Streivor SAWCBD
Wall-Mounted Canopy Exhaust Hood
Performance Report

Application of ASTM Standard
Test Method F1704-09

FSTC Report 501311200

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The information in this report is based on data generated at the PG&E Food Service Technology Center's
Commercial Kitchen Ventilation Laboratory

Scope and Application of ASTM 1704, Standard Test Method for Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems

The capture and containment exhaust air flow rates for the 10-foot wall canopy exhaust hood were determined under controlled laboratory conditions. The makeup air was supplied at low velocity (less than 60 ft/min) through floor-mounted, displacement diffusers along the wall opposite the front face of the hood. Appliances were positioned to maximize hood overhang and minimize the gap between the appliance and rear wall. The repeatability/accuracy of the reported values is considered to be ± 5% (e.g., ± 100 cfm at 2000 cfm).

The hood under test was configured with manufacturer-specified hood features (e.g., hood height and depth and/or volume of hood reservoir, number of duct collars, location and size of duct collars, effluent plume containment features or technologies) and manufacturer-specified installation options (e.g., side panels, back wall, rear seal) over the specified appliances operating under simulated cooking conditions. The common denominator for the different styles and configurations of wall-canopy hoods tested by the PG&E Food Service Technology Center is the 10-foot hood length over a standardized appliance challenge (i.e., heavy-, medium-, light-, and mixed-duty appliance lines). The specifications of the hood and its installation configuration over each appliance line are detailed within the report.

The laboratory test setup was not intended to replicate a real-world installation of this hood where greater exhaust airflows may be required for the capture and containment of the cooking effluent. The objective of this ASTM 1704 testing was to characterize capture and containment performance of an exhaust hood in combination with the specified options within a controlled laboratory environment. The data in this report should not be used as the basis for design exhaust rates and specifications. Design exhaust rates must recognize UL710 safety listings, utilize the knowledge and experience of the designer with respect to the actual cooking operation, and compensate for the dynamics of a real-world kitchen.

Policy on the Use of Food Service Technology Center Test Results

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Objectives

This report summarizes the results of performance testing a 10.0-foot long by 4.5-foot deep by 2.5-foot high Streivor, model SAWCBD exhaust hood at the Commercial Kitchen Ventilation Laboratory within the scope of the PG&E Food Service Technology Center's program. The objectives were to:

(1) Evaluate and report the capture and containment performance of wall-mounted canopy hood with and without side panels when challenged with light-, medium-, heavy-, and mixed-duty appliances under the controlled conditions of the ASTM Standard Test Method F1704, *Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems* [Ref 1].

(2) Measure and report the pressure drop across the hood (measured at the hood collar) as a function of airflow.

(3) Measure and report the cartridge slot velocity profile across the length of the hood.

Equipment

Hood Specifications

The Streivor wall-mounted canopy hood was tested in accordance with ASTM Standard Test Method F1704 within a UL listed configuration. The hood's outside dimensions were 10.0 feet wide by 4.5 feet deep by 2.5 feet high. The hood was equipped with six stainless steel cartridge-type adjustable slot grease extractors located in a 110.0-inch by 14.8-inch filter bank opening. The lower edge of the filter bank opening was 15.0 inches above the lower edge of the hood. The filter bank exhausted through one 22.0-inch by 10.0-inch hood collar into the laboratory's exhaust system. The 3.0 inch high duct collar was extended to 8.5 inches and was centered in the filter bank and located 4.0 inches from the rear of the hood.

A 3-inch rear standoff was built-in to the entire height of the rear panel of the hood (see Appendix A). The hood contained two 7.0-inch by 6.0-inch by 4.0-inch grease collectors located outside the filter bank 3.0 inches from the sides of the hood and 7.0 inches above the lower edge of the hood. The hood was installed with the front lower edge of the hood located at 78.0 inches above the finished floor. Below the rear panel of the hood hung a stainless steel backwall. It was assembled in four sections. Each panel measured 42.0 inches high by 30.0 wide by 4.0 inches deep. The bottom of the wall was 35.8 inches above the finished floor. The typical hood setup over a heavy-duty broiler line was mounted in front of a transparent back wall and is shown in Figure 1.

Figure 1. Streivor Wall-Mounted Canopy Hood with Integrated Backwall

The hood design included air from the laboratory introduced internally to the hood through two slots along the entire front inside panel of the hood. The lower slot was flush with the 3.0-inch lower edge of the hood and directed inward approximately 10 degrees from vertical. The width of the slot opening was 0.13 inch. The upper slot was located 5.0 inches above the lower edge of the hood and directed approximately 30 degrees upward. The width of the slot opening was 0.06 inch. The slot was part of a triangle that measured 2.5 inches high by 2.0 inches deep. The total airflow through both slots was 75 cfm, or 7.5 cfm/ft.

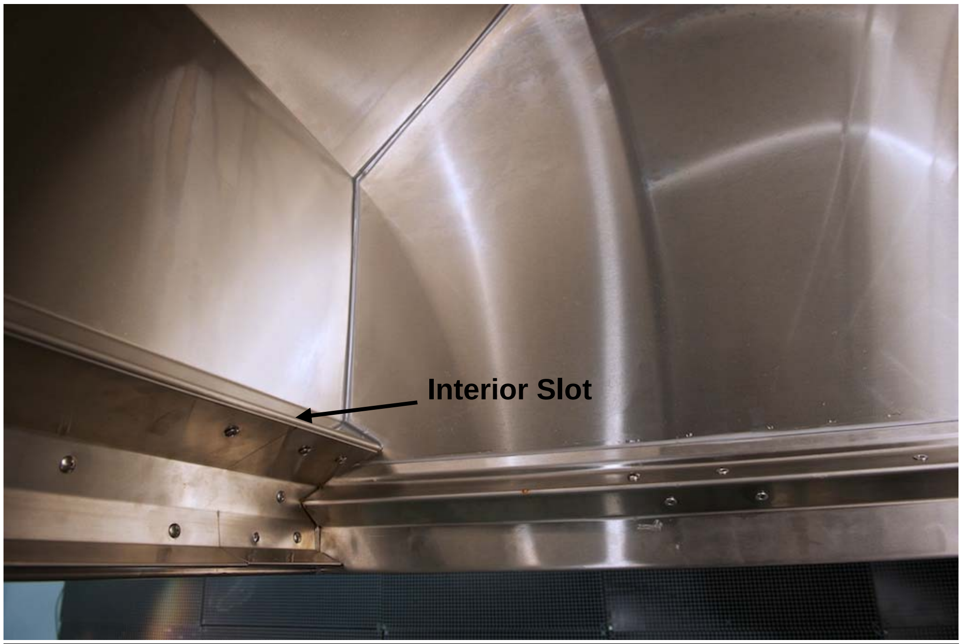

Figure 2. Interior Front Corner of Hood Showing Interior Slot

The sides incorporated a 1.6-inch high by 1.3-inch deep triangle along the length of each side. The triangles were located 2.8 inches above the lower edge of the hood and were also used to mount the side panels. Interior views of the front and side of the hood are shown in Figures 2 and 3.

