

TEST REPORT

Intertek

REPORT NUMBER: 101113787COQ-005
ORIGINAL ISSUE DATE: June 18, 2013

EVALUATION CENTER

INTERTEK TESTING SERVICES NA LTD.
1500 BRIGANTINE DRIVE
COQUITLAM, BC V3K 7C1

RENDERED TO

CEMENT BOARD FABRICATORS, INC.
2148 S. 41ST STREET
LOUISVILLE, KY 40211

PRODUCT EVALUATED: Silbonit™ Fiber-Cement Flat Sheets
EVALUATION PROPERTY: Physical Testing

**Report of Silbonit™ Fiber-Cement Flat Sheets for the selected requirements of
ASTM C1186-08 (Reapproved 2012), Standard Specification for Flat Fiber-
Cement Sheets**

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2 Introduction

Intertek Testing Services NA Ltd. (Intertek) has conducted physical testing on a fiber-cement panel product for Cement Board Fabricators, Inc. The testing was carried out in accordance with ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*. This evaluation was completed during the months of April to June 2013.

3 Test Samples

3.1. SAMPLE SELECTION

The client submitted the fiber-cement panels to the Evaluation Center on April 8, 2013 (Coquitlam ID# VAN1304081354-001). Samples were not independently selected for testing.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The product was identified as the Silbonit™ Fiber-Cement Flat Sheets, a fiber-reinforced panel product measuring 4 ft. x 8 ft. x 5/16 in. thick and weighing 3 lbs/ft².

4 Testing and Evaluation Methods

4.1. CONDITIONING

Unless otherwise stated, the sample materials were maintained in standard laboratory conditions for a minimum of 7 days at a temperature of 73 ± 4°F (23 ± 2°C) and relative humidity of 50 ± 5%.

Samples tested in the wet condition were immersed in water at 73 ± 7°F (23 ± 4°C) for a period of 48 hours minimum and tested immediately upon removal from the water as per ASTM C1185-08 (2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*.

4.2. DIMENSIONAL TOLERANCE

The dimensional tolerance was evaluated in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). Five (5) panels were measured for length, width, thickness, squareness, and edge straightness.

4.3. DENSITY

Density was determined in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012) using the water displacement method. Each specimen was weighed under water after being immersed for 48 hours. The saturated weight in air was then measured and the dry mass was obtained by drying each specimen to constant weight in an oven at 194 ± 4°F (90 ± 2°C). The density was calculated as follows:

$$D = [W / (B-S)] \times \rho_w$$

Where: D = Density, lb/ft³ (kg/m³)
W = Dry weight of specimen, lb (kg)
B = Saturated weight, lb (kg)
S = Suspended weight, lb (kg)
 ρ_w = Density of water lb/ft³ (kg/m³)

4.4. FLEXURAL STRENGTH

Flexural strength was evaluated in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). Five (5) specimens in both the machine and cross direction were prepared for testing. Sample dimensions measured 12 in. (305 mm) in length and 5 in. (127 mm) in width. The specimens were simply supported over a span of 10 in. (254 mm) and loaded at a rate to achieve failure within 5 and 30 seconds. Specimens were tested both in the dry and wet condition. The flexural strength was calculated as follows:

$$S = 3PL / 2bd^2$$

Where: S = Flexural strength, psi (MPa)
P = Maximum load, lbf (N)
L = Length of span, in. (mm)
b = Width of specimen, in. (mm)
d = Thickness of specimen, in. (mm)

4.5. MOISTURE MOVEMENT

Moisture movement was conducted in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). Five (5) specimens in both the machine and cross direction were prepared for testing. Sample dimensions measured 3 in. (76 mm) wide x 12 in. (305 mm) long. The specimens were conditioned to practical equilibrium at a temperature of 73 ± 4°F (23 ± 2°C) and relative humidity of 30 ± 2%. After conditioning, each specimen was measured for length to the nearest 0.001 in. (0.02 mm). The specimens were further conditioned to practical equilibrium at a temperature of 73 ± 6°F (23 ± 3°C) and relative humidity of 90 ± 5%. Each specimen was once again measured and recorded. These values were used to calculate the moisture movement as follows:

$$L = [(l_{90} - l_{30}) / l_{30}] \times 100$$

Where: L = linear change, %
l₉₀ = length of specimen at RH of 90%, in. (mm)
l₃₀ = length of specimen at RH of 30%, in. (mm)

