LIBERIA
CIVIL AVIATION REGULATIONS

PART 16
ENVIRONMENTAL PROTECTION

EDITION 3.0

JULY 2021

THE LIBERIA OFFICIAL GAZETTE

PUBLISHED BY AUTHORITY

VOL. XXI WEDNESDAY, AUGUST 11, 2021 NO. 46

E X T R A O R D I N A R Y

The Government of the Republic of Liberia announces that the Liberia Civil Aviation Authority, pursuant to its mandate under the Liberia Civil Aviation Act of 2019, and specifically consistent with Subchapter XII, Section 1218 (1), has issued on August 11, 2021 its Regulation N0. LCAA/LCAR/001/2021, herein under:

CONCERNING LIBERIA CIVIL AVIATION REGULATIONS

BY ORDER OF THE PRESIDENT

AMB. DEE-MAXWELL SAAH KEMAYAH, SR.
MINISTER OF FOREIGN AFFAIRS

MINISTRY OF FOREIGN AFFAIRS

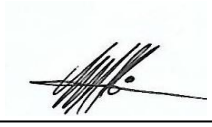
MONROVIA, LIBERIA

AUTHORITY TO PROMULGATE

CIVIL AVIATION REGULATIONS

IN EXERCISE OF THE POWERS CONFERRED ON THE DIRECTOR GENERAL OF LIBERIA CIVIL AVIATION AUTHORITY UNDER THE LIBERIA CIVIL AVIATION ACT OF 2019 THESE REGULATIONS ARE MADE.

DATE:13th July 2021

SIGNATURE: 

Hon. Moses Y. Kollie
DIRECTOR GENERAL

THIS PAGE INTENTIONALLY LEFT BLANK

DISTRIBUTION LIST

	PERSON/INSTITUTION	COPY NUMBER
1.	LCAA Library	001
2.	Director General	002
3.	Deputy Director General Technical	003
4.	Deputy Director General Administration	004
5.	Legal Affairs	005
6.	Flight Safety Standards Directorate (FSSD)	006
7.	Air Navigation Services Directorate	007
8.	Aerodrome and Ground Aids Directorate	008
9.	Air Transport and Economics Regulation Directorate	009
10.	AVSEC Directorate	010
11.	Ministry of Transport	011
12.	Aircraft Accident Investigation Bureau	012
13.	Stakeholders	013

AMENDMENTS

Location	Date	Description

THIS PAGE INTENTIONALLY LEFT BLANK

INTRODUCTION

Volume I of LCAR Part 16 contains requirements for noise certification applicable to the classification of aircraft specified in individual chapters of ICAO Annex 16 Volume I, where such aircraft are engaged in international air navigation.

Part A of Volume II contains definitions and symbols and **Part B** contains Standards relating to vented fuel. **Part C** contains Standards relating to emissions certification applicable to the classes of aircraft engines specified in the individual sections of the Part, where such engines are fitted to aircraft engaged in international civil aviation**. Part D** provides recommendations for non-volatile particular matter assessment for inventory and modeling purposes.

Part A of Volume III contains definitions and symbols. **Part B** contains Standards and Recommended Practices for certification of aeroplane CO_2 emissions based on the consumption of fuel applicable to the classification of aeroplanes specified in Part B of Volume III of this Regulation, where such aeroplanes are engaged in international air navigation.

Volume IV of LCAR Part 16 sets out the Standards necessary for the implementation of a global MBM scheme in the form of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).This Volume contains requirements and guidelines for monitoring, reporting and verification of an aircraft operator's CO_2 emissions. This Volume also contains requirements and guidelines on an aircraft operator's CO_2 offsetting requirements that can be reconciled using Emissions Units generated by eligible programmes.

Part A of Volume V deals with aerodrome operators in relation to aviation environmental issues and its implementation. Aircraft operators shall also meet aircraft performance standards set out in this Part, or referred to by this Part. Entities and individuals that undertake activities on Aerodrome property shall undertake the actions necessary to comply with the requirements of this Part. Tenants shall be responsible for ensuring that any of their sub-contractors or other employees comply with the requirements of this Part.

Part B of Volume V requires Aerodrome operators to prepare noise contour maps for the Aerodromes for which they are responsible in accordance with this Part. Noise reduction and management measures, operational procedures to reduce noise, noise reductions and management plan, aerodrome operations, spills management, atmospheric emissions, wildlife management, land use within aerodromes, land use planning around aerodromes, environmental management system, environmental impact assessment, environmental baseline, availability and inspection of documents, communications, and aerodrome environmental committee are discuss in this part.

Table of Contents

THIS PAGE INTENTIONALLY LEFT BLANK

16.1: ENVIRONMENTAL PROTECTION
VOLUME I – NOISE

THIS PAGE INTENTIONALLY LEFT BLANK

16.1 VOLUME I — NOISE

PART A: DEFINITIONS & NOMENCLATURE

16.1.1 DEFINITIONS

(a) When the following terms are used in these Regulations they have the following meanings:

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

(2) **Aircraft.** Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

(3) **Associated aircraft systems.** Those aircraft systems drawing electrical/pneumatic power from an auxiliary power unit during ground operations.

(4) **Auxiliary power-unit (APU).** 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).

(5) **By-pass ratio.** The ratio of the air mass flow through the by-pass 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.

(6) **Derived version of an aircraft**. An aircraft 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.

Note 1.— Where the certificating authority finds that the proposed change in design, configuration, power or mass is so extensive that a substantially new investigation of compliance with the applicable airworthiness directives is required, the aircraft should be considered to be a new type design rather than a derived version.

Note 2.— "Adversely" refers to an increase of more than 0.10 dB in any one of the noise certification levels unless the cumulative effects of changes in type design are tracked by an approved procedure in which case "adversely" refers to a cumulative increase in the noise level in any one of the noise certification levels of more than 0.30 dB or the margin of compliance, whichever is smaller

Note 2.— "Adversely" refers to an increase of more than 0.30 EPNdB in any one of the noise certification levels for helicopters certificated according to Chapter 8 and 0.30 dB(A) in the certification level for helicopters certificated according to Chapter 11 of Annex 16 Volume I.

(7) **External equipment (helicopter)**. 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.

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

(9) **Human performance**. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

(10) **Powered-lift**. 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.

(11) **Re-certification**. Certification of an aircraft with or without are vision to its certification noise levels, to a Standard different to that to which it was originally certificated.

(12) **Self-sustaining powered sailplane**. A powered aircraft with available engine power which allows it to maintain level flight but not to take off under its own power.

(13) **State of Design**. The State having jurisdiction over the organization responsible for the type design.

(14) **State of Registry**. The State on whose register the aircraft is entered.

(15) **Subsonic aircraft.** An aircraft incapable of sustaining

(i) Level flight at speeds exceeding flight Mach number of 1.

(16) **Tilt-rotor**. 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 nonrotating aerofoil(s) for lift during high-speed flight.

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

16.1.2 NOMENCLATURE

1.1 SYMBOLS AND UNITS

Symbol	***Unit***	***Meaning***
antilog	—	*Antilogarithm to the base 10.*
C(*k*)	dB	*Tone correction factor.* The factor to be added to PNL(*k*) to account for the presence of

		spectral irregularities such as tones at the *k*-th increment of time.
d	s	*Duration time.* The length of the significant noise time history being the time interval between the limits of *t*(1) and *t*(2) to the nearest second.
D	dB	*Duration correction.* The factor to be added to PNLTM to account for the duration of the noise.
EPNL	EPNdB	*Effective perceived noise level.* The value of PNL adjusted for both the spectral irregularities and the duration of the noise. (The unit EPNdB is used instead of the unit dB.)
f(*i*)	Hz	*Frequency.* The geometrical mean frequency for the *i*-th one-third octave band.
F(*i*,*k*)	dB	*Delta-dB.* The difference between the original sound pressure level and the final background sound pressure level in the *i*-th one-third octave band at the *k*-th interval of time.
h	dB	*dB-down.* The level to be subtracted from PNLTM that defines the duration of the noise.
H	%	*Relative humidity.* The ambient atmospheric relative humidity.
i	—	*Frequency band index.* The numerical indicator that denotes any one of the 24 one-third octave bands with geometrical mean frequencies from 50 to 10 000 Hz.
k	—	*Time increment index.* The numerical indicator that denotes the number of equal time increments that have elapsed from a reference zero.
log	—	*Logarithm to the base 10.*
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(*b*), *M*(*c*), etc.	—	*Noy inverse slope.* The reciprocals of the slopes of straight lines representing the variation of SPL with log *n*.
n	noy	*Perceived noisiness.* The perceived noisiness at any instant of time that occurs in a specified frequency range.
n(*i*,*k*)	noy	*Perceived noisiness.* The perceived noisiness at the *k*-th instant of time that occurs in the *i*-th one-third octave band.
n(*k*)	noy	*Maximum perceived noisiness.* The maximum value of all of the 24 values of *n*(*i*) that occurs at the *k*-th instant of time.
N(*k*)	noy	*Total perceived noisiness.* The total perceived noisiness at the *k*-th instant of time calculated from the 24 instantaneous values of *n*(*i*,*k*).
p(*b*), *p*(*c*), etc.	—	*Noy slope.* The slopes of straight lines representing the variation of SPL with log *n*.
PNL	PNdB	*Perceived noise level.* The perceived noise level at any instant of time. (The unit PNdB is used instead of the unit dB.)
PNL(*k*)	PNdB	*Perceived noise level.* The perceived noise level calculated from the 24 values of SPL(*i*,*k*) at the *k*-th increment of time. (The unit PNdB is used instead of the unit dB.)
PNLM	PNdB	*Maximum perceived noise level.* The maximum value of PNL(*k*). (The unit PNdB is used instead of the unit dB.)
PNLT	TPNdB	*Tone corrected perceived noise level.* The value of PNL adjusted for the spectral irregularities that occur at any instant of time. (The unit TPNdB is used instead of the unit dB.)

PNLT(*k*)	TPNdB	*Tone corrected perceived noise level.* The value of PNL(*k*) adjusted for the spectral irregularities that occur at the *k*-th increment of time. (The unit TPNdB is used instead of the unit dB.)
PNLTM	TPNdB	*Maximum tone corrected perceived noise level.* The maximum value of PNLT(*k*). (The unit TPNdB is used instead of the unit dB.)
s(*i*,*k*)	dB	*Slope of sound pressure level.* The change in level between adjacent one-third octave band sound pressure levels at the *i*-th band for the *k*-th instant of time.
s(*i*,*k*)	dB	*Change in slope of sound pressure level.*
s (*i*,*k*)	dB	*Adjusted slope of sound pressure level.* The change in level between adjacent adjusted one-third octave band sound pressure levels at the *i*-th band for the *k*-th instant of time
¯ (*i*,*k*)	dB	*Average slope of sound pressure level.*
SPL	dB re 20 µPa	*Sound pressure level.* The sound pressure level at any instant of time that occurs in a specified frequency range.
SPL(*a*)	dB re 20 µPa	*Noy discontinuity coordinate.* The SPL value of the intersection point of the straight lines representing the variation of SPL with log *n*.
SPL(*b*) SPL(*c*)	dB re 20 µPa	*Noy intercept.* The intercepts on the SPL-axis of the straight lines representing the variation of SPL with log *n*.
SPL(*i*,*k*)	dB re 20 µPa	*Sound pressure level.* The sound pressure level at the *k*-th instant of time that occurs in the *i*-th one-third octave band.
SPL (*i*,*k*)	dB re 20 µPa	*Adjusted sound pressure level.* The first approximation to background sound pressure level in the *i*-th one-third octave band for the *k*-th instant of time.
SPL(*i*)	dB re 20 µPa	*Maximum sound pressure level.* The sound pressure level that occurs in the *i*-th one-third octave band of the spectrum for PNLTM.
SPL(i)$_c$	dB re 20 µPa	*Corrected maximum sound pressure level.* The sound pressure level that occurs in the *i*-th one-third octave band of the spectrum for PNLTM corrected for atmospheric sound absorption.
SPL (*i*,*k*)	dB re 20 µPa	*Final background sound pressure level.* The second and final approximation to background sound pressure level in the *i*-th one-third octave band for the *k*-th instant of time.
t	s	*Elapsed time.* The length of time measured from a reference zero.
*t*1, *t*2	s	*Time limit.* The beginning and end of the significant noise time history defined by *h*.
t	s	*Time increment.* The equal increments of time for which PNL(*k*) and PNLT(*k*) are calculated.
T	s	*Normalizing time constant.* The length of time used as a reference in the integration method for computing duration corrections, where *T* = 10 s.
t(°C)	°C	*Temperature.* The ambient atmospheric temperature.
α(*i*)	dB/100 m	*Test atmospheric absorption.* The atmospheric attenuation of sound that occurs in the *i*-th one-third octave band for the measured atmospheric temperature and relative humidity.

ß	degrees	*First constant* climb angle.*
γ	degrees	*Second constant** climb angle.*
δ	degrees	*Thrust cutback angles.* The angles defining the points on the take-off flight path at which
ε	degrees	thrust reduction is started and ended, respectively.
η	degrees	*Approach angle.*
η_r	degrees	*Reference approach angle.*
θ	Degrees	*Take-off noise angle.* The angle between the flight path and noise path for take-off operations. It is identical for both measured and corrected flight paths.
λ	degrees	*Approach noise angle.* The angle between the flight path and the noise path for approach operations. It is identical for both measured and corrected flight paths.
1	EPNdB	*PNLT correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences in atmospheric absorption and noise path length between reference and test conditions.
2	EPNdB	*Noise path duration correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to the noise duration because of differences in flyover altitude between reference and test conditions.
3	EPNdB	*Mass correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between maximum mass and actual mass of the test aeroplane.
4	EPNdB	*Approach angle correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between the reference and the test approach angles.
AB ß Δγ Δδ Δε	metres degrees degrees degrees degrees	*Take-off profile changes.* The algebraic changes in the basic parameters defining the take- off profile due to differences between reference and test conditions

1.2 FLIGHT PROFILE IDENTIFICATION POSITIONS

Position	*Description*
A	Start of take-off roll.
B	Lift-off.

C	Start of first constant climb.
D	Start of thrust reduction.
E	Start of second constant climb.
E_c	Start of second constant climb on corrected flight path.
F	End of noise certification take-off flight path.
F_c	End of noise certification corrected take-off flight path.
G	Start of noise certification approach flight path.
G_r	Start of noise certification approach on reference flight path.
H	Position on approach path directly above noise measuring station.
H_r	Position on reference approach path directly above noise measuring station.
I	Start of level-off.
I_r	Start of level-off on reference approach flight path.
J	Touchdown.
K	Flyover noise measurement point .
L	Lateral noise measurement point(s) (not on flight track).
M	End of noise certification take-off flight track.
N	Approach noise measurement point.
O	Threshold of approach end of runway.
P	Start of noise certification approach flight track.
Q	Position on measured take-off flight path corresponding to apparent PNLTM at station K.
Q_C	Position on corrected take-off flight path corresponding to PNLTM at station K.
R	Position on measured take-off flight path nearest to station K
R_C	Position on corrected take-off flight path nearest to station K.
S	Position on measured approach flight path corresponding to PNLTM at station N.
S_r	Position on reference approach flight path corresponding to PNLTM at station N.
T	Position on measured approach flight path nearest to station N.
T_r	Position on reference approach flight path nearest to station N.
X	Position on measured take-off flight path corresponding to PNLTM at station L.

1.3 FLIGHT PROFILE DISTANCES

Distance	*Unit*	*Meaning*
AB	metres	*Length of take-off roll.* The distance along the runway between the start of take-off roll and lift- off.
AK	Metres	*Take-off measurement distance.* The distance from the start of roll to the take-off noise measurement station along the extended centre line of the runway.
AM	Metres	*Take-off flight track distance.* The distance from the start of roll to the take-off flight track position along the extended centre line of the runway for which the position of the aeroplane need no longer be recorded.
KQ	metres	*Measured take-off noise path.* The distance from station K to the measured aeroplane position Q.
KQ_c	metres	*Corrected take-off noise path.* The distance from station K to the corrected aeroplane position Q_c.
KR	metres	*Measured take-off minimum distance.* The distance from station K to point R on the measured flight path.
KR_c	metres	*Corrected take-off minimum distance.* The distance from station K to point $R_c$on the corrected flight path.
LX	metres	*Measured sideline noise path.* The distance from station L to the measured aeroplane position X.
NH	Metres (feet)	*Aeroplane approach height.* The height of the aeroplane above the approach measuring station.
NH_r	Metres (feet)	*Reference approach height.* The height of the reference approach path above the approach measuring station.
NS	metres	*Measured approach noise path.* The distance from station N to the measured aeroplane position S.
NS_r	metres	*Reference approach noise path.* The distance from station N to the reference aeroplane position S_r .
NT	metres	*Measured approach minimum distance.* The distance from station N to point T on the measured flight path.
NT_r	metres	*Reference approach minimum distance.* The distance from station N to point $T_r$on the corrected flight path
ON	Metres	*Approach measurement distance.* The distance from the runway threshold to the approach measurement station along the extended centre line of the runway.
OP	Metres	*Approach flight track distance.* The distance from the runway threshold to the approach flight track position along the extended centre line of the runway for which the position of the aeroplane need no longer be recorded

PART B – AIRCRAFT NOISE CERTIFICATION

16.1.3 ADMINISTRATION

16.1.3.1 **Applicability**

(a) The provisions under this subpart shall apply to all aircraft included in the classifications defined for noise Certification purposes of this Part where such aircraft are engaged in international air navigation.

16.1.3.2 Validation of Noise Certification

(a) Noise certification shall be validated by the Authority on the basis of satisfactory evidence that the aircraft complies with requirements which are at least equal to the applicable requirements specified in these directives.

(b) If noise re-certification of an aircraft is requested, it shall be validated by the Authority on the basis of satisfactory evidence that such aircraft complies with requirements which are at least equal to the applicable requirements specified in these directives. The date used to determine the re- certification basis shall be the date of acceptance of the first application for recertification.

(c) The documents attesting noise certification shall be approved by the Authority and shall be carried on the aircraft.

(d) The documents attesting noise certification for an aircraft shall provide at least the following information:

Item 1: Name of State

Item 2: Title of the noise document.

Item 3: Number of Document

Item 4: Nationality or common mark and registration marks (A8-)

Item 5: Manufacturer and manufacturer's designation of aircraft

Item 6: Aircraft serial number

Item 7: Engine manufacturer, type and model

Item 8: Propeller type and model for propeller-driven aircraft

Item 9: Maximum take-off weight (mass) in kilograms

Item 10: Maximum landing mass, in kilograms

Item 11: The chapter and section of these directives under which the aircraft was certified

Item 12: Additional modification incorporated for the purpose of compliance with the appropriate certification requirements

Item 13: The lateral/full-power noise level in the corresponding unit for documents issued under the appropriate chapters of Annex 16 Volume 1

Item 14: The approach noise level in the corresponding unit for documents issued under the appropriate chapters of Annex 16 Volume 1

Item 15: The flyover noise in the corresponding unit for documents issued under the appropriate chapters of Annex 16 Volume 1

Item 16: The over flight noise level in the corresponding unit for documents issued under the appropriate chapters of Annex 16 Volume 1

Item 17: The take-off noise level in the corresponding unit for documents issued under the appropriate chapters of Annex 16 Volume 1

Item 18: Statement of compliance, including a reference to Annex 16 Volume 1

Item 19: Date of issuance of the noise certification document

Item 20: Signature of the officer issuing it.

(e) Item headings on the noise certification documents shall be uniformly numbered in Arabic numerals as indicated in (d), so that on any noise certification document the number shall, under any arrangement, refer to the same item heading except where the information in Items 1 through 6 and Items 18 through 20 is given in the certificate of airworthiness, in which case the numbering system of the certificate of airworthiness according to Part 5 of this regulation shall prevail.

(f) The administrative system for implementation of noise certification documentation shall be applied under this Part.

Note: See IS: 16.1.3 for the format and structure of noise certification documentation

(g) The information required under this subpart shall be included in the flight manual. A note shall be added stating that the thrust/power cutback height relates to the noise certification demonstration procedure and is not intended for use in normal operations.

(h) The Authority shall 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 Annex 16 Volume 1.

(i) The Authority shall suspend or revoke the noise certification of an aircraft on its Register if the aircraft ceases to comply with the applicable noise Standards. The Authority shall not remove the suspension of a noise certification or validate a new noise certification unless the aircraft is found, on reassessment, to comply with the applicable noise Standards.

(j) The amendment of Volume 1 of Annex 16 to be used the Authority shall be that which is applicable on the date of submission to that Contracting State for:

(1) Type Certificate in the case of a new type; or

(2) Approval of a change in type design in the case of a derived version; or

(3) In either case, under an equivalent application procedure prescribed by the certificating authority of that Contracting State.

(k) The Authority will accept, unless otherwise specified and subject to the provisions in this subpart, the date to be used in determining the applicability of ICAO Standards shall be the date on which either the application for a Type Certificate was a submitted to the State of Design or the date for submission under an equivalent application procedure prescribed by the certificating authority of the State of Design. The application shall be effective for duration equal to the period applied in designation of airworthiness requirements appropriate to the aircraft type, except in special cases where the authority accepts an extension of this period.

(l) For derived versions where the provisions governing the applicability of ICAO Standards refer to "the application for the certification of the change in type design", the date to be accepted by the Authority in determining the applicability of the Standards in Annex 16 Volume 1 shall be the date the application for the change in type design was submitted to the Contracting State that first certified the change in type design, or the date of submission under an equivalent application procedure prescribed by the certificating authority of the Contracting State that first certified the change in type design

(m) The Authority shall only validate noise certification if the application was effective for the period specified in the designation of the airworthiness regulations appropriate to the aircraft type, except in special cases where the certificating authority accepted an extension of this period. When this period of effectivity is exceeded, the date to be used in determining the applicability of ICAO Standards 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 the State of Design, less the period of effectivity.

16.1.4 SUBSONIC JET AIRCRAFT — APPLICATION FOR TYPE CERTIFICATE SUBMITTED BEFORE 6 OCTOBER 1977

16.1.4.1 Applicability

(a) The requirements of this subpart shall be applicable to all subsonic jet aircraft for which the application for a Type Certificate was submitted before 6 October 1977, except those aircraft:

(1) requiring a runway length* of 610 m or less at maximum certificated mass for airworthiness; or

Note: * With no stopway or clearway.

(2) powered by engines with a by-pass ratio of 2 or more and for which a certificate of airworthiness for the individual aircraft was first issued before 1 March 1972; or

(3) powered by engines with a by-pass ratio of less than 2, and for which a Type Certificate was submitted before 1 January 1969, and for which a certificate of airworthiness for the individual aircraft was first issued before 1 January 1976.

(b) The maximum noise levels of 16.1.4.4(a) 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 16.1.4.4(b) shall apply.

(c) Notwithstanding **(a)** and **(b)** above**,** it may be recognized by the Authority 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 Annex 16, Volume I:

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

(ii) Spare engine and nacelle carriage external to the skin of the aircraft (and return of the pylon or other external mount); and

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

16.1.4.2 Noise Evaluation Measure

(a) The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in Attachment A.

16.1.4.3 Noise Measurement Points

(a) An aircraft, when tested in accordance with the flight test procedures shall not exceed the noise levels specified in this subpart at the following points:

(1) *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;

(2) *fly over 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;

(3) *approach noise measurement point:* the point on the ground, on the extended centre line of the runway, 120 m (395 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.

16.1.4.4 Maximum Noise Levels

(a) The maximum noise levels of aircraft when determined in accordance with the noise evaluation method of Attachment A shall not exceed the following:

(1) *at lateral and approach noise measurement points:* 108 EPNdB for aircraft 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;

(2) *at flyover noise measurement point:* 108 EPNdB for aircraft 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.

(b) The maximum noise levels of aircraft when determined in accordance with the noise evaluation method of Attachment A shall not exceed the following:

Note- See Attachment A of ICAO Annex 16 Vol.1 for the calculation maximum permitted noise levels as a function of takeoff mass.

(1) **AT LATERAL NOISE MEASUREMENT POINT**

(i) 106 EPNdB for aircraft 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) **AT FLYOVER NOISE MEASUREMENT POINT**

(i) ***Aircraft with two engines or less*** - 104 EPNdB for aircraft 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.

(ii) *Aircraft with three engines:*As (i) but with 107 EPNdB for aircraft with maximum certificated take-off mass of 325 000 kg or *over or*whichever is the lower.

(iii) *Aircraft with four engines or more*: As (i) but with 108 EPNdB for aircraft with maximum certificated take-off mass of 325,000kg or over or, whichever is the lower.

(3) **AT APPROACH NOISE MEASUREMENT POINT**

(i) 108 EPNdB for aircraft 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.

16.1.4.5 **Trade-Offs**

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

(1) the sum of excesses shall not be greater than 4 EPNdB, except that in respect of four-engined aircraft 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;

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

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

16.1.4.6 **Test Procedures**

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

(1) the sum of excesses shall not be greater than 4 EPNdB, except that in respect of four-engined aircrafts powered by engines with by-pass ratio of 2 or more and for which the application for 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;

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

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

(b) TAKE-OFF TEST PROCEDURE

(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.

(2) A speed of at least V2 + 19 km/h (V2 + 10 kt) shall be attained as soon as practicable after lift-off and be maintained throughout the take-off noise certification test.

(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.

(c) APPROACH TEST PROCEDURE

(1) The aircraft shall be stabilized and following a 3° ±0.5° glide path.

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

(3) The configuration of the aircraft shall be with maximum allowable landing flap setting.

16.1.5 SUBSONIC JET AIRCRAFT — APPLICATION FOR CERTIFICATE OF AIRWORTHINESS FOR THE PROTOTYPE ACCEPTED ON OR AFTER6 OCTOBER 1977 AND BEFORE 1 JANUARY 2006

(a) PROPELLER-DRIVEN AIRCRAFT OVER 5 700 kg — Application for Certificate of Airworthiness for the Prototype accepted on or after 1 January 1985 and before 17 November 1988

(b) PROPELLER-DRIVEN AIRCRAFT OVER 8 618 kg — Application for Certificate of Airworthiness for the Prototype accepted on or after 17 November, 1988 and before 1 January 2006

16.1.5.1 Applicability

(a) The provisions of this section shall, with the exception of those propeller-driven aircraft specifically designed and used for agricultural or firefighting purposes, be applicable to:

(1) all subsonic jet aircraft, including their derived versions, other than aircraft which require a runway1 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

(2) all propeller-driven aircraft, 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.

(b) Notwithstanding (a) above, it may be recognized by the Authority that the following situations for jet aircraft, and propeller-driven aircraft 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 Annex 16, Volume I:

(1) gear down flight with one or more retractable landing gear down during the entire flight.

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

(3) time-limited engine and nacelle changes, or where the change in type design specifies that the aircraft may not be operated for a period of more than 90 days unless compliance with the provisions of Section I of this part is shown for that change resulting from a required maintenance action.

16.1.5.2 Noise Measurements

(a) Noise evaluation measure: The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in Attachment B.

16.1.5.3 Noise Measurement Points

(a) **REFERENCE NOISE MEASUREMENT POINTS:** An aircraft, when tested in accordance with these Standards shall not exceed the noise levels specified in this subpart at the following points :

(1) **lateral full-power reference noise measurement point**

(i) for jet-powered aircraft : 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 ;

(ii) for propeller-driven aircraft : the point on the extended centre line of the runway 650 m vertically below the climb-out flight path at full take-off power;

(2) **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 ;

(3) **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.

(b) **TEST NOISE MEASUREMENT POINTS**

(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.

(2) Sufficient lateral test noise measurement points shall be used to demonstrate to the Authority that the maximum noise level on the appropriate lateral line has been clearly determined. For jet-powered aircraft 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 aircrafts, 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.

16.1.5.4 Maximum Noise Levels

(a) The maximum noise levels, when determined in accordance with the noise evaluation method of Attachment B shall not exceed the following:

(1) **AT THE LATERAL FULL-POWER REFERENCE NOISE MEASUREMENT POINT**

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

(2) **AT FLYOVER REFERENCE NOISE MEASUREMENT POINT**

(i) ***Aircraft with two engines or less****:* 101 EPNdB for aircraft 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 aircraft mass at the rate of 4 EPNdB per halving of mass down to 89 EPNdB, after which the limit is constant.

(ii) ***Aircraft with three engines****:* As (i) but with 104 EPNdB for aircraft with maximum certificated take-off mass of 385,000 kg and over.

(iii) ***Aircraft with four engines or more****:* As (i) but with 106 EPNdB for aircraft with maximum certificated take-off mass of 385,000 kg and over.

(3) **AT APPROACH REFERENCE NOISE MEASUREMENT POINT**

(i) 105 EPNdB for aircraft 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.

16.1.5.5 Trade-Offs

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

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

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

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

16.1.5.6 Noise Certification Reference Procedures

(a) GENERAL CONDITIONS

(1) The reference procedures shall comply with the appropriate airworthiness requirements

(2) The calculations of reference procedures and flight paths shall be approved by the certificating authority.

(3) the take-off and approach reference procedures shall be those defined.

(4) When it is shown by the applicant that the design characteristics of the aircraft would prevent flight being conducted, the reference procedures shall :

(i) be demanded by those design characteristics which make compliance with the procedures impossible ; and

(ii) be approved by the certificating authority.

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

(i) sea level atmospheric pressure of 1013.25 hPa;

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

(iii) relative humidity of 70 percent;

(iv) zero wind; and

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

(b) TAKE-OFF REFERENCE PROCEDURE

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

(i) 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 :

(A) aircrafts with two engines or less - 300m (984 ft);

(B) aircrafts with three engines - 260m (853 ft);

(C) aircrafts with four engines or more - 210m (689 ft);

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

(A) a climb gradient of 4 per cent ; or

(B) in the case of multi-engined aircrafts, level flight with one engine inoperative ; whichever thrust or power is greater;

(2) 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;

(3) the speed shall be:

(i) for those aircrafts for which the applicable airworthiness requirements define V2, the all engines operating take-off climb speed selected by the applicant for use in normal operation, which shall be at least V2 + 19 km/h (V2 + 10 kt) but not greater than V2 + 37 km/h (V2 + 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 V2 shall be the same for all reference masses of an aircraft model unless a difference in increment is substantiated based on performance characteristics of the aircraft.

(ii) for those aircrafts for which the applicable airworthiness requirements do not define V2, 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.

(4) 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;

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

(6) the average engine shall be defined by the average of all the certification compliant engines used during the aircraft 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. N1 or EPR). Noise measurements made during certification tests shall be corrected to this standard.

(c) APPROACH REFERENCE PROCEDURE

(1) The approach reference flight path shall be calculated as follows :

(i) the aircraft shall be stabilized and following a 3° glide path ;

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

(iii) 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 ;

(iv) the mass of the aircraft at the touchdown shall be the maximum landing mass permitted in the approach configuration at which noise certification is requested ; and

(v) 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 Attachment B that will contribute to the noisiest continuous state at the maximum landing mass in normal operation.

16.1.5.7 **Test Procedures**

(a) The test procedures shall be acceptable to the airworthiness and noise certification Authority of the state issuing the certificate.

(b) 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 Attachment B.

(c) 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 the certificating authority 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.

(d) Acoustic data shall be adjusted by the methods outlined in Attachment B to the reference conditions specified in this subpart. Adjustments for speed and thrust shall be made as described in Attachment B.

(e) 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 takeoffs and 1 EPNdB for approaches. Data approved by the Authority 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.

(f) For the approach conditions the test procedures shall be accepted if the aircraft follows a steady glide path angle of 3° ± 0.5°.

(g) 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 the certificating authority. 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.

(h) For take-off, lateral, and approach conditions, the variation in instantaneous indicated airspeed of the aircraft 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 the certificating authority representative on the flight deck to be due to atmospheric turbulence, then the flight so affected shall be rejected for noise certification purposes.

16.1.6 SUBSONIC JET AIRCRAFT — APPLICATION FOR CERTIFICATE OF AIRWORTHINESS FOR THE PROTOTYPE ACCEPTED ON OR AFTER 1 JANUARY 2006

PROPELLER-DRIVEN AIRCRAFT OVER 8 618 KG — APPLICATION FOR CERTIFICATE OF AIRWORTHINESS FOR THE PROTOTYPE ACCEPTED ON AFTER 1 JANUARY 2006

16.1.6.1 Applicability

(a) The provisions of this section shall be applicable to :

(1) all subsonic jet aircraft, including their derived versions, other than aircraft which require a runway length of 610 m or less (with no stop way or clearway) at maximum certificated mass for airworthiness, in respect of which either the application for certificate of airworthiness for the prototype was accepted or another equivalent prescribed procedure was carried out by the Authority, on or after 1 January 2006 and before 31 December 2017;

(2) all propeller-driven aircraft, including their derived versions, of over 8 618 kg maximum certificated takeoff mass, for which either the application for certificate of airworthiness for the prototype was accepted or another equivalent prescribed procedure was carried out by the Authority, on or after 1 January 2006; and

(3) all subsonic jet aircraft and all propeller-driven aircraft certificated originally as satisfying 2.Annex 16, Volume I, shall be re-certificated as requested.

(b) Notwithstanding this subpart, The Authority may accept that the following situations for jet aircraft and propeller-driven heavy aircraft on the registry do not require demonstration of compliance with the provisions of the requirements of this subpart

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

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

(3) time-limited engine and or nacelle changes, where the change in type design specifies that the aircraft may not be operated for a period of more than 90 days unless compliance with the provisions of Section 1 of this subpart is shown for that change resulting from a required maintenance action.

16.1.6.2 **Noise Measurements**

(a) The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in ICAO Annex 16, IS 16.4.4.2.

16.1.6.3 **Reference Noise Measurement Points**

(a) An aircraft, when tested in accordance with these provisions, shall not exceed the maximum noise level of the noise measured.

16.1.6.4 **Test Noise Measurement Points**

(a) Subsection 16.1.7.3 relating to test noise measurement points shall apply.

16.1.6.5 **Maximum Noise Levels**

(a) The maximum permitted noise levels shall not be exceeded at any of the measurement points.

(b) The sum of the differences at all three measurement points between the maximum noise levels and the maximum permitted noise levels shall not be less than10 EPNdB.

(c) The sum of the differences at any two measurement points between the maximum noise levels and the corresponding maximum permitted noise levels shall not be less than 2 EPNdB.

16.1.6.6 **Noise Certification Reference Procedures**

(a) The noise certification reference procedures shall be as specified in this subpart.

16.1.6.7 **Test Procedure**

(a) The test procedures shall be as specified in this subpart.

16.1.6.8 **Recertification**

(a) For aircraft re-certification shall be granted on the basis that the evidence used to determine compliance with this subpart is as satisfactory as the evidence associated with all aircraft.

16.1.7 PROPELLER-DRIVEN AIRCRAFT OVER 5 700 KG APPLICATION FOR CERTIFICATE OF AIRWORTHINESS FOR THE PROTOTYPE ACCEPTED BEFORE 1 JANUARY 1985

16.1.7.1 **Applicablity**

(a) The provisions defined hereunder are not applicable to :

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

(2) aircrafts specifically designed and used for firefighting purposes ; and

(3) aircraft specifically designed and used for agricultural purposes.

(4) aircraft specifically designed and used for aerial work.

(b) The provisions of this subpart shall be applicable to all propeller-driven aircraft, including their derived versions, of over 5 700 kg maximum take-off mass, for which either the application for a certificate of airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the Authority on or after 1 January 1985.

(c) The provisions of this subpart shall be applicable to derived versions and individual aircraft of over 5700 kg maximum certificated take-off mass and to which do not apply and are of the type for which application for a certificate of airworthiness for the prototype was accepted or another equivalent prescribed procedure was carried out by the Authority before 6 October 1977 and for which a certificate of airworthiness for the individual aircraft was issued on or after 26 November 1981.

(d) The provisions of this subpart shall be applicable to all propeller-driven aircraft, including their derived versions, of over 5 700 kg maximum take-off mass, for which either the application for a certificate of airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the Authority on or after 1 January 1985.

(e) Authority may accept that the following situations for jet aircraft and propeller-driven heavy aircraft on its registry do not require demonstration of compliance with the provisions of the Standards of this subpart;

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

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

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

16.1.7.2 **Noise Measurements**

(a) The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in Annex 16, IS 16.4.4.2.

(1) ***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 ;

(2) ***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

(3) ***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.

16.1.7.3 **Reference Noise Measurement Points**

(a) An aircraft, when tested in accordance with these Standards, shall not exceed the noise levels specified in this subpart at the following points:

(1) **lateral reference noise measurement point***:* the point on a line parallel to and450 m from the runway centre line or extended runway centre line, where the noise level is at a maximum during take-off;

(2) **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;

(3) **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 (395 ft) vertically below the 3° descent path originating from a point 300 m beyond the threshold.

16.1.7.4 **Test Noise Measurement Points**

(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.

(2) Sufficient lateral test noise measurement points shall be used to demonstrate to the Authority 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.

(3) The applicant shall demonstrate to the Authority that during flight test, lateral and flyover noise levels were not separately optimized at the expense of each other.

16.1.7.5 **Maximum Noise Levels**

(a) The maximum noise levels, when determined in accordance with the noise evaluation method of IS 16.4.4.2, shall not exceed the following:

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

(2) ***at flyover reference noise measurement point:*** 89 EPNdB constant limit for aircrafts with maximum take-off mass, at which the noise certification is requested, up to 34 000 kg and increasing linearly with the logarithm of aircraft 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

(3) ***at approach reference noise measurement point*:** 98 EPNdB constant limit for aircrafts with maximum take-off mass, at which the noise certification is requested, up to 34 000 kg and increasing linearly with the logarithm of aircraft 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.

16.1.7.6 **Trade-Offs**

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

(1) the sum of excesses shall not be greater than 3 EPNdB;
(2) any excess at any single point shall not be greater than 2 EPNdB; and
(3) any excesses shall be offset by corresponding reductions at the other point or points.

16.1.7.7 **Noise certification reference procedures**

(a) GENERAL CONDITIONS

(1) The reference procedures shall comply with the appropriate airworthiness requirements.

(2) The calculations of reference procedures and flight paths shall be approved by the Authority.

(3) The take-off and approach reference procedures shall be those defined.

(4) When it is shown by the applicant that the design characteristics of the aircraft would prevent flight being conducted the reference procedures shall:

(i) Be demanded by those design characteristics which make compliance with the procedures impossible; and

(ii) be approved by the Authority.

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

(i) sea level atmospheric pressure of 1 013.25 hPa;

(ii) ambient air temperature of 25°C, i.e. ISA + 10°C except that at the discretion of the authority, an alternative reference ambient air temperature of 15°C, i.e. ISA may be used;

(iii) relative humidity of 70 percent; and

(iv) zero wind.

(b) TAKE-OFF REFERENCE PROCEDURE

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

(i) 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 aircraft flight manual for the reference atmospheric conditions ;

(A) aircrafts with two engines or less - 300 m (984ft) ;

(B) aircrafts with three engines - 260 m (853ft) ;

(C) aircrafts with four engines or more - 210 m (689ft) ;

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

(A) a climb gradient of 4 per cent ; or

(B) in the case of multi-engined aircrafts, level flight with one engine inoperative ; whichever power is the greater ;

(2) 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 V2 + 19 km/h (V2 + 10 kt) and which shall be attained as soon as practicable after liftoff and be maintained throughout the take-off noise certification test ;

(3) 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

(4) 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

(5) the mass of the aircraft at the brake-release shall be the maximum take-off mass at which the noise certification is requested.

