

Central States Lab Seminar
Illinois Water Environment Association
Crystal Lake City Hall
100 W. Municipal Complex
Crystal Lake, IL 60039

June 17, 2008

CHEMICAL FUME HOOD CHALLENGES

Presented by Mike Bishop
LabTech Midwest, A Division of PSA LabTech, Inc.



ANSI/AIHA Z9.5-2003

**A
I
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A**

**American
National
Standard**

**Laboratory
Ventilation**

American Industrial Hygiene Association
2700 Prosperity Ave., Suite 250
Fairfax, VA 22031



Pre-Purchase Performance Test (PPT)

Procedure for Certifying Laboratory Fume Hoods To Meet EPA Standards

April 26, 2006

US Environmental Protection Agency
Safety, Health and Environmental Management Division
Policy, Programs and Oversight Branch
Howard O. Wilson, Chief

ANSI/ASHRAE 110-1995

Supersedes ANSI/ASHRAE 110-1985



ASHRAE[®] GUIDELINE

AN AMERICAN NATIONAL STANDARD

Method of Testing Performance of Laboratory Fume Hoods

Approved by the ASHRAE Standards Committee February 2, 1995; by the ASHRAE Board of Directors February 2, 1995; and by the American National Standards Institute April 14, 1995.

ASHRAE Standards are updated on a five-year cycle; the date following the Standard number is the year of ASHRAE Board of Directors approval. The latest copies may be purchased from ASHRAE Customer Services, 1791 Tullie Circle, NE, Atlanta, GA 30329.

*1995

ISSN 1041-2338

**AMERICAN SOCIETY OF HEATING,
REFRIGERATING AND
AIR-CONDITIONING ENGINEERS, INC.**
1791 Tullie Circle, NE • Atlanta, GA 30329

Scientific Equipment
& Furniture Association

SEFA 1-2006

Recommended Practices
For Laboratory Fume Hoods



TRADITIONAL DESIGN FUME HOOD DESIGN

Fixed Baffles

High Volume Air – Cubic Feet per Minute (cfm)

High Air Speed Rate – Feet Per Minute (fpm)

High Energy Cost

Safety – Good if Set up Correctly



2100 South Calhoun Road
Phone 262-754-9800
Fax 262-754-9802
Email: mbishop@labtech-midwest.com

TEST RESULTS
ANSI/ASHRAE 110-1995
Method of Testing Performance of Laboratory Fume Hoods

Fume Hood Type 8' Aux Air w/o panels
4/22/2008 12:27:28 PM

PERFORMED FOR:

Rohm & Hass Company
2531 Technology Dr., Suite 301
Elgin, IL 60123-7832
Mary Watti

LOCATION:

Rohm & Hass Company
2531 Technology Dr., Suite 301
Elgin, IL 60123-7832
R & D Lab
Room 148 FH#15b

This report contains the test results, for the specified fume hood, when tested in accordance with the ANSI ASHRAE 110-1995 "Method of Testing Performance of Laboratory Fume Hoods" test guideline. This method of testing applies to conventional, bypass, add air and VAV fume hoods.

The sub-headings listed below correspond to the sub-headings in the ANSI/ASHRAE 110-1995 guideline.

4. INSTRUMENTATION AND EQUIPMENT

Tracer Gas: 98% Sulfur Hexafluoride
Ejector System: Custom Fabricated Ejector per figures 1-3.
Critical Orifice: Provides a flow rate of 4.0 Lpm at an upstream pressure of 34 psi.

Detector Instrument: Qualitek Q200, S/N 2001966
Range of detection 0 to 0.6 PPM / 0 to 600 PPM.
Calibration Date 04-22-08 Calibration Time 11:30 AM
Recalibration Date 04-22-08 Recalibration Time 5:20 PM
Calibration Variance 0%

Recorder: Readings are recorder with a computer with accuracy of $\pm 0.092\%$ of full scale.

Manikin: Of size and placement as specified in the ASHRAE guideline.

FV Measuring Instrument: Alnor AVT55 Anemometer, Range 0 to 999 fpm

Smoke: Local and large-volume generating devices in accordance with the ASHRAE guideline.

5. TEST CONDITIONS

Room Ventilation:	At full normal operation.
Room Description:	Testing conducted in the R & D Laboratory - Room 148. Crosscurrents in the area 5' in front of the hood are far below 30 fpm. There are a total of 18 fume hoods operating within the lab. In addition, the room is equipped with 12 source capture exhaust systems.
Background Levels:	The background level is below 10% of control level.
Preliminary Data:	The R & D laboratory is 78' X 45' X 10' high with a total of 6 supply air fixtures throughout the ceiling. The fume hood is located on the west side of the lab on an island with 3 other hoods. The lab has four doors which remained closed during the test.

HOOD DESCRIPTION

Hood Type	8' Aux Air w/o panels
Baffle Type & Position:	Fixed lower and center slots. Adjustable upper set at full open.
Sash Opening:	Full Open Position with horizontal panels removed.
Specified Face Velocity:	100 Feet Per Minute
Volume:	1994 Cubic Feet Per Minute
Static Pressure:	Not Available

6. FLOW VISUALIZATION AND VELOCITY PROCEDURE

LOCAL VISUALIZATION CHALLENGE

Smoke was applied to the following locations with the listed results.

