XLT Ovens, Model 3255-TS3
Quiet Fire Gas Conveyor Oven
Performance Tests

Application of ASTM Standard
Test Method F 1817-03

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Executive Summary

Figure ES-1.
XLT Triple Deck Oven.

XLT Ovens' 3255-TS3 conveyor pizza oven is a stackable unit, available in single, double, and triple deck configurations. The oven is equipped with a 55-inch long by 32-inch wide variable speed conveyor, which passes through a high-velocity impingement bake zone using a natural gas burner rated at 150,000 Btu/h per deck. A solid-state control panel allows for temperature and conveyor speed adjustments. The 3255-TS3 triple stacked conveyor pizza oven is shown in Figure ES-1.

The 3255-TS3 oven was tested at the Commercial Kitchen Ventilation Laboratory (CKV Lab) located in Wood Dale, Illinois, which operates in conjunction with Pacific Gas & Electric Company's Food Service Technology Center (FSTC) in San Ramon, CA. The objective was to examine the performance of the oven under the tightly controlled conditions of the American Society for Testing and Materials' (ASTM) standard test method, designation F 1817.[1] Oven performance is characterized by preheat time and energy consumption, idle energy consumption rate, cooking-energy efficiency, and production capacity.

Testing was performed with the top deck operating at a calibrated temperature of 475°F, while the other two decks were not in operation. Ventilation was provided by a close-coupled canopy hood, which operated at 150 cfm/linear foot of filter bank. The ventilation rate was less than the 300 cfm/linear foot specified by the test method, however, due to close coupling, the 150 cfm/linear foot provided adequate and equal ventilation.

The oven preheated to 465 °F in 7.0 minutes while consuming at total of 14,560 Btu of energy. After stabilizing at operating temperature, the idle-

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[1] American Society for Testing and Materials. 2007. *Standard Test Method for the Performance of Conveyor Ovens.* ASTM Designation F 1817-03, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

energy rate was measured at 40,400 Btu/h. The oven consumed electric energy during idle at a rate of 0.372 kW.

Cooking performance was determined by baking 12-inch cheese pizzas under heavy-load conditions. The total test time was 8.71 minutes, which included the time from the first test pizza's leading edge entering the oven cavity to the last test pizza's trailing edge entering the oven cavity. During the heavy-load tests, the single deck of the XLT 3255-TS3 oven cooked pizzas at a rate of 165 per hour. The cooking-energy rate was 76,300 Btu/h and the electric energy consumption rate was 0.347 kW.

Cooking-energy efficiency is calculated by dividing the amount of energy delivered to the food product during the cooking process by the total amount of energy consumed by the oven. The heavy-load cooking-energy efficiency for the XLT oven was 42%, based on a minimum of three test replicates. A summary of the test results is presented in Table ES-1.

Table ES-1. Summary of Appliance Performance.

Input, Preheat and Idle Rate Tests	
Rated Energy Input Rate (Btu/h)	150,000
Measured Energy Input Rate (Btu/h)	123,100
Preheat Time to 465°F (min)	7.0
Preheat Gas Energy Consumption (Btu)	14,400
Preheat Electric Energy Consumption (Btu)	160
Idle Energy Rate (Btu/h)	40,400
Idle Energy Rate (kW)	0.372
Heavy-Load 12-inch Pizza Cooking Tests	
Gas Cooking-Energy Rate (Btu/h)	76,300
Electric Cooking-Energy Rate (kW)	0.347
Heavy-Load Cooking-Energy Efficiency (%)	42 ± 2.6
Production Capacity (pizzas/h)	165 ± 5
Production Capacity (lb/h)	242.2 ± 8.3

NOTE: All results are per oven deck.

The ASTM test results can be used to estimate the annual energy consumption for the oven 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 cooking costs) and the annual operating cost, using the ASTM test data. Table ES-2 summarizes the estimated annual energy consumption and associated cost based on the model.

Table ES-2. Estimated Appliance Energy Consumption and Cost.[a]

Preheat Energy (Btu /day)	14,400
Preheat Energy (kWh/day)	0.05
Idle Energy (Btu /day)	418,700
Idle Energy (kWh/day)	0.91
Cooking Energy (Btu /day)	116,000
Cooking Energy (kWh/day)	0.53
Annual Energy (Btu /year)	200,405,000
Annual Energy (kWh/year)	1,600
Annual Cost ($/year)[a]	2,168

[a] Energy costs are per oven deck, based on $0.10/kwh and. $1.00/therm

The estimated operational cost of the XLT Ovens model 3255-TS3 conveyor pizza oven is $2,165 per year. The model assumes the oven is used to bake 250 pizzas over a 12-hour day, 365 days a year. The model also assumes one preheat each day with the remaining on-time being in an idle (ready-to-cook) state.

