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

An ALION Technical Center

Test Report

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WALLACE CLEMENT SABINE

FOR: **Turf Design**
Elgin, IL

Sound Absorption
RAL-A18-435

CONDUCTED: 2018-12-07

ON: Carve baffles, spaced 6 in. on center

TEST METHOD

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 17025:2005 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." The specimen mounting was performed according to ASTM E795-16: "Standard Practices for Mounting Test Specimens During Sound Absorption Tests." A description of the measurement procedure and room specifications are available upon request.

DESCRIPTION OF THE SPECIMEN

The test specimen was designated by the manufacturer as Carve baffles, spaced 6 in. on center. A full internal inspection performed on the test specimen by Riverbank personnel verified the manufacturer's description.

Specimen

Trade Name:	Carve
Material:	Polyethylene terephthalate felt
Overall Dimensions:	10 @ 2387.6 mm (94 in.) long x 28.96 mm (1.14 in.) wide x 241.3 mm (9.5 in.) high
Key Geometry:	9 mm (0.354 in.) thick felt body with 2.5 mm (0.098 in.) deep ridge patterns on both sides Concentration and orientation of ridge pattern varies between baffles Additional 54 mm (2.126 in.) wide x 9 mm (0.354 in.) thick felt pieces adhered to both sides of body at top edge
Overall Weight:	13.38 kg (29.5 lbs)

Physical Measures (per unit)

Dimensions:	0.24 m (9.5 in) wide by 2.39 m (94.0 in) long
Thickness:	0.03 m (1.14 in)
Weight:	1.34 kg (2.95 lbs)

Test Environment

Room Volume:	291.98 m³
Temperature:	20.3 °C ± 0.0 °C
Relative Humidity:	61.2 % ± 0.2 %
Barometric Pressure:	100.5 kPa

Each sound absorbing unit had an average absorptive area (all exposed surfaces) of 2.00 m^2 (21.53 ft^2). The total absorptive area (all exposed surfaces) of all sound-absorbing units was 20.00 m^2 (215.28 ft^2). The array of units covered 3.34 m^2 (35.90 ft^2) of chamber floor surface (total treated area).

MOUNTING METHOD

Type J Mounting: The specimen is an array of ten (10) spaced sound absorbing baffles suspended from an array of cables such that the bottom face of the baffles is located approximately 1193.8 mm (47 in.) above the horizontal test surface. This approximates the mounting method of a typical ceiling baffle installation. The baffles were evenly distributed in a single row, spaced 152.4 mm (6 in.) on center.

Figure 1 - Specimen mounted in test chamber

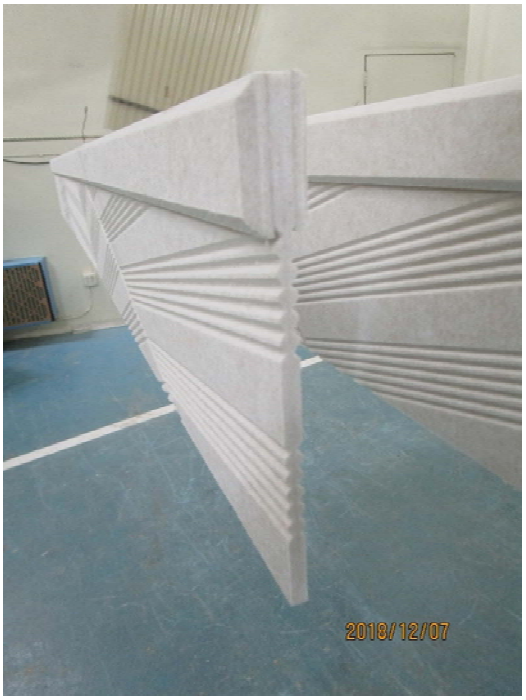

Figure 2 - Detail of individual baffle

TEST RESULTS

Note: There is currently no standardized method for calculating Absorption Coefficients from spaced object absorbers. The sound absorption performance of spaced object absorbers should not be compared directly with specimens tested as a single rectangular area (e.g. mounting types A, E, etc.).

