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A COMPARISON OF MONITORING OF AIRCRAFT NOISE FROM STANSTED AIRPORT AT HARLOW, ESSEX OVER THREE MONTHLY PERIODS IN 2004 AND 2008

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CONTENTS

Summary

A mobile Noise Monitoring Terminal (NMT) was deployed by Stansted Airport at Harlow in Essex, between January and March 2004 and between January and April 2008. The site is approximately 20 km south west of the airport.

The aim of this report is to present a comparison of the results of the two noise monitoring exercises and to interpret the results in a way that places the contribution of the noise from aircraft using Stansted in the context of the overall noise climate from all other sources.

The NMT records noise data relating to all noise events which exceed a selected threshold noise level for a selected minimum period of time. These selected conditions for both surveys were 60 dBA for 10 seconds.

These noise events are then compared by the airport's ANOMS (Airport Noise and Operations Monitoring System) noise and track keeping computer system with radar tracks of aircraft arriving at or departing from Stansted Airport. Only those noise events which are matched with Stansted aircraft tracks are called aircraft noise events, and those that are not matched are designated as residual noise events. The remainder of the noise at the site, i.e. that noise which is not captured as noise events, (because it fails to meet the capture conditions of being above 60 dBA for 10 seconds) is also classified as residual noise.

Therefore wherever reference is made to aircraft noise events within this document it should be understood that these relate only to aircraft using Stansted airport. Any noise arising from aircraft travelling to or from any other airport will be included as residual noise.

In addition to gathering data about noise events the NMT also collects and stores, on an hourly basis, information about the total level of noise at the site from all sources.

In 2004 a total of 3,234 aircraft noise events occurred during 39 days of the 68 day survey period, an average of 83 events per day. In 2008 a total of 1,806 aircraft noise events occurred during 32 days of the 73 day survey, an average of 56 events per day.

The numbers of aircraft noise events did not show any obvious correlation with day of the week or with weekends. The highest numbers of aircraft noise events per hour in the 2004 survey occurred in the evening between 18.00 and 19.00 hours but in the 2008 survey the highest numbers occurred in late evening, between 23.00 and midnight. All of the aircraft noise events were due to arriving aircraft using runway 05.

The daily average maximum noise level (L_{ASmax}) of aircraft noise events ranged between 63 dBA and 69 dBA during both surveys, with an overall average value of 68 dBA in 2004 and 66 dBA in 2008, and with no noticeable pattern to the variation either from day to day or from hour to hour.

The daily average (L_{Aeq}) level of the total noise at the site is a combination of that due to aircraft noise events and that due to residual noise. The residual noise provides the major component, generally 1 or 2dBA below that of the total noise level, with the average level due to aircraft noise events being typically about 6 dBA below the average (L_{Aeq}) level of total noise at the site

Therefore although each individual aircraft noise event is likely to be clearly audible and distinguishable, aircraft noise events in total make only a relatively minor contribution to the average (L_{Aeq}) level of total noise at the site.

The average maximum noise level (L_{ASmax}) during aircraft noise events does not vary significantly with aircraft type for the aircraft types which make up most of the aircraft noise events, for both the 2004 and the 2008 surveys.

The information presented in this report will serve as a baseline for comparison with any future noise level surveys in this format that may be undertaken at this location.

1.0 Introduction

1.1 A mobile Noise Monitoring Terminal (NMT) was deployed by Stansted Airport at a site in Harlow, Essex, between 1st January and 31 March 2004, and between 22nd January and 29th April 2008.

1.2 The noise monitor was located at a commercial premises in an industrial estate in Harlow. In the 2004 survey it was located on the roof of these premises but for operational reasons it was not possible to use the same location in 2008 and it was instead sited at ground level in the yard. It is considered that the change in microphone location will not significantly affect the conclusions of this report. During both surveys the microphone received noise from nearby plant and from vehicles. During visits to the site during the 2008 survey, a ventilation unit was observed to give rise to continuous noise levels at the microphone of 56 dBA, and a compressor used occasionally produced noise levels of 64 dBA at the microphone. The site is west south west of the centre of Harlow and approximately 20 km south west of the airport. On days when aircraft are taking off from Stansted to the east, the site lies on the path of arriving aircraft (see map at Appendix 1).

1.3 During both surveys there were days when no noise data was available. In 2004 these gaps in the data occurred between 2nd and 19th of February, and between 8th and 16th March, so that data was collected for 68 days during the survey period. In 2008 no data was available between 4th and 13th February, between 19th and 25th February, and between 11th and 25th March, so that data was collected for 73 days during the period.

1.4 The data only included information about aircraft noise on some of those days, when the wind speed and direction were such that aircraft were taking off to the east, and the site was over-flown by aircraft arriving at Stansted. Aircraft noise events were recorded on 39 (out of 68) days in 2004, and in 32 (out of 73) days in 2008.

1.5 The aims of this report are:

- to present and compare results of the two noise monitoring surveys, and

- to interpret results in a way that places the contribution of noise from passing aircraft using Stansted airport in the context of the overall noise climate from all other sources, and
- to provide a baseline for comparison with any future noise surveys that may be undertaken at this location.

1.6 A glossary of technical terms used in this report is given in the Appendix 2.

2.0 Data from the Noise Monitoring Terminal

2.1 The NMT always records all noise from all sources. It has, however, the facility to capture and show separately all noise events that meet particular pre-set conditions. This facility is used to capture noise events likely to arise from aircraft flying near to the monitor. The pre-set condition used for both the 2004 and the 2008 surveys was that the noise must exceed a level of 60 dBA for a minimum duration of 10 seconds. This is arrived at following preliminary noise measurements at the site, and is broadly similar to conditions set for other such studies. It is of course likely that noise arising form activities other than aircraft using Stansted Airport will occasionally cause noise events to be captured.

2.2 To determine which of all those events are due to aircraft using Stansted Airport their ANOMS (Aircraft Noise Management System) 'noise to track' matching software compares all captured noise events with all Stansted Airport's air traffic radar tracks. Noise events that are matched to aircraft are combined to provide a measure of 'aircraft noise' and noise events that are not matched to aircraft are included with 'all other noise' (i.e. that noise which is not captured as noise events, because it fails to meet the capture conditions of being above 60 dBA for 10 seconds), and is called residual noise.

2.3 Therefore wherever reference is made to aircraft noise events within this document it should be understood that these relate only to aircraft using Stansted airport. Any noise arising from aircraft travelling to or from any other airport will be included as residual noise.

2.4 The selection of the threshold conditions (noise level and time period) which trigger the capture of a noise event is a compromise judgement designed to include as much of the noise from passing aircraft as possible whilst at the same time excluding, as far as

possible, noise from other sources. For both these surveys a threshold trigger level 60 dBA for a duration of at least 10 seconds was used.

2.5 The following information is recorded for each noise event: date, time, duration, L_{ASmax} and SEL values, and, in addition, for aircraft noise events, event type (arrival/ departure), departure route, runway used, and aircraft type.

2.6 In addition to gathering data about noise events the NMT also collects and stores information on an hourly basis about the total level of noise at the site from all sources (including that from aircraft movements), including individual noise events.

2.7 Because the noise level is usually not constant, but varies continuously throughout each hour it is necessary to describe the total noise level statistically in terms of a measure of the average noise level throughout the hour (and called the hourly continuous equivalent noise level, L_{Aeq}) and also in terms of a series of hourly percentile levels. The most important of these is the L_{AS90}, which is the noise level exceeded for 90% of each hour. This level of noise is conventionally taken to be a measure of the background noise level for each hour, and is the more or less constant level of noise which underlies the variations caused by various transient sources including aircraft.

3.0 Analysis of Noise Monitoring Survey Results

3.1 <u>The numbers of aircraft noise events</u>

3.1.1 There were 3,234 aircraft noise events in the 2004 survey and 1,806 aircraft noise events in the 2008 survey.

3.1.2 Figures 1 and 2 show the total number of aircraft noise events occurring each day during the surveys in 2004 and 2008.

3.1.3 The number of aircraft noise events varied from 1 to 180 per day. The figures also shows the day of the week on which aircraft noise events occur and it can be seen that there is no obvious correlation between the number of aircraft noise events and the day of the week or weekend.

3.1.4 Figure 3 compares the average distribution of numbers of aircraft noise events throughout the day, for the 2004 and 2008 surveys. It is shown that in the 2004 survey the highest numbers occur in the evening between 18.00 and 19.00 hours but in the

2008 survey the highest numbers occurred in late evening, between 23.00 and midnight.

3.1.5 All of the aircraft noise events were due to arrivals using runway 05. This is to be expected bearing in mind the location of the site (please see map at Appendix 1) which is to the south west of the airport and not near to any of the westerly departure routes. Therefore the site is unlikely to be regularly affected by noise from departures (taking off to the west) under prevailing westerly wind conditions, but will be over flown by arriving aircraft when the wind is from the east.

3.2 Maximum noise levels of aircraft noise events

3.2.1 The NMT recorded the maximum noise level (measured using the 'A' frequency weighting and the Slow (S) time weighting) produced by each aircraft noise event, (L_{ASmax}).

3.2.2 The overall average L_{ASmax} value of all events was 68 dBA for the 2004 survey and 66 dBA in 2008, i.e. a decrease in the average value by 2dBA.

3.2.3 Figures 4 and 5 indicates the variation in daily average L_{ASmax} value of aircraft noise events recorded during the 2004 and 2008 surveys respectively. It can be seen in both cases that daily average maximum levels range between 63 dBA and 69 dBA.

