U. S. Department of Justice

Fire Research Laboratory
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Project Record

ANAB ISO/IEC 17025:2017
Accredited Forensic Testing Laboratory

Title	Cartridge Casings Exposed to Fire		
Test Type	Custom		
Lab Number	20FR0013-1	**Author**	David R. Tucholski
Test dates	6/16/21	**No. Tests**	1

Introduction

One experiment was conducted to expose 48 cartridge casings to a fire in a single room compartment. The fire was initiated on a sofa. The cartridge casings were placed in four locations to obtain different exposures to the fire. Instrumentation for the experiment included heat flux transducers and thermocouples. The experiments were also documented using video cameras and a digital camera. The experiments were conducted in the Large Burn Room (LBR) of the Bureau of Alcohol, Tobacco, Firearms and Explosive Fire Research Laboratory (ATF FRL) located in Beltsville, MD.

Contents

NOTE: All dimensional measurements were taken in English units and were later converted to metric units. Any inconsistencies between the two units are due to rounding errors when the English units were converted to metric.

Experiment Setup

The structure was a single room compartment with a single doorway, as shown in Figure 1. The interior of the structure was approximately 5.08 m (16 feet 8 inches) wide by 3.78 m (12 feet 5 inches) long and 2.59 m (8 feet 6 inches) high. A photograph of the structure's exterior is shown in Figure 2. The structure was repurposed from a previous test series, which resulted in the exposed studded walls in the front and left side of the structure (Figure 2).

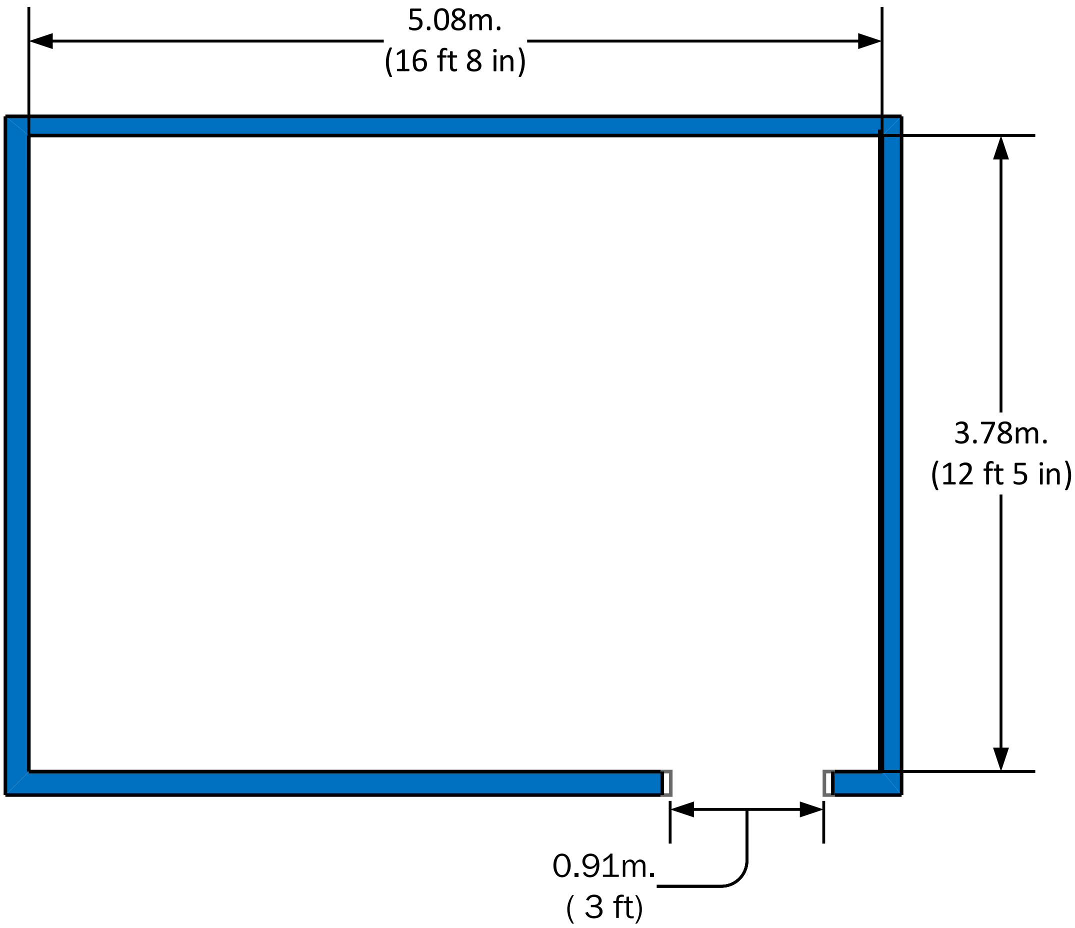

Figure 1. Plane view of test structure

Figure 2. Exterior view of structure (337704_1190276.jpg)

Construction Details

Walls

The walls were framed using 2 x 4 dimensional lumber[1] and the wall studs were spaced 40.6 cm (16 inch) on center. The interior wall surfaces were sheathed with a single layer of 1.27 cm (1/2 inch) thick gypsum wallboard. The seams of the gypsum wallboard were sealed with gypsum wallboard tape and joint compound. The interior walls were painted with builder's grade interior flat white paint. The exterior wall to the right-side of the doorway was sheathed with a single layer of 1.27 cm (1/2 inch) thick gypsum wallboard. This wall was also painted with a interior flat white paint.

Ceiling

The ceiling was framed using 2 x 10 dimensional lumber I-joists that were spaced 61.0 cm (24 inch) on center. The interior side of the ceiling was sheathed with one layer of 1.27 cm (1/2 inch) thick gypsum wallboard. The gypsum wallboard seams were sealed with gypsum wallboard tape and joint compound. The ceiling was painted with builder's grade interior flat white paint. The exterior side of the ceiling joists was exposed. The exterior ceiling in front of the doorway was sheathed with a single layer of 1.27 cm (1/2 inch) thick gypsum wallboard, which was painted with interior flat white paint.

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1 Lumber sizes listed in this report (e.g., 2 x 4) are given in terms of their nominal dimensions in inches, which is greater than the dressed size or actual size of the wood.

Floor

The test structure was built on a platform that was framed using 2 x 6 dimensional lumber. The floor joists were spaced 40.6 cm (16 inch) on center. The floor consisted of one layer of plywood that was nominally 1.59 cm (5/8 inch) thick. The plywood was then covered with a carpet pad and builder's grade carpet.

