

Appendix A9.1
Noise & Vibration Survey

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Appendix A9.1: Noise & Vibration Survey

1. Baseline Noise Monitoring

1.1 Introduction

This report includes the relevant survey details and results associated with baseline noise monitoring undertaken as part of the Liffey Valley to City Centre Core Bus Corridor (hereafter referred to as the Proposed Scheme). The survey has been undertaken to inform the noise and vibration chapter of the Proposed Scheme EIAR.

Survey details and results for each of the noise monitoring locations are included within this report.

1.2 Survey Methodology

1.2.1 Study Area

The assessment study area is split into three geographical zones, as described in Table 1.

Table 1: Description of Geographical Zones in the Study Area

Geographical Zone	Description of Study Area
Liffey Valley to Le Fanu Road	This section of the Proposed Scheme is between Liffey Valley Shopping and Le Fanu Road. The Proposed Scheme veers east from a new bus interchange facility on the northern boundary of Liffey Valley Shopping centre across the M50, along the R833 Coldcut Road, and continues east along the R833 Ballyfermot Road. The Proposed Scheme passes from Cherry Orchard Hospital along the R833 Ballyfermot Road to the Junction with Le Fanu Road.
Le Fanu Road to Sarsfield Road	This section of the proposed bus corridor Proposed Scheme travels along the R833 Ballyfermot Road between Le Fanu Road as far as the R833 Sarsfield Road. Road traffic diversions are proposed along Kylemore Road between Le Fanu Road and the R833 Ballyfermot Road.
Sarsfield Road to City Centre	This section of the Proposed Scheme extends from R833 Sarsfield Road east onto Inchicore Road, along Grattan Crescent, Emmett Road, R810 Old Kilmainham, R810 Mount Brown and R810 James's Street as far as St. James's Hospital entrance. Moving east, the Proposed Scheme continues past St. James's Hospital to Thomas Street, Cornmarket and terminates at High Street to the Junction of Nicholas Street and Winetavern Street / St Michaels Hill.

1.2.2 Survey Locations

Baseline noise surveys have been conducted at locations representative of the nearest noise sensitive areas which have the potential to be impacted by construction works and / or those likely to be impacted during the Operational Phase of the Proposed Scheme. Baseline noise measurements were made over both long-term and short-term periods to inform the assessment.

- Long-term surveys (typically up to one week in duration) were made at a total of two locations.
- Short-term surveys (attended day-time measurements), were made at a total of twelve locations along the length of the Proposed Scheme.

Figure 9.2 in Volume 3 of this EIAR illustrates the baseline noise monitoring locations. Each is discussed in the relevant geographical zone in the following sections.

1.2.2.1 Liffey Valley to Le Fanu Road

A total of one long-term unattended monitoring location and three attended survey locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 2.

Table 2: Noise Monitoring Locations – Liffey Valley to Le Fanu Road

Location	Description of Survey Location
Unattended Monitoring Locations	
CBC0007UNML001	In rear residential garden facing directly onto R833 Coldcut Road in Palmer Drive housing estate. Located approximately 8m from R833 road edge, separated by wall.
Attended Monitoring Locations	
CBC0007ANML001	Green area to southwest of Fonthill Road Roundabout, at rear of Greenfort Lawns housing estate gardens facing onto Fonthill Road. Located approximately 18m from road edge.
CBC0007ANML002	Green area to south of Palmers Walk housing estate, in line with closest facades facing onto R833 Coldcut Road. Located approximately 18m from R833 road edge.
CBC0007ANML003	On footpath to northeast of Cherry Orchard Hospital, in line with closest facades facing onto R833 Ballyfermot Road. Located approximately 6m from R833 road edge.

1.2.2.2 Le Fanu Road to Sarsfield Road

A total of six attended survey locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 3.

Table 3: Noise Monitoring Locations – Le Fanu Road to Sarsfield Road

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0007ANML004	On footpath to northeast of R833 Ballyfermot Road / Le Fanu Road junction, in line with facades facing onto R833 Ballyfermot Road. Located approximately 15m from R833 road edge.
CBC0007ANML005	Green area of Church to northwest of R833 Ballyfermot Road / R112 Kylemore Road junction. Located approximately 40m from R833 road edge.
CBC0007ANML006	On footpath to north of R112 Kylemore Road / Convent Lawns junction, in line with residential facades facing onto R112 Kylemore Road. Located approximately 13m from R11 road edge.
CBC0007ANML007	On footpath to west of Le Fanu Road / Colepark Drive junction, in line with residential façades facing onto Le Fanu Road. Located approximately 10m from road edge.
CBC0007ANML008	On footpath in The Steeples housing estate to south of R833 Ballyfermot Road, in line with closest facades facing onto R833 Ballyfermot Road. Located approximately 10m from R833 road edge.
CBC0007ANML009	On footpath to east of R833 Sarsfield Road / First Avenue junction, in line with commercial facades facing onto R833 Sarsfield Road. Located approximately 18m to R833 road edge.

1.2.2.3 Sarsfield Road to City Centre

A total of one long-term unattended monitoring location and three attended survey locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 4.

Table 4: Noise Monitoring Locations – Sarsfield Road to City Centre

Location	Description of Survey Location
Unattended Monitoring Locations	
CBC0007UNML002	In rear residential garden facing directly onto R839 Grattan Crescent road. Located approximately 8m from R839 road edge, separated by wall.
Attended Monitoring Locations	
CBC0007ANML010	Green area 85m to north of R111 South Circular Road / R810 Emmet Road junction, in line with closest residential facades facing onto R810 Emmet Road. Located approximately 13m from R810 Emmet Road.
CBC0007ANML011	Paved area to 145m east of R810 Old Kilmainham Road / Brookfield Road junction, in line with residential facades facing onto R810 Old Kilmainham Road. Located approximately 10m from R810 road edge.
CBC0007ANML012	On footpath 25m southwest of R108 High Street / R810 Thomas Street junction. Located approximately 9m from road edge.

1.2.3 Survey Periods

Unattended noise surveys were undertaken between 2 September 2020 and 7 October 2020. The specific survey dates for each location are included in the survey result tables in Section 1.3.

Attended noise surveys were undertaken between 24 June 2020 and 25 September 2020. The specific survey dates and times for each location are included in the survey results tables in Section 1.3.

1.2.4 Survey Equipment and Personnel

The unattended surveys were undertaken using RION NL-52 sound level meter. The attended surveys were undertaken using either RION NL-52 and Brüel and Kjær 2250L sound level meters. The specific equipment details are summarised in Table 5.

Table 5: Noise Monitoring Equipment

Survey Type	Equipment	Serial Number	Calibration Date
Unattended	Rion NL-52	764925	19/08/2020
		998411	16/09/2020
Attended	Rion NL-52	998413	22/01/2020
	Rion NL-52	186668	07/05/2020
	Brüel and Kjær 2250L	3008402	04/11/2019

Calibration certificate of the monitoring equipment are included within Section 4.

For unattended surveys, a Rion WS-15 Outdoor Microphone Protection System with microphone extension cable and outdoor peli-case was used. An image of the equipment install at each monitoring location is included in Section 5.

The surveys were conducted by Jack Brennan and Alex Ryan, acoustic technicians, AWN Consulting.

1.2.5 Survey Parameters

The following noise parameters were measured and are discussed within this report.

