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STANBRIDGE ROAD HAVANT

NOISE IMPACT ASSESSMENT

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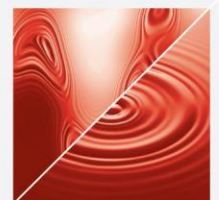
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1. INTRODUCTION

It is proposed to refurbish an existing industrial / warehouse building. The building is currently owned by Pfizer and was previously used as their distribution centre. The proposed immediate occupation is for industrial purposes with ancillary warehouse use. The proposal would involve the demolition of the existing three-story office building on the north elevation and the development of a new, ground level loading bay in its place with new loading doors on the north façade and replacement of the roof of the warehouse.

Alan Saunders Associates has been commissioned by Fishbourne N° 2 Limited (part of Geoffrey Osborne Limited) to undertake an assessment of the expected noise impact on nearby residential properties from noise sources pertaining to all future operations at the site as well as the construction / demolition activities expected during the development of the site.

The expected tenant for the developed space is Rimor, a manufacturer of specialised drilling equipment for the oil industry. An assessment of noise generated at Rimor's existing operation at their current premises has been made. In addition, consideration has been made of other potential future uses of the site in line with its current consent for B1c, B2 and B8 uses without limitation on hours of operation.

2. SITE DESCRIPTION

The site is located within an existing industrial estate with mixed commercial / light industrial areas to the north, south and west of the building. A railway line, on an embankment raised approximately 2.5m above the ground level, passes along the east boundary of the site with residential properties immediately beyond the railway line.

Service yards are located to the north and south of the building with access via a gate on the north-west corner of the site. Vehicle movements take place on the north, south and west sides of the building with no movements along the east side of the building.

The expected layout of operations within the building for Rimor's use will have painting / fabrication on the eastern side, CNC / Milling operating on the western side with inspection and testing / assembly in the centre of the building.

3. ASSESSMENT CRITERIA

Consultation with Havant Borough Council's Environmental Health Department has advised that the noise impact assessment be undertaken following the BS4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas* methodology with a view of achieving a Rating Level of 5dB below the existing background noise level.

Demolition/construction noise would be assessed using BS5228:2009 *Code of practice for noise and vibration control on construction and open sites* with predicted noise levels calculated at the nearest receptors. Best practicable means would be identified in order to reduce temporary noise levels to a minimum and mitigation measures identified in the Noise Management Plan.

4. ASSESSMENT METHODOLOGY

The following assessment of noise impacts is based upon noise monitoring undertaken at the site and mathematical prediction of noise propagation.

The assessment of impacts has been undertaken in accordance with current British Standards and other guidance documents, as referenced in the relevant sections.

The noise impact assessment will consider noise from the proposed operation of the site, vehicle noise and construction noise.

4.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (Department for Communities and Local Government, March 2012) sets out the Government's planning policies for England and the way in which these are expected to be applied by local authorities. Paragraph 109 of the document states the general principle that,

The planning system should contribute to and enhance the natural and local environment by ... preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability..

4.2 World Health Organisation (WHO) Guidelines for Community Noise (1999)

These guidelines provide a summary of research into the effect of noise on communities for a number of scenarios and provide guideline values for specific health effects of noise. The pertinent findings are shown below:

Sleep Disturbance

Measurable effects of noise on sleep begin at L_{Aeq} levels of about 30 dB. However, the more intense the background noise, the more disturbing is its effect on sleep. Sensitive groups mainly include the elderly, shift workers, people with physical or mental disorders and other individuals who have difficulty sleeping.

Sleep disturbance from intermittent noise events increases with the maximum noise level. Even if the total equivalent noise level is fairly low, a small number of noise events with a high maximum sound pressure level will affect sleep. Therefore, to avoid sleep disturbance, guidelines for community noise should be expressed in terms of the equivalent sound level of the noise, as well as in terms of maximum noise levels and the number of noise events. It should be noted that low-frequency noise, for example, from ventilation systems, can disturb rest and sleep even at low sound pressure levels.

When noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. For noise with a large proportion of low-frequency sound a still lower guideline value is recommended. When the background noise is low, noise exceeding 45 dB L_{Amax} should be limited, if possible, and for sensitive persons an even lower limit is preferred. Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep.

Annoyance

The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, few people are highly annoyed at L_{Aeq} levels below 55 dB(A), and few are moderately annoyed at L_{Aeq} levels below 50 dB(A). Sound levels during the evening and night should be 5–10 dB lower than during the day. Noise with low-frequency components require lower guideline values. For intermittent noise, it is emphasized that it is necessary to take into account both the maximum sound pressure level and the number of noise events. Guidelines or noise abatement measures should also take into account residential outdoor activities.

4.3 BS8233:1999

BS8233:1999 *Sound insulation and noise reduction for buildings-Code of practice* provides advice on the control of noise in and around buildings and suggests suitable criteria and limits. The document, in Section 7, indicates 'good' and 'reasonable' noise levels for various activities within residential and commercial buildings. These are based upon the research discussed in the WHO document.

The relevant criteria within a residential dwelling from this standard are shown in the following table:

Criterion	Typical Situations	Design range $L_{Aeq,T}$ dB	
		Good	Reasonable
Reasonable resting/sleeping conditions	Living Rooms	30	40
	Bedrooms	30	35

T for Living Rooms is taken as 16-hours, between 07:00 and 23:00 and for Bedrooms is taken as 8-hours, between 23:00 and 07:00.

Table 4.1 – Excerpt from BS8233: 1999

The guidance also states that *For a reasonable standard in bedrooms at night, individual noise events (measured with F time-weighting) should not normally exceed 45dB L_{Amax}* . The research underpinning this limit stated that *...for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night* (Vallet & Vernet 1991).

The standard also refers to typical levels of sound insulation provided by building components within a façade. Table 10 in BS8233 refers to sound insulation provided by windows, whereby a reduction of around 10 to 15dB R_w is typical for *any type of window in façade when partially open*.

4.4 BS4142: 1997

BS4142 describes a method by which noise from fixed industrial plant, processes or premises should be assessed to indicate the likelihood of complaint by nearby residential receivers. This Standard compares the measured and analysed noise levels of the industrial or fixed plant noise with the existing typical background noise level. Noise impact is assessed in terms of the likelihood of complaints being received.

The method of establishing whether the noise is likely to give rise to complaints is not applicable for assessing the noise measured inside residential buildings or when the background and rating noise levels are both very low.

4.5 BS5228:2009

BS 5228: Part 1: 2009 *Code of practice for noise and vibration control on construction and open sites - Part 1: Noise* and BS 5228: Part 2: 2009 *Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration* provide information and advice on reducing impact of construction works on neighbouring properties. Neither document sets criteria for noise or vibration limits, instead referring the reader to other documents.

Havant Borough Council has not provided criteria to be met during the construction phase. Best practicable means would be identified in order to reduce temporary noise levels to a minimum.

Criteria for construction noise are recommended in Department of the Environment Advisory Leaflet (AL) 72, whereas BS 7385: Part 2: 1993 *Evaluation and Measurement for Vibration in Buildings. Guide to damage levels from groundborne vibration* provides limits on vibration levels that should not be exceeded in order to avoid risk of cosmetic damage to structures.

4.6 Summary of Assessment Criteria

To summarise, the table below lists the criteria relevant in current British Standards or UK guidance documents.

Reference Document	Criteria
WHO/BS8233	NOEL Inside: <30dB $L_{Aeq,T}$ (T=8h night and 16h daytime) LOAEL Inside: ≥ 30dB $L_{Aeq,T}$ (T=8h night and 16h daytime); ≤ 45dB L_{Amax} (night) NOEL Outside: <50dB $L_{Aeq,T}$ (daytime), <45dB $L_{Aeq,T}$ (evening), <40dB $L_{Aeq,T}$ (night) LOAEL Outside: ≥ 50dB $L_{Aeq,T}$ (daytime), ≥ 45dB $L_{Aeq,T}$ (evening), ≥ 40dB $L_{Aeq,T}$ (night)
BS4142: 1997	$L_{Aeq,T}$ Rating Level from fixed industrial plant, processes or premises to be assessed against typical L_{A90} Background Noise Level. Rating Level - Background Noise Level: around -10dB, complaints unlikely; around +5dB, of marginal significance; around +10dB, complaints likely.

Table 4.2– Summary of assessment criteria

The criteria above derived from the WHO guidance and BS8233 are all absolute. The assessment method of BS4142: 1997 results in relative criteria.

All of the above mentioned assessment criteria will be considered when assessing the noise impact of these proposals.

5. ENVIRONMENTAL NOISE SURVEY

5.1 Noise Survey Methodology

An environmental noise survey was carried out on the Stanbridge Road site in order to establish the existing noise climate. Noise monitoring equipment was installed on the site from Thursday 9th May to Monday 13th May 2013. The noise monitoring equipment was programmed to take measurements of the L_{Aeq} , L_{A90} , L_{A10} and L_{Amax} parameters over consecutive five-minute periods throughout the duration of the survey. The monitoring location, as shown on the site plan Figure AS7427/SP1, was in the north-east corner of the site which is considered representative of the noise climate at the adjacent residential houses.

The following equipment was used for the surveys:-

- Norsonic precision integrating sound level meter type 118;
- Norsonic sound level calibrator type 1251.

The equipment calibration was verified before and after use. No calibration drift was observed.

Weather conditions during the survey were suitable for noise monitoring, being mostly dry with moderate wind speeds.

Descriptions and explanations of the acoustic parameters used in this report are shown in Appendix A.

5.2 Survey Results

The results of the noise monitoring surveys are shown as time histories of the $L_{Aeq,5min}$, $L_{A10,5min}$, $L_{A90,5min}$ and L_{Amax} in Figures AS7427/TH1-TH4.