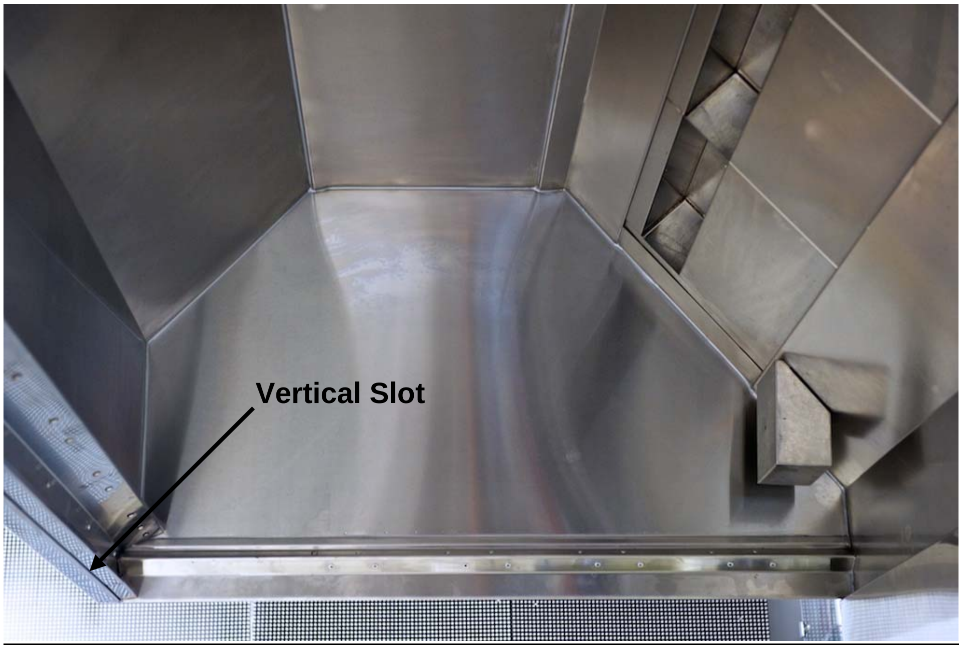

Figure 3. Interior Side Profile of Hood Showing Vertical Slot

Filter Specification

The six stainless steel removable cartridge-type slotted grease filters were supplied in two sizes. Four cartridges measured 19.5 inches wide by 15.0 inches high by 4.5 inches thick; two cartridges measured 15.5 inches wide by 15.0 inches high by 4.5 inches thick. Each cartridge had a 3.8-inch slot towards the top. Each had a sliding baffle to adjust the 2.5-inch slot opening in the back of the cartridge to vary the flow though the cartridge. The baffle was adjusted to maintain a 100% open slot for all testing conditions. Front and back views of the cartridge are shown in Figure 4.

Figure 4. Front and Back Views of Removable Cartridge-Type Grease Filter

Side Panel Configurations

Two side panel designs were used in eleven capture and containment evaluations for the standard appliance challenge. The smaller side panel measured 18.0 inches high by 21.0 inches along the top by 16.0 inches along the front with a 4.0-inch radius corner. It was tapered at approximately 20 degrees from the front to the rear of the hood. The larger side panel measured 42.0 inches high by 38.0 inches along the top by 40.0 inches along the front with a 4.0-inch radius corner. It was tapered at approximately 10 degrees from the front to the rear of the hood. A photo of the side panels installed on the hood is shown in Figure 5.

Figure 5. Streivor Hood with 40-in. by 38-in. and 21-in. by 18-in. Side Panels Installed

Cooking Appliances

The appliances used to challenge this wall-mounted canopy hood were full-size electric ovens (light-duty), 2-vat high-efficiency gas fryers (medium-duty), a three-foot gas griddle (medium-duty) and three-foot underfired gas broilers (heavy-duty). For each setup, the appliances were operated under simulated heavy-load cooking conditions established by an ASHRAE research project [Ref 2] based on the heavy load cooking scenario defined by the applicable ASTM Standard Test Method [Ref 5,6,7,8]. The cooking appliance specifications are listed in Table 1.

Table 1 Cooking Appliance Specifications

	3-Ft. Gas Broiler	Full-Size Electric Convection Oven	2-Vat Gas Fryer	3-Ft. Gas Griddle
Rated Input	96,000 Btu/h	11.0, 12.1 kW	160,000 Btu/h	90,000 Btu/h
Capacity	719 sq. in.	9.7, 8.6 cu. ft	Two 50 lb. vats	1026 sq. in.
Height	37 in.	58, 57 in.	45 in.	37 in.
Width	34 in.	38, 40 in.	31 in.	36 in.
Depth	31 in.	40, 41 in.	28 in.	37 in.

Hood/Appliance Overhang Relationship

The appliance lines were positioned in a “pushed back” condition with a minimum distance (one inch or less) between the back wall and the rear of the appliance (i.e., rear gap). Once the appliances were positioned, the front overhang dimensions were measured and reported. Figure 6 illustrates the relationship between front overhang and rear gap. Table 2 shows the dimensions of front overhang and rear gap in the “pushed back” condition.

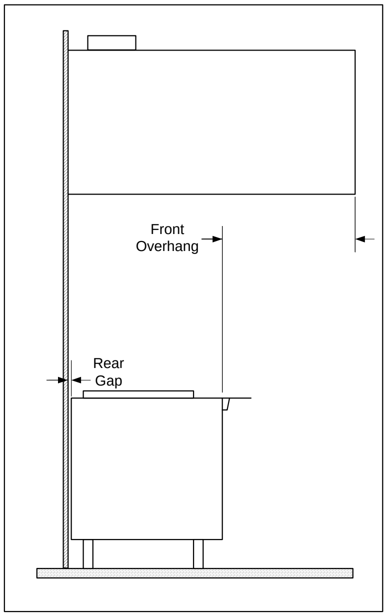

Figure 6. Relationship Between Front Overhang and Rear Gap

Table 2. Hood/Appliance Overhang and Rear Gap Settings

	3-Ft. Gas Broiler	Full-Size Electric Convection Oven	2-Vat Gas Fryer	3-Ft Gas Griddle
Front Overhang to Appliance [in.]	19	11, 10	23	14
Rear of Appliance to Backwall [in.]	0	0	0	0

Test Protocol

<u>Capture & Containment Testing</u>

"Hood capture and containment" is defined in ASTM F1704-09, *Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems*, as "the 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, while containment refers to these products remaining in the hood reservoir and not spilling out into the space. "Minimum capture and containment" is defined as "the conditions of hood operation at which the exhaust flow rate is just sufficient to capture and contain the products generated by the appliance in idle and heavy load cooking conditions, or at any intermediate prescribed load condition."

