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# FIRE PERFORMANCE EVALUATION OF *EL 80*, IN ACCORDANCE WITH THE 2006 EDITION OF NATIONAL FIRE PROTECTION ASSOCIATION 286, *STANDARD METHODS OF FIRE TESTS FOR EVALUATING CONTRIBUTION OF WALL AND CEILING INTERIOR FINISH TO ROOM FIRE GROWTH*

**FINAL REPORT**
**Consisting of 14 Pages**

**SwRI Project No. 01.13544.01.216b[1]**
**Test Date: April 23, 2008**
**Report Date: May 20, 2008**

**Prepared for:**
**LUX ELEMENTS GmbH & Co. KG**
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5/22/08

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## INTRODUCTION

This report presents the results of a fire performance evaluation in accordance with the 2006 Edition of National Fire Protection Association (NFPA) Standard 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.* Testing was conducted by Southwest Research Institute's (SwRI) Fire Technology Department, in San Antonio, TX. This report has been revised to document Florida Professional Engineer witness and seal.

This test method is intended for the evaluation of the flammability characteristics of wall and ceiling interior finish, other than textile wall coverings, where such materials constitute the exposed interior surfaces of buildings. It determines how much a material will contribute to a fire by measuring the amount of heat and smoke released, along with the combustion products released.

NFPA 286 does not have criteria for passing or failing a product due to performance during the fire test. In general, this test is used as a tool for ranking material performance in a standard configuration. However, a major event that this test can identify is the propensity of a material to cause a standard room to "flashover", which according to NFPA 286, is determined to have occurred when two of five specified conditions are attained. The material being tested may perform differently when it is placed in a room of a different size or shape, or in different environmental conditions. The test data cannot be generalized to apply to these different conditions.

The heat release rate (HRR) is measured using the oxygen consumption technique. This technique requires the measurement of gas concentrations in the exhaust duct, as well as the volumetric flow of these gases. The products of combustion and entrained air are collected in a hood and extracted through an exhaust duct by a fan. A gas sample is drawn from the exhaust duct and analyzed for oxygen, carbon dioxide, and carbon monoxide concentrations. The gas temperature and differential pressure across a bi-directional probe are measured for calculating the mass flow rate of the exhaust gases.

Smoke release rate (SRR) is determined based on the measured light obscuration in the exhaust duct, using a vertically-oriented white-light extinction photometer located close to the gas sampling point. Temperature measurements were recorded using thermocouples positioned according to NFPA 286. The results apply specifically to the specimens tested, in the manner tested, and not to similar materials, nor to the performance when used in combination with other materials.

**NFPA 286 (2006)**

**Client:** LUX ELEMENTS GmbH & Co. KG
**Project No.:** 01.13544.01.216b[1]
**Material ID:** *EL 80*
**Trade Name:** *LUX ELEMENTS - Hardfoam support element*

**Material Description:*** Expanded Polystyrene (EPS) Foam with Coating of Mortar and Glass Fiber Mesh, Covered with Mortar Render.

**Table 1. Material Details.**

| Thickness (nominal) | Color | Weight (nominal) | Dimensions (nominal) | Density of EPS | Areal Weight* (nominal) |
|---|---|---|---|---|---|
| 78 mm (EPS foam)<br>1 mm (mortar layers)<br>5 mm (mortar render) | Light Blue (EPS core)<br>Light Grey (coating) | 20.2 kg<br>Per Panel | 0.6 m wide × 2.5 m long | 30 kg/m$^3$ | 5.3 kg/m$^2$ |

*Client Provided Information

**Table 2. Material Preparation.**

| Received | Prepared | Conditioned |
|---|---|---|
| April 11, 2008 | April 15 – 19, 2008 | 64 °F – 75°F |

**Construction Details:** SwRI constructed a 2 × 4-in. wood stud room with ½-in. thick gypsum wallboard on the walls and ceiling. Representatives of LUX ELEMENTS GmbH & Co. KG fastened *EL 80* panels to the ceiling of the test room using 4.75-in. screws and 2.75-in. washers, spaced every 21 in. around the perimeter. *EL 80* panels were also fastened to the back and side walls of the test room using 4.75-in. screws and 1.375-in. washers, placed around the perimeter every 18 in. on center. The joints were taped and floated with mortar. A layer of mortar render, approximately 5-mm thick, was applied over the wall and ceiling panels. See Figure 1 below, for a Client supplied diagram of *EL 80* panels.

