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Research-Scale Fire Performance Evaluation of a Wood Floor Joist/Tin Ceiling Panel Assembly

ASTM E119-98: *Standard Test Methods for Fire Tests of Building Construction and Materials**

***Research-scale horizontal test, modified in that the sample size was less than 180 ft^2 (16 ft^2) and no load was applied**

Conducted For:

Albi Manufacturing
A Division of StanChem Inc.
401 Berlin Street
East Berlin, CN 06023

WFCi Report #04042(b)

Conducted On: June 28, 2004

Report Issued On: August 11, 2004

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INTRODUCTION

This report documents the research-scale fire resistance testing of a wood floor joist/ tin ceiling panel assembly performed by Western Fire Center, Inc. (WFCi) for:

Albi Manufacturing
A Division of StanChem Inc.
401 Berlin Street
East Berlin, CN 06023.

Mike White of WFCi conducted the test with the assistance WFCi staff Wayne Beres, Logan Byman and Tony Mansur on June 28, 2004.

The 4ft x 4ft floor/ceiling assembly was constructed by the client's representative at the WFCi lab prior to testing. A description of the sample can be found on page seven of this report.

The purpose of this test was to evaluate the fire endurance characteristics (ability to contain a fire) of the client's floor/ceiling assembly when subjected to a standard fire exposure condition (ASTM E119 standard time-temperature curve).

Skip Gosser of Intumescent Technologies constructed the sample and witnessed the testing.

SUMMARY OF TEST METHOD

This is a horizontal research-scale fire test of a 16 ft^2 open joist floor construction exposed to the fire (time-temperature) conditions described in ASTM E 119-98, "Fire Tests of Building Construction and Materials". *The principal departure from this referenced standard was a reduction in specimen size, allowing the test results to be used only for research and development purposes.* A horizontal exposure furnace (described in the following section) was used to subject the samples to a standard time-temperature curve as specified in the referenced test procedures.

-For this fire endurance evaluation, the test was to be performed for a fire resistance period of 1 hour or until failure criteria (transmission of heat or flame) were met.

DESCRIPTION OF LABORATORY TEST FACILITY

FIGURE 1: HORIZONTAL FURNACE

The furnace used in the test is a small-scale fire burning apparatus, fueled by natural gas (pictured at right.) The sample was mounted on to the top of the furnace horizontally. The exposed surface is subjected to the time-temperature curve, while temperature measurements are taken from the unexposed surface, using a computerized data acquisition system. The furnace valves are controlled based upon the average of the interior furnace temperature, which is determined from the internal thermocouples. Additional thermocouples are added to the unexposed surface of the specimen to monitor the specimen's temperature. Windows are provided in the sides of the furnace to allow viewing of the specimen's exposed surface and the taking of photographs during testing. Upon completion, or early termination of a test, the main gas supply valve is closed and the specimen is removed from the furnace, allowing for hose stream testing of specimen, if applicable, and allowing for post-testing observations.

SAMPLE DESCRIPTION

The 4’ X 4’ ceiling/floor joist assembly was constructed of rough cut (full dimensional) Douglas fir 2”X10” wood joists spaced at 16” on center to simulate a flooring section of an older building. The exposed face of the sample was covered with two 2’ X 4’ tin ceiling panels which were then coated with Red Primer 15X0505 487 water-based primer, followed by 40 mils of sprayed-on intumescent material, identified as ALBI-TF. The unexposed side was covered with 1”x4” fir tongue and groove subfloor under 5/8” CDX plywood decking.

The overall sample was identified by the client as **A1-1**.

The ceiling/floor construction was instrumented with 10 thermocouples to take temperature measurements throughout the test. These measurements appear in tabular form in the Test Data section of this report and in graphical form in Appendix A of this report.

Thermocouples 1-5 were placed inside the sample beneath the tin covering on the exposed face. TC 1 was over the left joist and 13" in from the top edge, TC 2 was centered in the right cavity and 13" in from the top edge, TC 3 was centered in the sample, TC 4 was centered in the left cavity and 13" in from the bottom edge and TC 5 was over the right joist and 13" in from the bottom edge.

Thermocouples 6-10 were located on the unexposed face of the wall construction. TC 8 was centered on the sample and TCs 6, 7, 9 and 10 were placed at quarter points on the upper left, upper right, lower left and lower right corners of the sample, respectively.

