ARUP

Trades Union Congress

# Trades Union Congress – 1st Floor Refurbishment

## Noise Impact Assessment

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## Contents



## Tables

## Figures



## Drawings

**No table of figures entries found.**

## Pictures

**No table of figures entries found.**

## Photographs

**No table of figures entries found.**

## Attachments

**No table of figures entries found.**

## Appendices

**No table of contents entries found.**

# 1. Introduction

The Trade Union Congress are planning to refurbish areas on the first, third and fourth floors of Congress House.

This refurbishment forms part of a wider programme of works which, as well as improving amenity within the building, seeks to reduce the energy and carbon impact of the building.

The project seeks to achieve a high degree of sustainability by evaluating the options and adopting the most effective strategies from the outset.

As part of the works to decarbonise the heating of the building, heat pumps are proposed to be located externally on the roof.

Arup has carried out a noise impact assessment to predict emissions from the proposed additional plant to nearby residential properties, and to identify whether mitigation measures will be required to protect the occupants of those neighbouring properties and minimise the risk of causing them disturbance. This report presents the outcome of that assessment.

# 2. Environmental baseline noise survey

An environmental baseline noise survey was carried out by Marios Filippoupolitis and Nastassia Somikava from Arup with attended measurements taken on 6 and 16 November 2023 and unattended measurements taken between 6 and 20 November 2023 to determine the existing noise climate around Trades Union Congress (TUC).

The results of the survey have been used to establish the existing background noise levels during morning time hours (07:00 – 19:00) at locations considered representative of the nearest noise sensitive receptors (see Figure 1).

## 2.1 Site description and measurement locations

The existing building on site is a national trade union centre, situated in a commercial area of the London Borough of Camden, noisy in nature mainly during daytime hours. It is bounded by Great Russell Street to the north, Bainbridge Street to the south and Dyott Street to the East.

Figure 1 shows the site context, including the locations of the nearest noise sensitive receptors (NSRs) and the survey locations used in the environmental baseline noise survey. Table 1 summarises the type of the NSRs.

Locations A1 and U1 were selected to be representative of the noise climate near the noise sensitive receptors NSR1 and NSR2 whilst locations A2 and U2 were selected to be representative of the noise climate near the noise sensitive receptor NSR3.

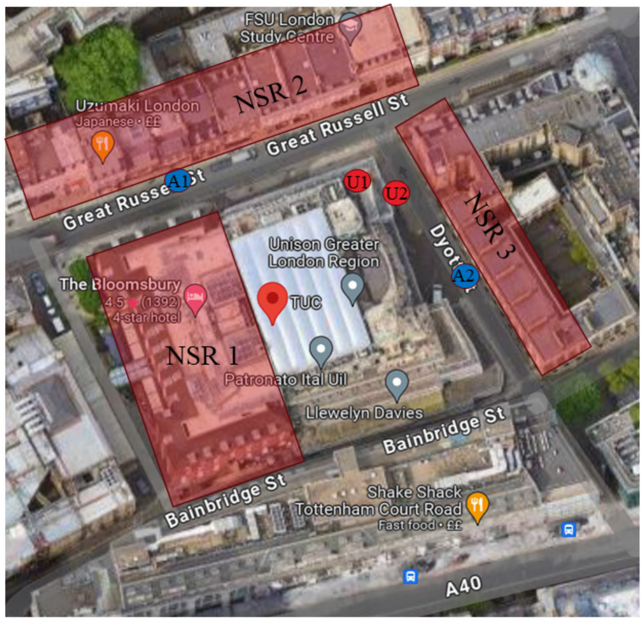


**Figure 1 Site context and measuring positions at the nearest noise sensitive receptors.**

| Noise Sensitive Receptor (NSR) | Type |
|---|---|
| 1 | Bloomsbury Hotel |
| 2 | Residential properties on Great Russell Street |

| | |
|---|---|
| 3 | Residential properties on Dyott Street |

**Table 1 Type of the Noise Sensitive Receptors (NSRs).**

## 2.2 Instrumentation

The sound level meters (SLMs), microphones and sound pressure level calibrators used by Arup are Class 1 instruments, conforming to BS EN 61672-1:2013. The SLMs were checked for correct calibration before and after each series of measurements. No significant fluctuation in level was noted throughout each survey period.

