APPENDIX G.17

Noise and Vibration Surveys – Accommodation Facilities (2020)

Assessment of various contaminants in accommodations and offices

Baffinland Iron Mines corp.

Mary River Mine and Milne Port Site (Nunavut)

December 2020

File # : HDS-8664-2

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1 INTRODUCTION

1.1 Mandate and Objectives

The services of Hudon Desbiens St-Germain Environnement inc. (HDS Environnement) were retained by Baffinland Iron Mines Corporation (BIM) to survey various physical, biological or chemical contaminants in accommodation facilities and offices complex of the Mary River and Milne Inlet sites, located in the Qikiqtani Region (Baffin Island; Nunavut).

This study was carried out at the request of M. Shawn Stevens, manager of Health, Safety, Environment and Security of BIM (Mine site). Measurements were taken in July and August 2020 when a representative of HDS Environnement was on site.

1.2 Scope and Approach

The scope of the study included the following:

- Mary River Mine site (MRM):
  - Sailivik camp and MSC camp: noise, whole body vibrations, mould spores and indoor air quality (IAQ) surveys;
  - MSC offices: illuminance and IAQ surveys;
- Milne Port site (MP):
  - PSC camp and 380-person camp: noise, whole body vibrations, mould spores and IAQ surveys;
  - PSC offices: illuminance and IAQ surveys.

The present report includes, but is not limited to, a brief description of the implemented strategy, sampling methodology, results, conclusions and relevant recommendations.

1.3 Study Limitations

The conclusions and recommendations included in this report are based upon professional opinions expressed within the context of the mandate given to HDS Environment by Baffinland Iron Mines. HDS Environment accepts no responsibility for any use that is made of this report in any other context or by any other party, unless being expressly informed prior to such use and having explicitly agreed to the use of this report by others.

2 SITES DESCRIPTIONS & OPERATING CONDITIONS

2.1 Sites descriptions

BIM operates two (2) sites 24/7/365 in the Qikiqtani Region: the Mary-River Mine site (MRM) and the Milne Inlet Port site (MP).

In MRM, the offices are located at the Mine Site Complex (MSC) while the accommodation facilities are at Sailiivik camp. Some surveys also took place in the accommodation facilities of MSC, during their decommissioning.

Three accommodations facilities are attached to the MP site: Port Site Complex (PSC), Port site Weather Haven (PWH) and a 380-person camp. In 2020, only PSC and the 380-person camp were opened due to the pandemic situation. In MP, the offices are located at the PSC.

This study was conducted in July and August 2020.

2.2 Conditions during surveys

Sailiivik camp, MSC and PSC, are composed of modular prefabricated structures; PWH and the 380-man camp are made of soft-wall structures. Rooms are standardised across each facility.

The office complexes, a combination of closed offices and desks in open spaces, are also composed of modular structures.

The indoor noise and whole-body vibrations measured in accommodation facilities include contributions from various indoor sources (HVAC systems, opening/closing doors, cleaning, etc.) as well as outdoor sources (idling vehicles, machinery operations, etc.).

Except for the decommissioning of the MSC camp, the various surveys in accommodations and offices were overall considered representative of regular operating, ventilation and occupancy conditions (please refer to section 4, *Methodology* for details).

3 GUIDELINE VALUES

3.1 Indoor noise levels

According to information collected over the course of the mandate, the Nunavut Impact Review Board (NIRB) defined a 75-dBA threshold for workers' average noise exposure during resting time. This limit is based on the 85-dBA exposure threshold established by the Mine Health and Safety Act R-125-95 for an 8-hr work shift (Part IX and Schedule 5).

Additional research allowed to pinpoint the World Health Organization (WHO) *Guidelines for Community Noise*[1] which recommends an 8-hr L_{Aeq}[2] of 30 dBA during night-time, inside a bedroom (continuous noises). This guideline is designed to minimize sleep disturbance for "*sensitive groups* […] *including shift workers* […] *and other individuals who have difficulty sleeping*".

Consequently, to take into account the NIRB requirements as well as the As Low As Reasonably Achievable (ALARA) safety principle, we will therefore consider in the present study a 30-dBA 8-hr L_{Aeq} comfort threshold and a 75-dBA 8-hr L_{Aeq} exposure limit (EL) to assess workers' exposure to indoor noise during resting time.

3.2 Whole-body vibrations

According to information collected over the course of the mandate, due to the lack of vibration exposure threshold in the Mine Health and Safety Act R-125-95, the NIRB refers to the daily exposure limits defined by the European Physical Agents Vibration Directive – 2002/44/EC for workers exposed to whole-body vibrations.

This directive defines an action limit (AL) of 0.5 m/s^2 and an EL of 1.15 m/s^2, both standardized to an 8-hr reference period, for workers exposed to whole-body vibrations.

Additional research allowed to pinpoint 5-part standard from the International Organization for Standardization (ISO) on human exposure to mechanical vibrations. In appendix C of part 1 of the standard[3], it is stated that "*fifty percent of alert, fit persons can just detect a weighted vibration with a peak magnitude of 0.015 m/s^2* […] *with a range of response* [that] *may extend from about 0.01 m/s^2 to 0.02 m/s^2 peak*".

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[1] *Guidelines for community noise*, World Health Organization, Geneva, Switzerland (1999).

[2] 8h-L_{Aeq} is the energy average equivalent level of A-weighted sound over eight (8) hours.

[3] ISO 2631-1:1997 *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration – Part 1: General requirements*

In part 2[4] of the same standard, it is also stated that "*experience showed in numerous countries that residents expressed complaints linked to vibrations in residential buildings when the magnitude of vibrations are slightly above the perception threshold defined in part 1, appendix C*".[5]

Consequently, to take into account the NIRB requirements as well as the ALARA safety principle, we will therefore consider in the present study a 0.015 m/s^2 (peak exposure) comfort threshold, an 8-hr action limit (AL) of 0.5 m/s^2 and an 8-hr EL of 1.15 m/s^2 to assess workers' exposure to whole-body vibrations during resting time.

It should be noted that the AL should be considered as a threshold for increased vigilance in order to prevent reaching the EL.

3.3 Mould spores

There are no regulatory thresholds for mould spore levels. According to several reference guides published by institutions such as the IRSST[6], « *comparison of species and concentrations of bioaerosols found indoors to those outdoors or at a reference location* » are key aspects to assess the fungal presence in a building.

Interpretation of fungal particulate concentrations (or mould spore levels) and identification of a potentially abnormal mould presence is based on the following criteria:

- fungal profile: moulds found indoor and moulds found at the reference location are significantly different;
- fungal charge: mould counts indoor are significantly higher than mould counts at the reference location, or ratios between mould counts are significantly different.

The significant indoor presence of specific mould species, generally recognised for their toxicity or for potentially increasing health risks, is also a key indicator (mould species such as, for example, *Stachybotrys chartarum*, *Aspergillus versicolor*, *Aspergillus fumigatus*, *Penicillium chrysogenum*, etc.).[7]

As stated by the IRSST, the interpretation of mould spore levels is complex and limited by the lack of exposure standard as well as the fact that a living material is being evaluated, with variable activity over time and meteorological conditions.

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[4] ISO 2631-2:2003 *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings (1 Hz to 80 Hz)*

[5] Free translation from the French version of ISO 2631-2:2003

[6] Institut de recherche Robert Sauvé en Santé et Sécurité du travail (IRSST) *Bioaerosols in the Workplace: Evaluation, Control and Prevention Guide*. Technical guide T-24 November 2001.

[7] Total mould spores sampling, as conducted in the present study, limits identification of moulds to genera and does not allow for identification down to species.

3.4 Illuminance

As per article 9.43 of the Nunavut Mine and Safety Act R-125-95, "*the manager* [of the Mine] *shall ensure that, at all working places on the surface of a mine, suitable and adequate illumination is provided that meets the standards set out in the ANSI/IES Standard RP-7-1979*, American National Standard Practice for Industrial Lighting".

Minimum illuminance levels for office areas are also defined in article 6.4 of the *Canadian Occupational Health and Safety Regulations* (COHSR) as well as in schedule I, part VI of the COHSR.

Based on a more recent version of the ANSI/IES standard RP-7-17 and on the current version of the COHSR, recommended and minimum illuminance targets applicable to office areas are as follow.

Table 1. Illuminance levels (ANSI/IES and COHSR)

ANSI/IES RP-7-17		COHSR	
Recommended target (Lux)[1]	**Visual performance description**	**Minimum level (lux)**	**Task position or area**
40 - 200	**Common social activity and large and/or high-contrast tasks** *Visual performance involves higher-level assessment of landscape, hardscape, architecture and people and can be work related*	100	**Service areas** *Frequently used stairways and corridors*
300 - 750	**Common, relatively small-scale, more cognitive or fast-performance visual tasks** *Visual performance is typically daily life- and work-related, including reading and writing of hardcopies and electronic media consecutively and/or simultaneously*	300	**Office work** *Conference and interview rooms, file storage area, switchboard or reception areas or other areas where ordinary visual tasks are performed*
		500	**Desk Work** *Task positions at which business machines are operated or stenography, accounting, typing, filing, clerking, billing, continuous reading or writing or other difficult visual tasks are performed*
1000 - 2000	**Small-scale, cognitive visual tasks** *Visual performance is work- or sport-related, close and distant fine inspection, very small detail, high-speed assessment and reaction*.	1000	**Desk Work** *Task positions at which cartography, designing, drafting, plan-reading or other very difficult visual tasks are performed*

Note: [1] Recommended illuminance targets for a group of observers where at least half are between 25 and 65 years old.

3.5 IAQ

Key IAQ parameters targeted in the present study are the temperature (T), relative humidity (RH), carbon dioxide (CO_2), and carbon monoxide (CO).

3.5.1 T and RH

Nunavut R-003-2016, art.74 stated that : *[...] at an indoor work site, an employer shall provide and maintain thermal conditions [...] that (a) are appropriate to the nature of the work performed; (b) provide effective protection for the health and safety of workers; and (c) provide reasonable thermal comfort for workers*.

Regarding thermal comfort, acceptable operating ranges recommended by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) to accommodate at least 80% of occupants are as follow (standard ASHRAE 55-2013):

- Summer (light clothing):
  - RH around 30%: 24.5 to 28°C;
  - RH around 60%: 23 to 25.5°C.
- Winter (warm clothing):
  - RH around 30%: 20.5 to 25.5°C;
  - RH around 60%: 20 to 24°C.

RH should also be kept at all times over 20% to avoid increased discomfort and drying of the mucus membranes and skin and under 60% to avoid condensation on cold surfaces and limit the growth of mould and fungi.

3.5.2 CO

As per article 11.4 of the Nunavut Mine and Safety Act R-125-95, occupational exposures to airborne contaminants will be compared to Threshold Limit Values (TLVs) listed in the current issue of the *Threshold Limit Values and Biological Exposure Indices Booklet* (“TLV Booklet”) as published by the *American Conference of Governmental Industrial Hygienists* (ACGIH).

The TLV for CO is 25 ppm over an 8-hr period.

However, IAQ standards usually define lower thresholds than applicable TLVs. For example, the standard ASHRAE 62.1-2013, based on the National Ambient Air Quality Standards (NAAQS) form the Environmental Protection Agency (EPA) of the United States of America, itself established to provide public health protection, including protecting the health of “sensitive” populations such as asthmatics, children and the elderly, lists an 8-hr reference level of 9 ppm for CO.

Other guidelines, such as those published by the *Agence nationale de sécurité sanitaire, de l’alimentation, de l’environnement et du travail* (ANSES) from France and established to protect general population from adverse effects due to exposure to pollution by inhalation, are compiled in the table 2 below.

Table 2. Guidelines for exposure to CO

Exposure duration	Guidelines [1]	
	mg/m³	*ppm*
8 hr	10	8,7
1 hr	30	26,2
30 min	60	52,4
15 min	100	87,3

Note: [1] considering a conversion factor of 0,873 at 25°C (from mg/m³ to ppm).

Consequently, to take into account the Nunavut regulation and the ALARA safety principle, we will consider in the present study both a 25 ppm 8-hr TLV for regulatory compliance and an 8.7 ppm maximum threshold for an acceptable IAQ.

3.5.3 CO_2

As per article 11.4 of the Nunavut Mine and Safety Act R-125-95, and the TLV Booklet of the ACGIH, the TLV for CO_2 is 5000 ppm over an 8-hr period.

However, human activity produces varying levels of CO_2 and its indoors levels can be used as an indicator of ventilation system efficiency and IAQ. As stated by standard ASHRAE 62.1-2013, maintaining a "*steady-state carbon dioxide concentration no greater than 700 ppm above outdoor air levels will indicate that a substantial majority of visitors entering a space will be satisfied with respect to human bioeffluents (body odour)*". Other guidelines, also published by the ANSES, establish the following scale[8] for indoors CO_2 levels.

Table 3. IAQ qualitative scale (CO_2 levels)

IAQ level	Differential between indoor and outdoor CO_2 levels
« Excellent »	Diff. ≤ 400 ppm
« Good »	400 ppm < diff. < 600 ppm
« Average »	600 ppm < diff. < 1000 ppm
« Low »	Diff. > 1000 ppm

Overall, when the differential between indoor and outdoor CO_2 levels is greater than 600 ppm ("Average" and "Low" IAQ level), it indicates that the ventilation system and the fresh air intake is insufficient.

[8] IAQ classification based standard NF EN 13779, *Ventilation in non-residential buildings – Performance requirements for ventilation and air conditioning systems* [free translation].

4 METHODOLOGY

4.1 Sampling strategy

The sampling strategy was initially established by BIM representatives prior to the industrial hygiene campaign and adjusted on the field by the HDS representative based on availability of offices and facilities. The final sampling strategy is presented in table 1 below.

In facilities, monitoring instruments were set-up in different rooms targeted by BIM representatives. The rooms were unoccupied during sampling periods.

In offices, monitoring instruments were set-up in different offices and areas targeted by BIM representatives. Occupancy levels varied during sampling time (refer to *Results* section for details).

4.2 Indoor noise levels

Indoor noise levels were measured with Noise-Pro DLX, from Quest. The dosimeters were calibrated prior to sampling using a Quest Electronics QC-10 acoustic calibrator and the calibration drift was checked post-sampling with the same calibrator. The dosimeters and acoustic calibrator were calibrated to the manufacturer's specifications less than one (1) year before the field work (calibration certificates available in Appendix A).

The instruments were set-up near the head of the bed or on a bedside table, when available.

Sound levels were logged at regular intervals (continuous readings integrated with a Q3 bisection factor, no integration threshold and a SLOW response).

Average noise levels (L_{avg}) measured in the present study were considered representative of equivalent average noise levels time-weighted over an 8-hr period (8h-L_{Aeq}) and were thus directly compared to the comfort threshold and the 8-hr EL considered in the present study.

4.3 Whole-body vibrations

Whole-body vibrations monitoring was conducted using a HVM200 from Larson Davis, equipped with a seat pad triaxial accelerometer SEN027. Surveys were performed with a HVM200, and its seat pad, both rented by HDS Environnement. The calibration certificates of these instruments are presented in Appendix A.

The HVM200 was set on “Whole-body Mode” for proper frequency weighting and measurements were logged at 1-min intervals during sampling, unless stated otherwise.

Seat pads were positioned on the floor, approximately in the center of targeted rooms.

Average accelerations (A_{eq} or A_{rms}) measured during the present study were considered representative of equivalent average accelerations time-weighted on an 8-hr reference period and were thus directly compared to the 8-hr AL and the 8-hr EL considered in the present study.

4.4 Mould spores

Air sampling were conducted using a Zefon Bio-pump® Plus equipped with Air-o-Cell sampling cassettes. Sampling trains (pump with cassette) were mounted on tripods (sampling height of approximately 5'). When sampling inside, tripods were installed in the center of targeted rooms. When sampling outside for outdoor reference, tripods were installed near doors or windows that could contribute to the natural ventilation of the facilities.

