POLICY UPDATE

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SUMMARIZES REGULATORY AND OTHER DEVELOPMENTS RELATED TO CLEAN TRANSPORTATION WORLDWIDE

The International Civil Aviation Organization's CAEP/13 aircraft noise standards

Dan Rutherford

Governments working under the auspices of the United Nations have been regulating aviation noise via new aircraft standards since the 1970s. In February 2025, at its 13th triennial meeting, the Committee for Aviation Environmental Protection (CAEP) of the International Civil Aviation Organization (ICAO) recommended new landing and takeoff (LTO) noise standards for adoption by member states. Two classes of aircraft are covered in the proposal: conventional subsonic aircraft similar to those that are in operation today, and future supersonic aircraft capable of flying faster than the speed of sound.

For subsonic aircraft, starting on January 1, 2029, the proposed Chapter 16 standards will require an additional margin of 6 effective perceived noise decibels for larger aircraft relative to the current Chapter 14 standards. Future supersonic aircraft will be required to meet noise limits equivalent to Chapter 14 starting in 2029. Both sets of standards will be enforced by national governments as airworthiness requirements for new type certifications only.

OVERVIEW OF THE PROPOSED STANDARDS

Subsonic LTO noise has been regulated via a set of increasingly stringent standards, referred to globally as "Chapters" under Annex 16 Volume 1 of the Chicago Convention.[1] Chapter 1 aircraft were certified before noise requirements. Chapter 2 aircraft were certified to an initial set of noise limits prior to 1977. Aircraft that were type certified between October 6, 1977, and 2005 were certified under Chapter 3. Chapter 4 took effect in on January 1, 2006, while the current Chapter 14 standards were implemented starting in 2017 for larger jets and 2020 for smaller jets of less than 55 tonnes maximum takeoff mass (MTOM).[2]

www.theicct.org

communications@theicct.org

@theicct.org

1 In the United States, noise limits are referred to as "Stages" rather than "Chapters." Here, we refer to standards using the international convention. The number between Chapters and Stages is consistent from 1 through 4; international Chapter 14 is referred to as Stage 5 in the United States.

2 "Reduction of Noise at Source," International Civil Aviation Organization, accessed April 25, 2025, https://www.icao.int/environmental-protection/pages/reduction-of-noise-at-source.aspx. Maximum takeoff mass, which is the aircraft equivalent of gross vehicle weight for road vehicles, is the regulated maximum mass of empty aircraft, payload, and fuel allowed for an aircraft to operate.

Landing and takeoff noise is measured using a representative duty cycle of noise exposure based on three measurement conditions: lateral (or sideline) to simulate noise during takeoff, flyover to simulate noise during climb, and approach to simulate noise at landing. For each condition, the level of perceived noise is measured in effective perceived noise decibels (EPNdB). Individual limits are set for each of the three measurement points for each aircraft as a function of its MTOM. Starting with Chapter 4, each new aircraft type had to maintain a cumulative margin that is at least 10 EPNdB quieter than the compliance requirements for Chapter 3.[3] Under the current Chapter 14 standards, the cumulative margin increased to at least 17 EPNdB quieter than Chapter 3 limits.

PROPOSED SUBSONIC STANDARDS (CHAPTER 16)

If adopted, the proposed Chapter 16 noise standards will take effect internationally starting on January 1, 2029.[4] They will require larger subsonic aircraft to meet an additional 6 EPNdB cumulative margin than for Chapter 14, or at least 23 EPNdB quieter than Chapter 3 limits. Smaller aircraft will need to maintain a smaller additional margin of 2 EPNdB, or at least 19 EPNdB quieter than Chapter 3 limits. The standards are triggered by manufacturers applying to certify a new aircraft type, a process that can take up to 5 years. Previously certified aircraft types that are delivered after 2029 are not affected, nor are aircraft that are already in service.