3.2.4 Figure 6 shows a comparison of the statistical distributions of L_{ASmax} values for the 2004 and 2008 surveys, and Figure 7 shows the corresponding cumulative statistical distributions. Figure 6 shows that the most frequently occurring value was 67 dBA in 2004 reduced to 65 dB in 2008 and that there were relatively fewer noisier events in 2008 than in 2004. The cumulative frequency distributions of Figure 7 show that in 2004 50% of events had L_{ASmax} values of about 67.5 dB, whereas in 2008 this median value reduced by about 2 dB to 65.5 dB, and that in 2004 about 75 % of events were at or below 70 dBA compared to 90% in 2008.

3.2.5 It is concluded that overall the maximum noise levels of aircraft noise levels at this site were on average lower by about 2 dBA in 2008 than in 2004.

3.3 The Total noise climate at the site

3.3.1 The NMT also recorded the total noise level (i.e. from all sources, including aircraft and residual noise events) each hour, measured in terms of the hourly values of L_{Aeq} (representing the average noise level over the hour) and the L_{AS90} statistical percentile levels: i.e. the noise level (measured using the 'A' frequency weighting (i.e. in dBA) and the Slow (S) time weighting) exceeded for 90% of the 1 hour measurement time interval.

3.3.2 By using the Single Event Noise Level (SEL) for each aircraft noise event it is possible. to calculate the average, or equivalent aircraft noise level (L_{Aeq}) due to aircraft noise events over a period of time (hour, day or month). Although this average noise level bears little relationship to the aircraft noise as heard, which occurs in short bursts of noise at higher levels rather than as a lower continuous average level, it is, nevertheless, a useful parameter for comparative purposes.

3.3.3 Figure 8 presents a comparison of the values of total noise (L_{Aeq} value), aircraft noise (L_{Aeq} value) and background noise (L_{A90} value) averaged over the 2004 and 2008 survey periods for each hour of the day.

3.3.4 Overall the noise levels recorded in the two surveys were fairly similar with only relatively small differences of two or three decibels between them. The values of total noise and of background noise were slightly higher by up to 2 dB in 2008 as compared to 2004 but on average the aircraft noise level was slightly higher in 2004 than in 2008 by about 2 dB. The value of total noise and background noise was fairly constant in the daytime from about 07.00 hours to 19.00 hours but then fell off outside these times (i.e. in the late evening, night-time and early morning periods).

3.4 <u>The contribution of aircraft noise events to the total noise climate at the site</u>

3.4.1 Since the NMT also records hourly L_{Aeq} values of the total noise from the site it is possible, by subtracting the aircraft noise level from the total noise level (using the decibel (or logarithmic) subtraction process which is appropriate in this case) to calculate the remaining component of the total noise, i.e. the residual noise.

3.4.2 The residual noise is a combination of the noise from residual noise events (i.e. those captured noise events which did not match with aircraft movements) and from other

residual noise, not captured as noise events, i.e. all other noise recorded by the monitor that did not exceed the trigger level for the required minimum time period.

3.4.3 Figures 9 and 10 show a comparison between the daily average hourly L_{Aeq} values of total noise, aircraft noise and residual noise for those days on which aircraft noise events occurred.

3.4.4 It can be seen that for a few days in the 2004 survey that aircraft noise was the major contributor to the total noise, but that this was never the case in the 2008 survey. The average of the daily total noise values was 55 dBA in 2004 and 58 dBA in 2008. The residual noise was on average 1 dBA below that of the total noise in 2004 and about 0.5 dBA below in 2008. The aircraft noise was on average 6 dB below the total noise in 2004 and 16 dB below in 2008.

3.4.5 Figures 9 and 10 show that when the noise from aircraft noise events is cumulatively averaged over an extended period of time (of hours days or weeks) they make only a relatively minor contribution to the average level of total noise at the site. However each individual aircraft noise event is likely to be clearly audible and distinguishable because, in addition to a change in character, it results in an increase in the level of the ambient noise by up to 10 dBA for a period of about 30 seconds.

3.5 The contribution of different aircraft types to aircraft noise at the site

3.5.1 More than sixty aircraft types contributed to the total number of aircraft noise events which occurred during the two survey periods in 2004 and 2008. Figure 11 shows the numbers of events from the 37 most frequent aircraft for both surveys. Each aircraft type shown in Figure 11 is described by a 3 character source code. A list of these codes is given in Appendix 3.

3.5.2 Although more than 60 different aircraft types were involved in total, most of the events were due to a much smaller number of aircraft types. In each year four aircraft types accounted for more than 80% of the events. In 2004 these were the 738, 733, 732, and 73G, and in 2008 they were the 73H, 319, 733 and 738. Furthermore only for 19 types of aircraft in 2004 and 17 in 2008 did more than 10 events occur.

3.5.3 Figure 12 shows the average L_{ASmax} value for each aircraft type, and it can be seen that there is very little variation among the most commonly occurring aircraft types. Although there are some aircraft types which produce significantly higher average values of L_{ASmax} there are only very small numbers of these types of events.

4.0 Summary of Results and Conclusions

4.1 In 2004 a total of 3,234 aircraft noise events occurred during 39 days of the 68 day survey period, an average of 83 events per day. In 2008 a total of 1,806 aircraft noise events occurred during 32 days of the 73 day survey, an average of 56 events per day. The numbers of aircraft noise events did not show any obvious correlation with day of the week or with weekends. The highest numbers of aircraft noise events per hour in the 2004 survey occurred in the evening between 18.00 and 19.00 hours but in the 2008 survey the highest numbers occurred in late evening, between 23.00 and midnight. All of the aircraft noise events were due to arriving aircraft using runway 05.

4.2 The daily average maximum noise level (L_{ASmax}) of aircraft noise events ranged between 63 dBA and 69 dBA during both surveys, with an overall average value of 68 dBA in 2004 and 66 dBA in 2008, and with no noticeable pattern to the variation either from day to day or from hour to hour. Statistical analysis showed that the most frequently occurring maximum aircraft noise level was 67 dBA in 2004 and 65 dBA in 2008 and that there were relatively fewer noisier events in 2008 than in 2004. In 2004 50% of events had L_{ASmax} values of about 67.5 dB, whereas in 2008 this median value reduced by about 2 dB to 65.5 dB, and that in 2004 about 75 % of events were at or below 70 dBA compared to 90% in 2008. The overall conclusion is that overall the maximum noise levels of aircraft noise levels at this site were on average lower by about 2 dBA in 2004 than in 2008.

4.3 The average of the daily total noise at the site (L_{Aeq} value) was 55 dBA in 2004 and 58 dBA in 2008. The values of background noise were also higher in 2008 as compared to 2004 by up to 2 dB.

4.4 The average noise level due to aircraft noise events is typically about 6 dBA below the average level of total noise at the site in 2004 and 16 dB below in 2008. The difference between the total noise levels and those due to aircraft noise events is due to the level of residual noise, which is all other noise recorded by the monitor that did not exceed

the trigger level for the required minimum time period. The residual noise was on average 1 dBA below that of the total noise in both 2004 and 2008.

4.5 Therefore although each individual aircraft noise event is likely to be clearly audible and distinguishable, aircraft noise events make only a relatively minor contribution to the average level of total noise at the site.

4.6 The average maximum noise level (L_{ASmax}) during events does not vary significantly with aircraft type for the relatively few aircraft types which make up most of the aircraft noise events, for both the 2004 and the 2008 dsurveys.

4.7 In conclusion overall noise levels in 2008 were slightly higher in 2008 than in 2004, by about 3 dB in terms of average L_{Aeq} values and about 2 dB in terms of background noise levels (L_{AS90}), but aircraft noise levels were lower in 2008 than in 2004 by on average 2 dB in terms of average maximum levels of aircraft noise events and 3 dB in terms of average (L_{Aeq}) vales. In both years aircraft noise made, on average only a minor contribution to the total overall noise level at the site although in 2004 there were a few days when aircraft noise was dominant.

4.8 The information presented in this report will serve as a baseline for comparison with any future noise level surveys at this location.

Figure 1: Numbers of Aircraft noise events each day at Harlow, January to March 2004