**Witnessed By:** Under the supervision of Mr. Barry L. Badders (Professional Engineer, License No. 61907, registered in the state of Florida) of Southwest Research Institute

**Comments:** Test Notification Number from Miami-Dade County Florida for the test program is SwRI 08017.

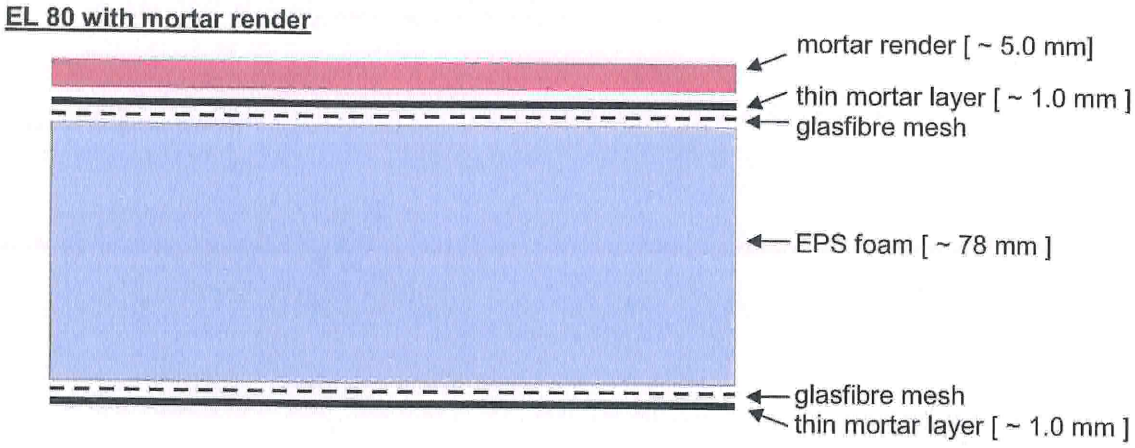



**Figure 1. Material Layers in *EL 80* Panel.**

The test room and building were at approximately 79 °F and 70% relative humidity during the test. A summary of the test results is given in Table 3 below. Selected photographic documentation is provided in Figures 2 through 8, and visual observations can be found in Table 4. The test results are summarized in Appendix A.

**Table 3. Summary of Test Results and Flashover Limits.**

| Material ID | Maximum Heat Release Rate (Total) | Total Heat Flux to the Floor | Maximum Average Upper Layer Temperature | Flames Exiting Doorway? | Auto-Ignition of Paper Target? |
|---|---|---|---|---|---|
| *EL 80* | 218 kW | 3.1 kW/m$^2$ | 352 °C | No | No |
| Flashover Limits Per Section 1.4.2 of NFPA 286 | 1,000 kW | 20 kW/m$^2$ | 600 °C | Not Allowed | Not Allowed |

The 2006 International Building Code (IBC) has acceptance criteria for interior wall or ceiling finishes tested in accordance with NFPA 286. The criteria as contained in the 2006 IBC, Section 803.2, is as follows:

1. During the 40-kW exposure, flames shall not spread to the ceiling.
2. During the 160-kW exposure, the interior finish shall comply with the following:
    a. Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
    b. Flashover, as defined in NFPA 286, shall not occur.
3. The peak rate of heat release throughout the NFPA 286 test shall not exceed 800 kW.
4. The total smoke released throughout the NFPA 286 test shall not exceed 1,000 m$^2$.

Based on the test results, the material identified as *EL 80,* did not cause the test room to flashover. The Client's material meets the acceptance criteria for interior wall or ceiling finishes as described in the 2006 IBC.

