Floatel Noise Monitoring Survey - 3 (October 8-11, 2024)

Woodfibre LNG Project

November 12, 2024

123221624EN-RPT0054

Woodfibre LNG

Preamble

The Woodfibre Liquefied Natural Gas Project (the Project) is a liquefied natural gas export facility being constructed on the former Woodfibre Pulp and Paper Mill site in Átl'ka7tsem (Howe Sound), approximately seven kilometres south of Sḵwx̱wú7mesh (Squamish). The Project is on the historical location of a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát and Átl'ḵ'a7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants, and to other Indigenous groups as defined in the Project's Environmental Assessment Certificates. The Project is also operating within the traditional, ancestral, and unceded territory of the səlilwətaɬ (Tsleil-Waututh) Nation, and to other Indigenous groups as defined in the Project's Environmental Assessment Certificates. Woodfibre LNG General Partner Inc. recognizes the importance of these areas to the Sḵwx̱wú7mesh stélmexw (Squamish People), and other Indigenous groups. Woodfibre LNG General Partner Inc., as general partner on behalf of Woodfibre LNG Limited Partnership (Woodfibre LNG) seeks to construct and operate the Project in a manner that is respectful of Indigenous values. This Floatel Noise Monitoring and Mitigation Plan is primarily written in English with important place names, phrases, and passages provided in Sḵwx̱wú7mesh sníchim (the Squamish language).

Temíxwiẏiḵw chet wa naantem chet ti temíxw Swiẏát
Chet wa sméṅhemswit kwis ns7éyx̱nitas chet ti temíxw
We7ú chet kwis t'íchimwit iy íẇas chet eḵ' I tti.

Our ancient ancestors named this place Swiẏát
We, as their descendants safeguard these lands
We will continue to swim and fish in these clear waters.

Limitations and Sign-off

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Squamish-English Translations

Squamish	English
Átl'ka7tsem	Howe Sound
ínexwantas	monitoring
Skwxwú7mesh	Squamish
Skwxwú7mesh sníchim	Squamish Language
Skwxwú7mesh stélmexw	Squamish people
Skwxwú7mesh Úxwumixw	Squamish Nation
Swiỷát	Historic Squamish Nation village located at Woodfibre Site

Abbreviations

ANSI	American National Standards Institute
BC	British Columbia
BC EAO	British Columbia Environmental Assessment Office
BC ER	British Columbia Energy Regulator
dB	Decibel level
dBA	A-weighted decibel level
EAC	Environmental Assessment Certificate
HVAC	Heating, ventilation, and air-conditioning
Hz	Hertz
L_{max}	Maximum A-weighted equivalent sound level
L_d	Daytime equivalent sound level
L_{eq}	Energy equivalent sound level
L_n	Nighttime equivalent sound level
LNG	Liquified natural gas
MOE	Ministry of Environment and Climate Change Strategy
MOF	Material Offloading Facility
MOH	Ministry of Health
the Project	Woodfibre Liquefied Natural Gas Project
RMS	Root mean square
SPL	Sound pressure level
VCH	Vancouver Coastal Health
WHO	World Health Organization
Woodfibre LNG	Woodfibre LNG General Partner Inc.

Glossary

Adaptive Management	A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.
Bands (octave, 1/3 octave)	A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it.
daytime	The hours from 07:00 to 22:00.
dB - Decibel	A logarithmic unit associated with sound pressure levels and sound power levels.
dBA - decibel, A-weighted	A logarithmic unit where the recorded sound has been filtered using the A frequency weighting scale. A-weighting somewhat mimics the response of the human ear to sounds at different frequencies. A weighted sound pressure levels are denoted by the suffix 'A' (i.e., dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).
energy equivalent sound level (L_{eq})	An energy-average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (e.g., $L_{eq}(24)$ for the 24-hour equivalent sound level). L_{eq} is usually A-weighted. A L_{eq} value expressed in dBA is a good, single value descriptor of the annoyance of noise.
frequency	Number of cycles per unit of time. In acoustics frequency is expressed in hertz (Hz), i.e., cycles per second.
floatel	The marine-based work camp, associated facilities and mooring infrastructure dedicated to house approximately 650 Workers during the Construction of the Project.
hertz (Hz)	Unit of measurement of frequency, numerically equal to cycles per second.
L_d	Daytime sound level, an equivalent continuous sound level taken over 15 hours from 07:00 to 22:00.
L_{Amax}	The maximum value of the A-weighted sound pressure level during a measurement duration.

L_n	Nighttime sound level, an equivalent continuous sound level taken over 9 hours from 22:00 to 07:00.
nighttime	The hours from 22:00 to 07:00.
noise	Unwanted sound.
noise level	Same as sound level, except applied to unwanted sounds.
sound	A dynamic (fluctuating) pressure.
sound pressure level (SPL)	The logarithmic ratio of the root mean square (RMS) sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by the equation below where P is the RMS pressure due to a sound and P_0 is the reference pressure. P_0 is usually taken as 2.0×10^{-5} Pascals. SPL (dB) = 20 log (P_{RMS}/P_0)

1.0 INTRODUCTION

1.1 OVERVIEW

Woodfibre LNG General Partner Inc. (Woodfibre LNG) is constructing the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC).

Woodfibre LNG received an amendment to the Environmental Assessment Certificate (EAC) #E15-02 (Amendment #3) on November 1, 2023, approving the use of temporary accommodations for off-duty construction workers in a self-contained floating housing facility (floatel). The Amendment #3 includes conditions related to air quality and noise monitoring for the floatel occupants.

The floatel was mobilized and moored at the Project site on June 21, 2024, and will be continuously operating for approximately three years during the construction of the Project. The floatel will provide accommodation for approximately 650 persons at peak construction. In addition to the accommodation spaces, the floatel also includes a variety of ancillary service facilities such as medical, food and beverage, laundry, recreational and leisure, and office spaces. Figure 1 in Appendix A shows the site plan and location of the floatel.

1.2 FLOATEL NOISE MONITORING AND MITIGATION PLAN

Amendment #3 includes conditions regarding noise management for the floatel. Condition 30 of Amendment #3 states that:

> *30.1 The Holder must retain a Qualified Professional(s) to develop the following monitoring and mitigation plans, in consultation with MOE, MOH, BC Energy Regulator, VCH[1] and Aboriginal Groups:*
>
> *b) Noise Monitoring and Mitigation Plan.*

In accordance with the requirements of Condition 30, the Noise Monitoring and Mitigation Plan (the FNMMP) has been developed and finalized on July 17, 2024 (Rev.4) by the Stantec Qualified Professional and reviewed by the regulatory agencies. The FNMMP specifically includes the Noise Monitoring Plan, Noise Mitigation Plan and Adaptive Management Plan.

The FNMMP provides general guidance about how to assess workers' sleep disturbance due to Project related construction noise within the floatel cabins. The general guidance includes the monitoring method, sleep disturbance noise threshold, data analysis procedures, and reporting requirements.

[1] MOE: Ministry of Environment and Climate Change Strategy
MOH: Ministry of Health
VCH: Vancouver Coastal Health

1.3 OBJECTIVE

In accordance with the FNMMP, a series of noise monitoring programs will be conducted quarterly or following construction activity changes.

An initial noise monitoring program was conducted to collect sound levels in the cabins from July 10 to July 14, 2024. The results were presented in a report "Floatel Noise Monitoring Survey -1 (July 10 - 14, 2024) – Woodfibre LNG Project" (Stantec 2024a). A second subsequent noise monitoring survey was conducted from September 4 to September 7, 2024; and the results were presented in a report "Floatel Noise Monitoring Survey -2 (September 4 – 7, 2024) – Woodfibre LNG Project" (Stantec 2024b). Both reports are listed in References section.

This third noise monitoring survey was conducted from October 8 to October 11, 2024. The shore grid power had been connected to the floatel prior to the noise monitoring survey. There were continuous Project vibratory and impact piling activities at the Material Offloading Facility (MOF) area during the day. Beginning October 10, there were vibratory piling activities during the night.

The objectives of the noise monitoring programs include the following:

- Measure sound levels at the selected cabins.
- Analyze data gathered and evaluate noise effects on the floatel cabins from construction piling activities.
- Compare the measured sound levels with applicable sleep disturbance thresholds.
- Conduct interviews about noise with occupants.
- Assess compliance for sleep disturbance effect for sleeping quarter occupants.
- Recommend mitigation or adaptive management plan if required.

1.4 ENVIRONMENTAL NOISE DESCRIPTORS

All noise descriptors in this assessment are based on the A-weighted decibel (dBA) scale. The dBA unit is based on relative loudness of sound at different frequencies and is meant to reflect the human ear's response to noise.

Environmental noise typically varies over time. To account for this variation, single number descriptors are used. It is defined as the steady, continuous sound level over a specified time that has the same acoustic energy as the actual varying sound levels over the specified time. The noise descriptors energy equivalent sound level (L_{eq}), daytime equivalent A-weighted sound level (L_d), nighttime equivalent A-weighted sound level (L_n), and maximum A-weighted sound level (L_{Amax}) are commonly used to quantify noise effects for activities of a project. The following provides a general description for these descriptors:

- L_{eq} represents the energy-average sound pressure encountered for the period.
- L_d is the 15-hour energy equivalent A-weighted sound level during the daytime period from 07:00 to 22:00.
- L_n is a 9-hour energy equivalent A-weighted sound level during the nighttime period from 22:00 to 07:00.
- L_{Amax} is the maximum A-weighted sound level recorded over the measurement duration.

The Glossary section provides addition details for these descriptors.

2.0 CABIN SOUND LEVEL TARGETS

The construction noise may result in sleep disturbance to occupants of the floatel during the Project construction phase. This section focuses on the sleep disturbance threshold recommendations by Health Canada and room sound level criteria from another international standards (i.e., American National Standards Institute [ANSI]).

2.1 HEALTH CANADA SLEEP DISTURBANCE THRESHOLD

Noise may cause sleep disturbance for people and there is clear evidence that ongoing sleep disturbance is associated with a wide variety of health effects, such as cardiovascular effects, mental health and hearing impairment. Health Canada's Guidance for Evaluating Human Health Effects in Impact Assessment: NOISE, 2023 (Health Canada Noise Guidance) references the guidelines and recommendations of the World Health Organization (WHO) for community noise (WHO 1999) and Night Noise Guidelines for Europe regarding sleep disturbance (WHO 2009). The WHO 1999 guideline recommends a threshold for sleep disturbance as being an indoor sound level of no more than 30 dBA L_{eq} for continuous noise during the sleep period. For individual noise events, Health Canada also refers to WHO's recommendations that indoor sound levels should not exceed 45 dBA L_{Amax} more than 10 to 15 times per night to provide for a good sleep environment (WHO 1999). Health Canada recommends that an outdoor-to-indoor transmission loss with windows at least partially open is 15 dBA and fully closed windows are assumed to reduce outdoor sound levels by approximately 27 dBA (Health Canada 2023).

The Project construction work has potential to be scheduled 24 hours per day. For 24 hours per day construction, the sleep disturbance noise effect will be evaluated for the floatel occupants who may be off-duty and sleeping during the daytime or nighttime while construction is ongoing. The indoor sound level sleep disturbance thresholds of 30 dBA (L_{eq}) and quantities of occurrence of L_{max} > 45 dBA (i.e., 15 times) during both daytime (07:00 to 22:00) and nighttime (22:00 to 07:00) are recommended for the floatel.

Although the Heath Canada sleep disturbance threshold of 30 dBA is used it this assessment, it is better suited for private residential bedrooms with very quiet background noise. However, for the spaces with dense occupants, such as apartment buildings and hotel or motel rooms, where central heating, ventilation and air-conditioning (HVAC) systems and local activities are sources of background noise, a sound level of 30 dBA may not be achievable.

Therefore, the ANSI standard for room sound level criteria for the hotel or motel rooms is used as an additional reference target in the evaluation of interior noise on the floatel.

2.2 ANSI S12.2 SOUND LEVEL CRITERIA FOR ROOM

The ANSI S12.2-2019 (Reaffirmed in 2023) Criteria for Evaluating Room Noise is commonly used as a reference guide for assessment of sound level criteria for occupants in various interior environments. The ANSI standard specifies sound level criteria when evaluating the room noise by using the survey method that employs the A-weighted sound level. Table 2.1 lists the A-weighted sound level criteria for individual rooms or suite in hotels and motels, based on ANSI sound level criteria for room of various uses (ANSI S12.2).

Table 2.1 A-weighted Sound Level Criteria for Rooms – Hotels and Motels

Occupancy	A-weighted Sound Level dBA
Hotels/motels	
Individual rooms or suites	39-44
Meeting/banquet rooms	35-44
Service support areas	48-57
Source: Table C.1 of ANSI S12.2	

As the floatel provides the worker accommodation and belongs to the hotels/motels category, the A-weighted sound level criteria of 39 to 44 dBA for individual rooms or suites are also included in the floatel noise evaluation.

3.0 NOISE MONITORING PROGRAM

In accordance with the FNMMP, a Stantec Qualified Professional conducted this noise monitoring program on the floatel from October 8 to October 11, 2024. The following sections outline the monitoring program details, including cabin locations, measurement instrumentation, measurement setup, Project construction activities occurring during the measurement period, and data analysis methods.

3.1 CABIN LOCATIONS

The sound level meters were set up inside the representative cabins on different decks of the floatel. A representative cabin is an unoccupied cabin that is available for occupancy. The cabin is selected based on the highest potential noise impact (e.g., the closest proximity to, and in line of sight with the construction activities and availability for occupancy.

Six cabins were selected for the third noise monitoring survey: Cabin 2002, Cabin 5004, Cabin 6004, Cabin 7027, Cabin 9412 and Cabin 0106, depending on availability of occupancy during the survey period. Each of the selected cabins is located on a different deck, represented by the first number of the cabin number (e.g., Cabin 5004 on Deck 5). Cabin 0106 was also selected in the second noise monitoring survey (Stantec 2024b). Table 6.2 summarizes all cabins selected in three surveys.