L_{Aeq,T} is the A-weighted equivalent continuous steady sound level during the sample period and effectively represents an average value of the defined measurement period, T.

$L_{Aeq,16hr}$ refers to the ambient daytime period between 07:00 and 23:00hrs.

$L_{A10,T}$ is the A-weighted sound level that is exceeded for 10% of the sample period; this parameter gives an indication of the upper limit of fluctuating noise such as that from road traffic. The T is the sample period the parameter is measured over.

$L_{A10,18hr}$ is the L_{A10} parameter between 06:00 and 00:00hrs as defined within the Calculation of Road Traffic Noise (hereafter referred to as CRTN) (UK Department of Transport 1998).

$L_{A90,T}$ is the A-weighted sound level that is exceeded for 90% of the sample period; generally used to quantify background noise. The T is the sample period the parameter is measured over.

$L_{A90,16hr}$, refers to the background daytime noise level between 07:00 and 23:00hrs

$L_{A90,8hr}$, refers to the background night-time noise level between 23:00 and 07:00hrs

The L_{den} parameter is also discussed within the report. For long-term survey locations, this parameter is derived from the L_{Aeq} data over each 24 hour period as is defined as follows:

L_{den} is the 24hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ (plus a 5dB penalty) and the L_{night} (plus a 10dB penalty). L_{den} is calculated using the following formula, as defined within the Environmental Noise Regulations (S.I.140 / 2006):

$$L_{den} = 10 \log \left(\frac{1}{24} \left(12 * \left(10^{\frac{L_{day}}{10}} \right) + 4 * \left(10^{\frac{L_{evening}+5}{10}} \right) + 8 * \left(10^{\frac{L_{night}+10}{10}} \right) \right) \right)$$

Where:

L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2:2017 Part 2: Determination of sound pressure levels (hereafter referred to as ISO 1996-2) (ISO 2017), determined over all the day periods of a year. The 12hr daytime period is between 07:00 to 19:00hrs.

$L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year. The 4hr evening period is between 19:00 to 23:00hrs.

L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year. The 8hr night-time period is between 23:00 to 07:00hrs.

1.2.6 Survey Procedure

Noise measurements were conducted in general accordance with the guidance contained in ISO 1996-1:2016 Acoustics – Description measurement and assessment and environmental noise. Part 1: Basic quantities and assessment procedures (hereafter referred to as ISO 1996-1) (ISO 2016) and ISO 1996-2 (ISO 2017).

1.2.6.1 Unattended Measurements

For unattended noise surveys, the monitoring equipment was installed within the private grounds of residential properties. For all unattended locations, the microphone was installed at a height of approximately 3.8m above ground. The equipment was set to log for 15 minute intervals on a continual basis over a 1 week period.

1.2.6.2 Attended Measurements

Attended noise surveys were undertaken at public locations at positions representative of the adjacent noise sensitive locations (e.g. on green areas in residential areas, footpaths, parks etc.). For all attended surveys, the microphone was positioned at height of approximately 1.2m above ground.

The attended surveys were undertaken in accordance with the shortened measurement procedure described in CRTN (UK Department of Transport 1998) and Transport Infrastructure Ireland's (TII) document Guidelines for the Treatment of Noise and Vibration on National Road (TII 2004).

This methodology involves a method whereby $L_{A10(18hour)}$ and L_{den} values are obtained through a combination of measurement and calculation as follows:

- Noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00 and 17:00hrs.
- Each sample period was measured over a 15 minute duration.
- The $L_{A10(18hour)}$ for the location is derived by subtracting 1 dB from the arithmetic average of the three hourly sample values, i.e.

$$L_{A10(18hour)} = ((\sum L_{A10(15\ minutes)}) \div 3) - 1\text{ dB.}$$
- The derived L_{den} value is calculated from the $L_{A10(18hour)}$ value, i.e.

$$L_{den} = 0.86 \times L_{A10(18hr)} + 9.86\text{ dB.}$$

1.3 Survey Results

1.3.1 Liffey Valley to Le Fanu Road

1.3.1.1 Unattended Surveys

The unattended noise survey results recorded during the baseline surveys within this study area are presented in Table 6.

Table 6: Unattended Noise Survey Results for Liffey Valley to Le Fanu Road

Survey Date	Daytime				Evening	Night-Time			L_{den}
	$L_{Aeq,16hr}$	L_{day}	$L_{A10,16hr}$	$L_{A90,16hr}$	$L_{evening}$	L_{night}	$L_{A10,8hr}$	$L_{A90,8hr}$	
CBC0007UNML001									
02/09/2020	67	67	69	62	65	61	63	53	70
03/09/2020	67	68	69	63	66	61	63	54	70
04/09/2020	67	68	70	63	67	-	-	-	67
Average	67	68	69	63	66	61	63	53	69

Road traffic from R833 Coldcut Road is the dominant noise source at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were recorded in the order of 67 dB $L_{Aeq,16hr}$. Average background daytime noise levels were measured in the order of 63 dB $L_{A90,16hr}$.

Night-time noise levels at the monitoring locations are dominated by road traffic from R833 Coldcut Road. Average ambient night-time noise levels were measured in the order of 61 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the order of 53 dB $L_{A90,8hr}$.

The measured L_{den} values in this geographical section was in the order of 69 dB L_{den} .

1.3.1.2 Attended Surveys

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 7 overleaf.

Table 7: Attended Noise Survey Results for Liffey Valley to Le Fanu Road

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10 ⁻⁵ Pa)			Derived L _{den}	Survey Notes
			L _{Aeq}	L _{A10}	L _{A90}		
CBC0007ANML001	06/08/2020	12:58	55	57	54	58	Road traffic noise from Fonthill Road Roundabout dominant noise source, aircraft flyover.
		13:49	56	58	54		
		14:35	57	58	54		Road traffic noise from Fonthill Road Roundabout dominant noise source, aircraft flyover, car horn.
CBC0007ANML002	24/06/2020	10:00	58	60	54	60	Road traffic noise from R833 Coldcut Road dominant noise source, birdsong, car horn.
		11:16	57	59	53		Road traffic noise from R833 Coldcut Road dominant noise source, birdsong.
		12:32	56	58	52		
CBC0007ANML003	06/08/2020	13:26	69	72	61	70	Road traffic noise from R833 Ballyfermot Road dominant noise source, birdsong, car horn.
		14:11	68	71	58		Road traffic noise from R833 Ballyfermot Road dominant noise source.
		14:58	68	71	56		

1.3.2 Le Fanu Road to Sarsfield Road

1.3.2.1 Attended Surveys

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 8 overleaf.

