/quality data, which determines the conformity of products, parts and appliances. The procedure must also define the traceability of such data to each individual product, part or appliance for the purpose of certifying condition for safe operation and issuing a Statement of Conformity or CARC Form 227.

GM 21.145(c) (1) Approval Requirements-Accountable manager

Accountable manager means the manager who is responsible, and has corporate authority for ensuring that all production work is carried out to the required standard. This function may be carried out by the Chief Executive or by another person in the organization, nominated by him or her to fulfill the function provided his or her position and authority in the organization permits to discharge the attached responsibilities.

The manager is responsible for ensuring that all necessary resources are available and properly used in order to produce under the production approval in accordance with Part 21 Subpart G.

The manager needs to have sufficient knowledge and authority to enable him or her to respond to the CARC regarding major issues of the production approval and implement necessary improvements.

The manager needs to be able to demonstrate that he or she is fully aware of and supports the quality policy and maintains adequate links with the quality manager.

GM 21.145(c)(2) Approval Requirements-Responsible managers

The person or persons nominated should represent the management structure of the organization and be responsible for all functions as specified in Part 21 Subpart G. It therefore follows that, depending on the size of the Part 21 Subpart G organization, the functions may be subdivided under individual managers (and in fact may be further subdivided) or combined in a variety of ways.

The CARC requires the nominated managers to be identified and their credentials submitted on CARC Form 285 (see format in CARC administrative procedures) to the CARC in order that they may be seen to be appropriate in terms of relevant knowledge and satisfactory experience related to the nature of the production activities as performed by the Part 21 Subpart G organization.

The responsibilities and the tasks of each individual manager are required to be clearly defined, in order to prevent uncertainties about the relations, within the organization. In the case of organization structures where staff-members are responsible to more than one person, as for instance in matrix and project organizations, responsibilities of the managers should be defined in such a way that all responsibilities are covered.
Where a Part 21 Subpart G organization chooses to appoint managers for all or any combination of the identified Part 21 functions because of the size of the undertaking, it is necessary that these managers report ultimately to the accountable manager. In cases where a manager does not directly report to the accountable manager, he or she should have a formally established direct access to the accountable manager.

One such manager, normally known as the quality manager is responsible for monitoring the organization's compliance with Part 21 Subpart G and requesting remedial action as necessary by the other managers or the accountable manager as appropriate. He or she should have a direct access to the accountable manager.

AMC 21.145(d) (1) Approval Requirements-Certifying staff

1. Certifying Staff are nominated by the production organization to ensure that products, parts, appliances and/or materials qualify for Statements of Conformity or Release Certificates. Certifying Staff positions and numbers are to be appropriate to the complexity of the product and the production rate.

2. The qualification of certifying staff is based on their knowledge, background and experience and a specific training (or testing) established by the organization to ensure that it is appropriate to the product, part, or appliance to be released.

3. Training must be given to develop a satisfactory level of knowledge of organization procedures, aviation legislation, and associated implementing rules, CS and GM, relevant to the particular role.

4. For that purpose, in addition to general training policy, the organization must define its own standards for training, including pre-qualification standards, for personnel to be identified as certifying staff.

5. Training policy is part of the Quality System and its appropriateness forms part of investigation by the CARC within the organization approval process and subsequent surveillance of persons proposed by managers.

6. The training must be updated in response to experience gained and changes in technology.

7. A feedback system to ascertain that the required standards are being maintained must be put in place to ensure the continuing compliance of personnel to Authorization requirements.

8. For release of products, parts or appliances, the responsibilities to issue statements of conformity/release certificates (CARC Form 227) are allocated to the certifying staff identified in 21.145 (d)(2).

9. The CARC holds the right to reject those personnel, appointed by the organization, if found to have inappropriate experience or not to otherwise comply with its requirements.

AMC 21.145(d)(2) Approval Requirements-Record of certifying staff

1. The following is the minimum information to be recorded in respect of each certifying person:

   a. Name
   b. Date of Birth
   c. Basic Training and standard attained
   d. Specific Training and standard attained
   e. If appropriate – Continuation Training
   f. Experience
   g. Scope of the Authorization
   h. Date of first issue of the Authorization
   i. If appropriate – expiry date of the Authorization
   j. Identification Number of the Authorization

2. The record may be kept in any format and must be controlled by an internal procedure of the organization. This procedure forms part of the quality system.

3. Persons authorized to access the system must be maintained at a minimum to ensure that records cannot be altered in an unauthorized manner and that confidential records cannot become accessible to unauthorized persons.

4. The certifying person must be given reasonable access on request to his or her own records.

5. Under the provision of 21.157 the CARC has a right of access to the data held in such a system.

6. The organization must keep the record for at least two years after the certifying person has ceased employment with the organization or withdrawal of the Authorization, whichever is the sooner.

AMC 21.145(d)(3) Approval requirements-Evidence of Authorization

1. The Authorization document must be in a style that makes its scope clear to the certifying staff and any authorized person who may require to examine the Authorization. Where codes are used to define scope, an interpretation document should be readily available.

2. Certifying staff are not required to carry the Authorization document at all times but should be able to make it available within a reasonable time of a request from an authorized person. Authorized persons include the CARC.

GM 21.147(a) Changes to the approved production organization-Significant changes

1. Changes to be approved by the CARC include:

   - Significant changes to production capacity or methods.
   - Changes in the organization structure especially those parts of the organization in charge of quality.
   - A change of the accountable manager or of any other person nominated under 21.145 (c)(2).
   - Changes in the production or quality systems that may have an important impact on the conformity/airworthiness of each product, part or appliance.
   - Changes in the placement or control of significant sub-contracted work or supplied parts.

2. To ensure that changes do not result in non-compliance with Part 21 Subpart G it is in the interest of both the CARC and the approval holder to establish a relationship and exchange information that will permit the necessary evaluation work to be conducted before the implementation of a change. This relationship should also permit agreement on the need for variation of the terms of approval (ref 21.143(a)(9)).

3. Where a change of name or ownership results in the issue of a new approval the investigation will normally take account of the CARC's knowledge and information from the preceding approval.

4. Changes of location are addressed in 21.148 and changes of ownership in 21.149, change of scope of approval in 21.153.

AMC 21.148 Changes of location-Management during change of location

1. The relocation of any work, to an unapproved location, or a location with inappropriate scope of approval, constitutes a change of significance to the organization and requires approval by the CARC as prescribed in 21.147. An unapproved relocation will invalidate the production organization approval, and may necessitate re-application for any similar approval required at the new location. However, suitable transitional arrangements may be agreed with the CARC, in advance of the relocation, which can allow continuation of the approval.

2. When an organization expands its facility to include a new production location or moves parts of its production to a new location the production organization approval may continue in force, but the approval does not include the new location until the CARC has indicated its satisfaction with the arrangements.

3. For a change in location, taking an extended period of time, suitable transitional arrangements would require preparation of a co-ordination plan for the removal. The plan must, at least, identify the following:

    a. A clearly identified person, or group of persons, responsible for co-ordinating the removal and acting as focal point for communication with all parties, including the CARC.
    b. The basis of the co-ordination plan, e.g., whether by product or area.
    c. Planned timing of each phase of relocation.
    d. Arrangements for maintaining the standards of the approval up to the point where the production area is closed down.
    e. Arrangements for verifying continued production quality upon resumption of work at the new location.
    f. Arrangements for check and/or re-calibration of inspection aids or production tools and jigs before resuming production.
    g. Procedures which ensure that goods are not released from the new location until their associated production and quality systems have been verified.
    h. Arrangements for keeping the CARC informed of progress with the relocation.

4. From the co-ordination plan, the CARC can determine the points at which it wishes to conduct investigation.

5. If an agreed co-ordination plan is in operation, the CARC will normally allow the existing approval to remain in force and will, where appropriate, grant an additional approval to cover the new address for the duration of the move.

GM 21.149 Transferability

Transfer of approval would normally only be agreed in cases where the ownership changes but the organization itself remains effectively unchanged. For example:

An acceptable transfer situation could be a change of company name (supported by the appropriate certificate from the National Companies Registration Office or equivalent) but with no changes to site address, facilities, type of work, staff, accountable manager or person nominated under 21.145.

Alternatively, in the event of receivership (bankruptcy, insolvency or other equivalent legal process) there may be good technical justification for continuation of the approval provided that the company continues to function in a satisfactory manner in accordance with their POE. It is likely that at a later stage the approval might be voluntarily surrendered or the organization transferred to new owners in which case the former paragraphs apply. If it does not continue to operate satisfactorily then the CARC could suspend or revoke the approval.

In order for the CARC to agree to a transfer of approval, it will normally prescribe it as a condition in accordance with 21.147(b) that the obligations and responsibilities of the former organization should be transferred to the new organization, otherwise transfer is not possible and application for a new approval will be required.

GM 21.151 Terms of approval-Scope and categories

Terms of approval document(s) will be issued by the CARC under 21.135 to identify the scope of work, the products, and/or categories for which the holder is entitled to exercise the privileges defined in 21.163.

The codes shown against each scope of work item are intended for use by the CARC for purposes such as managing, administering and filing details of approvals. It may also assist in the production and publication of a list of approval holders.

The scope of work, the Products, Parts, or Appliances for which the POA holder is entitled to exercise the privileges defined in 21.163 will be described by the CARC as follows:

FOR PRODUCTS:

1) General area, similar to the titles of the corresponding certification codes.
2) Type of Product, in accordance with the type-certificate.

FOR PARTS AND APPLIANCES:

1) General area, showing the expertise, e.g., mechanical, metallic structure.
2) Generic type, e.g., wing, landing gear, tyres.

SCOPE OF WORK	PRODUCTS/CATEGORIES
A1 Large Aeroplanes	State types
A2 Small Aeroplanes	“
A3 Large Helicopters	“
A4 Small Helicopters	“
A5 Gyroplanes	“
A6 Sailplanes	“
A7 Motor Gliders	“
A8 Manned Balloons	“
A9 Airships	“
A10 Microlight Aircraft	“
A11 Very Light Aeroplanes	“
A12 Other	“
B1 Turbine Engines	“
B2 Piston Engines	“
B3 APU’s	“
B4 Propellers	“

C1 Appliances: C2 Parts: C3 Materials	State appliance generic types (e.g., Tyres, Altimeter, etc.) Examples include: Avionic, Com/Nav/Pulse Computer System, Aircraft/Engine/Avionic Instruments, Mechanical/Electrical/ Gyroscopic/Electronic Mechanical/Hydraulic/Pneumatic State part generic types (e.g., Wing, Landing Gear, etc.) Examples include: Structural, Metallic/non-metallic Mechanical/Hydraulic/Pneumatic Electrical Electronic
D1 Maintenance	State aircraft types

AMC 21.153 Changes to the terms of approval-Application for a change to the terms of approval

CARC Form 286 must be obtained from the CARC and completed in accordance with the procedures of the POE.

The information entered on the form is the minimum required by the CARC to assess the need for change of the production organization approval.

The completed form and an outline of the changed production organization exposition and details of the proposed change to POA terms of approval must be forwarded to the CARC.

GM 21.157 Investigations-Arrangements

The arrangements made by the applicant for, or holder of an approval under Part 21 Subpart G should allow the CARC to make investigations that include the complete production organization including partners, sub-contractors and suppliers, whether they are in the State of the applicant or not.

The investigation may include; audits, enquiries, questions, discussions and explanations, monitoring, witnessing, inspections, checks, flight and ground tests and inspection of completed products, parts or appliances produced under the POA.

