Australian Government
Civil Aviation Safety Authority

DRAFT

ADVISORY CIRCULAR

AC 21-28

Permissible unserviceabilities - unrepaired defects (r. 21.007)

v1.0 – August 2014
Project Number: CS 13/12

Advisory Circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory Circulars should always be read in conjunction with the relevant regulations.

Audience

This Advisory Circular (AC) applies to:

- aircraft operators
- approved design organisations (ADO)
- authorised persons
- aircraft maintainers.

Purpose

The purpose of this AC is to provide guidance in relation to approval of an unrepaired defect in an aircraft under regulation 21.007 of the *Civil Aviation Safety Regulations 1998* (CASR).

Status

Version	Date	Details
v1.0	August 2014	Initial issue of this AC.

For further information

For further information on this AC, contact CASA's Airworthiness and Engineering Standards Branch (telephone 131 757).

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998* (CASR).

Contents

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Acronym	Description
AC	Advisory Circular
AD	Airworthiness Directive
ADO	Approved Design Organisation
AMC	Acceptable Means of Compliance
AMOC	Alternative Means of Compliance
ASETPA	Approved Single Engine Turbine Powered Aircraft
CAR	*Civil Aviation Regulations 1988*
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
CDL	Configuration Deviation List
CMA	Common Mode Analysis
CMR	Certification Maintenance Requirement
CS	Certification Specification
EASA	European Aviation Safety Agency
EDTO	Extended Diversion Time Operations
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FHA	Functional Hazard Analysis
FOD	Foreign Object Damage
ICA	Instructions for Continuing Airworthiness
IFE	Inflight Entertainment
MEL	Minimum Equipment List
MOS	Manual of Standards
pfh	Per Flight Hour
NEF	Nonessential equipment and furnishings
PRA	Particular Risks Analysis
TSO	Technical Standard Order
VFR	Visual Flight Rules
ZSA	Zonal Safety Analysis

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below.

Term	Definition
Additional airworthiness requirements	Include requirements such as airworthiness directives (AD), including exemptions and alternative means of compliance (AMOC), Part 90 Manual of Standards (MOS), extended diversion time operations (EDTO) and approved single engine turbine powered aircraft (ASETPA).
Airworthiness limitation	Mandatory replacement times, structural inspection intervals, and related structural inspection tasks for a particular part or system.
Airworthiness standard	A standard applied for certification of the aircraft under Part 21.
Approved Design Organisation	A person who holds an approval under regulation 21.243 (Subpart 21.J) that is in force.
Authorised Person	A person who is appointed under regulation 201.001 to be an authorised person for regulation 21.007.
Average Probability Per Flight Hour	Is a representation of the number of times a failure condition is predicted to occur during the entire operating life of the aircraft type divided by the anticipated total operating hours of all aircraft of that type.
Certification Maintenance Requirement	A required scheduled maintenance task established during certification of the aircraft systems as an operating limitation of the type certificate or supplemental type certificate.
Defect	An imperfection that impairs the structure, composition, or function of an object or system of an aircraft or component. For the purpose of regulation 21.007 it includes damage to aircraft structure or parts, system defects (including functional failures of systems or parts) and exceedance of operational limitations in the instructions for continuing airworthiness (ICA).
Major damage	Damage of such a kind that it may affect the safety of the aircraft or cause the aircraft to become a danger to persons or property.
Major defect	A defect of such a kind that it may affect safety of the aircraft or cause the aircraft to become a danger to persons or property.
Minor damage	Damage that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristic, or other characteristics affecting the airworthiness of an aircraft, aircraft engine or propeller.
Modification	An approved change to the design of an aircraft that is not a repair and is not a defect.
Nonessential equipment and furnishings (NEF)	Those items installed on the aircraft as part of the original certification, STC, or other form of modification or alteration that have no effect on the safe operation of flight and would not be required by the applicable certification requirements or operational requirements. They are those items that, if inoperative, damaged, or missing, have no effect on the aircraft's ability to be operated safely under all operational conditions. They do not include items that are functionally required to meet the applicable airworthiness standards, additional airworthiness requirements or for compliance with any operational requirements.
Passenger convenience items	Those items related to passenger convenience, comfort or entertainment such as galley equipment, entertainment equipment and reading lamps.

1.3 References

Regulations

Regulations are available on the ComLaw website http://www.comlaw.gov.au/Home

Document	Title
Part 21 of CASR	Certification and airworthiness requirements for aircraft and parts
CASR Dictionary	

CASA advisory material

CASA's advisory material is available at http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90902

Document	Title
AC 21.J-01	Approved design organisations
AC 21-8	Approval of modification and repair designs under Subpart 21.M
AC 21-09	Special flight permits
AC 21-12	Classification of design changes
AWB 02-6	Flexible Hose Assemblies - Maintenance Practices
CAAP 37-1	Minimum Equipment Lists (MEL)

Other documents

Airservices Australia Aeronautical Information Package General 1.5

Airservices Australia documents are available at http://www.airservicesaustralia.com/

EASA CS-23

EASA CS-25 AMC 25.1309

EASA CS-27

EASA CS-29

EASA CS-E AMC E 510

EASA CS-P AMC P 150

EASA documents are available at http://easa.europa.eu/

FAA Technical Standard Orders (TSO) C42, C75, C53, C140

FAA AC 23.1309-1

FAA AC 25-19

FAA AC 25.1309-1

FAA AC 27.1309 (found in FAA AC 27-1)

FAA AC 29.1309 (found in FAA AC 29-2)

FAA AC 33.75

FAA AC 35.23-1

FAA AC 43.13-1

FAA documents are available at http://www.faa.gov/

SAE International Aerospace Recommended Practice (ARP) 1658

SAE International ARP4754

SAE International ARP4761

SAE International documents are available at http://www.sae.org/

1.4 Forms

CASA's forms are available at http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_91308

Form number	Title
CASA Form 979	Statement of Compliance

2 Introduction

2.1 Purpose of this AC

2.1.1 This AC provides guidance on approval of an unrepaired defect in an aircraft as a permissible unserviceability under regulation 21.007.

2.1.2 Such approvals are intended for situations where the defect cannot be deferred via other provisions of the regulations, such as instructions for continuing airworthiness (ICA), minimum equipment lists (MEL) or configuration deviation lists (CDL).

2.2 Dealing with defects in an aircraft

2.2.1 When a defect is identified in relation to an aircraft (including an aeronautical product fitted to an aircraft), the defect must be reported to the aircraft's registered operator in accordance with the applicable regulations. The aircraft's registered operator must then deal with the defect through rectification or deferral. The regulations provide various means of deferring defects as explained (in general terms) in the following paragraphs.

2.2.2 Instructions for continuing airworthiness

2.2.2.1 The first option available for deferring a defect is in accordance with the ICA for the aircraft. ICA provide processes that ensure the aircraft complies with the applicable airworthiness requirements and conditions of safe operation.

2.2.2.2 ICA include ad hoc written instructions from the type certificate holder or manufacturer of an aircraft or aeronautical product that specify revised or new standards such as in-service-limits for continuing airworthiness of the aircraft or aeronautical products. These ICA may be used to defer rectification of a defect that is not covered by a pre-existing ICA.

2.2.2.3 To meet the requirements to be ICA, the instructions must:

a. be issued by the type certificate holder or manufacturer – in practice, the instructions will be acceptable if they are issued:
   i. by the part of the type certificate holder or manufacturer's organisation that is responsible for issuing ICA; or
   ii. by a person who has the authority to issue ICA on behalf of the type certificate holder or manufacturer; and
b. contain all the necessary information to be applied as ICA – documents that need to be supplemented to provide adequate instructions or that only provide design information (as opposed to instructions in the form of requirements, procedures and standards for in-service limits) may only be used as supporting information for an approval under the regulations.

2.2.2.4 Instructions issued by a type certificate holder's or a manufacturer's engineering support personnel, such as individuals from aircraft-on-ground (AOG) support or field service representatives, are acceptable as ICA if the instructions have been issued in accordance with the type certificate holder's or manufacturer's organisation procedures for issuing ICA for the aircraft or aeronautical product (as specified in paragraph 2.2.2.3 above).

2.2.3 Minimum equipment list and configuration deviation list

2.2.3.1 A defect may also be deferred in accordance with an aircraft's MEL or CDL. MELs provide for the aircraft to be operated with particular item(s) of equipment defective at the time of dispatch for the intended flight.[1] Whereas CDLs allow for operation of the aircraft if particular external components are missing. Where necessary, the CDL will also provide performance corrections for operating the aircraft with missing external components.

2.2.4 Modification/repair approval under Subpart 21.M

2.2.4.1 Subpart 21.M provides for a specific modification or repair to be approved that will restore the aircraft to an airworthy condition in compliance with the applicable airworthiness standards. The modification/repair may be permanent or temporary, and may apply specific conditions on the operation of the aircraft.

2.2.4.2 Aircraft return to service without repair cannot be approved under Subpart 21.M, nor can damage or a defect be considered a modification.

2.2.4.3 Regulation 21.007 may not be used to approve a modification or repair. If a modification or repair is required to ensure the aircraft complies with the applicable airworthiness standards or to ensure an acceptable level of safety, then the defect should be dealt with under Subpart 21.M. The following are examples of modifications/repairs often associated with defects and damage that must be approved under Subpart 21.M:

a. removal/blending of corrosion
b. stop drilling
c. restoration/application of surface treatment or paint
d. application of sealant or tape
e. additional or alternative restraint of loose parts (e.g. installation of cable ties, lockwire, clamps)
f. removal of a defective part required by the approved design (e.g. damaged/loose aerodynamic seal)
g. physical disconnection of parts or systems by a means not specified in the approved design or existing ICA (e.g. disconnecting cannon plugs, blanking fluid lines).

2.2.4.4 Deactivation or locking out parts or systems by a means specified in the ICA (e.g. via switches, circuit breakers, lockout mechanisms) does not require a modification/repair design approval – such an action may therefore be specified as a condition of an approval under regulation 21.007.

2.2.4.5 See AC 21-8 for more information on modification/repair design approvals under Subpart 21.M.

2.2.5 Special flight permit under regulation 21.200

2.2.5.1 A special flight permit may only be issued in accordance with the provisions provided in regulation 21.200. In the case of an aircraft with a defect, a special flight permit allows for the aircraft to be flown to a location where the defect can be rectified. A special flight permit does not allow the aircraft to be operated for revenue flights.[2]

[1] See CAAP 37-1 for more information on MELs.
[2] See AC 21-09 for more information about special flight permits.

