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STAR BRANDS LTD, HUNT END INDUSTRIAL ESTATE, REDDITCH

NOISE ASSESSMENT OF NEW EQUIPMENT

On behalf of:

Star Brands Ltd

Report No: P23-098-R01v1
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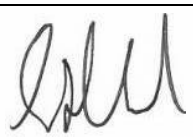

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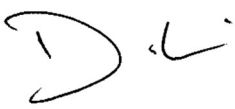

CONTENTS

1.0 INTRODUCTION

1.1 Hepworth Acoustics Ltd was commissioned to carry out a noise impact assessment relating to noise emissions from two specific sets of new externally located equipment at the Star Brands Ltd site at Hunt End Industrial Estate, Dunlop Road, Hunt End, Redditch.

1.2 The Star Brands site occupies a number of units at the south end of the Hunt End Industrial Estate. Due to the arrangement of units, Star Brands buildings allow access to two separate hardstanding areas.

1.3 The two specific sets of new externally located equipment are:

- Steam generation equipment – This equipment is located on the more northern of the two hardstandings, in the westernmost corner, close to Unit 17. The equipment comprises an approx. 2.5m x 2.5m x 2m high metal cabin containing pumps, cannisters and other relevant equipment. There are two low-level open louvres to the northeast side, either side of the access door, and another louvred fan unit to the opposite side. Also, to the southwest side is a penetration for an exhaust flue, which extents vertically, supported by the Unit 17 building, terminating slightly above eaves level. Noise emissions are generally steady and continuous, albeit with some occasional ramping up and down according to demand.

- Flour silo – This is a large stand-alone item located on the more southern of the two hardstandings, close to Unit 27/29. The equipment comprises a large, raised container with various items of mechanical equipment at low level, plus a discharge flue extending vertically at the northwest end. The low-level plant is shrouded with temporary-type flexible acoustic screens.

1.4 The nearest residences to the site are those on the opposite side of Enfield Road, which is to the southeast of the industrial site. Enfield Road is at an elevated level relative to the industrial site, by approximately 2m.

1.5 It is understood that comments of adverse noise impacts have been raised by at least one local resident regarding the steam generation equipment, but none in relation to the flour silo.

1.6 We understand that all fixed plant and machinery at the site, including the pre-existing equipment, has the potential to operate 24-hours a day during the working week.

1.7 The primary purposes of this assessment are to evaluate the noise associated with these two items and to identify potential means of noise mitigation.

1.8 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 ACOUSTIC CRITERIA

2.1 The *National Planning Policy Framework* (NPPF) 2021 states at paragraph 174 that "*Planning policies and decisions should contribute to and enhance the natural and local environment by: … e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of … noise pollution …*".

2.2 Paragraph 185 states that "*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life …*".

2.3 However, there is as yet no specific guidance on numerical acoustic assessment/design criteria provided in the NPPF, accompanying Technical Guidance document, National Planning Practice Guidance 'Noise', nor the NPSE.

British Standard 4142

2.4 British Standard 4142: 2014 +A1:2019 *'Methods for rating and assessing industrial and commercial sound'* provides methods for rating and assessing sound of an industrial and/or commercial nature.

2.5 BS 4142 requires the noise 'rating' level for the operation to be compared with the L_{A90} background sound level in the absence of the operational noise. The 'rating' level is derived based on the 'specific' L_{Aeq} noise level attributable to the operation with an 'acoustic feature' penalty added for any noise sources which give rise to tonal, impulsive, intermittent, or other characteristics readily distinctive against the residual acoustic environment at residential locations.

2.6 With regard to the background sound level, BS 4142 states that "*it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods*."

2.7 BS 4142 stipulates that impacts should be assessed over a reference time interval of 15-minutes during the night-time (2300-0700hrs).

2.8 An initial estimate of the impact of the operation is determined by subtracting the background sound level from the 'rating' level. BS 4142 states that:

- Typically, the greater this difference, the greater the magnitude of the impact
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context,
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context,
- The lower the 'rating' level is relative to the measured background level, the less likely it is that the operation 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.

