CIVIL AVIATION DIRECTIVE – 16 Vol I

ENVIRONMENTAL PROTECTION

AIRCRAFT NOISE

CIVIL AVIATION AUTHORITY OF MALAYSIA

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Introduction

In exercise of the powers conferred by section 24O of the Civil Aviation Act 1969 [Act 3], the Chief Executive Officer makes this Civil Aviation Directive (CAD) 16 Volume I – Environmental Protection, Aircraft Noise, pursuant to Regulation 23, 24, 25, 44, 45 and 46 of the Malaysian Civil Aviation Regulations (MCAR 2016).

This CAD contains the standards and requirements for noise certification applicable to the classification of aircraft specified in individual chapters. The standards and requirements in this CAD are based mainly on the Standards and Recommended Practices (SARPs) contained in the International Civil Aviation Organisation (ICAO) Annex 16 Volume I – Environmental Protection, Aircraft Noise.

Civil Aviation Directive 16 Volume I – Environmental Protection, Aircraft Noise is published by the Chief Executive Officer under 24O of the Civil Aviation Act 1969 [Act 3] and comes into operation on 1st August 2021.

Non-compliance with this CAD

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

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

Civil Aviation Directive components and Editorial practices

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

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

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

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

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

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

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

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

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

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

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

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

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Part I. Introduction

1 Introduction

1.1 Citation

1.1.1 These Directives are the Civil Aviation Directive 16 Volume I – Environmental Protection, Aircraft Noise, Issue 01/Revision 00, and comes into operation on 1st August 2021.

1.1.2 This CAD 16 Volume I – Environmental Protection, Aircraft Noise, Issue 01/Revision 00 will remain current until withdrawn or superseded.

1.2 Applicability

1.2.1 This CAD, shall be read together with CAD 1601, applies to all aircraft operating in Malaysia.

1.3 Revocation

1.3.1 This CAD together with CAD 1601, revokes Notice 9101 – Noise Certificate, issue 1 dated 1 July 2011.

1.4 Definitions

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

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

Associated aircraft systems means those aircraft systems drawing electrical/pneumatic power from an auxiliary power unit during ground operations.

Auxiliary power unit (APU) means a self-contained power unit on an aircraft providing electrical/pneumatic power to aircraft systems during ground operations or in flight, separate from the propulsion engine(s).

Bypass ratio means the ratio of the air mass flow through the bypass ducts of a gas turbine engine to the air mass flow through the combustion chambers calculated at maximum thrust when the engine is stationary in an international standard atmosphere at sea level.

Derived version of a helicopter means a helicopter which, from the point of view of airworthiness, is similar to the noise certificated prototype but incorporates changes in type design which may affect its noise characteristics adversely.

Derived version of an aeroplane means an aeroplane which, from the point of view of airworthiness, is similar to the noise certificated prototype but incorporates changes in type design which may affect its noise characteristics adversely.

External equipment (helicopter) means any instrument, mechanism, part, apparatus, appurtenance, or accessory that is attached to or extends from the helicopter exterior but is not used nor is intended to be used for operating or controlling a helicopter in flight and is not part of an airframe or engine.

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

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

Powered-lift means a heavier-than-air aircraft capable of vertical take-off, vertical landing, and low-speed flight, which depends principally on engine-driven lift devices or engine thrust for the lift during these flight regimes and on non-rotating aerofoil(s) for lift during horizontal flight.

Recertification means certification of an aircraft with or without a revision to its certification noise levels, to a Standard different to that to which it was originally certificated.

Self-sustaining powered sailplane means a powered aeroplane with available engine power which allows it to maintain level flight but not to take off under its own power.

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

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

Subsonic aeroplane means an aeroplane incapable of sustaining level flight at speeds exceeding flight Mach number of 1.

Tilt-rotor means a powered-lift capable of vertical take-off, vertical landing, and sustained low-speed flight, which depends principally on engine-driven rotors mounted on tiltable nacelles for the lift during these flight regimes and on non- rotating aerofoil(s) for lift during high-speed flight.

Type Certificate means a document issued by CAAM or other national aviation authorities to define the design of an aircraft, engine or propeller type and to certify that this design meets the appropriate airworthiness requirements of CAAM or other related national aviation authority.

1.5 Nomenclature: Symbols And Units

1.5.1 Velocity

Symbol	*Unit*	*Meaning*
c_R	m/s	*Reference speed of sound*. Speed of sound at reference conditions.
M_{ATR}	—	*Helicopter rotor reference advancing blade tip Mach number*. The sum of the reference rotor rotational tip speed and the reference speed of the helicopter, divided by the reference speed of sound.
M_H	—	*Propeller helical tip Mach number*. The square root of the sum of the square of the propeller test rotational tip speed and the square of the test airspeed of the aeroplane, divided by the test speed of sound.
M_{HR}	—	*Propeller reference helical tip Mach number*. The square root of the sum of the square of the propeller reference rotational tip speed and the square of the reference speed of the aeroplane, divided by the reference speed of sound.

Best R/C	m/s	*Best rate of climb*. The certificated maximum take-off rate of climb at the maximum power setting and engine speed.
V_{AR}	km/h	*Adjusted reference speed*. On a non-standard test day, the helicopter reference speed adjusted to achieve the same advancing tip Mach number as the reference speed at reference conditions.
V_{CON}	km/h	*Maximum airspeed in conversion mode*. The never-exceed airspeed of a tilt-rotor when in conversion mode.
V_G	km/h	*Ground speed*. The aircraft velocity relative to the ground.
V_{GR}	km/h	*Reference ground speed*. The aircraft true velocity relative to the ground in the direction of the ground track under reference conditions. VGR is the horizontal component of the reference aircraft speed VR.
V_H	km/h	*Maximum airspeed in level flight*. The maximum airspeed of a helicopter in level
V_{MCP}	km/h	*Maximum airspeed in level flight*. The maximum airspeed of a tilt-rotor in level flight when operating in aeroplane mode at maximum continuous power.
V_{MO}	km/h	*Maximum operating airspeed*. The maximum operating limit airspeed of a tilt- rotor that may not be deliberately exceeded.
V_{NE}	km/h	*Never-exceed airspeed*. The maximum operating limit airspeed that may not be deliberately exceeded.
V_R	km/h	*Reference speed*. The aircraft true velocity at reference conditions in the direction of the reference flight path. *Note.— This symbol should not be confused with the symbol commonly used for aeroplane take-off rotation speed.*
V_{REF}	km/h	*Reference landing airspeed*. The speed of the aeroplane, in a specific landing configuration, at the point where it descends through the landing screen height, in the determination of the landing distance for manual landings
V_S	km/h	*Stalling airspeed*. The minimum steady airspeed in the landing configuration.
V_{tip}	m/s	*Tip speed*. The rotational speed of a rotor or propeller tip at test conditions, excluding the aircraft velocity component.
V_{tipR}	m/s	*Reference tip speed.* The rotational speed of a rotor or propeller tip at reference conditions, excluding the aircraft velocity component.
V_Y	km/h	*Speed for best rate of climb*. The test airspeed for best take-off rate of climb.
V_2	km/h	*Take-off safety speed*. The minimum airspeed for a safe take-off.

1.5.2 Time

Symbol	*Unit*	*Meaning*
t_0	s	*Reference duration*. The length of time used as a reference in the integration equation for computing EPNL, where t_0 = 10 s.
t_R	s	*Reference reception time*. The reference time of reception calculated from time of reference aircraft position and distance between aircraft and microphone used in the integrated procedure.
Δt	s	*Time increment.* The equal time increment between one-third octave band spectra, where Δt = 0.5 s.
δt_R	s	*Reference time increment*. The effective duration of a time increment between reference reception times associated with PNLT points used in the integrated method.

1.5.3 Indices

Symbol	*Unit*	*Meaning*
i	—	*Frequency band index.* The numerical indicator that denotes any one of the 24 one-third octave bands with nominal geometric mean frequencies from 50 to 10 000 Hz.
k	—	*Time increment index*. The numerical indicator that denotes any one of the 0.5 second spectra in a noise time history. For the integrated method, the adjusted time increment associated with each value of k will likely vary from the original 0.5 second time increment when projected to reference conditions.
k_F	—	*First time increment identifier*. Index of the first 10 dB-down point in the discrete measured PNLT time history.
k_{FR}	—	*Reference first time increment identifier*. Index of the first 10 dB-down point in the discrete PNLT time history for the integrated method.
k_L	—	*Last time increment identifier*. Index of the last 10 dB-down point in the discrete measured PNLT time history.
k_{LR}	—	*Reference last time increment identifier*. Index of the last 10 dB-down point in the discrete PNLT time history for the integrated method.
k_M	—	*Maximum PNLTM time increment index*. Time increment index of PNLTM.
t	s	*Elapsed time.* The length of time measured from a reference zero.
t_1	s	*Time of first 10 dB-down point*. The time of the first 10 dB-down point in a continuous function of time. (See k_F.)
t_2	s	*Time of last 10 dB-down point*. The time of the last 10 dB-down point in a continuous function of time. (See k_L.)

1.5.4 Noise metrics

Symbol	*Unit*	*Meaning*
EPNL	EPNdB	*Effective perceived noise level.* A single-number evaluator for an aircraft pass-by, accounting for the subjective effects of aircraft noise on human beings, consisting of an integration over the noise duration of the perceived noise level (PNL) adjusted for spectral irregularities (PNLT), normalized to a reference duration of 10 seconds. (See ICAO Annex 16 Volume I Appendix 2, Section 4.1 for specifications.)
$EPNL_A$	EPNdB	*Approach EPNL* Effective perceived noise level at the aeroplane approach reference measurement points.
$EPNL_F$	EPNdB	*Flyover EPNL.* Effective perceived noise level at the aeroplane flyover reference measurement points.
$EPNL_L$	EPNdB	*Lateral EPNL.* Effective perceived noise level at the aeroplane lateral reference measurement points.
L_{AE}	dB SEL	*Sound exposure level (SEL)*. A single event noise level for an aircraft pass-by, consisting of an integration over the noise duration of the A-weighted sound level (dBA), normalized to a reference duration of 1 second. (See ICAO Annex 16 Volume I Appendix 4, Section 3 for specifications.)
L_{AS}	dB(A)	*Slow A-weighted sound level*. Sound level with frequency weighting A and time weighting S for a specified instance in time.
L_{ASmax}	dB(A)	*Maximum slow A-weighted sound level*. The maximum value of L_{AS} over a specified time interval.
L_{ASmaxR}	dB(A)	*Reference maximum slow A-weighted sound level.* The maximum value of L_{AS} over a specified time interval corrected to reference conditions.
$LIMIT_A$	EPNdB	*Approach EPNL limit*. The maximum permitted noise level at the aeroplane approach reference measurement points.
$LIMIT_F$	EPNdB	*Flyover EPNL limit*. The maximum permitted noise level at the aeroplane flyover reference measurement points.
$LIMIT_L$	EPNdB	*Lateral EPNL limit*. The maximum permitted noise level at the aeroplane lateral reference measurement points.
n	noy	*Perceived noisiness.* The perceived noisiness of a one-third octave band sound pressure level in a given spectrum.
N	noy	*Total perceived noisiness.* The total perceived noisiness of a given spectrum calculated from the 24 values of *n*.
PNL	PNdB	*Perceived noise level.* A perception-based noise evaluator representing the subjective effects of broadband noise received at a given point in time during an aircraft pass-by. It is the noise level empirically determined to be equally as noisy as a 1 kHz one-third octave band sample of random noise. (See ICAO Annex 16 Volume I Appendix 2, Section 4.2 for specifications.)
PNLT	TPNdB	*Tone-corrected perceived noise level.* The value of the PNL of a given spectrum adjusted for spectral irregularities.

