Food Service Technology Center

Henny Penny HCW5 Appliance Test Report
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Prepared by:
Kong Sham
David Zabrowski
Fisher-Nickel, Inc.

Prepared for:
Pacific Gas & Electric Company
Customer Energy Efficiency Programs
PO Box 770000
San Francisco, California 94177

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Appliance Test Report

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Executive Summary

Display warmers provide the functionality of hot food holding and can be used to openly display food product for customers. The Henny Penny HCW5 horizontal display warmer (Figure 1) has two cavities that operate independently—each having their own temperature control dials. The upper cavity operates with dry heat, while the lower cavity has additional moisture controls utilizing a heated water bath. The cavity can be accessed from both sides through large flap doors.

FSTC Engineers tested the performance of the Henny Penny HCW5 in controlled laboratory conditions to measure the warmer’s preheat time and energy, temperature uniformity, idle energy, and holding energy consumption. Due to its unique configuration, additional tests were performed to correctly monitor energy consumption under different modes of operation including scenarios with the access doors open. The warmer was also tested with a load of freshly cooked fried chicken to assess the holding performance of the Henny Penny HCW5.

Preheat for the display warmer was timed at 51.6 minutes taking the cavity from an initial temperature of 75 ± 5°F to 150°F while consuming 3,170 Wh. Idle energy rate was measured for a period of two hours after a hour long stabilization period where the temperature in both cavities was held at an average of 150 ± 5°F. Idle tests were conducted with the doors closed and open. An additional test was performed with the unit holding 50lbs of fried chicken for four hours. Idle and holding energy rates did not differentiate significantly between tests and averaged at 3.42 kW. A summary of the results is presented in Table 1.

Figure 1. Henny Penny HCW5 Display warmer.
### Table 1. Summary of Henny Penny HCW5 Performance.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Energy Input Rate (kW)</td>
<td>4.16</td>
</tr>
<tr>
<td>Measured Energy Input Rate (kW)</td>
<td>3.90</td>
</tr>
<tr>
<td>Percentage Difference (%)</td>
<td>6.25</td>
</tr>
<tr>
<td>Preheat to 150°F</td>
<td></td>
</tr>
<tr>
<td>Duration (min)</td>
<td>51.6</td>
</tr>
<tr>
<td>Electric Energy Consumption (kWh)</td>
<td>3.17</td>
</tr>
<tr>
<td>Idle/Holding Tests</td>
<td></td>
</tr>
<tr>
<td>Idle Energy Rate (kW) – doors closed</td>
<td>3.45</td>
</tr>
<tr>
<td>Idle Energy Rate (kW) – with door open</td>
<td>3.42</td>
</tr>
<tr>
<td>Holding Test (kW)</td>
<td>3.40</td>
</tr>
<tr>
<td>Average Energy Rate (kW)</td>
<td>3.42 ± 0.07</td>
</tr>
</tbody>
</table>
Introduction

Background
Dedicated to the advancement of the foodservice industry, The Food Service Technology Center (FSTC) has focused on the development of standard test methods for commercial foodservice equipment since 1987. The primary component of the FSTC is a 10,000 square-foot appliance laboratory equipped with energy monitoring and data acquisition hardware, 60 linear feet of canopy exhaust hoods integrated with utility distribution systems, appliance setup and storage areas, and a state-of-the-art demonstration and training facility.

A test protocol was developed for The Henny Penny HCW5 display warmer by monitoring preheat duration and energy consumption, temperature uniformity, idle energy rate, and holding energy in a controlled laboratory condition. The appliance performance can be used to estimate an appliance’s contribution to the energy consumption of an end-user’s kitchen.

The Henny Penny HCW5 horizontal display warmer (Figure 1) has two cavities that operate independently—having their own temperature control dials. The upper cavity operates with dry heat, while the lower cavity offers additional moisture controls utilizing a heated water bath. The cavity can be accessed from both sides through large flap doors. Additional tests were conducted to quantify the impact opening of the front flap doors and while holding a representative food product.

The glossary at the end of the report is provided so that the reader has a quick reference to the terms used in this report.