A quick warmup time, low gas idle energy rate of 40,400 Btu/h, and the ability to operate each oven deck as demand requires means reduced operating costs for a restaurateur. Quick cook times provide a food service operator with a conveyor pizza oven that can handle 165 pizzas/hour per deck, while its 42% cooking-energy efficiency is considered very competitive for this type of appliance.

1 Introduction

Background

Conveyor pizza ovens allow for the rapid cooking of food products with consistency and ease of operator use. Beyond the initial capital cost, conveyor pizza ovens can be evaluated with regards to long-term operational cost and performance as characterized by cooking energy efficiency, idle energy consumption and production capacity.

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.

Likewise, the Commercial Kitchen Ventilation Laboratory (CKV Lab) has been dedicated to the improvement of kitchen ventilation since the early 1980's. The test cell at the CKV Lab is a 900 square foot airtight room, equipped with similar energy metrology. In addition, two schlieren and two flow visualization systems are available to verify proper hood capture and containment performance and provide evaluation of hood and appliance modifications in real-time.

The hand-in-hand teamwork of the two facilities has provided the commercial kitchen industry with information regarding the hood and appliance systems that has been the foundation for codes, standards, ASHRAE Handbooks, and helped drive energy conservation with regards to commercial kitchens. The glossary in Appendix A is provided so that the reader has a quick reference to better understand the terminology used in this report.

Introduction

The test methods, approved and ratified by the American Society for Testing and Materials (ASTM), allow benchmarking of equipment such that users can make meaningful comparisons among available equipment choices. 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.

The XLT Ovens 3255-TS3 conveyor pizza oven features a stackable design. This design provides the end user with the option to purchase the appliance in a one, two or three deck configuration and each deck operates independently. The oven is stainless steel and operates with a solid-state control panel for temperature and conveyor speed adjustments.

Objectives

The objective of this report is to examine the operation and performance of XLT Ovens 3255-TS3 conveyor pizza oven 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 appliance from room temperature to 465°F.
3. Characterize the idle energy use with the thermostat set at a calibrated 475°F.
4. Document the cooking energy consumption and efficiency while cooking 12-inch cheese pizzas during a heavy-load scenario.
5. Determine the production capacity during the heavy-load test.

Appliance Description

XLT Ovens' 3255-TS3 conveyor pizza oven is a stackable unit and was tested in the triple deck configuration with only the top deck in operation. The energy consumption and production capacity results contained in this report may be doubled or tripled to determine the energy use and performance results with two or three decks in operation.

The oven is equipped with a 55-inch long by 32-inch wide variable speed conveyor, which passes through a high-velocity impingement bake zone using a natural gas burner rated at 150,000 Btu/h per deck and a 120 VAC electrical input rated at 6 amps per deck. The oven is of stainless steel construction and features a solid-state control panel for temperature and conveyor speed adjustments. A triple stack oven is shown in Figure 1-1, the appliance specifications are listed in Table 1-1, and the manufacturer's literature is in Appendix B.

Figure 1-1.
XLT Ovens' 3255-TS3.

Table 1-1. Appliance Specifications.

Manufacturer	XLT Ovens
Model	3255-TS3
Generic Appliance Type	Conveyor Pizza Oven
Rated Gas Input	150,000 Btu/h
Rated Electrical Input	6 amps @ 120 VAC
Cooking Area	32″ x 55″
Controls	Solid State
Construction	Stainless Steel

2 Methods

Setup and Instrumentation

The XLT Ovens 3255-TS3 was installed under a close-coupled canopy hood. The hood operated at 150 cfm/linear foot of filter bank. This ventilation rate was less than the 300 cfm/linear foot specified by the test method, however, due to close coupling, the 150 cfm/linear foot provided adequate and equal ventilation. The schlieren flow visualization systems were used to confirm proper effluent capture and containment.

Gas consumption was measured using a positive displacement gas meter. Electrical energy was measured with a watt/watt-hour transducer. Temperature measurement of the cooked pizzas was measured with evenly spaced type K thermocouples located at a radius of 3 inches from the center of the pizza. The oven cavity temperature was measured using a type K thermocouple located in the geometric center of the cavity and two inches above the conveyor. A Fluke Hydra data acquisition system was used for thermocouple measurements. To synchronize the Fluke and laboratory data acquisition systems, both were configured to scan and record the data at 5-second intervals. A photograph of the test setup is shown in Figure 2-1 and a photograph of the pizza temperature measurement is shown in Figure 2-2.

Figure 2-1.
Equipment configuration.