Table 8: Attended Noise Survey Results for Le Fanu Road to Sarsfield Road

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10 ⁻⁵ Pa)			Derived L _{den}	Survey Notes
			L _{Aeq}	L _{A10}	L _{A90}		
CBC0007ANML004	24/06/2020	10:26	62	65	53	65	Road traffic noise from R833 Ballyfermot Road dominant noise source, intermittent traffic light beacon, car horn, pedestrian crossing, pedestrian conversation.
		11:39	63	65	54		Road traffic noise from R833 Ballyfermot Road dominant noise source, car horn, dog barking.
		13:05	62	65	54		Road traffic noise from R833 Ballyfermot Road dominant noise source, car horn, pedestrian conversation.
CBC0007ANML005	24/06/2020	10:48	61	64	55	64	Road traffic noise from R833 Ballyfermot Road and R112 Kylemore Road dominant noise source.
		12:01	62	65	57		Road traffic noise from R833 Ballyfermot Road and R112 Kylemore Road dominant noise source, car horn.
		13:26	62	65	57		Road traffic noise from R833 Ballyfermot Road and R112 Kylemore Road dominant noise source, pedestrian conversation.
CBC0007ANML006	25/09/2020	10:18	68	72	56	71	Road traffic noise from R112 Kylemore Road dominant noise source. Construction noise nearby and children playing.
		11:18	68	72	58		Road traffic noise from R112 Kylemore Road dominant noise source. Construction noise nearby.
		12:17	68	71	58		Road traffic noise from R112 Kylemore Road dominant noise source. Construction noise nearby and children playing.
CBC0007ANML007	25/09/2020	09:58	61	64	51	65	Road traffic noise from Le Fanu Road and Colepark Drive dominant noise source.
		10:58	60	64	51		
		11:57	62	65	53		
CBC0007ANML008	24/06/2020	13:47	56	59	48	60	Road traffic noise from R833 Ballyfermot Road dominant noise source.
		15:01	55	59	48		
		16:19	57	60	50		
CBC0007ANML009	25/09/2020	10:38	64	67	54	67	Road traffic noise from R833 Sarsfield Road dominant noise source.
		11:38	64	68	53		
		12:37	62	66	53		

1.3.3 Sarsfield Road to City Centre

1.3.3.1 Unattended Surveys

The noise survey results recorded during the baseline surveys within this study area are presented in Table 9.

Table 9: Unattended Noise Survey Results for Sarsfield Road to City Centre

Survey Date	Daytime				Evening	Night-Time			L _{den}
	L _{Aeq,16hr}	L _{day}	L _{A10,16hr}	L _{A90,16hr}	L _{evening}	L _{night}	L _{A10,8hr}	L _{A90,8hr}	
CBC0007UNML003									
30/09/2020	65	66	67	53	62	59	60	42	67
01/10/2020	66	63	66	53	68	62	64	47	70
02/10/2020	67	65	66	53	68	58	61	40	69
03/10/2020	64	64	65	51	65	57	60	46	66
04/10/2020	64	65	67	51	62	60	60	42	68
05/10/2020	63	64	66	52	62	59	60	44	67
06/10/2020	64	64	66	53	64	59	60	46	67
Average	65	65	66	52	65	59	61	44	68

Road traffic from R839 Grattan Crescent is the dominant noise source at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were recorded in order of 65 dB L_{Aeq,16hr}. Average background daytime noise levels were measured in the order of 52 dB L_{A90,16hr}.

Night-time noise levels at the monitoring locations are dominated by road traffic from R839 Grattan Crescent. Average ambient night-time noise levels were measured in the order of 59 dB L_{Aeq,8hr}. Average background noise levels during this time period were measured in the order of 44 dB L_{A90,8hr}.

The measured L_{den} values in this study area order of 68 dB L_{den}.

1.3.3.2 Attended Surveys

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 10 overleaf.

Table 10: Attended Noise Survey Results for Sarsfield Road to City Centre

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10 ⁻⁵ Pa)			Derived L _{den}	Survey Notes
			L _{Aeq}	L _{A10}	L _{A90}		
CBC0007ANML010	24/06/2020	14:11	58	61	48	61	Road traffic noise from R111 South Circular Road and R810 Emmet Road dominant noise source, birdsong.
		15:28	57	60	48		
	25/06/2020	10:11	56	60	47		
CBC0007ANML011	24/06/2020	14:34	66	70	49	68	Road traffic noise from R810 Old Kilmainham Road / Brookfield Road dominant noise source, construction noise.
		15:49	65	69	48		Road traffic noise from R810 Old Kilmainham Road / Brookfield Road dominant noise source.
	25/06/2020	10:34	64	68	51		Road traffic noise from R810 Old Kilmainham Road / Brookfield Road dominant noise source, birdsong.
CBC0007ANML012	25/06/2020	11:15	64	68	56	67	Road traffic noise from R108 High Street and R810 Thomas Street dominant noise source, birdsong, pedestrian conversation.
		12:00	65	68	56		
		12:42	65	68	56		Road traffic noise from R108 High Street and R810 Thomas Street dominant noise source, birdsong.

2. Baseline Vibration Monitoring

2.1 Introduction

This section includes the relevant survey details and results associated baseline vibration surveys conducted as part of the overall Bus Connects Dublin – Core Bus Corridor Infrastructure Works (hereafter referred to as the Proposed Works). Baseline vibration data obtained from this study has been used to information all individual Bus Connects Core Bus Corridor Schemes.

2.2 Survey Methodology

2.2.1 Survey Locations

Attended vibration monitoring was undertaken a at sample locations adjacent to existing bus lanes within Dublin City. The surveys were undertaken to obtain typical baseline vibration levels along roads with both mixed vehicular traffic lanes and individual bus lanes. This information has been used to inform the operational vibration impact assessment for the Proposed Works.

Surveys were also undertaken along an access road to the Harristown Bus Depot, Horizon Logistics Park, Swords, Co. Dublin, to obtain a measurement of vibration relating to specific bus drive by in isolation at a controlled sampling location to characterise the specific vibration level associated with buses in the absence of other traffic. A description of the survey locations is set out in Table 11.

Table 11: Vibration Monitoring Locations

Vibration Monitoring Locations	Description of Survey Location
AVML001	Harristown – Entrance Road to Bus Depot, midway along inbound road, 5m from road edge
AVML002	Harristown – Roundabout at Bus Depot entrance, buses entering depot, 5m from road edge
AVML003	Harristown – Roundabout at Bus Depot entrance, buses exiting depot, 5m from road edge
AVML004	Harristown – Entrance Road to Bus Depot, midway along outbound road, 5m from road edge
AVML005	Harristown – Entrance Road to Bus Depot, midway along inbound road, 7m from road edge
AVML006	Malahide Road / St. Johns Court – 5m from edge of Inbound Bus Lane
AVML007	Malahide Road / St. Johns Court – 10m from edge of Inbound Bus Lane
AVML008	Malahide Road / Donnycarney Church – 2.5m from edge of Inbound Bus Lane
AVML009	Malahide Road– 2.5m from edge of outbound Bus Lane

The survey locations undertaken along the Harristown Bus Depot entrance are illustrated in Image 1. The survey locations undertaken along the Malahide Road are illustrated in Image 2.



Image 1: Vibration Monitoring Locations Harristown Bus Depot (source Google Earth)



Image 2: Vibration Monitoring Locations Malahide Road (source Google Earth)

2.2.2 Survey Periods

Vibration monitoring was undertaken on the following dates:

- AVML001 - AVML005 : 30th July 2020; and
- AVML005 – AMML009: 13th August 2020

2.2.3 Survey Equipment and Personnel

The survey was undertaken using a RION VM-56 vibration meter (S/N 680043) with PV-83D tri-axial accelerometer. Calibration certificate of monitoring equipment are included within Section 4.

The surveys were conducted Alex Ryan and David O'Donoghue, acoustic technicians, AWN Consulting.

2.2.4 Survey Procedure

Vibration measurements were conducted in general accordance with the guidance contained in British Standard BS 7385. Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings (1990).

