



Opinion No 09/2017

Implementation of the CAEP/10 amendments on climate change, emissions and noise

RELATED NPA/CRD: 2017-01 — RMT.0513 & RMT.0514

EXECUTIVE SUMMARY

The main objective of this Opinion is to reduce aviation’s climate change and local air quality impact by introducing the new ICAO aeroplane CO₂ standard and aircraft engine non-volatile particulate matter (PM) emissions standard into European Union (EU) legislation. Additional amendments are aimed at making the implementation of existing standards for noise and engine emissions more robust by introducing the respective updates from the ICAO Annex 16 standards into EU legislation.

The new and amended ICAO Standards (Annex 16 Volumes I, II and III) were adopted by the ICAO Council at the 7th meeting of its 210th Session on 3 March 2017 following consultation of ICAO Member States and based on the approval by the ICAO Committee on Aviation Environmental Protection at its 10th meeting (CAEP/10).

The amendments to ICAO Annex 16 Volume I address technical implementation issues with noise certification standards (Standards and Recommended Practices (SARPs)). The amendments to ICAO Annex 16 Volume II implement a new non-volatile PM emissions standard and address various technical implementation issues. The purpose of the 1st Edition of ICAO Annex 16 Volume III is to implement the new aeroplane CO₂ emissions standard.

EASA consulted on the proposed European implementation of the standards in NPA 2017-01 on 17.1.2017. The comments received by stakeholders were taken into account to develop this Opinion, and can be reviewed in CRD to NPA 2017-01 on the EASA website.

This Opinion is provided to the European Commission as the technical basis to prepare the proposed new EU legislation.

Action area:	Aircraft noise (RMT.0513); climate change (RMT.0514)		
Affected rules:	Regulation (EC) No 216/2008; Annex I (Part 21) to Regulation (EU) No 748/2012 and related AMC/GM; CS-34; CS-36; CS-CO2 (new)		
Affected stakeholders:	Member States; design organisations; production organisations		
Driver:	Environment	Rulemaking group:	No
Impact assessment:	Full (by ICAO CAEP)	Rulemaking Procedure:	Standard

• EASA rulemaking process milestones



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1. About this Opinion

1.1. How this Opinion was developed

EASA developed this Opinion in line with Regulation (EC) No 216/2008¹ (hereinafter referred to as the 'Basic Regulation') and the Rulemaking Procedure².

This rulemaking activity is included in the EASA 5-year Rulemaking Programme³ under rulemaking tasks RMT.0514 and RMT.0513. The scope and timescales of the tasks were defined in the related ToR⁴.

The *draft* text of this Opinion has been developed by EASA based on the outcome of the 10th meeting of the ICAO Committee on Aviation Environmental Protection (CAEP/10) and the 210th meeting of the ICAO Council. All interested parties were consulted through NPA 2017-01^{5,6}. 47 comments were received from interested parties, including industry, national aviation authorities (NAAs), and non-governmental organisations.

EASA has addressed and responded to the comments received on the NPA. The comments received, and the EASA responses thereto, are presented in Comment-Response Document (CRD) 2017-01⁷.

The *final* text of this Opinion and the draft regulations have been developed by EASA. The draft rule text proposed by EASA is published on the EASA website⁸.

The major milestones of this rulemaking activity are presented on the title page.

1.2. The next steps

This Opinion contains the proposed amendments to Regulation (EC) No 216/2008 and to Commission Regulation (EU) No 748/2012⁹, and their potential impacts. It is submitted to the European Commission to be used as a technical basis in order to prepare new EU legislation that incorporates CAEP/10 amendments on aircraft noise and emissions into Article 6 of Regulation (EC) No 216/2008 and into Annex I (Part 21) to Commission Regulation (EU) No 748/2012.

The decision containing the related certification specifications (CSs)/acceptable means of compliance (AMCs)/guidance material (GM) will be published by EASA when the related regulations are adopted by the European Commission, the European Parliament and the Council.

¹ Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1) (<http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1467719701894&uri=CELEX:32008R0216>).