2.2.6 Unrepaired defect approval under regulation 21.007

2.2.6.1 If an aircraft has incurred a defect and the aircraft with the defect complies with the applicable airworthiness standards, then the defect may be approved under regulation 21.007 as a permissible unserviceability.

2.2.6.2 Approval of a defect as a permissible unserviceability under regulation 21.007 is intended to function as an interim measure during which time the applicant should either:

a. have the defect rectified; or
b. obtain approval of another means of dealing with the defect in the form of approved maintenance data or ICA (as applicable under the *Civil Aviation Regulations 1988* (CAR) or CASR), from:
    i. the type certificate holder;
    ii. the manufacturer of the aeronautical product; or
    iii. the relevant design approval holder.

3 Approval of unrepaired defects under regulation 21.007 – general information

3.1 Scope of regulation 21.007

3.1.1 Aircraft

3.1.1.1 Regulation 21.007 is applicable to all aircraft operating under either the CAR or CASR continuing airworthiness regulations.

3.1.2 Defects

3.1.2.1 Regulation 21.007 is applicable for defects generally, including damage (for the purpose of regulation 21.007, damage is a subset of defect).

3.1.2.2 The scope of regulation 21.007 includes defects such as damage to aircraft structure or parts; damage to aircraft system, engine or propeller elements/components; system defects, including functional failures associated with aircraft systems, engines or propellers; and exceedance of limits in the ICA (e.g. leak rates, hard landings, engine over speed).

3.1.2.3 Regulation 21.007 cannot be used to approve a defect that would lead to a non-compliance with another requirement such as an AD, a direction issued by CASA, a certification maintenance requirement (CMR), an airworthiness limitation item or another regulatory requirement such as instruments and equipment required for a particular kind of operation under the regulations.

3.1.2.4 Regulation 21.007 cannot be used to approve a defect or kind of defect before the defect has occurred.

3.1.2.5 Regulation 21.007 cannot be used to approve an unrepaired defect on an aeronautical product that is not fitted to an aircraft (i.e. for the purposes of issuing an authorised release certificate for the product).

3.1.3 Minimum equipment list and configuration deviation list

3.1.3.1 Regulation 21.007 cannot be used to approve an MEL, a variation of an MEL or an extension of a MEL. All MEL approvals are made under regulation 37 of CAR.

3.1.3.2 Similarly, regulation 21.007 cannot be used to approve a CDL, a variation of a CDL or an extension of a CDL.

3.1.3.3 If an aircraft has incurred a defect that is covered by an MEL or CDL, then an application may be made under regulation 21.007 as an alternative to applying the MEL or CDL. In that case, a regulation 21.007 compliance demonstration must be carried out, and must take into account any operation of the aircraft with the defect under the MEL or CDL. That is, the assessment must take into account and subtract from any limitations necessary for approval under regulation 21.007, any calendar time, flight hours and flight cycles already consumed by the prior application of the MEL or CDL.

3.2 Who may apply?

3.2.1 The registered operator or a person acting on their behalf may apply for an unrepaired defect to be approved as a permissible unserviceability under regulation 21.007.

3.3 How an application should be made

3.3.1 An application may be made to:

a. a relevant ADO
b. an authorised person for regulation 21.007
c. CASA.

3.3.2 The application should be in writing and contain all the information necessary to assess the application, or a means of providing that information (e.g. access to the aircraft or the contact details of the person who will provide any necessary additional information).

3.4 Criteria for approval under regulation 21.007

3.4.1 A defect may only be approved as a permissible unserviceability under regulation 21.007 if:

a. granting the approval would not be likely to have an adverse effect on the safety of air navigation; and
b. the aircraft with the defect meets the applicable airworthiness standards for the aircraft, or a specified later version of the standard.

3.4.2 Unsafe feature or characteristic analysis

3.4.2.1 An unsafe feature or characteristic includes:

a. a feature or characteristic that may lead to an event that would:
   i. result in fatalities, usually with the loss of the aircraft; or
   ii. 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:
      A. a large reduction in safety margins or functional capabilities;
      B. physical distress or excessive workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely; or
      C. 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 standards;
b. a feature or characteristic that too frequently (i.e. significantly beyond the applicable safety objectives) leads to events having less severe immediate consequences than those listed above but:
   i. could eventually lead to one of the consequences listed above in specific operating environments; or
   ii. 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. a significant reduction in safety margins or functional capabilities;
      B. a significant increase in crew workload, or in conditions impairing crew efficiency; or
   iii. discomfort to occupants, possibly including injuries;

c. a feature or characteristic with which there is an unacceptable risk of serious or fatal injury to persons other than occupants; or
d. design features intended to minimise the effects of survivable accidents not performing their intended function.

3.4.2.2 The analysis may be qualitative or quantitative. In cases where formal and quantitative safety analyses are not available, as would be the case for the majority of regulation 21.007 applications, the level of analysis should be consistent with that required by the applicable airworthiness standards and may be based on engineering judgement supported by service experience data. The analysis may assume:

a. that the crew has the skill to apply the necessary procedures correctly, but without requiring exceptional piloting skill, alertness or strength
b. that the aircraft is maintained in accordance with the applicable maintenance program and ICA.

3.4.2.3 The analysis should include consideration of additional airworthiness requirements such as ADs, including exemptions and AMOCs, Part 90 MOS, EDTO and ASETPA, and operational requirements not specifically covered by the applicable airworthiness standards.

3.4.2.4 If an ADO or authorised person concludes that an unsafe situation might exist, then the defect may not be approved unless the unsafe feature or characteristic can be adequately addressed, for example, by conditions on the approval.

3.4.3 Applicable airworthiness standards

3.4.3.1 The applicable airworthiness standards for the aircraft are the standards that applied for airworthiness certification of the aircraft, or a later version of those standards (provided that the use of the later version would not have an adverse effect on the safety of air navigation), including any conditions associated with that certification (e.g. special conditions specified on a type certificate).

3.5 Who may grant an approval under regulation 21.007

3.5.1 An unrepaired defect in an aircraft may be approved as a permissible unserviceability under regulation 21.007 by:

a. a relevant ADO
b. an authorised person for regulation 21.007
c. CASA.

3.5.2 An ADO or an authorised person may have limitations associated with their scope of approval that restrict the range of aircraft and defects for which they may grant approval. Such limitations are based on the demonstrated competency of the ADO and individuals (including qualifications, experience, knowledge and resources), and may include kinds of aircraft or products (e.g. Part 25 aircraft) or engineering specialities (e.g. structures, systems, avionics).[3]

[3] See AC 21.J-01 for more information on ADOs.

3.6 How an approval is granted

3.6.1 An approval under regulation 21.007 must be granted in writing, and must contain the following:

a. the registration mark of the aircraft
b. a description of the defect
c. the limit at which the approval ceases (see section 3.7)
d. any conditions associated with the approval (see section 3.8)
e. the name of the individual and ADO (if applicable) granting the approval
f. the signature of the individual granting the approval
g. the provision under which the approval is granted (i.e. subregulation 21.007(2))
h. the date the approval is granted.

3.7 Approval period limits

3.7.1 An approval under regulation 21.007 may only be granted for a limited period. The period may be specified in any appropriate manner (e.g. calendar time, flight time, flight cycles), but the period must not exceed 1 year from the day the approval is given.

3.7.2 The period for which an approval may be granted depends on the nature of the defect and the showing of compliance. The period must not exceed the period for which compliance with the aircraft's applicable airworthiness standards is found.

3.7.3 Approvals will generally need to be carried out in two stages, except in cases where the nature of the defect and the information available to the ADO or authorised person is sufficiently comprehensive to ensure compliance with the applicable airworthiness standards. Detailed information is provided in section 4.4.

3.8 Conditions

3.8.1 An approval under regulation 21.007 may be granted subject to conditions, including inspections and operational limitations, which are necessary to ensure compliance with subregulation 21.007(2).

Note: Regulation 21.007 may not be used to approve a modification or repair – see subsection 2.2.4.

3.9 Categories of defects

3.9.1 A defect is an imperfection that impairs the structure, composition, or function of an object or system of an aircraft or component. In the case of permissible unserviceabilities under regulation 21.007, defects must be categorised as one of the following:

a. damage to aircraft structure
b. damage to aircraft system, engine or propeller elements/components
c. system defect, including a functional failure associated with an aircraft system, engine or propeller
d. exceedance of an operational limitation specified in the ICA for the aircraft.

3.9.2 Defect classification is further explained in subsection 4.2.6.

4 Assessment for approval under regulation 21.007

4.1 Assessment and analysis terminology

4.1.1 Use of service experience in the assessment and approval process

4.1.1.1 Service experience should be used to support qualitative analyses, assumptions and engineering judgements that may be necessary for assessment of defects for approval under regulation 21.007.

4.1.1.2 In order for service experience data to be acceptable, the data must be sufficient, pertinent and documented. The essentials of the process involve:

a. a clear understanding of the relevant airworthiness requirements and standards, their purpose and the hazards addressed
b. a detailed knowledge of the design
c. the availability of pertinent and sufficient service experience data (including world fleet data, where possible)
d. a documented and comprehensive review of that service experience data.

4.1.1.3 The data available locally should be supplemented with world fleet service experience data where possible (sources of world fleet data include direct requests to other operators and type certificate holders or fleet information systems provided by certain organisations and type certificate holders).

4.1.2 Defect effect classifications

4.1.2.1 Defect effects may be classified according to their severity as follows:

a. No Safety Effect: A defect that would have no effect on safety. For example, failure conditions that would not affect the operational capability of the aircraft or increase crew workload.
b. Minor: A defect that would not significantly reduce aircraft safety, and which involves crew actions that are well within their capabilities. For example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, or minor physical discomfort to passengers or cabin crew.
c. Major: A defect that would 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 a significant reduction in safety margins or functional capabilities. For example, a significant increase in crew workload, conditions impairing crew efficiency, discomfort to the flight crew, physical distress to passengers or cabin crew or possibly injuries.
d. Hazardous: A defect that would 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;
    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 a relatively small number of the occupants other than the flight crew.
e. Catastrophic: A defect that would result in multiple fatalities, usually with the loss of the aircraft.

4.1.3 Qualitative probability terms

4.1.3.1 The probabilities of the defect effect may be described in qualitative terms as follows:

a. Probable: anticipated to occur one or more times during the entire operational life of each aircraft.
b. Remote: unlikely to occur to each aircraft during its total life, but which may occur several times when considering the total operational life of a number of aircraft of the type.
c. Extremely Remote: not anticipated to occur to each aircraft during its total life but which may occur a few times when considering the total operational life of all aircraft of the type.
d. Extremely Improbable: so unlikely that they are not anticipated to occur during the entire operational life of all aircraft of the type.

