ICSA

International Coalition for Sustainable Aviation

June 2018

ICSA VIEWS ON FUTURE SUPERSONIC TRANSPORT ENGINES AND AIRCRAFT

(This paper represents the views of the International Coalition for Sustainable Aviation (ICSA) on specific issues in aviation environmental protection. ICSA has submitted a version of this paper to an upcoming meeting of the Steering Group of ICAO's Committee on Aviation Environment Protection (CAEP) Steering Group. In accordance with the non-disclosure requirements of the CAEP, no portion of this paper discloses, reproduces, communicates, or disseminates information or content of the CAEP secure site.)

SUMMARY

This paper presents the views of the International Coalition for Sustainable Aviation (ICSA) on future ICAO standards for supersonic transport (SST) aircraft. Three principles are presented here: first, that the introduction of SSTs should not lead to a net increase in emissions or noise impacts compared to a subsonic only baseline; second, that ICAO should develop new SARPs for supersonic aircraft and engines in deliberate, data-driven manner; third, that until sufficient data is available the latest subsonic standards should apply to new supersonic designs.

1. INTRODUCTION

1.1 Aviation is the fastest growing transportation sector, expected to quadruple its volume by 2050 compared to 2015 (OECD & ITF, 2017). Airports around the globe are under increasing pressure to curb noise and air pollution resulting from aviation operations while accommodating the ever-rising demand of air transport. Given aviation traffic and emissions growth, aggressive and accelerated action by industry is needed to reduce the environmental impact of flying.

1.2 As part of a long and difficult course to address aviation's growing carbon footprint, ICAO has adopted twin goals of improving fleetwide fuel efficiency by 2 per cent per annum and carbon neutral growth from 2020. Developing a CO_2 standard for new subsonic aircraft was a major focus of the CAEP/9 and CAEP/10 work cycles.

1.3 Several manufacturers are aiming to type certify new supersonic transport (SST) aircraft and engines within the next decade. This paper discusses the role of ICAO environmental standards in meeting ICAO goals, surveys the status of current supersonic requirements, and provides ICSA's views on future work to address gaps.

2. THE IMPORTANCE OF SUPERSONIC AIRCRAFT AND ENGINE PERFORMANCE STANDARDS

2.1 Performance standards for new aircraft represent an important contribution to ICAO's "basket of measures" to address international aviation emissions. Any potential emission reductions resulting from the existing standard implementation should be guarded, maintained, and not undermined or jeopardized.

2.2 ICSA and its members are concerned about the potential environmental consequences of re-introducing SSTs into the global fleet. In order to operate at a high Mach Number, supersonic aircraft will require high thrust, low bypass ratio engines. These engines have high specific fuel consumptions and LTO noise due to high exhaust velocities and low bypass ratios; separately sonic boom and dramatically expanded non-CO_2 climate impacts are expected during high altitude operations.

2.3 In 2017, ICSA presented an initial analysis on the potential environmental impact of new SSTs drawing upon available literature. As discussed in that paper, even a small replacement of subsonic aircraft by supersonic aircraft could cause significant increases in aviation climate radiative forcing, exceeding the gains envisaged by the CO_2 standard for subsonic aircraft alone.

2.4 ICAO supersonic regulations are currently either out-of-date, e.g. landing and take-off (LTO) engine emissions, or non-existent, in the case of noise and CO_2. Effectively, there are currently no standards to manage the environmental impacts of re-introducing SSTs. Supersonic aircraft, which are likely to replace some future subsonic aircraft in operation, should be subject to robust LTO, CO_2 and non-CO_2 emission limitations. ICSA believes strongly that the re-introduction of SST designs into the global fleet must not lead to a net increase in total noise, air pollution, or CO_2 emissions compared to a baseline of subsonic aircraft only.

3. SST EMISSION STANDARDS

3.1 ICSA maintains that new emission certification standards for supersonic aeroplane types are needed for both LTO emissions and CO_2. ICAO environmental standards have historically been set on the basis of technological feasibility, which means compliance to the standard can be achieved through proven Technology Readiness Level (TRL) 8+ technology. This approach generally means that metrics and stringency levels are based on the performance of existing aircraft or engine types, supplemented where possible by data on project aircraft or engines. Compliance with these stringency levels is then assessed via the performance of existing or emerging products, as established via test bed or in-flight measurement. This approach seems appropriate for the initial phases of SST emission and noise standards since those aircraft and engines may differ in important ways from previous products.

