London Borough of Hounslow

Comparison of Airport Noise Insulation Grant Schemes – An Update

4093497

June 2011
Document Control Sheet

Report number 4093497 4093497
Issue/Revision R01/Rev4 R02/Rev6
Remarks Final approved Final approved
Date February 2011 June 2011
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Summary

At the request of the London Borough of Hounslow, Bureau Veritas has been commissioned to carry out research into airport noise insulation grant schemes both within the UK and internationally. This study is an update to a previous study carried out in 2006.

Noise Insulation grant schemes are commonly used to mitigate the adverse effects of aircraft noise and these typically include improved sound insulation and some additional provision for ventilation. The area eligible for such schemes is usually defined by a specified noise contour around the airport. Various noise parameters are used to define the area of eligibility and this study gives a brief introduction to the various parameters.

It also tabulates the qualifying noise contours for a selection of UK airports and also for a selection of international airports.

The INM noise model has been used to represent the typical operation of a busy twin runway airport, such as Heathrow Airport, and to produce noise contours for the various noise parameters. In order to compare the schemes the contours have been calculated for the same set of notional input data (i.e. using a notional fleet mix and standardised operating pattern). The resulting contour areas have been tabulated.

In addition the contours have been plotted on a base map of the Heathrow airport area to enable a visual comparison to be made.

This report was first issued in February 2011. Since then, Heathrow Airport (under the British Airport Association, BAA) has issued its Review of Heathrow’s noise mitigation schemes document which sets out its proposed new noise mitigation scheme. This revised version of the February 2011 document includes BAA’s proposal criteria in the analysis.
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1.0 INTRODUCTION

1.1 Bureau Veritas UK Limited (BV) was instructed by the London Borough of Hounslow to carry out research into the various noise insulation grant schemes in operation at a selection of both UK and international airports.

1.2 Grant schemes are often used as a means of mitigating the adverse impacts of noise and typically include either the addition of secondary glazing or the replacement of the existing window with one of a higher noise reduction value. Schemes generally include an alternative means of ventilation as the expected level of sound insulation will only be achieved with windows closed. The insulation package generally only applies to “habitable rooms” which are generally taken to mean living rooms and bedrooms. Some schemes are designed to mitigate night noise only and consequently only apply to bedrooms.

1.3 The area of eligibility is usually defined by a specified noise contour around the airport, however the selected contour and the unit used varies from scheme to scheme and there is quite a wide variation of qualifying noise levels.

1.4 This study looks at various schemes and tries to compare the qualifying areas based on a typical 2 runway airport operation such as Heathrow Airport.

1.5 The FAA Integrated Noise Model (INM) has been used to develop a typical 2 runway airport model. Using a notional fleet mix and standardised operating pattern the noise insulation qualification criteria of a number of national and international airports has been modelled and compared. BAA’s proposed new noise scheme criteria have also been modelled and included in the comparison.

1.6 Whilst this means that none of the contours produced in this report (including those for Heathrow) represent the actual schemes in place, it does allow the areas of the schemes to be calculated and compared, even though the defining metrics are different.

1.7 The qualifying areas have been compared in terms of the area in km² and have been graphically overlaid on a base map.

1.8 This report is an update of a similar research study carried out in 2006.
2.0 NOISE ASSESSMENT UNITS

2.1 Various noise assessment units are used for defining airport noise insulation grant schemes. All, however, give a representation of an average noise exposure taking account of both the number of aircraft events and the noise level of those events. These generally fall into 3 broad categories; those based on $L_{Aeq,16h}$, with or without weighting; those based on the night $L_{Aeq,8h}$, and those based on EPNdB.

2.2 A brief description of the various units encountered is given below.

**Equivalent Continuous Noise Level ($L_{Aeq,T}$)**

2.3 In the UK the recommended measure of aircraft noise exposure is based on the $L_{Aeq,T}$. This is the equivalent continuous noise level, or the steady state dB(A) noise level which would produce the same acoustic energy over the time period $T$. The time period $T$ is generally taken as being the 16 hours from 07.00 to 23.00 hours. The remaining 8 hour period is defined as the night period. It is common practice to use an average of the summer 3 months as a representation of the busiest period of the year. An $L_{Aeq,16h}$ of 57 dB is often regarded as the trigger level for the onset of annoyance.

**Sound Exposure Level, SEL (dB(A))**

2.4 The SEL is a measure of a single event and is often used as an indication of the possibility of night time awakening due to a single overflight. It is a measure of a single sound event, expressed in A-weighted decibels, that takes into account all sound above a specified threshold set at least 10 decibels below the maximum level. All sound energy in the event is integrated over one second.