All Arup instrumentation is calibrated annually and has full traceable calibration to national and international standards, which are undertaken by an accredited calibration laboratory. Calibration certificates can be provided upon request.

## 2.3 Measurements methodology

At each location, the $L_{Aeq}$, $L_{A90}$, $L_{A10}$ and $L_{Amax}$ metric parameters were measured and recorded. All broadband measurements were A-weighted and used a fast time constant (0.125s).

At each attended measurement location, the SLM was mounted on a tripod with the microphone set between 1.2m to 1.5m above local ground level. All measurements were taken under acoustically free-field conditions. At unattended measurement location U1, the SLM microphone was mounted on a tripod on the terrace of the 6th floor of the building whilst at unattended measurement location U2, the SLM microphone was mounted on a tripod on the 2$^{nd}$ floor balcony facing Dyott Street. The appropriate windshield for the SLM was fitted to the microphone throughout to minimise wind-induced noise.

Attended measurements of 5 minutes duration were made at each location, dependent upon conditions at the measurement location. Unattended measurements of 5 minutes duration were made at each unattended measurement location. In each case, the time period was appropriate to provide a good representation of the typical noise climate at each measurement location.

## 2.4 Weather conditions

The weather conditions were in general appropriate for carrying out the environmental noise survey. During the attended measurements the temperature was above 3 Cº, the wind speed was below 5 m/sec and there was no rain. During the unattended measurements the temperature was above 3 Cº and there was no rain for most of the survey except for 4 hours rain on average on 8$^{th}$, 9$^{th}$, 10$^{th}$, 14$^{th}$ and 16$^{th}$ of November 2023. The wind speed was below 5 m/sec on the measuring days 16$^{th}$ and 17$^{th}$ of November 2023. In the rest of the measuring days the wind speed was greater than 5 m/sec in time periods of 4.5 hours on average except for 13$^{th}$ of November 2023 where the wind speed was greater than 5 m/sec the whole day. However, the comparison between the days with wind speed greater than 5 m/sec and below 5 m/sec have not shown any significant variation in the measurement results.

## 2.5 Site observations

The following comments highlight the key aspects of the survey.

- At location A1 (Figure **2**a), the noise climate is controlled by road traffic movements from Great Russel Street and pedestrian movements. Construction noise from Bloomsbury hotel was dominating the noise environment during the attended measurements of November 6th.
- At location A2 (Figure **2**b), the noise climate is controlled primarily by noise emissions from an existing louvre on Bainbridge Street (Figure 3) and secondarily by pedestrian movements on Dyott Streer as well as road traffic movements on Great Russel Street and A40. Very light traffic movements were observed on Dyott St.
- At location U1 (Figure **2**c), the noise climate is controlled mainly by the road traffic movements on Great Russel Street and audible noise emissions from plants located on the roof of TUC.
- At location U2 (Figure **2**d), the noise climate is controlled primarily by the road traffic movements on Great Russel Street and secondarily on A40.

(a) (b) (c)

(d)

Figure 2 Attended and unattended measurement locations. (a) location A1, (b) location A2, (c) location U1 and (d) location U2.

Figure 3 Louvre on Bainbridge Street.

## 2.6 Measurement results

### 2.6.1 Attended measurements

Table 2 summarises the attended baseline noise levels measured around the site. A logarithmic average of the individual measurements during each time period is used for $L_{Aeq}$, and a modal average for $L_{A90}$ which is typical of the background noise level.

| Sound Pressure Level, dB(A) (re 20 µPa) | | |
|---|---|---|
| Location | Daytime (7:00 to 19:00) | |
| | $L_{A90}$ | $L_{Aeq}$ |
| **A1** | 55 | 66 |
| **A2** | 55 | 60 |

