Designation: F1704 – 12 (Reapproved 2017)

An American National Standard

Standard Test Method for Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems[1]

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 and health 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 Deep Fat 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F1639 Test Method for Performance of Combination Ovens (Withdrawn 2012)[3]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

[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.

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[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.

made to be consistent with terminology used in the test methods for 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.

3.1.17 *ventilation, n*—that portion of supply air that is outdoor air plus any recirculated air that has been treated for the purpose of maintaining acceptable indoor air quality.

4. Summary of Test Method

4.1 This test method uses flow visualization to determine the threshold of capture and containment (C&C) of a hood/appliance combination under cooking and idle conditions.

5. Significance and Use

5.1 *Threshold of Capture and Containment*—This test method describes flow visualization techniques that are used to determine the threshold of capture and containment (C&C) for idle and specified heavy cooking conditions. The threshold of C&C can be used to estimate minimum flow rates for hood/appliance systems.

5.2 *Parametric Studies*—This test method also can be used to conduct parametric studies of alternative configurations of hoods, appliances, and replacement air systems. In general, these studies are conducted by holding constant all configuration and operational variables except the variable of interest. This test method, therefore, can be used to evaluate the following:

5.2.1 The overall system performance with various appliances, while holding the hood and replacement air system characteristics constant.

5.2.2 Entire hoods or characteristics of a single hood, such as end panels, can be varied with appliances and replacement air constant.

5.2.3 Replacement air characteristics, such as make-up air location, direction, and volume, can be varied with constant appliance and hood variables.

6. Apparatus

6.1 The general configuration and apparatus necessary to perform this test method include either an airtight or a non-airtight as shown schematically in Fig. 1 and Fig. 2. The minimum volume of the room shall be 6000 ft^3. The method of airflow measurement differs between the types of room used. The exhaust hood under test is hung and connected to an exhaust duct and fan. The terminal devices of the make-up air configuration, if applicable, are ducted and connected to a make-up air fan. The test facility includes the following:

6.2 *Airtight Room,* with sealable access door(s), to contain the exhaust hood and make-up air configuration to be tested, with specified cooking appliance(s) to be placed under the hood. The room air leakage shall not exceed 20 scfm (9.4 sL/s) at 0.2 in. w.c. (49.8 Pa). Complementary replacement air fans are controlled to balance the exhaust rate, thereby maintaining a negligible static pressure difference between the inside and outside of the test room. Such a facility is described in detail in Ref (**2**). Examples of test facilities are described in Refs (**3**, **4**, **5**).

NOTE 2—Because of potential problems with measurement in the hot, possibly grease-laden exhaust air stream, exhaust air flow rate can be determined by measuring the replacement air flow rate on the supply side. This requires the design of an airtight test facility that ensures the supply rate equals the exhaust rate since air leakage outside the system boundary,

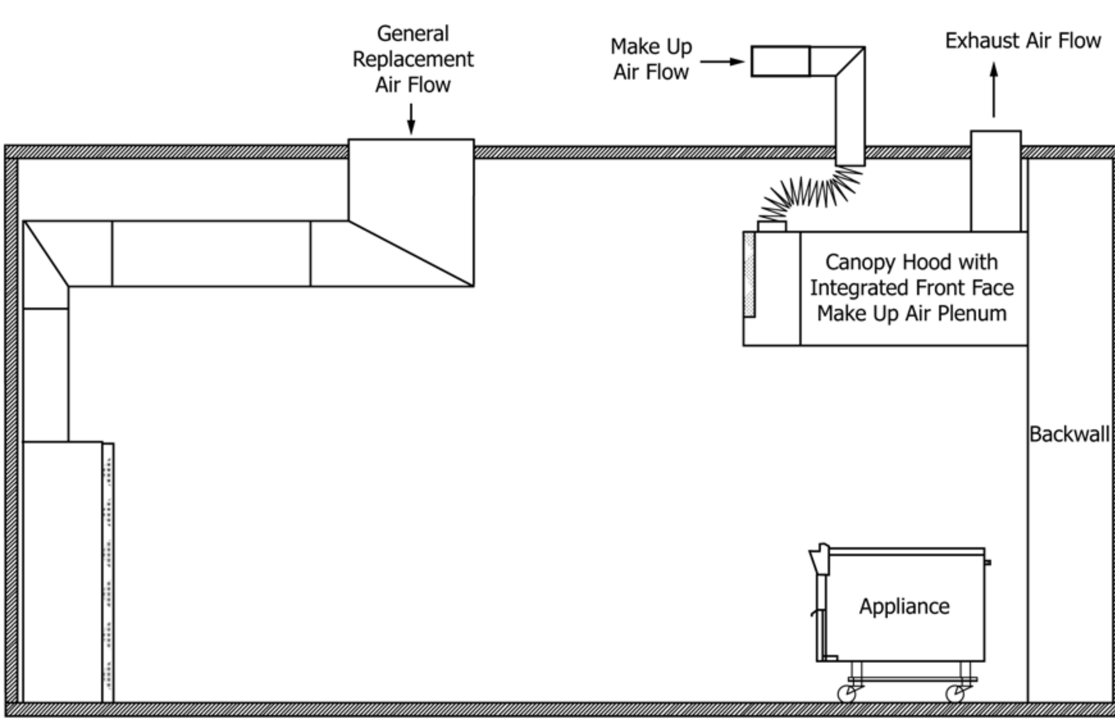

FIG. 1 Airtight Test Space Cross Section

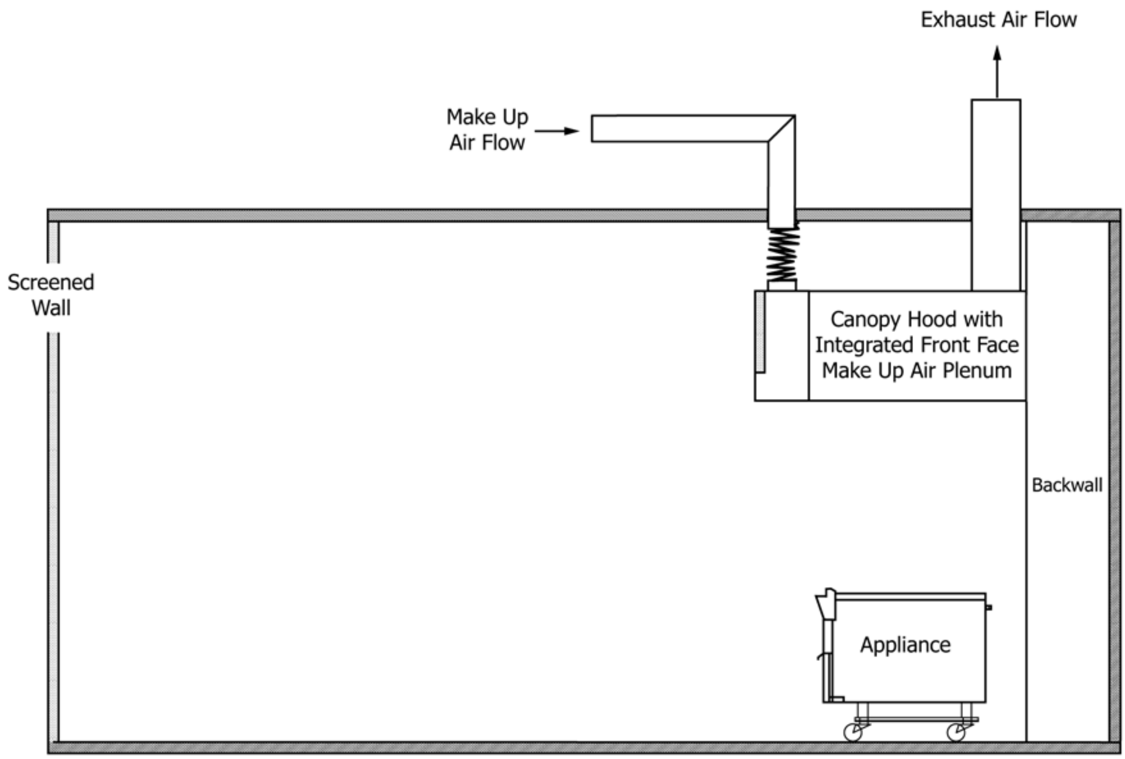

FIG. 2 Non-Airtight Test Space Cross Section

that is, all components between supply and exhaust blowers making up the system, is negligible.