Vibration was measured in the three orthogonal axes. The accelerometer was secured in place with a 5kg sandbag at all monitoring locations.

The equipment was set to log for 1 minute intervals on a continual basis with an instantaneous storage interval of 100ms. Vibration monitoring periods at AVML001 to AVML005 along the entrance road to Harristown Bus Depot were undertaken for a period of 15 minutes at each position. Vibration monitoring periods at AVML006 to AVML009 along the Malahide Road were undertaken for a period of 30 minutes at each position.

2.2.5 Survey Parameters

The following vibration parameters are discussed within this report.

PPV Peak Particle Velocity (PPV) is a measure of the velocity of vibration displacement in terms of millimetres per second (mm/s). It is defined as follows within BS 7385: (1990) as:

“the maximum instantaneous velocity of a particle at a point during a given time interval”

VDV Vibration Dose Value (VDV) is an evaluation of human exposure to vibration in buildings. It defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response. It is defined as follows within British Standard BS 6472: (2008) Guide to evaluation of human exposure to vibration in buildings (2008): Part 1 - Vibration sources other than blasting, as:

“The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in m/s² and the time period over which the VDV is measured is in seconds. This yields VDV_s in m/s^{1.75}”

The frequency weightings used in the BS 6472 (2008) document is W_b weighting for vertical axis and W_d for the horizontal axes.

2.3 Survey Results – Harristown Bus Depot

The vibration survey results measured at each location are presented for each pass by event (bus drive by) in terms of the PPV parameter in mm/s and in terms of the VDV parameter in $m/s^{1.75}$ for each axis.

2.3.1 Location AVML001

Table 12 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 12: Vibration Monitoring Results at ANML001

Event Time	PPV, mm/s			VDV _b , $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
14:57	0.05	0.05	0.06	0.0003	0.0003	0.0020
15:01	0.03	0.04	0.04	0.0002	0.0003	0.0016
15:02	0.03	0.03	0.03	0.0002	0.0002	0.0008
15:03	0.02	0.04	0.04	0.0001	0.0002	0.0016
15:04	0.03	0.02	0.06	0.0002	0.0002	0.0022
15:05	0.04	0.05	0.08	0.0002	0.0002	0.0028
15:06	0.03	0.04	0.03	0.0002	0.0002	0.0013
15:07	0.03	0.04	0.05	0.0002	0.0002	0.0018
Minimum event	0.02	0.02	0.03	0.0001	0.0002	0.0008
Maximum event	0.05	0.05	0.08	0.0003	0.0003	0.0028

2.3.2 Location AVML002

Table 13 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 13: Vibration Monitoring Results at ANML002

Event Time	PPV, mm/s			VDV _b , $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
15:22	0.03	0.03	0.08	0.0002	0.0002	0.0019
15:26	0.02	0.03	0.03	0.0002	0.0002	0.0012
15:29	0.02	0.07	0.09	0.0002	0.0003	0.0014
15:30	0.02	0.02	0.07	0.0001	0.0002	0.0019
15:31	0.03	0.04	0.06	0.0002	0.0002	0.0024
15:32	0.02	0.03	0.07	0.0002	0.0002	0.0022
15:33	0.03	0.03	0.06	0.0002	0.0002	0.0014
15:34	0.02	0.02	0.04	0.0001	0.0002	0.0016
Minimum event	0.03	0.07	0.09	0.0002	0.0003	0.0024
Maximum event	0.02	0.02	0.03	0.0001	0.0002	0.0012

2.3.3 Location AVML003

Table 14 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 14: Vibration Monitoring Results at ANML003

Event Time	PPV, mm/s			VDV _{b,d} , m/s ^{1.75}		
	X	Y	Z	X	Y	Z
15:40	0.06	0.06	0.09	0.0003	0.0003	0.0031
15:43	0.07	0.05	0.07	0.0003	0.0003	0.0027
15:44	0.04	0.05	0.06	0.0002	0.0003	0.0021
15:45	0.07	0.05	0.07	0.0003	0.0003	0.0032
15:49	0.03	0.03	0.03	0.0002	0.0002	0.0014
15:50	0.06	0.06	0.05	0.0003	0.0004	0.0027
Minimum event	0.07	0.06	0.09	0.0003	0.0004	0.0032
Maximum event	0.03	0.03	0.03	0.0002	0.0002	0.0014

2.3.4 Location AVML004

Table 15 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 15: Vibration Monitoring Results at ANML004

Event Time	PPV, mm/s			VDV _b , m/s ^{1.75}		
	X	Y	Z	X	Y	Z
16:04	0.08	0.12	0.1	0.0006	0.0008	0.0060
16:06	0.09	0.1	0.13	0.0004	0.0006	0.0061
16:08	0.1	0.13	0.11	0.0005	0.0008	0.0049
16:09	0.07	0.1	0.12	0.0005	0.0006	0.0049
16:10	0.11	0.12	0.15	0.0006	0.0007	0.0072
16:11	0.08	0.09	0.1	0.0005	0.0006	0.0046
16:12	0.07	0.08	0.11	0.0004	0.0006	0.0059
16:13	0.07	0.09	0.11	0.0004	0.0005	0.0054
Minimum event	0.11	0.13	0.15	0.0006	0.0008	0.0072
Maximum event	0.07	0.08	0.1	0.0004	0.0005	0.0046

2.3.5 Location AVML005

Table 16 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 16: Vibration Monitoring Results at ANML005

Event Time	PPV, mm/s			VDV _b , m/s ^{1.75}		
	X	Y	Z	X	Y	Z
16:36	0.03	0.02	0.03	0.0002	0.0002	0.0013
16:39	0.02	0.03	0.03	0.0002	0.0002	0.0017
16:40	0.03	0.04	0.04	0.0002	0.0003	0.0015
16:44	0.03	0.04	0.06	0.0002	0.0003	0.0021
16:46	0.03	0.03	0.03	0.0002	0.0002	0.0012
16:47	0.03	0.03	0.03	0.0002	0.0002	0.0013
16:48	0.03	0.03	0.04	0.0002	0.0002	0.0012
Minimum event	0.02	0.02	0.03	0.0002	0.0002	0.0012
Maximum event	0.03	0.04	0.06	0.0002	0.0003	0.0021

2.4 Survey Results – Malahide Road

2.4.1 Location AVML006

Table 17 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 17: Vibration Monitoring Results at ANML006

