

**ETS-LINDGREN
ACOUSTIC RESEARCH LABORATORY
OFFICIAL LABORATORY REPORT
ARL-SA6956 Revision 1**

Subject: Sound Absorption Test

Date: 04 January 2017

Contents: Sound Absorption Data, One-third Octave bands
Sound Absorption Coefficients, One-third Octave bands
Sound Absorption Average (SAA)
Noise Reduction Coefficient (NRC)

on

**3 Dimensional Xorel Artform Panels;
Type A Mounting; Specimen Area in Plan – 5.95 m²**

for

Carnegie

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INTRODUCTION

“The sound absorption coefficient is a property of the material composing the surface. It is ideally defined as the fraction of the randomly incident sound power absorbed by the surface.”

[ASTM C 423]

APPLICABLE STANDARDS

ASTM C 423–09a “Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method”

ASTM E 795–05(2012) “Standard Practices for Mounting Test Specimens during Sound Absorption Tests”

ANSI/ASA S1.11-2014/Part 1 / IEC 61260-1:2014 “Electroacoustics – Octave-band and Fractional-octave-band Filters – Part 1: Specifications”

Note: Revision 1 reflects the correct name/designation of the test specimen. No data was changed from Revision 0. Revision 1 makes NULL and VOID Revision 0 of this test report.

TEST SPECIMEN

The test specimen was one (1) assembly of sound absorptive panels whose dimensions were: 2440 mm in height by 2440 mm in width by 51 mm in height [96 by 96 by 2 inches], providing a surface area in plan of 5.95 m² [64 ft²]. The test specimen was submitted for test, and designated “**3 Dimensional Xorel Artform Panels, Thickness 51mm**” by Carnegie of Rockville Centre, New York.

The components that comprised the assembly are listed below:

- Eight (8) sound absorptive panels each of the dimension 610 mm in width by 1219 mm in length by 51 mm in thickness [24 by 48 by 2 inches]. Each panel consisted of 25.4 mm [1-inch] thick foil-backed Quietcore substrate, square edged, covered by **6423 Strie** fabric, 100% Xorel, that was brought over edges and attached with adhesive to the backside of each panel. Below the surface of fabric on each panel were placed dimensional supports that provided a maximum 25.4 mm [1-inch] height of fabric over the Quietcore substrate at the panels’ center.

The components acclimated to testing conditions for 24+ hours.

The surface area of the specimen was 5.95 square meters [64.0 square feet]. The weight of the test specimen was measured as 18.8 kg [41.5 pounds], giving a weight per unit area of 3.2 kg/m² [0.65 pounds/ft²].

TEST SPECIMEN MOUNTING

The test specimen was tested in a **Type A Mounting** in accordance with ASTM 795-05 (2012) requirements. Edges of the test specimen were flashed with sheet metal secured to the Reverberation room floor using 3M 6969 tape. Metal tape was used to seal the specimen to the top of the sheet metal flashings.

Exhibit 1 shows the test specimen mounted to the Receive Reverberation Chamber. Also observed in this exhibit are components below the surface of the fabric that provided additional depth of the specimen.

DESCRIPTION OF TEST

The decay rate of sound [which is directly related to sound absorption] is measured upon terminating a steady-state broadband pink noise signal in the 408-m³ reverberation chamber. Ten (10) ensemble averages containing twenty (20) decays each are measured with both the test specimen inside of and removed from the chamber. These decays were averaged using a linear averaging algorithm and analyzed using ASTM C423-09a required methods to determine sound absorption present in the reverberation chamber. The difference between these two (2) sound

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absorption tests (with and without the test specimen) at a given frequency is defined as the sound absorption of the specimen. The Sound Absorption Coefficient is the sound absorption per unit area of the test specimen. Sound Absorption Average (**SAA**) is the average of sound absorption coefficients for twelve (12) one-third-octaves with mid-band frequencies from 200 Hz through 2500 Hz inclusive. Noise Reduction Coefficient (**NRC**) is a four-frequency average of the Sound Absorption Coefficient. A rotating microphone boom and a Norsonic 840 Dual Channel Real Time Analyzer, computer controlled using custom software, are used for all measurements. Measurements are made in one-third octaves with mid-band frequencies from 100 Hz to 5000 Hz. The test was conducted in strict accordance with ASTM C423-09a. A reverberation room qualification report for testing to this standard is available on request.

This test took place at **ETS-LINDGREN ACOUSTIC RESEARCH LABORATORY**, Cedar Park, TX, on **16 December 2016**. ETS-Lindgren Acoustic Research Laboratory is 270 m above mean sea level at 30°32' N Latitude, 97°48' W Longitude.



Exhibit 1 – 3 Dimensional Xorel Artform Panels in a Type A Mounting

ENVIRONMENTAL CONDITIONS

Environmental conditions in the reverberation chamber were: 21.7°C, 64.5% relative humidity, and 101.4 kPa atmospheric pressure. Temperature and relative humidity variations remained within strict limits imposed by the laboratory.

Respectfully Submitted,

Michael C. Black
Laboratory Technical Director

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SOUND ABSORPTION DATA

Measured Sound Absorption [in units of area] and Sound Absorption Coefficients of the test specimen are reported in one-third-octaves with mid-band frequencies from 100 to 5000 Hz. These data are provided in the table below and then presented graphically on Page 5 of this report.