6.2.1 *Exhaust and Replacement Air Fans,* with variable-speed drives, to allow for operation over a wide range of exhaust air flow rates.

6.2.2 *Control System and Sensors,* to provide for automatic or manual adjustment of replacement air flow rate, relative to exhaust flow rate, to yield a differential static pressure between inside and outside of the airtight room not to exceed 0.05 in. w.c. (12.5 Pa).

6.2.3 *Air Flow Measurement System,* AMCA 210 or equivalent nozzle chamber, mounted in the general replacement or make-up airstream, or both, to measure airflow rate.

NOTE 3—Laminar flow elements have been used as an equivalent alternative to the flow nozzles in AMCA 210 (see 2.3).

6.3 *Non-Airtight Room,* to contain the exhaust hood and make-up air configuration to be tested, with specified cooking appliance(s) to be placed under the hood. The room is configured such that it allows replacement air to approach the entire front face of the exhaust hood slowly, as through a screened wall.

6.3.1 *Exhaust Fan,* with variable speed drive, to allow for operation over a wide range of exhaust airflow rates.

6.3.2 *Control System and Sensors,* to provide for automatic or manual adjustment of exhaust airflow rate.

6.3.3 *Air Flow Management System*—A Pitot tube traverse, nozzle chamber or equivalent in accordance with AMCA 210, mounted in the exhaust and make-up airstreams, to measure airflow rates.

NOTE 4—Laminar flow elements have been used as an equivalent alternative to the flow nozzles in AMCA 210 (see 2.3).

6.4 *Aspirated Temperature Tree(s),* for measurement of average temperature of replacement air from the test space crossing the plane of the tree(s) into the hood, see Fig. 3.

6.5 *Flow Enhancement Visualization Systems:*

6.5.1 *Optical Systems,* such as schlieren visualization (see Fig. 4) and shadowgraph.

6.5.2 *Seeding Methods,* such as theater fog.

NOTE 5—The seeding process shall only introduce small amounts of tracer material to avoid disturbances to the airflow. A seeding process introduces a tracer that artificially seeds the thermal plume that is rising between the cooking surface and the perimeter of the hood for visualization, and thereby making it more visible. This flow path will be generated continuously throughout the determination of the threshold capture and containment flow rate by suitable equipment and introduced at a trace rate only and not at an appreciable volume.

6.5.3 *Illumination,* such as with high-intensity, focused lighting.

NOTE 6—A 300-W halogen lamp with a lens or a 1000-W freznel equipped theater spotlight and a dark backdrop in place aids in visualizing seeded effluent plume.

6.6 *Data Acquisition System,* to provide for automatic logging of test parameters.

7. Reagents and Materials

7.1 *Water and Test Food Products*—Use water and test food products to determine energy-to-food as specified in the standards listed in Section 2 (Test Methods F1275, F1361, F1484, F1496, F1521, F1605, F1639, F1695, F1784, F1785, F1787, F1817, F1964, F1965, F1991, F2093, F2144, F2237, and F2239).

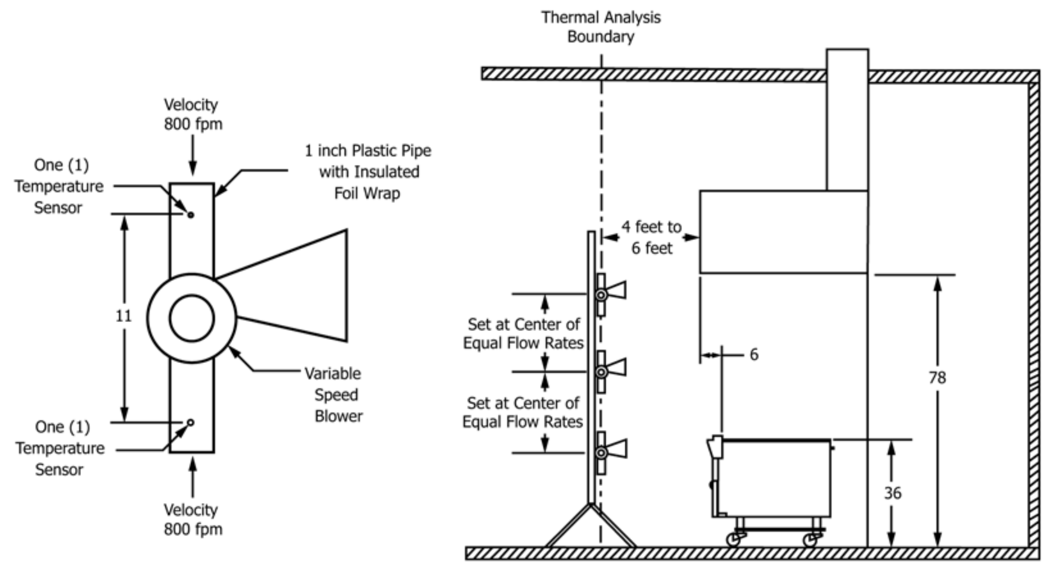

FIG. 3 Aspirated Trees and Schematic and Set-Up

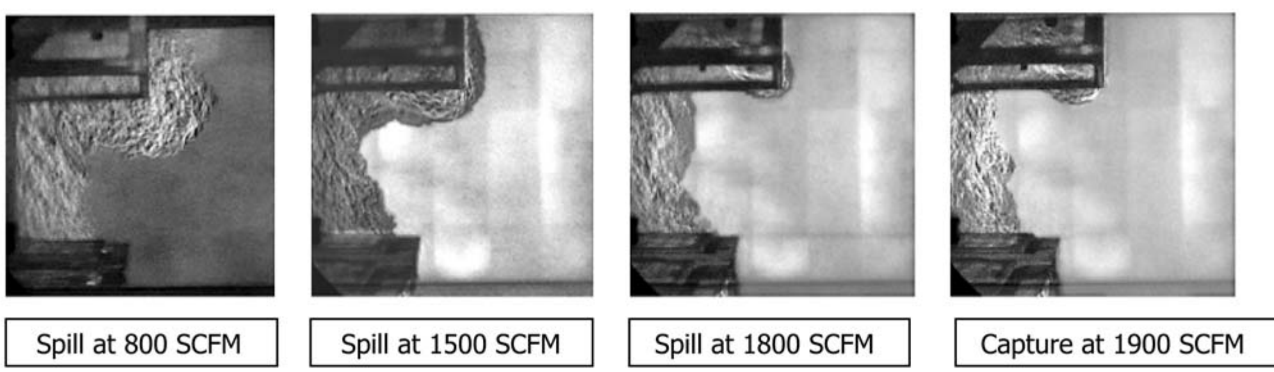

FIG. 4 Example of Schlieren Flow Visualization for Gas Charbroilers Under a Canopy Hood

8. Sampling

8.1 *Hood and Appliance(s)*—Select representative production models for performance testing.