Event Time	PPV, mm/s			VDV _b , m/s ^{1.75}			Notes
	X	Y	Z	X	Y	Z	
11:23	0.03	0.03	0.07	0.0002	0.0002	0.0020	
11:24	0.03	0.02	0.06	0.0002	0.0001	0.0018	
11:25	0.03	0.03	0.10	0.0002	0.0002	0.0030	Bus
11:26	0.02	0.02	0.06	0.0002	0.0002	0.0015	HGV
11:27	0.03	0.03	0.07	0.0002	0.0002	0.0030	
11:28	0.02	0.02	0.05	0.0001	0.0001	0.0019	
11:29	0.05	0.03	0.08	0.0002	0.0002	0.0033	Bus
11:30	0.04	0.16	0.17	0.0002	0.0008	0.0027	HGV
11:31	0.02	0.02	0.03	0.0001	0.0001	0.0017	
11:32	0.04	0.05	0.07	0.0002	0.0002	0.0029	HGV
11:33	0.03	0.03	0.05	0.0002	0.0002	0.0020	
11:34	0.02	0.02	0.04	0.0002	0.0001	0.0015	Bus
11:35	0.04	0.04	0.13	0.0002	0.0002	0.0050	HGV
11:36	0.02	0.02	0.04	0.0001	0.0002	0.0015	
11:37	0.02	0.02	0.05	0.0002	0.0002	0.0020	Bus
11:38	0.02	0.02	0.03	0.0001	0.0001	0.0014	
11:39	0.04	0.03	0.10	0.0002	0.0002	0.0037	
11:40	0.03	0.04	0.12	0.0002	0.0002	0.0026	
11:41	0.07	0.06	0.15	0.0003	0.0002	0.0056	
11:42	0.05	0.03	0.11	0.0002	0.0002	0.0040	
11:43	0.04	0.04	0.05	0.0002	0.0002	0.0023	HGV
11:44	0.03	0.08	0.08	0.0002	0.0004	0.0021	
11:45	0.03	0.03	0.05	0.0002	0.0002	0.0025	HGV
11:46	0.04	0.04	0.06	0.0002	0.0002	0.0027	HGV
11:47	0.02	0.03	0.04	0.0001	0.0002	0.0012	
11:48	0.04	0.04	0.10	0.0003	0.0002	0.0036	
11:49	0.06	0.04	0.08	0.0003	0.0002	0.0028	
11:50	0.03	0.02	0.05	0.0002	0.0002	0.0020	
11:51	0.03	0.04	0.05	0.0002	0.0003	0.0021	
11:52	0.04	0.05	0.21	0.0003	0.0003	0.0053	
Maximum all traffic	0.07	0.16	0.17	0.0003	0.0008	0.0056	
Maximum bus	0.05	0.03	0.10	0.0002	0.0002	0.0033	

2.4.2 Location AVML007

Table 18 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 18: Vibration Monitoring Results at ANML007

Event Time	PPV, mm/s			VDV _b , m/s ^{1.75}			Notes
	X	Y	Z	X	Y	Z	
11:55	0.03	0.02	0.04	0.0002	0.0001	0.0011	HGV
11:56	0.03	0.04	0.03	0.0002	0.0002	0.0011	
11:57	0.02	0.06	0.06	0.0002	0.0003	0.0011	
11:58	0.03	0.03	0.02	0.0002	0.0002	0.0004	
11:59	0.02	0.03	0.03	0.0001	0.0002	0.0008	
12:00	0.02	0.02	0.02	0.0001	0.0001	0.0005	
12:01	0.02	0.03	0.02	0.0001	0.0002	0.0005	
12:02	0.03	0.02	0.03	0.0002	0.0002	0.0009	
12:03	0.03	0.03	0.02	0.0002	0.0002	0.0008	
12:04	0.02	0.03	0.02	0.0001	0.0001	0.0004	
12:05	0.02	0.02	0.03	0.0002	0.0002	0.0011	
12:06	0.03	0.03	0.02	0.0002	0.0002	0.0006	Bus
12:07	0.02	0.05	0.05	0.0001	0.0002	0.0008	Bus
12:08	0.02	0.02	0.02	0.0002	0.0001	0.0007	Bus
12:09	0.02	0.02	0.03	0.0001	0.0002	0.0008	
12:10	0.02	0.03	0.02	0.0002	0.0002	0.0005	Bus
12:11	0.02	0.02	0.02	0.0001	0.0002	0.0009	
12:12	0.02	0.02	0.02	0.0001	0.0002	0.0003	
12:13	0.02	0.02	0.02	0.0001	0.0001	0.0007	Bus
12:14	0.02	0.02	0.02	0.0001	0.0002	0.0009	
12:15	0.02	0.02	0.02	0.0001	0.0001	0.0008	
12:16	0.02	0.02	0.02	0.0001	0.0001	0.0005	
12:17	0.02	0.02	0.02	0.0001	0.0001	0.0005	Bus
12:18	0.02	0.03	0.03	0.0002	0.0002	0.0008	
12:19	0.03	0.03	0.03	0.0002	0.0002	0.0010	
12:20	0.02	0.02	0.02	0.0002	0.0002	0.0009	Bus
12:21	0.02	0.02	0.04	0.0001	0.0001	0.0012	
12:22	0.02	0.03	0.03	0.0001	0.0002	0.0010	
Maximum all traffic	0.03	0.06	0.06	0.0002	0.0003	0.0012	
Maximum bus	0.03	0.05	0.05	0.0002	0.0002	0.0009	

2.4.3 Location AVML008

Table 19 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 19: Vibration Monitoring Results at ANML008

Event Time	PPV, mm/s			VDV _b , m/s ^{1.75}			Notes
	X	Y	Z	X	Y	Z	
12:31	0.02	0.02	0.06	0.0001	0.0001	0.0004	Bus
12:32	0.02	0.06	0.08	0.0001	0.0003	0.0009	
12:33	0.02	0.03	0.04	0.0001	0.0002	0.0012	Bus
12:34	0.02	0.02	0.02	0.0001	0.0001	0.0004	HGV
12:35	0.02	0.02	0.04	0.0002	0.0002	0.0010	
12:36	0.02	0.02	0.02	0.0002	0.0002	0.0006	
12:37	0.02	0.02	0.02	0.0001	0.0001	0.0003	
12:38	0.02	0.03	0.03	0.0001	0.0002	0.0005	
12:39	0.02	0.03	0.02	0.0001	0.0002	0.0005	
12:40	0.03	0.03	0.02	0.0002	0.0002	0.0006	
12:41	0.04	0.03	0.02	0.0003	0.0002	0.0005	
12:42	0.03	0.02	0.03	0.0002	0.0001	0.0013	Bus
12:43	0.06	0.07	0.18	0.0003	0.0003	0.0057	
12:44	0.01	0.02	0.02	0.0001	0.0001	0.0004	Bus
12:45	0.02	0.03	0.05	0.0001	0.0002	0.0015	
12:46	0.02	0.02	0.03	0.0001	0.0001	0.0010	
12:47	0.02	0.03	0.03	0.0001	0.0001	0.0007	HGV
12:48	0.02	0.03	0.03	0.0001	0.0002	0.0010	HGV
12:49	0.02	0.02	0.02	0.0001	0.0001	0.0005	
12:50	0.02	0.02	0.02	0.0001	0.0001	0.0004	
12:51	0.02	0.02	0.02	0.0001	0.0002	0.0004	
12:52	0.02	0.02	0.02	0.0001	0.0002	0.0005	Bus
12:53	0.02	0.02	0.03	0.0001	0.0002	0.0009	
12:54	0.02	0.03	0.04	0.0001	0.0002	0.0012	
12:55	0.02	0.02	0.02	0.0001	0.0002	0.0003	
12:56	0.04	0.05	0.23	0.0002	0.0003	0.0056	HGV
12:57	0.02	0.03	0.05	0.0001	0.0002	0.0017	Bus
12:58	0.02	0.02	0.04	0.0001	0.0001	0.0012	
12:59	0.02	0.03	0.02	0.0001	0.0002	0.0006	
Maximum all traffic	0.06	0.07	0.23	0.0003	0.0003	0.0057	
Maximum bus	0.03	0.03	0.06	0.0002	0.0002	0.0017	

2.4.4 Location AVML009

Table 20 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 20: Vibration Monitoring Results at ANML009