Figure 2-2.
Thermocouple placement for testing cooked pizza.

Measured Energy Input Rate and Preheat Tests

Rated energy input rate is the maximum or peak rate at which the appliance consumes energy as specified on the appliance'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 energized (such as preheat). For the purpose of this test, the appliance was cooled overnight to ambient room conditions. Then, the appliance was turned on and the energy input was monitored as the cooking cavity temperature climbed to 465°F.

Measured Idle Energy Input Rate

The idle energy consumption was monitored for two hours once the oven cavity, exhaust ventilation temperatures, appliance and hood skin temperatures were stabilized. This stable condition ensures a steady state for the oven during testing.

Cooking Tests

The cooking energy efficiency test was performed with 12-inch diameter cheese pizzas provided by the oven manufacturer and comparable to the pizza specification in the ASTM Standard Test Method. Each pizza weighed an average of 1.47 ± 0.1 pounds. The pizzas were stabilized in a refrigerator overnight to achieve temperature uniformity of 39°F ± 1°F.

Pizza doneness requires a final pizza temperature of 195 ± 5°F. While determining the temperature of the cooked pizzas, an insulated surface was used to avoid influencing the pizza temperature. This final pizza temperature was measured by placing six hypodermic-style thermocouple probes on the surface of the pizza, located 3 inches from the center of the pizza, and equidistant from each other. The probes were allowed to penetrate the cheese and rest in the crust-sauce interface. The highest recorded average temperature of the 6 probes was then used to determine the temperature of each pizza tested.

For purposes of testing, the oven cavity size of 32 inches by 55 inches is rounded down to the nearest foot, in this case to 2 feet by 4 feet. This dictated that 16 rows of 3 pizzas (48 total) were needed for each run of the heavy load tests, half of which were used to stabilize the oven. The pizzas were removed from the refrigerator and loaded onto the oven conveyor belt so that no more than 1 minute elapsed before the cooking process began. Each row was placed on the conveyor in a V-shaped pattern so 36 inches of pizza would fill a 32 inch conveyor. After cooking, all pizzas were measured for a final weight and temperature to use in the energy efficiency calculations.

The first half of cooking trial was designated as a stabilization load and was not counted when calculating the elapsed time and energy consumed. Energy monitoring and elapsed time of the test were determined after the second half of the cooking trial started to enter the cooking cavity. The cook test terminated when the last pizza was completely within the cooking cavity. Total elapsed time, energy consumption, initial and final weight of pizza, and initial and final temperature of pizza were recorded for the cook test.

The heavy load test was performed in triplicate to ensure that the reported cooking energy efficiency and production capacity results had an uncertainty of less than ± 10%. The results from each test run were averaged, and the absolute uncertainty was calculated based on the standard deviation of the results. The ASTM results reporting sheets appear in Appendix C.

Energy Cost Model

Conveyor oven operating cost was calculated based on a combination of test data and assumptions about typical conveyor oven usage. This provides a standard method for estimating conveyor oven energy consumption based on ASTM performance test results. The examples contained in the operating cost model are for informational purposes only, and should not be considered an absolute.

The model assumed a typical twelve-hour day, with the operation being broken down into three operating scenarios; preheat, idle and cooking. One preheat is assumed per day with the remainder being split between idle and cooking periods. During the day, 250 pizzas would be cooked. The idle time was calculated as the total time of operation minus preheat and cooking times. The total daily energy usage was calculated based on the oven’s energy consumption in each of these operating scenarios. Details of this calculation can be found in Appendix E of this report.

3 Results

Energy Input Rate

The maximum gas energy input rate was 123,100 Btu/h, which is 18.0% lower than the nameplate rate of 150,000 Btu/h, and outside the 5% dictated by the test method. Consulting the manufacturer confirmed the appliance was indeed operating properly, so testing continued without adjustment. The deviation from the test method is noted in the results reporting sheets of this report.

Thermostat Calibration

A thermostat setpoint of 465°F resulted in an average oven cavity temperature of 475 ± 2°F at the ASTM specified thermocouple location. This temperature setpoint was maintained for idle and cooking efficiency tests.

Preheat and Idle Tests

Preheat Energy and Time

During the preheat test, the appliance consumed 14,400 Btu of gas over a period of 7.0 minutes. Electric energy consumption was 160 Btu.

The measured gas-energy rate of 123,100 Btu/h indicates the appliance does not consume the 150,000 Btu/h indicated on the nameplate. Figure 3-1 shows preheat characteristics of the appliance.

