

Test Report

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

Sound Absorption
RAL™-A21-471

CONDUCTED: 2021-09-09

Page 1 of 9

ON: Flower Five - Helmholtz Absorption Span

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 Five - Helmholtz Absorption Span. 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 Five - Helmholtz Absorption Span
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)

Test Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 2 of 9

Test Specimen

Materials: Fourteen (14) glass hexagonal panels arranged in seven (7) pairs, one (1) pair of a flat panel and a curved panel, six (6) pairs of curved panels with various degrees of curvature, perforations on some curved panels

Panel Geometry: Regular hexagons with side length @ 381 mm (15 in.)

Thickness: Individual flat panel @ 4.06 mm (0.16 in.)
Curved panel pairs @ various thicknesses

Installation: Each pair comprised of a second panel stacked atop the first with 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: 64.65 % ± 1.1 % (Requirement: ≥ 40 % and ≤ 5 % change)

Barometric Pressure: 99.0 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 bottommost point of the curved panels was located approximately 381 mm (15 in.) from the horizontal test surface.

Test Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 3 of 9



Figure 1 – Specimen mounted in test chamber



Figure 2 – Specimen mounted in test chamber

Test Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 4 of 9

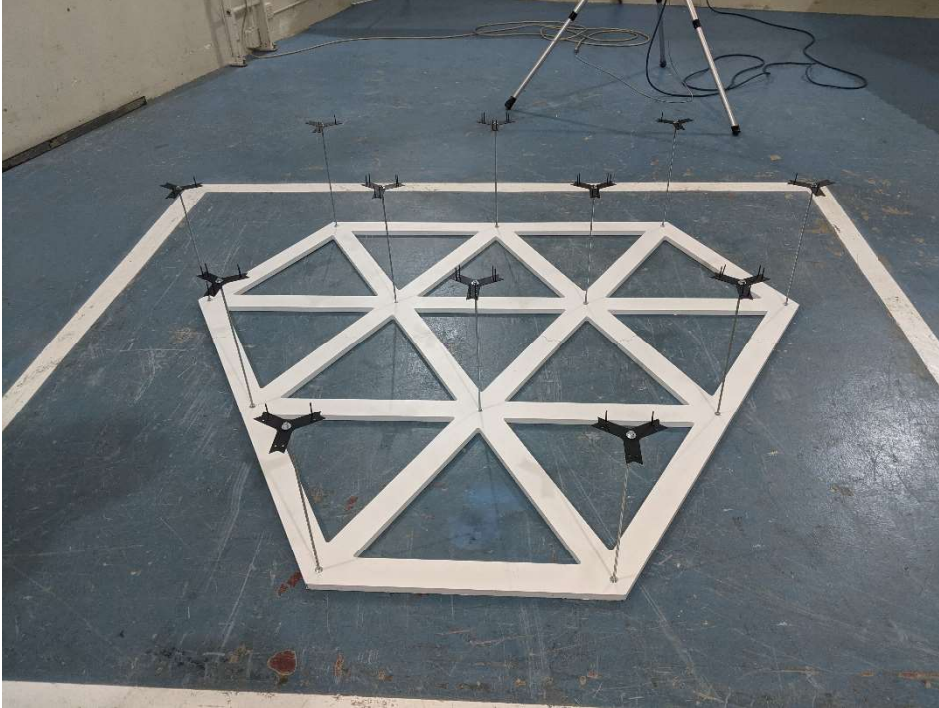


Figure 3 – Base frame and support rods in test chamber prior to installation of glass units



Figure 4 – Detail of support rod

Test Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 5 of 9



Figure 5 – Detail of curvature and perforations on some specimen glass panels



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

1512 S BATAVIA AVENUE
 GENEVA, IL 60134
 630-232-0104

An ALION Technical Center

RIVERBANK.ALIONSCIENCE.COM

FOUNDED 1918 BY
 WALLACE CLEMENT SABINE

Test Report

University of Michigan
 2021-09-09

RAL™-A21-471
 Page 6 of 9


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	0.07	0.80
** 125	0.59	6.37
160	0.87	9.34
200	1.08	11.63
** 250	1.26	13.53
315	0.40	4.30
400	0.26	2.76
** 500	0.57	6.10
630	0.38	4.09
800	0.43	4.64
** 1000	0.43	4.60
1250	0.37	3.99
1600	0.33	3.52
** 2000	0.25	2.72
2500	0.22	2.40
3150	0.27	2.88
** 4000	0.13	1.39
5000	0.14	1.53

Tested by 
 Marc Sciaky
 Senior Experimentalist

Report by 
 Keith Kimberling
 Associate Test Engineer

Approved by 
 Eric P. Wolfram
 Laboratory Manager
 Digitally signed by
 Eric P Wolfram
 Date: 2021.12.09
 11:21:08 -06'00'