Sampling trains were calibrated to 15 l/min prior to sampling with a dedicated rotameter, duly calibrated less than one (1) year before the sampling campaign. The calibration certificate is presented in Appendix A. Sampling duration was approximately five (5) minutes. Calibration drifts were measured after each sample using the same rotameter.

Quality assurance and quality control program (QA/QC program) included duplicate samples for each location as well as one (1) field blank per day. The sampling cassettes used for the field blanks were stored, transported, handled and analyzed as those used for sampling.

Mould spore concentrations measured in the present study were conducted with ventilating and operating conditions considered representative of regular conditions.

4.5 Illuminance

Light levels were monitored with a digital light meter (850007 light meter, Sper Scientific), duly calibrated less than one (1) year before the sampling campaign. The calibration certificate is presented in Appendix A.

The zero of the digital light meter was adjusted before each sampling campaign. The sensor was placed at the four (4) corners of the targeted workstation and each measurement lasted for approximately two (2) to three (3) minutes. Average illuminance levels compiled in the present report are arithmetic means of light levels measured for each targeted workstation.

Light levels measured in the present study were conducted with illuminance conditions considered representative of regular conditions (see details results for details about time of the day and meteorological conditions during sampling).

4.6 IAQ

IAQ parameters (T, HR, CO_2 and CO) were monitored with a direct-reading instrument (DRI) from TSI, model IAQCalc 7545, duly calibrated by the manufacturer less than one (1) year before the sampling campaign. The calibration certificate is available in Appendix A. The features of this instrument are as follows:

- T: from 0 to 60°C, with a resolution of 0.1°C and an accuracy of ± 0.5°C ;
- HR: from 5 to 95%, with a resolution of 0.1% and an accuracy of ± 3% ;
- CO2: 0 to 5,000 ppm, with a resolution of 1 ppm and an accuracy of ± 3% or 50 ppm, whichever is greater;
- CO: 0 to 500 ppm, with a resolution of 0.1 ppm and an accuracy of ± 3% or 3 ppm, whichever is greater.

IAQ parameters were monitored in real time and average measurements were datalogged at regular intervals during sampling time.

During mould spores sampling, IAQ parameters were monitored for five (5) to ten (10) minutes at each sampling station.

Each IAQ survey in offices have been conducted at the end of the day shift (around middle afternoon), during normal activities. The sensor of the DRI was mounted on a tripod, or any other support (office partition, furniture, etc.), to take measurements at breathing zone level and it was positioned approximately at the center of the targeted area.

Readings were also taken outside, at locations considered representative of the fresh air intake of the ventilation systems of the targeted rooms, for reference purposes.

Based on data collected on site from BIM representatives, IAQ parameters monitored in the present study were considered representative of the regular ventilation and occupancy conditions expected in the targeted areas during summer.

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TABLE 4

SAMPLING STRATEGY - Accommodations facilities and offices

Noise, whole-body vibrations, mold spores, indoor air quality and illuminance levels

Baffinland Iron Mines - Mary River Mine and Milne Port Sites (Nunavut)

Date	Location	Noise *Night shift*	Vibrations *Night shift*	Illuminance *Day shift*	Mold spores and IAQ *Day shift*	IAQ *Day shift*
Mary River Mine						
2020-07-23	Sailivik camp Room D2-12	-	-	-	1	-
2020-07-31	MSC camp[1] Room AF-6	-	-	-	1	-
2020-07-31	MSC offices -	-	-	1	-	1
2020-08-01	MSC offices -	-	-	-	-	1
2020-08-03	Sailivik camp Room C2-04	1	1	-	-	-
Milne Port						
2020-07-25	PSC camp Room BC-21	-	-	-	1	-
2020-07-25	PSC offices -	-	-	1	-	1
2020-07-26	380-person camp Room H-01	1	1	-	1	-
2020-07-28	PSC camp Room BC-21	-	-	-	1	-
2020-07-29	PSC camp Room BB-06	1	1	-	-	-

5 RESULTS

5.1 Indoor noise levels

The indoor noise levels collected in accommodation facilities in 2020 are compiled in table 5 below. The session reports are presented in Appendix B.

The notable facts are as follow:

- all the indoor noise measurements taken in the accommodation facilities respected the 75-dBA exposure level considered by the NIRB.

Dosimeters were set on a dynamic sampling range of 70 dBA – 140 dBA for occupational noise measurements. Therefore, the 30-dBA comfort threshold could not be assessed (outside of sampling range).

TABLE 5
Results - Indoor noise levels in accommodation facilities
Q3 2020
Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

Date	Location	Instrument	Sampling duration	Leq [1] (dBA)	Remarks
Comfort threshold[2] (dBA)				**30**	
Exposure Level[3] (dBA)				**75**	
Mary River Mine Site					
2020-08-03	Sailivik Camp - Room C2-04	NXN030014	from 18 h 00 to 6 h 00	< 65	Regular conditions
Milne Port					
2020-07-29	PSC - Room BB-06	NXN030014	from 18 h 00 to 6 h 00	< 65	Regular conditions
2020-07-26	380 person camp - Room H-01	NXN030014	from 18 h 00 to 6 h 00	< 65	Regular conditions

General remarks:

Measurements were taken with a dosimeter set-up with a Q3 bissection factor, no integration threshold, SLOW response time and a dynamic sampling range of 70 dBA - 140 dBA.

Measurements taken in vacant rooms.

Notes :

[1] Leq: equivalent noise level averaged over sampling time.

[2] Comfort threshold defined in the World Health Organization *Guidelines for Community Noise* and designed to minimize sleep disturbance

[3] Exposure level considered by the Nunavut Impact Review Board (NIRB) for exposure to noise during resting time.

5.2 Whole-body vibrations

The vibration levels measured in accommodation facilities in 2020 are compiled in table 6 below. The session reports are presented in Appendix C.

The notable facts are as follow:

- all the whole-body vibration measurements taken in the accommodations respected the 8-hr AL, and thus the 8-hr EL, considered by the NIRB for exposure to whole-body vibrations during resting time (regular conditions during sampling time);
- the 0,015 m/s^2 comfort threshold (peak exposure) was exceeded at each sampling station:
    - Sailivik Camp - Rooms C2-04: comfort threshold exceeded during 6% of sampling time;
    - PSC - Room BB-06: comfort threshold exceeded during 6% of sampling time;
    - 380-person camp - Room H-01: comfort threshold exceeded during 35% of sampling time.

TABLE 6
Results - Vibrations in accommodation facilities
Q3 2020
Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

Date	Location	Samping duration	A_{eq} [1] (m/s^2)	A_{peak} [2] (m/s^2)	Remarks
Comfort threshold (m/s^2) (peak) [3]			**-**	**0,015**	
8-hr action limit (m/s^2) [4]			**0,5**	**-**	
8-hr exposure level (m/s^2) [5]			**1,15**	**-**	
Mary River Mine Site					
2020-08-03	Sailivik Camp - Room C2-04	from 17 h 02 to 6 h 05	0,003	*0,022*	Regular conditions Comfort threshold exceeded during ~ 6% of sampling time
Milne Port					
2020-07-29	PSC - Room BB06	from 16 h 10 to 7 h 06	0,003	*0,024*	Regular conditions Comfort threshold exceeded during ~ 6% of sampling time
2020-07-26	380-person camp - Room H-01	from 16 h 45 to 6 h 40	0,004	*0,052*	Regular conditions Comfort threshold exceeded during ~ 35% of sampling time

General remarks:
All samples are taken with Larson Davis HVM200 with triaxial accelerometer in removable elastomeric pad (Whole Body Vibration mode).

Notes :
[1] A_{eq} or A_{rms}: the frequency-weighted, time-weighted acceleration sum over the sampling period.
[2] A_{peak}: the frequency-weighted, peak acceleration sum over the sampling period.
[3] Comfort threshold defined by the 5-part standard ISO 2631 1:1997 (peak measurement)
[4] 8-hr Action limit considered by the Nunavut Impact Review Board (NIRB) for exposure to whole-body vibrations during resting time.
[5] 8-hr Exposure limit considered by the Nunavut Impact Review Board (NIRB) for exposure to whole-body vibrations during resting time.

5.3 Mould spores

The levels of mould spores measured in accommodation facilities in 2020 are compiled in tables 7 and 8 below (Mine site and Port site respectively). The corresponding certificate of analysis is presented in Appendix D.

The notable facts are as follow:

Mine site

- levels of mould spores measured at the Sailiivik camp (room D2-12) overall respect the criteria for fungal profile and fungal charge considered in the present study;
- levels of mould spores measured at the MSC camp exceeded the fungal charge criteria for the spores of *Aspergillus* / *Penicillium* sp. but this is probably due to the decommissioning of the facilities during sampling (no occupants).

Port site

- levels of mould spores measured at the PSC camp (room BC-21) and at the 380-person camp (room H-01) both respected overall the criteria for fungal profile and fungal charge considered in the present study.

TABLE 7
Results - Mould spores in accommodation facilities, Mine site
Q3 2020
Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

		Sailiivik camp	Sailiivik reference (outdoor)	MSC camp	MSC reference (outdoor)
Sample ID & sampling date		**3100-0313 and 3100-0304** **2020-07-23**	**3100-0323 and 3100-0316** **2020-07-23**	**3100-3934 and 3100-0318** **2020-07-31**	**3100-0322 and 3100-3925** **2020-07-31**
Location & observations		Indoor samples taken at the center of room D2-12	Outdoor sample taken near the exit door of H wing	Indoor samples taken at the center of the room AF-6 (facility being decommissioned)	Outdoor sample taken near the main entrance
Results	***Total spores*** ***(spores/m³)***				
	Ascospores	-	87	40	100
	Aspergillus/Penicillium sp.	7	-	***114***	7
	Basidiospores	40	227	13	34
	Cladosporium sp.	-	7	-	7
	Unidentified spores and other related particulates ***(spores/m³)***				
	Hyphal fragments	7	7	-	-
	Total [1]	***53***	***327***	***167***	***147***
	Background particulates	3	3	3	3

Notes:

\- genus of mould not identified in the sample.

sp.: *species.* moulds are identified down to genus.

[1] All results are rounded. Totals may thus not equal to the sum of the individual results.

General remarks : Reported concentrations correspond to the arithmetic mean of the duplicate samples.
Spores or other elements were not detected in field blanks.
Methods IRSST MA-367-m and ASTM D 7391-09-m | Laboratory member of the AIHA EMPAT program (ID #193773)

Background particulates 0 : no background particulates | 1: slight amount | 2: moderate amount | 3: large amount | 4: very large amount.
According to the analytical laboratory, very large amounts of background particulates might hide spores and other elements. Thefore, results with background levels of 4 have to be regarded as underestimates.

TABLE 8
Results - Mould spores in accommodation facilities, Milne Port site
Q3 2020
Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

		PSC camp	PSC reference (outdoor)	PSC camp	PSC reference (outdoor)	380-person camp	380-person camp reference (outdoor)
Sample ID & sampling date		3100-0319 and 3100-0305 2020-07-25	3100-0296 and 3100-0312 2020-07-25	3100-0294 and 3100-0282 2020-07-28	3100-0309 and 3100-0307 2020-07-28	3100-0310 and 3100-314 2020-07-26	3100-0283 and 3100-0311 2020-07-26
Location & observations		Indoor samples taken at the center of room BC-21. Window 1/4 open	Outdoor sample taken near the main entrance.	Indoor samples taken at the center of room BC-21. Window closed	Outdoor sample taken near the main entrance.	Indoor samples taken at the center of room H-01	Outdoor sample taken near the main entrance.
Results	***Total spores*** ***(spores/m³)***						
	Ascospores	-	27	14	20	7	7
	Aspergillus/Penicillium sp.	7	-	-	7	14	-
	Basidiospores	34	127	27	173	20	34
	Cladosporium sp.	7	-	7	20	13	-
	Unidentified spores and other related particulates ***(spores/m³)***						
	Hyphal fragments	-	-	-	7	7	-
	Total [1]	***47***	***154***	***47***	***226***	***47***	***40***
	Background particulates	3	3	2	3	3	**4**

Notes:

\- genus of mould not identified in the sample.

sp.: *species.* moulds are identified down to genus.

[1] All results are rounded. Totals may thus not equal to the sum of the individual results.

General remarks : Reported concentrations correspond to the arithmetic mean of the duplicate samples.
Spores or other elements were not detected in field blanks.
Methods IRSST MA-367-m and ASTM D 7391-09-m | Laboratory member of the AIHA EMPAT program (ID

Background particulates 0 : no background particulates | 1: slight amount | 2: moderate amount | 3: large amount | 4: very large amount.
According to the analytical laboratory, very large amounts of background particulates might hide spores and other elements. Thefore, results with background levels of 4 have to be regarded as underestimates.

5.4 Illuminance

The results of the illuminance surveys at the MSC and PSC offices are compiled in table 9 below.

Based on the applicable threshold levels considered in the present study, the notable facts are as follow:

Mine site

- nine (9) out of fifteen (15) measurements failed to meet the 500-lux minimum illuminance level established by the COHSR:
  - BIM offices, three desks in open space and H&S administrator's desk;
  - Mine op, two offices and desk in open space;
  - Human resources, one office and front desk.
- out the nine (9) measurements listed above, four (4) also failed to meet the 300-lux minimum illuminance target defined by the ANSI/ES RP-7-17 standard:
  - BIM offices, H&S administrator's desk;
  - Mine op, two offices;
  - Human resources, one office.

Port site

- one (1) out of nine (9) measurements failed to meet the 500-lux minimum illuminance level established by the COHSR:
  - desk next to IT supervisor;
- the nine (9) measurements taken during the survey complied with the applicable 300-750 lux illuminance target defined by the ANSI/ES RP-7-17 standard.

TABLE 9
Results - Illuminance levels in offices
Q3 2020

Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

Location - Time		Average illuminance[a] (lux)		Remarks
Limit thresholds (lux)		*ANSI/IES RP-7-17[b]*	COHSR[c]	*ANSI/IES RP-7-17 lists recommended illuminance targets.*
Reception areas, conference rooms, etc.		*300 - 750*	*300*	
Desk work, common tasks			*500*	*COHSR lists minimum illumnance levels.*
Desk work, very fine details		*1000 - 2000*	*1000*	
PSC - 2020-07-25				
Environmental technician desk	*13:40 to 14:20 sunny*	569		*Regular lighthing conditions (day shift).*
Surveyor desk		533		*Regular lighthing conditions (day shift).*
IT technician desk		741		*Regular lighthing conditions (day shift).*
IT supervisor desk		510		*Regular lighthing conditions (day shift).*
Desk next to IT supervisor		413		*Regular lighthing conditions (day shift).*
Desk trainee corner		595		*Regular lighthing conditions (day shift).*
Desk 1 Site services		659		*Regular lighthing conditions (day shift).*
Desk 2 Site services		940		*Regular lighthing conditions (day shift).*
WI desk office #4		1 142		*Regular lighthing conditions (day shift).*
MSC - 2020-07-31				
IH equipment storage	*18:30 to 19:00 cloudy*	350		*Regular lighthing conditions (night shift).*
Inuit success team		399		*Regular lighthing conditions (night shift).*
BIM offices Desk 1 in open space		438		*Regular lighthing conditions (night shift).*
BIM offices Desk 2 in open space		308		*Regular lighthing conditions (night shift).*
BIM offices Desk 3 in open space		340		*Regular lighthing conditions (night shift).*
BIM offices H&S administrator desk		***250***		*Regular lighthing conditions (night shift).*
BIM offices office 1		536		*Regular lighthing conditions (night shift).*
BIM offices office 2		530		*Regular lighthing conditions (night shift).*
BIM offices office 3		850		*Regular lighthing conditions (night shift).*
BIM offices office 4		550		*Regular lighthing conditions (night shift).*
Mine Op office 1		***289***		*Regular lighthing conditions (night shift).*
Mine Op office 2		***162***		*Regular lighthing conditions (night shift).*
Mine Op Desk 1 in open space		489		*Regular lighthing conditions (night shift).*
Human resources front desk		325		*Regular lighthing conditions (night shift).*
Human resources office 1		***220***		*Regular lighthing conditions (night shift).*

Notes :

[a] Average illuminance measured at targeted workstation (arithmetic mean)
[b] Recommended illuminance targets for a group of observers where at least half are between 25 and 65 years old.
[c] Minimum illuminance levels for targeted tasks.