Four holes were cut into the floor to accommodate heat flux transducers, which were mounted at the floor level. The approximate hole locations are shown in Figure 3 and are noted as Zones 1-4. The square holes were approximately 25.4 cm by 25.4 cm (10 in by 10 in). The holes were then covered with a piece of 1.27 cm (1/2 in) thick cement board that was approximately 30.5 cm by 30.5 cm (12 in by 12 in). The heat flux transducer was mounted to the bottom of the cement board, as shown in Figure 4 and the cement board was held in place with screws.

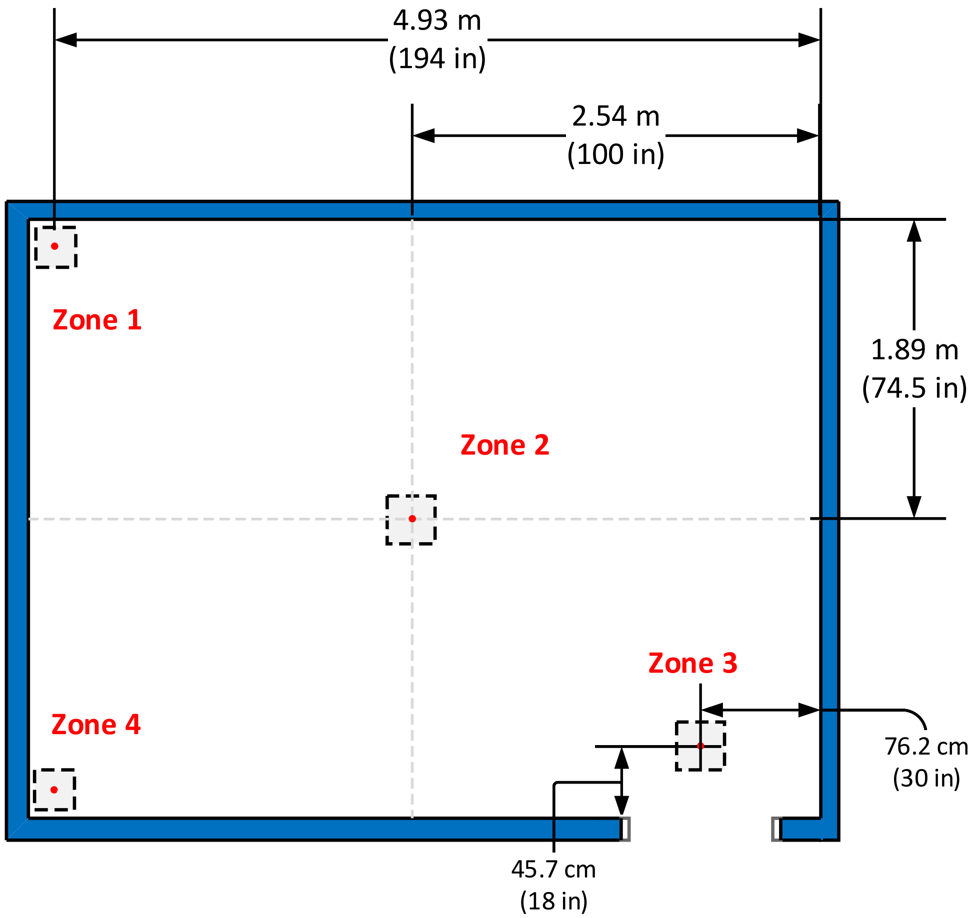

Figure 3. Location of holes in floor to accommodate floor mounted heat flux transducers

Figure 4. Hole in floor to accommodate heat flux transducer mounted to the bottom of the cement board (337704_1190298.jpg)

Furnishings

Sofa

An upholstered sofa was used in the experiment. Details of the sofa are provided in Table 1 and a photograph of the sofa is shown in Figure 5.

Table 1. Sofa details

Make	Model	Size	Materials*
Lifestyle Solutions (Walmart)	CC-WEN-KS3-M26-CF-VA	200 cm x 80 cm x 83 cm (78.70 in x 31.50 in x 32.70 in)	Polyurethane Foam Pad 49% Rebonded Polyurethane Foam Pad 41% Polyester Fiber Batting 10%

* Material information obtained from label on the sofa.

Figure 5. Sofa (337704_1190285.jpg)

Ignition Device

The fire was initiated on the sofa using an ignition package prepared by the FRL staff, as shown in Figure 6. The ignition package consisted of a quart-size plastic bag that contained paper towels and medical gauze rolled together and soaked in gasoline. The medical gauze used was a CVS/pharmacy Sterile Premium Rolled Gauze, constructed of a Rayon-polyester blend. The gauze had a listed un-stretched length of 7.62 cm x 1.92 m (3 inches x 2.1 yard). Ten sheets from a paper towel roll were used and each sheet of paper towel measured 22.5 cm x 27.9 cm (8.875 inch x 11 inch). The ignition packages were assembled by first unrolling the medical gauze and laying it out flat in the un-stretched position. A continuous section of ten (10) paper towel sheets was then removed from the paper towel roll and folded width wise in a tri-fold manner such that the folded width of the continuous section of paper towels measured approximately 7.3 cm (2.875 inches). The folded continuous section of paper towels was placed on top of the un-stretched medical gauze. They were then rolled together such that the paper towels were on the inside and the medical gauze was on the outside of the roll. The roll was then placed inside the quart-sized plastic bag and approximately 250 ml (8.5 fluid ounces) of gasoline was poured into the bag.

