Lee Cunningham Partnership

Acoustic Consultancy Report

70254/3/1/2

External Plant Assessment

Report Prepared For

Iceland Foods Ltd 161802
Iceland Hinckley
17 December 2014

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i) Executive Summary

New mechanical plant is to be installed at the Iceland Food store development on Rugby Road, Hinckley.

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 37 dB $L_{A90,\ 5\ mins}$.

The recommended residential design criterion is as follows:

35 dB $L_{Aeq,\ T}$ at the nearest residential Regent House on Rugby Road approximately 32m away.

The design as proposed and assessed including the mitigation in table 9 will achieve the required criteria, the report concludes that:

The calculations yield a BS4142 assessment between 'complaints are unlikely' and 'marginal significance'.

The calculated levels are acceptable according to BS8233 and WHO Guidelines for Community Noise.

ii) Document History

Issue	Date	Issue Details	Issued By
1	17th December 2014	Initial Issue	JN

1 Introduction

New mechanical plant is to be installed at the Iceland Food store development on Rugby Road, Hinckley.

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 report details recommendations for necessary noise mitigation where necessary.

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 surrounding roads.

4 Measurements

The noise monitoring took place from 16th December 2014. 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 $2x10^{-5}$ Pa

Measurement Position	$L_{A90,\ 5\ mins}$ Night*
MP1	37

* 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
37	47	Complaints are likely
	42	Marginal significance
	27	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.

Therefore a rating level of 35 dB is recommended. This will also ensure compliance with BS 8233 and World Health Organisation Guidelines.

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
Outdoors in parkland and conservation areas*	-	-	-

* Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

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.

The noise levels shown should be treated as overall noise levels, i.e., the combination of all existing noise levels at the site, and noise levels from any proposed plant or activity.

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 Recommended Rating Level

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

Table 6: Design rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approx. Distance (m)	Design Level $L_{A,T}$
Regent House on Rugby Road	32	35

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, and multiple source addition.

Calculations include mitigation in the form of attenuators; attenuator and plant noise level data used in this assessment are contained within Appendix C. Calculations are shown within Appendix D.

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

Table 7: Predicted and design noise levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approx. Distance (m)	Design Level $L_{Aeq, 8\ hr}$*	Predicted Level $L_{Aeq, 8\ hr}$
Regent House on Rugby Road	32	35	35

* For the purposes of this assessment, the design period is from 23:00 to 07:00

Calculations are shown within Appendix D.

8 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.

