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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF FIRE TECHNOLOGY
WWW.FIRE.SWRI.ORG
FAX 210/522-3377

September 30, 2003

Mr. John Mallette
Comfort Technologies, Inc.
3101 Winterset Parkway
Marietta, GA 30067

FINAL REPORT (Consisting of 6 Pages)

Subject: SwRI® Project No. 01.06061.01.801, Characterization of Thermal Performance of Protective Fabric in General Accordance with the Method Described in NISTIR 6400: *Development of an Apparatus for Measuring the Thermal Performance of Fire Fighters' Protective Clothing*

Dear Mr. Mallette:

This letter constitutes our final report for the above referenced project on the testing services performed at Southwest Research Institute (SwRI) on September 24 and 25, 2003, in general accordance with the method described in NISTIR: 6400: *Development of an Apparatus for Measuring the Thermal Performance of Fire Fighters' Protective Clothing*.

Method Description

Layered fabric samples were tested in general accordance with the method described in NISTIR 6400: *Development of an Apparatus for Measuring the Thermal Performance of Fire Fighters' Protective Clothing*. Information about the samples used in this study is listed in Table 1. This method makes use of a highly modified ASTM E 162 radiant panel apparatus to characterize the tendency of a material to reflect thermal energy. Photos of the apparatus are shown in Figure 1. The apparatus is located in a ventilated chamber approximately 12 feet wide by 10 feet deep by 10 feet high. A window in one wall of the chamber allowed the system to be observed while the test was in progress. The door to the chamber was kept closed for the first few tests; starting with test number 03-267Com801-7, the door was left open to reduce the ambient temperature in the chamber. The tracks extending from the front of the radiant panel were marked at six-inch intervals to allow for reproducible placement of the sample trolley. The sample could be placed as close as six inches from the panel face, and as far away as 42 inches.

At the start of testing, the radiant panel was ignited and adjusted to obtain a blackbody temperature of 670°C, as specified in ASTM E 162. A thermal radiation shield was placed on the tracks extending from the front of the radiant panel, about 18 inches from the front of the panel. A 12 × 12-inch fabric sample was mounted on the movable trolley, and three thermocouples were placed on the sample: one on the front face, and two on the back. For the first test, the front thermocouple was placed ¼ inch in front of the sample, the first back thermocouple was placed ¼ inch behind the sample, and the second back thermocouple was placed ½ inch behind the sample. For all subsequent tests, the front thermocouple and one of the back thermocouples were in contact with the sample at the center of the sample, and the second back thermocouple was ¼ inch from the center of the back face of the sample. An additional thermocouple was located by the test chamber wall at a height of about 4 ½ feet to measure ambient conditions. The trolley was placed on the tracks at the end furthest from the panel, and the sample thermocouples were connected to the data collection system. A thermal imaging camera located behind the sample was focused on the back face of the sample. A normal video camera located outside the test chamber was used to record the measurement.

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Once the sample was in place and the thermocouples were properly connected, data collection was initiated. Video was recorded using both the normal and thermal imaging cameras. A computer was used to collect readings from the four thermocouples. Temperature readings were taken once per second.

Data was collected for all samples for at least three minutes with the radiation shield in place to provide a baseline for comparison. The radiation shield was then removed, and data was collected for at least three minutes at the initial position of the sample. Data was then collected at a series of positions, as indicated in Table 2.

Results

Seventeen tests were run over the course of two days. Table 1 lists the samples used in each test, the presence of a vinyl or foam layer in each sample, and the state of the chamber door for each test. Table 2 lists the times at which the thermal shield was removed and the sample position was changed during each test. Videotapes from the normal and infrared cameras were provided to the client at the end of the second day of testing. Microsoft Excel files containing the raw data and graphs of the temperature profiles have been provided to the client.

Table 1. Samples used for each test.

Test Name	Sample	Vinyl	Foam	Door
03-267Com801-1	Kev 7.5 60/40	Yes	No	Closed
03-267Com801-2	100 Cotton	Yes	No	Closed
03-267Com801-3	100 Cotton	No	No	Closed
03-267Com801-4	Suede Leather	Yes	No	Closed
03-267Com801-5	Suede Leather	No	No	Closed
03-267Com801-6	Nylon	Yes	No	Closed
03-267Com801-7	Military Canvas	Yes	No	Open
03-267Com801-8	Military Canvas	No	No	Open
03-268Com801-1	Kev 7.5 60/40	No	Yes	Open
03-268Com801-2	Kev 100	No	Yes	Open
03-268Com801-3	Kev 60/40 6.9	No	Yes	Open
03-268Com801-4	CottonPoly 65/35	No	Yes	Open
03-268Com801-5	100 Nylon	No	Yes	Open
03-268Com801-6	Nomex III A	No	Yes	Open
03-268Com801-7	Nylon 100	No	No	Open
03-268Com801-8	CottonPoly 65/35	No	No	Open
03-268Com801-9	Nomex III A	No	No	Open

Table 2. Times for shield removal and sample position changes for each test.

