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Fire Performance of ASTM E119 Evaluation of a Non-Load-Bearing Wall Assembly with Flat Strap Backer

Indicative testing conducted in accordance with the test methodology described in ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials

Conducted For:

SAFTI-SEAL INC.
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Bellevue, WA 98006

WFCi Report #12142r1

Test Dates: November 19, 2012

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ACCREDITED
TL-180

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INTRODUCTION

This report documents the successful fire resistance test of a symmetrical, non-load-bearing wall assembly for Safti-Seal Inc. The wall assembly featured a Flat Strap Backer (FSB) down the vertical and horizontal centers of the assembly, which was designed to form an insulating barrier for the wall assembly joint. Testing was performed on November 19, 2012, and was conducted in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*. The test was conducted to evaluate the subject wall in an 'as built' scenario. This test assembly was designed to pass the two-hour fire endurance test, as well as the post-fire hose-stream test.

TEST ASSEMBLY

WFCi personnel constructed a 10' × 10' wall assembly in accordance with the specifications provided by the client. The primary supporting structure consisted of 2 layers of drywall, 2 × 4 metal stud wall assembly with vertical and horizontal FSB joints with drywall reveal mold (DRM) trim, and repeated layers of drywall (symmetric). The test specimen was representative of the construction that the test was intended to assess.

SUMMARY OF TEST METHOD

Testing was performed using a vertical fire resistance test configuration employing the fire endurance conditions and standard time-temperature curve described in ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*. The exposed surface of the panel assemblies was subjected to the standard E119 time-temperature curve, with temperature measurements taken inside the natural gas furnace using 9 thermocouples (TC_F) connected to a computerized data acquisition system. TC_F locations were symmetrically disposed and distributed to show the temperature near (within 6") the exposed face of the test assembly.

Here are the following criteria to which these tests were judged, according to ASTM E119:

- Wall assembly will have sustained the applied load (none) for the indicated time (2-hr, in this instance) without passage of flame or gases hot enough to ignite cotton waste
- Wall assembly will have not developed an opening that permits the projection of water from the hose stream beyond the unexposed surface (applicable for hose-stream portion of the test)
- Transmission of heat through the wall will not have risen the temperature on its unexposed side more than 139°C (average) above its initial temperature, or if a temperature higher than 30% (181°C) of the specified limit occurs at any one point (single-point) on the unexposed side of the assembly.

SAMPLE DESCRIPTION

WFCi personnel constructed a 10' × 10' wall assembly in accordance with the specifications provided by the client. Construction photographs are included in Figure 1. The supporting structure consisted of (from exposed face layer to unexposed layer) 2 layers of gypsum wall

board (GWB), 2 × 4 metal stud (6) assembly with 2 vertical FSB secured to sideways steel studs and 2 horizontal FSB (Figure 2) with included DRM trim over the FSB joints, and repeat GWB layers.

