SPONSOR: **University of Michigan**
Ann Arbor, MI

Sound Absorption
RAL™-A21-469

CONDUCTED: 2021-09-09

ON: Flower Zero - Flat

TEST METHODOLOGY

Riverbank Acoustical Laboratories™ is accredited by the U.S. Department of Commerce, National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP) as an ISO 17025:2017 Laboratory (NVLAP Lab Code: 100227-0) and for this test procedure. The test reported in this document conformed explicitly with ASTM C423-17: "Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method." Test Specimens During Sound Absorption Tests." A description of the measurement procedure and room specifications are available upon request. The results presented in this report apply to the sample as received from the test sponsor.

INFORMATION PROVIDED BY SPONSOR

The test specimen was designated by the sponsor as Flower Zero - Flat. The following nominal product information was provided by the sponsor prior to testing. The accuracy of such sponsor-provided information can affect the validity of the test results.

Specimen Under Test

Specimen Name:	Flower Zero - Flat
Fabricator:	University of Michigan

SPECIMEN MEASUREMENTS & TEST CONDITIONS

Through a full external visual inspection performed on the test specimen, Riverbank personnel verified the following information:

Base frame and support rods

Materials:	Flat grid of thirteen (13) equilateral triangles Twelve (12) support rods, each anchored at a vertex of the triangular grid
Dimensions:	1822 mm (71.75 in.) by 2102 mm (82.75 in.)
Frame Thickness:	19.25 mm (0.758 in.)
Installation:	Base frame placed on horizontal surface of test chamber Support rods used to hold test specimen panels
Overall Weight:	19.05 kg (42 lbs)

NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT.
THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.

Test Specimen

Materials:	Fourteen (14) flat glass hexagonal panels arranged in seven (7) pairs
Panel Geometry:	Regular hexagons with side length @ 381 mm (15 in.)
Thickness:	Individual panel @ 4.06 mm (0.16 in.) Pair @ 8.1 mm (0.319 in.)
Installation:	Each pair comprised of a second panel stacked atop the first with no rotation and no horizontal translation Seven (7) pairs of panels placed atop support rods in a hexagonal array Array consists of center pair, with other six (6) pairs evenly placed around center and with top surfaces of each parallel to a common horizontal plane Air spaces between each adjacent pair in array @ 10.97 mm (0.432 in.)
Overall Weight:	52.39 kg (115.5 lbs)

Test Environment

Room Volume:	291.98 m³
Temperature:	22.3 °C ± 0.1 °C (Requirement: ≥ 10 °C and ≤ 5 °C change)
Relative Humidity:	62.45 % ± 1.1 % (Requirement: ≥ 40 % and ≤ 5 % change)
Barometric Pressure:	98.9 kPa (Requirement not defined)

MOUNTING METHOD

Non-standard mounting: The specimen is an array of pairs of glass panels. The panels were supported by rods anchored to a base frame on the horizontal test surface such that the closest faces of the panels are located approximately 451 mm (17.75 in.) from the horizontal test surface.