(c) APPROACH REFERENCE PROCEDURE

(1) The approach reference flight path shall be calculated as follows:

(i) the aircraft shall be stabilized and following a 3° glide path;

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

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

(iv) the mass of the aircraft at the touchdown shall be the maximum landing mass permitted in the approach configuration at which noise certification is requested; and

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

16.1.7.8 **Test Procedures**

(a) The test procedures shall be acceptable to the Authority.

(a) 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 Annex 16 Appendix2.

(b) Acoustic data shall be adjusted by the methods outlined in IS 16.4.4.2 of Annex 16 Vol.1 to the reference conditions specified in this chapter. Adjustments for speed and thrust shall be made as described in Annex 16, IS 16.4.4.2.

(c) 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 the certificating authority 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.

(d) For the approach conditions the test procedures shall be accepted if the aircraft follows a steady glide path angle of 3° ±0.5°.

(e) 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 the Authority. 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.

16.1.8 PROPELLER-DRIVEN AIRCRAFT NOT EXCEEDING 8 618 KG — APPLICATION FOR CERTIFICATE OF AIRWORTHINESS FOR THE PROTOTYPE ACCEPTED BEFORE 17 NOVEMBER 1988

16.1.8.1 Applicability

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

(1) application for the certificate of airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the Authority, on or after 1 January 1975 and before 17 November 1988, except for derived versions for which an application for a certificate of airworthiness was accepted or another equivalent procedure was carried out by the certificating authority on or after 17 November 1988 ; or

(2) a certificate of airworthiness for the individual aircraft was first issued on or after 1 January 1980.

16.1.8.2 Noise Evaluation Measure

(a) The noise evaluation measure shall be a weighted overall sound pressure level as defined in International Electrotechnical Commission (IEC) Publication 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”.

16.1.8.3 Maximum Noise Levels

(a) The maximum noise levels when determined in accordance with the noise evaluation method of IS 16.4.4.2(a)(3)(i) of this subpart shall not exceed the following: — a 68 dB (A) constant limit up to an aircraft 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.

16.1.8.4 Noise Certification Reference Procedures

(a) The reference procedure shall be calculated under the following reference atmospheric conditions:

(1) sea level atmospheric pressure of 1 013.25 hPa;

(2) ambient air temperature of 25°C, i.e. ISA + 10°C.

16.1.8.5 **Test Procedures**

(a) Equivalent test procedures approved by the Authority shall be used.

(b) Tests to demonstrate compliance with the maximum noise levels shall consist of a series of level flights overhead the measuring station at a height of the aircraft shall pass over the measuring point within ±10° from the vertical.

(c) Over flight shall be performed at the highest power in the normal operating range, stabilized airspeed and with the aircraft in the cruise configuration.

16.1.9 PROPELLER-DRIVEN STOL AIRCRAFT

The provisions specified in Attachment B shall may apply to noise certification of propeller-driven STOL aircraft for which a certificate of airworthiness for the individual aircraft was first issued on or after 1 January 1976.

16.1.10 HELICOPTERS

16.1.10.1 **Applicability**

(a) The Standards of this subpart shall be applicable to all helicopters, except those designed exclusively for agricultural, fire fighting or external load carrying purposes.

(b) For a helicopter for which application for the certificate of airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the Authority, on or after 1 January 1985.

(c) For a derived version of a helicopter for which application for a change of type design was accepted, or other equivalent prescribed procedure was carried out by the Authority, on or after 17 November 1988.

(d) For all helicopters, including their derived versions, for which application for the Certificate of Airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the Authority, on or after 21 March 2002.

(e) Certification of helicopters, which are capable of carrying external loads or external equipment, shall be made without such loads or equipment fitted.

(f) An applicant may alternatively elect to show compliance if the helicopter has a maximum certificated take-off mass of 3 175 kg or less.

16.1.10.2 **Noise Evaluation Measure**

(a) The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in IS 16.4.4.2.

16.1.10.3 **Reference Noise Measurement Points**

(a) A helicopter, when tested in accordance with these requirements, shall not the following points:

(1) **Take-off reference noise measurement points:**

(i) 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.

(ii) 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.

(2) **Over flight reference noise measurement points:**

(i) A flight path reference point located on the ground 150 m (490 ft) vertically below the flight path

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

(3) **Approach reference noise measurement points**

(i) a flight path reference point located on the ground 120 m (395 ft) vertically below the flight path. On level ground, this corresponds to a position 1 140 m from the intersection of the 6.0° approach path with the ground plane;

(ii) 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.

16.1.10.4 **Maximum Noise Levels**

(a) The maximum noise levels when determined in accordance with the noise evaluation method of IS 16.4.4.2 shall not exceed the following:

(1) **FOR TAKE-OFF:** 109 EPNdB for helicopters with maximum certificated takeoff massat 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.

(2) **FOR OVER FLIGHT:** 108 EPNdB for helicopters with maximum certificated takeoffmass 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.

(3) **FOR APPROACH FLIGHT:** 110 EPNdB for helicopters with maximum certificatedtakeoff 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.

(b) For helicopters specified in 16.1.10.1(d) the maximum noise levels, when determined in accordance with the noise evaluation method of IS 16.4.4.2 of Annex 16 Vol.1, shall not exceed the following:

(1) **FOR TAKE-OFF FLIGHT:**106 EPNdB for helicopters with maximum certificated take-offmass 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.

(2) **FOR OVER FLIGHT:** 104 EPNdB for helicopters with maximum certificated take-offmass 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.

(3) **FOR APPROACH: 1**09 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

16.1.10.5 **Trade-Offs**

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

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

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

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

16.1.10.6 **Noise Certification Reference Procedures**

(a) GENERAL CONDITIONS

(1) The reference procedures shall comply with the appropriate airworthiness Requirement.

(2) The reference procedures and flight paths shall be approved by the Authority.

(3) When it is shown by the applicant that the design characteristics of the helicopter would prevent flight being conducted the reference procedures shall:

(i) only be demanded by those design characteristics which make compliance with the reference procedures impossible; and

(ii) be approved by the certificating Authority.

(4) The reference procedures shall be established for the following reference

atmospheric condition;

(i) sea level atmospheric pressure of 1 013.25 hPa;

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

(iii) relative humidity of 70 per cent; and

(iv) zero wind.

(5) 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 the Authority. 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 inked with flight condition, the maximum normal operating rotor speed corresponding with that flight condition shall be used during the noise certification procedure. If rotor speed can be changed by pilot action, the highest normal operating rotor speed specified in the flight manual limitation section for power-on conditions shall be used during the noise certification procedure.

(b) TAKE-OFF REFERENCE PROCEDURE

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

(i) 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;

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

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

(iv) 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 Vy; e) the mass of the helicopter shall be the maximum takeoff mass at which noise certification is requested; and

(v) 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 (BRC) and Vy for minimum specification engine performance.

(c) OVER FLIGHT REFERENCE PROCEDURE

(1) T h e over flight reference procedure shall be established as follows:

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

(ii) a speed of 0.9 VH or 0.9 VNE, or 0.45 VH + 120 km/h (0.45 VH + 65 kt) or 0.45 VNE + 120 km/h (0.45 VNE + 65 kt), whichever is the least, shall be maintained throughout the over flight reference procedure;

(iii) the over flight shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for level flight;

(iv) the helicopter shall be in the cruise configuration; and

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

(2) The value of V_H and V_{NE} used for noise certification shall be quoted in the Approved flight manual.

(d) APPROACH REFERENCE PROCEDURE

(1) The approach reference procedure shall be established as follows:

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

(ii) the approach shall be made at a stabilized airspeed equal to the best rate of climp speed Vy, 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;

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

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

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

16.1.10.7 **Test Procedures**

(a) The test procedures shall be acceptable to the Authority.

(b) 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 Annex 16,IS 16.4.4.2.

(c) 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 Annex 16,IS 16.4.4.2 to the reference conditions and procedures specified in this subpart.

(d) Adjustments for differences between test and reference flight procedures shall not exceed:

(1) for take-off 4.0 EPNdB, of which the arithmetic sum of D1 and the term –7.5 log (QK/Q*r*K*r*) from D2 shall not in total exceed 2.0 EPNdB;

(2) for over flight or approach 2.0 EPNdB.

(e) 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 time period.

(f) 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 time period.

(g) The number of level over flights made with a head wind component shall be equal to the number of level over flights made with a tailwind component.

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

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

(j) 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°.

(k) 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.

16.1.11 ASSOCIATED AIRCRAFT

(a) The provisions of Attachment C of Vol. 1 in the Annex 16, shall apply to noise certification of installed auxiliary power units (APU) and associated aircraft systems in:

(1) all aircraft for which application for a certificate of airworthiness for the prototype was accepted or another equivalent prescribed procedure was carried out by the Authority, on or after 6 October 1977; and

(2) aircraft of existing type design for which application for a change of type design involving the basic APU installation was accepted or another equivalent prescribed procedure was carried out by the certificating authority.

16.1.12 PROPELLER-DRIVEN AIRCRAFT NOT EXCEEDING 8 618 kg APPLICATION FOR CERTIFICATE OF AIRWORTHINESS FOR THE PROTOTYPE OR DERIVED VERSION ACCEPTED ON OR AFTER 17 NOVEMBER 1988

16.1.12.1 **Applicability**

(a) The Standards of this chapter shall be applicable to all propeller-driven aircraft and their derived versions, with a certificated take-off mass not exceeding 8 618 kg, except those aircraft specifically designed for aerobatic purposes and agricultural or fire fighting uses and self-sustaining powered sailplanes.

(b) For an aircraft for which application for the certificate of airworthiness for the prototype or for all derived versions was accepted, or another equivalent prescribed procedure was carried out by the authority, on or after 17 November 1988.

(c) For aircraft which fail to comply with the Standards of this chapter and where the application for the certificate of airworthiness for the prototype or all derived versions was accepted, or another equivalent prescribed procedure was carried out by the authority, before 17 November 1993, the Standards shall apply.

(d) For single-engined aircraft, except those aircraft specifically designed for aerobatic purposes and agricultural or fire fighting uses, self-sustaining powered sailplanes, float planes and amphibians, for which:

(1) the application for the certificate of airworthiness for the prototype or their derived versions was accepted, or another equivalent procedure was carried out by the authority, on or after 4 November 1999.

(2) an application for the certificate of airworthiness for the derived version was accepted, or other procedure was carried out, on or after 4 November 1999, but for which the application for the certificate of airworthiness for the prototype, or another equivalent procedure was carried out by the authority, before 4 November 1999.

(3) the requirements of (2) above apply, but which fail to meet the noise limits of the noise limits of (a) shall apply provided that the application for the derived version was made before 4 November 2004.

16.1.12.2 **Noise Evaluation Measure**

(a) The noise evaluation measure shall be the maximum A-weighted noise level as defined in Annex 16, Appendix 6.

16.1.12.3 **Reference Noise Measurement Points**

(a) An aircraft, when tested in accordance with these Directives, shall not exceed the noise level specified in this subpart at the take-off reference noise measurement point.

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

16.1.12.4 **Maximum Noise Levels**

(a) The maximum noise levels determined in accordance with the noise evaluation method of Appendix 6 shall not exceed the following:

(1) for aircraft specified in 16.1.12.1(b) a 76 dB(A) constant limit up to an aircraft mass of 600 kg varying linearly from that point with the logarithm of aircraft 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

(2) for aircraft specified in this subpart, a 70 dB(A) constant limit up to an aircraft mass of 570 kg increasing linearly from that point with the logarithm of aircraft mass until at 1500 kg the limit of 85 dB(A) is reached after which the limit is constant up to 8 618 kg.

16.1.12.5 **Noise Certification Reference Procedures**

(a) GENERAL CONDITIONS

(1) The calculations of reference procedures and flight paths shall be approved by the Authority.

(2) Except in conditions specified in (3), the take-off reference procedure shall be that defined in 16.1.10.6 (b).

(3) When it is shown by the applicant that the design characteristics of the aircraft would prevent flights being conducted the reference procedures shall:

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

(ii) be approved by the Authority.

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

(i) sea level atmospheric pressure of 1 013.25 hPa;

(ii) ambient air temperature of 15°C, i.e. ISA;

(iii) relative humidity of 70 per cent; and

(iv) zero wind.

(5) The acoustic reference atmospheric conditions shall be the same as the reference atmospheric conditions for flight.

(b) TAKE-OFF REFERENCE PROCEDURE

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

(i) **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 aircraft at the brake-release shall be the maximum take-off mass at which the noise certification is requested.

(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.

(ii) Second phase

(A) The beginning of the second phase corresponds to the end of the first phase.

(B) The aircraft 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 Vy.

(D) Take-off power and, for aircraft 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 sub-section shall not be permitted. The reference height shall be calculated assuming climb gradients appropriate to each power setting used.

16.1.12.6 **Test Procedures**

(a) The test procedures shall be acceptable to the Authority.

(b) The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure in units of LAmax as described in Appendix 6.

(c) Acoustic data shall be adjusted by the methods outlined in Annex 16, Appendix 6 to the reference conditions specified in this subpart.

(d) If equivalent test procedures are used, the test procedures and all methods for correcting the results to the reference procedures shall be approved by the Authority.

16.1.13 HELICOPTERS NOT EXCEEDING 3 175 kg MAXIMUM CERTIFICATED TAKE-OFF MASS

16.1.13.1 Applicability

(a) The requirements of this section shall be applicable to all helicopters having a maximum certificated take- off mass not exceeding 3 175 kg except those designed exclusively for agricultural, fire fighting or external load carrying purposes.

(b) For a helicopter for which application for the certificate of airworthiness for the prototype was issued, or another equivalent prescribed procedure was carried out by the Authority, on or after 11 November 1993.

(c) For a derived version of a helicopter for which application for the certificate of airworthiness for a change of type design was issued, or another equivalent prescribed procedure was carried out by the Authority, on or after 11 November 1993.

(d) For all helicopters, including their derived versions, for which application for the certificate of airworthiness for the prototype was accepted, or another equivalent prescribed procedure was carried out by the Authority, on or after 21 March 2002.

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

(f) An applicant may alternatively show compliance with this subpart by providing evidence to the Authority.

16.1.13.2 Noise Evaluation Measure

(a) The noise evaluation measure shall be the sound exposure level (SEL) as described in Appendix 4.

16.1.13.3 Reference Noise Measurement Point

(a) A helicopter, when tested in accordance with these Directives, shall not exceed the noise levels specified in this subpart at a flight path reference point located on the ground 150 m (492 ft) vertically below the flight path .

16.1.13.4 Maximum Noise Level

(a) The maximum noise levels when determined in accordance with the noise evaluation method of 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.

(b) The maximum noise levels when determined in accordance with the noise evaluation method of 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.

16.1.13.5 **Noise Certification Reference Procedure**

(a) GENERAL CONDITIONS

(1) The reference procedure shall comply with the appropriate airworthiness requirements and shall be approved by the Authority

(2) Except as otherwise approved, the over flight reference procedure shall be as defined in this subpart.

(3) When it is shown by the applicant that the design characteristics of the helicopter would prevent flight being conducted the reference procedure shall be permitted to depart from the specified reference procedure, with the approval of the Authority, but only to the extent demanded by those design characteristics which make compliance with the reference procedures impossible.

(4) The reference procedure shall be established for the following reference atmospheric conditions:

(i) sea level atmospheric pressure of 1 013.25 hPa;

(ii) ambient air temperature of 25°C;

(iii) relative humidity of 70 per cent; and

(iv) zero wind.

(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 the Authority for over flight. 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 that flight condition shall be used during the noise certification procedure. If rotor speed can be changed by pilot action, the highest normal operating rotor speed specified in the flight manual limitation section for power-on conditions shall be used during the noise certification procedure.

(b) REFERENCE PROCEDURE

(1) The reference procedure shall be established as follows:

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

(ii) a speed of 0.9 VH or 0.9 VNE or 0.45 VH + 120 km/h (65 kt) or 0.45 VNE + 120 km/h (65 kt), whichever is the least, shall be maintained throughout the over flight procedure. For noise certification purposes, VH 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. VNE is defined as the not-to-exceed airworthiness airspeed imposed by the manufacturer and approved by the certificating authority;

(iii) the over flight shall be made with the rotor speed stabilized at the maximum normal operating rpm certificated for level flight;

(iv) the helicopter shall be in the cruise configuration; and

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

(2) T h e value of V_H and/or V_{NE} used for noise certification shall be quoted in the approved flight manual.

16.1.13.6 **Test Procedures**

(a) The test procedure shall be acceptable to the Authority.

(b) 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 Annex 16, Appendix 4.

(c) 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 Annex 16, Appendix 4 to the reference conditions and procedures specified in this subpart.

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

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

(f) 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 time period.

(g) The helicopter airspeed shall not vary from the reference airspeed appropriate to the flight demonstration as described in Appendix 4 by more than ±5 km/h (±3 kt) throughout the 10 dB-down time period.

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

(i) 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 percent of the relevant maximum certificated mass.

16.1.14 SUPERSONIC AIRCRAFT

16.1.14.1 Supersonic Aircraft — Application For Certificate Of Airworthiness For The Prototype Accepted Before January 1975

(a) The provisions of this subpart, with the exception of maximum noise levels shall be applicable to all supersonic aircraft, including their derived versions, in respect of which either the application for the certificate of airworthiness for the prototype was accepted or another equivalent prescribed procedure was carried out by the Authority before 1 January 1975 and for which a certificate of airworthiness for the individual aircraft was first issued after 26 November 1981.

(b) The maximum noise levels of those aircraft when determined in accordance with the noise evaluation method of Annex 16, Appendix 1 OF ICAO Annex 16, Volume IV, shall not exceed the measured noise levels of the first certificated aircraft of the type.

16.1.14.2 Supersonic aircraft — application for certificate of airworthiness for the prototype accepted on or after 1 January 1975.

(a) The Standards of this subpart, with the exception of maximum noise levels shall be applicable to all supersonic aeroplanes, including their derived versions, in respect of which either the application for the certificate of airworthiness for the prototype was accepted or another equivalent prescribed procedure was carried out by the Authority before 1 January 1975 and for which a certificate of airworthiness for the individual aeroplane was first issued after 26 November 1981.

(b) The maximum noise levels of those aeroplanes when determined in accordance with the noise evaluation method of Annex 16, Appendix 1 OF ICAO Annex 16, Volume IV, shall not exceed the measured noise levels of the first certificated aeroplane of the type.

16.1.15 TILT-ROTOR AIRCRAFT

16.1.15.1 Applicability

(a) The Standards of this subpart 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.

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

16.1.15.2 Noise Evaluation Measure

(a) The noise evaluation measure shall be the effective perceived noise level in EPNdB as described in IS 16.4.4.2 of this directive. The correction for spectral irregularities shall start at 50 Hz (see 4.16.4.5.1of IS 16.4.4.2).

Note.— Additional data in SEL and LASmax as defined in Appendix 4, and one-third octave SPLs as defined in IS 16.4.4.2 corresponding to LASmax should be made available to the Authority for land-use planning purposes.

16.1.15.3 **Noise Measurement Reference Points**

(a) A tilt-rotor, when tested in accordance with the reference procedures of 16.1.15.6 and the test procedures of 16.1.15.7, shall not exceed the noise levels specified in 16.1.15.4 at the following reference points:

(1) Take-off reference noise measurement points:

(i) a flight path reference point located on the ground vertically below the flight path defined in the take-off reference procedure 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;

(ii) 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.

(2) Overflight reference noise measurement points:

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

(A) 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.

(3) Approach reference noise measurement points:

(i) 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;

(ii) 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.

16.1.15.4 **Maximum Noise Levels**

(a) For tilt-rotors specified in 16.1.15.1, the maximum noise levels, when determined in accordance with the noise evaluation method of IS 16.4.4.2 for helicopters, shall not exceed the following:

(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.

(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.

(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 Attachment A, for conditions described in Chapter 8, 8.4.1, are consistent with the maximum noise levels defined in 20.1.15.4.

16.1.15.5 **Trade-Offs**

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

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

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

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

16.1.15.6 **Noise Certification Reference Procedures**

(a) GENERAL CONDITIONS

(1) The reference procedures shall comply with the appropriate airworthiness requirements.

(2) The reference procedures and flight paths shall be approved by the certificating authority.

(3) Except in conditions specified in (4), the take-off, overflight and approach reference procedures shall be those defined in 16.1.15.6(b), 16.1.15.6(c) and 16.1.15.6(d), respectively.

(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 16.1.15.6(b), 16.1.15.6(c) or 16.1.15.6(d), the reference procedures shall:

(i) depart from the reference procedures defined in 16.1.15.6(b), 16.1.15.6(c) or 16.1.15.6(d) only to the extent demanded by those design characteristics which make compliance with the reference procedures impossible; and

(ii) be approved by the Authority.

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

(i) constant atmospheric pressure of 1 013.25 hPa;

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

(iii) constant relative humidity of 70 per cent; and

(iv) zero wind.

(6) In 16.1.15.6(b)(1)(iv), 16.1.15.6(c)(1)(iv) and 16.1.15.6(d)(1)(iii), 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 the certificating authority. 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.

(b) TAKE-OFF REFERENCE PROCEDURE

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

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

(ii) 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;

(iii) 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;

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

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

(vi) 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.

(c) OVERFLIGHT REFERENCE PROCEDURE

(1) The overflight reference procedure shall be established as follows:

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

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

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

(iv) 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, VCON is defined as the maximum authorized speed for VTOL/conversion mode at a specific nacelle angle.

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

(A) rotor speed stabilized at the rpm associated with the VTOL/conversion mode and a speed of 0.9 V_{CON}; and

(B) 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, VMCP 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 VMO is the maximum operating (MO) limit airspeed that may not be deliberately exceeded.

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

(d) APPROACH REFERENCE PROCEDURE

(1) The approach reference procedure shall be established as follows:

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

(ii) 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;

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

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

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

(e) TEST PROCEDURES

(1) The test procedures shall be acceptable to the Authority.

(2) The test procedures and noise measurements shall be conducted and processed in an approved manner to yield the noise evaluation measure designated in 16.1.15.2.

(3) Test conditions and procedures shall be similar to reference conditions and procedure or the acoustic data shall be adjusted, by the methods outlined in IS 16.4.4.2 for helicopters, to the reference conditions and procedures specified in this subpart.

(4) Adjustments for differences between test and reference flight procedures shall not exceed:

(i) *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

(ii) *for overflight or approach:* 2.0 EPNdB.

(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.

(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.

(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) 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).

(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).

(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.

(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.

PART C: NOISE MEASUREMENT FOR MONITORING PURPOSES

Where the measurement of aircraft noise is made for monitoring purposes, the method outlined in Annex 16, IS 16.4.4.3 shall be used. These purposes are described as including: monitoring compliance with and checking the effectiveness of such noise abatement requirements as may have been established for aircraft in flight or on the ground. An indication of the degree of correlation between values obtained by the method used for measuring noise for aircraft design purposes and the method(s) used for monitoring purposes would be necessary.

16.1.15.7 **Assessment Of Aerodrome Noise**

(a) Where international comparison of noise assessment around Aerodromes is undertaken, the methodology described in Recommended Method for Computing Noise Contours around Aerodromes shall be applied. The methodology described in Recommended Method for Computing Noise Contours around Aerodromes shall be applied in National noise assessment procedures and Directives.

16.1.15.8 **Balanced Approach To Noise Management**

(a) The balanced approach to noise management consists of identifying the noise problem at an Aerodrome and then analyzing the various measures available to reduce noise through the exploration of four principle elements, namely reduction of source 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. All the elements of the balanced approach are addressed in the ICAO guidance on the balanced approach to aircraft noise management (Doc 9829)

(b) Aircraft operating procedures for noise abatement shall not be introduced unless the Authority, based on appropriate studies and consultation, determines that a noise problem exists.

(c) Aircraft operating procedures for noise abatement should be developed in consultation with the operators which use the aerodrome concerned.

(1) the factors to be taken into operating procedures for noise abatement shall include the following:

(i) the nature and extent of the noise problem including:

(A) the location of noise sensitive areas; and

(B) critical hours.

(ii) the types of aircraft affected, including aircraft mass aerodrome elevation, temperature considerations;

(iii) the types of procedures likely to be most effective;

(iv) obstacle clearances (PANS-OPS (Doc 8168), Volume I and II); and human performance in the application of the operating Procedures

LIBERIA CIVIL AVIATION REGULATIONS

PART 16 VOLUME I – IMPLEMENTING STANDARDS

IS: 16.1.3 SAMPLE NOISE CERTIFICATION DOCUMENTATION

*	1. *Republic of Liberia*	3. N°:

Liberia Civil Aviation Authority

2. AIRCRAFT NOISE CERTIFICATE

4. Nationality and registration marks	**5.** Manufacturer and manufacturer's designation of aircraft	**6.** Aircraft serial number
7. Engine	**8.** Propeller (if applicable) (*)	
9. Maximum *takeoff mass* **Kg**	***10.*** Maximum *landing mass* (*) **Kg**	**11.***Noise* Certification *Standard*

12. *Additional* modifications *incorporated for the purpose of compliance with the applicable noise certification standards*

13. Lateral/full-power noise level(*) EPNdB	**14.**Approach noise level(*) EPNdB	**15.**Flyover noise level (*) EPNdB	**16.**Overflight noise level(*) EPNdB	**17.**Take-off noise level (*) EPNdB

Remarks

18. *This noise* certificate *is issued pursuant to Volume I of Annex 16 to the Convention on International Civil Aviation dated 7 December 1944 and Part 5 in respect of the above mentioned aircraft, which is considered to comply with the indicated noise Standard when maintained and operated in accordance with the relevant requirements and operating limitations*

19. *Date of* issue:	. . . . . . ***20.*** Name and Signature

(*) These boxes may be omitted depending on the noise certification standard

Completion instructions

Block 1. State of Registry

The name of the State issuing the noise certificate. This item shall match the corresponding information on the Certificate of Registration and Certificate of Airworthiness.

Block 2. Noise certificate

The title of the Form is "Noise Certificate'

Block 3. Document No

A unique number, issued by the State of Registry that identifies this particular document in their administration. Such a number will facilitate any enquiries with respect to the document.

Block 4. Registration marks

The nationality or common mark and registration marks as issued by the State of Registry in accordance with Annex 7 to the Chicago Convention[3]. This item shall match the corresponding information on the Certificate of Registration and Certificate of Airworthiness.

Block 5. Manufacturer and manufacturer's designation of aircraft

The type and model of the subject aircraft. This item shall match the corresponding information on the Certificate of Registration and Certificate of Airworthiness.

Block 6. Aircraft serial No

The aircraft serial number as given by the manufacturer of the aircraft. This item shall match the corresponding information on the Certificate of Registration and Certificate of Airworthiness.

Block 7. Engine

The designation of the installed engine(s) for identification and verification of the aircraft configuration. It shall contain the type and model of the subject engine(s). The designation shall be in accordance with the Type Certificate or Supplemental Type Certificate for the subject engine(s).

Block 8. Propeller

The designation of the installed propeller(s) for identification and verification of the aircraft configuration. It shall contain the type and model of the subject propeller(s). The designation shall be in accordance with the Type Certificate or Supplemental Type Certificate for the subject propeller(s). This item is included only in noise certification documentation for propeller driven aeroplanes.

Block 9. Maximum take-off mass (kg)

The maximum take-off mass associated with the certificated noise levels of the aircraft in kilograms. The unit (kg) shall be specified explicitly in order to avoid misunderstanding. If the primary unit of mass for the State of Manufacture of the aircraft is different from kilograms, the conversion factor used shall be in accordance with Annex 5 to the Chicago Convention.

Block 10. Maximum landing mass (kg)

The maximum landing mass associated with the certificated noise levels of the aircraft in kilograms. The unit (kg) shall be specified explicitly in order to avoid misunderstanding. If the primary unit of mass for the State of manufacture of the aircraft is different form kilograms, the conversion factor used shall be in accordance with Annex 5 to the Chicago Convention. This item will only be included in the noise certification documentation for noise certificates issued under Chapter 2, 3, 4,5 and 12 of Annex 16.

Block 11. Noise certification standard

The Chapter to which the subject aircraft is Noise Certificated. For chapters 2, 8, 10 and 11 of Annex 16, the section specifying the noise limits shall also be included.

Block 12. Additional modifications incorporated for the purpose of compliance with the applicable noise certification standards

This item shall contain as a minimum all additional modifications to the basic aircraft as defined by Blocks 5, 7 and 8 that are essential in order to meet the requirements of this Annex to which the aircraft is certificated as given under Block 11. Other modifications that are not essential to meet the stated chapter but are needed to attain the certificated noise levels as given may also be included at the discretion of the certificating authority. The additional modifications shall be given using unambiguous references, such as Supplemental Type Certificate (STC) numbers, unique part numbers or type/model designators given by the manufacturer of the modification.

Block 13. Lateral/full-power noise level

The lateral/full-power noise level as defined in the relevant Chapter. It shall specify the unit (e.g. EPNdB (unit of the effective perceived noise level)) of the noise level and the noise level shall be stated to the nearest tenth of a decibel (dB). This item is included only in noise certification documentation for aircraft certificated to Chapters 2, 3, 4, 5 and 12 of Annex 16.

Block 14. Approach noise level

The approach noise level as defined in the relevant chapter. It shall specify the unit (e.g. EPNdB) of the noise level and the noise level shall be stated to the nearest tenth of a dB. This item is included only in noise certification documentation for aircraft certificated to Chapters 2, 3, 4, 5, 8 and 12 of Annex 16.

Block 15. Flyover noise level

The flyover noise level as defined in the relevant chapter. It shall specify the unit (e.g. EPNdB) of the noise level and the noise level shall be stated to the nearest tenth of a dB. This item is included only in noise certification documentation for aircraft certificated to Chapters 2, 3, 4, 5 and 12 of Annex 16.

Block 16. Overflight noise level

The overflight noise level as defined in the relevant chapter. It shall specify the unit (e.g. EPNdB or dB(A) (unit of the A-weighted noise level)) of the noise level and the noise level shall be stated to the nearest tenth of a dB. This item is included only in

noise certification documentation for aircraft certificated to Chapters 6, 8 and 11 of Annex 16.

Block 17. The take-off noise level

The take-off noise level as defined in the relevant chapter. It shall specify the unit (e.g. EPNdB or dB(A)) of the noise level and the noise level shall be stated to the nearest tenth of a dB. This item is included only in noise certification documentation for aircraft certificated to Chapters 8 and 10 of Annex 16.

Block 18. Statement of compliance, including reference to Annex 16 to the Chicago Convention, Volume I

The statement is provided in the Form.

Block 19. Date of issue

The date on which the document was issued.

Block 20. Signature

The signature of the officer issuing the noise certificate. Other items may be added such as seal, stamp etc.

Additional information:

Logo and name of the issuing authority

In order to facilitate recognition the logo or symbol and the name of the issuing authority may be added in the box “For use by the State of registry”.

16.2: ENVIRONMENTAL PROTECTION
VOLUME II – EMISSIONS

INTENTIONALLY LEFT BLANK

16.2 - VOLUME II – EMISSIONS

PART A –DEFINITIONS AND SYMBOLS

16.2.1 DEFINITIONS

(a) Where the following expressions are used in this subpart, they shall have the following meanings:

(1) **Afterburning.** A mode of engine operation wherein a combustion system fed (in whole or part) by vitiated air is used.

(2) **Aircraft operator.** means the natural or juridical person operating and directing an aircraft, and putting it to use either personally or through his employees, agents or subsidiaries, and its crew members shall be under his instructions and commands, whether he is an owner, lessee or in possession thereof".

(3) **Aerodrome operator.** means the party responsible to operate the Aerodrome and holds an Aerodrome Operating Certificate.

(4) **Approach phase.** The operating phase defined by the time during which the engine is operated in the approach operating mode.

(5) **Authority.** means the Liberia Civil Aviation Authority.

(6) **Carbon sink.** means a natural or man-made feature that achieves a net reduction in atmospheric carbon dioxide**.**

(7) **Climb phase.** The operating phase defined by the time during which the engine is operated in the climb operating mode.

(8) **Date of manufacture.** The date of issue of the document attesting that the individual aircraft or engine as appropriate conforms to the requirements of the type or the date of an analogous document.

(9) **Derivative version.** An aircraft gas turbine engine of the same generic family as an originally type- certificated engine and having features which retain the basic core engine and combustor design of the original model and for which other factors, as judged by the Authority, have not changed.

(10) **Emissions.** means gases and particles emitted as a result of fossil fuel combustion.

(11) **Environment.** means the surroundings which include the living and nonliving beings, the materials contained, and what surrounds it, such as air, water, soil, and interactions of any of them, as well as the establishments built by the human being.

(12) **Exhaust nozzle**. In the exhaust emissions sampling of gas turbine engines where the jet effluxes are not mixed (as in some turbofan engines, for example) the nozzle considered is that for the gas generator (core) flow only. Where, however, the jet efflux is mixed the nozzle considered is the total exit nozzle.

(13) **Hazardous Waste.** means management, Transportation and Handling of Harmful and Hazardous Substances.

(14) **Movement.** means an aircraft take off and related taxiing or other motion, or an aircraft landing and related taxiing or other motion.

(15) **Multiple departure.** applies only to flying training organizations and means either an agreed number of take-offs or "touch-and-goes" by an individual aircraft during a notified flight, (such agreement being between the Aerodrome operator and the aircraft operator), or the actual number of recorded departures during the notified flight.

(16) **Non-volatile particulate matter (nvPM).** Emitted particles that exist at a gas turbine engine exhaust nozzle exit plane that do not volatilize when heated to a temperature of 350°C.

(17) **Oxides of nitrogen.** The sum of the amounts of the nitric oxide and nitrogen dioxide contained in a gas sample calculated as if the nitric oxide were in the form of nitrogen dioxide.

(18) **Quarantine waste** means organic waste generated on a flight arriving in Liberia from another country, and includes vegetable, fruit, meat, food, beverage and similar wastes and any materials that may be in contact with these wastes such as cutlery.

(19) **Rated thrust.** For engine emissions purposes, the maximum take-off thrust approved by the certificating authority for use under normal operating conditions at ISA sea level static conditions, and without the use of water injection. Thrust is expressed in kilonewtons.

(20) **Reference pressure ratio.** The ratio of the mean total pressure at the last compressor discharge plane of the compressor to the mean total pressure at the compressor entry plane when the engine is developing take-off thrust rating in ISA sea level static conditions.

(21) **Smoke.** The carbonaceous materials in exhaust emissions which obscure the transmission of light.

(22) **Smoke Number.** The dimensionless term quantifying smoke emissions.

(23) **Solid Waste** means management of Solid Waste Regulations.

(24) **Take-off phase.** The operating phase defined by the time during which the engine is operated at the rated output.

(25) **Taxi/ground idle.** The operating phases involving taxi and idle between the initial starting of the propulsion engine(s) and the initiation of the take-off roll and between the time of runway turn-off and final shutdown of all propulsion engine(s).

(26) **Tenant** means any organization – other than the relevant Aerodrome operator – who carries out any form of activities at the Aerodrome under a contract with the Aerodrome operator.

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

(28) **Unburned hydrocarbons.** The total of hydrocarbon compounds of all classes and molecular weights contained in a gas sample, calculated as if they were in the form of methane.

16.2.2 SYMBOLS

(a) The following symbols as used in this Section, shall have the meanings ascribed to them below:

CO: Carbon monoxide

Dp: The mass of any gaseous pollutant emitted during the reference emissions landing and take-off cycle

Fn: Thrust in International Standard Atmosphere (ISA), sea level conditions, for the given operating mode

Foo: Rated thrust (see definition)

F*oo: Rated thrust with afterburning applied

HC: Unburned hydrocarbons.

NO: Nitric oxide

NO_2: Nitrogen dioxide

NOx: Oxides of nitrogen

nvPM: Non-volatile particulate matter (see definition)

SN: Smoke Number

πoo: Reference pressure ratio (see definition)

PART B – VENTED FUEL

16.2.3 ADMINISTRATION

(a) The provision of this Part shall apply to all turbine engine powered aircraft intended for operation in international air navigation manufactured after 18 February 1982.

(b) Certification related to the prevention of intentional fuel venting shall be validated by the Authority on the basis of satisfactory evidence that either the aircraft or the aircraft engines comply with the requirements of Annex 16 Volume II.

(c) The Authority shall recognize as valid a certification relating to fuel venting granted by the certificating authority of another Contracting State provided the requirements under which such certification was granted are not less stringent than the provision of Annex 16 Volume II.

16.2.4 PREVENTION OF INTENTIONAL FUEL VENTING

(a) Aircraft shall be so designed and constructed as to prevent the intentional discharge into the atmosphere of liquid fuel from the fuel nozzle manifolds resulting from the process of engine shutdown following normal flight or ground operations.

PART C – EMISSIONS CERTIFICATION

16.2.5 ADMINISTRATION

(a) The provisions of subparts (b) to (e) shall apply to all engines and their derivative versions included in the classifications defined for emission certification purposes where such engines are fitted to aircraft engaged in international air navigation.

(b) Emissions certification shall be validated by the Authority on the basis of satisfactory evidence that the engine complies with requirements which are at least equal to the stringency of the provisions of this regulation.

(c) The document attesting emissions certification for each individual engine shall include at least the following information which is applicable to the engine type:

(1) name of certificating authority;

(2) manufacturer's type and model designation;

(3) statement of any additional modifications incorporated for the purpose of compliance with the applicable emissions certification requirements;

(4) rated thrust;

(5) reference pressure ratio;

(6) a statement indicating compliance with Smoke Number requirements;

(7) a statement indicating compliance with gaseous pollutant requirements.

(d) The Authority shall recognize as valid emissions certification granted by the certificating authority of another Contracting State provided that the requirements under which such certification was granted are not less stringent than the provisions of this regulation.

(e) The Authority shall recognize as valid engine exemptions for an engine production cut-off requirement granted by a certificating authority of another Contracting State provided that the exemptions are granted in accordance with the process and criteria defined in the Environmental Technical Manual (Doc 9501),Volume II — Procedures for the Emissions Certification of Aircraft Engines.

16.2.6 TURBOJET AND TURBOFAN ENGINES INTENDED FOR PROPULSION ONLY AT SUBSONIC SPEEDS

16.2.6.1 General

(a) Applicability

(1) The provisions of this chapter shall apply to all turbojet and turbofan engines, as further specified in 16.2.6.2 and 16.2.6.3, intended for propulsion only at subsonic speeds, except when certificating authorities make exemptions for:

(i) specific engine types and derivative versions of such engines for which the type certificate of the first basic type was issued or other equivalent prescribed procedure was carried out before 1 January 1965; and

(ii) a limited number of engines over a specific period of time beyond the dates of applicability specified in 16.2.6.2 and 16.2.6.3 for the manufacture of the individual engine.

(2) In such cases, an exemption document shall be issued by the certificating authority, the identification plates on the engines shall be marked “EXEMPT NEW” or “EXEMPT SPARE” and the grant of exemption shall be noted in the permanent engine record. Exemptions shall be reported by engine serial number and made available via an official public register.