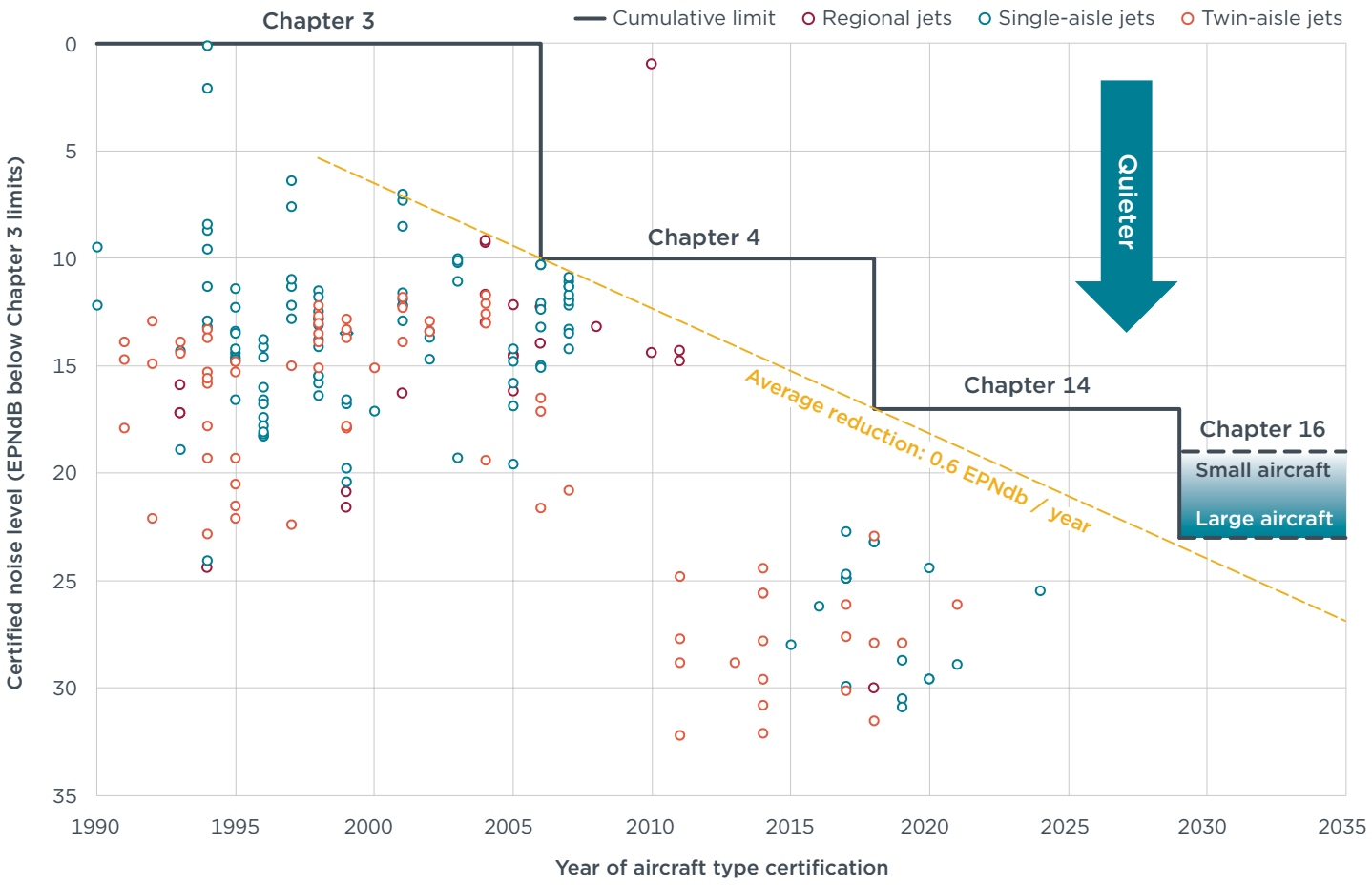
The new Chapter 16 limits continue the long-term trend of requiring a per annum cumulative reduction of 0.6 EPNdB for large aircraft through new type standards (dashed gray line, Figure 1). The standards are not expected to require substantive design changes or new technologies to reduce noise from major subsonic manufacturers, given that many state-of-the-art designs already comply with Chapter 14 requirements by 10 to 15 EPNdB.