Test Name	Sample	Distance from Panel (inches)	Test Time (hh:mm:ss)
03-267Com801-1	Kev 7.5 60/40	36 (Shield)	0:00:00
		36	0:02:05
		30	0:11:50
		30*	0:43:20
		24*,**	0:48:40
		24*	0:50:20
		18*	1:02:50
		12*	1:15:40
		6*	1:26:30
03-267Com801-2	100 Cotton	42 (Shield)	0:00:00
		42	0:05:50
		36	0:11:20
		30	0:16:30
		24	0:22:15
03-267Com801-3	100 Cotton	42 (Shield)	0:00:00
		42	0:04:30
03-267Com801-4	Suede Leather	42 (Shield)	0:00:00
		42	0:04:35
		36	0:10:05
03-267Com801-5	Suede Leather	42 (Shield)	0:00:00
		42	0:04:20
		36	0:09:20
03-267Com801-6	Nylon	42 (Shield)	0:00:00
		42	0:04:35
03-267Com801-7	Military Canvas	42 (Shield)	0:00:00
		42	0:04:45
03-267Com801-8	Military Canvas	42 (Shield)	0:00:00
		42	0:04:50
03-268Com801-1	Kev 7.5 60/40	42 (Shield)	0:00:00
		42	0:06:40
		36	0:18:00
		18	0:22:55

* Note: During the first test, a box made of 1-inch thick aluminum faced rigid fiberglass board was placed around the back of the sample to minimize the effect of convection currents.

** Note: During this time the first back thermocouple was placed in contact with the back surface.

Table 2 (cont.). Times for shield removal and sample position changes for each test.

Test Name	Sample	Distance from Panel (inches)	Test Time (hh:mm:ss)
03-268Com801-2	Kev 100	42 (Shield)	0:00:00
		42	0:04:35
		36	0:11:00
		30	0:19:20
03-268Com801-3	Kev 60/40 6.9	42 (Shield)	0:00:00
		42	0:04:30
		36	0:11:25
		30	0:20:10
03-268Com801-4	CottonPoly 65/35	42 (Shield)	0:00:00
		42	0:04:45
		36	0:11:00
		30	0:20:30
03-268Com801-5	100 Nylon	42 (Shield)	0:00:00
		42	0:04:43
		36	0:11:50
		30	0:20:00
03-268Com801-6	Nomex III A	42 (Shield)	0:00:00
		42	0:04:40
		36	0:10:50
		30	0:20:00
03-268Com801-7	Nylon 100	42 (Shield)	0:00:00
		42	0:04:40
		36	0:07:55
		30	0:11:00
03-268Com801-8	CottonPoly 65/35	42 (Shield)	0:00:00
		42	0:04:45
		36	0:07:55
		30	0:10:55
03-268Com801-9	Nomex III A	42 (Shield)	0:00:00
		42	0:04:55
		36	0:07:55
		30	0:10:55

