

Appendix A17.2: Detailed Baseline Noise Survey Results and Notes

1 Introduction

- 1.1.1 This appendix provides additional details of the baseline noise surveys which were undertaken as part of the DMRB 'Noise and Vibration' Stage 3 Assessment.
- 1.1.2 Noise monitoring was undertaken between 5 September 2016 and 11 October 2016 and consisted of unattended long term noise level measurements, supported by attended short term measurements, at 11 locations.
- 1.1.1 The following equipment was used when undertaking noise measurements and calibration certificates for all equipment are provided at the end of this appendix:
- Rion NC-74 Calibrator s/n 34536108;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00751323;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00482601;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00482602;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00751323;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00482602;
 - Cirrus CR: 71C s/n G061732; and
 - Cirrus CR: 71C s/n G061733
- 1.1.2 For each measurement location, two tables have been provided to illustrate the measured daily noise levels for the following time periods:
- The 18 hour daytime period (between 06:00 and 00:00), which is the time period that is used to describe road traffic noise in the Calculation of Road Traffic Noise (CRTN).
 - The 16 hour daytime period (between 07:00 and 23:00), which corresponds to the time period used in the World Health Organisation (WHO) and BS 8233 when describing the daytime period.
 - The eight hour night-time period (between 23:00 and 07:00), which corresponds to the time period used in WHO and BS 8233 when describing the night-time noise period.
- 1.1.3 Both the measured daily noise levels, including noise levels measured with and without periods of rainfall, are presented for each monitoring location. To minimise the effect on the noise levels as a consequence of rainfall, the noise levels measured during periods of rainfall have been removed from the data set. For each time period where rainfall has been measured, the noise levels corresponding to that time period and the following 30 minutes have been discarded. The following 30 minutes are excluded to help mitigate effects of standing water/road on measured road traffic noise on the A9 and nearby roads.
- 1.1.4 Daily noise levels are presented only for periods where noise levels were measured for the full duration of the period, i.e. the full 18 (06:00 to 00:00), 16 (07:00 to 23:00) or eight (23:00 to 07:00) hours. Where data for the full 18 hour (06:00 to 00:00) period is not available, the shortened measurement procedure (defined in CRTN) has been used to calculate the $L_{A10(18 \text{ hour})}$. The shortened measurement procedure has been used where there are three consecutive hours, between 10:00 and 17:00 hour, which has at least 15 minutes (and the following 30 minutes if rainfall has occurred) of rain free data per hour.

2 Summary of Unattended Long Term Measurements

2.1 Measurement Location R3.01 – Warren Lodge, Ballinluig, Pitlochry, PH9 0NS

2.1.1 The measurement location was as shown in Photograph 1. A Rion NL-32 Class 1 sound level meter (serial number (s/n) 00751323) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was approximately 15m on the southern façade of the building, on the southern property line.

Photograph 1: Noise monitoring equipment at Warren Lodge



2.1.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

2.1.3 At this location the noise climate was dominated by road traffic noise on the existing A9 (west of the measurement location), birdsong and wind in vegetation.

2.1.4 Throughout the monitoring period, hourly wind speeds did not exceed 1.0ms^{-1} and no rainfall was recorded on 5 September, 6 September, 7 September, 8 September, 10 September and 11 September. Occasional rainfall was recorded on 8 September, 9 September and 12 September, where total hourly rainfall peaked at 1.76mm, 1.52mm and 0.3mm respectively.

2.1.5 Table 1 and Table 2 provide the measured daily noise levels at this location, with and without noise levels measured during periods of rainfall.

Table 1: Daily summarised noise Warren Lodge, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
Wednesday	05/9/2016	-	-	-	-	-	-	50.8	54.9	36.4
Thursday	06/9/2016	56.6	59.3	44.0	56.9	59.7	45.1	50.9	55.3	36.9
Friday	07/9/2016	56.3	59.2	44.6	56.5	59.5	45.6	51.1	55.5	34.6

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
Saturday	08/9/2016	57.6	60.2	47.1	57.9	60.5	48.4	51.1	55.7	33.4
Sunday	09/9/2016	61.3	60.7	50.5	61.7	61.0	51.9	50.6	55.1	35.3
Monday	10/9/2016	56.8	59.4	46.1	57.2	59.8	47.2	48.4	52.8	32.9
Tuesday	11/9/2016	58.6	59.9	47.9	59.1	60.5	49.4	51.5	54.7	36.5
Wednesday	12/9/2016	-	59.9*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

Table 2: Daily summarised noise Warren Lodge, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
Wednesday	05/9/2016	-	-	-	-	-	-	50.8	54.9	36.4
Thursday	06/9/2016	56.6	59.3	44.0	56.9	59.7	45.1	50.9	55.3	36.9
Friday	07/9/2016	56.3	59.2	44.6	56.5	59.5	45.6	-	-	-
Saturday	08/9/2016	-	-	-	-	-	-	51.2	55.7	33.4
Sunday	09/9/2016	-	60.8*	-	-	-	-	50.6	55.1	35.3
Monday	10/9/2016	56.8	59.4	46.1	57.2	59.8	47.2	48.4	52.8	32.9
Tuesday	11/9/2016	58.6	59.9	47.9	59.1	60.5	49.4	-	-	-
Wednesday	12/9/2016	-	59.9*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.1.6 It should be noted that in Table 1 and Table 2 the reported L_{Aeq,T} level is the logarithmically averaged noise level, whereas the L_{A10,T} and L_{A90,T} levels are the arithmetically averaged noise levels.

2.1.7 In addition to long term measurements a series of short term attended measurements were also undertaken and the results are provided in Table 3. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions approximately 10m to the northern façade of the building. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 3: Additional attended noise level measurements at Warren Lodge

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
06/09/16	12:26	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period Noise sources included road traffic noise.
06/09/16	17:03	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and wind in vegetation.
07/09/16	15:45	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and wind in vegetation. Train pass-by at 15:51.
07/09/16	19:00	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.
08/09/16	16:21	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Prior to the measurement period, rainfall was noted, but no rainfall was observed during the monitoring period. Noise sources include road traffic noise.
08/09/16	17:34	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and wind in vegetation.
09/09/16	12:34	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and wind in vegetation.

2.2 Measurement Location R3.02 – St Colme’s, Ballinluig, Pitlochry, PH9 0NR

2.2.1 The measurement location was as shown in Photograph 2. A Rion NL-32 Class 1 sound level meter (s/n 00482601) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was approximately 50m from the northern façade of the building.

Photograph 2: Noise monitoring equipment at St Colme’s



- 2.2.2 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.2.3 At this location the noise climate was dominated by road traffic noise on the existing A9 (west of the measurement location), birdsong and occasional construction noise from the house.
- 2.2.4 Throughout the monitoring period, wind speeds did not exceed 1.0ms^{-1} and hourly rainfall did not exceed 0.1mm. Peak rainfall of 0.43mm was recorded on 8 October 2016, but no rainfall was recorded on the 5 October, 6 October and 9 October.
- 2.2.5 The results of the noise monitoring period are presented in Table 4 and Table 5. It was noted that between the final attended noise level measurement (6 October) and the collection of equipment (11 October), the grass near the monitoring location was cut. Consequently, high noise levels associated with the grass being cut on 7 October 2016 (11:00 to 13:00 hours) were removed to ensure data remained representative of typical noise levels at St Colme’s.