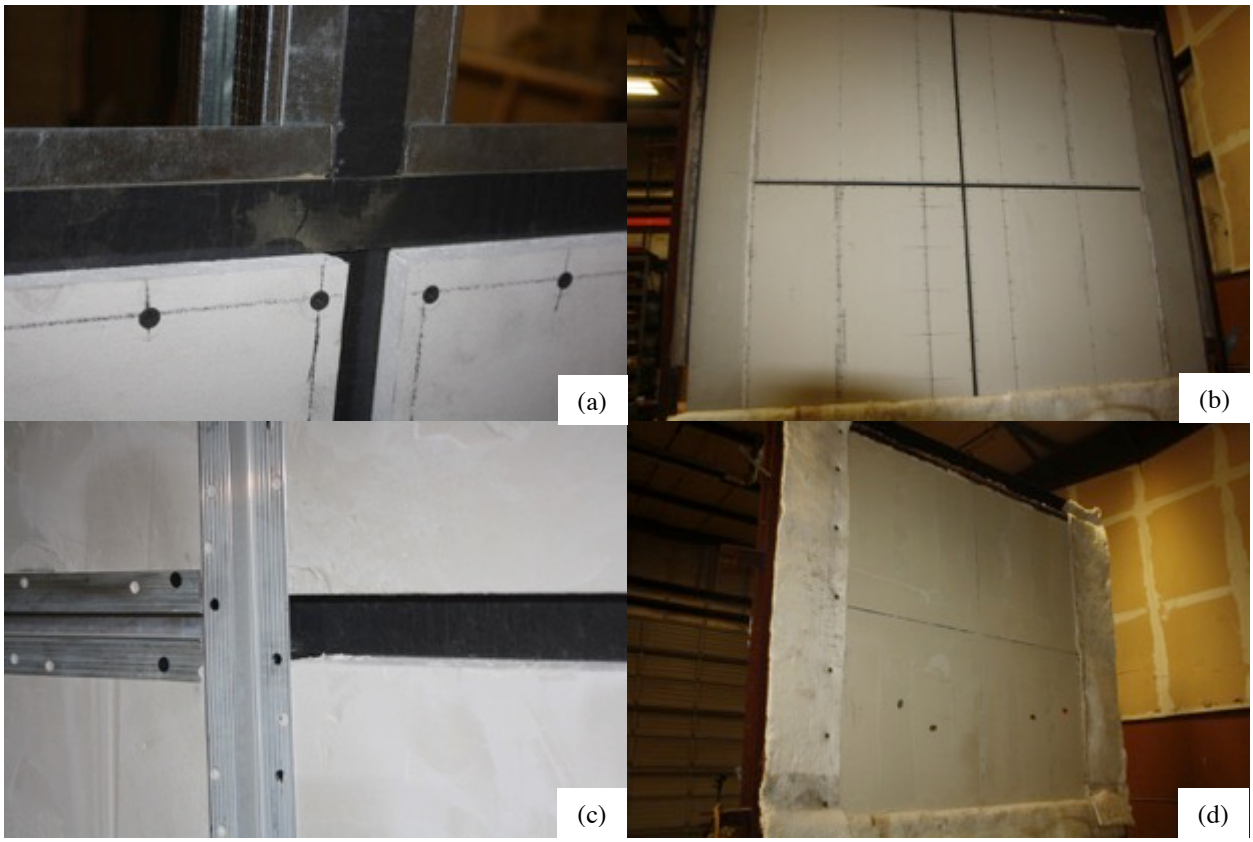


Figure 1. Construction photographs showing (a) center FSB joint with single layer of GWB, (b) wall before compound, (c) installation of DRM trim, and (d) completed assembly.

The FSB is a 3" flat steel (20 gauge) plate (10' in this assembly) with 1¼" strip of intumescent material that provides thermal protection to the interior of the wall assembly. Upon heating, the intumescent expands out from the strip, forming the insulated barrier, before finally being decomposed after successive heating.

The two-hour test assembly consisted (from exposed face layer to unexposed layer) of:

- Exposed face – Type X ⅝" GWB with a unit weight of approximately 2540 lb/1000 ft^2 which was fastened with 2" drywall screws (#6) with spacing of 8" on edge and 12" in the field (Figure 3a).
- Exposed base – Type X ⅝" GWB which was fastened with 1⅛" drywall screws (#6) with spacing of 8" on edge and 12" in the field (Figure 3b).
- 6, 2 × 4 steel studs (3½" × 1½" flange, 25 gauge) (on center) with 24" spacing. Vertical FSB panels placed on the sideways studs along the center of the assembly. Horizontal FSB panels were also placed mid-height of the assembly. This FBS inclusion allowed for 1¼" GWB gap where the intumescent strips were located (Figure 2). The 2¼" aluminum

DRM trim (½" × ½" channel) was placed over the GWB gap, fastened with 2" screws at 2' intervals.

- Unexposed base – Same as exposed (Figure 3c).
- Unexposed face – Same as exposed (Figure 3d).