5.5 IAQ

The results of the IAQ surveys at the MSC and PSC offices are compiled in tables 10 and 11 below (offices and accommodation facilities respectively).

Based on the reference levels considered in the present study, the notable facts are as follow:

Offices

- temperature and relative humidity average readings in offices comply overall with recommended target ranges for workers' thermal comfort;
- CO levels in offices comply with regulatory and recommended thresholds;
- CO_2 levels in offices comply with regulatory threshold;
- differentials between indoor and outdoor CO_2 levels correspond to "Excellent" or "Good" IAQ levels **except** for the front desk of Human Resources in MSC where CO_2 differentials indicate insufficient air changes per hour.

Accommodations

- temperature and relative humidity average readings in accommodations comply overall with recommended target ranges for occupants' thermal comfort **except** in MSC accommodations, room AF-6, where the temperature is too low but this is due the decommissioning of the facilities during the survey (no occupants);
- CO levels in accommodations comply with regulatory and recommended thresholds;
- CO_2 levels in accommodations comply with regulatory threshold;
- differentials between indoor and outdoor CO_2 levels correspond to "Excellent" or "Good" IAQ levels**.**

TABLE 10
Results - Indoor air quality (IAQ) in offices
(T° - RH% - CO_2- CO) - Q3 2020

Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

Location - Time		T[b] (°C)	RH[c] (%)	CO_2[d] (ppm)	CO[e] (ppm)	Remarks
Limit thresholds	*Nunavut R-003-2016*	*-*	*-*	*5000*	*25*	*Nunavut R-003-2016, art.74: [...] at an indoor work site, an employer shall provide and maintain thermal conditions [...] that (a) are appropriate to the nature of the work performed; (b) provide effective protection for the health and safety of workers; and (c) provide reasonable thermal comfort for workers.* *CO2 and CO levels listed in the Nunavut R-003-2016 equal the 8hr-TWAs listed in the ACGIH TLV Booklet 2020.*
	Recommended (comfort and good IAQ)	*20,5 to 25,5 °C if RH ~ 30%* *20,0 to 24,0 °C if RH ~ 60%*	*30-50%* *& < 60%*	*< outdoor + 600 ppm*	*< 8,7 ppm over 8h*	
MSC - 2020-07-31						
Offices main open space	*16:30 to 18:45*	24,9	34,3	642	0,3	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
HR offices front desk	*18:45 to 18:50*	20,5	42,9	619	0,3	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Mine op offices	*18:50 to 18:55*	22,6	37,9	657	0,3	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Training offices	*19:05 to 19:10*	19,5	50,4	598	0	*Regular operating conditions of the ventilation system,* ***no occupancy during the work shift.***
Outdoor reference	*15:20 to 15:30* *19:00 to 19:05*	14,5	48,1	353	0,3	*Regular operating conditions around camp.*
MSC - 2020-08-01						
Offices main open space	*14:20 to 18:10*	25,5	33,3	612	0,1	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Offices main corridor	*18:22 to 18:25*	19,8	51,1	770	0	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Mine op offices	*18:25 to 18:28*	21,4	43,3	607	0,2	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
HR offices front desk	*18:28 to 18:31*	22,2	44,9	***1 001***	0,4	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Training offices	*18:31 to 18:35*	22,8	41,1	776	0,3	*Regular operating conditions of the ventilation system,* ***no occupancy during the work shift.***
Offices main open space S-W corner	*18:35 to 18:38*	23,8	36,5	586	0,3	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.* *Window ajar*
Offices main open space N-W corner	*18:40 to 18:43*	24,5	35,4	734	0,4	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.* *Window ajar*
Offices main open space N-E corner	*18:43 to 18:46*	24,5	33,8	558	0,3	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Offices main open space S-E corner	*18:46 to 18:50*	24,3	34,4	591	0,4	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.* *Window ajar*
Outdoor reference	*14:10 to 14:20* *18:18 to 18:22*	16,2	46,9	375	0	*Regular operating conditions around camp.*
PSC - 2020-07-25						
Offices main open space	*15:05 to 19:10*	24,7	36,6	432	0,1	*Regular operating conditions of the ventilation system, regular occupancy during the work shift.*
Outdoor reference	*14:50 to 15:05* *19:25 to 19:35*	22,2	38,8	388	0,3	*Regular operating conditions around camp.*

Notes :

[a] *Nunavut consolidation of occupational health and safety regulations* , R-003-2016 (2016-06-19). Nunavut regulation specific to mining sites (Nunavut R-125-95) does not regulate temprature, relative humidity, carbon dioxide or carbon monoxide in offices or accomodations.
[b] Temperature. Arithmetic mean calculated over sampling time. References are based on thermal confort.
[c] Relative humidity. Arithmetic mean calculated over sampling time. References are based on thermal confort and limited fungal growth.
[d] Carbon dioxide. Arithmetic mean calculated over sampling time. Reference threshold is used to assess ventilation efficiency (sufficient fresh air intake and air changes per hour).
[e] Carbon monoxide. Arithmetic mean calculated over sampling time. Reference threshold based on recommended exposure limit for a good IAQ.

TABLE 11
Results - Indoor ar quality (IAQ) in accomodation facilities
(T° - RH% - CO_2- CO) - Q3 2020

Baffinland Iron Mines - Mary River and Milne Port Sites (Nunavut)

Location - Time		T[b] (°C)	RH[c] (%)	CO_2[d] (ppm)	CO[e] (ppm)	Remarks
Limit thresholds	*Nunavut R-003-2016*	*-*	*-*	*5000*	*25*	*Nunavut R-003-2016, art.74: [...] at an indoor work site, an employer shall provide and maintain thermal conditions [...] that (a) are appropriate to the nature of the work performed; (b) provide effective protection for the health and safety of workers; and (c) provide reasonable thermal comfort for workers. CO2 and CO levels listed in the Nunavut R-003-2016 equal the 8hr-TWAs listed in the ACGIH TLV Booklet 2020.*
	Recommended (comfort and good IAQ)	*20,5 to 25,5 °C if RH ~ 30% 20,0 to 24,0 °C if RH ~ 60%*	*30-50% & < 60%*	*< outdoor + 600 ppm*	*< 8,7 ppm over 8h*	
Sailiivik - 2020-07-23						
Room D2-12	*7:25 to 7:35*	23,7	42,7	612	0,5	*Regular operating conditions of the ventilation system.*
Outdoor reference	*5:50 to 6:10*	14,2	59,7	386	0	*Regular operating conditions around camp.*
PSC - 2020-07-25						
Room BC-21	*9:23 to 9:35*	22,6	42,8	662	0,3	*Regular operating conditions of the ventilation system.* ***Window ajar.***
Outdoor reference	*10:23 to 10:37*	20,3	47,6	393	0,1	*Regular operating conditions around camp.*
380-person camp - 2020-07-26						
Room H01	*16:39 to 16:51*	26,7	43,5	684	0,5	*Regular operating conditions of the ventilation system.*
Outdoor reference	*17:00 to 17:10*	21,9	41,4	388	0,2	*Regular operating conditions around camp.*
PSC - 2020-07-28						
Room BC-21	*12:35 to 12:46*	19,1	53,4	656	0,1	*Regular operating conditions of the ventilation system.*
Outdoor reference	*12:23 to 12:35*	12,8	66,5	394	0	*Regular operating conditions around camp.*
MSC - 2020-07-31						
Room AF-6	*16:13 to 16:25*	***16,4***	46,8	542	0,2	*Ventilation system in operation.* ***Facility being decommissioned.***
Outdoor reference	*15:51 to 16:03*	13,4	58,2	383	0	*Regular operating conditions around camp.*

Notes :

[a] *Nunavut consolidation of occupational health and safety regulations* , R-003-2016 (2016-06-19). Nunavut regulation specific to mining sites (Nunavut R-125-95) does not regulate temprature, relative humidity, carbon dioxide or carbon monoxide in offices or accomodations.
[b] Temperature. Arithmetic mean calculated over sampling time. References are based on thermal confort.
[c] Relative humidity. Arithmetic mean calculated over sampling time. References are based on thermal confort and limited fungal growth.
[d] Carbon dioxide. Arithmetic mean calculated over sampling time. Reference threshold is used to assess ventilation efficiency (sufficient fresh air intake and air changes per hour).
[e] Carbon monoxide. Arithmetic mean calculated over sampling time. Reference threshold based on recommended exposure limit for a good IAQ.

6 CONCLUSIONS AND RECOMMENDATIONS

The services of HDS Environnement were retained by BIM to conduct various studies regarding physical, biological or chemical contaminants in accommodation facilities and offices complex of the Mary River and Milne Inlet sites, located in the Qikiqtani Region (Baffin Island; Nunavut).

The scope of the study included noise, whole-body vibrations, mould spore, indoor air quality (IAQ) and illuminance surveys in various offices and accommodations.

The surveys took place between July 23rd, 2020 and August 3rd, 2020 (see table 4 for detailed sampling strategy). Overall, based on data collected on site, survey results were considered representative of regular operating, ventilation and occupancy conditions expected in summer, except for the MSC accommodation facilities which were being decommissioned during the surveys (no occupants).

The conclusions and recommendations based on data collected during the present study are listed below.

6.1 Indoor noise levels

All the indoor noise measurements taken in the accommodations respected the 75-dBA exposure limit considered by the Nunavut Impact Review Board (NIRB) for exposure to noise during rest time.

Based on elements above, HDS Environnement recommends:

- further documenting indoor noise levels in the accommodation facilities, especially during peak activity;
- identifying stationary sources of constant noise above 35 dBA in accommodation facilities.

6.2 Whole-body vibrations

All the whole-body vibrations measurements taken in the accommodations respected both the 8-hr action limit and the 8-hr exposure limit considered by the NIRB for exposure to whole-body vibrations during rest time (night shifts).

The comfort threshold of 0.015 m/s^2, established according to the ISO 2631 1:1997 standard, was exceeded during approximately 6% of the sampling time for Sailivik and PSC accommodations and approximately 35% of sampling time for the 380-man camp (night shifts).

Based on elements above, HDS Environnement recommends :

- further documenting whole-body vibration levels with a HVM200 in the accommodation facilities, especially during peak activity;
- identifying stationary sources of whole-body vibrations above 0.015 m/s^2 in accommodation facilities.

6.3 Mould spores

All the mould spore surveys taken in the accommodations respected overall the criteria for fungal profile and fungal charge considered in the present study (no evidence of abnormal fungal presence), **except** for the sample taken in MSC accommodations but this is probably due to the decommissioning of the facilities during sampling (no occupants).

Based on elements above, HDS Environnement recommends:

- further documenting mould spore levels in the accommodation facilities;
- regular visual inspection of accommodation facilities to quickly identifying and abate potential abnormal fungal growth that may appear.

6.4 Illuminance

Approximately 60% of the illuminance levels measured in the MSC offices failed to meet the 500-lux minimum illuminance level established by the COHSR. Approximately half of them also failed to meet the illuminance targets recommended by the ANSI/ES Rp-7-17 standard considered by Nunavut regulation (see the *Results* section for details).

Approximately 10% of the illuminance levels measured in the PSC facility failed to meet the 500-lux minimum illuminance level established by the COHSR, but all of them complied with the illuminance targets recommended by the ANSI/ES Rp-7-17 standard considered by Nunavut regulation (see the *Results* section for details).

Based on elements above, HDS Environnement recommends:

- increasing illuminance levels in MSC offices above 500 lux (open space and H&S administrator desk in BIM offices, closed offices and open space in Mine Op offices, Human Resources front desk, etc.);
- further documenting illuminance levels in facilities, especially during winter.

6.5 IAQ

IAQ surveys in offices comply overall with thermal comfort recommendations and show “Excellent” or “Good” IAQ levels, **except** for the front desk of the human resources in MSC where CO_2 differentials indicate insufficient air changes per hour.

IAQ surveys in accommodations show “Excellent” or “Good” IAQ levels and comply overall with thermal comfort recommendations, **except** in MSC accommodations where the temperature is too low but this is due the decommissioning of the facilities during the survey (no occupants).

Based on elements above, HDS Environnement recommends:

- Increasing air changes per hour in the human resources front office of MSC offices;
- further documenting IAQ in the accommodation facilities and offices, especially during winter.

REFERENCES

- *Mine Health and Safety Act (mine health and safety regulations)* R-125-95.
- *Safety Act (occupational health and safety regulations)* R-003-2016;
- *Canada Occupational Health and Safety Regulations,* SOR/86-304
- American Conference of Governmental Industrial Hygienists, *TLVs and BEIs booklet,* 2020 edition.
- American Society of Heating, Refrigerating and Air-conditioning Engineers, ASHRAE 62.1-2013 *Ventilation for acceptable indoor air quality*.
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- World Health Organization*, Guidelines for community noise,* 1999.
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- IRSST, technical guide T-24, *Bioaerosols in the workplace: evaluation, control and prevention guide*, November 2001.
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- United States Environmental Protection Agency (US EPA). *Mold remediation in schools and commercial buildings* (2008a).
- United States Environmental Protection Agency (US EPA). *A brief guide to mold moisture, and your home* (2008b).
- United States Environmental Protection Agency (US EPA). *National Ambient Air Quality Standards* (NAAQS).
- Illuminating Engineering Society, ANIS/IES RP-7-17, *Recommended Practice for lighting industrial facilities*.

APPENDIX A

Calibration certificates

THE MODAL SHOP
MTS SYSTEMS CORPORATION

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

~Calibration Certificate~

Sensor Information

Model Number: SEN027
Serial Number: P228957
Manufacturer: Larson Davis
ID Number:

Description: ICP® Accelerometer

Calibration Data

Sensitivity @ 100 Hz:	97.38	mV/g
	9.930	mV/m/s²
Phase @ 100 Hz:	-0.75	deg.
Test Level:	10.00	g

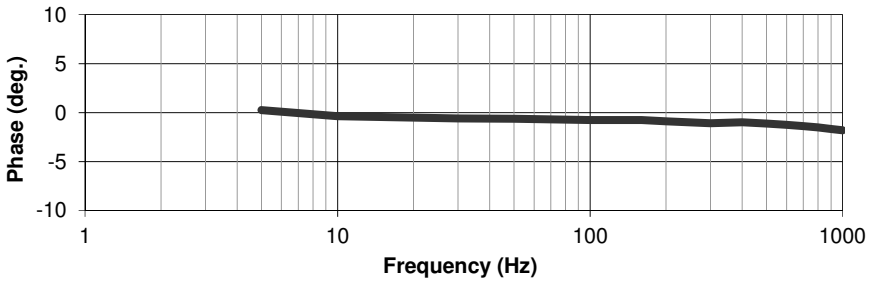
Transducer Specifications

Amp. Range:	± 10	g
Resolution:	0.0002	g
Resonant Freq:	≥ 27000	Hz
Temp. Range:	-10 to 50	℃
	14 to 122	℉
Axis:	Z - Axis	

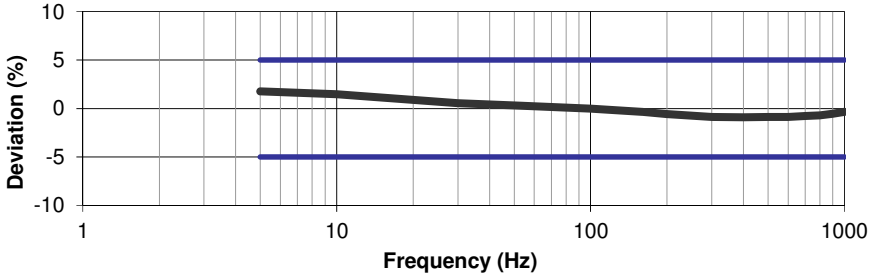
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
5	1.7758	0.2587
10	1.4806	-0.3637
30	0.5669	-0.5911
50	0.3101	-0.6163
100	0.0000	-0.7524
159	-0.3295	-0.7646
160	-0.3270	-0.7669
200	-0.5539	-0.8841
300	-0.8750	-1.0778
400	-0.8908	-0.9846
500	-0.8825	-1.1050
600	-0.8622	-1.2446
700	-0.7796	-1.3846
800	-0.6866	-1.5194
900	-0.5279	-1.6721
1000	-0.3531	-1.8120