$PNLT_R$	TPNdB	*Reference tone-corrected perceived noise level.* The value of PNLT adjusted to reference conditions.
PNLTM	TPNdB	*Maximum tone-corrected perceived noise level.* The maximum value of PNLT in a specified time history, adjusted for the bandsharing adjustment Δ_B.
$PNLTM_R$	TPNdB	*Reference maximum tone-corrected perceived noise level.* The maximum value of $PNLT_R$ in a specified time history, adjusted for the bandsharing adjustment Δ_B in the simplified method and Δ_{BR} in the integrated method.
SPL	dB	*Sound pressure level.* The level of sound, relative to the reference level of 20 µPa at any instant of time that occurs in a specified frequency range. The level is calculated as ten times the logarithm to the base 10 of the ratio of the time-mean square pressure of the sound to the square of the reference sound pressure of 20 µPa. *Note — Typical aircraft noise certification usage refers to a specific one-third octave band, e.g. SPL(i,k) for the i-th band of the k-th spectrum in an aircraft noise time-history*
SPL_R	dB	*Reference sound pressure level*. The one-third octave band sound pressure levels adjusted to reference conditions.
SPL_S	dB	*Slow weighted sound pressure level*. The value of one-third octave band sound pressure levels with time weighting S applied.
Δ_1	TPNdB	*PNLTM adjustment.* In the simplified adjustment method, the adjustment to be added to the measured EPNL to account for noise level changes due to differences in atmospheric absorption and noise path length, between test and reference conditions at PNLTM.
	dB(A)	For propeller-driven aeroplanes not exceeding 8 618 kg, the adjustment to be added to L_{ASmax} to account for noise level changes due to the difference between test and reference aeroplane heights.
Δ_2	TPNdB	*Duration adjustment.* In the simplified adjustment method, the adjustment to be added to the measured EPNL to account for noise level changes due to the change in noise duration, caused by differences between test and reference aircraft speed and position relative to the microphone.
	dB(A)	For propeller-driven aeroplanes not exceeding 8 618 kg, the adjustment to be added to L_{ASmax} to account for the propeller helical tip Mach number.
Δ_3	TPNdB	*Source noise adjustment.* In the simplified or integrated adjustment method, the adjustment to be added to the measured EPNL to account for noise level changes due to differences in source noise generating mechanisms, between test and reference conditions.
	dB(A)	For propeller-driven aeroplanes not exceeding 8 618 kg, the adjustment to be added to L_{ASmax} to account for engine power.

Δ_4	dB(A)	*Atmospheric absorption adjustment*. For propeller-driven aeroplanes not exceeding 8 618 kg, the adjustment to be added to the measured L_{ASmax} for noise level changes due to the change in atmospheric absorption, caused by the difference between test and reference aeroplane heights.
Δ_B	TPNdB	*Bandsharing adjustment.* The adjustment to be added to the maximum PNLT to account for possible suppression of a tone due to one-third octave bandsharing of that tone. PNLTM is equal to the maximum PNLT plus Δ_B
Δ_{BR}	TPNdB	Reference bandsharing adjustment. The adjustment to be added to the maximum $PNLT_R$ in the integrated method to account for possible suppression of a tone due to one-third octave bandsharing of that tone. $PNLTM_R$ is equal to the maximum $PNLT_R$ plus Δ_{BR}.
Δ_{peak}	TPNdB	*Peak adjustment*. The adjustment to be added to the measured EPNL for when the PNLT for a secondary peak, identified in the calculation of EPNL from measured data and adjusted to reference conditions, is greater than the PNLT for the adjusted PNLTM spectrum.

1.5.5 Calculation of PNL and tone correction

Symbol	*Unit*	*Meaning*
C	dB	*Tone correction factor.* The factor to be added to the PNL of a given spectrum to account for the presence of spectral irregularities, such as tones.
f	Hz	*Frequency.* The nominal geometric mean frequency of a one-third octave band.
F	dB	*Delta-dB.* The difference between the original sound pressure level and the final broadband sound pressure level of a one-third octave band in a given spectrum.
Log *n(a)*	—	*Noy discontinuity coordinate*. The log n value of the intersection point of the straight lines representing the variation of SPL with log n.
M	—	*Noy inverse slope.* The reciprocals of the slopes of straight lines representing the variation of SPL with log n.
s	dB	*Slope of sound pressure level.* The change in level between adjacent one-third octave band sound pressure levels in a given spectrum.
Δs	dB	*Change in slope of sound pressure level.*
s’	dB	*Adjusted slope of sound pressure level.* The change in level between adjacent adjusted one-third octave band sound pressure levels in a given spectrum.
$\bar{s}$	dB	*Average slope of sound pressure level.*
SPL(*a*)	dB	*Noy discontinuity level.* The SPL value at the discontinuity coordinate of the straight lines representing the variation of SPL with log n.

SPL(*b*) SPL(*c*)	dB	*Noy intercept levels*. The intercepts on the SPL-axis of the straight lines representing the variation of SPL with log n.
SPL(*d*)	dB	*Noy discontinuity level.* The SPL value at the discontinuity coordinate where log n equals −1.
SPL(*e*)	dB	*Noy discontinuity level*. The SPL value at the discontinuity coordinate where log *n* equals log 0.3.
SPL'	dB	*Adjusted sound pressure level.* The first approximation to broadband sound pressure level in a one-third octave band of a given spectrum.
SPL"	dB	*Final broadband sound pressure level.* The second and final approximation to broadband sound pressure level in a one-third octave band of a given spectrum.

1.5.6 Flight path geometry

Symbol	*Unit*	*Meaning*
H	m	*Height*. The aircraft height when overhead or abeam of the centre microphone.
H_R	m	*Reference height*. The reference aircraft height when overhead or abeam of the centre microphone.
X	m	*Aircraft position along the ground track*. The position coordinate of the aircraft along the x-axis at a specific point in time.
Y	m	*Lateral aircraft position relative to the reference ground track*. The position coordinate of the aircraft along the y-axis at a specific point in time.
Z	m	*Vertical aircraft position relative to the reference ground track*. The position coordinate of the aircraft along the z-axis at a specific point in time.
θ	degrees	*Sound emission angle.* The angle between the flight path and the direct sound propagation path to the microphone. The angle is identical for both the measured and reference flight paths.
ψ	degrees	*Elevation angle.* The angle between the sound propagation path and a horizontal plane passing through the microphone, where the sound propagation path is defined as a line between a sound emission point on the measured flight path and the microphone diaphragm.
ψ_R	degrees	*Reference elevation angle.* The angle between the reference sound propagation path and a horizontal plane passing through the reference microphone location, where the reference sound propagation path is defined as a line between a sound emission point on the reference flight path and the reference microphone diaphragm.

1.5.7 Miscellaneous

Symbol	*Unit*	*Meaning*
antilog	—	*Antilogarithm to the base 10.*
D	m	*Diameter.* Propeller or rotor diameter.
D_{15}	m	*Take-off distance.* The take-off distance required for an aeroplane to reach 15 m height above ground level.
e	—	*Euler's number*. The mathematical constant that is the base number of the natural logarithm, approximately 2.71828.
log	—	*Logarithm to the base 10.*
N	rpm	*Propeller speed.*
N_1	rpm	*Compressor speed.* The turbine engine low pressure compressor first stage fan speed.
RH	%	*Relative humidity.* The ambient atmospheric relative humidity.
T	°C	*Temperature.* The ambient atmospheric temperature.
u	m/s	*Wind speed along-track component*. The component of the wind speed vector along the reference ground track.
v	m/s	*Wind speed cross-track component*. The component of the wind speed vector horizontally perpendicular to the reference ground track.
α	dB/100 m	*Test atmospheric absorption coefficient.* The sound attenuation rate, due to atmospheric absorption, that occurs in a specified one-third octave band for the measured ambient temperature and relative humidity.
α_R	dB/100 m	*Reference atmospheric absorption coefficient.* The sound attenuation rate, due to atmospheric absorption, that occurs in a specified one-third octave band for a reference ambient temperature and relative humidity.
μ	—	*Engine noise performance parameter.* For jet aeroplanes, typically the normalized low pressure fan speed, normalized engine thrust, or engine pressure ratio used in the calculation of the source noise adjustment.

Part II. Aircraft Noise Certification

1 Administration

1.1 The requirements of 1.2 to 1.6 shall apply to all aircraft included in the classifications defined for noise certification purposes in Chapters 2, 3, 4, 5, 6, 8, 10, 11, 12, 13 and 14 of this part where such aircraft are engaged in international air navigation.

1.2 Application for noise certification shall provide satisfactory evidence that the aircraft complies with requirements of this CAD.

1.3 If noise recertification is requested, applicant shall provide satisfactory evidence that the aircraft complies with requirements of this CAD. The date used to determine the recertification basis shall be the date of acceptance of the first application for recertification.

1.4 The documents attesting noise certification shall be required to be carried on the aircraft.

Note: Refer CAD 1601 for application of noise certificate for Malaysian registered aircraft.

1.5 *RESERVED.*

1.6 *RESERVED.*

1.7 *RESERVED.*

1.8 CAAM may recognize as valid a noise certification granted by another Contracting State provided that the requirements under which such certification was granted are at least equal to the applicable Standards specified in ICAO Annex 16, Volume I.

1.9 CAAM may suspend or revoke the noise certification of an aircraft on its register if the aircraft ceases to comply with the applicable noise Standards. CAAM may remove the suspension of a noise certification or grant a new noise certification if the aircraft is found, on reassessment, to comply with the applicable noise Standards.

1.10 *RESERVED*.

1.11 Unless otherwise specified in this CAD, the date to be used in determining the applicability of the Standards in this CAD shall be the date the application for a Type Certificate was submitted to CAAM, or the date of submission under an equivalent application procedure prescribed by CAAM.

1.12 For derived versions where the provisions governing the applicability of the Standards of this CAD refer to “the application for the certification of the change in type design”, the date to be used in determining the applicability of the Standards in this CAD shall be the date the application for the change in type design was

submitted to CAAM, or the date of submission under an equivalent application procedure prescribed by CAAM.

1.13 An application shall be effective for the period specified in the designation of the airworthiness regulations appropriate to the aircraft type, except in special cases where CAAM accepts an extension of this period. When this period of effectivity is exceeded, the date to be used in determining the applicability of the Standards in this CAD shall be the date of issue of the Type Certificate or approval of the change in type design, or the date of issue of approval under an equivalent procedure prescribed by CAAM, less the period of effectivity.

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2 Subsonic Jet Aeroplanes — Application for Type Certificate submitted before 6 October 1977

2.1 Applicability

Note.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

2.1.1 The Standards of this chapter shall be applicable to all subsonic jet aeroplanes for which the application for a Type Certificate was submitted before 6 October 1977, except those aeroplanes:

a) requiring a runway length (with no stopway or clearway) of 610 m or less at maximum certificated mass for airworthiness; or

b) powered by engines with a bypass ratio of 2 or more and for which a certificate of airworthiness for the individual aeroplane was first issued before 1 March 1972; or

c) powered by engines with a bypass ratio of less than 2 and for which the application for a Type Certificate was submitted before 1 January 1969, and for which a certificate of airworthiness for the individual aeroplane was first issued before 1 January 1976.

2.1.2 The maximum noise levels of 2.4.1 shall apply except for derived versions for which the application for certification of the change in type design was submitted on or after 26 November 1981, in which case the maximum noise levels of 2.4.2 shall apply.

2.1.3 Notwithstanding 2.1.1 and 2.1.2, it may be recognized by CAAM that the following situations for jet aeroplanes, and propeller-driven aeroplanes over 8 618 kg maximum certificated take-off mass on its registry do not require demonstration of compliance with the provisions of the Standards of this CAD:

a) gear down flight with one or more retractable landing gear down during the entire flight;

b) spare engine and nacelle carriage external to the skin of the aeroplane (and return of the pylon or other external mount); and

c) time-limited engine and/or nacelle changes, where the change in type design specifies that the aeroplane may not be operated for a period of more than 90 days unless compliance with the provisions of this CAD, is shown for that change in type design. This applies only to changes resulting from a required maintenance action.

2.2 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 1.

2.3 Noise measurement points

An aeroplane, when tested in accordance with the flight test procedures of 2.6, shall not exceed the noise levels specified in 2.4 at the following points:

a) *lateral noise measurement point:* the point on a line parallel to and 650 m from the runway centre line, or extended runway centre line, where the noise level is a maximum during take-off;

b) *flyover noise measurement point:* the point on the extended centre line of the runway and at a distance of 6.5 km from the start of roll; and

c) *approach noise measurement point:* the point on the ground, on the extended centre line of the runway, 120 m (394 ft) vertically below the 3° descent path originating from a point 300 m beyond the threshold. On level ground this corresponds to a position 2 000 m from the threshold.

2.4 Maximum noise levels

2.4.1 The maximum noise levels of those aeroplanes covered by 2.1.1, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 1, shall not exceed the following:

a) *at lateral and approach noise measurement points:* 108 EPNdB for aeroplanes with maximum certificated take-off mass of 272 000 kg or over, decreasing linearly with the logarithm of the mass at the rate of 2 EPNdB per halving of the mass down to 102 EPNdB at 34 000 kg, after which the limit remains constant;

b) *at flyover noise measurement point:* 108 EPNdB for aeroplanes with maximum certificated take-off mass of 272 000 kg or over, decreasing linearly with the logarithm of the mass at the rate of 5 EPNdB per halving of the mass down to 93 EPNdB at 34 000 kg, after which the limit remains constant.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

2.4.2 The maximum noise levels of those aeroplanes covered by 2.1.2, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 1, shall not exceed the following:

2.4.2.1 *At lateral noise measurement point*

106 EPNdB for aeroplanes with maximum certificated take-off mass of 400 000 kg or over, decreasing linearly with the logarithm of the mass down to 97 EPNdB at 35 000 kg, after which the limit remains constant.