1/3 Octave Center Frequency	Total Absorption		Absorption per Unit	
(Hz)	(m^2)	(Sabins)	(m^2 / Unit)	(Sabins / Unit)
100	1.02	10.99	0.10	1.10
** 125	0.89	9.63	0.09	0.96
160	0.62	6.66	0.06	0.67
200	1.01	10.89	0.10	1.09
** 250	1.78	19.12	0.18	1.91
315	2.20	23.66	0.22	2.37
400	2.21	23.82	0.22	2.38
** 500	2.60	27.96	0.26	2.80
630	2.88	30.98	0.29	3.10
800	3.36	36.19	0.34	3.62
** 1000	3.68	39.62	0.37	3.96
1250	4.07	43.81	0.41	4.38
1600	4.82	51.86	0.48	5.19
** 2000	5.41	58.21	0.54	5.82
2500	6.09	65.53	0.61	6.55
3150	6.51	70.02	0.65	7.00
** 4000	6.65	71.55	0.66	7.15
5000	6.84	73.59	0.68	7.36

Tested by Marc Sciaky, *Experimentalist* Report by Malcolm Kelly, *Acoustical Test Engineer* Approved by Eric P. Wolfram, *Laboratory Manager*

Digitally signed by Eric P Wolfram
DN: cn=Eric P Wolfram, o=Alion Science & Technology, ou=Riverbank Acoustical Laboratories, email=ewolfram@alionscience.com, c=US
Date: 2018.12.19 14:48:05 -06'00'

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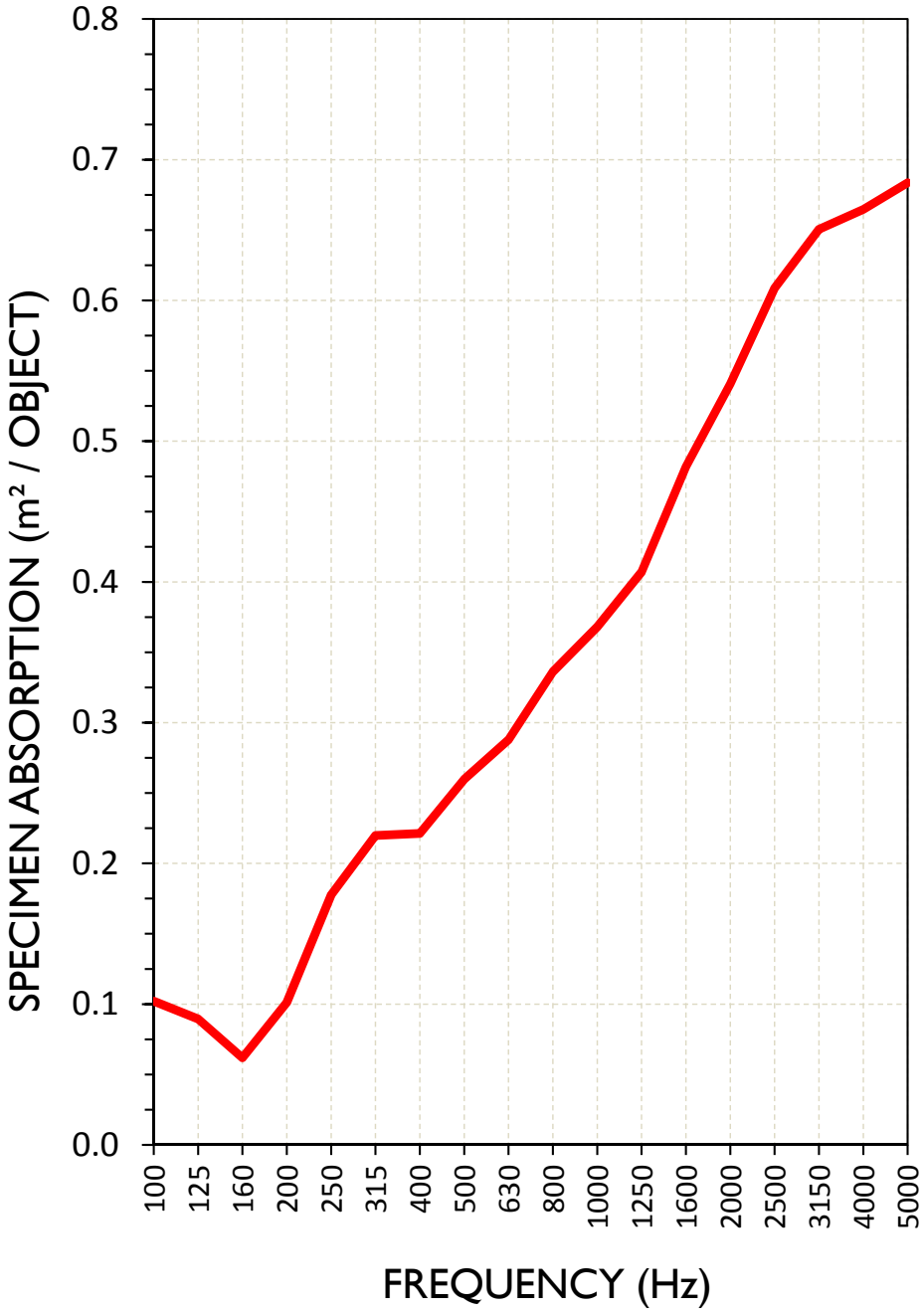
SOUND ABSORPTION REPORT

