



Standard Test Method for Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems¹

This standard is issued under the fixed designation F1704; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 Characterization of capture and containment performance of hood, appliance(s), and replacement air system during cooking and non-cooking conditions (idle):

1.2 Parametric evaluation of operational or design variations in appliances, hoods, or replacement air configurations.

1.3 The test method to determine heat gain to space from commercial kitchen ventilation/appliance systems has been re-designated as Test Method F2474.

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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.*

2. Referenced Documents

2.1 ASTM Standards:²

- F1275 Test Method for Performance of Griddles
- F1361 Test Method for Performance of Open Vat Fryers
- F1484 Test Methods for Performance of Steam Cookers
- F1496 Test Method for Performance of Convection Ovens
- F1521 Test Methods for Performance of Range Tops

F1605 Test Method for Performance of Double-Sided Griddles

F1639 Test Method for Performance of Combination Ovens (Withdrawn 2012)³

F1695 Test Method for Performance of Underfired Broilers

F1784 Test Method for Performance of a Pasta Cooker

F1785 Test Method for Performance of Steam Kettles

F1787 Test Method for Performance of Rotisserie Ovens

F1817 Test Method for Performance of Conveyor Ovens

F1964 Test Method for Performance of Pressure Fryers

F1965 Test Method for Performance of Deck Ovens

F1991 Test Method for Performance of Chinese (Wok) Ranges

F2093 Test Method for Performance of Rack Ovens

F2144 Test Method for Performance of Large Open Vat Fryers

F2237 Test Method for Performance of Upright Overfired Broilers

F2239 Test Method for Performance of Conveyor Broilers

F2474 Test Method for Heat Gain to Space Performance of Commercial Kitchen Ventilation/Appliance Systems

2.2 ASHRAE Standards:⁴

ASHRAE Guideline 2-1986 (RA90) Engineering Analysis of Experimental Data

2.3 ANSI Standard:⁵

ANSI/ASHRAE 41.2 Standard Methods for Laboratory Air-Flow Measurement

ANSI/ASHRAE 51 and ANSI/AMCA 210 Laboratory Method of Testing Fans for Rating

NOTE 1—The replacement air and exhaust system terms and their definitions are consistent with terminology used by the American Society of Heating, Refrigeration, and Air Conditioning Engineers, see Ref (1).⁶ Where there are references to cooking appliances, an attempt has been made to be consistent with terminology used in the test methods for

¹ This test method are under the jurisdiction of ASTM Committee F26 on Food Service Equipment and are the direct responsibility of Subcommittee F26.07 on Commercial Kitchen Ventilation.

Current edition approved May 1, 2022. Published June 2022. Originally approved in 1996. Last previous edition approved in 2017 as F1704 – 12 (2017). DOI: 10.1520/F1704-12R22.

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 The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁶ The boldface numbers in parentheses refer to the list of references at the end of these test methods.

commercial cooking appliances. For each energy rate defined as follows, there is a corresponding energy consumption that is equal to the average energy rate multiplied by elapsed time. Electric energy and rates are expressed in W, kW, and kWh. Gas Energy consumption quantities and rates are expressed in Btu, kBtu, and kBtu/h. Energy rates for natural gas-fueled appliances are based on the higher heating value of natural gas.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *aspect ratio, n*—ratio of length to width of an opening or grill.

3.1.2 *energy rate, n*—average rate at which an appliance consumes energy during a specified condition (for example, idle or cooking).

3.1.3 *cooking energy consumption rate, n*—average rate of energy consumed by the appliance(s) during cooking specified in appliance test methods in 2.1.

3.1.3.1 *Discussion*—In this test method, this rate is measured for heavy-load cooking in accordance with the applicable test method.

3.1.4 *exhaust flow rate, n*—volumetric flow of air (plus other gases and particulates) through the exhaust hood, measured in standard cubic feet per minute, scfm (standard litre per second, sL/s). This also shall be expressed as scfm per linear foot (sL/s per linear metre) of exhaust hood length.

3.1.5 *fan and control energy rate, n*—average rate of energy consumed by fans, controls, or other accessories associated with cooking appliance(s). This energy rate is measured during preheat, idle, and cooking tests.

