International Standards
and Recommended Practices

Annex 8
to the Convention on
International Civil Aviation

Airworthiness of Aircraft

This edition incorporates all amendments adopted by the Council prior to 25 February 2010 and supersedes, on 18 November 2010, all previous editions of Annex 8.

For information regarding the applicability of the Standards and Recommended Practices, *see* sections 1.1, 2.1, 3.1 and 4.1 of Part II, 1.1 of Parts IIIA and IVA, 1.1 of Parts IIIB, IVB, V, VI and VII, and the Foreword.

Eleventh Edition
July 2010

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TABLE OF CONTENTS

	Page
FOREWORD	(xv)
PART I. DEFINITIONS	I-1
PART II. PROCEDURES FOR CERTIFICATION AND CONTINUING AIRWORTHINESS	II-1-1
CHAPTER 1. Type certification	II-1-1
1.1 Applicability	II-1-1
1.2 Design aspects of the appropriate airworthiness requirements	II-1-1
1.3 Proof of compliance with the appropriate airworthiness requirements	II-1-2
1.4 Type Certificate	II-1-3
CHAPTER 2. Production	II-2-1
2.1 Applicability	II-2-1
2.2 Aircraft, engine and propeller production	II-2-1
2.3 Aircraft parts production	II-2-1
2.4 Production approval	II-2-1
CHAPTER 3. Certificate of Airworthiness	II-3-1
3.1 Applicability	II-3-1
3.2 Issuance and continued validity of a Certificate of Airworthiness	II-3-1
3.3 Standard form of Certificate of Airworthiness	II-3-2
3.4 Aircraft limitations and information	II-3-2
3.5 Temporary loss of airworthiness	II-3-2
3.6 Damage to aircraft	II-3-2
CHAPTER 4. Continuing airworthiness	II-4-1
4.1 Applicability	II-4-1
4.2 Responsibilities of Contracting States in respect of continuing airworthiness	II-4-1
CHAPTER 5. Safety management	II-5-1
PART III. LARGE AEROPLANES	IIIA-1-1
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	IIIA-1-1
CHAPTER 1. General	IIIA-1-1
1.1 Applicability	IIIA-1-1
1.2 Number of engines	IIIA-1-1
1.3 Operating limitations	IIIA-1-2

		Page
1.4	Unsafe features and characteristics	IIIA-1-2
1.5	Proof of compliance	IIIA-1-2
CHAPTER 2.	Flight	IIIA-2-1
2.1	General	IIIA-2-1
2.2	Performance	IIIA-2-1
2.3	Flying qualities	IIIA-2-3
CHAPTER 3.	Structures	IIIA-3-1
3.1	General	IIIA-3-1
3.2	Airspeeds	IIIA-3-1
3.3	Flight loads	IIIA-3-2
3.4	Ground and water loads	IIIA-3-2
3.5	Miscellaneous loads	IIIA-3-3
3.6	Flutter, divergence and vibration	IIIA-3-3
3.7	Fatigue strength	IIIA-3-3
CHAPTER 4.	Design and construction	IIIA-4-1
4.1	General	IIIA-4-1
CHAPTER 5.	Engines	IIIA-5-1
5.1	Scope	IIIA-5-1
5.2	Design, construction and functioning	IIIA-5-1
5.3	Declared ratings, conditions and limitations	IIIA-5-1
5.4	Tests	IIIA-5-1
CHAPTER 6.	Propellers	IIIA-6-1
6.1	Scope	IIIA-6-1
6.2	Design, construction and functioning	IIIA-6-1
6.3	Declared ratings, conditions and limitations	IIIA-6-1
6.4	Tests	IIIA-6-1
CHAPTER 7.	Powerplant installation	IIIA-7-1
7.1	General	IIIA-7-1
7.2	Arrangement and functioning	IIIA-7-1
CHAPTER 8.	Instruments and equipment	IIIA-8-1
8.1	Required instruments and equipment	IIIA-8-1
8.2	Installation	IIIA-8-1
8.3	Safety and survival equipment	IIIA-8-1
8.4	Navigation lights and anti-collision lights	IIIA-8-1
CHAPTER 9.	Operating limitations and information	IIIA-9-1
9.1	General	IIIA-9-1
9.2	Operating limitations	IIIA-9-1
9.3	Operating information and procedures	IIIA-9-2
9.4	Performance information	IIIA-9-3
9.5	Aeroplane flight manual	IIIA-9-3
9.6	Markings and placards	IIIA-9-3

Page

CHAPTER 10. Continuing airworthiness — maintenance information IIIA-10-1
10.1 General IIIA-10-1
10.2 Maintenance information IIIA-10-1
10.3 Maintenance programme information IIIA-10-1
10.4 Maintenance information resulting from the type design approval IIIA-10-1

CHAPTER 11. Security IIIA-11-1
11.1 Aeroplanes used for domestic commercial operations IIIA-11-1
11.2 Least-risk bomb location IIIA-11-1
11.3 Protection of the flight crew compartment IIIA-11-1
11.4 Interior design IIIA-11-1

PART IIIB. Aeroplanes over 5 700 kg for which application for certification was submitted on or after 2 March 2004 .... IIIB-1-1

CHAPTER 1. General IIIB-1-1
1.1 Applicability IIIB-1-1
1.2 Operating limitations IIIB-1-1
1.3 Unsafe features and characteristics IIIB-1-2
1.4 Proof of compliance IIIB-1-2

CHAPTER 2. Flight IIIB-2-1
2.1 General IIIB-2-1
2.2 Performance IIIB-2-1
2.3 Flying qualities IIIB-2-3
2.4 Stability and control IIIB-2-4

CHAPTER 3. Structure IIIB-3-1
3.1 General IIIB-3-1
3.2 Mass and mass distribution IIIB-3-1
3.3 Limit loads IIIB-3-1
3.4 Strength and deformation IIIB-3-1
3.5 Airspeeds IIIB-3-1
3.6 Strength IIIB-3-2
3.7 Survivability IIIB-3-2
3.8 Structural durability IIIB-3-3
3.9 Special factors IIIB-3-4

CHAPTER 4. Design and construction IIIB-4-1
4.1 General IIIB-4-1
4.2 Systems design features IIIB-4-2
4.3 Aeroelasticity IIIB-4-4
4.4 Occupants accommodation features IIIB-4-4
4.5 Electrical bonding and protection against lightning and static electricity IIIB-4-4
4.6 Emergency landing provisions IIIB-4-4
4.7 Ground handling IIIB-4-5

Page

CHAPTER 5. Powerplant IIIB-5-1
5.1 Engines IIIB-5-1
5.2 Propellers IIIB-5-1
5.3 Powerplant installation IIIB-5-1

CHAPTER 6. Systems and equipment IIIB-6-1
6.1 General IIIB-6-1
6.2 Installation IIIB-6-2
6.3 Safety and survival equipment IIIB-6-2
6.4 Navigation lights and anti-collision lights IIIB-6-2
6.5 Electromagnetic interference protection IIIB-6-2
6.6 Ice protection IIIB-6-2

CHAPTER 7. Operating limitations and information IIIB-7-1
7.1 General IIIB-7-1
7.2 Operating limitations IIIB-7-1
7.3 Operating information and procedures IIIB-7-2
7.4 Performance information IIIB-7-3
7.5 Flight manual IIIB-7-3
7.6 Markings and placards IIIB-7-3
7.7 Continuing airworthiness — maintenance information IIIB-7-3

CHAPTER 8. Crashworthiness and cabin safety IIIB-8-1
8.1 General IIIB-8-1
8.2 Design emergency landing loads IIIB-8-1
8.3 Cabin fire protection IIIB-8-1
8.4 Evacuation IIIB-8-2
8.5 Lighting and marking IIIB-8-2
8.6 Survival equipment IIIB-8-2

CHAPTER 9. Operating environment and Human Factors IIIB-9-1
9.1 General IIIB-9-1
9.2 Flight crew IIIB-9-1
9.3 Ergonomics IIIB-9-1
9.4 Operating environmental factors IIIB-9-2

CHAPTER 10. Security IIIB-10-1
10.1 Aeroplanes used for domestic commercial operations IIIB-10-1
10.2 Least-risk bomb location IIIB-10-1
10.3 Protection of the flight crew compartment IIIB-10-1
10.4 Interior design IIIB-10-1

PART IV. HELICOPTERS IVA-1-1

PART IVA. Helicopters for which application for certification was submitted on or after 22 March 1991 but before 13 December 2007 .... IVA-1-1

CHAPTER 1. General IVA-1-1
1.1 Applicability IVA-1-1
1.2 Limitations IVA-1-1

Page

1.3 Unsafe features and characteristics IVA-1-2
1.4 Proof of compliance IVA-1-2

CHAPTER 2. Flight........ IVA-2-1
2.1 General IVA-2-1
2.2 Performance IVA-2-1
2.3 Flying qualities........ IVA-2-3

CHAPTER 3. Structures........ IVA-3-1
3.1 General IVA-3-1
3.2 Airspeeds........ IVA-3-1
3.3 Main rotor(s) rotational speed limits IVA-3-2
3.4 Flight loads........ IVA-3-2
3.5 Ground and water loads........ IVA-3-2
3.6 Miscellaneous loads IVA-3-2
3.7 Flutter, divergence and vibration........ IVA-3-3
3.8 Fatigue strength........ IVA-3-3

CHAPTER 4. Design and construction........ IVA-4-1
4.1 General IVA-4-1

CHAPTER 5. Engines IVA-5-1
5.1 Scope........ IVA-5-1
5.2 Design, construction and functioning........ IVA-5-1
5.3 Declared ratings, conditions and limitations IVA-5-1
5.4 Tests IVA-5-1

CHAPTER 6. Rotor and power transmission systems and powerplant installation........ IVA-6-1
6.1 General IVA-6-1
6.2 Design, construction and functioning........ IVA-6-1
6.3 Declared ratings, conditions and limitations IVA-6-1
6.4 Tests IVA-6-1
6.5 Compliance with engine and rotor and power transmission systems limitations IVA-6-2
6.6 Control of engine rotation IVA-6-2
6.7 Engine restarting IVA-6-2
6.8 Arrangement and functioning........ IVA-6-2

CHAPTER 7. Instruments and equipment........ IVA-7-1
7.1 Required instruments and equipment IVA-7-1
7.2 Installation........ IVA-7-1
7.3 Safety and survival equipment IVA-7-1
7.4 Navigation lights and anti-collision lights........ IVA-7-1

CHAPTER 8. Electrical systems IVA-8-1

CHAPTER 9. Operating limitations and information........ IVA-9-1
9.1 General IVA-9-1
9.2 Operating limitations........ IVA-9-1
9.3 Operating information and procedures........ IVA-9-2
9.4 Performance information........ IVA-9-3

Page

9.5 Helicopter flight manual IVA-9-3
9.6 Markings and placards IVA-9-3

PART IVB. Helicopters for which application for certification was submitted on or after 13 December 2007 .... IVB-1-1

CHAPTER 1. General IVB-1-1
1.1 Applicability IVB-1-1
1.2 Operating limitations IVB-1-1
1.3 Unsafe features and characteristics IVB-1-2
1.4 Proof of compliance IVB-1-2

CHAPTER 2. Flight IVB-2-1
2.1 General IVB-2-1
2.2 Performance IVB-2-1
2.3 Flying qualities IVB-2-3
2.4 Stability and control IVB-2-4