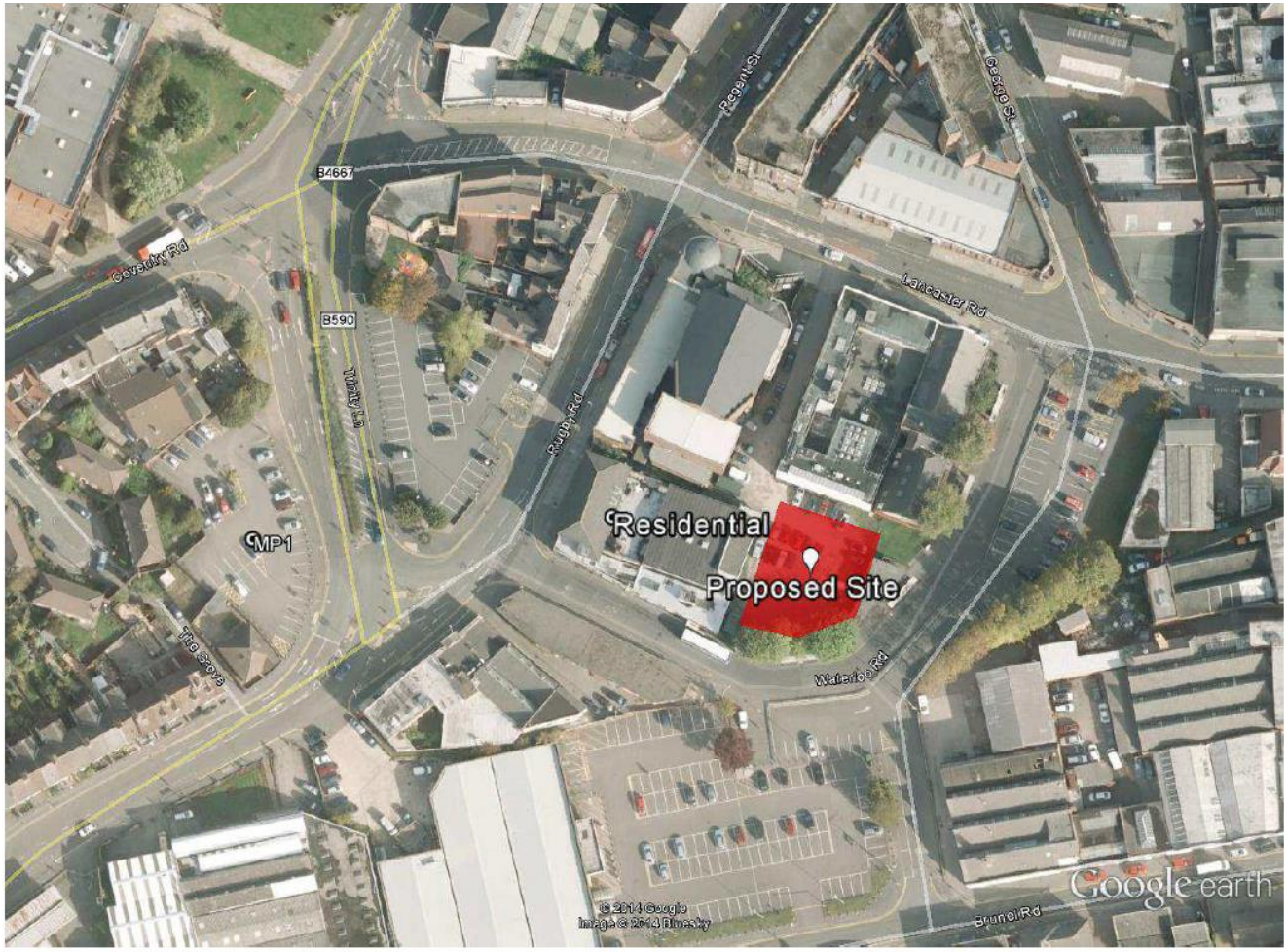
Calculations have been carried out, including the mitigation in table 9, to determine the noise levels at the nearest receiver premises.

The calculations yield a BS4142 assessment of ‘complaints are unlikely’ and ‘marginal significance’.

The calculated levels are acceptable according to BS8233 and WHO Guidelines for Community Noise.