4.6. WATER ABSORPTION

Water absorption was conducted in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). Five (5) specimens, measuring 4 in. (102 mm) x 4 in. (102 mm), were dried to constant weight in an oven at 194 ± 4°F (90 ± 2°C). After drying, the specimens were cooled in a desiccator and weighed to the nearest 0.001 g. The specimens were then immersed in distilled water at 73 ± 4°F (23 ± 2°C) for 48 ± 8 hours. At the end of this period, each specimen was carefully blotted dry, and then weighed again. The water absorption was calculated as follows:

$$A = (W_S - W_D) / W_D \times 100$$

Where: W_D = dry weight of specimen, lb (g)
W_S = saturated weight of specimen, lb (g)
A = water absorption, %

4.7. MOISTURE CONTENT

Moisture content was determined in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012), on material conditioned at 73 ± 4°F (23 ± 2°C) and relative humidity of 50 ± 5%. After equilibrium conditioning, the specimens were weighed to an accuracy of 0.5%. They were then dried to constant weight in an oven operating at 194 ± 4°F (90 ± 2°C). After drying, the specimens were cooled in a desiccator and weighed to the nearest 0.5% of the total weight. The moisture content was calculated as follows:

$$M = 100 \times [(W - F) / F]$$

Where

M	=	Moisture content, %
W	=	Initial weight of specimen, lb (kg)
F	=	Final weight of specimen, lb (kg)

4.8. WATER TIGHTNESS

Water tightness was tested in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). Three (3) specimens, measuring 20 in. (508 mm) x 24 in. (610 mm), were prepared for testing. The samples were sealed around the perimeter with a waterproof frame and then filled with water to a height of 2 in. (50 mm) above the strip. The prepared specimens were maintained at a temperature of $73 \pm 4^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and relative humidity of $50 \pm 5\%$. After 24 hours of exposure, the specimens were visually examined for any formation of liquid water on the underside of the sheet.

4.9. SURFACE BURNING CHARACTERISTICS

Surface burning characteristics was conducted in accordance with ASTM C1186-08 (2012) with reference to ASTM E84-12c, *Standard Test Method for Surface Burning Characteristics of Materials*. Testing was conducted in Intertek Report 101113787COQ-002, dated April 23, 2013.

4.10. FREEZE/THAW RESISTANCE

Freeze/thaw resistance was conducted in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). A minimum of five (5) specimens in both the machine and cross direction, each measuring 12 in. (305 mm) in length and 5 in. (127 mm) in width, were prepared for testing. The material was initially immersed in water at a temperature of 41°F (5°C) for a minimum of 48 hours. The specimens were then packaged individually into 8 mils (0.2 mm) plastic bags and subjected to 50 cycles of the following:

- Cooling to $-4 \pm 4^\circ\text{F}$ ($-20 \pm 2^\circ\text{C}$) during a time of between 1 and 2 hours, then holding at this temperature for 1 hour.
- Thawing to $68 \pm 4^\circ\text{F}$ ($20 \pm 2^\circ\text{C}$) during a time of between 1 and 2 hours, then holding at this temperature for 1 hour.

During weekends and holidays, the freeze/thaw process was suspended by holding the specimens in standard laboratory conditions. At the completion of 50 cycles, a visual examination was performed to check for signs of cracking, delamination, or other physical changes. Prepared specimens of the examined material were later subjected to flexural testing.

4.11. WARM WATER RESISTANCE

Warm water resistance was tested in accordance with ASTM C1186-08 (2012) with reference to ASTM C1185-08 (2012). Five (5) specimens in both the machine and cross direction, each measuring 12 in. (305 mm) in length and 5 in. (127 mm) in width, were prepared for testing. The material was immersed in water with an excess of lime at a temperature of $140 \pm 4^\circ\text{F}$ ($60 \pm 2^\circ\text{C}$) for duration of 56 ± 2 days. After conditioning, a visual examination was performed to check for signs of cracking, delamination, or other physical changes. Prepared specimens of the examined material were later subjected to flexural testing.

