Acoustic Consultancy Report

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External Plant Assessment

Report Prepared For

Pro-Mec (Uk) Ltd
Iceland Leek
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Contents

i) Executive Summary 3
ii) Document History 3
1 Introduction 4
2 Site Description 4
3 Local Noise Climate 4
4 Measurements 4
5 Results 4
6 Evaluation of Design Criteria 5
6.1 BS4142:2014 5
6.2 World Health Organisation Night Noise Guidelines for Europe (2009) 5
6.3 World Health Organisation (WHO) Guidelines for Community Noise (1999) 6
6.4 BS8233:2014 6
6.5 Recommended Rating Level 7
7 Review of Plant Installation 7
8 Conclusion 7
Appendix A: Site Plan 8
Appendix B: Measurement Data 9
Appendix C: Plant Data 10
Appendix D: Calculations 11
Appendix E: Glossary 13

i) Executive Summary

New mechanical plant is to be installed at the Iceland Food store development on Brook Street, Leek.

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

The representative background sound level was 28 dB $L_{A90,\ 15\ mins}$.

The recommended residential design criterion is as follows:

28 dB $L_{Aeq,\ T}$ at the nearest residential on St Edward Street, approximately 15m away.
28 dB $L_{Aeq,\ T}$ at the nearest residential on Russell Street, approximately 75m away.

The design, inclusive of attenuators shown in table 10, will achieve the recommended rating level, the report concludes that:

The calculations show an indication of low impact against BS4142:2014 criteria.
The calculated levels are acceptable according to BS8233 and WHO Guidelines for Community Noise.

ii) Document History

Issue	Date	Issue Details	Issued By
1	25th April 2019	Initial Issue	SS

1 Introduction

New mechanical plant is to be installed at the Iceland Food store development at Brook Street, Leek.

LCP has been commissioned by Pro-Mec UK Ltd to carry out an acoustic environment survey and to use the obtained data to assess the potential 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 source was road traffic along Brook Street.

4 Measurements

The noise monitoring took place on 16th – 17th April 2019. The measurement period was considered sufficient to establish the representative background sound levels corresponding to the operational period of the plant.

The weather conditions monitored during the survey are shown in the following table.

Table 1: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	4 m/s
Wind Direction	E, NE
Cloud Cover	80%
Temperature	6°C
Precipitation	None

5 Results

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

Table 2: Representative background sound levels, dB re $2x10^{-5}$ Pa

Measurement Position	$L_{A90,\ 15\ mins}$ Night*
MP1	28

* Day and Night periods are defined in BS4142:2014 as between 07:00 and 23:00, and 23:00 and 07:00 respectively.

6 Evaluation of Design Criteria

6.1 BS4142:2014

BS4142:2014 states that the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

Table 3: BS4142 assessment based upon rating level

Difference between background noise and rating levels	Assessment
+ 10 dB	Indication of a significant adverse impact
+ 5 dB	Indication of an adverse impact
0 dB	Indication of low impact

Certain acoustic features can increase the significance of impact. The specific sound level should be corrected if a tone, impulse or other acoustic feature is expected to be present.

Table 4: Corrections for acoustic features, subjective method

Acoustic Feature	Correction, dB		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	2	4	6
Impulsivity	3	6	9
Other Characteristics	3		
Intermittency	3		

Typically the acoustic feature correction would not be expected to exceed 10dB.

Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty.

6.2 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*."

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

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

Table 5: 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

6.4 BS8233:2014

The criteria offered in BS8233 for residential buildings are largely based on the recommendations made in the Guidelines for Community Noise.

Using the general guidance from above, on the expected sound insulation performance of a façade with a partly open window, the criteria shown in the table below have been adapted from the criteria offered in table 4 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 6: External ambient noise levels for dwellings, based on BS8233, dB re 2x10-5 Pa

Activity	Location	Time period	
		07:00 to 23:00	23:00 to 07:00
Resting	Living Room	50 $L_{Aeq,16\ hour}$	-
Dining	Dining Room/area	55 $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	50 $L_{Aeq,\ 16\ hour}$	45 $L_{Aeq,\ 8\ hour}$

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

"*For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 $L_{Aeq,\ T}$, with an upper guideline value of 55 dB $L_{Aeq,\ T}$ which would be acceptable in nosier environments*."