4.1.4 Quantitative probability terms

4.1.4.1 The probabilities of the defect effect may also be described quantitatively in terms of Average Probability Per Flight Hour (pfh):

a. For aircraft type certificated in the transport category:
   i. Probable: Average failure conditions of greater than the order of 1×10^{-5} pfh.
   ii. Remote: Average failure conditions of less than, or equal to, 1×10^{-5} pfh, but greater than of the order of 1×10^{-7} pfh.
   iii. Extremely Remote: Average failure conditions of less than, or equal to, $1x\ 10^{-7}$ pfh, but greater than of the order of 1×10^{-9} pfh.
   iv. Extremely Improbable: Average failure conditions of less than $1x\ 10^{-9}$ pfh.

b. For aircraft other than aircraft type certificated in the transport category, a relevant industry standard should be applied, e.g. FAA AC 23.1309-1.

Note: Quantitative assessment of a defect typically requires a detailed knowledge of the failure rates of the individual component(s) in a system. If the ADO did not design the particular system in which the defect exists then a qualitative assessment may be more appropriate.

4.1.5 Assessment tools

4.1.5.1 Defect assessment tools applicable to an approval under regulation 21.007 include the following:

a. Functional Hazard Analysis (FHA)
b. Common Cause Analysis (CCA)
   i. Zonal Safety Analysis (ZSA)
   ii. Particular Risks Analysis (PRA)
   iii. Common Mode Analysis (CMA).

4.1.5.2 FHA identifies each failure condition and effect at the aircraft and system level. FHA also gives consideration to the failure condition and its effect on a particular phase of flight.

4.1.5.3 CCA is the specific analyses necessary to ensure that independence of a failure can either be assured or deemed acceptable. CCA includes ZSA, PRA and CMA.

4.1.5.4 ZSA is to ensure that the installations within a zone are at an adequate safety standard. It identifies any failure or malfunction which by itself is considered sustainable, but which could have more serious effects when adversely affecting other adjacent systems or components.

4.1.5.5 PRA identifies events or influences outside the structure or system concerned and examines simultaneous or cascading effects or influences that may violate independence claims (e.g. fire, leaking fluids, bird strike, tire burst, HIRF exposure, lightning, uncontained failure of high energy rotating machines, etc.). Particular risks may influence several zones at the same time, whereas ZSA is restricted to each specific zone.

4.1.5.6 CMA is to confirm the independence of events that, in combination, would result in a given failure condition. In particular, effects of design, environmental factors (other than those already considered in the PRA) and failures of system components should be considered.

4.1.5.7 Additional details on applying these tools are available in the following airworthiness and industry standards:

a. FAA AC 23.1309-1
b. FAA AC 25-19
c. FAA AC 25.1309-1
d. FAA AC 27.1309 (found in FAA AC 27-1)
e. FAA AC 29.1309 (found in FAA AC 29-2)
f. FAA AC 33.75
g. FAA AC 35.23-1
h. EASA CS-23
i. EASA CS-25 AMC 25.1309
j. EASA CS-27
k. EASA CS-29
l. EASA CS-E AMC E 510
m. EASA CS-P AMC P 150
n. SAE International ARP4754
o. SAE International ARP4761.

4.2 Initial assessment

4.2.1 The following sections set out the requirements for the initial assessment of a permissible unserviceability under regulation 21.007.

4.2.2 Purpose of the initial assessment

4.2.2.1 The purpose of the initial assessment is to determine the possibility of approving the defect as a permissible unserviceability, based on the nature of the defect and the information that is available. The initial assessment establishes the framework for the comprehensive assessment that must be carried out in order to show compliance for approval.

4.2.3 Initial assessment process summary

4.2.3.1 Upon receipt of an application, the ADO or authorised person should carry out an initial assessment of the defect that includes the following (which are described in more detail below):

a. major defect classification
b. major/minor repair classification
c. defect classification
d. extent and effect of defect
e. potential for further deterioration
f. root cause analysis

g. service experience review of similar defects
h. continuing airworthiness standard compliance.

4.2.3.2 If the initial assessment indicates that the criteria for approval cannot be met (see section 3.4), the defect may not be approved as a permissible unserviceability.

4.2.4 Major defect classification

4.2.4.1 The reported defect must first be evaluated against the major defect definition provided in the CASR Dictionary.

4.2.4.2 The CASR Dictionary defines major defect to mean: in relation to an aircraft, a defect of such a kind that it may affect the safety of the aircraft or cause the aircraft to become a danger to persons or property.

4.2.4.3 If the defect is a major defect, it cannot be approved as a permissible unserviceability.

4.2.5 Major/minor repair classification

4.2.5.1 If the defect is determined to be damage to aircraft structure, or damage to aircraft system, engine or propeller elements/components, carry out major/minor classification of the defect in accordance with AC 21-12.

4.2.5.2 Major damage or any defect that would otherwise require a major repair will not meet the criteria for approval under regulation 21.007 and therefore cannot be approved as a permissible unserviceability.

4.2.6 Defect classification

4.2.6.1 The defect must be classified into one of the following categories:

a. Damage to aircraft structure. For example, foreign object damage (FOD) to landing gear doors.
b. Damage to aircraft system, engine or propeller elements/components. For example, a dent in a standby hydraulic system pipe.
c. System defect, including a functional failure associated with an aircraft system, engine or propeller. For example, intermittent operability of a hydraulic pump.
d. Exceedance of an operational limitation specified in the ICA for the aircraft. For example, fluid leak rate or propeller overspeed.

4.2.7 Extent and effect of defect

4.2.7.1 Determine the effect the defect has on the aircraft, including any reduction in safety margin or system redundancy, as described in subsection 4.1.2.

4.2.7.2 Any defect that has a failure effect other than No Safety Effect, Minor or Major will not meet the criteria for approval under regulation 21.007 (see section 3.4) and therefore cannot be approved as a permissible unserviceability.

Performance effects

4.2.7.3 If approval of the defect as a permissible unserviceability may cause a potential reduction of aircraft performance, appropriate performance penalty factors must be applied. For example, when aircraft is operated with some secondary structure missing, such as access panels or landing gear doors.

4.2.7.4 In the case of transport category aircraft, a CDL may be available and it may provide relevant data regarding performance penalties for operation with the kind of defect. If a CDL is not available, appropriate engineering assessment of the aircraft performance penalty must be carried out. The assessment may use CDL data for similar defects, if available, to establish appropriate performance penalties.

4.2.7.5 In order to provide a sufficient level of safety, a conservative approach in determining an appropriate safety margin for performance penalty factors should be applied for the initial approval. The approval may subsequently be varied if operation of the aircraft under the initial approval shows that less conservative performance penalties are acceptable.

4.2.7.6 A similar methodology can be applied if the effect of the defect is reduced engine performance (e.g. increased engine fuel consumption). A careful assessment must be made for extended range twin operations and long flights over water where alternative airports are not readily available. A conservative approach, including additional fuel reserves or other mitigating factors, such as availability of alternative airports, should be applied for the initial approval.

4.2.8 Potential for further deterioration

4.2.8.1 Determine the mechanics of the defect and the potential for further deterioration, including the rate of deterioration of the defect and the allowed limit of deterioration of the defect.

4.2.8.2 Qualitative analyses, assumptions and engineering judgements used to determine the potential for further deterioration must be supported with service experience data and/or statistical analysis.

4.2.8.3 If the operator has not experienced the particular defect previously, a stringent inspection program for the initial approval period may be necessary to ensure compliance with the applicable airworthiness standards and that approval of the defect does not lead to an unsafe condition. Interim inspection periods (times, flight hours or flight cycles) should be of a sufficiently short interval to ensure adequate monitoring of any deterioration.

4.2.8.4 Additional operational limitations may also be applied to help mitigate the risk of further deterioration.

4.2.9 Root cause analysis

4.2.9.1 Carry out a root cause analysis and determine the root cause of the defect.

4.2.9.2 In some cases it may not be possible to conclusively determine the root cause of the defect without extensive testing with special equipment or removal of parts for inspection and testing in a workshop. In such cases, it is acceptable to use engineering judgement supported by service experience and statistical data to make an assumption of the root cause and ensure the defective system or component does not influence other systems.

Example 1

4.2.9.3 In the event of structural cracking, it may not be necessary to determine the exact root cause of the cracking. However, it must be understood which direction the crack will propagate, the approximate rate of propagation and the critical crack length for the particular structural element or to provide an engineering justification why it would not be relevant to know any or all of these parameters for the purpose of an approval.

Example 2

4.2.9.4 In the event of a fluid leak in aircraft system or engine component as a result of a defective seal, it may not be necessary to establish the exact root cause of the defect in the seal before approval can be given. In some cases, certain seals may require the removal of the whole engine or major system component and its disassembly at shop level before the seal can be accessed. Nevertheless, before the approval is provided, the gradual degradation of the seal must be confirmed through statistical means, such as an oil consumption or oil leak monitoring program. It must be established that the leak occurred due to gradual wear of the seal (as opposed to another kind of defect, such as a cracked tube or housing). The oil consumption or oil leak rate increase must be gradual and with a constant and predictable gradient that will allow confirmation that the aircraft or engine oil system will have enough oil to complete the longest scheduled flight. In this case, additional maintenance inspections and frequent oil leak or consumption rate checks must be introduced and if necessary, an operational limitation on the maximum flight duration can be imposed as a condition of the approval.

4.2.10 Service experience review of similar defects

4.2.10.1 Consideration should be given to any service experience data relevant to the defect. In particular, the review should consider the following:

a. Previous approvals of similar defects granted by the ADO or authorised person.
b. Relevant fleet service experience data that is relevant to the defect analyses, including the operator's fleet and world fleet service experience data where possible.

4.2.10.2 A combination of relevant analyses, information from the type certificate holder or the manufacturer of the aeronautical product, and service experience data may be used to support qualitative analyses and determine the appropriate conditions, including the period for which the approval is to be granted (see subsection 4.2.12).

4.2.11 Compliance with applicable airworthiness standards

4.2.11.1 Determine the applicable airworthiness standards and show compliance with the standards applicable to the defect (see also the comprehensive assessment process described in section 4.3).

4.2.11.2 An approval may only be granted for the period for which compliance with the applicable airworthiness standards is found.

