



TEST SPECIMEN:

**DIELECTRIC RUBBER BOOT, STYLE 52001**

**THERMAL OVER THE FOOT BOOT**

TEST STANDARD:

**ELECTRIC ARC EXPOSURE TEST OF FOOTWEAR**

TEST REPORT: K-656007-2005T05 R00

Client

ArcWear

3018 Eastpoint Parkway

Louisville, KY 40223

Producer

Honeywell Salisbury

4091 Azalea Drive

Charleston, SC 29405

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Sample Received  
2020-Jul-03 & 2020-Jul-06

Test Date  
2020-Jul-22

Report Date  
2020-Sep-09


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## Revision History

Rev	Description		
00	Initial report creation		
	Issue Date	Prepared by	Approved by
	2020-Sep-09	Yosbani Guerra	Claude Maurice
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### QUALITY MANAGEMENT

The arc testing performed to the above mentioned Standard is accredited by the Standards Council of Canada (SCC) to conform to the requirements of CAN-P-4E (ISO/IEC 17025:2005). Accreditation by the Standards Council of Canada (SCC) is a mark of competence and reliability.

- The test performed does not apply to electrical contact or electrical shock hazard
- The test result is applicable only to the Test Specimens delivered to Kinectrics, other material, garment design or color may have a different response.
- It is the clients' responsibility to provide full and accurate information about the items supplied.
- No test is done to validate the fiber content or composition of the test item
- Photographs of the test specimens and waveforms of the arc current, voltage and calorimeters with the circuit and arc exposure calibration records are available from Kinectrics and provided to the client separately from this report.



# 1 Test Protocol:

## Electrical Arc Exposure Test of Rubber Boots

At the time of this test, there was no directly applicable test standard or method to cover arc testing or arc rating of protective footwear. Based on past testing and discussion between Kinectrics and Arcwear, the general set-up and procedure used for evaluation of finished products in accordance with ASTM 2621-19 was used.

The purpose of this test was to observe the response characteristics of safety boots when exposed to an open-air electric arc. The materials and boots are not arc rated. At the request of the Client, the goal was to evaluate the response of the safety boot to a 40 cal/cm<sup>2</sup> arc exposure. Following the arc exposure, the boot was examined for evidence of melting, dripping and ignition. Areas of particular interest were seams, materials, linings and shoe laces. The front area was examined for evidence of arc energy that may enter and expose inside of the boot.

### 1.1 Test Description

In order to complete testing, the test laboratory used the test fixture described in ASTM F2621-19 Standard Practice for Determining Response Characteristics and Design Integrity of Arc Rated Finished Products in an Electric Arc Exposure. Although the products being evaluated do not strictly fall within the scope of this standard, the apparatus and procedure was adopted to suit the Client’s requirements. The test procedure involved installing the finished product onto a secure platform with instrumented calorimeters on each side in order to evaluate the boots for melting, dripping and ignition response to an arc flash exposure.

Other effects than the thermal effects of an electric arc like noise, light emissions, pressure rise, hot oil, electric shock, the consequences of physical and mental shock or toxic influences are not covered by this evaluation.

### 1.2 Acceptance criteria for products exposed to electrical arc:

There are no performance criteria given for protective footwear for this type of test. Based on generally accepted criteria for arc rated products, meeting the parameters in Table 1-1 is considered the minimum acceptance requirements for this report.

**Table 1-1: Basic Acceptance Criteria for Non-Arc Rated Products**

Parameter	Criterion
Ignition	No electric arc ignition of any component.
Appearance	Any closure or fastener on the specimen shall not be rendered inoperable or fail to retain the product as installed (a closed fastener shall remain closed)
Melting	No melting through to the inner side.
Melting/Dripping	No melting and dripping of molten materials to the floor.
Break-Open	No hole bigger exceeding 160 mm <sup>2</sup> in area or 25 mm in any direction in the innermost layer.

## 2 Test Condition:

The following test circuit parameters and conditions were used.

- Electric arc current: 8 kA rms  $\pm$  10%, 60 Hz
- Open circuit voltage: 2500 V rms  $\pm$  10%, 60 Hz
- Nominal Heat Flux Density: 2100 kW/m<sup>2</sup> (50 cal/cm<sup>2</sup>·s)
- Arc duration: Varied to obtain required incident energy
- Electrode gap: 305 mm (12 inches)
- Distance from mannequin to electrode: 305 mm (12 inches)
- Pre-treatment reported by client: Laundered 3 times and dried once, by ArcWear, in accordance with AATCC Test Method 135-18, Procedure 3, IV, Aiii
- Pre-conditioning by Kinectrics: In controlled laboratory conditions for minimum 24 hrs.
- Deviations and abnormalities: None.

## 3 Test Specimen:

The following test sample identification was provided. Photos of the samples provided by the client are seen in Figure 3.1.

