

A stylized paper airplane icon in shades of blue is positioned on a dashed grey line that forms a wave-like flight path across the upper middle section of the cover.

CIVIL AVIATION DIRECTIVES – 8

# AIRWORTHINESS OF AIRCRAFT

CIVIL AVIATION AUTHORITY OF MALAYSIA

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## Introduction

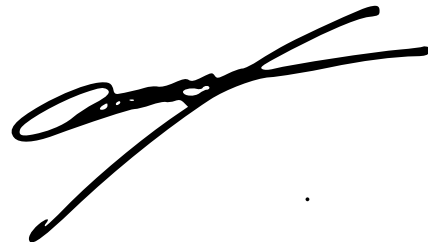
In exercise of the powers conferred by Section 24O of the Civil Aviation Act 1969 (Act 3), the Chief Executive Officer makes this Civil Aviation Directive (CAD) 8 – Airworthiness of Aircraft, pursuant to Regulation 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 189, 193 and 203 of the Malaysian Civil Aviation Regulations (MCA 2016).

This CAD contains the standards, requirements and procedures pertaining to the airworthiness of aircraft designed, manufactured or registered in Malaysia. The standards and requirements in this CAD are based mainly on the Standards and Recommended Practices (SARPs) contained in the International Civil Aviation Organisation (ICAO) Annex 8 to the Chicago Convention – Airworthiness of Aircraft.

Civil Aviation Directive 8 – Airworthiness of Aircraft (“CAD 8”) is published by the Chief Executive Officer under Section 24O of the Civil Aviation Act 1969 (Act 3) and comes into operation on the 1<sup>st</sup> April 2021.

### Non-compliance with this CAD

Any person who contravenes any provision in this CAD commits an offence and shall on conviction be liable to the punishments under Section 24O of the Civil Aviation Act 1969 (Act 3) and/or under Malaysia Civil Aviation Regulation 2016.



**(Captain Chester Voo Chee Soon)**  
Chief Executive Officer  
Civil Aviation Authority of Malaysia

## Civil Aviation Directive components and Editorial practices

This Civil Aviation Directive is made up of the following components and are defined as follows:

**Standards:** Usually preceded by words such as “*shall*” or “*must*”, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

**Recommended Practices:** Usually preceded by the words such as “*should*” or “*may*”, are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

**Appendices:** Material grouped separately for convenience but forms part of the Standards and Recommended Practices stipulated by the CAAM.

**Definitions:** Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

**Tables and Figures:** These add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

**Notes:** Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

**Attachments:** Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

It is to be noted that some Standards in this Civil Aviation Directive incorporates, by reference, other specifications having the status of Recommended Practices. In such cases, the text of the Recommended Practice becomes part of the Standard.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Directive, the use of the male gender should be understood to include male and female persons.





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## Part I – General

### 1.1 Citation

- 1.1.1 These Directives are the Civil Aviation Directives 8 – Airworthiness of Aircraft, Issue 01/Revision 00, and comes into operation on the 1<sup>st</sup> April 2021.
- 1.1.2 This CAD 8 – Airworthiness of Aircraft, Issue 01/Revision 00 will remain current until withdrawn or superseded.

### 1.2 Applicability

- 1.2.1 This CAD applies to:
  - a) aircraft eligible for issuance of Certificate of Airworthiness pursuant to the Article 31 of the Convention on International Civil Aviation;
  - b) an organisation engaging in any stage of design, manufacture or construction of any aeronautical product;
  - c) registered owner of an aircraft;
  - d) an operator of an aircraft; and
  - e) maintenance organisation.

### 1.3 Revocation

- 1.3.1 (Reserved).

### 1.4 Definitions

- 1.4.1 When the following terms are used in the Standards for the Airworthiness of Aircraft, they have the following meanings:

**Aeroplane** means a power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.

**Aircraft** means any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

**Airworthy** means the status of an aircraft, engine, propeller or part when it conforms to its approved design and is in a condition for safe operation.

**Anticipated operating conditions** means those conditions which are known from experience or which can be reasonably envisaged to occur during the operational life of the aircraft taking into account the operations for which the aircraft is made eligible, the conditions so considered being relative to the meteorological state of the atmosphere, to the configuration of terrain, to the functioning of the aircraft, to the efficiency of personnel and to all the factors affecting safety in flight. Anticipated operating conditions do not include:

- a) those extremes which can be effectively avoided by means of operating procedures; and

- b) those extremes which occur so infrequently that to require the Standards to be met in such extremes would give a higher level of airworthiness than experience has shown to be necessary and practical.

**Appropriate airworthiness requirements** means the comprehensive and detailed airworthiness codes established, adopted or accepted by CAAM for the class of aircraft, engine or propeller under consideration.

**Approved** means that it is accepted by CAAM as suitable for a particular purpose.

**Category A** means, with respect to helicopters, means a multi-engine helicopter designed with engine and system isolation features specified in Part IVB of CAD 8 and capable of operations using take-off and landing data scheduled under a critical engine failure concept which assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off.

**Category B** means, with respect to helicopters, means a single-engine or multi-engine helicopter which does not meet Category A standards. Category B helicopters have no guaranteed capability to continue safe flight in the event of an engine failure, and a forced landing is assumed.

**Configuration (as applied to the aeroplane)** means a particular combination of the positions of the moveable elements, such as wing flaps and landing gear, etc., that affect the aerodynamic characteristics of the aeroplane.

**Continuing airworthiness** means the set of processes by which an aircraft, engine, propeller or part complies with the applicable airworthiness requirements and remains in a condition for safe operation throughout its operating life.

**Critical engine(s)** means any engine whose failure gives the most adverse effect on the aircraft characteristics relative to the case under consideration.

**Design landing mass** means the maximum mass of the aircraft at which, for structural design purposes, it is assumed that it will be planned to land.

**Design take-off mass** means the maximum mass at which the aircraft, for structural design purposes, is assumed to be planned to be at the start of the take-off run.

**Design taxiing mass** means the maximum mass of the aircraft at which structural provision is made for load liable to occur during use of the aircraft on the ground prior to the start of take-off.

**Discrete source damage** means structural damage of the aeroplane that is likely to result from: impact with a bird, uncontained fan blade failure, uncontained engine failure, uncontained high-energy rotating machinery failure or similar causes.

**Engine** means a unit used or intended to be used for aircraft propulsion. It consists of at least those components and equipment necessary for functioning and control, but excludes the propeller/rotors (if applicable).

**Factor of safety.** A design factor used to provide for the possibility of loads greater than those assumed, and for uncertainties in design and fabrication.

**Final approach and take-off area (FATO)** means a defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by performance Class 1 helicopters, the defined area includes the rejected take-off area available.

**Fireproof** means the capability to withstand the application of heat by a flame for a period of 15 minutes.

**Fire resistant** means the capability to withstand the application of heat by a flame for a period of 5 minutes.

**Helicopter** means a heavier-than-air aircraft supported in flight chiefly by the reactions of the air on one or more power-driven rotors on substantially vertical axes.

**Human factors principles** means principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

**Human performance** means human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

**Landing surface** means that part of the surface of an aerodrome which the aerodrome authority has declared available for the normal ground or water run of aircraft landing in a particular direction.

**Limit loads** means the maximum loads assumed to occur in the anticipated operating conditions.

**Load factor** means the ratio of a specified load to the weight of the aircraft, the former being expressed in terms of aerodynamic forces, inertia forces, or ground reactions.

**Maintenance** means the performance of tasks on an aircraft, engine, propeller or associated part required to ensure the continuing airworthiness of an aircraft engine, propeller or associated part including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.

**Maintenance organisation's exposition** means a document endorsed by the head of the maintenance organisation which details the maintenance organisation's structure and management responsibilities, scope of work, description of facilities, maintenance procedures and quality assurance or inspection systems.

**Maintenance records** means records that set out the details of the maintenance carried out on an aircraft, engine, propeller or associated part.

**Maintenance release** means a document which contains a certification confirming that the maintenance work to which it relates has been completed in a satisfactory manner in accordance with appropriate airworthiness requirements.

**Modification** means a change to the type design of an aircraft, engine or propeller.

**Organisation responsible for the type design** means the organisation that holds the type certificate, or equivalent document, for an aircraft, engine or propeller type, issued by a Contracting State.

**Orphan aircraft type** means an aircraft which has its Type Certificate revoked by the State of Design, and no longer has a designated State of Design in accordance with this CAD. These aircraft do not meet the Standards of this CAD.

**Performance Class 1 helicopter** means a helicopter with performance such that, in case of engine failure, it is able to land on the rejected take-off area or safely continue the flight to an appropriate landing area.

**Performance Class 2 helicopter** means a helicopter with performance such that, in case of engine failure, it is able to safely continue the flight, except when the failure occurs prior to a defined point after take-off or after a defined point before landing, in which cases a forced landing may be required.

**Performance Class 3 helicopter** means a helicopter with performance such that, in case

of engine failure at any point in the flight profile, a forced landing must be performed.

**Powerplant** means the system consisting of all the engines, drive system components (if applicable), and propellers (if installed), their accessories, ancillary parts, and fuel and oil systems installed on an aircraft but excluding the rotors for a helicopter.

**Pressure-altitude** means an atmospheric pressure expressed in terms of altitude which corresponds to that pressure in the standard atmosphere.

**Repair** means the restoration of an aircraft, engine, propeller or associated part to an airworthy condition in accordance with the appropriate airworthiness requirements after it has been damaged or subjected to wear.

**Satisfactory evidence** means a set of documents or activities that CAAM accepts as sufficient to show compliance with an airworthiness requirement.

**Standard atmosphere** means an atmosphere defined as follows:

- a) the air is a perfect dry gas;
- b) the physical constants are:
  - Sea level mean molar mass:  
 $M_0 = 28.964\ 420 \times 10^{-3} \text{ kg mol}^{-1}$
  - Sea level atmospheric pressure:  
 $P_0 = 1\ 013.250 \text{ hPa}$
  - Sea level temperature:  
 $t_0 = 15^\circ\text{C}$   
 $T_0 = 288.15 \text{ K}$
  - Sea level atmospheric density:  
 $\rho_0 = 1.225\ 0 \text{ kg m}^{-3}$
  - Temperature of the ice point:  
 $T_i = 273.15 \text{ K}$
  - Universal gas constant:  
 $R^* = 8.314\ 32 \text{ JK}^{-1}\text{mol}^{-1}$
- c) the temperature gradients are:

<i>Geopotential altitude (km)</i>		<i>Temperature gradient (Kelvin per standard geopotential kilometer)</i>
<i>From</i>	<i>To</i>	
-5.0	11.0	-6.5
11.0	20.0	0.0
20.0	32.0	+1.0
32.0	47.0	+2.8
47.0	51.0	0.0
51.0	71.0	-2.8
71.0	80.0	-2.0

**State of Design** means the State having jurisdiction over the organisation responsible for the type design.

**State of Manufacture** means the State having jurisdiction over the organisation responsible for the final assembly of the aircraft, engine or propeller.

**State of Registry** means the State on whose register the aircraft is entered.

**Take-off surface** means that part of the surface of an aerodrome which the aerodrome authority has declared available for the normal ground or water run of aircraft taking off in a particular direction.

**Type Certificate** means a document issued by a Contracting State to define the design of an aircraft, engine or propeller type and to certify that this design meets the appropriate airworthiness requirements of that State.

**Type design** means the set of data and information necessary to define an aircraft, engine or propeller type for the purpose of airworthiness determination.

**Ultimate load** means the limit load multiplied by the appropriate factor of safety.

**Validation to a Type Certificate** means validation issued by CAAM to a foreign type certificate.



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## Part II – Procedures For Certification And Continuing Airworthiness

### 1 Type Certification

#### 1.1 Applicability

The Standards of this chapter shall be applicable to all aircraft, and to engines and propellers if type certificated separately, for which the application for certification was submitted to CAAM on or after 13 June 1960, except that:

- a) the provisions of 1.4 of this part shall only be applicable to an aircraft type for which an application for a Type Certificate was submitted to the CAAM on or after 2 March 2004;
- b) the provisions of 1.4 of this part shall only be applicable to an engine or propeller type for which an application for a Type Certificate was submitted to the CAAM on or after 10 November 2016;
- c) the provisions of 1.2.6 of this part shall only be applicable to an aircraft type for which an application for a Type Certificate was submitted to the CAAM on or after 31 December 2014; and
- d) the provisions of 1.2.7 of this part shall only be applicable to an aircraft type for which an application for a Type Certificate is submitted to CAAM on or after 28 November 2024.

#### 1.2 Design aspects of the appropriate airworthiness requirements

1.2.1 The design aspects of the appropriate airworthiness requirements for type certification of an aircraft, engine or propeller or for any change to such type certification, shall be determined by CAAM.

1.2.2 (Reserved).

1.2.3 The design shall not have any features or characteristics that render it unsafe under the anticipated operating conditions.

1.2.4 Where the design features of a particular aircraft, engine or propeller render any of the design aspects of the appropriate airworthiness requirements inappropriate, CAAM shall apply appropriate requirements that will give at least an equivalent level of safety.

1.2.5 Where the design features of a particular aircraft, engine or propeller render any of the design aspects of the appropriate airworthiness requirements inadequate, additional requirements that are considered by CAAM to give at least an equivalent level of safety shall be applied.

1.2.6 The approved design of an aircraft under Parts IIIB, IVB, VA and VB of this CAD shall use extinguishing agents that are not listed in the 1987 Montreal Protocol on

Substances that Deplete the Ozone Layer as it appears in the Eighth Edition of the Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, Annex A, Group II, in the aircraft fire suppression or extinguishing systems in the lavatories, engines and auxiliary power unit.

- 1.2.7 The approved design of an aircraft under Part IIIB of this CAD shall use extinguishing agents that are not listed in the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer as it appears in the Tenth Edition of the Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, Annex A, Group II, in the aircraft fire suppression or extinguishing systems for the cargo compartment.

### **1.3 Proof of compliance with the appropriate airworthiness requirements**

- 1.3.1 There shall be an approved design consisting of such drawings, specifications, reports and documentary evidence as are necessary to define the design of the aircraft, engine or propeller and to show compliance with the design aspects of the appropriate airworthiness requirements.

1.3.2 (Reserved).

- 1.3.3 The aircraft, engine or propeller shall be subjected to such inspections and ground and flight tests as are deemed necessary by CAAM to show compliance with the design aspects of the appropriate airworthiness requirements.

- 1.3.4 In addition to determining compliance with the design aspects of the appropriate airworthiness requirements for an aircraft, engine or propeller, CAAM shall take whatever other steps deem necessary to ensure that the design approval is withheld if the aircraft, engine or propeller is known or suspected to have dangerous features not specifically guarded against by those requirements.

- 1.3.5 CAAM may approve the design of a modification, of a repair or of a replacement part on the basis of satisfactory evidence that the aircraft, engine or propeller is in compliance with the airworthiness requirements used for the issuance of the Type Certificate in accordance with paragraph 1.4 of this CAD, its amendments or later requirements when determined by the CAAM.

### **1.4 Issuance of Type Certificate and Validation to a Type Certificate**

- 1.4.1 CAAM, in the case where Malaysia is the State of Design, upon receipt of satisfactory evidence that the aircraft, engine or propeller type if certificated separately is in compliance with the design aspects of the appropriate airworthiness requirements, shall issue a Type Certificate to define the type design and to signify its approval of the design of the aircraft type.

*Note. – Refer CAD 8102 for specific requirements related to Type Certificate*

- 1.4.2 CAAM may validate a Type Certificate for an aircraft, engine or propeller type issued by a Contracting State, on the basis of satisfactory evidence that the aircraft, engine



or propeller type is in compliance with the design aspects of the appropriate airworthiness requirements.

*Note.* – Refer CAD 8107 for specific requirements related to Validation to a Type Certificate.

## **1.5 Suspension of Type Certificate or Validation to a Type Certificate**

1.5.1 CAAM may suspend in whole or in part a Type Certificate or a Validation to the Type Certificate for an aircraft, engine or propeller type for a specified time period if there are reasonable ground for believing that not doing so would constitute a significant threat to aviation safety.

1.5.2 (Reserved).

1.5.3 During the period of suspension of the Type Certificate notified in 1.5.1, the organisation responsible for the type design of the aircraft, engine or propeller shall continue to fulfil its assigned obligations on continuing airworthiness under Chapter 4 of this part.

## **1.6 Revocation of Type Certificate**

1.6.1 Unless an acceptable arrangement is agreed upon, CAAM may revoke a Type Certificate when the organisation responsible for the type design surrenders or abandons the Type Certificate, or ceases to exist, and as a result the continuing airworthiness responsibilities established under Chapter 4 of this part can no longer be fulfilled for the affected aircraft type in service.

## **1.7 Transfer of Type Certificate**

1.7.1 When CAAM transfer the Type Certificate issued under the provision of 1.4.1 of this part, the organisation responsible for the type design shall ensure continued compliance of the approved design of the aircraft, engine or propeller type with the appropriate airworthiness requirements until completion of the transfer.



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## **2 Production**

### **2.1 Applicability**

The Standards of this chapter are applicable to the production of all aircraft, engines, propellers and associated parts in Malaysia.

### **2.2 Aircraft, engine and propeller production**

The organisation approved for production of each aircraft, engine or propeller shall ensure that each aircraft, engine or propeller, including associated parts manufactured by subcontractors and/or suppliers, is airworthy at the time of release.

### **2.3 Aircraft parts production**

The organisation taking responsibility for the production of aircraft parts manufactured under the design approval referred to in 1.3.5 of this part shall ensure that the aircraft parts are airworthy.

### **2.4 Production organisation approval**

2.4.1 The organisation responsible for production of an aircraft, engine, propeller or associated part shall ensure that:

- a) the supporting data, production facilities and processes is in compliance with the appropriate production requirements; and
- b) it has established and can maintain a quality system or a production inspection system such as to guarantee that each aircraft, engine, propeller or associated part produced by the organisation or by subcontractors and/or suppliers is airworthy at the time of release.

2.4.2 (Reserved).

2.4.3 The manufacturing organisation shall hold, for each aircraft, engine, propeller or associated part, a design approval as referred to in 1.3 of this part, or the right of access under an agreement or arrangement to the approved design data relevant for production purposes.

2.4.4 Records shall be maintained such that the origin of each aircraft, engine, propeller and associated part, and its identification with the approved design and production data, can be established.

2.4.5 Where Malaysia is not the State of Design, there shall be an agreement or arrangement acceptable to Malaysia and the State of Design to:

- a) ensure that the manufacturing organisation has the right of access to the approved design data relevant for production purposes;
- b) address the responsibilities of each State with regard to design, manufacture and continuing airworthiness of the aircraft, engine or propeller during the period of the agreement or arrangement, including such period when the State



of Design takes action to suspend in whole or in part the Type Certificate of the affected aircraft type; and

- c) terminate the production approval under this part when the State of Design revokes the Type Certificate corresponding to that aircraft type.

*Note. – Refer CAD 8201 for specific requirements related to Production Organisation Approval.*

### **3 Certificate Of Airworthiness**

#### **3.1 Applicability**

The Standards of this chapter are applicable in respect of all aircraft, except 3.3 and 3.4 which are not applicable in respect of all aircraft that are of a type of which the prototype was submitted to CAAM for certification before 13 June 1960.

#### **3.2 Eligibility, issuance and continued validity of a Certificate of Airworthiness**

3.2.1 A Certificate of Airworthiness shall be issued by CAAM on the basis of satisfactory evidence that the aircraft complies with the design aspects of the appropriate airworthiness requirements and in airworthy condition.

3.2.2 (Reserved).

3.2.3 For a Certificate of Airworthiness to be renewed, CAAM require that the continuing airworthiness of the aircraft be determined by means of a system of inspection, approved by CAAM.

*Note. – Refer CAD 8301 for specific requirements related to Certificate of Airworthiness.*

3.2.4 CAAM, when entering an aircraft on the Aircraft Register and issuing its Certificate of Airworthiness may consider the Export Certificate of Airworthiness of another Contracting State as satisfactory evidence, in part, that the aircraft complies with the applicable Standards of this CAD through compliance with the appropriate airworthiness requirements.

3.2.5 (Reserved).

#### **3.3 Standard form of Certificate of Airworthiness**

3.3.1 (Reserved).

3.3.2 Certificates of Airworthiness are issued in Malay language with English translation.

#### **3.4 Aircraft limitations and information**

Each aircraft shall be provided with a flight manual, placards or other documents stating the approved limitations within which the aircraft is considered airworthy as defined by the appropriate airworthiness requirements and additional instructions and information necessary for the safe operation of the aircraft.

#### **3.5 Temporary loss of airworthiness**

Any failure to maintain an aircraft in an airworthy condition as defined by the appropriate airworthiness requirements shall render the aircraft ineligible for operation until the aircraft is restored to an airworthy condition.

#### **3.6 Damage to aircraft**

- 3.6.1 When a Malaysian registered aircraft has sustained damage, the operator shall notify CAAM when a Malaysian registered aircraft is no longer airworthy due to sustained damage and require to be relocated to a base where maintenance can be performed.
- 3.6.2 If the damage is sustained or ascertained when the aircraft is in the territory of another Contracting State, the authorities of the other Contracting State shall be entitled to prevent the aircraft from resuming its flight on the condition that they shall advise the State of Registry immediately, communicating to it all details necessary to formulate the judgement referred to in 3.6.1.
- 3.6.3 If the damage is sustained or ascertained when the aircraft is in the territory of another Contracting State, when CAAM considers that the damage sustained is of a nature such that the aircraft is no longer airworthy, it shall prohibit the aircraft from resuming flight until it is restored to an airworthy condition. CAAM may, however, in exceptional circumstances, prescribe particular limiting conditions to permit the aircraft to fly a non- commercial air transport operation to an aerodrome at which it will be restored to an airworthy condition. In prescribing particular limiting conditions, CAAM shall consider all limitations proposed by the Contracting State that had originally prevented the aircraft from resuming its flight.
- 3.6.4 When CAAM considers that the damage sustained is of a nature such that the aircraft is still airworthy, the aircraft shall be allowed to resume its flight.
- 3.6.5 If the damage is sustained or ascertained when foreign registered aircraft is in Malaysia, CAAM shall be entitled to prevent the aircraft from resuming its flight on the condition that it shall advise the State of Registry immediately, communicating to it all details necessary to formulate the judgement whether the damage is of a nature such that the aircraft is no longer airworthy as defined by the appropriate airworthiness requirements.
- 3.6.6 Upon receiving limiting conditions by the State of Registry, CAAM shall permit such flight or flights within the prescribed limitations.
- 3.6.7 When the State of Registry considers that the damage sustained is of a nature such that the aircraft is still airworthy and allowed to resume its flight, CAAM shall permit such flight.

*Note. – Refer CAD 8305 for specific requirements related to Permit to Fly*

## **4 Continuing Airworthiness**

### **4.1 Applicability**

The Standards of this chapter are applicable to all aircraft, engines, propellers and associated parts.

### **4.2 Responsibilities in respect of continuing airworthiness**

4.2.1 (Reserved).

4.2.2 Malaysia as State of Manufacture

Where the organisation responsible for the production of an aircraft, engine or propeller is not the organisation responsible for the type design of the aircraft, engine or propeller, there must be an agreement acceptable to CAAM to ensure that the production organisation cooperates with the organisation responsible for the type design in assessing information on the design, manufacture and operation of the aircraft, engine or propeller.

4.2.3 Malaysia as State of Registry

4.2.3.1 (Reserved).

4.2.3.2 Maintenance organisation shall ensure compliance to the Standards of Chapter 6 of this part.



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## **5 Safety Management**

*Refer CAD 19 for specific requirements related to Safety Management.*



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## **6 Maintenance Organisation Approval**

### **6.1 Applicability**

The Standards of this chapter are applicable to the approval of organisations involved in the maintenance of aircraft, engines, propellers and associated parts.

### **6.2 Maintenance organisation approval**

6.2.1 (Reserved).

6.2.2 The issuance of a maintenance organisation approval by CAAM shall be dependent upon the applicant demonstrating compliance with the applicable Standards of this chapter through compliance with appropriate requirements defined in accordance with CAD 8601, CAD 8602 and relevant provisions contained in CAD 19 for such organisations.

6.2.3 (Reserved).

6.2.3.1 (Reserved).

6.2.4 The continued validity of the approval shall depend upon the organisation remaining in compliance with the appropriate requirements of 6.2.2.

6.2.5 The maintenance organisation shall notify CAAM of any changes to the organisation's scope of work, location or personnel nominated in accordance with this chapter.

*Note. – Refer CAD 8601 and CAD 8602 for specific requirements related to maintenance organisations.*

### **6.3 Maintenance organisation's exposition**

6.3.1 The maintenance organisation shall provide for the use and guidance of maintenance personnel concerned an exposition which may be issued in separate parts containing the following information:

- a) a general description of the scope of work authorised under the organisation's terms of approval;
- b) a description of the organisation's procedures and quality or inspection system in accordance with 6.4;
- c) a general description of the organisation's facilities;
- d) names and duties of the person or persons required by 6.6.1 and 6.6.2;
- e) a description of the procedures used to establish the competence of the maintenance personnel required by 6.6.4;
- f) a description of the method used for the completion and retention of the maintenance records required by 6.7;

- g) a description of the procedures for preparing the maintenance release and the circumstances under which the release is to be signed;
- h) the personnel authorised to sign the maintenance release and the scope of their authorisation;
- i) a description, when applicable, of contracted activities;
- j) a description, when applicable, of the additional procedures for complying with an operator's maintenance procedures and requirements;
- k) a description of the procedures for complying with the information reporting requirements of CAD 1900;
- l) a description of the procedure for receiving, assessing, amending and distributing within the maintenance organisation all necessary airworthiness data from the organisation responsible for the type design; and
- m) a description of the procedures for implementing changes affecting the approval of the maintenance organisation.

6.3.2 The maintenance organisation shall ensure that the exposition is amended as necessary to keep the information contained therein up to date.

6.3.3 The maintenance organisation shall furnish copies of all amendments to the exposition promptly to all organisations or persons to whom the manual has been issued.

#### **6.4 Maintenance procedures and quality assurance system**

6.4.1 The maintenance organisation shall establish procedures acceptable to CAAM granting the approval which ensure good maintenance practices and compliance with all relevant Standards prescribed in 6.2.2.

6.4.2 The maintenance organisation shall ensure compliance with 6.4.1 by either establishing an independent quality assurance system to monitor compliance with, and adequacy of, the procedures, or by providing a system of inspection to ensure that all maintenance is properly performed.

#### **6.5 Facilities**

6.5.1 The maintenance organisation shall provide the appropriate facilities and working environments for the tasks to be performed.

6.5.2 The maintenance organisation shall have the necessary technical data, equipment, tools and material to perform the work for which it is approved.

6.5.3 The maintenance organisation shall ensure that storage conditions provide adequate security and prevent deterioration of, and damage to, stored items such as parts, equipment, tools and material.

## **6.6 Personnel**

- 6.6.1 The maintenance organisation shall nominate an accountable manager who, irrespective of other functions, is accountable on behalf of the organisation.
- 6.6.2 The maintenance organisation's accountable manager shall nominate a person or group of persons whose responsibilities include ensuring that the maintenance organisation is in compliance with the requirements of 6.2.2.
- 6.6.3 The maintenance organisation shall employ the necessary personnel to plan, perform, supervise, inspect and release the maintenance work to be performed.
- 6.6.4 The maintenance organisation shall establish the competence of maintenance personnel in accordance with procedures and to a level acceptable to CAAM. If the person signing the maintenance release is a non-licensed person, the person shall meet the qualification requirements specified in CAD 1 — Personnel Licensing to sign a maintenance release.
- 6.6.5 The maintenance organisation shall ensure that all maintenance personnel receive initial and continuation training appropriate to their assigned tasks and responsibilities. The training programme established by the maintenance organisation shall include training in knowledge and skills related to human performance, including coordination with other maintenance personnel and flight crew.

## **6.7 Records**

- 6.7.1 The maintenance organisation shall retain detailed maintenance records to show that all requirements for the signing of a maintenance release have been met.
- 6.7.2 The records required by 6.7.1 shall be kept for a minimum period of three years after the signing of the maintenance release.
- 6.7.3 Records kept in accordance with 6.7 shall be maintained in a form and format that ensures readability, security and integrity of the records at all times.

## **6.8 Maintenance release**

- 6.8.1 A maintenance release shall be completed and signed to certify that the maintenance work performed has been completed satisfactorily and in accordance with approved data and the procedure described in the maintenance organisation's exposition.
- 6.8.2 A maintenance release shall be signed and include the following:
- a) basic details of the maintenance carried out including detailed reference to the data used;
  - b) the date such maintenance was completed;



- c) the identity of the approved maintenance organisation; and
- d) the identity of the person or persons signing the release.



## **Part III. Large Aeroplanes**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part are established by CAAM as the essential requirements in respect of all aeroplane designated in part IIIA and IIIB. For aeroplane certification purposes, refer to CAD 8102 Type Certificate or CAD 8107 Validation to a Type Certificate, as applicable.



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## **Part IIIA. Aeroplanes Over 5 700 Kg For Which Application For Certification Was Submitted On Or After 13 June 1960 But Before 2 March 2004**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part, except for those specified in 8.4, are applicable in respect of all aeroplanes designated in 1.1.3 that are of types of which the prototype was submitted to CAAM for certification on or after 13 June 1960, but before 2 March 2004.
- 1.1.2 The Standards specified in 8.4 are applicable in respect of all aeroplanes designated in 1.1.3 that are of types of which the prototype was submitted to the CAAM for certification on or after 22 March 1985, but before 2 March 2004.
- 1.1.3 Except for those Standards which specify a different applicability, the Standards of this part shall apply to aeroplanes with a maximum certificated take-off mass greater than 5 700 kg and intended for the carriage of passengers or cargo or mail in international air navigation.
- 1.1.4 (Reserved)
- 1.1.5 Unless otherwise stated, the Standards apply to the complete aeroplane including its powerplant, systems and equipment.

#### **1.2 Number of engines**

The aeroplane shall have not less than two engines.

#### **1.3 Operating limitations**

- 1.3.1 Limiting conditions shall be established for the aeroplane, its powerplant and its equipment (see 9.2). Compliance with the Standards of this part shall be established assuming that the aeroplane is operated within the limitations specified. The limitations shall be sufficiently removed from any condition(s) prejudicial to the safety of the aeroplane to render the likelihood of accidents arising therefrom extremely remote.
- 1.3.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the aeroplane, e.g. mass, centre of gravity location, load distribution, speeds, and altitude or pressure-altitude, shall be established within which compliance with all the pertinent Standards in this part is shown, except that combinations of conditions which are fundamentally impossible to achieve need not be considered.