4.12. HEAT/RAIN RESISTANCE

Heat/rain resistance was tested in accordance with ASTM C1186-08 (2012) with reference to

ASTM C1185-08 (2012). One test deck, measuring 8 ft. x 8 ft., was constructed using SPF grade 2, nominal 2 in. x 6 in. studs spaced at 16 in. on center. 1/2 in. plywood sheathing was applied to the test panel with fasteners spaced 6 in. on the perimeter and 12 in. in-field. Both framing members and sheathing were fastened using 2-1/2 in. coil nails. A layer of breathable waterproof membrane (supplied by the client) was fastened to the sheathing using staples spaced 12 in. on center. Plywood furring strips, measuring 1-1/2 in. x 3/4 in., were installed to the test deck at the vertical stud locations. The supplied EPDM rubber strips were then fastened to the furring strips. The Silbonit™ panels were installed vertically over the EPDM rubber strips using the supplied stainless steel 1-1/2 in. long screws spaced every 24 in. o/c along the studs. A 5/16 in. gap was left between sheets. Refer to Appendix B for installation details. The test specimen was vertically erected in an environmental test chamber and subjected to 25 cycles consisting of the following:

- Water spray at a rate of 1 gal/min for a duration of 2 h 55 min; water temperature not to exceed 86°F (30°C);
- Pause for a duration of 5 minute;
- Heat to give a measurement plate temperature of 140 ± 9°F (60 ± 5°C) for a duration of 2 h 55 minutes;
- Pause for a duration of 5 minute;

On completion, the material was examined for any evidence of physical or structural alterations.

5 Testing and Evaluation Results

The test results for Cement Board Fabricators, Inc. fiber-cement panels together with the applicable requirements of ASTM C1186-08 (2012) are shown in Table 1 below. A copy of the data sheets can be found in the Appendices.


Table 1. Test Results			
Property	Test Result	Requirement	Pass/Fail
Dimensional Tolerances			
▪ Length, in.	0.10	± 0.25	Pass
▪ Width, in.	0.05	± 0.25	Pass
▪ Thickness Variation			
▪ Between Sheets, in.	0.01	± 0.04	Pass
▪ Within Sheet, %	1.2	≤ 15	Pass
▪ Squareness, in.	0	± 0.125	Pass
▪ Edge straightness, in.	0	± 0.125	Pass
Density, lb/ft ³	99.2	As Reported	As Reported
Flexural Strength, psi			
▪ Dry	4773	≥ 3190 ¹	Pass
▪ Wet	3437	≥ 2610 ¹	Pass
Moisture Movement, %			
▪ Machine direction	0.02	As Reported	As Reported
▪ Cross Direction	0.02	As Reported	As Reported
Water Absorption, %	22.3	As Reported	As Reported
Moisture Content, %	9.2	As Reported	As Reported
Water Tightness	No formation of water drops	No formation of water drops	Pass
Surface Burning Characteristics			
▪ Flame Spread Index	0	0	Pass
▪ Smoke Developed Index	0	≤ 5	Pass
Freeze/Thaw Resistance			
▪ Strength Retention, %	103	≥ 80	Pass
▪ Observation	No deleterious effects	No deleterious effects	Pass
Warm Water Resistance			
▪ Strength Retention, %	107	As Reported	As Reported
▪ Observation	No deleterious effects	No deleterious effects	Pass
Heat Rain Resistance	No cracks or structural alteration	No cracks or structural alteration	Pass


Note ¹ – Grade IV requirements taken from Table 1 – “Flexural Strength Requirements” of ASTM C1186-08(2012)

6 Conclusion

The Cement Board Fabricators, Inc. Silbonit™ Fiber-Cement Flat Sheets product identified and evaluated in this report has met the requirements of ASTM C1186-08 (2012), *Standard Specification for Flat Fiber-Cement Sheets*. The product test results are presented in Section 5 of this report.

INTERTEK TESTING SERVICES NA LTD.

Reported by: 
Chris Chang, EIT
Engineer, Building Products

Reviewed by: 
Baldeep Sandhu
Technologist, Building Products

APPENDIX A: Test Data (13 pages)



Company	Cement Board Fabricators, Inc.	Technician(s)	Chris Chang <i>CC</i>
Project No.	G101113787	Reviewer	Baldeep Sandhu <i>BS</i>
Models	Silbonit™ Fiber-Cement Flat Sheets	Start/End Date	April 18 - June 18, 2013
Product Name	Same as above	Sample ID	VAN1304081354-001
Standard	ASTM C1186-08 (Reapproved 2012), Standard Specification for Flat Fiber-Cement Sheets		
	ASTM C1185-08 (Reapproved 2012), Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards		