Construction activities of vibratory and impact piling at the MOF area during daytime and vibratory piling during nighttime were the major noise sources onsite and were the focus of the third noise monitoring survey. Cabin 5004, Cabin 6004 and Cabin 7027 were selected because they are located at the stern of the floatel which is closest to and in line of sight with the construction piling locations. The floatel is berthed starboard to shore, Cabin 9412 and Cabin 0106 are located at the starboard side of the floatel and facing the southwestern construction site. They were selected to evaluate noise effects from construction activities on the southwest. The rationale for the cabin selections is also presented in Table 3.1.

Table 3.1 summarizes the selected cabins, general descriptions, and field observations. Figure 2 through Figure 4 illustrate these cabin locations on each deck of the floatel.

Table 3.1 Selected Cabins, Descriptions, and Observations

Cabin	Deck	Description and Observations during Monitoring Period	Reference Figures
2002	2	• Deck 2 is under the ship water line. • The 86 cabins on Deck 2 were only occupied by the crew members but no workers. • Some cabins are adjacent to the floatel operating facilities, including Engine Store (engine room) and workshop. • Shore grid power has been connected to the floatel during the measurement period. Noise levels due to the Engine Store were reduced along the corridors. • Cabin 2002 is adjacent to the operating facility, high noise emissions through the ceiling plenum to the room was measured. • Cabin ceiling ventilation was continuously operating during the noise monitoring period.	Figure 2 Figure 5
5004	5	• Total of 219 cabins, the second highest numbers of cabins per deck after Deck 6. • Cabins occupied by the construction workers. • There are Vent Stores (i.e., ventilation rooms) and Service Workshop located at the stern of Deck 5. • Cabin 5004 was selected as the cabin window is in line of sight with the construction piling site. • Cabin ceiling ventilation was continuously operating.	Figure 2 Figure 6
6004	6	• Total of 248 cabins, highest number of cabins per deck among all decks. • Cabins occupied by the construction workers. • Cabin 6004 was selected as it is located at the stern of the floatel and the cabin wall is facing the construction piling site. • Cabin ceiling ventilation was continuously operating.	Figure 3 Figure 7
7027	7	• Total of 58 cabins on Deck 7. • Ancillary service facilities on Deck 7 including Reception, Gym, Games Lounge, and other facility rooms. • Cabins occupied by the construction workers. • Cabin 7027 was selected as it is located at the stern of the floatel and the cabin wall is facing the construction piling site. • Cabin ceiling ventilation was not operating during the noise monitoring period.	Figure 3 Figure 8
9412	9	• Total of 88 cabins on Deck 9. • There is an outdoor area at the stern and a smoking area on the starboard side of Deck 9. • Cabins occupied by the construction workers. • Some cabins are located underneath several Fan Rooms (rooms with ventilation fans) on Deck 10, e.g., Cabins 9420 to 9436. • Higher noise from Fan Rooms ventilation openings was observed at the smoke area. • Cabin 9412 was selected as it is located at the starboard side of the floatel and facing the southwestern construction site. • Cabin ceiling ventilation was not operating during the noise monitoring period.	Figure 4 Figure 9

Cabin	Deck	Description and Observations during Monitoring Period	Reference Figures
0106	10	• Total of 17 cabins with office areas on Deck 10. • Cabins were occupied by crew members and construction workers. • There are several Fan Rooms on Deck 10. • Cabin 0106 is located at the starboard side of the floatel and facing the southwestern construction site. • Cabin ceiling ventilation was continuously operating during the noise monitoring period.	Figure 4 Figure 10

3.2 MEASUREMENT INSTRUMENTATION

Noise monitoring was conducted with three Brüel & Kjær Model 2250 sound level meters fitted with Brüel & Kjær 4966 and 4189 type microphones. The sound level meters meet the ANSI S1.4-2006 Type 1 and IEC 61672-1 Class 1 specifications. The sound level meters were field calibrated before and after each measurement period and have valid laboratory certificates. Laboratory certificates are considered valid within two-year period after last recalibration for the sound level meters and within one year period for the calibrator.

Table 3.2 summarizes details of the measurement instrumentation. Corresponding calibration certificates of sound level meters and calibrator are attached in Appendix C.

Table 3.2 Details of Measurement Instrumentation

Item	Description
Sound Level Meter	Brüel & Kjær Model 2250 s/n 3008995 Brüel & Kjær Model 2250 s/n 3003408 Brüel & Kjær Model 2250 s/n 3007710
Microphone	Brüel & Kjær Model 4966 s/n 3391835 Brüel & Kjær Model 4189 s/n 2866566 Brüel & Kjær Model 4189 s/n 2799496
Calibrator	Brüel & Kjær Model 4231 s/n 3009070
Bandwidth	1/3 Octave Band
Frequency Range	12.5 Hz – 20 kHz
Frequency Weightings	Z (Linear), A & C
Calibration Level	94 dB at 1 kHz

3.3 MEASUREMENT SETUP

Dayshift workers sleep during nighttime and nightshift workers sleep during daytime on the floatel. Therefore, continuous sound levels over 24 hours (i.e., over one daytime and one nighttime periods) were measured at the cabins.

Two sound level meters (Brüel & Kjær Model 2250), one per room, were deployed for continuous noise monitoring. The sound level meters were set to 1-minute logging intervals measuring L_{Amax} and L_{eq} sound levels in one-third octave band L_{eq} sound levels from 12.5 Hz to 20 kHz frequency range.

Sound level meters also recorded the continuous digital audio signal simultaneously for further data analysis and post-processing to remove (isolate) extraneous noise events from the dataset.

The microphones were set up at bed height (i.e., 1 metre above the room floor) at each cabin. Figure 5 though Figure 10 in Appendix A illustrate the sound level meter setup at each cabin.

The monitoring events are described as below:

- Two sound level meters were setup at Cabin 0106 and Cabin 2002 to collect continuous noise data over 24 hours from October 8 to October 9.
- The two sound level meters were switched to Cabin 5004 and Cabin 6004 to collect continuous noise data over 24 hours from October 9 to October 10.
- Noise monitoring was conducted at Cabin 7027 and Cabin 9412 for 24 hours from October 10 to October 11.
- During noise monitoring periods, spot measurements were conducted at the corridors on Deck 2, the results were used to compare with the initial spot measurement results.

Table 3.3 summarizes the measurement duration at each cabin during the noise monitoring period.

Table 3.3 Noise Monitoring Duration at Cabins

Cabin	Measurement Start		Measurement End		Measurement Duration (hrs mm))
	Date (mm/dd/yy yy)	Time (hh:mm)	Date (mm/dd/yy yy)	Time (hh:mm)	
2002	10/08/2024	10:14	10/09/2024	12:24	26 hrs 10 mins
5004	10/09/2024	12:20	10/10/2024	12:33	24 hrs 13 mins
6004	10/09/2024	12:30	10/10/2024	12:46	24 hrs 16 mins
7027	10/10/2024	12:41	10/11/2024	13:00	24 hrs 19 mins
9412	10/10/2024	12:59	10/11/2024	13:08	24 hrs 9 mins
0106	10/08/2024	10:00	10/09/2024	12:14	26 hrs 14 mins

3.4 PROJECT CONSTRUCTION ACTIVITIES

There were Project dayshift and nightshift construction activities during the noise monitoring period from October 8 to October 11. The dayshift was from 07:00 to 17:00 and the nightshift was from 19:00 to 07:00. Figure 13 illustrates the construction areas onsite with Area ID #. Construction activities during the noise monitoring period included the following:

Daytime:

- Area 1200: RCMI drilling and blasting at 1200 A/B/C – ongoing; removal of blast rock – ongoing
- Area 1100: Rock anchor installation – ongoing; rock breaking and crushing
- Area 1300 MOF area: Vibratory and impact hammering piling – ongoing; dynamic compaction started on October 12; pomerleau: pin pile installation – on going

Nighttime:

- Area 1100: Rock crushing in the area
- Area 1200: Overburden removal and stockpiling in Area 4100
- Area 1200 and 1100/4100: Rock trucks moving materials
- Barge offloading
- Area 1300 MOF area: Vibratory piling – started from October 10.

3.5 DATA ISOLATION ANALYSIS

The FNMMP prescribes that measured noise data that are not representative of the existing acoustic environment, non-anthropogenic sound, or non-representative weather conditions can be isolated from the data set prior to the calculation of any average values.

During the noise monitoring, the weather conditions were generally representative most time, there was no high wind; there were some periods with very light rain on October 8, however, the rain was too light to impact the noise measurement inside the cabins. Therefore, isolation was not applied for weather conditions.

Noise events isolated from the data set included:

- Qualified Professional activities (e.g., equipment setup and disassembly, daily regular checkups).
- Door knocking or opening at the monitored cabin.
- Floatel power shutdown periods. During the noise monitoring periods, the floatel scheduled power shutdowns for operation maintenance purposes. During power shutdowns, all operational equipment on the floatel was off and the background noise was not representative of the normal floatel acoustical environments. These periods include:
    1. October 8: 12:48 – 15:35
    2. October 9: 8:06 – 9:46
    3. October 10: 13:00 – 14:30; and 17:30 – 18:06
    4. October 11: 8:00 – 9:35

These noise events were identified using audio recordings and also based on the Qualified Professional's field notes, and then removed from the valid measurement data. Noise from local anthropogenic activities from neighbour occupants (e.g., toilet flushing, foot traffic and conversation in the corridor) and crew member activities (e.g., regular operations, cleaning and maintenance activities) was considered to be part of the existing acoustic environment and was not isolated.

After the data isolation, L_{eq}, L_d, L_n, and L_{Amax} values were determined for the different measurement periods. Once the data isolation analysis was completed, the resulting valid noise data set (i.e., with invalid data removed) was logarithmically averaged over the corresponding time periods using the following formula:

$$L_{Aeq}(isolated, ave) = 10lg_{10}\left[\frac{1}{N_V}\sum_{i=1}^{N_V} 10^{(0.1L_{A,eq})}\right] dBA$$

where N_V = number of valid 1-minute logging periods in the measurement data set.

4.0 MEASUREMENT RESULTS

This section summarizes the analysis results. The L_d, L_n, the occurrence of L_{Amax} higher than 45 dBA (i.e., Health Canada threshold) are analyzed and presented in tables herein. In total, there are more than 8,800 minutes logged measurement values at five cabins during the monitoring period.

4.1 MEASUREMENT RESULTS AT CABINS

Table 4.1 provides an overall summary of the noise monitoring results at each noise monitoring cabin.

Table 4.1 Summary of Measurement Results

Cabin	Deck	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Number of Highest Occurrence of L_{Amax} > 45 dBA	
				Daytime	Nighttime
2002	2	52.4	52.3	554	540
5004	5	38.7	38.5	23	10
6004	6	40.4	40.3	72	18
7027	7	27.8	28.6	0	8
9412	9	30.2	29.6	0	8
0106	10	38.4	38.6	48	14

Details of daily measurement results at each cabin are described in the following sections. The daily results are compared to the Health Canada sleep disturbance thresholds and ANSI room sound level criteria of 39 to 44 dBA.

4.1.1 Cabin 2002

Table 4.2 summarizes the daily L_d and L_n sound levels, and quantities of occurrence with L_{Amax} > 45 dBA at Cabin 2002.

Table 4.2 Summary of Daily L_d and L_n at Cabin 2002

Date (mm/dd/yyyy)	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Daytime Quantity of L_{Amax}> 45 dBA	Nighttime Quantity of L_{Amax} > 45 dBA	Health Canada		ANSI S12.2
					L_{eq}, dBA	Qty. of L_{Amax} > 45 dBA	L_{eq}, dBA
10/08/2024[1]	52.8	52.3	554	540	30	15	39 to 44
10/09/2024	51.9	-[2]	224	-[2]	30	15	39 to 44

Notes:

[1] The measurements started at 10:14.

[2] "-" indicates no data was measured. The survey ended at 12:24.

Monitoring results for Cabin 2002 are summarized as follows:

- L_d and L_n are higher than the Health Canada noise threshold of 30 dBA.
- L_d and L_n are higher than recommended ANSI room sound level criteria upper limit of 44 dBA.
- Quantities of occurrence with L_{Amax} > 45 dBA are more than 15 times during both daytime and nighttime periods. See Section 6.0 for further detail of discussion.

4.1.2 Cabin 5004

Table 4.3 summarizes the daily L_d and L_n sound levels, and quantities of occurrence with L_{Amax} > 45 dBA at Cabin 5004.

Table 4.3 Summary of Daily L_d and L_n at Cabin 5004

Date (mm/dd/yyyy)	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Daytime Quantity of L_{Amax}> 45 dBA	Nighttime Quantity of L_{Amax} > 45 dBA	Health Canada		ANSI S12.2
					L_{eq}, dBA	Qty. of L_{Amax} > 45 dBA	L_{eq}, dBA
10/09/2024[1]	38.7	38.5	23	10	30	15	39 to 44
10/10/2024	38.7	-[2]	18	-[2]	30	15	39 to 44

Notes:

[1] The measurements started at 12:20.

[2] "-" indicates no data was measured. The survey ended at 12:33.

Monitoring results for Cabin 5004 are summarized as follows:

- L_d and L_n are higher than the Health Canada noise threshold of 30 dBA.
- L_d and L_n are lower than recommended ANSI room sound level criteria lower limit of 39 dBA.
- Quantities of occurrence with L_{Amax} > 45 dBA are more than 15 times during the daytimes of October 9 and October 10.
- Quantities of occurrence with L_{Amax} > 45 dBA are less than 15 times during the nighttime period of October 9.

