

Business Jets Workshop 2025



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EASA Headquarters
Cologne, Germany

#easabusinessjets



Aeroplane CO₂ Certification

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Overview on ICAO Environmental Standards



Aircraft Noise

ICAO Annex 16 Vol. I



Engine Emissions

ICAO Annex 16 Vol. II



Aeroplane CO₂

ICAO Annex 16 Vol. III

Covered species:

- Nitric oxides (NO_x),
- Carbon monoxide (CO)
- Unburned hydrocarbons (HC)
- Visible smoke
- Non-volatile particulate matter (nvPM)

Implementation in Europe



→ Basic Regulation (EU) 2018/1139

Article 9 (2) contains direct reference to requirements of ICAO Annex 16
Volumes I (Aircraft Noise), II (Engine Emissions), and **Volume III (Aeroplane CO₂)**

→ Implementing Regulation (EU) 748/2012 (amended by Reg. (EU) 2019/897)

21.B.85 specifies the applicable Chapters per product from the ICAO Annex 16.

→ EASA Certification Specifications

CS-34 (engine emissions), CS-36 (aircraft noise), and **CS-CO₂** (aeroplane CO₂ emissions)

Note: EASA's environmental CSs are planned to be discontinued. The ICAO Annex 16 contains the applicable environmental protection requirements in Europe!

Applicability

Source: ICAO Annex 16 Vol. III, Part II, Chapter 2

New-Types
from 2020/2023

Derived versions*
from 2023 (-2028)

* To be considered together with the definition of a derived version of non-CO₂-certified aeroplanes from Chapter 1 of Annex 16 Vol. III

In-Production aircraft
from 2028

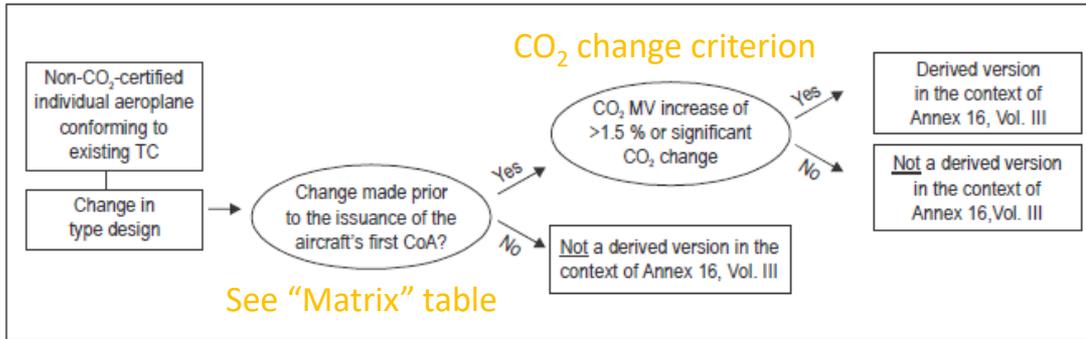
2.1 Applicability

Note.— See also Chapter 1, 1.4, 1.5, 1.6, 1.7, 1.8 and 1.11.

2.1.1 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:

- a) 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;
- b) 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;
- c) 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;
- d) derived versions of non-CO₂-certified subsonic jet aeroplanes, including their subsequent CO₂-certified derived versions, 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;
- e) derived versions of non-CO₂ certified propeller-driven aeroplanes, including their subsequent CO₂-certified derived versions, 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 1 January 2023;
- f) individual non-CO₂-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
- g) individual non-CO₂-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.

Derived versions of non-CO₂ certified aeroplanes (“deep dive”)



Left: *Elements of the definition of a derived version of non-CO₂-certified aeroplanes*

Source: ETM Vol. III, 3rd edition, Section 2.2.3

Right: *“Matrix” of CO₂ Standard applicability for derived versions*

Take-away message:

Only changes intended for newly-produced individual aeroplanes typically trigger CO₂ certification based on the derived versions applicability, if the CO₂ change criterion is met.