Table 5.1 summarises the typical background noise levels measured during the automated noise survey. A value for the noise level during normal operating hours for light industrial operations such as Rimor is included.

Time Period	Typical Background Noise Level L_{A90} *
Normal industrial operating hours (07:00 – 20:00) Monday - Saturday	44dB
Daytime (07:00 – 23:00) (including Sunday)	41dB
Night-time (23:00 – 07:00)	34dB

Table 5.1- Background noise levels

[dB ref. 20μPa]

* Typical background noise level is derived from the 10th percentile of the all L_{A90} measurements during the time period

Ambient noise levels at the sites are determined by road traffic noise and noise associated with surrounding industrial buildings.

6. NOISE SOURCES PERTAINING TO PROPOSED ACTIVITIES AT THE SITE

6.1 Survey of Factory Noise

Automated noise monitoring equipment was placed in appropriate locations in the two premises from which Rimor currently operate from Thursday 28th April to Monday 1st May 2013 in order to measure typical operational noise levels. The noise monitoring equipment was programmed to take measurements of the L_{Aeq} , L_{A90} , L_{A10} and L_{Amax} parameters over consecutive five-minute periods throughout the duration of the survey. The following equipment was used for the surveys:-

- Norsonic precision integrating sound level meter type 118;
- Norsonic precision integrating sound level meter type 118;
- Norsonic sound level calibrator type 1251.

The equipment calibration was verified before and after use. No calibration drift was observed.

In both premises the noise level was evenly distributed throughout the buildings and noise monitoring equipment was positioned to measure the diffuse sound pressure levels. The automated measurements were supported by manual measurements.

The results of the noise monitoring surveys are shown as time histories of the $L_{Aeq,5min}$, $L_{A10,5min}$, $L_{A90,5min}$ and L_{Amax} in Figures AS7427/TH5-TH12.

Table 6.1 summarises the findings of the noise survey:

Operational Area	Maximum Daytime $L_{Aeq,1hour}$	Maximum Night-time $L_{Aeq,5minutes}$
Paint / Fabrication	68 dB	56 dB
CNC / Milling	81 dB	81 dB

Table 6.1- Daytime and night-time average noise levels inside Rimor Factories [dB ref. 20μPa]

CNC / Milling is a 24 hour operation and shows no variation in maximum L_{Aeq} levels during the day and night.

Painting / Fabrication operates during the day with no operations at night. The location of the automated monitor within the factory was in relative proximity to an air compressor which dominated the night-time noise measurements.

6.2 Vehicle Noise

The following typical noise levels have been obtained from Alan Saunders Associates' library. These are measured noise levels from similar Planning Class B1 and B8 sites.

Type of Vehicle / Activity	Parameter	Measurement Distance, m	Noise Level, dB
Articulated Truck Arriving	L_{Aeq}	1	78
18t lorry arriving and reversing	L_{Aeq}	3	77
Fork-lift	L_{Aeq}	3	67
Door Slam	$L_{Amax, Fast}$	3	85
Lorry air breaks	$L_{Amax, Fast}$	1	88

Table 6.2- Daytime and night-time average noise levels inside Rimor Factories**[dB ref. 20µPa]**

It is assumed that all forklift and side-loader plant use broadband and visual (at night) reversing alarms, rather than tonal alarms.

7. EXPECTED OPERATION ON PREMISES

Two possible uses at the site are considered with the following assumed operations:

7.1 Light Industrial

Following consultation with Rimor and observation of the existing operation, the following operation is expected at the Stanbridge Road Facility:

- Painting / Fabrication operate between 07:00 and 16:30 hours Monday – Friday and between 07:00 and 13:00 hours on Saturdays
- CNC/Milling operate up to 24 hours a day, depending on orders
- Vehicle movements and external operations are minimal with up to 2 No. forklifts being the only equipment operating regularly.
- 2 no. small transporter vans per day
- 2 no. 7 tonnes delivery vehicles per day
- 2 no. Fork lifts are used intermittently throughout the day between 07:00 and 19:00 hours to move materials between areas.
- All manufacturing processes will take place within the warehouse with the loading bay doors closed. The doors will be opened for a maximum of 15 minutes at a time (no more than once per hour) during delivery and pick up of materials.
- Change of shift sirens and public announcement systems are not expected to be used in external areas.

7.2 Distribution Centre

Unrestricted vehicle movements at any times has been assessed with the following assumptions:

Vehicle	Daytime Occurrences (in a single 1 hour period)	Night-time Occurrences (in a single 5 minute period)
Large Articulated lorry	Up to 2 vehicles arriving/departing	One vehicle arriving in a single 5 minute period
18 ton Truck	Up to 4 vehicles arriving/departing	
Forklift	Operating within the building or carrying goods between a lorry and the building	Unloading the arriving vehicle

Table 7.1- Assumed vehicle movements

8. PREDICTED NOISE IMPACT

Predicted noise impact has been calculated in general accordance with the requirements and guidance of BS4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas*. The detailed calculations of noise emissions are attached in Appendix B.

8.1 Light Industrial

For the purposes of calculating the noise due to workshop activities, the following assumptions are made:

- All workshop activities are assumed to take place within the building with the loading bay doors closed. The loading bay doors will only be opened while materials are being moved in to or out of the building.
- The new north façade of the workshop building will be constructed of Kingspan composite panels with 60mm insulation and inner liner.
- The remaining walls of the building will be the existing masonry wall construction.
- The roof of the building will be constructed of Kingspan KS1000 panels (115mm thick). Each section of the roof will include ventilation openings comprising up to 5% of the roof area.
- There will be eight delivery bay doors included in the north façade, these being solid roller shutter type doors.

The source noise levels used in the calculations are the values measured in the existing workshops, assumed to be equivalent to the reverberant noise level expected in the Stanbridge Road premises. In practise, the average reverberant sound energy density in the Stanbridge Road premises can be expected to be lower than indicated by the results of the noise survey. This is due to the Stanbridge Road warehouse having a larger volume and the measurement data including significant influence from direct field noise caused by machinery movements in close proximity to the microphones.

The following table summarises the predicted noise level at the nearest residential receiver.

Noise Source	Daytime $L_{Aeq,1hour}$, dB	Night-time $L_{Aeq,5min}$, dB
Fabrication workshop doors open (15 minutes)	34	28
Fabrication workshop doors closed	16	5
CNC/Milling workshop doors open (15 minutes)	28	34
CNC/Milling workshop doors closed	20	20
Fabrication sound transmission through side wall and roof	28	16
Vehicle movements	28	29
Total	36	35

Table 8.1- Daytime and night-time predicted noise levels at nearest noise sensitive receiver. Daytime events corrected to $L_{Aeq,1hour}$

8.2 Distribution Centre

The noise level due to vehicle movements includes only movements within the Stanbridge Road site. As the site is within an industrial estate, there currently exists a significant number of HGV movements on the surrounding road network and the additional traffic noise due to activities on the site in question will be negligible.

The expected maximum sound pressure level at the nearest residential property due to the worst case scenario of all vehicle movements described above occurring simultaneously is as follows:

	Daytime $L_{Aeq,1hour}$	Night-time $L_{Aeq,5min}$
Predicted noise level	40	44

Table 8.2- Daytime and night-time predicted noise levels at nearest noise sensitive receiver due to vehicle movements

9. NOISE IMPACT ASSESSMENT

9.1 Light Industrial

The following table records the predicted Rating Level against the measured background noise levels for use as light industrial premises:

	Daytime	Night-time
Cumulative Noise Level	$L_{Aeq,1hour}$ 36dB	$L_{Aeq,5min}$ 35dB
Background L_{A90} Noise level	44*	34
Difference	-7	+1
BS4142 Impact Assessment	Tending towards level at which complaints are unlikely	"Marginal Significance"

Table 9.1- Daytime and night-time predicted noise rating levels

*The daytime background noise level is measured between 07:00 and 20:00 Monday - Saturday

The criterion proposed by Havant Borough Council is met during normal daytime operating hours under the following scenario:

- Average noise levels inside the factory do not exceed L_{Aeq} 81dB. Average noise levels in the eastern bay should not exceed L_{Aeq} 68dB
- Work is conducted with the loading doors closed except for when moving materials into or out of the factory.

The night time noise level is expected to exceed the design criteria. However, the +1 rating is considered as being of "Marginal Significance" when assessed in line with the BS 4142 methodology.

9.2 Distribution centre

The following table records the predicted Rating Level against the measured background noise levels for use as a distribution centres:

	Daytime	Night-time
Cumulative Noise Level	$L_{Aeq,1hour}$ 40dB	$L_{Aeq,5min}$ 44dB
Background L_{A90} Noise level	41	34
Difference	-1	+10
BS4142 Impact Assessment	"Marginal Significance"	"Complaints Likely"

Table 9.2- Daytime and night-time predicted noise rating levels

It is seen from the above table that night time levels are not expected to achieve the design criteria of -5dB below background level when assessed following the BS4142 methodology.

10. DEMOLITION AND CONSTRUCTION NOISE

It is proposed to demolish the three story office block on the northern side of the building and construct a new northern elevation to the building.

10.1 Proposed Construction Programme

- Main demolition works: 6 weeks
- Removal of existing roof: 6 weeks
- Install new roof: 10 weeks
- Construction of new north elevation + loading doors: 4weeks
- Hard landscaping: 4 weeks
- Internal works: 6 weeks

Typical equipment and plant likely to be in use at the site includes, but is not necessarily limited to, the following:

Trade	Activity	Plant Type	Vehicle Activity in/out
Demolition	Demolition of 3 storey office block	2no 45t Hitachi excavators	160 (15-20 yarders – av 5 per day)
	Removal of asbestos roof to warehouse	Sealed skip lorries – 8 yarders	12no estimated
Roofer	Construct new roof	Articulated lorry	8no
	Rainwater and guttering	Flat bed lorry	2no
General	Protections etc	By hand/Flat bed lorry	Allowance of 18no loads
Scaffolder	Erect scaffold for demo	Flat bed lorries	16no
M&E	New offices – warehouse area	Flat bed lorries	36no
Cladder	New walling to north/west elevation	Articulated lorry	8no
Landscaping	Tarmac	Flat bed lorry	6no
Block work	Internal walling	Flat bed lorry	6no

10.2 Typical Criteria

The intent of criteria for noise and vibration emissions for construction sites is primarily to minimise risk of adverse health effects and to avoid damage to structures. In suburban areas, such as this, a secondary consideration is to enable neighbours to continue to enjoy their property, even though, noise and vibration cannot be entirely prevented.