Results

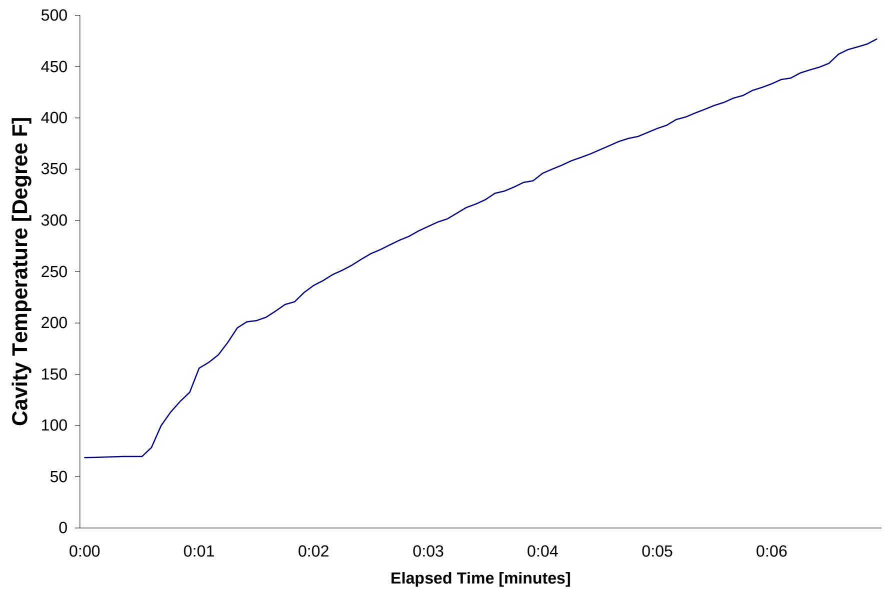

Figure 3-1.
Preheat characteristics.

Idle Energy Rate

The idle energy rate was 40,400 Btu/h for the gas burner, while the electric energy consumption rate was 0.372 kW. Input, preheat, and idle test results are summarized in Table 3-1.

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

Input Rate	
Rated Energy Input Rate (Btu/h)	150,000
Measured Energy Input Rate (Btu/h)	123,100
Percentage Difference (%)	18
Preheat Test	
Time to 465°F (min)	7.0
Gas Energy Consumption (Btu)	14,400
Electric Energy Consumption (Btu)	160
Preheat Rate (°F/min)	56.9
Idle Test	
Gas Energy Rate (Btu/h)	40,400
Electric Energy Rate (kW)	0.372

NOTE: All results are per oven deck.

Results

Cooking Tests

Using 24 test pizzas, the oven completed the heavy load test in 8.71 minutes, while delivering a 42% cooking efficiency at a production rate of 165 pizzas per hour.

Energy imparted to the pizzas was calculated by determining the amount of heat gained by each pizza (Appendix D). The oven's cooking-energy efficiency for a given loading scenario is the amount of energy imparted to the food, expressed as a percentage of the amount of energy consumed by the appliance during the cooking process.

Table 3-2 summarizes the results of the ASTM cooking-energy efficiency and production capacity tests.

Table 3-2. Cooking-Energy Efficiency and Production Capacity Test Results.

Number of Pizzas	24
ASTM Measured Cook Time (mm:ss)	5:05
Test Time (min)	8.71
Gas Cooking Energy Rate (Btu/h)	76,300
Electric Cooking Energy Rate (kW)	0.347
Energy Efficiency (%)	42 ± 2.6
Production Capacity (pizzas/h)	165 ± 5
Production Capacity (lb/h)	242.2 ± 8.3

NOTE: All results are per oven deck.

Energy Cost Model

The test results can be used to estimate the annual energy consumption for the conveyor pizza oven 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 cooking costs) and the annual operating cost, using the ASTM test data. For this model, the oven was used to cook 250 pizzas over a 12-hour day, with one preheat per day, 365 days per year. The idle (ready-to-cook) time for the appliance was determined by taking the difference between the total daily on-time (12 hours) and the equivalent full-load cooking time. This approach produces a more accurate estimate of the operating cost for the oven. Table 3-3 summarizes the estimated energy consumption and cost based on the model.

Table 3-3. Energy Cost Model.[a]

Preheat Energy (Btu /day)	14,400
Preheat Energy (kWh/day)	0.048
Idle Energy (Btu /day)	418,544
Idle Energy (kWh/day)	3.85
Cooking Energy (Btu /day)	115,976
Cooking Energy (kWh/day)	0.527
Annual Energy (Btu /year)	200,355,800
Annual Energy (kWh/year)	1,606
Annual Cost ($/year)[a]	2,165

[a] Energy costs are per oven deck, based on $0.10/kWh and $1.00/Therm.