Table 4: Daily summarised noise levels at St Colme’s, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
05/10/2016	Wednesday	-	53.7*	-	-	-	-	45.8	49.9	32.4
06/10/2016	Thursday	51.5	53.8	42.9	51.8	54.0	43.6	45.7	50.0	32.5
07/10/2016	Friday	-	53.8*	-	-	-	-	44.3	49.2	30.9
08/10/2016	Saturday	51.0	53.2	43.7	51.4	53.6	44.6	42.8	46.6	30.3
09/10/2016	Sunday	51.6	53.4	43.1	52.0	53.9	44.6	46.0	49.7	32.8
10/10/2016	Monday	53.9	54.1	44.9	54.2	54.5	45.7	45.6	49.6	32.6
11/10/2016	Tuesday	-	54.2*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

Table 5: Daily summarised noise levels at St Colme's, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
05/10/2016	Wednesday	-	53.7	-	-	-	-	45.8	49.9	32.4
06/10/2016	Thursday	51.5	53.8	42.9	51.8	54.0	43.6	45.7	50.0	32.5
07/10/2016	Friday	-	53.7	-	-	-	-	44.7	49.2	30.9
08/10/2016	Saturday	-	53.9	-	-	-	-	42.8	46.6	30.3
09/10/2016	Sunday	51.6	53.4	43.1	52.0	53.9	44.6	46.0	49.7	32.8
10/10/2016	Monday	-	54.6	-	-	-	-	45.6	49.6	32.6
11/10/2016	Tuesday	-	54.4	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.2.6

In addition to long term measurements a series of short term attended measurements were also undertaken and the results are provided in Table 6. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions adjacent to the long term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 6: Additional attended noise level measurements at St Colme's

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
06/10/16	12:25	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.
06/10/16	16:50	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.

2.3 Measurement Location R3.03 – The Mill, PH9 ONT

- 2.3.1 The measurement location was as shown in Photograph 3. A Rion NL-32 Class 1 sound level meter (s/n 00482601) was positioned at a height of 1.5m in free-field conditions. The equipment was approximately 4m from the northern façade of the building.

Photograph 3: Noise monitoring equipment at The Mill



- 2.3.2 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.3.3 At this location the noise climate was dominated by water flowing in a nearby burn to the north and wind induced noise from the trees surrounding the property. On occasion, faint traffic noise from the existing A9 was audible.
- 2.3.4 With the exception of peak wind speeds (1.3ms^{-1} on 28 September), wind speeds did not exceed 0.6ms^{-1} . Rainfall was occasionally recorded throughout the monitoring period, and in general, total hourly rainfall did not exceed 0.6mm. Peak rainfall of 1.69mm was recorded on 24 September.
- 2.3.5 Table 7 and 8 provides the measured daily noise levels at this location, with and without the periods of rainfall.

Table 7: Daily summarised noise levels at The Mill, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
23/09/16	Friday	-	-	-	-	-	-	55.7	56.1	55.4
24/09/16	Saturday	57.6	57.9	57.1	57.5	57.9	57.0	58.9	59.2	58.7
25/09/16	Sunday	57.8	58.2	57.6	57.8	58.2	57.6	57.4	57.7	57.2
26/09/16	Monday	57.4	57.6	57.1	57.4	57.6	57.1	57.1	57.4	56.9
27/09/16	Tuesday	57.9	58.4	57.2	57.9	58.4	57.2	57.5	58.1	56.9

Table 8: Daily summarised noise levels at The Mill, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
23/09/16	Friday	-	-	-	-	-	-	-	-	-
24/09/16	Saturday	-	56.4*	-	-	-	-	58.9	59.2	58.7
25/09/16	Sunday	-	57.2*	-	-	-	-	57.4	57.7	57.2
26/09/16	Monday	57.4	57.6	57.1	57.4	57.6	57.1	-	-	-
27/09/16	Tuesday	-	58.0*	-	-	-	-	57.5	58.1	56.9

* Determined using CRTN shortened measurement procedure

2.3.6

In addition to long term measurements, a series of short term attended measurements were also undertaken and the results are provided in Table 9. A Cirrus CR: 171C1 sound level meter (s/n G061732) was positioned at a height of 1.5m in free-field conditions adjacent to the long term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 9: Additional attended noise level measurements at The Mill

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
26/09/16	14:24	00:15	Light southerly breeze, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn.
26/09/16	16:53	00:15	Light southerly breeze, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn.
26/09/16	18:57	00:15	Light southerly breeze, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn.
27/09/16	11:40	00:15	Light south-westerly breeze, scattered cloud cover, light drizzle. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn. Wind in vegetation also audible.
27/09/16	14:59	00:15	Fairly strong south-westerly winds, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn. Wind in vegetation was also audible. Traffic noise from existing A9 audible during strong south-westerly winds.
27/09/16	19:07	00:15	Fairly strong south-westerly winds, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn.
28/09/16	11:25	00:15	Light westerly winds, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by water flowing in the burn. Car alarm audible at 11:32.

2.4 Measurement Location R3.04 – 1 Dowally Cottage, PH9 0NT

- 2.4.1 The measurement location was as shown in Photograph 4. A Rion NL-32 Class 1 sound level meter (s/n 00751323) was positioned at a height of 1.5m in free-field conditions. The equipment was approximately 4m from the north-western façade of the building.

Photograph 4: Noise monitoring equipment at 1 Dowally Cottage



- 2.4.2 The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.4.3 At this location the noise climate was dominated by road traffic noise on the existing A9, west of the measurement location.
- 2.4.4 With the exception of peak wind speeds (1.3ms^{-1} on 28 September), wind speeds did not exceed 0.6ms^{-1} . Rainfall was occasionally recorded throughout the monitoring period, and in general, total hourly rainfall did not exceed 0.6mm. Peak rainfall of 1.69mm was recorded on 24 September. Table 10 and Table 11 provides the measured daily noise levels at this location, with and without the periods of rainfall.

Table 10: Daily Summarised noise levels at 1 Dowally Cottage, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
23/09/16	Friday	-	-	-	-	-	-	61.1	63.0	42.7
24/09/16	Saturday	68.1	71.0	53.9	68.5	71.6	55.0	59.6	59.7	39.8
25/09/16	Sunday	67.4	70.5	52.5	67.8	71.2	54.1	62.4	63.6	39.3
26/09/16	Monday	67.4	70.7	51.3	67.7	71.1	52.5	62.9	63.7	38.1
27/09/16	Tuesday	67.8	71.3	51.2	68.0	71.7	52.0	62.4	64.2	42.6

Table 11: Daily summarised noise levels at 1 Dowally Cottage, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
23/09/16	Friday	-	-	-	-	-	-	-	-	-
24/09/16	Saturday	-	72.2	-	-	-	-	59.5	59.6	39.9
25/09/16	Sunday	-	71.1	-	-	-	-	62.2	62.8	39.2
26/09/16	Monday	67.4	70.7	51.3	67.7	71.1	52.5	-	-	-
27/09/16	Tuesday	-	71.3	-	-	-	-	62.4	64.2	42.6

* Determined using CRTN shortened measurement procedure

2.4.5

In addition to long term measurements, a series of short term attended measurements were also undertaken and the results are provided in Table 12. A Cirrus CR: 171C1 sound level meter (s/n G061732) was positioned at a height of 1.5m in free-field conditions adjacent to the long term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 12: Additional attended noise level measurements at 1 Dowally Cottage

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
26/09/16	14:00	00:15	Light southerly breeze, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise.
26/09/16	16:30	00:15	Light southerly breeze, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise. Fighter jet audible at 16:40.
26/09/16	18:35	00:15	Light southerly breeze, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise.
27/09/16	11:17	00:15	Light south- westerly breeze, scattered cloud cover, light drizzle. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise, occasional birdsong and owner of Dowally Cottage resident chopping wood in shed.
27/09/16	14:37	00:15	Fairly strong south-south-westerly winds, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise.
27/09/16	18:45	00:15	Fairly strong south-south-westerly winds, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by road traffic noise.
28/09/16	10:58	00:15	Light westerly wind, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise and occasional birdsong.