For each capture and containment (C&C) evaluation, the exhaust rate was reduced until spillage of the plume was observed (using the airflow visualization techniques described below) at any point along the perimeter of the hood. The exhaust rate was then increased in fine increments until capture and containment was achieved. For most cases, single-test determinations were used to establish the reported threshold of capture and containment for the specified test condition. In all evaluations, the replacement air was supplied from low-velocity, floor-mounted diffusers along the opposite wall with a maximum discharge velocity of 60 fpm (Figure 7). The introduction of replacement air from such sources has been found to be optimum (i.e., the least disruptive) for hood capture and containment [Ref 3].

For the hood equipped with side panels and installed over the combination-duty appliance line, a walk-by protocol was used to simulate operator movement in a restaurant environment and evaluate its effect on capture and containment. For this assessment, a researcher walked a line 18 inches in front of the oven, or 59 inches in front of the mounting wall, at a rate of 100 steps per minute. The exhaust rate was increased as needed to achieve capture and containment of the thermal plume under this dynamic challenge.

<u>Airflow Visualization</u>

The primary tools used for airflow visualization were schlieren and shadowgraph systems, which visualize the refraction of light due to air density changes. The sensitive flow visualization systems provide an image of the thermal activity along the perimeter of the hood by viewing the change in air density above the equipment caused by the heat and effluent generated by the cooking process. The front edge of the hood was monitored by a schlieren system and the left and right edges of the hood were monitored using shadowgraph systems. All visualization systems were located near the 78-inch hood height. Other flow visualization techniques that were utilized included smoke sticks. Figure 7 shows a plan view of the laboratory with the relative positions of the hood and flow visualization systems.

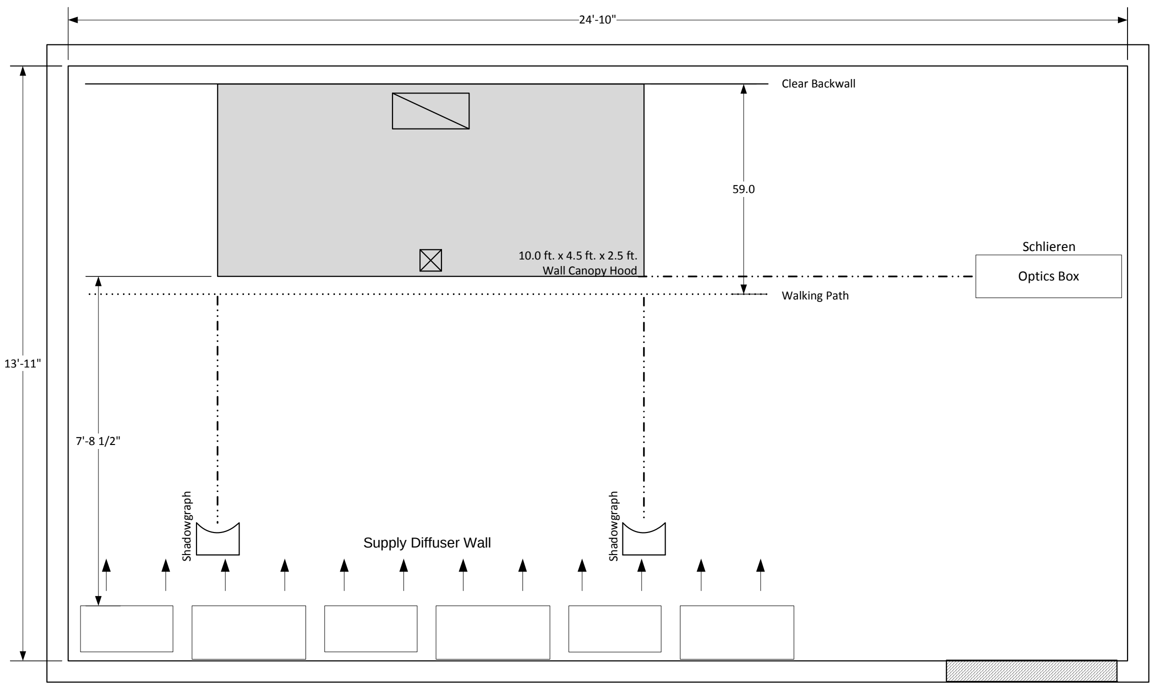

Figure 7. Plan View of Lab During Capture and Containment Evaluations

The airflow measurements in the laboratory comply with the AMCA 210/ASHRAE 51 Standard [Ref 4]. The error on the airflow rate measurement is less than 2%. The repeatability of capture and containment determinations is typically within 5% (e.g., ±100 cfm at 2000 cfm)

Static Pressure Differential

The static pressure difference was measured between the laboratory and the hood with filters with four 4-inch by 2-inch right-angle static pressure probes centered in each side of the exhaust collar. The measurement was taken 6 inches above the hood in the 22.0-inch by 10.0-inch exhaust collar. The pressures were measured at five exhaust flow rates, 1500, 2000, 2500, 3000, and 3300 cfm.

Cartridge Slot Velocity Profile

The cartridge slot velocity was measured with a 4-inch diameter rotating vane anemometer (RVA) positioned flush against the slot opening, perpendicular to the direction of the airflow with adjustable baffles in the 100% open position. The velocities through the six cartridges were measured using the traverse method. An average of three readings was recorded for each slot traverse. The velocity profiles were taken for two exhaust airflow rates, 2000 and 3000 cfm.

Appliance and Hood Configuration Test Matrix

The performance of the Streivor hood was evaluated for 17 basic tests, over five different appliances lines. Hood performance was evaluated without side panels, with 40-inch by 38-inch side panels and with 21-in. by 18-in. side panels for each appliance challenge. A test was performed on the mixed appliance line to evaluate hood performance with the 40-inch by 38-inch side panels and a dynamic walk-by challenge. In these cases, the exhaust rate was increased to achieve capture and containment with the disruption caused by operator movement.