3.1.6 *hood capture and containment, n*—ability of the hood to capture and contain grease-laden cooking vapors, convective heat, and other products of cooking processes. Hood capture refers to the products getting into the hood reservoir from the area under the hood while containment refers to the products staying in the hood reservoir.

3.1.7 *idle energy consumption rate, n*—average rate at which an appliance consumes energy while it is idling, holding, or ready-to-cook, at a temperature specified in the applicable test method from 2.1.

3.1.8 *measured energy input rate, n*—maximum or peak rate at which an appliance consumes energy measured during appliance preheat, that is, measured during the period of operation when all gas burners or electric heating elements are set to the highest setting.

3.1.9 *rated energy input rate, n*—maximum or peak rate at which an appliance consumes energy as rated by the manufacturer and specified on the appliance nameplate.

3.1.10 *replacement air, n*—air deliberately supplied into the space (test room), and to the exhaust hood to compensate for the air, vapor, and contaminants being expelled (typically referred to as make-up air); can be dedicated make-up air directed locally in the vicinity of the hood, transfer air, or a combination.

3.1.11 *replacement air configurations, n*—see below.

3.1.11.1 *ceiling diffuser, n*—outlet discharging supply air parallel to the ceiling either radially or in specific directions (for example, two-way, three-way, or four-way).

3.1.11.2 *displacement diffuser, n*—outlet supplying low velocity air at or near floor level.

3.1.11.3 *grille, n*—frame enclosing a set of either vertical or horizontal vanes (single deflection grill) or both (double deflection grill).

3.1.12 *integrated hood plenums, n*—see below.

3.1.12.1 *air curtain supply, n*—replacement air delivered directly to the interior plenum of an exhaust hood such that it is introduced vertically downward, typically from the front edge of the hood.

3.1.12.2 *backwall supply, n*—replacement air delivered behind and below the cooking appliance line, typically through a ducted wall plenum. Sometimes a referred to as rear supply.

3.1.12.3 *front face supply, n*—replacement air delivered directly to an interior plenum of the exhaust hood such that it is introduced into the kitchen space through the front face of the hood.

3.1.12.4 *internal supply, n*—replacement air delivered directly to the interior of an exhaust hood such that it is exhausted without entering the occupied space. Sometimes referred to as short-circuit supply.

3.1.12.5 *perforated perimeter supply, n*—replacement air delivered through perforated supply plenums located at or slightly below ceiling level and directed downward.

3.1.12.6 *perforated diffuser, n*—face of this ceiling diffuser typically has a free area of about 50 %. It can discharge downward or are available with deflection devices to provide for a horizontal discharge.

3.1.12.7 *register, n*—grilled equipped with a damper.

3.1.12.8 *transfer air, n*—air transferred from one room to another through openings in the room envelope.

3.1.12.9 *slot diffuser, n*—long narrow supply air grill or diffuser outlet with an aspect ratio generally greater than 10 to 1.

3.1.13 *supply flow rate, n*—volumetric flow of air supplied to the exhaust hood in an airtight room, measured in standard cubic feet per minute, scfm (standard litre per second, sL/s). This also shall be expressed as scfm per linear foot (sL/s per linear metre) of active exhaust hood length. It consists of the make-up air supplied locally to the exhaust hood (that is, through plenums, diffusers, and so forth) and general replacement air supplied through transfer or displacement diffusers.

3.1.14 *threshold of capture and containment, n*—conditions of hood operation in which minimum flow rates are just sufficient to capture and contain the products generated by the appliance(s). In this context, two minimum capture and containment points can be determined, one for appliance idle condition, and the other for heavy-load cooking condition.

3.1.15 *throw, n*—horizontal or vertical axial distance an air stream travels after leaving an air outlet before maximum stream velocity is reduced to a specified terminal velocity, for example, 100, 150, or 200 ft/min (0.51, 0.76, or 1.02 m/s).

3.1.16 *uncertainty, n*—measure of the precision errors in specified instrumentation or the measure of the repeatability of a reported result.