(Modified) NFPA 286 / AC 377 Appendix X
PERFORMANCE TEST REPORT

Report No.: F9961.05-121-24
Test Date: July 28, 2016

Rendered to:

FOAM SYSTEMS, LLC
New Canaan, Connecticut

PRODUCT TYPE: Spray Polyurethane Foam
SERIES/MODEL: ThermoSeal FlameGuard 500

This report contains in its entirety:

Cover Page:	1 page
Report Body:	7 pages
Graphical Data:	4 pages
Photographs:	2 pages

1.0 Report Issued To: Foam Systems, LLC
PO Box 32
New Canaan, Connecticut 06840

2.0 Test Laboratory: Architectural Testing, Inc., an Intertek company ("Intertek-ATI")
130 Derry Court
York, Pennsylvania 17406-8405
717-764-7700

3.0 Test Method Information:

3.1 Introduction: The objective of this testing is to evaluate the fire performance of spray-applied foam plastic insulation materials when tested in a room/ corner test configuration to determine if the insulation and/or the insulation system is acceptable for use in attics and crawl spaces without prescriptive ignition barriers per the IRC or IBC. (AC377 X1.1)

This method is to be used to evaluate the flammability characteristics of finish wall and ceiling coverings when such materials constitute the exposed interior surfaces of buildings. This test method does not apply to fabric covered less than ceiling height, freestanding, prefabricated panel furniture systems or demountable, relocatable, full-height partitions used in open building interiors. Freestanding panel furniture systems include all freestanding panels that provide visual and/or acoustical separation and are intended to be used to divide space and may support components to form complete work stations.

This fire test measures certain fire performance characteristics of spray-applied foam plastic insulation materials in an enclosure under specified fire exposure conditions. It determines the extent to which the materials may contribute to fire growth in a room and the potential for fire spread beyond the room under the particular conditions simulated. The test indicates the maximum extent of fire growth in a room, the rate of heat release, and if they occur, the time to flashover and the time to flame extension beyond the doorway following flashover. It does not measure the fire growth in, or the contribution of, the room contents. Time to flashover is defined herein as either the time when the radiant flux onto the floor reaches 20 kW/m^2 or the temperature of the upper air reaches 600°C. A pair of crumpled single sheets of newspaper is placed on the floor 2 feet out from the center of the rear wall and front walls to determine flashover. The spontaneous ignition of this newspaper provides the visual indication of flashover.

The heat release rate is measured using the oxygen consumption method. Oxygen consumption method requires the measurement of gas levels in the exhaust duct. During the test, the combustion gases are collected in a hood and a sample of this is gas is extracted and analyzed. The sampled gas is analyzed for levels of oxygen, carbon dioxide, carbon monoxide, temperature, and pressure. These variables when used in conjunction with equations in Chapter 10 of NFPA 286 allow us to calculate heat release rate.

3.0 Test Method Information: (continued)

The potential for spread of fire to other objects in the room, remote from the ignition source, is evaluated by measurements of:

1. The total heat flux incident on the center of the floor.
2. A characteristic upper-level gas temperature in the room.
3. Instantaneous net peak rate of heat release.

The potential for the spread of fire to objects outside the room of origin is evaluated by the measurement of the total heat release of the fire.

It is important for the user of fire standards and data generated from them to understand the method only exposes the system to one standard exposure. The standard does not address every possible scenario or hazard associated with an actual fire.

3.2 Ignition Source: The ignition source for the test is a gas burner with a nominal 12- by 12-inch porous top surface of a refractory material. The burner used at this laboratory is 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 is placed adjacent with both walls in the corner of the room opposite from the door in accordance with AC377 Section X2.1.1.

Maximum values of the burner distance were verified to be:

$S_0 = .25$	$B_0 = .125$
$S_3 = .875$	$B_3 = .25$
$S_6 = 1$	$B_6 = .5$
$S_9 = 1.25$	$B_9 = .5$
$S_{12} = .875$	$B_{12} = .625$

$S_{Avg} = (S_0, S_3, S_6, S_9, S_{12}) = .85$ in. ≤ 1 in

$B_{Avg.} = (B_0, B_3, B_6, B_9, B_{12}) = 0.4$ in. ≤ 1 in.

$S_{Max} = 1.25 \leq 2$ in.

$B_{Max} = .625 \leq 2$ in.

