TEST REPORT

**REPORT NUMBER: 3189954-SAT-005**
ORIGINAL ISSUE DATE: February 11, 2010
REVISED DATE: June 23, 2010

**EVALUATION CENTER**
Intertek Testing Services NA Inc.
16015 Shady Falls Rd.
Elmendorf, TX 78112

## RENDERED TO

TF System-The Vertical ICF Inc.
3030 Holmgren Way
GREEN BAY, WI, 54304,US

PRODUCT EVALUATED: ½" drywall over TF systems 6" ICF WALL
EVALUATION PROPERTY: Heat Release, Flame Spread

**Report of testing ½" gypsum drywall over insulated concrete forms for compliance with the applicable requirements of the following criteria: NFPA 286 and IBC 803.2.1.**

# 1 Table of Contents

# 2 Introduction

Intertek Testing Services NA (Intertek) has conducted testing for TF Systems on expanded polystyrene (EPS) Insulated Concrete Forms (ICF) covered with ½" of gypsum drywall, to evaluate heat release and flame spread properties when subjected to specific ignition conditions. Testing was conducted in accordance with NFPA 286. This evaluation was performed on February 11, 2010.

# 3 Test Samples

## 3.1. SAMPLE SELECTION

Samples were randomly selected on 9-15-09 by Intertek Justin Hendricks, at the TF systems manufacturing facility, located at 1045 Lindoerfer Road P.O. Box 580 Plymouth, WT 53073 Samples were received at the Evaluation Center on 9-21-09.

## 3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The sample consisted of one 8 foot x 8 foot wall and two 8 foot x 12 foot walls arranged using straight and 90° corner 6" TF System® Thermo-Forms. The ICFs consisted of PVC studs spaced nominally 16-inches on center. 8" wide X 2" thick X 10 foot long, 1.5 pcf (nominal) density pre formed polystyrene foam panels were inserted into the slots in the PCV studs. Number 4 rebar was spaced 16" vertically and 18" horizontally in the core cavity and the core was filled with normal weight (3000 psi) concrete. The walls were covered with a single layer of ½" gypsum board with all joints being tapped and floated. The board was fastened to the wall using 1-5/8" fine thread drywall screws spaced approximately every 16", all screw heads where covered with mud compound. Spacing of some screws was not uniform due to uneven locations of the ICF's interior webbing, which was used as an anchor.

The ceiling of the room was composed of standard gypsum and steel stud construction, but was not a part of the test sample.

See Photos in Appendix B for a visual depiction of the description.

# 4 Testing and Evaluation Methods

This fire test measures certain fire performance characteristics of finish wall and ceiling covering materials in an enclosure under specified fire exposure conditions. It determines the extent to which the finish covering 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℃. A pair of crumpled single sheets of newspaper are 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 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.

## TEST EQUIPMENT AND INSTRUMENTATION

### 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, and the burner enclosure is located such that the edge of the diffusion surface is located 1 inch from both walls in the left corner of the room opposite from the door.

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 for five minutes followed by a 160±5 kW for ten minutes. The flow rate is metered throughout the test. The design of the burner controls is such that when one quarter-turn ball valve is opened, the flow of gas to the burner produces 40 kW and when a second quarter-turn valve is opened the combined flow produces 160 kW.

### COMPARTMENT GEOMETRY AND CONSTRUCTION

The interior dimensions of the fire room measures 8'X8'X12'. 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' by 8' walls. No other openings are present to allow ventilation.

### TOTAL HEAT FLUX GAUGE

A gauge shall be mounted a maximum of 2 inches above the floor surface, facing upward in the geometric center of the test room. The gauge shall be of the Gardon type, with a flat black surface, and a 180-degree view angle. In operation, it shall be maintained at a constant

temperature (within ± 5% ℉) above the dew point by water supplied at a temperature from 120° to 150℉.

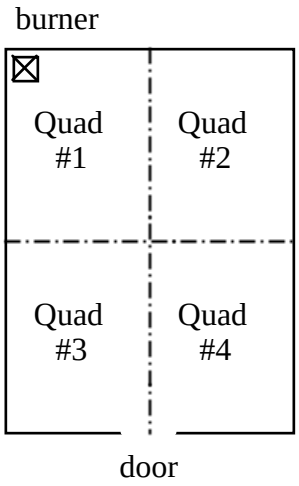
THERMOCOUPLES

Bare chromel-alumel thermocouples 20 mil in diameter (24 GA. Type K, Chromel-Alumel, and Special Limits of Error: ±1.1℃, purchased with Lot Traceability and with 5-point calibrations at each end of the Lot Purchase), with electrically welded thermo-junctions shall be used at each required location. The thermocouple wires, within 0.5 inches of the thermo-junction, shall be run along expected isotherms to minimize conduction errors. The insulation between the wires shall be stable to at least 2000℉ or the wires shall be separated.