4.1.3 Cabin 6004

Table 4.4 summarizes the daily L_d and L_n sound levels, and quantities of occurrence with L_{Amax} > 45 dBA at Cabin 6004.

Table 4.4 Summary of Daily L_d and L_n at Cabin 6004

Date (mm/dd/yyyy)	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Daytime Quantity of L_{Amax}> 45 dBA	Nighttime Quantity of L_{Amax} > 45 dBA	Health Canada		ANSI S12.2
					L_{eq}, dBA	Qty. of L_{Amax} > 45 dBA	L_{eq}, dBA
10/09/2024[1]	40.3	40.3	64	18	30	15	39 to 44
10/10/2024	40.5	-[2]	72	-[2]	30	15	39 to 44

Notes:

[1] The measurements started at 12:30.

[2] "-" indicates no data was measured. The survey ended at 12:46.

Monitoring results for Cabin 6008 are summarized as follows:

- L_d and L_n sound levels are higher than the Health Canada noise threshold of 30 dBA.
- L_d and L_n sound levels are lower than the ANSI S12.2 room sound level criteria upper limit of 44 dBA.
- Quantities of occurrence with L_{Amax} > 45 dBA are more than 15 times during both daytime and nighttime periods.

4.1.4 Cabin 7027

Table 4.5 summarizes the daily L_d and L_n sound levels, and quantities of occurrence with L_{Amax} > 45 dBA at Cabin 7027.

Table 4.5 Summary of Daily L_d and L_n at Cabin 7027

Date (mm/dd/yyyy)	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Daytime Quantity of L_{Amax}> 45 dBA	Nighttime Quantity of L_{Amax} > 45 dBA	Health Canada		ANSI S12.2
					L_{eq}, dBA	Qty. of L_{Amax} > 45 dBA	L_{eq}, dBA
10/10/2024[1]	28.6	28.6	0	8	30	15	39-44
10/11/2024	26.8	-[2]	0	-[2]	30	15	39-44

Notes:

[1] The measurements started at 12:41.

[2] "-" indicates no data was measured. The survey ended at 13:00.

Monitoring results for Cabin 7027 are summarized as follows:

- L_d and L_n sound levels are lower than the Health Canada noise threshold of 30 dBA.
- L_d and L_n sound levels are lower than the ANSI S12.2 room sound level criteria lower limit of 39 dBA.
- Quantities of occurrence with L_{Amax} > 45 dBA are less than 15 times during both daytime and nighttime periods.

4.1.5 Cabin 9412

Table 4.6 summarizes the daily L_d and L_n sound levels, and quantities of occurrence with L_{Amax} > 45 dBA at Cabin 9412.

Table 4.6 Summary of Daily L_d and L_n at Cabin 9412

Date (mm/dd/yyyy)	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Daytime Quantity of L_{Amax}> 45 dBA	Nighttime Quantity of L_{Amax} > 45 dBA	Health Canada		ANSI S12.2
					L_{eq}, dBA	Qty. of L_{Amax} > 45 dBA	L_{eq}, dBA
10/10/2024[1]	30.1	29.6	0	8	30	15	39 to 44
10/11/2024	30.2	-[2]	0	-[2]	30	15	39 to 44

Notes:

[1] The measurements started at 12:59.

[2] "-" indicates no data was measured. The survey ended at 13:08.

Monitoring results for Cabin 9412 are summarized as follows:

- L_d sound levels are approximately equal to the Health Canada noise threshold of 30 dBA (i.e., 30.1 dBA and 30.2 dBA vs. 30 dBA).
- L_n sound level is lower than the Health Canada noise threshold of 30 dBA.
- L_d and L_n sound level are lower than the ANSI S12.2 room sound level criteria lower limit of 39 dBA.
- Quantities of occurrence with L_{Amax} > 45 dBA are less than 15 times during both daytime and nighttime periods.

4.1.6 Cabin 0106

Table 4.7 summarizes the daily L_d and L_n sound levels, and quantities of occurrence with L_{Amax} > 45 dBA at Cabin 0106.

Table 4.7 Summary of Daily L_d and L_n at Cabin 0106

Date (mm/dd/yyyy)	Average Daytime L_d, dBA	Average Nighttime L_n, dBA	Daytime Quantity of L_{Amax}> 45 dBA	Nighttime Quantity of L_{Amax} > 45 dBA	Health Canada		ANSI S12.2
					L_{eq}, dBA	Qty. of L_{Amax} > 45 dBA	L_{eq}, dBA
10/08/2024[1]	38.3	38.6	48	14	30	15	39 to 44
10/09/2024	38.5	-[2]	8	-[2]	30	15	39 to 44

Note:

[1] The measurements started at 10:00.

[2] "-" indicates no data was measured. The survey ended at 12:14.

Monitoring results for Cabin 0106 are summarized as follows:

- L_d and L_n sound levels at Cabin 0106 are higher than the Health Canada noise threshold of 30 dBA.
- The L_d and L_n sound levels are lower than the ANSI S12.2 room sound level criteria lower limit of 39 dBA.
- Quantities of occurrence with L_{Amax} > 45 dBA are more than 15 times during the daytime of October 8.
- Quantities of occurrence with L_{Amax} > 45 dBA are less than 15 times during the nighttime period of October 8 and daytime of October 9.
- L_n is 0.3 dB higher than L_d. These values are acoustically comparable.

4.2 SPOT MEASUREMENTS

Spot measurements were conducted at different locations at the corridors on Deck 2. Sound levels were collected along the corridors outside the cabins during the daytime and nighttime periods. The purpose of the measurement was to collect the sound levels on Deck 2 and compare the differences before and after the shore grid power line was connected to the floatel.

Figure 11 (Appendix A) shows the measurement locations and corresponding L_{eq} sound levels. Table 4.8 summaries the measurement results from the first (initial) noise survey and this noise survey on Deck 2.

Table 4.8 Comparison of First and Third Spot Measurement Results on Deck 2

Measurement Location along Corridor	First Survey		Third Survey	
	Daytime (L_{eq}, dBA)	Nighttime (L_{eq}, dBA)	Daytime (L_{eq}, dBA)	Nighttime (L_{eq}, dBA)
Outside Cabin 2000/2002	52.2	57.9	47.5	48.6
Outside Cabin 2008	49.6	57.8	44.0	41.1
Outside Cabin 2025/2026/2027	48.0	53.2	48.4	46.8
Outside Cabin 2035/2034	N/A[1]	N/A[1]	55.2	51.8
Outside Cabin 2051	N/A[1]	N/A[1]	49.2	50.8
Outside Cabin 2065/2064	N/A[1]	N/A[1]	47.2	44.0
Outside Cabin 2084/2085	N/A[1]	N/A[1]	44.0	40.6

Note:

[1] N/A – The measurements were not taken as the corridors were closed.

After the shore grid power was connected to the floatel, the power generation units on the floatel were shut down and only operate in emergency situations. Comparison of the spot measurement results for the first and third survey at the same locations shows that noise levels were generally reduced, ranging from 5 dBA to 16 dBA reduction at different locations along the corridors on Deck 2. Daytime noise levels outside Cabin 2025/2026/2027 were comparable between two surveys.

However, other auxiliary equipment, such as ventilation equipment, compressors, boilers and heating equipment still operates on Deck 2 (and Deck 1). As such, noise levels on Deck 2 were still relatively high.

5.0 NOISE INTERVIEWS

During the noise monitoring period on the floatel, the Qualified Professional interviewed various cabin occupants. The purpose of the interview is to obtain an understanding of the noise effects of interest to the occupants; and perform an investigation if there are any potential noise issues identified on the floatel and inform the floatel management for further mitigation plans.

Twenty-five occupants were randomly selected for the interviews, which represents about 5% of the total occupants at the time. There were approximately 500 total construction worker occupants during the third noise monitoring period. Four questions were asked regarding noise issues:

1. General evaluation for your sleeping at the floatel.
2. Can you hear outside construction noise?
3. Do you feel any noise effects from the Gym activities? (This question is for occupants on Deck 6 only)
4. Any noise concern/complaints.

Question #3 was added for the third noise interview to address the questions regarding noise from the Gym activities raised by the occupants on Deck 6 in the previous two interviews.

Details of the interviews, including interviewee ID #, interview date, cabin location, and work shift; and answers for the questions are included in Appendix B.

Feedback for the questions from the interviewees is summarized as below:

- No interviewees have noise concerns or complaints regarding construction noise.
- No interviewees report sleep disturbance issues during the stay on the floatel, including sleeping during the daytime period.
- Interviewees do not perceive construction noise inside the cabins.
- Several interviewees living on Deck 6 reported perceptible noise events occasionally, due to activities in the Gym on Deck 7, such as weight dropping on the floor.

6.0 DISCUSSION

Table 6.1 summarizes the measurement results when compared to the Health Canada noise threshold and ANSI S12.2 room sound level criteria.

Table 6.1 Summary of Results

Cabin	Deck	Meet Health Canda Indoor L_{eq} Threshold of 30 dBA		Meet Health Canada L_{Amax} > 45 dBA Occurrence Less Than 15 Times		Meet ANSI S12.2 Room Sound Level Criteria of 39 to 44 dBA	
		Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
2002	2	No	No	No	No	No	No
5004	5	No	No	No	Yes	Yes	Yes
6004	6	No	No	No	No	Yes	Yes
7027	7	Yes	Yes	Yes	Yes	Yes	Yes
9412	9	Yes[1]	Yes	Yes	Yes	Yes	Yes
0106	10	No	No	Yes/No[2]	Yes	Yes	Yes

Notes:
[1] The highest noise level was 30.2 dBA, which is approximately equal to the threshold of 30 dBA.
[2] Meet threshold on October 9 but exceed threshold on October 8.

Most cabins are above the Health Canada sleep disturbance threshold of 30 dBA with exceptions at Cabin 7027 and Cabin 9412, where the ventilation in the cabins was off during the noise monitoring periods. Without the ceiling ventilation in operation, L_d and L_n results meet 30 dBA. The primary factors that contribute to the cabin sound levels are the ventilation system.

Cabin 2002 has the highest daytime and nighttime sound levels. The cabin is the closest to the Engine Stores (engine rooms), intrusive noise emitted from the auxiliary equipment operations was transmitted to the cabin through the partition walls and ceiling plenum and contributes to the high noise levels inside the cabin.

In terms of meeting the 45 dBA L_{Amax} or above occurrence less than 15 times, Cabin 2002 has the highest occurrence results due to its adjacency to the Engine Stores with local operating noise. Continuous L_{Amax} more than 45 dBA noise levels were measured during daytime and nighttime, except during the periods with power shutdowns. Results at Cabin 2002 provide new findings of cabins with potential high noise levels and directions for further noise mitigation measures. See Section 7.0 for additional discussion regarding cabin allocation on Deck 2 following the third noise survey.

However, as discussed in Section 4.2, sound levels at the corridors on Deck 2 were generally reduced from 5 dBA to 16 dBA after connection to the shore grid power. The overall acoustical environment on Deck 2 was improved.

Cabin 7027 and Cabin 9412 have the lowest occurrence results and meet the threshold during both daytime and nighttime. Cabin 5004 exceeds the threshold in daytime and meet the threshold in nighttime. Cabin 0106 meets the threshold in nighttime and exceeds the threshold on October 8 daytime but meets the threshold on October 9 daytime. Cabin 6004 exceeds the occurrence threshold during both daytime and nighttime. This is due to Deck 6 having the most occupied cabins and more local activities (e.g., regular operating activities including room services, people walking along corridors).

Table 6.2 compares the results from first (July 2024), second (September 2024), and third (October 2024) surveys.

Table 6.2 Comparisons of First, Second and Third Survey Results

Cabin #			Average Daytime Highest L_d, dBA			Average Nighttime Highest L_n, dBA			Number of Highest Occurrence of L_{Amax} > 45 dBA					
									Daytime			Nighttime		
1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
2025	N/A[1]	2002	41.9	N/A[1]	52.8	42.0	N/A[1]	52.3	482	N/A[1]	554	144	N/A[1]	540
5010	5010	5004	30.1	42.1	38.7	27.6	42.4	38.5	73	48	23	4	61	10
6010	6008	6004	35.7	34.2	40.5	34.9	34.3	40.3	65	21	72	28	6	18
7025	7033	7027	38.3	32.1	28.6	38.3	31.6	28.6	56	41	0	19	8	8
9420	9410	9412	36.0	39.1	30.2	36.0	39.3	29.6	64	40	0	5	6	8
0107	0106	0106	38.4	38.0	38.5	38.2	37.9	38.6	64	28	48	6	5	14

Notes:

[1] N/A – measurement was not taken.

Sound levels inside Cabin 2002 are much higher than Cabin 2025, as discussed above, Cabin 2002 is located adjacent to the Engine Store, and Cabin 2025 is further away (see Figure 2). Intrusive noise through the cabin ceiling plenum contributes the high interior sound levels at Cabin 2002.

The ceiling ventilations in Cabin 7027 and Cabin 9412 were not in operation during the third survey. The operating ceiling ventilation during the first and second surveys results in higher noise levels. This comparison confirms that the primary noise contributing factor is ceiling ventilation system inside the cabin.

Cabin 0106 was selected in both second and third survey, interior L_d and L_n sound levels were in a similar range of 37 to 38 dBA for both sets of measurements.

All cabins do not have the option to open the window. The ceiling ventilation is essential to keep the cabins in comfortable air flow conditions for the occupants, similar to any hotel room. Turning off ventilation will affect the air circulation and temperature for cabin occupants. Therefore, the measurement results are compared to the ANSI S12.2 room sound level criteria for hotel/motel rooms. In three surveys, most cabins are within the ANSI S12.2 room sound level criteria range of 39 dBA to 44 dBA, except Cabin 2002 during the third survey. Results at most cabins are below or close to the lower limit of 39 dBA, the exceptions are Cabin 5010 on Deck 5 during the second survey and Cabin 6004 during the third survey, the results at Cabin 5010 and Cabin 6004 are below the upper limit of 44 dBA threshold.