**Table 2 Summary of averaged sound pressures at attended measurement locations.**

### 2.6.2 Unattended measurements

Figure 4 and Figure 5 show the time history of the background noise ($L_{A90}$) measured during daytime (7:00 – 19:00) at the unattended locations U1 and U2. Table 3 show the typical lowest $L_{A90}$ at locations U1 and U2 as it was determined from the data of Figure 4 and Figure 5. These were used as a basis for determining the typical lowest $L_{A90}$ during daytime (7:00 – 19:00) near the noise sensitive receptors NSR1 – NSR3.

| Typical lowest $L_{A90}$ (dB) | |
|---|---|
| **Location** | **Daytime** (7:00 – 19:00) |
| **U1** | 51 |
| **U2** | 52 |

**Table 3 Typical lowest $L_{A90}$ at locations U1 and U2.**

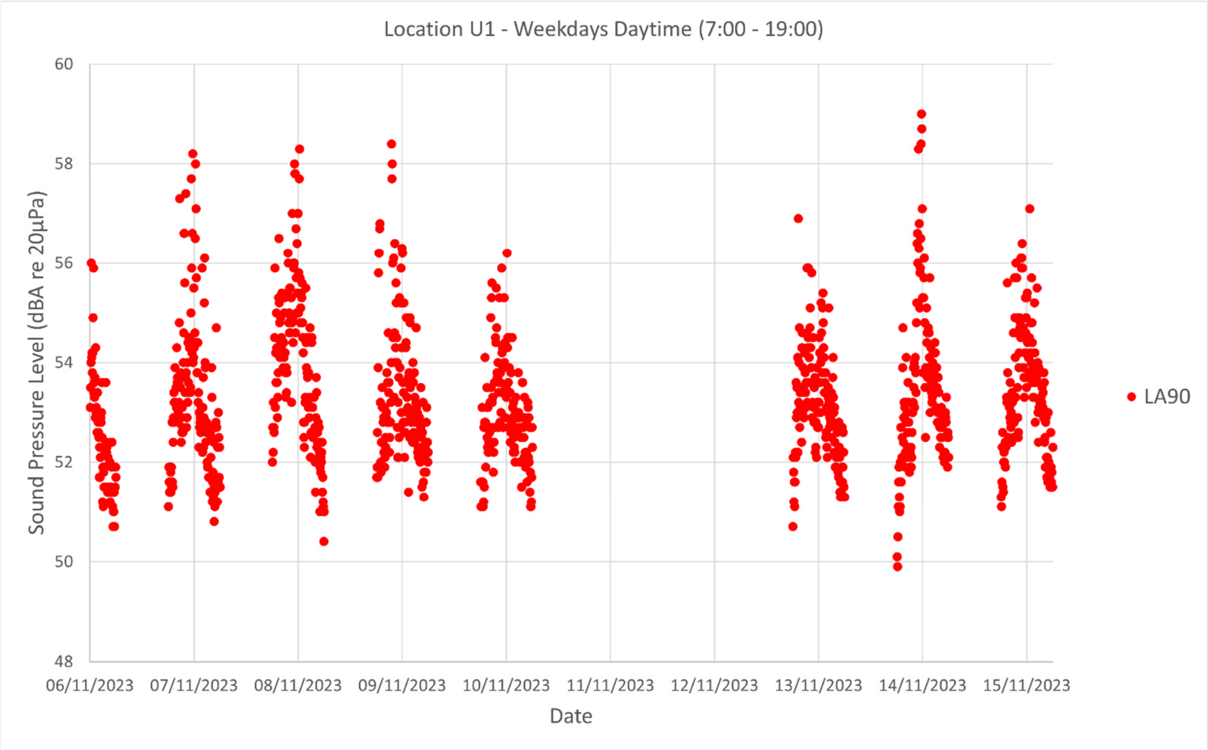


**Figure 4 Time history for the unattended daytime (7:00 – 19:00) measurements at location U1. Results are shown for weekdays.**

