



<b>Title</b>	Iron Temperature		
<b>Test Type</b>	Custom		
<b>Lab Number</b>	14F0047-2	<b>Author</b>	Stephen P. Fuss
<b>Test dates</b>	4/22/15	<b>No. Tests</b>	1

## Introduction

One experiment was conducted to characterize the surface temperature of an electric iron operating at its highest setting. The experiment was documented using thermocouples and digital still photography. The experiment was conducted in the Pyrometrics Laboratory of the Bureau of Alcohol, Tobacco, Firearms and Explosive Fire Research Laboratory (ATF FRL) located in Beltsville, MD.

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**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.**

## Test set up

The experiment was set up by placing an electric iron on top of cheesecloth. The iron was a Proctor Silex Model 17291Y flatiron. The cheesecloth came packaged in a 91.4 cm (36 inch) wide sheet folded into four layers, with the overall width measuring approximately 23 cm (9.1 inch). Four of these sections were layered on top of each other so that the overall length was approximately 45 cm (17.7 inch). Figure 1 shows a photo of the experiment setup.



Figure 1. Iron with cheesecloth. 51309\_515187.jpg

## Experiment Details

One experiment was conducted – Table 1 shows the Experiment ID and test date.

Table 1. Experiment ID numbers.

Experiment #	Experiment ID	Test Date
1	51039	4/22/15

## Test Procedures

The experiment was conducted by energizing the iron with the thermostat set to the full clockwise position (shown in Figure 1). After one hour the iron was de-energized. The experiment then continued for an additional 15 minutes while the iron cooled. Throughout the experiment, the only pressure applied was the weight of the iron.

## Instrumentation

The experiment was documented using thermocouples and digital still photography. Two Type K thermocouples were placed between the iron and the cheesecloth, as shown in Figure 2.



Figure 2. Placement of thermocouples. 51309\_515188.jpg

## Laboratory Conditions

The ambient laboratory temperature, barometric pressure, and relative humidity were measured during the experiment(s). The laboratory conditions were measured using an industrial probe and microserver. The probe measures the ambient conditions using capacitive digital sensors. The sensor probe has surface mounted circuitry which responds to changes in the environment and outputs a digital signal. 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 2. Lab Conditions Description

Description	Manufacturer	Model
Pyro	OMEGA	IBTHX-D

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.

Table 3. Ambient Laboratory Condition Summary

Test Number	Exp ID	Description	Temperature (C)	Pressure (kPa)	Relative Humidity (%)
1	51309	Pyro	24	100	33

### ***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 "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 4. Thermocouple Measurement Description

Description	Thermocouple type
Beneath Iron - Mid	Type K, Glass Ins., 24 AWG wire
Beneath Iron - Front	Type K, Glass Ins., 24 AWG wire

### ***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” [4].

## Results for Test 1 (ID 51309)

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 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second maximum average (C)	60 second maximum average (C)	300 second maximum average (C)	600 second maximum average (C)
Beneath Iron - Mid	24	253	251	246	206	189
Beneath Iron - Front	24	342	332	320	249	223

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

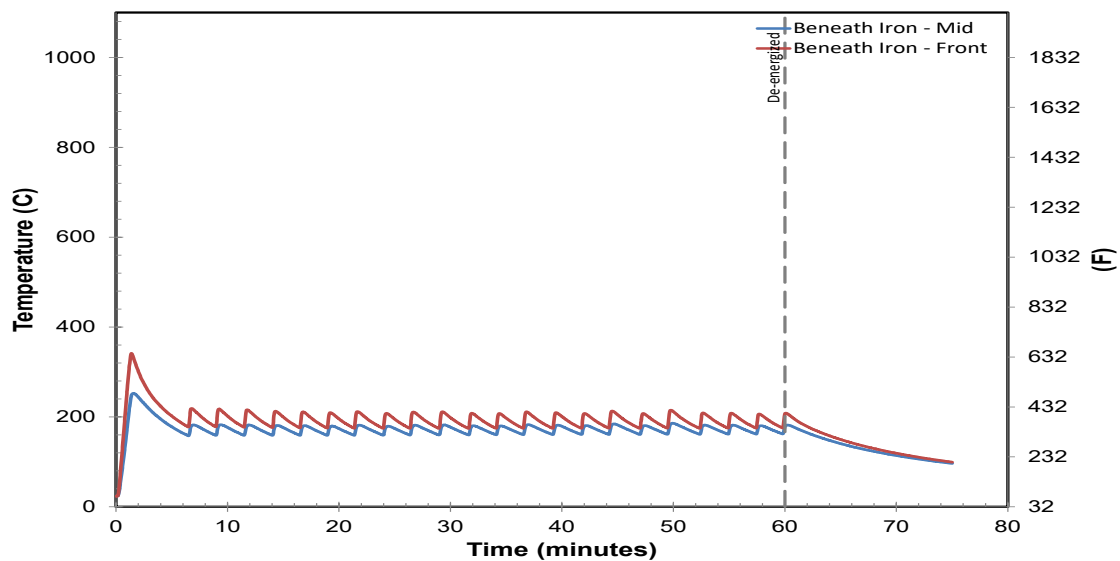


Figure 3. Temperature

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

Table 6. Experiment Events

Description	Time (s)
De-energized	3601

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 4. Pre test 11 minutes, 51309\_515188