4.2.12 Approval period

4.2.12.1 If the following criteria are met and there is sufficient information available to fully address all the subsections 4.2.4 through 4.2.11, or the defect affects only an NEF item, then the defect is eligible for approval as a permissible unserviceability for the period for which compliance with the applicable airworthiness standards can be shown, up to the maximum period of 1 year permitted by regulation 21.007, subject to the comprehensive assessment described in section 4.3:

a. the defect is a quantifiable physical defect (e.g. corrosion, crack, dent, wear);
b. the defect is classified minor;
c. failure of the affected part would not have the potential to cause a failure condition other than No Safety Effect, Minor or Major;
d. the defect is not in a high speed or high energy rotating part;

e. the extent of the defect is known (i.e. the dimensions of the physical defect);
f. the effect of the defect is known;
g. the potential for deterioration of the defect is known;
h. the rate of deterioration of the defect is known; and
i. the allowed limit of deterioration of the defect is known.

4.2.12.2 For defects that do not meet the criteria of paragraph 4.2.12.1 (e.g. system defects or exceedance of operational limitations in required systems), but for which there is sufficient information available from the type certificate holder or manufacturer and service experience data to address all the subsections 4.2.4 through 4.2.11, the defect is eligible for approval for the period for which the information shows compliance with the applicable airworthiness standards, up to the maximum period of 1 year.

4.2.12.3 For other cases, i.e. defects for which there is insufficient information available to address all the subsections 4.2.4 through 4.2.11, but where compliance with the applicable airworthiness standards can be found to a high degree of confidence for a limited period in accordance with the comprehensive assessment described in section 4.3, the initial approval should not exceed 10 calendar days, 100 flight hours or 50 flight cycles, whichever occurs first. If a longer period of approval is desired, then the period of the initial approval should be used to obtain the information necessary to show compliance for a longer period, such as inspections of the defect and technical advice or ICA from the type certificate holder or manufacturer.

Example

4.2.12.4 The information initially available is insufficient to determine the exact rate of deterioration, but it can be shown that it is extremely improbable that the defect will progress beyond the safe limit within a certain period. The defect may be approved for up to the latter period but not exceeding 10 calendar days, 100 flight hours or 50 flight cycles, whichever occurs first. If subsequent approval is desired, then inspections should be specified as a condition of the approval to accurately determine the rate of deterioration, and the type certificate holder or manufacturer should be contacted to obtain technical advice or ICA.

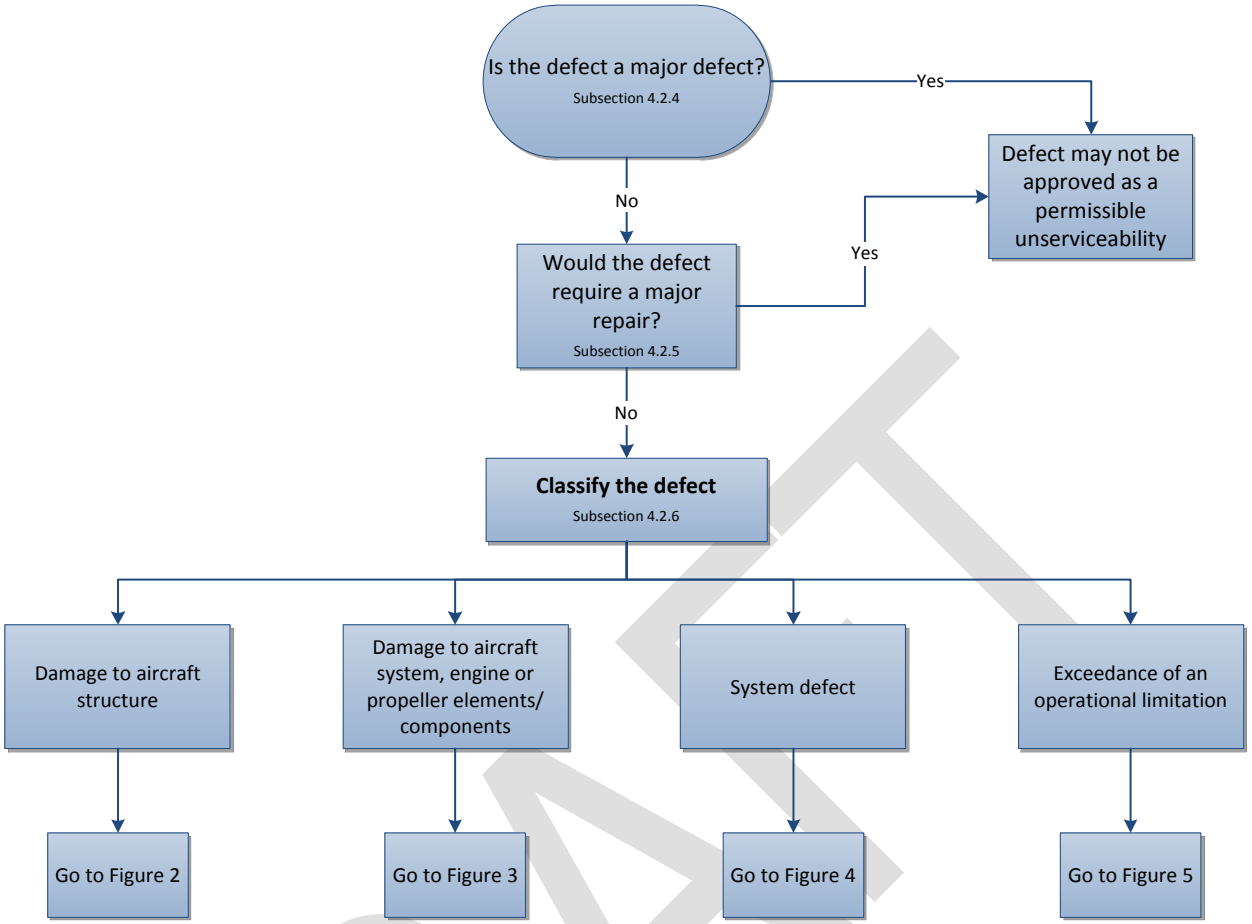

Figure 1: Initial assessment process and defect classification

4.3 Comprehensive assessment

4.3.1 A defect may only be approved as a permissible unserviceability if compliance with the applicable airworthiness standards and an acceptable level of safety for the aircraft operating with the unserviceability can be established. The following subsections describe the processes required to approve a defect as a permissible unserviceability following the initial assessment process outlined in section 4.2.

4.3.2 If the defect is classified as damage to aircraft structure

4.3.2.1 Identify the applicable airworthiness standards and design requirements applicable to the damaged area. Particular consideration should be given to additional airworthiness requirements such as ADs, including exemptions and AMOCs, Part 90 MOS, EDTO and ASETPA. The defect cannot be approved as a permissible unserviceability if the aircraft is no longer compliant with the applicable airworthiness standards.

4.3.2.2 A ZSA and PRA should also be carried out to ensure the damage does not create an unsafe condition in the aircraft. Particular focus should be given to the potential for FOD to enter the aircraft structure, any possible venturi effect, influence on fire detection/suppression systems and any existing defects applicable to the area.

4.3.2.3 An aircraft performance assessment should also be conducted to determine if any operational limits are required, or performance deficiencies are expected. Particular attention should be given to whether the defect affects a system that provides redundancy for mission capabilities. Any operational limitations, conditions or required maintenance action must be specified in the approval documentation.

4.3.2.4 Provide justification as to why the damage may be approved in regard to the airworthiness and design requirements using the outcome of the ZSA and PRA.

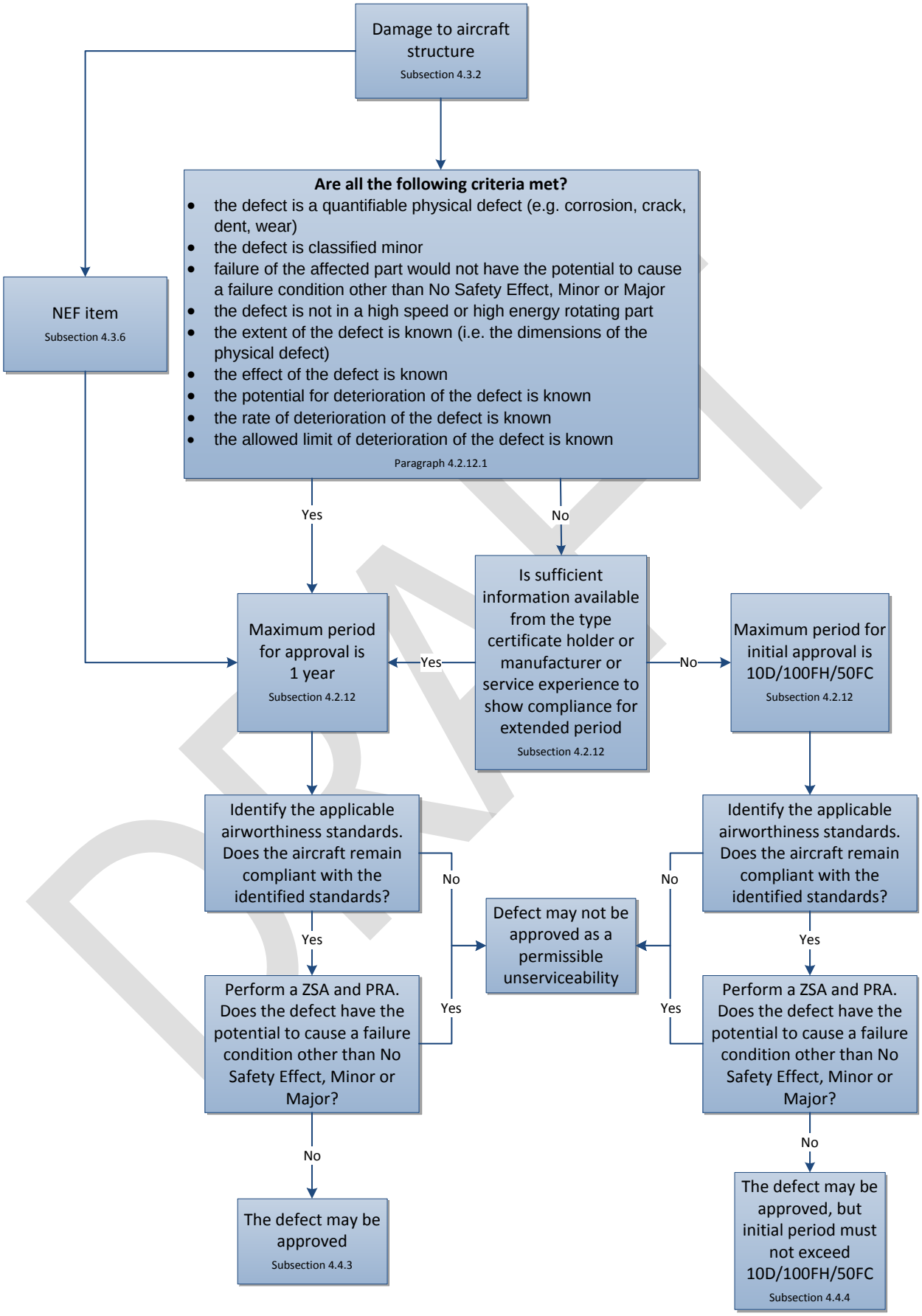

Figure 2: Assessment process for damage to aircraft structure

4.3.3 If the defect is classified as damage to aircraft system, engine or propeller elements/components

4.3.3.1 Identify the applicable airworthiness standards and design requirements applicable to the damaged area. Particular consideration should be given to additional airworthiness requirements such as ADs, including exemptions and AMOCs, Part 90 MOS, EDTO and ASETPA. The defect cannot be approved as a permissible unserviceability if the aircraft is no longer compliant with the applicable airworthiness standards.