On all decks, noise from the construction activities, including piling activities during the noise monitoring period does not affect the floatel interior acoustic environment.

The interview results indicate no sleep disturbance issues and no noise concerns or complaints due to construction noise during the noise monitoring period.

7.0 MITIGATION MEASURES

To prevent future noise concerns or complaints, potential noise mitigation measures and management controls that have been implemented or may be considered are summarized below:

- Shore grid power supply was connected to the floatel prior to the third noise monitoring survey. The power generation engines inside the Engine Stores were shut down and will be used only in emergency situations. Sound levels at corridors on Deck 2 have been reduced approximately 5 to more than 10 dBA at different locations.
- However, due to operations of other auxiliary equipment, high noise levels were still measured inside Cabin 2002. Workers cabin allocation to Deck 2 should be reduced, especially at the first row of the cabins, which are located next to the Engine Stores. These cabins are marked in Figure 12.
- For activities in the Gym, the floatel management has posted additional signage, and the receptionist also does regular patrolling to remind users that dropping the weights (e.g., deadlifts) should be minimized or avoided.
- The floatel management has been seeking solutions to reduce noise and vibration from weight dropping (e.g., rubber mats on the gym floor to dampen the impact).
- Should the floatel management receive noise complaints, administration controls can be implemented to select or change specific cabins or decks for the workers who need alternative cabins.
- Maintain the Communication Protocol and Complaint Response Procedure to address and manage any future noise concerns or complaints by the floatel occupants.

8.0 CONCLUSIONS

The third noise monitoring survey was conducted on the floatel from October 8 to October 11, 2024 to fulfill the requirements of Condition 30 of EAC. Continuous sound levels over 24 hours were collected at six selected cabins. Measured noise data were analyzed and compared with the Health Canada sleep disturbance thresholds, as well as ANSI S12.2 room sound level criteria and assess the compliance. Interviews with occupants for noise concerns were performed. Mitigation and an adaptive management plan were recommended.

The measurement results of the third noise monitoring survey are above the Health Canada thresholds with the cabin ventilation in operation, and below the thresholds without the cabin ventilation in operation. The measurement results meet the ANSI S12.2 room sound level criteria for hotel and motel rooms at most cabins, except Cabin 2002. There were no sleep disturbance issues and noise concerns or complaints received from the floatel occupants. Noise from the Project construction activities, including vibratory and impact piling does not affect the floatel interior acoustic environment. In addition, the Communication Protocol and Complaint Response Procedure will be maintained to address and manage any noise concerns or complaints by the floatel occupants.

9.0 REFERENCES

ANSI (American National Standard) 2005. ANSI S12.9 – 2005/Part 4, Quantities and Procedures for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response. New York, 2005.

ANSI (American National Standard) 2023. ANSI S12.2 – 2019 (Reaffirmed in 2023), Criteria for Evaluating Room Noise. New York, 2023.

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Stantec 2022. Construction Phase Noise Assessment Technical Report – Woodfibre LNG. September 2022.

Stantec 2024. Floatel Noise Monitoring and Mitigation Plan – Woodfibre LNG Project. April 2024.

Stantec 2024a. Floatel Noise Monitoring Survey -1 (July 10 -14, 2024) – Woodfibre LNG Project. 123222160EN-RPT0052 Revision 1, September 16, 2024.

Stantec 2024b. Floatel Noise Monitoring Survey -2 (September 4 - 7, 2024) – Woodfibre LNG Project. 123222160EN-RPT0053 Revision 1, November 2024.

Woodfibre LNG 2015. Woodfibre LNG Project Application for an Environmental Assessment Certificate.

Woodfibre LNG 2023. Application for a Temporary Use Permit for the District of Squamish – Floatel. August 2023.

APPENDIX A FIGURES

Figure 1 Site Plan with Floatel Location

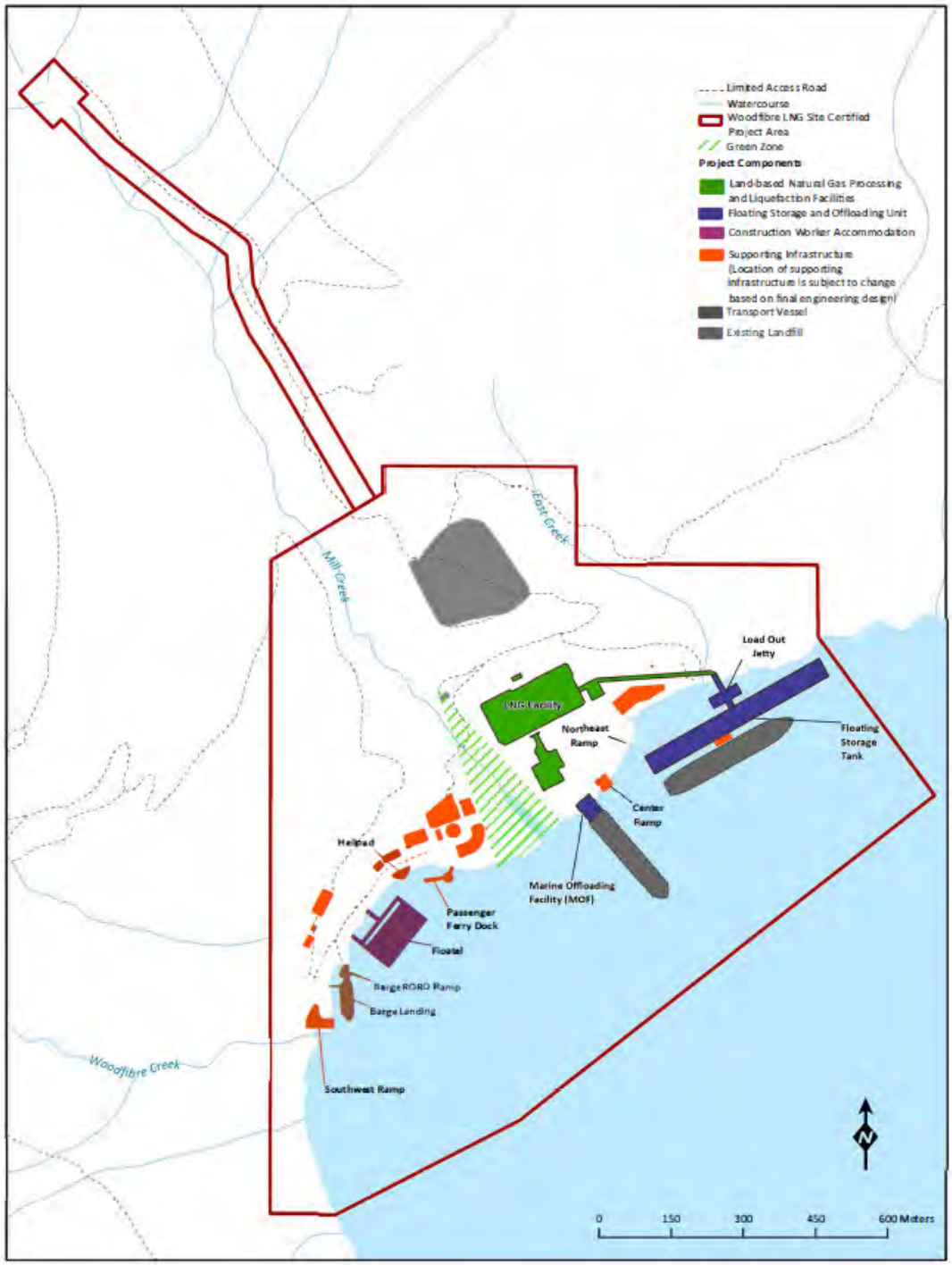


Figure 2 Measurement Location at Cabin 2002 and Cabin 5010 (Deck 2 and Deck 5)

Legend of Figure 2

Noise monitoring cabin

Quantity of cabins per deck (unless otherwise indicated, applies to all figures with cabins)

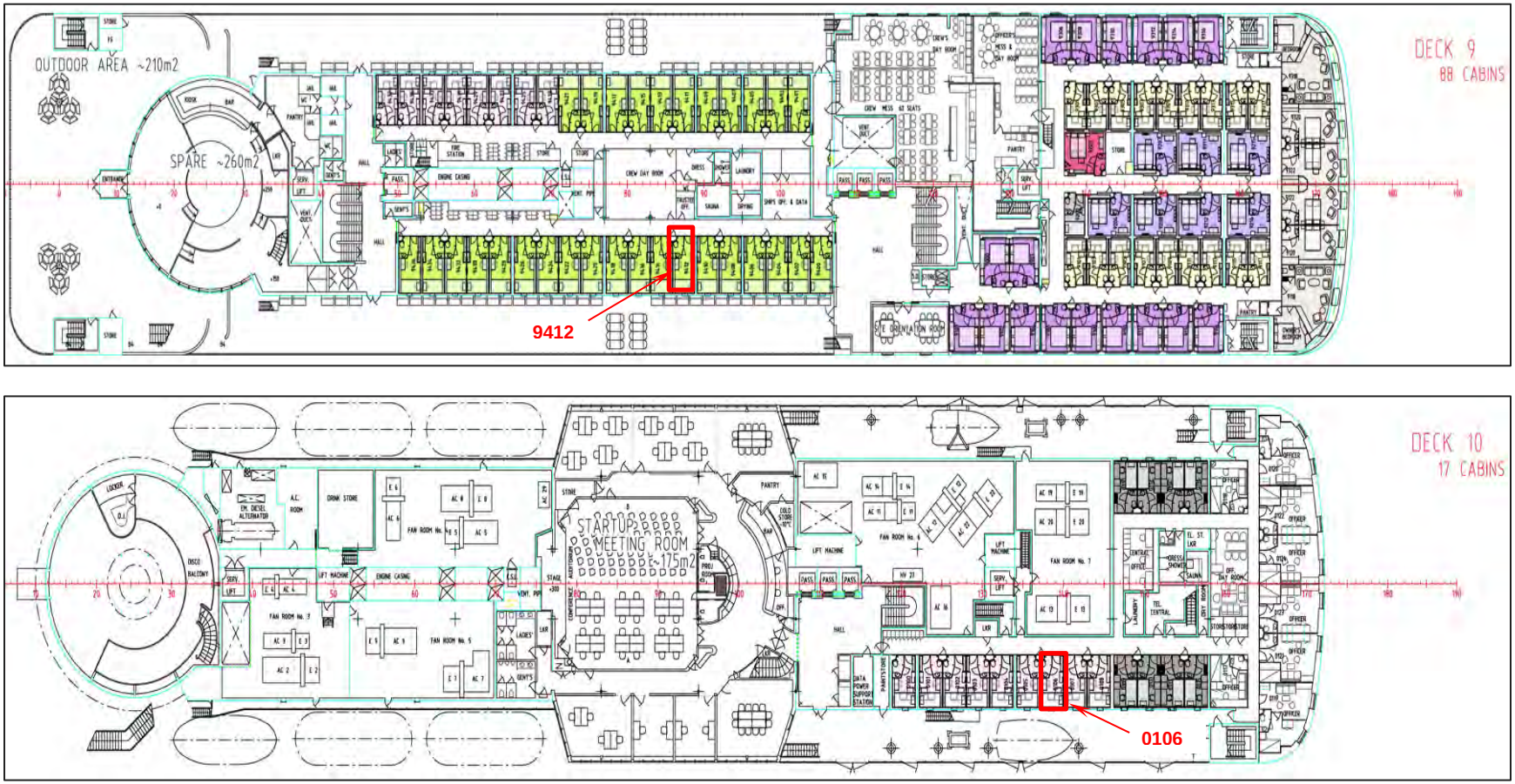
	TYPE 1A-1	TYPE 1A-2	TYPE 1A-3	TYPE 1B-1	TYPE 1B-2	TYPE 1B-3	TYPE 1B-4	TYPE 1B-5	TYPE 1B-6	TYPE 1B-7	TYPE 1B-8	TYPE 1C-1	TYPE 1C-2	TYPE 1D	TYPE 1E-1	TYPE 1E-2	TYPE 1F-1	TYPE 1F-2	TYPE 2A	TYPE 2B	TYPE 2C	TYPE 3A	TYPE 3B	TYPE 4A	TYPE 4B	QUANTITY OF CABINS PER DECK
DECK 10				9																				8		17
DECK 9	18			8								30				2		2	7	1	17	4	8		1	88
DECK 7	24											30														58
DECK 6	208												8		2		2		24	1					3	248
DECK 5	102	6	44		15	5	9	10	7	1	1			4					14						1	219
DECK 2	34																								52	86
CABINS PER TYPE	386	6	44	17	15	5	9	10	7	1	1	60	8	4	2	2	2	2	45	2	17	4	2	8	57	716

Figure 3 Measurement Location at Cabin 6004 and Cabin 7027 (Deck 6 and Deck 7)

Legend

Noise monitoring cabin

Figure 4 Measurement Location at Cabin 9412 and Cabin 0106 (Deck 9 and Deck 10)