2.5 Measurement R3.05 – Guay Farmhouse, Ballinluig, Pitlochry, PH9 0NP

- 2.5.1 The shortened measurement procedure defined in CRTN was used at Guay Farmhouse on 7 October 2016.
- 2.5.2 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.5.3 The results provided in Table 13 illustrate the predicted $L_{A10(18 \text{ hour})}$.

Table 13: Noise level measurements using the shortened measurement procedure at Guay Farmhouse

Date	Start Time (hh:mm)	Duration (mm:ss)	$L_{A10 \text{ 15 mins}}$ (dB)	Comments
07/10/16	10:00	15:00	73.9	Light rain was noted during the monitoring period, however, weather conditions remained conducive for noise monitoring throughout the monitoring period. Audible noise sources included road traffic and bird song. Fighter jet audible at 11:38. Cargo train pass-by (approximately 20 cars) at 12:45.
	10:15	15:00	74.4	
	10:30	15:00	74.2	
	10:45	15:00	74.1	
	11:00	15:00	74.1	
	11:15	15:00	74.5	
	11:30	15:00	74.9	
	11:45	15:00	74.3	
	12:00	15:00	74.8	
	12:15	15:00	74.6	
	12:30	15:00	74.1	
12:45	15:00	74.2		

- 2.5.4 Using the data provided in Table 13, a $L_{A10(18 \text{ hour})}$ of 73.3dB(A) is calculated.

2.6 Measurement Location R3.06– The Schoolhouse, Guay, Ballinluig, Pitlochry, PH9 0NW

- 2.6.1 The measurement location was as shown in Photograph 6. A Cirrus CR: 171C Class 1 sound level meter (s/n G061733) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was approximately 10m from the north-eastern façade of the building, in the back garden.

Photograph 6: Noise monitoring equipment at the Schoolhouse



- 2.6.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.6.3 At this location the noise climate was dominated by birdsong, road traffic noise on the existing A9 (south-west of the measurement location), running water and road traffic noise from surrounding local roads.
- 2.6.4 Wind speeds did not exceed 1.0ms^{-1} and occasional rainfall recorded throughout the monitoring period. However, total hourly rainfall did not exceed 0.1mm and total hourly rainfall peaked at 0.07mm on 12 September 2016.
- 2.6.5 The results of the noise monitoring period are presented in Table 14 and Table 15, with and without the periods of rainfall.

Table 14: Daily Summarised noise levels at the Schoolhouse, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	41.1	40.6	36.3
13/09/2016	Tuesday	50.7	44.2	38.3	51.1	44.5	38.5	41.6	41.7	38.4
14/09/2016	Wednesday	49.9	43.8	38.7	50.3	44.0	38.7	39.6	39.1	36.7
15/09/2016	Thursday	-	43.2*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

Table 15: Daily Summarised noise levels at the Schoolhouse, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	-	-	-
13/09/2016	Tuesday	-	44.7*	-	-	-	-	-	-	-
14/09/2016	Wednesday	49.9	43.8	38.7	50.3	44.0	38.7	39.6	39.1	36.7
15/09/2016	Thursday	-	43.2*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.6.6

In addition to long term measurements a series of short term attended measurements were also undertaken and the results are provided in Table 16. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions approximately 5m away from the south-western façade of the building. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 16: Additional attended noise level measurements at the Schoolhouse

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
13/09/16	12:35	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and wind in vegetation. Two cars passed by during the survey.
14/09/16	10:35	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources include distant road traffic noise, birdsong and running water.
14/09/16	14:12	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and running water. One car passed by during the survey.
14/09/16	18:48	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and running water. Four cars passed by during the survey.
15/09/16	10:45	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and running water. Dog barking inside the house was also audible.
15/09/16	13:40	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and running water. One car passed by during the survey.
15/09/16	18:35	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and running water. Helicopter audible at 18:40.
16/09/16	11:30	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, birdsong and running water. One car passed by during the survey.
16/09/16	14:32	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included distant road traffic noise, wind in vegetation and running water. One car passed by during the survey.

2.7 Measurement Location R3.07 – The Knoll, PH0 ONT

- 2.7.1 The measurement location was as shown in Photograph 7. A Rion NL-32 Class 1 sound level meter (s/n 00482601) was positioned at a height of 1.5m in free-field conditions. The equipment was approximately 25m from the south-western façade of the building.

Photograph 7: Noise monitoring equipment at The Knoll



- 2.7.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.7.3 At this location the noise climate was dominated by road traffic noise on the existing A9 to the south of the measurement location and birdsong. Farm animals (goats and chickens) around the property were occasionally audible. Noise in the distance from trains on the Highland Main Line railway was occasionally audible.
- 2.7.4 Wind speeds did not exceed 1.0ms^{-1} throughout the monitoring period. With the exception of rainfall on 22 September (1.22mm at 22:15), rainfall did not exceed 0.5mm. No rainfall was recorded on 19 September and 20 September.
- 2.7.5 Table 17 and Table 18 provides the measured daily noise levels at this location, with and without the periods of rainfall.

Table 17: Daily summarised noise levels at The Knoll, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/09/16	Monday	-	-	-	-	-	-	58.2	60.8	34.1
20/09/16	Tuesday	63.6	67.0	47.6	63.9	67.3	48.5	58.5	62.4	36.4
21/09/16	Wednesday	63.8	67.3	47.8	64.1	67.6	48.8	58.7	62.3	37.5
22/09/16	Thursday	64.3	67.5	50.2	64.6	67.8	51.3	58.6	62.8	36.1

Table 18: Daily summarised noise levels at The Knoll, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/09/16	Monday	-	-	-	-	-	-	58.2	60.8	34.1
20/09/16	Tuesday	63.6	67.0	47.6	63.9	67.3	48.5	58.5	62.4	36.4
21/09/16	Wednesday	-	67.5*	-	-	-	-	-	-	-
22/09/16	Thursday	-	67.4*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.7.6

In addition to long term measurements, a series of short term attended measurements were also undertaken and the results are provided in Table 19. A Cirrus CR: 171C1 sound level meter (s/n G061732) was positioned at a height of 1.5m in free-field conditions adjacent to the long term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 19: Additional attended noise level measurements at The Knoll

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
20/09/16	11:12	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Dog barking was also audible.
20/09/16	19:55	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong
21/09/16	12:21	00:15	Still, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise and birdsong. Train pass-by at 12:30.
22/09/16	13:00	00:15	Still, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise and birdsong. Farm animals were also audible.
22/09/16	16:23	00:15	Still, scattered cloud cover, dry. Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise and birdsong. Children playing football in garden and farm animals were also audible.

2.8 Measurement Location R3.08 – Morven, Kindallachan, Pitlochry, PH9 0NW

2.8.1 The measurement location was as shown in Photograph 8. A Rion NL-32 Class 1 sound level meter (s/n 00482601) was positioned at a height of approximately 1.5m in façade conditions. The equipment was 1m from the western façade of the building.

Photograph 8: Noise monitoring equipment at Morven



- 2.8.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.8.3 At this location the noise climate was dominated by birdsong, road traffic noise on the existing A9 (west of the measurement location) and occasional construction noise.
- 2.8.4 Wind speeds did not exceed 1.0ms^{-1} and occasional rainfall recorded throughout the monitoring period. However, total hourly rainfall did not exceed 0.1mm and total hourly rainfall peaked at 0.07mm on 12 September 2016.
- 2.8.5 Table 20 and Table 21 provides the measured daily noise levels at this location, with and without the periods of rainfall.