Carve baffles, spaced 6 in. on center



APPENDIX A: Extended Frequency Range Data

Specimen: Carve baffles, spaced 6 in. on center (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	Total Absorption		Absorption per Unit	
(Hz)	(m^2)	(Sabins)	(m^2 / Unit)	(Sabins / Unit)
31.5	-0.69	-7.39	-0.07	-0.74
40	1.08	11.60	0.11	1.16
50	1.57	16.86	0.16	1.69
63	0.33	3.60	0.03	0.36
80	0.98	10.56	0.10	1.06
100	1.02	10.99	0.10	1.10
125	0.89	9.63	0.09	0.96
160	0.62	6.66	0.06	0.67
200	1.01	10.89	0.10	1.09
250	1.78	19.12	0.18	1.91
315	2.20	23.66	0.22	2.37
400	2.21	23.82	0.22	2.38
500	2.60	27.96	0.26	2.80
630	2.88	30.98	0.29	3.10
800	3.36	36.19	0.34	3.62
1000	3.68	39.62	0.37	3.96
1250	4.07	43.81	0.41	4.38
1600	4.82	51.86	0.48	5.19
2000	5.41	58.21	0.54	5.82
2500	6.09	65.53	0.61	6.55
3150	6.51	70.02	0.65	7.00
4000	6.65	71.55	0.66	7.15
5000	6.84	73.59	0.68	7.36
6300	6.79	73.07	0.68	7.31
8000	6.92	74.45	0.69	7.45
10000	6.78	73.03	0.68	7.30
12500	7.39	79.50	0.74	7.95

APPENDIX B: Instruments of Traceability

Specimen: Carve baffles, spaced 6 in. on center (See Full Report)

Description	Model	Serial Number	Date of Certification	Calibration Due
System 1	Type 3160-A-4/2	System 1	2018-08-09	2019-08-09
Bruel & Kjaer Mic And Preamp A	Type 4943-B-001	2311428	2018-09-28	2019-09-28
Bruel & Kjaer Pistonphone	Type 4228	2781248	2018-08-06	2019-08-06
Omega Digital Temp., Humid. And Pressure Recorder	OM-CP-PRHTemp2000	P97844	2018-02-03	2019-02-03

END

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

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

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ON: Carve baffles, spaced 6 in. on center (See Full Test Report for Details)

Appendix C to ASTM C423 Sound Absorption Test
Non-standard calculation of equivalent NRC Rating and Absorption Coefficients from spaced absorbers.

At this time ASTM C423 does not provide a standard method for determining absorption coefficients of spaced object absorbers. Tests of a set of sound absorbing objects spaced apart from each other will yield higher absorption rates than a specimen joined together as a single patch (A-Mount or E-Mount). For this reason it is unfair to provide NRC or absorption coefficient ratings for specimens that consist of a spaced set of absorbers. Despite this, the architectural industry has expressed great demand for a simple "single number" rating for these treatments. Likewise, acoustical consultants desire equivalent absorption coefficient data for use in acoustical modeling programs. The following is an attempt to appease these demands until ASTM develops a standard method for calculation. Several alternate non-standard calculation methods are provided. Riverbank Acoustical Laboratories prefers method 1.