Legend

Noise monitoring cabin

Woodfibre LNG

Figure 5 Sound Level Meter Setup at Cabin 2002

Figure 6 Sound Level Meter Setup at Cabin 5004

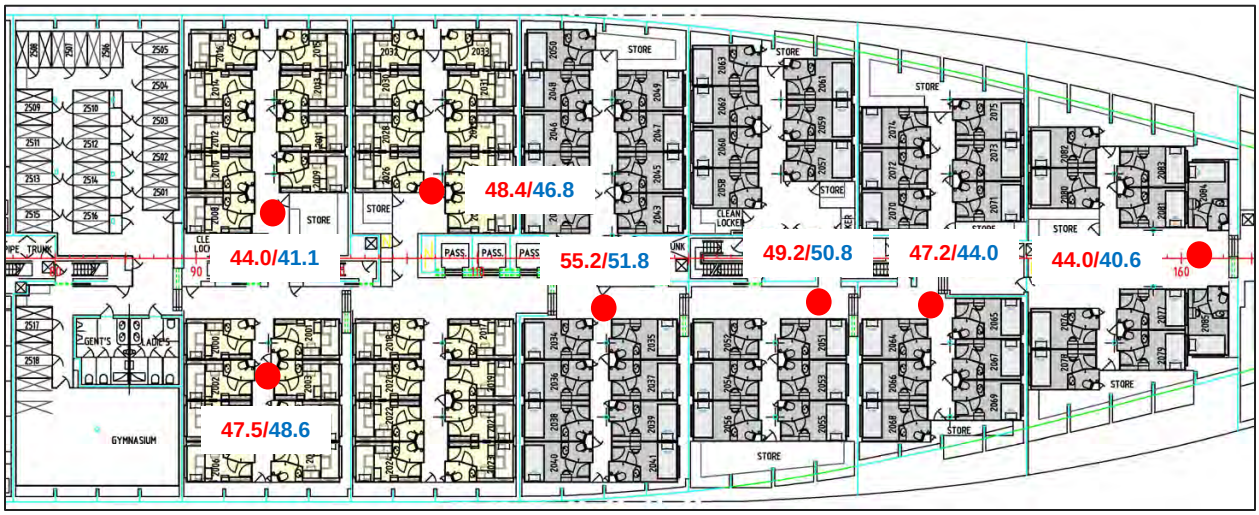
Figure 7 Sound Level Meter Setup at Cabin 6004

Figure 8 Sound Level Meter Setup at Cabin 7027

Figure 9 Sound Level Meter Setup at Cabin 9412

Figure 10 Sound Level Meter Setup at Cabin 0106

Figure 11 Spot Measurement locations and Sound Levels on Deck 2



Legend

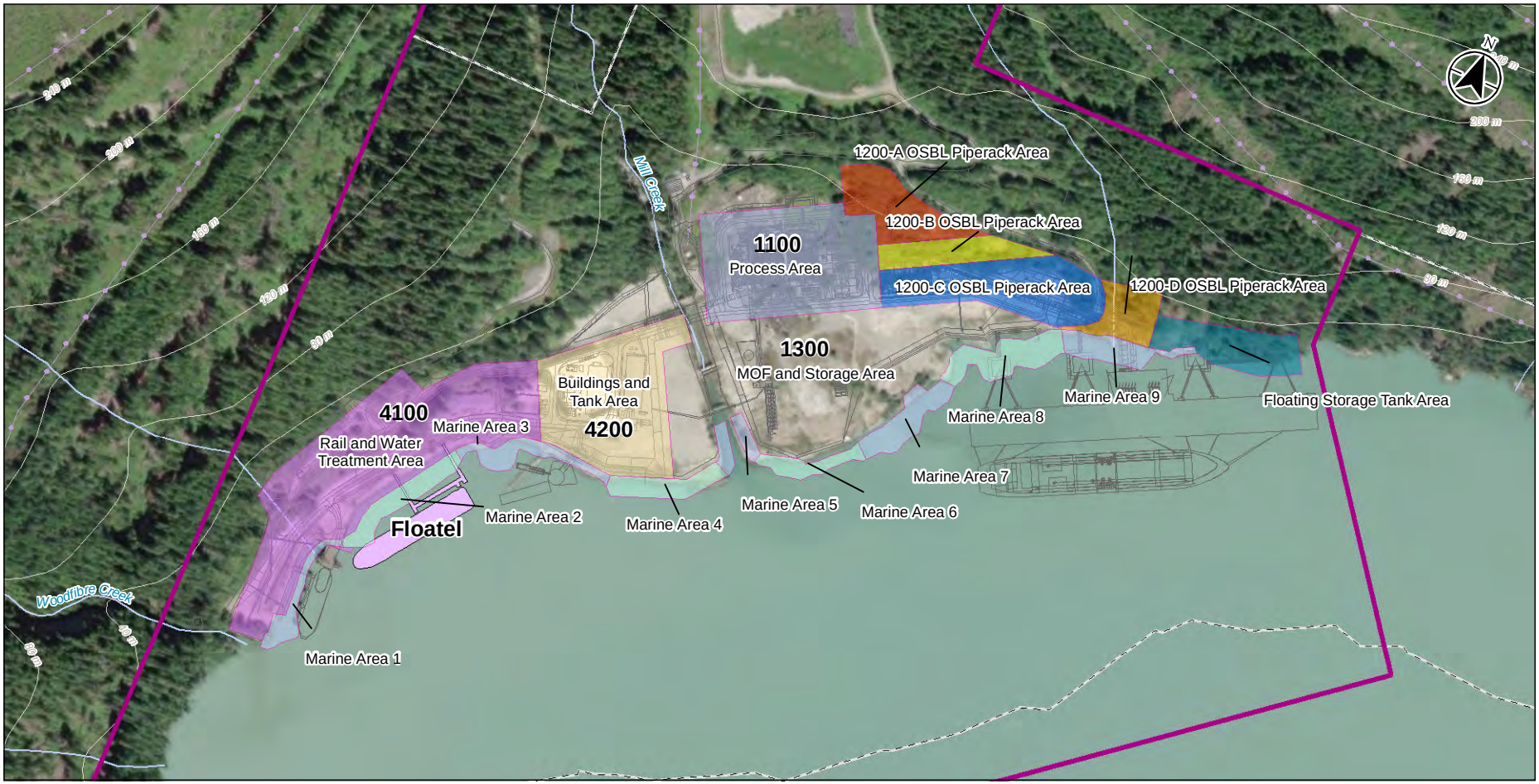
● Measurement Location

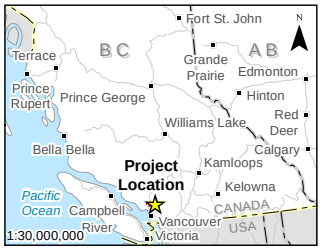
44.0/41.1 Red – Measured daytime sound level, dBA Blue – Measured nighttime sound level, dBA

Figure 12 Cabins Not Preferable for Worker Accommodation on Deck 2

Legend

▭ Cabins not preferable for worker accommodation





- Transmission Line
- Topographic Contour
- Watercourse
- Municipal Boundary
- Project Design Linework
- Floatel
- Certified Project Area

0 50 100 150 200 250 m

1:7,500 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Orthoimagery: ESRI World Imagery

Stantec

Project Location:
Woodfibre, British Columbia

Project Number: 123222160
Prepared by PKASIANCHUK on 20241004
Requested by ACALDERON on 20240822
Checked by YMA on 20240828

Client/Project/Report

Woodfibre LNG
Floatel Noise Monitoring Survey

Figure No.
13

Title
Construction Areas Onsite

APPENDIX B NOISE INTERVIEW RECORDS

Interviewer: Yong Ma, P. Eng.				Interview Questionnaire			
Interviewee Information							
ID # of Interviewee	Interview Date	Living Deck	Work Shift	1.General evaluation for your sleeping at Floatel	2.Can you hear outside construction noise?	3. Do you feel any noise effects from the Gym activities? (Deck 6 only)	3. Any noise concerns/ complaints
#1	Oct 8	7	Night	No problem	Not yet		No, it's OK
#2	Oct 8	6	Day	Sleep is OK other than ventilation noise	Nothing heard from outside construction	Not heard Gym noise (not under gym)	No complaints so far
#3	Oct 8	5	Day	No sleep disturbance	Nothing heard from outside construction		Not in room
#4	Oct 8	5	Day	No sleep disturbance	No		It's OK
#5	Oct 8	6	Night	It's OK	Nothing heard from construction	Not heard yet	Since stay, pretty happy
#6	Oct 8	5	Day	It's good	No sound heard from construction		Very happy
#7	Oct 8	9	Day	No problem	No		All good
#8	Oct 8	7	Day	No issues	No		Perfect condition
#9	Oct 8	5	Day	Generally Ok	Not hearing from construction		So far so good
#10	Oct 9	5	Day	All good	No		No issues
#11	Oct 9	7	Night	Excellent	Not hearing from construction		No complaints
#12	Oct 9	5	Day	It's good	No, but loud outside at smoke area		No noise concerns
#13	Oct 9	10	Day	Good condition	Not hearing from construction		No problem
#14	Oct 9	10	Night	It's good	No		No noise concerns
#15	Oct 9	6	Day	No problem	No	Not hearing noise from Gym	It's all OK
#16	Oct 9	6	Day	All good	No	Not heard	No problem
#17	Oct 9	6	Day	Not too bad	Not hearing from construction	One day 5:30 am heard something	Not bad
#18	Oct 9	6	Day	So far so good	No	OK	All good
#19	Oct 9	6	Day	It's fine	Not heard	Sometimes heard Gym noise	OK, sometimes heard mechanical noise
#20	Oct 9	6	Day	Good condition	Nothing heard from construction	No Gym noise (not under Gym)	No concerns
#21	Oct 10	9	Day	No problem	No		It's fine
#22	Oct 10	6	Night	It's OK	No	Gym is OK	All fine
#23	Oct 10	9	Day	All good	Not heard from outside		Nothing at all
#24	Oct 10	5	Day	It's OK	No		Not really
#25	Oct 10	6	Night	It's quiet actually	Not heard from construction	Gym is OK	OK, all good

APPENDIX C INSTRUMENTATION CALIBRATION CERTIFICATION

HBK HOTTINGER BRÜEL & KJÆR
The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-675839-J5S4Z9-701

CALIBRATION OF:

Calibrator:	Brüel & Kjær	Type	4231	Serial No.:	3009070
Identification:	Stantec Noise	IEC Class:	1		

CUSTOMER:

Stantec
155 Hawkvill Close NW
Calgary, AB, T3G 3C3
Canada

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23.3	°C
	Air pressure:	97.48	kPa
	Relative Humidity:	40.7	%RH

SPECIFICATIONS: This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Bruel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Hottinger Brüel & Kjær Inc. acoustic calibrator calibration application
Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the 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 EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: February 13, 2024

Certificate issued: February 13, 2024

Can Phan
Calibration Technician

Meshaun Hobbs
Quality Representative

Sound Pressure Levels

All stated values are valid at environmental reference conditions

Nominal Level [dB]	Accept Limit Lower [dB]	Accept Limit Upper [dB]	Measured Level [dB]	Measurement Uncertainty [dB]
94	93.80	94.20	94.01	0.12
114	113.80	114.20	114.00	0.12

Frequency

Nominal Frequency [Hz]	Accept Limit Lower [Hz]	Accept Limit Upper [Hz]	Measured Frequency [Hz]	Measurement Uncertainty [Hz]
1000	999.00	1001.00	999.98	0.10

Total Distortion*

Distortion mode: [X] **TD*** [ ] **THD***

Calibration Level [dB]*	Accept Limit [%]*	Measured Distortion [%]*	Measurement Uncertainty [%]*
94	1.00	0.75	0.13
114	1.00	0.20	0.13

Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

Instrument List

Type	Description	Serial no	Cal. date	Due date	Calibrated by	Trace number
3560	PULSE Analyzer	2723320	2023-10-19	2024-10-18	GK	CAS-664166-V3L2K7-801
9545	Transfer Microphone	3	2023-10-31	2024-10-30	MH	CAS-664166-V3L2K7-403
4228	Reference Sound Source	1618502	2023-04-19	2025-04-30	WS	CAS-632564-L2S0L9-708

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 mm^3 . For all other types the result is valid with the actual load volume.

Transfer Microphone Type	Fulfils standard IEC 61094-1 LS	Fulfils standard IEC 61094-4 WS	Load Volume 1" (1/2" mic including DP-0776)	Load Volume 1/2"
4180	yes	yes	1126 mm^3	43 mm^3
4192	-	yes	1273 mm^3	190 mm^3
9545	-	-	1333 mm^3	-

Condition "As Received": Good

HBK
HOTTINGER BRÜEL & KJÆR

Calibration Certificate Number 1568.01

The Hottinger Bruel & Kjaer Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770/209-6907
Fax: 770/447-4033
Web site address: http://www.hbkworld.com

CERTIFICATE OF CALIBRATION

Certificate No: CAS-630035-B6P3Z4-102

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	Serial No: 3003408
Microphone:	Brüel & Kjær	4189	Serial No: 2866566
Preamplifier:	Brüel & Kjær	ZC-0032	Serial No: 19030
Supplied Calibrator:	Brüel & Kjær	4231	Serial No: 3009070
Software version:	BZ7222 Version 4.7.7		

CLIENT:

Stantec
155 Hawkville Close NW
Calgary, AB T3G 3C3

CALIBRATION CONDITIONS:

Preconditioning:	4 hours at 23 ± 3 °C
Environment conditions	See actual values in Environmental Condition sections

SPECIFICATIONS:

This document certifies that the instrument as listed under "Model/Serial Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95%. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurement. The calibration of the listed instrumentation, was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and ISO 10012-1. For "as received" and/or "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation This Certificate and attached data pages shall not be reproduced, except in full, without the written approval of the Hottinger Brüel & Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. This instrument has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

Hottinger Brüel & Kjær Model 3630 Sound Level Meter Calibration System Software 7763 Version 8.6 - DB: 8.60 Test Collection 2250-4189.