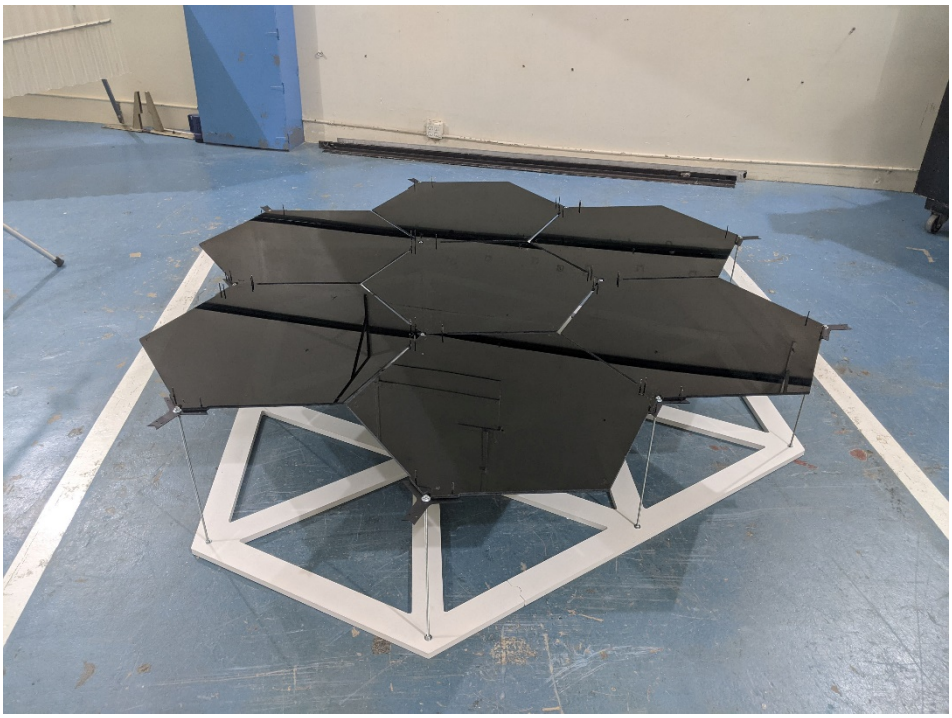


Figure 1 – Specimen mounted in test chamber

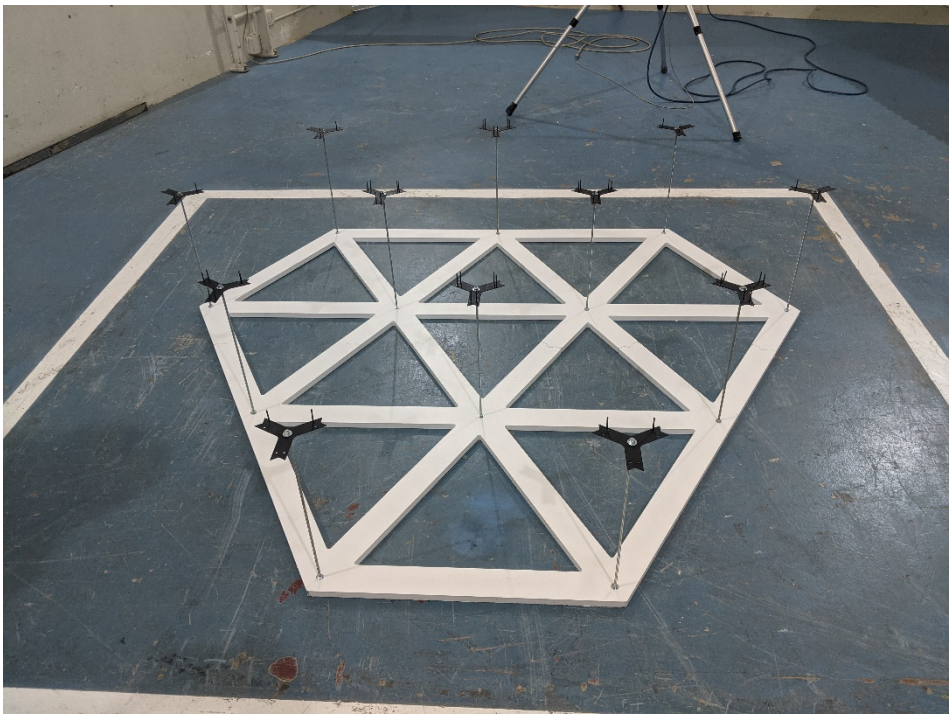


Figure 2 – Base frame and support rods in test chamber prior to installation of glass units

NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT.
THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.