9. Preparation of Apparatus

9.1 Install the test hood in the airtight room in accordance with the manufacturer's instructions, or as determined by particular experimental conditions.

9.2 Local make-up air shall be supplied to diffusers or plenums as determined by the test conditions. The specific arrangement shall be noted in the report.

NOTE 7—The general replacement air provided to the test space shall be admitted from diffusers or a wall located as far away from the hood as possible. The principal direction of replacement airflow from these diffusers shall be toward the front face of the exhaust hood in order to minimize the effects the airflow might have on the capture and containment process. The general arrangement of diffusers and replacement air are shown in Fig. 5 and Fig. 6. Document replacement air configuration and damper positions, following the manufacturer's recommendations.

9.3 Connect the appliance(s) to energy sources and test the instruments in accordance with the applicable test methods. Included is the connection to calibrated energy test meters and for gas equipment and the connection to a pressure regulator downstream of the test meter. Electric and gas energy sources are adjusted to within 2.5 % of voltages and pressures, respectively, as specified by the manufacturer's instructions or in accordance with applicable test methods.

9.4 Once the equipment has been installed, draw a front and side view of the test set-up.

10. Calibration

10.1 Calibrate the instrumentation and data acquisition system in accordance with device requirements to ensure accuracy of measurements.

10.2 Calibrate the flow measurement systems in accordance with the manufacturer's specifications and installed in accordance with AMCA 210. Other flow measurement systems must meet or exceed AMCA 210 accuracy requirements.

10.3 Calibrate humidity measuring instruments in accordance with the manufacturer's specifications annually against NIST-traceable reference meters. Relative humidity accuracy within ±0.5 % at 40 % RH and ±1.25 % at 95 % RH.

10.4 Calibrate all temperature sensors to within 2°F against a NIST-traceable temperature reference over the range of expected measurements.

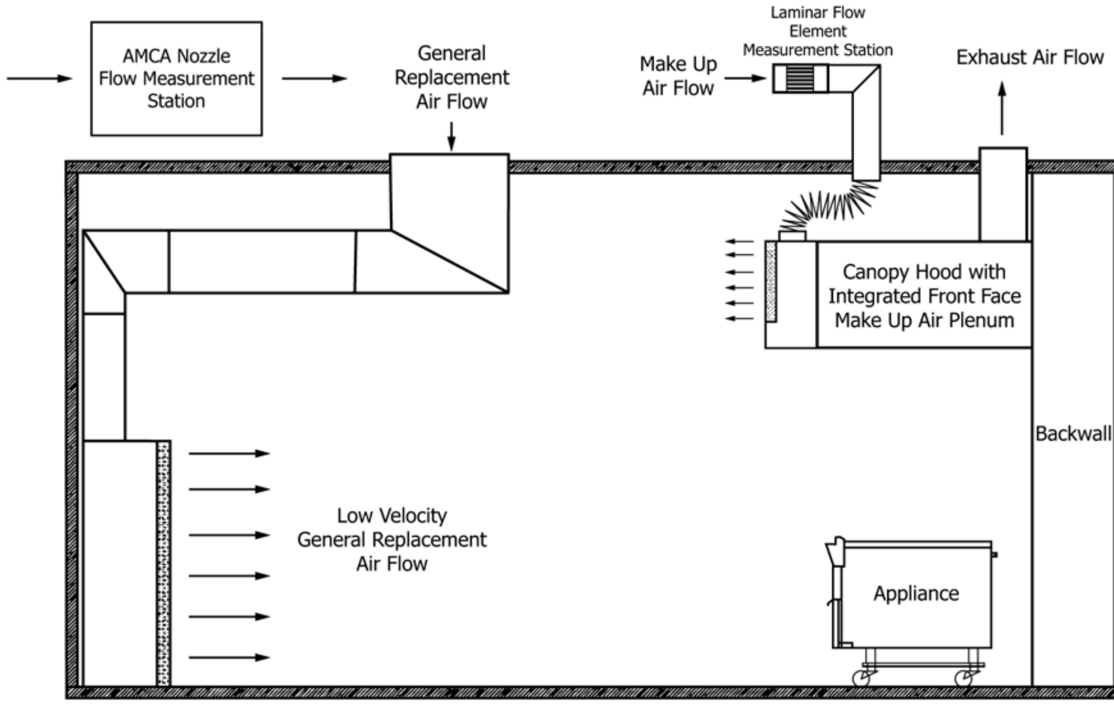

FIG. 5 Replacement Air Configuration for an Airtight Test Space

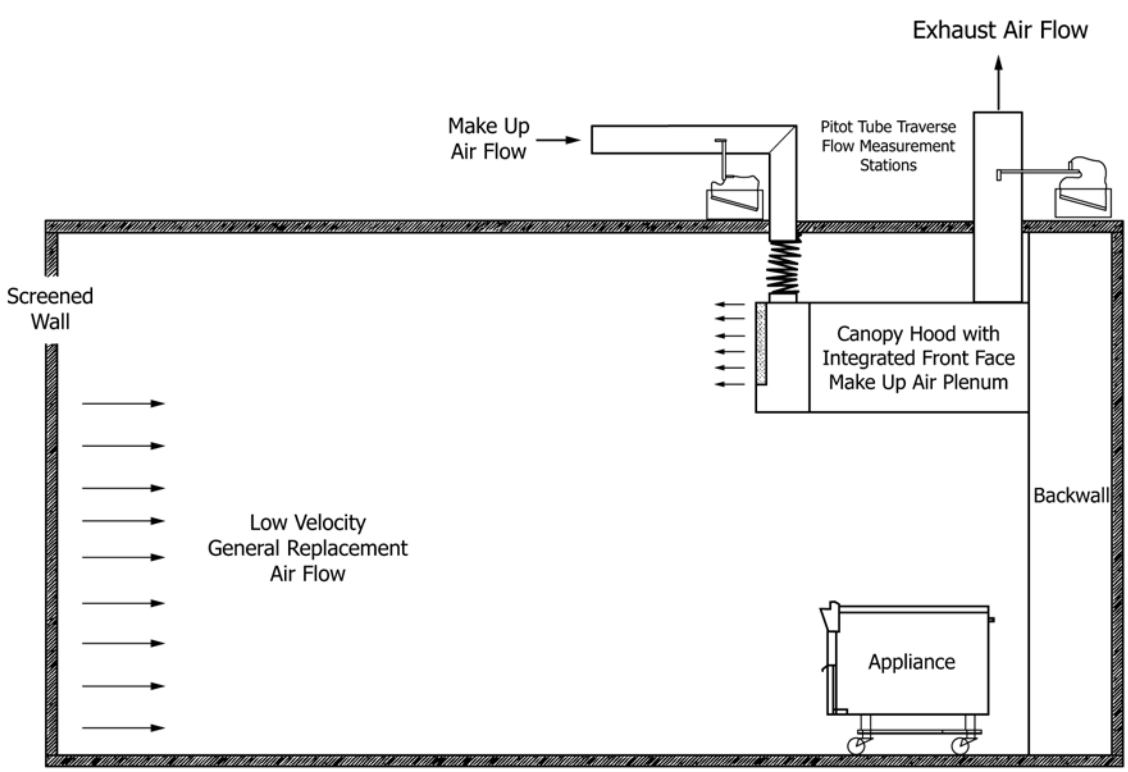

FIG. 6 Replacement Air Configuration for a Non-Airtight Test Space

11. Procedure

NOTE 8—The following procedures are the instructions for implementing the test method for determining the threshold capture and containment flow rate for appliance(s) during cooking and idle conditions and a hood with specific replacement air configurations. The procedure will establish two threshold capture and containment flow rates, for appliance heavy-load cooking, cfm_{cook} and for idling, cfm_{idle} (optional).