Test Data Package

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Test: **Dimensional Tolerance** Project No: G101113787
 Date: 17-Apr-13 Eng/Tech: Chris Chang
 Client: Cement Board Fabricators, Inc. Reviewer: Baldeep Sandhu
 Product: **Silbonit Fiber-Cement Flat Sheets**
 Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
 Conditioning: Minimum 7 days at a temperature of 23 ± 2° C and relative humidity of 50 ± 5%
 Equipment: Mitutoyo Digital 8 in. Calipers (Intertek ID# P60005, cal due May 2013)
 25 ft. Measuring Tape (Intertek ID# P60494, cal due August 2013)
 T&D Thermorecorder Temperature and Humidity Indicator (Intertek ID# P60554, cal due August 2013)
 Time/Temp/RH: 9:00AM / 22.9° C / 51.0%

Nominal Dimensions: Length: 96 in. 2438.4 mm
 Width: 48 in. 1219.2 mm
 Thickness: 5/16 in. 7.9375 mm

Panel	Squareness - X Direction 1 (mm)	Squareness - X Direction 2 (mm)	Edge Straightness (mm)
1	2728.00	2728.00	0
2	2728.00	2728.00	0
3	2728.00	2728.00	0
4	2728.00	2728.00	0
5	2728.00	2728.00	0
Mean:	2728.00	2728.00	0.00
StdDev:	0.00	0.00	0.00
COV:	0.0%	0.0%	0.0%

Panel	Length (mm)			
	1	2	3	Average
1	2441.00	2441.00	2441.00	2441.00
2	2441.00	2441.00	2441.00	2441.00
3	2442.00	2441.00	2441.00	2441.33
4	2440.00	2441.00	2441.00	2440.67
5	2440.00	2441.00	2441.00	2440.67
Mean:	2440.93			
StdDev:	0.28			
COV:	0.0%			

Panel	Width (mm)			
	1	2	3	Average
1	1220.00	1220.00	1220.00	1220.00
2	1222.00	1221.00	1221.00	1221.33
3	1221.00	1220.00	1221.00	1220.67
4	1220.00	1220.00	1220.00	1220.00
5	1220.00	1220.00	1220.00	1220.00
Mean:	1220.40			
StdDev:	0.60			
COV:	0.0%			

Panel	Thickness (mm)					Variation Within Sheet (%)
	1	2	3	4	Average	
1	8.18	8.09	8.19	8.11	8.14	1%
2	8.02	8.06	8.04	8.08	8.05	1%
3	8.07	7.99	8.05	7.99	8.03	1%
4	8.18	8.19	8.09	8.11	8.14	1%
5	7.99	7.99	7.96	7.99	7.98	0%
Mean:	8.07					
StdDev:	0.07					
COV:	0.9%					

Dimension	(mm)	(in)
Length Tolerance from Nominal	2.53	0.10
Width Tolerance from Nominal	1.20	0.05
Thickness Variation between Sheets	0.16	0.01
Max. Thickness Variation within Sheet	1.2%	
Squareness Tolerance	0.00	0.00
Edge Straightness	0.00	0.00



Test: **Density**
 Date: 3-May-13
 Client: Cement Board Fabricators, Inc.
 Product: **Silbonit Fiber-Cement Flat Sheets**
 Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
 Conditioning: Saturation - Immersed in water at 68 ± 2°F (20 ± 1°C) for 48 h minimum
 Drying - Dried in ventilated oven at 194 ± 4°F (90 ± 2°C) until equilibrium
 Equipment: Setra Scale 2000g (Intertek ID# P52606, cal due February 2014)
 Temperature controlled oven (Intertek ID# 9-0477)
 Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
 Time/Temp/RH: 1:20PM / 23.0°C / 51.0%

Project No: G101113787
 Eng/Tech: Chris Chang
 Reviewer: Baldeep Sandhu *BSS*

Sample	Oven-dry weight after 24 hours (g)	Oven-dry weight after 26 hours (g)	Increment of Loss ¹ (% by mass)	Suspended weight (g)	Saturated weight in air (g)	Calculated Volume (cm ³)	Density	
							(kg/m ³)	(lb/ft ³)
1	489.03	488.85	0.0	292.20	598.89	306.69	1594	99.51
2	493.99	493.70	0.1	281.40	593.63	312.23	1581	98.71
3	490.81	490.66	0.0	285.86	593.75	307.90	1594	99.48
4	491.62	491.34	0.1	277.81	588.07	310.27	1584	98.86
5	490.31	490.06	0.1	292.15	599.41	307.26	1595	99.57
Mean:							1589	99.2
StdDev:							6.50	0.41
COV:							0.4%	0.4%

¹ Not to exceed 0.1 %



Test: **Flexural Strength - Dry**

Date: 24-Apr-13

Client: Cement Board Fabricators, Inc.