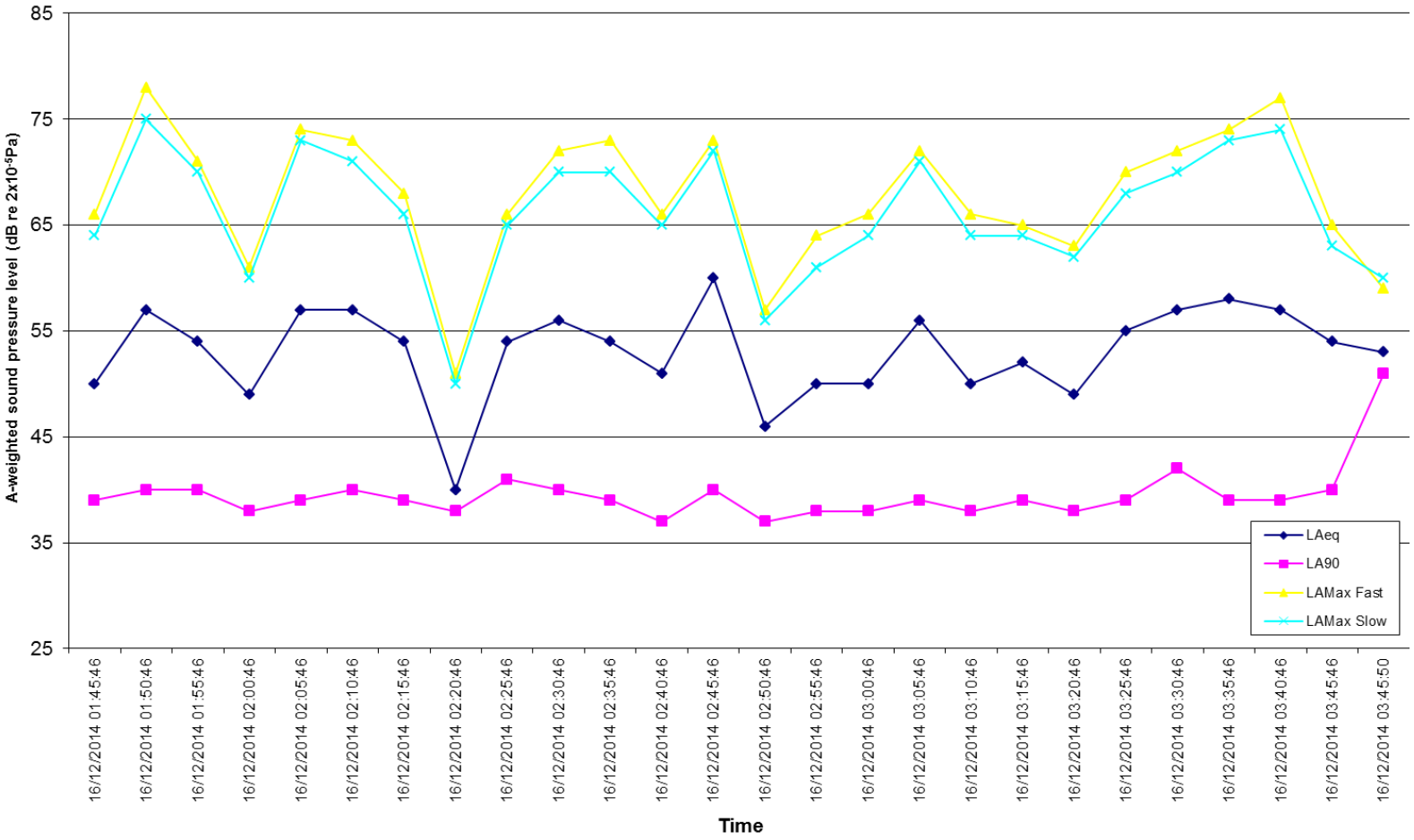
It is therefore recommended that planning permission in respect of the plant installation shall be given.

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: 11205
- Svantek pre-amplifier SV12L S/N: 13245 with GRAS microphone capsule 40AE S/N: 75181

Calibration checks were made prior to and after completion of measurements using a B&K Type 4231 calibrator, S/N: 2343437 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: Plant sound pressure data, dB re $2x10^{-5}$ Pa

Plant	Data Type	Octave Band Centre Frequency (Hz)								L_A
		63	125	250	500	1k	2k	4k	8k	
Weatherite Condenser*	Lp at 10m	44	38	40	40	38	33	23	34	42
Return**	Lp at 1m	67	67	63	66	69	69	61	49	73
Supply**	Lp at 1m	50	52	51	41	41	48	48	43	53
2 x Cold store condensers*	Lp at 10m	33	43	40	44	31	25	17	7	42
Milk Chiller*	Lp at 10m	40	44	36	31	25	19	14	9	34
Mitsubishi PUHZ RP35VVHA*	Lp at 1m	53	50	48	43	41	38	31	31	46
Mitsubishi PUHZRP125*	Lp at 1m	60	54	51	50	46	42	36	39	52
Woods Extract fan*	Fan Lw	83	88	77	71	68	66	58	74	78
Sovereign ISO Extract fan*	Fan Lw	52	52	55	59	67	66	63	59	71

*Manufacturers data. ** The sound pressure levels at 1m have been measured on site at the Iceland store in Kilburn.

Table 9: Atmosphere side in-duct mitigation, dB

Plant	Attenuator dimensions (mm)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Return	900 x 900 x 1500	6	9	18	36	38	25	16	11
Sovereign ISO 200 Extract fan	560 Dia x 1070 Long	3	7	13	24	27	22	19	15

Taken from Caice Acoustic Air Movement Ltd UKAS accredited insertion loss data.