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

6.5 Recommended Rating Level

The recommended residential design rating level, inclusive of any corrections for acoustic features should therefore be:

Residential Design Rating Level
Representative $L_{A90,\ 15\ mins}$ +/- 0 dB

On the basis of the above the recommended rating level is shown in the following table.

Table 7: Design rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level $L_{A,T}$
Residential on St Edward Street	15	28
Residential on Russell Street	75	28

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.

During the night-time period, the PUHY-P900YSNW is to operate in Low-Noise-Mode and the Mitsubishi MUZ-AP25VG condenser is not to operate.

The design rating levels to be adopted for this project, together with the predicted noise levels, are set out in the table below. Plant noise levels and fan attenuators used in this assessment are contained within Appendix C. Calculations are shown within Appendix D.

Table 8: Predicted and design noise levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approx. Distance (m)	Design Level $L_{Aeq,\ 8\ hr}$*	Predicted Level $L_{Aeq,\ 8\ hr}$
Residential on St Edward Street	15	28	28
Residential on Russell Street	75	28	25

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

8 Conclusion

An environmental noise survey has been undertaken in order to establish the existing background sound levels local to the site generally in accordance with the method contained within BS4142: 2014.

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

The calculations, inclusive of attenuators shown in table 10, meet the recommended rating level and show an indication of low impact against BS4142:2014 criteria.

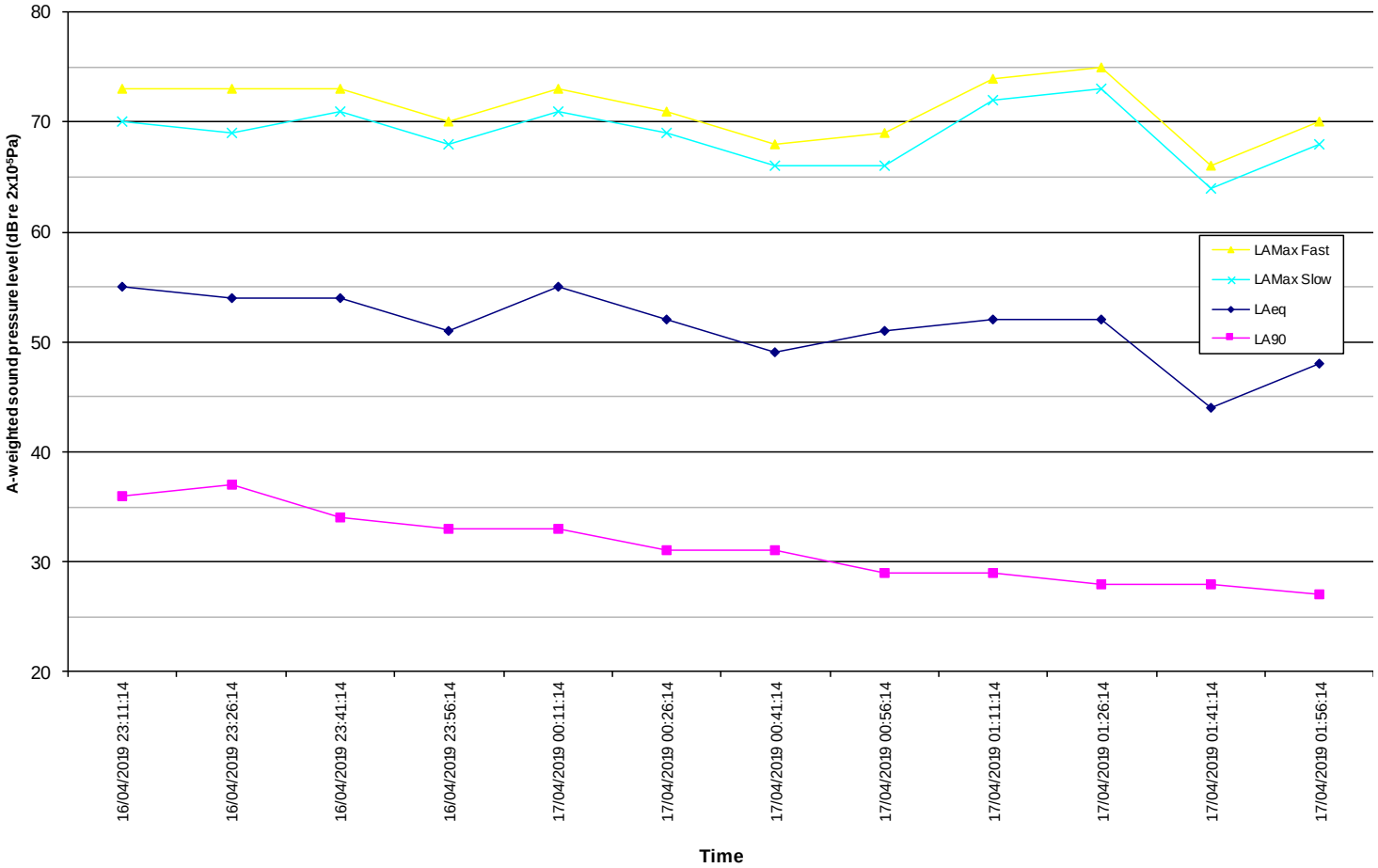
The calculated levels are acceptable according to BS8233 and WHO Guidelines for Community Noise.

