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Noise
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2aNSc1. Setting noise stringency by international consensus

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The paper evokes the background of Aviation Noise and examines the international consensus process used to set aircraft noise stringency requirements and present the role of controlling the noise at the source within the context of the overall community noise issue. The paper will also examine the role of technology in this process and examine the growing interdependencies of noise reduction technology on CO2 emissions, and on other emissions that impact air quality.

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SETTING NOISE STRINGENCY BY INTERNATIONAL CONSENSUS

History

Pioneer Days

More than 100 years ago, communications were mostly in written and printed forms that were transmitted by transport over land and water and take up to many weeks. Shipping was sea took time, was risky and even dangerous when facing piracy.

With the emergence of engines at the dawn of the 20th century, powered flight was sought. Of interest is Graham Bell who immigrated to Canada to research hydrofoils and flight resulting in the first flight of the Silver Dart in 1907. These pioneering short flights attracted the neighbors by curiosity.

Aviation Authorities

Other aviation uses were developed such as warfare, mail delivery and exploration in the first 20 years. The French company Aeropostale was one of the first intercontinental liaisons to fly Toulouse, Dakar and then Brazil.

The public was wary of aircraft falling upon them as much as the death of popular figures. By mid 1930's, in response to public pressure and numerous accidents, governments started to promote and regulate aviation in many countries. A key driver was design and construction of more reliable aircraft. The Second World War saw an explosion in aviation activities both for warfare and in support of military activities. The increase in air transportation and the possibly to cross oceans caused a decline in international shipping by sea when speed was critical.

An extraordinary during the war, was the Convention on International Civil Aviation, signed at Chicago on 7 December 1944. While the convention first acknowledges each state’s sovereignty over its air space, it enables air navigation, services and transportation by air between states in a similar fashion as the laws of the high seas. The Chicago convention established the International Civil Aviation Organisation, as a specialized agency of the United Nations in 1947. Two elements in this convention for this paper are aircraft design and construction certification for safety (called airworthiness) and mutual acceptance of airworthiness certificates as flight authorities.

The Jet Age

After the war, there was a major increase in emigration then followed by tourism. In those days before economic deregulations (price approved by the authorities) passengers were choosing flights by flight duration i.e. speed. In addition to the commercial use of the many airfields that had been constructed for training, testing, ferry and military use new ones are constructed. By the mid fifties all commercial aircraft were piston engines powered propeller driven and speed was the characteristic of choice.

We saw also the development of jet engines propulsion. Pulse jet for V Bomb and higher speed fighter aircraft started at the end of the war. By end of the fifties, manufacturers were proposing jets to airlines for faster service (even shorter duration flights) but airport authorities required that these jets to be no noisier than the aircraft (propeller) already in commercial use because of the growing discontent of communities near airports.

Port of New York Authority had already established noise monitoring in the communities around Idlewild airport (opened in 1948) and airline were performing power cut back over noise sensitive area as monitored by ground based radio operators. Pan Am was planning to debut jet service with Boeing 707 in 1958. Preliminary flight demonstrations of Boeing 707 were unacceptably loud.

Noise Measurement

In 1956, PNYA tasked an acoustic consulting firm Bolt Beranek and Newman of Cambridge, MA (BBN) to study the issue of communities protesting over aircraft noise. BBN studied the issue of perception and measures in term of operations and evaluation of aircraft designs. It identified noise variability caused by weather, piloting style (flight profile) and stage of flight (descending for arrival or accelerating for departure). To compare noise from different aircraft types, BBN developed the Noy as a measure of annoyance. The Noy is not measured directly like the phones; Noy results from third octave band analysis of sound pressure spectra. Then Noy values of each
spectrum are integrated for the duration of the noise event (a flight over a microphone). The noise evaluation measure is in effective perceived noise level (EPNdB) as measured at two points during the take-off and climb phases of a flight (called lateral and fly-over) and at one point during the final approach phase of a flight (called approach).