Diagram 1: Sample Layout and Interior Thermocouples

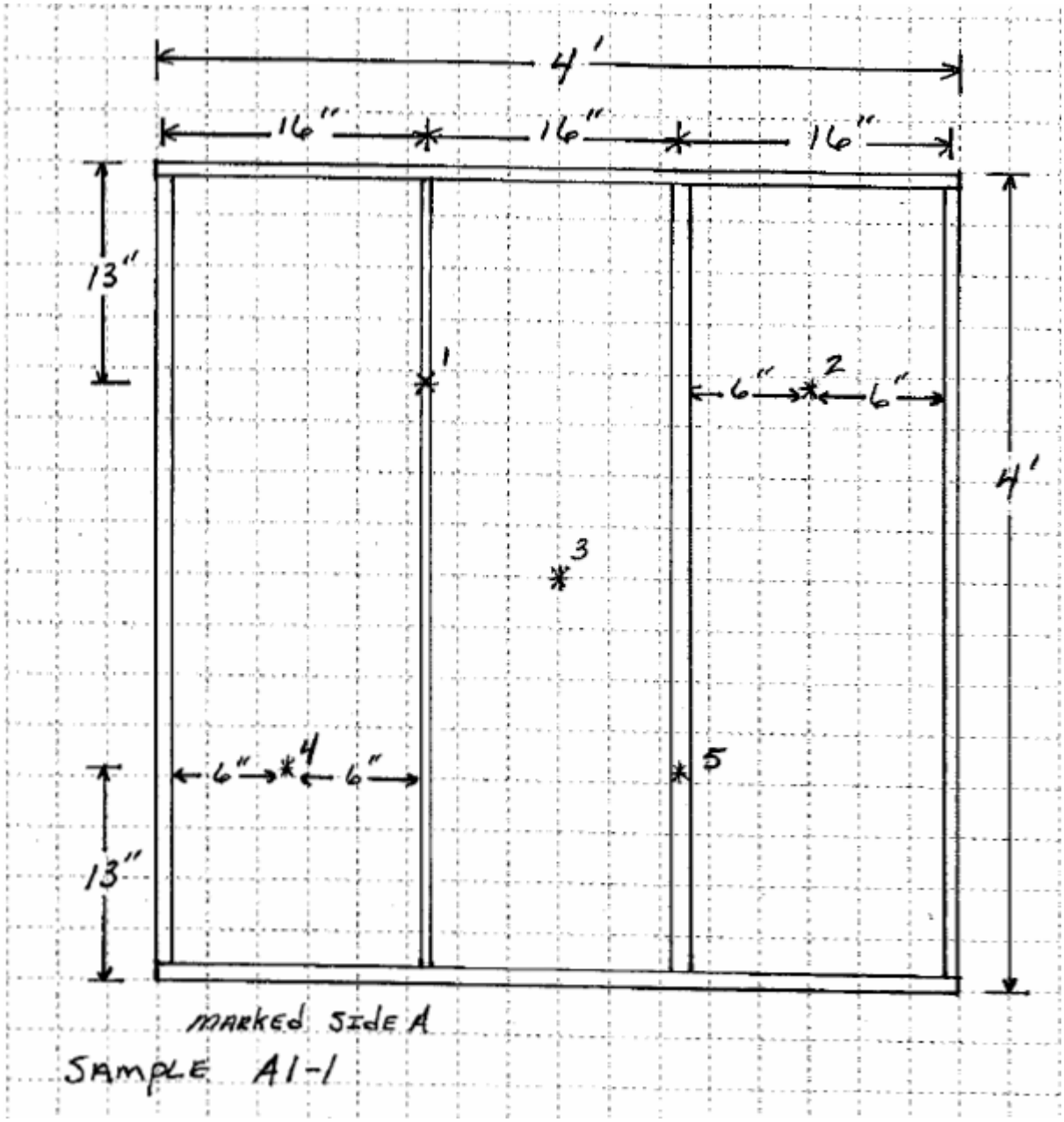
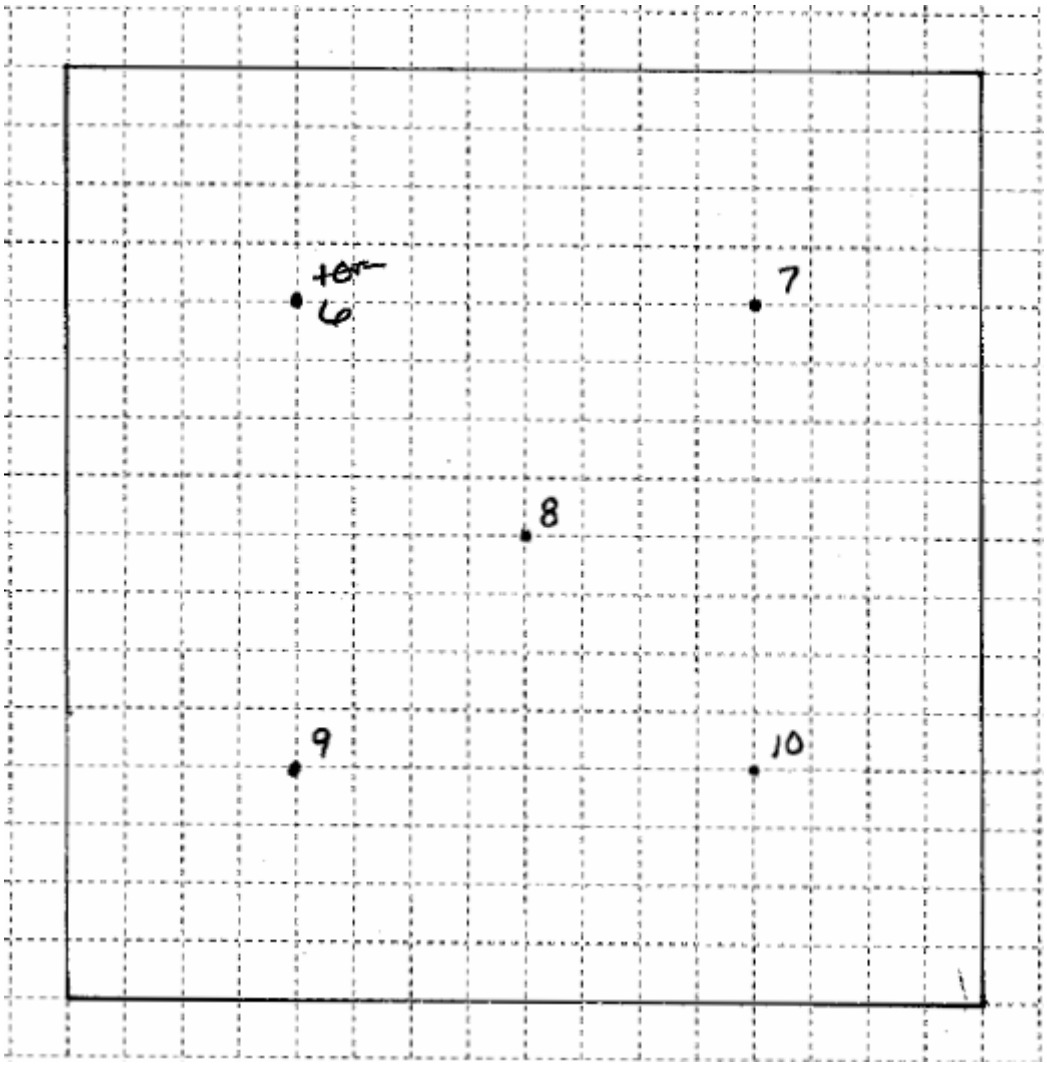