THERMOCOUPLE LOCATIONS

| LOCATION | DESCRIPTION OF PLACEMENT |
|---|---|
| DOORWAY | A thermocouple is located in the interior plane of the door opening on the door centerline, 4 inches down from the top. |
| ROOM | Thermocouples are located 4 inches below the ceiling at the center of the ceiling, the center of each of the four ceiling quadrants and directly over the center of the ignition burner. |
| HOOD EXHAUST DUCT | One pair of thermocouples is placed in the duct 9 duct diameters downstream of the entrance to the horizontal duct. |

The placement of the Quadrant Thermocouples is as shown in the drawing below. All plots and data tables follow this format.




Room Quadrant Thermocouple Locations (Plan View)

CANOPY AND EXHAUST DUCT

A hood is installed immediately adjacent to the door of the fire room. The bottom of the hood is level with the top surface of the room. The face dimensions of the hood are 15- by 15-feet, with

a depth of 15 feet. The hood feeds into a plenum having a 4- by 4-foot cross section and a height of 4 feet. The exhaust duct connected to the plenum is 30 inches in diameter, horizontal, and has a circular aperture of 24 inches at its entrance to allow for mixing of the fire products before being analyzed.

### DUCT GAS VELOCITY

A bi-directional probe is used to measure gas velocity in the duct. The probe consists of a short stainless steel cylinder 1.75 inches long and 0.875 inches inside diameter, with a solid diaphragm in the center. The pressure taps on either side of the diaphragm support the probe. The axis of the probe is along the center line of the duct, 9 duct diameters downstream from the entrance. The pressure taps are connected to a pressure transducer capable of resolving pressure differences of 0.001 inches W.C.

### OXYGEN MEASUREMENTS

A stainless steel gas sampling tube is located 10 duct diameters downstream from the entrance to the duct at the geometric center of the duct ±1/2 inch to obtain a continuously flowing sample for determining the oxygen concentration of the exhaust gas as a function of time. The oxygen content of the duct exhaust gas is determined by an oxygen analyzer with a relative accuracy of ±0.001% in the concentration range from 0 to 21% oxygen. The signal from the oxygen analyzer is within 5% of its final value within 30 seconds following a step change in the composition of the gas stream flowing past the sampling tube inlet.

### PHOTOGRAPHIC RECORDS

Digital color photographs and DV video taping are both used to record and document the test. Care is taken to position the photographic equipment so as to not interfere with the smooth flow of air into the test room.

## PROCEDURE

### SUMMARY OF METHOD

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 increased to the 160 kW level for a 10-minute period. During the burn period, all temperature, heat release and heat flux data is being recorded every 6 seconds. At the end of the fifteen 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.

### 4.1. TEST STANDARD

NFPA 286.

# 5 Testing and Evaluation Results

### 5.1. RESULTS AND OBSERVATIONS

FIRE TESTS
The test was started at 1:30 pm on February 11, 2010. The ambient temperature was 65℉ with a relative humidity of 60%. The data acquisition system was started and the burner was ignited. Events during the test are described below:

| TIME (min:sec) | OBSERVATION |
|---|---|
| 0:00 | Ignition of burner. Heat output set to 40 kW. |
| 1:30 | Scorching paper gypsum board |
| 3:14 | Paper is burnt on the sidewall 1FT above the burner . |
| 5:00 | Burner output increased to 160 KW |
| 5:04 | Flames to ceiling. |
| 5:36 | Light smoke |
| 7:00 | Paper Scorched from 1 t 8 ft in corner above burner |
| 9:05 | Paper burnt on ceiling above burner. |
| 15:00 | Gas off ( test terminated) |
| 15:02 | All afterflame ceased. |

The paper targets did not spontaneously ignite due to flash-over conditions.

Post Test Observations:
The wallboard was charred and burned in the area adjacent to the propane flame.

Examination of the extremities both on the wall surface and at the ceiling edge did not show signs of combustion or melting. The paper targets did not ignite.