The gas supply to the burner is C.P. grade propane (99 percent purity). The burner is capable of producing a gross heat output of 40±1 kW for five minutes. The flow rate is metered throughout the test. The gas burners are controlled with mass flow meters to control the volume of gas to match the heat outputs of the standard.

3.0 Test Method Information: (continued)

3.3 Procedure: A calibration test is run within 30 days of testing any material as specified in the standard. All instrumentation is zeroed, spanned and calibrated prior to testing. The specimen is installed and the diffusion burner is placed. The collection hood exhaust duct blower is turned on and an initial flow is established. The gas sampling pump is turned on and the flow rate is adjusted. When all instruments are reading steady state conditions, the computer data acquisition system and video equipment is started. Ambient data is taken then the burner is ignited at a fuel flow rate that is known to produce 40 kW of heat output. This level is maintained for five minutes at which time the fuel flow is stopped. During the burn period, all temperature, heat release and heat flux data is being recorded every at least every 6 seconds. At the end of the five minute burn period, the burner is shut off and all instrument readings are stopped. Post-test observations are made and this concludes the test.

All damage is documented after the test is over, using descriptions, photographs and drawings, as is appropriate.

4.0 Project Summary:

4.1 Product Type: Spray Polyurethane Foam

4.2 Series/Model: ThermoSeal FlameGuard 500

4.3 Compliance Statement: Results obtained are tested values and were secured by using the designated test method(s). The specimen(s) were tested and evaluated against the requirements of the standard. A summary of the results is listed in the Test Results section and the complete graphical test data is included in Appendix A of this report.

4.4 Test Date: 7/28/2016

4.5 Ambient Conditions: 81°F and 62% RH

4.6 Test Location: Intertek-ATI test facility in York, Pennsylvania

4.7 Test Sample Source: The combustible components of the test specimen were independently sampled and witnessed by Intertek personnel (initials) "KAL" on June 6, 2016, at ThermoSeal's facility in Wilton, CT. Information on sampling can be found in Intertek Sampling Project No. F9961.01. Remaining components of the assembly were acquired by Intertek-ATI personnel.

4.8 Test Method(s), Practices and/or Classifications:

4.8.1 (Modified) NFPA 286-12, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*

4.8.1.1 AC377 *Acceptance Criteria For Spray-Applied Foam Plastic Insulation*

4.8.1.2 Appendix X – *Testing for Use in Attics and Crawl Spaces with Alternatives to Code-prescribed Ignition Barrier*

4.0 Project Summary: (Continued)

4.9 List of Official Observers:

Name	Company
Cory Wuensch	Spray Foam Polymers/ThermoSeal
Ethan Grove	Intertek-ATI
Scott Gingrich	Intertek-ATI

5.0 Testing & Results:

5.1 Test Room Description: The interior dimensions of the floor of the fire room, when the specimens are in place, measures 8 feet, by 12 feet. The finished ceiling is 8 feet ± 0.5 inches above the floor. The four walls are at right angles defining the compartment. The compartment contains a 30 ± 0.25 by 80 ± 0.25 inch doorway in the center of one of the 8 feet by 8 feet walls. No other openings are present to allow ventilation. Below is a detailed description of the assembly:

Sheathing – The exterior of the test room wall and ceiling were clad with 5/8 inch thick National Gypsum Gold Bond® Fire-Shield® Gypsum Board meeting ASTM C 1396. The gypsum board sheets were fastened to the framing members with 1-1/4 inch long type W drywall screws every 8 inches around the perimeter of the board and every 12 inches in the field of the board. All joints were taped with USG Sheetrock® Brand paper joint tape, and spackled with USG Sheetrock® Brand Joint Compound.

Framing – The test room walls were constructed out of Spruce/Pine/Fir, 2 x 6 dimensional lumber spaced every 24 inches on center. The studs were fastened to the sill and header plated with (2) 16d framing nails per plate/stud connection. The test room ceiling was constructed out of Spruce/Pine/Fir, 2 x 12 dimensional lumber spaced every 24 inches on center. The studs were fastened to the sill and header plated with (2) 16d framing nails per plate/stud connection.

Insulation – ThermoSeal FlameGuard 500 was sprayed into each wall and ceiling stud cavity area to the full stud thickness. The foam, when cured, was not cut flush with the narrow plane of the wall studs and ceiling joists. Hose temperature was verified to be 121°F during application.