(3) The provisions of this chapter shall also apply to engines designed for applications that otherwise would have been fulfilled by turbojet and turbofan engines.

Note.— In considering exemptions, certificating authorities should take into account the probable numbers of such engines that will be produced and their impact on the environment. When such an exemption is granted, the certificating authority should

consider imposing a time limit on the production of such engines for installation on new aircraft. Further guidance on issuing exemptions is provided in the Environmental Technical Manual (Doc 9501), Volume II — Procedures for the Emissions Certification of Aircraft Engines.

(b) Emissions involved

(1) The following emissions shall be controlled for certification of aircraft engines:

(i) Smoke

(ii) Gaseous emissions

(iii) Unburned hydrocarbons (HC);

(iv) Carbon monoxide (CO); and

(v) Oxides of nitrogen (NOx).

(c) Units of measurement

(1) The smoke emission shall be measured and reported in terms of Smoke Number (SN).

(2) The mass (Dp) of the gaseous pollutant HC, CO, or NOx emitted during the reference emissions landing and take-off (LTO) cycle, defined in 16.2.6.1 (d) (2) and 16.2.6.1 (d) (3), shall be measured and reported in grams.

(d) Reference conditions

(1) *Atmospheric Conditions*

(i) The reference atmospheric conditions shall be ISA at sea level except that the reference absolute humidity shall be 0.00634 kg water/kg dry air.

(2) *Thrust settings*

(i) The engine shall be tested at sufficient thrust settings to define the gaseous and smoke emissions of the engine so that mass emission rates and Smoke Numbers can be determined at the following specific percentages of rated thrust as agreed by the certificating authority:

LTO operating mode	*Thrust setting*
Take-off	100 per cent F_{oo}
Climb	85 per cent F_{oo}
Approach	30 per cent F_{oo}
Taxi/ground idle	7 per cent F_{oo}

(3) *Reference emissions landing and take-off (LTO) cycle*

(i) The reference emissions LTO cycle for the calculation and reporting of gaseous emissions shall be represented by the following time in each operating mode.

LTO operating mode	*Time in operating mode, minutes*
Take-off	0.7
Climb	2.2
Approach	4.0
Taxi/ground idle	26.0

(4) *Fuel specifications*

(i) The fuel used during tests shall meet the specifications of ANNEX 16 — VOLUME II Appendix 4. Additives used for the purpose of smoke suppression (such as organo-metallic compounds) shall not be present.

(e) Test conditions

(1) The tests shall be made with the engine on its test bed.

(2) The engine shall be representative of the certificated configuration (see ANNEX 16 — VOLUME II Appendix 6); off-take bleeds and accessory loads other than those necessary for the engine's basic operation shall not be simulated.

(3) Measurements made for determination of emission levels at the thrusts specified in 16.2.6.1(d) (2) shall be made with the afterburner operating at the level normally used, as applicable.

(4) When test conditions differ from the reference conditions in 16.2.6.1(d), the test results shall be corrected to the reference conditions by the methods given in IS 16.4.4.3.

16.2.6.2 **Smoke**

(a) Applicability

(1) The provisions of (b) below shall apply to engines whose date of manufacture is on or after 1 January 1983.

(b) Regulatory Smoke Number

(1) The Smoke Number at any thrust setting when measured and computed in accordance with the procedures of IS 16.4.4.2 and converted to a characteristic level by the procedures of ANNEX 16 — VOLUME II Appendix 6 shall not exceed the regulatory level determined from the following formula:

Regulatory Smoke Number = 83.6 $(F^*_{oo})^{-0.274}$

or a value of 50, whichever is lower

Note.— Certificating authorities may alternatively accept values determined using afterburning provided that the validity of these data is adequately demonstrated.

16.2.6.3 **Gaseous emissions**

(a) Applicability

(1) The provisions of (b) below shall apply to engines whose rated thrust is greater than 26.7 kN and whose date of manufacture is on or after 1 January 1986 and as further specified for oxides of nitrogen.

(b) Regulatory levels

(1) Gaseous emission levels when measured and computed in accordance with the procedures of IS 16.4.4.2(a)(3)(i) or IS 16.4.4.3, as applicable, and converted to characteristic levels by the procedures of annex 16 — volume II Appendix 6 shall not exceed the regulatory levels determined from the following formulas:

Hydrocarbons (HC): $D_p / F_{oo} = 19.6$

Carbon monoxide (CO): $D_p / F_{oo} = 118$

Oxides of nitrogen (NOx):

(i) for engines of a type or model for which the date of manufacture of the first individual production model was before1 January 1996 and for which the date of manufacture of the individual engine was before 1 January 2000:

$$D_p / F_{oo} = 40 + 2\pi_{oo}$$

(ii) for engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 1996 or for which the date of manufacture of the individual engine was on or after 1 January 2000:

$$D_p / F_{oo} = 32 + 1.6\pi_{oo}$$

(iii) for engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 2004:

(A) for engines with a pressure ratio of 30 or less:

- for engines with a maximum rated thrust of more than 89.0 kN:

$$D_p / F_{oo} = 19 + 1.6\pi_{oo}$$

- for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p/F_{oo} = 37.572 + 1.6\pi_{oo} - 0.2087F_{oo}$$

(B) for engines with a pressure ratio of more than 30 but less than 62.5:

- for engines with a maximum rated thrust of more than 89.0 kN:

$$D_p/F_{oo} = 7 + 2.0\pi_{oo}$$

- for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p/F_{oo} = 42.71 + 1.4286\pi_{oo} - 0.4013F_{oo} + 0.00642\pi_{oo} \times F_{oo}$$

(C) for engines with a pressure ratio of 62.5 or more:

$$D_p/F_{oo} = 32 + 1.6\pi_{oo}$$

(iv) for engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 2008 or for which the date of manufacture of the individual engine was on or after 1 January 2013:

(A) for engines with a pressure ratio of 30 or less:

- for engines with a maximum rated thrust of more than 89.0 kN:

$$D_p/F_{oo} = 16.72 + 1.4080\pi_{oo}$$

- for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p/F_{oo} = 38.5486 + 1.6823\pi_{oo} - 0.2453F_{oo} - 0.00308\pi_{oo}F_{oo}$$

(B) for engines with a pressure ratio of more than 30 but less than 82.6:

- for engines with a maximum rated thrust of more than 89.0 kN:

- for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p/F_{oo} = 46.1600 + 1.4286\pi_{oo} - 0.5303F_{oo} + 0.00642\pi_{oo}F_{oo}$$

(C) for engines with a pressure ratio of 82.6 or more:

$$D_p / F_{oo} = 32 + 1.6\pi_{oo}$$

(v) for engines of a type or model for which the date of manufacture of the first individual production model was on or after 1 January 2014:

(A) for engines with a pressure ratio of 30 or less:

- for engines with a maximum rated thrust of more than 89.0 kN:

$$D_p / F_{oo} = 7.88 + 1.4080\pi_{oo}$$

- for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p / F_{oo} = 40.052 + 1.5681\pi_{oo} - 0.3615F_{oo} - 0.0018\pi_{oo}F_{oo}$$

(B) for engines with a pressure ratio of more than 30 but less than 104.7:

- for engines with a maximum rated thrust of more than 89.0 kN:

$$D_p / F_{oo} = -9.88 + 2.0\pi_{oo}$$

- for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN:

$$D_p / F_{oo} = 41.9435 + 1.505\pi_{oo} - 0.5823F_{oo} + 0.005562\pi_{oo}\, F_{oo}$$

(C) for engines with a pressure ratio of 104.7 or more:

$$D_p / F_{oo} = 32 + 1.6\pi_{oo}$$

Note.— Guidance material on the definition and the use of equivalent procedures is provided in the Environmental Technical Manual *(Doc 9501), Volume II —* Procedures for the Emissions Certification of Aircraft Engines.

16.2.6.4 **Information required**

Note.— The information required is divided into three groups: 1) general information to identify the engine characteristics, the fuel used and the method of data analysis; 2) the data obtained from the engine test(s); and 3) the results derived from the test data.

(a) General information

(1) The following information shall be provided for each engine type for which emissions certification is sought:

(i) engine identification;

(ii) rated output (in kilonewtons);

(iii) rated output with afterburning applied, if applicable (in kilonewtons);

(iv) reference pressure ratio;

(v) fuel specification reference;

(vi) fuel hydrogen/carbon ratio;

(vii) the methods of data acquisition;

(viii) the method of making corrections for ambient conditions; and

(ix) the method of data analysis.

(b) Test information

(1) The following information shall be provided for each engine tested for certification purposes at each of the thrust settings specified in 16.2.6.1(d)(2). The information shall be provided after correction to the reference ambient conditions where applicable:

(i) fuel flow (kilograms/second);

(ii) emission index (grams/kilogram) for each gaseous pollutant;

(iii) percentage of thrust contributed by afterburning; and

(iv) measured Smoke Number.

(c) Derived information

(1) The following derived information shall be provided for each engine tested for certification purposes:

(i) emission rate, i.e. emission index × fuel flow, (grams/second), for each gaseous pollutant;

(ii) total gross emission of each gaseous pollutant measured over the LTO cycle (grams);

(iii) values of Dp/F*oo for each gaseous pollutant (grams/kilonewton); and

(iv) maximum Smoke Number.

(2) The characteristic Smoke Number and gaseous pollutant emission levels shall be provided for each engine type for which emissions certification is sought.

LIBERIA CIVIL AVIATION REGULATIONS

Part 16 VOLUME II — IMPLEMENTING STANDARDS

IS: 16.2.5 SAMPLE ENGINE EMISSIONS CERTIFICATION DOCUMENTATION

*	1. **REPUBLIC OF LIBERIA**	3. **CERT N°:**

2. ENGINE EMMISSIONS CERTIFICATE

4. Engine Manufacturer, Type And Model Designation	**5.** Engine serial number
6. Rated thrust:	**7.** Reference pressure ratio:
8. A statement of any additional modifications incorporated for the purpose of compliance with the applicable emissions certification requirements:	
9. A statement indicating compliance with Smoke Number requirements:	
10.A statement indicating compliance with gaseous pollutant requirements:	
11. *This certificate is issued pursuant to Volume II of Annex 16 to the Convention on International Civil Aviation and Liberia Civil Aviation Regulation Part 16 Volume (II) in respect of the above-mentioned engine, which is considered to comply with the indicated emissions Standard when maintained and operated in accordance with the relevant requirements and operating limitations.*	
12.*Date of* issue*:*	. . . . . **13.**Name and Signature

16.3: ENVIRONMENTAL PROTECTION
VOLUME III — AEROPLANE CO_2 EMISSIONS

INTENTIONALLY LEFT BLANK

16.3 - VOLUME III –AEROPLANE CO_2 EMISSIONS

PART A – DEFINITIONS AND SYMBOLS

16.3.1 DEFINITIONS

(a) When the following terms are used in these Regulations they have the following meanings:

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

(2) ***Cockpit crew zone.*** The part of the cabin that is exclusively designated for flight crew use.

(3) ***Derived version of a CO_2-certified aeroplane.*** An aeroplane which incorporates changes in type design that either increase its maximum take-off mass, or that increase its CO_2 emissions evaluation metric value by more than:

(i) 1.35 per cent at a maximum take-off mass of 5 700 kg, decreasing linearly to;

(ii) 0.75 per cent at a maximum take-off mass of 60 000 kg, decreasing linearly to;

(iii) 0.70 per cent at a maximum take-off mass of 600 000 kg; and

(iv) a constant 0.70 per cent at maximum take-off masses greater than 600 000 kg.

Note.— Where the certificating authority finds that the proposed change in design, configuration, power or mass is so extensive that a substantially new investigation of compliance with the applicable airworthiness regulations is required, the aeroplane will be considered to be a new type design rather than a derived version.

(4) ***Derived version of a non-CO_2- certified aeroplane.*** An individual aeroplane that conforms to an existing Type Certificate, but which is not certified to Annex 16, Volume III, and to which changes in type design are made prior to the issuance of the aeroplane's first certificate of airworthiness that increase its CO_2 emissions evaluation metric value by more than 1.5 per cent or are considered to be significant CO_2 changes.

(5) ***Equivalent procedure***. A test or analysis procedure which, while differing from the one specified in this volume of Annex 16,in the technical judgment of the certificating authority yields effectively the same CO_2 emissions evaluation metric value as the specified procedure.

(6) ***Maximum passenger seating capacity.*** The maximum certificated number of passengers for the aeroplane type design.

(7) ***Maximum take-off mass.*** The highest of all take-off masses for the type design configuration.

(8) ***Optimum conditions.*** The combinations of altitude and airspeed within the approved operating envelope defined in the aeroplane flight manual that provides the highest specific air range value at each reference aeroplane mass.

(9) ***Performance model.*** An analytical tool or method validated from corrected flight test data that can be used to determine the SAR values for calculating the CO_2 emissions evaluation metric value at the reference conditions.

(10) ***Reference geometric factor.*** An adjustment factor based on a measurement of aeroplane fuselage size derived from a two-dimensional projection of the fuselage.

(11) ***Specific air range.*** The distance an aeroplane travels in the cruise flight phase per unit of fuel consumed.

(12) ***State of Design***. The State having jurisdiction over the organization responsible for the type design.

(13) ***Subsonic aeroplane.*** An aeroplane incapable of sustaining level flight at speeds exceeding a Mach number of 1.

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

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

16.3.2 SYMBOLS

(a) Where the following symbols are used in Volume III of this regulation, they have the meanings, and where applicable the units, ascribed to them below:

AVG	Average
CG	Centre of gravity
CO_2	Carbon dioxide
g_0	Standard acceleration due to gravity at sea level and a geodetic latitude of 45.5 degrees, 9.80665 (m/s_2)
Hz	Hertz (cycle per second)
MTOM	Maximum take-off mass (kg)
OML	Outer mould line
RGF	Reference geometric factor
RSS	Root sum of squares
SAR	Specific air range (km/kg)
TAS	True airspeed (km/h)
W_f	Total aeroplane fuel flow (kg/h)
δ	Ratio of atmospheric pressure at a given altitude to the atmospheric pressure at sea level

PART B – CERTIFICATION STANDARD FOR AEROPLANE CO_2 EMISSIONS BASED ON THE CONSUMPTION OF FUEL

16.3.3 ADMINISTRATION

(a) The provisions of (b) to (k) shall apply to all aeroplanes included in the classifications defined for CO_2 emissions certification purposes in 16.3.4 of this part where such aeroplanes are engaged in international air navigation.

(b) CO_2 emissions certification shall be granted or validated by the State of Registry of an aeroplane on the basis of satisfactory evidence that the aeroplane complies with requirements that are at least equal to the applicable Standards specified in this regulation.

(c) The Authority shall recognize as valid a CO_2 emissions 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 Annex 16 volume III.

(d) The amendment of volume III of Annex 16 to be used by a Contracting State shall be that which is applicable on the date of submission to that Contracting State for either a Type Certificate in the case of a new type, approval of a change in type design in the case of a derived version, or under equivalent application procedures prescribed by the certificating authority of that Contracting State.

Note.— As each new edition and amendment of this Annex becomes applicable (according to Table A of the Foreword), it supersedes all previous editions and amendments.

(e) Unless otherwise specified in volume III of Annex 16, the date to be used by Contracting States in determining the applicability of the Standards in this Annex shall be the date the application for a Type Certificate was submitted to the State of Design, or the date of submission under an equivalent application procedure prescribed by the certificating authority of the State of Design.

(f) An application shall be effective for the period specified in the airworthiness regulations appropriate to the aeroplane type, except in special cases where the certificating authority grants an extension. When the period of effectivity is extended, the date to be used in determining the applicability of the Standards in Annex 16 volume III 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 the State of Design, less the period of effectivity.

(g) For derived versions of non- CO_2-certified aeroplanes and derived versions of CO_2-certified aeroplanes, the applicability provisions concerning the Standards of Annex 16 volume III refer to the date on which "the application for the certification of the change in type design" was made. The date to be used by Contracting States in determining the applicability of the Standards in Annex 16 volume III shall be the date on which the application for the change in type design was submitted to the Contracting State that first certified the change in type design.

(h) Where the provisions governing the applicability of the Standards of Annex 16 volume III refer to the date on which the certificate of airworthiness was first issued to an individual aeroplane, the date to be used by Contracting States in determining the applicability of the Standards in Annex 16 volume III shall be the date on which the first certificate of airworthiness was issued by any Contracting State.

(i) The certificating authority shall publish the certified CO_2 emissions evaluation metric value granted or validated by that authority.

(j) The use of equivalent procedures in lieu of the procedures specified in the appendices of volume III Annex 16 shall be approved by the certificating authority.

Note.— Guidance material on the use of equivalent procedures is provided in the Environmental Technical Manual *(Doc 9501), Volume III —* Procedures for the CO_2Emissions Certification of Aeroplanes.

(k) Contracting States shall recognize valid aeroplane exemptions granted by an authority of another Contracting State responsible for production of the aeroplane provided that an acceptable process was used.

Note.— Guidance on acceptable processes and criteria for granting exemptions is provided in the Environmental Technical Manual (Doc 9501), Volume III — Procedures for the CO_2 Emissions Certification of Aeroplanes.

16.3.4 SUBSONIC JET AEROPLANES OVER 5 700 KG & PROPELLER-DRIVEN AEROPLANES OVER 8 618 KG

16.3.4.1 **Applicability**

(a) The Standards of this chapter shall, with the exception of amphibious aeroplanes, aeroplanes initially designed or modified and used for specialized operational requirements, aeroplanes designed with zero reference geometric factor (RGF), and those aeroplanes specifically designed or modified and used for fire-fighting purposes, be applicable to:

(1) subsonic jet aeroplanes, including their derived versions, of greater than 5 700 kg maximum take-off mass, for which the application for a type certificate was submitted on or after 1 January 2020, except for those aeroplanes of less than or equal to 60 000 kg maximum take-off mass with a maximum passenger seating capacity of 19 seats or less;

(2) subsonic jet aeroplanes, including their derived versions, of greater than 5 700 kg and less than or equal to 60 000 kg maximum take-off mass with a maximum passenger seating capacity of 19 seats or less, for which the application for a type certificate was submitted on or after 1 January 2023;

(3) all propeller-driven aeroplanes, including their derived versions, of greater than 8 618 kg maximum take-off mass, for which the application for a type certificate was submitted on or after 1 January 2020;

(4) derived versions of non-CO_2-certified subsonic jet aeroplanes of greater than 5 700 kg maximum certificated take-off mass, for which the application for certification of the change in type design was submitted on or after
1 January 2023;

(5) derived versions of non-CO_2 certified propeller-driven aeroplanes of greater than 8 618 kg maximum certificated take-off mass, for which the application for certification of the change in type design was submitted on or after January 2023;

(6) individual non-CO_2-certified subsonic jet aeroplanes of greater than 5 700 kg maximum certificated take-off mass, for which a certificate of airworthiness was first issued on or after 1 January 2028; and

(7) individual non-CO_2-certified propeller-driven aeroplanes of greater than 8 618 kg maximum certificated take-off mass, for which a certificate of airworthiness was first issued on or after 1 January 2028.

Note.— Aeroplanes initially designed or modified and used for specialized operational requirements refer to aeroplane type configurations which, in the view of the certificating authority, have different design characteristics to meet specific operational needs compared to typical civil aeroplane types covered by the scope of this volume of Annex 16, and which may result in a very different CO_2 emissions evaluation metric value.

(b) Notwithstanding (a) above, it may be recognized by a Contracting State that aeroplanes on its registry do not require demonstration of compliance with the provisions of the Standards of Annex 16, Volume III, for time-limited engine changes. These changes in type design shall specify that the aeroplane may not be operated for a period of more than 90 days, unless compliance with the provisions of Annex 16, Volume III, is shown for that change in type design. This applies only to changes resulting from a required maintenance action.

(c) The granting of an exemption for an aeroplane against applicability requirements specified in (a) shall be noted on the aeroplane statement of conformity issued by the certificating authority. Certificating authorities shall take into account the numbers of exempted aeroplanes that will be produced and their impact on the environment. Exemptions shall be reported by aeroplane serial number and made available via an official public register.

Note.— Further guidance on issuing exemptions is provided in the Environmental Technical Manual *(Doc 9501), Volume III* — Procedures for the CO_2Emissions Certification of Aeroplanes.

16.3.4.2 CO_2 emissions evaluation metric

(a) The metric shall be defined in terms of the average of the 1/SAR values for the three reference masses defined in 16.3.4.3 and the RGF defined in IS 16.3.4.2. The metric value shall be calculated according to the following formula:

$$\text{CO}_2 \text{ emissions evaluation metric value} = \frac{\left(1/\text{SAR}\right)_{\text{AVG}}}{\left(\text{RGF}\right)^{0.24}}$$

Note 1.— The metric value is quantified in units of kg/km.

Note 2.— The CO_2 emissions evaluation metric is a specific air range (SAR)-based metric adjusted to take into account fuselage size.

16.3.4.3 **Reference aeroplane masses**

(a) The 1/SAR value shall be established at each of the following three reference aeroplane masses, when tested in accordance with these Standards:

(1) high gross mass: 92 per cent maximum take-off mass (MTOM)

(2) mid gross mass: simple arithmetic average of high gross mass and low gross mass

(3) low gross mass: $(0.45 \times MTOM) + (0.63 \times (MTOM^{0.924}))$

Note.— MTOM is expressed in kilograms.

(b) CO_2 emissions certification for MTOM also represents the certification of CO_2 emissions for take-off masses less than MTOM. However, in addition to the mandatory certification of CO_2 metric values for MTOM, applicants may voluntarily apply for the approval of CO_2 metric values for take-off masses less than MTOM.

16.3.4.4 **Maximum permitted CO_2 emissions evaluation metric value**

(a) The CO_2 emissions evaluation metric value shall be determined in accordance with the evaluation methods described in IS 16.3.4.4 (a) of Volume III.

(b) The CO_2 emissions evaluation metric value shall not exceed the value defined in the following paragraphs:

(1) for aeroplanes specified in 16.3.4.1 (a)(1), (2) and (3) with a maximum take-off mass less than or equal to 60 000 kg:

Maximum permitted value = $10^{(-2.73780 + (0.681310 * \log_{10}(MTOM)) + (-0.0277861 * (\log_{10}(MTOM))^2))}$

(2) for aeroplanes specified in 16.3.4.1 (a)(1) and (3)with a maximum take-off mass greater than 60 000 kg, and less than or equal to 70 395 kg:

Maximum permitted value = 0.764

(3) for aeroplanes specified in 16.3.4.1 (a)(1) and (3)with a maximum take-off mass greater than 70 395 kg:

Maximum permitted value = $10^{(-1.412742 + (-0.020517 * \log_{10}(MTOM)) + (0.0593831 * (\log_{10}(MTOM))^2))}$

(4) for aeroplanes specified in 16.3.4.1 (a)(4), (5), (6) and (7) with a maximum certificated take-off mass less than or equal to 60 000 kg:

Maximum permitted value = $10^{(-2.57535 + (0.609766 * \log10(MTOM)) + (-0.0191302 * (\log10(MTOM))^2))}$

(5) for aeroplanes specified in 16.3.4.1 (a)(4), (5), (6) and (7) with a maximum certificated take-off mass greater than 60 000 kg, and less than or equal to 70 107 kg:

Maximum permitted value = 0.797

(6) for aeroplanes specified in 2.1.1 d), e), f) and g) with a maximum take-off mass greater than 70 107 kg:

Maximum permitted value $= 10^{(-1.39353 + (-0.020517 * \log10(MTOM)) + (0.0593831 * (\log10(MTOM))^2))}$

16.3.4.5 **Reference conditions for determining aeroplane specific air range**

(a) The reference conditions shall consist of the following conditions within the approved normal operating envelope of the aeroplane:

(1) the aeroplane gross masses defined in 16.3.4.3;

(2) a combination of altitude and airspeed selected by the applicant for each of the specified reference aeroplane gross masses;

Note.— These conditions are generally expected to be the combination of altitude and airspeed that results in the highest SAR value, which is usually at the maximum range cruise Mach number at the optimum altitude. The selection of conditions other than optimum conditions will be to the detriment of the applicant because the SAR value will be adversely affected.

(3) steady (unaccelerated), straight and level flight;

(4) aeroplane in longitudinal and lateral trim;

(5) ICAO standard day atmosphere1;

(6) gravitational acceleration for the aeroplane travelling in the direction of true North in still air at the reference altitude and a geodetic latitude of 45.5 degrees, based on g_0;

(7) fuel lower heating value equal to 43.217 MJ/kg (18 580 BTU/lb);

(8) a reference aeroplane centre of gravity (CG) position selected by the applicant to be representative of a mid-CG point relevant to design cruise performance at each of the three reference aeroplane masses;

Note.— For an aeroplane equipped with a longitudinal CG control system, the reference CG position may be selected to take advantage of this feature.

(9) a wing structural loading condition selected by the applicant for representative operations conducted in accordance with the aeroplane's payload capability and manufacturer standard fuel management practices;

(10) applicant selected electrical and mechanical power extraction and bleed flow relevant to design cruise performance and in accordance with manufacturer recommended procedures;

Note.— Power extraction and bleed flow due to the use of optional equipment such as passenger entertainment systems need not be included.

(11) engine handling/stability bleeds operating according to the nominal design of the engine performance model for the specified conditions; and

(12) engine deterioration level selected by the applicant to be representative of the initial deterioration level (a minimum of 15 take-offs or 50 engine flight hours).

(b) If the test conditions are not the same as the reference conditions, then corrections for the differences between test and reference conditions shall be applied as described in IS 16.3.4.4 (a) of Volume III.

16.3.4.6 **Test procedures**

(a) The SAR values that form the basis of the CO_2 emissions evaluation metric value shall be established either directly from flight tests or from a performance model validated by flight tests.

(b) The test aeroplane shall be representative of the configuration for which certification is requested.

(c) The test and analysis procedures shall be conducted in an approved manner to yield the CO_2 emissions evaluation metric value as described IS 16.3.4.4 (a). These procedures shall address the entire flight test and data analysis process, from pre-flight actions to post-flight data analysis.

Note.— The fuel used for each flight test should meet the specification defined in either ASTM D1655-15[2], DEF STAN 91-91 Issue 7, Amendment 3[3], or equivalent.

LIBERIA CIVIL AVIATION REGULATIONS

PART 16 VOLUME III – IMPLEMENTING STANDARDS

IS 16.3.4.4 (a): APPENDIX 1- DETERMINATION OF THE AEROPLANE CO2 EMISSIONS EVALUATION METRIC VALUE

1.— SUBSONIC JET AEROPLANES OVER 5 700 kg

2.— PROPELLER-DRIVEN AEROPLANES OVER 8 618 kg

1. INTRODUCTION

(a) The process for determining the CO_2 emissions evaluation metric value includes:

(1) determination of RGF;

(2) determination of the certification test and measurement conditions and procedures for the determination of SAR, either by direct flight test or by way of a validated performance model, including:

(i) measurement of parameters needed to determine SAR ;

(ii) correction of measured data to reference conditions for SAR; and

(iii) validation of data for calculation of the certified CO_2 emissions evaluation metric value;

(3) calculation of the CO_2 emissions evaluation metric value; and

(4) reporting of data to the certificating authority.

Note.— The instructions and procedures ensure uniformity of compliance tests, and permit comparison between various types of aeroplanes.

2. METHODS FOR DETERMINING SPECIFIC AIR RANGE

2.1 SAR may be determined by either direct flight test measurement of SAR test points, including any corrections of test data to reference conditions, or by the use of a performance model approved by the certificating authority. A performance model, if used, shall be validated by actual SAR flight test data.

2.2 In either case, the SAR flight test data shall be acquired in accordance with the procedures defined in this Standard and approved by the certificating authority.

2.3 **Recommendation.—***Validation of the performance model should only need to be shown for the test points and conditions relevant to showing compliance with the Standard. Test and analysis methods, including any algorithms that may be used, should be described in sufficient detail.*

3. SPECIFIC AIR RANGE CERTIFICATION TEST AND MEASUREMENT CONDITIONS

3.1 General

This section prescribes the conditions under which SAR certification tests shall be conducted and the measurement procedures that shall be used.

Note.— Many applications for certification of a CO_2 emissions metric value involve only minor changes to the aeroplane type design. The resultant changes in the CO_2 emissions metric value can often be established reliably by way of equivalent procedures without the necessity of resorting to a complete test.

3.2 Flight test procedure

3.2.1 Pre-flight

(a) The pre-flight procedure shall be approved by the certificating authority and shall include the following elements:

(1) ***Aeroplane conformity***. The test aeroplane shall be confirmed to be in conformance with the type design configuration for which certification is sought.

(2) ***Aeroplane weighing***. The test aeroplane shall be weighed. Any change in mass after the weighing and prior to the test flight shall be accounted for.

(3) ***Fuel lower heating value***. A sample of fuel shall be taken for each flight test to determine its lower heating value. Fuel sample test results shall be used for the correction of measured data to reference conditions. The determination of lower heating value and the correction to reference conditions shall be subject to the approval of the certificating authority.

(i) **Recommendation.—** *The fuel lower heating value should be determined in accordance with methods which are at least as stringent as those defined in ASTM specification D4809-13*[1].

(ii) **Recommendation.—** *The fuel sample should be representative of the fuel used for each flight test and should not be subject to errors or variations due to fuel being uplifted from multiple sources, fuel tank selection or fuel layering in a tank.*

(4) ***Fuel specific gravity and viscosity***. A sample of fuel shall be taken for each flight test to determine its specific gravity and viscosity when volumetric fuel flow meters are used.

Note.— When using volumetric fuel flow meters, the fuel viscosity is used to determine the volumetric fuel flow from the parameters measured by a volumetric fuel flow meter. The fuel specific gravity (or density) is used to convert the volumetric fuel flow to a mass fuel flow.

(i) **Recommendation.—** *The fuel specific gravity should be determined in accordance with methods which are atleast as stringent as those defined in ASTM specification D4052-11*[2].

(ii) **Recommendation.—** *The fuel kinematic viscosity should be determined in accordance with methods which are at least as stringent as those defined in ASTM specification D445-15*[3].

3.2.2 Flight test method

3.2.2.1 The flight tests shall be performed in accordance with the following flight test method and the stability conditions described in 3.2.3.

3.2.2.2 Test points shall be separated by a minimum duration of two minutes, or separated by an exceedance of one or more of the stability criteria limits described in 3.2.3.1.

3.2.2.3 **Recommendation.—***During the test conditions flown to determine SAR, the following criteria should beadhered to:*

(a) *the aeroplane is flown at constant pressure altitude and constant heading along isobars to the extent that is practicable;*

(b) *the engine thrust/power setting is stable for unaccelerated level flight;*

(c) *the aeroplane is flown as close as practicable to the reference conditions to minimize the magnitude of any corrections;*

(d) *there are no changes in trim or engine power/thrust settings, engine stability and handling bleeds, and electrical and mechanical power extraction (including bleed flow). Any changes in the use of aeroplane systems that may affect the SAR measurement should be avoided; and*

(e) *movement of on-board personnel is kept to a minimum.*

3.2.3 Test condition stability

3.2.16.4.5.1 For a SAR measurement to be valid, the following parameters shall be maintained within the indicated tolerances for a minimum duration of 1 minute during which the SAR data is acquired:

(a) Mach number within ±0.005;

(b) ambient temperature within ±1°C;

(c) heading within ±3 degrees;

(d) track within ±3 degrees;

(e) drift angle less than 3 degrees;

(f) ground speed within ±3.7 km/h (±2 kt);

(g) difference in ground speed at the beginning of the test condition from the ground speed at the end of the test condition within ±2.8 km/h/min (±1.5 kt/min); and

(h) pressure altitude within ±23 m (±75 ft).

3.2.3.2 Alternatives to the stable test condition criteria listed above may be used provided that stability can be sufficiently demonstrated to the certificating authority.

3.2.3.3 Test points that do not meet the stable test criteria defined in 3.2.16.4.5.1should normally be discarded. However, test points that do not meet the stability criteria listed in 3.2.16.4.5.1may be acceptable subject to the approval of the certificating authority, and would be considered as an equivalent procedure.

3.2.4 Verification of aeroplane mass at test conditions

3.2.4.1 The procedure for determining the mass of the aeroplane at each test condition shall be subject to the approval of the certificating authority.

3.2.4.2 **Recommendation.—***The mass of the aeroplane during a flight test should be determined by subtracting the fuel used (i.e. integrated fuel flow) from the mass of the aeroplane at the start of the test flight. The accuracy of the determination of the fuel used should be verified by weighing the test aeroplane on calibrated scales either before and after the SAR test*

flight, or before and after another test flight with a cruise segment provided that flight occurs within one week or 50 flight hours (at the option of the applicant) of the SAR test flight and with the same, unaltered fuel flow meters.

4. MEASUREMENT OF AEROPLANE SPECIFIC AIR RANGE

4.1 Measurement system

4.1.1 The following parameters shall be recorded at a minimum sampling rate of 1 Hz:

(a) airspeed;

(b) ground speed;

(c) true airspeed;

(d) fuel flow;

(e) engine power setting parameter (e.g. fan speed, engine pressure ratio, torque, shaft horse power);

(f) pressure altitude;

(g) temperature;

(h) heading;

(i) track; and

(j) fuel used (for the determination of gross mass and CG position).

4.1.2 The following parameters shall be recorded at a suitable sampling rate:

(a) latitude;

(b) engine bleed positions and power off-takes; and

(c) power extraction (electrical and mechanical load).

4.1.3 The value of each parameter used for the determination of SAR, except for ground speed, shall be the simple arithmetic average of the measured values for that parameter obtained throughout the stable test condition (see 3.2.3.1).

Note.— The rate of change of ground speed during the test condition is to be used to evaluate and correct any acceleration or deceleration that might occur during the test condition.

4.1.4 The resolution of the individual measurement devices shall be sufficient to determine that the stability of the parameters defined in 3.2.16.4.5.1is maintained.

4.1.5 The overall SAR measurement system is considered to be the combination of instruments and devices, including any associated procedures, used to acquire the following parameters necessary for the determination of SAR:

(a) fuel flow;

(b) Mach number;

(c) altitude;

(d) aeroplane mass;

(e) ground speed;

(f) outside air temperature;

(g) fuel lower heating value; and

(h) CG.

4.1.6 The accuracy of the individual elements that comprise the overall SAR measurement system is defined in terms of its effect upon SAR. The cumulative error associated with the overall SAR measurement system is defined as the root sum of squares (RSS) of the individual accuracies.

Note.— Parameter accuracy need only be examined within the range of the parameter needed for showing compliance with the CO_2 emissions Standard.

4.1.7 If the absolute value of the cumulative error of the overall SAR measurement system is greater than 1.5 per cent, a penalty equal to the amount that the RSS value exceeds 1.5 per cent shall be applied to the SAR value corrected to reference conditions. If the absolute value of the cumulative error of the overall SAR measurement system is less than or equal to 1.5 per cent, no penalty shall be applied.

5. CALCULATION OF REFERENCE SPECIFIC AIR RANGE FROM MEASURED DATA

5.1 Calculation of SAR

SAR is calculated from the following equation: $SAR = TAS/W_f$

where:

TAS is the true airspeed; and

W_f is total aeroplane fuel flow.

5.2 Corrections from test to reference conditions

5.2.1 Corrections shall be applied to the measured SAR values to correct to the reference conditions specified in 16.3.4.5 of this volume. Corrections shall be applied for each of the following measured parameters that are not at the reference conditions:

(a) ***Acceleration/deceleration (energy).*** Drag determination is based on an assumption of steady, unaccelerated flight. Acceleration or deceleration occurring during a test condition affects the assessed drag level. The reference condition is steady, unaccelerated flight.

(b) ***Aeroelastics.*** Wing aeroelasticity may cause a variation in drag as a function of aeroplane wing mass distribution. Aeroplane wing mass distribution will be affected by the fuel load distribution in the wings and the presence of any external stores.

(c) ***Altitude.*** The altitude at which the aeroplane is flown affects the fuel flow.

(d) ***Apparent gravity.*** Acceleration, caused by the local effect of gravity, and inertia, affect the test weight of the aeroplane. The apparent gravity at the test conditions varies with latitude, altitude, ground speed, and direction of motion relative to the

Earth's axis. The reference gravitational acceleration is the gravitational acceleration for the aeroplane travelling in the direction of true North in still air at the reference altitude, a geodetic latitude of 45.5 degrees, and based on g_0.

(e) ***CG position.*** The position of the aeroplane CG affects the drag due to longitudinal trim.

(f) ***Electrical and mechanical power extraction and bleed flow.*** Electrical and mechanical power extraction, and bleed flow affect the fuel flow.

(g) ***Engine deterioration level.*** When first used, engines undergo a rapid, initial deterioration in fuel efficiency. Thereafter, the rate of deterioration significantly decreases. Engines with less deterioration than the reference engine deterioration level may be used, subject to the approval of the certificating authority. In such a case, the fuel flow shall be corrected to the reference engine deterioration level using an approved method. Engines with more deterioration than the reference engine deterioration level may be used. In this case, a correction to the reference condition shall not be permitted.

(h) ***Fuel lower heating value.*** The fuel lower heating value defines the energy content of the fuel. The lower heating value directly affects the fuel flow at a given test condition.
Mass/ .The lift coefficient of the aeroplane is a function of mass/δand Mach number, whereδis the ratio of the atmospheric pressure at a given altitude to the atmospheric pressure at sea level. The lift coefficient for the test condition affects the drag of the aeroplane. The reference mass/δ is derived from the combination of the reference mass, reference altitude and atmospheric pressures determined from the ICAO standard atmosphere.

(i) ***Reynolds number.*** The Reynolds number affects aeroplane drag. For a given test condition the Reynolds number is a function of the density and viscosity of air at the test altitude and temperature. The reference Reynolds number is derived from the density and viscosity of air from the ICAO standard atmosphere at the reference altitude and temperature.

(j) ***Temperature.*** The ambient temperature affects the fuel flow. The reference temperature is the standard day temperature from the ICAO standard atmosphere at the reference altitude.

Note.— Post-flight data analysis includes the correction of measured data for data acquisition hardware response characteristics (e.g. system latency, lag, offset, buffering, etc.).

5.2.2 Correction methods are subject to the approval of the certificating authority. If the applicant considers that a particular correction is unnecessary, then acceptable justification shall be provided to the certificating authority.

5.3 Calculation of specific air range

The SAR values for each of the three reference masses defined in 16.3.4.3, shall be calculated either directly from the measurements taken at each valid test point adjusted to reference conditions, or indirectly from a performance model that has been validated by the test points. The final SAR value for each reference mass shall be the simple arithmetic average of all valid test points at the appropriate gross mass, or derived from a validated performance model. No data acquired from a valid test point shall be omitted unless agreed by the certificating authority.

Note.— Extrapolations consistent with accepted airworthiness practices to masses other than those tested may be allowable using a validated performance model. The performance model should be based on data covering an adequate range of lift coefficient, Mach number, and thrust specific fuel consumption such that there is no extrapolation of these parameters.

6. VALIDITY OF RESULTS

6.1 The 90 per cent confidence interval shall be calculated for each of the SAR values at the three reference masses.

6.2 If clustered data is acquired independently for each of the three gross mass reference points, the minimum sample size acceptable for each of the three gross mass SAR values shall be six.

