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ICAO FUTURE TRENDS IN NOISE CERTIFICATION. WHAT'S HAPPENING BETWEEN CAEP/3 AND CAEP/4

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1. INTRODUCTION

For a number of consecutive years, air traffic shows a steady growth which is expected to continue well into the next Century. This will result in a significant increase in traffic volume, which in turn raises concern about its impact on the noise around airports. It is anticipated that serious problems can only be avoided if the effects of traffic growth on the noise impact around airports can be counterbalanced by a continuing decrease of the (average) noise levels of civil transport aircraft. This underscores the importance of transport aircraft source noise control. This paper focusses on the role of the International Civil Aviation Organization (ICAO) in regulating (civil transport) noise through noise certification, and describes recent developments.

2. THE ROLE OF ICAO

The International Civil Aviation Organization

The development of international civil aviation would not have been possible without global and regional agreements, covering the operational, technical, legal, and economis aspects. In order to facilitate the safe and orderly development of civil aviation after the second world war, the International Civil Aviation Organization (ICAO) was established in 1944 with the Chicago Convention. Its headquarters are in Montreal, Canada. The organization is governed by the Council, which is made up of permanent reperesentatives from 36 member states.

Standards and Recommended Practices (SARP's)

One of the most important tasks of ICAO is the establishment and updating of international Standards and Recommended Practices (SARP's). These are considered as necessary (Standards) or desirable (Recommended Practices) for the safe and orderly conduct of international civil aviation. They are published in Annexes to the Chicago Convention.

The Committee on Aviation Environmental Protection (CAEP)

In recognition of the serious problem of noise in the vicinity of aerodromes due to the introduction of civil jet aircraft and the rapid expansion of air traffic, the ICAO General Assembly instructed the Council in 1968 to establish international specifications and associated guidance material to control aircraft noise. On the basis of recommendations of the Special Meeting on Aircraft Noise in the Vicinity of Aerodromes, held in 1969, the Council established the Committee on aircraft Noise (CAN) to assist ICAO in the development of noise certification requirements for different classes of aircraft. In 1983, the Council merged the Committees on Aircraft Noise and of Aircraft Engine Emissions into the Committee on Aviation Environmental Protection (CAEP). The Committee has 15 members from member States' Civil Aviation Administrations, appointed by the Council, and a number of observers, mainly from international aviation industry organizations. The European Commission also has observer status.

CAEP Terms of Reference. The Terms of Reference of the Committee are:

"To undertake specific studies, as approved by the Council, related to control of aircraft noise and gaseous emissions from aircraft engines.

In its work the Committee shall take into account the following:

a) effectiveness and reliability of certification schemes from the viewpoint of technical feasibility, economic reasonableness and environmental benefit to be achieved;

b) developments in other associated fields, e.g. land use planning, noise abatement operating procedures, emission control through operating practices;

c) international and national programmes of research into control of aircraft noise and control of gaseous emissions from aircraft engines; and

d) the potential interdependence of measures taken to control noise and to control engine emissions".

Annex 16 (Environmental Protection)

In the seven CAN meetings held since 1972 and the three CAEP meetings held since 1983, the Committee developed and updated noise certification requirements for different categories of aircraft. They are published in Annex 16 (Environmental Protection) to the Chicago Convention, and consists of Volumes I (Aircraft Noise) and II (Aircraft Engine Gaseous Emissions).

Noise certification standards for subsonic jet aeroplanes, the Chapter 2 standards, became applicable in 1972. More stringent requirements, the Chapter 3 standards, became applicable in 1977.

The leading principle in setting the noise certification standards has always been to ensure that current noise reduction technology is applied in the design and manufacture of aircraft; they have never been intended to direct and force technology to achieve preset objectives.

3. MAIN RESULTS OF CAEP/3

The CAEP/3 Work Programme

The third CAEP meeting was held in December 1995 to decide on recommendations to the Council on the basis of the results and conclusions of the studies carried out by its working groups under the work programme, established at the second meeting.