Table 20: Daily summarised noise levels at Morven, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	55.2	58.0	38.8
13/09/2016	Tuesday	60.8	63.6	49.0	61.1	64.1	50.0	54.9	57.6	36.9
14/09/2016	Wednesday	60.6	63.6	49.6	60.9	63.9	50.5	-	57.2	34.9
15/09/2016	Thursday	-	63.3*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

Table 21: Daily Summarised noise levels at Morven, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	-	-	-
13/09/2016	Tuesday	-	64.2	-	-	-	-	-	-	-
14/09/2016	Wednesday	60.6	63.6	49.6	60.9	63.9	50.5	53.9	57.2	34.9
15/09/2016	Thursday	-	63.3	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.8.6

In addition to long term measurements a series of short term attended measurements were also undertaken and the results are provided in Table 22. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions approximately 16m away from the western façade of the building. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 22: Additional attended noise level measurements at Morven

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
13/09/16	12:03	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic, birdsong and music in the background played by a construction worker.
14/09/16	10:08	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic, birdsong and residents' activity (talking).
14/09/16	13:47	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic, birdsong, construction noise and residents' activity (talking and shutting car door). Construction noise (grinder) was heard for five seconds and was kept running idle at 13:55 and again audible for 20 seconds at 13:59. Construction noise (mixer) at 13:59.
14/09/16	18:24	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period Noise sources included road traffic and birdsong.
15/09/16	10:19	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. The presence of mist was noted which may affect road traffic flow. Noise sources included road traffic, birdsong and TV sound from the inside of the house.
15/09/16	13:17	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Construction noise (mixer) audible between 13:16 and 13:22.
15/09/16	18:13	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.
16/09/16	11:04	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic, birdsong and wind in vegetation. Construction noise and construction workers' activity were audible between 11:16 and 11:18.
16/09/16	14:07	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic, construction noise and wind in vegetation.

2.9 Measurement R3.09 – Croftnascallaig Farmhouse, Ballinluig, Dunkeld, PH9 0NN

- 2.9.1 The measurement location was as shown in Photograph 9. A Rion NL-32 Class 1 sound level meter (s/n 00482601) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was approximately 4m from the south-western façade of the building.

Photograph 9: Noise monitoring equipment at Croftnascallaig Farmhouse



- 2.9.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.9.3 At this location the noise climate was dominated by birdsong and road traffic noise on the existing A9 (west of the measurement location).
- 2.9.4 Throughout the monitoring period, recorded wind speeds were relatively low and did not exceed 1ms^{-1} . Similarly, low rainfall events occurred during the monitoring period, where peak hourly rainfall of 0.21mm was recorded on 1 October 2016. No rainfall was recorded between 2 October and 4 October.
- 2.9.5 The results of the noise monitoring period are presented in Table 23 and Table 24 with and without the periods of rainfall.

Table 23: Daily summarised noise levels at Croftnascallaig Farmhouse, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
29/09/2016	Thursday	-	58.4*	-	-	-	-	45.9	48.8	37.6
30/09/2016	Friday	52.8	53.4	46.2	53.2	54.0	47.1	40.9	43.1	32.8
01/10/2016	Saturday	48.4	49.3	42.3	48.8	50.0	43.2	39.3	39.6	30.7
02/10/2016	Sunday	49.8	50.4	43.6	50.3	51.3	44.7	45.1	47.8	37.3
03/10/2016	Monday	54.6	54.2	45.4	55.1	54.7	46.1	45.6	48.9	37.5
04/10/2016	Tuesday	51.2	52.0	44.2	51.5	52.4	44.7	44.6	47.7	36.9
05/10/2016	Wednesday	-	52.8*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

Table 24: Daily summarised noise levels at Croftnascallaig Farmhouse, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
29/09/2016	Thursday	-	58.5*	-	-	-	-	45.9	48.8	37.6
30/09/2016	Friday	53.9	53.1	45.9	54.3	53.6	46.8	40.9	43.1	32.8
01/10/2016	Saturday	-	50.1*	-	-	-	-	37.7	39.6	30.7
02/10/2016	Sunday	49.8	50.4	43.6	50.3	51.3	44.7	45.1	47.8	37.3
03/10/2016	Monday	54.6	54.2	45.4	55.1	54.7	46.1	45.6	48.9	37.5
04/10/2016	Tuesday	51.2	52.0	44.2	51.5	52.4	44.7	44.6	47.7	36.9
05/10/2016	Wednesday	-	52.8*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.9.6

In addition to long term measurements a series of short term attended measurements were also undertaken and the results are provided in Table 25. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions approximately 20m to the south of the building. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 25: Additional attended noise level measurements at Croftnascallaig Farmhouse

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
03/10/16	15:28	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic noise in the background and birdsong. Residents' activity (talking and gardening) was also audible during the survey.
04/10/16	12:29	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic in the background and birdsong.
04/10/16	17:23	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic in the background, birdsong and wind in vegetation.

2.10 Measurement Location R3.10 – Haugh of Kilmorich, Ballinluig, Dunkeld, PH9 0NN

- 2.10.1 The measurement locations are shown in Photographs 10 and 11. A Rion NL-32 Class 1 sound level meter (s/n 00751323) and Rion NL-53 Class 1 sound level meter (s/n 00482602) were positioned at a height of approximately 1.5m in free-field conditions approximately 20m from the north-eastern façade of the building and 8m from the south-western façade of the building respectively.

Photograph 10: Noise monitoring equipment at Haugh of Kilmorich (near the A9)



Photograph 11: Noise monitoring equipment at Haugh of Kilmorich (away from the A9)



- 2.10.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.10.3 At this location the noise climate was dominated by birdsong, road traffic noise on the existing A9 adjacent to the first measurement locations and to the north-east of the second measurement location. Additionally, occasional train pass-bys on the Highland Main Line railway (located to the south-west of the monitoring location) were audible.
- 2.10.4 In general, wind speeds did not exceed 1.0ms^{-1} during the monitoring period, but peak wind speeds of 1.12ms^{-1} were recorded on 16 September. Occasional rainfall occurred throughout the monitoring period. With the exception of hourly rainfall recorded on 16 September 2016 (0.3mm at 01:00), hourly rainfall did not exceed 0.1mm.
- 2.10.5 Table 26 and Table 27 provide the measured daily noise levels at Haugh of Kilmorich (close to the A9), with and without the periods of rainfall.

Table 26: Daily summarised noise levels at Haugh of Kilmorich positioned close to the A9, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	60.7	60.0	35.5
13/09/2016	Tuesday	65.5	68.1	47.3	65.7	68.8	48.5	60.8	59.0	32.8
14/09/2016	Wednesday	65.2	68.1	49.1	65.4	68.7	50.3	60.2	58.3	29.7
15/09/2016	Thursday	65.0	68.0	48.9	65.2	68.5	50.3	61.1	60.5	38.3
16/09/2016	Friday	66.0	68.9	49.2	66.2	69.5	50.6	58.8	58.3	31.5
17/09/2016	Saturday	65.7	68.1	50.2	66.1	68.7	51.8	56.5	54.5	26.2
18/09/2016	Sunday	64.5	67.1	48.4	64.9	68.1	50.4	59.9	58.2	30.9

Table 27: Daily summarised noise levels at Haugh of Kilmorich positioned close to the A9, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	-	-	-
13/09/2016	Tuesday	-	69.0*	-	-	-	-	-	-	-
14/09/2016	Wednesday	65.2	68.1	49.1	65.4	68.7	50.3	60.0	58.3	29.7
15/09/2016	Thursday	65.0	68.0	48.9	65.2	68.5	50.3	-	-	-
16/09/2016	Friday	66.0	68.9	49.2	66.2	69.5	50.6	58.8	58.3	31.5
17/09/2016	Saturday	65.7	68.1	50.2	66.1	68.7	51.8	56.5	54.5	26.2
18/09/2016	Sunday	64.5	67.1	48.4	64.9	68.1	50.4	59.9	58.2	30.9

* Determined using CRTN shortened measurement procedure

2.10.6 Table 28 and Table 29 provide the measured daily noise levels at Haugh of Kilmorich (away from the A9), with and without the periods of rainfall.