CHAPTER 3. Structure IVB-3-1
3.1 General IVB-3-1
3.2 Mass and mass distribution IVB-3-1
3.3 Limit loads IVB-3-1
3.4 Strength and deformation IVB-3-1
3.5 Airspeeds IVB-3-1
3.6 Main rotor(s) rotational speed limits IVB-3-2
3.7 Loads IVB-3-2
3.8 Ground and water loads IVB-3-2
3.9 Miscellaneous loads IVB-3-3
3.10 Fatigue strength IVB-3-3
3.11 Special factors IVB-3-3

CHAPTER 4. Design and construction IVB-4-1
4.1 General IVB-4-1
4.2 Systems design features IVB-4-2
4.3 Flutter IVB-4-2
4.4 Occupant accommodation features IVB-4-2
4.5 Electrical bonding and protection against lightning and static electricity IVB-4-3
4.6 Emergency landing provisions IVB-4-3
4.7 Ground handling IVB-4-3

CHAPTER 5. Rotors and powerplant IVB-5-1
5.1 Engines IVB-5-1
5.2 Rotors and powerplant installation IVB-5-1

CHAPTER 6. Systems and equipment IVB-6-1
6.1 General IVB-6-1
6.2 Installation IVB-6-2
6.3 Safety and survival equipment IVB-6-2

Page

6.4 Navigation lights and anti-collision lights IVB-6-2
6.5 Electromagnetic interference protection IVB-6-2
6.6 Ice protection IVB-6-2

CHAPTER 7. Operating limitations and information IVB-7-1
7.1 General IVB-7-1
7.2 Operating limitations IVB-7-1
7.3 Operating information and procedures IVB-7-2
7.4 Performance information IVB-7-3
7.5 Flight manual IVB-7-3
7.6 Markings and placards IVB-7-3
7.7 Continuing airworthiness — maintenance information IVB-7-3

CHAPTER 8. Crashworthiness and cabin safety IVB-8-1
8.1 General IVB-8-1
8.2 Design emergency landing loads IVB-8-1
8.3 Cabin fire protection IVB-8-1
8.4 Evacuation IVB-8-1
8.5 Lighting and marking IVB-8-2

CHAPTER 9. Operating environment and Human Factors IVB-9-1
9.1 General IVB-9-1
9.2 Flight crew IVB-9-1
9.3 Ergonomics IVB-9-1
9.4 Operating environmental factors IVB-9-2

PART V. SMALL AEROPLANES — AEROPLANES OVER 750 KG BUT NOT EXCEEDING 5 700 KG FOR WHICH APPLICATION FOR CERTIFICATION WAS SUBMITTED ON OR AFTER 13 DECEMBER 2007 .... V-1-1

CHAPTER 1. General V-1-1
1.1 Applicability V-1-1
1.2 Operating limitations V-1-1
1.3 Unsafe features and characteristics V-1-2
1.4 Proof of compliance V-1-2

CHAPTER 2. Flight V-2-1
2.1 General V-2-1
2.2 Performance V-2-1
2.3 Flying qualities V-2-3
2.4 Stability and control V-2-4

CHAPTER 3. Structure V-3-1
3.1 General V-3-1
3.2 Mass and mass distribution V-3-1
3.3 Limit loads V-3-1
3.4 Strength and deformation V-3-1
3.5 Airspeeds V-3-1

Page

3.6 Strength V-3-2
3.7 Survivability V-3-2
3.8 Structural durability V-3-2
3.9 Special factors V-3-3

CHAPTER 4. Design and construction V-4-1
4.1 General V-4-1
4.2 Systems design features V-4-2
4.3 Aeroelasticity V-4-3
4.4 Occupant accommodation features V-4-3
4.5 Electrical bonding and protection against lightning and static electricity V-4-3
4.6 Emergency landing provisions V-4-3
4.7 Ground handling V-4-4

CHAPTER 5. Powerplant V-5-1
5.1 Engines V-5-1
5.2 Propellers V-5-1
5.3 Powerplant installation V-5-1

CHAPTER 6. Systems and equipment V-6-1
6.1 General V-6-1
6.2 Installation V-6-2
6.3 Safety and survival equipment V-6-2
6.4 Navigation lights and anti-collision lights V-6-2
6.5 Electromagnetic interference protection V-6-2
6.6 Ice protection V-6-2

CHAPTER 7. Operating limitations and information V-7-1
7.1 General V-7-1
7.2 Operating limitations V-7-1
7.3 Operating information and procedures V-7-2
7.4 Performance information V-7-2
7.5 Flight manual V-7-3
7.6 Markings and placards V-7-3
7.7 Continuing airworthiness — maintenance information V-7-3

CHAPTER 8. Crashworthiness and cabin safety V-8-1
8.1 General V-8-1
8.2 Design emergency landing loads V-8-1
8.3 Cabin fire protection V-8-1
8.4 Evacuation V-8-2
8.5 Lighting and marking V-8-2

CHAPTER 9. Operating environment and Human Factors V-9-1
9.1 General V-9-1
9.2 Flight crew V-9-1
9.3 Ergonomics V-9-1
9.4 Operating environmental factors V-9-2

Page

PART VI. ENGINES VI-1-1

CHAPTER 1. General VI-1-1
1.1 Applicability VI-1-1
1.2 Engine installation and interfaces VI-1-1
1.3 Declared ratings, conditions and limitations VI-1-1
1.4 Continuing airworthiness — maintenance information VI-1-1

CHAPTER 2. Design and construction VI-2-1
2.1 Functioning VI-2-1
2.2 Failure analysis VI-2-1
2.3 Materials and manufacturing methods VI-2-1
2.4 Integrity VI-2-1

CHAPTER 3. Tests VI-3-1

PART VII. PROPELLERS VII-1-1

CHAPTER 1. General VII-1-1
1.1 Applicability VII-1-1
1.2 Declared ratings, conditions and limitations VII-1-1
1.3 Continuing airworthiness — maintenance information VII-1-1

CHAPTER 2. Design and construction VII-2-1
2.1 Functioning VII-2-1
2.2 Failure analysis VII-2-1
2.3 Materials and manufacturing methods VII-2-1
2.4 Pitch control and indication VII-2-1

CHAPTER 3. Tests and inspection VII-3-1
3.1 Blade retention test VII-3-1
3.2 Operational and endurance tests VII-3-1

FOREWORD

Historical background

Standards and Recommended Practices for the Airworthiness of Aircraft were adopted by the Council on 1 March 1949 pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as Annex 8 to the Convention.

The Annex contained, in Part II, general airworthiness procedures applicable to all aircraft and in Part III, minimum airworthiness characteristics for aeroplanes provided, or to be provided, with certificates of airworthiness classifying them in an established ICAO category. Part I contained definitions.

At its fourth session, the Airworthiness Division collaborating with the Operations Division made recommendations concerning the use of a performance code as an alternative to the one contained in the Annex, in which the climb values had the status of Recommended Practices. Further, the Airworthiness Division made recommendations concerning certain aspects of the certification in ICAO categories. As a result of those recommendations, the Council approved the incorporation of the alternative performance code as Attachment A but stated its belief that since agreement had not yet been reached on Standards covering performance, there existed no basis for certification in ICAO Category A. It urged the Contracting States to refrain from such certification pending the becoming effective of Standards on performance or until such time as the Council decides on the basic policy on airworthiness.

The Assembly at its seventh session (June 1953) endorsed the action already taken by the Council and the Air Navigation Commission to initiate a fundamental study of ICAO policy on international airworthiness and directed the Council to complete the study as rapidly as practicable.

In pursuing such study, the Air Navigation Commission was helped by an international body of experts designated as the "Airworthiness Panel", which contributed to the preparation of the work of the Third Air Navigation Conference.

As a result of these studies, a revised policy on international airworthiness was developed and it was approved by the Council in 1956. According to this policy, the principle of certification in an ICAO Category was abandoned. Instead, Annex 8 included broad Standards which defined, for application by the competent national authorities, the complete minimum international basis for the recognition by States of certificates of airworthiness for the purpose of the flight of aircraft of other States into or over their territories, thereby achieving, among other purposes, protection of other aircraft, third persons and property. It was considered that this met the obligation of the Organization under Article 37 of the Convention to adopt International Standards of airworthiness.

It was recognized that the ICAO Standards of airworthiness would not replace national regulations and that national codes of airworthiness containing the full scope and extent of detail considered necessary by individual States would be necessary as the basis for the certification of individual aircraft. Each State would establish its own comprehensive and detailed code of airworthiness or would select a comprehensive and detailed code established by another Contracting State. The level of airworthiness defined by this code would be indicated by the Standards, supplemented, if necessary, by Acceptable Means of Compliance.

In application of those principles, the Annex was declared as constituting the minimum standards for the purpose of Article 33. It was also recognized that the Annex might, at the time of adoption, not include technical Standards for all classes of aircraft or even for all classes of aeroplanes, if the Council felt that no technical Standards were required at that time to render Article 33 operative. Furthermore, adoption or amendment of the Annex declared to be complete for the purpose of Article 33 did not constitute the end of ICAO's work in the airworthiness field, as there was a need to continue international collaboration in airworthiness matters.

A revised text for Annex 8 consistent with the above principles was prepared on the basis of the recommendations made by the Third Air Navigation Conference (Montréal, September–October 1956). Part III of the Annex was limited to broad Standards stating the objectives rather than the methods of realizing those objectives. However, to indicate by examples the level of airworthiness intended by some of the broad Standards, specifications of a more detailed and quantitative nature were included under the title "Acceptable Means of Compliance". These specifications were intended to assist the Contracting States in the establishment and application of comprehensive and detailed national airworthiness codes.

To adopt a code giving an appreciably lower level of airworthiness than that given in an Acceptable Means of Compliance was considered to be a violation of the Standard supplemented by that Acceptable Means of Compliance.

The revised text for Annex 8 was included in the Fourth Edition of the Annex, which superseded the First, Second and Third Editions.

Another recommendation of the Third Air Navigation Conference led to the establishment by the Council in 1957 of the Airworthiness Committee, consisting of airworthiness experts with broad experience and selected from those Contracting States and International Organizations willing to contribute.

Present policy on international airworthiness. There had been some concern about the slow progress that had been made over the years with respect to developing supplementary airworthiness specifications in the form of Acceptable Means of Compliance. It was noted that the majority of the Acceptable Means of Compliance in Annexes 6 and 8 had been developed in 1957 and were therefore applicable to only those aeroplane types operating at that time. No effort had been made to update the specifications in these Acceptable Means of Compliance nor had there been any recommendations from the Airworthiness Committee for upgrading of any of the Provisional Acceptable Means of Compliance, which had been developed as potential material for full-fledged Acceptable Means of Compliance. The Air Navigation Commission therefore requested the Airworthiness Committee to review the progress made by it since its inception with a view to determining whether or not desired results had been achieved and to recommend any changes to improve the development of detailed airworthiness specifications.

The Airworthiness Committee at its Ninth Meeting (Montréal, November/December 1970) made a detailed study of the problems and recommended that the concept of developing airworthiness specifications in the form of Acceptable Means of Compliance and Provisional Acceptable Means of Compliance be abandoned and a provision be made for an airworthiness technical manual to be prepared and published by ICAO to include guidance material intended to facilitate the development and uniformity of national airworthiness codes by Contracting States.