5.2 Test Observations:

Time (min:sec)	Observations
00:00	Ignition of burner. Heat output set at 40 kW.
00:08	Ignition of foam in the area of the flame plume.
05:00	Flames propagated to 3 feet above the burner.
05:05	Gas flow terminated. Test concluded per client request.

5.0 Testing & Results: (Continued)

5.3 Test Results:

AC 377 Annex X Conditions of Acceptance	Test Observations	Pass/Fail
X2.1.4.a: Time at which the Heat Release Rate exceeds 1 MW.	**Heat Release Rate did not exceed 1 MW before 4 minutes and 18 seconds.**	**PASS**
X2.1.4.b: Time at which the heat flux to the floor exceeds 20 kW/m².	**The heat flux on the floor did not exceed 20 kW/m² before 4 minutes and 18 seconds.**	**PASS**
X2.1.4.c: Time at which the average upper layer temperature exceeds 600ºC.	**The average upper layer temperature did not exceed 600°C before 4 minutes and 18 seconds.**	**PASS**
X2.1.4.d: Time at which flames exit the doorway.	**Flames did not exit the doorway before 4 minutes and 18 seconds.**	**PASS**

5.4 Test Conclusion:

The material provided to Intertek-ATI from Foam Systems, LLC, and described in this report met the condition of acceptance outlined in AC377-12, *Acceptance Criteria for Spray-Applied Foam Plastic Insulation*, Appendix X.

Intertek-ATI will service this report for the entire test record retention period. Test records that are retained such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Intertek-ATI for the entire test record retention period.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimen(s) tested. This report may not be reproduced, except in full, without the written approval of Intertek-ATI.

For INTERTEK-ATI:

Digitally Signed by: Ethan Grove

Ethan Grove
Project Manager – Fire Testing

Digitally Signed by: Karl Houser

Karl D. Houser, P.E.
Sr. Fire Protection Engineer – Fire Testing

EJG:ddr

Attachments (pages): This report is complete only when all attachments listed are included.
Appendix A: Graphical Data (4)
Appendix B: Photographs (4)

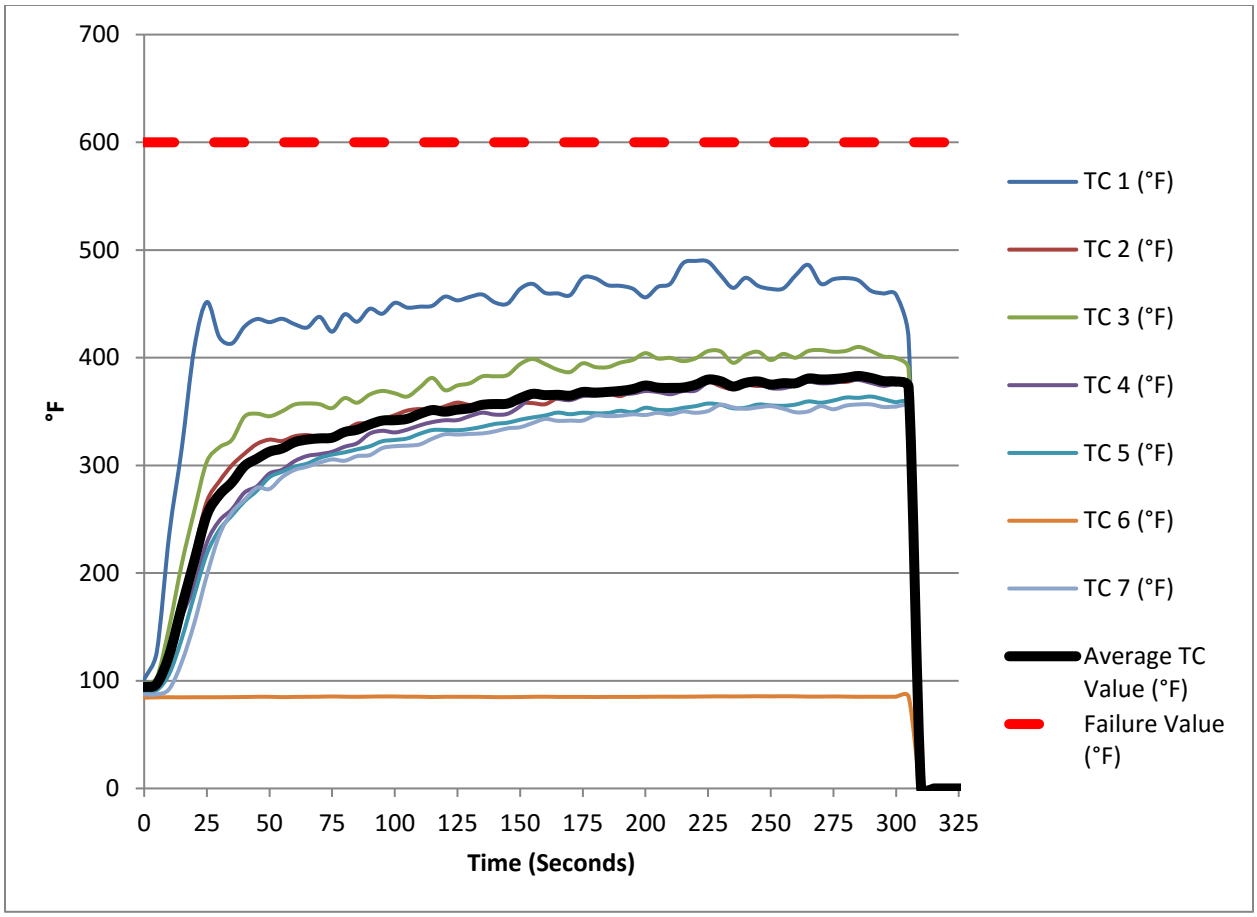
Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	8/19/2016	N/A	Original Report Issue