4.3.3.2 Perform an FHA and CCA at the aircraft and system level.

4.3.3.3 Any defect that has the potential to cause a failure condition other than No Safety Effect, Minor or Major must not be approved.

4.3.3.4 An aircraft performance assessment should also be conducted to determine if any operational limits are required, or performance deficiencies are expected. Particular attention should be given to whether the defect affects a system that provides redundancy for mission capabilities and any existing defects applicable to the system, engine or propeller. Any operational limitations, conditions or required maintenance action applicable for the duration of the permissible unserviceability must be specified in the approval documentation.

4.3.3.5 Provide justification as to why the damage may be approved in regard to the airworthiness and design requirements using the outcome of the FHA and CCA.

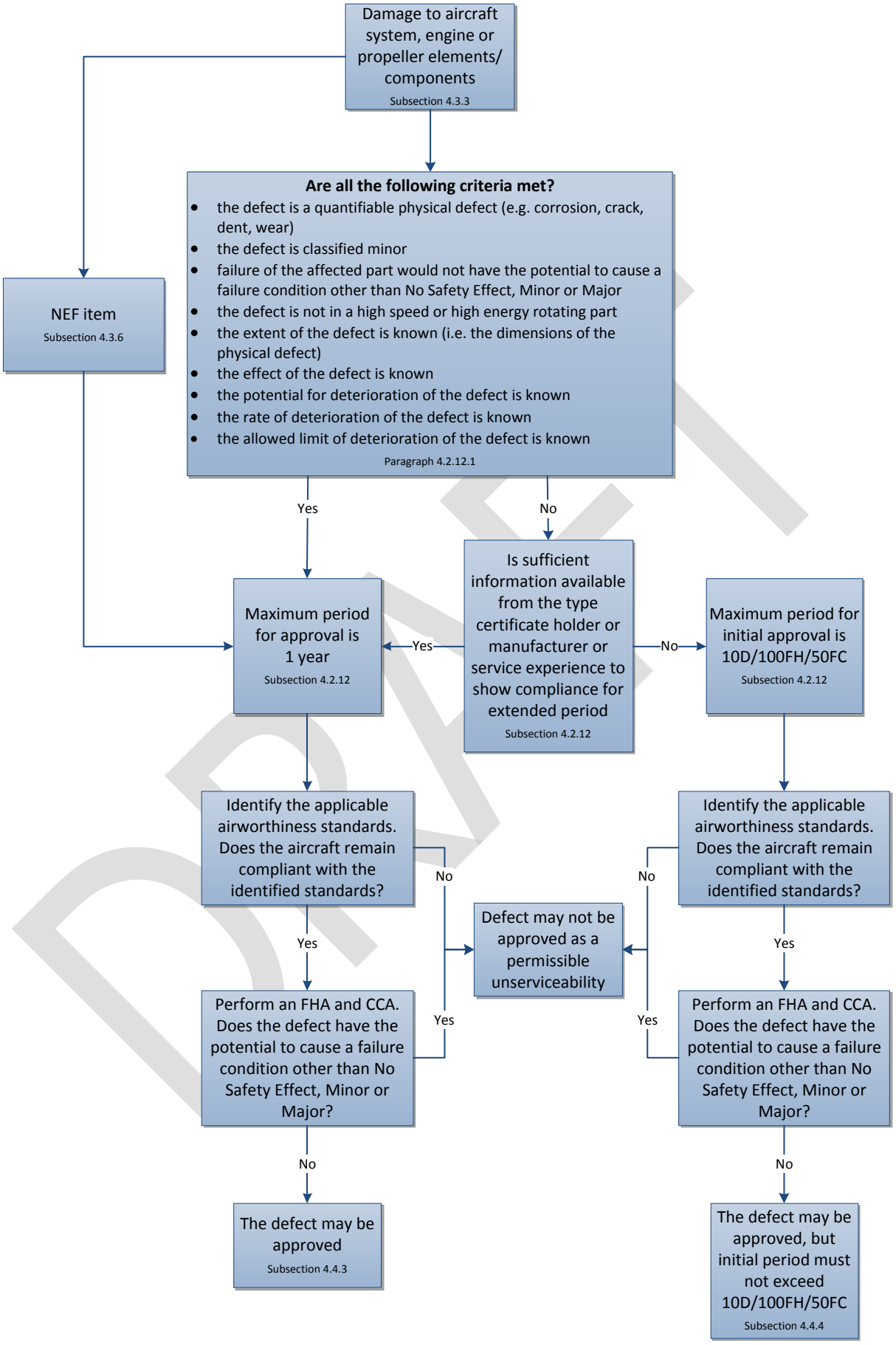

Figure 3: Assessment process for damage to aircraft system, engine or propeller elements/components

4.3.4 If the defect is classified as a system defect, including a functional failure associated with an aircraft system, engine or propeller

4.3.4.1 Identify the applicable airworthiness standards and design requirements applicable to the defect. Particular consideration should be given to additional airworthiness instruments such as ADs, exemptions, AMOCs, Part 90 MOS, EDTO and ASETPA. The defect cannot be approved as a permissible unserviceability if the aircraft is no longer compliant with the applicable airworthiness standards.

4.3.4.2 Perform an FHA and CCA at the aircraft and system level.

4.3.4.3 Any defect that has the potential to cause a failure condition other than No Safety Effect, Minor or Major must not be approved.

4.3.4.4 An aircraft performance assessment should also be conducted to determine if any operational limits are required, or performance deficiencies are expected. Particular attention should be given to whether the defect affects a system that provides redundancy for mission capabilities and any existing defects applicable to the system, engine or propeller. Any operational limitations, conditions or required maintenance action applicable for the duration of the permissible unserviceability must be specified in the approval documentation.

4.3.4.5 Provide justification as to why the damage may be approved having regard to the airworthiness and design requirements using the outcomes of each of the FHA and CCA.

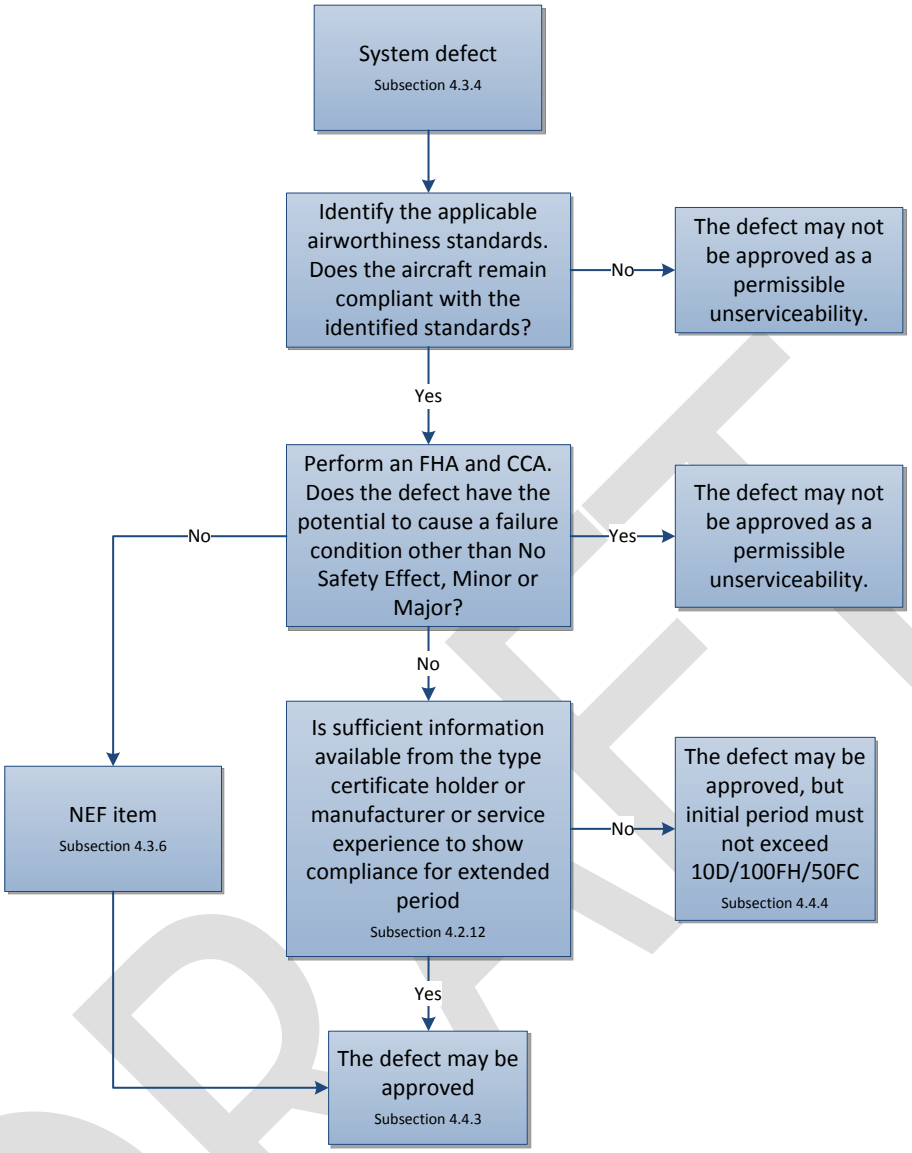

Figure 4: Assessment process for system defects

4.3.5 If the defect is classified as a exceedance of an operational limitation

4.3.5.1 Identify the applicable airworthiness standards and design requirements applicable to the exceedance. Particular consideration should be given to additional airworthiness instruments such as ADs, exemptions, AMOCs, Part 90 MOS, EDTO and ASETPA. The defect cannot be approved as a permissible unserviceability if the aircraft is no longer compliant with the applicable airworthiness standards.

