



Noise Certification Workshop

Session 3: Aircraft Noise Re-certification

Assessment criteria

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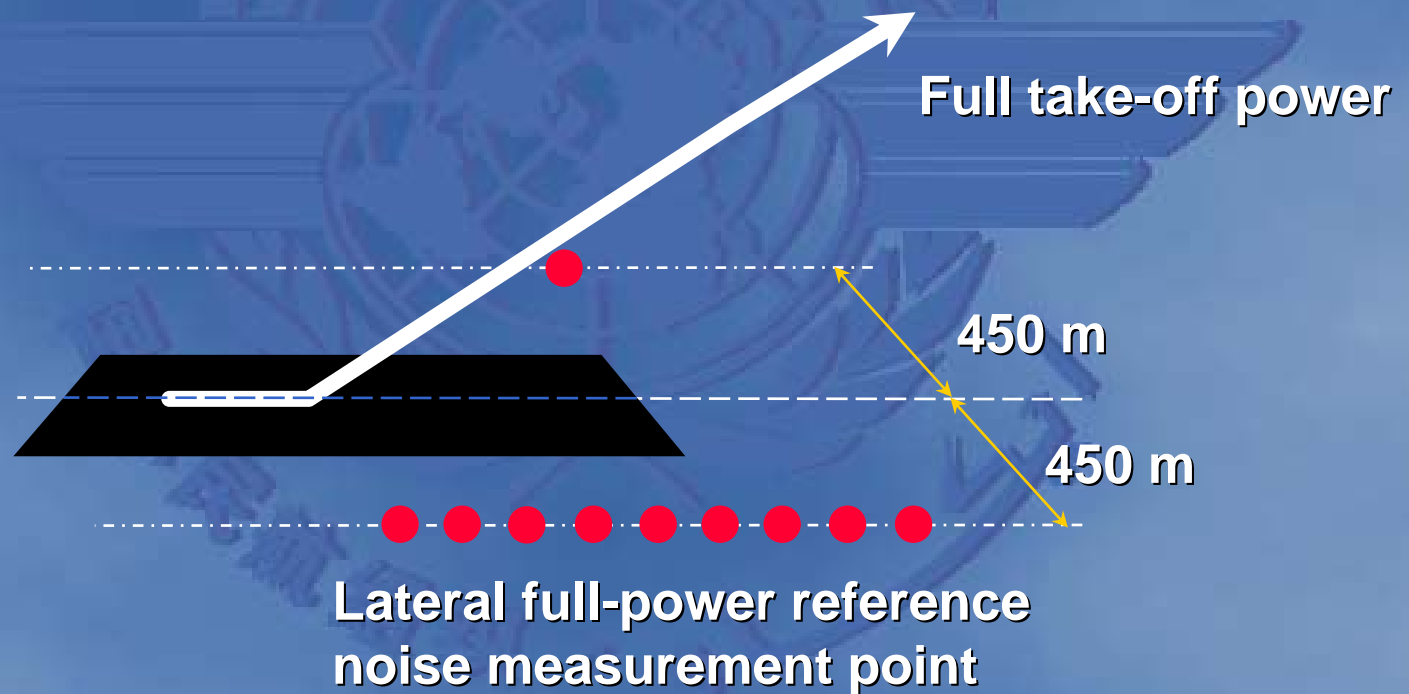
2. Re-certification roadmap

Chapter 3/5 to Chapter 4 (1) - The “12 Questions” (from a to l) -

- ☀ What are the “12 questions”?
 - The “12 questions” consider the technical changes within Annex 16 (and the Environmental Technical Manual, ETM) from the beginning towards Annex 16, Volume I, Third Edition, Amendment 5.
- ☀ Where are the “12 questions” documented?
 - In the ETM, Appendix 8.
- ☀ For which aeroplanes the “12 questions” have to be applied?
 - Five questions (a to e) to all aeroplanes (subsonic jet and large propeller-driven),
 - four questions (f to i) to subsonic jet aeroplanes only,
 - three questions (j to l) to large propeller-driven aeroplanes only.