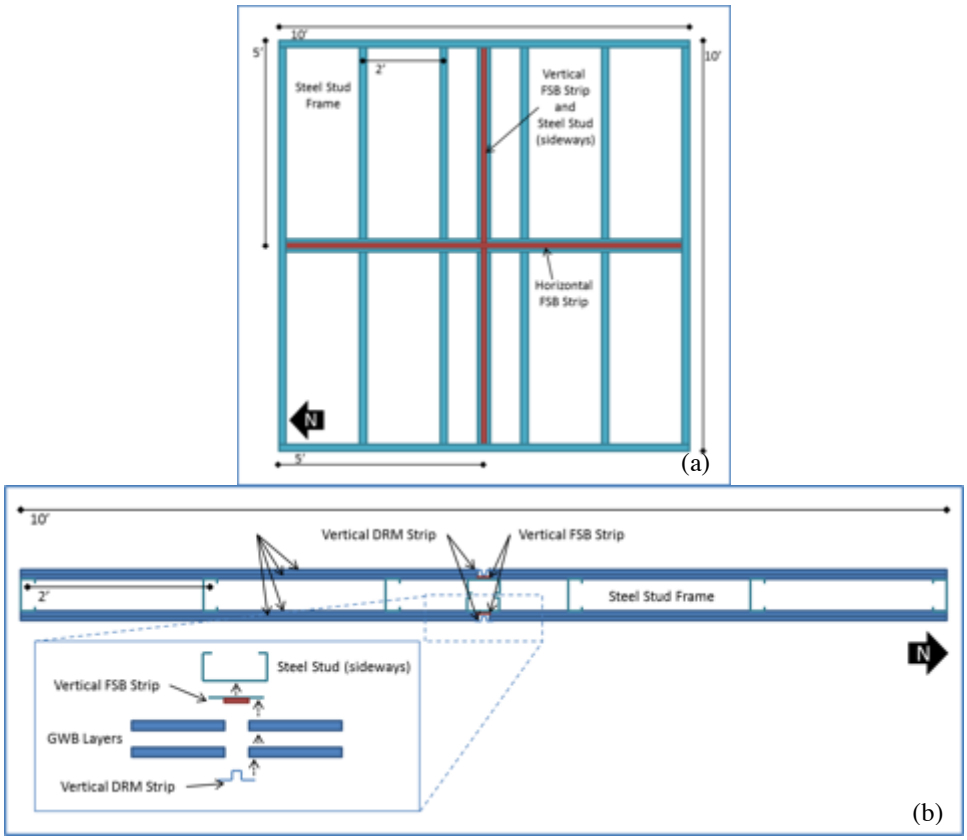


Figure 2. Schematic of wall assembly showing (a) frame, and (b) top-view cross section.