Diagram 2: Unexposed Face Thermocouple Layout



TEST DATA

Test Observations

Test Date: 6/28/2004, 1:36 PM

Specimen Tested: 4' X 4' wood ceiling/floor joist assembly

Furnace: Research-Scale Horizontal Exposure Furnace

Cameras: 1 digital still camera and 1 video camera

Ambient Conditions: Lab room Temp: 76F

Relative Humidity: 41%

Observations:

Test Time (h:mm:ss)		**Event**
0:00:00		Ignite Furnace, Start Test
0:00:54		Surface blackening and intumescing
0:01:30		Intumescent material fell from sample
0:03:00		Sample appears to have some intumescent left on tin panels, a thick layer fell at 1:30
0:13:30		No change
0:16:17		Approx. 50% of exposed surface has no intumescent material covering it
0:21:45		No change
0:22:15		Smoke escaping around sample perimeter
0:28:54		Intumescent material is thickening and turning ash grey or white
0:31:42		All the intumescent material around the center of the sample has fallen, attached flames at the seam of the tin panels
0:40:40		Sounds of crackling coming from the sample, no intumescent material covering the tin surface except a couple of inches around the perimeter
1:00:00		Stop Test

Average Furnace Temperatures (every 5 min.)

Time	Total % of Standard Curve	Temperature (Celsius)	Standard Temperature
0:00:00	0	0	0
0:05:00	89.7	558.4	556.9
0:10:00	96.1	624.0	658.7
0:15:00	94.2	648.0	718.7
0:20:00	91.1	668.1	761.5
0:25:00	92.0	795.1	794.7
0:30:00	94.1	812.5	821.9
0:35:00	95.7	848.2	844.9
0:40:00	96.8	854.4	864.8
0:45:00	97.1	863.9	882.4
0:50:00	97.2	876.6	898.1
0:55:00	97.3	890.6	912.4
0:60:00	97.2	895.2	924.1

Interior Thermocouple Temperatures (every 5 min.)

