TOWARDS QUIETER SKIES AND GREENER AIRCRAFT

The Ninth Meeting of the Committee on Aviation Environmental protection (CAEP/9) was held at ICAO headquarters in Montréal from 4 to 15 February 2013. The meeting was attended by 191 participants, representing 22 Member States and 15 observer States and organizations. This meeting marked the culmination of three intense years of activity by the CAEP working groups in aircraft noise, operations and emissions that involved more than 400 experts from different States and organizations around the world.

The CAEP/9 meeting agreed on a comprehensive set of 18 recommendations, based on the work of the technical experts in CAEP that will help ICAO to fulfil its mandate on aviation environmental protection. Key recommendations include an agreement on a new aircraft noise standard; an updated set of technology goals for aircraft noise; a set of aspirational operational goals for fuel burn reduction; issues regarding the progress in the developments of the new ICAO CO_2 standard; and the establishment of priorities and a work programme for the next CAEP/10 work cycle (2013-2016).

A NEW NOISE STANDARD FOR JET AND TURBOPROP AIRCRAFT

The primary purpose of noise certification is to ensure that the latest available noise reduction technology is incorporated into aircraft designs, and that the noise reductions offered by these technologies are reflected in real reductions in aircraft noise around airports.

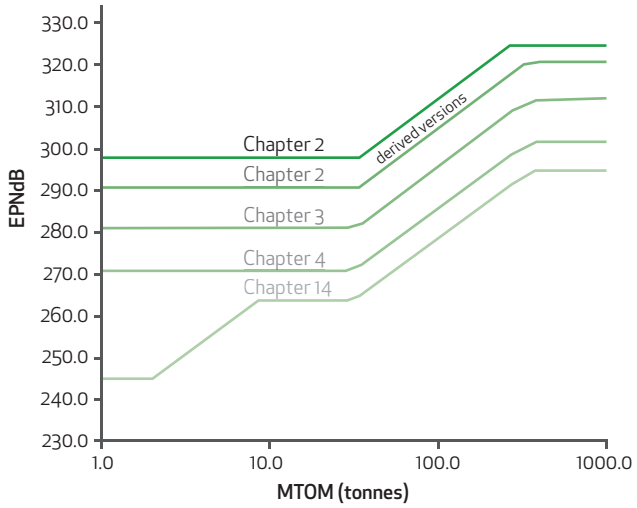
ABOUT CAEP

The Committee on Aviation Environmental Protection (CAEP) is a technical committee of the ICAO Council and the international expertise forum for the study and development of proposals to minimize aviation's effects on the environment. CAEP was established in 1983, superseding the Committee on Aircraft Noise and the Committee on Aircraft Engine Emissions. It is composed of 23 Members from all Regions of the world and 16 Observers (key aviation stakeholders and environmental NGOs). Approximately 400 internationally-renowned experts are involved in the CAEP's activities and all of its proposals are assessed on the basis of four criteria: technical feasibility; environmental benefit; economic reasonableness; and interrelationships (e.g. if measures to minimize noise are likely to increase emissions). CAEP is the only technical committee of the ICAO Council. The Council reviews and adopts CAEP's recommendations, including Annex 16 Standards and Recommended Practices, and in turn reports to the ICAO Assembly (191 States plus international organizations) where the main policies on environmental protection are ultimately defined.

Ninth Meeting of the Committee on Aviation Environmental Protection (CAEP/9) Members and Observers.

[1] The EPNdB is a measure of human annoyance due to aircraft noise, taking into account the perceived noise level and duration.

Overview of Annex 16, Vol. I Noise Standards, including the new CAEP/9 agreed Chapter 14 limit line



Chapter 2, CAN 1973
Chapter 3, CAN 1977
Chapter 4, CAEP/5-2001
Chapter 14, CAEP/9-2013

The CAEP continued to pursue this goal by agreeing on a new noise stringency that is 7 EPNdB[1] below the current ICAO Annex 16, Volume I Chapter 4 noise standard. As a new Chapter 14, it will come into force for new-design aircraft from the end of 2017. For new aircraft below 55 tonnes the standard will be applicable after the end of 2020, and this intends to account for the delay observed in the availability of the latest technologies for lower weight aircraft compared to heavier types. Also introduced as part of the new noise standard is a lower noise limit applicable to subsonic jet airplanes with take-off masses below 8,618kg.