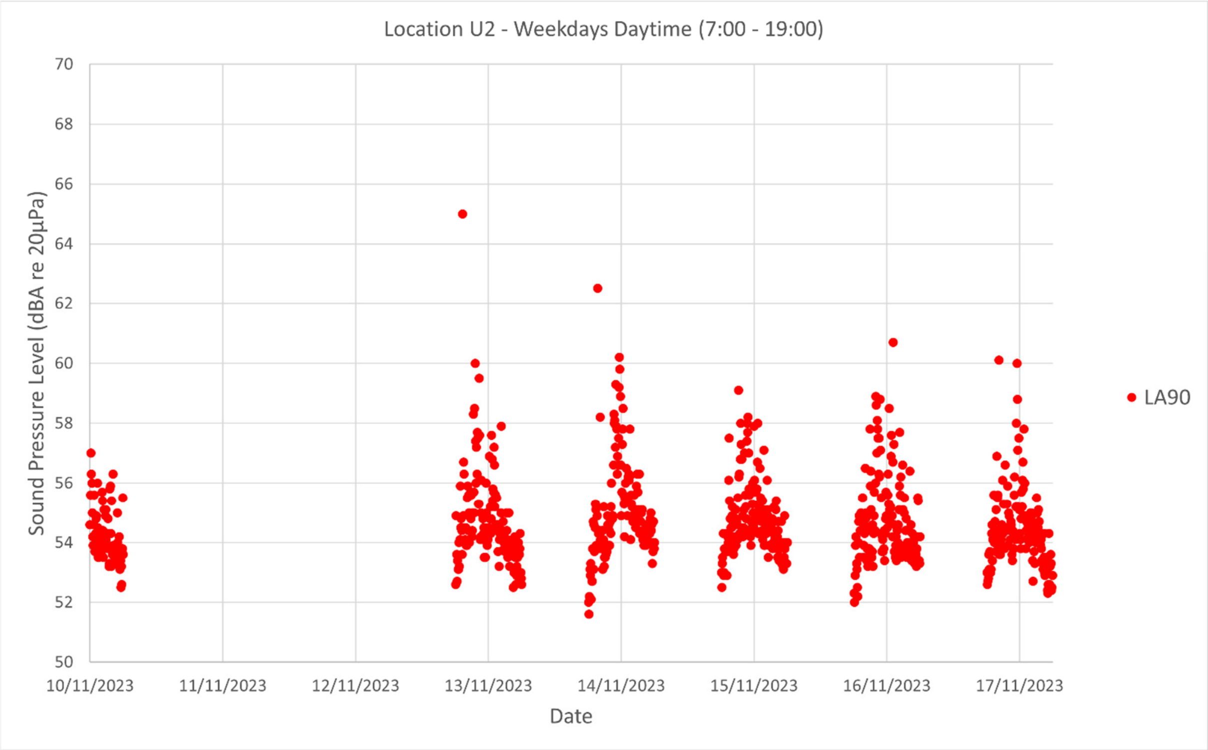


**Figure 5 Time history for the unattended daytime (7:00 – 19:00) measurements at location U2. Results are shown for weekdays.**

# 3. Policy and guidance

## 3.1 Local planning policy

### 3.1.1 Camden Council

In the Appendix 3: Noise Threshold of Camden Local Plan dated 2017 it is stated that:

*“The significance of noise impact varies dependent on the different noise sources, receptors and times of operation presented for consideration within a planning application. Therefore, Camden’s thresholds for noise and vibration evaluate noise impact in terms of various ‘effect levels’ described in the National Planning Policy Framework and Planning Practice Guidance: • NOEL – No Observed Effect Level • LOAEL – Lowest Observed Adverse Effect Level • SOAEL – Significant Observed Adverse Effect Level Three basic design criteria have been set for proposed developments, these being aimed at guiding applicants as to the degree of detailed consideration needed to be given to noise in any planning application. The design criteria outlined below are defined in the corresponding noise tables. The values will vary depending on the context, type of noise and sensitivity of the receptor: • Green – where noise is considered to be at an acceptable level. • Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development. • Red – where noise is observed to have a significant adverse effect.”*

It is also stated that:

