



# Noise Certification Workshop

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## SESSION 2: AIRCRAFT NOISE CERTIFICATION

### HISTORY / DEVELOPMENT

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#### SUMMARY

This paper presents the aircraft noise certification history, comparing different Standards developed by ICAO, US FAA, Russian Civil Aviation, and European JAA and EASA. Harmonisation of rules is paramount for reinforcing ICAO Standards as the universal technical base for noise certification.

Attention is directed to the difficulties of noise certification in connection with the complexity of equivalent procedures and lack of specialized expertise.

#### 1. NOISE CERTIFICATION STANDARD DEVELOPMENT

1.1 The first ICAO meeting on the subject of aeroplane noise took place in 1968 as a result of the concerns of airport communities over the increased levels of noise from early jet aeroplanes. This meeting, (Sixteenth Session of the Assembly) held in Buenos Aires, adopted Resolution A 16-3 calling for an international conference to consider the problem of aircraft noise in the vicinity of airports, and seeking to establish international specifications and associated guidance material relating to aircraft noise .

1.2 In response to Assembly Resolution A 16-3, a special Meeting on Aircraft Noise in the vicinity of Aerodromes was convened in Montreal in December 1969. Based on the recommendations of this special meeting, draft International Standards and Recommended Practices for Aircraft Noise were developed and, after amendment following the usual consultation with the Contracting States of the Organization, were adopted by the Council to form the text of the Annex 16.

1.3 The first certification regulations for subsonic jet aeroplanes, the ICAO Standards in Annex 16, Chapter 2 Standards, became applicable in January 1972. Since then, seven meetings of the Committee on Aircraft Noise (CAN) and six meetings of its successor, the Committee on Aviation Environmental Protection (CAEP), have been held. Each of these meetings has resulted in additions and modifications to the previous noise measurement and data analysis regulations.

1.4 During the same period, other Standards were developed. For example, the United States developed FAR Part 36, which contained numerous technical differences, both minor and significant, from the provisions in Annex 16. One difficulty in the application of these Standards was that certification authorities considered that the Standards were equivalent. Application of FAR Part 36 was “progressive”. The first application was on new subsonic aeroplanes with a Maximum Take-off Weight (MTOW) over 34 t except for the PW JT3D, on 1 December 1969. Application to all aeroplanes with a MTOW over 34 t was on 1 December 1973 and application to all aeroplanes was on 31 December 1974.

1.5 When aeroplane noise certification began, the intention was to ensure that the best noise local authorities used reduction technology was used in the design of new types of aircraft. Subsequently, however, certification as a basis for operating restrictions to limit the level of noise around airports. From that time on, airlines became interested in recertifying their aircraft to show compliance with newer and more stringent standards.

## 2. ICAO STANDARDS

2.1 The first noise certification activities conducted by ICAO were to develop Standards and Recommended Practices for jet aeroplanes. Progressively, ICAO Annex 16 was expanded to include other aircraft, in Chapter 6 for light propeller-driven aeroplanes in 1975, in Chapter 5 for heavy propeller-driven aeroplanes in 1977 and in Chapter 8 for helicopters in 1981. New Chapters were developed for light propeller driven aeroplanes in 1988 (Chapter 10) to enhance demonstration procedures and for light helicopters in 1993 (Chapter 11) for reducing noise demonstration cost. Guidance material was developed for tilt-rotor noise certification in 2001.

2.2 During this period, considerations were given to the level of stringency of these different Standards. One goal of noise certification is to encourage manufacturers to develop the best possible technology for reducing noise. More stringent Standards were approved for jets in 1977 with Chapter 3 application for new aircraft, and in 1981 for derivative versions of aircraft certified on Chapter 2. The introduction of Chapter 4 for jets and heavy aeroplanes, where the application for certificate of airworthiness for the prototype was accepted on or after 1 January 2006, is the latest step.

More stringent Standards for light propeller-driven aeroplanes appeared in 1988 with the application of Chapter 10 and again in 1999 with a further increase in stringency to Chapter 10.

In the case of helicopters, the noise limits of the original chapter 8 were relaxed in 1985 due to economical difficulties in applying these stringent Standards. Following technological progress, a new degree of stringency was introduced in 2002.

2.3 Milestones in the increase in stringency were:

- a) for subsonic jet aircraft the 1977 limits are more stringent than the original 1972 limits by 16 dB for light aeroplanes and 10 dB for heavy aeroplanes. In Chapter 4 Standard is 10 dB more stringent than the

Chapter 3 Standards, although the Chapter 4 becomes applicable in 2006, it is possible that aircraft manufacturers will ask for a voluntary certification or re-certification of some aircraft produced before 2006, due to market pressure and interest in the development of airport local rules;

- b) for light propeller-driven aeroplanes, the Chapter 10 Standard is more stringent than the Chapter 6 Standard by 6 dB for light aeroplanes and 3 dB for heavy aeroplanes
- c) for helicopters, progress was limited and average increase of stringency of 3 dB for take-off and 4 dB in approach conditions was instituted.

2.4 One important step in the development of ICAO Annex 16 was the introduction of material resulting from harmonisation with FAA's FAR Part 36 rule. This step is seen as progress in the treatment of distortion of competition problems among airlines, and leads to a sensible decrease of noise certification costs for aircraft manufacturers. Harmonised technical requirements were introduced in Annex 16 in 1999.