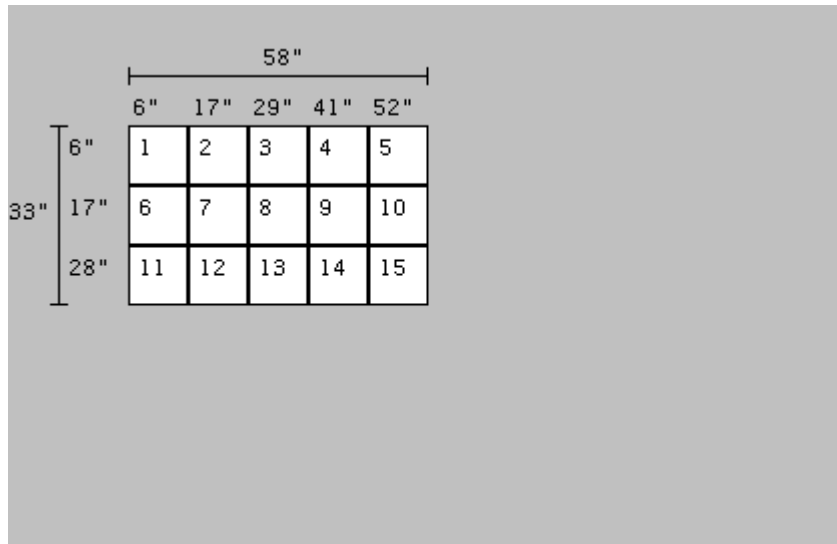
Under the airfoil:	Smoke was exhausted smoothly and was not entrained in the vortex at the top of the hood.
Along both walls:	Positive air movement, no reverse flows.
Along the floor:	Positive air movement, no reverse flows.
8" diameter on back:	Positive air movement, no reverse flows, no dead air space, no visible smoke flow out of the front of the hood.
Along equipment:	There was no equipment present in the hood. Smoke generated at the work top flowed evenly into the lower baffle opening almost immediately.

LARGE VOLUME VISUALIZATION CHALLENGE

Large volume release:	All smoke was rapidly and smoothly exhausted. There was no visible release of smoke from the hood. There was no equipment present in the hood.
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FACE VELOCITY MEASUREMENTS

A grid pattern is formed by equally dividing the hood opening into vertical and horizontal dimensions, not exceeding 12". Face velocity readings were taken at the center of the grid spaces indicated by number. (The dimensions shown below indicate the center of the grid spaces from the edge of the opening.) Four readings were taken at each point at approximately five second intervals.



Position Number	Reading #1	Reading #2	Reading #3	Reading #4	Average
1	81	81	60	75	74
2	108	82	105	79	94
3	60	69	67	69	66
4	76	51	79	68	69
5	51	54	52	50	52
6	68	85	65	63	70
7	129	133	137	127	132
8	68	70	56	64	65
9	64	58	63	56	60
10	78	75	79	86	80
11	160	114	173	134	145
12	146	144	139	141	143
13	68	74	71	72	71
14	58	53	55	57	56
15	71	75	75	80	75

Average Face Velocity: 83
 Highest Reading: 173
 Lowest Reading: 50

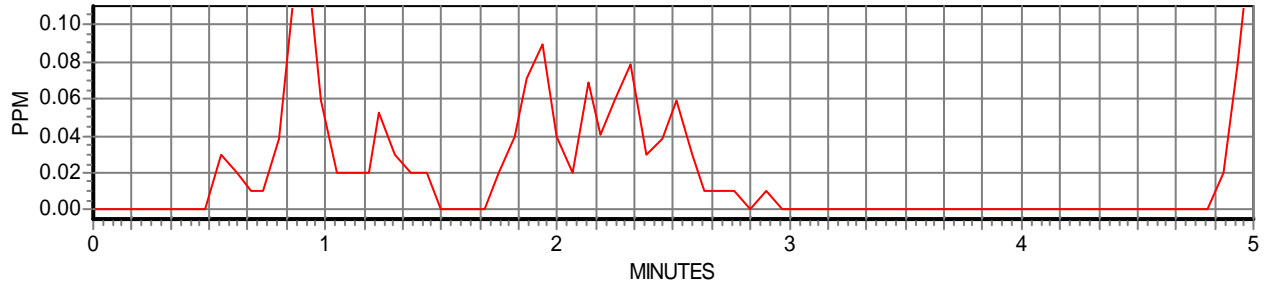
TESTED BY:

7.1 TRACER GAS TEST - REPORT #1

Report #1: With the sash set at the specified opening, three five minute tests are performed with the ejector and manikin located in the left, center, and right positions. Ratings for each position and overall hood rating are as shown.

TRACER GAS TEST - Left Position

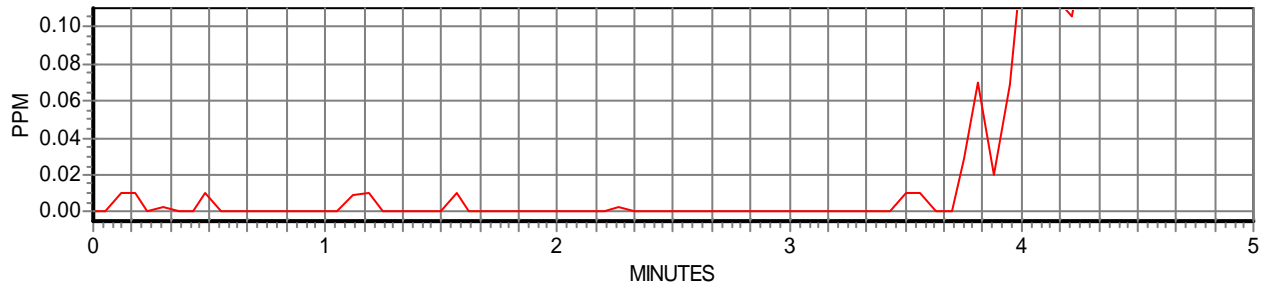
Ejector is located 12" from the left side of the hood. The front of the ejector is 6" from the hood face.