² EASA is bound to follow a structured rulemaking process as required by Article 52(1) of Regulation (EC) No 216/2008. Such a process has been adopted by the EASA Management Board (MB) and is referred to as the 'Rulemaking Procedure'. See MB Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by EASA for the issuing of opinions, certification specifications and guidance material (<http://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-18-2015-rulemaking-procedure>).

³ <http://easa.europa.eu/rulemaking/annual-programme-and-planning.php>

⁴ ToR RMT.0513 and RMT.0514 'Implementation of the CAEP/10 amendments: Climate change, emissions and noise' Issue 1, available at <https://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-rmt0513-and-rmt0514>.

⁵ In accordance with Article 52 of Regulation (EC) No 216/2008, and Articles 6(3) and 7 of the Rulemaking Procedure.

⁶ NPA 2017-01 'Implementation of the CAEP/10 amendments on climate change, emissions and noise' available at <https://www.easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2017-01>.

⁷ <http://easa.europa.eu/document-library/comment-response-documents>

⁸ <http://easa.europa.eu/document-library/opinions>

⁹ Commission Regulation (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (OJ L 224, 21.8.2012, p. 1) (<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0748&qid=1508165856865&from=EN>).

2. In summary — why and what

2.1. Why we need to change the rules — issue/rationale

Following its 10th formal meeting (CAEP/10) from 1 to 12 February 2016, the ICAO CAEP recommended amendments to ICAO Annex 16 Volume I 'Aircraft Noise' and Volume II 'Aircraft Engine Emissions', as well as the creation of a new Volume III 'Aeroplane CO₂ Emissions'. These recommendations are the outcome of work conducted during the 3 years preceding the meeting in accordance with the CAEP/10 Work Programme, and that were subsequently adopted by the ICAO Council at the 7th meeting of its 210th Session on 3 March 2017.

Amendment 12 of the 7th Edition of ICAO Annex 16 Volume I addresses technical issues arising from the application of the SARPs and related guidance for aircraft noise certification, and includes miscellaneous editorial changes and corrections to enhance the documents' utility and compatibility with ICAO Doc 9501 'Environmental Technical Manual' (ETM) Volume I 'Procedures for the Noise Certification of Aircraft'. This includes the definition of reference conditions, flight path measurement techniques and guidelines for noise certification of tilt-rotor aircraft. There are no changes to the noise limits. All changes to Volume I are considered to be stringency-neutral. No new standard on aircraft noise was recommended at CAEP/10.

Amendment 9 of the 3rd Edition of ICAO Annex 16 Volume II addresses various technical issues arising from the application of the SARPs and related guidance for aircraft engine emissions certification. These include a definition of 'engine type certification', an update to the sampling line temperature stability limits, a change of the NO_x analyser calibration gas to NO, and a change in the naphthalene content within the test fuel specifications. There are no changes to the existing emissions limits. All changes to Volume II are considered to be stringency-neutral. In addition, a new nvPM-emissions mass concentration standard has been introduced as Chapter 4 into Part III. This is supplemented by Appendix 7 which contains the certification procedures, including measurement methodology, system operation and instrument calibration.

The proposed new Volume III of ICAO Annex 16 introduces an aeroplane CO₂ emissions standard for both new and in-production aeroplane types.

In addition to the amendments to ICAO Annex 16, CAEP/10 approved ICAO Doc 9501 'Environmental Technical Manual' (ETM), Volume I 'Procedures for the Noise Certification of Aircraft', Volume II 'Procedures for the Emissions Certification of Aircraft Engines' and a new Volume III 'Aeroplane CO₂ Emissions'. The updated ETM Volumes provide clarifications and additional guidance material to facilitate a harmonised implementation of ICAO Annex 16.

The current EASA rules and measures make a direct reference to the amendments to Volumes I and II of ICAO Annex 16, as well as to specific editions of the ETM. These rules and measures need therefore to be amended to ensure that the EU regulations in the field of aviation environmental protection are aligned with the latest ICAO SARPs and associated guidance material.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 2 of the Basic Regulation. This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in this



section. The specific objective of this proposal is to ensure a high uniform level of environmental protection, as well as to provide a level playing field for all actors in the aviation sector, by aligning the EU implementing rules (IRs) and AMCs/GM/CSs with the ICAO SARPs (ICAO Annex 16) and guidance (ETM).

