Addressing Local Air Quality: Latest Progress by ICAO

By ICAO Secretariat

One of ICAO's Environmental Goals is to limit or reduce the impact of aviation emissions on local air quality (LAQ). The existing LAQ considerations focus on aircraft engine emissions released below 3,000 feet (914 metres) and emissions from airport sources, such as airport traffic, ground service equipment, and de-icing operations, but are not limited to them.

To address Aircraft Engine Emissions, ICAO developed Annex 16, Volume II , which contains Standards and Recommended Practices (SARPs) for environmental certification of the aircraft engines. These SARPs aim to address potential adverse effects of air pollutants on LAQ, primarily pertaining to human health and welfare. Among other considerations, these provisions address: liquid fuel venting, non-volatile Particulate Matter (nvPM) impacts from mass and particles number perspectives, and the main gaseous exhaust emissions from jet engines, namely; unburned hydrocarbons (HC), oxides of nitrogen (NO_x), and carbon monoxide (CO).

Specifically, Annex 16, Volume II sets limits on the amounts of gaseous emissions and nvPM mass and number allowable in the exhaust of most civil aircraft engine types. The certification process for aircraft engine emissions is based on the Landing and Take-Off (LTO) cycle, which is considered as average and representative for the emissions emitted in the vicinity of airports. The LTO cycle contains four modes of operation, which involve a thrust setting and times-in-mode, as shown on Figure 1.

Procedurally, the engine certification process is performed on a test bed where the engine is run at each thrust setting to generate fuel flow and emissions data for each of the modes of operation. The submission of these data are mandated as part of the engine emissions certification. This certification data is stored in the publicly available ICAO Engine Emission Databank (EEDB)[1]. EEDB is the official data source for many projects and analyses performed in ICAO's Committee of Aviation Environmental Protection (CAEP) and beyond.

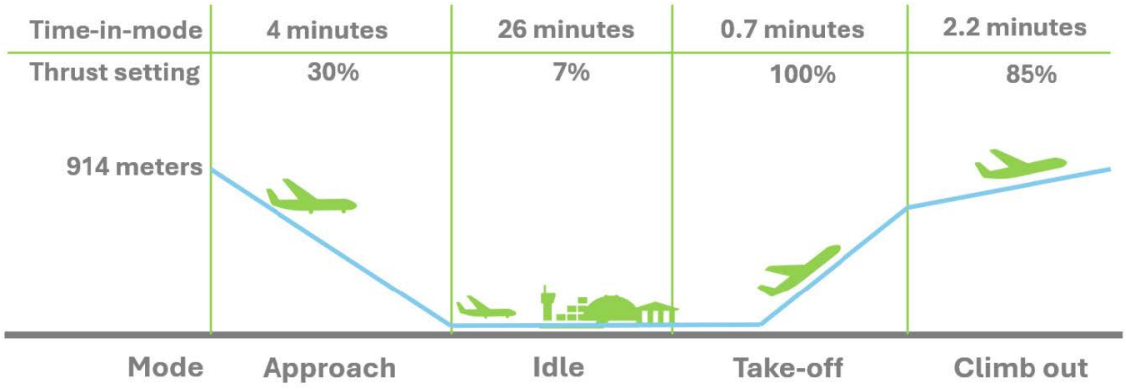

FIGURE 1: Standard engine certification LTO cycle.

1 https://www.easa.europa.eu/en/domains/environment/icao-aircraft-engine-emissions-databank

During its 13th work cycle in 2022-2025, CAEP under its Working Group 3 (WG3, Emissions Technical) successfully completed its work items on maintenance of Annex 16, Volume II and the associated guidance material reflected in the ICAO Doc 9501 – Environmental Technical Manual, Volume II. CAEP has recommended for Council's consideration the amendments to engine emissions SARPs, which include:

- the applicability language and introduction of the new terms "parent engine" and "no emissions change criteria" to increase consistency and practical clarity for the users;
- introduction of three methods to determine the maximum nvPM mass concentration and three methods to determine maximum nvPM mass and number emission indices;
- new nvPM certification point reporting requirement for 57.5 per cent of the rated thrust to the list of reference certification point (this certification point is also important for nvPM cruise emissions understanding and transitional thrust settings between 30 and 85 per cent of the rated thrust);
- alignment of Annex 16, Volume II provisions with the SAE Aerospace Recommended Practices (ARP6320B "Procedure for the Continuous Sampling and Measurement of Non-volatile Particulate Matter Emissions from Aircraft Turbine Engines" and SAE ARP6481A "Procedure for the Calculation of nvPM Sampling and Measurement System Losses and System Loss Correction Factors").

In addition to engine certification provisions, ICAO developed and is continuously updating ICAO Doc 9889 – Airport Air Quality Manual. This manual contains advice and practical information to assist ICAO Member States in implementing best practices with respect to airport-related air quality. This document also provides a process for States to determine the best approaches and analytical frameworks for assessing airport-related air quality and identifies best practices for different needs or scenarios.

CAEP/13 also provided recommendations on consequential changes to ICAO Doc 9889, such as inclusion of a new parameterised volatile particulate matter estimation methodology, guidance on the SAF impacts, expanded example calculations and additional guidance on interpolation

For the new triennium, CAEP will keep its high pace on addressing LAQ issues and progressing the related work items. For example, subject for Council approval, CAEP will develop new NO_x LTO stringency options based on the existing NO_x metrics and Overall Pressure Ration (OPR) correlating parameter while considering small engine thrust alleviation, building upon already reached progress on this topic. CAEP is planning to assess NO_x emissions mitigation technologies associated with stringency options, including costs. Additionally, CAEP plans to investigate the feasibility and added value of a potential reporting point for NO_x emission indices at 57.5 per cent of the rated thrust, with the goal to better characterize NO_x cruise emissions.

Furthermore, CAEP WG3 will continue updating ICAO Doc 9889 to reflect industry best practices, new emissions data for modern aircraft and airport emission sources, and airport operational information that affect aviation emissions, and emissions modelling methodologies, including engines not currently regulated for gaseous and nvPM emissions.

In parallel, under CAEP Modelling and Databases Group (MDG) the LAQ modelling experts are working on approaches for elaborating a "gold standard" for LAQ dispersion modelling, which involves coordination and inputs from various LAQ software tools used in CAEP.

ICAO is firmly committed to enhance its efforts in addressing LAQ and will further continue developing measures and approaches aimed at mitigating emissions impact of aviation in the vicinity of airports. And as part of this broad work stream, ICAO will continuously develop international standards, guidance material, and technical documentation as appropriate for the needs of the international community, towards sustainable future of the international aviation sector.

[1] https://www.easa.europa.eu/en/domains/environment/icao-aircraft-engine-emissions-databank