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**REPORT**  
ON

**FULL-SCALE FIRE TEST OF AN AVERAGE MATTRESS  
AND FOUNDATION WITH BEDDING**

Pacific Fire Laboratory Project Number: 06-2003

submitted to

Mr. Joel P. Rawson  
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by

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Kelso, August 6, 2003

## Introduction

The Providence Journal Company, the client, requested that our laboratory conducts a full-scale fire test of a “queen sized bed” following the methodology described as Option C in the California Technical Bulletin 129 [1]. The test sample that comprised of a mattress, foundation, steel frame, and bedding, was not specified as to the materials and manufacturer. The client requested that we purchase “a set that would be considered typical, popular, and in the average price range”. The cost of the mattress set and the steel frame was limited to \$950. The bedding was to be supplied by the client.

Photographing and videotaping was arranged by the client.

## Test Methodology

The methodology described in [1] was used for this test. Option C was chosen to best serve the client’s objectives.

## Description of Test Sample

The queen size mattress set (the mattress, the foundation, and the steel frame) was purchased in a local mattress store as a set that, according to the merchant’s understanding, best matched the client’s description.

The bedding was brought by the client and was, according to the client, a typical “bed in a bag” set. The bedding was placed on the bed in the presence of the client’s representatives, Mr. Peter Lord and Ms. Mary Murphy. The bedding consisted of a bed skirt, two sheets, a pillow and a pillow case, a sham cover, and a comforter. The materials for these components are identified in Table 1 as presented by the client.

The dimensions of the mattress were 80” x 60” x 10-1/2”. The dimensions of the foundation were 80” x 60” x 8”. The following are the specifications for the mattress and foundation exactly as provided by the merchant<sup>1</sup>:

<b>MATTRESS:</b>	<b>FOUNDATION:</b>
368 high profile innerspring	8” single I beam platform
Double offset 12-3/4” gauge coil	Fiberboard insulator
Densified fiber	5/8” foam topper
1” high density foam	Continental upholstery
1” high density foam	
Comfort Seal 2000	
Reinforced fabric handles	
Sheet holders <sup>2</sup>	
Quilted top side only	

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<sup>1</sup> Since an average product was tested the manufacturer will not be identified in this report. The mattress and foundation manufacturer is known to the client.

<sup>2</sup> Not used in the test.

The weights (masses) of the sample components are given in Table 1:

**Table 1:** Sample components and materials

<i>Number</i>	<i>Component</i>	<i>Mass (g)</i>	<i>Material</i>
1	Comforter	2,018	70% polyester, 30% cotton, filled with 100% polyester
2	Pillow	721	100% polyester filling, 100% cotton cover
3	Bed skirt	508	70% polyester, 30% cotton, bed skirt platform was 100% polypropylene
4	Sham cover	121	70% polyester, 30% cotton
5	Sheets (2 pieces)	1,344	Cotton blend
6	Pillow case	102	50% polyester, 50% cotton
7	Bed frame	10,859	Steel
8	Foundation	25,796	See manufacturer's description above
9	Mattress	38,925	See manufacturer's description above
	<b>TOTAL SAMPLE</b>	<b>80,394</b>	

The sample was placed on a 6' x 8' platform made of Type X 5/8" Gypsum thermal barrier, wood frame, and plywood guides for positioning of the platform on two scales. The mass of the platform was 119,295 g.

### **Test Instrumentation and Procedure**

The sample was positioned entirely under a 16' x 16' exhaust hood designed as an oxygen consumption calorimeter. During the test the following parameters were measured: oxygen concentration, carbon dioxide concentration, carbon monoxide concentration, exhaust gas flow, exhaust gas temperature, and smoke attenuation. These parameters were used to calculate the following: heat release rate (HRR), smoke release rate (SRR), and total heat released (THR). Per the client's request, one Type K, 24 AWG thermocouple was mounted about one foot from the right and front edges of the bed (the front edge was ignited with the T burner) and one foot above the bed for temperature measurements. All the measurements were made at three second intervals and recorded in a computer file using a Fluke Hydra II data acquisition system.