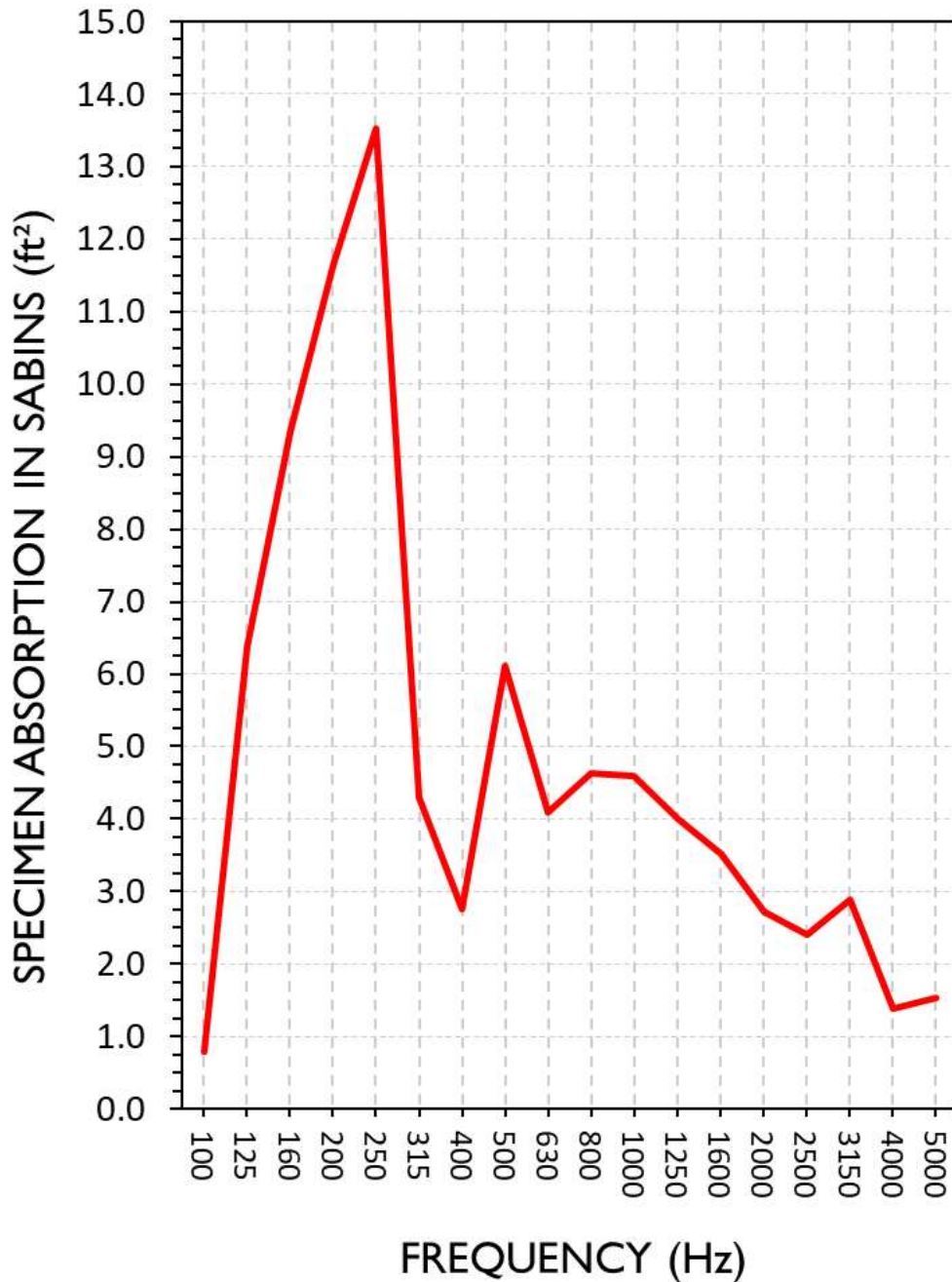
RIVERBANK ACOUSTICAL LABORATORIES IS ACCREDITED BY NVLAP (LAB CODE 100227-0) FOR ACOUSTICAL TESTING SERVICES IN ACCORDANCE WITH ISO/IEC 17025:2017 AND FOR THIS PROCEDURE. THIS REPORT MUST NOT BE USED BY THE CLIENT TO CLAIM PRODUCT CERTIFICATION, APPROVAL, OR ENDORSEMENT BY RAL, NVLAP, NIST, OR ANY AGENCY 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 Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 7 of 9

SOUND ABSORPTION REPORT
Flower Five - Helmholtz Absorption Span



Test Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 8 of 9

APPENDIX A: Extended Frequency Range Data

Specimen: Flower Five - Helmholtz Absorption Span (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)	(Sabins)
31.5	-0.09	-0.93
40	0.72	7.73
50	0.22	2.38
63	0.26	2.83
80	-0.01	-0.09
<hr/>		
100	0.07	0.80
125	0.59	6.37
160	0.87	9.34
200	1.08	11.63
250	1.26	13.53
315	0.40	4.30
400	0.26	2.76
500	0.57	6.10
630	0.38	4.09
800	0.43	4.64
1000	0.43	4.60
1250	0.37	3.99
1600	0.33	3.52
2000	0.25	2.72
2500	0.22	2.40
3150	0.27	2.88
4000	0.13	1.39
5000	0.14	1.53
<hr/>		
6300	0.28	3.03
8000	0.04	0.43
10000	0.39	4.22
12500	-0.15	-1.62

1512 S BATAVIA AVENUE
GENEVA, IL 60134
630-232-0104

An ALION Technical Center

RIVERBANK.ALIONSCIENCE.COM

FOUNDED 1918 BY
WALLACE CLEMENT SABINE

Test Report

University of Michigan
2021-09-09

RAL™-A21-471
Page 9 of 9

APPENDIX B: Instruments of Traceability

Specimen: Flower Five - Helmholtz Absorption Span (See Full Report)

<u>Description</u>	<u>Model</u>	<u>Serial Number</u>	<u>Date of Certification</u>	<u>Calibration Due</u>
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 Five - Helmholtz Absorption Span (See Full Report)

<u>Date</u>	<u>Revision</u>
2021-12-08	Original report issued

END



Riverbank Acoustical Laboratories
1512 S. Batavia Ave.
Geneva, IL 60134-3302

Tel: 630-232-0104
Fax: 630-232-0138
Email: RAL@alionscience.com

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

Report Referenced: **RAL™-A21-471**
Page 1 of 1

CONDUCTED: 2021-09-09

ON: Flower Five - Helmholtz Absorption Span (See Full Test Report for Details)