Groen Vortex, Model VRC-6E
Electric Steamer Performance Test

Application of ASTM Standard
Test Method F 1484-99

FSTC Report # 5011.03.23

Food Service Technology Center

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Specific appreciation is extended to Groen, Inc. for supplying the FSTC with a Vortex, Model VRC-6E connectionless steamer for controlled testing in the appliance laboratory.

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Executive Summary

The Food Service Technology Center (FSTC) tested the Groen Vortex, Model VRC-6E connectionless electric steamer under the controlled conditions of the American Society for Testing and Materials (ASTM) Standard Test Method for the Performance of Steam Cookers.[1] Steamer performance was characterized by preheat duration and energy consumption , idle energy rate, cooking energy rate and efficiency, production capacity, water consumption, and condensate temperature from product testing. Cooking tests were conducted with frozen green peas and grade B red potatoes in accordance with ASTM test materials specifications for weight, size, and water content.[1] Since the Vortex was not configured with an automatic water fill option or condensate drain, researchers did not monitor water consumption and condensate temperature for these tests.

The Groen Vortex, Model VRC-6E is one of the best electric connectionless steamers tested to date at the FSTC. The Vortex performed outstandingly compared with other connectionless steamers thanks to its unprecedented heavy load (6 pan) cooking energy efficiencies for frozen green peas (91.5%) and red potatoes (71.0%). The Vortex also earns high marks for impressive heavy load production capacities of 94.5 lb/h for frozen green peas and 116.2 lb/h for red potatoes.

Cooking-energy efficiency is a measure of how much of the energy that an appliance consumes is actually delivered to the food product during the cooking process. Cooking-energy efficiency is therefore defined by the following relationship:

[1] American Society for Testing and Materials, 1999. Standard Test Method for the Performance of Steam Cookers. ASTM Designation F1484-99, in the Annual Book of ASTM Standards, West Conshohocken, PA.

$$\text{Cooking Energy Efficiency} = \frac{\text{Energy to Food}}{\text{Energy to Steamer}}$$

A summary of the ASTM test results is presented in Table ES-1.

Table ES-1. Summary of Vortex Steamer Performance.

Rated Energy Input Rate (kW)	12.0
Measured Energy Input Rate (kW)	12.6
Preheat Time (min)	17.0
Preheat Energy (kWh)	2.2
Idle Energy Rate (kW)	0.2
Frozen Green Peas	
Light-Load Cooking-Energy Efficiency (%)	60.8 ± 2.1
Heavy-Load Cooking-Energy Efficiency (%)	91.5 ± 2.5
Production Capacity (lb/h)	94.5 ± 1.6
Red Potatoes	
Light-Load Cooking-Energy Efficiency (%)	30.4 ± 2.5
Heavy-Load Cooking-Energy Efficiency (%)	71.0 ± 2.7
Production Capacity (lb/h)	116.2 ± 2.7

Beyond its respectable productivity and high cooking-energy efficiencies, the Vortex steamer also exhibited low water usage. Typical water consumption during heavy-load cooking tests was much lower than the unit's 4.0-gallon reservoir capacity. Other steam cooking technologies, such as boiler-based or steam generator-type steamers, typically consume between 20 and 60 gal/h while cooking.

1 Introduction

Background

Steaming provides a fast-cooking option for preparing large quantities of food, while retaining vital nutrients in the cooked product. Steamers are versatile appliances that can be used to prepare almost any food that does not require a crust. Delicate vegetables, such as asparagus and broccoli, are cooked without damage; frozen foods are defrosted and cooked in one step; and hard-to-cook meats, such as beef ribs, can be par-cooked quickly with less weight loss than oven roasting.

Dedicated to the advancement of the food service industry, the Food Service Technology Center (FSTC) has focused on the development of standard test methods for commercial food service 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.

The test methods, approved and ratified by the American Society for Testing and Materials (ASTM), allow benchmarking of equipment so that users can make informed comparisons among available equipment choices. By collaborating with the Electric Power Research Institute (EPRI) and the Gas Technology Institute (GTI) through matching funding agreements, the test methods have remained unbiased to fuel choice. End-use customers and commercial appliance manufacturers consider the FSTC to be the national leader in commercial food service equipment testing and standards, sparking alliances with several major chain customers to date.

Since the development of the ASTM test method for steam cookers in 1993,[1] the FSTC has tested a wide range of gas and electric steamers,[2–14] including Groen's very own HyperSteam 3 pan unit.

Introduction

The Groen Vortex steamer is the product of continued dedication from Groen to make quality connectionless steamers. The Vortex shares many of the same features with its sibling, the HyperSteam, including a powerful squirrel cage fan that provides the advantages of forced convection steaming, a compartment with a mirror finish for easy cleaning and durability, and a deep four gallon reservoir.

The glossary in Appendix A 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 Groen, Model VRC-6E steamer, under the controlled conditions of the ASTM Standard Test Method. 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 steamer to an operating condition.
3. Characterize the idle energy use of the steamer while maintaining a ready-to-cook state.
4. Determine the cooking-energy efficiency under four scenarios: heavy-load frozen green peas (6 pans), light-load frozen green peas (single-pan), heavy-load red potatoes (6 pans) and light-load red potatoes (single-pan).
5. Determine the production capacity, cooking energy rate and cook time for each loading scenario.

Appliance Description

The Groen Vortex, Model VRC-6E is a 6-pan capacity, single compartment, electric, connectionless steamer (Figure 1-1). The steamer is powered by a 12.0-kW heating element placed beneath the cooking compartment's water reservoir. Steam is generated within the cooking compartment without a separate boiler. Water is added and drained manually at the beginning and end of the day. The cooking chamber accommodates six standard full-size, 2½-

inch deep hotel pans. The Vortex has two cooking modes: timed and continuous. The timed mode allows operators to set a pre-determined cooktime of up to 90 minutes. When the cook time has expired, the unit automatically switches to a hold mode. This hold feature allows the operator to maintain an idle state of 180°F inside the cooking compartment. In the continuous cooking mode, steam generation is cycled automatically by microprocessor controls or by manually shutting the unit on or off.

Appliance specifications are listed in Table 1-1, and the manufacturer's literature is in Appendix B. The appliance is pictured in Figure 1-1.

Figure 1-1. The Groen Vortex steamer.

Table 1-1. Appliance Specifications.