Noise

Department of the Environment Advisory Leaflet (AL) 72 states that construction noise levels at residential locations in rural, suburban and urban areas away from main road traffic and industrial noise should not exceed 70dB(A) during the daytime (defined as 7am – 7pm). The advice also recommends that noise levels during evening periods are at least 10dB lower. It is usually accepted that these limits apply to the average noise level over the working day. The numerical limits can, therefore, be exceeded for short periods provided that these are balanced by periods of relative calm.

Vibration

Guidance given in BS 7385: Part 2: 1993 *Evaluation and Measurement for Vibration in Buildings. Guide to damage levels from groundborne vibration*, as referenced by BS5228 Part 2, advises that the onset of cosmetic damage within residential buildings from transient vibration occurs at a peak particle velocity, ppv of 15mm/s, with structural damage occurring at magnitudes twice to four times this. For continuous vibration that may give rise to resonant response of the structure, such as might be expected with heavy breakers, 50% reduction in the limits is recommended, i.e. to 7mm/s.

10.3 Typical Emissions

Based upon typical library noise levels, supported by information given in BS5228, likely worst case noise emissions have been predicted at the immediately adjacent residential properties. Calculations are shown in Appendix B.

The greatest levels of noise and vibration are expected during the demolition phase. Limited ground works during the construction phase will limit the noise expected. The average day time levels are not expected to exceed $L_{Aeq,12hour}$ 70dB.

From ASA's extensive database of vibration measurements from demolition works, heavy breakers typically generate vibration levels of 3mm/s to 5mm/s ppv in structures situated within several metres of the working area. Due to geometric spreading and geological attenuation, vibration will diminish rapidly with increasing distance, such that vibration is likely to be imperceptible throughout large areas of neighbouring properties away from the site boundaries.

10.4 Mitigation and Measurement

Demolition and construction activities should be limited to between 7am and 7pm Monday to Friday.

- At all times and subject to availability, select and use quietest plant, machinery and vehicles appropriate for the task being undertaken will be used at all times. All vehicles and mechanical plant used for the purpose of the works will be fitted with effective exhaust silencers, will be maintained in good and efficient working order and operated in such a manner as to minimise noise emissions;
- Employ at all times the Best Practicable Means (BPM), as defined in Section 72 of the Control of Pollution Act 1974, to reduce noise (including vibration) to a minimum;
- Operate a 'considerate builder' type scheme in which a commitment is made, amongst others, to undertake proper maintenance of equipment, control use of radios on site, site equipment with due consideration to proximity of neighbours and ensure it is turned off when not in use.

11. CONCLUSION

It is proposed to refurbish an existing industrial/warehouse building at Stanbridge Road, Havant.

An assessment of noise due to proposed operations at the site has been undertaken following the BS4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas* methodology. An assessment of expected construction noise has been undertaken in line with the methodology of BS 5228.

Steven Liddell

ALAN SAUNDERS ASSOCIATES

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

1.0 ACOUSTIC TERMINOLOGY

The annoyance produced by noise is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and any variations in its level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

dB (A):	The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level.
L_{10} & L_{90}:	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the average minimum level and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise, as being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic noise.
L_{eq}:	The concept of L_{eq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise. L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The use of digital technology in sound level meters now makes the measurement of L_{eq} very straightforward. Because L_{eq} is effectively a summation of a number of noise events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute noise limit.
L_{max}:	L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.
D	The sound insulation performance of a construction is a function of the difference in noise level either side of the construction in the presence of a loud noise source in one of the pair of rooms under test. D , is therefore simply the <i>level difference</i> in decibels between the two rooms in different frequency bands.
D_w	D_w is the <i>Weighted Level Difference</i> The level difference is determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1.
$D_{nT,w}$	$D_{nT,w}$ is the <i>Weighted Standardised Level Difference</i> as defined in BS EN ISO 717-1 and represents the <i>weighted level difference</i> , as described above, corrected for room reverberant characteristics.
C_{tr}	C_{tr} is a spectrum adaptation term to be added to a single number quantity such as $D_{nT,w}$, to take account of characteristics of a particular sound.
$L'_{nT,w}$	$L'_{nT,w}$ is the <i>Weighted Standardised Impact Sound Pressure Level</i> as defined in BS EN ISO 717-2 and represents the level of sound pressure when measured within room where the floor above is under excitation from a calibrated tapping machine, corrected for the receive room reverberant characteristics.

APPENDIX A

ACOUSTIC TERMINOLOGY & HUMAN RESPONSE TO BROADBAND NOISE

2.0 OCTAVE BAND FREQUENCIES

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation have agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, eg. 250 Hz octave band runs from 176 Hz to 353 Hz. The most commonly used bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000
---------------------------------	----	-----	-----	-----	------	------	------	------

3.0 HUMAN PERCEPTION OF BROADBAND NOISE

Because of the logarithmic nature of the decibel scale, it should be borne in mind that noise levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) is not twice as loud as 50 dB(A) sound level. It has been found experimentally that changes in the average level of fluctuating sound, such as traffic noise, need to be of the order of 3dB(A) before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10 dB(A) is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in traffic noise level can be given.

INTERPRETATION

Change in Sound Level dB(A)	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

4.0 EARTH BUNDS AND BARRIERS - EFFECTIVE SCREEN HEIGHT

When considering the reduction in noise level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a 3 metre high barrier exists between a noise source and a listener, with the barrier close to the listener, the listener will perceive the noise source is louder, if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the noise source would seem quieter than it was if he were standing. This may be explained by the fact that the "effective screen height" is changing with the three cases above, the greater the effective screen height, in general, the greater the reduction in noise level.

Where the noise sources are various roads, the attenuation provided by a fixed barrier at a specific property will be greater for roads close to the barrier than for roads further away.

APPENDIX C

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AS7427 Stanbridge Road

$$L_2 = L_1 - R_C + 10 \log_{10} S_p - 20 \log_{10} r - 14$$

Where:

R_C = Composite Sound Reduction index of partition

S_p = Surface area of partition

L_1 = Internal reverberant sound pressure level

L_2 = Resultant sound pressure level

r = Distance to receiver

CNC Workshop with door open

			63	125	250	500	1000	2000	4000	8000	dBA
L_1	CNC Workshop Internal Noise Level (Night)		77	76	79	76	75	74	72	70	81
$+10 \log_{10} S_p$	Area of Partition (Door + Walls)	108 m ²	20	20	20	20	20	20	20	20	
	Kingspan AWP/60+F SRI	88 m ²	12	19	32	42	50	52	60	60	
	Large Open Door SRI	20 m ²	0	0	0	0	0	0	0	0	
$-R_C$	Combined SRI		-6	-7	-7	-7	-7	-7	-7	-7	
$-20 \log_{10} r$	Distance to Receiver	84 m	-38	-38	-38	-38	-38	-38	-38	-38	
	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
-14	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Directivity correction	80 degrees	-4	-4	-8	-8	-8	-8	-8	-8	
L_2	Noise level at noise sensitive receiver		35	33	32	29	28	27	25	23	34

Paint / Fabrication at night with door open

			63	125	250	500	1000	2000	4000	8000	dBA
L_1	Fabrication Workshop Internal Noise Level (Night)		51	45	49	48	44	48	50	52	56
$+10 \log_{10} S_p$	Area of Partition (Door + Walls)	108 m ²	20	20	20	20	20	20	20	20	
	Kingspan AWP/60+F SRI	88 m ²	12	19	32	42	50	52	60	60	
	open door	20 m ²	0	0	0	0	0	0	0	0	
$-R_C$	Combined SRI		-6	-7	-7	-7	-7	-7	-7	-7	
$-20 \log_{10} r$	Distance to Receiver	42 m	-32	-32	-32	-32	-32	-32	-32	-32	
	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
-14	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Correction for Acoustic Character		5	5	5	5	5	5	5	5	
	Barrier Calculation	2 m high	0	0	0	0	0	0	0	0	
L_2	Noise level at noise sensitive receiver		23	17	21	19	16	20	21	24	28

Paint / Fabrication during the day with door open

			63	125	250	500	1000	2000	4000	8000	dBA
L_1	Fabrication Workshop Internal Noise Level (Day)		63	57	61	60	56	60	62	64	68
$+10 \log_{10} S_p$	Area of Partition (Door + Walls)	108 m ²	20	20	20	20	20	20	20	20	
	Kingspan AWP/60+F SRI	88 m ²	12	19	32	42	50	52	60	60	
	Large Open Door SRI	20 m ²	0	0	0	0	0	0	0	0	
$-R_C$	Combined SRI		-6	-7	-7	-7	-7	-7	-7	-7	
$-20 \log_{10} r$	Distance to Receiver	42 m	-32	-32	-32	-32	-32	-32	-32	-32	
	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
-14	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Correction for Acoustic Character		5	5	5	5	5	5	5	5	
	Barrier Calculation	2 m high	0	0	0	0	0	0	0	0	
L_2	Noise level at noise sensitive receiver		35	29	33	31	28	32	33	36	40