2.9 Where the initial estimate of the impact needs to be modified due to the context, BS 4142 states that all pertinent factors should be taken into account in determining whether the initial estimate of the impact needs to be modified, including:

- The absolute level of sound, including "*where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds background*",
- The character and level of the residual sound,
- The sensitivity of the receptor and whether dwellings … will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as: i) façade insulation treatment, ii) ventilation and/or cooling, and iii) acoustic screening.

BS 8233: 2014

2.10 British Standard 8233: 2014 *Guidance on sound insulation and noise reduction for buildings* recommends guidance on design criteria for acceptable noise levels within residential accommodation.

2.11 BS 8233 guidelines for the daytime (07:00-23:00) and night-time (23:00-07:00) periods are summarised in Table 1.

Table 1 : BS 8233 Recommended Acoustic Design Criteria

Activity	Location	Internal Noise Levels	
		Daytime (07:00-23:00)	Night-time (23:00-07:00)
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

2.12 These levels apply only to noise without specific character at the residential location (e.g. such as that which has a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content). BS 8233 states that where such characteristics are present, lower noise limits might be appropriate.

2.13 BS 8233 also recognises that regular individual noise events at night can cause sleep disturbance. Peaks of noise from individual events are usually described in terms of L_{Amax} values and these can be highly variable and unpredictable. ProPG: Planning & Noise 'Professional Practice Guidance on Planning & Noise' 2017 states that "*in most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB* $L_{Amax,F}$ *more than 10 times a night*".

3.0 NOISE SURVEY

3.1 As set of fully attended noise surveys was undertaken at the site during the daytime, late evening and night-time of Tuesday 4 April 2023. The weather during the survey was observed to be dry and clear, with low wind speeds.

3.2 All noise measurements were undertaken using a Norsonic 140 Class 1 Integrating Sound Level Meter (serial no. 1406529). The microphone of the sound level meter was fitted with a windshield. Calibration checks were carried out on the sound level meter before and after the survey using a Bruel & Kjaer Acoustic Calibrator, Type 4231 (serial no. 2389221), and no variation in the calibration was observed.

On Site Noise Measurements

3.3 A survey of operational noise levels was undertaken on the Star Brands site itself.

3.4 Noise measurements of the stream generation equipment were undertaken during the mid/late afternoon. Due to the steady nature of the noise from this equipment, when operating at full duty, noise measurements were undertaken in relatively brief samples at locations around the unit.

3.5 The measured octave band L_{eq} noise levels are summarised close to the steam generation equipment are shown in Table 2.

Table 2 – Summary of On Site Noise Measurements – Steam Generation Equipment

Measurement Position	dB L_{eq} Noise Level								
	Octave Band Centre Frequency (Hz)								A wtd
	63	125	250	500	1k	2k	4k	8k	
NE elevation, 1m from right louvre, 0.5m above ground	78	82	70	66	64	59	55	45	71
NE elevation, 1m from left louvre, 0.5m above ground	75	79	72	67	62	58	52	42	70
NE elevation, between louvres, 0.5m above ground	77	80	74	66	59	55	48	40	70
NW elevation, 1m from centre, 1.5 above ground	82	88	70	61	60	54	46	39	73
SW elevation, 1.5 above ground, between plant cabin and boundary screen	82	83	68	63	59	54	47	38	69
SE elevation, 1m from fan louvre, 2m above ground	80	82	73	68	66	64	58	51	73
SE elevation, 1m from low level discharge flue opening	84	86	76	68	66	63	56	47	74
Inside cabin, moving average	83	90	81	76	73	68	64	58	80
1m above cabin roof, centre	77	81	67	59	57	53	47	41	67

3.6 At the time of the above afternoon measurements the flour silo was not in normal operation, plus noise from busy daytime HGV / forklift loading activity would have hampered attempts to measure noise from this source in any case. Therefore some on-site noise measurements of this item were undertaken during the late evening period when the equipment was operating normally.