2.4.2.2 *At flyover noise measurement point*

a) *Aeroplanes with two engines or less*

104 EPNdB for aeroplanes with maximum certificated take-off mass of 325 000 kg or over, decreasing linearly with the logarithm of the mass at the rate of 4 EPNdB per halving of mass down to 93 EPNdB, after which the limit remains constant.

b) *Aeroplanes with three engines*

As a) but with 107 EPNdB for aeroplanes with maximum certificated take-off mass of 325 000 kg or over

or

as defined by 2.4.1 b), whichever is the lower.

c) *Aeroplanes with four engines or more*

As a) but with 108 EPNdB for aeroplanes with maximum certificated take-off mass of 325 000 kg or over

or

as defined by 2.4.1 b), whichever is the lower.

2.4.2.3 *At approach noise measurement point*

108 EPNdB for aeroplanes with maximum certificated take-off mass of 280 000 kg or over, decreasing linearly with the logarithm of the mass down to 101 EPNdB at 35 000 kg, after which the limit remains constant.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

2.5 Trade-offs

If the maximum noise levels are exceeded at one or two measurement points:

a) the sum of excesses shall not be greater than 4 EPNdB, except that in respect of four-engined aeroplanes powered by engines with a bypass ratio of 2 or more and for which the application for a certificate of airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the certificating authority, before 1 December 1969, the sum of any excesses shall not be greater than 5 EPNdB;

b) any excess at any single point shall not be greater than 3 EPNdB; and

c) any excesses shall be offset by corresponding reductions at the other point or points.

2.6 Test procedures

2.6.1 Take-off test procedure

2.6.1.1 Average take-off thrust shall be used from the start of take-off to the point at which a height of at least 210 m (690 ft) above the runway is reached, and the thrust thereafter shall not be reduced below that thrust which will maintain a climb gradient of at least 4 per cent.

Note. – Take-off thrust representative of the mean characteristics of the production engine.

2.6.1.2 A speed of at least V_2 + 19 km/h (V_2 + 10 kt) shall be attained as soon as practicable after lift-off and be maintained throughout the take-off noise certification test.

2.6.1.3 A constant take-off configuration selected by the applicant shall be maintained throughout the take-off noise certification demonstration test except that the landing gear may be retracted.

2.6.2 Approach test procedure

2.6.2.1 The aeroplane shall be stabilized and following a 3° ± 0.5° glide path.

2.6.2.2 The approach shall be made at a stabilized airspeed of not less than 1.3 V_S + 19 km/h (1.3 V_S + 10 kt) with thrust stabilized during approach and over the measuring point and continued to a normal touchdown.

2.6.2.3 The configuration of the aeroplane shall be with maximum allowable landing flap setting.

3 (1) Subsonic Jet Aeroplanes — Application for Type Certificate submitted on or after 6 October 1977 and before 1 January 2006

(2) Propeller-Driven Aeroplanes Over 8 618 kg — Application for Type Certificate submitted on or after 1 January 1985 and before 1 January 2006

3.1 Applicability

Note 1.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

Note 2.— See ICAO Annex 16 Volume I Attachment E for guidance on interpretation of these applicability provisions.

3.1.1 The Standards of this chapter shall, with the exception of those propeller-driven aeroplanes specifically designed and used for agricultural or firefighting purposes, be applicable to:

a) all subsonic jet aeroplanes, including their derived versions, other than aeroplanes which require a runway (with no stopway or clearway) length of 610 m or less at maximum certificated mass for airworthiness, for which the application for a Type Certificate was submitted on or after 6 October 1977 and before 1 January 2006; and

b) all propeller-driven aeroplanes, including their derived versions, of over 8 618 kg maximum certificated take-off mass, for which the application for a Type Certificate was submitted on or after 1 January 1985 and before 1 January 2006.

3.1.2 Notwithstanding 3.1.1, it may be recognized by CAAM that the following situations for jet aeroplanes, and propeller-driven aeroplanes over 8 618 kg maximum certificated take-off mass on its registry do not require demonstration of compliance with the provisions of the Standards of this CAD:

a) gear down flight with one or more retractable landing gear down during the entire flight;

b) spare engine and nacelle carriage external to the skin of the aeroplane (and return of the pylon or other external mount); and

c) time-limited engine and/or nacelle changes, where the change in type design specifies that the aeroplane may not be operated for a period of more than 90 days unless compliance with the provisions of this CAD, is shown for that change in type design. This applies only to changes resulting from a required maintenance action.

3.2 Noise measurements

3.2.1 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 2.

3.3 Noise measurement points

3.3.1 Reference noise measurement points

An aeroplane, when tested in accordance with these Standards, shall not exceed the noise levels specified in 3.4 at the following points:

a) *lateral full-power reference noise measurement point*

1) for jet-powered aeroplanes: the point on a line parallel to and 450 m from the runway centre line, where the noise level is a maximum during take-off;
2) for propeller-driven aeroplanes: the point on the extended centre line of the runway 650 m vertically below the climb-out flight path at full take-off power, as defined in 3.6.2. Until 19 March 2002, the requirement for lateral noise in 3.3.1 a) 1) shall alternatively be permitted;

Note.— For aeroplanes specified in 3.1.1 b) for which the application for a Type Certificate was submitted before 19 March 2002, the lateral noise requirement specified in 3.3.1 a) 1) is permitted as an alternative.

b) *flyover reference noise measurement point:* the point on the extended centre line of the runway and at a distance of 6.5 km from the start of roll;

c) *approach reference noise measurement point:* the point on the ground, on the extended centre line of the runway, 2 000 m from the threshold. On level ground this corresponds to a position 120 m (394 ft) vertically below the 3° descent path originating from a point 300 m beyond the threshold.

3.3.2 Test noise measurement points

3.3.2.1 If the test noise measurement points are not located at the reference noise measurement points, any corrections for the difference in position shall be made in the same manner as the corrections for the differences between test and reference flight paths.

3.3.2.2 Sufficient lateral test noise measurement points shall be used to demonstrate to CAAM that the maximum noise level on the appropriate lateral line has been clearly determined. For jet-powered aeroplanes simultaneous measurements shall be made at one test noise measurement point at a symmetrical position on the other side of the runway. In the case of propeller-driven aeroplanes, because of their inherent asymmetry in lateral noise, simultaneous measurements shall be made at each and every test noise

measurement point at a symmetrical position (within ±10 m parallel with the axis of the runway) on the opposite side of the runway.

3.4 Maximum noise levels

3.4.1 The maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 2, shall not exceed the following:

3.4.1.1 *At the lateral full-power reference noise measurement point*

103 EPNdB for aeroplanes with maximum certificated take-off mass, at which the noise certification is requested, of 400 000 kg and over and decreasing linearly with the logarithm of the mass down to 94 EPNdB at 35 000 kg, after which the limit remains constant.

3.4.1.2 *At flyover reference noise measurement point*

a) *Aeroplanes with two engines or less*

101 EPNdB for aeroplanes with maximum certificated take-off mass, at which the noise certification is requested, of 385 000 kg and over and decreasing linearly with the logarithm of the aeroplane mass at the rate of 4 EPNdB per halving of mass down to 89 EPNdB, after which the limit is constant.

b) *Aeroplanes with three engines*

As a) but with 104 EPNdB for aeroplanes with maximum certificated take-off mass of 385 000 kg and over.

c) *Aeroplanes with four engines or more*

As a) but with 106 EPNdB for aeroplanes with maximum certificated take-off mass of 385 000 kg and over.

3.4.1.3 *At approach reference noise measurement point*

105 EPNdB for aeroplanes with maximum certificated take-off mass, at which the noise certification is requested, of 280 000 kg or over, and decreasing linearly with the logarithm of the mass down to 98 EPNdB at 35 000 kg, after which the limit remains constant.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

3.5 Trade-offs

If the maximum noise levels are exceeded at one or two measurement points*:*

a) the sum of excesses shall not be greater than 3 EPNdB;

b) any excess at any single point shall not be greater than 2 EPNdB; and

c) any excesses shall be offset by corresponding reductions at the other point or points.

3.6 Noise certification reference procedures

3.6.1 General conditions

3.6.1.1 The reference procedures shall comply with the appropriate airworthiness requirements.

3.6.1.2 The calculations of reference procedures and flight paths shall be approved by CAAM.

3.6.1.3 Except in conditions specified in 3.6.1.4, the take-off and approach reference procedures shall be those defined in 3.6.2 and 3.6.3, respectively.

3.6.1.4 When it is shown by the applicant that the design characteristics of the aeroplane would prevent flight being conducted in accordance with 3.6.2 and 3.6.3, the reference procedures shall:

a) depart from the reference procedures defined in 3.6.2 and 3.6.3 only to the extent demanded by those design characteristics which make compliance with the procedures impossible; and

b) be approved by CAAM.

3.6.1.5 The reference procedures shall be calculated under the following reference atmospheric conditions:

a) atmospheric pressure at sea level of 1 013.25 hPa, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere;

b) ambient air temperature at sea level of 25°C, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere (i.e. 0.65°C per 100 m);

c) constant relative humidity of 70 per cent;

d) zero wind;

e) for the purpose of defining the reference take-off profiles for both take-off and lateral noise measurements, the runway gradient is zero; and

f) the reference atmosphere in terms of temperature and relative humidity is considered to be homogeneous (i.e. ambient temperature 25°C and relative humidity 70 per cent) for the purpose of calculating:

1) the reference sound attenuation rate due to atmospheric absorption; and

2) the reference speed of sound used in the calculation of the reference sound propagation geometry.

3.6.2 Take-off reference procedure

Take-off reference flight path shall be calculated as follows:

a) average engine take-off thrust or power shall be used from the start of take-off to the point where at least the following height above runway level is reached:

1) aeroplanes with two engines or less — 300 m (984 ft);
2) aeroplanes with three engines — 260 m (853 ft);
3) aeroplanes with four engines or more — 210 m (689 ft);

b) upon reaching the height specified in a) above, the thrust or power shall not be reduced below that required to maintain:

1) a climb gradient of 4 per cent; or
2) in the case of multi-engined aeroplanes, level flight with one engine inoperative;

whichever thrust or power is greater;

c) for the purpose of determining the lateral full-power noise level, the reference flight path shall be calculated on the basis of using full take-off power throughout without a thrust or power reduction;

d) the speed shall be:

1) for those aeroplanes for which the applicable airworthiness requirements define V_2, the all-engines operating take-off climb speed selected by the applicant for use in normal operation, which shall be at least V_2 + 19 km/h (V_2 + 10 kt) but not greater than V_2 + 37 km/h (V_2 + 20 kt) and which shall be attained as soon as practicable after lift-off and be maintained throughout the take-off noise certification test. The increment applied to V_2 shall be the same for all reference masses of an aeroplane model unless a difference in increment is substantiated based on performance characteristics of the aeroplane.

Note.— V_2 is defined in accordance with the applicable airworthiness requirements.

2) for those aeroplanes for which the applicable airworthiness requirements do not define V_2, the take-off speed at 15 m (50 ft) plus an increment of at least 19 km/h (10 kt) but not greater than 37 km/h (20 kt), or the minimum climb speed, whichever speed is greater. This speed shall be attained as soon as practicable after lift-off and be maintained throughout the take-off noise certification test.

Note.— Take-off speed at 15 m (50 ft) and minimum climb speed are defined in accordance with the applicable airworthiness requirements.

e) a constant take-off configuration selected by the applicant shall be maintained throughout the take-off reference procedure except that the landing gear may be retracted. Configuration shall be interpreted as meaning the conditions of the systems and centre of gravity position and shall include the position of lift augmentation devices used, whether the APU is operating, and whether air bleeds and power off-takes are operating;

f) the mass of the aeroplane at the brake release shall be the maximum take-off mass at which the noise certification is requested; and

g) the average engine shall be defined by the average of all the certification compliant engines used during the aeroplane flight tests up to and during certification when operated to the limitations and procedures given in the flight manual. This will establish a technical standard including the relationship of thrust/power to control parameters (e.g. N_1 or EPR). Noise measurements made during certification tests shall be corrected to this standard.

