

CLIENT:

International Fireproof Technology, Inc.
17528 Von Karman Ave.
Irvine, CA 92614

And

International Carbide Technology
No. 1-17, Toa-Chan, 13 Ling
Lu-Chu Hsiang
Kern-Ko Village
Taiwn, Rep, of China

Test Report No: TJ3568 Rev 1

Date: April 1, 2016

SUBJECT: Wall assemblies evaluated in accordance with Technical Guide for Intumescent Coating as a Thermal Barrier over Spay Urethane Insulation (Master Format 09 96 48) Appendix F

PRODUCT EVALUATED: Client refers to samples received as "SWD Quick-Shield 112 F, 2lb closed cell spray applied polyurethane foam (CCMC #13555-L) with 18 mil wft of International Fireproof Technology DC315" and "SWD Quick-Shield 112 F, 2lb closed cell spray applied polyurethane foam (CCMC #13555-L) with 3 mil primer and 24 wft of International Fireproof Technology DC315". This project was entered into our receiving system on 02/01/16 in good condition.

TEST REQUESTED: Technical Guide for Intumescent Coating as a Thermal Barrier over Spay Urethane Insulation (Master Format 09 96 48) Appendix F (Mechanical Protection of Insulation). The referenced procedure was used to generate this report and data obtained from the test identified in the subsequent pages. After the the "Concontracted Load Following Impact Load" procedure was concluded the spray foam assemblies were subjected to fire resistance client defined protocol defined in the Appendix of this report.

SAMPLING DETAIL: Foam Barrel samples (Polyol Lot # 000231 and ISO Lot # 000322) were randomly selected and sealed by Intertek representative John H. Waskow on December 18, 2015. The foam components arrived at and were verified by QAI Laboratories on January 27, 2016. Construction of the assemblies, application of SWD Quick-Shield polyurethane foam insulation, and subsequent covering of the foam with DC315 was witnessed by QAI in accordance with Section 3.3 of ICC-ES AC85. International Fireproof Technology, Inc. is part of WHI 3rd party inspection program. The DC315 used on this test (Batch# 1647) was randomly selected and sealed by Intertek representative Freddy Soto on September 21st, 2015. QAI Laboratories verified the seals and inspector marks upon receipt at the laboratory on September 25th, 2015.

TEST DATE: February 16, 2016 to February 24, 2016


AUTHORIZATION: Signed proposal SP-2016-012604 by Johnny Chang February February 3, 2016

TEST RESULTS: Detailed test results are presented in the subsequent pages of this report.

Prepared By

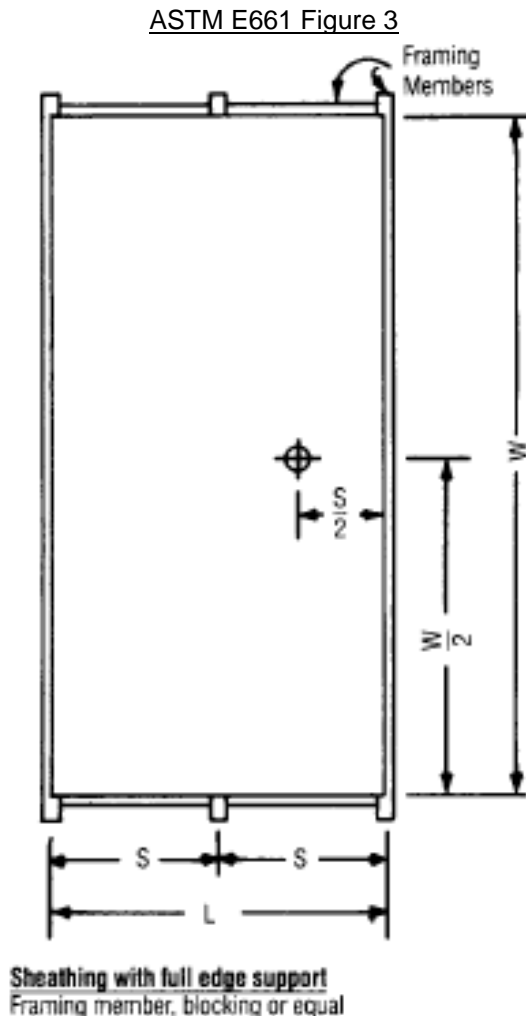

Rocky Hale
Materials Test Technician

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


J. Brian McDonald
Operations Manager

ASSEMBLY DETAILS

Note: The below assembly configuration was utilized in all the testing outlined in this test report. Premium grade 2X4's were utilized in the frame construction of the 4 foot by 8 foot assemblies and a stud placed 24 inches on center as shown in the figure below:



Four assemblies were constructed. The first assembly was covered with Gerogia-Pacific ToughRock 3/8 inch gypsum board and fastened to the assembly every 12 inches with Grip-Rite #8 black phosphate drywall screws. The second assembly was covered with Gerogia-Pacific ToughRock 1/2 inch gypsum board and fastened to the assembly every 12 inches with Grip-Rite #8 black phosphate drywall screws. The third assembly was covered with Gerogia-Pacific ToughRock 1/2 inch gypsum board, fastened to the assembly every 12 inches with Grip-Rite #8 black phosphate drywall screws, the drywall was sprayed with approximately 3-1/2 inches of SWD Quick-Shield 112 F spray applied foam, and the foam was coated with 18 mil (wft) of DC315. The fourth assembly was covered with Gerogia-Pacific ToughRock 1/2 inch gypsum board, fastened to the assembly every 12 inches with Grip-Rite #8 black phosphate drywall screws, the drywall was sprayed with approximately 3-1/2 inches of SWD Quick-Shield 112 F spray applied foam, and the foam was coated with 3 mil (wft) primer and 24 mil (wft) of DC315.

