



Standard Test Method for Performance of Conveyor Toasters¹

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1. Scope

1.1 This test method evaluates the energy consumption and cooking performance of conveyor toasters including radiant and contact toasters. The food service operator can use this evaluation to select a conveyor toaster and understand its energy consumption.

1.2 This test method is applicable to gas and electric conveyor toasters.

1.3 The conveyor toaster can be evaluated with respect to the following (where applicable):

1.3.1 Energy input rate and preheat temperature profile (10.2),

1.3.2 Preheat energy consumption and time (10.3),

1.3.3 Idle energy rate (10.4),

1.3.4 Pilot energy rate (if applicable, 10.5),

1.3.5 Cooking energy rate (10.8), and

1.3.6 Production capacity (10.8).

1.4 The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are for information only.

1.5 *This test method may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This test method is under the jurisdiction of ASTM Committee F26 on Food Service Equipment and is the direct responsibility of Subcommittee F26.06 on Productivity and Energy Protocol.

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2. Referenced Documents

2.1 *ASTM Standards*:²

D3588 Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels

2.2 *ASHRAE Document*:

ASHRAE Guideline 2 (RA90) Engineering Analysis of Experimental Data³

2.3 *UL Document*:

UL 1026 Electric Household Cooking and Food Service Appliances⁴

3. Terminology

3.1 *Definitions*:

3.1.1 *contact toaster, n*—toaster that cooks product primarily by conduction via contact with a heated surface.

3.1.2 *conveyor toaster, n*—an appliance for caramelizing bread products that carries the bread product on a belt or chain into and through a heated chamber. The chamber may be heated by gas or electric forced convection, radiants, or quartz tubes. Top and bottom heat may be independently controlled.

3.1.3 *cooking energy rate, n*—average rate of energy consumption (Btu/h or kW) during the production capacity tests.

3.1.4 *energy input rate, n*—peak rate at which a conveyor toaster consumes energy (Btu/h or kW).

3.1.5 *idle energy rate, n*—the conveyor toaster's rate of energy consumption (kW or Btu/h), when empty, required to maintain its cavity temperature at the predetermined temperature set point.

3.1.6 *pilot energy rate, n*—rate of energy consumption (Btu/h) by a conveyor toaster's continuous pilot (if applicable).

3.1.7 *preheat energy, n*—amount of energy consumed (Btu or kWh), by the conveyor toaster while preheating its cavity from ambient temperature to the determined steady state temperature.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

⁴ Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

3.1.8 *preheat time*, *n*—time (min) required for the conveyor toaster cavity to preheat from ambient temperature to the specified set point.

3.1.9 *production capacity*, *n*—maximum rate (slices/h) at which a conveyor toaster can bring the specified bread product to a specified “toasted” condition.

3.1.10 *production rate*, *n*—rate (slices/h) at which a conveyor toaster brings the specified food product to a specified “toasted” condition. This does not necessarily refer to maximum rate. Production rate varies with the amount of food being toasted.

3.1.11 *radiant toaster*, *n*—toaster that cooks product primarily by radiation.

3.1.12 *toaster cavity*, *n*—that portion of the conveyor toaster in which bread products are heated or toasted.

3.1.13 *uncertainty*, *n*—measure of systematic and precision errors in specified instrumentation or measure of repeatability of a reported test result.

4. Summary of Test Method

4.1 Energy input rate is determined to confirm that the conveyor toaster is operating within 5 % of the nameplate energy input rate. For gas conveyor toaster, the pilot energy rate and the fan and control energy rates are also determined.

4.2 Preheat energy and time are determined.

4.3 Idle energy rate is determined.

4.4 Production rate is determined using sliced bread as a food product.

5. Significance and Use

5.1 The energy input rate test is used to confirm that the conveyor toaster is operating properly prior to further testing.

5.2 Preheat energy and time can be useful to food service operators to manage power demands and to know how quickly the conveyor toaster can be ready for operation.