Figure 3 – Detail of support rod

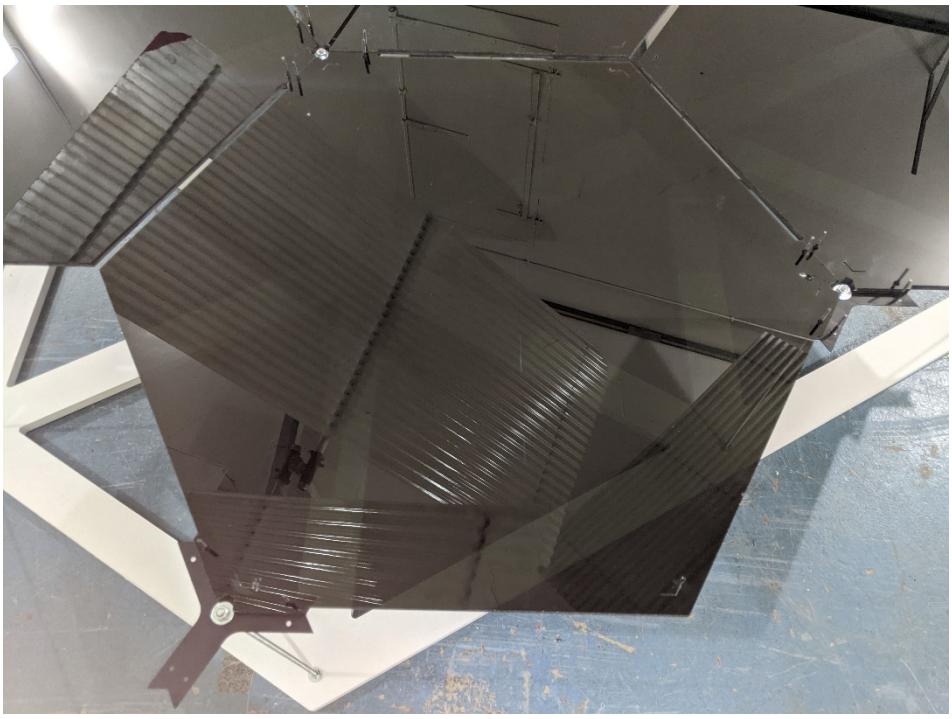


Figure 4 – Individual specimen hexagon comprised of two layers of flat glass plates mounted on support rods

NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT.
THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.