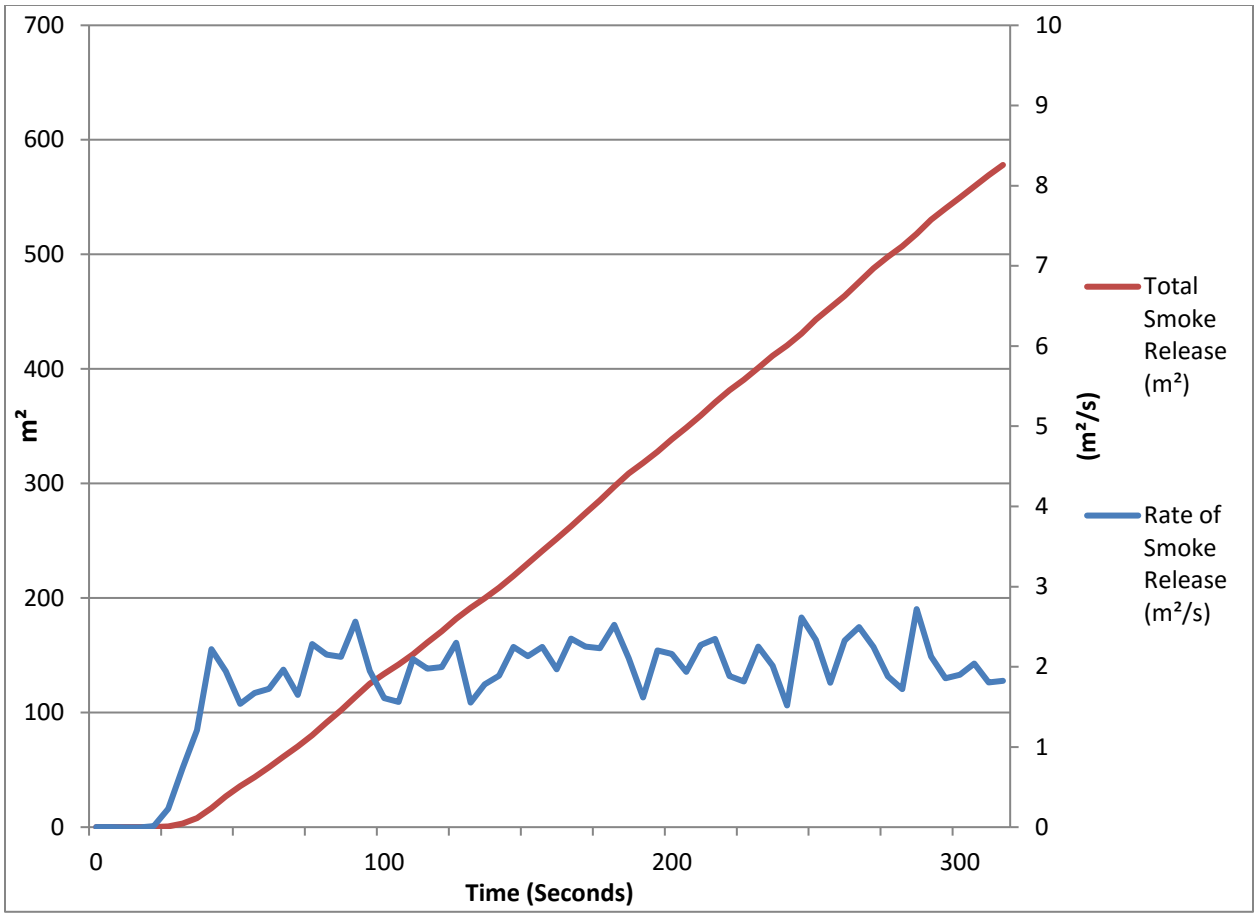
This report produced from controlled document template ATI 00766, revised 04/16/15.