RESULTS:

As Received Condition	As Received Data	Final Data
_X_ Received in good condition	_X_ Within acceptance criteria	_X_ Within acceptance criteria
___ Damaged - See attached report	___ Outside acceptance criteria	___ Limited test - See attached details
	___ Inoperative	
	___ Data not taken	

Date of Calibration: 17 Mar. 2023

Certificate issued: 20 Mar. 2023

John Avitabile
Calibration Technician

Aundra Welch
Quality Representative

Summary

Preliminary inspection	**Passed**
Environmental conditions, Prior to calibration	**Passed**
Reference information	**Passed**
Indication at the calibration check frequency	**Passed**
Acoustical signal tests of a frequency weighting, C weighting	**Passed**
Self-generated noise, Microphone installed	**Passed**
Self-generated noise, Electrical	**Passed**
Electrical signal tests of frequency weightings, A weighting	**Passed**
Electrical signal tests of frequency weightings, C weighting	**Passed**
Electrical signal tests of frequency weightings, Z weighting	**Passed**
Frequency and time weightings at 1 kHz	**Passed**
Long-term stability, Reference	**Passed**
Level linearity on the reference level range, Upper	**Passed**
Level linearity on the reference level range, Lower	**Passed**
Toneburst response, Time-weighting Fast	**Passed**
Toneburst response, Time-weighting Slow	**Passed**
Toneburst response, LAE	**Passed**
C-weighted peak sound level, 8 kHz	**Passed**
C-weighted peak sound level, 500 Hz	**Passed**
Overload indication	**Passed**
Long-term stability, 1. relative	**Passed**
High-level stability	**Passed**
Long-term stability, 2. relative	**Passed**
Environmental conditions, Following calibration	**Passed**

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.
However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61672-1:2013 for the same coverage probability of 95 %.

Instruments

Category:	Type:	Manufacturer:	Serial No.:	Next Calibration Date:	Traceable to:
Voltmeter	DMM34461A	Keysight / Agilent	MY57220483	18 Jan. 2024	488288
Generator	Pulse Generator	Brüel & Kjær	3161-105309	19 Apr. 2023	CAS-594143-C0Q8W1-814
Calibrator	4226	Brüel & Kjær	2590978	19 Apr. 2023	CAS-570928-T3Z7L5-313
AmplifierDivider	WB-3630 Output Module	Brüel & Kjær	3328633	19 Apr. 2023	CAS-594143-C0Q8W1-814
Adaptor	WA0302B, 15 pF	Brüel & Kjær	2368672	31 Aug. 2023	470615

Preliminary inspection

Visually inspect instrument, and operate all relevant controls. (clause 5)

	Result
Visual inspection	OK

Environmental conditions, Prior to calibration

Actual environmental conditions prior to calibration. (clause 7)

	Expected	Accept - Limit	Accept + Limit	Measured [Deg / kPa / %RH]
Air temperature	23.00	-3.00	3.00	23.00
Air pressure	101.30	-21.30	3.70	97.47
Relative humidity	50.00	-25.00	20.00	35.00

Reference information

Information about reference range, level and channel. (clause 22.h + 22.m)

	Value [dB SPL]
Reference sound pressure level	94
Reference level range	140
Channel number	1

Indication at the calibration check frequency

Measure and adjust sound level meter using the supplied calibrator. (clause 10 + 22.m)

	Expected [dB SPL / Hz]	Measured [dB SPL / Hz]	Uncertainty [dB]
Calibration check frequency (supplied calibrator)	1000.00	1000.00	1.00
Initial indication (supplied calibrator)	93.85	94.02	0.22
Adjusted indication (supplied calibrator)	93.85	93.86	0.22

Acoustical signal tests of a frequency weighting, C weighting

Frequency weightings measured acoustically with a calibrated multi-frequency sound calibrator. Averaging time is 10 seconds, and the result is the average of 2 measurements. (clause 12)

	Coupler Pressure Lc [dB SPL]	Mic. Correction C4226 [dB]	Body Influence [dB]	Expected [dB SPL]	Measured [dB SPL]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref. (1st)	94.01	0.10	-0.07	93.98	93.72	-0.7	0.7	-0.26	0.25
1000Hz, Ref. (2nd)	94.01	0.10	-0.07	93.98	93.71	-0.7	0.7	-0.27	0.25
1000Hz, Ref. (Average)	94.01	0.10	-0.07	93.98	93.72	-0.7	0.7	-0.26	0.25
125.89Hz (1st)	94.04	0.00	0.00	93.64	93.69	-1.0	1.0	0.05	0.25
125.89Hz (2nd)	94.04	0.00	0.00	93.64	93.70	-1.0	1.0	0.06	0.25
125.89Hz (Average)	94.04	0.00	0.00	93.64	93.69	-1.0	1.0	0.05	0.25
7943.3Hz (1st)	93.71	2.80	-0.08	87.79	87.38	-2.5	1.5	-0.41	0.52
7943.3Hz (2nd)	93.71	2.80	-0.08	87.79	87.36	-2.5	1.5	-0.43	0.52
7943.3Hz (Average)	93.71	2.80	-0.08	87.79	87.37	-2.5	1.5	-0.42	0.52

Self-generated noise, Microphone installed

Self-generated noise measured with microphone submitted for periodic testing. Averaging time is 30 seconds. An anechoic chamber is used to isolate environmental noise.
The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. (clause 11.1)

	Max [dB SPL]	Measured [dB SPL]	Uncertainty [dB]
A weighted	17.70	16.32	0.50

Self-generated noise, Electrical

Self-generated noise measured in most sensitive range, with electrical substitution for microphone, according to manufactures specifications.
The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. (clause 11.2)

	Max [dB SPL]	Measured [dB SPL]	Uncertainty [dB]
A weighted	13.60	11.46	0.30
C weighted	14.30	11.55	0.30
Z weighted	19.40	16.72	0.30

Electrical signal tests of frequency weightings, A weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level [dBV]	Expected [dB SPL]	Measured [dB SPL]	Response Corr. [dB]	Body Influence [dB]	Corr. Measured [dB SPL]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref.	-23.59	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	2.61	95.00	95.06	0.00	0.07	95.13	-1.0	1.0	0.13	0.12
125.89Hz	-7.49	95.00	95.02	0.00	0.07	95.09	-1.0	1.0	0.09	0.12
251.19Hz	-14.99	95.00	94.98	0.00	0.14	95.12	-1.0	1.0	0.12	0.12
501.19Hz	-20.39	95.00	94.97	0.00	0.29	95.26	-1.0	1.0	0.26	0.12
1995.3Hz	-24.79	95.00	95.01	-0.01	-0.02	94.98	-1.0	1.0	-0.02	0.12
3981.1Hz	-24.59	95.00	95.00	-0.02	-0.02	94.96	-1.0	1.0	-0.04	0.12
7943.3Hz	-22.49	95.00	95.00	0.00	-0.01	94.99	-2.5	1.5	-0.01	0.12
15849Hz	-16.99	95.00	94.10	0.87	0.18	95.15	-16.0	2.5	0.15	0.12

Electrical signal tests of frequency weightings, C weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level [dBV]	Expected [dB SPL]	Measured [dB SPL]	Response Corr. [dB]	Body Influence [dB]	Corr. Measured [dB SPL]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref.	-23.59	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	-22.79	95.00	95.01	0.00	0.07	95.08	-1.0	1.0	0.08	0.12
125.89Hz	-23.39	95.00	95.04	0.00	0.07	95.11	-1.0	1.0	0.11	0.12
251.19Hz	-23.59	95.00	95.00	0.00	0.14	95.14	-1.0	1.0	0.14	0.12
501.19Hz	-23.59	95.00	95.03	0.00	0.29	95.32	-1.0	1.0	0.32	0.12
1995.3Hz	-23.39	95.00	95.04	-0.01	-0.02	95.01	-1.0	1.0	0.01	0.12
3981.1Hz	-22.79	95.00	95.01	-0.02	-0.02	94.97	-1.0	1.0	-0.03	0.12
7943.3Hz	-20.59	95.00	95.00	0.00	-0.01	94.99	-2.5	1.5	-0.01	0.12
15849Hz	-15.09	95.00	94.08	0.87	0.18	95.13	-16.0	2.5	0.13	0.12

Electrical signal tests of frequency weightings, Z weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level	Expected	Measured	Response Corr.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dBV]	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
1000Hz, Ref.	-23.59	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	-23.59	95.00	95.03	0.00	0.07	95.10	-1.0	1.0	0.10	0.12
125.89Hz	-23.59	95.00	95.01	0.00	0.07	95.08	-1.0	1.0	0.08	0.12
251.19Hz	-23.59	95.00	95.00	0.00	0.14	95.14	-1.0	1.0	0.14	0.12
501.19Hz	-23.59	95.00	95.00	0.00	0.29	95.29	-1.0	1.0	0.29	0.12
1995.3Hz	-23.59	95.00	95.01	-0.01	-0.02	94.98	-1.0	1.0	-0.02	0.12
3981.1Hz	-23.59	95.00	95.03	-0.02	-0.02	94.99	-1.0	1.0	-0.01	0.12
7943.3Hz	-23.59	95.00	95.00	0.00	-0.01	94.99	-2.5	1.5	-0.01	0.12
15849Hz	-23.59	95.00	94.13	0.87	0.18	95.18	-16.0	2.5	0.18	0.12

Frequency and time weightings at 1 kHz

Frequency and time weighting measured at 1 kHz with electrical signal in reference range. Measured relative to A-weighted and Fast response. (clause 14)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
LAF, Ref.	94.00	94.00	-0.5	0.5	0.00	0.12
LCF	94.00	94.00	-0.2	0.2	0.00	0.12
LZF	94.00	94.00	-0.2	0.2	0.00	0.12
LAS	94.00	93.95	-0.1	0.1	-0.05	0.12
LAeq	94.00	93.99	-0.1	0.1	-0.01	0.12

Long-term stability, Reference

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Adjusting to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]		[dB]
Reference	94.00	-0.5	0.5	0.00	2023-03-17 10:52:33	0.10

Level linearity on the reference level range, Upper

Level linearity in reference range, measured at 8 kHz until overload. (clause 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
94 dB	94.00	94.00	-0.2	0.2	0.00	0.13
99 dB	99.00	99.00	-0.8	0.8	0.00	0.13
104 dB	104.00	104.00	-0.8	0.8	0.00	0.13
109 dB	109.00	109.00	-0.8	0.8	0.00	0.13
114 dB	114.00	114.01	-0.8	0.8	0.01	0.13
119 dB	119.00	119.02	-0.8	0.8	0.02	0.13
124 dB	124.00	124.02	-0.8	0.8	0.02	0.13
129 dB	129.00	129.02	-0.8	0.8	0.02	0.13
134 dB	134.00	134.02	-0.8	0.8	0.02	0.13
135 dB	135.00	135.02	-0.8	0.8	0.02	0.13
136 dB	136.00	136.02	-0.8	0.8	0.02	0.13
137 dB	137.00	137.02	-0.8	0.8	0.02	0.13
138 dB	138.00	138.02	-0.8	0.8	0.02	0.13
139 dB	139.00	139.02	-0.8	0.8	0.02	0.13

Level linearity on the reference level range, Lower

Level linearity in reference range, measured at 8 kHz down to lower limit, or until underrange. (clause 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
94 dB	94.00	94.00	-0.2	0.2	0.00	0.13
89 dB	89.00	89.00	-0.8	0.8	0.00	0.13
84 dB	84.00	84.00	-0.8	0.8	0.00	0.13
79 dB	79.00	79.00	-0.8	0.8	0.00	0.13
74 dB	74.00	74.00	-0.8	0.8	0.00	0.13
69 dB	69.00	69.00	-0.8	0.8	0.00	0.13
64 dB	64.00	64.00	-0.8	0.8	0.00	0.13
59 dB	59.00	59.00	-0.8	0.8	0.00	0.13
54 dB	54.00	54.00	-0.8	0.8	0.00	0.13
49 dB	49.00	49.01	-0.8	0.8	0.01	0.13
44 dB	44.00	44.01	-0.8	0.8	0.01	0.13
39 dB	39.00	39.02	-0.8	0.8	0.02	0.24
34 dB	34.00	34.04	-0.8	0.8	0.04	0.24
30 dB	30.00	30.09	-0.8	0.8	0.09	0.24
29 dB	29.00	29.11	-0.8	0.8	0.11	0.24
28 dB	28.00	28.14	-0.8	0.8	0.14	0.24
27 dB	27.00	27.15	-0.8	0.8	0.15	0.24
26 dB	26.00	26.20	-0.8	0.8	0.20	0.24
25 dB	25.00	25.24	-0.8	0.8	0.24	0.24

Toneburst response, Time-weighting Fast

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12
200 ms Burst	136.00	136.00	-0.5	0.5	0.00	0.12
2 ms Burst	119.00	118.94	-1.5	1.0	-0.06	0.12
0.25 ms Burst	110.00	109.83	-3.0	1.0	-0.17	0.12

Toneburst response, Time-weighting Slow

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12
200 ms Burst	129.60	129.60	-0.5	0.5	0.00	0.12
2 ms Burst	110.00	109.99	-3.0	1.0	-0.01	0.12

Toneburst response, LAE

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12
200 ms Burst	130.00	129.99	-0.5	0.5	-0.01	0.12
2 ms Burst	110.00	109.95	-1.5	1.0	-0.05	0.12
0.25 ms Burst	101.00	100.84	-3.0	1.0	-0.16	0.12

C-weighted peak sound level, 8 kHz

Peak-response to a 8 kHz single-cycle sine measured in least-sensitive range, relative to continuous signal. (clause 19)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	132.00	132.00	-0.5	0.5	0.00	0.09
Single Sine	135.40	135.47	-2.0	2.0	0.07	0.20

C-weighted peak sound level, 500 Hz

Peak-response to a 500 Hz half-cycle sine measured in least-sensitive range, relative to continuous signal. (clause 19)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	135.00	135.00	-0.5	0.5	0.00	0.09
Half-sine, Positive	137.40	137.13	-1.0	1.0	-0.27	0.12
Half-sine, Negative	137.40	137.14	-1.0	1.0	-0.26	0.12

Overload indication

Overload indication in the least sensitive range determined with a 4 kHz positive/negative half-cycle signal. (clause 20)