3.7 Firstly, measurements were undertaken of the noise from the mechanical equipment at low level to the southeast end of the unit. Due to the steady nature of this noise, measurements were undertaken in relatively brief samples at 1m to the southwest side of the plant, and at 1m above local ground. The measured octave band L_{eq} noise levels are summarised in Table 3.

Table 3 – Summary of On Site Noise Measurements – Flour Silo (Low Level Equipment)

Measurement Position	dB L_{eq} Noise Level								
	Octave Band Centre Frequency (Hz)								A wtd
	63	125	250	500	1k	2k	4k	8k	
1m from low level mechanical equipment	73	66	74	72	66	66	55	56	73

3.8 In addition, some brief noise measurements were carried out at the opposite end of the flour silo, at ground level but coinciding with transient noise emissions from the discharge flue, that terminates at high level at this end of the equipment. Of relevance here was the 'peak' noise in terms of L_{max}, during the transient air discharge noise emanating from the flue, typically about four times per minute. The measured octave band L_{max} noise levels are summarised in Table 4.

Table 4 – Summary of On Site Noise Measurements – Flour Silo (Discharge Flue 'Peak' Noise)

Measurement Position	dB L_{max} Noise Level								
	Octave Band Centre Frequency (Hz)								A wtd
	63	125	250	500	1k	2k	4k	8k	
Ground level closest to flue	74	71	67	64	68	76	76	80	83

Off Site Noise Measurements

3.9 Further to above, a survey of prevailing noise levels was carried out on the pavement immediately outside the nearest residences to the relevant external plant at the operations on Enfield Road. The off site noise measurement locations are identified in Figure 1. This was carried out during the early part of the night-time, i.e. after 2300hrs, to be representative the most sensitive time of operation of the plant, at a time that background and residual noise was minimal.

3.10 These noise measurements were undertaken with the measurement microphone elevated to >4m above local ground height, in free-field conditions. This is therefore representative of upper floor bedroom window height.

3.11 Noise measurements at Location 1 were undertaken in relation to the steam generation equipment. This was noted to be the main source of steady noise in this area. These measurements were taken in 5-minute sample periods, and it was found that the overall noise level was consistently 44dB L_{Aeq}. The octave band L_{eq} noise levels are summarised in Table 5.

Table 5 – Summary of Off Site Noise Measurements – Location 1

Measurement Position	dB L_{eq} Noise Level								
	Octave Band Centre Frequency (Hz)								A wtd
	63	125	250	500	1k	2k	4k	8k	
Location 1	58	51	49	40	37	31	23	15	44

3.12 Noise measurements at Location 2 were undertaken in relation to the flour silo. The general noise of the low-level machinery on this item was not distinguishable at Location 2, however the periodic transient air discharge noise from the flue was clearly audible and distinctive against the residual noise.

3.13 Noise measurements at Location 2 were undertaken in 1-minute samples to optimise resolution on 'peak' L_{max} noise readings Both the L_{eq} and L_{max} noise levels were again found to be consistent. The octave band values are summarised in Table 6.

Table 6 – Summary of Off Site Noise Measurements – Location 2

Measurement Position	Index	dB Noise Level								
		Octave Band Centre Frequency (Hz)								A wtd
		63	125	250	500	1k	2k	4k	8k	
Location 2	L_{eq} 'average'	50	45	43	37	34	31	29	22	41
	L_{max} 'peak'	55	49	47	45	48	48	46	39	53

3.14 Finally, a set of background / residual noise measurements were undertaken in 15-minute samples at Location 3, which was selected due to noise from the Star Brands site generally, as well as the specific plant items to which this assessment pertains, being relatively minimal against the underlying noise environment.