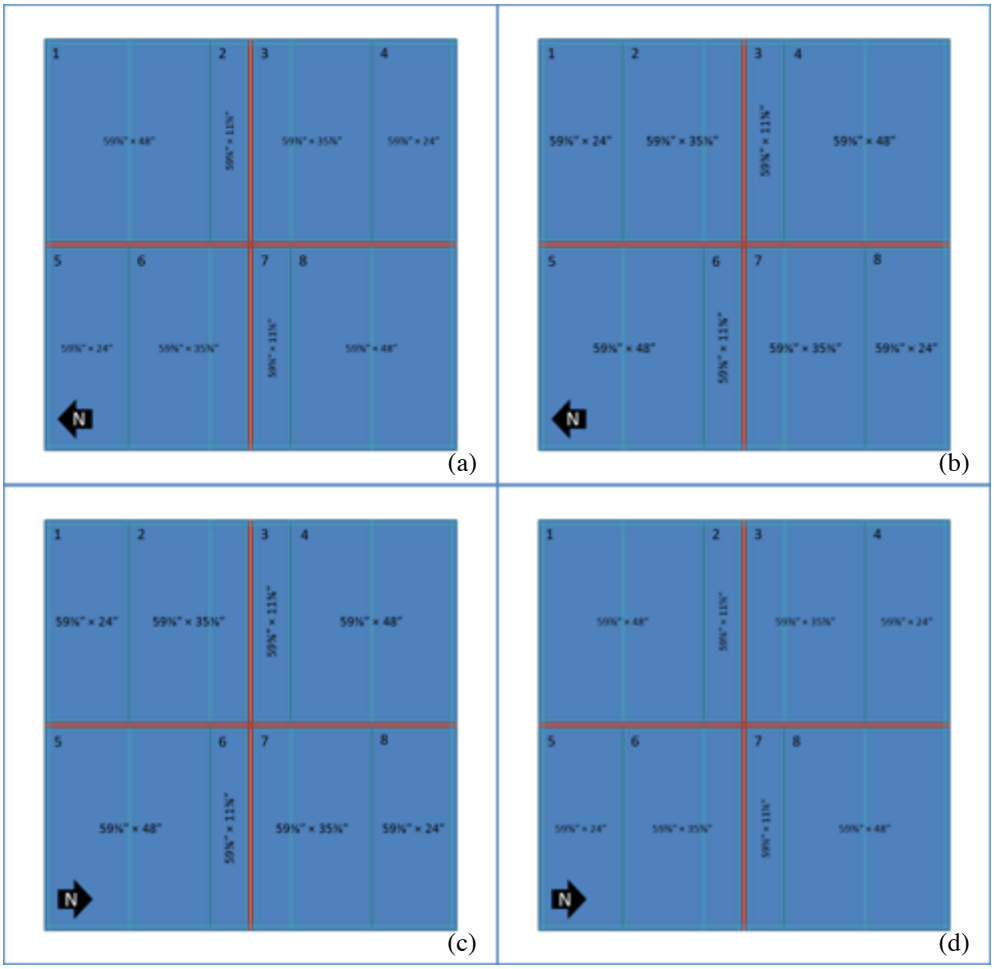


Figure 3. Schematic of drywall layout showing (a) exposed face, (b) exposed base, (c) unexposed base, and (d) unexposed face.

Temperature

To obtain representative thermal information of the samples during the tests, the two-hour wall assembly was instrumented with sample thermocouples (TC_S). These TC_S were divided into four main groups:

- Finish TC_S (1-5): Located between the GWB and metal studs on the exposed side (for finish rating) at the center and relative quarter points (according to stud location) of the assembly (Figure 4a).
- Field TC_S (6-14): Located on the unexposed side of the assembly on the GWB, not along the DRM trim. TC_S (6-9) was located on the unexposed layer of GWB at the center, quarter, and midline center points of the assembly. Locations are specified in Figure 4b.
- Trim TC_S (15-18): Located on the unexposed side of the assembly on the GWB inside the DRM trim channel. Locations are specified in Figure 4b.
- Joint Cavity TC_S (19): Located between the FSB and DRM trim. The location is specified in Figure 4b.

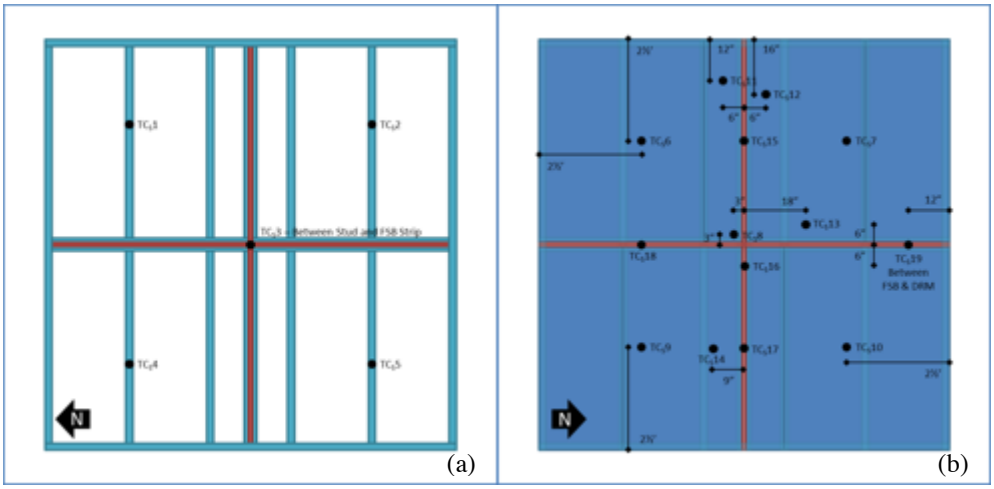


Figure 4. Sample thermocouple locations on assembly showing (a) finish TC_S and (b) unexposed TC_S.

TEST RESULTS

Testing of the wall assembly took place on November 19, 2012. The panels were fixed in place within the 10' x 10' sample holder and insulated on the perimeter edges with ceramic wool insulation. The furnace temperature, samples temperatures, and furnace pressure, were continuously monitored at 1 Hz until test termination. These data are presented in the figures below. Photographs of the samples during and after the test are also provided below.

Test Date & Time: 11/19/12, 09:30 AM

Furnace: Large-scale vertical exposure E119 furnace – 2-hr exposure with hose-stream

Laboratory Conditions: 16°C, 61% RH

Witnesses: Jim Klein (Safti-Seal)

Table 1. Observations for two-hour wall test

Test Time (hr:mm:ss)		**Event**
00:00		Start test
00:45		Cracking of compound near DRM joints
03:00		Bowing of DRM along horizontal joint
04:30		Bowing of DRM along vertical joint (Figure 5a)
10:30		Continued bowing of DRM
16:30		Increased deterioration/melting of DRM
27:20		Visible intumescent from joint
29:27		Single-point finish failure – $TC_S3 > 197°C$
35:00		Approximately 1" intumescent layer from horizontal and vertical gaps
42:00		Light flaming from horizontal joint