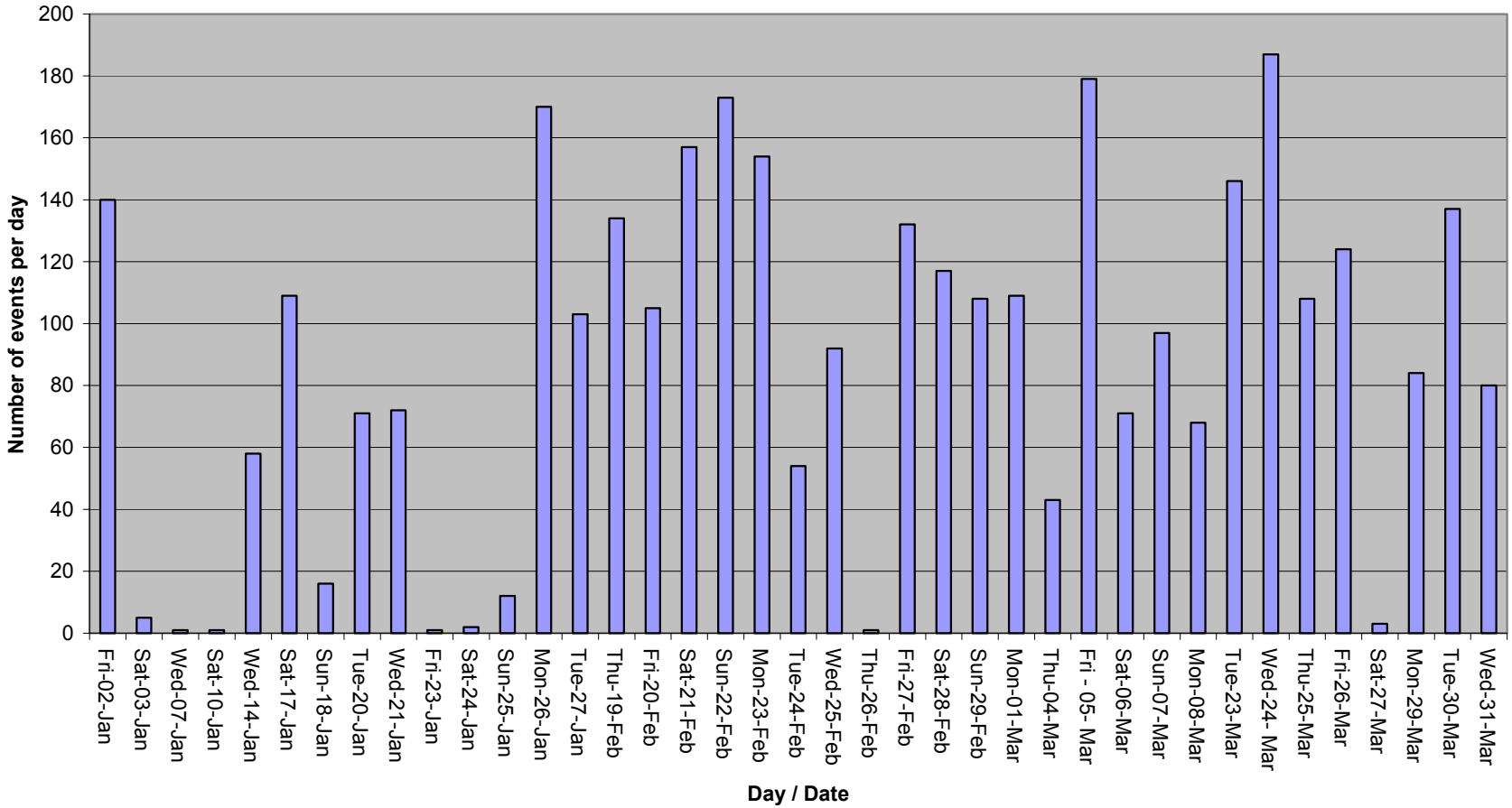


Figure 2: Numbers of aircraft noise events per day at Harlow, January to April 2008

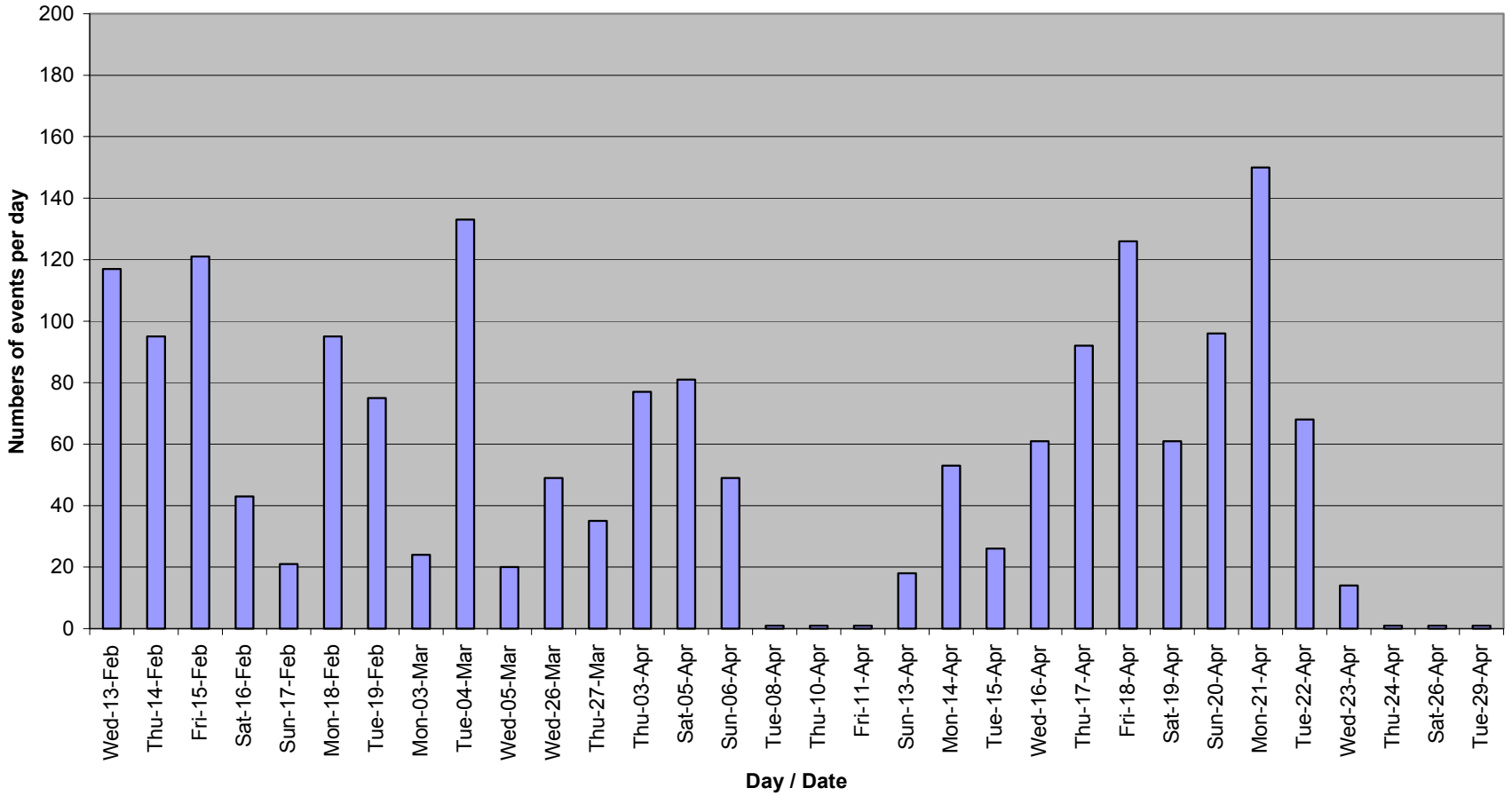


Figure 3: Numbers of aircraft noise events by hour throughout the day at Harlow during survey periods in 2004 and 2008

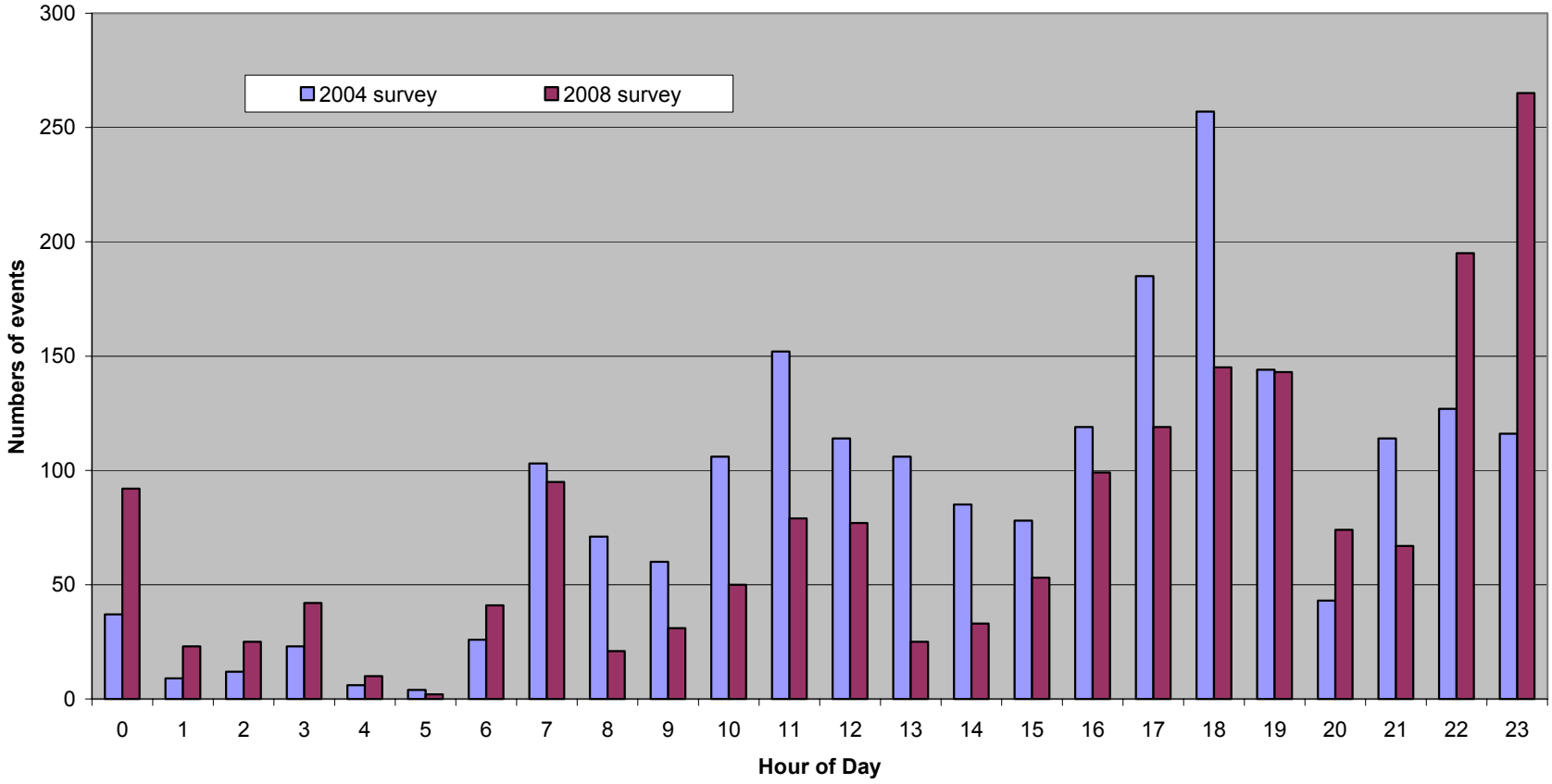


Figure 4: Average values of maximum noise levels of aircraft noise events (LASmax), each day at Harlow, January to March 2004