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TEST PROCEDURE

Concentrated Static Load

The load was applied to a 3" diameter disk using a hydraulic cylinder. The loads were measured using a calibrated load cell which transmitted a readout, in pounds, to a digital display. A dial indicator was set on a steel plate tab located on the load pin and was held in place by a similar fixture as that described in Section 5.1.4 of ASTM E661

An initial deflection reading was taken at 0 lbs. of force. Load was then increased at an approximate rate of 0.2" inches/minute. The load was applied to the ultimate load at failure (Fult) and the load/deflection curve was observed.

Impact Load Test

A leather drop bag outlined in section in section 6.2 of ASTM E661 with a load of 30 lbs specified in Table 1 of ASTM E661 was then raised 6" above the concentrated load point using a hoist and a quick-release latch. Once the bag was stable the latch was released, the bag fell on the substrate and was then moved from the impact point, and any visible deformations were noted. Again the concentrated load was applied to half of the ultimate load of the greatest drywall covered assembly (Fult/2) obtained through the concentrated static load testing. If the panel supported half the ultimate load of the greatest drywall covered assembly (Fult/2) then the impact height was increased 6 inches and the concentrated load utilizing half of the ultimate load (Fult/2) was repeated until failure was observed. The results are recorded below:

Falling Ball Impact

A 62.5mm steel ball weighing 1 kg was dropped on the assemblies from a height starting at 6 inches and was removed immediately after the initial impact ensuring that the ball did not impact the surface again. If no substrate failure was observed the height was increased 6 inches until substrate failure occurred. Following this procedure three specimens of each assembly was evaluated to failure.

RESULTS

Concentrated Load Test

Assembly (1): 3/8 inch gypsum covering				
Test Results	Sample 1	Sample 2	Sample 3	Average
Deflection at Ultimate Load	0.1012	0.0983	0.0963	0.0986
Ultimate Load, lbs	156	147	159	154

Assembly (2): 1/2 inch gypsum covering				
Test Results	Sample 1	Sample 2	Sample 3	Average
Deflection at Ultimate Load	0.0981	0.0924	0.0951	0.0952
Ultimate Load, lbs	181	183	186	183

Assembly (3): SWD Quick-Shield 112 F spray applied foam and the foam was coated with 18 mil (wft) of DC315				
Test Results	Sample 1	Sample 2	Sample 3	Average
Deflection at Ultimate Load	0.0912	0.0932	0.0981	0.0941
Ultimate Load, lbs	376	372	381	376

Assembly (4): SWD Quick-Shield 112 F spray applied foam, and the foam was coated with 3 mil (wft) primer and 24 mil (wft) of DC315				
Test Results	Sample 1	Sample 2	Sample 3	Average
Deflection at Ultimate Load	0.0234	0.0251	0.0274	0.0253
Ultimate Load, lbs	423	428	416	423

RESULTS (Continued)

Impact Load Test

Assembly (1): 3/8 inch gypsum covering				
Test Results	Sample 1	Sample 2	Sample 3	Average
Ultimate Impact Height Observed	< 6 inches	< 6 inches	< 6 inches	< 6 inches
Impact Failure Point	NA	NA	NA	-
Proof Load	NA	NA	NA	-
Deflection @ Proof Load	NA	NA	NA	-

Assembly (2): 1/2 inch gypsum covering				
Test Results	Sample 1	Sample 2	Sample 3	Average
Ultimate Impact Height Observed	6 inches	6 inches	6 inches	6 inches
Impact Failure Point	12 inches	12 inches	12 inches	-
Proof Load @ 6" Impact, lbs	92	92	92	92
Deflection @ Proof Load	0.0489	0.0514	0.0503	0.0502

Assembly (3): SWD Quick-Shield 112 F spray applied foam and the foam was coated with 18 mil (wft) of DC315				
Test Results	Sample 1	Sample 2	Sample 3	Average
Ultimate Impact Height Observed	18 inches	18 inches*	18 inches*	18 inches*
Impact Failure Point	>30 inches*	>30 inches*	>30inches*	-
Load ¹ @ 18" Impact, lbs	183	183	183	183-
Deflection @ Proof Load	0.0580	0.0390	0.0480	0.0483

*small chips less than 1/2" in diameter of coating delaminated from the foam substrate was observed after the 18" drop height.

Assembly (4): SWD Quick-Shield 112 F spray applied foam, and the foam was coated with 3 mil (wft) primer and 24 mil (wft) of DC315				
Test Results	Sample 1	Sample 2	Sample 3	Average
Ultimate Impact Height Observed	24 inches	24 inches*	24 inches*	24 inches*
Impact Failure Point	>30 inches*	>30 inches*	>30inches*	-
Load ¹ @ 24 Impact", lbs	183	183	183	183-
Deflection @ Proof Load	0.0623	0.0419	0.0536	0.0526

*small chips less than 3/16" in diameter of coating delaminated from the foam substrate was observed after the 18" drop height.