4.0 AU 0.020

TRACER GAS TEST - Center Position

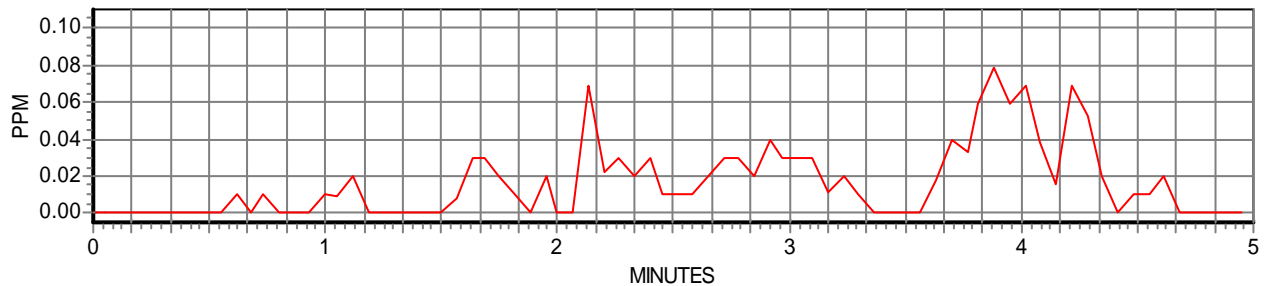
Ejector is located equidistant from either side of the hood. The front of the ejector is 6" from the hood face.



4.0 AU 0.067

TRACER GAS TEST - Right Position

Ejector is located 12" from the right side of the hood. The front of the ejector is 6" from the hood face.



4.0 AU 0.016

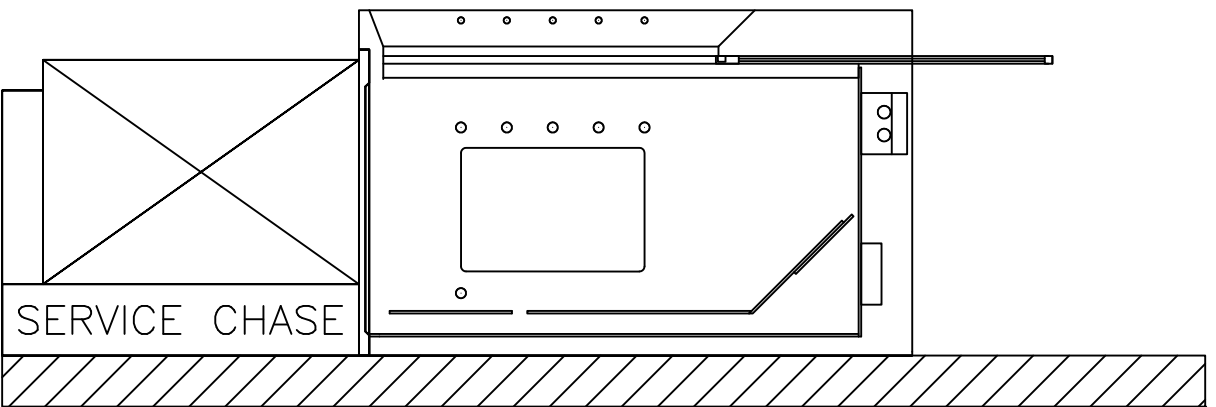
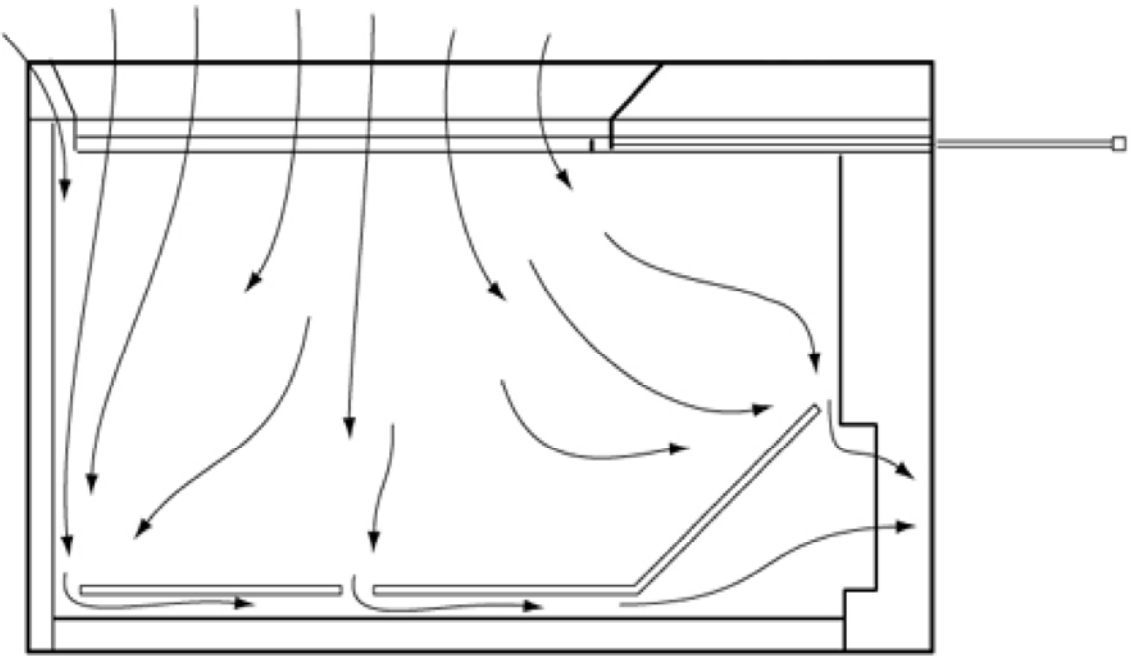
HOOD RATING
4.0 AU 0.067