4 Conclusions

XLT Ovens' 3255-TS3 conveyor pizza oven performed well under the rigorous conditions of the ASTM *Standard Test Method for the Performance of Conveyor Ovens* (F 1817-03). Upon start up the oven reached a ready-to-cook state of 465°F in a very rapid 7.0 minutes consuming 14,500 Btu's of total energy in the process, with 14,400 Btu's being gas energy. Once heated, studies have shown that appliances spend a good portion of the day in a ready-to-cook standby (idle) mode[2]. The 3255-TS3 exhibited a low idle energy rate of 41,700 Btu/h of total energy, of which 40,400 Btu/h was gas energy. To a restaurateur, a low idle rate means lower operating costs for the XLT conveyor pizza oven.

During heavy-load testing, the 3255-TS3 conveyor pizza oven achieved a production capacity of 165 pizzas per hour, while demonstrating a cooking-energy efficiency of 42%.

The estimated operational cost of the XLT 3255-TS3 gas conveyor oven is $2,165 per year. The model assumes the oven is used to cook 250 pizzas over a 12-hour day, 365 days a year. The model also assumes one preheat each day, with the remaining on-time being an idle (ready-to-cook) state.

The combination of good efficiency, excellent temperature control and quick cook times during operation provide a food service operator with an excellent conveyor pizza oven.

5 References

1. American Society for Testing and Materials. 2003. *Standard Test Method for the Performance of Conveyor Ovens.* ASTM Designation F 1817-03, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

2. Pieretti, G., Blessent, J., Kaufman, D., Nickel, J., Fisher, D., 1990. *Cooking Appliance Performance Report - Pacific Gas and Electric Company Production-Test Kitchen*. Pacific Gas and Electric Company Department of Research and Development Report 008.1-90.8, May.

A Glossary

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-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.

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.

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.

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

Glossary

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 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 cook zone heats during a preheat.

Preheat Time (minute)
Preheat Period

The time required for an appliance to warm 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.

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.

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.

B Appliance Specifications

Appendix B includes the product literature for the XLT Ovens 3255-TS3 conveyor pizza oven.

Table B-1. Appliance Specifications.

Manufacturer	XLT Ovens
Model	3255-TS3
Generic Appliance Type	Conveyor Pizza Oven
Rated Gas Input	150,000 Btu/h
Rated Electrical Input	6 amps @ 120 VAC
Cooking Area	32″ x 55″
Controls	Solid State
Construction	Stainless Steel

XLT 3255-TS3 Quiet Fire
Natural Gas or
Liquid Propane

quiet FIRE™

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www.xltovens.com

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Simple. Smart.

Easy, Efficient, and Even Cooking

XLT 3255-TS3 Quiet Fire

Gas Conveyor Oven

Are you looking for an affordable solution for your cooking needs?

In our continuing pursuit of excellence in **XLT** ovens, we now produce our own, Quiet Fire™ burner. It utilizes state-of-the-art design and components to provide the ultimate in combustion, with a perfect balance between gas and combustion air. The resulting flame is pure and efficient, with lower CO2 emissions and up to 35% in fuel savings. And with our Simple Smart design, the unit needs no forced air fan, thus providing much quieter operation, while heat transfer and bake speed are improved.