6.3 Alternatively, SAR data may be collected over a range of masses. In this case, the minimum sample size shall be 12 and the 90 per cent confidence interval shall be calculated for the mean regression line through the data.

6.4 If the 90 per cent confidence interval of the SAR value at any of the three reference aeroplane masses exceeds ±1.5 per cent, the SAR value at that reference mass may be used, subject to the approval of the certificating authority, if a penalty is applied to it. The penalty shall be equal to the amount that the 90 per cent confidence interval exceeds ±1.5 per cent. If the 90 per cent confidence interval of the SAR value is less than or equal to ±1.5 per cent, no penalty need be applied.

Note.— Methods for calculating the 90 per cent confidence interval are given in the Environmental Technical Manual *(Doc 9501), Volume III* — Procedures for the CO_2Emissions Certification of Aeroplanes.

7. CALCULATION OF THE CO_2 EMISSIONS EVALUATION METRIC VALUE

The CO_2 emissions evaluation metric value shall be calculated according to the formula defined in 16.4.4.2.

8. REPORTING OF DATA TO THE CERTIFICATING AUTHORITY

Note.— The information required is divided into: 1) general information to identify the aeroplane characteristics and the method of data analysis; 2) list of reference conditions used; 3) data obtained from the aeroplane test(s); 4) calculations and corrections of SAR test data to reference conditions; and 5) results derived from the test data.

8.1 General information

(a) The following information shall be provided for each aeroplane type and model for which CO_2 certification is sought:

(1) designation of the aeroplane type and model;

(2) general characteristics of the aeroplane, including CG range, number and type designation of engines and, if fitted, propellers;

(3) MTOM;

(4) relevant dimensions needed for calculation of RGF; and

(5) serial number(s) of the aeroplane(s) tested for CO_2 certification purposes and, in addition, any modifications or non-standard equipment likely to affect the CO_2 characteristics of the aeroplane.

8.2 Reference conditions

The reference conditions used for the determination of SAR (see 16.3.4.5) shall be provided.

8.3 Test data

(a) The following measured test data, including any corrections for instrumentation characteristics, shall be provided for each of the test measurement points:

(1) airspeed, ground speed and true airspeed;

(2) fuel flow;

(3) pressure altitude;

(4) static air temperature;

(5) aeroplane gross mass and CG for each test point;

(6) levels of electrical and mechanical power extraction and bleed flow;

(7) engine performance:

(i) for jet aeroplanes, engine power setting; and

(ii) for propeller-driven aeroplanes, shaft horsepower or engine torque and propeller rotational speed;

(8) fuel lower heating value;

(9) fuel specific gravity and kinematic viscosity if volumetric fuel flow meters are used (see 3.2.1 (a)(4));

(10) the cumulative error (RSS) of the overall measurement system (see 4.1.6);

(11) heading, track and latitude;

(12) stability criteria (see 3.2.3.1); and

(13) description of the instruments and devices used to acquire the parameters necessary for the determination of SAR, and their individual accuracies in terms of their effect on SAR (see 4.1.5 and 4.1.6).

8.4 Calculations and corrections of SAR test data to reference conditions

The measured SAR values, corrections to the reference conditions and corrected SAR values shall be provided for each of the test measurement points.

8.5 Derived data

(a) The following derived information shall be provided for each aeroplane tested for certification purposes:

(1) SAR (km/kg) for each reference aeroplane mass and the associated 90 per cent confidence interval;

(2) average of the inverse of the three reference mass SAR values;

(3) RGF; and

(4) CO_2 emissions evaluation metric value.

IS 16.3.4.2: APPENDIX 2- REFERENCE GEOMETRIC FACTOR

(a) RGF is a non-dimensional parameter used to adjust $(1/SAR)_{AVG}$. RGF is based on a measure of fuselage size normalized with respect to 1 m^2, and is derived as follows:

(1) for aeroplanes with a single deck determine the area of a surface (expressed in m^2) bounded by the maximum width of the fuselage outer mould line (OML) projected to a flat plane parallel with the main deck floor; and

(2) for aeroplanes with an upper deck determine the sum of the area of a surface (expressed in m^2) bounded by the maximum width of the fuselage OML projected to a flat plane parallel with the main deck floor, and the area of a surface bounded by the maximum width of the fuselage OML at or above the upper deck floor projected to a flat plane parallel with the upper deck floor is determined; and

(3) determine the non-dimensional RGF by dividing the areas defined in(a)(1) or (a)(2) by 1 m^2.

(b) RGF includes all pressurized space on the main or upper deck including aisles, assist spaces, passage ways, stairwells and areas that can accept cargo and auxiliary fuel containers. It does not include permanent integrated fuel tanks within the cabin or any unpressurized fairings, nor crew rest/work areas or cargo areas that are not on the main or upper deck (e.g. 'loft' or under floor areas). RGF does not include the cockpit crew zone.

(c) The aft boundary to be used for calculating RGF is the aft pressure bulkhead. The forward boundary is the forward pressure bulkhead except for the cockpit crew zone.

(d) Areas that are accessible to both crew and passengers are excluded from the definition of the cockpit crew zone. For aeroplanes with a cockpit door, the aft boundary of the cockpit crew zone is the plane of the cockpit door. For aeroplanes having optional interior configurations that include different locations of the cockpit door, or no cockpit door, the boundary shall be determined by the configuration that provides the smallest cockpit crew zone. For aeroplanes certified for single-pilot operation, the cockpit crew zone shall extend half the width of the cockpit.

(e) Figures (16.3.4.2)-1 and (16.3.4.2)-2 provide a notional view of the RGF boundary conditions.

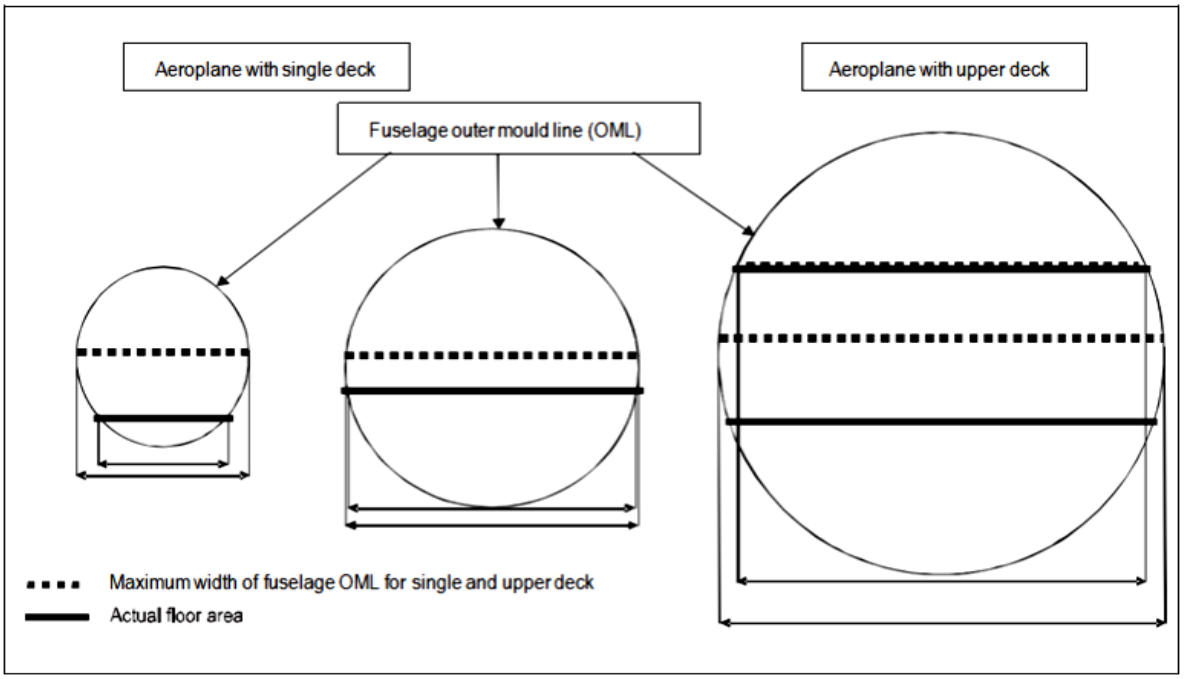


Figure (16.3.4.2)-1 : **Cross-sectional view**

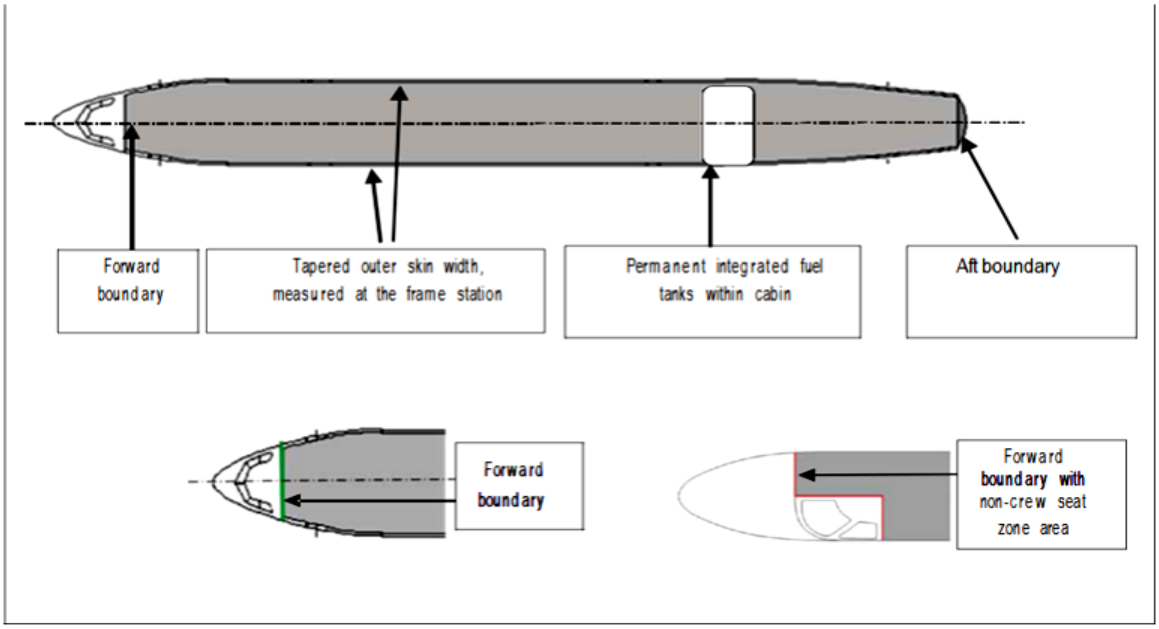


Figure (16.3.4.2)-2 : **Longitudinal view**

16.4: ENVIRONMENTAL PROTECTION

VOLUME IV — CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION (CORSIA)

INTENTIONALLY LEFT BLANK

16.4 - VOLUME IV – CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION (CORSIA)

PART A-DEFINITIONS, ABBREVIATIONS AND UNITS

16.4.1 DEFINITIONS

(a) When the following terms are used in these Regulations they have the following meanings:

(1) ***Administrative partnership.*** Delegation of administering tasks in this Volume from one State to another State(s).

(2) ***Aerodrome.*** A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

(3) ***Aerodrome pair.*** A group of two aerodromes composed of a departing aerodrome and an arrival aerodrome.

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

(5) ***Aeroplane owner.*** Person(s), organization(s) or enterprise(s) identified via Item 4 (Name of owner) and Item 5 (Address of owner) on the certificate of registration of an aeroplane.

(6) ***Air operator certificate (AOC).*** A certificate authorizing an operator to carry out specified commercial air transport operations.

(7) ***Conversion process.*** A type of technology used to convert a feedstock into aviation fuel.

(8) ***CORSIA eligible fuel.*** A CORSIA sustainable aviation fuel or a CORSIA lower carbon aviation fuel, which an operator may use to reduce their offsetting requirements.

(9) ***CORSIA lower carbon aviation fuel.*** A fossil-based aviation fuel that meets the CORSIA Sustainability Criteria under this Volume.

(10) ***CORSIA sustainable aviation fuel.*** A renewable or waste-derived aviation fuel that meets the CORSIA Sustainability Criteria under this Volume.

(11) ***Feedstock.*** A type of unprocessed raw material used for the production of aviation fuel.

(12) ***Flight plan.*** Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

(13) ***Fuel uplift.*** Measurement of fuel provided by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight (in litre).

(14) ***Great Circle Distance.*** The shortest distance, rounded to the nearest kilometre, between the origin and the destination aerodromes, measured over the earth's surface modelled according to the World Geodetic System 1984 (WGS84).

Note.— Latitude and longitude coordinates of aerodromes can be obtained from the ICAO Location Indicators database.

(15) ***National accreditation body.*** A body authorized by a State which attests that a verification body is competent to provide specific verification services.

(16) ***New entrant.*** Any aeroplane operator that commences an aviation activity falling within the scope of this Volume on or after its entry into force and whose activity is not in whole or in part a continuation of an aviation activity previously performed by another aeroplane operator.

(17) ***Notifying State.*** The State that has submitted to ICAO the request for the registration of or change in the three-letter designator of an aeroplane operator over which it has jurisdiction.

(18) ***Operator.*** The person, organization or enterprise engaged in or offering to engage in an aircraft operation.

(19) ***Pathway.*** A specific combination of feedstock and conversion process used for the production of aviation fuel.

(20) ***Reporting period.*** A period which commences on 1 January and finishes on 31 December in a given year for which an aeroplane operator or State reports required information. The flight departure time (UTC) determines which reporting period a flight belongs to.

(21) ***State pair.*** A group of two States composed of a departing State or its territories and an arrival State or its territories.

(22) ***Verification body.*** A legal entity that performs the verification of an Emissions Report and, when required, an Emissions Unit Cancellation Report, as an accredited independent third party.

(23) ***Verification of report.*** An independent, systematic and sufficiently documented evaluation process of an emissions report and, when required, a cancellation of eligible emissions units report.

(24) ***Verification report.*** A document, drafted by the verification body, containing the verification statement and required supporting information.

(25) ***Verification team.*** A group of verifiers, or a single verifier that also qualifies as a team leader, belonging to a verification body conducting the verification of an Emissions Report and, when required, an Emissions Unit Cancellation Report. The team can be supported by technical experts.

16.4.2 ABBREVIATIONS AND UNITS

16.4.2.1 Abbreviations

(a) Where the following abbreviations are used in Volume IV of this Regulation, they have the meanings ascribed to them below:

ACARS Aircraft Communications Addressing and Reporting System
AOC Air operator certificate

CERT CO_2 Estimation and Reporting Tool

CO_2 Carbon dioxide

CO_2e Carbon dioxide equivalent

CORSIA Carbon Offsetting and Reduction Scheme for International Aviation

GHG Greenhouse gases

IAF International Accreditation Forum

IEC International Electrotechnical Commission

ISO International Organization for Standardization

MRV Monitoring, Reporting and Verification

MJ Megajoule

RTK Revenue Tonne Kilometres

16.4.2.2 Non-SI units

(a) The non-SI units listed in Table below shall be used either in lieu of, or in addition to, SI units as primary units of measurement under this Volume.

Non -SI units use with SI units

Specific quantity	*Unit*	*Symbol*	*Definition (in terms of SI units)*
mass	tonne	t	1 t = 10^3 kg
time	hour	h	1 h = 60 min = 3 600 s
volume	litre	L	1 L = 1 dm^3 = 10^{-3} m^3

PART B- CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION (CORSIA)

16.4.3 ADMINISTRATION

(a) The following provisions shall apply to the classifications defined in this Subpart.[1]

16.4.3.1 Attribution of International Flights To An Air Operator

(a) The Air Operator shall identify international flights, as defined in (b) and 16.4.4.1, that are attributed to it according to the approach in (b) and (c) below.

Note. – Two or more consecutive flights operated under the same flight number are considered as separate flights for the purposes of this Volume.

(b) For the purpose of this Sub Part, an international flight shall be defined as the operation of an aircraft from take-off at an aerodrome of a State or its territories, and landing at an aerodrome of another State or its territories. A domestic flight shall also be defined as the operation of an aircraft from take-off at an aerodrome of a State or its territories, and landing at an aerodrome of the same State or its territories.

(c) The attribution of a specific international flight to an Air Operator shall be determined as follows:

(1) **ICAO Designator:** When Item 7 (aircraft identification) of the flight plan contains the ICAO Designator, that flight shall be attributed to the Air Operator that has been assigned this Designator;

Note 1. – ICAO Designators are contained in Doc 8585 — Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services.

Note 2. – The reference to Item 7 is based on the ICAO model flight plan form contained in IS 16.4.4.2 of Doc 4444 — Procedures for Air Navigation Services - Air Traffic Management.

(2) **Registration marks:** When Item 7 (aircraft identification) of the flight plan contains the nationality or common mark, and registration mark of an aeroplane that is explicitly listed in an AOC (or equivalent) issued by a State, that flight shall be attributed to the Air Operator that holds the AOC (or equivalent); and

(3) **Others:** When the Air Operator of a flight has not been identified via (3)(i) or (3)(ii) above, that flight shall be attributed to the aeroplane owner who shall then be considered the air operator.

(d) If requested by the Authority, the owners of Liberia registered aircraft identified via (c)(3) shall provide all information necessary to identify the actual Air Operator of a flight.

(e) Subject to prior approval by the Authority, the Air Operator may, by contract, delegate the administrative requirements of this Volume to a third party, as long as the delegation is not to the same entity as the verification body. Liability for compliance shall not be delegated.

Recommendation.— *The State should ensure the correct attribution of an international flight departing from an aerodrome in its territory to an aeroplane operator using the approach in 16.4.3.1(c) and perform the required order of magnitude checks to ensure the completeness of reported data as described in 16.4.4.3 (*d)(1)(iv).

16.4.3.2 **Attribution Of An Air Operator To a State**

(a) The air operator with international flights, as defined in 16.4.3.1(b) and 16.4.4.1, attributed to it shall identify the State to which it is attributed according to the approach in (c).

(b) The Authority shall ensure the correct attribution of an Air Operator to it according to the approach in sub-paragraph (3) below.

Recommendation.— *The State should use the ICAO document entitled "CORSIA Air Operator to State Attributions" that is available on the ICAO CORSIA website to meet its requirements under paragraph (2) above.*

(c) The attribution of an Air Operator to a State shall be determined as follows:

(1) **ICAO Designator:** Where the Air Operator has an ICAO Designator, the State to which the Air Operator fulfils its requirements under this Volume shall be the Notifying State;

Note. – ICAO Designators and Notifying States are contained in Doc 8585 — Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services.

(2) **Air operator certificate:** Where the Air Operator does not possess an ICAO Designator, but has a valid air operator certificate (or equivalent), the State to which the Air Operator fulfils its requirements under this Volume shall be the State that issued the air operator certificate (or equivalent); and

(3) **Place of juridical registration:** Where the Air Operator does not possess an ICAO Designator or air operator certificate, the State where the Air Operator is registered as juridical person shall be the State to which the Air Operator fulfils its requirements under this Volume. Where the Air Operator is a natural person, the State of residence and registration of this person shall be the State to which the Air Operator fulfils its requirements under this Volume.

(d) If the Air Operator changes its ICAO Designator, AOC (or equivalent) or place of juridical registration, and is subsequently attributed to a new State, but it is not establishing a new entity or a subsidiary, then this State shall become the State to which the Air Operator fulfils its requirements under this subpart.

(e) The air operator with a wholly owned subsidiary air operator that is legally registered in the same State can be treated as a single consolidated air operator liable for compliance with the requirements of this Volume, subject to the approval of the Authority. Evidence shall be provided in the air operator's Emissions Monitoring Plan to demonstrate that the subsidiary aeroplane operator is wholly owned.

(f) The Authority shall submit to ICAO a list of aeroplane operators which are attributed to it according to the requirements as described in IS 16.4.4.3 Table A5-3 (Field 1), and in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV. The Authority may submit updates to this list to ICAO on a more frequent basis.

16.4.3.3 **State**

(a) The Authority shall approve the Air Operator compliance on the basis of satisfactory evidence that the aeroplane operator meets requirements that are at least equal to the applicable Standards specified in this Volume.

Note.— As each new edition and amendment of this Annex becomes applicable (according to Table A of the Foreword) it supersedes all previous editions and amendments.

(b) The Authority shall not delegate enforcement of the requirements in this Volume, or their administrative tasks towards ICAO, to another State. The State may delegate administration processes of this Volume to another State through an administrative partnership based on bilateral agreement among the respective States.

Note.— A template for, and guidance on, administrative partnerships is provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(c) The Authority providing capacity support through an administrative partnership shall notify ICAO about the contracting administrating authorities, affected aeroplane operators, scope and duration of the administrative partnership and a copy of the bilateral agreement.

Recommendation.— *The State providing capacity support should assess whether the administrating authority that has been delegated authority, which will provide administering tasks for another State, has the required resources to offer such services.*

(d) The State receiving capacity support shall ensure that aeroplane operators attributed to it are advised of the administrative arrangements prior to start of the administrative partnership and any potential changes thereafter.

(e) The State shall not withdraw from an administrative partnership before completion of the reporting activities at the end of the reporting period, but it may withdraw from an administrative partnership according to the notice period defined in the agreement.

(f) The State shall submit to ICAO a list of verification bodies accredited in the State according to the requirements as described in IS 16.4.4.3 Table A5-3 (Field 2), and in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, volume IV. The State may submit updates to this list to ICAO on a more frequent basis.

16.4.3.4 **Record Keeping**

(a) The Air Operator shall keep the necessary records relevant to demonstrating compliance with the requirements of this Part for a period of ten (10) years.

Recommendation.— *The aeroplane operator should keep records relevant to its CO_2 emissions per State pairduring the 2019-2020 period in order to cross-check its offsetting requirements calculated by the State during the 2030-2035 compliance periods.*

(b) The Authority shall keep records relevant to the air operator's CO_2 emissions per State pair during the period of 2019-2020 in order to calculate the air operator's offsetting requirements during the 2030-2035 compliance periods.

16.4.3.5 **Compliance Periods And Timeline**

(a) Air operators shall comply with the requirements of this subpart in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, volume IV.

16.4.3.6 **Equivalent Procedures - Exemptions**

(a) The use of equivalent procedures in lieu of the procedures specified in this Volume shall be approved by the State to which the air operator has been attributed in 16.4.3.2. Equivalent procedures shall demonstrably meet the requirements in this Volume.

Note.— Guidance material, including the use of equivalent procedures, is provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(b) An Air Operator requesting the use of equivalent procedures shall demonstrate to the Authority that the proposed equivalent procedures meet the requirements of this Volume.

16.4.4 MONITORING, REPORTING AND VERIFICATION (MRV) OF AIR OPERATOR ANNUAL CO_2 EMISSIONS

16.4.4.1 **Applicability Of MRV Requirements**

(a) The provisions of this subpart shall be applicable to an Air Operator that produces annual CO_2 emissions greater than 10 000 tonnes from the use of an aeroplane(s) with a maximum certificated take-off mass greater than 5 700 kg conducting international flights, as defined in 16.4.3.1(b), on or after 1 January 2019, with the exception of humanitarian, medical and firefighting flights.

Recommendation.— *When considering whether a flight is international or domestic, an aeroplane operator anda State should use, for the purpose of this Volume, Doc 7910* — Location Indicators, *which contains a list of aerodromes and the State they are attributed to. Further guidance material is also provided in the* Environmental Technical Manual *(Doc 9501), Volume IV* – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(b) When considering whether a flight is international or domestic, an Air Operator and a State should use, for the purpose of this Volume, Doc 7910 — Location Indicators, which contains a list of aerodromes and the State they are attributed to.

Note- Further guidance material is also provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(c) The provisions of this subpart shall not be applicable to international flights, as defined in 16.4.3.1(b), preceding or following a humanitarian, medical or firefighting flight provided such flights were conducted with the same aeroplane, and were required to accomplish the related humanitarian, medical or firefighting activities or to reposition thereafter the aeroplane for its next activity. The aeroplane operator shall provide supporting evidence of such activities to the verification body or, upon request, to the State.

(d) The Standards and Recommended Practices of this Chapter shall be applicable to a new entrant air operator from the year after it meets the requirements in (a) and (b) above.

Recommendation.— If the air operator is close to the threshold of annual CO2emissions, as defined in (a) and (b) above, from international flights, as defined in 16.4.3.1(b), it should consider engaging with the State to which it is attributed for guidance. Likewise, the State should carry out oversight of the air operators attributed to it, and engage with any that it considers may be close to or above the threshold. The air operator with annual CO_2 emissions below the threshold may choose to voluntarily engage with the State to which it is attributed.

Note.— See Attachment B Figure B-1 for a process flowchart on the determination of the applicability of Chapter 2 to international flights, as defined in 16.4.3.1(b).

16.4.4.2 Monitoring Of CO_2 Emissions

(a) Eligibility Of Monitoring Methods

(1) The air operator shall monitor and record its fuel use from international flights, as defined in 16.4.3.1(b) and 16.4.4.1, in accordance with an eligible monitoring method as defined in 16.4.4.2 (a)(2) and 16.4.4.2 (a)(3), and approved by the State to which it is attributed. Following approval of the Emissions Mon**itori**ng Plan, the air operator shall use the same eligible monitoring method for the entire compliance period.

(2) **2019-2020 Period**

(i) The Air Operator with annual CO_2 emissions from international flights, as defined in 16.4.3.1(b), and 16.4.4.1, greater than or equal to 500 000 tonnes shall use a Fuel Use Monitoring Method as described in IS 16.4.4.2.

(ii) The Air Operator with annual CO_2 emissions from international flights, as defined in 16.4.3.1(b), and 16.4.4.1of less than 500 000 tonnes shall use either a Fuel Use Monitoring Method or the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT), as described in Appendices 2 and 3 respectively.

(iii) If the aeroplane operator's annual CO_2 emissions from international flights, as defined in 16.4.3.1(b), and 16.4.4.1, increases above the threshold of 500 000 tonnes in 2019, the State shall permit, at its discretion, the Air Operator to continue to use the monitoring method chosen in accordance with (2) during 2020.

Recommendation.— The air operator should use the same monitoring method during the 2019-2020 period that it expects to use during the 2021-2023 period, taking into account its expected annual CO_2 emissions during the 2021-2023 period. If the air operator needs to change monitoring method, it will submit a

revised Emissions Monitoring Plan by 30 September 2020 in order to implement the new monitoring method from 1 January 2021.

(iv) If the air operator does not have an approved Emissions Monitoring Plan as of 1 January 2019, it shall monitor and record its CO_2 emissions in accordance with the eligible monitoring method outlined in the Emissions Monitoring Plan that it will submit, or has submitted, to the State to which it is attributed.

(v) If the air operator's Emissions Monitoring Plan, as defined in 16.4.4.2(b) is determined to be incomplete and/or inconsistent with the eligible Fuel Use Monitoring Method in IS 16.4.4.2, then the State to which the air operator is attributed shall, at its discretion, approve a different eligible Fuel Use Monitoring Method within the Emissions Monitoring Plan for a period lasting no later than 30 June 2019.

(vi) If the air operator does not have sufficient information to use a Fuel Use Monitoring Method, as defined in IS 16.4.4.2, the State to which the air operator is attributed shall, at its discretion, approve the use of the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) for a period lasting no later than 30 June 2019.

Note.— See Attachment B Figure B-2 for a process flowchart on the eligibility of Fuel Use Monitoring Methods during the 2019-2020 period.

(3) **2021-2035 Period**

(A) The aeroplane operator, with annual CO_2 emissions from international flights subject to offsetting requirements, as defined in 16.4.3.1(b) and 16.4.5.1, of greater than or equal to 50 000 tonnes, shall use a Fuel Use Monitoring Method as described in IS 16.4.4.2 for these flights. For international flights, as defined in 16.4.3.1(b), and 16.4.4.1, not subject to offsetting requirements, as defined in 3.1, the aeroplane operator shall use either a Fuel Use Monitoring Method, as described in IS 16.4.4.2, or the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT), as described in IS 16.4.4.2(a)(3)(i).

(B) The air operator, with annual CO_2 emissions from international flights subject to offsetting requirements, as defined in 16.4.3.1(b) and 16.4.5.1, of less than 50 000 tonnes, shall use either a Fuel Use Monitoring Method or the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) as described in Appendices 2 and 3 respectively.

(C) If the air operator's annual CO_2 emissions from international flights subject to offsetting requirements, as defined in 16.4.3.1(b) and 3.1, increases above the threshold of 50 000 tonnes in a given year (y), and also in year (y+1), the air operator shall submit an updated Emissions Monitoring Plan by 30 September of year (y+2). The air operator shall change to a Fuel Use Monitoring Method, as described in IS 16.4.4.2, on 1 January of year (y+3).

(D) If the air operator's annual CO_2 emissions from international flights subject to offsetting requirements, as defined in 16.4.3.1(b) and 16.4.5.1, decreases below the threshold of 50 000 tonnes in a given year (y), and also in year

(y+1), the air operator may change monitoring method on 1 January of year (y+3). If the air operator chooses to change its monitoring method, it shall submit an updated Emissions Monitoring Plan by 30 September of year (y+2).

Note.— See Attachment B Figure B-3 for a process flowchart on the eligibility of Fuel Use Monitoring Methods during the 2021-2035 compliance periods.

(b) Emissions Monitoring Plan

(1) The air operator shall submit an Emissions Monitoring Plan to the State to which it is attributed for approval by the State in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV. The Emissions Monitoring Plan shall contain the information as defined in IS 16.4.4.2(b).

(2) A new entrant air operator shall submit an Emissions Monitoring Plan to the State to which it is attributed within three months of falling within the scope of applicability as defined in 16.4.4.1.

(3) The air operator shall resubmit the Emissions Monitoring Plan to the State to which it is attributed for approval if a material change is made to the information contained within the Emissions Monitoring Plan (i.e., a change to the information presented in the plan that would affect the status or eligibility of the air operator for an option under the emissions monitoring requirements, or that would otherwise affect the decision by the State to which the air operator is attributed with regard to whether the air operator's approach to monitoring conforms with the requirements).

(4) The air operator shall also inform the State to which it is attributed of changes that would affect the State's oversight (e.g., change in corporate name or address), even if the changes do not fall within the definition of a material change.

(5) If the air operator's Emissions Monitoring Plan is determined to be incomplete and/or inconsistent with the Emissions Monitoring Plan requirements in IS 16.4.4.2(b), the State to which it is attributed shall engage with the air operator to resolve outstanding issues. This may involve returning the Emissions Monitoring Plan to the air operator along with an explanation as to why the plan was found deficient, or a request for further information.

Note.— Further guidance material on the Emissions Monitoring Plan and material changes is provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(c) Calculation of CO_2 emissions from aeroplane fuel use

(1) The air operator shall apply a fuel density value to calculate fuel mass where the amount of fuel uplift is determined in units of volume.

(2) The air operator shall record the fuel density (which may be an actual or a standard value of 0.8 kg per litre) that is used for operational and safety reasons (e.g., in an operational, flight or technical log). The procedure for informing the use of actual or standard density shall be detailed in the Emissions Monitoring Plan along with a reference to the relevant air operator documentation.

Note.— Further guidance material on fuel density is provided in the Environmental Technical Manual (Doc 9501), Volume IV — Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(3) The air operator using a Fuel Use Monitoring Method, as defined in IS 16.4.4.2, shall determine the CO_2 emissions from international flights, as defined in 16.4.3.1(b) and 16.4.4.1, using the following equation:

$$CO_2 = \sum_f M_f * FCF_f$$

Where:

CO_2	=	CO_2 emissions (in tonnes);
M_f	=	Mass of fuel f used (in tonnes); and
FCF_f	=	Fuel conversion factor of given fuel f, equal to 3.16 (in kg CO_2/kg fuel) for Jet-A fuel / Jet-A1 fuel and 3.10 (in kg CO_2/kg fuel) for AvGas or Jet-B fuel.

Note.— For the purpose of calculating CO_2 emissions the mass of fuel used includes all aviation fuels.

(d) Monitoring of CORSIA eligible fuels claims

(4) The air operator that intends to claim for emissions reductions from the use of CORSIA eligible fuels shall use a CORSIA eligible fuel that meets the CORSIA Sustainability Criteria as defined within the ICAO document entitled "CORSIA Sustainability Criteria for CORSIA Eligible Fuels" that is available on the ICAO CORSIA website.

(5) The air operator that intends to claim for emissions reductions from the use of CORSIA eligible fuels shall only use CORSIA eligible fuels from fuel producers that are certified by an approved Sustainability Certification Scheme included in the ICAO document entitled "CORSIA Approved Sustainability Certification Schemes", that is available on the ICAO CORSIA website. Such certification schemes meet the requirements included in the ICAO document entitled "CORSIA Eligibility Framework and Requirements for Sustainability Certification Schemes", that is available on the ICAO CORSIA website.

(6) If the air operator cannot demonstrate the compliance of the CORSIA eligible fuel with the CORSIA Sustainability Criteria, then it shall not be accounted for as CORSIA eligible fuel.

Note 1.— The provisions of this Chapter consider that aviation fuel supply chains are not segregated at aerodromes, and that CORSIA eligible fuels will be typically co-mingled at various points in the fuel supply infrastructure (e.g., pipelines, storage terminals, aerodrome fuel storage systems). The CORSIA eligible fuels purchased by a particular air operator may not be physically used in its aeroplane, and it will not be feasible to determine the specific CORSIA eligible fuel content at the point of uplift in an aeroplane. Claims of emissions reductions from the use of CORSIA eligible fuels

by an air operator are based on mass of CORSIA eligible fuels according to purchasing and blending records.

Note 2.— The emissions reductions from the use of a CORSIA eligible fuel are calculated as indicated in 16.4.5, 16.4.5.3 in the context of the calculation of the CO_2 offsetting requirements in 16.4.5. These calculations use the approved life cycle emissions value (LSf) for the CORSIA eligible fuel. Information on emissions reductions from using CORSIA eligible fuel is included in the aeroplane operator's Emissions Report (Field 12 of Table A5-1 in IS 16.4.4.3), in accordance with 16.4.4.3 (a) and 16.4.4.3(c).

16.4.4.3 **Reporting of CO_2 emissions**

(a) Air Operator reporting

(1) The air operator shall submit to the State to which it is attributed a copy of the verified Emissions Report for approval by the State and a copy of the associated Verification Report in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV.

(2) The State shall decide on the level of aggregation (i.e., State pair or aerodrome pair) for which an aeroplane operator attributed to it shall report the number of international flights, as defined in 1.1.2 (i.e., Table A5 -1 Field 7) and CO_2 emissions (i.e., Table A5-1 Field 8). The State shall inform an air operator attributed to it whether Field 7 and 8 in the Emissions Report shall be reported at the level of State pair or aerodrome pair during the approval process for the Emissions Monitoring Plan.

(3) The Emissions Report shall contain the information as defined in IS 16.4.4.3 Table A5-1. An air operator that uses the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) is not required to report Field 5.

Recommendation.— *The air operator should use the standardized Emissions Report template provided in Appendix 1 OF ICAO Annex 16, Volume IV of the* Environmental Technical Manual *(Doc 9501), Volume IV* – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*, or a template approved by the State to which it is attributed, for submission of information to the State to which it is attributed.*

(4) When the air operator reports its consolidated CO_2 emissions from international flights, as defined in 16.4.3.1(b) and 16.4.4.1, during the 2019-2020 period, including subsidiary air operators, disaggregated data relating to each subsidiary air operator shall be appended to the main Emissions Report.

(5) In specific circumstances where the air operator operates a very limited number of State pairs that are subject to offsetting requirements, and/or a very limited number of State pairs that are not subject to offsetting requirements, it may request in writing to the State to which it is attributed that such data not be published at the air operator level, as defined in IS 16.4.4.3, 16.4.5.2, explaining the reasons why disclosure would harm its commercial interests. Based on this request, the State shall determine whether this data is confidential.

Note.— In the application of 16.4.4.3(a)(5) and/or 16.4.4.3(a)(6), the annual CO_2 emissions of an air operator on a given State pair are considered as commercially

sensitive if they are determined using a Fuel Use Monitoring Method as described in IS 16.4.4.2.

(6) In specific circumstances where aggregated State pair data may be attributed to an identified air operator as a result of a very limited number of air operators conducting flights on a State pair, that air operator may request in writing to its State that such data not be published at State pair level, explaining the reasons why disclosure would harm their commercial interests. Based on this request, the State shall determine whether this data is confidential.

(b) State reporting

(1) The Authority shall calculate and inform each of the aeroplane operators that are attributed to it of their average total annual CO_2 emissions during the 2019 and 2020 period, in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV.

(2) The Authority shall submit a report to ICAO in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV. This report shall contain the information as defined in IS 16.4.4.3, Tables A5-4, A5-5 and A5-6, when applicable.

(3) The Authority shall inform ICAO of any reported data deemed confidential in accordance with 16.4.4.3(a)(5) and 16.4.4.3(a)(6),

(4) All air operator data which is deemed confidential in accordance with 16.4.4.3(a)(5) and 16.4.4.3(a)(6), shall be aggregated without attribution to the specific air operator, and included within the ICAO document entitled "CORSIA Central Registry (CCR): Information and Data for Transparency" that is available on the ICAO CORSIA website.

(c) Reporting of CORSIA eligible fuels

(1) The air operator shall subtract CORSIA eligible fuels traded or sold to a third party from its total reported quantity of CORSIA eligible fuels.

(2) The air operator shall provide a declaration of all other GHG schemes it participates in where the emissions reductions from the use of CORSIA eligible fuels may be claimed, and a declaration that it has not made claims for the same batches of CORSIA eligible fuel under these other schemes.

(3) To claim emissions reductions from the use of CORSIA eligible fuels in the Emissions Report, the air operator shall provide the information as described in IS 16.4.4.3 Table A5-2 within a given compliance period for all CORSIA eligible fuel received by a blender by the end of that compliance period. The information provided is through to the blend point, and includes information received from both the neat (unblended) fuel producer and the fuel blender.

Recommendation.— *The air operator should make CORSIA eligible fuel claims on an annual basis in order to ensure all documentation is dealt with in a timely manner. However, the air operator has the option to decide when to make a CORSIA eligible fuel claim within a given compliance period for all CORSIA eligible fuel received by a blender within that compliance period. For blending that occurs in the second half of the final year of a compliance period, the air operator and the State to which it is attributed should determine what, if any, flexibility is needed in terms of submitting reports.*

(5) If the air operator purchases fuel from a supplier downstream from the fuel blender (e.g., from a distributor, another air operator, or an aerodrome-based fuel distributor), this fuel supplier shall provide all of the requisite documentation in order for the emissions reductions from the use of CORSIA eligible fuels to be claimed by the air operator in accordance with 16.4.5.

(d) Verification of CO_2 emissions

(1) Annual verification of an air operator's Emissions Report

(i) The air operator shall engage a verification body for the verification of its annual Emissions Report.

Note.— The verification body is one of the verification bodies included in the list of verification bodies accredited in States, included within the ICAO document entitled "CORSIA Central Registry (CCR): Information and Data for Transparency" that is available on the ICAO CORSIA website.

Recommendation.— *The air operator should perform an internal pre-verification of its Emissions Report prior to the verification by a verification body.*

Note.— Further guidance material on internal pre-verification is provided in the Environmental Technical Manual (Doc 9501), Volume IV — Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(ii) A verification body shall conduct the verification according to ISO 14064-3:2006 [1] , and the relevant requirements in Appendix 6 Section 3.