11.1 Conduct the capture and containment test for idle and cooking conditions a minimum of three times. Additional test runs may be necessary to obtain the required precision of the reported test results (Annex A1).

11.2 Set the initial airflow rates.

11.2.1 Set the initial local make-up airflow rates, if applicable, to the make-up air plenums or ceiling diffusers as specified by the manufacturer.

11.2.2 Set the initial exhaust flow rate high enough to be certain to capture and contain the thermal/effluent plume produced from the cooking appliance(s) under either cooking or idle conditions. Turn off all test space recirculating systems.

11.2.3 For an airtight room, set the general replacement airflow rate from the displacement diffusers at approximately the difference between the exhaust airflow rate and the local make-up air rate. Keep room differential pressure within 0.05 in. w.c. by using automatic pressure equilibration. For a non-airtight room, the supply airflow rate at the screened wall will be the difference between the exhaust airflow rate and the local make-up air rate.

11.3 Establish the cooking or idle threshold capture and containment flow rate, whereby the appliance is operating to maintain a full-load cooking condition (for the cook test) or a ready to cook condition (for the idle test) using a flow enhancement visualization system. While cooking, the appliance must cycle a minimum of one full-load cook cycle; while idling, the appliances shall cycle for at least two periods. The hood must show capture and containment during the full cycle period over the full hood perimeter from the hood edge to the floor level during idle or cooking conditions when using a flow enhancement visualization system.

11.4 During the test, reduce the exhaust flow rate until the hood begins to spill. Any observed leak moving beyond 3 in. (7.6 cm) from the hood face will be construed to have escaped from the hood, even if it may appear to be drawn back into the hood. If the effluent/thermal plume mixes with the local make-up air, and the local make-up air is not captured and contained by the hood, then the effluent/thermal plume will be construed to have escaped from the hood.

11.5 Gradually increase the exhaust flow rate in fine increments until full capture and containment of the thermal/effluent plume is achieved.

11.6 Note the exhaust motor RPM (N_{exh}) and for the airtight room, note the supply motor RPM (N_{supply}).

11.7 Perform Runs 2 and 3 by repeating 11.2 – 11.6 to ensure proper capture and containment of the entire thermal/effluent plume at this flow rate.

11.8 Allow hood/appliance system to stabilize 5 min with or without appliances underneath hood at the maximum exhaust rpm required for capture and containment, noted in 11.6. After the stabilization period, take a 1-min average of the actual flow.

11.8.1 For the airtight room, measure the general replacement air supplied and local make-up air flow rates (if applicable).

NOTE 9—The replacement air supplied is representative of the outdoor airflow requirements necessary for roof top units supplying a restaurant during appliance idling conditions (see 11.8) at the capture and containment exhaust flow rate.

11.8.2 For the non-airtight room, measure the air exhausted and local make-up air flow rates (if applicable).

11.9 Calculate the corresponding airflow rate at standard conditions, in accordance with AMCA 210.

11.10 At the user's request, the procedure in the Appendix can be used to evaluate hood performance with appliances calibrated to generate simulated cooking plumes in specific appliances lines.

12. Calculation and Report

12.1 *Capture and Containment Flow Rate Percent Uncertainty:*

12.1.1 Calculate mean of capture and containment flow rates in accordance with Annex A1.

12.1.2 Calculate standard sample deviation of capture and containment flow rates in accordance with Annex A1.

12.1.3 Calculate percent uncertainty of capture and containment flow rates expressed as a percentage.

12.2 *Test Hood and Appliance(s)*—Summarize the physical and operating characteristics of the exhaust hood and installed appliances, reporting all manufacturers' specifications and deviations therefrom. Include in the summary hood and appliance(s) rated energy input rate, measured energy input rate, idle energy consumption rate, cooking energy consumption rate, hood overhangs, and hood and appliance(s) height(s), size, integral, and manufacturer supplied make-up air configurations. Describe the specific appliance operating condition (for example, type and amount of product cooked, number of burners or elements on, and actual control settings).

12.3 *Apparatus*—Describe the physical characteristics of the test room, exhaust, and make-up air systems, and installed instrumentation.

12.4 *Data Acquisition:*

12.4.1 The following parameters are determined or known prior to each test run:

12.4.1.1 *HV*, Btu/ft^3—Higher (gross) saturated heating value of natural gas.

12.4.1.2 C_{pa}, specific heat of dry air, 0.24 Btu/[lb_a·°F].

12.4.1.3 C_{pv}, specific heat of water vapor, 0.44 Btu/[lb_a·°F].

12.4.1.4 R_a, gas constant for dry air, 53.352 ft·lb_f / [lb_m·°F].

12.4.2 The following parameters are monitored and recorded during each test run or at the end of each test run, or both:

12.4.2.1 cfm_{idle}, standard cubic feet per minute, scfm-threshold capture and containment exhaust flow rate under idle condition.

12.4.2.2 cfm_{cook}, standard cubic feet per minute, scfm-threshold capture and containment exhaust flow rate under heavy-load cooking mode.

12.4.2.3 N_{exh}, exhaust fan motor RPM at threshold of capture and containment.

12.4.2.4 N_{supply}, supply fan motor RPM at threshold of capture and containment.

12.4.2.5 V_{gas}, cubic feet, ft^3—Volume of gas consumed by the appliance(s) over the test period.

12.4.2.6 cfm_{gas}, cubic feet per minute, cfm—Average flow rate of combustion gas consumed over the test period.

12.4.2.7 E_{ctrl} , Btu/h—Average rate of energy consumed by controls, indicator lamps, fans, or other accessories associated with cooking appliance(s).

12.4.2.8 E_{app} , Btu/h—Average rate of energy consumed by burners of gas appliances, or heating elements of electric appliances, to maintain set operating temperature.

12.4.2.9 E_{input} , Btu/h—Average rate of total energy (that is, E_{app} + E_{ctrl}) consumed by the appliance(s).

12.4.2.10 ΔP_{neut}, in. H_2O—Static pressure differential between inside and outside the test space, measured at the neutral zone of the test space.

12.4.2.11 P_{gas} , in. Hg—Gas line gage pressure.

12.4.2.12 *Bp*, in. Hg—Ambient barometric pressure.

12.4.2.13 T_{is} , °F—Average dry bulb temperature of supply air into the test space.

12.4.2.14 T_{exh} , °F—Average dry bulb temperature of exhaust air.

12.4.2.15 T_{tree} , °F—Average dry bulb temperature of makeup air supplied from the test space

12.4.2.16 T_{space} , °F—Average dry bulb temperature of test space.

12.4.2.17 T_{gas} , °F—Average dry bulb temperature of the gas consumed by the appliance(s).

12.4.2.18 $T_{w,tree}$, °F—Average wet bulb temperature of test space air, measured at the aspirated thermocouple tree(s) plane.