Each appliance line configuration was evaluated in a best practice “pushed back” condition. However, the positioning of the appliances essentially closed the rear gap and sealed the area between the appliance and mounting wall (within an inch). The rear gap that existed in previous hood testing, for practical purposes, did not exist in this evaluation. As a result, the “rear seal” test became redundant and was reported as a duplicate of the condition where the mounting wall and appliance positioning created the rear seal.

The following test matrices present the details of the test setups for the respective appliance lines.

Underfired Gas Broiler (Heavy-Duty) Test Matrix

The heavy-duty challenge was comprised of three 3-foot, underfired gas broilers, which were tested in a static (no operator movement) condition. The appliances were located at a front overhang of 19 inches and resulted in a negligible rear gap (i.e., 0 inches). The hood performance was tested with and without two side panel designs. The "rear seal" Test 3 was not conducted as in previous hood testing. The backwall and the "pushed back" condition created the rear seal for all test conditions. As a result, the conditions of Test 2a and Test 3 were identical and the capture and containment rate of Test 2a was applied to the reported value for Test 3. The test matrix for the heavy-duty broilers is shown in Table 3 and the setup is shown in Figure 8.

Table 3. Underfired Gas Broiler (Heavy-Duty) Test Matrix

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	RH Appliance Effective Rear Gap [in]	Side Panels	Side Overhang[1] [in]
1	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/o SP	6
2a	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/ 40x38 SP	6
2b	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/ 21x18 SP	6
3	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/ SP & Rear Seal	6

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.

Figure 8. Heavy-Duty Underfired Gas Broiler Line

Gas Fryer (Medium-Duty) Test Matrix

The medium-duty test matrix consisted of a 6-vat fryer line (three 2-vat gas fryers), which were tested in a static (no operator movement) condition. The front overhang was 23 inches and resulted in a negligible rear gap (i.e., 0 inches). The hood performance was tested without and with two side panel designs. The test matrix for the medium-duty fryers is shown in Table 4 and the setup is shown in Figure 9.

Table 4. Fryer (Medium-Duty Appliance) Test Matrix

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	RH Appliance Effective Rear Gap [in]	Side Panels	Side Overhang[1] [in]
4	2-Vat Fryer	23	0	2-Vat Fryer	23	0	2-Vat Fryer	23	0	w/o SP	6
5a	2-Vat Fryer	23	0	2-Vat Fryer	23	0	2-Vat Fryer	23	0	w/ 40x38 SP	6
5b	2-Vat Fryer	23	0	2-Vat Fryer	23	0	2-Vat Fryer	23	0	w/ 21x18 SP	6

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.

Figure 9. Medium-Duty Gas Fryer Line

Full-Size Convection Oven (Light-Duty) Test Matrix

The light-duty test matrix consisted of three full-size electric convection ovens, which were tested in a static (no operator movement) condition. The front overhang was 11 and 10 inches and resulted in a negligible rear gap (i.e., 0 inches). The rear gap was measured from the backwall to either the rear of the oven cabinet or convection fan motor, whichever extended farther. The hood performance was tested without and with two side panel designs. The test matrix for the full-size ovens is shown in Table 5 and the setup is shown in Figure 10.

Table 5. Full-Size Convection Oven (Light-Duty) Test Matrix

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	RH Appliance Effective Rear Gap [in]	Side Panels	Side Overhang[1] [in]
6	Oven	11	0	Oven	11	0	Oven	10	0	w/o SP	Oven
7a	Oven	11	0	Oven	11	0	Oven	10	0	w/ 40x38 SP	Oven
7b	Oven	11	0	Oven	11	0	Oven	10	0	w/ 21x18 SP	Oven

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.

Figure 10. Light-Duty Full Size Convection Oven Line

2-Vat Fryer/Broiler or Griddle/Convection Oven (Combination-Duty) Test Matrix

The combination duty test matrix consisted of the 2-vat fryer in the left position, the 3-foot underfired broiler in the center position and the full size convection oven in the right position. The hood performance was tested without and with two side panel designs. The tests were performed with a static (no operator movement) condition, except for Test 10a that evaluated the hood performance using a walk-by protocol. For Tests 11, 12a and 12b the broiler was replaced with a griddle. The test matrix for the combination-duty appliance line is shown in Table 6 and the setup is shown in Figure 11.

Table 6. Fryer/Broiler or Griddle/Convection Oven (Combination Duty) Test Matrix

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	RH Appliance Effective Rear Gap [in]	Side Panels	Side Overhang[1] [in]
8	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/o SP	6
9a	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/ 40x38 SP	6
9b	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/ 21x18 SP	6
10a[2]	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/ 40x38 SP & walk-by	6
11	2-Vat Fryer	23	0	Griddle	14	0	Oven	10	0	w/o SP	6
12a	2-Vat Fryer	23	0	Griddle	14	0	Oven	10	0	w/ 40x38 SP	6
12b	2-Vat Fryer	23	0	Griddle	14	0	Oven	10	0	w/ 21x18 SP	6

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.
[2] Test condition was conducted with "walk-by" protocol.

Figure 11. Fryer/Broiler or Griddle/Convection Oven Appliance Line

Results and Discussion

The capture and containment results are presented for the different appliance line configurations in this section of the report.

Underfired Gas Broiler (Heavy-Duty) Testing

It was found that the exhaust rate required to capture and contain the thermal challenge from three broilers was 2100 cfm (210 cfm/ft) when utilizing the canopy hood without side panels. With the 40 in. x 38 in. and the side panels, the threshold airflow rate for capture and containment was reduced to 2000 cfm (200 cfm/ft). With the 21 in. x 18 in. side panels, the threshold airflow rate for capture and containment was 2100 cfm (210 cfm/ft). For Test 3, the integral backwall and the positioning of the broiler sealed the space between the appliance and backwall wall, and a “rear seal” was not necessary. The condition was the same as Test 2a. The same exhaust rate as Test 2a was applied to Test 3, 2000 cfm (200 cfm/ft). The results of the broiler line capture and containment tests are presented in Table 7.

Table 7. Capture and Containment Results for Broilers

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	Side Panels and/or Accessory	Side Overhangs	C&C Exhaust Rate [cfm]	C&C Exhaust Rate [cfm/ft]
1	Broiler	19	Broiler	19	Broiler	19	w/o Panels	6	2100	210
2a	Broiler	19	Broiler	19	Broiler	19	40x38 Panels	6	2000	200
2b	Broiler	19	Broiler	19	Broiler	19	21x18 Panels	6	2100	210
3	Broiler	19	Broiler	19	Broiler	19	40x38 Side Panels Rear Seal	6	2000	200

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.