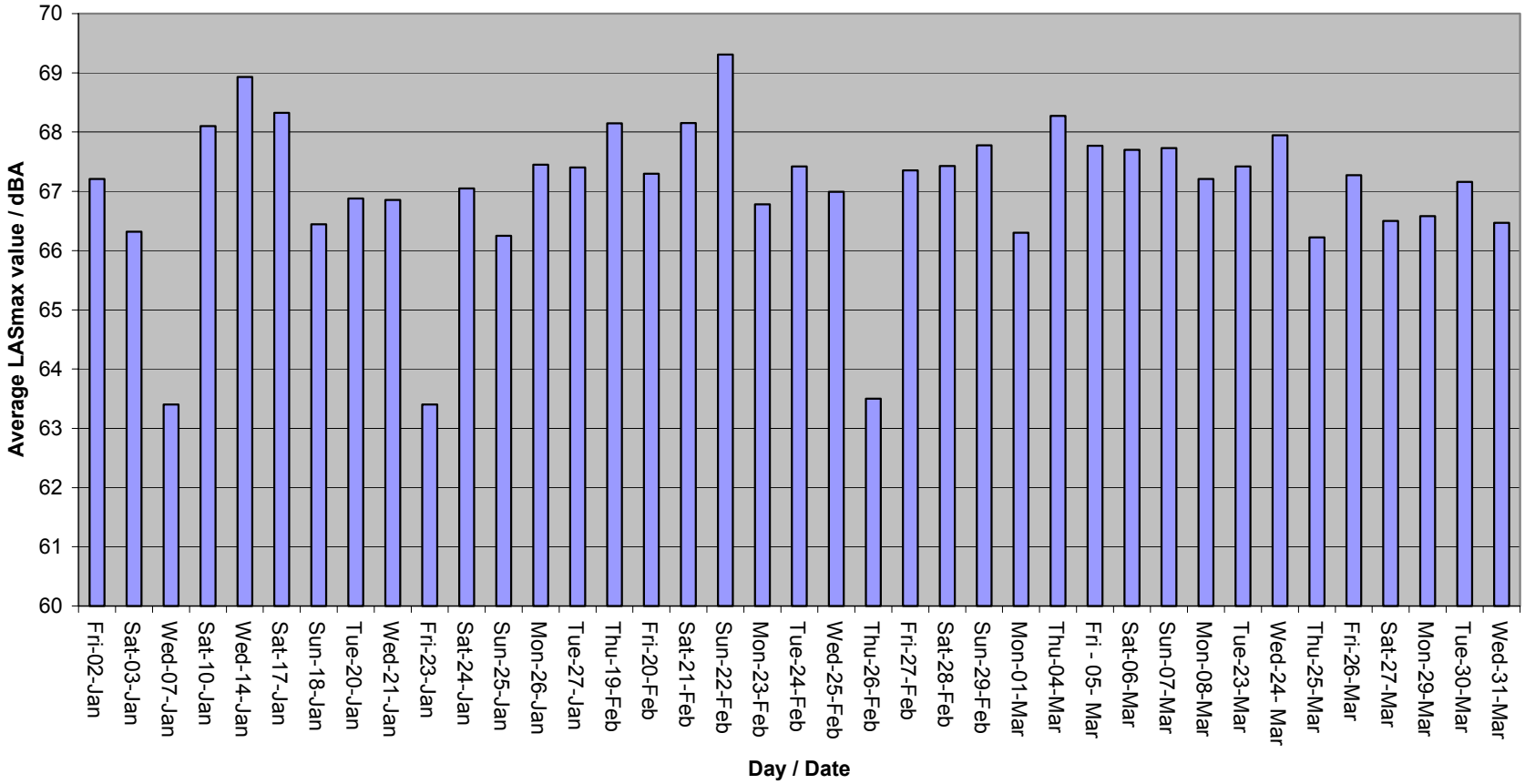


Figure 5: Daily average LASmax values at Harlow, January to April 2008

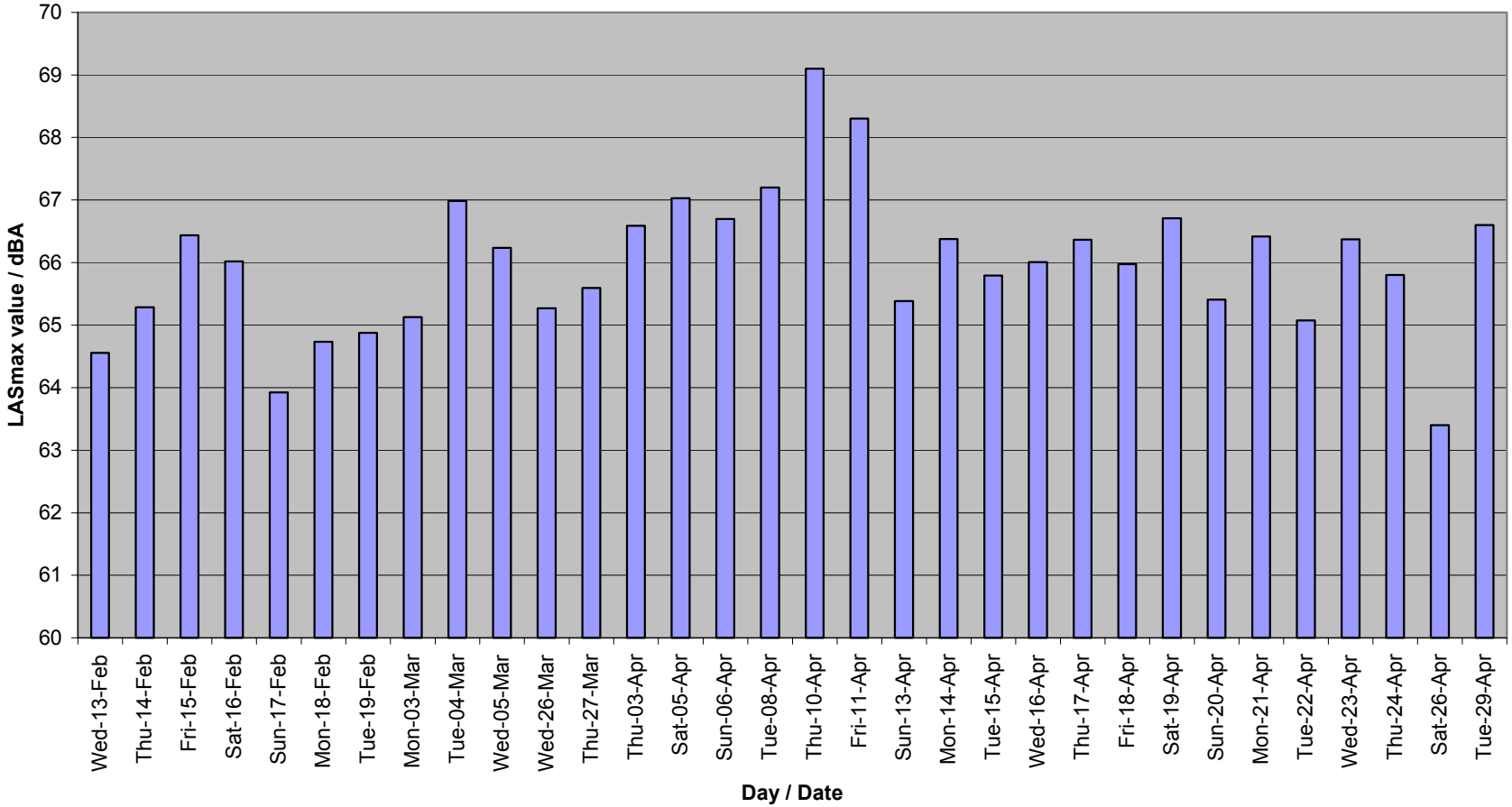


Figure 6: Statistical analyses of maximum levels of aircraft noise events (LASmax values) at Harlow during survey periods in 2004 and 2008