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: 11258
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 86548

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10893 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 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 9: Manufacturers Plant Sound Data, dB

Plant	Data Type	Octave Band Centre Frequency (Hz)								L_A
		63	125	250	500	1k	2k	4k	8k	
ISO 250 (Basement)	Fan Lw	54	54	58	62	69	68	66	62	74
MSA 132	Lp at 10m	26	36	33	37	24	18	10	3	35
PUHY-P900YSNW	Lp at 1m	78	67	70	68	63	58	53	48	69
PUHY-P900YSNW (Low Noise Mode)	Lp at 1m	68	61	57	54	52	48	44	47	57
Milk Condensing Unit	Lp at 10m	42	41	42	37	32	27	22	22	39
Woods 560	Fan Lw	83	88	77	71	68	66	58	74	78
ISO 250	Lp at 1m	54	54	58	62	69	68	66	62	74
MUZ-AP25VG	Lp at 1m	49	53	49	44	43	35	30	25	47

Table 10: Atmosphere side in-duct mitigation, dB

Plant	Attenuator dimensions (mm)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
ISO 250	315⌀ x 1370L	5	13	20	33	34	29	28	24
Woods 560	875W x 800H x 1800L	9	14	27	53	55	55	34	28
ISO 250 (Basement)	200⌀ x 615L	1	3	7	14	29	21	16	15

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

The manufacturer/supplier of any attenuators shall ensure that the air volumes through all attenuators and the configurations of the attenuators will not create regenerated noise. Alternative configurations may have to be selected.

It is recommended that all attenuator performances are verified by test data in accordance with ISO 7235.

It is important to note that as the criteria is a single figure dB(A) value, the performance of any enclosure, screen or attenuator at each individual frequency can vary from those shown above and still meet the single figure dB(A) value.