4.3.5.2 Perform an FHA and CCA at the aircraft and system level.

4.3.5.3 Any exceedance condition that has the potential to cause a failure condition other than No Safety Effect, Minor or Major must not be approved.

4.3.5.4 Particular attention should be given to whether a potential failure due to the exceedance could affect any redundancies required for mission capabilities and any existing defects applicable to the system. Any operational limitations, conditions or required maintenance action applicable for the duration of the permissible unserviceability must be specified in the approval documentation.

4.3.5.5 Provide justification as to why the exceedance may be approved in regard to the airworthiness and design requirements using the outcome of the FHA and CCA.

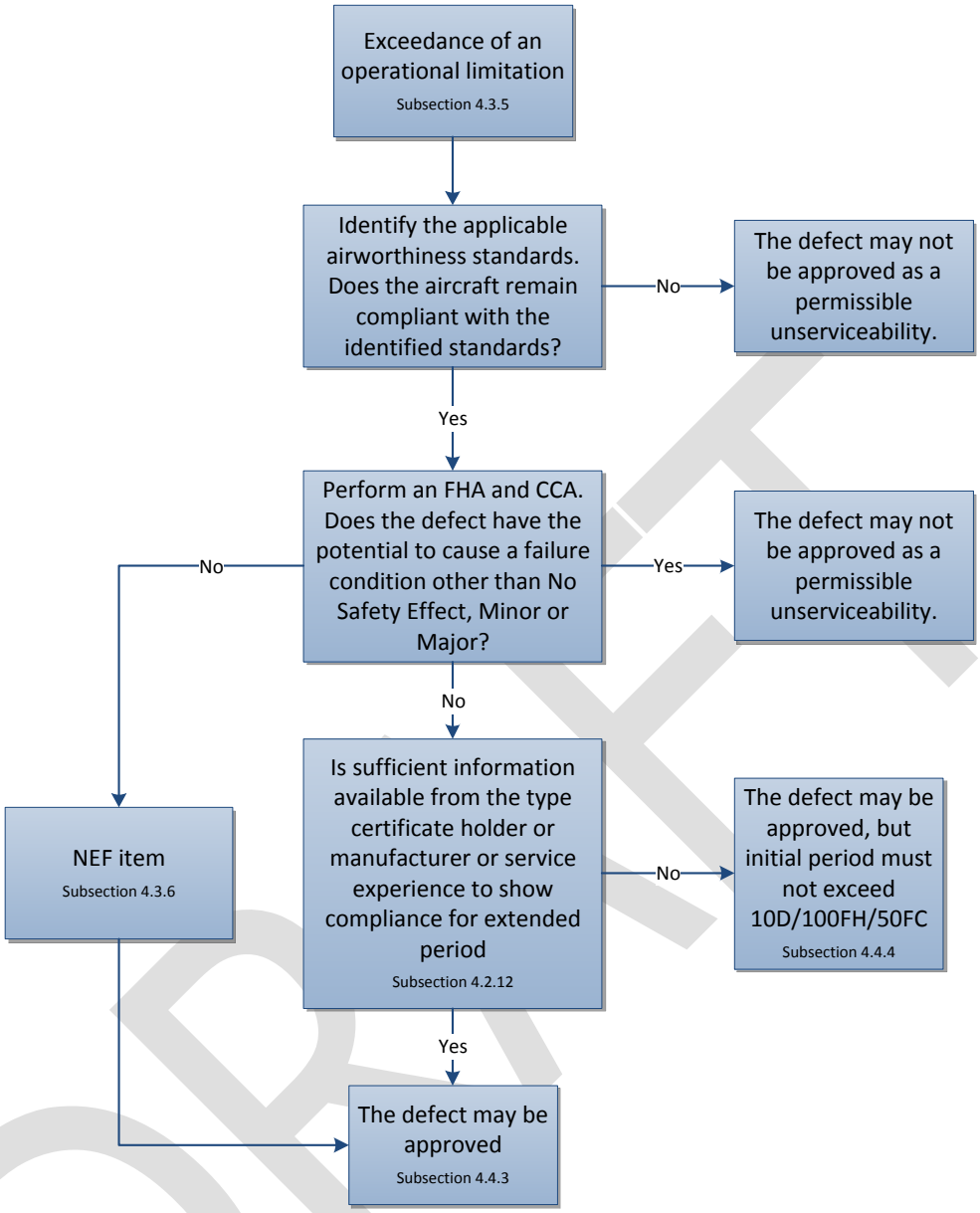

Figure 5: Assessment process for exceedance of an operational limitation

4.3.6 If the defect affects only an NEF item

4.3.6.1 NEF items are those items that have no effect on the safe operation of flight and would not be required by the applicable airworthiness standards, additional airworthiness requirements or operational requirements. They are those items that, if inoperative, damaged, or missing, have no effect on the aircraft's ability to be operated safely under all operational conditions. NEF items also include passenger convenience items and equipment that is used only on the ground for maintenance purposes.

4.3.6.2 The assessment must consider whether the item serves a second essential function, such as entertainment equipment being used for cabin safety briefings, in which case additional procedures may be required to provide the essential function.

4.3.6.3 If the NEF item is part of another aircraft system, for example, the electrical system, procedures must be developed and included for deactivating and isolating the defective item.

Note: Regulation 21.007 cannot be used to approve a modification – see subsection 2.2.4.

4.3.6.4 Identify the applicable airworthiness standards, including any operational or cabin safety requirements affected by the defect. Particular consideration should be given to defects affecting Part 90 MOS or items that serve second functions or are integrated into other aircraft systems. The defect cannot be approved as permissible unserviceability if the aircraft is no longer compliant with the applicable standards.

4.3.6.5 Perform an FHA and CCA at the aircraft and system level.

4.3.6.6 Any defect that has the potential to cause a failure condition other than No Safety Effect, Minor or Major must not be approved.

4.3.6.7 Provide justification as to why the defect may be approved in regard to the airworthiness and design requirements using the outcome of the FHA and CCA.

4.3.7 Additional considerations

4.3.7.1 ADOs and authorised persons must ensure that an approval under regulation 21.007 does not result in an aircraft becoming susceptible to safety-significant latent failures that would, in combination with one or more other specific failures or events, result in a hazardous or catastrophic failure condition.

4.3.7.2 If an approval under regulation 21.007 affects the availability of a system redundancy then the probability of another failure creating a hazardous or catastrophic failure may have increased. In such cases, the approval must ensure compliance with the applicable airworthiness standards and that the required level of safety is maintained, for example by including specific inspection conditions to ensure the remaining systems continue to be serviceable during the approval period.

4.4 Approvals

4.4.1 The period for which an approval may be granted depends on the nature of the defect and the showing of compliance. The period must not exceed that for which compliance with the applicable airworthiness standards is found.

4.4.2 Certain defects may be initially approved up to the maximum period of 1 year (see subsection 4.2.12). However, the information initially available to the ADO or authorised person will often be insufficient to find compliance with the applicable airworthiness standards for an

extended period of time, particularly in the case of the first occurrence of a particular kind of defect. In these cases the initial approval period should not exceed 10 calendar days, 100 flight hours of 50 flight cycles, whichever occurs first.

4.4.3 Defects eligible for up to the maximum 1 year period initial approval

4.4.3.1 A defect that meets the criteria of paragraph 4.2.12.1 or 4.2.12.2 is eligible for initial approval up to the maximum 1 year period.

4.4.3.2 If the aircraft's MEL or CDL has already been applied to the defect, the assessment must take into account and subtract from any limitations necessary for approval under regulation 21.007, any calendar time, flight hours and flight cycles already consumed by the prior application of the MEL or CDL.

4.4.3.3 Certification of compliance against the applicable airworthiness standards is to be completed on CASA Form 979 or equivalent.

Note: This compliance finding cannot be made or approved as technical data under regulation 21.009.

Subsequent approvals

4.4.3.4 If additional information that substantiates the showing of compliance with the applicable airworthiness standards for a longer period is obtained from the type certificate holder or equipment manufacturer or further analysis of the defect over the initial approval period, including inspection data that confirms the predicted rate of deterioration, then a subsequent approval may be granted. The subsequent approval must not exceed the period for which compliance with the applicable airworthiness standards is found.

4.4.3.5 If the additional information provided by the type certificate holder or the manufacturer of the aeronautical product specifies a limit for approval of the defect, then the cumulative approval period (i.e. MEL/CDL + initial approval + subsequent approval) should not exceed that limit.

4.4.3.6 In all cases the subsequent approval period must not exceed 1 year.

4.4.3.7 If the initial approval period expires and no additional information is obtained to substantiate a subsequent approval, then no subsequent approval may be given.

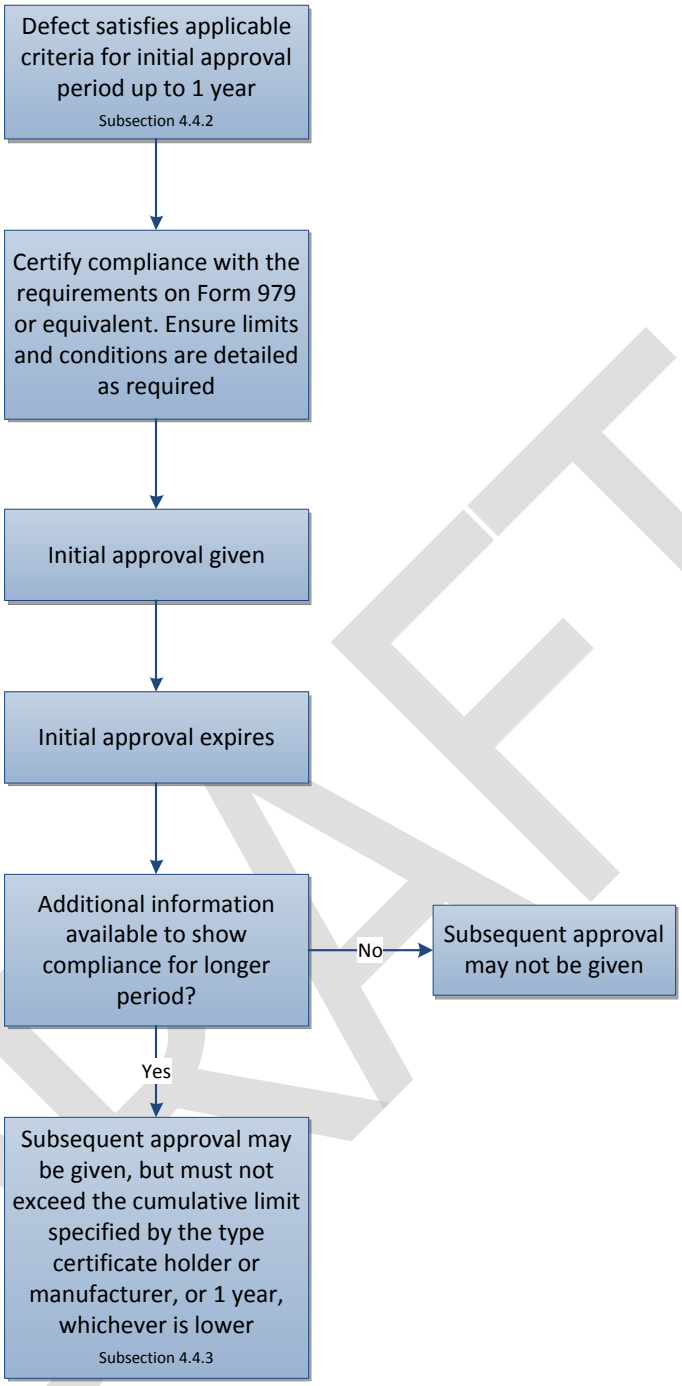

Figure 6: Approval process

4.4.4 Defects only eligible for an initial approval period up to 10 calendar days, 100 flight hours or 50 flight cycles

4.4.4.1 If the defect does not meets the criteria of paragraph 4.2.12.1 or 4.2.12.2 (i.e. if insufficient information is available to show compliance for an extended period), then initial approval of the defect should not exceed 10 calendar days, 100 flight hours or 50 cycles, whichever occurs first.

