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., a 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

Legal Notice

Accurex, Model XXEW-T-10.0-S
Wall-Mounted Tapered Canopy Exhaust Hood
Performance Report

Application of ASTM Standard
Test Method F 1704-05

Food Service Technology Center
(www.fishnick.com)
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- The Food Service Technology Center (FSTC) and the Commercial Kitchen Ventilation Laboratory (CKVL) are committed to testing food service equipment using the best available scientific techniques and instrumentation.
- The FSTC and CKVL do not endorse any of the equipment tested.
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Contents

Objectives and Scope

This report summarizes the results of performance testing a Accurex, model XXEW-T-10.0-S 30-inch high tapered exhaust hood at the Commercial Kitchen Ventilation Laboratory within the scope of the PG&E Food Service Technology Center program. The objectives were to:

(1) Evaluate the capture and containment performance of this exhaust only, wall-mounted canopy hood when challenged with light-, medium-, heavy-, and mixed-duty appliances under the controlled conditions of the ASTM Standard Test Method F-1704 [Ref 1].

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

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

Equipment

Hood Specifications

The Accurex, model XXEW-T-10.0-S 30-inch high, serial 11327609, wall-mounted canopy hood tapered from 30 inches at the rear to a 24-inch height at the front of the hood. The 30-inch high portion extended 12 inches from the back wall of the hood. The hood measured 10 feet wide by 4.5 feet deep by 3.0 feet high at the rear, 2.0 feet high at the front, and was mounted to a transparent back wall. A 3-inch standoff behind the back panel was incorporated within the depth of the hood, and extended along the top 20.0 inches of its height. The hood was equipped with six 19.5-inch by 19.5-inch stainless steel removable centrifugal-type grease filters, and exhausted through one centered 36.0-inch by 14.0-inch exhaust collar located 3.0 inches from the back of the hood. The front lower edge of the hood was located at 78.0 inches above the finished floor. The hood over a heavy-duty broiler line is shown in Figure 1.

Figure 1. Accurex XXEW-10.0-S Tapered Wall-Mounted Canopy Hood Test Setup (Note Transparent Back Wall)

<u>Filter Specification</u>

The stainless steel centrifugal-type Grease-X-Tractor™ grease extractors measured 19.5 inches wide by 19.5 inches high by 1.8 inches deep with an inlet height of 3.5 inches. A front and back view are shown in Figure 2.

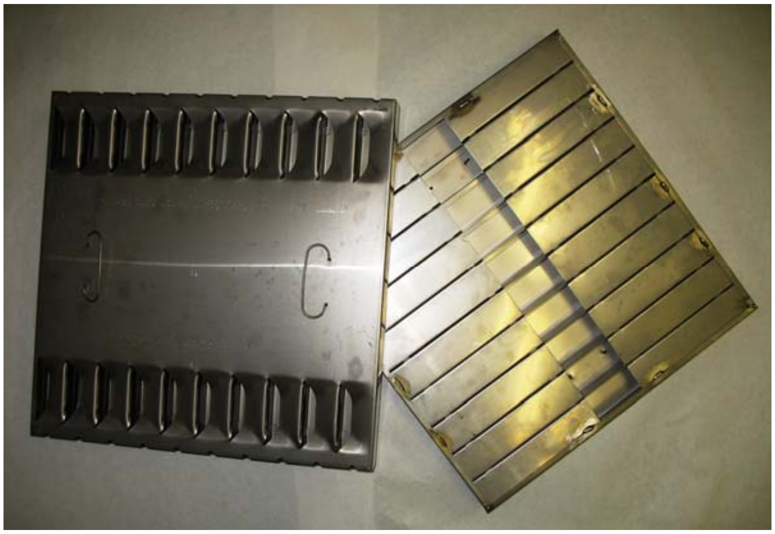

Figure 2. Centrifugal-Type Grease-X-Tractor™ Filters

Side Panel Configuration

To enhance hood capture and containment performance, side panels were used in eight capture and containment evaluations. The standard side panels measured 45 inches deep by 45 inches high by 45°, and were truncated below the appliance height and the front of the hood with a 4-inch edge. The 4-inch vertical front edge incorporated a 0.8-inch 90° bend. Photographs without and with the side panels installed on the three-broiler line are shown in Figure 3 and 4, respectively.