(See diagram on page 7 for locations)

Time	Temperature (Celsius)				
	TC1	TC2	TC3	TC4	TC5
0:00:00	28.4	26.0	28.9	26.7	26.8
0:05:00	92.7	99.6	163.0	94.9	114.0
0:10:00	101.0	136.7	178.8	107.1	113.3
0:15:00	111.5	171.6	200.5	130.0	123.9
0:20:00	120.9	205.8	236.5	147.3	133.6
0:25:00	145.1	286.3	336.5	200.2	153.0
0:30:00	156.2	462.4	411.6	282.5	181.4
0:35:00	183.1	558.9	508.2	478.8	282.8
0:40:00	204.8	579.6	553.2	525.7	351.9
0:45:00	257.3	602.2	583.8	555.5	409.8
0:50:00	324.6	626.2	616.9	585.0	456.6
0:55:00	378.3	656.2	638.0	605.7	494.4
0:60:00	415.7	661.4	633.6	608.4	521.1

Unexposed Thermocouple Temperatures (every 5 min.)

(See diagram on page 8 for locations)

Time	Temperature (Celsius)				
	TC6	TC7	TC8	TC9	TC10
0:00:00	25.3	25.0	25.2	26.1	24.5
0:05:00	25.4	25.1	25.3	25.8	24.1
0:10:00	25.8	25.4	25.5	25.8	24.0
0:15:00	26.7	26.5	26.9	26.4	24.7
0:20:00	28.2	28.2	29.9	27.6	26.0
0:25:00	30.2	30.5	34.2	29.2	28.0
0:30:00	32.6	33.3	39.7	31.3	30.3
0:35:00	35.7	36.5	46.2	34.6	33.3
0:40:00	39.9	41.1	53.9	44.5	38.7
0:45:00	47.1	47.1	60.5	53.4	47.0
0:50:00	54.6	54.9	67.3	59.3	52.9
0:55:00	60.9	62.1	76.0	63.8	57.5
0:60:00	65.0	67.7	86.7	66.9	60.6

TEST RESULTS AND CONCLUSION

Charts illustrating data collected from the test are included in Appendix A. Photographs from the test are included in Appendix B.

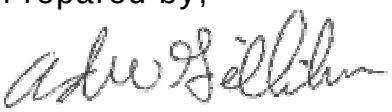
From ASTM E 119:

> ***32. Conditions of Acceptance—Unrestrained Assembly***
> *32.1 In obtaining an unrestrained assembly classification, the following conditions shall be met:*
> *32.1.1 The specimen shall have sustained the applied load during the classification period without developing unexposed surface conditions which will ignite cotton waste.*
> *32.1.2 The transmission of heat through the specimen during the classification period shall not have been such as to raise the average temperature on its unexposed surface more than 250°F (139°C) above its initial temperature.*

The 4’ X 4’ fire-retardant coated tin ceiling/wood floor joist assembly described in this report successfully withstood a 1 hour fire endurance period in this research-scale test. Temperatures on the unexposed side of the assembly remained below failure limits (with thermocouple 8 peaking at below 90°C) and no flaming occurred on the unexposed side during the test. The load-bearing capability of this assembly was not assessed in this test.

SIGNATURES

Prepared by,



Andrew Gillihan
Technical Writer

Reviewed by,

Howard Stacy
Manager

The test specimen identification is as provided by the client and WFCi accepts no responsibilities for any inaccuracies therein. WFCi did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

APPENDIX A:

