

## DUBLIN AIRPORT

## ICAO AIRCRAFT NOISE CHAPTER ASSESSMENT

### Report to

daa plc  
Old Central Terminal Building  
Dublin Airport  
Co Dublin  
Ireland

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25 August 2022



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## REVISION HISTORY

Revision	Details
1.0	Issued for client comment.

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## 1.0 INTRODUCTION

Before a newly developed aircraft model may enter into operation, it must obtain a type certificate from the responsible aviation regulatory authority, such as the European Union Aviation Safety Agency (EASA) or the Federal Aviation Administration (FAA). One element assessed as part of the certification process is the noise produced by an aircraft type. Noise levels are established in compliance with the applicable noise standards as defined in International Civil Aviation Organisation (ICAO) Annex 16<sup>1</sup>. If satisfactory this leads to the declaration that the aircraft type in question meets the requirements of a given Chapter of ICAO Annex 16, Volume I, for example Chapter 4.

EU regulation 598/2014<sup>2</sup> contains the related definition of a ‘marginally compliant aircraft’. This is an aircraft type that meets the Chapter 3 requirements but by a limited amount. Consequently, the type falls between the requirements of Chapter 3 and those of the more stringent Chapter 4.

The ICAO Chapters provide a means of assessing the relative noise of the fleet operating at an airport. Specifically, by determining the proportion of operations that meet the requirements of the various chapters.

This report assesses the noise chapters of the aircraft which operated in 2021, and compares the results with those previously reported for 2020. Section 0 details the noise chapters, and Section 3.0 details the latest assessment of the Dublin Airport operations against them.

A glossary of acoustic terminology is contained in Appendix 1.

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<sup>1</sup> ICAO Annex 16 - Environmental Protection - Volume I - Aircraft Noise

<sup>2</sup> REGULATION (EU) No 598/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0598&from=EN>

## 2.0 NOISE CHAPTERS

### 2.1 ICAO

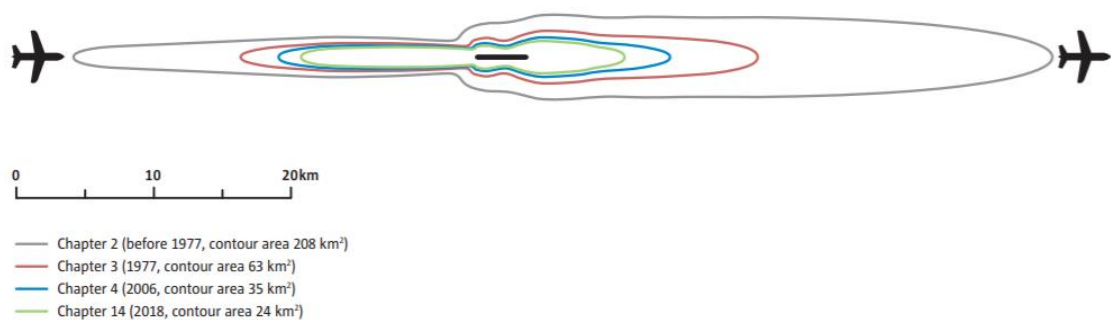
ICAO Annex 16 contains the standards and recommended practices for aircraft noise certification. It also covers international specifications relating to aircraft noise measurement and evaluation methods.

The document is split into a series of chapters which relate to specific aircraft categories from supersonic aircraft to helicopters. Of most relevance to Dublin Airport are Chapters 2, 3, 4 and 14 which relate to subsonic jet aircraft and large propeller aircraft (over 8,618 kg). Aircraft of these general types undertake most of the operations at Dublin Airport.

The most recent standard for these aircraft types is given in ICAO Chapter 14, which is applicable to new aeroplane types submitted for certification on or after 31 December 2017, and on or after 31 December 2020 for aircraft less than 55 tonnes in mass. The previous equivalent standards were contained in ICAO Chapter 4 (applicable from 2006), ICAO Chapter 3 (applicable from 1978), and ICAO Chapter 2 (applicable from 1972).