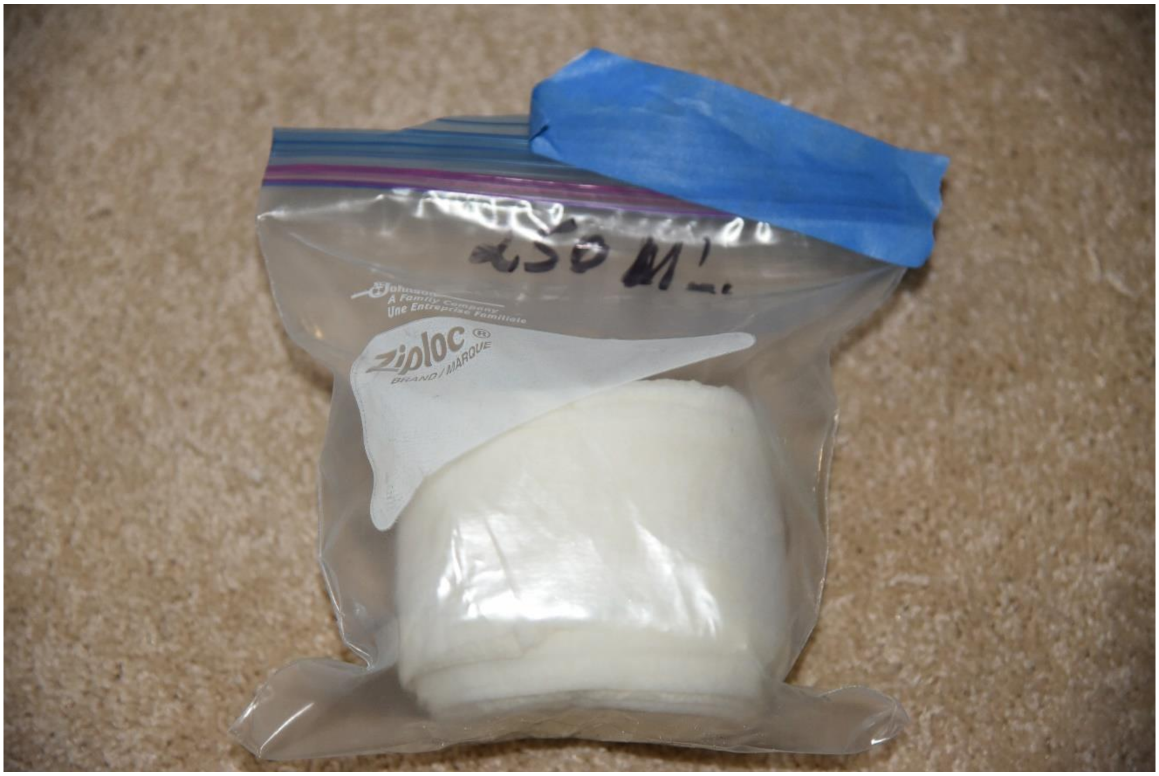

Figure 6. Standard ignition package (337704_1190327.jpg)

Experiment Details

A single test was conduct for this test series. Table 2 provides the Experiment ID associated with the test.

Table 2. Summary of Experiment

Test Number	Experiment ID
1	337704

Procedures

Twelve cartridge casings were placed on each cement board located in Zones 1-4. Figure 7 shows an example of how the cartridge casings were placed in Zone 1, which was next to the left side of the sofa. The cartridge casings were placed around the heat flux transducer, which was located in the center of the cement board. After the cartridge casings were in place, the ignition package was placed underneath the left-rear corner of the sofa, as shown in Figure 8. A propane torch was then used to ignite the ignition package. The fire was allowed to progress past full room involvement for several minutes, after fire was observed extending outside of the doorway. Figure 9 shows the fire prior to suppression. The fire was then suppressed with water and the cartridge casings were recovered from the structure.

Figure 7. Twelve cartridge casings placed on the cement board in Zone 1 (337704_1190306.jpg)

Figure 8. Ignition package located under left rear corner of sofa (337704_1190348.jpg)

Figure 9. Fire prior to suppression (337704_1190543.jpg)

Instrumentation

The instrumentation used during the experiment included thermocouples for temperature measurement, heat flux transducers to measure the heat flux, and a weather station to measure the atmospheric conditions (pressure, temperature, and relative humidity) in the laboratory. In addition, the experiment was documented using a digital camera and several video cameras placed inside of the structure.

Figure 10 provides the general location of the thermocouples (TC) and the heat flux transducers (HF). The exact location of each instrument is based on a Cartesian coordinate system (X, Y, Z). Location X and Location Y are located in the horizontal plane. Location Z is the vertical distance from the floor to the centerline of the instrument. The exact location of each instrument is provided in the following sections that describe the individual instrumentation.

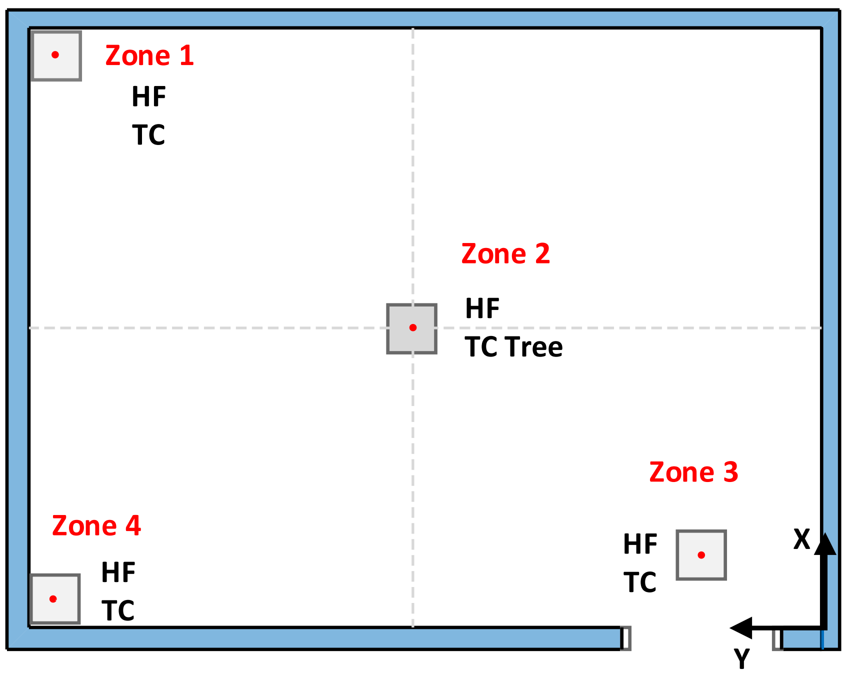

Figure 10. General location of the instrumentation

In each zone, a heat flux transducer and a thermocouple were mounted at the floor level, as shown in Figure 11. In the center of the room (Zone 2), the floor mounted thermocouple was part of a thermocouple tree, in which a thermocouple was placed approximately every 61.0 cm (2 feet) in the vertical direction, starting at the floor level.

