

**CLIENT:** **GREENSTONE STRUCTURAL SOLUTIONS**  
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Oshawa, ON  
L1J 2K9

**Test Report No: T1090-2a**

**Report Date: November 25, 2016**

**SAMPLE ID:** Greenstone Structural Solutions 191 mm (7.5 in.) 1.25 mm (18 Gauge) prefabricated steel stud panel with Type 1 Expanded Polystyrene (EPS), with 16 mm (5/8 inch) Type X gypsum board.

**SAMPLING DETAIL:** Production of the panels was witnessed by Pam Sumner, P.Eng on September 22, 2016 at the Greenstone Structural Solutions, Brandon, MB plant. The panels were marked by the noted Engineer, and QAI Laboratories was provided with a sealed letter confirming that the steel frame and EPS insulation met standard panel manufacturing specifications.

**DATE OF RECEIPT:** The Greenstone Structural panels were received on November 3, 2016 in good condition.

**TESTING PERIOD:** November 21, 2016.

**TEST PROCEDURE:** Testing to the following requirements:

- CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials (CAN/ULC S101).
- ASTM E119-16a, Standard Methods for Fire Tests of Building Construction and Materials (ASTM E119).

**TEST RESULTS:** The Greenstone Structural Solutions prefabricated wall assembly with 2 layers of 16 mm (5/8 in.) on the interior face, and 1 layer of 16 mm (5/8 in.) exterior gypsum on the outside face, achieved a 55 kN/m (3,800 lbs/ft) load-bearing fire-resistance-rating of 1 hour when tested with interior face orientated to fire, classified in accordance with CAN/ULC S101 and ASTM E119.

Further details of the tested assembly can be found on subsequent pages of this report.

**Prepared By**

**Signed for and on behalf of  
QAI Laboratories, Ltd.**

**Scott Leduc, EIT**  
Project Manager

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Director of Engineering

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## Introduction:

This report documents fire testing conducted by QAI Laboratories Ltd. (QAI) for Greenstone Structural Solutions on a test wall assembly constructed of 191 mm (7.5 in.) 1.25 mm (18 Gauge) prefabricated steel stud wall panel with Type 1 EPS and 16 mm (5/8 in.) thickness Type X gypsum board. Testing was performed in accordance with CAN/ULC S101-14 and ASTM E119-16a.

The wall assembly was evaluated for a 1-hour load-bearing fire-resistance-rating with interior face of assembly facing fire on November 21, 2016.

## Assembly Description:

**Table 1: Wall Description**

COMPONENT	DESCRIPTION	
<b>Assembly</b>	Size:	2.74 m (9 ft.) high by 3.66 m (12 ft.) wide by 251 mm (9-7/8 in.) thick
	Type:	Steel stud and Type 1 EPS prefabricated wall panel 16 mm (5/8 in.) Type X gypsum faces.
<b>Greenstone Panels</b>	Type:	Prefabricated Wall Panels
	Wall Stud:	1.25 mm (18 Gauge) x 64 mm (2-1/2 in.) x 30 mm (1-3/16 in.) C-channel wall studs. The end studs at the joint have a 3 mm (1/8 in.) x 25 mm (1 in.) jog in the channel along the 64 mm (2-1/2 in.) dimension. There is one row of studs on each side of the panels spaced 406 mm (16 in.) on center (OC).
	Horizontal Bracing:	A 0.71 mm (22 Gauge) x 86 mm (3-3/8 in.) steel strapping spanned the panels on the interior of the stud framing on both sides of the panel. Horizontal strapping was located at 1.22 m (4 ft) and 2.44 m (8 ft) vertical heights on wall panels.
	Top Track:	The top track was replaced with a 1.65 mm (16 Gauge) x 89 mm (3-1/2 in.) x 32 mm (1-1/4 in.) J-shaped channel with a 13 mm (1/2 in.) return. Sides were fastened to the wall studs with #10 x 19 mm (3/4 in.) self-drilling pan head screws. Two screws were placed side by side at each wall stud and one screw at each joint stud.
	Bottom Track:	A 51 mm (2 in.) x 51 mm (2 in.) angle was placed over top of the bottom track on both sides of the wall and was fastened to each stud with one #10 x 19 mm (3/4 in.) self-drilling pan head screw.
	Connection Plates:	The panels were held together with 1.25 mm (18 Gauge) x 152 mm (6 in.) x 51 mm (2 in.) plates fastened using six #10 x 19 mm (3/4 in.) self-drilling pan head screws. The plates were placed every 610 mm (2 ft.) starting 152 mm (6 in.) from the bottom.
	Insulation:	Type1 EPS.