Note.— Take-off thrust/power used shall be the maximum available for normal operations as scheduled in the performance section of the aeroplane flight manual for the reference atmospheric conditions given in 3.6.1.5.

3.6.3 Approach reference procedure

The approach reference flight path shall be calculated as follows:

a) the aeroplane shall be stabilized and following a 3° glide path;

b) a steady approach speed of V_{REF} + 19 km/h (V_{REF} + 10 kt), with thrust or power stabilized, shall be maintained over the measurement point;

Note.— In airworthiness terms V_{REF} is defined as the "reference landing speed". Under this definition reference landing speed means "the speed of the aeroplane, in a specified landing configuration, at the point where it descends through the landing screen height in the determination of the landing distance for manual landings".

c) the constant approach configuration as used in the airworthiness certification tests, but with the landing gear down, shall be maintained throughout the approach reference procedure;

d) the mass of the aeroplane at the touchdown shall be the maximum landing mass permitted in the approach configuration defined in 3.6.3 c) at which noise certification is requested; and

e) the most critical (that which produces the highest noise level) configuration with normal deployment of aerodynamic control surfaces including lift and drag producing devices, at the mass at which certification is requested shall be used. This configuration includes all those items listed in 5.2.5 of ICAO Annex 16 Volume I Appendix 2 that will contribute to the noisiest continuous state at the maximum landing mass in normal operation.

3.7 Test procedures

3.7.1 The test procedures shall be acceptable to CAAM.

3.7.2 The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure designated as

effective perceived noise level, EPNL, in units of EPNdB, as described in ICAO Annex 16 Volume I Appendix 2.

3.7.3 Acoustic data shall be adjusted by the methods outlined in ICAO Annex 16 Volume I Appendix 2 to the reference conditions specified in this chapter. Adjustments for speed and thrust shall be made as described in Section 8 of ICAO Annex 16 Volume I Appendix 2.

3.7.4 If the mass during the test is different from the mass at which the noise certification is requested, the necessary EPNL adjustment shall not exceed 2 EPNdB for take-offs and 1 EPNdB for approaches. Data approved by CAAM shall be used to determine the variation of EPNL with mass for both take-off and approach test conditions. Similarly the necessary EPNL adjustment for variations in approach flight path from the reference flight path shall not exceed 2 EPNdB.

3.7.5 For the approach conditions the test procedures shall be accepted if the aeroplane follows a steady glide path angle of 3° ± 0.5°.

3.7.6 If equivalent test procedures different from the reference procedures are used, the test procedures and all methods for adjusting the results to the reference procedures shall be approved by CAAM. The amounts of the adjustments shall not exceed 16 EPNdB on take-off and 8 EPNdB on approach, and if the adjustments are more than 8 EPNdB and 4 EPNdB, respectively, the resulting numbers shall be more than 2 EPNdB below the noise limits specified in 3.4.

3.7.7 For take-off, lateral, and approach conditions, the variation in instantaneous indicated airspeed of the aeroplane must be maintained within ±3 per cent of the average airspeed between the 10 dB-down points. This shall be determined by reference to the pilot's airspeed indicator. However, when the instantaneous indicated airspeed varies from the average airspeed over the 10 dB-down points by more than ±5.5 km/h (±3 kt), and this is judged by CAAM representative on the flight deck to be due to atmospheric turbulence, then the flight so affected shall be rejected for noise certification purposes.

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4 (1) Subsonic Jet Aeroplanes And Propeller-Driven Aeroplanes With Maximum Certificated Take-Off Mass 55 000 KG And Over — Application for Type Certificate submitted on or after 1 January 2006 and before 31 December 2017

(2) Subsonic Jet Aeroplanes With Maximum Certificated Take-Off Mass Less Than 55 000 KG — Application for Type Certificate submitted on or after 1 January 2006 and before 31 December 2020

(3) Propeller-Driven Aeroplanes With Maximum Certificated Take-Off Mass Over 8 618 Kg And Less Than 55 000 KG — Application for Type Certificate submitted on or after 1 January 2006 and before 31 December 2020

4.1 Applicability

Note.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

4.1.1 The Standards of this chapter shall, with the exception of those aeroplanes which require a runway (with no stopway or clearway) length of 610 m or less at maximum certificated mass for airworthiness or propeller-driven aeroplanes specifically designed and used for agricultural or firefighting purposes, be applicable to:

a) all subsonic jet aeroplanes and propeller-driven aeroplanes, including their derived versions, with a maximum certificated take-off mass of 55 000 kg and over for which the application for a Type Certificate was submitted on or after 1 January 2006 and before 31 December 2017;

b) all subsonic jet aeroplanes, including their derived versions, with a maximum certificated take-off mass of less than 55 000 kg for which the application for a Type Certificate was submitted on or after 1 January 2006 and before 31 December 2020;

c) all propeller-driven aeroplanes, including their derived versions, with a maximum certificated take-off mass of over 8 618 kg and less than 55 000 kg, for which the application for a Type Certificate was submitted on or after 1 January 2006 and before 31 December 2020; and

d) all subsonic jet aeroplanes and all propeller-driven aeroplanes certificated originally as satisfying CAD 16, Volume I, Chapter 3 or Chapter 5, for which recertification to Chapter 4 is requested.

4.1.2 Notwithstanding 4.1.1, it may be recognized by CAAM that the following situations for jet aeroplanes and propeller-driven aeroplanes over 8 618 kg maximum

certificated take-off mass on its registry do not require demonstration of compliance with the provisions of the Standards of this CAD:

a) gear down flight with one or more retractable landing gear down during the entire flight;

b) spare engine and nacelle carriage external to the skin of the aeroplane (and return of the pylon or other external mount); and

c) time-limited engine and/or nacelle changes, where the change in type design specifies that the aeroplane may not be operated for a period of more than 90 days unless compliance with the provisions of this CAD, is shown for that change in type design. This applies only to changes resulting from a required maintenance action.

4.2 Noise measurements

4.2.1 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 2.

4.3 Reference noise measurement points

4.3.1 An aeroplane, when tested in accordance with these Standards, shall not exceed the maximum noise level specified in 4.4 of the noise measured at the points specified in Chapter 3, 3.3.1 a), b) and c).

4.3.2 Test noise measurement points

The provisions of Chapter 3, 3.3.2, relating to test noise measurement points shall apply.

4.4 Maximum noise levels

4.4.1 The maximum permitted noise levels are defined in Chapter 3, 3.4.1.1, 3.4.1.2 and 3.4.1.3, and shall not be exceeded at any of the measurement points.

4.4.1.1 The sum of the differences at all three measurement points between the maximum noise levels and the maximum permitted noise levels specified in Chapter 3, 3.4.1.1, 3.4.1.2 and 3.4.1.3, shall not be less than 10 EPNdB.

4.4.1.2 The sum of the differences at any two measurement points between the maximum noise levels and the corresponding maximum permitted noise levels specified in Chapter 3, 3.4.1.1, 3.4.1.2 and 3.4.1.3, shall not be less than 2 EPNdB.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

4.5 Noise certification reference procedures

The noise certification reference procedures shall be as specified in Chapter 3, 3.6.

4.6 Test procedures

The test procedures shall be as specified in Chapter 3, 3.7.

4.7 Recertification

For aeroplanes specified in 4.1.1 c), recertification shall be granted on the basis that the evidence used to determine compliance with Chapter 4 is as satisfactory as the evidence associated with aeroplanes specified in 4.1.1 a) and b).

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5 Propeller-Driven Aeroplanes Over 8 618 KG — Application for Type Certificate submitted before 1 January 1985

5.1 Applicability

Note 1.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

Note 2.— See ICAO Annex 16 Volume I Attachment E for guidance on interpretation of these applicability provisions.

5.1.1 The Standards defined hereunder are not applicable to:

a) aeroplanes requiring a runway (with no stopway or clearway) length of 610 m or less at maximum certificated mass for airworthiness;

b) aeroplanes specifically designed and used for firefighting purposes; and

c) aeroplanes specifically designed and used for agricultural purposes.

5.1.2 The Standards of this chapter shall be applicable to all propeller-driven aeroplanes, including their derived versions, of over 8 618 kg maximum certificated take-off mass for which either the application for a Type Certificate was submitted on or after 6 October 1977 and before 1 January 1985.

5.1.3 The Standards of Chapter 2, with the exception of Sections 2.1 and 2.4.2, shall be applicable to propeller-driven aeroplanes of over 8 618 kg for which the application for a Type Certificate was submitted before 6 October 1977 and which are either:

a) derived versions for which the application for certification of the change in type design was submitted on or after 6 October 1977; or

b) individual aeroplanes for which a certificate of airworthiness was first issued on or after 26 November 1981.

5.1.4 Notwithstanding 5.1.2 and 5.1.3, it may be recognized by CAAM that the following situations for jet aeroplanes, and propeller-driven aeroplanes over 8 618 kg maximum certificated take-off mass on its registry do not require demonstration of compliance with the provisions of the Standards of this CAD:

a) gear down flight with one or more retractable landing gear down during the entire flight;

b) spare engine and nacelle carriage external to the skin of the aeroplane (and return of the pylon or other external mount); and

c) time-limited engine and/or nacelle changes, where the change in type design specifies that the aeroplane may not be operated for a period of more than 90 days unless compliance with the provisions of this CAD, is shown for that change in type design. This applies only to changes resulting from a required maintenance action.

5.2 Noise measurements

5.2.1 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 2.

5.3 Noise measurement points

5.3.1 Reference noise measurement points

An aeroplane, when tested in accordance with these Standards, shall not exceed the noise levels specified in 5.4 at the following points:

a) *lateral reference noise measurement point:* the point on a line parallel to and 450 m from the runway centre line, or extended runway centre line, where the noise level is a maximum during take-off;

b) *flyover reference noise measurement point:* the point on the extended centre line of the runway and at a distance of 6.5 km from the start of roll; and

c) *approach reference noise measurement point:* the point on the ground, on the extended centre line of the runway, 2 000 m from the threshold. On level ground this corresponds to a position 120 m (394 ft) vertically below the 3° descent path originating from a point 300 m beyond the threshold.

5.3.2 Test noise measurement points

5.3.2.1 If the test noise measurement points are not located at the reference noise measurement points, any corrections for the difference in position shall be made in the same manner as the corrections for the differences between test and reference flight paths.

5.3.2.2 Sufficient lateral test noise measurement points shall be used to demonstrate to CAAM that the maximum noise level on the appropriate lateral line has been clearly determined. Simultaneous measurements shall be made at one test noise measurement point at a symmetrical position on the other side of the runway.

5.3.2.3 The applicant shall demonstrate to the certificating authority that during flight test, lateral and flyover noise levels were not separately optimized at the expense of each other.

5.4 Maximum noise levels

The maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 2, shall not exceed the following:

a) *at lateral reference noise measurement point:* 96 EPNdB constant limit for aeroplanes with maximum take-off mass, at which the noise certification is requested, up to 34 000 kg and increasing linearly with the logarithm of

aeroplane mass at the rate of 2 EPNdB per doubling of mass from that point until the limit of 103 EPNdB is reached, after which the limit is constant;

b) *at flyover reference noise measurement point:* 89 EPNdB constant limit for aeroplanes with maximum take-off mass, at which the noise certification is requested, up to 34 000 kg and increasing linearly with the logarithm of aeroplane mass at the rate of 5 EPNdB per doubling of mass from that point until the limit of 106 EPNdB is reached, after which the limit is constant; and

c) *at approach reference noise measurement point:* 98 EPNdB constant limit for aeroplanes with maximum take-off mass, at which the noise certification is requested, up to 34 000 kg and increasing linearly with the logarithm of aeroplane mass at the rate of 2 EPNdB per doubling of mass from that point until the limit of 105 EPNdB is reached, after which the limit is constant.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

5.5 Trade-offs

If the maximum noise levels are exceeded at one or two measurement points:

a) the sum of excesses shall not be greater than 3 EPNdB;

b) any excess at any single point shall not be greater than 2 EPNdB; and

c) any excesses shall be offset by corresponding reductions at the other point or points.

5.6 Noise certification reference procedures

5.6.1 General conditions

5.6.1.1 The reference procedures shall comply with the appropriate airworthiness requirements.

5.6.1.2 The calculations of reference procedures and flight paths shall be approved by CAAM.

5.6.1.3 Except in conditions specified in 5.6.1.4, the take-off and approach reference procedures shall be those defined in 5.6.2 and 5.6.3, respectively.