The differences between the noise certification standards are illustrated in the following figure reproduced from the European Aviation Environmental Report 2019<sup>3</sup>. This shows noise contours for four hypothetical 75-tonne jet aircraft that just meet the various Chapter limits. The contours represent areas that are exposed to noise levels greater than 80 dB during one landing and take-off, and can be seen to reduce over time from the first Chapter 2 standard applicable before 1977 to the latest Chapter 14 standard applicable from 2018.

**Figure 2.1** Single landing and take-off 80 dB noise contours for four hypothetical aircraft that just meet the noise limits of the various ICAO Annex 16 Volume I Chapters



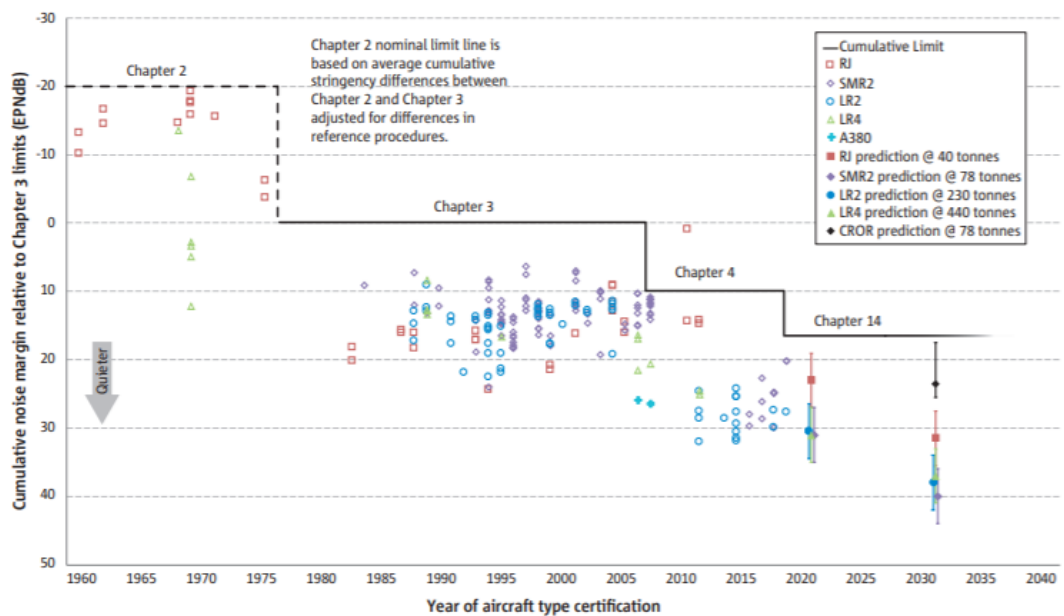
**Figure 1: Comparison of aircraft just meeting requirements of different chapters**

<sup>3</sup> EASA, EEA, EUROCONTROL, European Aviation Environmental Report 2019  
<https://ec.europa.eu/transport/sites/transport/files/2019-aviation-environmental-report.pdf>

The European Aviation Environmental Report 2019 also presents an overview of the improvement in aircraft noise technology-design performance over time in terms of the cumulative margin to the Chapter 3 limits. While recognising that aircraft are often sold in various configurations, the Figure 2.2, which is reproduced below, only contains data for the heaviest weights and maximum engine thrust ratings. As the associated noise limits are higher for larger, heavier aircraft, this figure permits a comparison between the relative performance across a range of different aircraft types.

A view on future development goals that illustrate what the best technology could potentially achieve in 2020 and 2030, along with uncertainty bands, is also included. These are based on a review of noise technology by independent experts for the ICAO Committee on Aviation Environmental Protection that was performed between 2010 and 2013.