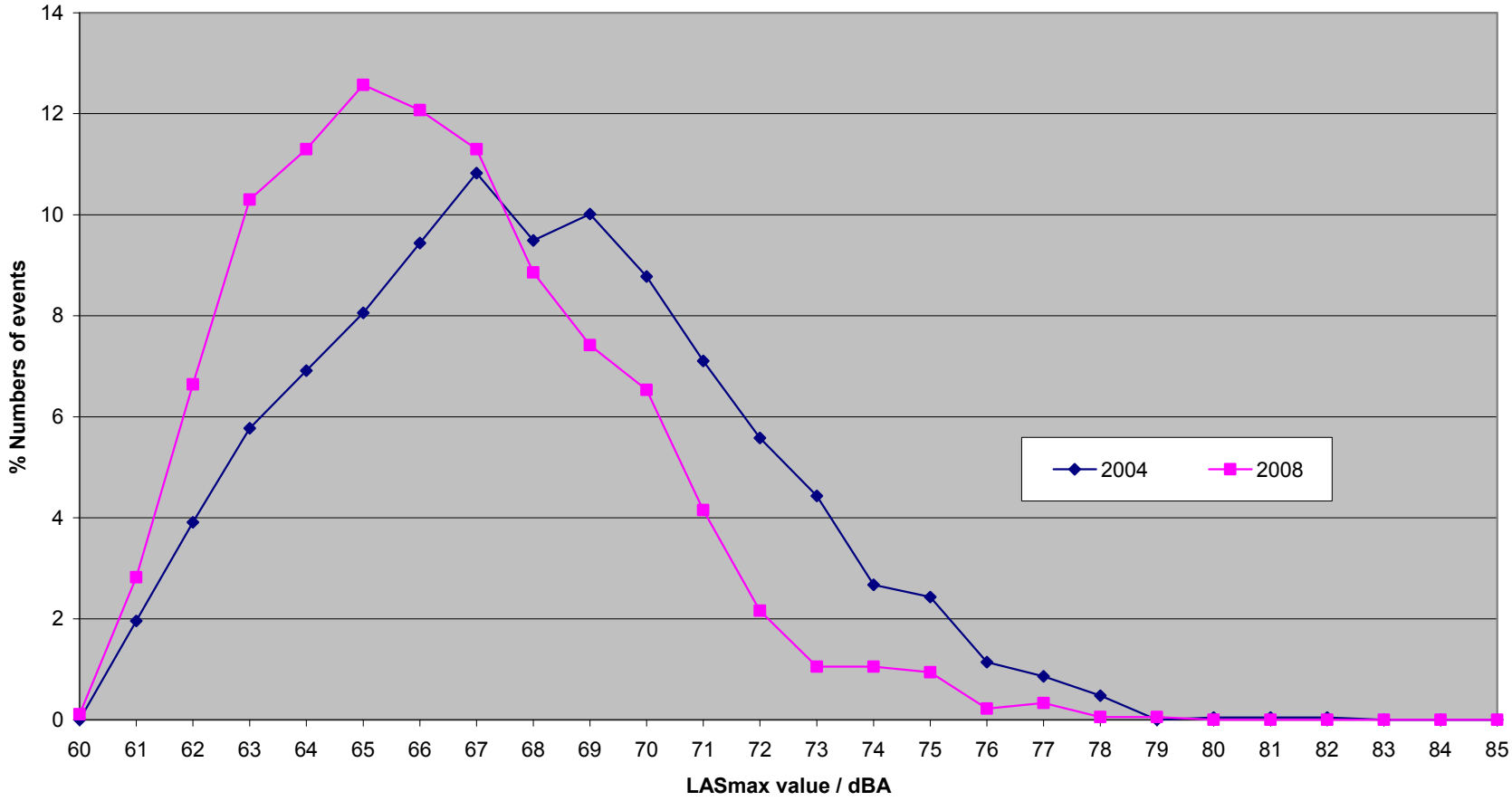


Figure 7: Cumulative statistical analysis of maximum levels of aircraft noise events (LASmax values) at Harlow during survey periods in 2004 and 2008

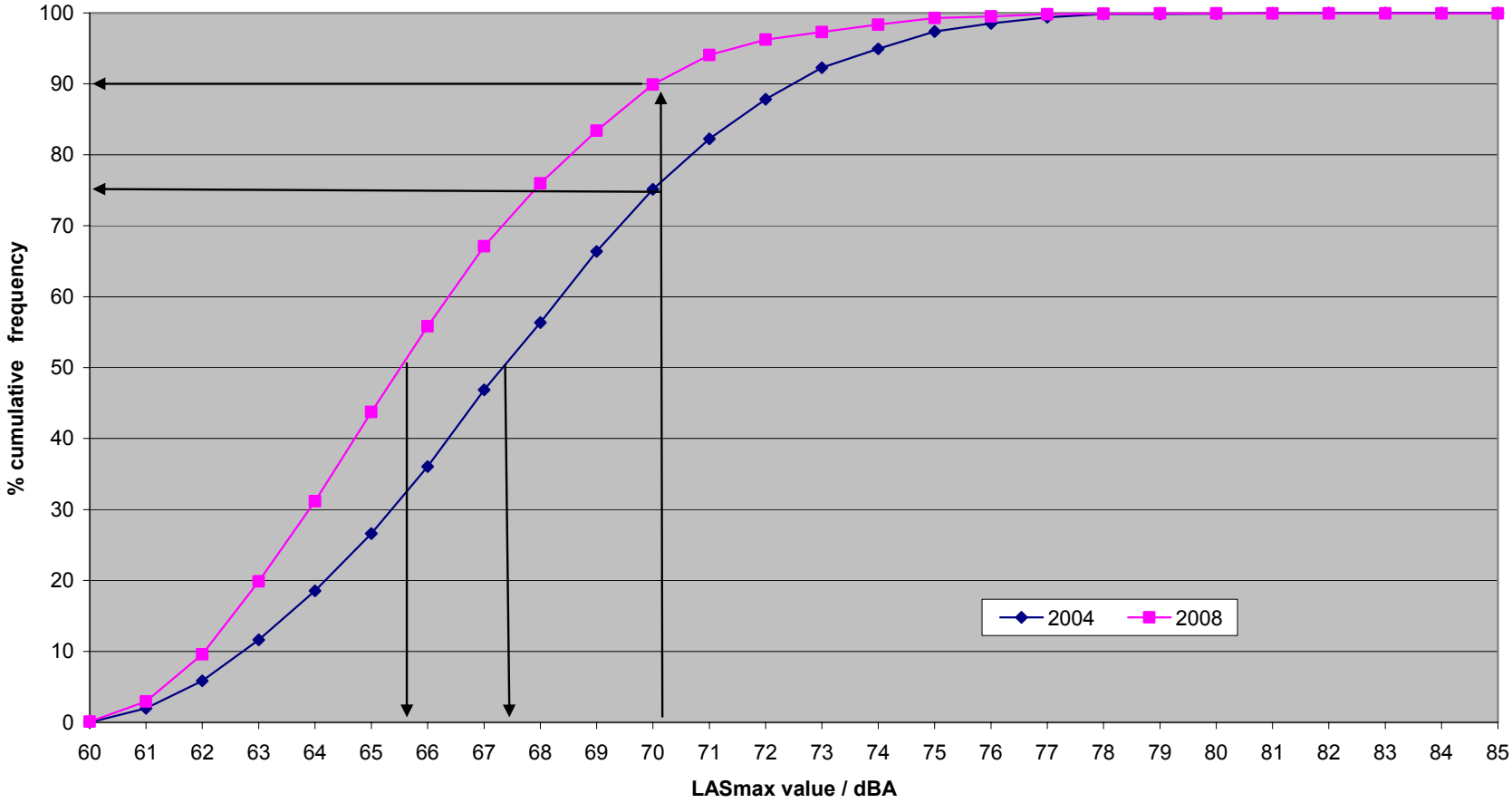


Figure 8: Comparison of hourly average values of Total noise, Aircraft noise and background noise (LAS90 values) at Harlow during surveys in 2004 and 2008

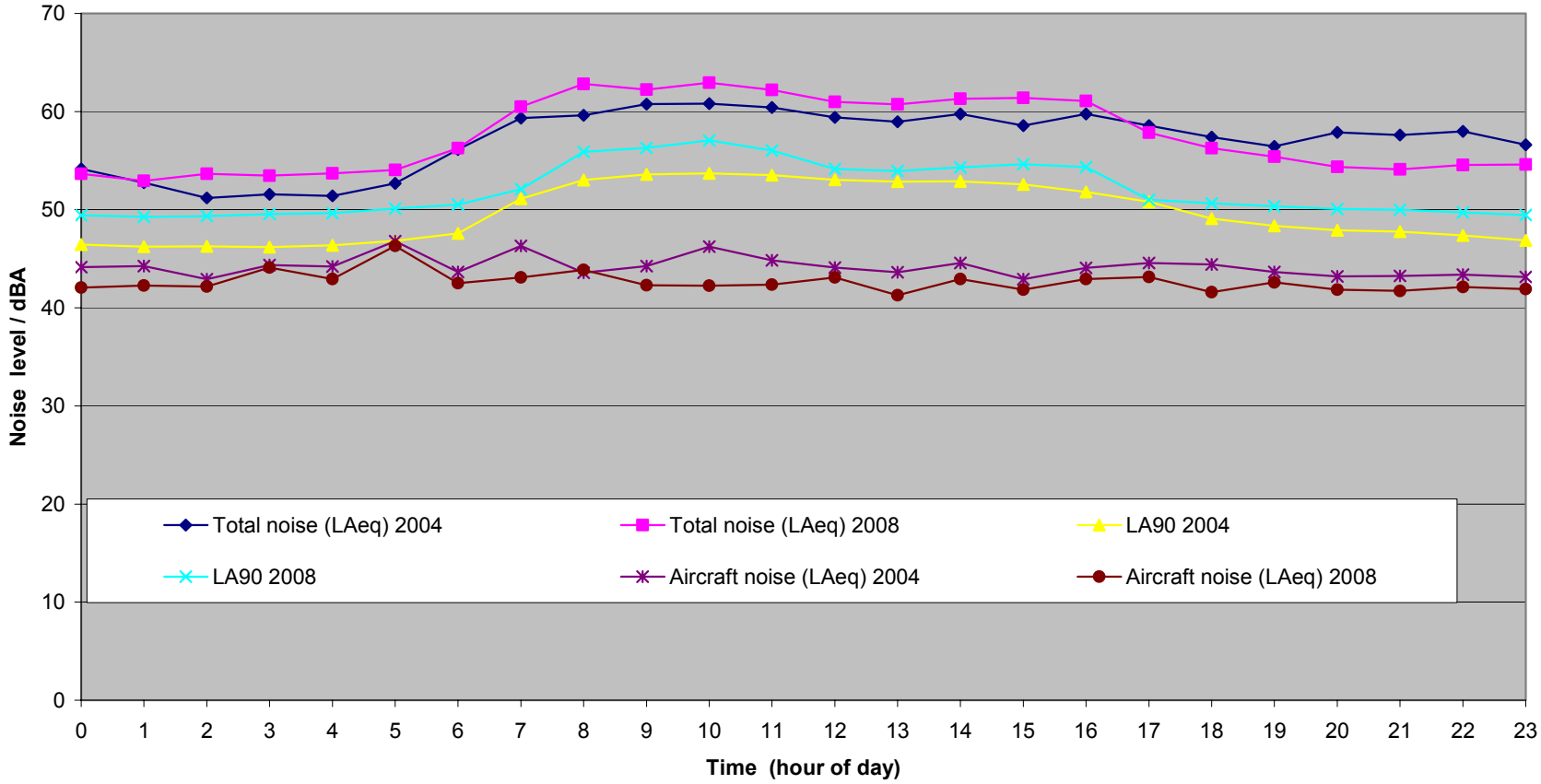


Figure 9: Contribution of Aircraft Noise and Residual Noise to daily average values of Total Noise (LAeq values) for those days on which Aircraft Noise events occurred, at Harlow January to March 2004