Figure 3. Side View of Set Up Without Standard 45-inch by 45-inch by 45° Side Panels

Figure 4. Side View of Set Up With Standard 45-inch by 45-inch by 45° Side Panels

Cooking Appliances

The appliances used to challenge this wall-mounted canopy hood were full-size electric ovens (light-duty category), 2-vat high-efficiency gas fryers, a three-foot griddle (medium-duty) and 3-foot underfired gas broilers (heavy-duty). For each setup, the appliances were operated under simulated heavy-load cooking conditions established by a recent ASHRAE research project [Ref 2] based on the heavy load testing per the ASTM Standard Test Methods for appliances [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	12.1 kW	160,000 Btu/h	90,000 Btu/h
Capacity	719 sq. in.	8.6 cu. ft	Two 50 lb. vats	1026 sq. in.
Height	37.0 in.	57.3 in.	45.3 in.	37.0 in.
Width	34.0 in.	40.0 in.	31.3 in.	36.0 in.
Depth	31 in.	41/38/42 in.	28 in.	37 in.

Hood/Appliance Overhang Relationship

The appliance lines were positioned in a "pushed back" condition with a minimum distance between the back wall and the rear of the appliance (i.e., minimized rear gap), while allowing enough space for utility connections. Figure 5 illustrates the relationship between front overhang and rear gap. Table 2 shows the actual dimensions of front overhang and rear gap in the "pushed back" condition. Ovens remained in the 12-inch overhang position for all tests, as this was also the position of maximum "push back" and minimum rear gap.

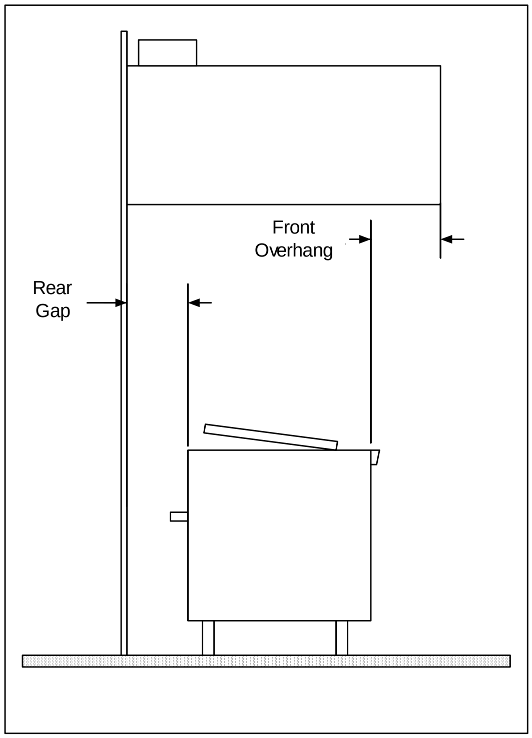

Figure 5. Relationship between Front Overhang and Rear Gap

Table 2. Hood/Appliance Overhang Relationships

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

Test Protocol

Capture & Containment Testing

"Hood capture and containment" is defined in ASTM F1704-05, *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 staying 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. This threshold capture and containment rate was used for direct comparisons across scenarios. In all evaluations, the replacement air was supplied from low velocity, floor-mounted diffusers along the opposite wall (Figure 8). The introduction of replacement air from such sources has been found to be optimum (i.e., the least disruptive) for the laboratory test setup [Ref 3].

A walk-by protocol was introduced to simulate operator movement in the restaurant in the vicinity of the hood during the cooking process. The procedure was used in the lab to emulate the effect of operator disturbance on capture and containment. For this assessment, a researcher walked a line 18 inches in front of the appliances with a 12 inch front overhang (i.e., 6 inches forward of the front panel of the hood) at a rate of 100 steps per minute. The exhaust rate was then increased to achieve capture and containment of the thermal plume under this dynamic challenge.

Airflow Visualization

The primary tools used for airflow visualization were schlieren and shadowgraph systems, which visualize the refraction of light due to air density changes. Since the heat and effluent generated by the cooking process change the air density above the equipment, the sensitive flow visualization systems provide a graphic image of the thermal activity along the perimeter of the hood. The front and left lower edges of the hood were monitored by schlieren systems located at a height that was centered between the typical 36-inch appliance height and the 78-inch hood height. The right lower edge of the hood was monitored using a shadowgraph system, located at the same height as the hood edge. Other flow visualization tools available to seed the thermal plume included smoke sticks and theater fog. Figure 6 shows a plan view of the laboratory with the relative position of the hood and flow visualization tools.