**Table 1: Wall Description - Continued**

<b>Interior Sheathing</b>	Type:	Type X gypsum board compliant with ASTM C1396.
	Thickness:	16 mm (5/8 in.)
	Manufacturer:	CGC
	Product Name:	Sheetrock Brand Ultralight Panels Firecode X
	Orientation:	Two layers were mounted horizontally with the joints staggered between layers.
	Fastener Detail:	Both layers were fastened 203 mm (8 in.) OC. The first layer was fastened using #6 x 32 mm (1-1/4 in.) Type S drywall screws and the second layer was fastened using #6 x 51 mm (2 in.) Type S drywall screws. All screw heads were covered with CGC Durabond 90 drywall compound.
	Joint Treatment:	A 0.56 mm (24 Gauge) x 130 mm (5-1/8 in.) flat strapping was placed at each horizontal joint location of the first layer and screwed to the wall studs. CGC Durabond 90 drywall compound and 51 mm (2 in.) paper tape was used on the second layer.
<b>Exterior Sheathing</b>	Type:	Exterior grade Type X gypsum wall board compliant with ASTM C1177.
	Thickness:	16 mm (5/8 in.)
	Manufacturer:	Georgia Pacific
	Product Name:	Densglass Sheathing
	Orientation:	One layer was mounted horizontally with the vertical joints staggered.
	Fastener Detail:	The boards were fastened with #6 x 32 mm (1-1/4 in.) Type S drywall screws spaced 203 mm (8 in. OC).
	Joint Treatment:	CGC Durabond 90 drywall compound and 51 mm (2 in.) fiberglass tape.

## Test Apparatus:

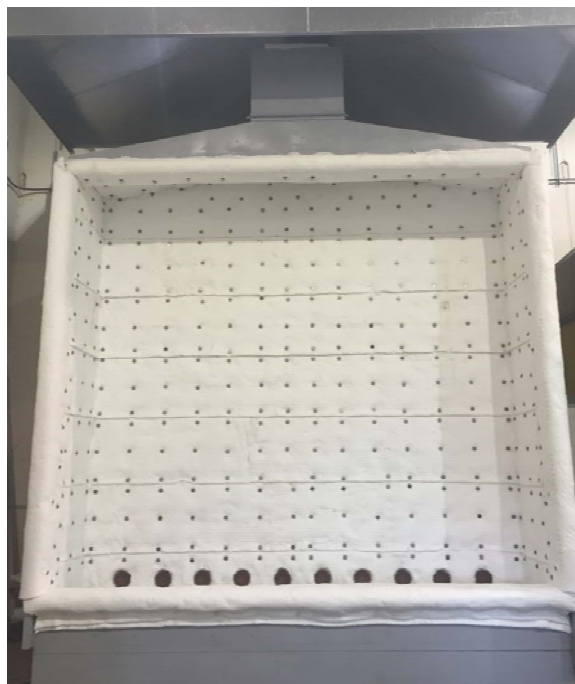
The furnace used in the tests had dimensions of 3.96 m (13 ft.) in height, 3.96 m (13 ft.) in width, and 0.91 m (3 ft.) in depth.

Temperatures within the furnace were monitored using nine thermocouples. The temperatures are controlled by adjusting fuel to the furnace burners to conform to the time/temperature curve specified by the test standards. Temperature measurements are recorded by a Keithley 2750 data acquisition unit (ID# DMM1) which passes the readings to a computer for graphical display and storage.

Unexposed wall surface temperatures were monitored by thermocouples (TCs) placed at nine locations. Five of these were symmetrically disposed, one to be at the center of the assembly, and four at the center of each quarter section. Detailed locations are shown in Figure 3 in Appendix A. The temperatures were recorded continuously for the duration of the test. The temperature rise data are provided graphically in Figure 4 in Appendix A.

The wall assembly was mounted vertically into a steel frame specimen holder with a movable lower beam. Vertical loading was applied to the lower beam using three hydraulic rams monitored using a verified pressure gauge.

Two pressure taps are installed along the longitudinal center line of the test assembly. The pressure taps are each attached and monitored by Setra model 264 pressure transducers (ID# Pressure T1 and Pressure T2). The furnace pressure is controlled by adjusting a damper in the furnace exhaust stack.