12.4.2.19 T_{test} , minutes—Elapsed time of the test run.

12.4.3 The following parameters are calculated at the end of each test run:

12.4.3.1 C_p, Btu/lb°F—Specific heat of replacement air.

12.4.3.2 P_{cf} , dimensionless—Pressure correction factor.

12.4.3.3 T_{cf} , dimensionless—Temperature correction factor.

12.4.3.4 $scfm_{tree}$, scfm—Flow rate of makeup air supplied from the test space at standard density air.

12.4.3.5 M_{sup} , lb/h—Total mass flow rate of air supplied by the system.

12.4.3.6 W_{sup} , lb_v/lb_a—Equivalent humidity ratio of replacement air supplied from the hood and test space.

12.4.3.7 $W^*_{s,tree}$, lb_v/lb_a—Humidity ratio at saturation of makeup air supplied from the test space.

12.4.3.8 W_{tree} , lb_v/lb_a—humidity ratio of make-up air supplied from the test space.

12.4.3.9 RH_{tree} , %—Relative humidity of air supplied from the test space.

12.4.3.10 v_{tree}, (ft^3/lb_a)—Specific volume of makeup air supplied from the test space.

12.5 Report the threshold capture and containment flow rate for a particular hood/appliance(s) system based on flow visualization techniques. The standard flow rate will be reported along with its associated uncertainty.

12.5.1 Note the type of measurement system. Using the flow rates acquired in 11.9, convert the flow rates to standard conditions in accordance with AMCA 210. Note whether it is a measurement of the air exhausted or the makeup air supplied to an airtight room.

13. Precision and Bias

13.1 *Precision:*

13.1.1 *Repeatability (Within Laboratory, Same Operator and Equipment)*—For capture and containment flow rate, the percent uncertainty shall not exceed 20 %.

13.1.2 *Reproducibility (Multiple Laboratories)*—The interlaboratory precision of the procedures in this test method for measuring each reported parameter is being determined.

13.2 *Bias*—No statement can be made concerning the bias of the procedures in this test method because there are no accepted reference values for the parameters reported.

14. Keywords

14.1 capture and containment; commercial kitchen ventilation; exhaust airflow rates; hood performance; test method

ANNEX

(Mandatory Information)

A1. UNCERTAINTY IN REPORTED TEST RESULTS

NOTE A1.1—The procedure described as follows is based on the method for determining the confidence interval for the average of several test results discussed in ASHRAE Guideline 2-1986 (RA90) (see 2.2). It only should be applied to test results that have been obtained within the tolerances specified in this test method.

A1.1 For the capture and containment procedure, results are reported for the exhaust flow rate under idle condition cfm_{idle}, or cooking condition cfm_{cook}, or both.

A1.1.1 The uncertainty for the exhaust flow rate is calculated after the test run has been repeated three times. Then, it is checked against the maximum allowable uncertainty specified for the variable. If the uncertainty exceeds its maximum allowable uncertainty, the test run is repeated and the uncertainty based on four runs is calculated and verified again. This process is continued until the uncertainty of each variable falls within its maximum allowable range.

NOTE A1.2—Verification tests that are spread over a long time span (several months) help evaluate environmental impacts like seasonal climatic changes.

A1.2 The uncertainty in a reported result helps to evaluate its precision. If, for example, the cfm_{cook} is 2000 cfm, the uncertainty specified for this variable in this test method must be not larger than ±20 % or ±400 cfm. This means that the true cfm_{cook} is within the interval between 1600 and 2400 cfm. This interval is determined at the 95 % confidence level, which means that there is only a 1 in 20 chance that the true cfm_{cook} could be outside of this interval.

A1.3 Calculating the uncertainty not only guarantees the maximum uncertainty in the reported result but also is used to determine how many test runs are needed to satisfy this requirement. The uncertainty is calculated by multiplying the standard deviation of three or more test runs by a factor from Table A1.1, which depends on the number of test runs used to compute the average. The percent uncertainty is the ratio of the uncertainty to the average expressed as a percent.

A1.4 *Procedure* :

A1.4.1 The following procedure is provided for calculating uncertainty. It shall be carried out for the variables stated in A1.1.

A1.4.1.1 *Step 1*—Using the results of the first three test runs, calculate the average and standard deviation of the variable.

NOTE A1.3—The following formulas may be used to calculate the average and sample standard deviation. It is recommended, however, that a calculator with statistical function be used. If one is used, be sure to use the sample standard deviation function. Using the population standard deviation function will result in an error in the uncertainty.

The average of the variable based on three test runs is calculated as follows:

$$Xa_3 = (1/3) \times (X_1 + X_2 + X_3) \quad (A1.1)$$

where:

Xa_3 = average of results of the three test runs, and
X_1, X_2, X_3 = results of the variable from Test Runs 1 through 3.

A1.4.1.2 The sample standard deviation of the variable based on the three test runs is given as follows:

$$S_3 \left(1/\sqrt{2}\right) \times \sqrt{(A_3 - B_3)} \quad (A1.2)$$

where:

S_3 = standard deviation of the variable based on three test runs,
A_3 = $(X_1)^2 + (X_2)^2 + (X_3)^2$, and
B_3 = $(1/3) \times (X_1 + X_2 + X_3)^2$.

A1.4.2 *Step 2*—Calculate the absolute uncertainty in each variable. From Table A1.1, look up the uncertainty factor for three test runs, then multiply the standard deviation computed in Step 1 by that factor:

$$U_3 = C_3 \times S_3 \quad (A1.3)$$

$$= 2.48 \times S_3$$

where:

U_3 = absolute uncertainty in the average value of the variable based on three test runs, and
C_3 = uncertainty factor for three test runs from Table A1.1.

A1.4.3 *Step 3*—Calculate the percent uncertainty in each variable using the average of the three test runs obtained from Step 1 and the absolute uncertainty from Step 2:

$$\% U_3 = (U_3/Xa_3) \times 100\,\% \quad (A1.4)$$

where:

$\% U_3$ = percent uncertainty in the average value of the variable based on three test runs.

A1.4.4 *Step 4*—If the percent uncertainty in each variable stated in Section 13 is within the maximum allowable uncertainty specified for the variable, then report the average of each variable obtained from Step 1 along with its uncertainty from Step 2 in the following format:

$$Xa_3 \pm U_3 \quad (A1.5)$$

If the percent uncertainty in any one of the variables exceeds the maximum allowable uncertainty specified for that variable, then proceed to Step 5.

A1.4.5 *Step 5*—Run a fourth test for the test exhaust flow rate at which one of the variables calculated uncertainty exceeded its maximum allowable uncertainty.

A1.4.6 *Step 6*—Compute the average and the standard deviation of each variable based on the four test runs as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4) \quad (A1.6)$$

where:

Xa_4 = average of results of the four test runs, and
X_1, X_2, X_3, X_4 = results of the variable from Test Runs 1 through 4.

A1.4.6.1 The sample standard deviation of the variable based on four test runs is given as follows:

$$S_4 \left(1/\sqrt{3}\right) \times \sqrt{(A_4 - B_4)} \quad (A1.7)$$

where:

S_4 = standard deviation of the variable based on four test runs,
A_4 = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2$, and
B_4 = $(1/4) \times (X_1 + X_2 + X_3 + X_4)^2$.