The decision on the new noise standard is the result of a significant data driven exercise, including three rounds of cost-benefit modelling which analyzed potential noise stringency options at minus 3, 5, 7, 9, and 11 EPNdB relative to the Chapter 4 standard. For each option, the technical feasibility, costs and environmental benefits were considered.

As a result of the new Chapter 14 noise standard it is expected that the number of people affected by significant aircraft noise will be reduced. Analysis conducted by the CAEP during the noise stringency analysis has shown that over one million people could be removed from Day/Night average sound Level (DNL) 55 dB affected areas between 2020 and 2036.

A NEW NOISE STANDARD FOR TILT-ROTOR AIRCRAFT

In anticipation of civil Tilt-rotor production, the CAEP agreed to turn current guidance material (Annex 16, Attachment F) on the noise certification of Tilt-Rotor aircraft into a standard (as a new Chapter 13). The new standard uses the same noise limits as used for helicopters in Annex 16, Chapter 8, Paragraph 8.4.1. The CAEP consulted on noise, airworthiness, operations and legal issues

"By achieving this new unanimous agreement through the CAEP, ICAO is continuing to demonstrate its commitment to establishing effective consensus on CO_2 progress for global aviation. We are now looking to the CAEP's wide cross-section of air transport experts to get to work on the last agreements needed to realize the aircraft CO_2 standard, namely its stringency and scope of applicability."

ICAO Council President, Roberto Kobeh González

"This new noise standard is an important step for aviation and will provide a much quieter environment for the communities living in proximity to the world's airports. ICAO is encouraged that while it took air transport more than 20 years to agree to the last significant noise reduction standard, this one has been determined in less than half that time. This progress confirms our community's continued determination to deliver on tangible and consensus-based environmental improvements."

ICAO Secretary General, Raymond Benjamin

"Air transport is already 75 per cent quieter than it was four decades ago and the industry will continuously pursue cost-effective noise management options to reduce the number of people subject to aircraft noise, in line with our broader global commitments on sustainability and environmental performance."

IATA's Director General, Tony Tyler

"Federal Aviation Administration statistics demonstrate that we have reduced the number of people exposed to significant levels of aircraft noise in the United States by more than 90 per cent since the late 1970s, even as we have tripled enplanements. CAEP's recommendation of this new standard, which is even more stringent than the cost-effectiveness analysis supported, will bring further, significant noise reductions from the next generation of aircraft."

Vice President Environmental Affairs for Airlines for America, Nancy Young

"The CAEP Working Group realized that a seven-decibel reduction would be more difficult to achieve for manufacturers of smaller aircraft, and that more time would be needed for compliance. That's why they have three more years for research, development and testing, to ensure they can meet the standard while maintaining the high levels of quality that are the hallmarks of the general aviation industry."

President of the National Business Aviation Association (NBAA), Ed Bolen

before making a comprehensive decision to form the standard and recommending that consideration be given to Tilt-rotor provisions in Personal Licensing, Nationality and Registration Marks, Airworthiness and Operations Annexes.

The CAEP agreed to turn current guidance material on the noise certification of Tilt-Rotor aircraft into a standard.

AGREEMENT ON MEDIUM AND LONG-TERM NOVEL AIRCRAFT NOISE TECHNOLOGY REDUCTION GOALS

The CAEP agreed on an updated set of medium- (2020) and (2030) long-term novel aircraft noise technology reduction goals. The goals are the result of an extensive review performed by an Independent Expert Panel during the CAEP/9 cycle. The review assessed the possibility of noise reduction from each technology, and commented on the environmental efficiency, and other economic trade-offs resulting from adopting the candidate technologies. This includes goals for turboprop, turbofan and novel aircraft concepts.