In order to maintain its confidence in the standards achieved by a POA holder or applicant the CARC may make an investigation of a sample product part or appliance and its associated records, reports and certifications.

The arrangements should enable the organization to give positive assistance to the CARC and co-operate in performing the investigation during both initial assessment and for the subsequent surveillance to maintain the POA.

Co-operation in performing investigation means that the CARC has been given full and free access to the facilities and to any information relevant to show compliance to Part 21 Subpart G requirements, and assistance (personnel support, records, reports, computer data, etc, as necessary).

Assistance to the CARC includes all appropriate means associated with the facilities of the production organization to allow the CARC to perform these investigations, such as the availability of a meeting room, office and personnel support, documentation and data, and communication facilities, all properly and promptly available as necessary.

The CARC seeks to have an open relationship with the organization and suitable liaison personnel should be nominated to facilitate this, including suitable representative(s) to accompany CARC staff during visits not only at the organizations own facilities but also at sub-contractors, partners or suppliers.

GM No. 1 to 21.158(a) Uncontrolled non-compliance with applicable design data

An uncontrolled non-compliance with applicable design data is non-compliance:

- that cannot be discovered through systematic analysis; or
- that prevents identification of affected products, parts, appliances, or material.

GM No. 2 to 21.158(a) Examples of level one findings

Examples of level one findings are non-compliances with any of the following paragraphs, that could affect the safety of the aircraft:

21.139, 21.145, 21.147, 21.148, 21.151, 21.163, 21.165(b), (c), (d), (e), (f) and (g).

It should be anticipated that a non-compliance with these paragraphs is only considered a level one finding when objective evidence has been found that this finding is an uncontrolled non-compliance that could affect the safety of the aircraft.

In addition, the failure to arrange for investigations under 21.157, in particular to obtain access to facilities, after denial of one written request should be classified as a level one finding.

GM 21.159(a)(3) Evidence of a lack of satisfactory control

A positive finding by the CARC of:

1. an uncontrolled non-compliance with type design data affecting the airworthiness of product part or appliance

2. an incident/accident identified as caused by POA holder

3. non-compliance with the POE and its associated procedures which could affect conformity of manufactured items to design data

4. insufficient competence of certifying staff

5. insufficient resources in respect of facilities, tools and equipment

6. insufficient means to ensure good production work standards

7. a lack of effective and timely response to prevent a recurrence of any of paragraph 1 to 6.

AMC 21.163(c) Computer generated signature

1. Submission to the CARC

Any POA holder intending to implement a computer generated signature procedure to issue CARC form 227 or equivalent must document it and submit it to the CARC as part of the documents attached with its exposition and dealing with the issue of airworthiness certifications.

2. Characteristics of the computer generated signature system

The electronic system must:

- guarantee secure access for each certifying staff;
- provide for a "personal" signature;
- insure integrity and validity of the data that may be used coming from the computer system to issue the Form;
- be active only at the location where the part is being released with a CARC Form 227;
- not permit to sign a blank form;
- not permit modification after signature (if modification is necessary after issuance, i.e., re-certification of a part), a new form with a new number and reference to the initial certification should be made;
- insure integrity of the data certified by the signature of the Form and be able to show evidence of the authenticity of the JCAR form 227 or equivalent (recording and record keeping).

POA holders/applicants are reminded that additional requirements may need to be satisfied when operating computer generated signature systems.

3. Characteristics of the computer generated signature

The computer generated signature must take the form of a representation of the hand-written signature of the person signing (i.e. scanned signature). In addition to facilitate understanding and acceptance of the CARC form 227 or equivalent released with a computer generated signature the following statement should be printed in Block 13 of the Form: "This document has been issued according to an approved computer generated signature procedure".

AMC 21.163(d) Privileges-Maintenance

The applicant may apply for terms of approval, which cover maintenance of a new aircraft that it has manufactured, as necessary to keep it in an airworthy condition, but not beyond the point at which the applicable operational rules require maintenance to be performed by an approved maintenance organization. If the production organization intends to maintain the aircraft beyond that point, it would have to apply for and obtain an appropriate maintenance approval.

When the CARC is satisfied that the procedures required by 21.139 are satisfactory to control maintenance activities so as to ensure that the aircraft is airworthy, this capability will be stated in the terms of approval.

MAINTENANCE OF AIRCRAFT

Examples of such maintenance activities are:

- Preservation, periodic inspection visits, etc.
- Embodiment of a Service Bulletin.
- Application of airworthiness directives.
- Repairs.
- Maintenance tasks resulting from special flights.
- Maintenance tasks to maintain airworthiness during flight training, demo flights and other non-revenue flights.

Any maintenance activities must be recorded in the Aircraft Log Book. It must be signed by certifying staff for attesting the conformity of the work to the applicable airworthiness data.

In some cases the Aircraft Log Book is not available, or the production organization prefers to use a separate form (for instance for a large work package or for delivery of the aircraft to the customer). In these cases, production organizations must use CARC Form 295 which must subsequently become part of the aircraft maintenance records.

Maintenance of components outside the POA capability

Such maintenance activity outside the capability of the Aircraft POA holder may still be accomplished under the production approval of the original release organization. In such circumstances the engine(s), propeller(s), parts and appliances will require re-release in accordance with GM 21A.163(c) (CARC Form 227 or equivalent).

Records relevant to continued airworthiness or retirement lives, such as engine runs, flight hours, landings, etc., which affect part retirement of maintenance schedules must be specified on any re-release.
As an alternative the engine, propeller, part or appliance may be maintained by the holder of an approval in accordance with Part 145, classified and released as ‘used’.

GM 21.165(a) Obligations of the holder-Basic working document

Compliance with the production organization exposition (POE) is a prerequisite for obtaining and retaining a production organization approval.

The organization should make the POE available to its personnel where necessary for the performance of their duties. A distribution list should therefore be established. Where the POE mainly refers to separate manuals or procedures, the distribution of the POE could be limited.

The organization should ensure that personnel have access to and are familiar with that part of the content of the POE or the referenced documents, which covers their activities.

Monitoring of compliance with the POE is normally the responsibility of the quality assurance function.

GM No.1 to21.165(c) Obligations of the holder-Conformity of prototype models and test specimens

21.33 requires determination of conformity of prototype models and test specimens to the applicable design data. The CARC Form 227 or equivalent may be used as a conformity certificate as part of the assistance a POA holder/applicant provides to a design approval holder/applicant.

GM No.2 to 21.165(c) Obligations of holder-Conformity with type design

Individual configurations are often based on the needs of the customer and improvements or changes which may be introduced by the type-certificate holder. There are also likely to be unintentional divergences (concessions or non-conformances) during the manufacturing process. All these changes should have been approved by the design approval holder, or when necessary by the CARC.

GM No. 3 to 21.165(c) Obligations of the holder-Condition for safe operation

Before issue of the Statement of Conformity to the authority of the State of registry, the holder of a production organization approval should make an investigation so as to be satisfied in respect of each of the items listed below. The documented results of this investigation should be kept on file by the POA holder. Certain of these items may be required to be provided (or made available) to the operator or owner of the aircraft, and to the CARC or the authority of the State of registry (or Importing Country):

1. Equipment or modifications which do not meet the requirements of the State of manufacture/CARC but have been accepted by the authority of the importing country.

2. Identification of products, parts or appliances which:

   a. Are not new.
   b. Are furnished by the buyer or future operator (including those identified in 21.801 and 21.805).

3. Technical records which identify the location and serial numbers of significant components including those identified in 21.801 and 21.805.

4. Log book and a modification record book for the aircraft as required by the CARC.

5. Log books for products identified in 21.801 installed as part of the type design as required by the CARC.

6. A weight and balance report for the completed aircraft.

7. A record of missing items or defects which do not affect airworthiness these for example could be furnishing or BFE (Items may be recorded in a technical log or other suitable arrangement such that the operator and CARC are formally aware).

8. Product support information required by other implementing rules and associated CS or GM, such as a Maintenance Manual, a Parts Catalogue, or MMEL all of which are to reflect the actual build standard of the particular aircraft. Also an Electrical load analysis and a wiring diagram.

9. Records which demonstrate completion of maintenance tasks appropriate to the test flight flying hours recorded by the aircraft. These records should show the relationship of the maintenance status of the particular aircraft to the manufacturers recommended maintenance task list and the MRB document/report.

10. Details of the serviceability state of the aircraft in respect of; (a) the fuel and oil contents, (b) provision of operationally required emergency equipment such as life rafts, etc.

11. Details of the approved interior configuration if different from that approved as part of the type design.

12. An approved Flight Manual which conforms to the build standard and modification state of the particular aircraft shall be available.

13. Show that inspections for foreign objects at all appropriate stages of manufacture have been satisfactorily performed.

14. The registration has been marked on the exterior of the aircraft as required by national legislation. Where required by national legislation fix a fireproof owners nameplate.

15. Where applicable there should be a certificate for noise and for the aircraft radio station.

16. The installed compass and or compass systems have been adjusted and compensated and a deviation card displayed in the aircraft.

17. Software criticality list.

18. A record of rigging and control surface movement measurements.

19. Details of installations which will be removed before starting commercial air transport operations (e.g., ferry kits for fuel, radio or navigation).

20. Where maintenance work has been performed under the privilege of 21.163(d) issue a release to service that includes a statement that the aircraft is in a condition for safe operation.

21. List of all applicable Service Bulletins and airworthiness directives that have been implemented.

GM No. 4 to 21.165(c) Airworthiness Release or Conformity Certificate

The CARC Form 227 or equivalent, when used as a release certificate as addressed in 21.165(c)(2) and (3), may be issued in two ways:

- As an airworthiness release, only when by virtue of the arrangement described in 21.133(b) and (c), it can be determined that the part conforms to the approved design data and is in condition for safe operation.

- As a conformity Certificate, only when by virtue of the arrangement described in 21.133(b) and (c), it can be determined that the part conforms to applicable design data which is not (yet) approved, for a reason that is indicated in Block 13. Parts released with a CARC Form 227 or equivalent as a conformity Certificate are not eligible for installation in a type-certificated aircraft.

The CARC Form 227 or equivalent should only be used for Conformity release purposes when it is possible to indicate the reason that prevents its issue as for airworthiness release purposes.

GM 21.165(d) and (h) Obligations of the holder-Recording and archiving system

Records within a production environment satisfy two purposes. Firstly, they are required, during the production process to ensure that products, parts, or appliances are in conformity with the controlling data throughout the manufacturing cycle. Secondly, certain records of milestone events are needed to subsequently provide objective evidence that all prescribed stages of the production process have been satisfactorily completed and that compliance with the applicable design data has been achieved.

Therefore, the approved production organization should implement a system for the compilation and retention of records during all stages of manufacture, covering short-term and long-term records appropriate to the nature of the product and its production processes.

The management of such information should be subject to appropriate procedures in the Quality System required by 21.139.

All forms of recording media are acceptable (paper, film, magnetic ...) provided they can meet the required duration for archiving under the conditions provided.

The related organization procedures should:

- Identify records to be kept.

- Describe the organization of and responsibility for the archiving system (location, compilation, format) and conditions for access to the information (e.g., by product, subject).
- Control access and provide effective protection from deterioration or accidental damage.

- Ensure continued readability of the records.

- Demonstrate to the CARC proper functioning of the records system.

- Clearly identify the persons involved in conformity determination.

- Define archiving period for each type of data taking into account importance in relation to conformity determination subject to the following:

a. Data which supports conformity of a product, part, or appliance should be kept for not less than three years from the issue date of the related Statement of Conformity or Authorized Release Certificate.

b. Data considered essential for continuing airworthiness should be kept throughout the operational life of the product, part or appliance.