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.
This certificate may not be reproduced except in full, without written permision.
Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21
This calibration was performed with TMS 9155 Calibration Workstation 2 version 6.0.0
Proficiency in calibration traceable to PTB (17014/17004) and NIST (683/287323).
Back-to-Back Comparison Calibration per ISO 16063-21
Procedure Used: PRD-P220
Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; ± 1.7%, 10-99 Hz; ± 1.2%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.0%, 921-5000 Hz; ± 1.4%, 5001-10,000 Hz; ± 1.9%, 10,001-15,000 Hz; ± 2.2%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 77 (25) ℉ (℃)
Humidity: 29 %

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Cal Date: 19-Nov-19
Due Date:

Approval Information

Technician: Ed Devlin
Approval:

ACCREDITED
2649.01

Cal ID: 41971 Calibration Lab

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	1A9CBC1	12/12/2019
Reference Std	PCB	080A200	175127	9/26/2020
Air Bearing Shaker	PCB	396C10	712	n/a
Ref Std Conditioner	PCB	442A102	261	9/26/2020
SUT Signal Conditioner	PCB	443B101	450	6/10/2020
Power Amplifier	TMS	2100E21-C	50097	n/a

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MTS SYSTEMS CORPORATION

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

~Calibration Certificate~

Sensor Information

Model Number:	SEN041F
Serial Number:	P105716
Manufacturer:	Larson Davis
ID Number:	73287
Description:	ICP® Accelerometer

Calibration Data

Sensitivity @ 100 Hz:	10.52	mV/g
	1.072	mV/m/s²
Phase @ 100 Hz:	-0.16	deg.
Test Level:	10.00	g

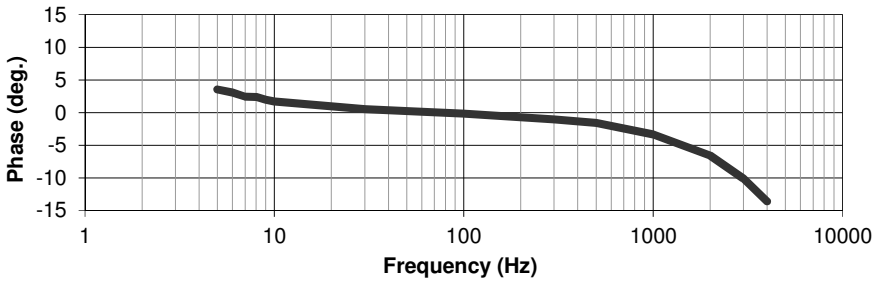
Transducer Specifications

Amp. Range:	± 500	g
Resolution:	0.008	g
Resonant Freq:	≥ 55000	Hz
Temp. Range:	-54 to 121	℃
	-65 to 250	℉
Axis:	X - Axis	

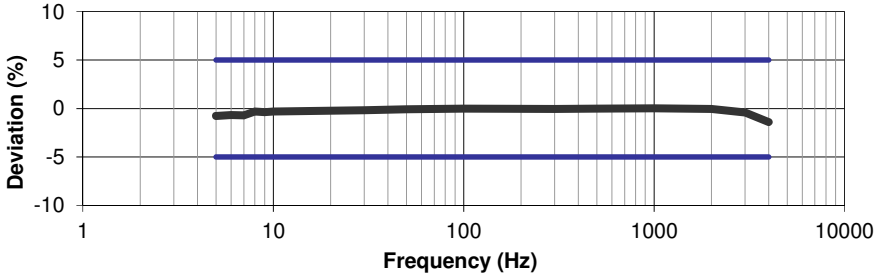
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
5	-0.7517	3.5496
6	-0.6782	3.0842
7	-0.7040	2.4301
8	-0.3013	2.3843
9	-0.3772	1.9575
10	-0.3218	1.7013
30	-0.1717	0.5261
50	-0.0630	0.2335
100	0.0000	-0.1575
300	-0.0363	-1.0319
500	-0.0214	-1.5928
1000	0.0380	-3.3527
2000	-0.0490	-6.5959
3000	-0.4048	-10.1026
4000	-1.3918	-13.6038

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.

This certificate may not be reproduced except in full, without written permision.

Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21

This calibration was performed with TMS 9155 Calibration Workstation 2 version 6.0.0

Proficiency in calibration traceable to PTB (17014/17004) and NIST (683/287323).

Back-to-Back Comparison Calibration per ISO 16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; ± 1.7%, 10-99 Hz; ± 1.2%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.0%, 921-5000 Hz; ± 1.4%, 5001-10,000 Hz; ± 1.9%, 10,001-15,000 Hz; ± 2.2%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 71 (21) ℉ (℃)
Humidity: 31 %

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Cal Date: 17-Dec-19
Due Date:

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	1D22DFB	10/25/2020
Reference Std	PCB	080A200	175127	9/26/2020
Air Bearing Shaker	PCB	396C10	712	n/a
Ref Std Conditioner	PCB	442A102	261	9/26/2020
SUT Signal Conditioner	PCB	443B101	450	6/10/2020
Power Amplifier	TMS	2100E21-C	50097	n/a

Approval Information

Technician: Brad Haarmeyer
Approval:

ACCREDITED
2649.01

Cal ID: 42274 Calibration Lab

Calibration Certificate

Certificate Number 2019014164

Customer:
The Modal Shop
3149 East Kemper Road
Cincinnati, OH 45241, United States

Model Number	HVM200	***Procedure Number***	D0001.8391		
Serial Number	0001526	***Technician***	Eric Olson		
Test Results	**Pass**	***Calibration Date***	20 Nov 2019		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***			
Description	Larson Davis Model HVM200	***Temperature***	23.88	°C	± 0.01 °C
		Humidity	50	%RH	± 0.5 %RH
		Static Pressure	84.93	kPa	± 0.03 kPa

Evaluation Method Tested electrically using ADSIT.99 test fixture. Data reported in m/s² with equivalent sensor sensivity of 1 mV/m/s².

Compliance Standards Compliant to Manufacturer Specifications and the following standards:
ISO 8041:2005 IEC 61260:2014
ANSI S2.70 ANSI S1.11

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

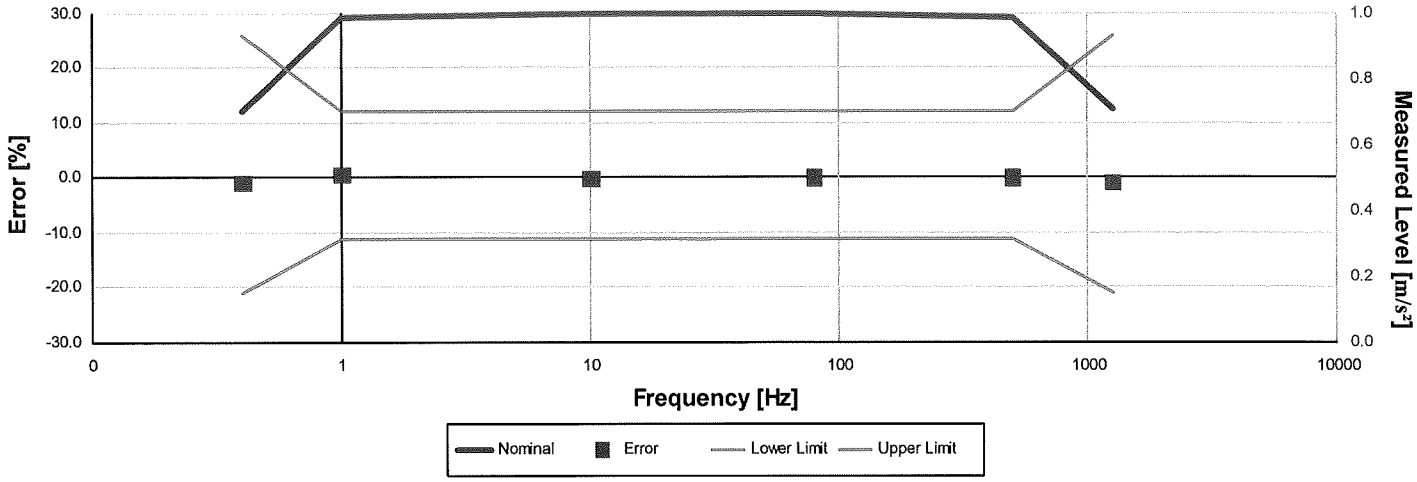
This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-S Humidity/Temperature Sensor	07/18/2019	07/18/2020	006946
SRS DS360 Ultra Low Distortion Generator	03/18/2019	03/18/2020	007174

X-Axis, Fb-weighting

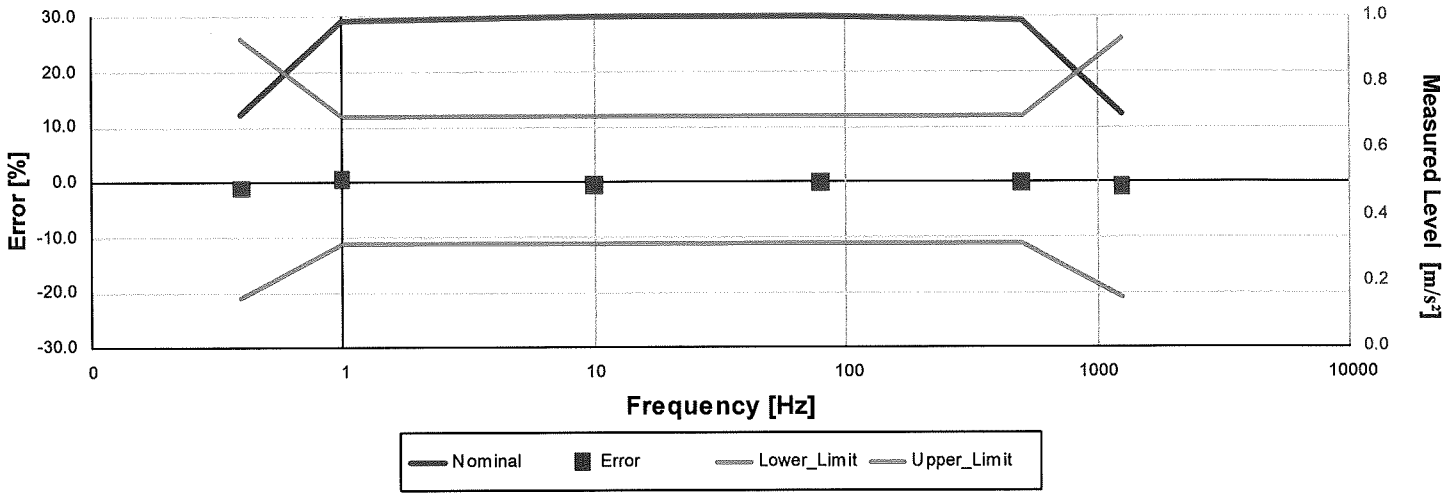


Electrical signal test of frequency weighting performed according to ISO 8041:2005 13.10.3

Frequency [Hz]	Test Result [m/s²]	Error [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
0.40	0.6966	-1.00	-21	26	1.90	Pass
1.00	0.9931	0.57	-11	12	1.90	Pass
10.00	0.9965	-0.35	-11	12	1.90	Pass
79.43	0.9995	-0.05	-11	12	1.90	Pass
501.19	0.9875	-0.02	-11	12	1.90	Pass
1,258.90	0.7009	-0.87	-21	26	1.90	Pass

-- End of measurement results--

Y-Axis, Fb-weighting

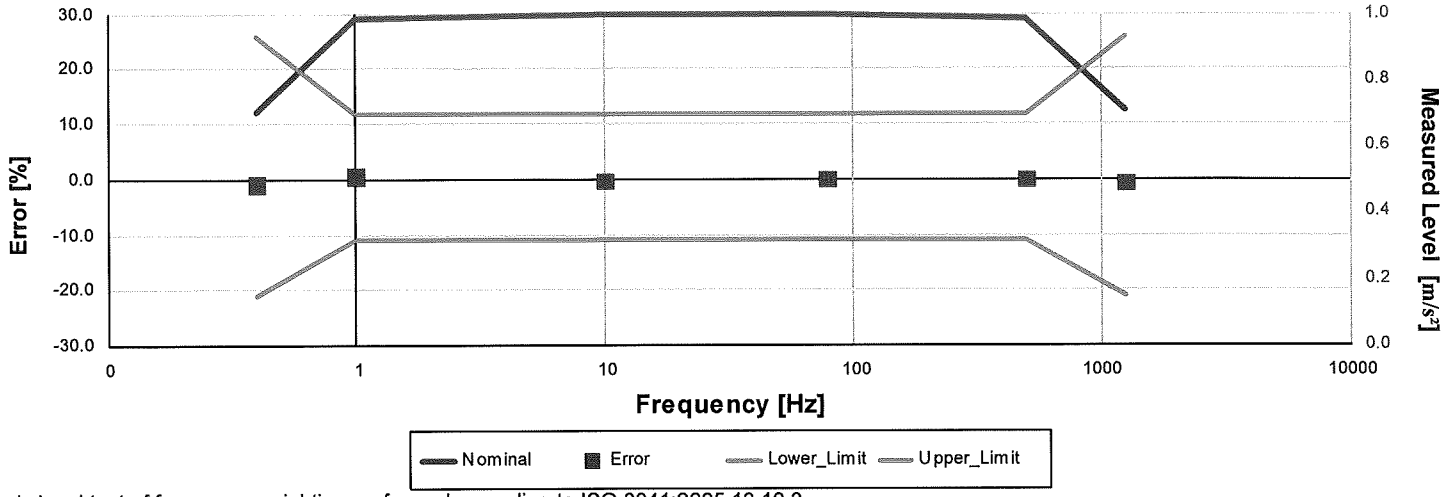


Electrical signal test of frequency weighting performed according to ISO 8041:2005 13.10.3

Frequency [Hz]	Test Result [m/s²]	Error [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
0.40	0.6967	-1.00	-21	26	1.90	Pass
1.00	0.9931	0.58	-11	12	1.90	Pass
10.00	0.9965	-0.35	-11	12	1.90	Pass
79.43	0.9995	-0.05	-11	12	1.90	Pass
501.19	0.9875	-0.02	-11	12	1.90	Pass
1,258.90	0.7012	-0.83	-21	26	1.90	Pass

-- End of measurement results--

Z-Axis, Fb-weighting

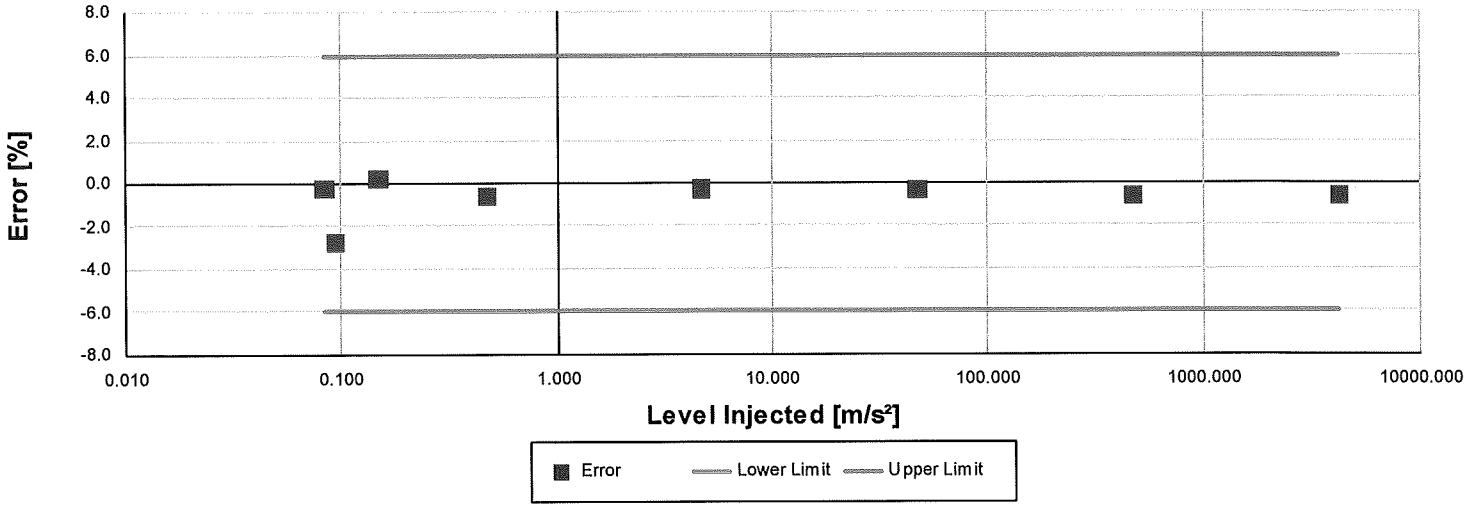


Electrical signal test of frequency weighting performed according to ISO 8041:2005 13.10.3