The Air Navigation Commission reviewed the recommendations of the Airworthiness Committee in the light of the history of the development of the airworthiness policy approved by the Council in 1956. It came to the conclusion that the basic objectives and principles on which the ICAO airworthiness policy had been based were sound and did not require any significant change. It was also concluded that the main reason for the slow progress in the development of airworthiness specifications in the form of Acceptable Means of Compliance and Provisional Acceptable Means of Compliance was the degree of mandatory status to the former implied by the following statement included in the Forewords of the Fourth and Fifth Editions of Annex 8:

> "To adopt a code giving an appreciably lower level of airworthiness than that given in an Acceptable Means of Compliance would be a violation of the Standard supplemented by that Acceptable Means of Compliance."

Several approaches were examined by the Air Navigation Commission to eliminate this difficulty. Finally, it came to the conclusion that the idea of developing airworthiness specifications in the form of Acceptable Means of Compliance and Provisional Acceptable Means of Compliance should be abandoned and ICAO should declare that the States' obligations, for the purpose of Article 33 of the Convention, shall be met by their compliance with the broad Standards in Annex 8 supplemented, as necessary, by airworthiness technical guidance material, devoid of all mandatory implications or obligations. Also the requirement that each Contracting State should either establish its own comprehensive and detailed code of airworthiness or select a comprehensive and detailed code established by another Contracting State should be retained.

The Council on 15 March 1972 approved the above approach to form the basis for the present policy of ICAO in the field of airworthiness. According to this policy:

a) the objective of international airworthiness Standards is to define, for application by the competent national authorities, the minimum level of airworthiness constituting the international basis for the recognition by States, under Article 33 of the Convention, of certificates of airworthiness for the purpose of the flight of aircraft of other States into or over their territories, thereby achieving, among other things, protection of other aircraft, third parties and property;

b) the Standards developed to meet the objective stated in a) are considered by the Council as meeting, in the necessary scope and detail, the obligations of the Organization under Article 37 of the Convention to adopt International Standards of airworthiness;

c) international airworthiness Standards adopted by the Council are recognized as being the complete international code necessary to bring into force and effect the rights and obligations which arise under Article 33 of the Convention;

d) the technical airworthiness Standards in Annex 8 shall be presented as broad specifications stating the objectives rather than the means of realizing these objectives; ICAO recognizes that national codes of airworthiness containing the full scope and extent of detail considered necessary by individual States are required as the basis for the certification by individual States of airworthiness of each aircraft;

e) to assist States in applying the Standards of Annex 8 and in developing their own comprehensive national codes in a uniform manner, detailed guidance material shall be developed and published expeditiously in the working languages of the Organization.

The Council also approved the issuance of the airworthiness guidance material under the title of *Airworthiness Technical Manual*. It was understood that the guidance material will, before issuance, be examined by the Air Navigation Commission. It will however have no formal status and its main purpose would be to provide guidance to Contracting States in developing the appropriate airworthiness requirements mentioned in 3.2.2 of Part II of the Annex.

A text for Annex 8 consistent with the policy on international airworthiness, approved by the Council on 15 March 1972, was developed by the Air Navigation Commission.

Table A shows the origin of amendments together with a list of the principal subjects involved and the dates on which the Annex and the amendments were adopted by the Council, when they became effective and when they became applicable.

On 6 June 2000, the Air Navigation Commission reviewed the recommendation of the Continuing Airworthiness Panel and the Airworthiness Study Group, in light of the introduction of the type certification process, to introduce the Type Certificate concept. It came to the conclusion that this internationally used and known certificate was already introduced in the *Airworthiness Technical Manual* (Doc 9051) and that its introduction complements the type certification process, making the text of Annex 8 consistent with its international airworthiness use.

It was further noted that the State of Registry, which is in charge of the issuance or validation of Certificates of Airworthiness by virtue of Article 31 of the Convention, and the State of Design may be different States, with separate functions and duties, and two independent responsibilities. Accordingly, the requirements governing the issuance of Type Certificates in accordance with applicable provisions of Annex 8 are not part of "the minimum standards" which govern the issuance or validation of Certificates of Airworthiness, and lead to the recognition of their validity pursuant to Article 33 of the Convention.

On 7 October 2003, the Air Navigation Commission reviewed the recommendations of the Airworthiness Panel and in light of the observation that small aircraft of a maximum certificated take-off mass greater than 750 kg but not exceeding 5 700 kg are more engaged in international air navigation, it agreed to include in the Annex, for the first time, airworthiness Standards for small aeroplanes, making the text of Annex 8 consistent with its international use.

Applicability

The applicability of the Standards is indicated in 1.1, 2.1, 3.1 and 4.1 of Part II, in 1.1 of Parts IIIA and IVA, and in 1.1 of Parts IIIB, IVB, V, VI and VII. The dates were established so as to take account of the provisions of Article 41 of the Convention. However, the Council has recommended that, as far as practicable, earlier dates be applied.

Related Standards of Annex 6, Part I. Chapter 5 of Annex 6, Part I, dealing with aeroplane performance operating limitations contains Standards that are complementary to the airworthiness Standards of Annex 8. Both state broad objectives. The Standards of Annex 6, Part I, Chapter 5, are supplemented by guidance material in the form of green page attachments which indicate by examples the level of performance intended by the Standards.

The Council has urged Contracting States not to impose on visiting aeroplanes operational requirements other than those established by the State of Registry, provided those requirements are not lower than the Standards of Chapter 5 of Annex 6, Part I, as amended by Amendment 2, 2.2 of Part IIIA and 2.2 of Parts IIIB, IVB and V of this edition of Annex 8.

Action by Contracting States

Notification of differences. The attention of Contracting States is drawn to the obligation imposed by Article 38 of the Convention by which Contracting States are required to notify the Organization of any differences between their national regulations and practices and the International Standards contained in this Annex and any amendments thereto. Contracting States are invited to keep the Organization currently informed of any differences which may subsequently occur or of the withdrawal of any differences previously notified. A specific request for notification of differences will be sent to Contracting States immediately after the adoption of each Amendment to this Annex.

Use of the text of the Annex in national regulations. The Council, on 13 April 1948, adopted a resolution inviting the attention of Contracting States to the desirability of using in their own national regulations, as far as practicable, the precise language of those ICAO Standards which are of a regulatory character and also of indicating departures from the Standards, including any additional regulations that are important for the safety or regularity of air navigation. Wherever possible, the provisions of Part II of this Annex have been written in such a way as would facilitate incorporation, without major textual changes, into national legislation. The provisions of Parts IIIA and IIIB of this Annex, on the other hand, are applicable to aeroplanes through the medium of national codes more comprehensive and detailed than the Standards, so that the Council Resolution of 13 April 1948 does not apply to Parts IIIA and IIIB.

Information concerning the national codes establishing compliance with the Annex. States are invited to notify the Organization either of the establishment or of the selection of the comprehensive and appropriate airworthiness requirements mentioned in 3.2.2 of Part II. States that establish such codes are invited to forward a copy of each with its successive amendments, and any appropriate interpretation document concerning them. States that select codes of other Contracting States to comply with 3.2.2 of Part II are invited to indicate the codes that they intend to use.

Use of the guidance material in the Airworthiness Manual *(Doc 9760).* Contracting States are invited to note that the material in the *Airworthiness Manual* is intended to guide them in the development of their detailed and comprehensive national codes with a view to introducing uniformity in those national codes. The material has no mandatory status and

Contracting States are quite free to differ from it either in detail or in methods. States are also not required to notify any differences that may exist between their detailed national regulations and practices and the relevant material in the *Airworthiness Manual*.

Status of Annex components

An Annex is made up of the following component parts, not all of which, however, are necessarily found in every Annex; they have the status indicated.

1.— *Material comprising the Annex proper*

a) *Standards* and *Recommended Practices* adopted by the Council under the provisions of the Convention. They are defined as follows:

   Standard: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.

   Recommended Practice: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention.

b) *Appendices* comprising material grouped separately for convenience but forming part of the Standards and Recommended Practices adopted by the Council.

c) *Definitions* of 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.

d) *Tables* and *Figures*, which 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.

2.— *Material approved by the Council for publication in association with the Standards and Recommended Practices*

a) *Forewords* comprising historical and explanatory material based on the action of the Council and including an explanation of the obligations of States with regard to the application of the Standards and Recommended Practices ensuing from the Convention and the Resolution of Adoption.

b) *Introductions* comprising explanatory material introduced at the beginning of parts, chapters or sections of the Annex to assist in the understanding of the application of the text.

c) *Notes* included in the text, where appropriate, to give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices.

d) *Attachments* comprising material supplementary to the Standards and Recommended Practices or included as a guide to their application.

Selection of language

This Annex has been adopted in six languages — English, Arabic, Chinese, French, Russian and Spanish. Each Contracting State is requested to select one of those texts for the purpose of national implementation and for other effects provided for in the Convention, either through direct use or through translation into its own national language, and to notify the Organization accordingly.

Editorial practice

The following practice has been adhered to in order to indicate at a glance the status of each statement: *Standards* have been printed in light face roman; *Recommended Practices* have been printed in light face italics, the status being indicated by the prefix **Recommendation**; *Notes* have been printed in light face italics, the status being indicated by the prefix *Note*.

The following editorial practice has been followed in the writing of specifications: for Standards the operative verb "shall" is used, and for Recommended Practices the operative verb "should" is used.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in Annex 5. Where Annex 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.

Table A. Amendments to Annex 8

Amendment(s)	*Source(s)*	*Subject(s)*	*Adopted* *Effective* *Applicable*
1st Edition	First and Second Sessions of the Airworthiness Division (1946 and 1947)	—	1 March 1949 1 August 1949 1 September 1949
1 to 63 (2nd Edition)	Third and Fourth Sessions of the Airworthiness Division (1949 and 1951)	—	26 January 1950 1 January 1951 1 February 1951
64 to 83	Third and Fourth Sessions of the Airworthiness Division (1949 and 1951)	—	13 November 1951 15 April 1952 15 May 1952
84 (3rd Edition)	Fourth Session of the Airworthiness Division (1951)	Incorporation of an alternative performance code as an attachment.	2 December 1952 1 May 1953 1 June 1953