Event Time	PPV, mm/s			VDV _b , m/s ^{1.75}			Notes
	X	Y	Z	X	Y	Z	
13:05	0.03	0.02	0.05	0.0001	0.0001	0.0012	
13:06	0.02	0.04	0.03	0.0002	0.0001	0.0011	Bus
13:07	0.04	0.05	0.08	0.0002	0.0002	0.0028	HGV
13:08	0.04	0.05	0.06	0.0002	0.0002	0.0019	
13:09	0.04	0.03	0.03	0.0002	0.0002	0.0011	
13:10	0.03	0.04	0.04	0.0002	0.0001	0.0012	
13:11	0.03	0.04	0.04	0.0002	0.0001	0.0011	
13:12	0.02	0.03	0.04	0.0002	0.0001	0.0012	Bus
13:13	0.03	0.06	0.04	0.0002	0.0003	0.0013	
13:14	0.03	0.04	0.03	0.0002	0.0002	0.0012	Bus
13:15	0.04	0.04	0.04	0.0002	0.0003	0.0014	Bus
13:16	0.04	0.04	0.09	0.0002	0.0001	0.0028	HGV
13:17	0.06	0.06	0.05	0.0002	0.0002	0.0016	
13:18	0.03	0.04	0.05	0.0002	0.0002	0.0016	Bus
13:19	0.02	0.03	0.03	0.0001	0.0001	0.0008	
13:20	0.04	0.04	0.03	0.0002	0.0002	0.0011	Bus
13:21	0.03	0.03	0.03	0.0001	0.0001	0.0011	Bus
13:22	0.04	0.04	0.09	0.0002	0.0002	0.0030	
13:23	0.03	0.03	0.03	0.0001	0.0001	0.0013	
13:24	0.02	0.03	0.05	0.0001	0.0002	0.0012	HGV
13:25	0.03	0.03	0.05	0.0002	0.0002	0.0014	
13:26	0.03	0.05	0.05	0.0002	0.0003	0.0015	Bus
13:27	0.03	0.04	0.04	0.0002	0.0002	0.0012	
13:28	0.02	0.04	0.04	0.0001	0.0002	0.0008	Bus
13:29	0.04	0.05	0.04	0.0003	0.0003	0.0022	
13:30	0.03	0.03	0.08	0.0002	0.0002	0.0022	
13:31	0.04	0.04	0.03	0.0002	0.0002	0.0011	
13:32	0.02	0.02	0.04	0.0001	0.0001	0.0011	
13:33	0.02	0.03	0.04	0.0002	0.0002	0.0014	
13:05	0.03	0.02	0.05	0.0001	0.0001	0.0012	
Maximum all traffic	0.06	0.06	0.09	0.0003	0.0003	0.0030	
Maximum bus	0.04	0.05	0.05	0.0002	0.0003	0.0016	

3. References

British Standard Institute (BSI) British Standard (BS) 7385: 1990: Evaluation and measurement for vibration in buildings. Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings. (BSI 1990)

BS 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings. Part 1 Vibration sources other than blasting (BSI 2008)

ISO 1996-1:2016 Acoustics - Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures (ISO 2016)

ISO 1996-2:2017 - Description, measurement and assessment of environmental noise - Part 2: Determination of sound pressure levels (ISO 2017)

Transport Infrastructure Ireland (TII) (previously National Roads Authority (NRA)) (2004), Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1

UK Department of Transport (1998). The UK Department of Transport Calculation of Road Traffic Noise

Directives and Legislation

S.I. No. 140/2006 – European Communities (Environmental Noise) Regulations 2006

4. Calibration Certificates for Monitoring Equipment

4.1 Rion NL-52 S/N 764925



**CERTIFICATE
 OF
 CALIBRATION**



Date of Issue: 19 August 2020

Certificate Number: UCRT20/1788

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
K. Mistry

Customer AWN Consulting Limited
 The Tecpro Building
 IDA Business and Technology Park
 Clonshaugh
 Dublin 17
 Ireland

Order No. PO 2062
Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator
Identification

Manufacturer	Instrument	Type	Serial No. / Version
Rion	Sound Level Meter	NL-52	00764925
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	65051
Rion	Microphone	UC-59	09853
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1
Test Procedure TP 2.SLM 61672-3 TPS-49
Procedures from IEC 61672-3:2006 were used to perform the periodic tests.
Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02
If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003
Date Received 19 August 2020 ANV Job No. UKAS20/08452
Date Calibrated 19 August 2020

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	Dated	Certificate No.	Laboratory
	22 August 2018	UCRT18/1863	0653

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 UCRT20/1788
	Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source	Manufacturer	
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data	Manufacturer	
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data	Manufacturer	
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections	Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002	Yes	
Specified or equivalent Calibrator	Specified	
Customer or Lab Calibrator	Lab Calibrator	
Calibrator adaptor type if applicable		NC-74-002
Calibrator cal. date		15 July 2020
Calibrator cert. number		UCRT20/1634
Calibrator cal cert issued by		0653
Calibrator SPL @ STP	94.00	dB Calibration reference sound pressure level
Calibrator frequency	1001.92	Hz Calibration check frequency
Reference level range	25 - 130	dB

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
 Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	23.88	24.01	± 0.30 °C
Humidity	51.1	52.1	± 3.00 %RH
Ambient Pressure	99.17	99.12	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.3	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device -	UR = Under Range indicated					
Weighting	A		C		Z	
	12.9	dB UR	17.7	dB UR	22.9	dB UR

Uncertainty of the electrical self generated noise ±	0.12	dB
--	------	----

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

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END

Calibrated by: B. Giles R 1

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
 None

4.2 Rion NL-52 S/N 998411



**CERTIFICATE
 OF
 CALIBRATION**



Date of Issue: 16 September 2020

Certificate Number: UCRT20/1875

Calibrated at & Certificate 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  K. Mistry

Customer AWN Consulting Limited
 The Tecpro Building
 IDA Business and Technology Park
 Clonshaugh
 Dublin 17
 Ireland

Order No. 2075
Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator
Identification

Manufacturer	Instrument	Type	Serial No. / Version
Rion	Sound Level Meter	NL-52	00998411
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	98625
Rion	Microphone	UC-59	17215
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1
Test Procedure TP 2.SLM 61672-3 TPS-49
Procedures from IEC 61672-3:2006 were used to perform the periodic tests.
Type Approved to IEC 61672-1:2002 **YES** Approval Number 21.21 / 13.02
If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003
Date Received 15 September 2020 ANV Job No. UKAS20/09503
Date Calibrated 16 September 2020

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	Dated	Certificate No.	Laboratory
	22 January 2020	UCRT20/1094	0653

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CERTIFICATE OF CALIBRATION	Certificate Number UCRT20/1875
	Page 2 of 2 Pages

UKAS Accredited Calibration Laboratory No. 0653

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source	Manufacturer	
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data	Manufacturer	
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data	Manufacturer	
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections	Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes
Specified or equivalent Calibrator	Specified	
Customer or Lab Calibrator	Lab Calibrator	
Calibrator adaptor type if applicable	NC-74-002	
Calibrator cal. date	19 August 2020	
Calibrator cert. number	UCRT20/1789	
Calibrator cal cert issued by	0653	
Calibrator SPL @ STP	94.02	dB Calibration reference sound pressure level
Calibrator frequency	1001.89	Hz Calibration check frequency
Reference level range	25 - 130	dB

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
 Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	23.61	24.27	± 0.30 °C
Humidity	55.1	50.7	± 3.00 %RH
Ambient Pressure	101.47	101.47	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.			
Initial indicated level	94.0	dB	Adjusted indicated level 94.0 dB
The uncertainty of the associated calibrator supplied with the sound level meter ±			0.10 dB

Self Generated Noise	This test is currently not performed by this Lab.		
Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	
Microphone replaced with electrical input device -	UR = Under Range indicated		
Weighting	A	C	Z
	11.5 dB UR	16.4 dB UR	21.2 dB UR
Uncertainty of the electrical self generated noise ±		0.12	dB

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

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END
 Calibrated by: C. Hirlav R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
 Prior to calibration the instrument's microphone was replaced and the meter was re-aligned.