3.15 The lowest measured background and residual noise levels were as set out in Table 7.

Table 7 – Summary of Off Site Noise Measurements – Location 3

Measurement Position	Index	dB Noise Level								
		Octave Band Centre Frequency (Hz)								A wtd
		63	125	250	500	1k	2k	4k	8k	
Location 3	L_{eq} 'residual'	51	46	36	33	28	26	23	19	36
	L_{90} 'background'	47	42	33	30	24	18	15	15	33

4.0 ASSESSMENT OF NOISE POTENTIAL IMPACT

4.1 An indicative initial estimate of the impact of each of the specific plant items to which this assessment pertains, has been carried out.

4.2 Considering the steam generation equipment, the measured ambient sound level at Location 1 has been corrected using the residual sound level measured at Location 3 to obtain the specific sound level. A +3dB acoustic feature penalty bas been applied to derive the rating sound level, based on the distinctive characteristic of the equipment noise ramping up and down at times. This is not a frequently noticeable characteristic, but a correction is included nonetheless to ensure a robust assessment. The rating level has been compared to the background noise level measured at Location 3. This assessment is summarised in Table 8.

Table 8 – BS 4142 Initial Assessment – Location 1 (Steam Generation Equipment)

	dB Noise Level
Measured Ambient Sound Level – dB L_{Aeq}	44
Residual Sound Level – dB L_{Aeq}	36
Specific Sound Level – dB L_{Aeq}	43
Acoustic Feature Correction – dB	+3
Rating Sound Level – dB L_{Ar}	46
Background Sound Level – dB L_{Ar}	33
Difference = Rating minus Background – dB	+13
Initial Estimate of Impact	Significant Adverse, Depending on the Context

4.3 A similar exercise has been undertaken in relation to the flour silo, based on the measured L_{Aeq} noise level at Location 2. A +6dB acoustic feature penalty bas been applied to derive the rating sound level, accounting for the impulsiveness of the transient noise emissions from the discharge flue. This assessment is summarised in Table 9.

Table 9 – BS 4142 Initial Assessment – Location 2 (Flour Silo)

	dB Noise Level
Measured Ambient Sound Level – dB L_{Aeq}	41
Residual Sound Level – dB L_{Aeq}	36
Specific Sound Level – dB L_{Aeq}	39
Acoustic Feature Correction – dB	+6
Rating Sound Level – dB L_{Ar}	45
Background Sound Level – dB L_{Ar}	33
Difference = Rating minus Background – dB	+12
Initial Estimate of Impact	Significant Adverse, Depending on the Context

4.4 As pert above, the initial estimates of the impact in line with BS 4142 indicate that the noise from the specific items of plant has the potential to give rise to "*significant adverse impact, depending on the context*". This is based on the current situation, in the absence of any further noise mitigation measures.

4.5 As stated in Section 2.0, where the initial estimate of the impact needs to be modified due to the context, BS 4142 states that all pertinent factors should be taken into account. This includes the absolute level of the sound, and the character and level of the *residual* sound.

4.6 With regard to the absolute level of sound, the derived *specific* sound level for the steam generation of equipment up 43dB L_{Aeq} is relatively modest. Even with a window partially open, this would be expected to result in operational noise within 30dB $L_{Aeq,15min}$ inside the most exposed dwellings, hence consistent with the recommended internal night-time noise level guideline of BS 8233. With windows closed, internal noise levels will be lower still. However, with windows open, this does not include any substantial margin to account for the specific character of the noise. Therefore, although consideration of contextual factors may be considered to dilute the potential impact (compared to the BS 4142 initial estimate) some additional noise mitigation would be warranted.

4.7 The absolute level of steady sound at Location 2 is lower. Based on measured L_{A90} noise levels at that location, the underlying plant noise is no greater than about 38dB(A). However, the specific L_{Aeq} noise levels are higher due to the transient noise emissions from the discharge flue. Noting that this component of the noise gives rise to 'peak' levels of 53dB L_{Amax} at Location 2, internal night-time 'peak' noise levels would be well within the usual criterion of 45dB L_{Amax}, even with windows open. Again, therefore, consideration of contextual factors dilutes the potential impact (compared to the BS 4142 initial estimate). Nonetheless, some mitigation of this noise also would be preferable.