Case No.	Date of application for the change in type design is...	Date of individual aeroplane's first CoA is issued...	CO ₂ certification required if CO ₂ change criterion is met*	Examples (Non-exhaustive)
1	Before 1 January 2023	Before the change is made	No	Individual in-service aeroplanes
2		After the change is made	No	Individual in-production aeroplanes
3	After 1 January 2023	Before the change is made	No	Individual in-service aeroplanes
4		After the change is made	Yes	Individual in-production aeroplanes
* Increase of CO ₂ MV > 1.5 per cent or significant CO ₂ change, per 'derived version' definition.				

Aeroplane CO₂ Standard – Metric

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

SAR: Specific Air Range (km/kg fuel)

RGF: Reference Geometric Factor (-)

- How to obtain SAR? -> *See Appendix 1 of Annex 16 Vol. III*
 - By approved flight test measurements in cruise, corrected to reference conditions.
 - Or by use of an approved performance model validated by flight test data.
- RGF is a dimensionless measure of the aeroplane's cabin size.
 - > *See Appendix 2 of Annex 16 Vol. III for details*
- The CO₂ metric value is compared to the applicable limit, which is a function of Maximum Take-off Mass (MTOM).

Information for the TCDS

- Compliance to the CO₂ standard is recorded in the EASA TCDS as follows:

7.3 Carbon Dioxide Emissions

ICAO Annex 16, Volume III, Amendment **1**,
CO₂ standard in accordance with Part II, Chapter 2, paragraph 2.4.2 **c) / f)**;
Note: corresponds to CAEP/10 **New Type / In-Production** Standard.
For CO₂ metric values see [EASA Aeroplane CO₂ Emissions Database](#).

Request for OEMs

- Compliance to the Aeroplane CO₂ Standard for In-Production Aeroplanes needs to be demonstrated **by 1 January 2028**.
- EASA encourages **early applications** to kick-off the compliance demonstration to the CO₂ Standard for the current range of products, with sufficient buffer to the 1 January 2028 deadline.

Outlook on ongoing ICAO „rulemaking“

- The **ICAO Committee on Aviation Environmental Protection (CAEP)** continuously maintains and updates the environmental standards in ICAO Annex 16.
- A potential **„Dual Stringency“** of ICAO’s Aeroplane Noise and CO₂ Emissions Standards will be decided on at the CAEP/13 meeting in February 2025, which may lead to more stringent limits for new-type and/or in-production aeroplanes with applicability in the late 2020s or 2030s.

