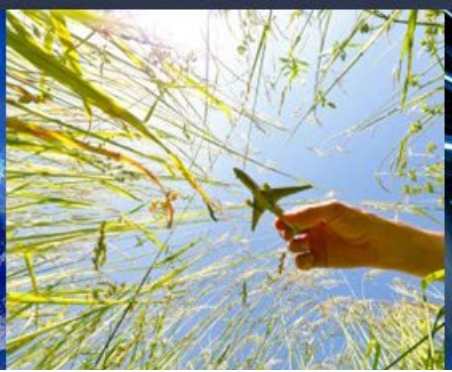
# Introduction to the ICAO Airplane $CO_2$ Certification Database

**Version 1.1**

**June 2023**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# INTRODUCTION

## Background

The International Civil Aviation Organization's (ICAO) Airplane $CO_2$ Certification Database ($CO_2$DB) contains information on airplane $CO_2$ emissions, determined according to the procedures in ICAO Annex 16, Volume III, and where noted, certified by the States of Design of the airplanes according to their national regulations.

The $CO_2$DB covers new airplane type designs from 2020, and airplane type designs already in-production as of 2023. Those in-production airplanes which by 2028 do not meet the standard will no longer be able to be produced unless their designs are sufficiently modified to comply with the in-production standard. In accordance with Annex 16 Volume III, the CO2DB covers subsonic jet airplanes over 5,700 kg and propeller-driven airplanes over 8,618 kg.

The information is provided by the Certification Authority of State of Design or airplane manufacturers, who are solely responsible for its accuracy. The U.S. Federal Aviation Administration (FAA) is hosting the $CO_2$DB on behalf of ICAO and is not responsible for the contents.

The objective of the $CO_2$DB is to:

- Provide publicly available data on the $CO_2$ metric value (MV) which represents an indication of $CO_2$ emissions performance of airplane types against $CO_2$ technology/design standards.
- Track and communicate the improvement in airplane $CO_2$ MVs over time.
- Provide an incentive to improve the $CO_2$ MV of airplane types.

## Overview of the ICAO Airplane $CO_2$ Certification Database

The ICAO $CO_2$DB includes several key components:

- ***CO2DB Datasheet Template*** to be used by manufacturers or the CA to submit data to the database manager for review and integration into the database. To ensure standardized data submission, the $CO_2$DB template is available in Excel format and can be widely used by manufacturers and/or CAs.
- ***Database*** that centralizes and integrates the set of data submitted by manufacturers or CAs. The database is available in two formats, including (1) a set of "datasheets" (one per engine or aircraft) in pdf format and (2) a summary and integrated version of the datasheets in Excel format.
- ***Archived versions*** (or Record of Changes) of the database. In support of version control, the $CO_2$DB provides a version number (and date) for the current $CO_2$DB and a Record of Changes that tracks "Issue", "Date of Publication" and "Detail of Changes" of prior versions of the CO2DB.
- ***Supporting Documentation*** that provides background information on the database, data management framework and processes, instructions, etc.