**Figure 1: Burners Fired in the Furnace**

## Test Conditions:

The Greenstone Structural Solutions prefabricated wall assembly was constructed in a full-scale moveable steel restraint frame. Side walls were constructed using wood stud and 3 layers of 16 mm (5/8 in.) Type X gypsum board. The wall was initially held in place with two screw jacks which clamped the wall into place between the lower and upper steel beams. The screw jacks were backed off once the load was applied by the hydraulic rams. The space between the test frame and the wall assembly was filled with ceramic fiber batt to prevent air movement between the frame and wall.

The vertical load that was applied to the wall assembly at client specified load of 55 kN/m (3,800 lbs/ft). The load was induced uniformly across a loading beam with three hydraulic rams. The load was applied in 25% increments prior to testing. The weight of the wall and loading beam were accounted for when calculating the applied force to achieve the correct load.

Prior to the fire endurance test the test assembly was moved into place, the load was applied and the pilot burners were ignited. The fire endurance test was initiated after igniting the burners. The temperature inside the furnace was controlled to follow the time/temperature curve within the limits described in the test standards.

After the fire endurance test, the assembly was subjected to the impact, erosion, and cooling effects of a hose stream as described in the test standard. The pressure and duration of the hose stream test were 205 kPa (30 psi) and 6.5 sec/m<sup>2</sup> (0.6 sec/ft<sup>2</sup>).

## Test Requirements

Per CAN/ULC S101 and ASTM E119, the following requirements were followed for testing:

1. No individual thermocouple can exceed 180°C above 12°C ambient for CAN/ULC S101, and 325°F above 54°F ambient for ASTM E119:  
 **$T_{\text{Individual}} \leq 192^{\circ}\text{C}$  CAN/ULC S101 or  $T_{\text{Individual}} \leq 379^{\circ}\text{F}$  ASTM E119**
2. The average of thermocouples can exceed 140°C above 12°C ambient for CAN/ULC S101 and 250°F above 54°F ambient for ASTM E119:  
 **$T_{\text{AVE}} \leq 152^{\circ}\text{C}$  CAN/ULC S101 or  $T_{\text{AVE}} \leq 304^{\circ}\text{F}$  ASTM E119**
3. The test specimen shall have sustained the applied load throughout the fire endurance test without passage of flame or passage of gases hot enough to ignite cotton pads.
4. The test specimen shall have sustained the applied load during the fire and hose stream tests without passage of flame, gases hot enough to ignite cotton pads and passage of the hose stream.

**Test Results:**

**Observations**

**Table 3: Test Observations**

Test Time (min)	Unexposed	Exposed
1:45		Ignition of the surface.
2:30		Flames have self-extinguished.
11:53		A 2 ft. section of joint compound and tape has fallen from the top joint.
12:30		A 3 ft. section has fallen from the bottom joint and a 2 ft. section has fallen from the top joint.
14:45		80% of the joint compound has fallen off.
24:35		Light flaming at the joints in isolated areas.
28:53		Light flaming across the joints.
30:50	Slight curvature of the wall into the furnace.	
38:30		Flaming at the joints has stopped.
34:00	No change.	Test discontinued.

**Flaming and Penetration**

No flaming occurred on the unexposed face of the test assemblies, and no through penetrations or openings were observed during the fire test.

**Unexposed Temperature Rise**

During the fire endurance test the average temperature measured by the unexposed thermocouples did not rise more than 140°C above its initial average temperature for CAN/ULC S101 or 250°F for ASTM E119; and none of the temperatures at any individual point exceeded 180°C above its initial temperature for CAN/ULC S101 or 325°F for ASTM E119.

**Hose Stream Test**

Immediately after the fire test, a hose stream test was conducted for 65 seconds. The wall assembly successfully met the conditions of acceptance for the hose stream test: no through openings were developed that would allow a projection of water from the stream beyond the unexposed face during the time of the hose stream test.