49:00		Center – approximately 2” intumescent (Figure 5b)
53:00		Cracking in non-FSB joints (1-2, 3-4)
1:21:00		No significant change
1:32:00		Intumescent has turned white – deterioration (Figure 5c)
1:38:30		Light smoking from center of unexposed DRM joints
1:48:15		More cracking in non-FSB joints
1:57:50		No significant change
2:00:00		Terminate test

When pulled away from the furnace, there was no apparent change to the unexposed side of the wall assembly. There was some cracking on the exposed side, though there was no passage of flame or gases hot enough to ignite cotton waste, therefore, this assembly passed this endurance requirement.

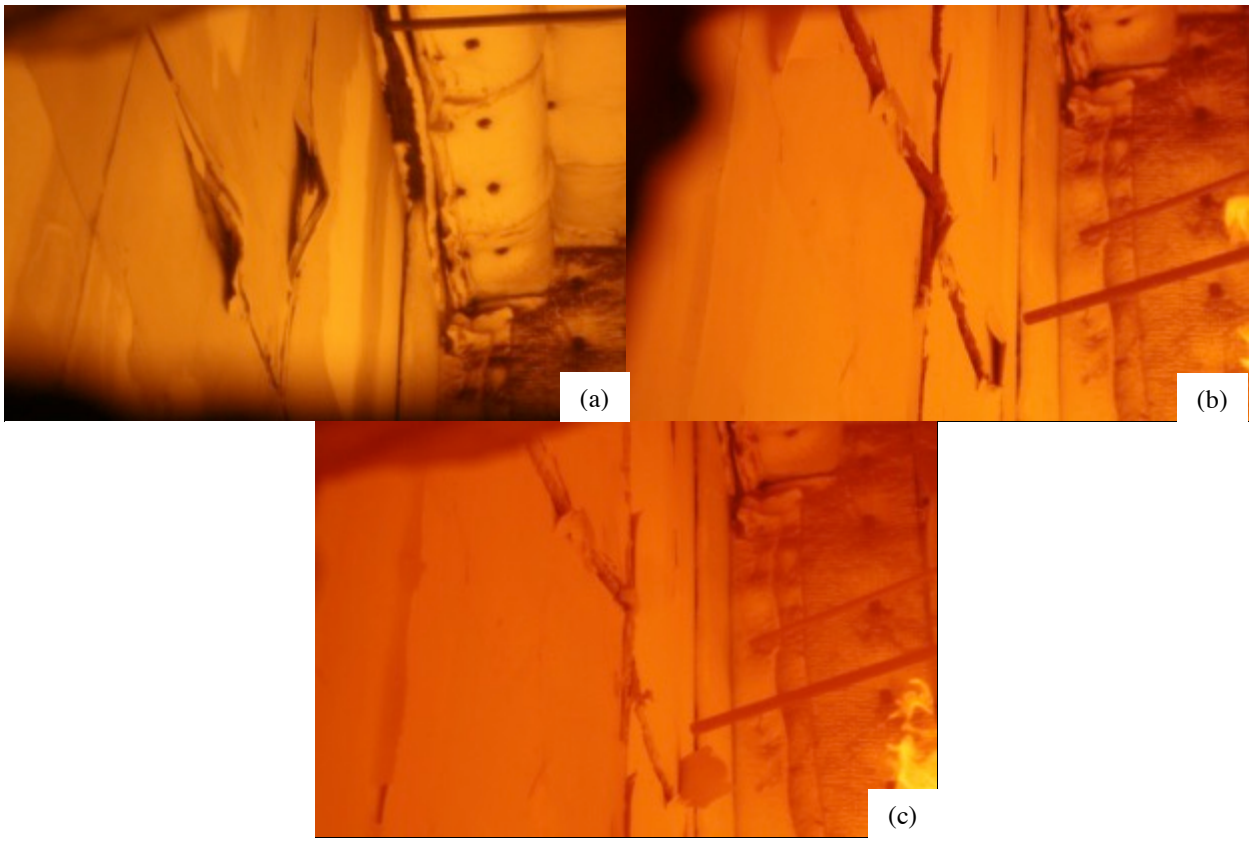


Figure 5. Test fire resistance photographs showing (a) bowing DRM trim, (b) center intumescent, (c) deteriorated center intumescent.