Objectives
The objective of this report is to examine the operation and performance of the Henny Penny HCW5 under controlled laboratory test conditions. The scope of this testing is as follows:

1. Verify that the appliance is operating at the manufacturer’s rated energy input.
2. Determine the time and energy required to preheat the display warmer from room temperature to operational temperature.
3. Characterize the idle energy use with the display warmer set to maintain a typical operating temperature.
4. Determine the average energy consumption rate while holding a representative food product.
5. Estimate the display warmer’s operating cost, based on a standard cost model.
Appliance Test Report

Appliance Description
The Henny Penny HCW5 is a horizontal pass through display warmer where the cavity can be accessed from both sides via large plastic flip doors. It uses electricity to power two adjoined cavities that operate independently of each other. The upper cavity uses a heating element to heat the air passively within the cavity. The lower warmer uses both air and a water bath heating element to evaporate steam into the warmer keeping the contents moist. Each section has its own set of temperature controls. An on/off switch is used to control a set of four 60W incandescent light bulbs to light both the upper and lower warmers. (See Figure 2) Appliance specifications are listed in Table 2.

Figure 2. Henny Penny HCW5 Display warmer.

Table 2. Appliance Specifications.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Henny Penny</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>HCW5</td>
</tr>
<tr>
<td>Generic Appliance Type</td>
<td>Hot Food Display Warmer</td>
</tr>
<tr>
<td>Rated Input</td>
<td>4.16</td>
</tr>
<tr>
<td>Controls</td>
<td>Temperature, moisture, lighting</td>
</tr>
<tr>
<td>Construction</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>External Dimensions (W x D x H)</td>
<td>61&quot; x 31&quot; x 33&quot;</td>
</tr>
</tbody>
</table>

Methods and Results
Setup and Instrumentation
FSTC researchers installed the display warmer on a tiled floor under a 4-foot-deep canopy hood that was 6 feet, 6 inches above the floor. The hood operated at a nominal exhaust rate of 300 cfm per linear foot of hood. There was at least 6-inches of clearance between the vertical plane of the display warmer and the edge of the hood.

The HCW5 was installed in accordance with the manufacturer’s instructions in a conditioned test space. The room was maintained at an ambient condition of 75 ± 5°F during testing. The Henny Penny HCW5 is rated at both 208/240 V and testing for this report was performed at 208V. Energy was measured with a watt/watt-hour transducer that generated a pulse for each 10 Wh used. A voltage regulator, connected to the warmer, main-
tained a constant voltage for all tests. Temperature was monitored in three equally spaced locations within each cavity using K-type thermocouple probes. The transducer and thermocouple probes were connected to a computerized data acquisition unit that recorded data every 5 seconds.

**Measured Energy Input Rate Test**

Rated energy input rate is the maximum or peak rate at which the display appliance consumes energy—as specified on the display warmer’s nameplate. Measured energy input rate is the maximum or peak rate of energy consumption, which is recorded during a period when the elements are fully energized (such as preheat). Prior to testing, the energy input rate was determined by measuring the energy consumed from the time the display warmer first began operating until the elements first cycled off. The input rate was measured at 3.90 kW—6.25% lower than the rated input of 4.16 kW. Testing was temporarily halted before the manufacturer suggested the difference was acceptable and thus testing resumed. Table 3 summarizes the results from the input test.

**Preheat Test**

During testing, the set point temperature for preheat and idle tests was 150°F. The preheat test was conducted at the beginning of a test day after the display warmer was stabilized to room temperature overnight. The preheat test recorded the time and energy required for the display warmer to reach the operational temperature of 150°F from a stabilized temperature of 75 ± 5°F. Data recording began when the warmer was first turned on, so any time delay before the powering of the elements was included in the test. During the preheat test, the upper display warmer reached the desired internal cavity temperature in 51.6 minutes while consuming 3.17 kWh. The lower cavity and water temperature reached a high of 123°F and 131°F respectively at the end of this period. The lower cavity and water temperature would continue to climb to their individual set points as the display warmer remained on. Figure 3 shows the preheat characteristics for the HCW5.
Idle Tests

These tests typically show how the display warmer uses energy when it is not holding food. The idle energy rate represents the energy required to maintain the set-point temperature of 150°F. After the display warmer was preheated, it was allowed to stabilize for one hour and time and energy consumption were monitored for an additional two-hour period while the unit remained at operating temperatures. The HCW5 display warmer is a pass through model and can potentially be used with the flap doors closed or open. Therefore FSTC engineers tested the warmer under doors closed and doors opened conditions.