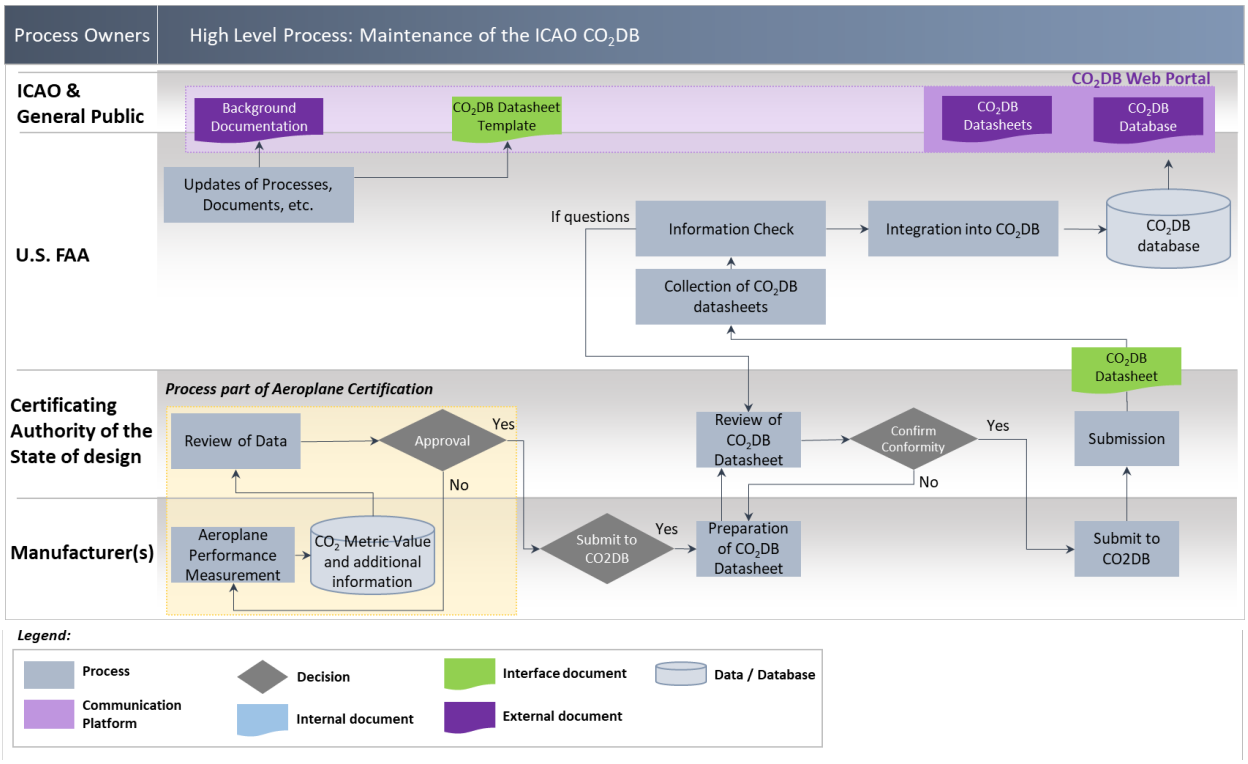
# PROCESSES AND INFORMATION FLOWS ASSOCIATED WITH THE ICAO AIRPLANE CO2DB

The ICAO $CO_2$DB provides publicly available data on the $CO_2$ metric value (MV). As such, it relies on the collection of data from manufacturers and/or Certificating Authorities, processing and integrating this data, and publication on the FAA $CO_2$DB website.

The figure below (Figure 1) shows a summary of the high-level processes associated with the collection, integration, and publication of the $CO_2$DB. The collection of data towards the $CO_2$DB is expected to leverage the Aeroplane Airworthiness Certification process which includes aeroplane performance measurement, computation of relevant metrics (e.g., $CO_2$ MV) and submission of the information to the CA of the State of Design. As part of the airworthiness certification process, the data/information is reviewed by the CA and approved.

Given that the submission of information into the $CO_2$DB is voluntary, the applicant (e.g., manufacturer) decides to submit a $CO_2$DB datasheet to its CA and ultimately to the U.S. FAA. If the applicant (e.g., manufacturer) decides to submit information to the $CO_2$DB, the applicant will prepare a $CO_2$DB datasheet by using the $CO_2$DB Datasheet Template that is publicly available via the $CO_2$DB website.

**Figure 1 | Processes associated with the maintenance and publication of the Airplane CO2DB**



To ensure the quality of the information contained in the $CO_2$DB datasheets, the CA reviews the $CO_2$DB datasheet and conducts a conformity check. Following the review/conformity check of the $CO_2$DB datasheets, if it is determined to conform the CA will inform the applicant that the datasheet is ready to submit to the U.S. FAA. If the CA characterizes the $CO_2$DB as being non-conforming, the CA will inform the applicant and it would be sent back to the applicant for revision(s) and resubmission.

In special circumstances (e.g., if the CA does not have resources or cannot submit $CO_2$DB datasheet(s) to the U.S. FAA), an alternative process could be agreed between the CA, the applicant and the U.S. FAA.

Once the U.S. FAA collects the $CO_2$DB datasheets it may conduct an information check to identify errors or mistakes. Like other ICAO environment databases, the entity submitting the information (in this case CAs) is solely responsible for the accuracy of the information. If there are any questions about submissions, the U.S. FAA will communicate with the CA to attempt to address any questions.