3 For more information, see: Jan Boettche, "Annex 16, Volume I and Equivalent Procedures" (presentation, Noise Certification Workshop, Bangkok, Thailand, November 6–7, 2006), https://www.icao.int/Meetings/EnvironmentalWorkshops/Documents/Noise-Certification-Workshop-2006/Boettcher_3.pdf. The cumulative margin is the total difference between the measured EPNdb and the limit across the three points. Requiring that an aircraft maintain a cumulative margin, rather than stricter limits at each point, provides manufacturers with flexibility; manufacturers can achieve greater improvements at one of the measurement points but lower improvements at others, as long as the overall cumulative margin is achieved.

4 International Civil Aviation Organization, *Report of the Thirteenth Meeting of the Committee on Aviation Environmental Protection* (forthcoming).

Figure 1

Reductions in aircraft noise limits required for commercial aircraft under international standards by certification year, 1990 to 2035



Source: Adapted from European Union Aviation Safety Agency, *European Aviation Environmental Report 2025*, https://www.easa.europa.eu/en/domains/environment/eaer.

Aircraft noise standards have served as the basis for incentives and operational restrictions, particularly in Europe. Today, some airports use noise certification values as a means to differentiate landing charges, with quieter aircraft being charged less and noisier aircraft charged more. Aircraft noise standards have been applied to in-service aircraft in the past, first as a "phase out" of uncertified (Stage 1) aircraft in the United States in 1985, followed by restrictions on Stage 2 aircraft in the United States in 2000, and then by Australia, Canada, the European Union, Japan, New Zealand, and Singapore in 2002. The new Chapter 16 standards could serve as a reference for either approach in the future.

PROPOSED SUPERSONIC STANDARDS (CHAPTER 15)

There are currently no applicable noise standards for certifying supersonic aircraft. Supersonic aircraft types certified before 1975 were subject to Chapter 2 subsonic limits; after that time, manufacturers were encouraged to use subsonic limits as a guideline for certification.[5] To date, only one commercial supersonic aircraft, Concorde, entered into service, and did so at limited volumes, with 14 total aircraft flying between

5 Supersonic aircraft are addressed in Chapter 12 of ICAO's Annex 16, Volume I on aircraft noise.

1976 and 2003. In the United States, Concorde operated under noise limits detailed in 14 CFR §36.301, equivalent to subsonic Chapter 3 requirements.[6]

For supersonic aircraft, CAEP agreed to new Chapter 15 standards that will require new supersonic designs applying for type certification on or after January 1, 2029 to meet noise limits equivalent to the current subsonic Chapter 14 noise standards. Thus, they will be subject to somewhat less stringent noise limits than subsonic aircraft certified after that date under the new Chapter 16 requirements. Supersonic aircraft will use a similar noise certification procedure as for subsonic aircraft, with allowances for variable noise reduction systems. This may include mandatory procedures for reduced thrust takeoff to lower sideline noise.[7] Reduced thrust takeoffs may be particularly important for reducing noise from supersonic aircraft, as they have oversized engines to enable supersonic cruise.

Because there are no applicable noise standards for supersonic aircraft, the alignment with the Chapter 14 subsonic noise standard provides manufacturers with a certification basis for their planes. However, meeting the agreed standards is expected to impose a fuel burn penalty of up to 40% relative to the Chapter 3 limits that were applied to Concorde.[8] The Chapter 14 limits are also expected to require novel engine design and noise-abatement technologies for supersonic engines.[9] With the standards, some future supersonic designs are expected to emit 25% more noise per flight and 7 times more carbon dioxide (CO_2) per seat-kilometer compared with subsonic aircraft, according to an ICAO analysis approved at CAEP/13.[10]

ENFORCEMENT

Like other environmental standards, the new noise standards will be implemented under each National Aviation Authority's aircraft type certification for airworthiness. The standards apply to new applications for aircraft type certification after January 1, 2029; because a typical aircraft requires 4 to 5 years to complete type certifications, the noise limits will begin to take effect after 2033 and only for new designs. They will not be applied to previously certified aircraft delivered after 2029, nor to in-service aircraft. In the event that a future aircraft design generates more noise than is allowed under the standard, it would not be allowed to be type-certified for international sale.