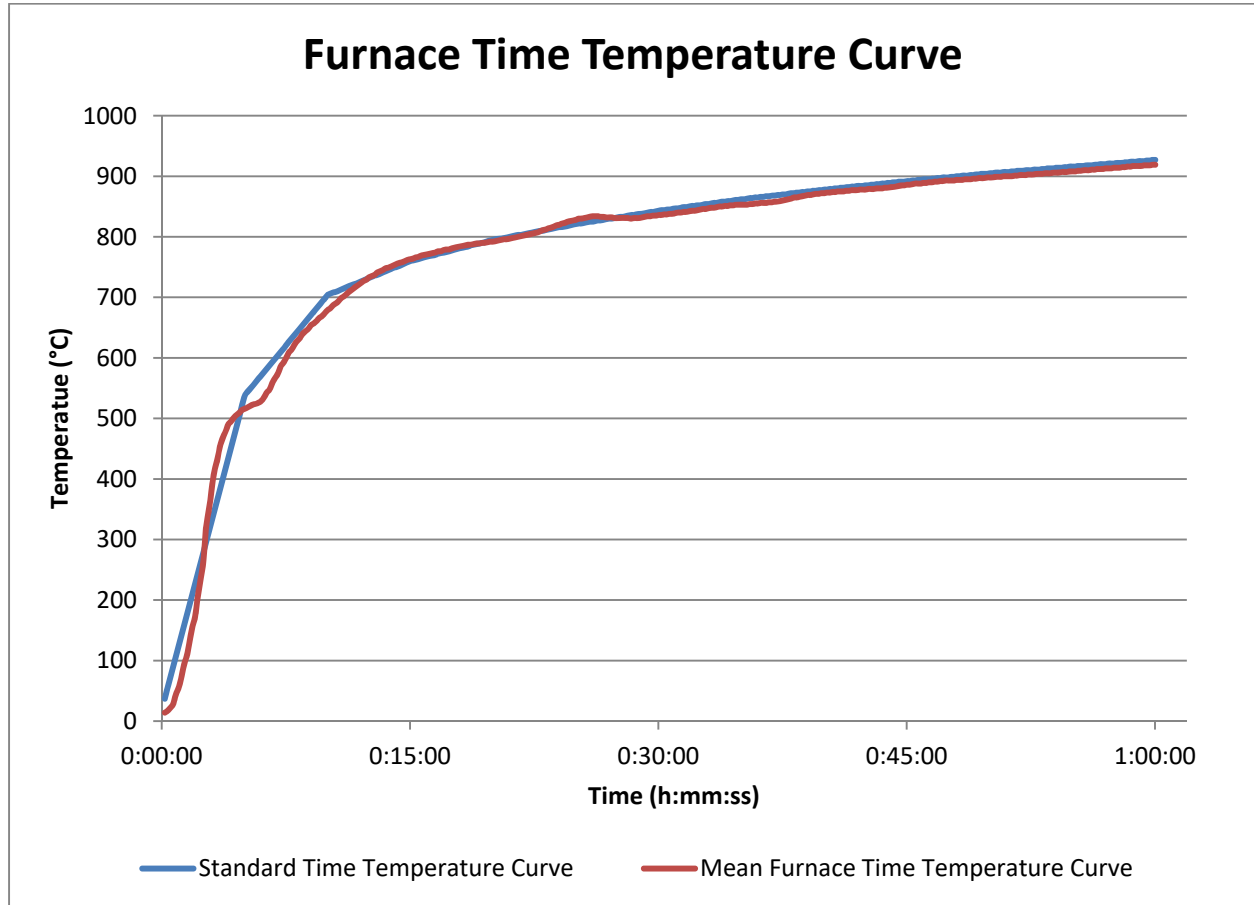
## Conclusion

QAI performed testing in accordance with CAN/ULC S101-14 *Standard Methods of Fire Endurance Tests of Building Construction and Materials* and ASTM E119-14 *Standard Test Methods for Fire Tests of Building Construction and Materials* on a representative Greenstone Structural Solutions 191 mm (7.5 in.) 1.25 mm (18 Gauge) prefabricated steel stud panel with Type 1 Expanded Polystyrene (EPS), with 16 mm (5/8 inch) Type X gypsum board.

The noted testing showed Greenstone Structural Solutions prefabricated wall assembly achieved a 55 kN/m (3,800 lbs/ft) load-bearing fire-resistance-rating of 1 hour when tested with interior face orientated to fire per CAN/ULC S101-14 and ASTM E119-16a.