CHARTS

Chart 1: Furnace Temperature Vs. Standard Curve

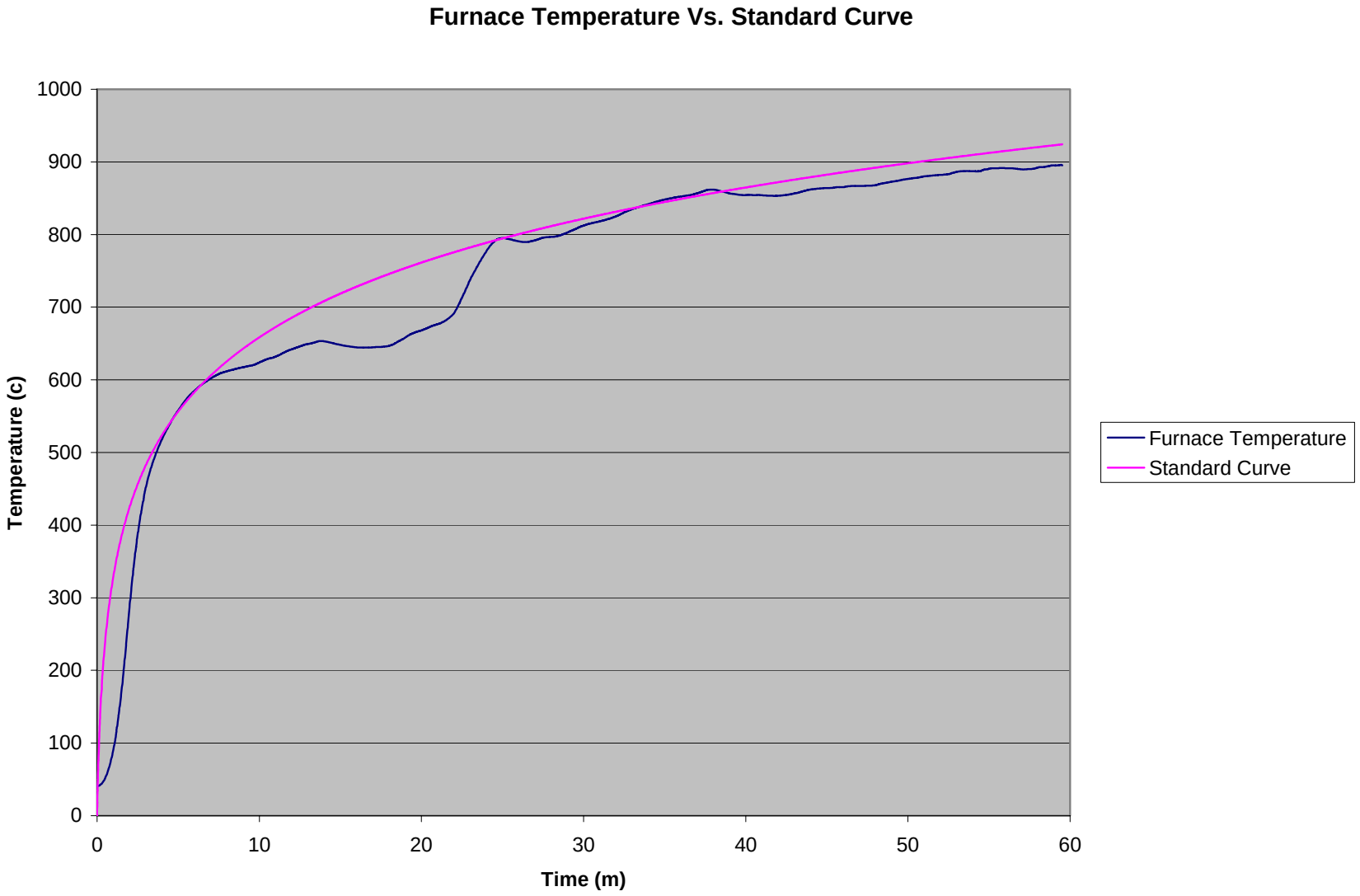