The noise technology goals and full independent expert review will be published by ICAO in the coming year.

Long-Term (2030) Cumulative Noise Margin Goals Relative to Chapter 4

Aircraft Category	Long-term Noise Goal
Regional Jet (RJ)	
40 tonnes (nominal)	21.5±4
50 tonnes (max)	17±4
Short Medium Range Twin (SMR2)	
Turbofans: 78 tonnes (nominal)	30±4
98 tonnes (max)	26.5±4
CROR: 78 tonnes (nominal)	13.5+2/-6
91 tonnes (max)	10.5+2/-6
Long Range Twin (LR2)	
230 tonnes (nominal)	28±4
290 tonnes (max)	24.5±4
Long Range Quad (LR4)	
440 tonnes (nominal)	27±4
550 tonnes (max)	20.5±4

OPERATIONS

Recognizing that an effective way to reduce emissions is to minimize the amount of fuel used in operating each flight, CAEP/9 recommended the publication of a new "ICAO Manual on operational opportunities to reduce fuel burn and emissions." The manual contains information on current practices that are followed by States, aircraft and airport operators, air navigation service providers and other industry organizations. It features specific chapters on maintenance, weight reduction, payload air traffic management, route planning, and aircraft operations. The manual updates and replaces the ICAO circular 303 (Operational Opportunities to Minimize Fuel Burn and Reduce Emissions) that was published in 2004.

In addition, CAEP/9 approved and recommended for publication a new guidance document on environmental assessment of air traffic management operational changes. The manual contains detailed information on how to conduct an environmental assessment related to proposed changes in operational procedures, redesigning of airspace and other operational aspects: from the preparation phase to the actual drafting steps, through the consideration of interdependencies and trade-off between noise and emission impacts. It also contains multiple appendixes with examples that can serve as useful resources for the reader.

CAEP/9 also considered the Independent Expert review on operational goals, which developed challenging and aspirational operational environmental goals. CAEP agreed to publish the fuel burn operational goals, which will be included in future CAEP environmental trends analysis as a new scenario. Fuel burn operational goals are expressed in terms of percentage of fuel usage and emissions reductions compared to a 2010 baseline that can be achieved by new operational practices assuming new technology investments and changes in policies.

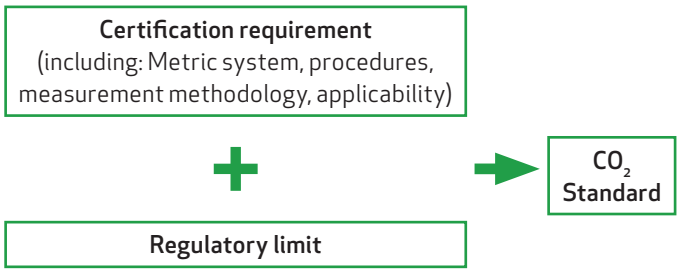
	2020	2030	2040
Fuel burn operational goals	3.25%	6.75%	9.00%

AIRCRAFT ENGINE EMISSIONS

The Development of an ICAO Aircraft CO_2 Emissions Standard

The CAEP is currently focussed on developing an Aircraft CO_2 Emissions standard which was a recommendation from the ICAO Programme of Action on International Aviation and Climate Change, as part of a set of measures to reduce greenhouse gas emissions from the air transport system. Subsequently in October 2010 the 37th Assembly (Resolution A37-19) requested the development of an ICAO CO_2 Emissions standard. The development of the ICAO CO_2 standard will result in a new Annex 16, Volume III to the Chicago Convention.

The work towards the ICAO CO_2 standard aims at developing an aircraft-based standard to reduce aircraft CO_2 emissions by encouraging the integration of fuel efficient technologies into aircraft design and development.