Product: **Silbonit Fiber-Cement Flat Sheets**

Test Methods: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*

Conditioning: Minimum 7 days at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%

Load Rate: 0.5 in./min

Support Span: 10 in. 254 mm

Specimen: 5 in. x 12 in.

Equipment: T&D Thermorecorder Temperature and Humidity Indicator (Intertek ID# P60554, cal due August 2013)

Mitutoyo Digital 8 in. Calipers (Intertek ID# 52650, cal due May 2013)

Instron 3382 (Intertek ID# P60553, cal due July 2013)

Time/Temp/RH: 12:40PM / 23.8°C / 51.0%

Project No: G101113787

Eng/Tech: Chris Chang

Reviewer: Baldeep Sandhu 

Machine Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
1	127.14	126.94	126.96	8.08	8.13	8.12	836.2	38.14	5531
2	126.93	126.76	126.87	8.21	8.20	8.17	829.7	37.12	5384
3	126.98	126.85	126.84	8.10	8.09	8.06	807.2	37.09	5380
4	127.03	126.95	126.82	8.09	8.12	8.13	807.7	36.83	5342
5	126.90	126.97	127.24	8.18	8.20	8.20	876.5	39.16	5679
							Mean	37.67	5463
							StdDev:	0.97	141
							COV:	2.6%	2.6%

Cross Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
6	128.31	128.18	128.10	8.02	7.92	7.95	547.0	25.63	3718
7	128.07	128.28	128.13	8.00	7.92	7.97	633.3	29.69	4306
8	127.52	128.17	128.04	7.99	7.93	7.97	610.9	28.70	4162
9	127.61	127.44	127.31	8.02	8.06	8.13	637.6	29.27	4245
10	128.22	128.29	128.32	7.97	7.90	8.02	586.7	27.48	3986
							Mean	28.15	4083
							StdDev:	1.63	237
							COV:	5.8%	5.8%

Average

Flexural Strength	
(Mpa)	(psi)
32.91	4773



Test: **Flexural Strength - Wet**

Date: 3-May-13

Client: Cement Board Fabricators, Inc.

Product: **Silbonit Fiber-Cement Flat Sheets**

Test Methods: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*

Conditioning: Minimum 7 days at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 48 hour minimum saturation

Load Rate: 0.5 in./min

Support Span: 10 in. 254 mm

Specimen: 5 in. x 12 in.

Equipment: T&D Thermorecorder Temperature and Humidity Indicator (Intertek ID# P60554, cal due August 2013)
 Mitutoyo Digital 8 in. Calipers (Intertek ID# 52650, cal due May 2013)
 Instron 3382 (Intertek ID# P60553, cal due July 2013)

Time/Temp/RH: 12:40PM / 23.8°C / 51.0%

Project No: G101113787

Eng/Tech: Chris Chang

Reviewer: Baldeep Sandhu 

Machine Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
1	126.76	126.86	127.03	8.08	8.08	8.09	595.0	27.34	3966
2	126.78	126.59	126.74	8.06	8.05	8.06	593.3	27.49	3987
3	126.81	126.82	126.83	8.06	7.99	7.99	591.3	27.66	4012
4	126.67	126.70	127.08	7.87	7.90	7.93	617.3	29.71	4310
5	126.88	126.74	126.69	7.91	7.91	7.90	553.2	26.60	3857
							Mean:	27.76	4026
							StdDev:	1.17	169
							COV:	4.2%	4.2%

Cross Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
6	127.46	127.20	127.55	7.99	7.99	8.07	441.9	20.56	2983
7	128.31	128.32	128.45	8.03	7.95	8.03	370.9	17.19	2493
8	127.59	127.49	127.40	8.02	8.06	8.14	409.5	18.78	2723
9	128.31	128.20	128.32	8.02	7.94	7.98	428.5	19.98	2898
10	127.52	127.60	127.71	8.02	7.99	7.99	464.4	21.66	3142
							Mean:	19.63	2848
							StdDev:	1.72	249
							COV:	8.8%	8.8%