2.3. How we want to achieve it — overview of the proposals

This Opinion proposes amendments to:

- the Basic Regulation;
- Annex I (Part 21) to Commission Regulation (EU) No 748/2012;
- the AMCs/GM to Annex I (Part 21);
- CS-34 'Aircraft Engine Emissions and Fuel Venting'; and
- CS-36 'Aircraft Noise'.

Additionally, it proposes to create a new CS-CO₂.

The proposed amendments are drafted to reflect the updates in the ICAO SARPs and guidance material, as described hereafter:

ICAO Annex 16 Volume I amendment

This amendment addresses technical issues arising from the application of the SARPs and related guidance for aircraft noise certification, and includes miscellaneous editorial changes and corrections to enhance the documents' utility and compatibility with ETM Volume I:

(a) Definition of reference conditions

The amendment aims to ensure consistency in the way each of the Chapters of Volume I define the reference atmosphere in order to improve clarity, thereby providing for a common interpretation. The proposed changes use common text to define the same concept. Moreover, the current situation whereby identical text (e.g. in current Chapter 3, Section 3.6.1.5 and Chapter 8, Section 8.6.1.5) has different intended meanings has been remedied. In addition, references to the ICAO 'standard atmosphere' and to related guidance material in the ETM have been added.

This proposal also includes amendments to the definition of the reference day speed of sound in terms of a temperature lapse rate, and to the derivation of reference power in terms of temperature and pressure lapse rates, as defined by the ICAO 'standard atmosphere'.

(b) Flight path measurement techniques

The amendment proposes to remove references to outdated flight path measurement techniques and align the text of Volume I with the extensively revised guidance material of ETM Volume I.

(c) Guidelines for noise certification of tilt rotor

The amendment proposes to correct editorial and technical errors in Attachment F 'Guidelines for noise certification of tilt-rotor aircraft' and standardise the terminology and symbols throughout Volume I.



ICAO Annex 16 Volume II amendment

This proposed amendment of the SARP in Volume II addresses technical issues arising from the application of the SARP and related guidance for aircraft engine emissions certification, and includes miscellaneous editorial changes and corrections:

(a) Definition of 'engine type certification' added

The term 'type-certificated engine' is used in the definition of the 'derivative version' of an engine, and 'engine type certificate' is also used in ETM Volume II. In that context, a definition of the term 'type certificate' has been added in Part I Chapter 1.

(b) Update of the sampling line temperature stability limits

The Volume II Appendix 3 paragraph 5.1.2 requirements for sampling line temperature stability are to maintain the line temperature at 160 ± 15 °C (with a stability of ± 10 °C). This could be interpreted to allow a range of temperatures of 135 to 185 °C, whereas the intent of the current text is to ensure that the line temperature is maintained at 160 ± 15 °C (i.e. 145 to 175 °C). To clarify this issue, the amendment proposes the deletion of 'with a stability of ± 10 °C', which also aligns the text with Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) 1256D.

(c) Improve calibration and use of NO_x analysers

For the NO_x analyser, the current Attachment D to Appendix 3 requires a test gas of NO in zero nitrogen and a calibration gas of NO_x in zero nitrogen. SAE ARP 1256D recommends NO_x for both test and calibration gases. This inconsistency between ICAO and SAE specifications was discussed within CAEP and SAE, and both groups came to the same conclusion of specifying the use of NO in zero nitrogen for both test and calibration gases.

In practice, the NO bottles contain traces of NO₂ (usually a few ppm). An NO_x bottle could be misinterpreted as a true mixture of NO and NO₂ compared to an NO bottle with traces of NO₂. Some bottle providers indicate the NO concentration as well as the NO_x concentration to reflect the presence of NO₂ in small quantities. Generally, the NO_x analyser can be calibrated by two different approaches depending on the measurement mode being utilised ('NO only' mode or 'NO_x' mode). The NO mode is considered as the default mode since NO is what is measured by the NO_x analyser. When the NO mode is used, the presence of NO₂ is not desirable. In this case, it is appropriate to require NO in zero nitrogen for both the calibration and test gas, instead of NO_x in zero nitrogen. Thus, the calibration and test gas for the NO_x analyser in Attachment D to Appendix 3 should be NO in zero nitrogen.