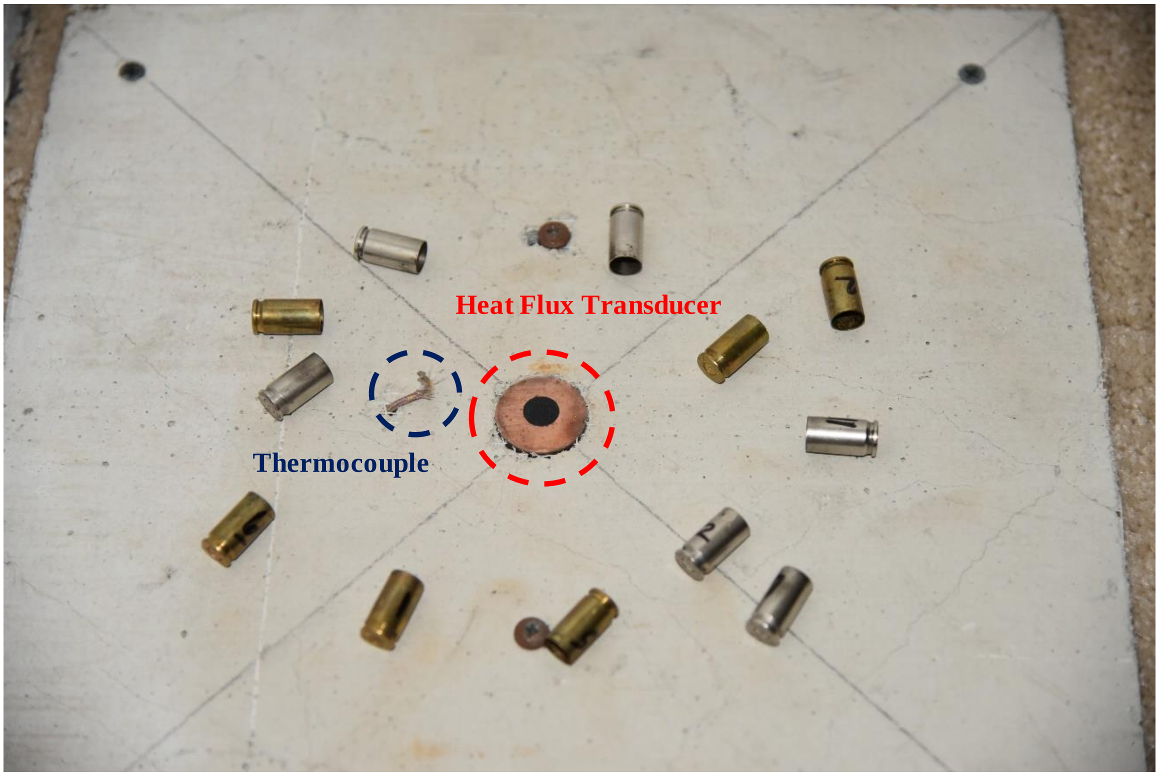

Figure 11. Thermocouple and heat flux transducer mounted at the floor level (337704_1190307).

The approximate location of the three video cameras is shown in Figure 12.

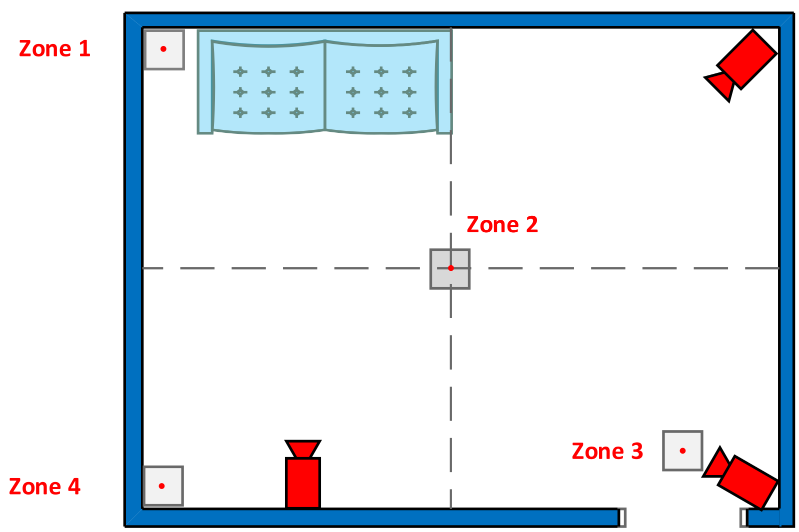

Figure 12. Approximate location of the video cameras inside of the structure

Laboratory Conditions

The ambient laboratory temperature, barometric pressure, and relative humidity were measured during the experiment(s). Barometric pressure measurement is accomplished using a silicon capacitive absolute sensor. The micromechanical sensor uses dimensional changes in its silicon membrane to measure pressure. Humidity measurement is achieved using a capacitive humidity sensor. The capacitance of the thin-film polymer sensor changes as the relative humidity changes. Temperature measurement is attained using a platinum Resistance Temperature Detector (RTD) sensor. The RTD contains a resistor that changes resistance as the temperature changes. The Laboratory Conditions were measured in accordance with the method defined in FRL Laboratory Instruction "LI017 Laboratory Conditions" [1].

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 3. Lab Conditions Description

Test Number	Description	Manufacturer	Model	Bar Code
1	Vaisala LBR	Vaisala	PTU301	99001075

The following table provides a summary of the initial conditions at the start of the experiment(s). The 'Description' column shows the location of the measurements. RH shows the initial relative humidity.

Table 4. Ambient Laboratory Initial Condition Summary

Test Number	Description	Temperature (C)	Pressure (kPa)	RH (%)
1	Vaisala LBR	22	101	44

Thermocouples

Thermocouples are temperature measurement sensors that consist of two dissimilar metals joined at one end (a junction) that produces a small thermo-electrical voltage when the wire is heated. The change in voltage is interpreted as a change in temperature [2]. There are many configurations of thermocouples which affect the temperature range, ruggedness, and response time. The information required to identify these factors for the thermocouples that were used during the experiment(s) conducted for this test series is provided in the "Thermocouple Measurement Description" table. Thermocouples used during this test series were used in accordance with the method defined in FRL laboratory instruction "LI001 Thermocouple" [3].

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement. The "Z" location is the height of the thermocouple above the floor. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 5. Thermocouple Measurement Description

Test Number	Description	X (m)	Y (m)	Z (m)	Thermocouple type
1	Zone 2 - 0 ft	1.905	2.540	0.000	Type K, Glass Ins., 24 AWG wire
1	Zone 2 - 2 ft	1.905	2.540	0.610	Type K, Glass Ins., 24 AWG wire
1	Zone 2 - 4 ft	1.905	2.540	1.219	Type K, Glass Ins., 24 AWG wire
1	Zone 2 - 6 ft	1.905	2.540	1.829	Type K, Glass Ins., 24 AWG wire
1	Zone 2 - 8 ft	1.905	2.540	2.438	Type K, Glass Ins., 24 AWG wire
1	Zone 1 - 0 ft	3.632	4.928	0.000	Type K, Glass Ins., 24 AWG wire
1	Zone 3 - 0 ft	0.457	0.762	0.000	Type K, Glass Ins., 24 AWG wire
1	Zone 4 - 0 ft	0.152	4.928	0.000	Type K, Glass Ins., 24 AWG wire

Heat Flux Transducers

A heat flux transducer is a device that measures the rate of absorbed incident energy, and expresses it on a per unit area basis. The operating principle of the Schmidt-Boelter heat flux transducer(s) used during this test series is based on one-dimensional heat conduction through a solid. Temperature sensors are placed on a thin, thermally conductive sensor element, and applying heat establishes a temperature gradient across the element. The heat flux is proportional to the temperature difference across the element according to Fourier's Law [4].