Amendment(s)	*Source(s)*	*Subject(s)*	*Adopted Effective Applicable*
85 (4th Edition)	Third Air Navigation Conference (1956)	Revised text consistent with new policy on international airworthiness approved by the Council; Part III of Annex 8 limited to broad Standards stating objectives with more detailed examples of the level of airworthiness intended being included as “Acceptable Means of Compliance”.	13 June 1957 1 October 1957 1 December 1957 or 13 June 1960 depending on date of application for certification for the aeroplane
86 (5th Edition)	Fourth Meeting of the Airworthiness Committee	Amendment of Standards for navigation lights and introduction of requirements for anti-collision lights.	13 December 1961 1 April 1962 13 December 1964
87	Proposal of the United States Committee on the Extension to the Standard Atmosphere	Redefinition of the standard atmosphere.	12 November 1963 1 April 1964 12 November 1966
88	Consequence of Amendment 2 to Annex 7	Revised definition of aircraft; revision of 2.2.3.2 b) of Part III to cater for 3-engined aeroplanes.	8 November 1967 8 March 1968 22 August 1968
89	Consequence of the adoption of Annex 16	Introduction of a reference to noise certification Standards in Annex 16 and Annex 6.	2 April 1971 2 August 1971 6 January 1972
90	Ninth Meeting of the Airworthiness Committee (1970)	Deletion of two Acceptable Means of Compliance for aeroplane performance from the 5th Edition.	10 December 1971 10 April 1972 7 December 1972
91 (6th Edition)	Council action following Ninth Airworthiness Committee	New text consistent with revised policy on airworthiness; deletion of Acceptable Means of Compliance; guidance material henceforth to appear in the *Airworthiness Technical Manual*.	16 March 1973 30 July 1973 23 May 1974
92	Tenth Meeting of the Airworthiness Committee	Introduction of provisions relating to the transmission of continuing airworthiness information; addition of a note concerning lease, charter and interchange of aircraft.	3 April 1974 3 August 1974 27 February 1975
93	Study by the Air Navigation Commission	Revision of the provisions relating to exterior lights to align with new provisions in Annexes 2 and 6.	22 March 1982 22 July 1982 22 March 1985
94 (7th Edition)	Fourteenth Meeting of the Airworthiness Committee (1981)	Introduction of a new provision relating to information on faults, malfunctions, defects and other occurrences and to include SI units in conformity with Annex 5 provisions.	6 December 1982 6 April 1983 24 November 1983
95 (8th Edition)	Proposal of States; Studies by the Council and Air Navigation Commission; Third Meeting of the HELIOPS Panel	Extension of the standard atmosphere; strengthened provisions relating to crash survival and fire protection; introduction of airworthiness provisions for helicopters.	22 March 1988 31 July 1988 22 March 1991
96	Third Meeting of the Continuing Airworthiness Panel (CAP/3)	Introduction of responsibilities of State of Design and definition thereof; revision of responsibilities of parties involved in transfer of information relating to continuing airworthiness; addition of new requirements concerning provision of maintenance information.	22 March 1994 25 July 1994 10 November 1994

Amendment(s)	*Source(s)*	*Subject(s)*	*Adopted Effective Applicable*
97	Secretariat study, assisted by ISAD Study Group	Changes to design features; identification of a least-risk bomb location and addition of a new Chapter 11 containing security-related provisions.	12 March 1997 21 July 1997 6 November 1997; 12 March 2000
98 (9th Edition)	Fifth Meeting of the Continuing Airworthiness Panel (CAP/5); Air Navigation Commission studies	a) New definitions of Human Factors principles, human performance, maintenance, repair, Type Certificate; b) restructuring of Part II into four chapters: Type Certificate, Production, Certificate of Airworthiness and Continuing Airworthiness; c) revision of the provisions in Part II to allow the introduction of type certificate concept and production control; d) restructuring of Part III into Part IIIA (same provisions as those contained in the current Part III of Annex 8, Eighth Edition, including Amendment 97, except for applicability clauses and cross-references) and Part IIIB (new); e) revision of provisions (old Part III) in Part IIIB pertaining to performance, stability, control, and cargo compartment fire protection, and new provisions pertaining to cabin environment, electrical bonding, emergency landing, electromagnetic interference, ice protection and systems software; f) the provision of translation into English for Certificates of Airworthiness; and g) new provisions concerning Human Factors.	2 March 2001 16 July 2001 2 March 2004
99	Air Navigation Commission studies	a) Revision of the title of Part IIIA; b) revision of applicability provisions to reflect the introduction of Recommended Practices in Annex 8 and to change the applicability of Parts IIIA and IIIB to make some provisions applicable only to large aeroplanes of a specific maximum certificated take-off mass and passenger seating capacity; c) revision of design, construction and security provisions in Annex 8, Parts IIIA and IIIB with regard to 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 an application for certification was submitted on or after 12 March 2000 and 2 March 2004, respectively, and introduction of Recommended Practices for aircraft of a maximum certificated take-off mass between 5 700 kg and 45 500 kg; d) introduction of Recommended Practices regarding security provisions for application to aeroplanes engaged in domestic commercial operations; e) introduction of security provisions for all aeroplanes which are required by Annex 6 to have an approved flight crew compartment door providing additional protection to also require additional protection of the bulkheads, floors and ceilings; and f) addition of provisions in Part IIIB for operating information and procedures to require the identification of a least-risk bomb location.	20 May 2003 13 October 2003 20 May 2006

Amendment(s)	*Source(s)*	*Subject(s)*	*Adopted Effective Applicable*
100 (10th Edition)	First meeting of the Airworthiness Panel	a) New definitions of Category A, Category B, discrete source damage, engine, fireproof, fire resistant and satisfactory evidence, new note to critical power-unit; b) amendment to the definition of repair; c) revision of the provisions of Part II to allow the introduction of new parts in the Annex, amend Chapter 3 to clarify provisions relating to the limiting conditions under which a damaged aircraft is permitted to fly uncommercially to an aerodrome where it can be restored to an airworthy condition, and re-organize Chapter 4 to clarify States' responsibilities; d) revision of provisions in Part IIIA pertaining to applicability and operating limitations, proof of compliance; e) revision of provisions in Part IIIB pertaining to applicability, operating limitations, performance, stability, structure, design and construction, powerplant, operating limitations, crashworthiness and cabin safety, operating environment and Human Factors; f) restructuring of Part IV into Part IVA (same provisions as those contained in Part IV of Annex 8, Ninth Edition including Amendment 99, except for applicability clauses and cross-references) and Part IVB (new); g) introduction of new Part V — *Small Aeroplanes,* Part VI — *Engines* and Part VII — *Propellers*.	13 December 2004 13 April 2005 13 December 2007
101	Secretariat	Amendment concerning the development of harmonized provisions relating to safety management on the implementation and maintenance of a State's safety programme from 18 November 2010 and the requirement for organizations responsible for the type design or manufacture of aircraft to implement a safety management system from 14 November 2013.	4 March 2009 20 July 2009 18 November 2010; 14 November 2013
102 (11th Edition)	Recommendations of the twelfth meeting of the Airworthiness Panel Working Group of the Whole (AIRP/WG/WHL/12); Secretariat proposal to restructure Annex 8	a) Amendment introduces new definitions in order to harmonize the use of terminology between Annexes 6 and 8; b) restructuring of Annex 8 so the format and structure align with other Annexes; c) adopts existing industry best practice, notably, updating aircraft design in order to reflect modern practice and specifies the applicability date of each amended design Standard.	24 February 2010 12 July 2010 18 November 2010; 24 February 2013
103	Secretariat	The amendment requires the design and manufacture of aircraft's fire extinguishing and/or suppression systems for engines, auxiliary power-units (APUs) and lavatories to use alternative fire extinguishing agents to halon.	13 June 2011 30 October 2011 31 December 2014
104	Special Meeting of the Safety Management Panel (SMP/SM/1)	The transfer of safety management provisions to Annex 19.	25 February 2013 15 July 2013 14 November 2013

Amendment(s)	*Source(s)*	*Subject(s)*	*Adopted* *Effective* *Applicable*
105-A	Airworthiness Panel (AIRP); Safety and Information Protection Task Force (SIP TF); First Meeting of the Safety Management Panel (SMP)	Provisions to recognize organizations responsible for the type design and manufacture of engines and propellers to support the extension of SMS applicability to these organizations	2 March 2016 11 July 2016 10 November 2016

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

PART I. DEFINITIONS

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

Aeroplane. 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. 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. 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. 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. The comprehensive and detailed airworthiness codes established, adopted or accepted by a Contracting State for the class of aircraft, engine or propeller under consideration (see 3.2.2 of Part II of this Annex).

Approved. Accepted by a Contracting State as suitable for a particular purpose.

Category A. With respect to helicopters, means a multi-engine helicopter designed with engine and system isolation features specified in Part IVB 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. 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). 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. 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). Any engine whose failure gives the most adverse effect on the aircraft characteristics relative to the case under consideration.

Note.— On some aircraft there may be more than one equally critical engine. In this case, the expression "the critical engine" means one of those critical engines.

Design landing mass. 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. 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. 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. 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. 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). 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. The capability to withstand the application of heat by a flame for a period of 15 minutes.

Note.— The characteristics of an acceptable flame can be found in ISO 2685.

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

Note.— The characteristics of an acceptable flame can be found in ISO 2685.

Helicopter. 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. 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. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Landing surface. 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. The maximum loads assumed to occur in the anticipated operating conditions.

Load factor. 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. The performance of tasks required to ensure the continuing airworthiness of an aircraft, including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.

Organization responsible for the type design. The organization that holds the type certificate, or equivalent document, for an aircraft, engine or propeller type, issued by a Contracting State.

Performance Class 1 helicopter. 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. 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. 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. 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. An atmospheric pressure expressed in terms of altitude which corresponds to that pressure in the Standard Atmosphere.

Rendering (a Certificate of Airworthiness) valid. The action taken by a Contracting State, as an alternative to issuing its own Certificate of Airworthiness, in accepting a Certificate of Airworthiness issued by any other Contracting State as the equivalent of its own Certificate of Airworthiness.

Repair. The restoration of an aeronautical product to an airworthy condition as defined by the appropriate airworthiness requirements.

Satisfactory evidence. A set of documents or activities that a Contracting State accepts as sufficient to show compliance with an airworthiness requirement.

Standard atmosphere. An atmosphere defined as follows:

a) the air is a perfect dry gas;

b) the physical constants are:

— Sea level mean molar mass:
$M_0 = 28.964\,420 \times 10^{-3}$ kg mol^{-1}
— Sea level atmospheric pressure:
$P_0 = 1\,013.250$ hPa
— Sea level temperature:
$t_0 = 15°C$
$T_0 = 288.15$ K

— Sea level atmospheric density:
ρ_0 = 1.225 0 kg m^{-3}
— Temperature of the ice point:
T_i = 273.15 K
— Universal gas constant:
R* = 8.314 32 $JK^{-1}mol^{-1}$

c) the temperature gradients are:

Geopotential altitude (km)		*Temperature gradient (Kelvin per standard geopotential kilometre)*
From	*To*	
–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

Note 1.— The standard geopotential metre has the value 9.80665 $m^2 s^{-2}$.

Note 2.— See Doc 7488 for the relationship between the variables and for tables giving the corresponding values of temperature, pressure, density and geopotential.

Note 3.— Doc 7488 also gives the specific weight, dynamic viscosity, kinematic viscosity and speed of sound at various altitudes.

State of Design. The State having jurisdiction over the organization responsible for the type design.

State of Manufacture. The State having jurisdiction over the organization responsible for the final assembly of the aircraft, engine or propeller.

State of Registry. The State on whose register the aircraft is entered.

Note.— In the case of the registration of aircraft of an international operating agency on other than a national basis, the States constituting the agency are jointly and severally bound to assume the obligations which, under the Chicago Convention, attach to a State of Registry. See, in this regard, the Council Resolution of 14 December 1967 on Nationality and Registration of Aircraft Operated by International Operating Agencies which can be found in Policy and Guidance Material on the Economic Regulation of International Air Transport *(Doc 9587).*

Take-off surface. 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. 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.

Note.— In some Contracting States a document equivalent to a Type Certificate may be issued for an engine or propeller type.

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

Ultimate load. The limit load multiplied by the appropriate factor of safety.