**1.4 Unsafe features and characteristics**

Under all anticipated operating conditions, the aeroplane shall not possess any feature or characteristic that renders it unsafe.

**1.5 Proof of compliance**

1.5.1 Compliance with the appropriate airworthiness requirements shall be based on evidence from tests, calculations, or calculations based on tests, provided that in each case the accuracy achieved will ensure a level of airworthiness equal to that which would be achieved were direct tests conducted.

1.5.2 The tests of 1.5.1 shall be such as to provide reasonable assurance that the aeroplane, and its components, systems and equipment, are reliable and function correctly under the anticipated operating conditions.

## **2 Flight**

### **2.1 General**

- 2.1.1 Compliance with the Standards prescribed in this chapter shall be established by flight or other tests conducted upon an aeroplane or aeroplanes of the type for which a Certificate of Airworthiness is sought, or by calculations based on such tests, provided that the results obtained by calculations are equal in accuracy to, or conservatively represent, the results of direct testing.
- 2.1.2 Compliance with each Standard shall be established for all applicable combinations of aeroplane mass and centre of gravity position, within the range of loading conditions for which certification is sought.
- 2.1.3 Where necessary, appropriate aeroplane configurations shall be established for the determination of performance in the various stages of flight and for the investigation of the aeroplane's flying qualities.

### **2.2 Performance**

#### **2.2.1 General**

- 2.2.1.1 Sufficient data on the performance of the aeroplane shall be determined and scheduled in the flight manual to provide operators with the necessary information for the purpose of determining the total mass of the aeroplane on the basis of the values, peculiar to the proposed flight, of the relevant operational parameters, in order that the flight may be made with reasonable assurance that a safe minimum performance for that flight will be achieved.
- 2.2.1.2 Achieving the performance scheduled for the aeroplane shall take into consideration human performance and in particular shall not require exceptional skill or alertness on the part of the flight crew.
- 2.2.1.3 The scheduled performance of the aeroplane shall be consistent with compliance with 1.3.1 and with the operation in logical combinations of those of the aeroplane's systems and equipment, the operation of which may affect performance.

#### **2.2.2 Minimum performance**

At the maximum masses scheduled (see 2.2.3) for take-off and for landing as functions of the aerodrome elevation or pressure-altitude either in the standard atmosphere or in specified still air atmospheric conditions, and, for seaplanes, in specified conditions of smooth water, the aeroplane shall be capable of accomplishing the minimum performances specified in 2.2.2.1 and 2.2.2.2, respectively, not considering obstacles or runway or water run length.

##### **2.2.2.1 Take-off**

- a) The aeroplane shall be capable of taking off assuming the critical engine to fail (see 2.2.3), the remaining engines being operated within their take-off power limitations.
- a) After the end of the period during which the take-off power may be used, the aeroplane shall be capable of continuing to climb, with the critical engine inoperative and the remaining engine(s) operated within their maximum continuous power limitations, up to a height that it can maintain and at which it can carry out a circuit of the aerodrome.
- b) The minimum performance at all stages of take-off and climb shall be sufficient to ensure that under conditions of operation departing slightly from the idealised conditions for which data is scheduled (see 2.2.3), the departure from the scheduled values is not disproportionate.

#### 2.2.2.2 Landing

- a) Starting from the approach configuration and with the critical engine inoperative, the aeroplane shall be capable, in the event of a missed approach, of continuing the flight to a point from which a fresh approach can be made.
- b) Starting from the landing configuration, the aeroplane shall be capable, in the event of a balked landing, of making a climb-out, with all engines operating.

#### 2.2.3 Scheduling of performance

Performance data shall be determined and scheduled in the flight manual so that its application by means of the operating rules to which the aeroplane is to be operated in accordance with 5.2 of CAD 6, Part I, will provide a safe relationship between the performance of the aeroplane and the aerodromes and routes on which it is capable of being operated. Performance data shall be determined and scheduled for the following stages for the ranges of mass, altitude or pressure- altitude, wind velocity, gradient of the take-off and landing surface for landplanes; water surface conditions, density of water and strength of current for seaplanes; and for any other operational variables for which the aeroplane is to be certificated.

2.2.3.1 Take-off. The take-off performance data shall include the accelerate-stop distance and the take-off path.

2.2.3.1.1 Accelerate-stop distance. The accelerate-stop distance shall be the distance required to accelerate and stop, or, for a seaplane to accelerate and come to a satisfactorily low speed, assuming the critical engine to fail suddenly at a point not nearer to the start of the take-off than that assumed when determining the take-off path (see 2.2.3.1.2).

2.2.3.1.2 *Take-off path.* The take-off path shall comprise the ground or water run, initial climb and climb-out, assuming the critical engine to fail suddenly during the

take-off (see 2.2.3.1.1). The take-off path shall be scheduled up to a height that the aeroplane can maintain and at which it can carry out a circuit of the aerodrome. The climb-out shall be made at a speed not less than the take-off safety speed as determined in accordance with 2.3.1.3.

2.2.3.2 *En route.* The en-route climb performance shall be the climb (or descent) performance with the aeroplane in the en-route configuration with:

- a) the critical engine inoperative; and
- b) the two critical engines inoperative in the case of aeroplanes having three or more engines. The operating engine(s) shall not exceed maximum continuous power.

2.2.3.3 *Landing.* The landing distance shall be the horizontal distance traversed by the aeroplane from a point on the approach flight path at a selected height above the landing surface to the point on the landing surface at which the aeroplane comes to a complete stop, or, for a seaplane, comes to a satisfactorily low speed. The selected height above the landing surface and the approach speed shall be appropriately related to operating practices. This distance may be supplemented by such distance margin as may be necessary; if so, the selected height above the landing surface, the approach speed and the distance margin shall be appropriately interrelated and shall make provision for both normal operating practices and reasonable variations therefrom.

## 2.3 Flying qualities

The aeroplane shall comply with the Standards of 2.3 at all altitudes up to the maximum anticipated altitude relevant to the particular requirement in all temperature conditions relevant to the altitude in question and for which the aeroplane is approved.

### 2.3.1 Controllability

The aeroplane shall be controllable and manoeuvrable under all anticipated operating conditions, and it shall be possible to make smooth transitions from one flight condition to another (e.g. turns, sideslips, changes of engine power, changes of aeroplane configurations) without requiring exceptional skill, alertness or strength on the part of the pilot even in the event of failure of any engine. A technique for safely controlling the aeroplane shall be established for all stages of flight and aeroplane configurations for which performance is scheduled.

2.3.1.1 *Controllability on the ground (or water).* The aeroplane shall be controllable on the ground (or on the water) during taxiing, take-off and landing under the anticipated operating conditions.

2.3.1.2 *Controllability during take-off.* The aeroplane shall be controllable in the event of sudden failure of the critical engine at any point in the take-off, when the aeroplane is handled in the manner associated with the scheduling of take-off paths and accelerate-stop distances.

2.3.1.3 *Take-off safety speed.* The take-off safety speeds assumed when the performance of the aeroplane (after leaving the ground or water) during the take-off is determined shall provide an adequate margin above the stall and above the minimum speed at which the aeroplane remains controllable after sudden failure of the critical engine.

### 2.3.2 Trim

The aeroplane shall have such trim and other characteristics as to ensure that the demands made on the pilot's attention and ability to maintain a desired flight condition are not excessive when account is taken of the stage of flight at which these demands occur and their duration. This shall apply both in normal operation and in the conditions associated with the failure of one or more engines for which performance characteristics are established.

### 2.3.3 Stability

The aeroplane shall have such stability in relation to its other flight characteristics, performance, structural strength and most probable operating conditions (e.g. aeroplane configurations and speed ranges) as to ensure that demands made on the pilot's powers of concentration are not excessive when the stage of the flight at which these demands occur and their duration are taken into account. The stability of the aeroplane shall not, however, be such that excessive demands are made on the pilot's strength or that the safety of the aeroplane is prejudiced by lack of manoeuvrability in emergency conditions.

### 2.3.4 Stalling

2.3.4.1 *Stall warning.* When the aeroplane approaches a stall both in straight and turning flight with all engines operating and with one engine inoperative, a clear and distinctive stall warning shall be apparent to the pilot with the aeroplane in all permissible configurations and powers, except those which are not considered to be essential for safe flying. The stall warning and other characteristics of the aeroplane shall be such as to enable the pilot to arrest the development of the stall after the warning begins and, without altering the engine power, to maintain full control of the aeroplane.

2.3.4.2 *Behaviour following a stall.* In any configuration and power in which it is considered that the ability to recover from a stall is essential, the behaviour of the aeroplane following a stall shall not be so extreme as to make difficult a prompt recovery without exceeding the airspeed or strength limitations of the aeroplane. It shall be acceptable to throttle back the operating engines during recovery from the stall.

2.3.4.3 *Stalling speeds.* The stalling speeds or minimum steady flight speeds in configurations appropriate for each stage of flight (e.g. take-off, en route, landing) shall be established. One of the values of the power used in establishing the stalling speeds shall be not more than that necessary to give zero thrust at a speed just above the stall.

### 2.3.5 Flutter and vibration

It shall be demonstrated by suitable tests that all parts of the aeroplane are free from flutter and excessive vibration in all aeroplane configurations under all speed conditions within the operating limitations of the aeroplane (see 1.3.2). There shall be no buffeting severe enough to interfere with control of the aeroplane, to cause structural damage or to cause excessive fatigue to the flight crew.



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## 3 Structure

### 3.1 General

The Standards of this chapter apply to the aeroplane structure consisting of all portions of the aeroplane, the failure of which would seriously endanger the aeroplane.

#### 3.1.1 Mass and mass distribution

Unless otherwise stated, all structural Standards shall be complied with when the mass is varied over the applicable range and is distributed in the most adverse manner, within the operating limitations on the basis of which certification is sought.

#### 3.1.2 Limit loads

Except as might be otherwise qualified, the external loads and the corresponding inertia loads, or resisting loads obtained for the various loading conditions prescribed in 3.3, 3.4 and 3.5 shall be considered as limit loads.

#### 3.1.3 Strength and deformation

In the various loading conditions prescribed in 3.3, 3.4 and 3.5, no part of the aeroplane structure shall sustain detrimental deformation at any load up to and including the limit load, and the aeroplane structure shall be capable of supporting the ultimate load.

### 3.2 Airspeeds

#### 3.2.1 Design airspeeds

Design airspeeds shall be established for which the aeroplane structure is designed to withstand the corresponding manoeuvring and gust loads in accordance with 3.3. In establishing the design airspeeds, consideration shall be given to the following speeds:

- a)  $V_A$ , the design manoeuvring speed;
- b)  $V_B$ , the speed at which the maximum vertical gust velocity assumed in accordance with 3.3.2 can be withstood;
- c)  $V_C$ , a speed not expected to be exceeded in normal cruising flight taking into account possible effects of upsets when flying in turbulent conditions;
- d)  $V_D$ , maximum dive speed, sufficiently greater than the speed in c), to make it unlikely that such a design speed would be exceeded as a result of inadvertent speed increases in the anticipated operating conditions, taking into account the flying qualities and other characteristics of the aeroplane;
- e)  $V_{E1}$  to  $V_{En}$ , maximum speeds at which flaps and landing gears may be extended or other configuration changes be made.

The speeds  $V_A$ ,  $V_B$ ,  $V_C$ , and  $V_E$  in a), b), c) and e) shall be sufficiently greater than the stalling speed of the aeroplane to safeguard against loss of control in turbulent air.

### 3.2.2 Limiting airspeeds

Limiting airspeeds, based on the corresponding design airspeeds with safety margins, where appropriate, in accordance with 1.3.1, shall be included in the aeroplane flight manual as part of the operating limitations (see 9.2.2).

## 3.3 Flight loads

The flight loading conditions of 3.3.1, 3.3.2 and 3.5 shall be considered for the range of mass and mass distributions prescribed in 3.1.1 and at airspeeds established in accordance with 3.2.1. Asymmetrical as well as symmetrical loading shall be taken into account. The air, inertia and other loads resulting from the specified loading conditions shall be distributed so as to approximate actual conditions closely or to represent them conservatively.

### 3.3.1 Manoeuvring loads

Manoeuvring loads shall be computed on the basis of manoeuvring load factors appropriate to the manoeuvres permitted by the operating limitations. They shall not be less than values that experience indicates will be adequate for the anticipated operating conditions.

### 3.3.2 Gust loads

Gust loads shall be computed for vertical and horizontal gust velocities and gradients that statistics or other evidence indicates will be adequate for the anticipated operating conditions.

## 3.4 Ground and water loads

The structure shall be able to withstand all the loads due to the reactions of the ground and water surface that are likely to arise during taxiing, take-off and landing.

### 3.4.1 Landing conditions

The landing conditions at the design take-off mass and at the design landing mass shall include such symmetrical and asymmetrical attitudes of the aeroplane at ground or water contact, such velocities of descent, and such other factors affecting the loads imposed upon the structure as might be present in the anticipated operating conditions.

## 3.5 Miscellaneous loads

In addition to or in conjunction with the manoeuvring and gust loads and with the ground and water loads, consideration shall be given to all other loads (flight control loads, cabin pressures, effects of engine operation, loads due to changes of configuration, etc.) that are likely to occur in the anticipated operating conditions.

## 3.6 Flutter, divergence and vibration

The aeroplane structure shall be designed to be free from flutter, structural divergence (i.e. unstable structural distortion due to aerodynamic loading), and loss of control due to structural deformation, at speeds within and sufficiently beyond the operating limitations to comply with 1.3.1. Adequate strength shall be provided to withstand the vibration and buffeting that might occur in the anticipated operating conditions.

### **3.7 Fatigue strength**

The strength and fabrication of the aeroplane shall be such as to ensure that the probability of disastrous fatigue failure of the aeroplane's structure under repeated loads and vibratory loads in the anticipated operating conditions is extremely remote.



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## 4 Design And Construction

### 4.1 General

Details of design and construction shall be such as to give reasonable assurance that all aeroplane parts will function effectively and reliably in the anticipated operating conditions. They shall be based upon practices that experience has proven to be satisfactory or that are substantiated by special tests or by other appropriate investigations or both. They shall also consider human factors principles.

#### 4.1.1 Substantiating tests

The functioning of all moving parts essential to the safe operation of the aeroplane shall be demonstrated by suitable tests in order to ensure that they will function correctly under all operating conditions for such parts.

#### 4.1.2 Materials

All materials used in parts of the aeroplane essential for its safe operation shall conform to approved specifications. The approved specifications shall be such that materials accepted as complying with the specifications will have the essential properties assumed in the design.

#### 4.1.3 Manufacturing methods

The methods of manufacturing and assembly shall be such as to produce a consistently sound structure which shall be reliable with respect to maintenance of strength in service.

#### 4.1.4 Protection

The structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes, which could pass unnoticed, taking into account the maintenance the aeroplane will receive.

#### 4.1.5 Inspection provisions

Adequate provision shall be made to permit any necessary examination, replacement or reconditioning of parts of the aeroplane that require such attention, either periodically or after unusually severe operations.

#### 4.1.6 Systems design features

Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following

- a) *Controls and control systems.* The design of the controls and control systems shall be such as to minimise the possibility of jamming, inadvertent operation and unintentional engagement of control surface locking devices.
- b) System survivability.
  - 1) For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 and

for which the application for certification was submitted on or after 12 March 2000, aeroplane systems shall be designed, arranged and physically separated to maximise the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems.

- 2) (Reserved)
- c) *Crew environment.* The design of the flight crew compartment shall be such as to minimise the possibility of incorrect or restricted operation of the controls by the crew, due to fatigue, confusion or interference. Consideration shall be given at least to the following: layout and identification of controls and instruments, rapid identification of emergency situations, sense of controls, ventilation, heating and noise.
- d) *Pilot vision.* The arrangement of the pilot compartment shall be such as to afford a sufficiently extensive, clear and undistorted field of vision for the safe operation of the aeroplane, and to prevent glare and reflections that would interfere with the pilot's vision. The design features of the pilot windshield shall permit, under precipitation conditions, sufficient vision for the normal conduct of flight and for the execution of approaches and landings.
- e) *Provision for emergencies.* Means shall be provided which shall either automatically prevent, or enable the flight crew to deal with, emergencies resulting from foreseeable failures of equipment and systems, the failure of which would endanger the aeroplane. Reasonable provisions shall be made for continuation of essential services following engine or system failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this CAD and in CAD 6, Parts I and II.
- f) *Fire precautions.* The design of the aeroplane and the materials used in its manufacture, including cabin interior furnishing materials replaced during major refurbishing, shall be such as to minimise the possibility of in-flight and ground fires and also to minimise the production of smoke and toxic gases in the event of a fire. Means shall be provided to contain or to detect and extinguish such fires as might occur in such a way that no additional danger to the aeroplane is caused.
- g) *Fire suppression.* For aeroplanes for which the application for certification was submitted on or after 12 March 2000, cargo compartment fire suppression systems, including their extinguishing agents, shall be designed so as to take into account a sudden and extensive fire such as could be caused by an explosive or incendiary device or dangerous goods.
- h) Incapacitation of occupants.

- 1) For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 and for which the application for certification was submitted on or after 12 March 2000, design precautions shall be taken to protect against possible instances of cabin depressurisation and against the presence of smoke or other toxic gases, including those caused by explosive or incendiary devices or dangerous goods, which could incapacitate the occupants of the aeroplane.
  - 2) (Reserved)
- i) Protection of the flight crew compartment from smoke and fumes.
- 1) For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 and for which the application for certification was submitted on or after 12 March 2000, means shall be provided to minimise entry into the flight crew compartment of smoke, fumes and noxious vapours generated by an explosion or fire on the aeroplane.
  - 2) (Reserved)

#### 4.1.7 Emergency landing provisions

- 4.1.7.1 Provisions shall be made in the design of the aeroplane to protect the occupants, in the event of an emergency landing, from fire and from the direct effects of deceleration forces as well as from injuries arising from the effect of deceleration forces on the aeroplane's interior equipment.
- 4.1.7.2 Facilities shall be provided for the rapid evacuation of the aeroplane in conditions likely to occur following an emergency landing. Such facilities shall be related to the passenger and crew capacity of the aeroplane.
- 4.1.7.3 The interior layout of the cabin and the position and number of emergency exits, including the means of locating and illuminating the escape paths and exits, shall be such as to facilitate rapid evacuation of the aeroplane in conditions likely to occur following an emergency landing.
- 4.1.7.4 On aeroplanes certificated for ditching conditions, provisions shall be made in the design to give maximum practicable assurance that safe evacuation from the aeroplane of passengers and crew can be executed in case of ditching.

#### 4.1.8 Ground handling

Adequate provisions shall be made in the design to minimise the risk that ground-handling operations (e.g. towing, jacking) may cause damage, which could pass unnoticed, to the parts of the aeroplane essential for its safe operation. The protection that any limitations and instructions for such operations might provide may be taken into account.



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## 5 Engines

### 5.1 Scope

The Standards of this chapter shall apply to engines of all types that are used on the aeroplane as primary propulsion units.

### 5.2 Design, construction and functioning

The engine complete with accessories shall be designed and constructed so as to function reliably within its operating limitations under the anticipated operating conditions when properly installed in the aeroplane in accordance with Chapter 7 and, if applicable, fitted with a suitable propeller.

### 5.3 Declared ratings, conditions and limitations

The power ratings and the conditions of the atmosphere upon which they are based and all operating conditions and limitations, which are intended to govern the operation of the engine shall be declared.

### 5.4 Tests

An engine of the type shall complete satisfactorily such tests as are necessary to verify the validity of the declared ratings, conditions and limitations and to ensure that it will operate satisfactorily and reliably. The tests shall include at least the following:

- a) *Power calibration.* Tests shall be conducted to establish the power or thrust characteristics of the engine when new and also after the tests in b) and c). There shall be no excessive decrease in power at the conclusion of all the tests specified.
- b) *Operation.* Tests shall be conducted to ensure that starting, idling, acceleration, vibration, overspeeding and other characteristics are satisfactory and to demonstrate adequate margins of freedom from detonation, surge or other detrimental conditions as may be appropriate to the particular type engine.
- c) *Endurance.* Tests of sufficient duration shall be conducted at such powers, thrust, speeds and other operating conditions as are necessary to demonstrate reliability and durability of the engine. They shall also include operation under conditions in excess of the declared limits to the extent that such limitations might be exceeded in actual service.



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## **6 Propellers**

### **6.1 Scope**

The Standards of this chapter shall apply to propellers of all types.

### **6.2 Design, construction and functioning**

The propeller assembly complete with accessories shall be designed and constructed so as to function reliably within its operating limitations under the anticipated operating conditions when properly fitted to the engine and installed in the aeroplane in accordance with Chapter 7.

### **6.3 Declared ratings, conditions and limitations**

The power ratings and all operating conditions and limitations which are intended to govern the operation of the propeller shall be declared.

### **6.4 Tests**

A propeller of the type shall complete satisfactorily such tests as are necessary to ensure that it will operate satisfactorily and reliably within the declared ratings, conditions and limitations. The tests shall include at least the following:

- a) *Operation*. Tests shall be conducted to ensure that strength vibration and overspeeding characteristics are satisfactory and to demonstrate proper and reliable functioning of pitch changing and control mechanisms.
- b) *Endurance*. Tests of sufficient duration shall be conducted at such powers, speeds and other operating conditions as are necessary to demonstrate reliability and durability of the propeller.



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## **7 Powerplant Installation**

### **7.1 General**

#### 7.1.1 Applicable Standards

The powerplant installation shall comply with the Standards of Chapter 4 and with the Standards of this chapter.

#### 7.1.2 Compliance with engine and propeller limitations

The powerplant installation shall be so designed that the engines and propellers (if applicable) are capable of being used in the anticipated operating conditions. In conditions established in the aeroplane flight manual, the aeroplane shall be capable of being operated without exceeding the limitations established for the engines and propellers in accordance with Chapters 5, 6 and this chapter.

#### 7.1.3 Control of engine rotation

In those installations where continued rotation of a failed engine would increase the hazard of fire or of a serious structural failure, means shall be provided for the crew to stop the rotation of the engine in flight or to reduce it to a safe level.

#### 7.1.4 Engine restarting

Means shall be provided for restarting an engine in flight at altitudes up to a declared maximum altitude.

### **7.2 Arrangement and functioning**

#### 7.2.1 Independence of engines

The powerplant shall be arranged and installed so that each engine together with its associated systems is capable of being controlled and operated independently from the others and so that there is at least one arrangement of the powerplant and systems in which any failure, unless the probability of its occurrence is extremely remote, cannot result in a loss of more power than that resulting from complete failure of the critical engine.

#### 7.2.2 Propeller vibration

The propeller vibration stresses shall be determined and shall not exceed values that have been found safe for operation within the operating limitations established for the aeroplane

#### 7.2.3 Cooling

The cooling system shall be capable of maintaining powerplant temperatures within the established limits (see 7.1.2) at ambient air temperatures up to the maximum air temperature appropriate to the intended operation of the aeroplane. The maximum and, if necessary, minimum ambient air temperature for which the powerplant has been established as being suitable shall be scheduled in the aeroplane flight manual.

#### 7.2.4 Associated systems

The fuel, oil, air induction and other systems associated with the powerplant shall be capable of supplying each engine in accordance with its established requirements, under all conditions affecting the functioning of the systems (e.g. engine power, aeroplane attitudes and accelerations, atmospheric conditions, fluid temperatures) within the anticipated operating conditions.

#### 7.2.5 Fire protection

For regions of the powerplant where the potential fire hazards are particularly serious because of the proximity of ignition sources to combustible materials, the following shall apply in addition to the general Standard of 4.1.6 e).

- a) *Isolation*. Such regions shall be isolated by fire-resisting material from other regions of the aeroplane where the presence of fire would jeopardise continued flight, taking into account the probable points of origin and paths of propagation of fire.
- b) *Flammable fluids*. Flammable fluid system components located in such regions shall be capable of containing the fluid when exposed to fire conditions. Means shall be provided for the crew to shut off the flow of flammable fluids into such regions if a fire occurs.
- c) *Fire detection*. A sufficient number of fire detectors shall be provided and located to ensure rapid detection of any fire that might occur in such regions.
- d) *Fire extinguishment*. Such regions shall be provided with a fire extinguisher system capable of extinguishing any fire likely to occur therein, unless the degree of isolation, quantity of combustibles, fire resistance of the structure and other factors are such that any fire likely to occur in the region would not jeopardise the safety of the aeroplane.

## **8 Instruments And Equipment**

### **8.1 Required instruments and equipment**

The aeroplane shall be provided with approved instruments and equipment necessary for the safe operation of the aeroplane in the anticipated operating conditions. These shall include the instruments and equipment necessary to enable the crew to operate the aeroplane within its operating limitations. Instruments and equipment design shall observe human factors principles.

### **8.2 Installation**

Instrument and equipment installations shall comply with the Standards of Chapter 4.

### **8.3 Safety and survival equipment**

Prescribed safety and survival equipment that the crew or passengers are expected to use or operate at the time of an emergency shall be reliable, readily accessible and easily identified, and its method of operation shall be plainly marked.

### **8.4 Navigation lights and anti-collision lights\***

8.4.1 The lights required by CAD 2 — Rules of the Air to be displayed by aeroplanes in flight or operating on the movement area of an aerodrome shall have intensities, colours, fields of coverage and other characteristics such that they furnish the pilot of another aircraft or personnel on the ground with as much time as possible for interpretation and for subsequent manoeuvre necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.

8.4.2 Lights shall be installed in aeroplanes so as to minimise the possibility that they will:

- a) adversely affect the satisfactory performance of the flight crews' duties; or
- b) subject an outside observer to harmful dazzle.



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## **9 Operating Limitations And Information**

### **9.1 General**

The operating limitations within which compliance with the Standards of this CAD is determined, together with any other information necessary to the safe operation of the aeroplane, shall be made available by means of an aeroplane flight manual, markings and placards, and such other means as may effectively accomplish the purpose. The limitations and information shall include at least those prescribed in 9.2, 9.3 and 9.4.

### **9.2 Operating limitations**

Limitations which there is a risk of exceeding in flight and which are defined quantitatively shall be expressed in suitable units and corrected if necessary for errors in measurements so that the flight crew can, by reference to the instruments available to them, readily determine when the limitations are reached.

#### **9.2.1 Loading limitations**

The loading limitations shall include all limiting masses, centre of gravity positions, mass distributions and floor loadings (see 1.3.2).

#### **9.2.2 Airspeed limitations**

The airspeed limitations shall include all speeds (see 3.2) that are limiting from the standpoint of structural integrity or flying qualities of the aeroplane, or from other considerations. These speeds shall be identified with respect to the appropriate aeroplane configurations and other pertinent factors.

#### **9.2.3 Powerplant limitations**

The powerplant limitations shall include all those established for the various powerplant components as installed in the aeroplane (see 7.1.2 and 7.2.3).

#### **9.2.4 Limitations on equipment and systems**

The limitations on equipment and systems shall include all those established for the various equipment and systems as installed in the aeroplane.

#### **9.2.5 Miscellaneous limitations**

Miscellaneous limitations shall include any necessary limitations with respect to conditions found to be prejudicial to the safety of the aeroplane (see 1.3.1).

#### **9.2.6 Flight crew limitations**

The flight crew limitations shall include the minimum number of flight crew personnel necessary to operate the aeroplane, having regard, among other things, to the accessibility to the appropriate crew members of all necessary controls and instruments and to the execution of the established emergency procedures.

#### **9.2.7 Flying time limitation after system or engine failure**

The systems limitations shall include the maximum flying time for which system reliability has been established in relation to the approval of operations by aeroplanes with two turbine engines beyond the threshold time established in accordance with 4.7 of CAD 6, Part I.

### **9.3 Operating information and procedures**

#### **9.3.1 Types of eligible operations**

There shall be listed the particular types of operations, as may be defined in CAD 6, Parts I and II, or be generally recognised, for which the aeroplane has been shown to be eligible by virtue of compliance with the appropriate airworthiness requirements.

#### **9.3.2 Loading information**

The loading information shall include the empty mass of the aeroplane, together with a definition of the condition of the aeroplane at the time of weighing, the corresponding centre of gravity position, and the reference points and datum lines to which the centre of gravity limits are related.

#### **9.3.3 Operating procedures**

A description shall be given of normal and emergency operating procedures which are peculiar to the particular aeroplane and necessary for its safe operation. These shall include procedures to be followed in the event of failure of one or more engines.

#### **9.3.4 Handling information**

Sufficient information shall be given on any significant or unusual features of the aeroplane characteristics. Those stalling speeds or minimum steady flight speeds required to be established by 2.3.4.3 shall be scheduled.

#### **9.3.5 Least-risk bomb location**

For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 and for which the application for certification was submitted on or after 12 March 2000, a least-risk location on the aeroplane shall be identified where a bomb or other explosive device may be placed to minimise the effects on the aeroplane in the case of detonation.

### **9.4 Performance information**

The performance of the aeroplane shall be scheduled in accordance with 2.2. There shall be included information regarding the various aeroplane configurations and powers involved and the relevant speeds, together with information that would assist the flight crew in attaining the performance as scheduled.

### **9.5 Aeroplane flight manual**

A flight manual shall be made available. It shall identify clearly the specific aeroplane or series of aeroplanes to which it is related. The flight manual shall include at least the limitations, information and procedures specified in this chapter.

## **9.6 Markings and placards**

- 9.6.1 Markings and placards on instruments, equipment, controls, etc., shall include such limitations or information as necessary for the direct attention of the flight crew during flight.
  
- 9.6.2 Markings and placards or instructions shall be provided to give any information that is essential to the ground crew in order to preclude the possibility of mistakes in ground servicing (e.g. towing, refuelling) that could pass unnoticed and that could jeopardise the safety of the aeroplane in subsequent flights.



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## **10 Continuing Airworthiness — Maintenance Information**

### **10.1 General**

Information for use in developing procedures for maintaining the aeroplane in an airworthy condition shall be made available. The information shall include that described in 10.2, 10.3 and 10.4.

### **10.2 Maintenance information**

Maintenance information shall include a description of the aeroplane and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

### **10.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and the recommended intervals at which these tasks are to be performed.

### **10.4 Maintenance information resulting from the type design approval**

Maintenance tasks and frequencies that have been specified as mandatory by the State of Design in approval of the type design shall be identified as such.



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## **11 Security**

### **11.1 Aeroplanes used for domestic commercial operations**

(Reserved)

### **11.2 Least-risk bomb location**

For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 and for which the application for certification was submitted on or after 12 March 2000, consideration shall be given during the design of the aeroplane to the provision of a least-risk bomb location so as to minimise the effects of a bomb on the aeroplane and its occupants.

