Local Air Quality and ICAO Engine Emissions Standards

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• ICAO Engine Emissions Standards
• NOx Standards and Technology
• Developing a new Standard for Particulate Matter
• Summary
ICAO Engine Emissions Standards
• Current ICAO Standards for emissions certification of aircraft engines are contained in Annex 16, Volume II:
  – The Engine Emissions Standards cover HC, CO, NOx and smoke.

• Concerns about Local Air Quality (LAQ) in the vicinity of airports focus on the effects of emissions released below 3,000 feet.
Established by the ICAO Council in 1983, superseding the Committee on Aircraft Noise (CAN) and the Committee on Aircraft Engine Emissions (CAEE)
• ICAO adopted its first smoke, fuel venting and gaseous emissions from turbojet and turbofan engines in 1981.
Engine Emissions Certification Procedure

The certification process is based on the Landing Take-off (LTO) cycle.

- **Take-off:** (100% available thrust) for 0.7 minutes;
- **Climb:** (85% available thrust) for 2.2 minutes;
- **Approach:** (30% available thrust) for 4.0 minutes;
- **Taxi:** (7% available thrust) for 26 minutes.

The certification process involves running the engine on a test bed at each thrust setting.
• Result of the engine emissions certification:
  – Fuel flow (kg/s),
  – Emissions index (g/kg), and
  – Measured smoke number.

• Allows for the calculation of data values for each pollutant:
  – Emission rate (g/s)
  – Total gross emission (g)
  – Values of Dp/Foo (g/kn)
  – Maximum Smoke Number.

• Data are stored in the publically available ICAO emissions databank.
NOx Standards and Technology
Establishing Technology Standards
• Much of the international focus has been on the reduction of NOx.
• Technological innovations continue to lead the way towards achieving ICAO’s environmental goals

• CAEP developed, with the assistance of a panel of independent experts (in 2010), medium- and long-term NOx technology goals:
  – -45% of CAEP/6 for 2016;
  – -60% of CAEP/6 for 2026.

• Most recently an industry-led NOx technology review was performed and presented to CAEP.
• Demonstrated the challenges in meeting the medium and long-term ICAO goals.

• For smaller it was not possible to conclude that the Mid-Term 2016 goal will be met.

• For the Long-Term 2026 goal it was demonstrated that no entire engine family has yet to meet the goal.
NOx reduction technologies include:

- Novel cycles that increase bypass ratios
- Incorporation of lean burn technology
- Rich Quick Quench Lean (RQL) technology
Developing a new Particulate Matter Standard
Aircraft engines burning hydrocarbon-based fuels emit gaseous and Particulate Matter (PM) emissions.

Epidemiological evidence indicates that fine particles may impact human health.

Soot or black carbon particles have also been shown to have climate impacts.
• ICAO is currently developing the first non-volatile PM (nvPM) Standard for aircraft engines.
  – Developing an nvPM mass and number standard for turbofan/turbojet engines >26.7 kN.

• Technical work is underway to develop a potential nvPM emissions standard to turbosfans/turbojets ≤26.7 kN:
  – Turboprops, Helicopter turboshaft, and APU engines.
• Data on nvPM engine emissions is crucial to informing the ICAO Standard-setting process.
• Standardization of the instrumentation to measure nvPM is crucial.
• Technically demanding measurement of nvPM from aircraft engines.
• Development of an nvPM Standard will address one of the gaps in the ICAO engine emissions Standards.
• An nvPM Standard will align aviation with other transportation modes.
• Will lead to better assessment of nvPM impacts.
Summary
Current ICAO Standards for engine emissions are contained in Annex 16, Volume II:
- HC, CO, NOx and Smoke.

Standard for NOx was first adopted in 1981.

Development of an nvPM Standard will address a gap in the ICAO engine emissions Standards.
- Main priority is to obtain nvPM emissions data to aid the development of the Standard.
For more information on ICAO activities on LAQ and Engine Emissions…

ICAO Web Page

www.icao.int/

THANK YOU