Average

Flexural Strength	
(Mpa)	(psi)
23.70	3437



Test: **Moisture Movement - Machine Direction**
 Date: 15-May-13
 Client: Cement Board Fabricators, Inc.
 Product: **Silbonit Fiber-Cement Flat Sheets**
 Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
 Conditioning: Temperature of 23 ± 2°C and relative humidity of 30 ± 2% until equilibrium
 Temperature of 23 ± 2°C and relative humidity of 90 ± 5% until equilibrium
 Equipment: Mitutoyo Digital 18 in. Calipers (Intertek ID# P52639, cal due May 2014)
 Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
 Lunaire Environmental Chamber (Intertek ID# 22079)
 Time/Temp/RH: 3:00PM / 22.5°C / 48.0%

Project No: G101113787
 Eng/Tech: Chris Chang
 Reviewer: Baldeep Sandhu *BS*

Measurement at 23°C and 30 % RH after equilibrium			
Specimen	Length (mm)		
1	304.91	304.99	305.13
2	304.40	304.40	304.31
3	304.58	304.59	304.32
4	304.37	304.21	304.30
5	304.62	304.46	304.58

Measurement at 23°C and 90 % RH after equilibrium			
Specimen	Length (mm)		
1	305.04	305.20	305.15
2	304.64	304.49	304.35
3	304.61	304.65	304.33
4	304.38	304.21	304.27
5	304.74	304.49	304.64

Linear Change				
Specimen	Length (%)			Mean (%)
1	0.04	0.07	0.01	0.04
2	0.08	0.03	0.01	0.04
3	0.01	0.02	0.00	0.01
4	0.00	0.00	-0.01	0.00
5	0.04	0.01	0.02	0.02
Mean:				0.02
StdDev:				0.02
COV:				82%



Test: **Moisture Movement - Cross Direction**
 Date: 15-May-13
 Client: Cement Board Fabricators, Inc.
 Product: **Silbonit Fiber-Cement Flat Sheets**
 Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
 Conditioning: Temperature of 23 ± 2°C and relative humidity of 30 ± 2% until equilibrium
 Temperature of 23 ± 2°C and relative humidity of 90 ± 5% until equilibrium
 Equipment: Mitutoyo Digital 18 in. Calipers (Intertek ID# P52639, cal due May 2014)
 Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
 Lunaire Environmental Chamber (Intertek ID# 22079)
 Time/Temp/RH: 3:00PM / 22.5°C / 48.0%

Project No: G101113787
 Eng/Tech: Chris Chang
 Reviewer: Baldeep Sandhu *BS*

Measurement at 23°C and 30 % RH after equilibrium			
Specimen	Length (mm)		
1	304.00	303.97	303.79
2	304.21	304.09	303.99
3	303.92	303.91	304.12
4	304.01	304.00	303.94
5	304.15	304.17	304.21

Measurement at 23°C and 90 % RH after equilibrium			
Specimen	Length (mm)		
1	304.07	304.02	303.84
2	304.29	304.18	304.05
3	303.95	304.08	304.18
4	304.03	304.05	303.98
5	304.24	304.30	304.27

Linear Change				
Specimen	Length (%)			Mean (%)
1	0.02	0.02	0.02	0.02
2	0.03	0.03	0.02	0.03
3	0.01	0.06	0.02	0.03
4	0.01	0.02	0.01	0.01
5	0.03	0.04	0.02	0.03
Mean:				0.02
StdDev:				0.01
COV:				33%



Test: Water Absorption
Date: 26-Apr-13
Client: Cement Board Fabricators, Inc.
Product: **Silbonit Fiber-Cement Flat Sheets**
Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
Conditioning: Minimum 7 days at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 Drying - Dried in ventilated oven at 194 ± 4°F(90 ± 2°C) until equilibrium
 48 hour water immersion at 73 ± 7°F(23 ± 4°C)
Equipment: Setra Scale 2000g (Intertek ID# P52606, cal due February 2014)
 Temperature controlled oven (Intertek ID# 9-0477)
 Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)
Time/Temp/RH: 7:45AM / 23.4°C / 50.0%