4.4.4.2 The initial approval of 10 calendar days, 100 flight hours or 50 cycles provides time for the applicant to:

a. have the defect rectified;
b. obtain approval of another means of dealing with the defect, in the form of approved maintenance data or ICA (as applicable under CAR or CASR); or
c. obtain the necessary information for the ADO or authorised person to grant a subsequent approval.

4.4.4.3 If the aircraft's MEL or CDL has already been applied to the defect, the assessment must take into account and subtract from any limitations necessary for approval under regulation 21.007, any calendar time, flight hours and flight cycles already consumed by the prior application of the MEL or CDL.

4.4.4.4 Certification of compliance against the airworthiness and design standards is to be completed on CASA Form 979 or equivalent.

Note: This compliance finding cannot be made or approved as technical data under regulation 21.009.

Subsequent approvals

4.4.4.5 If additional information that substantiates the showing of compliance with the applicable airworthiness standards for an extended period is obtained from the type certificate holder or equipment manufacturer or further analysis of the defect over the initial approval period, including inspection data that confirms the predicted rate of deterioration, then a subsequent approval may be granted. The subsequent approval must not exceed the period for which compliance with the applicable airworthiness standards is found.

4.4.4.6 If the initial approval period expires and information was unable to be obtained from the type certificate holder or manufacturer, then the subsequent approval period should not exceed one additional approval of up to 10 calendar days, 100 flight hours or 50 cycles, whichever occurs first. In this case the initial analysis and ongoing compliance must be supported by inspections of the area and engineering analyses. An inspection program specified as a condition of the initial approval may provide sufficient data to show compliance for the subsequent approval period.

4.4.4.7 If the additional information provided by the type certificate holder or the manufacturer of the aeronautical product specifies a limit for approval of the defect, then the cumulative approval period (i.e. MEL/CDL + initial approval + subsequent approval) should not exceed that limit.

4.4.4.8 In all cases the subsequent approval period must not exceed 1 year.

4.4.4.9 If the initial approval period expires and no additional information is obtained to substantiate a subsequent approval, then no subsequent approval may be given.

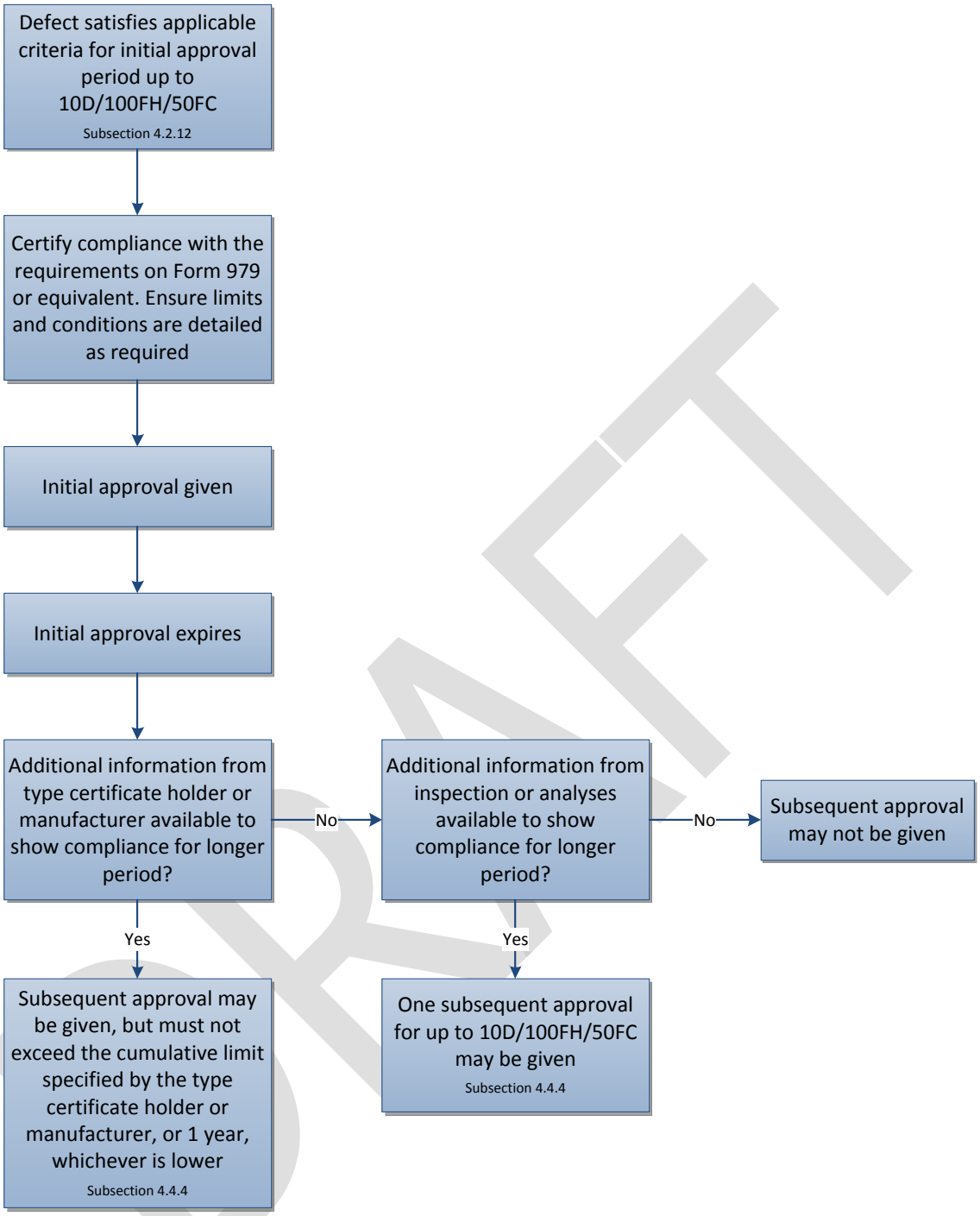

Figure 7: Approval process with 10D/100FH/50FC limit

Executive Manager
Standards Division

August 2014

Appendix A

Permissible unserviceability examples

Note: The following sections provide examples of defects which may be considered for approval under regulation 21.007. These are hypothetical operational scenarios intended to illustrate a possible approach and some, but not all, considerations, assessments and engineering analysis that should be carried out. The actual approach may differ from these examples, based on the specifics of the individual situation.

A.1 Structures

A.1.1 Skin and honeycomb damage

A.1.1.1 Damage to aircraft structure can occur through collision with ground support equipment. In cases where the damage is outside structural repair limits or a repair is not practical at that point in time, the damage may be allowed as a permissible unserviceability.

A.1.1.2 For example, a thrust reverser could be struck by ground support equipment. The assessment of the area may find that the skin had separated from the honeycomb core in an area that was not subject to any adverse loading and would not cause loss of structural integrity. The damage is assessed as minor, with aerodynamic performance being unaffected and the potential for growth of the debonded area being minimal until a permanent repair could be performed, provided the sleeve was not deployed. Operational restrictions could be placed on the aircraft, ensuring that the thrust reverser is not deployed until a permanent repair is made.

A.1.2 Minor skin creases, chafing, dents and punctures

A.1.2.1 Assessment of minor skin creases, chafing, dents and punctures should consider a number of factors. Primarily, the function of the structural component and whether the localised reduction in skin thickness would have any bearing on the ability of the structure to carry design loads. Damage to the adjacent structure should also be considered. Ongoing inspections with before and after photographs of the damaged area would also be advised. The ADO or authorised person would also need to carry out the root cause analysis.

A.1.3 Loose or missing rivets or other fasteners

A.1.3.1 Rivets found loose and working through skin surfaces need to first be assessed as to how they influence the surrounding structure and whether the structure is primary or secondary. It should also be determined whether sufficient rivets remain to carry bypass and redistribute loads. Ongoing inspections with before and after photographs of the damaged area would also be advised. The ADO or authorised person would also need to carry out the root cause analysis.

A.1.3.2 During a scheduled maintenance check, two of the right wing aft gear support spar assembly attach rivets were found loose and working through upper and lower wing skins. Oil and dirt ingress combined with flight and landing loads caused the attach rivets to loosen and start working. The structure must be confirmed not to be a principal structural element and that the remaining rivets are sufficient to carry bypass and redistributed loads. The relevant structural clauses of FAR 23 must be addressed and compliance found. Ongoing inspections must be defined and it would be advisable to take before and after photographs of the damaged area. The ADO or authorised person would also need to carry out the root cause analysis.

A.1.4 Cracking of non-principal structural elements

A.1.4.1 Assessment for cracking of non-principal structural elements should consider the size of the crack, duration crack has been present, estimation of crack growth rate and a residual strength calculation. This ensures structural redundancy, a positive margin of safety and compliance against FAR 23.573(b) (or equivalent) can be achieved. Ensuring the cracked component does not influence the function of surrounding components should also be considered. The type certificate holder or manufacturer's ICAs may also provide information in relation to the tolerance of certain components to cracking. It would be advisable to specify ongoing inspections with before and after photographs of the damaged area. The ADO or authorised person would also need to carry out the root cause analysis.