3.2 ICSA realizes that data may not be immediately available to revise the Chp3 SST standard. It is also aware that manufacturers may desire to certify a new supersonic aircraft in the near future for international flights. Therefore, to ensure environmental protection and provide regulatory certainty for manufacturers, the current subsonic emission standards should be applied to new supersonic aircraft. ICSA supports the replacement of Chp3 SST with Chp2/Chp4 with CAEP/8 subsonic NOx standards.

3.3 Similarly, ICSA believes that a full SST CO_2 standard should be developed only when primary flight test data is available. Until that time, an anti-backsliding emission standard should be put in place to enable type certification as needed. Therefore, ICSA supports the application of the current subsonic CO_2 standard as an interim measure for future SSTs with applicability date as soon as possible.

4. SST NOISE STANDARDS

4.1 With very powerful take-off and climb performance needed to reach supersonic speed as soon as possible, supersonic aircraft may be noisier in LTO than equivalent subsonic aircraft with similar weight and passenger capacity. Future certifications must be handled carefully to ensure no net increase in airport noise and community disturbance. Furthermore, many studies show that public tolerance of aircraft noise is falling. The introduction of new supersonic designs must take this fact into account. Until a robust data set of SST noise performance is available to develop supersonic noise standards, ICSA proposes that new SST aircraft comply with the current subsonic Chapter 14 noise standards.

4.2 Independent of LTO noise, SSTs can also generate powerful shock waves during supersonic cruise, or sonic boom. While researchers hope that lower boom SSTs can be developed, ICSA reiterates the need for a data driven approach to establishing policy, including the potential lifting of overland flight bans. ICSA notes with particular concern the suggestion by one US manufacturer that the US repeal its overland flight ban and grandfather future SST designs into Chapter 4 noise limits before demonstration flight test data has even been gathered.

4.3 Interest has been expressed in developing en route certification schemes for aircraft noise to replace existing restrictions on overland SST operations. The complexity of defining representative certification schemes should not be underestimated. For example, while the sonic boom of NASA's demonstrator may reach 75dB in perfect weather conditions, atmospheric turbulence could increase that level by 20dB. In specific situations such as climb, descent, and while turning, noise could further increase, with a sonic boom exceeding 100 db or more. The example, while simplified, highlights the need for robust data on the representativeness of test conditions before ICAO considers en route noise certification.

5. OTHER ISSUES

5.1 Due to the higher cruise altitudes of SSTs, their climate impact is likely to be considerably higher than existing subsonic aeroplanes. ICSA believes that in evaluating the climate and environmental impacts of supersonic flight, it is essential that these more intense non-CO_2 climate impacts be taken into account.

5.2 Because supersonic aircraft operate at high speeds, they will be disproportionately heavy, and with higher thrust engines, than subsonic aircraft providing similar transport service on a passenger-kilometer or tonne-kilometer basis. Since ICAO environmental standards are set as a function of parameters like maximum takeoff mass and rated thrust, with more lenient regulatory limits assigned to heavier aircraft and larger engines, this means that a new supersonic aircraft design that meets subsonic aircraft standards may still increase emissions when used to meet demand that would otherwise have been served by the subsonic fleet.

5.3 To ensure continuation of ICAO's efforts to effectively address aviation emissions, a fleet-wide analysis of supersonic CO_2 and other emissions should be performed before new SST standards are developed. Those results should be made public. This effort is a necessary first step for ICAO and its member states to demonstrate its commitment to demonstrating the public acceptability of supersonic aircraft operations, as recognized in Assembly Resolution A39.1.

5.4 In closing, ICSA believes that ICAO SARPs should be robust, data driven standards to improve the environmental performance of aircraft and aircraft engines. We caution against developing SARPs purely to facilitate the certification of products that may, on net, increase air pollution and nuisance relative to current subsonic operations.