Note¹: 183 lbs was utilized as the concentrated load following the impact to demonstrate the comparison to the ultimate load of 1/2 inch gypsum

RESULTS (Continued)

Falling Ball Impact

Assembly (1): 3/8 inch gypsum covering				
Test Results	Sample 1	Sample 2	Sample 3	Average
Impact Failure Point (Front)	42 inches	42 inches	36 inches	42 inches
Impact Failure Point (Back)	30 inches	30 inches	30 inches	30 inches
Impact Failure Point (Complete Penetration)	72 inches	68 inches	72 inches	72 inches

Assembly (2): 1/2 inch gypsum covering				
Test Results	Sample 1	Sample 2	Sample 3	Average
Impact Failure Point (Front)	42 inches	42 inches	42 inches	42 inches
Impact Failure Point (Back)	24 inches	24 inches	24 inches	24 inches
Impact Failure Point (Complete Penetration)	78 inches	78 inches	72 inches	78 inches

Assembly (3): SWD Quick-Shield 112 F spray applied foam and the foam was coated with 18 mil (wft) of DC315				
Test Results	Sample 1	Sample 2	Sample 3	Average
Impact Point @ Defined Cracking ¹	48 inches	48 inches	48 inches	48 inches
Impact Failure Point (Complete Penetration) ²	Not Observed	Not Observed	Not Observed	-




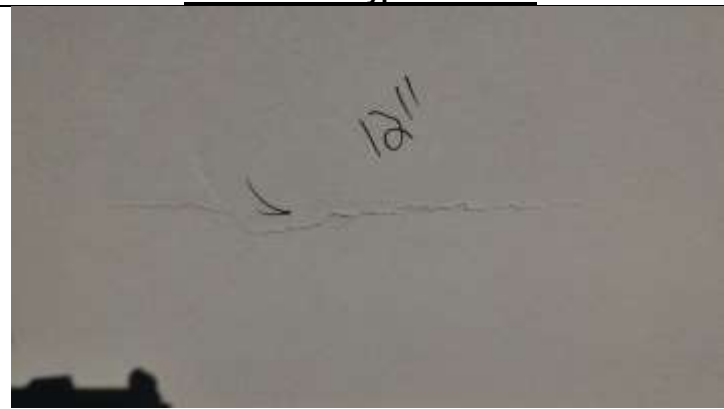
Assembly (4): SWD Quick-Shield 112 F spray applied foam, and the foam was coated with 3 mil (wft) primer and 24 mil (wft) of DC315				
Test Results	Sample 1	Sample 2	Sample 3	Average
Impact Point @ Defined Cracking ¹	48 inches	48 inches	48 inches	48 inches
Impact Failure Point (Complete Penetration) ²	Not Observed	Not Observed	Not Observed	-

Note¹: The height that defined cracking was observed is characterized as consistent cracking of the coating in the surface of the assembly. The observed cracking does not constitute a failure of the fire resistant characteristics of the coating (see pictures on page 10)

Note²: Complete penetration of the coating or complete exposure of spray applied foam was not observed

PICTURES

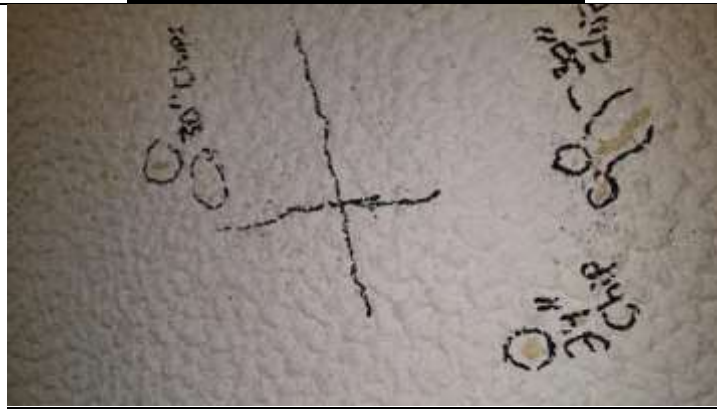



ASTM E661 Impact Pictures (Gypsum Assemblies)

<p><u>Assembly (1): 3/8 inch gypsum covering Failure @ 6" Impact</u> <u>Backside of Gypsum Board</u></p> 	<p><u>Assembly (1): 3/8 inch gypsum covering Failure @ 6" Impact</u> <u>Frontside of Gypsum Board</u></p> 
<p><u>Assembly (2): 1/2 inch gypsum covering Failure @ 12" Impact</u> <u>Backside of Gypsum Board</u></p> 	<p><u>Assembly (1): 1/2 inch gypsum covering Failure @ 12" Impact</u> <u>Frontside of Gypsum Board</u></p> 