**Table 4. Test Observations.**

| Time (min:s) | Observations |
|---|---|
| 00:00 | Start of Test, **burner set at 40 kW.** |
| 00:10 | Flames from burner are 3 to 3½ ft in height. |
| 01:00 | Discoloration on the tile surface on both walls forming in the burner corner from 1 to 2 ft. |
| 02:30 | Discoloration with scorching along both walls, starting at the top of the burner up to 2½ ft, and approximately 6 in. in width. |
| 03:00 | Flames in the burner corner are 3½ to 4 ft in height. |
| 04:00 | Flames in the burner corner are 4 to 4½ ft in height. Light grey smoke in room interior down to 5½ ft above the floor. |
| 04:45 | No change. |
| 05:00 | **Burner increased to 160 kW.** Flames from burner are up to the ceiling and flashing 1 ft along both walls at the ceiling. |
| 05:45 | Discoloration and scorching on the wall panels up to 5½ ft in height in the burner corner. |
| 06:30 | No change in room interior. Light grey smoke down to 5½ ft above the floor. |
| 07:00 | Flames from the burner are up to the ceiling and flashing 1 to 2 ft along both walls at the ceiling. |
| 08:20 | Flames from the burner are up to the ceiling, with ignition of the wall panels approximately 6 in. in width along both walls up to the ceiling. Sporadic ignition on the ceiling panel at direct flame impingement from the burner. |
| 10:00 | Flames from the burner are up to the ceiling with flaming in the burner corner on the wall panels and up to the ceiling. Flames are 2 to 3 ft along both walls at the ceiling with intermittent flaming on the ceiling in a 2-ft radius. |
| 11:30 | Light grey smoke in the room interior down to 5½ ft above the floor. Continuous flaming on the ceiling panels in the burner corner in an 18-in. radius away from the burner corner. |
| 13:30 | Flaming in the burner corner approximately 12 in. in width along both walls up to the ceiling and burning on the ceiling in a 24-in. radius away from both walls. |
| 14:30 | No change. |
| 15:00 | **End of Test**, burner extinguished. No afterflaming on walls. Flaming on the ceiling panel approximately 24 in. in radius. |
| 15:20 | Room interior extinguished. |