Chart 2: Interior Thermocouple Temperatures

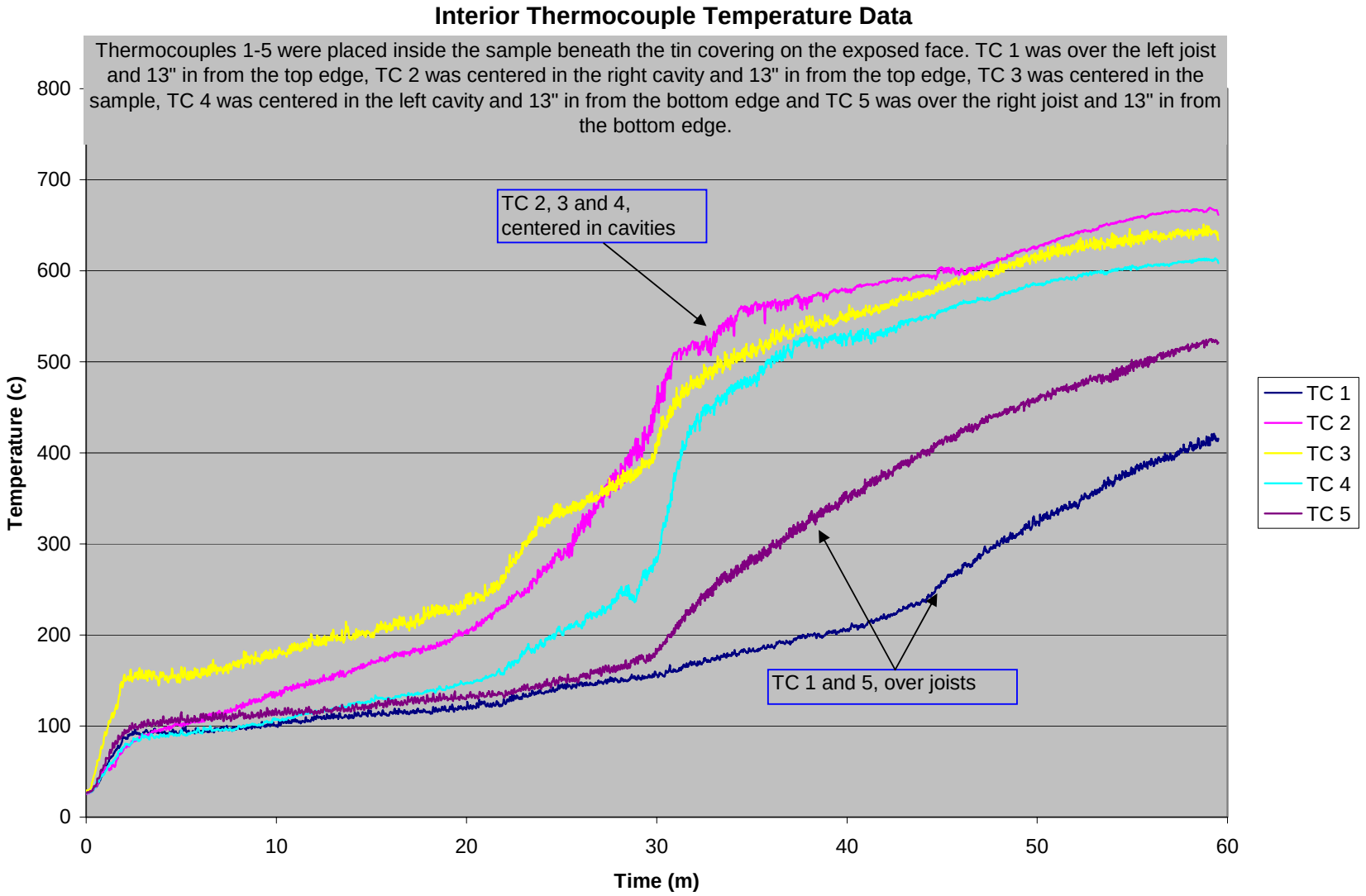
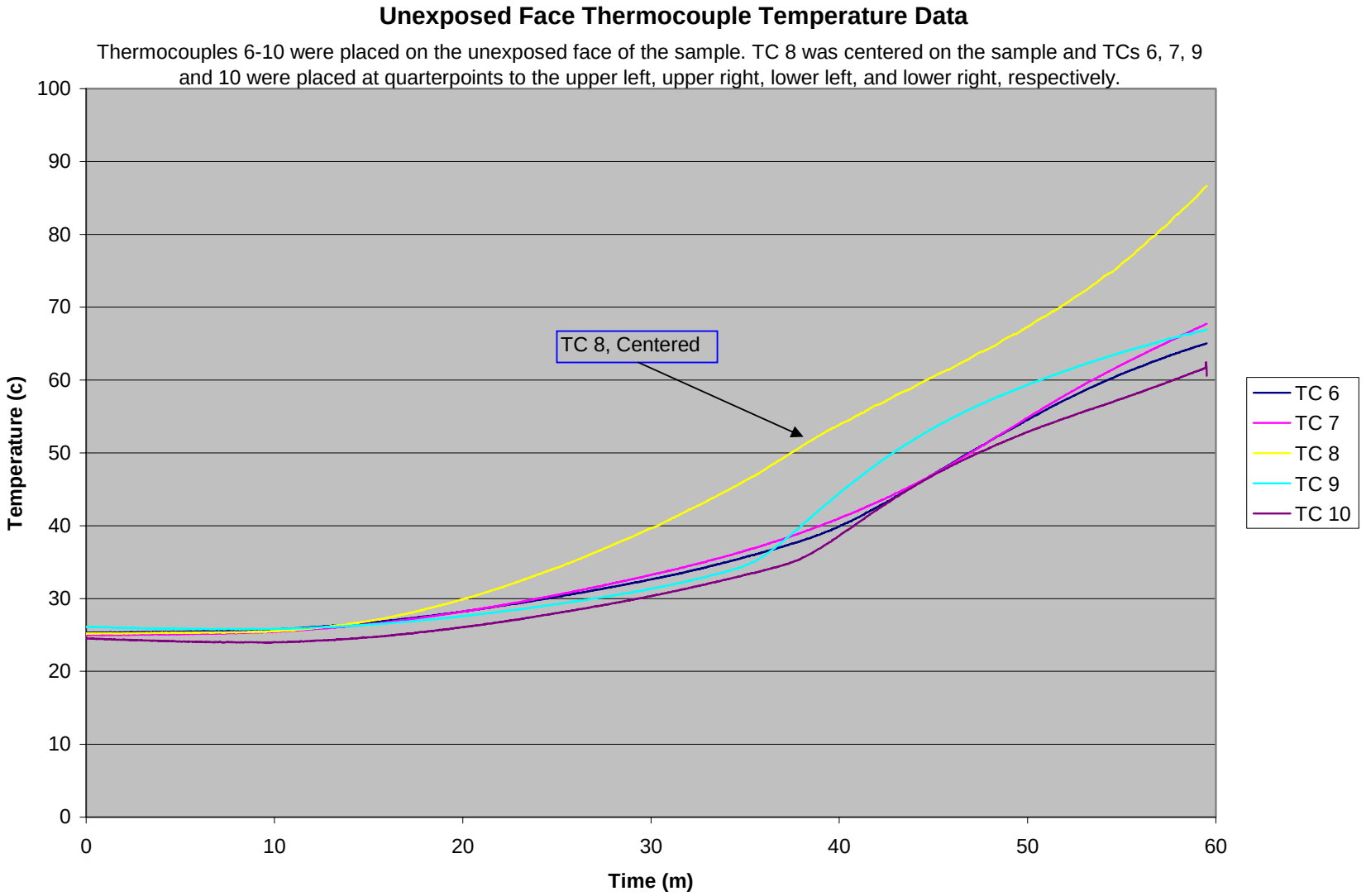