PART II. PROCEDURES FOR CERTIFICATION AND CONTINUING AIRWORTHINESS

Note.— Although the Convention on International Civil Aviation allocates to the State of Registry certain functions which that State is entitled to discharge, or obligated to discharge, as the case may be, the Assembly recognized, in Resolution A23-13, that the State of Registry may be unable to fulfil its responsibilities adequately in instances where aircraft are leased, chartered or interchanged — in particular without crew — by an operator of another State and that the Convention may not adequately specify the rights and obligations of the State of an Operator in such instances until such time as Article 83 bis *of the Convention enters into force. Accordingly, the Council urged that if, in the above-mentioned instances, the State of Registry finds itself unable to discharge adequately the functions allocated to it by the Convention, it delegate to the State of the Operator, subject to acceptance by the latter State, those functions of the State of Registry that can more adequately be discharged by the State of the Operator. It was understood that pending entry into force of Article 83* bis *of the Convention, the foregoing action would only be a matter of practical convenience and would not affect either the provisions of the Chicago Convention prescribing the duties of the State of Registry or any third State. However, as Article 83* bis *entered into force on 20 June 1997, such transfer agreements will have effect in respect of those Contracting States which have ratified the related Protocol (Doc 9318) upon fulfilment of the conditions established in Article 83* bis.

CHAPTER 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 a Contracting State 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 is submitted to the State of Design 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 is submitted to the State of Design on or after 10 November 2016; and

c) the provisions of 1.2.5 of this part shall only be applicable to an aircraft type for which an application for a Type Certificate is submitted to the State of Design on or after 31 December 2014.

Note.— Normally, a request for a Type Certificate is submitted by the manufacturer when the aircraft, engine or propeller is intended for serial production.

1.2 Design aspects of the appropriate airworthiness requirements

1.2.1 The design aspects of the appropriate airworthiness requirements, used by a Contracting State for type certification of an aircraft, engine or propeller or for any change to such type certification, shall be such that compliance with them will ensure compliance with the Standards of Part II of this Annex and, where applicable, with the Standards of Parts III, IV, V, VI or VII of this Annex.

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

1.2.3 Where the design features of a particular aircraft, engine or propeller render any of the design aspects of the appropriate airworthiness requirements or the Standards in Parts III, IV, V, VI or VII inappropriate, the Contracting State shall apply appropriate requirements that will give at least an equivalent level of safety.

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 or the Standards in Parts III, IV, V, VI or VII inadequate, additional requirements that are considered by the Contracting State to give at least an equivalent level of safety shall be applied.

Note.— An Airworthiness Manual *(Doc 9760) containing guidance material has been published by ICAO.*

1.2.5 The approved design of an aircraft under Parts IIIB, IVB and V of this Annex 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.

Note.— Information concerning extinguishing agents is contained in the UNEP Halons Technical Options Committee Technical Note No. 1 — New Technology Halon Alternatives *and* FAA Report No. DOT/FAA/AR-99-63, Options to the Use of Halons for Aircraft Fire Suppression Systems*.*

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.

Note.— The approval of the design is facilitated, in some States, by approving the design organization.

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

1.3.3 In addition to determining compliance with the design aspects of the appropriate airworthiness requirements for an aircraft, engine or propeller, Contracting States shall take whatever other steps they 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.

1.3.4 A Contracting State issuing an approval for the design of a modification, of a repair or of a replacement part shall do so 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, its amendments or later requirements when determined by the State.

Note 1.— While a repair may be completed and shown to be in compliance with the set of requirements that had been selected for the original type certification of the aircraft, engine or propeller, some repairs may need to be shown to comply with the latest applicable certification requirements. In such cases, States may issue a repair design approval against the latest set of requirements for that aircraft, engine or propeller type.

Note 2.— The approval of the design of a modification to an aircraft, engine or propeller is signified, in some States, by the issuance of a supplemental Type Certificate or amended Type Certificate.

1.4 Type Certificate

1.4.1 The State of Design, upon receipt of satisfactory evidence that the aircraft type (or engine type 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.

1.4.2 When a Contracting State, other than the State of Design, issues a Type Certificate for an aircraft, engine or propeller type, it shall do so 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.

CHAPTER 2. PRODUCTION

2.1 Applicability

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

2.2 Aircraft, engine and propeller production

The State of Manufacture shall ensure that each aircraft, engine or propeller, including associated parts manufactured by sub-contractors and/or suppliers, is airworthy at the time of release.

2.3 Aircraft parts production

The Contracting State taking responsibility for the production of aircraft parts manufactured under the design approval referred to in 1.3.4 of Part II shall ensure that the aircraft parts are airworthy.

2.4 Production approval

2.4.1 When approving production of an aircraft, engine, propeller or associated part, the Contracting State having jurisdiction over the organization responsible for production shall:

a) examine the supporting data and inspect the production facilities and processes so as to determine that the manufacturing organization is in compliance with the appropriate production requirements; and

b) ensure that the manufacturing organization 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 organization or by sub-contractors and/or suppliers is airworthy at the time of release.

Note 1.— Normally, the oversight of production is facilitated by approving the manufacturing organization.

Note 2.— Where the State of Manufacture is a State other than the Contracting State where the associated parts are produced, there may be an agreement or arrangement acceptable to both States to support the oversight responsibilities of the State of Manufacture over the organizations manufacturing the associated parts.

2.4.2 The manufacturing organization shall hold, for each aircraft, engine, propeller and associated part concerned, a design approval as referred to in 1.3 of Part II or the right of access under an agreement or arrangement to the approved design data relevant for production purposes.

2.4.3 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.

Note.— The origin of an aircraft, engine, propeller and associated part refers to the manufacturer, the date of manufacture, the serial number or other information that can be tracked to its production record.

2.4.4 Where the State of Manufacture is other than the State of Design, there shall be an agreement or arrangement acceptable to both States to:

a) ensure that the manufacturing organization has the right of access to the approved design data relevant for production purposes; and

b) address the responsibilities of each State with regard to design, manufacture and continuing airworthiness of the aircraft, engine or propeller.

CHAPTER 3. CERTIFICATE OF AIRWORTHINESS

Note.— The Certificate of Airworthiness as used in these Standards is the Certificate of Airworthiness referred to in Article 31 of the Convention.

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 appropriate national authorities for certification before 13 June 1960.

3.2 Issuance and continued validity of a Certificate of Airworthiness

3.2.1 A Certificate of Airworthiness shall be issued by a Contracting State on the basis of satisfactory evidence that the aircraft complies with the design aspects of the appropriate airworthiness requirements.

3.2.2 A Contracting State shall not issue or render valid a Certificate of Airworthiness for which it intends to claim recognition pursuant to Article 33 of the Convention on International Civil Aviation unless it has satisfactory evidence that the aircraft complies with the applicable Standards of this Annex through compliance with appropriate airworthiness requirements.

3.2.3 A Certificate of Airworthiness shall be renewed or shall remain valid, subject to the laws of the State of Registry, provided that the State of Registry shall require that the continuing airworthiness of the aircraft shall be determined by a periodical inspection at appropriate intervals having regard to lapse of time and type of service or, alternatively, by means of a system of inspection, approved by the State, that will produce at least an equivalent result.

3.2.4 When an aircraft possessing a valid Certificate of Airworthiness issued by a Contracting State is entered on the register of another Contracting State, the new State of Registry, when issuing its Certificate of Airworthiness may consider the previous Certificate of Airworthiness as satisfactory evidence, in whole or in part, that the aircraft complies with the applicable Standards of this Annex through compliance with the appropriate airworthiness requirements.

Note.— Some Contracting States facilitate the transfer of aircraft onto the register of another State by the issue of an "Export Certificate of Airworthiness" or similarly titled document. While not valid for the purpose of flight, such a document provides confirmation by the exporting State of a recent satisfactory review of the airworthiness status of the aircraft. Guidance on the issue of an "Export Certificate of Airworthiness" is contained in the Airworthiness Manual *(Doc 9760).*

3.2.5 When a State of Registry renders valid a Certificate of Airworthiness issued by another Contracting State, as an alternative to issuance of its own Certificate of Airworthiness, it shall establish validity by suitable authorization to be carried with the former Certificate of Airworthiness accepting it as the equivalent of the latter. The validity of the authorization shall not extend beyond the period of validity of the Certificate of Airworthiness being rendered valid. The State of Registry shall ensure that the continuing airworthiness of the aircraft is determined in accordance with 3.2.3.

3.3 Standard form of Certificate of Airworthiness

3.3.1 The Certificate of Airworthiness shall contain the information shown in Figure 1 and shall be generally similar to it.

3.3.2 When Certificates of Airworthiness are issued in a language other than English, they shall include an English translation.

Note.— Article 29 of the Convention on International Civil Aviation requires that the Certificate of Airworthiness be carried on board every aircraft engaged in international air navigation.

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 an aircraft has sustained damage, the State of Registry shall judge whether the damage is of a nature such that the aircraft is no longer airworthy as defined by the appropriate airworthiness requirements.

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 When the State of Registry 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. The State of Registry 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 the State of Registry shall consider all limitations proposed by the Contracting State that had originally, in accordance with 3.6.2, prevented the aircraft from resuming its flight. That Contracting State shall permit such flight or flights within the prescribed limitations.

3.6.4 When the State of Registry 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.

*	*State of Registry* *Issuing Authority*	*

CERTIFICATE OF AIRWORTHINESS

1. Nationality and registration marks	2. Manufacturer and manufacturer's designation of aircraft**	3. Aircraft serial number
. . . .	. . . .	. . . .
. . . .	. . . .	. . . .

4. Categories and/or operation***

5. This Certificate of Airworthiness is issued pursuant to the Convention on International Civil Aviation dated 7 December 1944 and †....................................... in respect of the above-mentioned aircraft which is considered to be airworthy when maintained and operated in accordance with the foregoing and the pertinent operating limitations.

Date of issue.. Signature ....

† Insert reference to appropriate Airworthiness Code.

6. ****

* For use of the State of Registry.

** Manufacturer's designation of aircraft should contain the aircraft type and model.

*** This space is normally used to indicate the certification basis, i.e. certification code, with which the particular aircraft complies and/or its permitted operational category, e.g. commercial air transportation, aerial work or private.

**** This space shall be used either for periodic endorsement (giving date of expiry) or for a statement that the aircraft is being maintained under a system of continuous inspection.

Figure 1

CHAPTER 4. CONTINUING AIRWORTHINESS

4.1 Applicability

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

4.2 Responsibilities of Contracting States in respect of continuing airworthiness

Note.— Guidance on continuing airworthiness requirements is contained in the Airworthiness Manual *(Doc 9760).*

4.2.1 State of Design

4.2.1.1 The State of Design of an aircraft shall:

a) transmit to every Contracting State which has in accordance with 4.2.3 a) advised the State of Design of the aircraft that it has entered the aircraft on its register, and to any other Contracting State upon request, any generally applicable information which it has found necessary for the continuing airworthiness and safe operation of the aircraft, including any engines and propellers (hereinafter called mandatory continuing airworthiness information), and notification of the suspension or revocation of a Type Certificate;

Note 1.— The term "mandatory continuing airworthiness information" is intended to include mandatory requirements for modification, replacement of parts or inspection of aircraft and amendment of operating limitations and procedures. Among such information is that issued by Contracting States in the form of airworthiness directives.

Note 2.— The Continuing Airworthiness of Aircraft in Service (Cir 95) *provides the necessary information to assist Contracting States in establishing contact with competent authorities of other Contracting States for the purpose of maintaining continuing airworthiness of aircraft in service.*

Note 3.— If the State of Design of the aircraft is satisfied that mandatory continuing airworthiness information previously issued by the State of Design of the engine or propeller under 4.2.1.2 fully addresses a continuing airworthiness issue, then the State of Design of the aircraft need not retransmit that information to Contracting States that have already been informed.

b) ensure that, in respect of aeroplanes over 5 700 kg and helicopters over 3 175 kg maximum certificated take-off mass, there exists a system for:

i) receiving information submitted in accordance with 4.2.3 f);

ii) deciding if and when airworthiness action is needed;

iii) developing the necessary airworthiness actions; and

iv) promulgating the information on those actions including that required in 4.2.1.1 a);

c) ensure that, in respect of aeroplanes over 5 700 kg maximum certificated take-off mass, there exists a continuing structural integrity programme to ensure the airworthiness of the aeroplane. The programme shall include specific information concerning corrosion prevention and control.