**Noise Exposure Forecast (NEF)**

2.5 The Noise Exposure Forecast index was developed by the Federal Aviation Agency in the U.S.A. as a standard measure of aircraft noise exposure although it has recently lost favour to other indices. It is based on the Effective Perceived Noise Level (EPNdB) which is a complex unit commonly used in the noise certification process for new aircraft types. Any noise created during the night period, defined as 22.00 to 07.00 hours, carries a 12 dB penalty. It is worth noting here that NEF, together with several other international indices, is based on a night period of 9 hours commencing at 22.00 hours whereas in the UK the night period is defined as the 8 hour period commencing 23.00 hours. It seems to be generally accepted that housing is not desirable in areas of > 30 NEF.

**Australian Noise Exposure Forecast (ANEF)**

2.6 The Australian Noise Exposure Forecast is a development of the NEF. It was developed in Australia in 1982 introducing an evening period from 19.00 to 22.00 hours and applying a 6 dB weighting to both the evening and the night periods (i.e. 19.00 to 07.00). Levels of 20 to 25 ANEF may be found incompatible with housing and levels above 25 ANEF are regarded as unacceptable.

**Day-Night Average Sound Level (DNL)**

2.7 The Day-Night Average Sound Level, DNL or sometimes written as $L_{dn}$, is derived from an $L_{Aeq,T}$ Value. It is used in the U.S.A. and recognises 2 time periods covering the 24 hours; the day period from 07.00 to 22.00 hours and the night period from 22.00 to 07.00 hours. The
night period attracts a 10 dB penalty. The index is sometimes prefixed with a Y (YDNL) to indicate that it is based on a yearly average figure. Levels in excess of 65 DNL are judged as unsuitable for new housing.

Community Noise Equivalent Level (CNEL)

2.8 The Community Noise Equivalent Level was introduced in the State of California in the early 1970’s as a simplified alternative to the NEF system. It is based on dB(A) values rather than the more complex EPNdB levels. Unlike NEF it introduces an evening period with the intermediate penalty of 5 dB for any noise events occurring between 19.00 and 22.00 hours. DNL and CNEL are often regarded as interchangeable. When compared to NEF values CNEL will typically be 35 greater +/- 2 dB.

Lden

2.9 The Lden value is the Day-Evening-Night level. It is a descriptor of noise level based on the A-weighted energy equivalent noise level \( L_{Aeq,T} \) over the day (07.00 to 19.00) with a penalty of 10 dB(A) for night time noise (23.00 to 7.00) and an additional penalty of 5 dB(A) for evening noise (i.e. 19.00 to 23.00). It is a relatively new descriptor resulting from a European Union Directive on the Assessment and management of environmental noise (Directive 2002/49/EC).

Kosten Unit

2.10 The Kosten Unit, or Kosten eenheid abbreviated to Ke, was commonly used as a measure of annual exposure to aircraft noise in the Netherlands, having been proposed by the Kosten Committee in 1963. The calculation is based on maximum (peak) levels above 65 dB, hence aircraft with maximum levels lower than 65 dB(A) are not included in the calculation. As it is based on a maximum noise level the Ke unit cannot be converted to average noise exposure in dB(A).

2.11 It was developed from the NNI (Noise and Number Index) concept which preceded the use of the \( L_{Aeq,T} \) unit in the UK and was based on the average maximum noise level. The NNI unit was superseded in the UK in the early 1980s. The Ke calculation includes a varying penalty according to the time of day up to a night period penalty of 10 dB.

2.12 It is calculated using the following formula

\[
B = 20 \log \sum_{j=1}^{m} n_j 10^{L_j/10} - 157
\]

Where; 
- \( B \) = the noise load in Kosten units
- \( L_j \) = maximum noise level of an overflight in dB(A)
- \( m \) = number of flights per year
- \( n = \) correction for time of day as follows
  - 06.00 to 07.00 \( n = 8 \)
  - 07.00 to 08.00 \( n = 4 \)
  - 08.00 to 18.00 \( n = 1 \)
  - 18.00 to 19.00 \( n = 2 \)
  - 19.00 to 20.00 \( n = 4 \)
  - 20.00 to 21.00 \( n = 4 \)
  - 21.00 to 22.00 \( n = 6 \)
  - 22.00 to 23.00 \( n = 8 \)
  - 23.00 to 06.00 \( n = 10 \)
2.13 The planning guidance given in relation to various Kosten units was as follows.