In addition, mass of the sample was measured during the test in three second intervals using two Sartorius electronic scales each having a capacity of 150 kg and 1 g accuracy.

**Date of Test**

The test was conducted on July 30, 2003.

**Conditioning of Sample**

The sample was conditioned at  $23\pm 3$  °C, 50±5% RH.

**Test Results***Record of Events*

The bed was ignited at the location and with the T burner prescribed in [1]. The bed ignited practically at the instant the burner was ignited and the flames came in contact with the end of the bed. The flames spread quickly over the bed and the fire intensity increased quickly. The fire was extinguished at 170 seconds due to the heat generation that exceeded the capacity of the calorimeter. At the time of extinguishment most of the bed was involved in the fire and a part of the bed was already consumed. Melting and dripping was observed of mainly the bedding, and a pool fire resulted on the floor perimeter of the bed. The entire test was videotaped and photographed per the client's arrangement.

*Results of Measurements*

The results of measurements required in [1] are given in Table 2. Non-mandatory results are given in Table 3. The plots of heat release rate, smoke release rate, mass remaining, carbon dioxide concentration, carbon monoxide concentration, duct mass flow, duct gas temperature, smoke extinction coefficient, and temperature at the location of the thermocouple during the test are given in Figures 1-9.

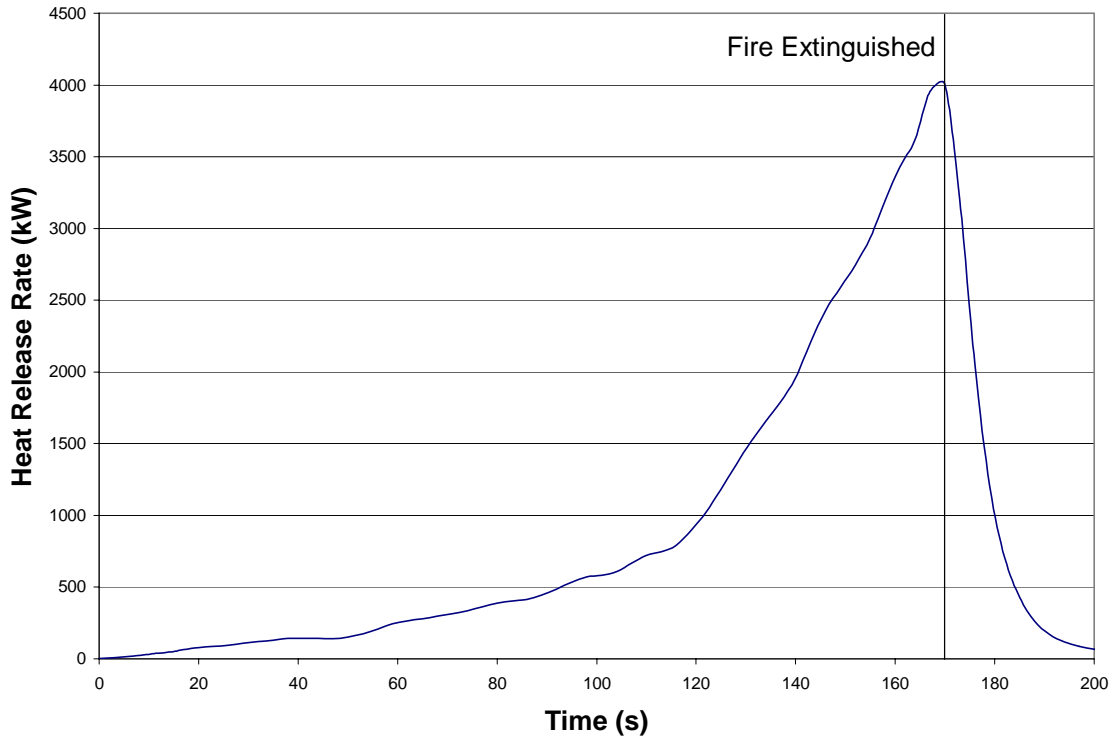
**Table 2:** Numerical Results of Measurements