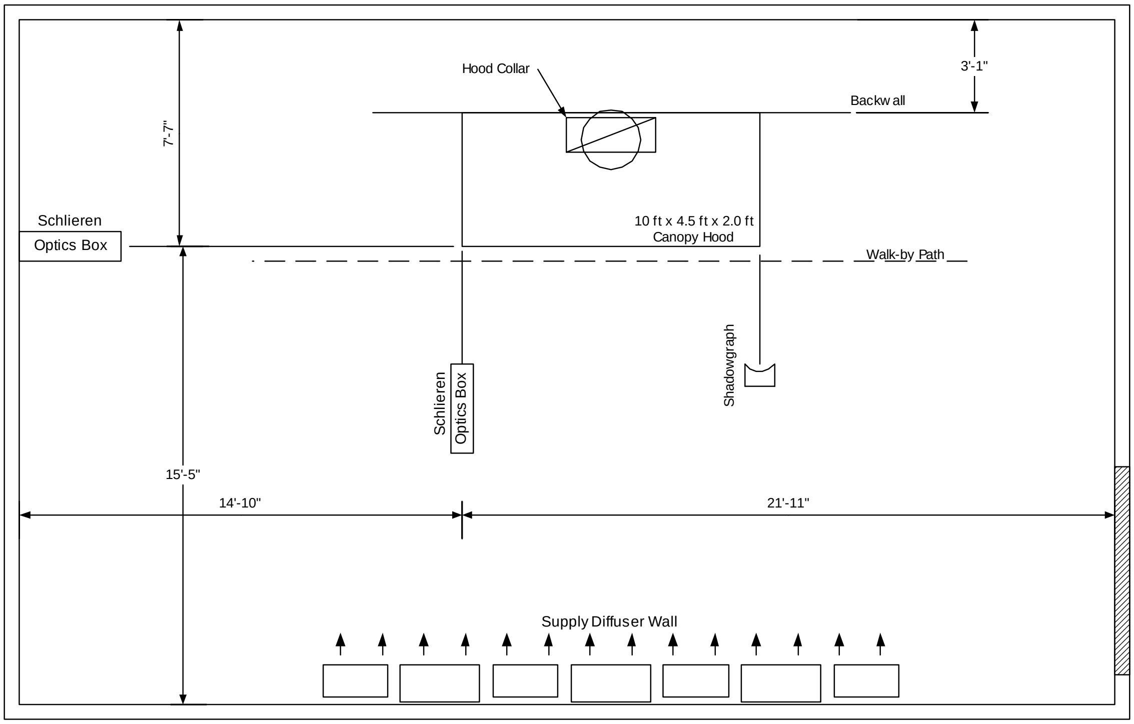

Figure 6. Plan View of Lab During Hood Evaluation

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%.

Static Pressure Differential

The static pressure drop of the hood was measured between the laboratory and the offset transition above the hood's collar. The pressure was taken in the 13-inch vertical section of the 36.0 inch by 14.0 inch transition with a 4-inch by 2-inch right-angle static pressure probe inserted 10.0 inches above the top of the hood. The pressures were measured at five exhaust flow rates, 1500, 2000, 2500, 3000, and 3300 cfm.

Filter Velocity Profile

The grease filter velocity was measured with a 2.75-inch diameter, rotating vane anemometer (RVA) traversed flush against the openings. An average of two sixteen second average readings was recorded for measurement. The velocity profiles were taken for two exhaust airflow rates, 2000 and 3000 cfm.

Appliance and Hood Configuration Test Matrix

The performance of the Accurex model XXEW-10.0-S tapered hood was evaluated under 12 test conditions. Generally, each appliance line configuration was evaluated in a best practice “pushed back” condition. Hood performance was evaluated either without side panels, or with standard side panels. In addition, one test with the broiler challenge included a seal between the rear of the appliances and the wall. Another supplementary test was performed on the mixed appliance line to evaluate hood performance under a dynamic walk-by challenge. In this case, the exhaust rate was increased to achieve capture and containment under the disruption caused by operator movement. The following test matrices present the details of the test setups for the respective appliance lines. Each test condition is sequentially numbered for reference to the reported data.

Underfired Gas Broiler (Heavy-Duty) Test Matrix

The heavy-duty challenge was comprised of three 3-foot, underfired gas broilers. The front overhang was 18 inches in the pushed back condition and resulted in a rear gap of 5 inches. The hood performance was tested without side panels or with standard side panels. They were tested in a static (no operator movement) condition. With the broilers in the pushed-back configuration and the side panels installed, an additional evaluation was done with the 5-inch rear gap sealed between the broilers and the back wall at the height of the top of the appliance cabinet (Test 3). The test matrix for the heavy-duty broilers is shown in Table 3 and the setup illustrated in Figure 7.

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 Overhang[2] [in.]	Side Panels
1	Charbroiler	18	5	Charbroiler	18	5	Charbroiler	18	5	6	Without
2	Charbroiler	18	5	Charbroiler	18	5	Charbroiler	18	5	6	With
3	Charbroiler	18	5	Charbroiler	18	5	Charbroiler	18	5	6	With Side Panels & Rear Seal

[1]Front overhang measured from front of hood to front of appliance

Figure 7. 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). The front overhang was 22 inches and resulted in a rear gap of 4 inches. The hood performance was tested either without side panels, or with standard side panels, or with mini side panels. They were tested in a static (no operator movement) condition. The test matrix for the medium-duty fryers is in Table 4 and the setup is shown in Figure 8.