<table>
<thead>
<tr>
<th>Noise Level</th>
<th>Planning Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;=35</td>
<td>No restrictions</td>
</tr>
<tr>
<td>&gt;35</td>
<td>Generally no new residential areas allowed</td>
</tr>
<tr>
<td>&gt;40</td>
<td>Generally no new dwellings allowed</td>
</tr>
<tr>
<td>40-50</td>
<td>Insulation of existing dwellings noise level reduction of 30-35 dB(A)</td>
</tr>
<tr>
<td>50-55</td>
<td>Insulation of existing dwellings noise level reduction of 35-40 dB(A)</td>
</tr>
</tbody>
</table>

Table 1, Dutch Planning Guidance relating to Aircraft Noise

2.14 It is now largely defunct having been superseded by the adoption of Lden in the Netherlands.
3.0 INM MODELLING

3.1 The US Federal Aviation Administration (FAA), Office of Environment and Energy, Noise Division has developed Version 7.0b of INM (Integrated Noise Model). This software is widely used by the civilian aviation community for evaluating aircraft noise impacts in the vicinity of airports. Both INM Version 7.0b and the Civil Aviation’s ANCON Version 2.3 comply with the guidance defined by ECAC in Document 29, 3rd Edition, published in 2005, which is the European guidance on the method of calculation of aircraft noise.

3.2 The INM model has options for calculating contours in various standard parameters and also has the facility to allow custom designed parameters to be calculated. It is possible, therefore, to use the same model and aircraft movement database to calculate noise exposure in terms of all the commonly used aircraft noise exposure units used to define a noise insulation scheme.

3.3 The INM model has been developed for a two runway airport operating a 76/24 % west/east runway split and with 480,000 air transport movements. Various aircraft types have been used in the model to represent a busy typical busy two runway airport such as Heathrow. This notional fleet mix and pattern of operation has been used for each of the model runs.

3.4 Noise level contours have been plotted to represent the various qualification levels for a noise insulation grant scheme and have been plotted on a base map of Heathrow Airport for comparative purposes. These plots are shown in the figures in Appendix A.
4.0 COMPARISON OF INSULATION SCHEMES

4.1 Both national and international airports were selected for the comparison. The level at which properties become eligible for insulation has been compared for the following airports.

National Airports

<table>
<thead>
<tr>
<th>National Airports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heathrow</td>
</tr>
<tr>
<td>Birmingham</td>
</tr>
<tr>
<td>London city</td>
</tr>
<tr>
<td>Robin Hood (Doncaster)</td>
</tr>
<tr>
<td>Edinburgh</td>
</tr>
<tr>
<td>Manchester</td>
</tr>
<tr>
<td>Liverpool</td>
</tr>
<tr>
<td>Nottingham East Midlands</td>
</tr>
<tr>
<td>Aberdeen (proposed)</td>
</tr>
<tr>
<td>Gatwick</td>
</tr>
</tbody>
</table>

4.2 Bristol Airport has not been included in this analysis as the metric used to define the grant scheme is not derived on the same basis. Its scheme is now closed but it was defined by the 82 dB(A) SEL level of an individual aircraft departure rather than an average noise exposure. There is provision to reassess the scheme should L\text{Aeq,16h} noise levels increase by 3 dB.

4.3 The current Heathrow scheme is based on an 18 hour L\text{Aeq} contour rather than the 16 hour period commonly associated with the assessment of aircraft noise. The two additional hours are in the early morning period consequently the contour period covers the hours from 05.00 to 23.00. In developing this qualifying contour BAA doubled the number of movements in the hours 05.00 to 07.00 in order to take more account of the adverse effect of early morning arrivals.

International Airports

<table>
<thead>
<tr>
<th>International Airports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta Oakwood</td>
</tr>
<tr>
<td>Chicago Midway</td>
</tr>
<tr>
<td>Minneapolis</td>
</tr>
<tr>
<td>Baltimore Washington</td>
</tr>
<tr>
<td>Washington DC</td>
</tr>
<tr>
<td>Pittsburgh</td>
</tr>
<tr>
<td>Santa Ana (John Wayne)</td>
</tr>
<tr>
<td>Ontario</td>
</tr>
<tr>
<td>Nice</td>
</tr>
<tr>
<td>Sydney</td>
</tr>
<tr>
<td>Chicago O'Hare</td>
</tr>
<tr>
<td>Los Angeles</td>
</tr>
<tr>
<td>San Francisco</td>
</tr>
<tr>
<td>San Diego</td>
</tr>
<tr>
<td>Oakland</td>
</tr>
<tr>
<td>New Orleans</td>
</tr>
<tr>
<td>Austin TX</td>
</tr>
<tr>
<td>Auckland</td>
</tr>
<tr>
<td>Düsseldorf</td>
</tr>
<tr>
<td>Adelaide</td>
</tr>
</tbody>
</table>