Temperature Data

The furnace temperature followed the standard time-temperature curve as shown in Figure 6a. A comparison of the area under the time-temperature curve with the standard is also shown in Figure 6b. Little variation (0.05%) is observed, well below the 7.5% recommended for a 2-hr test.

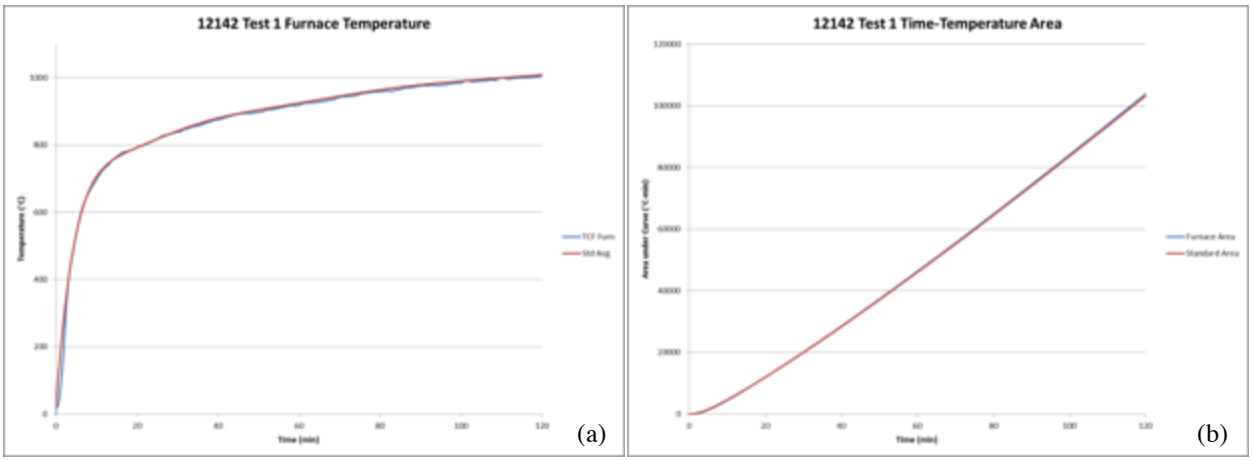


Figure 6. Furnace temperature comparison showing (a) temperature and (b) area under curve.

The various groups of sample thermocouple temperature profiles are shown in Figure 7. The finish TC_S showed TC_S3 supersede the single-point finish temperature limit (181°C + ambient [16°C] = 197°C) at 29 m 27, giving an overall finish rating of 29 min, reported to the nearest integral minute. Since this specific center TC_S was placed between the sideways stud and steel FSB plate, the temperature was significantly higher than the quarter-point finish TC_S. The quarter-point TC_S plateaued at 100°C for approximately 40-50 min, the rose steadily. The final average finish value at the end of the test was 475°C.

The field TC_S showed increasing temperature after the first 20 min of the test, which plateaued at approximately 80 min at a value of 80°C. The trim TC_S showed a similar behavior, though at approximately 60 min into the test, there appeared to be a slight dip in the temperature, possible due to swelling/intumescing material, indicating insulating behavior. The unexposed TC_S (field and trim) did not supersede the average (139°C + ambient [16°C] = 155°C) or single-point temperature criteria, but had an average of 86°C at the time of test termination. This assembly qualified for the heat temperature transmission criterion as defined by the standard.

TC_S19 showed representative information of the behavior of the unexposed FSB intumescing strip. This TC_S showed increase temperature for the first 60 min, slightly higher than the unexposed TC_S. There was again a slight dip in temperature over the next 20 min, presumably due to intumescing material. After 80 min, the temperature again began to increase, where the temperature again plateaued at 160°C with significant variation.