Chapter 3/5 to Chapter 4 (2) - For All Aeroplanes - Question a -

- ☀ **Question a:** “Was full take-off power used throughout the reference flight path in the determination of the lateral noise level?” (Annex 16, 3.6.2.1c)



Chapter 3/5 to Chapter 4 (3) - For All Aeroplanes - Question a -

- ☀ **Question a:** “Was full take-off power used throughout the reference flight path in the determination of the lateral noise level?” (Annex 16, 3.6.2.1c)
- ☀ **History:** In early amendments of Annex 16 there existed an ambiguity in the definition of engine configuration during lateral noise level measurements. Clarified in Annex 16, Amendment 5 (Nov. 1997).
- ☀ **Discussion:** Not applying full take-off power could result in a lower lateral noise level.
- ☀ **If answer is no:** Can normally be corrected by re-analysis.

Chapter 3/5 to Chapter 4 (4) - For All Aeroplanes - Question b -

- ☀ Question b: “Was the ‘average engine’ rather than the ‘minimum engine’ thrust or power used in the calculation of the take-off reference flight path?”
(Annex 16, 3.6.2.1a and g)
- ☀ History: ‘Average engine’ was introduced in Annex 16, Amendment 3 (Nov. 1988).
- ☀ Discussion: Different engine performance could result in different lateral and flyover noise levels.
- ☀ If answer is no: Can be corrected by re-analysis of aircraft take-off performance.

Chapter 3/5 to Chapter 4 (5) - For All Aeroplanes - Question c -

- ✿ Question c: “Was the ‘simplified’ method of adjustment defined in Appendix 2 of the Annex used and, if so, was -7.5 used as the factor for the calculation of the noise propagation path duration correction term?”
(Annex 16, Appendix 2, 9.3.3.2)
- ✿ History: The factor -7.5 was introduced in Annex 16, Amendment 2 (Nov. 1985). Before that -10.0 was used.
- ✿ Discussion: A different factor could result in different flyover, lateral and approach levels.
- ✿ If answer is no: Can be corrected by analysis.

Chapter 3/5 to Chapter 4 (6) - For All Aeroplanes - Question d -

- ☀ Question d: “Was the take-off reference speed between $V_2 + 10$ kt and $V_2 + 20$ kt?” (Annex 16, 3.6.2.1d).
- ☀ History: There were cases where a speed higher than $V_2 + 20$ kt was used. The limitation to $V_2 + 20$ kt was introduced in Annex 16, Amendment 1 (Nov. 1983).
- ☀ Discussion: If speed was greater than $V_2 + 20$ kt, it could result in different lateral and flyover noise levels.
- ☀ If answer is no: Can be corrected by re-calculation.

Chapter 3/5 to Chapter 4 (7) - For All Aeroplanes - Question e -

- ☀ Question e: “Was the four 1/2 s linear average approximation to exponential averaging used and, if so, were the 100% weighting factors used?”
(Annex 16, Appendix 2, 3.7.4 and 3.7.5)
- ☀ History: Earlier amendments of Annex 16 have defined different weighting factors. Today's factors were introduced in Annex 16, Amendment 5 (Nov. 1997)
- ☀ Discussion: Different factors could result in different noise levels.
- ☀ If answer is no: Can normally be handled by correction.

Chapter 3/5 to Chapter 4 (8)

- For Jet Aeroplanes Only - Question f -

- ☀ Question f: “Were the noise measurements conducted at a test site below 366 m and, if not, was the jet source noise correction applied?” (ETM, Appendix 6)
- ☀ History: Correction of jet source noise was introduced in 1997.
- ☀ Discussion: Not applying jet source noise correction could result in lower noise levels.
- ☀ If answer is no: Can be handled by source correction.

Chapter 3/5 to Chapter 4 (9) - For Jet Aeroplanes Only - Question g -

- ✿ Question g: “Do the engines have bypass ratios of more than 2 and, if not, was the peak lateral noise established by undertaking a number of flights over a range of heights?” (ETM, 2.1.3.2b)
- ✿ History: Was introduced in 1997.
- ✿ Discussion: The maximum noise level along the lateral line must be clearly determined. A single clustered data set taken around one height is not acceptable.
- ✿ If answer is no: Can normally be corrected by analysis.