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 Overhang[2] [in.]	Side Panels
4	2-Vat Fryer	22	4	2-Vat Fryer	22	4	2-Vat Fryer	22	4	6	Without
5	2-Vat Fryer	22	4	2-Vat Fryer	22	4	2-Vat Fryer	22	4	6	With

[1]Front overhang measured from front of hood to front of appliance

Figure 8. Medium-Duty Gas Fryer Line

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

The light-duty test matrix consisted of one full-size electric convection oven and two full size gas convection ovens. For these tests, the electric oven continuously idled. The gas ovens were idled to maintain the same operating temperature, and then the burners were turned off during the capture and containment evaluation [Ref 2]. The front overhang was 12.0 inches. In this configuration, the left oven had 4.0 inches between the convection motor and the back wall, the center oven had 1.0 inch between the motor and the back wall, and the right oven was flush against the back wall. The rear gap was measured from the rear of the convection fan motor to the back wall, except for the center oven that had its motor shrouded. The hood performance was tested with either without side panels or with the standard side panels. They were tested in a static (no operator movement) condition. The test matrix for the full-size ovens is shown in Table 5 and the setup illustrated in Figure 9.

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 Overhang[2] [in.]	Side Panels
6	Oven	12	4	Oven	12	1	Oven	12	0	0	Without
7	Oven	12	4	Oven	12	1	Oven	12	0	0	With

[1]Front overhang measured from front of hood to front of appliance

Figure 9. 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 with either without side panels or with standard side panels. They were tested in a static (no operator movement) condition, except for Test 10. For this test, hood performance was evaluated using a walk-by protocol. In Test 11 and 12, the broiler was replaced with a griddle. The test matrix for the combination-duty appliance line is shown in Table 6 and the setup illustrated in Figure 10.

Table 6. Fryer/Broiler/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 Overhang[2] [in.]	Side Panels
8	2-Vat Fryer	22	4	Charbroiler	18	5	Oven	12	1	6	Without
9	2-Vat Fryer	22	4	Charbroiler	18	5	Oven	12	1	6	With
10-walkby	2-Vat Fryer	22	4	Charbroiler	18	5	Oven	12	1	6	With
11	2-Vat Fryer	22	4	Griddle	12	5	Oven	12	1	6	Without
12	2-Vat Fryer	22	4	Griddle	12	5	Oven	12	1	6	With

[1]Front overhang measured from front of hood to front of appliance
[3]Test condition was conducted with "walk-by" protocol.

Figure 10. Fryer/Broiler/Convection Oven Appliance Line

Results and Discussion

The capture and containment results are presented below for the different appliance-line configurations.

Underfired Gas Broiler (Heavy-Duty) Testing

The results of the broiler-line capture and containment testing are presented in Table 7. It was found that the exhaust rate required to capture and contain the thermal challenge from three broilers was 2600 cfm (260 cfm/ft) when utilizing the canopy hood without side panels. With the standard side panels, the threshold airflow rate for capture and containment was maintained at 2600 cfm (260 cfm/ft). When the rear gap between the broiler cabinet and backwall was sealed in addition to the side panels, the capture and containment exhaust rate was reduced to 2000 cfm (200 cfm/ft).

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 Overhang[2] [in.]	Side Panels	C&C [cfm]	C&C [cfm/ft]
1	Charbroiler	18	Charbroiler	18	Charbroiler	18	6	Without	2600	260
2	Charbroiler	18	Charbroiler	18	Charbroiler	18	6	With	2600	260
3	Charbroiler	18	Charbroiler	18	Charbroiler	18	6	With Side Panels & Rear Seal	2000	200

[1]Front overhang measured from front of hood to front of appliance

Fryer (Medium-Duty) Testing

The results of the fryer capture and containment testing are presented in Table 8. It was found that the exhaust rate required to capture and contain the 6-vat fryer line (three 2-vat fryers) was 1700 cfm (170 cfm/ft) without side panels. The 30-inch high portion of the hood within 12 inches of the backwall provided a means to contain the fryer flue jets. When the standard side panels were added, the capture and containment flow rate was reduced to 1600 cfm (160 cfm/ft).