A1.4.7 *Step 7*—Calculate the absolute uncertainty in each variable. From Table A1.1, look up the uncertainty factor for four test runs, then multiply the standard deviation computed in Step 1 by that factor:

$$U_4 = C_4 \times S_4 \quad (A1.8)$$

$$= 1.59 \times S_4$$

where:

U_4 = absolute uncertainty in the average value of the variable based on four test runs, and
C_4 = uncertainty factor for four test runs from Table A1.1.

TABLE A1.1 Uncertainty Factors

Number of Test Runs, *n*	Uncertainty Factor, C_n
3	2.48
4	1.59
5	1.24
6	1.05
7	0.92
8	0.84
9	0.77
10	0.72

A1.4.8 *Step 8*—Calculate the percent uncertainty in each variable using the average of the four test runs obtained from Step 1 and the absolute uncertainty from Step 2:

$$\% U_4 = (U_4/Xa_4) \times 100\% \quad (A1.9)$$

where:

$\% U_4$ = percent uncertainty in the average value of the variable based on four test runs.

A1.4.9 *Step 9*—If the percent uncertainty in each variable stated in Section 10 is within the maximum allowable uncertainty specified for the variable, then report the average of each variable obtained from Step 1 along with its uncertainty from Step 2 in the following format:

$$Xa_4 \pm U_4 \quad (A1.10)$$

If the percent uncertainty in any one of the variables exceeds its maximum allowable uncertainty, then proceed to Step 10.

A1.4.10 *Step 10*—Run a fifth test for the test flow rate at which one of the variables calculated uncertainty exceeded its maximum allowable uncertainty. Then the calculation procedure is repeated over again for five test runs. The general formulas for calculating the average, standard deviation, absolute uncertainty, and percent uncertainty are listed as follows. These formulas shall be applied for each variable. The average of the variable based on "n" test runs is calculated as follows:

$$Xa_n = (1/n) \times \sum_i X_i \text{ for } i = 1 \text{ to } n \quad (A1.11)$$

$$= (1/n) \times (X_1 + X_2 + X_3 + X_4 + \ldots + X_n)$$

where:

Xa_n = average of results of n test runs, and

$X_1, X_2, X_3, X_4, \ldots, X_n$ = results of the variable from Test Runs 1 through n.

A1.4.10.1 The sample standard deviation of the variable based on n test runs is given as follows:

$$S_n \left(1/\sqrt{(n-1)}\right) \times \sqrt{(A_n - B_n)} \quad (A1.12)$$

where:

S_n = standard deviation of the variable based on n test runs,
A_n = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2 + \ldots + (X_n)^2$, and
B_n = $(1/n) \times (X_1 + X_2 + X_3 + X_4 + \ldots + X_n)^2$.

A1.4.10.2 The uncertainty in n test runs is given as follows:

$$U_n = C_n \times S_n \quad (A1.13)$$

where:

U_n = absolute uncertainty in the average value of the variable based on n test runs, and
C_n = uncertainty factor for n test runs from Table A1.1.

A1.4.10.3 The percent uncertainty in each variable is calculated as follows:

$$\% U_n = (U_n/Xa_n) \times 100\% \quad (A1.14)$$

where:

$\% U_n$ = percent uncertainty in the average value of the variable based on n test runs.

A1.4.10.4 Upon satisfying the uncertainty requirement for each variable based on n test runs, the average value of each variable is reported in the following format:

$$Xa_n \pm U_n \quad (A1.15)$$

APPENDIXES

(Nonmandatory Information)

X1. PROCEDURE FOR DETERMINING THE CAPTURE AND CONTAINMENT EXHUAST RATE FOR A STANDARD APPLIANCE LINE CHALLENGE

X1.1 Scope

X1.1.1 The test procedure in this appendix determines the capture and containment performance of a standard 10-ft canopy hood installed over standardized cooking appliance thermal plume challenges under specified appliance configurations and positioning.

X1.1.2 The test procedure determines static pressure differential after the exhaust collar of the hood.

X1.1.3 The test procedure determines the exhaust air temperature at the capture and containment flow rate.

X1.2 Terminology

X1.2.1 *Definitions of Terms Specific to This Appendix:*

X1.2.1.1 *simulated thermal plume challenge, n*—an appliance plume that duplicates the actual cooking effluent or thermal plume, or both, from an appliance or line of appliances.

X1.3 Summary of Test Method

X1.3.1 This test method uses flow visualization to determine the threshold of capture and containment of a canopy hood over 3 combinations of 3 appliances during simulated cooking conditions.

X1.4 Significance and Use

X1.4.1 The threshold of C&C can be used to estimate minimum exhaust flow rates for a particular hood with a specified thermal plume challenge. The threshold of C&C can be used as an indicator to compare hoods and modify hood design features.

X1.5 Apparatus

X1.5.1 Install the test hood in the room per the manufacturer's instructions. The canopy hood to be tested will be of Type I construction measuring 10-ft wide by 24 in. high by 54 in. deep, which includes a 3 in. standoff. The exhaust collar opening is centered with an area of 1.5 ft^2 and shall be 18 in. wide by 12 in. deep.

X1.5.1.1 Other deviations can be tested and reported.

X1.5.2 *Appliances*—The general specifications for the appliances are given in Table X1.1.

X1.5.3 Local make-up air shall be supplied to the floor mounted displacement type diffusers.

X1.6 Preparation of Apparatus

X1.6.1 *Appliance Cooking Simulation:*

X1.6.1.1 The simulated cooking condition for the gas charbroiler is specified with an average input of 65 000 Btu⁄h. The simulated cooking condition for the 2 gas fryers is specified as a water boil with an input of 40 750 Btu/h to one infrared burner per vat. The simulated cooking condition for the full-size convection oven is specified as an electric oven idling or a gas oven hot/off at 350°F. The appliances at their rated and simulated cooking inputs are summarized in Table X1.2.

NOTE X1.1—The simulated cooking condition of the 2 fryers is best created with the use of a high efficiency, Energy Star fryer rated at 80 000 Btu⁄h. The fryer controls should be modified for continuous burner operation. One of the two burners attached to each vat should be disconnected and the piping plugged. The gas pressure to each fryer should be regulated to raise the consumption rate of each fryer from 40 000 Btu/h to 40 750 Btu/h. To keep the plume strength consistent, the water level in each vat must be maintained by periodically adding water between C&C evaluations.

X1.6.2 *Appliance Location and Position:*

X1.6.2.1 The appliances are located under the 10-ft hood according to Table X1.3, and positioned according to Table X1.4.

(1) The positioning of the appliances on the 54-in. deep standard hood is according to the front overhang.

(2) The positioning of the appliances on hoods other than 54 in. deep is according to the rear gap.

X1.7 Procedure

X1.7.1 *Hood Capture and Containment Performance:*

X1.7.1.1 Determine capture and containment according to Section 11.

X1.7.1.2 Determine capture and containment during walk-by condition.

(1) Determine capture and containment according to Section 11 while a tester walks a line 18 in. in front of the appliances (or 6 in. outside the front of the hood with a 12-in. overhang) at a rate of 100 steps per minute with a 2.5-ft step (that is, 250 ± 25 fpm) as shown in Fig. X1.1.