Project No: G101113787
 Eng/Tech: Chris Chang
 Reviewer: Baldeep Sandhu *BSS*

Sample	Oven-dry weight after 24 hours (g)	Oven-dry weight after 48 hours (g)	Increment of Loss ¹ (% by mass)	Wet Weight (g)	Water Absorption %
1	132.70	132.70	0.0	161.07	21.4
2	130.81	130.81	0.0	160.81	22.9
3	131.61	131.53	-0.1	160.40	22.0
4	130.36	130.36	0.0	159.54	22.4
5	131.97	131.94	0.0	161.79	22.6
Mean:					22.3
StdDev:					0.61
COV:					2.7%

¹ Not to exceed 0.1 %



Test: **Moisture Content**
 Date: 22-Apr-13
 Client: Cement Board Fabricators, Inc.
 Product: **Silbonit Fiber-Cement Flat Sheets**

Project No: G101113787
 Eng/Tech: Chris Chang
 Reviewer: Baldeep Sandhu 

Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
 ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*

Conditioning: Minimum 7 days at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 Drying - Dried in ventilated oven at 194 ± 4°F(90 ± 2°C) until equilibrium

Equipment: Setra Scale 2000g (Intertek ID# P52606, cal due February 2014)
 Temperature controlled oven (Intertek ID# 9-0477)
 Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)

Time/Temp/RH: 12:PM / 24.1°C / 49.0%

Sample	Initial Mass (g)	Oven-dry weight after 24 hours (g)	Oven-dry weight after 48 hours (g)	Increment of Loss ¹ (% by mass)	Moisture Content %
1	533.97	489.03	488.85	0.0	9.2
2	539.31	493.99	493.70	0.1	9.2
3	535.05	490.81	490.66	0.0	9.0
4	536.68	491.62	491.34	0.1	9.2
5	536.05	490.31	490.06	0.1	9.4
Mean:					9.2
StdDev:					0.12
COV:					1.3%

¹ Not to exceed 0.1 %



Test: **Water Tightness**
Date: 17-Apr-13
Client: Cement Board Fabricators, Inc.
Product: **Silbonit Fiber-Cement Flat Sheets**
Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
Conditioning: Minimum 7 days at a temperature of $23 \pm 2^\circ\text{C}$ and relative humidity of $50 \pm 5\%$
Equipment: T&D Thermorecorder Temperature and Humidity Indicator (Intertek ID# P60554, cal due August 2013)
Time/Temp/RH: 9:00AM / 22.9°C / 51.0%

Project No: G101113787
Eng/Tech: Chris Chang
Reviewer: Baldeep Sandhu 

Sample	Observation
1	No moisture or formation of water drops on underside of specimen
2	No moisture or formation of water drops on underside of specimen
3	No moisture or formation of water drops on underside of specimen



Test: **Freeze Thaw Resistance**

Date: 7-Jun-13

Client: Cement Board Fabricators, Inc.

Product: **Silbonit Fiber-Cement Flat Sheets**

Test Methods: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*

ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*

Conditioning: Minimum 7 days at a temperature of $23 \pm 2^\circ\text{C}$ and relative humidity of $50 \pm 5\%$

48 hour minimum saturation at temperature greater than 5°C

50 freeze/thaw cycles, each consisting of:

a) Freeze to $-20 \pm 2^\circ\text{C}$ in approximately 1-2 hours and held for 1 hour

b) Thaw to $+20 \pm 2^\circ\text{C}$ in approximately 1-2 hours and held for 1 hour

48 hour minimum saturation

Load Rate: 0.5 in./min

Support Span: 10 in. 254 mm

Specimen: 5 in. x 12 in.

Equipment: Mitutoyo Digital 8 in. Calipers (Intertek ID# P60005, cal due May 2014)

Instron 3382 (Intertek ID# P60553, cal due July 2013)

Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)

Time/Temp/RH: 8:00AM / 22.5°C / 50.0%

Project No: G101113787

Eng/Tech: Chris Chang

Reviewer: Baldeep Sandhu *BSS*

Machine Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
1	127.21	126.98	126.93	8.19	8.24	8.21	611.1	27.17	3941
2	126.96	126.98	127.29	8.19	8.22	8.26	614.7	27.25	3953
3	126.72	126.91	127.27	8.05	8.07	8.10	598.4	27.55	3996
4	127.03	127.05	127.07	8.02	8.08	8.06	594.9	27.51	3990
5	127.02	127.01	127.37	8.21	8.24	8.26	638.5	28.21	4091
							Mean:	27.54	3994
							StdDev:	0.41	59
							COV:	1.5%	1.5%