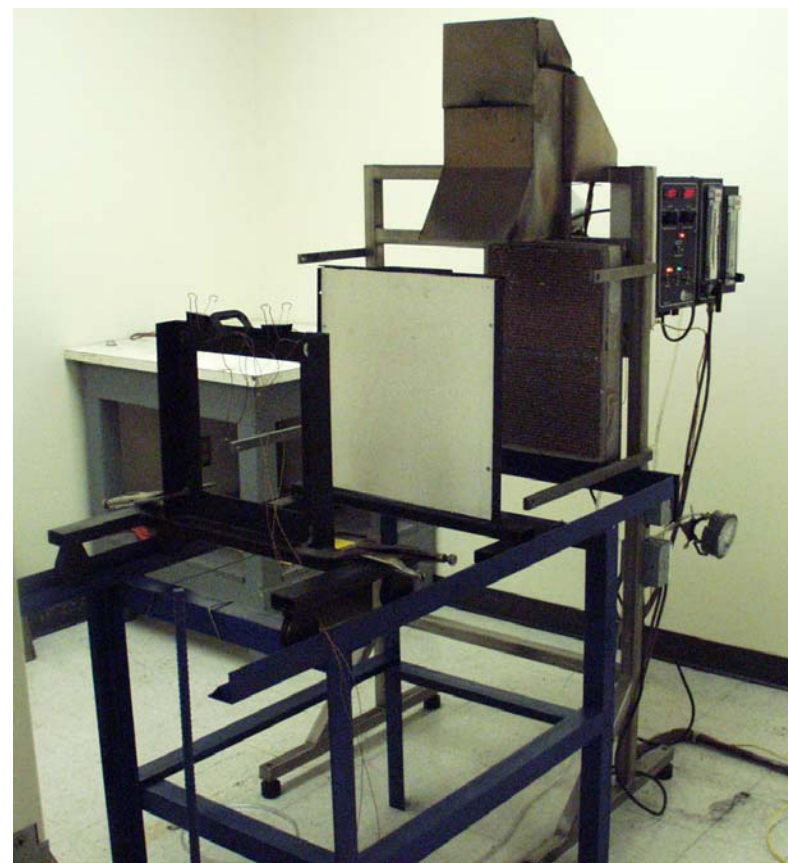
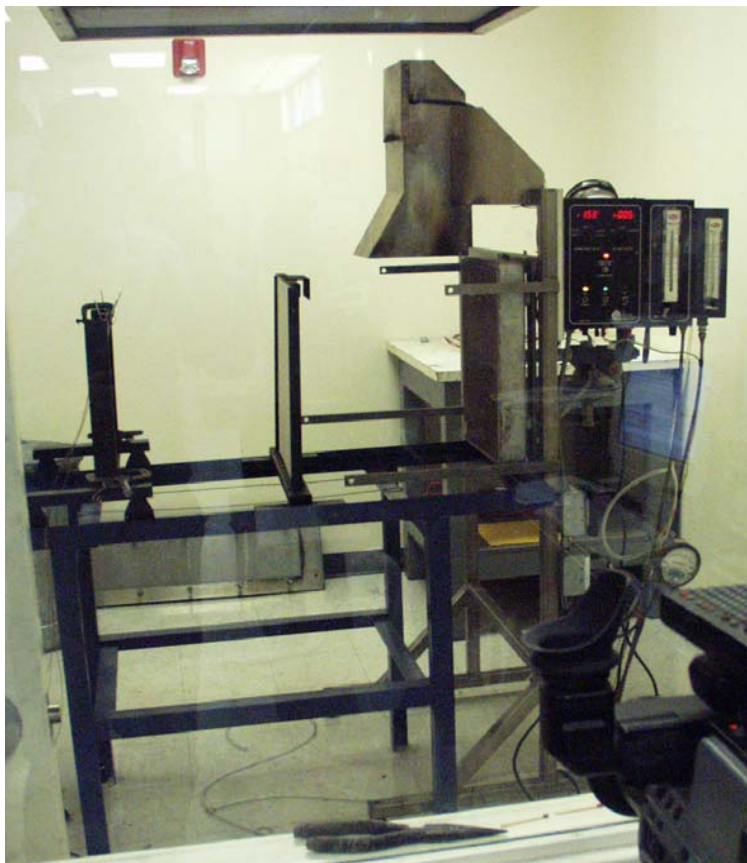


Figure 1. View of test apparatus: Note the ASTM E 162 radiant panel on the right. The sample trolley is on the left, and the shield is between the panel and the sample.

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If you have any questions regarding the results of this work, or if I can be of further assistance, please feel free to contact me by phone at 210-522-5008, by fax at 210-522-3377, or by e-mail at keith.willson@swri.org. If you have any further questions regarding SwRI's fire testing, listing and labeling, or applied research services, please visit our website at www.fire.swri.org.

With regards,

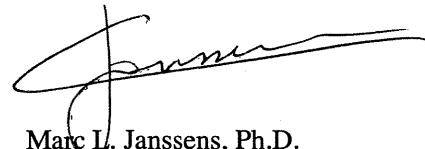


W Keith R. Willson, Ph.D.
Group Leader
Material Flammability Section

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cc: Record Copy A – DFT
Record Copy B – QA

Approved by:



Marc L. Janssens, Ph.D.
Director
Department of Fire Technology