Nationaal Lucht- en Ruimtevaartlaboratorium
National Aerospace Laboratory NLR

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Abstract

In order to limit the effects caused by air traffic in terms of community noise the European Union and governments are currently studying possible increased noise stringencies that could be introduced by the International Civil Aviation Organisation (ICAO). Recent studies focus on stringency measures that propose an 8 dB, 11 dB and 14 dB reduction with respect to the ICAO Chapter 3 standards and the phase-out of aircraft that do not comply with the new standard. This reduction is the total difference of the 3 noise certification points with the Chapter 3 certification limits. On behalf of the Dutch CAA, an investigation into the effects of these increased stringencies on the fleet composition and noise exposure at Amsterdam Schiphol airport is carried out, using a number of possible scenarios. The time frame for these scenarios is 1999-2020, with the increased stringencies taking effect in 2002/2003. Firstly, for each of the years 1999, 2002, 2010 and 2020, the fleet exposure level is calculated, based on fleet projections by the airlines and airports. In a second stage, the proposed phase-out scenarios are implemented and fleet exposures are determined for 2010 and 2020 showing the effect of the increased stringencies. The results show that increased stringencies of 8 dB and 11 dB will have a limited effect on the noise exposure and fleet composition at Amsterdam Schiphol Airport. Only the 14 dB stringency will have a more significant effect at Amsterdam Schiphol Airport.

Contents

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1 Introduction

Due to the considerable growth of air traffic in recent years, the noise nuisance around airports has increased substantially. In order to reduce this noise nuisance, both airports and governments are studying operational, technological and legislative measures. The starting point for these studies are the current ICAO Chapter 3 limits, with which all new aircraft have to comply. In January this year, ICAO's Committee on Aviation Environmental Protection (CAEP) held a meeting to decide on new stringency measures. Noise reductions of between 8 and 14 dB were proposed to the CAEP.

On behalf of the Dutch CAA, an investigation is carried out to assess the effect of these proposed noise reductions on the fleet composition and noise exposure at Amsterdam Schiphol Airport. This paper discusses the effects of stringency measures that propose an 8 dB, 11 dB or 14 dB cumulative margin with respect to the current Chapter 3 certification limits.

2 Research Lay-out

The traffic distribution and fleet composition of four years (1999, 2002, 2010 and 2020) form the basis for this research, together with the noise certification levels of the aircraft used. The traffic distributions and fleet compositions are taken from existing projections by airlines and the airport. The noise certification data are taken from both the appendices of AC36-1G [1] of the Federal Aviation Administration (FAA) as well as from the Lärmliste (noise list) [2] of the German Luftfahrtbundesamt (LBA).
To determine the effect of the increased stringencies, the following seven scenarios were used, based on the years mentioned and with the new measures taking effect in 2003:

- Current situation (1999), the reference scenario.
- No ICAO-action scenario (2002, 2010 and 2020). This scenario shows the improvements with respect to noise in the fleet composition, as expected by airlines and airports.
- 8 dB, 11 dB and 14 dB measures, no phase-out (2010). For this scenario it is assumed that from 2003, no new aircraft are bought that do not comply with the margin of 8, 11 or 14 dB respectively.
- 8 dB measure with phase-out of non-compliant aircraft (2010). No new aircraft are bought that do not comply with the 8 dB measure and all existing aircraft that do not comply with the 8 dB measure will be phased out by 2010.
- 11 dB measure with phase-out of non-compliant aircraft (2010). No new aircraft are bought that do not comply with the 11 dB measure and all existing aircraft that do not comply with the 11 dB measure will be phased out by 2010.
- 11 dB measure with phase-out of non-compliant aircraft (2020). No new aircraft are bought that do not comply with the 11 dB measure and all existing aircraft that do not comply with the 11 dB measure will be phased out by 2020.
- 14 dB measure with phase-out of non-compliant aircraft (2020). No new aircraft are bought that do not comply with the 14 dB measure and all existing aircraft that do not comply with the 14 dB measure will be phased out by 2020.

3 Calculation methodology

To calculate the noise exposure of an aircraft fleet, the following data is needed:

- the composition of the fleet, i.e. the aircraft types
- the number of movements for each aircraft type
- the noise certification data for each aircraft type

Then, the fleet noise exposure can be calculated with the following formula [3]:

$$L_{fleet} = 10 \cdot \log \sum^{cat} n_{cat} \cdot 10^{\frac{L_{ave}}{10}} \qquad (1)$$

Where:

L_{fleet} = Fleet noise exposure.

n_{cat} = Number of aircraft movements (including time-of-day weightings) for an aircraft type.

L_{ave} = Average of the three noise certification levels for an aircraft type.