Heathrow Airport - Proposed Noise Mitigation Scheme

Heathrow (proposed)

4.4 Following submission of BAA’s proposals for their new Noise Mitigation Scheme, a scenario representing the scheme’s criteria has been included in the comparison. BAA proposes to extend the area covered out to the 63 dB(A) L\text{den} contour as it is forecast to be in 2014 following the ending of the Cranford Agreement. The area is to be split into three zones, with Zone 1 being the area closest to the airport and Zone 3 the furthest away.

4.5 The 69 dB(A) L\text{den} contour is proposed as the boundary for Zone 1, the 66 dB(A) L\text{den} contour as the boundary for Zone 2, and the 63 dB(A) L\text{den} contour as the boundary for Zone 3. Each Zone is proposed to qualify for different levels of mitigation to ensure there is a clear link between the level of impact from aircraft noise experienced by local communities and the level of financial assistance towards noise mitigation provided by BAA. Therefore,
properties in Zone 1, will qualify for more than those in Zone 2, which in turn will qualify for more than those in Zone 3.

4.6 In addition to the above comparison of eligibility for insulation at the airports listed, the following planning guidance has been given by the respective nationalities for new housing and aircraft noise. Further details on the international comparison of planning guidance and aircraft noise can be found in a 2004 London South Bank University MSc dissertation Methods of Assessment of Aircraft Noise by Nigel Burton. The following table is based on information from that dissertation together with additional web based information.

Table 2, National Planning Guidance on Housing and Aircraft Noise

<table>
<thead>
<tr>
<th>Country</th>
<th>Criteria for housing development</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>PPG 24, 57 dB $L_{A_{eq,16h}}$, 48 dB $L_{A_{eq,8h}}$</td>
</tr>
<tr>
<td>Canada</td>
<td>&lt; 30 NEF</td>
</tr>
<tr>
<td>Australia</td>
<td>&lt; 20 ANEF</td>
</tr>
<tr>
<td>USA</td>
<td>&lt; 65 DNL, &lt; 65 CNEL</td>
</tr>
<tr>
<td>Denmark</td>
<td>65 $L_{A_{eq,T}}$ (State subsidised grant scheme)</td>
</tr>
<tr>
<td>Austria</td>
<td>65 LDN (Residential insulation required)</td>
</tr>
<tr>
<td>Belgium (Wallonie)</td>
<td>65 LDN (Financial aid provided for insulation)</td>
</tr>
</tbody>
</table>

4.7 The respective contour areas calculated from the INM model have been assigned to each airport in the table below according to the published criterion for eligibility for inclusion in an insulation grant scheme. The same notional input data, i.e. movement types, numbers and flight routes, has been used to allow direct comparison between the schemes.

4.8 Care should be exercised when interpreting the area figures as some schemes are defined by a combination of overlapping noise contours, e.g. an $L_{A_{eq,T}}$ area plus an SEL area.
Table 3, Comparison of areas eligible for noise insulation grant scheme using a notional fleet mix and a standardised operating pattern

