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ACOUSTIC RESEARCH LABORATORY

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ACOUSTIC RESEARCH LABORATORY
OFFICIAL LABORATORY REPORT
ARL-SA6986/ARL-SA6987
Revision 0

Subject: **Sound Absorption Test**

Date: 01 February 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

6877 CIRCUIT, Unbacked, 100% XOREL
Type A Mounting, Specimen Plan Area 72 ft^2

for

Carnegie

ARL DRAFT

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1301 Arrow Point Drive • Cedar Park, TX 78613 • Phone: 512-531-6400 • Fax: 512-531-6500
www.ets-lindgren.com • email: acousticlab@ets-lindgren.com

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"

TEST SPECIMEN

The test specimen consisted of a 2743 mm in length by 2438 mm in width *[108 by 96 inches]* fabric application that was manufactured, submitted for test, and designated "**6877 Circuit, Unbacked, 100% XOREL, Type A Mounting**" by Carnegie of Rockville Center, NY. Quoted test specimen weight on a 1473 mm *[58 inches]* wide roll was 0.3 kg/m *[9.8 ounces per linear yard]*.

In order to test the acoustic characteristics of the fabric for a specific application, two (2) separate absorption tests were conducted. As a basis, one (1) layer of Johns Manville Spin-Glas® Board, density 48 kg/m^3 *[3.0 pounds per cubic foot]* was placed on the Reverberation Room floor in a Type A Mount. The dimensions of this specimen's components were 2743 mm in length by 2438 mm in width by 52 mm in depth *[108 by 96 by 2 inches]*. This component served as the underlayment for the fabric application. This underlayment was tested **with** (Test Number ARL-SA6987) and **without** (Test Number ARL-SA6986) the fabric application installed. The plan area for both tests was 6.7 m^2 *[72 ft^2]*.

The weight of the fabric tested was 1.6 kg *[3.5 pounds]*. The overall weight of the fabric application plus underlayment was 17.9 kg *[39.5 pounds]*.

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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 and taped to the Reverberation room floor. Metal tape sealed the top of the flashing to the top of the specimen. Interior joints of the underlayment specimen were not sealed.

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-m^3 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 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. These tests took place at **ETS-LINDGREN ACOUSTIC RESEARCH LABORATORY**, Cedar Park, TX, on 20 January 2017.

SOUND ABSORPTION DATA

Measured Sound Absorption [in units of area] and Sound Absorption Coefficients of the test specimens at the preferred one-third octave mid-band frequencies are provided in the tables below and then presented graphically.

ARL-SA6986

Carnegie – Johns Manville Spin-Glas® Board **WITHOUT** 6877 **CIRCUIT**, Unbacked, 100% XOREL, Specimen Thickness - 2", Specimen Plan Area 72 ft^2 Type A Mounting

One-third Octave Mid-band Frequency (Hz)	Sound Absorption (m^2)	Notes	Sound Absorption Coefficient	Repeatability* (+/-)	Reproducibility** (+/-)
100	1.40		**0.21**	**0.15**	**0.27**
125	1.69		**0.25**	**0.11**	**0.22**
160	3.16		**0.47**	**0.11**	**0.23**
200	4.12		**0.62**	**0.09**	**0.17**
250	4.91		**0.73**	**0.07**	**0.15**
315	6.43		**0.96**	**0.09**	**0.22**
400	7.33		**1.10**	**0.14**	**0.16**
500	7.73		**1.16**	**0.09**	**0.14**
630	7.86		**1.18**	**0.06**	**0.14**
800	7.73		**1.16**	**0.07**	**0.14**
1000	7.36		**1.10**	**0.06**	**0.12**
1250	7.10		**1.06**	**0.05**	**0.13**
1600	6.82		**1.02**	**0.05**	**0.14**
2000	6.82		**1.02**	**0.05**	**0.13**
2500	6.81		**1.02**	**0.06**	**0.14**
3150	6.54		**0.98**	**0.08**	**0.15**
4000	6.63		**0.99**	**0.11**	**0.16**
5000	6.74		**1.01**	**0.15**	**0.21**
Sound Absorption Average (SAA)			**1.01**	**0.03**	**0.08**
Noise Reduction Coefficient (NRC)			**1.00**	***NA***	***NA***

Notes: [a] due to the very low absorption of the specimen tested, actual absorption values cannot be determined within 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 test 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.

During the test ARL-SA6986, environmental conditions in the reverberation chamber were 22.2C, 64.8% relative humidity, and 100.8 kPa barometric pressure. Temperature and relative humidity conditions remained within strict limits imposed by the laboratory.