At the Lancaster House, London, the international conference on the reduction of noise and disturbance caused by civil aircraft (also known as the London Noise Conference) was held on 22 to 30 November 1966, with the objective of reaching international solution through the machinery of ICAO. The following year, the Fifth Air Navigation Conference of ICAO held at Montreal in November 1967 made certain recommendations on the subject. Based upon these recommendations, the 16th Session of the ICAO Assembly, held in September 1968 in Buenos Aires, adopted Resolution A16-3 calling for an international conference to consider the problem of aircraft noise in the vicinity of airports and seeking to establish international specifications and guidance material relating to aircraft noise. This resulted in the adoption of a new Annex to the Chicago convention. The EPNdB and the measurement points used for Idlewild (then renamed JFK) were adopted as the international Standards and Recommended Practices, Annex 16 to the Chicago convention.

Balanced Approach

The first version adopted in April 1971 was a balance between Operation, noise monitoring around airport and aircraft noise certification. The task to review and update the document was given to a group of experts initially called Committee on Aircraft Noise (CAN). These experts represented the states member of that committee and complemented by industrial and operations experts. Eventually, this committee was fused with the Committee on Aircraft Engine Emissions (CAEE) to form the Committee on Aviation Environmental Protection (CAEP). Using the rigorous process of design for safety, the reduction at source was made more severe over the decades: Stringency.

The reduction of perceived noise would be a combination of measures: insulation of the population from outside noise, operational measures such as increasing the distance of the noise sources to the population (altitude, distance and thrust cut back over populated areas), avoidance of the more noise sensitive areas, and reduction at the source. This would also include measures to keep population growth from encroaching noisy areas near airports (land use) but this is typically more difficult to enforce.

Increase in Stringency

Since the first edition where a single chapter applicable to aircraft over 5700 kg with engine bypass ratio over 2.0 in 1971, the noise certification requirements applicability has expanded to general aviation, helicopters and heavy propeller driven aircraft and increase in the severity of the limits to get a certificate (stringency) are now documented in 8 chapters that mirror Part 36 of the US Code of Federal Regulations.

The requirements are applicable to obtain a certificate of noise compliance that is now essential to complete a Type design certification and obtain a certificate of airworthiness for each aircraft. This later certificate serves a flight authority that is recognized by the states member of the Chicago convention.

CAEP

Nowadays, CAEP is a triennial meeting timed to be before the General Assembly every 3 years. It brings together 18 members, 23 observers and a large number of advisors to them. The observers range from Manufacturers and pilots to airports and NGO. Such large gathering (around 200 attendees) represents a large range of views but must reach a consensus resulting in revisions to the Annex 16, guidance and other documents related to protection of the environment from aviation activities.

Interdependencies

From operational measures to reduce noise at an airport, annex 16 standards require testing and meeting strict limits to get aircraft noise certification. Such certification is appended to the airworthiness certification activities required before serial production of an aircraft (manufacture) and to maintain its airworthy condition.

Along with standard of engine exhaust for local air quality, Annex 16 address issues of communities near airports. Airlines were always limited in payload (passengers and cargo for fares) by the weight of the fuel and since the 1973 embargo, fuel costs dominate direct operating costs. It is predicted that with advances in fuel economies in
other human activities, the contribution to global environment from burning fuel in aviation will increase from relatively minor to major.

ICAO CAEP has therefore put a higher priority on fuel burn. Some of the noise reduction design technologies come at a weight penalty and most of the noise abatement and other procedures have a fuel burn penalty. Otherwise, some fuel saving operational measures cause an increase in the noise perceived by communities and noise sensitive areas.

**Conclusion**

Noise certification is an important commercial consideration, first to airlines, operators and airport, but also to manufacturers and certification authorities.

With increased stringency aimed at reducing the population exposed to significant noise levels while allowing growth in aviation activities, more aircraft design are no longer acceptable and must be retired.

The decision to increase noise stringency must be made with considerations of fuel burn and global effects.

**REFERENCES**


Cranfield University. “Air Registration Board,” [http://www.cranfield.ac.uk/library/cranfield/about/archive/air%20registration%20board/page28917.html](http://www.cranfield.ac.uk/library/cranfield/about/archive/air%20registration%20board/page28917.html). (Last viewed Jan. 2012.)