XLT AVI Hood
Available in all oven sizes

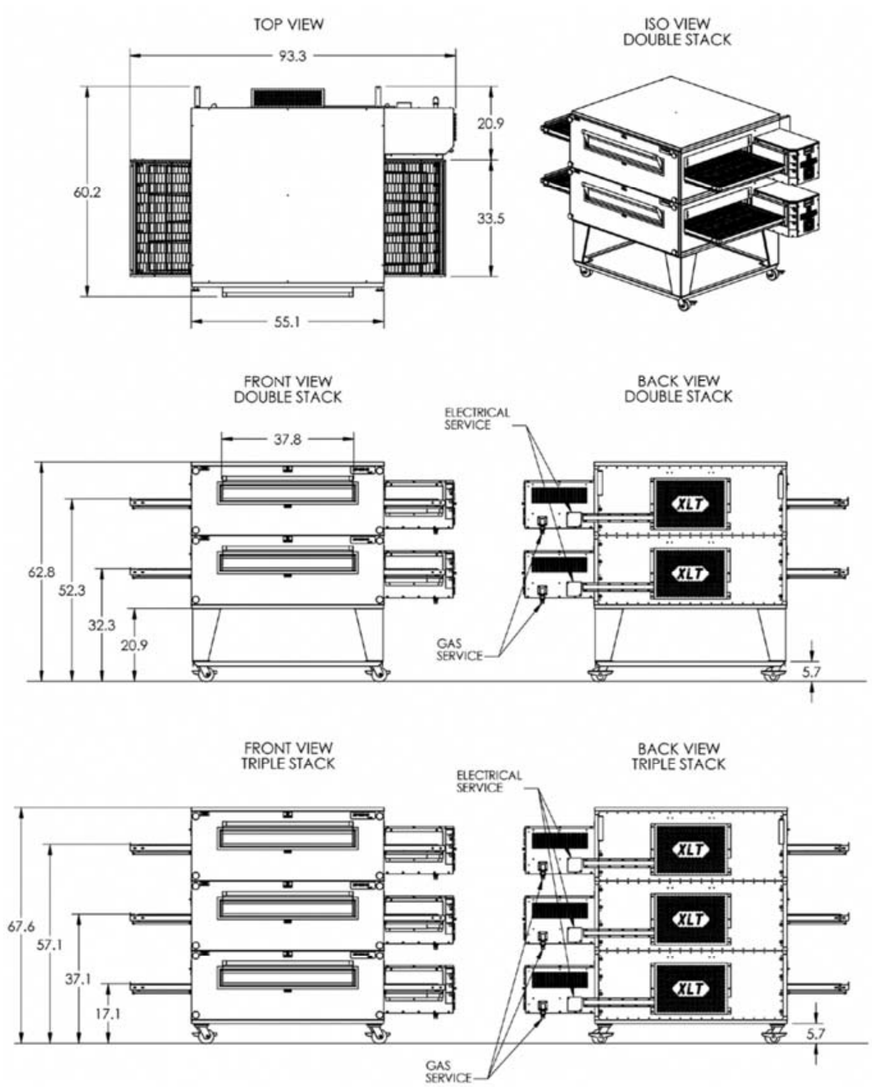
FEATURES

- The **XLT-3870-TS3 Quiet Fire** is available in three configurations, the single, the double, and the triple stack models.
- The optional front sandwich door is provided to load or unload product for different cook times.
- Both exterior AND INTERIOR exposed surfaces are made of easy cleaning stainless steel.
- **XLT™** ovens are manufactured with pride in the USA under stringent quality standards.
- Replacement parts are readily available through the **XLT** Fast Parts Program at a fraction of the cost of our competitors.
- The large removable front panel allows for easy access to oven interior, making cleaning much easier than our competitors' ovens of the same size.
- All **XLT™** ovens are 100% factory tested with a minimum 4-hour burn-in time.
- The conveyors can be set up to move either right-to-left or left-to-right.

XLT™ ovens are an improved combustion flue-less design and are more efficient than comparable ovens.

All ducts, crumb trays, and the conveyor are readily removable for easy cleaning. An overhead ventilation hood is required. All **XLT** ovens available with custom fitted AVI hood systems for the most efficient and comfortable ventilation package in the industry. 120 Volt electrical power does not require an expensive electrician to install, simply plug into an available outlet. The gas connections require a licensed plumber. All fuses are EXTERNALLY panel-mounted allowing easy troubleshooting. A two-year warranty is standard.

LAYOUT AND DIMENSIONS



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XLT OVENS®
Simple. Smart.

SPECIFICATIONS

XLT 3255-TS3 Quiet Fire

Electrical Requirements:

	Voltage (AC)	Phase	HZ	Amps
One Oven	120	1	60	6.0
Double Stack	120	1	60	12.0
Triple Stack	120	1	60	18.0

Natural Gas Requirements:

	Burner Capacity BTU/hr (Max)	Gas Supply Pressure Inches, Water Column	Gas Pipe Size (NPT)
One Oven	150,000	8-14	1″
Double Stack	300,000	8-14	1-1/4″
Triple Stack	450,000	8-14	1-1/2″

Or Optional Propane Gas Requirements:

	Burner Capacity BTU/hr (Max)	Gas Supply Pressure Inches, Water Column	Gas Pipe Size (NPT)
One Oven	150,000	11.5-14	3/4″
Double Stack	300,000	11.5-14	1″
Triple Stack	450,000	11.5-14	1-1/4″

*Adjustments can be made for other bake time ranges. Specifications and dimensions are subject to change without notice. Local codes and regulations may also apply

* Adjustments can be made for other bake time ranges. Specifications and dimensions are subject to change without notice. Local codes and regulations may also apply.

Options:

- 3255 model ovens and smaller control panels can be mounted on the left side
- Stainless steel sandwich door handle
- 4″ conveyor opening height
- Stainless steel handle
- Solid fronts
- Product shelves
- Product slides
- Split belts
- Perforated crumb trays

- All **XLT** ovens available with custom fitted AVI hood systems for the most efficient and comfortable ventilation package in the industry.

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C Results Reporting Sheets

Manufacturer: XLT Ovens

Model: 3255-TS3

Test Conveyor Oven.