	Measured / Input Level	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous	140.00	-0.5	0.5	0.00	0.20
Half-sine, Positive	140.40	-10.0	10.0	0.40	0.20
Half-sine, Negative	140.70	-10.0	10.0	0.70	0.20
Difference	140.70	-1.5	1.5	0.30	0.24

Long-term stability, 1. relative

Long-term,stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Relative to prior adjustment to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL / Min]	[dB / Min]	[dB / Min]	[dB / Min]		[dB]
Measurement	94.00	-0.1	0.1	0.00	2023-03-17 11:06:44	0.10
Time passed	14.11	0.0	35.0	14.11		0.00

High-level stability

High-level stability over 5 minutes, with steady 1kHz signal, 1dB below upper boundary. (clause 21)

	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]	[dB]
High-level, Ref.	139.00	-0.5	0.5	0.00	0.10
High-level, after 5min	139.00	-0.1	0.1	0.00	0.10

Long-term stability, 2. relative

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Relative to prior adjustment to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL/ Min]	[dB / Min]	[dB / Min]	[dB / Min]		[dB]
Wait	25.00	25.0	120.0	25.00		0.00
Measurement	94.00	-0.1	0.1	0.00	2023-03-17 11:18:04	0.10

Environmental conditions, Following calibration

Actual environmental conditions following calibration. (clause 7)

	Expected	Accept - Limit	Accept + Limit	Measured
				[Deg / kPa / %RH]
Air temperature	23.00	-3.00	3.00	23.00
Air pressure	101.30	-21.30	3.70	97.47
Relative humidity	50.00	-25.00	20.00	35.00

HBK
HOTTINGER BRÜEL & KJÆR

The Hottinger Bruel & Kjaer Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770/209-6907
Fax: 770/447-4033
Web site address: http://www.hbkworld.com

ACCREDITED
Calibration Certificate Number 1568.01

CERTIFICATE OF CALIBRATION

Certificate No: CAS-675620-C0D5T5-101

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	Serial No: 3008995
Microphone:	Brüel & Kjær	4966	Serial No: 3391835
Preamplifier:	Brüel & Kjær	ZC-0032	Serial No: 23441
Supplied Calibrator:	Brüel & Kjær	4231	Serial No: 3009303
Software version:	BZ7222 Version 4.5.2		

CLIENT:

Stantec
155 Hawkville Close NW
Calgary, AB T3G 3C3

CALIBRATION CONDITIONS:

Preconditioning:	4 hours at 23 ± 3 °C
Environment conditions	See actual values in Environmental Condition sections

SPECIFICATIONS:

This document certifies that the instrument as listed under "Model/Serial Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95%. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurement. The calibration of the listed instrumentation, was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and ISO 10012-1. For "as received" and/or "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation This Certificate and attached data pages shall not be reproduced, except in full, without the written approval of the Hottinger Brüel & Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. This instrument has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

Hottinger Brüel & Kjær Model 3630 Sound Level Meter Calibration System Software 7763 Version 8.6 - DB: 8.60 Test Collection 2250-4966.

RESULTS:

As Received Condition	As Received Data	Final Data
_X_ Received in good condition	_X_ Within acceptance criteria	_X_ Within acceptance criteria

Date of Calibration: 05 March 2024

Certificate issued: 05 March 2024

John Avitabile
Calibration Technician

Grant Kennedy
Quality Representative

Summary

Preliminary inspection	**Passed**
Environmental conditions, Prior to calibration	**Passed**
Reference information	**Passed**
Indication at the calibration check frequency	**Passed**
Acoustical signal tests of a frequency weighting, C weighting	**Passed**
Self-generated noise, Microphone installed	**Passed**
Self-generated noise, Electrical	**Passed**
Electrical signal tests of frequency weightings, A weighting	**Passed**
Electrical signal tests of frequency weightings, C weighting	**Passed**
Electrical signal tests of frequency weightings, Z weighting	**Passed**
Frequency and time weightings at 1 kHz	**Passed**
Long-term stability, Reference	**Passed**
Level linearity on the reference level range, Upper	**Passed**
Level linearity on the reference level range, Lower	**Passed**
Toneburst response, Time-weighting Fast	**Passed**
Toneburst response, Time-weighting Slow	**Passed**
Toneburst response, LAE	**Passed**
C-weighted peak sound level, 8 kHz	**Passed**
C-weighted peak sound level, 500 Hz	**Passed**
Overload indication	**Passed**
Long-term stability, 1. relative	**Passed**
High-level stability	**Passed**
Long-term stability, 2. relative	**Passed**
Environmental conditions, Following calibration	**Passed**

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.
As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61672-1:2013 for the same coverage probability of 95 %.

Instruments

Category:	Type:	Manufacturer:	Serial No.:	Next Calibration Date:	Traceable to:
Voltmeter	DMM34970A	Keysight / Agilent	MY44026960	26 April 2024	491487
Generator	Pulse Generator	Brüel & Kjær	2626307	22 May 2024	164641-101
Calibrator	4226	Brüel & Kjær	3188086	31 July 2024	CAS-642872-V8Z3V6-702
AmplifierDivider	3111 Output Module	Brüel & Kjær	2973326	22 May 2024	164641-101
Adaptor	WA0302B, 15 pF	Brüel & Kjær	2368682	17 October 2025	497518

Preliminary inspection

Visually inspect instrument, and operate all relevant controls. (clause 5)

	Result
Visual inspection	OK

Environmental conditions, Prior to calibration

Actual environmental conditions prior to calibration. (clause 7)

	Expected	Accept - Limit	Accept + Limit	Measured [Deg / kPa / %RH]
Air temperature	23.00	-3.00	3.00	23.00
Air pressure	101.30	-21.30	3.70	98.00
Relative humidity	50.00	-25.00	20.00	45.00

Reference information

Information about reference range, level and channel. (clause 22.h + 22.m)

	Value [dB SPL]
Reference sound pressure level	94
Reference level range	140
Channel number	1

Indication at the calibration check frequency

Measure and adjust sound level meter using the supplied calibrator. (clause 10 + 22.m)

	Expected [dB SPL / Hz]	Measured [dB SPL / Hz]	Uncertainty [dB]
Calibration check frequency (supplied calibrator)	1000.00	1000.00	1.00
Initial indication (supplied calibrator)	93.85	93.93	0.22
Adjusted indication (supplied calibrator)	93.85	93.85	0.22

Acoustical signal tests of a frequency weighting, C weighting

Frequency weightings measured acoustically with a calibrated multi-frequency sound calibrator. Averaging time is 10 seconds, and the result is the average of 2 measurements. (clause 12)

	Coupler Pressure Lc [dB SPL]	Mic. Correction C4226 [dB]	Body Influence [dB]	Expected [dB SPL]	Measured [dB SPL]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref. (1st)	94.20	0.06	-0.07	94.21	93.89	-0.7	0.7	-0.32	0.33
1000Hz, Ref. (2nd)	94.20	0.06	-0.07	94.21	93.89	-0.7	0.7	-0.32	0.33
1000Hz, Ref. (Average)	94.20	0.06	-0.07	94.21	93.89	-0.7	0.7	-0.32	0.33
125.89Hz (1st)	94.21	0.00	0.00	93.76	93.88	-1.0	1.0	0.12	0.31
125.89Hz (2nd)	94.21	0.00	0.00	93.76	93.88	-1.0	1.0	0.12	0.31
125.89Hz (Average)	94.21	0.00	0.00	93.76	93.88	-1.0	1.0	0.12	0.31
7943.3Hz (1st)	94.10	2.88	-0.08	88.05	87.59	-2.5	1.5	-0.46	0.56
7943.3Hz (2nd)	94.10	2.88	-0.08	88.05	87.60	-2.5	1.5	-0.45	0.56
7943.3Hz (Average)	94.10	2.88	-0.08	88.05	87.59	-2.5	1.5	-0.46	0.56

Self-generated noise, Microphone installed

Self-generated noise measured with microphone submitted for periodic testing. Averaging time is 30 seconds. An anechoic chamber is used to isolate environmental noise.
The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. (clause 11.1)

	Max [dB SPL]	Measured [dB SPL]	Uncertainty [dB]
A weighted	17.80	16.89	0.50

Self-generated noise, Electrical

Self-generated noise measured in most sensitive range, with electrical substitution for microphone, according to manufactures specifications.
The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. (clause 11.2)

	Max [dB SPL]	Measured [dB SPL]	Uncertainty [dB]	
A weighted	13.60	12.50	0.30	*
C weighted	14.30	12.66	0.30	*
Z weighted	19.40	17.72	0.30	*

Electrical signal tests of frequency weightings, A weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level [dBV]	Expected [dB SPL]	Measured [dB SPL]	Response Corr. [dB]	Body Influence [dB]	Corr. Measured [dB SPL]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref.	-24.41	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	1.79	95.00	95.06	0.01	0.07	95.14	-1.0	1.0	0.14	0.12
125.89Hz	-8.31	95.00	95.02	0.01	0.07	95.10	-1.0	1.0	0.10	0.12
251.19Hz	-15.81	95.00	94.97	0.01	0.14	95.12	-1.0	1.0	0.12	0.12
501.19Hz	-21.21	95.00	94.96	0.01	0.29	95.26	-1.0	1.0	0.26	0.12
1995.3Hz	-25.61	95.00	95.00	-0.03	-0.02	94.95	-1.0	1.0	-0.05	0.12
3981.1Hz	-25.41	95.00	94.99	-0.08	-0.02	94.89	-1.0	1.0	-0.11	0.12
7943.3Hz	-23.31	95.00	95.00	0.18	-0.01	95.17	-2.5	1.5	0.17	0.12
15849Hz	-17.81	95.00	94.10	0.68	0.18	94.96	-16.0	2.5	-0.04	0.12

Electrical signal tests of frequency weightings, C weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level [dBV]	Expected [dB SPL]	Measured [dB SPL]	Response Corr. [dB]	Body Influence [dB]	Corr. Measured [dB SPL]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref.	-24.41	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	-23.61	95.00	95.01	0.01	0.07	95.09	-1.0	1.0	0.09	0.12
125.89Hz	-24.21	95.00	95.04	0.01	0.07	95.12	-1.0	1.0	0.12	0.12
251.19Hz	-24.41	95.00	95.00	0.01	0.14	95.15	-1.0	1.0	0.15	0.12
501.19Hz	-24.41	95.00	95.03	0.01	0.29	95.33	-1.0	1.0	0.33	0.12
1995.3Hz	-24.21	95.00	95.04	-0.03	-0.02	94.99	-1.0	1.0	-0.01	0.12
3981.1Hz	-23.61	95.00	95.00	-0.08	-0.02	94.90	-1.0	1.0	-0.10	0.12
7943.3Hz	-21.41	95.00	95.00	0.18	-0.01	95.17	-2.5	1.5	0.17	0.12
15849Hz	-15.91	95.00	94.07	0.68	0.18	94.93	-16.0	2.5	-0.07	0.12

Electrical signal tests of frequency weightings, Z weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level	Expected	Measured	Response Corr.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dBV]	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
1000Hz, Ref.	-24.41	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	-24.41	95.00	95.03	0.01	0.07	95.11	-1.0	1.0	0.11	0.12
125.89Hz	-24.41	95.00	95.01	0.01	0.07	95.09	-1.0	1.0	0.09	0.12
251.19Hz	-24.41	95.00	95.00	0.01	0.14	95.15	-1.0	1.0	0.15	0.12
501.19Hz	-24.41	95.00	95.00	0.01	0.29	95.30	-1.0	1.0	0.30	0.12
1995.3Hz	-24.41	95.00	95.01	-0.03	-0.02	94.96	-1.0	1.0	-0.04	0.12
3981.1Hz	-24.41	95.00	95.02	-0.08	-0.02	94.92	-1.0	1.0	-0.08	0.12
7943.3Hz	-24.41	95.00	95.00	0.18	-0.01	95.17	-2.5	1.5	0.17	0.12
15849Hz	-24.41	95.00	94.13	0.68	0.18	94.99	-16.0	2.5	-0.01	0.12

Frequency and time weightings at 1 kHz

Frequency and time weighting measured at 1 kHz with electrical signal in reference range. Measured relative to A-weighted and Fast response. (clause 14)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
LAF, Ref.	94.00	94.00	-0.5	0.5	0.00	0.12
LCF	94.00	94.00	-0.2	0.2	0.00	0.12
LZF	94.00	94.00	-0.2	0.2	0.00	0.12
LAS	94.00	93.95	-0.1	0.1	-0.05	0.12
LAeq	94.00	93.99	-0.1	0.1	-0.01	0.12

Long-term stability, Reference

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Adjusting to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]		[dB]
Reference	94.00	-0.5	0.5	0.00	2024-03-05 09:11:20	0.10

Level linearity on the reference level range, Upper

Level linearity in reference range, measured at 8 kHz until overload. (clause 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
94 dB	94.00	94.00	-0.5	0.5	0.00	0.13
99 dB	99.00	99.00	-0.8	0.8	0.00	0.13
104 dB	104.00	104.00	-0.8	0.8	0.00	0.13
109 dB	109.00	109.01	-0.8	0.8	0.01	0.13
114 dB	114.00	114.02	-0.8	0.8	0.02	0.13
119 dB	119.00	119.02	-0.8	0.8	0.02	0.13
124 dB	124.00	124.02	-0.8	0.8	0.02	0.13
129 dB	129.00	129.03	-0.8	0.8	0.03	0.13
134 dB	134.00	134.02	-0.8	0.8	0.02	0.13
135 dB	135.00	135.03	-0.8	0.8	0.03	0.13
136 dB	136.00	136.02	-0.8	0.8	0.02	0.13
137 dB	137.00	137.02	-0.8	0.8	0.02	0.13
138 dB	138.00	138.02	-0.8	0.8	0.02	0.13
139 dB	139.00	139.02	-0.8	0.8	0.02	0.13