Appendix D: Calculations

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Façade correction	dB	Attenuation 63	125	250	500	1k	2k	4k	8k
1	Weatherite Condenser	10.00	44	38	40	40	38	33	23	34	42	70	33.0	-38	32	1	0	None	0	0	0	0	0	0	0	0	Yes	3								
2	Return	1.00	67	67	63	66	69	69	61	49	73	81	37.0	-39	42	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	Yes	3	6	9	18	36	38	25	16	11
3	Supply	1.00	50	52	51	41	41	48	48	43	53	61	33.0	-38	23	1	0	None	0	0	0	0	0	0	0	0	Yes	3								
4	2 x cold store condensers	10.00	33	43	40	44	31	25	17	7	42	70	32.0	-38	32	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	Yes	3								
5	milk chiller	10.00	40	44	36	31	25	19	14	9	34	62	32.0	-38	23	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	Yes	3								
6	Mitsubishi PUHZ RP35VVHA4	1.00	53	50	48	43	41	38	31	31	46	54	32.0	-38	16	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	Yes	3								
7	Mitsubishi PUHZRP125	1.00	60	54	51	50	46	42	36	39	52	60	32.0	-38	22	2	3	None	0	0	0	0	0	0	0	0	Yes	3								
8	sovereign		83	88	77	71	68	66	58	74	78	78	32.0	-38	40	1	0	None	0	0	0	0	0	0	0	0	Yes	3	3	7	13	24	27	22	19	15
9	woods		52	52	55	59	67	66	63	59	71	71	32.0	-38	33	1	0	None	0	0	0	0	0	0	0	0	Yes	3								

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Weatherite Condenser	36	30	32	32	30	25	15	26	35
2	Return	32	32	28	31	34	34	26	14	39
3	Supply	22	24	23	13	13	20	20	15	26
4	2 x cold store condensers	19	29	26	30	17	11	3	-7	28
5	milk chiller	26	30	22	17	11	5	0	-5	20
6	Mitsubishi PUHZ RP35VVHA4	19	16	14	9	7	4	-3	-3	13
7	Mitsubishi PUHZRP125	35	29	26	25	21	17	11	14	27
8	sovereign	47	52	41	35	32	30	22	38	42
9	woods	16	16	19	23	31	30	27	23	36
	Total	**48**	**53**	**42**	**39**	**38**	**37**	**31**	**39**	**45**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
8.1	9.0	7.6	1.0	32.0	-0.14	-3	0	0	0	0	0	0	0
6.8	9.0	7.6	5.0	32.0	0.03	-5	-5	-6	-7	-8	-10	-12	-15
6.8	9.0	7.6	1.0	32.0	0.24	-7	-8	-10	-12	-15	-18	-21	-24
6.5	9.0	7.6	9.0	23.0	0.01	-5	-5	-5	-6	-6	-8	-9	-12
6.6	9.0	7.6	10.0	22.0	0.00	-5	-5	-5	-5	-5	-6	-7	-9
6.6	9.0	7.6	10.0	22.0	0.00	-5	-5	-5	-5	-5	-6	-7	-9
7.4	9.0	7.6	10.0	22.0	-0.01	-5	-5	-4	-4	-3	-2	0	0
3.0	9.0	8.0	2.0	30.0	2.84	-14	-17	-19	-22	-24	-24	-24	-24
3.0	9.0	8.0	2.0	30.0	2.84	-14	-17	-19	-22	-24	-24	-24	-24

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
25	55	44	35	29	25	22	20	18	35

Barrier SRI		63	125	250	500	1k	2k	4k	8k
	Manual								
	Unknown	100	100	100	100	100	100	100	100

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Weatherite Condenser	-19	-14	-3	3	5	3	-4	8	0
2	Return	-23	-12	-7	2	9	12	7	-4	4
3	Supply	-33	-20	-12	-16	-12	-2	1	-3	-9
4	2 x cold store condensers	-36	-14	-9	1	-8	-10	-16	-24	-6
5	milk chiller	-29	-13	-13	-12	-14	-16	-19	-22	-15
6	Mitsubishi PUHZ RP35VVHA4	-36	-27	-21	-20	-18	-17	-22	-20	-22
7	Mitsubishi PUHZRP125	-20	-14	-9	-4	-4	-4	-8	-3	-8
8	sovereign	-8	9	6	6	7	9	3	21	8
9	woods	-39	-27	-16	-6	6	9	8	6	1
	Total	-7	9	7	10	13	15	12	21	10