The first important milestone in the development of the CO_2 standard was reached on 11 July 2012, when the CAEP steering Group reached a unanimous agreement on a CO_2 metric system to measure the aircraft fuel burn performance and therefore the CO_2 emissions produced. The intent of the CO_2 metric system is to equitably reward advances in aircraft technologies (i.e. structural, propulsion and aerodynamic) which contribute to reductions in aircraft CO_2 emissions, and differentiate between aircraft with different generations of these technologies. As well as accommodating the full range of technologies and designs which manufacturers can employ to reduce CO_2 emissions, the CO_2 metric system has been designed to be common across different aircraft categories, regardless of aircraft purpose or capability.

Based on this CO_2 metric system, the CAEP developed the procedures and measurement methodologies which will form the important components of the Annex 16, Volume III certification requirement. At the CAEP/9 meeting the mature Annex 16 Volume IIII certification requirement was approved and it was decided that it would be published in an ICAO Circular to communicate the significant progress made. This will be published following the Council session in June 2013.

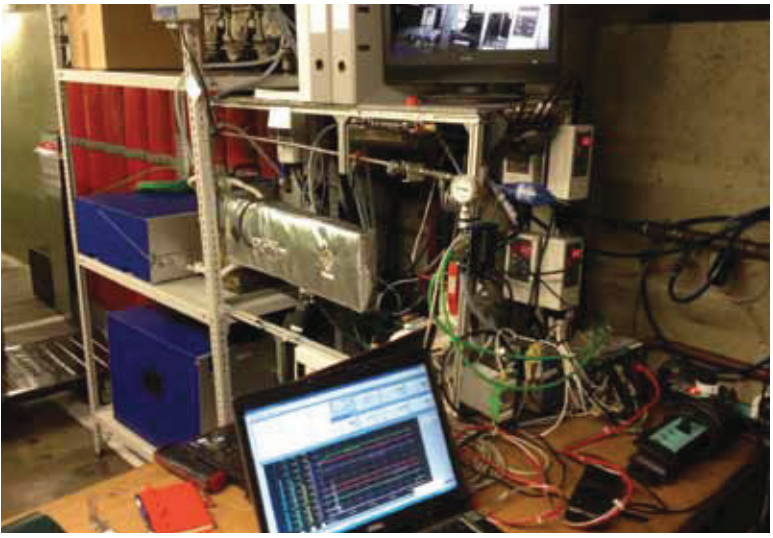
The complexity of the CO_2 standard work has been significant both from a technical and political perspective. This was demonstrated by the number of international experts involved which has been approximately 150, more than double of any other CAEP group. The commercial sensitivity associated with this topic, and the technical challenges encountered, resulted in a postponement of the delivery date for the full CO_2 standard, originally intended for 2013. To move forward and to build on the significant progress made, the CAEP reviewed a comprehensive CO_2 standard setting work plan and agreed on a late-2015 deliverable date, in time for approval by CAEP/10 in 2016.

Leading up to 2016, the work will focus on the standard-setting process where, on the basis of the agreed certification requirement and a data driven environmental cost-benefit analysis, a regulatory level and scope of applicability will be established. This will follow the ICAO criteria of technical feasibility, environmental benefit, cost effectiveness and the impacts of interdependencies.

Progress on a Particulate Matter Standard

Since the 1970s, ICAO has set standards for emissions that affect local air quality, including carbon monoxide (CO), oxides of nitrogen (NOx), and unburned hydrocarbons (HC). In an effort to address concerns regarding visible smoke from the exhaust plume from jet aircraft, standards for Smoke Number (SN) were also established. The visible smoke is made up of particles of varying size, known as particulate matter (PM). While today, visible smoke from modern aircraft is nearly non-existent, as a result of intensive research, the science regarding the formation of PM and its effects on human health and local air quality is maturing. The CAEP worked with the SAE International Aircraft Exhaust Emissions Measurement Committee (E-31) to test a non-volatile PM (nvPM) sampling system used to measure soot (also called black carbon) behind aircraft engines. SAE International has a long history of serving in a complementary role to that of CAEP by addressing technical aspects related to measurement techniques that support the ICAO standards-setting process. Results from seven test campaigns led to a major breakthrough for SAE E-31 to define the process for sampling and measuring nvPM from aircraft engines.