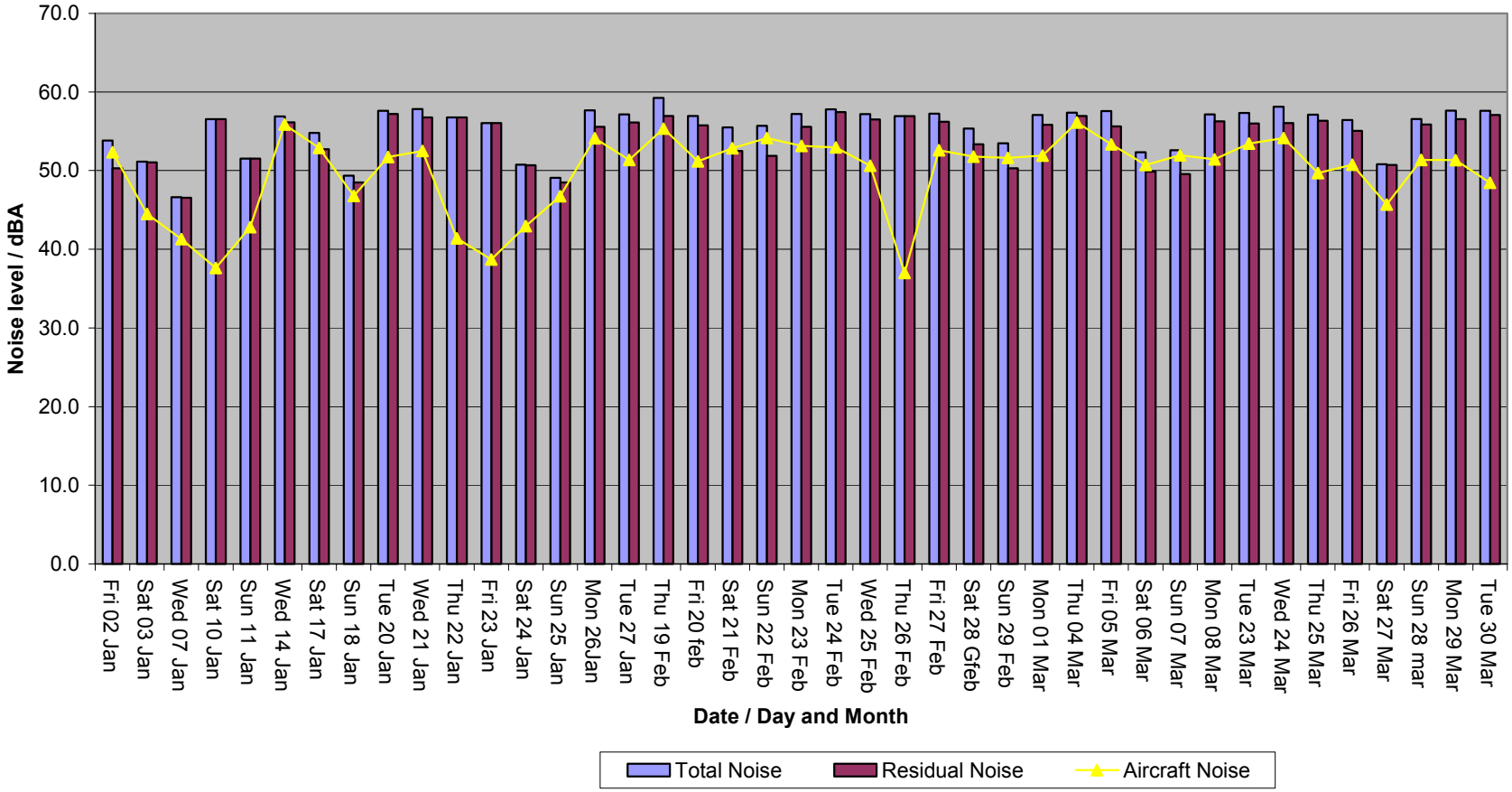


Figure 10: Contribution of Aircraft Noise and Residual Noise to average daily Total Noise level (LAeq value) for days on which Aircraft Noise events at Harlow in January to April 2008

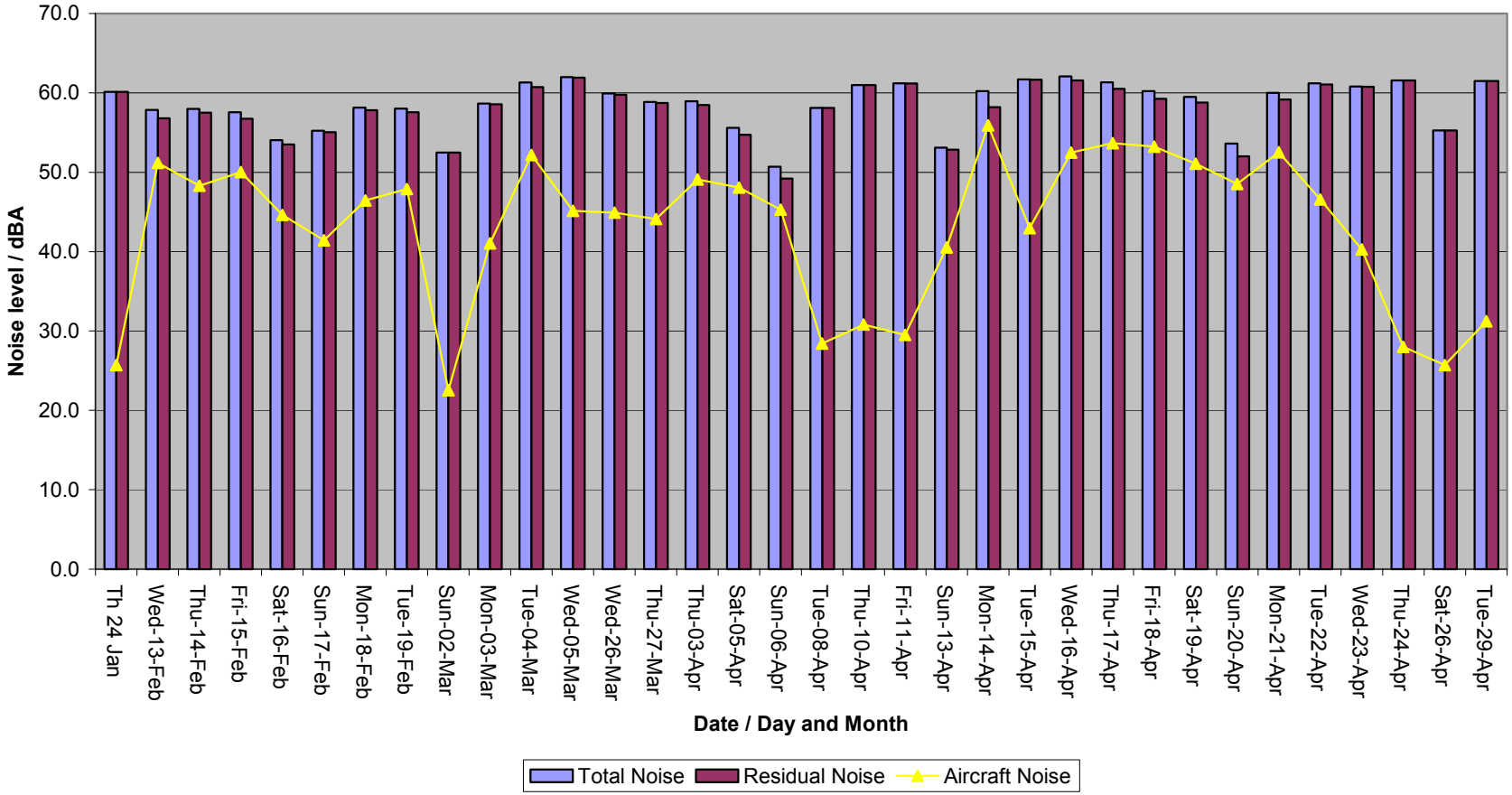


Figure 11: Numbers of aircraft noise events arising from different aircraft types at Harlow during surveys in 2004 and 2008