Fryer (Medium-Duty) Testing

It was found that the exhaust rate required to capture and contain the 6-vat fryer line (three 2-vat fryers) was 1800 cfm (180 cfm/ft), when utilizing the hood without side panels. When the hood was equipped with 40 in. x 38 in. side panels, the capture and containment exhaust flow rate was reduced to 1400 cfm (140 cfm/ft), and with the 21 in. x 18 in. side panels, the capture and containment exhaust flow rate was reduced to 1500 cfm (150 cfm/ft). The results of the fryer capture and containment tests are presented in Table 8.

Table 8. Capture and Containment Results for Fryers

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	C&C Exhaust Rate [cfm]	C&C Exhaust Rate [cfm/ft]
4	2-Vat Fryer	23	2-Vat Fryer	23	2-Vat Fryer	23	w/o Panels	6	1800	180
5a	2-Vat Fryer	23	2-Vat Fryer	23	2-Vat Fryer	23	40x38 Panels	6	1400	140
5b	2-Vat Fryer	23	2-Vat Fryer	23	2-Vat Fryer	23	21x18 Panels	6	1500	150

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.

Full-Size Convection Oven (Light Duty) Testing

It was found that the exhaust rate required to capture and contain three full-size convection ovens without side panels was 1000 cfm (100 cfm/ft). When the hood was operated with 40 in. x 38 in. or 21 in. x 18 in. side panels, the capture and containment capture rate was reduced to 800 cfm (80 cfm/ft). The results of the full-size convection oven tests are presented in Table 9.

Table 9. Capture and Containment Results Full-Size Convection Ovens

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	Side Panels	Side Overhang[1] [in]	C&C Exhaust Rate [cfm]	C&C Exhaust Rate [cfm/ft]
6	Oven	20	Oven	20	Oven	19	w/o Panels	0	1000	100
7a	Oven	20	Oven	20	Oven	19	40x38 Panels	0	800	80
7b	Oven	20	Oven	20	Oven	19	21x18 Panels	0	800	80

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.

Fryer/Broiler or Griddle/Convection Oven (Combination-Duty) Testing

The combination-duty appliance line was evaluated with seven configurations. All evaluations for the combination-duty appliance line were conducted at a static condition except for Test 10a, which incorporated a walk-by protocol. Test 11, 12a and 12b were conducted with a griddle in place of the broiler. The capture and containment test results for the two combination-duty appliance lines are presented in Table 10.

The exhaust rate required to capture and contain a 2-vat fryer/3-foot broiler/full-size convection oven cook line was 1800 cfm (180 cfm/ft) without side panels installed. When the hood operated with either the 40 in. x 38 in. or 21 in. x 18 in side panels, the capture and containment exhaust rate was reduced to 1400 cfm (140 cfm/ft).

A walk-by evaluation was conducted for the combination duty line with 40 in. x 38 in. side panels. The exhaust flow rate required to capture and contain the dynamically disturbed thermal plume was 1500 cfm (150 cfm/ft).

The combination-duty appliance line was evaluated with a griddle replacing the broiler in the center position. The exhaust rate for capture and containment without side panels was 1700 cfm (170 cfm/ft). With the 40 in. x 38 in. side panels, the capture and containment rate was 1300 cfm (130 cfm/ft), and with the 21 in. x 18 in. side panels, the capture and containment rate was 1400 cfm (140 cfm/ft).

Table 10. Capture and Containment Results for 2-Vat Fryer / Broiler or Griddle/ Full-Size Convection Oven Appliance Line

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	C&C Exhaust Rate [cfm]	C&C Exhaust Rate [cfm/ft]
8	2-Vat Fryer	23	Broiler	19	Oven	10	w/o Panels	6	1800	180
9a	2-Vat Fryer	23	Broiler	19	Oven	10	40x38 Panels	6	1400	140
9b	2-Vat Fryer	23	Broiler	19	Oven	10	21x18 Panels	6	1400	140
10a[2]	2-Vat Fryer	23	Broiler	19	Oven	10	40x38 Panels Walk-By	6	1500	150
11	2-Vat Fryer	23	Griddle	14	Oven	10	w/o Panels	6	1700	170
12a	2-Vat Fryer	23	Griddle	14	Oven	10	40x38 Panels	6	1300	130
12b	2-Vat Fryer	23	Griddle	14	Oven	10	21x18 Panels	6	1400	140

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.
[2] Test condition was conducted with "walk-by" protocol.

Static Pressure Differential Measured Above Exhaust Collar

The static pressure difference was measured between the laboratory and the exhaust hood with cartridges installed and baffles in the 100% open position. The pressure was taken 6 inches above the exhaust collar in the 22.0-inch by 10.0-inch duct. The pressures were measured at five exhaust flow rates, 1500, 2000, 2500, 3000, and 3300 cfm. The pressure drop across the hood ranged from 0.48 in. of water at 1500 cfm to 2.04 in. of water at 3300 cfm. The results are presented in Table 11.

Table 11. Hood Static Pressure Readings in Exhaust Duct

Exhaust Airflow Rate [cfm]	Hood Static Pressure Drop [inches of water]
1500	0.48
2000	0.82
2500	1.19
3000	1.69
3300	2.04

Figure 12 presents a curve of the static pressure versus airflow data.