Frequency [Hz]	Test Result [m/s²]	Error [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
0.40	0.6967	-1.00	-21	26	1.90	Pass
1.00	0.9931	0.58	-11	12	1.90	Pass
10.00	0.9966	-0.34	-11	12	1.90	Pass
79.43	0.9995	-0.05	-11	12	1.90	Pass
501.19	0.9875	-0.02	-11	12	1.90	Pass
1,258.90	0.7011	-0.84	-21	26	1.90	Pass

-- End of measurement results--

X-Axis Log Linearity at 12.59 Hz

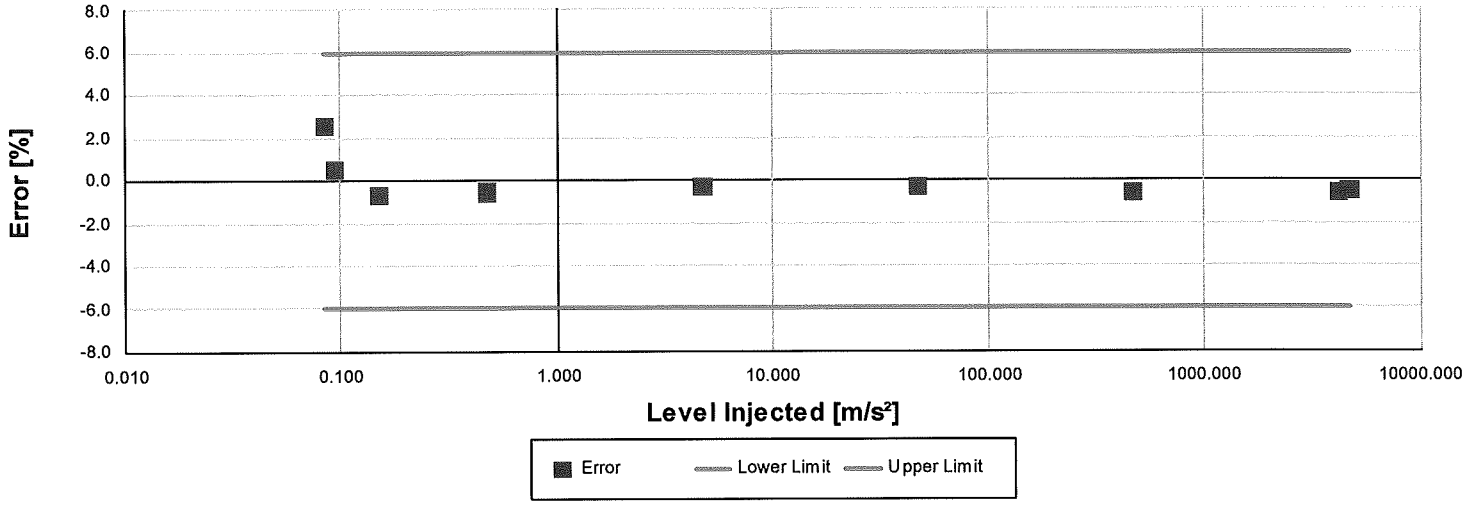


Broadband level linearity with Wh-weighting

Level [m/s²]	Measured [m/s²]	Error [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
0.0839	0.0837	-0.22	-6.00	6.00	1.90	Pass
0.0941	0.0915	-2.75	-6.00	6.00	2.80	Pass
0.1491	0.1494	0.20	-6.00	6.00	2.21	Pass
0.4716	0.4687	-0.61	-6.00	6.00	1.90	Pass
4.7161	4.7026	-0.29	-6.00	6.00	1.90	Pass
47.1611	47.0216	-0.30	-6.00	6.00	1.90	Pass
471.6112	468.8909	-0.58	-6.00	6.00	1.90	Pass
4,203.2395	4,179.0051	-0.58	-6.00	6.00	1.90	Pass

-- End of measurement results--

Y-Axis Log Linearity at 12.59 Hz

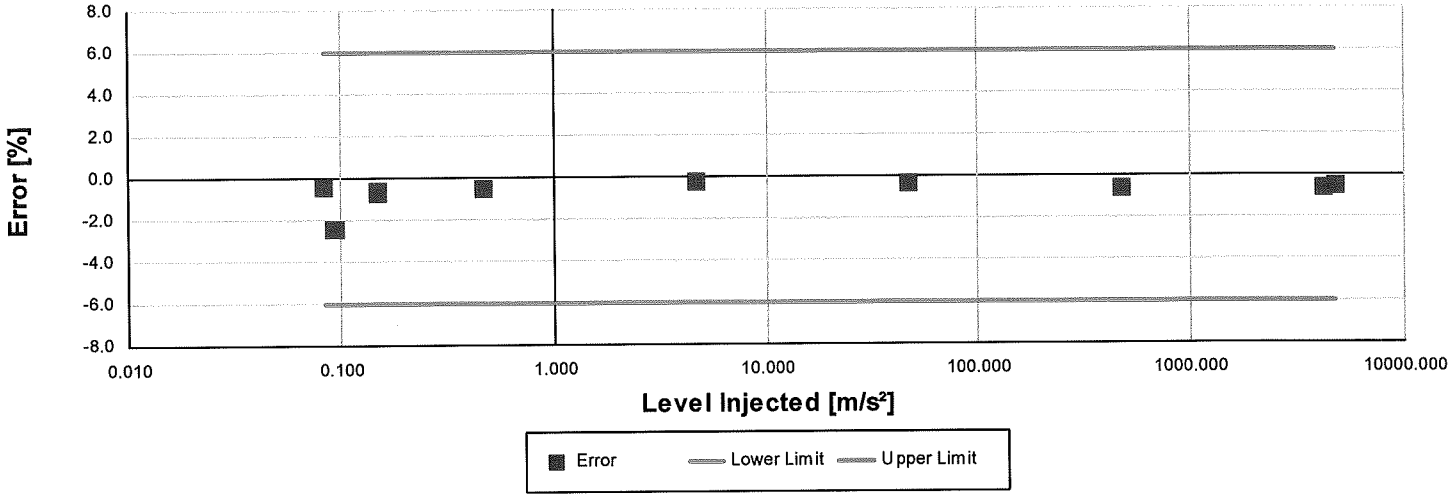


Broadband level linearity with Wh-weighting

Level [m/s²]	Measured [m/s²]	Error [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
0.0839	0.0860	2.58	-6.00	6.00	1.90	Pass
0.0941	0.0946	0.53	-6.00	6.00	2.80	Pass
0.1491	0.1481	-0.68	-6.00	6.00	2.21	Pass
0.4716	0.4690	-0.56	-6.00	6.00	1.90	Pass
4.7161	4.6998	-0.34	-6.00	6.00	1.90	Pass
47.1611	47.0172	-0.31	-6.00	6.00	1.90	Pass
471.6108	468.8863	-0.58	-6.00	6.00	1.90	Pass
4,203.2356	4,178.9914	-0.58	-6.00	6.00	1.90	Pass
4,716.1079	4,691.9328	-0.51	-6.00	6.00	1.90	Pass

-- End of measurement results--

Z-Axis Log Linearity at 12.59 Hz



Broadband level linearity with Wh-weighting

Level [m/s²]	Measured [m/s²]	Error [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
0.0839	0.0835	-0.41	-6.00	6.00	1.90	Pass
0.0941	0.0918	-2.42	-6.00	6.00	2.80	Pass
0.1491	0.1482	-0.66	-6.00	6.00	2.21	Pass
0.4716	0.4690	-0.55	-6.00	6.00	1.90	Pass
4.7161	4.7056	-0.22	-6.00	6.00	1.90	Pass
47.1608	47.0206	-0.30	-6.00	6.00	1.90	Pass
471.6082	468.8884	-0.58	-6.00	6.00	1.90	Pass
4,203.2125	4,178.9516	-0.58	-6.00	6.00	1.90	Pass
4,716.0820	4,691.8980	-0.51	-6.00	6.00	1.90	Pass

-- End of measurement results--

Overload Detector

Overload indication performed according to ISO 8041:2005 13.12 with Fb-weighting

Measurement	Nominal [m/s²]	Test Result [m/s²]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
X-Axis: Negative	4,931.68	4,931.68	-15.00	15.00	2.10	Pass
X-Axis: Positive	4,931.68	4,655.81	-15.00	15.00	2.10	Pass
Y-Axis: Negative	4,931.68	4,931.68	-15.00	15.00	2.10	Pass
Y-Axis: Positive	4,931.68	4,931.68	-15.00	15.00	2.10	Pass
Z-Axis: Negative	4,931.68	4,931.68	-15.00	15.00	2.10	Pass
Z-Axis: Positive	4,931.68	4,931.68	-15.00	15.00	2.10	Pass

-- End of measurement results--

Overload Comparison

Overload indication performed according to ISO 8041:2005 13.13 with Fb-weighting

Measurement	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
X-Axis	5.93	-15.00	15.00	2.50	Pass
Y-Axis	0.00	-15.00	15.00	2.50	Pass
Z-Axis	0.00	-15.00	15.00	2.50	Pass

-- End of measurement results--

Cross-talk (Fb-weighting)

Cross-talk performed according to ISO 8041:2005 13.8

Injected : Read	Test Result [%]	Upper Limit [%]	Expanded Uncertainty [%]	Result
X-Axis : Y-Axis	0.002	0.50	1.90 ‡	Pass
X-Axis : Z-Axis	0.002	0.50	1.90 ‡	Pass
Y-Axis : X-Axis	0.002	0.50	1.90 ‡	Pass
Y-Axis : Z-Axis	0.001	0.50	1.90 ‡	Pass
Z-Axis : X-Axis	0.001	0.50	1.90 ‡	Pass
Z-Axis : Y-Axis	0.002	0.50	1.90 ‡	Pass

-- End of measurement results--

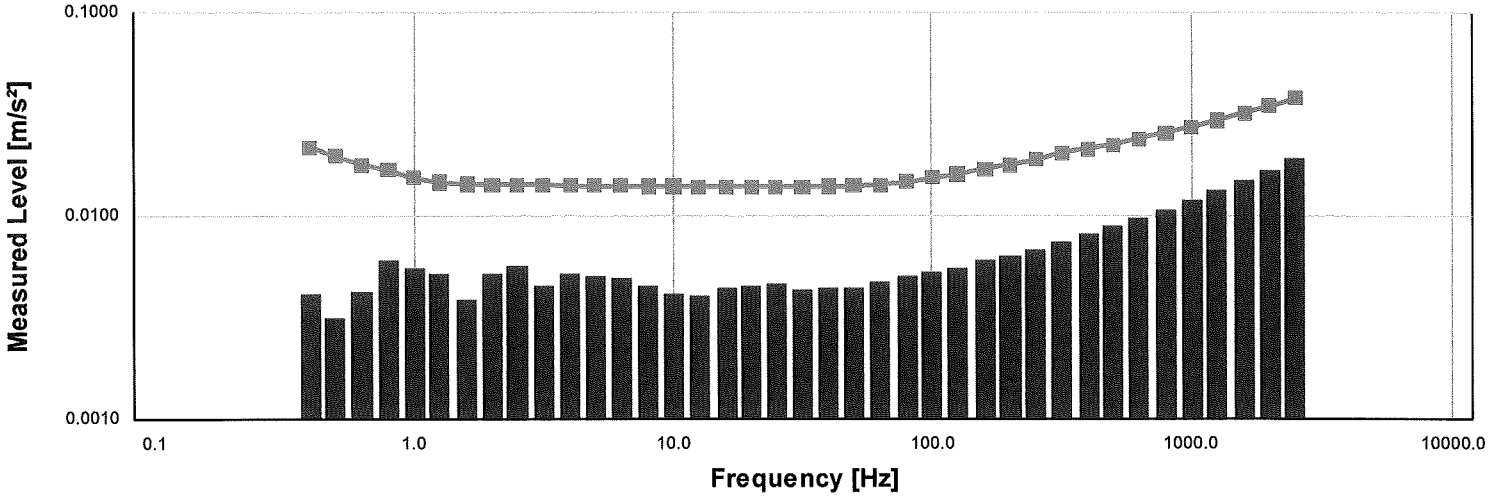
Frequency-weighted Noise Floor

Self-generated noise measured according to ISO 8041:2005 13.11

Weighting	Axis	Test Result [m/s²]	Upper limit [m/s²]	Result
Fb	X-Axis	0.037126	0.066800	Pass
	Y-Axis	0.045950	0.066800	Pass
	Z-Axis	0.042061	0.066800	Pass

-- End of measurement results--

X-Axis 1/3-Octave Self-Generated Noise

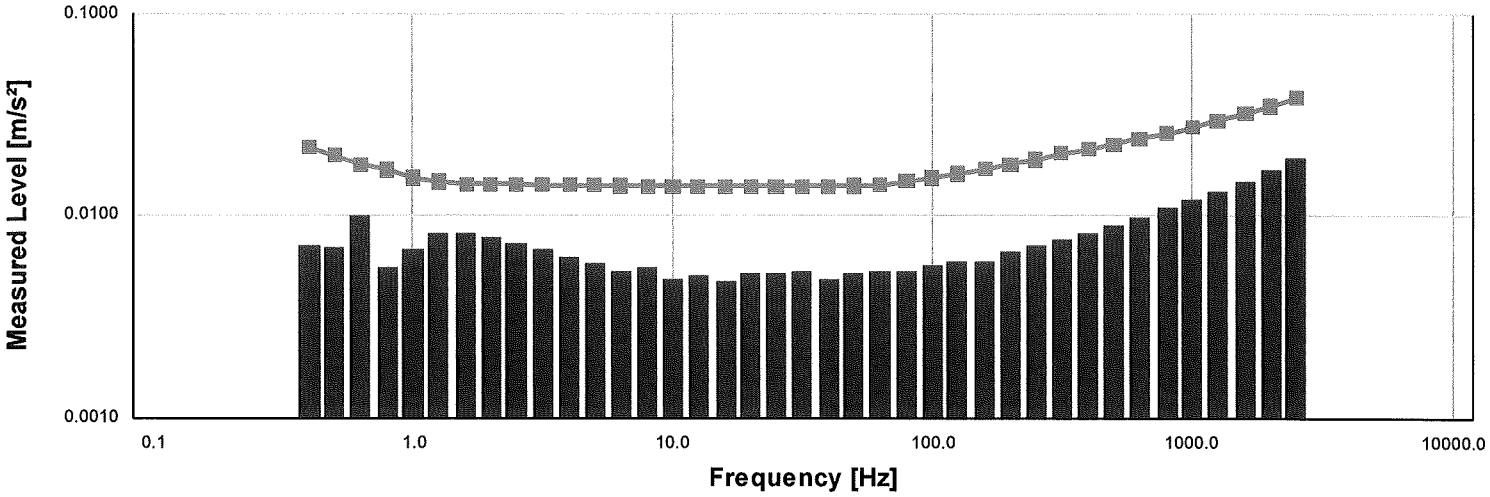


Frequency [Hz]	Test Result [m/s²]	Upper limit [m/s²]	Result
0.40	0.004175	0.022000	Pass
0.50	0.003199	0.020000	Pass
0.63	0.004244	0.018000	Pass
0.80	0.006123	0.017000	Pass
1.00	0.005643	0.015500	Pass
1.25	0.005166	0.014800	Pass
1.60	0.003880	0.014400	Pass
2.00	0.005196	0.014350	Pass
2.50	0.005647	0.014320	Pass
3.15	0.004604	0.014300	Pass
4.00	0.005273	0.014250	Pass
5.00	0.005131	0.014200	Pass
6.30	0.004931	0.014150	Pass
8.00	0.004572	0.014100	Pass
10.00	0.004207	0.014070	Pass
12.50	0.004094	0.014050	Pass
16.00	0.004416	0.014030	Pass
20.00	0.004544	0.014010	Pass
25.00	0.004657	0.014000	Pass
31.50	0.004321	0.014010	Pass
40.00	0.004496	0.014080	Pass
50.00	0.004440	0.014180	Pass
63.00	0.004792	0.014300	Pass
80.00	0.005071	0.014900	Pass
100.00	0.005342	0.015500	Pass
125.00	0.005557	0.016200	Pass
160.00	0.006112	0.017100	Pass
200.00	0.006419	0.018000	Pass
250.00	0.006875	0.019000	Pass
315.00	0.007517	0.020500	Pass
400.00	0.008231	0.021500	Pass
500.00	0.008917	0.022580	Pass
630.00	0.009899	0.024170	Pass
800.00	0.010837	0.025740	Pass
1,000.00	0.012064	0.027530	Pass
1,250.00	0.013347	0.029730	Pass
1,600.00	0.014943	0.032310	Pass