4.2.1.2 The State of Design of an engine or a propeller, where it is different from the State of Design of the aircraft, shall:

a) transmit any continuing airworthiness information to the State of Design of the aircraft and to any other Contracting State upon request.

Note.— While the overall responsibility for the transmission of mandatory continuing airworthiness information rests with the State of Design of the aircraft, it is recognized that some States of Design of the engine or propeller transmit mandatory continuing airworthiness information directly to States of Registry and other Contracting States. This practice has the benefit of speeding up the availability of mandatory continuing airworthiness information and processing this information in the normal way in accordance with 4.2.3 d). However, if the State of Design of the aircraft subsequently transmits additional mandatory continuing airworthiness information to that of the State of Design of the engine or propeller, then the mandatory continuing airworthiness information originating from the State of Design of the aircraft must take precedence in case of incompatibility.

b) ensure that, in respect of engines and propellers installed on aeroplanes over 5 700 kg and helicopters over 3 175 kg maximum certificated take-off mass, there exists a system for:

i) receiving information submitted in accordance with 4.2.3 f);

ii) deciding if and when airworthiness action is needed; and

iii) developing the necessary airworthiness actions.

4.2.1.3 Where the State of Design of a modification is different from the State of Design of the aircraft, engine or propeller being modified, the State of Design of the modification shall transmit the mandatory continuing airworthiness information to all States that have the modified aircraft on their registries.

4.2.1.4 Where, for a given aircraft, engine or propeller, the State of Manufacture is other than the State of Design, then the State of Design shall ensure that there is an agreement acceptable to both States to ensure that the manufacturing organization cooperates with the organization responsible for the type design in assessing information on the design, manufacture and operation of the aircraft, engine or propeller.

4.2.2 State of Manufacture

The State of Manufacture shall ensure that where it is not the State of Design there is an agreement acceptable to both States to ensure that the manufacturing organization cooperates with the organization responsible for the type design in assessing information on the design, manufacture and operation of the aircraft, engine or propeller.

4.2.3 State of Registry

The State of Registry shall:

a) ensure that, when it first enters on its register an aircraft of a particular type for which it is not the State of Design and issues or validates a Certificate of Airworthiness in accordance with 3.2 of this part, it shall advise the State of Design that it has entered such an aircraft on its register;

b) determine the continuing airworthiness of an aircraft in relation to the appropriate airworthiness requirements in force for that aircraft;

c) develop or adopt requirements to ensure the continuing airworthiness of the aircraft during its service life, including requirements to ensure that the aircraft:

  i) continues to comply with the appropriate airworthiness requirements after a modification, a repair or the installation of a replacement part; and

  ii) is maintained in an airworthy condition and in compliance with the maintenance requirements of Annex 6, and where applicable, Parts III, IV, V, VI and VII of this Annex;

d) upon receipt of mandatory continuing airworthiness information from the State of Design, adopt the mandatory information directly or assess the information received and take appropriate action;

e) ensure that all mandatory continuing airworthiness information which it, as the State of Registry, originated in respect of that aircraft, is transmitted to the appropriate State of Design; and

f) ensure that, in respect of aeroplanes over 5 700 kg and helicopters over 3 175 kg maximum certificated take-off mass, there exists a system whereby information on faults, malfunctions, defects and other occurrences that cause or might cause adverse effects on the continuing airworthiness of the aircraft is transmitted to the organization responsible for the type design of that aircraft. Whenever this information relates to an engine or propeller, such information shall be transmitted to both the organization responsible for engine or propeller type design and the organization responsible for aircraft type design. Where a continuing airworthiness safety issue is associated with a modification, the State of Registry shall ensure that there exists a system whereby the above information is transmitted to the organization responsible for the design of the modification.

4.2.4 All Contracting States

Each Contracting State shall establish, in respect of aeroplanes over 5 700 kg and helicopters over 3 175 kg maximum certificated take-off mass, the type of information that is to be reported to its airworthiness authority by operators, organizations responsible for type design and maintenance organizations. Procedures for reporting this information shall also be established.

CHAPTER 5.   SAFETY MANAGEMENT

Note.— Safety management provisions for organizations responsible for the type design or manufacture of aircraft are included in Annex 19. Further guidance is contained in the Safety Management Manual (SMM) *(Doc 9859).*

PART III. LARGE AEROPLANES

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

Note.— The provisions of Part IIIA are the same as those contained in Part III of Annex 8, Ninth Edition (including Amendment 99), except for modified applicability clauses and cross-references.

CHAPTER 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 the appropriate national authorities for certification on or after 13 June 1960, but before 2 March 2004.

1.1.2 The Standards specified in 8.4 of this part are applicable in respect of all aeroplanes designated in 1.1.3 that are of types of which the prototype was submitted to the appropriate national authorities for certification on or after 22 March 1985, but before 2 March 2004.

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

Note.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

1.1.4 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 1.1.3 shall be at least substantially equivalent to the overall level intended by the broad Standards of this part.

1.1.5 Unless otherwise stated, the Standards apply to the complete aeroplane including 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.

Note.— Guidance material concerning the expression "extremely remote" is contained in the Airworthiness Manual *(Doc 9760).*

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.

Note 1.— The maximum operating mass and centre of gravity limits may vary, for example, with each altitude and with each separate operating condition, e.g. take-off, en route, landing.

Note 2.— The following items, for instance, may be considered as basic aeroplane limitations:

— *maximum certificated take-off mass;*

— *maximum certificated taxiing mass;*

— *maximum certificated landing mass;*

— *maximum certificated zero fuel mass; and*

— *most forward and rearward centre of gravity positions in various configurations (take-off, en route, landing).*

Note 3.— Maximum operating mass may be limited by the application of Noise Certification Standards (see Annex 16, Volume I, and Annex 6, Parts I and II).

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 either 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, its components and equipment are reliable and function correctly under the anticipated operating conditions.

CHAPTER 2. FLIGHT

2.1 General

2.1.1 Compliance with the Standards prescribed in Chapter 2 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.

Note.— Guidance material on human performance can be found in the Human Factors Training Manual *(Doc 9683).*

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 mass 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.

Note.— This Standard permits the maximum take-off mass and maximum landing mass to be scheduled in the aeroplane flight manual against, for example:

— *aerodrome elevation, or*

— *pressure-altitude at aerodrome level, or*

— *pressure-altitude and atmospheric temperature at aerodrome level,*

so as to be readily usable when applying the national code on aeroplane performance operating limitations.

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.

b) 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 engines 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.

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 idealized conditions for which data are 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 their application by means of the operating rules to which the aeroplane is to be operated in accordance with 5.2 of Annex 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 engines 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.

Note.— If the landing distance includes the distance margin specified in this Standard, it is not necessary to allow for the expected variations in the approach and landing techniques in applying 5.2.11 of Annex 6, Part I.

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.

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.

2.3.1.1 *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.

Note.— Buffeting as a stall warning is considered desirable and discouragement of this type of buffeting is not intended.

CHAPTER 3. STRUCTURES

3.1 General

The Standards of Chapter 3 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 indicate 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.

Note.— Guidance material concerning the expression "extremely remote" is contained in the Airworthiness Manual *(Doc 9760).*

CHAPTER 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.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683).*

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 minimize the possibility of jamming, inadvertent operations, 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 maximize the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems.

2) **Recommendation.—** *For aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg but not exceeding 45 500 kg and for which the application for certification was submitted on or after 12 March 2000, aeroplane systems should be designed, arranged and physically separated to maximize the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems.*

c) *Crew environment.* The design of the flight crew compartment shall be such as to minimize 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 systems' failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this Annex and in Annex 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 minimize the possibility of in-flight and ground fires and also to minimize 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 depressurization 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) **Recommendation.—** *For aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg but not exceeding 45 500 kg and for which the application for certification was submitted on or after 12 March 2000, design precautions should be taken to protect against possible instances of cabin depressurization 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.*

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 minimize entry into the flight crew compartment of smoke, fumes and noxious vapours generated by an explosion or fire on the aeroplane.

2) **Recommendation.—** *For aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg but not exceeding 45 500 kg and for which the application for certification was submitted on or after 12 March 2000, means should be provided to minimize entry into the flight crew compartment of smoke, fumes and noxious vapours generated by an explosion or fire on the aeroplane.*

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 minimize 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.

CHAPTER 5. ENGINES

5.1 Scope

The Standards of Chapter 5 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.

CHAPTER 6. PROPELLERS

6.1 Scope

The Standards of Chapter 6 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.

CHAPTER 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 7.

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 jeopardize 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 anyfire 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 jeopardize the safety of the aeroplane.

CHAPTER 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.

Note 1.— Instruments and equipment additional to the minimum necessary for the issuance of a Certificate of Airworthiness are prescribed in Annex 6, Parts I and II, for particular circumstances or on particular kinds of routes.

Note 2.— Instruments and equipment design shall observe Human Factors principles.

Note 3.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the* Human Factors Guidelines for Air Traffic Management (ATM) Systems *(Doc 9758).*

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 anticollision lights

8.4.1 The lights required by Annex 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.

Note 1.— It is likely that lights will be viewed against a variety of backgrounds, such as typical city lighting, clear starry sky, moonlit water and daytime conditions of low background luminance. Furthermore, collision risk situations are most likely to arise in terminal control areas in which aircraft are manoeuvring in the intermediate and lower flight levels at closing speeds that are unlikely to exceed 900 km/h (500 kt).

Note 2.— See the Airworthiness Manual *(Doc 9760) for detailed technical specifications for exterior lights for aeroplanes.*

* Please refer to 1.1.2 of this part.

8.4.2 Lights shall be installed in aeroplanes so as to minimize 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.

Note.— In order to avoid the effects mentioned in 8.4.2, it will be necessary in some cases to provide means whereby the pilot can switch off or reduce the intensity of the flashing lights.

CHAPTER 9. OPERATING LIMITATIONS AND INFORMATION

9.1 General

The operating limitations within which compliance with the Standards of this Annex 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, centres 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.

Note.— See Annex 6 — Operation of Aircraft*, Parts I and II, for the circumstances in which the flight crew shall include members in addition to the minimum flight crew defined in this Annex.*

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 Annex 6, Part I.

Note.— The maximum time established in accordance with 4.7 of Annex 6, Part I, for a particular route may be less than that determined in accordance with 9.2.7 because of the operational considerations involved.

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 Annex 6, Parts I and II, or be generally recognized, 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.

Note.— Usually the empty mass excludes the mass of the crew and payload, the usable fuel supply and the drainable oil; it includes the mass of all fixed ballast, unusable fuel supply, undrainable oil, total quantity of engine coolant and total quantity of hydraulic fluid.

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 minimize 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 jeopardize the safety of the aeroplane in subsequent flights.

CHAPTER 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.

CHAPTER 11. SECURITY

11.1 Aeroplanes used for domestic commercial operations

Recommendation.— *International Standards and Recommended Practices set forth in this chapter should be applied by all Contracting States for aeroplanes engaged in domestic commercial operations (air services).*

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 minimize the effects of a bomb on the aeroplane and its occupants.