A.1.5 Paint

A.1.5.1 In many instances, there is damage done to paint and other surface coatings. Surface coatings provide, amongst other things, corrosion protection for metallic structure as well as UV protection for composite structure. In some cases it is not practical or possible to perform a satisfactory repaint of a structure as it requires a clean environment and access to solvent disposal facilities and other specialist equipment.

A.1.5.2 Assessing localised damage to the aircraft's paint system needs to consider a number of factors. Firstly, it must be assessed if damage to the underlying structure (clad layer on aluminium or resin/fibre on composite structure) exists. If there is no visible damage to the underlying structure, safe operation would likely be permissible, provided an assessment is made of how long the surface coating can be absent before the underlying structure is damaged. Obviously, in a marine environment, or if the aircraft is not hangared, then this must be taken into account when deciding this period. Damage to the underlying structure cannot be given approval as a permissible unserviceability under regulation 21.007.

A.2 Avionics

A.2.1 General

A.2.1.1 Avionic equipment may be divided into two basic groups, appliances or systems that are required to be fitted and serviceable to ensure compliance with the type design of the aircraft (e.g. FAR 23 or CS-23) or the additional appliances or systems that are mandated for certain operations (e.g. required by CAO 20.18 Appendix I to XI and/or Aeronautical Information Package General 1.5).

A.2.1.2 In addition, the certification of the aircraft for single or dual pilot operations will dictate the duplication required. These systems cannot be left unserviceable unless operational restrictions are imposed. As an example, an EDTO approved aircraft that has had a generator failure would not be eligible for EDTO operations until that defect was repaired as three independent systems are required. Similarly, damage to deice boot heaters etc. will require operational restrictions.

A.2.1.3 Non-required equipment includes inflight entertainment, passenger convenience equipment (galleys, etc.), which can be electrically isolated prior to flight to remove any risk resulting from the damage or defect.

A.2.1.4 Damaged wiring may be left unrepaired provided the source of the damage has been removed/rectified and the damage to the wiring is limited to minor insulation damage only. A reasonable assessment is that any penetration of the insulation greater than 30% of the thickness is not acceptable and must be repaired. Bare/broken wires must be repaired before the next flight unless the wiring belongs to non-required equipment or systems and can be positively identified and rendered inert.

A.2.1.5 Cracked or broken navigation lights or other lighting systems, apart from emergency lighting, may be approved provided operational restrictions for VFR use are imposed.

A.2.1.6 External antennae damaged by a birdstrike or weather events may be assessed as being capable of still being used provided they are still structurally sound and there has been no degradation in performance. This would include minor delamination/deformation. Antenna for non-required systems need only be assessed for structural stability.

A.3 Engines

A.3.1.1 Turbine engine internal rotating components are subject to high level stress and impact damage. A common type of damage for engines operated around airports that are located in sand and industrial pollution impacted environments is erosion. Erosion can have a significant impact on compressor and turbine blades and can degrade the performance of engines to below acceptable levels. Engine manufacturers provide erosion acceptance criteria for some or all compressor and turbine blade assemblies in their engines. However, the level of engine performance is not only dependant on individual level of erosion of each blade assembly but on their combinations as well. In some cases, an engine could still perform above its minimum required level but one or more sets of blades, installed on one or more of the assemblies, may be slightly outside the type certificate holder or manufacturer's prescribed minimum tolerances.

A.3.1.2 In this case, the assessment of applicable airworthiness standards and design requirements, for example, for a transport category aircraft, will have to consider, among other requirements, FAR or CS 25.121 Climb: One-engine-inoperative. Major/ minor classification per AC 21-12 will indicate that a drop of engine performance below minimum set, in accordance with FAR or CS 25.121, in the engine's ICA and aircraft's flight manual would be considered a major repair and would make this damage ineligible for the regulation 21.007 approval.

A.3.1.3 Therefore, the assessment must make sure that the engine is and will stay above its minimum required performance level throughout the period of time the regulation 21.007 approval is valid. In order to calculate this period of time and to confirm that the engine is and will be above the required performance minimum, the assessor must have access to engine performance monitoring data and the ability to assess and interpret the information provided by the monitoring system / software. It is acceptable, for the assessor, to use already interpreted data by an individual who is officially trained and approved for this purpose. Once the engine minimum performance acceptability is confirmed, the assessor may turn their attention to other requirements, such as those listed in, but not limited to, FAR 25, CS-25, FAR 33, CS-E, etc.

A.3.1.4 A major consideration in this case is to confirm that erosion is the root cause of damage and exclude other possibilities. The engine ICA would usually provide instructions on how to do this. For example, if the damage is evenly spread across all the blades and there is a known history of operation of this aircraft / engine around airports located in sand and industrial pollution impacted environments then this could be a good indication that the damage is due to erosion and not due to some other reason. Inspecting other engines, with the same utilisation / flight hours, installed on the same aircraft, may also provide further confirmation.

A.3.1.5 Confirming the current airworthiness status of the engine would also be required and should involve checking engine parameters such as exhaust gas temperatures and vibration levels that may indicate slightly increased but acceptable levels. The evolution of the change / increase of these parameters over the past period should also indicate steady slope gradients that will allow for confident prediction of potential key engine parameter changes over the period of time the regulation 21.007 approval will be valid. The prediction must indicate that all the key parameters will stay within the prescribed limitations over the period.

A.4 Interiors

A.4.1.1 Cabin structures are often subject to 'off-design' load cases principally applied by occupants of the aircraft, also known as 'wear and tear'. Typically this could be tears in seat or carpet fabrics, broken plastic in armrests or tables, broken recline, table or bin mechanisms,

dinged wall or galley panels, etc. This type of damage, whilst not hazardous to the aircraft, often needs to be secured or temporarily repaired which is beyond the scope of regulation 21.007. However, small tears, dings, and/or cuts may be satisfactorily left, depending on the aircraft or its type of operation.

A.4.1.2 A small tear in seat fabric may appear minor and may not impair its practical use; however, it may impact flammability performance. Understanding the method of compliance is key. A cushion assembly that contains a fire blocking layer that is perforated can no longer be assured of meeting its design standard. However, a cushion assembly that relies on fire hardened foams will continue to resist post-crash fire with a tear because a fire blocking layer is not relied upon.

A.4.1.3 Similarly, cracked or broken polymer components in locations can sometimes be tolerated as they have no obvious implications for continued use like protruding jagged edges. Again non-compliance with design standard emergency provisions may not be immediately apparent. Some parts in row-to-row seats certificated to emergency dynamic landing conditions are designed to be energy absorbing during an accident. These can be dedicated devices or can be an integrated part of the seat back structure. So a cracked thermoplastic sheet or frame may have consequences for the Head Injury Criterion for those seats so certificated.

A.4.1.4 Before an ADO or authorised person can approve a permissible unserviceability regarding interiors under regulation 21.007 they must consider the applicable airworthiness standards concerning structural load, factors of safety, strength and deformation, emergency landing conditions, personal accommodations and fire protection among others.

A.5 Propeller

A.5.1.1 Propeller and propeller component defects can arise from a variety of events. Operational wear and tear, FOD, ground handling techniques, ice and rain erosion and poor maintenance techniques could all cause defects of propeller or propeller components. A number of examples are provided below.

A.5.1.2 A spinner backplate may develop a crack that could be beyond an acceptable ICA recorded limit. Avenues for the crack to be allowed as a permissible unserviceability under regulation 21.007 would require, for example, an assessment of the structural integrity of the backplate crack, root cause analysis, growth rate analysis and critical length analysis.

A.5.1.3 A propeller deice boot may partially debond in the blade root/cuff area. The ICA does not allow any debonding of deice boots. Some of the considerations for allowing the debonding of the boot as a permissible unserviceability would require, for example, assessing where the debonding has occurred and its impact on the structural integrity and functionality of the propeller and boot, if any propeller vibration is evident, operational restrictions regarding flying in icing conditions, ongoing inspections to monitor any progression, etc.

A.5.1.4 A propeller may have blade shake or blade twist movement outside the limits of the ICA. Some of the considerations for allowing the shake or twist outside of the limits of the ICA as a permissible unserviceability would require, for example, understanding the root cause, service experience, twist movement (wear) propagation rate, performance implications, assessment of full functional checks such as feathering, grease or oil leakage from the propeller hub (which may indicate a more critical defect), propeller vibration, etc.

A.5.1.5 In all of the above examples the ADO or authorised person would also need to carry out the root cause analysis and assess the impact of the defect against the applicable FAR 35 regulations, in particular FAR 35.15.

A.6 Mechanical Systems – Damage

A.6.1.1 Acceptable damage to aircraft hoses or pipes that may not be within the limits of the aircraft maintenance manual may be approved via regulation 21.007 under certain circumstances. Damage or deterioration of hoses may be presented in many forms; assessment firstly needs to be determined for major or minor damage in accordance with AC 21-12. If the damage is classified as major, it must not be approved under regulation 21.007.

A.6.1.2 Typical damage to hoses and pipes that may be acceptable under regulation 21.007 approval includes the following:

a. Broken braids – isolated random breakage of the braid wires.
b. Chafing and cuts – light scuffing, cuts and abrasion of the outer cover, with the braids not exposed.
c. Corrosion – light local corrosion of braids and end fittings, due to oxidation or chemical attack, subsequent monitoring would be advised.
d. Damage fire sleeve – localised cuts and abrasions where the hose is not exposed, subsequent monitoring would be advised.

A.6.1.3 Before an ADO or authorised person can approve a permissible unserviceability regarding mechanical systems damage under regulation 21.007, they must consider the applicable FARs concerning the affected system as well as major/minor damage as defined by AC 21-12.

A.6.1.4 For example, a dent in a standby hydraulic system pipe may eventually cause a hydraulic system leak. The leak rate may be more than that provided for in the ICA and as such, may be a candidate for approval as a permissible unserviceability under regulation 21.007. The appropriate system safety assessments would need to be conducted to conclude whether the leak on its own, or in combination with another common cause or cascading defect, may cause a hazardous or catastrophic failure condition. Considering the leak exists on a standby system, application of operational restrictions or MEL may also be appropriate. The system safety analysis must also consider the surrounding structure and systems where the leak exists. For example, a slow hydraulic leak in a standby system would not be allowed if the leak existed in the main landing gear bay due to the potential for fire, resulting in a hazardous or catastrophic condition.

A.6.1.5 Further information can be obtained from the following industry standards:

a. AWB 02-6 Issue 1
b. FAA TSO C42, C75, C53, C140
c. FAA AC 43.13-1B
d. SAE International ARP1658.