Table 28: Daily summarised noise levels at Haugh of Kilmorich positioned away from the A9, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	54.9	58.1	36.9
13/09/2016	Tuesday	59.7	61.7	49.6	60.0	62.0	50.8	54.9	57.8	35.1
14/09/2016	Wednesday	59.1	61.6	50.2	59.3	61.8	51.2	53.8	56.9	30.9
15/09/2016	Thursday	58.9	61.4	49.8	59.1	61.6	51.3	55.2	58.3	39.9
16/09/2016	Friday	60.3	62.5	52.4	60.5	62.8	53.7	54.1	56.8	34.9
17/09/2016	Saturday	63.0	61.8	51.6	63.4	62.1	52.8	51.2	53.5	27.8
18/09/2016	Sunday	58.8	60.8	50.0	59.1	61.3	52.0	54.4	57.1	33.5

Table 29: Daily summarised noise levels at Haugh of Kilmorich positioned away from the A9, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
12/09/2016	Monday	-	-	-	-	-	-	-	-	-
13/09/2016	Tuesday	-	61.8*	-	-	-	-	-	-	-
14/09/2016	Wednesday	59.1	61.6	50.2	59.3	61.8	51.2	53.6	56.9	30.9
15/09/2016	Thursday	58.9	61.4	49.8	59.1	61.6	51.3	-	-	-
16/09/2016	Friday	60.3	62.5	52.4	60.5	62.8	53.7	54.1	56.8	34.9
17/09/2016	Saturday	63.0	61.8	51.6	63.4	62.1	52.8	51.2	53.5	27.8
18/09/2016	Sunday	58.8	60.8	50.0	59.1	61.3	52.0	54.4	57.1	33.5

* Determined using CRTN shortened measurement procedure

2.10.7 In addition to long term measurements, a series of short term attended measurements were also undertaken and the results are provided in Table 30 and Table 31. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions near the long term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 30: Additional attended noise level measurements at Haugh of Kilmorich, near the A9

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
13/09/16	13:15	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.
14/09/16	11:17	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 11:31.
14/09/16	14:51	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
14/09/16	19:47	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 19:55.
15/09/16	11:22	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 11:36.
15/09/16	14:39	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 14:40.
15/09/16	19:12	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Residents' activity (talking) was audible during the survey.
16/09/16	12:06	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 12:16.
16/09/16	15:09	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 15:19.

Table 31: Additional attended noise level measurements at Haugh of Kilmorich, away from the A9

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
13/09/16	13:59	00:15	Prior to survey, rainfall was recorded. Measurements were started when rainfall stopped and weather conditions were conducive for noise monitoring. Noise sources included road traffic and birdsong. A train pass-by at 13:39. Measurement stopped after 5:29 minutes due to rain, recalibrated at 13:42 with calibration offset of -0.10 and at 13:58 with calibration offset of -0.24 then started measuring again.
14/09/16	11:35	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.
14/09/16	15:09	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 15:21.
14/09/16	19:26	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong.
15/09/16	11:39	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 11:50.
15/09/16	14:57	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Residents' activity (talking) audible during survey.
15/09/16	19:29	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and bird song. Residents' activity (talking) audible during the survey.
16/09/16	12:24	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Train pass-by at 12:24.
16/09/16	15:27	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. Residents' activity (talking) audible during the survey.

2.11 Measurement Location R3.11 – Westhaugh of Tulliemet, Ballinluig, Dunkeld, PH9 0NN

- 2.11.1 The measurement location was as shown in Photograph 11. A Rion NL-32 Class 1 sound level meter (s/n 00482602) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was approximately 10m from the north-eastern façade of the building.

Photograph 11: Noise monitoring equipment at Westhaugh of Tulliemet



- 2.11.2 The monitoring equipment was calibrated both before and after the measurement period using an Rion NC-74 (s/n 34536108) acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.
- 2.11.3 At this location the noise climate was dominated by birdsong, road traffic noise on the existing A9 (north-east of the measurement location), livestock in surrounding fields, road traffic noise from adjacent local road (mostly farm vehicles and HGV's) and occasional train pass-bys on the Highland Main Line railway located to the south-west.
- 2.11.4 Throughout the monitoring period, recorded wind speeds were relatively low and did not exceed 1.0ms^{-1} . Similarly, low rainfall events occurred during the monitoring period, where a maximum hourly rainfall of 0.21mm was recorded on 1 October 2016. No rainfall was recorded between 2 October and 4 October.

2.11.5 Table 32 and Table 33 provides the measured daily noise levels at this location, with and without the periods of rainfall

Table 32: Daily summarised noise levels at Westhaugh of Tulliemet, including periods of rainfall

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
29/09/2016	Thursday	-	64.5*	-	-	-	-	55.3	59.5	36.7
30/09/2016	Friday	62.0	63.9	55.1	62.3	64.3	56.8	54.2	58.3	32.4
01/10/2016	Saturday	61.0	63.1	52.7	61.3	63.6	54.4	52.0	56.1	27.3
02/10/2016	Sunday	60.7	62.7	52.7	61.1	63.3	54.9	54.9	58.6	34.8
03/10/2016	Monday	62.7	64.5	53.8	63.0	65.0	55.8	55.6	59.6	34.6
04/10/2016	Tuesday	61.7	64.0	53.0	62.0	64.3	54.5	55.9	60.4	37.4
05/10/2016	Wednesday	-	64.1*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

Table 33: Daily summarised noise levels at Westhaugh of Tulliemet, with periods of rainfall removed

Date	Day	Daytime (06:00 – 00:00) 18 hour Time Period			Daytime (07:00 – 23:00) 16 hour Time Period			Night-time (23:00 – 07:00) 8 hour Time Period		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
29/09/2016	Thursday	-	64.6*	-	-	-	-	55.3	59.5	36.7
30/09/2016	Friday	62.7	63.9	55.2	63.0	64.2	56.8	54.2	58.3	32.4
01/10/2016	Saturday	-	64.2*	-	-	-	-	51.9	56.1	27.3
02/10/2016	Sunday	60.7	62.7	52.7	61.1	63.3	54.9	54.9	58.6	34.8
03/10/2016	Monday	62.7	64.5	53.8	63.0	65.0	55.8	55.6	59.6	34.6
04/10/2016	Tuesday	61.7	64.0	53.0	62.0	64.3	54.5	55.9	60.4	37.4
05/10/2016	Wednesday	-	64.1*	-	-	-	-	-	-	-

* Determined using CRTN shortened measurement procedure

2.11.6 In addition to long term measurements a series of short term attended measurements were also undertaken and the results are provided in Table 34. A Cirrus Optimus Green CR: 171C sound level meter (s/n G061732) was positioned at a height of approximately 1.5m in free-field conditions near the long term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using an acoustic calibrator, which has itself been calibrated against a reference set traceable to National and International Standards. There was no significant shift in the observed calibration level.

Table 34: Additional attended noise level measurements at Westhaugh of Tulliemet

Start Date	Start Time (hh:mm)	Duration (hh:mm)	Comments
03/10/16	14:48	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic, birdsong, ducks and nearby animals. Fighter jet audible at 14:55.
03/10/16	19:24	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic. Train pass-by at 19:29.
04/10/16	11:48	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic and birdsong. One farm vehicle passed by during the survey.
04/10/16	16:45	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic.
04/10/16	19:14	00:15	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources included road traffic. One HGV passed by and ran idle during the survey.