Appendix D: Calculations

Nearest Residential on St Edward Street

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	ISO250 (basement)		54	54	58	62	69	68	66	62	74	74
2	MSA 132 (cp roof)	10	26	36	33	37	24	18	10	3	35	63
3	PUHY-P900YSNW	1	78	67	70	68	63	58	53	48	69	77
4	Milk Condensing unit	10	42	41	42	37	32	27	22	22	39	67
5	Woods 560		83	88	77	71	68	66	58	74	78	78
6	ISO250	1	54	54	58	62	69	68	66	62	74	82

Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections	dB	Façade correction	dB
28.0	-37	37	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	0	Yes	3
23.0	-35	28	2	3	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3	Yes	3
23.0	-35	41	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3	Yes	3
23.0	-35	32	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	1	3	Yes	3
15.0	-32	46	1	0	None	0	0	0	0	0	0	0	0	0	0	Yes	3
15.0	-32	50	1	0	None	0	0	0	0	0	0	0	0	0	0	Yes	3

Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k
-13	-8	-4	-1	0	0	0	0
-5	-2	0	0	0	0	0	0
-10	-6	-2	0	0	0	0	0

Additional Attenuation 63	125	250	500	1k	2k	4k	8k
2	5	9	16	32	24	20	22
10	16	29	55	58	58	38	35
6	15	22	35	37	32	32	31

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	ISO250 (basement)	14	14	18	22	29	28	26	22	34
2	MSA 132 (cp roof)	22	32	29	33	20	14	6	-1	31
3	PUHY-P900YSNW	50	40	42	41	35	31	25	21	41
4	Milk Condensing unit	35	34	35	30	25	20	15	15	32
5	Woods 560	54	59	48	42	39	37	29	45	49
6	ISO250	33	33	37	41	48	47	45	41	53
	Total	**56**	**60**	**50**	**47**	**49**	**48**	**46**	**47**	**55**

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
1.0				28.0	-0.98	0	0	0	0	0	0	0	0
0.7	-1.0	3.0	3.0	20.0	1.14	-11	-13	-16	-18	-21	-24	-24	-24
1.0	-1.0	3.0	1.0	22.0	1.51	-12	-14	-17	-20	-23	-24	-24	-24
0.5	-1.0	3.0	1.0	22.0	2.00	-13	-15	-18	-21	-24	-24	-24	-24
1.0				15.0	-0.97	0	0	0	0	0	0	0	0
1.0				15.0	-0.97	0	0	0	0	0	0	0	0

ISO 250 Basement	-13	-8	-4	-1	0	0	0	0
ISO250	-10	-6	-2	0	0	0	0	0

Weather Louvre	1	2	2	2	3	3	4	7
ISO250 Basement	1	3	7	14	29	21	16	15
Woods 560	9	14	27	53	55	55	34	28
ISO250	5	13	20	33	34	29	28	24

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
18	50	38	29	22	18	15	12	11	28

Barrier SRI	63	125	250	500	1k	2k	4k	8k	Rw
Manual									0
Typical 110mm brick wall	33	37	34	40	48	56	61	61	45

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	ISO250 (basement)	-36	-24	-11	0	11	13	14	12	5
2	MSA 132 (cp roof)	-28	-6	0	10	2	-1	-7	-12	2
3	PUHY-P900YSNW	1	2	14	18	17	16	13	10	13
4	Milk Condensing unit	-15	-4	6	7	7	5	2	4	3
5	Woods 560	5	22	20	20	21	23	17	35	21
6	ISO250	-16	-4	9	19	30	33	33	31	25
	Total	6	22	21	24	31	33	33	36	27

Barrier Deration	63	125	250	500	1k	2k	4k	8k
ISO250 (basement)	0	0	0	0	0	0	0	0
MSA 132 (cp roof)	0	0	0	0	0	0	0	0
PUHY-P900YSNW	0	0	0	0	0	0	0	0
Milk Condensing unit	0	0	0	0	0	0	0	0
Woods 560	0	0	0	0	0	0	0	0
ISO250	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	ISO250 (basement)	-1	1	5	5	-3	4	6	0	11
2	MSA 132 (cp roof)	11	19	13	14	-2	-10	-18	-25	13
3	PUHY-P900YSNW	39	26	26	21	13	7	1	-3	22
4	Milk Condensing unit	22	19	17	9	1	-4	-9	-9	12
5	Woods 560	39	41	19	-13	-19	-21	-9	10	26
6	ISO250	17	12	13	6	11	15	13	10	20
	Total	**42**	**42**	**27**	**22**	**15**	**16**	**14**	**14**	**28**