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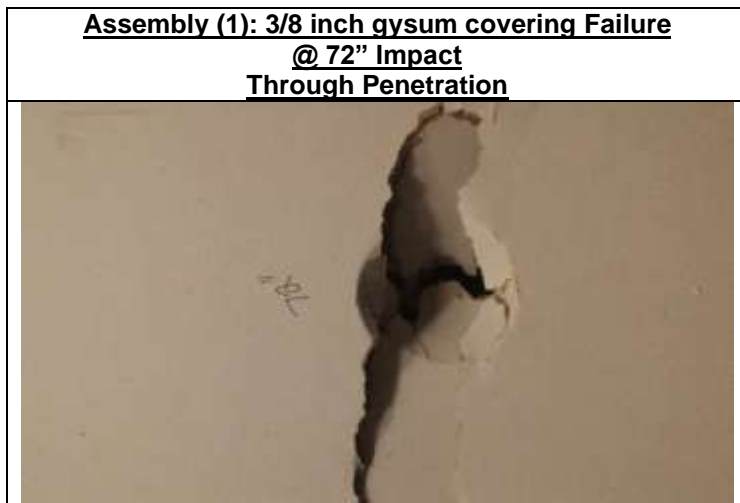
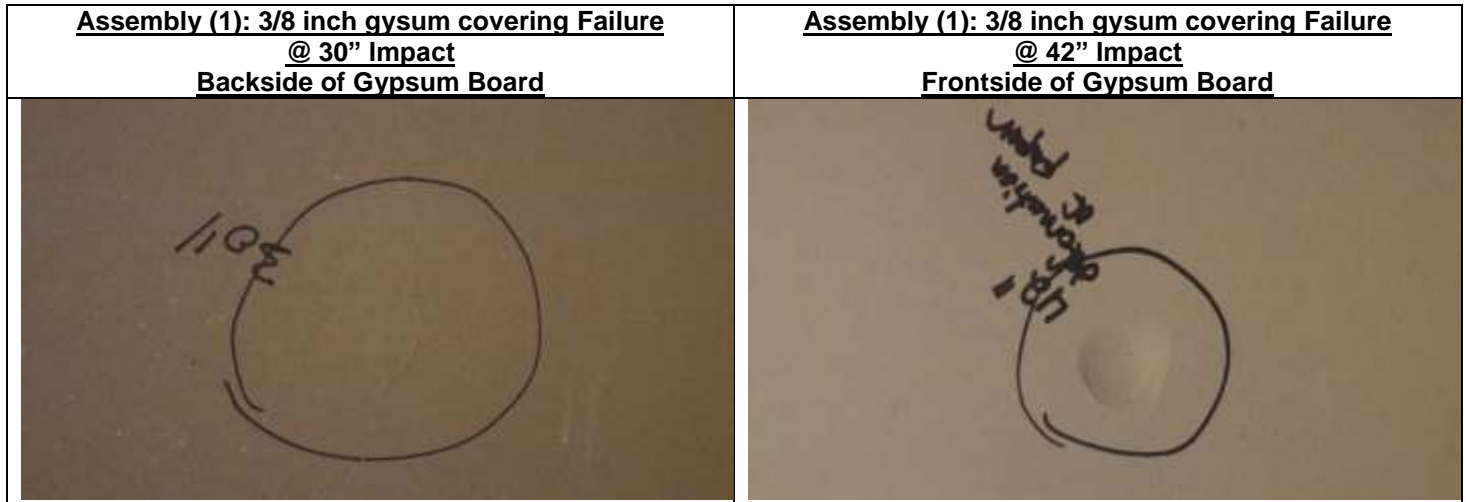
PICTURES (Continued)

ASTM E661 Impact Pictures (SPF Assemblies)

<p><u>Assembly (3): 18 mil (wft) of DC315 Coating Delamination @ 24" and 30" Impact</u></p>	<p><u>Assembly (3): 18 mil (wft) of DC315 Coating Delamination @ 30" Impact</u></p>
	
<p><u>Assembly (4): 3 mil (wft) primer and 24 mil (wft) of DC315 Delamination @ 30" Impact</u></p>	<p><u>Assembly (4): 3 mil (wft) primer and 24 mil (wft) of DC315 Delamination @ 30" Impact</u></p>
	


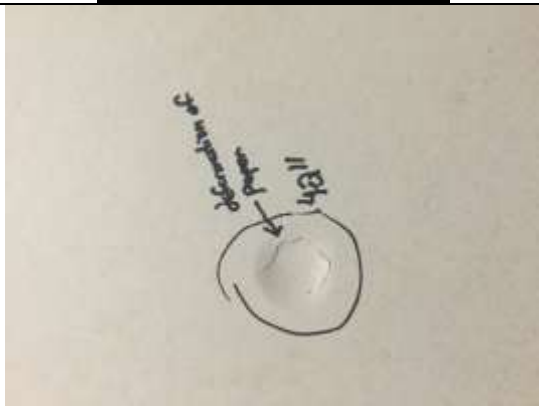
PICTURES (Continued)

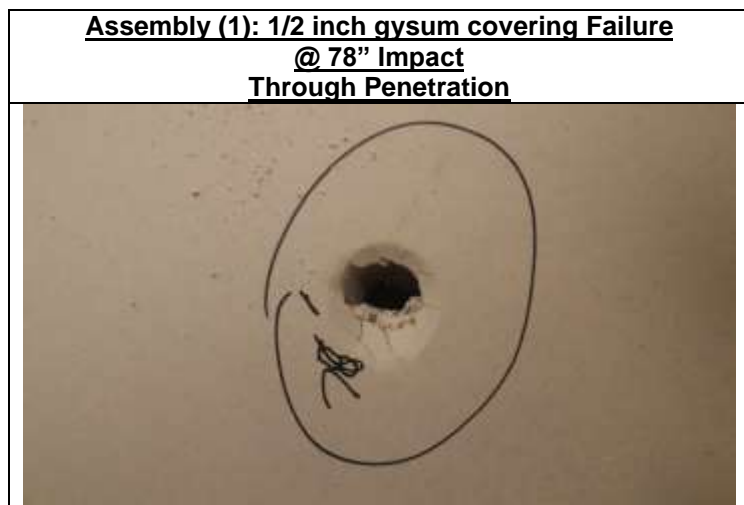
Ball Impact Pictures (Gypsum Assemblies)