TESTED BY:

Rick Nannetti

4/22/2008

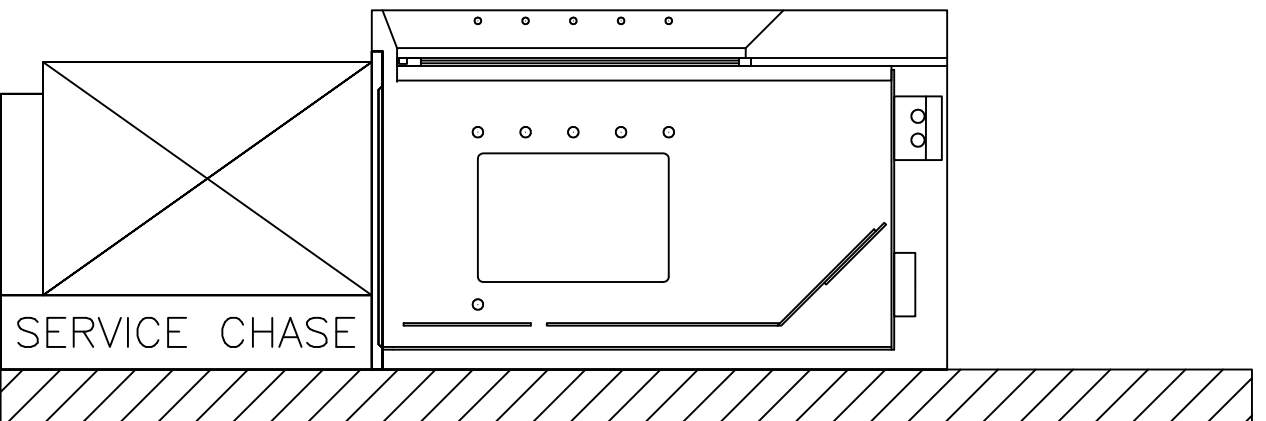
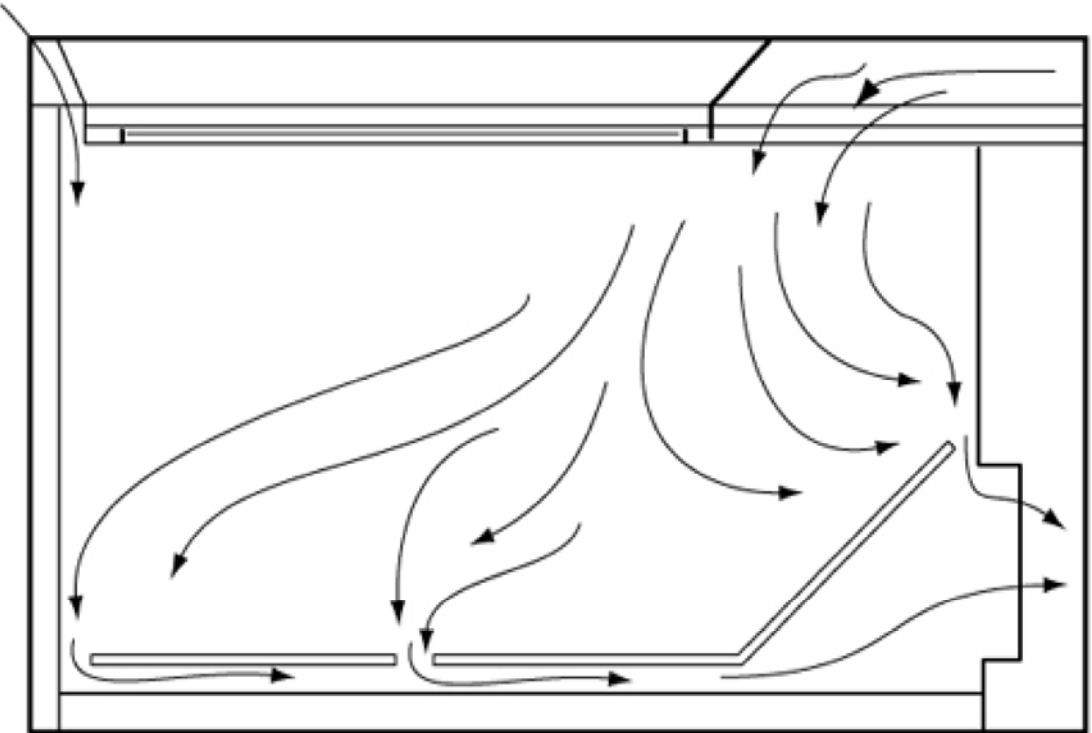
SASH OPEN



