



COMMITTEE ON AVIATION ENVIRONMENTAL PROTECTION (CAEP)

STEERING GROUP MEETING

Brussels, Belgium, 8 to 12 July 2024

Agenda Item 8: Emissions Technical (WG3)

VIEWES OF THE UNITED STATES ON NO_x AND nvPM

(Presented by the United States of America)

SUMMARY

This working paper provides the views of the United States on efforts in WG3 with respect to progress on nitrogen oxides (NO_x) and non-volatile particulate matter (nvPM) emissions. Specifically, the U.S. supports the work done by WG3 to lay the groundwork for an updated landing and take-off (LTO) and new cruise NO_x stringency during the CAEP/14 cycle. Given inherent trade-offs in NO_x and nvPM emissions in gas turbine engines, the United States sees value in evaluating NO_x and nvPM emissions together whenever it is practicable to do so, because continued reduction of both pollutants will benefit air quality and climate change. The United States strongly supports CAEP resources be put towards lowering the uncertainties of nvPM emissions measurements by supporting the research activities of SAE-E31.

Action by the CAEP-SG is in paragraph 5.

1. INTRODUCTION

1.1 Aircraft engine NO_x and nvPM emissions continue to adversely impact air quality in the United States, particularly in the vicinity of airports, as well as contribute to regional air pollution.

1.2 The United States also notes that full flight emissions of NO_x and nvPM increasingly appear to play a role in both air quality and climate change, although several nvPM measurement uncertainties remain.

1.3 This paper presents the views of the United States on WG3's work this CAEP cycle to address NO_x and nvPM emissions from aeroplane gas turbine engines. The United States views on the

work with respect to NO_x emissions, nvPM, and Task E.20 are provided in Sections 2, 3 and 4 of the paper, respectively. Actions are found in Section 5.

2. VIEWS OF THE UNITED STATES WITH RESPECT TO NO_x EMISSIONS

2.1 The United States recognises that the current overall pressure ratio (OPR) dependent form of the CAEP/8 LTO NO_x limit line allows increased NO_x emissions from newer generation engines compared to their predecessors, and that Task E.19 directed WG3 to assess the issue and propose a solution.

2.2 The United States recognises a clear need to update the LTO NO_x stringency during the CAEP/14 cycle for several reasons:

2.2.1 (1) The last update to both the new type and in-production LTO NO_x stringencies occurred at the CAEP/8 meeting in 2010, (2) new combustion technologies (i.e., lean burn and advanced rich-quench-lean burn geared turbofan) have entered the market since the last LTO NO_x stringency update, (3) CAEP has recognised that an OPR-dependent NO_x limit line has led to increases in LTO NO_x along with improvements in fuel burn, and (4) WG3 has examined the OPR-dependent NO_x limit line framework and has recommended addressing the issue by updating the shape of the stringency line to limit future increases in NO_x related to fuel burn improvements.

2.3 The United States supports the work done by WG3 in examining alternatives to the existing NO_x metric and standards framework. While WG3 is not recommending a structural change to the LTO NO_x standards framework or metric, the United States supports WG3's conclusion that a change in the shape of the stringency limit line is likely the most effective means of addressing the OPR-NO_x correlation.

2.4 The United States recognizes that developing a new shape for the LTO NO_x stringency line in order to prevent future NO_x increases due to higher OPR will be challenging. The United States supports continued evaluation of different approaches to OPR and setting a new LTO NO_x limit line shape.

2.5 The United States recognises the thorough work done by WG3 in assessing many new cruise and climb NO_x metric system candidates.¹ The United States agrees with WG3 that, at this time, the best cruise NO_x metric is based on a weighted sum of 30% and 85% LTO thrust points and should be considered for an initial cruise NO_x stringency during the CAEP/14 cycle.

3. VIEWS OF THE UNITED STATES WITH RESPECT TO nvPM EMISSIONS

3.1 Given inherent trade-offs in NO_x and nvPM emissions in gas turbine engines, the United States sees value in evaluating NO_x and nvPM emissions and standards together whenever it is practicable to do so, because continued reduction of both pollutants will benefit air quality and climate change. The United States supports WG3's continued technical work with respect to understanding engine combustion technology, uncertainty reduction, and cruise data reporting for nvPM emissions.

3.2 The United States identifies SAE-E31 as a valuable source of technical expertise when it comes to improving the measurements of nvPM emissions. We note there has been substantial progress by

¹ See CAEP-SG/20243-WP/27.

SAE-E31 in improving nvPM line loss estimation through measured particle size distribution. The United States strongly supports CAEP resources be put towards lowering the uncertainties of nvPM emissions measurements by supporting the research activities of SAE-E31. The United States continues to pursue accurate and robust nvPM measurement capabilities. Therefore, we support the work of SAE E-31 on a measured particle size-based loss correction and believe it would improve the accuracy and robustness of nvPM measurements if it were incorporated into the nvPM certification metric framework.

4. VIEWS OF THE UNITED STATES WITH RESPECT TO TASK E.20

4.1 The United States appreciates the exploratory analysis provided by WG3 under Task E.20 to assess the value of providing targeted exceptions during the standard-setting process to achieve more ambitious results.²

4.2 We recognise that the exploratory analysis looked at one possible application of the targeted exception concept and the following conclusion was reached. First, the value of this approach depends greatly on the assumptions used to define the exception (and in the case that was examined, the value was modest). However, the United States believes this concept could have some merit in particular, targeted instances, and recommends that relevant working groups keep it in mind for possible use in future standard-setting activities.

5. ACTION BY THE CAEP-SG

5.1 The CAEP-SG is invited to:

- a) note that the United States supports the WG3 offering for both LTO and cruise/climb NO_x metrics and believes the work done this cycle supports new NO_x standards next cycle;
- b) agree to continuing WG3 work on an updated stringency line shape for LTO NO_x;
- c) support evaluating NO_x and nvPM emissions and standards together whenever it is practicable to do so; and
- d) note the United States agrees with SAE-E31 that there are significant benefits to including size-dependent particle loss corrections in the nvPM certification procedure.

— END —

² See CAEP-SG/20243-WP/29.