5.6.1.4 When it is shown by the applicant that the design characteristics of the aeroplane would prevent flight being conducted in accordance with 5.6.2 and 5.6.3, the reference procedures shall:

a) depart from the reference procedures defined in 5.6.2 and 5.6.3 only to the extent demanded by those design characteristics which make compliance with the procedures impossible; and

b) be approved by CAAM.

5.6.1.5 The reference procedures shall be calculated under the following reference atmospheric conditions:

a) atmospheric pressure at sea level of 1 013.25 hPa, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere;

b) ambient air temperature at sea level of 25°C, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere (i.e. 0.65°C per 100 m), except that at the discretion of CAAM, an alternative ambient air temperature at sea level of 15°C may be used;

c) constant relative humidity of 70 per cent;

d) zero wind; and

e) the reference atmosphere in terms of temperature and relative humidity is considered to be homogeneous (i.e. ambient temperature 25°C and relative humidity 70 per cent) for the purpose of calculating:

1) the reference sound attenuation rate due to atmospheric absorption; and

2) the reference speed of sound used in the calculation of the reference sound propagation geometry.

5.6.2 Take-off reference procedure

The take-off flight path shall be calculated as follows:

a) average take-off power shall be used from the start of take-off to the point where at least the height above runway level shown below is reached. The take-off power used shall be the maximum available for normal operations as scheduled in the performance section of the aeroplane flight manual for the reference atmospheric conditions given in 5.6.1.5;

1) aeroplanes with two engines or less — 300 m (984 ft);
2) aeroplanes with three engines — 260 m (853 ft);
3) aeroplanes with four engines or more — 210 m (689 ft);

b) upon reaching the height specified in a) above, the power shall not be reduced below that required to maintain:

1) a climb gradient of 4 per cent; or
2) in the case of multi-engined aeroplanes, level flight with one engine inoperative;

whichever power is the greater;

c) the speed shall be the all-engines operating take-off climb speed selected by the applicant for use in normal operation, which shall be at least V_2 + 19 km/h (V_2 + 10 kt) and which shall be attained as soon as practicable after lift-off and be maintained throughout the take-off noise certification test;

d) a constant take-off configuration selected by the applicant shall be maintained throughout the take-off reference procedure except that the landing gear may be retracted; and

e) the mass of the aeroplane at the brake release shall be the maximum take-off mass at which the noise certification is requested.

5.6.3 Approach reference procedure

The approach reference flight path shall be calculated as follows:

a) the aeroplane shall be stabilized and following a 3° glide path;

b) the approach shall be made at a stabilized airspeed of not less than 1.3 V_S + 19 km/h (1.3 V_S + 10 kt) with power stabilized during approach and over the measuring point and continued to a normal touchdown;

c) the constant approach configuration used in the airworthiness certification test, but with the landing gear down, shall be maintained throughout the approach reference procedure;

d) the mass of the aeroplane at the touchdown shall be the maximum landing mass permitted in the approach configuration defined in 5.6.3 c) at which noise certification is requested; and

e) the most critical (that which produces the highest noise levels) configuration at the mass at which certification is requested shall be used.

5.7 Test procedures

5.7.1 The test procedures shall be acceptable to CAAM.

5.7.2 The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure designated as effective perceived noise level, EPNL, in units of EPNdB, as described in ICAO Annex 16 Volume I Appendix 2.

5.7.3 Acoustic data shall be adjusted by the methods outlined in ICAO Annex 16 Volume I Appendix 2 to the reference conditions specified in this chapter. Adjustments for speed and thrust shall be made as described in Section 8 of ICAO Annex 16 Volume I Appendix 2.

5.7.4 If the mass during the test is different from the mass at which the noise certification is requested, the necessary EPNL adjustment shall not exceed 2 EPNdB for take-offs and 1 EPNdB for approaches. Data approved by CAAM shall be used to determine the variation of EPNL with mass for both take-off and approach test conditions. Similarly, the necessary EPNL adjustment for variations in approach flight path from the reference flight path shall not exceed 2 EPNdB.

5.7.5 For the approach conditions the test procedures shall be accepted if the aeroplane follows a steady glide path angle of 3° ± 0.5°.

5.7.6 If equivalent test procedures different from the reference procedures are used, the test procedures and all methods for adjusting the results to the reference procedures shall be approved by CAAM. The amounts of the adjustments shall not exceed 16 EPNdB on take-off and 8 EPNdB on approach, and if the adjustments are more than 8 EPNdB and 4 EPNdB, respectively, the resulting numbers shall not be within 2 EPNdB of the limit noise levels specified in 5.4.

6 Propeller-Driven Aeroplanes Not Exceeding 8 618 KG — Application for Type Certificate submitted before 17 November 1988

6.1 Applicability

Note 1.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

Note 2.— See ICAO Annex 16 Volume I Attachment E for guidance on interpretation of these applicability provisions.

The Standards of this chapter shall be applicable to all propeller-driven aeroplanes, except those aeroplanes specifically designed and used for aerobatic, agricultural or firefighting purposes, having a maximum certificated take-off mass not exceeding 8 618 kg for which either:

a) the application for the Type Certificate was submitted on or after 1 January 1975 and before 17 November 1988, except for derived versions for which the application for certification of the change in type design was submitted on or after 17 November 1988, in which case the Standards of Chapter 10 apply; or

b) a certificate of airworthiness for the individual aeroplane was first issued on or after 1 January 1980.

6.2 Noise evaluation measure

The noise evaluation measure shall be a weighted overall sound pressure level as defined in International Electrotechnical Commission (IEC) Publication No. 179. The weighting applied to each sinusoidal component of the sound pressure shall be given as a function of frequency by the standard reference curve called “A”.

6.3 Maximum noise levels

For aeroplanes specified in 6.1 a) and b), the maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 3, shall not exceed the following:

— a 68 dB(A) constant limit up to an aeroplane mass of 600 kg, varying linearly with mass from that point to 1 500 kg, after which the limit is constant at 80 dB(A) up to 8 618 kg.

Note 1.— Where an aeroplane comes within the provisions of Chapter 10, 10.1.2, the limit of 80 dB(A) applies up to 8 618 kg.

Note 2.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

6.4 Noise certification reference procedures

The reference procedures shall be calculated under the following reference atmospheric conditions:

a) atmospheric pressure at sea level of 1 013.25 hPa, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere; and

b) ambient air temperature at sea level of 25°C, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere (i.e. 0.65°C per 100 m);

6.5 Test procedures

6.5.1 Either the test procedures described in 6.5.2 and 6.5.3 or equivalent test procedures approved by CAAM shall be used.

6.5.2 Tests to demonstrate compliance with the maximum noise levels of 6.3 shall consist of a series of level flights overhead the measuring station at a height of

$$300^{+10}_{-30}\ \text{m}\ (984^{+30}_{-100}\ \text{ft})$$

The aeroplane shall pass over the measuring point within ±10° from the vertical.

6.5.3 Overflight shall be performed at the highest power in the normal operating range, stabilized airspeed and with the aeroplane in the cruise configuration.

7 Propeller-Driven STOL Aeroplanes

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8 Helicopters

8.1 Applicability

Note.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

8.1.1 The Standards of this chapter shall be applicable to all helicopters for which 8.1.2, 8.1.3 and 8.1.4 apply, except those specifically designed and used for agricultural, firefighting or external load-carrying purposes.

8.1.2 For a helicopter for which the application for the Type Certificate was submitted on or after 1 January 1985, except for those helicopters specified in 8.1.4, the maximum noise levels of 8.4.1 shall apply.

8.1.3 For a derived version of a helicopter for which the application for certification of the change in type design was submitted on or after 17 November 1988, except for those helicopters specified in 8.1.4, the maximum noise levels of 8.4.1 shall apply.

8.1.4 For all helicopters, including their derived versions, for which the application for the Type Certificate was submitted on or after 21 March 2002, the maximum noise levels of 8.4.2 shall apply.

8.1.5 Certification of helicopters which are capable of carrying external loads or external equipment shall be made without such loads or equipment fitted.

Note.— Helicopters which comply with the Standards with internal loads may be excepted when carrying external loads or external equipment, if such operations are conducted at a gross mass or with other operating parameters which are in excess of those certificated for airworthiness with internal loads.

8.1.6 An applicant under 8.1.1 may alternatively elect to show compliance with Chapter 11 instead of Chapter 8 if the helicopter has a maximum certificated take-off mass of 3 175 kg or less.

8.2 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 2.

8.3 Reference noise measurement points

A helicopter, when tested in accordance with these Standards, shall not exceed the noise levels specified in 8.4 at the following points:

a) *Take-off reference noise measurement points*

1) a flight path reference point located on the ground vertically below the flight path defined in the take-off reference procedure and 500 m horizontally in the direction of flight from the point at which transition to climbing flight is initiated in the reference procedure (see 8.6.2);

2) two other points on the ground symmetrically disposed at 150 m on both sides of the flight path defined in the take-off reference procedure and lying on a line through the flight path reference point.

b) *Overflight reference noise measurement points*

1) a flight path reference point located on the ground 150 m (492 ft) vertically below the flight path defined in the overflight reference procedure (see 8.6.3.1);

2) two other points on the ground symmetrically disposed at 150 m on both sides of the flight path defined in the overflight reference procedure and lying on a line through the flight path reference point.

c) *Approach reference noise measurement points*

1) a flight path reference point located on the ground 120 m (394 ft) vertically below the flight path defined in the approach reference procedure (see 8.6.4). On level ground, this corresponds to a position 1 140 m from the intersection of the 6.0° approach path with the ground plane;

2) two other points on the ground symmetrically disposed at 150 m on both sides of the flight path defined in the approach reference procedure and lying on a line through the flight path reference point.

8.4 Maximum noise levels

8.4.1 For helicopters specified in 8.1.2 and 8.1.3, the maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 2, shall not exceed the following:

8.4.1.1 *For take-off:* 109 EPNdB for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the helicopter mass at a rate of 3 EPNdB per halving of mass down to 89 EPNdB after which the limit is constant.

8.4.1.2 *For overflight:* 108 EPNdB for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the helicopter mass at a rate of 3 EPNdB per halving of mass down to 88 EPNdB after which the limit is constant.

8.4.1.3 *For approach:* 110 EPNdB for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the helicopter mass at a rate of 3 EPNdB per halving of mass down to 90 EPNdB after which the limit is constant.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

8.4.2 For helicopters specified in 8.1.4, the maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 2, shall not exceed the following:

8.4.2.1 *For take-off:* 106 EPNdB for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the helicopter mass at a rate of 3 EPNdB per halving of mass down to 86 EPNdB after which the limit is constant.

8.4.2.2 *For overflight:* 104 EPNdB for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the helicopter mass at a rate of 3 EPNdB per halving of mass down to 84 EPNdB after which the limit is constant.

8.4.2.3 *For approach:* 109 EPNdB for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the helicopter mass at a rate of 3 EPNdB per halving of mass down to 89 EPNdB after which the limit is constant.

8.5 Trade-offs

If the noise level limits are exceeded at one or two measurement points:

a) the sum of excesses shall not be greater than 4 EPNdB;

b) any excess at any single point shall not be greater than 3 EPNdB; and

c) any excess shall be offset by corresponding reductions at the other point or points.

8.6 Noise certification reference procedures

8.6.1 General conditions

8.6.1.1 The reference procedures shall comply with the appropriate airworthiness requirements.

8.6.1.2 The reference procedures and flight paths shall be approved by CAAM.

8.6.1.3 Except in conditions specified in 8.6.1.4, the take-off, overflight and approach reference procedures shall be those defined in 8.6.2, 8.6.3 and 8.6.4, respectively.

8.6.1.4 When it is shown by the applicant that the design characteristics of the helicopter would prevent flight being conducted in accordance with 8.6.2, 8.6.3 or 8.6.4, the reference procedures shall:

a) depart from the reference procedures defined in 8.6.2, 8.6.3 or 8.6.4 only to the extent demanded by those design characteristics which make compliance with the reference procedures impossible; and

b) be approved by CAAM.

8.6.1.5 The reference procedures shall be calculated under the following reference atmospheric conditions:

a) constant atmospheric pressure of 1 013.25 hPa;

b) constant ambient air temperature of 25°C;

c) constant relative humidity of 70 per cent; and

d) zero wind.

8.6.1.6 In 8.6.2 c), 8.6.3.1 c) and 8.6.4 c), the maximum normal operating rpm shall be taken as the highest rotor speed for each reference procedure corresponding to the airworthiness limit imposed by the manufacturer and approved by CAAM. Where a tolerance on the highest rotor speed is specified, the maximum normal operating rotor speed shall be taken as the highest rotor speed about which that tolerance is given. If the rotor speed is automatically linked with flight condition, the maximum normal operating rotor speed corresponding with the reference flight condition shall be used during the noise certification procedure. If rotor speed can be changed by pilot action, the maximum normal operating rotor speed specified in the flight manual limitation section for the reference conditions shall be used during the noise certification procedure.