PICTURES (Continued)

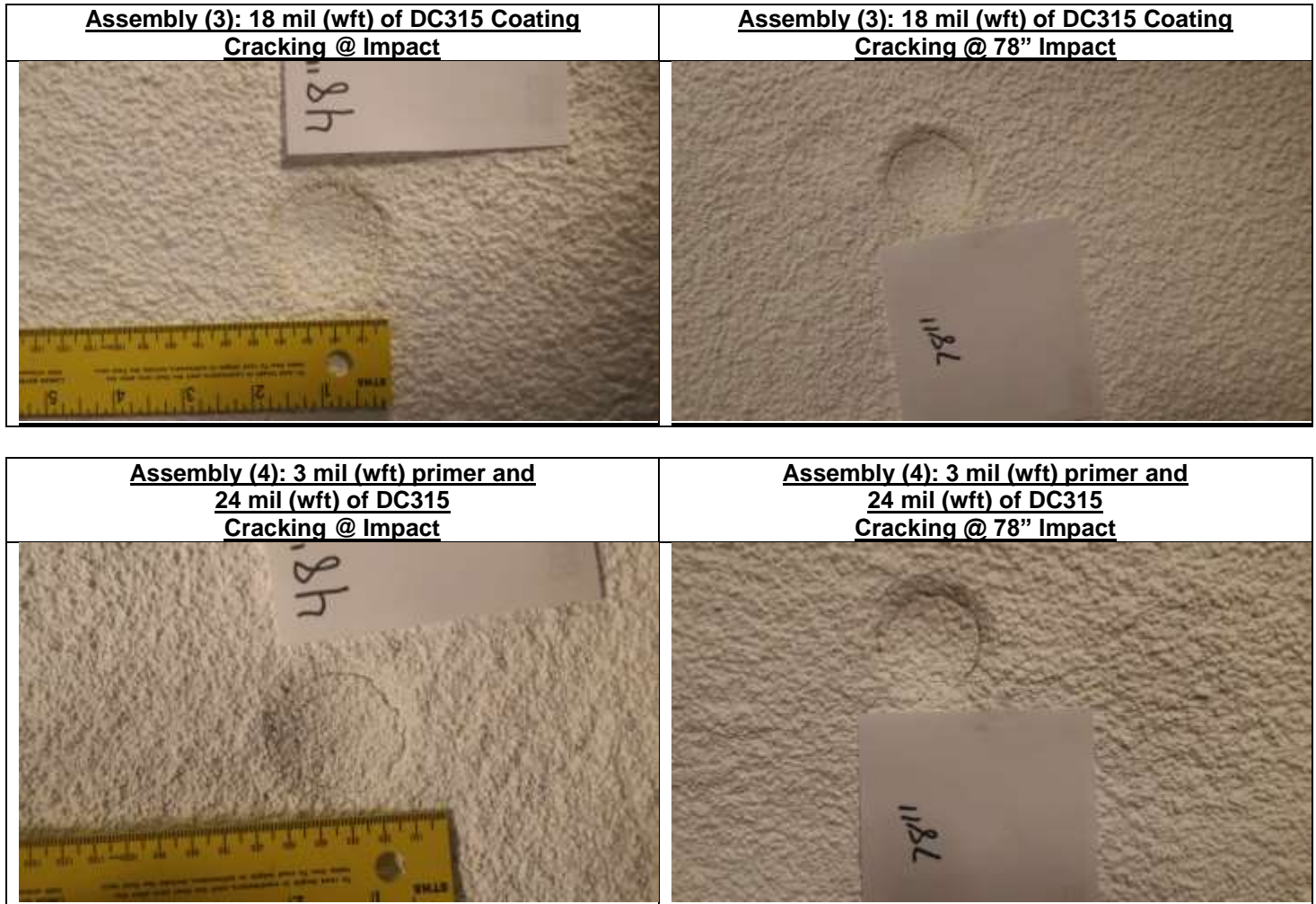
Ball Impact Pictures (Gypsum Assemblies)

<p><u>Assembly (1): 1/2 inch gypsum covering Failure @ 24" Impact</u> <u>Backside of Gypsum Board</u></p>	<p><u>Assembly (1): 1/2 inch gypsum covering Failure @ 42" Impact</u> <u>Frontside of Gypsum Board</u></p>
	



PICTURES (Continued)

Ball Impact Pictures (SPF Assemblies)



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APPENDIX A (Client Defined Fire Resistant Protocol)