- Ensure that the recording and record-keeping system used by the partners, supplier and sub-contractors meet the objective of conformity of the product, part or appliance with the same level of confidence as for their own manufacture. They should define in each case who is to retain the record data (organization or partner, supplier or sub-contractor). They should also define method for surveillance of the recording/record keeping system of the partners, suppliers or sub-contractors.

Subpart H
Airworthiness certificates
(Reserved)

Subpart I
Noise certificates
(Reserved)

Subpart J – Design organization approval

GM No. 1 to 21.239(a) Design assurance system

1. Purpose

This GM outlines some basic principles and objectives of 21.239(a).

2. Definitions

2.1 The design assurance system is the organizational structure, responsibilities, procedures and resources to ensure the proper functioning of the design organization.

2.2 The design assurance means all those planned and systematic actions necessary to provide adequate confidence that the organization has the capability

- to design products or parts in accordance with the applicable CS and environmental protection requirements,
- to show and verify the compliance with these CS and environmental protection requirements, and
- to demonstrate to the CARC this compliance.

2.3 The "Type Investigation" means the tasks of the organization in support of the type-certificate, supplemental type-certificate or other design approval processes necessary to show and verify and to maintain compliance with the applicable CS and environmental protection requirements.

3. Design Assurance

The complete process, starting with the CS and environmental protection requirements and product specifications and culminating with the issuing of a type-certificate, is shown in the diagram on Figure 1. This identifies the relationship between the design, the Type Investigation and design assurance processes.

Effective Design Assurance demands a continuing evaluation of factors that affect the adequacy of the design for intended applications, in particular that the product, or part, complies with applicable CS and environmental protection requirements and will continue to comply after any change.

Two main aspects should therefore be considered:

(1) How the planned and systematic actions are defined and implemented, from the very beginning of design activities up to continued airworthiness activities;

(2) How these actions are regularly evaluated and corrective actions implemented as necessary.

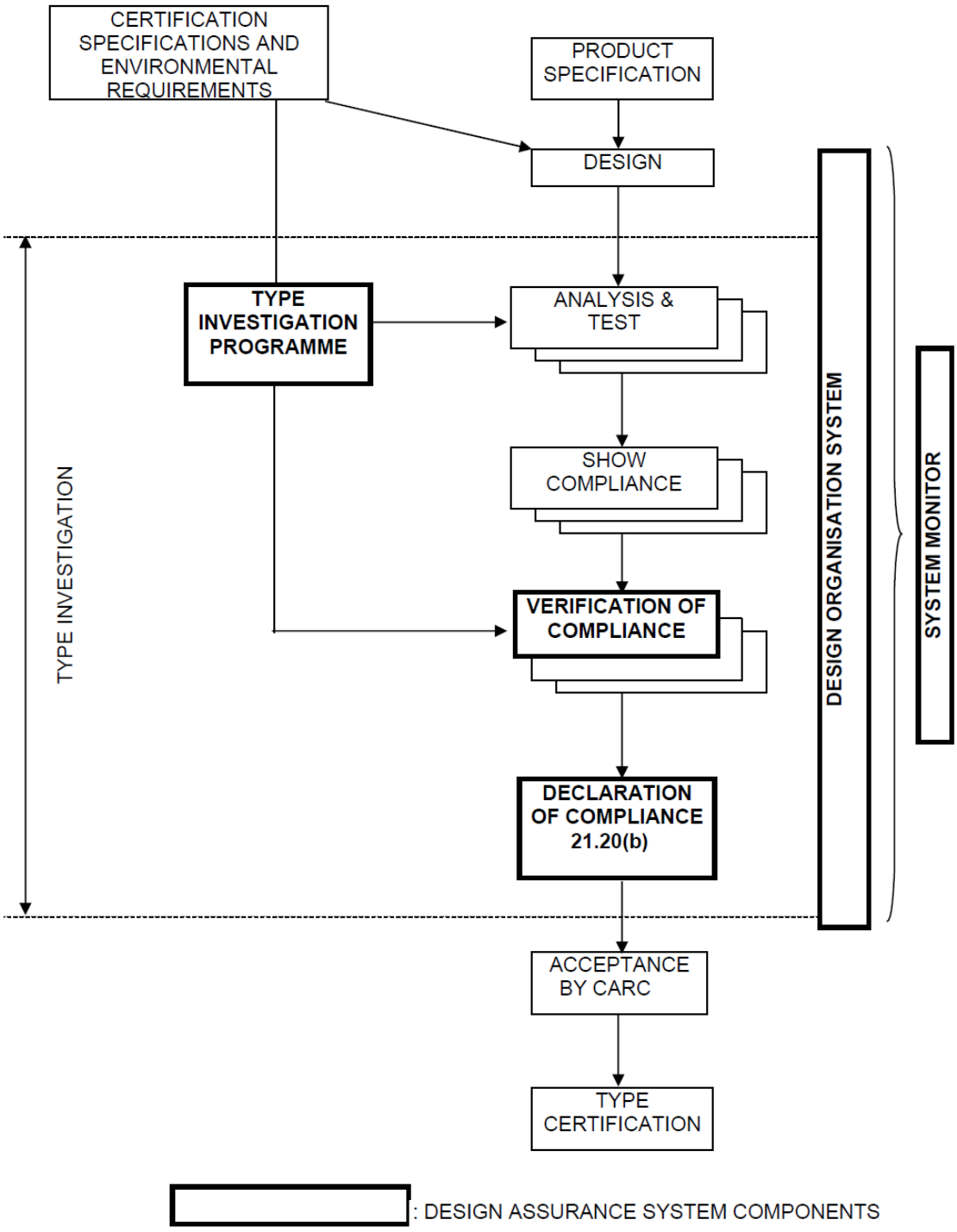


Figure 1 - RELATIONSHIPS BETWEEN DESIGN, DESIGN ASSURANCE AND TYPE INVESTIGATION

3.1 Planned and Systematic Actions

For design organizations carrying out Type Investigation of products, the planned and systematic actions should cover the following tasks and procedures should be defined accordingly:

3.1.1 General

a. To issue or, where applicable, supplement or amend the handbook in accordance with 21.243, in particular to indicate the initiation of design activities on a product.
b. To assure that all instructions of the Handbook are adhered to,
c. To conduct Type Investigation,
d. To nominate staff as "compliance verification engineers" responsible to approve compliance documents as defined in paragraph 3.1.3,
e. To nominate personnel belonging to the Office of Airworthiness responsible as defined in paragraph 3.1.4.
f. In the case of an applicant for a supplemental type-certificate, to obtain the agreement of the type-certificate holder for the proposed supplemental type-certificate to the extent defined in 21.115.
g. To ensure full and complete liaison between the type design organization and related organizations having responsibility for products manufactured to the type-certificate.
h. To provide the assurance to the CARC that prototype models and test specimens adequately conform to the type design (see 21.33(b)(1)).

3.1.2 Chief Executive and Head of design organization (or his or her Deputy)

a. The Chief Executive should provide the necessary resources for the proper functioning of the design organization.
b. The Head of the design organization, or an authorized representative, should sign a declaration of compliance (see 21.20(b) and 21.97(a)(3)) with the applicable CS and environmental protection requirements after verification of satisfactory completion of the Type Investigation. In accordance with 21.20(c) and 21.97(a)(4), his or her signature on the declaration of compliance confirms that the procedures as specified in the handbook have been followed (see also GM 21.265(b)).
c. The functions of Chief Executive and Head of the design organization may be performed by the same person.

3.1.3 Compliance Verification

a. Approval by signing of all compliance documents, including test programs and data, necessary for the verification of compliance with the applicable CS and environmental protection requirements as defined in Type Investigation program.
b. Approval of the technical content (completeness, technical accuracy...), including any subsequent revisions, of the manuals approved by the CARC (Aircraft Flight Manual, the Airworthiness Limitations section of the Instructions for Continued Airworthiness and the Certification Maintenance Requirements (CMR) document, where applicable).

3.1.4 Office of Airworthiness

a. Liaison between the design organization and the CARC with respect to all aspects of Type Investigation.
b. Ensuring that a handbook is prepared and updated as required in 21.243.
c. Co-operation with the CARC in developing procedures to be used for the type certification process.
d. Issuing of guidelines for documenting compliance.
e. Co-operation in issuing guidelines for the preparation of the manuals required by the applicable implementing rules, Service Bulletins, drawings, specifications, and standards.
f. Ensuring procurement and distribution of applicable CS and environmental protection requirements and other specifications.
g. Co-operating with the CARC in proposing the type-certification basis
h. Interpretation of CS and environmental protection requirements and requesting decisions of the CARC in case of doubt.
i. Advising of all departments of the design organization in all questions regarding airworthiness, environmental protection approvals and certification.
j. Preparation of the Type Investigation program and co-ordination of all tasks related to Type Investigation in concurrence with the CARC.
k. Regular reporting to the CARC about Type Investigation progress and announcement of scheduled tests in due time.
l. Ensuring co-operation in preparing test programs needed for demonstration of compliance.
m. Establishing the compliance checklist and updating for changes.
n. Checking that all compliance documents are prepared as necessary to show compliance with all CS and environmental protection requirements, as well as for completeness, and signing for release of the documents.
o. Checking the required type design definition documents described in 21.31 and ensuring that they are provided to the CARC for approval when required.
p. Preparation, if necessary, of a draft for a type-certificate data sheet and/or type-certificate data sheet modification.
q. Providing verification to the head of the design organization that all activities required for Type Investigation have been properly completed.
r. Approving the classification of changes in accordance with 21.91 and granting the approval for minor changes in accordance with 21.95(b).
s. Monitoring of significant events on other aeronautical products as far as relevant to determine their effect on airworthiness of products being designed by the design organization.
t. Ensuring co-operation in preparing Service Bulletins and the Structural Repair Manual, and subsequent revisions, with special attention being given to the manner in which the contents affect airworthiness and environmental protection and granting the approval on behalf of the CARC.
u. Ensuring the initiation of activities as a response to failure (accident/incident/in-service experience) evaluation and complaints from the operation and providing of information to the CARC in case of airworthiness impairment (continuing airworthiness).
v. Advising the CARC with regard to the issue of airworthiness directives in general based on Service Bulletins.
w. Ensuring that the manuals approved by the CARC, including any subsequent revisions (the Aircraft Flight Manual, MMEL, the Airworthiness Limitations section of the Instructions for Continued Airworthiness and the Certification Maintenance Requirements (CMR)

document, where applicable) are checked to determine that they meet the respective requirements, and that they are provided to the CARC for approval.

3.1.5 Maintenance and Operating Instructions

a. Ensuring the preparation and updating of all maintenance and operating instructions (including Services Bulletins) needed to maintain airworthiness (continuing airworthiness) in accordance with relevant CS. For that purpose, the applicant should:

- establish the list of all documents it is producing to comply with the Appendix referred to in CS 23.1529, CS 25.1529, CS 27.1529, CS 29.1529, CS-E 25 or CS-P 40 (NPA P-3);
- define procedures and organization to produce and issue these documents, using where applicable and so elected 21.263(c)(3) privilege.

b. In accordance with 21.57, 21.61, 21.107, 21.119, 21.120 and 21.449, ensuring that these documents are provided to all affected operators and all involved authorities.

3.2 Continued Effectiveness of the design assurance system.

The organization should establish the means by which the continuing evaluation (system monitoring) of the design assurance system will be performed in order to ensure that it remains effective.