<table>
<thead>
<tr>
<th>Airport</th>
<th>Criteria for insulation</th>
<th>Area, km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heathrow</td>
<td>69 dB L_{Aeq,16h} (+ 90 dB(A) SEL)</td>
<td>11.8 (10.0 x 4 *)</td>
</tr>
<tr>
<td>Manchester</td>
<td>69 dB L_{Aeq,16h}</td>
<td>12.2</td>
</tr>
<tr>
<td>Birmingham</td>
<td>63 dB L_{Aeq,16h} (2002)</td>
<td>34.9</td>
</tr>
<tr>
<td>Liverpool</td>
<td>63 dB L_{Aeq,16h} (+ 59 dB L_{Aeq,8h})</td>
<td>34.9 (22.3 *)</td>
</tr>
<tr>
<td>London City</td>
<td>57 dB L_{Aeq,16h}</td>
<td>95.3</td>
</tr>
<tr>
<td>Nottingham East Midlands</td>
<td>55 dB L_{Aeq,8h} night (+ 90 dB(A) SEL)</td>
<td>42.4 (10.0 x 2 *)</td>
</tr>
<tr>
<td>Robin Hood (Doncaster)</td>
<td>63 dB L_{Aeq,16h} (55 dB L_{Aeq,8h})</td>
<td>34.9, (42.4 *)</td>
</tr>
<tr>
<td>Atlanta Oakwood</td>
<td>65 CNEL</td>
<td>35.8</td>
</tr>
<tr>
<td>Chicago O’Hare</td>
<td>68 DNL</td>
<td>20.1</td>
</tr>
<tr>
<td>Chicago Midway</td>
<td>68 DNL</td>
<td>20.1</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>65 CNEL</td>
<td>35.8</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>65 DNL</td>
<td>32.4</td>
</tr>
<tr>
<td>San Francisco</td>
<td>65 CNEL</td>
<td>35.8</td>
</tr>
<tr>
<td>Baltimore Washington</td>
<td>65 DNL</td>
<td>32.4</td>
</tr>
<tr>
<td>San Diego</td>
<td>70 CNEL</td>
<td>15.4</td>
</tr>
<tr>
<td>Washington DC</td>
<td>65 DNL</td>
<td>32.4</td>
</tr>
<tr>
<td>Oakland</td>
<td>65 CNEL</td>
<td>35.8</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>65 DNL</td>
<td>32.4</td>
</tr>
<tr>
<td>New Orleans</td>
<td>65 DNL</td>
<td>32.4</td>
</tr>
<tr>
<td>Santa Ana (John Wayne)</td>
<td>65 CNEL</td>
<td>35.8</td>
</tr>
<tr>
<td>Austin TX</td>
<td>65 DNL</td>
<td>32.4</td>
</tr>
<tr>
<td>Ontario</td>
<td>65 CNEL</td>
<td>35.8</td>
</tr>
<tr>
<td>Auckland</td>
<td>65 Ldn</td>
<td>32.4</td>
</tr>
<tr>
<td>Nice</td>
<td>55 Lden</td>
<td>223.3</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>60 dB L_{Aeq,16h} (06.00 to 22.00)</td>
<td>58.4</td>
</tr>
<tr>
<td>Sydney</td>
<td>30 ANEF</td>
<td>27.1</td>
</tr>
<tr>
<td>Adelaide</td>
<td>30 ANEF</td>
<td>27.1</td>
</tr>
<tr>
<td>Gatwick</td>
<td>66 dB L_{Aeq,16h}</td>
<td>22.1</td>
</tr>
<tr>
<td>Edinburgh</td>
<td>66 dB L_{Aeq,16h}</td>
<td>22.1</td>
</tr>
<tr>
<td>Aberdeen (proposed)</td>
<td>66 dB L_{Aeq,16h}</td>
<td>22.1</td>
</tr>
<tr>
<td>Heathrow (proposed)</td>
<td>63, 66 and 69 dB L_{Aeq,8h}</td>
<td>53.0, 33.4 and 20.9</td>
</tr>
</tbody>
</table>

NB * indicates there will be some area overlap between contours

4.9 It can be seen that there is a wide spread of qualifying areas in terms of the L_{Aeq,T} qualifying area ranging from 11.8 km² to 223.3 km² with an average of about 40 km². It must be remembered that some qualifying areas also include night time contours, e.g. the 90 dB(A) SEL contour, and that there will be an element of overlap between, for example, day and night qualifying areas.

4.10 Some schemes have changed in recent years, for example the earlier Manchester Airport scheme was based on the 62 dB L_{Aeq,24h} contour (33.6 km²) but the more recent scheme is based on the 69 dB L_{Aeq,16h} contour which is less generous, however, many properties outside that boundary have been insulated due to the previous scheme.

4.11 The contours have been plotted on figures 1 to 15 in Appendix A showing a comparison of the existing Heathrow Airport scheme area with the various other schemes.
5.0 Discussion and Conclusions

5.1 Table 3 above shows the qualifying areas for an offer of insulation for a range of airports both in the UK and abroad.

5.2 It must be pointed out here that this study has used notional figures for the aircraft movements whereas the actual qualifying area for the current Heathrow Airport scheme is based on the 1994 movement figures, consequently this study should only be regarded as giving an indicative comparison between the various schemes.