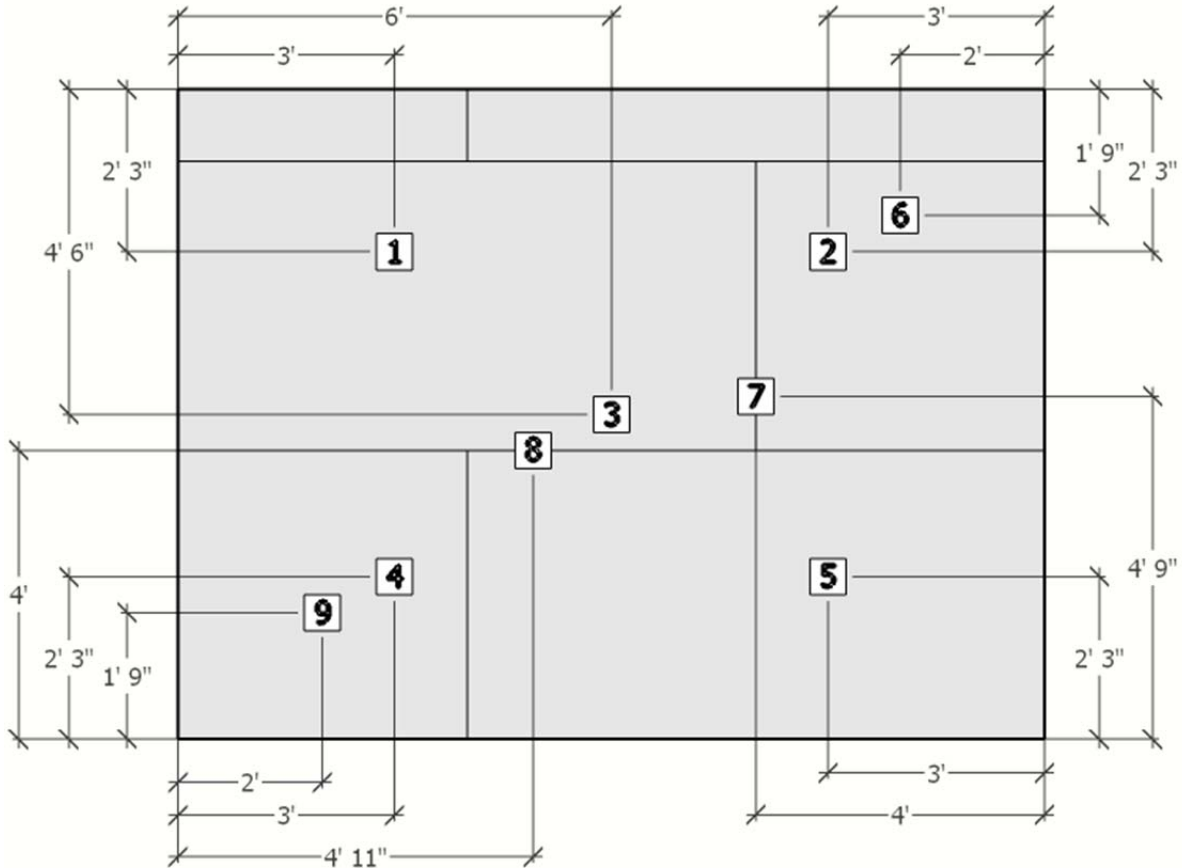
**APPENDIX A**

<b>Page</b>	<b>Title</b>
9	Furnace Time Temperature Curve
10	Unexposed Thermocouple Locations
11	Unexposed Time Temperature Curves