There are many configurations of heat flux transducers which affect range, size, mode and sensitivity. The information required to identify these factors for the heat flux transducer(s) that were used during the experiment(s) conducted for this test series is provided in the "Heat Flux Measurement Description" table. Heat flux transducers were used in accordance with the method defined in FRL laboratory instruction "LI002 Heat Flux Transducer" [5].

The following table provides a description of the transducer used to collect heat flux measurements during the experiment(s). The "Description" column typically describes the location of the heat flux transducer. Location X and Location Y are Cartesian coordinates generally located in a horizontal plane. Location Z is the distance from the floor to the centerline of the transducer. Heat flux mode indicates whether the total heat flux was measured or just the radiation fraction. Heat flux over range is the maximum measured value reported for this transducer.

Table 6. Heat Flux Measurement Description

Experiment: Test Number	Description	X (m)	Y (m)	Z (m)	Heat Flux Mode	Heat Flux Over Range (kW/m²)	Bar Code
1	Zone 1	3.63	4.93	0.00	Total	225.00	99001097
1	Zone 2	1.91	2.54	0.00	Total	225.00	99001105
1	Zone 3	0.46	0.76	0.00	Total	225.00	99001098
1	Zone 4	0.15	4.93	0.00	Total	225.00	99001106

Experiment Photographs

Digital Cameras are used within the FRL to record digital still photographs during experiments. Digital Cameras used during this test series were used in accordance with the method defined in FRL Laboratory Instruction “LI003 Digital Cameras” [6].

Results for Test 1 (ID 337704)

The following table provides a summary of the temperature results. The "Initial" column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the "Max" column. The remaining columns provide the calculated maximum average temperatures.

Table 7. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
Zone 2 - 0 ft	23.9	979.0	972.3	962.2	526.2	277.3
Zone 2 - 2 ft	22.5	985.8	979.0	973.5	654.2	343.1
Zone 2 - 4 ft	22.4	995.1	987.7	977.9	700.1	378.0
Zone 2 - 6 ft	22.4	984.4	976.5	970.8	743.9	409.4
Zone 2 - 8 ft	22.5	981.2	975.4	968.6	767.1	441.2
Zone 1 - 0 ft	25.3	938.6	900.8	874.4	663.1	402.1
Zone 3 - 0 ft	27.4	721.3	678.6	662.3	375.3	202.7
Zone 4 - 0 ft	24.0	564.1	546.1	523.9	369.8	200.6

The following chart(s) present a time-dependent representation of the instantaneous temperatures measured during the experiment.

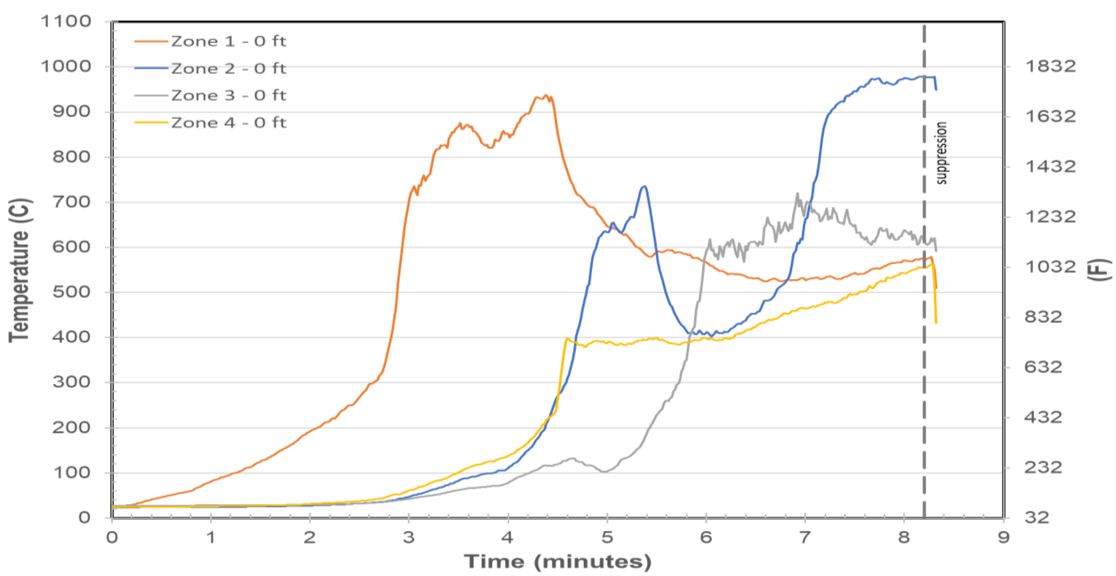

Figure 13. Temperature at Floor Level for Zones 1-4

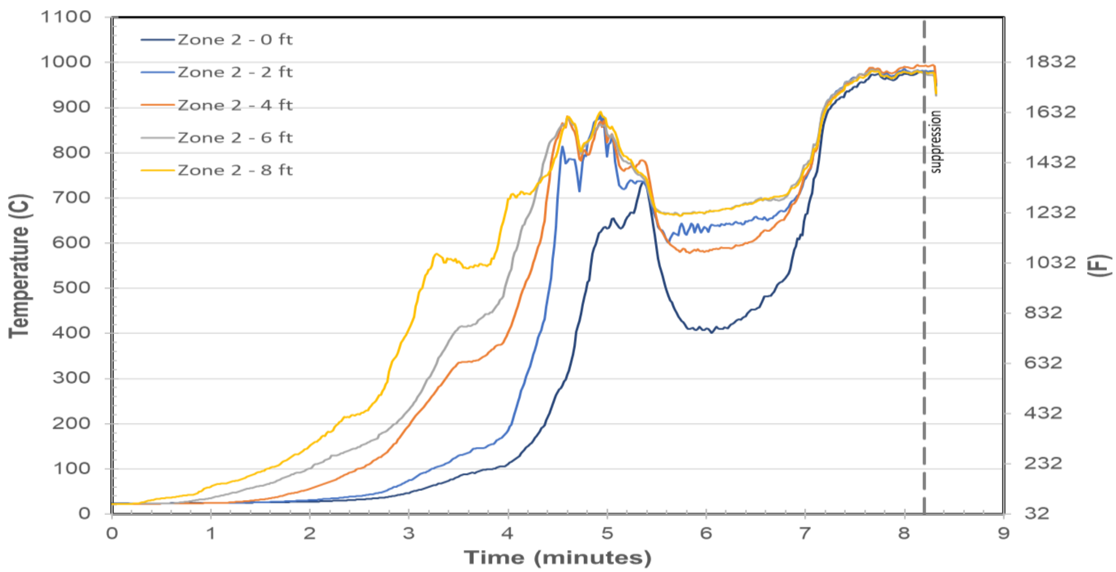

Figure 14. Temperature in Zone 2 at Different Elevations

The following table provides a summary of the heat flux results. The "Description" column typically describes the location of the heat flux transducer. The time at which the heat flux first changes by a pre-determined amount is provided in the "Time of Initial Change" column. The pre-determined amount of change in heat flux is provided in the "Initial Change Amount" column. The maximum heat flux recorded during the test is provided in the "Maximum" column. The "Maximum Average" columns are calculated over four pre-determined time spans.