Manufacturer	Groen Equipment
Model	Model VRC-6E Vortex
Generic Appliance Type	Connectionless, 1-compartment, electric, atmospheric, connectionless steamer.
Rated Input	12.0 kW
Technology	Boiler-less steamer with forced-convection.
Construction	Mirror finished stainless-steel walls.
Interior	18 Ga. stainless-steel
Exterior	33 Ga. stainless-steel
Controls	Main ON/OFF buttons. 90 minute mechanical timer with continuous steam or hold setting. Thermostat ranging from 140 °F to 212 °F.
Compartment Capacity	6 (12" x 20" x $2^1/_2$") pans, 4 (12" x 20" x 4") pans, or 3 (12" x 20" x 6") pans
Dimensions	23" x $23^1/_4$" x 30"(w×d×h)

2 Methods

Setup and Instrumentation

The steamer was installed in accordance with the manufacturer's instructions and in accordance with Section 9 of the ASTM test method[1]: under a 4-foot-deep canopy hood, with the lower edge of the hood 6 feet, 6 inches above the floor and a minimum of 6 inches inside the vertical front edge of the hood. The exhaust ventilation operated at a nominal rate of 150 cfm per linear foot of hood with the ambient temperature maintained at 75 ±5°F.

Power and energy were measured with a watt/watt-hour transducer that generated an analog signal for instantaneous power and a pulse for every 10 Wh. The transducer and thermocouples were connected to a computerized data acquisition unit that recorded data every 5 seconds. A voltage regulator, connected to the steamer, maintained a steady voltage for all tests. Figure 2-1 shows the Vortex instrumented with the data acquisition system.

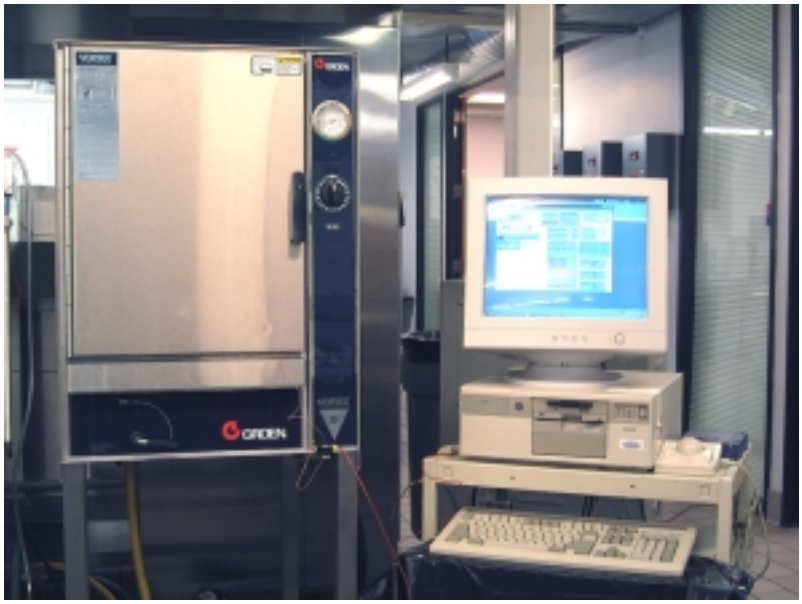

Figure 2-1. The Vortex instrumented for testing.

Methods

Non-Cooking Tests

The energy input rate was determined by measuring the energy consumed by the steamer during a complete preheat cycle. The maximum power draw during this period was reported as the measured energy input rate. Preheat tests recorded the time and energy required for the steamer to reach operating temperature from a cold start when turned on for the first time in a day. An hour after the preheat cycle, idle energy consumption was monitored over a 2-hour period and conducted in the steamer's "idle/hold" mode.

Frozen Green Pea Efficiency Tests

Individually flash-frozen, grade A green peas (Figure 2-2) represented one of two food products for steamer performance testing. Standard full-size (12" x 20" x 2½"), perforated stainless-steel hotel pans were used for cooking the green peas. The Vortex required 6 pans of green peas for a full load, while a single pan placed on the center rack of the steamer cavity comprised a light load. Each pan contained 8.0 ± 0.2 lb of green peas. Pre-weighed green peas in perforated pans were stored in sealed plastic bags at 0 ± 5°F for at least 24 hours prior to testing. The pans of peas were transferred into an insulated box and transported to the testing location where the plastic bags were removed, and the pan(s) of green peas were loaded into the steamer according to the loading time prescribed in section 10.7.6 of the ASTM test method.[1]

Figure 2-2.
Frozen green pea load.

Since probing proves to be difficult and erroneous in measuring the temperature of small-sized green peas, a water-bath calorimeter was utilized to determine the final bulk temperature of the cooked green peas. The time required to cook the frozen peas to a bulk temperature of 180 ± 2°F was determined through an iterative process. Once the cook time was established, the test was replicated a minimum of three times to minimize the uncertainty in the test results.

Red Potato Efficiency Tests

Freshly packed, size B, red potatoes (Figure 2-3) served as the second food product for steamer performance testing. Again, the Vortex required 6 pans of

red potatoes for a full load and a single pan for a light load. Each pan contained 8.0 ± 0.2 pounds of red potatoes.

Figure 2-3.
Red potato load.

The red potatoes were loaded into perforated pans prior to the test and stabilized to a room temperature of 75 ± 5°F. The potatoes were then cooked to 195 ± 2°F using a predetermined cook time. The final temperature was determined by probing a minimum of 3 potatoes during testing and then randomly probing potatoes(using a hand-held, digital thermocouple meter) within 3 minutes after cooking was terminated. Again, the test was replicated a minimum of three times to minimize the uncertainty in the test results.

The ASTM results reporting sheets appear in Appendix C.

3 Results

Energy Input Rate

Researchers compared the manufacturer's nameplate value for energy input rate with that measured in the lab prior to any testing to ensure that the steamer was operating within its specified parameters. The Vortex drew a maximum energy input rate of 12.6 kW.

Preheat and Idle Tests

Preheat Energy and Time

The cavity was manually filled with four gallons of water at 70 ±5°F. The steamer was started in its “On” mode of operation indicated by continual steaming cycles until the compartment reached approximately 203°F. Preheat was complete when the primary elements had cycled off and the compartment reached 203°F, indicating a ready-to-cook state. Figure 3-1 illustrates the preheat and idle characteristics of the Vortex.