For additional details, see the post-test photographs later in this report.

# 6 Conclusion

The sample submitted, installed, and tested as described in this report displayed low levels of heat release, and low upper level temperatures. The heat flux on the floor did not reach flashover levels. The sample did not spread flames to the ceiling during the 40 kW exposure. The flames did not spread to the extremities of the right 12-foot wall, and the rear 8 ft wall during the test. The sample did not exhibit flashover conditions during the test. Smoke measurements were well bellow 1000$m^2$.

NFPA 286 does not publish pass/fail criteria. One must consult the codes to determine pass fail.

This specimen **MET** the criteria set forth in the 2006 IBC Section 803.2.1

The conclusions of this test report may be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

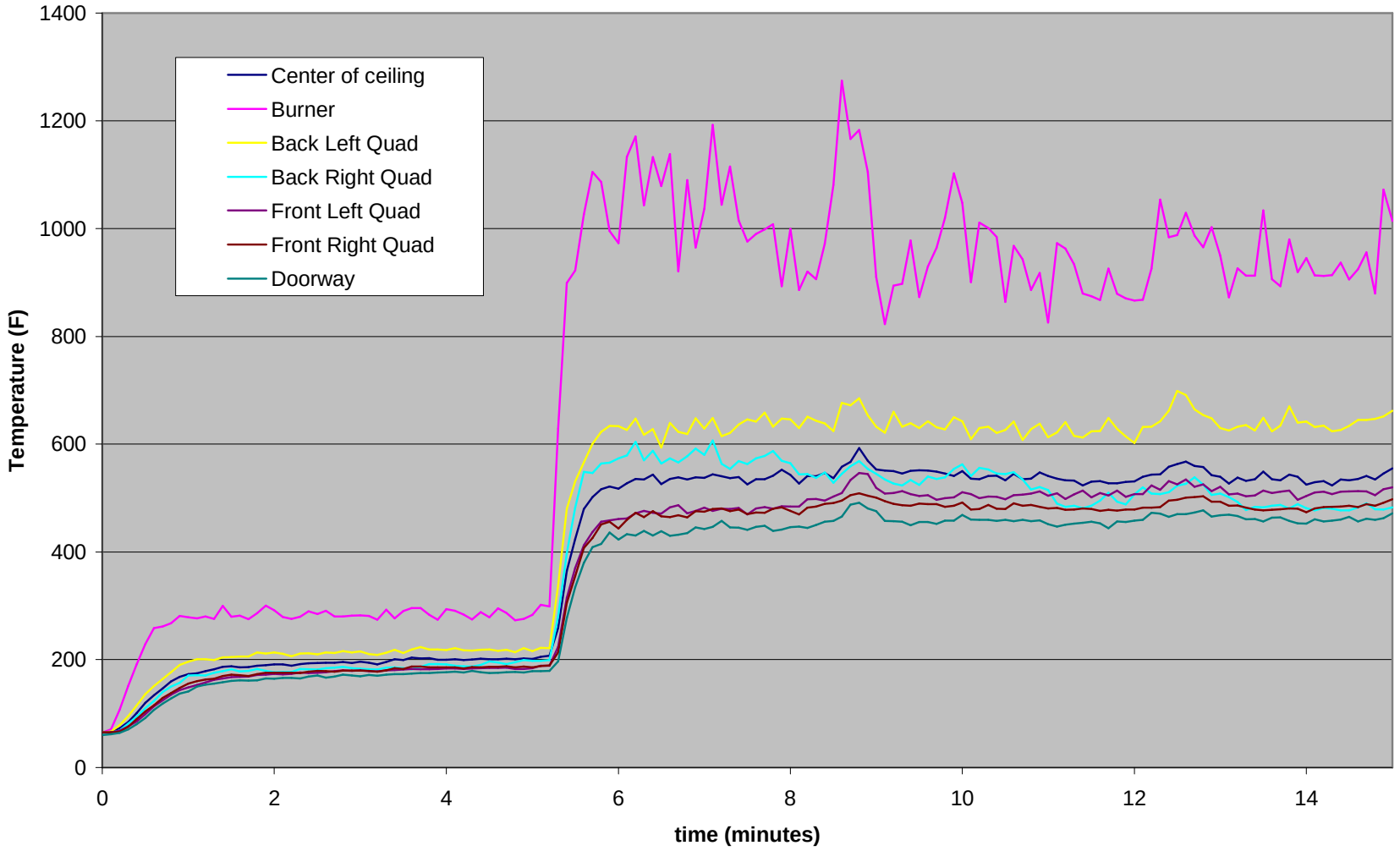
**INTERTEK TESTING SERVICES NA**

Reported by: _____
Troy G. Bronstad
**Senior Associate Engineer**

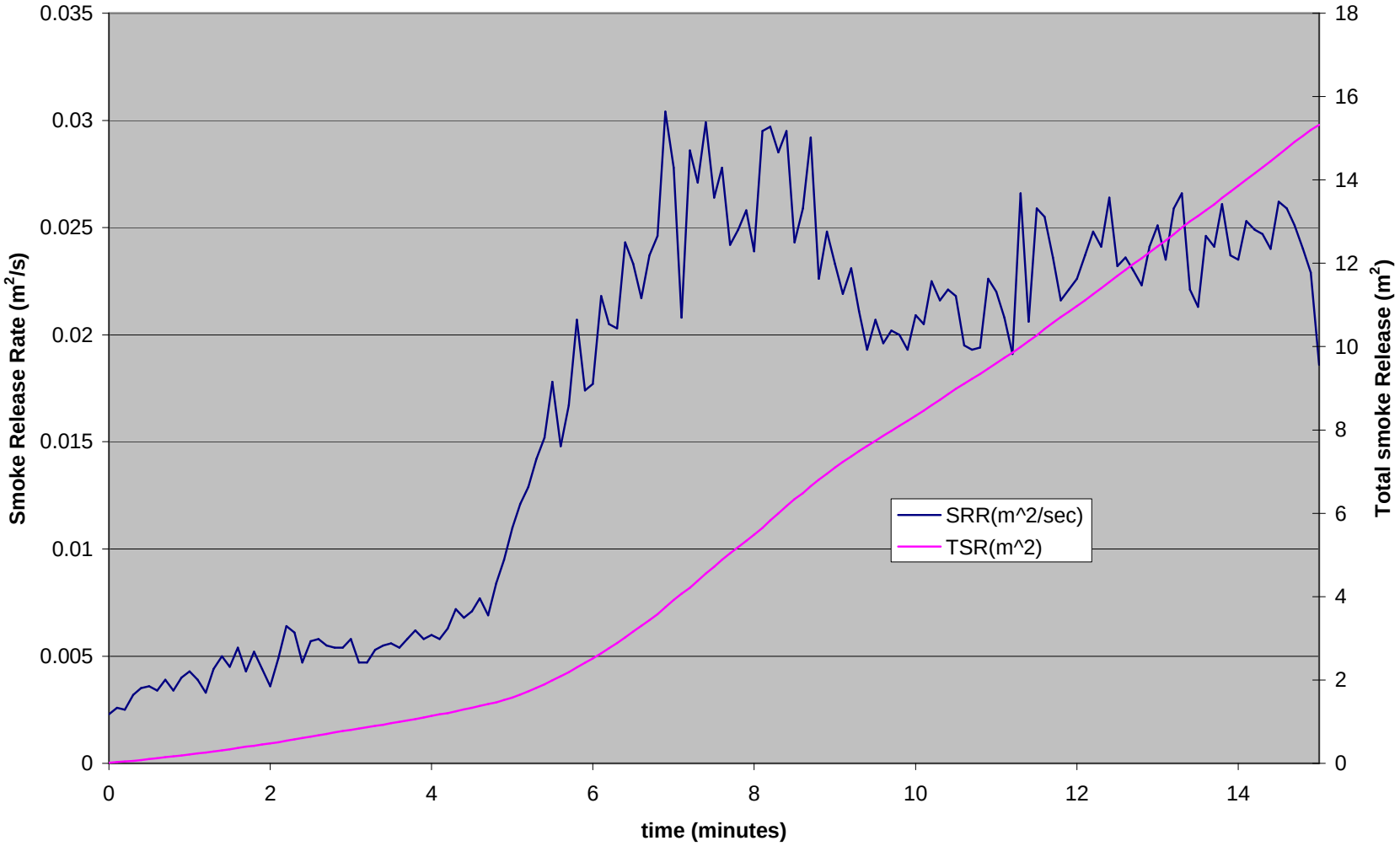
Reviewed by: _____
C. Anthony Peñaloza
**Engineering Team Leader**