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ARL-SA6987

Carnegie – Johns Manville Spin-Glas® Board **WITH** 6877 **CIRCUIT**, Unbacked, 100% XOREL, Specimen Thickness - 2", Specimen Plan Area 72 ft^2 Type A Mounting

One-third Octave Mid-band Frequency (Hz)	Sound Absorption (m^2)	Notes	Sound Absorption Coefficient	Repeatability* (+/-)	Reproducibility** (+/-)
100	1.65		**0.25**	**0.15**	**0.27**
125	1.97		**0.29**	**0.11**	**0.22**
160	3.71		**0.55**	**0.11**	**0.23**
200	4.82		**0.72**	**0.09**	**0.17**
250	5.70		**0.85**	**0.07**	**0.15**
315	7.17		**1.07**	**0.09**	**0.22**
400	7.82		**1.17**	**0.14**	**0.16**
500	8.15		**1.22**	**0.09**	**0.14**
630	8.00		**1.20**	**0.06**	**0.14**
800	7.76		**1.16**	**0.07**	**0.14**
1000	7.37		**1.10**	**0.06**	**0.12**
1250	6.99		**1.05**	**0.05**	**0.13**
1600	6.76		**1.01**	**0.05**	**0.14**
2000	6.58		**0.98**	**0.05**	**0.13**
2500	6.57		**0.98**	**0.06**	**0.14**
3150	6.34		**0.95**	**0.08**	**0.15**
4000	6.21		**0.93**	**0.11**	**0.16**
5000	6.21		**0.93**	**0.15**	**0.21**
Sound Absorption Average (SAA)			**1.04**	**0.03**	**0.08**
Noise Reduction Coefficient (NRC)			**1.05**	***NA***	***NA***

Notes: [a] due to the very low absorption of the specimen tested, actual absorption values cannot be determined within 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 test 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.

During the test ARL-SA6987, environmental conditions in the reverberation chamber were 22.0C, 65.5% relative humidity, and 100.9 kPa barometric pressure. Temperature and relative humidity conditions remained within strict limits imposed by the laboratory.

Respectfully Submitted,

Michael C. Black
Laboratory Technical Director

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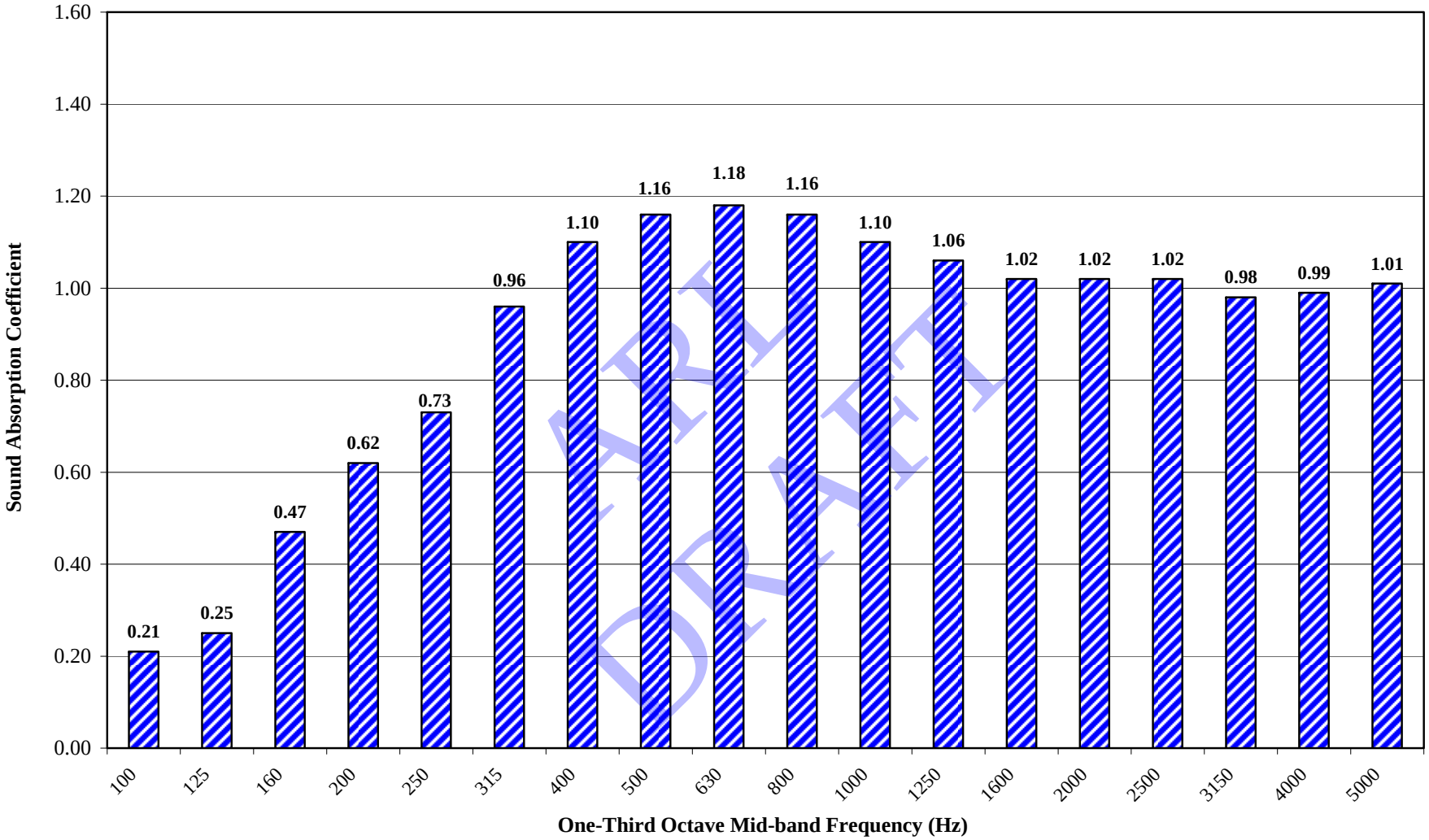
Carnegie Johns Mansville Equipment Spin-Glas® Board, 3 pcf, Thickness 2", 72 ft^2, Type A Mounting
ARL-SA6986; SAA 1.01 NRC 1.00