3 Calibration Certificates



CERTIFICATE OF CALIBRATION



Date of Issue: 11 May 2016

Certificate Number: UCRT16/1161

Issued by:

ANV Measurement Systems

Beaufort Court

17 Roebuck Way

Milton Keynes MK5 8HL

Telephone 01908 642846 Fax 01908 642814

E-Mail: info@noise-and-vibration.co.uk

Web: www.noise-and-vibration.co.uk

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 2 Pages

Approved Signatory

M. Breslin []

K. Mistry []

J. Harriman [✓]

Customer ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes
MK5 8HL

Order No. ANV MS Hire

Test Procedure Procedure TP 1 Calibration of Sound Calibrators

Description Acoustic Calibrator

Identification	Manufacturer	Instrument	Model	Serial No.
	Rion	Calibrator	NC-74	34536108

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No. UKAS16/05098

Date Received 06 May 2016

Date Calibrated 11 May 2016

Previous Certificate *Dated* 22 May 2015
Certificate No. UCRT15/1143
Laboratory 7623

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION	Certificate Number UCRT16/1161
	Page 2 of 2 Pages

UKAS Accredited Calibration Laboratory No. 7623

Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

Test Microphone	<i>Manufacturer</i>	<i>Type</i>
	Brüel & Kjær	4134

Results

The level of the calibrator output under the conditions outlined above was

$$93.97 \pm 0.10 \text{ dB rel } 20 \mu\text{Pa}$$

Functional Tests and Observations

The frequency of the sound produced was	1001.36 Hz	±	0.13 Hz
The total distortion was	1.42 %	±	6.6 % of Reading

During the measurements environmental conditions were

Temperature	22	to	23 °C
Relative Humidity	33	to	39 %
Barometric Pressure	99.3	to	99.4 kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

..... END

Note:

Calibrator adjusted prior to calibration?	NO
Initial Level	N/A dB
Initial Frequency	N/A Hz

Additional Comments

None

Calibrated by: A Patel

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CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Date of issue 22/5/15 Certificate N° 1505281



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Page 1 of 4 Pages

Signed

G. Parry [] B. Baker [✓]

Acoustics Noise and Vibration Ltd trading as AV Calibration

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Shrewsbury Business Park
Sitka Drive
Shrewsbury
SY2 6LG

F.A.O. Barry Salway

ORDER No - Job No TRAC15/05127/02

DATE OF RECEIPT 12 May 2015

PROCEDURE AV Calibration Engineer's Handbook section 3

IDENTIFICATION ⁽⁰⁸⁷¹⁾ Sound level meter Rion type NL-32 serial No 00751323 connected via extension lead type EC-04 and preamplifier type NH-21 serial No 23663 to a half-inch microphone type UC-53A serial No 308645 fitted with a foam windshield type WS-03. Associated calibrator Rion type NC-74 serial No 34257024 with a one-inch housing and adapter type NC-74-002 for half-inch microphone.

CALIBRATED ON 22/5/15

PREVIOUS CALIBRATION Calibrated on 17 March 2014, Certificate No. TCRT14/1094 issued by a non accredited calibration laboratory ANV Measurement Systems

The measurements detailed herein are traceable to units of measurement realised at the National Physical Laboratory. This certificate may not be reproduced other than in full, except with the prior written approval of AV Calibration.

CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Certificate N° 1505281

Page 2 of 4 Pages

The sound level meter was set to frequency weighting A and adjusted to read 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure) in response to the sound calibrator supplied. This reading was derived from the Calibration Certificate No. 1505280 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter when fitted with the windshield.

The sound level meter was then tested, and its overall sensitivity adjusted as required.

An acoustic calibration at 1kHz was performed by application of a standard sound calibrator, whilst the tests at 125Hz and 8kHz were performed by the electrostatic actuator method.

At the end of the test, the sound calibrator was reapplied to the sound level meter and the meter reading was recorded.

RESULTS

The sound level meter was found to conform to the type 1 requirements of BS EN 60651:1994* and BS EN 60804:1994* for those tests carried out.

The self-generated noise recorded was:

10.9 dB (A)

16.3 dB (C)

23.2 dB (Lin)

The sound level meter reading obtained at the end of the test in response to the sound calibrator was 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure). This reading, corrected for ambient pressure, should be used henceforth to set up the sound level meter for field use.

The expanded level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.22 dB; that of the calibrator supplied with the sound level meter is ± 0.23 dB.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the *Guide to the Expression of Uncertainty in Measurement* published by the International Organisation for Standards (ISO).

All measurement data are held at AV Calibration for a period of at least six years.

The case reflection factors have been taken as zero, since an extension lead has been used for this verification.

The reference range, linearity range and primary indicator range specified by the manufacturer have been used. See note 5 Below.

The Rion NL-32 sound level meter design has successfully undergone pattern evaluation at Physikalisch-Technische Bundesanstalt (PTB). It was found to meet the requirements of BS EN 60651* and BS EN 60804* and was granted pattern approval as a Type 1 sound level meter.

No component of uncertainty for manufacturer-specified corrections has been included in the uncertainty budget and, in accordance with amendments to the standards, the measured values obtained during the verification have not been extended by any measurement uncertainty when assessing conformance to each standard.

CERTIFICATE OF CALIBRATION

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Certificate N° 1505281

Page 3 of 4 Pages

NOTES

- *1 BS EN 60651:1994 and BS EN 60804:1994 were formerly numbered BS 5969:1981 and BS 6698:1986 respectively.
- 2 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method.
 - 3 The instrument was tested with integral software as received.
 - 4 The NL-32 does not have a "max hold" function available when operating with time weighting I. The results recorded for the test of time weighting I are therefore the highest instantaneous reading shown on the display. Whilst these results meet the requirements of the standard, those for response to a single tone burst in particular may give a misleading impression of the accuracy of time weighting I on this instrument.
 - 5 After consultation with the manufacturer and their European agents, it has been established that the specifications given in the standard English-language handbook for the NL-32 are both incomplete and incorrect. An addendum to the handbook based on the PTB tests has been provided by Rion, and this revised specification has been used for the purposes of the present verification. For information, extracts from the addendum have been appended as page 4 of this certificate.
 - 6 The instrument was labelled "Aspinwall 00871" and "SKM GB-A03516"

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Certificate N° 1505281

Page 4 of 4 Pages

The following data supplied by Rion are included for completeness:

Addendum to the NL-32 Instruction Manual

Errata (page 133):

- Total range: 23 to 137 dB(A).
- Linearity range (on 30 - 120 dB reference range): 99 dB (28 to 127).

Additional information

- Primary indicator range (on 30 - 120 dB reference range): 32 - 111 dB, allowing a crest factor of 10 for Impulse time weighting.
- Pulse range: > 63 dB
- Measurement range for various LEVEL settings: See table below.

Measurement ranges				
Measurement range for various "LEVEL" range settings (dB) * Frequency weighting A-, C- and Lin.				
"LEVEL" Setting (dB)	Time weighting			Leq
	Fast/Slow	Impulse	Peak	
20 - 80	23 - 80 **	23 - 70 **	50 - 90	23 - 87 **
20 - 90	23 - 90 **	23 - 80 **	50 - 100	23 - 97 **
20 - 100	23 - 100 **	23 - 90 **	50 - 110	23 - 107 **
20 - 110	23 - 110 **	23 - 100 **	50 - 120	23 - 117 **
30 - 120	28 - 120 **	28 - 110 **	50 - 130	28 - 127 **
40 - 130	38 - 130	38 - 120	50 - 140	38 - 137

* For time weighting Fast and Slow a crest factor 3, and for time weighting Impulse a crest factor 10, is taken into account.
** The lower limit of the measurement range is 30 dB(C) for C-weighting and 35 dB(Lin) for Lin weighting.