### 3. CURRENT STANDARDS FOR NOISE CERTIFICATION

3.1 Different Standards were developed around the world for aircraft noise certification. The first two Standards were established by ICAO (Annex 16) and the US (FAR Part 36). Technical differences existed; for example, the sideline noise measurement distances for Chapter 2 and Stage 2 were not the same. More than 120 differences were treated during harmonisation work conducted during the years 1995 to 1999. Caution had to be exercised regarding this subject; some people, not noise specialists, considered that Standards were the same or considered that differences were minor and, consequently, certificated noise levels were the same.

3.2.1 In an European organization, 38 States have created the Joint Aviation Authorities (JAA) and published JAR36 on 23 May 1997. It reproduced the active parts of the Standards recommended by ICAO for environmental protection in Annex 16, Volume I — *Aircraft Noise*; Third Edition (1993), Amendment 4. Associated Advisory Material Joint (AMJ) was based on the ICAO Environmental Technical Manual (ETM) at Working Group's Approved Revision 5 (WGAR/5). Following the publication of Amendment 5 of ICAO Annex 16, Volume 1 and WGAR/6 of the ETM, the JAR 36 Study Group recommended changes to JAR 36 and these were adopted via NPA 36-2. During the approval process for NPA36-2, Amendments 6 and 7 of ICAO Annex 16, Volume 1 Third Edition and SGAR/7 of the ETM were published. Consequently the JAR 36 Study Group has recommended these changes to JAR 36 via NPA 36-3 Part I (Amendment 6) and Part II (Amendment 7). They incorporate the ICAO Annex 16, Volume 1, Third Edition amendments into Section 1 of JAR 36 and SGAR/7 of the ETM into Section 2.

3.2.2. It is likely to think that JAR 36 will not be amended in the future, due to the development of the European Aviation Safety Agency (EASA).

3.3 With regard to the European Commission regulation (EC) N° 1702/2003 of 24 September 2003 providing implementation rules for the airworthiness and environmental

certification of aircraft, EASA produced decision N° 2003/4/RM on 17 October 2003 on certification specifications for acceptable means of compliance for aircraft noise (CS-36).

3.3.2 Acceptable means of compliance are based on ICAO Annex 16, Volume 1, and Guidance Material in ICAO Annex 16 and in the ICAO Environmental Technical Manual.

3.4 The first version of AP 36 on “certification of noise emitted by aircraft on ground” was written in the Russian Federation in 1995. The AP 36 was made up of corresponding parts of FAR Part 36 US, ICAO Annex 16 Standards, and national governmental rules. After the FAA/JAA (ICAO Annex 16) harmonisation, a second version of AP 36 was written. This second edition can be considered in line with ICAO Annex 16.

3.5 In conclusion, different Standards on aircraft noise certification were developed around the world, but after harmonisation between FAR Part 36 and JAR 36 (Annex 16), differences between these Standards are minimised. It is possible to conclude that ICAO Annex 16 is representative technically of all Standards applied around the world for aircraft noise certification.

3.6 After harmonisation of different Standards, and a high level of stringency in aircraft production, it might be thought that noise certification is simple. In fact, due to the complexity of rules, practices, and equivalencies, different interpretations of rules create difficulties, especially for the noise certification of heavy aeroplanes.

#### **4. DIFFICULTIES FOR NOISE CERTIFICATION**

4.1 Annex 16 describes in Chapters and Appendices demonstration procedures for noise evaluation, but in fact these procedures are generally not applied. ICAO Working Groups developed equivalent procedures which are described in the Environmental Technical Manual, but due to the fact that aircraft are, from an acoustic point of view, more and more complex, noise specialists must evaluate and accept or refuse new equivalent procedures, which may not necessarily be taken into account in the ETM.

4.2 As more and more modifications are applied to engines, the family concept is frequently used. The family concept was developed to flight testing for each engine modification. The family concept is based on a flight test conducted for the parent aircraft, and a noise engine static test conducted on engine types of the parent aircraft. Differences are calculated between flight tests results and calculated values.

4.3 Generally, engine modifications are evaluated by engine static tests, but in the case of a lesser noise impact, use of techniques described in the ETM are not very accurate. In the future, new techniques of engine noise measurement will have to be developed.

4.4 A noise certification project requires a high level of technical expertise experience is required especially when the techniques applied as equivalent procedures are not completely described in Annex 16 or in the ETM.

4.5 Noise certification presents two aspects: to satisfy ICAO Annex 16 Chapters and obtain a noise certificate; and to satisfy aircraft local rules by reference to certificated

noise levels (example: Chapter 3 limits minus 5 dB or minus 8 dB developed by airports as local rules).

4.6.1 Annex 16, Chapter 1 “Administration”, paragraph 1.2 stipulates that:  
“Noise certification shall be granted or validated by the State of Registry of an aircraft on the basis of satisfactory evidence that the aircraft complies with requirements which are at least equal to the applicable Standards specified in this Annex.”

4.6.2 An interpretation indicating that it is an obligation to grant or validate a foreign noise certificate even if some doubt exists about conformity to ICAO Standards for demonstration could cause difficulties.

## 5. **IMPACT OF LACK OF APPROPRIATE EXPERTISE**

5.1 Lack of appropriate expertise for noise certification can lead to creation of a distortion of competition among airlines. As information about noise certificates and operational noise levels measured in the vicinity of airports becomes available, confidence in noise certification procedures may be diminished. The idea developed by ICAO that local rules should be referred to noise certification development could be challenged.

5.2 Examples of lack of appropriate expertise will be presented during Session 2 of this workshop; nevertheless, a current example is the delivery of a noise certificate for flap/slat deflection in other than the noisiest configuration for a heavy aircraft. In this case, noise levels must be considered as complementary information, and not certification criteria.

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