Acoustic Consultancy Report

56976/3/1/4
External Plant Assessment 1

Report Prepared For

Iceland Foods Ltd 161802
Iceland Foods Swiss Cottage
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Contents

i) Executive Summary

New mechanical plant is to be installed at the Iceland Food store development, in Swiss Cottage.

LCP has been commissioned by Iceland Foods to carry out a background noise survey and to use the obtained data to assess the noise impact of the plant installation on surrounding noise sensitive receptors.

The lowest background noise level measured was 34 dB $L_{A90,\ 15\ mins}$.

The calculated noise level at the nearest residential receiver is 29 dB L_{Aeq}.

The report concludes that the local authority criteria will be met.

ii) Document History

Issue	Date	Issue Details	Issued By
1	13th April 2012	Initial Issue	MB
2	18th May 2012	50% night time reduction included	MB

1 Introduction

New mechanical plant is to be installed at the Iceland Food store development, in Swiss Cottage.

LCP has been commissioned by Iceland Foods to carry out a background noise survey and to use the obtained data to assess the noise impact of the plant installation on surrounding noise sensitive receptors.

The guidance in this report is on the basis that the mechanical plant will be consistently operating over a 24 hour period.

2 Site Description

The site layout together with the measurement position is shown in the drawing contained within Appendix A.

3 Local Noise Climate

The predominant local noise sources were vehicular traffic on Finchley Road and Fairfax Road and regular night buses stopping at the bus stop on Fairfax Road.

4 Measurements

The noise monitoring took place from 12th April 2012. The measurement period was considered sufficient to establish the lowest background noise levels corresponding to the operational period of the plant.

The weather conditions during the survey were predominantly calm and dry.

5 Results

The measured statistical broad-band sound pressure levels are shown within Appendix B. The lowest representative background noise level(s) obtained being as follows:

Table 1: Lowest measured background noise levels, dB re 2×10^{-5} Pa

Measurement Position	$L_{A90,\ 15\ mins}$ Night*
MP1	34

* Day and Night periods are defined in BS4142:1997 as between 07:00 and 23:00, and 23:00 and 07:00 respectively.

6 Evaluation of Design Criteria

6.1 Residential Design Criterion

6.1.1 BS4142:1997

BS4142:1997 states that the 'likelihood of complaints' are to be assessed by subtracting the measured background noise level from the calculated rating level. The following table demonstrates the resultant assessments based upon the calculated rating level.

Table 2: BS4142 assessment based upon rating level

Difference between background noise and rating levels	Assessment
+ 10 dB	Complaints are likely
+ 5 dB	Marginal significance
- 10 dB	Complaints are unlikely

In acoustic terms, a calculated rating level 10 dB below the measured background noise level means that the measured background noise level is not increased.

The table below relates the above BS4142 assessment levels against the lowest night time noise levels measured on the survey.

Table 3: Night time BS4142 assessment based upon rating level, dB re $2x10^{-5}$ Pa

Lowest measured background	BS4142 Level	Assessment
34	44	Complaints are likely
	39	Marginal significance
	24	Complaints are unlikely

An explanation of the effects of changes in the difference between the rating level and the background noise level can be found in the glossary in Appendix E. The corresponding subjective change in loudness is described.

BS4142:1997 also states that background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low.

6.1.2 World Health Organisation Night Noise Guidelines for Europe (2009)

The WHO's document 'Night Noise Guidelines for Europe (NNG) states the following:

"*…it is recommended that the population should not be exposed to night noise levels greater than 40 dB of $L_{night,\ outside}$ during the part of the night when most people are in bed*."

It then goes on to say:

"*An interim target (IT) if 55 dB $L_{night, outside}$ is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons*."

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

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:

Table 4: Guideline values for community noise, from Guidelines for Community Noise (WHO, 1999)

Specific Environment	$L_{Aeq, T}$ dB	Time Base (hours)	L_{Amax}, fast dB
Outdoor living area (serious annoyance, daytime and evening)	55	16	-
Outdoor living area (moderate annoyance, daytime and evening)	50	16	-
Dwelling, indoors	35	16	-
Inside bedrooms	30	8	45
Outside bedrooms	45	8	60

6.1.4 BS8233:1999

The criteria offered in BS8233 for residential buildings are largely based on the recommendations made in the Guidelines for Community Noise. BS8233 gives internal criteria for bedrooms and living rooms for both 'reasonable' and 'good' resting/sleeping conditions. BS8233 also gives general guidance on the expected sound insulation performance of a given building façade, with details of how various elements can affect the overall performance. Concerning windows, it states that:

"…*if windows are intended to be opened to provide rapid ventilation and summer cooling, the insulation will reduce to about 10 dB or 15 dB*…"

This infers that should windows on a noise affected façade be openable, a sound insulation value of 10-15 dB should be applied to the whole façade to an internal room being assessed. On this basis, the criteria shown in the table below have been adapted from the criteria offered in table 5 of BS8233 in order to obtain acceptable external noise levels.