TRADITIONAL FUME HOOD SECTION (SASH OPEN)

Illinois Water Environment Association
Central States Lab Seminar

SASH CLOSED



TRADITIONAL FUME HOOD SECTION (SASH CLOSED)

Illinois Water Environment Association
Central States Lab Seminar

HIGH PERFORMANCE FUME HOOD DESIGN (VORTEX II)

Dynamic Baffles

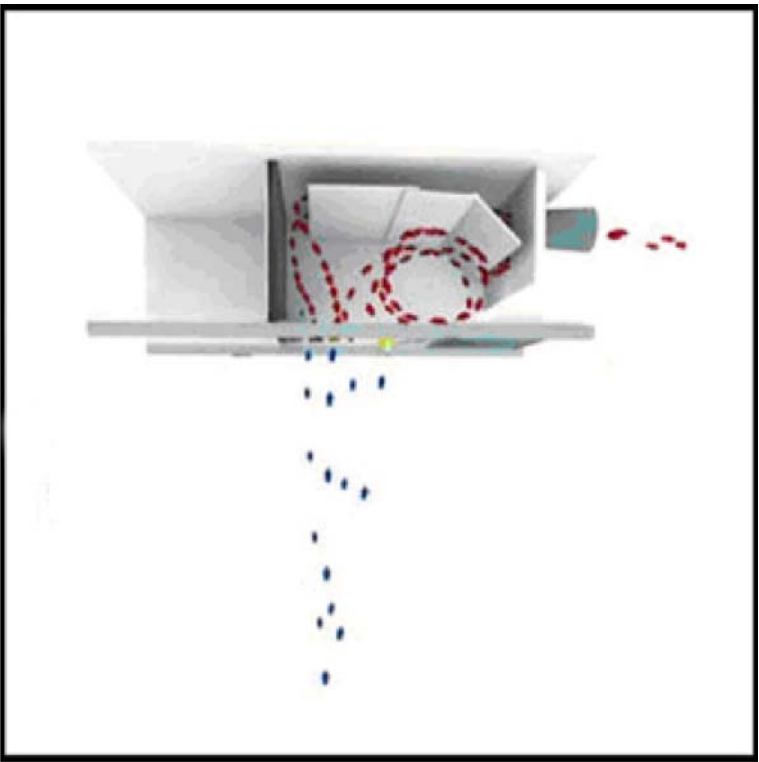
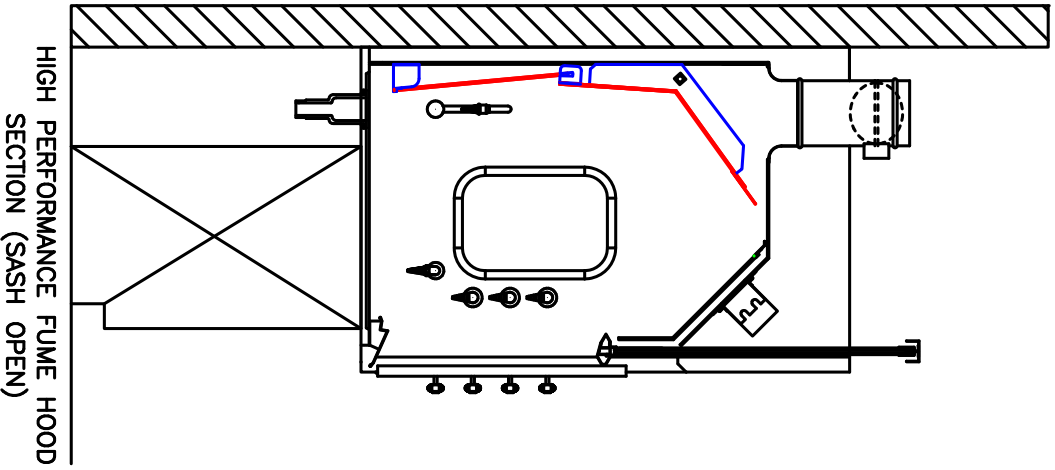
Low Volume Air – Cubic Feet per Minute (cfm)

Low Air Speed Rate – Feet Per Minute (fpm)