Net barrier loss	63	125	250	500	1k	2k	4k	8k
ISO250 (basement)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MSA 132 (cp roof)	**-11**	**-13**	**-16**	**-18**	**-21**	**-24**	**-24**	**-24**
PUHY-P900YSNW	**-12**	**-14**	**-17**	**-20**	**-23**	**-24**	**-24**	**-24**
Milk Condensing unit	**-13**	**-15**	**-18**	**-21**	**-24**	**-24**	**-24**	**-24**
Woods 560	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ISO250	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Nearest Residential on Russell Street

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	ISO250 (basement)		54	54	58	62	69	68	66	62	74	74
2	MSA 132 (cp roof)	10	26	36	33	37	24	18	10	3	35	63
3	PUHY-P900YSNW (LNM)	1	68	61	57	54	52	48	44	47	57	65
4	Milk Condensing unit	10	42	41	42	37	32	27	22	22	39	67
5	Woods 560		83	88	77	71	68	66	58	74	78	78
6	ISO250	1	54	54	58	62	69	68	66	62	74	82

Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k
84.0	-46	27	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9
75.0	-46	17	2	3	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6
75.0	-46	20	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6
75.0	-46	21	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6
84.0	-46	31	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9
84.0	-46	35	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9

Reflections	dB	Façade correction	dB
0	0	Yes	3
1	3	Yes	3
1	3	Yes	3
1	3	Yes	3
0	0	Yes	3
0	0	Yes	3

Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k
-13	-8	-4	-1	0	0	0	0
-5	-2	0	0	0	0	0	0
-10	-6	-2	0	0	0	0	0

Additional Attenuation 63	125	250	500	1k	2k	4k	8k
2	5	9	16	32	24	20	22
10	16	29	55	58	58	38	35
6	15	22	35	37	32	32	31

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	ISO250 (basement)	2	2	6	10	17	16	14	10	21
2	MSA 132 (cp roof)	12	22	19	23	10	4	-4	-11	20
3	PUHY-P900YSNW (LNM)	30	23	19	16	14	10	6	9	20
4	Milk Condensing unit	24	23	24	19	14	9	4	4	21
5	Woods 560	31	36	25	19	16	14	6	22	25
6	ISO250	10	10	14	18	25	24	22	18	29
	Total	**34**	**36**	**29**	**27**	**26**	**25**	**22**	**23**	**32**

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
2.0	6.0	6.0	0.1	83.9	3.81	-15	-18	-21	-24	-24	-24	-24	-24
1.0				75.0	-0.99	0	0	0	0	0	0	0	0
1.0				75.0	-0.99	0	0	0	0	0	0	0	0
1.0				75.0	-0.99	0	0	0	0	0	0	0	0
2.0	6.0	6.0	0.1	83.9	3.81	-15	-18	-21	-24	-24	-24	-24	-24
2.0	6.0	6.0	0.1	83.9	3.81	-15	-18	-21	-24	-24	-24	-24	-24

	63	125	250	500	1k	2k	4k	8k
ISO 250 Basement	-13	-8	-4	-1	0	0	0	0
ISO250	-10	-6	-2	0	0	0	0	0

	63	125	250	500	1k	2k	4k	8k
Weather Louvre	1	2	2	2	3	3	4	7
ISO250 Basement	1	3	7	14	29	21	16	15
Woods 560	9	14	27	53	55	55	34	28
ISO250	5	13	20	33	34	29	28	24

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
23	54	42	33	27	23	20	17	16	33

Barrier SRI		63	125	250	500	1k	2k	4k	8k	Rw
	Manual									0
	Typical 110mm brick wall	33	37	34	40	48	56	61	61	45