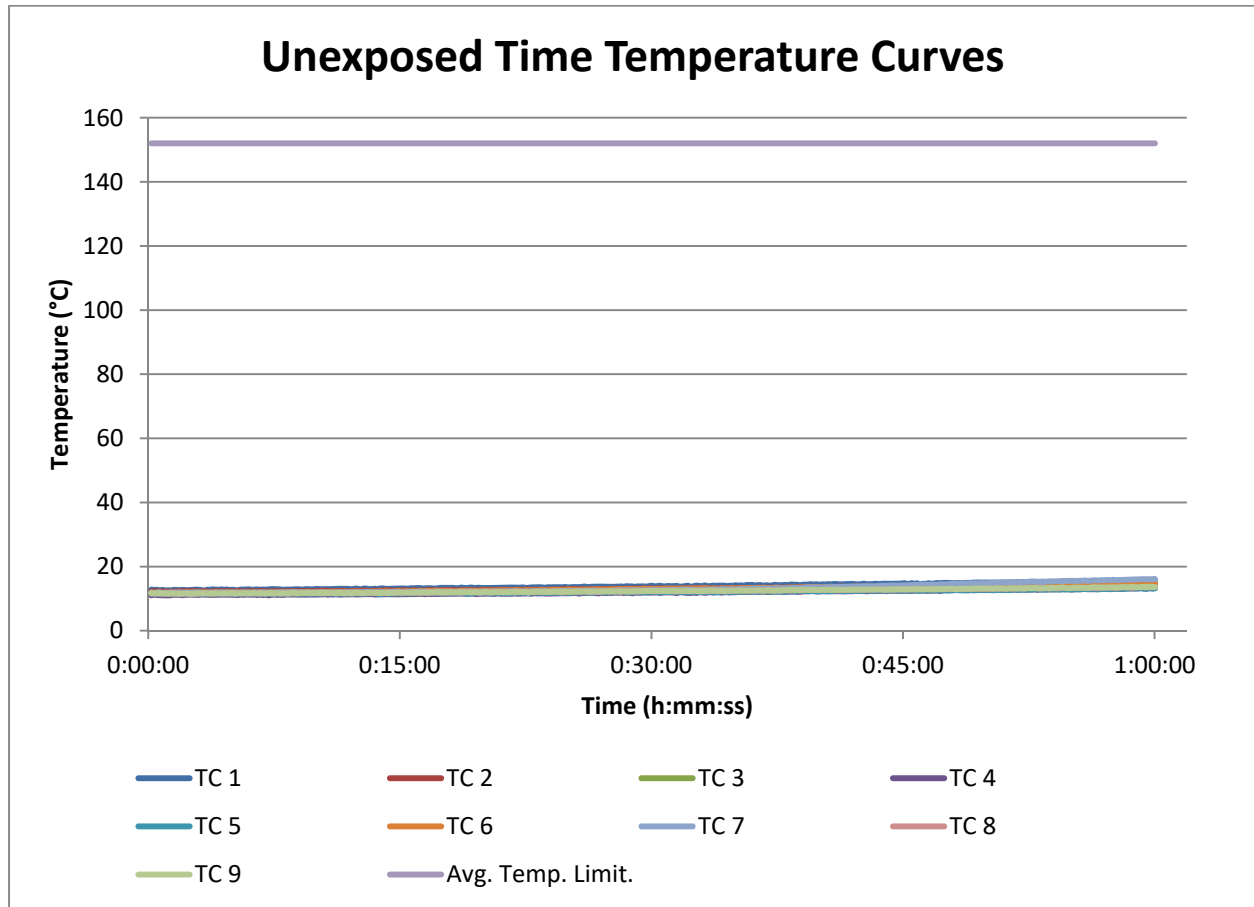


**Figure 2: Time Temperature Curve**

**Thermocouple Locations**



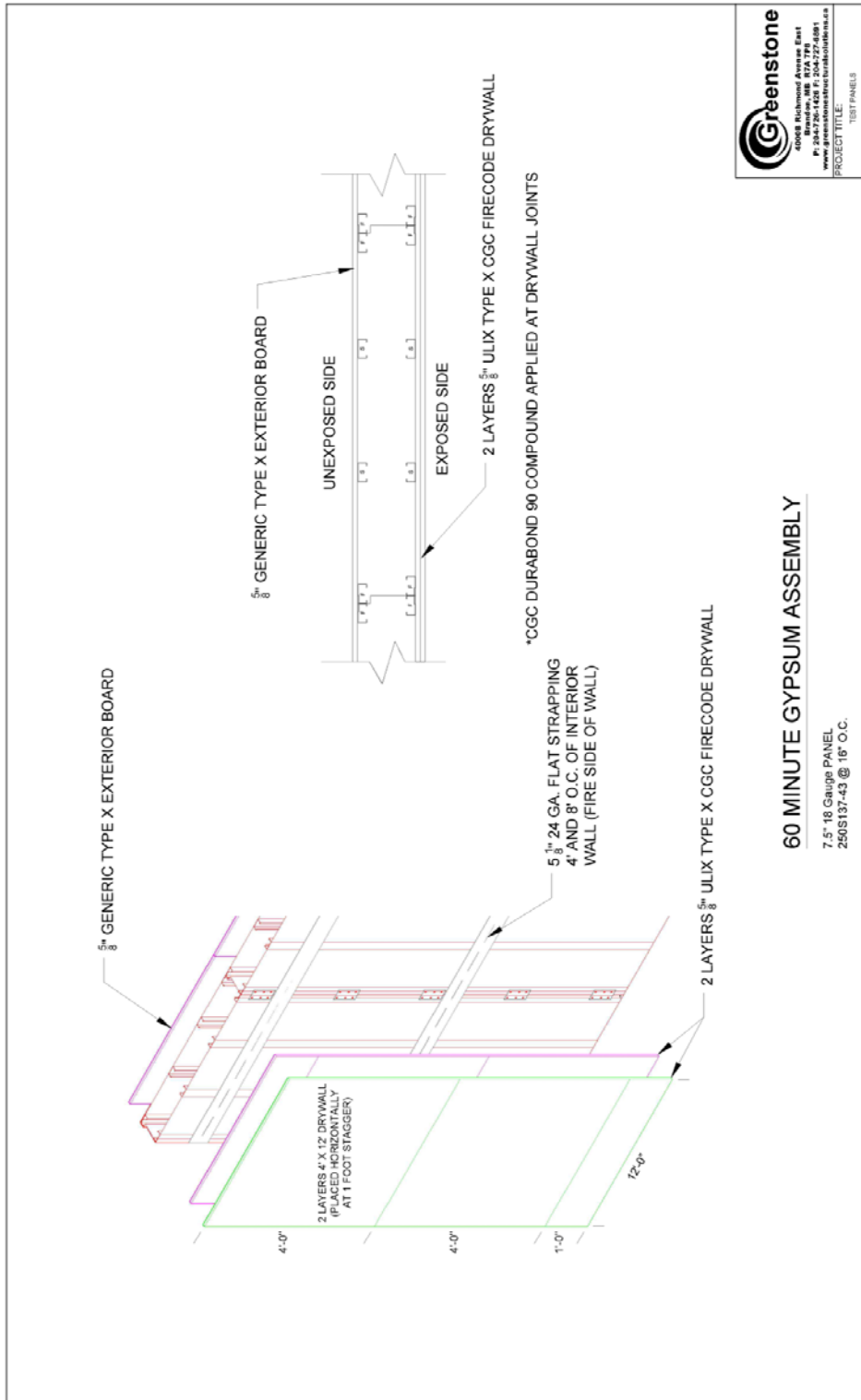