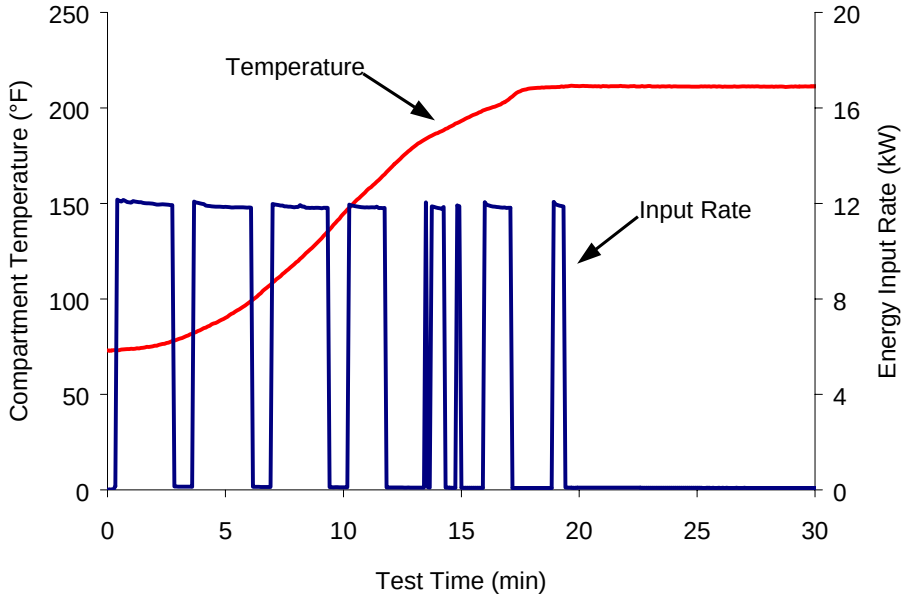

Figure 3-1.
Preheat characteristics.

Results

Idle Energy Rate

Following the preheat period, the steamer was left in the "On" mode and allowed to stabilize for one hour. Then, the steamer was placed in its "idle/hold" mode and the energy consumption was monitored over a 2-hour period and the idle energy rate was determined to be 0.2 kW.

Test Results

Rated energy input, preheat energy and idle rate test results are summarized in Table 3-1. The Vortex had a preheat time of 17.0 minutes and exhibited a idle rate of 0.2 kW.

Table 3-1. Average Input, Preheat and Idle Test Results.

Rated Energy Input Rate (kW)	12.0
Measured Energy Input Rate (kW)	12.6
Preheat to Operational Capacity:	
Time (min)	17.0
Energy (kWh)	2.2
Idle Energy Rate (kW)	0.2

Cooking Tests

The steamer was tested using two different food products (green peas and red potatoes) under two loading scenarios—heavy (6 pans) and light (single pan). All cooking scenarios were conducted in the unit's "On" mode.

The Groen Vortex steamer does not employ a separate boiler, water connection or drain. Four gallons of water were poured into the reservior at the bottom of the cooking compartment before testing began. The steamer was emptied at the end of the day, as directed by the manufacturer's instructions.

Results

Typical water usage for each cooking scenario was less than the 4.0-gallon capacity of the reservoir.

Frozen Green Pea Tests

Moisture content of the frozen green peas was 81% by weight, corresponding to specific heats (Cp) of 0.44 Btu/lb°F for frozen and 0.84 Btu/lb°F for thawed peas.[1] The Vortex required 30.5 minutes to cook a full load of frozen green peas and had a cooking-energy efficiency of 91.5% and a production capacity of 94.5 lb/h.

The light-load test required an average of 8.1 minutes when cooking a single pan of frozen green peas. Cooking energy efficiency and productivity during the light-load tests were determined to be 60.8% and 59.4 lb/h, respectively.

Red Potato Tests

The red potatoes contained 84% moisture by weight with the specific heat (Cp) of 0.87 Btu/lb°F.[1] A full load of potatoes averaged 24.8 minutes to reach a bulk cooked temperature of 195 ± 2°F. The cooking-energy efficiency and production capacity was 71.0% and 116.2 lb/h, respectively.

The single pan of red potatoes required 18.0 minutes to achieve an average bulk temperature of 195 ± 2°F. The light-load potato test exhibited a cooking-energy efficiency of 30.4% and a productivity of 26.7 lb/h.

Results Discussion

The rate at which steam condenses on food depends on the surface temperature and area of the food. Therefore, frozen green peas (at 0°F) and red potatoes (at room temperature) represent two extremities in steam cooking. Frozen green peas, having a large surface area to volume ratio, promote condensation. The energy transfer from steam to frozen food is high, resulting in greater cooking-energy efficiency and productivity. Potatoes are

"tough" to cook, due to low surface to volume ratio and the slower rate of condensation.

Appendix D lists the physical properties of the test food product and measured values of each test run. Using the detailed equations provided in section 11 of the Steamer ASTM Standard Test Method, the cooking energy efficiencies are calculated. Tables 3-2 and 3-3 summarize the Vortex's cooking performance.

Table 3-2. Frozen Green Pea Cooking Test Results.

	Heavy-Load	Light-Load
Number of Pans	6	1
Cook Time (min)	30.5	8.1
Cooking Energy Rate (kW)	8.0	7.4
Cooking-Energy Efficiency (%)	91.5	60.8
Production Rate (lb/h)	94.5	59.4
Energy Consumption (Btu/lb)	292	435

Table 3-3. Red Potato Cooking Test Results.

	Heavy-Load	Light-Load
Number of Pans	6	1
Cook Time (min)	24.8	18.0
Cooking Energy Rate (kW)	5.1	2.8
Cooking-Energy Efficiency (%)	71.0	30.4
Production Rate (lb/h)	116.2	26.7
Energy Consumption (Btu/lb)	151	354

Figure 3-2 illustrates the relationship between cooking-energy efficiency and production rate for this steamer, when cooking two different types of food product. The upper line represents the part-load efficiency curve for the steamer when cooking frozen vegetables, while the lower curve represents the steamer's part-load efficiency while cooking more stubborn food products. Steamer production rate is a function of the cook time. Appendix D contains a synopsis of test data for each replicate of the cooking tests.

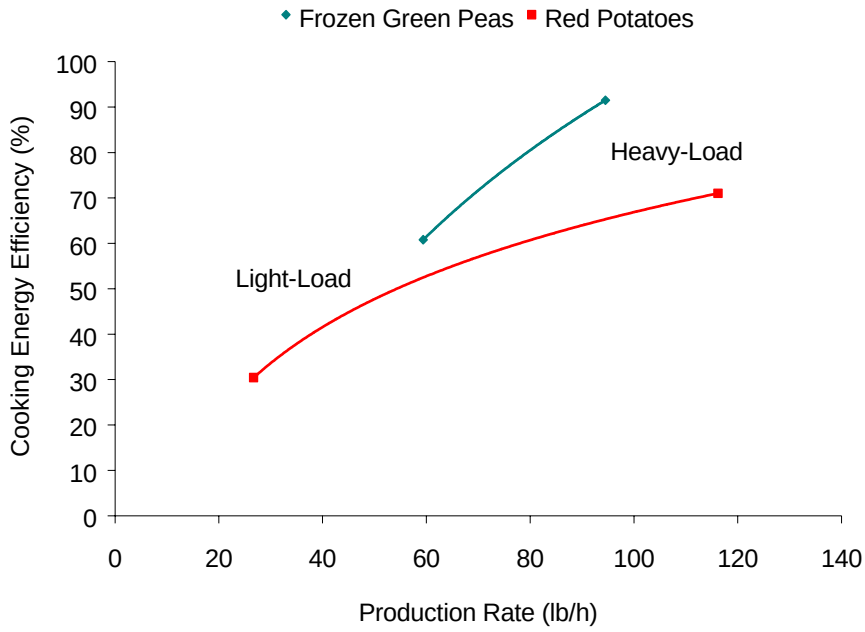

Figure 3-2. Steamer part-load cooking-energy efficiency.