Frequency [Hz]	Test Result [m/s²]	Upper limit [m/s²]	Result
2,000.00	0.016862	0.035000	Pass
2,500.00	0.019503	0.038500	Pass

-- End of measurement results--

Y-Axis 1/3-Octave Self-Generated Noise

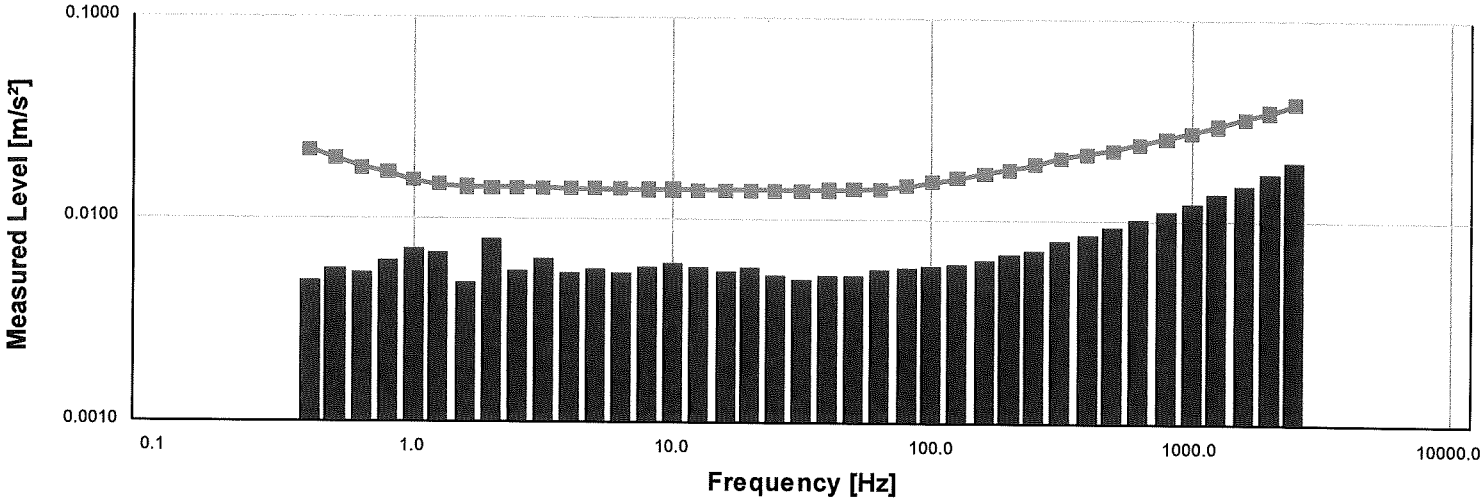


Frequency [Hz]	Test Result [m/s²]	Upper limit [m/s²]	Result
0.40	0.007172	0.022000	Pass
0.50	0.007065	0.020000	Pass
0.63	0.009961	0.018000	Pass
0.80	0.005587	0.017000	Pass
1.00	0.006915	0.015500	Pass
1.25	0.008206	0.014800	Pass
1.60	0.008177	0.014400	Pass
2.00	0.007865	0.014350	Pass
2.50	0.007299	0.014320	Pass
3.15	0.006910	0.014300	Pass
4.00	0.006284	0.014250	Pass
5.00	0.005821	0.014200	Pass
6.30	0.005289	0.014150	Pass
8.00	0.005557	0.014100	Pass
10.00	0.004833	0.014070	Pass
12.50	0.005067	0.014050	Pass
16.00	0.004796	0.014030	Pass
20.00	0.005176	0.014010	Pass
25.00	0.005253	0.014000	Pass
31.50	0.005334	0.014010	Pass
40.00	0.004916	0.014080	Pass
50.00	0.005226	0.014180	Pass
63.00	0.005353	0.014300	Pass
80.00	0.005361	0.014900	Pass
100.00	0.005651	0.015500	Pass
125.00	0.005974	0.016200	Pass
160.00	0.005922	0.017100	Pass
200.00	0.006711	0.018000	Pass
250.00	0.007130	0.019000	Pass
315.00	0.007614	0.020500	Pass
400.00	0.008217	0.021500	Pass
500.00	0.008957	0.022580	Pass
630.00	0.009873	0.024170	Pass
800.00	0.010987	0.025740	Pass
1,000.00	0.012103	0.027530	Pass
1,250.00	0.013256	0.029730	Pass
1,600.00	0.014955	0.032310	Pass

Frequency [Hz]	Test Result [m/s²]	Upper limit [m/s²]	Result
2,000.00	0.017006	0.035000	Pass
2,500.00	0.019643	0.038500	Pass

-- End of measurement results--

Z-Axis 1/3-Octave Self-Generated Noise



Frequency [Hz]	Test Result [m/s²]	Upper limit [m/s²]	Result
0.40	0.004956	0.022000	Pass
0.50	0.005644	0.020000	Pass
0.63	0.005447	0.018000	Pass
0.80	0.006213	0.017000	Pass
1.00	0.007208	0.015500	Pass
1.25	0.006884	0.014800	Pass
1.60	0.004900	0.014400	Pass
2.00	0.008074	0.014350	Pass
2.50	0.005531	0.014320	Pass
3.15	0.006327	0.014300	Pass
4.00	0.005390	0.014250	Pass
5.00	0.005752	0.014200	Pass
6.30	0.005446	0.014150	Pass
8.00	0.005770	0.014100	Pass
10.00	0.006107	0.014070	Pass
12.50	0.005801	0.014050	Pass
16.00	0.005550	0.014030	Pass
20.00	0.005801	0.014010	Pass
25.00	0.005324	0.014000	Pass
31.50	0.005031	0.014010	Pass
40.00	0.005331	0.014080	Pass
50.00	0.005332	0.014180	Pass
63.00	0.005630	0.014300	Pass
80.00	0.005847	0.014900	Pass
100.00	0.005932	0.015500	Pass
125.00	0.006052	0.016200	Pass
160.00	0.006352	0.017100	Pass
200.00	0.006831	0.018000	Pass
250.00	0.007157	0.019000	Pass
315.00	0.008041	0.020500	Pass
400.00	0.008465	0.021500	Pass
500.00	0.009300	0.022580	Pass
630.00	0.010212	0.024170	Pass
800.00	0.011140	0.025740	Pass
1,000.00	0.012370	0.027530	Pass
1,250.00	0.013639	0.029730	Pass
1,600.00	0.015154	0.032310	Pass

Frequency [Hz]	Test Result [m/s²]	Upper limit [m/s²]	Result
2,000.00	0.017204	0.035000	Pass
2,500.00	0.019720	0.038500	Pass

-- End of measurement results--

-- End of Report--

Signatory: *Eric Olson*

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ACCREDITED
Cert. #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

THE MODAL SHOP
MTS SYSTEMS CORPORATION

~Calibration Certificate~

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number: SEN027
Serial Number: P228957
Manufacturer: Larson Davis
ID Number:

Description: ICP® Accelerometer

Calibration Data

Sensitivity @ 100 Hz:	98.37	mV/g
	10.03	mV/m/s²
Phase @ 100 Hz:	-0.76	deg.
Test Level:	10.00	g

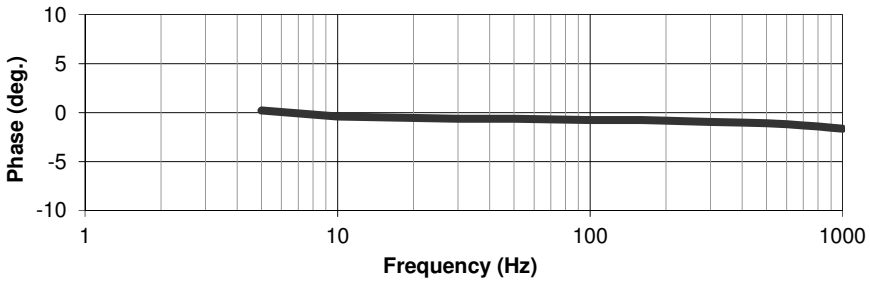
Transducer Specifications

Amp. Range:	± 10	g
Resolution:	0.0002	g
Resonant Freq:	≥ 27000	Hz
Temp. Range:	-10 to 50	℃
	14 to 122	℉
Axis:	X - Axis	

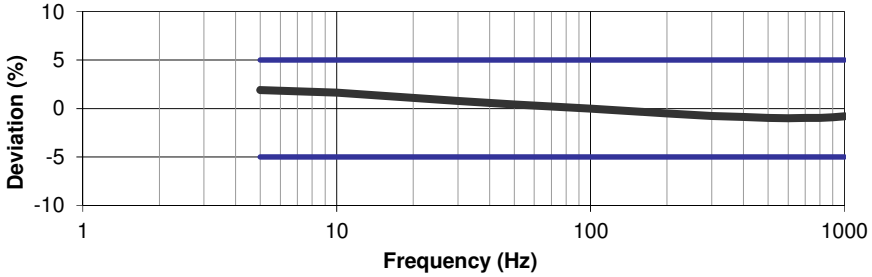
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
5	1.9191	0.2093
10	1.6509	-0.3837
30	0.7747	-0.6157
50	0.4258	-0.6333
100	0.0000	-0.7590
159	-0.3242	-0.7594
160	-0.3248	-0.7613
200	-0.5044	-0.8291
300	-0.7700	-0.9624
400	-0.8523	-1.0165
500	-0.9544	-1.0786
600	-0.9946	-1.1838
700	-0.9788	-1.3014
800	-0.9698	-1.4134
900	-0.8927	-1.5274
1000	-0.8129	-1.6422

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.

Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21

This calibration was performed with TMS 9155 Calibration Workstation 2 version 6.0.0

Proficiency in calibration traceable to PTB (17014/17004) and NIST (683/287323).

Back-to-Back Comparison Calibration per ISO 16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; ± 1.7%, 10-99 Hz; ± 1.2%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.0%, 921-5000 Hz; ± 1.4%, 5001-10,000 Hz; ± 1.9%, 10,001-15,000 Hz; ± 2.2%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 77 (25) ℉ (℃)
Humidity: 29 %

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Cal Date: 19-Nov-19
Due Date:

Approval Information

Technician: Ed Devlin
Approval:

ACCREDITED
2649.01

Cal ID: 41971 Calibration Lab

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	1A9CBC1	12/12/2019
Reference Std	PCB	080A200	175127	9/26/2020
Air Bearing Shaker	PCB	396C10	712	n/a
Ref Std Conditioner	PCB	442A102	261	9/26/2020
SUT Signal Conditioner	PCB	443B101	450	6/10/2020
Power Amplifier	TMS	2100E21-C	50097	n/a

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Fax: 513-458-2172
www.modalshop.com

~Calibration Certificate~

Sensor Information

Model Number: SEN027
Serial Number: P228957
Manufacturer: Larson Davis
ID Number:

Description: ICP® Accelerometer

Calibration Data

Sensitivity @ 100 Hz:	101.7	mV/g
	10.37	mV/m/s²
Phase @ 100 Hz:	-0.78	deg.
Test Level:	10.00	g

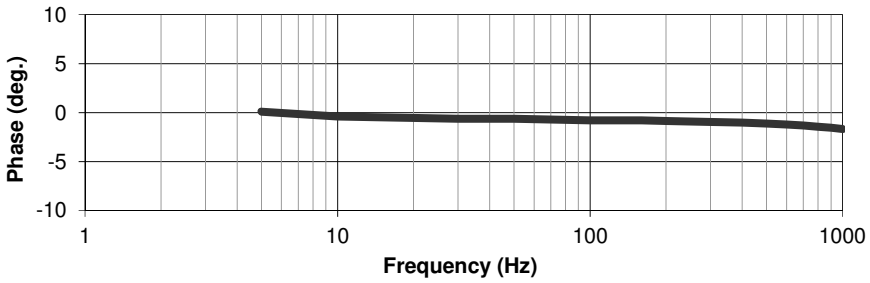
Transducer Specifications

Amp. Range:	± 10	g
Resolution:	0.0002	g
Resonant Freq:	≥ 27000	Hz
Temp. Range:	-10 to 50	℃
	14 to 122	℉
Axis:	Y - Axis	

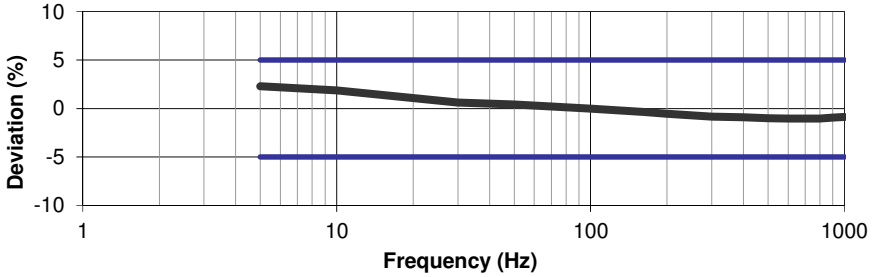
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
5	2.3018	0.1022
10	1.8897	-0.4049
30	0.6262	-0.6252
50	0.4331	-0.6322
100	0.0000	-0.7830
159	-0.3504	-0.7841
160	-0.3522	-0.7870
200	-0.5343	-0.8471
300	-0.8497	-0.9707
400	-0.8903	-1.0360
500	-0.9990	-1.1050
600	-1.0431	-1.2125
700	-1.0343	-1.3300
800	-1.0250	-1.4438
900	-0.9494	-1.5589
1000	-0.8664	-1.6735

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.

Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21

This calibration was performed with TMS 9155 Calibration Workstation 2 version 6.0.0

Proficiency in calibration traceable to PTB (17014/17004) and NIST (683/287323).