Table 5: BS8233 criteria, dB re $2x10^{-5}$ Pa

External Facade	Design Range $L_{Aeq, T}$		L_{Amax}*
	Good	Reasonable	
Living Rooms	40	50	n/a
Bedrooms	40	45	55

* Fast time weighting

In addition to the above criteria, BS8233 goes on to say:

"*In gardens and balconies etc it is desirable that the steady noise level does not exceed 50 $L_{Aeq,\,T}$ dB and 55 dB $L_{Aeq,\,T}$ dB should be regarded as the upper limit*."

The above criteria are in line with the recommendations made in WHO's 'Guidelines for Community Noise'.

6.1.5 Local Authority Requirements

The Local Authority Conditions state that the noise level from any fixed mechanical plant/activity shall not exceed 5 dB below the lowest measured background noise level.

6.1.6 Recommended Rating Level

On the basis of the above the recommended rating level shall therefore be:

Design Rating Level
Existing lowest $L_{A90,\,15\,mins}$ - 5 dB

7 Review of Plant Installation

Calculations of the predicted noise levels have been carried out with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces, multiple source addition and any noise mitigation measures detailed in section 8.

The design rating levels to be adopted for this project, together with the predicted noise levels, are set out in the table below.

Table 6: Predicted and design noise levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level Night $L_{Aeq,\,8\,hr}$	Predicted Level Night $L_{Aeq,\,8\,hr}$
Residential on Naseby Close	16	29	29

Plant noise level data used in this assessment are contained within Appendix C.

Calculations are shown within Appendix D.

8 Noise Mitigation

The calculations have been carried out with the following attenuator insertion losses on the atmosphere side of the fans:

Table 7: Attenuator selections

Plant	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Return Air	5	6	14	28	28	18	13	9
Fresh Air Intake	7	13	23	43	46	33	23	18
Exhaust	6	9	16	32	46	32	21	16

In addition to the attenuators shown above, the Searle units and compressor unit in the basement area will run at 50% operation during the night time period reducing their noise levels by 3dB.