Chart 3: Unexposed Thermocouple Temperatures



APPENDIX B:

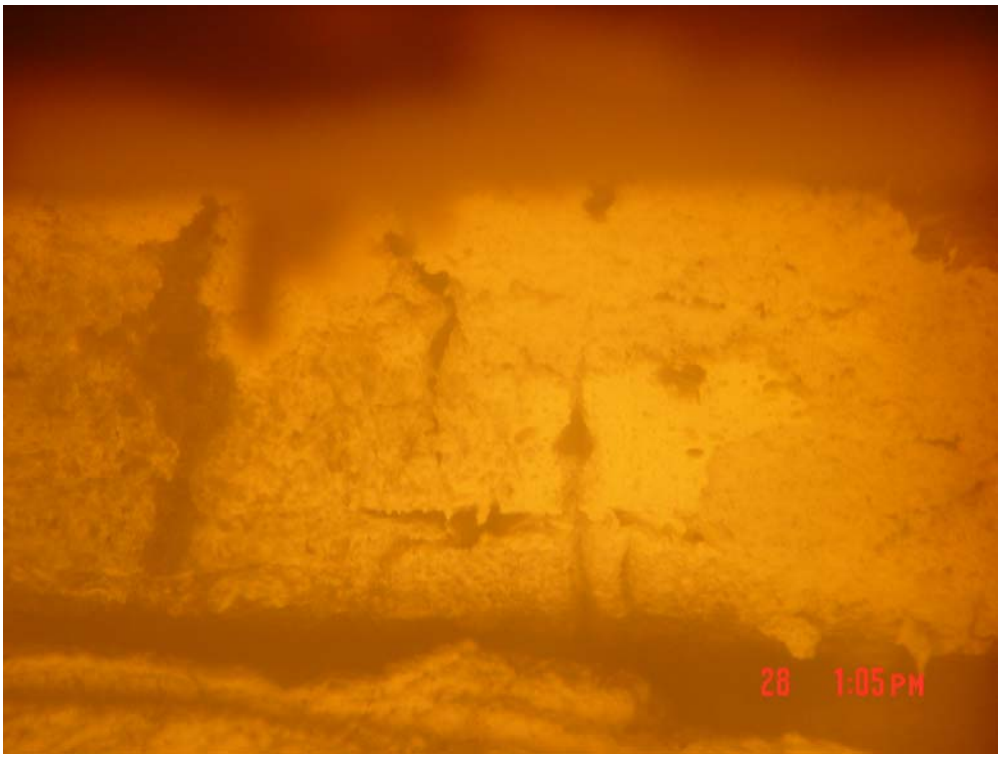
PHOTOGRAPHS

Photograph 1: Exposed face of sample, pre-test

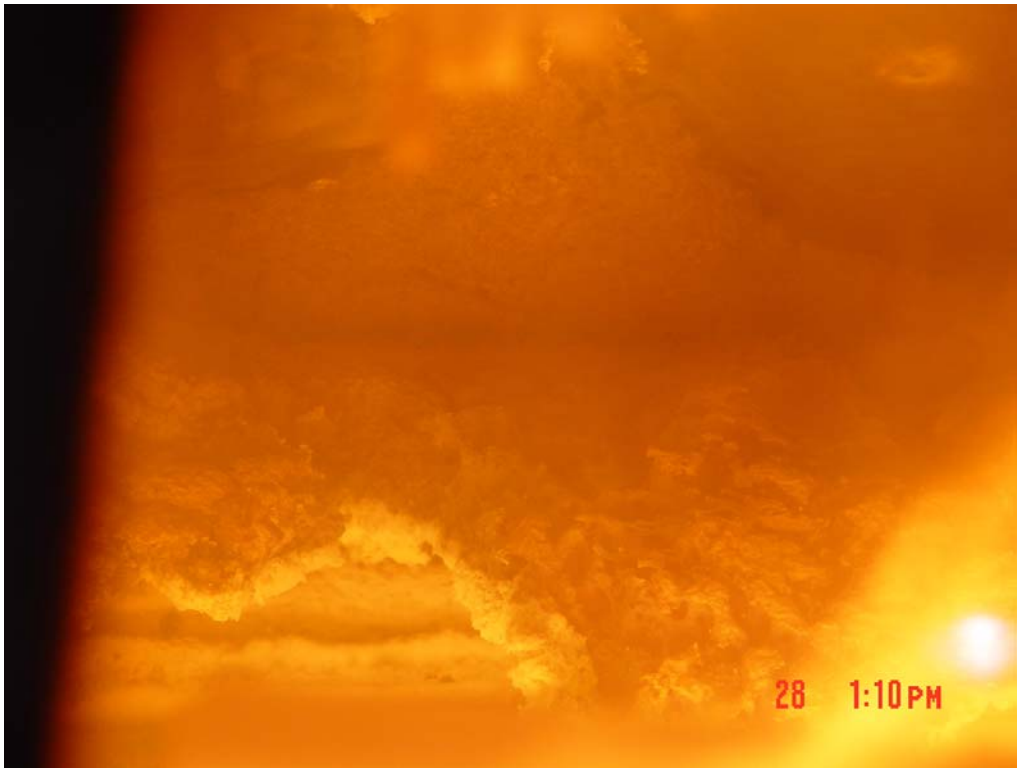
Photograph 2: Closer view of sample exposed face

Photograph 3: Unexposed sample face pre-test showing thermocouple placement

Photograph 4: Smoke rising from the sample early in the test



Photograph 5: Intumescent material cracking on the sample