NEXT STEPS

Following CAEP's recommendation, the CAEP/13 standards must be ratified by the ICAO Council, consisting of 36 member states, and then endorsed by the ICAO Assembly in October 2025. The standard would then be implemented by individual contracting states (or countries) under domestic legislation.

ICAO's recommended Chapter 15 standards are expected to replace the U.S.-specific standards proposed under a 2020 Notice of Proposed Rulemaking for supersonic

6 Noise Limits: Concorde, 14 CFR § 36.301(2002), https://www.ecfr.gov/current/title-14/part-36. Based on contemporary measurements, Concorde emitted about 10 EPNdb more noise than the loudest subsonic transport aircraft, which would be perceived by humans as twice as loud. See Boyce Rensberger, "How Loud Is Concorde?—Not Just a Matter of Decibels," *The New York Times*, October 20, 1977, https://www.nytimes.com/1977/10/20/archives/how-loud-is-concordenot-just-a-matter-of-decibels.html.

7 Jeffrey J. Berton, "Variable Noise Reduction Systems for a Notional Supersonic Business Jet," *Journal of Aircraft*, 60, no. 3 (2023): 688–701, https://doi.org/10.2514/1.C037019.

8 "Lee-Gardner Amendment would reduce supersonic fuel burn by 20 percent or more," FlyBy Blog, Boom Supersonic, March 5, 2018, https://boomsupersonic.com/flyby/lee-gardner-amendment-would-reduce-supersonic-fuel-burn-by-20-percent-or-more.

9 Joe Anselmo, host, "Is Boom's Supersonic Airliner Closer to Reality?" *Check 6 Podcast* (transcript), *Aviation Week*, https://aviationweek.com/podcasts/check-6/podcast-booms-supersonic-airliner-closer-reality.

10 International Civil Aviation Organization, *Complementary Supersonics Study*, (forthcoming).

noise by the U.S. Federal Aviation Administration (FAA).[11] The draft rule, which was required under the 2018 FAA Reauthorization Act, would have established noise limits between Chapter 4 and Chapter 14 for supersonic aircraft with an MTOM of less than 150,000 lb (68.2 tonnes) and a design speed of Mach 1.8 (180% the speed of sound) or less. The FAA's proposed rule was criticized by citizens' groups, airports, European governments, and environmental groups for allowing carbon-intensive supersonic aircraft to produce more noise than subsonic designs.[12]

For supersonic aircraft, work continues to develop an en route noise standard. In addition to LTO noise, supersonic aircraft generate a powerful shock wave, or sonic boom, when operating above the speed of sound. Due to the disruptive nature of sonic booms, many countries throughout the world ban supersonic flight over land.[13] ICAO is expected to develop an en route noise standard during the 2028–2031 CAEP/15 work cycle. This work is to be informed by data on acceptable noise levels gathered during test flights of the National Aeronautics and Space Administration's Quiet Supersonic Technology (QueSST) research aircraft.[14] Where adopted, the en route noise standard would replace the current speed limit that is enforced over most parts of the world.

11 Noise Certification of Supersonic Airplanes, 85 F.R. 20431 (proposed April 13, 2020) (to be codified at 14 C.F.R. § 21 and 36), https://www.regulations.gov/document/FAA-2020-0316-0001.

12 Dan Rutherford, "Weak Supersonic Regulation for Me, but Not for Thee?" *International Council on Clean Transportation Staff Blog*, August 5, 2020, https://theicct.org/weak-supersonic-regulation-for-me-but-not-for-thee/.

13 Gaurav Joshi and Tatenda Karuwa, "Which Countries Banned Concorde from Supersonic Flight?" *Simple Flying*, updated July 6, 2023, https://simpleflying.com/concorde-super-sonic-flight-ban/.

14 Lori Ozoroski, "NASA Quesst Mission Update" (presentation, High Speed Aerospace Transportation Workshop, Midland, Texas, November 14, 2024), https://ntrs.nasa.gov/api/citations/20240013353/downloads/HSAT-11-2024.pdf.

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