**Figure 2. Ceiling Panels Installed, and Wall Panels Partially Installed.**

**Figure 3. Pre-Test View of Completed Room.**

**Figure 4. 4 min 41 s into Test; Burner at 40 kW.**


**Figure 5. 15 min into Test; Burner at 160 kW; Test Completed.**

**Figure 6. Post-Test View of Back Wall at Ceiling.**

**Figure 7. Post-Test View of Burn Corner Walls Near Ceiling with Foam Exposed.**

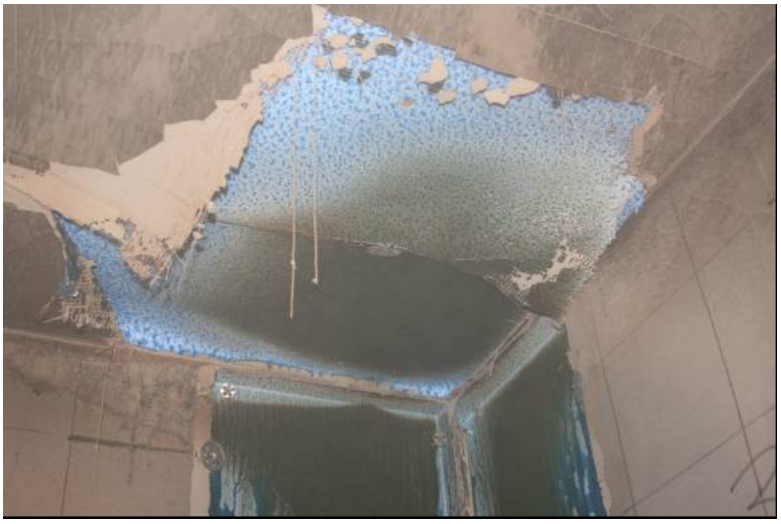


**Figure 8. Post-Test View of Burn Corner Ceiling with Foam Exposed.**

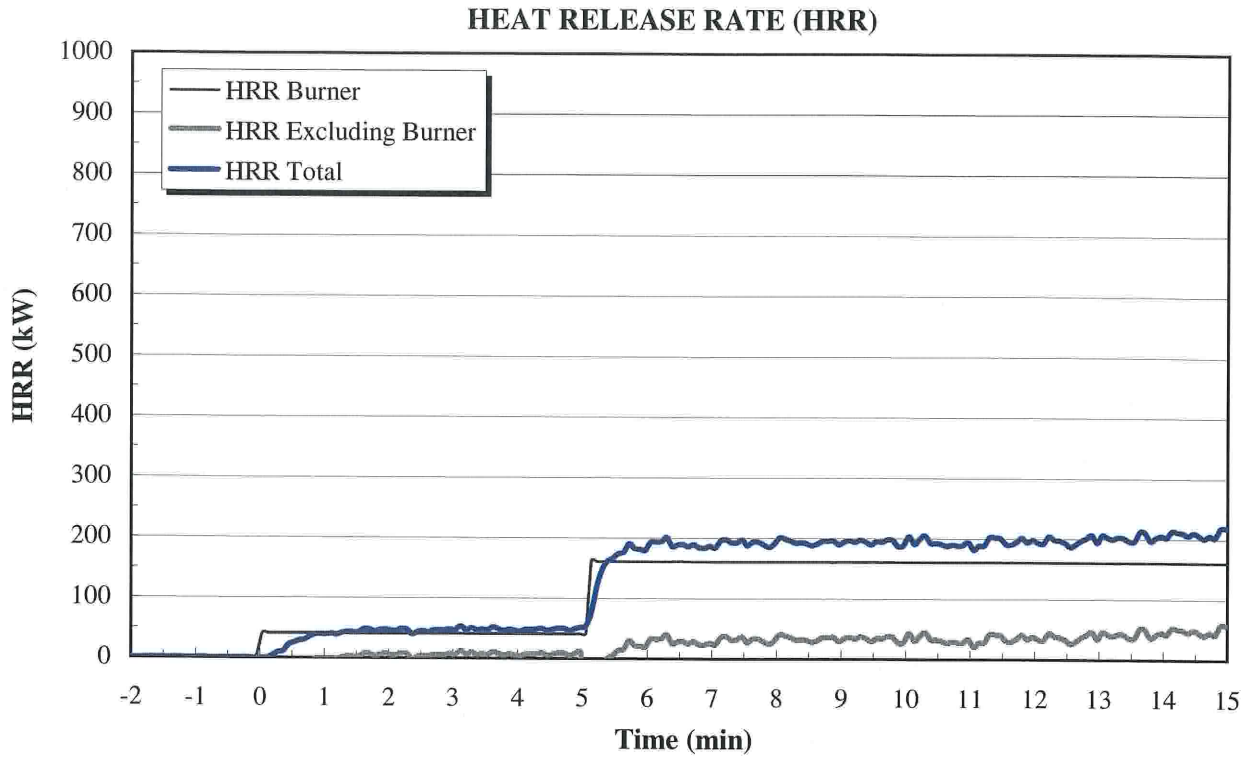