In the first testing scenario with all doors closed, the HCW5 was able to hold temperature relatively constant at an average temperature 148°F for the upper cavity and 147°F for the lower cavity. The water temperature cycled between high and low temperatures averaging 155°F. The relative humidity in the lower cavity was 93% and the energy consumption rate was 3.45 kW. Figure 4 shows the temperature profile of the HCW5 during the closed door idle test.
Figure 4. Door Closed Idle Temperature Profile for HCW5

The second testing scenario was performed with the front flaps open (rear flaps closed), and the cavity did not reach the set point of 150°F. The upper warmer averaged at 120°F. The lower warmer averaged at a temperature of 123°F with the water temperature at 145°F and a relative humidity of 42% RH. The idle energy rate for this second run was 3.42 kW. Figure 5 shows the temperature profile of the display warmer during the flap doors open idle test.

Figure 5. Door Open Idle Temperature Profile for HCW5
Holding Tests
To Evaluate the holding performance of the HCW5, FSTC engineers included a four hour holding test using 50 pounds of freshly cooked fried chicken split evenly between the upper and lower cavities (Figure 6). The display warmer was set to keep the internal temperature of the chicken above 140°F. Food temperatures and energy consumption were monitored during the entire four hour test. In this scenario the water temperature was increased to 165°F to maintain temperature in the bottom cavity warmer. The upper cavity averaged at 160°F, and the lower warmer averaged at 147°F. The temperature profile is shown in Figure 8. The energy rate for this test was 3.40 kW. Table 3 summarizes the results from preheat, idle, and holding tests.

Figure 6. Fried Chicken Holding Test Set Up

![5 Hour Chicken Holding Temperature](image)

Figure 7. Four Hour Chicken Holding Temperature Profile for HCW5
Table 3. Input, Preheat and Idle Test Results.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Energy Input Rate (kW)</td>
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</tr>
<tr>
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<tr>
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</tr>
<tr>
<td>Electric Energy Consumption (kWh)</td>
<td>3.17</td>
</tr>
<tr>
<td>Idle Energy Rate (kW) – Doors Closed</td>
<td>3.45</td>
</tr>
<tr>
<td>Idle Energy Rate (kW) – Flap Doors Opened</td>
<td>3.42</td>
</tr>
<tr>
<td>Holding Energy Rate (kW) – Four Hour Chicken Holding</td>
<td>3.40</td>
</tr>
<tr>
<td>Average Energy Rate (kW)</td>
<td>3.42 ± 0.07</td>
</tr>
</tbody>
</table>

Energy Cost Model

The test results can be used to estimate the annual energy consumption for the display warmer in a real-world operation. A simple cost model was developed to calculate the relationship between the various cost components (e.g., preheat, idle and holding costs) and the annual operating cost, using the ASTM test data (see equation below).

\[ E_{\text{elec, daily}} = E_{\text{elec, h}} + E_{\text{elec, i}} + n_p \times E_{\text{elec, p}} \]

\[ E_{\text{elec, daily}} = t_{\text{hold}} \times q_{\text{elec, h}} + q_{\text{elec, i}} \times \left( t_{\text{on}} - t_{\text{hold}} - \frac{n_p \times t_p}{60} \right) + n_p \times E_{\text{elec, p}} \]

Where:

- \( E_{\text{elec, daily}} \) = Daily energy consumption
- \( E_{\text{elec, h}} \) = Energy consumed while holding per day
- \( E_{\text{elec, i}} \) = Energy consumed while in idle per day
- \( E_{\text{elec, p}} \) = Preheat Energy
- \( t_{\text{hold}} \) = Amount of time the appliance is holding food
- \( q_{\text{elec, h}} \) = Holding energy rate
- \( q_{\text{elec, i}} \) = Idle energy rate
- \( t_{\text{on}} \) = Total time the appliance is on per day
- \( n_p \) = Number of preheats per day
- \( t_p \) = Duration of preheat

This model assumes the display warmer was used for 12 hours a day, 365 days per year. These 12 hours were divided between one preheat, 10 hours of food holding, and the remaining time in idle. The estimated opera-
tional cost of the display warmer is $1,498 per year. Table 4 summarizes the annual energy consumption and associated energy cost for the display warmer under this scenario.

**Table 4. Estimated Display warmer Energy Consumption and Cost.**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Preheat Energy (kWh/day)</td>
<td>3.17</td>
</tr>
<tr>
<td>Idle Energy (kWh/day)</td>
<td>3.90</td>
</tr>
<tr>
<td>Holding Energy (kWh/day)</td>
<td>33.97</td>
</tr>
<tr>
<td><strong>Annual Energy (kWh/year)</strong></td>
<td>14,978</td>
</tr>
<tr>
<td><strong>Annual Cost ($/year)</strong></td>
<td>1,498</td>
</tr>
</tbody>
</table>

*a Display warmer energy costs are based on $0.10/kWh.*
Additional Resources

Glossary

**Cooking Energy** (kWh or kBtu)
The total energy consumed by an appliance as it is used to bake a specific food product.

**Cooking Energy Consumption Rate** (kW or kBtu/h)
The average rate of energy consumption during the cooking period.

**Cooking-Energy Efficiency** (%)
The quantity of energy input to the food product; expressed as a percentage of the quantity of the energy input to the appliance during the cooking test.

**Duty Cycle** (%)
Load factor
The average energy consumption rate (based on a specified operating period for the appliance) expressed as a percentage of the measured energy input rate.

\[
\text{Duty Cycle} = \frac{\text{Average Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100
\]

**Energy Rate** (kW or kBtu/h)
Energy Consumption Rate
Energy Rate
The peak rate at which an appliance will consume energy, typically reflected during preheat.

**Heating Value** (Btu/ft³)
The quantity of heat (energy) generated by the combustion of fuel. For natural gas, this quantity varies depending on the constituents of the gas.

**Idle Energy Rate** (kW or Btu/h)
Idle Energy Input Rate
Idle Rate
The rate of appliance energy consumption while it is “holding” or maintaining a stabilized operating condition or temperature.

**Idle Temperature** (°F, Setting)
The temperature of the cooking cavity/surface (selected by the appliance operator or specified for a controlled test) that is maintained by the appliance under an idle condition.

**Idle Duty Cycle** (%)
Idle Energy Factor
The idle energy consumption rate expressed as a percentage of the measured input rate.

\[
\text{Idle Duty Cycle} = \frac{\text{Idle Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100
\]

**Measured Input Rate** (kW or Btu/h)
Measured Energy Input Rate
Measured Peak Energy Input Rate
The maximum or peak rate at which an appliance consumes energy, typically reflected during appliance preheat (i.e. the period of operation when all burners or elements are “on”).

**Preheat Energy** (kWh, Wh or Btu)
Preheat Energy Consumption
The total amount of energy consumed by an appliance during the preheat period.

**Preheat Rate** (°F/min)
The rate at which the display warmer cavity heats during a preheat.

**Preheat Time** (minute)
The time required for an appliance to heat from the ambient room temperature (75 ± 5°F) to a specified (and calibrated) operating temperature or thermostat set point.

**Production Capacity** (lb/h)
The maximum production rate of an appliance while cooking a specified food product in accordance with the heavy-load cooking test.

**Rated Energy Input Rate** (kW, W or Btu/h)
Input Rating (ANSI definition)
Nameplate Energy Input Rate
Rated Input
The maximum or peak rate at which an appliance consumes energy as rated by the manufacturer and specified on the nameplate.