END

CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Date of issue 22/5/15 Certificate N° 1505286



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Page 1 of 4 Pages

Signed

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Acoustics Noise and Vibration Ltd trading as AV Calibration

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F.A.O. Barry Salway

ORDER No - Job No TRAC15/05127/03

DATE OF RECEIPT 12 May 2015

PROCEDURE AV Calibration Engineer's Handbook section 3

IDENTIFICATION Sound level meter Rion type NL-32 serial No 00482601 connected via extension lead type EC-04 and preamplifier type NH-21 serial No 27705 to a half-inch microphone type UC-53A serial No 321276 fitted with a foam windshield type WS-03. Associated calibrator Rion type NC-74 serial No 34257024 with a one-inch housing and adapter type NC-74-002 for half-inch microphone. (0873)

CALIBRATED ON 22/5/15

PREVIOUS CALIBRATION Calibrated on 17 March 2014, Certificate No. TCRT14/1093 issued by a non accredited calibration laboratory ANV Measurement Systems

The measurements detailed herein are traceable to units of measurement realised at the National Physical Laboratory. This certificate may not be reproduced other than in full, except with the prior written approval of AV Calibration.

CERTIFICATE OF CALIBRATION

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Certificate N° 1505286

Page 2 of 4 Pages

The sound level meter was set to frequency weighting A and adjusted to read 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure) in response to the sound calibrator supplied. This reading was derived from the Calibration Certificate No. 1505280 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter when fitted with the windshield.

The sound level meter was then tested, and its overall sensitivity adjusted as required.

An acoustic calibration at 1kHz was performed by application of a standard sound calibrator, whilst the tests at 125Hz and 8kHz were performed by the electrostatic actuator method.

At the end of the test, the sound calibrator was reapplied to the sound level meter and the meter reading was recorded.

RESULTS

The sound level meter was found to conform to the type 1 requirements of BS EN 60651:1994* and BS EN 60804:1994* for those tests carried out.

The self-generated noise recorded was:

9.3 dB (A)

15.5 dB (C)

22.2 dB (Lin)

The sound level meter reading obtained at the end of the test in response to the sound calibrator was 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure). This reading, corrected for ambient pressure, should be used henceforth to set up the sound level meter for field use.

The expanded level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.22 dB; that of the calibrator supplied with the sound level meter is ± 0.23 dB.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the *Guide to the Expression of Uncertainty in Measurement* published by the International Organisation for Standards (ISO).

All measurement data are held at AV Calibration for a period of at least six years.

The case reflection factors have been taken as zero, since an extension lead has been used for this verification.

The reference range, linearity range and primary indicator range specified by the manufacturer have been used. See *note 5 Below*.

The Rion NL-32 sound level meter design has successfully undergone pattern evaluation at Physikalisch-Technische Bundesanstalt (PTB). It was found to meet the requirements of BS EN 60651* and BS EN 60804* and was granted pattern approval as a Type 1 sound level meter.

No component of uncertainty for manufacturer-specified corrections has been included in the uncertainty budget and, in accordance with amendments to the standards, the measured values obtained during the verification have not been extended by any measurement uncertainty when assessing conformance to each standard.

CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Certificate N° 1505286

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NOTES

- *1 BS EN 60651:1994 and BS EN 60804:1994 were formerly numbered BS 5969:1981 and BS 6698:1986 respectively.
- 2 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method.
- 3 The instrument was tested with integral software as received.
- 4 The NL-32 does not have a "max hold" function available when operating with time weighting I. The results recorded for the test of time weighting I are therefore the highest instantaneous reading shown on the display. Whilst these results meet the requirements of the standard, those for response to a single tone burst in particular may give a misleading impression of the accuracy of time weighting I on this instrument.
- 5 After consultation with the manufacturer and their European agents, it has been established that the specifications given in the standard English-language handbook for the NL-32 are both incomplete and incorrect. An addendum to the handbook based on the PTB tests has been provided by Rion, and this revised specification has been used for the purposes of the present verification. For information, extracts from the addendum have been appended as page 4 of this certificate.
- 6 The instrument was labelled "Aspinwall 00873" and "SKM GB-A03515"
- 7 The combination of microphone response and WS-03 windshield corrections was causing a FAIL result at 8kHz - instrument fitted with new replacement UC-53A microphone for this verification.

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CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Certificate N° 1505286

Page 4 of 4 Pages

The following data supplied by Rion are included for completeness:

Addendum to the NL-32 Instruction Manual

Errata (page 133):

- Total range: 23 to 137 dB(A).
- Linearity range (on 30 - 120 dB reference range): 99 dB (28 to 127).

Additional information

- Primary indicator range (on 30 - 120 dB reference range): 32 - 111 dB, allowing a crest factor of 10 for Impulse time weighting.
- Pulse range: > 63 dB
- Measurement range for various LEVEL settings: See table below.

Measurement ranges				
Measurement range for various "LEVEL" range settings (dB) * Frequency weighting A-, C- and Lin.				
"LEVEL" Setting (dB)	Time weighting			Leq
	Fast/Slow	Impulse	Peak	
20 - 80	23 - 80 **	23 - 70 **	50 - 90	23 - 87 **
20 - 90	23 - 90 **	23 - 80 **	50 - 100	23 - 97 **
20 - 100	23 - 100 **	23 - 90 **	50 - 110	23 - 107 **
20 - 110	23 - 110 **	23 - 100 **	50 - 120	23 - 117 **
30 - 120	28 - 120 **	28 - 110 **	50 - 130	28 - 127 **
40 - 130	38 - 130	38 - 120	50 - 140	38 - 137

* For time weighting Fast and Slow a crest factor 3, and for time weighting Impulse a crest factor 10, is taken into account.
** The lower limit of the measurement range is 30 dB(C) for C-weighting and 35 dB(Lin) for Lin weighting.

END

RR

CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Date of issue 22/5/15 Certificate N° 1505285



AV Calibration
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Page 1 of 4 Pages

Signed

G. Parry [] B. Baker [✓]

Acoustics Noise and Vibration Ltd trading as AV Calibration

CLIENT Jacobs Ltd
 Enviros House
 Shrewsbury Business Park
 Sitka Drive
 Shrewsbury
 SY2 6LG

F.A.O. Barry Salway

ORDER No - Job No TRAC15/05127/04

DATE OF RECEIPT 12 May 2015

PROCEDURE AV Calibration Engineer's Handbook section 3

IDENTIFICATION Sound level meter Rion type NL-32 serial No 00482602 connected via extension lead type EC-04 and preamplifier type NH-21 serial No 27706 to a half-inch microphone type UC-53A serial No 321107 fitted with a foam windshield type WS-03. Associated calibrator Rion type NC-74 serial No 34257024 with a one-inch housing and adapter type NC-74-002 for half-inch microphone. (875)

CALIBRATED ON 22/5/15

PREVIOUS CALIBRATION Calibrated on 14 March 2014, Certificate No. TCRT14/1092 issued by a non accredited calibration laboratory ANV Measurement Systems

The measurements detailed herein are traceable to units of measurement realised at the National Physical Laboratory. This certificate may not be reproduced other than in full, except with the prior written approval of AV Calibration.

CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Certificate N° 1505285

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The sound level meter was set to frequency weighting A and adjusted to read 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure) in response to the sound calibrator supplied. This reading was derived from the Calibration Certificate No. 1505280 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter when fitted with the windshield.

The sound level meter was then tested, and its overall sensitivity adjusted as required.

An acoustic calibration at 1kHz was performed by application of a standard sound calibrator, whilst the tests at 125Hz and 8kHz were performed by the electrostatic actuator method.

At the end of the test, the sound calibrator was reapplied to the sound level meter and the meter reading was recorded.

RESULTS

The sound level meter was found to conform to the type 1 requirements of BS EN 60651:1994* and BS EN 60804:1994* for those tests carried out.