FAA Part 38

Airplane Fuel Efficiency Certification



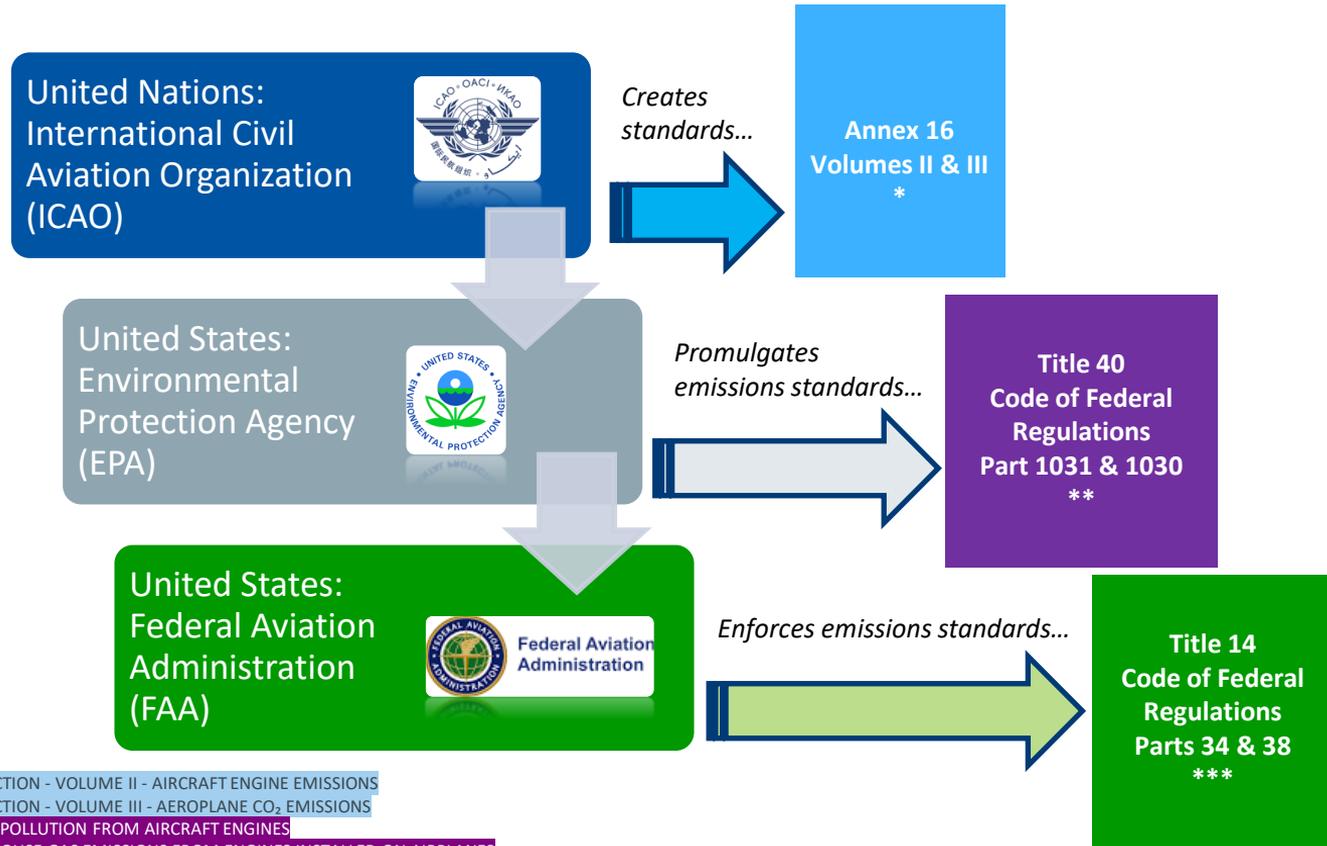
**Federal Aviation
Administration**



Part 38 – Implementation

- In the US, requirements from ICAO Annex 16 Vol. III have been implemented in airplane certification as Part 38 – Airplane Fuel Efficiency Certification.
- The FAA’s Part 38 requirements are aligned with ICAO Annex 16 Vol. III, to ensure international compatibility. Minor differences include:
 - Terminology updated as needed to be compatible with FAA’s regulatory framework for airplane certification (e.g., name of standard, referring to modifications within applicability section instead of definitions of derived versions).
 - Applicability dates for new type standards are the effective dates of when the rulemaking was completed (i.e., 11/1/2021 vs the 1/1/2020 international effective date because the new rule could not to be retroactive and the delay did not affect any projects).
 - Publication of metric values in the airplane flight manual (AFM) to ensure clarity on the status of individual airplanes.
 - “Significant CO₂ changes” under changes to non-CO₂ certified airplanes was not included in the FAA rule due to lack of clarity needed to enforce it. The >1.5% element under the same changes to non-CO₂ certified airplanes was included, and any change larger than 1.5% is considered to cover “significant CO₂ changes”.