**Test Method**
A definitive procedure for the identification, measurement and evaluation of one or more qualities, characteristics, or properties of a material, product system, or service that produces a test result.

**Typical Day**
A sample day of average appliance usage based on observations and/or operator interviews, used to develop and energy cost model for the appliance.
Appendix A: Appliance Specifications

Display counter warmers
Two-tier, dry over humidified

These attractive, dependable humidified countertop warmers offer practical pass-through convenience while keeping hot food items fresh, appetizing and on display for customer impulse purchases.

The HCW two-tier models also offer a combination of separate holding environments. The unit's lower tier features humidified operation from a heated, auto-fill reservoir in the base. Upper tiers operate with dry radiant heat, only. Temperatures for each tier are controlled separately.

Tough acrylic flip up doors offer excellent product visibility and convenient pass-through access—a must for high-volume service.

Units are built from high-quality stainless steel and are insulated for energy-efficient operation.

General Information
The Henny Penny two tier counter warmers are designed specifically for serving and displaying hot food at the point of sale in retail foodservice operations. Units feature high product visibility, pass-through operation, and water-wall humidity control.

Standard Features
- Stainless steel interior and exterior construction for easy cleaning and long-lasting service.
- Available in two sizes: 5-pan or 8-pan capacity.
- Lower tier features moist heat humidified operation.
- Water reservoir runs length of unit with automatic or manual fill.
- Two water well strip heaters.
- Low water indicator light.
- Drain tube prevents water well overflow.
- Water temperature display and control.
- Upper tier operates dry.
- Long-lasting sheath radiant heaters.
- Insulated top and bottom for energy efficient operation.
- Independent heating controls for each tier hold different foods at optimum temperatures.
- Water temperature display and control.
- Tough, durable acrylic flip-up door panels for see-through, pass-through operation.
- Incandescent lighting for appealing food display.
- Removable access panels for easy maintenance.
Display counter warmers
Two-tier, dry over humidified

Dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>HCW-5</th>
<th>HCW-8</th>
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</thead>
<tbody>
<tr>
<td>Length</td>
<td>96 in. (2438 mm)</td>
<td>96 in. (2438 mm)</td>
</tr>
<tr>
<td>Depth</td>
<td>29 3/4 in. (756 mm)</td>
<td>29 3/4 in. (756 mm)</td>
</tr>
<tr>
<td>Height</td>
<td>32 5/8 in. (832 mm)</td>
<td>32 5/8 in. (832 mm)</td>
</tr>
</tbody>
</table>

Required clearances: N/A

Cradle dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>HCW-5</th>
<th>HCW-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>96 in. (2438 mm)</td>
<td>96 in. (2438 mm)</td>
</tr>
<tr>
<td>Depth</td>
<td>32 5/8 in. (832 mm)</td>
<td>32 5/8 in. (832 mm)</td>
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<tr>
<td>Height</td>
<td>40 5/8 in. (1020 mm)</td>
<td>40 5/8 in. (1020 mm)</td>
</tr>
<tr>
<td>Volume</td>
<td>87 cu. ft. (2.44 m³)</td>
<td>87 cu. ft. (2.44 m³)</td>
</tr>
</tbody>
</table>

Net weight: N/A

Cradle weight

<table>
<thead>
<tr>
<th>Model</th>
<th>HCW-5</th>
<th>HCW-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>355 lbs. (161.7 kg)</td>
<td>504 lbs. (229 kg)</td>
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Water connections: 1/2 in. hot water supply, drain.