Note: Light-load = single pan/load; Heavy-load = 6 pans/load.

Figure 3-3 illustrates the relationship between the Vortex steamer's average cooking energy efficiency and the production rate for different types of food product at different test scenarios. Heavy loads tend to exhibit higher efficiencies due to better use of the available compartment space, as opposed to light load single pan tests, where most of the space in the steamer compartment is empty. Furthermore, Figure 3-3 shows that the frozen green

peas have higher cooking energy efficiencies than the red potatoes due to their higher surface to volume ratio.

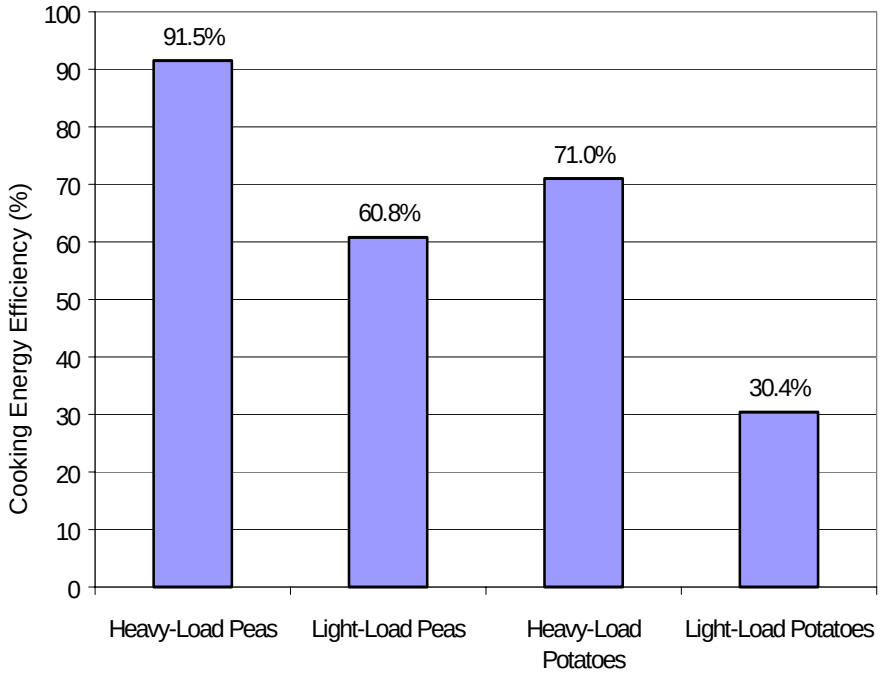

Figure 3-3. Steamer cooking-energy efficiency results.

Note: Light-load = single pan/load; Heavy-load = 6 pans/load.

Figure 3-4 represents the cooking energy input rate for two different food products at the two test load scenarios. The upper line represents the steamer's energy consumption rate when cooking frozen vegetables, while the lower curve represents the steamer's energy consumption rate while cooking more stubborn food products. This graph can be used as a tool to estimate the daily energy consumption and probable demand for the steamer in a real-world operation, based on the type of usage. Average energy consumption rates at 15, 30, and 60 pounds per hour of frozen vegetables are 1.9 kW, 3.0 kW, and 4.1 kW, respectively. For an operation cooking an average of 15 pounds of frozen vegetables per hour over the course of the day (e.g., 150

pounds of food over a ten hour day), the probable demand contribution from this steamer would be 1.9 kW.

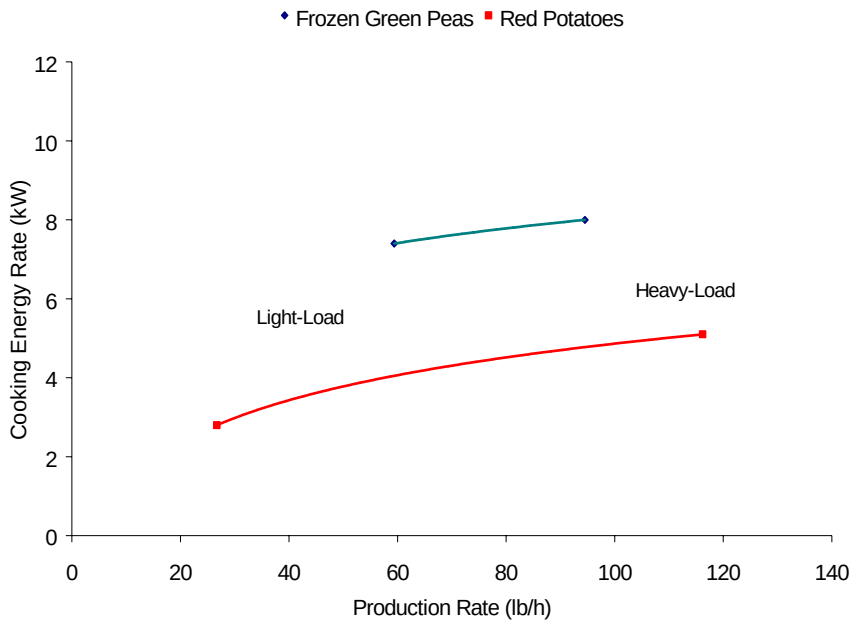

Figure 3-4.
Steamer cooking energy consumption profile.

Note: Light-load = single pan/load; Heavy-load = 6 pans/load.

4 Conclusions

The Groen Vortex VRC-6E is a highly productive and energy efficient connectionless, electric steamer. With its six-pan loading capacity, the unit achieved one of the highest frozen green pea production capacities of any connectionless steamer (94.5 lb/h). Its 116 pounds-per-hour red potato production capacity was also one of the highest of any connectionless steamer tested to date at the FSTC.[3–10, 15, 16] During heavy load cooking tests, the Vortex was able to transfer its steam energy to the food product quite efficiently while minimizing heat loss. The Vortex was recorded as having the highest heavy load frozen green pea cooking efficiencies (91.5%) and one of the best efficiencies with red potatoes (71.0%) of any electric connectionless steamer.