Level linearity on the reference level range, Lower

Level linearity in reference range, measured at 8 kHz down to lower limit, or until underrange. (clause 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
94 dB	94.00	94.00	-0.5	0.5	0.00	0.13
89 dB	89.00	88.99	-0.8	0.8	-0.01	0.13
84 dB	84.00	83.99	-0.8	0.8	-0.01	0.13
79 dB	79.00	78.99	-0.8	0.8	-0.01	0.13
74 dB	74.00	73.98	-0.8	0.8	-0.02	0.13
69 dB	69.00	68.98	-0.8	0.8	-0.02	0.13
64 dB	64.00	63.98	-0.8	0.8	-0.02	0.13
59 dB	59.00	58.98	-0.8	0.8	-0.02	0.13
54 dB	54.00	53.98	-0.8	0.8	-0.02	0.13
49 dB	49.00	48.99	-0.8	0.8	-0.01	0.13
44 dB	44.00	44.00	-0.8	0.8	0.00	0.13
39 dB	39.00	39.02	-0.8	0.8	0.02	0.24
34 dB	34.00	34.07	-0.8	0.8	0.07	0.24
30 dB	30.00	30.14	-0.8	0.8	0.14	0.24
29 dB	29.00	29.17	-0.8	0.8	0.17	0.24
28 dB	28.00	28.23	-0.8	0.8	0.23	0.24
27 dB	27.00	27.26	-0.8	0.8	0.26	0.24
26 dB	26.00	26.35	-0.8	0.8	0.35	0.24
25 dB	25.00	25.44	-0.8	0.8	0.44	0.24
24 dB	24.00	24.53	-0.8	0.8	0.53	0.24

Toneburst response, Time-weighting Fast

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12	*
200 ms Burst	136.00	136.00	-0.5	0.5	0.00	0.12	*
2 ms Burst	119.00	118.92	-1.5	1.0	-0.08	0.12	*
0.25 ms Burst	110.00	109.86	-3.0	1.0	-0.14	0.12	*

Toneburst response, Time-weighting Slow

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12	*
200 ms Burst	129.60	129.60	-0.5	0.5	0.00	0.12	*
2 ms Burst	110.00	109.99	-3.0	1.0	-0.01	0.12	*

Toneburst response, LAE

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12	*
200 ms Burst	130.00	129.98	-0.5	0.5	-0.02	0.12	*
2 ms Burst	110.00	109.95	-1.5	1.0	-0.05	0.12	*
0.25 ms Burst	101.00	100.84	-3.0	1.0	-0.16	0.12	*

C-weighted peak sound level, 8 kHz

Peak-response to a 8 kHz single-cycle sine measured in least-sensitive range, relative to continuous signal. (clause 19)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	132.00	132.00	-0.5	0.5	0.00	0.09
Single Sine	135.40	135.31	-2.0	2.0	-0.09	0.20

C-weighted peak sound level, 500 Hz

Peak-response to a 500 Hz half-cycle sine measured in least-sensitive range, relative to continuous signal. (clause 19)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	135.00	135.00	-0.5	0.5	0.00	0.09
Half-sine, Positive	137.40	137.11	-1.0	1.0	-0.29	0.12
Half-sine, Negative	137.40	137.12	-1.0	1.0	-0.28	0.12

Overload indication

Overload indication in the least sensitive range determined with a 4 kHz positive/negative half-cycle signal. (clause 20)

	Measured / Input Level	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous	140.00	-0.5	0.5	0.00	0.20
Half-sine, Positive	141.30	-10.0	10.0	1.30	0.20
Half-sine, Negative	141.40	-10.0	10.0	1.40	0.20
Difference	141.40	-1.5	1.5	0.10	0.24

Long-term stability, 1. relative

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Relative to prior adjustment to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL / Min]	[dB / Min]	[dB / Min]	[dB / Min]		[dB]
Measurement	94.00	-0.1	0.1	0.00	2024-03-05 09:28:47	0.10
Time passed	17.27	0.0	35.0	17.27		0.00

High-level stability

High-level stability over 5 minutes, with steady 1kHz signal, 1dB below upper boundary. (clause 21)

	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]	[dB]
High-level, Ref.	139.00	-0.5	0.5	0.00	0.10
High-level, after 5min	139.00	-0.1	0.1	0.00	0.10

Long-term stability, 2. relative

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Relative to prior adjustment to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL/ Min]	[dB / Min]	[dB / Min]	[dB / Min]		[dB]
Wait	25.00	25.0	120.0	25.00		0.00
Measurement	94.00	-0.1	0.1	0.00	2024-03-05 09:37:01	0.10

Environmental conditions, Following calibration

Actual environmental conditions following calibration. (clause 7)

	Expected	Accept - Limit	Accept + Limit	Measured
				[Deg / kPa / %RH]
Air temperature	23.00	-3.00	3.00	23.00
Air pressure	101.30	-21.30	3.70	98.00
Relative humidity	50.00	-25.00	20.00	45.00

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Fax: 770/447-4033
Web site address: http://www.hbkworld.com

Calibration Certificate Number 1568.01

CERTIFICATE OF CALIBRATION

Certificate No: CAS-631530-K7C7J6-101

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	Serial No: 3007710
Microphone:	Brüel & Kjær	4189	Serial No: 2680261
Preamplifier:	Brüel & Kjær	ZC-0032	Serial No: 15717
Software version:	BZ7222 Version 4.7.7		

CLIENT:

Xscala Rental Instruments Inc.
4819-3151 Lakeshore Blvd.
Kelowna, BC V1W 3S9 Canada

CALIBRATION CONDITIONS:

Preconditioning:	4 hours at 23 ± 3 °C
Environment conditions	See actual values in Environmental Condition sections

SPECIFICATIONS:

This document certifies that the instrument as listed under "Model/Serial Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95%. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurement. The calibration of the listed instrumentation, was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and ISO 10012-1. For "as received" and/or "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation This Certificate and attached data pages shall not be reproduced, except in full, without the written approval of the Hottinger Brüel & Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. This instrument has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

Hottinger Brüel & Kjær Model 3630 Sound Level Meter Calibration System Software 7763 Version 8.6 - DB: 8.60 Test Collection 2250-4189.

RESULTS:

As Received Condition	As Received Data	Final Data
___ Received in good condition	___ Within acceptance criteria	_X_ Within acceptance criteria
_X_ Damaged - See Service report	___ Outside acceptance criteria	___ Limited test - See attached details
	___ Inoperative	
	_X_ Data not taken	

Date of Calibration: 27 Mar. 2023

Certificate issued: 28 Mar. 2023

John Avitabile

Calibration Technician

Grant Kennedy

Quality Representative

Summary

Preliminary inspection	**Passed**
Environmental conditions, Prior to calibration	**Passed**
Reference information	**Passed**
Indication at the calibration check frequency	**Passed**
Acoustical signal tests of a frequency weighting, C weighting	**Passed**
Self-generated noise, Microphone installed	**Passed**
Self-generated noise, Electrical	**Passed**
Electrical signal tests of frequency weightings, A weighting	**Passed**
Electrical signal tests of frequency weightings, C weighting	**Passed**
Electrical signal tests of frequency weightings, Z weighting	**Passed**
Frequency and time weightings at 1 kHz	**Passed**
Long-term stability, Reference	**Passed**
Level linearity on the reference level range, Upper	**Passed**
Level linearity on the reference level range, Lower	**Passed**
Toneburst response, Time-weighting Fast	**Passed**
Toneburst response, Time-weighting Slow	**Passed**
Toneburst response, LAE	**Passed**
C-weighted peak sound level, 8 kHz	**Passed**
C-weighted peak sound level, 500 Hz	**Passed**
Overload indication	**Passed**
Long-term stability, 1. relative	**Passed**
High-level stability	**Passed**
Long-term stability, 2. relative	**Passed**
Environmental conditions, Following calibration	**Passed**

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.
However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61672-1:2013 for the same coverage probability of 95 %.

HBK HOTTINGER BRÜEL & KJÆR
The Hottinger Brüel & Kjær Inc. Calibration Laboratory
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Duluth, GA 30097
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Fax: 770-447-4033
Web site address: http://www.hbkworld.com

A2LA ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION

No.: CAS-675839-J5S4Z9-403

CALIBRATION OF:

Microphone: Brüel & Kjær Type 4189 Serial No. 2799496

CUSTOMER:

Stantec
155 Hawkvill Close NW
Calgary, AB T3G 3C3
Canada

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23.7	°C
	Air pressure:	97.416	kPa
	Relative Humidity:	40.7	%RH
Applied polarization voltage:	0 Vdc		

SPECIFICATIONS:

This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Bruel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.11 using calibration procedure: 4189-S251-FF-01

RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the 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 EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short-term contribution from the device under calibration.

Date of Calibration: February 13, 2024

Certificate issued: February 13, 2024

Meshaun Hobbs
Calibration Technician

John Avitabile
Quality Representative

Sensitivity

Nominal sensitivity:	-26 dB re. 1V/Pa	+/-	1.5 dB	
Sensitivity at calibration conditions:	-25.13 dB re. 1V/Pa	or	55.39 mV/Pa	
Sensitivity at reference conditions:	-25.17 dB re. 1V/Pa	or	55.15 mV/Pa	
Uncertainty:	+/- 0.11 dB			
Correction factor K at reference conditions:	-0.83 dB			
Calibration Frequency:	251.19 Hz			

Reference Conditions:
Pressure: 101.3 kPa
Temperature: 23 °C
Relative Humidity: 50%

Traceable references

Type	Serial no	Cal. date	Due date	Calibrated by	Trace number
4180	2602426	2023-02-10	2025-02-28	DPLA	M2. 10-1562-2.1

Condition "As Received":

Good

Comments:

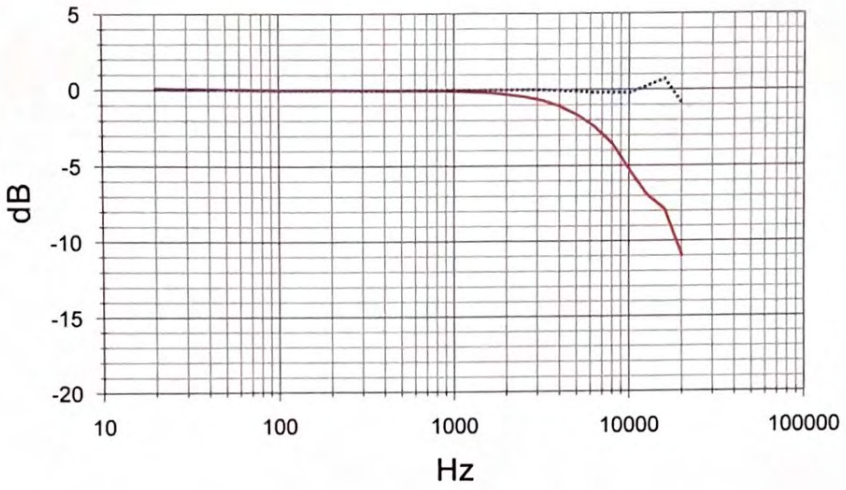
Normalized Frequency Response

Normalization Frequency: 251.19 Hz
Actuator Response is valid at Calibration Conditions
Applied Sound Field Correction: Free-field Correction with Grid, 0 deg incidence.

Frequency [Hz]	Actuator Response [dB]	Sound Field Response [dB]	Combined Uncertainty [dB]	Upper Tolerance [dB]	Lower Tolerance [dB]	Tolerance Exceeded
19.9526	0.13	0.13	0.30	1.00	-1.00	
25.1189	0.10	0.10	0.24	1.00	-1.00	
31.6228	0.09	0.09	0.19	1.00	-1.00	
39.8107	0.08	0.08	0.17	1.00	-1.00	
50.1187	0.06	0.06	0.16	1.00	-1.00	
63.0957	0.05	0.04	0.16	1.00	-1.00	
79.4328	0.04	0.04	0.16	1.00	-1.00	
100.000	0.02	0.02	0.16	1.00	-1.00	
125.893	0.02	0.01	0.16	1.00	-1.00	
158.489	0.02	0.01	0.16	1.00	-1.00	
199.526	0.02	0.01	0.16	1.00	-1.00	
251.189	0.00	0.00	0.02	1.00	-1.00	
316.228	-0.01	-0.01	0.16	1.00	-1.00	
398.107	-0.02	-0.01	0.16	1.00	-1.00	
501.187	-0.03	-0.01	0.16	1.00	-1.00	
630.957	-0.04	-0.01	0.16	1.00	-1.00	
794.328	-0.06	0.01	0.16	1.00	-1.00	
1000.00	-0.09	0.01	0.16	1.00	-1.00	
1258.93	-0.14	0.01	0.16	1.00	-1.00	
1584.89	-0.21	0.01	0.16	1.00	-1.00	
1995.26	-0.31	0.01	0.16	1.00	-1.00	
2511.89	-0.47	0.00	0.17	1.00	-1.00	
3162.28	-0.71	0.00	0.18	1.00	-1.00	
3981.07	-1.10	-0.03	0.19	1.00	-1.00	
5011.87	-1.66	-0.09	0.19	1.00	-1.00	
6309.57	-2.46	-0.19	0.20	1.00	-1.00	
7943.28	-3.55	-0.17	0.20	1.00	-1.00	
10000.0	-5.32	-0.20	0.25	2.00	-2.00	
12589.3	-6.94	0.25	0.31	2.00	-2.00	
15848.9	-7.87	0.72	0.40	2.00	-2.00	
19952.6	-10.97	-0.92	0.54	2.00	-2.00	

Measured Frequency Response

Solid curve: Actuator response Dotted curve: Sound field response
Applied Sound Field Correction: Free-field Correction with Grid, 0 deg incidence.



Result Response

Solid curve: Sound field response Dotted curves: Tolerance limits
Applied Sound Field Correction: Free-field Correction with Grid, 0 deg incidence.