The amendment proposes to change the calibration gas to NO in Attachment D to Appendix 3, and ETM Volume II provides technical procedural information on the NO_x analyser calibration.

(d) Change in the naphthalene content within the test fuel specifications to facilitate use of commercially available jet fuel

The current emissions test fuel specification allows naphthalene to be present in the fuel between 1 and 3.5 % vol. An ICAO/CAEP investigation highlighted that manufacturers and organisations involved in gas turbine emissions measurements have reported difficulties in obtaining fuel that meets the minimum naphthalene content test fuel specification of

Appendix 4. This investigation concluded that the ICAO Annex 16 naphthalene limits are not representative of current, commercially available jet fuel.

When consideration was given to removing the lower limit on the naphthalene content in the emissions test fuel specification (i.e. from 1 to 0 % vol.), it was concluded that there would be no effect on gaseous emissions levels, and a negligible effect on the 'Smoke Number' (SN) level as long as the aromatic and hydrogen content remains within the current emissions test fuel specification limits. There is no proposal to change the current aromatic and hydrogen limits.

The amendment proposes to change the naphthalene content range of the emissions test fuel specification (Appendix 4) to between 0 and 3 % vol. (from between 1 and 3.5 % vol.).

(e) Introduction of an aircraft engine nvPM (Chapter 4 and Appendix 7)

Aircraft engines burning hydrocarbon-based fuels emit gaseous and PM emissions as by-products of combustion. At the engine exhaust, particulate emissions mainly consist of ultrafine soot or black carbon emissions. Such particles are called non-volatile PM (nvPM). Compared to traditional diesel engines, non-volatile particles from gas turbine engines are typically smaller in size. Their geometric mean diameter ranges approximately from 15 to 60 nm (0.06 micrometres; 10nm = 1/100 000 of a millimetre (mm)). These particles are ultra-fine and invisible to the human eye.

During the CAEP/10 meeting, the first nvPM standard for aircraft engines was recommended. The proposed amendment includes the new nvPM engine emissions standard in Chapter 4 as well as the nvPM sampling and measurement system provisions in Appendix 7. The proposed nvPM standard will apply to turbofan and turbojet engines manufactured as from 1 January 2020, and is for aircraft engines with rated thrust greater than 26.7 kN.

The regulatory limit applied within the nvPM mass concentration standard is equivalent to the current ICAO Annex 16 Volume II SN regulatory limit. If an engine meets the current SN regulatory limit, it will also meet the proposed nvPM regulatory limit. Therefore, the proposed CAEP/10 nvPM standard does not introduce a new stringency. The main benefit of the nvPM standard is that it aims to address the visibility of engine emissions (as per SN) while also being more relevant to the impact on human health.

The purpose of the engine exhaust emission certification is to compare engine technologies and to ensure that the engines produced comply with the prescribed regulatory limits. The nvPM sampling and measurement system requirements, as described in the proposed Appendix 7, standardise the particle losses in the measurement system such that particle losses are minimised and that engine measurements performed by engine manufacturers at different test facilities are directly comparable. The proposed nvPM standard will allow, for the first time, the technological comparison of different engine type designs in terms of nvPM emissions.

The nvPM sampling and measurement system will lose a portion of the particles when they travel through the sampling lines because of the very small size of the nvPM particles. Therefore, the nvPM emissions measured at the instruments will be lower than the values at the exit plane of the engine. For emission inventories and impact assessments, nvPM emissions at the engine exit should be estimated through application of a standardised methodology to better reflect real-world emissions. To achieve this, an nvPM system loss correction method is proposed, and



the reporting of nvPM system loss correction factors is requested (Part IV and Appendix 8). The proposed Part IV and Appendix 8 request the reporting of particle losses although this is not part of the proposed nvPM certification requirements.