11.3 Protection of the flight crew compartment

Recommendation.— *In all aeroplanes, which are required by Annex 6, Part I, Chapter 13 to have an approved flight crew compartment door, and for which an application for amending the Type Certificate to include a derivative type design is submitted to the appropriate national authority, consideration should be given to reinforcing the flight crew compartment bulkheads, floors and ceilings so as 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.*

Note.— Standards and Recommended Practices concerning the requirements for the flight crew compartment door in all commercial passenger-carrying aeroplanes are contained in Annex 6, Part I, Chapter 13.

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.

PART IIIB. AEROPLANES OVER 5 700 KG FOR WHICH APPLICATION FOR CERTIFICATION WAS SUBMITTED ON OR AFTER 2 MARCH 2004

CHAPTER 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 the appropriate national authorities on or after 2 March 2004.

1.1.2 Except for those Standards and Recommended Practices which specify a different applicability, the Standards and Recommended Practices 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.

Note 1.— The aeroplanes described in 1.1.2 are known in some States as transport category aeroplanes.

Note 2.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

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.

Note 1.— The maximum operating mass and centre of gravity limits may vary, for example, with each altitude and with each separate operating condition, e.g. take-off, en route, landing.

Note 2.— Maximum operating mass may be limited by the application of Noise Certification Standards (see Annex 16, Volume I, and Annex 6, Parts I and II).

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.

CHAPTER 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.

Note.— Guidance material on human performance can be found in the Human Factors Training Manual *(Doc 9683).*

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

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, 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.

Note.— This Standard permits the maximum take-off mass and maximum landing mass to be scheduled in the flight manual against, for example:

— *aerodrome elevation, or*

— *pressure-altitude at aerodrome level, or*

— *pressure-altitude and atmospheric temperature at aerodrome level,*

so as to be readily usable when applying the national code on aeroplane performance operating limitations.

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 idealized conditions for which data are scheduled (see 2.2.7), the departure from the scheduled 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 engine(s) operating.

2.2.7 Scheduling of performance

Performance data shall be determined and scheduled in the flight manual so that their application by means of the operating rules to which the aeroplane is to be operated in accordance with 5.2 of Annex 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.

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 c)). 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 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*. 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.

Note.— If the landing distance includes the distance margin specified in this Standard, it is not necessary to allow for the expected variations in the approach and landing techniques in applying 5.2.11 of Annex 6, Part I.

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 *Stall warning.* When the aeroplane approaches a stall both in straight and turning flight with all engines operating, 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.

Note.— Buffeting as a stall warning is considered desirable and discouragement of this type of buffeting is not intended.

CHAPTER 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 profiles, 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 pressurization 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;

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) widespread fatigue damage;

h) specified maintenance; and

i) likely structural repairs.

Note.— The expression "wherever practicable" is introduced to ensure that when an effective damage-tolerant structure cannot be achieved within the limitations of geometry, inspectability or good design practice, the structure can be designed to the fatigue evaluation (safe-life) principles. Typical examples of structures that might not be amenable to damage-tolerant design are landing gear, engine mounts and their attachments.

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.

CHAPTER 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.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683)*.

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 operations and unintentional engagement of control surface locking devices is minimized; and

4) each element of each flight control system is designed, or distinctively and permanently marked, to minimize 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 maximize the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems.

2) **Recommendation.—** *For aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg but not exceeding 45 500 kg, aeroplane systems should be designed, arranged and physically separated to maximize the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems.*

c) *Crew environment.* The design of the flight crew compartment shall be such as to minimize 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 systems' failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this Annex and in Annex 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 minimize the risk of in-flight and ground fires, to minimize 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 minimize 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.

Note.— Design precautions may include the selection of appropriate materials and types of equipment installed in these areas, as well as the reduction of possible ignition sources, typically by preventing the ingress of fuel or fuel vapour, upgrading the flammability requirements of aircraft wiring or improving the detection of overheating or smoke and the indication of its presence to the flight crew, etc.

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) 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 depressurization 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 depressurization 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) **Recommendation.—** *For aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg but not exceeding 45 500 kg, design precautions should be taken to protect against possible instances of cabin depressurization 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.*

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 minimize entry into the flight crew compartment of smoke, fumes and noxious vapours generated by an explosion or fire on the aeroplane.

2) **Recommendation.—** *For aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg but not exceeding 45 500 kg, means should be provided to minimize entry into the flight crew compartment of smoke, fumes and noxious vapours generated by an explosion or fire on the aeroplane.*

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 1.2.1. 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 structure during the operation of the aeroplane.

4.4.2 Cabin environment

Ventilation, heating and, where applicable, pressurization 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 minimize 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.

CHAPTER 5. POWERPLANT

5.1 Engines

The Standards of Part VI of this Annex 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 Annex 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 minimize 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 jeopardize 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 minimize 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 jeopardize the safety of the aeroplane.

CHAPTER 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.

Note 1.— Instruments and equipment additional to the minimum necessary for the issuance of a Certificate of Airworthiness are prescribed in Annex 6, Parts I and II, for particular circumstances or on particular kinds of routes.

Note 2.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the* Human Factors Guidelines for Air Traffic Management (ATM) Systems *(Doc 9758).*

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 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).

Note.— Some States accept the use of national or international industry standards for the development assurance (development, verification and validation) of complex electronic hardware and systems software.

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 Annex 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.

Note.— It is likely that lights will be viewed against a variety of backgrounds, such as typical city lighting, clear starry sky, moonlit water and daytime conditions of low background luminance. Furthermore, collision risk situations are most likely to arise in terminal control areas in which aircraft are manoeuvring in the intermediate and lower flight levels at closing speeds that are unlikely to exceed 900 km/h (500 kt).

6.4.2 Lights shall be installed in aeroplanes so as to minimize the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

Note.— In order to avoid the effects mentioned in 6.4.2, it will be necessary in some cases to provide means whereby the pilot can adjust the intensity of the flashing lights.

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.

CHAPTER 7. OPERATING LIMITATIONS AND INFORMATION

7.1 General

The operating limitations within which compliance with the Standards of this Annex 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, centres 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) 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.

Note.— See Annex 6 — Operation of Aircraft*, Parts I and II, for the circumstances in which the flight crew shall include members in addition to the minimum flight crew defined in this Annex.*

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 Annex 6, Part I.

Note.— The maximum time established in accordance with 4.7 of Annex 6, Part I, for a particular route may be less than that determined in accordance with 7.2.8 because of the operational considerations involved.

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.

Note.— Usually the empty mass excludes the mass of the crew and payload, the usable fuel supply and the drainable oil; it includes the mass of all fixed ballast, unusable fuel supply, undrainable oil, total quantity of engine coolant and total quantity of hydraulic fluid.

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 minimize 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 jeopardize 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.

Note.— The development of initial maintenance programme information at the time of aeroplane type certification is sometimes referred to as the Maintenance Review Board (MRB) process.

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.

Note.— Mandatory requirements identified as part of the type design approval are often referred to as Certification Maintenance Requirements (CMR) and/or airworthiness limitations.

CHAPTER 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 maximize 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.

CHAPTER 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.

Note.— The human/machine interface is often the weak link in an operating environment and so it is necessary to ensure that the aeroplane is capable of being controlled at all phases of the flight (including any degradation due to failures) and that neither the crew nor passengers are harmed by the environment in which they have been placed for the duration of the flight.

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.

Note.— Workload can be affected by both cognitive and physiological factors.

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 standardization; 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.

CHAPTER 10. SECURITY

10.1 Aeroplanes used for domestic commercial operations

Recommendation.— *International Standards and Recommended Practices set forth in this chapter should be applied by all Contracting States for aeroplanes engaged in domestic commercial operations (air services).*

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 minimize 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 Annex 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 is first 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 **Recommendation.—** *In all aeroplanes, which are required by Annex 6, Part I, Chapter 13 to have an approved flight crew compartment door, and for which an application for amending the Type Certificate to include a derivative type design is submitted to the appropriate national authority on or after 20 May 2006, consideration should be given to reinforcing the flight crew compartment bulkheads, floors and ceilings so as 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.*

Note.— Standards and Recommended Practices concerning the requirements for the flight crew compartment door in all commercial passenger-carrying aeroplanes are contained in Annex 6, Part I, Chapter 13.

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.

PART IV. HELICOPTERS

PART IVA. HELICOPTERS FOR WHICH APPLICATION FOR CERTIFICATION WAS SUBMITTED ON OR AFTER 22 MARCH 1991 BUT BEFORE 13 DECEMBER 2007

Note.— The provisions of Part IVA are the same as those contained in Part IV of Annex 8, Ninth Edition except for modified applicability clauses and cross references.

CHAPTER 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 appropriate national authorities 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.

Note.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

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 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.

Note 1.— The maximum operating mass and centre of gravity limits may vary, for example, with each altitude and with each separate operating condition, e.g. take-off, en route, landing.

Note 2.— The following items, for instance, may be considered as basic helicopter limitations:

— *maximum certificated take-off (including lift-off) mass;*

— *maximum certificated ground-taxiing mass;*

— *maximum certificated landing mass;*

— *most forward, rearward, and lateral centre of gravity positions in various configurations; and*

— *maximum certificated cargo sling mass.*

Note 3.— Maximum operating mass may be limited by the application of Noise Certification Standards (see Annex 16, Volume I, and Annex 6, Part III).

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

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.

CHAPTER 2. FLIGHT

2.1 General

2.1.1 Compliance with the Standards prescribed in Chapter 2 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.

Note.— Guidance material on human performance can be found in the Human Factors Training Manual *(Doc 9683).*

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.

Note.— This Standard permits the maximum take-off mass and maximum landing mass to be scheduled in the helicopter flight manual against, for example at the take-off or landing site:

— *elevation, or*

— *pressure-altitude, or*

— *pressure-altitude and atmospheric temperature,*

so as to be readily usable when applying the national code on helicopter performance operating limitations.

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 idealized conditions for which data are 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 their application by means of the operating rules to which the helicopter is to be operated in accordance with 5.1.2 of Annex 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 (Vy) or the best angle of climb speed (Vx) 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.

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.

2.3.1.1 *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 must 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.

CHAPTER 3. STRUCTURES

3.1 General

The Standards of Chapter 3 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 indicate 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.

Note 1.— This Standard can be complied with by the establishment of "safe lives" or "fail safe" characteristics of the structure, having regard to the reasonable expected load magnitudes and frequencies under the anticipated operating conditions and inspection procedures. For some parts of the structure, it might be necessary to establish "fail safe" characteristics as well as "safe lives".

Note 2.— Guidance material concerning the expression "extremely remote" is contained in the Airworthiness Manual *(Doc 9760).*

CHAPTER 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.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683).*

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 minimize the possibility of jamming, inadvertent operations, and unintentional engagement of control surface locking devices.

   i) Each control and control system shall operate with the ease, smoothness and effectiveness appropriate to its function.

   ii) Each element of each flight control system shall be designed to minimize 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 minimize 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 systems' failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this Annex and in Annex 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 minimize the possibility of in-flight and ground fires and also to minimize 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 depressurization 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 minimize 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.

CHAPTER 5. ENGINES

5.1 Scope

The Standards of Chapter 5 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

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.