Low Energy Cost

Safety – Exceptional

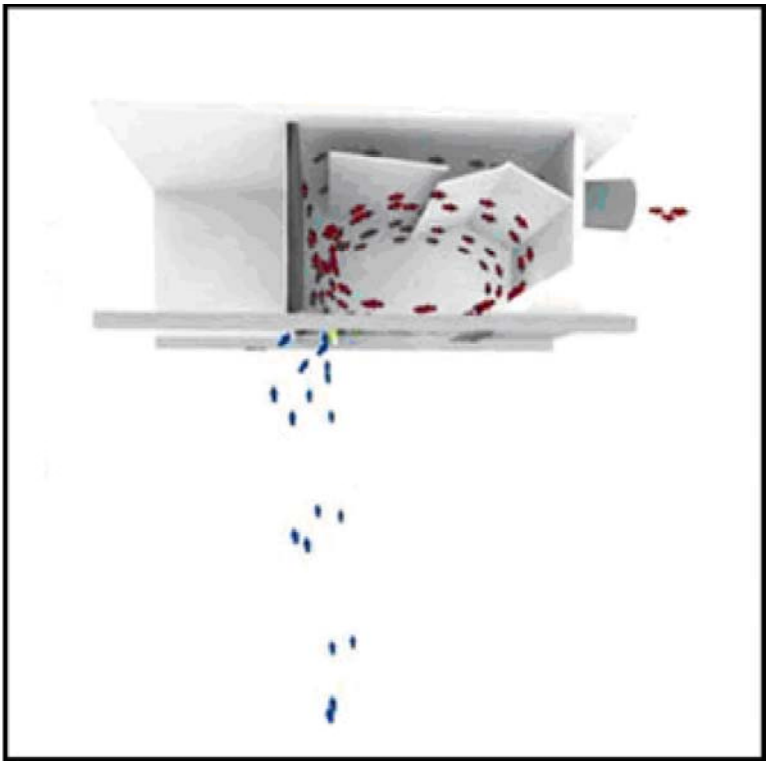
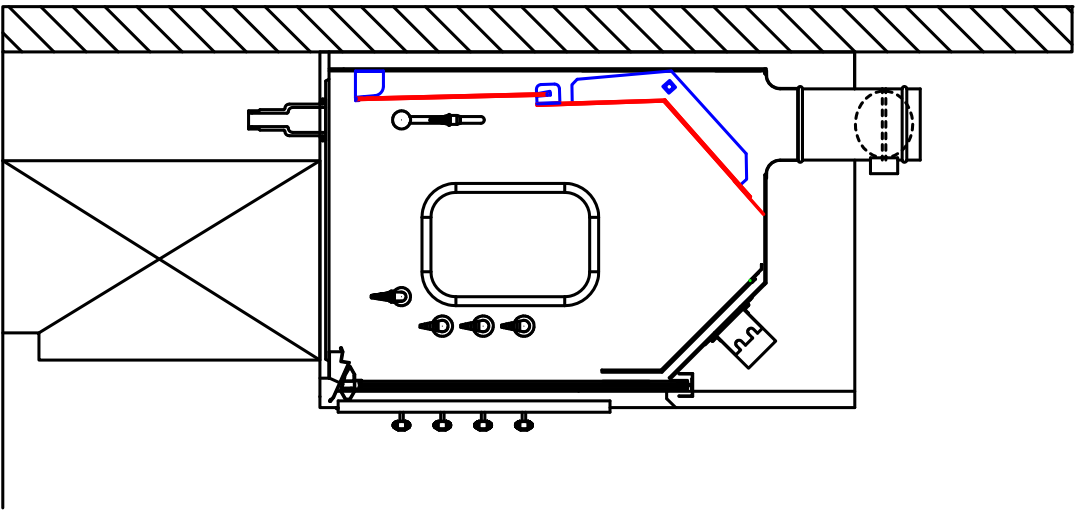
SASH OPEN



Illinois Water Environment Association
Central States Lab Seminar

SASH CLOSED

HIGH PERFORMANCE FUME HOOD SECTION (SASH CLOSED)



Illinois Water Environment Association
Central States Lab Seminar

5. TEST CONDITIONS

Room Ventilation: At full normal operation.

Room Description: The room is Enclosed and the hood is the Western Most Hood in the Chemistry Laboratory. REFERENCE Drawing #08M-CED-0828-D.

Background Levels: The background level is below 10% of control level.

Preliminary Data: This is a Six Foot (6') Vortex II 7239BH High Performance Chemical Fume Hood.

HOOD DESCRIPTION

Hood Type VORTEX II 7239BH

Baffle Type & Position: Flow Safe Dynamic Baffles with VFV Controls.

Sash Opening:

Specified Face Velocity: 50 feet per minute design specification

Volume: 605cfm

Static Pressure: 0.35"

6. FLOW VISUALIZATION AND VELOCITY PROCEDURE**LOCAL VISUALIZATION CHALLENGE**

Smoke was applied to the following locations with the listed results.

Under the airfoil: Smoke was exhausted smoothly and was not entrained in the vortex at the top of the hood.

Along both walls: Positive air movement, no reverse flows.

Along the floor: Positive air movement, no reverse flows.

8" diameter on back: Positive air movement, no reverse flows, no dead air space, no visible smoke flow out of the front of the hood.

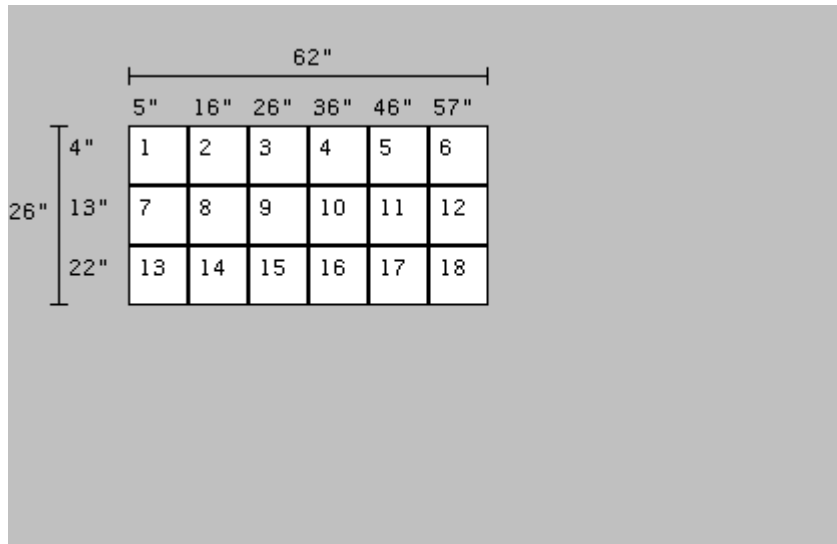
Along equipment: There was no equipment present in the hood. Smoke generated at the work top flowed evenly into the lower baffle opening almost immediately.