Prime area of concern was the evolution of noise around major airports as a result of the continued air traffic growth into the next century. At is second meeting, the Committee agreed on the objective to have no increase of the number of people, seriously affected by aircraft noise around airports, after completion of the phase-out of the relatively noisy Chapter 2 aircraft. On the basis of an ICAO-resolution, phase-out regulations are in force in the USA and Europe, and the phase-out is scheduled to be completed in 2002.

To achieve this goal, a balanced programme was developed, aimed at noise control which included the following three elements:

a) land-use controls and insulation measures;
b) operational measures
c) reduction at source by further technological improvements leading to stringency increases of the subsonic trtansport aircraft noise standards.

Main results and conclusions

Evolution of Aircraft Noise Control Technology. The general noise control technology standard incorporated in today's product line is effectively that which will pertain in the aircraft and engine design processes until the end of the Century and, therefore, will reflect the average airline fleet technology well into the next Century.

The noise control techniques used today are much the same as those available when Chapter 3 standards were being formulated in the mid seventies but, of course, their means of application to the product are some 15 years more mature. As a result, some of the higher noise levels have reduced since the late 1970s but, since no new technology "break-through" has materialized, average noise levels have not fallen to any great degree. Moreover, since the benefits of any new research in the next 5-10 years can not be presumed to affect production lines well into the next Century, any fundamental change to the current technology standard could not be foreseen.

Table 1 (page 4) provides some illustration of the product improvements that have materialized. This table summarizes for a number of generic aeroplane classes the average margins by which recently certificated types, i.e those which reflect the current aero-acoustic technology, comply with the Chapter 3 limits. It should be kept in mind, however, that within each aeroplane class, there are significant variations in noise levels for specific aeroplane types.

Evolution of noise around airports. At CAEP/3 the results of a study of the evolution of noise around airports was presented. For 13 (US and European) airports, noise exposure contours were calculated for 1992, 2003, and 2015. Contours were calculated for a baseline case, assuming a fleet development not constrained by more stringent noise certification requirements, and for a number of different noise certification stringency options with a stringency increase relative to the present

Chapter 3 standards of up to 4 dB. the results are summarized in Table 2.

Table 1. Average noise certification margins relative to Chapter 3

Class	Seats	Sample no.	Lateral	Flyover	Approach
1	<80 Jets	6	7.4	6.2	6.4
	<80 Props.	20	9.7	5.8 *) 9.2 **)	5.3
2	81-150	17	4.6	4.0	2.3
3	151-210	16	3.7	4.8	3.5
4	211-300	22	3.9	4.4	3.9
5	301-400	12	5.3	7.0	1.1
6	401-500	7	4.4	6.1	1.2

*) Full Takeoff Power
**) Cut-Back Power

Table 2. Aggregate noise trends for 13 airports sample

	1992	2003 baseline	2015 baseline	2015 Increased noise stringency*)
DNL 55 dB contour area (sq km)	2080 100 %	1160 56 %	1080 52 %	1040 50 %
DNL 65 dB contour area (sq km)	424 100 %	227 53 %	212 50 %	208 49 %
DNL 55 dB population (people x 1000)	3510 100 %	2220 63 %	1460 42 %	1390 40 %
DNL 65 dB population (people x1000)	693 100 %	190 27 %	126 18 %	123 18 %

*) Most severe stringency option, i.e. -4 PNdB for flyover and sideline and -2 EPNdB for approach relative to the Chapter 3 noise limits.

Although these results seem to indicate that:

a) the noise climate around airports will improve significantly relative to the present situation and will not deteriorate after 2003, and
b) increasing the stringency of the noise standards will only have a marginal effect,

it should be mentioned that the results are highly dependent on the assumptions made.

For example, the baseline case assumes a continuing improvement of average fleet noise levels and the study assumed a stable population around the airports. Further,

questions were raised about the representativity of the 13 airport sample, taking into account that the estimated average growth rate at these airports is clearly below the estimated global traffic growth rate. Moreover the results for individual airports differ widely, and in particular the four Long Range airports out of the 13 airport sample show a trend of increasing noise exposure after 2003, which is illustrated in Table 3.