### **11.3 Protection of the flight crew compartment**

(Reserved)

### **11.4 Interior design**

For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60 and for which the application for certification was submitted on or after 12 March 2000, consideration shall be given to design features that will deter the easy concealment of weapons, explosives or other dangerous objects on board aircraft and that will facilitate search procedures for such objects.



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## **Part IIIB. Aeroplanes Over 5 700 Kg For Which Application For Certification Was Submitted On Or After 2 March 2004**

### **1 General**

#### **1.1 1.1 Applicability**

1.1.1 The Standards of this part are applicable in respect of all aeroplanes designated in 1.1.2 for which an application for the issue of a Type Certificate was submitted to the CAAM on or after 2 March 2004.

1.1.2 Except for those Standards which specify a different applicability, the Standards of this part shall apply to all aeroplanes with a maximum certificated take-off mass greater than 5 700 kg and intended for the carriage of passengers or cargo or mail in international air navigation.

1.1.3 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code referred to in 1.2.1 of Part II for the aeroplanes designated in 1.1.2 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.

1.1.4 Unless otherwise stated, the Standards apply to the complete aeroplane including its powerplant, systems and equipment.

#### **1.2 Number of engines**

As of 7 March 2021, the aeroplane shall have not less than two engines.

#### **1.3 Operating limitations**

1.3.1 Limiting conditions shall be established for the aeroplane, its powerplant, systems and equipment (see 7.2). Compliance with the Standards of this part shall be established assuming that the aeroplane is operated within the limitations specified. The limitations shall include a margin of safety to render the likelihood of accidents arising therefrom extremely remote.

1.3.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the aeroplane, e.g. mass, centre of gravity location, load distribution, speeds, ambient air temperature and altitude, shall be established within which compliance with all the pertinent Standards in this part is shown.

#### **1.4 Unsafe features and characteristics**

Under all anticipated operating conditions, the aeroplane shall not possess any feature or characteristic that renders it unsafe.

#### **1.5 Proof of compliance**



The means by which compliance with the appropriate airworthiness requirements is demonstrated shall ensure that in each case the accuracy achieved will be such as to provide reasonable assurance that the aeroplane, its components and equipment comply with the requirements and are reliable and function correctly under the anticipated operating conditions.

## **2 Flight**

### **2.1 General**

- 2.1.1 Compliance with the Standards prescribed in this chapter shall be established by flight or other tests conducted upon an aeroplane or aeroplanes of the type for which a Type Certificate is sought, or by calculations (or other methods) based on such tests, provided that the results obtained by calculations (or other methods) are equal in accuracy to, or conservatively represent, the results of direct testing.
- 2.1.2 Compliance with each Standard shall be established for all applicable combinations of aeroplane mass and centre of gravity position, within the range of loading conditions for which certification is sought.
- 2.1.3 Where necessary, appropriate aeroplane configurations shall be established for the determination of performance in the various stages of flight and for the investigation of the aeroplane's flying qualities.

### **2.2 Performance**

- 2.2.1 Sufficient data on the performance of the aeroplane shall be determined and furnished in the flight manual to provide operators with the necessary information for the purpose of determining the maximum total mass of the aeroplane at the time of take-off that would allow the flight to be made with reasonable assurance that a safe minimum performance for that flight will be achieved considering the values of the operational parameter peculiar to the proposed flight.
- 2.2.2 Achieving the performance furnished in the flight manual for the aeroplane shall take into consideration human performance and in particular shall not require exceptional skill or alertness on the part of the flight crew.
- 2.2.3 The performance data in the flight manual of the aeroplane shall be consistent with compliance with 1.3.1 and with the operation in logical combinations of those of the aeroplane's systems and equipment, the operation of which may affect performance
- 2.2.4 Minimum performance
- 2.2.4.1 For aeroplanes for which application for certification was submitted before 2 March 2019, at the maximum masses scheduled for take-off and for landing permitted by the performance data in the flight manual (see 2.2.7.2) as functions of the aerodrome elevation or pressure-altitude either in the standard atmosphere or in specified still air atmospheric conditions, and, for seaplanes, in specified conditions of smooth water, the aeroplane shall be capable of accomplishing the minimum performances specified in 2.2.5 and 2.2.6, respectively, not considering obstacles, or runway or water run length.

2.2.4.2 For aeroplanes for which application for certification was submitted on or after 2 March 2019, at the maximum masses scheduled for take-off and for landing permitted by the performance data in the flight manual (see 2.2.7.3) as functions of the aerodrome elevation or pressure-altitude either in the standard atmosphere or in specified still air atmospheric conditions, and, for seaplanes, in specified conditions of smooth water, the aeroplane shall be capable of accomplishing the minimum performances specified in 2.2.5 and 2.2.6, respectively, not considering obstacles, or runway or water run length.

#### 2.2.5 Take-off

- a) The aeroplane shall be capable of taking off assuming the critical engine to fail (see 2.2.7), the remaining engine(s) being operated within their take-off power or thrust limitations.
- b) After the end of the period during which the take-off power or thrust may be used, the aeroplane shall be capable of continuing to climb, with the critical engine inoperative and the remaining engine(s) operated within their maximum continuous power or thrust limitations, up to a height that it can maintain and at which it can continue safe flight and landing.
- c) The minimum performance at all stages of take-off and climb shall be sufficient to ensure that under conditions of operation departing slightly from the idealised conditions for which data is furnished (see 2.2.7), the departure from the furnished values is not disproportionate.

#### 2.2.6 Landing

- a) Starting from the approach configuration and with the critical engine inoperative, the aeroplane shall be capable, in the event of a missed approach, of continuing the flight to a point from which another approach can be made.
- b) Starting from the landing configuration, the aeroplane shall be capable, in the event of a balked landing, of making a climb-out, with all engines operating.

#### 2.2.7 Performance data

2.2.7.1 The following stages are considered, as applicable:

- a) *Take-off*. The take-off performance data shall include the accelerate-stop distance and the take-off path.
- b) *Accelerate-stop distance*. The accelerate-stop distance shall be the distance required to accelerate and stop, or, for a seaplane to accelerate and come to a satisfactorily low speed, assuming the critical engine to fail suddenly at a point not nearer to the start of the take-off than that assumed when determining the take-off path (see 2.2.7.1 c). Additionally, for landplanes, the distance shall be based on operations with all the wheel brake assemblies at the fully worn limit of their allowable wear range.

- c) *Take-off path.* The take-off path shall comprise the ground or water run, initial climb and climb-out, assuming the critical engine to fail suddenly during the take-off (see 2.2.7.1 b)). The take-off path shall be scheduled up to a height from which the aeroplane can continue safe flight and landing. The climb-out shall be made at a speed not less than the take-off safety speed as determined in accordance with 2.3.2.4.
- d) *En-route.* The en-route climb performance shall be the climb (or descent) performance with the aeroplane in the en-route configuration with:
  - 1) the critical engine inoperative; and
  - 2) the two critical engines inoperative in the case of aeroplanes having three or more engines.

The operating engine(s) shall not exceed maximum continuous power or thrust.

- e) *Landing. Landing performance data at the time of take-off.* The landing distance shall be the horizontal distance traversed by the aeroplane from a point on the approach flight path at a selected height above the landing surface to the point on the landing surface at which the aeroplane comes to a complete stop, or, for a seaplane, comes to a satisfactorily low speed. The selected height above the landing surface and the approach speed shall be appropriately related to operating practices. This distance may be supplemented by such distance margin as may be necessary; if so, the selected height above the landing surface, the approach speed and the distance margin shall be appropriately interrelated and shall make provision for both normal operating practices and reasonable variations therefrom. For landplanes, this distance shall be based on operations with all the wheel brake assemblies at the fully worn limit of their allowable wear range.
- f) *Landing. At time of landing performance data.* The landing distance shall be the horizontal distance traversed by the aeroplane from a point on the approach flight path to the point on the landing surface at which the aeroplane comes to a complete stop, or, for a seaplane, comes to a satisfactorily low speed. The approach speed, use of deceleration devices, and airborne portion of the landing distance shall be in accordance with and reflect directly actual normal operating practices. This distance may be supplemented by such distance margin as may be necessary. For landplanes, this distance shall be based on operations with all the wheel brake assemblies at the fully worn limit of their allowable wear range.

2.2.7.2 For aeroplanes for which application for certification was submitted before 2 March 2019, performance data shall be determined and furnished in the flight manual so that its application by means of the operating rules to which the aeroplane is to be operated in accordance with 5.2 of CAD 6, Part I, will provide a safe relationship

between the performance of the aeroplane and the aerodromes and routes on which it is capable of being operated. Performance data shall be determined and furnished for the stages in 2.2.7.1 a) to e) for the ranges of mass, altitude or pressure-altitude, wind velocity, gradient of the take-off and landing surface for landplanes; water surface conditions, density of water and strength of current for seaplanes; and for any other operational variables for which the aeroplane is to be certificated.

- 2.2.7.3 For aeroplanes for which application for certification was submitted on or after 2 March 2019, performance data shall be determined and furnished in the flight manual. Such performance data shall be so that its application by means of the operating rules to which the aeroplane is to be operated in accordance with 5.2 of CAD 6, Part I, will provide a safe relationship between the performance of the aeroplane and the aerodromes and routes on which it is capable of being operated. Performance data shall be determined and furnished for the stages in 2.2.7.1 a) to f) for the ranges of mass, pressure-altitude, ambient temperature, wind velocity, and for any other operational variables for which the aeroplane is to be certificated. Additionally, the take-off performance data and the at time of landing performance data shall include the effect of the gradient and conditions (dry, wet or contaminated) of the take-off or landing surface as appropriate for landplanes, and water surface conditions, density of water and strength of current for seaplanes. The at time of take-off landing performance data need only to be determined with standard day temperature and level, dry landing surfaces for landplanes, but shall include the effect of water surface conditions, density of water, and strength of current for seaplanes.

## 2.3 Flying qualities

- 2.3.1 The aeroplane shall comply with the Standards of 2.3 at all altitudes up to the maximum anticipated altitude relevant to the particular requirement in all temperature conditions relevant to the altitude in question and for which the aeroplane is approved.

### 2.3.2 Controllability

- 2.3.2.1 The aeroplane shall be controllable and manoeuvrable under all anticipated operating conditions, and it shall be possible to make smooth transitions from one flight condition to another (e.g. turns, sideslips, changes of engine power or thrust, changes of aeroplane configurations) without requiring exceptional skill, alertness or strength on the part of the pilot even in the event of failure of any engine. A technique for safely controlling the aeroplane shall be established for all stages of flight and aeroplane configurations for which performance is scheduled.

*Note.— This Standard is intended, among other things, to relate to operation in conditions of no appreciable atmospheric turbulence and also to ensure that there is no undue deterioration of the flying qualities in turbulent air.*

- 2.3.2.2 Controllability on the ground (or water). The aeroplane shall be controllable on the ground (or on the water) during taxiing, take-off and landing under the anticipated operating conditions.
- 2.3.2.3 Controllability during take-off. The aeroplane shall be controllable in the event of sudden failure of the critical engine at any point in the take-off, when the aeroplane is handled in the manner associated with the scheduling of take-off paths and accelerate-stop distances.
- 2.3.2.4 Take-off safety speed. The take-off safety speeds assumed when the performance of the aeroplane (after leaving the ground or water) during the take-off is determined shall provide an adequate margin above the stall and above the minimum speed at which the aeroplane remains controllable after sudden failure of the critical engine.

### 2.3.3 Trim

The aeroplane shall have such trim characteristics as to ensure that the demands made on the pilot's attention and ability to maintain a desired flight condition are not excessive when account is taken of the stage of flight at which these demands occur and their duration. This shall apply both in normal operation and in the conditions associated with the failure of one or more engines for which performance characteristics are established.

## 2.4 Stability and control

### 2.4.1 Stability

The aeroplane shall have such stability in relation to its other flight characteristics, performance, structural strength and most probable operating conditions (e.g. aeroplane configurations and speed ranges) as to ensure that demands made on the pilot's powers of concentration are not excessive when the stage of the flight at which these demands occur and their duration are taken into account. The stability of the aeroplane shall not, however, be such that excessive demands are made on the pilot's strength or that the safety of the aeroplane is prejudiced by lack of manoeuvrability in emergency conditions. It shall be shown that any combination of failures or conditions that would result in the need for exceptional piloting skills is extremely improbable. The stability may be achieved by natural or artificial means, or a combination of both. If compliance with the flight characteristics requirements is dependent upon a stability augmentation system or upon any other automatic or power-operated system, compliance shall be shown with 4.2 of this part.

### 2.4.2 Stalling

- 2.4.2.1 *2.4.2.1 Stall warning.* When the aeroplane approaches a stall both in straight and turning flight, a clear and distinctive stall warning shall be apparent to the pilot with the aeroplane in all permissible configurations and powers or thrusts, except those which are not considered to be essential for safe flying. The stall warning and other characteristics of the aeroplane shall be such as to enable the pilot to

arrest the development of the stall after the warning begins and, without altering the engine power or thrust, to maintain full control of the aeroplane.

2.4.2.2 *Behaviour following a stall.* In any configuration and at any level of power or thrust in which it is considered that the ability to recover from a stall is essential, the behaviour of the aeroplane following a stall shall not be so extreme as to make difficult a prompt recovery without exceeding the airspeed or strength limitations of the aeroplane.

2.4.2.3 *Stalling speeds.* The stalling speeds or minimum steady flight speeds in configurations appropriate for each stage of flight (e.g. take-off, en route, landing) shall be established. One of the values of the power or thrust used in establishing the stalling speeds shall be not more than that necessary to give zero thrust at a speed just above the stall.

2.4.3 Flutter and vibration

2.4.3.1 It shall be demonstrated by suitable tests, analyses or any acceptable combination of tests and analyses that all parts of the aeroplane are free from flutter and excessive vibration in all aeroplane configurations under all speed conditions within the operating limitations of the aeroplane (see 1.3.2). There shall be no vibration or buffeting severe enough to cause structural damage.

2.4.3.2 There shall be no vibration or buffeting severe enough to interfere with control of the aeroplane or to cause excessive fatigue to the flight crew.



## **3 Structure**

### **3.1 General**

3.1.1 For aeroplanes for which application for certification was submitted before 24 February 2013, the aeroplane structure shall be designed, manufactured and provided with instructions for its maintenance and repair with the objective of avoiding catastrophic failure throughout its operational life.

3.1.2 For aeroplanes for which application for certification was submitted on or after 24 February 2013, the aeroplane structure shall be designed, manufactured and provided with instructions for its maintenance and repair with the objective of avoiding hazardous and catastrophic failure throughout its operational life.

### **3.2 Mass and mass distribution**

Unless otherwise stated, all structural Standards shall be complied with when the mass is varied over the applicable range and is distributed in the most adverse manner, within the operating limitations on the basis of which certification is sought.

### **3.3 Limit loads**

Except as might be otherwise qualified, the external loads and the corresponding inertia loads, or resisting loads obtained for the various loading conditions prescribed in 3.6 shall be considered as limit loads.

### **3.4 Strength and deformation**

In the various loading conditions prescribed in 3.6, no part of the aeroplane structure shall sustain detrimental deformation at any load up to and including the limit load, and the aeroplane structure shall be capable of supporting the ultimate load.

### **3.5 Airspeeds**

#### **3.5.1 Design airspeeds**

Design airspeeds shall be established for which the aeroplane structure is designed to withstand the corresponding manoeuvring and gust loads. To avoid inadvertent exceedances due to upsets or atmospheric variations, the design airspeeds shall provide sufficient margin for the establishment of practical operational limiting airspeeds. In addition, the design airspeeds shall be sufficiently greater than the stalling speed of the aeroplane to safeguard against loss of control in turbulent air. Consideration shall be given to a design manoeuvring speed, a design cruising speed, a design dive speed and any other design airspeeds necessary for configurations with high lift or other special devices.

#### **3.5.2 Limiting airspeeds**

Limiting airspeeds, based on the corresponding design airspeeds with safety margins, where appropriate, in accordance with 1.2.1, shall be included in the flight manual as part of the operating limitations (see 7.2).

### **3.6 Strength**

3.6.1 All structural elements shall be designed to withstand the maximum loads expected in service under all anticipated operating conditions without failure, permanent distortion or loss of functionality. In determining these loads, account shall be taken of:

- a) the expected operational life of the aeroplane;
- b) the vertical and horizontal gust environment, taking into consideration the expected variations in mission profile and loading configurations;
- c) the manoeuvre spectrum, taking into account variations in mission profile and loading configurations;
- d) asymmetrical as well as symmetrical loading;
- e) the ground and water loads, including taxi, landing and take-off loads, and ground/water handling loads;
- f) the speed range of the aeroplane, taking into account the aeroplane characteristics and operation limitations;
- g) vibration and buffeting loads;
- h) corrosion or other degradation, given the maintenance specified, and various operating environments; and
- i) any other loads, such as flight control loads, cabin pressurisation loads, engine loads, or dynamic loads due to changes to the steady state configuration.

3.6.2 The air, inertia and other loads resulting from the specific loading conditions shall be distributed so as to approximate actual conditions closely or to represent them conservatively.

### **3.7 Survivability**

The aeroplane shall be designed so as to provide the occupants with the maximum practicable protection in the event of structural failure, or in the event of damage due to ground, water or object impact. Consideration shall be given to at least the following:

- a) likely impact with birds;
- b) energy absorption by the airframe, occupant seats and restraints;
- c) the probable behaviour of the aeroplane in ditching; and
- d) allowing egress in the shortest practicable time.

### **3.8 Structural durability**

3.8.1 For aeroplanes for which application for certification was submitted before 24 February 2013, the design and construction of the aeroplane shall, wherever

practicable, conform to damage tolerance principles and shall be such as to ensure that the probability of catastrophic failure during the operational life is extremely remote, taking into account:

- a) the expected environment;
- b) the expected repeated loads applied in service;
- c) expected vibrations from aerodynamic interaction or internal sources;
- d) thermal cycles;
- e) accidental and discrete source damage;
- f) likely corrosion or other degradation;
- g) specified maintenance; and
- h) likely structural repairs.

3.8.2 For aeroplanes for which application for certification was submitted on or after 24 February 2013, the design and construction of the aeroplane shall, wherever practicable, conform to damage tolerance and failsafe principles and shall be such as to avoid catastrophic failure during the operational life, taking into account:

- a) the expected environment;
- i) the expected repeated loads applied in service;
- j) expected vibrations from aerodynamic interaction or internal sources;
- k) thermal cycles;
- l) accidental and discrete source damage;
- m) likely corrosion or other degradation;
- n) widespread fatigue damage;
- o) specified maintenance; and
- p) likely structural repairs.

### 3.9 Special factors

For aeroplanes for which application for certification was submitted on or after 24 February 2013, the design features (e.g. castings, bearings or fittings), the strength of which is subject to variability in manufacturing processes, deterioration in service or any other cause, shall be accounted for by a suitable factor.



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## **4 Design And Construction**

### **4.1 General**

4.1.1 Details of design and construction shall be such as to give reasonable assurance that all aeroplane parts will function effectively and reliably in the anticipated operating conditions. They shall be based upon practices that experience has proven to be satisfactory or that are substantiated by special tests or by other appropriate investigations or both. They shall also consider human factors principles.

#### **4.1.2 Substantiation of moving parts**

The functioning of all moving parts essential to the safe operation of the aeroplane shall be demonstrated by suitable tests in order to ensure that they will function correctly under all operating conditions for such parts.

#### **4.1.3 Materials**

All materials used in parts of the aeroplane essential for its safe operation shall conform to approved specifications. The approved specifications shall be such that materials accepted as complying with the specifications will have the essential properties assumed in the design. The effect of the materials on the occupants of the aeroplane and other persons on the ground, and the environment in general, in normal and emergency situations, shall be taken into account.

#### **4.1.4 Manufacturing methods**

The methods of manufacturing and assembly shall be such as to produce a consistently sound structure which shall be reliable with respect to maintenance of strength in service.

#### **4.1.5 Protection**

The structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes, which could pass unnoticed, taking into account the maintenance the aeroplane will receive.

#### **4.1.6 Inspection provisions**

Adequate provision shall be made to permit any necessary examination, replacement or reconditioning of parts of the aeroplane that require such attention, either periodically or after unusually severe operations.

### **4.2 Systems design features**

Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following:

- a) *Controls and control systems*. The design of the controls and control systems shall be such that:

- 1) each control and control system shall operate with the ease, smoothness and precision appropriate to its function;
  - 2) continued safe flight and landing of the aeroplane shall not be prevented by:
    - i) any single failure not shown to be extremely improbable in the control system; or
    - ii) any event that results in a jam of a flight control in any normally encountered position of the flight controls;
  - 3) the possibility of jamming, inadvertent operation and unintentional engagement of control surface locking devices is minimised; and
  - 4) each element of each flight control system is designed, or distinctively and permanently marked, to minimise the probability of any incorrect assembly that could result in the malfunction of the system.
- b) System survivability.
- 1) For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60, aeroplane systems shall be designed, arranged and physically separated to maximise the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems.
  - 2) (Reserved)
- c) *Crew environment*. The design of the flight crew compartment shall be such as to minimise the possibility of incorrect or restricted operation of the controls by the crew, due to fatigue, confusion or interference. Consideration shall be given at least to the following: layout and identification of controls and instruments, rapid identification of emergency situations, sense of controls, ventilation, heating and noise.
- d) *Pilot vision*. The arrangement of the flight crew compartment shall be such as to afford a sufficiently extensive, clear and undistorted field of vision for the safe operation of the aeroplane, and to prevent glare and reflections that would interfere with the pilot's vision. The design features of the windshield shall permit, under precipitation conditions, sufficient vision for the normal conduct of flight and for the execution of approaches and landings.
- e) *Provision for emergencies*. Means shall be provided which shall either automatically prevent, or enable the flight crew to deal with, emergencies resulting from foreseeable failures of equipment and systems, the failure of which would endanger the aeroplane. Reasonable provisions shall be made for continuation of essential services following engine or system failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this CAD and in CAD 6, Parts I and II.
- f) Fire precautions.

- 1) The design of the aeroplane and the materials used in its manufacture shall be such so as to minimise the risk of in-flight and ground fires, to minimise the production of smoke and toxic gases in the event of a fire and to delay the occurrence of flashover resulting from heat release in the cabin. Means shall be provided to contain or to detect and extinguish such fires as might occur in such a way that no additional danger to the aeroplane is caused. Lavatories installed in aeroplanes shall be equipped with a smoke detection system and a built-in fire extinguisher system for each receptacle intended for the disposal of towels, paper or waste.
  - 2) For aeroplanes for which application for certification was submitted on or after 24 February 2013, design precautions shall be taken to minimise the risk of an uncontained fire initiating in areas of the aeroplane that contain high concentrations of wiring or equipment that are not normally accessible in flight.
- g) Cargo compartment protection.
- 1) Each cargo compartment accessible to a crew member in a passenger-carrying aeroplane shall be equipped with a fire suppression system;
  - 2) each cargo compartment not accessible to a crew member shall be equipped with a built-in fire detection system and a built-in fire suppression system; and
  - 3) for aeroplanes of a maximum certificated take-off mass in excess of 45 000 kg or with a passenger seating capacity greater than 60, cargo compartment fire suppression systems, including their extinguishing agents, shall be designed so as to take into account a sudden and extensive fire such as could be caused by an explosive or incendiary device or dangerous goods.
- h) Incapacitation of occupants.
- 1) For aeroplanes for which application for certification was submitted on or after 24 February 2013, design precautions shall be taken to protect against possible instances of cabin depressurisation and against the presence of smoke or other toxic gases that could incapacitate the occupants of the aeroplane.
  - 2) In addition, for aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60, design precautions shall be taken to protect against possible instances of cabin depressurisation and against the presence of smoke or other toxic gases caused by explosive or incendiary devices or dangerous goods which could incapacitate the occupants of the aeroplane.
  - 3) (Reserved)
- i) Protection of the flight crew compartment from smoke and fumes.

- 1) For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60, means shall be provided to minimise entry into the flight crew compartment of smoke, fumes and noxious vapours generated by an explosion or fire on the aeroplane.
- 2) (Reserved)

### **4.3 Aeroelasticity**

The aeroplane shall be free from flutter, structural divergence, and loss of control due to structural deformation and aeroelastic effects, at all speeds within and sufficiently beyond the design envelope to comply with 1.3.1. Account shall be taken of the characteristics of the aeroplane and variations in pilot skill and workload. Allowable limits for aerodynamic control surfaces and how those limits are to be monitored shall be specified so as to ensure that the aeroplane remains free from aeroelastic problems during its operational life.

### **4.4 Occupants accommodation features**

#### **4.4.1 Seating and restraints**

Adequate seating and restraints shall be provided for the occupants, taking account of the likely flight and emergency landing loads to be encountered. Attention shall be paid to minimizing injury to occupants due to contact with surrounding structures during the operation of the aeroplane.

#### **4.4.2 Cabin environment**

Ventilation, heating and, where applicable, pressurisation systems shall be designed to provide the cabin with an adequate environment during the anticipated flight and ground or water operating conditions. The systems design shall also consider likely emergency conditions.

### **4.5 Electrical bonding and protection against lightning and static electricity**

#### **4.5.1 Electrical bonding and protection against lightning and static electricity shall be such as to:**

- a) protect the aeroplane, its systems, its occupants and those who come in contact with the aeroplane on the ground or water from the dangerous effects of lightning discharge and electrical shock; and
- b) prevent dangerous accumulation of electrostatic charge.

#### **4.5.2 The aeroplane shall also be protected against catastrophic effects of lightning. Due account shall be taken of the material used in the construction of the aeroplane.**

### **4.6 Emergency landing provisions**

#### **4.6.1 Provisions shall be made in the design of the aeroplane to protect the occupants, in the event of an emergency landing, from fire and from the direct effects of**



deceleration forces as well as from injuries arising from the effect of deceleration forces on the aeroplane's interior equipment.

- 4.6.2 Facilities shall be provided for the rapid evacuation of the aeroplane in conditions likely to occur following an emergency landing. Such facilities shall be related to the passenger and crew capacity of the aeroplane and shall be shown to be suitable for their intended purpose.
- 4.6.3 The interior layout of the cabin and the position and number of emergency exits, including the means of locating and illuminating the escape paths and exits, shall be such as to facilitate rapid evacuation of the aeroplane in conditions likely to occur following an emergency landing.
- 4.6.4 On aeroplanes certificated for ditching conditions, provisions shall be made in the design to give maximum practicable assurance that safe evacuation from the aeroplane of passengers and crew can be executed in case of ditching.

#### **4.7 Ground handling**

Adequate provisions shall be made to minimise the risk that normal ground handling operations (e.g. towing, jacking) may cause damage, which could pass unnoticed, to the parts of the aeroplane essential for its safe operation. The protection that any limitations and instructions for such operations might provide may be taken into account.



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## 5 Powerplant

### 5.1 Engines

The Standards of Part VI of this CAD shall apply to each engine that is used on the aeroplane as a primary propulsion unit.

### 5.2 Propellers

The Standards of Part VII of this CAD shall apply to each propeller that is used on the aeroplane.

### 5.3 Powerplant installation

#### 5.3.1 Compliance with engine and propeller limitations

The powerplant installation shall be so designed that the engines and propellers (if applicable) are capable of functioning reliably in the anticipated operating conditions. In conditions established in the flight manual, the aeroplane shall be capable of being operated without exceeding the limitations established for the engines and propellers in accordance with this chapter and with Parts VI and VII.

#### 5.3.2 Control of engine rotation

In those installations where continued rotation of a failed engine would increase the hazard of fire or of a serious structural failure, means shall be provided for the crew to stop the rotation of the failed engine in flight or to reduce it to a safe level.

#### 5.3.3 Turbine engine installation

For a turbine engine installation:

- a) the design shall minimise the hazards to the aeroplane in the event of failure of engine rotating parts, or an engine fire which burns through the engine case; and
- b) the powerplant installation shall be designed to give reasonable assurance that those engine operating limitations that adversely affect the structural integrity of rotating parts shall not be exceeded in service.

#### 5.3.4 Engine restarting

Means shall be provided for restarting an engine in flight at altitudes up to a declared maximum altitude.

#### 5.3.5 Arrangement and functioning

- 5.3.5.1 *Independence of engines.* For aeroplanes for which application for certification was submitted before 24 February 2013, the powerplant shall be arranged and installed so that each engine together with its associated systems is capable of being controlled and operated independently from the others and so that there is at least one arrangement of the powerplant and systems in which any failure, unless

the probability of its occurrence is extremely remote, cannot result in a loss of more power than that resulting from complete failure of the critical engine.

5.3.5.2 *Independence of engines and associated systems.* For aeroplanes for which application for certification was submitted on or after 24 February 2013, the engines together with their associated systems shall be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or of any system that can affect the engine, will not:

- a) prevent the continued safe operation of the remaining engine(s); or
- b) require immediate action by any crew member for continued safe operation of the remaining engine(s).

5.3.5.3 *Propeller vibration.* The propeller vibration stresses shall be determined and shall not exceed values that have been found safe for operation within the operating limitations established for the aeroplane.

5.3.5.4 *Cooling.* The cooling system shall be capable of maintaining the temperature of powerplant components and fluids within the established limits (see 5.3.1) at ambient air temperatures up to the maximum air temperature appropriate to the intended operation of the aeroplane. The maximum and, if necessary, minimum ambient air temperature for which the powerplant has been established as being suitable shall be scheduled in the flight manual.

5.3.5.5 *Associated systems.* The fuel, oil, air induction and other systems associated with the powerplant shall be capable of supplying each engine in accordance with its established requirements, under all conditions affecting the functioning of the systems (e.g. engine power or thrust, aeroplane attitudes and accelerations, atmospheric conditions, fluid temperatures) within the anticipated operating conditions.

5.3.5.6 *Fire protection.* For regions of the powerplant where the potential fire hazards are particularly serious because of the proximity of ignition sources to combustible materials, the following shall apply in addition to the general Standard of 4.2 f):

- a) *Isolation.* Such regions shall be isolated by fireproof material from other regions of the aeroplane where the presence of fire would jeopardise continued flight, taking into account the probable points of origin and paths of propagation of fire.
- b) *Flammable fluids.* Flammable fluid system components located in such regions shall be fire resistant. Drainage of each region shall be provided to minimise hazards resulting from the failure of any component containing flammable fluids. Means shall be provided for the crew to shut off the flow of flammable fluids into such regions if a fire occurs. Where sources of flammable fluid exist in such regions, the whole of the related system within the region, including supporting structure, shall be fireproof or shielded from the effects of the fire.