CHAPTER 6. ROTOR AND POWER TRANSMISSION SYSTEMS AND POWERPLANT INSTALLATION

6.1 General

The powerplant installation, including rotor and power transmission system, 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 Chapters 5 and 6.

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 jeopardize 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 jeopardize the safety of the helicopter.

CHAPTER 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.

Note 1.— Instruments and equipment additional to the minimum necessary for the issuance of a Certificate of Airworthiness are prescribed in Annex 6, Part III, for particular circumstances or on particular kinds of routes.

Note 2.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the* Human Factors Guidelines for Air Traffic Management (ATM) Systems *(Doc 9758).*

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 Annex 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.

Note 1.— It is likely that lights will be viewed against a variety of backgrounds, such as typical city lighting, clear starry sky, moonlit water and daytime conditions of low background luminance. Furthermore, collision risk situations are most likely to arise in terminal control areas in which aircraft are manoeuvring in the intermediate and lower flight levels at closing speeds that are unlikely to exceed 900 km/h (500 kt).

Note 2.— See the Airworthiness Manual *(Doc 9760) for detailed technical specifications for exterior lights for helicopters.*

7.4.2 Lights shall be installed in helicopters so as to minimize 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.

Note.— In order to avoid the effects mentioned in 7.4.2, it will be necessary in some cases to provide means whereby the pilot can switch off or reduce the intensity of the flashing lights.

CHAPTER 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.

CHAPTER 9. OPERATING LIMITATIONS AND INFORMATION

9.1 General

The operating limitations within which compliance with the Standards of this Annex 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, centres 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.

Note.— See Annex 6 — Operation of Aircraft*, Part III, for the circumstances in which the flight crew shall include members in addition to the minimum flight crew defined in this Annex.*

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 Annex 6, Part III, or be generally recognized, 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.

Note.— Usually the empty mass excludes the mass of the crew and payload, the usable fuel supply and the drainable oil; it includes the mass of all fixed ballast, unusable fuel supply, undrainable oil, total quantity of engine coolant and total quantity of hydraulic fluid.

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 jeopardize the safety of the helicopter in subsequent flights.

PART IVB. HELICOPTERS FOR WHICH APPLICATION FOR CERTIFICATION WAS SUBMITTED ON OR AFTER 13 DECEMBER 2007

CHAPTER 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 is submitted to the appropriate national authorities on or after 13 December 2007.

1.1.2 Except for those Standards and Recommended Practices which specify a different applicability, the Standards and Recommended Practices 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.

Note.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

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.

Note 1.— The maximum operating mass and centre of gravity limits may vary, for example, with each altitude and with each practicably separate operating condition, e.g. take-off, en route, landing.

Note 2.— Maximum operating mass may be limited by the application of Noise Certification Standards (see Annex 16, Volume I and Annex 6, Part III).

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.

CHAPTER 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.

Note.— Guidance material on human performance can be found in the Human Factors Training Manual *(Doc 9683).*

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 idealized conditions for which data are 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 (Vy) 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 (V_{TOSS}), 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 this paragraph 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 configuration) 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.

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 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.

CHAPTER 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.

Note.— Structure includes the airframe, undercarriage, control system, blades and rotorhead, rotor pylon and auxiliary lifting surfaces.

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 indicate 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 manoeuvering 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.

CHAPTER 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.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683).*

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 minimize the possibility of jamming, inadvertent operations 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 minimize 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 structure 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 minimize 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.

CHAPTER 5. ROTORS AND POWERPLANT

5.1 Engines

The Standards of Part VI of this Annex 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 minimize 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, a 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 jeopardize continued flight and landing (helicopters of a maximum certificated take-off mass greater than 3 175 kg or Category A) or would jeopardize 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 minimize 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 jeopardize the safety of the helicopter.

CHAPTER 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.

Note 1.— Instruments and equipment additional to the minimum necessary for the issuance of a Certificate of Airworthiness are prescribed in Annex 6, Part III, for particular circumstances or on particular kinds of routes.

Note 2.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the* Human Factors Guidelines for Air Traffic Management (ATM) Systems *(Doc 9758).*

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 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 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).

Note.— Some States accept the use of national or international industry standards for the development assurance (development, verification and validation) of complex electronic hardware and systems software.

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 Annex 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.

Note.— It is likely that lights will be viewed against a variety of backgrounds, such as typical city lighting, clear starry sky, moonlit water and daytime conditions of low background luminance. Furthermore, collision risk situations are most likely to arise in terminal control areas in which aircraft are manoeuvring in the intermediate and lower flight levels at closing speeds that are unlikely to exceed 900 km/h (500 kt).

6.4.2 Lights shall be installed in helicopters so as to minimize the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

Note.— In order to avoid the effects mentioned in 6.4.2, it will be necessary in some cases to provide means whereby the pilot can adjust the intensity of the flashing lights.

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.

CHAPTER 7. OPERATING LIMITATIONS AND INFORMATION

7.1 General

The operating limitations within which compliance with the Standards of this Annex 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, centres 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.

Note.— See Annex 6 — Operation of Aircraft, *Part III, for the circumstances in which the flight crew includes members in addition to the minimum flight crew defined in this Annex.*

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.

Note.— Usually the empty mass excludes the mass of the crew and payload, and the usable fuel supply; it includes the mass of all fixed ballast, unusable fuel supply and total quantity of oil, engine coolant and hydraulic fluid.

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 jeopardize 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.

Note.— The development of initial maintenance programme information at the time of helicopter type certification is sometimes referred to as the Maintenance Review Board (MRB) *process or the process of developing instructions for continued airworthiness.*

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.

Note.— Mandatory requirements identified as part of the type design approval are often referred to as Certification Maintenance Requirements (CMR) and/or airworthiness limitations.

CHAPTER 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.

CHAPTER 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.

Note.— The human/machine interface is often the weak link in an operating environment and so it is necessary to ensure that the helicopter is capable of being controlled at all phases of the flight (including any degradation due to failures) and that neither the crew nor passengers are harmed by the environment in which they have been placed for the duration of the flight.

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.

Note.— Workload can be affected by both cognitive and physiological factors.

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 standardization; 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.

PART V. SMALL AEROPLANES —

AEROPLANES OVER 750 KG BUT NOT EXCEEDING 5 700 KG FOR WHICH APPLICATION FOR CERTIFICATION WAS SUBMITTED ON OR AFTER 13 DECEMBER 2007

CHAPTER 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 the appropriate national authorities on or after 13 December 2007.

1.1.2 Except for those Standards and Recommended Practices which specify a different applicability, the Standards and Recommended Practices 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.

Note 1.— The aeroplanes described in 1.1.2 are known in some States as normal, utility and aerobatic category aeroplanes.

Note 2.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

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.

Note 1.— The maximum operating mass and centre of gravity limits may vary, for example, with each altitude and with each separate operating condition, e.g. take-off, en route, landing.

Note 2.— Maximum operating mass may be limited by the application of Noise Certification Standards (see Annex 16, Volume 1 and Annex 6, Parts I and II).

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.

CHAPTER 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.

Note.— Guidance material on human performance can be found in the Human Factors Training Manual *(Doc 9683).*

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.

Note.— This Standard permits the maximum take-off mass and maximum landing mass to be scheduled in the flight manual against, for example:

— *aerodrome elevation, or*

— *pressure-altitude at aerodrome level, or*

— *pressure-altitude and atmospheric temperature at aerodrome level,*

so as to be readily usable when applying the national code on aeroplane performance operating limitations.

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 idealized conditions for which data are 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 must be determined for each mass, altitude and temperature within the operational limits established for take-off with:

— take-off power on each engine;

— wing flaps in the take-off position(s); and,

— 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.

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.

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.

Note.— Buffeting as a stall warning is considered desirable and discouragement of this type of buffeting is not intended.

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.

CHAPTER 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 profiles, 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 pressurization 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.

CHAPTER 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.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683).*

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 minimize 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 minimize 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 maximize 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 minimize 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 systems' failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this Annex and in Annex 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 minimize the risk of in-flight and ground fires, and to minimize 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 depressurization 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 structure during the operation of the aeroplane.

4.4.2 Cabin environment

Ventilation, heating and, where applicable, pressurization 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.

CHAPTER 5. POWERPLANT

5.1 Engines

The Standards of Part VI of this Annex 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 Annex 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 minimize 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 jeopardize 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 minimize 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 fire proof 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.

CHAPTER 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.

Note 1.— Instruments and equipment additional to the minimum necessary for the issuance of a Certificate of Airworthiness are prescribed in Annex 6, Parts I and II, for particular circumstances or on particular kinds of routes.

Note 2.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the* Human Factors Guidelines for Air Traffic Management (ATM) Systems *(Doc 9758).*

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).

Note.— Some States accept the use of national or international industry standards for the development assurance (development, verification and validation) of complex electronic hardware and systems software.

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 Annex 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.

Note.— It is likely that lights will be viewed against a variety of backgrounds, such as typical city lighting, clear starry sky, moonlit water and daytime conditions of low background luminance. Furthermore, collision risk situations are most likely to arise in terminal control areas in which aircraft are manoeuvring in the intermediate and lower flight levels at closing speeds that are unlikely to exceed 900 km/h (500 kt).

6.4.2 Lights shall be installed in aeroplanes so as to minimize the possibility that they will adversely affect the satisfactory performance of the flight crews' duties.

Note.— In order to avoid the effects mentioned in 6.4.2, it will be necessary in some cases to provide means whereby the pilot can adjust the intensity of the flashing lights.

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.

CHAPTER 7. OPERATING LIMITATIONS AND INFORMATION

7.1 General

The operating limitations within which compliance with the Standards of this Annex 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, centres 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.

Note.— See Annex 6 — Operation of Aircraft, *Parts I and II, for the circumstances in which the flight crew shall include members in addition to the minimum flight crew defined in this Annex.*

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.

Note.— Usually the empty mass excludes the mass of the crew and payload, the usable fuel supply and the drainable oil; it includes the mass of all fixed ballast, unusable fuel supply, undrainable oil, total quantity of engine coolant and total quantity of hydraulic fluid.

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 jeopardize 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.

Note.— The development of initial maintenance programme information at the time of aircraft type certification is sometimes referred to as the Maintenance Review Board (MRB) process or the process of developing instructions for continued airworthiness.

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.

Note.— Mandatory requirements identified as part of the type design approval are often referred to as Certification Maintenance Requirements (CMR) and/or airworthiness limitations.

CHAPTER 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 maximize 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.

CHAPTER 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.

Note.— The human/machine interface is often the weak link in an operating environment and so it is necessary to ensure that the aeroplane is capable of being controlled at all phases of the flight (including any degradation due to failures) and that neither the crew nor passengers are harmed by the environment in which they have been placed for the duration of the flight.

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.

Note.— Workload can be affected by both cognitive and physiological factors.

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 standardization; 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.

PART VI. ENGINES

CHAPTER 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 the appropriate national authority for a type approval.

Note.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

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.

CHAPTER 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 or V of this Annex 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.

CHAPTER 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.

Note.— Operating environment may include encounter with birds, rain and hail, electromagnetic interference and lightning.

PART VII. PROPELLERS

CHAPTER 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 the appropriate national authority for a type approval.

Note.— The following Standards do not include quantitative specifications comparable to those found in national airworthiness codes. In accordance with 1.2.1 of Part II, these Standards are to be supplemented by requirements established, adopted or accepted by Contracting States.

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.

CHAPTER 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 IIIB or V of this Annex 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 must 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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CHAPTER 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.

— END —

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