**Carnegie – 3 Dimensional Xorel Artform Panels; Panel Thickness 51 mm;
Type A Mounting; Specimen Plan Area – 5.95 m²**

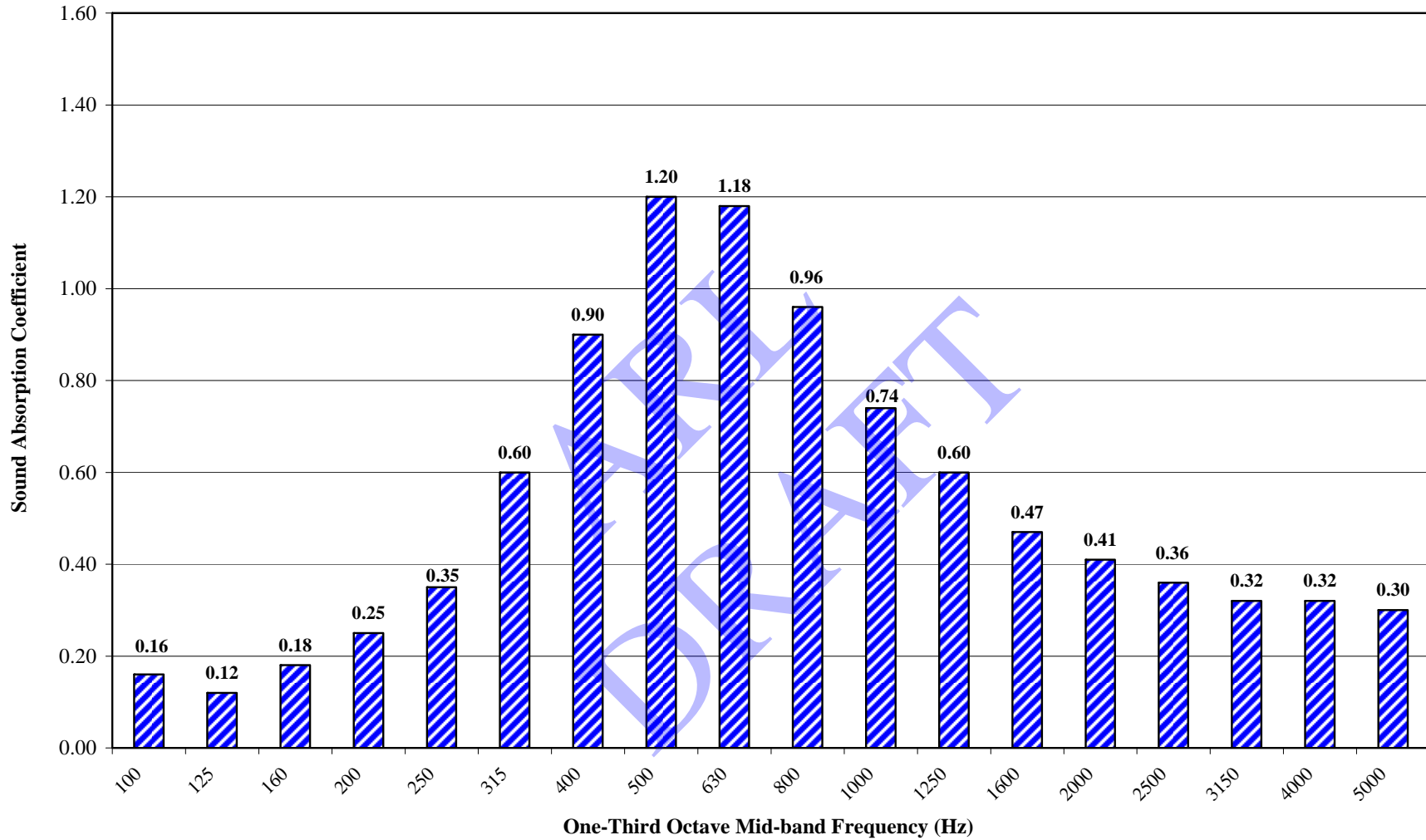
One-third Octave Mid-band Frequencies (Hz)	Sound Absorption (m²)	Notes	Sound Absorption Coefficient	Repeatability* (+/-)	Reproducibility** (+/-)
100	0.98	[a]	0.16	0.15	0.27
125	0.71	[a]	0.12	0.11	0.22
160	1.08		0.18	0.11	0.23
200	1.49		0.25	0.09	0.17
250	2.09		0.35	0.07	0.15
315	3.59		0.60	0.09	0.22
400	5.32		0.90	0.14	0.16
500	7.11		1.20	0.09	0.14
630	7.01		1.18	0.06	0.14
800	5.69		0.96	0.07	0.14
1000	4.39		0.74	0.06	0.12
1250	3.55		0.60	0.05	0.13
1600	2.80		0.47	0.05	0.14
2000	2.44		0.41	0.05	0.13
2500	2.15		0.36	0.06	0.14
3150	1.88		0.32	0.08	0.15
4000	1.89		0.32	0.11	0.16
5000	1.79		0.30	0.15	0.21
Sound Absorption Average (SAA)			0.67	0.02	0.08
Noise Reduction Coefficient (NRC)			0.70	NA	NA

Notes: [a] due to the very low absorption of the specimen tested, actual absorption values cannot be determined within method repeatability values given. The result for this band should be considered inconclusive.

Repeatability** values are those values below which the absolute difference between two (2) single test results in the same laboratory that are obtained with the same method on identical test material under the same conditions in a Type A Mounting. Values are based on Round Robin testing between 16 laboratories. Repeatability values represent the probability of 95% that single tests lay within this absolute range. *Reproducibility** values are those values below which the absolute difference between two (2) single tests results from different laboratories that are obtained with the same method on identical test material in a Type A Mounting. Values are based on Round Robin testing between 16 laboratories. Reproducibility values represent the probability of 95% that single tests between laboratories lay within this absolute range.

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Carnegie 3 Dimensional Xorel Artform Panels; Thickness 51 mm; Type A Mounting;
Specimen Plan Area 5.95 m² ARL-SA6956; SAA 0.67 NRC 0.70



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