Table 8. Capture and Containment Results for Fryers

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 Overhang[2] [in.]	Side Panels	C&C [cfm]	C&C [cfm/ft]
4	2-Vat Fryer	22	2-Vat Fryer	22	2-Vat Fryer	22	6	Without	1700	170
5	2-Vat Fryer	22	2-Vat Fryer	22	2-Vat Fryer	22	6	Standard w/4x90	1600	160

[1]Front overhang measured from front of hood to front of appliance

Full-Size Convection Oven (Light Duty) Testing

The results of the full-size convection oven testing are presented in Table 9. It was found that the exhaust rate required to capture and contain three full-size convection ovens without side panels was 1100 cfm (110 cfm/ft). When the hood was used with standard side panels, the capture and containment capture and containment exhaust rate was maintained at 1100 cfm (110 cfm/ft).

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 Overhang[2] [in.]	Side Panels	C&C [cfm]	C&C [cfm/ft]
6	Oven	12	Oven	12	Oven	12	0	Without	1100	110
7	Oven	12	Oven	12	Oven	12	0	Standard	1100	110

[1]Front overhang measured from front of hood to front of appliance

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

The results for the 2-vat fryer/3-foot broiler/full-size convection oven capture and containment tests are presented in Table 10. All evaluations were conducted at a static condition except for test 10 that incorporated a walk-by protocol. Test 11 and 12 were conducted with a griddle in place of the broiler.

The exhaust rate required to capture and contain a 2-vat fryer/3-foot broiler/full-size convection oven cook line was 1900 cfm (190 cfm/ft) without side panels. When the hood was used with standard side panels the capture and containment exhaust rate was not reduced.

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.]	CTR Appliance	CTR Appliance Effective Front Overhang[1] [in.]	RH Appliance	RH Appliance Effective Front Overhang[1] [in.]	Side Overhang[2] [in.]	Side Panels	C&C [cfm]	C&C [cfm/ft]
8	2-Vat Fryer	22	Charbroiler	18	Oven	12	6	Without	1900	190
9	2-Vat Fryer	22	Charbroiler	18	Oven	12	6	Standard	1900	190
10-walkby	2-Vat Fryer	22	Charbroiler	18	Oven	12	6	Standard	2500	250
11	2-Vat Fryer	22	Griddle	12	Oven	12	6	Without	1600	160
12	2-Vat Fryer	22	Griddle	12	Oven	12	6	Standard	1400	140

[1]Front overhang measured from front of hood to front of appliance
[2]Test condition was conducted with "walk-by" protocol.

A walk-by evaluation was conducted for the combination duty line with standard side panels. The increase in exhaust flow rate required to capture and contain the dynamically disturbed thermal plume was 2500 cfm (250 cfm/ft) or 600 cfm (60 cfm/ft) higher than the static condition.

The combination-duty appliance line was also evaluated with a griddle replacing the broiler in the center position. The exhaust rate for capture and containment without side panels was 1600 cfm (160 cfm/ft). With standard side panels, the capture and containment rate was reduced to 1400 cfm (140 cfm/ft).

Static Pressure Differential Measured at Hood's Transition

The static pressure drop of the hood was measured between the laboratory and the duct transition for five exhaust flow rates. The pressure drop ranged from 0.25 inches of water at 1500 cfm to 0.99 inches of water at 3300 cfm. At 2500 cfm the pressure drop was 0.63 in. of water. The results are presented in Table 11.

Table 11. Hood Static Pressure Readings at Hood's Transition

Exhaust Flow Rate [cfm]	Hood Static Pressure at Exhaust Transition [inches of water]
1500	0.25
2000	0.43
2500	0.63
3000	0.84
3300	0.99

Figure 11 presents the static pressure versus airflow curve. The data fit very well, reflecting a typical pressure versus airflow relationship.