**Figure 3: Unexposed Thermocouple Locations**



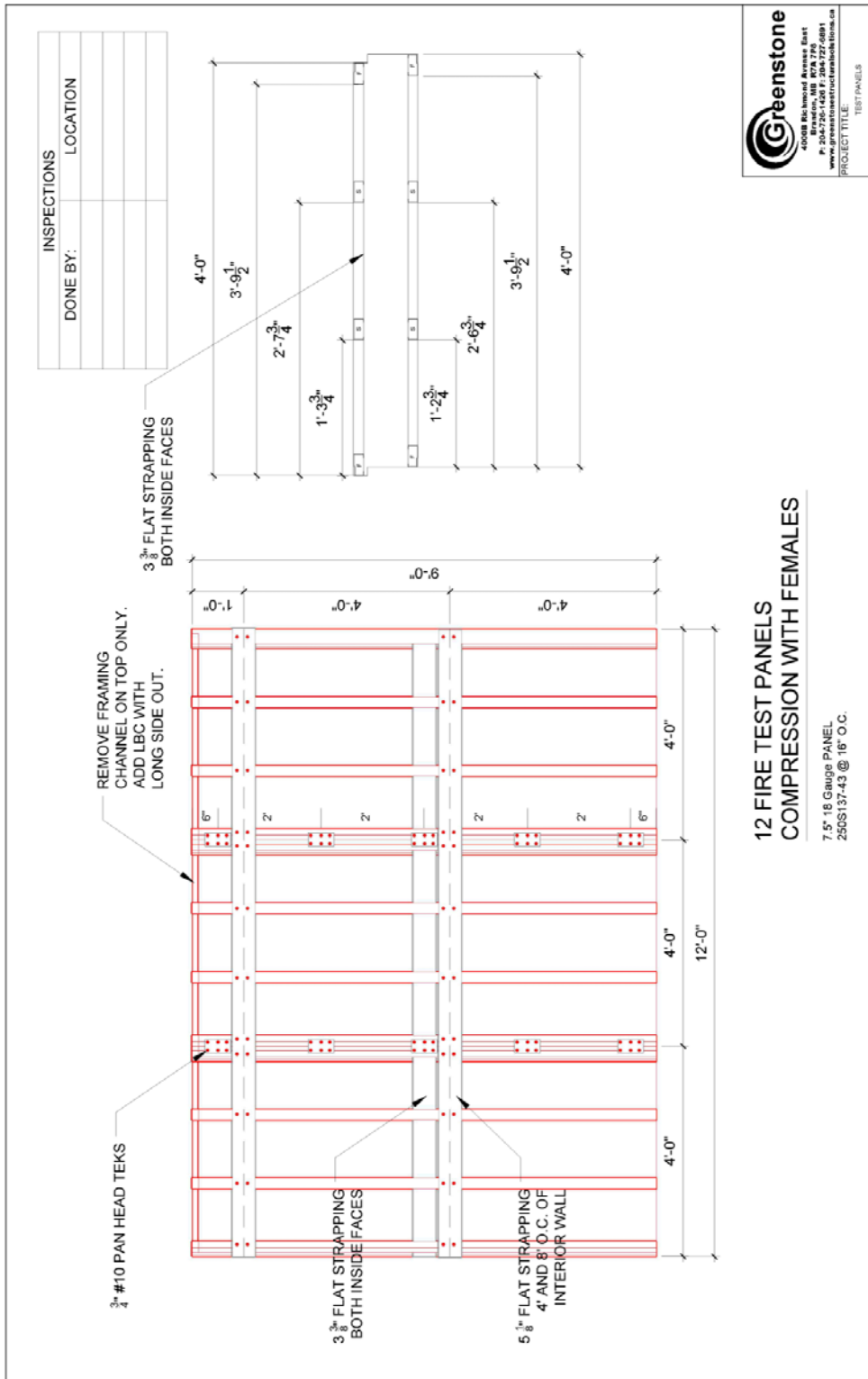
**Figure 4:** Unexposed Time Temperature Curves