Chapter 3/5 to Chapter 4 (10) - For Jet Aeroplanes Only - Question h -

- ☀ Question h: “In the event that ‘family’ certification methods were used, were the 90% confidence intervals for the pooling together of flight and static engine test data established according to the Technical Manual guidance?” (ETM, Appendix 1)
- ☀ History: Was introduced around 1980.
- ☀ Discussion: An application for re-certification may be supported by many sets of data (flight and static test data). The calculation of noise levels must be consistent with ETM, Appendix 1.
- ☀ If answer is no: Can normally be corrected by analysis, if data are available.

Chapter 3/5 to Chapter 4 (11)

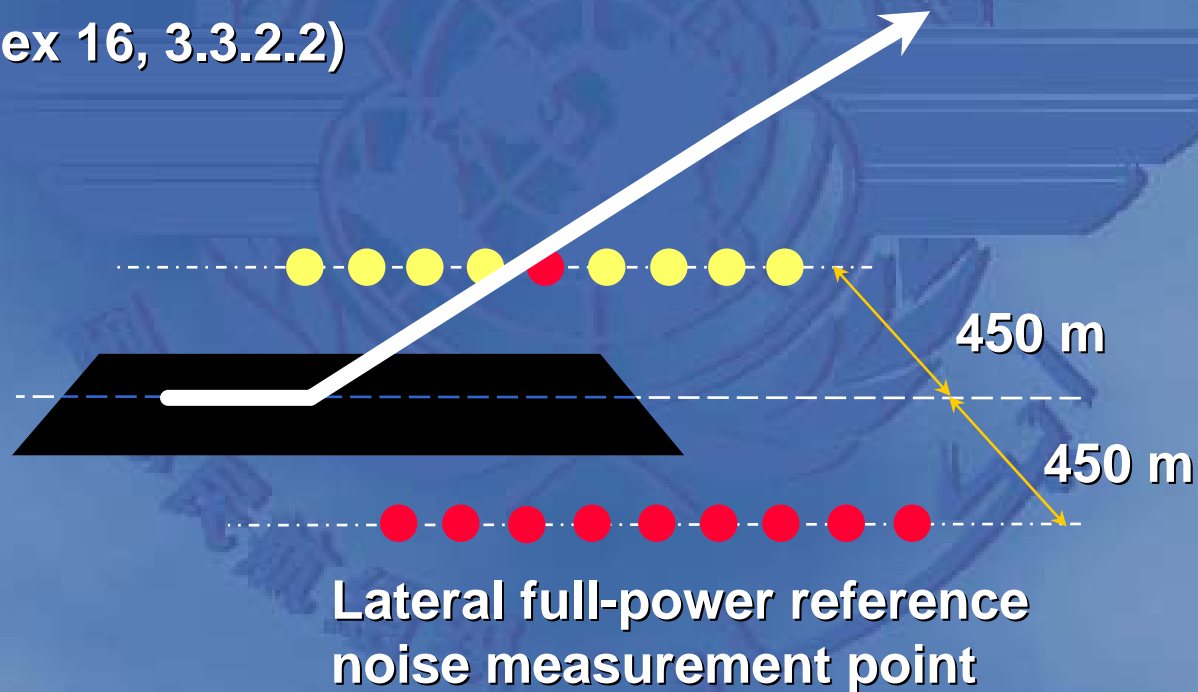
- For Jet Aeroplanes Only - Question i -

- ☀ Question i: “Do the engines have bypass ratios of 2 or less and, if not, in the event that ‘family’ certification methods were used, did all associated static engine tests involve the use of a turbulence control screen (TCS) or inflow control device (ICD)?” (ETM, 2.3.3.4.1)
- ☀ History: Was introduced around 1980.
- ☀ Discussion: The ETM requires the use of a TCS or ICD. Not using this device could lead to different noise levels.
- ☀ If answer is no: Cannot be corrected. New static test is necessary.