Back-to-Back Comparison Calibration per ISO 16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; ± 1.7%, 10-99 Hz; ± 1.2%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.0%, 921-5000 Hz; ± 1.4%, 5001-10,000 Hz; ± 1.9%, 10,001-15,000 Hz; ± 2.2%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 77 (25) ℉ (℃)
Humidity: 29 %

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Cal Date: 19-Nov-19
Due Date:

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	1A9CBC1	12/12/2019
Reference Std	PCB	080A200	175127	9/26/2020
Air Bearing Shaker	PCB	396C10	712	n/a
Ref Std Conditioner	PCB	442A102	261	9/26/2020
SUT Signal Conditioner	PCB	443B101	450	6/10/2020
Power Amplifier	TMS	2100E21-C	50097	n/a

Approval Information

Technician: Ed Devlin
Approval:

ACCREDITED
2649.01

Cal ID: 41971 Calibration Lab

THE MODAL SHOP
MTS SYSTEMS CORPORATION

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

~Calibration Certificate~

Sensor Information

Model Number:	SEN041F
Serial Number:	P105716
Manufacturer:	Larson Davis
ID Number:	73287
Description:	ICP® Accelerometer

Calibration Data

Sensitivity @ 100 Hz:	10.59	mV/g
	1.080	mV/m/s²
Phase @ 100 Hz:	-0.09	deg.
Test Level:	10.00	g

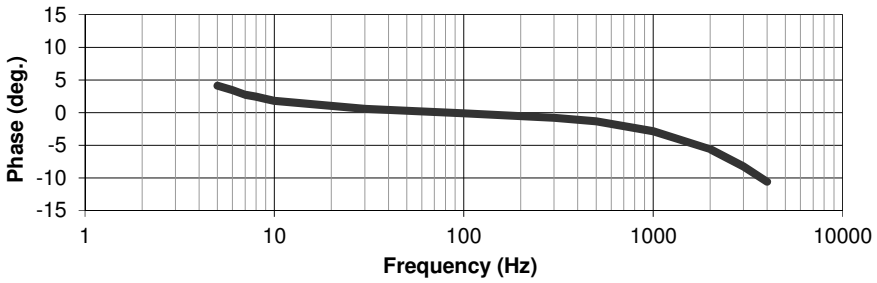
Transducer Specifications

Amp. Range:	± 500	g
Resolution:	0.008	g
Resonant Freq:	≥ 55000	Hz
Temp. Range:	-54 to 121	℃
	-65 to 250	℉
Axis:	Y - Axis	

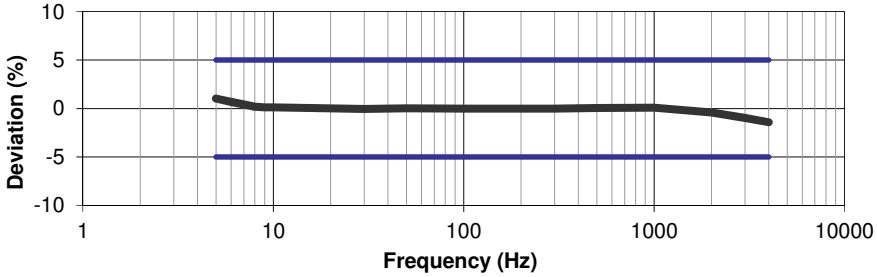
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
5	1.0265	4.1113
6	0.6713	3.4187
7	0.4338	2.7298
8	0.1877	2.4216
9	0.1345	2.0813
10	0.1136	1.8121
30	-0.0581	0.5711
50	0.0120	0.2647
100	0.0000	-0.0884
300	0.0052	-0.7991
500	0.0411	-1.3407
1000	0.0829	-2.8490
2000	-0.4015	-5.5889
3000	-0.9759	-8.2314
4000	-1.4134	-10.5867

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.

This certificate may not be reproduced except in full, without written permision.

Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21

This calibration was performed with TMS 9155 Calibration Workstation 2 version 6.0.0

Proficiency in calibration traceable to PTB (17014/17004) and NIST (683/287323).

Back-to-Back Comparison Calibration per ISO 16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; ± 1.7%, 10-99 Hz; ± 1.2%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.0%, 921-5000 Hz; ± 1.4%, 5001-10,000 Hz; ± 1.9%, 10,001-15,000 Hz; ± 2.2%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 71 (21) ℉ (℃)
Humidity: 31 %

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Cal Date: 17-Dec-19
Due Date:

Approval Information

Technician: Brad Haarmeyer
Approval:

ACCREDITED
2649.01

Cal ID: 42274 Calibration Lab

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	1D22DFB	10/25/2020
Reference Std	PCB	080A200	175127	9/26/2020
Air Bearing Shaker	PCB	396C10	712	n/a
Ref Std Conditioner	PCB	442A102	261	9/26/2020
SUT Signal Conditioner	PCB	443B101	450	6/10/2020
Power Amplifier	TMS	2100E21-C	50097	n/a

THE MODAL SHOP
MTS SYSTEMS CORPORATION

~Calibration Certificate~

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number: SEN041F
Serial Number: P105716
Manufacturer: Larson Davis
ID Number: 73287

Description: ICP® Accelerometer

Calibration Data

Sensitivity @ 100 Hz:	10.55	mV/g
	1.076	mV/m/s²
Phase @ 100 Hz:	-0.07	deg.
Test Level:	10.00	g

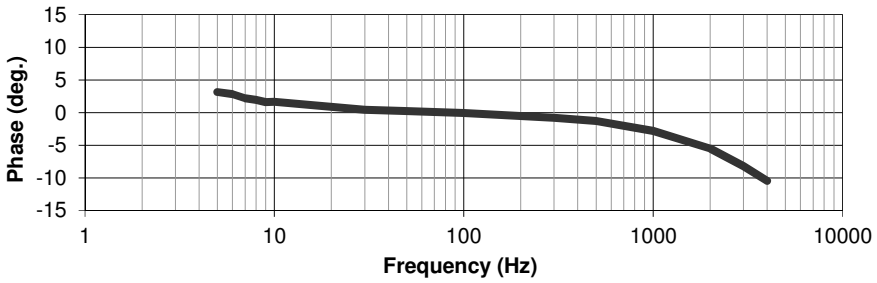
Transducer Specifications

Amp. Range:	± 500	g
Resolution:	0.008	g
Resonant Freq:	≥ 55000	Hz
Temp. Range:	-54 to 121	℃
	-65 to 250	℉
Axis:	Z - Axis	

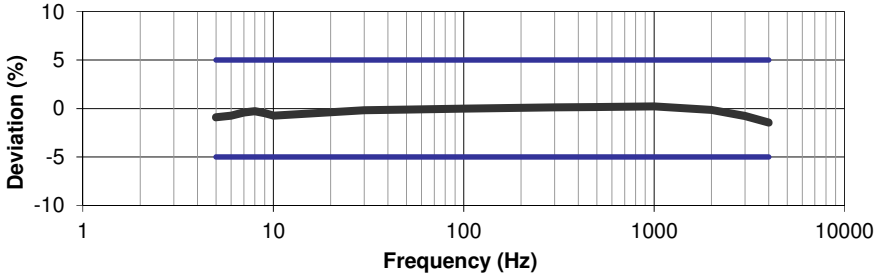
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
5	-0.8924	3.1475
6	-0.7294	2.8296
7	-0.3957	2.2204
8	-0.2825	1.9435
9	-0.4602	1.5860
10	-0.7490	1.6659
30	-0.1825	0.4173
50	-0.0937	0.2382
100	0.0000	-0.0702
300	0.1205	-0.7755
500	0.1458	-1.2981
1000	0.2164	-2.7847
2000	-0.1535	-5.5267
3000	-0.7815	-8.1888
4000	-1.4581	-10.4649

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.
This certificate may not be reproduced except in full, without written permision.
Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21
This calibration was performed with TMS 9155 Calibration Workstation 2 version 6.0.0
Proficiency in calibration traceable to PTB (17014/17004) and NIST (683/287323).
Back-to-Back Comparison Calibration per ISO 16063-21
Procedure Used: PRD-P220
Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; ± 1.7%, 10-99 Hz; ± 1.2%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.0%, 921-5000 Hz; ± 1.4%, 5001-10,000 Hz; ± 1.9%, 10,001-15,000 Hz; ± 2.2%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 71 (21) ℉ (℃)
Humidity: 31 %

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Cal Date: 17-Dec-19
Due Date:

Approval Information

Technician: Brad Haarmeyer
Approval:

ACCREDITED
2649.01

Cal ID: 42274 Calibration Lab

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	1D22DFB	10/25/2020
Reference Std	PCB	080A200	175127	9/26/2020
Air Bearing Shaker	PCB	396C10	712	n/a
Ref Std Conditioner	PCB	442A102	261	9/26/2020
SUT Signal Conditioner	PCB	443B101	450	6/10/2020
Power Amplifier	TMS	2100E21-C	50097	n/a

CONCEPT CONTROLS

6031 103A Street
Edmonton, AB T6H 2J7
1-888-207-2212
www.conceptcontrols.com

Certificate of Calibration

Certificate Number: 209567NXI070043

Submitted by:	Concept Controls Inc 1565 Rue Begin ST Laurent, QC, Canada, H4R 1W9	**Date Issued:** **Valid until:**	31-Oct-19 30-Oct-20
Order Number:	209567		
Model:	NoisePro DLX	**Serial number:**	NXI070043
Sub-Assemblies:	Type 2 Pendant Microphone	**Serial number:**	NA

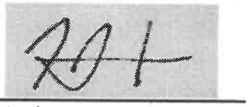
Test Condition:		**Model condition:**	
Temperature :	18 C to 29 °C	As Found:	In Tolerance
Humidity:	20% to 80%	As Left:	In Tolerance
Barometric Pressure:	890mbar to 1050mbar		

Calibration per Procedure : V053-864

Reference Standard(s):

ID Number:	Device:	Last Calibration:	Calibration Due:
CCI0001	B & K Ensemble	19-Jun-19	19-Jun-20
CCI0004	Quest Cal	12-Feb-19	12-Feb-20

Measurement Uncertainty:
± 2.2% Accoustic (0.19DB)
Estimated at 95% confidence level (k=2)

Calibrated By:  31-Oct-19
Ian Holt

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirely without the written approval of Concept Controls Inc.

CONCEPT CONTROLS

6031 103A Street
Edmonton, AB T6H 2J7
1-888-207-2212
www.conceptcontrols.com

Certificate of Calibration

Certificate Number: 209567NXN030014

Submitted by:	Concept Controls Inc 1565 Rue Begin ST Laurent, QC, Canada, H4R 1W9	**Date Issued:** **Valid until:**	31-Oct-19 30-Oct-20
Order Number:	209567		
Model:	NoisePro DLX	**Serial number:**	NXN030014
Sub-Assemblies:	Type 2 Pendant Microphone	**Serial number:**	NA

Test Condition:

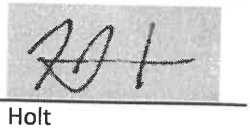
		Model condition:	
Temperature :	18 C to 29 °C	As Found:	In Tolerance
Humidity:	20% to 80%	As Left:	In Tolerance
Barometric Pressure:	890mbar to 1050mbar		

Calibration per Procedure : V053-864

Reference Standard(s):

ID Number:	**Device:**	**Last Calibration:**	**Calibration Due:**
CCI0001	B & K Ensemble	19-Jun-19	19-Jun-20
CCI0004	Quest Cal	12-Feb-19	12-Feb-20

Measurement Uncertainty:
± 2.2% Accoustic (0.19DB)
Estimated at 95% confidence level (k=2)

Calibrated By:  31-Oct-19

Ian Holt

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirely without the written approval of Concept Controls Inc.

6031 103A Street
Edmonton, AB T6H 2J7
1-888-207-2212
www.conceptcontrols.com

Certificate of Calibration

Certificate Number: 209567NXL070014

Submitted by:	Concept Controls Inc 1565 Rue Begin ST Laurent, QC, Canada, H4R 1W9	**Date Issued:** **Valid until:**	31-Oct-19 30-Oct-20
Order Number:	209567		
Model:	NoisePro DLX	**Serial number:**	NXL070014
Sub-Assemblies:	Type 2 Pendant Microphone	**Serial number:**	NA

Test Condition:

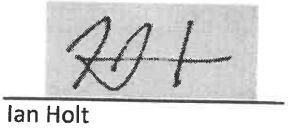
		Model condition:	
Temperature :	18 C to 29 °C	As Found:	In Tolerance
Humidity:	20% to 80%	As Left:	In Tolerance
Barometric Pressure:	890mbar to 1050mbar		

Calibration per Procedure : V053-864

Reference Standard(s):

ID Number:	**Device:**	**Last Calibration:**	**Calibration Due:**
CCI0001	B & K Ensemble	19-Jun-19	19-Jun-20
CCI0004	Quest Cal	12-Feb-19	12-Feb-20

Measurement Uncertainty:
± 2.2% Accoustic (0.19DB)
Estimated at 95% confidence level (k=2)

Calibrated By:  31-Oct-19
Ian Holt

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirely without the written approval of Concept Controls Inc.

pco.

Test & Verification

Customer: Concept Controls

Instrument: 850007

Serial Number: Q885108

Manufacturer: Sper Scientific

File Number: T-SO718

PCO certifies that the subject instrument was tested for illuminance on this date using the following equipment:

PR670 S/N 67171703 Calibrated using illuminance standards traceable to NIST
F-804 working standard lamp
OL83A Programmable Current Source

Calibration room temperature: 23 C Humidity: 30%

Calibration of this instrument was performed using
procedure:Cal.illum.3% Color Temperature: 2856K

Reference	Initial Reading	Out of Tolerance
1000 lux	951 lux	4.9%
122 lux	117 lux	4.1%
10000lux	9554 lux	4.46%

Correction Factor: Readings X 1.05

This instrument was found to be within 3%____/ greater than 3% ✓

This report and data it contains is valid for **12 months** from the date of issue.

Date of Issue: February 6, 2020

PCO-TECH (USA) formerly Cooke
6930 Metroplex Dr.
Romulus, MI 48174
866-662-6653

PCO Photonics (Canada) formerly Optikon
1099 Guelph St.
Kitchener, ON N2B 2E4
866-678-4566

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	70.35 (21.3)	°F (°C)
RELATIVE HUMIDITY	46.2	%RH
BAROMETRIC PRESSURE	29.18 (988.1)	inHg (hPa)

MODEL	7545
SERIAL NUMBER	T75451228006

☒ AS LEFT ☒ IN TOLERANCE
☐ AS FOUND ☐ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

TEMPERATURE VERIFICATION — SYSTEM T-101 — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	32.1 (0.0)	32.4 (0.2)	31.1~33.1 (-0.5~0.6)	2	140.0 (60.0)	140.1 (60.1)	139.0~141.0 (59.5~60.6)

HUMIDITY VERIFICATION — SYSTEM H-102 — *Unit: %RH*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	10.0	9.3	7.8~12.2	4	70.0	69.8	67.8~72.2
2	30.0	29.5	27.8~32.2	5	90.0	89.6	87.8~92.2
3	50.0	50.0	47.8~52.2				

CO2 GAS VERIFICATION — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	0	0	0~50	4	3020	3027	2929~3110
2	502	506	452~552	5	5056	5062	4904~5208
3	1005	1029	955~1055				

CO GAS VERIFICATION — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	35	36	32~38	2	101	100	98~104

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Temperature	E010657	02-14-20	02-28-21	Temperature	E010658	02-14-20	02-28-21
Temperture	E010655	01-21-20	01-31-21	Humidity	E003539	02-26-20	08-31-20
5000 CO2	14A044095	04-06-20	04-06-25	900 CO	119886	04-30-20	03-24-28
N2	T-0602	05-19-20	05-19-25	Air	117178	03-09-20	04-09-26
Flow	E003541	09-03-19	09-30-20	Flow	E005980	04-22-20	04-30-21
Flow	E003525	01-06-20	01-31-21	Flow	E005342	09-03-19	09-30-20
2000 C4H8	EB0054467	08-13-19	08-12-22	100 C4H8	CC507339	03-24-20	03-24-28

CALIBRATED

June 17, 2020
DATE

TSI P/N 2900157

CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

ENVIRONMENT CONDITIONS		
TEMPERATURE	74.5 (23.6)	°F (°C)
RELATIVE HUMIDITY	39	%RH
BAROMETRIC PRESSURE	29.21 (989.2)	inHg (hPa)