When an aircraft does not comply with the new stringency measure, an aircraft with a similar range and seating capacity or maximum cargo load replaces it. In case there is no similar aircraft available that complies with the new measure, the noise characteristics of the existing aircraft are adjusted in such a way that it exactly complies with the new measure. In case of a new measure without compulsory phase-out of non-compliant aircraft, it is assumed that from the year in which it is assumed the new measure takes effect (2003) the number of movements for non-compliant aircraft does not increase. When the number of movements does increase according to the scenario that is used, the extra movements will be operated by a similar aircraft (as explained above).

When a measure includes compulsory phase-out of non-compliant aircraft, it is assumed that no movements are executed by non-compliant aircraft in 2010 or 2020, depending on the scenario. Therefore, all movements will be executed by a similar aircraft. To be able to see whether an aircraft fleet of a certain year has become relatively quieter with respect to previous years, the fleet exposure of each scenario is also calculated using the noise certification limits. In this way, the different scenarios can be compared by the margin of the fleet exposure with the fleet exposure for the certification limits.

4 Results

The table below shows the results of the fleet exposure calculations for the different scenarios, both with the certification levels as well as with the certification limits, and the margin between the two fleet exposures.

Scenario	Total number of movements	Fleet exposure	Fleet exposure (for cert. limits)	Margin
1999	908758	154,33	157,99	3,66
2002	1283045	156,43	159,97	3,54
2010	1734920	156,84	161,04	4,20
2010 -8 dB no phase-out	1734920	156,84	161,04	4,20
2010 -11 dB no phase-out	1734920	156,84	161,04	4,20
2010 -14 dB no phase-out	1734920	156,59	161,04	4,45
2010 -8 dB phase-out	1734920	156,30	161,05	4,75
2010 -11 dB phase-out	1734920	156,30	161,05	4,75
2020	2746811	159,63	164,54	4,91
2020 -11 dB phase-out	2746811	159,61	164,54	4,94
2020 -14 dB phase-out	2746811	159,18	164,55	5,37

Table 1: Fleet noise exposures

The margin with the fleet exposure for certification limits shows whether an aircraft fleet has become relatively quieter, independent of the total number of movements. A larger margin means that the fleet has quieter aircraft. The margin is calculated using the average of the three noise certification levels. Therefore, a margin of, for example, 4dB means that this fleet has an average total margin of 12 dB with the certification limits. The fleet exposure is dependent on the total number of movements. For example, a fleet with quieter aircraft but a higher total number of movements (e.g. in 2020) has a larger fleet exposure than a fleet with noisier aircraft and a much lower number of movements (e.g. 1999).

5 Conclusions

For this investigation, the scenarios used were based on a noise reduction of 8 dB, 11 dB or 14 dB and the assumption was that the new measure would take effect in 2003. However, ICAO's Committee on Aviation Environmental Protection, during its meeting in January this year, recommended a 10 dB noise reduction to be effective from 1 January 2006. The ICAO/CAEP has not (yet) reached an agreement on the phase-out of aircraft that do not meet the 10 dB margin [4].

While keeping in mind the outcome of the ICAO/CAEP meeting, the following conclusions can be drawn from this research:

- The fleet exposures for the no ICAO-action scenarios show that the fleet is expected to be relatively quieter in the future because the margin with the certification limits increases. Only in 2002, the margin decreases slightly which is caused by a shift in fleet composition. In 2002, relatively more large aircraft are used that have a smaller margin with the certification limits. In an absolute sense, the fleet exposure increases every year because of the large increase of the number of aircraft movements.
- The no phase-out scenarios do not affect the fleet at Amsterdam Schiphol Airport very much. Only the 14 dB scenario leads to a replacement of two aircraft types and a reduction of the fleet exposure with 0.25 dB.
- The two phase-out scenarios for 2010 result in the same fleet composition and fleet exposure because the aircraft fleet for 2010 does not contain aircraft that both comply with the 8 dB measure and do not comply with the 11 dB measure.
- Only the 14 dB phase out scenario for 2020 causes a large change in fleet composition and fleet exposure. This is caused by the fact that a large number of movements is carried out by aircraft types that do not comply with the 14 dB measure, but do comply with the 11 dB measure.
- This research shows that the fleet at Amsterdam Schiphol Airport, as projected by airlines and the airport, already is relatively quiet and is expected to easily comply with the 10 dB reduction as proposed by ICAO. This might lead to the conclusion that the proposed reduction means "business as usual" for Amsterdam Schiphol Airport. However, the projected change in fleet composition still needs to be realized, since this is necessary to accommodate the expected growth in aircraft movements without crossing legal noise limits. Therefore it is important for the competitive position of the airlines operating mainly out of Amsterdam Schiphol Airport that worldwide measures are being taken to ensure a quieter aircraft fleet.

6 References

1. Smith, M.J.T., “Aircraft Noise”, Cambridge, 1989.
2. Luftfahrtbundesamt, “Lärmliste S: Strahlflugzeuge”, 2000 (www.lba.de).
3. Federal Aviation Administration, “Aircraft noise level Advisory Circular 36-3G, Appendices”, 1996 (www.aee.faa.gov).
4. Flight International 23-29 January 2001, pages 5 and 8.