Barrier Deration		63	125	250	500	1k	2k	4k	8k
	Weatherite Condenser	0	0	0	0	0	0	0	0
	Return	0	0	0	0	0	0	0	0
	Supply	0	0	0	0	0	0	0	0
	2 x cold store condensers	0	0	0	0	0	0	0	0
	milk chiller	0	0	0	0	0	0	0	0
	Mitsubishi PUHZ RP35VVHA4	0	0	0	0	0	0	0	0
	Mitsubishi PUHZRP125	0	0	0	0	0	0	0	0
	sovereign	0	0	0	0	0	0	0	0
	woods	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Weatherite Condenser	33	30	32	32	30	25	15	26	35
2	Return	21	18	4	-12	-12	-1	-2	-12	6
3	Supply	15	16	13	1	-2	2	0	-8	9
4	2 x cold store condensers	14	24	21	25	11	4	-6	-18	**23**
5	milk chiller	22	26	17	12	6	-1	-7	-13	15
6	Mitsubishi PUHZ RP35VVHA4	15	12	9	4	2	-2	-10	-11	7
7	Mitsubishi PUHZRP125	31	25	22	21	18	16	11	14	**24**
8	sovereign	31	29	9	-11	-19	-16	-21	-1	14
9	woods	3	0	0	1	7	6	3	-1	12
	Total	**37**	**35**	**33**	**33**	**30**	**26**	**17**	**26**	**35**

Net barrier loss		63	125	250	500	1k	2k	4k	8k
	Weatherite Condenser	**-3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Return	**-5**	**-5**	**-6**	**-7**	**-8**	**-10**	**-12**	**-15**
	Supply	**-7**	**-8**	**-10**	**-12**	**-15**	**-18**	**-21**	**-24**
	2 x cold store condensers	**-5**	**-5**	**-5**	**-6**	**-6**	**-8**	**-9**	**-12**
	milk chiller	**-5**	**-5**	**-5**	**-5**	**-5**	**-6**	**-7**	**-9**
	Mitsubishi PUHZ RP35VVHA4	**-5**	**-5**	**-5**	**-5**	**-5**	**-6**	**-7**	**-9**
	Mitsubishi PUHZRP125	**-5**	**-5**	**-4**	**-4**	**-3**	**-2**	**0**	**0**
	sovereign	**-14**	**-17**	**-19**	**-22**	**-24**	**-24**	**-24**	**-24**
	woods	**-14**	**-17**	**-19**	**-22**	**-24**	**-24**	**-24**	**-24**

Appendix E: Glossary

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

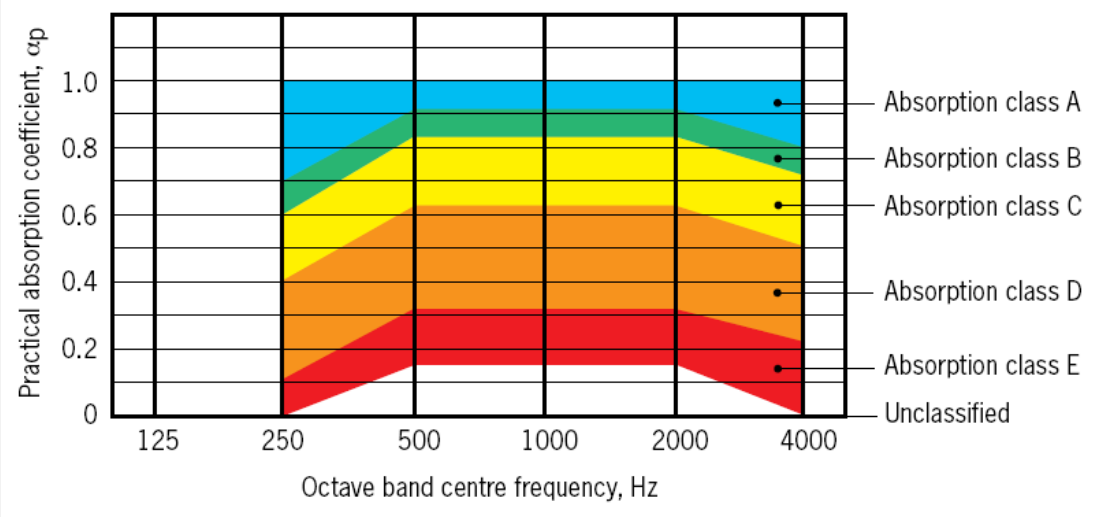
'A' Weighting

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

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.