It was reported to the CAEP that research studies have shown that the size distribution of nvPM emitted by modern aircraft gas turbine engines and measured with the SAE E-31 specified system exhibit a log normal distribution that peaks normally between 15nm – 40nm, depending on engine power and engine technology and that few solid particles below 10nm can be expected. During the development of the draft ARP system for the measurement of nvPM mass and number from aircraft gas turbine engines, it has been determined that it is technically feasible to measure particle sizes in this range and this capability has been included in the instrument specifications.



Number and Mass Instrumentation

The existence of these smaller particles explains the complexity of the system needed to measure them and the need for devoted facilities, funding and resources necessary to complete this work. Additional full scale testing is needed for engines of all sizes, yet insufficient funding has prevented these tests from being conducted. Nevertheless, measurement campaigns and finalization of the ARP by the SAE Committee will continue as a prelude to the nvPM emissions certification requirement and new ICAO Standard. CAEP was also informed that significant research progress is advancing the understanding of volatile PM (nvPM that evolves and disperses from the engine).

MODELLING AND ECONOMICS

ICAO strives to provide its Member States with the best available information to support sound decision-making. Future projections of aircraft noise and emissions are developed by CAEP to support the development of new standards and policies for the Organization. Leading to the CAEP/9 meeting, the CAEP Forecast and Economic Analysis Support Group (FESG) completed the development of new traffic and fleet forecasts. The forecasts build upon the forecasts developed by ICAO and other organizations through a peer review, consensus-based process that considers the input of a broad range of stakeholders. While the ICAO Secretariat generates forecasts of future air traffic that serve most of the activities of the Organization, for the purposes of the environmental technology standards-setting process, additional information is needed. The expansion of the ICAO traffic forecast by CAEP to include a fleet forecast, including for small aircraft of less than 20 seats, and the associated aircraft retirement curves are critical elements of the related analyses.

The CAEP/9 meeting recommended that the forecast be used as the basis for all environmental analyses undertaken during the CAEP/10 cycle. In particular, the updated forecast will support the analysis of stringency options for the new CO_2 standard and will be used to generate updated trends of fuel consumption and net CO_2 emissions to inform the ICAO Assembly.

As the decisions taken, based on the trends assessments and stringency analyses, have significant implications for all stakeholders, the peer review elements of the CAEP process are essential. States and organizations provide access to multi-million dollar models such as the United States' Aviation Environmental Design Tool (AEDT) for noise and emissions, EUROCONTROL's Advanced Emission Model (AEM) for emissions, Manchester Metropolitan University's Future Civil Aviation Scenario Software Tool (FAST), and EUROCONTROL's SysTem for AirPort noise Exposure Studies (STAPES) for noise, to CAEP to carry out the studies.

CONCLUSION

ICAO has set three environmental goals for international aviation related to reducing the number of people exposed to significant aircraft noise as well as reducing the impact of aviation emissions on global climate and local air quality. The excellent results of the CAEP/9 meeting represent further steps towards achieving these goals, and continue to demonstrate the strong determination of the international community to deliver comprehensive environmental solutions for the aviation sector.

Over the next three years CAEP efforts will continue to be focused on emissions, noise and operations, including the completion of the CO_2 standard and the further development of a PM Standard. ■

CAEP pioneered the use of sustainable management practices within ICAO as it was the first Committee to adopt a paperless environment for its meetings. The CAEP/9 documentation counted 60 working papers for a total of 1,028 pages in addition to 29 information papers for another 1,661 pages, amounting to 2,689 pages. To reduce the amount of paper used, each of the 191 meeting participants received an 8GB USB card which contained the CAEP/9 meeting and background documentation on aviation and the environment.