- c) *Fire detection.* A sufficient number of fire detectors shall be provided and located to ensure rapid detection of any fire that might occur in such regions.
- d) *Fire extinguishment.* Such regions shall be provided with a fire extinguisher system capable of extinguishing any fire likely to occur therein, unless the degree of isolation, quantity of combustibles, fire resistance of the structure and other factors are such that any fire likely to occur in the region would not jeopardise the safety of the aeroplane.



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## **6 Systems And Equipment**

### **6.1 General**

6.1.1 The aeroplane shall be provided with approved instruments, equipment and systems, including guidance and flight management systems necessary for the safe operation of the aeroplane in the anticipated operating conditions. These shall include the instruments and equipment necessary to enable the crew to operate the aeroplane within its operating limitations. Instruments and equipment design shall observe human factors principles.

6.1.2 The design of the instruments, equipment and systems required by 6.1.1 and their installation shall be such that:

- a) an inverse relationship exists between the probability of a failure condition and the severity of its effect on the aircraft and its occupants, as determined by a system safety assessment process;
- b) they perform their intended function under all anticipated operating conditions; and
- c) electromagnetic interference between them is minimised.

6.1.3 Means shall be provided to warn the crew of unsafe system operating conditions and to enable them to take corrective action.

#### **6.1.4 Electrical power supply**

The design of the electrical power supply system shall be such as to enable it to supply power loads during normal operations of the aeroplane and essential power loads after failures that affect the electrical generating system and under expected environmental conditions.

#### **6.1.5 Development assurance of complex electronic hardware and system software**

For aeroplanes for which application for certification was submitted on or after 24 February 2013, complex electronic hardware and system software shall be developed, verified and validated such as to ensure that the systems in which they are used perform their intended functions at a level of safety that complies with the requirements of this section, notably those of 6.1.2 a) and 6.1.2 b).

### **6.2 Installation**

Instrument and equipment installations shall comply with the Standards of Chapter 4.

### **6.3 Safety and survival equipment**

Prescribed safety and survival equipment that the crew or passengers are expected to use or operate at the time of an emergency shall be reliable, readily accessible and easily identified, and its method of operation shall be plainly marked.

### **6.4 Navigation lights and anti-collision lights**

- 6.4.1 The lights required by CAD 2 — *Rules of the Air* to be displayed by aeroplanes in flight or operating on the movement area of an aerodrome shall have intensities, colours, fields of coverage and other characteristics such that they furnish the pilot of another aircraft or personnel on the ground with as much time as possible for interpretation and for subsequent manoeuvre necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.
- 6.4.2 Lights shall be installed in aeroplanes so as to minimise the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

### **6.5 Electromagnetic interference protection**

Aeroplane electronic systems, particularly flight-critical and flight-essential systems, shall be protected against electromagnetic interference from both internal and external sources.

### **6.6 Ice protection**

If certification for flight in icing conditions is requested, the aeroplane shall be shown to be able to operate safely in icing conditions likely to be encountered in all anticipated operating environments.



## **7 Operating Limitations And Information**

### **7.1 General**

The operating limitations within which compliance with the Standards of this CAD is determined, together with any other information necessary to the safe operation of the aeroplane, shall be made available by means of a flight manual, markings and placards, and such other means as may effectively accomplish the purpose.

### **7.2 Operating limitations**

7.2.1 Limitations which might be exceeded in flight and which are defined quantitatively shall be expressed in suitable units. These limitations shall be corrected if necessary for errors in measurements so that the flight crew can, by reference to the instruments available to them, readily determine when the limitations are reached.

#### **7.2.2 Loading limitations**

The loading limitations shall include all limiting masses, centre of gravity positions, mass distributions and floor loadings (see 1.3.2).

#### **7.2.3 Airspeed limitations**

The airspeed limitations shall include all speeds (see 3.5) that are limiting from the standpoint of structural integrity or flying qualities of the aeroplane, or from other considerations. These speeds shall be identified with respect to the appropriate aeroplane configurations and other pertinent factors.

#### **7.2.4 Powerplant limitations**

The powerplant limitations shall include all those established for the various powerplant components as installed in the aeroplane (see 5.3.1 and 5.3.5.4).

#### **7.2.5 Limitations on equipment and systems**

The limitations on equipment and systems shall include all those established for the various equipment and systems as installed in the aeroplane.

#### **7.2.6 Miscellaneous limitations**

Miscellaneous limitations shall include any necessary limitations with respect to conditions found to be prejudicial to the safety of the aeroplane (see 1.3.1).

#### **7.2.7 Flight crew limitations**

The flight crew limitations shall include the minimum number of flight crew personnel necessary to operate the aeroplane, having regard, among other things, to the accessibility to the appropriate crew members of all necessary controls and instruments and to the execution of the established emergency procedures.

#### **7.2.8 Flying time limitation after system or engine failure**

The systems limitations shall include the maximum flying time for which system reliability has been established in relation to the approval of operations by

aeroplanes with two turbine engines beyond the threshold time established in accordance with 4.7 of CAD 6, Part I.

### **7.3 Operating information and procedures**

#### **7.3.1 Types of eligible operations**

The particular types of operations for which the aeroplane has been shown to be eligible by virtue of compliance with the appropriate airworthiness requirements shall be listed.

#### **7.3.2 Loading information**

The loading information shall include the empty mass of the aeroplane, together with a definition of the condition of the aeroplane at the time of weighing, the corresponding centre of gravity position, and the reference points and datum lines to which the centre of gravity limits are related.

#### **7.3.3 Operating procedures**

A description shall be given of normal and emergency operating procedures which are peculiar to the particular aeroplane and necessary for its safe operation. These shall include procedures to be followed in the event of failure of one or more engines.

#### **7.3.4 Handling information**

Sufficient information shall be given on any significant or unusual features of the aeroplane characteristics. Those stalling speeds or minimum steady flight speeds required to be established by 2.4.2.3 shall be scheduled.

#### **7.3.5 Least-risk bomb location**

For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60, a least-risk location on the aeroplane shall be identified where a bomb or other explosive device may be placed to minimise the effects on the aeroplane in the case of detonation.

### **7.4 Performance information**

The performance of the aeroplane shall be scheduled in accordance with 2.2. There shall be included information regarding the various aeroplane configurations and powers or thrusts involved and the relevant speeds, together with information that would assist the flight crew in attaining the performance as scheduled.

### **7.5 Flight manual**

A flight manual shall be made available. It shall identify clearly the specific aeroplane or series of aeroplanes to which it is related. The flight manual shall include at least the limitations, information and procedures specified in 7.2, 7.3, 7.4 and 7.6.1.

### **7.6 Markings and placards**

7.6.1 Markings and placards on instruments, equipment, controls, etc., shall include such limitations or information as necessary for the direct attention of the flight crew during flight.

7.6.2 Markings and placards or instructions shall be provided to give any information that is essential to the ground crew in order to preclude the possibility of mistakes in ground servicing (e.g. towing, refuelling) that could pass unnoticed and that could jeopardise the safety of the aeroplane in subsequent flights.

## **7.7 Continuing airworthiness — maintenance information**

### **7.7.1 General**

Information for use in developing procedures for maintaining the aeroplane in an airworthy condition shall be made available. The information shall include that described in 7.7.2, 7.7.3 and 7.7.4.

### **7.7.2 Maintenance information**

Maintenance information shall include a description of the aeroplane and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

### **7.7.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and recommended intervals at which these tasks are to be performed.

### **7.7.4 Mandatory maintenance requirements resulting from the type design approval**

Mandatory maintenance requirements that have been specified by the State of Design as part of the approval of the type design shall be identified as such and included in the maintenance information of 7.7.3.



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## **8 Crashworthiness And Cabin Safety**

### **8.1 General**

Crashworthiness shall be taken into account in the design of aeroplanes to improve the probability of occupant survival.

### **8.2 Design emergency landing loads**

8.2.1 For aeroplanes for which application for certification was submitted before 24 February 2013, emergency landing (crash) loads shall be determined for all categories of aeroplanes so that the interiors, furnishings, support structure and safety equipment can be designed to maximise survivability for the occupants. Items to be considered shall include:

- a) dynamic effects;
- b) restraint criteria for items that could cause a hazard;
- c) distortion of the fuselage in the areas of emergency exits;
- d) fuel cell integrity and position; and
- e) integrity of electrical systems to avoid sources of ignition.

8.2.2 For aeroplanes for which application for certification was submitted on or after 24 February 2013, emergency landing (crash) loads shall be determined so that the interiors, furnishings, support structure and safety equipment can be designed to protect the occupants under emergency landing conditions. Items to be considered shall include:

- a) dynamic effects;
- b) restraint criteria for items that could cause a hazard;
- c) deformation of the fuselage in the areas of emergency exits;
- d) fuel cell integrity and position; and
- e) integrity of electrical systems to avoid sources of ignition.

### **8.3 Cabin fire protection**

The cabin shall be so designed as to provide fire protection to the occupants in the event of airborne systems failures or a crash situation. Items to be considered shall include:

- a) flammability of cabin interior materials;
- b) fire resistance and the generation of smoke and toxic fumes;
- c) provision of safety features to allow for safe evacuation; and
- d) fire detection and suppression equipment.

#### **8.4 Evacuation**

The aeroplane shall be equipped with sufficient emergency exits to allow maximum opportunity for cabin evacuation within an appropriate time period. Items to be considered shall include:

- a) number of seats and seating configuration;
- b) number, location and size of exits;
- c) marking of exits and provision of instructions for use;
- d) likely blockages of exits;
- e) operation of exits; and
- f) positioning and weight of evacuation equipment at exits, e.g. slides and rafts.

#### **8.5 Lighting and marking**

Emergency lighting shall be provided and shall have the following characteristics:

- a) independence from main electrical supply;
- b) automatic activation upon loss of normal power/impact;
- c) visual indication of the path to emergency exits in smoke-filled cabin conditions;
- d) illumination both inside and outside the aeroplane during evacuation; and
- e) no additional hazard in the event of fuel spillage.

#### **8.6 Survival equipment**

The aeroplane shall be so equipped as to provide the crew and occupants with the maximum opportunity to survive in the expected external environment for a reasonable time span. Items to be considered shall include:

- a) number of life rafts/life jackets;
- b) survival equipment suited to the likely environment;
- c) emergency radios and pyrotechnical distress signalling equipment; and
- d) automatic emergency radio beacons.

## **9 Operating Environment And Human Factors**

### **9.1 General**

The aeroplane shall be designed to allow safe operation within the performance limitations of its passengers and those who operate, maintain and service it.

### **9.2 Flight crew**

9.2.1 The aeroplane shall be designed in such a way as to allow safe and efficient control by the flight crew. The design shall allow for variations in flight crew skill and physiology commensurate with flight crew licensing limits. Account shall be taken of the different expected operating conditions of the aeroplane in its environment, including operations degraded by failures.

9.2.2 The workload imposed on the flight crew by the design of the aeroplane shall be reasonable at all stages of flight. Particular consideration shall be given to critical stages of flight and critical events which may reasonably be expected to occur during the service life of the aeroplane, such as a contained engine failure or windshear encounter.

### **9.3 Ergonomics**

During design of the aeroplane, account shall be taken of ergonomic factors including:

- a) ease of use and prevention of inadvertent misuse;
- b) accessibility;
- c) flight crew working environment;
- d) cockpit standardisation; and
- e) maintainability.

### **9.4 Operating environmental factors**

The design of the aeroplane shall take into consideration the flight crew operating environment including:

- a) effect of aeromedical factors such as level of oxygen, temperature, humidity, noise and vibration;
- b) effect of physical forces during normal flight;
- c) effect of prolonged operation at high altitude; and
- d) physical comfort.



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## **10 Security**

### **10.1 Aeroplanes used for domestic commercial operations**

(Reserved)

### **10.2 Least-risk bomb location**

For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60, consideration shall be given during the design of the aeroplane to the provision of a least-risk bomb location so as to minimise the effects of a bomb on the aeroplane and its occupants.

### **10.3 Protection of the flight crew compartment**

10.3.1 In all aeroplanes, which are required by CAD 6, Part I, Chapter 13 to have an approved flight crew compartment door, and for which an application for the issue of a Type Certificate was submitted to the appropriate national authority on or after 20 May 2006, the flight crew compartment bulkheads, floors and ceilings shall be designed to resist penetration by small arms fire and grenade shrapnel and to resist forcible intrusions, if these areas are accessible in flight to passengers and cabin crew.

10.3.2 (Reserved)

### **10.4 Interior design**

For aeroplanes of a maximum certificated take-off mass in excess of 45 500 kg or with a passenger seating capacity greater than 60, consideration shall be given to design features that will deter the easy concealment of weapons, explosives or other dangerous objects on board aircraft and that will facilitate search procedures for such objects.



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## **Part IV. Helicopters**

### **1 General**

#### **1.1 Applicability**

The Standards of this part are established by CAAM as the essential requirements in respect of all helicopters designated in part IVA and IVB. For helicopters certification purposes, refer to CAD 8102 or CAD 8107, as applicable



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## **Part IVA. Helicopters For Which Application For Certification Was Submitted On Or After 22 March 1991 But Before 13 December 2007**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part are applicable in respect of all helicopters designated in 1.1.2 that are of types of which the prototype was submitted to the CAAM for certification on or after 22 March 1991 but before 13 December 2007.
- 1.1.2 The Standards of this part shall apply to helicopters intended for the carriage of passengers or cargo or mail in international air navigation.
- 1.1.3 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code referred to in 1.2.1 of Part II for the helicopters designated in 1.1.2 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.
- 1.1.4 Unless otherwise stated, the Standards apply to the complete helicopter including its powerplant, systems and equipment.

#### **1.2 Limitations**

- 1.2.1 Limiting conditions shall be established for the helicopter, its powerplant and its equipment (see 9.2). Compliance with the Standards of this part shall be established assuming that the helicopter is operated within the limitations specified. The limitations shall be sufficiently removed from any conditions prejudicial to the safety of the helicopter to render the likelihood of accidents arising therefrom extremely remote.
- 1.2.2 Limiting ranges of mass, centre of gravity location, load distribution, speeds and ambient conditions shall be established within which compliance with all the pertinent Standards in this part is shown, except that combinations of conditions which are fundamentally impossible to achieve need not be considered

#### **1.3 Unsafe features and characteristics**

- 1.3.1 Under all anticipated operating conditions, the helicopter shall not possess any feature or characteristic that renders it unsafe.

#### **1.4 Proof of compliance**

- 1.4.1 Compliance with the appropriate airworthiness requirements shall be based on evidence either from tests, calculations, calculations based on tests, or other

methods, provided that in each case the accuracy achieved will ensure a level of airworthiness equal to that which would be achieved were direct tests conducted.

- 1.4.2 The tests of 1.4.1 shall be such as to provide reasonable assurance that the helicopter, its components and equipment are reliable and function correctly under the anticipated operating conditions.

## **2 Flight**

### **2.1 General**

- 2.1.1 Compliance with the Standards prescribed in this chapter shall be established by flight or other tests conducted upon a helicopter or helicopters of the type for which a Certificate of Airworthiness is sought, or by calculations (or other methods) based on such tests, provided that the results obtained by calculations (or other methods) are equal in accuracy to, or conservatively represent, the results of direct testing.
- 2.1.2 Compliance with each Standard shall be established for all applicable combinations of helicopter mass and centre of gravity position, within the range of loading conditions for which certification is sought.
- 2.1.3 Where necessary, appropriate helicopter configurations shall be established for the determination of performance in the various stages of flight and for the investigation of the helicopter's flying qualities.

### **2.2 Performance**

#### **2.2.1 General**

- 2.2.1.1 Sufficient data on the performance of the helicopter shall be determined and scheduled in the flight manual to provide operators with the necessary information for the purpose of determining the total mass of the helicopter on the basis of the values, peculiar to the proposed flight, of the relevant operational parameters, in order that the flight may be made with reasonable assurance that a safe minimum performance for that flight will be achieved.
- 2.2.1.2 Achieving the performance scheduled for the helicopter shall take into consideration human performance and in particular shall not require exceptional skill or alertness on the part of the pilot.
- 2.2.1.3 The scheduled performance of the helicopter shall be consistent with compliance with 1.2.1 and with the operation in logical combinations of those of the helicopter's systems and equipment, the operation of which may affect performance.

#### **2.2.2 Minimum performance**

At the maximum mass scheduled (see 2.2.3) for take-off and for landing as functions of the take-off or landing site elevation or pressure-altitude either in the standard atmosphere or in specified still air atmospheric conditions, and, for water operations, in specified conditions of smooth water, the helicopter shall be capable of accomplishing the minimum performances specified in 2.2.2.1 and 2.2.2.2, respectively, not considering obstacles, or final approach and take-off area length.

##### **2.2.2.1 Take-off**

- a) In the event of critical engine failure, at or after the take-off decision point (for performance Class 1) or the defined point after take-off (for performance Class 2), performance Classes 1 and 2 helicopters shall be capable of continuing safe flight, the remaining engine(s) being operated within the approved limitations.
- b) The minimum performance at all stages of take-off and climb shall be sufficient to ensure that under conditions of operation departing slightly from the idealised conditions for which data is scheduled (see 2.2.3), the departure from the scheduled values is not disproportionate.

#### 2.2.2.2 Landing

- a) Starting from the approach configuration, in the event of critical engine failure at or before the landing decision point (performance Class 1) or the defined point before landing (performance Class 2), the helicopter shall be capable of continuing safe flight, the remaining engine(s) being operated within the approved limitations.
- b) Starting from the landing configuration, the helicopter shall be capable, in the event of a balked landing, of making a climb-out, with all engines operating.

#### 2.2.3 Scheduling of performance

Performance data shall be determined and scheduled in the flight manual so that its application by means of the operating rules to which the helicopter is to be operated in accordance with 5.1.2 of CAD 6, Part III, will provide a safe relationship between the performance of the helicopter and the aerodromes, heliports and routes on which it is capable of being operated. Performance data shall be determined and scheduled for the following stages for the ranges of mass, altitude or pressure-altitude, wind velocity, and other ambient conditions and any other operational variables for which the helicopter is to be certificated, and additionally for amphibians, water surface conditions and strength of current.

2.2.3.1 *Take-off.* The take-off performance data shall include the take-off distance required and the take-off path. For performance Class 1 helicopters, it shall also include the rejected take-off distance required.

2.2.3.1.1 *Take-off decision point.* (For performance Class 1 helicopters only.) The take-off decision point shall be the point in the take-off phase used in determining take-off performance and from which either a rejected take-off may be made or a take-off safely continued, with the critical engine inoperative.

2.2.3.1.2 *Take-off distance required.* (For performance Class 1 helicopters only.) The take-off distance required shall be the horizontal distance required from the start of the take-off to the point at which the take-off safety speed ( $V_{TOSS}$ ), a selected



height above the take-off surface, and a positive climb gradient are achieved, following failure of the critical engine at the take-off decision point, the remaining engine(s) operating within approved operating limits.

2.2.3.1.3 *Rejected take-off distance required.* (For performance Class 1 helicopters only.) The rejected take-off distance required shall be the horizontal distance required from the start of the take-off to the point where the helicopter comes to a complete stop following an engine failure and rejection of the take-off at the take-off decision point.

2.2.3.1.4 *Take-off distance required.* (For performance Classes 2 and 3 helicopters only.) The take-off distance required shall be the horizontal distance required from the start of take-off to the point where the best rate of climb speed ( $V_y$ ) or the best angle of climb speed ( $V_x$ ) or a selected intermediate speed (provided this speed does not involve flight within the avoid areas of the height-velocity diagrams) and a selected height above the take-off surface are achieved, all engines operating at approved take-off power.

2.2.3.2 *En route.* The en-route performance shall be the climb, cruise or descent performance with:

- a) the critical engine inoperative;
- b) the two critical engines inoperative in the case of helicopters having three or more engines; and
- c) the operating engine(s) not exceeding the power for which they are certificated.

2.2.3.3 *Landing.* The landing performance data shall include the landing distance required and, for performance Class 1 helicopters, the landing decision point.

2.2.3.3.1 *Landing decision point.* (For performance Class 1 helicopters only.) The landing decision point shall be the latest point in the approach phase from which either a landing may be made or a rejected landing (go-around) safely initiated, with the critical engine inoperative.

2.2.3.3.2 *Landing distance required.* The landing distance required shall be the horizontal distance required to land and come to a complete stop from a point on the approach flight path at a selected height above the landing surface.

## 2.3 Flying qualities

The helicopter shall comply with the Standards of 2.3 at all altitudes up to the maximum anticipated altitude relevant to the particular requirement in all temperature conditions relevant to the altitude in question and for which the helicopter is approved.

### 2.3.1 Controllability

The helicopter shall be controllable and manoeuvrable under all anticipated operating conditions, and it shall be possible to make smooth transitions from one flight condition to another (e.g. turns, sideslips, changes of engine power, changes of helicopter configurations) without requiring exceptional skill, alertness or strength on the part of the pilot even in the event of failure of any engine. A technique for safely controlling the helicopter shall be established for all stages of flight and helicopter configurations for which performance is scheduled.

2.3.1.1 *Controllability on the ground (or water)*. The helicopter shall be controllable on the ground (or on the water) during taxiing, take-off and landing under the anticipated operating conditions.

2.3.1.2 *Controllability during take-off*. The helicopter shall be controllable in the event of sudden failure of the critical engine at any point in the take-off, when the helicopter is handled in the manner associated with the scheduling of the take-off data.

### 2.3.2 Trim

The helicopter shall have such trim and handling capabilities as to ensure that the demands made on the pilot's attention and ability to maintain a desired flight condition are not excessive when account is taken of the stage of flight at which these demands occur and their duration. In the event of a malfunction of the systems associated with the flight controls, there shall not be any significant deterioration of the handling characteristics.

### 2.3.3 Stability

The helicopter shall have such stability in relation to its other flight characteristics, performance, structural strength and most probable operating conditions (e.g. helicopter configurations and speed ranges) as to ensure that demands made on the pilot's powers of concentration are not excessive when the stage of the flight at which these demands occur and their duration are taken into account. The stability of the helicopter shall not, however, be such that excessive demands are made on the pilot's strength or that the safety of the helicopter is prejudiced by lack of manoeuvrability in emergency conditions.

### 2.3.4 Autorotation

2.3.4.1 *Rotor speed control*. The autorotation characteristics of the helicopter shall be such as to enable the pilot to control the rotor speed to within prescribed limits and to maintain full control of the helicopter.

2.3.4.2 *Behaviour following a power loss*. The behaviour of the helicopter following a power loss shall not be so extreme as to make difficult a prompt recovery of rotor speed without exceeding the airspeed or strength limitations of the helicopter.

2.3.4.3 *Autorotation airspeeds.* The autorotation airspeeds recommended for maximum range and minimum rate of descent shall be established.

2.3.5 Flutter and vibration

It shall be demonstrated by suitable tests that all parts of the helicopter are free from flutter and excessive vibration in all helicopter configurations under all speed conditions within the operating limitations of the helicopter (see 1.2.2). There shall be no vibration severe enough to interfere with control of the helicopter, to cause structural damage or to cause excessive fatigue to the flight crew.



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## **3 Structure**

### **3.1 General**

The Standards of this chapter apply to the helicopter structure consisting of all portions of the helicopter, the failure of which would seriously endanger the helicopter.

#### **3.1.1 Mass and mass distribution**

Unless otherwise stated, all structural Standards shall be complied with when the mass is varied over the applicable range and is distributed in the most adverse manner, within the operating limitations on the basis of which certification is sought.

#### **3.1.2 Limit loads**

Except as might be otherwise qualified, the external loads and the corresponding inertia loads, or resisting loads obtained for the various loading conditions prescribed in 3.4, 3.5 and 3.6 shall be considered as limit loads.

#### **3.1.3 Strength and deformation**

In the various loading conditions prescribed in 3.4, 3.5 and 3.6, no part of the helicopter structure shall sustain detrimental deformation at any load up to and including the limit load, and the helicopter structure shall be capable of supporting the ultimate load.

### **3.2 Airspeeds**

#### **3.2.1 Design airspeeds**

Design airspeeds shall be established for which the helicopter structure is designed to withstand the corresponding manoeuvring and gust loads in accordance with 3.4.

#### **3.2.2 Limiting airspeeds**

Limiting airspeeds, based on the corresponding design airspeeds with safety margins, where appropriate, in accordance with 1.2.1, shall be included in the helicopter flight manual as part of the operating limitations (see 9.2.2). When airspeed limitations are a function of mass, mass distribution, altitude, rotor speed, power or other factors, airspeed limitations based on the critical combination of these factors shall be established.

### **3.3 Main rotor(s) rotational speed limits**

A range of main rotor(s) speeds shall be established that:

- a) with power on, provides adequate margin to accommodate the variations in rotor speed occurring in any appropriate manoeuvre and is consistent with the kind of governor or synchronizer used; and

- b) with power off, allows each appropriate autorotative manoeuvre to be performed throughout the ranges of airspeed and mass for which certification is requested.

### **3.4 Flight loads**

The flight loading conditions of 3.4.1, 3.4.2 and 3.6 shall be considered for the range of mass and mass distributions prescribed in 3.1.1 and at airspeeds established in accordance with 3.2.1. Asymmetrical as well as symmetrical loading shall be taken into account. The air, inertia and other loads resulting from the specified loading conditions shall be distributed so as to approximate actual conditions closely or to represent them conservatively.

#### **3.4.1 Manoeuvring loads**

Manoeuvring loads shall be computed on the basis of manoeuvring load factors appropriate to the manoeuvres permitted by the operating limitations. They shall not be less than values that experience indicates will be adequate for the anticipated operating conditions.

#### **3.4.2 Gust loads**

Gust loads shall be computed for vertical and horizontal gust velocities that statistics or other evidence indicates will be adequate for the anticipated operating conditions.

### **3.5 Ground and water loads**

The structure shall be able to withstand all the loads due to the reactions of the ground or water surface, as applicable, that are likely to arise during start-up, ground and water taxiing, lift-off, touchdown and rotor braking.

#### **3.5.1 Landing conditions**

The landing conditions at the design take-off mass and at the design landing mass shall include such symmetrical and asymmetrical attitudes of the helicopter at ground or water contact, such velocities of descent, and such other factors affecting the loads imposed upon the structure as might be present in the anticipated operating conditions.

### **3.6 Miscellaneous loads**

In addition to or in conjunction with the manoeuvring and gust loads and with the ground and water loads, consideration shall be given to all other loads (flight control loads, cabin pressures, effects of engine operation, loads due to changes of configuration, loads due to external mass, etc.) that are likely to occur in the anticipated operating conditions.

### **3.7 Flutter, divergence and vibration**

Each part of the helicopter structure shall be free from excessive vibration or oscillation (ground resonance, flutter, etc.) under each appropriate speed and power condition.

### **3.8 Fatigue strength**

The strength and fabrication of the helicopter shall be such as to ensure that the probability of disastrous fatigue failure of the helicopter's structure under repeated loads and vibratory loads in the anticipated operating conditions is extremely remote.



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## **4 Design And Construction**

### **4.1 General**

Details of design and construction shall be such as to give reasonable assurance that all helicopter parts will function effectively and reliably in the anticipated operating conditions. They shall be based upon practices that experience has proven to be satisfactory or that are substantiated by special tests or by other appropriate investigations or both. They shall also consider human factors principles.

#### **4.1.1 Substantiating tests**

The functioning of all moving parts essential to the safe operation of the helicopter shall be demonstrated by suitable tests in order to ensure that they will function correctly under all operating conditions for such parts.

#### **4.1.2 Materials**

All materials used in parts of the helicopter essential for its safe operation shall conform to approved specifications. The approved specifications shall be such that materials accepted as complying with the specifications will have the essential properties assumed in the design.

#### **4.1.3 Manufacturing methods**

The methods of manufacturing and assembly shall be such as to produce a consistently sound structure which shall be reliable with respect to maintenance of strength in service.

#### **4.1.4 Protection**

The structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes, which could pass unnoticed, taking into account the maintenance the helicopter will receive.

#### **4.1.5 Inspection provisions**

Adequate provision shall be made to permit any necessary examination, replacement or reconditioning of parts of the helicopter that require such attention, either periodically or after unusually severe operations.

#### **4.1.6 Systems design features**

Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following:

- a) Controls and control systems. The design of the controls and control systems shall be such as to minimise the possibility of jamming, inadvertent operation and unintentional engagement of control surface locking devices.
  - 1) Each control and control system shall operate with the ease, smoothness and effectiveness appropriate to its function.

- 2) Each element of each flight control system shall be designed to minimise the probability of any incorrect assembly that could result in the malfunction of the system.
- b) Crew environment. The design of the flight crew compartment shall be such as to minimise the possibility of incorrect or restricted operation of the controls by the crew, due to fatigue, confusion or interference. Consideration shall be given at least to the following: layout and identification of controls and instruments, rapid identification of emergency situations, sense of controls, ventilation, heating and noise.
  - c) Pilot vision. The arrangement of the pilot compartment shall be such as to afford a sufficiently extensive, clear and undistorted field of vision for the safe operation of the helicopter, and to prevent glare and reflections that would interfere with the pilot's vision. The design features of the pilot windshield shall permit, under precipitation conditions, sufficient vision for the normal conduct of flight and for the execution of approaches and landings.
  - d) Provision for emergencies. Means shall be provided which shall either automatically prevent, or enable the flight crew to deal with, emergencies resulting from foreseeable failures of equipment and systems, the failure of which would endanger the helicopter. Reasonable provisions shall be made for continuation of essential services following engine or system failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this CAD and in CAD 6, Part III.
  - e) Fire precautions. The design of the helicopter and the materials used in its manufacture, including cabin interior furnishing materials replaced during major refurbishing, shall be such as to minimise the possibility of in-flight and ground fires and also to minimise the production of smoke and toxic gases in the event of a fire. Means shall be provided to contain or to detect and extinguish, wherever possible, all accessible fires as might occur in such a way that no additional danger to the helicopter is caused.
  - f) Incapacitation of occupants. Design precautions shall be taken to protect against possible instances of cabin depressurisation and against the presence of smoke or other toxic gases that could incapacitate the occupants of the helicopter.

#### 4.1.7 Emergency landing provisions

Provisions shall be made in the design of the helicopter to protect the occupants from fire and effects of deceleration in the event of an emergency landing. Facilities shall be provided for the rapid evacuation of the helicopter in conditions likely to occur following an emergency landing. Such facilities shall be related to the passenger and crew capacity of the helicopter. On helicopters certificated for ditching conditions, provisions shall also be made in the design to give maximum practicable assurance that safe evacuation from the helicopter of passengers and crew can be executed in case of ditching.