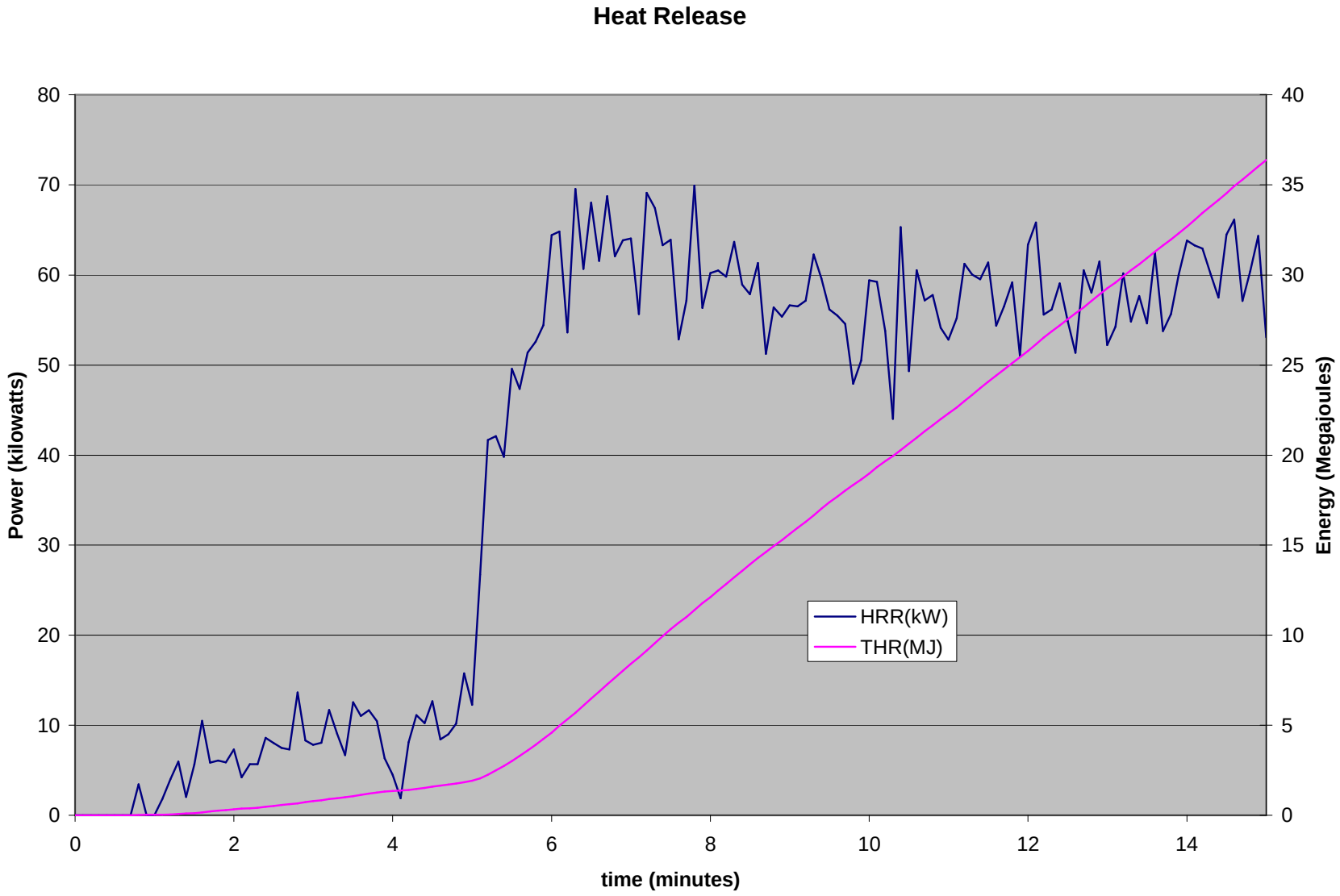
# APPENDIX A
Test Data

## Thermocouple Data

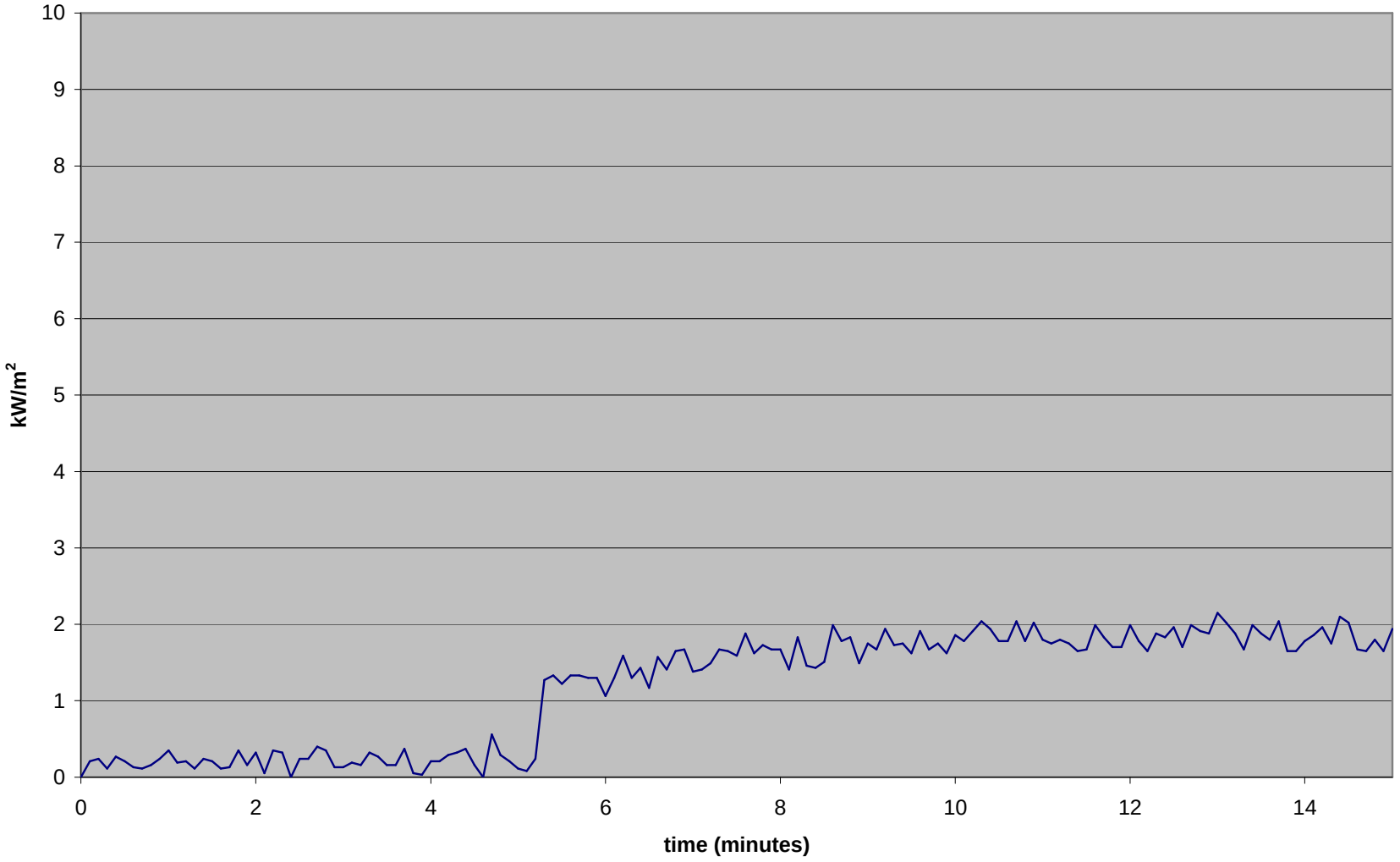


## Smoke Release




Heat Release
Power (kilowatts)
Energy (Megajoules)
time (minutes)
HRR(kW)
THR(MJ)
0
10
20
30
40
50
60
70
80
0
5
10
15
20
25
30
35
40
0
2
4
6
8
10
12
14