Overall, the proposed nvPM standard will allow manufacturers to become more familiar with the nvPM measurement certification requirements. It will also provide data to support the development of an nvPM mass and number landing take-off (LTO)-based standard, aiming for CAEP/11 in 2019, which will be more relevant to human health and climate impacts.

- (e) Update of ICAO Annex 16 Volume II to include the new nvPM emissions standard

The amendment proposes to introduce the necessary changes into a large number of sections in order to incorporate the proposed new nvPM standard.

ICAO Annex 16 Volume III — 1st Edition

The purpose of the 1st Edition of ICAO Annex 16 Volume III is to implement the new standard and related guidance for aeroplane CO₂ emissions certification.

Volume III is applicable to new aeroplane type designs as from 1.1.2020, except for aeroplanes with a maximum take-off mass (MTOM) of less than or equal to 60 t and with a maximum operational passenger seating configuration (MOPSC) of less than or equal to 19 seats, for which the applicability date is 1.1.2023. The requirements for aeroplane type designs that are already in production are also applicable as from 1.1.2023. If an in-production aeroplane type design is changed at a time beyond 1.1.2023 and meets agreed change criteria, then the aeroplane will have to comply with the CO₂ emissions standard. As from 1.1.2028, there will be a general production cut-off irrespective of whether the type design has been changed, which means that in-production aeroplane types can only continue to be produced if the design meets that standard. The CO₂ emissions standard covers subsonic jet aeroplanes with an MTOM of greater than 5 700 kg and propeller-driven aeroplanes with an MTOM of greater than 8 618 kg. The CO₂ emissions standard is especially stringent for larger aeroplanes with an MTOM of greater than 60 t, where it will have the greatest environmental benefit. This recognises the fact that the designs of larger aeroplanes have had access to the broadest range of CO₂ emissions reduction technologies. For aeroplanes with an MTOM of less than or equal to 60 t, the standard provides some margin for a sector that has not had access to the most advanced technologies.

Volume III was designed to be environmentally effective, technically feasible and economically reasonable, while considering environmental interdependencies. The final decision on the CO₂ emissions standard was supported by a data-informed process that included a cost-effectiveness modelling analysis of various stringency and applicability options.

ICAO Doc 9501 'Environmental Technical Manual', Volume I 'Procedures for the Noise Certification of Aircraft'

The document was revised during the 10th CAEP cycle¹⁰. The revision includes various editorial improvements as well as the following changes:

- (a) new guidance on the calculation of confidence intervals for interpolation between already approved noise/mass values (Chapter 4.2);

¹⁰ The latest version is available at <http://www.icao.int/environmental-protection/Pages/environment-publications.aspx>.

- (b) improved guidance to reflect modern aircraft tracking methods using differential global positioning tracking systems (Chapter 3.2);
- (c) introduction of guidelines for recertification of aircraft to ICAO Annex 16, Volume I, Chapter 14 (Chapter 9); and
- (d) introduction of guidelines on the certification standards for tilt rotors into Annex 16, Volume I, Chapter 13 and Attachment F (Chapter 7).

ICAO Doc 9501 'Environmental Technical Manual', Volume II 'Procedures for the Emissions Certification of Aircraft Engines'

This document was revised during the 10th CAEP cycle¹¹. The revision includes new guidance text associated with:

- (a) clarification of the carbon balance check (Appendix 3, paragraph 6);
- (b) clarification of the engine type certification definition (Part I, Chapter 1);
- (c) clarification of the calibration gases for the NOx analyser (Appendix 3, Attachment D);
- (d) guidance text on the possibility to elect to comply with the latest standard (Part III, Chapter 2);
- (e) clarification of the probe temperature (Appendix 3, paragraph 5);
- (f) technical and equivalent procedures to meet the fuel venting requirements (Part II, Chapter 2);
- (g) guidance on the 'no emissions change' certification process (Part III, Chapter 2);
- (h) procedures for the nvPM emissions certification of aircraft engines (Part III, Chapter 4 and Appendix 7); and
- (i) miscellaneous editorial changes and corrections to enhance the documents.