Table 3. Aggregate noise trends for Long Range airports sample

	1992	2003 baseline	2015 baseline
DNL 55 dB contour area (sq km)	813 (100%)	529 (65%)	554 (68)%
DNL 65 dB contour area (sq km)	169 (100%)	106 (63%)	107 (63%)
DNL 55 dB population (people x 1000)	961 (100%)	622 (65%)	662 (69%)
DNL 65 dB population (people x 1000)	123 (100%)	68 (55%)	73 (60%)

Economic analysis. An economic analysis was performed to calculate the costs of the different stringency options. These costs consist of the costs of new aircraft deliveries, i.e. the costs to bring future production of non-complying aircraft types into compliance with more stringent noise standards, and of the loss of asset value of existing fleets. As for the noise exposure study, the results are highly dependent of the assumptions made. This is clearly illustrated in Table 4.

Table 4. Noise costs for the most severe noise stringency option
(Discounted present values, 1993 US $ millions)

	Existing fleet costs	Costs of new aircraft deliveries	Total costs
ATA/IATA cash flow model *)	$ 27 502	$ 1 714	$ 29 216
ATA/IATA financial survey - Low estimate *)	$ 17 200	$ 1 714	$ 18 914
ATA/IATA financial survey - High estimate *)	$ 22 700	$ 1 714	$ 24 414
EC study **)	$ 3 111		

*) all existing non-compliant aircraft
**) only existing non-compliant aircraft still in production after 1998

Conclusions on stringency. Having regard to the leading principle mentioned on page 2 under **Annex 16 (Environmental Protection),** a significant number of members felt that the improvements in application of aircraft noise technology since the introduction in 1977 of the Chapter 3 noise certification standards enabled an increase of the stringency of the noise standards, it is not suprising - taking into account the results of the forementioned studies - that CAEP/3 was unable to reach consensus on a recommendation to the ICAO Council.

4. WHAT'S HAPPENING BETWEEN CAEP/3 AND CAEP/4

CAEP/4 Work Programme

It is interesting to note that the work programme agreed by CAEP/4 and approved by the ICAO Council does not specifically address the question of the stringency of the subsonic jet and heavy propeller-driven aircraft noise standards. An explanation for this is the inability of CAEP/2 and CAEP/3 to reach consensus on a recommendation for increased stringency. However broad interest has been expressed in establishing future CAEP noise objectives and the specification of technology milestones in support of this.

In its discussion of the CAEP/3 report, the ICAO Council was firm on having CAEP/3 reporting before the next General ICAO Assembly, which is in the autumn of 1998. This implies that CAEP will have to finalize its work programme before the end of 1996, which seems to be a very challenging time frame.

Developments outside CAEP

Airport operating restrictions. In the light of the outcome of CAEP/3 and the noise problems airports are facing, it is not unlikely that operational measures to further control airport noise will be developed by individual airports or groups of airports, with the serious risk of different local rules proliferating, creating operating difficulties for airlines. At CAEP/3, such initiative for co-ordinated action was already announced by the airports of Frankfurt, London, Amsterdam and Paris (the so-called FLAP-airports) in case CAEP would not recommend an increase in stringency of the noise standards.

Regional actions. Taking into account that most CAEP-members from European countries were in favour of an increase in stringency - a position strongly supported by the European Commission - it is conceivable that within Europe further measures will be considered, such as the non addition to national registers of aircraft types that do not incorporate modern noise reduction technology.

The outlook for improved Noise Reduction Technology

A sustainable further development of civil aviation requires further source noise reductions. Such reductions can only be achieved through increased Research and Development efforts. In this context two programmes should be mentioned, i.e the FAA/NASA Advanced Subsonic Noise Reduction Programme and the European Association of Aerospace Industries "Environmentally Friendly Aircraft" (TEFA) programme that has been submitted to the European Commission for EU funding. Both programmes offer the prospect of significant reductions of aircraft source noise.