**APPENDIX A**

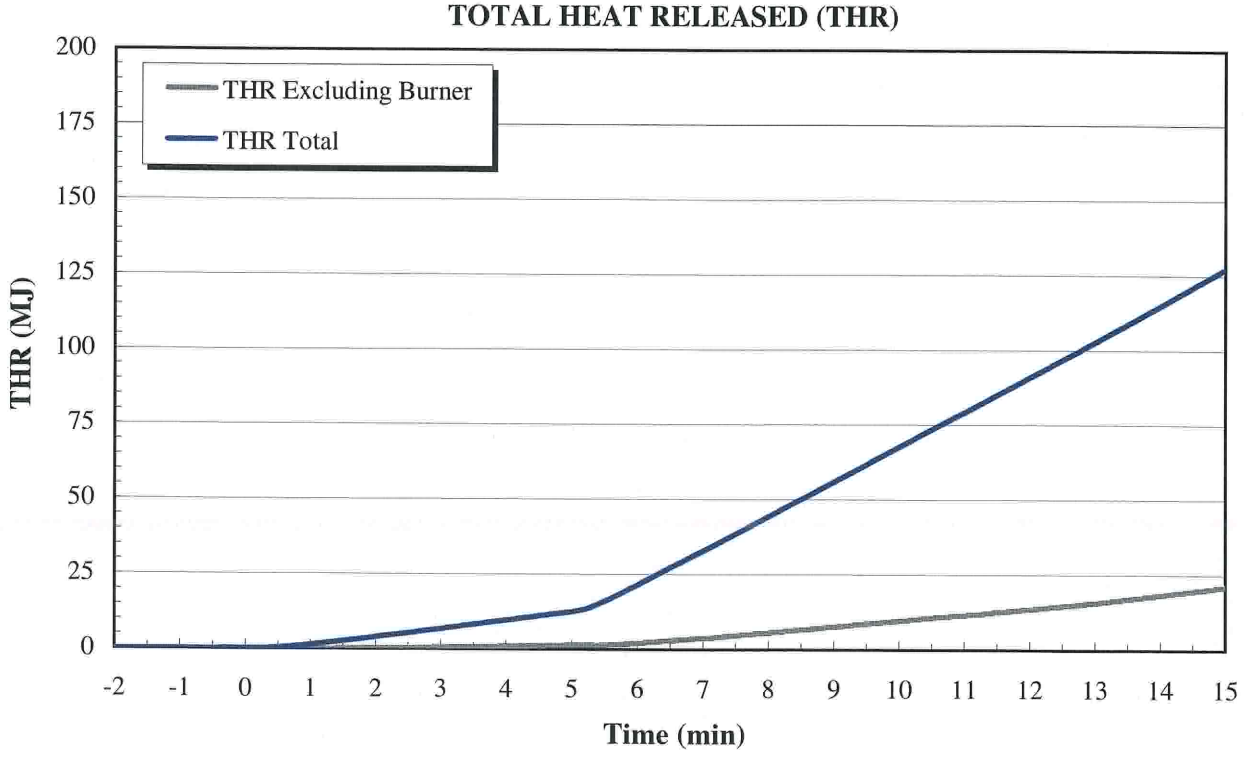
**TEST DATA**

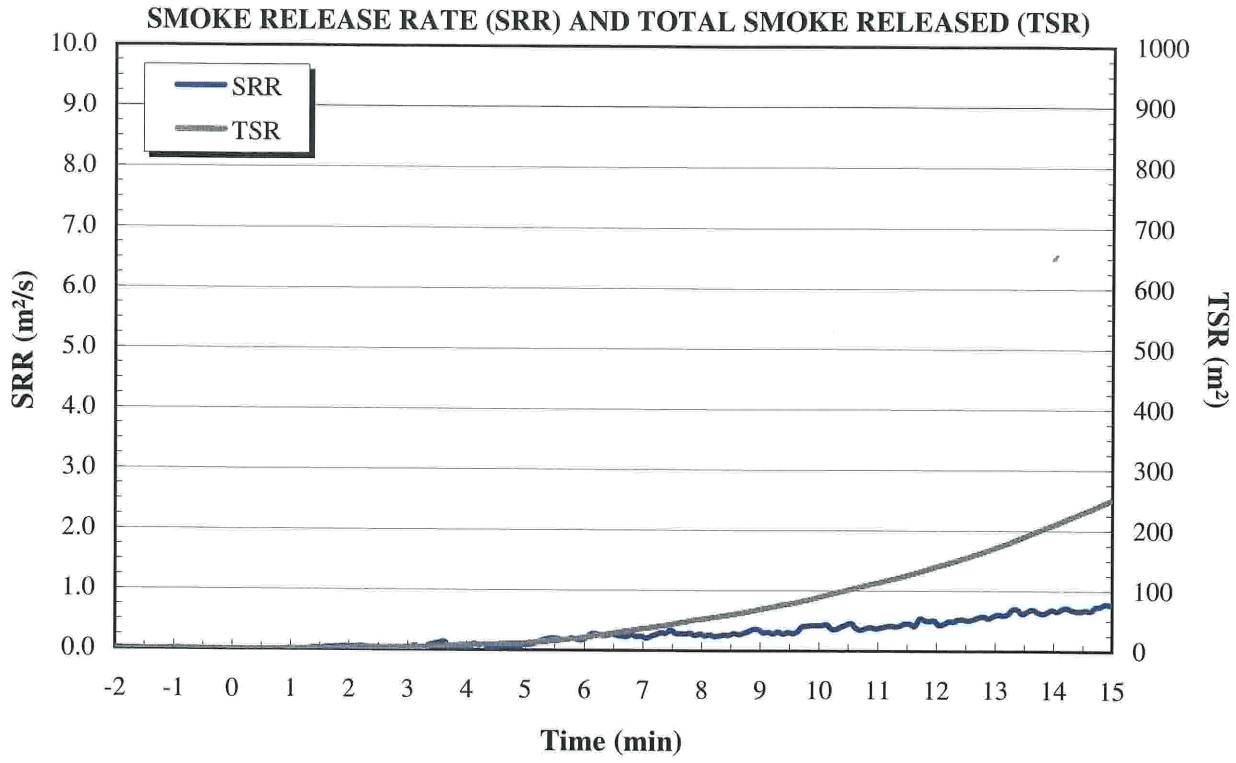
**(Consisting of 5 Pages)**

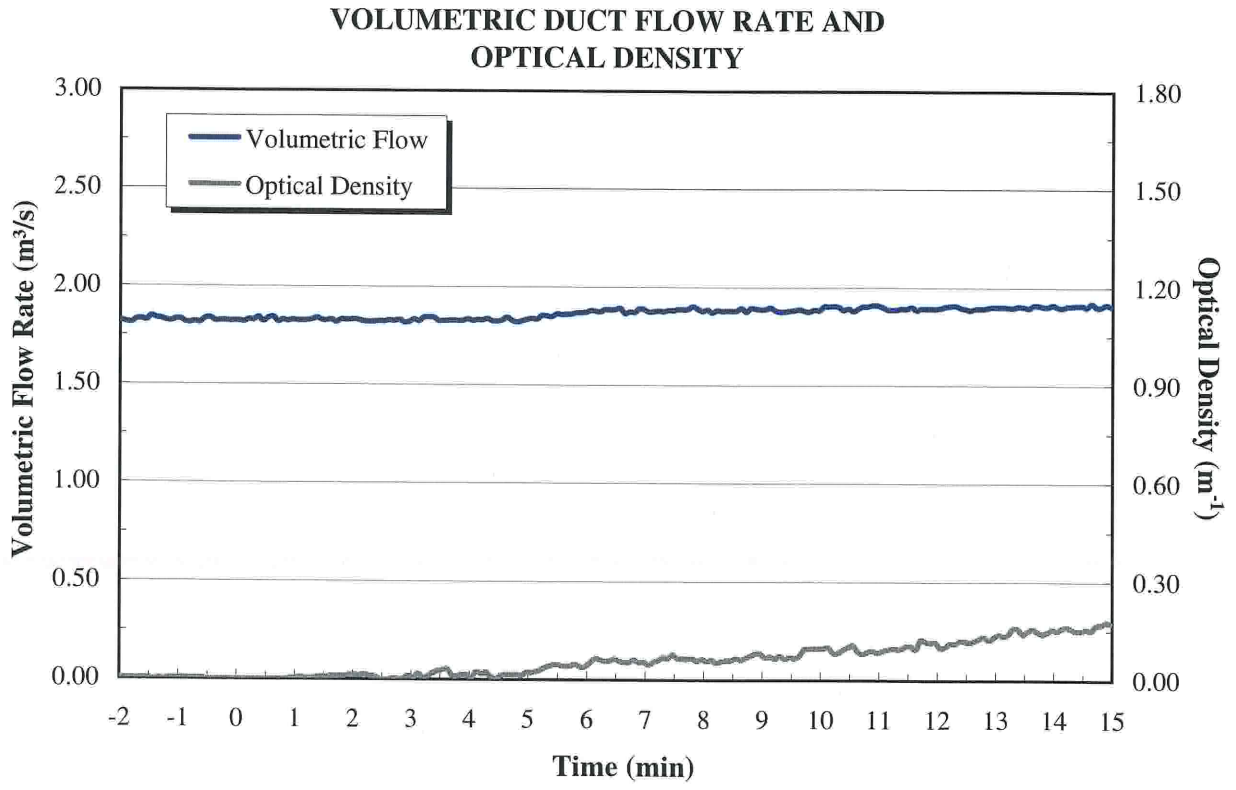
## SUMMARY OF TEST RESULTS

| | | | |
|---|---|---|---|
| Maximum $HRR_{total}$ | 218 kW | at | 14 min 58 s |
| Average $HRR_{total}$ | 141 kW | | |
| Total Heat Released | 127 MJ | | |
| Maximum $HRR_{excl.\ burner}$ | 58 kW | at | 14 min 58 s |
| Average $HRR_{excl.\ burner}$ | 23 kW | | |
| Total Heat Released (Excluding Burner) | 21 MJ | | |
| Maximum Smoke Release Rate | 0.78 $m^2/s$ | at | 14 min 53 s |
| Average Smoke Release Rate | 0.28 $m^2/s$ | | |
| Total Smoke Released | 250 $m^2$ | | |
| Maximum Optical Density | 0.18 1/m | at | 14 min 53 s |
| Maximum Duct Flow Rate | 1.92 $m^3/s$ | | |
| Average Optical Density | 0.064 1/m | | |
| Average Volumetric Duct Flow Rate | 1.87 $m^3/s$ | | |
| Total Heat Flux to the Floor | 3.1 $kW/m^2$ | at | 14 min 53 s |
| Max. Average Upper Layer Temperature | 352 °C<br>665 °F | at | 14 min 53 s |
| Maximum Doorway Temperature | 299 °C<br>570 °F | at | 14 min 58 s |