(iii) Following the verification of the Emissions Report by the verification body, the air operator and the verification body shall both independently submit, upon authorization by the air operator, a copy of the Emissions Report and associated Verification Report to the State to which the air operator is attributed, in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV.

(iv) The State shall perform an order of magnitude check of the Emissions Report in accordance with the timeline, as defined in Appendix 1 OF ICAO Annex 16, Volume IV.

Note.— Further guidance material on the order of magnitude check is provided in the Environmental Technical Manual (Doc 9501), Volume IV — Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(v) To facilitate order of magnitude checks and ensure the completeness of reported data, and where necessary to support the implementation of the requirements in this Volume, the State shall share, upon agreement with another State, specific data and information contained in the air operator's Emissions Report for air operators performing flights to and from the requesting State.

Note.— Such data and information could include air operator's name, reporting year, number of international flights, as defined in 16.4.3.1(b), per aerodrome pair or State pair and aeroplane and emissions data.

(vi) The State shall inform concerned air operators on the requests for data sharing. In the absence of an agreement between the two States, this information shall not be disclosed to third parties.

ISO 14064-3:2006 entitled "Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions.

Recommendation.— *The State should share, upon a justified request from another State, data on air operators which are attributed to it, where the request relates to the correct attribution of flights to air operators. This includes leased aeroplanes where there is a risk of incorrect attribution of flights due to the complexity of leasing and Parent/Subsidiary arrangements between air operators. In addition, States should support each other and provide flight information (e.g., from ATM systems), especially in cases where the flight is between two States which does not include the State to which the air operator is attributed. Such data includes origin and destination aerodromes, flight date and time, aircraft type.*

Note.— As an example of leasing complexities, Operator A may lease its aeroplane to Operator B, with both operators using the same aeroplane during the year but Operator B not operating to the State making the request for information. The State regulating Operator A may want to confirm that the leased aeroplane is identified in the Emissions Report from Operator B to be confident that Operator A has not under reported.

(vii) The State shall provide the name of the verification body used to verify each Emissions Report upon a request for information disclosure.

Recommendation.— *The State should inform concerned air operators of any request for information disclosure*

(2) Verification body and national accreditation body

(i) A verification body shall be accredited to ISO 14065:2013 [2] and the relevant requirements in Appendix 6 Section 2 by a national accreditation body, in order to be eligible to verify the Emissions Report of the air operator.

Note.— An aeroplane operator may engage a verification body accredited in another State, subject to rules and regulations affecting the provision of verification services in the State to which the aeroplane operator is attributed.

(ii) A national accreditation body shall be working in accordance with ISO/IEC 17011[3].

(3) Verification of CORSIA eligible fuels

(i) Fuel purchases, transaction reports, fuel blending records and sustainability credentials shall constitute the documentary proof for the purpose of verification and approval of emissions reductions from the use of CORSIA eligible fuels.

(ii) The air operator shall ensure that it, or its designated representative, has audit rights of the production records for the CORSIA eligible fuels that it purchases.

---

2. ISO 14065:2013 entitled "Greenhouse gases — Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition, Document published on: 2013-04."
3. ISO/IEC 17011:2004 entitled "Conformity assessment – General requirements for accreditation bodies accrediting conformity assessment bodies".

Recommendation.— *When an audit provision is triggered, and an audit of the fuel producer is undertaken, the air operator should share the results of the audit with the fuel producer so that the producer may then make it available to other air operators seeking assurance on the fuel producer's internal processes for the purpose of this Volume.*

Note.— The quality control assurances of CORSIA eligible fuel producers include declarations and/or process certifications, with periodic audits by verifiers, purchasers, or trusted entities. The process certifications, including the sustainability credentials, provide assurance that the CORSIA eligible fuel producer has established business processes to prevent double counting, and the periodic audits verify that the producer is following their established procedures. Purchasers and States may elect to independently audit the production records of the CORSIA eligible fuel producer in order to provide further assurance.

Recommendation.— *In order to ensure this capability exists, CORSIA eligible fuel procurement controls should seek to enable audit rights for fuel purchasers, air operators, or their designated representatives.*

(e) Data gaps

Note 1.— Data gaps occur when an air operator is missing data relevant for the determination of its fuel use for one or more international flights in accordance with 16.4.4.2(a)(1). Gaps in emissions- related data can occur due to various reasons, including irregular operations, data feed issues or critical system failures. Procedures to prevent data gaps are to be detailed in the Emissions Monitoring Plan of the air operator in accordance with IS 16.4.4.2(b)*, 16.4.4.3(d)(1). When data gaps are identified by the verification body, it may be unable to obtain sufficient evidence to determine compliance with the requirements, which for severe data gaps, could result in the verification body concluding that the Emissions Report is unsatisfactory. A data gap could also be identified by the State in its review of the verified Emissions Report.*

Note 2.— Guidance material on data gaps is provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

(1) Aeroplane operator

(i) The air operator using a Fuel Use Monitoring Method, as described in IS 16.4.4.2, shall fill data gaps using the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT), as described in IS 16.4.4.2(a)(3)(i), provided that the data gaps during a compliance period do not exceed the following thresholds:

(A) 2019-2020 period: 5 per cent of international flights, as defined in 1.1.2 and 2.1;

(B) 2021-2035 period: 5 per cent of international flights subject to offsetting requirements, as defined in 16.4.3.1(b) and 16.4.5.1.

(ii) The air operator shall correct issues identified with the data and information management system in a timely manner to mitigate ongoing data gaps and system weaknesses.

(iii) If the aeroplane operator realizes it has data gaps and system weaknesses that exceed the threshold in 16.4.4.3(e)(1)(i), then it shall engage with the State to take remedial action to address this.

(iv) When the threshold is exceeded, the aeroplane operator shall state the percentage of international flights, as defined in 16.4.3.1(b) and 16.4.4.1 for the 2019-2020 period, or flights subject to offsetting requirements, as defined in 16.4.5.1for the 2021-2035 period, that had data gaps, and provide an explanation to the State to which it is attributed in their annual Emissions Report.

(v) The air operator shall fill all data gaps and correct systematic errors and misstatements prior to the submission of the Emissions Report.

(2) State

(i) If the air operator does not provide its annual Emissions Report in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV, then the State to which it is attributed shall engage with the aeroplane operator to obtain the necessary information. If this proves unsuccessful, then the State shall estimate the air operator's annual emissions using the best available information and tools, such as the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) as described in IS 16.4.4.2(a)(3)(i).

(ii) If the State does not provide its annual aggregated Emissions Report to ICAO in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV, then the data provided by ICAO shall be used to fill these gaps and calculate the total sectoral CO_2 emissions in a given year and the Sectoral Growth Factor, as defined in 16.4.5.

(f) Error correction to Emissions Reports

(1) If an error in the air operator's reported emissions is identified by the State, the verification body, or the aeroplane operator after the reported CO_2 emissions have been submitted to ICAO in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV, the State shall update the reported CO_2 emissions to address the error. The State shall assess any implications with respect to the air operator's offsetting requirements in previous years and, if necessary, make an adjustment to compensate for the error during the compliance period in which the error has been identified.

(2) The State shall report an error in the aeroplane operator's CO_2 emissions and the follow-up result of the related adjustment to ICAO.

Note.— No adjustments will be made to the total sectoral CO_2 emissions or the Sector's Growth Factor (SGF), as defined in 16.4.5, as a result of error correction to Emissions Reports.

16.4.5 CO_2 OFFSETTING REQUIREMENTS FROM INTERNATIONAL FLIGHTS AND EMISSIONS REDUCTIONS FROM THE USE OF CORSIA ELIGIBLE FUELS

16.4.5.1 Applicability of CO_2 offsetting requirements

(a) From 1 January 2021 to 31 December 2035, the offsetting requirements of this subpart shall be applicable to an air operator with international flights, as defined in 16.4.3.1(b) and 16.4.4.1, between States as defined in the ICAO document entitled "CORSIA States for subpart 16.4.5 State Pairs" that is available on the ICAO CORSIA website.

(b) The provisions of this subpart shall not be applicable to a new entrant air operator for three years starting in the year when it meets the requirements in 16.4.4.1(a) and 16.4.4.1(b), or until its annual CO_2 emissions exceed 0.1 per cent of total CO_2 emissions from international flights, as defined in 16.4.3.1(b) and 16.4.4.1, in 2020, whichever occurs earlier. The Standards of this subpart shall then be applicable in the subsequent year. The Authority shall use the information on the total CO_2 emissions in 2020 from the ICAO document entitled "CORSIA 2020 Emissions" that is available on the ICAO CORSIA website. This information will be produced in accordance with the timeline described in Appendix 1 OF ICAO Annex 16, Volume IV.

(c) The State shall notify ICAO of their decision to voluntarily participate, or to discontinue the voluntary participation in CORSIA, for the purpose of the inclusion of the State in the ICAO document entitled "CORSIA States for subpart 16.4.5 State Pairs", according to the timeline described in Appendix 1 OF ICAO Annex 16, Volume IV.

Note.— The ICAO document entitled "CORSIA States for subpart 16.4.5 State Pairs" that is available on the ICAO CORSIA website includes:

- *States that have volunteered to participate during the compliance periods from 1 January 2021 to 31 December 2026;*
- *States, with the exception of Least Developed Countries (LDCs), Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs), which meet the following criteria during the compliance periods from1 January 2027 to 31 December 2035:*
  - ✓ *an individual share of international aviation activities in RTKs in the year 2018 above 0.5 per cent of total RTKs; or*
  - ✓ *whose cumulative share in the list of States from the highest to the lowest amount of RTKs reaches 90 per cent of total RTKs in the year 2018.*
- *States which are not within the applicability scope of (b), but which have volunteered to participate.*

(d) The State shall calculate the annual aeroplane operator's final CO_2 offsetting requirements based on the data reported in accordance with 16.4.4, the applicability requirements in 16.4.5.1, and the application of 16.4.5.2, 16.4.5.3 and 16.4.5.4 where applicable.

16.4.5.2 **CO_2 offsetting requirements**

(a) The State shall calculate, for each of the air operators attributed to it, the amount of CO_2 emissions required to be offset in a given year from 1 January 2021 to 31 December 2023 prior to consideration of the CORSIA eligible fuels, as follows:

$$OR_y = OE * SGF_y$$

where:

OR_y = Aeroplane operator's offsetting requirements in the given year *y*;

OE = Aeroplane operator's CO_2 emissions covered by 16.4.5.1 in the given year *y* or aeroplane operator's CO_2 emissions covered by 16.4.5.1 in 2020, depending upon the option selected by the State which will be applied to all aeroplane operators that have been attributed to it; and

SGF_y= Sector's Growth Factor.

Note 1.— The Sector's Growth Factor applicable for a given year (SGF_y) is provided in the ICAO document entitled "CORSIA Annual Sector's Growth Factor (SGF)" that is available from the ICAO CORSIA website, and is calculated as

$$\frac{(SE_y - SE_{B,y})}{SE_y},$$

where:

SE_y = *Total sectoral CO_2 emissions covered by 16.4.5.1 in the given year y and*

$SE_{B,y}$ = *Average total annual sectoral CO_2 emissions during 2019 and 2020 covered by 16.4.5.1 in the given year y.*

Note 2.— Sectoral emissions in a given year (SE_y) do not include the CO_2 emissions from new entrants during their exception period, as defined in 16.4.5.1(b).

Note 3.— As the States which form the "CORSIA States for this subpart State Pairs", as defined by 16.4.5.1, change over time, the average total annual sectoral CO_2 emissions during 2019 and 2020 covered by these State pairs in the given year y ($SE_{B,y}$) will be recalculated.

(b) The State shall calculate, for each of the aeroplane operators attributed to it, the amount of CO_2 emissions required to be offset in a given year from 1 January 2024 to 31 December 2035 prior to consideration of the CORSIA eligible fuels, every year as follows:

$$OR_y = \%S_y * (OE_y * SGF_y) + \%O_y * (OE_y * OGF_y)$$

Where:

OR_y= Aeroplane operator's offsetting requirements in the given year *y*;

OE_y= Aeroplane operator's CO_2 emissions covered by 16.4.5.1 in the given year *y*;

$\%S_y$= Per cent Sectoral in the given year *y*;

$\%O_y$= Per cent Individual in the given year *y* where $\%O_y$ = (100%- $\%S_y$);

SGF_y= Sector's Growth Factor; and Factor.

Table : Overview of CO_2 offsetting requirements on a sectoral and individual basis

Year of applicability	*$\%S_y$*	*$\%O_y$*
1 January 2024 to 31 December 2029	100%	0%
1 January 2030 to 31 December 2032	(100% - $\%O_y$)	A specified percentage of at least 20%
1 January 2033 to 31 December 2035	(100% - $\%O_y$)	A specified percentage of at least 70%

Note. – The specified percentage (i.e., $\%O_y$) will be determined by the ICAO Assembly in 2028.

(c) The State shall use the Sector Growth Factor applicable for a given year (SGFy) in the ICAO document entitled "CORSIA Annual Sector's Growth Factor (SGF)" that is available from the ICAO CORSIA website. This information will be produced in accordance with the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV.

(d) The State shall calculate, when applicable, the aeroplane operator's Growth Factor for a given year (OGFy) in accordance with the CO_2 emissions from the verified Emissions Reports submitted by aeroplane operators attributed to it, as follows:

$$OGF_y = \frac{(OE_y - OE_{B,y})}{OE_y}$$

Where:

OE_y = Total aeroplane operator's CO_2 emissions covered by 16.4.5.1 in the given year *y*; and

$OE_{B,y}$ = Average total annual aeroplane operator's CO_2 emissions during 2019 and 2020 covered by 3.1 in the given yearly

(e) The State shall, upon calculating the offsetting requirements in a given year (ORy) of each of the aeroplane operators attributed to it, inform the aeroplane operator of its offsetting requirements according to the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV.

16.4.5.3 **Emissions reductions from the use of CORSIA eligible fuels**

(a) The aeroplane operator that intends to claim for emissions reductions from the use of CORSIA eligible fuels in a given year shall compute emissions reductions as follows:

$$ER_y = FCF * \left[\sum_f MS_{f,y} * \left(1 - \frac{LS_f}{LC}\right)\right]$$

Where:

ER_y = Emissions reductions from the use of CORSIA eligible fuels in the given year y (in tonnes);

FCF = Fuel conversion factor, equal to 3.16 kg CO_2/kg fuel for Jet-A fuel / Jet-A1 fuel and 3.10 kg CO_2/kg fuel

$MS_{f,y}$ = Total mass of a neat CORSIA eligible fuel claimed in the given year y (in tonnes), as described and reported in Field 12.b in Table A5-1 from IS 16.4.4.3;

LS_f = Life cycle emissions value for a CORSIA eligible fuel (in gCO_2e/MJ); and

LC = Baseline life cycle emissions values for aviation fuel, equal to 89 gCO_2e/MJ for jet fuel and equal to 95 gCO_2e/MJ for AvGas.

Note 1. –The ratio $\left(1 - \frac{LS_f}{LC}\right)$ is also referred to as the emissions reduction factor (ERF_f) of a CORSIA eligible fuel.

Note 2.— For each of the CORSIA eligible fuels claimed, the total mass of the neat CORSIA eligible fuel claimed in the given year y needs to be multiplied by its emissions reduction factor (ERF_f). Then the quantities are summed for all CORSIA eligible fuels.

(b) If a Default Life Cycle Emissions value is used, then the aeroplane operator shall use the ICAO document entitled “CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels” that is available on the ICAO CORSIA website for the calculation in (a) above.

(c) If an Actual Life Cycle Emissions value is used, then an approved Sustainability Certification Scheme shall ensure that the methodology, as defined in the ICAO document entitled “CORSIA Methodology for Calculating Actual Life Cycle Emissions Values” that is available on the ICAO CORSIA website, has been applied correctly.

16.4.5.4 **Total final CO_2 offsetting requirements for a given compliance period with emissions reductions from the use of CORSIA eligible fuels**

(a) The amount of CO2 emissions required to be offset by the aeroplane operator, after taking into account emissions reductions from the use of CORSIA eligible fuels in a given compliance period from 1 January 2021 to 31 December 2035, shall be calculated by the State as follows:

$$FOR_c = (OR_{1,c} + OR_{2,c} + OR_{3,c}) - (ER_{1,c} + ER_{2,c} + ER_{3,c})$$

Where:

FOR_c= Aeroplane operator's total final offsetting requirements in the given compliance period *c*;

$OR_{y,c}$= Aeroplane operator's offsetting requirements in the given year y (where y = 1, 2 or 3) of the compliance period *c*; and

$ER_{y,c}$= Emissions reductions from the use of CORSIA eligible fuels in the given year y (where y = 1, 2 or 3) of the compliance period *c*.

(b) If the aeroplane operator's total final offsetting requirements during a compliance period (i.e., FORc) is negative, then the aeroplane operator has no offsetting requirements for the compliance period. These negative offsetting requirements shall not be carried forward to subsequent compliance periods.

(c) The aeroplane operator's total final offsetting requirements during a compliance period (i.e., FORc) shall be rounded up to the nearest tonne of CO_2.

(d) The State shall, upon calculating the total final offsetting requirements for a given compliance period of each of the aeroplane operators attributed to it, inform the aeroplane operator of its total final offsetting requirements according to the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV.

Note.— Information on CORSIA Eligible Emissions Units, which can be used to meet CO_2 offsetting requirements, are contained in the following subpart.

16.4.6 EMISSIONS UNITS

Note.— An emissions unit represents one metric tonne of carbon dioxide equivalent.

16.4.6.1 **Applicability of emissions units**

(a) The provisions in this subpart shall be applicable to an aeroplane operator who is subject to offsetting requirements in subpart 16.4.5.

16.4.6.2 **Cancelling CORSIA Eligible Emissions Units**

(a) The aeroplane operator shall meet its offsetting requirements according to 16.4.5.4(d), as calculated by the State to which it is attributed, by cancelling CORSIA Eligible Emissions Units in a quantity equal to its total final offsetting requirements for a given compliance period (i.e., FOR_c). The CORSIA Eligible Emissions Units are only those

units described in the ICAO document entitled "CORSIA Eligible Emissions Units", which meet the CORSIA Emissions Unit Eligibility Criteria contained in the ICAO document entitled "CORSIA Emissions Unit Eligibility Criteria". These ICAO documents are available on the ICAO CORSIA website.

Note.— The CORSIA Eligible Emissions Units are determined by the Council, upon recommendation of a technical advisory body established by the Council, and meet the CORSIA Emissions Unit Eligibility Criteria. The CORSIA Emissions Unit Eligibility Criteria are approved and may only be amended by the Council, with the technical contribution of CAEP, taking into account relevant developments in the UNFCCC and the Paris Agreement. The emissions units generated from mechanisms established under the UNFCCC and the Paris Agreement are eligible for use in CORSIA, provided that they align with decisions by the Council with the technical contribution of CAEP, including on avoiding double counting and on eligible vintage and timeframe.

(b) To fulfil the provisions in (a) above, the aeroplane operator shall:

(1) cancel such CORSIA Eligible Emissions Units within a registry designated by a CORSIA Eligible Emissions Unit Programme in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV; and

(2) request each CORSIA Eligible Emissions Unit Programme registry to make visible on the registry's public website, information on each of the aeroplane operator's cancelled CORSIA Eligible Emissions Units for a given compliance period, as defined in Appendix 1 of ICAO Annex 16, Volume IV. Such information for each cancelled CORSIA Eligible Emissions Unit shall include the consolidated identifying information in Field 5 of Table A5-7, except fields 5.j, 5.k and 5.m.

Note.— "Cancel" means the permanent removal and single use of a CORSIA Eligible Emissions Unit within a CORSIA Eligible Emissions Unit Programme designated registry such that the same emissions unit may not be used more than once. This is sometimes also referred to as "retirement", "cancelled", "cancelling" or "cancellation".

16.4.6.3 **Reporting emissions unit cancellation**

(a) The aeroplane operator shall report to the State to which it is attributed, the cancellation of CORSIA Eligible Emissions Units carried out in accordance with 16.4.6.2 to meet its total final offsetting requirements for a given compliance period, by submitting to the State a copy of the verified Emissions Unit Cancellation Report for approval and a copy of the associated Verification Report. The Emissions Unit Cancellation Report shall contain information using the required fields defined in IS 16.4.4.3 Table A5-7 and shall be submitted to the State according to the timeline as defined in Appendix 1 of ICAO Annex 16, Volume IV.

(b) The State shall report to ICAO in accordance with the timeline as defined in Appendix 1 OF ICAO Annex 16, Volume IV. This report shall contain the information as defined in IS 16.4.4.3 Table A5-8, using an ICAO approved form.

Recommendation.— *The State should publish the following information, once submitted to ICAO, for a given compliance period:*

- *Total final offsetting requirements over the compliance period for each aeroplane operators attributed to the State; and*
- *Total quantity of emissions units cancelled over the compliance period by each aeroplane operator to reconcile the total final offsetting requirements, as reported by each aeroplane operator attributed to the State.*

16.4.6.4 **Verification of Emissions Unit Cancellation Report**

(a) Verification of an aeroplane operator's Emissions Unit Cancellation Report

(1) The aeroplane operator shall engage a verification body for the verification of its Emissions Unit Cancellation Report.

Note.— The aeroplane operator may choose to use the same verification body engaged for the verification of its Emissions Report, although it is not obligated to do so.

(2) A verification body shall conduct the verification according to ISO 14064-3:2006 [1] , and the relevant requirements in Appendix 6, Section 3.

(3) If required by the verification body, the aeroplane operator shall provide access to relevant information on the cancellation of emissions units.

(4) Following the verification of the Emissions Unit Cancellation Report by the verification body, the aeroplane operator and the verification body shall both independently submit, upon authorization by the aeroplane operator, a copy of the Emissions Unit Cancellation Report and associated Verification Report to the State to which the aeroplane operator is attributed in accordance with the timeline in Appendix 1 of ICAO Annex 16, Volume IV.

(5) The State shall perform an order of magnitude check of the Emissions Unit Cancellation Report in accordance with the timeline, as defined in Appendix 1 of ICAO Annex 16, Volume IV.

ISO 14064-3:2006 entitled "Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions."

Note.— Further guidance material on the verification of Emissions Unit Cancellation Report is provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

16.4.6.5 **Verification body and national accreditation body**

(a) A verification body shall be accredited to ISO 14065:2013[2] and the relevant requirements in Appendix 6, Section 2 by a national accreditation body, in order to be eligible to verify the Emissions Unit Cancellation Report of an aeroplane operator.

Note.— An aeroplane operator may engage a verification body accredited in another State, subject to rules and regulations affecting the provision of verification services in the State to which the aeroplane operator is attributed.

(b) A national accreditation body shall be working in accordance with ISO/IEC 17011:2004[3].

---

2. ISO 14065:2013 entitled "Greenhouse gases – Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition, Document published on: 2013-04."

3. ISO/IEC 17011:2004 entitled "Conformity assessment – General requirements for accreditation bodies accrediting conformity assessment bodies".

PART 16 VOLUME IV – IMPLEMENTING STANDARDS

IS 16.4.4.2: APPENDIX 2-FUEL USE MONITORING METHODS

1. INTRODUCTION

Note.— The procedures specified in this Appendix are concerned with the monitoring of fuel use by aeroplane operators. The methods proposed are representative of the most accurate established practices.

Any equivalent procedures to those contained in this Appendix shall only be allowed after prior application to and approval by the State.

2. FUEL USE MONITORING METHODS

2.1 The aeroplane operator, with the exception of an aeroplane operator eligible to use the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT), shall choose from the following fuel use monitoring methods:

(a) Method A;

(b) Method B;

(c) Block-off / Block-on;

(d) Fuel Uplift; or

(e) Fuel Allocation with Block Hour.

2.2 **Method A**

Note.— See Attachment C-1 for process diagram for monitoring fuel use by flight using Method A.

2.2.1 The aeroplane operator shall use the following formula to compute fuel use according to Method A:

$$F_N = T_N - T_{N+1} + U_{N+1}$$

where:

F_N = Fuel used for the flight under consideration (=flight $_N$) determined using Method A (in tonnes);

T_N = Amount of fuel contained in aeroplane tanks once fuel uplifts for the flight under consideration (i.e., flight $_N$) are complete (in tonnes);

T_{N+1} = Amount of fuel contained in aeroplane tanks once fuel uplifts for the subsequent flight (i.e., flight $_{N+1}$) are complete (in tonnes); and

U_{N+1} = Sum of fuel uplifts for the subsequent flight (i.e., flight $_{N+1}$) measured in volume and multiplied with a density value (in tonnes).

Note 1.— See 16.4.4.2 (c)(1) for requirements on fuel density values.

Note 2.— Fuel uplift U_{N+1} *is determined by the measurement by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight; see Attachment C-2 for process diagram for collecting the required data to implement Method A.*

Note 3.— For ensuring completeness of the data, it is important to note that not only data generated during the flight under consideration (i.e., flight $_N$) is needed, but also data generated from the subsequent flight (i.e., flight $_{N+1}$). This is of particular importance when a domestic flight is followed by an international flight, as defined in 16.4.3.1(b), or vice versa. In order to avoid data gaps it is therefore recommended that the Block-on fuel or the amount of fuel in the tank after all fuel uplifts for a flight is always recorded on flights of aeroplanes which are used for international flights, as defined in Part II, 16.4.3.1(b),. For the same reasons, fuel uplift data for all flights of those aeroplanes should be collected, before deciding which flights are international.

2.2.2 The aeroplane operator performing on an ad-hoc basis flights attributed to another aeroplane operator shall provide to the latter the fuel measurement values according to the Block-off / Block-on method.

2.2.3 Where no fuel uplift for the flight or subsequent flight takes place, the amount of fuel contained in aeroplane tanks (T_N or T_{N+1}) shall be determined at block-off for the flight or subsequent flight. In exceptional cases the variable T_{N+1} cannot be determined. This is the case when an aeroplane performs activities other than a flight, including undergoing major maintenance involving the emptying of the tanks, after the flight to be monitored. In such case the aeroplane operator may substitute the quantity "T_{N+1} + U_{N+1}" with the amount of fuel remaining in tanks at the start of the subsequent activity of the aeroplane or fuel in tanks at Block-on, as recorded by technical logs.

2.3 **Method B**

Note.— See Attachment C-3 for process diagram for monitoring fuel use by flight using Method B.

2.3.1 The aeroplane operator shall use the following formula to compute fuel use according to Method B:

$$F_N = R_{N-1} - R_N + U_N$$

where:

F_N = Fuel used for the flight under consideration (i.e., flight $_N$) determined using Method B (in tonnes);

R_{N-1} = Amount of fuel remaining in aeroplane tanks at the end of the previous flight (i.e., flight $_{N-1}$) at Block-on before the flight under consideration, (in tonnes);

R_N = Amount of fuel remaining in aeroplane tanks at the end of the flight under consideration (i.e., flight $_N$) at Block-on after the flight, (in tonnes); and

U_N = Fuel uplift for the flight considered measured in volume and multiplied with a density value (in tonnes).

Note 1.— See 16.4.4.2 (c)(1) for requirements on fuel density values.

Note 2.— Fuel uplift is determined by the measurement by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight; see Attachment C-4 for process diagram for collecting the required data to implement Method B.

Note 3.— For ensuring completeness of the data, it is important to note that not only data generated during the flight under consideration (i.e., flight $_N$) is needed, but also data generated from the previous flight (i.e., flight $_{N-1}$). This is in particular important when a domestic flight is followed by an

international, or vice versa. For avoiding data gaps it is therefore recommended that, the amount of fuel remaining in the tank after the flight or the amount of fuel in the tank after fuel uplift is always recorded on flights of aeroplane which are used for international flights, as defined in 16.4.3.1(b) For the same reasons, fuel uplift data for all flights of those aeroplane should be collected, before deciding which flights are international.

2.3.2 The aeroplane operator performing on an ad-hoc basis flights attributed to another aeroplane operator shall provide to the latter the fuel measurement values according to the Block-off / Block-on method.

2.3.3 Where an aeroplane does not perform a flight previous to the flight for which fuel consumption is being monitored (e.g., if the flight follows a major revision or maintenance), the aeroplane operator may substitute the quantity R_{N-1} with the amount of fuel remaining in aeroplane tanks at the end of the previous activity of the aeroplane, as recorded by technical logs.

2.4 **Block-off / Block-on**

Note.— See Attachment C-5 for process diagram for monitoring fuel use by flight using Method Block-off / Block-on, and Attachment C-6 for the process for collecting the required data to implement Method Block-off / Block-on.

2.4.1 The aeroplane operator shall use the following formula to compute fuel use according to the Block-off / Block-on Method:

Where: $F_N \quad T_N - R_N$

F_N = Fuel used for the flight under consideration (=flight $_N$) determined using Block-off / Block-on Method (in tonnes);

T_N = Amount of fuel contained in aeroplane tanks at Block-off for the flight under consideration i.e., flight $_N$ (in tonnes); and

R_N = Amount of fuel remaining in aeroplane tanks at Block-on of the flight under consideration i.e., flight $_N$ (in tonnes);

2.5 **Fuel uplift**

Note.— See Attachment C-7 for process diagram for monitoring fuel use by flight using the Fuel Uplift Method.

2.5.1 For flights with a fuel uplift unless the subsequent flight has no uplift, the aeroplane operator shall use the following formula to compute fuel use according to the Fuel Uplift Method:

$$F_N = U_N$$

where:

F_N = Fuel used for the flight under consideration (i.e., flight $_N$) determined using fuel uplift (in tonnes); and

U_N = Fuel uplift for the flight considered, measured in volume and multiplied with a density value (in tonnes).

Note.— See 16.4.4.2(c)(1) for requirements on fuel density values.

2.5.2 For flight(s) without a fuel uplift (i.e., flight $_{N+1}$, …, flight $_{N+n}$,), the aeroplane operator shall use the following formula to allocate fuel use from the prior fuel uplift (i.e., from flight $_N$) proportionally to block hour:

$$F_N = U_N * \left[\frac{BH_N}{BH_N + BH_{N+1} + \cdots + BH_{N+n}}\right]$$

$$F_{N+1} = U_N * \left[\frac{BH_{N+1}}{BH_N + BH_{N+1} + \cdots + BH_{N+n}}\right]$$

$$\cdots$$

$$F_{N+n} = U_N * \left[\frac{BH_{N+n}}{BH_N + BH_{N+1} + \cdots + BH_{N+n}}\right]$$

where:

F_N = Fuel used for the flight under consideration (i.e., flight $_N$) determined using fuel uplift (in tonnes);

F_{N+1} = Fuel used for the subsequent flight (i.e., flight $_{N+1}$) determined using fuel uplift (in tonnes);

…

F_{N+n} = Fuel used for the follow-on flight (i.e., flight $_{N+n}$) determined using fuel uplift (in tonnes);

U_N = Fuel uplift for the flight under consideration (i.e., flight $_N$) (in tonnes);

BH_N = Block hour for the flight under consideration (i.e., flight $_N$) (in hours);

BH_{N+1} = Block hour for the subsequent flight (i.e., flight $_{N+1}$) (in hours); and

…

BH_{N+n} = Block hour for the follow-on flight (i.e., flight $_{N+n}$) (in hours).

Note.— Fuel uplift is determined by the measurement by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight.

2.6 **Fuel Allocation with Block Hour**

Note.— See Attachment C-8 for process diagram for monitoring fuel use by flight using Fuel Allocation with Block Hour method.

2.6.1 Computation of average fuel burn ratios

2.6.1.1 For an aeroplane operator which can clearly distinguish between international and domestic fuel uplifts, the aeroplane operator shall compute, for each aeroplane type, the average fuel burn ratios by summing up all actual fuel uplifts from international flights, as defined in 16.4.3.1(b), divided by the sum of all actual block hours from international flights for a given year, as defined in 16.4.3.1(b), according to the following formula:

$$AFBR_{AO,AT} = \frac{\sum_N U_{AO,AT,N}}{\sum_N BH_{AO,AT,N}}$$

where:

$AFBR_{AO,AT}$ = Average fuel burn ratios for aeroplane operator (AO) and aeroplane type (AT) (in tonnes per hour);

$U_{AO,AT,N}$ = Fuel uplifted for the international flight $_N$ for aeroplane operator (AO) and aeroplane type (AT) determined using monitoring method Fuel Uplift (in tonnes); and

$BH_{AO,AT,N}$ = Block hour for the international flight $_N$ for aeroplane operator (AO) and aeroplane type (AT) (in hours).

2.6.1.2 For an aeroplane operator which cannot clearly distinguish between international and domestic fuel uplifts, the aeroplane operator shall compute, for each aeroplane type, the average fuel burn ratios by summing up all actual fuel uplifts from international and domestic flights divided by the sum of all actual block hours from these flights for a given year, according to the following formula:

$$AFBR_{AO,AT} = \frac{\sum_N U_{AO,AT,N}}{\sum_N BH_{AO,AT,N}}$$

where:

$AFBR_{AO, AT}$ = Average fuel burn ratios for aeroplane operator (AO) and aeroplane type (AT) (in tonnes per hour);

$U_{AO, AT, N}$ = Fuel uplifted for the international or a domestic flight $_N$ for aeroplane operator (AO) and aeroplane type (AT) measured in volume and multiplied with a specific density value (in tonnes); and

$BH_{AO, AT, N}$ = Block hour for the international and domestic flight $_N$ for aeroplane operator (AO) and aeroplane type (AT) (in hours).

2.6.1.3 An aeroplane operator specific average fuel burn ratios shall be calculated on a yearly basis by using the yearly data from the actual reporting year. The average fuel burn ratios shall be reported, for each aeroplane type, in the aeroplane operator's Emissions Report.

Note 1.— See 16.4.4.2(c)(1) for requirements on fuel density values.

Note 2.— Aeroplane types are contained in Doc 8643 — Aircraft Type Designators.

2.6.2 Computation of fuel use for individual flights

2.6.2.1 The aeroplane operator shall compute the fuel consumption for each international flight by multiplying the aeroplane operator specific average fuel burn ratios with the flight's block hour according to the following formula:

$$F_N = AFBR_{AO, AT} * BH_{AO, AT, N}$$

where:

F_N = Fuel allocated to the international flight under consideration (i.e., flight $_N$) using the Fuel Allocation Block Hour method (in tonnes);

$AFBR_{AO, AT}$ = Average fuel burn ratios for aeroplane operator (AO) and aeroplane type (AT) (in tonnes per hour); and

$BH_{AO, AT, N}$ = Block hour for the international flight under consideration (=flight $_N$) for aeroplane operator (AO) and aeroplane type (AT) (in hours).

Note 1.— Fuel uplift is determined by the measurement by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight.

Note 2.— The Verification Report of the external verification body includes an assessment of the aeroplane operator specific average fuel burn ratio per ICAO aircraft type designator used.

Note 3.— Average fuel burn ratio (AFBR) based on all flights for a reporting year and rounded to at least three decimal places.

2.6.2.2 A verification body shall cross-check whether the emissions reported are reasonable in comparison to other fuel related data of the aeroplane operator.

IS 16.4.4.2(a)(3)(i): APPENDIX 3- CO_2 EMISSIONS ESTIMATION AND REPORTING METHODS AND TOOLS

1. INTRODUCTION

Note 1.— The procedures specified in this Appendix are concerned with the estimation of CO_2 emissions by an aeroplane operator for the purposes of monitoring CO_2 emissions and filling data gaps. The methods and tools proposed are representative of most accurate established practices.

Note 2.— The ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) can be obtained from the ICAO document entitled "ICAO CORSIA CO_2 Estimation and Reporting Tool" for use in a given year. The CERT can be found on the ICAO CORSIA website.

2. ICAO CORSIA CO_2 ESTIMATION AND REPORTING TOOL (CERT)

2.1 Use of the ICAO CORSIA CERT for complying with monitoring and reporting requirements

Note 1. — The ICAO CORSIA CERT is developed for and made available to aeroplane operators to support the monitoring and reporting of their CO 2 emissions. The CERT supports aeroplane operators in fulfilling their monitoring and reporting requirements by populating the standardized Emissions Monitoring Plan and Emissions Report templates provided in Appendix 1 OF ICAO Annex 16, Volume IV of the Environmental Technical Manual *(Doc 9501), Volume IV* – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). *This support includes:*

(a) *assessing its eligibility to use the CERT, as defined in IS 16.4.4.2(a)(3)(i), in support of their Emissions Monitoring Plan (e.g., CO_2 emissions threshold requirements);*

(b) *assessing whether or not it is within the applicability scope of Part II, Chapter 2 MRV requirements; and*

(c) *filling any CO_2 emissions data gaps.*

Note 2.— The ICAO CORSIA CERT is also made available to States to support order of magnitude checks and fill any CO_2 emissions data gaps as described in 16.4.4.4(e)(2)(i).

2.1.1 The aeroplane operator shall use the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) according to the eligibility criteria as described in 16.4.4 and upon approval by the State to which they are attributed.

2.1.2 The aeroplane operator shall use either the (1) Block Time input method or (2) the Great Circle Distance input method to enter the necessary information into the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT).

2.1.3 The aeroplane operator approved to use the Block Time input method shall collect the following data and shall enter it into the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) to estimate its CO_2 emissions during the compliance year:

(a) ICAO aircraft type — model designator;

(b) Origin aerodrome ICAO Designator;

(c) Destination aerodrome ICAO Designator;

(d) Block time (in hours);

(e) Number of flights;

(f) Date (optional); and

(g) Flight ID (optional).

2.1.4 The aeroplane operator approved to use the Great Circle Distance input method shall collect the following data and shall enter it into the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) to estimate its CO_2 emissions during the compliance year:

(a) ICAO aircraft model - type designator;

(b) Origin aerodrome;

(c) Destination aerodrome;

(d) Number of flights;

(e) Date (optional); and

(f) Flight ID (optional).

Note 1.— The ICAO aircraft type — model designators are contained in Doc 8643 — Aircraft Type Designators.

Note 2.— The origin aerodrome and destination aerodrome designators are contained in Doc 7910 — Location Indicators.

Note 3.— The ICAO CORSIA CERT will automatically compute Great Circle Distance based on the origin aerodrome and destination aerodrome.