**Figure 2.2** Improvement in aircraft noise performance has occurred over time



Aircraft categories as defined by ICAO/CAEP independent experts (IE)

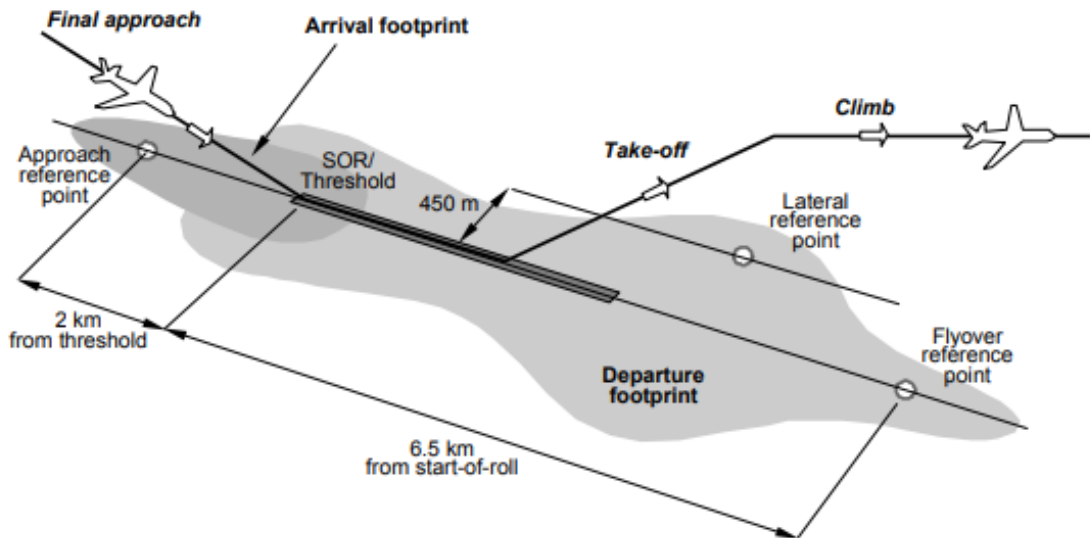
Description	MTOW (tonnes)
RJ Regional Jet	30 - 50
SMR2 Short/Medium Range 2-engine	58 - 98
CROR Counter-Rotating Open Rotor	58 - 91
LR2 Long Range 2-engine	170 - 290
LR4 Long Range 4-engine	330 - 550

Airbus A380 plotted for information as outside weight range for LR4 (575 tonnes)

The certification process involves an example of the aircraft type being operated in a prescribed manner when weather conditions fall within a set range to aid comparability. As a result, the process is often undertaken at airfields in warmer and drier climates, where there is limited other activity. The certification results are not based on measurements from operations at Dublin Airport.

There are three Reference Points, approach, lateral and flyover, which are used for the noise measurements. These are shown in the figure below, which is reproduced from CAP 1869<sup>4</sup>.

**Figure 1 Aircraft noise reference points (in relation to illustrative noise footprints)**



To determine whether an aircraft type meets the requirements of a particular ICAO Chapter, the noise levels from the three reference points are used. These are compared with limit values for the aircraft type which are determined from the certificated maximum takeoff weight of the aircraft on departure, and the number of engines it has, using the formula given in Annex 16.

Compliance with the requirements of a Chapter requires the measured noise levels to be within a specified margin of the limit values at each reference point, and for the overall margin across the three points to be at least a specified amount. In the case of Chapter 4 the requirement is that the measured noise levels must be no greater than the limit value at any of the reference points, the measured noise levels at any pair of reference points must be cumulatively at least 2 EPNdB less than the limit values, and the measured noise levels at all three reference points must be cumulatively at least 10 EPNdB less than the limit values.