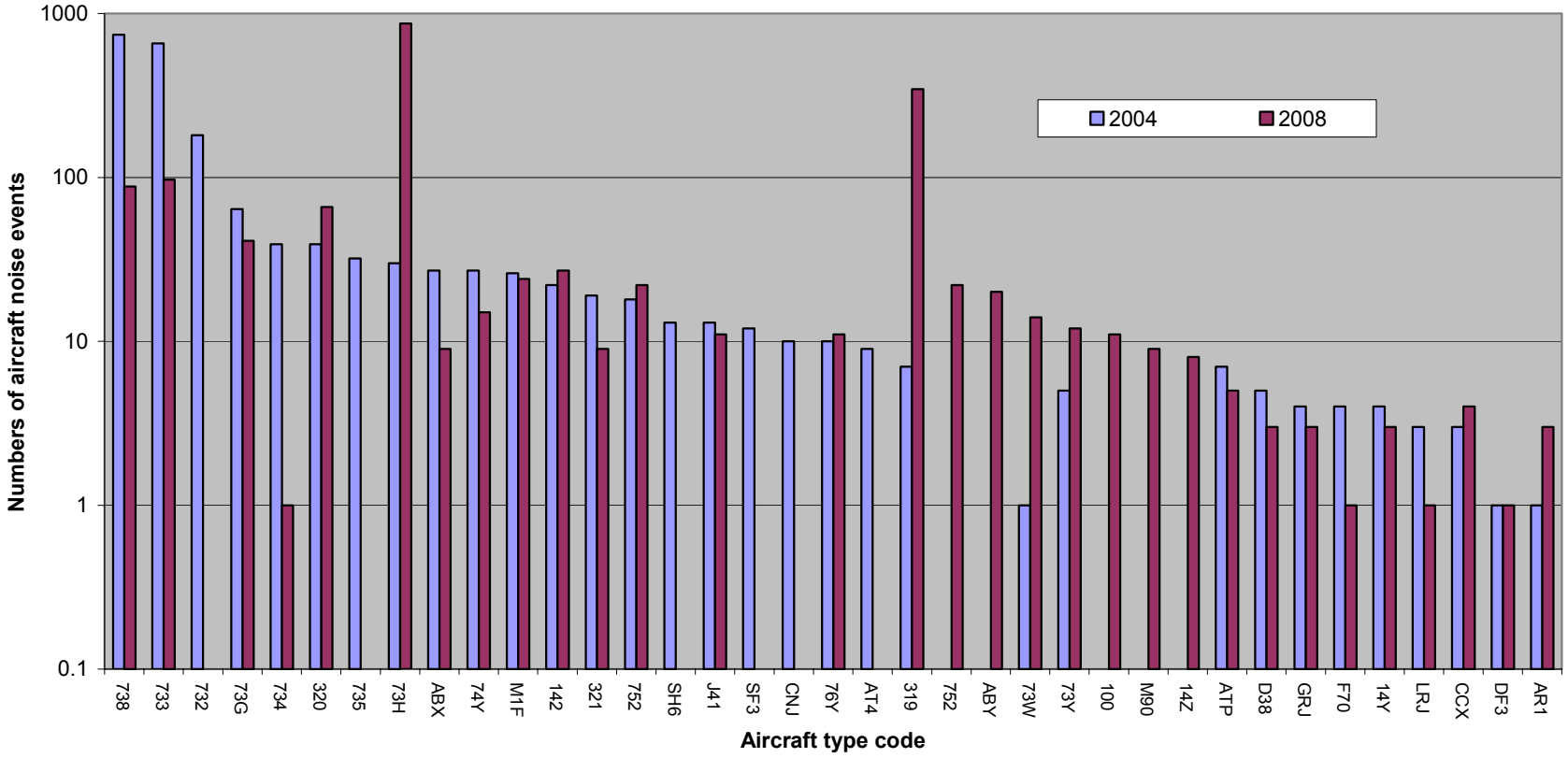
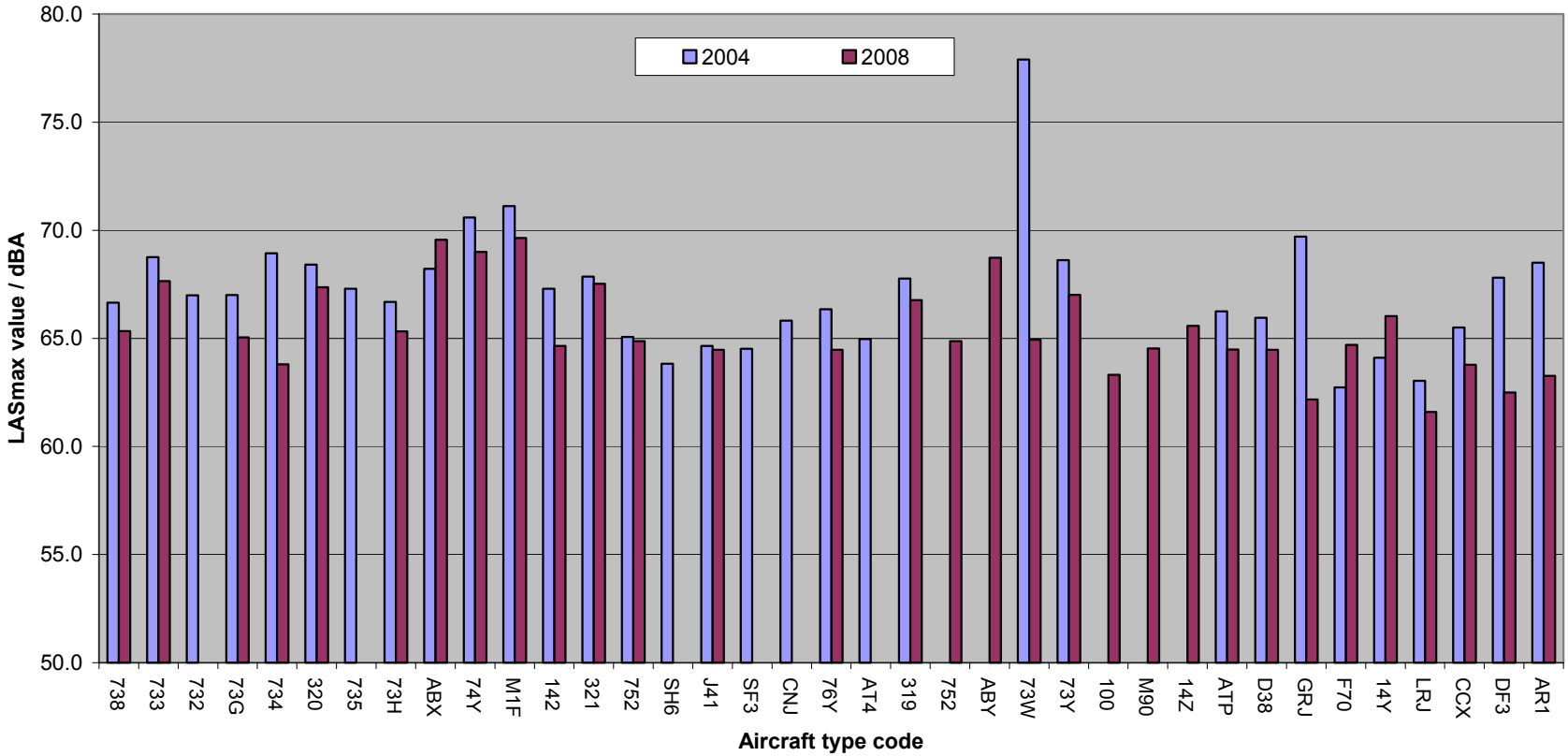


Figure 12: Average maximum levels (LASmax values) of aircraft noise events arising from different aircraft types at Harlow during survey periods in 2004 and 2008



APPENDIX 1

MAP OF SITE

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Map showing location of noise monitoring site (Marked A) at Harlow (HorseCroft Road, CM19 5BZ), relative to Stansted Airport

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APPENDIX 2

GLOSSARY OF ACOUSTIC TERMS

THE GREEN BUSINESS CENTRE
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GLOSSARY OF TERMS

This glossary is presented in two parts. The first part contains definitions relating specifically to the context of this report, followed, in the second part, by a more general glossary of acoustic terms.

Definitions relating specifically to the context of this Report:

Aircraft Noise events	Noise events which have been matched by the GEMS noise and track keeping system to radar tracks in the vicinity of the NMT from aircraft arriving at or departing from Stansted airport.
Aircraft noise level	The average noise level derived from aircraft noise events, aggregated into hourly, daily or monthly average (LAeq) values.
ANOMS	Airport Noise and Operations Monitoring System. The software data analysis system currently in use at the airport (incorporating the NTK system).
Applied Acoustic Design (AAD)	Acoustic consultants retained by FEU
Average L_{ASmax} level	The arithmetic average of the L_{ASmax} values of all the events (of a particular type i.e. either aircraft noise or community noise) which occur over a particular period of time (eg hour, day or month).
Building Research Establishment	A former government organisation, now privately owned, which conducts research on noise. Carried out the National Noise Incidence Study for Defra in 2000.
Defra	UK government Department for Environment Food and Rural Affairs, which has responsibility for aspects of policy relating to environmental noise
Flight Evaluation Unit (FEU)	The unit within BAA which monitors all aircraft movements to ensure compliance with Department for Transport noise regulations relating to track keeping, noise abatement and night flights, and which also provides a means of investigating and responding to complaints and enquiries from the public.

National Noise Incidence Study 2000

A study carried out by the Building Research Establishment for Defra based on a survey of noise levels outside 1020 dwellings in England and Wales in 2000, giving proportions of the population exposed to various levels of environmental noise.

Noise event

A burst of noise at a high level which satisfies the noise event capture conditions for a particular NMT, i.e. which exceeds the pre-set trigger noise level (in this report 60 dBA) for a pre-set time interval (in this report 10 seconds).