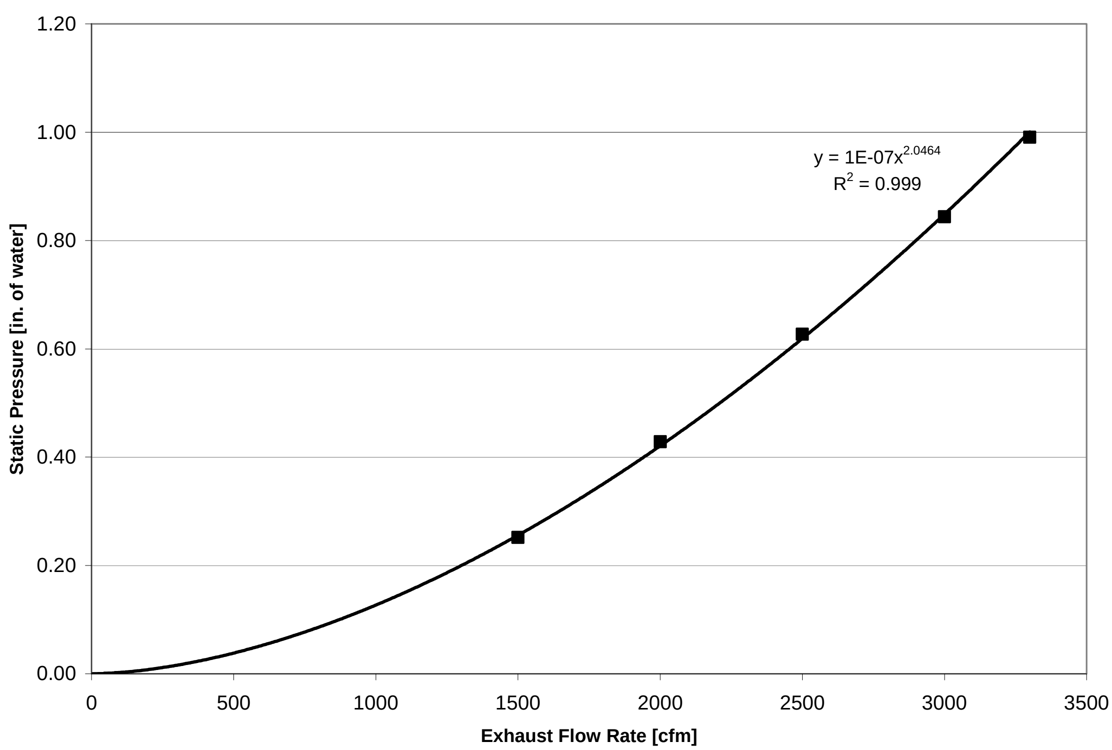

Figure 11. Static Pressure Differential Measured at the Hood's Duct Transition

Filter Velocity Testing

Filter velocity readings were taken for each of the six filters at two exhaust flow rates. For the 2000 cfm exhaust rate, the filter velocities ranged from 458 to 505 fpm. For the 3000 cfm exhaust rate, the filter velocities ranged from 650 to 702 fpm. The results are presented in Table 12 and a velocity profile is shown in Figure 12.

Table 12. Filter Face Velocity Readings

Exhaust Flow Rate [cfm]	Left Filter #1 Velocity [fpm]	Filter #2 Velocity [fpm]	Filter #3 Velocity [fpm]	Filter #4 Velocity [fpm]	Filter #5 Velocity [fpm]	Right Filter #6 Velocity [fpm]	Avg. Filter Velocity [fpm]	Standard Deviation [fpm]	Standard Deviation [%]
2000	463	482	503	489	505	458	483	20	4
3000	669	671	702	689	666	650	674	19	3