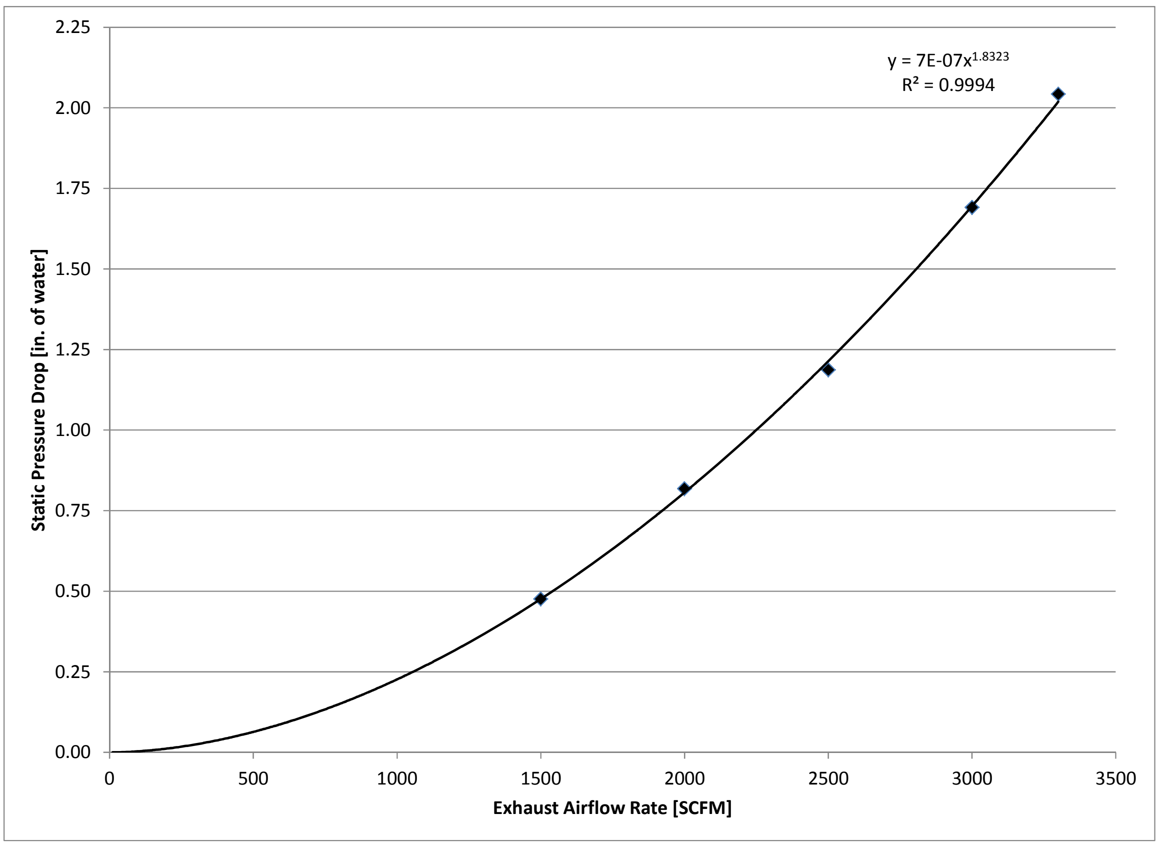

Figure 12. Static Pressure Differential Measured Above Exhaust Collar

Cartridge Slot Velocity Testing

Cartridge slot velocity readings were taken for each of the six cartridges installed with baffles in the 100% open position at two exhaust airflow rates. For the 3000 cfm exhaust rate, the slot velocities ranged from 1061 to 1175 fpm. For the 2000 cfm exhaust rate, the slot velocities ranged from 745 to 814 fpm. The data is presented in Table 12 and a velocity profile is shown in Figure 13.

Table 12. Filter Cartridge Slot Velocity Readings

Exhaust Flow Rate [cfm]	Filter Cartridge #1 (Left) [fpm]	Filter Cartridge #2 [fpm]	Filter Cartridge #3 [fpm]	Filter Cartridge #4 [fpm]	Filter Cartridge #5 [fpm]	Filter Cartridge #7 (Right) [fpm]	Average Filter Cartridge Velocity [fpm]	Standard Deviation [fpm]	Standard Deviation [%]
3000	1082	1143	1120	1113	1061	1175	1115	41	4
2000	748	780	768	753	745	814	768	26	3

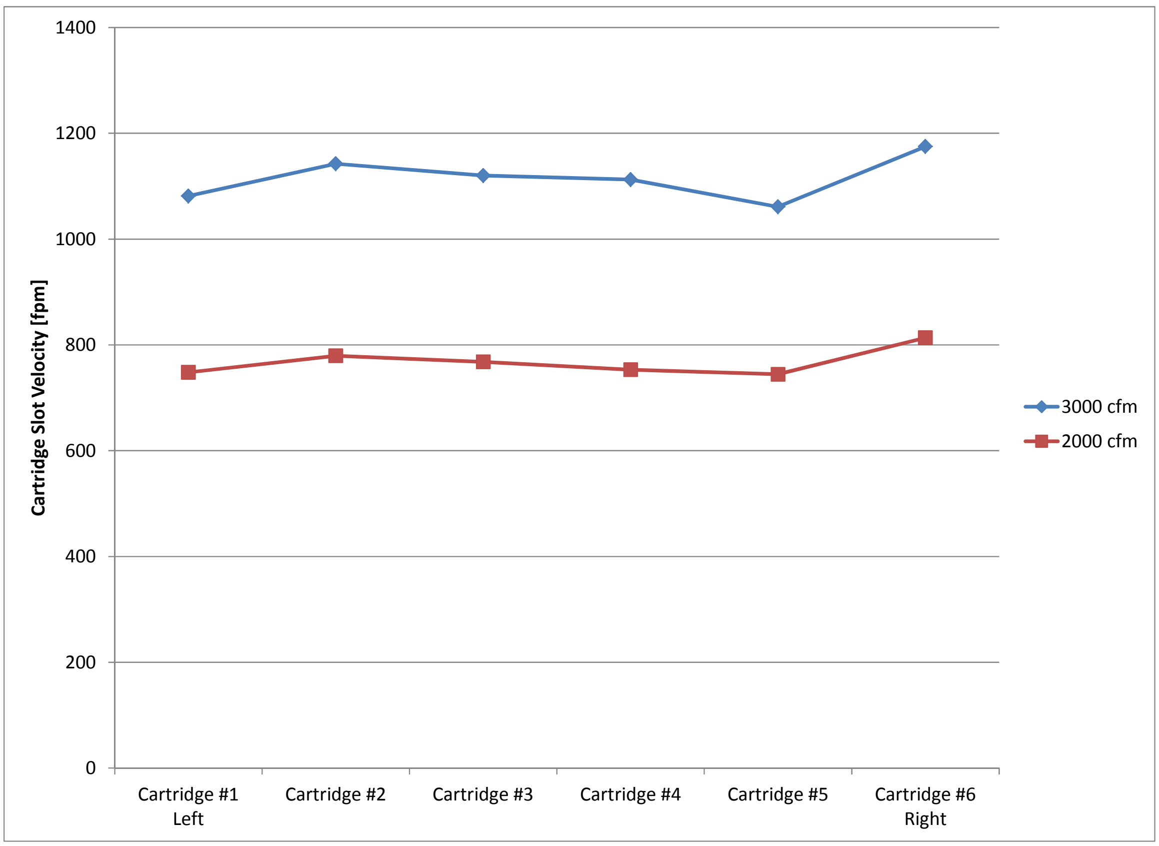

Figure 13. Filter Cartridge Slot Velocity Profiles

For both exhaust rates, the profiles show that the cartridge slot velocity was generally uniform across the hood. For the 3000 cfm exhaust rate, the average slot velocity was 1115 fpm, with a standard deviation of 41 fpm. For the 2000 cfm rate, the average slot velocity was 768 fpm, with a standard deviation of 26 fpm.

Summary and Conclusions

Table 13 and Figure 13 summarize the results for the capture and containment tests. The capture and containment airflow rates ranged from a low of 700 cfm (70 cfm/ft) for the light-duty three oven line, to a high of 2100 cfm (210 cfm/ft) for the heavy-duty three broiler line.