Noise events are detected, captured and stored by the NMT, and following subsequent processing by the NTK system are classified in this report as either aircraft noise events or community noise events

Noise Monitoring Terminal (NMT)

The noise measurement and analysis system installed at each site consisting of a precision grade sound level meter (Larson Davis type 870) inside a weather proof and tamper proof metal cabinet connected to an outdoor microphone located at a height of approximately 3.5 m above ground level.

NTK system

Noise and Track Keeping system.

A software system able to match noise events recorded by the NMTs with aircraft tracks.

PPG24

Planning Policy Guidance Note 24:Planning and Noise, a document issued by the UK government Department for the Environment in 1994 which gives guidance to local authorities and others on noise and planning.

Residual noise

All noise arriving at the NMT microphone apart from aircraft noise events, i.e. comprising residual noise events and all other noise which does not satisfy the trigger conditions for capture as a noise event.

Residual Noise events

Those noise events which have not been matched by the NTK system to aircraft tracks using Stansted Airport in the vicinity of the NMT.

Statistical frequency Analysis (of L_{ASmax} noise levels)

An analysis of a group of L_{ASmax} values giving the numbers of events (or percentages of total numbers) at different dBA levels

Total noise

All noise arriving at the NMT microphone, i.e. not only including all noise events (both aircraft and residual) but also all other noise which does not satisfy the trigger conditions for capture as a noise event.

Total noise level

The average or continuous equivalent level (L_{Aeq}) of the total noise at the site, recorded each hour by the NMT, which may also be aggregated into daily or monthly values.

Total noise climate

The level of the total noise at the NMT microphone varies with time. Over a particular period of time e.g. one hour, this variation may be described in terms of a number of different noise indices including the average or equivalent noise level, maximum and minimum noise level values and various percentile levels.

Such a description constitutes the noise climate at the site over that period of time.

The NMT records the following total noise indices every hour: L_{Aeq}, L_{ASmax}, L_{AS10}, L_{AS50}, L_{AS90} and L_{AS99}.

World Health Organisation

Issued 'Guidelines for Community Noise' in 2000

A general Glossary of acoustic Terms:

A-weighting

A method of producing a single figure measure of a broad band noise (as opposed to the 8 or 9 figures which make up an octave band spectrum) which takes into account, in an approximate way at least, the frequency response of the human hearing system. The idea is that sound levels measured in this way should give an indication of the loudness of the sound.

A-weighted sound pressure level (dBA).

The value of the sound pressure level, in decibels, measured using an A-weighting electronic circuit built into the sound level meter. The vast majority of noise measurements are carried out in this way.

Day, evening, night level, L_{den}

An index of environmental noise based on average noise levels (L_{Aeq}) throughout the 24 hour period, but with a weighting factor of 5 dBA added to evening noise levels (19.00 to 23.00 hours), and a weighting of 10 dB added to night-time noise levels (23.00 to 07.00 hours). It is the noise index used in the UK Noise mapping exercise commissioned by Defra in response to the European Union Directive on Environmental Noise in 2002.

decibel scale

The decibel scale is the scale on which sound pressure levels are commonly measured. It is a logarithmic scale and is used for convenience to compress the audible range of sound pressures into a manageable range, from 0 dB to 140 dB. The zero of the scale, 0 dB,

corresponds to the notional threshold of hearing, 0.00002 Pa, and the upper limit, 140 dB, corresponds to 20 Pa, which would cause immediate damage to the ear.

Equivalent continuous sound level ($L_{Aeq,T}$), also called the Average noise level.

The $L_{Aeq,T}$ represents a measure of the 'average' sound level over the measurement period. It corresponds to the steady continuous level of sound which, over the same period of time, T, would contain the same amount of (A-weighted) sound energy as the time varying noise.

This is the most common method of measuring time varying noise, and within certain limits gives the best correlation with human response to noise, for example with annoyance.

Frequency

The frequency of a musical note is what gives it its pitch. It is the number of cycles of the fluctuating sound pressure which occur each second, and is measured in cycles per second, Hertz (Hz). The human ear can detect frequencies in the range 20 to 20000 Hz.

Most noises are a mixture of all frequencies, called broad-band noise.

$L_{AS90,T}$

This is the most commonly used of many possible statistical measures of a time varying noise. It is the 90th percentile of the statistical noise level distribution, or, more simply, the noise level that is exceeded for 90% of the measurement time (T). Thus over one hour for example it represents the noise level which is exceeded for all but (the quietest) six minutes of that hour.

It is commonly used as a measure of the background noise in any given situation, against which the level of any new, potentially intrusive source of noise is often compared. Background noise itself often varies with time and so the $L_{A90,T}$ is almost universally used as the best measure of the 'more or less always present' noise level which underlies short term variations from other sources of noise.

Maximum sound pressure level ($L_{ASmax,T}$)

This is the highest value of the time weighted sound pressure level, (measured using the A frequency weighting and the Slow time weighting) which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the $L_{Aeq,T}$ value.

In the context of this report the L_{ASmax} value for each aircraft noise event and community noise event is monitored

Noise

Unwanted sound

Octave band spectra

In order investigate the frequency content of broad band sounds, called its frequency spectrum, measurements of sound pressure are carried out over a range of frequency bands. The most common method is to split the audio frequency range into 8 or 9 octave bands. An octave is a frequency range from one particular frequency to double that frequency.

Octave band measurements are not referred to in this report.

Percentile noise level, (L_{ASN}, where N is a number between 0 and100)

The noise level which is exceeded for N% of the measurement period. For example, a value of $L_{A10,1hour}$ of 57 dBA means that in that hour the noise level was at or above 57 dBA for 6 minutes (i.e.10% of an hour), or alternatively, was at or below 57 dBA for 54 minutes.

Sound exposure level (SEL)

This is a measure of the A-weighted sound energy used to describe single noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted sound energy as the event.

SEL values for events may be used to calculate the average noise level over a period of time (hour, day or month)

Sound pressure

sound is a disturbance or fluctuation in air pressure, and sound pressure, measured in Pascals (Pa), is used as a measure of the magnitude of the sound. The human ear can detect sound pressures in the range from 0.00002 Pa to 20 Pa. This is an enormously wide range and so for convenience sound pressures are commonly measured on a decibel (dB) scale.

Time varying noise

When the level of noise varies with time, as is often the case, for example with noise from road traffic, various measures or noise indices as they are called are used to give a single figure description of the noise over a given period of time. The three most commonly used noise indices are the $L_{Aeq,T}$ the $L_{A90,T}$ and the $L_{Amax,T}$ values.

In all three cases the 'L' stands for the level of the sound in decibels, the 'A' for the fact that it is the A- weighted value, and the 'T' for the time period over which the noise is measured, for example 5min, 1 hour, 24 hour etc.

Time weighting (Fast (F) and Slow (S))

An exponential function of time, of a specified time constant, that weights the square of the instantaneous sound pressure. (Defined in BS EN 61672 – 1:2003).

There are two time constants defined in BS EN 61672 – 1:2003, designated Fast (F) and Slow (S), and noise indices such as the maximum, or percentile noise levels which are based on instantaneous time-weighted sound pressure should indicate which time weighting has been used in the measurement.

In this report, in line with standard practice for aircraft noise measurement, it is the Slow (S) time weighting that has been used, hence reference is made to L_{ASmax} and to L_{AS90}.

APPENDIX 3

LIST OF AIRCRAFT IDENTIFICATION CODES

AAD
applied
acoustic
design

THE GREEN BUSINESS CENTRE
THE CAUSEWAY
STAINES
MIDDLESEX
TW18 3AL

TELEPHONE: 01784 464404
FACSIMILE: 01784 465447

List of Aircraft Identification Codes

100	Fokker 100
142	BAe 146-200
143	BAe 146-300
313	Airbus A310-300
319	Airbus A319
320	Airbus A320
321	Airbus A321
332	Airbus A330-200
346	Airbus A340-600
721	Boeing 727-100
722	Boeing 727-200
732	Boeing 737-200
733	Boeing 737-300
734	Boeing 737-400
735	Boeing 737-500
736	Boeing 737-600
738	Boeing 737-800
73G	Boeing 737-700
73H	Boeing 737-800 (winglets)
73W	Boeing 737-700 (winglets)
73Y	Boeing 737-300 Freighter
744	Boeing 747-400
74L	Boeing 747SP
74X	Boeing 747-200 Freighter
74Y	Boeing 747-400 Freighter
752	Boeing 757-200
762	Boeing 767-200
763	Boeing 767-300
76Y	Boeing 767-300 Freighter
ABX	Airbus A300 Freighter
ANF	Antonov AN-12 Freighter
AR1	Avro RJ-100
AR8	Avro RJ-85
AT4	ATR-42
AT7	ATR-72
ATP	BAe ATP
BE2	Beech B200
CCJ	Bombardier Challenger
CCX	Bombardier Global Express
CNJ	Cessna Citation
CR2	Bombardier CRJ-200
CR9	Bombardier CRJ-900
D38	Dornier 328
DF3	Dassault Falcon 50/900
EM2	Embraer Brasillia
ER3	Embraer RJ-135
F50	Fokker 50
FRJ	Dornier 328 Jet
GRJ	Gulfstream II/III/IV/V
H25	Hawker HS-125
J31	BAe Jetstream 31
LRJ	Bombardier Learjet 23/24/25/31/35/40/45/55/60

M1F	Boeing (McDonnell Douglas) MD11 Freighter
M82	Boeing (McDonnell Douglas) MD82
M83	Boeing (McDonnell Douglas) MD83
M87	Boeing (McDonnell Douglas) MD87
M90	Boeing (McDonnell Douglas) MD90
PA2	Piper
S20	Saab 2000
TU5	Tupolev TU-154