Appendix A

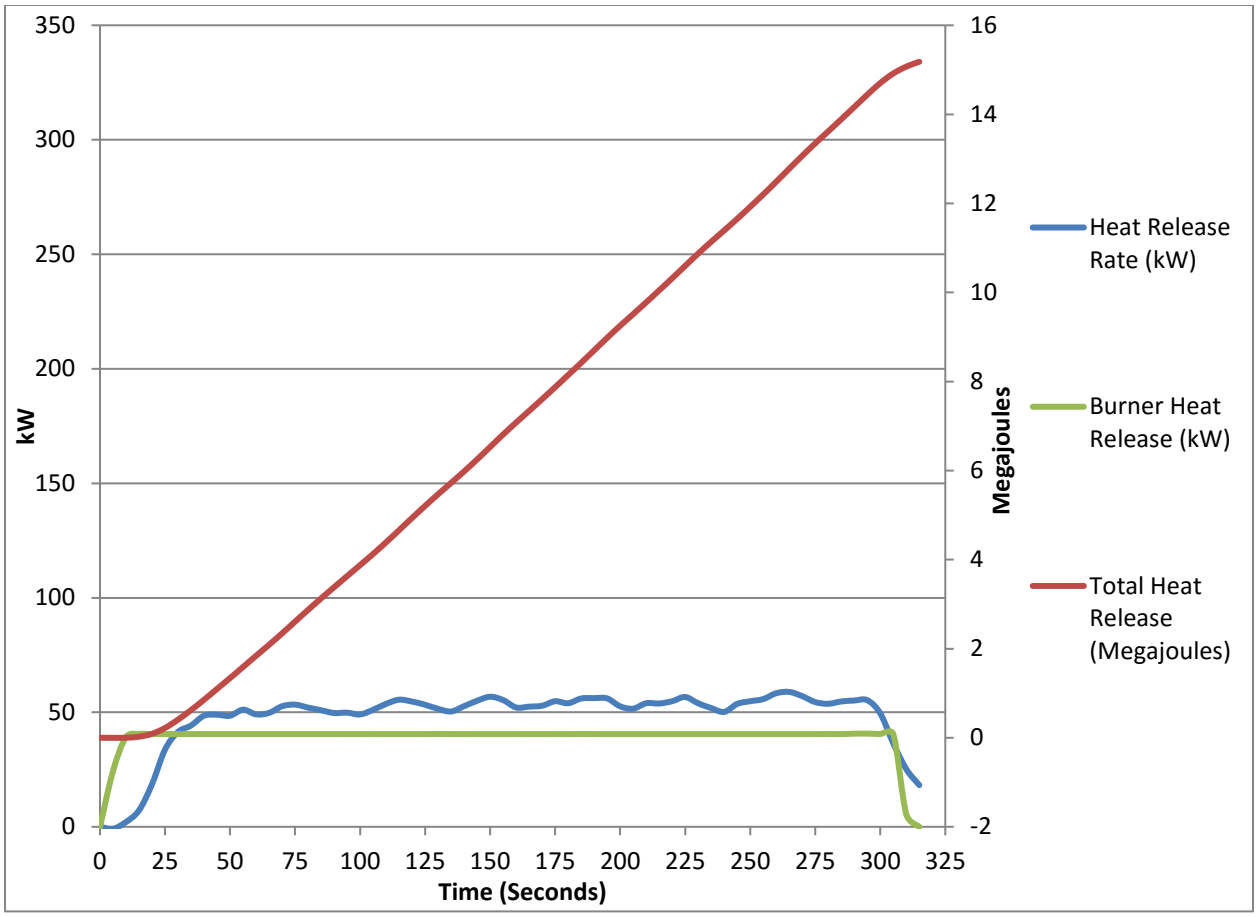
Graphical Data



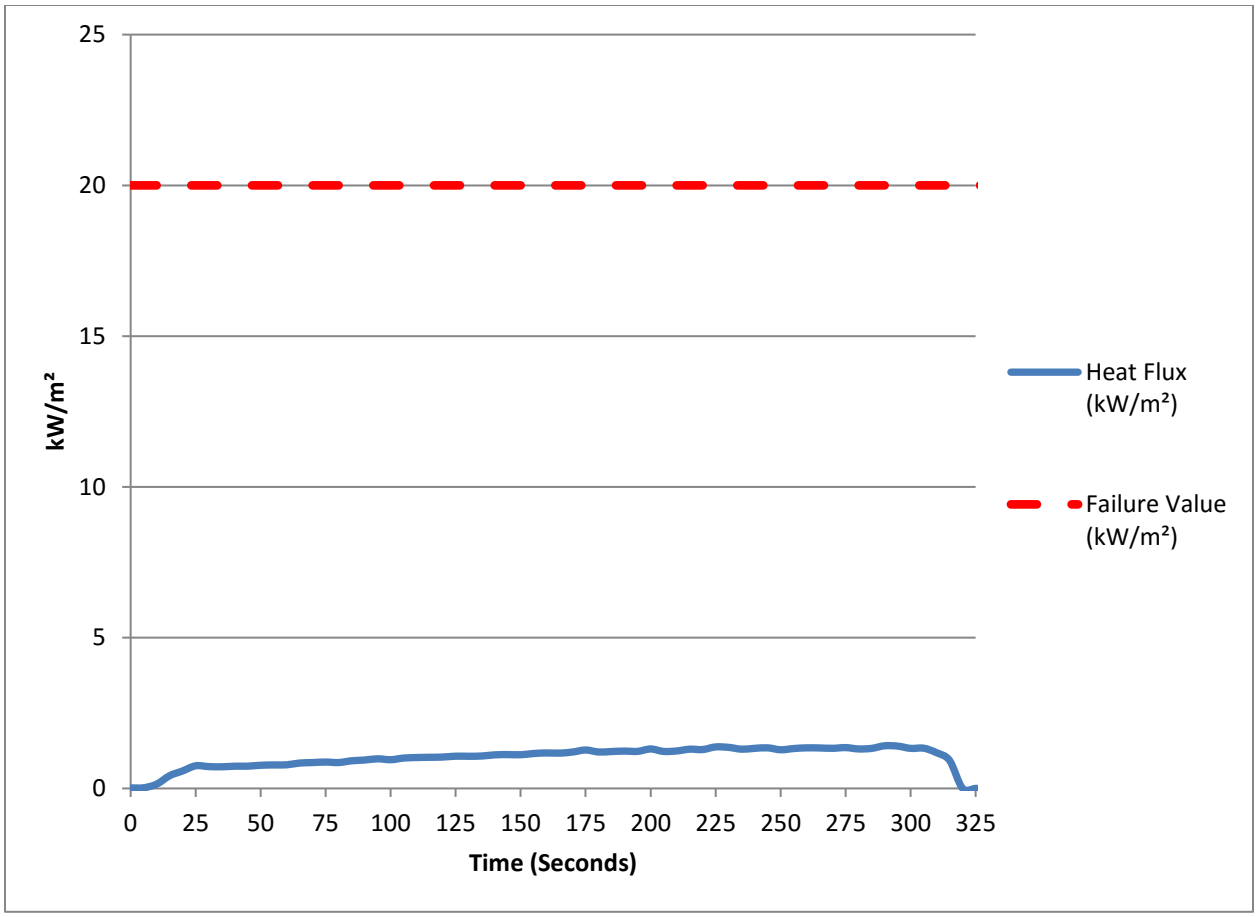
Graph No. 1
Thermocouple Data



Graph No. 2
Smoke Release



Graph No. 3
Heat Release
(burner output will also be added to graph)



Graph No. 4
Radiant Heat

Appendix B

Photographs

Photo No. 1
Sampled Part A Component

Photo No. 2
Sampled Part B Component

Photo No. 3
Pre-test

Photo No. 4
Thermocouple and Burner Placement

Photo No. 5
Burner Ignition

Photo No. 6
Burner Extinguished

Photo No. 7
Post-test