Method 1) Apparent Sound Absorption Coefficient calculated from total test surface area covered.
The total sound absorption yielded by the specimen is divided by the total surface area of the test surface covered by the suspended baffles, including intermediate spaces. The baffle rigging covered 3.34 m^2 (35.90 ft^2) of horizontal test surface area. With an additional 152.4 mm (6 in.) of width to account for the space between the tested array and what would be the next baffle in a larger array, the surface area comes to 3.70 m^2 (39.82 ft^2). Apparent Noise Reduction Coefficient (NRC) rating and Sound Absorption Average (SAA) figures are calculated from this data based on the methods described in ASTM C423-17. This may be the most accurate method for comparing baffle arrays to ceiling tile products. In acoustical modeling applications, the apparent sound absorption coefficient data can be assigned to a single horizontal surface or plane for approximation of baffle array performance. Such approximations rely on the assumptions that baffle spacing is similar to the tested specimen and that the installation occurs over a perfectly reflective ceiling surface.

Method 2) Apparent Sound Absorption Coefficient calculated from total exposed surface area of specimen.
The total sound absorption yielded by the specimen is divided by the total surface area of all exposed specimen faces, as obtained from client CAD models (2.00 m^2 (21.53 ft^2) per baffle x 10 baffles = 20.00 m^2 (215.28 ft^2) total surface area). Apparent Noise Reduction Coefficient (NRC) rating and Sound Absorption Average (SAA) figures are calculated from this data based on the methods described in ASTM C423-17. This method shows the actual absorption occurring at the exposed surfaces, but does not provide a fair comparison with materials mounted as a uniform patch (in A-mount or E-mount).

Method 3) Apparent Sound Absorption Coefficient calculated from one face per baffle.
The total sound absorption yielded by the specimen is divided by the surface area of one side of one large face for each baffle in the specimen (0.58 m^2 (6.20 ft^2) per baffle x 10 baffles = 5.76 m^2 (62.01 ft^2) total surface area). Apparent Noise Reduction Coefficient (NRC) rating and Sound Absorption Average (SAA) figures are calculated from this data based on the methods described in ASTM C423-17. This method is favored by some material manufacturers since it yields very high NRC figures, but does not provide a fair comparison with other ceiling tile or wall panel products. Riverbank Acoustical Laboratories recommends that results obtained from this method be used for research and comparison purposes only; such results should not be used for marketed claims of product performance.

Riverbank Acoustical Laboratories
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Tel: 630-232-0104
Fax: 630-232-0138
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Appendix D: Data Note: See full test report for details of mounting position, spacing and configuration as these parameters greatly affect sound absorption performance.

Specimen Absorption			Method 1	Method 2	Method 3
Freq. (Hz)	Sabins	Sabins / Unit	Apparent Abs. Coefficient From Total Coverage Area	Apparent Abs. Coefficient From Total Exposed Surface Area	Apparent Abs. Coefficient From One Face/Baffle
31.5	-7.39	-0.74	-0.19	-0.03	-0.12
40	11.60	1.16	0.29	0.05	0.19
50	16.86	1.69	0.42	0.08	0.27
63	3.60	0.36	0.09	0.02	0.06
80	10.56	1.06	0.27	0.05	0.17
100	10.99	1.10	0.28	0.05	0.18
125	9.63	0.96	0.24	0.04	0.16
160	6.66	0.67	0.17	0.03	0.11
200	10.89	1.09	0.27	0.05	0.18
250	19.12	1.91	0.48	0.09	0.31
315	23.66	2.37	0.59	0.11	0.38
400	23.82	2.38	0.60	0.11	0.38
500	27.96	2.80	0.70	0.13	0.45
630	30.98	3.10	0.78	0.14	0.50
800	36.19	3.62	0.91	0.17	0.58
1,000	39.62	3.96	0.99	0.18	0.64
1,250	43.81	4.38	1.10	0.20	0.71
1,600	51.86	5.19	1.30	0.24	0.84
2,000	58.21	5.82	1.46	0.27	0.94
2,500	65.53	6.55	1.65	0.30	1.06
3,150	70.02	7.00	1.76	0.33	1.13
4,000	71.55	7.15	1.80	0.33	1.15
5,000	73.59	7.36	1.85	0.34	1.19
6,300	73.07	7.31	1.83	0.34	1.18
8,000	74.45	7.45	1.87	0.35	1.20
10,000	73.03	7.30	1.83	0.34	1.18
12,500	79.50	7.95	2.00	0.37	1.28
		Apparent NRC:	**0.90**	**0.15**	**0.60**
		Apparent SAA:	**0.90**	**0.17**	**0.58**

Prepared by
Malcolm Kelly
Acoustical Test Engineer