8.6.2 Take-off reference procedure

The take-off reference flight procedure shall be established as follows:

a) the helicopter shall be stabilized at the maximum take-off power corresponding to minimum installed engine(s) specification power available for the reference ambient conditions or gearbox torque limit, whichever is lower, and along a path starting from a point located 500 m prior to the flight path reference point, at 20 m (65 ft) above the ground;

b) the best rate of climb speed, V_Y, or the lowest approved speed for the climb after take-off, whichever is the greater, shall be maintained throughout the take-off reference procedure;

c) the steady climb shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for take-off;

d) a constant take-off configuration selected by the applicant shall be maintained throughout the take-off reference procedure with the landing gear position consistent with the airworthiness certification tests for establishing the best rate of climb speed, V_Y;

e) the mass of the helicopter shall be the maximum take-off mass at which noise certification is requested; and

f) the reference take-off path is defined as a straight line segment inclined from the starting point (500 m prior to the centre microphone location and 20 m (65 ft) above ground level) at an angle defined by best rate of climb and V_Y for minimum specification engine performance.

8.6.3 Overflight reference procedure

8.6.3.1 The overflight reference procedure shall be established as follows:

a) the helicopter shall be stabilized in level flight overhead the flight path reference point at a height of 150 m (492 ft);

b) a speed of 0.9 V_H or 0.9 V_{NE} or 0.45 V_H + 120 km/h (0.45 V_H + 65 kt) or 0.45 V_{NE} + 120 km/h (0.45 V_{NE} + 65 kt), whichever is the least, shall be maintained throughout the overflight reference procedure;

Note.— For noise certification purposes, V_H is defined as the airspeed in level flight obtained using the torque corresponding to minimum engine installed, maximum continuous power available for sea level pressure (1 013.25 hPa), 25°C ambient conditions at the relevant maximum certificated mass. V_{NE} is defined as the not-to- exceed airworthiness airspeed imposed by the manufacturer and approved by CAAM.

c) the overflight shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for level flight;

d) the helicopter shall be in the cruise configuration; and

e) the mass of the helicopter shall be the maximum take-off mass at which noise certification is requested.

8.6.3.2 The value of V_H and/or V_{NE} used for noise certification shall be quoted in the approved flight manual.

8.6.4 Approach reference procedure The approach reference procedure shall be established as follows:

a) the helicopter shall be stabilized and following a 6.0° approach path;

b) the approach shall be made at a stabilized airspeed equal to the best rate of climb speed, V_Y, or the lowest approved speed for the approach, whichever is the greater, with power stabilized during the approach and over the flight path reference point, and continued to a normal touchdown;

c) the approach shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for approach;

d) the constant approach configuration used in airworthiness certification tests, with the landing gear extended, shall be maintained throughout the approach reference procedure; and

e) the mass of the helicopter at touchdown shall be the maximum landing mass at which noise certification is requested.

8.7 Test procedures

8.7.1 The test procedures shall be acceptable to CAAM.

8.7.2 The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure designated as effective perceived noise level, EPNL, in units of EPNdB, as described in ICAO Annex 16 Volume I Appendix 2.

8.7.3 Test conditions and procedures shall be closely similar to reference conditions and procedures or the acoustic data shall be adjusted, by the methods outlined in ICAO Annex 16 Volume I Appendix 2, to the reference conditions and procedures specified in this chapter.

8.7.4 Adjustments for differences between test and reference flight procedures shall not exceed:

a) *for take-off:* 4.0 EPNdB, of which the arithmetic sum of Δ_1 and the term – 7.5 log (QK/Q_rK_r) from Δ_2 shall not in total exceed 2.0 EPNdB;

b) *for overflight or approach:* 2.0 EPNdB.

8.7.5 During the test the average rotor rpm shall not vary from the normal maximum operating rpm by more than ±1.0 per cent during the 10 dB-down period.

8.7.6 The helicopter airspeed shall not vary from the reference airspeed appropriate to the flight demonstration by more than ±9 km/h (±5 kt) throughout the 10 dB-down period.

8.7.7 The number of level overflights made with a headwind component shall be equal to the number of level overflights made with a tailwind component.

8.7.8 The helicopter shall fly within ±10° or ±20 m, whichever is greater, from the vertical above the reference track throughout the 10 dB-down period (see Figure 8-1).

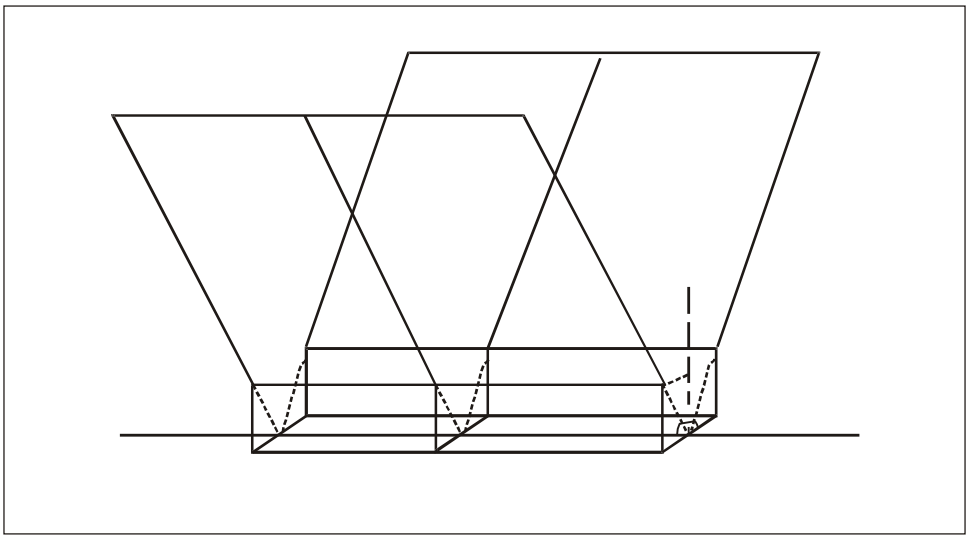

Figure 8-1. Helicopter lateral deviation tolerances

8.7.9 The helicopter height shall not vary during overflight from the reference height at the overhead point by more than ±9 m (±30 ft).

8.7.10 During the approach noise demonstration the helicopter shall be established on a stabilized constant speed approach within the airspace contained between approach angles of 5.5° and 6.5°.

8.7.11 Tests shall be conducted at a helicopter mass not less than 90 per cent of the relevant maximum certificated mass and may be conducted at a mass not exceeding 105 per cent of the relevant maximum certificated mass. For each of the three flight conditions, at least one test must be completed at or above this maximum certificated mass.

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9 Auxiliary Power Units (APU) And Associated Aircraft Systems During Ground Operations

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10 Propeller-Driven Aeroplanes Not Exceeding 8 618 KG — Application for Type Certificate or Certification of Derived Version submitted on or after 17 November 1988

10.1 Applicability

Note 1.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

Note 2.— See ICAO Annex 16 Volume I Attachment E for guidance on interpretation of these applicability provisions.

10.1.1 The Standards of this chapter shall be applicable to all propeller-driven aeroplanes with a certificated take-off mass not exceeding 8 618 kg, except those aeroplanes specifically designed and used for aerobatic, agricultural or firefighting purposes and self-sustaining powered sailplanes.

10.1.2 For aeroplanes for which the application for the Type Certificate was submitted on or after 17 November 1988, except for those aeroplanes specified in 10.1.6, the maximum noise levels of 10.4 a) shall apply.

10.1.3 For aeroplanes specified in 10.1.2 where the application for the Type Certificate was submitted before 17 November 1993 and which fail to comply with the Standards of this chapter, the Standards of Chapter 6 shall apply.

10.1.4 For derived versions for which the application for certification of the change in type design was submitted on or after 17 November 1988, except for those derived versions specified in 10.1.6, the maximum noise levels of 10.4 a) shall apply.

10.1.5 For derived versions specified in 10.1.4 where the application for certification of the change in type design was submitted before 17 November 1993 and which fail to comply with the Standards of this chapter, the Standards of Chapter 6 shall apply.

10.1.6 For single-engined aeroplanes, except float planes and amphibians:

a) the maximum noise levels of 10.4 b) shall apply to those aeroplanes, including their derived versions, for which the application for the Type Certificate was submitted on or after 4 November 1999;

b) the maximum noise levels of 10.4 b) shall apply to those derived versions of aeroplanes for which the application for the Type Certificate was submitted before 4 November 1999 and for which the application for certification of the change in type design was submitted on or after 4 November 1999; except

c) for those derived versions described in 10.1.6 b) where the application for certification of the change in type design was submitted before 4 November 2004 and which exceed the maximum noise levels of 10.4 b), in which case the maximum noise levels of 10.4 a) shall apply.

10.2 Noise evaluation measure

The noise evaluation measure shall be the maximum A-weighted noise level, L_{ASmax}, as defined in ICAO Annex 16 Volume I Appendix 6.

10.3 Reference noise measurement points

10.3.1 An aeroplane, when tested in accordance with these Standards, shall not exceed the noise level specified in 10.4 at the take-off reference noise measurement point.

10.3.2 The take-off reference noise measurement point is the point on the extended centre line of the runway at a distance of 2 500 m from the start of take-off roll.

10.4 Maximum noise levels

The maximum noise levels determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 6 shall not exceed the following:

a) for aeroplanes specified in 10.1.2 and 10.1.4, a 76 dB(A) constant limit up to an aeroplane mass of 600 kg varying linearly from that point with the logarithm of aeroplane mass until at 1 400 kg the limit of 88 dB(A) is reached after which the limit is constant up to 8 618 kg; and

b) for aeroplanes specified in 10.1.4, a 70 dB(A) constant limit up to an aeroplane mass of 570 kg increasing linearly from that point with the logarithm of aeroplane mass until at 1 500 kg the limit of 85 dB(A) is reached after which the limit is constant up to 8 618 kg.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

10.5 Noise certification reference procedures

10.5.1 General conditions

10.5.1.1 The calculations of reference procedures and flight paths shall be approved by CAAM.

10.5.1.2 Except in conditions specified in 10.5.1.3, the take-off reference procedure shall be that defined in 10.5.2.

10.5.1.3 When it is shown by the applicant that the design characteristics of the aeroplane would prevent flights being conducted in accordance with 10.5.2, the reference procedures shall:

a) depart from the reference procedures defined only to the extent demanded by those design characteristics which make compliance with the procedures impossible; and

b) be approved by CAAM.

10.5.1.4 The reference procedures shall be calculated under the following atmospheric conditions:

a) atmospheric pressure at sea level of 1 013.25 hPa, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere;

b) ambient air temperature at sea level of 15°C, decreasing with altitude at a rate defined by the ICAO Standard Atmosphere (i.e. 0.65°C per 100 m);

c) constant relative humidity of 70 per cent; and

d) zero wind.

10.5.1.5 The acoustic reference atmospheric conditions shall be the same as the reference atmospheric conditions for flight.

10.5.2 Take-off reference procedure

The take-off flight path shall be calculated taking into account the following two phases.

First phase

a) take-off power shall be used from the brake release point to the point at which the height of 15 m (50 ft) above the runway is reached;

b) a constant take-off configuration selected by the applicant shall be maintained throughout this first phase;

c) the mass of the aeroplane at the brake release shall be the maximum take-off mass at which the noise certification is requested; and

d) the length of this first phase shall correspond to the length given in the airworthiness data for a take-off on a level paved runway.

Second phase

a) the beginning of the second phase corresponds to the end of the first phase;

b) the aeroplane shall be in the climb configuration with landing gear up, if retractable, and flap setting corresponding to normal climb throughout this second phase;

c) the speed shall be the best rate of climb speed, V_Y; and

d) take-off power and, for aeroplanes equipped with variable pitch or constant speed propellers, rpm shall be maintained throughout the second phase. If airworthiness limitations do not permit the application of take-off power and rpm up to the reference point, then take-off power and rpm shall be maintained for as long as is permitted by such limitations and thereafter at maximum continuous power and rpm. Limiting of time for which take-off power and rpm shall be used in order to comply with this chapter shall not

be permitted. The reference height shall be calculated assuming climb gradients appropriate to each power setting used.