5.0 NOISE MITIGATION

Steam Generation Equipment

5.1 For the steam generation equipment, it is our understanding that local resident(s) have asserted that noise from this item has become more significant since the recent introduction of a new storage building (itself not noise generating) a few metres to the northwest of the plant cabin.

5.2 It is difficult to comment on this point as we do not have directly comparable noise measurements prior to erection of the storage building.

5.3 Also relevant to this is that within the past few years a substantial acoustic barrier (~4m high) has been incorporated to the southeast extents of both hardstanding areas.

5.4 It certainly possible that the additional acoustically-reflective surface to the opposite side of the plant from the nearby residences (i.e. the new storage building) creates an unimpeded reflected path of noise propagation over the acoustic barrier. This could hence give rise to a small increase in noise levels on Enfield Road. However, equally true is that we would expect the current noise levels to be somewhat lower than those that would have prevailed at Location 1 prior to introduction of the acoustic barrier.

5.5 In lieu of above, one mitigation option that would directly counter the above potential effect (i.e acoustic reflection via the new storage building), would be to line the southeast elevation of the storage building with acoustically absorbent panels, e.g. formed of ~100mm mineral fibre of density 10-60kg/m3, retained behind perforated sheet steel. Proprietary solutions for acoustically absorbent panels are available from numerous companies, including www.gallowaygroup.co.uk, www.allawayacoustics.co.uk and www.iacacoustics.global.

5.6 However, although this measure would, in theory, counter any real-world effects of the new storage building in terms of steam generation equipment noise, it is not expected that a very significant reduction would result, particularly (subject to assessment by others) relative to the potential cost.

5.7 The ideal means of mitigating noise from this equipment would be to relocate it, either externally to another part of the site, remote from existing residences, or internally. On this latter point, equally a potential option would be to retain the existing location, but create a new housing around the plant.

5.8 This could take the form of a full housing, enveloping the equipment, with dedicated acoustically controlled ventilation systems for necessary air flow requirements for the plant.

5.9 More practicable, however, likely providing a lesser but still appreciable level of noise control, would be to provide a roof only to the existing installation, for example joining the top of the acoustic barrier, the main original warehouse and the new storage building, and ideally extending well beyond the existing plant towards the northeast. The northeast vertical side would then remain open for airflow provision, subject to confirmation from the steam generation equipment manufacturer that this would be adequate.

5.10 Other than above, preferable means of mitigating noise from this equipment would be those that can be applied more directly to the source.

5.11 Noise from the plant comprises higher frequency noise break-out via open louvres and lower frequency noise break-out via the cabin construction itself, as well as noise egress from the discharge flue, but at the bottom via an open duct branch, and at the main high level termination.

5.12 To control noise break-out, firstly, consideration may be given to reducing internal noise levels within the cabin by applying localised housing, lagging (e.g. proprietary acoustic lagging material such as Muftilag, by www.tapacoustic.com) or similar to especially noisy items (where possible, accounting for any air flow requirements) and or by incorporating enhanced acoustic absorption panels where space allows. It is recommended that the implications of any direct application of noise mitigation to plant should be discussed with the equipment manufacturers, to ensure this would not impede safe and proper operation.

5.13 Secondly, consideration may be given to improving the sound insulation performance of the cabin's building envelope. The general building fabric maybe readily upgraded by installing additional mass layers to new framing around the cabin. More detailed specification could be provided in this regard if such a measure is to be adopted. It is noted that an additional door would be required for access, and further demountable/removable panels may be required to allow access to the main equipment doors, when needed.

5.14 Also, to control break-out via open louvres, additional acoustic measures would be required. Firstly, it would be helpful to determine which of the existing louvres are required, as perhaps some of these could simply be blocked up. Alternatively, where the airflow provided needs to be retained, these may be replaced with acoustic louvres or alternatively in-line duct attenuators (i.e. silencers), which again would be available from numerous companies, including www.gallowaygroup.co.uk, www.allawayacoustics.co.uk and www.iacacoustics.global.