ICAO Doc 9501 'Environmental Technical Manual', Volume III 'Procedures for the CO₂ Emissions Certification of Aeroplanes'

The new Volume III of the ETM was created during the 10th CAEP cycle to complement the new ICAO Annex 16 Volume III.

2.4. What are the stakeholders' views — outcome of the consultation

The comments from state organisations (10) and from industry (33) on NPA 2017-01 were generally positive, with some suggestions for clarification of the text within the NPA. 4 comments were received from non-governmental organisations which questioned the methodology of the standard-setting process and the environmental effectiveness of the final decisions.

2.5. What are the expected benefits and drawbacks of the proposals

The impact assessment (IA) performed as part of NPA 2017-01 highlighted the expected benefits and drawbacks of the two policy options identified, namely: leave current rules unchanged (i.e. 'do nothing') or implement the CAEP/10 amendments. Out of these two options, only Option 1 (implementation of the CAEP/10 amendments) has positive impacts in various aspects (environment,

¹¹ The latest version is available at <http://www.icao.int/environmental-protection/Pages/environment-publications.aspx>.

economics and harmonisation), while Option 0 ('do nothing') has negative impacts in all these aspects. It is therefore proposed to select Option 1 and proceed with the implementation of the CAEP/10 amendments. It should be noted that CAEP/10 amendments result from the work of the CAEP working groups during the 2013–2016 period, in which European stakeholders were actively involved. In particular, the CAEP working groups have conducted a detailed cost-effectiveness analysis of the various stringency options envisaged for the proposed new aeroplane CO₂ standard.

2.6. How we monitor and evaluate the rules

The ICAO Annex 16 Volume I 'Aircraft Noise', Volume II 'Aircraft Engine Emissions' and Volume III 'Aeroplane CO₂ Emissions' requirements will be continuously reviewed within the ICAO CAEP work programme and monitored in the European Aviation Environmental Report (EAER)¹². This will typically involve monitoring newly certified data points to inform discussions on when to review a regulatory limit. In addition, if there are issues identified in implementing the certification requirements during a type certification programme, then these lessons learnt shall be fed back into the CAEP process and the requirements shall be updated.

Done at Cologne, on 6 November 2017.

Patrick KY
Executive Director

¹² <https://www.easa.europa.eu/eaer/>



3. References

3.1. Affected regulations

- Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1)
- Commission Regulation (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (OJ L 224, 21.8.2012, p. 1)

3.2. Related decisions

- Decision No. 2003/3/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications providing for acceptable means of compliance for aircraft engine emissions and fuel venting ('CS-34')
- Decision No. 2003/4/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications providing for acceptable means of compliance for aircraft noise ('CS-36')
- Decision N° 2012/020/R of the Executive Director of the Agency of 30th October 2012 on Acceptable Means of Compliance and Guidance Material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organizations ('AMC and GM to Part-21')

3.3. Other reference documents

- ICAO CAEP/10 Working Paper (WP)/92, Report of the 10th meeting of the Committee on Aviation Environmental Protection, February 2016
- ICAO State Letter AN 1/17.14-16/53, 'Proposals for the amendment of Annex 16, Volume I concerning Standards and Recommended Practices relating to environmental protection — Aircraft noise', 8 July 2016
- ICAO State Letter AN 1/17.14-16/55, 'Proposals for the amendment of Annex 16, Volume II concerning Standards and Recommended Practices relating to environmental protection — Aircraft engine emissions', 8 July 2016
- ICAO State Letter AN 1/17.14-16/56, 'Proposals for the First Edition of Annex 16, Volume III, concerning Standards and Recommended Practices relating to environmental protection — Aeroplane CO₂ emissions', 8 July 2016
- Annex 16 'Environmental Protection' to the Convention on International Civil Aviation
- ICAO Doc 9501 'Environmental Technical Manual', Volumes I, II and III



4. Appendix

Appendix to Opinion No 09/2017: CRD to NPA 2017-01 'Implementation of the CAEP/10 amendments on climate change, emissions and noise'