*“A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 ‘Methods for rating and assessing industrial and Camden Local Plan | Appendices 347 commercial sound’ (BS 4142) will be used. For such cases a ‘Rating Level’ of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion)”.*

| Existing noise sensitive receptor | Assessment location | Design Period | LOAEL (Green) | LOAEL to SOAL (Amber) | SOAL (Red) |
|---|---|---|---|---|---|
| Dwellings** | Garden used for main amenity (free field) and Outside living or dinning or bedroom window (façade) | Day | ‘Rating level’ 10dB* below background | ‘Rating level’ between 9dB below and 5dB above background | ‘Rating level’ greater than 5dB above background |
| Dwellings** | Outside bedroom window (façade) | Night | ‘Rating level’ 10dB* below background and no events of exceeding 57dB$L_{Amax}$ | ‘Rating level’ between 9dB below and 5dB above background or noise events between 57dB and 88dB $L_{Amax}$ | ‘Rating level’ greater than 5dB above background and/or events exceeding 88 dB $L_{Amax}$ |

**Table 4 Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)**

**10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.*

***levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.*

The periods in Table 4 correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

### 3.2 BS 4142:2019

The assessment approach adheres to the methodology detailed in BS 4142:2014+A1:2019 - *Methods for rating and assessing industrial and commercial sound*. This standard describes a method for rating external noise levels from factories, industrial premises, or fixed installations of an industrial nature, such as building services plant, to determine the likelihood of complaints from occupants of nearby noise sensitive receivers.

The assessment method in BS 4142 is based on the difference between the measured background noise level without the influence of any industrial noise source, and the 'rating level' of the industrial source, at the receiver location.

The 'background sound level' ($L_{A90,T}$) is the sound level existing in the absence of the 'specific sound level' at the receiver location. The 'specific sound level' ($L_{Aeq,Tr}$) from the industrial source can be subject to a certain weighting (penalty) where it displays an identifiable character (such as tonality, impulsivity, intermittency or otherwise distinctive features) to provide a 'rating level' ($L_{Ar,Tr}$). Specifically, about tonality BS 4142:2019 advises that: *For sound ranging from not tonal to prominently tonal the joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.*

The 'background sound level' is subtracted from the rating level and the difference used to inform the assessment of the impacts.

BS 4142 advises: *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs."*

It also states that an initial estimate of the impact of the specific sound be conducted by subtracting the measured background sound level from the rating level and considering the following:

- typically, the greater this difference, the greater the magnitude of the impact;
- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

# 4. Noise emission limits

Table 5 outlines the cumulative noise emission limits for the proposed building services noise emissions to satisfy the planning requirements. The reduced limits that would apply if the noise emissions contained tonality is also included.

| Noise Sensitive Receptor | External building services noise emission limits (dBLAr,Tr) | |
|---|---|---|
| | Daytime (7:00 to 19:00) | |
| | Non-tonal emissions | Tonal emissions |
| Bloomsbury hotel | 43 | 38 |
| Residential properties on Great Russel Street | 43 | 38 |
| Residential properties on Dyott Street | 41 | 36 |

**Table 5 Noise emission limits**

# 5. Assessment and mitigation

The early selection of MEP consists of 5 VRV heat recovery condensing units, which are proposed to be located at roof level of the building next to the existing chillers as Figure 6 shows. The result of the initial assessment was that the predicted noise emissions were above the required limits. To mitigate that, noise barriers are expected to be needed, and the associated assessment results are summarised in Table 6.


**Figure 6 Proposed zone for locating the 5 VRV heat recovery condensing units (shaded in red).**

| Receptor | Daytime (07:00 – 19:00) | |
|---|---|---|
| | Predicted noise level after mitigation ($dBL_{Ar,Tr}$) | Noise emission limit ($dBL_{Ar,Tr}$) |
| Bloomsbury hotel | 43 | 43 |
| Residential properties on Great Russell Street | 36 | 43 |
| Residential properties on Dyott Street | 40 | 41 |

**Table 6 Predicted noise levels after barrier mitigation at the nearby residential receptors close to the proposed development.**

An alternative option being investigated currently as part of the ongoing design development is to locate two of the VRF units on the exposed rooftop on Bainbridge Street. Even though the 2023 baseline survey did not include this location, a previous survey was carried-out in 2018, with the background noise levels at this location being broadly the same as the more recent one on Dyott Street and Great Russell Street i.e., circa 50dBLA90. This would suggest that an acoustic barrier would be an appropriate mitigation in this scenario too, and it would also lead to lower noise emissions to the NSRs on Dyott Street and Great Russell Street.