X1.7.2 *Hood Static Pressure Drop at Capture and Containment Airflow Rates:*

X1.7.2.1 The static pressure difference is measured between the room and the duct above the hood collar.

X1.7.2.2 The duct pressure is taken at four locations around the duct according to ANSI/ASHRAE 41.2 or equivalent.

X1.7.2.3 The static pressure measurements are taken at the capture and containment airflow rates as determined in X1.7.

X1.7.3 *Exhaust Air Temperature at Capture and Containment Airflow Rates:*

X1.7.3.1 The exhaust air temperature measurements will be taken near the four static pressure probe locations. They will be within 3 in. of the duct wall.

X1.7.3.2 The individual measurements will be averaged to obtain an approximate bulk exhaust air temperature.

X1.7.3.3 The temperature measurements are taken at the capture and containment airflow rates as determined in X1.7.

TABLE X1.1 Minimum Cooking Appliance Specifications

	3-ft Gas Charbroiler	Full-Size Electric Convection Oven	2 Gas Fryers
Rated Input	96 000 Btu/h	12.1 kW	160 000 Btu/h (80 000 Btu/h each)
Capacity	719 in.^{2}	8.6 ft^3	50 lb capacity each

TABLE X1.2 Rated and Simulated Cooking Appliance Inputs

	3-ft Gas Charbroiler	Full-Size Electric Convection Oven	2 Gas Fryers
Rated Input	96 000 Btu/h	12.1 KW	80 000 Btu/h per vat or 160 000 Btu/h total
Simulated Cooking Input	65 000 Btu/h with horizontal grates and temperature disks at 600°F average temperature measured according to Test Method F1695	Idling at 350°F calibrated according to Test Method F1496	Water boiling at a minimum energy consumption of 40 750 Btu/h per fryer or 81 500 Btu/h total

TABLE X1.3 Appliance Location

Line #	LH Appliance	CTR Appliance	RH Appliance
1-Heavy Duty	Charbroiler	Charbroiler	Charbroiler
2-Mixed Duty	2-Vat Fryer	Charbroiler	Oven
3-Mixed Duty with Walk-By	2-Vat Fryer	Charbroiler	Oven

TABLE X1.4 Appliance Position with Overhang Relationships for 54-in. Deep Hood

	3-ft Gas Broiler	Full-Size Electric Convection Oven	2 Gas Fryer
Front Overhang to Appliance [in.]	18	12	22
Rear of Appliance to Backwall [in.]	5	1	4
Side of Appliance to Hood [in.]	6	6	6

NOTE X1.2—Flow mixing means may be necessary if high input gas appliances are tested on one side of the hood. Mixing should be considered if the range of exhaust temperatures exceeds 10°F.

X1.8 Calculation and Report

X1.8.1 *Capture and Containment Flow Rate:*

X1.8.1.1 Calculate and report capture and containment exhaust airflow rate according to X1.7, including makeup air configuration.

X1.8.2 *Hood Static Pressure Drop:*

X1.8.2.1 Record pressure drop at corresponding capture and containment airflow rates.

X1.8.3 *Summary Report:*

X1.8.3.1 The summary section of the performance report shall include the following information:

(1) Name and location of the test laboratory,

(2) Date of the test,

(3) Test operator's name(s),

(4) Manufacturer's name and location,

(5) Description of the hood tested, including:

(a) Brand and model number,

(b) Physical description of construction (for example, canopy hood, wall style, extractor style),

(c) Length, depth, and width,

(d) Rear standoff dimensions shown in cross section,

(e) Filter type and size,

(f) Specifications of internal slots, louvers, flow enhancements, etc.,

(g) Collar size and location,

(h) Plan and cross-section view, and

(i) Deviations from standard hood configuration in X1.5.

(6) Plan of test set-up and make-up air configurations,

(7) Table of results:

(a) Capture and containment exhaust flow rate data in accordance with Annex A1,

(b) Hood pressure drop data in accordance with Annex A1, and

(c) Exhaust air temperature data in accordance with Annex A1.

(8) Bar chart of capture and containment flow rate results.

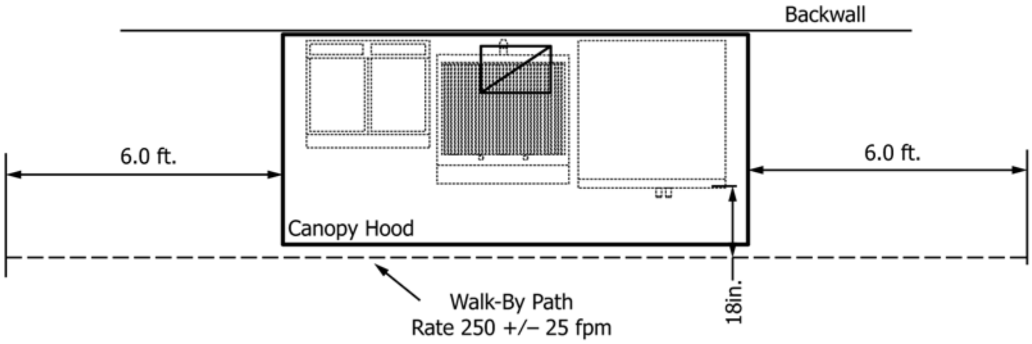

FIG. X1.1 Plan View of Hood Set Up with Walk-By Path

X2. PROCEDURE FOR DETERMINING THE CAPTURE AND CONTAINMENT EXHUAST RATE FOR A BACKSHELF/ PROXIMITY HOOD AND STANDARD APPLIANCE LINE CHALLENGE

X2.1 Scope

X2.1.1 The test procedure in this appendix determines the capture and containment performance of a 34-in. to 54-in. backshelf/proximity hood(s) installed over standardized cooking appliance thermal plume challenges under specified appliance configurations and positioning.

X2.1.2 The test procedure determines static pressure differential after the exhaust collar of the hood.

X2.1.3 The test procedure determines the exhaust air temperature at the capture and containment flow rate.

X2.2 Terminology

X2.2.1 *Definitions of Terms Specific to This Appendix:*

X2.2.1.1 *simulated thermal plume challenge, n*—an appliance plume that duplicates the actual cooking effluent or thermal plume from an appliance or line of appliances, or both.

X2.3 Summary of Test Method

X2.3.1 This test method uses flow visualization to determine the threshold of capture and containment of a backshelf hood over four conditions of three different appliances during simulated cooking conditions.

X2.4 Significance and Use

X2.4.1 The threshold of C&C can be used to estimate minimum exhaust flow rates for a particular hood with a specified thermal plume challenge. The threshold of C&C can be used as an indicator to compare hoods and modify hood design features.

X2.5 Apparatus

X2.5.1 Install the test hood(s) in the room per the manufacturer's instructions. The backshelf hood(s) to be tested will be of Type I construction measuring from 34 to 54 in. in length. The hood mounting height shall be per the manufacturer's installation instructions. The exhaust collar opening is centered with an area of 1.0 ft^2 and shall be 16 in. wide by 9 in. deep.

X2.5.1.1 Other deviations can be tested and reported.

X2.5.2 *Appliances*—The general specifications for the appliances are given in Table X2.1.

TABLE X2.1 Minimum Cooking Appliance Specifications

			
	3-ft Gas Charbroiler	3-ft Gas Griddle	3 Gas Fryers
Rated Input	96 000 Btu/h	96 000 Btu/h	240 000 Btu/h (80 000 Btu/h each)
Capacity	719 $in.^2$	1026 $in.^2$	50 lb capacity each

X2.5.3 Local make-up air shall be supplied to the floor mounted displacement type diffusers.