9 Conclusion

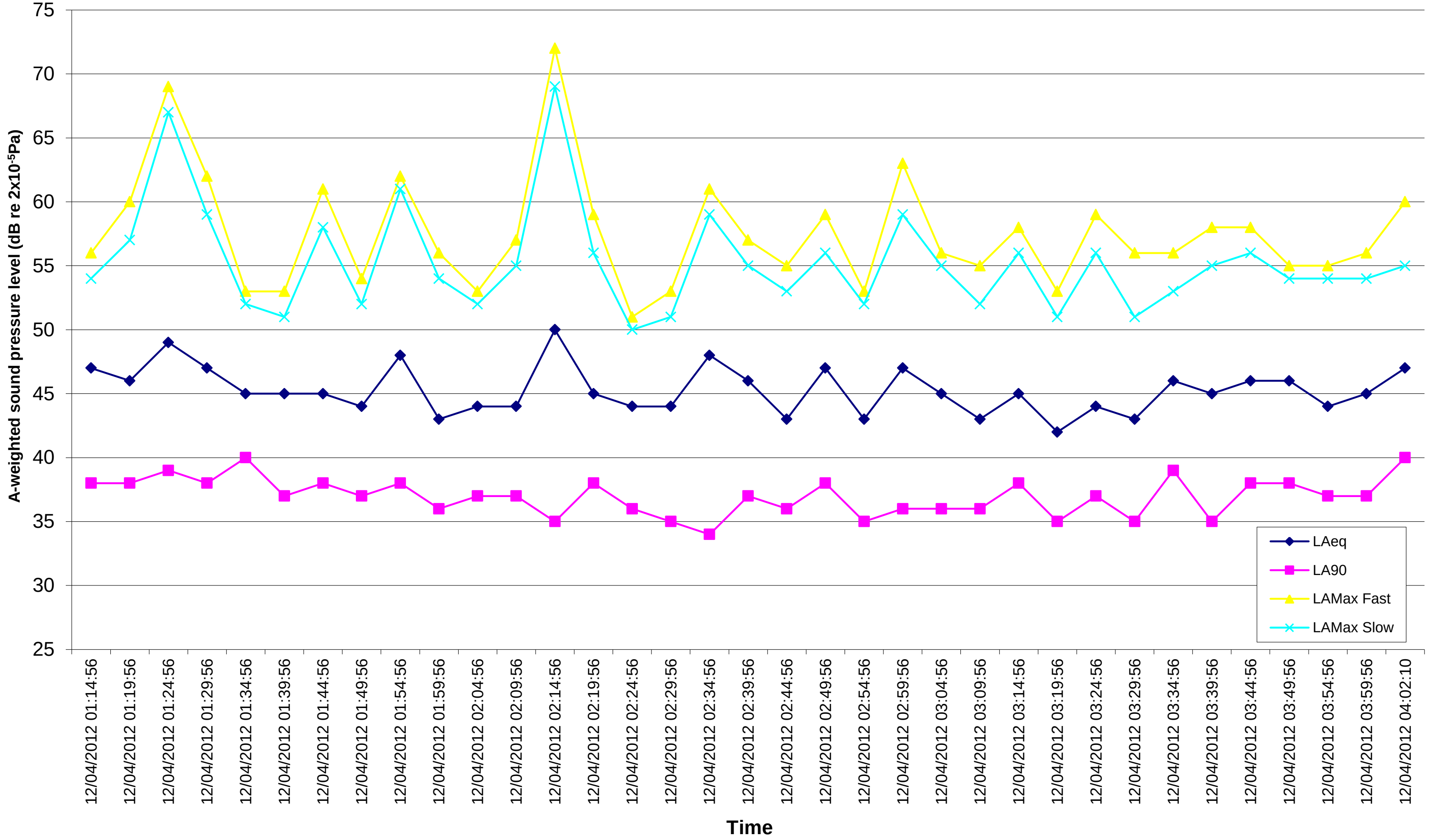
An environmental noise survey has been undertaken in order to establish the existing background noise levels local to the site generally in accordance with the method contained within BS4142: 1997.

Calculations have been carried out to determine the noise levels at the nearest receiver premises.

The calculated noise level at the nearest residential receiver is 29 dB L_{Aeq} and therefore meets the local authority criteria.

Appendix A: Site Plan

Appendix B: Measurement Data



Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11261
- Svantek pre-amplifier SV12L S/N: 11467 with B&K microphone capsule S/N: 2353026

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890 complying with Class 1 specification of BS EN 60942:2003, calibration level 94.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Plant Data

Plant noise data used in the preceding assessment follow.

Table 8: Manufacturers Plant sound data, dB re $2x10^{-5}$ Pa

Plant	Data Type	Octave Band Centre Frequency (Hz)								L_A
		63	125	250	500	1k	2k	4k	8k	
Searle	Lp at 10m	30	40	37	41	28	22	14	4	39
Milk Chiller	Lp at 10m	40	44	36	31	25	19	14	9	34
Compressor night (50% operation)	Lp at 10m	41	35	37	37	35	30	20	31	39
Exhaust fan	Fan Lw	78	81	76	76	73	70	66	61	78
Return Air Fan	Fan Lw	73	78	73	70	73	72	65	56	77
Fresh Air Intake Fan	Fan Lw	85	88	85	79	79	77	74	69	84

Appendix D: Calculations

Fresh Air intake		63	125	250	500	1k	2k	4k	8k	dB(A)
Fan Lw		85	88	85	79	79	77	74	69	84
Attenuator		7	13	23	43	46	33	23	18	
Duct loss		-5	-3	-1	-1	-1	-1	-1	-1	
End Ref.		-2	0	0	0	0	0	0	0	
Lw		71	72	61	35	32	43	50	50	59
Shortest side (m)	0.80	0.25								
Longest side (m)	3.00	0.95								
Distance (m)	27.00	27.00								
Q	2	3	3	3	3	3	3	3	3	
Position		Grille flush with surface								
Source Type		Far Field Plane Source								
Distance Attenuation		-35	-35	-35	-35	-35	-35	-35	-35	
Geometric Attenuation		-4	-4	-4	-4	-4	-4	-4	-4	
Angular Directionality	90	-2	-3	-5	-8	-10	-11	-11	-11	
Atmosphere Attenuation		-38	-39	-41	-44	-46	-47	-47	-47	
Façade correction	3	3	3	3	3	3	3	3	3	
Receiver Lp		36	37	23	-5	-10	0	7	7	**22**
Criteria (NR)	24	54	43	34	28	24	21	19	17	34
Excess		-18	-6	-11	-34	-34	-21	-12	-10	-12