Paint / Fabrication transmission loss through Roof

			63	125	250	500	1000	2000	4000	8000	dBA
L_1	Fabrication Workshop Internal Noise Level (Day)		63	57	61	60	56	60	62	64	68
$+10 \log_{10} S_p$	Area of Roof element	1068 m ²	30	30	30	30	30	30	30	30	
	Kingspan KS1000 RW/40+H+L SRI	1015 m ²	13	14	29	38	40	45	55	55	
	upto 5% ducted ventilation openings in	53.41 m ²	6	6	6	6	6	6	6	6	
$-R_C$	Combined SRI		-12	-13	-19	-19	-19	-19	-19	-19	
$-20 \log_{10} r$	Distance to Receiver	36 m	-31	-31	-31	-31	-31	-31	-31	-31	
	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
-14	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Correction for Acoustic Character		5	5	5	5	5	5	5	5	
	Directivity correction		-3	-6	-11	-11	-11	-11	-11	-11	
L_2	Noise level at noise sensitive receiver		38	28	22	20	16	20	22	24	28

CNC Workshop with door closed											
			63	125	250	500	1000	2000	4000	8000	dBA
L_1	CNC Workshop Internal Noise Level (Night)		77	76	79	76	75	74	72	70	81
$+10\log_{10}S_p$	Area of Partition (Door + Walls)	108 m ²	20	20	20	20	20	20	20	20	
	Kingspan AWP/60+F SRI	88 m ²	12	19	32	42	50	52	60	60	
$-R_C$	Roller shutter doors SRI	20 m ²	6	3	8	14	20	20	20	20	
	Combined SRI		-10	-10	-15	-21	-27	-27	-27	-27	
$-20\log_{10}r$	Distance to Receiver	84 m	-38	-38	-38	-38	-38	-38	-38	-38	
-14	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Directivity correction	80 degrees	-4	-4	-8	-8	-8	-8	-8	-8	
L_2	Noise level at noise sensitive reciever		31	31	24	15	8	7	5	3	20

Paint / Fabrication at night with door closed			63	125	250	500	1000	2000	4000	8000	dBA
L_1	Fabrication Workshop Internal Noise Level (Night)		51	45	49	48	44	48	50	52	56
$+10\log_{10}S_p$	Area of Partition (Door + Walls)	108 m ²	20	20	20	20	20	20	20	20	
$-R_C$	Kingspan AWP/60+F SRI	88 m ²	12	19	32	42	50	52	60	60	
	Roller shutter doors SRI	20 m ²	6	3	8	14	20	20	20	20	
	Combined SRI		-10	-10	-15	-21	-27	-27	-27	-27	
$-20\log_{10}r$	Distance to Receiver	42 m	-32	-32	-32	-32	-32	-32	-32	-32	
-14	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Correction for Acoustic Character		5	5	5	5	5	5	5	5	
	Barrier Calculation	2 m high	0	0	0	0	0	0	0	0	
L_2											
	Noise level at noise sensitive reciever		20	14	13	5	-4	0	1	4	10

Paint / Fabrication during the day with door closed											
			63	125	250	500	1000	2000	4000	8000	dBA
L_1	Fabrication Workshop Internal Noise Level (day)		63	57	61	60	56	60	62	64	68
$+10\log_{10}S_p$	Area of Partition (Door + Walls)	108 m ²	20	20	20	20	20	20	20	20	
	Kingspan AWP/60+F SRI	88 m ²	12	19	32	42	50	52	60	60	
$-R_C$	Roller shutter doors SRI	20 m ²	6	3	8	14	20	20	20	20	
	Combined SRI		-10	-10	-15	-21	-27	-27	-27	-27	
$-20\log_{10}r$	Distance to Receiver	42 m	-32	-32	-32	-32	-32	-32	-32	-32	
-14	Hemispherical spreading	Q= 2	-8	-8	-8	-8	-8	-8	-8	-8	
	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Correction for Acoustic Character		5	5	5	5	5	5	5	5	
	Barrier Calculation	2 m high	0	0	0	0	0	0	0	0	
L_2	Noise level at noise sensitive reciever		32	26	25	17	8	12	13	16	22

Paint / Fabrication transmission loss through Wall											
		63	125	250	500	1000	2000	4000	8000	dBA	
L_1	Fabrication Workshop Internal Noise Level (Day)										
		63	57	61	60	56	60	62	64	68	
$+10\log_{10}S_p$	Area of side wall	593 m ²	28	28	28	28	28	28	28		
	Brick Wall	593 m ²	30	43	36	41	49	54	55	55	
$-R_C$	No opening		0	0	0	0	0	0	0	0	
	Combined SRI		-30	-43	-36	-41	-49	-54	-55	-55	
$-20\log_{10}r$	Distance to Receiver	36 m	-31	-31	-31	-31	-31	-31	-31	-31	
-14	Hemispherical spreading	Q= 4	-5	-5	-5	-5	-5	-5	-5	-5	
	Reverberant room to outdoors		-6	-6	-6	-6	-6	-6	-6	-6	
	Correction for Acoustic Character		5	5	5	5	5	5	5	5	
	Barrier Calculation	2 m high	0	0	0	0	0	0	0	0	
L_2	Noise level at noise sensitive reciever										
		23	5	16	9	-2	-3	-3	0	11	

Combined contribution due to loss through wall and roof 28.4

Daytime: 07:00 - 23:00

	38 ton lorry arriving and reversing	Fork-lift use	Combined Impact
Sound Exposure Level, dB(A)	97	67	
Duration of measurement, seconds	124		
Measurement distance, m	3	1	
Distance loss to receiver @ 40 m, dB	24	32	
No. events	1		
Duration of use, seconds	-	900	
Screening, dB	10	10	
60 min Leq @ 40 m, dB(A)	27	19	28

Night time 23:00-07:00

	17 ton lorry arrival and reversing	Fork-lift use	Combined Impact
Sound Exposure Level, dB(A)	85	67	
Duration of measurement, seconds	30		
Measurement distance, m	3	1	
Distance loss to receiver @ 40 m, dB	24	32	
No. events	1		
Duration of use, seconds	-	300	
Screening, dB	10	10	
5 min Leq @ 40 m, dB(A)	26	25	29

Daytime Levels

No mitigation												
Distance to source		35 m										
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 k	2.0 k	4.0 k	8.0 k	dB(A)	
forklift		67	71	73	65	63	61	60	56	49	67	
Measurement distance		3 m	-21	-21	-21	-21	-21	-21	-21	-21		
Barrier			-5	-5	-5	-5	-5	-5	-5	-5		
assesment period		60 mins	-3	-3	-3	-3	-3	-3	-3	-3		
operating period		30 mins										
character correction			5	5	5	5	5	5	5	5		
			43	46	49	41	38	37	36	32	25	43
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 k	2.0 k	4.0 k	8.0 k	dB(A)	
Large articulated truck			78	72	80	79	72	70	73	68	57	78
number of events		2										
Measurement distance		1 m	-31	-31	-31	-31	-31	-31	-31	-31	-31	
Barrier			-5	-5	-5	-5	-5	-5	-5	-5	-5	
assesment period		60 mins	-10	-10	-10	-10	-10	-10	-10	-10	-10	
operating period		3 mins										
character correction			5	5	5	5	5	5	5	5	5	
			38	31	39	38	31	29	32	27	16	37
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 k	2.0 k	4.0 k	8.0 k		
18 ton truck arriving			86	78	73	72	73	73	71	67	60	77
number of events		4										
Measurement distance		1 m	-31	-31	-31	-31	-31	-31	-31	-31	-31	
Barrier			-5	-5	-5	-5	-5	-5	-5	-5	-5	
assesment period		60 mins	-7	-7	-7	-7	-7	-7	-7	-7	-7	
operating period		3 mins										
character correction			5	5	5	5	5	5	5	5	5	
			48	40	35	34	35	35	33	29	22	39
Combined Sound Pressure Level											45	

Night - Time vehicle movements for distribution centre

No mitigation											
Distance to source		35 m									
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 k	2.0 k	4.0 k	8.0 k	dB(A)
forklift		67	71	73	65	63	61	60	56	49	67
Measurement distance	3 m	-21	-21	-21	-21	-21	-21	-21	-21	-21	
Barrier		-5	-5	-5	-5	-5	-5	-5	-5	-5	
assesment period	5 mins	0	0	0	0	0	0	0	0	0	
operating period	5 mins										
character correction		5	5	5	5	5	5	5	5	5	
		46	49	52	44	41	40	39	35	28	46
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 k	2.0 k	4.0 k	8.0 k	dB(A)
articulated truck arriving		78	72	80	79	72	70	73	68	57	78
Measurement distance	1 m	-31	-31	-31	-31	-31	-31	-31	-31	-31	
Barrier		-5	-5	-5	-5	-5	-5	-5	-5	-5	
assesment period	5 mins	-2	-2	-2	-2	-2	-2	-2	-2	-2	
operating period	3 mins										
character correction		5	5	5	5	5	5	5	5	5	
		45	39	47	46	39	37	40	35	24	45
Combined Sound Pressure Level										48.5	

APPENDIX B

Noise Emissions Predictions - Demolition

Equipment	Noise Level, dB(A) @	m	Data Source	No. in concurrent use	Distance to receptor, m	Noise Level dB(A)	Mitigation		Mitigated Noise Level, dB(A)
							"On" time	Screening, dB	
Lorry movements	77	1	BS5228	2	35	49	10%	0	39
Handheld pneumatic breaker	83	10		1		72	25%	0	66
Dump truck (tipping fill)	79	10		1		68	10%	0	58
Tracked excavator (15t)	73	10		2		65	50%	0	62
Total						74	Total		68