Chapter 3/5 to Chapter 4 (12)

- For Propeller-driven Aeroplanes Only - Question j -

- ☀ Question j: “Were symmetrical microphones used at every position along the lateral array for the determination of the peak lateral noise level?”
(Annex 16, 3.3.2.2)



Chapter 3/5 to Chapter 4 (13)

- For Propeller-driven Aeroplanes Only - Question j -

- ☀ **Question j**: “Were symmetrical microphones used at every position along the lateral array for the determination of the peak lateral noise level?” (Annex 16, 3.3.2.2)
- ☀ **History**: Was introduced in Annex 16, Amendment 4 (Nov. 1993).
- ☀ **Discussion**: If symmetrical microphones were not used at each position, this could result in different noise levels.
- ☀ **If answer is no**: Can be corrected, but not in all cases.

Chapter 3/5 to Chapter 4 (14)

- For Propeller-driven Aeroplanes Only - Question k -

- ☀ **Question k**: “Was the approach noise level demonstrated at the noisiest configuration?” (Annex 16, 3.6.3.1e)
- ☀ **History**: Was introduced in Annex 16, Amendment 3 (Nov. 1988).
- ☀ **Discussion**: Not applying the noisiest configuration results in lower approach noise level.
- ☀ **If answer is no**: May be possible to correct, but not in all cases.

Chapter 3/5 to Chapter 4 (15)

- For Propeller-driven Aeroplanes Only - Question I -

- ✿ Question I: “Was the target airspeed flown during the flight tests appropriate to the actual test mass of the aeroplane?” (ETM, 3.1.2a)
- ✿ History: Was introduced around 1990.
- ✿ Discussion: The propeller inflow angle has an influence on the noise level. In order to ensure that propeller inflow angles are similar throughout the test flights, the airspeed shall be appropriate to the actual mass of the aeroplane.
- ✿ If answer is no: Can be corrected by analysis.

Chapter 2 to Chapter 4

- ✿ First step: Re-certification from Chapter 2 to Chapter 3. For the lateral noise measurement point it has to be considered that
 - Chapter 2 - 650 m from runway centreline
 - Chapter 3 - 450 m from runway centreline
- ✿ Second Step: Re-certification from Chapter 3 to Chapter 4.

FAR Part 36 Stage 3 to Chapter 4 (1) - Amendment 24 (August 2002) or higher -

One question has to be considered:

- ☀ Question g: “Do the engines have bypass ratios of more than 2 and, if not, was the peak lateral noise established by undertaking a number of flights over a range of heights?” (ETM, 2.1.3.2b)
- ☀ History: Was introduced in 1997.
- ☀ Discussion: The maximum noise level along the lateral line must be clearly determined. A single clustered data set taken around one height is not acceptable.
- ☀ If answer is no: Can normally be corrected by analysis.

FAR Part 36 Stage 3 to Chapter 4 (2)

- Amendment 7 through 23 -

- ✿ 12 Questions already discussed have to be considered**
- ✿ Two additional questions (below) have to be considered**

FAR Part 36 Stage 3 to Chapter 4 (3)

- Amendment 7 through 23 -

- ✿ Question a: “Was the speed component of the EPNL duration adjustment determined by using $10 \log V/V_r$?” (Annex 16, Appendix 2, 9.3.3.2)
- ✿ History: Was introduced into Part 36 in July 2004 (Amendment 24)
- ✿ Discussion: Prior to harmonisation, Part 36 required a speed correction without giving any specific method or equation. In practice $10 \log V/V_r$ was used by most applicants.
- ✿ If answer is no: Can normally be corrected by analysis.

FAR Part 36 Stage 3 to Chapter 4 (4)

- Amendment 7 through 23 -

- ✿ **Question b:** “For derivative engine certifications using static engine procedures, is the summation of the magnitudes, neglecting signs, of the noise changes for the three reference certification conditions between the 'flight datum' aeroplane and derived version not greater than 5 EPNdB with a maximum 3 EPNdB at any one of the reference conditions?” (ETM, 2.3.2.4)
- ✿ **History:** Was introduced in FAA Advisory Circular in July 2003.
- ✿ **Discussion:** Larger values in general are seen as to exceed the validity of static engine tests.
- ✿ **If answer is no:** Additional flight testing is recommended in the ETM. However, ETM, 2.3.2.5 lists circumstances under which additional tests can be avoided.

Roadmap for Re-certification to Chapter 4