The combination-duty line was incorporated within the test matrix to reflect a cooking equipment challenge in a real-world kitchen. In this case, the capture and containment rate was 1800 cfm (180 cfm/ft). When the 40-inch by 38-inch side panels were installed on the hood on both sides, the exhaust flow rate dropped to 1400 cfm (140 cfm/ft). With the 21-inch by 18-inch side panels, the exhaust flow rate was also 1400 cfm (140 cfm/ft). Under the dynamic walk-by condition for the combination-duty line with the broiler, the capture and containment exhaust rate for the hood with 40-inch by 38-inch side panels increased to 1500 cfm (150 cfm/ft). When the griddle was substituted for the broiler under static test conditions without side panels, a capture and containment rate of 1700 cfm (170 cfm/ft) was recorded.

The benefit of the 40-inch by 38-inch side panels was demonstrated for all tested appliance lines. Reductions of 100, 400, 300, 400, and 400 cfm were found for the heavy, medium, light, combination with broiler, and combination with griddle appliance lines, respectively. The 21-inch by 18-inch side panels demonstrated reductions similar to the larger panels. Reductions of 300, 100, 400, and 300 cfm were found for the medium, light, combination with broiler and combination with griddle appliance lines, respectively.

The static pressure differential measured at the exhaust collar varied from 0.48 to 1.69 inches of water between 1500 to 3000 cfm of exhaust airflow.

The measured filter velocities across the length of the exhaust hood showed a 4% standard deviation from the average measured velocity. This result indicated a reasonably uniform filter velocity across the length of the hood.

The laboratory test setup was not intended to replicate a real-world installation of this hood where greater exhaust airflows may be required for the capture and containment of the cooking effluent. The objective of this ASTM 1704 testing was to characterize capture and containment performance of an exhaust hood in combination with the specified options within a controlled laboratory environment. The data in this report should not be used as the basis for design exhaust rates and specifications. Design exhaust rates must recognize UL710 safety listings, utilize the knowledge and experience of the designer with respect to the actual cooking operation, and compensate for the dynamics of a real-world kitchen.

Table 13. Summary of Capture and Containment Results for Streivor SAWCBD Hood and Standard Appliance Challenge

Test #	LH Appliance	LH Appliance Effective Front Overhang[1] [in]	LH Appliance Effective Rear Gap [in]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in]	CTR Appliance Effective Rear Gap [in]	RH Appliance	RH Appliance Effective Front Overhang[1] [in]	RH Appliance Effective Rear Gap [in]	Side Panels (SP)	Side Overhang[1] [in]	C&C Exhaust Rate [cfm]
1	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/o SP	6	2100
2a	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/ 40x38 SP	6	2000
2b	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/ 21x18 SP	6	2100
3	Broiler	19	0	Broiler	19	0	Broiler	19	0	w/ SP & 40x38 Rear	6	2000
4	2-Vat Fryer	23	0	2-Vat Fryer	23	0	2-Vat Fryer	23	0	w/o SP	6	1800
5a	2-Vat Fryer	23	0	2-Vat Fryer	23	0	2-Vat Fryer	23	0	w/ 40x38 SP	6	1400
5b	2-Vat Fryer	23	0	2-Vat Fryer	23	0	2-Vat Fryer	23	0	w/ 21x18 SP	6	1500
6	Oven	11	0	Oven	11	0	Oven	10	0	w/o SP	0	1000
7a	Oven	11	0	Oven	11	0	Oven	10	0	w/ 40x38 SP	0	700
7b	Oven	11	0	Oven	11	0	Oven	10	0	w/ 21x18 SP	0	900
8	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/o SP	6	1800
9a	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/ 40x38 SP	6	1400
9b	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/ 21x18 SP	6	1400
10a[2]	2-Vat Fryer	23	0	Broiler	19	0	Oven	10	0	w/ 40x38 SP & walk-by	6	1500
11	2-Vat Fryer	23	0	Griddle	14	0	Oven	10	0	w/o SP	6	1700
12a	2-Vat Fryer	23	0	Griddle	14	0	Oven	10	0	w/ 40x38 SP	6	1300
12b	2-Vat Fryer	23	0	Griddle	14	0	Oven	10	0	w/ 21x18 SP	6	1400

[1] Overhang measured from outer vertical surface of hood to vertical surface of appliance.
[2] Test condition was conducted with "walk-by" protocol.