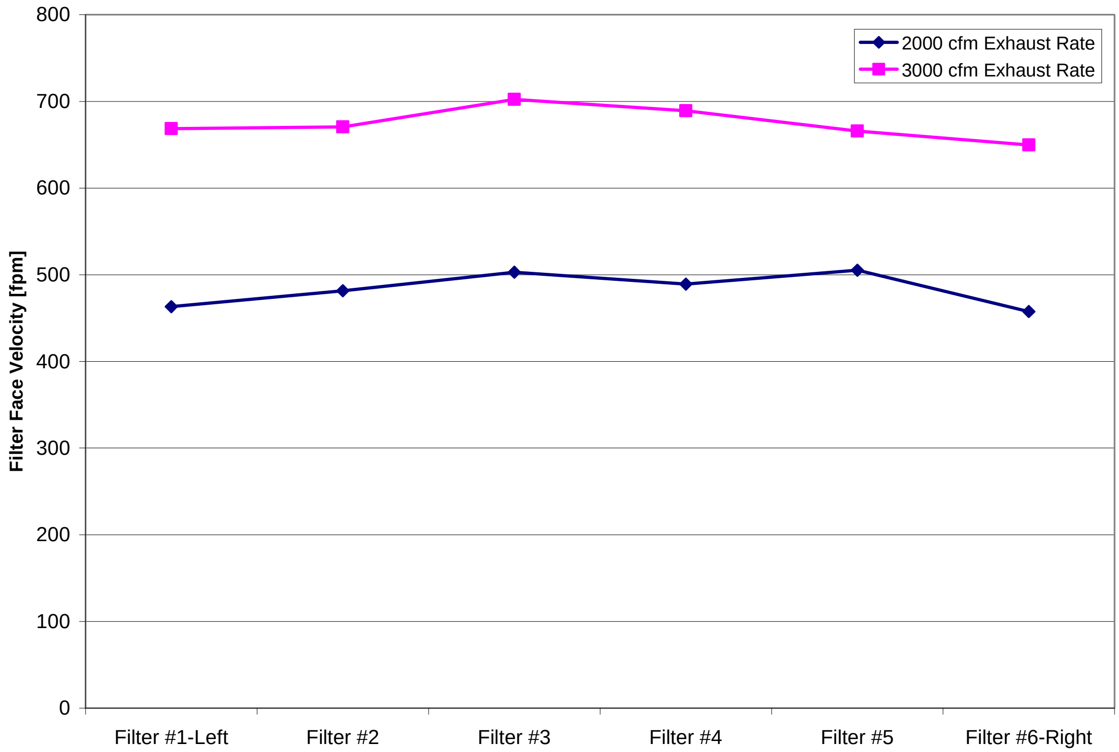

Figure 12. Filter Velocity Profiles

For both exhaust rates, the profiles show that the slot velocity was at a maximum toward the duct opening and left side, and a minimum towards the right side of the hood. For the 2000 cfm exhaust rate, the average velocity was 483 fpm and the minimum rate of 458 fpm was found at the right side. For the 3000 cfm rate, the average filter velocity was 674 fpm, with a maximum velocity of 702 fpm at the center, and a minimum velocity of 650 fpm at the right side. The average effective filter area was calculated as 4.3 square feet.

Summary of Results and Conclusions

Table 13 and Figure 13 summarize the results for the capture and containment testing. The test numbers in Figure 13 refer to the first column of Table 13 and associated test condition. Overall, the capture and containment airflow rates ranged from a low of 1100 cfm (110 cfm/ft) to a high of 2600 cfm (260 cfm/ft).

The benefit of the standard side panels was demonstrated for most appliance lines, with a 100 to 200 cfm (10 to 20 cfm/ft) improvement compared to operating without side panels. When a rear shield was installed (between the rear of the charbroilers and the back wall), a 600 cfm (60 cfm/ft) improvement was found, with the capture and containment flow rate dropping from 2600 cfm (260 cfm/ft) to 2000 cfm (200 cfm/ft). Based on testing experience of the CKV research team and data from the ASHRAE study [Ref 2], a 2000 cfm (200 cfm/ft) exhaust rate is a very low threshold of capture and containment for a heavy-duty appliance challenge. For the 6-vat fryer line, the hood's performance was reduced 100 cfm (10 cfm/ft) with side panels. The 30-inch high portion of the hood within 12 inches of the backwall provided a means to contain the fryer flue jets in front of the filter bank without side panels. When the standard side panels were added, the capture and containment flow rate was reduced from 1700 cfm (170 cfm/ft) to 1600 cfm (160 cfm/ft).

The multi-duty line was incorporated within the test matrix to reflect a cooking equipment challenge in a real-world, casual dining kitchen. In this case, the capture and containment rate was 1900 cfm (190 cfm/ft). When the standard side panels were installed, the capture and containment rate was not reduced. When the griddle was substituted for the broiler under static test conditions, a capture and containment rate of 1600 cfm (160 cfm/ft) was recorded. Under the dynamic walk-by condition for the multi-duty line with the broiler, the capture and containment exhaust rate for the hood with side panels increased to 2500 cfm (250 cfm/ft). Based on the experience of the CKV/FSTC research team, this exhaust rate is believed to be a representative design value for a multi-duty appliance line.

The static pressure drop of the hood was measured at the duct transition varied from 0.25 to 0.84 in. of water between 1500 to 3000 cfm of exhaust airflow. At 2500 cfm (250 cfm/ft) the measured static pressure difference was 0.63 in. of water taken in the duct transition joining the hood collar and the lab exhaust duct.

The measured filter velocities across the length of the exhaust hood showed a maximum standard deviation of 3% from the average measured velocity.

Table 13. Summary of Capture and Containment Results

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 Overhang[2] [in.]	Side Panels	C&C [cfm]	C&C [cfm/ft]
1	Charbroiler	18	5	Charbroiler	18	5	Charbroiler	18	5	6	Without	2600	260
2	Charbroiler	18	5	Charbroiler	18	5	Charbroiler	18	5	6	With	2600	260
3	Charbroiler	18	5	Charbroiler	18	5	Charbroiler	18	5	6	With Side Panels & Rear Seal	2000	200
4	2-Vat Fryer	22	4	2-Vat Fryer	22	4	2-Vat Fryer	22	4	6	Without	1700	170
5	2-Vat Fryer	22	4	2-Vat Fryer	22	4	2-Vat Fryer	22	4	6	With	1600	160
6	Oven	12	4	Oven	12	1	Oven	12	0	0	Without	1100	110
7	Oven	12	4	Oven	12	1	Oven	12	0	0	With	1100	110
8	2-Vat Fryer	22	4	Charbroiler	18	5	Oven	12	1	6	Without	1900	190
9	2-Vat Fryer	22	4	Charbroiler	18	5	Oven	12	1	6	With	1900	190
10-walkby	2-Vat Fryer	22	4	Charbroiler	18	5	Oven	12	1	6	With	2500	250
11	2-Vat Fryer	22	4	Griddle	12	5	Oven	12	1	6	Without	1600	160
12	2-Vat Fryer	22	4	Griddle	12	5	Oven	12	1	6	With	1400	140

[1]Front overhang measured from front of hood to front of appliance
[2]Test condition was conducted with “walk-by” protocol.