$CO_2$DB datasheets are then integrated into the $CO_2$DB, and the records of changes are updated. The database is made available for download in a common table format (e.g., Microsoft Excel file) as well as a collection of the submitted $CO_2$DB datasheets.

# TEMPLATE FOR CO2DB DATASHEETS

## Overview of the $CO_2$DB datasheet template

As depicted in Figure 1, the $CO_2$DB datasheets are critical throughout the processes from preparations, review, submissions, publication of the information contained in the $CO_2$DB. The template ensures compliance with requirements recommended by ICAO and consistency across submissions.

Figure 2 shows the template of the $CO_2$ Certification data sheet. It includes a section on the identification of the aeroplane type design that captures the aeroplane, engine and propeller information along with the $CO_2$ Certification basis. The aeroplane $CO_2$DB Unique Identifier (UID) is expected to be the primary key to the $CO_2$DB. The applicant can prepare and submit the $CO_2$DB datasheet as TC Holder or STC Holder (available in a drop-down menu in the template).

In the CO2 Certification Basis section, the applicant can enter details about the reference ICAO and national certification basis. The user can also select whether the aeroplane type design is certified against the CAEP/10 In Production certification requirements (in accordance with Annex 16 Volume III, Part II, Chapter 2, 2.4.2 [d]-[f]) or CAEP/10 New Type certification requirements (in accordance with Annex 16 Volume III, Part II, Chapter 2, 2.4.2 [a]-[c]). Selecting a Certification Basis in the associated drop-down boxes will grey out the Limit for this MTOM and the MV Percentage of this limit in the section titled “Summary of data as per ICAO Annex 16 Volume III: Limit for this MTOM and comparison of Metric Value to this limit”. This information will still be computed and displayed for information purpose (only). However, those levels will not be reported in the $CO_2$DB for this UID.

## Figure 2 | Template for the CO2DB Datasheet

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# ICAO $CO_2$ CERTIFICATION DATABASE ($CO_2$DB)

### CO2DB Datasheet Template

Record Status:

**IDENTIFICATION OF AEROPLANE TYPE DESIGN:**

Aeroplane CO2DB UID:

If revised, these data supersede Aeroplane CO2DB UID:

Applicant:

**Aeroplane:**

Aeroplane Type Certificate Identification:

Aeroplane Supplemental Type Certificate Identification (if applicable):

Aeroplane TC Holder:

Aeroplane STC Holder (if applicable):

Aeroplane Type Designation:

Mod. No. / Freeform Description:

Number of Propulsion Engines:

**$CO_2$ Certification Basis:**

Primary Certificating Authority (CA):

Date of $CO_2$ Certification (yyyy-mm-dd):

State's Regulation:

Edition/Amendment:

Certification Basis:

**Engine:**

Engine TC Holder:

Engine STC Holder (if applicable):

Type Designation:

Engine Type Certificate Identification:

Engine Supplemental Type Certificate Identification (if applicable):

Mod. No. / Freeform Description:

**Propeller (if applicable):**

Propeller TC Holder:

Propeller STC Holder (if applicable):

Type Designation:

Propeller Type Certificate Identification:

Propeller Supplemental Type Certificate Identification (if applicable):

Mod. No. / Freeform Description:

**REGULATORY DATA:**

Certified $CO_2$ MTOM (kg): *Value rounded to nearest kilogram*

$CO_2$ Emissions Evaluation Metric Value* (kg/km): *Value rounded to 3 decimal places (X.XXX)*

**Summary of data as per ICAO Annex 16 Volume III : Limit for this MTOM and comparison of Metric Value to this limit**

| | | Limit for this MTOM | MV Percentage of this limit |
|---|---|---|---|
| Part II, Chapter 2, 2.4.2 d)-f) | CAEP/10 In-Production | | |
| Part II, Chapter 2, 2.4.2 a)-c) | CAEP/10 New Type | | |

REMARKS

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The Regulatory Data section includes the aeroplane maximum takeoff mass (MTOM, in kg). When the applicant enters a MTOM value, the template is auto populated with the Limit for this MTOM under the Regulatory Data section (i.e., Summary of data as per ICAO Annex 16 Volume III: Limit for this MTOM and comparison of Metric Value to this limit). When the applicant enters the $CO_2$ Emissions Evaluation Metric Value, the MV Percentage of this limit will be automatically calculated as the ratio of the $CO_2$ Emissions Evaluation Metric Value and the Limit for this MTOM. The $CO_2$ Emissions Evaluation Metric Value should be rounded by the applicant to 3 decimal places (e.g., X.XXX).