While cooking tests revealed the steamer's ability to perform with minimal energy input and short cook times, the Vortex was equally impressive with it's very low 0.2 kW idle rate. This is a credit to the design of the steamer, both in its ability to minimize heat loss and it's control strategy that allows it to maintain a steady, standby temperature within the cooking compartment.

The Vortex steamer was subjected to a series of heavy and light load cooking scenarios, and, for each cooking test, the steamer consumed less than 2.5 gallons. On average, researchers needed only to replenish the water reservoir with a gallon to two gallons of water after multiple cooking tests. Steam-generator and boiler-based units typically consume between 20 and 60 gal/h while cooking.[2, 11–14]

The Groen Vortex VRC-6E is an energy efficient connectionless steamer that is versatile enough to will satisfy all menu demands. Throughout all of the rigorous ASTM tests, the Vortex outperformed nearly all other FSTC tested steamers in its category. In addition, the Vortex also provides labor saving features such as a low maintenance mirror finish on the interior, a deep, four-

Conclusions

inch reservoir, and an available, automatic water fill option. The Groen Vortex is a perfect candidate for facilities looking to reduce operating and maintenance costs. With its low energy consumption, high production rates, and minimal water usage, it is a fine choice for replacing boiler-based steamers and other connectionless steamers. Operators are sure to be pleased with this quality steamer unit.

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A Glossary

Boiler

Self-contained electric, gas, or steam coil powered vessel wherein water is boiled to produce steam for the steam cooker. Also called a steam generator.

Boiler Preheat
Preheat

Process of bringing the boiler water from potable supply temperature to operating temperature (pressure).

Condensate

A mixture of condensed steam and cooling water, exiting the steam cooker and directed to the floor drain.

Condensate Temperature (°F)

The temperature at which the condensate enters the floor drain.

Cooking Energy (kWh or kBtu)

The total energy consumed by an appliance as it is used to cook a specified 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 products; expressed as a percentage of the quantity of energy input to the appliance during the heavy-, medium-, and light-load tests.

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 Input Rate (kW or kBtu/h)
Energy Consumption Rate
Energy Rate

The peak rate at which an appliance will consume energy, typically reflected during preheat.

Frozen Green Peas Load

12 x 20 x 2½ in. hotel pan filled with 8.0 ± 0.2 lb of frozen, grade A, green peas subsequently frozen to 0±5°F. One of two food products used to determine cooking-energy efficiency and production capacity.

High-Pressure Steam Cooker

Steam cooker wherein cooking compartment operates between 10 and 15 psig (ASTM F1217-92 Classification Type III).

Glossary

Heating Value (Btu/ft^3)
Heating Content

The quantity of heat (energy) generated by the combustion of fuel. For natural gas, this quantity varies depending on the constituents of the gas.

Ice Load

12 x 20 x 2½ in. hotel pan filled with 8.0 ± 0.2 lb of water and subsequently frozen to 0±5°F. This is used to simulate a food product load in the ice load cooking-energy efficiency and production capacity test.

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 energy input rate.

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

Low-Pressure Steam Cooker

Steam cooker wherein the cooking compartment operates between 3 and 9.9 psig (ASTM F1217-92 Classification Type II).

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").

Pilot Energy Rate (kBtu/h)
Pilot Energy Consumption Rate

The rate of energy consumption by the standing or constant pilot while the appliance is not being operated (i.e., when the thermostats or control knobs have been turned off by the food service operator).

Potato Load

12 x 20 x 2½ in. hotel pan filled with 8.0 ± 0.2 lb of fresh, whole, US No. 1, size B, red potatoes. One of two food products used to determine cooking-energy efficiency and production capacity.

Preheat Energy (kWh 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 cooking surface heats during a preheat.

Preheat Time (minute)
Preheat Period

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.

Glossary

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.

Production Rate (lb/h)
Productivity

The average rate at which an appliance brings a specified food product to a specified "cooked" condition.

Rated Energy Input Rate
(kW, W or Btu/h, 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.

Steam Cooker

Cooking appliance wherein heat is imparted to food in a closed compartment by direct contact with steam. The compartment can be at or above atmospheric pressure. The steam can be static or circulated.

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 sampled day of average appliance usage based on observations and/or operator interviews, used to develop an energy cost model for the appliance.

Water Consumption (gal/h)

Water consumed by the steam cooker. Includes both water used in the production of steam and cooling water (if applicable) for condensing/cooling unused steam.

B Appliance Specifications

Appendix B includes the product literature for the Groen Vortex, Model VRC-6E steamer.

VRC-6E

GROEN®

VORTEX™

6 Pan Capacity Stainless Steel Pressureless Connectionless Steamer

Table Top Self-Contained Electric Heated

Short Form

Unit shall be a Groen Vortex™ pressureless connectionless steamer Model VRC-6E with a cavity water reservoir electric heated for steam generation per Bulletin 142590. Stainless steel construction with a powerful blower to circulate steam within the cavity. Standard operating controls includes: 90 minute mechanical timer, constant steam setting, HOLD mode and add H_2O light (to know when to add water into the reservoir to continue operation.) Door is field reversible, with easy open latch and hidden magnetic door switch. The inside cavity water reservoir for steam generation requires no pressure gauge or switches. Unit has 12KW power input. Unit shall come ready to steam in 15-20 minutes from a cold start, and provide warm cavity-instant steam capability. See other side for electric connections required. Made in the U.S.A.

Description

Steamer shall be a Groen Model VRC-6E stainless steel pressureless connectionless steamer with an 12 KW atmospheric 12 KW electric steam reservoir, per Bulletin 142590 as follows:

Construction

Steamer cavity and cabinet shall be all stainless steel construction with removable right and left side panels providing access to internal components.

Steamer door is all stainless steel with strong continuous hinge and is field reversible for left or right swing. Door shall be insulated and provided with a one piece, replaceable seal. Easy open handle and latch shall provide positive lock and seal when door is pushed or slammed shut.

Hidden magnetic door switch cuts power to blower and reduces power to generator when door is opened. Pan support racks shall be polished stainless steel and removable for easy cleaning. A removable stainless steel condensate collection tray is positioned under cavity door.

Finish

Cabinet exterior including door shall be finished to a No. 4 uniform finish. Cavity interiors are polished stainless steel.

UL Listing

Steamer shall be UL listed.

Sanitation

Unit shall be NSF listed. Unit to allow operator easy cleaning of water reservoir through cavity door.