Table 8. Heat Flux Result Summary

Description	Time of Initial Change (s)	Initial Change Value (kW/m²)	Maximum (kW/m²)	10 Second Maximum Average (kW/m²)	30 Second Maximum Average (kW/m²)	1 Minute Maximum Average (kW/m²)	5 Minute Maximum Average (kW/m²)	10 Minute Maximum Average (kW/m²)
Zone 1	48	5	183.8	161.8	156.3	150.3	68.8	40.3
Zone 2	190	5	84.3	72.2	62.5	50.1	27.7	14.2
Zone 3	232	5	109.6	96.7	88.5	85.1	47.7	24.0
Zone 4	201	5	44.7	32.9	26.5	23.8	19.2	9.8

The following chart(s) shows a time dependent representation of the baseline corrected instantaneous heat flux measured during the experiment.

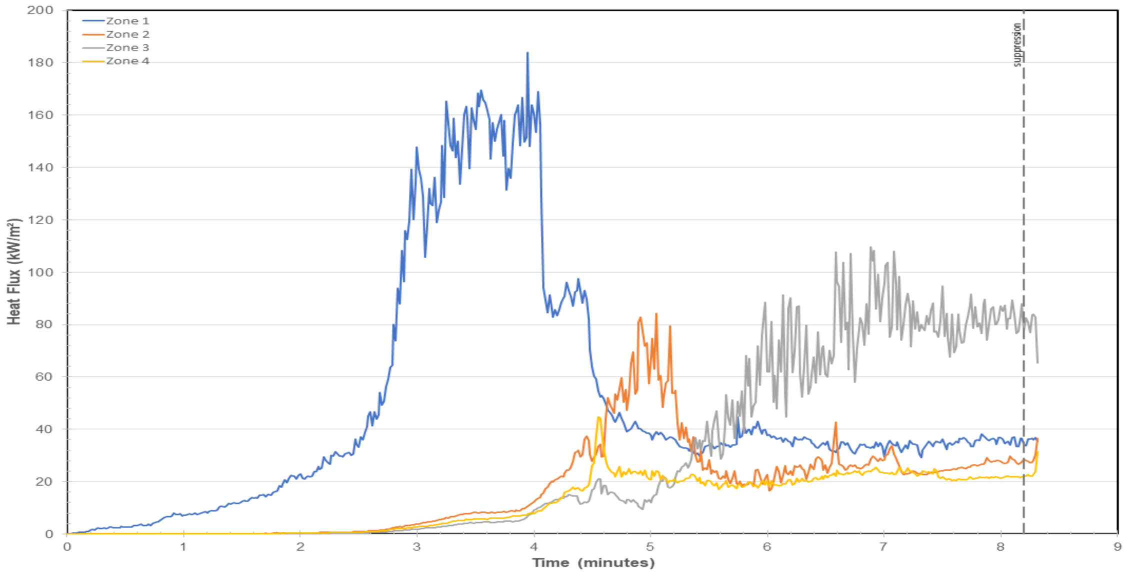

Figure 15. Heat Flux at the Floor Level for Zones 1-4

The following table lists selected events that occurred during the experiment.

Table 9. Experiment Events

Description	Time (s)
suppression	492

The following table provides a description of the video(s) taken during this experiment.

Table 10. Video Log

Description	Start Time	Duration (s)	Filename
Side Sofa	09:23:51	580	337704_20210616_092351_21A.mov
Distance View Sofa	09:23:59	585	337704_20210616_092359_23A.mov
Front View Sofa	09:24:07	589	337704_20210616_092407_24A.mov
SIDE SOFA	09:24:21	588	337704_20210616_092421_5.mov
DISTANCE VIEW SOFA	09:24:23	592	337704_20210616_092423_7.mov
FRONT VIEW SOFA	09:24:24	592	337704_20210616_092424_8.mov
MASTER			337704_1211058.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.


Figure 16. Pre test 53 minutes, 337704_1190523


Figure 17. Pre test 53 minutes, 337704_1190524


Figure 18. Pre test 51 minutes, 337704_1190276


Figure 19. Pre test 51 minutes, 337704_1190277


Figure 20. Pre test 51 minutes, 337704_1190278

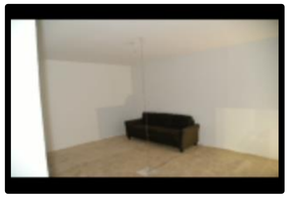
Figure 21. Pre test 51 minutes, 337704_1190279

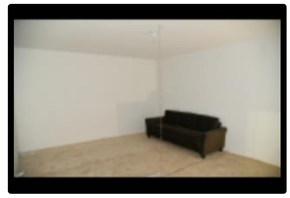
Figure 22. Pre test 51 minutes, 337704_1190280


Figure 23. Pre test 51 minutes, 337704_1190281

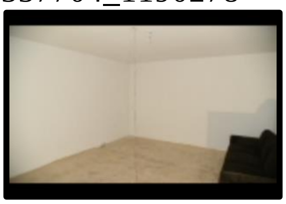
Figure 24. Pre test 51 minutes, 337704_1190282


Figure 25. Pre test 51 minutes, 337704_1190283


Figure 26. Pre test 51 minutes, 337704_1190284

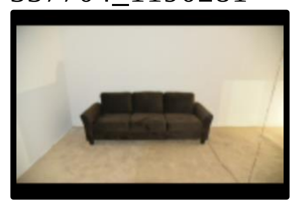
Figure 27. Pre test 51 minutes, 337704_1190285


Figure 28. Pre test 51 minutes, 337704_1190286

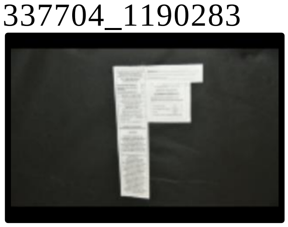
Figure 29. Pre test 50 minutes, 337704_1190287