GM No. 2 to 21.239(a) Design assurance system for minor changes to type design or minor repairs to products

1. Purpose

This GM outlines some basic principles and objectives in order to comply with 21.239(a) for organizations designing only minor changes to type design or minor repairs to products.

2. Design assurance system

The design assurance system should include the following:

- an organizational structure to:
- control the design

- show compliance with applicable CS and environmental protection requirements

- independently check showings of compliance

- -liaise with the CARC
- continuously evaluate the design organization

- control sub-contractors

- procedures and responsibilities associated with the functions listed above, taking due account of Part 21 requirements applicable to design and approval of minor changes to type design or minor repairs to products.

AMC 21.239(a)(3) Design assurance system - Independent system monitoring

The system monitoring function required by 21.239(a)(3) may be undertaken by the existing quality assurance organization when the design organization is part of a larger organization.

AMC 21.239(b) Design assurance system - Independent checking function of the showing of compliance

1. The independent checking function of the showing of compliance should consist of the verification by a person not creating the compliance data. Such person may work in conjunction with the individuals who prepare compliance data.
2. The verification should be shown by signing compliance documents, including test programs and data.
3. For a product, there is normally only one compliance verification engineer nominated for each relevant subject.
   A procedure should cover the non-availability of nominated persons and their replacement when necessary.
4. For STC cases, when compliance statement and associated documentation are produced by the TC holder, and when these data are approved under the system of the CARC of TC holder, then the STC applicant does not need to provide, within its own DOA, the independent checking function required in 21.239(b) for these data.

GM 21.239(c) Design assurance system

In meeting the requirements of 21.239(c) the applicant for a design organization approval under Subpart J may adopt the following policy:

1. The satisfactory integration of the Partner/Sub-contractor and applicant's design assurance systems should be demonstrated for the activities covered under the applicant's terms of approval.
2. In the event that a Partner/Sub-contractor holds a design organization approval (DOA.), then in accordance with 21.239(c), the applicant may take this into account in demonstrating the effectiveness of this integrated system.
3. When any Partner/Sub-contractor does not hold a DOA then the applicant will need to establish to its own satisfaction and the satisfaction of the CARC, the adequacy of that partner's/sub-contractor's design assurance system in accordance with 21.243(b).

AMC No. 1 to 21.243(a) Data requirements

The handbook should provide the following information for each product covered by the design organization approval.

1. A description of the tasks which can be performed under the approval, according to the following classification:

   a. General areas, like subsonic turbojet aeroplanes, turbopropeller aeroplanes, small aeroplanes, rotorcraft.
   b. Technologies handled by the organization (composite, wood or metallic construction, electronic systems, etc.)

c. A list of types and models for which the design approval has been granted and for which privileges may be exercised, supported by a brief description for each product.
d. For repair design, classification and (if appropriate) approval activities it is necessary to specify the scope of activity in terms of structures, systems, engines, etc.

2. A general description of the organization, its main departments, their functions and the names of those in charge; a description of the line management and of functional relationships between the various departments.
3. A description of assigned responsibilities and delegated authority of all parts of the organization which, taken together, constitute the organization's design assurance system together with a chart indicating the functional and hierarchical relationship of the design assurance system to Management and to other parts of the organization; also the chains of responsibilities within the design assurance system, and the control of the work of all partners and sub-contractors.
4. A general description of the way in which the organization performs all the design functions in relation to airworthiness and environmental protection approvals including:

a. The procedures followed and forms used in the Type Investigation process to ensure that the design of, or the change to the design of, the product as applicable is identified and documented, and complies with the applicable CS and environmental protection requirements, including specific requirements for import by importing authorities.
b. The procedures for classifying design changes as "major" or "minor" and for the approval of minor changes.
c. The procedures for classifying and approving unintentional deviations from the approved design data occurring in production (concessions or non-conformance's).
d. The procedure for classifying and obtaining approval for repairs.

5. A general description of the way in which the organization performs its functions in relation to the continuing airworthiness of the product it designs, including co-operation with the production organization when dealing with any continuing airworthiness actions that are related to production of the product, part or appliance, as applicable.
6. A description of the human resources, facilities and equipment, which constitutes the means for design, and where appropriate, for ground and flight testing.
7. An outline of a system for controlling and informing the Staff of the organization of current changes in engineering drawings, specifications and design assurance procedures.
8. A description of the recording system for:

a. The type design, including relevant design information, drawings and test reports, including inspection records of test specimens.
b. The means of compliance.
c. The compliance documentation (compliance check list, reports...).

9. A description of the record keeping system to comply with 21.55 and 21.105.
10. A description of the means by which the organization monitors and responds to problems affecting the airworthiness of its product during design, production and in service in particular to comply with 21.3 (see also GM No. 1 to 21.239, paragraphs 3.1.4(s) and (u)).
11. The names of the design organization authorized signatories. Nominated persons with specific responsibilities such as mentioned in 21.33 and 21.35 should be listed.
12. (Reserved).

13. A clear definition of the tasks, competence and areas of responsibility of the Office of Airworthiness.
14. A description of the procedures for the establishment and the control of the maintenance and operating instructions (see 21.57, 21.61, 21.107, 21.119, 21.120 and 21.449).
15. A description of the means by which the continuing evaluation (system monitoring) of the design assurance system will be performed in order to ensure that it remains effective.

AMC No. 2 to 21.243(a) Data requirements-Model content of handbook for organizations designing minor changes to type design or minor repairs to products

Part 1 Organization

1.1 Objective of handbook and binding statement
1.2 Responsible person for administration of handbook
1.3 Amendment procedure
1.4 List of effective pages
1.5 Distribution list
1.6 Presentation of design organization (including locations)
1.7 Scope of work (with identification of type and models of products)
1.8 Organization charts
1.9 Human resources
1.10 Management staff
1.11 Certifying personnel (see GM No. 2 to 21.243(d), paragraph 2)
1.12 Independent system monitoring

Part 2 Procedures

2.1 Management of changes to type design and design of repairs
- configuration control
- classification
- approval of minor changes to type design and minor repairs

2.2 Control of design subcontractors
2.3 Collecting/Investigating of failures, malfunctions and defects
2.4 Co-ordination with production
2.5 Documentation control
- in relations with the changes and repairs
- in relation with failures/malfunctions and defects (i.e. Services - Bulletins)

2.6 Record keeping

GM No. 1 to 21.243(d) Statement of qualifications and experience

1. Purpose

This GM provides guidelines on the following points:

- Who are the persons covered by 21.243(d)?
- What is requested from the applicant for these persons?

2. Who are the persons?

Three different types of functions are named or implicitly identified in the requirements of Part 21 Subpart J or in associated AMC and GM, using qualified and experienced personnel:

- the Chief Executive [see GM No. 1 to 21.239(a), para. 3.1.2, GM 21.249, GM 21A.265(b)]
- the other management staff:
  - the Head of the design organization [see GM No. 1 to 21.239(a), para.3.1.2, GM No. 1 to 21.245, para.4.1, GM 21.265(b)]
  - the Chief of the Office of Airworthiness, or [see GM No. 1 to 21A.245, para. 4.2]
  - the Chief of the independent monitoring function of the design assurance system [see 21.239(a)(3) and AMC No. 1 to 21.243(a), para.2]
- the personnel making decisions affecting airworthiness and environmental protection:
  - compliance verification engineers [see GM No. 1 to 21.239(a), para.3.1.3; AMC 21.239(b)]
  - personnel of the Office of Airworthiness making decisions affecting airworthiness and environmental protection, especially those linked with the 21.263 privileges (signing documents for release, approving classification of changes and repairs, and granting the approval of minor changes and minor repairs, granting the approval of SBs, and documentary changes to the aircraft flight manual) [see GM No. 1 to 21.239(a), para. 3.1.4]

3. Kind of statement

3.1 Chief Executive

The Chief Executive should provide the necessary resources for the proper functioning of the design organization.

A statement of the qualification and experience of the Chief Executive is normally not required.

3.2 Other management staff

The person or persons nominated should represent the management structure of the organization and be responsible through the Head of design organization to the Chief Executive for the execution of all functions as specified in Part 21, Subpart J. Depending on the size of the organization, the functions may be subdivided under individual managers.

The nominated managers should be identified and their credentials furnished to the CARC.

CARC Form 285 expected in order that they may be seen to be appropriate in terms of relevant knowledge and satisfactory experience related to the nature of the design activities as performed by the organization.

The responsibilities and the tasks of each individual manager should be clearly defined, in order to prevent uncertainties about the relations, within the organization. Responsibilities of the managers should be defined in a way that all responsibilities are covered.

3.3 Personnel making decisions affecting airworthiness and environmental protection

For these personnel, no individual statement is required. The applicant should show to the CARC that there is a system to select, train, maintain and identify them for all tasks where they are necessary.

The following guidelines for such a system are proposed:

- These personnel should be identified in the handbook, or in a document linked to the handbook. This, and the corresponding procedures, should enable them to carry out the assigned tasks and to properly discharge associated responsibilities.

- The needs, in terms of quantity of these personnel to sustain the design activities, should be identified by the organization.

- These personnel should be chosen on the basis of their knowledge, background and experience.

- When necessary, complementary training should be established, to ensure sufficient background and knowledge in the scope of their authorization. The minimum standards for new personnel to qualify in the functions should be established. The training should lead to a satisfactory level of knowledge of the procedures relevant for the particular role.

- Training policy forms part of the design assurance system and its appropriateness forms part of investigation by the CARC within the organization approval process and subsequent surveillance of persons proposed by the organization.

- This training should be adapted in response to experience gained within the organization

- The organization should maintain a record of these personnel which includes details of the scope of their authorization. The personnel concerned should be provided with evidence of the scope of their authorization.

- The following minimum information should be kept on record:

(a) Name
(b) Date of birth
(c) Experience and training
(d) Position in organization
(e) Scope of the authorization
(f) Date of first issue of the authorization
(g) If appropriate, date of expiry of the authorization
(h) Identification number of the authorization.

The record may be kept in any format and should be controlled.

- Persons authorized to access the system should be maintained at a minimum to ensure that records cannot be altered in an unauthorized manner or that such confidential records do not become accessible to unauthorized persons.

- Personnel should be given access to their own record.

- Under the provision of 21.257 the CARC has a right of access to the data held in such a system.

- The organization should keep the record for at least two years after a person has ceased employment with the organization or withdrawal of the authorization, whichever is the sooner.

GM No. 2 to 21.243(d) Data requirements-Statement of the qualification and experience-Organizations designing minor changes to type design or minor repairs to products

For organizations designing minor changes to type design or minor repairs to products, the statement of the qualifications and experience required by 21.243(d) should be addressed as follows:

1. The nominated managers should be identified and their credentials submitted to the CARC on CARC Form 285 in order that they may be seen to be appropriate in terms of relevant knowledge and satisfactory experience related to the nature of the design activities as performed by the organization.

2. The persons responsible to:

   - classify changes to type design or repairs
   - verify compliance [21.239(b)]
   - approve minor changes to type design and minor repairs [21.263(c)(2)]
   - issue information or instructions [21.263(c)(3)]

   should be selected by the organization in accordance with a procedure and criteria agreed with the CARC.

GM No. 1 to 21.245 Requirements for approval
See 21.245

1. General.

The data submitted in accordance with 21.243 should show that sufficient skilled personnel are available and suitable technical and organizational provisions have been made for carrying out the Type Investigation defined by GM No. 1 to 21.239(a), paragraph 2.3.