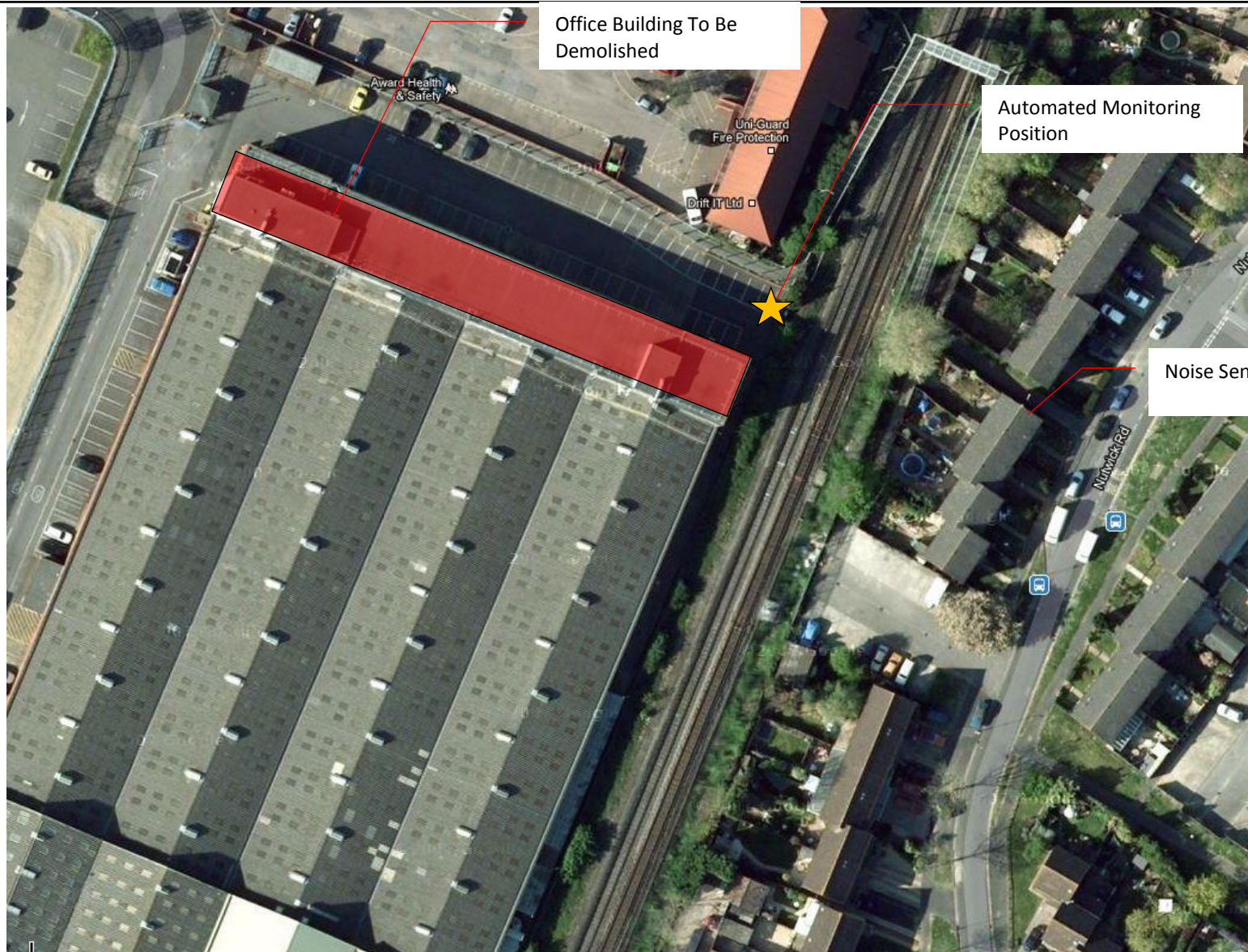
Noise Emissions Predictions - Construction

Equipment	Noise Level, dB(A) @	m	Data Source	No. in concurrent use	Distance to receptor, m	Noise Level dB(A)	Mitigation "On" time	Screening, dB	Mitigated Noise Level, dB(A)
Angle Grinder	80	10	BS5228	2	35	72	25%	0	66
Concrete pump	78	10		1		67	25%	0	61
Lorry movements	77	10		1		66	50%	0	63
Dump truck (tipping fill)	79	10		1		68	20%	0	61
Tracked excavator (15t)	73	10		1		62	50%	0	59
Tower crane (assumed <20m height)	77	10		1	35	66	25%	0	60
Total						76	Total		70

APPENDIX C

Noise Emissions Predictions - Construction

Equipment	Noise Level, dB(A) @	m	Data Source	No. in concurrent use	Distance to receptor, m	Noise Level dB(A)	Mitigation		Mitigated Noise Level, dB(A)
							"On" time	Screening, dB	
Angle Grinder	80	10	BS5228	2	35	72	25%	0	66
Concrete pump	78	10		1		67	25%	0	61
Lorry movements	77	10		1		66	50%	0	63
Dump truck (tipping fill)	79	10		1		68	20%	0	61
		10		1					
Tracked excavator (15t)	73	10		1	35	#REF!	25%	0	#REF!
Total						#REF!	Total		#REF!



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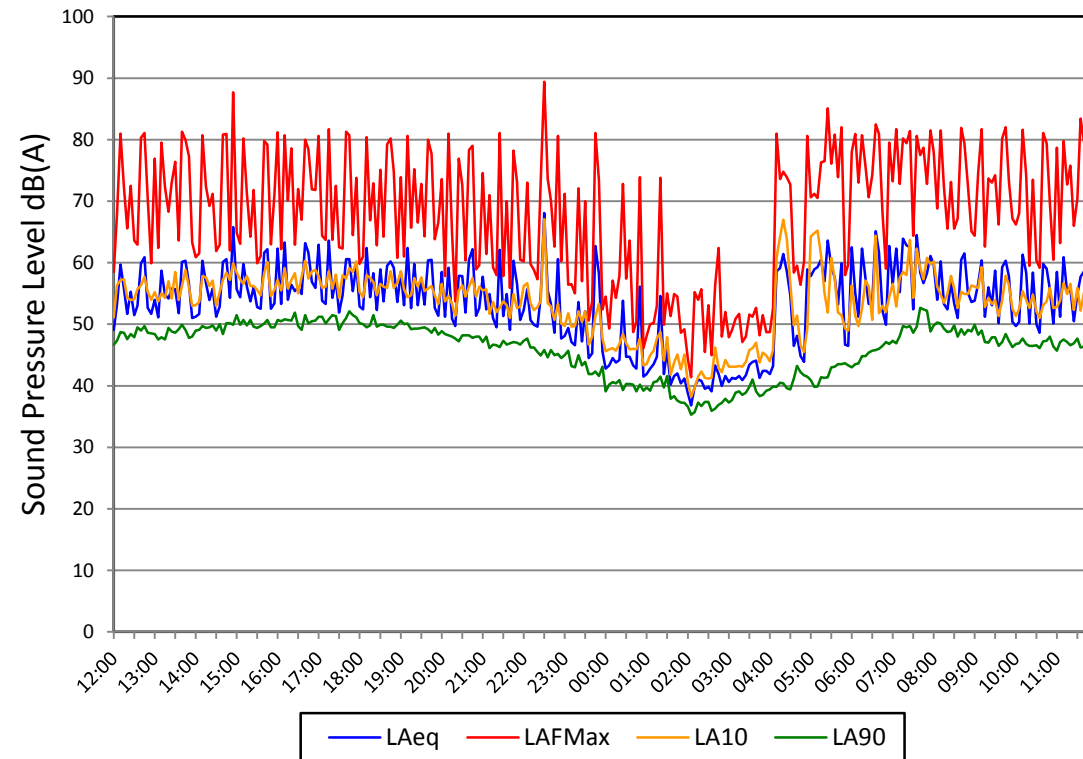
Title:
Indicative Site Plan