Figure 5. Pre test 10 minutes, 51309\_515187



Figure 6. Pre test 13 seconds, 51309\_515185

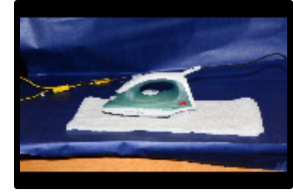


Figure 7. Pre test 13 seconds, 51309\_515186



Figure 8. 3 seconds, 51309\_515184



Figure 9. 7 seconds, 51309\_515182

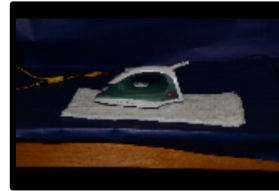


Figure 10. 7 seconds, 51309\_515183

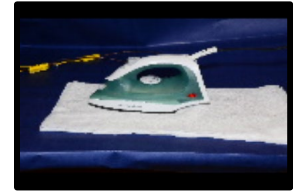


Figure 11. 21 seconds, 51309\_515181

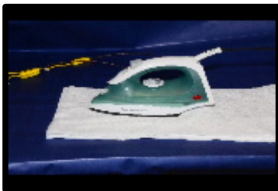


Figure 12. 63 seconds, 51309\_515180



Figure 13. 149 seconds, 51309\_515179



Figure 14. 1805 seconds, 51309\_515178



Figure 15. 1807 seconds, 51309\_515177



Figure 16. 1813 seconds, 51309\_515176



Figure 17. 1817 seconds, 51309\_515175

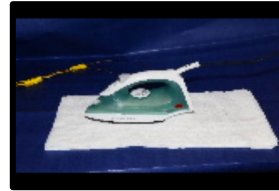


Figure 18. 3669 seconds, 51309\_515174

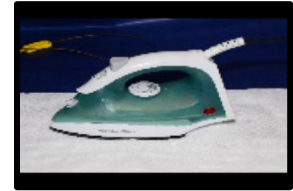


Figure 19. 3671 seconds, 51309\_515173



Figure 20. 3681 seconds, 51309\_515172



Figure 21. Post test 0 minutes, 51309\_515171



Figure 22. Post test 0 minutes, 51309\_515170



Figure 23. Post test 0 minutes, 51309\_515169





Figure 24. Post test 0 minutes, 51309\_515168



Figure 25. Post test 0 minutes, 51309\_515167



Figure 26. Post test 0 minutes, 51309\_515166



Figure 27. Post test 1 minutes, 51309\_515165

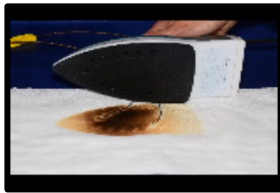


Figure 28. Post test 1 minutes, 51309\_515163



Figure 29. Post test 1 minutes, 51309\_515164

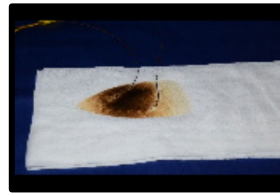


Figure 30. Post test 1 minutes, 51309\_515162

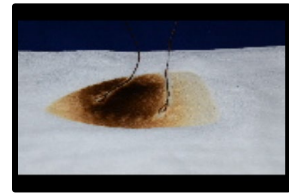


Figure 31. Post test 1 minutes, 51309\_515161



Figure 32. Post test 2 minutes, 51309\_515160



Figure 33. Post test 2 minutes, 51309\_515159



Figure 34. Post test 4 minutes, 51309\_515158



Figure 35. Post test 5 minutes, 51309\_515157

## **References**

1. Laboratory Instruction LI017 – Laboratory Conditions, Bureau of Alcohol, Tobacco, Firearms and Explosives - Fire Research Laboratory, Beltsville, MD.
2. The Temperature Handbook, 2nd edition, Omega Engineering, Stamford, CT, 2000.
3. Laboratory Instruction LI001 - Thermocouple, Bureau of Alcohol, Tobacco, Firearms and Explosives – Fire Research Laboratory, Beltsville, MD.
4. Laboratory Instruction LI003 - Digital Cameras, Bureau of Alcohol, Tobacco, Firearms and Explosives - Fire Research Laboratory, Beltsville, MD