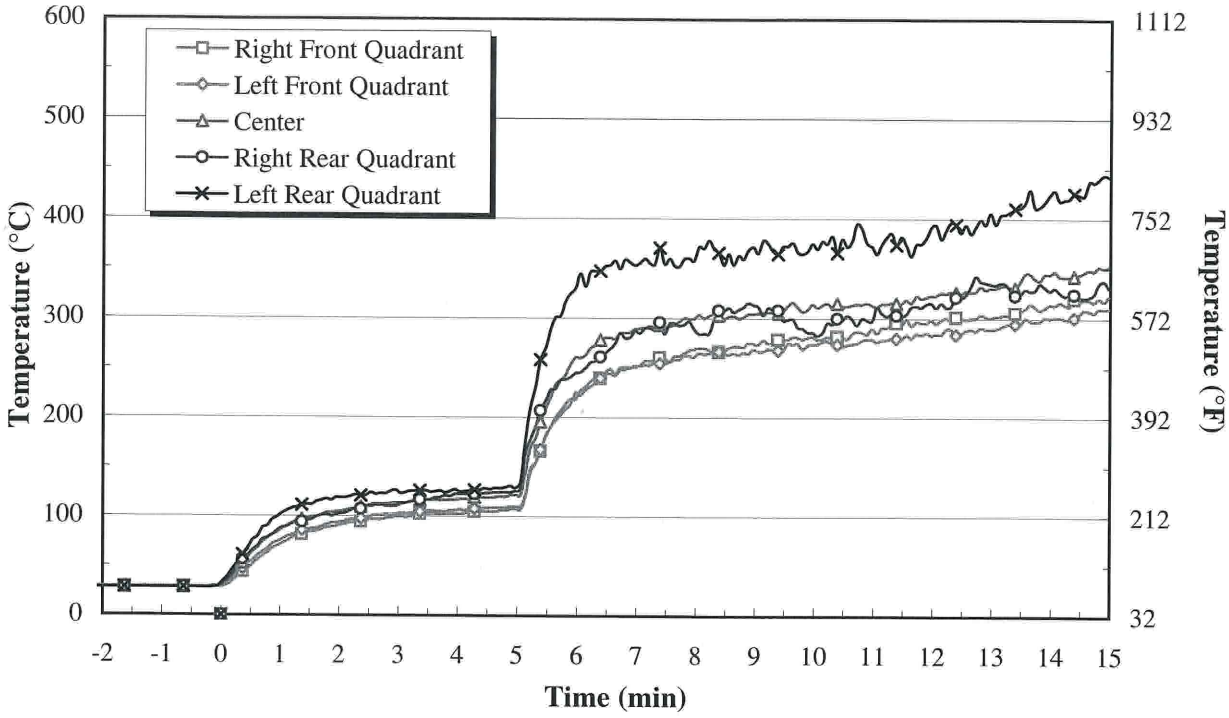

HEAT RELEASE RATE (HRR)
HRR Burner
HRR Excluding Burner
HRR Total
HRR (kW)
1000
900
800
700
600
500
400
300
200
100
0
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Time (min)


TOTAL HEAT RELEASED (THR)
THR Excluding Burner
THR Total
THR (MJ)
200
175
150
125
100
75
50
25
0
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Time (min)