A section on Remarks is also made available to capture additional and/or contextual information about the Aeroplane $CO_2$DB UID.

## Details on input fields contained in the $CO_2$DB datasheet template

This section provides additional information and guidance on the process of filling the $CO_2$DB datasheet template. It also includes examples that are for illustrations only.

### IDENTIFICATION OF AEROPLANE TYPE DESIGN:

***General identification:*** This section includes the aeroplane $CO_2$DB UID expected to be a unique identifier. This UID will become the primary key to the CO2DB.

| Data field | Description and guidance |
|---|---|
| Aeroplane $CO_2$DB UID | This field will contain a Unique Identification number that will be used as primary key in the $CO_2$DB.<br>The U.S. FAA will assign a Unique Identification when integrating the datasheet into the $CO_2$DB.<br>This field will be populated in the published version of the $CO_2$DB. |
| Applicant | The applicant should specify its role as<br>(1) a Type Certificate (TC) Holder, or<br>(2) a Supplemental Type Certificate (STC) Holder. |

***Aeroplane:*** This section allows the applicant to capture details about the aeroplane described in the CO2DB datasheet.

| Data field | Description and guidance | Example (for illustration only) |
|---|---|---|
| Aeroplane Type Certificate Identification | This field captures the Aeroplane Type Certificate Identification. | "A16WE" for a Boeing 737-800 |

| | | |
|---|---|---|
| Aeroplane Supplemental Type Certificate Identification (if applicable) | If applicable an Aeroplane Supplemental Type Certificate (STC) Identification can be specified. | "ST00830SE" for a Boeing 737-800 |
| Aeroplane TC Holder | The name of the TC Holder can be entered in this field. This can be the name of the manufacturer or OEM.<br>If the $CO_2$DB datasheet is submitted by more than one TC Holder, additional information should be added as a note in the "Remarks" section. | "The Boeing Company" for a Boeing 737-800 |
| Aeroplane STC Holder (if applicable) | If applicable, the applicant can enter the name of the Supplemental Type Certificate Holder (i.e., entity that holds the Supplemental Type Certificate).<br>If the $CO_2$DB datasheet is submitted by more than one STC Holder, additional information should be added as a note in the "Remarks" section. | "Aviation Partners Boeing" for a Boeing 737-800 |
| Aeroplane Type Designation | The Type Designation of the aeroplane should be entered in this field. | "737-800" for a Boeing 737-800 |
| Mod. No. / Freeform Description | The Model Number or Freeform Description of the aeroplane complement the information provided in the Aeroplane Type Designation. | "737-800W Split Scimitar Winglets" for a Boeing 737-800 |
| Number of Propulsion Engines | This field captures the number of propulsion engines installed on the aeroplane.<br>It should be noted that an Auxiliary Power Unit (APU) is not considered a propulsion engine and therefore should not be included. | |

***Engine:*** This section allows the applicant to capture details about the engine associated with the aeroplane described in the $CO_2$DB datasheet.

| Data field | Description and guidance | Example (for illustration only) |
|---|---|---|
| Engine TC Holder | Enter the name of the Engine Type Certificate Holder. | "CFM International, S.A." for a Boeing 737-800 |
| Engine STC Holder (if applicable) | If applicable, enter the name of the Engine STC Holder (i.e., entity that holds the STC for the engine(s) mounted on the aeroplane).<br>If the $CO_2$DB datasheet is submitted by more than one STC Holder, additional information should be added as a note in the "Remarks" section. | "PRATT & WHITNEY" for a CFM56-3B1 engine (FAA STC SE00033EN). |

| | | |
|---|---|---|
| Type Designation | If applicable, the applicant should enter the Type Designation of the Engine. | "CFM56-7B27E/B1F" for a Boeing 737-800. |
| Engine Type Certificate Identification | If applicable, the applicant should enter the Type Certificate Identification of the Engine. | "E00055EN" for a CFM56-7B27E/B1F engine installed on a Boeing 737-800. |
| Engine Supplemental Type Certificate Identification (if applicable) | If applicable, the applicant should enter the STC Identification of the Engine. | "FAA STC SE00033EN" for a CFM56-3B1 engine with an STC held by "PRATT & WHITNEY". |
| Mod. No. / Freeform Description | If applicable, the applicant should enter the Model Number or Freeform Description of the Engine. | "Trent 1000-J TEN" for a Trent 1000-J3 installed on a Boeing 787-8. |