2.2 Collection of data to develop and maintain the ICAO CO_2 estimation module used within the ICAO CORSIA CERT

2.2.1 ***Recommendation.—*** *States should contribute to improving the ICAO CO_2 estimation module used within the ICAO CORSIA CERT by collecting flight level fuel burn data from aeroplane operators who are willing to share this information. Aeroplane operator data should include:*

(a) *Date and time (in Universal Time Coordinated);*

(b) *ICAO aircraft type — model designator;*

(c) *Origin aerodrome ICAO Designator;*

(d) *Destination aerodrome ICAO Designator;*

(e) *Block hour (in hours to 2 decimal places);*

(f) *Fuel used (in tonnes to at least 1 decimal place) based on a Fuel Use Monitoring Method as described in IS 16.4.4.2;*

(g) *Type of Fuel Use Monitoring Method used;*

(h) *Aircraft maximum certificated take-off mass (in kg); and*

(i) *Flight Great Circle Distance (in km).*

2.2.2 ***Recommendation.—*** *States should share data with ICAO for continuous improvement of the ICAO CO_2 estimation module used within the ICAO CORSIA CERT. If a State shares data, then this will include:*

(a) *Date and time (in Universal Time Coordinated);*

(b) *Generic code to de-identify aeroplane operator information and allow integration of information;*

(c) *ICAO aircraft type — model designator;*

(d) *Flight Great Circle Distance (in km);*

(e) *Block hour (in hours to 2 decimal places);*

(f) *Fuel used (in tonnes to at least 1 decimal place based on a fuel use monitoring method as described in IS 16.4.4.2; and*

(g) *Type of Fuel Use Monitoring Method used.*

2.2.3 States shall anonymize the aeroplane operator data shared with ICAO under 16.4.4.2(b), if data is shared as per 16.4.4.2(b)

IS 16.4.4.4(b)(1): APPENDIX 4. EMISSIONS MONITORING PLANS

1. INTRODUCTION

The Emissions Monitoring Plan of an aeroplane operator shall contain the information listed in Section 2 of this Appendix.

2. CONTENT OF EMISSIONS MONITORING PLANS

Note.— The template of an Emissions Monitoring Plan (from aeroplane operator to State) is provided in Appendix 1 OF ICAO Annex 16, Volume IV of the Environmental Technical Manual *(Doc 9501), Volume IV* – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

2.1 Aeroplane operator identification

2.1.1 Name and address of the aeroplane operator with legal responsibility.
2.1.2 Information for attributing the aeroplane operator to a State:

(a) ***ICAO Designator:*** ICAO Designator(s) used for air traffic control purposes, as listed in Doc 8585 — *Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services*.

(b) ***Air operator certificate:*** If the aeroplane operator does not have an ICAO Designator, then a copy of the air operator certificate.

(c) ***Place of juridical registration:*** If the aeroplane operator does not have an ICAO Designator or an air operator certificate, then the aeroplane operator's place of juridical registration

2.1.3 Details of ownership structure relative to any other aeroplane operators with international flights as defined in 16.4.3.3(b), including identification of whether the aeroplane operator is a parent company to other aeroplane operators with international flights, a subsidiary of another aeroplane operator(s) with international flights, and/or has a parent and or subsidiaries that are aeroplane operators with international flights.

2.1.4 If the aeroplane operator in a parent-subsidiary relationship seeks to be considered a single aeroplane operator for purposes of this Regulation, then confirmation shall be provided that the parent and subsidiary(ies) are attributed to Liberia and that the subsidiary(ies) are wholly-owned by the parent.

2.1.5 Contact information for the person within the aeroplane operator's company who is responsible for the Emissions Monitoring Plan.

2.1.6 Description of the aeroplane operator's activities (e.g. scheduled/non-scheduled, passenger/cargo/executive, and geographic scope of operations).

2.2 Fleet and operations data

2.2.1 List of the aeroplane types and type of fuel (e.g. Jet-A, Jet-A1, Jet-B, AvGas) used in aeroplanes operated for international flights at the time of submission of the Emissions Monitoring Plan, recognizing that there may be changes over time. The list shall include:

(a) Aeroplane types with a maximum certificated take-off mass of 5 700 kg or greater and the number of aeroplane per type, including owned and leased aeroplanes; and

Note 1. — Aeroplane types are contained in Doc 8643 — Aircraft Type Designators.

Note 2. — The aeroplane operator using the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) could use the functionality of the CERT to identify applicable aeroplane types.

(b) Type of fuel(s) used by the aeroplanes (e.g., Jet-A, Jet-A1, Jet-B, AvGas).

Note. — The aeroplane operator using the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) does not need to specify the type of fuel used by aeroplanes.

2.2.2 Information used for attributing international flights to the aeroplane operator:

(a) ***ICAO Designator:*** List of the ICAO Designator(s) used in Item 7 of the aeroplane operator's flight plans.

(b) ***Registration marks:*** If the aeroplane operator does not have an ICAO Designator, then a list of the nationality or common mark, and registration mark of aeroplanes that are explicitly stated in the air operator certificate (or equivalent) and used in Item 7 of the aeroplane operator's flight plans.

2.2.3 Procedures on how changes in the aeroplane fleet and fuel used will be tracked, and subsequently integrated in the Emissions Monitoring Plan.

2.2.4 Procedures on how the specific flights of an aeroplane will be tracked to ensure completeness of monitoring.

2.2.5 Procedures for determining which aeroplane flights meet the definition of international flights, as defined in 16.4.3.1(b) and 16.4.4.4, and are therefore subject to the 16.4.4 requirements.

Note.— The aeroplane operator using the ICAO CORSIA CO2 Estimation and Reporting Tool (CERT) could use the functionality of the CERT to identify international flights, as defined in 16.4.3.1(b), as long as all flights (i.e., domestic and international) conducted during the reporting year are entered as input into the tool.

2.2.6 List of States to where the aeroplane operator operates international flights as defined in 16.4.3.1(b), at the time of initial submission of the Emissions Monitoring Plan.

Note. — The aeroplane operator using the estimation functionality of the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) to assess its eligibility to use the CERT could use the output of the tool (i.e., list of States) as input to the Emissions Monitoring Plan submission.

2.2.7 Procedures for determining which international aeroplane flights are subject to CORSIA offsetting requirements.

Note. — The aeroplane operator using the ICAO CORSIA CO2 Estimation and Reporting Tool (CERT) could use the functionality of the CERT to identify flights subject to offsetting

requirements in a given year of compliance as long as the aeroplane operator uses the correct version (i.e., year of compliance) of the CERT.

2.2.8 Procedures for identifying domestic flights and/or humanitarian, medical or firefighting international flights, as defined in 16.4.3.1(b), that would not be subject to Part II, 16.4.4 requirements.

2.3 Methods and means of calculating emissions from international flights

2.3.1 Methods and means for establishing the average emissions during the 2019-2020 period

2.3.1.1 If the aeroplane operator meets the eligibility criteria in 16.4.4.2 (a)(2)(ii) and chooses to use the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) as described in IS 16.4.4.2(a)(3)(i), then the following information shall be provided:

(a) An estimate of CO_2 emissions for all international flights, as defined in 16.4.3.1(b) and Part II, 16.4.4.1, for 2019 with supporting information on how the estimation was calculated.

(b) The type of input method used in the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT):

- Great Circle Distance input method; or
- Block Time input method.

Note.— Guidance on estimating CO_2 emissions for 2019 is provided in the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

2.3.1.2 If the aeroplane operator meets the eligibility criteria in 16.4.4.2 (a)(2)(i), or chooses to use a Fuel Use Monitoring method as described in IS 16.4.4.2, then the following information shall be provided:

(a) The Fuel Use Monitoring Method that will be used:

- Method A;
- Method B;
- Block-off / Block-on;
- Fuel Uplift; or
- Fuel Allocation with Block Hour.

(b) If different Fuel Use Monitoring Methods are to be used for different aeroplane types, then the aeroplane operator shall specify which method applies to which aeroplane type;

(c) Information on the procedures for determining and recording fuel density values (standard or actual) as used for operational and safety reasons and a reference to the relevant aeroplane operator documentation; and

(d) The systems and procedures to monitor fuel consumption in both owned and leased aeroplane. If the aeroplane operator has chosen the Fuel Allocation with Block Hour method, information shall be provided on the systems and procedures used to establish the average fuel burn ratios as described in IS 16.4.4.2.

2.3.1.3 If the aeroplane operator is in a parent-subsidiary relationship and seeks to be considered as a single aeroplane operator for purposes of this Volume, then it shall provide the procedures that will be used for maintaining records of fuel used and emissions monitored during the 2019-2020 period of the various corporate entities. This shall be used to establish individual average emissions during the 2019-2020 period for the parent and subsidiary (or subsidiaries).

2.3.2 Methods and means for emissions monitoring and compliance on or after 1 January 2021

2.3.2.1 If the aeroplane operator has international flights, as defined in 16.4.3.1(b), but these are not subject to offsetting requirements as defined in 16.4.5.1, then it shall confirm whether it plans to use the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) as described in IS 16.4.4.2(a)(3)(i) or the Fuel Use Monitoring Methods as described in IS 16.4.4.2.

2.3.2.2 If the aeroplane operator meets the eligibility criteria in 16.4.4.2(a)(3)(ii), and it chooses to use the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) as described in IS 16.4.4.2(a)(3)(i), then the following information shall be provided:

(a) An estimate of CO_2 emissions for all international flights, as defined in 16.4.3.1(b), subject to offsetting requirements, as defined in 16.4.5, for the year before the emissions monitoring is to occur (for example, an estimate of such emissions for 2020 for monitoring in 2021), as well as information on how the fuel use and CO_2 estimation was calculated.

(b) The type of input method used in the ICAO CORSIA CO2 Estimation and Reporting Tool (CERT):

- Great Circle Distance input method; or
- Block Time input method.

2.3.2.3 If the aeroplane operator meets the eligibility criteria in 16.4.4.2(a)(3)(i), or chooses to use a Fuel Use Monitoring method as described in IS 16.4.4.2, then the following information shall be provided:

(a) The Fuel Use Monitoring Method that will be used:

- Method A;
- Method B;
- Block-off / Block-on;
- Fuel Uplift; or
- Fuel Allocation with Block Hour.

(b) If different Fuel Use Monitoring Methods are to be used for different aeroplane types, then the aeroplane operator shall specify which method applies to which aeroplane type;

(c) Information on the procedures for determining and recording fuel density values (standard or actual) as used for operational and safety reasons and a reference to the relevant aeroplane operator documentation; and

(d) The systems and procedures to monitor fuel consumption in both owned and leased aeroplane. If the aeroplane operator has chosen the Fuel Allocation with Block Hour method, information shall be provided on the systems and procedures used to establish the average fuel burn ratios as described in IS 16.4.4.2.

2.3.2.4 If the aeroplane operator is using a Fuel Use Monitoring Method, as defined in IS 16.4.4.2, it shall state whether it plans to use the ICAO CORSIA CERT for international flights, as defined in 16.4.3.1(b), that are subject to emissions monitoring but not offsetting requirements. If so, the aeroplane operators shall also state which input method into the ICAO CORSIA CERT is being used (i.e., Great Circle Distance input method, or Block Time input method)

2.4 Data management, data flow and control

2.4.1 The aeroplane operator shall provide the following information:

(a) roles, responsibilities and procedures on data management;

(b) procedures to handle data gaps and erroneous data values, including:

- Secondary data reference sources which would be used as an alternative;
- Alternative method in case the secondary data reference source is not available; and
- For those aeroplane operators using a Fuel Use Monitoring Method, information on systems and procedures for identifying data gaps and for assessing whether the 5 per cent threshold for significant data gaps has been reached.

(c) documentation and record keeping plan;

(d) assessment of the risks associated with the data management processes and means for addressing significant risks;

(e) procedures for making revisions to the Emissions Monitoring Plan and resubmitting relevant portions to the State when there are material changes;

(f) procedures for providing notice in the Emissions Report of non-material changes that require the attention of the State; and

(g) a data flow diagram summarizing the systems used to record and store data associated with the monitoring and reporting of CO_2 emissions.

IS 16.4.4.3: APPENDIX 5-REPORTING

1. INTRODUCTION

Note.— The procedures specified in this Appendix are concerned with the reporting requirements under Part II of this Volume.

1.1 Unless otherwise stated, fuel use and CO_2 emissions shall be reported to the nearest tonne.

2. CONTENT OF EMISSIONS REPORT FROM AEROPLANE OPERATOR TO STATE

Table A5-1. Content of aeroplane operator Emissions Report

Note.— The template of an Emissions Report (from aeroplane operator to State) is provided in Appendix 1 OF ICAO Annex 16, Volume IV of the Environmental Technical Manual *(Doc 9501), Volume IV* – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Field #	*Data Field*	*Details*
Field 1	Aeroplane operator information	1.a Name of aeroplane operator 1.b Detailed contact information of aeroplane operator 1.c Name of a point of contact 1.d Method and identifier used to attribute an aeroplane operator to a State in accordance with 16.4.3.2(c) 1.e State
Field 2	Reference details of aeroplane operator Emissions Monitoring Plan	2. Reference to the Emissions Monitoring Plan that is the basis for emissions monitoring that year *Note.— State may require providing reference to updated Emissions Monitoring Plan, if applicable.*
Field 3	Information to identify the verification body and Verification Report	3.a Name and contact information of the verification body 3.b Verification Report to be a separate report from aeroplane operator's Emissions Report
Field 4	Reporting year	4. Year during which emissions were monitored
Field 5	Type and mass of fuel(s)used	5.a Total fuel mass per type of fuel: • Jet-A (in tonnes) • Jet-A1 (in tonnes) • Jet-B (in tonnes) • AvGas (in tonnes) *Note 1.— Above totals to include CORSIA eligible fuels.* *Note 2.— The aeroplane operator using the ICAO CORSIA CERT, as described in IS 16.4.4.2(a)(3)(i), does not need to report Field 5.*

Field 6	Total number of international flights during the reporting period	6.a Total number of international flights, as defined in 16.4.3.1(b) and 16.4.4.1, during the reporting period *Note.— Total (sum of values from Field 7)*
Field 7	Number of international flights per State pair or aerodrome pair	7.a Number of international flights, as defined 16.4.3.1(b) and 16.4.4.1, per State pair (no rounding); or 7.b Number of international flights, as defined in 16.4.3.1(b) per aerodrome pair (no rounding).
Field 8	CO_2 emissions per aerodrome pair or State pair	8.a CO_2 emissions from international flights, as defined in 16.4.3.1(b) and 16.4.4.1per State pair (in tonnes); or 8.b CO_2 emissions from international flights, as defined in 16.4.3.1(b) and 16.4.4.1per aerodrome pair (in tonnes).
Field 9	Scale of data gaps	9.a Per cent of data gaps (according to criteria defined in 16.4.4.3(e) and rounded to the nearest 0.1%) 9.b Reason for data gaps if per cent of data gaps exceeds the threshold defined in 16.4.4.3(e)
Field 10	Aeroplane information	10.a List of aeroplane types 10.b Aeroplane identifiers used in flight plans' Item 7 during the year for all international flights. Where the identifier is based on an ICAO Designator, only the ICAO Designator is to be reported 10.c Information on leased aeroplanes 10.d Average fuel burn ratio (AFBR) for each aeroplane type under 10.a in line with Doc 8643 — Aircraft Type Designator (in tonnes per hour to 3 decimal places *Note: - 10.d is only required if the aeroplane operator is using the Fuel Allocation with Block Hour method, method, as defined in IS 16.4.4.2*
Field 11	Eligibility for and use of the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) as per 16.4.4.2(a)	11.a Version of the ICAO CORSIA CERT used 11.b Scope of use of the ICAO CORSIA CERT i.e., on all flights or only on the international flights, as defined in 16.4.3.1(b), not subject to offsetting requirements, as defined in 16.4.5
Field 12 *Note.- If emissions reductions from the use of CORSIA eligible fuel are claimed, see Table*	CORSIA eligible fuel claimed	12.a Fuel type (i.e., type of fuel, feedstock and conversion process) 12.b Total mass of the neat CORSIA eligible fuel claimed (in tonnes) per fuel type
	Emissions information (per fuel type)	12.c Approved Life Cycle Emissions values 12.d Emissions reductions claimed from a CORSIA eligible fuel

A5-2 for supplementary information that is to be provided with the aeroplane operator's Emissions Report.	Emissions reductions (total)	12.e Total emissions reductions claimed from the use of all CORSIA eligible fuels (in tonnes) *Note. – During the 2019-2020 period, fields 12.a to 12.e are not required as the applicability of 16.4.5 starts on 1 January 2021 i.e., there are no offsetting requirements and no emissions reductions from the use of CORSIA eligible fuels during the 2019-2020 period*
Field 13	Total CO_2 emissions	13.a Total CO_2 emissions (based on total mass of fuel in tonnes from Field 5 and reported in tonnes) 13.b Total CO_2 emissions from flights subject to offsetting requirements (in tonnes) 13.c Total CO_2 emissions from international flights as defined in 16.4.3.1(b) and 16.4.4.1 and that are not subject to offsetting requirements as defined in 16.4.5.1 (in tonnes) *Note. – During the 2019-2020 period, only fields 13.a is required as the applicability of Part II, Chapter 3 starts on 1 January 2021 i.e., there are no State pairs subject to offsetting requirements during the 2019-2020 period.*

Note.— The State may expand on this list to include additional or more detailed data from aeroplane operators registered in their State.

Table A5-2. Supplementary information to an aeroplane operator's Emissions Report if emissions reductions from the use of each CORSIA eligible fuel being claimed

Note. – The template of a CORSIA eligible fuels supplementary information to the Emissions Report (from aeroplane operator to State) is provided in Appendix 1 of ICAO Annex 16, Volume IV of the Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Field #	*Data Field*	*Details*
Field 1	Purchase date of the neat CORSIA eligible fuel	
Field 2	Identification of the producer of the neat CORSIA eligible fuel	2.a Name of producer of the neat CORSIA eligible fuel 2.b Contact information of the producer of the neat CORSIA eligible fuel
Field 3	Fuel Production	3.a Production date of the neat CORSIA eligible fuel 3.b Production location of the neat CORSIA eligible fuel 3.c Batch number of each batch of

		neat CORSIA eligible fuel 3.d Mass of each batch of neat CORSIA eligible fuel produced
Field 4	Fuel type	4.a Type of fuel (i.e., Jet-A, Jet-A1, Jet-B, AvGas) 4.b Feedstock used to create the neat CORSIA eligible fuel 4.c Conversion process used to create the neat CORSIA eligible fuel
Field 5	Fuel Purchased	5.a Proportion of neat CORSIA eligible fuel batch purchased (rounded to the nearest %) *Note. - If less than an entire batch of CORSIA eligible fuel is purchased.* 5.b Total mass of each batch of neat CORSIA eligible fuel purchased (in tonnes) 5.c Mass of neat CORSIA eligible fuel purchased (in tonnes) *Note. — Field 5.c is equal to the total for all batches of CORSIA eligible fuels reported in Field 5.b.*
Field 6	Evidence that fuel satisfies the CORSIA Sustainability Criteria	
Field 7	Life cycle emissions values of the CORSIA eligible fuel	7.a Default or Actual Life Cycle Emissions Value(LSf) for given CORSIA eligible fuel f, which is equal to the sum of 7.b and 7.c (in gCO2e/MJ rounded to the nearest whole number) 7.b Default or Actual Core Life Cycle Assessment (LCA) value for given CORSIA eligible fuel f (in gCO_2e/MJ rounded to the nearest whole number) 7.c Default Induced Land Use Change (ILUC) value for given CORSIA eligible fuel f (in gCO_2e/MJ rounded to the nearest whole number)
Field 8	Intermediate purchaser	8.a Name of the intermediate purchaser 8.b Contact information of the intermediate purchaser *Note. — This information would be included in the event that the aeroplane operator claiming emissions reductions from the use of CORSIA eligible fuels was not the original purchaser of the fuel from the producer(e.g., the aeroplane*

		operator purchased fuel from a broker or a distributor). In those cases, this information is needed to demonstrate the complete chain of custody from production to blend point.
Field 9	Party responsible for shipping of the neat CORSIA eligible fuel to the fuel blender	9.a Name of party responsible for shipping of the neat CORSIA eligible fuel to the fuel blender 9.b Contact information of party responsible for shipping of the neat CORSIA eligible fuel to the fuel blender
Field 10	Fuel Blender	10.a Name of the party responsible for blending neat CORSIA eligible fuel with aviation fuel 10.b Contact information of the party responsible for blending neat CORSIA eligible fuel with aviation fuel
Field 11	Location where neat CORSIA eligible fuel is blended with aviation fuel	
Field 12	Date the neat CORSIA eligible fuel was received by blender	
Field 13	Mass of neat CORSIA eligible fuel received (in tonnes)	*Note. - This number may differ from the number in Field 5.c in cases where only a portion of a batch or batches are received by the blender (i.e due to sale to intermediate purchaser).*
Field 14	Blend ratio of neat CORSIA eligible fuel and aviation fuel (rounded to the nearest %)	
Field 15	Documentation demonstrating that the batch or batches of neat CORSIA eligible fuel were blended into aviation fuel (e.g., the subsequent Certificate of Analysis of the blended fuel)	
Field 16	Mass of neat CORSIA eligible fuel claimed (in tonnes)	*Note. - This number may differ from the number in Field 5.c in cases where only a portion of a batch or batches are claimed by the aeroplane operator.*

3. CONTENT OF EMISSIONS REPORT FROM STATE TO ICAO

3.1 List of aeroplane operators attributed to the State and verification bodies accredited in a State

Table A5-3. State Report of aeroplane operators attributed to the State and verification bodies accredited in the State

Field #	*Data Field*	*Details*
Field 1	List of aeroplane operators attributed to the State	1.a Name and contact information of aeroplane operator 1.b Aeroplane operator Code 1.c Method and identifier used to attribute aeroplane operator to a State in accordance with 16.4.3.2(c)
Field 2	List of verification bodies accredited in the State (for a given year of compliance)	2.a State 2.b Name of verification body

Note. – Information on the following fields can be found in the ICAO document entitled "CORSIA Central Registry (CCR): Information and Data for Transparency" that is available from the ICAO CORSIA website:

- *List of aeroplane operator attributed to the State; and*
- *List of verification bodies accredited in each Stat*

3.2 Emissions Report from a State to ICAO

Table A5-4. Emissions Report from a State to ICAO for 2019 and 2020

Field #	*Data Field*	*Details*
Field 1	Total annual CO_2 emissions per State pair aggregated for all aeroplane operators attributed to the State (in tonnes)	Note. – Include emissions from CORSIA eligible fuels, calculated using fuel conversion factor(s) from corresponding aviation fuels, in accordance with 16.4.4.2(c)(3).

Table A5-5. Emissions Report from a State to ICAO annually after 2021

Field #	*Data Field*	*Details*
Field 1	Total annual CO_2 emissions on each State pair aggregated for all aeroplane operators attributed to the State	1.a Total annual CO_2 emissions on each State pair subject to offsetting requirements, as defined 16.4.5.1, aggregated for all aeroplane operators attributed to the State (in tonnes) 1.b Total annual CO_2 emissions on each State pair not subject to offsetting requirements, as defined in 16.4.5.1, aggregated for all aeroplane operators attributed to the State (in tonnes)
Field 2	Total annual CO_2 emissions for each aeroplane operator attributed to the State	2.a Total annual CO_2 emissions for each aeroplane operator attributed to the State (in tonnes) 2.b Indicate whether the ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT), as defined in Appendix 3 is used
Field 3	Total aggregated annual CO_2 emissions for all State pairs subject to offsetting requirements, as defined in 16.4.5.1, for each aeroplane operator attributed to the State (in tonnes)	
Field 4	Total aggregated annual CO_2 emissions for all State pairs not subject to offsetting requirements, as defined in 16.4.5.1 for each aeroplane operator attributed tothe State (in tonnes)	

Note 1. – Information on the following fields can be found in the ICAO document entitled "CORSIA Central Registry (CCR): Information and Data for Transparency" that is available from the ICAO CORSIA website:

(a) *Total average CO_2 emissions for 2019 and 2020 aggregated for all aeroplane operators on each State pair;*

(b) *Total annual CO_2 emissions aggregated for all aeroplane operators on each State pair (with identification of State pairs subject to offsetting requirements i.e., 16.4.5 in a given year) (Field 1); and*

(c) *For each aeroplane operator:*

- *Aeroplane operator name;*
- *State in which aeroplane operator is attributed;*
- *Reporting year;*
- *Total annual CO_2 emissions (Field 2);*
- *Total aggregated annual CO_2 emissions for all State pairs subject to offsetting requirements, as defined in 16.4.5.1 (Field 3); and*
- *Total aggregated annual CO_2 emissions for all State pairs not subject to offsetting requirements, as defined in Part II, Chapter 3, 3.1 (Field 4).*

Note 2. – Where CO_2 emissions are based on the ICAO CORSIA CO_2 Estimation and Reporting Tool as described in Appendix 3, this will be indicated.

Note 3. – All data recognized as confidential in accordance with 16.4.4.3(a)(5) will be aggregated and published by ICAO without attribution to a specific aeroplane operator. All data recognized as confidential in accordance with 16.4.4.3(a)(6) will be aggregated and published by ICAO without attribution to specific State pair, but with distinction between State pairs subject to offsetting requirements, as defined in Part II, Chapter 3, 3.1 and those not subject to offsetting requirements.

3.3 Use of CORSIA eligible fuels in a State

Table A5-6: CORSIA eligible fuels supplementary information to the Emissions Report from a State to ICAO

Field #	*Data Field*	*Details*	*Notes*
Field 1	Production	1.a Production year of CORSIA eligible fuel claimed 1.b Producer of CORSIA eligible fuel	
Field 2	Batch of CORSIA eligible fuel	2.a Batch number(s) of each CORSIA eligible fuel claimed 2.b Total mass of each batch of CORSIA eligible fuel claimed (in tonnes)	
Field 3	CORSIA eligible fuel claimed	3.a Fuel types (i.e., type of fuel, feedstock and conversion process)	This would provide a total mass for each fuel type being claimed by all aeroplane operators attributed to the State.
Field 4	Emissions information (per fuel type)	4. Total emissions reductions claimed from the use of a CORSIA eligible fuel (in tonnes)	
Field 5	Emissions reductions (total)	5. Total emissions reductions claimed by all aeroplane operators attributed to the State from the use of all CORSIA eligible fuel use (in tonnes)	

Note. – In order to avoid double claiming of CORSIA eligible fuels, information on the following fields can be found in the ICAO document entitled "CORSIA Central Registry (CCR): Information and Data for Transparency" that is available from the ICAO CORSIA website:

(a) Production year of the CORSIA eligible fuel claimed;

(b) Producer of the CORSIA eligible fuel claimed;

(c) Type of fuel, feedstock and conversion process for each CORSIA eligible fuel claimed;

(d) Batch number(s) of each CORSIA eligible fuel claimed; and

(e) Total mass of each batch of CORSIA eligible fuel claimed.

4. CONTENT OF EMISSIONS UNIT CANCELLATION REPORT FROM AEROPLANE OPERATOR TO STATE

Table A5-7. Emissions Unit Cancellation Report from aeroplane operator to State

Field #	*Data Field*	*Details*
Field 1	Aeroplane operator information	1.a Name of aeroplane operator 1.b Detailed contact information of aeroplane operator 1.c Name of a point of contact 1.d Unique identifier by which an aeroplane operator is attributed to a State, in accordance with 16.4.3.2(c) 1.e State
Field 2	Compliance period years reported	2. Year(s) in the reported compliance period for which offsetting requirements are reconciled in this report
Field 3	Aeroplane operator's total final offsetting requirements	3. Aeroplane operator's total final offsetting requirements (in tonnes), as informed by the State
Field 4	Total quantity of emissions units cancelled	4. Total quantity of emissions units cancelled to reconcile the total final offsetting requirements in Field 3
Field 5	Consolidated identifying information for cancelled emissions units	For each batch of cancelled emissions units (*batch* defined as a contiguous quantity of serialized emissions units), identify the following: 5.a Quantity of emissions units cancelled; 5.b Start of serial numbers;

		5.c End of serial numbers; 5.d Date of cancellation; 5.e Eligible emissions unit programme; 5.f Unit type; 5.g Host country; 5.h Methodology[7]; 5.i Demonstration of unit date eligibility; 5.j Programme-designated registry name; 5.k Unique identifier for registry account to which the batch was cancelled; 5.l Aeroplane operator in whose name the unit was cancelled; and 5.m The unique identifier for the registry account from which the cancellation was initiated.

Note. — The State may expand on this list to include additional or more detailed data from aeroplane operators registered in their State.

5. CONTENT OF EMISSIONS UNIT CANCELLATION REPORT FROM STATE TO ICAO

Table A5-8. Content of Emissions Unit Cancellation Report from State to ICAO

Table A5-8. Content of Emissions Unit Cancellation Report from State to ICAO

Field #	*Data Field*	*Details*
Field 1	Aeroplane operators attributed to the State	1.a Aeroplane operators attributed to the State with offsetting requirements in the reported compliance period
Field 2	Compliance period years reported	2. Year(s) in the reported compliance period for which offsetting requirements are reconciled in the report
Field 3	Total final offsetting requirements	3. Total aggregated aeroplane operators' final offsetting requirements (in tonnes), as informed by the State
Field 4	Total quantity of emissions units cancelled	4. Total aggregated quantity of emissions units cancelled to reconcile the total final offsetting requirements in Field 3

Field 5	Consolidated identifying information for cancelled emissions units	For each batch of cancelled emissions units (*batch* defined as a contiguous quantity of serialized emissions units), identify the following: 5.a Quantity of emissions units cancelled; 5.b Start of serial numbers; 5.c End of serial numbers; 5.d Date of cancellation; 5.e Eligible emissions unit programme; 5.f Unit type; 5.g Host country; 5.h Methodology; 5.i Demonstration of unit date eligibility; and 5.j Programme-designated registry name.

Note 1. — The information in Field 5 will be required for ensuring critical CORSIA registry functions, including ICAO monitoring, periodic review, and statistical analysis of CORSIA.

Note 2. — The information on the following fields can be found in the ICAO document entitled "CORSIA Central Registry (CCR): Information and Data for Transparency" that is available on the ICAO CORSIA website:

(a) *Information at a State and global aggregate level for a specific compliance period:*

(1) Total final offsetting requirements over the compliance period;

(2) Total quantity of emissions units cancelled over the compliance period to reconcile the total final offsetting requirements; and

(3) Consolidated identifying information for cancelled emissions units included in Field 5 of Table A5-8.

IS 16.4.6.4: APPENDIX 6- VERIFICATION

1. INTRODUCTION

Note — The procedures specified in this Appendix are concerned with the verification requirements in Part II of this Volume.

2. VERIFICATION BODY

2.1 The verification body shall be accredited to ISO 14065:2013, and meet the following additional requirements in order to be eligible to verify the Emissions Report, and the Emissions Unit Cancellation Report where applicable, of an aeroplane operator.

Note — The following documents should be used as normative references that provide guidance for the application of this Volume:

(a) *Environmental Technical Manual (Doc 9501), Volume IV – Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA);*

(b) *The International Accreditation Forum (IAF) document entitled, "IAF Mandatory Document for the Application of ISO 14065:2013 (IAF MD 6:2014)"; and*

(c) *The International Organization for Standardization (ISO) document entitled, "ISO 14066:2011 Greenhouse gases – Competence requirements for greenhouse gas validation team and verification teams".*

2.2 Avoidance of conflict of interest (ISO 14065:2013 section 5.4.2)

2.2.1 If the leader of the verification team undertakes six annual verifications for one aeroplane operator, then the leader of the verification team shall take a three consecutive year break from providing verification services to that same aeroplane operator. The six year maximum period includes any greenhouse gas verifications performed for the aeroplane operator prior to it requiring verification services under this Volume.

2.2.2 The verification body, and any part of the same legal entity, shall not be an aeroplane operator, the owner of an aeroplane operator or owned by an aeroplane operator.

2.2.3 The verification body, and any part of the same legal entity, shall not be a body that trades emissions units, the owner of a body that trades emissions units or owned by a body that trades emissions units.

2.2.4 The relationship between the verification body and the aeroplane operator shall not be based on common ownership, common governance, common management or personnel, shared resources, common finances and common contracts or marketing.

2.2.5 The verification body shall not take over any delegated activities from the aeroplane operator with regard to the preparation of the Emissions Monitoring Plan, the

Emissions Report (including monitoring of fuel use and calculation of CO_2 emissions) and the Emissions Unit Cancellation Report.

2.2.6 To enable an assessment of impartiality and independence by the national accreditation body, the verification body shall document how it relates to other parts of the same legal entity.

2.3 Management and personnel (ISO 14065:2013 section 6.1)

2.3.1 The verification body shall establish, implement and document a method for evaluating the competence of the verification team personnel against the competence requirements outlined in ISO 14065:2013, ISO 14066:2011 and paragraphs 2.4, 2.5 and 2.6 of this Appendix.

2.3.2 The verification body shall maintain records to demonstrate the competency of the verification team and personnel in accordance with paragraph 2.4 of this Appendix.

2.4 Competencies of personnel (ISO 14065:2013 section 6.2)

The verification body shall:

(a) identify and select competent team personnel for each engagement;

(b) ensure appropriate verification team composition for the aviation engagement;

(c) ensure the verification team, at a minimum, includes a team leader who is responsible for the engagement planning and management of the team;

(d) ensure continued competence of all personnel conducting verification activities, including continual professional development and training for verifiers to maintain and/or develop competencies; and

(e) conduct regular evaluations of the competence assessment process to ensure that it continues to be relevant for this Volume.

2.5 Validation or verification team knowledge (ISO 14065:2013 section 6.3.2)

2.5.1 The verification team as a whole, and the independent reviewer, shall demonstrate knowledge of:

(a) the requirements as outlined in this Volume, the Assembly Resolution A39-3, the *Environmental Technical Manual* (Doc 9501), Volume IV – *Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*, and any public ICAO explanatory material;

(b) the verification requirements as outlined in this Volume, and *Environmental Technical Manual* (Doc 9501), Volume IV – *Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*, including materiality threshold, verification criteria, verification scope and objectives and the Verification Report preparation and submission requirements;

(c) the eligibility criteria for technical exemptions, scope of applicability, State pair phase-in rules, and State pair coverage as outlined in this Volume and the Assembly Resolution A39-3;

(d) the monitoring requirements as outlined in this Volume; and

(e) the national requirements in addition to the provisions set out in this Volume.

2.5.2 When conducting the verification of an Emissions Unit Cancellation Report, only 2.5.1 (a), (b) and (e) shall be applicable.

2.6 Validation or verification team technical expertise (ISO 14065:2013 section 6.3.3)

2.6.1 The verification team as a whole, and the independent reviewer, shall demonstrate knowledge in the following technical competencies:

(a) general technical processes in the field of civil aviation;

(b) aviation fuels and their characteristics, including CORSIA eligible fuel;

(c) fuel related processes including flight planning and fuel calculation;

(d) relevant aviation sector trends or situations that may impact the CO_2 emissions estimate;

(e) CO_2 emissions quantification methodologies as outlined in this Volume, including assessment of Emissions Monitoring Plans;

(f) fuel use monitoring and measurement devices, and related procedures for monitoring of fuel use related to greenhouse gas emissions, including procedures and practices for operation, maintenance and calibration of such measurement devices;

(g) greenhouse gas information and data management systems and controls, including quality management systems and quality assurance / quality control techniques;

(h) aviation related IT systems such as flight planning software or operational management systems;

(i) knowledge of approved CORSIA Sustainability Certification Schemes relevant for CORSIA eligible fuels under this Volume, including certification scopes; and

(j) basic knowledge of greenhouse gas markets and emissions units programme registries.

2.6.2 Evidence of the above competencies shall include proof of relevant professional experience, complemented by appropriate training and education credentials.

2.6.3 When conducting the verification of an Emissions Report, 2.6.1 (a) to (i) shall be applicable.

2.6.4 When conducting the verification of an Emissions Unit Cancellation Report, only 2.6.1 (g) and (j) shall be applicable.

2.7 Validation or verification team data and information auditing (ISO 14065:2013 section 6.3.4)

2.7.1 The verification team as a whole shall demonstrate detailed knowledge of ISO 14064-3:2006, including demonstrated ability to develop a risk-based verification approach, perform verification procedures including assessing data and information systems and controls, collect sufficient and appropriate evidence and draw conclusions based on that evidence.

2.7.2 Evidence of data and information auditing expertise and competencies shall include previous professional experience in auditing and assurance activities, complemented by appropriate training and education credentials.

2.8 Use of contracted validators and verifiers (ISO 14065:2013 section 6.4)

The verification body shall document roles and responsibilities of the verification personnel, including contracted persons involved in the verification activity.

2.9 Outsourcing (ISO 14065:2013 section 6.6)

2.9.1 The verification body shall not outsource the final decision on the verification and the issuance of the verification statement.

2.9.2 The independent review shall only be outsourced as long as the outsourced service is appropriate, competent, and covered by the accreditation.

2.10 Confidentiality (ISO 14065:2013 section 7.3)

The verification body shall ensure it has the express consent of the aeroplane operator prior to submission of the verified Emissions Report, the Emissions Unit Cancellation Report where applicable, and the Verification Report to the State. The mechanism for authorizing this consent shall be specified in the contract between the verification body and aeroplane operator.

2.11 Records (ISO 14065:2013 section 7.5)

The verification body shall keep records on the verification process for a minimum of ten years, including:

(a) client's Emissions Monitoring Plan, Emissions Report and Emissions Unit Cancellation Report where applicable;

(b) Verification Report and related internal documentation;

(c) identification of team members and criteria for selection of team; and

(d) working papers with data and information reviewed by the team in order to allow for an independent party to assess the quality of the verification activities and conformance with verification requirements.

2.12 Agreement (ISO 14065:2013 section 8.2.3)

The contract between verification body and aeroplane operator shall specify the conditions for verification by stating:

(a) scope of verification, verification objectives, level of assurance, materiality threshold and relevant verification standards (ISO 14065, ISO 14064-3, this Volume and the Environmental Technical Manual, Volume IV);

(b) amount of time allocated for verification;

(c) flexibility to change time allocation if this proves necessary because of findings during the verification;

(d) conditions which have to be fulfilled to conduct the verification such as access to all relevant documentation, personnel and premises;

(e) requirement of the aeroplane operator to accept the audit as a potential witness audit by national accreditation body's assessors;

(f) requirement of the aeroplane operator to authorize the release of the Emissions Report, the Emissions Unit Cancellation Report, where applicable, and the Verification Report by the verification body to the State; and

(g) liability coverage.

3. VERIFICATION OF EMISSIONS REPORT AND EMISSIONS UNIT CANCELLATION REPORT

The verification team shall conduct the verification according to ISO 14064-3:2006, and the following additional requirements.

3.1 Level of assurance (ISO 14064-3:2006 section 4.3.1)

A reasonable level of assurance shall be required for all verifications under this Volume.

3.2 Objectives (ISO 14064-3:2006 section 4.3.2)

3.2.1 When conducting the verification of an Emissions Report, the verification body shall perform sufficient procedures to conclude whether:

(a) the greenhouse gas assertion is materially fair and an accurate representation of emissions over the period of the Emissions Report and is supported by sufficient and appropriate evidence;

(b) the aeroplane operator has monitored, quantified and reported its emissions over the period of the Emissions Report in accordance with this Volume and the approved Emissions Monitoring Plan;

(c) the aeroplane operator has correctly applied the method of flight attribution documented in the approved Emissions Monitoring Plan and in accordance with this Volume, to ensure a correct attribution of leased aeroplane and international flights, as defined in 16.4.3.1(b) of this volume, operated by other aeroplane operators under the same corporate structure;

(d) the stated amount of emissions reductions from the use of CORSIA eligible fuels is materially fair and an accurate representation of emissions reductions over the reporting period, and is supported by sufficient and appropriate internal and external evidence;

(e) the claimed batches of CORSIA eligible fuels have not also been claimed by the aeroplane operator under any other voluntary or mandatory schemes it has participated in (where the emissions reductions from CORSIA eligible fuels may be claimed), during the current compliance period, as well as the compliance period immediately preceding it; and

(f) the aeroplane operator has monitored, calculated and reported its emissions reductions associated from the use of CORSIA eligible fuels over the period of the reporting period in accordance with this Volume.