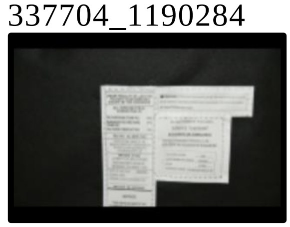
Figure 30. Pre test 50 minutes, 337704_1190288

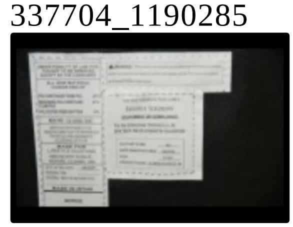
Figure 31. Pre test 50 minutes, 337704_1190289


Figure 32. Pre test 49 minutes, 337704_1190290


Figure 33. Pre test 49 minutes, 337704_1190291


Figure 34. Pre test 49 minutes, 337704_1190292


Figure 35. Pre test 49 minutes, 337704_1190293


Figure 36. Pre test 49 minutes, 337704_1190294


Figure 37. Pre test 49 minutes, 337704_1190295


Figure 38. Pre test 49 minutes, 337704_1190296


Figure 39. Pre test 49 minutes, 337704_1190297


Figure 40. Pre test 45 minutes, 337704_1190298


Figure 41. Pre test 45 minutes, 337704_1190299


Figure 42. Pre test 45 minutes, 337704_1190300


Figure 43. Pre test 22 minutes, 337704_1190305


Figure 44. Pre test 22 minutes, 337704_1190306


Figure 45. Pre test 22 minutes, 337704_1190307


Figure 46. Pre test 21 minutes, 337704_1190308


Figure 47. Pre test 21 minutes, 337704_1190309


Figure 48. Pre test 20 minutes, 337704_1190314


Figure 49. Pre test 20 minutes, 337704_1190315


Figure 50. Pre test 20 minutes, 337704_1190316


Figure 51. Pre test 19 minutes, 337704_1190317


Figure 52. Pre test 19 minutes, 337704_1190318


Figure 53. Pre test 19 minutes, 337704_1190319


Figure 54. Pre test 17 minutes, 337704_1190320


Figure 55. Pre test 17 minutes, 337704_1190327


Figure 56. Pre test 10 minutes, 337704_1190328


Figure 57. Pre test 10 minutes, 337704_1190333


Figure 58. Pre test 10 minutes, 337704_1190334

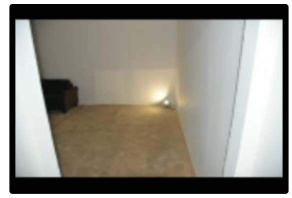
Figure 59. Pre test 10 minutes, 337704_1190335


Figure 60. Pre test 10 minutes, 337704_1190336


Figure 61. Pre test 9 minutes, 337704_1190337


Figure 62. Pre test 9 minutes, 337704_1190338


Figure 63. Pre test 9 minutes, 337704_1190339

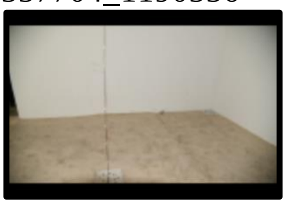
Figure 64. Pre test 9 minutes, 337704_1190340

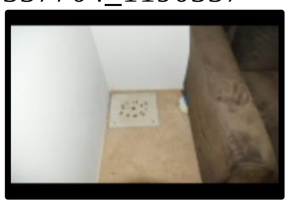
Figure 65. Pre test 9 minutes, 337704_1190342

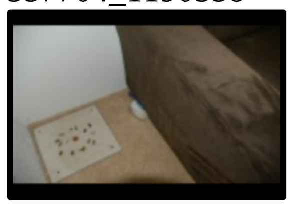
Figure 66. Pre test 9 minutes, 337704_1190348

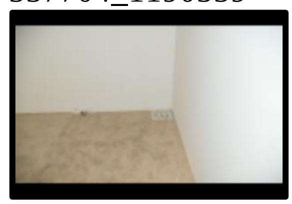
Figure 67. Pre test 9 minutes, 337704_1190349


Figure 68. Pre test 9 minutes, 337704_1190458


Figure 69. Pre test 9 minutes, 337704_1190459


Figure 70. Pre test 9 minutes, 337704_1190460

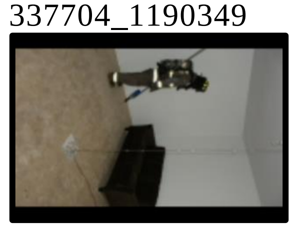
Figure 71. Pre test 20 seconds, 337704_1190525

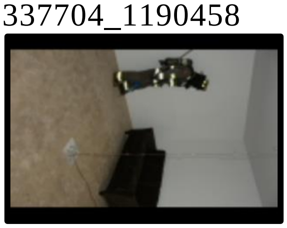
Figure 72. Pre test 16 seconds, 337704_1190526

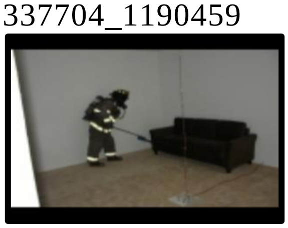
Figure 73. Pre test 2 seconds, 337704_1190527

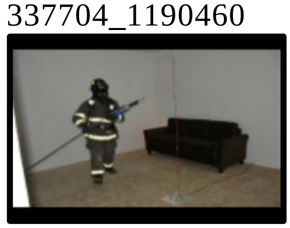
Figure 74. 0 seconds, 337704_1190528


Figure 75. 14 seconds, 337704_1190529


Figure 76. 14 seconds, 337704_1190530


Figure 77. 18 seconds, 337704_1190531


Figure 78. 78 seconds, 337704_1190532


Figure 79. 118 seconds, 337704_1190533


Figure 80. 158 seconds, 337704_1190534


Figure 81. 162 seconds, 337704_1190535


Figure 82. 196 seconds, 337704_1190536


Figure 83. 250 seconds, 337704_1190537


Figure 84. 274 seconds, 337704_1190538

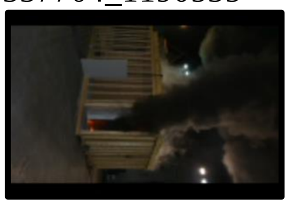
Figure 85. 312 seconds, 337704_1190539


Figure 86. 336 seconds, 337704_1190540

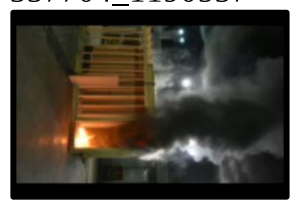
Figure 87. 378 seconds, 337704_1190541


Figure 88. 432 seconds, 337704_1190542

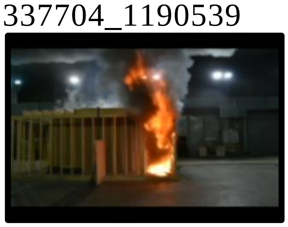
Figure 89. 440 seconds, 337704_1190543


Figure 90. Post test 0 minutes, 337704_1190544

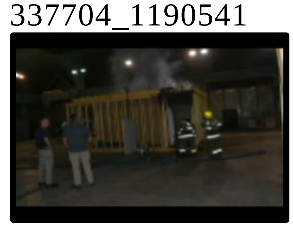
Figure 91. Post test 4 minutes, 337704_1190545