<sup>4</sup> Civil Aviation Authority, Environmental Research and Consultancy Department, Quota Count validation study at Heathrow Airport CAP 1869, 2020  
<http://publicapps.caa.co.uk/docs/33/CAP1869QuotaCountvalidationstudy31Jan2020.pdf>



## 2.2 Marginally Compliant Aircraft

The definition of a marginally compliant aircraft was introduced in an EU directive<sup>5</sup> in 2002. It was:

*“civil subsonic jet aeroplanes, that meet the certification limits laid down in Volume 1, Part II, Chapter 3 of Annex 16 to the Convention on International Civil Aviation by a cumulative margin of not more than 5 EPNdB.”*

The directive was repealed and by a subsequent regulation<sup>6</sup>. This revised the marginally compliant definition to mean:

*“aircraft which are certified in accordance with limits laid down in Volume 1, Part II, Chapter 3 of Annex 16 to the Convention on International Civil Aviation signed on 7 December 1944 (the Chicago Convention) by a cumulative margin of less than 8 EPNdB (Effective Perceived Noise in Decibels) during a transitional period ending on 14 June 2020, and by a cumulative margin of less than 10 EPNdB following the end of that transitional period, whereby the cumulative margin is the figure expressed in EPNdB obtained by adding the individual margins (i.e. the differences between the certificated noise level and the maximum permitted noise level) at each of the three reference noise measurement points defined in Volume 1, Part II, Chapter 3 of Annex 16 to the Chicago Convention.”*

This change has broadened the definition of marginally compliant aircraft such that to avoid being classed as marginally compliant to Chapter 3 an aircraft almost has to meet the Chapter 4 standards.

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<sup>5</sup> DIRECTIVE 2002/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0030&from=EN>

<sup>6</sup> REGULATION (EU) No 598/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014

on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0598&from=en>

### 3.0 CHAPTER ASSESSMENT OF DUBLIN OPERATIONS

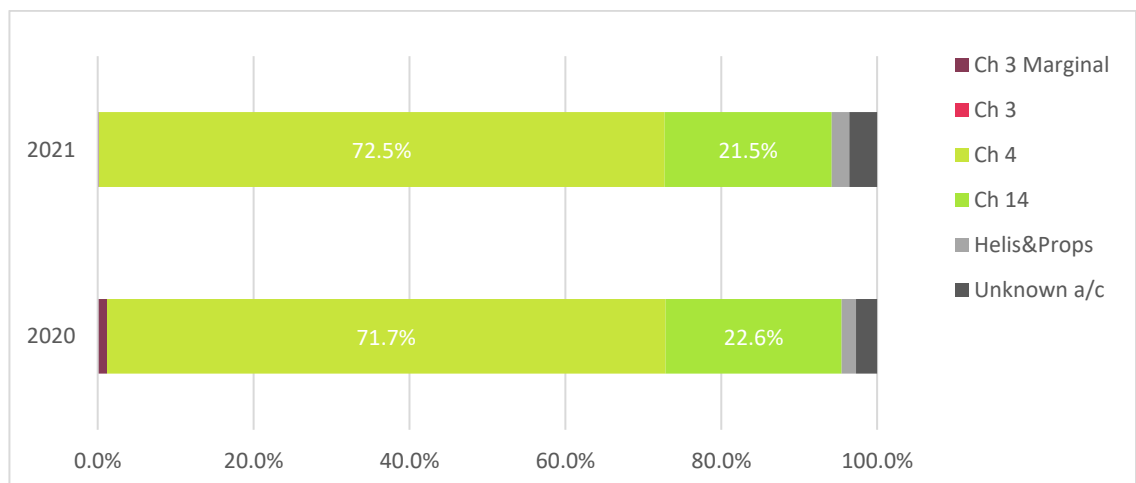
daa have provided a schedule of the operations in 2021. This lists movements individually with aircraft types and registrations. The schedule also includes the aircraft noise certification data and certificated maximum takeoff weight for the large majority of the specific aircraft. These are taken from the latest Fleet Declaration Forms provided to daa by the airlines.