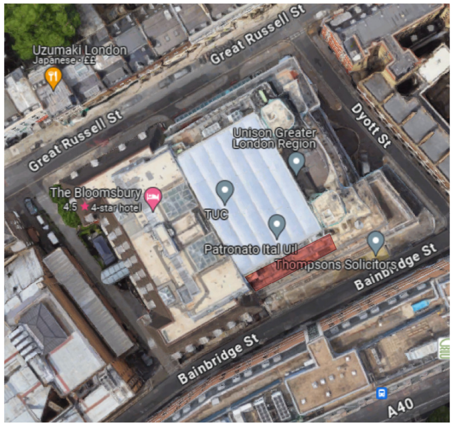


**Figure 7 Potential zone for locating 2 of the 5 VRV heat recovery condensing units (shaded in red).**

# 6. Conclusion

Arup has carried-out an environmental noise survey in the vicinity of Trades Union Congress.

Based on the survey results, and compliance with Camden Council on environmental noise emission from new plant, cumulative noise emission limits for the proposed building services have been assessed.

The future design of the building plant associated with the proposed development will be based on achieving these limits, so that the risk of causing noise disturbance to the building occupants neighbouring the development are minimised.

Based on the initial selection of plant, this will mean that a noise barrier will be included so that the emission limits required by Camden Council policy are achieved.

# Appendix A – Measurement Instrumentation

| Description | Serial number | Item type |
| --- | --- | --- |
| B&K 2250 | 3007217 | Sound level meter |
| B&K 4189 | 2920108 | Microphone |
| B&K 4231 | 3014588 | Calibrator |
| B&K ZC-0032 | 21701 | Preamplifier |
| Rion NL-52 | 00120480 | Sound level meter |
| Rion NH-25 | 10479 | Preamplifier |
| Rion UC-59 | 03152 | Microphone |
| Rion NC-74 | 35015346 | Calibrator |
| Rion NL-52 | 00231670 | Sound level meter |
| Rion NH-25 | 21614 | Preamplifier |
| Rion UC-59 | 12921 | Microphone |
| Rion NC-74 | 34336007 | Calibrator |

# Appendix B – Acoustic Terminology

## Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of $10^6$:1 (one million: one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' ($L_p$) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

## dBA

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the 'A' weighting forms part of a subscript, such as $L_{A10}$, $L_{A90}$, and $L_{Aeq}$ for the 'A' weighted equivalent continuous noise level.

## Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, $L_{eq}$. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

## Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

## Sound power level

The sound power level ($L_w$) of a source is a measure of the total acoustic power radiated by a source. The sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.

## Sound pressure level

The sound power emitted by a source, results in pressure fluctuations in the air, which are heard as sound. The sound pressure level ($L_p$) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of $2 \times 10^{-5}$Pa (the threshold of hearing).

Thus, $L_p$ (dB) = 10 log $(P1/P_{ref})^2$ where $P_{ref}$, the lowest pressure detectable by the ear, is 0.00002 pascals (ie $2x10^{-5}$ Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dB$L_A$ and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

## Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The $L_{10}$, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that $L_{Aeq}$ is used in BS 8233 for assessing traffic noise). The $L_{90}$, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The $L_1$, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted $L_{A10}$, dB$L_{A90}$ etc. The reference time period (T) is normally included, e.g. dB$L_{A10,\ 5min}$ or dB$L_{A90,\ 8hr}$.

## Typical levels

Some typical dB(A) noise levels are given below:

| Noise Level, dB(A) | Example |
|---|---|
| 130 | Threshold of pain |

| Noise Level, dB(A) | Example |
|---|---|
| 120 | Jet aircraft take-off at 100m |
| 110 | Chain saw at 1m |
| 100 | Inside disco |
| 90 | Heavy lorries at 5m |
| 80 | Kerbside of busy street |
| 70 | Loud radio (in typical domestic room) |
| 60 | Office or restaurant |
| 50 | Domestic fan heater at 1m |
| 40 | Living room |
| 30 | Theatre |
| 20 | Remote countryside on still night |
| 10 | Sound insulated test chamber |