International Civil Aviation Organization

CAEP-SG/20232-WP/47
29/09/23
English only

WORKING PAPER

COMMITTEE ON AVIATION ENVIRONMENTAL PROTECTION (CAEP)

STEERING GROUP MEETING

Takamatsu, Japan, 16 to 20 October 2023

Agenda Item 8: Emissions Technical (WG3)
Agenda Item 9: Noise Technical (WG1)

VIEWS OF THE UNITED STATES ON SUPERSONICS

(Presented by the United States of America)

SUMMARY

The United States has continuously supported development of civil supersonic environmental standards at CAEP as evidenced by its technical contributions in areas of Landing and Take Off (LTO) noise and engine emissions, en-route noise, and CO_2 standards. This paper provides the views of the United States on progress to-date on these tasks and offers its views on next steps during the CAEP/13 cycle:

1. Supersonic exploratory study public release
2. Supersonic LTO noise Standard
3. En-route noise Standard and Community Testing
4. Supersonic LTO engine emissions

We continue to support this work within CAEP, and this paper offers some additional recommendations for CAEP to enable this technology in a harmonized and technically sound manner that also recognizes and addresses the climate and noise impacts of this technology. With delays of National Aeronautics and Space Administration (NASA) X-59, we call on CAEP Member States to take this opportunity to commit to supporting future NASA human response testing through technical and financial collaboration that will broaden the cultural noise dose response understanding as it relates to the future of advanced quieter supersonic aeroplanes.

Action by the CAEP-SG is in paragraph 3.

1. INTRODUCTION

1.1 The United States continues to advance the development of civil supersonic airplanes for their potential innovation in transportation. At the same time, the United States is committed to meaningful climate action from the aviation sector as evidenced by ICAO's adoption of a long-term aspirational goal. We strongly believe that international standards developed at ICAO are critical to the development of civil supersonic airplanes as they predominantly serve international travel. Given the potential climate and noise impacts of this this technology, we believe that such standards will enable ICAO and its Member States to

ensure this technology could be incorporated with a full recognition of the potential climate and noise impacts along with their potential economic benefits.

1.2 The exploratory study (e-study) for supersonic transport aircraft was completed during the CAEP12 cycle. The e-study documented an understanding of airport noise impacts resulting from the introduction of supersonic aircraft. It is indeed unfortunate that after CAEP endorsement for public release, it has not been possible to share the e-study report publicly due to legal issues related to proprietary information of OEM Aerion and its subsequent dissolution.

1.3 Given the on-going development activity for supersonic airplanes and the goals to introduce them into the fleet in the near term (by 2030), CAEP has recognized the critical need to finalize the N.10 task for an LTO noise Standard using Chapter 14 limits during the CAEP13 cycle. The manufacturers have requested this clarity to ensure their designs comply with such standards in a global marketplace.

1.4 Looking beyond the first-generation supersonic airplanes, shaped signature, low-boom technology for the second-generation supersonic airplanes is expected to improve the business case and that technology is being explored by manufacturers for future designs. As such, WG1 Supersonic Task Group (SSTG) N.05 tasks for en-route noise (low boom) Standard development continues to progress the long-term, multi-CAEP effort. The United States continues to offer research addressing the technical planning, and investment of resources to deliver the scientific noise data for future Standard consideration over the next several CAEP cycles.

1.5 From an emissions perspective, the current engine emissions standard for supersonic engines is outdated and must be revised to reflect more current engine designs that do not use afterburning technologies (see task E.16). In order to address the climate impact of supersonic airplanes, task E.17 looks to progress work regarding a CO_2 emissions metric system that could support future technology-based standard setting for supersonic aeroplane CO_2 emissions. We support this work and an eventual standard for supersonic aeroplane CO_2 emissions after the first aircraft is certified.

1.6 The United States supports CAEP's current tasks and associated timelines to enable the introduction of civil supersonic airplanes.

2. SUPERSONIC ACTIVITIES

2.1 Supersonic e-study

2.1.1 Although the United States supported the publication the initial e-study for public release, we recognize that ICAO time and resources are limited and reproducing the e-study analysis without Aerion's contribution would not be the best use of those resources. As such, we agree that it cannot be released to the public given the legal risks and current activities must take priority. Therefore, in our opinion, the e-study is complete "as is," especially since similar studies have now been published and are available to the public.

2.2 LTO Noise

2.2.1 Given the importance of international harmonization, the United States encourages all Member States to work within CAEP to finalize and complete the LTO noise Standard within the current CAEP13 cycle, as this will provide needed certainty to the supersonic airplane manufacturers.

2.2.2 The United States remains committed to support the LTO noise Standard development for supersonic airplanes in WG1 (task N.10). The United States encourages the European Union Aviation Safety Agency (EASA) to continue to work towards a common regulatory expectation under the principles of CAEP to reach consensus on the two remaining noise procedural issues (see sections 2.2.3 and 2.2.4) for Standard completion before the SG2024.

2.2.3 The most recent WG1 meeting reported that a near 90% complete Standard has been prepared for preliminary Steering Group consideration today and a 100% completed Standard is planned by SG2024 in order to be available for decision at CAEP13. We note that the LTO noise subgroup has

resolved the Programmed Lapse Rate (PLR) balancing/thrust limitation concern and continues to address: (1) reference take-off speed and tolerance; and (2) Variable Noise Reduction Systems (VNRS) for approach (landing) procedure, by SG2024.