Figure:
AS7427.SP1

Date:
13 May 2013

Stanbridge Road, Havant

Environmental Noise Time History

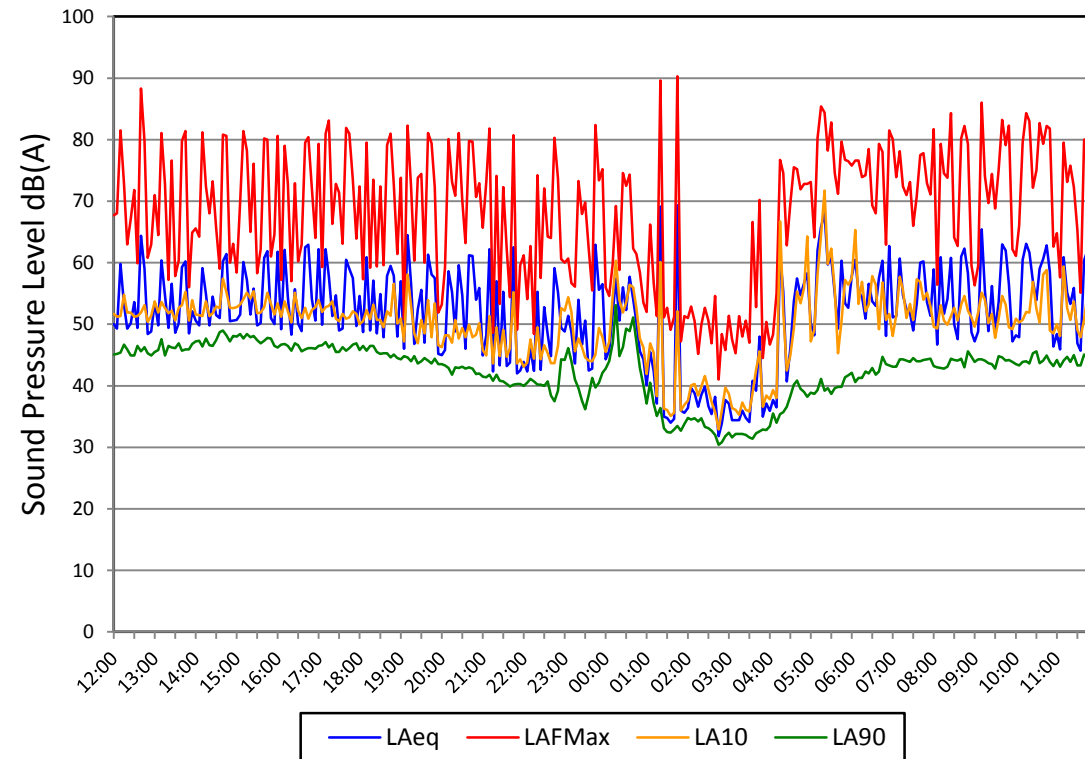


Thursday 09 May to Friday 10 May 2013

Figure AS7427/TH1

Stanbridge Road, Havant

Environmental Noise Time History

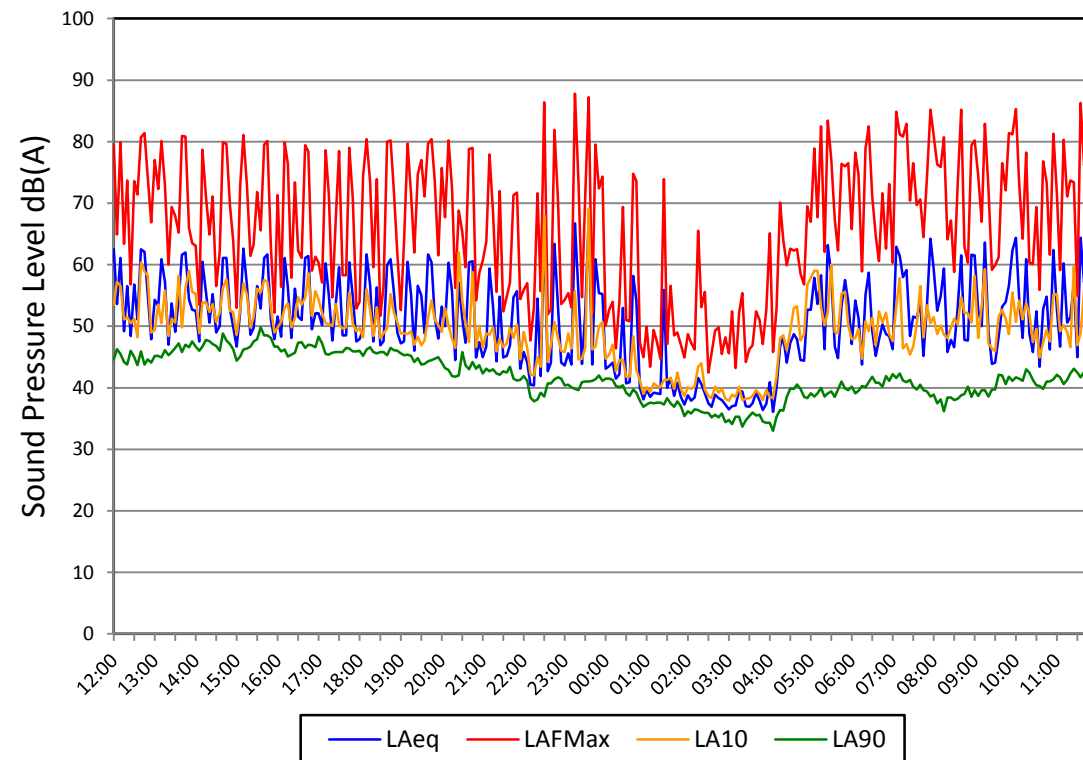


Friday 10 May to Saturday 11 May 2013

Figure AS7427/TH2

Stanbridge Road, Havant

Environmental Noise Time History

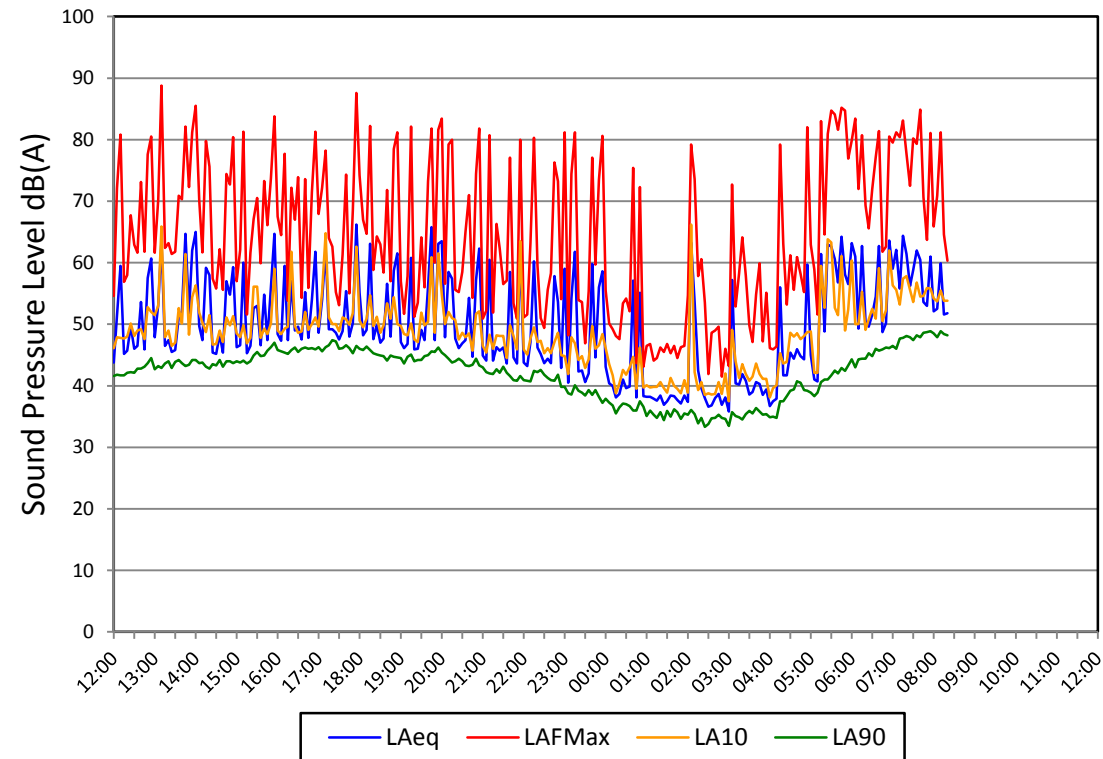


Saturday 11 May to Sunday 12 May 2013

Figure AS7427/TH3

Stanbridge Road, Havant

Environmental Noise Time History

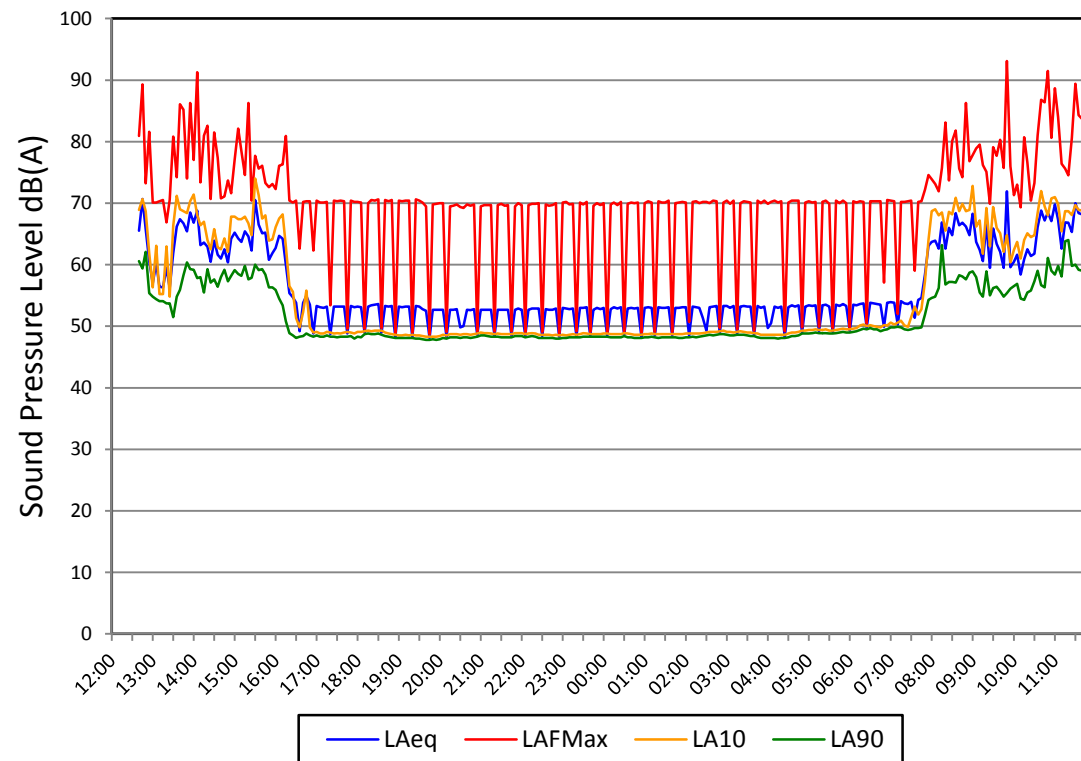


Sunday 12 May to Monday 13 May 2013