Using the formula in ICAO Annex 16 the limit values at the reference points have been computed and compared to the certification noise levels for each aircraft. This has enabled the determination of the most stringent Chapter that the aircraft complies with the requirements of, including whether it is marginally compliant (applicable to Chapter 3 only).

In some cases, this results in the aircraft having a different classification to that shown on its noise certificate. This can arise because when an aircraft is certificated it is compared against the then current Chapter. So, an aircraft being certificated in 2000 would be compared against Chapter 3 standards, even if it also met the more stringent Chapter 4 standards, as these were not applicable until 2006.

The assessment therefore more accurately reflects the actual noise performance of the operations against the Chapters, as the date an aircraft type was certificated does not affect the classification of the noise it produced.

The results of the assessment, and those from the earlier assessment of 2020 operations, are presented in Figure 2 and Table 1 below.



**Figure 2: Latest ICAO Noise Chapter Assessment Results**

Chapter	Percentage of Flights	
	2020	2021
Chapter 3 Marginal	1.2%	0.2%
Chapter 3	0.0%	0.0%
Chapter 4	71.7%	72.5%
Chapter 14	22.6%	21.5%
Helicopter and Light Propeller Aircraft	1.9%	2.3%
Unknown	2.7%	3.6%

Note – Totals may not sum to 100% due to rounding

**Table 1: Latest ICAO Noise Chapter Assessment Results**

The results show that the large majority of the operations, over 90% in 2021, were by aircraft that meet at least the Chapter 4 standard. Of these, over 21% also meet the more stringent Chapter 14 standard. These are similar to the split in 2020.

Very few of the operations in 2021 were by aircraft types which only meet the Chapter 3 requirement or are classified as marginally compliant with regard to Chapter 3. Aircraft in these categories have reduced from 1.2% in 2020 to 0.2% in 2021 of the activity in the respective years.

As in 2020, relatively few operations in 2021 were by helicopters or light propeller aircraft. Requirements for these aircraft are given in different ICAO chapters which are not directly comparable.

A small proportion of the operations in 2021 did not have complete data and it was therefore not possible to assess these aircraft. This generally related to movements by business jets which are typically smaller and quieter than the main passenger flights.

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# APPENDIX 1

## GLOSSARY OF ACOUSTIC TERMS

## **Sound**

Sound is a form of energy that is transmitted away from its source through a medium such as air by longitudinal pressure waves. The human ear can detect the small changes in pressure associated with sound and this manifests as the sense of hearing.

### **The Decibel, dB**

The decibel (dB) is the unit used to describe the magnitude of sound. It is a logarithmic ratio between a measured level and a reference level, typically sound pressure level against a reference pressure level of 20  $\mu$ Pa.

The decibel scale effectively compresses a wide range of values to a more manageable range of numbers; the threshold of hearing occurs at approximately 0 dB (corresponding to the reference value of 20  $\mu$ Pa) and the threshold of pain is around 120 dB (corresponding to a value of 20 Pa).

### **Frequency, Hz**

Frequency is equivalent to musical pitch. It is the rate of vibration of the air molecules that transmit the sound and is measured as the number of cycles per second or Hertz (Hz).

The human ear is sensitive to sound in the range 20 Hz to 20 kHz. This frequency range is normally divided up into discrete bands for engineering use. The most common are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is further divided into three. The bands are named by their centre frequency value.

### **Certificated noise levels**

The ICAO aircraft noise certification procedure for subsonic jet aeroplanes and propeller-driven aeroplanes over 8,618 kg requires three separate noise measurements to be made at approach, lateral and flyover locations. The three certificated noise levels (measured in EPNdB) are determined within tight tolerances and normalised to standard atmospheric conditions.

### **EPNdB**

Effective Perceived Noise decibels. The measurement unit for EPNL.

### **EPNL**

Effective Perceived Noise Level (measured in EPNdB). Its measurement involves analysis of the frequency spectra of noise events as well as the duration of the sound.