#### 4.1.8 Ground handling

Adequate provisions shall be made in the design to minimise the risk that ground handling operations (e.g. towing, jacking) may cause damage, which could pass unnoticed, to the parts of the helicopter essential for its safe operation. The protection that any limitations and instructions for such operations might provide may be taken into account.



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## 5 Engines

### 5.1 Scope

The Standards of this chapter shall apply to engines of all types that are used on the helicopter as primary propulsion units.

### 5.2 Design, construction and functioning

The engine complete with accessories shall be designed and constructed so as to function reliably within its operating limitations under the anticipated operating conditions when properly installed in the helicopter in accordance with Chapter 6 and with the suitable rotor and power transmission installed.

### 5.3 Declared ratings, conditions and limitations

The power ratings and the conditions of the atmosphere upon which they are based and all operating conditions and limitations which are intended to govern the operation of the engine shall be declared.

### 5.4 Tests

5.4.1 An engine of the type shall complete satisfactorily such tests as are necessary to verify the validity of the declared ratings, conditions and limitations and to ensure that it will operate satisfactorily and reliably. The tests shall include at least the following:

- a) *Power calibration.* Tests shall be conducted to establish the power characteristics of the engine when new and also after the tests in b) and c). There shall be no excessive decrease in power at the conclusion of all the tests specified.
- b) *Operation.* Tests shall be conducted to ensure that starting, idling, acceleration, vibration, overspeeding and other characteristics are satisfactory and to demonstrate adequate margins of freedom from detonation, surge or other detrimental conditions as may be appropriate to the particular type engine.
- c) *Endurance.* Tests of sufficient duration shall be conducted at such powers, engine and rotor speeds and other operating conditions as are necessary to demonstrate reliability and durability of the engine. They shall also include operation under conditions in excess of the declared limits to the extent that such limitations might be exceeded in actual service.



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## 6 Rotor And Power Transmission Systems And Powerplant Installation

### 6.1 General

The powerplant installation, including rotor and power transmission systems, shall comply with the Standards of Chapter 4 and with the Standards of this chapter.

### 6.2 Design, construction and functioning

The rotor and power transmission systems assembly complete with accessories shall be designed and constructed so as to function reliably within its operating limitations under the anticipated operating conditions when properly fitted to the engine and installed in the helicopter in accordance with this chapter.

### 6.3 Declared ratings, conditions and limitations

The power ratings and all operating conditions and limitations which are intended to govern the operation of the rotor and power transmission systems shall be declared.

#### 6.3.1 Maximum and minimum rotor rotational speed limitations

Maximum and minimum speeds for the rotors in both power-on and power-off conditions shall be established. Any operating conditions (e.g. airspeed) that affect such maxima or minima shall be declared.

#### 6.3.2 Rotor underspeed and overspeed warnings

When the helicopter is made to approach a rotor rotational speed limit, with or without engines inoperative, clear and distinctive warnings shall be apparent to the pilot. The warnings and initial characteristics of the condition shall be such as to enable the pilot to arrest the development of the condition after the warning begins and to recover the rotor rotational speed to within prescribed normal limits and to maintain full control of the helicopter.

### 6.4 Tests

Rotor and power transmission systems shall complete satisfactorily such tests as are necessary to ensure that they will operate satisfactorily and reliably within the declared ratings, conditions and limitations. The tests shall include at least the following:

- a) *Operation*. Tests shall be conducted to ensure that strength, vibration and overspeeding characteristics are satisfactory and to demonstrate proper and reliable functioning of pitch changing and control mechanisms and free wheel mechanisms.
- b) *Endurance*. Tests of sufficient duration shall be conducted at such powers, engine and rotor speeds and other operating conditions as are necessary to demonstrate reliability and durability of the rotor and power transmission systems.

## **6.5 Compliance with engine and rotor and power transmission systems limitations**

The powerplant installation shall be so designed that the engines and rotor and power transmission systems are capable of being used in the anticipated operating conditions. In conditions established in the helicopter flight manual, the helicopter shall be capable of being operated without exceeding the limitations established for the engines and rotor and power transmission systems in accordance with Chapter 5 and this chapter.

## **6.6 Control of engine rotation**

In those installations where continued rotation of a failed engine would increase the hazard of fire or of a serious structural failure, means shall be provided for the crew to stop the rotation of the engine in flight or to reduce it to a safe level.

## **6.7 Engine restarting**

Means shall be provided for restarting an engine in flight at altitudes up to a declared maximum altitude.

## **6.8 Arrangement and functioning**

### **6.8.1 Independence of engines**

For performance Classes 1 and 2 helicopters, the powerplant shall be arranged and installed so that each engine together with its associated systems is capable of being controlled and operated independently from the others and so that there is at least one arrangement of the powerplant and systems in which any failure, unless the probability of its occurrence is extremely remote, cannot result in a loss of more power than that resulting from complete failure of the critical engine.

### **6.8.2 Rotor and power transmission systems vibration**

The vibration stresses for the rotor and power transmission systems shall be determined and shall not exceed values that have been found safe for operation within the operating limitations established for the helicopter.

### **6.8.3 Cooling**

The cooling system shall be capable of maintaining powerplant and power transmission systems temperatures within the established limits (see 6.5) at ambient air temperatures approved for operation of the helicopter. The maximum and minimum air temperatures for which the powerplant and power transmission systems have been established as being suitable shall be scheduled in the helicopter flight manual.

### **6.8.4 Associated systems**

The fuel, oil, air induction and other systems associated with each engine, each power transmission unit and each rotor shall be capable of supplying the appropriate unit in accordance with its established requirements, under all conditions affecting the functioning of the systems (e.g. engine power setting, helicopter attitudes and accelerations, atmospheric conditions, fluid temperatures) within the anticipated operating conditions.



#### 6.8.5 Fire protection

For designated fire zones where the potential fire hazards are particularly serious because of the proximity of ignition sources to combustible materials, the following shall apply in addition to the general Standard of 4.1.6 e):

- a) *Isolation*. Such zones shall be isolated by fire-resisting material from other zones of the helicopter where the presence of fire would jeopardise continued flight, taking into account the probable points of origin and paths of propagation of fire.
- b) *Flammable fluids*. Flammable fluid system components located in such zones shall be capable of containing the fluid when exposed to fire conditions. Means shall be provided for the crew to shut off the flow of hazardous quantities of flammable fluids into such zones if a fire occurs.
- c) *Fire detection*. There shall be provided a sufficient number of fire detectors so located as to ensure rapid detection of any fire that might occur in such zones.
- d) *Fire extinguishment*. Such zones shall be provided with a fire extinguisher system capable of extinguishing any fire likely to occur therein, unless the degree of isolation, quantity of combustibles, fire resistance of the structure and other factors are such that any fire likely to occur in the zone would not jeopardise the safety of the helicopter.



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## **7 Instruments And Equipment**

### **7.1 Required instruments and equipment**

The helicopter shall be provided with approved instruments and equipment necessary for the safe operation of the helicopter in the anticipated operating conditions. These shall include the instruments and equipment necessary to enable the crew to operate the helicopter within its operating limitations. Instruments and equipment design shall observe human factors principles.

### **7.2 Installation**

Instrument and equipment installations shall comply with the Standards of Chapter 4.

### **7.3 Safety and survival equipment**

Prescribed safety and survival equipment that the crew or passengers are expected to use or operate at the time of an emergency shall be reliable, readily accessible and easily identified, and its method of operation shall be plainly marked.

### **7.4 Navigation lights and anti-collision lights**

7.4.1 The lights required by CAD 2 — *Rules of the Air* to be displayed by helicopters in flight or operating on the movement area of an aerodrome or a heliport shall have intensities, colours, fields of coverage and other characteristics such that they furnish the pilot of another aircraft or personnel on the ground with as much time as possible for interpretation and for subsequent manoeuvre necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.

7.4.2 Lights shall be installed in helicopters so as to minimise the possibility that they will:

- a) adversely affect the satisfactory performance of the flight crews' duties; or
- b) subject an outside observer to harmful dazzle.



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## **8 Electrical Systems**

The electrical system shall be so designed and installed as to ensure that it will perform its intended function under any foreseeable operating conditions.



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## **9 Operating Limitations And Information**

### **9.1 General**

The operating limitations within which compliance with the Standards of this CAD is determined, together with any other information necessary to the safe operation of the helicopter, shall be made available by means of a helicopter flight manual, markings and placards, and such other means as may effectively accomplish the purpose. The limitations and information shall include at least those prescribed in 9.2, 9.3 and 9.4.

### **9.2 Operating limitations**

Limitations which there is a risk of exceeding in flight and which are defined quantitatively shall be expressed in suitable units and corrected if necessary for errors in measurements so that the flight crew can, by reference to the instruments available to them, readily determine when the limitations are reached.

#### **9.2.1 Loading limitations**

The loading limitations shall include all limiting masses, centre of gravity positions, mass distributions and floor loadings (see 1.2.2).

#### **9.2.2 Airspeed limitations**

The airspeed limitations shall include all speeds (see 3.2) that are limiting from the standpoint of structural integrity or flying qualities of the helicopter, or from other considerations. These speeds shall be identified with respect to the appropriate helicopter configurations and other pertinent factors.

#### **9.2.3 Powerplant and power transmission limitations**

The powerplant limitations shall include all those established for the various powerplant and transmission components as installed in the helicopter (see 6.5 and 6.6).

#### **9.2.4 Rotor limitations**

Limitations on rotor speeds shall include maximum and minimum rotor speeds for power-off (autorotation) and power-on conditions.

#### **9.2.5 Limitations on equipment and systems**

The limitations on equipment and systems shall include all those established for the various equipment and systems as installed in the helicopter.

#### **9.2.6 Miscellaneous limitations**

Miscellaneous limitations shall include any necessary limitations with respect to conditions found to be prejudicial to the safety of the helicopter (see 1.2.1).

#### **9.2.7 Flight crew limitations**

The flight crew limitations shall include the minimum number of flight crew personnel necessary to operate the helicopter, having regard, among other

things, to the accessibility to the appropriate crew members of all necessary controls and instruments and to the execution of the established emergency procedures.

### **9.3 Operating information and procedures**

#### **9.3.1 Types of eligible operations**

There shall be listed the particular types of operations, as may be defined in CAD 6, Part III, or be generally recognised, for which the helicopter has been shown to be eligible by virtue of compliance with the appropriate airworthiness requirements.

#### **9.3.2 Loading information**

The loading information shall include the empty mass of the helicopter, together with a definition of the condition of the helicopter at the time of weighing, the corresponding centre of gravity position, and the reference points and datum lines to which the centre of gravity limits are related.

#### **9.3.3 Operating procedures**

A description shall be given of normal and emergency operating procedures which are peculiar to the particular helicopter and necessary for its safe operation. These shall include procedures to be followed in the event of failure of one or more engine(s)

#### **9.3.4 Handling information**

Sufficient information shall be given on any significant or unusual features of the helicopter characteristics.

### **9.4 Performance information**

The performance of the helicopter shall be scheduled in accordance with 2.2. There shall be included information regarding the various helicopter configurations and powers involved and the relevant speeds, together with information that would assist the flight crew in attaining the performance as scheduled.

### **9.5 Helicopter flight manual**

A flight manual shall be made available. It shall identify clearly the specific helicopter or series of helicopters to which it is related. The flight manual shall include at least the limitations, information and procedures specified in this chapter.

### **9.6 Markings and placards**

9.6.1 Markings and placards on instruments, equipment, controls, etc., shall include such limitations or information as necessary for the direct attention of the flight crew during flight.

9.6.2 Markings and placards or instructions shall be provided to give any information that is essential to the ground crew in order to preclude the possibility of mistakes in





ground servicing (e.g. towing, refuelling) that could pass unnoticed and that could jeopardise the safety of the helicopter in subsequent flights.



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## **Part IVB. Helicopters For Which Application For Certification Was Submitted On Or After 13 December 2007**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part are applicable in respect of all helicopters designated in 1.1.2 for which an application for the issue of a Type Certificate was submitted to CAAM on or after 13 December 2007.
- 1.1.2 Except for those Standards which specify a different applicability, the Standards of this part shall apply to helicopters greater than 750 kg maximum certificated take-off mass intended for the carriage of passengers or cargo or mail in international air navigation.
- 1.1.3 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code referred to in 1.2.1 of Part II for the helicopters designated in 1.1.2 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.
- 1.1.4 Unless otherwise stated, the Standards apply to the complete helicopter including its powerplant, rotors, systems and equipment.

#### **1.2 Operating limitations**

- 1.2.1 Limiting conditions shall be established for the helicopter, its powerplant, rotors, systems and equipment (see 7.2). Compliance with the Standards of this part shall be established assuming that the helicopter is operated within the limitations specified. The safety implications of exceeding these operating limits shall be considered.
- 1.2.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the helicopter, e.g. mass, centre of gravity location, load distribution, speeds, ambient air temperature and altitude, shall be established within which compliance with all the pertinent Standards of this part is shown.

#### **1.3 Unsafe features and characteristics**

Under all anticipated operating conditions, the helicopter shall not possess any feature or characteristic that renders it unsafe.

#### **1.4 Proof of compliance**

The means by which compliance with the appropriate airworthiness requirements is demonstrated shall ensure that in each case the accuracy achieved will be such as to provide reasonable assurance that the helicopter, its components and equipment comply with the requirements and are reliable and function correctly under the anticipated operating conditions.



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## **2 Flight**

### **2.1 General**

- 2.1.1 Compliance with the Standards prescribed in this chapter shall be established by flight or other tests conducted upon a helicopter or helicopters of the type for which a Type Certificate is sought, or by calculations (or other methods) based on such tests, provided that the results obtained by calculations (or other methods) are equal in accuracy to, or conservatively represent, the results of direct testing.
- 2.1.2 Compliance with each Standard shall be established for all applicable combinations of helicopter mass and centre of gravity position, within the range of loading conditions for which certification is sought.
- 2.1.3 Where necessary, appropriate helicopter configurations shall be established for the determination of performance in the various stages of flight and for the investigation of the helicopter's flying qualities.

### **2.2 Performance**

- 2.2.1 Sufficient data on the performance of the helicopter shall be determined and scheduled in the flight manual to provide operators with the necessary information for the purpose of determining the total mass of the helicopter on the basis of the values, peculiar to the proposed flight, of the relevant operational parameters, in order that the flight may be made with reasonable assurance that a safe minimum performance for that flight will be achieved.
- 2.2.2 Achieving the performance scheduled for the helicopter shall take into consideration human performance and in particular shall not require exceptional skill or alertness on the part of the flight crew.
- 2.2.3 The scheduled performance of the helicopter shall be consistent with compliance with 1.2.1 and with the operation in logical combinations of those of the helicopter's systems and equipment, the operation of which may affect performance.
- 2.2.4 Minimum performance
- At the maximum masses scheduled (see 2.2.7) for take-off and for landing as functions of the take-off and landing site pressure-altitude and temperature in still air conditions, and, for water operations, in specified conditions of smooth water, the helicopter shall be capable of accomplishing the minimum performances specified in 2.2.5 and 2.2.6, respectively, not considering obstacles or final approach and take-off area length.
- 2.2.5 Take-off
- a) The performance at all stages of take-off and climb shall be sufficient to ensure that under conditions of operation departing slightly from the

idealised conditions for which data is scheduled (see 2.2.7), the departure from the scheduled values is not disproportionate.

- b) For Category A helicopters, in the event of critical engine failure at or after the take-off decision point, the helicopter shall be capable of continuing safe flight, the remaining engine(s) being operated within the approved limitations.

#### 2.2.6 Landing

- a) It shall be possible to make a safe landing on a prepared landing surface after complete power failure occurring during normal cruise.
- b) For Category A helicopters, starting from the landing configuration in the event of critical engine failure at or before the landing decision point, the helicopter shall be capable of continuing safe flight, the remaining engine(s) being operated within the approved limitations.

#### 2.2.7 Scheduling of performance

Performance data shall be determined and scheduled in the flight manual as follows for the ranges of mass, altitude, temperature and other operational variables for which the helicopter is to be certificated, and additionally for amphibians, water surface conditions and strength of current shall be included.

- a) *Hover performance.* The hover performance shall be determined for both in-ground effect and out-of-ground effect with all engines operating.
- b) *Climb.* The steady rate of climb with the engine(s) operating at or within approved limits shall be established.
- c) *Height-velocity envelope.* If there are any combinations of height and forward velocity (including hover) under which a safe landing cannot be made after failure of the critical engine and with the remaining engine(s) (if applicable) operating within approved limits, a height-velocity envelope shall be established.
- d) *Take-off distance* — all engines operating. Where required by the operating rules, the take-off distance — all engines operating shall be the horizontal distance required from the start of the take-off to the point where a selected speed up to the best rate of climb speed ( $V_y$ ) and selected height above the take-off surface are achieved, all engines operating at approved take-off power required.

In addition, for Category A helicopters:

- e) *Minimum performance.* The minimum climb performance shall be established for both take-off and landing.
- f) *Take-off decision point.* The take-off decision point shall be the point in the take-off phase used in determining take-off performance and from which

either a rejected take-off may be made or a take-off safely continued, with the critical engine inoperative.

- g) *Take-off distance required.* The take-off distance required shall be the horizontal distance required from the start of the take-off to the point at which the take-off safety speed (VTOSS), a selected height above the take-off surface and a positive climb gradient are achieved, following failure of the critical engine at take-off decision point, the remaining engine(s) operating within approved operating limits. If procedures involve rearward flight, the back-up distance shall be included.
- h) *Rejected take-off distance required.* The rejected take-off distance required shall be the horizontal distance required from the start of the take-off to the point where the helicopter comes to a complete stop following engine failure and rejection of the take-off at the take-off decision point.
- i) *Take-off path — climb gradients.* The take-off path — climb gradient shall be the steady gradient(s) of climb for the appropriate configuration(s) with the critical engine inoperative from the end of the take-off distance required to a defined point above the take-off surface.
- j) *Engine inoperative climb.* The engine inoperative climb shall be the steady rate of climb/descent with the critical engine inoperative and the operating engine(s) not exceeding the power for which they are certificated.
- k) *Landing decision point.* The landing decision point shall be the latest point in the approach phase from which either a landing may be made or a rejected landing (go-around) safely initiated, with the critical engine inoperative.
- l) *Landing distance required.* The landing distance required shall be the horizontal distance required to land and come to a complete stop from a point on the approach flight path at a selected height above the landing surface with the critical engine inoperative.

## 2.3 Flying qualities

2.3.1 The helicopter shall comply with the Standards of 2.3 at all altitudes up to the maximum anticipated altitude relevant to the particular requirement in all temperature conditions relevant to the altitude in question and for which the helicopter is approved.

### 2.3.2 Controllability

2.3.2.1 The helicopter shall be controllable and manoeuvrable under all anticipated operating conditions, and it shall be possible to make smooth transitions from one flight condition to another (e.g. turns, sideslips, changes of engine power, changes of helicopter configurations) without requiring exceptional skill, alertness or strength on the part of the pilot even in the event of failure of any engine. A technique for safely

controlling the helicopter shall be established for all stages of flight and helicopter configurations for which performance is scheduled.

2.3.2.2 *Controllability on the ground (or water)*. The helicopter shall be controllable on the ground (or on the water) during taxiing, take-off and landing under the anticipated operating conditions.

2.3.2.3 *Controllability during take-off*. The helicopter shall be controllable in the event of sudden failure of the critical engine at any point in the take-off, when the helicopter is handled in the manner associated with the scheduling of the take-off data.

### 2.3.3 Trim

The helicopter shall have such trim and handling capabilities as to ensure that the demands made on the pilot's attention and ability to maintain a desired flight condition are not excessive when account is taken of the stage of flight at which these demands occur and their duration. In the event of a malfunction of the systems associated with the flight controls, there shall not be any significant deterioration of the handling characteristics.

## 2.4 Stability and control

### 2.4.1 Stability

The helicopter shall have such stability in relation to its other flight characteristics, performance, structural strength and most probable operating conditions (e.g. helicopter configurations and speed ranges) as to ensure that demands made on the pilot's powers of concentration are not excessive when the stage of the flight at which these demands occur and their duration are taken into account. The stability of the helicopter shall not, however, be such that excessive demands are made on the pilot's strength or that the safety of the helicopter is prejudiced by lack of manoeuvrability in emergency conditions.

### 2.4.2 Autorotation

2.4.2.1 *Rotor speed control*. The autorotation characteristics of the helicopter shall be such as to enable the pilot to control the rotor speed to within prescribed limits and to maintain full control of the helicopter.

2.4.2.2 Behaviour following a power loss. The behaviour of the helicopter following a power loss shall not be so extreme as to make difficult a prompt recovery of rotor speed without exceeding the airspeed or strength limitations of the helicopter.

2.4.2.3 Autorotation airspeeds. For Category A helicopters, airspeeds for autorotative landings shall be established. For other helicopters, the autorotation airspeeds recommended for maximum range and minimum rate of descent shall be established.

### 2.4.3 Vibration

There shall be no vibration or buffeting severe enough to interfere with the control of the helicopter.





#### 2.4.4 Ground resonance

The helicopter shall have no dangerous tendency to oscillate on the ground with the rotor turning.



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## **3 Structure**

### **3.1 General**

3.1.1 For helicopters for which application for certification was submitted before 24 February 2013, the helicopter structure shall be designed, manufactured and provided with instructions for its maintenance with the objective of avoiding catastrophic failure throughout its operational life.

3.1.2 For helicopters for which application for certification was submitted on or after 24 February 2013, the helicopter structure shall be designed, manufactured and provided with instructions for its maintenance and repair with the objective of avoiding hazardous and catastrophic failure throughout its operational life.

### **3.2 Mass and mass distribution**

Unless otherwise stated, all structural Standards shall be complied with when the mass is varied over the applicable range and is distributed in the most adverse manner, within the operating limitations on the basis of which certification is sought.

### **3.3 Limit loads**

Except as might be otherwise qualified, the external loads and the corresponding inertia loads, or resisting loads obtained for the various loading conditions prescribed in 3.7, 3.8 and 3.9 shall be considered as limit loads.

### **3.4 Strength and deformation**

In the various loading conditions prescribed in 3.7, 3.8 and 3.9, no part of the helicopter structure shall sustain detrimental deformation at any load up to and including the limit load, and the helicopter structure shall be capable of supporting the ultimate load.

### **3.5 Airspeeds**

#### **3.5.1 Design airspeeds**

Design airspeeds shall be established for which the helicopter structure is designed to withstand the corresponding manoeuvring and gust loads in accordance with 3.7.

#### **3.5.2 Limiting airspeeds**

Limiting airspeeds, based on the corresponding design airspeeds with safety margins, where appropriate, in accordance with 1.2.1, shall be included in the flight manual as part of the operating limitations (see 7.2.3). When airspeed limitations are a function of mass, mass distribution, altitude, rotor speed, power or other factors, airspeed limitations based on the critical combination of these factors shall be established.

### **3.6 Main rotor(s) rotational speed limits**

A range of main rotor(s) speeds shall be established that:

- a) with power on, provides adequate margin to accommodate the variations in rotor speed occurring in any appropriate manoeuvre, and is consistent with the kind of governor or synchronizer used; and
- b) with power off, allows each appropriate autorotative manoeuvre to be performed throughout the ranges of airspeed and mass for which certification is requested.

### **3.7 Loads**

3.7.1 The loading conditions of 3.7, 3.8 and 3.9 shall consider the range of mass and mass distributions prescribed in 3.2, the main rotor rpm ranges established in 3.6, and airspeeds established in accordance with 3.5.1. Asymmetrical as well as symmetrical loading shall be taken into account. The air, inertia and other loads resulting from the specific loading conditions shall be distributed so as to approximate actual conditions closely or to represent them conservatively in consideration of all anticipated operating conditions.

#### **3.7.2 Manoeuvring loads**

Manoeuvring loads shall be computed on the basis of manoeuvring load factors appropriate to the manoeuvres permitted by the operating limitations. They shall not be less than values that experience indicates will be adequate for the anticipated operating conditions.

#### **3.7.3 Gust loads**

Gust loads shall be computed for vertical and horizontal gust velocities that statistics or other evidence indicates will be adequate for the anticipated operating conditions.

### **3.8 Ground and water loads**

3.8.1 The structure shall be able to withstand all the loads due to the reactions of the ground or water surface, as applicable, that arise during start-up, ground and water taxiing, lift-off, touchdown and rotor braking.

#### **3.8.2 Landing conditions**

The landing conditions at the maximum certificated take-off mass and at the maximum certificated landing mass shall include such symmetrical and asymmetrical attitudes of the helicopter at ground or water contact, such velocities of descent, and such other factors affecting the loads imposed upon the structure as might be present in the anticipated operating conditions.

### **3.9 Miscellaneous loads**

In addition to or in conjunction with the manoeuvring and gust loads and with the ground and water loads, consideration shall be given to all other loads (flight

control loads, pilot forces, engine torque, loads due to changes of configuration, external loads, etc.) that are likely to occur in the anticipated operating conditions.

### **3.10 Fatigue strength**

The strength and fabrication technique of the helicopter structure shall be such as to avoid catastrophic fatigue failure under repeated loads and vibratory loads in the anticipated operating conditions. Environmental degradation, accidental damage and other likely failures shall be considered.

### **3.11 Special factors**

Design features (e.g. castings, bearings or fittings), the strength of which are subject to variability in manufacturing processes, deterioration in service or any other cause, shall be accounted for by a suitable factor.



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## **4 Design And Construction**

### **4.1 General**

4.1.1 Details of design and construction shall be such as to give reasonable assurance that all helicopter parts will function effectively and reliably in the anticipated operating conditions. They shall be based upon practices that experience has proven to be satisfactory or that are substantiated by special tests or by other appropriate investigations or both. They shall also consider human factors principles.

#### **4.1.2 Substantiation of moving parts**

The functioning of all moving parts essential to the safe operation of the helicopter shall be demonstrated in order to ensure that they will function correctly under all operating conditions for such parts.

#### **4.1.3 Materials**

All materials used in parts of the helicopter essential for its safe operation shall conform to approved specifications. The approved specifications shall be such that materials accepted as complying with the specifications will have the essential properties assumed in the design.

#### **4.1.4 Manufacturing methods**

The methods of manufacturing and assembly shall be such as to produce consistently sound structure which shall be reliable with respect to maintenance of strength in service.

#### **4.1.5 Protection**

The structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes, which could pass unnoticed, taking into account the maintenance the helicopter will receive.

#### **4.1.6 Inspection provisions**

Adequate provision shall be made to permit any necessary examination, replacement or reconditioning of parts of the helicopter that require such attention, either periodically or after unusually severe operations.

#### **4.1.7 Critical parts**

All critical parts used in the helicopter shall be identified and procedures shall be established to ensure that the required level of integrity for critical parts is controlled during design, manufacture and throughout the service life of those parts.

### **4.2 Systems design features**

Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following:

- a) *Controls and control systems.* The design of the controls and control systems shall be such as to minimise the possibility of jamming, inadvertent operation and unintentional engagement of control locking devices.
  - 1) Each control and control system shall operate with the ease, smoothness and precision appropriate to its function.
  - 2) Each element of each flight control system shall be designed, or distinctively and permanently marked, to minimise the probability of any incorrect assembly that could result in the malfunction of the system.
- b) *Crew environment.* The design of the flight crew compartment shall allow operation of the controls by the crew without unreasonable concentration or fatigue.
- c) *Crew vision.* The arrangement of the flight crew compartment shall be such as to afford a sufficiently extensive, clear and undistorted field of vision for the safe operation of the helicopter under all foreseeable operating conditions for which certification is requested.
- d) *Provision for emergencies.* Means shall be provided which shall either automatically prevent, or enable the flight crew to deal with, emergencies resulting from foreseeable failures of equipment and systems which would endanger the helicopter.
- e) *Fire precautions.* The helicopter shall have adequate fire protection.
- f) *Incapacitation of crew.* Design precautions shall be taken to protect against the presence of toxic gases which under normal operating conditions could incapacitate the flight crew.

### **4.3 Flutter**

Each aerodynamic surface of the helicopter shall be free from flutter under each appropriate speed and power condition.

### **4.4 Occupant accommodation features**

#### **4.4.1 Seating and restraints**

Adequate seating and restraints shall be provided for the occupants, taking account of the likely flight and emergency landing loads to be encountered. Attention shall be paid to minimizing injury to occupants due to contact with surrounding structures during the operation of the helicopter.

#### **4.4.2 Cabin environment**

Ventilation systems shall be designed to provide the cabin with an adequate environment during the anticipated flight and ground operating conditions.

### **4.5 Electrical bonding and protection against lightning and static electricity**



- 4.5.1 Electrical bonding and protection against lightning and static electricity shall be such as to:
- a) protect the helicopter, its systems, its occupants and those who come in contact with the helicopter on the ground or water from the dangerous effects of lightning discharge and electrical shock; and
  - b) prevent dangerous accumulation of electrostatic charge.

4.5.2 The helicopter shall also be protected against catastrophic effects of lightning. Due account shall be taken of the material used in the construction of the helicopter.

#### **4.6 Emergency landing provisions**

4.6.1 Provisions shall be made in the design of the helicopter to protect the occupants from fire and effects of deceleration in the event of an emergency landing.

4.6.2 For helicopters for which application for certification was submitted before 24 February 2013, facilities shall be provided for rapid evacuation of the helicopter in conditions likely to occur following an emergency landing, and such facilities shall be related to the passenger and crew capacity of the helicopter. On helicopters certificated for ditching conditions, provisions shall also be made in the design to give reasonable assurance that safe evacuation from the helicopter of passengers and crew can be executed in case of ditching.

4.6.3 For helicopters for which application for certification was submitted on or after 24 February 2013, facilities shall be provided for rapid evacuation of the helicopter in conditions likely to occur following an emergency landing. Such facilities shall be related to the passenger and crew capacity of the helicopter and shall be shown to be suitable for their intended purpose. On helicopters certificated for ditching conditions, provisions shall also be made in the design to give reasonable assurance that safe evacuation from the helicopter of passengers and crew can be executed in case of ditching.

#### **4.7 Ground handling**

Adequate provisions shall be made in the design to minimise the risk that normal ground handling operations (e.g. towing, jacking) may cause damage, which could pass unnoticed, to the parts of the helicopter essential for its safe operation. The protection that any limitations and instructions for such operations might provide may be taken into account.



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## 5 Rotors And Powerplant

### 5.1 Engines

The Standards of Part VI of this CAD shall apply to each engine that is used on the helicopter as a primary propulsion unit(s).

### 5.2 Rotors and powerplant installation

#### 5.2.1 General

The powerplant installation and rotors shall comply with the Standards of Chapter 4 and with the Standards of 5.2.