The self-generated noise recorded was:

8.7 dB (A) 14.3 dB (C) 21.9 dB (Lin)

The sound level meter reading obtained at the end of the test in response to the sound calibrator was 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure). This reading, corrected for ambient pressure, should be used henceforth to set up the sound level meter for field use.

The expanded level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.22 dB; that of the calibrator supplied with the sound level meter is ± 0.23 dB.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the *Guide to the Expression of Uncertainty in Measurement* published by the International Organisation for Standards (ISO).

All measurement data are held at AV Calibration for a period of at least six years.

The case reflection factors have been taken as zero, since an extension lead has been used for this verification.

The reference range, linearity range and primary indicator range specified by the manufacturer have been used. See note 5 Below.

The Rion NL-32 sound level meter design has successfully undergone pattern evaluation at Physikalisch-Technische Bundesanstalt (PTB). It was found to meet the requirements of BS EN 60651* and BS EN 60804* and was granted pattern approval as a Type 1 sound level meter.

No component of uncertainty for manufacturer-specified corrections has been included in the uncertainty budget and, in accordance with amendments to the standards, the measured values obtained during the verification have not been extended by any measurement uncertainty when assessing conformance to each standard.

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NOTES

- *1 BS EN 60651:1994 and BS EN 60804:1994 were formerly numbered BS 5969:1981 and BS 6698:1986 respectively.

- 2 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method.

- 3 The instrument was tested with integral software as received.

- 4 The NL-32 does not have a "max hold" function available when operating with time weighting I. The results recorded for the test of time weighting I are therefore the highest instantaneous reading shown on the display. Whilst these results meet the requirements of the standard, those for response to a single tone burst in particular may give a misleading impression of the accuracy of time weighting I on this instrument.

- 5 After consultation with the manufacturer and their European agents, it has been established that the specifications given in the standard English-language handbook for the NL-32 are both incomplete and incorrect. An addendum to the handbook based on the PTB tests has been provided by Rion, and this revised specification has been used for the purposes of the present verification. For information, extracts from the addendum have been appended as page 4 of this certificate.

- 6 The instrument was labelled "Aspinwall 00875"

- 7 The combination of microphone response and WS-03 windshield corrections was causing a FAIL result at 8kHz - instrument fitted with new replacement UC-53A microphone for this verification.



CERTIFICATE OF CALIBRATION

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The following data supplied by Rion are included for completeness:

Addendum to the NL-32 Instruction Manual

Errata (page 133):

- Total range: 23 to 137 dB(A).
- Linearity range (on 30 - 120 dB reference range): 99 dB (28 to 127).

Additional information

- Primary indicator range (on 30 - 120 dB reference range): 32 - 111 dB, allowing a crest factor of 10 for impulse time weighting.
- Pulse range: > 63 dB
- Measurement range for various LEVEL settings: See table below.

Measurement ranges				
Measurement range for various "LEVEL" range settings (dB) * Frequency weighting A-, C- and Lin.				
"LEVEL" Setting (dB)	Time weighting			Leq
	Fast/Slow	Impulse	Peak	
20 - 80	23 - 80 **	23 - 70 **	50 - 90	23 - 87 **
20 - 90	23 - 90 **	23 - 80 **	50 - 100	23 - 97 **
20 - 100	23 - 100 **	23 - 90 **	50 - 110	23 - 107 **
20 - 110	23 - 110 **	23 - 100 **	50 - 120	23 - 117 **
30 - 120	28 - 120 **	28 - 110 **	50 - 130	28 - 127 **
40 - 130	38 - 130	38 - 120	50 - 140	38 - 137

* For time weighting Fast and Slow a crest factor 3, and for time weighting Impulse a crest factor 10, is taken into account.
** The lower limit of the measurement range is 30 dB(C) for C-weighting and 35 dB(Lin) for Lin weighting.

END

Certificate of Calibration



Equipment Details

Instrument Manufacturer Cirrus Research plc
Instrument Type CR:171C
Description Sound Level Meter
Serial Number G061732

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K 4192	Serial Number	1920791	Calibration Ref.	S6450
Pistonphone Type	B&K 4220	Serial Number	613843	Calibration Ref.	S6388

Calibrated by

Calibration Date

03 September 2015

Calibration Certificate Number

231584

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk



Calibration Chart for Electret Microphone

Type: MK:224 Serial No.: 20045595

Open Circuit Sensitivity at 1kHz:
-24.6 dB rel. 1V/Pa

58.7 mV/Pa

Conditions of Tests:

Barometric Pressure 1008 mBar

Relative Humidity 40 %

Temperature 24 °C

Signature: *[Signature]* Date: 20/09/2015

Cirrus Research plc
Acoustic House, Humnany YO14 0PH UK
www.cirrusresearch.co.uk

Specifications:

Outside Diameter:

13.2mm with protecting grid
12.7mm without protecting grid

Mounting Thread:

11.7mm 60 UNS 2

Ambient Pressure Coefficient:

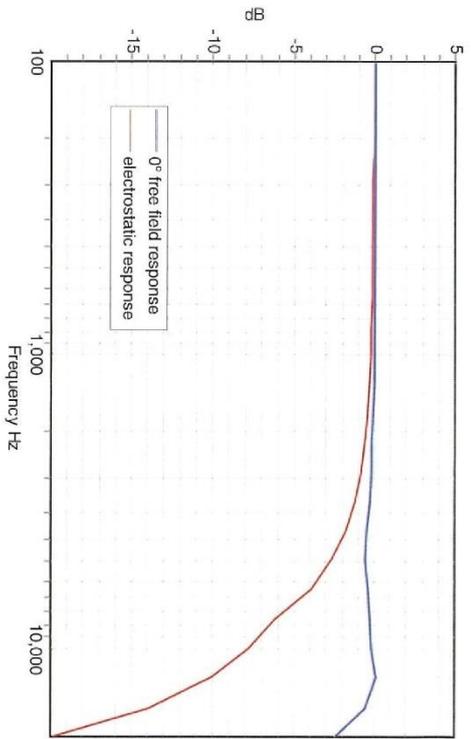
-0.02 to +0.02 dB/KPa for
±10% pressure change at 250Hz

Temperature Coefficient:

-10°C to +50°C
Approx. -0.015dB/K at 250Hz

Dynamic Range:

SPL below which total harmonic
distortion is <1%: 130dB



Certificate of Calibration



Equipment Details

Instrument Manufacturer Cirrus Research plc
Instrument Type CR:171C
Description Sound Level Meter
Serial Number G061733

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

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Microphone Type	B&K 4192	Serial Number	1920791	Calibration Ref.	S6450
Pistonphone Type	B&K 4220	Serial Number	613843	Calibration Ref.	S6388

Calibrated by

Calibration Date

03 September 2015

Calibration Certificate Number

231592

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk



Calibration Chart for Electret Microphone

Type: MK:224 Serial No.: 606473B

Open Circuit Sensitivity at 1kHz:

-25.2 dB rel.1V/Pa

54.8 mV/Pa

Conditions of Tests:

Barometric Pressure 1004 mBar

Relative Humidity 32 %

Temperature 22 °C

Signature:  Date: 03/09/2015

Cirrus Research plc

Acoustic House, Hummanby YO14 0PH UK
www.cirrusresearch.co.uk

Specifications:

Outside Diameter:

13.2mm with protecting grid

12.7mm without protecting grid

Mounting Thread:

1.7mm 60 UNS 2

Ambient Pressure Coefficient:

-0.02 to +0.02 dB/KPa for

±10% pressure change at 250Hz

Temperature Coefficient:

-10°C to +50°C

Approx. -0.015dB/K at 250Hz

Dynamic Range:

SPL below which total harmonic distortion is <1%: 130dB