5.15 Similarly, attenuators will be potentially required to control noise emissions from the discharge flue. It may be necessary to discuss this option with the steam generation equipment manufacturers, to ensure this would not impede safe and proper operation. Ideally, any attenuator should be fitted as close to the source of the noise as possible, ideally abutting the structure of the cabin. This is preferable to mounting an attenuator within the vertical external section of the duct, to ensure reduction of noise emission via an open duct branch to the bottom is also achieved.

5.16 As well as reducing the noise emissions, an improved situation is possible if the equipment can be adjusted to ensure that, when in operation, the noise emissions are steady and continuous, i.e. without the potential for occasional ramping up and down according to demand, as was observed during the noise survey. This would result in the noise being less distinctive against the residual noise environment and hence less likely to attract attention. This would hence be especially beneficial during the late-evening / night-time periods.

Flour Silo

5.17 With regard to the flour silo, it is considered that the only component for which there is a clear need to identify potential noise mitigation measures is the transient air discharge noise emanating from the flue, which occurs typically about four times per minute.

5.18 In this case, again, relocation of the equipment may be a consideration, however given the height of the noisy element, this may have little benefit. As such, as an alternative or potential addition to such a measure, it may be possible to consider additional routing just of the flue to a position whereby residences will be less exposed.

5.19 Alternative options would be to incorporate an attenuator or other form of proprietary muffler within the exhaust. This would need to be discussed with the plant manufacturer. We have come across mufflers being fitted to silo air discharge terminations in the past, however this is a specialist area upon which the specific manufacturer should advise.

5.20 The final alternative would be to create a physical screen around the flue termination. This could potentially be formed around the access gantry framework (provided this can be done without impeding safe access when needed) to block the line-of-sight to this component from the residences to the southeast, ideally extending over the duct termination (with the duct returned 90 degrees to discharge horizontally if necessary/feasible), with then the side facing to the northwest (i.e. not facing towards sensitive areas) left open.

5.21 Any such screening should be formed of an imperforate material of superficial mass not less than 10kg/m^2. This may be of solid board material (e.g. marine-grade ply) or potentially a polymeric acoustic barrier material. In any case, the material must be overlapped and sealed at any join to ensure a continuous barrier.

5.22 As well as reducing the noise emissions, a greatly improved situation may be possible if the equipment can be adjusted to discharge air slowly and continuously, rather than storing this up for intermittent more powerful releases of air. This would potentially result in a substantial reduction of noise.

6.0 SUMMARY AND CONCLUSION

6.1 Hepworth Acoustics has undertaken a noise impact assessment relating to a relating to noise emissions from two specific pieces of externally located equipment at the Star Brands Ltd site at Hunt End Industrial Estate, Dunlop Road, Hunt End, Redditch

6.2 A set of surveys has been undertaken at the site to determine reference operational noise levels on site and also prevailing noise levels at the nearest existing residences.

6.3 The potential noise impact has been assessed based on British Standard 4142: 2014 +A1:2019 methodology.

6.4 It has been demonstrated that initial estimate of the impact in line with BS 4142 indicates a potential "*significant adverse impact, depending on the context*" and in the absence of further noise mitigation measures. Consideration of the relevant contextual factors demonstrates that the initial assessment may in fact be modified towards a lesser potential impact, but that nonetheless some additional noise mitigation measures should be considered.

6.5 A set of potential noise mitigation options has been outlined herein.

Figure 1: Aerial View of Site

Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kilohertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

L_{Aeq} This is the A–weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A–weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_{Amax} This is the maximum A-weighted noise level that was recorded during the monitoring period.

L_{A90} This is the A-weighted noise level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.

L_{Ar} This is the rating sound level as defined with BS 4142: 2014, taking account of the specific noise level generated and any applicable acoustic feature penalties.