#### 5.2.2 Design, construction and functioning

- a) The rotors and rotor drive systems assembly complete with accessories shall be designed and constructed so as to function reliably within their operating limitations under the anticipated operating conditions when properly fitted to the engine and installed in the helicopter in accordance with this chapter.
- b) For helicopters of maximum certificated take-off mass greater than 3 175 kg or helicopters which are certificated to Category A Standard, an assessment shall be conducted for the rotors and rotor drive systems to ensure that they function safely throughout the full range of operating conditions. Where this assessment identifies a failure which could prevent continued safe flight or landing of the helicopter, means shall be prescribed to minimise the likelihood of that failure.

#### 5.2.3 Declared ratings, conditions and limitations

The power ratings and all operating conditions and limitations which are intended to govern the operation of the rotors and rotor drive systems shall be declared.

- a) *Maximum and minimum rotor rotational speed limitations.* Maximum and minimum speeds for the rotors in both power-on and power-off conditions shall be established. Any operating conditions (e.g. airspeed) that affect such maxima or minima shall be declared.
- b) *Rotor underspeed warnings for single engine helicopters, and for multi-engine helicopters not having an approved device for automatically increasing power when an engine fails.* When the helicopter approaches a rotor rotational speed limit, with or without engines inoperative, clear and distinctive warnings shall be apparent to the pilot. The warnings or initial characteristics of the condition shall be such as to enable the pilot to arrest the development of the condition after the warning begins and to recover the rotor rotational speed to within prescribed normal limits and to maintain full control of the helicopter.

#### 5.2.4 Tests

Rotors and rotor drive systems shall complete satisfactorily such tests as are necessary to ensure that they will operate satisfactorily and reliably within the declared ratings, conditions and limitations. The tests shall include at least the following:

- a) *Operation*. Tests shall be conducted to ensure that strength and vibration characteristics are satisfactory and to demonstrate proper and reliable functioning of pitch changing and control mechanisms and free wheel mechanisms. Overspeed characteristics shall be demonstrated to be satisfactory for helicopters of maximum certificated take-off mass greater than 3 175 kg; and
- b) *Endurance*. Tests of sufficient duration shall be conducted at such powers, engine and rotor speeds, and other operating conditions as are necessary to demonstrate reliability and durability of the rotors and rotor drive systems.

#### 5.2.5 Compliance with engine, rotor and rotor drive system limitations

The powerplant installation shall be so designed that the engines, rotors and rotor drive systems are capable of functioning reliably in the anticipated operating conditions. In conditions established in the flight manual, the helicopter shall be capable of being operated without exceeding the limitations established for the engines, rotors and rotor drive systems in accordance with this chapter and Part VI.

#### 5.2.6 Control of engine rotation

For helicopters of a maximum certificated take-off mass greater than 3 175 kg and for helicopters which are certificated to Category A Standard, where continued rotation of a failed engine would increase the hazard of fire or of a serious structural failure, means shall be provided for the crew to stop the rotation of the failed engine in flight or to reduce it to a safe level.

#### 5.2.7 Engine restarting

For helicopters of a maximum certificated take-off mass greater than 3 175 kg and for helicopters which are certificated to Category A Standard, means shall be provided for restarting an engine in flight at altitudes up to a declared maximum altitude.

#### 5.2.8 Arrangement and functioning

- 5.2.8.1 *Independence of engines*. For Category A helicopters for which application for certification was submitted before 24 February 2013, the powerplant shall be arranged and installed so that each engine together with its associated systems is capable of being controlled and operated independently from the others and so that there is at least one arrangement of the powerplant and systems in which any failure, unless the probability of its occurrence is extremely remote, cannot result in a loss of more power than that resulting from complete failure of the critical engine.

- 5.2.8.2 *Independence of engines and associated systems.* For Category A helicopters for which application for certification was submitted on or after 24 February 2013, the engines together with their associated systems shall be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or the failure of any system that can affect any engine, will not:
- a) prevent the continued safe operation of the remaining engine(s); or
  - b) require immediate action, other than normal pilot action with primary flight controls, by any crew member to maintain safe operation.
- 5.2.8.3 *Rotors and rotor drive systems vibration.* The vibration stresses for the rotors and rotor drive systems shall be determined and shall not exceed values that have been found safe for operation within the operating limitations established for the helicopter.
- 5.2.8.4 *Cooling.* The cooling system shall be capable of maintaining the temperature of powerplant components and fluids within the established limits (see 5.2.5) at all ambient temperatures approved for operation of the helicopter. The maximum and minimum ambient air temperatures for which the powerplant has been established as being suitable shall be scheduled in the flight manual.
- 5.2.8.5 *Associated systems.* The fuel, oil, air induction and other systems associated with the powerplant and the rotor(s), shall be capable of supplying the appropriate unit in accordance with its established requirements, under all conditions affecting the functioning of the systems (e.g. engine power setting, helicopter attitudes and accelerations, atmospheric conditions, fluid temperatures) within the anticipated operating conditions.
- 5.2.8.6 *Fire protection.* For regions of the powerplant where the potential fire hazards are particularly serious because of the proximity of ignition sources to combustible materials, the following shall apply in addition to the general Standard of 4.2 e).
- a) *Isolation.* Such regions shall be isolated by fire resistant material from other regions of the helicopter where the presence of fire would jeopardise continued flight and landing (helicopters of a maximum certificated take-off mass greater than 3 175 kg or Category A) or would jeopardise safe landing (other helicopters), taking into account the probable points of origin and paths of propagation of fire.
  - b) *Flammable fluids.* Flammable fluid system components located in such regions shall be fire resistant. Drainage of each region shall be provided to minimise hazards resulting from the failure of any component containing flammable fluids. Means shall be provided for the crew to shut off the flow of flammable fluids into such regions if a fire occurs. Where sources of flammable fluid exist in such regions, the whole of the related system

within the region, including supporting structure, shall be fireproof or shielded from the effects of fires.

- c) *Fire detection.* For turbine engine installations, a sufficient number of fire detectors shall be provided and located to ensure rapid detection of any fire that might occur in such regions, unless the fire can be readily observed in flight by the pilot in the cockpit.
- d) *Fire extinguishment.* For turbine engine helicopters of a maximum certificated take-off mass greater than 3 175 kg, such regions shall be provided with a fire extinguisher system capable of extinguishing any fire likely to occur therein, unless the degree of isolation, quantity of combustibles, fire resistance of the structure and other factors are such that any fire likely to occur in the region would not jeopardise the safety of the helicopter.

## **6 Systems And Equipment**

### **6.1 General**

6.1.1 The helicopter shall be provided with approved instruments, equipment and systems necessary for the safe operation of the helicopter in the anticipated operating conditions. These shall include the instruments and equipment necessary to enable the crew to operate the helicopter within its operating limitations. Instruments and equipment design shall consider human factors principles.

6.1.2 The design of the instruments, equipment and systems required by 6.1.1 and their installation shall be such that:

- a) for a Category A helicopter, an inverse relationship exists between the probability of a failure condition and the severity of its effect on the helicopter and its occupants, as determined by a system safety assessment process;
- b) they perform their intended function under all anticipated operating conditions; and
- c) electromagnetic interference between them is minimised.

6.1.3 Means shall be provided to warn the crew of unsafe system operating conditions and to enable them to take corrective action.

#### **6.1.4 Electrical power supply**

The design of the electrical power supply system shall be such as to enable it to supply power loads during normal operations and shall also be such that no single failure or malfunction could impair the ability of the system to supply essential loads for safe operation.

#### **6.1.5 Development assurance of complex electronic hardware and system software**

For helicopters for which application for certification was submitted on or after 24 February 2013, complex electronic hardware and system software shall be developed, verified and validated such as to ensure that the systems in which they are used perform their intended functions at a level of safety that complies with the requirements of this part, notably those of 6.1.2 a) and 6.1.2 b).

### **6.2 Installation**

Instrument and equipment installations shall comply with the Standards of Chapter 4.

### **6.3 Safety and survival equipment**

Prescribed safety and survival equipment that the crew or passengers are expected to use or operate at the time of an emergency shall be reliable, readily accessible and easily identified, and its method of operation shall be plainly marked.

### **6.4 Navigation lights and anti-collision lights**

- 6.4.1 The lights required by CAD 2 — *Rules of the Air* to be displayed by helicopters in flight or operating on the movement area of an aerodrome or a heliport shall have intensities, colours, fields of coverage and other characteristics such that they furnish the pilot of another aircraft or personnel on the ground with as much time as possible for interpretation and for subsequent manoeuvre necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.
- 6.4.2 Lights shall be installed in helicopters so as to minimise the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

### **6.5 Electromagnetic interference protection**

Aircraft electronic systems, particularly flight-critical and flight-essential systems, shall be protected as appropriate against electromagnetic interference from both internal and external sources.

### **6.6 Ice protection**

If certification for flight in icing conditions is required, the helicopter shall be shown to be able to operate safely in all icing conditions likely to be encountered in all anticipated operating environments.



## **7 Operating Limitations And Information**

### **7.1 General**

The operating limitations within which compliance with the Standards of this CAD is determined, together with any other information necessary to the safe operation of the helicopter, shall be made available by means of a flight manual, markings and placards, and such other means as may effectively accomplish the purpose.

### **7.2 Operating limitations**

7.2.1 Limitations which might be exceeded in flight and which are defined quantitatively shall be expressed in suitable units. These limitations shall be corrected if necessary for errors in measurements so that the flight crew can, by reference to the instruments available to them, readily determine when the limitations are reached.

#### **7.2.2 Loading limitations**

The loading limitations shall include all limiting masses, centre of gravity positions, mass distributions and floor loadings (see 1.2.2).

#### **7.2.3 Airspeed limitations**

The airspeed limitations shall include all speeds (see 3.5.2) that are limiting from the standpoint of structural integrity or flying qualities of the helicopter, or from other considerations. These speeds shall be identified with respect to the appropriate helicopter configurations and other pertinent factors.

#### **7.2.4 Powerplant limitations**

The powerplant limitations shall include all those established for the various powerplant components as installed in the helicopter (see 5.2.5 and 5.2.8.4).

#### **7.2.5 Rotor limitations**

Limitations on rotor speeds shall include maximum and minimum rotor speeds for power-off (autorotation) and power-on conditions.

#### **7.2.6 Limitations on equipment and systems**

The limitations on equipment and systems shall include all those established for the various equipment and systems as installed in the helicopter.

#### **7.2.7 Miscellaneous limitations**

Miscellaneous limitations shall include any necessary limitations with respect to conditions found to be prejudicial to the safety of the helicopter (see 1.2.1).

#### **7.2.8 Flight crew limitations**

The flight crew limitations shall include the minimum number of flight crew personnel necessary to operate the helicopter, having regard, among other things, to the accessibility to the appropriate crew members of all necessary

controls and instruments and to the execution of the established emergency procedures.

### **7.3 Operating information and procedures**

#### **7.3.1 Types of eligible operations**

The particular types of operations for which the helicopter has been shown to be eligible by virtue of compliance with the appropriate airworthiness requirements shall be listed.

#### **7.3.2 Loading information**

The loading information shall include the empty mass of the helicopter, together with a definition of the condition of the helicopter at the time of weighing, the corresponding centre of gravity position, and the reference points and datum lines to which the centre of gravity limits are related.

#### **7.3.3 Operating procedures**

A description shall be given of normal and emergency operating procedures which are peculiar to the particular helicopter and necessary for its safe operation. These shall include procedures to be followed in the event of failure of one or more engines.

#### **7.3.4 Handling information**

Sufficient information shall be given on any significant or unusual features of the helicopter characteristics.

### **7.4 Performance information**

The performance of the helicopter shall be scheduled in accordance with 2.2. There shall be included information regarding the various helicopter configurations and powers involved and the relevant speeds, together with information which will assist the flight crew in attaining the performance as scheduled.

### **7.5 Flight manual**

A flight manual shall be made available. It shall identify clearly the specific helicopter or series of helicopters to which it is related. The flight manual shall include at least the limitations, information and procedures specified in 7.2, 7.3, 7.4 and 7.6.1.

### **7.6 Markings and placards**

7.6.1 Markings and placards on instruments, equipment, controls, etc., shall include such limitations or information as necessary for the direct attention of the flight crew during flight.

7.6.2 Markings and placards or instructions shall be provided to give any information that is essential to the ground crew in order to preclude the possibility of mistakes in ground servicing (towing, refuelling, etc.) that could pass unnoticed and that could jeopardise the safety of the helicopter in subsequent flights.

## **7.7 Continuing airworthiness — maintenance information**

### **7.7.1 General**

Information for use in developing procedures for maintaining the helicopter in an airworthy condition shall be made available. The information shall include that described in 7.7.2, 7.7.3 and 7.7.4.

### **7.7.2 Maintenance information**

Maintenance information shall include a description of the helicopter and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

### **7.7.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and the recommended intervals at which these tasks are to be performed.

### **7.7.4 Mandatory maintenance requirements resulting from the type design approval**

Mandatory maintenance requirements that have been specified by the State of Design as part of the approval of the type design shall be identified as such and included in the maintenance information of 7.7.3.



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## **8 Crashworthiness And Cabin Safety**

### **8.1 General**

Crashworthiness shall be taken into account in the design of helicopters to improve the probability of occupant survival.

### **8.2 Design emergency landing loads**

Emergency landing (crash) loads shall be determined so that the interiors, furnishings, support structure and safety equipment can be designed to reasonably protect occupants under emergency landing conditions. Items to be considered shall include:

- a) dynamic effects;
- b) restraint criteria for items that could cause a hazard;
- c) deformation of the fuselage in the areas of emergency exits;
- d) fuel cell integrity and position; and
- e) integrity of electrical systems to avoid sources of ignition in the area of fuel components.

### **8.3 Cabin fire protection**

The cabin shall be so designed as to provide fire protection to the occupants in the event of airborne systems failures or a crash situation. Items to be considered shall include:

- a) flammability of cabin interior materials;
- b) fire resistance and, for helicopters of a maximum certificated take-off mass greater than 3 175 kg, the generation of smoke;
- c) provision of safety features to allow for safe evacuation; and
- d) fire suppression equipment.

### **8.4 Evacuation**

The helicopter shall be equipped with sufficient emergency exits to allow for cabin evacuation within an appropriate time period. Items to be considered, appropriate to the size and category of the helicopter, shall include:

- a) number of seats and seating configuration;
- b) number, location and size of exits;
- c) marking of exits and provision of instructions for use;
- d) likely blockages of exits;
- e) operation of exits; and
- f) positioning and weight of evacuation equipment at exits, e.g. slides and rafts.

## **8.5 Lighting and marking**

For helicopters with 10 or more passenger seats, emergency lighting shall be provided and shall have the following characteristics:

- a) independence from main electrical supply;
- b) for helicopters for which application for certification was submitted on or after 24 February 2013, automatic activation upon loss of normal power/impact;
- c) visual indication of emergency exits; and
- d) illumination both inside and outside the helicopter during evacuation.

## **9 Operating Environment And Human Factors**

### **9.1 General**

The helicopter shall be designed to allow safe operation within the performance limitations of its passengers and those who operate, maintain and service it.

### **9.2 Flight crew**

9.2.1 The helicopter shall be designed in such a way as to allow safe and efficient control by the flight crew. The design shall allow for variations in flight crew skill and physiology commensurate with flight crew licensing limits. Account shall be taken of the different expected operating conditions of the helicopter in its environment, including operations degraded by failures.

9.2.2 The workload imposed on the flight crew by the design of the helicopter shall be reasonable at all stages of flight. Particular consideration shall be given to critical stages of flight and critical events which may reasonably be expected to occur during the service life of the helicopter, such as engine failure.

### **9.3 Ergonomics**

During design of the helicopter, account shall be taken of ergonomics factors including:

- a) ease of use and prevention of inadvertent misuse;
- b) accessibility;
- c) flight crew working environment;
- d) cockpit standardisation; and
- e) maintainability.

### **9.4 Operating environmental factors**

The design of the helicopter shall take into consideration the flight crew operating environment including:

- a) effect of aeromedical factors such as noise and vibration; and
- b) effect of physical forces during normal flight.



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## **Part V Small Aeroplanes**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part are established by CAAM as the essential requirements in respect of all aeroplane designated in part VA and VB. For aeroplane certification purposes, refer to CAD 8102 or CAD 8107, as applicable.



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## **Part VA. Aeroplanes Over 750 Kg But Not Exceeding 5 700 Kg For Which Application For Certification Was Submitted On Or After 13 December 2007 But Before 7 March 2021**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part are applicable in respect of all aeroplanes designated in 1.1.2 for which an application for the issue of a Type Certificate was submitted to CAAM on or after 13 December 2007 but before 7 March 2021.
- 1.1.2 Except for those Standards which specify a different applicability, the Standards of this part shall apply to all aeroplanes having a maximum certificated take-off mass greater than 750 kg but not exceeding 5 700 kg intended for the carriage of passengers or cargo or mail in international air navigation.
- 1.1.3 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code referred to in 1.2.1 of Part II for the aeroplanes designated in 1.1.2 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.
- 1.1.4 Unless otherwise stated, the Standards apply to the complete aeroplane including its powerplant, systems and equipment.

#### **1.2 Operating limitations**

- 1.2.1 Limiting conditions shall be established for the aeroplane, its powerplant, systems and equipment (see 7.2). Compliance with the Standards of this part shall be established assuming that the aeroplane is operated within the limitations specified. The limitations shall include a margin of safety to render the likelihood of accidents arising therefrom extremely remote.
- 1.2.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the aeroplane, e.g. mass, centre of gravity location, load distribution, speeds, ambient air temperature and altitude, shall be established within which compliance with all the pertinent Standards in this part is shown.

#### **1.3 Unsafe features and characteristics**

Under all anticipated operating conditions, the aeroplane shall not possess any feature or characteristic that renders it unsafe.

#### **1.4 Proof of compliance**

The means by which compliance with the appropriate airworthiness requirements is demonstrated shall ensure that in each case the accuracy achieved will be such as to provide reasonable assurance that the aeroplane, its components and



equipment comply with the requirements and are reliable and function correctly under the anticipated operating conditions.

## 2 Flight

### 2.1 General

- 2.1.1 Compliance with the Standards prescribed in this chapter shall be established by flight or other tests conducted upon an aeroplane or aeroplanes of the type for which a Type Certificate is sought, or by calculations (or other methods) based on such tests, provided that the results obtained by calculations (or other methods) are equal in accuracy to, or conservatively represent, the results of direct testing.
- 2.1.2 Compliance with each Standard shall be established for all applicable combinations of aeroplane mass and centre of gravity position, within the range of loading conditions for which certification is sought.
- 2.1.3 Where necessary, appropriate aeroplane configurations shall be established for the determination of performance in the various stages of flight and for the investigation of the aeroplane's flying qualities.

### 2.2 Performance

- 2.2.1 Sufficient data on the performance of the aeroplane shall be determined and scheduled in the flight manual to provide operators with the necessary information for the purpose of determining the total mass of the aeroplane on the basis of the values, peculiar to the proposed flight, of the relevant operational parameters, in order that the flight may be made with reasonable assurance that a safe minimum performance for that flight will be achieved.
- 2.2.2 Achieving the performance scheduled for the aeroplane shall take into consideration human performance and in particular shall not require exceptional skill or alertness on the part of the flight crew.
- 2.2.3 The scheduled performance of the aeroplane shall be consistent with compliance with 1.2.1 and with the operation in logical combinations of those of the aeroplane's systems and equipment, the operation of which may affect performance.
- 2.2.4 Minimum performance
- Minimum performance shall be scheduled for aeroplanes with more than one engine that are turbine-powered or have a maximum certificated take-off mass of over 2 721 kg as follows:
- a) at the maximum masses scheduled (see 2.2.7) for take-off and for landing, as functions of the aerodrome elevation or pressure-altitude either in the standard atmosphere or in specified still air atmospheric conditions; and
  - b) for seaplanes in specified conditions in smooth water,

the aeroplane shall be capable of accomplishing the minimum performances specified in 2.2.5 a) and 2.2.6 a) respectively, not considering obstacles, or runway or water run length.

#### 2.2.5 Take-off

- a) For aeroplanes with more than one engine that are turbine-powered or have a maximum certificated take-off mass of over 2 721 kg, after the end of the period during which the take-off power or thrust may be used, the aeroplane shall be capable of continuing to climb, with the critical engine inoperative and the remaining engine(s) operated within their maximum continuous power or thrust limitations, up to a height that it can maintain and at which it can continue safe flight and landing.
- b) The minimum performance at all stages of take-off and climb shall be sufficient to ensure that under conditions of operation departing slightly from the idealised conditions for which data is scheduled (see 2.2.7), the departure from the scheduled values is not disproportionate.

#### 2.2.6 Landing

- a) For aeroplanes for which application for certification was submitted on or after 24 February 2013, aeroplanes with one engine, or a single propeller, or aeroplanes with more than one engine that cannot maintain a positive climb gradient following an engine or propeller failure, the design shall, in the case of engine or propeller failure, enable the aeroplane to be operated to a safe forced landing in favourable conditions.
- b) For aeroplanes with more than one engine that are turbine-powered or have a maximum certificated take-off mass of over 2 721 kg, starting from the approach configuration and with the critical engine inoperative, the aeroplane shall be capable, in the event of a missed approach, of continuing the flight to a point from which another approach can be made.
- c) Starting from the landing configuration, the aeroplane shall be capable, in the event of a balked landing, of making a climb-out, with all engines operating.

#### 2.2.7 Scheduling of performance

Performance data shall be determined and scheduled in the flight manual in order to provide a safe relationship between the performance of the aeroplane and the aerodromes and routes on which it is capable of being operated. Performance data shall be determined and scheduled for the following stages for the ranges of mass, altitude or pressure-altitude, wind velocity, gradient of the take-off and landing surface for landplanes; water surface conditions, density of water and strength of current for seaplanes; and for any other operational variables for which the aeroplane is to be certificated.

- a) Take-off. The take-off performance data shall include the distance required to take-off and climb to a selected height above the take-off surface. It shall be

determined for each mass, altitude and temperature within the operational limits established for take-off with:

- 1) take-off power on each engine;
  - 2) wing flaps in the take-off position(s); and
  - 3) landing gear extended.
- b) En route. For aeroplanes with more than one engine, the en-route climb performance shall be the climb (or descent) performance with the aeroplane in the en-route configuration with the critical engine inoperative. The operating engine(s) shall not exceed maximum continuous power or thrust.
- c) Landing. The landing distance shall be the horizontal distance traversed by the aeroplane from a point on the approach flight path at a selected height above the landing surface to the point on the landing surface at which the aeroplane comes to a complete stop, or, for a seaplane, comes to a satisfactorily low speed. The selected height above the landing surface and the approach speed shall be appropriately related to operating practices. This distance may be supplemented by such distance margin as may be necessary; if so, the selected height above the landing surface, the approach speed and the distance margin shall be appropriately interrelated and shall make provision for both normal operating practices and reasonable variations therefrom.

## 2.3 Flying qualities

2.3.1 The aeroplane shall comply with the Standards of 2.3 at all altitudes up to the maximum anticipated altitude relevant to the particular requirement in all temperature conditions relevant to the altitude in question and for which the aeroplane is approved.

### 2.3.2 Controllability

2.3.2.1 The aeroplane shall be controllable and manoeuvrable under all anticipated operating conditions, and it shall be possible to make smooth transitions from one flight condition to another (e.g. turns, sideslips, changes of engine power or thrust, changes of aeroplane configurations) without requiring exceptional skill, alertness or strength on the part of the pilot even in the event of failure of any engine. A technique for safely controlling the aeroplane shall be established for all stages of flight and aeroplane configurations for which performance is scheduled.

2.3.2.2 *Controllability on the ground (or water).* The aeroplane shall be controllable on the ground (or on the water) during taxiing, take-off and landing under the anticipated operating conditions.

2.3.2.3 *Controllability during take-off.* The aeroplane shall be controllable in the event of sudden failure of the critical engine at any point in the take-off.

2.3.2.4 *Take-off safety speed.* The take-off safety speeds assumed when the performance of the aeroplane (after leaving the ground or water) during the take-off is determined shall provide an adequate margin above the stall and above the minimum speed at which the aeroplane remains controllable after sudden failure of the critical engine.

### 2.3.3 Trim

The aeroplane shall have such trim characteristics as to ensure that the demands made on the pilot's attention and ability to maintain a desired flight condition are not excessive when account is taken of the stage of flight at which these demands occur and their duration. This shall apply both in normal operation and in the conditions associated with the failure of one or more engines for which performance characteristics are established.

## 2.4 Stability and control

### 2.4.1 Stability

The aeroplane shall have such stability in relation to its other flight characteristics, performance, structural strength and most probable operating conditions (e.g. aeroplane configurations and speed ranges) as to ensure that demands made on the pilot's powers of concentration are not excessive when the stage of the flight at which these demands occur and their duration are taken into account. The stability of the aeroplane shall not, however, be such that excessive demands are made on the pilot's strength or that the safety of the aeroplane is prejudiced by lack of manoeuvrability in emergency conditions. The stability may be achieved by natural or artificial means, or a combination of both. In those cases where artificial stability is necessary to show compliance with the Standards of this part, it shall be shown that any failure or condition that would result in the need for exceptional pilot skill or strength for recovery of aeroplane stability is extremely improbable.

### 2.4.2 Stalling

2.4.2.1 *Stall warning.* When the aeroplane approaches a stall both in straight and turning flight, a clear and distinctive stall warning shall be apparent to the pilot with the aeroplane in all permissible configurations and powers or thrusts, except those which are not considered to be essential for safe flying. The stall warning and other characteristics of the aeroplane shall be such as to enable the pilot to arrest the development of the stall after the warning begins and, without altering the engine power or thrust, to maintain full control of the aeroplane.

2.4.2.2 *Behaviour following a stall.* In any configuration and at any level of power or thrust in which it is considered that the ability to recover from a stall is essential, the behaviour of the aeroplane following a stall shall not be so extreme as to make difficult a prompt recovery without exceeding the airspeed or strength limitations of the aeroplane.



2.4.2.3 *Stalling speeds.* The stalling speeds or minimum steady flight speeds in configurations appropriate for each stage of flight (e.g. take-off, en route, landing) shall be established. One of the values of the power or thrust used in establishing the stalling speeds shall be not more than that necessary to give zero thrust at a speed just above the stall.

#### 2.4.3 Flutter and vibration

2.4.3.1 It shall be demonstrated by suitable tests, analyses or any acceptable combination of tests and analyses that all parts of the aeroplane are free from flutter and excessive vibration in all aeroplane configurations under all speed conditions within the operating limitations of the aeroplane (see 1.2.2). There shall be no vibration or buffeting severe enough to cause structural damage.

2.4.3.2 There shall be no vibration or buffeting severe enough to interfere with control of the aeroplane or to cause excessive fatigue to the flight crew.

#### 2.4.4 Spinning

It shall be demonstrated that the aeroplane during normal operation does not exhibit any tendency to inadvertently enter into a spin. If the design is such that spinning is allowed or for aeroplanes with one engine inadvertently possible, it shall be demonstrated that with normal use of the controls and without the use of exceptional piloting skill the aeroplane can be recovered from a spin within appropriate recovery limits.



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## **3 Structure**

### **3.1 General**

The aeroplane structure shall be designed, manufactured and provided with instructions for its maintenance and repair with the objective of avoiding catastrophic failure throughout its operational life.

### **3.2 Mass and mass distribution**

Unless otherwise stated, all structural Standards shall be complied with when the mass is varied over the applicable range and is distributed in the most adverse manner, within the operating limitations on the basis of which certification is sought.

### **3.3 Limit loads**

Except as might be otherwise qualified, the external loads and the corresponding inertia loads, or resisting loads obtained for the various loading conditions prescribed in 3.6 shall be considered as limit loads.

### **3.4 Strength and deformation**

In the various loading conditions prescribed in 3.6, no part of the aeroplane structure shall sustain detrimental deformation at any load up to and including the limit load, and the aeroplane structure shall be capable of supporting the ultimate load.

### **3.5 Airspeeds**

#### **3.5.1 Design airspeeds**

Design airspeeds shall be established for which the aeroplane structure is designed to withstand the corresponding manoeuvring and gust loads. To avoid inadvertent exceedences due to upsets or atmospheric variations, the design airspeeds shall provide sufficient margin for the establishment of practical operational limiting airspeeds. In addition, the design airspeeds shall be sufficiently greater than the stalling speed of the aeroplane to safeguard against loss of control in turbulent air. Consideration shall be given to a design manoeuvring speed, a design cruising speed, a design dive speed and any other design airspeeds necessary for configurations with high lift or other special devices.

#### **3.5.2 Limiting airspeeds**

Limiting airspeeds, based on the corresponding design airspeeds with safety margins, where appropriate, in accordance with 1.2.1, shall be included in the flight manual as part of the operating limitations (see 7.2).

### **3.6 Strength**

3.6.1 All structural elements shall be designed to withstand the maximum loads expected in service under all anticipated operating conditions without failure, permanent

distortion or loss of functionality. In determining these loads, account shall be taken of:

- a) the expected operational life of the aeroplane;
- b) the vertical and horizontal gust environment, taking into consideration the expected variations in mission profile and loading configurations;
- c) the manoeuvre spectrum, taking into account variations in mission profile and loading configurations;
- d) asymmetrical as well as symmetrical loading;
- e) the ground and water loads, including taxi, landing and take-off loads, and ground/water handling loads;
- f) the speed range of the aeroplane, taking into account the aeroplane characteristics and operation limitations;
- g) vibration and buffeting loads;
- h) corrosion or other degradation, given the maintenance specified, and various operating environments; and
- i) any other loads, such as flight control loads, cabin pressurisation loads, engine loads, or dynamic loads due to changes to the steady state configuration.

3.6.2 The air, inertia and other loads resulting from the specific loading conditions shall be distributed so as to approximate actual conditions closely or to represent them conservatively.

### 3.7 Survivability

The aeroplane shall be designed so as to provide the occupants with the maximum practicable protection in the event of structural failure, or in the event of damage due to ground, water or object impact. Consideration shall be given to at least the following:

- a) energy absorption by the airframe, occupant seats and restraints; and
- b) allowing egress in the shortest practicable time.

### 3.8 Structural durability

The structure of the aeroplane shall conform to damage tolerance, safe-life or failsafe principles and shall be such as to avoid catastrophic failure during the operational life, taking into account, where appropriate:

- a) the expected environment;
- b) the expected repeated loads applied in service;
- c) expected vibrations from aerodynamic interaction or internal sources;
- d) thermal cycles;

- e) accidental and discrete source damage;
- f) likely corrosion or other degradation;
- g) specified maintenance; and
- h) likely structural repairs.