2. Personnel.

The applicant should show that the personnel available to comply with 21.245(a) are, due to their special qualifications and number, able to provide assurance of the design or modification of a product, as well as the compilation and verification of all data needed to meet the applicable CS and environmental protection requirements while taking into account the present state of the art and new experience.

3. Technical.

The applicant should have access to:

a. Workshops and production facilities which are suitable for manufacturing prototype models and test specimens.
b. Accommodation and test facilities which are suitable for carrying out tests and measurements needed to demonstrate compliance with the CS and environmental protection requirements. The test facilities may be subjected to additional technical conditions related to the nature of tests performed.

4. Organization.

The data submitted in accordance with 21.243 should show that:

4.1 The Head of the design organization for which an application for approval has been made, has the direct or functional responsibility for all departments of the organization which are responsible for the design of the product. If the departments responsible for design are functionally linked, the Head of the design organization still carries the ultimate responsibility for compliance of the organization with Part 21Subpart J.
4.2 An Office of Airworthiness, or equivalent function, has been established and staffed on a permanent basis to act as the focal point for co-ordinating airworthiness and environmental protection matters (see GM No. 1 to 21.239 (a) paragraph 3.1.4); it reports directly to the Head of the design organization or is integrated into an independent quality assurance organization reporting to the Head of the design organization.
4.3 [Reserved]
4.4 Responsibilities for all tasks related to Type Investigations are assigned in such a way that gaps in authority are excluded.
4.5 The responsibility for a number of tasks as in paragraph 4.4 may be assigned to one person especially in the case of simple projects.
4.6 Co-ordination between technical departments and the persons in charge of the system monitoring required by 21.239(a)(3) has been established:

- to ensure quick and efficient reporting and resolution of difficulties encountered using the handbook and associated procedures
- to maintain the design assurance system
- to optimize auditing activities.

GM No. 2 to 21.245 Requirements for approval-Organizations designing minor changes to type design or minor repairs to products

The data submitted in accordance with 21.243 should show that:

1. The manager responsible for design has the direct or functional responsibility for all departments of the organization which are involved in the design of minor changes to type design or minor repairs to products.

2. Person(s) have been nominated to liaise with the CARC and to co-ordinate airworthiness and environmental protection matters. Their position in the organization should allow direct report to the manager responsible for design.
3. Responsibilities for all tasks related to the design and approval of minor changes to type design or minor repairs to products are assigned to ensure that all areas are covered.
4. The responsibility for a number of tasks as in paragraph 3 may be assigned to one person especially in the case of simple projects.

GM 21.247 Significant changes in the design assurance system

In addition to a change in ownership (see 21.249), the following changes to the design assurance system should be considered as "significant" to the showing of compliance or to the airworthiness or environmental protection of the products:

1. Organization

- Relocation to new premises (see also GM 21.249)

- Change in the industrial organization (partnership, suppliers, design worksharing) unless it can be shown that the independent checking function of the showing of compliance is not affected

- Change in the parts of the organization that contribute directly to the airworthiness or environmental protection (independent checking function, office of airworthiness [or equivalent])

- Change to the independent monitoring principles (see 21.239(a)(3))

2. Responsibilities

- Change of the management staff

- the Head of the design organization [GM No. 1 to 21.239(a), para.3.1.2, GM No. 1 to 21.245, para.4.1, GM 21.265(b)]

- the Chief of the Office of Airworthiness [GM No. 1 to 21.245, para. 4.2]

- the Chief of the independent monitoring function of the design assurance system [21.239(a)(3) and AMC No. 1 to 21.243(a), para.2]

- New distribution of responsibilities affecting airworthiness or environmental protection.

- For organizations designing minor changes to type design or minor repairs to products, change of the persons identified in GM No. 2 to 21.243(d).

3. Procedures

Change to the principles of procedures related to:

- the type certification

- the classification of changes and repairs as " major " or " minor " [21.263(c)(1)]
- the treatment of major changes and major repairs
- the approval of the design of minor changes and minor repairs [21.263(c)(2)]
- the issue of information and instructions under the privilege of 21.263(c)(3)
- the approval of documentary changes to the Aircraft Flight Manual [21.263(c)(4)]
- the approval of the design of major repairs [21A.437 or 21.263(c)(5)]
- continued airworthiness (see 21.3)
- the configuration control, when airworthiness or environmental protection is affected
- the acceptability of design tasks undertaken by partners or subcontractors [21.239(c)]

4. Resources

- Substantial reduction in number and/or experience of staff (see 21.245(a)).

GM 21.249 Transferability

1. Transfer of the approval would normally only be agreed in cases where the organization itself remains substantially unchanged.
2. An acceptable transfer situation could be for example a change of company name (supported by the appropriate certificate from the Companies Registration Office or equivalent) but with no changes to site address or Chief Executive. However, if the same legal entity were to relocate to new premises with a new Chief Executive and/or new departmental heads, then a substantial investigation by the CARC would be necessary such that the change would be classified as a re-approval.
3. In the event of receivership there may be good technical justification for continuation of the approval provided that the company continues to function in a satisfactory manner. It is likely that at a later stage the approval might be surrendered by the receiver or transferred to another legal entity in which case the former paragraphs apply.

GM No. 1 to 21.251 Terms of approval

1. The terms of approval are stated on the certificate of approval issued by the CARC. The certificate states the scope of work and the products, changes or repairs thereof, with the appropriate limitations for which the approval has been granted. For design organization approval covering type certification or JTSO authorization for APU, the list of product types covered by the design assurance system should be included.
2. Approval of a change in the terms of approval in accordance with 21.253 will be confirmed by an appropriate amendment of the certificate of approval.

3. The certificate references the handbook of the approved design organization, provided in accordance with 21.243. This handbook defines the tasks which may be performed under the approval.
4. Scopes of work are, for example, "subsonic turbojet aeroplanes", "turbo-propeller aeroplanes", "small aeroplanes", "rotorcraft"... Technologies are quoted in the scope of work when it is considered by the CARC as a limitation for the design organization approval.
5. For repair design activities, the certificate states the scope of work with the appropriate limitations for which the approval has been granted.

GM No. 2 to 21.251 Terms of approval-Organizations designing minor changes to type design or minor repairs to products

Terms of approval issued for organizations designing minor changes to type design or minor repairs to products should contain:

1. Scope of work

This design organization approval has been granted for:

- designing minor changes to type design or minor repairs to [aircraft, engine, propeller] in accordance with the applicable CS and environmental protection requirements,
- showing and verifying the compliance with these CS and environmental protection requirements.

2. Category of products

Any other indication if the CARC has found a limitation related to aircraft systems or technologies and reducing the scope as defined in paragraph 1.

3. Privileges

The holder of this approval is entitled to list of the privileges granted with the approval, pursuant to 21.263(c)(1), (2) and (3).

GM 21.257(a) Investigations

Arrangements that allow the CARC to make investigations include the complete design organization including partners, sub-contractors and suppliers, assisting and co-operating with the CARC in performing inspections and audits conducted during initial assessment and subsequent surveillance.

Assistance to the CARC includes all appropriate means associated with the facilities of the design organization to allow the CARC to perform these inspections and audits, such as a meeting room and office support.

GM 21.263(b) DOA privilege related to compliance documents

A compliance document is the end result of a certification process, where the showing of compliance is recorded. For each specific certification process, the CARC is involved in the process itself at an early stage, especially through the establishment of the certification program. The

inspections or tests under 21.257(b) may be performed at various stages of the whole certification process, not necessarily when the compliance document is presented.

Therefore, according to the scheduled level of involvement, the CARC should agree with the DOA holder documents to be accepted without further CARC verification under the DOA privilege of 21.263(b).

AMC No. 1 to 21.263(c)(1) Procedure for the classification of changes to type design and repairs as minor and major

1. INTENT

This acceptable means of compliance provides means to develop a procedure for the classification of changes to type design and repairs.

Each DOA applicant must develop its own internal classification procedure following this AMC, in order to obtain the associated 21.263(c)(1) privilege.

2. PROCEDURE FOR THE CLASSIFICATION OF CHANGES TO TYPE DESIGN AND REPAIRS

2.1 Content

The procedure must address the following points:

- the identification of changes to type design or repairs
- classification
- justification of the classification
- authorized signatories
- supervision of changes to type design or repairs initiated by subcontractors

For changes to type design, criteria used for classification must be in compliance with 21.91 and GM 21.91.

For repairs, criteria used for classification must be in compliance with 21.435 and GM 21.435.

2.2 Identification of changes to type design or repairs

The procedure must indicate how the following are identified:

- major changes to type design or major repairs
- those minor changes to type design or minor repairs where additional work is necessary to show compliance with the CS and environmental protection requirements
- other minor changes to type design or minor repairs requiring no further showing of compliance.

2.3 Classification

The procedure must show how the effects on airworthiness and environmental protection are analyzed, from the very beginning, by reference to the applicable requirements.

If no specific CS or environmental protection requirements are applicable to the change or repairs, the above review must be carried out at the level of the part or system where the change or repair is integrated and where specific CS or environmental protection requirements are applicable.

2.4 Justification of the classification

All decisions of classification of changes to type design or repairs as "major" or "minor" must be recorded and, for those which are not straightforward, also documented. These records must be easily accessible to the CARC for sample check.

2.5 Authorized signatories

All classifications of changes to type design or repairs must be accepted by an appropriate authorized signatory.

The procedure must indicate the authorized signatories for the various products listed in the terms of approval.

For those changes or repairs that are handled by subcontractors, as described under paragraph 2.6, it must be described how the DOA holder manages its classification responsibility.

2.6 Supervision of changes to type design or repairs initiated by subcontractors

The procedure must indicate, directly or by cross-reference to written procedures, how changes to type design or repairs may be initiated and classified by subcontractors and are controlled and supervised by the DOA holder.

AMC No. 2 to 21.263(c)(1) Privileges -Organizations designing minor changes to type design or minor repairs to products : classification procedure

1. Content

The procedure must address the following points:

- configuration control rules, especially the identification of changes to type design or repairs
- classification, in compliance with 21.91 and GM 21.91 for changes and GM 21.435 for repairs
- justification of the classification
- authorized signatories

2. Identification of changes to type design or repairs

The procedure must indicate how the following minor changes to type design or minor repairs are identified:

- those minor design changes to type design or minor repairs where additional substantiation data is necessary to show compliance with the CS or environmental protection requirements
- other minor design changes to type design or minor repairs requiring no further showing of compliance.

3. Classification

The procedure must show how the effects on airworthiness and environmental protection are analyzed, from the very beginning, by reference to the applicable requirements.

If no specific requirements are applicable to the change or the repair, the above review must be done at the level of the part or system where the change or repair is integrated and where specific CS or environmental protection requirements are applicable.

For repair, see also GM 21.435.

4. Justification of the classification

All decisions of classification of changes to type design or repairs as "minor" must be recorded and, for those which are not straightforward, also documented. These records must be easily accessible to the CARC for sample check.

It may be in the format of meeting notes or register.

5. Authorized signatories

All classifications of changes to type design or repairs must be accepted by an appropriate authorized signatory.

The procedure must indicate the authorized signatories for the various products listed in the terms of approval.

AMC No. 1 to 21.263(c)(2) Procedure for the approval of minor changes to type design or minor repairs

1. INTENT

This acceptable means of compliance provides means to develop a procedure for the approval of minor changes to type design or minor repairs.

Each DOA applicant must develop its own internal procedures following this AMC, in order to obtain the associated privilege under 21.263(c)(2).