% Retention of Wet Flexural Strength
99%

Cross Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
6	127.68	127.39	127.40	8.05	8.04	8.13	440.3	20.19	2928
7	128.10	127.93	128.18	8.10	8.20	8.19	471.0	21.03	3050
8	127.77	127.57	128.27	8.10	8.22	8.22	486.1	21.64	3139
9	128.29	127.82	127.64	8.24	8.14	8.08	477.0	21.37	3100
10	128.23	128.19	128.08	8.17	8.29	8.30	476.3	20.78	3014
							Mean:	21.00	3046
							StdDev:	0.56	81
							COV:	2.7%	2.7%

% Retention of Wet Flexural Strength
107%

Average

% Retention of Wet Flexural Strength
103%



Test: **Warm Water Flexural Strength**

Date: 18-Jun-13

Client: Cement Board Fabricators, Inc.

Product: **Silbonit Fiber-Cement Flat Sheets**

Test Methods: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*

ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*

Conditioning: Minimum 7 days at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 56 days in lime solution at a temperature of 60 ± 2°C
 48 hours at a temperature of 23 ± 2°C and relative humidity of 50 ± 5%
 48 hour minimum saturation

Load Rate: 0.5 in./min

Support Span: 10 in. 254 mm

Specimen: 5 in. x 12 in.

Equipment: Mitutoyo Digital 8 in. Calipers (Intertek ID# P60005, cal due May 2014)

Instron 3382 (Intertek ID# P60553, cal due July 2013)

Graphtec MIDI Logger (Intertek ID# P60555, cal due August 2013)

Time/Temp/RH: 8:50AM / 23.3°C / 49.0%

Project No: G101113787

Eng/Tech: Chris Chang

Reviewer: Baldeep Sandhu *BSS*

Machine Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
1	127.27	127.16	127.04	8.34	8.37	8.32	657.1	28.29	4102
2	127.14	126.88	126.99	8.26	8.26	8.23	643.2	28.35	4112
3	127.23	127.03	126.91	8.21	8.20	8.16	659.9	29.50	4279
4	127.34	126.97	126.94	7.89	7.99	8.01	603.7	28.54	4140
5	127.33	126.97	127.19	8.29	8.29	8.31	678.1	29.52	4281
Mean:								28.84	4183
StdDev:								0.62	90
COV:								2.1%	2.1%

% Retention of Wet Flexural Strength
104%

Cross Direction

Specimen	Width (mm)			Depth (mm)			Max Load (N)	Flexural Strength	
	W1	W2	W3	D1	D2	D3		(MPa)	(psi)
6	128.36	128.31	127.73	8.25	8.15	8.12	510.1	22.71	3293
7	128.37	128.40	128.23	8.01	8.00	8.07	460.4	21.21	3077
8	128.44	127.41	128.29	7.99	7.99	8.02	448.8	20.86	3026
9	128.33	128.10	128.28	8.32	8.26	8.27	500.7	21.68	3144
10	127.75	127.51	127.27	8.08	8.02	8.10	478.9	21.99	3189
Mean:								21.69	3146
StdDev:								0.71	103
COV:								3.3%	3.3%

% Retention of Wet Flexural Strength
110%

Average

% Retention of Wet Flexural Strength
107%



Test: **Heat-Rain Resistance** Project No: G101113787
Date: 28-May-13 Eng/Tech: Chris Chang
Client: Cement Board Fabricators, Inc. Reviewer: Baldeep Sandhu
Product: **Silbonit Fiber-Cement Flat Sheets**
Test Method: ASTM C1186-08 (Reapproved 2012), *Standard Specification for Flat Fiber-Cement Sheets*
ASTM C1185-08 (Reapproved 2012), *Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards*
Conditioning: Minimum 7 days at a temperature of 23 ± 2° C and relative humidity of 50 ± 5%
Exposure: 25 cycles consisting of:
5 minute pause, 2 hrs, 55 minutes of water spray at a rate of 1 gal/min
5 minute pause, 2 hrs, 55 minutes of 60°C (140°F) heat
Equipment: Universal Heat Rain Chamber
Vaisala Temperature and Humidity Indicator (Intertek ID# 9-0176, cal due June 2013)
Time/Temp/RH: 1:15PM / 22.0° / 48.0%

Specimen ID	Observation
Silbonit Fiber-Cement Flat Sheets	No visible cracks or structural alteration of the sheet and frame assembly

APPENDIX B: Installation Instructions (24 pages)