- Assembly:** (1) specimen of assembly 3 (18 mil (wft) of DC315 Coating) and (1) specimen of assembly 4 (3 mil (wft) primer and 24 mil (wft) of DC315) were connected to form a 4 foot by 8 foot corner assembly.
- Ignition Source:** The ignition source for the test was a gas burner with a nominal 12 by 12 inch orifice, filled with a minimum 4 inch layer of Ottawa sand. The top surface of the burner through which the gas is applied is positioned 12 inches above the floor. The burner enclosure was placed as approximately 1 inch from each wall.
- Gas Flow:** CP Grade Propane was used for burner supply gas. A calibrated mass flow meter (Asset A300110, due for calibration 6/3/16) was used to meter flow to the burner. The 40 kW 5 minute exposure flowed 27 l/min Propane and the 160 kW exposure flowed 108 l/min Propane for an additional 10 minutes. These numbers were based upon the following constant: 1.485 kW min/l.
- Heat Release:** All Heat Release Rate information obtained during this test utilized oxygen consumption calorimetry. The equation used for calculation is as follows:

$$\dot{q} = E * 1.10 * C \sqrt{\left[\frac{\Delta p}{T_e} \right]} * \left[\frac{(X_{O_2}^{A^*} - X_{O_2}^A)}{1 + \phi + (\alpha - 1)} \right]$$

Visual Observations:

- 0:00:00 – Sand diffusion burner lit to 40 kW flame
- 0:01:00 – Very light smoke and no contribution from wall
- 0:02:00 – Flame height leveling off at around 4 feet from floor
- 0:03:00 – Continued light smoke development, very little contribution from assembly, impact point ignited with very little contribution
- 0:04:00 – Continued light smoke development, very little contribution from assembly, an additional impact point approximately 1 inch below the burner ignited with very little contribution
- 0:05:00 – Sand diffusion burner increased to 160 kW flame, impact points that ignited have intumesced and no further flaming was observed.
- 0:06:00 – Cracking of char layer on left side wall approximately 2 feet above burner and right side wall approximately 3 feet above burner is causing sparatic flaming
- 0:08:00 – Little change in conditions above to coating and foam, wood framing at the top of the assembly has ignited
- 0:10:00 – Little change in conditions above
- 0:12:00 – Wood framing ignition has increased at the top of the assembly
- 0:13:00 – Continued steady performance
- 0:14:00 – Fairly steady flame intensity and smoke developed throughout test
- 0:15:00 – Test concluded, charing of coating and spray applied foam did not extend past the width of the burner flames. There was no contribution of combustion outside of the flames provided by the burner.

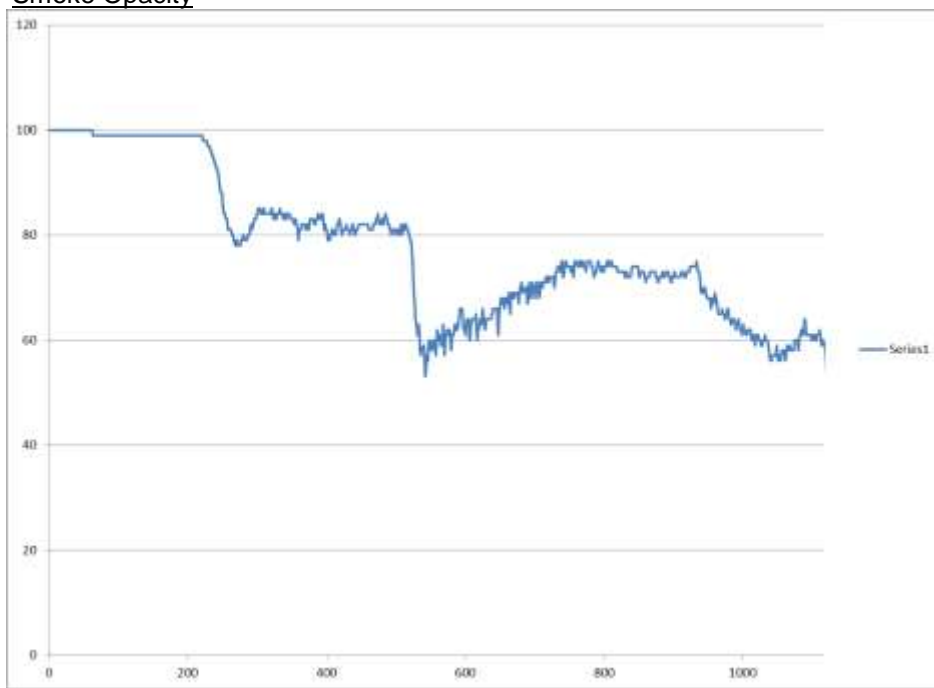
APPENDIX A (Continued)

Flame Spread Observation: Flame spread of the sample was minimal. Almost no visible contribution from the test sample was noted around flames from burner for the first 5 minutes of test. From that point forward there was no significant contribution of material to the intensity of flaming. Flames did not reach the extremities of the test module.

Smoke Density: A peak duct smoke value of 22% (78% obscured) and a Peak Smoke Release Rate was measured to be 1.19 m²/s 14 minutes and 39 seconds after ignition. The smoke obscuration reading was taken in the center of a 16 inch diameter duct.