10.6 Test procedures

10.6.1 The test procedures shall be acceptable to CAAM.

10.6.2 The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure in units of L_{ASmax} as described in ICAO Annex 16 Volume I Appendix 6.

10.6.3 Acoustic data shall be adjusted by the methods outlined in ICAO Annex 16 Volume I Appendix 6 to the reference conditions specified in this chapter.

10.6.4 If equivalent test procedures are used, the test procedures and all methods for correcting the results to the reference procedures shall be approved by CAAM.

11 Helicopters Not Exceeding 3 175 KG Maximum Certificated Take-Off Mass

11.1 Applicability

Note.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

11.1.1 The Standards of this chapter shall be applicable to all helicopters having a maximum certificated take-off mass not exceeding 3 175 kg for which 11.1.2, 11.1.3 and 11.1.4 apply, except those specifically designed and used for agricultural, firefighting or external load-carrying purposes.

11.1.2 For a helicopter for which the application for the Type Certificate was submitted on or after 11 November 1993, except for those helicopters specified in 11.1.4, the maximum noise levels of 11.4.1 shall apply.

11.1.3 For a derived version of a helicopter for which the application for certification of the change in type design was submitted on or after 11 November 1993, except for those helicopters specified in 11.1.4, the maximum noise levels of 11.4.1 shall apply.

11.1.4 For all helicopters, including their derived versions, for which the application for the Type Certificate was submitted on or after 21 March 2002, the maximum noise levels of 11.4.2 shall apply.

11.1.5 Certification of helicopters which are capable of carrying external loads or external equipment shall be made without such loads or equipment fitted.

Note.— Helicopters which comply with the Standards with internal loads may be excepted when carrying external loads or external equipment, if such operations are conducted at a gross mass or with other operating parameters which are in excess of those certificated for airworthiness with internal loads.

11.1.6 An applicant under 11.1.1, 11.1.2, 11.1.3 and 11.1.4 may alternatively elect to show compliance with Chapter 8 instead of complying with this chapter.

11.2 Noise evaluation measure

The noise evaluation measure shall be the sound exposure level (SEL) as described in ICAO Annex 16 Volume I Appendix 4.

11.3 Reference noise measurement points

A helicopter, when tested in accordance with these Standards, shall not exceed the noise levels specified in 11.4 at a flight path reference point located on the ground 150 m (492 ft) vertically below the flight path defined in the overflight reference procedure (see 11.5.2.1).

11.4 Maximum noise level

11.4.1 For helicopters specified in 11.1.2 and 11.1.3, the maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 4, shall not exceed 82 decibels SEL for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of up to 788 kg and increasing linearly with the logarithm of the helicopter mass at a rate of 3 decibels per doubling of mass thereafter.

11.4.2 For helicopters specified in 11.1.4, the maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 4, shall not exceed 82 decibels SEL for helicopters with maximum certificated take-off mass, at which the noise certification is requested, of up to 1 417 kg and increasing linearly with the logarithm of the helicopter mass at a rate of 3 decibels per doubling of mass thereafter.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

11.5 Noise certification reference procedures

11.5.1 General conditions

11.5.1.1 The reference procedure shall comply with the appropriate airworthiness requirements and shall be approved by CAAM.

11.5.1.2 Except as otherwise approved, the overflight reference procedures shall be as defined in 11.5.2.

11.5.1.3 When it is shown by the applicant that the design characteristics of the helicopter would prevent flight being conducted in accordance with 11.5.2 the reference procedure shall be permitted to depart from the standard reference procedure, with the approval of CAAM, but only to the extent demanded by those design characteristics which make compliance with the reference procedures impossible.

11.5.1.4 The reference procedures shall be established for the following reference atmospheric conditions:

a) constant atmospheric pressure of 1 013.25 hPa;

b) constant ambient air temperature of 25°C;

c) constant relative humidity of 70 per cent; and

d) zero wind.

11.5.1.5 The maximum normal operating rpm shall be taken as the highest rotor speed corresponding to the airworthiness limit imposed by the manufacturer and approved by CAAM for overflight. Where a tolerance on the highest rotor speed is specified, the maximum normal operating rotor speed shall be taken as the highest rotor speed about which that tolerance is given. If rotor

speed is automatically linked with flight condition, the maximum normal operating rotor speed corresponding with the reference flight condition shall be used during the noise certification procedure. If rotor speed can be changed by pilot action, the maximum normal operating rotor speed specified in the flight manual limitation section for the reference conditions shall be used during the noise certification procedure.

11.5.2 Reference procedure

11.5.2.1 The reference procedure shall be established as follows:

a) the helicopter shall be stabilized in level flight overhead the flight path reference point at a height of 150 m ± 15 m (492 ft ± 50 ft);

b) a speed of 0.9 V_H or 0.9 V_{NE} or 0.45 V_H + 120 km/h (65 kt) or 0.45 V_{NE} + 120 km/h (65 kt), whichever is the least, shall be maintained throughout the overflight procedure. For noise certification purposes, V_H is defined as the airspeed in level flight obtained using the torque corresponding to minimum engine installed, maximum continuous power available for sea level pressure (1 013.25 hPa), 25°C ambient conditions at the relevant maximum certificated mass. V_{NE} is defined as the not-to-exceed airworthiness airspeed imposed by the manufacturer and approved by CAAM;

c) the overflight shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for level flight;

d) the helicopter shall be in the cruise configuration; and

e) the mass of the helicopter shall be the maximum take-off mass at which noise certification is requested.

11.5.2.2 The value of V_H and/or V_{NE} used for noise certification shall be quoted in the approved flight manual.

11.6 Test procedures

11.6.1 The test procedures shall be acceptable to CAAM.

11.6.2 The test procedure and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure designated as sound exposure level (SEL), in A-weighted decibels, as described in ICAO Annex 16 Volume I Appendix 4.

11.6.3 Test conditions and procedures shall be closely similar to reference conditions and procedures or the acoustic data shall be adjusted, by the methods outlined in ICAO Annex 16 Volume I Appendix 4, to the reference conditions and procedures specified in this chapter.

11.6.4 During the test, flights shall be made in equal numbers with tailwind and headwind components.

11.6.5 Adjustments for differences between test and reference flight procedures shall not exceed 2.0 dB(A).

11.6.6 During the test, the average rotor rpm shall not vary from the normal maximum operating rpm by more than ±1.0 per cent during the 10 dB-down period.

11.6.7 The helicopter airspeed shall not vary from the reference airspeed appropriate to the flight demonstration as described in ICAO Annex 16 Volume I Appendix 4 by more than ±5.5 km/h (±3 kt) throughout the 10 dB-down period.

11.6.8 The helicopter shall fly within ±10° from the vertical above the reference track through the reference noise measurement position.

11.6.9 Tests shall be conducted at a helicopter mass not less than 90 per cent of the relevant maximum certificated mass and may be conducted at a mass not exceeding 105 per cent of the relevant maximum certificated mass.

12 Supersonic Aeroplanes

12.1 Supersonic aeroplanes — Application for Type Certificate submitted before 1 January 1975

12.1.1 The Standards of Chapter 2 of this Part, with the exception of the maximum noise levels specified in 2.4, shall be applicable to all supersonic aeroplanes, including their derived versions, for which the application for the Type Certificate was submitted before 1 January 1975, and for which a certificate of airworthiness for the individual aeroplane was first issued after 26 November 1981.

12.1.2 The maximum noise levels of those aeroplanes covered by 12.1.1, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 1, shall not exceed the measured noise levels of the first certificated aeroplane of the type.

12.2 Supersonic aeroplanes — Application for Type Certificate submitted on or after 1 January 1975

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13 Tilt-Rotors

Note.— These Standards are not intended to be used for tilt-rotors that have one or more configurations that are certificated for airworthiness for STOL only. In such cases, different or additional procedures/conditions would likely be needed.

13.1 Applicability

Note.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

13.1.1 The Standards of this chapter shall be applicable to all tilt-rotors, including their derived versions, for which the application for a Type Certificate was submitted on or after 1 January 2018.

13.1.2 Noise certification of tilt-rotors which are capable of carrying external loads or external equipment shall be made without such loads or equipment fitted.

13.2 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 2 of this CAD. The correction for spectral irregularities shall start at 50 Hz (see 4.3.1 of ICAO Annex 16 Volume I Appendix 2).

13.3 Noise measurement reference points

A tilt-rotor, when tested in accordance with the reference procedures of 13.6 and the test procedures of 13.7, shall not exceed the noise levels specified in 13.4 at the following reference points:

a) *Take-off reference noise measurement points:*

1) a flight path reference point located on the ground vertically below the flight path defined in the take-off reference procedure (see 13.6.2) and 500 m (1 640 ft) horizontally in the direction of flight from the point at which transition to climbing flight is initiated in the reference procedure;

2) two other points on the ground symmetrically disposed at 150 m (492 ft) on both sides of the flight path defined in the take-off reference procedure and lying on a line through the flight path reference point.

b) *Overflight reference noise measurement points:*

1) a flight path reference point located on the ground 150 m (492 ft) vertically below the flight path defined in the overflight reference procedure (see 13.6.3);

2) two other points on the ground symmetrically disposed at 150 m (492 ft) on both sides of the flight path defined in the overflight reference procedure and lying on a line through the flight path reference point.

c) *Approach reference noise measurement points:*

1) a flight path reference point located on the ground 120 m (394 ft) vertically below the flight path defined in the approach reference procedure (see 13.6.4). On level ground, this corresponds to a position 1 140 m (3 740 ft) from the intersection of the 6.0° approach path with the ground plane;

2) two other points on the ground symmetrically disposed at 150 m (492 ft) on both sides of the flight path defined in the approach reference procedure and lying on a line through the flight path reference point.

13.4 Maximum noise levels

13.4.1 For tilt-rotors specified in 13.1, the maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 2 for helicopters, shall not exceed the following:

13.4.1.1 *For take-off:* 109 EPNdB for tilt-rotors in VTOL/conversion mode with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the tilt-rotor mass at a rate of 3 EPNdB per halving of mass down to 89 EPNdB after which the limit is constant.

13.4.1.2 *For overflight:* 108 EPNdB for tilt-rotors in VTOL/conversion mode with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the tilt-rotor mass at a rate of 3 EPNdB per halving of mass down to 88 EPNdB after which the limit is constant.

Note 1.— For the tilt-rotor in aeroplane mode, there is no maximum noise level.

Note 2.— VTOL/conversion mode is all approved configurations and flight modes where the design operating rotor speed is that used for hover operations.

13.4.1.3 *For approach:* 110 EPNdB for tilt-rotors in VTOL/conversion mode with maximum certificated take-off mass, at which the noise certification is requested, of 80 000 kg and over and decreasing linearly with the logarithm of the tilt-rotor mass at a rate of 3 EPNdB per halving of mass down to 90 EPNdB after which the limit is constant.

Note.— The equations for the calculation of noise levels as a function of take-off mass presented in Section 7 of ICAO Annex 16 Volume I Attachment A, for conditions described in Chapter 8, 8.4.1, are consistent with the maximum noise levels defined in 13.4.

13.5 Trade-offs

If the maximum noise levels are exceeded at one or two measurement points:

a) the sum of excesses shall not be greater than 4 EPNdB;

b) any excess at any single point shall not be greater than 3 EPNdB; and

c) any excess shall be offset by corresponding reductions at the other point or points.

13.6 Noise certification reference procedures

13.6.1 General conditions

13.6.1.1 The reference procedures shall comply with the appropriate airworthiness requirements.

13.6.1.2 The reference procedures and flight paths shall be approved by CAAM.

13.6.1.3 Except in conditions specified in 13.6.1.4, the take-off, overflight and approach reference procedures shall be those defined in 13.6.2, 13.6.3 and 13.6.4, respectively.

13.6.1.4 When it is shown by the applicant that the design characteristics of the tilt-rotor would prevent a flight from being conducted in accordance with 13.6.2, 13.6.3 or 13.6.4, the reference procedures shall:

a) depart from the reference procedures defined in 13.6.2, 13.6.3 or 13.6.4 only to the extent demanded by those design characteristics which make compliance with the reference procedures impossible; and

b) be approved by CAAM.

13.6.1.5 The reference procedures shall be calculated under the following reference atmospheric conditions:

a) constant atmospheric pressure of 1 013.25 hPa;

b) constant ambient air temperature of 25°C, i.e. ISA + 10°C;

c) constant relative humidity of 70 per cent; and

d) zero wind.