Controls

Steamer controls shall include an ON-OFF power button; 90 minute mechanical timer, with continuous steam setting; a HOLD light which indicates when cavity is at holding temperature and an ADD - H_2O light to indicate when water is needed in the reservoir to generate steam.

Performance Features

Steamer cavity shall have a powerful side mounted blower, which increases steam velocity and provides efficient steam distribution throughout the cavity and between loaded pans. Water reservoir steam generator delivers 2KW power input per 2 1/2" deep steam pan.

Unit shall come ready to steam in 15 - 20 minutes from a cold start, and provide warm cavity-instant steam capacity. Cavity is kept warm and ready for instant steam between loads.

H_2O indicator light warns operator of need to add water to the cavity reservoir. Unit will shut off if no water is added. Water reservoir can be drained by turning the drain handle to the open position.

Atmospheric Steam Generation

Unit shall have an electric heated water reservoir to provide atmospheric steam at the temperature of approximately 212º F. Water reservoir has electric water level sensors. When filled to the high level sensor, it has a capacity of 4 gallons.

Pan Capacity

Pan Size / Type	*Number*
12 x 20 x 1"	12
12 x 20 x 2 1/2"	6
12 x 20 x 4"	4

Installation

Unit requires 208, 240 or 480 volt, three phase electric service. Unit is shipped with a cord set ready to plug in.

Water Supply Requirements

No water hook up is needed.

Options/Accessories

- ❑Stainless steel support stand
- ❑Pan racks for support stand
- ❑Water fill/drain kit
- ❑Single phase models
- ❑Water grate

Origin of Manufacture

Steamer shall be designed and manufactured in the United States.

Applications

Pasta
Rice
Vegetables
(Fresh and Frozen)
Seafood
(Fresh and Frozen)
Poultry
Potatoes
Eggs
Meats
Reheat Cook-Chill & Prepared Foods

DI FOODSERVICE COMPANIES

1055 Mendell Davis Drive
Jackson, MS 39272
www.groen.com

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Toll Free (800) 676-9040
FAX (601) 373-9587
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GROEN

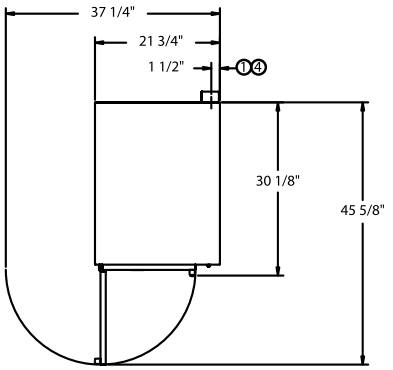
VRC-6E

6 Pan Capacity
Stainless Steel
Pressureless
ConnectionlessSteamer

142590

Revised 4/03

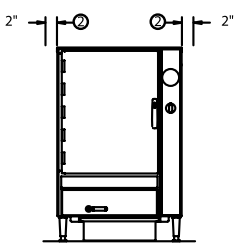
Due to continual product improvement, designs are subject to change without notice.

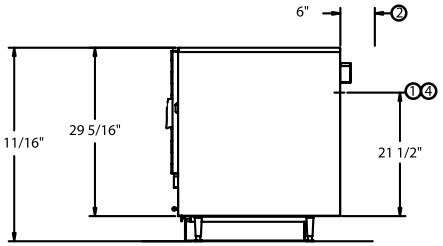


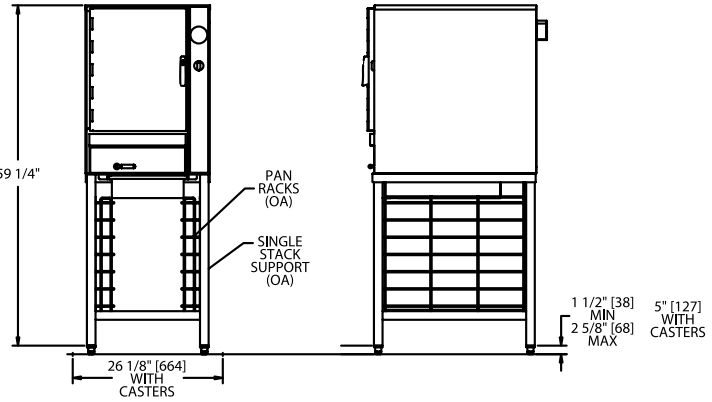
VOLTAGE	PHASE	KW MAX	AMP MAX	NEMA CONNECTOR NO.
208	3	12	33.3	15-50P (3HP)
240	3	12	29.0	15-50P (3HP)
480	3	12	25.0	CS8165C Hubbel or Equivalent

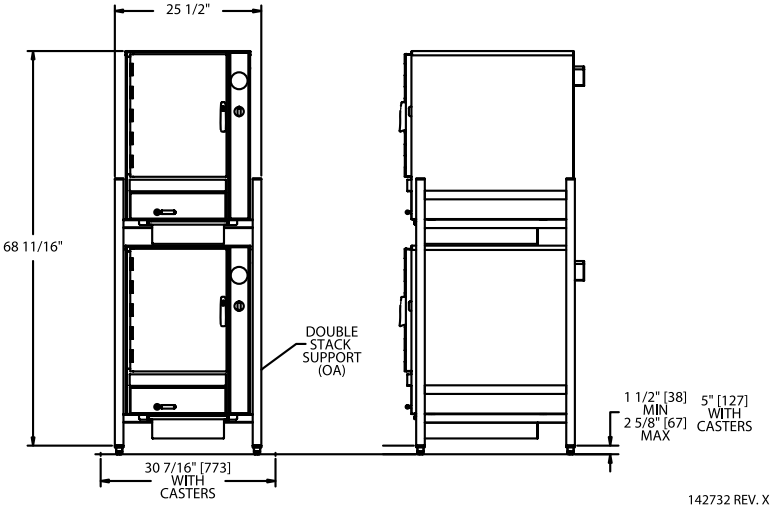
NOTES:

1. REFER TO ELECTRICAL CHART FOR NEMA TYPE PLUG CONNECTOR.
2. MINIMUM CLEARANCE REQUIRED.
3. DIMENSIONS IN BRACKETS [ ] ARE MM.
4. FIVE FOOT CORD WITH NEMA CONNECTOR NOT SHOWN.