Figure AS7427/TH4

Rimor: Fabrication Workshop

Environmental Noise Time History

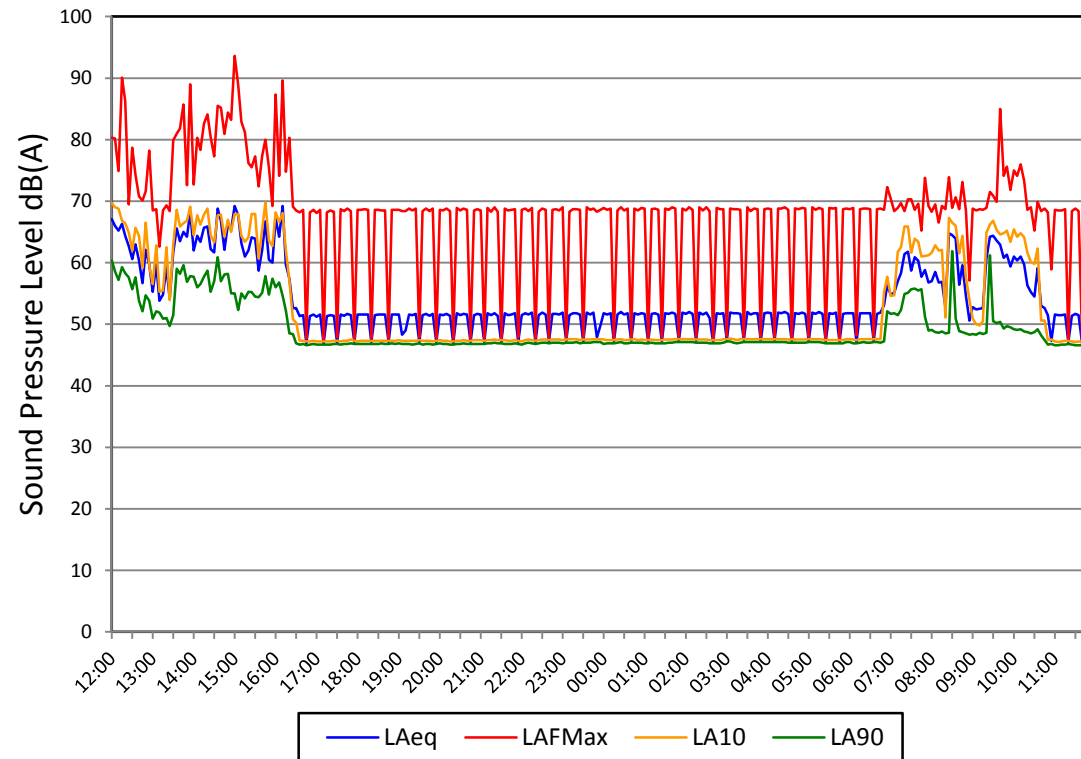


Thursday 25 April to Friday 26 April 2013

Figure AS7427/TH5

Rimor: Fabrication Workshop

Environmental Noise Time History

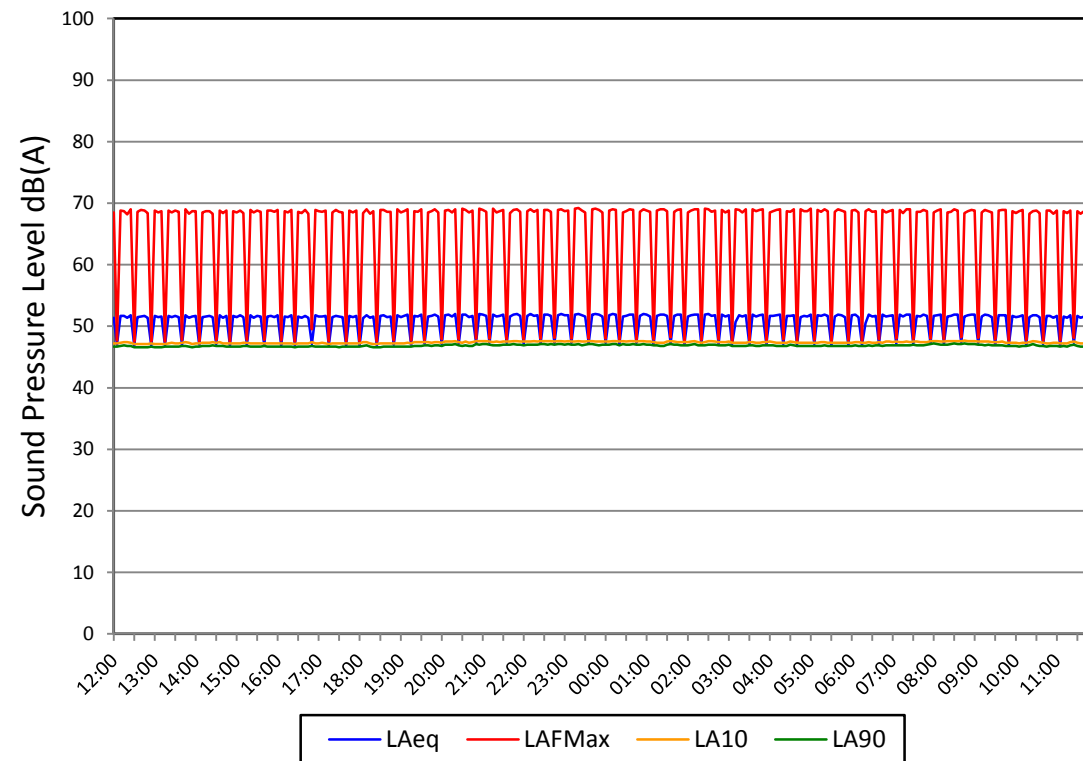


Friday 26 April to Saturday 27 April 2013

Figure AS7427/TH6

Rimor: Fabrication Workshop

Environmental Noise Time History

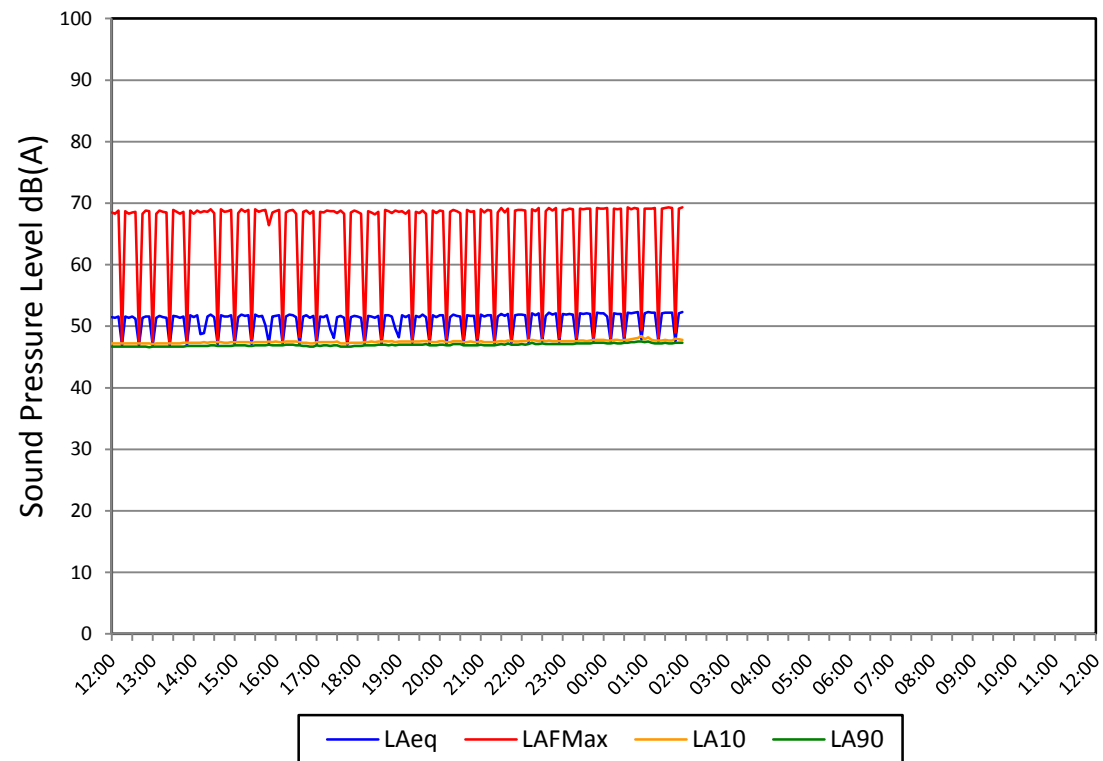


Saturday 27 April to Sunday 28 April 2013

Figure AS7427/TH7

Rimor: Fabrication Workshop

Environmental Noise Time History

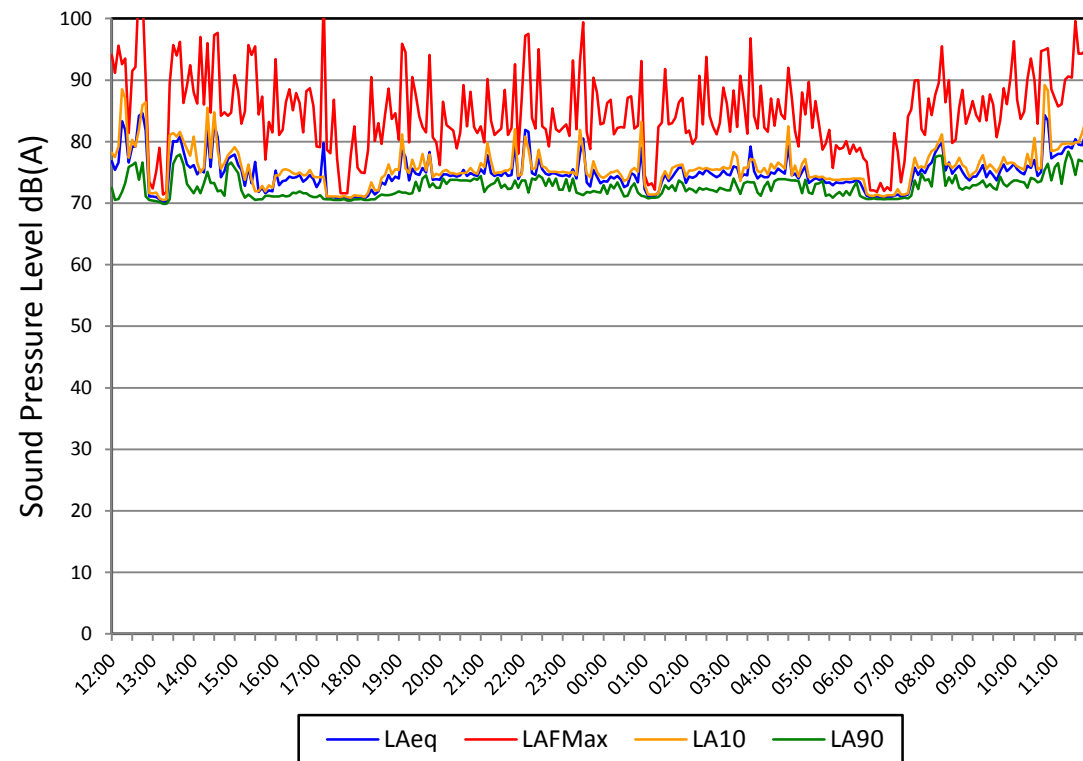