4.3 Rion NL-52 S/N 998413



**CERTIFICATE
 OF
 CALIBRATION**



Date of Issue: 22 January 2020

Certificate Number: UCRT20/1095

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

 K. Mistry

Customer AWN Consulting
 The Tecpro Building
 IDA Business and Technology Park
 Clonshaugh
 Dublin 17

Order No. AWNC150120QTE
Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator
Identification

Manufacturer	Instrument	Type	Serial No. / Version
Rion	Sound Level Meter	NL-52	00998413
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	98627
Rion	Microphone	UC-59	15920
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1
Test Procedure TP 2.SLM 61672-3 TPS-49
Procedures from IEC 61672-3:2006 were used to perform the periodic tests.
Type Approved to IEC 61672-1:2002 **YES** **Approval Number** 21.21 / 13.02
If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003
Date Received 17 January 2020 **ANV Job No.** UKAS20/01036
Date Calibrated 22 January 2020

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	Dated	Certificate No.	Laboratory
	Initial Calibration		

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
	UCRT20/1095
	Page 2 of 2 Pages
UKAS Accredited Calibration Laboratory No. 0653	

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source	Manufacturer	
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data	Manufacturer	
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data	Manufacturer	
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections	Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002	Yes	
Specified or equivalent Calibrator	Specified	
Customer or Lab Calibrator	Lab Calibrator	
Calibrator adaptor type if applicable		NC-74-002
Calibrator cal. date		21 January 2020
Calibrator cert. number		UCRT20/1082
Calibrator cal cert issued by		0653
Calibrator SPL @ STP	93.98	dB Calibration reference sound pressure level
Calibrator frequency	1001.97	Hz Calibration check frequency
Reference level range	25 - 130	dB

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
 Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	22.18	22.19	± 0.30 °C
Humidity	38.7	37.6	± 3.00 %RH
Ambient Pressure	102.72	102.74	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.			
Initial indicated level	93.9	dB	Adjusted indicated level
			94.0
			dB
The uncertainty of the associated calibrator supplied with the sound level meter ±			0.10
			dB

Self Generated Noise	This test is currently not performed by this Lab.		
Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device -	UR = Under Range indicated					
Weighting	A		C		Z	
	11.7	dB UR	16.3	dB UR	23.2	dB UR
Uncertainty of the electrical self generated noise ±			0.12		dB	

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

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END

Calibrated by: **B. Bogdan** R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
 None

4.4 Rion NL-52 S/N 186668



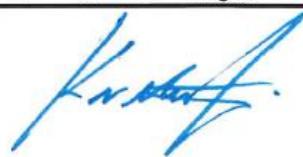
**CERTIFICATE
 OF
 CALIBRATION**



Date of Issue: 07 May 2020

Certificate Number: UCRT20/1405

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

 K. Mistry

Customer AWN Consulting
 The Tecpro Building
 IDA Business and Technology Park
 Clonshaugh
 Dublin 17

Order No. RM/20/Cal019
 Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator
 Identification

Manufacturer	Instrument	Type	Serial No. / Version
Rion	Sound Level Meter	NL-52	00186668
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	76701
Rion	Microphone	UC-59	12813
Brüel & Kjær	Calibrator	4231	2205805
	Calibrator adaptor type if applicable		UC 0210

Performance Class 1
 Test Procedure TP 2.SLM 61672-3 TPS-49
 Procedures from IEC 61672-3:2006 were used to perform the periodic tests.
 Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02
 If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003
 Date Received 30 April 2020 ANV Job No. UKAS20/04240
 Date Calibrated 07 May 2020

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	Dated	Certificate No.	Laboratory
	20 April 2018	UCRT18/1436	0653

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 UCRT20/1405
	Page 2 of 2 Pages

UKAS Accredited Calibration Laboratory No. 0653

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source	Manufacturer	
Internet download date if applicable		N/A
Case corrections available	Yes	
Uncertainties of case corrections	Yes	
Source of case data	Manufacturer	
Wind screen corrections available	Yes	
Uncertainties of wind screen corrections	Yes	
Source of wind screen data	Manufacturer	
Mic pressure to free field corrections	Yes	
Uncertainties of Mic to F.F. corrections	Yes	
Source of Mic to F.F. corrections	Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002	Yes	
Specified or equivalent Calibrator	Specified	
Customer or Lab Calibrator	Customers Calibrator	
Calibrator adaptor type if applicable	UC 0210	
Calibrator cal. date	06 December 2019	
Calibrator cert. number	UCRT19/2333	
Calibrator cal cert issued by	0653	
Calibrator SPL @ STP	93.95	dB Calibration reference sound pressure level
Calibrator frequency	999.97	Hz Calibration check frequency
Reference level range	25 - 130	dB

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
 Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	23.24	23.17	± 0.30 °C
Humidity	35.0	37.5	± 3.00 %RH
Ambient Pressure	101.20	101.19	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.			
Initial indicated level	94.0	dB	Adjusted indicated level 93.9 dB
The uncertainty of the associated calibrator supplied with the sound level meter ±			0.10 dB

Self Generated Noise This test is currently not performed by this Lab.
 Microphone installed (if requested by customer) = Less Than N/A dB A Weighting
 Uncertainty of the microphone installed self generated noise ± N/A dB

Microphone replaced with electrical input device -	UR = Under Range indicated					
Weighting	A		C		Z	
	12.4	dB UR	16.2	dB UR	22.1	dB UR
Uncertainty of the electrical self generated noise ±				0.12 dB		

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

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

END

Calibrated by: B. Bogdan

R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above. Prior to calibration the instrument's main PCB was replaced and the meter was re-aligned.

4.5 Bruel and Kjaer 2250L

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate No UCRT19/2218

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The sound level meter was set up using the type 4231 sound calibrator supplied; it was set to frequency weighting A, and initially read 94.1 dB. It was then adjusted to read 93.9 dB (corresponding to 93.9 dB at standard atmospheric pressure). This reading was derived from Calibration Certificate no. UCRT19/2217 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter. The calibration check frequency was 1kHz. The final microphone sensitivity calculated and stored by the instrument was 45.25 mV/Pa.

Procedures from IEC 61672-3:2006 (BS EN 61672-3:2006) as modified by UKAS TPS 49 Edition 2:June 2009 were used to perform the periodic tests.

RESULTS

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006 (BS EN 61672-3:2006), for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2 : 2003 (BS EN 61672-2 : 2003), to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1 : 2002 (BS EN 61672-1 2003).