13.6.1.6 In 13.6.2 d), 13.6.3 d) and 13.6.4 c), the maximum normal operating rpm shall be taken as the highest rotor speed for each reference procedure corresponding to the airworthiness limit imposed by the manufacturer and approved by CAAM. Where a tolerance on the highest rotor speed is specified, the maximum normal operating rotor speed shall be taken as the highest rotor speed about which that tolerance is given. If the rotor speed is automatically linked with the flight condition, the maximum normal operating rotor speed corresponding with the reference flight condition shall be used during the noise certification procedure. If the rotor speed can be changed by pilot action, the maximum normal operating rotor speed specified in the flight manual limitation section for the reference conditions shall be used during the noise certification procedure.

13.6.2 Take-off reference procedure

The take-off reference flight procedure shall be established as follows:

a) a constant take-off configuration, including nacelle angle, selected by the applicant shall be maintained throughout the take-off reference procedure;

b) the tilt-rotor shall be stabilized at the maximum take-off power corresponding to minimum installed engine(s) specification power available for the reference ambient conditions or gearbox torque limit, whichever is lower, and along a path starting from a point located 500 m (1 640 ft) prior to the flight path reference point, at 20 m (65 ft) above the ground;

c) the nacelle angle and the corresponding best rate of climb speed, or the lowest approved speed for the climb after take-off, whichever is the greater, shall be maintained throughout the take-off reference procedure;

d) the steady climb shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for take-off;

e) the mass of the tilt-rotor shall be the maximum take-off mass at which noise certification is requested; and

f) the reference take-off path is defined as a straight line segment inclined from the starting point (500 m (1 640 ft) prior to the centre noise measurement point and 20 m (65 ft) above ground level) at an angle defined by best rate of climb and the best rate of climb speed corresponding to the selected nacelle angle and for minimum specification engine performance.

13.6.3 Overflight reference procedure

13.6.3.1 The overflight reference procedure shall be established as follows:

a) the tilt-rotor shall be stabilized in level flight overhead the flight path reference point at a height of 150 m (492 ft);

b) a constant configuration selected by the applicant shall be maintained throughout the overflight reference procedures;

c) the mass of the tilt-rotor shall be the maximum take-off mass at which noise certification is requested;

d) in the VTOL/conversion mode, the nacelle angle at the authorized fixed operation point that is closest to the lowest nacelle angle certificated for zero airspeed, a speed of 0.9 V_{CON} and a rotor speed stabilized at the maximum normal operating rpm certificated for level flight shall be maintained throughout the overflight reference procedure;

Note.— For noise certification purposes, V_{CON} is defined as the maximum authorized speed for VTOL/conversion mode at a specific nacelle angle.

e) in the aeroplane mode, the nacelles shall be maintained on the down-stop throughout the overflight reference procedure, with:

1) rotor speed stabilized at the rpm associated with the VTOL/conversion mode and a speed of 0.9 V_{CON}; and
2) rotor speed stabilized at the normal cruise rpm associated with the aeroplane mode and at the corresponding 0.9 V_{MCP} or 0.9 V_{MO}, whichever is lesser, certificated for level flight.

Note.— For noise certification purposes, V_{MCP} is defined as the maximum operating limit airspeed for aeroplane mode corresponding to minimum engine installed, maximum continuous power (MCP) available for sea level pressure (1 013.25 hPa), 25°C ambient conditions at the relevant maximum certificated mass; and V_{MO} is the maximum operating (MO) limit airspeed that may not be deliberately exceeded.

13.6.3.2 The values of V_{CON} and V_{MCP} or V_{MO} used for noise certification shall be quoted in the approved flight manual.

13.6.4 Approach reference procedure The approach reference procedure shall be established as follows:

a) the tilt-rotor shall be stabilized and follow a 6.0° approach path;

b) the approach shall be in an airworthiness approved configuration in which maximum noise occurs, at a stabilized airspeed equal to the best rate of climb speed corresponding to the nacelle angle, or the lowest approved airspeed for the approach, whichever is the greater, and with power stabilized during the approach and over the flight path reference point, and continued to a normal touchdown;

c) the approach shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for approach;

d) the constant approach configuration used in airworthiness certification tests, with the landing gear extended, shall be maintained throughout the approach reference procedure; and

e) the mass of the tilt-rotor at touchdown shall be the maximum landing mass at which noise certification is requested.

13.7 Test procedures

13.7.1 The test procedures shall be acceptable to CAAM.

13.7.2 The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure designated in 13.2.

13.7.3 Test conditions and procedures shall be similar to reference conditions and procedures or the acoustic data shall be adjusted, by the methods outlined in ICAO Annex 16 Volume I Appendix 2 for helicopters, to the reference conditions and procedures specified in this chapter.

13.7.4 Adjustments for differences between test and reference flight procedures shall not exceed:

a) *for take-off:* 4.0 EPNdB, of which the arithmetic sum of Δ_1 and the term −7.5 log QK/Q_rK_r from Δ_2 shall not in total exceed 2.0 EPNdB; and

b) *for overflight or approach:* 2.0 EPNdB.

13.7.5 During the test the average rotor rpm shall not vary from the normal maximum operating rpm by more than ±1.0 per cent throughout the 10 dB-down period.

13.7.6 The airspeed of the tilt-rotor shall not vary from the reference airspeed appropriate to the flight demonstration by more than ±9 km/h (±5 kt) throughout the 10 dB-down period.

13.7.7 The number of level overflights made with a headwind component shall be equal to the number of level overflights made with a tailwind component.

13.7.8 The tilt-rotor shall fly within ±10° or ±20 m (±65 ft), whichever is greater, from the vertical above the reference track throughout the 10 dB-down period (see Figure 8-1).

13.7.9 The height of the tilt-rotor shall not vary during overflight from the reference height throughout the 10 dB-down period by more than ±9 m (±30 ft).

13.7.10 During the approach noise demonstration the tilt-rotor shall be established on a stabilized constant speed approach within the airspace contained between approach angles of 5.5° and 6.5° throughout the 10 dB-down period.

13.7.11 Tests shall be conducted at a tilt-rotor mass not less than 90 per cent of the relevant maximum certificated mass and may be conducted at a mass not exceeding 105 per cent of the relevant maximum certificated mass. For each of the flight conditions, at least one test must be completed at or above this maximum certificated mass.

14 (1) Subsonic Jet Aeroplanes And Propeller-Driven Aeroplanes With Maximum Certificated Take-Off Mass 55 000 KG And Over — Application For Type Certificate Submitted On Or After 31 December 2017

(2) Subsonic Jet Aeroplanes With Maximum Certificated Take-Off Mass Less Than 55 000 KG — Application For Type Certificate Submitted On Or After 31 December 2020

(3) Propeller-Driven Aeroplanes With Maximum Certificated Take-Off Mass Over 8 618 KG And Less Than 55 000 Kg — Application For Type Certificate Submitted On Or After 31 December 2020

14.1 Applicability

Note.— See also Chapter 1, 1.10, 1.11, 1.12 and 1.13.

14.1.1 The Standards of this chapter shall, with the exception of those aeroplanes which require a runway (with no stopway or clearway) length of 610 m or less at maximum certificated mass for airworthiness or propeller-driven aeroplanes specifically designed and used for agricultural or firefighting purposes, be applicable to:

a) all subsonic jet aeroplanes and propeller-driven aeroplanes, including their derived versions, with a maximum certificated take-off mass of 55 000 kg and over for which the application for a Type Certificate was submitted on or after 31 December 2017;

b) all subsonic jet aeroplanes, including their derived versions, with a maximum certificated take-off mass of less than 55 000 kg for which the application for a Type Certificate was submitted on or after 31 December 2020;

c) all propeller-driven aeroplanes, including their derived versions, with a maximum certificated take-off mass of over 8 618 kg and less than 55 000 kg for which the application for a Type Certificate was submitted on or after 31 December 2020; and

d) all subsonic jet aeroplanes and all propeller-driven aeroplanes certificated originally as satisfying CAD 16, Volume I, Chapter 3, Chapter 4 or Chapter 5, for which recertification to Chapter 14 is requested.

14.1.2 Notwithstanding 14.1.1, it may be recognized by CAAM that the following situations for jet aeroplanes and propeller-driven aeroplanes over 8 618 kg maximum certificated take-off mass on its registry do not require demonstration

of compliance with the provisions of the Standards of this CAD or ICAO Annex 16, Volume I:

a) gear down flight with one or more retractable landing gear down during the entire flight;

b) spare engine and nacelle carriage external to the skin of the aeroplane (and return of the pylon or other external mount); and

c) time-limited engine and/or nacelle changes, where the change in type design specifies that the aeroplane may not be operated for a period of more than 90 days unless compliance with the provisions of this CAD, is shown for that change in type design. This applies only to changes resulting from a required maintenance action.

14.2 Noise measurements

14.2.1 Noise evaluation measure

The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16 Volume I Appendix 2.

14.3 Reference noise measurement points

14.3.1 An aeroplane, when tested in accordance with these Standards, shall not exceed the maximum noise level specified in 14.4 of the noise measured at the points specified in Chapter 3, 3.3.1 a), b) and c).

14.3.2 Test noise measurement points

The provisions of Chapter 3, 3.3.2, relating to test noise measurement points shall apply.

14.4 Maximum noise levels

14.4.1 The maximum noise levels, when determined in accordance with the noise evaluation method of ICAO Annex 16 Volume I Appendix 2, shall not exceed the following:

14.4.1.1 *At the lateral full-power reference noise measurement point*

103 EPNdB for aeroplanes with maximum certificated take-off mass, at which the noise certification is requested, of 400 000 kg and over, decreasing linearly with the logarithm of the mass down to 94 EPNdB at 35 000 kg, after which the limit is constant to 8 618 kg, where it decreases linearly with the logarithm of the mass down to 88.6 EPNdB at 2 000 kg, after which the limit is constant.

14.4.1.2 *At the flyover reference noise measurement point*

a) *Aeroplanes with two engines or less*

101 EPNdB for aeroplanes with maximum certificated take-off mass, at which the noise certification is requested, of 385 000 kg and over, decreasing linearly with the logarithm of the mass at the rate of 4 EPNdB per halving of mass down to 89 EPNdB, after which the limit is constant to 8 618 kg, where it decreases linearly with the logarithm of the mass at a rate of 4 EPNdB per halving of mass down to 2 000 kg, after which the limit is constant.

b) *Aeroplanes with three engines*

As a) but with 104 EPNdB for aeroplanes with maximum certificated take-off mass of 385 000 kg and over.

c) *Aeroplanes with four engines or more*

As a) but with 106 EPNdB for aeroplanes with maximum certificated take-off mass of 385 000 kg and over.

14.4.1.3 *At the approach reference noise measurement point*

105 EPNdB for aeroplanes with maximum certificated take-off mass, at which the noise certification is requested, of 280 000 kg and over, decreasing linearly with the logarithm of the mass down to 98 EPNdB at 35 000 kg, after which the limit is constant to 8 618 kg, where it decreases linearly with the logarithm of the mass down to 93.1 EPNdB at 2 000 kg, after which the limit is constant.

14.4.1.4 The sum of the differences at all three measurement points between the maximum noise levels and the maximum permitted noise levels specified in 14.4.1.1, 14.4.1.2 and 14.4.1.3, shall not be less than 17 EPNdB.

14.4.1.5 The maximum noise level at each of the three measurement points shall not be less than 1 EPNdB below the corresponding maximum permitted noise level specified in 14.4.1.1, 14.4.1.2 and 14.4.1.3.

Note.— See ICAO Annex 16 Volume I Attachment A for equations for the calculation of maximum permitted noise levels as a function of take-off mass.

14.5 Noise certification reference procedures

The noise certification reference procedures shall be as specified in Chapter 3, 3.6.

14.6 Test procedures

The test procedures shall be as specified in Chapter 3, 3.7.

14.7 Recertification

For aeroplanes specified in 14.1.1 d), recertification shall be granted on the basis that the evidence used to determine compliance with Chapter 14 is as satisfactory as the evidence associated with aeroplanes specified in 14.1.1 a), b) and c).

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Part III – Noise Measurement For Monitoring Purposes

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Part IV – Assessment Of Airport Noise

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Part V – Balanced Approach to Noise Management

1. The balanced approach to noise management consists of identifying the noise problem at an airport and then analysing the various measures available to reduce noise through the exploration of four principal elements, namely reduction at source (addressed in Part II of this CAD), land-use planning and management, noise abatement operational procedures and operating restrictions, with the goal of addressing the noise problem in the most cost-effective manner.

2. Aircraft operating procedures for noise abatement to be introduced if based on appropriate studies and consultation, it is determined that a noise problem exists.

3. Aircraft operating procedures for noise abatement shall be developed in consultation with operators that use the aerodrome concerned.