MODEL	7545
SERIAL NUMBER	T75451228006

☐ AS LEFT ☒ AS FOUND

☐ IN TOLERANCE ☒ OUT OF TOLERANCE

– CALIBRATION VERIFICATION RESULTS –

GAS CO_2 AS FOUND — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	0	0	0~50	4	3019	2975	2928~3109
2	502.2	* 440.4	452.2~552.2	5	5056	4968	4904~5208
3	1006	1001	956~1056				

GAS CO AS FOUND — SYSTEM G-101 — *Unit: ppm*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	35	36	32~38	2	101	98	98~104

TEMPERATURE AS FOUND — SYSTEM T-101 — *Unit: °F (°C)*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	32.1 (0.0)	32.4 (0.2)	31.1~33.1 (-0.5~0.6)	2	140.0 (60.0)	140.1 (60.1)	139.0~141.0 (59.5~60.6)

HUMIDITY AS FOUND — SYSTEM H-102 — *Unit: %RH*

#	STANDARD	MEASURED	ALLOWABLE RANGE	#	STANDARD	MEASURED	ALLOWABLE RANGE
1	10.0	9.3	7.0~13.0	4	70.0	67.2	67.0~73.0
2	30.0	28.5	27.0~33.0	5	90.02	* 86.3	87.02~93.02
3	50.0	48.1	47.0~53.0				

**Indicates Out-of-Tolerance Condition*

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Measurement Variable	System ID	Last Cal.	Cal. Due
5000 CO_2	14A044095	04-06-20	04-06-25
N2	T-0608	05-19-20	05-19-28
Flow	E003341	09-03-19	09-30-20
Flow	E003525	01-06-20	01-31-21
2000 C4H8	EB0054467	08-13-19	08-12-22
Temperature	E010657	02-14-20	02-28-21
Temperture	E010655	01-21-20	01-31-21

Measurement Variable	System ID	Last Cal.	Cal. Due
200 CO	149886	04-30-20	03-24-28
Air	T17939	04-09-20	04-09-28
Flow	E003980	04-22-20	04-30-21
Flow	E003342	09-03-19	09-30-20
100 C4H8	CC507339	03-24-20	03-24-28
Temperature	E010658	02-14-20	02-28-21
Humidity	E003539	02-26-20	08-31-20

VERIFIED

June 16, 2020
DATE

Doc ID. CERT_GEN_WCC

APPENDIX B

Dosimetry session reports

Indoor noise level report - 380 person camp (Milne port)

2020-07-26

Information Panel

Name	NXN030014_2672020_180005
Comments	
Company Name	
Description	
Location	
User Name	
Start Time	2020-07-26 18:00:05
Stop Time	2020-07-27 06:00:05
Run Time	12:00:00
Device Name	NXN030014
Serial Number	NXN030014
Model Type	NoisePro DLX
Device Firmware Rev	R176

Calibration History

Date		Level	Serial Number	Certification Date
2020-07-24 08:02:57	Calibration	114,0		
2020-07-27 09:20:46	Verification	114,0		

SLM Q3

Description	Meter	Value	Description	Meter	Value
Dose	3	0,4 %	Leq	3	65 dB
Response	3	SLOW	Exchange Rate	3	3 dB
Weighting	3	A	Dosimeter Name	3	SonoQ3
Rtime	3	12:00:00	Log Rate		60 s

Indoor noise level report - PSC (Milne port)

2020-07-29

Information Panel

Name	NXN030014_2972020_180005
Comments	
Company Name	
Description	
Location	
User Name	
Stop Time	2020-07-30 06:00:05
Start Time	2020-07-29 18:00:05
Run Time	12:00:00
Device Name	NXN030014
Serial Number	NXN030014
Model Type	NoisePro DLX
Device Firmware Rev	R176

Calibration History

Date		Level	Serial Number	Certification Date
2020-07-29 08:00:35	Calibration	114,0		
2020-07-30 17:26:15	Verification	114,1		

SLM Q3

Description	Meter	Value	Description	Meter	Value
Dose	3	0,4 %	Leq	3	65 dB
Response	3	SLOW	Exchange Rate	3	3 dB
Weighting	3	A	Rtime	3	12:00:00
UL Time	3	00:00:00	Dosimeter Name	3	SonoQ3
Log Rate		60 s			

Indoor noise level report - Sailiivik camp (Mary River Mine)

2020-08-03

Information Panel

Name	NXN030014_382020_180005
Comments	
Company Name	
Description	
Location	
User Name	
Device Name	NXN030014
Serial Number	NXN030014
Model Type	NoisePro DLX
Device Firmware Rev	R176
Stop Time	2020-08-04 06:00:05
Start Time	2020-08-03 18:00:05
Run Time	12:00:00

Calibration History

Date		Level	Serial Number	Certification Date
2020-08-03 10:41:21	Calibration	114,0		
2020-08-04 06:07:33	Verification	114,0		

SLM Q3

Description	Meter	Value	Description	Meter	Value
Dose	3	0,4 %	Leq	3	65 dB
Response	3	SLOW	Exchange Rate	3	3 dB
Weighting	3	A	Rtime	3	12:00:00
Dosimeter Name	3	SonoQ3	ULL	3	115 dB
UL Time	3	00:00:00	Log Rate		60 s

APPENDIX C

Vibration session reports

HVM General Information

Serial Number	0001526
Model	HVM200
Firmware Version	4.5.0R0
HVM File Name	HVM_0001526_200726_164558.00.hvm2
User	BIM - MP
Location	380 Man camp - MP
Job Description	accomodation - NIRB
Note	2020-07-26

Setup

Operating Mode	WholeBody
Averaging	5 minutes
Exposure Limit	1.15
Exposure Action	0.50
Integration	None
Selected Accelerometer	ICP

	x	y	z
Sensitivity mV/(m/s²)	10,030000	10,370000	9,930000
Weighting	Wm	Wm	Wm
k-Factors	1.0000	1.0000	1.0000

Overall Data

Start Date and Time	2020-Jul-26 16:45:58
Run Time (hh:mm:ss)	13:56:46

	x	y	z	Sum	Units
a_{RMS}	0,0022	0,0020	0,0025	0,0039	m/s²
MTVV	0,0042	0,0040	0,0224	0,0229	m/s²
a_{PEAK}	0,0172	0,0130	0,0510	0,0520	m/s²
a_{MIN}	0,0010	0,0009	0,0017	0,0027	m/s²
A(8)	0,0029	0,0027	0,0033	0,0033	m/s²
A(8) Act.	>24	>24	>24	>24	Hours
A(8) Exp.	>24	>24	>24	>24	Hours
VDV	0,0424	0,0407	0,0720	0,0720	m/s^1.75
Exposure Points				0	Points

HVM General Information

Serial Number	0001526
Model	HVM200
Firmware Version	4.5.0R0
HVM File Name	HVM_0001526_200729_161051.01.hvm2
User	BIM - MP
Location	PSC - BB06
Job Description	Accomodation
Note	2020-07-29

Setup

Operating Mode	WholeBody
Averaging	5 minutes
Exposure Limit	1.15
Exposure Action	0.50
Integration	None
Selected Accelerometer	ICP

	x	y	z
Sensitivity mV/(m/s²)	10,030000	10,370000	9,930000
Weighting	Wm	Wm	Wm
k-Factors	1.0000	1.0000	1.0000

Overall Data

Start Date and Time	2020-Jul-29 16:10:51
Run Time (hh:mm:ss)	14:55:37

	x	y	z	Sum	Units
a_{RMS}	0,0012	0,0014	0,0018	0,0025	m/s²
MTVV	0,0028	0,0039	0,0072	0,0082	m/s²
a_{PEAK}	0,0122	0,0131	0,0216	0,0243	m/s²
a_{MIN}	0,0006	0,0006	0,0010	0,0015	m/s²
A(8)	0,0017	0,0019	0,0024	0,0024	m/s²
A(8) Act.	>24	>24	>24	>24	Hours
A(8) Exp.	>24	>24	>24	>24	Hours
VDV	0,0250	0,0280	0,0357	0,0357	m/s^1.75
Exposure Points				0	Points

HVM General Information

Serial Number	0001526
Model	HVM200
Firmware Version	4.5.0R0
HVM File Name	HVM_0001526_200803_170231.00.hvm2
User	BIM
Location	MRM
Job Description	Sailiivik Camp - C2-04
Note	2020-08-03

Setup

Operating Mode	WholeBody
Averaging	5 minutes
Exposure Limit	1.15
Exposure Action	0.50
Integration	None
Selected Accelerometer	ICP

	x	y	z
Sensitivity mV/(m/s²)	10,030000	10,370000	9,930000
Weighting	Wm	Wm	Wm
k-Factors	1.0000	1.0000	1.0000

Overall Data

Start Date and Time	2020-Aug-03 17:02:31
Run Time (hh:mm:ss)	13:03:17

	x	y	z	Sum	Units
a_{RMS}	0,0014	0,0014	0,0018	0,0027	m/s²
MTVV	0,0031	0,0038	0,0042	0,0063	m/s²
a_{PEAK}	0,0126	0,0167	0,0222	0,0223	m/s²
a_{MIN}	0,0008	0,0007	0,0010	0,0018	m/s²
A(8)	0,0018	0,0018	0,0023	0,0023	m/s²
A(8) Act.	>24	>24	>24	>24	Hours
A(8) Exp.	>24	>24	>24	>24	Hours
VDV	0,0273	0,0280	0,0350	0,0350	m/s^1.75
Exposure Points				0	Points

APPENDIX D

Certificate of analysis

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Identifiant au Programme EMPAT de l'AIHA : no 193773

Certificat d'analyses microbiologiques

Identification des spores de moisissures cultivables ou non dans l'air

Client :	Monsieur Ballot - HDS Environnement (2888)		
Identification du projet	Projet HDS-8664-2 Q3 (62273)	Date de réception	11 août 2020
Adresse d'échantillonnage	BIM	Date d'échantillonnage	23 au 31 juillet 2020
Type d'échantillonnage	Air-O-Cell	Date d'analyse	18 août 2020

Identification	**3100-0323 (2020-07-23)**			**3100-0316 (2020-07-23)**			**3100-0313 (2020-07-23)**		
No. d'échantillon	108671			108672			108673		
Volume d'air (L)	75,00			75,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Ascospores	5	18	67	8	38	107			
Basidiospores	22	79	293	12	57	160	3	75	40
Cladosporium sp.	1	4	13						
Fragment d'hyphe				1	5	13			
Aspergillus/Penicillium sp.							1	25	13
Totaux	28	100	373	21	100	280	4	100	53
Limites de détection (spores/m³)	13			13			13		
Débris	3			3			3		

Identification	**3100-0304 (2020-07-23)**			**3100-0321 (2020-07-23)**			**3100-0322 (2020-07-31)**		
No. d'échantillon	108674			108675			108676		
Volume d'air (L)	75,00			0,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Basidiospores	3	75	40	-	-	-	2	18	27
Fragment d'hyphe	1	25	13	-	-	-			
Ascospores							9	82	120
Totaux	4	100	53	-	-	-	11	100	147
Limites de détection (spores/m³)	13			-			13		
Débris	3			0			3		

Identification	**3100-3925 (2020-07-31)**			**3100-3934 (2020-07-31)**			**3100-0318 (2020-07-31)**		
No. d'échantillon	108677			108678			108679		
Volume d'air (L)	75,00			75,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Ascospores	6	55	80	5	22	67	1	50	13
Aspergillus/Penicillium sp.	1	9	13	17	74	227			
Basidiospores	3	27	40	1	4	13	1	50	13
Cladosporium sp.	1	9	13						
Totaux	11	100	146	23	100	307	2	100	26
Limites de détection (spores/m³)	13			13			13		
Débris	3			3			3		

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Identification	**3100-0302 (2020-07-31)**			**3100-0283 (2020-07-26)**			**3100-0311 (2020-07-26)**		
No. d'échantillon	108680			108681			108682		
Volume d'air (L)	0,00			75,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Ascospores	-	-	-	1	33	13			
Basidiospores	-	-	-	2	67	27	3	100	40
Totaux	-	-	-	3	100	40	3	100	40
Limites de détection (spores/m³)	-			13			13		
Débris	0			4			4		

Identification	**3100-0314 (2020-07-26)**			**3100-0310 (2020-07-26)**			**3100-3923 (2020-07-26)**		
No. d'échantillon	108683			108684			108685		
Volume d'air (L)	75,00			75,00			0,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Basidiospores	1	50	13	2	29	27	-	-	-
Cladosporium sp.	1	50	13	1	14	13	-	-	-
Ascospores				1	14	13	-	-	-
Aspergillus/Penicillium sp.				2	29	27	-	-	-
Fragment d'hyphe				1	14	13	-	-	-
Totaux	2	100	26	7	100	93	-	-	-
Limites de détection (spores/m³)	13			13			-		
Débris	3			3			0		

Identification	**3100-0296 (2020-07-25)**			**3100-0312 (2020-07-25)**			**3100-0319 (2020-07-25)**		
No. d'échantillon	108686			108687			108688		
Volume d'air (L)	75,00			75,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Ascospores	2	17	27	2	18	27			
Basidiospores	10	83	133	9	82	120	2	50	27
Aspergillus/Penicillium sp.							1	25	13
Cladosporium sp.							1	25	13
Totaux	12	100	160	11	100	147	4	100	53
Limites de détection (spores/m³)	13			13			13		
Débris	3			3			3		

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Identification	**3100-0305 (2020-07-25)**			**3100-3928 (2020-07-25)**			**3100-0309 (2020-07-28)**		
No. d'échantillon	108689			108690			108691		
Volume d'air (L)	75,00			0,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Basidiospores	3	100	40	-	-	-	16	76	213
Ascospores				-	-	-	1	5	13
Aspergillus/Penicillium sp.				-	-	-	1	5	13
Cladosporium sp.				-	-	-	2	10	27
Fragment d'hyphe				-	-	-	1	5	13
Totaux	3	100	40	-	-	-	21	100	279
Limites de détection (spores/m³)	13			-			13		
Débris	3			0			3		

Identification	**3100-0307 (2020-07-28)**			**3100-0294 (2020-07-28)**			**3100-0282 (2020-07-28)**		
No. d'échantillon	108692			108693			108694		
Volume d'air (L)	75,00			75,00			75,00		
Spores Fongiques	Compte	%	spores /m³	Compte	%	spores /m³	Compte	%	spores /m³
Ascospores	2	15	27	2	40	27			
Basidiospores	10	77	133	2	40	27	2	100	27
Cladosporium sp.	1	8	13	1	20	13			
Totaux	13	100	173	5	100	67	2	100	27
Limites de détection (spores/m³)	13			13			13		
Débris	2			2			2		

Identification	**3100-0325 (2020-07-28)**		
No. d'échantillon	108695		
Volume d'air (L)	0,00		
Spores Fongiques	Compte	%	spores /m³
Totaux	-	-	-
Limites de détection (spores/m³)	-		
Débris	0		

Notes :

- Les résultats de l'essai ne se rapportent qu'aux échantillons reçus.
- Le mandat du laboratoire ACM se limite à l'analyse des échantillons reçus. L'interprétation des résultats est à l'entière responsabilité de l'expert/échantillonneur.
- Méthode IRSST MA-367-m et ASTM D 7391-09-m
- La présence de débris peut cacher certaines spores. Les comptes ayant des débris de niveau 4 doivent être considérés comme sous-estimés. (0 = pas de débris, 1: débris léger. 2: débris moyen, 3: débris nombreux, 4 : débris très nombreux).
- Le type *Aspergillus/Penicillium sp.* peut inclure *Acremonium, Trichoderma, Paecilomyces* et d'autres types similaires.
- **No. d'échantillon 108675:** Aucune spore et/ou débris détectés.
- **No. d'échantillon 108680:** Aucune spore et/ou débris détectés.
- **No. d'échantillon 108685:** Aucune spore et/ou débris détectés.
- **No. d'échantillon 108690:** Aucune spore et/ou débris détectés.
- **No. d'échantillon 108695:** Aucune spore et/ou débris détectés.

Analyste :

Valérie Hue, B.Sc., Microbiologiste Agréée