5.3 Idle energy rate and pilot energy rate can be used to estimate energy consumption during non-cooking periods. In addition, a power saving mode (if applicable) will demonstrate energy savings during idle periods.

5.4 Production capacity information can help an end user to better understand the production capabilities of a conveyor toaster as it is used to cook a typical food product and this could help in specifying the proper size and quantity of equipment. If production information is desired using a food product other than the specified test food, the test method could be adapted and applied.

6. Apparatus

6.1 *Analytical Balance Scale*, for measuring weights up to 20 lb, with a resolution of 0.01 lb and an uncertainty of 0.01 lb.

6.2 *Barometer*, for measuring absolute atmospheric pressure, to be used for adjustment of measured natural gas volume to standard conditions. It shall have a resolution of 0.2 in. Hg and an uncertainty of 0.2 in. Hg.

6.3 *Gas Meter*, for measuring the gas consumption of a conveyor toaster, shall be a positive displacement type with a resolution of at least 0.1 ft³ and a maximum uncertainty no greater than 1 % of the measured value for any demand greater than 2.2 ft³/h. If the meter is used for measuring the gas consumed by the pilot lights, it shall have a resolution of at least 0.1 ft³ and a maximum uncertainty no greater than 2 % of the measured value.

6.4 *Pressure Gage*, for monitoring natural gas pressure. It shall have a range of zero to 10 in. water, a resolution of 0.5 in. water, and a maximum uncertainty of 3 % of the measured value.

6.5 *Stop Watch*, with a 1-s resolution.

6.6 *Temperature Sensor*, for measuring natural gas temperature in the range of 50 to 100°F with an uncertainty of $\pm 1^\circ\text{F}$.

6.7 *Thermocouple*, high temperature glass insulated, 24 gage, type K thermocouple wire, connected at the exposed ends by tightly twisting or soldering the two wires together.

6.8 *Watt-Hour Meter*, for measuring the electrical energy consumption of a conveyor toaster, shall have a resolution of at least 10 Wh and a maximum uncertainty no greater than 1.5 % of the measured value for any demand greater than 100 W. For any demand less than 100 W, the meter shall have a resolution of at least 10 Wh and a maximum uncertainty no greater than 10 %.

7. Reagents and Materials

7.1 *Bread for Toasting* shall be a generic grocery store brand, 1.5 ± 0.1 lb white loaf with a crown, consisting of 20 slices (not including the ends) measuring approximately 4.5 by 4.5 by 0.5 in. per slice. Each slice must weigh 0.065 ± 0.01 lb. The bread shall be stored at room temperature $75 \pm 5^\circ\text{F}$.

7.2 *Buns for Toasting* shall be 5 in. in diameter consisting of a crown and a heel without sesame seeds and weigh 0.125 ± 0.02 lb for both crown and heel. Toasters that have the capability for toasting clubs (center piece of the bun) shall be toasted with a three-piece bun consisting of a crown, club and a heel and weigh 0.16 ± 0.02 lb for all three pieces. The buns shall be stored at room temperature $75 \pm 5^\circ\text{F}$.

NOTE 1—The bread is not to have any type of topping such as a butter top, flour top, or any seed/nut topping. Sandwich type bread is not to be used because it does not have a crown. In addition, loaves of bread that only have 19 slices (not including the heels) typically have too high of individual slice weight. The 1.5 lb of generic store brand white bread that has 20 slices (not including the heels) more often than not consists of individual slices that weigh approximately 0.065 lb which is specified for this test method.

8. Sampling and Test Units

8.1 *Conveyor Toaster*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Install the appliance according to the manufacturer’s instructions. The associated heating or cooling system shall be capable of maintaining an ambient temperature of $75 \pm 5^\circ\text{F}$ ($24 \pm 3^\circ\text{C}$) within the testing environment when the exhaust ventilation system is operating.