### **3.9 Special factors**

For aeroplanes for which application for certification was submitted on or after 24 February 2013, design features (e.g. castings, bearings or fittings), the strength of which is subject to variability in manufacturing processes, deterioration in service or any other cause, shall be accounted for by a suitable factor.



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## 4 Design And Construction

### 4.1 General

4.1.1 Details of design and construction shall be such as to give reasonable assurance that all aeroplane parts will function effectively and reliably in the anticipated operating conditions. They shall be based upon practices that experience has proven to be satisfactory or that are substantiated by special tests or by other appropriate investigations or both. They shall also consider human factors principles.

#### 4.1.2 Substantiation of moving parts

The functioning of all moving parts essential to the safe operation of the aeroplane shall be demonstrated in order to ensure that they will function correctly under all operating conditions for such parts.

#### 4.1.3 Materials

All materials used in parts of the aeroplane essential for its safe operation shall conform to approved specifications. The approved specifications shall be such that materials accepted as complying with the specifications will have the essential properties assumed in the design.

#### 4.1.4 Manufacturing methods

The methods of manufacturing and assembly shall be such as to produce a consistently sound structure which shall be reliable with respect to maintenance of strength in service.

#### 4.1.5 Protection

The structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes, which could pass unnoticed, taking into account the maintenance the aeroplane will receive.

#### 4.1.6 Inspection provisions

Adequate provision shall be made to permit any necessary examination, replacement or reconditioning of parts of the aeroplane that require such attention, either periodically or after unusually severe operations.

### 4.2 Systems design features

Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following:

a) *Controls and control systems.* The design of the controls and control systems shall be such as to minimise the possibility of jamming, inadvertent operation including prevention of mis-assembly, and unintentional engagement of control surface locking devices.

1) Each control and control system shall operate with the ease, smoothness and precision appropriate to its functions.

- 2) Each element of each flight control system shall be designed, or distinctively and permanently marked, to minimise the probability of any incorrect assembly that could result in the malfunction of the system.
- b) *System survivability.* Aeroplane systems shall be designed and arranged to maximise the potential for continued safe flight and landing after events resulting in damage to the aeroplane structure or systems.
- c) *Crew environment.* The design of the flight crew compartment shall be such as to minimise the possibility of incorrect or restricted operation of the controls by the crew, due to fatigue, confusion or interference. Consideration shall be given at least to the following: layout and identification of controls and instruments, rapid identification of emergency situations, sense of controls, ventilation, heating and noise.
- d) *Pilot vision.* The arrangement of the flight crew compartment shall be such as to afford a sufficiently extensive, clear and undistorted field of vision for the safe operation of the aeroplane, and to prevent glare and reflections that would interfere with the pilot's vision. The design features of the windshield shall permit, under precipitation conditions of moderate rain, sufficient vision for the normal conduct of flight and for the execution of approaches and landings.
- e) *Provision for emergencies.* Means shall be provided which shall either automatically prevent, or enable the flight crew to deal with, emergencies resulting from foreseeable failures of equipment and systems, the failure of which would endanger the aeroplane. Reasonable provisions shall be made for continuation of essential services following engine or system failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this CAD and in CAD 6, Parts I and II.
- f) *Fire precautions.* The design of the aeroplane and the materials used in its manufacture shall be such so as to minimise the risk of in-flight and ground fires, and to minimise the production of smoke and toxic gases in the event of a fire.
- g) *Cargo compartment protection.*
  - 1) Sources of heat within the compartment which are capable of igniting the cargo or baggage shall be shielded or insulated to prevent such ignition; and
  - 2) Each cargo and baggage compartment shall be constructed of materials which are at least flame resistant.
- h) *Incapacitation of occupants.* Design precautions shall be taken to protect against possible instances of cabin depressurisation and against the presence of smoke or other toxic gases that could incapacitate the occupants of the aeroplane.

### 4.3 Aeroelasticity



The aeroplane shall be free from flutter, structural divergence, control reversal, loss of control due to structural deformation and aeroelastic effects, at all speeds within and sufficiently beyond the design envelope to comply with 1.2.1. Account shall be taken of the characteristics of the aeroplane.

#### **4.4 Occupant accommodation features**

##### **4.4.1 Seating and restraints**

Adequate seating and restraints shall be provided for the occupants, taking account of the likely flight and emergency landing loads to be encountered. Attention shall be paid to minimizing injury to occupants due to contact with surrounding structures during the operation of the aeroplane.

##### **4.4.2 Cabin environment**

Ventilation, heating and, where applicable, pressurisation systems shall be designed to provide the cabin with an adequate environment during the anticipated flight and ground or water operating conditions. The systems design shall also consider likely emergency conditions.

#### **4.5 Electrical bonding and protection against lightning and static electricity**

##### **4.5.1 Electrical bonding and protection against lightning and static electricity shall be such as to:**

- a) protect the aeroplane, its systems, its occupants and those who come in contact with the aeroplane on the ground or water from the dangerous effects of lightning discharge and electrical shock; and
- b) prevent dangerous accumulation of electrostatic charge.

##### **4.5.2 The aeroplane shall also be protected against catastrophic effects of lightning. Due account shall be taken of the material used in the construction of the aeroplane.**

#### **4.6 Emergency landing provisions**

##### **4.6.1 Provisions shall be made in the design of the aeroplane to protect the occupants, in the event of an emergency landing, from fire and from the direct effects of deceleration forces as well as from injuries arising from the effect of deceleration forces on the aeroplane's interior equipment.**

##### **4.6.2 Facilities shall be provided for the rapid evacuation of the aeroplane in conditions likely to occur following an emergency landing. Such facilities shall be related to the passenger and crew capacity of the aeroplane and shall be shown to be suitable for their intended purpose.**

#### **4.7 Ground handling**



Design provisions and procedures for safe ground-handling (e.g. towing, jacking) shall be defined. The protection that any limitations and instructions for such operations might provide may be taken into account.

## **5 Powerplant**

### **5.1 Engines**

The Standards of Part VI of this CAD shall apply to each engine that is used on the aeroplane as a primary propulsion unit.

### **5.2 Propellers**

The Standards of Part VII of this CAD shall apply to each propeller that is used on the aeroplane.

### **5.3 Powerplant installation**

#### **5.3.1 Compliance with engine and propeller limitations**

The powerplant installation shall be so designed that the engines and propellers (if applicable) are capable of functioning reliably in the anticipated operating conditions. In conditions established in the flight manual, the aeroplane shall be capable of being operated without exceeding the limitations established for the engines and propellers in accordance with this chapter and Parts VI and VII.

#### **5.3.2 Control of engine rotation**

In those installations where continued rotation of a failed engine would increase the hazard of fire or of a serious structural failure, means shall be provided for the crew to stop the rotation of the failed engine in flight or to reduce it to a safe level.

#### **5.3.3 Turbine engine installation**

For a turbine engine installation:

- a) the design shall minimise the hazards to the aeroplane in the event of failure of engine rotating parts, or an engine fire which burns through the engine case; and
- b) the powerplant installation shall be designed to give reasonable assurance that those engine operating limitations that adversely affect the structural integrity of rotating parts shall not be exceeded in service.

#### **5.3.4 Engine restarting**

Means shall be provided for restarting an engine in flight at altitudes up to a declared maximum altitude.

#### **5.3.5 Arrangement and functioning**

- 5.3.5.1 Independence of engines. For aeroplanes for which application for certification was submitted before 24 February 2013, the powerplant shall be arranged and installed so that each engine together with its associated systems is capable of being controlled and operated independently from the others and so that there is at least one arrangement of the powerplant and systems in which any failure, unless the

probability of its occurrence is extremely remote, cannot result in a loss of more power than that resulting from complete failure of the critical engine.

5.3.5.2 Independence of engines and associated systems. For aeroplanes for which application for certification was submitted on or after 24 February 2013, the engines together with their associated systems shall be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or the failure or malfunction (including destruction by fire in the engine compartment) of any system that can affect an engine (other than a fuel tank if only one fuel tank is installed), will not:

- a) prevent the continued safe operation of the remaining engine(s); or
- b) require immediate action by any crew member for continued safe operation of the remaining engine(s).

5.3.5.3 *Propeller vibration.* The propeller vibration stresses shall be determined and shall not exceed values that have been found safe for operation within the operating limitations established for the aeroplane.

5.3.5.4 *Cooling.* The cooling system shall be capable of maintaining the temperature of powerplant components and fluids within the established limits (see 5.3.1) at ambient air temperatures up to the maximum air temperature appropriate to the intended operation of the aeroplane.

5.3.5.5 *Associated systems.* The fuel, oil, air induction and other systems associated with the powerplant shall be capable of supplying each engine in accordance with its established requirements, under all conditions affecting the functioning of the systems (e.g. engine power or thrust, aeroplane attitudes and accelerations, atmospheric conditions, fluid temperatures) within the anticipated operating conditions.

5.3.5.6 *Fire protection.* For regions of the powerplant where the potential fire hazards are particularly serious because of the proximity of ignition sources to combustible materials, the following shall apply in addition to the general Standard of 4.2 f).

- a) *Isolation.* Such regions shall be isolated by fireproof material from other regions of the aeroplane where the presence of fire would jeopardise continued flight, taking into account the probable points of origin and paths of propagation of fire.
- b) *Flammable fluids.* Flammable fluid system components located in such regions shall be fire resistant. Drainage of each region shall be provided to minimise hazards resulting from the failure of any component containing flammable fluids. Means shall be provided for the crew to shut off the flow of flammable fluids into such regions if a fire occurs. Where sources of flammable fluid exist in such regions, the whole of the related system within the region, including supporting structure, shall be fireproof or shielded from the effects of the fire.

- c) *Fire detection.* A sufficient number of fire detectors shall be provided and located to ensure rapid detection of any fire that might occur in such regions of the following aeroplane types: aeroplanes with more than one engine powered by turbine or turbo-charged engines, or aeroplanes where the engine(s) are not readily visible from the cockpit.



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## **6 Systems And Equipment**

### **6.1 General**

6.1.1 The aeroplane shall be provided with approved instruments, equipment and systems, including guidance and flight management systems necessary for the safe operation of the aeroplane in the anticipated operating conditions. These shall include the instruments and equipment necessary to enable the crew to operate the aeroplane within its operating limitations. Instruments and equipment design shall consider human factors principles.

6.1.2 The design of the instruments, equipment and systems required by 6.1.1 and their installation shall be such that:

- a) an inverse relationship exists between the probability of a failure condition and the severity of its effect on the aircraft and its occupants, as determined by a system safety assessment process;
- b) they perform their intended function under all anticipated operating conditions; and
- c) electromagnetic interference between them is minimized.

6.1.3 Means shall be provided to warn the crew of unsafe system operating conditions and to enable them to take corrective action.

#### **6.1.4 Electrical power supply**

The design of the electrical power supply system shall be such as to enable it to supply power loads during normal operations and shall also be such that no single failure or malfunction could impair the ability of the system to supply essential loads for safe operation.

#### **6.1.5 Development assurance of complex electronic hardware and system software**

For aeroplanes for which application for certification was submitted on or after 24 February 2013, complex electronic hardware and system software shall be developed, verified and validated such as to ensure that the systems in which they are used perform their intended functions at a level of safety that complies with the requirements of this part, notably those of 6.1.2 a) and 6.1.2 b).

### **6.2 Installation**

Instrument and equipment installations shall comply with the Standards of Chapter 4.

### **6.3 Safety and survival equipment**

Prescribed safety and survival equipment that the crew or passengers are expected to use or operate at the time of an emergency shall be reliable, readily accessible and easily identified, and its method of operation shall be plainly marked.

### **6.4 Navigation lights and anti-collision lights**

- 6.4.1 The lights required by CAD 2 — *Rules of the Air* to be displayed by aeroplanes in flight or operating on the movement area of an aerodrome shall have intensities, colours, fields of coverage and other characteristics such that they furnish the pilot of another aircraft or personnel on the ground with as much time as possible for interpretation and for subsequent manoeuvre necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.
- 6.4.2 Lights shall be installed in aeroplanes so as to minimise the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

### **6.5 Electromagnetic interference protection**

Aeroplane electronic systems, particularly flight-critical and flight-essential systems, shall be protected against electromagnetic interference from both internal and external sources.

### **6.6 Ice protection**

If certification for flight in icing conditions is requested, the aeroplane shall be shown to be able to operate safely in icing conditions likely to be encountered in all anticipated operating environments.



## **7 Operating Limitations And Information**

### **7.1 General**

The operating limitations within which compliance with the Standards of this CAD is determined, together with any other information necessary to the safe operation of the aeroplane, shall be made available by means of a flight manual, markings and placards, and such other means as may effectively accomplish the purpose.

### **7.2 Operating limitations**

7.2.1 Limitations which might be exceeded in flight and which are defined quantitatively shall be expressed in suitable units. These limitations shall be corrected if necessary for errors in measurements so that the flight crew can, by reference to the instruments available to them, readily determine when the limitations are reached.

#### **7.2.2 Loading limitations**

The loading limitations shall include all limiting masses, centre of gravity positions, mass distributions and floor loadings (see 1.2.2).

#### **7.2.3 Airspeed limitations**

The airspeed limitations shall include all speeds (see 3.5.2) that are limiting from the standpoint of structural integrity or flying qualities of the aeroplane, or from other considerations. These speeds shall be identified with respect to the appropriate aeroplane configurations and other pertinent factors.

#### **7.2.4 Powerplant limitations**

The powerplant limitations shall include all those established for the various powerplant components as installed in the aeroplane (see 5.3.1 and 5.3.5.4).

#### **7.2.5 Limitations on equipment and systems**

The limitations on equipment and systems shall include all those established for the various equipment and systems as installed in the aeroplane.

#### **7.2.6 Miscellaneous limitations**

Miscellaneous limitations shall include any necessary limitations with respect to conditions found to be prejudicial to the safety of the aeroplane (see 1.2.1).

#### **7.2.7 Flight crew limitations**

The flight crew limitations shall include the minimum number of flight crew personnel necessary to operate the aeroplane, having regard, among other things, to the accessibility to the appropriate crew members of all necessary controls and instruments and to the execution of the established emergency procedures.

### **7.3 Operating information and procedures**

#### **7.3.1 Types of eligible operations**

The particular types of operations for which the aeroplane has been shown to be eligible by virtue of compliance with the appropriate airworthiness requirements shall be listed.

#### 7.3.2 Loading information

The loading information shall include the empty mass of the aeroplane, together with a definition of the condition of the aeroplane at the time of weighing, the corresponding centre of gravity position, and the reference points and datum lines to which the centre of gravity limits are related.

#### 7.3.3 Operating procedures

A description shall be given of normal and emergency operating procedures which are peculiar to the particular aeroplane and necessary for its safe operation. These shall include procedures to be followed in the event of failure of one or more engines.

#### 7.3.4 Handling information

Sufficient information shall be given on any significant or unusual features of the aeroplane characteristics. Those stalling speeds or minimum steady flight speeds required to be established by 2.4.2.3 shall be scheduled.

### 7.4 Performance information

The performance of the aeroplane shall be scheduled in accordance with 2.2. There shall be included information regarding the various aeroplane configurations and powers or thrusts involved and the relevant speeds, together with information that would assist the flight crew in attaining the performance as scheduled.

### 7.5 Flight manual

A flight manual shall be made available. It shall identify clearly the specific aeroplane or series of aeroplanes to which it is related. The flight manual shall include at least the limitations, information and procedures specified in 7.2, 7.3, 7.4 and 7.6.1.

### 7.6 Markings and placards

7.6.1 Markings and placards on instruments, equipment, controls, etc., shall include such limitations or information as necessary for the direct attention of the flight crew during flight.

7.6.2 Markings and placards or instructions shall be provided to give any information that is essential to the ground crew in order to preclude the possibility of mistakes in ground servicing (towing, refuelling, etc.) that could pass unnoticed and that could jeopardise the safety of the aeroplane in subsequent flights.

### 7.7 Continuing airworthiness — maintenance information

#### 7.7.1 General

Information for use in developing procedures for maintaining the aeroplane in an airworthy condition shall be made available. The information shall include that described in 7.7.2, 7.7.3 and 7.7.4.

**7.7.2 Maintenance information**

Maintenance information shall include a description of the aeroplane and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

**7.7.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and the recommended intervals at which these tasks are to be performed.

**7.7.4 Mandatory maintenance requirements resulting from the type design approval**

Mandatory maintenance requirements that have been specified by the State of Design as part of the approval of the type design shall be identified as such and included in the maintenance information of 7.7.3.



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## **8 Crashworthiness And Cabin Safety**

### **8.1 General**

Crashworthiness shall be taken into account in the design of aeroplanes to improve the probability of occupant survival.

### **8.2 Design emergency landing loads**

8.2.1 For aeroplanes for which application for certification was submitted before 24 February 2013, emergency landing (crash) loads shall be determined for all categories of aeroplanes so that the interiors, furnishings, support structure and safety equipment can be designed to maximise survivability for the occupants. Items to be considered shall include:

- a) dynamic effects;
- b) restraint criteria for items that could cause a hazard;
- c) distortion of the fuselage in the areas of emergency exits;
- d) fuel cell integrity and position; and
- e) integrity of electrical systems to avoid sources of ignition.

8.2.2 For aeroplanes for which application for certification was submitted on or after 24 February 2013, emergency landing (crash) loads shall be determined so that the interiors, furnishings, support structure and safety equipment can be designed to protect the occupants under emergency landing conditions. Items to be considered shall include:

- a) dynamic effects;
- b) restraint criteria for items that could cause a hazard;
- c) deformation of the fuselage in the areas of emergency exits;
- d) fuel cell integrity and position; and
- e) integrity of electrical systems to avoid sources of ignition.

### **8.3 Cabin fire protection**

The cabin shall be so designed as to provide fire protection to the occupants in the event of airborne systems failures or a crash situation. Items to be considered shall include:

- a) flammability of cabin interior materials;
- b) fire resistance and the generation of smoke and toxic fumes;
- c) provision of safety features to allow for safe evacuation; and
- d) fire detection and suppression equipment.

#### **8.4 Evacuation**

The aeroplane shall be equipped with sufficient emergency exits to allow for cabin evacuation within an appropriate time period. Items to be considered, appropriate to the size of the aeroplane, shall include:

- a) number of seats and seating configuration;
- b) number, location and size of exits;
- c) marking of exits and provision of instructions for use;
- d) likely blockages of exits;
- e) operation of exits; and
- f) positioning and weight of evacuation equipment at exits, e.g. rafts.

#### **8.5 Lighting and marking**

Emergency lighting, if installed, shall have the following characteristics:

- a) independence from main electrical supply;
- b) automatic activation upon loss of normal power/impact;
- c) visual indication of emergency exits;
- d) illumination both inside and outside the aeroplane during evacuation; and
- e) no additional hazards in the event of fuel spillage, emergency landings and minor crash events.

## **9 Operating Environment And Human Factors**

### **9.1 General**

The aeroplane shall be designed to allow safe operation within the performance limitations of its passengers and those who operate, maintain and service it.

### **9.2 Flight crew**

9.2.1 The aeroplane shall be designed in such a way as to allow safe and efficient control by the flight crew. The design shall allow for variations in flight crew skill and physiology commensurate with flight crew licensing limits. Account shall be taken of the different expected operating conditions of the aeroplane in its environment, including operations degraded by failures.

9.2.2 The workload imposed on the flight crew by the design of the aeroplane shall be reasonable at all stages of flight. Particular consideration shall be given to critical stages of flight and critical events which may reasonably be expected to occur during the service life of the aeroplane, such as a contained engine failure or windshear encounter.

### **9.3 Ergonomics**

During design of the aeroplane, account shall be taken of ergonomic factors including:

- a) ease of use and prevention of inadvertent misuse;
- b) accessibility;
- c) flight crew working environment;
- d) cockpit standardisation; and
- e) maintainability.

### **9.4 Operating environmental factors**

The design of the aeroplane shall take into consideration the flight crew operating environment including:

- a) effect of aeromedical factors such as level of oxygen, temperature, humidity, noise and vibration;
- b) effect of physical forces during normal flight;
- c) effect of prolonged operation at high altitude; and
- d) physical comfort.



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## **PART VB. Aeroplanes Not Exceeding 5 700 Kg For Which Application For Certification Is Submitted On Or After 7 March 2021**

### **1 General**

#### **1.1 Applicability**

- 1.1.1 The Standards of this part are applicable in respect of all aeroplanes designated in 1.1.2 for which an application for the issue of a Type Certificate is submitted to CAAM on or after 7 March 2021.
- 1.1.2 Except for those Standards which specify a different applicability, the Standards of this part shall apply to all aeroplanes having a maximum certificated take-off mass not exceeding 5 700 kg intended for the carriage of passengers or cargo or mail in international air navigation.
- 1.1.3 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code referred to in 1.2.1 of Part II for the aeroplanes designated in 1.1.2 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.
- 1.1.4 Unless otherwise stated, the Standards apply to the complete aeroplane including its powerplants, systems and equipment.

#### **1.2 Operating limitations**

- 1.2.1 Limiting conditions shall be established for the aeroplane, its powerplant, systems and equipment (see 7.2). Compliance with the Standards of this part shall be established assuming that the aeroplane is operated within the limitations specified. The limitations shall include a margin of safety to render the likelihood of accidents arising therefrom extremely remote.
- 1.2.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the aeroplane, e.g. mass, centre of gravity location, load distribution, speeds, ambient air temperature and altitude, shall be established within which compliance with all the pertinent Standards in this part is shown.

#### **1.3 Unsafe features and characteristics**

Under all anticipated operating conditions, the aeroplane shall not possess any feature or characteristic that renders it unsafe.

#### **1.4 Proof of compliance**

The means by which compliance with the appropriate airworthiness requirements is demonstrated shall ensure that in each case the accuracy achieved will be such as to provide reasonable assurance that the aeroplane, its components and equipment comply with the requirements and are reliable and function correctly under the anticipated operating conditions.



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## **2 Flight**

### **2.1 General**

- 2.1.1 Compliance with the Standards prescribed in this chapter shall be established by flight or other tests conducted upon an aeroplane or aeroplanes of the type for which a Type Certificate is sought, or by calculations (or other methods) based on such tests, provided that the results obtained by calculations (or other methods) are equal in accuracy to, or conservatively represent, the results of direct testing.
- 2.1.2 Compliance with each Standard shall be established for all applicable combinations of aeroplane mass and centre of gravity position, within the range of loading conditions for which certification is sought.
- 2.1.3 Where necessary, appropriate aeroplane configurations shall be established for the determination of performance in the various stages of flight and for the investigation of the aeroplane's flying qualities.

### **2.2 Performance**

- 2.2.1 Sufficient data on the performance of the aeroplane shall be determined and furnished in the flight manual to provide operators with the necessary information for the purpose of determining the maximum total mass of the aeroplane at the time of take-off that would allow the flight to be made with reasonable assurance that a safe minimum performance for that flight will be achieved considering the values of the operational parameters peculiar to the proposed flight.
- 2.2.2 Achieving the performance scheduled for the aeroplane shall take into consideration human performance and in particular shall not require exceptional skill or alertness on the part of the flight crew.
- 2.2.3 The scheduled performance of the aeroplane shall be consistent with compliance with 1.2.1 and with the operation in logical combinations of those of the aeroplane's systems and equipment, the operation of which may affect performance.
- 2.2.4 Minimum performance
- Minimum performance shall be scheduled for aeroplanes with more than one engine that are turbine-powered or have a maximum certificated take-off mass of over 2 721 kg as follows:
- a) at the maximum masses scheduled (see 2.2.7) for take-off and for landing, as functions of the aerodrome elevation or pressure-altitude either in the standard atmosphere or in specified still air atmospheric conditions; and
  - b) for seaplanes in specified conditions in smooth water,

the aeroplane shall be capable of accomplishing the minimum performances specified in 2.2.5 a) and 2.2.6 a) respectively, not considering obstacles, or runway or water run length.

#### 2.2.5 Take-off

- a) For aeroplanes with more than one engine that are turbine-powered or have a maximum certificated take-off mass of over 2 721 kg, after the end of the period during which the take-off power or thrust may be used, the aeroplane shall be capable of continuing to climb, with the critical engine inoperative and the remaining engine(s) operated within their maximum continuous power or thrust limitations, up to a height that it can maintain and at which it can continue safe flight and landing.
- b) The minimum performance at all stages of take-off and climb shall be sufficient to ensure that under conditions of operation departing slightly from the idealised conditions for which data is scheduled (see 2.2.7), the departure from the scheduled values is not disproportionate.

#### 2.2.6 Landing

- a) For aeroplanes for which application for certification was submitted on or after 24 February 2013, aeroplanes with one engine, or a single propeller, or aeroplanes with more than one engine that cannot maintain a positive climb gradient following an engine or propeller failure, the design shall, in the case of engine or propeller failure, enable the aeroplane to be operated to a safe forced landing in favourable conditions.
- b) For aeroplanes with more than one engine that are turbine-powered or have a maximum certificated take-off mass of over 2 721 kg, starting from the approach configuration and with the critical engine inoperative, the aeroplane shall be capable, in the event of a missed approach, of continuing the flight to a point from which another approach can be made.
- c) Starting from the landing configuration, the aeroplane shall be capable, in the event of a balked landing, of making a climb-out, with all engines operating.

#### 2.2.7 Scheduling of performance

Performance data shall be determined and scheduled in the flight manual in order to provide a safe relationship between the performance of the aeroplane and the aerodromes and routes on which it is capable of being operated. Performance data shall be determined and scheduled for the following stages for the ranges of mass, altitude or pressure-altitude, wind velocity, gradient of the take-off and landing surface for landplanes; water surface conditions, density of water and strength of current for seaplanes; and for any other operational variables for which the aeroplane is to be certificated.

- a) Take-off. The take-off performance data shall include the distance required to take-off and climb to a selected height above the take-off surface. It shall be

determined for each mass, altitude and temperature within the operational limits established for take-off with:

- 1) take-off power on each engine;
  - 2) wing flaps in the take-off position(s); and
  - 3) landing gear extended.
- b) En route. For aeroplanes with more than one engine, the en-route climb performance shall be the climb (or descent) performance with the aeroplane in the en-route configuration with the critical engine inoperative. The operating engine(s) shall not exceed maximum continuous power or thrust.
- c) Landing. The landing distance shall be the horizontal distance traversed by the aeroplane from a point on the approach flight path at a selected height above the landing surface to the point on the landing surface at which the aeroplane comes to a complete stop, or, for a seaplane, comes to a satisfactorily low speed. The selected height above the landing surface and the approach speed shall be appropriately related to operating practices. This distance may be supplemented by such distance margin as may be necessary; if so, the selected height above the landing surface, the approach speed and the distance margin shall be appropriately interrelated and shall make provision for both normal operating practices and reasonable variations therefrom.

## 2.3 Flying qualities

2.3.1 The aeroplane shall comply with the Standards of 2.3 at all altitudes up to the maximum anticipated altitude relevant to the particular requirement in all temperature conditions relevant to the altitude in question and for which the aeroplane is approved.

### 2.3.2 Controllability

2.3.2.1 The aeroplane shall be controllable and manoeuvrable under all anticipated operating conditions, and it shall be possible to make smooth transitions from one flight condition to another (e.g. turns, sideslips, changes of engine power or thrust, changes of aeroplane configurations) without requiring exceptional skill, alertness or strength on the part of the pilot even in the event of failure of any engine. A technique for safely controlling the aeroplane shall be established for all stages of flight and aeroplane configurations for which performance is scheduled.

2.3.2.2 *Controllability on the ground (or water).* The aeroplane shall be controllable on the ground (or on the water) during taxiing, take-off and landing under the anticipated operating conditions.

2.3.2.3 Controllability during take-off. The aeroplane shall be controllable in the event of sudden failure of the critical engine at any point in the take-off.

2.3.2.4 *Take-off safety speed.* The take-off safety speeds assumed when the performance of the aeroplane (after leaving the ground or water) during the take-off is determined shall provide an adequate margin above the stall and above the minimum speed at which the aeroplane remains controllable after sudden failure of the critical engine.

### 2.3.3 Trim

The aeroplane shall have such trim characteristics as to ensure that the demands made on the pilot's attention and ability to maintain a desired flight condition are not excessive when account is taken of the stage of flight at which these demands occur and their duration. This shall apply both in normal operation and in the conditions associated with the failure of one or more engines for which performance characteristics are established.

## 2.4 Stability and control

### 2.4.1 Stability

The aeroplane shall have such stability in relation to its other flight characteristics, performance, structural strength, and most probable operating conditions (e.g. aeroplane configurations and speed ranges) as to ensure that demands made on the pilot's powers of concentration are not excessive when the stage of the flight at which these demands occur and their duration are taken into account. The stability of the aeroplane shall not, however, be such that excessive demands are made on the pilot's strength or that the safety of the aeroplane is prejudiced by lack of manoeuvrability in emergency conditions. The stability may be achieved by natural or artificial means, or a combination of both. In those cases where artificial stability is necessary to show compliance with the Standards of this part, it shall be shown that any failure or condition that would result in the need for exceptional pilot skill or strength for recovery of aeroplane stability is extremely improbable.

### 2.4.2 Stalling

2.4.2.1 *Stall warning.* When the aeroplane approaches a stall both in straight and turning flight, a clear and distinctive stall warning shall be apparent to the pilot with the aeroplane in all permissible configurations, except those which are not considered to be essential for safe flying. The stall warning and other characteristics of the aeroplane shall be such as to enable the pilot to arrest the development of the stall after the warning begins and, without altering the engine power or thrust, to maintain full control of the aeroplane.

2.4.2.2 *Behaviour following a stall.* In any configuration and at any level of power or thrust in which it is considered that the ability to recover from a stall is essential, the behaviour of the aeroplane following a stall shall not be so extreme as to make difficult a prompt recovery without exceeding the airspeed or strength limitations of the aeroplane.

2.4.2.3 *Stalling speeds.* The stalling speeds or minimum steady flight speeds in configurations appropriate for each stage of flight (e.g. take-off, en route, landing)

shall be established. One of the values of the power or thrust used in establishing the stalling speeds shall be not more than that necessary to give zero thrust at a speed just above the stall.

#### 2.4.3 Flutter and vibration

2.4.3.1 It shall be demonstrated by suitable tests, analyses or any acceptable combination of tests and analyses that all parts of the aeroplane are free from flutter and excessive vibration in all aeroplane configurations under all speed conditions within the operating limitations of the aeroplane (see 1.2.2). There shall be no vibration or buffeting severe enough to cause structural damage.

2.4.3.2 There shall be no vibration or buffeting severe enough to interfere with control of the aeroplane or to cause excessive fatigue to the flight crew.