LARGE VOLUME VISUALIZATION CHALLENGE

Large volume release: All smoke was rapidly and smoothly exhausted. There was no visible release of smoke from the hood. There was no equipment present in the hood.

FACE VELOCITY MEASUREMENTS

A grid pattern is formed by equally dividing the hood opening into vertical and horizontal dimensions, not exceeding 12". Face velocity readings were taken at the center of the grid spaces indicated by number. (The dimensions shown below indicate the center of the grid spaces from the edge of the opening.) Four readings were taken at each point at approximately five second intervals.



Position Number	Reading #1	Reading #2	Reading #3	Reading #4	Average
73	66	74	50	64	64
53	48	55	65	52	55
65	68	75	69	69	70
74	48	63	72	63	62
68	59	63	49	51	56
79	49	71	59	74	63
59	56	50	65	77	62
76	74	56	56	56	61
57	65	69	71	66	68
66	69	66	56	64	64
73	63	76	50	69	65
49	72	73	76	57	70
60	72	62	45	61	60
45	47	51	54	48	50
70	58	59	79	74	68
52	58	62	53	47	55
47	78	48	59	44	57
48	58	65	53	53	57

VORTEX II 7239BH

4/16/2008

Page 4

Position Number	Reading #1	Reading #2	Reading #3	Reading #4	Average
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Average Face Velocity: 61

Highest Reading: 79

Lowest Reading: 44

TESTED BY:

Mike Bishop

4/16/2008



2100 South Calhoun Road
Phone 262-754-9800
Fax 262-754-9802
Email: mbishop@labtech-midwest.com

TEST RESULTS
ANSI/ASHRAE 110-1995
Method of Testing Performance of Laboratory Fume Hoods

Fume Hood Type VORTEX II 7239BH
4/16/2008 1:58:15 PM

PERFORMED FOR:

On Site Test April 2008
by PSA LabTech, Inc.

LOCATION:

Chemistry Laboratory Hood #4

This report contains the test results, for the specified fume hood, when tested in accordance with the ANSI ASHRAE 110-1995 "Method of Testing Performance of Laboratory Fume Hoods" test guideline. This method of testing applies to conventional, bypass, add air and VAV fume hoods.

The sub-headings listed below correspond to the sub-headings in the ANSI/ASHRAE 110-1995 guideline.

4. INSTRUMENTATION AND EQUIPMENT

Tracer Gas: 98% Sulfur Hexafluoride
Ejector System: Custom Fabricated Ejector per figures 1-3.
Critical Orifice: Provides a flow rate of 4.0 Lpm at an upstream pressure of 34 psi.

Detector Instrument: Qualitek Q200, S/N 2001966
Range of detection 0 to 0.6 PPM / 0 to 600 PPM.
Calibration Date 4-16-2008 Calibration Time 12:22 AM
Recalibration Date 4-16-2008 Recalibration Time 4:22 PM
Calibration Variance 0%

Recorder: Readings are recorder with a computer with accuracy of $\pm 0.092\%$ of full scale.

Manikin: Of size and placement as specified in the ASHRAE guideline.

FV Measuring Instrument: Alnor AVT55 Anemometer, Range 0 to 999 fpm

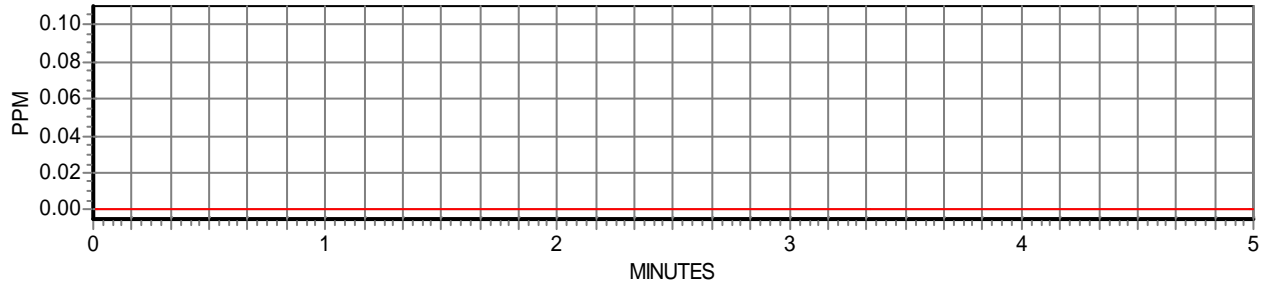
Smoke: Local and large-volume generating devices in accordance with the ASHRAE guideline.

7.1 TRACER GAS TEST - REPORT #1

Report #1: With the sash set at the specified opening, three five minute tests are performed with the ejector and manikin located in the left, center, and right positions. Ratings for each position and overall hood rating are as shown.