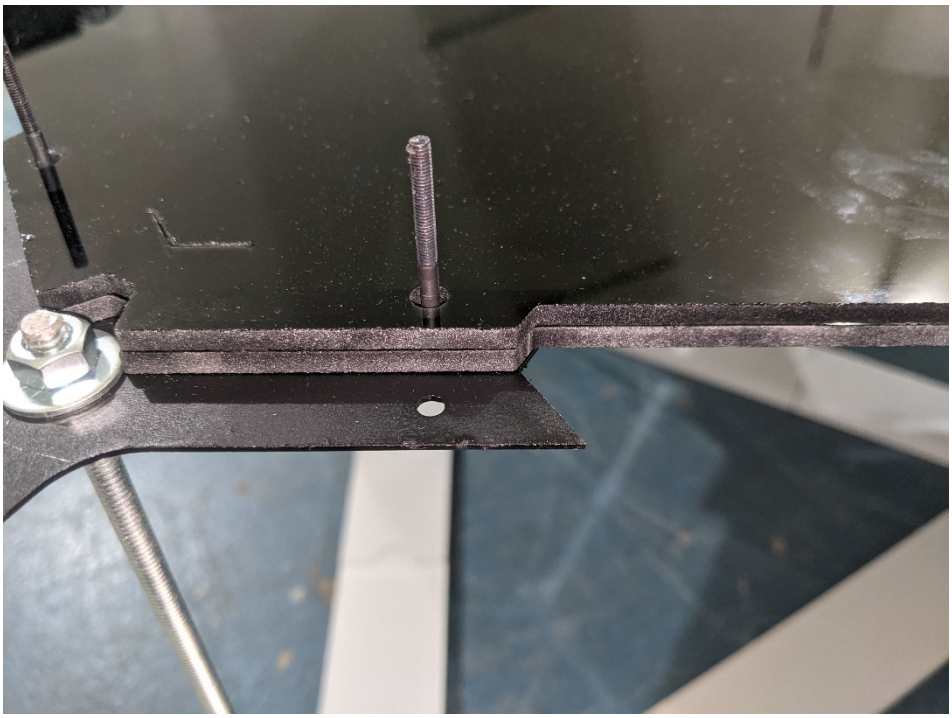


Figure 5 – Detail of specimen glass plates mounted on support rods

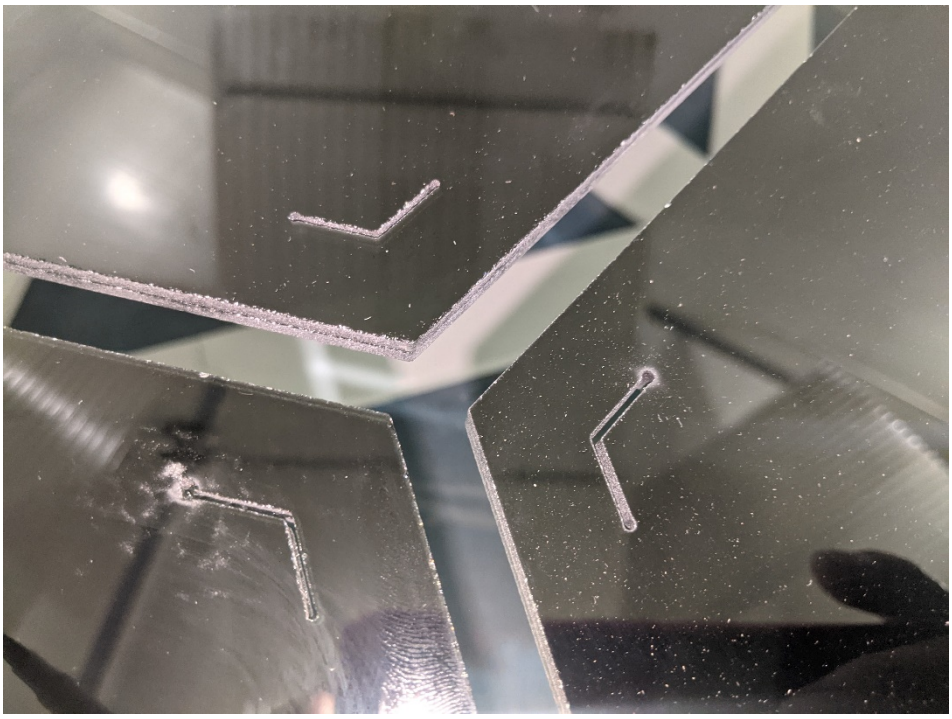


Figure 6 – Detail of air gaps between adjacent pairs of glass plates

NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT.
THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.

TEST RESULTS

Note: The empty room absorption test, which is used as a correction factor for the specimen absorption test data, was conducted with the base frame and support rods in the test chamber to minimize the effect of these elements on the specimen absorption data. As such, the specimen absorption data should theoretically represent the acoustic absorption of only the glass panel elements.

1/3 Octave Center Frequency (Hz)	**Total Absorption** (m^2)	(Sabins)
100	-0.62	-6.63
** 125	0.29	3.17
160	0.25	2.67
200	0.23	2.48
** 250	-0.07	-0.77
315	0.03	0.33
400	-0.07	-0.78
** 500	0.09	0.92
630	0.03	0.28
800	0.07	0.77
** 1000	0.13	1.43
1250	0.14	1.52
1600	0.06	0.67
** 2000	0.06	0.65
2500	0.17	1.85
3150	0.18	1.92
** 4000	0.14	1.54
5000	0.00	-0.04

Tested by Marc Sciaky
Marc Sciaky
Senior Experimentalist

Report by Keith Kimberling
Keith Kimberling
Associate Test Engineer

Approved by
Eric P. Wolfram
Laboratory Manager

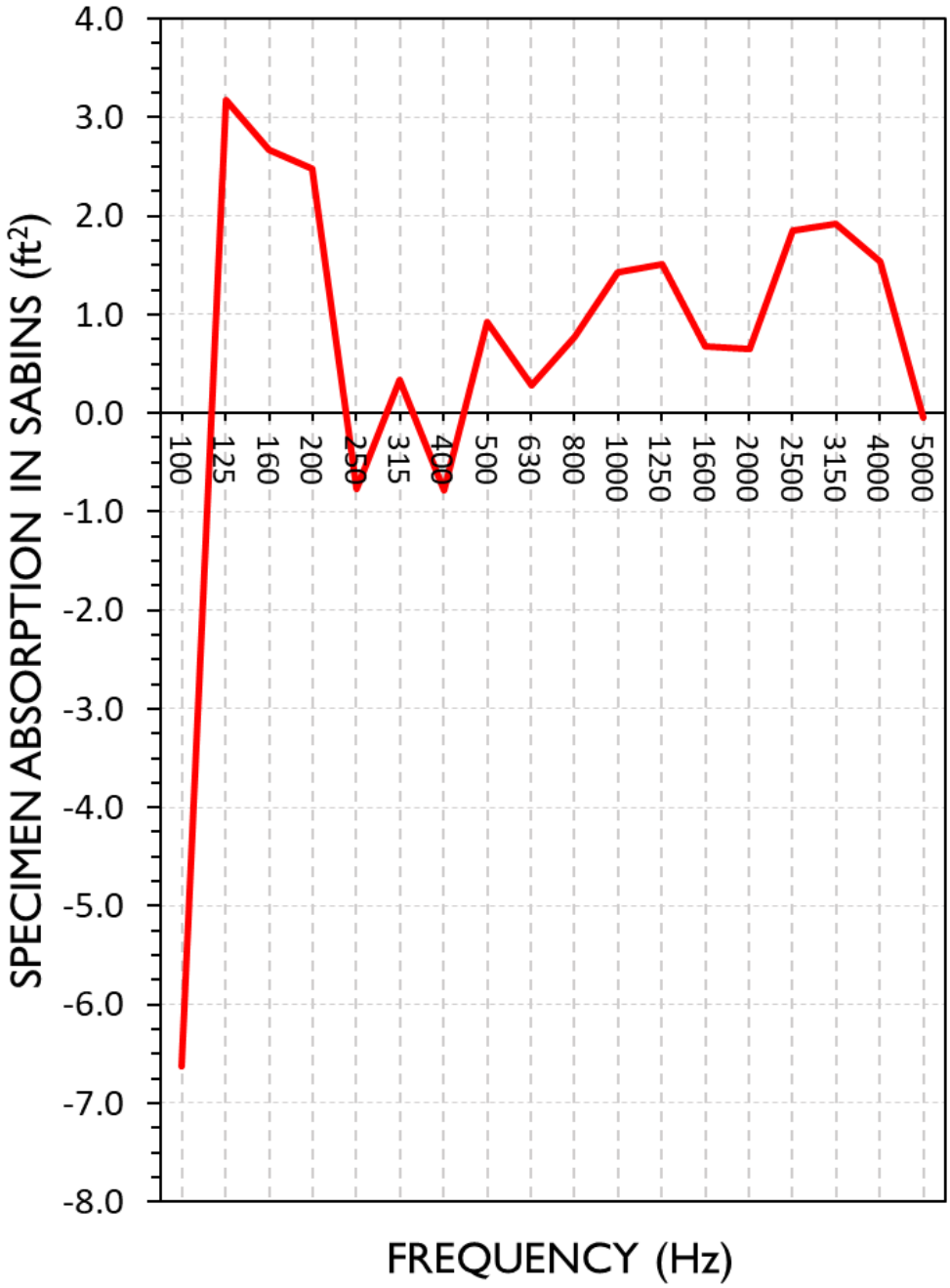
Digitally signed by Eric P Wolfram
Date: 2021.12.09 11:22:02 -06'00'

NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT.
THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.

SOUND ABSORPTION REPORT

Flower Zero - Flat



NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT.
THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.

APPENDIX A: Extended Frequency Range Data

Specimen: Flower Zero - Flat (See Full Report)

The following non-accredited data were obtained in accordance with ASTM C423-17, but extend beyond the defined frequency range of 100Hz to 5,000Hz. These unofficial results are representative of the RAL test environment only and intended for research & comparison purposes.

1/3 Octave Band Center Frequency (Hz)	Total Absorption (m^2)	Total Absorption (Sabins)
31.5	0.07	0.71
40	0.23	2.47
50	-0.41	-4.37
63	0.22	2.38
80	0.04	0.43
100	-0.62	-6.63
125	0.29	3.17
160	0.25	2.67
200	0.23	2.48
250	-0.07	-0.77
315	0.03	0.33
400	-0.07	-0.78
500	0.09	0.92
630	0.03	0.28
800	0.07	0.77
1000	0.13	1.43
1250	0.14	1.52
1600	0.06	0.67
2000	0.06	0.65
2500	0.17	1.85
3150	0.18	1.92
4000	0.14	1.54
5000	0.00	-0.04
6300	0.08	0.91
8000	-0.23	-2.52
10000	0.34	3.65
12500	-0.76	-8.18

APPENDIX B: Instruments of Traceability

Specimen: Flower Zero - Flat (See Full Report)

Description	Model	Serial Number	Date of Certification	Calibration Due
System 1	Type 3160-A-042	3160-106968	2021-07-01	2022-07-01
Bruel & Kjaer Mic And Preamp A	Type 4943-B-001	2311428	2020-09-30	2021-09-30
Bruel & Kjaer Pistonphone	Type 4228	2781248	2021-08-13	2022-08-13
EXTECH Hygro 639	SD700	A.103639	2020-12-18	2021-12-18

APPENDIX C: Revisions to Original Test Report

Specimen: Flower Zero - Flat (See Full Report)

Date	Revision
2021-12-08	Original report issued

END

NVLAP TESTING
NVLAP LAB CODE 100227-0

RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY OF THE U.S. GOVERNMENT. THIS REPORT SHALL NOT BE MODIFIED WITHOUT THE WRITTEN APPROVAL OF RAL. THE RESULTS REPORTED APPLY ONLY TO THE SPECIFIC SAMPLE SUBMITTED FOR TESTING; RAL ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF ANY OTHER SAMPLE.