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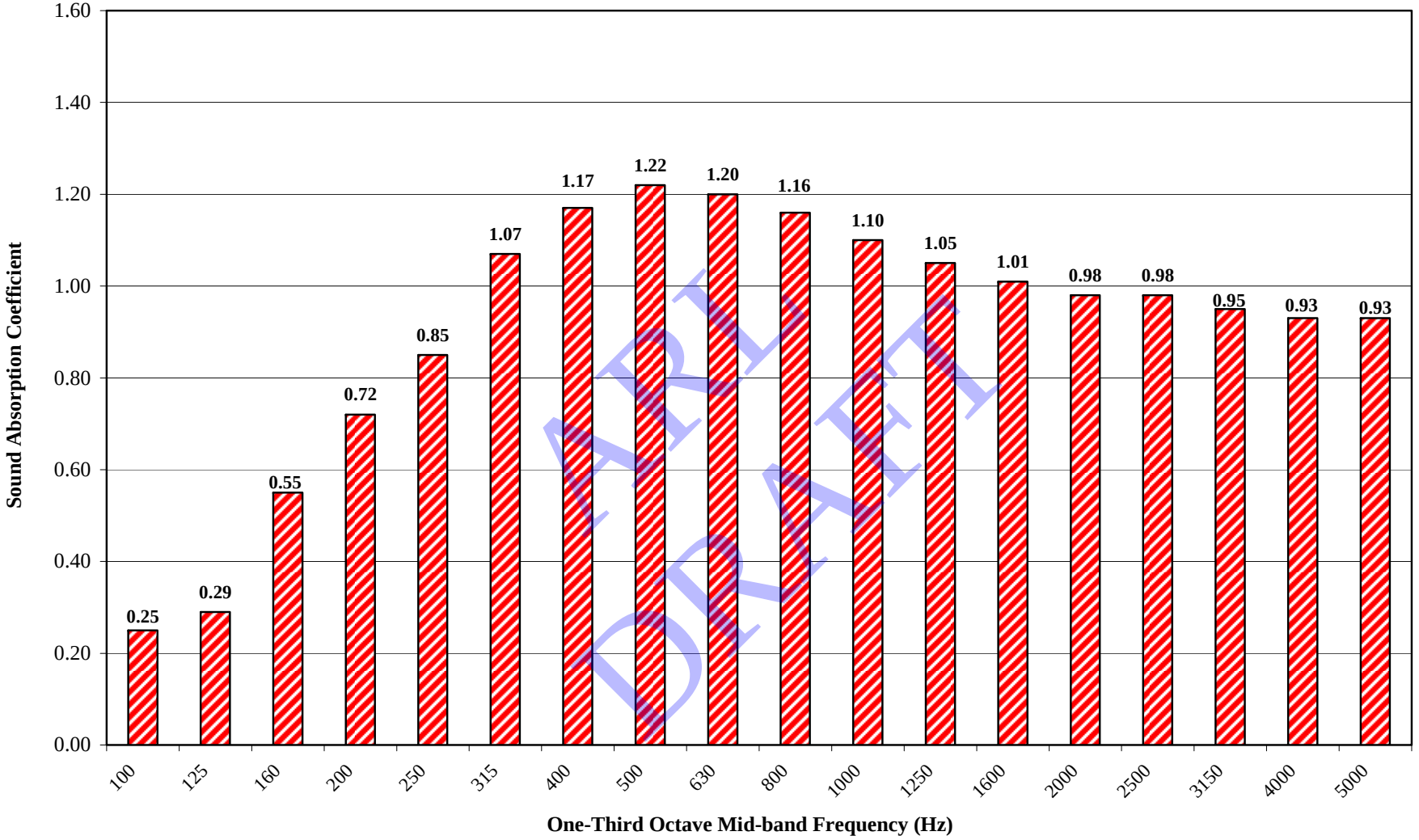
Carnegie Johns Mansville Equipment Spin-Glas® Board WITH 6877 CIRCUIT, Unbacked, 100% Xorel
Specimen Thickness 2", Type A Mounting ***ARL-SA6987; SAA 1.04 NRC 1.05***