3.2.2 When conducting the verification of an Emissions Unit Cancellation Report, the verification body shall perform sufficient procedures to conclude whether:

(a) the aeroplane operator has accurately reported cancellations of its CORSIA Eligible Emissions Units in accordance with this Volume;

(b) the stated number of cancelled CORSIA Eligible Emissions Units is sufficient for meeting the aeroplane operator's total final offsetting requirements associated with the relevant compliance period, after accounting for any claimed emissions reductions from the use of CORSIA eligible fuels, and the aeroplane operator can demonstrate sole right of use to such cancelled CORSIA Eligible Emissions Units; and

(c) the eligible emissions units cancelled by the aeroplane operator to meet its offsetting requirements under this Volume have not been used by the aeroplane operator to offset any other emissions.

3.3 Scope (ISO 14064-3:2006 section 4.3.4)

3.3.1 When conducting the verification of an Emissions Report, the scope of the verification shall reflect the period of time and information covered by the report and the CORSIA eligible fuels claim(s) where applicable. This includes:

(a) CO_2 emissions from aeroplane fuel monitoring methods, calculated in accordance with 16.4.4.2; and

(b) Emissions reductions from the use of CORSIA eligible fuel(s).

3.3.2 The scope of the verification of the CORSIA eligible fuel claim(s) in the Emissions Report shall include the following:

(a) Any internal aeroplane operator procedures for CORSIA eligible fuels, including aeroplane operator controls to ensure the claimed CORSIA eligible fuels satisfies the CORSIA Sustainability Criteria;

(b) Checks for double claiming are limited to the specific aeroplane operator. Any findings outside of this scope are not relevant for the verification statement, however they should still be included in the Verification Report for further consideration by the State;

(c) Assessment of verification risk with appropriate changes to the verification plan; and

(d) Assessment of whether there is sufficient access to relevant internal and external information to obtain sufficient confidence in each CORSIA eligible fuel claim. Where evidence of the sustainability or the size of the CORSIA eligible fuels claim is considered either inappropriate or insufficient, further information should be sought directly from the fuel producer with direct access facilitated through the aeroplane operator.

3.3.3 When conducting the verification of an Emissions Unit Cancellation Report, the scope of the verification shall reflect the period of time and information covered by the report and the verification body shall confirm that the cancelled eligible emissions units used to meet the aeroplane operator's offsetting requirements under this Volume have not been used to offset any other emissions.

3.4 Materiality (ISO 14064-3:2006 section 4.3.5)

3.4.1 When conducting the verification of an Emissions Report, the verification body shall apply the following materiality thresholds:

(a) of 2 per cent for aeroplane operators with annual emissions on international flights, as defined in 16.4.3.1(b) and 16.4.4.1, above 500 000 tonnes; and

(b) of 5 per cent for aeroplane operators with annual emissions on international flights, as defined in 16.4.3.1(b) and 16.4.4.1, equal or less than 500 000 tonnes of CO_2.

3.4.2 When conducting the verification of an Emissions Report, the over and understatements in 3.4.1 shall be allowed to balance out in both cases.

3.5 General (ISO 14064-3:2006 section 4.4.1)

Prior to the development of the verification approach, the verification body shall assess the risk of misstatements and non-conformities and their likelihood of a material effect on the basis of a strategic analysis of the aeroplane operator's greenhouse gas emissions information[8]. Depending on the information obtained during the verification, the verification body shall revise the risk assessment and modify or repeat the verification activities to be performed.

3.6 Validation or verification plan (ISO 14064-3:2006 section 4.4.2)

3.6.1 The verification team shall prepare the verification plan on the basis of the strategic analysis and assessment of risks. The verification plan shall include a description of the verification activities for each variable that has a potential impact on the reported emissions. The verification team shall consider the assessment of risk, and the requirement to deliver a verification opinion with reasonable assurance, when determining sample size.

3.6.2 The verification plan shall include the following:

(a) verification team members, roles, responsibilities and qualifications;

(b) any external resources required;

(c) schedule of verification activities; and

(d) sampling plan, including the processes, controls and information to be verified and details of the risk assessment conducted to identify these.

3.7 Sampling plan (ISO 14064-3:2006 section 4.4.3)

3.7.1 The Emissions Report sampling plan shall include the following:

(a) number and type of records and evidence to be examined;

(b) methodology used to determine a representative sample; and

(c) justification for the selected methodology.

3.7.2 When conducting the verification of an Emissions Unit Cancellation Report, the verification body shall not rely on sampling.

3.8 Assessment of GHG data and information (ISO 14064-3:2006 section 4.6)

3.8.1 The verification team shall confirm that the Emissions Report data has been collected in accordance with the approved Emissions Monitoring Plan and monitoring requirements specified in this Volume.

3.8.2 In accordance with the Emissions Report sampling plan, the verification body shall carry out substantive data testing consisting of analytical procedures and data verification to assess the plausibility and completeness of data. The verification team shall, as a minimum, assess the plausibility of fluctuations and trends over time or between comparable data items as well as identify and assess immediate outliers, unexpected data, anomalies, and data gaps.

3.8.3 Depending on the outcome of Emissions Report data testing and assessment, the assessment of risk, verification and sampling plans shall be amended, where necessary.

3.9 Evaluation of the GHG assertion (ISO 14064-3:2006 section 4.8)

3.9.1 The verification body shall use an independent reviewer not involved in the verification activities to assess the internal verification documentation, and the Verification Report, prior to its submission to the aeroplane operator and State.

3.9.2 The independent review, whose scope includes the complete verification process, shall be recorded in the internal verification documentation.

3.9.3 The independent review shall be performed to ensure that the verification process has been conducted in accordance with ISO 14065:2013, ISO 14064-3:2006 and this Volume, and that the evidence gathered is appropriate and sufficient to enable the verification body to issue a Verification Report with reasonable assurance.

3.10 Validation and verification statement (ISO 14064-3:2006 section 4.9)

3.10.1 The verification body shall submit a copy of the Verification Report to the aeroplane operator. Upon authorization by the aeroplane operator, the verification body shall forward a copy of the Verification Report together with the Emissions Report, the Emissions Unit Cancellation Report, or both, to the State. The Verification Report shall include:

(a) names of the verification body and verification team members;

(b) time allocation (including any revisions and dates);

(c) scope of the verification;

(d) main results of impartiality and avoidance of conflict of interest assessment;

(e) criteria against which the Emissions Report was verified;

(f) aeroplane operator information and data used by the verification body to cross-check data and carry out other verification activities;

(g) main results of the strategic analysis and assessment of risk;

(h) description of verification activities undertaken, where each was undertaken (on-site vs off-site) and results of checks made on the CO_2 emissions information system and controls;

(i) description of data sampling and testing conducted, including records or evidence sampled, sample size, and sampling method(s) used;

(j) the results of all data sampling and testing, including cross-checks;

(k) compliance with the Emissions Monitoring Plan;

(l) any non-compliances of the Emissions Monitoring Plan with this Volume;

(m) non-conformities and misstatements identified (including a description of how these have been resolved);

(n) conclusions on data quality and materiality;

(o) conclusions on the verification of the Emissions Report;

(p) conclusions on the verification of the Emissions Unit Cancellation Report;

(q) justifications for the verification opinion made by the verification body;

(r) results of the independent review and the name of the independent reviewer; and

(s) concluding verification statement.

3.10.2 When conducting the verification of an Emissions Unit Cancellation Report, only 3.10.1 (a), (b), (c), (d), (f), (g), (h), (m), (p), (q), (r) and (s) shall be applicable.

3.10.3 The verification body shall provide a conclusion on each of the verification objectives listed in 3.2, as applicable, in the concluding verification statement.

3.10.4 When conducting the verification of an Emissions Report or an Emissions Unit Cancellation Report, the verification body shall choose between two types of verification opinion statements, either 'verified as satisfactory' or 'verified as not satisfactory'. If the report includes non-material misstatements and / or non-material non-conformities, the report shall be 'verified as satisfactory with comments', specifying the misstatements and non-conformities. If the report contains material misstatements and / or material non-conformities, or if the scope of the verification is too limited or the verification body is not able to obtain sufficient confidence in the data, then the report shall be 'verified as not satisfactory'.

3.11 Validation or verification records (ISO 14064-3:2006 section 4.10)

3.11.1 On request of the State, the verification body shall disclose the internal verification documentation on a confidential basis to the State.

3.11.2 Where issues that may render a previously issued verification statement invalid or inaccurate are brought to the attention of the verification body, then it shall notify the State

Attachment A – Attribution processes

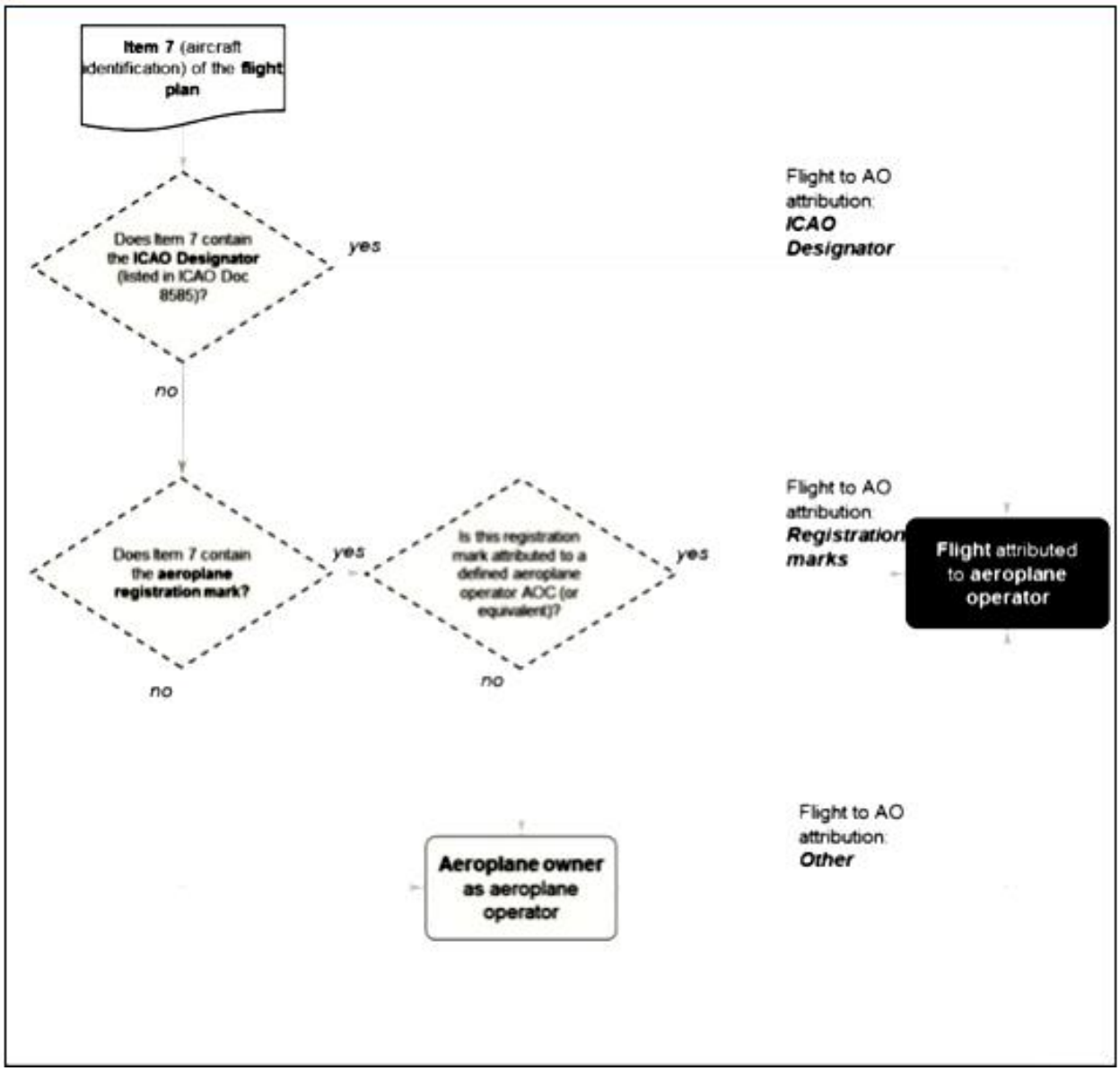


FIGURE A-1 Process for attribution of a flight to an aeroplane operator

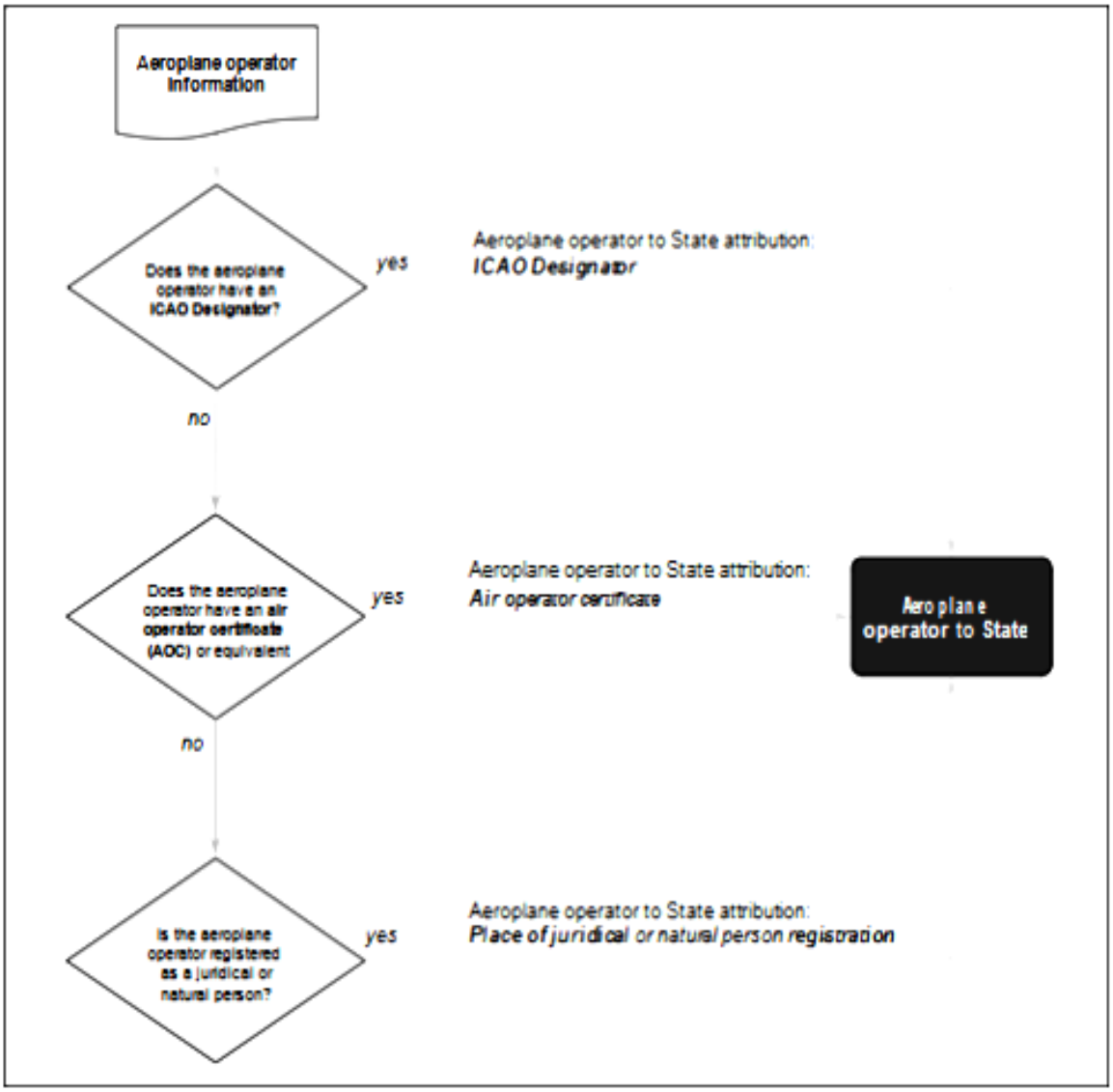


FIGURE A-2 Process for attribution of an aeroplane operator to a State

Attachment B – Applicability of the MRV requirements to international flights

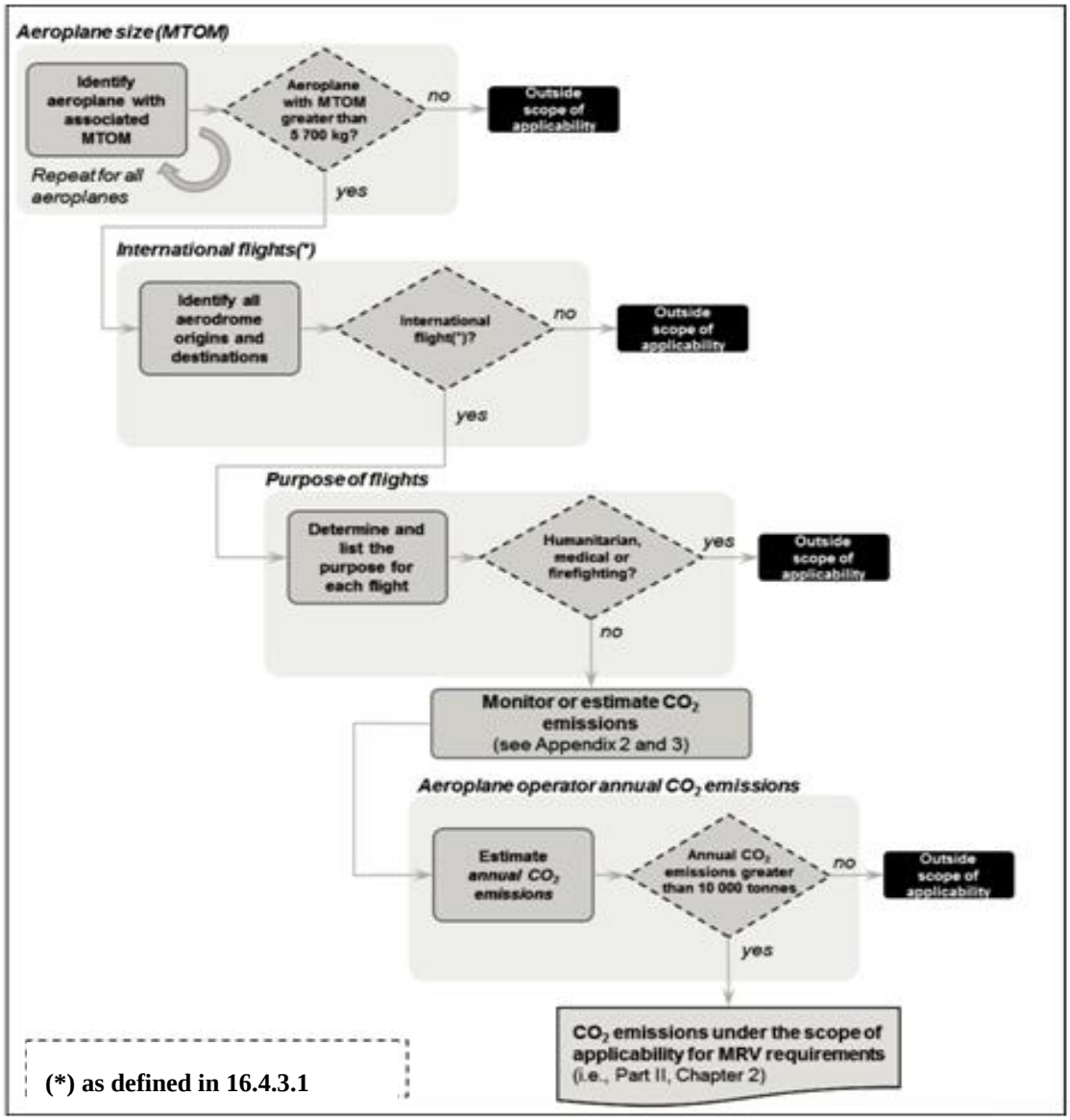


FIGURE B-1: Determination of the applicability of subpart 16.4.4 to international flights, as defined in 16.4.3.1(b) (for MRV requirements).

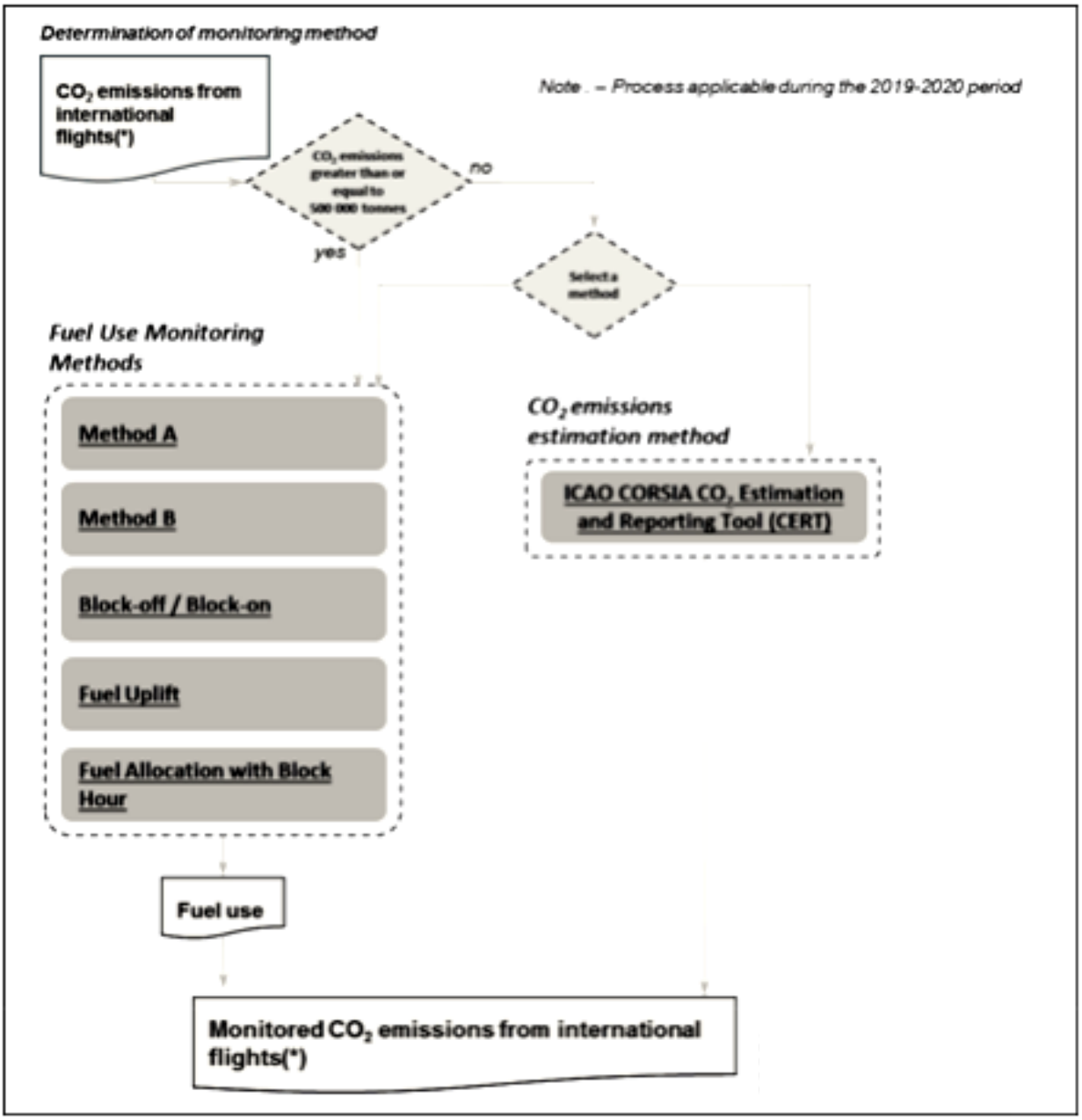


FIGURE B-2: Determination of eligible Fuel Use Monitoring Methods during the 2019- 2020 period

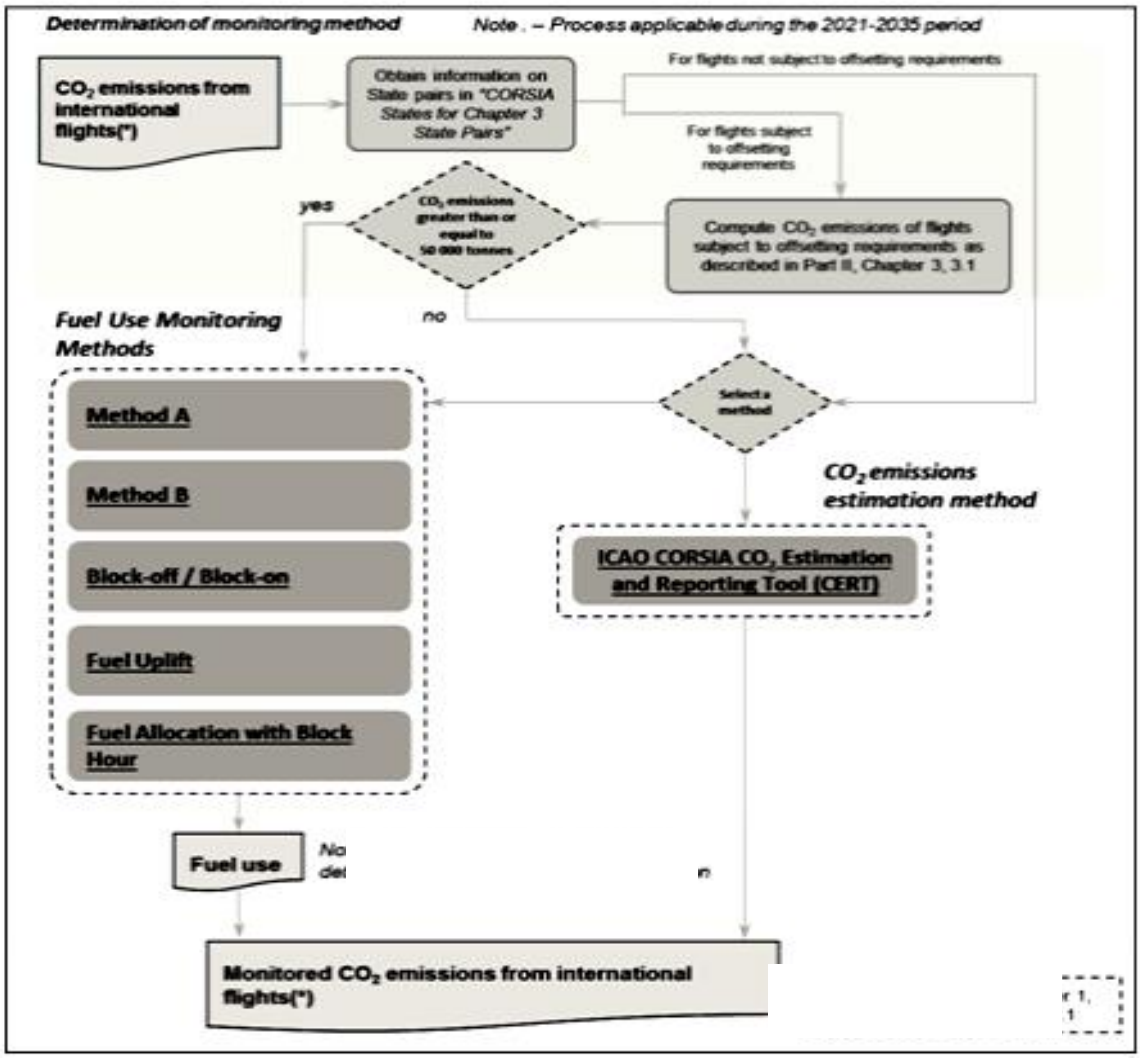


FIGURE B-3: Determination of eligible Fuel Use Monitoring Methods during the compliance periods (2021-2035)

Attachment C - Processes for fuel use monitoring

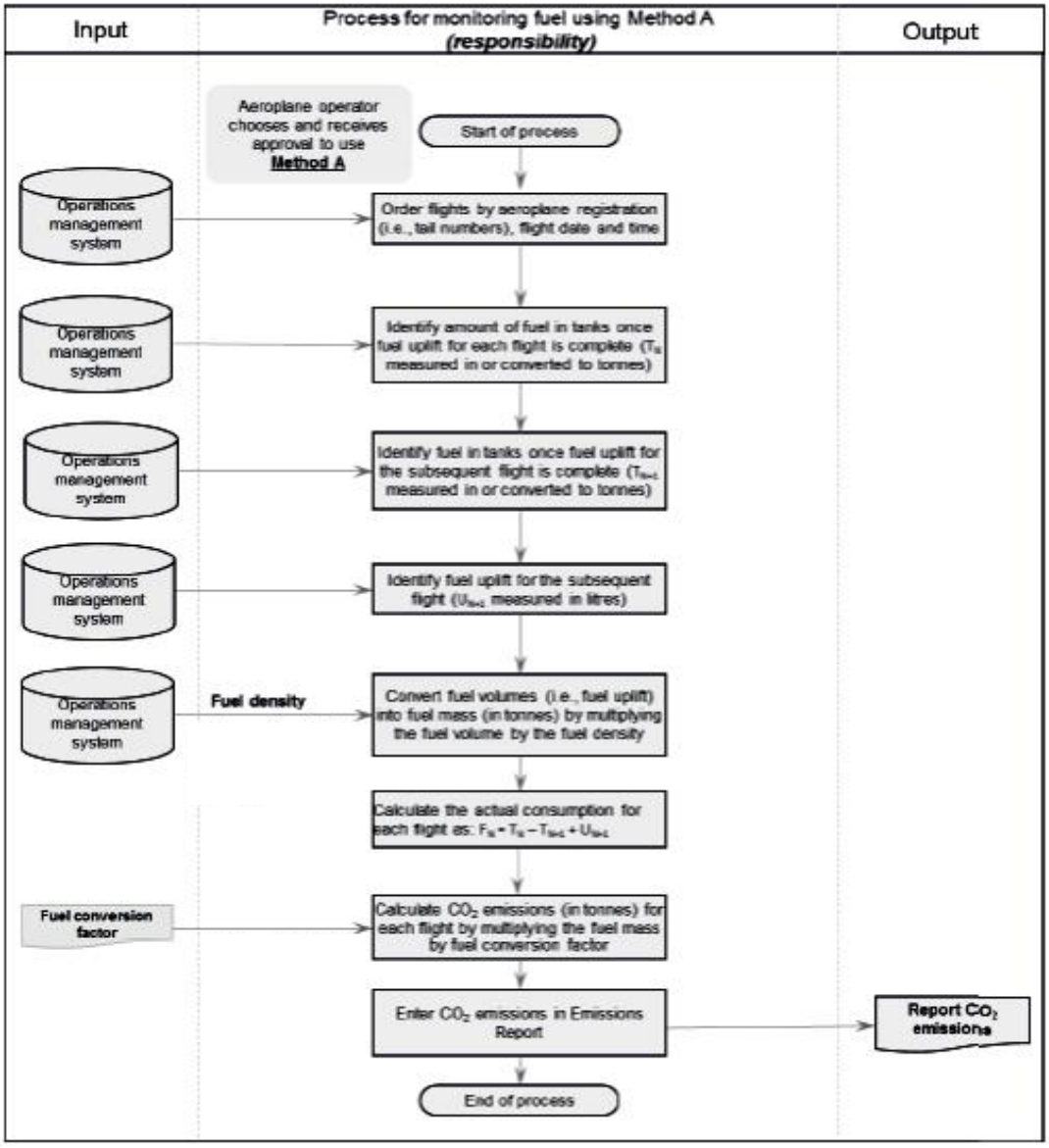


FIGURE C-1: Monitoring fuel use by flight using Method A

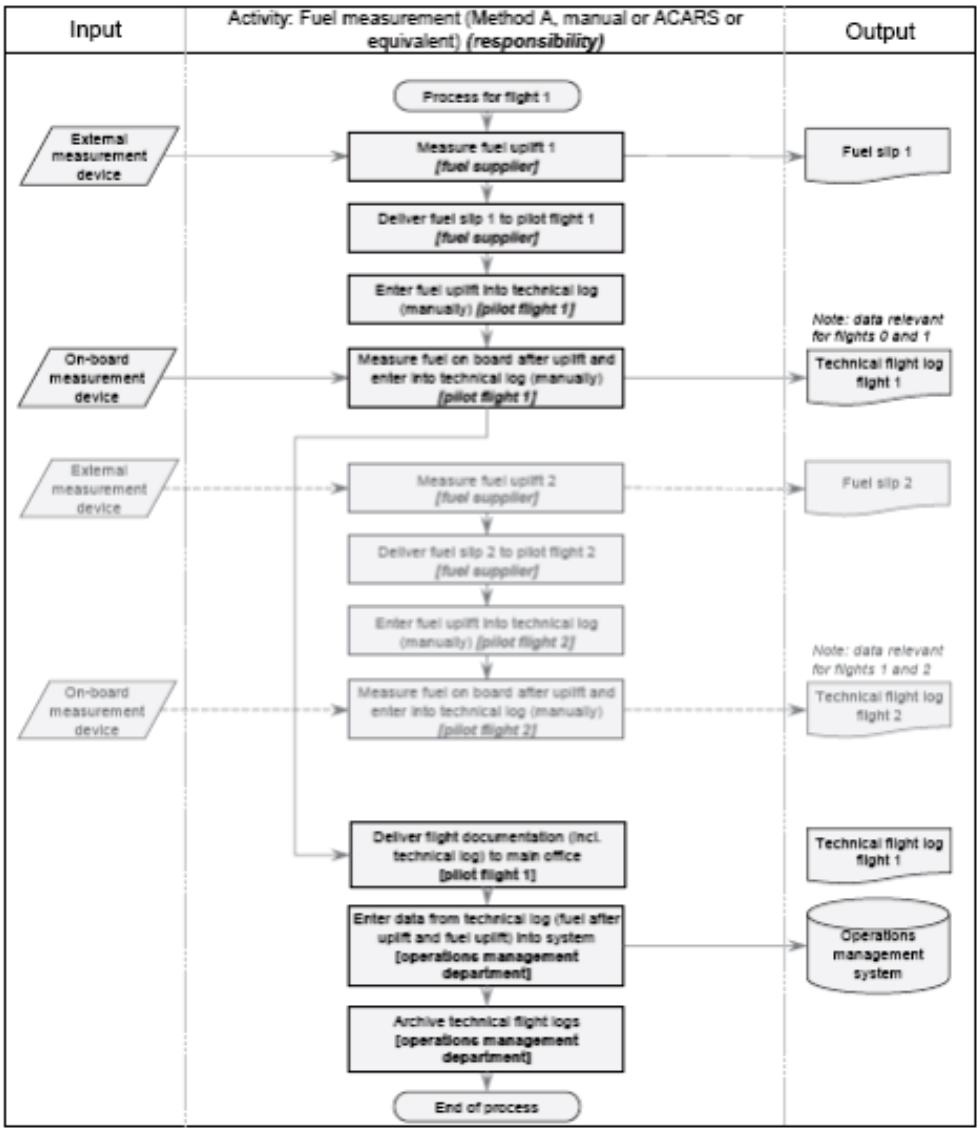


FIGURE C-2: Collection of required data to implement Method A with fuel uplift from fuel supplier