***Propeller:*** If applicable, this section allows the applicant to capture details about the engine associated with the aeroplane described in the $CO_2$DB datasheet.

| Data field | Description and guidance | Example (for illustration only) |
|---|---|---|
| Propeller TC Holder | The applicant can enter the name of the Propeller Type Certificate Holder. | "Dowty Propellers" for a select DHC-8 Series 400. |
| Propeller STC Holder (if applicable) | If applicable, the applicant can enter the name of the Propeller STC Holder (i.e., entity that holds the STC for the propeller(s) mounted on the engine(s)).<br>If the $CO_2$DB datasheet is submitted by more than one STC Holder, additional information should be added as a note in the "Remarks" section. | "AIR PLAINS SERVICES, CORPORATION" for the installation of McCauley D3A34C401/90DFA propellers. |
| Type Designation | If applicable, the applicant can enter the Type Designation of the Propeller. | "R408/6-123-F/17" for a PW150A engine installed on a DHC-8 Series 400. |
| Propeller Type Certificate Identification | If applicable, the applicant can enter the Type Designation of the Propeller(s). | "P-31" for a R408/6-123-F/17 propeller on a PW150A engine installed on a DHC-8 Series 400 |
| Propeller Supplemental Type Certificate Identification (if applicable) | If applicable, the applicant can enter the Supplemental Type Designation of the Propeller(s). | "FAA SA00393WI" for a propeller STC (installation of McCauley D3A34C401/90DFA propellers) held by "AIR PLAINS SERVICES, CORPORATION". |

| | | |
|---|---|---|
| Mod. No. / Freeform Description | If applicable, the applicant can enter the Model Number or Freeform Description of the Propeller. | |

***$CO_2$ Certification Basis:*** In the $CO_2$ Certification Basis section, the applicant can enter details about the reference ICAO and national certification basis.

| Data field | Description and guidance | Example (for illustration only) |
|---|---|---|
| Primary Certificating Authority (CA) | This field captures the name of the Primary Certificating Authority (CA) of the aeroplane. | "U.S. FAA" for a Boeing 737-800 |
| Date of $CO_2$ Certification (yyyy-mm-dd) | The date of the $CO_2$ certification should be reported in this field. The date should be in the following format: yyyy-mm-dd. | "2020-01-01". |
| State's Regulation | This field captures the ICAO Member State regulation related to ICAO Annex 16, Volume III. | "14 CFR Part XX" |
| Edition/Amendment | The applicant should enter the reference of the Edition and/or Amendment of the regulation/certification requirements under which the $CO_2$ certification was obtained. | "Amendment 01" |
| Certification Basis | The certification basis under which the aeroplane certification was obtained should be specified in this field. The applicant can select whether the certification basis is against the ICAO CAEP/10 In Production or the ICAO CAEP/10 New Type certification requirements. | CAEP/10 New Type |

## REGULATORY DATA:

The Regulatory Data section includes the aeroplane MTOM (in kg) and the $CO_2$ Emissions Evaluation Metric Value.

### ***Certified $CO_2$ MTOM (kg):***

When the applicant enters a MTOM value, the template is auto populated with the Limit for this MTOM under the Regulatory Data section (i.e., Summary of data as per ICAO Annex 16 Volume III: Limit for this MTOM and comparison of Metric Value to this limit).

The Certified $CO_2$ MTOM should be entered in kilograms and be rounded to the nearest kilogram (e.g., "29,999.62 kg" should be rounded to "30000 kg").

### ***$CO_2$ Emissions Evaluation Metric Value (kg/km):***

The $CO_2$ metric value (MV) is used to compare to the applicable $CO_2$ MV limit line to know if an aeroplane is compliant with the $CO_2$ standard.