<i>Peak Heat Release Rate (kW)</i>	<i>Time of Peak Heat Release Rate (s)</i>	<i>Total Heat Released at 170 s* (MJ)</i>	<i>Peak Smoke Release Rate (m<sup>2</sup>/s)</i>	<i>Time of Peak Smoke Release Rate (s)</i>	<i>Total Smoke Released at 170 s (m<sup>2</sup>)</i>	<i>Total Mass Loss at 170s (kg)</i>
4004	170	187.4	30.1	170	1137.3	9.560

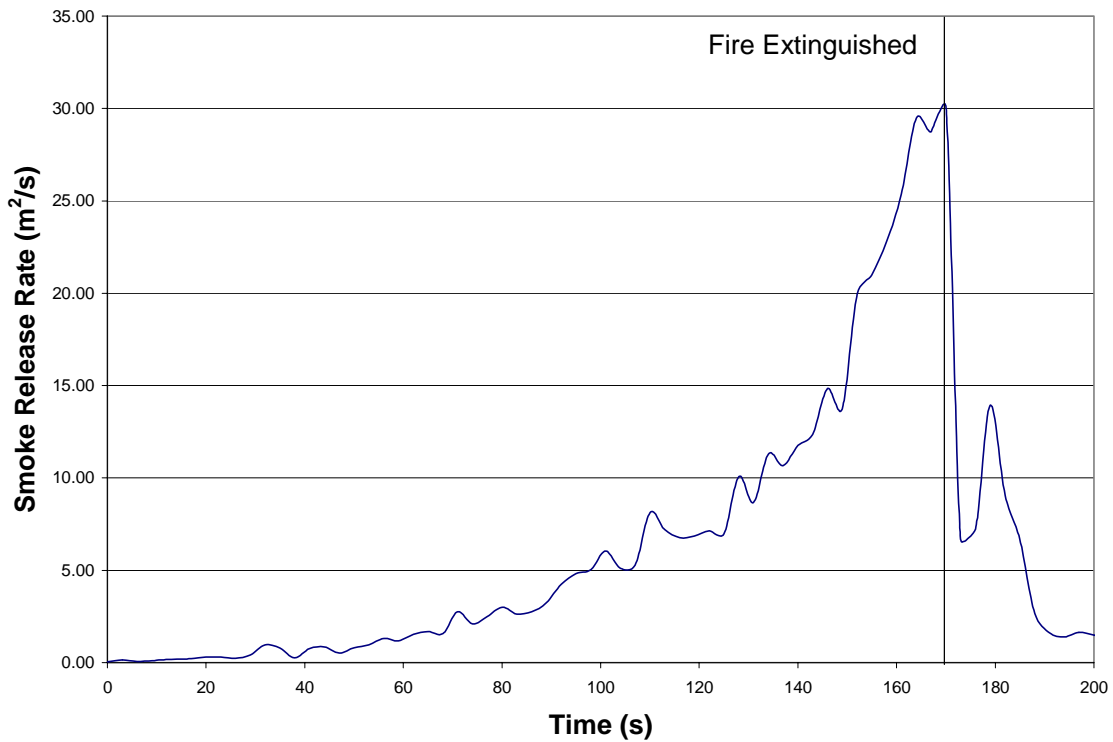
\*The standard [1] requires the total heat release rate to be reported at 10 minutes, which is not applicable in this test.