Part 38 – Implementation



* ICAO: ANNEX 16 - ENVIRONMENTAL PROTECTION - VOLUME II - AIRCRAFT ENGINE EMISSIONS

* ICAO: ANNEX 16 - ENVIRONMENTAL PROTECTION - VOLUME III - AEROPLANE CO₂ EMISSIONS

** EPA: 40 CFR PART 1031—CONTROL OF AIR POLLUTION FROM AIRCRAFT ENGINES

** EPA: 40 PART 1030—CONTROL OF GREENHOUSE GAS EMISSIONS FROM ENGINES INSTALLED ON AIRPLANES

*** FAA: 14 CFR PART 34—FUEL VENTING AND EXHAUST EMISSION REQUIREMENTS FOR TURBINE ENGINE POWERED AIRPLANES

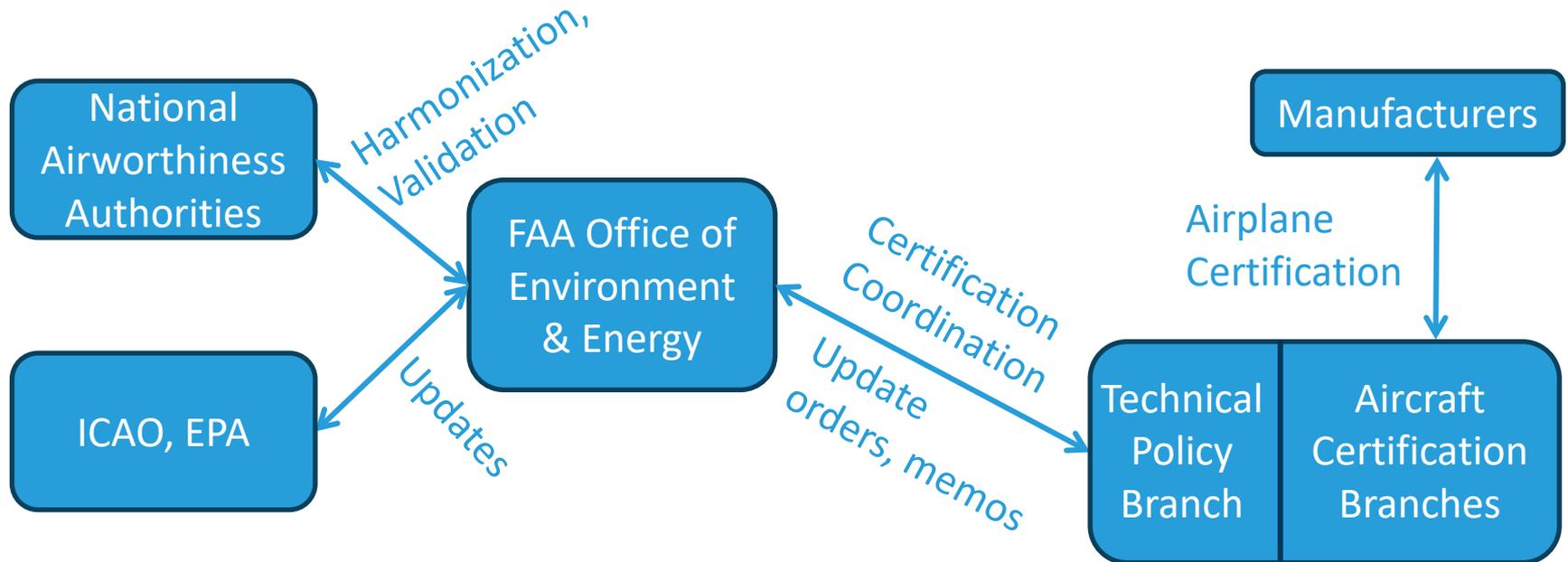
*** FAA: 14 CFR PART 38—AIRPLANE FUEL EFFICIENCY CERTIFICATION

Part 38 Structure

- Subpart A—General
 - 38.1 Applicability.
 - 38.3 Definitions.
 - 38.4 Compatibility with airworthiness requirements.
 - 38.5 Exemptions.
 - 38.7 Incorporation by reference.
 - 38.9 Relationship to other regulations.
- Subpart B—Determining Fuel Efficiency for Subsonic Airplanes
 - 38.11 Fuel efficiency metric.
 - 38.13 Specific air range.
 - 38.15 Reference geometric factor.
 - 38.17 Fuel efficiency limits.
 - 38.19 Change criteria.
 - 38.21 Approval before compliance testing.
 - 38.23 Manual information and limitations.
- Appendix A to Part 38—Determination of Airplane Fuel Efficiency Metric Value
 - A38.1 Introduction
 - A38.2 Reference specifications for SAR flight tests
 - A38.3 Determination of reference geometric factor (RGF)
 - A38.4 Certification test specifications
 - A38.5 Measurement of specific air range
 - A38.6 Submission of certification data to the FAA

Part 38 Coordination Overview

- Part 38 requires domestic/internal and international/external coordination.
- Key areas of coordination include airplane certification, harmonization and validation, roles and responsibilities, and standard updates.