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	ISO250 (basement)	-52	-40	-28	-18	-6	-4	-4	-6	-12
2	MSA 132 (cp roof)	-42	-21	-15	-5	-13	-16	-22	-27	-12
3	PUHY-P900YSNW (LNM)	-23	-19	-14	-11	-9	-9	-11	-6	-13
4	Milk Condensing unit	-29	-19	-9	-8	-9	-10	-13	-11	-12
5	Woods 560	-23	-6	-9	-9	-7	-6	-12	6	-7
6	ISO250	-44	-32	-20	-10	2	4	4	2	-4
	Total	-20	-6	-5	-1	3	5	5	8	-1

Barrier Deration		63	125	250	500	1k	2k	4k	8k
	ISO250 (basement)	0	0	0	0	0	0	0	0
	MSA 132 (cp roof)	0	0	0	0	0	0	0	0
	PUHY-P900YSNW (LNM)	0	0	0	0	0	0	0	0
	Milk Condensing unit	0	0	0	0	0	0	0	0
	Woods 560	0	0	0	0	0	0	0	0
	ISO250	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	ISO250 (basement)	-28	-29	-28	-31	-39	-32	-30	-36	-26
2	MSA 132 (cp roof)	12	22	19	23	10	4	-4	-11	20
3	PUHY-P900YSNW (LNM)	30	23	19	16	14	10	6	9	20
4	Milk Condensing unit	24	23	24	19	14	9	4	4	21
5	Woods 560	1	0	-25	-60	-66	-68	-56	-37	-16
6	ISO250	-21	-29	-31	-41	-36	-32	-34	-37	-28
	Total	**32**	**28**	**26**	**25**	**18**	**14**	**9**	**11**	**25**

Net barrier loss		63	125	250	500	1k	2k	4k	8k
	ISO250 (basement)	-15	-18	-21	-24	-24	-24	-24	-24
	MSA 132 (cp roof)	0	0	0	0	0	0	0	0
	PUHY-P900YSNW (LNM)	0	0	0	0	0	0	0	0
	Milk Condensing unit	0	0	0	0	0	0	0	0
	Woods 560	-15	-18	-21	-24	-24	-24	-24	-24
	ISO250	-15	-18	-21	-24	-24	-24	-24	-24

Appendix E: Glossary

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

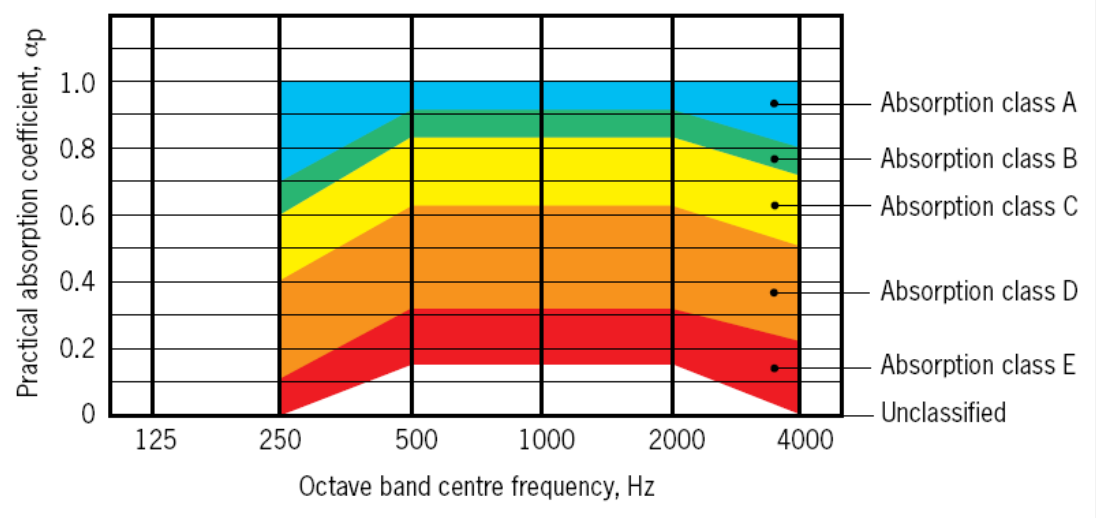
'A' Weighting

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 sound 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.