The self-generated noise recorded with the microphone replaced by the electrical input device was:

13.4 dB (A) 13.8 dB (C) 19.5 dB (Z)

The environmental conditions recorded at the start and end of testing were:

Start: 23 to 24 °C, 31 to 41 %RH and 97.2 to 97.3 kPa

End: 24 to 25 °C, 34 to 44 %RH and 97.2 to 97.3 kPa

Technical information including adjustment data specified in the manufacturers' Instruction Manual BE 1774-11 (2007) and User Manual BE 1766 has been used to carry out this verification. These data include manufacturer-specified uncertainties.

Publicly-available evidence has been found that the B&K 2250-L sound level meter design has successfully undergone pattern evaluation in accordance with IEC 61672-2:2002 (BS EN 61672-2:2003) by Physikalisch-Technische Bundesanstalt (PTB), an independent testing organisation responsible for pattern approvals.

All measurement data are held at ANV Measurement Systems for a period of at least six years.

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

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate No UCRT19/2218

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NOTES

Any opinions or interpretations which may be expressed in the following notes are not UKAS Accredited.

- 1 All tests were carried out in "Broad Band".
- 2 Windscreen correction was set to "None", soundfield to "Free-field" and microphone to "4950".
- 3 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method. This response in isolation is not UKAS Accredited.
- 4 It was noted that in order to obtain the correct A-weighted response to the sound calibrator, the relevant software setting in the meter had to be changed from '4231' to 'custom' with the appropriate calibration level entered.
- 5 The electrical tests have been carried out with the instrument set for the nominal microphone sensitivity, as specified in the Instruction Manual. This may mean that the instrument has a slightly different linearity range when in normal use.
- 6 Typical case reflection factors specified by the manufacturer have been used for this verification.

The instrument was running on hardware version 4.0

The instrument firmware settings were:

Module i.d.	Function	Version	Active?	Licenced?	Template used?
BZ 7130	SLM	4.7.5	Y	Y	Y
BZ 7131	Octave analysis	4.7.5	Y	N	N/A
BZ 7132	1/3-oct analysis	4.7.5	Y	Y	N/A
BZ 7133	Logging	4.7.5	Y	Y	N/A
BZ 7226	Signal Recording Option	4.7.5	Y	N	N/A
BZ 7231	Tone Assessment	4.7.5	Y	N	N/A
BZ 7232	Noise Monitoring Software	4.7.5	Y	N	N/A
BZ	N/A	N/A	N/A	N/A	N/A
BZ	N/A	N/A	N/A	N/A	N/A
BZ	N/A	N/A	N/A	N/A	N/A

The results on this certificate only relate to the items calibrated as identified above.

END

R 3

4.6 Rion VM-56 (S/N 680043)



CERTIFICATE OF CALIBRATION

Date of Issue: 01 November 2019

Certificate Number: TCRT19/1825

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

Page 1 of 3 Pages
Approved Signatory

K. Mistry

A handwritten signature in blue ink, appearing to read 'K. Mistry', is written over a horizontal line.

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Client	AWN Consulting Limited The Tecpro Building, IDA Business & Technology Park, Clonshaugh Dublin 17 Ireland
Purchase Order No.	DOD/19/Cal03
Instrument	Rion VM-56 Tri-Axial Vibration Meter
Serial No.	00680043
Accelerometer Type	VM-56
Accelerometer Serial No.	80047
Program	2.0
Client Asset No.	N/A
Procedure ID.	VM-56 Issue 1
Job Number	TRAC19/11477
Date of Calibration	01 Nov 2019
Previous Cert. number	N/A
Date of Previous Cert.	N/A
Rig Number	6
Kit Number	24
Calibration Status	Passed Calibration

This calibration is traceable to National Standards. ANV Measurement Systems sources used to perform calibrations are calibrated at the National Physical Laboratory or by UKAS laboratories accredited for the purpose.

The performance of the system (the meter, accelerometer) was found to be within the manufacturer's specification.

Comment

This certificate reports recorded values for the instrument 'As Received'.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT19/1825

Page 2 of 3 Pages

Environment

The ambient environmental conditions at the time of the calibration were;
 Temperature: 22.9 ± 1°C, Humidity: 40 ± 5%RH, Atmospheric pressure 98.2 ± 1 kPa

Test results

Each accelerometer axis was mounted co-axially with a Rion LS-10C servo accelerometer, and tests conducted for the dynamic range, PPV linearity and frequency response of the complete system. Additional electrical tests were carried out on the amplitude linearity of the instrument.

PPV linearity response for the complete system at 16 Hz

With PV-83CW serial No. 80047

Weightings for all channels turned OFF

Target Vel. mm/s	Actual Vel. mm/s	Indicated (X) mm/s	Error (X) %	Indicated (Y) mm/s	Error (Y) %	Indicated (Z) mm/s	Error (Z) %
0.50	0.51	0.57	11.56	0.55	7.65	0.54	5.69
1.00	1.02	1.09	6.67	1.08	5.69	1.06	3.73
2.50	2.55	2.67	4.51	2.66	4.12	2.60	1.77
5.00	5.11	5.31	3.93	5.30	3.73	5.18	1.38
10.00	10.13	10.59	4.50	10.43	2.92	10.35	2.13
20.00	20.27	21.24	4.80	21.03	3.76	20.61	1.69

Permitted tolerance ± 10% ± 1 LSD (Least Significant Digit).

Linearity errors in dB measured electrically at 40 Hz

Weightings for all channels turned OFF

Level changes in dB; reading error in dB given for each axis. "m/s²" is actual reading in m/s².

1 m/s² Range

Level dB	Error (X) dB	m/s ² (X)	Error (Y) dB	m/s ² (Y)	Error (Z) dB	m/s ² (Z)
0	REF	0.98154	REF	0.98129	REF	0.98130
-20	-0.01	0.09805	-0.01	0.09802	-0.01	0.09803
-40	-0.02	0.00979	-0.02	0.00979	-0.02	0.00979
-60	-0.10	0.00097	-0.10	0.00097	-0.10	0.00097
-66	-0.03	0.00049	-0.21	0.00048	-0.03	0.00049
-72	-0.23	0.00024	-0.23	0.00024	-0.23	0.00024

Permitted tolerance ±1.0 dB.

10 m/s² Range

Level dB	Error (X) dB	m/s ² (X)	Error (Y) dB	m/s ² (Y)	Error (Z) dB	m/s ² (Z)
20	-0.03	9.79122	-0.03	9.75526	-0.03	9.73534
0	REF	0.98208	REF	0.97857	REF	0.97679
-20	-0.01	0.09808	-0.01	0.09775	-0.01	0.09758
-30	-0.01	0.03102	-0.03	0.03085	-0.06	0.03067
-40	0.04	0.00987	-0.02	0.00976	0.02	0.00979
-52	-0.31	0.00238	0.69	0.00266	-0.01	0.00245

Permitted tolerance ±1.0 dB.

5. Unattended Monitoring Equipment Set Up

Location	Equipment Set up
<p>CBC0007UNML001</p> <p>In rear residential garden facing directly onto R833 Coldcut Road in Palmer Drive housing estate. Located approximately 8m from R833 road edge, separated by wall.</p>	

Location	Equipment Set up
<p>CBC0007UNML002</p> <p>In rear residential garden facing directly onto R839 Grattan Crescent road. Located approximately 8m from R839 road edge, separated by wall.</p>	