When the applicant enters the $CO_2$ Emissions Evaluation Metric Value the MV Percentage of this limit will be automatically calculated as the ratio of the $CO_2$ Emissions Evaluation Metric Value and the Limit for this MTOM. The applicant should round the $CO_2$ Emissions Evaluation Metric Value to 3 decimal places (e.g., "0.567" kg/km).

The $CO_2$ Emissions Evaluation Metric Value shall be defined in terms of the average of the 1/SAR values (where SAR is Specific Air Range in km/kg) for the three reference masses and the Reference Geometric Factor (RGF). The 1/SAR value shall be established at each of the following three reference aeroplane masses, when tested in accordance with the Standards in Annex 16 Volume III:

a) high gross mass of 92 per cent maximum take-off mass (MTOM),

b) mid gross mass defined as a simple arithmetic average of the high gross mass and the low gross mass,

c) low gross mass defined as (0.45 x MTOM) + (0.63 x ($MTOM^{0.924}$).

The metric value shall be calculated according to the following formula:

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

It is important to note that the numerical metric value published in the ICAO $CO_2$DB has the units of kg of fuel burnt / km flown, the same units as the term 1/SAR. As defined by ICAO Annex 16, Volume III, Appendix 2, the RGF is a dimensionless factor based on the area of a surface (in $m^2$) divided by $1m^2$ (the RGF is essentially the external planform area of the pressurized cabin, excluding the cockpit).

Despite the units of the metric value being kg of fuel burnt / km flown, one should take care not to multiply any metric value by any distance flown to get an estimation of cruise fuel consumption. As an example, for an aeroplane with an area equal to $100m^2$ (RGF=100), doing this would introduce a factor of approximately 3 between the estimated cruise fuel consumption (based on the $CO_2$ metric value) and the true cruise fuel consumption (based on the SAR). The factor of 3 is because $100^{0.24} \approx 3.02$. However, the metric value and the average SAR which is part of the metric value are only valid for the mass values and other conditions as defined by ICAO Annex 16 Volume III. The metric value is not intended for the estimation of actual cruise fuel consumption over any specific distance.

More information on the $CO_2$ metric value is provided in ICAO Annex 16, Volume III and the corresponding ICAO Environmental Technical Manual Volume III (Doc 9501).

**REMARKS:**

A section on Remarks is also made available to capture additional and/or contextual information about the Aeroplane $CO_2$DB datasheet. The applicant can enter any additional relevant information in this section that can help substantiate and clarify information contained in the $CO_2$DB datasheet.

If the length of the information entered is longer than the remark field length (i.e., more than one row is required), the row height can be adjusted manually by selecting the double vertical arrow

between rows on the left-hand side of the screen (i.e., section where the rows are numbered). This is also valid for any input field in the CO2DB datasheet template.

## SUBMISSION OF CO2DB DATASHEETS

Once deemed to conform, and after informing the applicant that the datasheet is ready to submit, the CA can submit the datasheet(s) to the U.S. FAA using the following contact information:

U.S. Federal Aviation Administration, Office of Environment and Energy

Email: 9-AWA-CO2DB@faa.gov

*Note. – As noted above, in special circumstances (e.g., if the CA does not have resources or cannot submit $CO_2$DB datasheet(s) to the U.S. FAA), an alternative process could be agreed between the CA, the applicant, and the U.S. FAA.*

Any inquiries about the ICAO Airplane $CO_2$ Certification Database ($CO_2$DB) can be submitted at the email address indicated above.

# ABBREVIATIONS AND UNITS

*Abbreviations*

| | |
|---|---|
| AEE | FAA Office of Environment and Energy |
| APU | Auxiliary Power Unit |
| CA | Certificating Authority |
| CAEP | Committee on Aviation Environmental Protection |
| $CO_2$ | Carbon Dioxide |
| $CO_2$DB | $CO_2$ Certification Database |
| FAA | Federal Aviation Administration |
| FAR | Federal Aviation Regulations |
| ICAO | International Civil Aviation Organization |
| MTOM | Maximum Take-Off Mass |
| MV | Metric Value |
| OEM | Original Equipment Manufacturer |
| RGF | Reference Geometric Factor |
| SAR | Specific Air Range |
| STC | Supplemental Type Certificate |
| TC | Type Certificate |
| UID | Unique Identifier |
| U.S. | United States |

*Units*

| | |
|---|---|
| kg | kilogram |
| km | kilometer |
| m | meter |