Description of operational characteristics: The XLT Ovens 3255-TS3 is a gas-fired conveyor pizza oven with a rated gas input of 150,000 Btu/h. The oven uses impingement baking technology to transfer heat into food. The oven has a cooking cavity area of 32 inches by 55 inches, and is operated with solid-state controls.

Apparatus.

_____ Check if testing apparatus conformed to specifications in section 6.

Deviations:
The natural gas input was 18% lower than nameplate.
Final cooked pizza temperature averaged 0.7°F below the specified 195 ± 5°F range.

Energy Input Rate.

Name Plate Natural Gas Input Rate (Btu/h)	150,000
Measured Natural Gas Input Rate (Btu/h)	123,000
Percent Difference between Measured and Rated (%)	18%

Results Reporting Sheets

Preheat Energy and Time.

Starting Temperature (°F)	68.6
Ending Temperature (°F)	465.0
Gas Energy Consumption (Btu)	14,400
Electric Energy Consumption (Btu)	160
Duration (min)	7.0
Preheat Rate (°F/min)	56.9

Idle Energy Rate.

Gas Idle Energy Rate (Btu/h)	40,400
Idle Energy Rate (kW)	0.372

Heavy-Load Cooking-Energy Efficiency and Cooking Energy Rate.

Quantity of Pizzas for Test	24
Pizza Cook Time (mm:ss)	5:05
Production Capacity (pizzas/h) [a]	165 ± 5
Production Capacity (lb/h) [a]	242.2 ± 8.3
Energy to Food (Btu/lb)	133
Gas Cooking Energy Rate (Btu/h)	76,300
Electric Cooking Energy Rate (kW)	0.347
Total Energy per Pound of Food Cooked (Btu/lb)	320
Cooking-Energy Efficiency (%)[a]	42 ± 2.6

[a] This range indicates the experimental uncertainty in the test result based on a minimum of three test runs.

D Cooking Energy Efficiency Data

Table D-1. Specific Heat and Latent Heat.

Specific Heat of Cheese Pizza (Btu/lb, °F)	0.593
Latent Heat of Vaporization, Water (Btu/lb)	982

Table D-2. Heavy-Load Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Gas Energy Consumption (Btu)	10,532	11,512	11,181
Electrical Energy Consumption (Wh)	48	52	51
Electric Energy Consumed by Appliance (Btu)	164	178	174
Total Appliance Energy (Btu)	10,696	11,689	11,355
Number of Pizzas	24	24	24
Conveyor speed (min)	4.17	4.17	4.17
Cook Time (min)	5.05	5.05	5.05
Total Test Time (min)	8.78	8.78	8.55
Initial Weight (lb)	35.2	35.0	35.2
Final Weight (lb)	33.7	33.4	33.6
Initial Temperature (°F)	39.4	41.0	41.0
Final Temperature (°F)	187.2	191.7	189.0
Calculated Values			
Total Energy to Food (Btu)	4,600	4,738	4,689
Energy to Food (Btu/lb)	131	135	133
Total Energy to Appliance (Btu)	10,696	11,689	11,355
Energy to Appliance per Pound of Food Cooked (Btu/lb)	304	334	323
Cooking-Energy Efficiency (%)	43.0	40.5	41.3
Total Cooking Energy Rate (Btu/h)	73,066	79,849	79,684
Electric Energy Rate During Cooking (W)	328	356	358
Production Rate (Pizzas/h)	164	164	168
Production Rate (lb/h)	240.5	239.3	246.9

Table D-3. Cooking-Energy Efficiency and Production Capacity Statistics.

	Heavy-Load Cooking Energy Efficiency (%) [a]	Production Capacity (pizzas/h) [a]	Production Capacity (lbs/h) [a]
Repetition #1	43.0	164	240.5
Repetition #2	40.5	164	239.3
Repetition #3	41.3	168	246.9
Average	42	165	242.2
Standard Deviation	1.03	2.11	3.33
Absolute Uncertainty	2.6	5.2	8.3
Percent Uncertainty	6.2	3.2	3.4

[a] This range indicates the experimental uncertainty in the test result based on a minimum of three test runs.

E Energy Cost Model

Procedure for Calculating the Energy Consumption of a Conveyor Oven Based on Reported Test Results

Appliance test results are useful not only for benchmarking appliance performance, but also for estimating appliance energy consumption. The following procedure is a guideline for estimating conveyor oven energy consumption based on data obtained from applying the appropriate test method.

The intent of this Appendix is to present a standard method for estimating conveyor oven energy consumption based on ASTM performance test results. The examples contained herein are for information only and should not be considered an absolute. To obtain an accurate estimate of energy consumption for a particular operation, parameters specific to that operation should be used (e.g., operating time, and amount of food cooked).