2. PROCEDURE FOR THE APPROVAL OF MINOR CHANGES TO TYPE DESIGN OR MINOR REPAIRS

2.1 Content

The procedure must address the following points:

- compliance documentation
- approval under the DOA privilege
- authorized signatories
- supervision of minor changes to type design or minor repairs handled by subcontractors.

2.2 Compliance documentation

For those minor changes to type design or minor repairs where additional work to show compliance with the applicable CS and environmental protection requirements is necessary, compliance documentation must be established and independently checked as required by 21.239(b).
The procedure must describe how the compliance documentation is produced and checked.

2.3 Approval under the DOA privilege

2.3.1 For those minor changes to type design or minor repairs where additional work to show compliance with the applicable CS and environmental protection requirements is necessary, the procedure must define a document to formalize the approval under the DOA privilege.

This document must include at least:

- identification and brief description of the change or repair and reasons for change or repair
- applicable CS or environmental protection requirements and methods of compliance
- reference to the compliance documents
- effects, if any, on limitations and on the approved documentation
- evidence of the independent checking function of the showing of compliance
- evidence of the approval under the privilege of 21.263(c)(2) by an authorized signatory
- date of the approval

For repairs, see AMC 21.433(a).

2.3.2 For the other minor changes to type design or minor repairs, the procedure must define a means to identify the change or repair and reasons for the change or repair, and to formalize its approval by the appropriate engineering authority under an authorized signatory. This function may be delegated by the Office of Airworthiness but must be controlled by the Office of Airworthiness, either directly or through appropriate procedures of the DOA holder's design assurance system.

2.4 Authorized signatories

The persons authorized to sign for the approval under the privilege of 21.263(c)(2) must be identified (name, signature and scope of authority) in appropriate documents that maybe linked to the handbook.

2.5 Supervision of minor changes to type design or minor repairs handled by subcontractors

For the minor changes to type design or minor repairs described in 2.3.2, that are handled by subcontractors, the procedure must indicate, directly or by cross-reference to written procedures how these minor changes to type design or minor repairs are approved at the subcontractor level and the arrangements made for supervision by the DOA holder.

AMC No. 2 to 21.263(c)(2) Privileges-Organizations designing minor changes to type design or minor repairs to products: procedure for the approval of minor changes to type design or minor repairs

1. Content

The procedure must address the following points:

- compliance documentation
- approval under the DOA privilege
- authorized signatories

2. Compliance documentation

For those minor changes to type design or minor repairs where additional work to show compliance with the applicable CS and environmental protection requirements is necessary, compliance documentation must be established and independently checked as required by 21.239(b).

The procedure must describe how the compliance documentation is produced and checked.

3. Approval under the DOA privilege

3.1. For those minor changes to type design or minor repairs where additional work to show compliance with the applicable CS or environmental protection requirements is necessary, the procedure must define a document to formalize the approval under the DOA privilege.

This document must include at least:

- identification and brief description of the change or the repair and reason for change or repair
- applicable CS or environmental protection requirements and methods of compliance
- reference to the compliance documents
- effects, if any, on limitations and on the approved documentation
- evidence of the independent checking function of the showing of compliance
- evidence of the approval under the privilege of 21.263(c)(2) by an authorized signatory
- date of the approval

For repairs, see also AMC 21.433(a).

3.2. For the other minor changes to type design or minor repairs, the procedure must define a means to identify the change or repair and reasons for the change or repair, and to formalize its approval by the appropriate engineering authority under an authorized signatory. This function must be controlled through appropriate procedures of the DOA holder's design assurance system.

4. Authorized signatories

The persons authorized to sign for the approval under the privilege of 21.263(c)(2) must be identified (name, signature and scope of authority) in appropriate documents that may be linked to the handbook.

GM 21.263(c) (3) Issue of information or instructions

1. INTENT

This GM provides guidelines to address the various aspects the DOA should cover in order to have a comprehensive procedure for the issue of information or instructions.

2. SCOPE

The information or instructions referred to in 21.263(c)(3) are issued by a DOA holder to make available to the owners or operators of a product with all necessary data to implement a change on the product or a repair, or to inspect it. Some are also issued to provide maintenance organizations and other interested persons with all necessary maintenance data for the performance of maintenance, including implementation of a change on the product or a repair, or inspection, in accordance with 21.61, 21.107, 21.120 or 21.449 (Instructions for Continued Airworthiness).

This information or instructions may be issued in a format of a Service Bulletin as defined in ATA 100 system or in Structural Repair Manuals, Maintenance Manuals, Engine and Propeller Manuals etc. The preparation of this data involves design, production and inspection. As the overall responsibility, through the privilege, is allocated to the DOA holder, the three aspects should be properly handled under the DOA to obtain the privilege "to issue information or instructions containing a statement that the technical content is approved" and a procedure should exist.

3. PROCEDURE

For the information and instructions issued under 21.263(c)(3), the DOA holder should establish a procedure addressing the following points:

- preparation
- verification of technical consistency with corresponding approved change(s) , repair(s) or approved data, including effectivity, description, effects on airworthiness and environmental protection, especially when limitations are changed
- verification of the feasibility in practical applications
- authorized signatories.

The procedure should include the information or instructions prepared by subcontractors or vendors, and declared applicable to its products by the DOA holder.

4. STATEMENT

The statement provided in the information or instructions should also cover the information or instructions prepared by subcontractors or vendors and declared applicable to its products by the DOA holder.

The technical content is related to the design data and accomplishment instructions, and its approval means that:

- the design data has been appropriately approved; and
- the instructions provide for practical and well defined installation/inspection methods, and, when accomplished, the product is in conformity with the approved design data.

Note : Information and instructions related to required actions under 21.3B(b) (airworthiness directives) are submitted to the CARC to ensure compatibility with Airworthiness directive content (see 21.265(e)), and contain a statement that they are, or will be, subject to an airworthiness directive issued by the CARC.

GM 21.263(c)(4) Procedure for the approval of documentary changes to the Aircraft Flight Manual

1. INTENT

This GM provides guidelines to develop a procedure for the approval of documentary changes to the Aircraft Flight Manual (AFM).

Each DOA applicant should develop its own internal procedure, based on these guidelines, in order to obtain the associated privilege under 21.263(c)(4).

2. DEFINITION OF DOCUMENTARY CHANGES TO THE AFM

Examples of documentary changes to the AFM that may be approved under the DOA privilege:

A. FOR AFM ISSUED BY THE TYPE-CERTIFICATE HOLDER

- Editorial changes or corrections to the AFM.
- Changes to weight limitations that are within all previously CARC approved limitations (e.g., structural, noise, etc.)
- The addition of compatible and previously CARC approved AFM Temporary changes, appendices or Supplements.
- Conversions of previously CARC, FAA, or EASA approved combinations of units of measurement added to the AFM in a previously approved manner.
- The addition of aircraft serial numbers to an existing AFM where the aircraft configuration, as related to the AFM, is identical to aircraft already in that AFM.
- The removal of reference to aircraft serial numbers no longer applicable to that AFM.

B. FOR AFM SUPPLEMENTS ISSUED BY STC HOLDERS

Editorial changes or corrections to the AFM Supplement.

- Changes to weight limitations that are within all previously CARC approved limitations (e.g., structural, noise, etc.)
- Conversions of previously CARC,FAA, or EASA approved combinations of units of measurement added to the AFM Supplement in a previously approved manner.

- The addition of aircraft serial numbers to an existing AFM Supplement where the aircraft configuration, as related to the AFM Supplement, is identical to aircraft already in that AFM Supplement.
- The removal of reference to aircraft serial numbers no longer applicable to that AFM Supplement.

3. PROCEDURE FOR THE APPROVAL OF DOCUMENTARY CHANGES

3.1 Content

The procedure should address the following points:

- preparation of all AFM changes,
- classification as documentary AFM change,
- verification by the airworthiness function, especially regarding the classification of the AFM change,
- approval of AFM changes,
- approval statement and authorized signatories,
- distribution.

3.2 Preparation

The procedure should indicate how AFM changes are prepared and how the co-ordination with people in charge of design changes is performed.

3.3 Classification

The procedure should indicate how AFM changes are classified as documentary changes, in accordance with the criteria of paragraph 2.

Changes to the AFM of an editorial nature should be non-technical and should normally only affect existing approved data.

3.4 Verification by Office of airworthiness function

The procedure should indicate how people in charge of Office of airworthiness function will:

- verify the classification as documentary changes
- review the content of the AFM changes.

3.5 Approval

Any change to the AFM should be approved, either by the CARC, or under the privilege of 21.263(c)(4) for documentary AFM changes.

For documentary AFM changes, the procedure should indicate how the approval under the privilege will be formalized.

3.6 Approval statement and authorized signatories

Revisions of the AFM containing only documentary changes should be issued with the approval statement defined in 21.263(c)(4).

When approval status is shown on each page, a simplified statement such as "Approved under the authority of DOA nr" may be used.

The authorized signatories should be identified (name, signature), together with the scope of authorization, in a document that can be linked to the DOA handbook.

3.7 Maintaining, updating and distribution

The procedure should indicate how the master copy of the AFM is maintained and updated, and how approved revisions are distributed, taking account of 21.57 or 21.119.

AMC 21.265(a) Administration of the Handbook

1. The handbook of the applicant must be in the language which will permit the best use of it by all personnel charged with the tasks performed for the purpose of the design organization. The applicant may be requested to provide an English translation of the handbook and other supporting documents as necessary for the investigation.

2. The handbook must be produced in a concise form with sufficient information to meet 21.243 relevant to the scope of approval sought by the applicant. The handbook must include the following:
   a. Organization name, address, telephone, telex and facsimile numbers.
   b. Document title, and company document reference No (if any).
   c. Amendment or revision standard identification for the document.
   d. Amendment or revision record sheet.
   e. List of effective pages with revision/date/amendment identification for each page.
   f. Contents list or index.
   g. A distribution list for the Handbook.
   h. An introduction, or foreword, explaining the purpose of the document for the guidance of the organization’s own personnel. Brief general information concerning the history and development of the organization and, if appropriate, relationships with other organizations which may form part of a group or consortium, must be included to provide background information for the CARC.
   i. The certificate of approval must be reproduced in the document.
   j. Identification of the department responsible for administration of the Handbook.

   NOTE: In the case of an initial or revised approval it is recognized that certificate will be issued after CARC agreement to the handbook content in draft form. Arrangements for formal publication in a timely manner must be agreed before the certificate of approval is issued.

3. An updating system must be clearly laid down for carrying out required amendments and modifications to the handbook.

4. The handbook may be completely or partially integrated into the company organization manual. In this case, identification of the information required by 21.243 must be provided

by giving appropriate cross references, and these documents must be made available, on request, to the CARC.

GM 21.265(b) Use of the Handbook

1. The handbook should be signed by the Chief Executive and the Head of the design organization and declared as a binding instruction for all personnel charged with the development and type investigation of products.

2. All procedures referenced in the handbook are considered as parts of the handbook and therefore as basic working documents.

Subpart K-Parts and appliances

GM No. 1 to 21.303(c) Standard Parts

In this context a part is considered as a "standard part" where it is designated as such by the design approval holder responsible for the product, part or appliance, in which the part is intended to be used. In order to be considered a "standard part", all design, manufacturing, inspection data and marking requirements necessary to demonstrate conformity of that part should be in the public domain and published or established as part of officially recognized Standards.

GM No. 2 to 21.303(c) Officially recognized Standards

In this context "officially recognized Standards" means those standards established or published by an official body whether having legal personality or not, which are widely recognized by the air transport sector as constituting good practice.