142732 REV. X

NSF

UL

MADE IN USA

C Results Reporting Sheets

Manufacturer:	Groen
Model:	Vortex, VRC-6E
Date:	May 2002

Test Steam Cooker

ASTM F 1216 Classification (check one for each classification)

- ✓ Type I - Zero to 2.9 psig compartment pressure
- _____ Type II - Three to 9.9 psig compartment pressure
- _____ Type III - Ten to 15 psig compartment pressure

- _____ Size 1-3 - One Compartment, 3 full-size pan capacity
- _____ Size 1-4 - One Compartment, 4 full-size pan capacity
- _____ Size 1-5 - One Compartment, 5 full-size pan capacity
- ✓ Size 1-6 - One Compartment, 6 full-size pan capacity
- _____ Size 2-6 - Two Compartment, 6 full-size pan capacity
- _____ Size 2-8 - Two Compartment, 8 full-size pan capacity
- _____ Size 2-10 - Two Compartment, 10 full-size pan capacity
- _____ Size 2-12 - Two Compartment, 12 full-size pan capacity
- _____ Size 2-16 - Two Compartment, 16 full-size pan capacity
- _____ Size 3-12 - Three Compartment, 12 full-size pan capacity
- _____ Size 3-15 - Three Compartment, 15 full-size pan capacity
- _____ Size 3-18 - Three Compartment, 18 full-size pan capacity
- _____ Size 3-24 - Three Compartment, 24 full-size pan capacity

- _____ Style A - Counter mounted
- ✓ Style B - Floor mounted on an open stand
- _____ Style C - Floor mounted on a cabinet base
- _____ Style D - Wall Mounted

- _____ Class A - Direct connection to potable external steam source
- _____ Class B - Self-contained steam coil steam generator
- _____ Class C - Self-contained gas fired steam generator
- ✓ Class D - Self-contained electric steam generator

Results Reporting Sheets

Description of operational characteristics: Approximately 2.5 gallons of water is manually poured in the bottom of the cooking compartment. Upon starting the preheat, a pump draws a vacuum within the stainless-steel chamber to reduce vapor pressure, inducing quicker steam generation. Food is cooked with natural-convection steam to a desired temperature and held until ready to be served.

Apparatus

The steamer was installed in accordance with the manufacturer's instructions under a 4-foot-deep canopy hood, with the lower edge of the hood 6 feet, 6 inches above the floor and a minimum of 6 inches inside the vertical front edge of the hood. The exhaust ventilation operated at a nominal rate of 150 cfm per linear foot of hood with the ambient temperature maintained between 75 ±5°F. All test apparatus were installed in accordance with Section 9 of the ASTM test method.[1]

The steamer was instrumented with an electric transducer to measure power and energy; a voltage regulator was used to maintain constant voltage for all tests. A computerized data acquisition system recorded test information at 10-seconds intervals for the red potato tests and 5-second intervals for the rest. All test apparatus were installed in accordance with Section 9 of the ASTM test method.

Energy Input Rate

Test Voltage	208 V
Measured	12.6 kW
Rated	12.0 kW
Percent Difference between Measured and Rated	5.0%

Appliance Preheat Energy Consumption and Duration

Test Voltage	208 V
Energy Consumption	2.2 kWh
Duration	17.0 min

Results Reporting Sheets

Appliance Idle Energy Rate

Test Voltage	208 V
Idle Energy Rate	0.2 kW

<u>Frozen Green Peas</u> Cooking Time, Energy Efficiency, Energy Rate, Production Capacity, and Water Consumption Rate

Heavy-Load:

Test Voltage	208 V
Cooking Time	30.5 min
Cooking-Energy Efficiency	91.5 ±2.5%
Cooking Energy Rate	8.0 ± 0.1kW
Production Capacity	94.5 ±1.6 lb/h
Water Consumption Rate	< 2.5 gal/h

Light-Load:

Test Voltage	208 V
Cooking Time	8.1 min
Cooking-Energy Efficiency	60.8 ±2.1%
Cooking Energy Rate	7.4 ± 0.5 kW
Production Rate	59.4 ± 0.0 lb/h
Water Consumption Rate	< 2.5 gal/h

Results Reporting Sheets

<u>Whole Red Potatoes</u> Cooking Time, Energy Efficiency, Energy Rate, Production Capacity, and Water Consumption Rate

Heavy-Load:	
Test Voltage	208 V
Cooking Time	24.8 min
Cooking-Energy Efficiency	71.0 ±2.7%
Cooking Energy Rate	5.1 ± 0.2 kW
Production Capacity	116.2 ± 2.7 lb/h
Water Consumption Rate	< 2.5 gal/h

Light-Load:	
Test Voltage	208 V
Cooking Time	18.0 min
Cooking-Energy Efficiency	30.4 ± 2.5%
Cooking Energy Rate	2.8 ± 0.1kW
Production Capacity	26.7 ± 0.9 lb/h
Water Consumption Rate	< 2.5 gal/h

D Cooking-Energy Efficiency Data

Table D-1. Specific Heat and Latent Heat.

Specific Heat (Btu/lb, °F)	
Ice	0.50
Solids	0.20
Frozen Green Peas	0.84
Red Potatoes	0.84
Latent Heat (Btu/lb)	
Fusion, Water	144
Vaporization, Water	970

Cooking-Energy Efficiency Data

Table D-2. Heavy-Load Peas Data

	Replication 1	Replication 2	Replication 3
Measured Values			
Number of Pan(s)	6	6	6
Cook Time (min)	**30.25**	**30.5**	**30.7**
Initial Water Temperature (°F)	37.0	37.2	39.5
Final Water Temperature (°F)	95.4	95.8	97.7
Frozen Food Temperature (°F)	0.0	0.00	0.0
Weight of Empty Calorimeter (lb)	44.7	44.7	44.7
Weight of Full Calorimeter (lb)	155.2	155.2	155.7
Weight of Calorimeter Water (lb)	60.0	60.0	60.0
Weight of Cooked Food (lb)	50.5	50.5	51.0
Weight of Frozen Food (lb)	48.0	48.0	48.0
Weight of Stainless-Steel Pans (lb)	15.7	15.7	15.7
Moisture Content (%)	81	81	81
Condensate Temperature (°F)	n/a	n/a	n/a
Water Consumption (gal/h)	<2.5	<2.5	<2.5
Calculated Values			
Moisture Weight in Green Peas (lb)	38.9	38.9	38.9
Final Food Temperature (°F)	178.0	178.6	179.2
Cooking Energy (kWh)	4.04	4.12	4.16
Energy Consumed by Green Peas (Btu)	12,468	12,495	12,581
Energy to Food (Btu/lb)	**259.8**	**260.3**	**262.1**
Energy Consumed by Pans (Btu)	306.5	307.6	308.6
Energy of Boiler Re-init (Btu)	n/a	n/a	n/a
Energy Consumed by the Steamer (Btu)	13,785	14,058	14,195
Energy to Steamer (Btu/lb of food cooked)	287.2	292.9	295.7
Cooking Energy Rate (kW)	**8.0**	**8.0**	**8.1**
Productivity (lb/h)	**95.2**	**94.4**	**93.9**
Energy Efficiency (%)	**92.7**	**91.1**	**90.8**