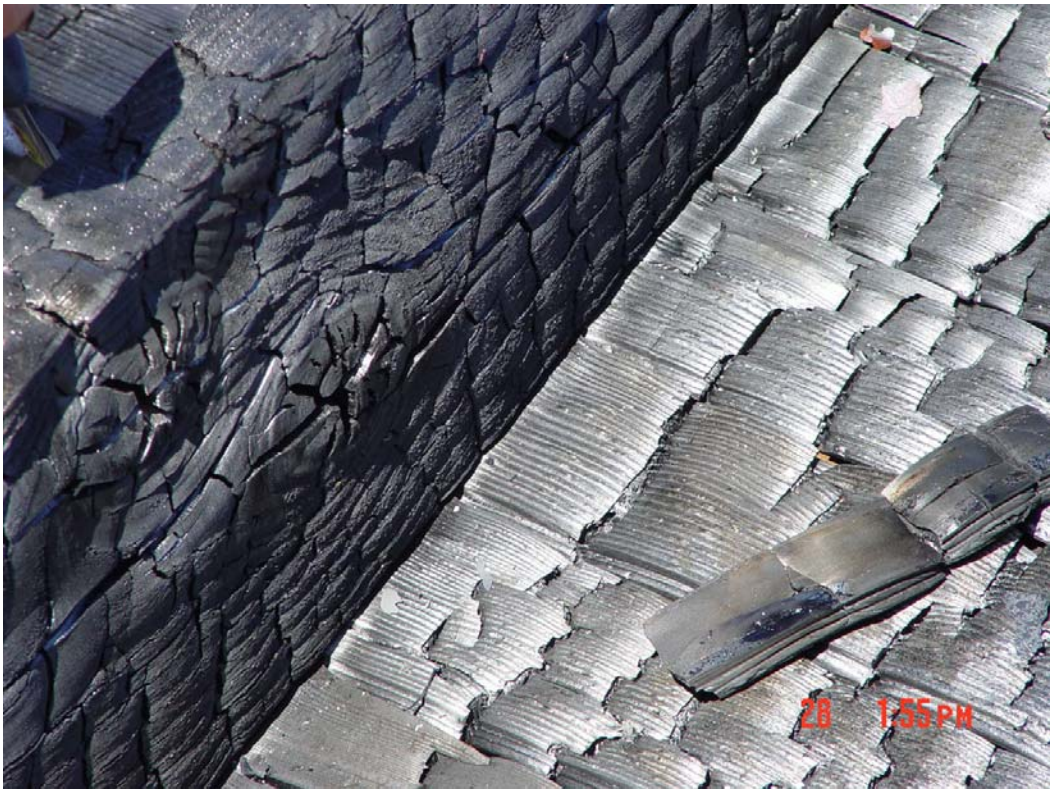
Photograph 6: A flap of intumescent material falling from the sample

Photograph 7: Unexposed face of the sample during test

Photograph 8: Smoke shooting from a gap in the frame of the sample

Photograph 9: Exposed face of the sample post-test

Photograph 10: Interior of sample post-test



Photograph 11: Close-up of sample interior post-test

Photograph 12: Close-up of exposed joist with char scraped away