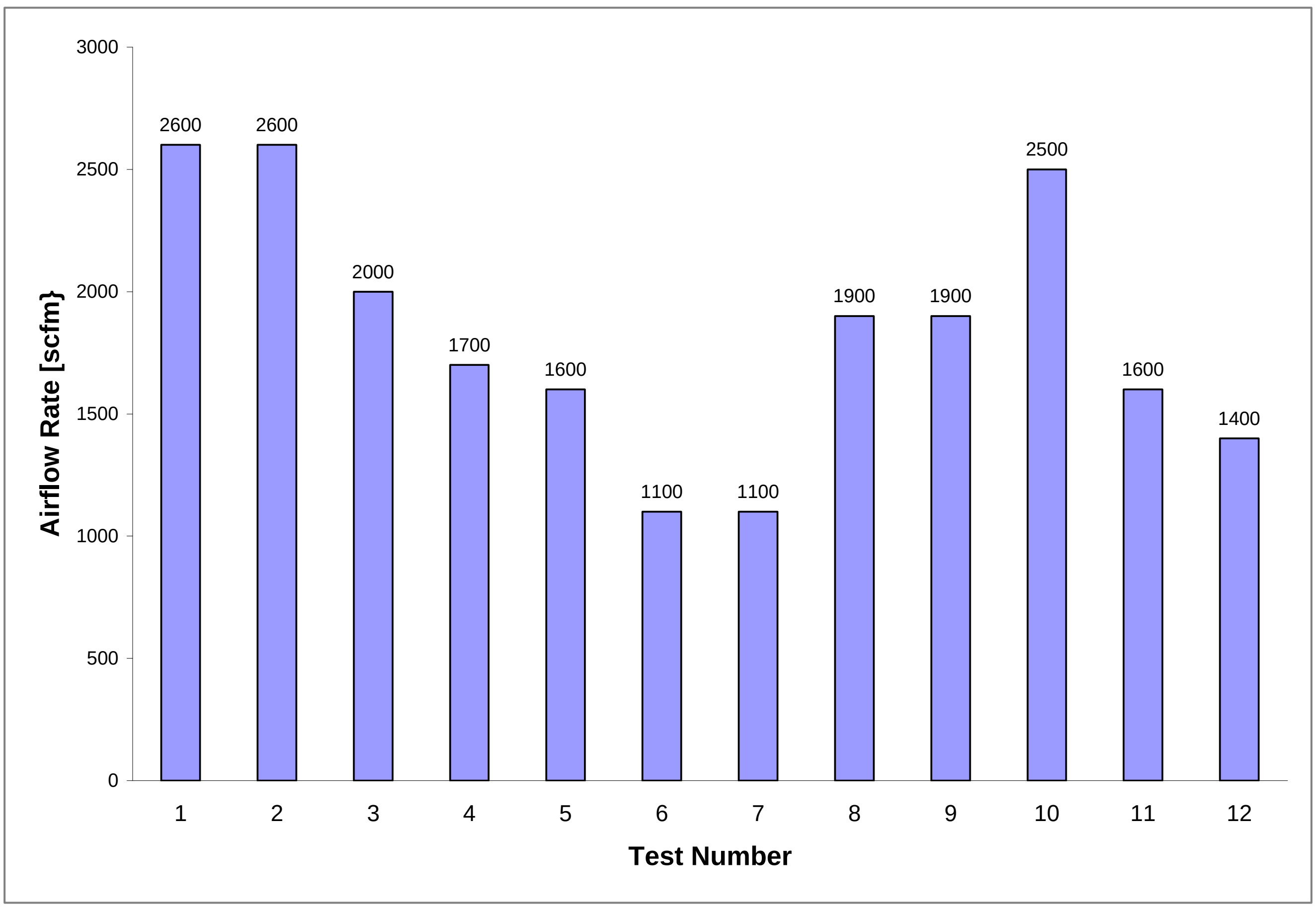

Figure 13. Summary of Capture and Containment Results

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Appendix A: Accurex Model XXEW-T-10.0 S