**APPENDIX B**

<b>Page</b>	<b>Title</b>
13-14	Drawings
15-18	Sample Pictures



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**Figure 5:** The exposed face prior to the first layer of gypsum being completed.

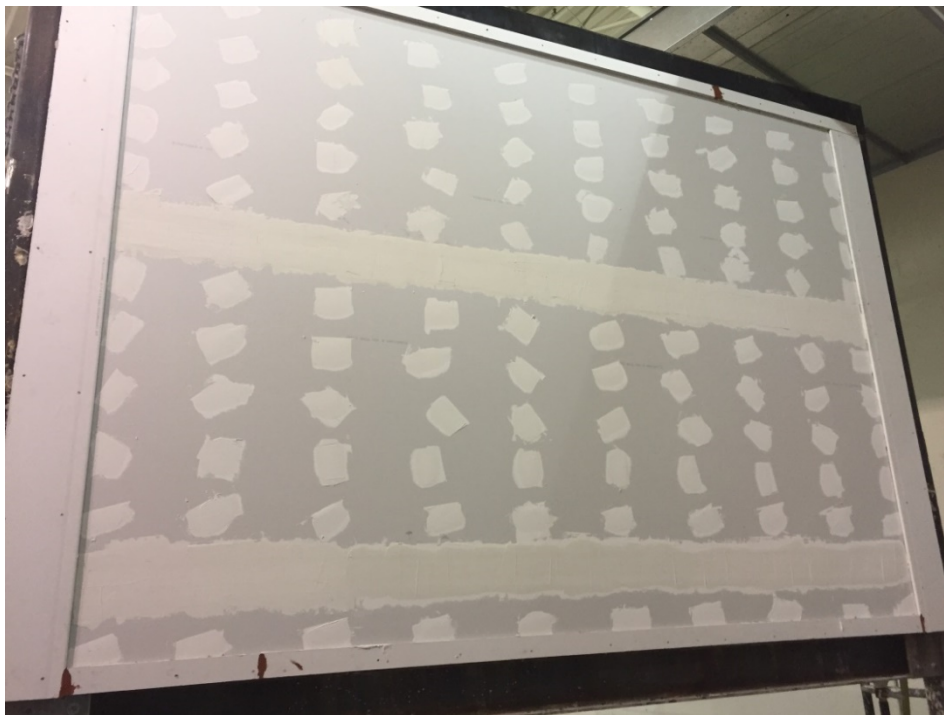


**Figure 6:** The unexposed face prior to the exterior gypsum board being mounted.

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**Figure 7:** The unexposed face prior to the fire test.



**Figure 8:** The exposed face prior to the fire test.

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**Figure 9:** The unexposed face at the end of the fire test.



**Figure 10:** The exposed face at the beginning of the hose stream test.

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**Figure 11:** The exposed face after the hose stream test.