**Table 3:** Non-Mandatory Numerical Results of Measurements

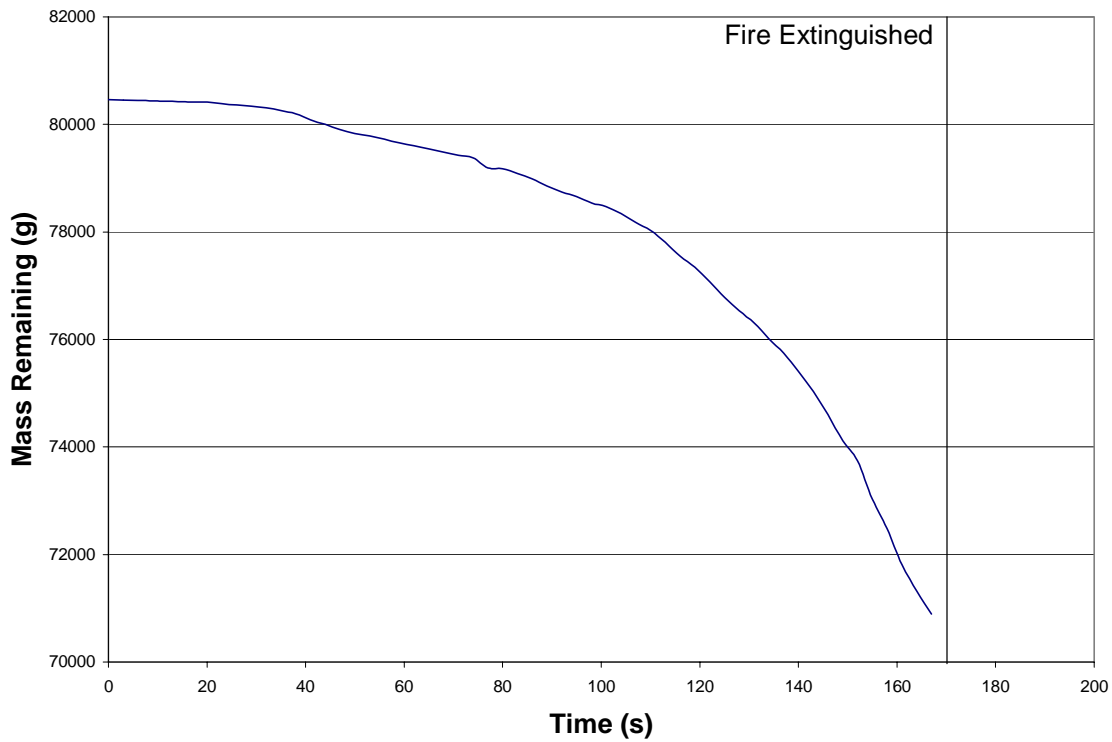
<i>Peak Carbon Monoxide Release Rate (kg/s)</i>	<i>Time to Peak Carbon Monoxide Release Rate (s)</i>	<i>Total Carbon Monoxide Released (kg)</i>	<i>Average Heat Release Rate (kW)</i>	<i>Peak Thermocouple Temperature (°C)</i>
0.00472	159	0.310	689	776