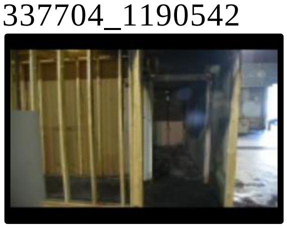
Figure 92. Post test 55 minutes, 337704_1190461

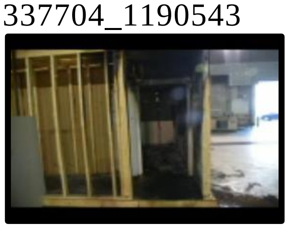
Figure 93. Post test 55 minutes, 337704_1190462


Figure 94. Post test 55 minutes, 337704_1190463


Figure 95. Post test 55 minutes, 337704_1190464


Figure 96. Post test 55 minutes, 337704_1190465


Figure 97. Post test 56 minutes, 337704_1190466


Figure 98. Post test 56 minutes, 337704_1190467


Figure 99. Post test 56 minutes, 337704_1190468

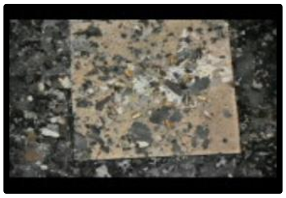
Figure 100. Post test 56 minutes, 337704_1190469

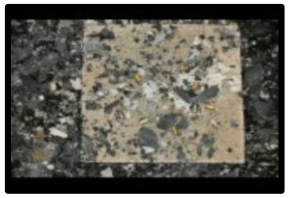
Figure 101. Post test 57 minutes, 337704_1190470


Figure 102. Post test 57 minutes, 337704_1190471


Figure 103. Post test 57 minutes, 337704_1190472


Figure 104. Post test 57 minutes, 337704_1190473


Figure 105. Post test 57 minutes, 337704_1190474


Figure 106. Post test 57 minutes, 337704_1190475


Figure 107. Post test 58 minutes, 337704_1190476


Figure 108. Post test 58 minutes, 337704_1190477


Figure 109. Post test 58 minutes, 337704_1190478


Figure 110. Post test 58 minutes, 337704_1190479


Figure 111. Post test 58 minutes, 337704_1190480


Figure 112. Post test 58 minutes, 337704_1190481


Figure 113. Post test 58 minutes, 337704_1190482


Figure 114. Post test 58 minutes, 337704_1190483


Figure 115. Post test 58 minutes, 337704_1190484


Figure 116. Post test 59 minutes, 337704_1190485


Figure 117. Post test 59 minutes, 337704_1190486


Figure 118. Post test 59 minutes, 337704_1190487


Figure 119. Post test 59 minutes, 337704_1190488


Figure 120. Post test 59 minutes, 337704_1190489

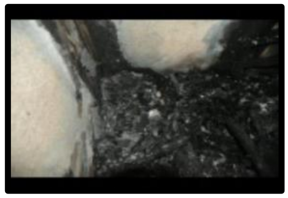
Figure 121. Post test 59 minutes, 337704_1190490


Figure 122. Post test 59 minutes, 337704_1190491


Figure 123. Post test 59 minutes, 337704_1190492


Figure 124. Post test 59 minutes, 337704_1190493


Figure 125. Post test 1:01 hr:min, 337704_1190494


Figure 126. Post test 1:01 hr:min, 337704_1190495


Figure 127. Post test 1:06 hr:min, 337704_1190496


Figure 128. Post test 1:07 hr:min, 337704_1190497


Figure 129. Post test 1:07 hr:min, 337704_1190498


Figure 130. Post test 1:07 hr:min, 337704_1190499


Figure 131. Post test 1:07 hr:min, 337704_1190500


Figure 132. Post test 1:14 hr:min, 337704_1190501


Figure 133. Post test 1:14 hr:min, 337704_1190502


Figure 134. Post test 1:14 hr:min, 337704_1190503


Figure 135. Post test 1:14 hr:min, 337704_1190504


Figure 136. Post test 1:14 hr:min, 337704_1190505

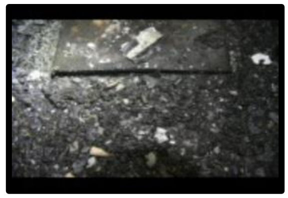
Figure 137. Post test 1:14 hr:min, 337704_1190506

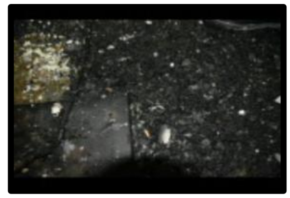
Figure 138. Post test 1:15 hr:min, 337704_1190507

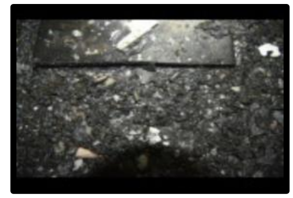
Figure 139. Post test 1:15 hr:min, 337704_1190508


Figure 140. Post test 1:18 hr:min, 337704_1190509


Figure 141. Post test 1:18 hr:min, 337704_1190510


Figure 142. Post test 1:19 hr:min, 337704_1190511


Figure 143. Post test 1:19 hr:min, 337704_1190512


Figure 144. Post test 1:19 hr:min, 337704_1190513


Figure 145. Post test 1:20 hr:min, 337704_1190514


Figure 146. Post test 1:20 hr:min, 337704_1190515


Figure 147. Post test 1:21 hr:min, 337704_1190516


Figure 148. Post test 1:21 hr:min, 337704_1190517


Figure 149. Post test 1:22 hr:min, 337704_1190518


Figure 150. Post test 1:23 hr:min, 337704_1190519


Figure 151. Post test 1:30 hr:min, 337704_1190520

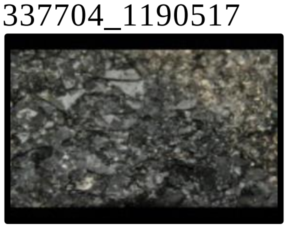
Figure 152. Post test 1:32 hr:min, 337704_1190521


Figure 153. Post test 1:32 hr:min, 337704_1190522

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