GM 21.307 Release of Parts and Appliances for Installation

"Authorized release certificate certifying airworthiness for a new part or appliance" means certifying that the part or appliance conforms with the approved design data and is in condition for safe operation.

Subpart L
(Reserved)

Subpart M
Repairs

GM 21.431(a) Scope

Manuals and other instructions for continued airworthiness (such as the Manufacturers Structural Repair Manual, Maintenance Manuals and Engine Manuals provided by the holder of the type-certificate, supplemental type-certificate, design approval or JTSO authorization as applicable) for operators, contain useful information for the development and approval of repairs.

When these data are explicitly identified as approved, they may be used by operators without further approval to cope with anticipated in-service problems arising from normal usage provided that they are used strictly for the purpose for which they have been developed.

Approved data is data which is approved either by the CARC, or by an appropriately approved design organization.

NB: Flow Chart 1 addresses the procedures that should be followed for products where the State of design is CARC.

Flow Chart 2 addresses procedures that should be followed for products where the State of design is not CARC.

When specific repair data is approved outside of Jordan, conditions for acceptance may be defined in the bilateral arrangements between Jordan and the CAA of a third country. In the absence of such arrangement, the repair data shall follow the approval route as if it was designed and approved within Jordan.

GM 21.431(d) Repairs to articles

A repair to an article under 21.611 has to be seen in the context of an JTSO authorization, i.e., when an article as such is specifically approved under Subpart O, with dedicated rules that give specific rights and obligations to the designer of the article, irrespective of any product type design or change to the type design. For a repair to such an article, irrespective of installation on any aircraft, Subpart O, and 21.611 in particular, should be followed.

When an airline or a maintenance organization is designing a new repair (based on data not published in the TC holder or Original Equipment Manufacturer documentation) on an article installed on an aircraft, such a repair can be considered as a repair to the product in which the article is installed, not to the article taken in isolation. Therefore Subpart M can be used for the approval of this repair that will be identified as repair to product x affecting article y", but not "repair to article y".

AMC 21.433 (a) and 21.447 Repair design and Record Keeping

1. Relevant substantiation data associated with a new major repair design and record keeping should include:

    a. damage identification and reporting source,

b. major repair design approval sheet identifying applicable requirements and references of justifications,
c. repair drawing and/or instructions and scheme identifier,
d. correspondence with the TC, STC, design approval or JTSO holder, if its advice on the design has been sought,
e. structural justification (static strength, fatigue, damage tolerance, flutter etc) or references to this data,
f. effect on the aircraft, engines and/or systems, (performance, flight handling, etc as appropriate)
g. effect on maintenance program,
h. effect on Airworthiness limitations, the Flight Manual and the Operating Manual,
i. weight and moment change,
j. Special test requirements.

2. Relevant minor repair documentation includes paragraphs 1(a) and (c). Other points of paragraph 1 may be included where necessary. If the repair is outside the approved data, justification for classification is required.

3. Special consideration should be given to repairs that impose subsequent limitations on the part, product or appliance, (e.g. engine turbine segments that may only be repaired a finite number of times, number of repaired turbine blades per set, over sizing of fastener holes, etc.).

4. Special consideration should also be given to Life Limited parts and Critical Parts, notably with the involvement of the type-certificate or STC holder, when deemed necessary under 21.433 (b).

5. Repairs to engine critical parts would normally only be accepted with the involvement of the TC holder.

GM 21.435(a) Classification of repairs

1. Clarification of the terms Major/Minor

In line with the definitions given in 21.91, a new repair is classified as 'major' if the result on the approved type design has an appreciable effect on structural performance, weight, balance, systems, operational characteristics or other characteristics affecting the airworthiness of the product, part or appliance. In particular, a repair is classified as major if it needs extensive static, fatigue and damage tolerance strength justification and/or testing in its own right, or if it needs methods, techniques or practices that are unusual (i.e., unusual material selection, heat treatment, material processes, jigging diagrams, etc.).

Repairs that require a re-assessment and re-evaluation of the original certification substantiation data to ensure that the aircraft still complies with all the relevant requirements are to be considered as major repairs.

Repairs whose effects are considered minor and require minimal or no assessment of the original certification substantiation data to ensure that the aircraft still complies with all the relevant requirements, are to be considered “minor”.

It is understood that not all the certification substantiation data will be available to those persons/organizations classifying repairs. A qualitative judgment of the effects of the repair will therefore be acceptable for the initial classification. The subsequent review of the design of the repair may lead to it being re-classified, owing to early judgments being no longer valid.

2. Airworthiness concerns for Major/Minor classification

The following should be considered for the significance of their effect when classifying repairs. Should the effect be considered to be significant then the repair should be classified 'Major'. The repair may be classified as 'Minor' where the effect is known to be without appreciable consequence.

(i) Structural performance

Structural performance of the product includes static strength, fatigue, damage tolerance, flutter and stiffness characteristics. Repairs to any element of the structure should be assessed for their effect upon the structural performance.

(ii) Weight and balance

The weight of the repair may have a greater effect upon smaller aircraft as opposed to larger aircraft. The effects to be considered are related to overall aircraft centre of gravity and aircraft load distribution. Control surfaces are particularly sensitive to the changes due to the effect upon the stiffness, mass distribution and surface profile which may have an affect upon flutter characteristics and controllability.

(iii) Systems

Repairs to any elements of a system should be assessed for the effect intended on the operation of the complete system and for the effect on system redundancy. The consequence of a structural repair on an adjacent or remote system should also be considered as above, (for example: airframe repair in area of a static port).

(iv) Operational characteristics Changes may include:

- stall characteristics
- handling
- performance and drag
- vibration

(v) Other characteristics

- changes to load path and load sharing
- change to noise and emissions
- fire protection / resistance

Note: Considerations for classifying repairs 'Major/Minor' should not be limited to those listed above.

3. Examples of 'Major' repairs

(i) A repair that requires a permanent additional inspection to the approved maintenance program, necessary to ensure the continued airworthiness of the product. Temporary repairs for which specific inspections are required prior to installation of a permanent repair do not necessarily need to be classified as 'Major'. Also, inspections and changes to inspection frequencies not required as part of the approval to ensure continued airworthiness do not cause classification as 'Major' of the associated repair.

(ii) A repair to life limited or critical parts.

(iii) A repair that introduces a change to the Aircraft Flight Manual.

GM 21.437 Issue of repair design approval

1. Approval by DOA holder

Approval of repairs through the use of procedures agreed with the CARC, means an approval issued by the DOA holder without requiring CARC involvement. The CARC will monitor application of this procedure within the surveillance plan for the relevant organization. When the organization exercises this privilege, the repair release documentation should clearly show that the approval is under their DOA privilege.

2. Previously approved data for other applications

When it is intended to use previously approved data for other applications, it is expected that applicability and effectiveness would be checked with an appropriately approved design organization. After damage identification, if a repair solution exists in the available approved data, and if the application of this solution to the identified damage remains justified by the previous approved repair design, (structural justifications still valid, possible airworthiness limitations unchanged), the solution can be considered approved and can be used again.

3. Temporary repairs

These are repairs that are life limited, to be removed and replaced by a permanent repair after a limited service period. These repairs should be classified under 21.435 and the service period defined at the approval of the repair.

4. Fatigue and damage tolerance

When the repaired product is released into service before the fatigue and damage tolerance evaluation has been completed, the release should be for a limited service period, defined at the issue of the repair.

GM 21.437(a) Issue of repair design approval

1. Products type-certificated by the CARC and products certificated nationally without a type certificate.

(i) CARC approval is required in cases of major repairs proposed by design organization approval holders, not being the TC or STC holder, and in cases of minor repairs proposed by persons not holding a design organization approval.

(ii) CARC approval may be required in cases of major repairs proposed by design organization approval holders, being the TC or STC holder, if the major repair is:

- related to new interpretation of the airworthiness requirement as used for type certification.
- related to different means of compliance from that used for type certification.
- related to the application of airworthiness requirements different from that used for type certification.

NOTE: This should be established at the time of DOA approval.

2. Products type-certificated by CAA (Foreign Country) other than CARC.

CARC approval is always required for major repairs on products first type-certificated by the CAA of a foreign country. Approval privileges extended to TC holders (noted in 21.437(b)) are not extended to TC holders of products first type-certificated by the CAA of a foreign country. Type-certificate holders of those types may need to be involved when an arrangement with the TC holder has been determined necessary under 21.433(b).

For repairs approved outside Jordan, conditions for acceptance may be defined in the bilateral arrangement between CARC and the CAA of a foreign country. In the absence of such arrangement, the repair data shall follow the approval route as defined by CARC and as if it was designed and approved within Jordan.

AMC 21.437(b) Issue of repair design approval

In order for the approved design organization that is also the type-certificate holder to approve 'Major' repair design the following should be considered applicable:

(i) The type-certificate holder being approved under JCAR Part 21 Subpart J.

(ii) Procedures having been established that comply with Part 21 Subpart M as agreed with CARC.

(iii) The type-certification basis for the product, part or appliance to be repaired having been identified together with all other relevant requirements.

(iv) All records and substantiation data including documents showing compliance with all relevant airworthiness requirements being held for reviews by CARC.

(v) A summary list of all major repair approvals being provided to CARC on a regular basis as agreed with CARC.

(vi) Whether the repair design is affected by the presence of any supplemental type-certificate.

GM 21.439 Production of repair parts

A maintenance organization may manufacture parts for repair purposes when in accordance with Subpart F or when approved under Subpart G of Part 21. In addition, a maintenance organization may manufacture parts for its own repair purposes when expressly authorized by the CARC in accordance with the applicable JCAR.

GM 21.441 Repair Embodiment

Repairs should be accomplished by an organization in accordance with the relevant JCAR.