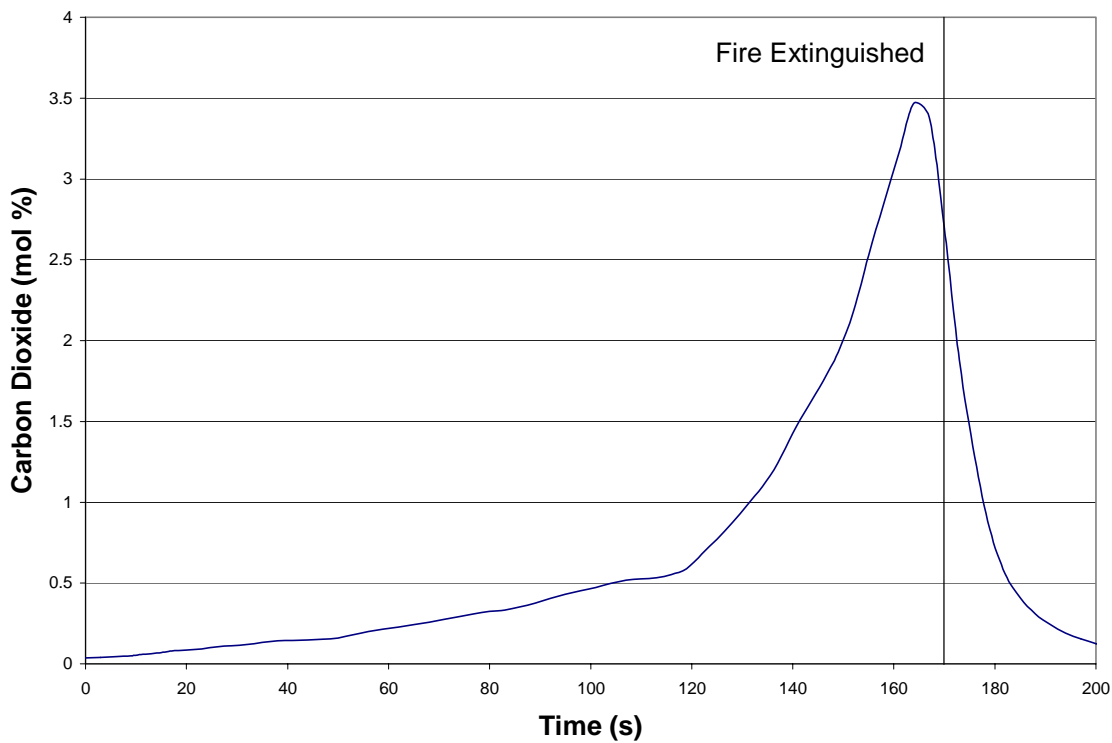
**Figure 1** Bed set heat release rate during the test



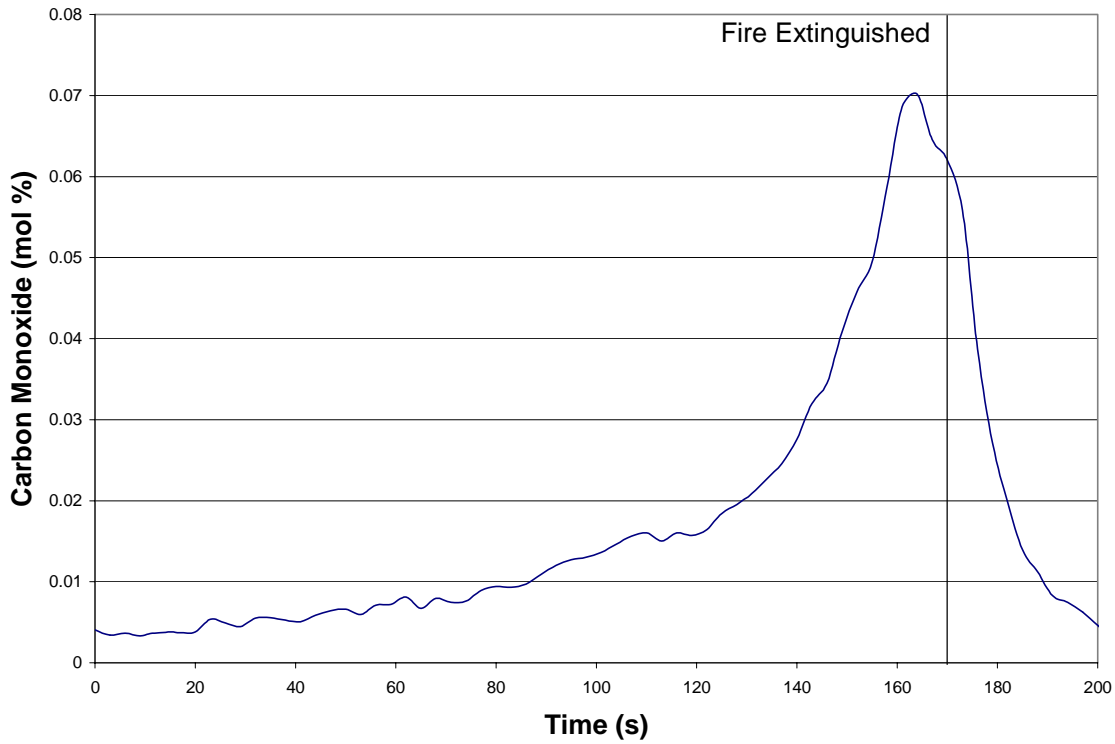
**Figure 2** Bed set smoke release rate during the test



