NRC·CNRC CONSTRUCTION

Sound Absorption Measurements of AccuForm Roofing Steel Deck

Author: Pascal Beaulieu
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Contract Number: A-0046015
Agreement Date: 12/16/2022

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Overview of Tested Materials

Specimen ID	Short Description	SAA	NRC
A1-021792-02A	• Roofing Steel Deck 96” X 26” X 3” Flutes • Fiberglass Insulation 3”, Female flutes only • Polyethylene Vapour Barrier 6mil • EPS insulation 4’ X 4’ X 3.5” • EPS Insulation 4’ X 4’ X 3.5” • Mounting frame, ASTM E795-16 Type A	0.79	0.80

Client	ACCUFORM METAL LTD.
	37055 Range Road 17-3
	Steller, AB T0C2L0
Specimen	AccuForm Steel deck roof 3”
Specimen ID	A1-021792-02A

Specimen Description

The specimen consisted of a corrugated steel deck with 76 mm (3”) flutes, Fiberglass insulation, a 0.15 mm (.006”) polyethylene vapour barrier and two layers of 89 mm (3.5”) EPS insulation. The corrugated steel deck was provided by the client, all other components were sourced by NRC. The test frame was built by NRC.

Element	Actual thickness (mm)	Mass/length, area or volume
Corrugated steel deck 3”	76	11.7 kg/m^2
Fiberglass Insulation	*76	0.4 kg/m^2
Vapour barrier 6mil	0.1	0.1 kg/m^2
EPS insulation	89	1.9 kg/m^2
EPS insulation	89	1.9 kg/m^2
Total	**254.1**	

* The thickness of this element does not contribute to the total specimen thickness.

Test Specimen Installation

The specimen was assembled in the mounting frame according to the ASTM standard E795-23 Type A (Figure 1). The empty test frame measured 2476 x 2781 mm, with an area of 6.87 m² and 251.1 mm depth. The test specimen comprised of full size and trimmed EPS insulation in order to fill the internal frame area. Two layers of EPS insulation were laid on the test surface in a staggered layout (figure 2a). The polyethylene vapour barrier was laid on top of the insulation (figure 2b). Fiberglass insulation was installed within the female flutes of the corrugated steel deck (figure 3a). The corrugated steel deck was laid on top of the vapour barrier with the underside exposed (figure 3b). The final exposed surface area for the test was 2438 x 2743 mm, with an area of 6.68m². The final assembled test specimen is shown in Figure 4.

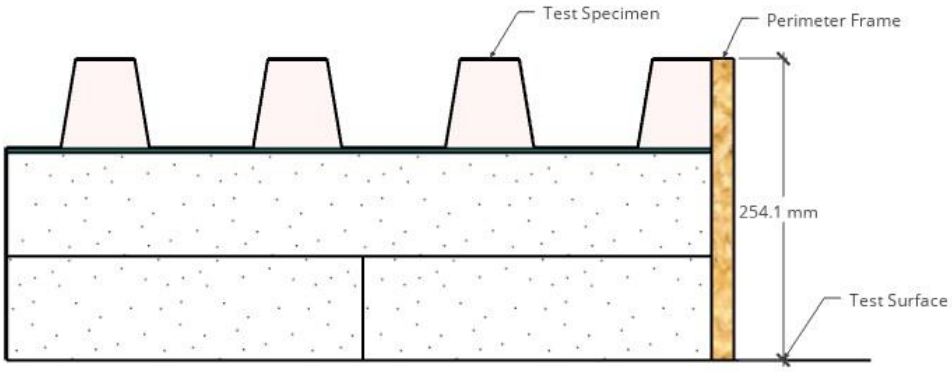


Figure 1: Specimen representation

(a) (b)

Figure 2. Preparation of the test specimen at M27 Acoustics laboratory at NRC – Rigid Insulation Layout

(a) (b)

Figure 3. Preparation of the test specimen at M27 Acoustics laboratory at NRC – Steel deck Layout.

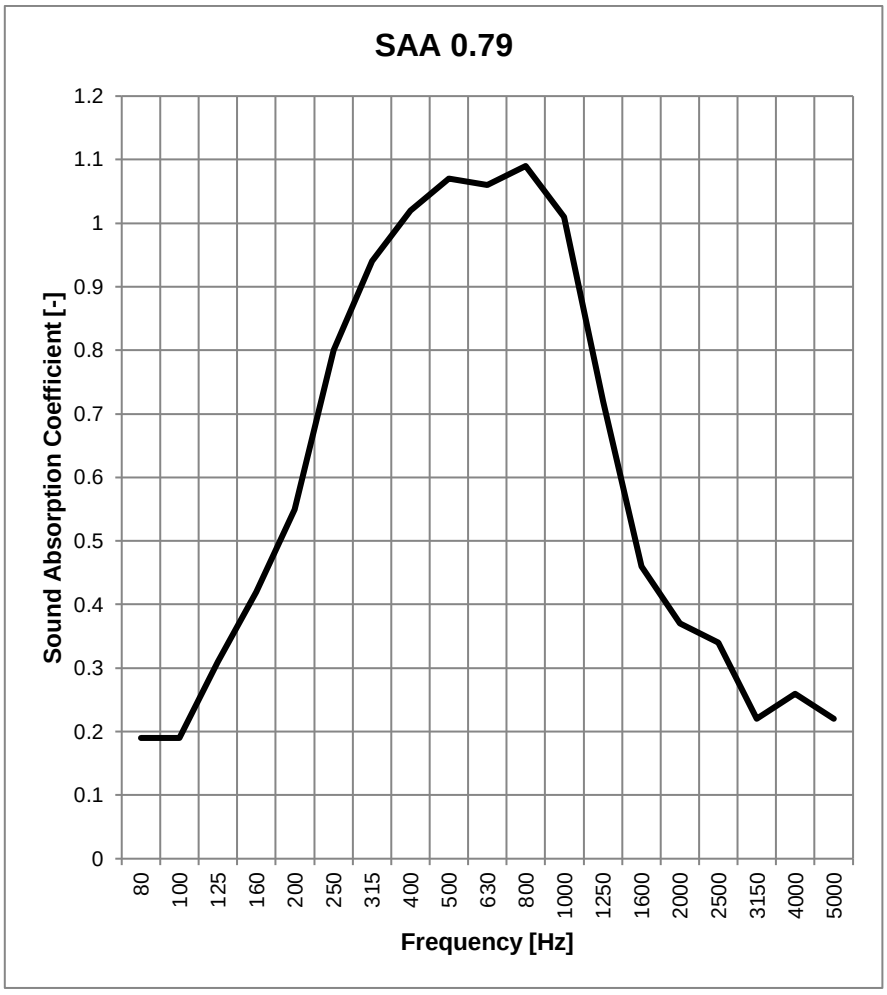
Figure 4. Assembled test specimen at M27 Acoustics laboratory at NRC. The exposed area was 6.68 m^2.