Cooking-Energy Efficiency Data

Table D-3. Light-Load Peas Data

	Replication 1	Replication 2	Replication 3
Measured Values			
Number of Pan(s)	1	1	1
Cook Time (min)	**8.08**	**8.08**	**8.08**
Initial Water Temperature (°F)	33.6	36.7	38.5
Final Water Temperature (°F)	94.6	95.0	95.0
Frozen Food Temperature (°F)	0.0	0.0	0.0
Weight of Empty Calorimeter (lb)	44.7	44.7	44.7
Weight of Full Calorimeter (lb)	63.1	62.8	62.8
Weight of Calorimeter Water (lb)	10.0	10.0	10.0
Weight of Cooked Food (lb)	8.4	8.1	8.1
Weight of Frozen Food (lb)	8.0	8.0	8.0
Weight of Stainless-Steel Pans (lb)	2.8	2.4	2.4
Moisture Content (%)	81	81	81
Condensate Temperature (°F)	n/a	n/a	n/a
Water Consumption (gal/h)	< 2.5	< 2.5	< 2.5
Calculated Values			
Moisture Weight in Green Peas (lb)	6.5	6.5	6.5
Final Food Temperature (°F)	181.4	180.6	178.1
Cooking Energy (kWh)	1.04	1.00	1.02
Energy Consumed by Green Peas (Btu)	2,096	2,057	2,040
Energy to Food (Btu/lb)	**262.0**	**257.1**	**255.0**
Energy Consumed by Pans (Btu)	55.6	47.7	47.1
Energy of Boiler Re-init (Btu)	n/a	n/a	n/a
Energy Consumed by the Steamer (Btu)	3,549	3,412	3,480
Energy to Steamer (Btu/lb of food cooked)	443.6	426.5	435.0
Cooking Energy Rate (kW)	**7.4**	**7.3**	**7.7**
Productivity (lb/h)	**59.4**	**59.4**	**59.4**
Energy Efficiency (%)	**60.0**	**61.7**	**60.6**

Cooking-Energy Efficiency Data

Table D-4. Heavy-Load Potatoes Data

	Replication 1	Replication 2	Replication 3
Measured Values			
Number of Pan(s)	6	6	6
Cook Time (min)	**25.08**	**24.67**	**24.69**
Temperature of Uncooked Potatoes (°F)	73.8	71.6	73.1
Temperature of Cooked Potatoes (°F)	195.0	195.1	195.0
Weight of Stainless-Steel Pans (lb)	15.65	15.82	15.82
Weight of Potatoes (lb)	48.04	48.02	48.05
Total Potato Count	300	298	300
Moisture Content (%)	84	84	84
Condensate Temperature (°F)	n/a	n/a	n/a
Water Consumption (gal/h)	<2.5	<2.5	<2.5
Calculated Values			
Moisture Weight in Potatoes (lb)	40.35	40.34	40.36
Average Weight of Each Potato (lb)	0.16	0.16	0.16
Cooking Energy (kWh)	2.12	2.12	2.16
Energy Consumed by Potatoes (Btu)	4,891	4,982	4,920
Energy to Food (Btu/lb)	**101.8**	**103.7**	**102.4**
Energy Consumed by Pans (Btu)	234.09	236.2	235.95
Energy of Boiler Re-init (Btu)	n/a	n/a	n/a
Energy Consumed by the Steamer (Btu)	7,234	7,234	7,370
Energy to Steamer (Btu/lb of food cooked)	150.6	150.6	153.4
Cooking Energy Rate (kW)	**5.06**	**5.09**	**5.19**
Productivity (lb/h)	**114.9**	**116.8**	**116.8**
Energy Efficiency (%)	**70.9**	**72.1**	**70.0**

Cooking-Energy Efficiency Data

Table D-5. Light-Load Potatoes Data

	Replication 1	Replication 2	Replication 3
Measured Values			
Number of Pan(s)	1	1	1
Cook Time (min)	**18.25**	**17.83**	**17.83**
Temperature of Uncooked Potatoes (°F)	73.7	73.2	70.2
Temperature of Cooked Potatoes (°F)	195.0	195.0	195.0
Weight of Stainless-Steel Pans (lb)	2.41	2.40	2.82
Weight of Potatoes (lb)	8.00	8.00	8.00
Total Potato Count	50	50	50
Moisture Content (%)	84	84	84
Condensate Temperature (°F)	n/a	n/a	n/a
Water Consumption (gal/h)	<2.5	<2.5	<2.5
Calculated Values			
Moisture Weight in Potatoes (lb)	6.72	6.72	6.72
Average Weight of Each Potato (lb)	0.16	0.16	0.16
Cooking Energy (kWh)	0.84	0.84	0.82
Energy Consumed by Potatoes (Btu)	815.25	819.38	838.37
Energy to Food (Btu/lb)	**101.9**	**102.4**	**104.8**
Energy Consumed by Pans (Btu)	36.84	36.62	43.77
Energy of Boiler Re-init (Btu)	n/a	n/a	n/a
Energy Consumed by the Steamer (Btu)	2,866	2,866	2,798
Energy to Steamer (Btu/lb of food cooked)	358.3	358.3	349.7
Cooking Energy Rate (kW)	**2.77**	**2.84**	**2.78**
Productivity (lb/h)	**26.3**	**26.9**	**26.9**
Energy Efficiency (%)	**29.7**	**29.9**	**31.5**

Cooking-Energy Efficiency Data

Table D-6. Frozen Green Pea Cooking-Energy Efficiency and Production Capacity Statistics.

	Cooking-Energy Efficiency		Production Capacity
	Heavy Load	Light Load	
Replicate #1	92.7	60.0	95.2
Replicate #2	91.1	61.7	94.4
Replicate #3	90.8	60.6	93.9
Average	**91.5**	**60.8**	**94.5**
Standard Deviation	1.01	0.87	0.65
Absolute Uncertainty	2.50	2.15	1.62
Percent Uncertainty	2.73%	3.54%	1.71%

Table D-7. Red Potato Cooking-Energy Efficiency and Production Capacity Statistics.

	Cooking-Energy Efficiency		Production Capacity
	Heavy Load	Light Load	
Replicate #1	72.1	31.5	116.8
Replicate #2	70.9	29.9	114.9
Replicate #3	70.0	29.7	116.8
Average	**71.0**	**30.4**	**116.2**
Standard Deviation	1.09	1.00	1.09
Absolute Uncertainty	2.71	2.48	2.71
Percent Uncertainty	3.82%	8.18%	2.33%