## Radiant Heat



# APPENDIX B
Photographs

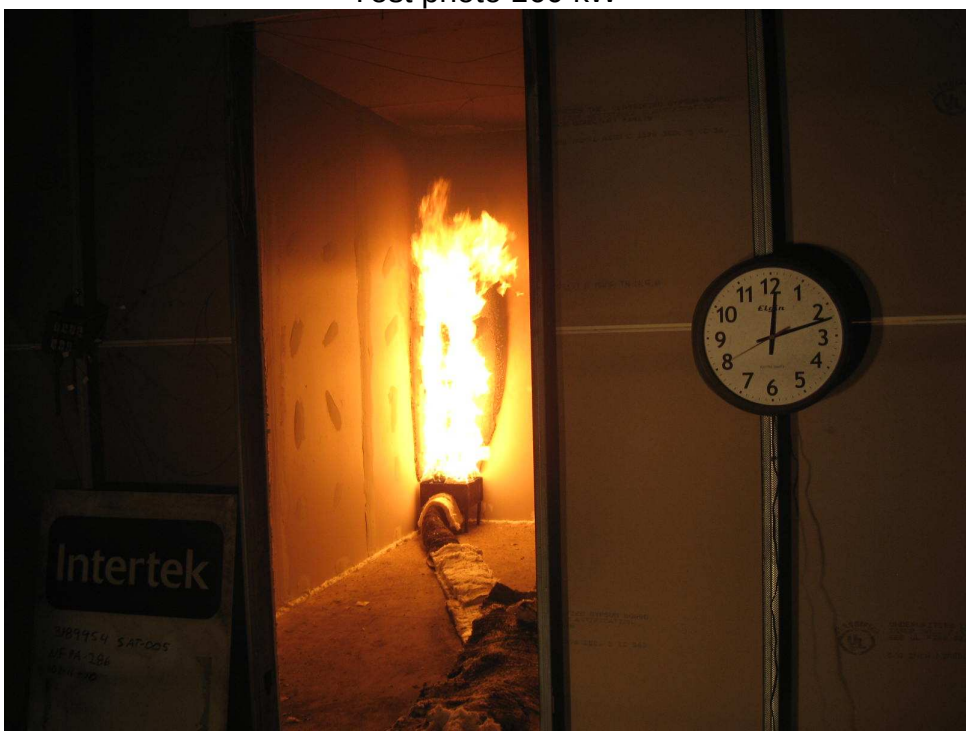
Pre test picture

Finished interior and gypsum


Start of test

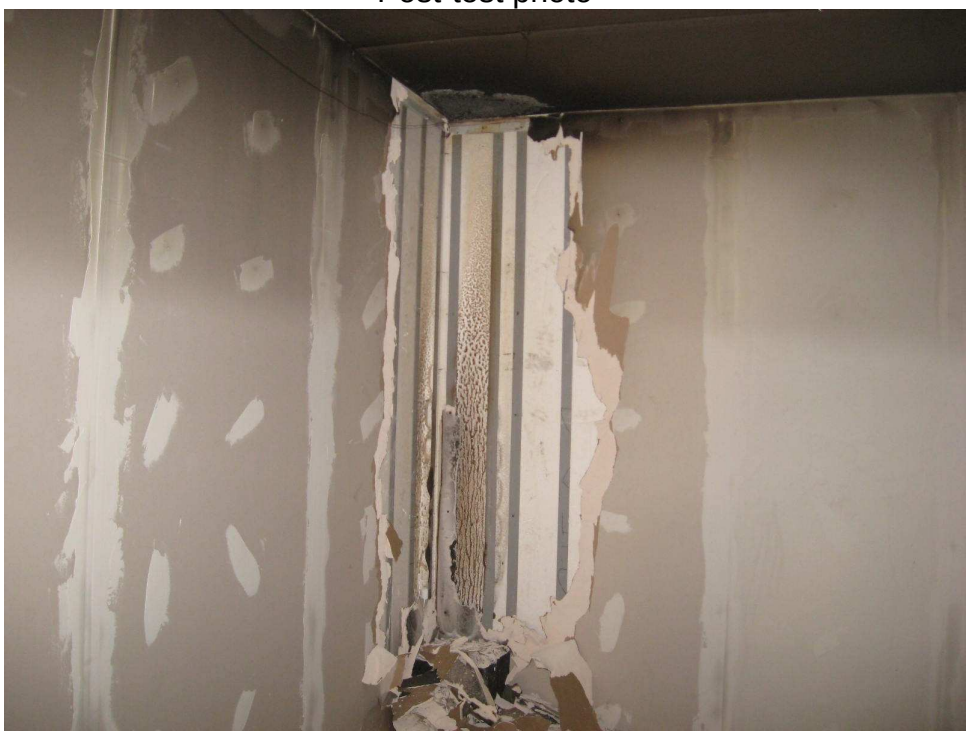
Test photo 40 kW

Test photo 160 kW




Test photo. 160 kW

Post-test photo



Post-test photo with Gypsum removed form corner

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# REVISION SUMMARY

| DATE | SUMMARY |
|---|---|
| February 11, 2010 | First issue. No revisions. |
| June 23, 2010 | Change sample and assembly |