ASTM C423 Test Results – Sound Absorption

Client: Accuform Metal Ltd.
Specimen ID: A1-021792-02A
Test ID: ABA-23-001
Date of Test: 09 March 2023

Specimen Area (m^2)	Room Volume (m^3)	Temperature (°C)	Humidity (%)	Atmospheric Pressure (kPa)
6.68	251.7	20.9 to 21.5	48.9 to 51.1	101.5

Frequency [Hz]	Sound Absorption Coefficient [-]
80	0.19
100	0.19
125	0.31
160	0.42
200	0.55
250	0.80
315	0.94
400	1.02
500	1.07
630	1.06
800	1.09
1000	1.01
1250	0.72
1600	0.46
2000	0.37
2500	0.34
3150	0.22
4000	0.26
5000	0.22
SAA	**0.79**
NRC	**0.80**



In the graph: The solid line is the measured sound absorption coefficient calculated for this specimen according to ASTM C423-22.
In the table: SAA is the Sound Absorption Average, and NRC is the Noise Reduction Coefficient, as defined in ASTM C423-22.

The sound absorption measurements were conducted in accordance with the requirements of ASTM C423-22, “Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.”

The results in this report apply only to the specimen that was tested. NRC does not represent that the results in this report apply to any other specimen.

APPENDIX – ASTM C423-22 – Sound Absorption Measurement

Facility and Equipment: The NRC Construction large reverberation room used for the sound absorption testing has an approximate volume of 250 m^3 and an approximate surface area of 245 m^2. The walls, floor and ceiling are made of 300 mm thick reinforced concrete. The room is mounted on springs to provide vibration isolation. The room has a 2230 mm x 1300 mm steel door on the east wall and a 3770 mm x 2540 mm steel sliding door on the north wall. The room has four loudspeakers driven by separate amplifiers and signal generators controlled by a computer. The four loudspeaker systems are mounted at four corners facing into the trihedral corners of the room. To increase the diffusivity of the sound field, the reverberation room includes nine fixed diffusers and four rotating diffusers. The diffusers are melamine panels 2.44 m long x 1.22 m wide x 16 mm thick. The rotating diffusers are installed in the middle of the reverberation room. The fixed diffusers are placed against the four walls, with two diffusers for the north, south and west walls and three diffusers for the east wall.

Test Procedure: The sound absorption measurements were conducted in accordance with the requirements of ASTM C423-22, "Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method". Measurements of the decay rate are made on eight different positions using eight calibrated Brüel & Kjær type 4942 microphones with preamplifier. The mean reverberation times of the empty room are obtained by averaging the measurements of ten decays at each of the eight microphone positions. Similarly, the mean reverberation times are obtained with the specimen in the chamber, at eight microphone positions. The mean reverberation times are then used to calculate the absorption of the test specimens in each one-third octave band.

Specimen Mounting: The mounting conditions for the sound absorption testing conform to the standards ASTM C423-22 and ASTM E795-23 "Standard Practices for Mounting Test Specimens during Sound Absorption Tests." The mounting conditions used in the measurements are described in the specimen description for each specimen.

Interpretation of Results: The sound absorption for a specimen is measured in square meters. "1 m^2 of absorption" may be thought of as one square meter of perfect absorber. Sound absorption coefficients are derived by dividing the sound absorption of the specimen at each frequency by its total surface area. Diffraction effects usually cause the effective area of a specimen to be greater than its geometrical area, thereby increasing the measured absorption coefficient. When the coefficients are large, the measured values may exceed unity, but no adjustments to the measured coefficients are made.

Sound Absorption Average (SAA) and Noise Reduction Coefficient (NRC): The SAA and the NRC values are single-number ratings that are calculated from measured sound absorption coefficients as specified in ASTM C423-22. SAA is the average of the sound absorption coefficients of a material for the one-third octave bands from 200 Hz through 2500 Hz, inclusive, rounded to the nearest multiple of 0.01. NRC is the average of the sound absorption coefficients of a material for 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz, rounded to the nearest multiple of 0.05. The higher the SAA or the NRC value, the greater is the average sound absorption.