X2.6 Preparation of Apparatus

X2.6.1 *Appliance Cooking Simulation:*

X2.6.1.1 The simulated cooking condition for the gas charbroiler is specified with an average input of 65 000 Btu/h. The simulated cooking condition for each of the 3 gas fryers is specified as a water boil with an input of 40 750 Btu/h to one infrared burner per vat. The simulated cooking condition for the 3-ft gas griddle is specified as a thermostatically controlled gas griddle idling with at 350°F with a water drip at a rate of 0.16 gpm total located at 24 equally spaced positions on the surface. The appliances at their rated and simulated cooking inputs are summarized in Table X2.2.

NOTE X2.1—The simulated cooking condition of the 3 fryers is best achieved with the use of a high efficiency, Energy Star fryer rated at 80 000 Btu/h. The fryer controls should be modified for continuous burner operation. One of the two burners attached to each vat should be disconnected and the piping plugged. The gas pressure to each fryer should be regulated to raise the consumption rate of each fryer from 40 000 Btu/h to 40 750 Btu/h. To keep the plume strength consistent, the water level in each vat must be maintained by periodically adding water between C&C evaluations. The simulated cooking condition for the griddle is best achieved by using a manifold suspended above the grill surface with a 6 by 4 hole pattern.

X2.6.2 *Appliance Location and Position:*

X2.6.2.1 The appliances are located under the 34-in. to 54-in. hood(s) according to Table X2.3, and positioned according to Table X2.4.

(1) The positioning of the appliances on the backshelf hood is according to the rear gap.

X2.7 Procedure

X2.7.1 *Hood Capture and Containment Performance:*

X2.7.1.1 Determine capture and containment according to Section 11.

X2.7.1.2 Determine capture and containment during walk-by condition.

(1) Determine capture and containment according to Section 11 while a tester walks a line 18 in. in front of the fryers at a rate of 100 steps per minute with a 2.5-ft step (i.e., 250 ± 25 fpm) as shown in Fig. X2.1.

X2.7.2 *Hood Static Pressure Drop at Capture and Containment Airflow Rates:*

X2.7.2.1 The static pressure difference is measured between the room and the duct above the hood collar.

TABLE X2.3 Appliance Location

Line #	Appliance
1-Heavy Duty	1-Charbroiler
2-Medium Duty	1-Griddle
3-Medium Duty	3 Gas Fryers
4-Medium Duty with Walk-By	3 Gas Fryers

TABLE X2.4 Appliance Position with Rear Gap Relationships Backshelf Hood

	3-ft Gas Broiler	3-ft. Gas Griddle	3 Gas Fryers
Hood Front Setback to Appliance [in.]	Variable	Variable	Variable
Rear Gap Between Appliance and Back of Hood [in.]	3	3	3
Side of Appliance to Hood [in.]	Variable	Variable	Variable

X2.7.2.2 The duct pressure is taken at four locations around the duct according to ANSI/ASHRAE 41.2 or equivalent.

X2.7.2.3 The static pressure measurements are taken at the capture and containment airflow rates as determined in X2.7.

X2.7.3 *Exhaust Air Temperature at Capture and Containment Airflow Rates:*

X2.7.3.1 The exhaust air temperature measurements will be taken near the four static pressure probe locations. They will be within 3 inches of the duct wall.

X2.7.3.2 The individual measurements will be averaged to obtain an approximate bulk exhaust air temperature.

X2.7.3.3 The temperature measurements are taken at the capture and containment airflow rates as determined in X2.7.

NOTE X2.2—Flow mixing means may be necessary if high input gas appliances are tested on one side of the hood. Mixing should be considered if the range of exhaust temperatures exceeds 10°F.

X2.8 Calculation and Report

X2.8.1 *Capture and Containment Flow Rate:*

X2.8.1.1 Calculate and report capture and containment exhaust airflow rate according to X2.7, including makeup air configuration.

X2.8.2 *Hood Static Pressure Drop:*

X2.8.2.1 Record pressure drop at corresponding capture and containment airflow rates.

X2.8.3 *Summary Report:*

X2.8.3.1 The summary section of the performance report shall include the following information:

TABLE X2.2 Rated and Simulated Cooking Appliance Inputs

	3-ft Gas Charbroiler	3-ft Gas Griddle	3 Gas Fryers
Rated Input	96 000 Btu/h	96 000 Btu/h	80 000 Btu/h per vat or 240 000 Btu/h total
Simulated Cooking Input	65 000 Btu/h with horizontal grates and temperature disks at uniform temperature measured according to Test Method F1695	Water drip at 24 locations on surface at a rate of 0.16 gpm	Water boiling at a minimum energy consumption of 40 750 Btu/h per fryer or 122 250 Btu/h total

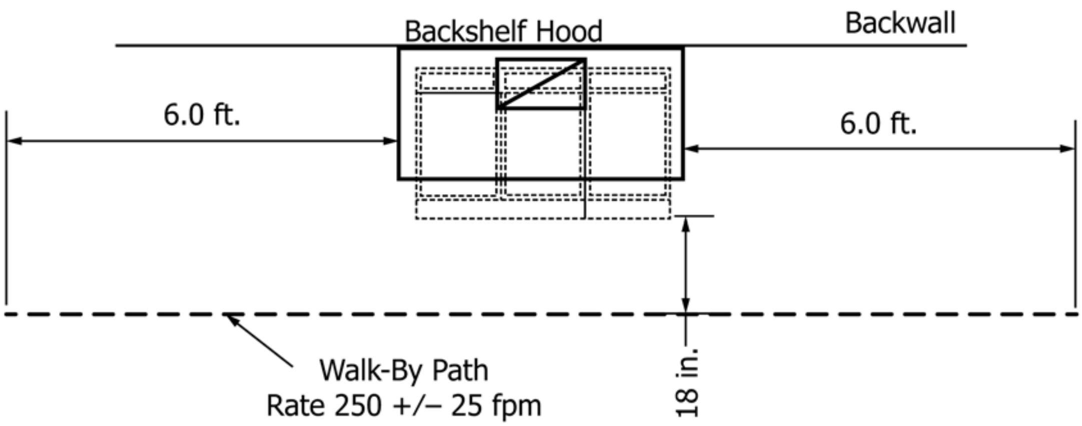

FIG. X2.1 Plan View of Backshelf Hood Set Up with Walk-by Path

(1) Name and location of the test laboratory,
(2) Date of the test,
(3) Test operator's name(s),
(4) Manufacturer's name and location,
(5) Description of the hood tested, including:
(a) Brand and model number,
(b) Physical description of construction (for example, canopy hood, wall style, extractor style),
(c) Length, depth, and width,
(d) Rear standoff dimensions shown in cross-section,
(e) Filter type and size,
(f) Specifications of internal slots, louvers, flow enhancements, etc.,
(g) Collar size and location,
(h) Plan and cross-section view, and
(i) Deviations from standard hood configuration in X2.5.
(6) Plan of test set-up and make-up air configurations,
(7) Table of results:
(a) Capture and containment exhaust flow rate data in accordance with Annex A1,
(b) Hood pressure drop data in accordance with Annex A1, and
(c) Exhaust air temperature data in accordance with Annex A1.
(8) Bar chart of capture and containment flow rate results.

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