Producer: Salisbury Honeywell

Material Arc Rating Test Report: **Arc rating of boot material has not been established.**

Pre-treatment reported by client: None.

Pre-conditioning by Kinectrics: In controlled laboratory conditions for minimum 24 hrs.

Deviations and abnormalities: None

Product description by agency:

Salisbury Honeywell, Dielectric Rubber Boot, Style 52001 - Thermal Over The Foot Boot, Upper: Red Rubber, Outsole: Black/Blue Molded Rubber JT-02, Lining: Black CR + Mesh Lining, Toe Cap: Light Gray Composite JY-111C, PRD: PR Fibric MJQS-501, White, ArcWear# 2005T05



Figure 3.1: Example of the boot samples provided.



## 4 Results and Observations:

The detailed test observations are provided in the following product evaluation form. These were completed at the time of the test. The subjective evaluation of the product involved documenting product design or material response concerns that may lower the protection level of the boot in an arc flash incident. The test observations were performed by a qualified observer that has knowledge of behavior of materials in an arc exposure and in depth knowledge of arc testing specifications and requirements. A summary of the test results is given in Table 4- 1. Photographs of the boots before and after the arc exposure are provided in Figures 6.1 - 6.2.

**Table 4-1: Summary of Test Results**

Test Identification	20-4326 (Specimen #1) Front Exposure	20-4326 (Specimen #2) Side Exposure
Arc Energy (Warc), kJ	3171	3171
Incident Energy, cal/cm <sup>2</sup>	44.6	45.0
Afterflame time (s)	2	1.5
Shrinkage	N	N
Melting and dripping	N	N
Break-open through the product	N	N
Closure failure	N	N
Ignition of any component	N	N

### 4.1 Observations:

Heavy charring was observed on the outer layer of the boot exposed to the arc. No ablation, break-open, melting, dripping or ignition occurred.

## 5 Interpretation of Results:

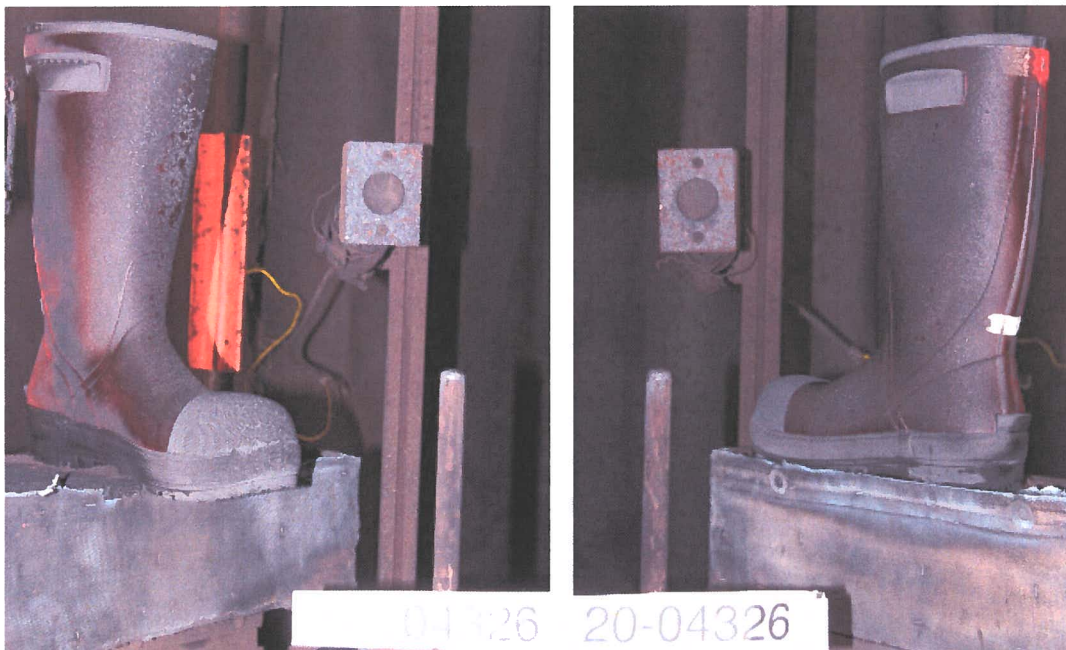
Based on the test results in Table 4-1 and observations, Style 52001 - Thermal over the Foot Boot meets the criteria in Table 1-1. This testing does not assign an arc rating to this product. The purpose of this test was to observe the response characteristics of this footwear when exposed to an open-air electric arc. Additional compliance responsibilities may be imposed by other occupational and health requirements depending on the application.

## 6 Photographs

Photographs for the garments before and after the arc exposure are shown in Figure 6.1 - 6.2.



**Figure 6.1: Boots as tested before arc exposure (left: front, right: side).**



**Figure 6.2: Boots as tested after arc exposure (left: front, right: side).**