5.3 It is worth repeating here the guidance offered by the government in the 2003 White Paper The Future of Air Transport. Section 3.21 of that document gives the government’s expectations of airport operators. It recommends that households subject to high levels of noise (69 dB L_{Aeq}) or more should be offered assistance with the cost of relocation; and an offer of acoustic insulation should be made to residential properties and other noise sensitive buildings exposed to high noise level of 63 dB L_{Aeq}. To address the impact of future growth airport operators should offer to purchase properties suffering from both a high level of noise (69 dB L_{Aeq} or more) and a large increase in noise (3 dB(A) or more); and offer acoustic insulation to any residential property suffering from both a medium to high noise level (63 dB L_{Aeq} or more) and a large increase (3 dB(A) or more). Although not specified, this referred to the 16 hour L_{Aeq} contour commonly used for the assessment of aircraft noise.

5.4 The previous study commissioned by the London Borough of Hounslow (2006) showed that the Heathrow Airport scheme, at that time, had the smallest qualifying area of those compared. The current daytime Heathrow scheme has, in fact shrunk in area due to the change from 16 hour to 18 hour L_{Aeq}, but the scheme has since been enhanced by the addition of the area covered by the 90 dB(A) SEL contour, however it is understood that this enhancement only applies to bedrooms.

5.5 Some other schemes, notably Manchester, have revised their scheme; in particular it now has a smaller qualifying inner area allowing 100% of the cost of noise insulation measures, up to a maximum limit, and an outer area allowing 80% of the cost of noise insulation measures, up to a maximum limit.

5.6 Internationally the scheme with the most generous qualifying area is Nice Airport which is based on the 55 dB L_{den} level, however Nice Airport is fortunate in that it is surrounded by sea on three sides. Nationally, that with the most generous qualifying area is London City Airport which is based on the 57 dB L_{Aeq,16h} level.

5.7 The criteria for the proposed London Heathrow Airport scheme are outlined in their consultation document ‘Review of Heathrow’s noise mitigation schemes’. The indicative contours presented in Figure 15 show larger areas of eligibility than for the existing scheme. The level of assistance, however, is banded according to the 69, 66 and 63 dB L_{den} contour levels. Therefore, the actual generousness of the scheme should be judged taking the details of the offer into account.

---

1 Heathrow Airport Ltd. 9th May – 1st August 2011
Appendix A

Figures
Noise Insulation Grant Scheme - Noise Contours

Figure 1 - 69 dB LAeq,18h (purple) and 90 dB(A) SEL night-time (23:00 - 06:30) footprint (red)
Criteria at London Heathrow Airport

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Noise Insulation Grant Scheme - Noise Contours

Figure 2 - 69 dB LAeq,16h (black)
Criterion at Manchester Airport

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Noise Insulation Grant Scheme - Noise Contours

Figure 3 - 66 dB L\text{A}\text{eq},16\text{h} (black)
Criterion at Gatwick Airport

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Noise Insulation Grant Scheme - Noise Contours

Figure 4 - 63 dB LAeq,16h (black)
Criterion at Robin Hood Doncaster Sheffield and Birmingham Airport

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Noise Insulation Grant Scheme - Noise Contours

Figure 5 - 57 dB LAeq,16h (black)
Criterion at London City Airport

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Noise Insulation Grant Scheme - Noise Contours

Figure 6 - 55 dB LAeq,8h (black)
Criterion at Robin Hood Doncaster Sheffield and East Midlands Airport

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Figure 7 - 63 dB LAeq,16h (black) and 59 dB LAeq,8h night-time (black) Criterion at Liverpool John Lennon Airport

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Figure 8 - 70 dB CNEL (black)
Criterion at San Diego Airport

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Figure 9 - 65 dB CNEL (black)
Criterion at Atlanta Oakwood Airport, Los Angeles Airport, San Francisco Airport, Oakland Airport, Santa Ana (John Wayne) Airport and Ontario Airport

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Figure 10 - 68 dB DNL (black)
Criterion at Chicago O’Hare Airport and Chicago Midway Airport

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Figure 11 - 65 dB DNL (black)
Criterion at Minneapolis Airport, Baltimore Washington Airport, Washington DC Airport, Pittsburgh Airport, New Orleans Airport, Austin TX Airport and Auckland Airport

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Figure 12 - 55 dB Lden (black)
Criterion at Nice Airport

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Figure 13 - 60 dB LAeq,16h (06:00 - 22:00) (black)
Criterion at Dusseldorf Airport

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Figure 14 - 30 dB ANEF (black)
Criterion at Sydney Airport and Adelaide Airport

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Figure 15 - 63, 66 and 69 dB Lden (black)
Proposed criteria at London Heathrow Airport

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