Return Air		63	125	250	500	1k	2k	4k	8k	dB(A)
Fan Lw		73	78	73	70	73	72	65	56	77
Attenuator		5	6	14	28	28	18	13	9	
Duct loss		-8	-4	-2	-1	-1	-1	-1	-1	
End Ref.		-2	0	0	0	0	0	0	0	
Lw		58	68	57	41	44	53	51	46	59
Shortest side (m)	0.80	0.25								
Longest side (m)	2.50	0.80								
Distance (m)	22.00	22.00								
Q	2	3	3	3	3	3	3	3	3	
Position		Grille flush with surface								
Source Type		Far Field Plane Source								
Distance Attenuation		-34	-34	-34	-34	-34	-34	-34	-34	
Geometric Attenuation		-3	-3	-3	-3	-3	-3	-3	-3	
Angular Directionality	90	-2	-3	-5	-8	-10	-11	-11	-11	
Atmosphere Attenuation		-36	-37	-39	-42	-44	-45	-45	-45	
Façade correction	3	3	3	3	3	3	3	3	3	
Receiver Lp		25	34	21	2	3	11	9	4	**21**
Criteria (NR)	24	54	43	34	28	24	21	19	17	34
Excess		-29	-9	-13	-26	-21	-9	-9	-12	-13

Exhaust		63	125	250	500	1k	2k	4k	8k	dB(A)
Fan Lw		78	81	76	76	73	70	66	61	78
Attenuator		6	9	16	32	46	32	21	16	
Duct loss		-3	-3	-1	-1	-1	-1	-1	-1	
End Ref.		-7	-3	-1	0	0	0	0	0	
Lw		62	66	58	43	26	37	44	44	54
Shortest side (m)	0.60	0.19								
Longest side (m)	0.60	0.19								
Distance (m)	24.00	24.00								
Q	2	3	3	3	3	3	3	3	3	
Position		Grille flush with surface								
Source Type		Far Field Point Source								
Distance Attenuation		-28	-28	-28	-28	-28	-28	-28	-28	
Geometric Attenuation		-11	-11	-11	-11	-11	-11	-11	-11	
Angular Directionality	90	-2	-3	-5	-8	-10	-11	-11	-11	
Atmosphere Attenuation		-38	-39	-41	-44	-46	-47	-47	-47	
Façade correction	3	3	3	3	3	3	3	3	3	
Receiver Lp		27	31	20	3	-16	-6	1	1	**17**
Criteria (NR)	24	54	43	34	28	24	21	19	17	34
Excess		-27	-12	-14	-25	-40	-27	-18	-16	-17

Basemennt		63	125	250	500	1k	2k	4k	8k	dB(A)
Combined Night Lw		72	74	69	71	64	59	50	59	71
Minimum Barrier loss		-5	-5	-5	-5	-5	-5	-5	-5	
Lw		67	69	64	66	59	54	45	54	66
Shortest side (m)	2.00	0.64								
Longest side (m)	2.00	0.64								
Distance (m)	32.00	32.00								
Q	4	6	6	6	6	6	6	6	6	
Position		Grille at junction of two surfaces.								
Source Type		Far Field Plane Source								
Distance Attenuation		-34	-34	-34	-34	-34	-34	-34	-34	
Geometric Attenuation		-6	-6	-6	-6	-6	-6	-6	-6	
Angular Directionality	90	-2	-3	-5	-8	-10	-11	-11	-11	
Atmosphere Attenuation		-36	-37	-39	-42	-44	-45	-45	-45	
Façade correction	3	3	3	3	3	3	3	3	3	
Receiver Lp		34	35	28	27	18	12	3	12	**27**
Criteria (NR)	19	51	39	30	23	19	16	13	12	29
Excess		-17	-4	-1	3	-1	-4	-10	0	-2

	63	125	250	500	1k	2k	4k	8k	dB(A)
Fresh Air Intake	36	37	23	-5	-10	0	7	7	22
Return Air	25	34	21	2	3	11	9	4	21
Exhaust	27	31	20	3	-16	-6	1	1	17
Basement	34	35	28	27	18	12	3	12	27
Total	**39**	**41**	**31**	**27**	**19**	**16**	**13**	**15**	**29**