#### 2.4.4 Spinning

It shall be demonstrated that the aeroplane during normal operation does not exhibit any tendency to inadvertently enter into a spin. If the design is such that spinning is allowed or for aeroplanes with one engine inadvertently possible, it shall be demonstrated that with normal use of the controls and without the use of exceptional piloting skill the aeroplane can be recovered from a spin within appropriate recovery limits.



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## **3 Structure**

### **3.1 General**

The aeroplane structure shall be designed, manufactured and provided with instructions for its maintenance and repair with the objective of avoiding catastrophic failure throughout its operational life.

### **3.2 Mass and mass distribution**

Unless otherwise stated, all structural Standards shall be complied with when the mass is varied over the applicable range and is distributed in the most adverse manner, within the operating limitations on the basis of which certification is sought.

### **3.3 Limit loads**

Except as might be otherwise qualified, the external loads and the corresponding inertia loads, or resisting loads obtained for the various loading conditions prescribed in 3.6 shall be considered as limit loads.

### **3.4 Strength and deformation**

In the various loading conditions prescribed in 3.6, no part of the aeroplane structure shall sustain detrimental deformation at any load up to and including the limit load, and the aeroplane structure shall be capable of supporting the ultimate load.

### **3.5 Airspeeds**

#### **3.5.1 Design airspeeds**

Design airspeeds shall be established for which the aeroplane structure is designed to withstand the corresponding manoeuvring and gust loads. To avoid inadvertent exceedences due to upsets or atmospheric variations, the design airspeeds shall provide sufficient margin for the establishment of practical operational limiting airspeeds. In addition, the design airspeeds shall be sufficiently greater than the stalling speed of the aeroplane to safeguard against loss of control in turbulent air. Consideration shall be given to a design manoeuvring speed, a design cruising speed, a design dive speed and any other design airspeeds necessary for configurations with high lift or other special devices.

#### **3.5.2 Limiting airspeeds**

Limiting airspeeds, based on the corresponding design airspeeds with safety margins, where appropriate, in accordance with 1.2.1, shall be included in the flight manual as part of the operating limitations (see 7.2).

### **3.6 Strength**

3.6.1 All structural elements shall be designed to withstand the maximum loads expected in service under all anticipated operating conditions without failure, permanent

distortion or loss of functionality. In determining these loads, account shall be taken of:

- a) the expected operational life of the aeroplane;
- b) the vertical and horizontal gust environment, taking into consideration the expected variations in mission profile and loading configurations;
- c) the manoeuvre spectrum, taking into account variations in mission profile and loading configurations;
- d) asymmetrical as well as symmetrical loading;
- e) the ground and water loads, including taxi, landing and take-off loads, and ground/water handling loads;
- f) the speed range of the aeroplane, taking into account the aeroplane characteristics and operation limitations;
- g) vibration and buffeting loads;
- h) corrosion or other degradation, given the maintenance specified, and various operating environments; and
- i) any other loads, such as flight control loads, cabin pressurisation loads, engine loads, or dynamic loads due to changes to the steady state configuration.

3.6.2 The air, inertia and other loads resulting from the specific loading conditions shall be distributed so as to approximate actual conditions closely or to represent them conservatively.

### 3.7 Survivability

The aeroplane shall be designed so as to provide the occupants with the maximum practicable protection in the event of structural failure, or in the event of damage due to ground, water or object impact. Consideration shall be given to at least the following:

- a) energy absorption by the airframe, occupant seats and restraints; and
- b) allowing egress in the shortest practicable time.

### 3.8 Structural durability

The structure of the aeroplane shall conform to damage tolerance, safe-life or failsafe principles and shall be such as to avoid catastrophic failure during the operational life, taking into account, where appropriate:

- a) the expected environment;
- b) the expected repeated loads applied in service;
- c) expected vibrations from aerodynamic interaction or internal sources;

- d) thermal cycles;
- e) accidental and discrete source damage;
- f) likely corrosion or other degradation;
- g) specified maintenance; and
- h) likely structural repairs.

### **3.9 Special factors**

For aeroplanes for which application for certification was submitted on or after 24 February 2013, design features (e.g. castings, bearings or fittings), the strength of which is subject to variability in manufacturing processes, deterioration in service, or any other cause, shall be accounted for by a suitable factor.



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## 4 Design And Construction

### 4.1 General

4.1.1 Details of design and construction shall be such as to give reasonable assurance that all aeroplane parts will function effectively and reliably in the anticipated operating conditions. They shall be based upon practices that experience has proven to be satisfactory or that are substantiated by special tests or by other appropriate investigations or both. They shall also consider human factors principles.

#### 4.1.2 Substantiation of moving parts

The functioning of all moving parts essential to the safe operation of the aeroplane shall be demonstrated in order to ensure that they will function correctly under all operating conditions for such parts.

#### 4.1.3 Materials

All materials used in parts of the aeroplane essential for its safe operation shall conform to approved specifications. The approved specifications shall be such that materials accepted as complying with the specifications will have the essential properties assumed in the design.

#### 4.1.4 Manufacturing methods

The methods of manufacturing and assembly shall be such as to produce a consistently sound structure which shall be reliable with respect to maintenance of strength in service.

#### 4.1.5 Protection

The structure shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion or other causes, which could pass unnoticed, taking into account the maintenance the aeroplane will receive.

#### 4.1.6 Inspection provisions

Adequate provision shall be made to permit any necessary examination, replacement or reconditioning of parts of the aeroplane that require such attention, either periodically or after unusually severe operations.

### 4.2 Systems design features

4.2.1 Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following:

- a) *Controls and control systems.* The design of the controls and control systems shall be such as to minimise the possibility of jamming, inadvertent operation including prevention of mis-assembly, and unintentional engagement of control surface locking devices.

- 1) Each control and control system shall operate with the ease, smoothness and precision appropriate to its functions.
  - 2) Each element of each flight control system shall be designed, or distinctively and permanently marked, to minimise the probability of any incorrect assembly that could result in the malfunction of the system.
- b) *System survivability.* Aeroplane systems shall be designed and arranged to maximise the potential for continued safe flight and landing after events resulting in damage to the aeroplane structure or systems.
- c) *Crew environment.* The design of the flight crew compartment shall be such as to minimise the possibility of incorrect or restricted operation of the controls by the crew, due to fatigue, confusion or interference. Consideration shall be given at least to the following: layout and identification of controls and instruments, rapid identification of emergency situations, sense of controls, ventilation, heating and noise.
- d) *Pilot vision.* The arrangement of the flight crew compartment shall be such as to afford a sufficiently extensive, clear and undistorted field of vision for the safe operation of the aeroplane, and to prevent glare and reflections that would interfere with the pilot's vision. The design features of the windshield shall permit, under precipitation conditions of moderate rain, sufficient vision for the normal conduct of flight and for the execution of approaches and landings.
- e) *Provision for emergencies.* Means shall be provided which shall either automatically prevent, or enable the flight crew to deal with, emergencies resulting from foreseeable failures of equipment and systems, the failure of which would endanger the aeroplane. Reasonable provisions shall be made for continuation of essential services following engine or system failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this CAD and in CAD 6, Parts I and II.
- f) *Fire precautions.* The design of the aeroplane and the materials used in its manufacture shall be such so as to minimise the risk of in-flight and ground fires, and to minimise the production of smoke and toxic gases in the event of a fire.
- g) Cargo compartment protection.
- 1) Sources of heat within the compartment which are capable of igniting the cargo or baggage shall be shielded or insulated to prevent such ignition; and
  - 2) Each cargo and baggage compartment shall be constructed of materials which are at least flame resistant.
- h) *Incapacitation of occupants.* Design precautions shall be taken to protect against possible instances of cabin depressurisation and against the

presence of smoke or other toxic gases that could incapacitate the occupants of the aeroplane.

### **4.3 Aeroelasticity**

The aeroplane shall be free from flutter, structural divergence, control reversal, loss of control due to structural deformation and aeroelastic effects, at all speeds within and sufficiently beyond the design envelope to comply with 1.2.1. Account shall be taken of the characteristics of the aeroplane.

### **4.4 Occupant accommodation features**

#### **4.4.1 Seating and restraints**

Adequate seating and restraints shall be provided for the occupants, taking account of the likely flight and emergency landing loads to be encountered. Attention shall be paid to minimising injury to occupants due to contact with surrounding structures during the operation of the aeroplane.

#### **4.4.2 Cabin environment**

Ventilation, heating and, where applicable, pressurisation systems shall be designed to provide the cabin with an adequate environment during the anticipated flight and ground or water operating conditions. The systems design shall also consider likely emergency conditions.

### **4.5 Electrical bonding and protection against lightning and static electricity**

4.5.1 Electrical bonding, protection against static electricity and lightning protection when appropriate for the type of approved operations shall be such as to:

- a) protect the aeroplane, its systems, its occupants and those who come in contact with the aeroplane on the ground or water from the dangerous effects of lightning discharge and electrical shock; and
- b) prevent dangerous accumulation of electrostatic charge.

4.5.2 When appropriate for the type of approved operation, the aeroplane shall also be protected against catastrophic effects of lightning. Due account shall be taken of the material used in the construction of the aeroplane.

### **4.6 Emergency landing provisions**

4.6.1 Provisions shall be made in the design of the aeroplane to protect the occupants, in the event of an emergency landing, from fire and from the direct effects of deceleration forces as well as from injuries arising from the effect of deceleration forces on the aeroplane's interior equipment.

4.6.2 Facilities shall be provided for the rapid evacuation of the aeroplane in conditions likely to occur following an emergency landing. Such facilities shall be related to the passenger and crew capacity of the aeroplane and shall be shown to be suitable for their intended purpose.

#### **4.7 Ground handling**

Design provisions and procedures for safe ground handling (e.g. towing, jacking) shall be defined. The protection that any limitations and instructions for such operations might provide may be taken into account.



## 5 Powerplant

### 5.1 Engines

The Standards of Part VI of this CAD shall apply to each engine that is used on the aeroplane as a primary propulsion unit.

### 5.2 Propellers

The Standards of Part VII of this CAD shall apply to each propeller that is used on the aeroplane.

### 5.3 Powerplant installation

#### 5.3.1 Compliance with engine and propeller limitations

The powerplant installation shall be so designed that the engines and propellers (if applicable) are capable of functioning reliably in the anticipated operating conditions. In conditions established in the flight manual, the aeroplane shall be capable of being operated without exceeding the limitations established for the engines and propellers in accordance with this chapter and Parts VI and VII.

#### 5.3.2 Control of engine rotation

In those installations where continued rotation of a failed engine would increase the hazard of fire or of a serious structural failure, means shall be provided for the crew to stop the rotation of the failed engine in flight or to reduce it to a safe level.

#### 5.3.3 Turbine engine installation

For a turbine engine installation:

- a) the design shall minimise the hazards to the aeroplane in the event of failure of engine rotating parts, or an engine fire which burns through the engine case; and
- b) the powerplant installation shall be designed to give reasonable assurance that those engine operating limitations that adversely affect the structural integrity of rotating parts shall not be exceeded in service.

#### 5.3.4 Engine restarting

Means shall be provided for restarting an engine in flight at altitudes up to a declared maximum altitude.

#### 5.3.5 Arrangement and functioning

- 5.3.5.1 *Independence of engines.* The powerplant shall be arranged and installed so that each engine together with its associated systems is capable of being controlled and operated independently from the others and so that there is at least one arrangement of the powerplant and systems in which any failure, unless the probability of its

occurrence is extremely remote, cannot result in a loss of more power than that resulting from complete failure of the critical engine.

5.3.5.2 *Independence of engines and associated systems.* The engines together with their associated systems shall be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or the failure or malfunction (including destruction by fire in the engine compartment) of any system that can affect an engine (other than a fuel tank if only one fuel tank is installed), will not:

- a) prevent the continued safe operation of the remaining engine(s); or
- b) require immediate action by any crew member for continued safe operation of the remaining engine(s).

5.3.5.3 *Propeller vibration.* The propeller vibration stresses shall be determined and shall not exceed values that have been found safe for operation within the operating limitations established for the aeroplane.

5.3.5.4 *Cooling.* The cooling system shall be capable of maintaining the temperature of powerplant components and fluids within the established limits (see 5.3.1) at ambient air temperatures up to the maximum air temperature appropriate to the intended operation of the aeroplane.

5.3.5.5 *Associated systems.* The fuel, oil, air induction and other systems associated with the powerplant shall be capable of supplying each engine in accordance with its established requirements, under all conditions affecting the functioning of the systems (e.g. engine power or thrust, aeroplane attitudes and accelerations, atmospheric conditions, fluid temperatures) within the anticipated operating conditions.

5.3.5.6 *Fire protection.* For regions of the powerplant where the potential fire hazards are particularly serious because of the proximity of ignition sources to combustible materials, the following shall apply in addition to the general Standard of 4.2 f).

- a) *Isolation.* Such regions shall be isolated by fireproof material from other regions of the aeroplane where the presence of fire would jeopardise continued flight, taking into account the probable points of origin and paths of propagation of fire.
- b) *Flammable fluids.* Flammable fluid system components located in such regions shall be fire resistant. Drainage of each region shall be provided to minimise hazards resulting from the failure of any component containing flammable fluids. Means shall be provided for the crew to shut off the flow of flammable fluids into such regions if a fire occurs. Where sources of flammable fluid exist in such regions, the whole of the related system within the region, including supporting structure, shall be fireproof or shielded from the effects of the fire.

- c) *Fire detection.* A sufficient number of fire detectors shall be provided and located to ensure rapid detection of any fire that might occur in such regions of the following aeroplane types: aeroplanes with more than one engine powered by turbine or turbo-charged engines, or aeroplanes where the engine(s) are not readily visible from the cockpit.



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## **6 Systems And Equipment**

### **6.1 General**

6.1.1 The aeroplane shall be provided with approved instruments, equipment and systems, including guidance and flight management systems necessary for the safe operation of the aeroplane in the anticipated operating conditions. These shall include the instruments and equipment necessary to enable the crew to operate the aeroplane within its operating limitations. Instruments and equipment design shall consider human factors principles.

6.1.2 The design of the instruments, equipment and systems required by 6.1.1 and their installation shall be such that:

- a) an inverse relationship exists between the probability of a failure condition and the severity of its effect on the aircraft and its occupants, as determined by a system safety assessment process;
- b) they perform their intended function under all anticipated operating conditions; and
- c) electromagnetic interference between them is minimised.

6.1.3 Means shall be provided to warn the crew of unsafe system operating conditions and to enable them to take corrective action.

#### **6.1.4 Electrical power supply**

The design of the electrical power supply system shall be such as to enable it to supply power loads during normal operations and shall also be such that no single failure or malfunction could impair the ability of the system to supply essential loads for safe operation.

#### **6.1.5 Development assurance of complex electronic hardware and system software**

For aeroplanes for which application for certification was submitted on or after 24 February 2013, complex electronic hardware and system software shall be developed, verified and validated such as to ensure that the systems in which they are used perform their intended functions at a level of safety that complies with the requirements of this part, notably those of 6.1.2 a) and 6.1.2 b).

### **6.2 Installation**

Instrument and equipment installations shall comply with the Standards of Chapter 4.

### **6.3 Safety and survival equipment**

Prescribed safety and survival equipment that the crew or passengers are expected to use or operate at the time of an emergency shall be reliable, readily accessible and easily identified, and its method of operation shall be plainly marked.

### **6.4 Navigation lights and anti-collision lights**

- 6.4.1 The lights required by CAD 2 — *Rules of the Air* to be displayed by aeroplanes in flight or operating on the movement area of an aerodrome shall have intensities, colours, fields of coverage and other characteristics such that they furnish the pilot of another aircraft or personnel on the ground with as much time as possible for interpretation and for subsequent manoeuvre necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.
- 6.4.2 Lights shall be installed in aeroplanes so as to minimise the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

### **6.5 Electromagnetic interference protection**

Aeroplane electronic systems, particularly flight-critical and flight-essential systems, shall be protected against electromagnetic interference from both internal and external sources.

### **6.6 Ice protection**

If certification for flight in icing conditions is requested, the aeroplane shall be shown to be able to operate safely in icing conditions likely to be encountered in all anticipated operating environments.

## **7 Operating Limitations And Information**

### **7.1 General**

The operating limitations within which compliance with the Standards of this CAD is determined, together with any other information necessary to the safe operation of the aeroplane, shall be made available by means of a flight manual, markings and placards, and such other means as may effectively accomplish the purpose.

### **7.2 Operating limitations**

7.2.1 Limitations which might be exceeded in flight and which are defined quantitatively shall be expressed in suitable units. These limitations shall be corrected if necessary for errors in measurements so that the flight crew can, by reference to the instruments available to them, readily determine when the limitations are reached.

#### **7.2.2 Loading limitations**

The loading limitations shall include all limiting masses, centre of gravity positions, mass distributions and floor loadings (see 1.2.2).

#### **7.2.3 Airspeed limitations**

The airspeed limitations shall include all speeds (see 3.5.2) that are limiting from the standpoint of structural integrity or flying qualities of the aeroplane, or from other considerations. These speeds shall be identified with respect to the appropriate aeroplane configurations and other pertinent factors.

#### **7.2.4 Powerplant limitations**

The powerplant limitations shall include all those established for the various powerplant components as installed in the aeroplane (see 5.3.1 and 5.3.5.4).

#### **7.2.5 Limitations on equipment and systems**

The limitations on equipment and systems shall include all those established for the various equipment and systems as installed in the aeroplane.

#### **7.2.6 Miscellaneous limitations**

Miscellaneous limitations shall include any necessary limitations with respect to conditions found to be prejudicial to the safety of the aeroplane (see 1.2.1).

#### **7.2.7 Flight crew limitations**

The flight crew limitations shall include the minimum number of flight crew personnel necessary to operate the aeroplane, having regard, among other things, to the accessibility to the appropriate crew members of all necessary controls and instruments and to the execution of the established emergency procedures.

### **7.3 Operating information and procedures**

#### **7.3.1 Types of eligible operations**

The particular types of operations for which the aeroplane has been shown to be eligible by virtue of compliance with the appropriate airworthiness requirements shall be listed.

#### 7.3.2 Loading information

The loading information shall include the empty mass of the aeroplane, together with a definition of the condition of the aeroplane at the time of weighing, the corresponding centre of gravity position, and the reference points and datum lines to which the centre of gravity limits are related.

#### 7.3.3 Operating procedures

A description shall be given of normal and emergency operating procedures which are peculiar to the particular aeroplane and necessary for its safe operation. These shall include procedures to be followed in the event of failure of one or more engines.

#### 7.3.4 Handling information

Sufficient information shall be given on any significant or unusual features of the aeroplane characteristics. Those stalling speeds or minimum steady flight speeds required to be established by 2.4.2.3 shall be scheduled.

### 7.4 Performance information

The performance of the aeroplane shall be furnished in accordance with 2.2. There shall be included information regarding the various aeroplane configurations and powers or thrusts involved and the relevant speeds, together with information that would assist the flight crew in attaining the performance as furnished.

### 7.5 Flight manual

A flight manual shall be made available. It shall identify clearly the specific aeroplane or series of aeroplanes to which it is related. The flight manual shall include at least the limitations, information and procedures specified in 7.2, 7.3, 7.4 and 7.6.1.

### 7.6 Markings and placards

7.6.1 Markings and placards on instruments, equipment, controls, etc., shall include such limitations or information as necessary for the direct attention of the flight crew during flight.

7.6.2 Markings and placards or instructions shall be provided to give any information that is essential to the ground crew in order to preclude the possibility of mistakes in ground servicing (towing, refuelling, etc.) that could pass unnoticed and that could jeopardise the safety of the aeroplane in subsequent flights.

### 7.7 Continuing airworthiness — maintenance information

#### 7.7.1 General



Information for use in developing procedures for maintaining the aeroplane in an airworthy condition shall be made available. The information shall include that described in 7.7.2, 7.7.3 and 7.7.4.

**7.7.2 Maintenance information**

Maintenance information shall include a description of the aeroplane and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

**7.7.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and the recommended intervals at which these tasks are to be performed.

**7.7.4 Mandatory maintenance requirements resulting from the type design approval**

Mandatory maintenance requirements that have been specified by the State of Design as part of the approval of the type design shall be identified as such and included in the maintenance information of 7.7.3.

## **8 Crashworthiness And Cabin Safety**

### **8.1 General**

Crashworthiness shall be taken into account in the design of aeroplanes to improve the probability of occupant survival.

### **8.2 Design emergency landing loads**

Emergency landing (crash) loads shall be determined so that the interiors, furnishings, support structure and safety equipment can be designed to protect the occupants under emergency landing conditions. Items to be considered shall include:

- a) dynamic effects;
- b) restraint criteria for items that could cause a hazard;
- c) deformation of the fuselage in the areas of emergency exits;
- d) fuel cell integrity and position; and
- e) integrity of electrical systems to avoid sources of ignition.

### **8.3 Cabin fire protection**

The cabin shall be so designed as to provide fire protection to the occupants in the event of airborne systems failures or a crash situation. Items to be considered shall include:

- a) flammability of cabin interior materials;
- b) fire resistance and the generation of smoke and toxic fumes;
- c) provision of safety features to allow for safe evacuation; and
- d) fire detection and suppression equipment.

### **8.4 Evacuation**

The aeroplane shall be equipped with sufficient emergency exits to allow for cabin evacuation within an appropriate time period. Items to be considered, appropriate to the size of the aeroplane, shall include:

- a) number of seats and seating configuration;
- b) number, location and size of exits;
- c) marking of exits and provision of instructions for use;
- d) likely blockages of exits;
- e) operation of exits; and
- f) positioning and weight of evacuation equipment at exits, e.g. rafts.

### **8.5 Lighting and marking**

Emergency lighting, if installed, shall have the following characteristics:

- a) independence from main electrical supply;
- b) automatic activation upon loss of normal power/impact;
- c) visual indication of emergency exits;
- d) illumination both inside and outside the aeroplane during evacuation; and
- e) no additional hazards in the event of fuel spillage, emergency landings and minor crash events.



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## **9 Operating Environment And Human Factors**

### **9.1 General**

The aeroplane shall be designed to allow safe operation within the performance limitations of its passengers and those who operate, maintain and service it.

### **9.2 Flight crew**

9.2.1 The aeroplane shall be designed in such a way as to allow safe and efficient control by the flight crew. The design shall allow for variations in flight crew skill and physiology commensurate with flight crew licensing limits. Account shall be taken of the different expected operating conditions of the aeroplane in its environment, including operations degraded by failures.

9.2.2 The workload imposed on the flight crew by the design of the aeroplane shall be reasonable at all stages of flight. Particular consideration shall be given to critical stages of flight and critical events which may reasonably be expected to occur during the service life of the aeroplane, such as a contained engine failure or windshear encounter.

### **9.3 Ergonomics**

9.3.1 During design of the aeroplane, account shall be taken of ergonomic factors including:

- a) ease of use and prevention of inadvertent misuse;
- b) accessibility;
- c) flight crew working environment;
- d) cockpit standardisation; and
- e) maintainability.

### **9.4 Operating environmental factors**

The design of the aeroplane shall take into consideration the flight crew operating environment including:

- a) effect of aeromedical factors such as level of oxygen, temperature, humidity, noise and vibration;
- b) effect of physical forces during normal flight;
- c) effect of prolonged operation at high altitude; and
- d) physical comfort.



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## **Part VI Engines**

### **1 General**

#### **1.1 Applicability**

1.1.1 Except as noted below, the Standards of this part are applicable to engines of all types, used as primary propulsion units, as required in Parts IIIB, IVB and V. The Standards of this part are applicable to an engine type at the time of submission of an application to CAAM for a type approval.

1.1.2 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code for the engines designated in 1.1.1 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.

#### **1.2 Engine installation and interfaces**

1.2.1 All necessary information for the safe and correct interfaces between the engine and the aircraft shall be made available.

1.2.2 The installation instructions shall specify those assumptions concerning the conditions that may be imposed on the engine when it is eventually installed in an aircraft.

#### **1.3 Declared ratings, conditions and limitations**

1.3.1 The thrust or power ratings and the conditions of the atmosphere upon which they are based and all operating conditions and limitations which are intended to govern the operation of the engine shall be declared.

1.3.2 Within the stated limits of 1.3.1, the engine shall produce the thrust or power demanded of it at all required flight conditions, taking into account environmental effects and conditions.

#### **1.4 Continuing airworthiness – maintenance information**

##### **1.4.1 General**

Information for use in developing procedures for maintaining the engine in an airworthy condition shall be made available. The information shall include that described in 1.4.2, 1.4.3 and 1.4.4.

##### **1.4.2 Maintenance information**

Maintenance information shall include a description of the engine and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

##### **1.4.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and the recommended intervals at which these tasks are to be performed.

1.4.4 Mandatory maintenance requirements resulting from the type design approval

Mandatory maintenance requirements that have been specified by the State of Design as part of the approval of the type design shall be identified as such and included in the maintenance information of 1.4.3.



## **2 Design And Construction**

### **2.1 Functioning**

The engine shall be designed and constructed so as to function reliably within its operating limitations under its anticipated operating conditions when installed in accordance with Parts IIIB, IVB and V of this CAD and, if applicable, fitted with a propeller approved for the installation.

### **2.2 Failure analysis**

For turbine engines, a safety assessment of the engine shall be conducted to ensure that it functions safely throughout the full range of operating conditions. A summary shall be made of all foreseeable failures and combinations of failures that result in hazardous engine effects. If the primary failure of single elements (for example, disks) is likely to result in hazardous engine effects, reliance shall be placed on meeting prescribed integrity requirements.

### **2.3 Materials and manufacturing methods**

The selection of materials and the manufacturing methods and processes shall account for the operational environment of the engine expected in service. The materials and manufacturing methods and processes used in the construction of the engine shall result in known and reproducible structural behaviour.

### **2.4 Integrity**

The integrity of the engine shall be demonstrated throughout its operating envelope and be maintained for its operational life. The effects of cyclic loading, environmental and operational degradation and likely subsequent part failures shall not reduce the integrity of the engine below acceptable levels. All necessary instructions for ensuring continued airworthiness in this regard shall be promulgated.



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### 3 TESTS

The engine type shall complete satisfactorily such tests as are necessary to verify the validity of the declared ratings, conditions and limitations and to ensure that it will operate satisfactorily and reliably. The tests shall include at least the following:

- a) *Power calibration.* Tests shall be conducted to establish the power or thrust characteristics of the engine when new and also after the tests in b) and c). There shall be no excessive decrease in power at the conclusion of all the tests specified.
- b) *Operation.* Tests shall be conducted to ensure that starting, idling, acceleration, vibration, over-speeding and other characteristics are satisfactory and to demonstrate adequate margins of freedom from detonation, surge, flutter or other detrimental conditions as may be appropriate to the particular type engine.
- c) *Endurance.* Tests of sufficient duration shall be conducted at such powers, thrust, speeds, temperatures and other operating conditions as are necessary to demonstrate reliability and durability of the engine. They shall also include operation under conditions in excess of the declared limits to the extent that such limitations might be exceeded in actual service.
- d) *Operating Environment.* Tests shall be conducted to ensure that the engine characteristics are satisfactory with regard to the operating environment.



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## **PART VII. Propellers**

### **1 General**

#### **1.1 Applicability**

1.1.1 The Standards of this part are applicable to all propellers, as required in Parts IIIB and V. The Standards of this part are applicable to a propeller at the time of submission of an application to CAAM for a type approval.

1.1.2 The level of airworthiness defined by the appropriate parts of the comprehensive and detailed national code for the propellers designated in 1.1.1 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.

#### **1.2 Declared ratings, conditions and limitations**

The power ratings and all operating conditions and limitations which are intended to govern the operation of the propeller shall be declared.

#### **1.3 Continuing airworthiness — maintenance information**

##### **1.3.1 General**

Information for use in developing procedures for maintaining the propeller in an airworthy condition shall be made available. The information shall include that described in 1.3.2, 1.3.3 and 1.3.4.

##### **1.3.2 Maintenance information**

Maintenance information shall include a description of the propeller and recommended methods for the accomplishment of maintenance tasks. Such information shall include guidance on defect diagnosis.

##### **1.3.3 Maintenance programme information**

Maintenance programme information shall include the maintenance tasks and the recommended intervals at which these tasks are to be performed.

##### **1.3.4 Mandatory maintenance requirements resulting from the type design approval**

Mandatory maintenance requirements that have been specified by the State of Design as part of the approval of the type design shall be identified as such and included in the maintenance information of 1.3.3.



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## **2 Design And Construction**

### **2.1 Functioning**

The propeller assembly shall be designed and constructed so as to function reliably within its operating limitations under its anticipated operating conditions when installed in accordance with Parts III B and V of this CAD and shown to be not hazardous.

### **2.2 Failure analysis**

A safety assessment of the propeller shall be conducted to ensure that it functions safely throughout the full range of operating conditions. A summary shall be made of those failures which could result in hazardous propeller effects. If the primary failure of single elements (for example, blades) is likely to result in hazardous propeller effects, reliance shall be placed on meeting prescribed integrity requirements.

### **2.3 Materials and manufacturing methods**

The selection of materials and the manufacturing methods and processes shall account for the operational environment of the propeller expected in service. The materials and manufacturing methods and processes used in the construction of the propeller shall result in known and reproducible structural behaviour.

### **2.4 Pitch control and indication**

2.4.1 No loss of normal propeller pitch control shall cause a hazardous overspeeding under anticipated operating conditions.

2.4.2 No single failure or malfunction in the propeller control system during normal or emergency operation shall result in unintended travel of the propeller blades to a position below the in-flight low-pitch position. Failure of structural elements need not be considered if the occurrence of such a failure is shown to be extremely remote.



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### **3 Tests And Inspections**

#### **3.1 Blade retention test**

Propeller assemblies with detachable blades shall be subjected to a centrifugal load with sufficient margin to ensure that the hub and blade retention system will operate satisfactorily and reliably under the expected loads in service under all anticipated operating conditions.

#### **3.2 Operational and endurance tests**

The propeller shall satisfactorily complete such tests as are necessary to ensure that it will operate satisfactorily and reliably within the declared ratings, conditions and limitations. The tests shall include at least the following:

- a) *Function*. Tests shall be conducted to demonstrate proper and reliable functioning of the pitch control system.
- b) *Endurance*. Tests of sufficient duration shall be conducted at such powers, speeds and other operating conditions as are necessary to demonstrate reliability and durability of the propeller.
- c) *Operating environment*. Except for fixed pitch wood propellers, it shall be demonstrated by tests or analysis based on tests or experience on similar designs, that the propeller is capable of withstanding the likely impact of a bird or a lightning strike without causing a hazardous propeller effect.



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