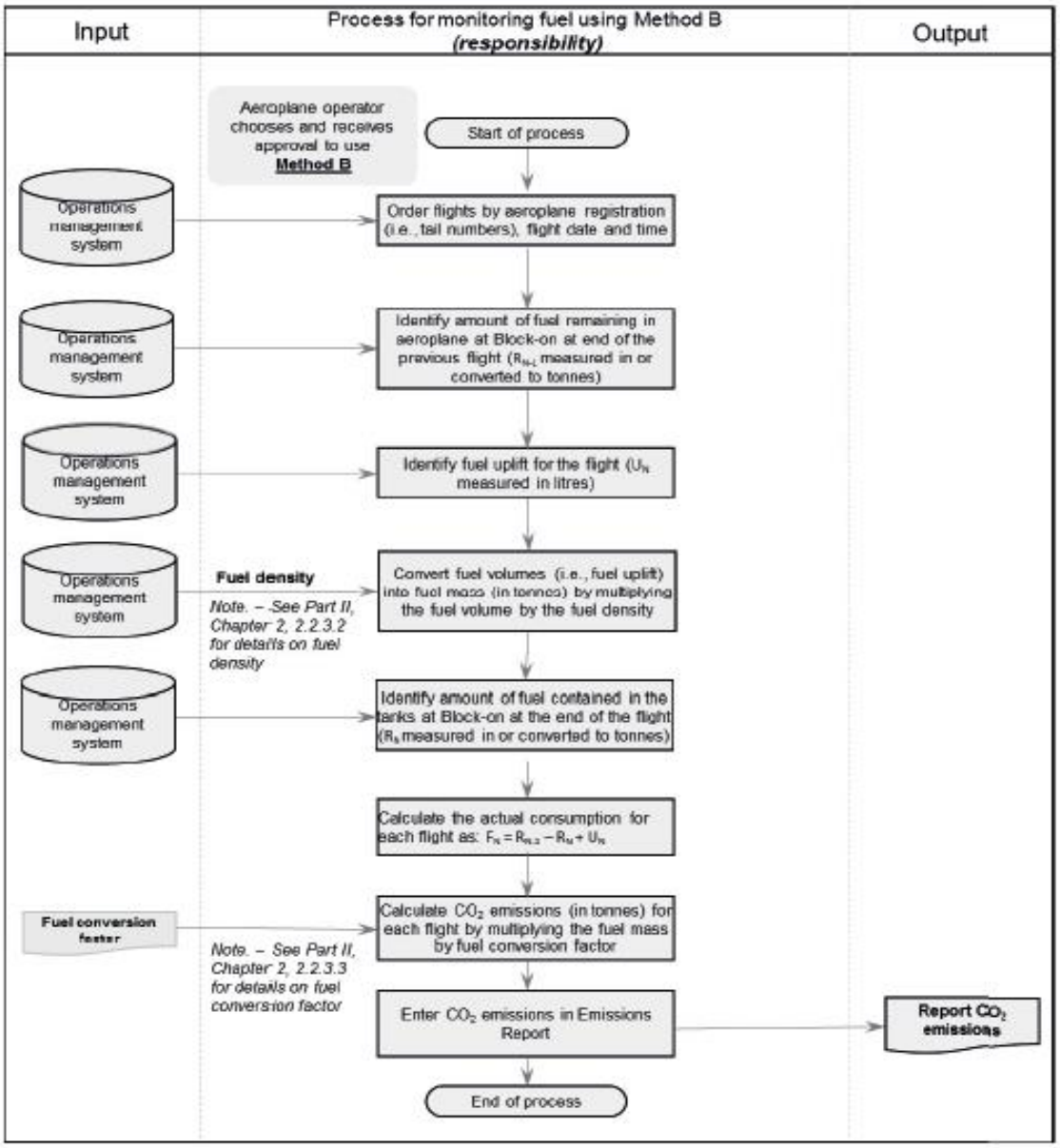


FIGURE C-3: Monitoring fuel use by flight using Method B

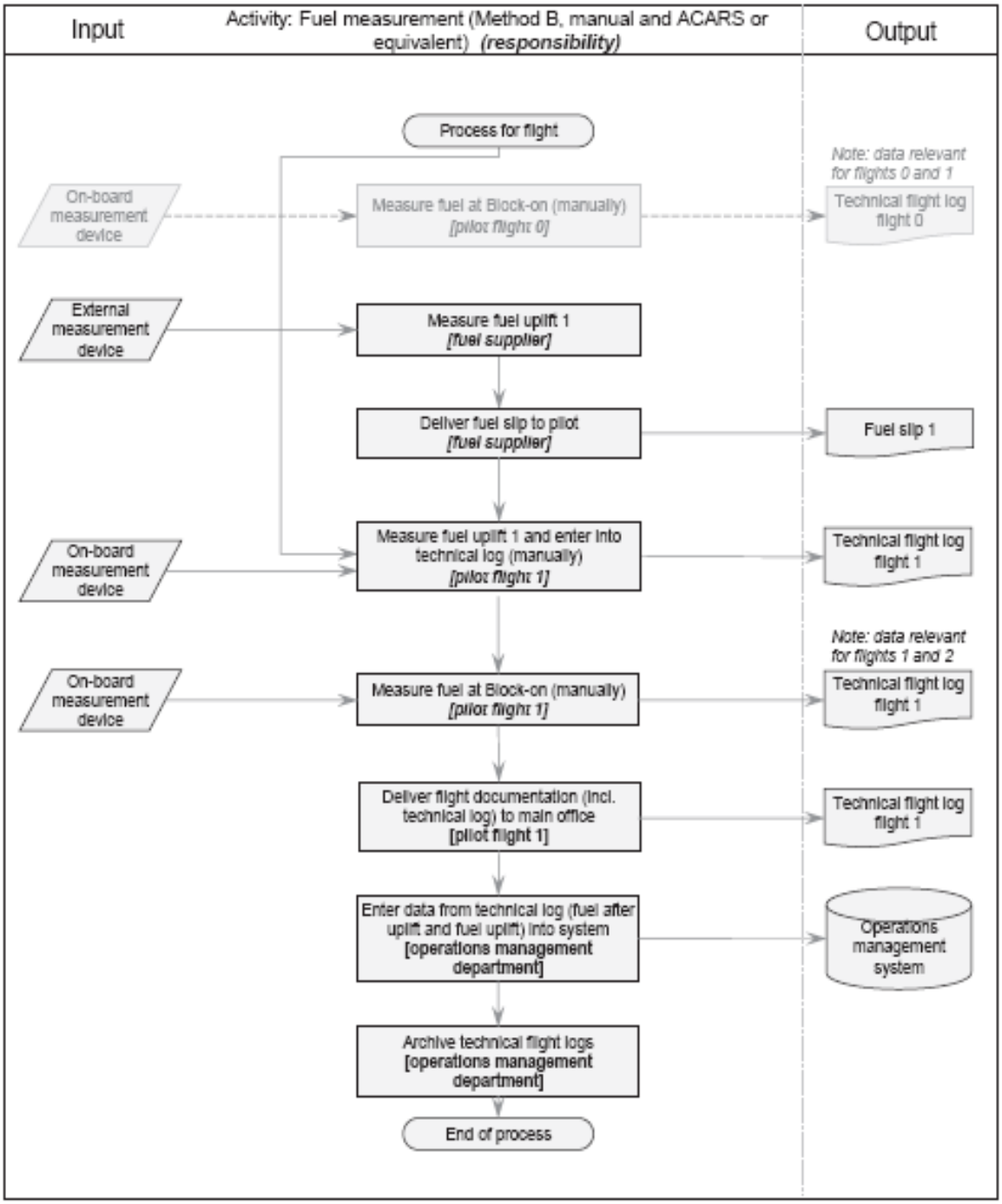


FIGURE C-4: Collection of required data to implement Method B with fuel uplift (manual process)

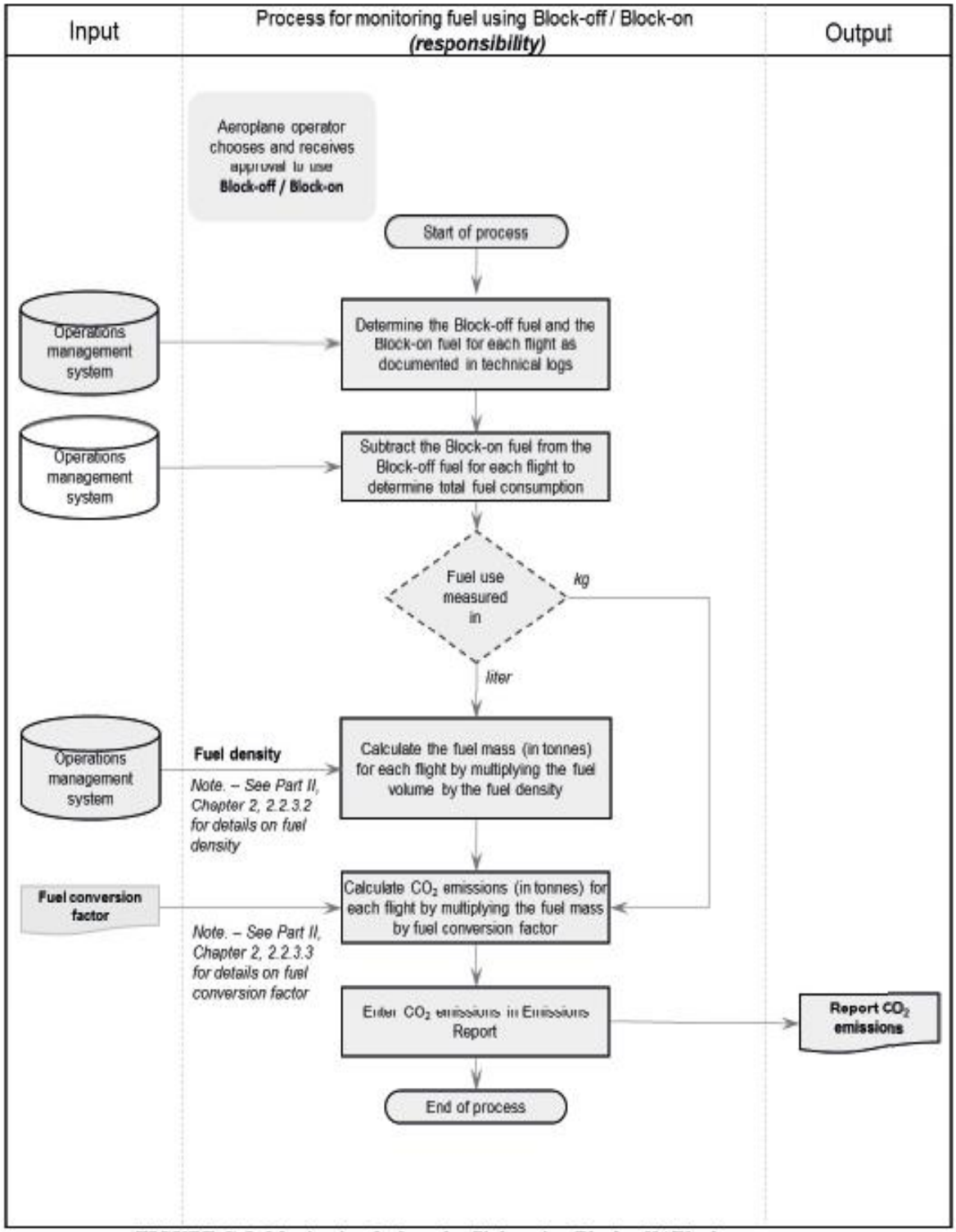


FIGURE C-5: Monitoring fuel use by flight using Block-off / Block-on

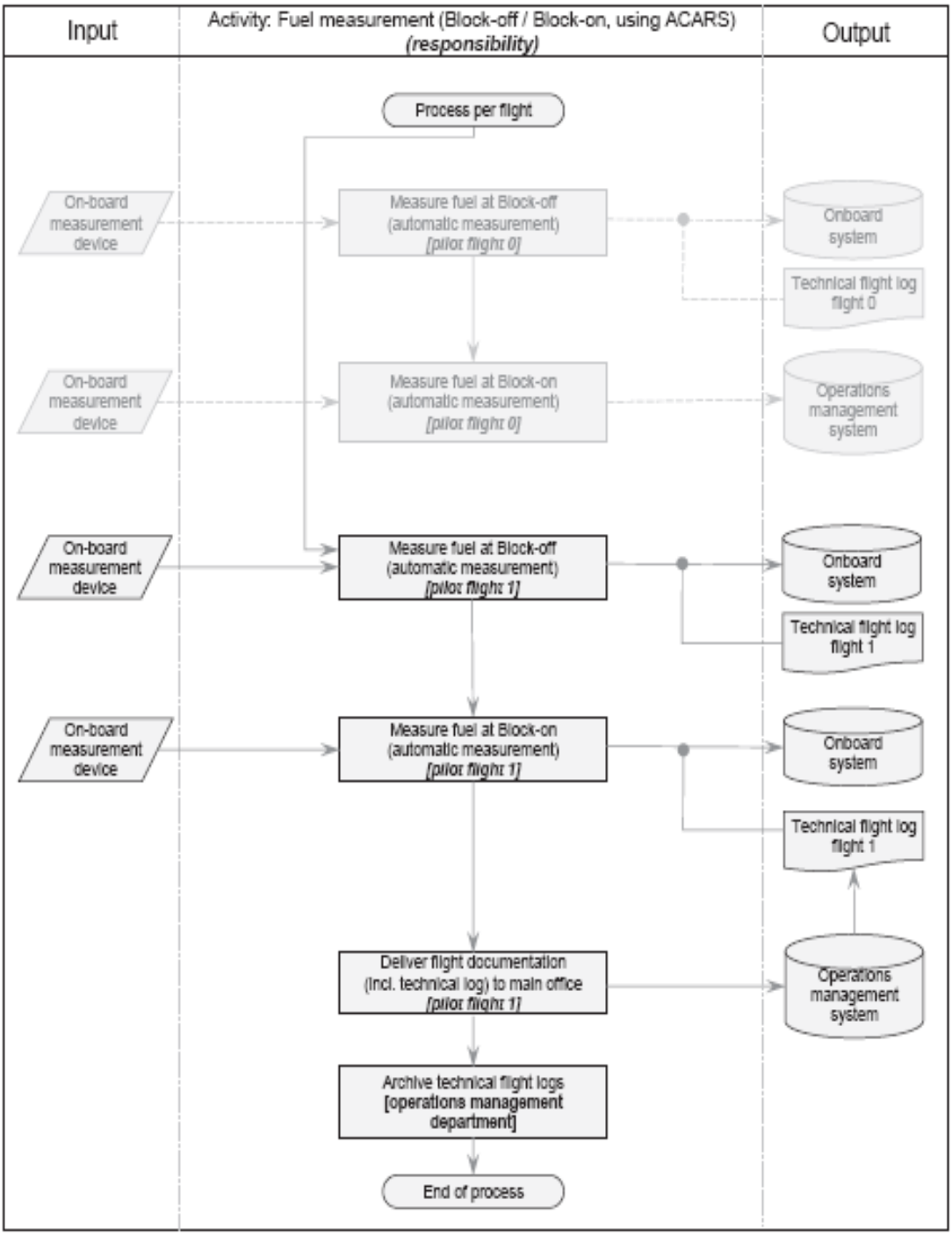


FIGURE C-6: Collection of required data to implement Block-off / Block-on

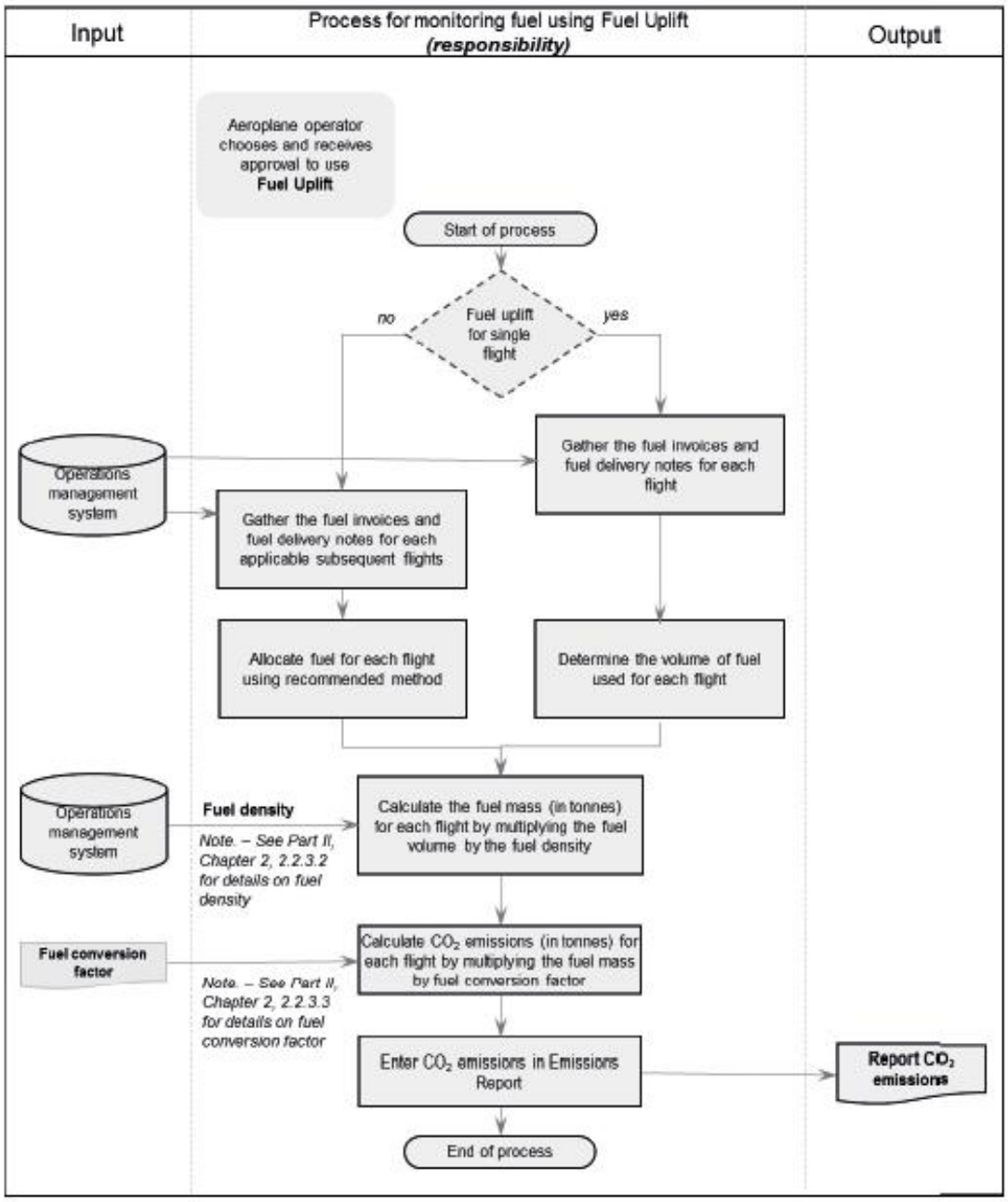


FIGURE C-7: Monitoring fuel use by flight using Fuel Uplift

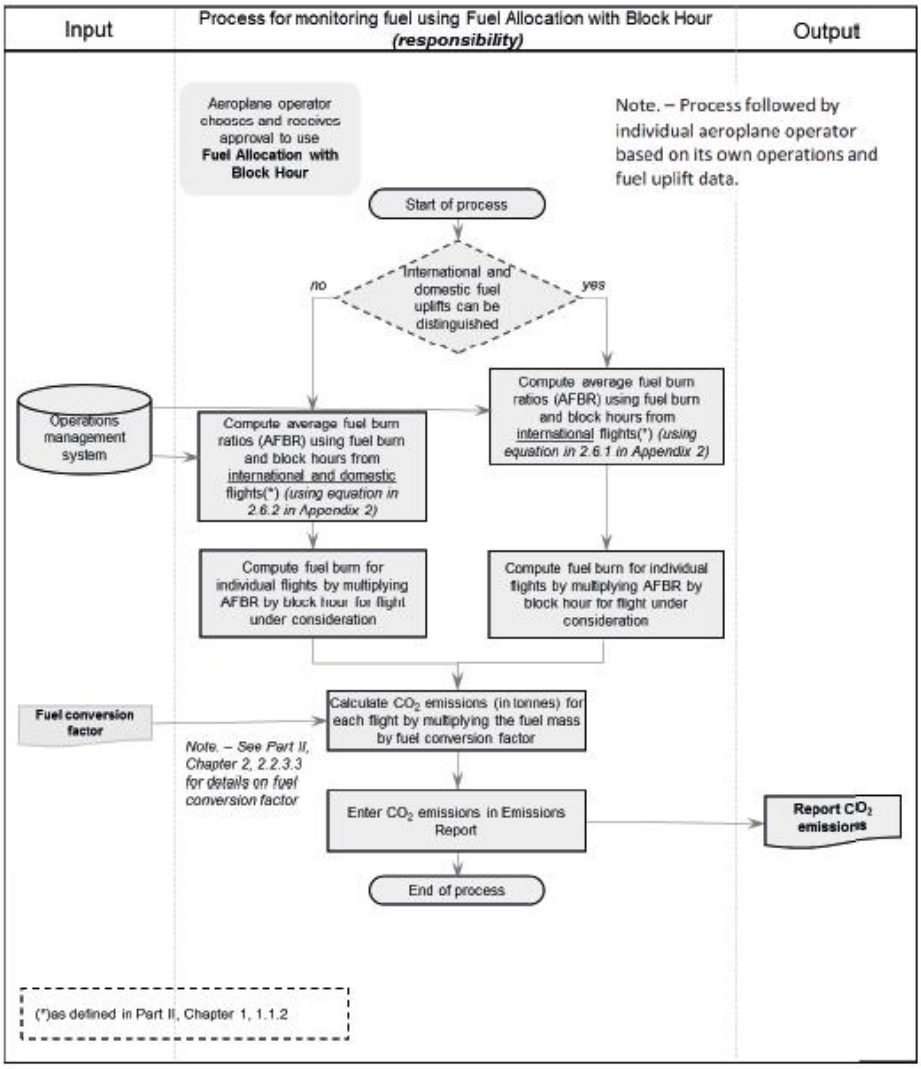


FIGURE C-8: Monitoring fuel use by flight using Fuel Allocation with Block Hour

16.5: ENVIRONMENTAL PROTECTION

VOLUME V — AERODROME ENVIRONMENTAL STANDARDS

VOLUME V — AERODROME ENVIRONMENTAL STANDARDS

PART A - AERODROME ENVIRONMENTAL STANDARDS

16.5.1 APPLICABILITY

(a) The Authority shall supervise all aspects of this Part related to aviation environmental issues and its implementation. Relevant Government Authorities shall supervise also non-aviation environmental issues.

(b) Aerodrome operators shall ensure that appropriate staff with environmental management expertise exists to coordinate the implementation of this Part and shall promptly communicate the name(s) of the individual responsible for environmental management to the Authority.

(c) Where Aerodrome operator does not have environmental office, within 6 months of the enactment of this Part, each Aerodrome operator shall identify and, as necessary, train appropriate staff to ensure sufficient environmental management capacity to coordinate the implementation of this Part at the Aerodrome operator level and shall promptly communicate the name of the individual responsible for environmental management to the Authority.

(d) Aerodrome operators shall adhere to the requirements of this Part. Aerodrome operators shall also ensure that all entities and individuals who undertake operations or other activities on their behalf meet the environmental standards, procedures and requirements set out in this Part. Where more than one entity has a responsibility for Aerodrome operations, each such entity shall meet the requirements set out in this Part.

(e) Aircraft operators shall meet aircraft performance standards set out in this Part, or referred to by this Part.

(f) Entities and individuals that undertake activities on Aerodrome property shall undertake the actions necessary to comply with the requirements of this Part. Tenants shall be responsible for ensuring that any of their sub-contractors or other employees comply with the requirements of this Part.

(g) All reports, charts, maps and other documents required to be provided to the Authority by this Part, shall be in both electronic and hard copy formats.

(h) Nothing in this Part shall be understood or construed to prevent the application of any other requirement that may be required by any other government entity according to applicable laws.

PART B - AERODROME NOISE

16.5.2 PREPARATION OF NOISE CONTOURS

(a) Aerodrome operators shall prepare noise contour maps for the Aerodromes for which they are responsible in accordance with this Part within 6 months of the effective date of this Part. Aerodrome operators shall submit noise contour maps to the Authority within 40 working days of their completion.

(b) Aerodrome operators shall submit to the Authority, noise contour maps assessment report once every two years for review.

(c) Validation of the noise contour maps shall be through:

(1) A revision of the aircraft fleet mix that was used to construct noise contours; or

(2) A new run of the noise model if the aircraft fleet mix does not fall within the criteria established for the previous noise contour development; or

(3) On-site measurement of noise levels.

(d) The Authority shall review noise contour maps submitted to it and shall approve them within 30 working days provided they meet the requirements for preparation of noise contour maps set out in this Part.

16.5.3 NOISE REDUCTION AND MANAGEMENT MEASURES

(a) Where a noise contour map referred to in 16.5.2 of this Part, identifies a non-compatible land use with respect to 16.1 of this Part, the Authority shall immediately order the Aerodrome operator to:

(1) Specify and implement operational procedures to reduce noise levels in specific areas to become compatible with the existing land use as specified in Volume I of this Part, and

(2) Prepare, in consultation with the appropriate authorities, a Noise Reduction and Management Plan to be implemented in the case where the operational procedures to reduce noise were ineffective in reaching compatible noise levels as specified by the Authority.

16.5.4 OPERATIONAL PROCEDURES TO REDUCE NOISE

(a) Where the Aerodrome operator receives an order from the Authority to specify and implement operational procedures to reduce noise at the aerodrome, the Aerodrome operator shall consider the following, in consultation with the concerned parties, among other things that may be specified by the Authority:

(1) Selection of runways to reduce noise in adjacent communities.

(2) Delayed engine start up.

(3) Use of ground power units in place of auxiliary power units.

(4) Application of continuous descent approach procedures.

(5) Use of low power/low drag procedure.

(6) Minimizing flap angles.

(7) Reduced use of reverse thrust.

(8) Taxiing with fewer engines running

(9) Joining the instrument landing slope from a higher angle

(10) Enforced shut down of engines while on the apron/ramp.

(11) Requirements for aircraft to maintain airspace allotted for take-off and landing.

(12) Imposing curfews.

(13) The Aerodrome operator shall specify, and forward to the Authority, operational measures within 30 working days of an order being issued by the Authority under this Section after consulting with all relevant Aerodrome operational units.

(14) The Authority shall give its determination on the specified operational measures within 30 working days of receipt of the measures.

(15) The Aerodrome operator shall implement operational procedures to reduce noise at the Aerodrome within 60 working days of the date of issuance of an approval by the Authority.

16.5.5 NOISE REDUCTIONS AND MANAGEMENT PLAN

(a) Where the Aerodrome operator receives an order to prepare a Noise Reduction and Management Plan under this Section, and/or where operational conditions prescribed by the Authority exist, the Aerodrome operator shall develop a Noise Reduction and Management Plan to reduce noise levels in the non-compatible area to levels that fall within the criteria of the Environmental Protection Agency (EPA).

(b) The Noise Reduction and Management Plan shall include the following:

(1) Operational measures in accordance with those approved by the Authority or, if these have not been approved at the time the Noise Reduction and Management Plan are submitted to the Authority they shall be added as soon as they have been approved.

(2) Identification of properties and buildings in the area(s) of non-compatible land use identified by the noise contour maps together with specification of measures to be undertaken by the Aerodrome operator to reduce Aerodrome noise in buildings in

these areas. The measures to be specified shall include, as appropriate and among other measures that may be considered appropriate:

(i) installation of windows and doors designed to reduce noise.

(ii) installation of noise insulation.

(iii) construction of berms on Aerodrome property.

(iv) installation of noise barriers.

(3) Identification of the sites that will be used for aircraft noise monitoring.

(4) The identification of a schedule of noise charges that shall be paid by aircraft operators for each aircraft movement at the Aerodrome.

(5) A schedule for terminating within 3 years following commencement of the implementation of the Noise Reduction and Management Plan, the use of the Aerodrome by aircraft that do not meet Stage 3 noise certification standards as specified by this Part, or subsequent noise certification standards for quieter aircraft that may be adopted by the Authority.

(6) Specified restrictions in the use of the Aerodrome by aircraft in the event that other measures to reduce noise in communities adjacent to the Aerodrome do not reduce noise levels to within the thresholds.

(7) An implementation and financing plan in accordance with this Part shall achieve implementation of all measures in this part within 3 years of approval of the plan by the Authority, which shall be implemented as necessary after the third year following approval of the Noise Reduction and Management Plan to achieve noise levels to within the thresholds.

(c) The Aerodrome operator shall submit the Noise Reduction and Management Plan to the Authority within 12 months of receiving an order under this Section.

(d) The Authority shall give its determination on the specified operational measures within 30 working days of receipt of the Noise Reduction and Management Plan.

(e) Where an updated noise contour map prepared after the implementation of operational procedures identified in this Section identifies a continuing level of noise that exceeds the levels as determined under this Part, the Authority shall within 60 working days of receipt of the updated noise contour map, orders the Aerodrome operator to implement the measures of the Noise Reduction and Management Plan.

(f) The Authority shall monitor the implementation of the Noise Reduction and Monitoring Plan and may order the Aerodrome operator to take additional measures to reduce noise.

16.5.6 AERODROME OPERATIONS

16.5.6.1 **General**

(a) The Aerodrome Operator shall undertake Aerodrome operations in compliance with the requirements of this Part and in compliance with the environmental and planning requirements of relevant government authorities.

16.5.6.2 **Non-Hazardous Solid Waste Management**

(a) The Aerodrome operator and all parties operating at the Aerodrome:

(1) Shall manage their non-hazardous solid waste in accordance with the requirements of the Environmental Protection Agency (EPA) "Solid Waste Management", or the requirements of relevant authorities, as applicable, through an established Non-Hazardous Solid Waste Management Plan.

(2) Shall not dispose of solid waste except in containers that are designed for solid waste management and for which the Aerodrome operator, service provider or commercial entity, as appropriate, has made waste collection and disposal arrangements and which comply with international or national requirements which relate to recycling of non-hazardous solid waste.

(3) Shall not discard solid waste into a solid waste container that is too small for the waste or which is too full to properly accommodate the waste.

(4) Shall not place liquids in a container designed or intended for solid waste.

16.5.6.3 **Hazardous Wastes**

(a) The Aerodrome operator and all parties operating at the Aerodrome shall prepare a Management Plan that identifies actions to address hazardous waste at the Aerodrome. The plan shall be in accordance with the requirements of EPA on Hazardous Waste Management and Handling (Storage of Hazardous Substances), or the requirements of relevant authorities, as applicable.

16.5.6.4 **Dangerous Goods**

(a) Aerodrome operator and all parties operating at the Aerodrome shall manage their Dangerous Goods in accordance with the requirements of Part 15 of the Liberia Civil Aviation Authority Regulations and ICAO Document 9284. Airline operators who are International Air Transport Association (IATA) members shall also be required to comply with the requirements of the IATA Technical Instructions.

16.5.7 SPILLS MANAGEMENT

16.5.7.1 **Planning**

(a) The Aerodrome operator and all parties operating at the Aerodrome and who store, transport or use dangerous goods, hazardous materials or who generate any hazardous waste shall prepare a Hazardous Materials Spills Management Plan that identifies actions to address spills of hazardous goods or hazardous waste in accordance with the Environmental Protection Agency Regulations on Hazardous Waste Management and Handling – General Requirements for Storage of Hazardous Substances, as well as ICAO Document 9284 requirements.

(b) The Hazardous Materials Spills Management Plan for each service provider and commercial entity operating at the Aerodrome shall specify actions to be taken at their own facilities as well as at notification of appropriate officials and Aerodrome operations.

(c) The Hazardous Materials Spills Management Plan of the Aerodrome operator shall address the actions at facilities it operates itself, as well as the range of requirements in this Part.

(d) The Hazardous Materials Spills Management Plan shall include the minimum quantities of spills that must be reported to the Authority.

(e) The Aerodrome operator and all parties operating at the Aerodrome shall submit their Hazardous Materials Spills Management Plans to the Authority, within 3 months of establishment of the party that uses or generates the hazardous waste for Aerodrome operators and parties already established on the Aerodrome, and prior to the establishment of the party for new entities. The Authority shall approve them when it is satisfied that the Hazardous Materials Spills Management Plan will provide an effective response to a hazardous materials spill, and shall advise the concerned party of its decision within 30 working days of receipt of the Hazardous Material Spills Management Plans.

(f) The Aerodrome operator shall ensure that the approved Hazardous Material Spills Management Plans are distributed to all relevant parties.

(g) The Aerodrome operator shall designate staff members contactable 24 hours per day who shall have responsibility for taking action in respect to spills of hazardous goods or hazardous waste, and shall communicate details regarding contacting these staff members to all parties operating at the Aerodrome.

16.5.7.2 **Implementation**

(a) The operator of the facility in which the spill occurred shall be responsible for the containment and clean-up of the spill and for actions to address the spill and its consequences within the facility it operates.

(b) The operator of the facility in which a spill has occurred shall immediately contact the Aerodrome operator or the relevant authority, as appropriate, and to report the spill.

(c) The Aerodrome operator, in consultation with the appropriate government authority, shall be responsible for determining whether the spill poses a threat to other facilities, to people outside the facility in which the spill occurred, or to the environment, and shall undertake all communication and coordination measures necessary to protect people, property and the environment from the consequences of the spill.

(d) The Aerodrome operator and all parties operating at the Aerodrome shall immediately implement their Hazardous Materials Spills Management Plan in the event of a spill of a hazardous good or a hazardous waste.

(e) All parties operating at the Aerodrome must immediately contact the Aerodrome operations department in the event of a spill of a hazardous good or a hazardous waste for which they are responsible.

16.5.7.3 **Enforcement**

(a) The Aerodrome Operator may order the Aerodrome operator or the responsible party, as may be appropriate, for causing the spill to take additional actions to address spills or the clean-up of spills. The additional actions required shall be at the expense of the party found to have caused the spill

16.5.7.4 **Surface Water and Wastewater**

(a) The Aerodrome Operator shall ensure that surface waters are separately collected and stored on Aerodrome for non-potable usage. Surplus shall, in any case, be discharged separately from sewage and other wastewater.

(b) The Aerodrome operator shall ensure that wastewater generated on the Aerodrome property is managed through a system that ensures it is treated prior to discharge in accordance with standards prepared by relevant Institution for responsible for applicable regulatory standards.

(c) The Aerodrome operator and all parties operating at the Aerodrome shall ensure that no hazardous goods or hazardous waste, including oil, fuel or chemical substance, is discarded into the surface water management system or into the wastewater management system.

16.5.8 ATMOSPHERIC EMISSIONS

(a) The Aerodrome operator and all parties operating at the Aerodrome shall not discharge gases or vapors to the atmosphere except in accordance with the standards and provisions of EPA or relevant authorities as applicable on Ambient Air Quality.

16.5.9 WILDLIFE MANAGEMENT

(a) Wildlife at the Aerodrome shall be managed in accordance with the provisions of the appropriate regulatory agency in Liberia.

16.5.10 LAND USE WITHIN AERODROMES

(a) Land use within the Aerodrome shall be managed by the Aerodrome operator in accordance with the rules and procedures established by the Aerodrome operator.

16.5.11 LAND USE PLANNING AROUND AERODROMES

(a) In accordance with the Liberia Civil Aviation Authority Aerodrome Regulation, the approval of land use planning around the Aerodrome is the responsibility of the Authority and shall be determined in cooperation with the concerned Ministries, and Municipalities.

(b) In the case of land around the Aerodrome, the Aerodrome operator shall comply with approved land use plans.

(c) In the case of any actual or suspected infringement, such infringement shall be reported by the relevant Aerodrome operator to the appropriate land authority and to the Authority for redress accordingly.

16.5.12 ENVIRONMENTAL MANAGEMENT SYSTEM

(a) Aerodrome Operators shall develop an Environmental Management System to be submitted to the Authority for approval. The Environmental Management System shall address the environmental compliance requirements of this part by both the Aerodrome operator and by the services and commercial entities operating at the Aerodrome under agreement with the Aerodrome operator.

16.5.12.1 **Content of an Environmental Management System**

(a) The Environmental Management System document to be submitted to the Authority shall satisfy the following criteria:

(1) The Environmental Policy statement for the Aerodrome operator that provides the Aerodromes' commitment to environmental quality.

(2) The Environmental Management Plan to be implemented by the Aerodrome operator, including:

(i) environmental priorities of the Aerodrome operator during the period during the Aerodrome certification period to ensure compliance with applicable environmental requirements.

(ii) How the priorities shall be achieved.

(iii) General timing of key actions to achieve the priorities.

(iv) financial resources necessary to achieve the priorities and how they shall be raised.

(3) The Environmental Monitoring and Enforcement Plan to be implemented by the Aerodrome operator, including:

(i) Mechanisms for monitoring the proper environmental performance of all parties operating at the Aerodrome.

(ii) Mechanisms for enforcing the environmental management obligations of all parties operating at the Aerodrome.

(iii) Provision to the Authority of a report annually that verifies the compliance of the Aerodrome operator and all parties operating at the Aerodrome with the environmental requirements set out in this Part as well as including non-compliance and corrective actions.

(b) The Authority shall give its determination on the specified operational measures within 20 working days of receipt of the measures.

16.5.13 ENVIRONMENTAL IMPACT ASSESSMENT

(a) The Aerodrome operator shall notify the Authority of any construction or other development they propose to undertake and shall conduct an Environmental Impact Assessment, in accordance with the regulations of the Environmental Protection Agency (EPA), as applicable and a copies of reports submitted to the Authority for acceptance.

(b) The Environmental Impact Assessment reports shall be presented to the Authority prior to submission to the EPA for comment.

16.5.14 ENVIRONMENTAL BASELINE

16.5.14.1 Environmental Baseline Report

(a) The Aerodrome Operator shall prepare an Environmental Baseline Report in accordance with the requirements of the EPA, as applicable, or in accordance with this Part.

(b) The Environmental Baseline Reports shall be submitted as follows:

(1) Existing Aerodromes under the same management. Within 6 months of the coming into force of this Part, the Aerodrome operator shall submit to the Authority an Environmental Baseline Report prepared according to Terms of Reference drafted by the operator and approved by the Authority. The report shall contain all the findings and recommendations, and be independently prepared by duly qualified individuals experienced in preparation of such reports without hindrance or influence from the Aerodrome operator, the Authority or any service or commercial enterprise operating currently or in the past at the Aerodrome or other parties except that the Aerodrome operator shall undertake the administrative functions to hire the necessary expertise and to ensure the proper delivery of the report.

(2) New Aerodromes applicants shall comply with the relative requirements of the EPA.

16.5.14.2 Scope of Environmental Baseline Report

(a) The Environmental Baseline Report shall address at least the following environmental liabilities, as they existed at the time that the Aerodrome operator assumes operational control of the Aerodrome; as well as any other requirements imposed by the EPA, as applicable, as well as the requirements of the Authority:

(1) Pollution of soil.

(2) Pollution of groundwater.

(3) Air emissions.

(4) Noise levels.

(5) Extent of uncontrolled solid waste and litter.

(6) Aircraft that are not airworthy or other aircraft or parts of aircraft or support equipment or other related aviation materials that are on the Aerodrome site and for which an owner cannot be identified.

(7) Other conditions at the Aerodrome that impact negatively on the ambient environment and which pose an inherited environmental liability for the operator of the Aerodrome as a consequence of previous actions or absence of actions.

(8) Recommended approaches for correcting the identified environmental liabilities.

(9) Costs for correcting the identified environmental liabilities.

(10) Environmental criteria and standards used in the report shall be the most recent standards, as applicable.

16.5.14.3 **Agreement on Environmental Baseline Study**

(a) Appropriate international standards and benchmarks shall be used where environmental liabilities are found for which no Liberian standard or criterion exists, having regard for both environmental quality and Aerodrome safety.

(b) The Authority shall advise its acceptance of the report within 2 months of its receipt.

16.5.14.4 **Responsibility of Aerodrome Operator For Environmental Liabilities**

(a) The Aerodrome operator or intending Aerodrome operator shall be financially responsible for environmental liabilities determined by the Environmental Baseline Study to have existed at the time that the operator's report was first submitted to the Authority.

(b) Within 6 months of notification of acceptance of the Environmental Baseline Report for established Aerodrome operators, or within 6 months of receiving the authorization to operate the Aerodrome in the case of new Aerodrome operators or new Aerodromes, the Aerodrome operator shall undertake the work necessary to correct the environmental liabilities.

16.5.15 AVAILABILITY AND INSPECTION OF DOCUMENTS

16.5.15.1 **Availability of documents**

(a) The Aerodrome operator shall retain all documents related to the scope of this Part for a minimum of 5 years following the end of the calendar year to which they pertain. The Aerodrome operator shall include the following clause into all contracts and agreements with service deliverers and commercial entities at the Aerodrome:

"[NAME OF ENTITY] shall retain all documents relating to environmental management for a minimum of 5 years following the end of the calendar year to which they pertain and shall make them available for inspection by the Aerodrome operator and/or the Authority upon demand."

16.5.15.2 **Inspection of Documents**

(a) The Authority shall have the right to inspect at any time and without prior notice any documents of the Aerodrome operator that may be related to the implementation of the requirements of this Part.

16.5.16 COMMUNICATIONS

(a) The Authority shall respond in writing to the Aerodrome operator within 14 working days to confirm receipt of any report, application, proposal or amendment it receives from the Aerodrome operator.

(b) The Authority shall approve, and, unless otherwise specified in this Part, shall notify the Aerodrome operator in writing of its approval, within 30 working days of receipt of the report, application, proposal or amendment, or within the same timeframe it shall notify the Aerodrome operator in writing of deficiencies requirements that it must address and the date by which the deficiencies or requirements must be addressed.

16.5.17 AERODROME ENVIRONMENTAL COMMITTEE

(a) The Aerodrome operator shall establish an Aerodrome Environment Committee to advise and facilitate the application of this Part generally, including the noise reduction and management measures as well as carbon management at the Aerodrome to minimize the adverse effect of carbon emissions.

(b) The committee shall comprise an odd number of full members drawn from relevant government and municipal entities, a representative of the airlines, other entities that the Aerodrome operator considers relevant.

(c) The Authority may attend meetings of the committee as an observer. All full members of the Committee shall have equal voting rights.

(d) The Aerodrome Operator shall:

(1) Chair the meetings of the Committee.

(2) Set the agenda of meetings of the committee and distribute this to members of the committee and to the Authority at least 5 working days before each meeting of the committee.

(3) Prepare Minutes of each meeting of the committee and distribute the minutes to each member of the committee and to the Authority within 5 working days following each meeting.

(e) The Committee shall meet at least once every three (3) months.

(f) Unless it can show just cause the Aerodrome operator shall comply with the resolutions of the Committee