Request to OEMs

- The FAA shares EASA's views, shown on slide 9, regarding OEMs' proactive work with NAAs to ensure affected applicable airplanes are certified to the standard by 1 January 2028. It is essential that certifications are planned out in an orderly manner to avoid a large number of projects from various manufacturers piling up in 2027.
- Given the standard is new and will require OEMs/NAAs to gain experience/knowledge, the FAA requests OEMs to recognize that certification procedures will likely take iterations as experience is gained through certification projects. This is another reason that proper time/schedule management between now and 1 January 2028 is critical.

Backup Slides

Reference Points for SAR Measurements



SAR is measured at three Reference Gross Masses:

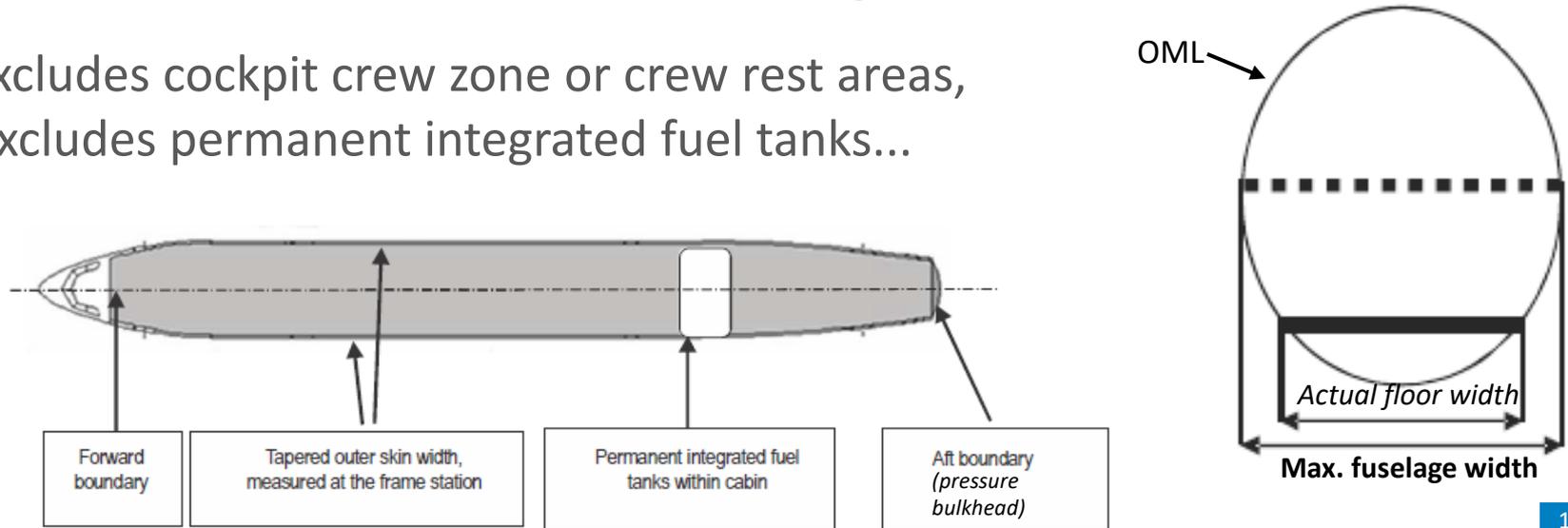
- High Gross Mass: 92% MTOM
- Mid Gross Mass: average of high and low GM
- Low Gross Mass: $0.45 * MTOM + 0.63 * MTOM^{0.924}$

Other reference conditions:

- Combinations of altitude and airspeed for the three gross masses selected by the applicant
(and typically expected to be the SAR-optimal conditions, i.e. MRC Mach at optimum altitude)
- ISA Standard Atmospheric Conditions

What is the Reference Geometric Factor (RGF)?

- Is a measure of fuselage size, independent of an operator's operational considerations.
- Can be understood as generic floor area, if the cabin floor was at the position of maximum width of the fuselage outer mould line (OML)
- Excludes cockpit crew zone or crew rest areas, excludes permanent integrated fuel tanks...



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