TRACER GAS TEST - Left Position

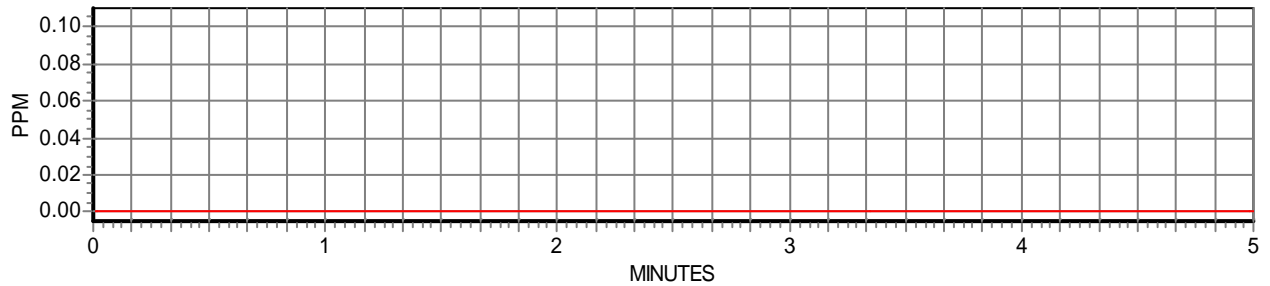
Ejector is located 12" from the left side of the hood. The front of the ejector is 6" from the hood face.



4.0 AU 0.000

TRACER GAS TEST - Center Position

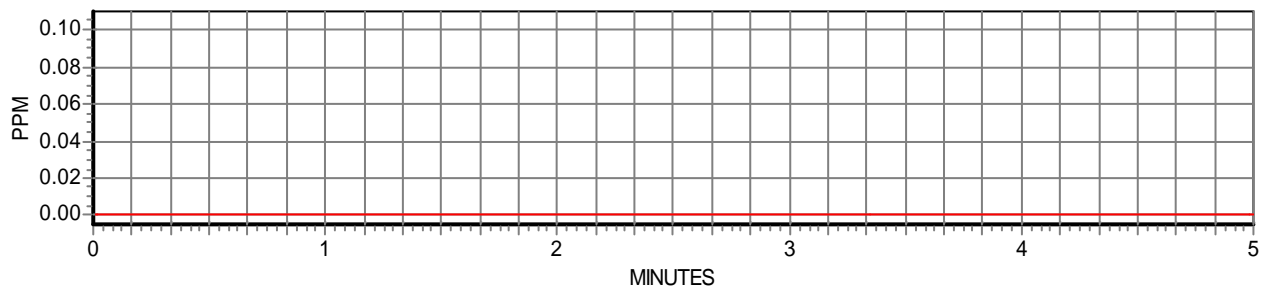
Ejector is located equidistant from either side of the hood. The front of the ejector is 6" from the hood face.



4.0 AU 0.000

TRACER GAS TEST - Right Position

Ejector is located 12" from the right side of the hood. The front of the ejector is 6" from the hood face.



4.0 AU 0.000

HOOD RATING
4.0 AU 0.000

TESTED BY:

Mike Bishop

4/16/2008

LABORATORY FUME HOOD ENERGY MODEL Links & Sources

Laboratory fume hoods are energy-intensive. They are intended to provide adequate protection for workers conducting experiments or manufacturing activities within the hoods. The typical fume hood in US climates uses 3.5-times as much energy as a home. This web calculator estimates annual fume hood energy use and costs for user-specified climates and assumptions about operation and equipment efficiencies. To create comparative energy-use scenarios, vary inputs (in blue) in the Assumptions panel as desired.

Location

ASSUMPTIONS	Hood 1	Hood 2	ANALYSIS	Hood 1	Hood 2	Hood 2 Difference
Energy Prices [1]			Flow Rate	1,631	816	816 CFM
Electricity	0.07	0.07	Cooling & Air-handling			
Electricity Demand	120	120	Chiller Energy [1]	12,267	6,134	6,134 kWh/year
Fuel	9.5	9.5	Fan Energy	25,722	12,861	12,861 kWh/year
Operation [2]			Total	37,989	18,994	18,994 kWh/year
Hood Opening (Horizontal)	24	24	Total Power	8.8	4.4	4.4 kW/hood
Hood Opening (Vertical)	27	27	of which Fan	2.9	1.5	1.5 kW/hood
Face Velocity	100	80	of which Chiller	5.9	2.9	2.9 kW/hood
Fan Power (supply/exhaust) [3]	1.80	1.80	Heating			
Cooling Plant Efficiency	1.00	1.00	Supply Load [5]	179	89	90 million BTU
Heating System Efficiency	70	70	Reheat Load	154	77	77 million BTU
HVAC Supply Air Setpoints			Total Load	333	166	167 million BTU
Heating	55	55	Energy (fuel)	476	238	238 million BTU
Cooling	55	55	Energy (electric)	0	0	0 kWh
Reheat Energy [4]			Average Reheat Power	0.0	0.0	0.0 kW
Delivery Air Temp.	55	55	Total Per-Hood Costs	6,816	3,408	3,408 \$/year
Energy Type	Fuel	Fuel	Cost Per CFM	4.16	4.16	0.00 \$



Disclaimer