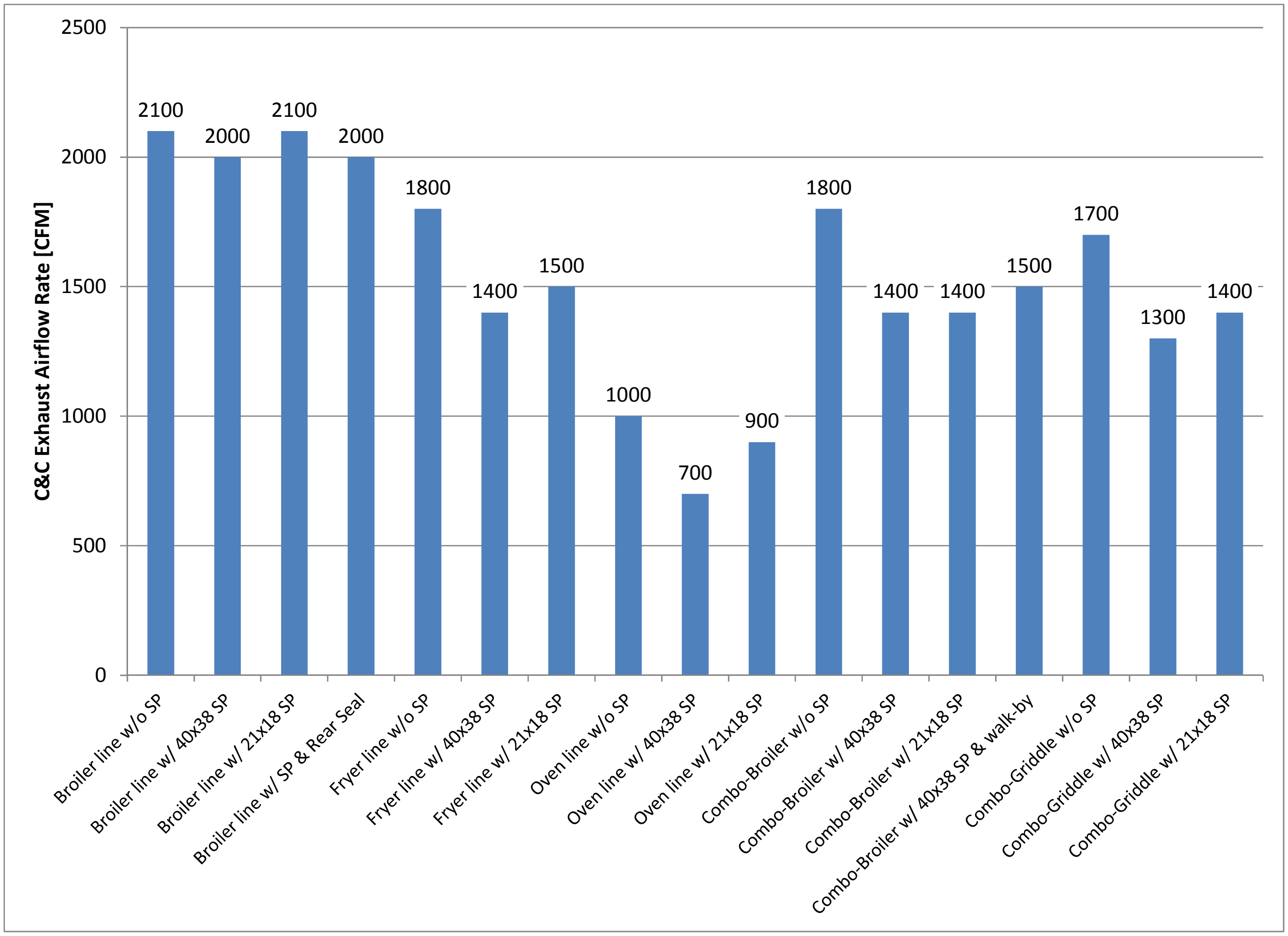

Figure 14. Graphical Summary of Capture and Containment Results for Streivor SAWCBD Hood and Standard Appliance Challenge

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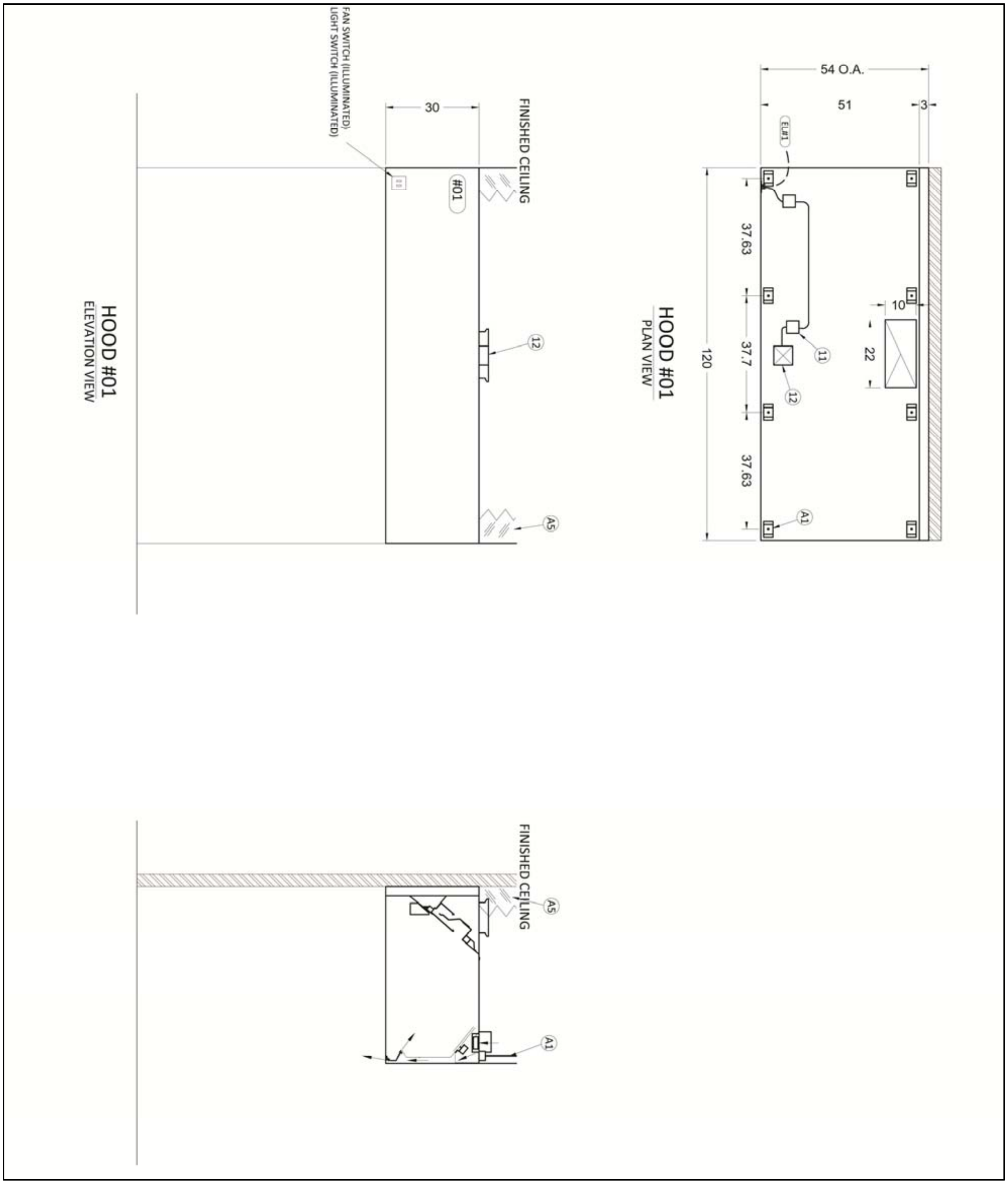
Appendix A. Streivor SAWCBD Hood as Tested



Food Service Technology Center

Addendum: Report Certification

EPA Organization ID: 1113443

This certifies that the undersigned has performed equipment testing according to the methodology outlined in the report described below, and verifies that the results recorded in that report were the actual results observed.

Report: Streivor SAWCBD Wall-Mounted Canopy Exhaust Hood Performance Report

Report #: 501311200-0 Date published: April 2013

File name: StreivorReport501311200April2013.pdf

Date sent for authorization: 05/06/2013

Tested by: (signature) Date signed: 6 MAY '13

R. Swierczyna (print name) Senior Engineer (title)

FNi Authorization: (signature) Date signed: 5/6/2013

David Zabrowski (print name) (title)

PG&E Authorization: (signature) Date signed: 5/6/13

Charlene Spoor (print name) Senior Program Engineer (title)