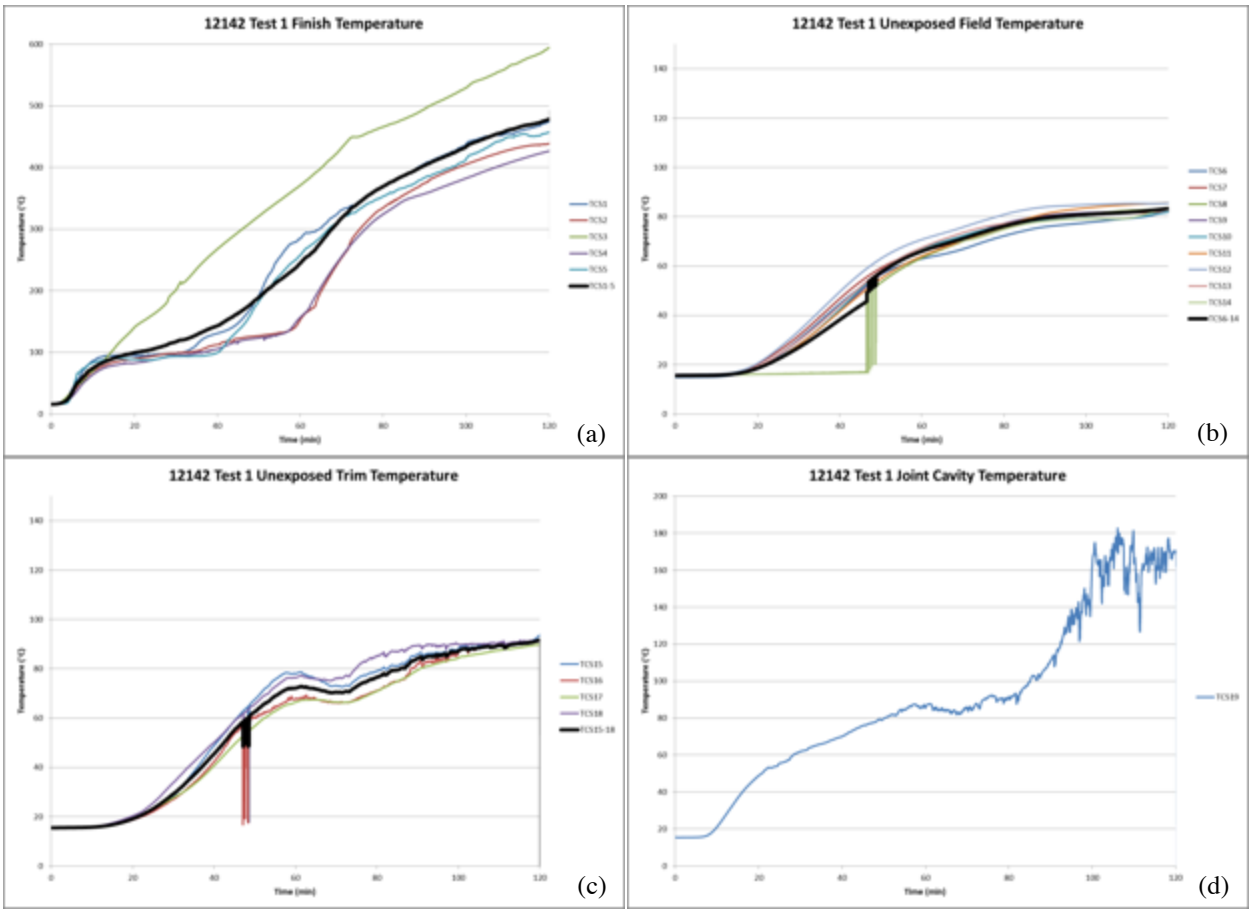


Figure 7. Sample thermocouple groups showing (a) finish TC_S, (b) field TC_S, (c) trim TC_S, and (d) joint cavity TC_S.

Displacement Data

This was a non-load-bearing wall assembly, so no vertical deflection measurements were obtained for this test. However, horizontal deflection measurements were taken every five minutes at three locations along the horizontal midline on the unexposed sample surface to monitor horizontal movement and/or buckling of the sample. It can be seen in Figure 8 that the center horizontal deflection (toward the furnace) reached up to 2" by the end of the two-hour test, with the average deflection being 1½".

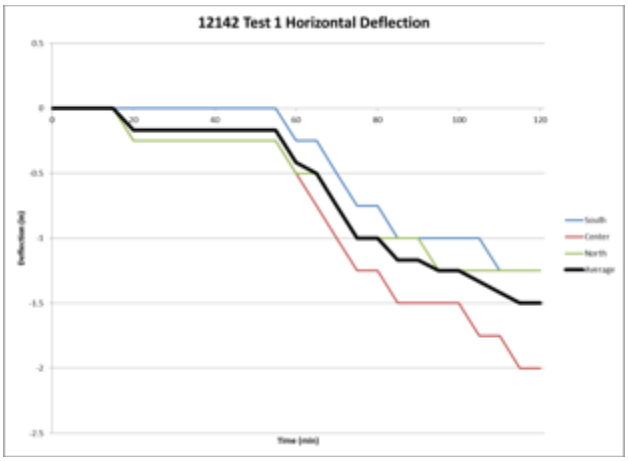


Figure 8. Horizontal deflection of wall assembly for the two-hour test exposure.