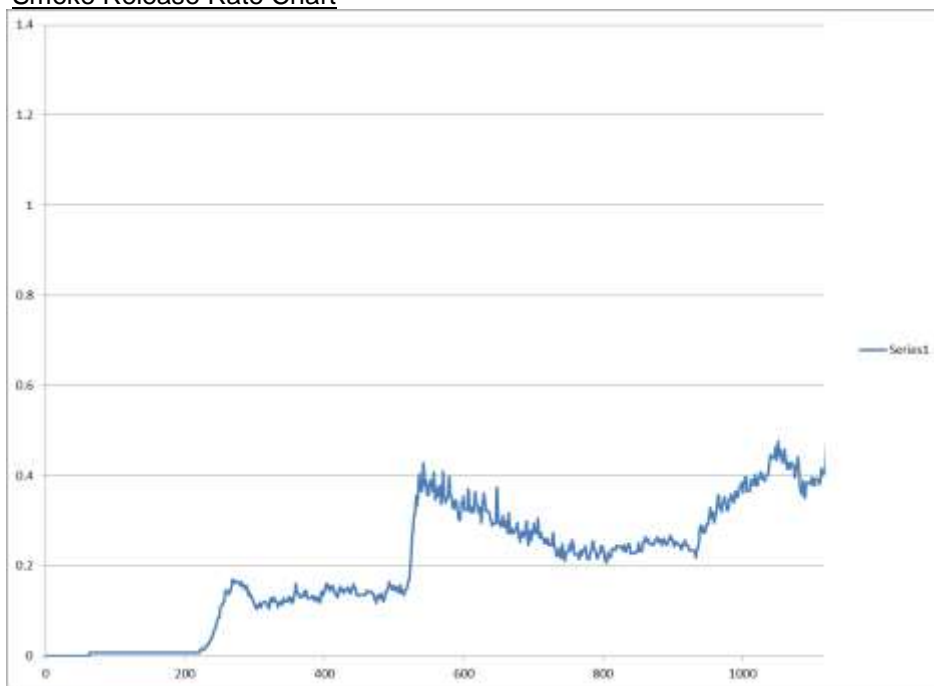
Peak Heat Release: The heat release measured was 317 kW at 14 minutes 1 second into test.

Charts: Smoke Opacity

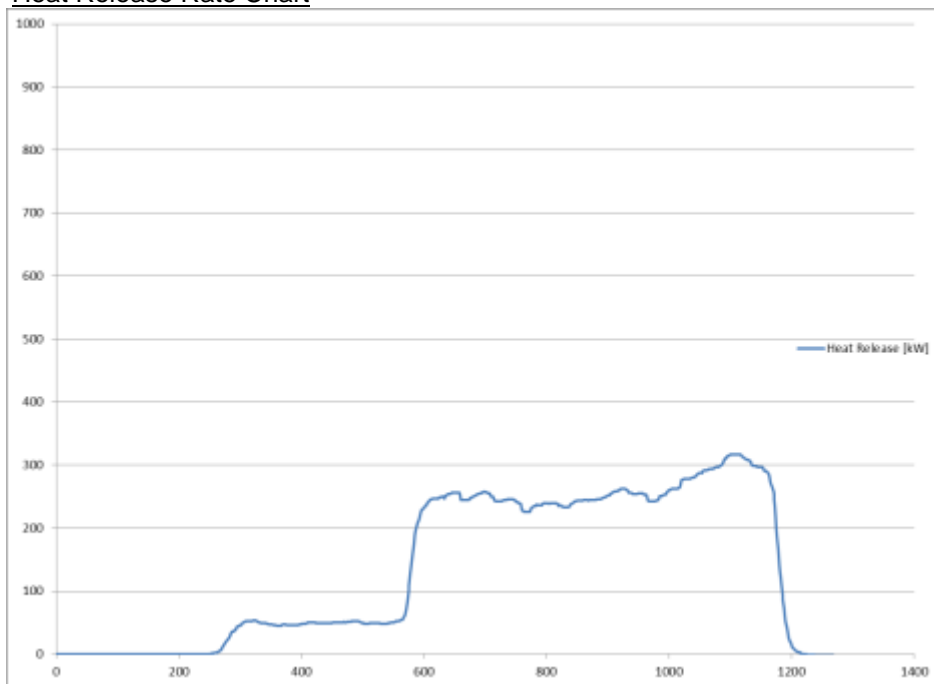


APPENDIX A (Continued)