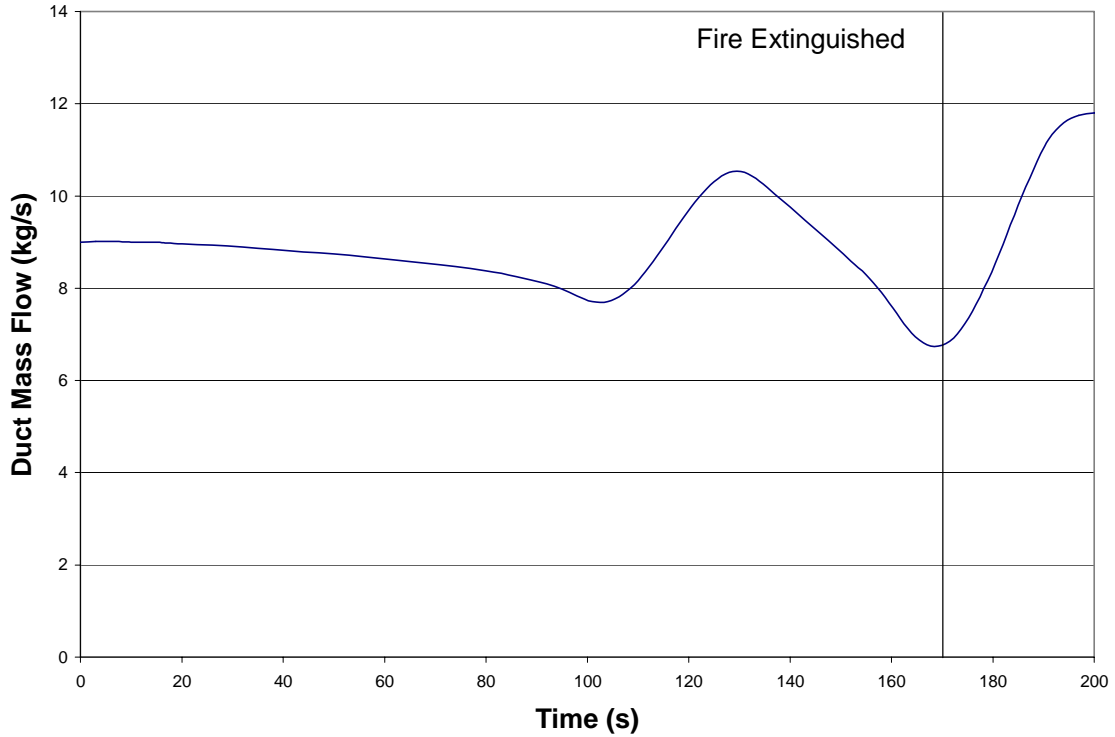
**Figure 3** Bed set mass remaining during the test