Hose-stream

Directly following the two-hour exposure, the wall assembly was pulled away from the furnace and a water hose stream (Figure 9) was applied at a pressure of 30 psi for 2 min 30 s (2½ min/100 ft^2 for 2-hr resistance, ASTM E2226, *Standard Practice for Application of Hose Stream*). No opening allowed for the penetration of water from the applied hose stream beyond the unexposed surface, therefore, passing this hose-stream requirement. It appeared that little damage was done to the base layer of GWB on the unexposed side.

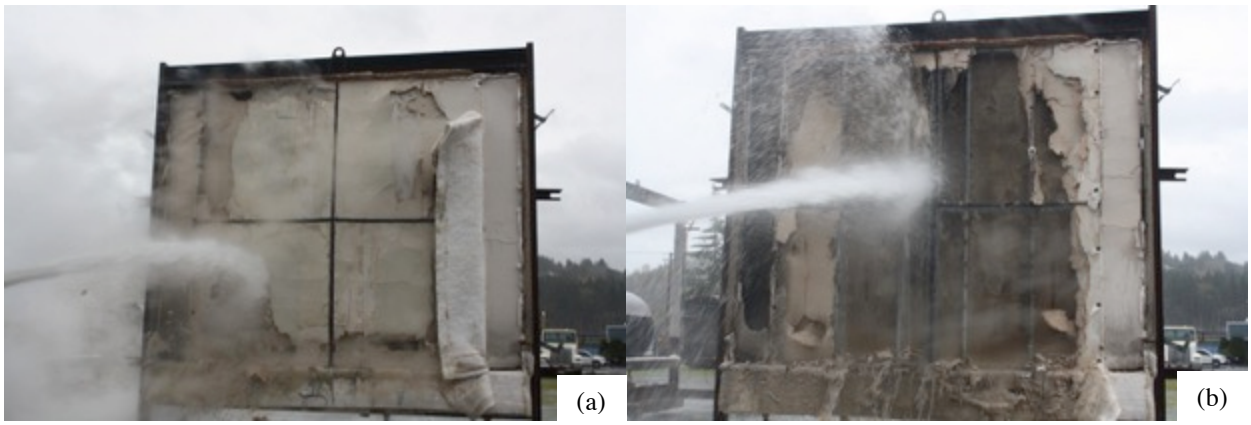


Figure 9. Test hose stream photographs showing water application near (a) the beginning and (b) the end of the test.

Qualitative Discussion

After the fire resistance and hose stream test, the exposed section of the assembly was torn completely gone, leaving only the steel FSB strips and sideways stud. The unexposed GWB was mostly intact with only some deterioration on the paper face (Figure 10). The DRM strip was removed from the assembly to analyze the FSB intumescent strip, which appeared to swell between ⅛" - ¼". It appeared that the material behaved as designed, allowing the jointed wall to pass the necessary requirements.

Figure 10. Post-test photographs showing (a) exposed assembly, (b) close-up of horizontal and vertical FSB, (c) unexposed assembly, and (d) unexposed FSB strip on unexposed side of assembly.

CONCLUSION

The wall assembly passed all requirements for the 2-hr fire endurance tests, according to ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*. The 2-hr wall assembly maintained structure its resistance period without the passage of flame or gases hot enough to ignite cotton waste or did not transmit heat through the wall assembly allowing the average temperature to supersede 139°C + ambient or the single-point temperature to supersede 181°C + ambient. In addition, the wall assembly was subjected to a hose-stream following heating (2 min 30 s hose stream) and did not develop an opening that permits the projection of water from the hose stream beyond the unexposed surface.

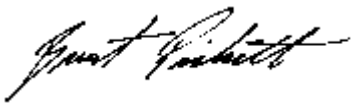
SIGNATURES

Testing performed by,

Mike White

Laboratory Manager

Reviewed and Approved by,



Brent M. Pickett, Ph.D.

Technical Director

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The test specimen identification is as provided by the client and WFCi accepts no responsibilities for any inaccuracies therein. WFCi did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

Version	Date Issued	Document Number	Changes
Original	November 20, 2012	12142	Original report
Revision 1	July 28, 2017	12142r1	Changed company name from BlazeFrame to Safti-Seal.