Smoke Release Rate Chart



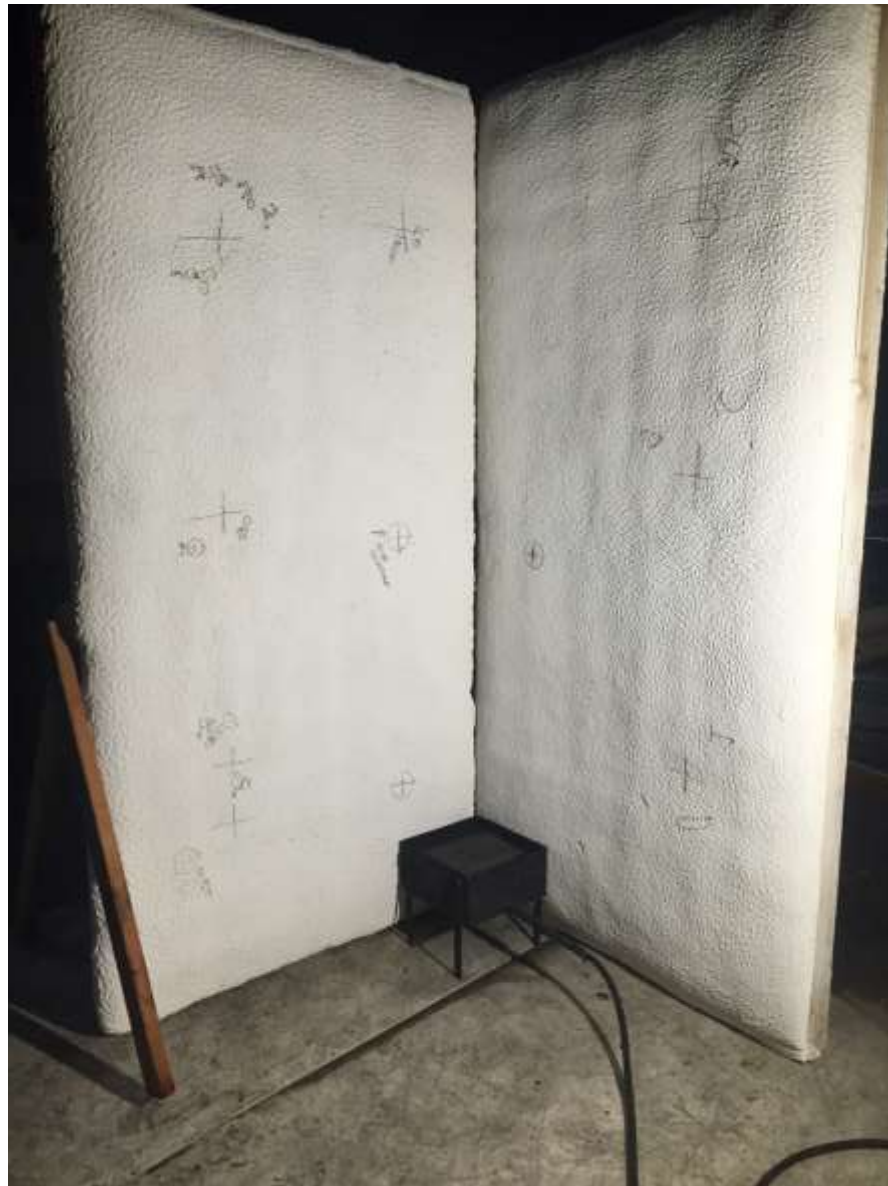
Heat Release Rate Chart



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APPENDIX A (Continued)

Assembly Picture:



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APPENDIX A (Continued)

Test Pictures:

5 Minutes



10 Minutes



15 Minutes



After Pictures:

Wood Frame Ignition



Wood Frame Ignition



Extinguished Assembly



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APPENDIX B (Adhesion to Substrate)

Specimens: (5) specimens approximately 4" X 4" were removed from assembly 3 (18 mil (wft) of DC315 Coating) and (5) specimens approximately 4" X 4" were removed assembly 4 (3 mil (wft) primer and 24 mil (wft) of DC315).

Conditioning: The coating film, applied and dried 'as specified' and then subjected for 7 days to the environmental conditions of 35°C and 92% relative humidity.

Tape Used: Permaccel 99

Results:

Specimen Description	Specimen ID	Adhesion Rating	
SPF Foam / 18 Wet Mils	18-1	2A	Jagged removal along most of incisions up to 3.2 mm (1/8 in.) on either side,
SPF Foam / 18 Wet Mils	18-2	3A	Jagged removal along most of incisions up to 1.6 mm (1/16 in.) on either side,
SPF Foam / 18 Wet Mils	18-3	3A	Jagged removal along most of incisions up to 1.6 mm (1/16 in.) on either side,
SPF Foam / 18 Wet Mils	18-4	2A	Jagged removal along most of incisions up to 3.2 mm (1/8 in.) on either side,
SPF Foam / 18 Wet Mils	18-5	2A	Jagged removal along most of incisions up to 3.2 mm (1/8 in.) on either side,
Average Rating:		2A	
Minimum Rating		2A	
Maximum Rating		3A	

Specimen Description	Specimen ID	Adhesion Rating	
SPF Foam / 3+24 Wet Mils	P1	5A	No peeling or removal,
SPF Foam / 3+24 Wet Mils	P2	4A	Trace peeling or removal along incisions or at their intersection
SPF Foam / 3+24 Wet Mils	P3	5A	No peeling or removal,
SPF Foam / 3+24 Wet Mils	P4	5A	No peeling or removal,
SPF Foam / 3+24 Wet Mils	P5	5A	No peeling or removal,
Average Rating:		5A	
Minimum Rating		4A	
Maximum Rating		5A	

APPENDIX B (Continued)

Specimen Pictures:

SWD Quick-Shield 112 F spray applied foam and 18 mil (wft) of DC315 Coating



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APPENDIX B (Continued)

SWD Quick-Shield 112 F spray applied foam and 3 mil (wft) primer and 24 mil (wft) of DC315.



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Instrumentation List

Equipment Description	Certificate No./Asset No.	Calibration Performed	Calibration Due
1" Dial Indicator	15299-1304	10/26/15	10/31/16
1" Dial Indicator with 3" Disk	15299-1311	10/26/15	10/31/16
6" Micrometer	799370	7/21/15	7/21/16
25' Measuring Tape	15301-1301	10/28/15	10/31/16
Weight Scale	15299-0515	10/26/16	10/31/16
Load Cell	849477	12/15/15	12/15/17

*** END OF TEST REPORT ***