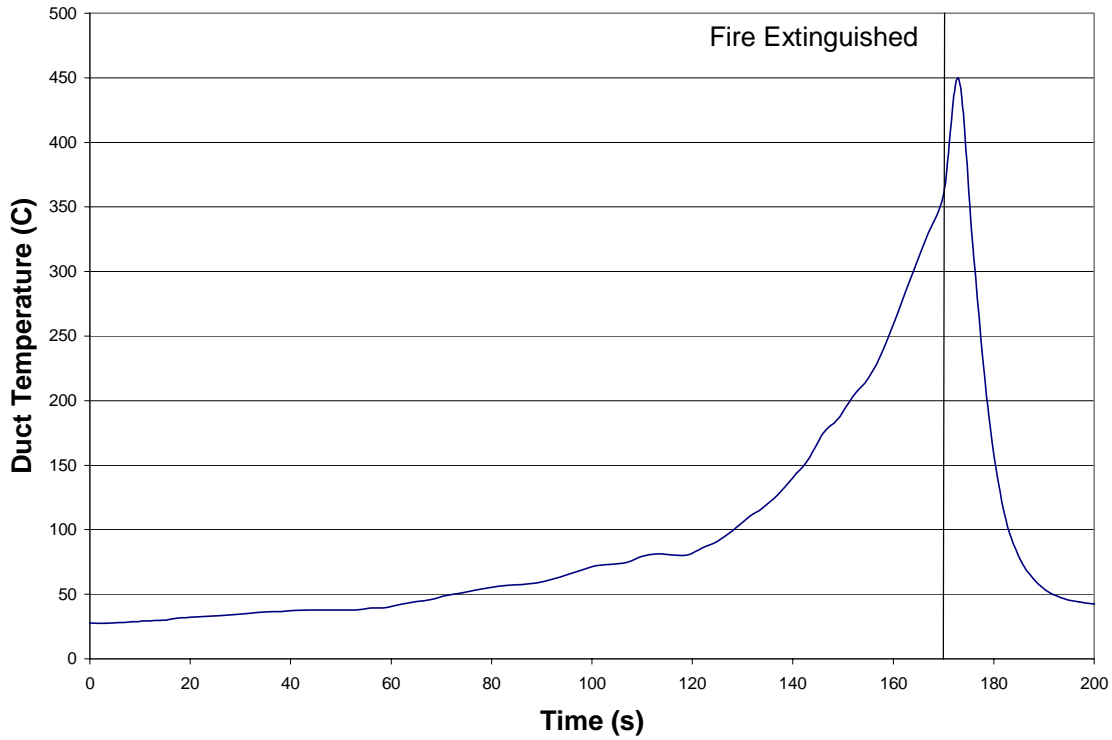
**Figure 4** Carbon dioxide concentration in the calorimeter exhaust duct during the test



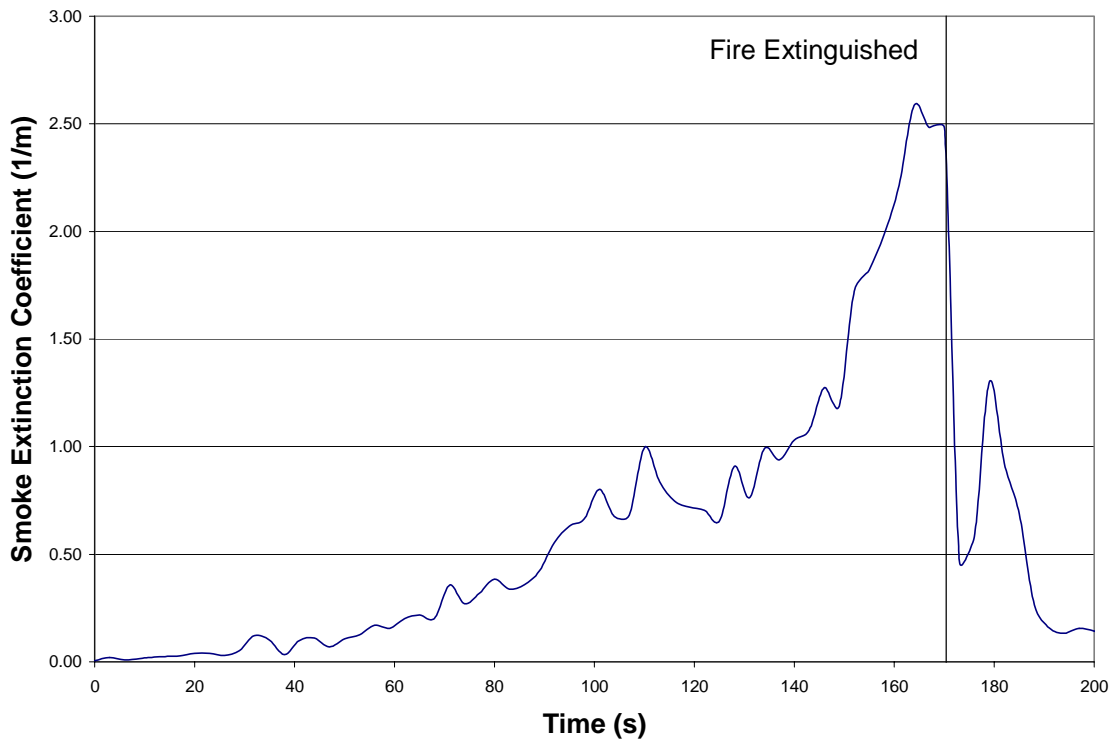
**Figure 5** Carbon monoxide concentration in the calorimeter exhaust duct during the test