Capacity: Full size sheet pans, 18 x 26 in. (457 x 660 mm)

Laboratory certifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Volts</th>
<th>Phase</th>
<th>Cycle/Hz</th>
<th>Watts</th>
<th>Amps</th>
<th>Wire</th>
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<td>4150</td>
<td>19.5</td>
<td>3+G</td>
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<td></td>
<td>120/240</td>
<td>1</td>
<td>50/60</td>
<td>4150</td>
<td>18.0</td>
<td>3+G</td>
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<td>HCW-8</td>
<td>120/208</td>
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<td>50/60</td>
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<td></td>
<td>300-415</td>
<td>3</td>
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<td>4150</td>
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<td>8080</td>
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<td>50/60</td>
<td>8080</td>
<td>35.1</td>
<td>3+G</td>
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<td>220-240</td>
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<td>50/60</td>
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<td>130/208</td>
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<td></td>
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<td>4+G</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>3</td>
<td>50/60</td>
<td>8080</td>
<td>11.7</td>
<td>3NG</td>
</tr>
</tbody>
</table>

NOTE: Units must be hard-wired at site by qualified technician.

Bidding specifications

- Provide Henny Penny model HCW-5 or HCW-8 two-tiered display counter warmer for accumulating, holding and displaying freshly cooked food prior to serving.
- Units feature flip-up door panels on both sides for easy pass-through operation.
- HCW-5 shall hold up to (5) full size sheet pans. HCW-8 shall hold up to (6) full size sheet pans.
- Materials—interior and exterior of welded stainless steel. Flip-up doors on both sides of scratch-resistant acrylic.
- Units shall have rear-mounted control panel with independent temperature control for upper and lower tiers.

Continuing product improvement may subject specifications to change without notice.

Henny Penny
Global Foodservice Solutions

Food Service Technology Center
Henny Penny HCW Appliance Test Report—S01310045

© 2005 Henny Penny Corporation, Canal, OH 43520 USA. Revised 12-0-07
The information in this report is based on data generated at the PG&E Food Service Technology Center. California consumers are not obligated to purchase any full service or other service not funded by the program. This program is funded by the California utility rate payers under the auspices of the California Public Utilities Commission.

### Manufacturer
Henny Penny

### Model / Serial Number
HCW5

### Appliance
Hot Food Warming Display- Electric

### Cavity Size (H x W x D)
27” x 20” x 20”

### Report Number
501310046

### Test Date
Oct., 2010

### Tested By
K. Sham

#### Purpose of Testing
The test was conducted to characterize the performance of the hot food display’s preheat duration and energy consumption, idle energy rate, and holding energy rate under controlled laboratory conditions.

#### Test Conditions
<table>
<thead>
<tr>
<th>Test Voltage (V)</th>
<th>Average Ambient Temperature (75°F ± 2.5°F)</th>
<th>Average Cavity Temperature (150°F ± 2.5°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>208</td>
<td>76.1</td>
<td>148.5</td>
</tr>
</tbody>
</table>

#### Energy Input Rate
<table>
<thead>
<tr>
<th>Test Voltage (V)</th>
<th>Rated Energy Input (kW)</th>
<th>Measured Energy Input (kW)</th>
<th>Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>208</td>
<td>4.16</td>
<td>3.90</td>
<td>6.25</td>
</tr>
</tbody>
</table>

#### Preheat to 150°F –Wet
<table>
<thead>
<tr>
<th>Duration (min)</th>
<th>Energy Consumption (kW)</th>
<th>Average Pre-heat Rate (*°F/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51.6</td>
<td>3.17</td>
<td>1.49</td>
</tr>
</tbody>
</table>

#### Idle at 150°F –Dry Upper Cavity, Wet Lower Cavity
-Doors Closed (maximum settings)

<table>
<thead>
<tr>
<th>Upper Cavity</th>
<th>Lower Cavity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #1 -Left (*°F)</td>
<td>150.4</td>
</tr>
<tr>
<td>Position #2 -Center (*°F)</td>
<td>152.4</td>
</tr>
<tr>
<td>Position #3 -Right (*°F)</td>
<td>142.6</td>
</tr>
<tr>
<td>Water Temperature (*°F)</td>
<td>154.7</td>
</tr>
<tr>
<td>Relative Humidity (%)</td>
<td>93.0</td>
</tr>
<tr>
<td>Wet Idle Energy Consumption Rate (kW)</td>
<td>3.45</td>
</tr>
</tbody>
</table>
**Pre-Heat Test**

![Preheat Temperature Profile](image)

**Idle Test Chart**

![Door Closed Temperature Profile](image)

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