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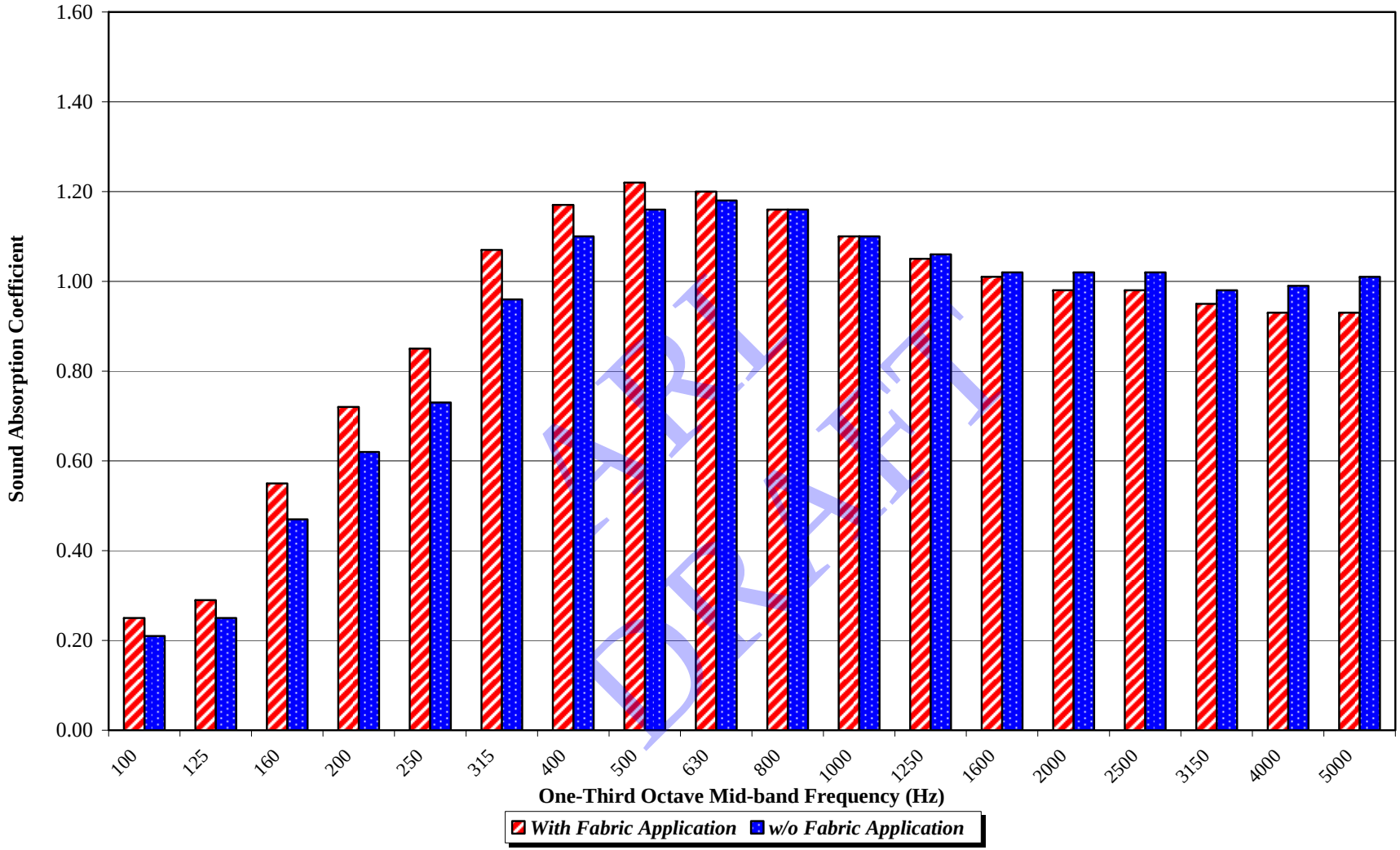
Carnegie Johns Mansville Equipment Spin-Glas® Board WITH (ARL-SA6997) and WITHOUT (ARL-SA6986)
6877 CIRCUIT, Unbacked, 100% Xorel, Specimen Thickness 2", Type A Mounting



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