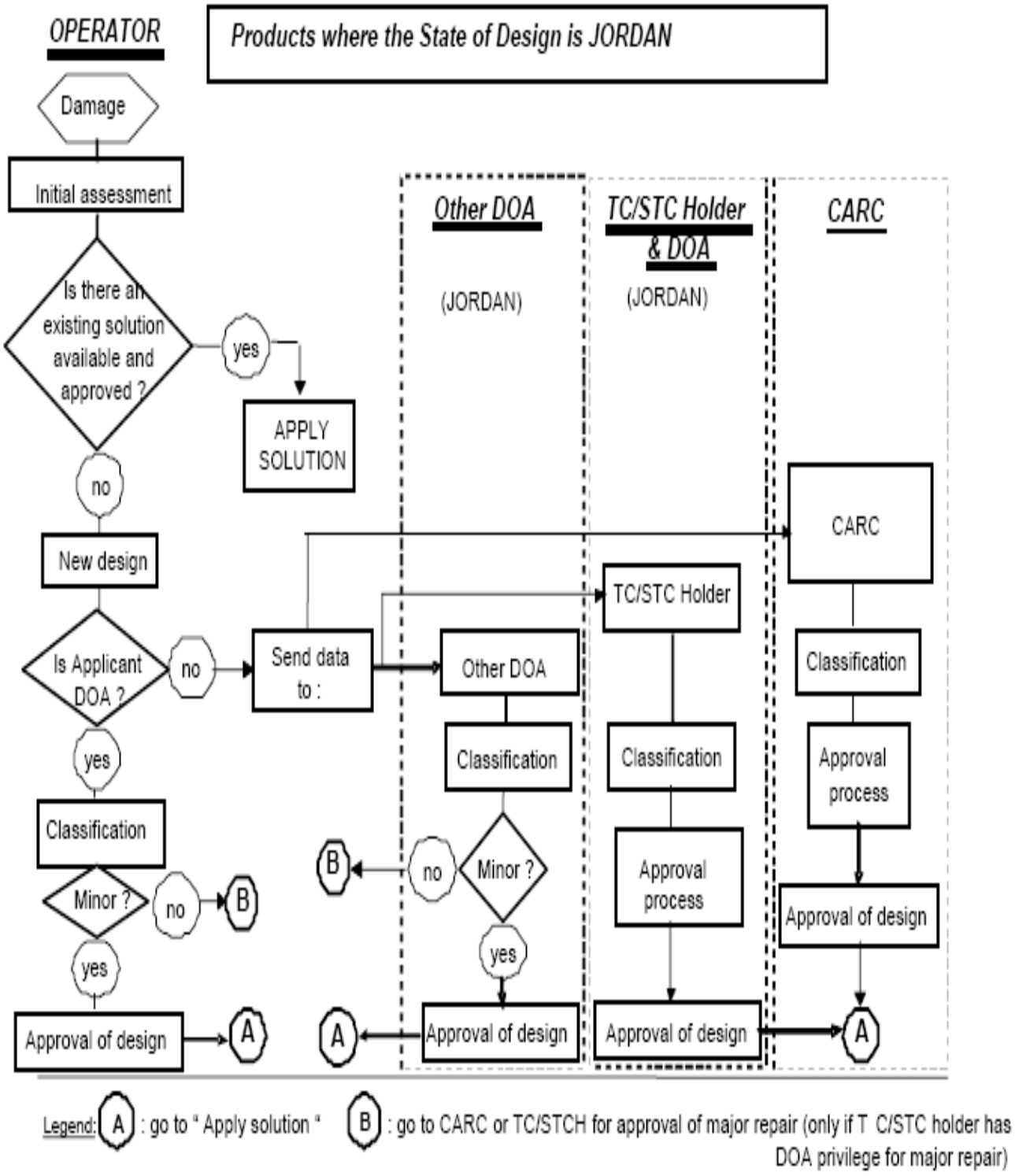
The holder of a production organization approval under Subpart G of Part 21 may accomplish repairs to new aircraft, within its terms of approval, under the privilege of 21.163(d).

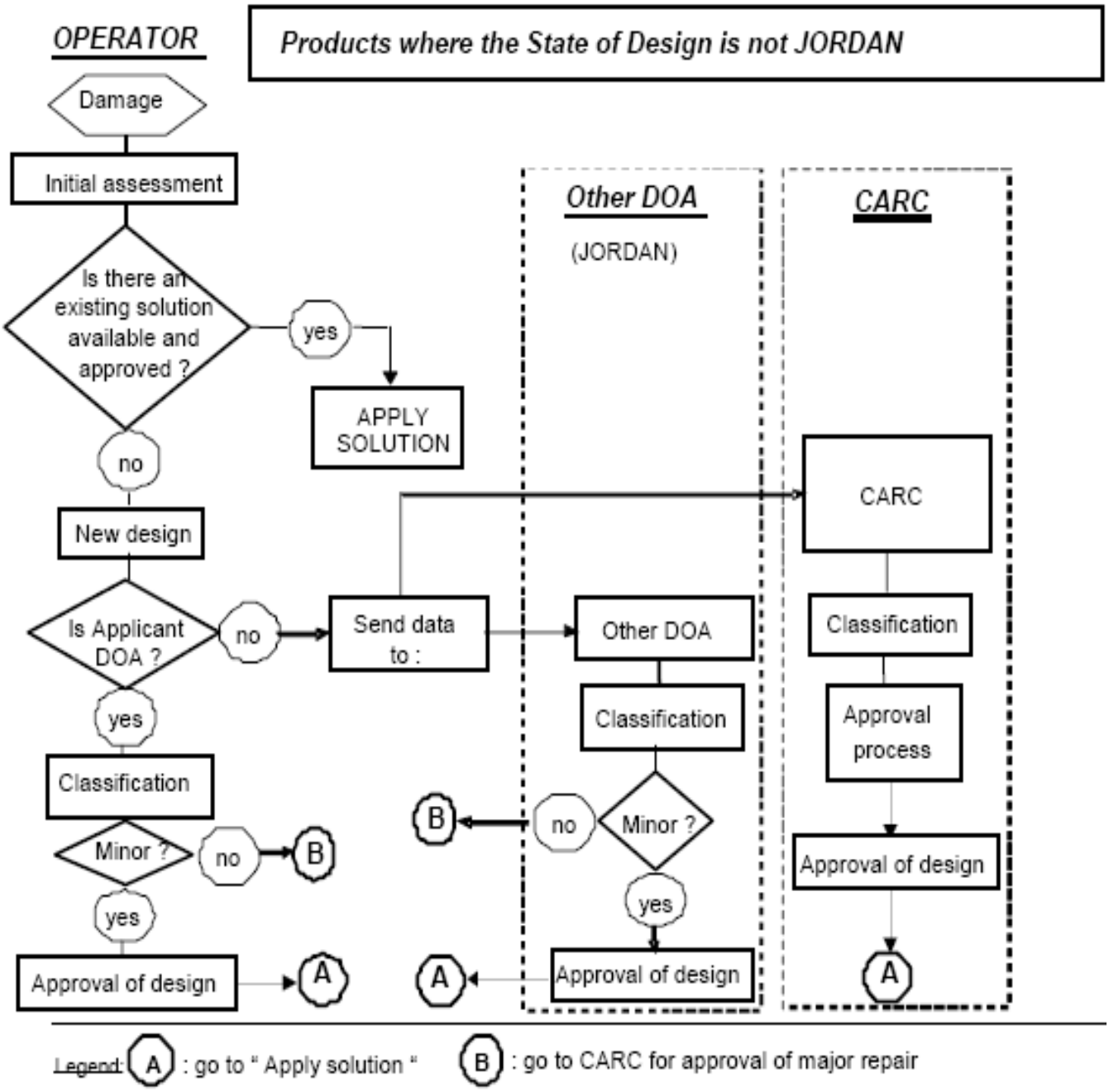
GM 21.443 Limitations

Instructions and limitations associated with repairs should be specified and controlled by those procedures required by the applicable JCAR.

GM 21.445 Unrepaired damage

This is not intended to supersede the normal maintenance practices defined by the type-certificate holder, (e.g., blending out corrosion and re-protection, stop drilling cracks, etc.), but addresses specific cases not covered in the manufacturer's documentation.


OPERATOR
Products where the State of Design is JORDAN
Damage
Initial assessment
Is there an existing solution available and approved ?
yes
APPLY SOLUTION
no
New design
Is Applicant DOA ?
no
Send data to :
yes
Classification
Minor ?
no
B
yes
Approval of design
A
Other DOA
(JORDAN)
TC/STC Holder & DOA
(JORDAN)
CARC
CARC
TC/STC Holder
Other DOA
Classification
Classification
Minor ?
no
B
yes
Approval of design
A
Classification
Approval process
Approval process
Approval of design
Approval of design
A
Legend: A : go to " Apply solution "
B : go to CARC or TC/STCH for approval of major repair (only if T C/STC holder has DOA privilege for major repair)


OPERATOR
Products where the State of Design is not JORDAN
Damage
Initial assessment
Is there an existing solution available and approved ?
yes
APPLY SOLUTION
no
New design
Is Applicant DOA ?
no
Send data to :
yes
Classification
Minor ?
no
B
yes
Approval of design
A
Other DOA
(JORDAN)
Other DOA
Classification
no
Minor ?
B
yes
A
Approval of design
CARC
CARC
Classification
Approval process
Approval of design
A
Legend: A : go to " Apply solution "
B : go to CARC for approval of major repair

Subpart N
(Reserved)

Subpart O
Technical Standard Order Authorizations

AMC 21.602B(b)(2) Procedures for JTSO authorizations

1. Scope

1.1 A manual of procedures must set out specific design practices, resources and sequence of activities relevant for the specific projects, taking account of Part 21 requirements.

1.2 These procedures must be concise and limited to the information needed for quality and proper control of activities by the applicant/holder, and by the CARC.

2. Management of the JTSO authorization process

2.1 For JTSO authorization, a procedure following the principles of AMC 21.14(b), paragraph 2.1, 2.2 and 2.3, with the necessary adaptation related to Part 21 Subpart O context, must be established.

3. Management of design changes

3.1 A procedure following the principles of AMC 21.14(b), paragraphs 3.2 and 3.3, with the necessary adaptation to take into account 21.611, must be established for the classification and approval of design changes on articles under JTSO authorization,

3.2 Repairs and production deviations from the approved design data.

A procedure following the principles of paragraph 3.1 must be established for the classification and approval of repairs and unintentional deviations from the approved design data occurring in production (concessions or non-conformance's). For repairs, the procedure must be established in accordance with Part 21 Subpart M and associated AMC or GM. For deviations, the procedure must be established in accordance with 21.610.

4. Obligations addressed in 21.609

The applicant should establish the necessary procedures to show to the CARC how it will fulfill the obligations under 21.609.

For issue of information and instructions, a procedure following the principles of AMC 21.14(b), paragraph 4 must be established.

5. **Control of design subcontractors**

The applicant must establish the necessary procedures to show to CARC how it will control design subcontractors.

AMC 21.608 Declaration of Design and Performance

STANDARD FORM

DDP No. .....
ISSUE No. .....

1. Name and address of manufacturer.

2. Description and identification of article including:

   Type No .....
   Modification Standard
   Master drawing record
   Weight and overall dimensions

3. Specification reference, i.e., JTSO No. and Manufacturer's design specification.

4. The rated performance of the article directly or by reference to other documents.

5. Particulars of approvals held for the equipment.

6. Reference to qualification test report.

7. Service and Instruction Manual reference number.

8. Statement of compliance with appropriate JTSO and any deviations there from.

9. A statement of the level of compliance with the JTSO in respect of the ability of the article to withstand various ambient conditions or to exhibit various properties.

The following are examples of information to be given under this heading depending on the nature of the article and the requirements of the JTSO.

a. Working and ultimate pressure or loads.

b. Limitations of voltage and frequency.

c. Time rating (e.g., continuous, intermittent) or duty cycle.

d. Limits of accuracy of measuring instruments.

e. Whether the equipment is "flameproof" (explosion-proof).

f. Whether the equipment is "fire-resistant".

g. The compass safe distance.

h. Level of radio interference.

i. Radio and audio frequency susceptibility.

j. Degree of vibration which the equipment will withstand.

k. Degree of acceleration and shock which the equipment will withstand.

l. Degree of waterproofness or sealing of equipment.

m. Ability to withstand sand and dust.

n. Ability to resist salt spray and aircraft fluids.

o. Fungus resistance.

p. Temperature and altitude category.

q. Humidity category.

r. Any other known limitations which may limit the application in the aircraft e.g., restrictions in mounting attitude.

(NOTE: The "categories" referred to are those listed in the current issue of EUROCAE ED–14/RTCA document DO–160).

10. A statement of criticality of software.

(NOTE: Software levels are those defined in the current issue of EUROCAE ED–12B/RTCA document DO–178B.)

11. The declaration in this document is made under the authority of

……(name of manufacturer)

(Manufacturer's name) cannot accept responsibility for equipment used outside the limiting conditions stated above without their agreement.

Date: …….Signed……..(Manufacturer's authorized representative)

Subpart P
(Reserved)

Subpart Q
Identification of products, parts and appliances
(Reserved)