Sunday 28 April to Monday 29 April 2013

Figure AS7427/TH8

Rimor:CNC workshop

Environmental Noise Time History

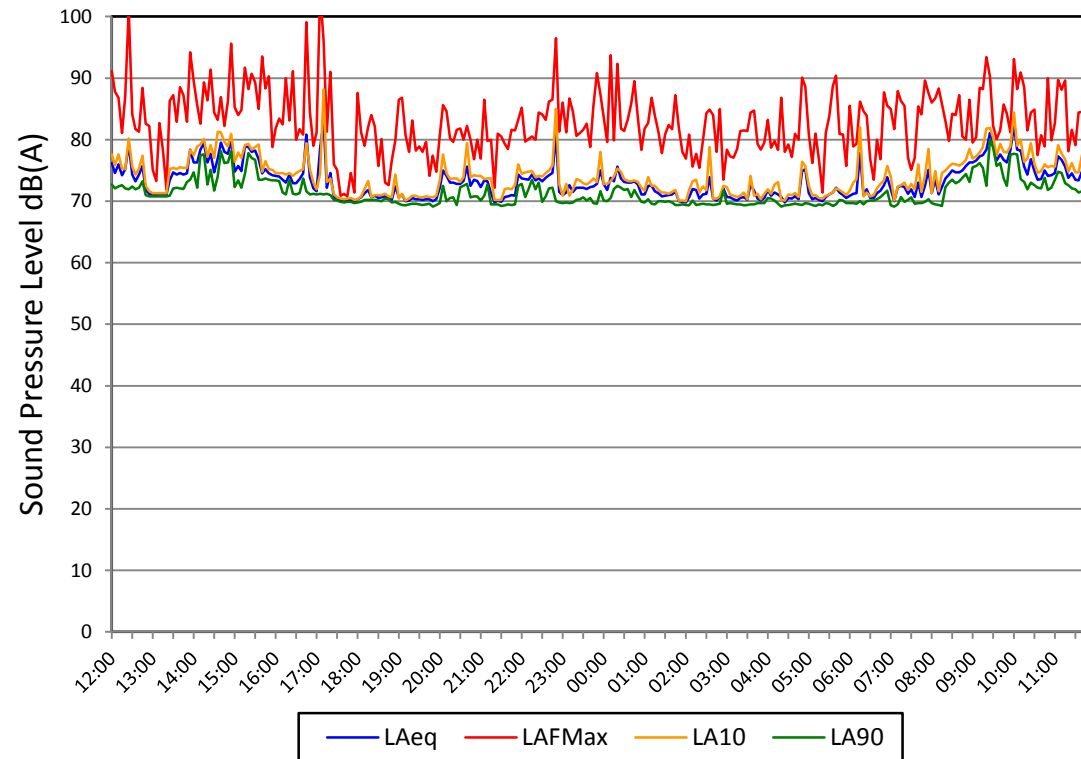


Thursday 25 April to Friday 26 April 2013

Figure AS7427/TH9

Rimor:CNC workshop

Environmental Noise Time History

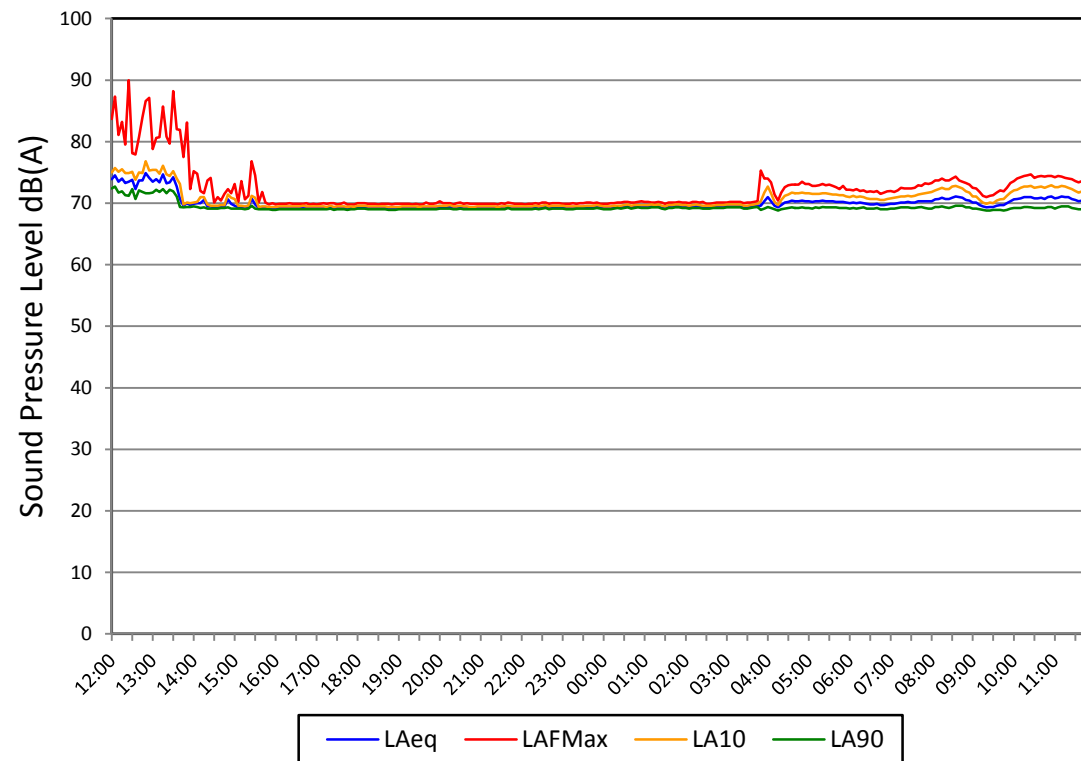


Friday 26 April to Saturday 27 April 2013

Figure AS7427/TH10

Rimor:CNC workshop

Environmental Noise Time History

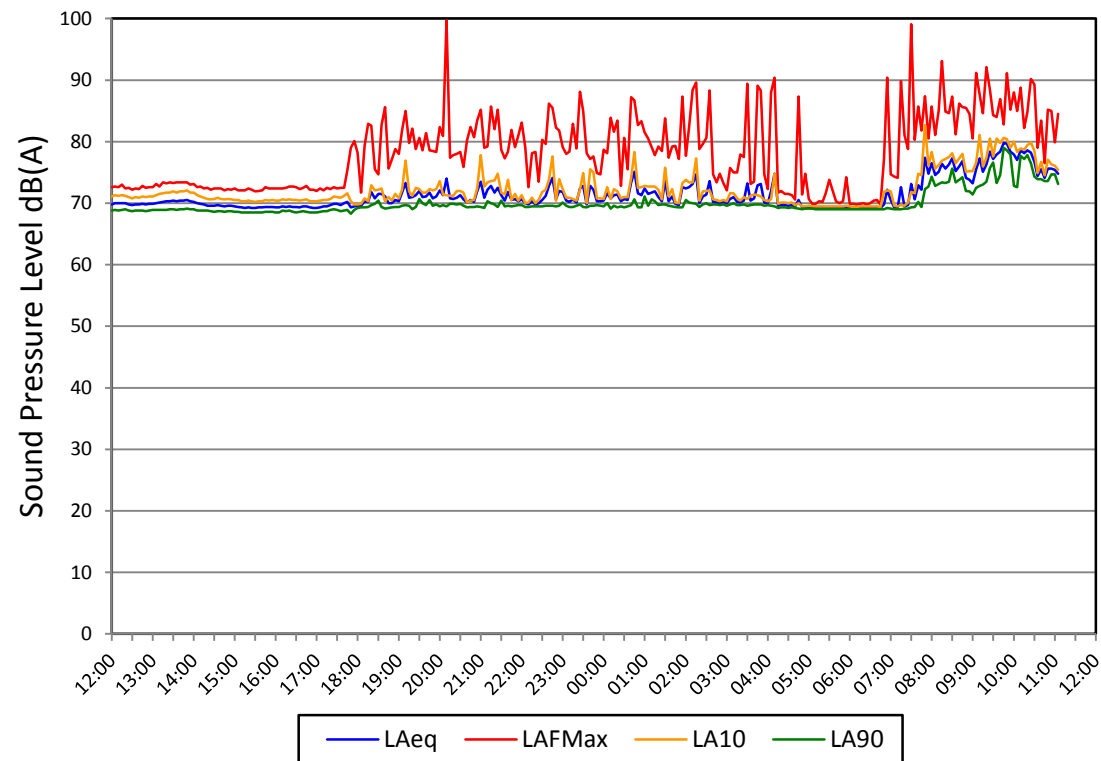


Saturday 27 April to Sunday 28 April 2013

Figure AS7427/TH11

Rimor:CNC workshop

Environmental Noise Time History



Sunday 28 April to Monday 29 April 2013

Figure AS7427/TH12