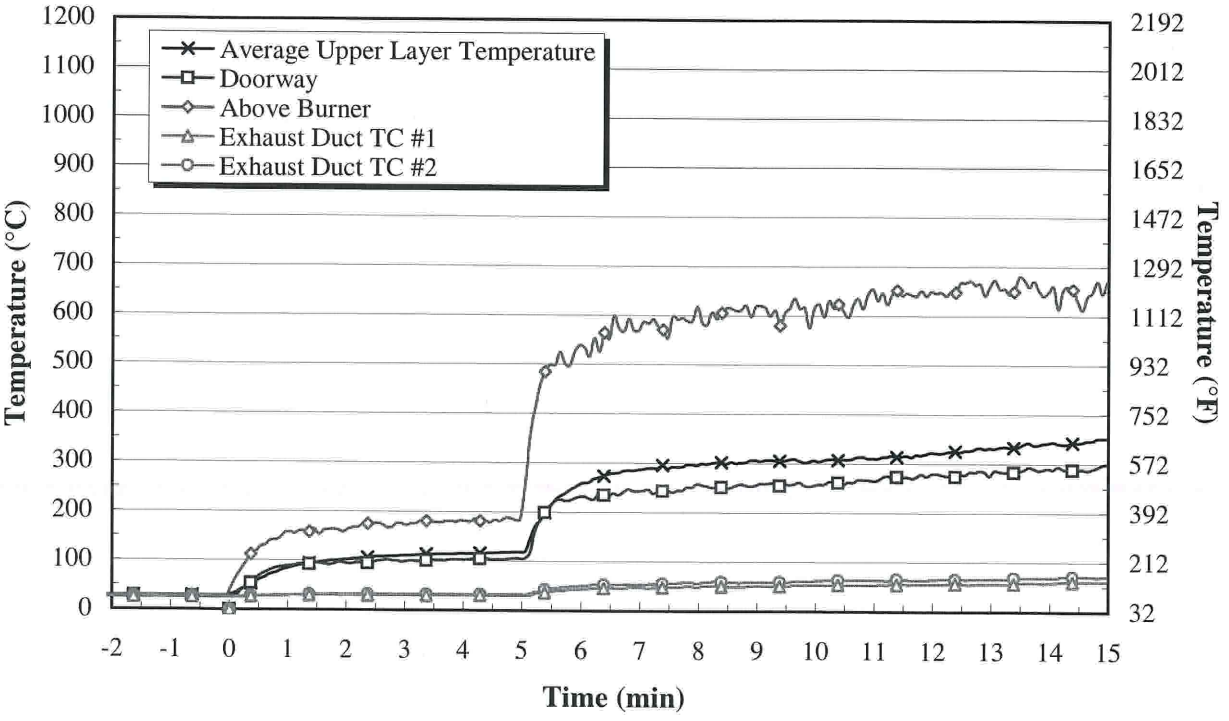

SMOKE RELEASE RATE (SRR) AND TOTAL SMOKE RELEASED (TSR)
SRR
TSR
SRR (m²/s)
TSR (m²)
Time (min)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1000
900
800
700
600
500
400
300
200
100
0
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

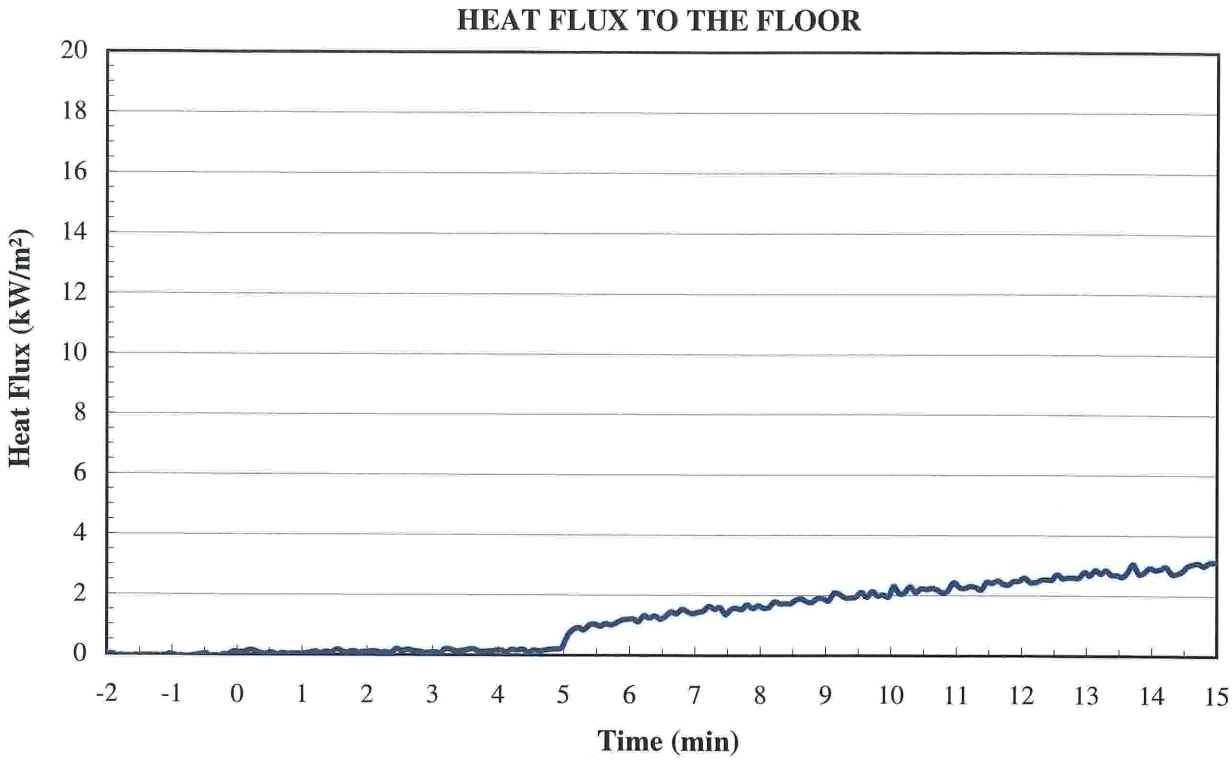

VOLUMETRIC DUCT FLOW RATE AND
OPTICAL DENSITY
Volumetric Flow
Optical Density
Volumetric Flow Rate (m³/s)
Optical Density (m⁻¹)
Time (min)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1.80
1.50
1.20
0.90
0.60
0.30
0.00
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

**UPPER LAYER TEMPERATURES**




**DOORWAY, ABOVE BURNER, AND DUCT TEMPERATURES**




HEAT FLUX TO THE FLOOR
Heat Flux (kW/m²)
20
18
16
14
12
10
8
6
4
2
0
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Time (min)