2.2.4 In order to reach a common understanding on these two outstanding technical issues, the United States provides the following input:

2.2.4.1 Reference take-off speed and speed range tolerance: Both, the NASA Supersonic Technology Concept Airplane (STCA) and OEM analyses served to demonstrate by simulation the flexibility of implementing a range of technologies and OEM designs that could reduce noise, such as increased high-speed climb out that reduces noise from reduced turbulence and reduced duration, recognizing that such procedures may entail increased fuel burn and emissions. Higher speed also generates more lift, allowing for a deeper pilot-initiated engine thrust cutback for further reduction in flyover noise level. The current subsonic aircraft procedure of constraining take-off speed with a fixed tolerance range will, in all likelihood, constrain the possible variable design options needed to realize take-off noise reduction by the VNRS. Also, it is worth noting that initial range of take-off speed for subsonic aircraft was equally large and was tightened as more data on subsonic airplanes was acquired. As we acquire more data on supersonic airplanes, including their emissions profiles, it may be possible to tighten the take-off speed range.

2.2.4.2 Therefore, the United States suggests that it may be technically premature to prescribe a single take-off speed and fixed tolerance based on the large body of data from subsonic airplanes for the current supersonic airplane designs, which have different low-speed flight characteristics compared to subsonic airplanes. Also, the current supersonic airplane designs span from business jets to transport class, range of cruise Mach number, and mission requirements (such as, pay load, range, and take-off and landing field lengths). These supersonic airplane designs are employing VNRS procedures optimized to reduce take-off noise levels not hitherto employed by subsonic airplanes. Therefore, we recommend that the sufficient latitude be provided for the current supersonic airplanes' take-off reference true airspeed. The United States recommends that the take-off speed must be attained as soon as practicable after lift-off, with a minimum (V_2 +10 kts) or higher, but not to exceed 250 knots.

2.2.4.3 Variable Noise Reduction Systems (VNRS) for approach (landing) procedure: Prescribing approach procedure based on subsonic airplanes may also be restricting innovation regarding the use of VNRS during approach condition for supersonic airplanes. We believe that the LTO noise Standard should allow the potential use of new technology using VNRS for approach conditions as well to further reduce aircraft noise of future designs.

2.2.5 The United States recognizes that aviation regulatory proposals from both the United States and EASA served to reinforce WG1's supersonic LTO noise Standard development (task N.10) effort with broad perspectives. While these efforts help the process, the United States highly recommends a harmonized ICAO standardization prior to any finalized independent state rulemaking.

2.3 En-route Noise

2.3.1 In addition to LTO noise, the United States remains committed to support the en route noise (low boom) standard development for future supersonic airplanes (task N.05) and provides leadership for this task. We will maintain this commitment to ensure the en-route noise Standard development continues to make steady technical progress through CAEP/15.

2.3.2 As the X-59 flight demonstrator aircraft is the key simulator for the community response testing, its delay in fabrication has shifted NASA test planning enough that they cannot deliver a fully representative set of community response data during the CAEP/14 cycle as originally planned. NASA revisions to its internal schedule and proposed adjustments to the WG1 timeline for en route Standard development is discussed in CAEPSG.20232.WP027.9.en-WG1 Supersonic Aeroplane SARP Developments. The United States fully supports the revised planning as proposed.

2.3.3 Given that it allows more time for greater collaboration, this shift in timeline represents a synergistic opportunity for the development of active international participation in the NASA testing by interested CAEP member States outside the United States.

2.3.4 As such, we call on CAEP Member States to take this opportunity to commit to identifying the technical and financial resources required to collaborate with NASA to host community testing that will broaden the cultural relevance of noise dose response research as it relates to the future of advanced quieter supersonic aeroplanes. NASA has produced a shareable white paper of the proposed framework for such collaboration that they have previously presented to WG1. We recommend that WG1 members request this paper from NASA and share it with interested organizations in their States as a basis for this collaboration.

2.4 Supersonic Emissions

2.4.1 The United States supports CAEP developing an appropriate CO_2 metric system for civil supersonic airplanes and establishing CO_2 emission limits for supersonic aeroplanes that are based on vehicle technical data and analysis once the first supersonic aeroplane is certified.

2.4.2 We note that WG3 has offered a preliminary LTO cycle for the certification of supersonic engine emissions during the CAEP/12 cycle. This is a good step towards achieving the goal of updating Annex 16, Volume 2, engine emissions standards. The United States looks forward to seeing certification-like emissions measurements from modern supersonic engines, when they become available, to continue CAEP's standard setting process. The United States believes that possible emissions stringency options should be underpinned by emissions measurements, like all CAEP's past engine emissions standard settings.

2.5 Considerations

2.5.1 On both the noise and emissions front, the United States emphasizes the need to develop internationally harmonized environmental standards for civil supersonic airplanes. Harmonized standards will provide industry with the regulatory certainty to make investments in the development of these technologies.

3. ACTION BY THE CAEP-SG

3.1 The CAEP-SG is invited to:

a) agree that states should coordinate within CAEP to develop harmonized global environmental standards for supersonic aircraft to ensure this technology could be incorporated with a full recognition of and commitment to address the potential climate and noise impacts along with their potential economic benefits;

b) acknowledge the supersonic exploratory study cannot be released to the public given legal risks and accept the e-study complete "as is;"

c) note the U.S. support of the significant WG1 progress achieved by the 90% complete supersonic LTO noise Standard reported to the Steering Group for consideration;

d) note U.S. recommendations to WG1 regarding the proposed remaining two outstanding procedures for the LTO noise Standard;

e) support the WG1 request to shift the completion of the supersonic en-route Standard into CAEP15 due to NASA Quesst community testing and data deliverable as reflected in the timeline of CAEPSG.20232.WP027.9.en-WG1 Supersonic Aeroplane SARP Developments; and

f) encourage ICAO members to partner with NASA on such community testing for a wider global human response understanding of noise.

— END —