The calculation will proceed as follows: First, determine the appliance operating time and total number of preheats. Then estimate the quantity of food cooked for heavy- load cooking of 250 pizzas. Calculate the energy due to cooking at the heavy-load cooking rate, and then calculate the idle energy consumption. The total daily energy is the sum of these components plus the preheat energy.

The application of the test method to a gas conveyor oven yielded the following results:

Table E-1: Conveyor Oven Performance Parameters.

Test	Result
Preheat Time (min)	7.0
Preheat Energy - Gas (Btu)	14,400
Preheat Energy - Electric (kWh)	0.048
Idle Energy Rate - Gas (Btu/h)	40,400
Idle Energy Rate - Electric (kW)	0.372
Heavy-Load Cooking Energy Rate - Gas (Btu/h)	76,300
Heavy-Load Cooking Energy Rate - Electric (kW)	0.347

***Step 1*—The operation being modeled has the following parameters.**

Table E-2: Conveyor Oven Operation Assumptions.

Operating Time (h)	12
Number of Preheats	1
Number of Pizzas Cooked Under Heavy-Load Conditions	250

***Step 2*—Calculate the total heavy-load energy.**

The total time cooking heavy-loads is as follows:

$$t_h = \frac{\%_h \times W}{PC},$$

$$t_h = \frac{100\% \times 250 \text{ pizzas}}{165 \text{ pizzas/h}},$$

$$t_h = 1.52 \ h$$

The total heavy-load energy consumption is then calculated as follows:

$E_{gas,h} = q_{gas,h} \times t_h$,

$E_{gas,h} = 76{,}300\ Btu/h \times 1.52\ h$,

$E_{gas,h} = 115{,}976\ Btu$

$E_{elec,h} = q_{elec,h} \times t_h$,

$E_{elec,h} = 0.347\ kW \times 1.52\ h$,

$E_{elec,h} = 0.527\ kWh$

***Step 3*—Calculate the total idle time and energy consumption.**

The total idle time is determined as follows:

$$t_i = t_{on} - t_h - \frac{\mathrm{np} \times \mathrm{tp}}{60},$$

$$t_i = 12.0\ \mathrm{h} - 1.52\ \mathrm{h} - \frac{1\ \mathrm{preheat} \times 7.0\ \mathrm{min}}{60\ \mathrm{min/h}}$$

$t_i = 10.36\ h$

The idle energy consumption is then calculated as follows:

$E_{gas,i} = q_{gas,i} \times t_i$,

$E_{gas,i} = 40{,}400\ Btu/h \times 10.36\ h$

$E_{gas,i} = 418{,}544\ Btu$

$E_{elec,i} = q_{elec,i} \times t_i$,

$E_{elec,i} = 0.38\ kW \times 10.36\ h$

$E_{elec,i} = 3.85\ kWh$

***Step 4*—The total daily energy consumption is calculated as follows:**

$E_{gas,daily} = E_{gas,h} + E_{gas,i} + n_p \times E_{gas,p}$,

$E_{gas,daily} = 115{,}976\ Btu + 418{,}544\ Btu + 1 \times 14{,}400\ Btu$

$E_{gas,daily} = 548{,}920\ Btu/day$

$$E_{elec,daily} = E_{elec,h} + E_{elec,i} + n_p \times E_{elec,p},$$

$$E_{elec,daily} = 0.527\ kWh + 3.85\ kWh + 1 \times 0.048\ kWh$$

$$E_{elec,daily} = 4.4\ kWh/day$$

***Step 5*—Calculate the average demand as follows:**

$$q_{avg} = \frac{E_{elec,\ daily}}{t_{on}},$$

$$q_{avg} = \frac{4.4\ \text{kWh}}{12.0\ \text{h}},$$

$$q_{avg} = 0.37\ kW$$

***Step 6*—The annual energy cost is calculated as follows:**

$$Cost_{annual,gas} = E_{gas,daily} \times R_{gas} \times Days$$

$$Cost_{snnual,gas} = 548{,}920\ Btu/day \times 1.00\ \$/Therm \times 1\ Therm/100{,}000\ Btu \times 365\ days/year$$

$$Cost_{annual,gas} = 2{,}004\ \$/year$$

$$Cost_{annual,elec} = E_{elec,daily} \times R_{elec} \times Days$$

$$Cost_{snnual,elec} = 4.4\ kWh/day \times 0.10\ \$/kWh \times 365\ days/year$$

$$Cost_{annual,elec} = 161\ \$/year$$

$$Cost_{annual,total} = 2{,}165\ \$/year$$