Appendix E: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

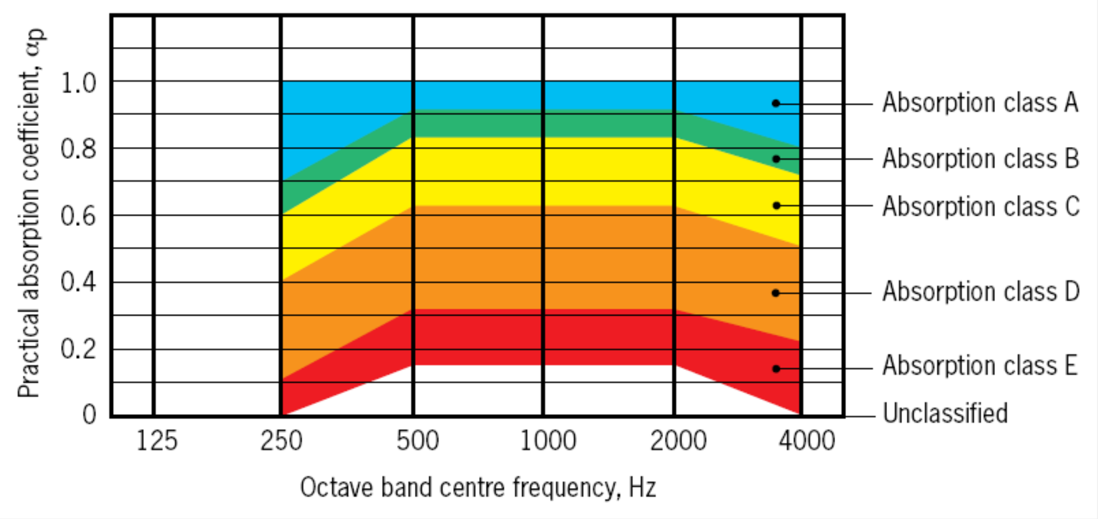
'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

The chart shown below has been extracted from BB93, and demonstrates the characteristics of each class according to BS EN ISO 11654:1997.



Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

Airborne Noise

Noise transmitted through air.

Ambient Noise

The total noise level including all 'normally experienced' noise sources.

dB or Decibel

Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB ≠ 60 dB	30 dB + 30 dB = 33 dB

D_{nTw}+C_{tr}

The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D	Is simply L1 – L2.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.
C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

Impact Noise

Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors. Measured in L'_{nTw}.

Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The ‘A’ weighted noise level exceeded for 90% of the time period T, described or measured. The ‘90’ can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The ‘A’ weighted ‘equivalent’ noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The ‘A’ weighted maximum measured noise level. Can be measured with a ‘slow’ (1 sec) or ‘fast’ (0.125 sec) time weighting.

L_{Amin}

The ‘A’ weighted minimum measured noise level.

L'_{nTw}

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

L	Is the spatially averaged impact sound pressure level measured in a receive room.
L'_{nT}	Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.
L'_{nTw}	Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to $2x10^{-5}$ Pa.

Speech Intelligibility, Speech Transmission Index (STI)

Speech intelligibility is the measure of how well a speaker’s voice can be heard within a given space. Speech intelligibility within a room depends on a number of factors, including reverberation time and background noise.

The Speech Transmission Index or STI has emerged as the favoured method of describing speech intelligibility.

Subjective Effect of Changes in Sound Pressure Level

A basic example to illustrate the assessment of difference in noise levels follows.

A background noise survey is undertaken that yields a lowest background noise level of L_{A90} 30 dB.

As the existing background noise level is low, a rating level for new plant noise of $L_{Aeq, T}$ 30 dB is set.

After calculation, the plant noise is predicted to achieve $L_{Aeq,T}$ 30 dB at the nearest residential property.

After the addition of the plant predicted noise level (or Rating Level), the new overall ambient noise level will be 33 dB. The background noise level measured originally will therefore be increased by 3 dB. In terms of the subjective impression of an increase of this order, the change in levels will be 'just perceptible'.

The table below details the subjective effects of variations in sound pressures (adapted from Bies and Hansen).

Difference between background noise and rating levels	Increase in ambient noise level in 'real terms'	Change in apparent loudness
+ 10 dB	+ 10 dB	Twice as loud
+ 5 dB	+ 6 dB	Clearly noticeable
0 dB	+ 3 dB	Just perceptible
-10 dB	0 dB	No change

W

Watts, the SI unit to describe power, after engineer James Watt.