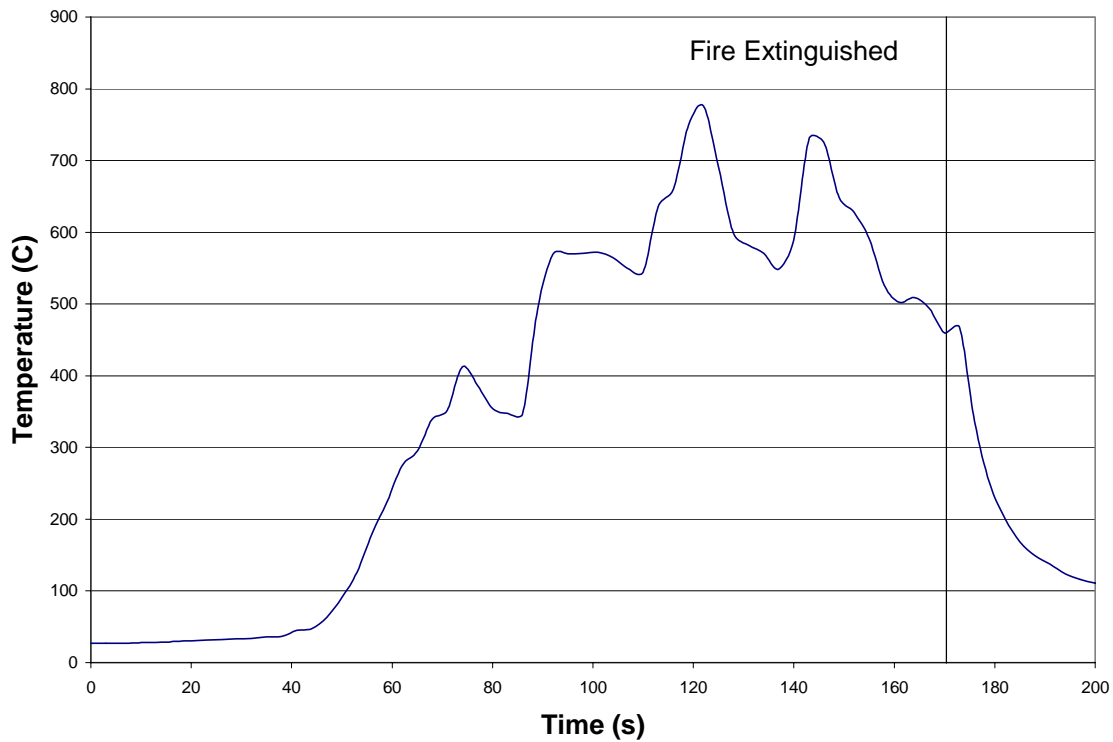
**Figure 6** Mass flow of combustion gases in the calorimeter exhaust duct during the test



**Figure 7** Temperature of combustion gases in the calorimeter exhaust duct during the test



**Figure 8** Smoke extinction coefficient across the calorimeter exhaust duct during the test



**Figure 9** Temperature measured by the Type K, 24 AWG thermocouple above the bed

### Reference

[1] State of California, Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation, Technical Bulletin 129, Flammability Test Procedure for Mattresses for Use in Public Buildings, October 1992.